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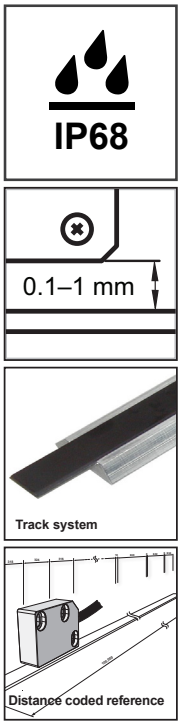
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Data sheet
LM13D02_05
Issue 5, 16th May 2018

LM13 incremental magnetic encoder system





The LM13 is a contactless high-speed linear magnetic system designed for linear or rotary motion sensing in harsh environments.

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

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 ring or by adding a reference sticker on top of the scale with the help of a self-aligning installation tool.

The encoders come with a range of 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.

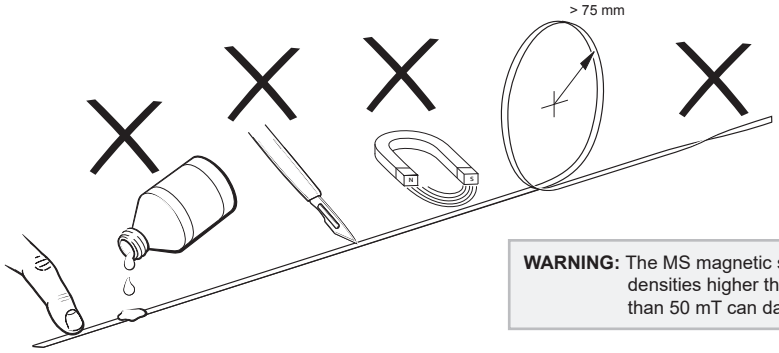
Engineered for extreme service, the solid-state LM13 linear encoder operates from –10 °C to +80 °C, sealing to IP68 and is highly resistant to shock, vibrations and pressure. The robust magnetic scale and ring are also resistant to a range of chemicals commonly found in industry.

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

The 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.

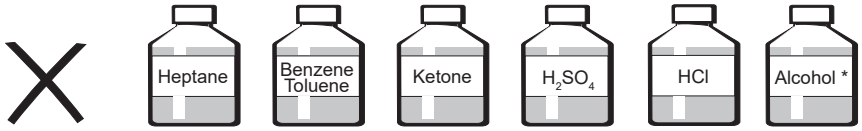
- Compact readhead
- Bidirectional reference mark option
- High speed operation
- Excellent dirt immunity
- Integral set-up LED
- Linear or rotary position sensing possible
- High reliability from proven non-contact sensing technology
- Industry standard digital and analogue output options
- Repeatability inside resolution
- CE compliant, including RoHS - see Declaration of conformity

Storage and handling

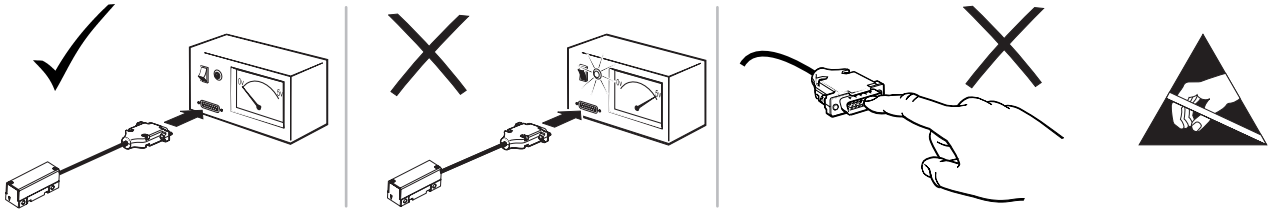


WARNING: The MS magnetic scale should not be exposed to magnetic field densities higher than 50 mT on its surface. Magnetic fields higher than 50 mT can damage the scale.



