Data sheet
RLMD01_04
Issue 4, 7th October 2011

RoLin™ component magnetic encoder system

- Incremental quadrature
- TTL output signals A, B and index Z
- RS422 output option
- Resolutions from 0.244 µm for linear and up to 753,664 cpr for ring applications
- High speed operation
- Bi-directional reference mark
- High reliability from proven non-contact sensing technology
- Pin / Flex options
- Self-diagnosis feature
- RoHS compliant

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

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

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

The position information is output in incremental quadrature format with the option of a periodic reference mark (every pole) or a unique reference mark.

The maximum traverse velocity depends on the chosen resolution and minimum edge separation time, to 4 m/s at 1 µm and to 40 m/s at 10 µm.

The error terminal enables the sub-system to diagnose potential failures of the encoder. The different types of errors are signalled on the Error line using a PWM formatted code.

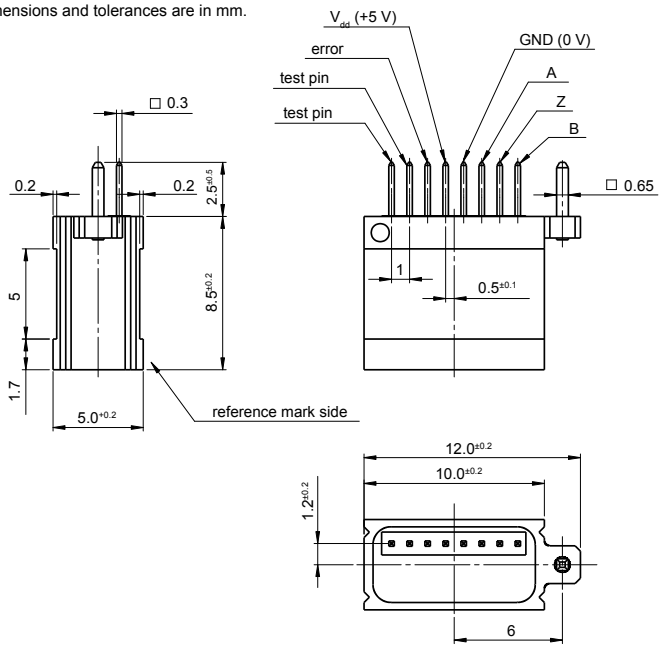
With purpose to meet various customer needs different configurations of connection terminals are available:

	RoLin with Pins	RoLin with flex cable output	RoLin with RS422 FPC
			
Installation	Direct soldering to PCB	Dislocated RoLin head from PCB	Dislocated RoLin head from PCB
Available Flex cable output lengths	-	136 mm; 73 mm;	136 mm
Overall distance to subsequent device	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
Output signals	TTL: A, B, Z	TTL: A, B, Z	RS422: A, A-, B, B-, Z, Z-
Error signal	Available	Available	Not available
EMC	Should be assured by system's housing and sub-system's circuitry	Should be assured by system's housing and sub-system's circuitry	Enhanced but still should be assured by system's housing and sub-system's circuitry

