The LM10 is a contactless high-speed magnetic encoder designed for linear or rotary motion sensing in harsh environments.

The LM10 features a compact sealed readhead that rides at up to 1.0 mm from the self-adhesive magnetic scale or ring.

Simple to install, the LM10 features an integral set-up LED, wide installation tolerances. A bidirectional reference is provided that can be actuated either by a preset mark integrated within the scale or ring or by adding a reference sticker on top of the scale with the help of a self-aligning installation tool.

The encoders come in digital or analogue output variants and offer a range of customer selectable resolutions from 0.244 µm to 250 µm.

Maximum speed depends on the chosen resolution and minimum edge separation time; eg. 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 applications go to magnetic ring data sheet.

Engineered for extreme service, the solid-state LM10 linear encoders operate from –10 °C to +80 °C, have water-proof sealing to IP68 and are highly resistant to shock, vibration and pressure. The robust magnetic scale and ring are also resistant to a range of chemicals commonly found in industry.

The non-contact, frictionless design eliminates wear while reducing hysteresis.

The LM10 encoders bring reliable solutions to tough, hard-working applications including woodworking, stone-cutting, sawing, metalworking, textiles, printing, packaging, plastics processing, automation and assembly systems, laser/flame/water-jet cutting, electronic assembly equipment etc.

- Customer selectable resolutions
- Bi-directional reference mark option
- High speed operation
- Excellent dirt immunity to IP68
- Integral set-up LED
- Linear or rotary position sensing possible
- High reliability from proven non-contact sensing technology
- Industry standard incremental digital and analogue output options
- CE compliant, including RoHS - see Declaration of conformity
Storage and handling

WARNING: The MS magnetic scale should not be exposed to magnetic field densities higher than 50 mT on its surface. Magnetic fields higher than 50 mT 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 refer to magnetic ring data sheet.

Electrical connections
## Dimensions

Dimensions and tolerances in mm.

![Dimensions Diagram]

**NOTE:** Ensure recommended M3 readhead fixing screws are tightened to 0.5 Nm to 0.7 Nm.

<table>
<thead>
<tr>
<th>Magnetic scale thickness (D)</th>
<th>Ride height (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With back adhesive*</td>
<td>Without back adhesive*</td>
</tr>
<tr>
<td>No cover foil, cut or magnetised reference mark</td>
<td>1.5 ± 0.15</td>
</tr>
<tr>
<td>No cover foil, stick-on reference mark</td>
<td>1.5 ± 0.15</td>
</tr>
<tr>
<td>With cover foil, cut or magnetised reference mark</td>
<td>1.6 ± 0.15</td>
</tr>
<tr>
<td>With cover foil, stick-on reference mark</td>
<td>1.6 ± 0.15</td>
</tr>
</tbody>
</table>

* See MS10 part numbering on page 14 for more information on the options available.
** Not applicable for AS output.
***For greater ride heights please see LM15 encoder system (LM15D01).

### Installation tolerances

**Ride height**

- H ±3°

**Lateral offset**

- H ±1 (±0.2 for AS output)

**Pitch**

- ±3°

**Roll**

- ±3° (±0.5° for AS output)

**Yaw**

- ±1°

For radial and axial ring installation tolerances refer to magnetic ring data sheet.

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Technical specifications

System data

Maximum length for MS scale: 100 m (up to 180 m per request)
Pole length: 2 mm
Sinusoidal period length (for analogue voltage output): 2 mm

For rotary maximum speed table refer to magnetic ring data sheet.

