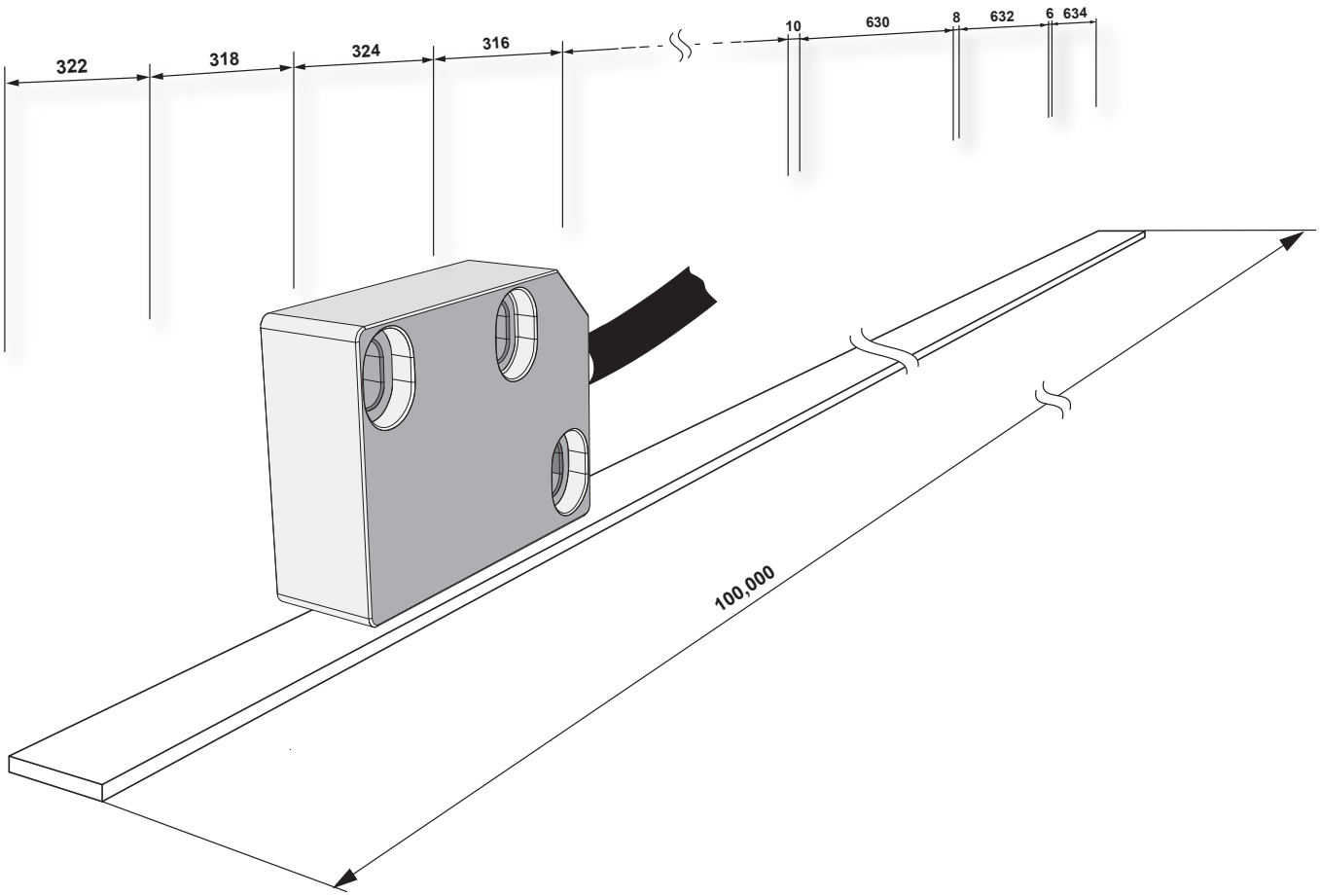
Data sheet
LM10D17_02
Issue 2, 12th April 2011

DCRM distance coded reference mark system



The distance coded reference mark (DCRM) scale allows a measuring system to re-establish absolute position after traversing a short travel. It represents a great usage benefit especially on long axis (several tens of meters), in comparison with conventional reference marks, where re-establishing of absolute position can require traversing the entire axis.

The distance coding is created by having multiple reference marks individually spaced according to mathematical algorithm. Absolute position is known after traversing 2 succesive reference marks.

