Radial incremental magnetic rings

Radial magnetic rings for use in harsh environments

The robust RLS radial magnetic rings consist of a vulcanised elasto-ferrite layer which is firmly connected to a steel hub. The elasto-ferrite layer is magnetised with 2 mm or 5 mm long alternating magnetic poles that form an incremental magnetic pattern.

A unique or distance-coded (DCRM) reference marks can also be added to the incremental magnetic pattern.

Compatible with RLS readheads

The magnetic incremental rings are compatible with the RLS standard LM family or the component-level RoLin readheads, which provide reliable operation due to their non-contact design. Incremental or analogue output types are available according to industry standards.

Enhanced safety and reliability

To assure safety and reliability at high speeds and temperatures, the rings can optionally be covered with a protective stainless steel foil.

This protective layer also protects the elasto-ferrite from swarfs (e.g. metal, stone, glass, wood, etc.) and minimises the influence of ageing (e.g. UV radiation).

Easy mounting for different shaft diameters

Different inner diameters from 20 mm to 143 mm are supported.

Radial rings allow heating up to 160 °C and are therefore ideal for shrink fitting. Due to high-precision machining, the rings can also be press-fitted.

Applications

The magnetic incremental rings offer reliable solutions for high performance applications.

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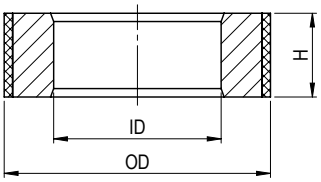
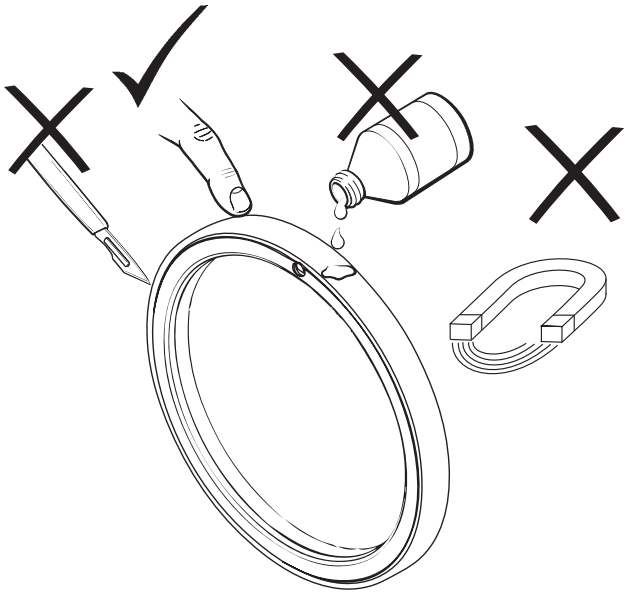
Selection guide



Ring	Outer diameter (OD) [mm]	Inner diameter (ID) [mm]	Height (H) [mm]	Pole length [mm]	Number of poles	Compatible with:							Page
						LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM	
MR031G	31.0 ± 0.1	20 H7	8 ± 0.1	2	50	Ri	Ri	-	No Ri	No Ri	Ri	Ri	12
	31.85 ± 0.1			5	20	-	-	Ri	-	-	-	-	
MR040G	40.0 ± 0.1	30 H7	8 ± 0.1	2	64	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	16
	40.7 ± 0.1			5	26	-	-	Ri	-	-	-	-	
MR047B	47.5 ± 0.1	40 ± 0.1	5.5 ± 0.1	2	76	No Ri	No Ri	-	No Ri	No Ri	Ri	Ri	20
MR050E	50.1 ± 0.1	40 H7	10 ± 0.1	2	80	Ri	Ri	-	No Ri	No Ri	Ri	Ri	24
				5	32	-	-	Ri	-	-	-	-	
MR057E	56.5 ± 0.1	45 H7	10 ± 0.1	2	90	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	28
	57.3 ± 0.1			5	36	-	-	Ri+DCRM	-	-	-	-	
MR057R	57.5 ± 0.1	51 ± 0.1	11 ± 0.1	2	90	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	32
MR075E	75.4 ± 0.1	60 H7	10 ± 0.1	2	120	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	36
				5	48	-	-	Ri+DCRM	-	-	-	-	
MR080R	80.3 ± 0.1	74	11 ± 0.1	2	128	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	40
MR100F	100.5 ± 0.1	84.77 ± 0.05	8.6 ± 0.1	2	160	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	44
MR122E	122 ± 0.1	90 H7	10 ± 0.1	2	194	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	47
MR162Q	161.7 ± 0.1	$143\ ^{0}_{-0.03}$	12 ± 0.1	2	256	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM	50

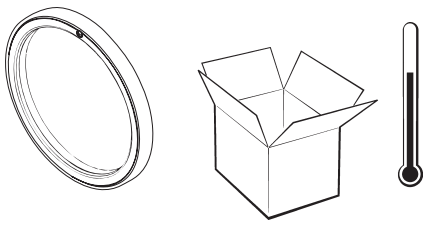
Ri - Unique reference mark or only incremental track available
No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance-coded reference mark or only incremental track available

Storage and handling



NOTE: The magnetic ring should not be exposed to magnetic field densities of more than 50 mT on its surface, as this can damage the ring.

Operating and storage temperature



HNBR –40 °C to +160 °C

Humidity

Up to 100 % RH

Chemical resistance

Test performed with		Compatibility
Ethanol	Technical, ≥ 95 %	✔
Isopropanol	Technical, ≥ 95 %	✔
Cutting oil	Rezilol SCM BCL	✔
Brake fluid	DOT-4	✔
Grease	ISOFLEX® TOPAS NB 52	✔

The test samples were immersed in chemicals at 25 °C for four weeks according to standard ISO 175:2010. Changes in the mass and height of the elasto-ferrite layer were controlled during the test.

Accuracy of ring encoder systems

The accuracy of the ring encoder measurement is influenced by **encoder-specific errors** and i**nstallation-dependent errors**. In order to evaluate the total accuracy, each of the significant errors must be considered. Fig. 1 shows a typical accuracy error plot with marked particular influences.

Encoder-specific error

System error consists of a magnetisation error, crosstalk and SDE.

Ring	System error [°] (2 mm pole length)	System error [°] (5 mm pole length)	
	Over the entire RH	Up to 1 mm RH*	Up to 2.5 mm RH*
MR031G	±0.16	±0.50	±1.00
MR040G	±0.13	±0.40	±0.80
MR047B	±0.11	-	
MR050E	±0.10	±0.30	±0.60
MR057E	±0.09	±0.28	±0.56
MR057R	±0.09	-	

Ring	System error [°] (2 mm pole length)	System error [°] (5 mm pole length)	
	Over the entire RH	Up to 1 mm RH*	Up to 2.5 mm RH*
MR075E	±0.07	±0.20	±0.40
MR080R	±0.06	-	
MR100F	±0.10	-	
MR122E	±0.04	-	
MR162Q	±0.03	-	

*Ride height (RH) on 5 mm pole length systems (LM15) influences system error.

Magnetisation error

The magnetisation error is caused by imperfections in the elasto-ferrite materials and possible deviations resulting from the magnetisation process. The following factors influence the result:

- the magnetic nonhomogeneity of the elasto-ferrite layer,
- the ring installation tolerances during the magnetisation process,
- the accuracy of used measuring system during the magnetisation process,
- the quality of the magnetisation system.

The magnetisation accuracy A_M can be calculated by the following formula:

$$A_M = \pm \frac{4.6}{D}$$

where *D* is the outer ring diameter in [mm].

D [mm]	A_M [°]
20	±0.229
40	±0.115
60	±0.076

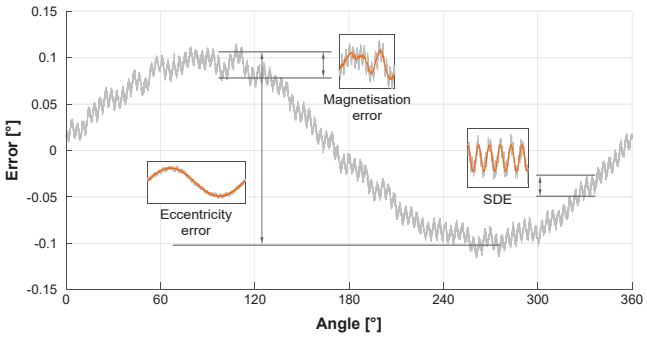


Fig. 1. Typical accuracy error plot.

Crosstalk

Crosstalk is an undesirable effect of reference mark magnetisation on the incremental track magnetisation, which leads to accuracy peaks. It depends on both the ride height and the lateral offset.

An example of crosstalk is shown in Fig. 2

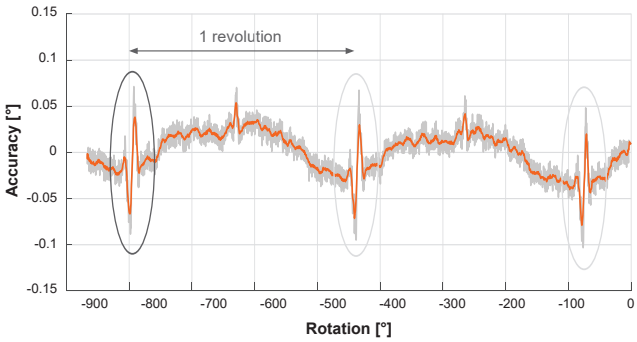


Fig. 2. Crosstalk representation. The crosstalk (Ri magnetisation) is circled.

NOTE: Figures 1 - 4 are for representation purpose only.

Sub divisional error (SDE) or interpolation error

The sub divisional or interpolation error is a periodical accuracy error. It is influenced by the following factors:

- the length of poles,
- the homogeneity and cycle definition of magnetic poles,
- the sensing distance (ride height) of the installed readhead,
- the quality of the signal processing,
- the characteristics of the internal AMR sensor.

The SDE leads to speed ripples in applications where the encoder is used as speed feedback, e.g. in speed control loops. For radial rings, SDE is strongly influenced by ride height.

The maximum SDE at optimal sensing distance can be calculated by the following formula:

$$\text{For 2 mm pole length: } SDE_2 = \pm \frac{0.58 \times K}{D}$$

$$\text{For 5 mm pole length: } SDE_5 = \pm \frac{1.61 \times K}{D}$$

where *D* is the outer ring diameter in [mm].

D [mm]	SDE_2 [°]	SDE_5 [°]
20	±0.029	±0.081
40	±0.014	±0.040
60	±0.009	±0.027

Hysteresis

Hysteresis is the difference in result of measuring the same point when approached from different directions.

It is known that ferromagnetic materials maintain their magnetised state in response to external fields, trying to change their direction.

The hysteresis in encoder systems depends on the strength of the magnetic field. A stronger magnetic field leads to a smaller hysteresis and vice versa. Therefore the hysteresis is strongly influenced by the ride height at which the readhead is installed (Fig. 3).

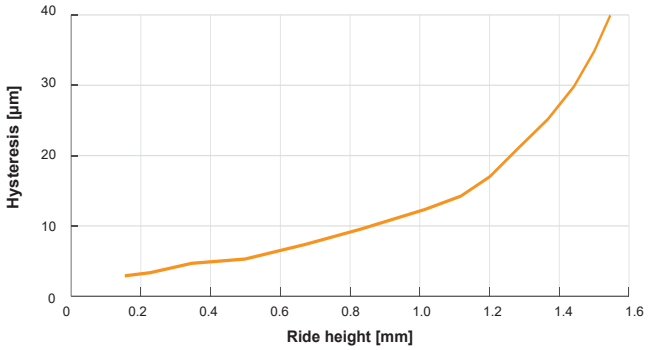


Fig. 3. Hysteresis vs. ride height (for encoder systems with 2 mm pole length).

Installation-dependent errors

Installation and adjustment of the ring and the readhead, in addition to the given encoder-specific error, normally have a significant effect on the overall accuracy of a system. Of particular importance are the installation eccentricity and the effect of deformations resulting from the ring installation.

Installation eccentricity

Eccentricity can be caused by the misalignment of the ring's center towards the rotational axis, as can be seen on Fig. 4.

The error caused by eccentricity can be calculated by the following formula

$$E_{accuracy} = \pm 0.114 \frac{e}{D}$$

where $E_{accuracy}$ is eccentricity error in [°], *e* is misalignment of ring's center towards the rotational axis in [µm] and *D* is the outer ring diameter in [mm].

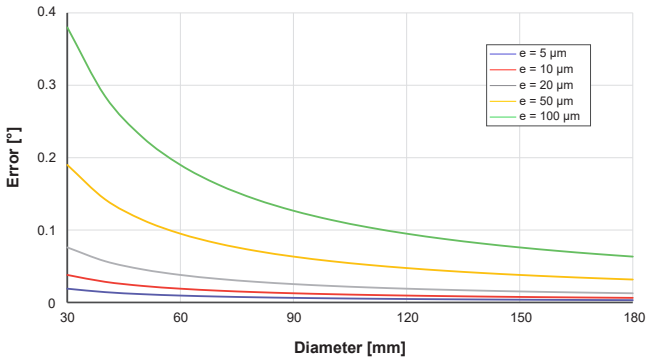


Fig. 4. Influence of installation eccentricity on accuracy.

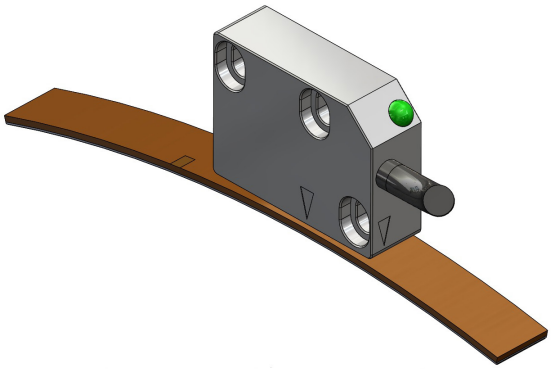
Deformations of the ring during installation

By installing a ring to a non-ideally circular shaft, possible deformations can occur. These can have a significant influence on the system accuracy error.

Reference mark

1. **Selected at point of order.**
   The readhead and magnetic ring should be ordered with reference mark option A (see Part numbering on page 53).

Magnetised reference mark



NOTE: The shape and position of the magnetised reference mark are critical so this option is only available as factory order.

2. **Distance-coded reference marks (DCRM).**
   The readhead should be ordered with reference mark option A and the magnetic ring with reference mark option D (see Part numbering on page 53). The distance-coded reference mark option provides multiple reference marks that are individually spaced according to a specific mathematical algorithm. The absolute position is calculated after traversing 2 consecutive reference marks. The maximum length and the minimum traverse path depend on the basic distance (K) between the reference marks. The positions of the reference marks on each ring are listed in the table below.

MR040G	MR057E/MR057R		MR075E		MR080R	MR100F	MR122E	MR162Q
2 mm pole length **K = 32** [°]	2 mm pole length **K = 36** [°]	5 mm pole length **K = 60** [°]	2 mm pole length **K = 92** [°]	5 mm pole length **K = 60** [°]	2 mm pole length **K = 64** [°]	2 mm pole length **K = 40** [°]	2 mm pole length **K = 48** [°]	2 mm pole length **K = 64** [°]
360	360	360	360	360	360	360	360	360
309.38	320	290	288	307.5	312.19	335.25	335.88	336.09
270	288	240	222	270	270	315	315.46	315
213.75	244	160	147	210	219.38	288	289.48	289.69
180	216	120	84	180	180	270	270.93	270
118.13	168	30	6	112.5	126.56	240.75	243.09	243.28
90	144	0	0	90	90	225	226.39	225
22.5	92	-	-	15	33.75	193.5	196.70	196.88
0	72	-	-	0	0	180	181.86	180
-	16	-	-	-	-	146.25	150.31	150.47
-	0	-	-	-	-	135	137.32	135
-	-	-	-	-	-	99	103.92	104.06
-	-	-	-	-	-	90	92.78	90
-	-	-	-	-	-	51.75	57.53	57.66
-	-	-	-	-	-	45	48.25	45
-	-	-	-	-	-	0	11.13	11.25
-	-	-	-	-	-	-	0	0

Mounting instructions

Machine the mounting shaft according to the dimensions given in the table below:

Radial ring	Outer ring diameter - OD[a] [mm]		Inner ring diameter - ID [mm]		Shaft diameter (clearance fit installation) - Ds [mm		Shaft outer diameter (press or shrink fit) - Ds [d] [mm]	
MR031G	31.0 / 31.2	+0.1	20 H7	+0.021	20 f7[c]	–0.02	20.035	+0.01
		–0.1		0		–0.041		–0.01
	31.85 / 32.05	+0.1	20 H7	+0.021	20 f7[c]	–0.02	20.035	+0.01
		–0.1		0		–0.041		–0.01
MR040G	40.0 / 40.2	+0.1	30 H7	+0.021	30 f7[c]	–0.02	30.04	+0.01
		–0.1		0		–0.041		–0.01
	40.7 / 40.9	+0.1	30 H7	+0.021	30 f7[c]	–0.02	30.04	+0.01
		–0.1		0		–0.041		–0.01
MR047B	47.5	+0.1	44 +0.02[b]		See mounting instructions on page 20.			
		–0.1						
MR050E	50.1 / 50.3	+0.1	40 H7	+0.025	40 f7[c]	–0.025	40.045	+0.01
		–0.1		0		–0.05		–0.01
MR057E	56.5 / 56.7	+0.1	45 H7	+0.025	45 f7[c]	–0.025	45.045	+0.01
		–0.1		0		–0.05		–0.01
	57.3 / 57.5	+0.1	45 H7	+0.025	45 f7[c]	–0.025	45.045	+0.01
		–0.1		0		–0.05		–0.01
MR057R	57.5 / 57.7	+0.1	53[b]	+0.02	53	–0.04	53.07	+0.01
		–0.1		–0.02		–0.06		–0.01
MR075E	75.4 / 75.6	+0.1	60 H7	+0.030	60 f7[c]	–0.03	60.055	+0.01
		–0.1		0		–0.06		–0.01
MR080R	80.3 / 80.5	+0.1	76.13[b]	+0.02	76 f7	–0.03	76.18	+0.01
		–0.1		–0.02		–0.06		–0.01
MR100F	100.5	+0.1	84.77	+0.05	See mounting instructions on page 44.			
		–0.1		–0.05				
MR122E	122 / 122.2	+0.1	90 H7	+0.035	90 f7[c]	–0.036	90.07	+0.01
		–0.1		0		–0.071		–0.01
MR162Q	161.7 / 161.9	+0.1	143	0	143 f7[c]	–0.043	143.06	+0.015
		–0.1		–0.03		–0.083		–0.015

[a] The orange values apply to ring OD with protective foil (see Part numbering on page 53).
[b] The value does not represent the minimum ring diameter.
[c] To improve accuracy (lower eccentricity error), clearance fit H7/g6 is recommended.
[d] Valid for steel with typical properties ρ=7850 kg/m^3, E= 210 kN/mm^2, $Rp_{0.2}$ = 500 N/mm^2, α = 11 ppm K-1 with the coefficient of friction μ=0.3, under operating conditions a_{max}=20000 rpm/s or 2095 rad/s^2 and T from –40°C to +85°C.

Recommended ride height table

Please refer to the table below for the recommended ride height values. The readheads are calibrated at these values, therefore the SDE is lowest at these ride height values. The maximum range of installation tolerances for the ride height is shown in the drawings of the individual rings and readheads.

Readhead	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
Recommended ride height [mm]	0.3	0.3	0.5	0.3	0.3	0.3	0.3

NOTE: Ride height for radial rings with protective foil is reduced by **0.1 mm**.

Installation by gluing

Use clearance fit for installation by gluing.

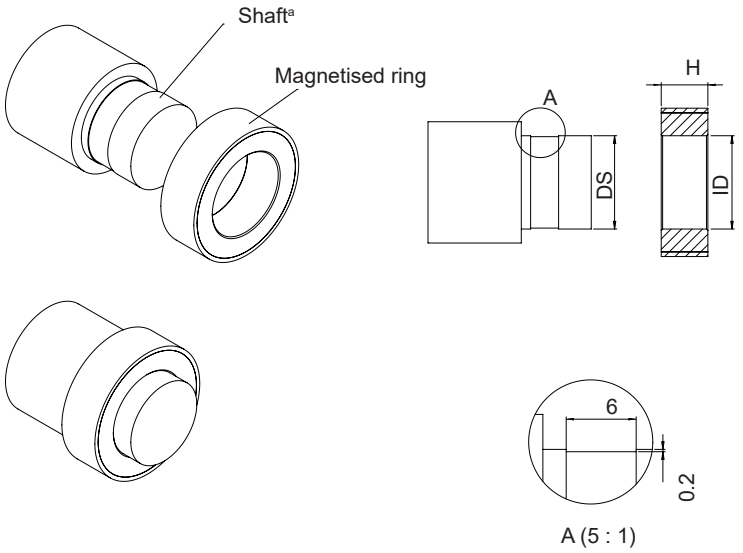
Application

The surfaces to be stuck together must be cleaned very thoroughly before the adhesive is applied. It is worth first using abrasive cloth (abrasive rating 150-200) then degreasing using cellulose moistened with a grease solvent.

The adhesive should be applied to the parts to be stuck together as soon as possible after mixing, to ensure the best possible bond. The parts to be assembled usually need to be fixed under pressure. It is not necessary to apply extreme pressure.

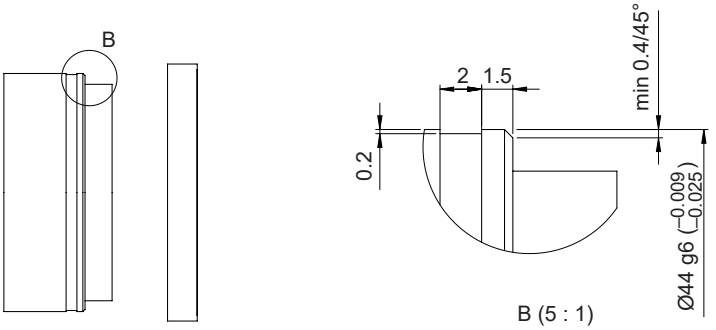
At temperatures below room temperature, the hardening process takes somewhat longer. After the parts to be stuck together have been prepared, the adhesive is dosed. The adhesive should be very thoroughly mixed. For more information see adhesive manufacturer's datasheet.

For all radial rings except MR047B and MR100F



[a] Not provided.

For ring MR047B



Installation by shrink-fi

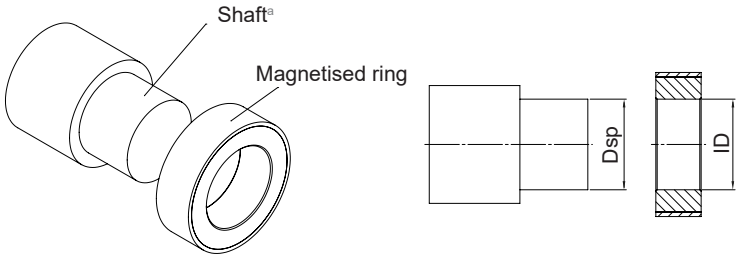
1) Heat the ring to 160 °C for 30 minutes.
2) Slip the ring onto the mating shaft.

For recommended shaft diameter (Dsp) see table on page 8.

Installation by press-fi

Press the ring onto the mating shaft applying equal or uniform force along the whole ring circumference. For recommended shaft diameter (Dsp) see table on page 8.

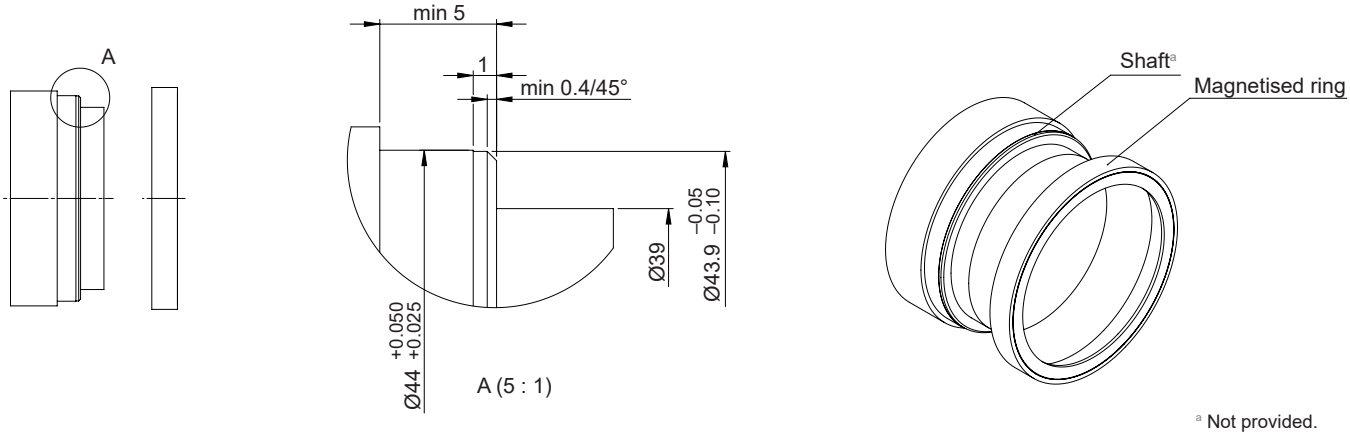
For all radial rings except MR047B and MR100F



[a] Not provided.

For ring MR047B

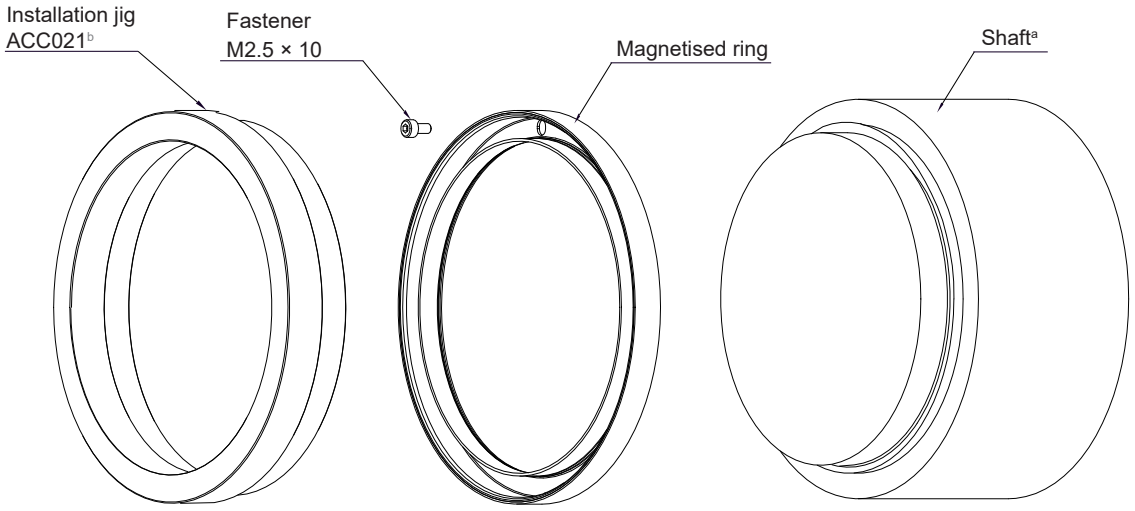
1. Slip the ring onto the mating shaft applying equal or uniform force along the whole ring circumference.



[a] Not provided.

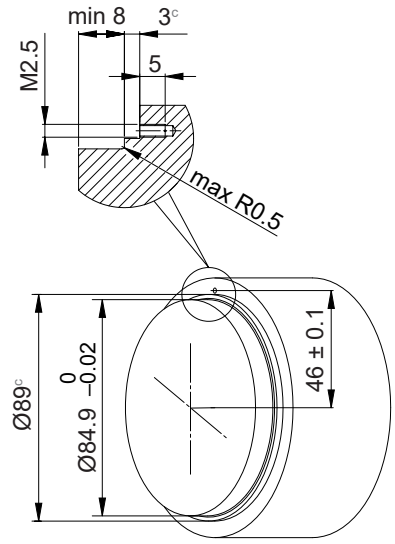
For ring MR100F

1. The inner diameter of the ring is slightly conical. Make sure that the ring is press fitted with the wider diameter first. Insert the M2.5 × 10 fastener.
2. Attach the ring by press fitting.
3. During press fitting equal pressure must be applied round the whole circumference. You may use the installation jig ACC021*.
4. Secure the ring by M2.5 × 10 fastener. Tightening torque 0.5 Nm should be applied.

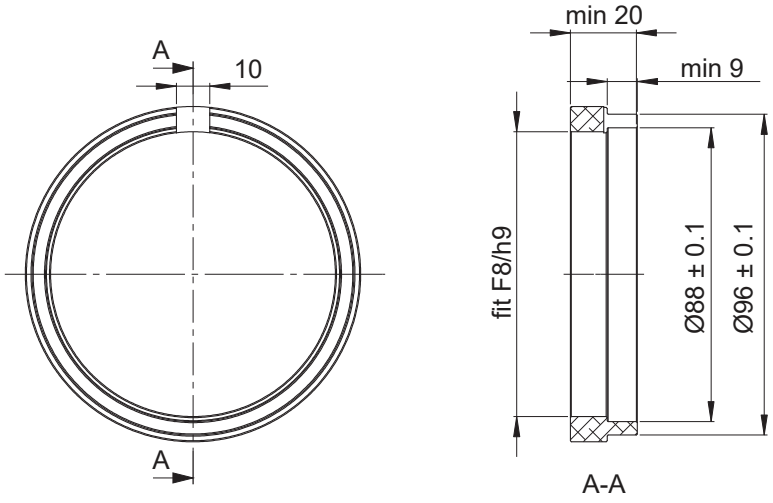


[a] Not provided.
[b] Ordered separately
(see Accessories part numbering).

Shaft dimensions



Installation jig ACC021 recommended[b]



[b] Ordered separately (see Accessories part numbering).

[c] Recommended for replacement purpose.

