MS
Incremental Magnetic Scales

ACCURACY UP TO ±10 µm/m

UP TO 150 m LENGTH

DISTANCE CODED REFERENCE MARK

The robust MS incremental magnetic scales consist of a stainless steel carrier and an elastomer-bonded ferrite. The elasto-ferrite layer is magnetised with 2 mm, 2.032 mm or 5 mm long alternating magnetic poles that form an incremental magnetic pattern.

Features and benefits

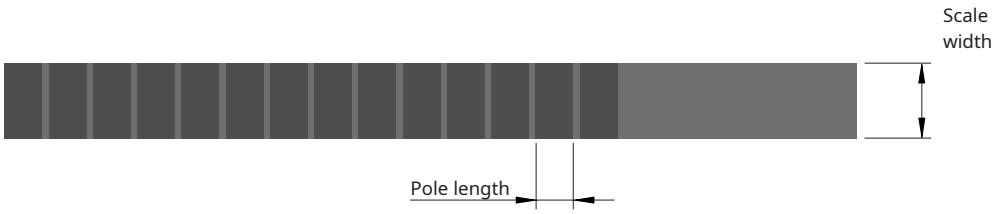
- Customer selectable position of reference mark
- Four accuracy grades available: ±10 µm/m, ±20 µm/m, ±40 µm/m, ±100 µm/m
- Partial arc application possibility
- Optional protective cover foil for heavy duty applications
- Excellent resistance to dirt, dust and humidity
- Easy installation with adhesive tape, end clamps or track section

SMT PICK AND PLACE | PRINTING TECHNOLOGY | LINEAR MOTOR | INDUSTRIAL AUTOMATION | ASSEMBLY LINES

General information

The incremental RLS magnetic scales are compatible with RLS standard LM and component level RoLin readheads, which ensure reliable operation due to the non-contact design.

Selection guide



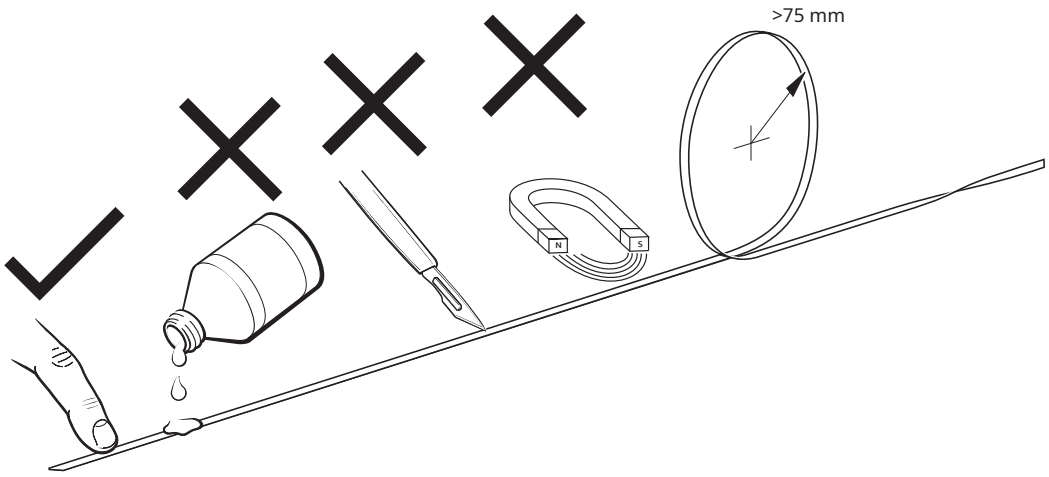
Scale	Pole length [mm]	Scale width [mm]	Accuracy [µm/m]	Compatibility with readheads						
				LM10	LM13	LM15	RLB2	RLC2HD	RLC2IC	RLM2
MS05	2	5	±10 / ±20 / ±40	-	-	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM
MS07	2.032	5	±40	-	-	-	-	-	-	Ri*
MS10	2	10	±10 / ±20 / ±40	Ri+DCRM	Ri+DCRM	-	No Ri	No Ri	Ri+DCRM	Ri+DCRM
MS12	2.032	10	±40	Ri*	Ri*	-	-	-	-	-
MS15	5	10	±100	-	-	Ri+DCRM	-	-	-	-

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

* Compatible with DPI version only.

For readhead specifications see data sheets available at **RLS media center**.

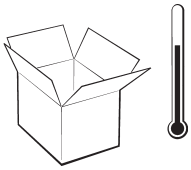
Storage and handling



It is strongly recommended that the scale is factory cut at RLS otherwise product warranty does not apply.

The magnetic scale should not be exposed to magnetic field densities higher than 50 mT on its surface, as this can damage the scale.

Storage temperature



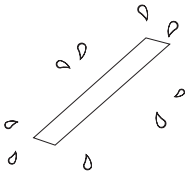
–40 °C to +60 °C

Operating temperature

Scale applied on the linear guide:
–40 to +100 °C

Scale applied on the curved surface:
–40 °C to +80°C

Humidity



Up to 100 % RH

Chemical resistance

The use of alcohol for cleaning is considered safe, but it is not allowed to immerse the scale in alcohol. Furthermore, the scale surface print and drawn reference mark may disappear if the scale is not carefully cleaned.

For more information on chemical resistance **contact RLS**.

Packaging

The type of packaging depends on both the length of the magnetic scale and its accuracy class. Shorter scales are packed individually, while scales with a longer length are rolled.

To maintain accuracy, special packaging is used for magnetic scales of accuracy class D; Scales shorter than 1 m are packed in a plastic tube, while spiral packaging is used for longer lengths. This prevents demagnetisation of the scale by maintaining the distance between the scale rolls.

If option B, H or N is selected, the protective cover foil is supplied together with the scale. The cover foil is not mounted on the scale.

All MS magnetic scales have 12 months shelf life and should be installed within this period.

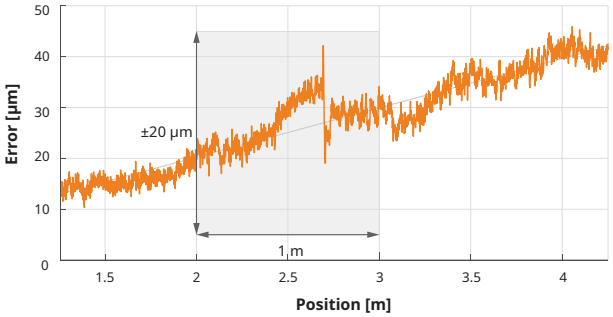
Accuracy of linear encoder systems

The accuracy class is a sum of Sub-Divisional Error (SDE) and magnetisation error. The extreme values of the measurement curves over any one-meter section of the measuring length are within the accuracy class, as shown on the right. If measuring length is shorter than one meter, the accuracy class corresponds to this length. Magnetic scales are produced in four accuracy classes:

- Class D: ±10 µm/m
- Class A: ±20 µm/m
- Class B: ±40 µm/m
- Class C: ±100 µm/m

For accuracy class D (±10 µm/m) a special packaging is provided to ensure the performance of the scale (see **Packaging**).

All figures below are for representation purpose only.



Example for accuracy class A.

Encoder-specific errors

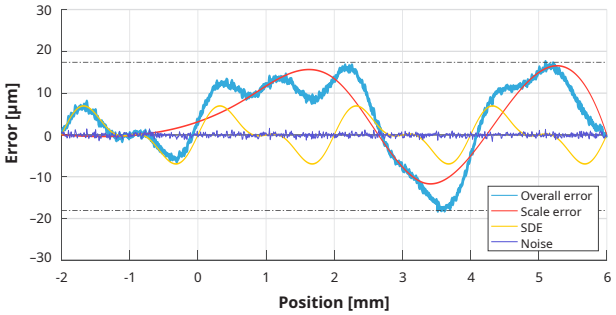
The accuracy of the linear encoder measurement is influenced by the encoder-specific errors and the installation-dependent error. To evaluate the overall accuracy, each of the significant errors must be taken into account.

Magnetisation error

The magnetisation error is caused by imperfections in the elasto-ferrite material and possible deviations resulting from the magnetisation process.

The following factors influence the result:

- Magnetic inhomogeneity of the elasto-ferrite layer,
- Oscillations in the elasto-ferrite thickness,
- Measurement uncertainty of the magnetisation system during manufacturing process



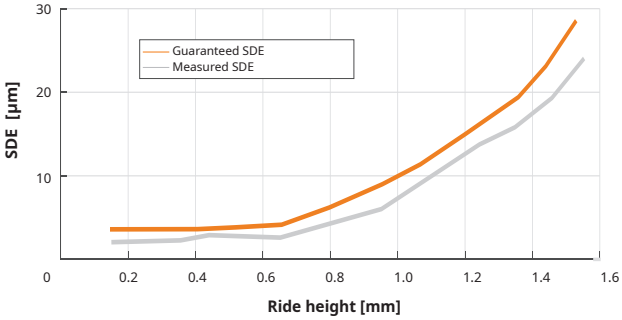
Typical error plot representation.

Sub-divisional error (SDE)

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

- Inhomogeneity and cycle definition of magnetic poles,
- Sensing distance (ride height) of the installed readhead,
- Quality of signal processing,
- Properties of the sensor.

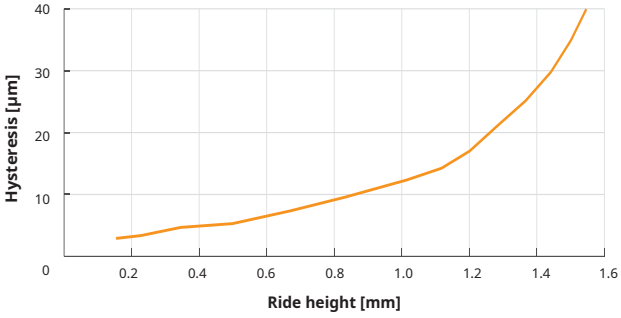
The SDE leads to speed undulations in applications where the encoder is used as a feedback, e.g. in speed control loops.



Representation of an SDE as a function of the ride height.

Hysteresis

Hysteresis is a difference in the measurement results when approaching the same point from different directions. The ferromagnetic materials maintain the magnetised state in response to external fields and try to change their direction. Hysteresis in the encoder systems depends on the magnetic field strength. A stronger magnetic field leads to a smaller hysteresis and vice versa. Therefore hysteresis is strongly influenced by the sensing distance at which the readhead is installed.