Available resolutions and maximum speed for linear application:

For analogue voltage output: 80 m/s
For digital output signals:

<table>
<thead>
<tr>
<th>Resolution (µm)</th>
<th>Counts / 2 mm</th>
<th>Maximum speed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>9.33</td>
<td>4.67</td>
</tr>
<tr>
<td>1.58</td>
<td>14.58</td>
<td>7.30</td>
</tr>
<tr>
<td>1.953</td>
<td>14.58</td>
<td>7.30</td>
</tr>
<tr>
<td>2.5</td>
<td>18.67</td>
<td>2.34</td>
</tr>
<tr>
<td>3.906</td>
<td>29.17</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Accuracy grade for MS scales:

| ±10 µm (available for lengths up to 20 m only), ±20 µm and ±40 µm |
| Better than unit of resolution for movement in the same direction |
| < 4 µm up to 0.5 mm ride height |

Mechanical data

| Mass | Readhead (1 m cable, no connector) 57 g, Cable (1 m) 34 g |
|      | Magnetic scale (1 m) 60 g, Cover foil (1 m) 3.5 g |

Environmental data

| Temperature | Operating: -10 °C to +80 °C (cable under non-dynamic conditions: -20 °C to +85 °C) |
|            | Storage: -40 °C to +85 °C |
| Environmental sealing | IP68 (according to IEC 60529) |

EMC Immunity

IEC 61000-6-2 (particularly: ESD: IEC 61000-4-2; EM fields: IEC 61000-4-3; Burst: IEC 61000-4-4; Surge: IEC 61000-4-5; Conducted disturbances: IEC 61000-4-6; Power frequency magnet fields: IEC 61000-4-6; Pulse magnetic fields: IEC 61000-4-9) |

EMC Emission

IEC 61000-6-4 (for industrial, scientific and medical equipment: IEC 55011) |

Vibrations (55 Hz to 2000 Hz)

300 m/s² (IEC 60068-2-6) |

Shocks (11 ms)

300 m/s² (IEC 60068-2-27)
### Cable specifications

<table>
<thead>
<tr>
<th>Cable type</th>
<th>PUR high flexible cable, drag-chain compatible, double-shielded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of wires</td>
<td>8</td>
</tr>
<tr>
<td>Outer diameter</td>
<td>4.2 mm ±0.2 mm</td>
</tr>
<tr>
<td>Jacket material</td>
<td>Extruded polyurethane (PUR)</td>
</tr>
<tr>
<td>White wire</td>
<td>0.14 mm², 26 AWG, 0.13 Ω/m</td>
</tr>
<tr>
<td>Other wires</td>
<td>0.05 mm², 30 AWG, 0.35 Ω/m</td>
</tr>
<tr>
<td>Durability</td>
<td>20 million cycles at 25 mm bend radius</td>
</tr>
<tr>
<td>Weight</td>
<td>34 g/m nominal</td>
</tr>
<tr>
<td>Bend radius (internal radius)</td>
<td>Dynamic 25 mm, static 10 mm</td>
</tr>
</tbody>
</table>

### Output specifications

**LM10AV and LM10AS** – Incremental analogue output signals (1 V<sub>pp</sub>)

2 channels V<sub>1</sub> and V<sub>2</sub> differential sinusoids (90° phase shifted)

<table>
<thead>
<tr>
<th>Connection</th>
<th>Signal Type</th>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Voltage</td>
<td>Voltage on readhead</td>
<td>4.7 V to 7 V ** – reverse polarity protection</td>
</tr>
<tr>
<td></td>
<td>Current</td>
<td>Current consumption</td>
<td>&lt; 50 mA</td>
</tr>
<tr>
<td>Voltage drop over cable</td>
<td></td>
<td>Without load (V&lt;sub&gt;1&lt;/sub&gt;())</td>
<td>~ 13 mV/m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With load (V&lt;sub&gt;2&lt;/sub&gt;())</td>
<td>~ 54 mV/m</td>
</tr>
<tr>
<td>Output signals</td>
<td>V&lt;sub&gt;1&lt;/sub&gt;, V&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Differential sinusoids</td>
<td>90° ±0.5°</td>
</tr>
<tr>
<td>Sine / cosine signals</td>
<td>Amplitude (with 120 Ω termination)</td>
<td>0.6 V&lt;sub&gt;pp&lt;/sub&gt; to 1.2 V&lt;sub&gt;pp&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phase shift</td>
<td>90° ±0.5°</td>
<td></td>
</tr>
<tr>
<td>Reference signal</td>
<td>Amplitude (with 120 Ω termination)</td>
<td>0.8 V&lt;sub&gt;pp&lt;/sub&gt; to 1.2 V&lt;sub&gt;pp&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position</td>
<td>45°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Width</td>
<td>22.5° for AV output</td>
<td>360° ±180° for AS output</td>
</tr>
</tbody>
</table>