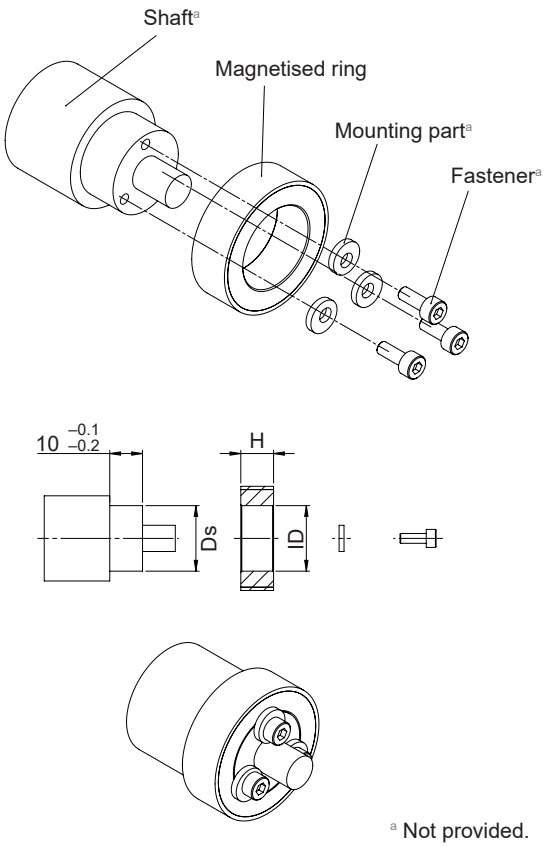
Installation with fasteners

Installation with fasteners is possible for ring **MR122E**. Use clearance fit for installation with fasteners. Make sure the installation surface is clean and free of debris. Rings need to be attached with fasteners as per installation drawings (see appropriate ring page).

Recommended tightening torque:

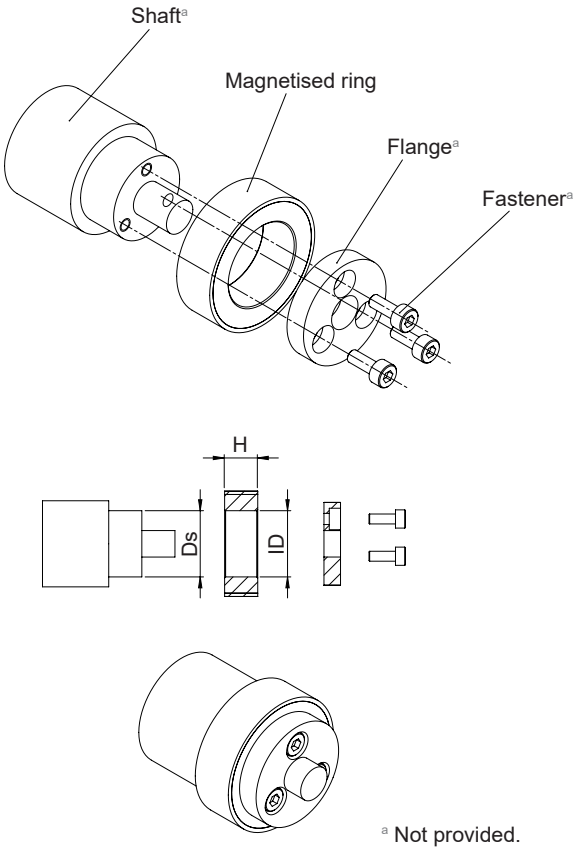
- fasteners M3: 1 Nm
- fasteners M6: 8 Nm

Variant A: Mounting part



[a] Not provided.

Variant B: Flange



[a] Not provided.

MR031G

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
50 poles, 2 mm pole length	Ri	Ri	-	No Ri	No Ri	Ri	Ri
20 poles, 5 mm pole length	-	-	Ri	-	-	-	-

Ri - Unique reference mark or only incremental track available
No Ri - No reference mark option, only incremental track available

Technical features

Pole length	2 mm	5 mm
Number of poles	50	20
System error	±0.16°	±0.50°[a] ±1.00°[b]
Outer diameter	31.0 ± 0.1 mm[c] 31.2 ± 0.1 mm[d]	31.85 ± 0.1 mm[c] 32.05 ± 0.1 mm[d]
Moment of inertia	4.12 × 10^{-6} kgm²	4.37 × 10^{-6} kgm²
Mass	24 g	26 g

Inner diameter	20 H7 mm
Height	8 ± 0.1 mm
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

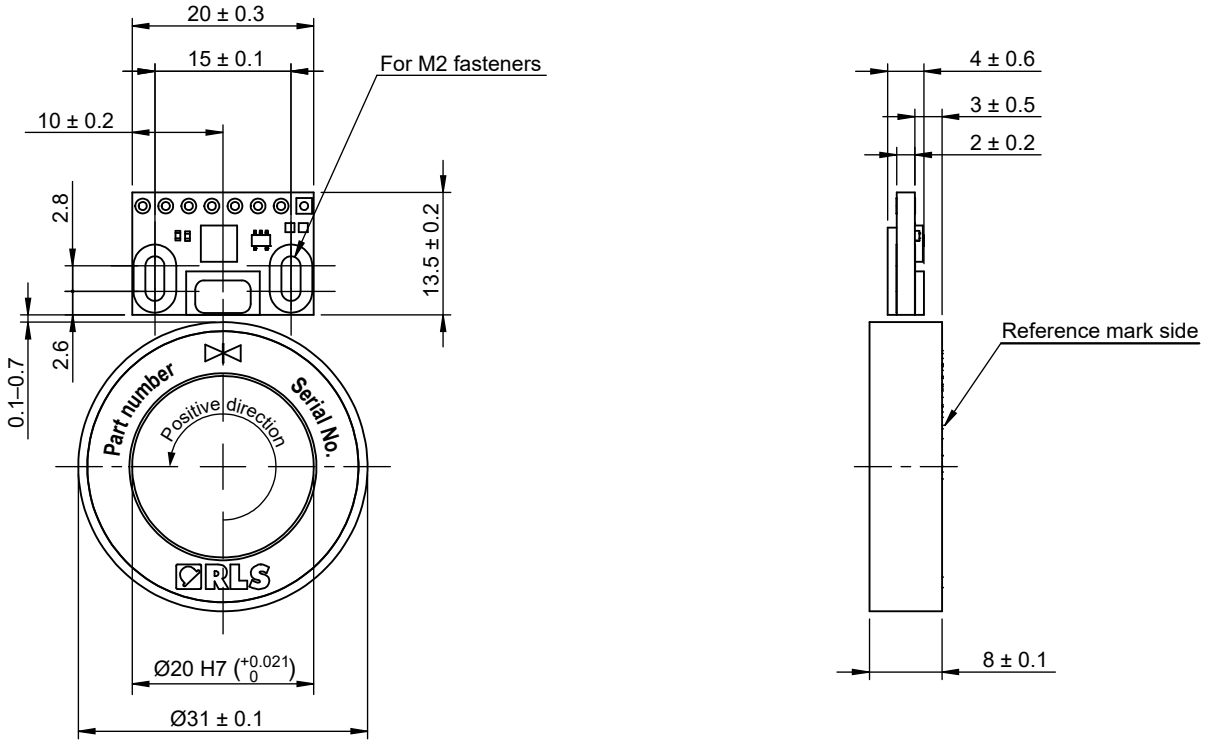
[a] 1 mm ride height
[b] 2.5 mm ride height
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

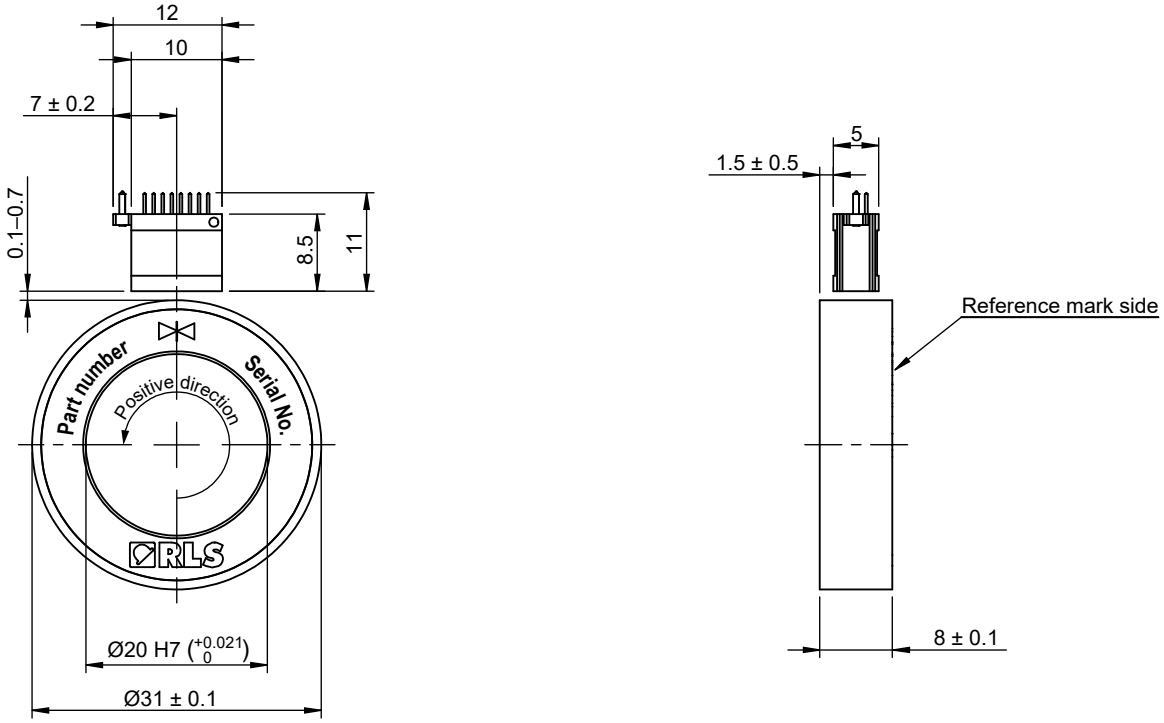
RLC2IC



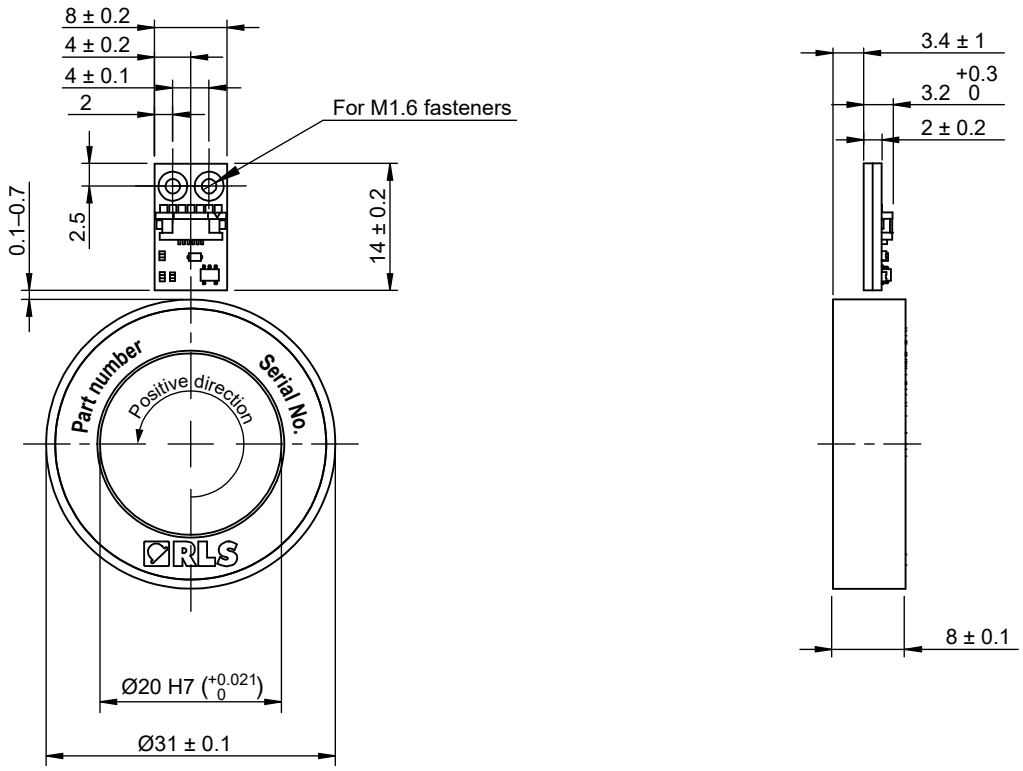
MR031G

Outer diameter: 31.0 ± 0.1 mm /
31.85 ± 0.1 mm
Inner diameter: 20 H7 mm
Number of poles: 50 / 20

RLM



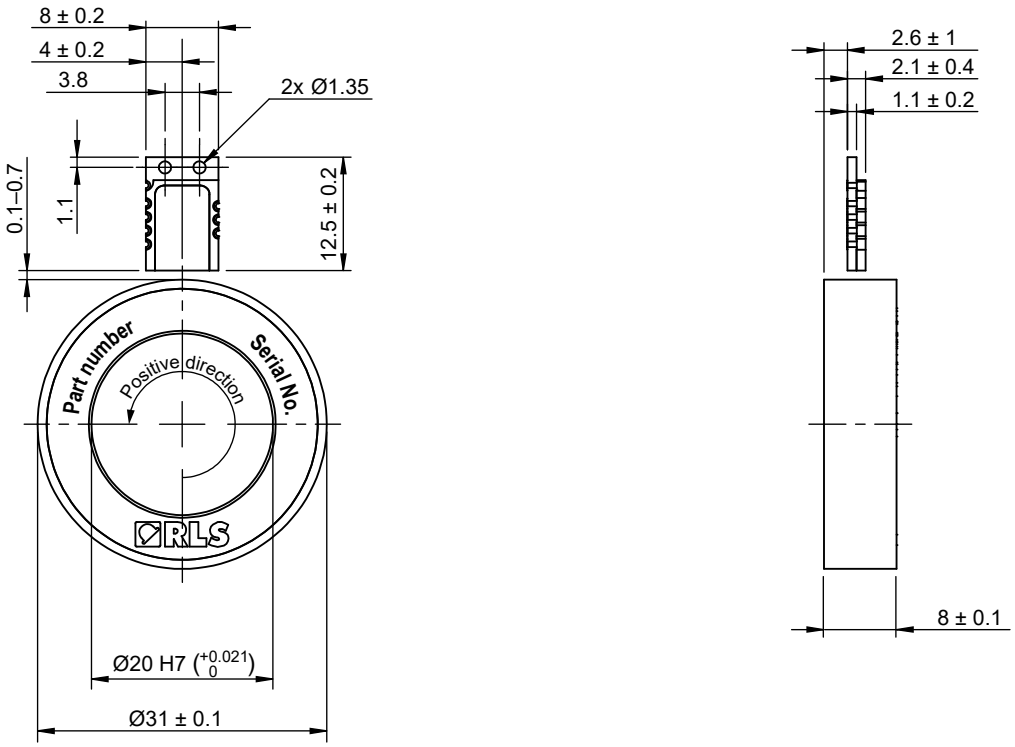
RLB



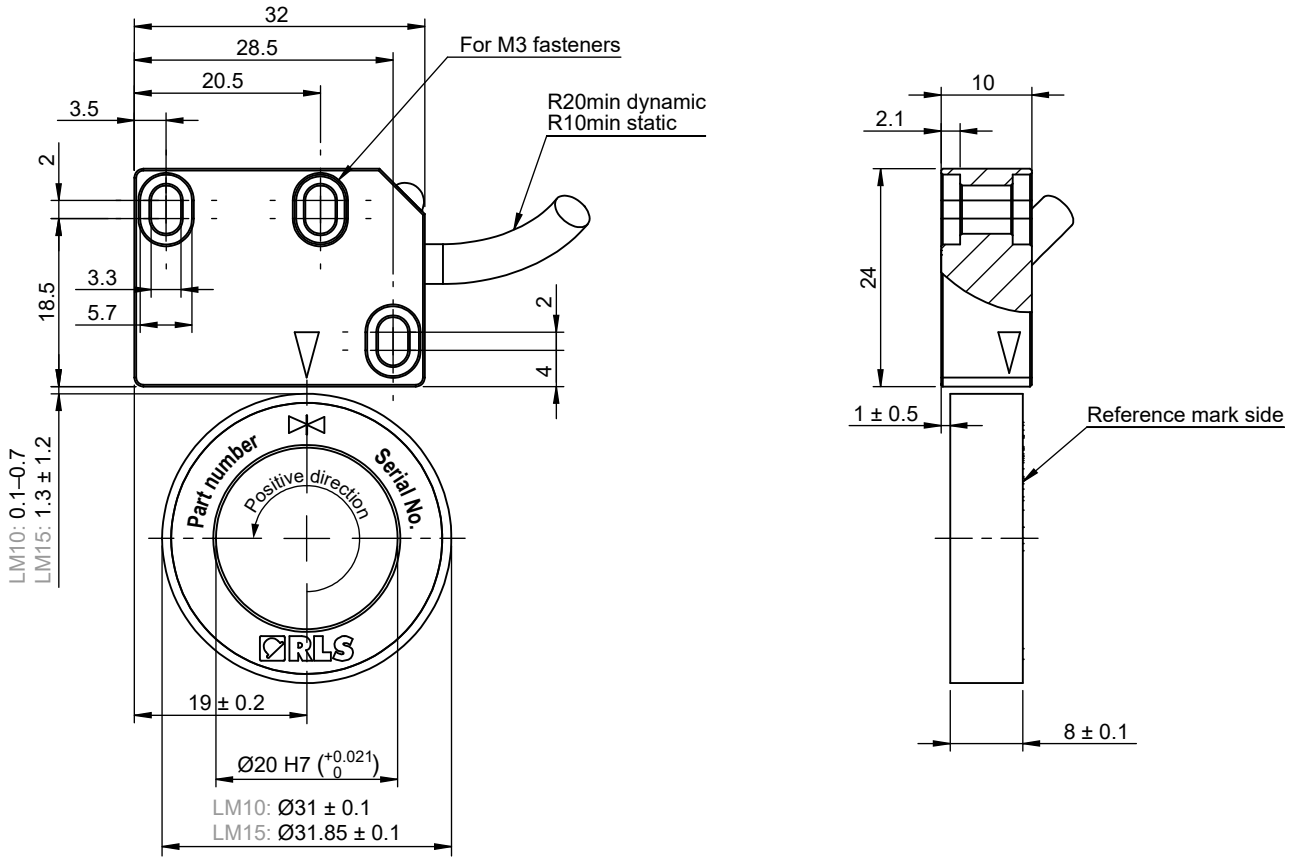
MR031G

Outer diameter: 31.0 ± 0.1 mm /
31.85 ± 0.1 mm
Inner diameter: 20 H7 mm
Number of poles: 50 / 20

RLC2HD



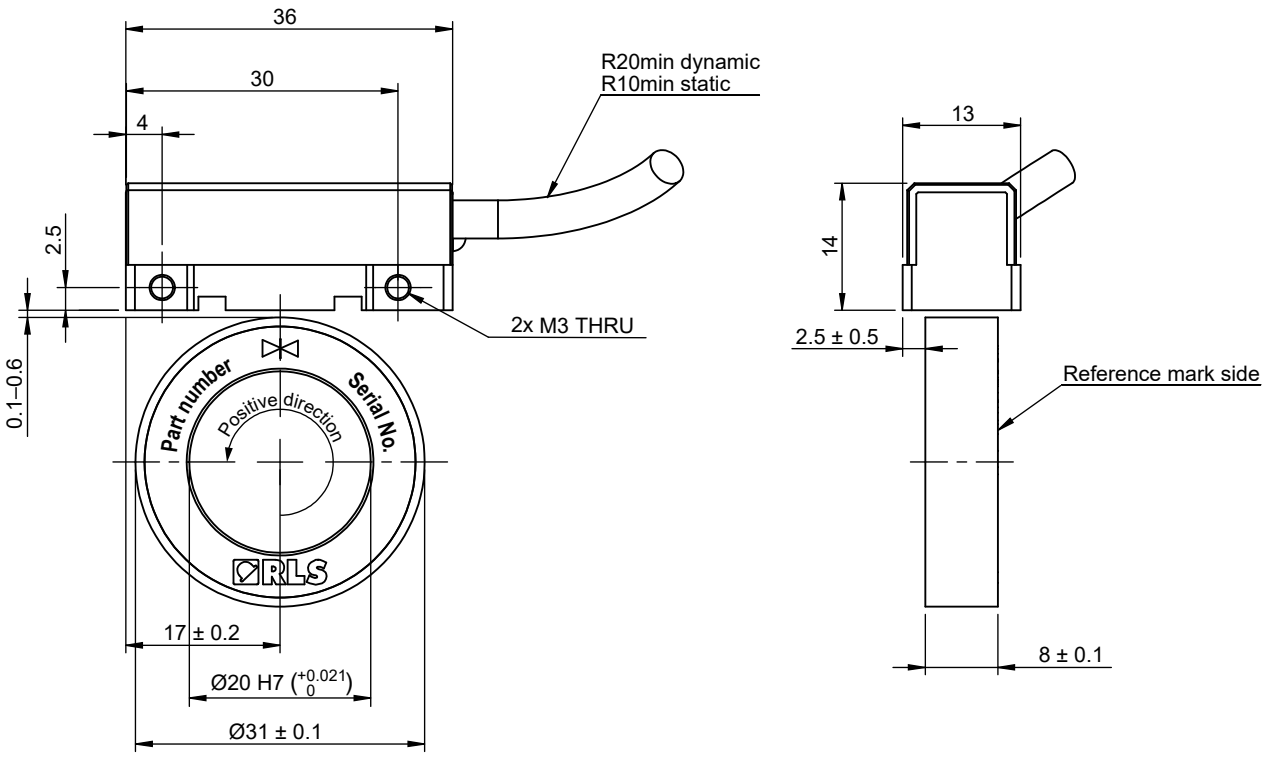
LM10/15



MR031G

Outer diameter: 31.0 ± 0.1 mm / 31.85 ± 0.1 mm
Inner diameter: 20 H7 mm
Number of poles: 50 / 20

LM13

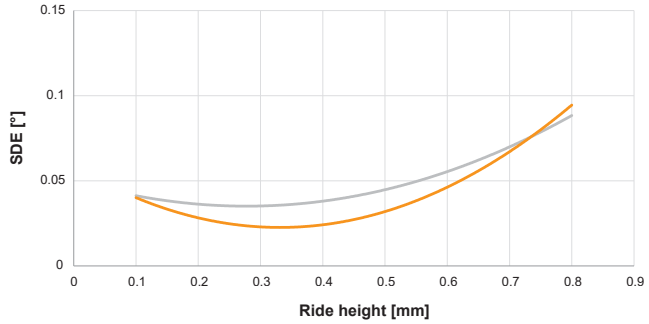


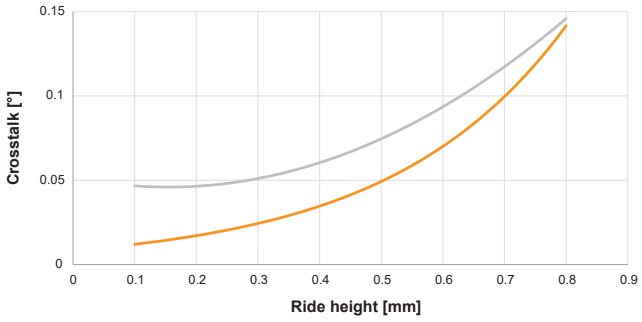
SDE and crosstalk error

(typical measured value)

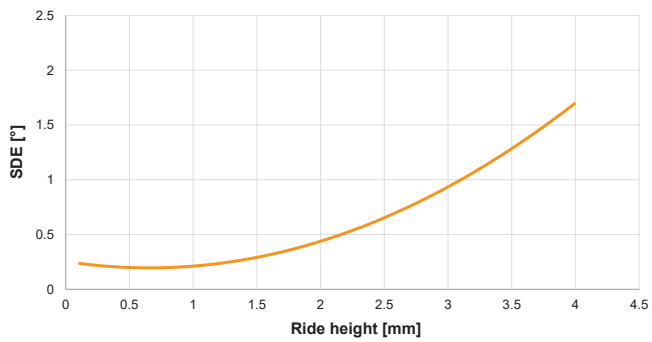
Legend
- LM
- RoLin

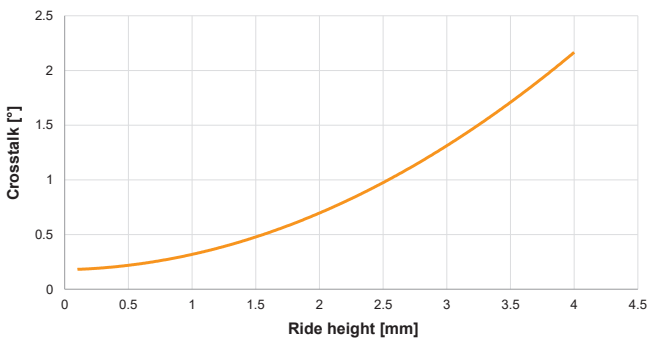
50 poles, 2 mm width





20 poles, 5 mm width





MR040G

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
64 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM
26 poles, 5 mm pole length	-	-	Ri	-	-	-	-

Ri - Unique reference mark or only incremental track available
No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Pole length	2 mm	5 mm
Number of poles	64	26
Basic increment of distance coded reference mark	32 mm / 90°	-
System error	±0.13°	±0.40°[a] ±0.80°[b]
Outer diameter	40.0 ± 0.1 mm[c] 40.2 ± 0.1 mm[d]	40.7 ± 0.1 mm[c] 40.9 ± 0.1 mm[d]
Moment of inertia	9.54 × 10^{-6} kgm²	1.01 × 10^{-5} kgm²
Mass	30 g	32 g

Inner diameter	30 H7 mm
Height	8 ± 0.1 mm
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

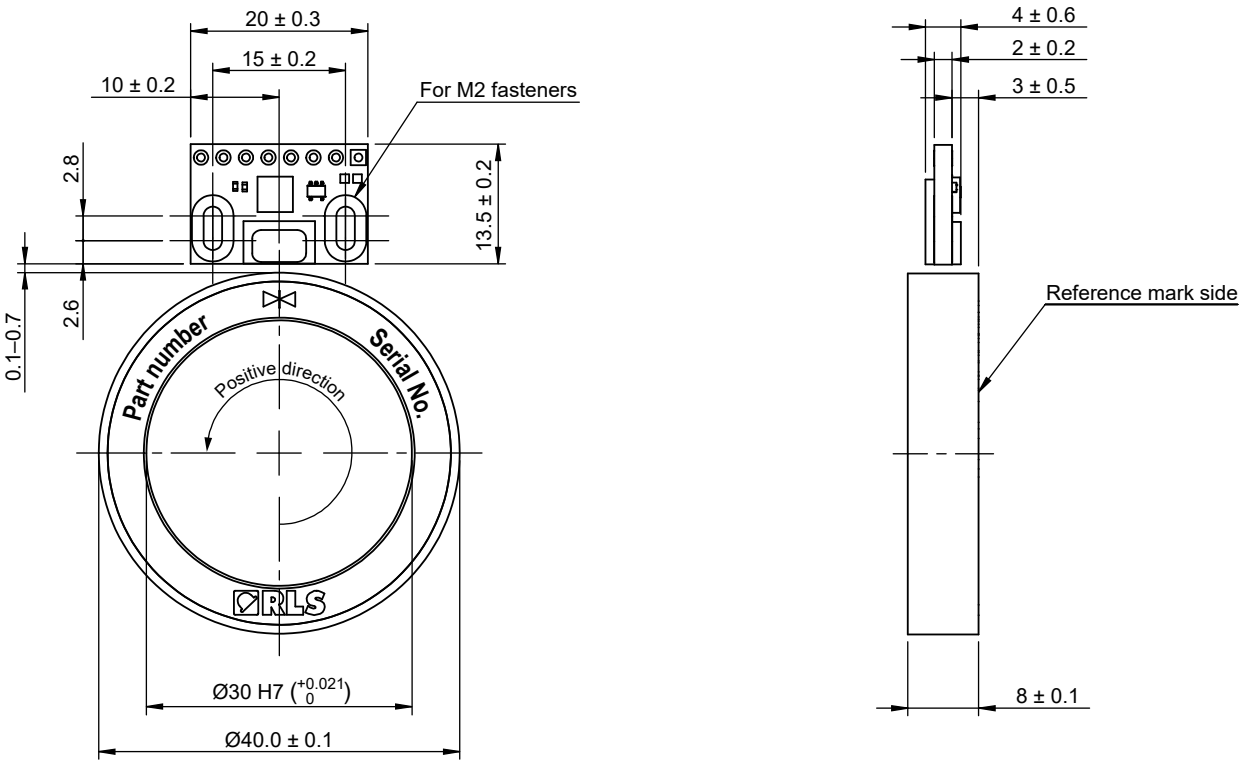
[a] 1 mm ride height
[b] 2.5 mm ride height
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

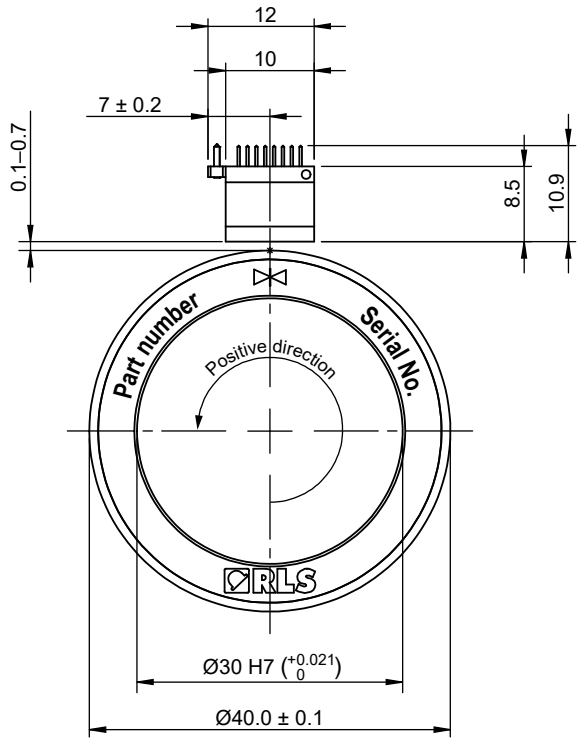
RLC2IC

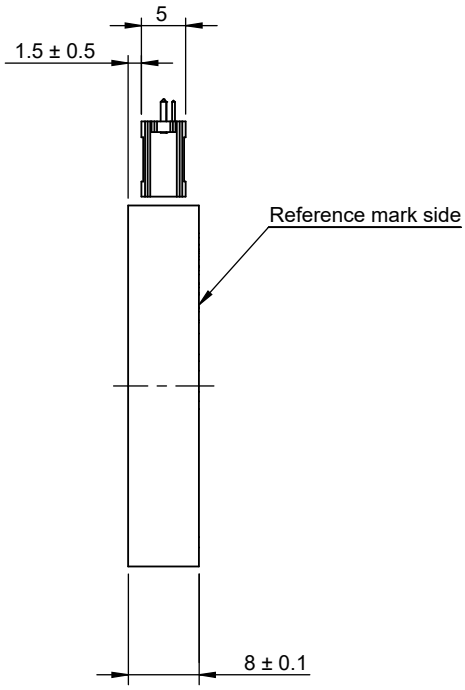


MR040G

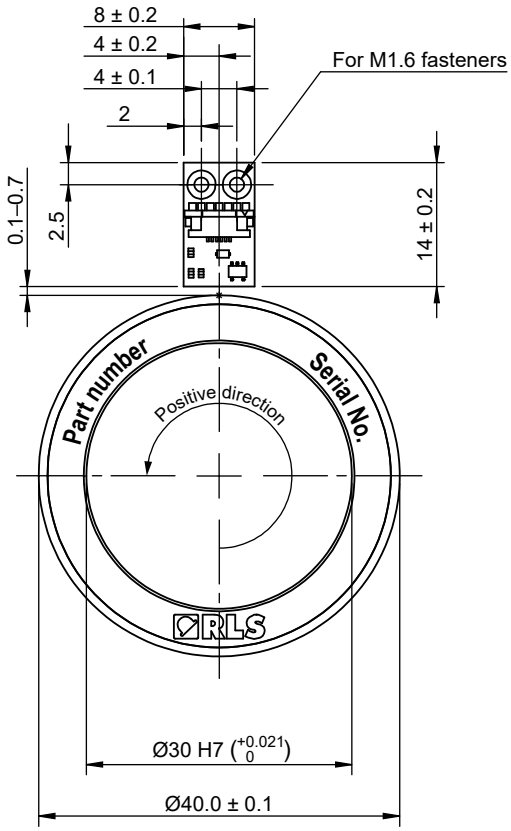
Outer diameter: 40.0 ± 0.1 mm /
40.7 ± 0.1 mm
Inner diameter: 30 H7 mm
Number of poles: 64 / 26

