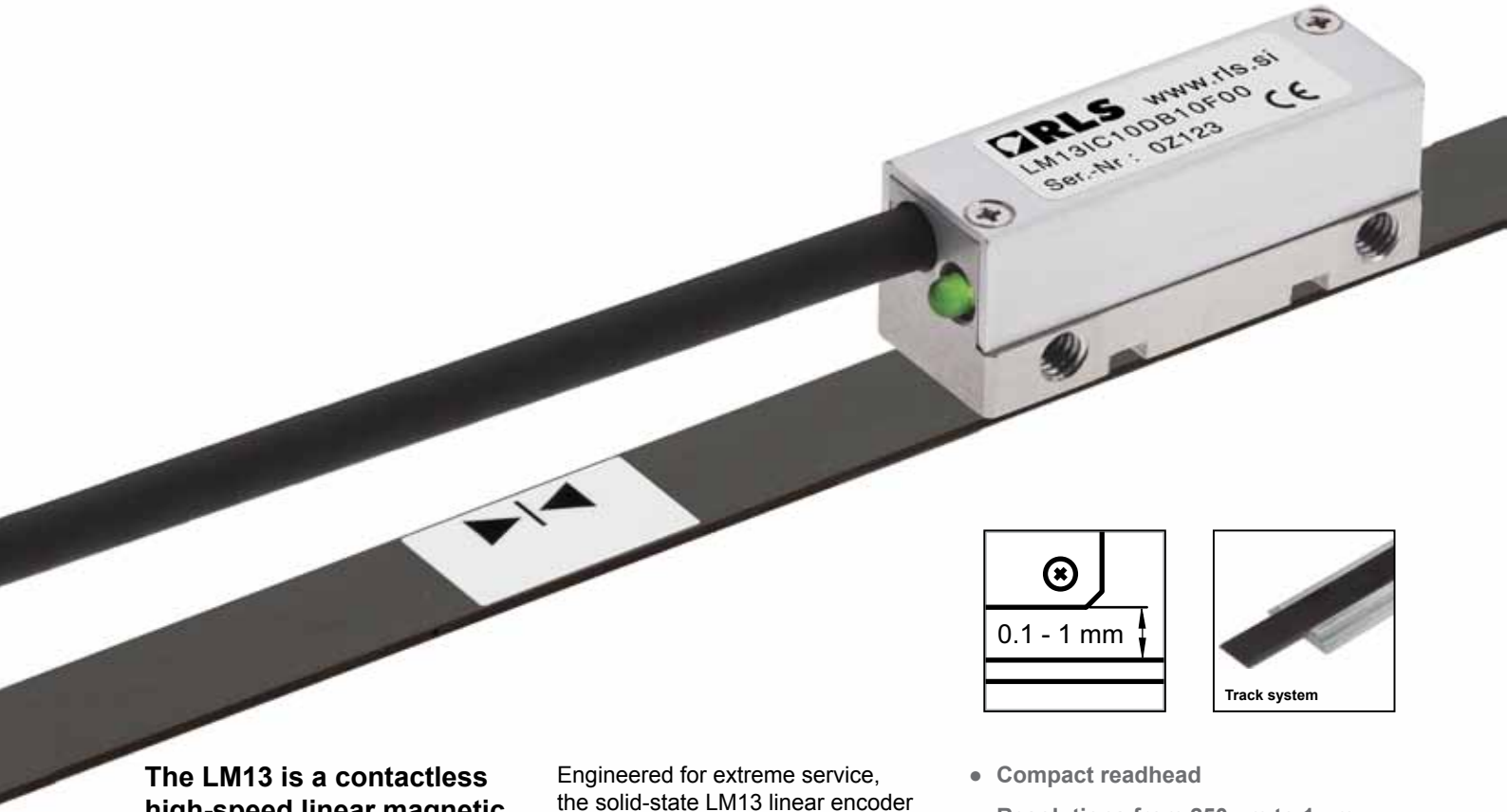
Data sheet
LM13D02_03
Issue 3, 5th May 2011

LM13 linear magnetic encoder system



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 encoders come with a range of digital or analogue output variants and offer a range of customer selectable resolutions including 1 µm, 2 µm, 4 µm, 5 µm, 10 µm, 20 µm, 25 µm, 50 µm, 125 µm and 250 µm. The LM13 is capable of velocities up to 25 m/s; even at 1 µm resolution it is capable of 4 m/s.

