Data sheet
LM10D01_02
30th November 2007

Rotary and Linear Motion Sensors

LM10 Linear magnetic encoder system

The LM10 is a contactless high-speed linear magnetic encoder designed for use in harsh environments.

The LM10 features a compact sealed readhead that rides at up to 1.5 mm from the self-adhesive magnetic strip scale, which brings up to 100 m travel.

Simple to install, the LM10 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 either actuated 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 or analogue output variants and offer a range of customer selectable resolutions including 1, 2, 5, 10, 20, 50 and 100 µm. At 1 µm the LM10 offers a maximum velocity of more than 4 m/s.

Engineered for extreme service, the solid-state LM10 linear encoders operate from -20 °C to +85 °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.

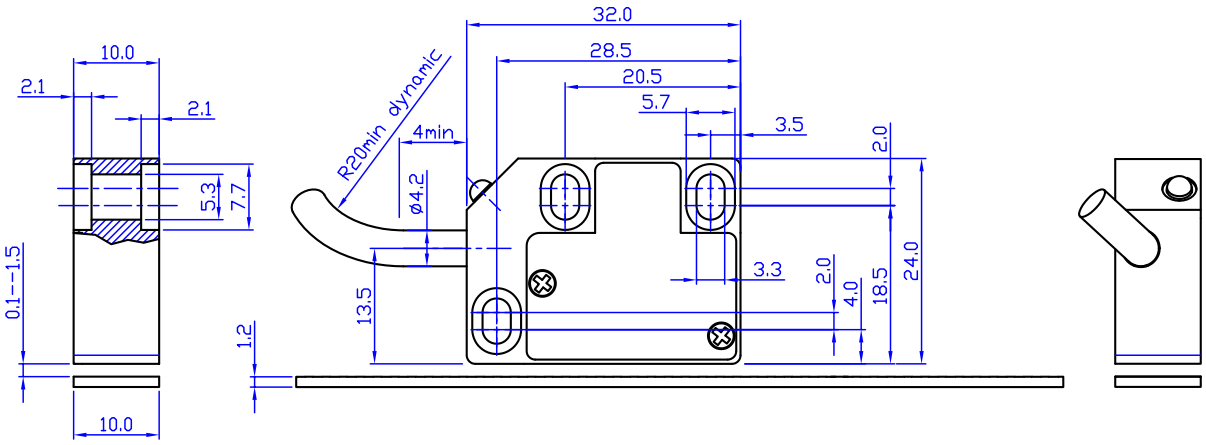
The non-contact, frictionless design eliminates wear while reducing hysteresis for high precision at high speeds and acceleration.

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 chip/board production etc.

- Stick-on reference mark
- Customer selectable resolutions from 100 to 1 µm
- 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

LM10 Dimensions

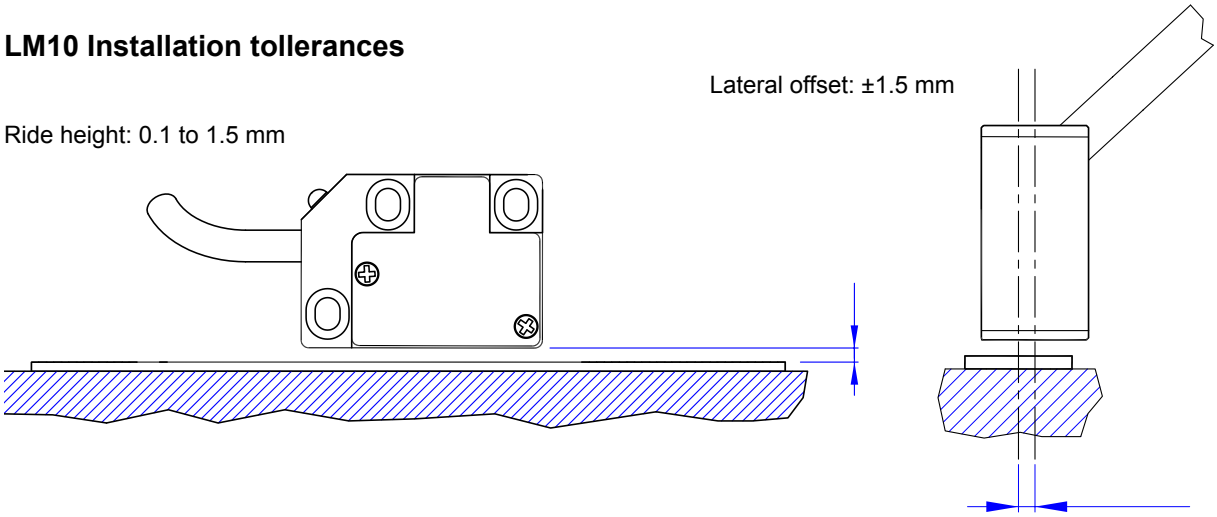
Dimensions and tolerances in mm.