Representation of a Hysteresis as a function of ride height (for 2 mm pole length only).

Installation and temperature-dependent errors

In addition to the given encoder-specific error, the installation of the encoder system has a considerable influence on the total accuracy of the encoder system. Of particular importance are the installation eccentricity and the effect of deformations caused by scale installation.

Temperature-dependent error

Temperature-dependent error is an effect of a thermal expansion coefficient α that can be used to calculate the thermal expansion coefficient (CTE) ΔL

$$\Delta L = L \cdot \alpha \cdot \Delta T$$

where L is an effective length of the magnetic scale in [m] and ΔT is a relative temperature difference in [K]. RLS offers steel with CTE ΔL = 17 x 106 [m/mK].

Influence of stress during installation

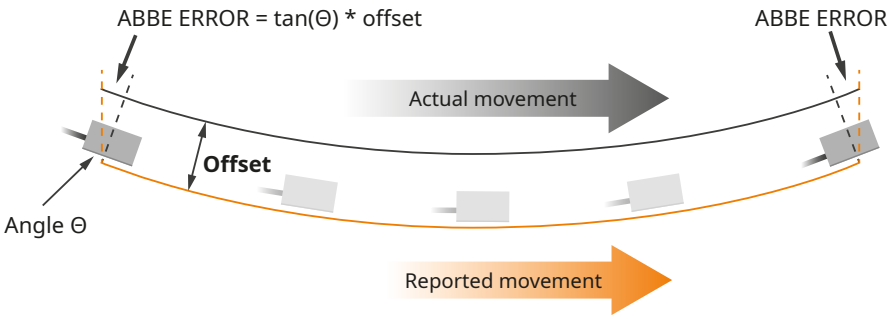
The accuracy of the system is influenced by the repeated cycling of the load. The tensile load of 1 kg causes the magnetic scale to expand for 17 µm. The linear expansion ΔL can be calculated as

$$\Delta L = \frac{F}{A \cdot E} L$$

where F is tensile force in [N], A cross-sectional area in [m2], E Young's modulus of elasticity in [Pa] and L scale length in [m].

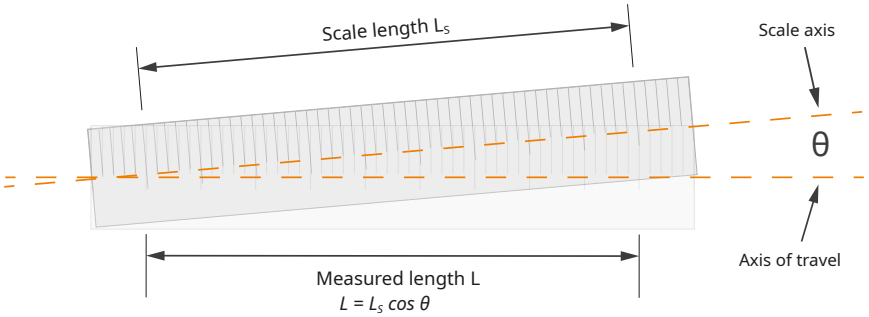
Abbe or sine error

Abbe or sine error occurs when the axis of measurement is offset from the axis to be measured. If the axis of linear movement is curved, the difference between the actual movement and the reported movement contains an error proportional to the offset and the tangent of the angle θ.



Cosine error

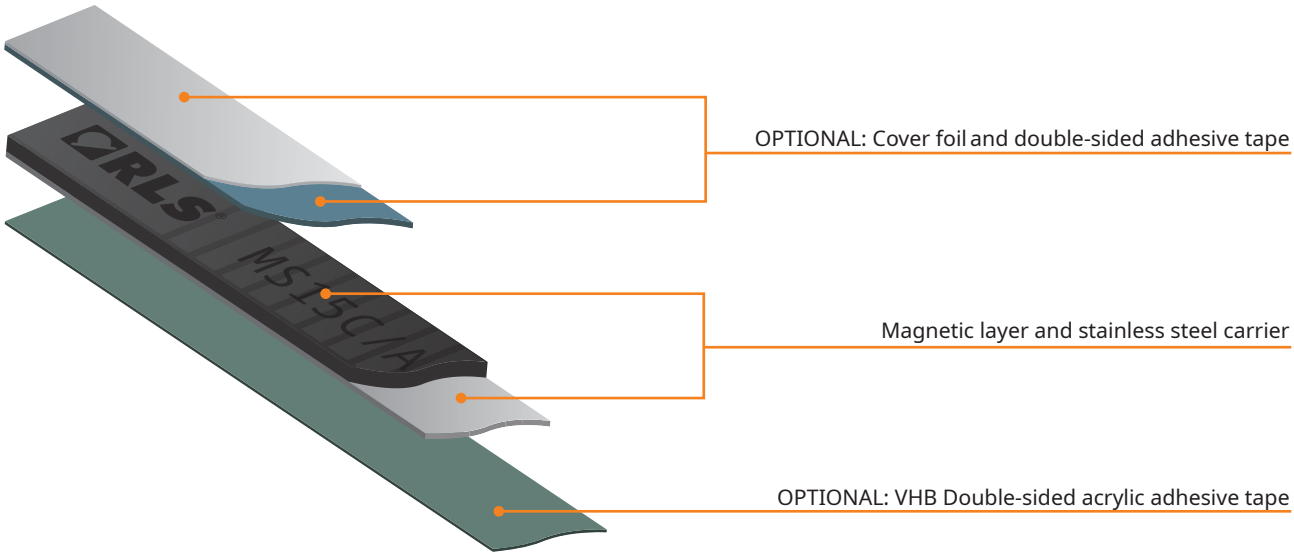
The cosine error results from an angular offset between the axis of motion and the position-giving element (encoder). The cosine error is as small as the angle θ.



Magnetic scale design

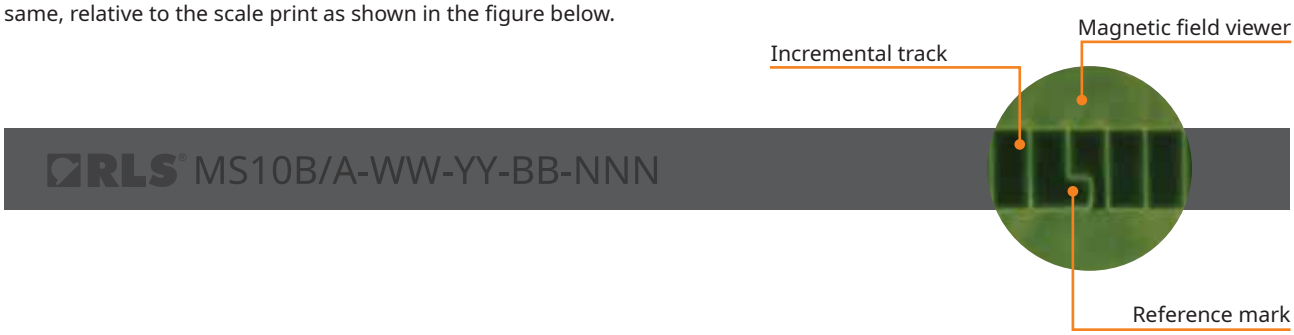
Dimensions and tolerances are in mm.

Structure



Appearance and print

The orientation of the magnetised reference mark and the incremantal track is always the same, relative to the scale print as shown in the figure below.



The shape of the reference mark may vary. The image is for representation purposes only.

Scale surface print description

Scale surface print appears every 100 mm and contains the RLS logo and a unique code.

MS 10 B / A WW YY BB NNN

- MS — Magnetic scale
- 10 — Scale type
- B / A — Accuracy class
- WW — Back adhesive options
- YY — Week of scale production
- BB — Year of scale production
- NNN — Batch number
- Counter designator (100 mm = +1 count)

Technical specifications

System data

Pole length		2 mm, 2.032 mm, 5 mm
Reference mark		Unique, DCRM, multiple reference marks
Scale accuracy	Class A	±20 µm/m
	Class B	±40 µm/m
	Class C	±100 µm/m
	Class D	±10 µm/m

Mechanical data

Material	Carrier	1.4310 stainless steel
	Magnetic scale	NBR elasto-ferrite
Thickness	Carrier	0.3 ±0.05 mm
	Double-sided acrylic adhesive tape VHB 3M9469	0.13 mm
	Cover foil	0.076 ±0.006 mm
	Double sided tape	0.05 mm
	Scale	1.43 ±0.1 mm (with back adhesive) 1.3 ±0.1 mm (without back adhesive)
Mass	MS05, MS07	0.031 kg/m
	MS10, MS12, MS15	0.062 kg/m
Width	MS05, MS07	$5^{-0.05}_{+0.15}$ mm
	MS10, MS12, MS15	$10^{-0.05}_{+0.15}$ mm
Cover foil width	CF05 (MS05, MS07)	4.8 ±0.35 mm
	CF08 (MS10, MS12, MS15)	7.6 ±0.35 mm
	CF10 (MS10, MS12, MS15)	9.5 ±0.1 mm
Maximum length	Accuracy class A, B, C	50 m (150 m with longer lead time*)
	Accuracy class D	20 m
Expansion coefficient (carrier)		~17 × 10^{-6} [m/mK]
Minimum bending radius		75 mm

* Not applicable for MS05 and MS07.

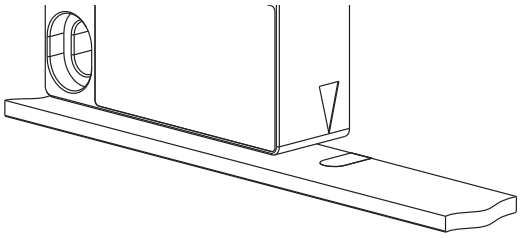
Environmental data

Temperature	Operating	Scale applied on the linear guide: –40 °C to +100 °C Scale applied on the curved surface: –40 °C to +80 °C
	Storage	–40 °C to +60 °C

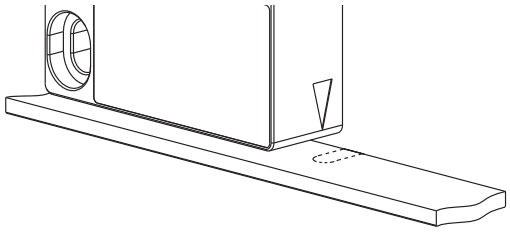
Reference mark options

Unique reference mark

The readhead must be ordered with reference mark option A (see corresponding readhead data sheet). The magnetic scale must be ordered with reference mark (see **Part numbering**). If required, the cover foil can be installed over the reference mark. See below table of default reference marks for each magnetic scale. MS10 can also be ordered with magnetised reference mark (see **Part numbering** for Reference mark option M).



