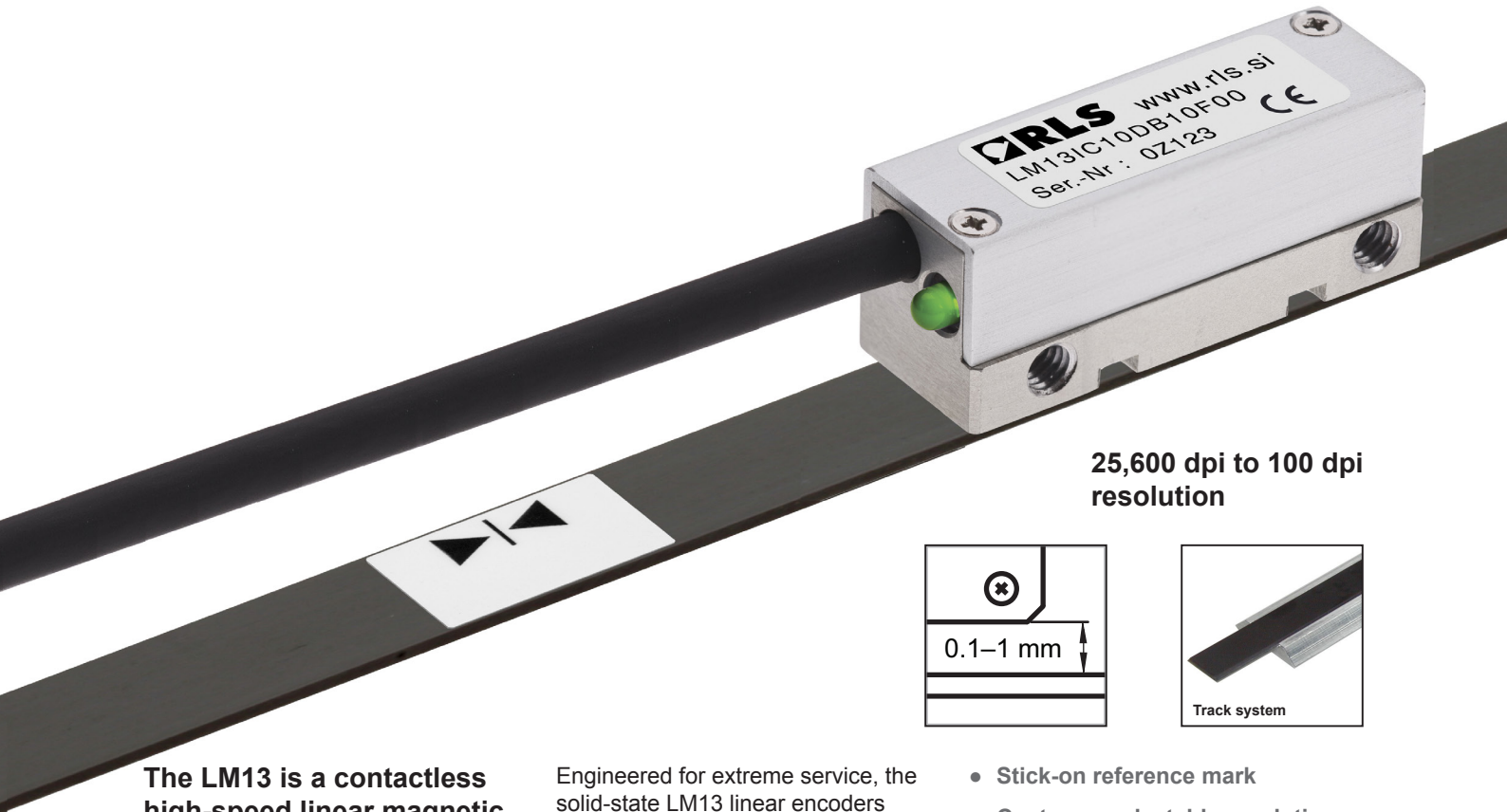
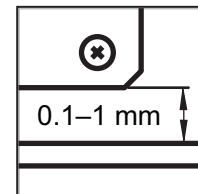


LM13 linear magnetic encoder system (DPI)



25,600 dpi to 100 dpi
resolution



The LM13 is a contactless high-speed linear magnetic encoder designed for DPI applications.

The LM13 features a compact sealed readhead that rides at up to 1.0 mm from the self-adhesive magnetic strip scale, which brings up to 100 m travel.

