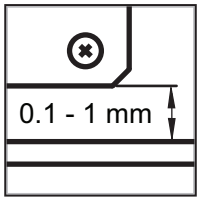
Data sheet
LM13D01_04
Issue 4, 5th May 2011

LM13 magnetic ring encoder system



The LM13 is a contactless high-speed magnetic ring encoder designed for use in harsh environments.

The LM13 features a compact sealed readhead that rides at up to 1.0 mm from the ring's surface. Simple to install, the LM13 features an integral set-up LED on the readhead and wide installation tolerances.

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

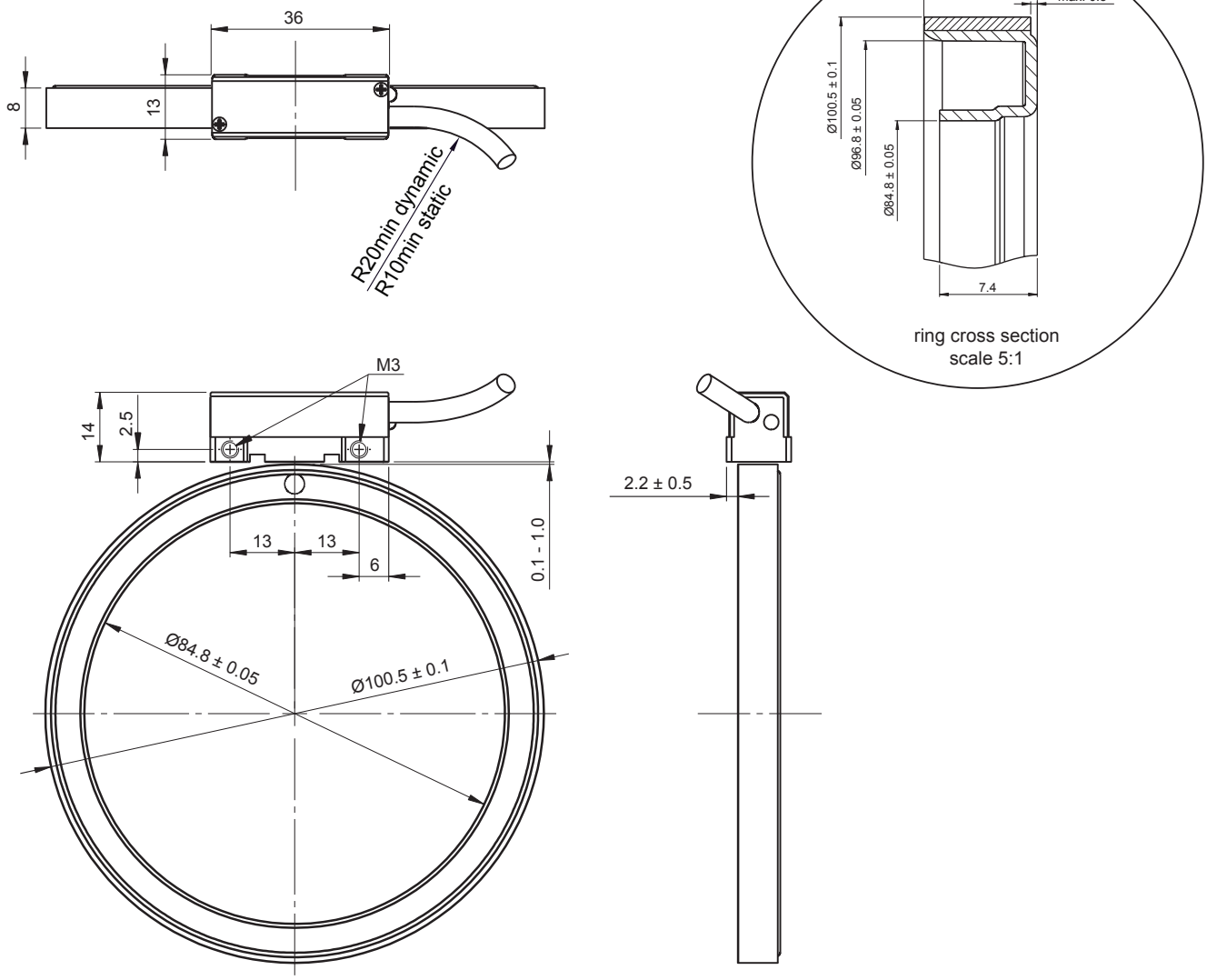
The non-contact, frictionless design eliminates wear while reducing hysteresis.

