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:

<table>
<thead>
<tr>
<th>Installation</th>
<th>RoLin with Pins</th>
<th>RoLin with flex cable output</th>
<th>RoLin with RS422 FPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct soldering to PCB</td>
<td>Dislocated RoLin head from PCB</td>
<td>Dislocated RoLin head from PCB</td>
<td></td>
</tr>
<tr>
<td>Available Flex cable output lengths</td>
<td>-</td>
<td>136 mm; 73 mm;</td>
<td>136 mm</td>
</tr>
<tr>
<td>Overall distance to subsequent device</td>
<td>Distance depends on loading characteristics and edge separation time; generally: &gt;300 mm</td>
<td>Distance depends on loading characteristics and edge separation time; generally: &gt;300 mm</td>
<td>&lt;50 m</td>
</tr>
<tr>
<td>Error signal</td>
<td>Available</td>
<td>Available</td>
<td>Not available</td>
</tr>
<tr>
<td>EMC</td>
<td>Should be assured by system's housing and sub-system's circuitry</td>
<td>Should be assured by system's housing and sub-system's circuitry</td>
<td>Enhanced but still should be assured by system's housing and sub-system's circuitry</td>
</tr>
</tbody>
</table>
RLM readhead dimensions with pins and pin-out

Dimensions and tolerances are in mm.

![RLM readhead diagram](image)

**PCB footprint**

Without conductive pattern at shaded area

---

**RLM readhead dimensions with flex cable output**

<table>
<thead>
<tr>
<th>Pad</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>case</td>
</tr>
<tr>
<td>2</td>
<td>test pin</td>
</tr>
<tr>
<td>3</td>
<td>test pin</td>
</tr>
<tr>
<td>4</td>
<td>error</td>
</tr>
<tr>
<td>5</td>
<td>$V_{dd}$ (+5 V)</td>
</tr>
<tr>
<td>6</td>
<td>GND (0 V)</td>
</tr>
<tr>
<td>7</td>
<td>A</td>
</tr>
<tr>
<td>8</td>
<td>Z</td>
</tr>
<tr>
<td>9</td>
<td>B</td>
</tr>
<tr>
<td>10</td>
<td>case</td>
</tr>
</tbody>
</table>

Connections A (mm):

<table>
<thead>
<tr>
<th>Pad</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>73</td>
</tr>
<tr>
<td>15</td>
<td>136</td>
</tr>
</tbody>
</table>

**Notes:**
- Dynamic bend radius: 5 mm
- Static bend radius: 1 mm

---

**RLM readhead dimensions with RS422 flex cable output**

<table>
<thead>
<tr>
<th>Pad</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>case</td>
</tr>
<tr>
<td>2</td>
<td>A+</td>
</tr>
<tr>
<td>3</td>
<td>A-</td>
</tr>
<tr>
<td>4</td>
<td>B-</td>
</tr>
<tr>
<td>5</td>
<td>$V_{dd}$ (+5 V)</td>
</tr>
<tr>
<td>6</td>
<td>GND (0 V)</td>
</tr>
<tr>
<td>7</td>
<td>B+</td>
</tr>
<tr>
<td>8</td>
<td>Z-</td>
</tr>
<tr>
<td>9</td>
<td>Z+</td>
</tr>
<tr>
<td>10</td>
<td>case</td>
</tr>
</tbody>
</table>

Connections A (mm):

<table>
<thead>
<tr>
<th>Pad</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>136</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

**Notes:**
- Dynamic bend radius: 20 mm
- Static bend radius: 5 mm

---

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

* Not provided.
RoLin installation tolerances
Dimensions and tolerances are in mm.

**Linear application**

![Diagram of linear application with tolerances indicated](image)

- **Ride height**: ±0.5 mm
- **Lateral offset**: ±0.5 mm
- **Pitch**: ±2°
- **Roll**: ±2°
- **Yaw**: ±2°

**Magnetic scale thickness (A)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>With back-adhesion tape (option A)</td>
<td>1.5±0.15</td>
</tr>
<tr>
<td>No back-adhesion tape (option I)</td>
<td>1.3±0.15</td>
</tr>
</tbody>
</table>

Dimensions and tolerances are in mm.
RoLin installation tolerances  continued
Dimensions and tolerances are in mm.

