

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 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 or analogue output variants and offer a range of customer selectable resolutions including 1 μm , 2 μm ,

5 μm , 10 μm , 20 μm and 50 μm . The LM10 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 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.

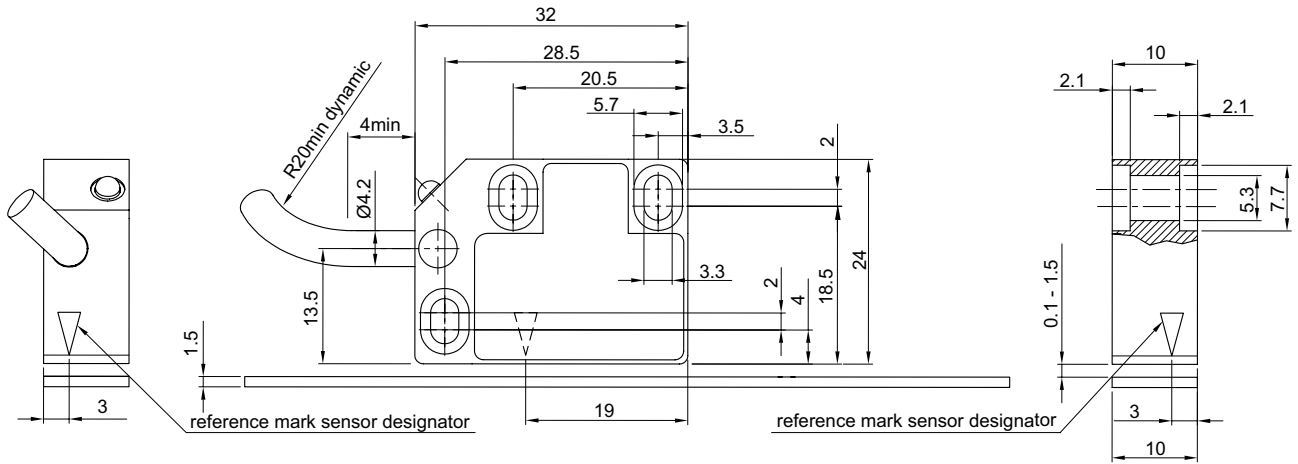
The non-contact, frictionless design eliminates wear while reducing hysteresis giving precision at high speeds and accelerations.

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 assembly equipment etc.

- Stick-on reference mark
- Customer selectable resolutions from 50 μm 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

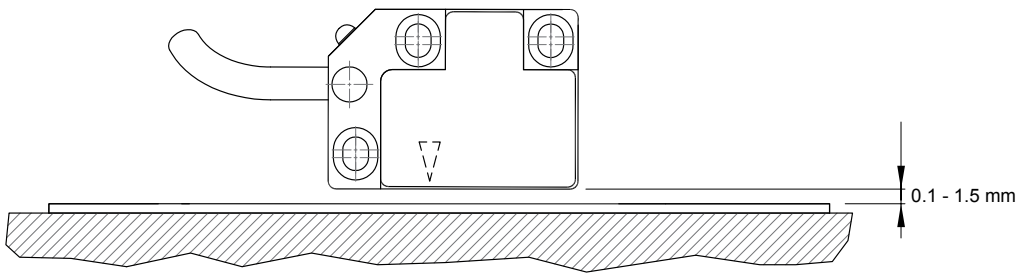
LM10 dimensions

Dimensions and tolerances in mm.