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 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
- 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

Data sheet
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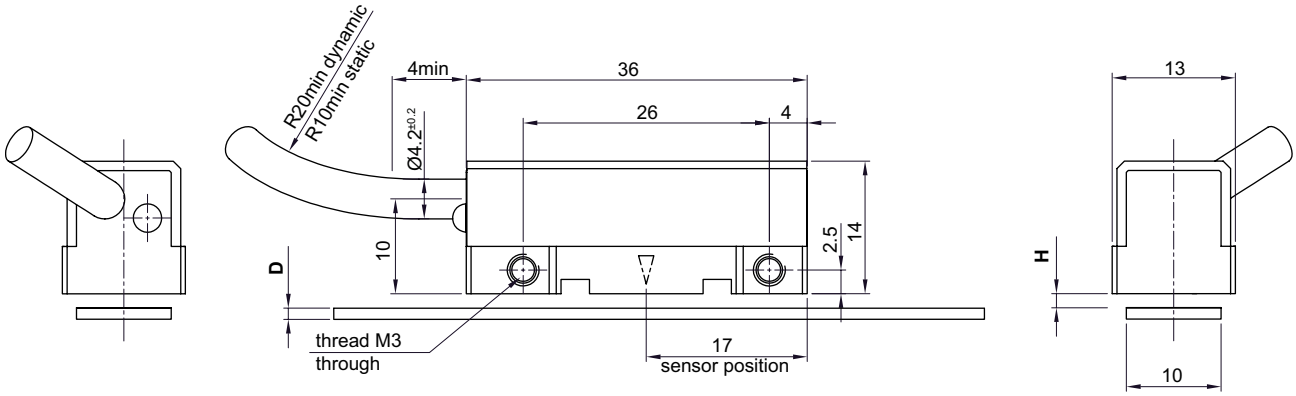
LM13 dimensions

Dimensions and tolerances in mm.

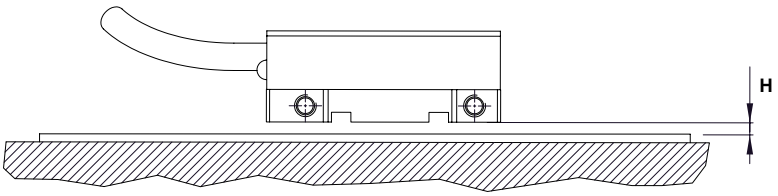


	Magnetic scale thickness (D)	Ride height (H)	
		Maximum range	Recommended range *
No cover foil, cut or magnetised reference mark	$1.5^{-0.2}$	0.1 - 1.5	0.1 - 1.0
No cover foil, stick-on reference mark	$1.5^{-0.2}$	0.5 - 1.5	0.5 - 1.0
With cover foil, cut or magnetised reference mark	$1.65^{-0.2}$	0.1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

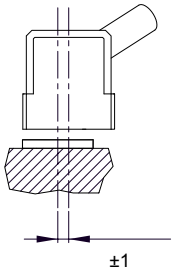
* For larger ride height (H) please see LM15 linear encoder system (LM15D01).

LM13 installation tolerances

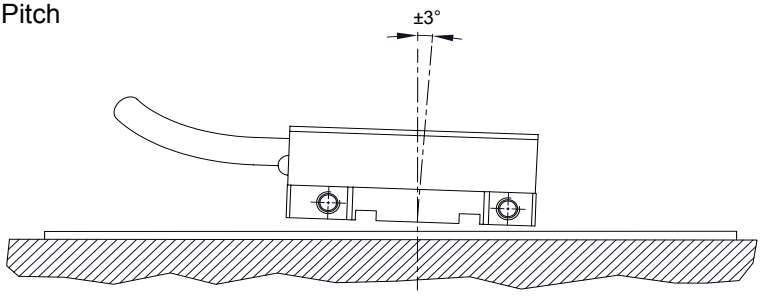
Ride height



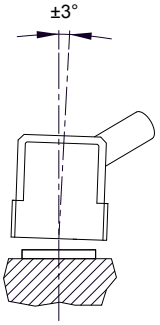
Lateral offset



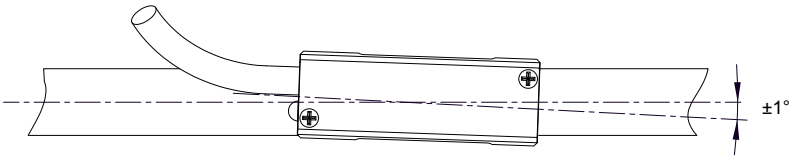
Pitch



Roll



Yaw



LM13 technical specifications

System data	
Maximum measuring length of MS scale	50 m (100 m special order)
Pole length	2 mm
Available resolutions	1 µm, 2 µm, 4 µm, 5 µm, 10 µm, 20 µm, 25 µm, 50 µm, 125 µm and 250 µm
Maximum speed	For analogue voltage output: 25 m/s For digital output signals:

Resolution (µm)	Interpolation factor	Maximum speed (m/s)				
1	**2000**	4.16	1.04	0.52	0.26	0.13
2	**1000**	8.32	2.08	1.04	0.52	0.25
4	**500**	16.64	4.16	2.08	0.99	0.51
5	**400**	20.80	5.20	2.59	1.30	0.63
10	**200**	25.00	10.40	5.20	2.59	1.27
20	**100**	25.00	10.40	5.20	2.59	1.27
25	**80**	25.00	6.50	3.25	1.62	0.79
50	**40**	25.00	6.50	3.25	1.62	0.79
125	**16**	N/A	25.00	25.00	25.00	15.14
250	**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

Precision class	±20 µm/m and ±40 µm/m
Linear expansion coefficient of MS scale	~ 17 × 10^{-6}/K
Repeatability	Better than unit of resolution
Hysteresis	< 3 µm up to 0.5 mm ride height
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	Ø$4.2^{\pm 0.2}$ 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

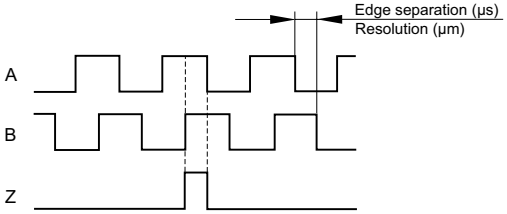
Square wave differential line driver to EIA RS422

Power supply *	4.7 V to 7 V – voltage on readhead Reverse polarity protection
Power supply rise time	< 1 ms (for PRG option only)
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: $U_H \geq 2.5$ 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
Alarm	High impedance on output lines A, B, A-, B-
Switching time (10 to 90 %)	t+, t- < 30 ns (with 1 m cable and recommended input circuit)
Cable length *	max. 100 m

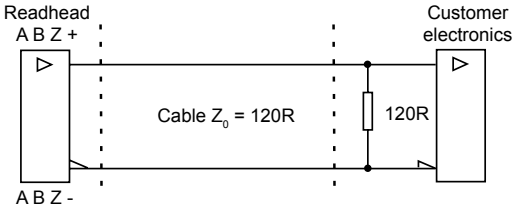
* Please consider voltage drop over cable.

Timing diagram

Complementary signals not shown



Recommended signal termination



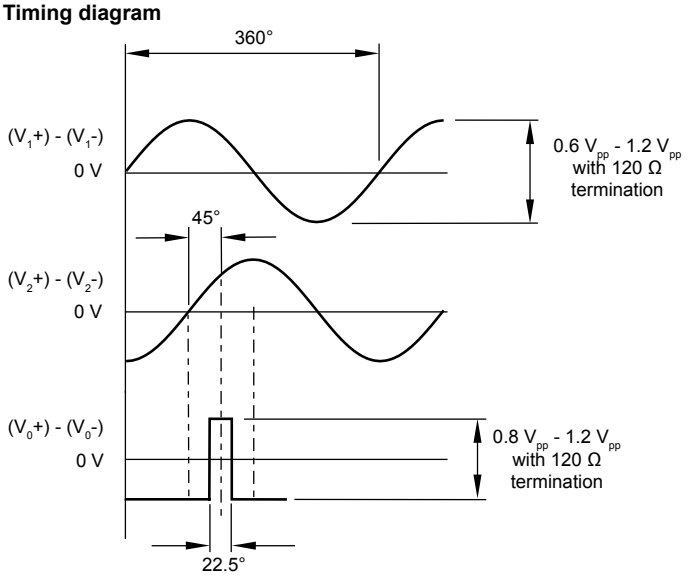
LM13AV – Analogue output signals (1 V_{pp})

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 Ω between associated outputs	
Cable length *	max. 50 m	

* Please consider voltage drop over cable.

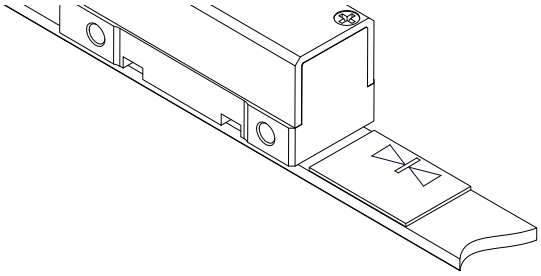
Timing diagram



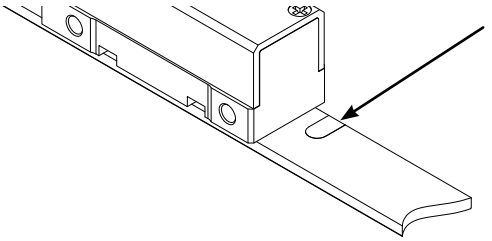
Reference mark

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.