Cut reference mark



Magnetised reference mark

Scale	Default reference mark
MS05	magnetised
MS07	magnetised
MS10	cut
MS12	cut
MS15	magnetised

The shape and the position of the cut or magnetised reference mark are critical so these options are only available as factory order.

Multiple reference mark

The readhead must be ordered with reference mark option A (see corresponding readhead data sheet). The magnetic scale must be ordered with reference mark option P (see **Part numbering**). Multiple reference marks are magnetised, factory predefined and spaced every 50, 100, or 200 mm on a 20 m long scale. For custom options please **contact RLS**.

Distance coded reference marks (DCRM)

The readhead must be ordered with reference mark option A (see corresponding readhead data sheet). The magnetic scale must be ordered with a reference mark option D and a basic increment value stated as K (see **Part numbering**). The distance coded reference mark option provides multiple magnetised reference marks that are individually spaced according to a specific mathematical algorithm. The absolute position is calculated after traversing 2 consecutive reference marks. Maximum length and minimum traverse depend on basic spacing (K) between reference marks, as shown in the figure below. which is customer selectable at point of order.

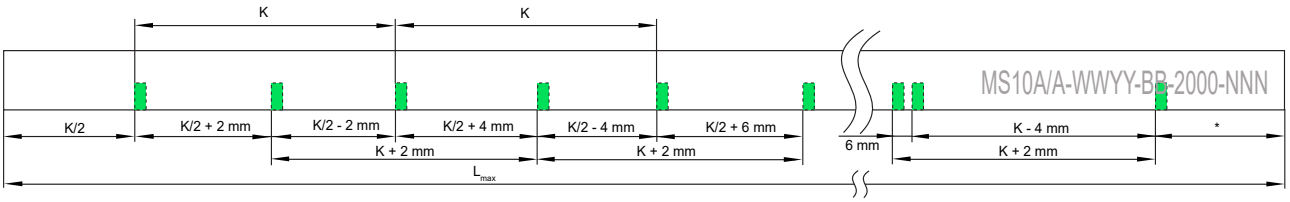
The basic increment K (in mm) is chosen at the point of order and must be divisible by 2 × P with no remainder. **K** determines:
Maximum codable length:

$$L_{max} = K\left(\frac{K}{2P} - 1\right) - 2P$$

L_{max} - Maximum codable length (in mm)
K - Basic increment (in mm)
P - Pole length (in mm)

Minimum distance along the measuring scale which needs to be traversed in order to calculate the absolute position.
The minimum travel distance equals the basic increment **K - 2P**.

The distribution of the reference marks is shown in the figure below. DCRMs are produced by additional magnetisation of the magnetic scale.



* Depends on magnetic scale length.

K (mm)	Maximum codable length (mm)	
	P = 2 mm	P = 5 mm
20	76	
40	356	
60	836	
80	1,516	
100	2,396	890
200	9,796	3,790
300	22,196	8,690
400	39,596	15,590
500	61,996	24,490
600	89,396	35,390
700		48,290
800		63,190
900		80,090
1,000		98,990

Basic increment (K in mm) - Represents the distance in mm between odd reference marks; it determines the maximum codable length over which the absolute position can be defined. It also determines the minimum distance which needs to be traversed to capture 2 neighbouring reference marks. The basic distance should be divisible by the length of 2 poles (in mm). K is customer selectable.

Maximum codable length (L_{max} in mm) - Is the maximum length of the magnetic scale over which the DCRM feature can be applied and still provide a unique absolute position. Lengths shorter than the maximum length can also be used (see Table 1).

Pole lenght (P in mm) - Is the length of one magnetised pole (S or N). We currently offer magnetic scales with pole lenghts 2 mm (MS10) and 5 mm (MS15).

How the absolute position is evaluated

The absolute position of the first traversed reference mark is calculated by the following formula:

$$RI1 = \left[\frac{1}{P} \times \mathbf{abs}(2 \times \Delta RI - K) - \mathbf{sgn}(2 \times \Delta RI - K) - 1\right] \times \frac{K}{2} + \left[\mathbf{sgn}(2 \times \Delta RI - K) - \mathbf{sgn}(D)\right] \times \frac{\mathbf{abs}(\Delta RI)}{2}$$

Variables

RI1 - Absolute position of first traversed reference mark (in mm)
ΔRI - Distance between two successively traversed reference marks (in mm)
K - Basic increment between two fixed reference marks (in mm)
D - Direction of movement (+1 or –1)

Operators

abs - Absolute value
sgn - Sign function (+1 or –1)

Timing of reference mark capturing

The minimum distance between 2 successive reference marks equals 3 × P. Subsequent electronics must be able to capture position of 2 successive reference marks under the maximum speed condition. Minimum time at which 2 successive reference marks appear is given by formula:

$$T_{Rimin} = \frac{3P}{v_{max}}$$

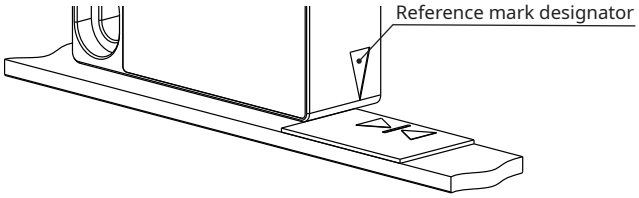
T_{Rimin} - Minimum time between 2 successive reference marks (in ms)
P - Pole length (in mm)
v_{max} - Maximum traverse speed (in m/s)

Periodic reference mark

The readhead must be ordered with reference mark option C (see corresponding readhead data sheet). The magnetic scale must be ordered without reference mark option (see **Part numbering**). The position information is output in incremental quadrature format with periodic reference pulses. The periodic reference pulses correspond to the magnetic pole length.

Stick-on reference mark

The readhead must be ordered with reference mark option A (see corresponding readhead data sheet). The magnetic scale must be ordered without reference mark option (see **Part numbering**). After the scale is installed, a reference mark sticker can be applied to the desired position on top of the scale using the reference mark applicator tool. Make sure that the reference mark sticker is aligned with the corresponding side of the readhead where the reference mark designator is located. It is recommended that the stick-on reference mark is applied for prototyping purposes only. As soon as the applications go to serial production, it is recommended to use a predefined reference mark (cut or magnetised). For the part number of the reference mark and applicatior tool, see Accessories on **page 28**.



Stick-on reference mark is only available for MS10 scale.

Installation instructions

Installation with adhesive tape

Applicable for MS05, MS07, MS10, MS12 and MS15

Installation surface preparation

Magnetic scales can be equipped with VHB backside adhesive tape. Most substrates are best prepared by cleaning with a 50:50 mixture of isopropyl alcohol and water before applying the magnetic scale. Exceptions to the general procedure that may require additional surface preparation include:

- Heavy oil/grease: To remove heavy oil or grease from a surface, a degreaser or solvent-based cleaning agent may be required, followed by cleaning with IPA/water.
- Abrasion: Sanding a surface and then cleaning with IPA/water can remove heavy dirt or oxidation and improve adhesion.
- Adhesion promoters: Priming a surface can significantly improve initial and ultimate adhesion to many materials such as plastics and paints.
- Porous surfaces: Most porous and fibrous materials such as wood, chipboard, concrete, etc. must be sealed to provide a unified surface.
- Unique materials: Special surface preparation may be required for glass and glass-like materials, copper and copper-containing metals, plastics or rubber containing migrating components (e.g. plasticisers).

Further information can be found under "**Surface Preparation for 3M™ VHB™ Tape Applications**".

Shelf life

All MS magnetic scales have 12 months shelf life and should be installed within this period.

Scale application

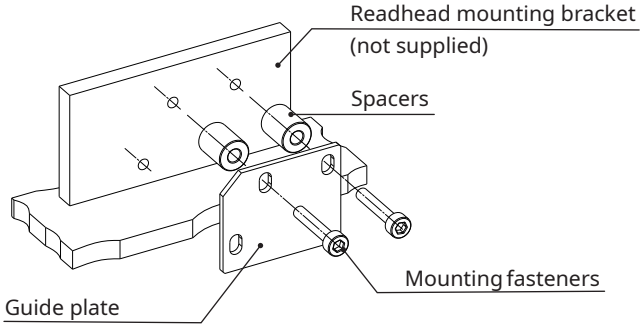
Good surface contact can be achieved by applying a pressure of about 100 kPa. At room temperature, approximately 50 % of the final bond strength is achieved after 20 minutes, 90 % after 24 hours and 100 % after 72 hours. Dynamic overlap shear (peak force to separate is measured after 72 hours dwell time): 830 kPa.

Installation of self-adhesive scale using the applicator tool

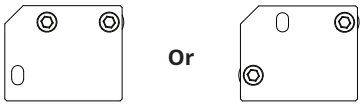
The following figures show the installation of LM10/LM15 using **LM10ASC00** Applicator tool. A video presentation of the following installation process for LM10/LM15 is available in the **RLS Media Center**. For LM13 readhead please use the **LM13ASC00** Applicator tool.

1. **Prepare the mounting surface.**
   Ensure the mounting surface for the magnetic scale has been cleaned and degreased before proceeding.

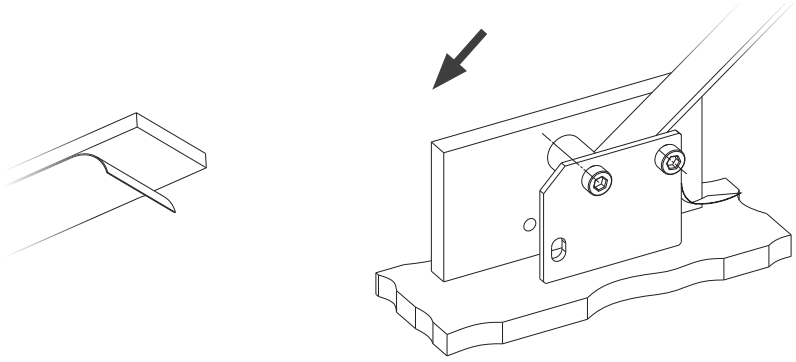
2. **Install the applicator tool.**
   Mount the applicator tool to the readhead bracket. Use two fasteners as per readhead mounting configuration.