Radial ring application  76 poles

Axial ring application  92 or 90 poles

Mounting bracket dimensions

Recommended use of M2 screws with washers.
RLM readhead technical specifications

System data

<table>
<thead>
<tr>
<th>Maximum length of MS scale</th>
<th>50 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole length</td>
<td>2 mm</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Resolution (µm)</th>
<th>Maximum speed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.244</td>
<td>1.01 0.25 0.12 0.06 0.06</td>
</tr>
<tr>
<td>0.488</td>
<td>2.02 0.51 0.23 0.12 0.06</td>
</tr>
<tr>
<td>1</td>
<td>4.16 1.04 0.47 0.25 0.13</td>
</tr>
<tr>
<td>2</td>
<td>8.32 2.08 1.04 0.50 0.25</td>
</tr>
<tr>
<td>5</td>
<td>20.80 5.20 2.59 1.24 0.63</td>
</tr>
<tr>
<td>10</td>
<td>40.00* 10.40 5.20 2.46 1.27</td>
</tr>
<tr>
<td>50</td>
<td>26.00 6.50 3.25 1.55 0.79</td>
</tr>
<tr>
<td>125</td>
<td>40.00* 40.00* 40.00* 30.94 15.84</td>
</tr>
</tbody>
</table>

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_{sat} - 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.
## Resolution (counts per revolution)

<table>
<thead>
<tr>
<th>Resolution (cpr) for 92 poles</th>
<th>Resolution (cpr) for 90 poles</th>
<th>Interpolation factor</th>
<th>Maximum speed (revolutions per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>753,664</td>
<td>737,280</td>
<td>8,192</td>
<td>331</td>
</tr>
<tr>
<td>376,832</td>
<td>368,640</td>
<td>4,096</td>
<td>657</td>
</tr>
<tr>
<td>188,416</td>
<td>184,320</td>
<td>2,048</td>
<td>1,320</td>
</tr>
<tr>
<td>184,000</td>
<td>180,000</td>
<td>2,000</td>
<td>1,357</td>
</tr>
<tr>
<td>147,200</td>
<td>144,000</td>
<td>1,600</td>
<td>1,696</td>
</tr>
<tr>
<td>94,208</td>
<td>92,160</td>
<td>1,024</td>
<td>2,645</td>
</tr>
<tr>
<td>92,000</td>
<td>90,000</td>
<td>1,000</td>
<td>2,713</td>
</tr>
<tr>
<td>73,600</td>
<td>72,000</td>
<td>800</td>
<td>3,391</td>
</tr>
<tr>
<td>47,104</td>
<td>46,080</td>
<td>512</td>
<td>5,296</td>
</tr>
<tr>
<td>46,000</td>
<td>45,000</td>
<td>500</td>
<td>5,426</td>
</tr>
<tr>
<td>36,800</td>
<td>36,000</td>
<td>400</td>
<td>6,783</td>
</tr>
<tr>
<td>29,440</td>
<td>28,800</td>
<td>320</td>
<td>8,478</td>
</tr>
<tr>
<td>23,552</td>
<td>23,040</td>
<td>256</td>
<td>10,597</td>
</tr>
<tr>
<td>18,400</td>
<td>18,000</td>
<td>200</td>
<td>13,565</td>
</tr>
<tr>
<td>14,720</td>
<td>14,400</td>
<td>160</td>
<td>8,478</td>
</tr>
<tr>
<td>11,776</td>
<td>11,520</td>
<td>128</td>
<td>21,193</td>
</tr>
<tr>
<td>9,200</td>
<td>9,000</td>
<td>100</td>
<td>13,565</td>
</tr>
<tr>
<td>7,360</td>
<td>7,200</td>
<td>80</td>
<td>8,478</td>
</tr>
<tr>
<td>5,888</td>
<td>5,760</td>
<td>64</td>
<td>20,000*</td>
</tr>
<tr>
<td>3,680</td>
<td>3,600</td>
<td>40</td>
<td>8,478</td>
</tr>
<tr>
<td>2,944</td>
<td>2,880</td>
<td>32</td>
<td>20,000*</td>
</tr>
<tr>
<td>1,472</td>
<td>1,440</td>
<td>16</td>
<td>20,000*</td>
</tr>
<tr>
<td>736</td>
<td>720</td>
<td>8</td>
<td>20,000*</td>
</tr>
</tbody>
</table>