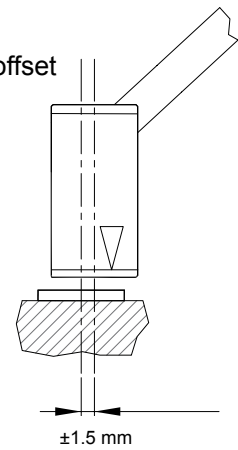


LM10 installation tolerances

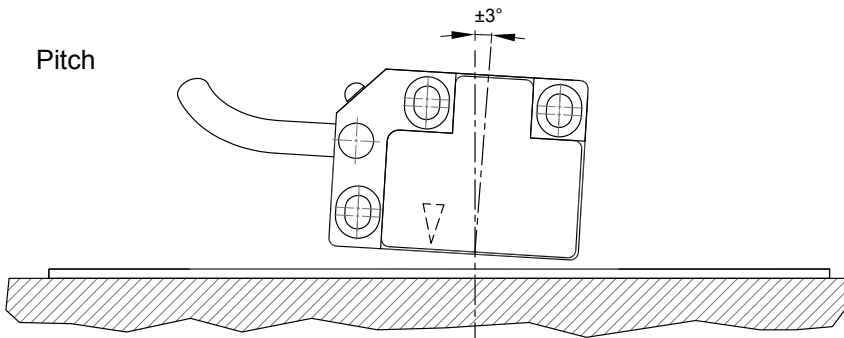
Ride height



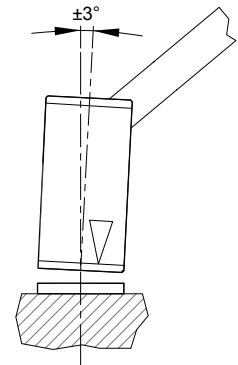
Lateral offset



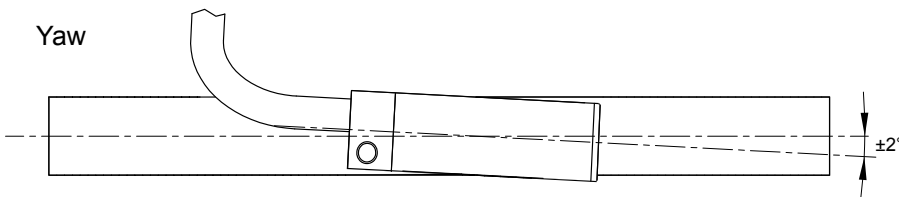
Pitch



Roll



Yaw



LM10 technical specifications

System data																																																							
Maximum measuring length	50 m (100 m special order)																																																						
Pole length	2 mm																																																						
Available resolution for digital outputs	1 µm, 2 µm, 5 µm, 10 µm, 20 µm and 50 µm																																																						
Sinusoidal period length	2 mm																																																						
Maximum speed	For analogue voltage and analogue current output: 25 m/s For digital output signals:																																																						
	<table border="1"> <thead> <tr> <th>Resolution (µm)</th> <th colspan="5">Maximum velocity (m/s)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4.16</td> <td>1.04</td> <td>0.52</td> <td>0.26</td> <td>0.13</td> </tr> <tr> <td>2</td> <td>8.32</td> <td>2.08</td> <td>1.04</td> <td>0.52</td> <td>0.25</td> </tr> <tr> <td>5</td> <td>20.80</td> <td>5.20</td> <td>2.59</td> <td>1.30</td> <td>0.63</td> </tr> <tr> <td>10</td> <td>25.00</td> <td>10.40</td> <td>5.20</td> <td>2.59</td> <td>1.27</td> </tr> <tr> <td>20</td> <td>25.00</td> <td>10.40</td> <td>5.20</td> <td>2.59</td> <td>1.27</td> </tr> <tr> <td>50</td> <td>25.00</td> <td>6.50</td> <td>3.25</td> <td>1.62</td> <td>0.79</td> </tr> <tr> <td>Edge separation (µs)</td> <td>0.12</td> <td>0.50</td> <td>1</td> <td>2</td> <td>4</td> </tr> <tr> <td>Count frequency (kHz)</td> <td>8333</td> <td>2000</td> <td>1000</td> <td>500</td> <td>250</td> </tr> </tbody> </table>	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	Edge separation (µs)	0.12	0.50	1	2	4	Count frequency (kHz)	8333	2000	1000	500	250
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Count frequency (kHz)	8333	2000	1000	500	250																																																		
Sensor/magnetic scale gap	With periodic or machined reference: 0.1 to 1.5 mm With stick-on reference: 0.5 to 1.5 mm																																																						
Error band	±40 µm at 20 °C																																																						
Linear expansion coefficient	~ 17 × 10 ⁻⁶ /K																																																						
Repeatability	Better than unit of resolution for movement in the same direction																																																						
Hysteresis*	< 3 µm up to 0.2 mm ride height																																																						
Sub divisional error	±3.5 µm for < 0.7 mm ride height (to ensure SDE remains under ±3.5 µm order option 01 that provides alarm and red LED at 0.7 mm ride height) ±7.5 µm for 1 mm ride height ±15 µm for 1.5 mm ride height																																																						
Electrical data																																																							
Power supply	4.7 V to 7 V – reverse polarity protected; voltage on readhead																																																						
Power consumption (without any load)	< 30 mA for digital output type < 50 mA for analogue output types																																																						
Voltage drop over cable	13 mV/m – without load 54 mV/m – with 120 Ω load																																																						
Output signals	Digital – Open Collector NPN, Differential RS422, short circuit protected Analogue – Differential 1 V _{pp} , 12 µA																																																						
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																																																						
Mass	Readhead (1 m cable, no connector) 56.4 g, Magnetic scale (1 m) 60 g, Cover foil (1 m) 3.5 g																																																						
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)																																																						