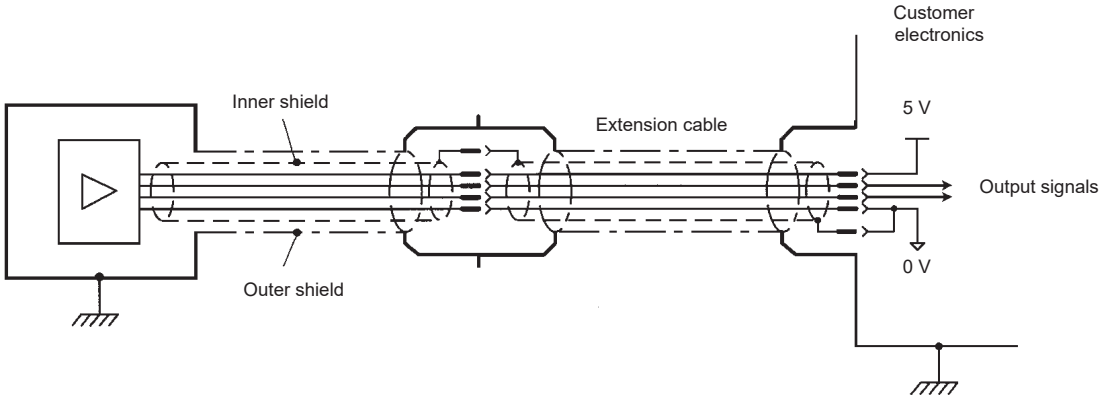


* Use of alcohol for cleaning is considered safe, however, it is not allowed to immerse the scale in alcohol.



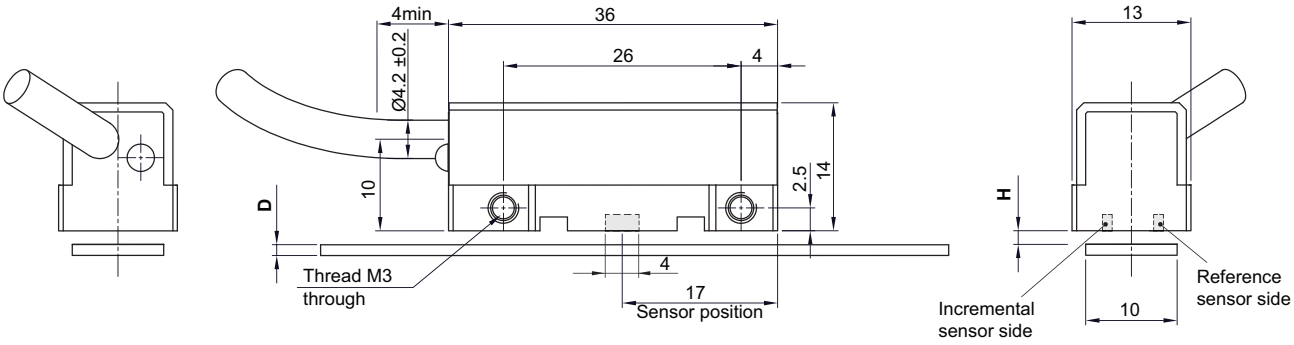
For radial and axial ring storage and handling refer to magnetic ring data sheet.

Electrical connections



Dimensions

Dimensions and tolerances in mm.



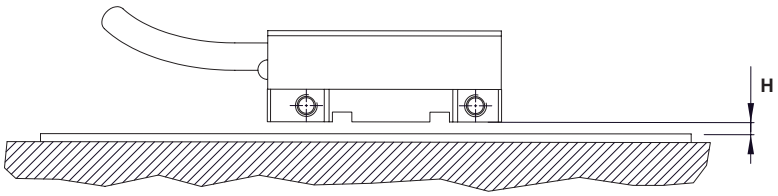
NOTE: Ensure recommended M3 readhead fixing screws are tightened to 0.5 Nm to 0.7 Nm.

	Magnetic scale thickness (D)		Ride height (H)	
	With back adhesive*	**Without back adhesive***	**Maximum range****	**Recommended range*****
No cover foil, cut or magnetised reference mark	1.5 ± 0.15	1.3 ± 0.15	0.1–1.5	0.1–1.0
No cover foil, stick-on reference mark	1.5 ± 0.15	1.3 ± 0.15	0.5–1.5	0.5–1.0
With cover foil, cut or magnetised reference mark	1.6 ± 0.15	1.4 ± 0.15	0.1–1.3	0.1–0.9
With cover foil, stick-on reference mark	1.6 ± 0.15	1.4 ± 0.15	0.5–1.3	0.5–0.9

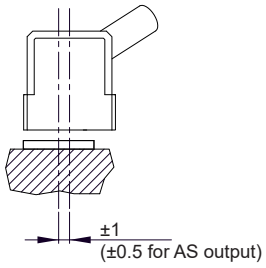
* See MS10 part numbering on page 10 for more information on the options available.
** Not applicable for AS output.
*** For greater ride heights please see LM15 lencoder system (LM15D01).