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 encoders come in digital output variants and offer a range of customer selectable resolutions from 25,600 dpi to 100 dpi.

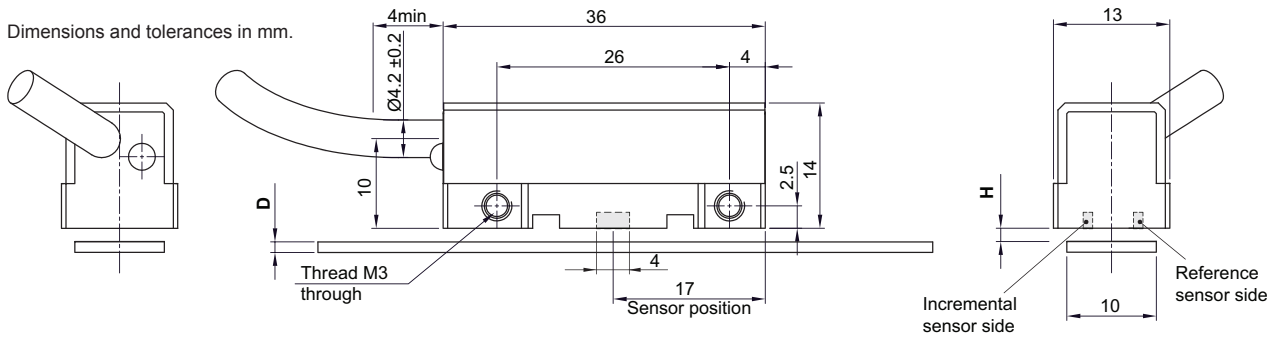
Engineered for extreme service, the solid-state LM13 linear encoders operate from -10 °C to +80 °C, have water-proof sealing to IP68 and are highly resistant to shock, vibrations and pressure. The robust magnetic scale is also resistant to a range of chemicals commonly found in industry.

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

- Stick-on reference mark
- Customer selectable resolutions from 25,600 dpi to 100 dpi
- 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 output options

LM13 dimensions

Dimensions and tolerances in mm.

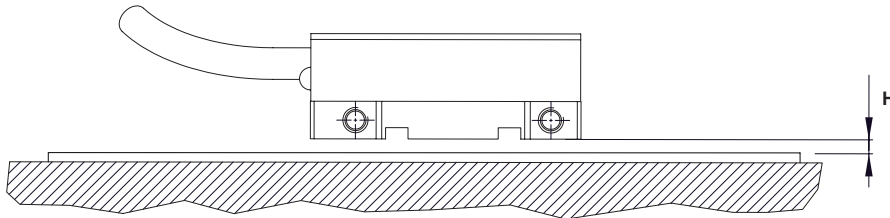


	Magnetic scale thickness (D)	Ride height (H)	
		Maximum range	Recommended range
No cover foil, cut or magnetised reference mark	1.5 ^{-0.2}	0.1 - 1.5	0.1 - 1.0
No cover foil, stick-on reference mark	1.5 ^{-0.2}	0.5 - 1.5	0.5 - 1.0
With cover foil, cut or magnetised reference mark	1.65 ^{-0.2}	0.1 - 1.3	0.1 - 0.9
With cover foil, stick-on reference mark	1.65 ^{-0.2}	0.5 - 1.3	0.5 - 0.9

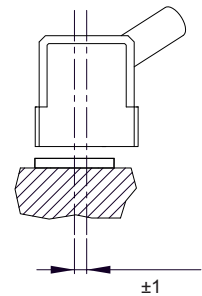
* For larger ride height (H) please see LM15 linear encoder system (LM15D01).

