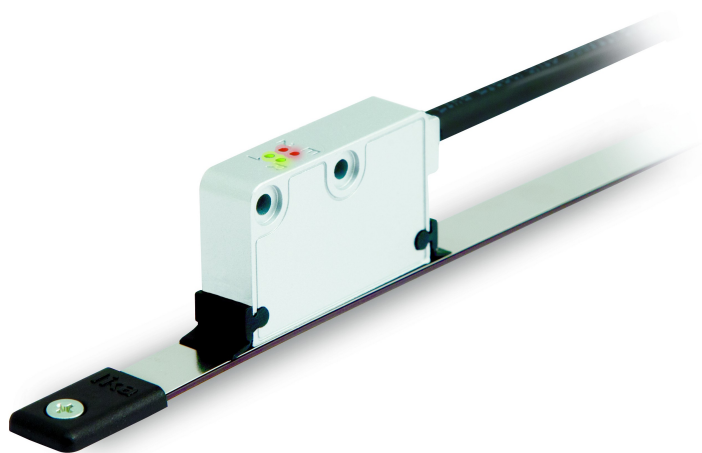


## SME53



- High-resolution incremental linear encoder
- Five resolution options between 0.08  $\mu\text{m}$  and 5  $\mu\text{m}$
- Measuring length up to 100 m / 328 ft
- Protection rate up to IP67
- Wide mounting tolerances up to 2 mm / 0.078"

#### Suitable for the following models:

- SME53-Y-2-...
- SME53-YC-2-...
- SME53-L-1-...

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The logo for Lika Electronic s.r.l. features the word "lika" in a bold, lowercase, sans-serif typeface. The letter "i" is stylized with a dot that is slightly offset to the right. The letters "l", "k", and "a" are thick and solid.

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# Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters are coloured in **GREEN**;
- alarms are coloured in **RED**;
- states are coloured in **FUCSIA**.

When scrolling through the text some icons can be found on the side of the page: they are expressly designed to highlight the parts of the text which are of great interest and significance for the user. Sometimes they are used to warn against dangers or potential sources of danger arising from the use of the device. You are advised to follow strictly the instructions given in this guide in order to guarantee the safety of the user and ensure the performance of the device. In this guide the following symbols are used:

	This icon, followed by the word <b>WARNING</b> , is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment.
	This icon, followed by the word <b>NOTE</b> , is meant to highlight the parts of the text where important notes needful for a correct and reliable use of the device can be found. User must pay attention to them! Failure to comply with instructions could cause the equipment to be set wrongly: hence a faulty and improper working of the device could be the consequence.
	This icon is meant to highlight the parts of the text where suggestions useful for making it easier to set the device and optimize performance and reliability can be found. Sometimes this symbol is followed by the word <b>EXAMPLE</b> when instructions for setting parameters are accompanied by examples to clarify the explanation.

# Preliminary information

This guide is designed to provide the most complete and exhaustive information the operator needs to correctly and safely install and operate the **SME53 high-resolution incremental linear encoder**.

SME53 linear encoder is designed to measure linear or angular displacements on industrial machines and automation systems. The measurement system includes a magnetic tape and a magnetic sensor. The tape has alternating magnetic north/south poles that are magnetized at a fixed distance (5 mm / 0.1968") called the pole pitch. The conversion electronics inside the sensor translates the magnetic fields of the tape into electrical signals equivalent to those of an incremental encoder or a linear scale. The readhead must be paired with the MT50 magnetic tape. SME53 encoder can also integrate a sensor for detecting an external Reference magnet (order code LKM-1309/5) and is equipped with four diagnostic LEDs.

# 1 Safety summary



## 1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.



## 1.2 Electrical safety

- Turn OFF the power supply before connecting the device;
- connect according to the explanation in the "Electrical connection" section on page 15;
- the wires of unused output signals must be cut at different lengths and insulated singularly;
- in compliance with 2014/30/EU norm on electromagnetic compatibility, the following precautions must be taken:
  - before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise; install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;



- minimize noise by connecting the cable shield (or the connector housing) and the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user;
- do not stretch the cable; do not pull or carry by cable; do not use the cable as a handle.



### 1.3 Mechanical safety

- Install the device following strictly the information in the "Mechanical installation" section on page 9;
- mechanical installation must be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit;
- delicate electronic equipment: handle with care; do not subject the device to knocks or shocks;
- protect the unit against acid solutions or chemicals that may damage it;
- respect the environmental characteristics of the product;
- we suggest installing the unit providing protection means against waste, especially swarf as turnings, chips, or fillings; should this not be possible, please make sure that adequate cleaning measures (as for instance brushes, scrapers, jets of compressed air, etc.) are in place in order to prevent the sensor and the magnetic tape from jamming.