Installation tolerances

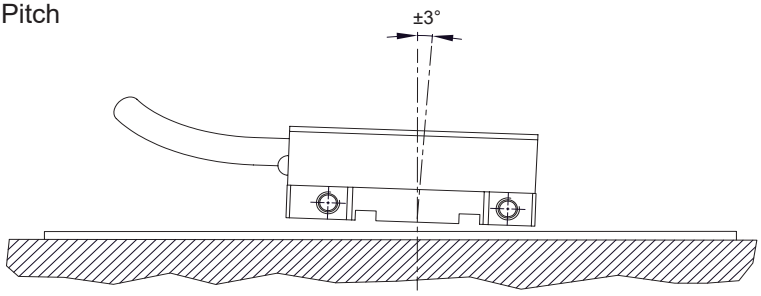
Ride height



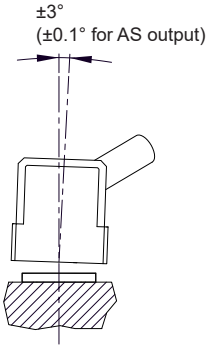
Lateral offset



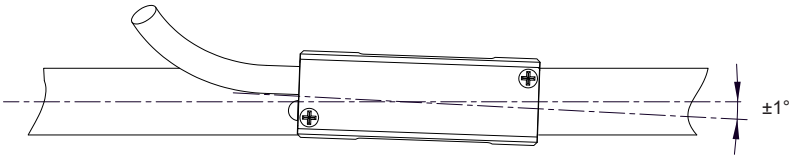
Pitch



Roll



Yaw



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

Technical specifications

System data	
Maximum measuring length of MS scale	50 m (100 m special order)
Pole length	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: 20 m/s (for spec. option 20 max. speed is 80 m/s)
For digital output signals:

Part numbering	Resolution (µm)	Counts / 2 mm	Maximum speed (values in grey for special option 20) (m/s)								
13B	**≈ 0.244**	**8,192**	1.82	0.91	0.23	0.11	0.06	0.03	0.02	0.01	0.01
12B	**≈ 0.488**	**4,096**	3.65	1.82	0.46	0.23	0.12	0.06	0.05	0.02	0.01
11B	**≈ 0.976**	**2,048**	7.30	3.65	0.91	0.46	0.24	0.12	0.10	0.05	0.02
2D0	**1**	**2,000**	7.47	3.73	0.93	0.47	0.24	0.12	0.10	0.05	0.02
1D6	**1.25**	**1,600**	9.33	4.67	1.17	0.58	0.30	0.16	0.12	0.06	0.03
10B	**≈ 1.953**	**1,024**	14.58	7.30	1.82	0.91	0.48	0.24	0.19	0.10	0.05
1D0	**2**	**1,000**	14.93	7.47	1.87	0.93	0.49	0.25	0.20	0.10	0.05
D80	**2.5**	**800**	18.67	9.33	2.34	1.17	0.61	0.31	0.25	0.12	0.06
09B	**≈ 3.906**	**512**	20 / 29.17	14.58	3.65	1.82	0.95	0.49	0.38	0.19	0.10
D50	**4**	**500**	20 / 29.87	14.93	3.73	1.87	0.97	0.50	0.39	0.20	0.10
D40	**5**	**400**	20 / 37.33	18.67	4.67	2.34	1.22	0.62	0.49	0.25	0.12
D32	**6.25**	**320**	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
08B	**≈ 7.812**	**256**	20 / 58.34	20 / 29.17	7.30	3.65	1.90	0.97	0.77	0.39	0.19
D20	**10**	**200**	20 / 74.67	20 / 37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
D16	**12.5**	**160**	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
07B	**15.625**	**128**	20 / 80	20 / 58.34	14.58	7.30	3.81	1.94	1.53	0.77	0.39
D10	**20**	**100**	20 / 74.67	20 / 37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
D08	**25**	**80**	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
06B	**31.25**	**64**	20 / 80	20 / 80	20 / 29.17	14.58	7.62	3.89	3.07	1.55	0.78
D04	**50**	**40**	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
05B	**62.5**	**32**	20 / 80	20 / 80	20 / 58.34	20 / 29.17	15.22	7.78	6.14	3.10	1.56
04B	**125**	**16**	N/A	20 / 80	20 / 80	20 / 58.34	20 / 30.43	15.56	12.28	6.19	3.11
03B	**250**	**8**	N/A	N/A	20 / 80	20 / 80	20 / 60.86	20 / 31.11	20 / 24.56	12.39	6.23
Minimum edge separation (µs)			0.07	0.13	0.50	1	2	4	5	10	20
Maximum count frequency (MHz)			15	8	2	1	0.5	0.25	0.2	0.1	0.05
Part numbering			**K**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**