### Timing diagram

![Timing diagram](image)

**Recommended signal termination**

V<sub>1</sub>, V<sub>2</sub>, V<sub>0</sub> 120 Ω

### Connections

<table>
<thead>
<tr>
<th>Function</th>
<th>Signal</th>
<th>Colour (option F)</th>
<th>15 pin D type plug (option L)</th>
<th>9 pin D type plug (option A)</th>
<th>9 pin D type plug (option P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>5 V</td>
<td>Brown</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>0 V</td>
<td>White</td>
<td>12</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Analogue signals</td>
<td>V&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Green</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;1&lt;/sub&gt;–</td>
<td>Yellow</td>
<td>1</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Blue</td>
<td>10</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;2&lt;/sub&gt;–</td>
<td>Red</td>
<td>2</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Reference signals</td>
<td>V&lt;sub&gt;0&lt;/sub&gt;</td>
<td>Pink</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;0&lt;/sub&gt;–</td>
<td>Grey</td>
<td>11</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Shield</td>
<td>Inner</td>
<td>–</td>
<td>15</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Outer</td>
<td>Case</td>
<td>Case</td>
<td>Case</td>
<td></td>
</tr>
</tbody>
</table>
Data sheet
LM10D01_15

LM10IA – Incremental, push-pull; 24 V power supply

Power supply *
4.7 V to 30 V – voltage on readhead
Without reverse polarity protection

Power consumption
< 35 mA

Voltage drop over cable
~ 13 mV/m – without load
~ 54 mV/m – with 120 Ω load

Response time **
< 100 ms
< 10 µs (special option 02)

Output signals
3 square-wave signals A, B, Z and their inverted signals A–, B–, Z–

Reference signal
1 or more square-wave pulse Z and its inverted pulse Z–

Signal level
For 30 V: \[ U_H \geq 29.2 \text{ V at } I_H = 30 \text{ mA} \]
\[ U_L \leq 0.5 \text{ V at } I_L = 30 \text{ mA} \]
For 5 V: \[ U_H \geq 4.2 \text{ V at } I_H = 20 \text{ mA} \]
\[ U_L \leq 0.5 \text{ V at } I_L = 20 \text{ mA} \]

Permissible load
\[ I_L \leq 50 \text{ mA max. load per output} \]
Outputs are protected against short circuit to 0 V and to +5 V

Alarm
High impedance on output lines A, B, A–, B–
Special option 02: Alarm is not signalled by high impedance state **
Special option 07: Alarm signal is output parallel as line driver signal

Switching time (10 to 90 %)
For 24 V: \[ t^+ = t^- < 380 \text{ ns (typ. 120 ns)} \]
For 5 V: \[ t^+ = t^- < 200 \text{ ns (typ. 42 ns)} \]
Measured at \[ C_{LOAD} = 1000 \text{ pF} \]

Cable length *
Max. 100 m

* If power supply voltage is <10 V, please consider voltage drop over cable.
** See description on page 10.

Connections

<table>
<thead>
<tr>
<th>Function</th>
<th>Signal</th>
<th>Colour (option F)</th>
<th>15 pin D type plug (option D)</th>
<th>9 pin D type plug (option A)</th>
<th>15 pin HD type plug (option H)</th>
<th>7 pin DIN EN60130-9 plug (option U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>5 V</td>
<td>Brown</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>0 V</td>
<td>White</td>
<td>2</td>
<td>9</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Incremental signals</td>
<td>A</td>
<td>Green</td>
<td>14</td>
<td>4</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A–</td>
<td>Yellow</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Blue</td>
<td>13</td>
<td>3</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B–</td>
<td>Red</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>–</td>
</tr>
<tr>
<td>Reference signals</td>
<td>Z</td>
<td>Pink</td>
<td>12</td>
<td>2</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Z–</td>
<td>Grey</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>Alarm</td>
<td>E</td>
<td>Violet</td>
<td>11</td>
<td>–</td>
<td>11</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>E–</td>
<td>Black</td>
<td>3</td>
<td>–</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Shield</td>
<td>Inner</td>
<td>–</td>
<td>15</td>
<td>1</td>
<td>15</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Outer</td>
<td>–</td>
<td>Case</td>
<td>Case</td>
<td>Case</td>
<td>Case</td>
</tr>
</tbody>
</table>
**LM10IB – Digital output signals, Open Collector NPN**