## 2 Identification

Device can be identified through the **order code** and the **serial number** printed on the label applied to its enclosure. Information is listed in the delivery document too. Please always quote the order code and the serial number when reaching Lika Electronic for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product refer to the technical catalogue.



**Warning:** encoders having order code ending with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical Info).



### 3 Mechanical installation

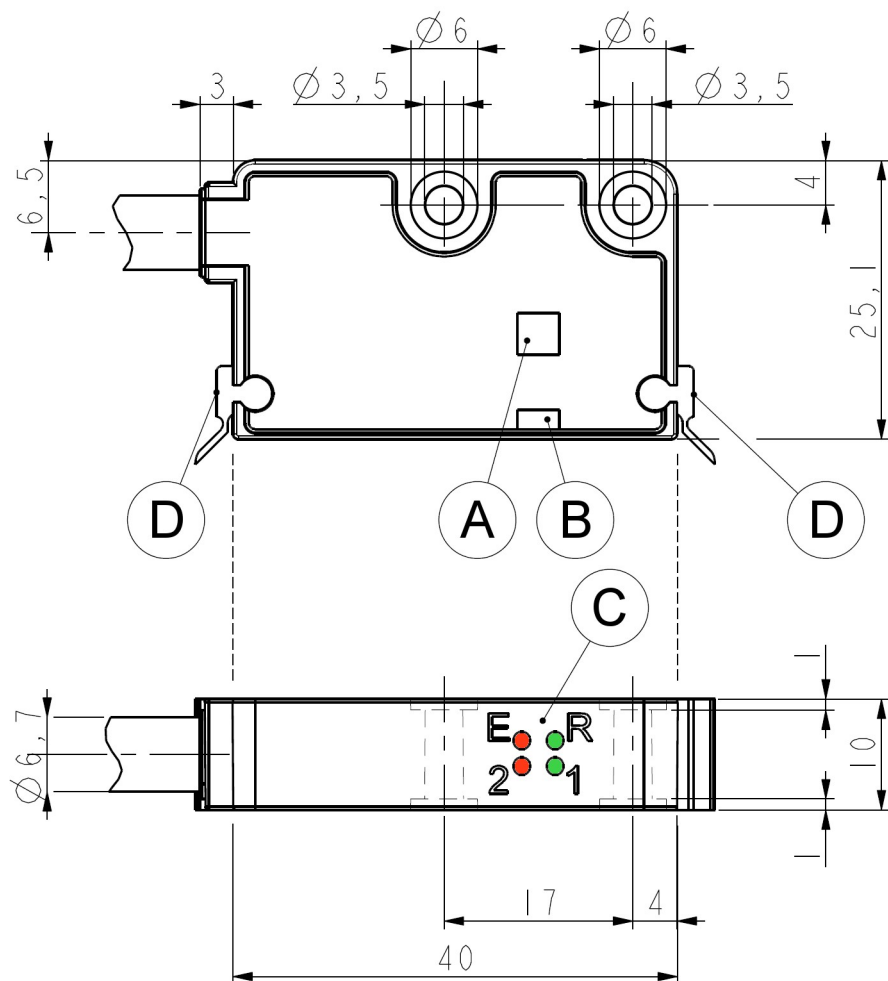


## WARNING

Installation must be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop.

### 3.1 Overall dimensions

(values are expressed in mm)



A	Reference sensor "R" (page 20)	C	Diagnostic LEDs (page 21)
B	Incremental sensor	D	Optional cleaning wipers (page 14)

### 3.2 Magnetic tape

The sensor must be paired with the **MT50 type magnetic tape** only. For detailed information on the MT50 type tape and how to mount it properly, please refer to the specific technical documentation.

Install the unit providing protection means against waste, especially swarf as turnings, chips or filings; should this not be possible, please make sure that adequate cleaning measures (as for instance brushes, scrapers, jets of compressed air, etc.) are in place in order to prevent the sensor and the magnetic scale from jamming. We suggest installing the optional cleaning wipers order code **KIT WIPERS**.

Make sure that the mechanical installation complies with the system's requirements for distance, planarity and parallelism between the readhead and the scale indicated in Figure 2 all along the whole measuring length.

MT50 magnetic tape can be provided with a cover strip to protect its magnetic surface (see the order code of the magnetic tape).

You can mount the readhead in both directions over the tape. The arrow in Figure 1 indicates the **standard counting direction** (the rising edge of A signal leads the rising edge of B signal) when the sensor moves in the direction indicated by the arrow; further information in the "4.7 Counting direction" section on page 19.

The external Reference "R" magnet order code **LKM-1309/5** must be compulsorily installed as shown in Figure 3. For complete information please refer to the "3.4 Mounting the sensor with "R" Reference" section on page 12.