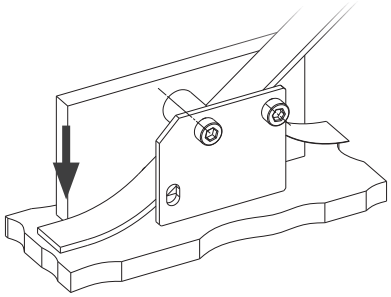
Fastener mounting variants



3. **Load the scale into the applicator tool.**
   Separate the backing paper from the first 40 mm of scale and feed the scale into the applicator tool.

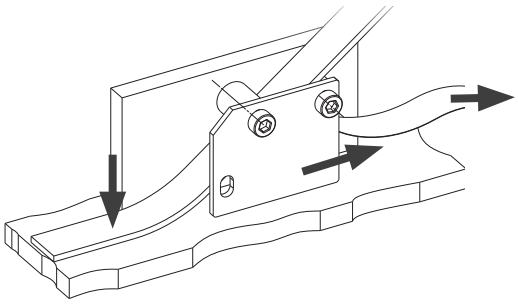


4. **Apply the scale.**
   Push the scale carefully through to the end of scale mark, ensuring that it does not stick to the mounting surface until it is in position. Attach the end of the scale to the mounting surface with light finger pressure.



> To prevent the scale sticking to the mounting surface during this operation it may be necessary to re-apply approximately 20 mm of backing paper to the end of the scale before inserting through applicator tool.

   Traverse the axis through its full travel at a slow, steady speed. While moving the axis apply a light pressure (with a finger) to the scale behind the applicator tool to attach it to the mounting surface and gently pull the backing paper away from the applicator tool as it is separated.



5. **Ensure complete adhesion.**
   Apply firm finger pressure along the full length of the scale from the centre outwards to each end.

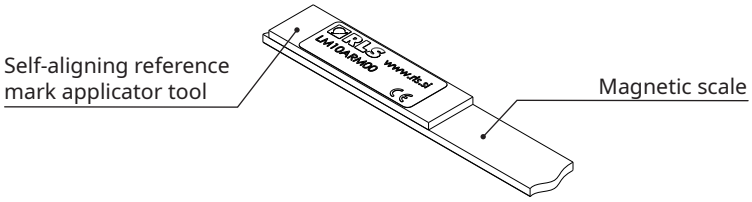
6. **Apply cover foil (if used).**
   Degrease the scale surface with alcohol and install as per scale installation instructions in step 3 onwards.

7. **Remove the applicator tool.**
   When the scale has been applied unbolt the applicator tool from the readhead mounting bracket.

Steps 8-10 apply for MS10 system only.

8. Apply the stick-on reference mark (if used).

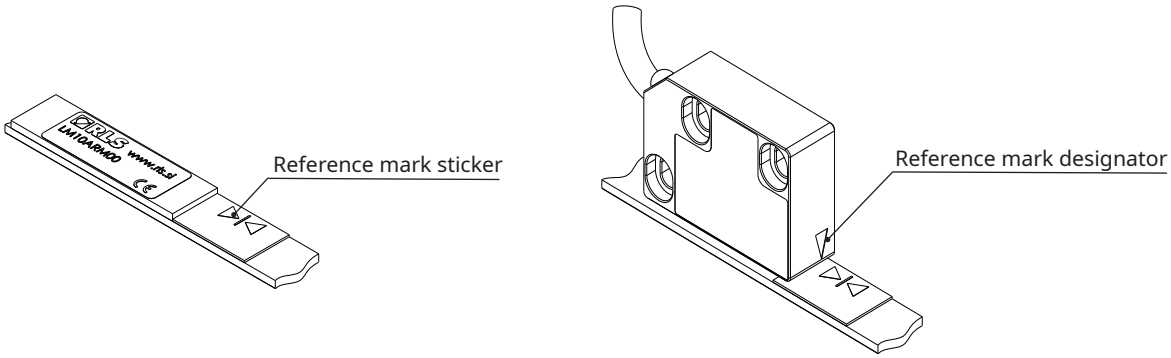
Place the LM10ARM00 reference mark applicator tool on scale in the correct orientation/required position along the length.



9. Stick the reference mark on the scale.

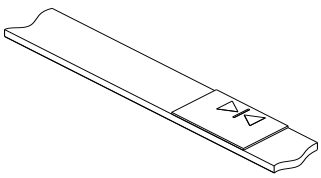
Remove the backing paper from the reference mark sticker and carefully attach it to the surface of the scale by placing it next to the applicator tool.

Correct orientation of the reference mark is crucial. The mark on the sticker should be on the same side as the reference mark designators.



10. Remove the stick-on reference mark applicator tool.

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



Do not remove the scale for refitting or use elsewhere once it has been applied to the mounting surface. The scale can be applied only once.

Partial arc installation

Applicable for MS05, MS07, MS10, MS12 and MS15

The minimum bending radius of the magnetic scale is 75 mm. It is advised using the end-clamps on both ends to prevent the scale from peeling off the surface.

Please note that installing the scale around the circular part will reduce the system total accuracy.

Installation with end clamps

Applicable for MS10, MS12 and MS15

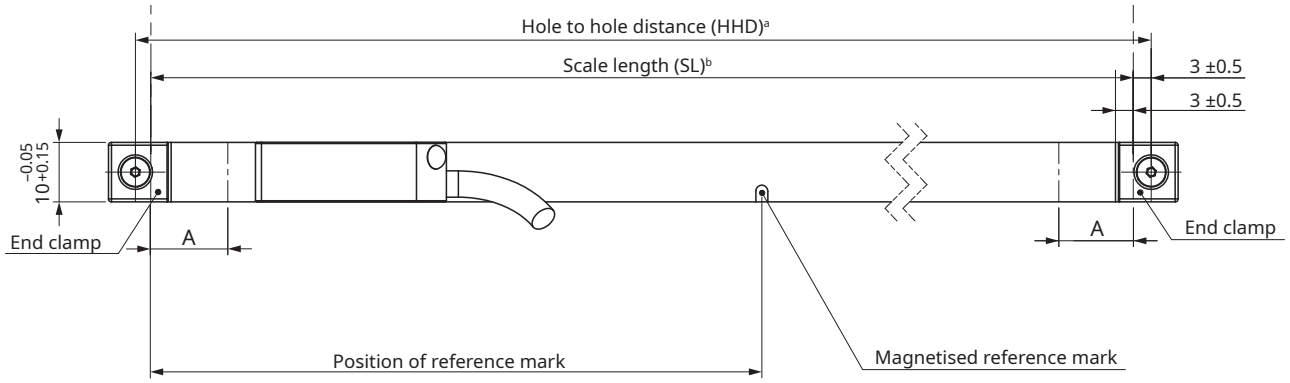
End clamp kit has been designed to anchor the ends of the MS magnetic scale. Make sure the installation surface is clean and free of debris. Included in the kit are 2 end clamps and 2 fasteners M2.5 × 6 DIN 965.

Installation process

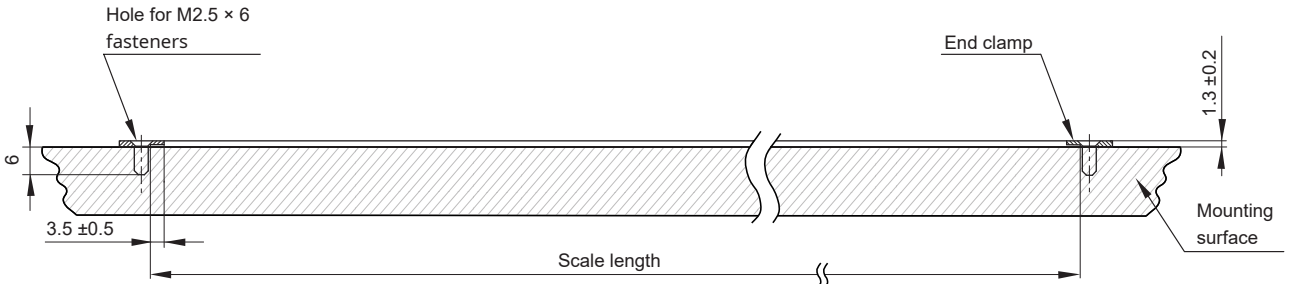
Example given for magnetic scale MS10 with LM10 readhead

1. **Prepare the mounting surface.**
   Drill the holes to the mounting surface as shown below. Refer to the table below for the minimum distance of the reference mark from the edge (marked A).

Magnetic scale	Minimum distance of the reference mark from the edge (A)
MS10, MS15	13 mm
MS12	10 mm



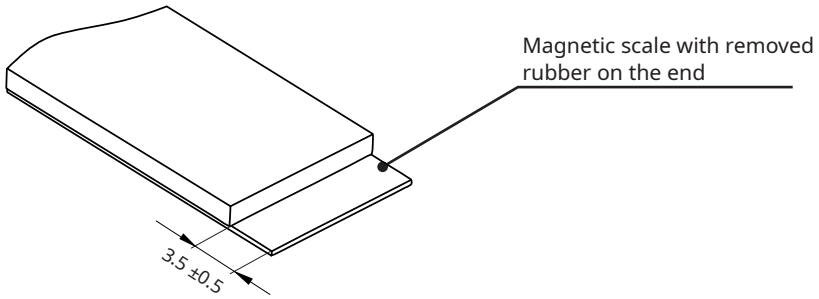
[a] HHD = (SL + 6) ±1 mm (for end clamp mounting)
[b] Measuring length with end clamps = SL - 26 mm



2. Prepare the magnetic scale.

If the scale was not ordered pre-prepared for installation with end clamps, please make sure that:

- the hole to hole distance is correct (SL + 6 mm),
- the rubber surface at the ends of the scale was cut and removed as shown in the figure below.

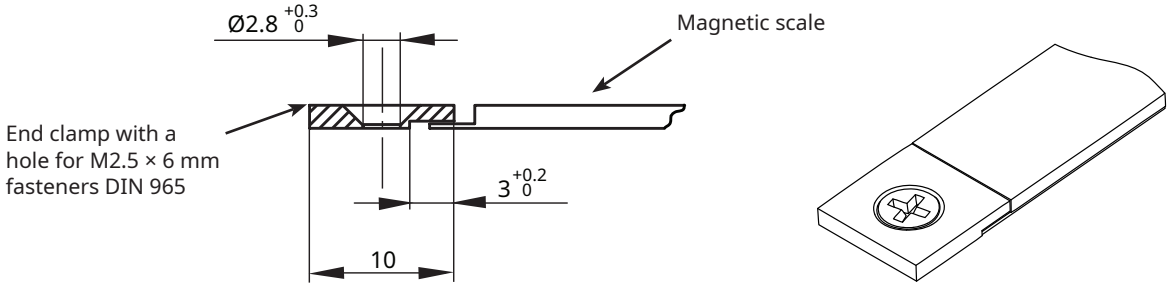


3. Install the scale to the surface.

Make sure that the scale has been cut to the correct length and the mounting surface has been cleaned. Install the self-adhesive scale using the scale applicator tool.