Square wave output

<table>
<thead>
<tr>
<th>Power supply voltage</th>
<th>5 V</th>
<th>12 V</th>
<th>24 V</th>
<th>30 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge separation (µs)</td>
<td>0.07</td>
<td>0.2</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>3</td>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2, 4, 5, 10, 20</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>$R_L$ (Ω) *</td>
<td>500</td>
<td>1200</td>
<td>2400</td>
<td>3000</td>
</tr>
</tbody>
</table>

For higher values of $R_L$ shorter cables should be used.

**Encoder cable length and all other cable extensions should be taken into account.**

Set-up LED is flashing red in case of poor signal strength (see table Status LED on page 10).

---

**Connections**

<table>
<thead>
<tr>
<th>Function</th>
<th>Signal</th>
<th>Colour (option F)</th>
<th>9 pin D type plug (option A)</th>
<th>7 pin DIN EN60130-9 plug (option U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>5 V</td>
<td>Brown</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>0 V</td>
<td>White</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Incremental signals</td>
<td>A</td>
<td>Green</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Blue</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Reference signal</td>
<td>Z</td>
<td>Pink</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Shield</td>
<td>Inner</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Outer</td>
<td>–</td>
<td>Case</td>
<td>Case</td>
</tr>
</tbody>
</table>

---

**Power supply**

- 5 V to 30 V
- Without reverse polarity protection

**Power consumption**

- 13 mV/m – without load
- 54 mV/m – with 120 Ω load

**Output signals**

- A, B, Z

**Reference signal**

- 1 or more square-wave pulses Z

**Maximum load**

- 10 mA

**Cable length**

- See table below

---

**Recommended signal termination**

---

**Timing diagram**

---

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---
Data sheet
LM10D01_15

LM10IC – Digital output signals, RS422
Square wave differential line driver to RS422

Table: Power supply

<table>
<thead>
<tr>
<th>Function</th>
<th>Signal</th>
<th>Colour (option F)</th>
<th>15 pin D type plug (option D)</th>
<th>9 pin D type plug (option A)</th>
<th>15 pin HD type plug (option H)</th>
<th>7 pin DIN EN60130-9 plug (option U)</th>
<th>9 pin CPC connector (option E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>5 V</td>
<td>Brown</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>0 V</td>
<td>White</td>
<td>2</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Incremental</td>
<td>A</td>
<td>Green</td>
<td>14</td>
<td>4</td>
<td>14</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>signals</td>
<td>A–</td>
<td>Yellow</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Blue</td>
<td>13</td>
<td>3</td>
<td>13</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>B–</td>
<td>Red</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>Reference</td>
<td>Z</td>
<td>Pink</td>
<td>12</td>
<td>2</td>
<td>12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>signals</td>
<td>Z–</td>
<td>Grey</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>–</td>
<td>6</td>
</tr>
<tr>
<td>Alarm</td>
<td>E</td>
<td>Violet</td>
<td>11</td>
<td>–</td>
<td>11</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>E–</td>
<td>Black</td>
<td>3</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Shield</td>
<td>Inner</td>
<td>–</td>
<td>15</td>
<td>1</td>
<td>15</td>
<td>–</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Outer</td>
<td>–</td>
<td>Case</td>
<td>Case</td>
<td>Case</td>
<td>Case</td>
<td>9</td>
</tr>
</tbody>
</table>

Recommended signal termination

Connections

Programming (for IC output only)

Readheads can be ordered preset to the required resolution or provided so that they can be programmed as needed on the machine to the chosen resolution. This programming is carried out by connecting the readhead to a computer via a programming interface. The readhead must be ordered with the PRG resolution option to use this function. For more information on the programming function of LM10 readheads, please refer to the UPRG01 programming interface datasheet.
Reference mark

Reference marks can be provided in 4 ways:

1) **Selected at point of order.** The LM10 readhead should be ordered with reference mark option A. Magnetic scale or ring should be ordered with reference mark. For scales with magnetised reference mark an additional letter M should be added to the end of the part numbering. If required, the cover foil can be installed over reference marks.