### 3.3 Mounting the readhead

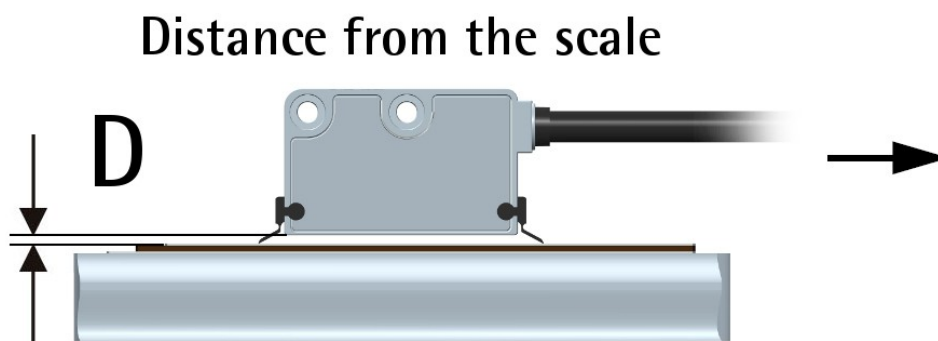


Figure 1 - Encoder / tape mounting gap

Make sure that the mechanical installation complies with the system requirements concerning distance, planarity and parallelism between the sensor and the scale as shown in Figure 2. Avoid contact between the parts.

Fix the sensor by means of **two M3 15 mm min. long cylinder head screws** inserted in the provided holes.

The recommended tightening torque is **1.1 Nm**.

The recommended **minimum bend radius** of the cable is:  **$R \geq 42 \text{ mm}$** .

Install the sensor and the magnetic scale as shown in the Figure. As previously stated, the arrow is intended to indicate the standard counting direction (the rising edge of A signal leads the rising edge of B signal).

Please note that the MT50 magnetic scale can be provided with a cover strip to protect its magnetic surface (see the order code). Therefore the distance between the sensor and the magnetic scale is different whether the cover strip is applied.

**The distance D (see Figure 1) between the bottom of the encoder and the MT50 magnetic scale must be as follows:**

without cover strip	with cover strip
0.1 mm ÷ 2.0 mm (0.004" ÷ 0.078")	0.1 mm ÷ 1.7 mm (0.004" ÷ 0.067")

**For better operation the suggested distance D is 1.0 mm (0.039").**



#### WARNING

Make sure that the mechanical installation complies with the system's requirements for distance, planarity and parallelism between the readhead and the scale as shown in Figure 2 all along the whole measuring length.

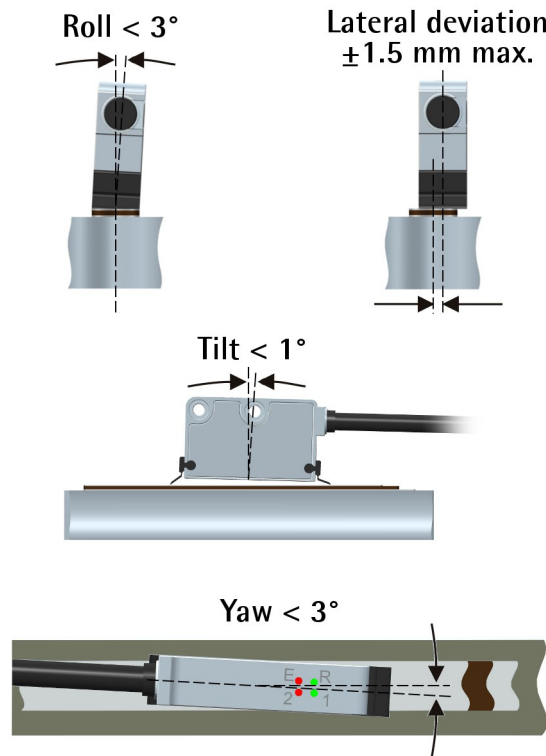
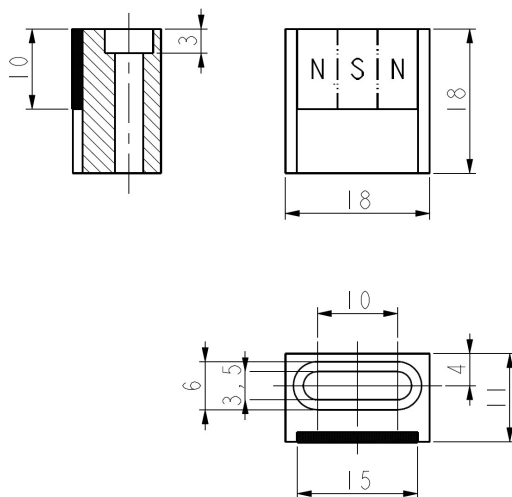