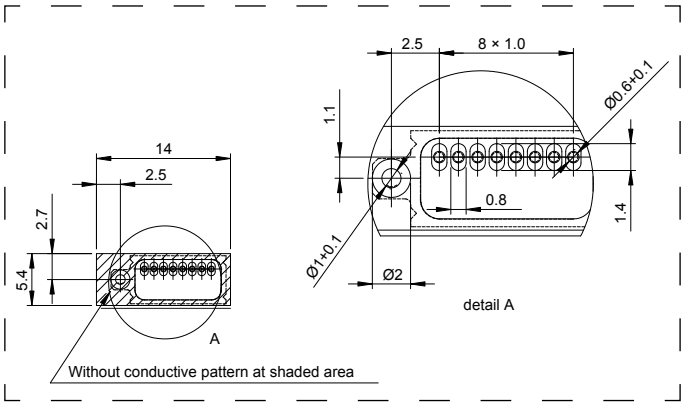
Data sheet
RLMD01_04

RLM readhead dimensions with pins and pin-out

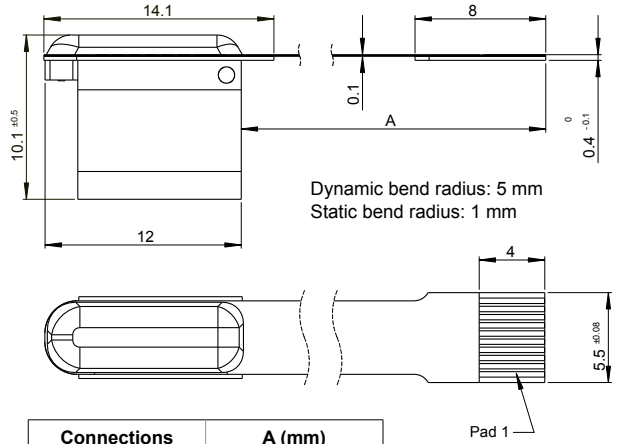
Dimensions and tolerances are in mm.



PCB footprint



RLM readhead dimensions with flex cable output



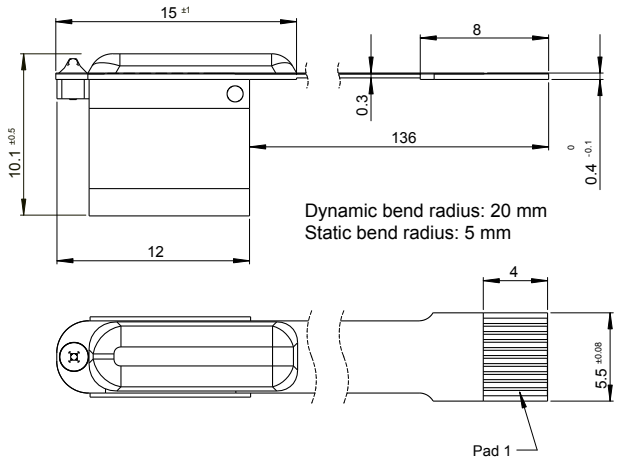
Connections	A (mm)
04	73
15	136

Pad	Signal
1	case
2	test pin
3	test pin
4	error
5	V_{dd} (+5 V)
6	GND (0 V)
7	A
8	Z
9	B
10	case

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

* Not provided.

RLM readhead dimensions with RS422 flex cable output



Pad	Signal
1	case
2	A+
3	A-
4	B-
5	V_{dd} (+5 V)
6	GND (0 V)
7	B+
8	Z-
9	Z+
10	case

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

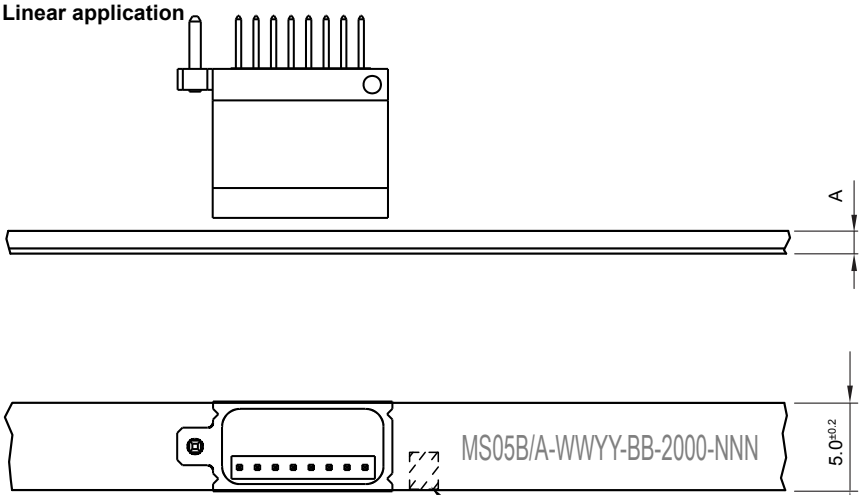
* Not provided.

Note: Error signal not output

RoLin installation tolerances

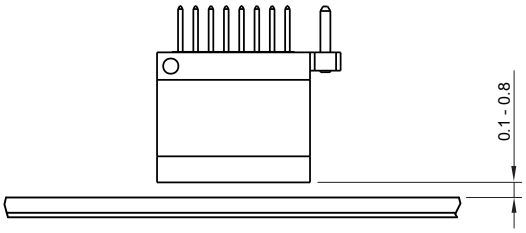
Dimensions and tolerances are in mm.