4. Install the end clamp.

Use the supplied fasteners and attach the end clamps so that the magnetic scale is held under the clamp.



Installation with TRS

Applicable for MS10 and MS15

TRS system is designed for applications that require an easily removable scale. The track system consists of aluminium guide rails, available in 1 m and 2 m sections, and a scale clamp element. It holds the magnetic scale securely while allowing it to expand and contract freely. The scale clamp provides a fixed point from which the MS scale can expand.

If damaged, the scale can be pulled out of the guide rails and replaced even if access is limited, reducing machine downtime. This feature also makes the system ideal for large machines that need to be disassembled for transport.

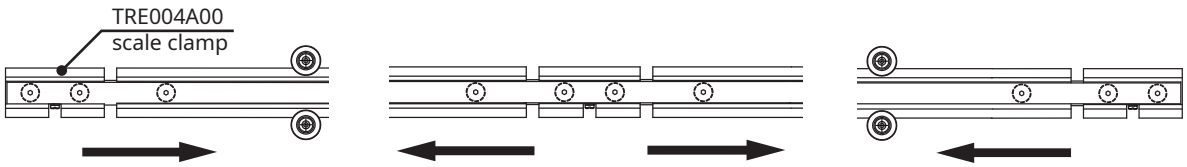
The design of the track section allows installation next to most standard guide rails or freely on any surface. This makes it suitable for many applications, such as automated assembly lines, packaging equipment, printing and other machines where the scale must be installed/removed for transport, or simply for all applications where the thermal expansion of the scale must be independent of the machine structure.

TRS technical specifications

Material	Aluminium, EN AW-6060
Mass	157 g/m
Thermal expansion	~25 µm/m/°C
Dimensions - cross section	20 mm × 4 mm
Available section lengths	1 m, 2 m

Installation tips

Thermal expansion control
The scale can be fixed either at the left/right end or at the center depending on the thermal expansion scheme.

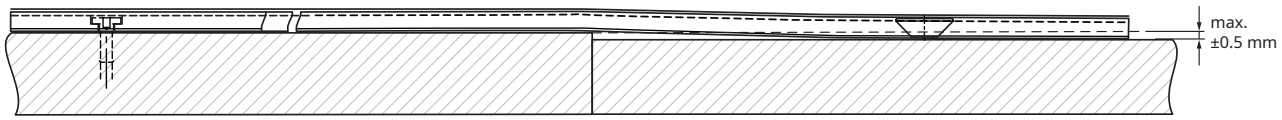


The scale expands to the **right**.

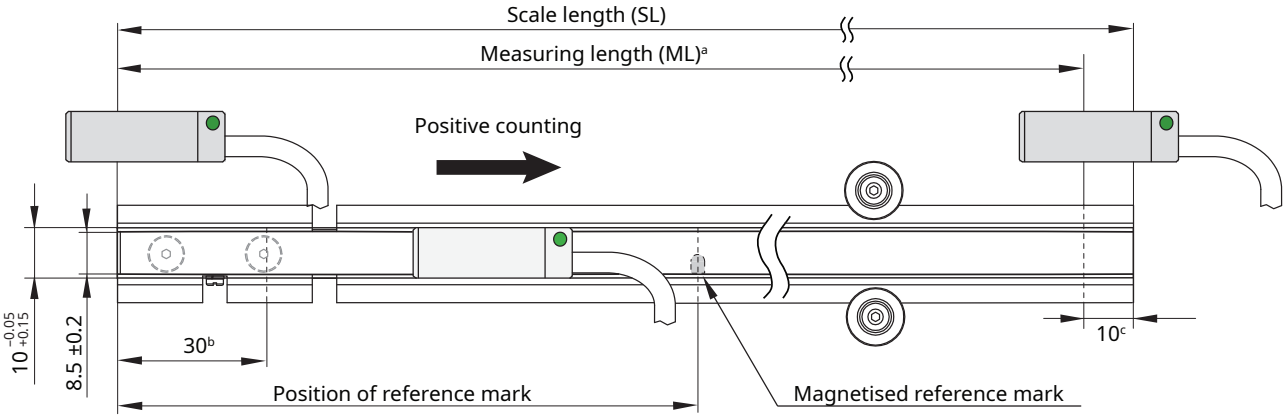
The scale expands in **both directions**.

The scale expands to the **left**.

Alignment of different-level-substrate
The TRS system helps secure the level alignment of the scale across the whole axis.

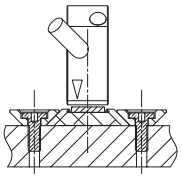
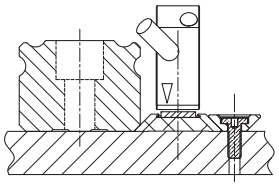


Example: LM10 on MS10 scale with track system



[a] ML = SL - 10 mm
[b] Minimum distance of reference mark from left edge
[c] Minimum distance of reference mark from right edge

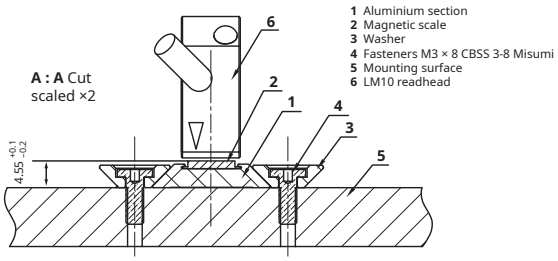
Installation methods

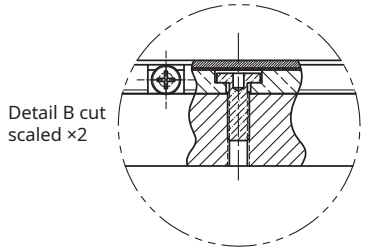
Installation method 1 (see page 17)	Installation method 2 (see page 18)
	
No reference surface available.	Reference surface available for alignment of track section.

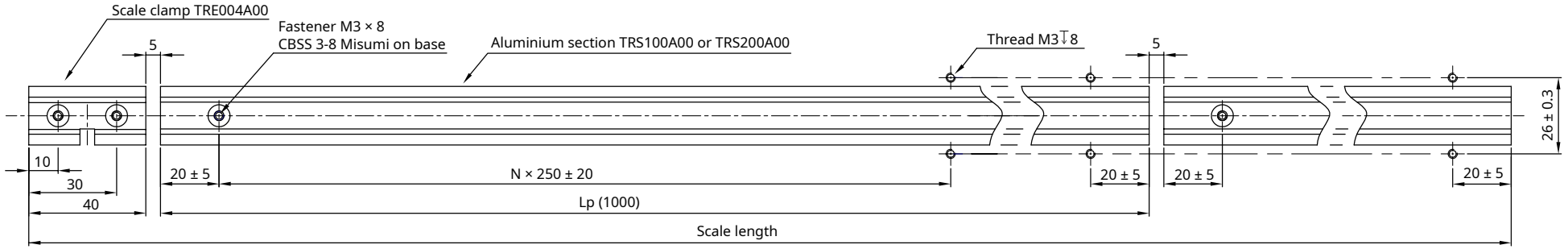
	Number of TRC00 (fasteners and washers) required	
Track section	**Installation method 1**	**Installation method 2**
TRS100A00	8	**4**
TRS200A00	16	**8**