Figure 2 - Encoder / tape mounting tolerances

### 3.4 Mounting the sensor with "R" Reference



The Reference signal is available with "R" order code and in combination with **LKM-1309/5** Reference pole support. It can be provided as an alternative to the Index signal. It provides a datum position along the scale for use at power-up or following a loss of power. The external Reference magnet is placed next to the scale on the side shown in the Figure at the preferred location to mark a relevant position in the travel (the home position, for instance). The R LED lights up when the sensor

detects the LKM-1309/5 external reference. If the zero signal is not present on the output or has not the indicated length when the LED is ON, move the

Reference Mark (LKM-1309/5) of about half a pole length to align it with the scale while keeping the same distance from the sensor. Further information in the "4.9 Reference "R"" section on page 20.

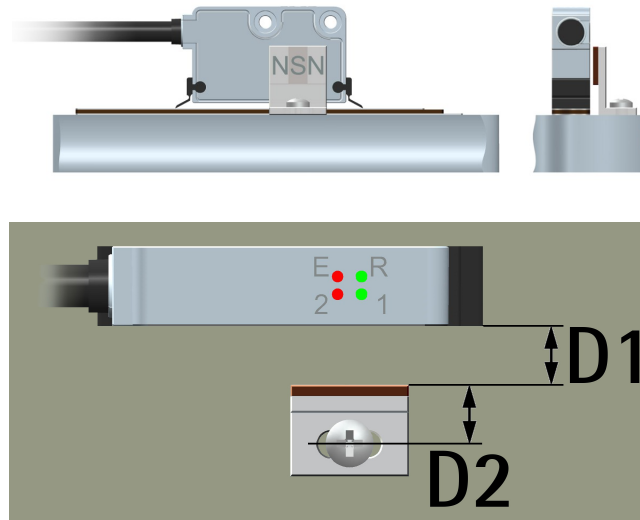


Figure 3 - External Reference

**D1:** gap to be compliant with between the sensor and the LKM-1309/5 external magnet.

**D2:** distance from the centre of fixing hole to the edge of the Reference Mark.

	D1	D2
SME53 / LKM-1309/5	0.5 – 1.0 mm 0.020" – 0.039"	7.5 mm 0.295"

### 3.5 Measuring length

The **length of the tape** can be theoretically unlimited. The tape is supplied in rolls up to 100 m / 328 ft long.

The sensor area must always be fully within the limits of the tape magnetic surface, then the **maximum measuring length** is the maximum length of the tape minus the length of the sensor head (and further two safety sections at both end each one being min. 1-pole pitch long). For instance: if the travel in your application is 500 mm / 19.685", then the length of the tape to be installed will be: 500 mm / 19.685" (measuring length) + 40 mm / 1.575" (length of the readhead, see the Figure on page 9) + 2 x 5 mm (the length of two pole pitches for safety reasons) = 550 mm / 21.653".

### 3.6 Standard counting direction

The positive counting direction (the rising edge of A signal leads the rising edge of B signal) is achieved when the sensor moves on the tape according to the arrow shown in Figure 1. For further information see the "4.7 Counting direction" section on page 19.

### 3.7 Optional cleaning wipers (Figure 1)

This encoder can be optionally provided with rubber cleaning wipers to be mounted on the sensing head (order code **KIT WIPERS**). They are designed for debris removal from the magnetic tape surface in order to ensure a clear path of motion.

## 4 Electrical connection



### WARNING

Electrical connection must be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop.



### WARNING

If wires of unused signals come in contact, irreparable damage could be caused to the device. Thus they must be cut at different lengths and insulated singularly.

### 4.1 Cable and connector connections

Function	M8 cable	M12 8-pin
0Vdc	Black	1
+Vdc <sup>1</sup>	Red	2
A	Yellow	3
/A	Blue	4
B	Green	5
/B	Orange	6
0 <sup>2</sup>	White	7
/0 <sup>2</sup>	Grey	8
Shield	Shield	Case

<sup>1</sup> See the order code for power supply voltage level



### EXAMPLE

SME53-L-1-... +Vdc = +5Vdc  $\pm$  5%

SME53-YC-2-... +Vdc = +10Vdc +30Vdc

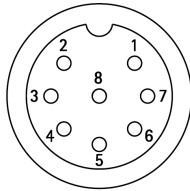
<sup>2</sup> Index "I" (see the "4.8 Index "I"" section on page 19) or Reference "R" (see the "4.9 Reference "R"" section on page 20) signals, see the order code. With "N" order code the signals are not provided, the wires must be cut at different lengths and insulated singularly.