Linear application

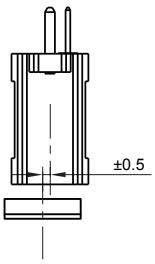


Magnetic scale thickness (A)	
With back-adhesion tape (option A)	$1.5^{\pm 0.15}$
No back-adhesion tape (option I)	$1.3^{\pm 0.15}$

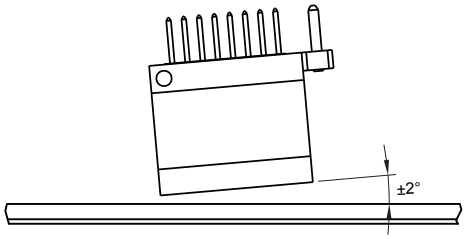
Ride height



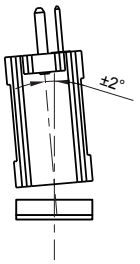
Lateral offset



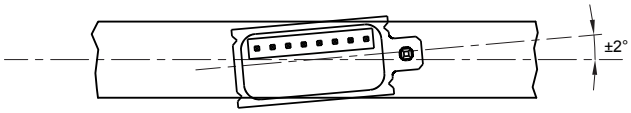
Pitch



Roll

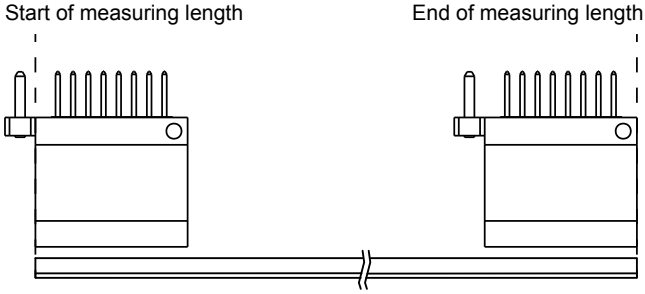


Yaw



Start of measuring length