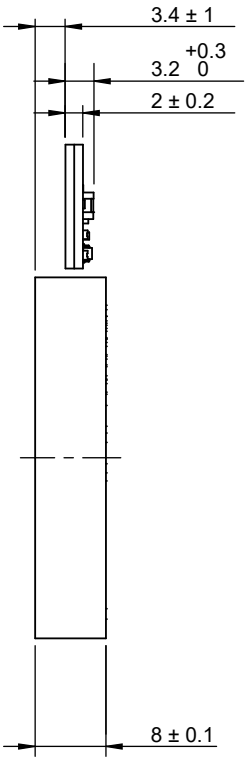
RLM





RLB

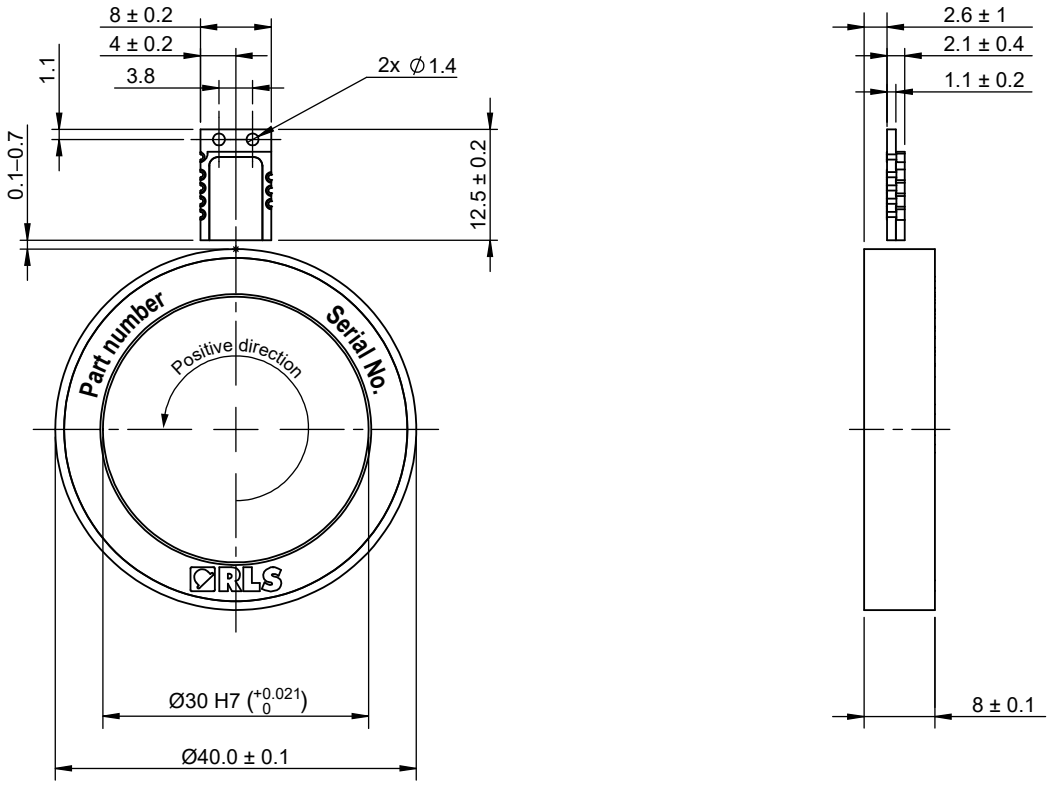




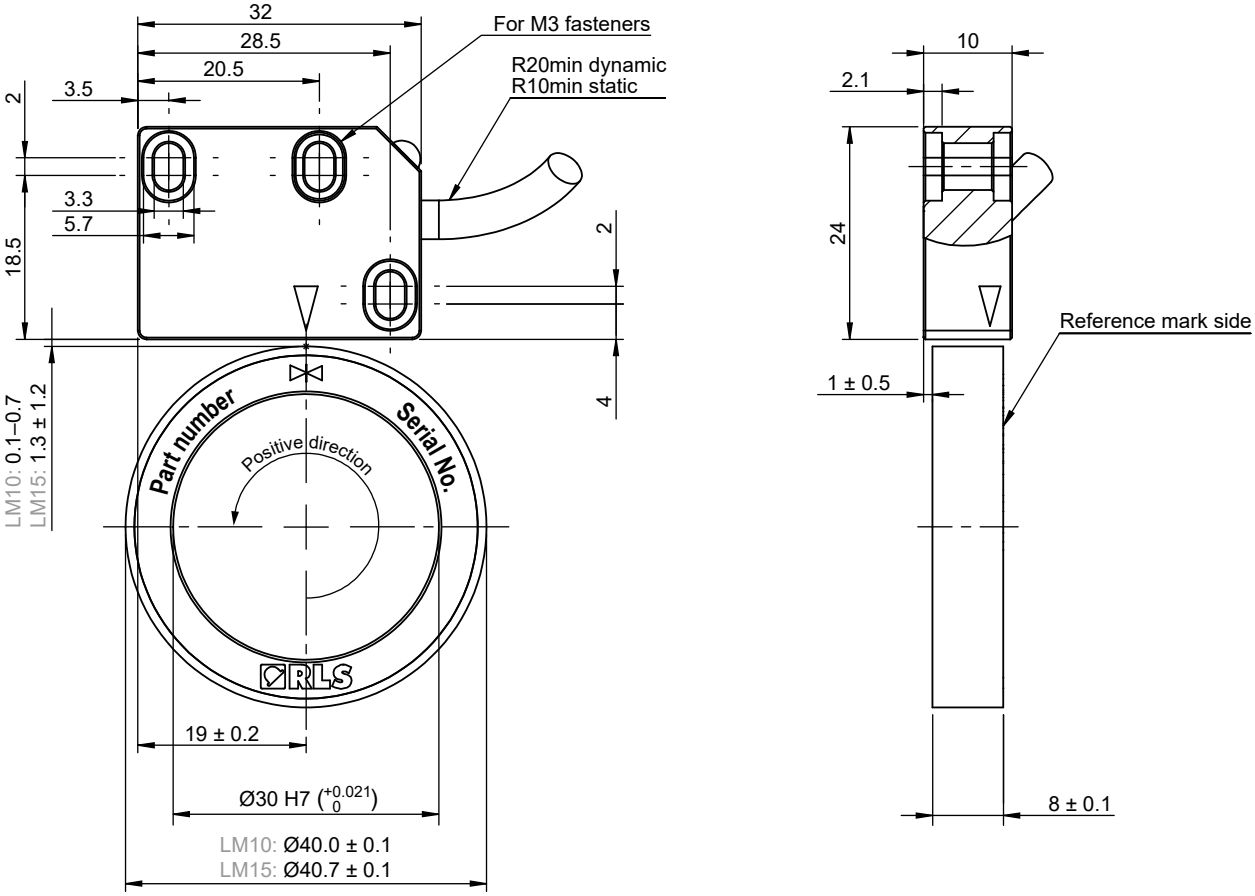
MR040G

Outer diameter: 40.0 ± 0.1 mm /
40.7 ± 0.1 mm
Inner diameter: 30 H7 mm
Number of poles: 64 / 26

RLC2HD



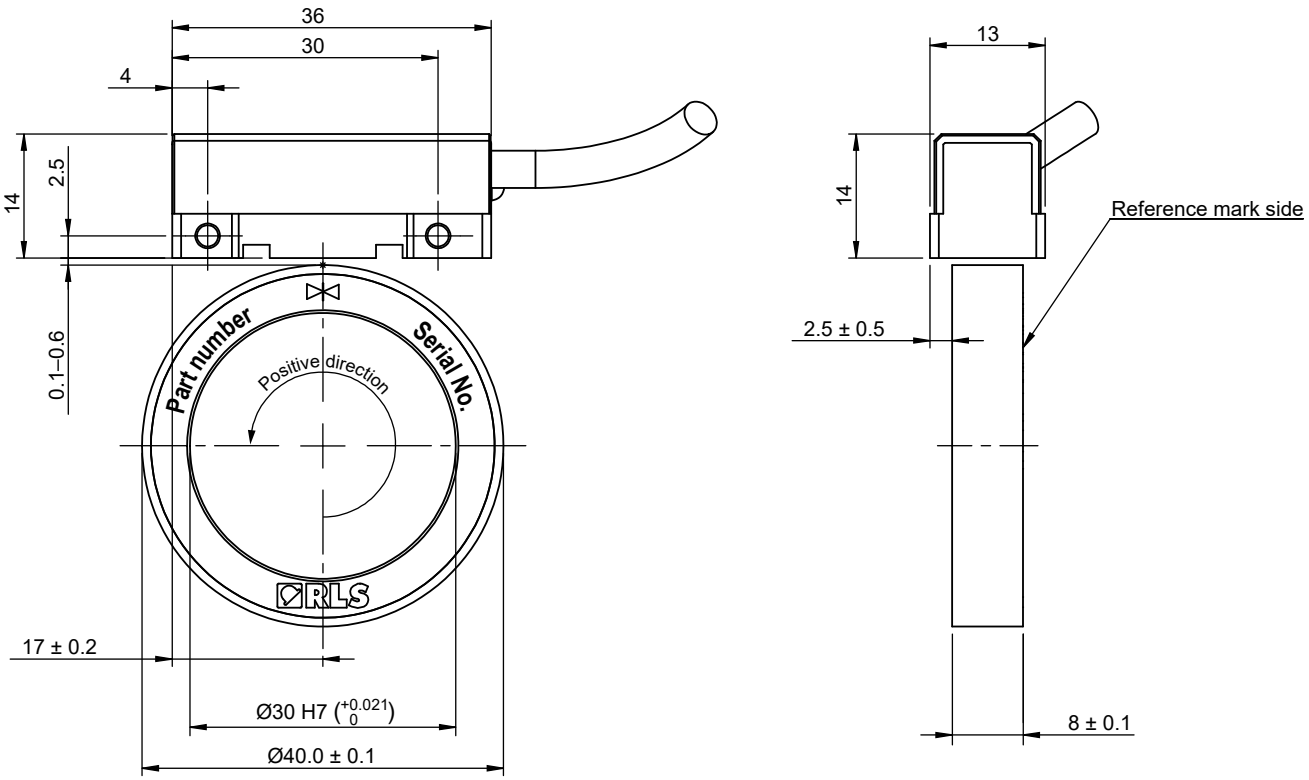
LM10/15



MR040G

Outer diameter: 40.0 ± 0.1 mm / 40.7 ± 0.1 mm
Inner diameter: 30 H7 mm
Number of poles: 64 / 26

LM13

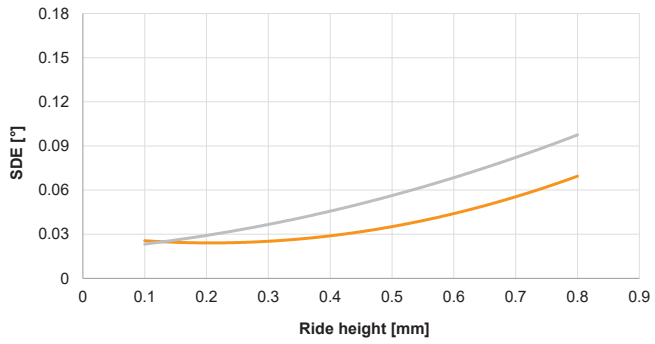


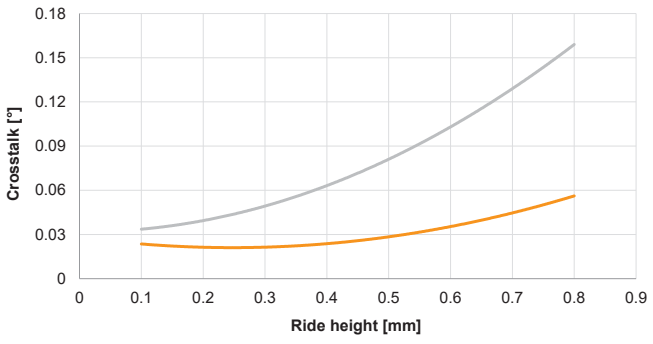
SDE and crosstalk error

(typical measured value)

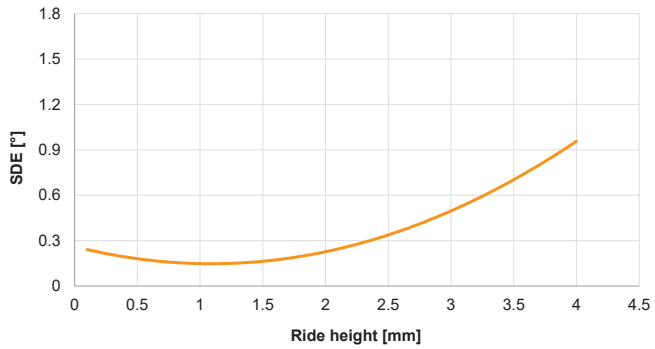
Legend
- LM
- RoLin

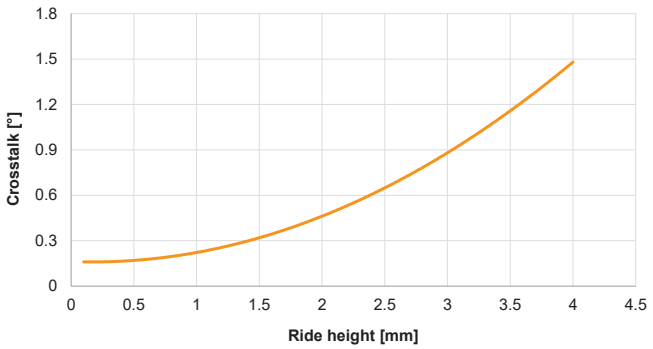
64 poles, 2 mm width





26 poles, 5 mm width





MR047B

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
76 poles, 2 mm pole length	No Ri	No Ri	-	No Ri	No Ri	Ri	Ri

Ri - Unique reference mark or only incremental track available
No Ri - No reference mark option, only incremental track available

Technical features

Outer diameter	47.5 ± 0.1 mm
Inner diameter	40 ± 0.1 mm
Installation diameter	44 ± 0.02 mm
Height	5.5 ± 0.1 mm
Mass	8 g
Moment of inertia	4.31 × 10^{-6} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4016 / AISI 430
Hub thermal expansion coefficient (CT	10 × 10^{-6} K^{-1}
Protective foil option	No

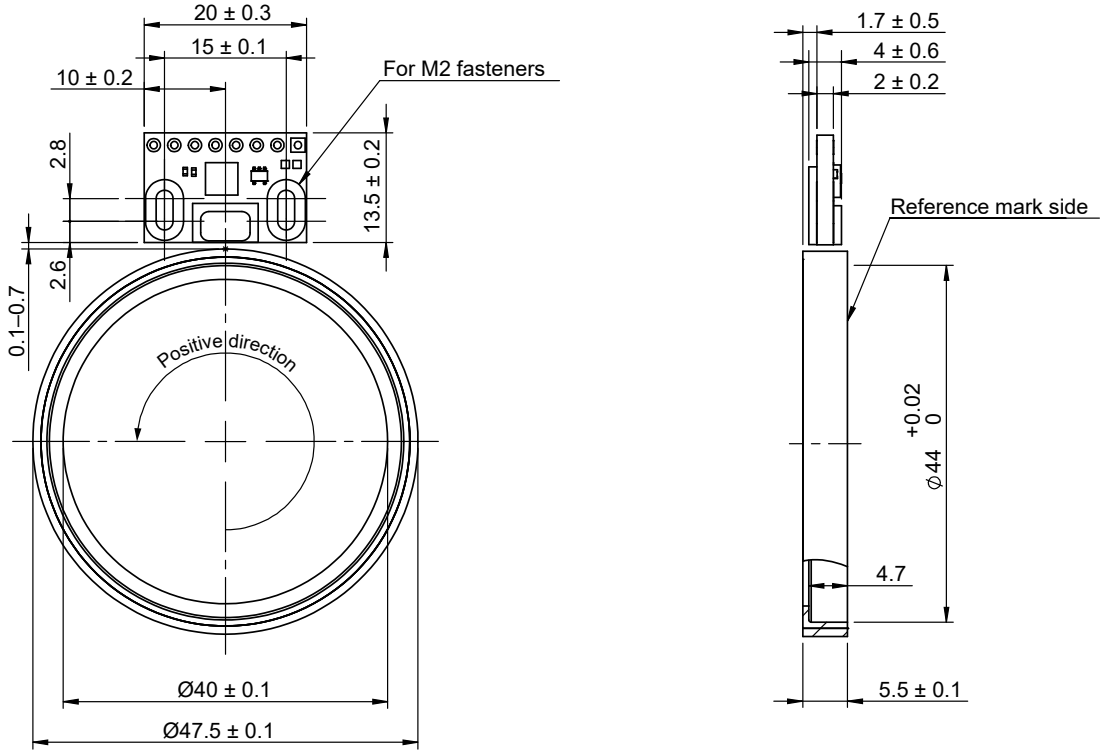
Pole length	2 mm
Number of poles	76
System error	±0.11°

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

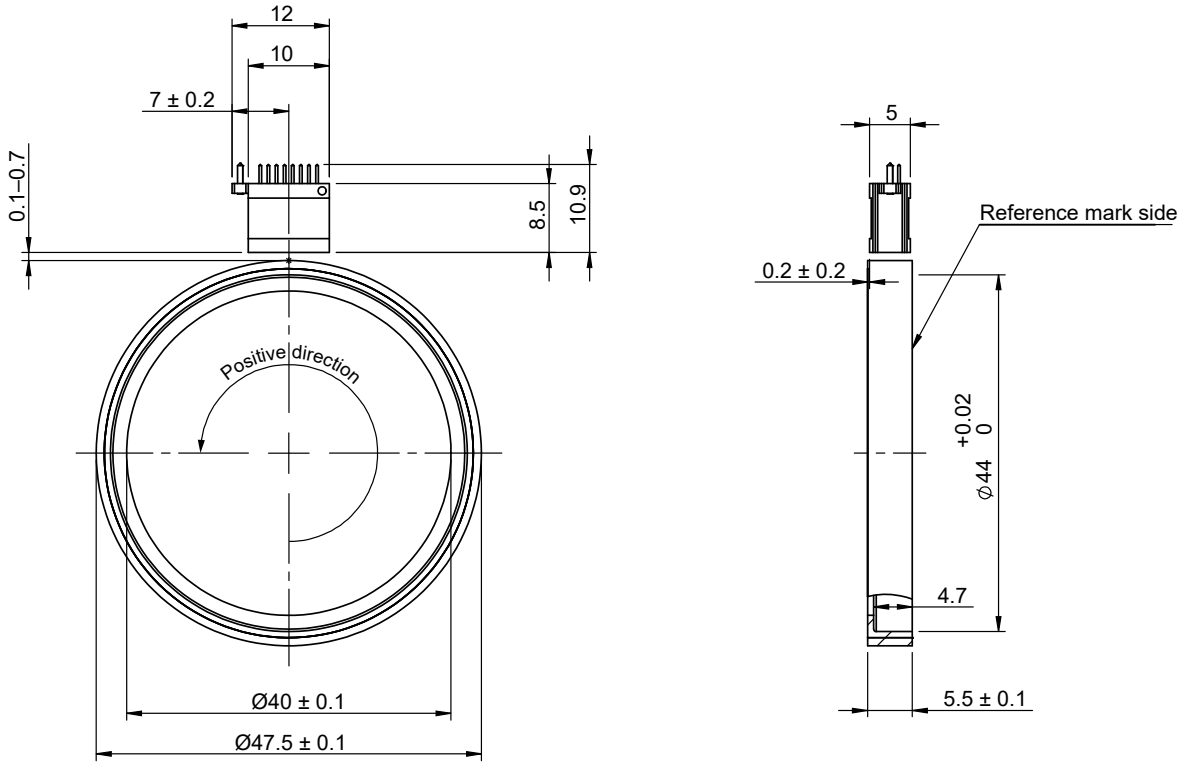
RLC2IC



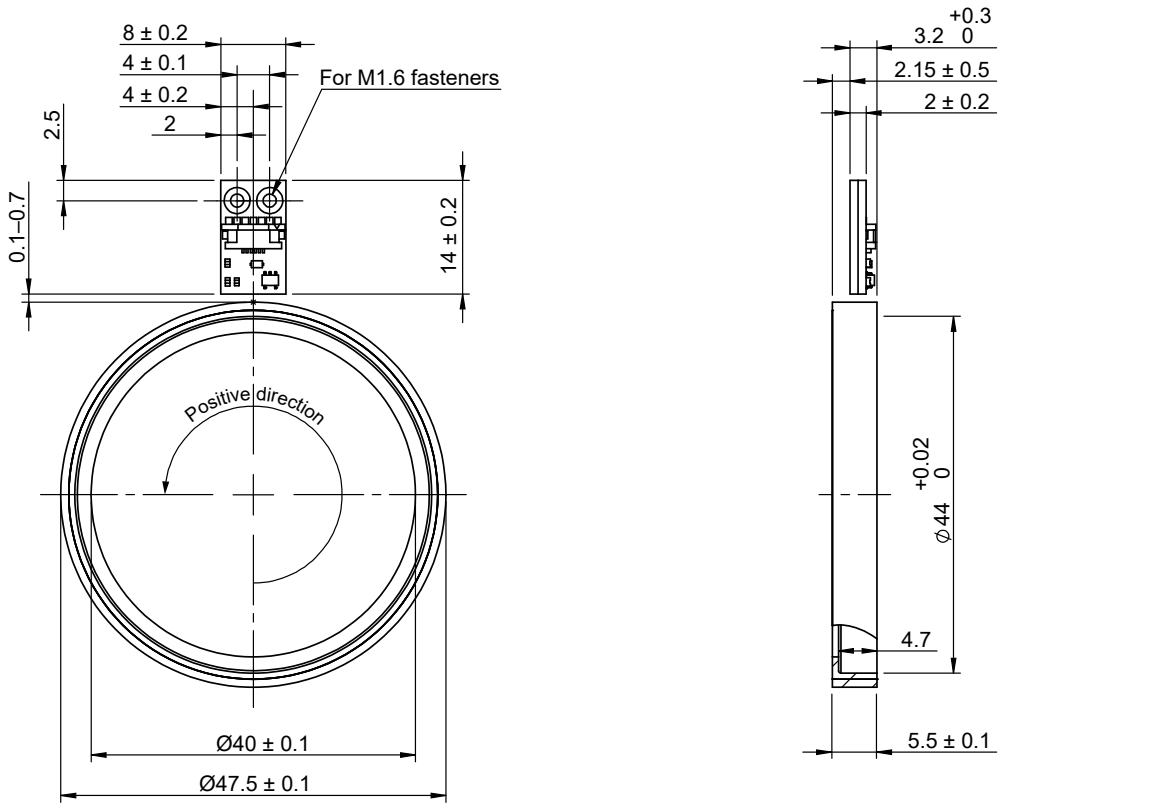
MR047B

Outer diameter: 47.5 ± 0.1 mm
Inner diameter: 40 ± 0.1 mm
Number of poles: 76

RLM



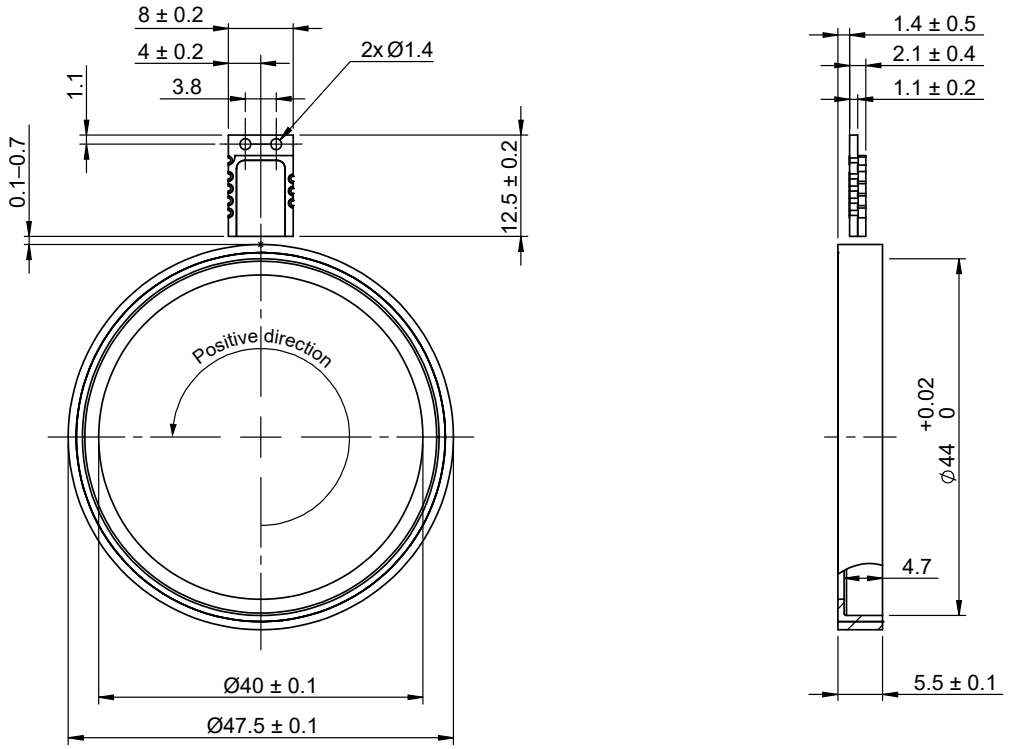
RLB



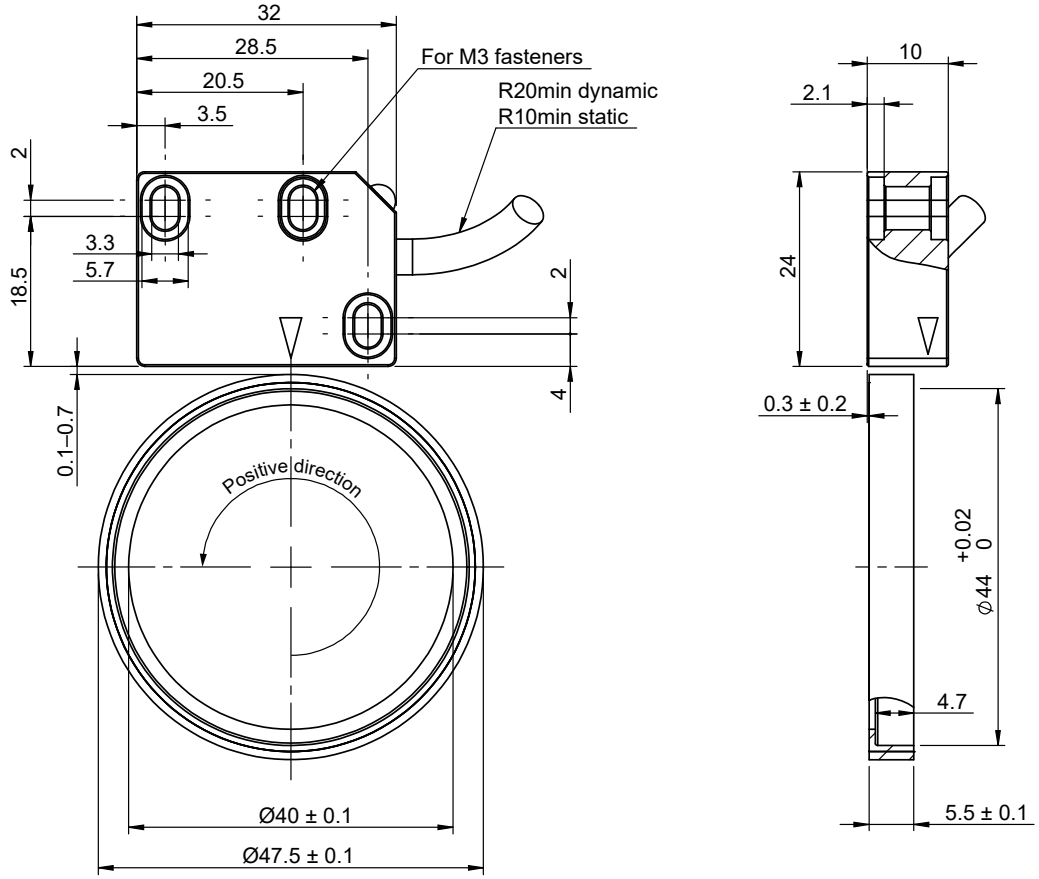
MR047B

Outer diameter: 47.5 ± 0.1 mm
Inner diameter: 40 ± 0.1 mm
Number of poles: 76

RLC2HD



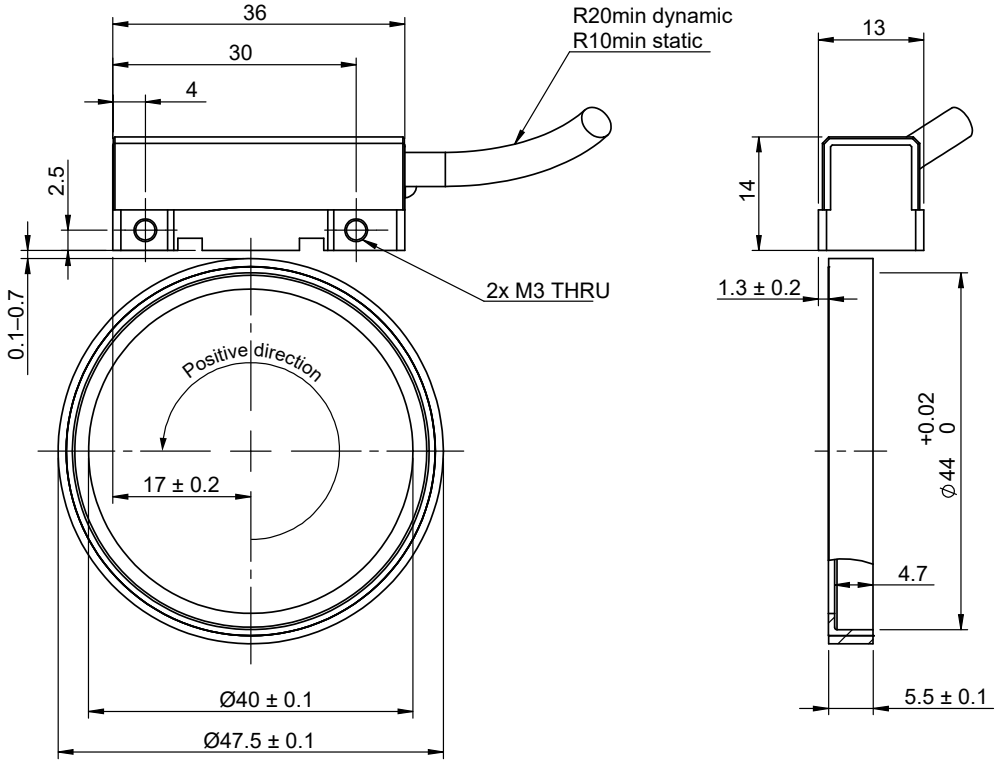
LM10



MR047B

Outer diameter: 47.5 ± 0.1 mm
Inner diameter: 40 ± 0.1 mm
Number of poles: 76

LM13

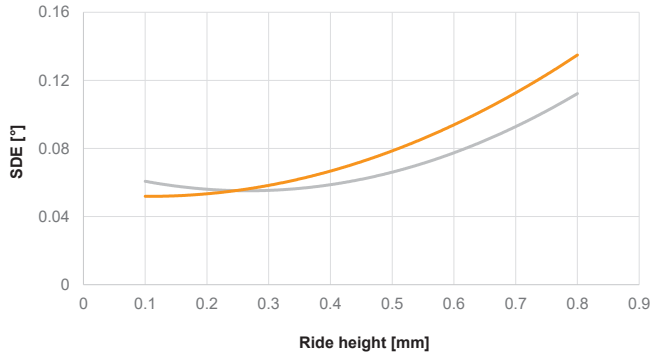


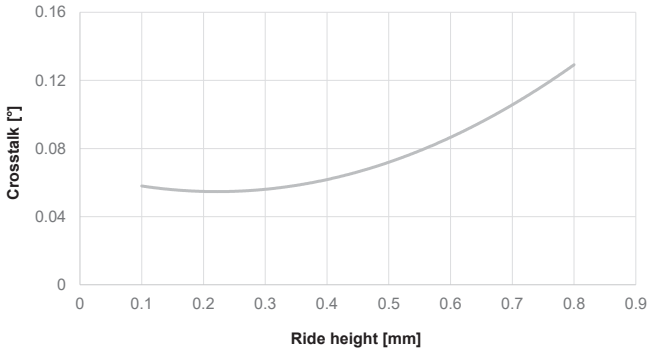
SDE and crosstalk error

(typical measured value)