Accuracy grade for MS scales	±10 µm (available for lengths up to 20 m only), ±20 µm and ±40 µm
Linear expansion coefficient of MS scale	~ 17 × 10^{-6}/K
Repeatability	Better than unit of resolution for movement in the same direction
Hysteresis	< 4 µm up to 0.5 mm ride height
Mechanical data	
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
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 61000-4-8; 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/s² (IEC 60068-2-6)
Shocks (11 ms)	300 m/s² (IEC 60068-2-27)

Cable specifications

Cable type	PUR high flexible cable, drag-chain compatible, double-shielded	
Number of wires	8	12
Outer diameter	4.2 mm ±0.2 mm	4.5 mm ±0.2 mm
Jacket material	Extruded polyurethane (PUR)	
White wire	0.14 mm², 26 AWG, 0.13 Ω/m	0.08 mm², 28 AWG, 0.23 Ω/m
Other wires	0.05 mm², 30 AWG, 0.35 Ω/m	
Durability	20 million cycles at 25 mm bend radius	20 million cycles at 50 mm bend radius
Weight	34 g/m nominal	38 g/m nominal
Bend radius (internal radius)	Dynamic 25 mm, static 10 mm	Dynamic 50 mm, static 10 mm

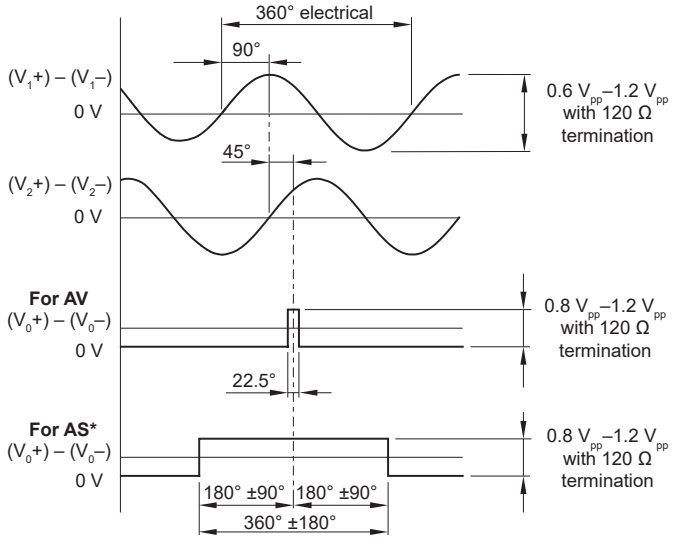
Output specifications

LM13AV and LM13AS* – Incremental 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	
Voltage drop over cable	~ 13 mV/m – without load ~ 54 mV/m – with 120 Ω load	
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° for **AV** output 360° ± 180° for **AS*** output
Termination	Z_0 = 120 Ω between associated outputs	
Cable length **	Max. 50 m	

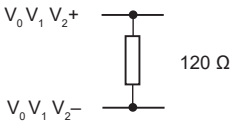
Timing diagram



* AS output type is compatible with controllers (eg. Siemens, Fanuc) with 1 V_{pp} encoder inputs.
AS output type cannot be used with stick-on reference or cut reference mark.
AS output type has limitations in sensing distance (ride height), lateral offset and roll (see page 3).