The LM13 encoders 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.

- **Resolutions from 1,280 to 327,680 counts per revolution**
- **High speed operation to 20,000 revolutions per minute**
- **Excellent dirt immunity**
- **Integral set-up LED**
- **High reliability from proven non-contact sensing technology**
- **Industry standard digital and analogue outputs**

LM13 dimensions

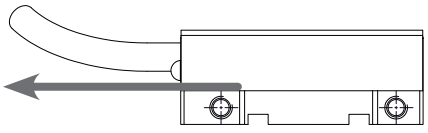
Dimensions and tolerances in mm.



Positive direction

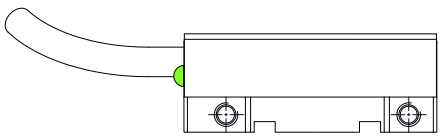
Digital output signals – A leads B

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

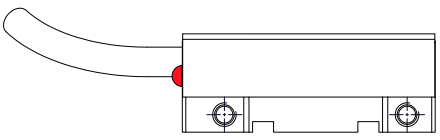


Set-up LED

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

LM13 technical specifications

System data

Pole length

2.25° (approx. 2 mm)

Available resolutions and maximum speed

For analogue voltage output type: 8,000 rpm

For digital output type:

Resolution (counts per revolution)	Interpolation factor	Maximum speed (revolutions per minute)				
327,680	**2,048**	759	191	95	45	23
320,000	**2,000**	780	195	98	46	24
256,000	**1,600**	975	244	122	58	30
163,840	**1,024**	1,521	378	190	91	46
160,000	**1,000**	1,560	390	195	93	48
128,000	**800**	1,950	486	244	116	59
81,920	**512**	3,045	759	293	181	93
80,000	**500**	3,120	780	390	186	95
64,000	**400**	3,900	975	486	232	119
51,200	**320**	4,875	1,218	609	290	149
40,960	**256**	6,093	1,521	759	360	186
32,000	**200**	7,800	1,950	975	462	238
25,600	**160**	4,875	1,218	609	303	149
20,480	**128**	8,000*	3,045	1,521	723	369
16,000	**100**	7,800	1,950	975	462	238
12,800	**80**	4,875	1,218	609	303	149
10,240	**64**	8,000**	6,093	3,045	1,449	741
6,400	**40**	4,875	1,218	609	290	149
5,120	**32**	8,000**	8,000*	6,093	2,901	1,485
2,560	**16**	N/A	8,000**	8,000*	5,802	2,970
1,280	**8**	N/A	8,000**	8,000**	8,000*	5,943
Edge separation (µs)		0.12	0.50	1	2	4
Count frequency (kHz)		8333	2000	1000	500	250

* 12,000 rpm when special requirement 20 chosen.
** 20,000 rpm when special requirement 20 chosen.

Repeatability

Better than unit of resolution

Hysteresis

< 12 arc sec up to 0.5 mm ride height

Sub divisional error

±14 arc sec for < 0.7 mm ride height
±30 arc sec for 1 mm ride height

Mass

Readhead (1 m cable, no connector) 79.6 g, Readhead (1 m cable, with connector) 132.4 g, Cable (1 m) 34 g, Magnetic ring 42 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	**Readhead**	Operating	-10 °C to +80 °C (cable under non-dynamic conditions: -20 °C to +85 °C)
		Storage	-40 °C to +85 °C
	Ring	Operating and storage	-40 °C to +120 °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)

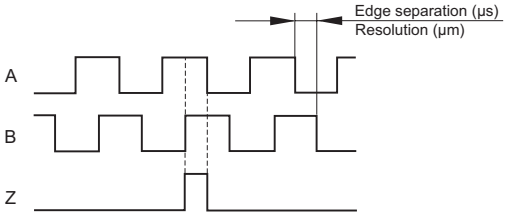
LM13IC – Digital output signals, RS422

Square wave differential line driver to EIA RS422

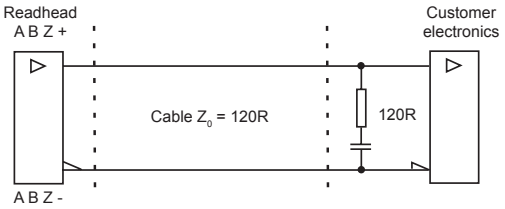
Power supply *	4.7 V to 7 V – voltage on readhead Reverse polarity protection
Power supply rise time (for PRG option only)	< 1 ms
Power consumption (without any load)	< 35 mA
Output signals	3 square-wave signals A, B, Z and their inverted signals A-, B-, Z-
Reference signal	1 or more square-wave pulse 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