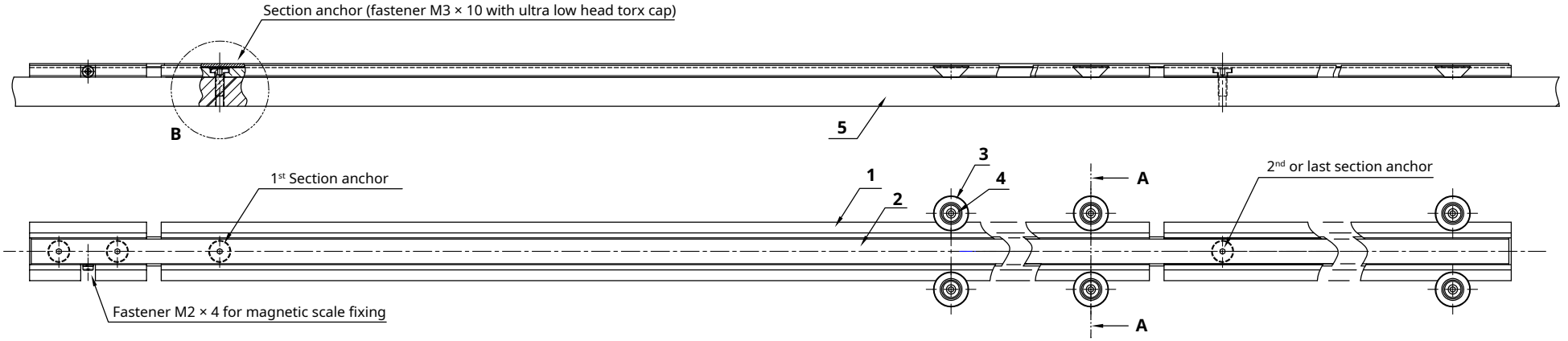
Installation method 1

Dimensions in mm



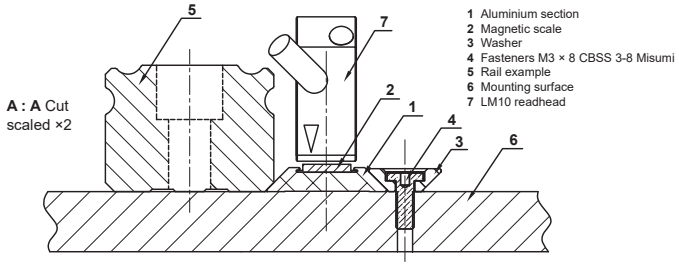


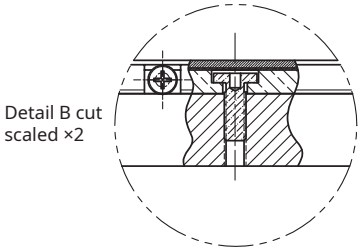


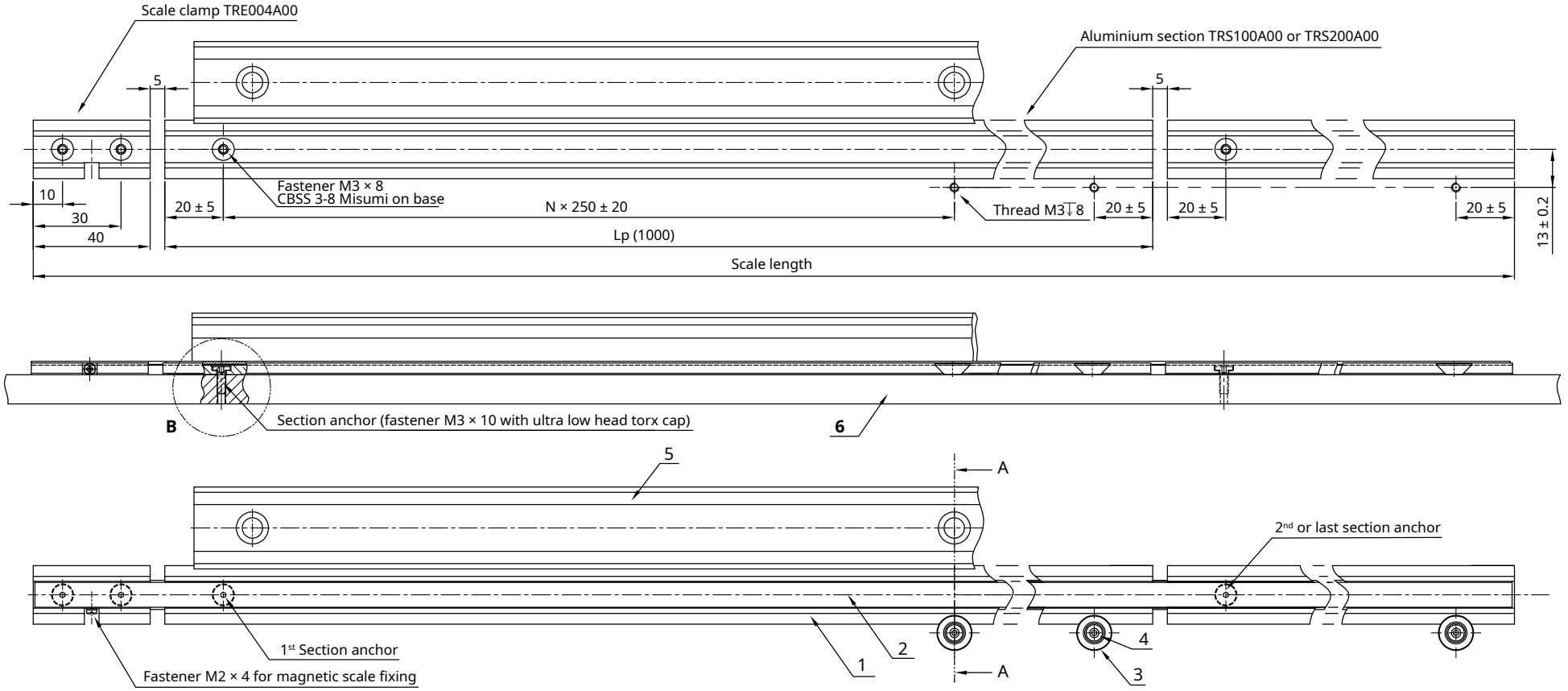


Installation method 2

Dimensions in mm







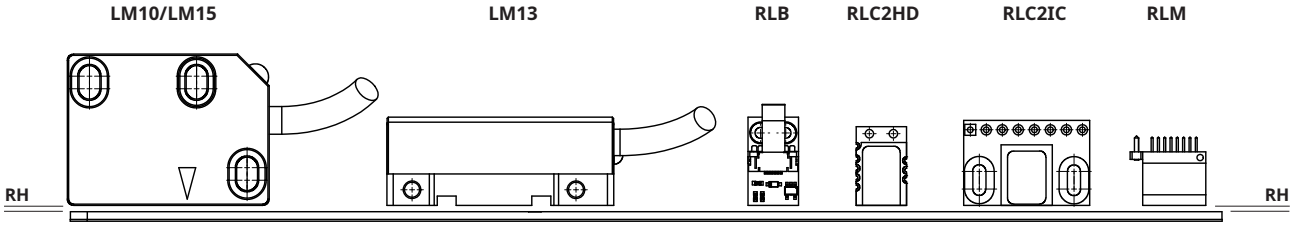
Scale and readhead installation

Dimensions and tolerances are in mm.

Ride height (RH)

		LM10/LM13		LM15	RLB, RLC, RLM
		AV, IA, IB, IC outputs	AS output*	All outputs	All outputs
No cover foil	No Ri	$0.3^{+1.2}_{-0.2}$	$0.3^{+1.2}_{-0.2}$	$0.5^{+3.5}_{-0.4}$	$0.3^{+0.5}_{-0.2}$
	Cut Ri	$0.3^{+0.7}_{-0.2}$	–	–	
	Magnetised Ri		0.3 ± 0.2	$0.5^{+2.5}_{-0.4}$	
	Stick-on Ri	$0.6^{+0.4}_{0}$	–	–	–
With cover foil	No Ri	$0.3^{+1.1}_{-0.2}$	$0.3^{+1.1}_{-0.2}$	$0.5^{+3.4}_{-0.4}$	$0.3^{+0.4}_{-0.2}$
	Cut Ri	$0.3^{+0.6}_{-0.2}$	–	–	
	Magnetised Ri		$0.3^{+0.1}_{-0.2}$	$0.5^{+2.4}_{-0.4}$	

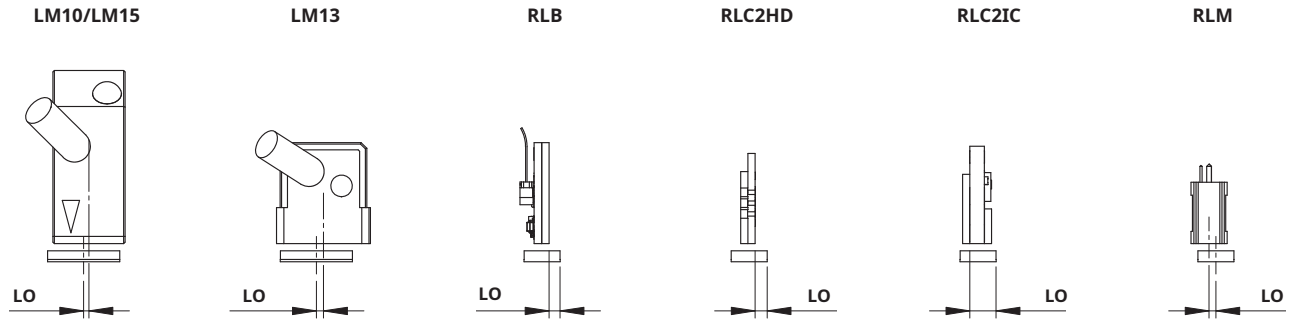
*AS Output is available for LM10 only.



Lateral offset (LO)

	LM10/LM13		LM15	RLB, RLC, RLM
	For AV, IA, IB, IC outputs	For AS output*	All outputs	All outputs
No Ri	0 ± 1	0 ± 1	0 ± 1	0 ± 0.5
Cut Ri	0 ± 0.7	–	–	
Magnetised Ri		0 ± 0.2	0 ± 0.7	
Stick-on Ri	0 ± 1	–	–	–

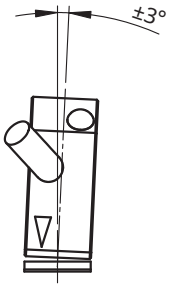
*As Output is available for LM10 only.



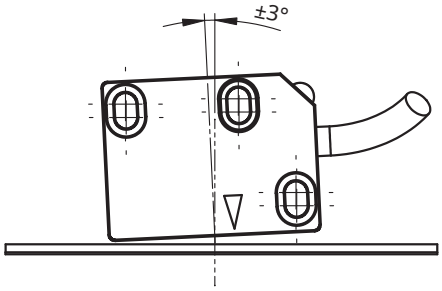
All figures are for presentation purpose only.

LM10/LM15

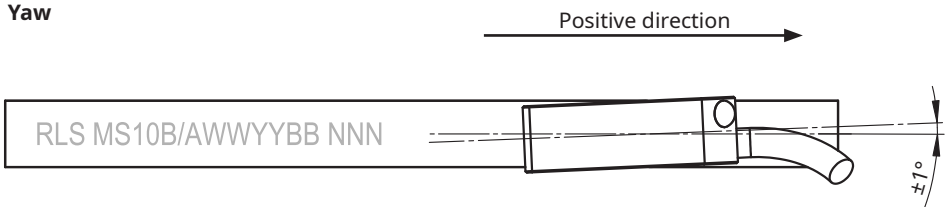
Roll



Pitch

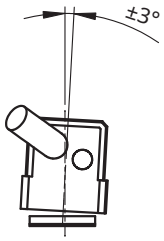


Yaw



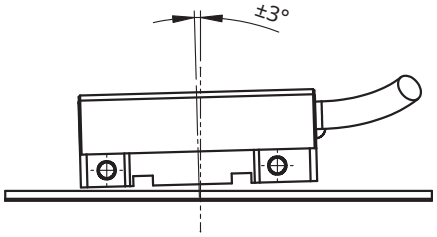
LM13

Roll

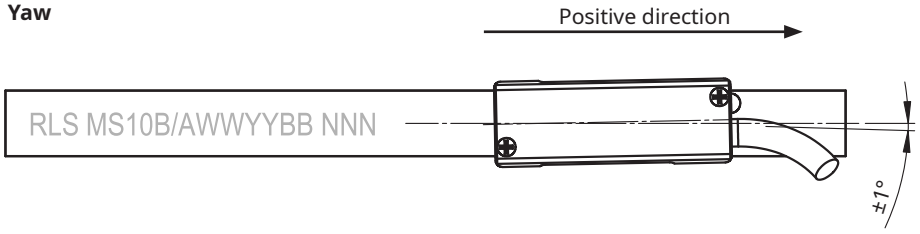


(±0.5 for AS output)

