The LM13 is a contactless high-speed linear magnetic system designed for use in harsh environments.

The system consists of a compact readhead and a separate self-adhesive magnetic scale.

Simple to install, the LM13 features an integral set-up LED on the readhead, wide installation tolerances and an applicator tool for the adhesive-backed magnetic scale. A bidirectional reference is provided that can be actuated either by a preset mark integrated within the scale or by adding a reference sticker on top of the scale with the help of a self-aligning installation tool.

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

The LM13 linear encoder system brings 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.

Engineered for extreme service, the solid-state LM13 linear encoder operates from -10 °C to +80 °C, sealing to IP68 and is highly resistant to shock, vibrations and pressure. The robust magnetic scale is also resistant to a range of chemicals commonly found in industry.

The LM13 is capable of velocities up to 25 m/s; even at 1 µm resolution it is capable of 4 m/s.

- Compact readhead
- Resolutions from 250 µm to 1 µm
- Stick-on reference mark
- High speed operation
- Excellent dirt immunity
- Integral set-up LED
- Axis lengths of up to 100 m
- High reliability from proven non-contact sensing technology
- Industry standard digital and analogue output options
- Repeatability inside resolution

0.1 - 1 mm

Track system
LM13 dimensions

Dimensions and tolerances in mm.

<table>
<thead>
<tr>
<th>Magnetic scale thickness (D)</th>
<th>Ride height (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No cover foil, cut or magnetised reference mark</td>
<td>1.5±0.2</td>
</tr>
<tr>
<td>No cover foil, stick-on reference mark</td>
<td>1.5±0.2</td>
</tr>
<tr>
<td>With cover foil, cut or magnetised reference mark</td>
<td>1.65±0.2</td>
</tr>
<tr>
<td>With cover foil, stick-on reference mark</td>
<td>1.65±0.2</td>
</tr>
</tbody>
</table>

* For larger ride height (H) please see LM15 linear encoder system (LM15D01).

LM13 installation tolerances

Ride height

Lateral offset

Pitch

Roll

Yaw
LM13 technical specifications

System data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum measuring length of MS scale</td>
<td>50 m (100 m special order)</td>
</tr>
<tr>
<td>Pole length</td>
<td>2 mm</td>
</tr>
<tr>
<td>Available resolutions</td>
<td>1 µm, 2 µm, 4 µm, 5 µm, 10 µm, 20 µm, 25 µm, 50 µm, 125 µm and 250 µm</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>For analogue voltage output: 25 m/s</td>
</tr>
</tbody>
</table>

For digital output signals:

<table>
<thead>
<tr>
<th>Resolution (µm)</th>
<th>Interpolation factor</th>
<th>Maximum speed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2000</td>
<td>4.16</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>8.32</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>16.64</td>
</tr>
<tr>
<td>5</td>
<td>400</td>
<td>20.80</td>
</tr>
<tr>
<td>10</td>
<td>200</td>
<td>25.00</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>25.00</td>
</tr>
<tr>
<td>25</td>
<td>80</td>
<td>25.00</td>
</tr>
<tr>
<td>50</td>
<td>40</td>
<td>25.00</td>
</tr>
<tr>
<td>125</td>
<td>16</td>
<td>≥20 µm/m and ±40 µm/m</td>
</tr>
<tr>
<td>250</td>
<td>8</td>
<td>≥20 µm/m and ±40 µm/m</td>
</tr>
</tbody>
</table>

Precision class

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear expansion coefficient of MS scale</td>
<td>~ 17 × 10⁻⁶/K</td>
</tr>
<tr>
<td>Repeatability</td>
<td>Better than unit of resolution</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>&lt; 3 µm up to 0.5 mm ride height</td>
</tr>
<tr>
<td>Sub divisional error</td>
<td>±3.5 µm for &lt; 0.7 mm ride height</td>
</tr>
<tr>
<td></td>
<td>±7.5 µm for 1 mm ride height</td>
</tr>
<tr>
<td>Mass</td>
<td>Readhead (1 m cable, no connector) 80 g, Cable (1 m) 34 g Magnetic scale (1 m) 60 g, Cover foil (1 m) 3.5 g</td>
</tr>
</tbody>
</table>