** Please consider voltage drop over cable.

Recommended signal termination



Connections

Function	Signal	Colour (option F)	15 pin D type plug (option L)	9 pin D type plug (option A)	9 pin D type plug (option P)
Power	5 V	Brown	4	5	5
	0 V	White	12	9	1
Analogue signals	V_1	Green	9	4	2
	V_1–	Yellow	1	8	6
	V_2	Blue	10	3	4
	V_2–	Red	2	7	8
Reference signals	V_0	Pink	3	2	3
	V_0–	Grey	11	6	7
Shield	Inner	–	15	1	9
	Outer	–	Case	Case	Case

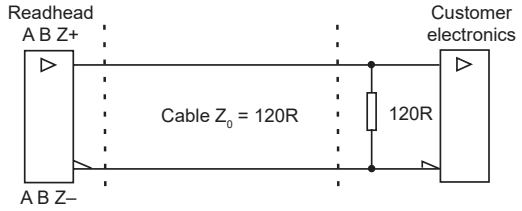
LM13IC – Digital output signals, RS422

Square wave differential line driver to RS422

Power supply *	4.7 V to 7 V – voltage on readhead Reverse polarity protection
Power consumption	< 35 mA
Voltage drop over cable	~ 13 mV/m – without load ~ 54 mV/m – with 120 Ω load
Power supply rise time	< 1 ms (for PRG option only)
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	Differential line driver to EIA standard RS422: $U_H \geq 2.5$ V at $-I_H = 20$ mA $U_L \leq 0.5$ V at $I_L = 20$ mA
Permissible load	$Z_0 \geq 100\ \Omega$ between associated outputs $I_L \leq 20$ mA max. load per output Capacitive load ≤ 1000 pF Outputs are protected against short circuit to 0 V and to +5 V Only one output shorted at a time
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 %)	t+, t– < 30 ns (with 1 m cable and recommended input circuit)
Cable length *	Max. 100 m

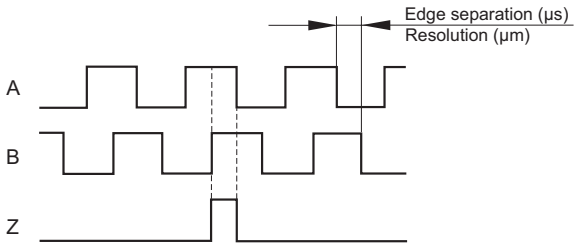
* Please consider voltage drop over cable.
** See description on page 8.

Recommended signal termination



Timing diagram

Complementary signals not shown



Connections

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

Programming (for IC output only)

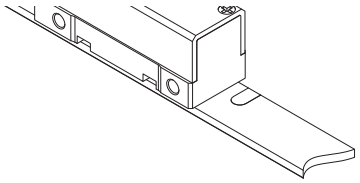
Readheads can be ordered preset to the required resolution or provided so that they can be programmed as needed on the machine to the chosen resolution. This programming is carried out by connecting the readhead to a computer via a programming interface. The readhead must be ordered with the PRG resolution option to use this function. For more information on the programming function of LM13 readheads, please refer to the UPRG01 programming interface datasheet.

Reference mark

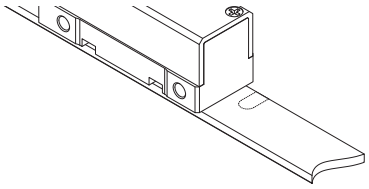
Reference marks can be provided in 4 ways:

1) **Selected at point of order.** The LM13 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.

Cut reference mark

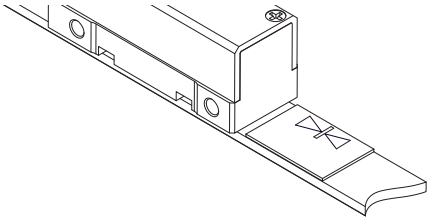


Magnetised reference mark



NOTE: The shape and position of the cut or magnetised reference are critical so these options are only available as factory order.