Legend
- LM
- RoLin

76 poles, 2 mm width





MR050E

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
80 poles, 2 mm pole length	Ri	Ri	-	No Ri	No Ri	Ri	Ri
32 poles, 5 mm pole length	-	-	Ri	-	-	-	-

Ri - Unique reference mark or only incremental track available
No Ri - No reference mark option, only incremental track available

Technical features

Outer diameter	50.1 ± 0.1 mm[c] 50.3 ± 0.1 mm[d]
Inner diameter	40 H7 mm
Height	10 ± 0.1 mm
Mass	47 g
Moment of inertia	2.43 × 10^{-5} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

Pole length	2 mm	5 mm
Number of poles	80	32
System error	±0.10°	±0.30°[a] ±0.60°[b]

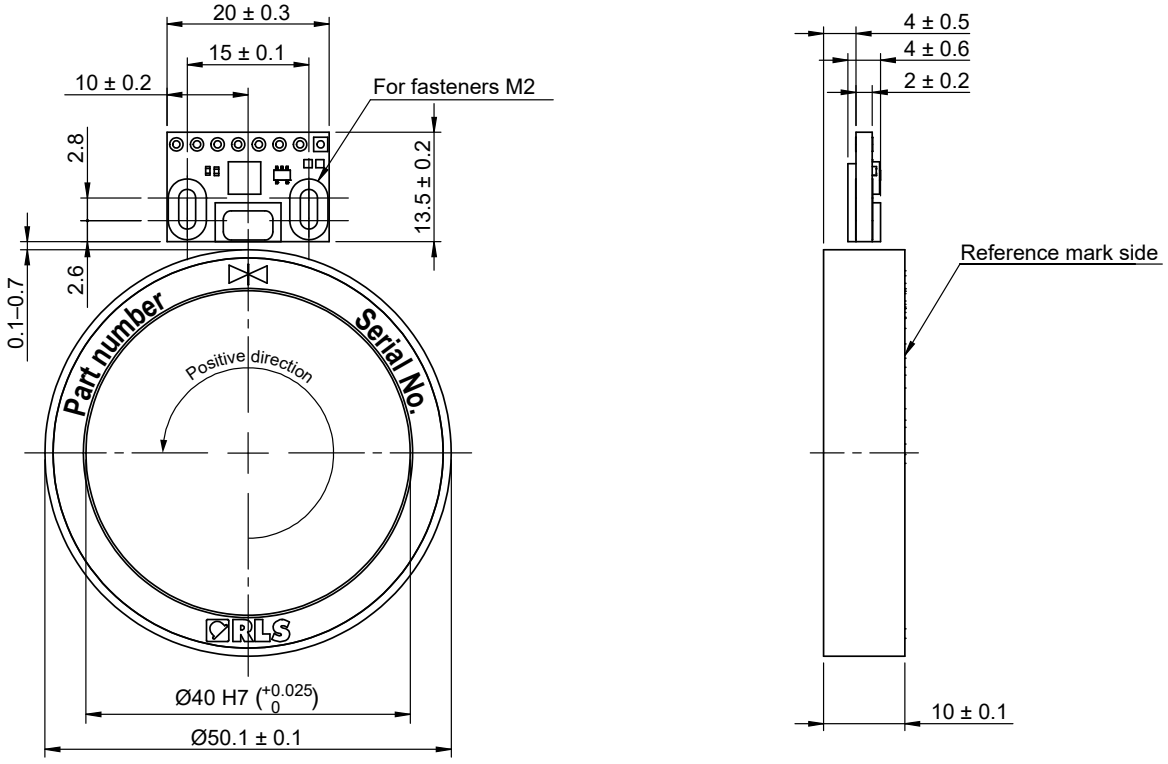
[a] 1 mm ride height
[b] 2.5 mm ride height
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

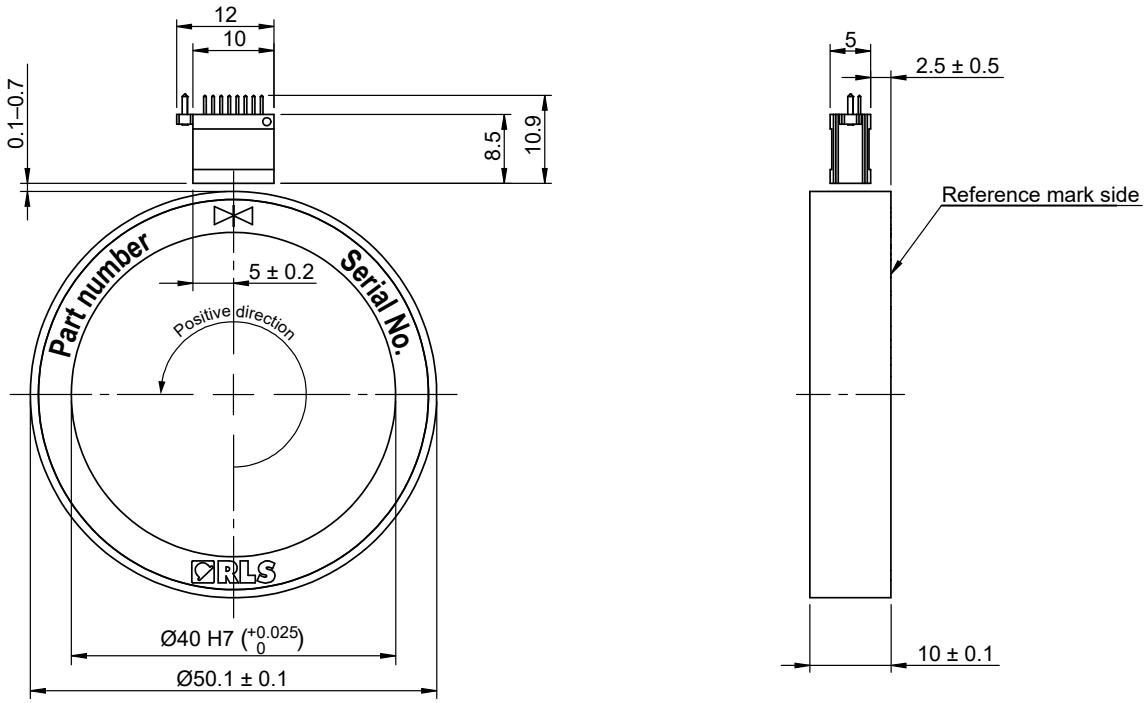
RLC2IC



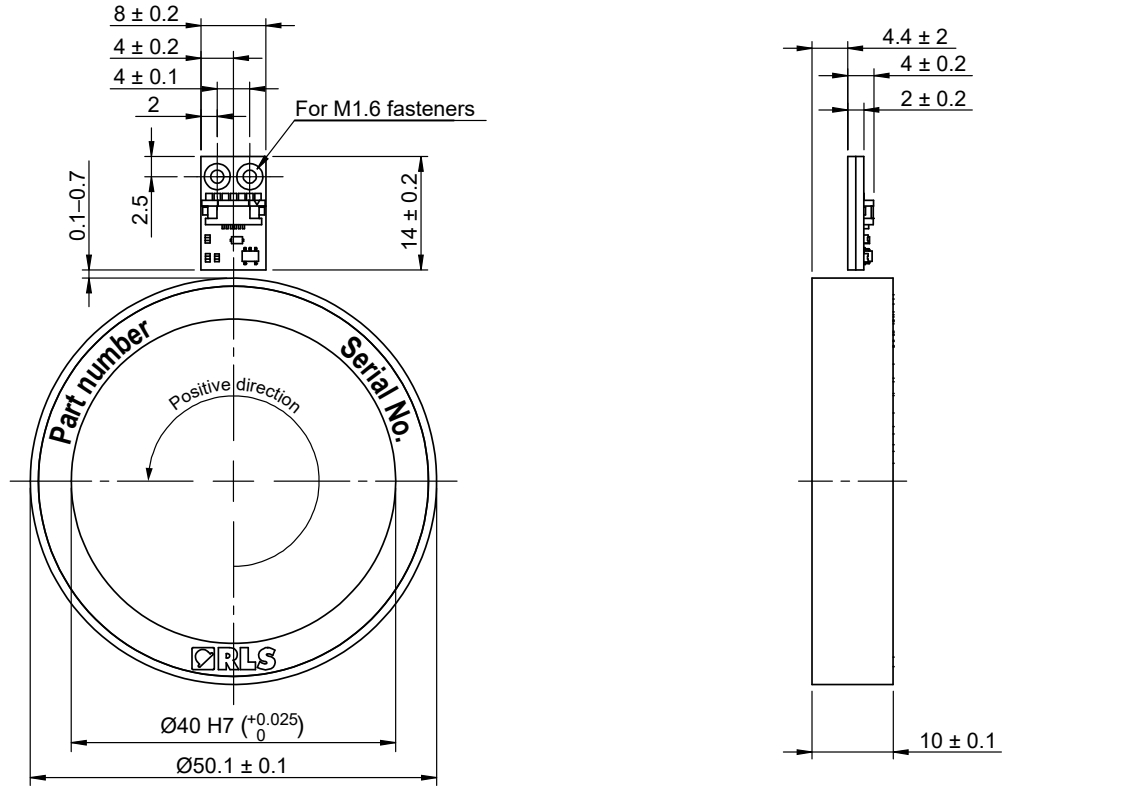
MR050E

Outer diameter: 50.1 ± 0.1 mm
Inner diameter: 40 H7 mm
Number of poles: 80 / 32

RLM



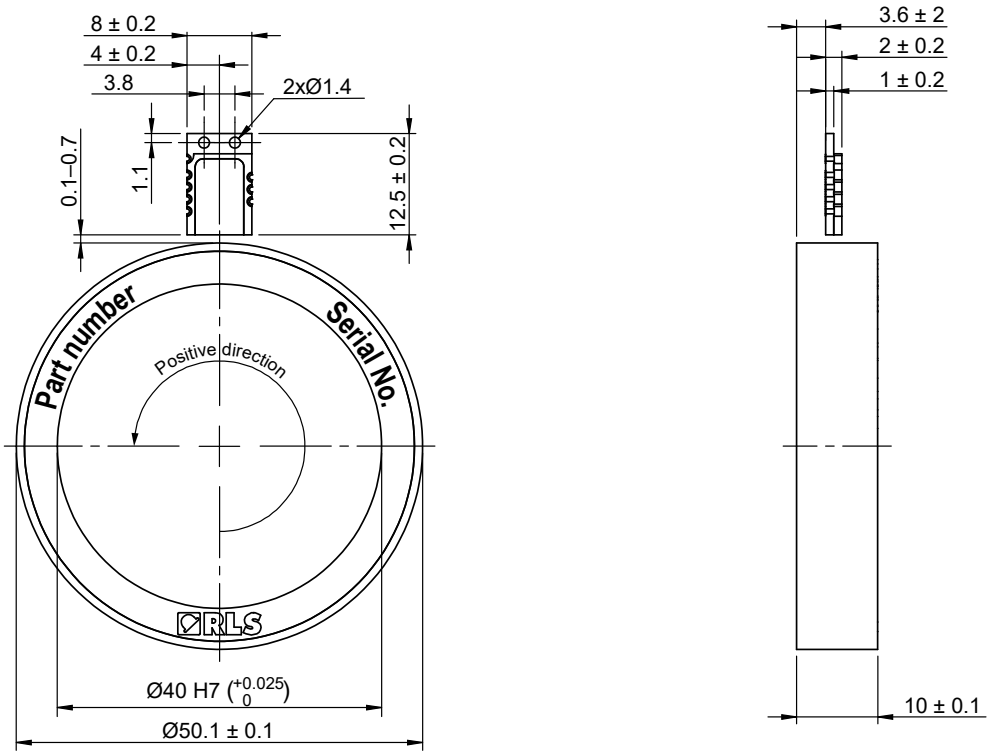
RLB



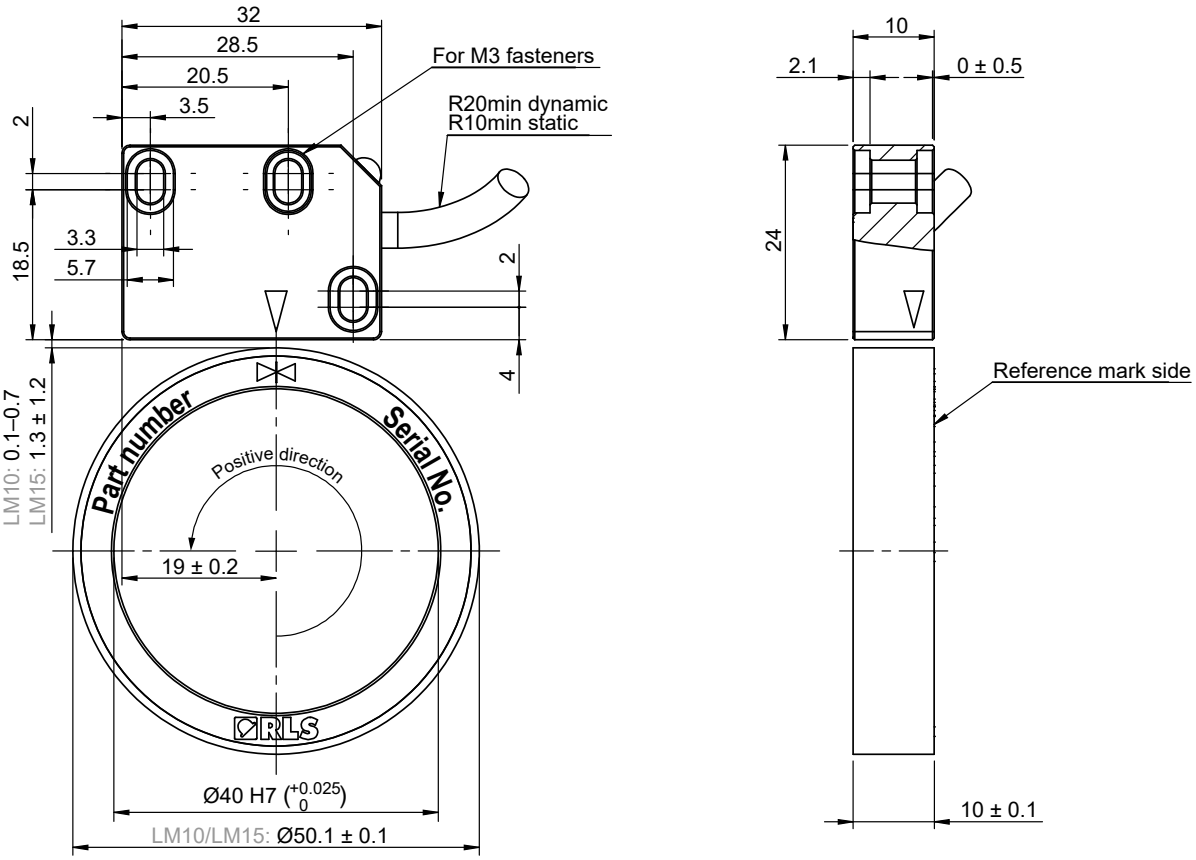
MR050E

Outer diameter: 50.1 ± 0.1 mm
Inner diameter: 40 H7 mm
Number of poles: 80 / 32

RLC2HD



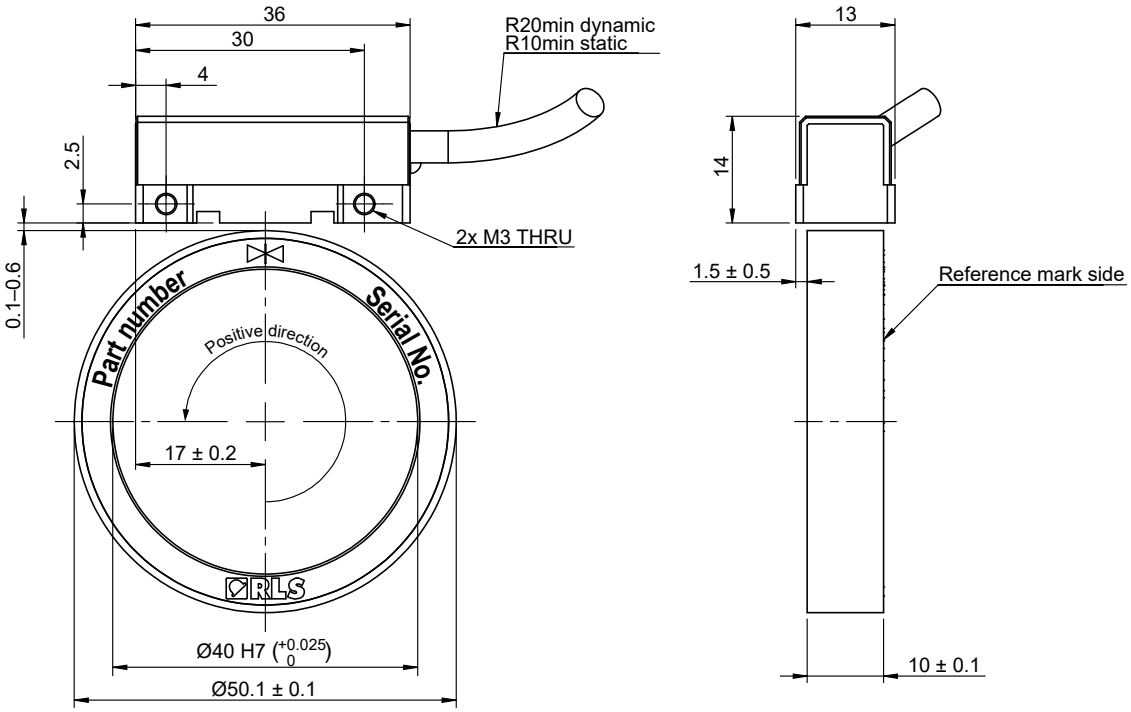
LM10/15



MR050E

Outer diameter: 50.1 ± 0.1 mm
Inner diameter: 40 H7 mm
Number of poles: 80 / 32

LM13

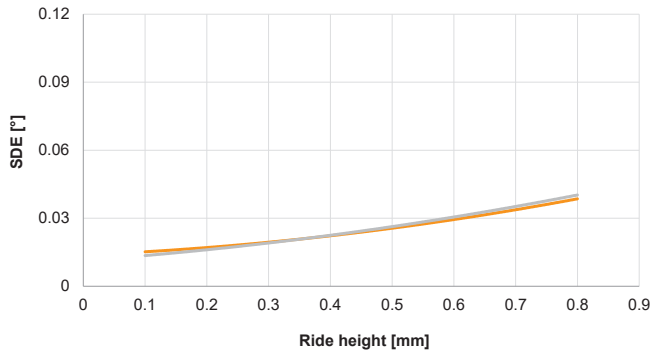


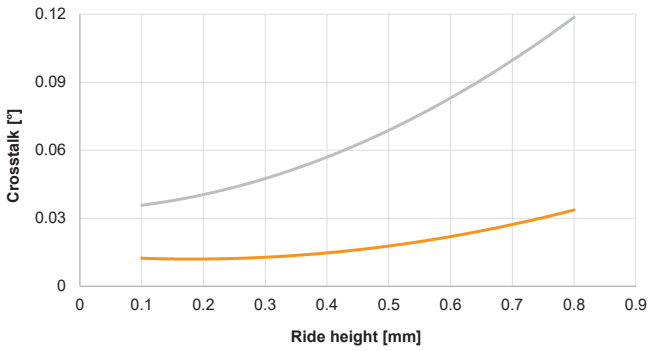
SDE and crosstalk error

(typical measured value)

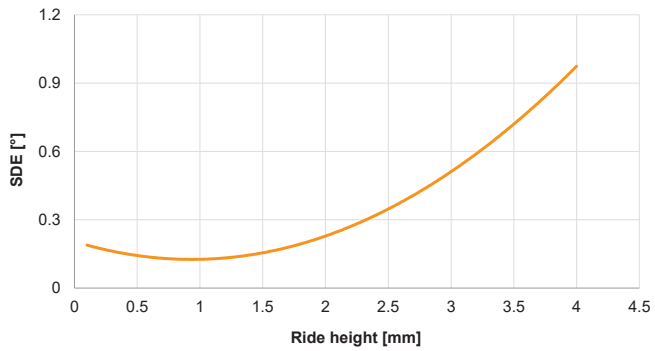
Legend
- LM
- RoLin

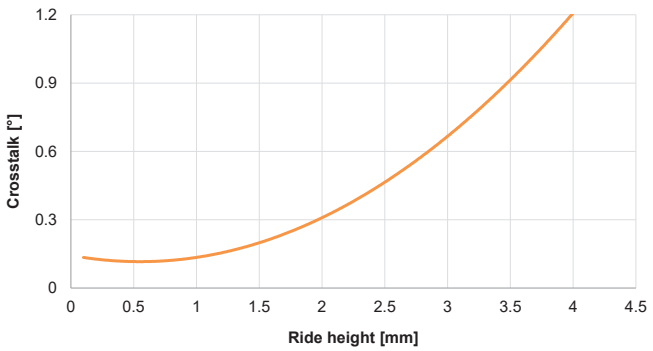
80 poles, 2 mm width





32 poles, 5 mm width





MR057E

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
90 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM
36 poles, 5 mm pole length	-	-	Ri+DCRM	-	-	-	-

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Pole length	2 mm	5 mm
Number of poles	90	36
Basic increment of distance coded reference mark	36 mm / 72°	60 mm / 120°
System error	±0.09°	±0.28°[a] ±0.56°[b]
Outer diameter	56.5 ± 0.1 mm[c] 56.7 ± 0.1 mm[d]	57.3 ± 0.1 mm[c] 57.5 ± 0.1 mm[d]
Moment of inertia	4.26 × 10^{-5} kgm²	4.47 × 10^{-5} kgm²
Mass	65 g	67 g

Inner diameter	45 H7 mm
Height	10 ± 0.1 mm
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

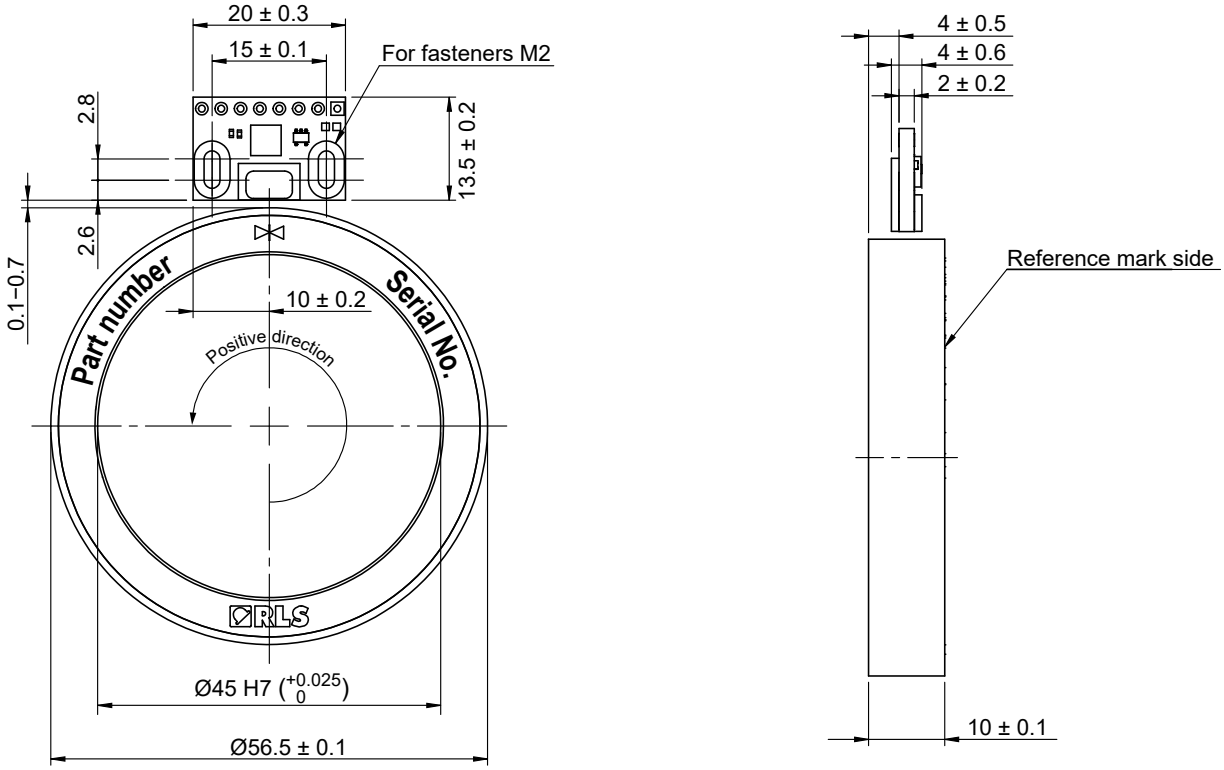
[a] 1 mm ride height
[b] 2.5 mm ride height
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