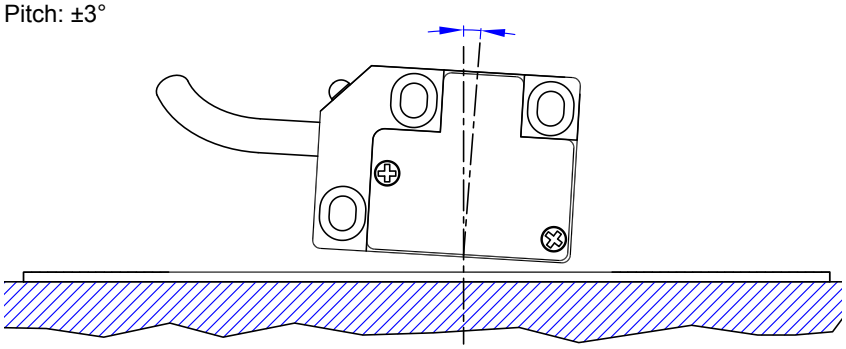
LM10 Installation tollerances

Lateral offset: ±1.5 mm

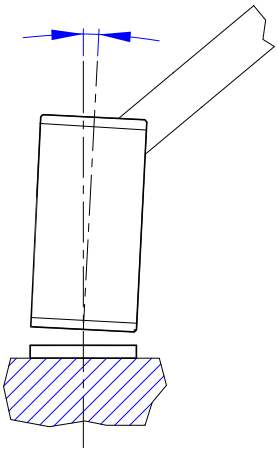
Ride height: 0.1 to 1.5 mm



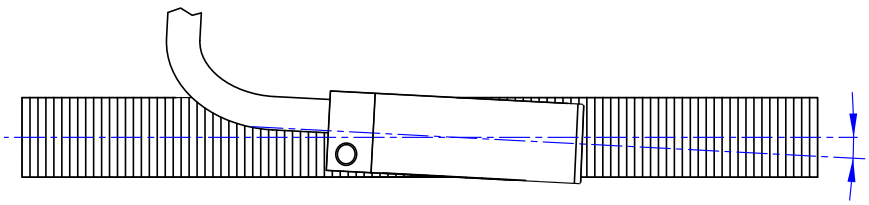
Pitch: ±3°



Roll: ±3°



Yaw: ±2°



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LM10 Technical specifications

System data

Maximum measuring length	50 m (100 m special order)
Pole pitch	2 mm
Available resolution for digital outputs	1, 2, 5, 10, 20, 50 and 100 µm
Sinusoidal period length	2 mm
Maximum speed	For sinusoidal output signals: 25 m/s For digital output signals:

Resolution (µm)	Maximum velocity (m/s)				
1	4.16	1.04	0.52	0.26	0.13
2	8.32	2.08	1.04	0.52	0.25
5	20.80	5.20	2.59	1.30	0.63
10	25.00	10.40	5.20	2.59	1.27
20	25.00	10.40	5.20	2.59	1.27
50	25.00	6.50	3.25	1.62	0.79
100	25.00	25.00	25.00	25.00	20.00
Edge separation (µs)	0.12	0.50	1	2	4
Count frequency (kHz)	8333	2000	1000	500	250

Sensor/magnetic scale gap	With stick-on reference: 0.5 to 1.5 mm With periodic or machined reference: 0.1 to 1.5 mm
System accuracy	±40 µm at 20 °C
Linear expansion coefficient	(11±1) × 10^{-6}/K
Repeatability	Better than ±5 µm
Hysteresis	< 2 µm
Sub divisional error	< 7 µm for < 0.7 mm ride height < 15 µm for 1 mm ride height < 30 µm for 1.5 mm ride height