2) **Stick-on reference mark.** The LM13 readhead should be ordered with reference mark option A. Magnetic scale should be ordered with **no** reference mark. After installation of the scale and optionally cover foil a reference mark sticker can be applied at the required position using the reference mark applicator tool. Ensure that the reference sticker is oriented to the corresponding side of the readhead as shown on the drawing below.



NOTE: Not available for magnetic rings.

Part numbering: LM10SRM00

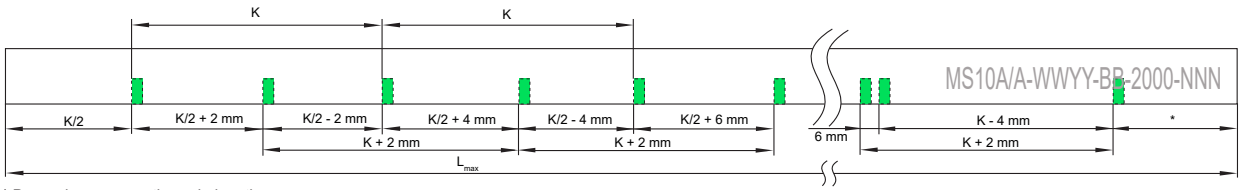
3) **Tool for custom selectable reference mark.** The LM13 readhead should be ordered with reference mark option A. Magnetic scale should be ordered with **no** reference mark. Operator can magnetise reference mark in a position to suit the application.



Part numbering: LM10CRM00

4) **Periodic reference impulse. Every 2 mm.** The LM13 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 LM13 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 succesive 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).



* Depends on magnetic scale length.

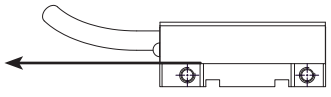
Multiple reference marks. For cut reference marks on multiple locations on the MS magnetic scale please contact RLS for a special part numbering.

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_{pp}) – V_1 leads V_2



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).

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

Response time

	LM13AV/AS	LM13IC_02	LM13IC
Set-up time	10 ms		
Conversion time	<250 ns		
Transition time	<10 µs		<100 ms

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

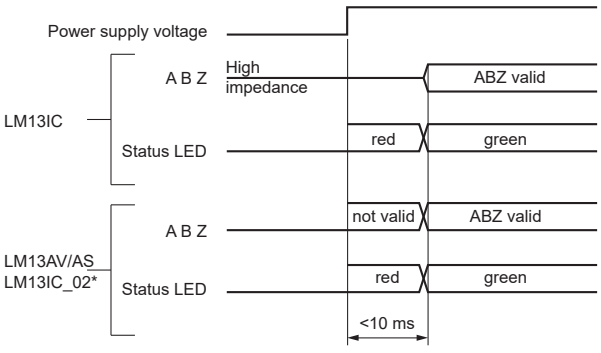
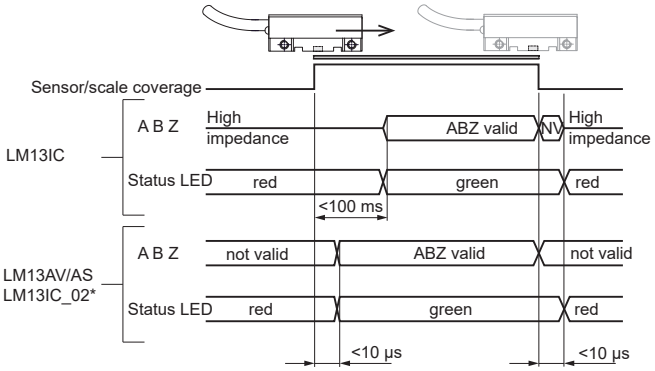
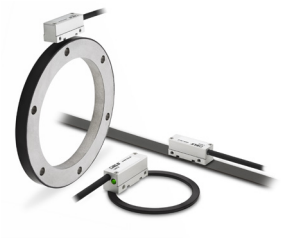


Diagram 2: Transition time



* In alarm state LED flashes red/green.