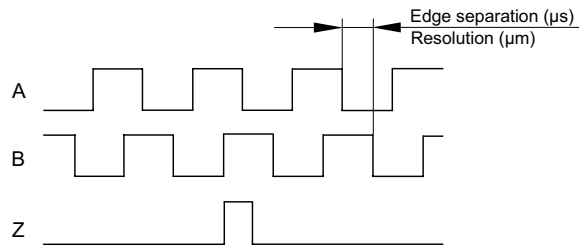
* Repeatable, and can be measured and compensated once installed

LM10IB – Digital output signals, Open Collector NPN

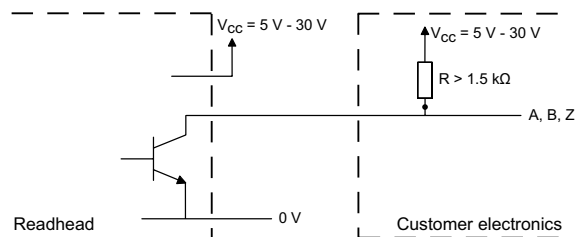
Square wave output

Power supply voltage	5 V to 30 V
Power consumption	30 mA
Output signals	A, B, Z
Reference signal	1 or more square-wave pulses Z
Maximum load	20 mA
Cable	max. 10 m

Timing diagram



Recommended signal termination



NOTE: Set-up LED in the case of poor signal strength is flashing red.

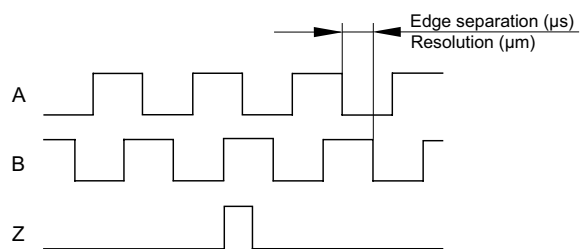
LM10IC – Digital output signals, RS422

Square wave differential line driver to EIA RS422

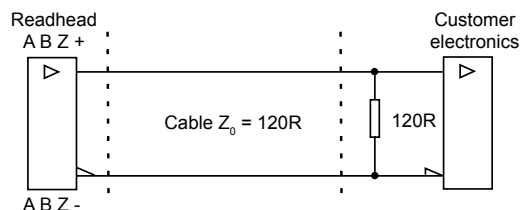
Power supply voltage	4.7 V to 7 V – reverse polarity protected; voltage on readhead * Reverse polarity protection
Incremental signals	2 square-wave signals A, B and their inverted signals A-, B-
Reference signal	1 or more square-wave pulse Z and its inverted pulse Z-
Signal level	Differential line driver 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	$Z_O \geq 100 \Omega$ 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 $+5 \text{ V}$
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

Timing diagram

Complementary signals not shown



Recommended signal termination



* Please consider voltage drop over cable.

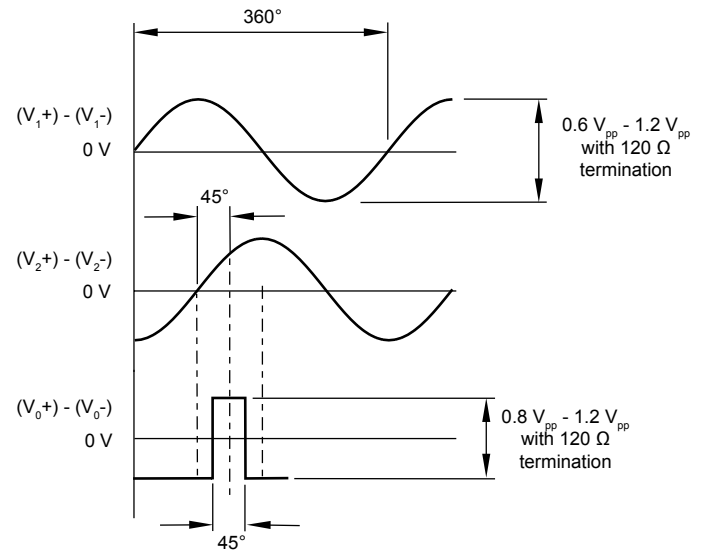
LM10AV – Analogue output signals (1 V_{pp})