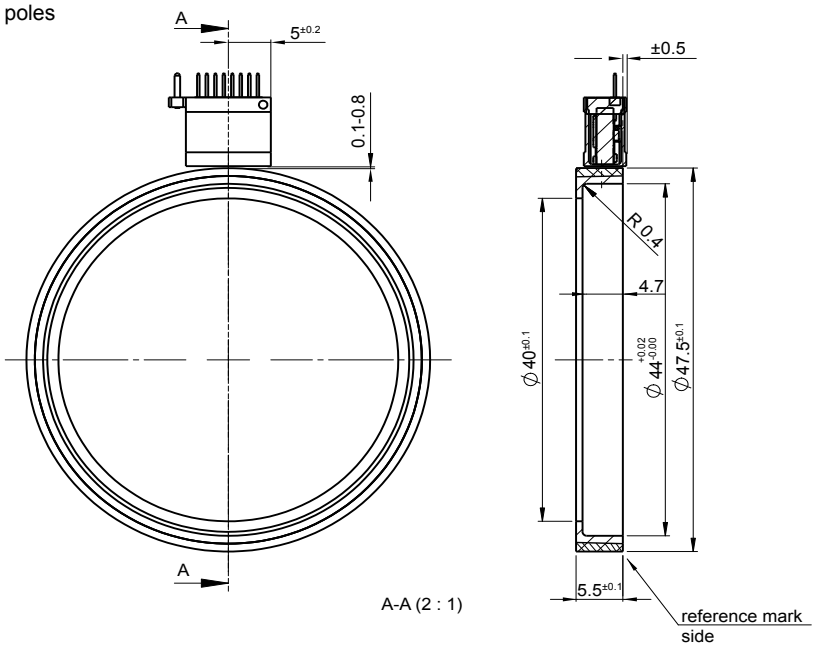
End of measuring length



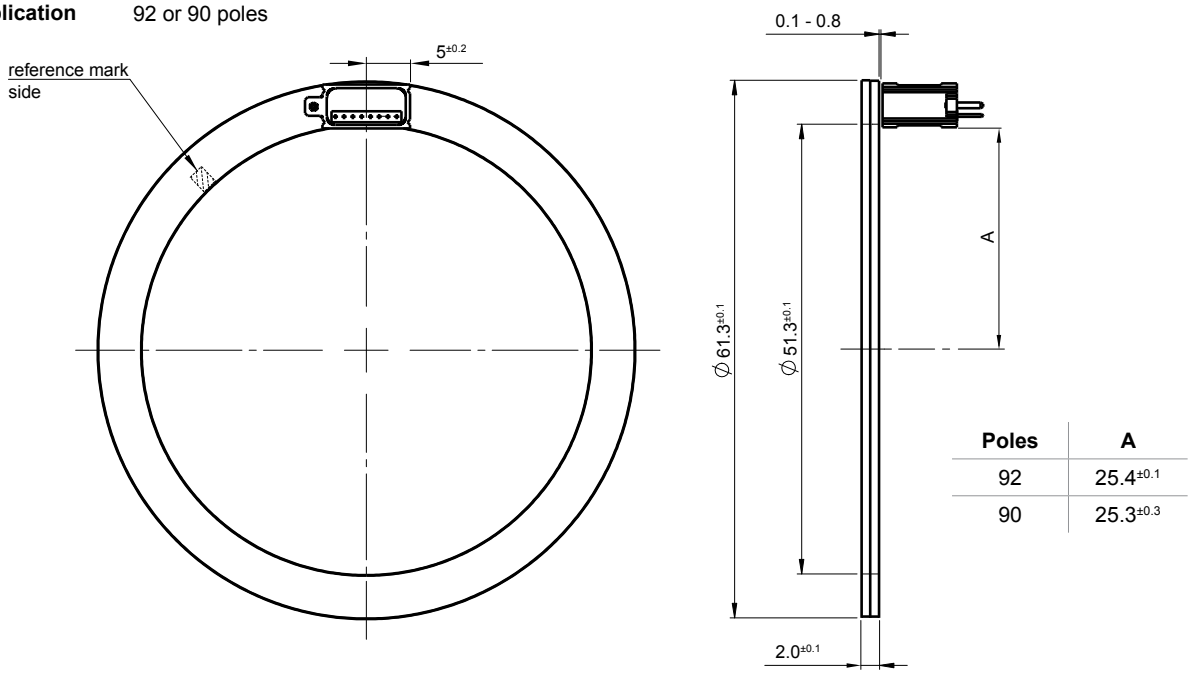
RoLin installation tolerances continued

Dimensions and tolerances are in mm.

Radial ring application 76 poles

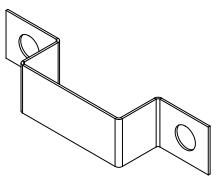


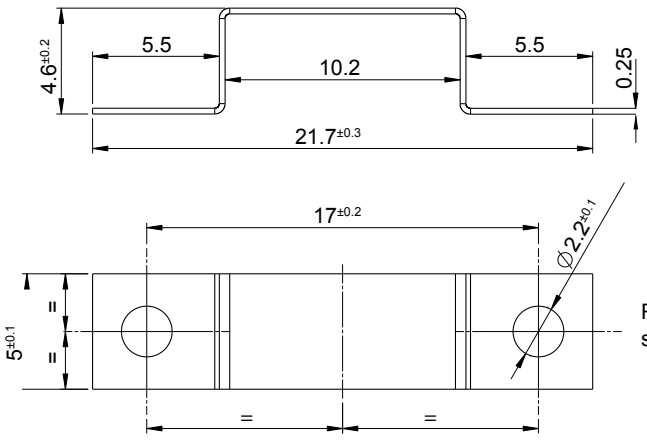
Axial ring application 92 or 90 poles



Poles	A
92	25.4±0.1
90	25.3±0.3

Mounting bracket dimensions





Recommended use of M2 screws with washers.