### Edge separation (μs)

|                    | 0.12 | 0.50 | 1    | 2    | 4    | 10.336 |

### Count frequency (kHz)

|                    | 8333 | 2000 | 1000 | 500  | 250  |

## Interpolation factor

<table>
<thead>
<tr>
<th>Maximum speed (revolutions per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>622,592</td>
</tr>
<tr>
<td>311,296</td>
</tr>
<tr>
<td>155,648</td>
</tr>
<tr>
<td>152,000</td>
</tr>
<tr>
<td>121,600</td>
</tr>
<tr>
<td>77,824</td>
</tr>
<tr>
<td>76,000</td>
</tr>
<tr>
<td>60,800</td>
</tr>
<tr>
<td>38,912</td>
</tr>
<tr>
<td>38,000</td>
</tr>
<tr>
<td>30,400</td>
</tr>
<tr>
<td>24,320</td>
</tr>
<tr>
<td>19,456</td>
</tr>
<tr>
<td>15,200</td>
</tr>
<tr>
<td>12,160</td>
</tr>
<tr>
<td>9,728</td>
</tr>
<tr>
<td>7,600</td>
</tr>
<tr>
<td>6,080</td>
</tr>
<tr>
<td>4,864</td>
</tr>
<tr>
<td>3,680</td>
</tr>
<tr>
<td>2,944</td>
</tr>
<tr>
<td>1,472</td>
</tr>
<tr>
<td>736</td>
</tr>
</tbody>
</table>

### Count frequency (kHz)

|                    | 8333 | 2000 | 1000 | 500  | 250  |

## Maximum speed and resolution

### Axial ring, 92 and 90 poles (2 mm pole length)

### Radial ring, 76 poles (2 mm pole length)

### Edge separation (μs)

|                    | 0.12 | 0.50 | 1    | 2    | 4    | 10.336 |

### Count frequency (kHz)

|                    | 8333 | 2000 | 1000 | 500  | 250  |

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

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

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

A leads B
### RLM readhead part numbering

**RoLin system**

**RLM readhead**

eg. RLM2HDA13BA00A00

**Magnetic scale / ring**

eg. MR047B040A076B00

<table>
<thead>
<tr>
<th>RL</th>
<th>M</th>
<th>2</th>
<th>HD</th>
<th>A</th>
<th>13B</th>
<th>A</th>
<th>00</th>
<th>A</th>
<th>00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Housing**

- M - Vertical

**Pole length (P)**

Z - 2 mm pole length

**Output type**

- IC - Incremental RS422
- HD - Incremental

**Interpolation**

- 13B - 8192
- 12B - 4096
- 11B - 2048
- 10B - 1024
- 1D6 - 1600
- 1D5 - 1000
- D80 - 800

- 09B - 512
- D50 - 500
- D40 - 400
- D32 - 320
- D20 - 200
- D16 - 160
- D07 - 128

- D10 - 100
- D08 - 80
- D06 - 64
- D04 - 40
- 08B - 256
- 04B - 16
- 03B - 8

**Special requirements**

- 00 - No special requirements (standard)

**Reference**

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

**Connections**

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

**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)

### Accessories part numbering

**Mounting bracket**

RLMMB01
Magnetic scale part numbering

Scale length
Positive counting
Measuring length 1

Min. distance of Z from left edge
Position of reference mark

Min. distance of Ri from right edge
Magnetised reference mark (Z)

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

Reference mark
A - With reference
B - No reference

Counts per revolution = No. of poles × Interpolation

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Document issues

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

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