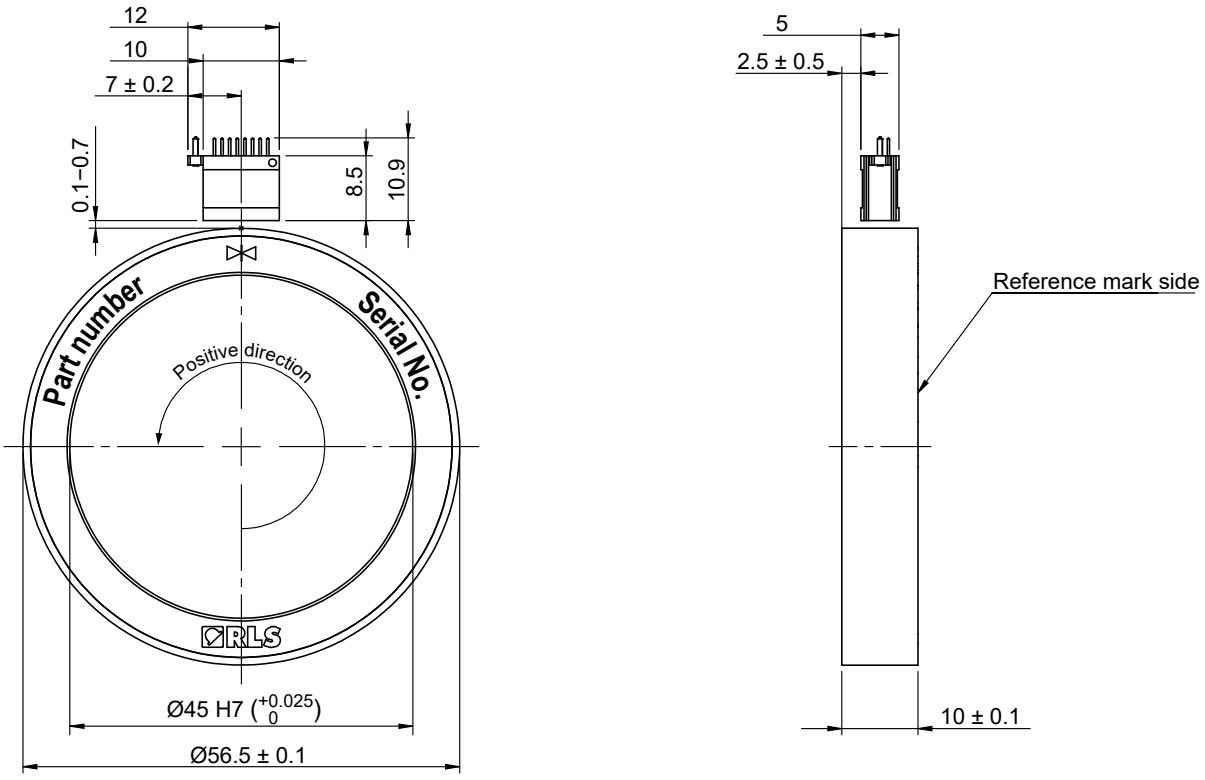
RLC2IC



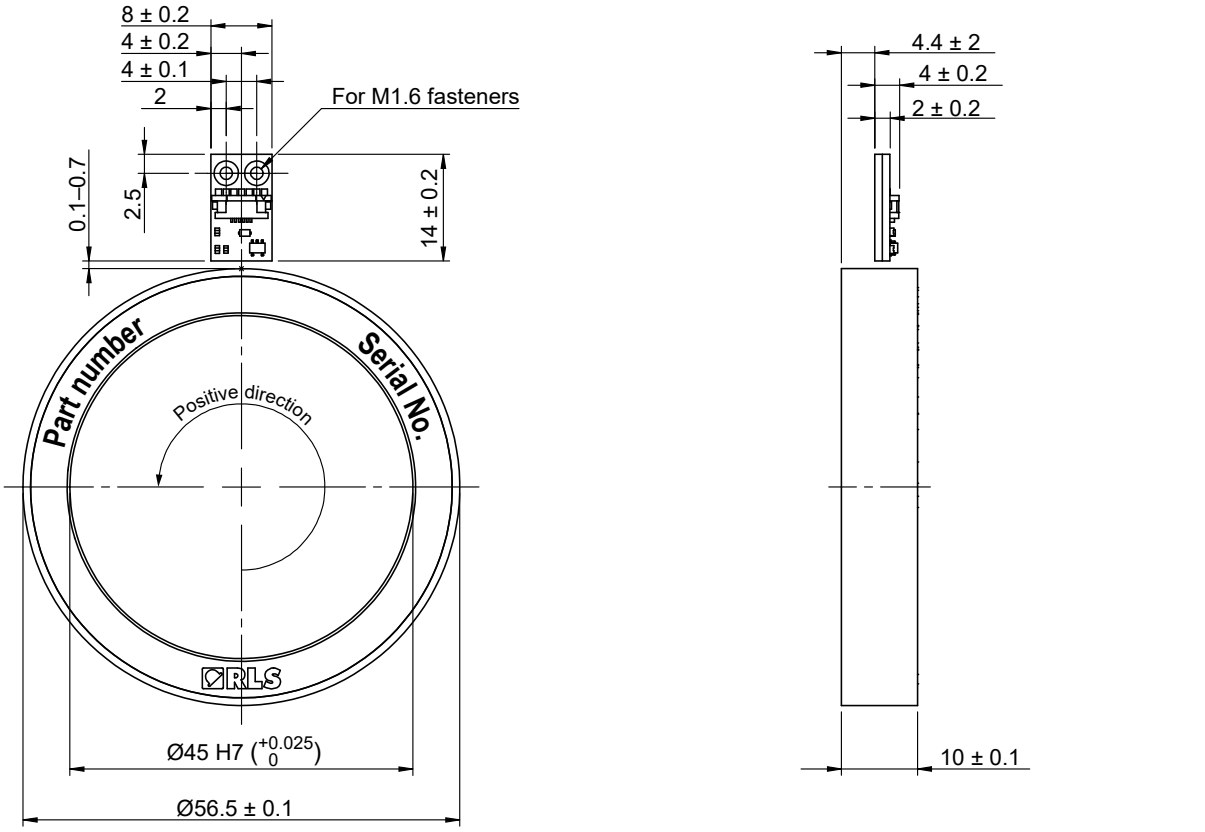
MR057E

Outer diameter: 56.5 ± 0.1 mm / 57.3 ± 0.1 mm
Inner diameter: 45 H7 mm
Number of poles: 90 / 36

RLM



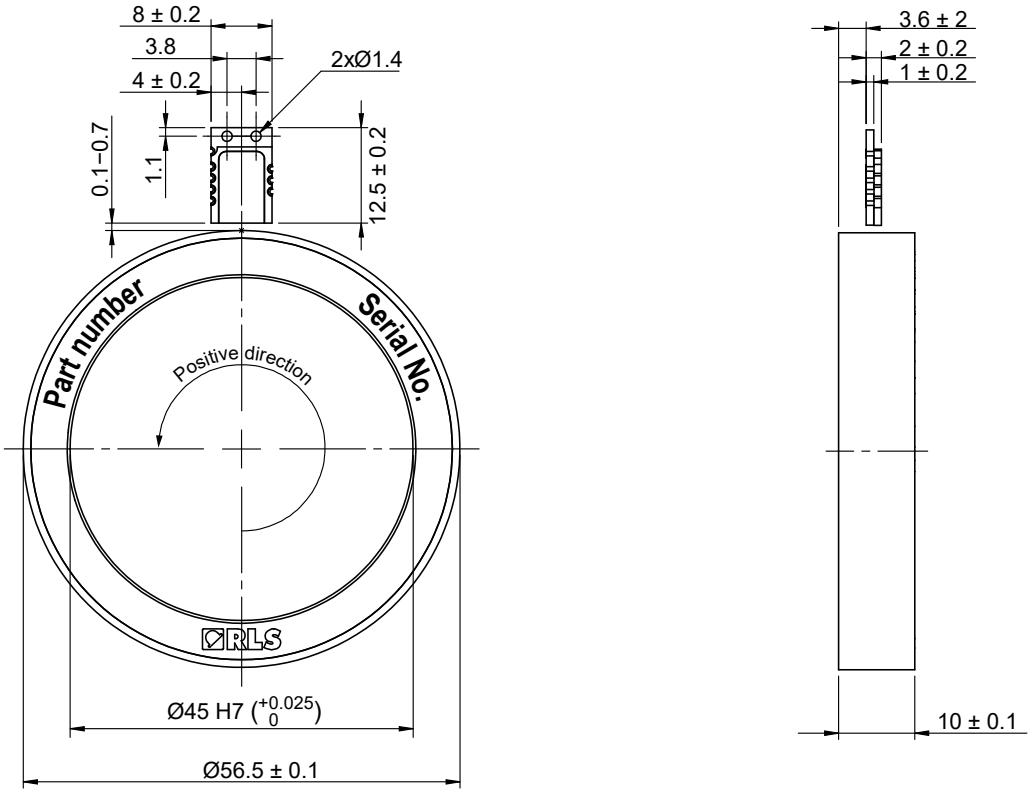
RLB



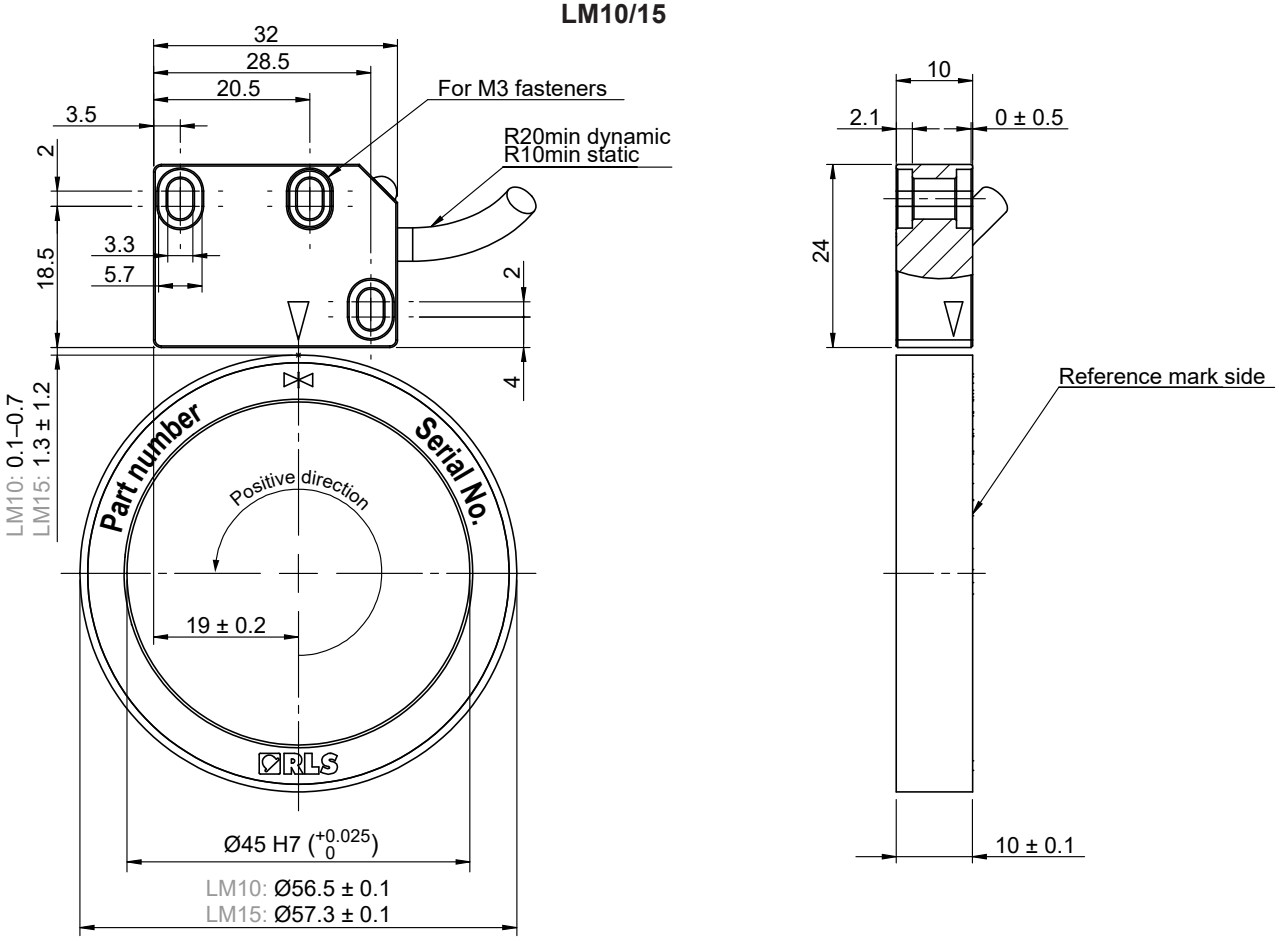
MR057E

Outer diameter: 56.5 ± 0.1 mm / 57.3 ± 0.1 mm
Inner diameter: 45 H7 mm
Number of poles: 90 / 36

RLC2HD

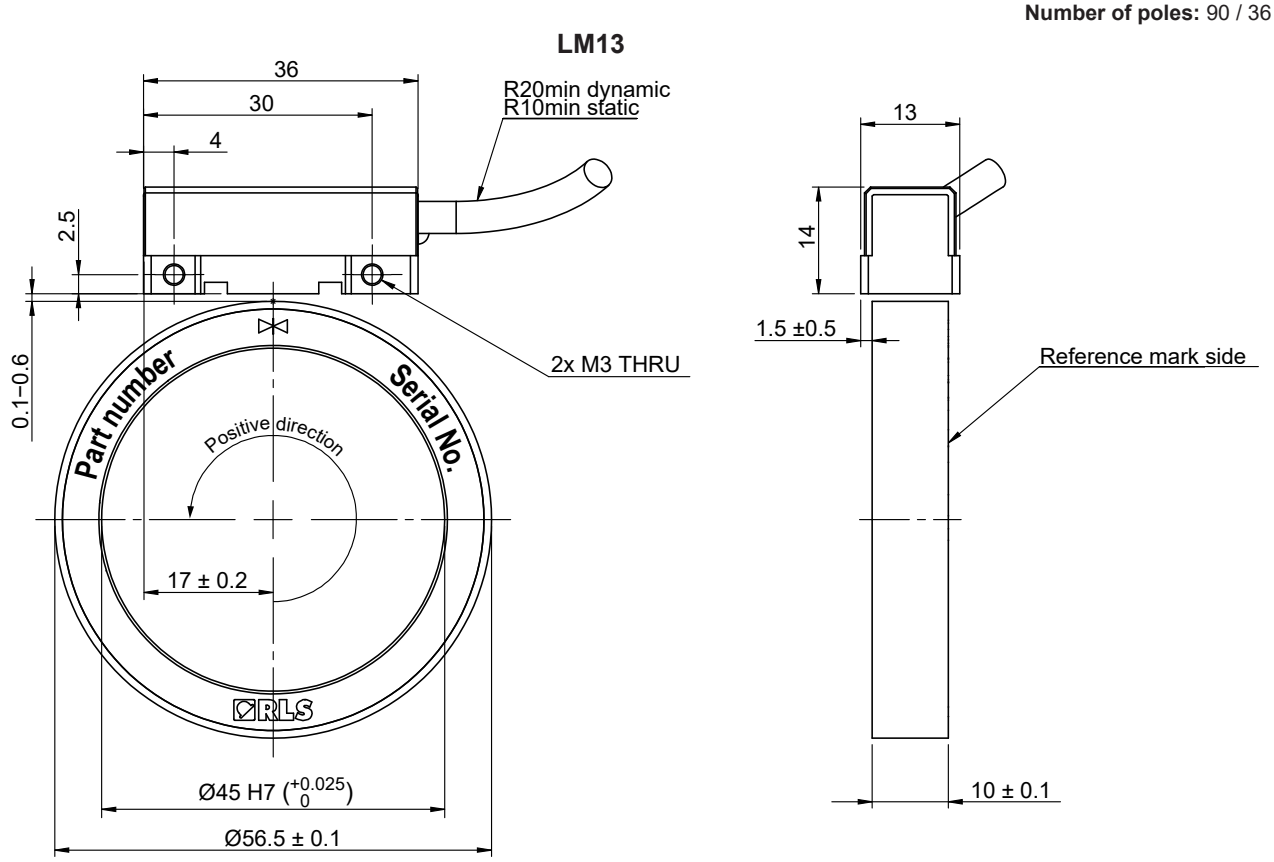


LM10/15



MR057E

Outer diameter: 56.5 ± 0.1 mm / 57.3 ± 0.1 mm
Inner diameter: 45 H7 mm
Number of poles: 90 / 36

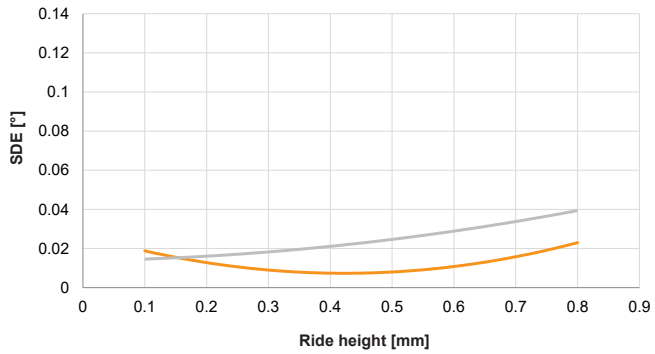


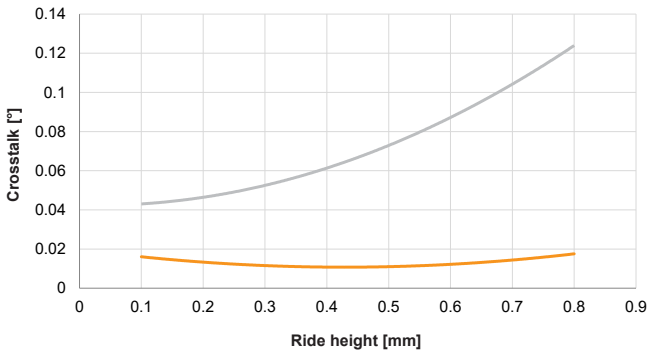
SDE and crosstalk error

(typical measured value)

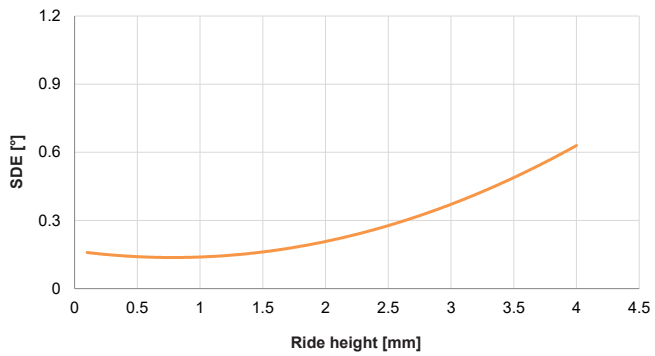
Legend
- LM
- RoLin

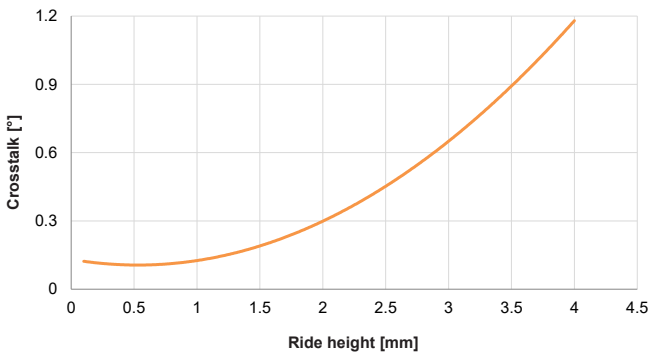
90 poles, 2 mm width





36 poles, 5 mm width





MR057R

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
90 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Outer diameter	57.5 ± 0.1 mm[c] 57.7 ± 0.1 mm[d]
Inner diameter	51 ± 0.1 mm
Installation diameter	53 ± 0.02 mm
Height	11 ± 0.1 mm
Mass	26 g
Moment of inertia	2.02 × 10^{-5} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4104 / AISI 430F
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

Pole length	2 mm
Number of poles	90
Basic increment of distance coded reference mark	36 mm / 72°
System error	±0.09°

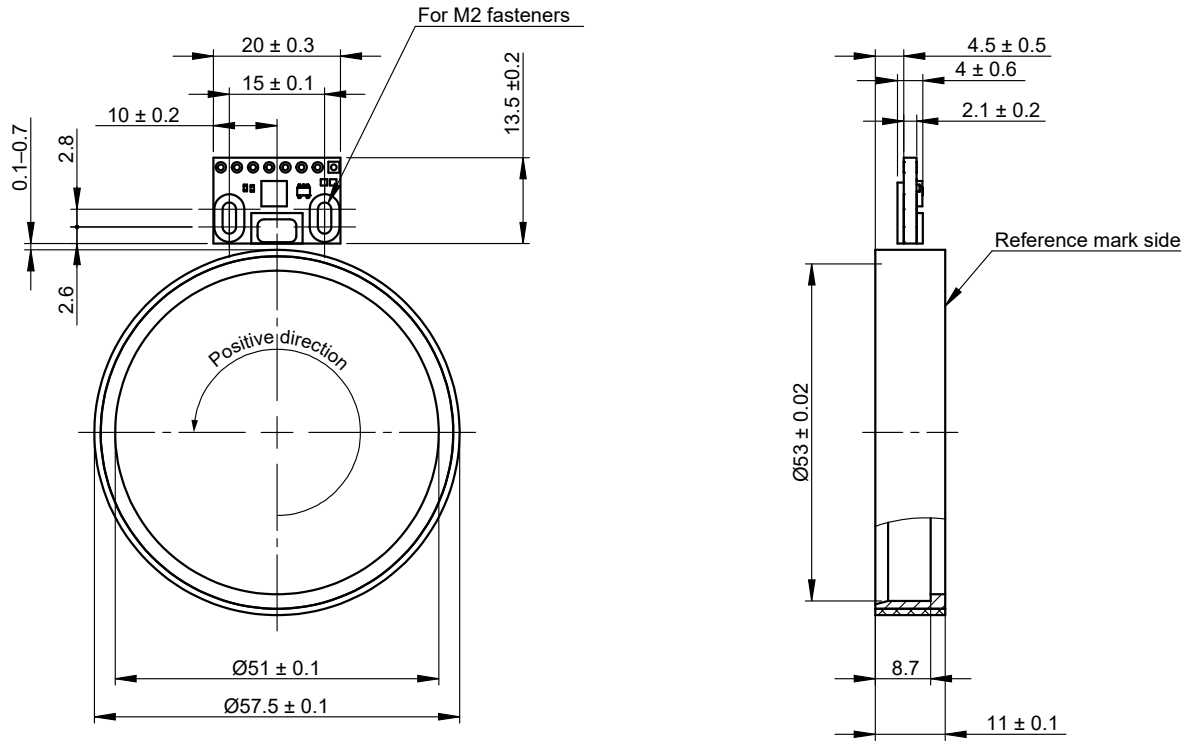
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