#### 4.2 M8 cable specifications

Model	: LIKA HI-FLEX sensor cable type M8
Cross section	: $2 \times 0.22 \text{ mm}^2 + 6 \times 0.14 \text{ mm}^2$ (24/26AWG)
Jacket	: Matt Polyurethane (TPU) halogen free, oil, hydrolysis, abrasion resistant
Shield	: Tinned copper braid, coverage > 85%
Outer diameter	: $5.3 \div 5.6 \text{ mm}$ (0.209" $\div$ 0.220")
Min. bending radius	: outer diameter $\times$ 7.5
Work temperature	: dyn $-40 + 90^\circ\text{C}$ ( $-40^\circ + 194^\circ\text{F}$ ) / fix $-50 + 90^\circ\text{C}$ ( $-58^\circ + 194^\circ\text{F}$ )
Conductor resistance	: $< 90 \Omega/\text{Km}$ ( $0.22 \text{ mm}^2$ ), $< 148 \Omega/\text{Km}$ ( $0.14 \text{ mm}^2$ )

The total length of the cable that connects the sensor and the receiving device should not exceed the values stated in the "Cable lengths" section of the linear encoders' catalogue; they are specific for each type of output circuit. If you need to reach greater distances please contact Lika Electronic Technical Dept.

#### 4.3 M12 8-pin connector specifications

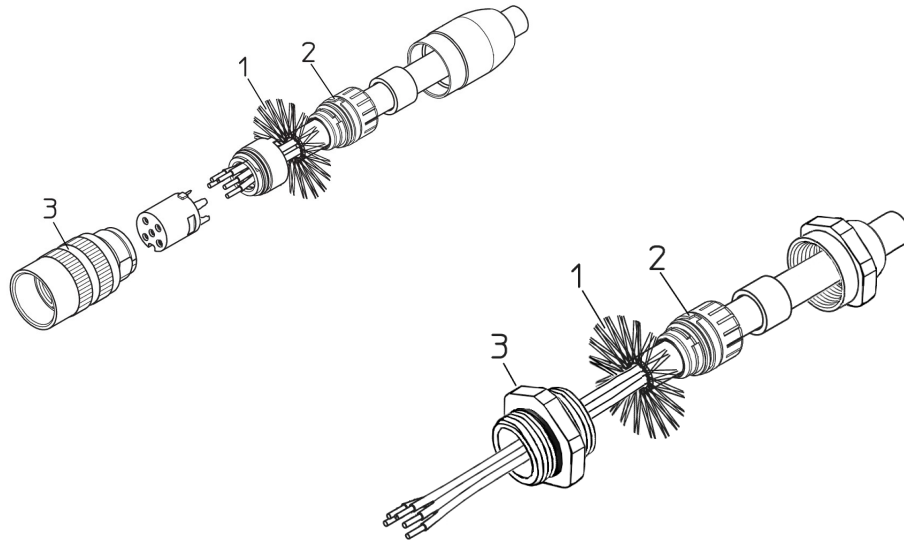


Male  
Frontal side  
A coding



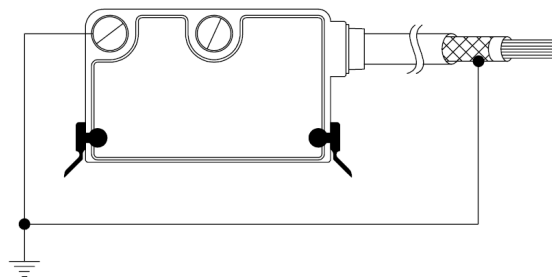
#### 4.4 Connection of the shield

For signals transmission always use shielded cables. The cable shielding must be connected properly to the metal ring nut **3** of the connector in order to ensure a good earthing through the frame of the device. To do this disentangle and shorten the shielding **1** and then bend it over the part **2**; finally place the ring nut **3** of the connector. Be sure that the shielding **1** is in tight contact with the ring nut **3**.



#### 4.5 Ground connection

Minimize noise by connecting the cable shield (or the connector housing) and the sensor to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on the user's side. The best solution to minimize the interference must be carried out by the user. You are advised to provide the ground connection as close as possible to the encoder.