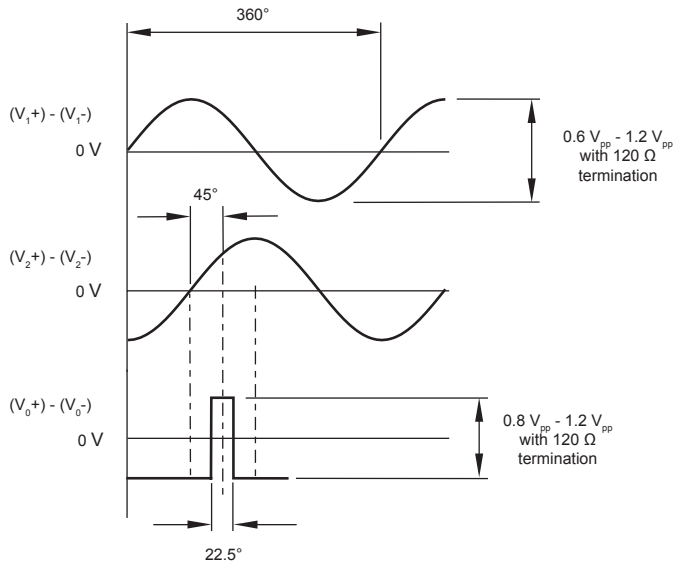
LM13AV – Analogue output signals (1 V_{pp})

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 (without any load)	< 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



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.

LM13 readhead part numbering

LM13 magnetic ring encoder system = Readhead + Ring

Readhead part number
eg **LM13IC10DBA10F00**

Ring part number
eg **MN00134**

LM13 IC 10D B 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

11B - 327,680 cpr	**D50** - 80,000 cpr	**D10** - 16,000 cpr
2D0 - 320,000 cpr	**D40** - 64,000 cpr	**D08** - 12,800 cpr
1D6 - 256,000 cpr	**D32** - 51,200 cpr	**06B** - 10,240 cpr
10B - 163,840 cpr	**08B** - 40,960 cpr	**D04** - 6,400 cpr
1D0 - 160,000 cpr	**D20** - 32,000 cpr	**05B** - 5,120 cpr
D80 - 128,000 cpr	**D16** - 25,600 cpr	**04B** - 2,560 cpr
09B - 81,920 cpr	**07B** - 20,480 cpr	**03B** - 1,280 cpr

PRG - Programmable from 327,680 cpr to 1,280 cpr (preset to 320,000 cpr)

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)

* Default for **PRG** option.
NOTE: Not available with 1,280 cpr and 2,560 cpr resolution options.

Special requirements
00 - No special requirements (standard)
20 - High speed version **

** Please check the maximum speed table on page 3 for available options

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 high density D type plug (for **IC** output type)
P - 9 pin D type plug (for **AV** output type)
F - Flying lead (no connector)

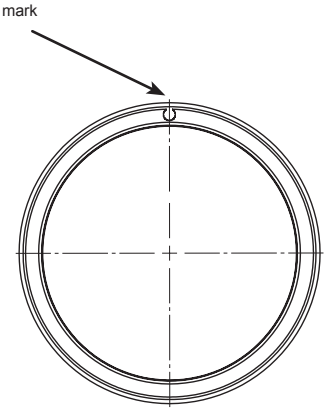
Cable length
10 - 1.0 m (standard)

Reference
A - With reference
B - No reference
C - Periodic as per ring pitch (every 2.25°)

100.5 mm diameter ring part number MN00134

100.5 mm diameter ring with reference mark part number MN00147

Position of reference mark



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Document issues

Issue	Date	Page	Corrections made
1	6. 1. 2009	-	New document
2	19. 6. 2009	5	Added connector option H
3	16. 9. 2009	2, 4	Amended the diimensions image and positive direction image added
4	5. 5. 2011	3	Maximum speed table updated
		4	Analogue voltage output added
		5	High speed version as special requirement option added

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