2 channels V₁ and V₂ differential sinusoidals (90° phase shifted)

Power supply voltage	4.7 V to 7 V – reverse polarity protected; voltage on readhead * Reverse polarity protection	
Incremental signals	Amplitude	0.6 V _{pp} to 1.2 V _{pp} (with 120 Ω termination)
	Phase shift	90° ± 0.5°
Reference signal	Amplitude	0.8 V _{pp} to 1.2 V _{pp} (with 120 Ω termination)
	Position	45°
	Width	45°
Termination	Z _o = 120 Ω between associated outputs	
Cable length	max. 50 m	

* Please consider voltage drop over cable.

Timing diagram



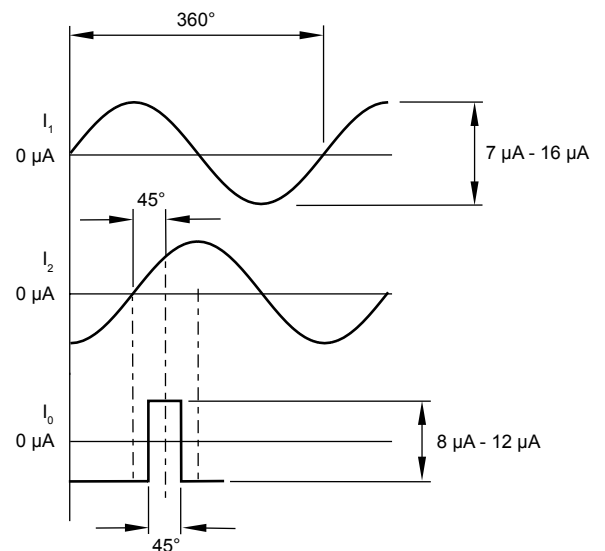
LM10AC – Analogue micro current output signals (12 μA)

2 channels I₁ and I₂ sinusoidals (90° phase shifted)

Power supply voltage	4.7 V to 7 V – reverse polarity protected; voltage on readhead * Reverse polarity protection	
Incremental signals	Amplitude	7 μA to 16 μA
	Phase shift	90° ± 0.5°
Reference signal	Amplitude	8 μA to 12 μA
	Position	45°
	Width	45°
Cable length	max. 10 m	

* Please consider voltage drop over cable.

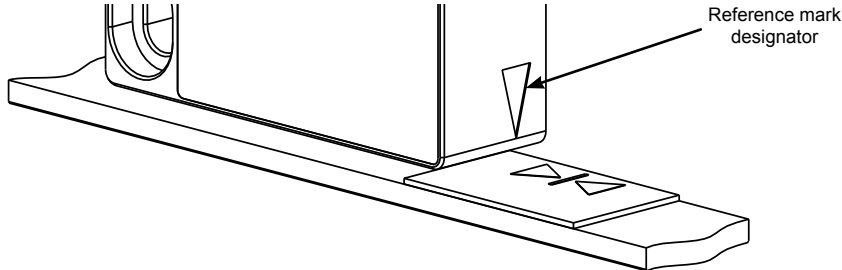
Timing diagram



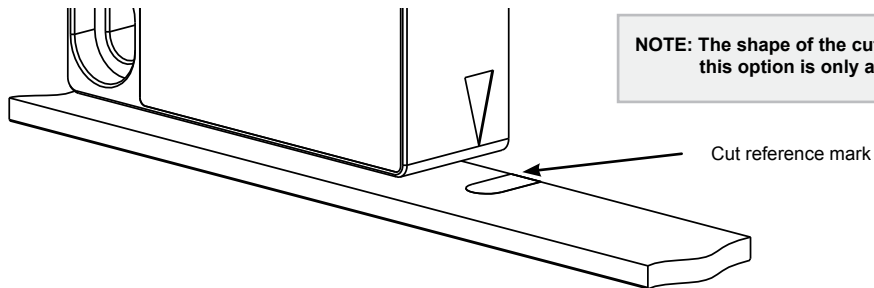
Reference mark

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

- 1) **Stick-on reference mark.** The LM10 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.



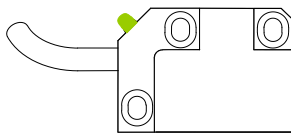
- 2) **Selected at point of order.** The LM10 readhead should be ordered with the reference mark option. If required the cover foil can be installed over the cut reference mark.