LM13 installation tolerances

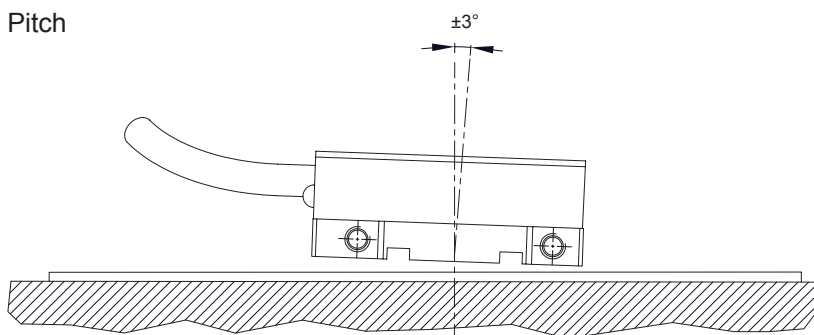
Ride height



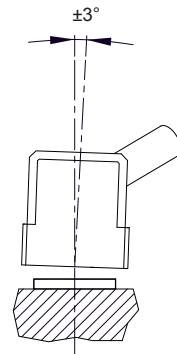
Lateral offset



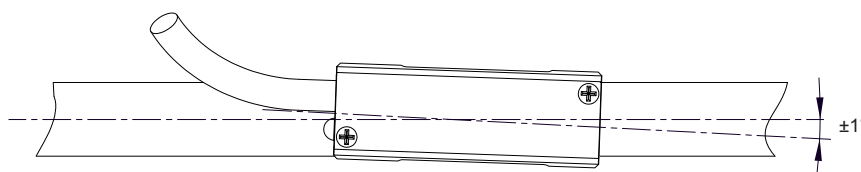
Pitch



Roll



Yaw



LM13 technical specifications

System data																																																																																																																																																																									
Maximum measuring length for MS scale	50 m (100 m special order)																																																																																																																																																																								
Pole length	2.032 mm																																																																																																																																																																								
Available resolutions	100, 200, 400, 500, 800, 1,000, 1,250, 1,600, 2,000, 2,500, 3,200, 4,000, 5,000, 6,250, 6,400, 10,000, 12,500, 12,800, 20,000, 25,000, 25,600 dpi																																																																																																																																																																								
Maximum speed	For analogue voltage output: 25 m/s For digital outputs:																																																																																																																																																																								
	<table border="1"> <thead> <tr> <th>Resolution (dpi)</th> <th>Interpolation factor</th> <th colspan="5">Maximum speed (m/s)</th> </tr> </thead> <tbody> <tr><td>25,600</td><td>2,048</td><td>4.11</td><td>1.03</td><td>0.52</td><td>0.25</td><td>0.13</td></tr> <tr><td>25,000</td><td>2,000</td><td>4.23</td><td>1.06</td><td>0.53</td><td>0.25</td><td>0.13</td></tr> <tr><td>20,000</td><td>1,600</td><td>5.28</td><td>1.32</td><td>0.66</td><td>0.31</td><td>0.16</td></tr> <tr><td>12,800</td><td>1,024</td><td>8.24</td><td>2.05</td><td>1.03</td><td>0.49</td><td>0.25</td></tr> <tr><td>12,500</td><td>1,000</td><td>8.45</td><td>2.11</td><td>1.06</td><td>0.50</td><td>0.26</td></tr> <tr><td>10,000</td><td>800</td><td>10.57</td><td>2.63</td><td>1.32</td><td>0.63</td><td>0.32</td></tr> <tr><td>6,400</td><td>512</td><td>16.50</td><td>4.11</td><td>1.59</td><td>0.98</td><td>0.50</td></tr> <tr><td>6,250</td><td>500</td><td>16.91</td><td>4.23</td><td>2.11</td><td>1.01</td><td>0.52</td></tr> <tr><td>5,000</td><td>400</td><td>21.13</td><td>5.28</td><td>2.63</td><td>1.26</td><td>0.64</td></tr> <tr><td>4,000</td><td>320</td><td>25.00</td><td>6.60</td><td>3.30</td><td>1.57</td><td>0.81</td></tr> <tr><td>3,200</td><td>256</td><td>25.00</td><td>8.24</td><td>4.11</td><td>1.95</td><td>1.01</td></tr> <tr><td>2,500</td><td>200</td><td>25.00</td><td>10.57</td><td>5.28</td><td>2.50</td><td>1.29</td></tr> <tr><td>2,000</td><td>160</td><td>25.00</td><td>6.60</td><td>3.30</td><td>1.64</td><td>0.81</td></tr> <tr><td>1,600</td><td>128</td><td>25.00</td><td>16.50</td><td>8.24</td><td>3.92</td><td>2.00</td></tr> <tr><td>1,250</td><td>100</td><td>25.00</td><td>10.57</td><td>5.28</td><td>2.50</td><td>1.29</td></tr> <tr><td>1,000</td><td>80</td><td>25.00</td><td>6.60</td><td>3.30</td><td>1.64</td><td>0.81</td></tr> <tr><td>800</td><td>64</td><td>25.00</td><td>25.00</td><td>16.50</td><td>7.85</td><td>4.02</td></tr> <tr><td>500</td><td>40</td><td>25.00</td><td>6.60</td><td>3.30</td><td>1.57</td><td>0.81</td></tr> <tr><td>400</td><td>32</td><td>25.00</td><td>25.00</td><td>25.00</td><td>15.72</td><td>8.05</td></tr> <tr><td>200</td><td>16</td><td>N/A</td><td>25.00</td><td>25.00</td><td>25.00</td><td>16.09</td></tr> <tr><td>100</td><td>8</td><td>N/A</td><td>25.00</td><td>25.00</td><td>25.00</td><td>25.00</td></tr> <tr><td colspan="2">Edge separation (µs)</td><td>0.12</td><td>0.50</td><td>1</td><td>2</td><td>4</td></tr> <tr><td colspan="2">Count frequency (kHz)</td><td>8333</td><td>2000</td><td>1000</td><td>500</td><td>250</td></tr> </tbody> </table>	Resolution (dpi)	Interpolation factor	Maximum speed (m/s)					25,600	2,048	4.11	1.03	0.52	0.25	0.13	25,000	2,000	4.23	1.06	0.53	0.25	0.13	20,000	1,600	5.28	1.32	0.66	0.31	0.16	12,800	1,024	