RLM readhead technical specifications

System data	
Maximum length of MS scale	50 m
Pole length	2 mm
Available resolutions	For ring applications: See table on page 6 For linear applications: 0.244 µm, 0.488 µm, 1 µm, 2 µm, 5 µm, 10 µm, 50 µm and 125 µm (other resolutions also available)
Maximum speed	For ring applications: See table on page 6 For linear applications:

Resolution (µm)	**Maximum speed (m/s)**				
0.244	1.01	0.25	0.12	0.06	0.06
0.488	2.02	0.51	0.23	0.12	0.06
1	4.16	1.04	0.47	0.25	0.13
2	8.32	2.08	1.04	0.50	0.25
5	20.80	5.20	2.59	1.24	0.63
10	40.00*	10.40	5.20	2.46	1.27
50	26.00	6.50	3.25	1.55	0.79
125	40.00*	40.00*	40.00*	30.94	15.84
Edge separation (µs)	0.12	0.50	1	2	4
Count frequency (kHz)	8333	2000	1000	500	250

* Mechanical limitations; error output will not be signalled as overspeed

Precision class for MS scale	±40 µm/m	
Linear expansion coefficient for MS scale	~ 17 × 10^{-6}/K	
Unidirectional repeatability	< 2 µm	
Hysteresis	< 3 µm up to 0.2 mm ride height	
Sub divisional error	±3.5 µm	
Electrical data		
Power supply	4.75 V to 5.5 V – reverse polarity protected	
Power consumption (without any load)	< 25 mA without line driver; < 30 mA with line driver*	
Output signals	Digital – TTL-level (A, B, Z)	
	Saturation voltage hi (I = -4 mA)	V_{dd} - 0.4 V
	Saturation voltage lo (I = 4 mA)	0.4 V
	Rise and fall time (c_c = 50 pF)	60 ns
	Digital – RS422 (A+, B+, Z+, A-, B-, Z-)	
	High level output voltage (I_{OH} = -20 mA)	> 2.4 V
	Low level output voltage (I_{OL} = 20 mA)	< 0.4 V
	Rise and fall time (c_c = 50 pF)	< 10 ns
Hand soldering (for pin variant)	T_{max} 260 °C; t_{max} 5 s	
ESD susceptibility of all pins (HBM 100 pF, discharge through 1.5 kΩ)	2 kV	
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; radial ring MR047 8 g; axial ring MR061 9 g	
Environmental conditions		
Temperature	Operating	-20 °C to +85 °C
	Storage	-40 °C to +85 °C
Vibrations (55 Hz to 2000 Hz)	300 m/s² (IEC 60068-2-6)	
Shocks (11 ms)	300 m/s² (IEC 60068-2-27)	

* For longer lengths please consider voltage drop over cable.

Maximum speed and resolution Axial ring, 92 and 90 poles (2 mm pole length)

Resolution (cpr) for 92 poles	Resolution (cpr) for 90 poles	Interpolation factor	Maximum speed (revolutions per minute)				
753,664	737,280	8,192	331	83	38	20	20
376,832	368,640	4,096	657	165	75	39	20
188,416	184,320	2,048	1,320	331	150	79	40
184,000	180,000	2,000	1,357	339	154	81	41
147,200	144,000	1,600	1,696	424	212	101	52
94,208	92,160	1,024	2,645	657	301	158	81
92,000	90,000	1,000	2,713	678	339	161	83
73,600	72,000	800	3,391	845	424	202	103
47,104	46,080	512	5,296	1,320	509	315	162
46,000	45,000	500	5,426	1,357	678	323	165
36,800	36,000	400	6,783	1,696	845	404	207
29,440	28,800	320	8,478	2,118	1,059	505	258
23,552	23,040	256	10,597	2,645	1,320	626	323
18,400	18,000	200	13,565	3,391	1,696	803	414
14,720	14,400	160	8,478	2,118	1,059	527	258
11.776	11,520	128	21,193	5,296	2,645	1,257	642
9.200	9,000	100	13,565	3,391	1,696	803	414
7.360	7,200	80	8,478	2,118	1,059	527	258
5.888	5,760	64	20,000*	10,597	5,296	2,520	1,289
3.680	3,600	40	8,478	2,118	1,059	505	258
2.944	2,880	32	20,000*	20,000*	10,597	5,045	2,583
1.472	1,440	16	not valid	20,000*	20,000*	10,090	5,165
736	720	8	not valid	20,000*	20,000*	20,000*	10,336
Edge separation (µs)			0.12	0.50	1	2	4
Count frequency (kHz)			8333	2000	1000	500	250