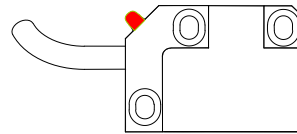
- 3) **Every 2 mm.** The LM10 readhead should be ordered with this specific mode activated only.

Set-up LED

After the installation of the magnetic scale (see LM10 Installation guide) 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

NOTE: IB output type: LED flashes red.

Programming

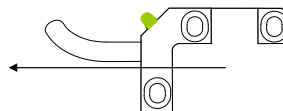
Readheads can be ordered preset to the required resolution or provided so that they can be programmed as needed on the machine to the chosen resolution. This programming is carried out by connecting the readhead to a computer via a programming interface.

Positive direction

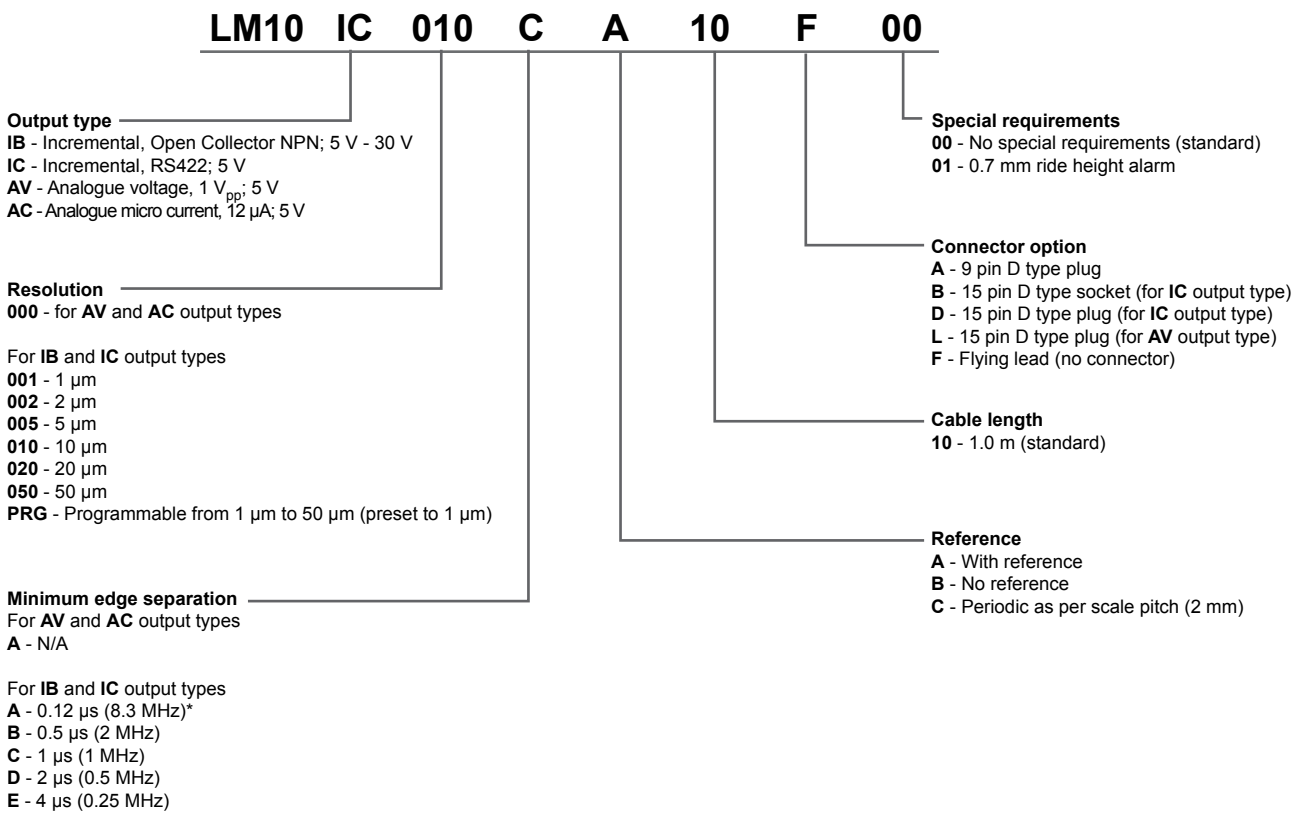
Digital output signals – A leads B

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

Analogue output signals ($12 \mu A$) – I_1 leads I_2

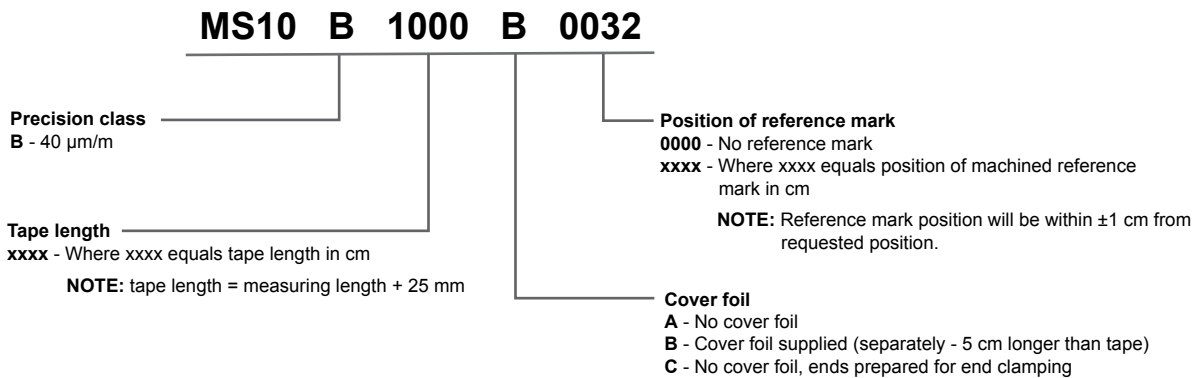
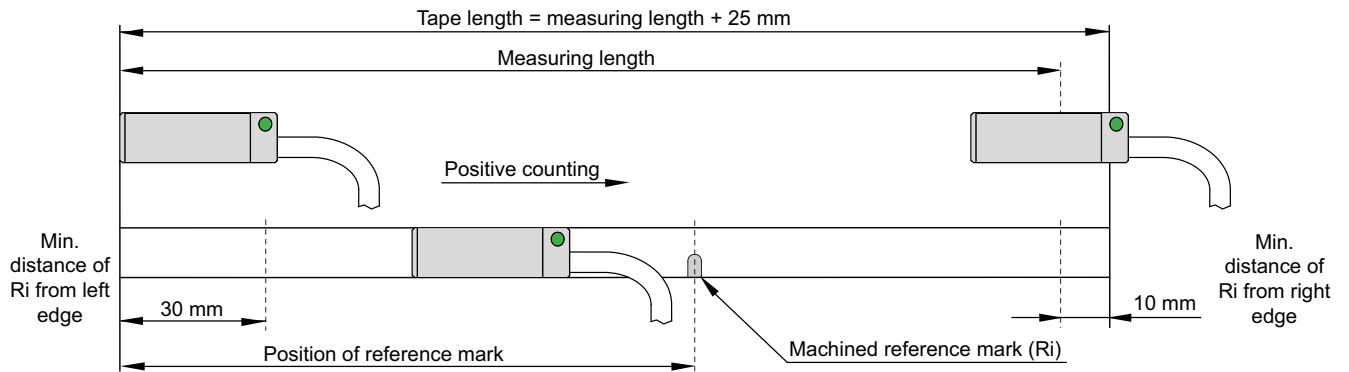


LM10 readhead part numbering