8.24	2.05	1.03	0.49	0.25	12,500	1,000	8.45	2.11	1.06	0.50	0.26	10,000	800	10.57	2.63	1.32	0.63	0.32	6,400	512	16.50	4.11	1.59	0.98	0.50	6,250	500	16.91	4.23	2.11	1.01	0.52	5,000	400	21.13	5.28	2.63	1.26	0.64	4,000	320	25.00	6.60	3.30	1.57	0.81	3,200	256	25.00	8.24	4.11	1.95	1.01	2,500	200	25.00	10.57	5.28	2.50	1.29	2,000	160	25.00	6.60	3.30	1.64	0.81	1,600	128	25.00	16.50	8.24	3.92	2.00	1,250	100	25.00	10.57	5.28	2.50	1.29	1,000	80	25.00	6.60	3.30	1.64	0.81	800	64	25.00	25.00	16.50	7.85	4.02	500	40	25.00	6.60	3.30	1.57	0.81	400	32	25.00	25.00	25.00	15.72	8.05	200	16	N/A	25.00	25.00	25.00	16.09	100	8	N/A	25.00	25.00	25.00	25.00	Edge separation (µs)		0.12	0.50	1	2	4	Count frequency (kHz)		8333	2000	1000	500	250
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Precision class for MS scale	±20 µm/m and ±40 µm/m																																																																																																																																																																								
Linear expansion coefficient for MS scale	~ 17 × 10 ⁻⁶ /K																																																																																																																																																																								
Hysteresis	< 3 µm up to 0.5 mm ride height																																																																																																																																																																								
Repeatability	Better than unit of resolution																																																																																																																																																																								
Sub divisional error	±3.5 µm for < 0.7 mm ride height ±7.5 µm for 1 mm ride height																																																																																																																																																																								
Mass	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																																																																																																																																																																								
Cable data																																																																																																																																																																									
Voltage drop over cable	~ 13 mV/m – without load ~ 54 mV/m – with 120 Ω load																																																																																																																																																																								
Cable	Ø4.2 ^{+0.2} mm, PUR high flexible cable, drag-chain compatible, double-shielded 8 × 0.05 mm ² ; durability: 20 million cycles at 20 mm bend radius																																																																																																																																																																								
Environmental conditions																																																																																																																																																																									
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 61000-4-8; Pulse magnetic fields: IEC 61000-4-9)																																																																																																																																																																								
EMC Interference	IEC 61000-6-4 (for industrial, scientific and medical equipment: IEC 55011)																																																																																																																																																																								
Vibrations (55 Hz to 2000 Hz)	300 m/s ² (IEC 60068-2-6)																																																																																																																																																																								
Shocks (11 ms)	300 m/s ² (IEC 60068-2-27)																																																																																																																																																																								

LM13IC – Digital output signals

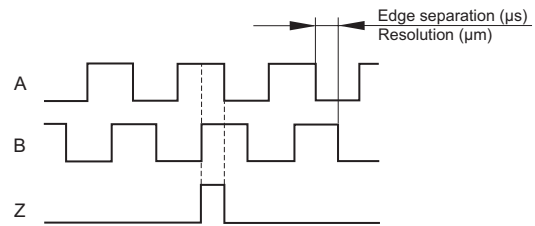
Square wave differential line driver to EIA RS422