## 4.6 AB0, /AB0 output channels

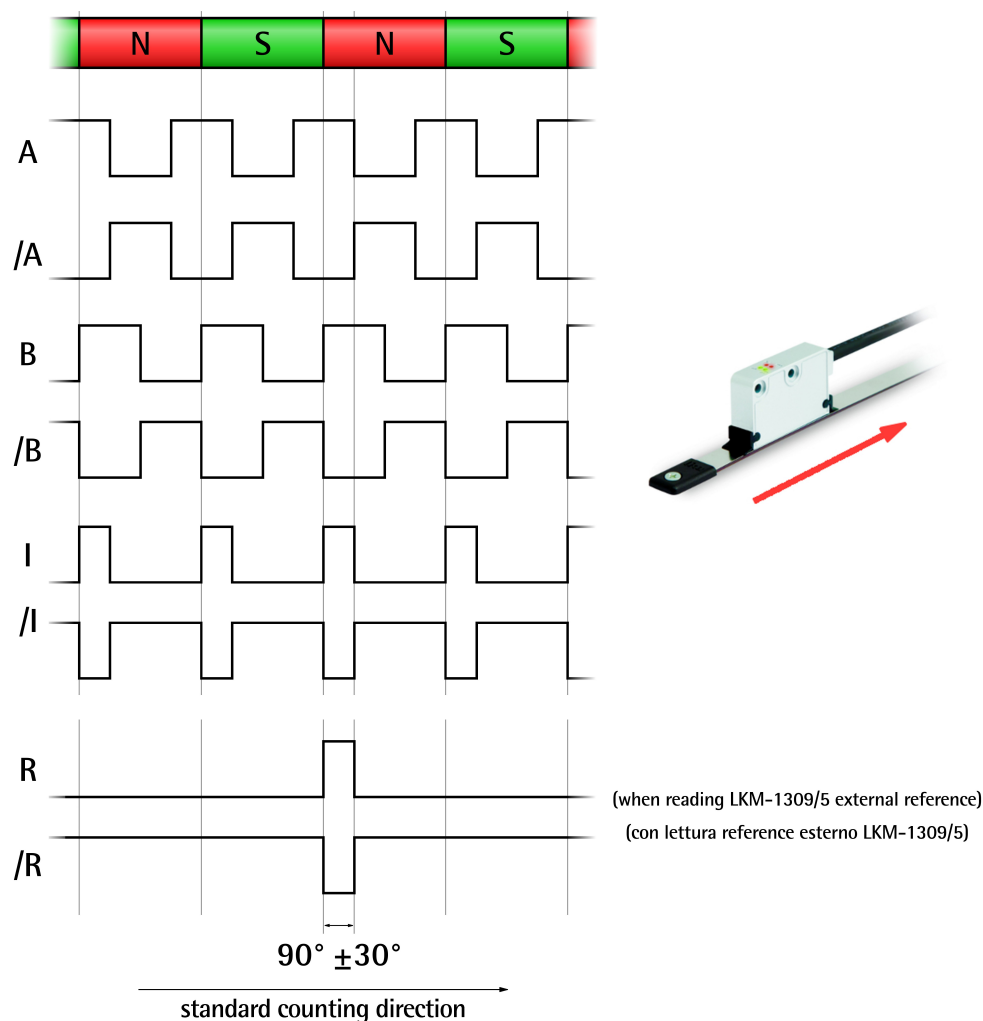


Figure 4 - Example with interpolation factor x4

The conversion electronics inside the sensor translates the magnetic fields of the scale into electrical signals equivalent to those of an incremental encoder or similar incremental optical devices.

The frequency of the output signal is proportional to the measuring speed and the displacement of the sensor.

Resolution after quadrature (reading of four edges) can be determined by the order code of the sensor.

If you need to know the interpolation factor, then you have to divide the pole pitch value by the resolution indicated in the order code.

**EXAMPLE**

Let's suppose we are using an SME53-xx-x-**5**-... linear encoder paired with the MT50 magnetic scale; as the pole pitch is 5 mm / 0.1968" long and the resolution is  $5\text{ }\mu\text{m} = 0.005\text{ mm}$ , this means that the interpolation factor is x1000 (5 mm / 0.005 mm).

**WARNING**

The position value issued by the sensor is expressed in pulses; to convert the pulses into a metric measuring unit you must multiply the number of detected pulses by the resolution expressed in millimetres or micrometres.

**EXAMPLE**

SME53-xx-x-**5**-...

resolution =  $5\text{ }\mu\text{m} = 0.005\text{ mm}$

detected pulses = 71

position value =  $71 * 5 = 355\text{ }\mu\text{m} = 0.355\text{ mm}$

**NOTE**

The **standard counting direction** (the channel A leads the channel B) is to be intended with sensor moving as shown in Figure 4.

## 4.7 Counting direction

By default the phase relationship between A and B channels is so that the rising edge of A channel leads the rising edge of B channel when the encoder moves in the direction shown by the arrow in Figure 4 (see the "4.6 ABO, /ABO output channels" section on page 18). Thus the counter in the subsequent electronics will get a count up. It cannot be changed.