* Mechanical limitations; error output will not be signalled as overspeed

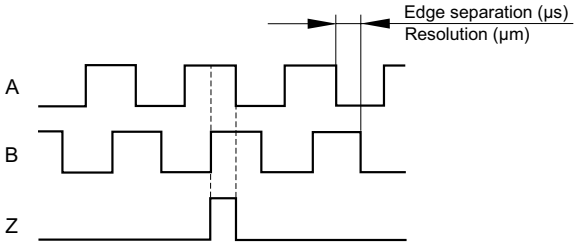
Maximum speed and resolution Radial ring, 76 poles (2 mm pole length)

Resolution (counts per revolution)	Interpolation factor	Maximum speed (revolutions per minute)				
622,592	**8,192**	400	100	46	24	24
311,296	**4,096**	796	200	91	48	24
155,648	**2,048**	1,598	401	182	95	49
152,000	**2,000**	1,642	411	187	98	50
121,600	**1,600**	2,053	513	256	122	63
77,824	**1,024**	3,202	796	364	191	98
76,000	**1,000**	3,284	821	411	195	100
60,800	**800**	4,105	1,023	513	244	125
38,912	**512**	6,411	1,598	616	382	196
38,000	**500**	6,568	1,642	821	391	200
30,400	**400**	8,211	2,053	1,023	489	250
24,320	**320**	10,263	2,564	1,282	611	313
19,456	**256**	12,827	3,202	1,598	758	391
15,200	**200**	16,421	4,105	2,053	973	501
12,160	**160**	10,263	2,564	1,282	638	313
9,728	**128**	25,000	6,411	3,202	1,522	777
7,600	**100**	16,421	4,105	2,053	973	501
6,080	**80**	10,263	2,564	1,282	638	313
4,864	**64**	25,000	12,827	6,411	3,051	1,560
3,040	**40**	10,263	2,564	1,282	611	313
2,432	**32**	25,000	25,000	12,827	6,107	3,126
1,216	**16**	not valid	25,000	25,000	12,215	6,253
608	**8**	not valid	25,000	25,000	24,436	12,512
Edge separation (µs)		0.12	0.50	1	2	4
Count frequency (kHz)		8333	2000	1000	500	250

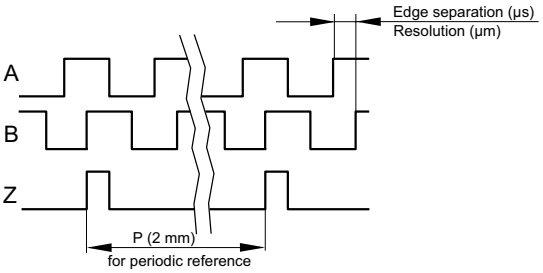
RLM readhead output signals

The position information is output in incremental quadrature format with the option of a periodic reference mark (every pole) or a unique reference mark.

Timing diagram – Incremental, unique reference mark
In the case of RS422 outputs, inverted signals are not shown



Timing diagram – Incremental, periodic reference mark
In the case of RS422 outputs, inverted signals are not shown



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.

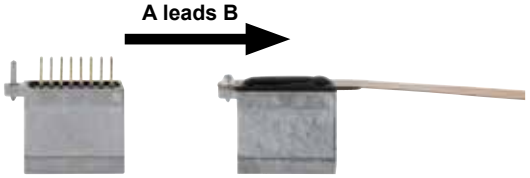
In the case of amplitude or frequency failure the PWM cycle frequency is approximately 16.5 Hz (cycle duration: 60.7 ms).

Failure mode	Error output	Possible cause of failure
No error	High	
Amplitude error	Low: 75 % High: 25 %	Readhead removed from tape / ring Demagnetisation of magnetic tape / ring
Frequency error	Low: 50 % High: 50 %	Traverse velocity too high Not effective for mechanical limitation of speed/rpm
Configuration	Low	Internal electronic failure
Undervoltage	Low	Power supply

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 open collector type with built in pull up resistor. It can be used in “wired-or” configuration with other error signals in the system.