Power supply *	4.7 V to 7 V – voltage on readhead Reverse polarity protection
Power supply rise time (for PRG option only)	< 1 ms
Power consumption	< 35 mA
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	Differential line driver to EIA standard RS422: $U_H \geq 2.5 \text{ V}$ at $-I_H = 20 \text{ mA}$ $U_L \leq 0.5 \text{ V}$ at $I_L = 20 \text{ mA}$
Permissible load	$Z_0 \geq 100 \Omega$ between associated outputs $I_L \leq 20 \text{ mA}$ max. load per output Capacitive load $\leq 1000 \text{ pF}$ Outputs are protected against short circuit to 0 V and to +5 V
Alarm	High impedance on output lines A, B, A-, B-
Switching time (10 to 90 %)	t_+ , $t_- < 30 \text{ ns}$ (with 1 m cable and recommended input circuit)
Cable length *	max. 100 m

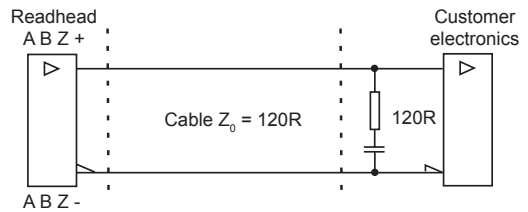
* Please consider voltage drop over cable.

Timing diagram

Complementary signals not shown



Recommended signal termination



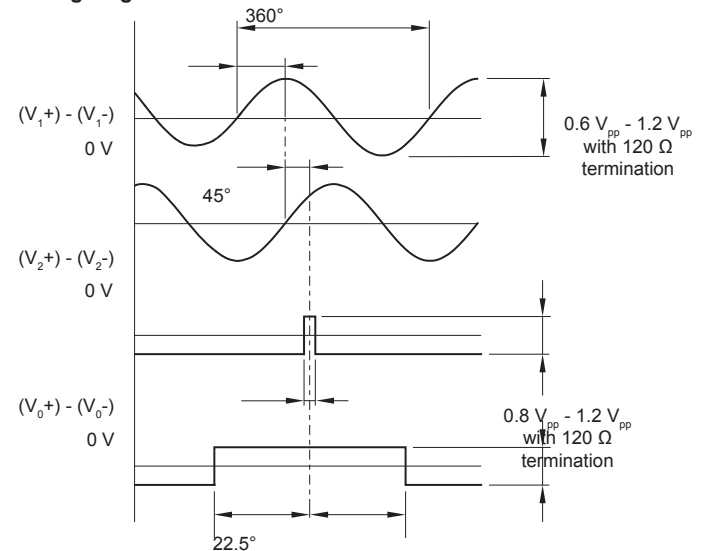
LM13AV – Analogue output signals (1 V_{pp})

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

Power supply *	4.7 V to 7 V – voltage on readhead Reverse polarity protection	
Power consumption	< 50 mA	
Output signals	V_1, V_2, V_0	
Sine / cosine signals	Amplitude (with 120 Ω termination)	0.6 V _{pp} to 1.2 V _{pp}
	Phase shift	90° ± 0.5°
Reference signal	Amplitude (with 120 Ω termination)	0.8 V _{pp} to 1.2 V _{pp}
	Position	45°
	Width	22.5°
Termination	$Z_0 = 120 \Omega$ between associated outputs	
Cable length *	max. 50 m	

* Please consider voltage drop over cable.

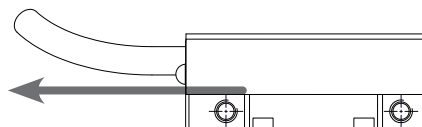
Timing diagram



Positive direction

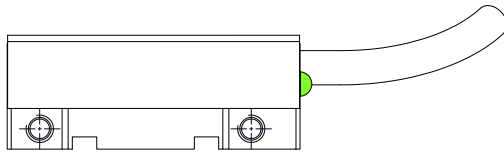
Digital output signals – A leads B

Analogue output signals (1 V_{pp}) – V_1 leads V_2

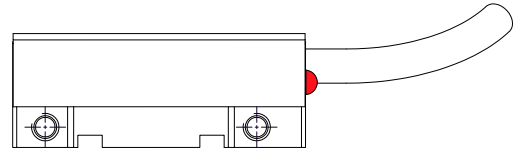


Set-up LED

After the installation of the magnetic scale (see LM13D10) 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