## 4.8 Index "I"

Index signals (0, /0) are available with "I" order code only. With either "N" or "R" order code the Index output signals are not supplied. As show in Figure 4, the periodic Index pulse is synchronised with A and B channels and is provided once per pulse. It is always sent at the same position inside the pole, thus the distance between two index pulses is the pole pitch (= 5 mm / 0.1968"). It has a

duration of one measuring step (90 electrical degrees  $\pm$  30°). The R LED is lit green when the Index signals are provided.

#### 4.9 Reference "R"

Reference signals (0, /0) are available with "R" order code and in combination with LKM-1309/5 support. With either "N" or "I" order code the Reference output signals are not supplied. They provide a datum position along the scale for use at power-up or following a loss of power. The external Reference magnet is placed next to the scale on the side shown in Figure 3 at the preferred location to mark a relevant position in the travel (the home position, for instance). The R LED lights up when the sensor detects the LKM-1309/5 external reference. Please note that this does not mean that the Reference pulse is output in the same time: the Reference pulse is synchronized with A and B channels within the South pole (Figure 5) and has a duration of one measuring step (90 electrical degrees  $\pm$  30°). Thus, it may be either not output yet or already output while the LED is lit. The accuracy and the duration of the Reference pulse may vary depending on the alignment of the Reference and the magnetic scale, see the Figure 5. For additional information refer to the "3.4 Mounting the sensor with "R" Reference" section on page 12.

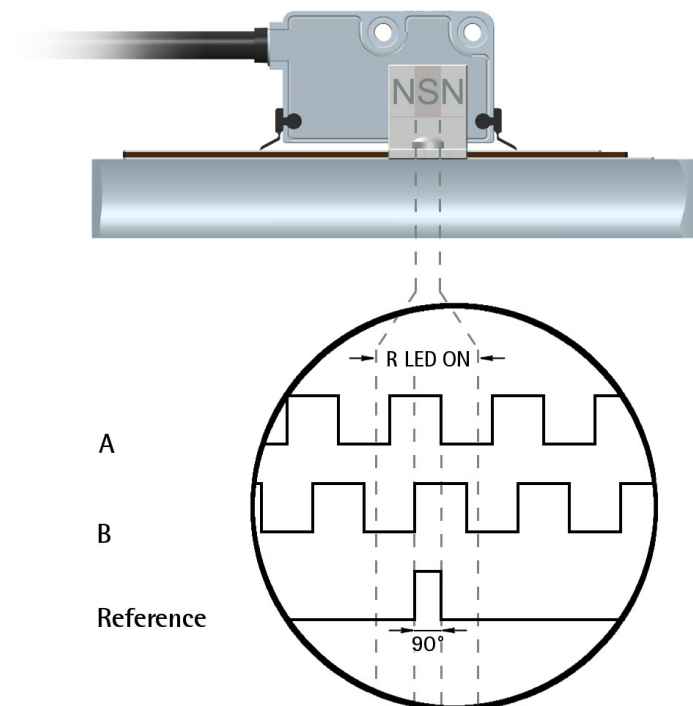


Figure 5 - Reference

#### 4.10 Diagnostic LEDs (Figure 6)

Four LEDs located in the upper face of the encoder enclosure are intended to show visually the work status of the device as explained in the following table.

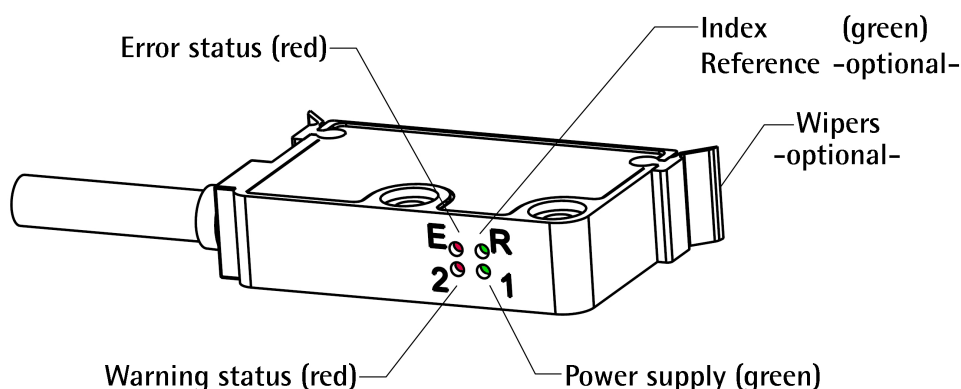


Figure 6 - Diagnostic LEDs and optional cleaning wipers

1 GREEN LED (power supply)	Description
ON Lit green	The encoder is supplied and running properly.
OFF	The encoder is off, the power is not supplied.