Electrical data

Power supply	4.5 V to 5.5 V - reverse polarity protected
Power consumption	< 30 mA - without load
Voltage drop over cable	ΔU = 21.4 × length × 10^{-3} [V] - without load
Output signals	Digital - Differential RS422A, short circuit protected Sinusoidal - Differential 1 V_{pp}

Mechanical data

Cable	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

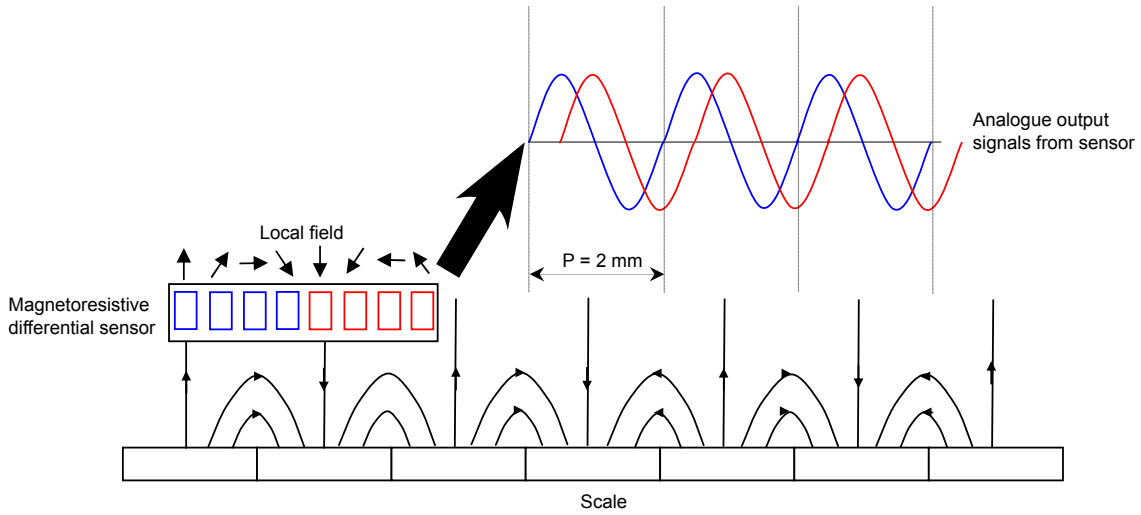
Temperature	Operating -20 °C to +85 °C Storage -40 °C to +85 °C
Degree of protection	IP68 (according to IEC 60529)
EMC Immunity	IEC 61000-6-2 (particulary: ESD: IEC 61000-4-2; EM fields: IEC 61000-4-3; Burst: IEC 61000-4-4; Surge: IEC 61000-4-5; Conducted disturbances: IEC 61000-4-6; Power frequency 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)

How it works

A differential magnetoresistive sensor detects the magnetic signature of the magnetised scale. The sensor produces a sine and cosine signal as the sensor moves along the scale. These analogue signals can then be interpolated internally to produce a range of resolutions to 1 µm.

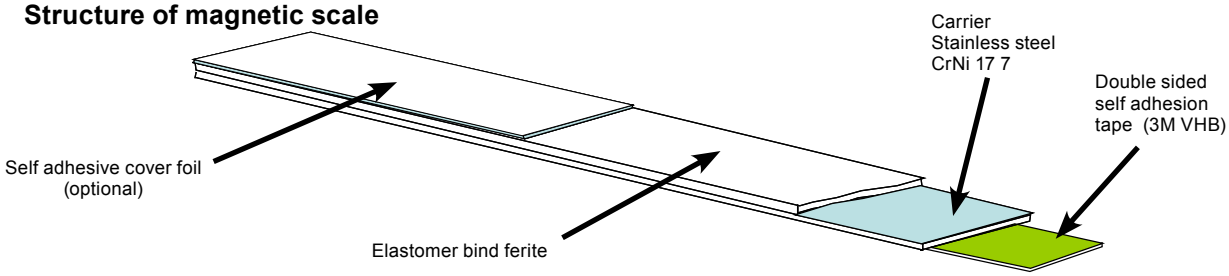
Accurate and reliable reading is obtained by saturating the sensors with flux from the magnetic scale. To achieve this condition the distance between the sensor and the magnetic scale must not exceed 3/4 of the pole pitch. Within this ride height tolerance the Sine/Cosine signals are stable to 10 % signal amplitude.