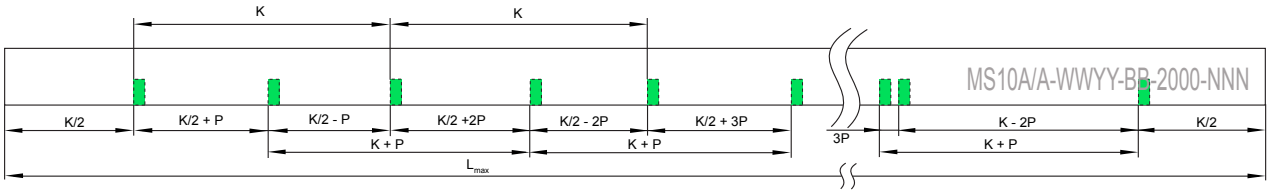
2) **Selected at point of order.** The LM13 readhead should be ordered with the reference mark option. If required the cover foil can be installed over the cut reference mark.



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

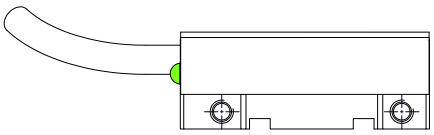
3) **Every 2 mm.** The LM13 readhead should be ordered with this specific mode activated only.

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 succesive 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).

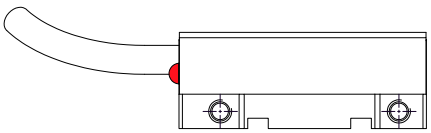


Set-up LED

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

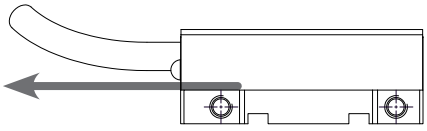
Programming (for IC output type only)

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 V_{pp}) – V_1 leads V_2



LM13 readhead part numbering

LM13 system = Readhead + Scale

Readhead part number
eg **LM13IC2D0CA10F00**

Magnetic scale part number
eg **MS10B1000B0032**

LM13 IC 2D0 C A 10 F 00

Output type
IC - Incremental, RS422; 5 V
AV - Analogue voltage, 1 V_{pp}; 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
04B - 125 µm
03B - 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)

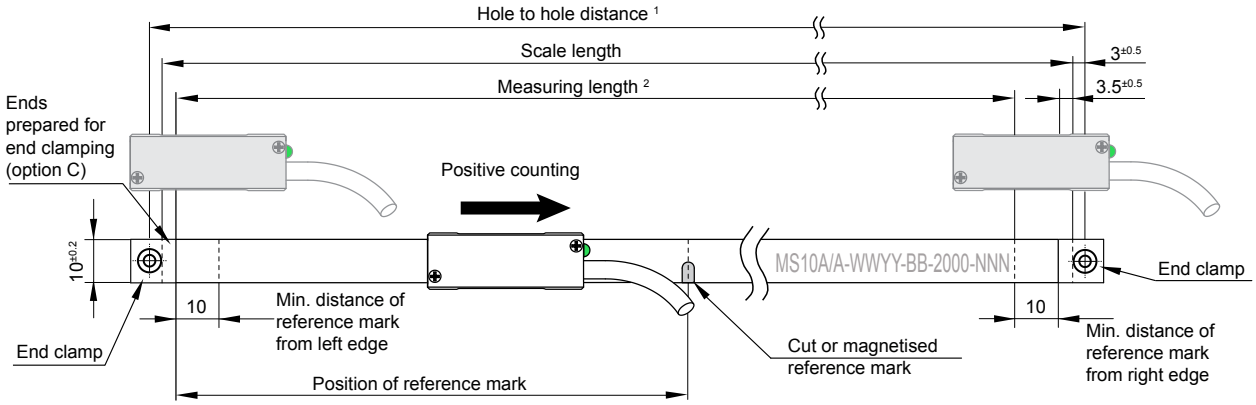
Cable length
10 - 1.0 m (standard)

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



1 Hole to hole distance = scale length + 6±1 mm (for end clamp mounting)
2 Measuring length = scale length - 17 mm

MS10 B 1000 B 0032

Precision class
A - ±20 µm/m
B - ±40 µm/m

Scale length
xxxx - Where xxxx equals scale length in cm

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

Issue	Date	Page	Corrections made
1	6. 1. 2009	-	New document
2	14. 1. 2009	-	New layout
3	5. 5. 2011	2	Ride height table added
		3	Power consumption data updated
		3, 4	Analogue output type added
		5	DCRM added to reference mark options
		6, 7	New connector options and DCRM, end clamp and track system options added to part numbering

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