Readhead part numbering



LM13 system

=



LM13 readhead
eg. LM13IC2D0CA10F00

+



Magnetic scale / ring
eg. MS10BM100A0000 for scale /
MR047B040B076B00 for ring

LM13 IC 2D0 C A 10 F 00

Output type
AS - Analogue voltage 1V_{pp}, wide reference pulse, 5 V [6]
AV - Analogue voltage, 1 V_{pp}; 5 V
IC - Incremental, RS422; 5 V

Interpolation factor
For **AS** and **AV**: **000** - N/A
For **IC**:
13B - 8192 (0.244 µm)
12B - 4096 (0.488 µm)
11B - 2048
2D0 - 2000 (1 µm)
1D6 - 1600
10B - 1024
1D0 - 1000 (2 µm)
D80 - 800
09B - 512
D50 - 500 (4 µm)
D40 - 400 (5 µm)
D32 - 320
08B - 256
D20 - 200 (10 µm)
D16 - 160
07B - 128
D10 - 100 (20 µm)
D08 - 80 (25 µm)
06B - 64
D04 - 40 (50 µm)
05B - 32
04B - 16 (125 µm)
03B - 8 (250 µm)
PRG - Programmable, preset to 1 µm (for **IC** only)

For resolutions in µm see table on page 4.

Minimum edge separation
For **AS** and **AV**: **A** - N/A
For **IC**:
K - 0.07 µs (15 MHz) [1]
A - 0.12 µs (8 MHz) [2]
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 **IC**; not available for **PRG** option)
07 - Additional alarm output (for **IC**; not available for **PRG** option)
20 - High speed version (only available for certain resolutions and frequencies; see page 4)
0M - Cable length in meters

Connector option
A - 9 pin D type plug [5]
D - 15 pin D type plug (for **IC**)
E - 9 pin CPC connector (for **IC**)
F - Flying lead (no connector)[3]
H - 15 pin HD type plug (for **IC**)
L - 15 pin D type plug (for **AV** and **AS**)
P - 9 pin D type plug (for **AV** and **AS**)

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 [1]
B - No reference sensor [4]
C - Periodic reference impulse as per scale pitch (every 2 mm) [4]

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

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

Formula for rotary application resolution

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

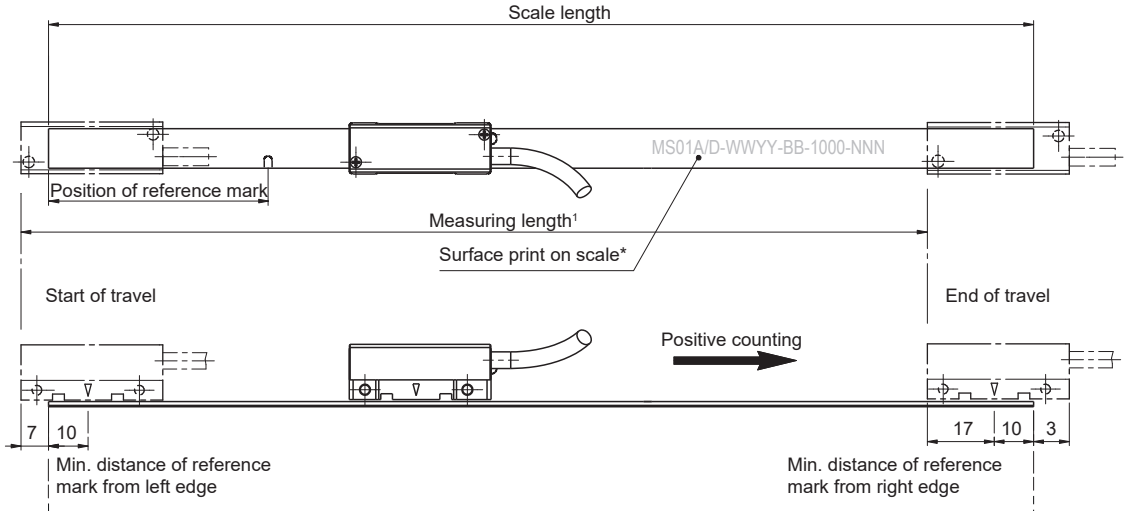
$$\text{Resolution } (cpr) = \text{Pole number} \times \text{Interpolation}$$