The sensor detects the magnetic field gradient and is therefore almost insensitive to homogenous stray fields.



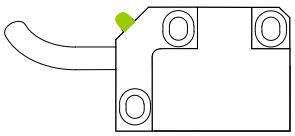
The scale applicator is mounted in place of the readhead and uses the motion of the axis to apply the scale parallel to the guideway. If needed a protective cover strip can also be installed over the magnetic tape.

Structure of magnetic scale

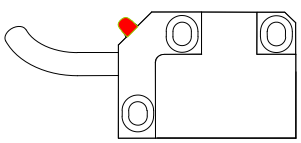


Once installed the readhead can be easily adjusted on the machine using the set-up LED indicator.

Green LED = good signal strength / set-up



Red LED = poor signal strength - adjustment required
A, B, A-, B- outputs become high impendance



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.

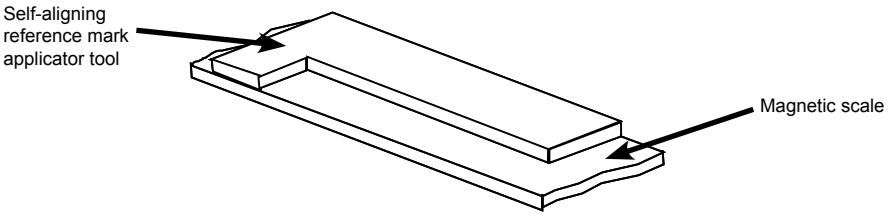
Reference mark

The repeatable bi-directional reference signal can be provided in 3 ways.

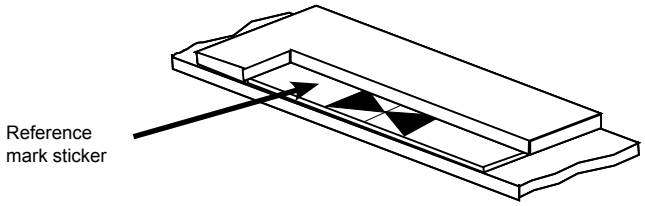
1) **Stick-on reference mark**. The LM10 readhead should also have the reference mark option selected. After installation of the scale a reference mark sticker can be applied to the scale at the required position using the reference mark applicator tool. Ensure that the reference sticker is orientated to the corresponding side of the readhead that has the reference mark detector installed.

   Process of installation

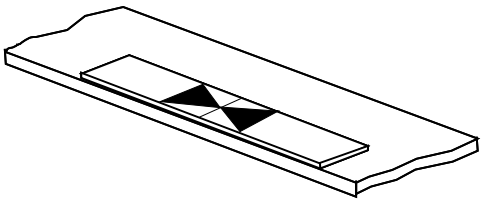
   Install scale (+ optional cover strip) – place the reference mark applicator tool on scale in the correct orientation/required position along the length.



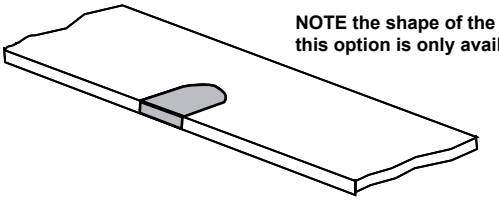
   Remove the backing tape from the reference mark sticker and carefully attach it to the surface of the scale by placing it in the recess provided by the applicator tool.



   Remove the applicator tool leaving the reference mark sticker in the desired position.



2) **Selected at point of order.** The LM10 readhead should also have the reference mark option selected. If required the cover foil can be installed over the cut reference mark.



3) **Every 2 mm** – the LM10 readhead should be ordered with this specific mode activated only.