Cable data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage drop over cable</td>
<td>~ 13 mV/m – without load</td>
</tr>
<tr>
<td></td>
<td>~ 54 mV/m – with 120 Ω load</td>
</tr>
<tr>
<td>Cable</td>
<td>Ø4.2²±0.2 mm, PUR high flexible cable, drag-chain compatible, double-shielded 8 × 0.05 mm²; durability: 20 million cycles at 20 mm bend radius</td>
</tr>
</tbody>
</table>

Environmental conditions

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Operating: -10 °C to +80 °C (cable under non-dynamic conditions: -20 °C to +85 °C) Storage: -40 °C to +85 °C</td>
</tr>
<tr>
<td>Environmental sealing</td>
<td>IP68 (according to IEC 60529)</td>
</tr>
<tr>
<td>EMC Immunity</td>
<td>IEC 61000-4-2 (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 61000-4-8; Pulse magnetic fields: IEC 61000-4-9)</td>
</tr>
<tr>
<td>EMC Interference</td>
<td>IEC 61000-6-4 (for industrial, scientific and medical equipment: IEC 55011)</td>
</tr>
<tr>
<td>Vibrations (55 Hz to 2000 Hz)</td>
<td>300 m/s² (IEC 60068-2-6)</td>
</tr>
<tr>
<td>Shocks (11 ms)</td>
<td>300 m/s² (IEC 60068-2-27)</td>
</tr>
</tbody>
</table>
**LM13D02_03**

**LM13IC – Digital output signals**

Square wave differential line driver to EIA RS422

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>4.7 V to 7 V – voltage on readhead</td>
</tr>
<tr>
<td></td>
<td>Reverse polarity protection</td>
</tr>
<tr>
<td><strong>Power supply rise time</strong></td>
<td>&lt; 1 ms (for PRG option only)</td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td>&lt; 35 mA</td>
</tr>
<tr>
<td><strong>Output signals</strong></td>
<td>3 square-wave signals A, B, Z and their inverted signals A-, B-, Z-</td>
</tr>
<tr>
<td><strong>Reference signal</strong></td>
<td>1 or more square-wave pulse Z and its inverted pulse Z-</td>
</tr>
<tr>
<td><strong>Signal level</strong></td>
<td>Differential line driver to EIA standard RS422:</td>
</tr>
<tr>
<td></td>
<td>$U_h \geq 2.5$ V at $-I_h = 20$ mA</td>
</tr>
<tr>
<td></td>
<td>$U_l \leq 0.5$ V at $I_l = 20$ mA</td>
</tr>
<tr>
<td><strong>Permissible load</strong></td>
<td>$Z_0 \geq 100$ Ω between associated outputs $I_l \leq 20$ mA max. load per output</td>
</tr>
<tr>
<td></td>
<td>Capacitive load $\leq 1000$ pF</td>
</tr>
<tr>
<td></td>
<td>Outputs are protected against short circuit to 0 V and to $+5$ V</td>
</tr>
<tr>
<td><strong>Alarm</strong></td>
<td>High impedance on output lines A, B, A-, B-</td>
</tr>
<tr>
<td><strong>Switching time</strong> (10 to 90 %)</td>
<td>$t_+ &lt; 30$ ns (with 1 m cable and recommended input circuit)</td>
</tr>
<tr>
<td><strong>Cable length</strong></td>
<td>max. 100 m</td>
</tr>
</tbody>
</table>

*Please consider voltage drop over cable.*

---

**LM13AV – Analogue output signals (1 V<sub>pp</sub>)**

2 channels $V_1$ and $V_2$ differential sinusoids (90° phase shifted)

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>4.7 V to 7 V – voltage on readhead</td>
</tr>
<tr>
<td></td>
<td>Reverse polarity protection</td>
</tr>
<tr>
<td><strong>Output signals</strong></td>
<td>$V_1$, $V_2$, $V_0$</td>
</tr>
<tr>
<td><strong>Sine / cosine signals</strong></td>
<td>Amplitude $0.6$ V&lt;sub&gt;pp&lt;/sub&gt; to $1.2$ V&lt;sub&gt;pp&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>(with 120 Ω termination)</td>
</tr>
<tr>
<td><strong>Reference signal</strong></td>
<td>Amplitude $0.8$ V&lt;sub&gt;pp&lt;/sub&gt; to $1.2$ V&lt;sub&gt;pp&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>(with 120 Ω termination)</td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td>45°</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>22.5°</td>
</tr>
<tr>
<td><strong>Termination</strong></td>
<td>$Z_0 = 120$ Ω between associated outputs</td>
</tr>
<tr>
<td><strong>Cable length</strong></td>
<td>max. 50 m</td>
</tr>
</tbody>
</table>

*Please consider voltage drop over cable.*
Reference mark

The repeatable bi-directional reference signal can be provided in 4 ways.