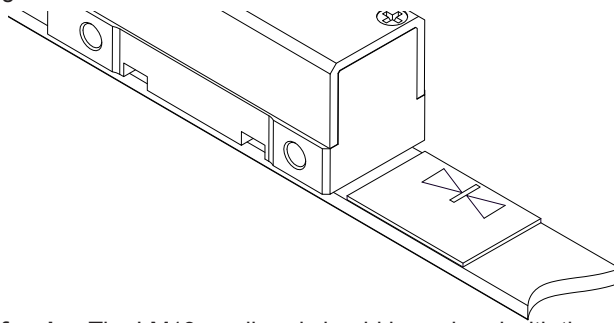
Programming (for IC output type only)

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.

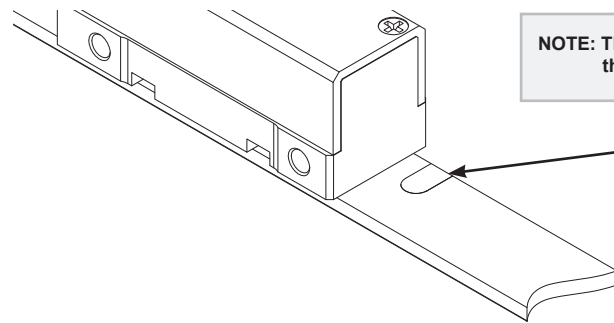
Reference mark

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 corresponding side of the readhead that has the reference mark designator marked.



- 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.

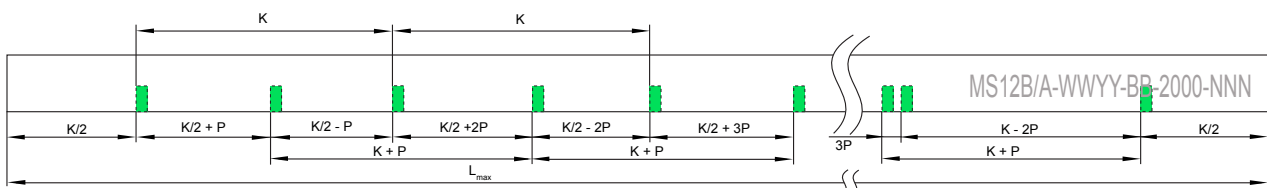


NOTE: The shape of the cut and position is critical so this option is only available as factory order.

Cut reference mark

- 3) **Every 2.032 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 (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).



LM13 readhead part numbering

LM13 DPI system = Readhead + Scale



Readhead part number
eg **LM13IC10DCA10F05**



Magnetic scale part number
eg **MS12B1000B0032**

LM13 IC 2D0 C A 10 F 05

Output type

IC - Incremental, RS422; 5 V power supply
AV - Analogue voltage, 1 V_{pp}; 5 V

Resolution

000 - for **AV** output type

For **IC** output type

- | | |
|-------------------------|---|
| 11B - 25,600 dpi | D20 - 2,500 dpi |
| 2D0 - 25,000 dpi | D16 - 2,000 dpi |
| 1D6 - 20,000 dpi | 07B - 1,600 dpi |
| 10B - 12,800 dpi | D10 - 1,250 dpi |
| 1D0 - 12,500 dpi | D08 - 1,000 dpi |
| D80 - 10,000 dpi | 06B - 800 dpi |
| 09B - 6,400 dpi | D04 - 500 dpi |
| D50 - 6,250 dpi | 05B - 400 dpi |
| D40 - 5,000 dpi | 04B - 200 dpi |
| D32 - 4,000 dpi | 03B - 100 dpi |
| 08B - 3,200 dpi | PRG - Programmable from
25,600 dpi to 100 dpi
(preset to 25,000 dpi) |

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

05 - 2.032 mm pitch

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)