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

Series	Output type	Interpolation factor	Minimum edge separation	Reference	Cable length	Connector option	Special requirements
LM13	IC	PRG	A	A / C	10	A / D / E / H / F	00 / 05 / 0M / 02 / 07 / 20
				B			
		13B / 12B / 11B / 2D0 / 1D6 / 10B / 1D0 / D80 / 09B / D50	K / A / B / C / D / E / F / G / H	A / C			
				B			
		D40 / D32 / 08B / D20 / D16 / 07B / D10 / D08 / 06B / D04 / 05B		A / C			
				B			
		04B	A / B / C / D / E / F / G / H	C			
				B			
		03B	B / C / D / E / F / G / H	C			
				B			
	AV	000	A	A / C		A / L / P / F	00 / 05 / 0M / 20
				B			
	AS			A			

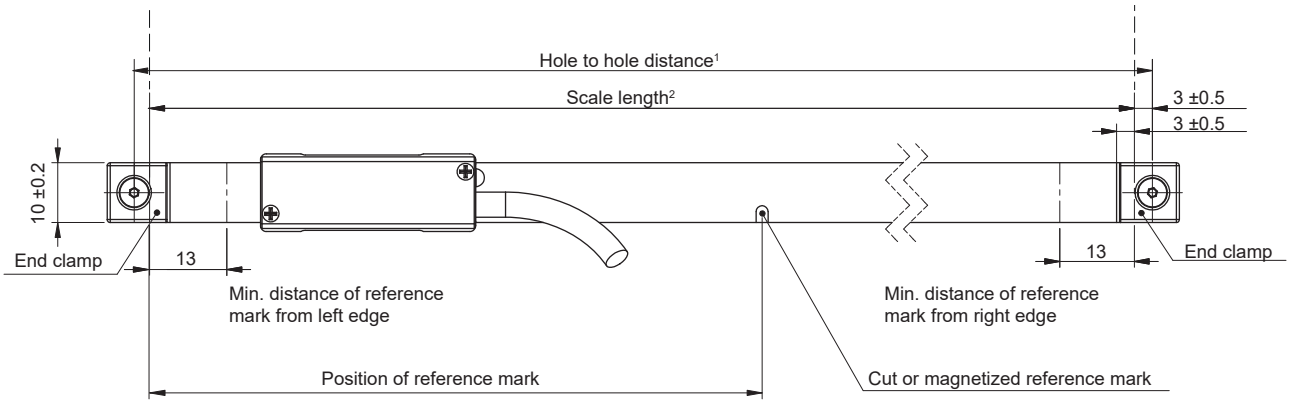
Diagram for magnetic scale ordering

Dimensions in 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 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

Magnetic scale part numbering

Please refer to diagram for magnetic scale on page 11.

MS10 B 1000 B 0032

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 clamping[3]
G - No VHB back-adhesive tape, sides prepared for insertion into track section[2]
H - No VHB back-adhesive tape, sides prepared for insertion into track section, with cover foil[2]
I - No back-adhesive tape
N - No back-adhesive tape, with cover foil*
P - No back-adhesive tape, ends prepared for end clamping[3]

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

CF10 1000

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/trs.
[3] For details on end clamp installation please refer to data sheet LM10D14 on www.rls.si/lm10.

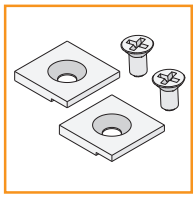
For radial and axial ring part numbering refer to magnetic ring data sheet.

Accessories part numbering



Stick-on reference mark

LM10SRM00



End clamp kit
(2 clamps + 2 screws)

LM10ECL00



Applicator tool for stick-on reference mark

LM10ARM00



Tool for custom selectable reference mark

LM10CRM00



Applicator tool for magnetic scale and cover foil

LM13ASC00



Programmable interface

UPRG01



USB encoder interface

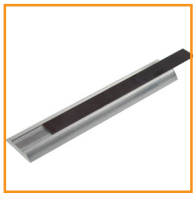
E201



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

Issue	Date	Page	Corrections made
5	16. 5. 2018	1, 2, 4, 11-13	Ring reference added
		3, 4, 5	Cable specifications amended
		8	9-pin CPC connector added
		11, 12	Readhead part numbering amended
		13	Magnetic scale part numbering amended

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