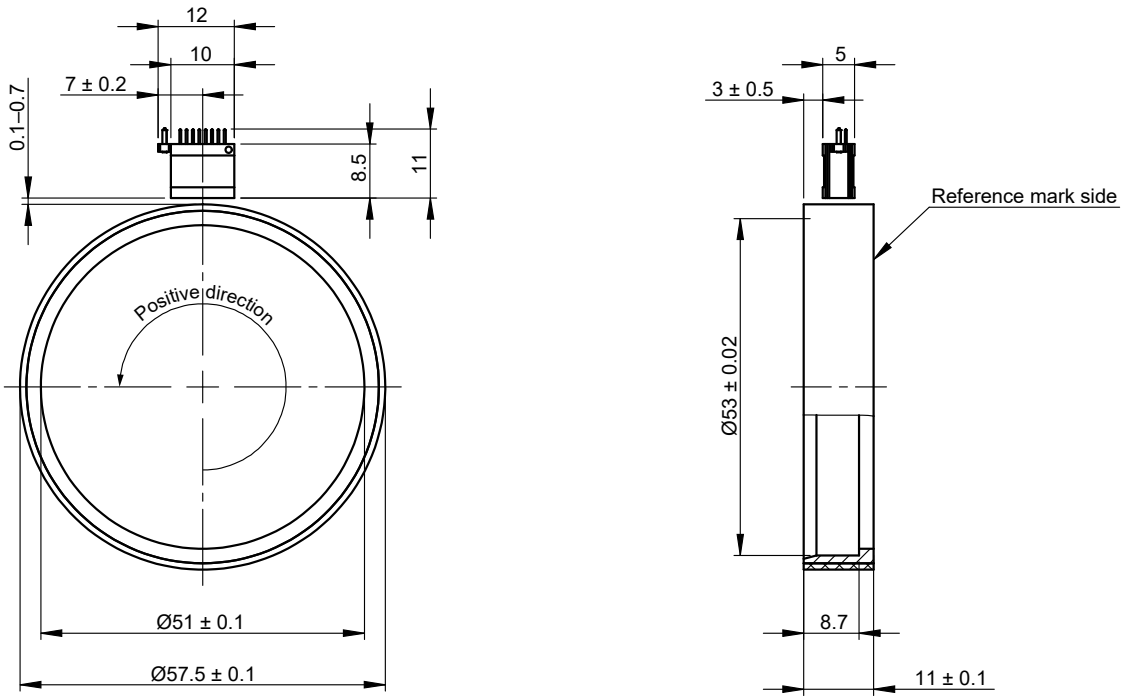
RLC2IC



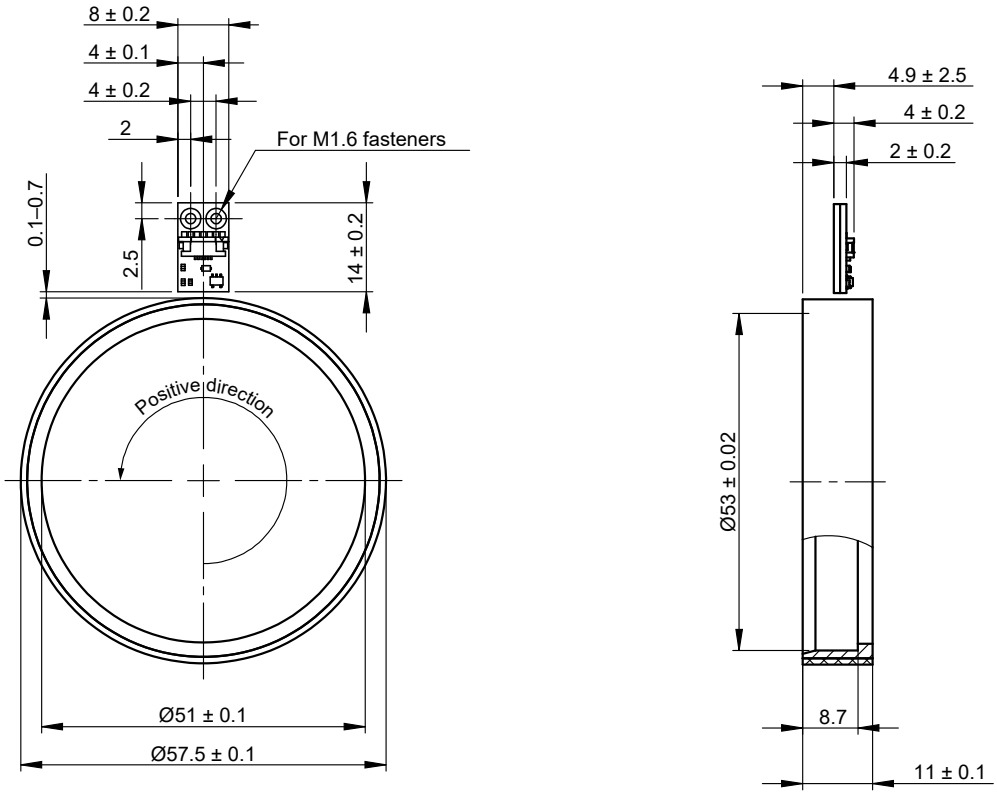
MR057R

Outer diameter: 57.5 ± 0.1 mm
Inner diameter: 51 ± 0.1 mm
Number of poles: 90

RLM



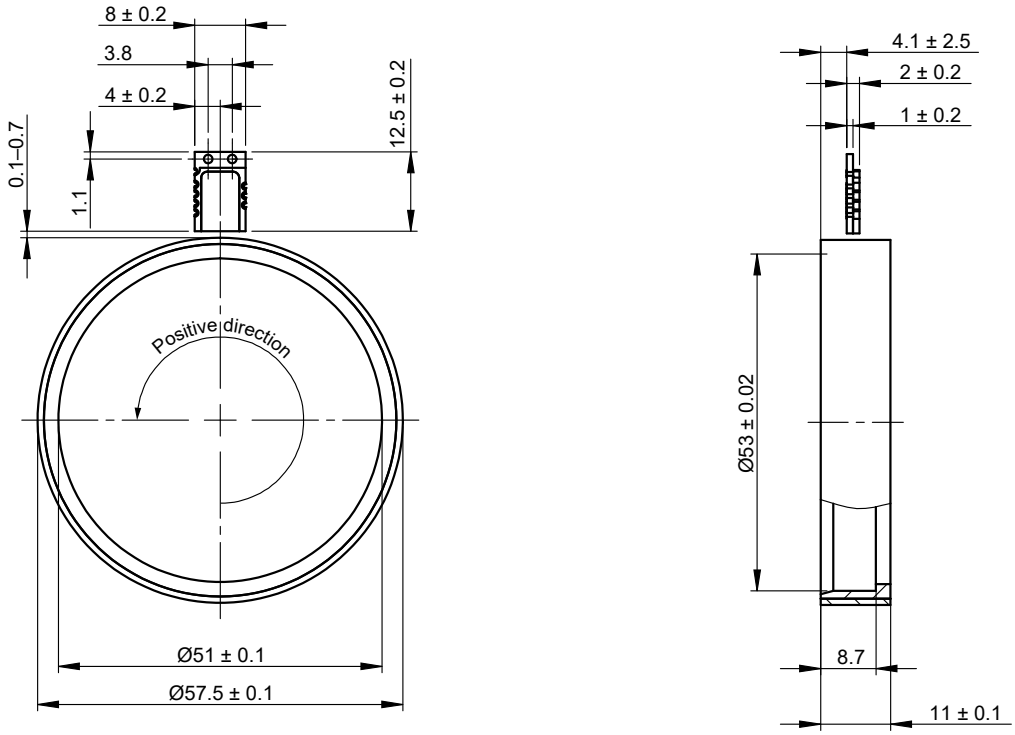
RLB



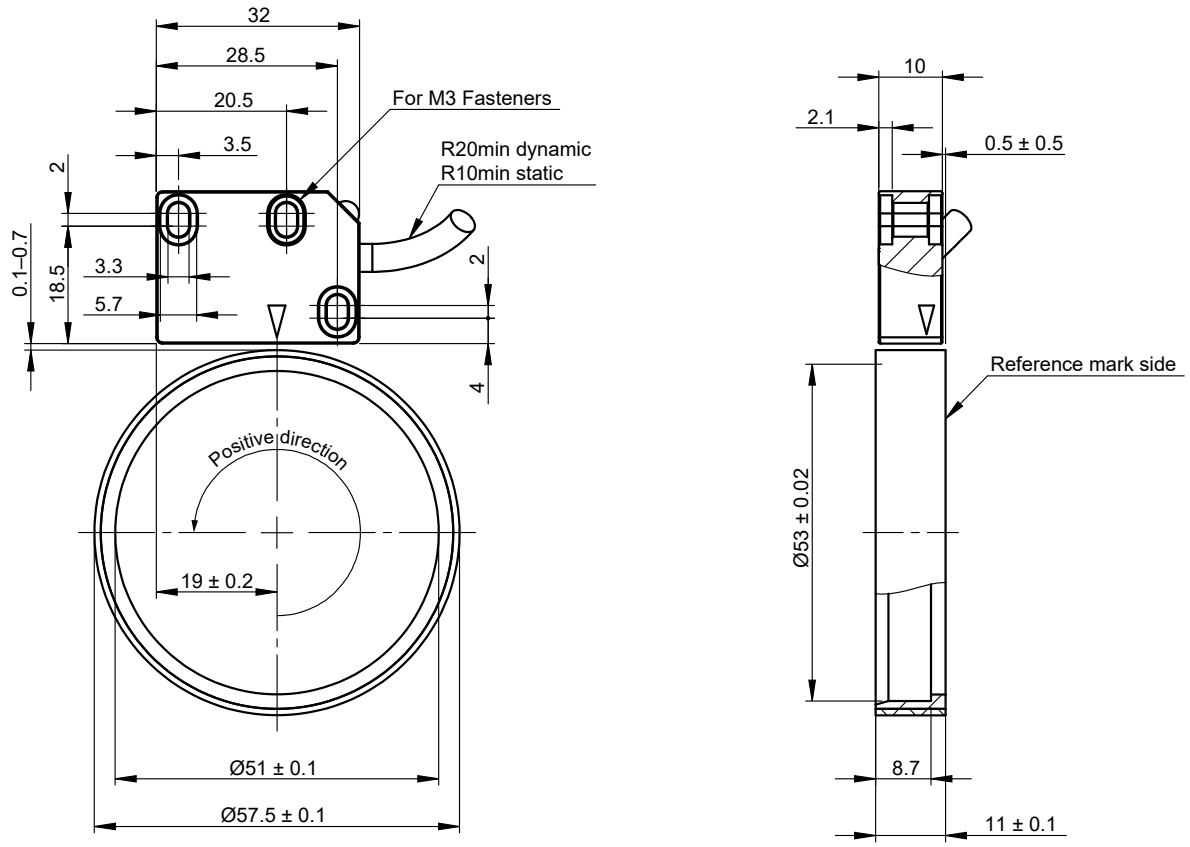
MR057R

Outer diameter: 57.5 ± 0.1 mm
Inner diameter: 51 ± 0.1 mm
Number of poles: 90

RLC2HD



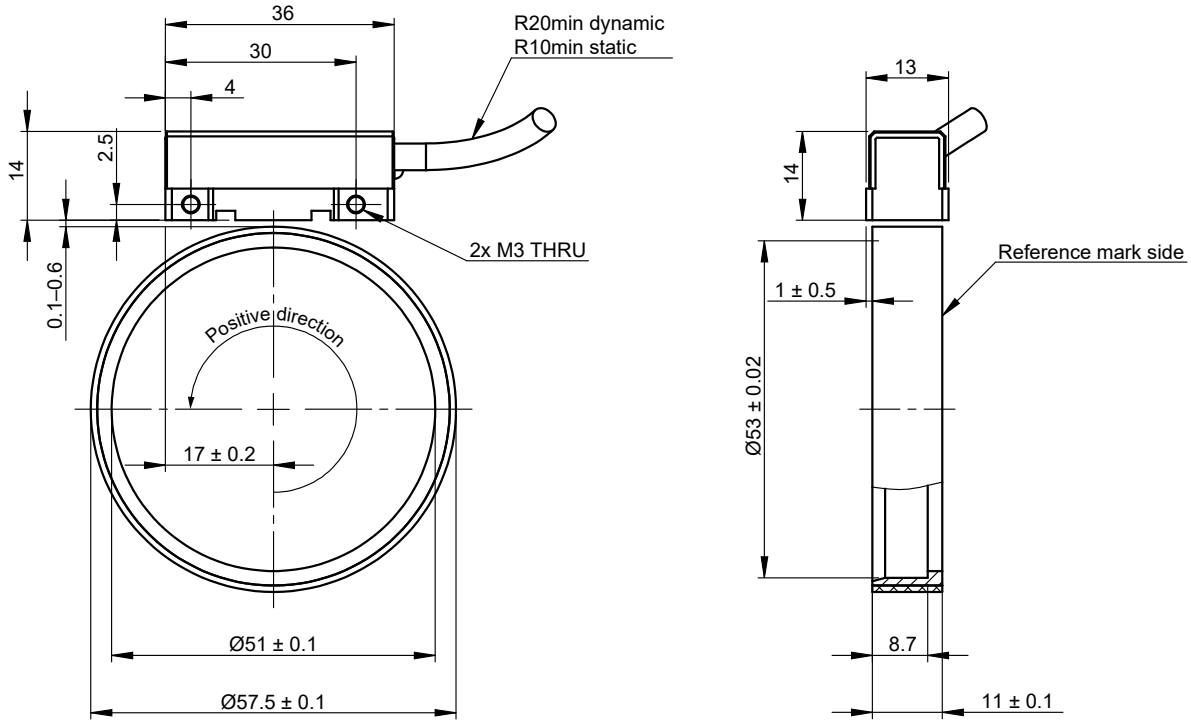
LM10



MR057R

Outer diameter: 57.5 ± 0.1 mm
Inner diameter: 51 ± 0.1 mm
Number of poles: 90

LM13

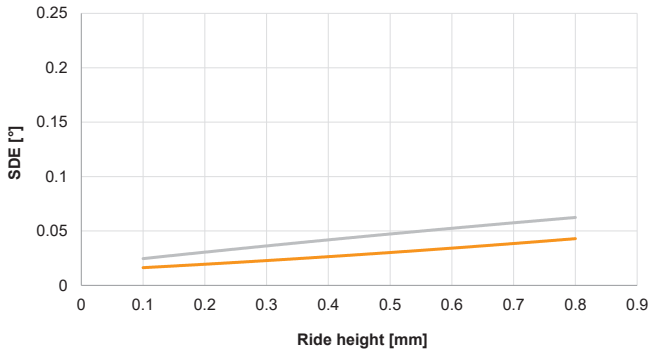


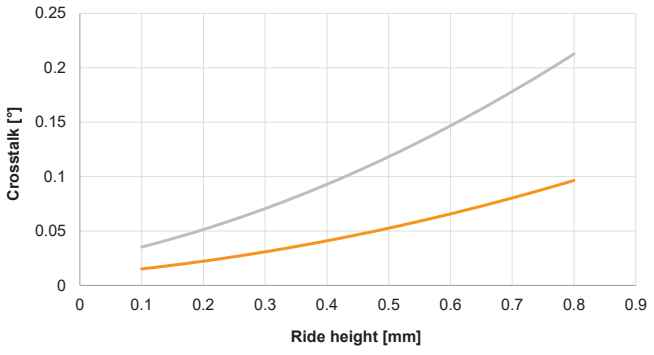
SDE and crosstalk error

(typical measured value)

Legend
LM
RoLin

90 poles, 2 mm width





MR075E

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
120 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM
48 poles, 5 mm pole length	-	-	Ri+DCRM	-	-	-	-

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Outer diameter	75.4 ± 0.1 mm[c] 75.6 ± 0.1 mm[d]
Inner diameter	60 H7 mm
Height	10 ± 0.1 mm
Mass	114 g
Moment of inertia	1.33 × 10^{-4} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

Pole length	2 mm	5 mm
Number of poles	120	48
Basic increment of distance coded reference mark	92 mm / 140°	60 mm / 90°
System error	±0.07°	±0.20°[a] ±0.40°[b]

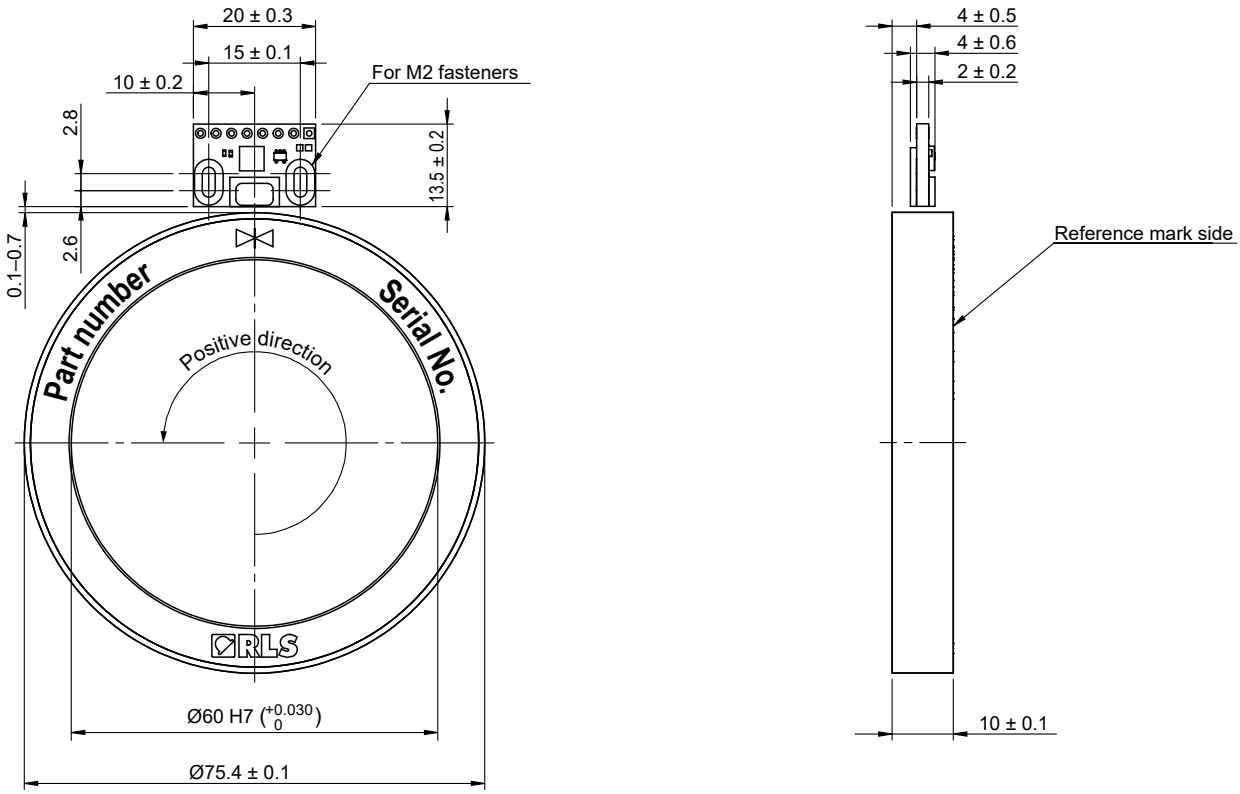
[a] 1 mm ride height
[b] 2.5 mm ride height
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

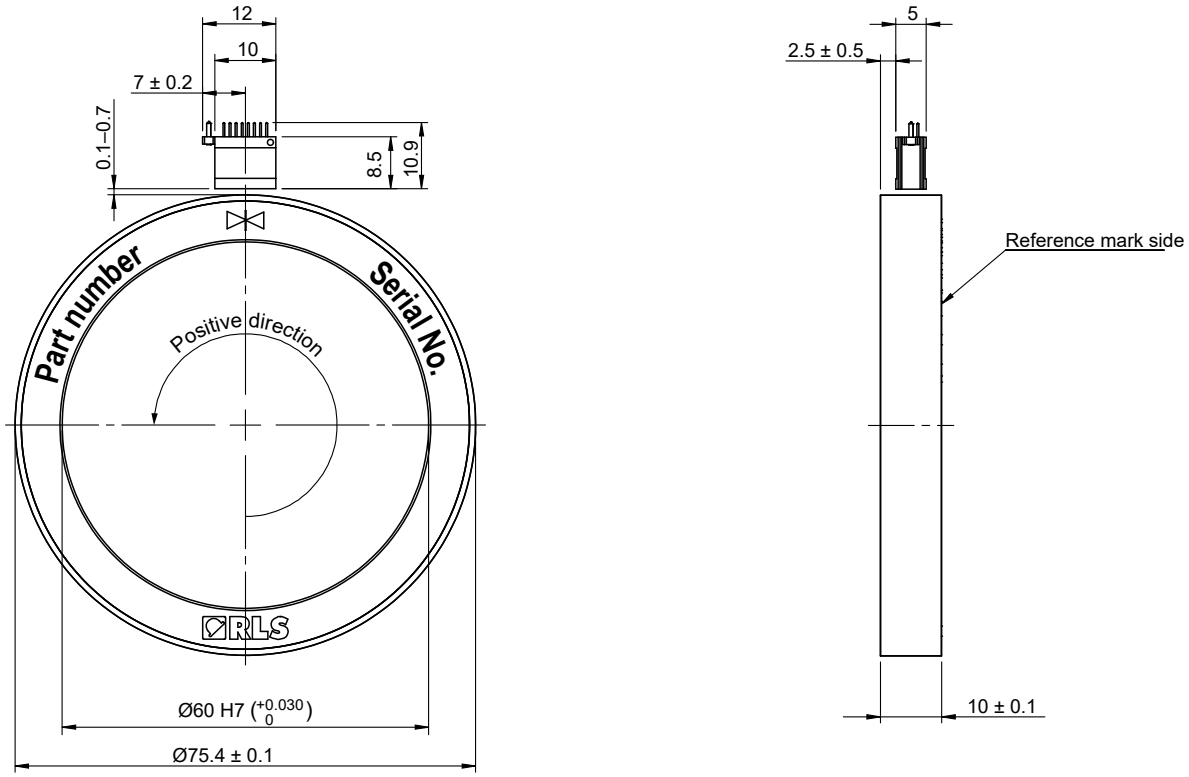
RLC2IC



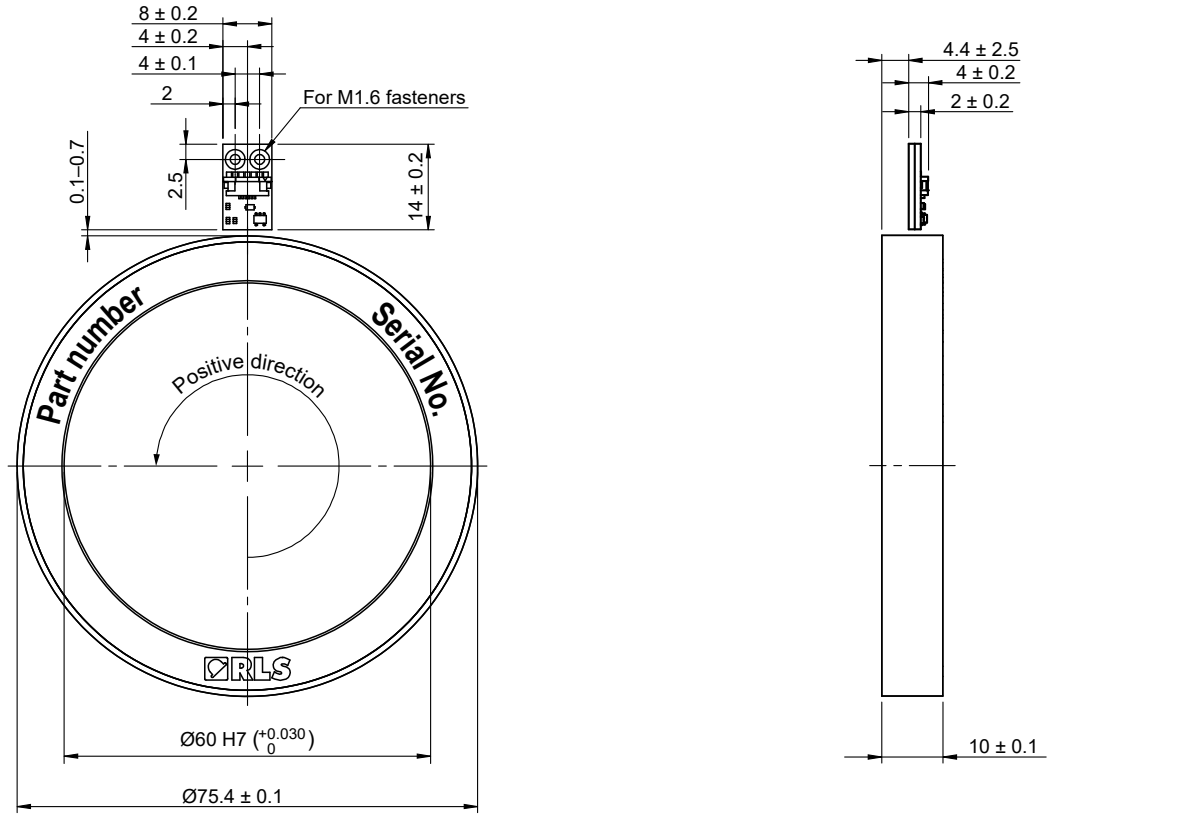
MR075E

Outer diameter: 75.4 ± 0.1 mm
Inner diameter: 60 H7 mm
Number of poles: 120 / 48

RLM



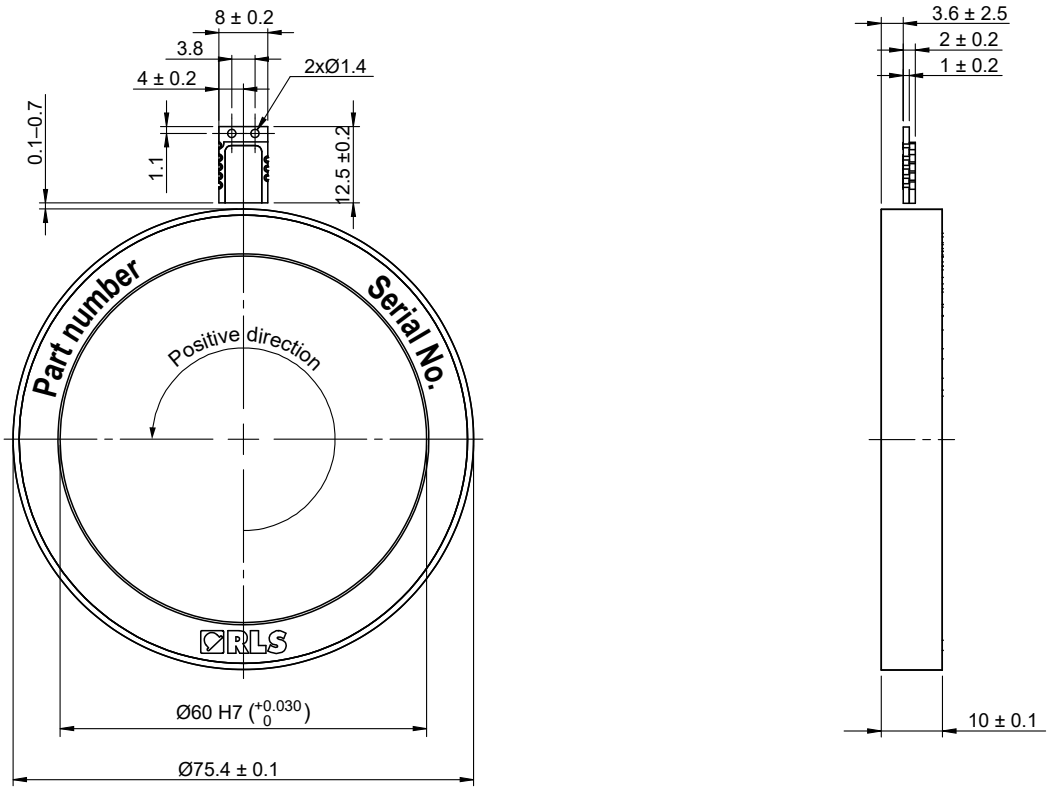
RLB



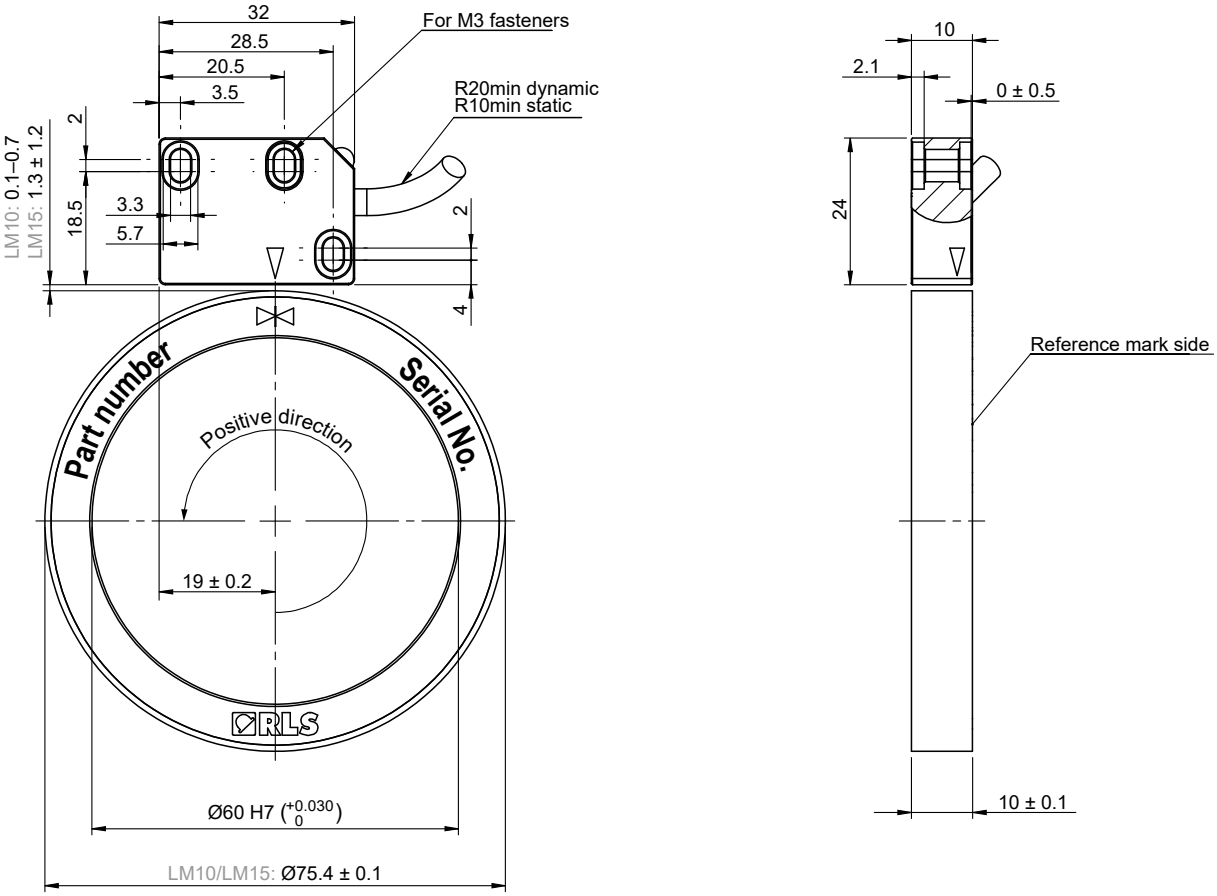
MR075E

Outer diameter: 75.4 ± 0.1 mm
Inner diameter: 60 H7 mm
Number of poles: 120 / 48

RLC2HD



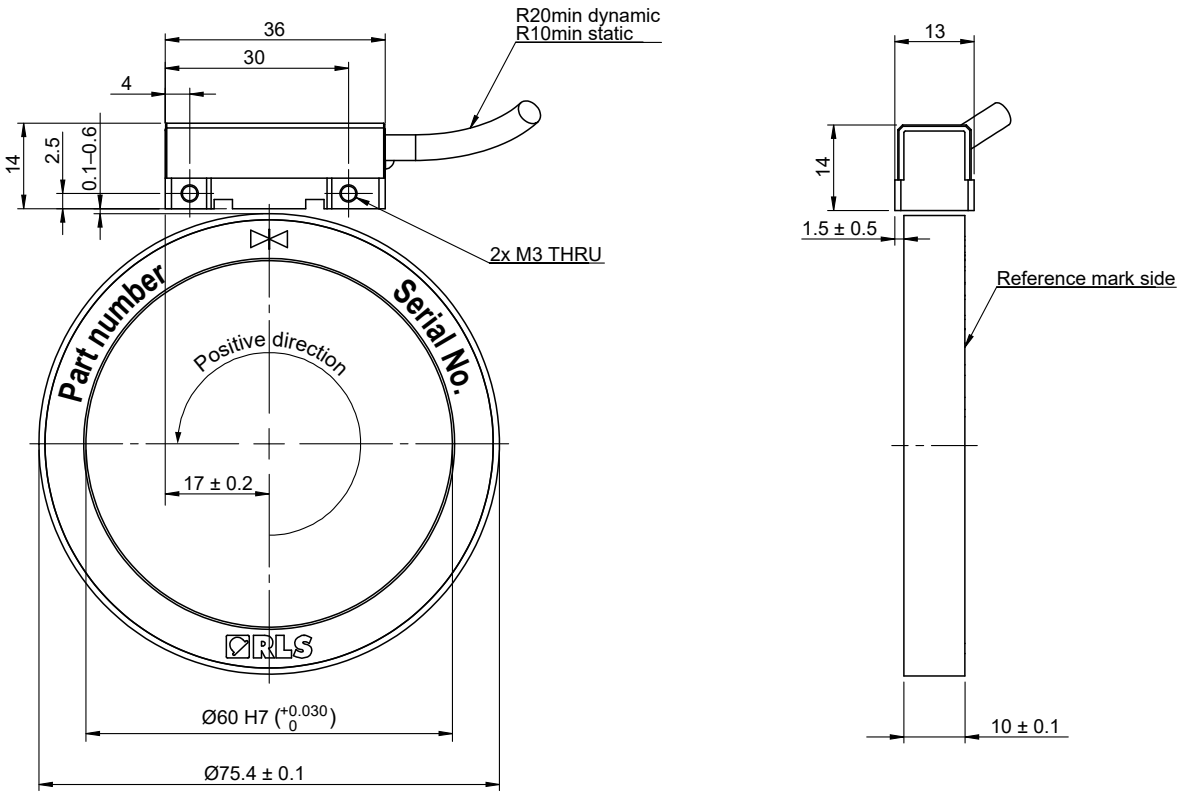
LM10/15



MR075E

Outer diameter: 75.4 ± 0.1 mm
Inner diameter: 60 H7 mm
Number of poles: 120 / 48

LM13

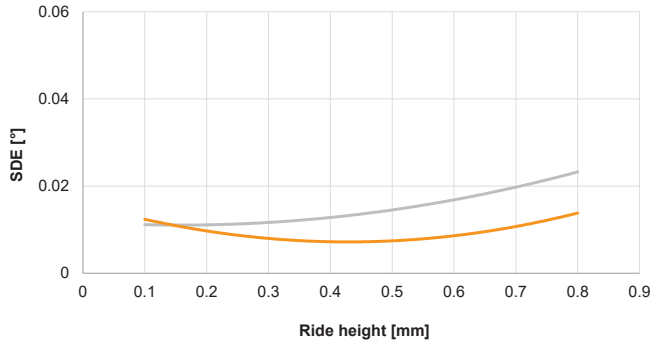


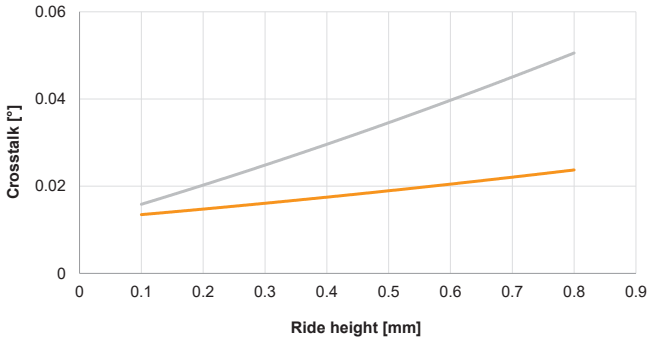
SDE and crosstalk error

(typical measured value)

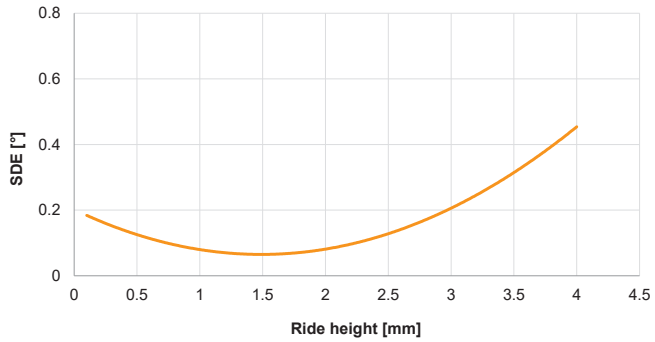
Legend
- LM
- RoLin

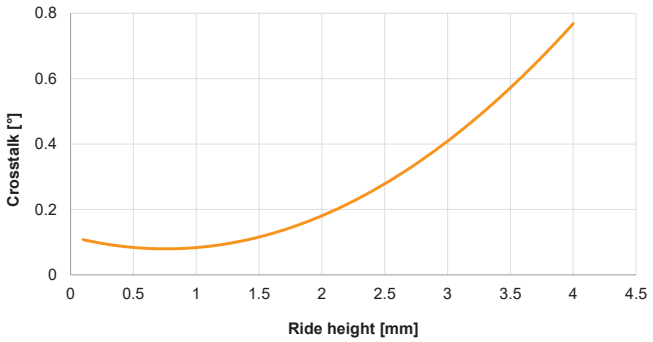
120 poles, 2 mm width





48 poles, 5 mm width





MR080R

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
128 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Outer diameter	80.3 ± 0.1 mm[c] 80.5 ± 0.1 mm[d]
Inner diameter	74 mm
Installation diameter	76.1 ± 0.02
Height	11 ± 0.1 mm
Mass	34 g
Moment of inertia	5.34 × 10^{-5} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4021 / AISI 420
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	Yes

Pole length	2 mm
Number of poles	128
Basic increment of distance coded reference mark	64 mm / 90°
System error	±0.09°

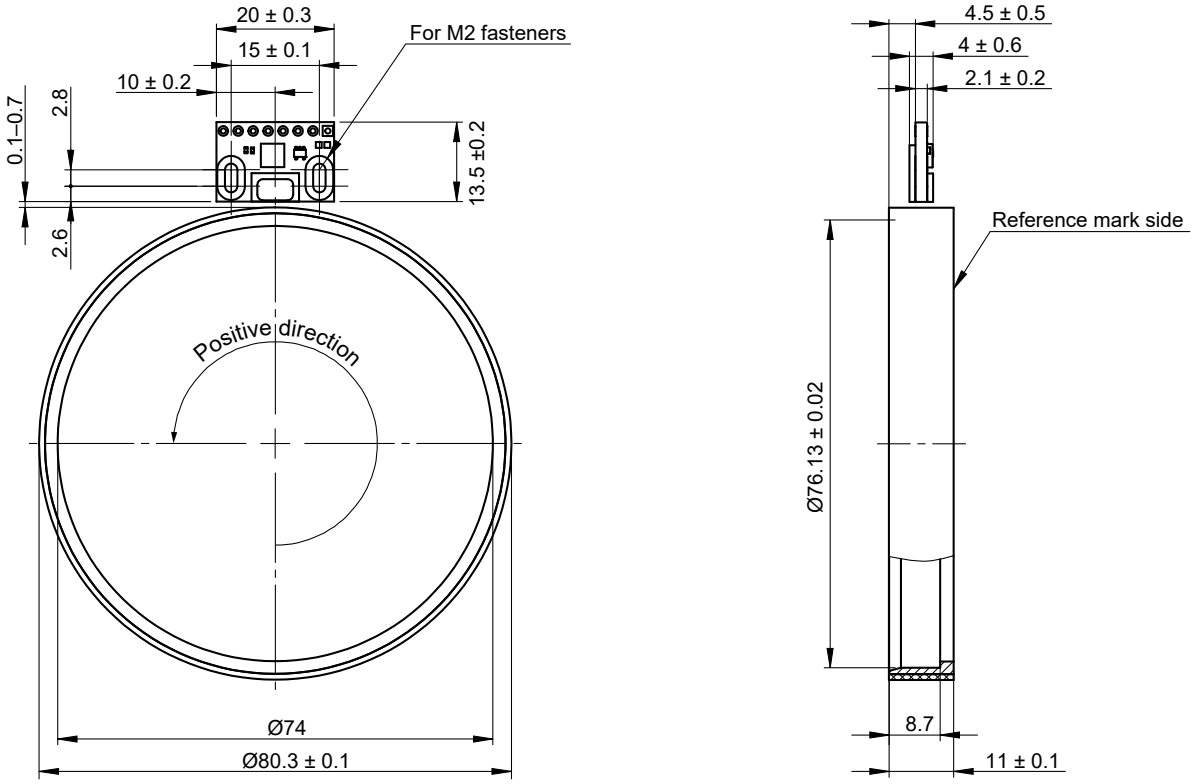
[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

Dimensions and tolerances in mm.