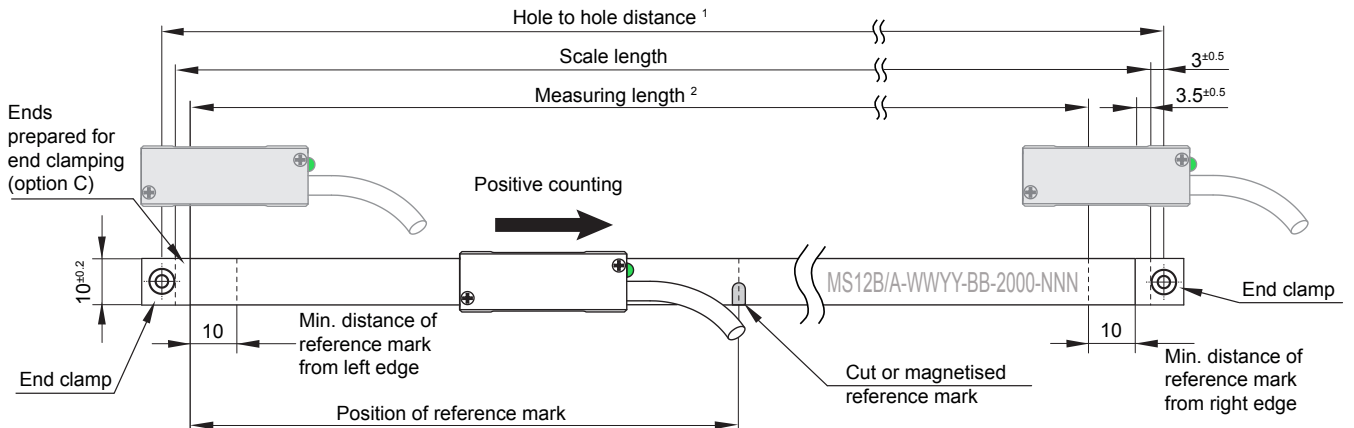
Reference

- A** - With reference
B - No reference
C - Periodic as per scale pitch

* Default for **PRG** option.

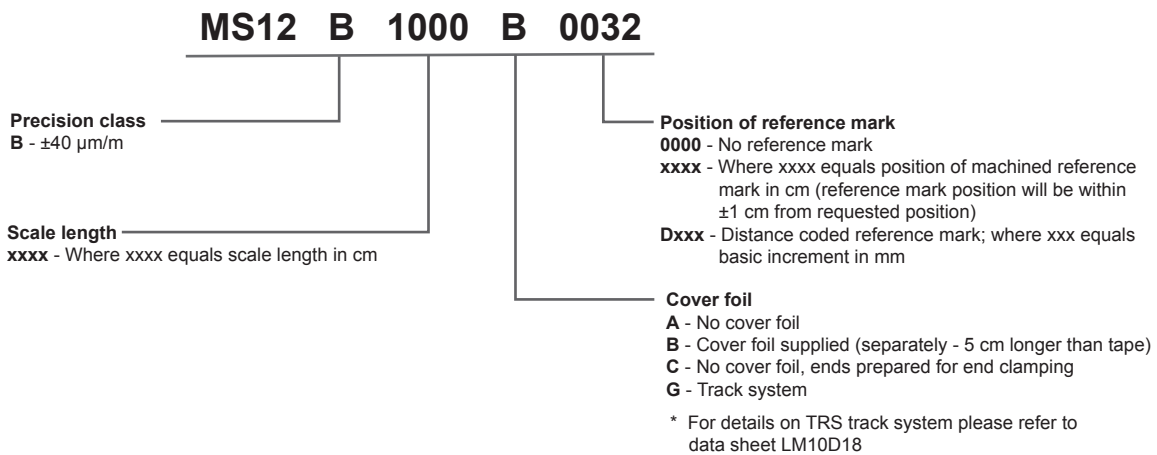
NOTE: Not available with 100 dpi and 200 dpi resolution options.

Magnetic scale part numbering

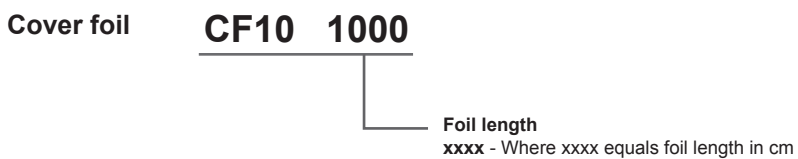


¹ Hole to hole distance = scale length + 6^{±1} mm (for end clamp mounting)

² Measuring length = scale length - 17 mm



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
End clamp kit (2 clamps + 2 screws)	LM10ECL00

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Document issues

Issue	Date	Page	Corrections made
1	6. 1. 2009	-	New document
2	5. 5. 2011	2	Ride height table added
		5	DCRM added to reference mark options
		6	AV output type and HD connector option added
		7	End clamp option added to technical drawing; track system and DCRM option added

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