Positive direction



RLM readhead part numbering

RoLin system = **RLM readhead**
eg. RLM2HDA13BA00A00 + **Magnetic scale / ring**
eg. MR047B040A076B00

RL M 2 HD A 13B A 00 A 00

Housing
M - Vertical

Pole length (P)
2 - 2 mm pole length

Output type
IC - Incremental RS422
HD - Incremental

Interpolation

13B - 8192	**09B** - 512	**D10** - 100
12B - 4096	**D50** - 500	**D08** - 80
11B - 2048	**D40** - 400	**06B** - 64
2D0 - 2000	**D32** - 320	**D04** - 40
1D6 - 1600	**08B** - 256	**05B** - 32
10B - 1024	**D20** - 200	**04B** - 16
1D0 - 1000	**D16** - 160	**03B** - 8
D80 - 800	**07B** - 128	

Minimum edge separation (Frequency)
A - 0.12 µs (8.3 MHz)
B - 0.5 µs (2 MHz)
C - 1 µs (1 MHz)
D - 2 µs (0.5 MHz)
E - 4 µs (0.25 MHz)

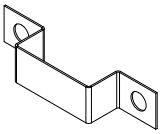
Connections
00 - Pins only (HD output type only)
04 - Flex cable 75 m long (HD output type only)
15 - Flex cable (length 136 mm)

Reference
A - With reference
B - No reference
C - Periodic as per scale pitch (2 mm)

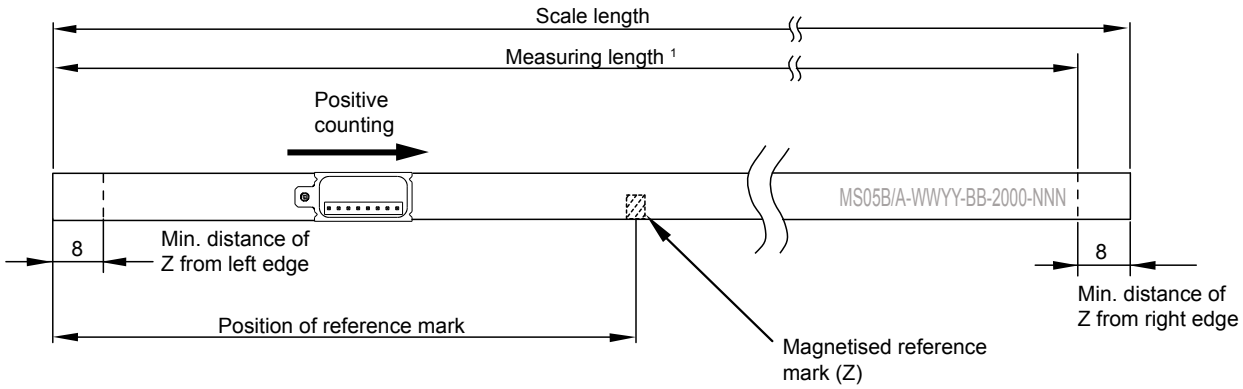
Special requirements
00 - No special requirements (standard)

Accessories part numbering

Mounting bracket **RLMMB01**



Magnetic scale part numbering



[1] Measuring length = scale length - 10 mm

MS05 B M100 A M010

Series
MS05 - 5 mm width, 2 mm pole

Precision class
B - ±40 µm/m

Scale length
Mxxx - Where xxx equals scale length in mm
xxxx - Where xxxx equals scale length in cm

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

Position of reference mark
0000 - No reference mark
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 ±0,1 mm from requested position.

Option
A - Back-adhesion tape (standard)
I - No back-adhesion tape
N - No back-adhesion tape, with cover foil

Accessories part numbering

Cover foil **CF05 1000**

Foil length
xxxx - Where xxxx equals foil length in cm
Mxxx - Where xxx equals scale length in mm

Magnetic ring part numbering

Radial ring

76 poles (2 mm pole length)

MR 047 B 040 A 076 B 00

Reference mark
A - With reference
B - No reference

Axial ring

92 poles (2 mm pole length)

MR 061 C 051 A 092 B 00

092 - 92 poles
090 - 90 poles

Reference mark
A - With reference
B - No reference

Counts per revolution = No. of poles × Interpolation

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Document issues

Issue	Date	Page	Corrections made
1	4. 2. 2011	-	New document
2	18. 2. 2011	2	Mounting bracket dimensions updated
		5	Timing diagram for unique reference added
		6	Magnetic ring part number updated
3	8. 4. 2011	2	PCB footprint added
		3	MS scale dimensions and measuring length start/end drawing added
		8	Magnetic scale installation drawing added
4	7. 10. 2011	2, 5, 7	Flex cable with integrated line driver added; 90 pole ring added

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