2) **Stick-on reference mark.** The LM10 readhead should be ordered with reference mark option A. Magnetic scale should be ordered with no reference mark. After installation of the scale a reference mark sticker can be applied to the scale at the required position using the reference mark applicator tool. Ensure that the reference sticker is oriented to the corresponding side of the readhead that has the reference mark designator marked.

3) **Tool for custom selectable reference mark.** The LM10 readhead should be ordered with reference mark option A. Magnetic scale should be ordered with no reference mark. Operator can magnetise reference mark in a position to suit the application.

4) **Periodic reference impulse. Every 2 mm.** The LM10 readhead should be ordered with reference mark option C. Magnetic scale or ring should be ordered with no reference mark. Position information is output in incremental quadrature format with periodic reference impulses. Reference periods correspond to pole length of magnetisation.

**Distance coded reference marks.** The LM10 readhead should be ordered with reference mark option A. The distance coded reference mark option provides multiple reference marks that are individually spaced according to specific mathematical algorithm. Absolute position is calculated after traversing 2 successive reference marks. Maximum length and minimum traverse depend on basic spacing (K) between reference marks, which is customer selectable at point of order. For further information please refer to Distance coded reference mark data sheet (LM10D17).

**Multiple reference marks.** For cut reference marks on multiple locations on the MS magnetic scale please contact RLS for a special part numbering. For radial and axial ring references refer to magnetic ring data sheet.
Positive direction

Digital output signals – A leads B
Analogue output signals (1 V<sub>pp</sub>) – V<sub>1</sub> leads V<sub>2</sub>

Status LED

After the installation of the magnetic scale or ring (see MS magnetic scale installation guide for LM10 and LM15 readheads) the readhead can be easily adjusted on the machine using the set-up LED indicator. When special option 07 (additional alarm outputs) is selected status of LED is available also by additional lines (HI = green LED, LO = red LED).

<table>
<thead>
<tr>
<th>LED Status</th>
<th>Status</th>
<th>Possible reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good signal strength/set-up</td>
<td>-</td>
</tr>
<tr>
<td>Red</td>
<td>Poor signal strength - adjustment required A, B, A-, B- become high impedance</td>
<td>Incorrect readhead orientation. Readhead installation out of tolerance.</td>
</tr>
<tr>
<td>Red/green flashing</td>
<td>IB, IC_02, IA_02: poor signal strength</td>
<td>Demagnetisation of measuring scale or ring. Insufficient power supply voltage.</td>
</tr>
</tbody>
</table>

Response time

<table>
<thead>
<tr>
<th></th>
<th>LM10AV/AS</th>
<th>LM10IB</th>
<th>LM10IC_02</th>
<th>LM10IA_02</th>
<th>LM10IC</th>
<th>LM10IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set-up time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 ms</td>
</tr>
<tr>
<td>Conversion time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;250 ns</td>
</tr>
<tr>
<td>Transition time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;10 µs</td>
</tr>
</tbody>
</table>

Set-up time is the time needed for the encoder readhead to start reading the position information after power-on (see diagram 1). Conversion time is the time needed for the encoder readhead to convert the position information into an output signal. Transition time is the time it takes the encoder readhead to switch from an alarm state to a valid output signal (see diagram 2).