Pitch

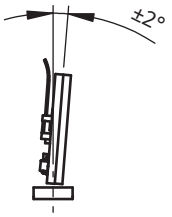


Yaw

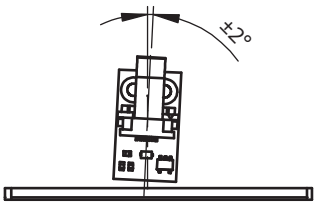


RLB

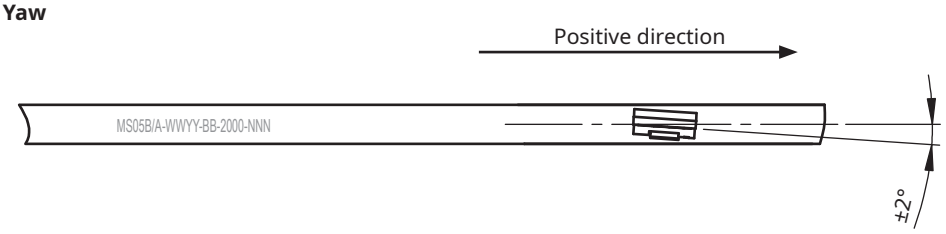
Roll



Pitch

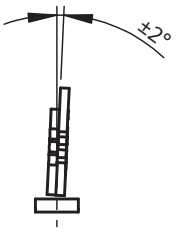


Yaw

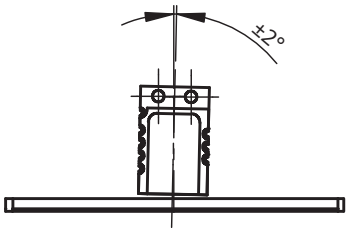


RLC2HD

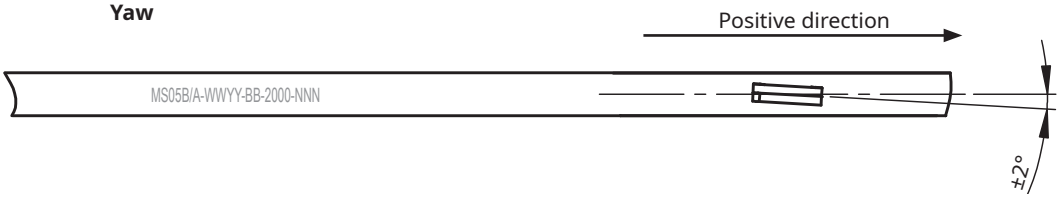
Roll



Pitch

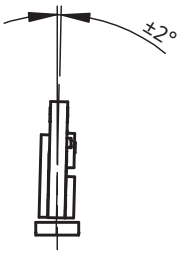


Yaw

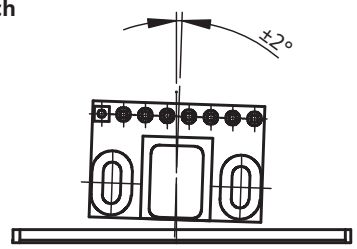


RLC2IC

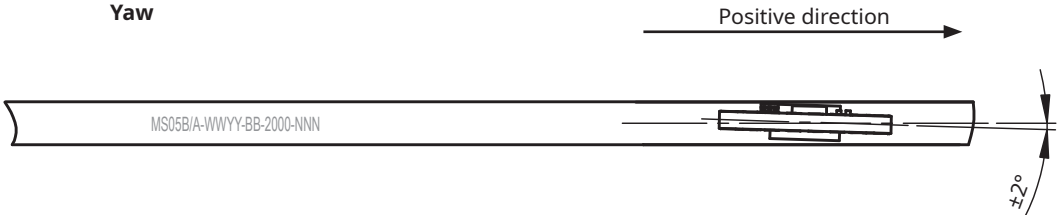
Roll



Pitch

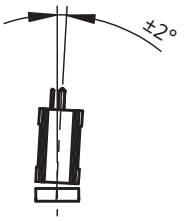


Yaw

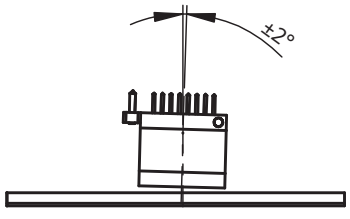


RLM

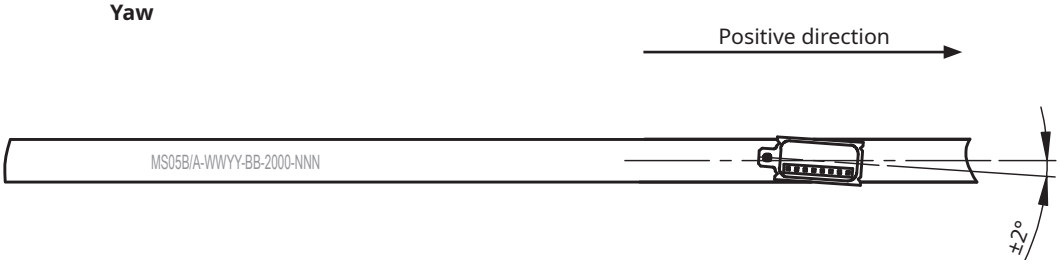
Roll



Pitch



Yaw



Maximum speed tables

MS05, MS10

Readheads LM10, RLB, RLC2HD, RLC2IC, RLM

Resolution [µm]	Counts / 2 mm	Maximum speed [m/s]								
≈ **0.244**	**8,192**	1.82	0.91	0.23	0.11	0.06	0.03	0.02	0.01	0.01
≈ **0.488**	**4,096**	3.65	1.82	0.46	0.23	0.12	0.06	0.05	0.02	0.01
≈ **0.976**	**2,048**	7.30	3.65	0.91	0.46	0.24	0.12	0.10	0.05	0.02
1	**2,000**	7.47	3.73	0.93	0.47	0.24	0.12	0.10	0.05	0.02
1.25	**1,600**	9.33	4.67	1.17	0.58	0.30	0.16	0.12	0.06	0.03
≈ **1.953**	**1,024**	14.58	7.30	1.82	0.91	0.48	0.24	0.19	0.10	0.05
2	**1,000**	14.93	7.47	1.87	0.93	0.49	0.25	0.20	0.10	0.05
2.5	**800**	18.67	9.33	2.34	1.17	0.61	0.31	0.25	0.12	0.06
≈ **3.906**	**512**	29.17	14.58	3.65	1.82	0.95	0.49	0.38	0.19	0.10
4	**500**	29.87	14.93	3.73	1.87	0.97	0.50	0.39	0.20	0.10
5	**400**	37.33	18.67	4.67	2.34	1.22	0.62	0.49	0.25	0.12
6.25	**320**	46.67	23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
≈ **7.812**	**256**	58.34	29.17	7.30	3.65	1.90	0.97	0.77	0.39	0.19
10	**200**	74.67	37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
12.5	**160**	46.67	23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
15.625	**128**	80.00	58.34	14.58	7.30	3.81	1.94	1.53	0.77	0.39
20	**100**	74.67	37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
25	**80**	46.67	23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
31.25	**64**	80.00	80.00	29.17	14.58	7.62	3.89	3.07	1.55	0.78
50	**40**	46.67	23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
62.5	**32**	80.00	80.00	58.34	29.17	15.22	7.78	6.14	3.10	1.56
125	**16**	n/a	80.00	80.00	58.34	30.43	15.56	12.28	6.19	3.11
250	**8**	n/a	n/a	80.00	80.00	60.86	31.11	24.56	12.39	6.23
Minimum edge separation [µs]		0.07	0.13	0.50	1	2	4	5	10	20
Maximum count frequency [MHz]		15	8	2	1	0.5	0.25	0.2	0.1	0.05
Part numbering		**K**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**

MS05, MS10

Readheads LM13 and LM13_20 (high speed version)

Resolution [µm]	Counts / 2 mm	Maximum speed (values in orange for special option 20) [m/s]								
≈ 0.244	8,192	1.82	0.91	0.23	0.11	0.06	0.03	0.02	0.01	0.01
≈ 0.488	4,096	3.65	1.82	0.46	0.23	0.12	0.06	0.05	0.02	0.01
≈ 0.976	2,048	7.30	3.65	0.91	0.46	0.24	0.12	0.10	0.05	0.02
1	2,000	7.47	3.73	0.93	0.47	0.24	0.12	0.10	0.05	0.02
1.25	1,600	9.33	4.67	1.17	0.58	0.30	0.16	0.12	0.06	0.03
≈ 1.953	1,024	14.58	7.30	1.82	0.91	0.48	0.24	0.19	0.10	0.05
2	1,000	14.93	7.47	1.87	0.93	0.49	0.25	0.20	0.10	0.05
2.5	800	18.67	9.33	2.34	1.17	0.61	0.31	0.25	0.12	0.06
≈ 3.906	512	20 / 29.17	14.58	3.65	1.82	0.95	0.49	0.38	0.19	0.10
4	500	20 / 29.87	14.93	3.73	1.87	0.97	0.50	0.39	0.20	0.10
5	400	20 / 37.33	18.67	4.67	2.34	1.22	0.62	0.49	0.25	0.12
6.25	320	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
≈ 7.812	256	20 / 58.34	20 / 29.17	7.30	3.65	1.90	0.97	0.77	0.39	0.19
10	200	20 / 74.67	20 / 37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
12.5	160	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
15.625	128	20 / 80	20 / 58.34	14.58	7.30	3.81	1.94	1.53	0.77	0.39
20	100	20 / 74.67	20 / 37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25
25	80	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
31.25	64	20 / 80	20 / 80	20 / 29.17	14.58	7.62	3.89	3.07	1.55	0.78
50	40	20 / 46.67	20 / 23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16
62.5	32	20 / 80	20 / 80	20 / 58.34	20 / 29.17	15.22	7.78	6.14	3.10	1.56
125	16	N/A	20 / 80	20 / 80	20 / 58.34	20 / 30.43	15.56	12.28	6.19	3.11
250	8	N/A	N/A	20 / 80	20 / 80	20 / 60.86	20 / 31.11	20 / 24.56	12.39	6.23
Minimum edge separation [µs]		0.07	0.13	0.50	1	2	4	5	10	20
Maximum count frequency [MHz]		15	8	2	1	0.5	0.25	0.2	0.1	0.05
Part numbering		K	A	B	C	D	E	F	G	H

Readhead LM13 (DPI), RLM (DPI)