Absolute position of 1st traversed reference mark is calculated in controller electronics, based on relative distance between 2 neighbouring reference marks, direction of movement, basic increment, and magnetisation pole length. DCRM is currently available with 2 mm and 5 mm pole lengths.

- **Customer selectable basic increment for optimal maximum length selection**
- **Compatible with standard RLS® LM10, LM13 and LM15 readheads**
- **Available for MS10 and MS15 magnetic scales**
- **Vertical / horizontal transport application**

Glossary

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).

Specification

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:**

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

Where:

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 figure 1. DCRMs are produced by additional magnetisation of the magnetic tape.

Figure 1

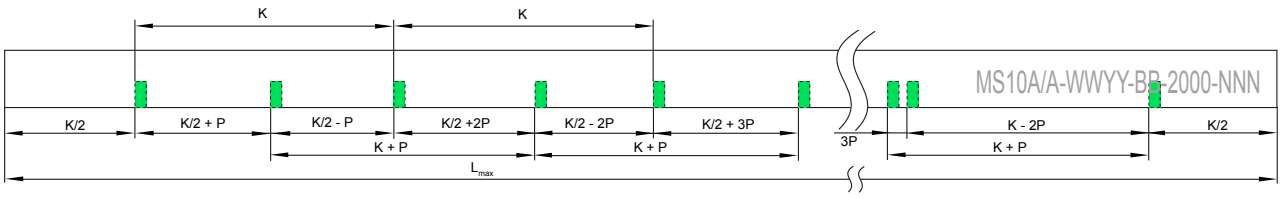


Table 1

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

How the absolute position is evaluated

The absolute position of the 1st traversed reference mark is calculated by the following formula:

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

Where:

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)

Other considerations

Timing of reference mark capturing

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

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

Where:

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

Installation

It is recommended that the readhead is installed so that the ride height is smaller than 1/2 of the pole length (1/2P). Angular misalignment and lateral offset should be as close as possible to nominal values.

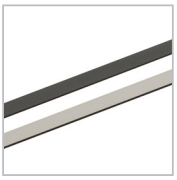
The DCRM is compatible with the TRS track system

The TRS track system is a carrier-type system for applications that require the scale to be installed/removed for transit, or simply for any application where thermal expansion of the scale must be independent of the machine structure. See TRS track system data sheet (LM10D18) for more information.

Distance coded reference mark part numbering

Magnetic scales

MS10 or MS15



Please choose the appropriate MS magnetic scale with the “Dxxx - Distance coded reference mark” option selected.

NOTE: The LM10 and LM13 readheads can be used with the MS10 scale, the LM15 can only be used with the MS15 scale.

MS10 B 0392 A D400

Precision class
A - ±20 µm/m
B - ±40 µm/m

Scale length
xxxx - Where xxxx equals scale length in cm

Reference mark
0000 - No reference mark
xxxx - Where xxxx equals position of machined reference mark in cm (reference mark position will be within ±1 cm from requested position)
Dxxx - Distance coded reference mark; where xxx equals basic increment in mm

Options
A - No cover foil
B - Cover foil supplied (separately - 5 cm longer than tape)
C - No cover foil, ends prepared for end clamping
G - Track system *

* For details on TRS track system please refer to data sheet LM10D18

MS15 C 0195 B D150

Precision class
C - 100 µm/m

Scale length
xxxx - Where xxxx equals scale length in cm

Position of reference mark
0000 - No reference mark
xxxx - Where xxxx equals position of magnetised reference mark in cm (reference mark position will be within ±1 cm from requested position)
Dxxx - Distance coded reference mark; where xxx equals basic increment in mm

Additional requirements
A - None
B - Cover foil (supplied separately - 5 cm longer than tape)
C - No cover foil, ends prepared for end clamping
G - Track system *

* For details on TRS track system please refer to data sheet LM10D18

Readheads

Please make sure that where “Reference” is defined, option A “With reference” is chosen.

LM10, LM15

or

LM13

Example:
LM10 IC 010 C A 10 F 00

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

NOTE: Please check the LM10, LM13 or LM15 data sheet for a complete part numbering.

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Document issues

Issue	Date	Page	Corrections made
1	7. 12. 2009	-	New document
2	12. 4. 2011	2	Maximum codable length formula and table changed

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