Diagram 1: Set-up time

Diagram 2: Transition time

* In alarm state LED flashes red/green.
Readhead part numbering

LM10 system

LM10 readhead
e.g. LM10IC010CA10F00

Magnetic scale / ring
e.g. MS10BM100A0000 for scale /
MR047B040B076B00 for ring

Output type
- AS - Analogue voltage 1Vpp, wide reference pulse, 5 V
- AV - Analogue voltage, 1 Vpp, 5 V
- IA - Incremental Push-Pull outputs; 5 V – 30 V
- IB - Incremental, Open Collector NPN; 5 V – 30 V
- IC - Incremental, RS422; 5 V

Interpolation factor
For AS and AV: 000 - N/A
For IA, IB and IC:
13B - 6192 (0.244 µm)
12B - 4096 (0.488 µm)
11B - 2048
001 - 2000 (1 µm)
106 - 1600
10B - 1024
002 - 1000 (2 µm)
080 - 800
07B - 128
PRG - Programmable, preset to 1 µm (for IC only)

Minimum edge separation
For AS and AV: A - N/A
For IA, IB and IC:
K - 0.07 µs (15 MHz)
A - 0.12 µs (8 MHz)
B - 0.5 µs (2 MHz)
C - 1 µs (1 MHz)
D - 2 µs (0.5 MHz)
E - 4 µs (0.25 MHz)
F - 5 µs (0.2 MHz)
G - 10 µs (0.1 MHz)
H - 20 µs (0.05 MHz)

Special requirements
00 - No special requirements (standard)
02 - Shortened reaction time (for IA, IC; not available for PRG option)
07 - Additional alarm output (for IA, IC; not available for PRG option)
10 - Not potted, protected to IP50
19 - Stainless steel housing
40 - Protective stainless-steel tube for cable
0M - Cable length in meters

Connector option
- A - 9 pin D type plug
- D - 15 pin D type plug (for IA and IC)
- E - 9 pin CPC connector (for IC)
- F - Flying lead (no connector)
- H - 15 pin HD type plug (for IA and IC)
- L - 15 pin D type plug (for AV and AS)
- P - 9 pin D type plug (for AV and AS)
- U - 7 pin DIN EN60130-9 plug (for IA, IB and IC)

Cable length
10 - 1.0 m (standard)
(eg. 13 - 1.3 m cable and
13 - 13 m cable if special option 0M is chosen)

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

1 Not available with 03B and 04B interpolation factors.
2 Default for PRG option; not available with 03B interpolation factor.
3 The PRG option comes with a plastic connector.
4 Not available with AS output type.
5 Not available with special option 07.
6 Magnetic scale must be ordered with magnetised reference mark.
**Formula for linear application resolution**

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

**Formula for rotary application resolution**

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

Resolution (cpp) = Pole number x Interpolation

For radial and axial ring part numbering refer to magnetic ring data sheet.

<table>
<thead>
<tr>
<th>Series</th>
<th>Output type</th>
<th>Interpolation factor</th>
<th>Minimum edge separation</th>
<th>Reference</th>
<th>Cable length</th>
<th>Connector option</th>
<th>Special requirements</th>
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</thead>
<tbody>
<tr>
<td>IC</td>
<td>PRG</td>
<td>001 / 002 / 13B / 12B / 11B / 1D6 / 10B / D80 / 09B / D50</td>
<td>A / C / B</td>
<td>00 / 05 / 10 / 0M / 02 / 07 / 19 / 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>005 / 010 / 020 / 050 / D32 / 08B / D16 / 07B / D08 / 06B / 05B</td>
<td>K / A / B / C / D / E / F / G / H</td>
<td>A / C / B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>04B</td>
<td>A / B / C / D / E / F / G / H</td>
<td>C / B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>03B</td>
<td>B / C / D / E / F / G / H</td>
<td>C / B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| IA     |            | 001 / 002 / 13B / 12B / 11B / 1D6 / 10B / D80 / 09B / D50 | A / C / B | |
| IA     | 005 / 010 / 020 / 050 / D32 / 08B / D16 / 07B / D08 / 06B / 05B | K / A / B / C / D / E / F / G / H | A / C / B | |
| IA     | 04B         | A / B / C / D / E / F / G / H | C / B | |
| IA     | 03B         | B / C / D / E / F / G / H | C / B | |

| IB     |            | 001 / 002 / 13B / 12B / 11B / 1D6 / 10B / D80 / 09B / D50 | A / C / B | |
| IB     | 005 / 010 / 020 / 050 / D32 / 08B / D16 / 07B / D08 / 06B / 05B | K / A / B / C / D / E / F / G / H | A / C / B | 00 / 05 / 10 / 0M / 02 / 19 / 40 |
| IB     | 04B         | A / B / C / D / E / F / G / H | C / B | |
| IB     | 03B         | B / C / D / E / F / G / H | C / B | |

| AV     |            | 000 | A / C / B | |
| AS     |            | 000 | A / C / B | |
Diagram for magnetic scale ordering