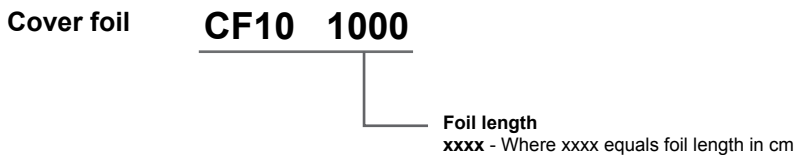


* Default for **PRG** option.

Magnetic scale part numbering



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
02	29.11.2007	-	Minor text errors corrected, Corrected Maximum speed table data on page 3
	30.11.2007	2	Changed Pitch and Yaw description and image layout
	15. 1. 2008	3, 4, 5	Minor text errors corrected
03	28. 2. 2008	1, 3, 7	Removed the 100 µm option
		2	Added the Reference mark detection side symbol
		5	New reference mark images
		8	Added the magnetic scale dimensions image
04	6. 6. 2008	2, 5	New installation drawing
		-	Reference mark installation moved to LM10 Installation guide
		4, 6	Analogue output signal specifications added
		6	IB output type removed, AC output type and connector option L added
05	25. 11. 2008	4, 7, 8	IB output type, new magnetic scale diagram and end clamping option added
06	5. 12. 2008	3	Hysteresis data added
07	14. 1. 2009	-	New layout

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