Resolution [dpi]	Counts / 2 mm	Maximum speed [m/s]				
25,600	**2,048**	4.11	1.03	0.52	0.25	0.13
25,000	**2,000**	4.23	1.06	0.53	0.25	0.13
20,000	**1,600**	5.28	1.32	0.66	0.31	0.16
12,800	**1,024**	8.24	2.05	1.03	0.49	0.25
12,500	**1,000**	8.45	2.11	1.06	0.50	0.26
10,000	**800**	10.57	2.63	1.32	0.63	0.32
6,400	**512**	16.50	4.11	1.59	0.98	0.50
6,250	**500**	16.91	4.23	2.11	1.01	0.52
5,000	**400**	21.13	5.28	2.63	1.26	0.64
4,000	**320**	25.00	6.60	3.30	1.57	0.81
3,200	**256**	25.00	8.24	4.11	1.95	1.01
2,500	**200**	25.00	10.57	5.28	2.50	1.29
2,000	**160**	25.00	6.60	3.30	1.64	0.81
1,600	**128**	25.00	16.50	8.24	3.92	2.00
1,250	**100**	25.00	10.57	5.28	2.50	1.29
1,000	**80**	25.00	6.60	3.30	1.64	0.81
800	**64**	25.00	25.00	16.50	7.85	4.02
500	**40**	25.00	6.60	3.30	1.57	0.81
400	**32**	25.00	25.00	25.00	15.72	8.05
200	**16**	N/A	25.00	25.00	25.00	16.09
100	**8**	N/A	25.00	25.00	25.00	25.00
	Edge separation [µs]	0.12	0.50	1	2	4
	Count frequency [kHz]	8333	2000	1000	500	250

MS15

Readhead LM15

Resolution [µm]	Counts / 5 mm	Maximum speed [m/s]								
≈ **0.61**	**8,192**	4.56	2.28	0.57	0.28	0.15	0.08	0.06	0.03	0.02
≈ **1.22**	**4,096**	9.12	4.56	1.14	0.57	0.30	0.15	0.12	0.06	0.03
≈ **2.441**	**2,048**	18.24	9.12	2.28	1.14	0.59	0.30	0.24	0.12	0.06
2.5	**2,000**	18.68	9.32	2.33	1.17	0.61	0.31	0.25	0.12	0.06
3.125	**1,600**	23.32	11.68	2.92	1.46	0.76	0.39	0.31	0.15	0.08
≈ **4.882**	**1,024**	36.44	18.24	4.56	2.28	1.19	0.61	0.48	0.24	0.12
5	**1,000**	37.32	18.68	4.68	2.33	1.22	0.62	0.49	0.25	0.12
6.25	**800**	46.68	23.32	5.84	2.92	1.52	0.78	0.61	0.31	0.16
≈ **9.765**	**512**	72.92	36.44	9.12	4.56	2.38	1.22	0.96	0.48	0.24
10	**500**	74.68	37.32	9.32	4.68	2.43	1.24	0.98	0.50	0.25
12.5	**400**	93.32	46.68	11.68	5.84	3.04	1.56	1.23	0.62	0.31
15.625	**320**	116.68	58.32	14.60	7.28	3.80	1.94	1.54	0.77	0.39
≈ **19.531**	**256**	145.84	72.92	18.24	9.12	4.76	2.43	1.92	0.97	0.49
25	**200**	186.68	93.32	23.32	11.68	6.08	3.11	2.46	1.24	0.62
31.25	**160**	116.68	58.32	14.60	7.28	3.80	1.94	1.54	0.77	0.39
39.0625	**128**	200.00	145.84	36.44	18.24	9.52	4.86	3.84	1.94	0.97
50	**100**	186.68	93.32	23.32	11.68	6.08	3.11	2.46	1.24	0.62
62.5	**80**	116.68	58.32	14.60	7.28	3.80	1.94	1.54	0.77	0.39
78.125	**64**	200.00	200.00	72.92	36.44	19.04	9.72	7.67	3.87	1.95
125	**40**	116.68	58.32	14.60	7.28	3.80	1.94	1.54	0.77	0.39
156.25	**32**	200.00	200.00	145.84	72.92	38.04	19.45	15.35	7.74	3.89
312.5	**16**	n/a	200.00	200.00	145.84	76.08	38.89	30.70	15.48	7.78
625	**8**	n/a	n/a	200.00	200.00	152.16	77.78	61.40	30.97	15.56
Minimum edge separation [µs]		0.07	0.12	0.50	1	2	4	5	10	20
Maximum count frequency [MHz]		15	8	2	1	0.5	0.25	0.2	0.1	0.05
Part numbering		**K**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**

Part numbering

MS 10 B 1000 B 0032

Scale type

05 - 2 mm pole length, 5 mm width
07 - 2.032 mm pole length, 5 mm width
10 - 2 mm pole length, 10 mm width
12 - 2.032 mm pole length, 10 mm width
15 - 5 mm pole length, 10 mm width

Accuracy class

A - ±20 µm/m
B - ±40 µm/m
C - ±100 µm/m
D - ±10 µm/m

Scale length

xxxx - xxxx equals scale length in cm
Mxxx - xxx equals scale length in mm

See next page for scale length defining.

Options

A - VHB back adhesive tape (standard)
B - VHB back adhesive tape; with cover foil *
C - VHB back adhesive tape; ends prepared for end clamping
G - No VHB back adhesive tape; sides prepared for insertion into track section
H - No VHB back adhesive tape, sides prepared for insertion into track section; with cover foil *
I - No back adhesive tape
N - No back adhesive tape; with cover foil *
P - No back adhesive tape; ends prepared for end clamping **

* Cover foil is not factory mounted on the scale and must be ordered separately.
** It can only be used when the magnetic scale is installed in the groove to prevent lateral sliding. The groove dimension must correspond to the scale width.

Reference mark

0000 - No reference mark
xxxx - Reference mark; xxxx equals position of reference mark in cm
(Reference mark position will be within ±1 mm from requested position)
Mxxx - Reference mark; xxxx equals position of reference mark in mm
(Reference mark position will be within ±1 mm from requested position)
Dxxx - Distance coded reference mark; xxx equals basic increment K
xxxxM - Magnetised reference mark; xxxx equals position of magnetised reference mark in cm
(Available only for MS10. Reference mark position will be within ±1 mm from requested position)
MxxxM - Magnetised reference mark in mm; xxx equals position of magnetised reference mark in mm
(Available only for MS10. Reference mark position will be within ±1 mm from requested position)
Pxxx - Multiple reference marks in mm; xxx equals distance between magnetised reference marks in mm, factory predefined to 50 mm, 100mm and 200 mm.
(each reference mark position will be within ±1 mm from requested position)

Cover foil part numbering

CF 10 1000

Cover foil width

05 - 5 mm
08 - 8 mm (for track system option only)
10 - 10 mm

Cover foil length

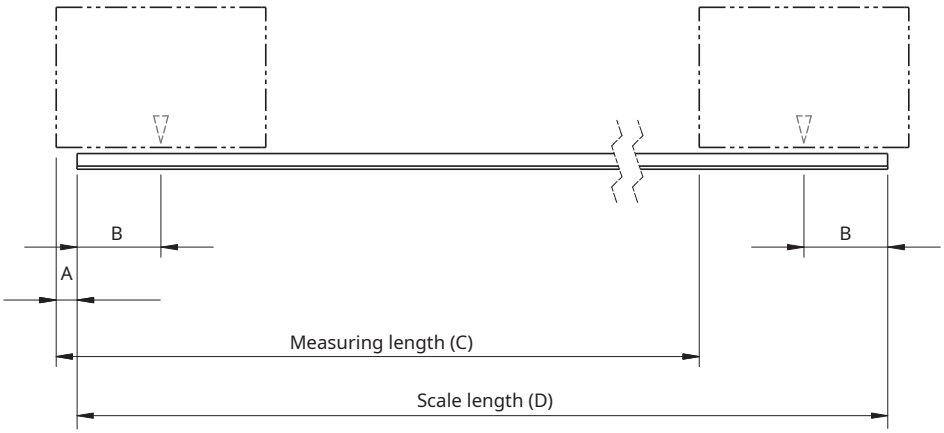
xxxx - xxxx equals foil length in cm

Not all part number combinations are valid. Please refer to the table of available combinations on the next page.

Table of available combinations

Series	Scale type	Accuracy class	Scale length	Options	Reference mark
MS	05	A / B / D	xxxx / Mxxx	A / B / C / I / N / P	0000 / xxxx / Mxxx / Dxxx
	07	B	xxxx / Mxxx		0000 / xxxx / Mxxx
	10	A / B / D	xxxx / Mxxx	A / B / C / G / H / I / N / P	0000 / xxxx / Mxxx /Dxxx / xxxxM / MxxxM
			2000		P050 / P100 / P200
	12	B	xxxx / Mxxx		0000 / xxxx / Mxxx
	15	C	xxxx / Mxxx		0000 / xxxx / Mxxx / Dxxx

How to define scale length



Readhead	A	B	C
LM10*	9 mm	Min. 10 mm	D – 20 mm
LM13*	7 mm	Min. 10 mm	D – 20 mm
LM15*	9 mm	Min. 10 mm	D – 20 mm
RLB	1 mm	–	D – 10 mm
RLC2HD	1 mm	–	D – 10 mm
RLC2IC	2 mm	Min. 8 mm	D – 16 mm
RLM	0	Min. 8 mm	D – 10 mm

* For magnetic scale with ends prepared for end clamping (options C and P) refer to page 14.

Accessories

Stick-on reference mark
LM10SRM00

End clamp kit
LM10ECL00

(2 clamps + 2 fasteners)

Applicator tool for stick-on reference mark
LM10ARM00

Magnet viewer
MM0001

Applicator tool for magnetic scale and cover foil
LM10ASC00

Applicator tool for magnetic scale and cover foil
LM13ASC00

Track section, 1.00 m
TRS100A00

(1x fastener M3x10 included)

Track section, 2.00 m
TRS200A00

(1x fastener M3x10 included)

Fastener and washer
TRC00

Scale clamp with fasteners, 0.04 m
TRE004A00

(2x fastener M3x10 and 1x fastener M2x4 included)

Head office

RLS merilna tehnika d.o.o.

Poslovna cona Žeje pri Komendi
Pod vrbami 2
SI-1218 Komenda
Slovenia

T +386 1 5272100
F +386 1 5272129
E mail@rls.si

www.rls.si

Global support

Visit our **website** to contact your nearest sales representative.