Dimensions in mm.

Magnetic scale with ends prepared for end clamping (options C and P)

1 Hole to hole distance = Scale length - 6 ±1 mm (for end clamp mounting)
2 Measuring length with end clamps = Scale length - 26 mm

1 Measuring length = Scale length - 20 mm
* Scale markings are shown for orientation purpose only. The markings do not represent the actual part numbering.
Magnetic scale part numbering

Please refer to diagram for magnetic scale on page 13.

Accuracy grade
A - ±20 µm
B - ±40 µm
D - ±10 µm (available for lengths up to 20 m only)

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

Options
A - VHB back-adhesive tape (standard)
B - VHB back-adhesive tape, with cover foil*
C - VHB back-adhesive tape, ends prepared for end clamping¹
G - No VHB back-adhesive tape, sides prepared for insertion into track section²
H - No VHB back-adhesive tape, sides prepared for insertion into track section, with cover foil²
I - No back-adhesive tape
N - No back-adhesive tape, with cover foil*
P - No back-adhesive tape, ends prepared for end clamping³

Reference mark
0000 - No reference mark**
xxxx - Cut reference mark; Where xxxx equals position of machined reference mark in cm (reference mark position will be within ±0.5 mm from requested position)**
Mxxx - Cut reference mark; Where xxx equals position of machined reference mark in mm (for scale lengths below 1 m)**
Dxxx - Distance coded reference mark; where xxx equals basic increment in mm**¹
xxxxM - Magnetised reference mark; where xxxx equals position of magnetised reference mark in cm (reference mark position will be within ±0.5 mm from requested position)
MxxxM - Magnetised reference mark in mm; where xxx equals position of magnetised reference mark in mm (for scale lengths below 1m)

* Cover foil supplied separately.
** Not for use with AS output type.

Cover foil part numbering

Width of cover foil
CF08 - Width 8 mm (for TRS option only)²
CF10 - Width 10 mm

Foil length
xxxx - Where xxxx equals foil length in cm

¹ For details on DCRM system please refer to data sheet LM10D17 on www.rls.si/lm10.
² For details on TRS system please refer to data sheet LM10D18 on www.rls.si/lm10.
³ For details on end clamp installation please refer to data sheet LM10D14 on www.rls.si/lm10.

For radial and axial ring part numbering refer to magnetic ring data sheet.
Accessories part numbering

- **Stick-on reference mark**
  - LM10SRM00

- **Applicator tool for stick-on reference mark**
  - LM10ARM00

- **Applicator tool for magnetic scale and cover foil**
  - LM10ASC00

- **USB encoder interface**
  - E201

- **End clamp kit**
  - (2 clamps + 2 screws)
  - LM10ECL00

- **Tool for custom selectable reference mark**
  - LM10CRM00

- **Programmable interface**
  - UPRG01

- **Magnet viewer**
  - MM0001

Accessories for MS Track System

- **Track section, 1.00 m**
  - TRS100A00

- **Track section, 2.00 m**
  - TRS200A00

- **Scale clamp, 0.04 m**
  - TRE004A00

- **Joining element, 0.04 m**
  - TRE004A01

- **Screw and washer**
  - TRC00

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Document issues

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<td></td>
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<td>8</td>
<td>9-pin CPC connector added</td>
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<tr>
<td></td>
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<td>11, 12</td>
<td>Readhead part numbering amended</td>
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<tr>
<td></td>
<td></td>
<td>13, 14</td>
<td>Magnetic scale part numbering amended</td>
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