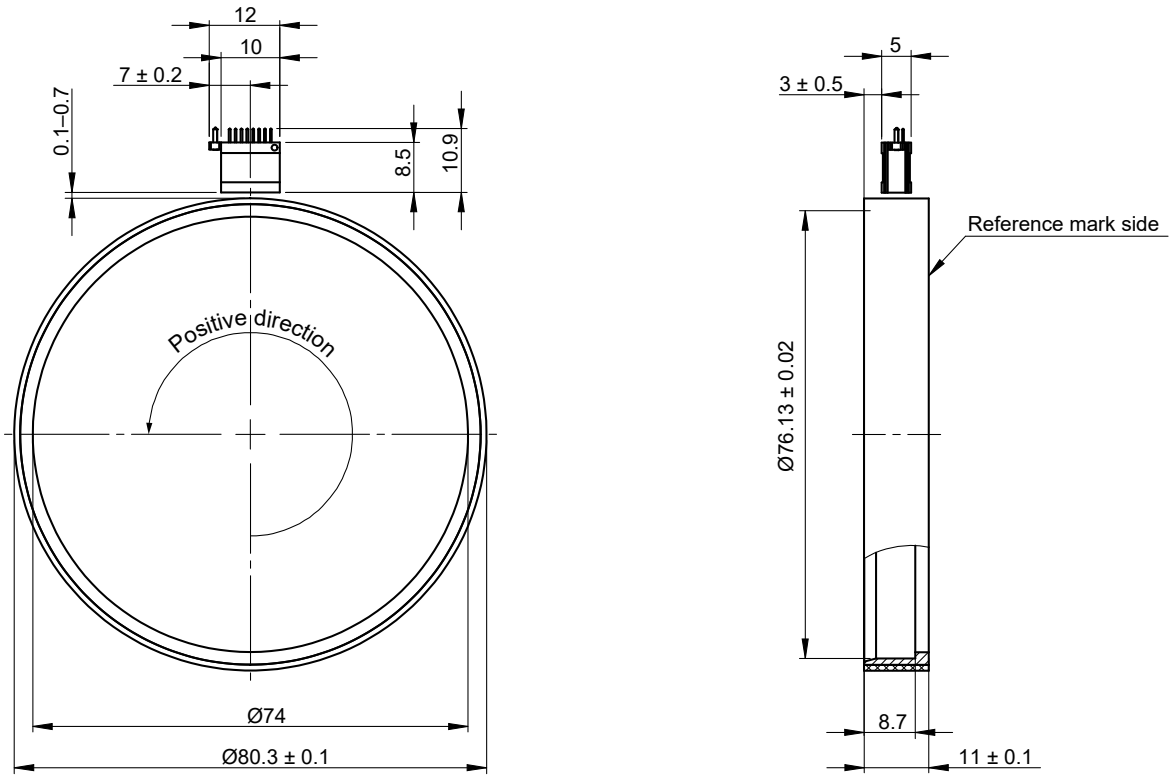
RLC2IC



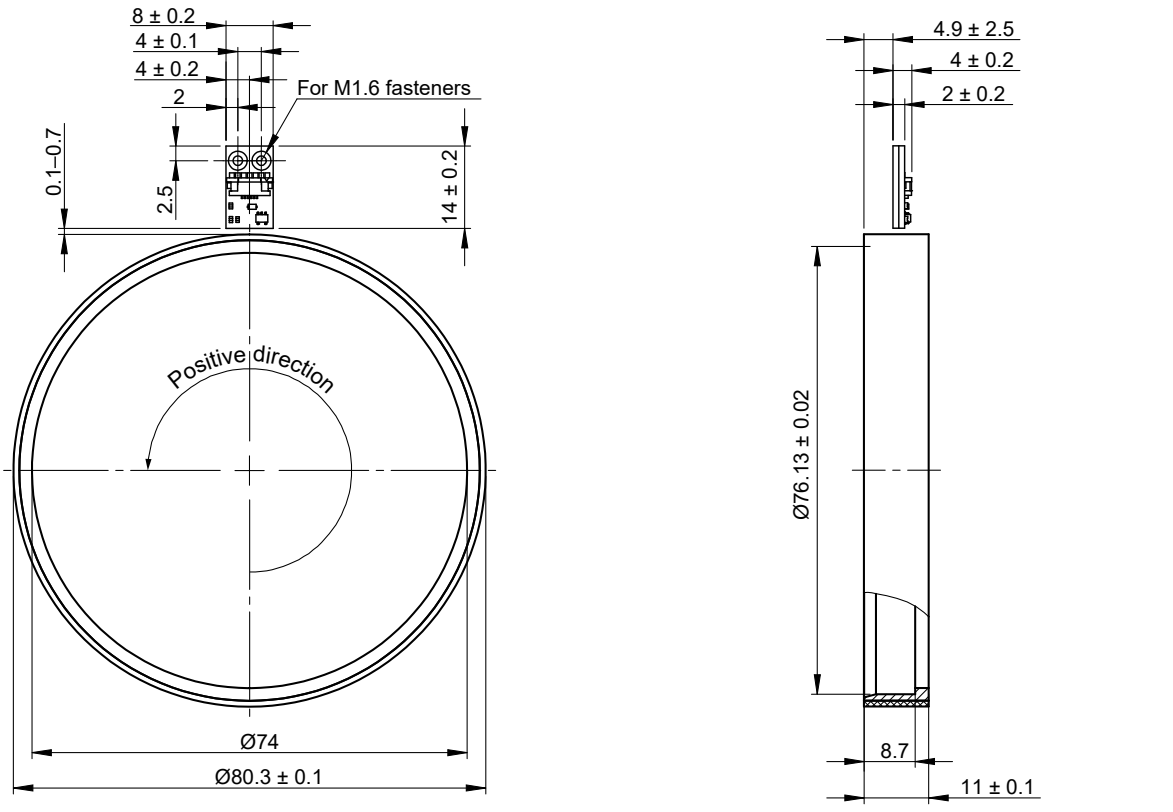
MR080R

Outer diameter: 80.3 ± 0.1 mm
Inner diameter: 74 mm
Number of poles: 128

RLM



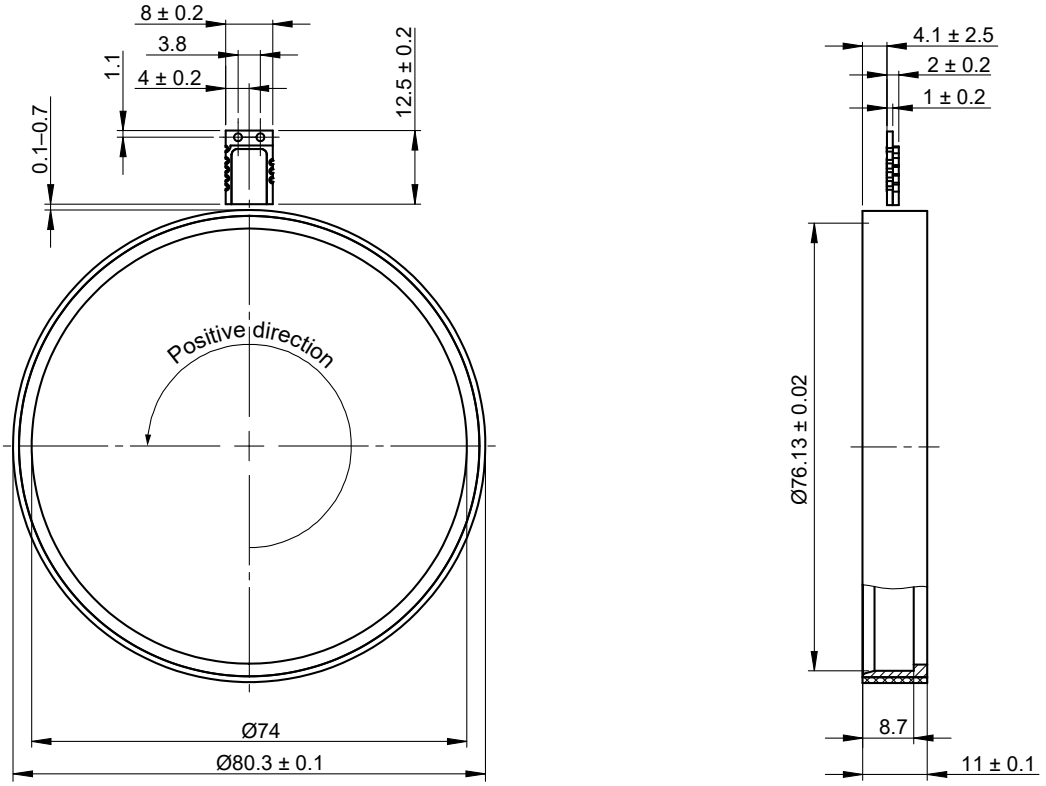
RLB



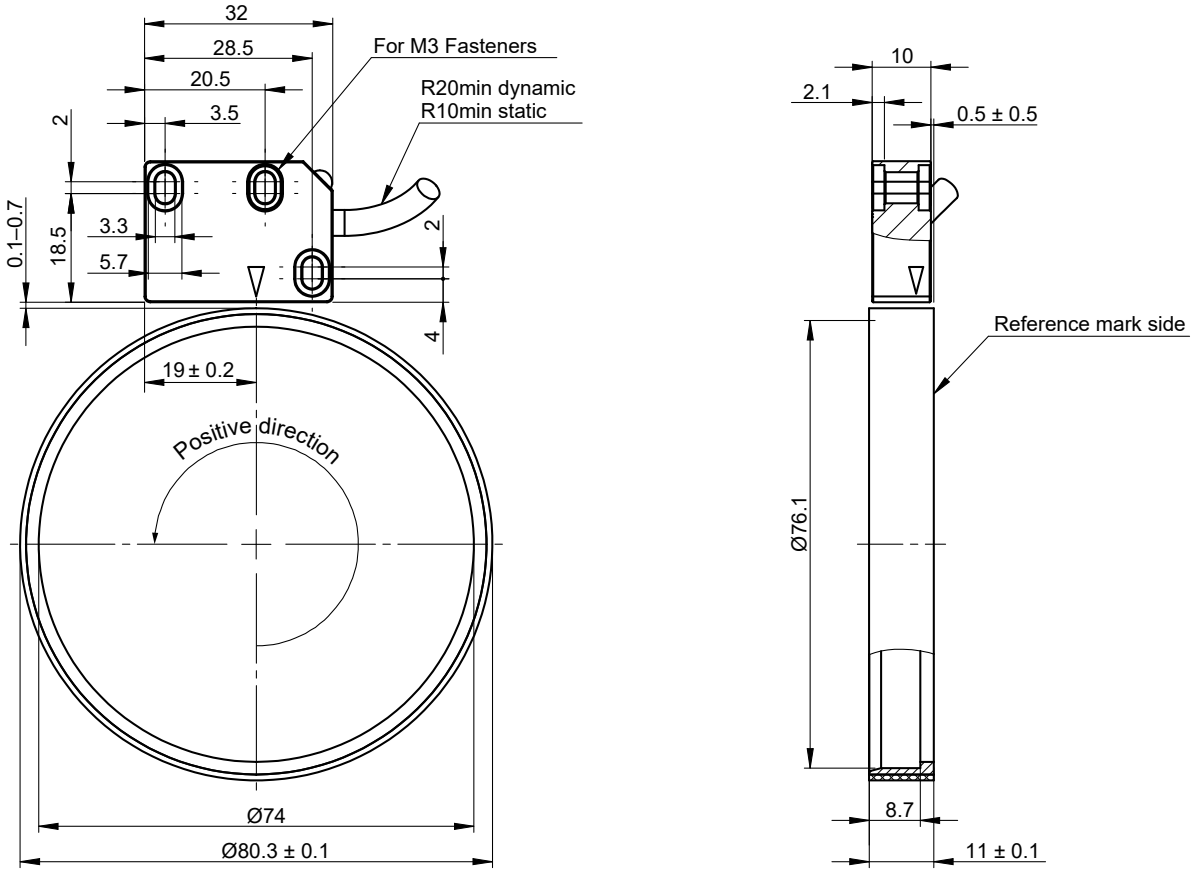
MR080R

Outer diameter: 80.3 ± 0.1 mm
Inner diameter: 74 mm
Number of poles: 128

RLC2HD



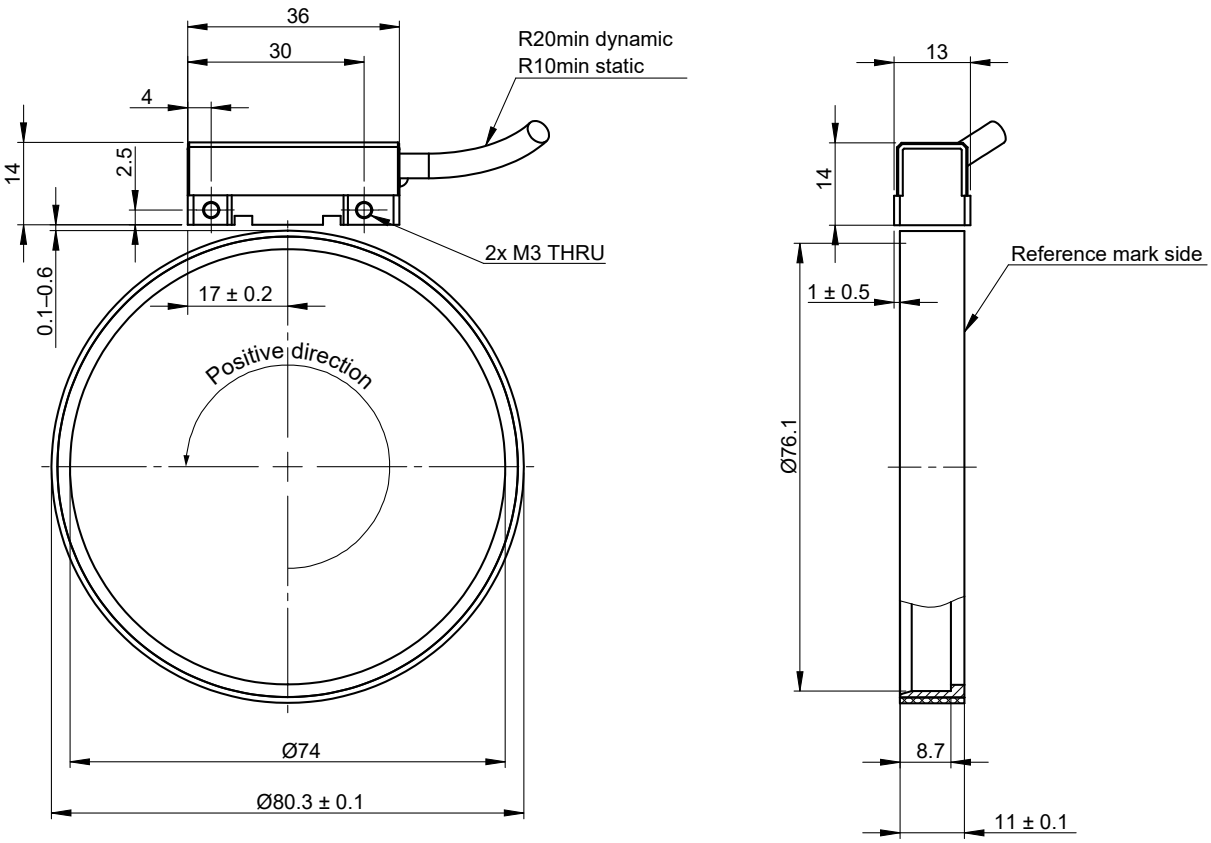
LM10



MR080R

Outer diameter: 80.3 ± 0.1 mm
Inner diameter: 74 mm
Number of poles: 128

LM13

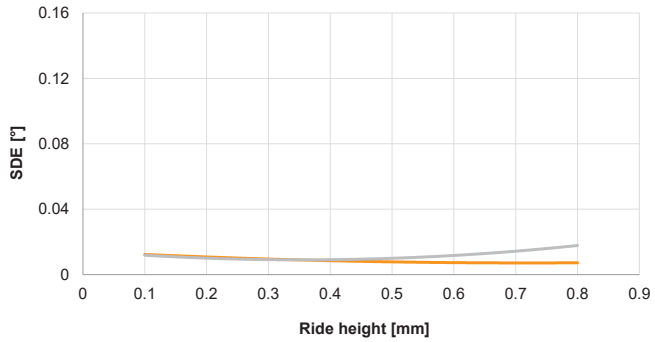


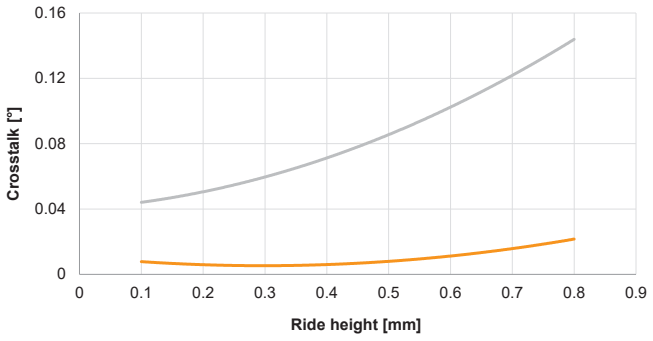
SDE and crosstalk error

(typical measured value)

Legend
LM
RoLin

128 poles, 2 mm width





MR100F

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
160 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

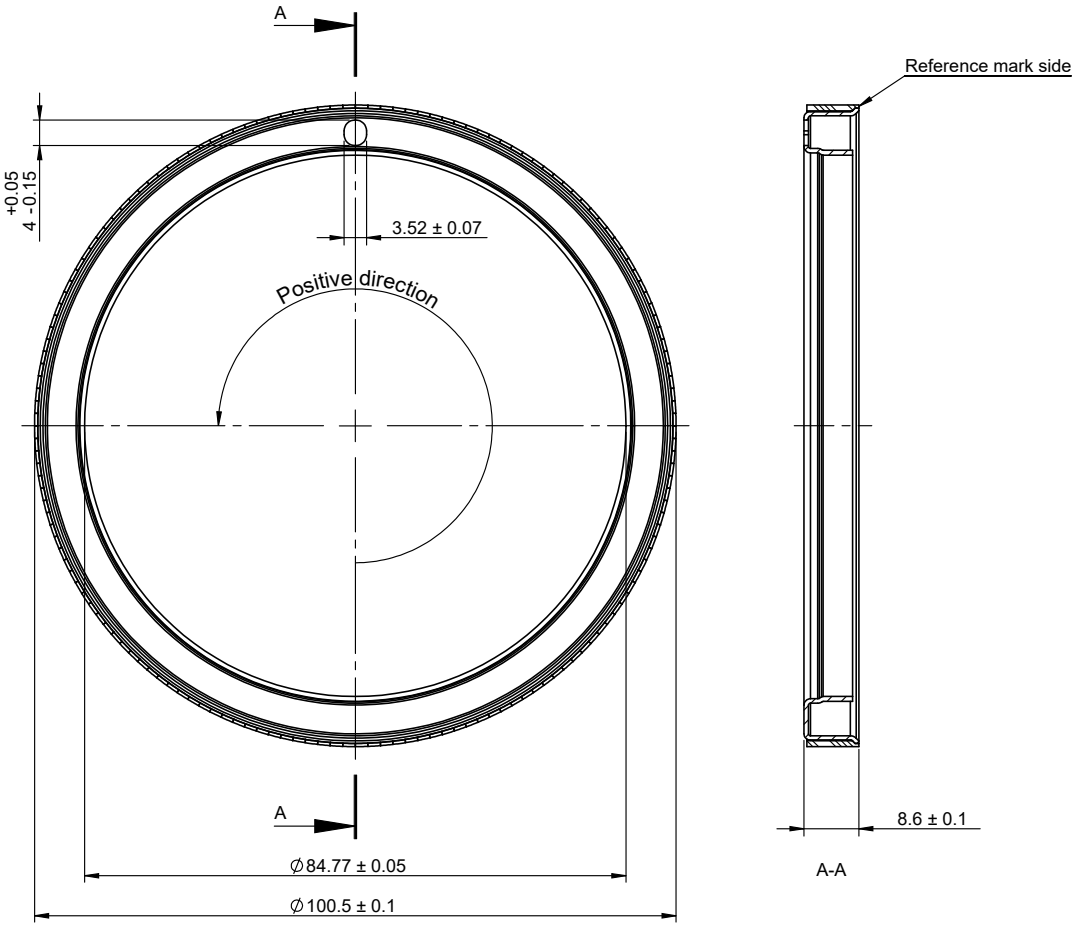
Outer diameter	100.5 ± 0.1 mm
Inner diameter	84.77 ± 0.05 mm
Height	8.6 ± 0.1 mm
Mass	38 g
Moment of inertia	9.11 × 10^{-5} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.0312 + Zn 4 µm
Hub thermal expansion coefficient (CT	11 × 10^{-6} K^{-1}
Protective foil option	No

Pole length	2 mm
Number of poles	160
Basic increment of distance coded reference mark	40 mm / 45°
System error	±0.10°

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

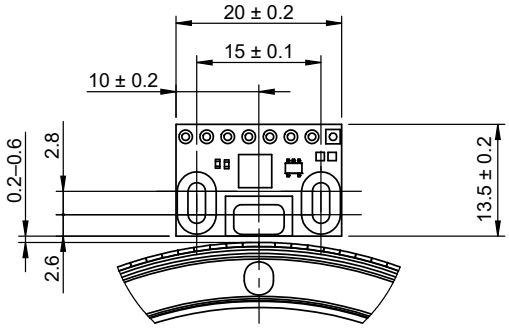
Dimensions and tolerances in mm.

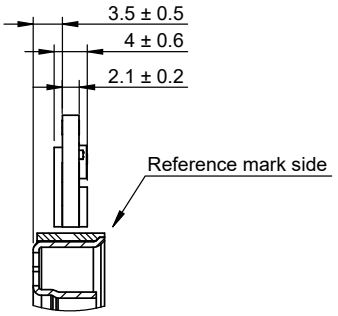


MR100F

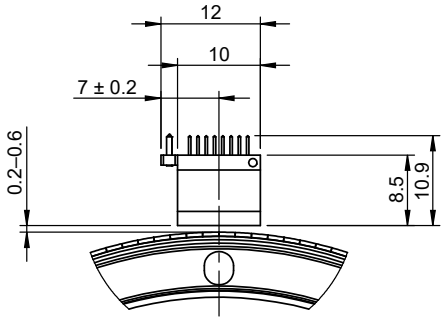
Outer diameter: 100.5 ± 0.1 mm
Inner diameter: 84.77 ± 0.05 mm
Number of poles: 160

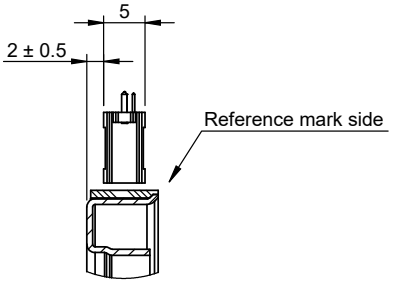
RLC2IC



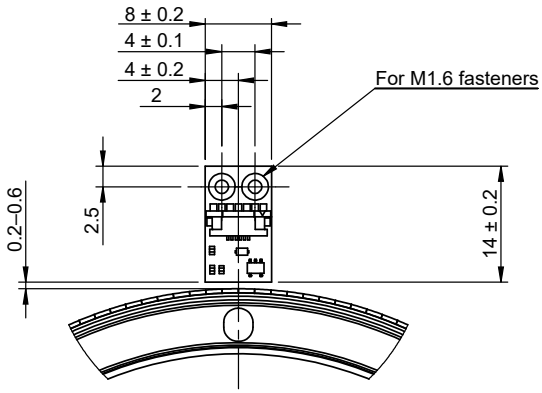


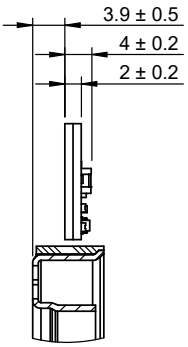
RLM



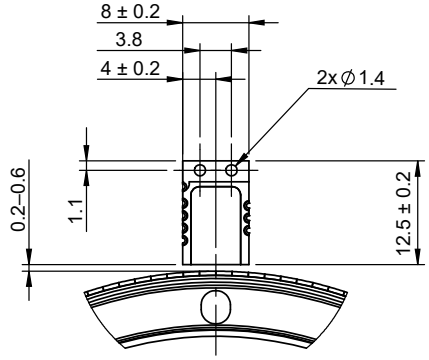


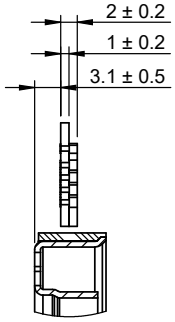
RLB





RLC2HD

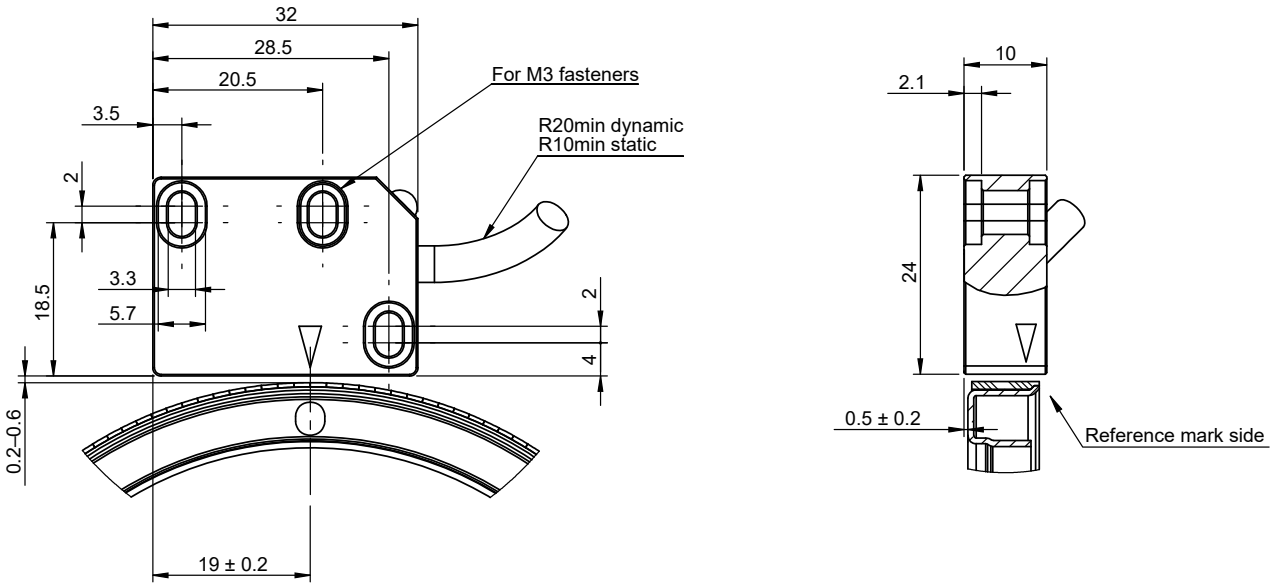




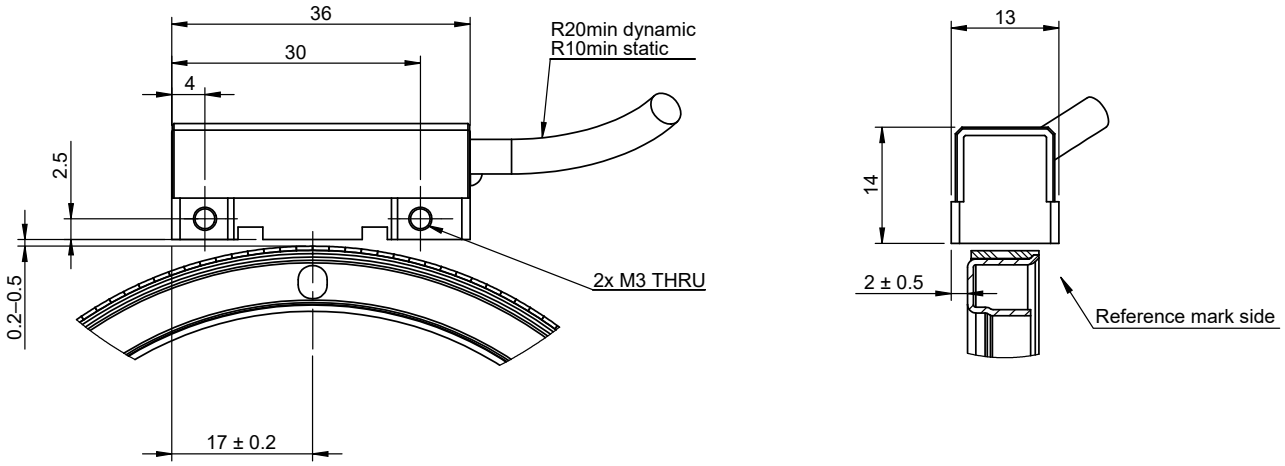
MR100F

Outer diameter: 100.5 ± 0.1 mm
Inner diameter: 84.77 ± 0.05 mm
Number of poles: 160