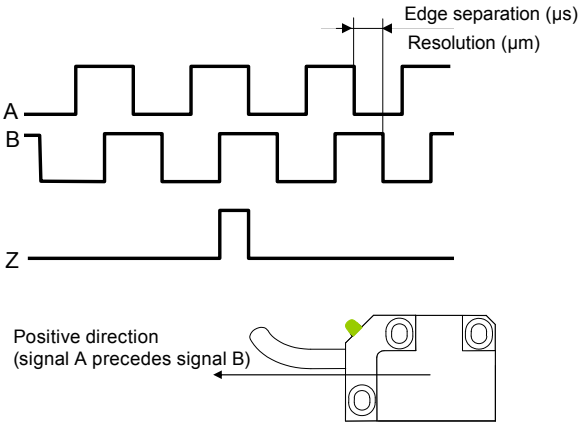
Digital output signals

Square wave differential line driver to EIA RS422

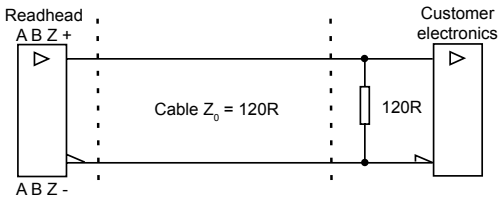
Power supply voltage	4.5 V to 5.5 V Reverse polarity protection
Incremental signals	2 square-wave signals A, B and their inverted signals A-, B-
Reference mark signal	1 or more square-wave pulse Z and its inverted pulse Z-
Signal level	Differential line driver to EIA standard RS422: $U_H \geq 2.5$ V at $-I_H = 20$ mA $U_L \leq 0.5$ V at $I_L = 20$ mA
Permissible load	$Z_O \geq 100\ \Omega$ 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 impendance 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	Double shielded PUR cable; max. 100 m

Timing diagram

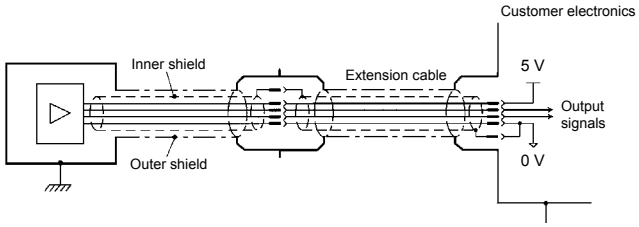
(Complementary signals not shown)



Recommended signal termination



Electrical connections



Connections

Function	Signal	Colour	15 pin D type male	9 pin D type male
Power	5 V	Brown	7	5
	0 V	White	2	9
Incremental signals	A+	Green	14	4
	A-	Yellow	6	8
	B+	Blue	13	3
	B-	Red	5	7
Reference mark	Z+	Pink	12	2
	Z-	Grey	4	6
Shield	Inner	Green/ Yellow	15	1, 9
	Outer	-	Case	Case

LM10 readhead part numbering

LM10 system = Readhead + Scale

Readhead part number
eg LM10IC010CA10F00

Magnetic scale part number
eg MS10B1000B0032

LM10 IC 010 C A 10 F 00

Output type
IC - Incremental, RS422; 5 V power supply
IB* - Incremental, open collector; 24 V power supply
AV* - Analogue voltage, 1 V_{pp}; 5 V power supply

Resolution
000 - for AV
001 - 1 µm
002 - 2 µm
005 - 5 µm
010 - 10 µm
020 - 20 µm
050 - 50 µm
100 - 100 µm
XX1* - Programmable from 1 to 50 µm (preset to 1 µm)
XX2* - Programmable from 5 to 100 µm (preset to 5 µm)

Minimum edge separation
A - 0.12 µs
B - 0.5 µs
C - 1 µs
D - 2 µs
E - 4 µs
F - 5 µs
G - 10 µs
H - 20 µs

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

Cable length
10 - 1.0 m (standard)

Connector option
A - 9 pin D type plug
D - 15 pin D type plug
F - Flying lead (no connector)

Special requirements
00 - No special requirements (standard)
01 - 0.7 mm ride height alarm

* Available from April 2008

Magnetic scale part numbering

MS10 B 1000 B 0032

Precision class
B - 40 µm/m

Tape length
xxxx - Where xxxx equals tape length in cm

Cover foil
A - No cover foil
B - Cover foil supplied separately

Position of reference mark
0000 - No reference mark
xxxx - Where xxxx equals position of machined reference mark in cm

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	**LM10ASC00**

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Document revision details

Issue	Date	Page	Corrections made
02	29.11.2007	-	Minor text errors corrected, Corrected Maximum speed table data on page 3
02	30.11.2007	2	Changed Pitch and Yaw description and image layout

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