1) Stick-on reference mark. The LM13 readhead should be ordered with the reference mark option. 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 side of the readhead that has the cable outlet.

2) Selected at point of order. The LM13 readhead should be ordered with the reference mark option. If required the cover foil can be installed over the cut reference mark.

3) Every 2 mm. The LM13 readhead should be ordered with this specific mode activated only.

4) Distance coded reference mark. 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 minimal traverse depend on basic spacing between reference marks, which is customer selectable at point of order. For further information please refer to Distance coded reference mark data sheet (LM10D17).

Set-up LED

The readhead can be easily adjusted on the machine using the set-up LED indicator.

Green LED = good signal strength / set-up

Red LED = poor signal strength - adjustment required

A, B, A-, B- outputs become high impedance

Programming (for IC output type 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 option to use this function.

Positive direction

Digital output signal – A leads B
Analogue output signals (1 Vpp) – V_j leads V_i
LM13 readhead part numbering

LM13 system = Readhead + Scale

Readhead part number
eg LM13IC2D0CA10F00

Magnetic scale part number
eg MS10B1000B0032

Output type
IC - Incremental, RS422; 5 V
AV - Analogue voltage, 1 Vpp; 5 V

Resolution
000 - for AV output type
For IC output type
2D0 - 1 µm
1D0 - 2 µm
D50 - 4 µm
D40 - 5 µm
D20 - 10 µm
D10 - 20 µm
D08 - 25 µm
D04 - 50 µm
D06 - 75 µm
D04B - 125 µm
D03B - 250 µm
PRG - Programmable from 1 µm to 250 µm – preset to 1 µm

Minimum edge separation
For AV output type
A - N/A
For IC output type
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)

Special requirements
00 - No special requirements (standard)

Connector option
A - 9 pin D type plug
D - 15 pin D type plug (for IC output type)
L - 15 pin D type plug (for AV output type)
H - 15 pin HD type plug (for IC output type)
P - 9 pin D type plug (for AV output type)
F - Flying lead (no connector)

Cable length
10 - 1.0 m (standard)

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

* Default for PRG option.
NOTE: Not available with 125 µm and 250 µm resolution options.
Magnetic scale part numbering

Dimensions in mm

<table>
<thead>
<tr>
<th>Ends prepared for end clamping (option C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole to hole distance (^1)</td>
</tr>
<tr>
<td>Scale length</td>
</tr>
<tr>
<td>Measuring length (^2)</td>
</tr>
<tr>
<td>MS10A/WVXY-BB-2000-NNN</td>
</tr>
</tbody>
</table>

\(^1\) Hole to hole distance = scale length + 6\(^{\circ}\) mm (for end clamp mounting)

\(^2\) Measuring length = scale length - 17 mm

MS10  B  1000  B  0032

Position of reference mark

- 0000 - No reference mark
- xxxx - Where xxxx equals position of machined reference mark in cm (reference mark position will be within ±1 cm from requested position)
- Dxxx - Distance coded reference mark; where xxx equals basic increment in mm

Cover foil

- A - No cover foil
- B - Cover foil supplied (separately - 5 cm longer than tape)
- C - No cover foil, ends prepared for end clamping
- G - Track system

**For details on TRS track system please refer to data sheet LM10D18**

Accessories part numbering

Cover foil

CF10  1000

Foil length

- xxxx - Where xxxx equals foil length in cm

Stick-on reference mark  LM10SRM00
Applicator tool for stick-on reference mark  LM10ARM00
Applicator tool for magnetic scale and cover foil  LM13ASC00
End clamp kit (2 clamps + 2 screws)  LM10ECL00

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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>6. 1. 2009</td>
<td>-</td>
<td>New document</td>
</tr>
<tr>
<td>2</td>
<td>14. 1. 2009</td>
<td>-</td>
<td>New layout</td>
</tr>
<tr>
<td>3</td>
<td>5. 5. 2011</td>
<td>2</td>
<td>Ride height table added</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Power consumption data updated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3, 4</td>
<td>Analogue output type added</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>DCRM added to reference mark options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6, 7</td>
<td>New connector options and DCRM, end clamp and track system options added to part numbering</td>
</tr>
</tbody>
</table>

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