LM10



LM13

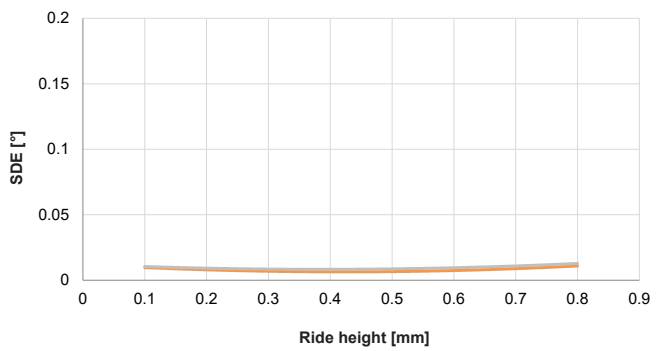


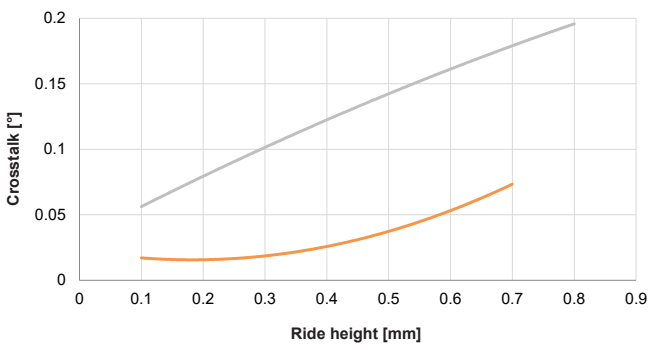
SDE and crosstalk error

(typical measured value)

Legend
LM
RoLin

160 poles, 2 mm width





MR122E

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
194 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Outer diameter	122 ± 0.1 mm[c] 122.2 ± 0.1 mm[d]
Inner diameter	90 H7 mm
Height	10 ± 0.1 mm
Mass	380 g
Moment of inertia	1.10 × 10^{-3} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4104 / AISI 430
Hub thermal expansion coefficient (CT	10 × 10^{-6} K^{-1}
Protective foil option	Yes

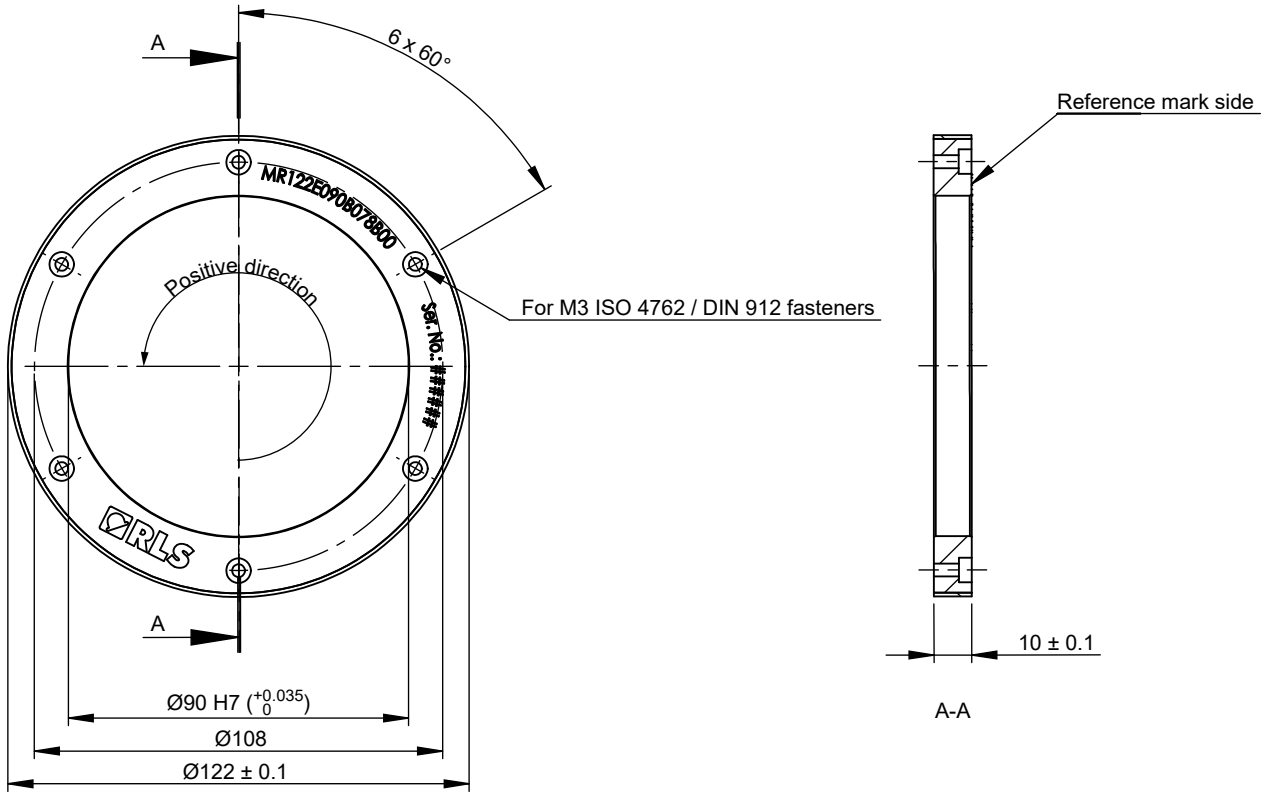
Pole length	2 mm
Number of poles	194
Basic increment of distance coded reference mark	48 mm / 45°
System error	±0.04°

[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

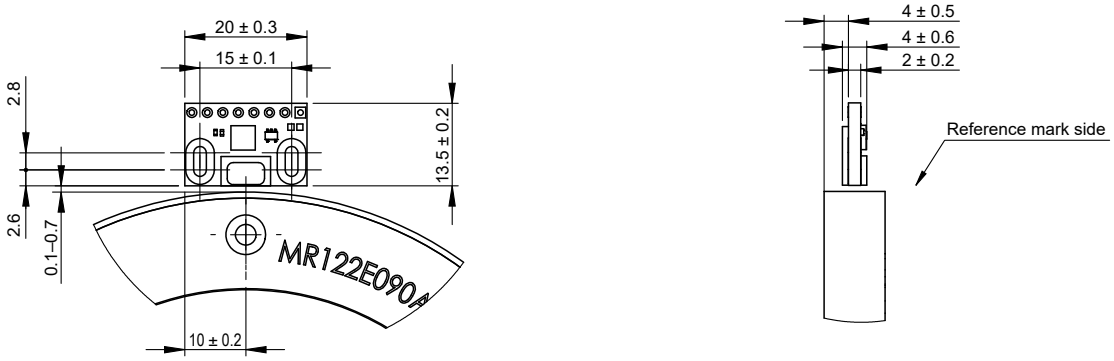
Dimensions and tolerances in mm.



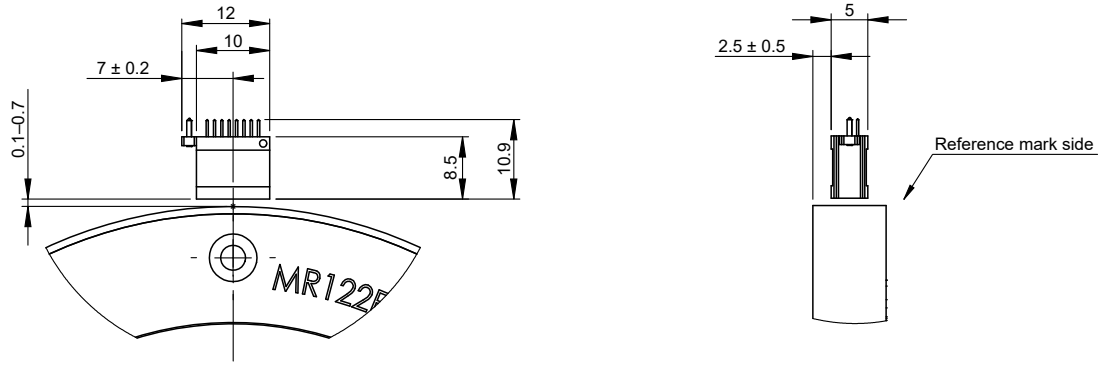
MR122E

Outer diameter: 122 ± 0.1 mm
Inner diameter: 90 H7 mm
Number of poles: 194

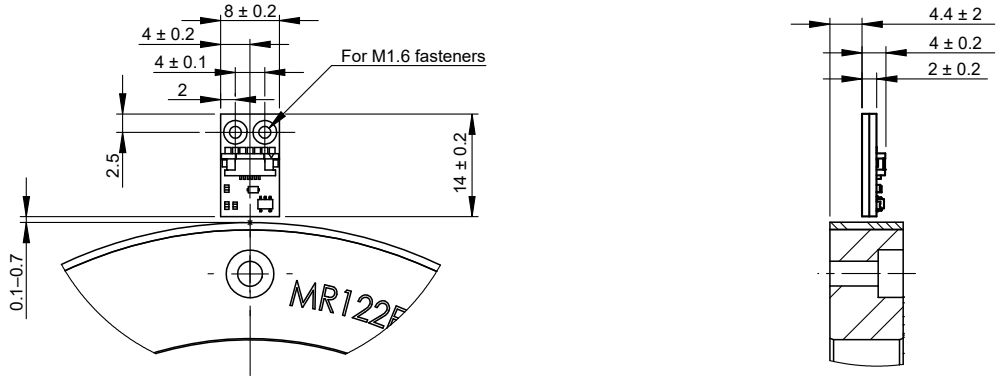
RLC2IC



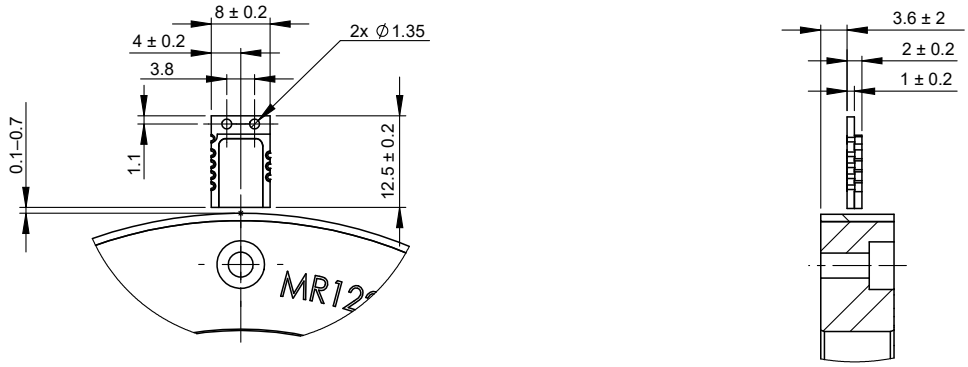
RLM



RLB



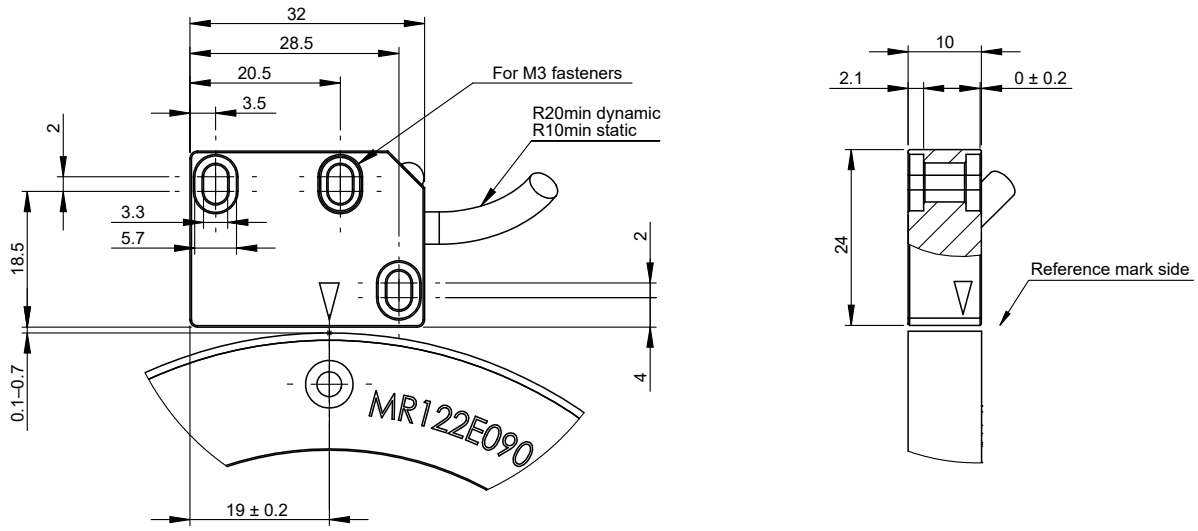
RLC2HD



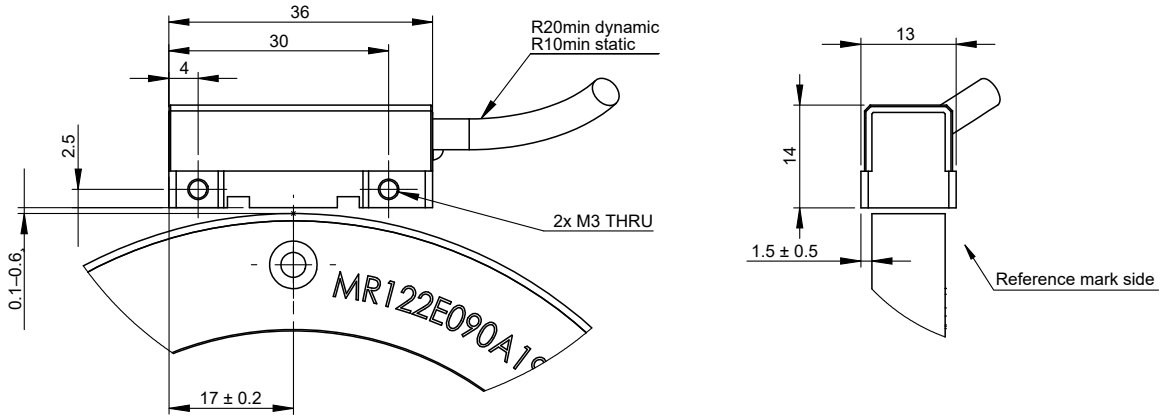
MR122E

Outer diameter: 122 ± 0.1 mm
Inner diameter: 90 H7 mm
Number of poles: 194

LM10



LM13

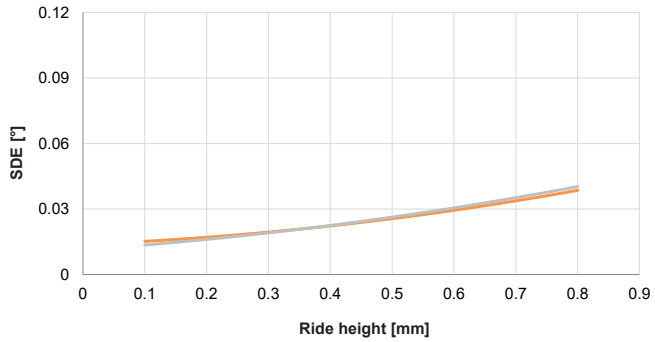


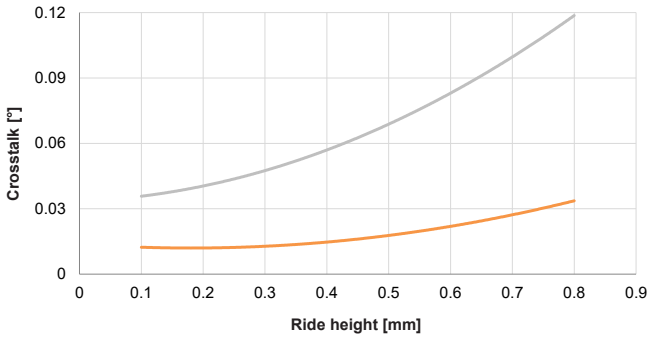
SDE and crosstalk error

(typical measured value)

Legend
- LM
- RoLin

194 poles, 2 mm width





MR162Q

Compatibility table

	LM10	LM13	LM15	RLB	RLC2HD	RLC2IC	RLM
256 poles, 2 mm pole length	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM

No Ri - No reference mark option, only incremental track available
Ri+DCRM - Unique, distance coded reference mark or only incremental track available

Technical features

Outer diameter	161.7 ± 0.1 mm[c] 161.9 ± 0.1 mm[d]
Inner diameter	$143\ ^{0}_{-0.03}$ mm
Height	12 ± 0.1 mm
Mass	365 g
Moment of inertia	2.14×10^{-3} kgm^2
Material of magnetic layer	HNBR + ferrite
Hub material	EN1.4104 / AISI 430
Hub thermal expansion coefficient (CT	10×10^{-6} K^{-1}
Protective foil option	Yes

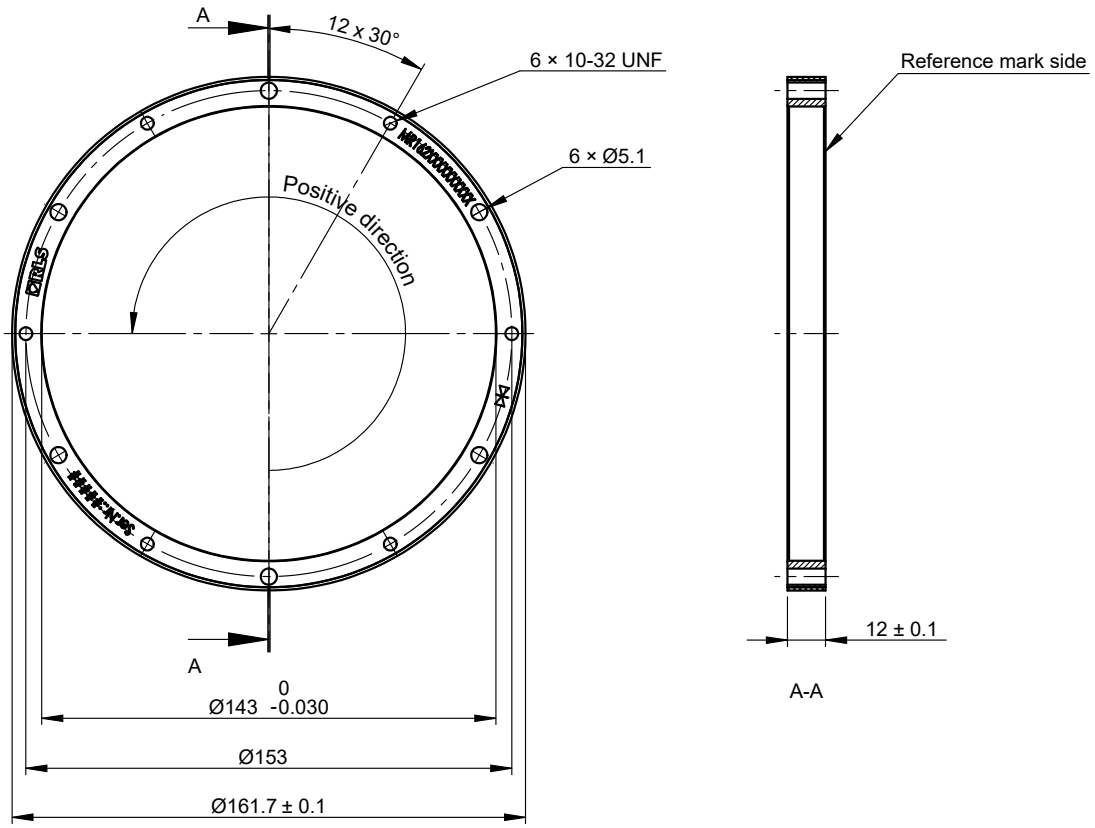
Pole length	2 mm
Number of poles	256
Basic increment of distance coded reference mark	64 mm / 45°
System error	±0.03°

[c] without protective foil
[d] with protective foil

NOTE: For maximum speed table refer to MR01D03.

Dimensions and installation tolerances

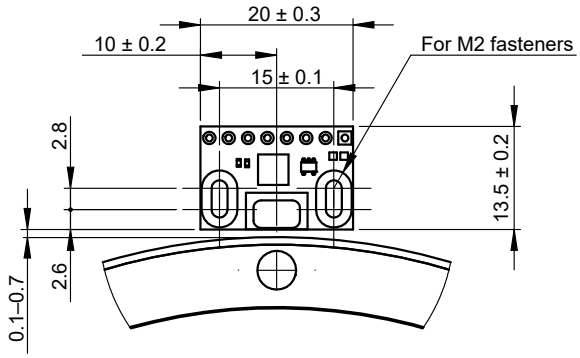
Dimensions and tolerances in mm.

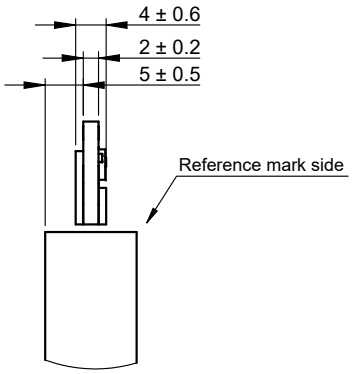


MR162Q

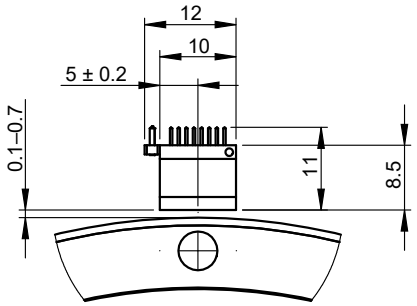
Outer diameter: 161.7 ± 0.1 mm
Inner diameter: 143 $^{0}_{-0.03}$ mm
Number of poles: 256

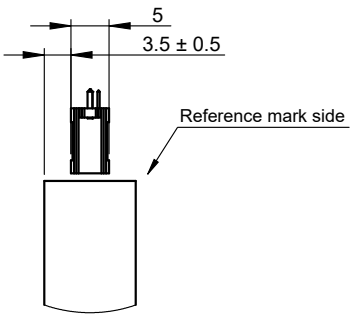
RLC2IC



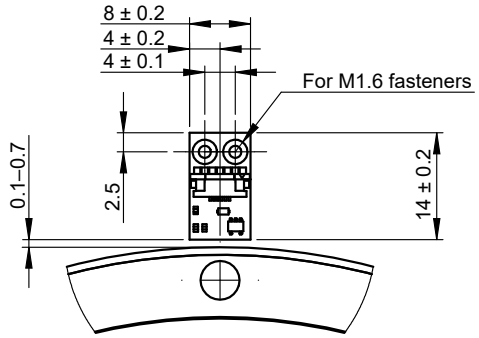


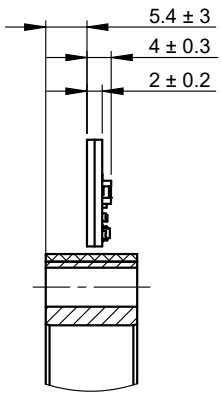
RLM



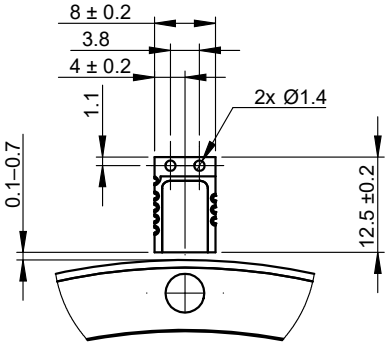


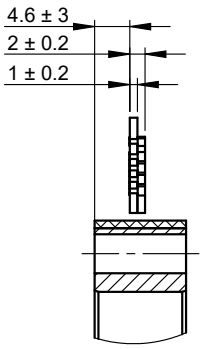
RLB





RLC2HD

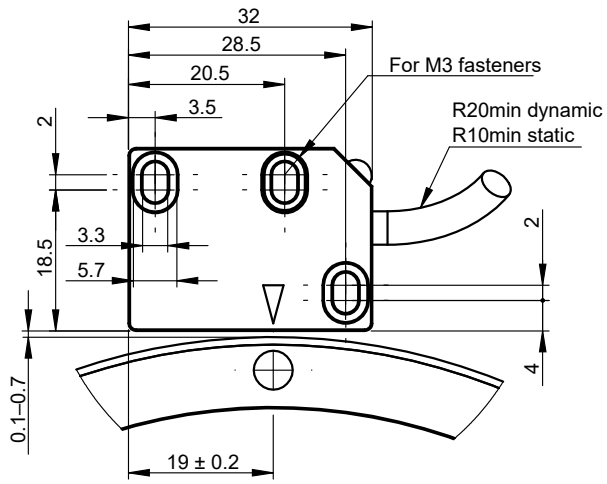


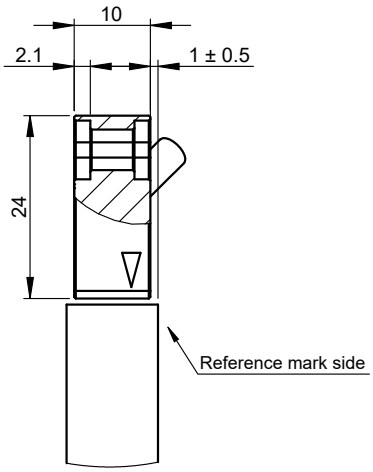


MR162Q

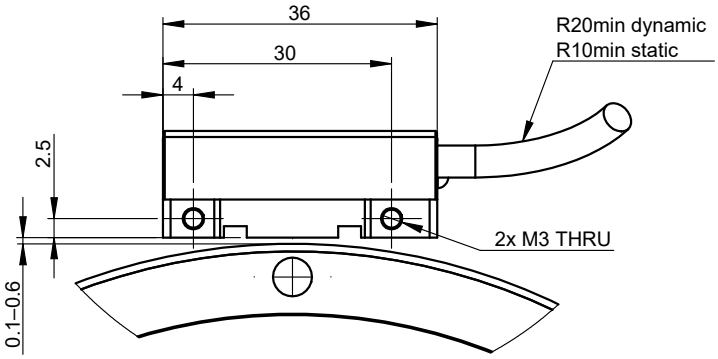
Outer diameter: 161.7 ± 0.1 mm
Inner diameter: 143 $^{0}_{-0.03}$ mm
Number of poles: 256

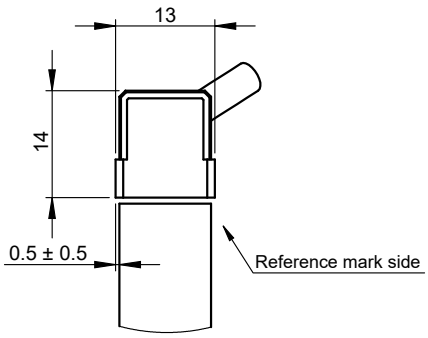
LM10





LM13



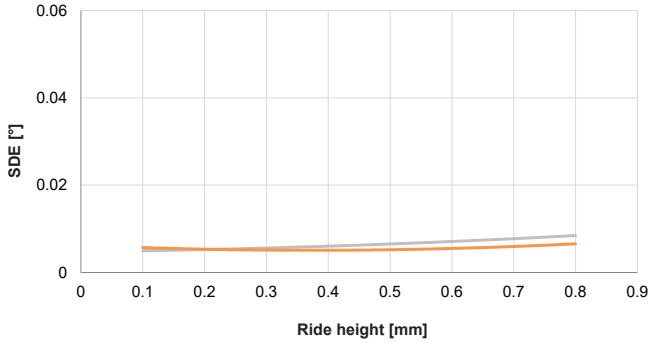


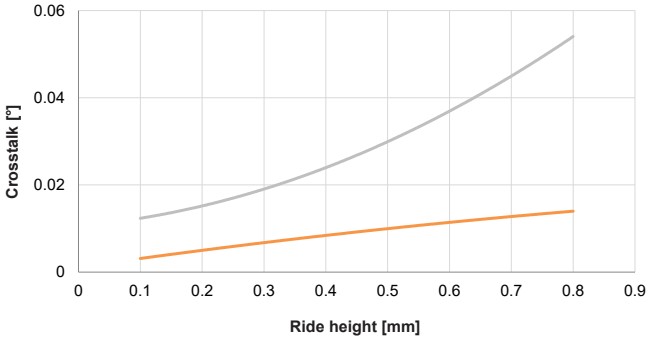
SDE and crosstalk error

(typical measured value)

Legend
- LM
- RoLin

256 poles, 2 mm width





Part numbering

MR 040 G 030 A 064 M 00

Series
MR - Magnetic incremental ring

Outer diameter
031 - 31 mm
040 - 40 mm
047 - 47 mm
050 - 50 mm
057 - 57 mm
075 - 75 mm
080 - 80 mm
100 - 100 mm
122 - 122 mm
162 - 162 mm

Cross section
B - Height 5.5 mm, radial magnetisation
E - Height 10 mm, radial magnetisation
F - Height 8.6 mm, radial magnetisation
G - Height 8 mm, radial magnetisation
Q - Height 12 mm, radial magnetisation
R - Height 11 mm, radial magnetisation

Inner diameter
020 - 20 mm
030 - 30 mm
040 - 40 mm
045 - 45 mm
051 - 51 mm
060 - 60 mm
074 - 74 mm
085 - 85 mm
090 - 90 mm
143 - 143 mm

Reference mark
A - With reference mark
B - No reference mark
D - Distance coded reference mark[1]

Number of poles
2 mm pole length:
050 - 50 poles
064 - 64 poles
076 - 76 poles
080- 80 poles
090 - 90 poles
120 - 120 poles
128 - 128 poles
160 - 160 poles
194 - 194 poles
256 - 256 poles
5 mm pole length:
020 - 20 poles
032 - 32 poles
036 - 36 poles
048 - 48 poles

Material
M - Stainless steel hub with vulcanised elastoferrite layer
P - Stainless steel hub with vulcanised elastoferrite layer and protective foil (for high speed applications)[2]

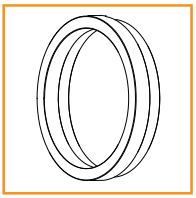
Special requirements
00 - No special requirements

[1] For basic increment length refer to technical specifications of a selected ring.
[2] Not available for rings with Cross sections B and F. For availability refer to technical specifications of a selected ring.

NOTE: Not all combinations are valid. The inner diameter of rings is related to the outer diameter and cannot be randomly selected. Please check table below for available options.

Series	Outer diameter	Cross section	Inner diameter	Reference mark	Number of poles	Material	Special requirements
MR	031	G	020	A / B	050 / 020	M / P	00
	040	G	030	A / B / D	064		
				A / B	026		
	047	B	040	A / B	076	M	
	050	E	040		080 / 032	M / P	
	057	E	045	A / B / D	090 / 036		
	057	R	051		090		
	075	E	060		120 / 048		
	080	R	074		128		
	100	F	085		160	M	
	122	E	090		194	M / P	
	162	Q	143		256		

Accessories part numbering



Installation jig for MR100F

ACC021

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Саранск (8342)22-96-24
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

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