2 RED LED (warning status)	Description
ON Blinking or lit red	<p>It warns of the presence of a warning.</p> <ul style="list-style-type: none"> <li>Distance warning: the distance between the readhead and the tape is not optimal; please refer to the "3.3 Mounting the readhead" section on page 10.</li> <li>Speed warning: the sensor is travelling near to the frequency limit. For more information please refer to the technical datasheet.</li> </ul>
OFF	No warning is active currently.

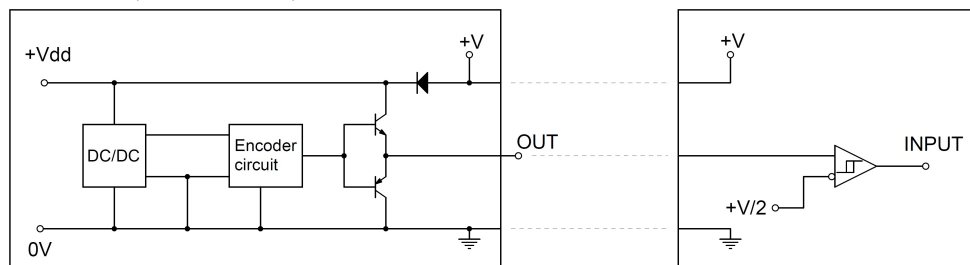
E RED LED (error status)	Description
ON Blinking or lit red	<p>It warns of the presence of an error.</p> <ul style="list-style-type: none"> <li>Distance error: the specified mounting tolerances are not met; please refer to the "3.3</li> </ul>

	<p>Mounting the readhead" section on page 10.</p> <ul style="list-style-type: none"> <li>• Speed error: overspeed detected, the sensor exceeded the frequency limit and the zero may be lost; switch off and then on the power supply. For more information please refer to the technical datasheet.</li> <li>• Tape error: the surface of the tape is damaged or maybe you installed a tape which is not suitable for this encoder</li> </ul>
OFF	No error is active currently.

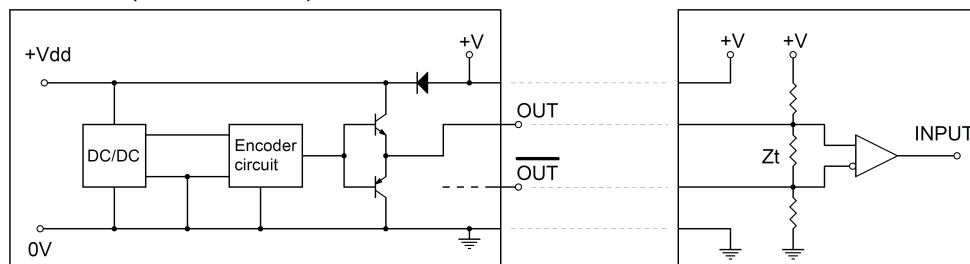
R GREEN LED (Reference)	Description
ON Blinking or lit green	It is ON as long as the Index / Reference signals are supplied (see Figure 4 and Figure 5). Refer to the 4.8 Index "I" section on page 19; and to the "4.9 Reference "R"" section on page 20.
OFF	Index / Reference not supplied / not detected.

#### 4.11 Recommended circuit

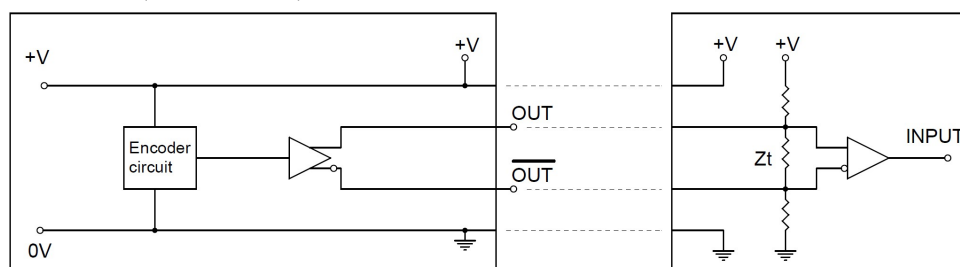
##### Push-Pull (Y order code)



##### Push-Pull (YC order code)



Line Driver (L order code)



## 5 Maintenance and troubleshooting

The magnetic measurement system does not need any particular maintenance; please always consider it is a delicate electronic equipment and therefore it must be handled with care. From time to time we recommend the following operations:

- Check the mounting tolerances between the sensor and the magnetic scale all along the measuring length. Wear of the machine may increase the tolerances.
- The surface of the magnetic scale should be cleaned periodically using a soft cloth to remove dust, chips, moisture etc.

The following list shows some typical faults and errors that may occur during installation and operation of the magnetic measurement system. Refer also to the "4.10 Diagnostic LEDs (Figure 6)" section on page 21.

**Fault:**

The system does not work (no pulse output).

**Possible cause:**

- The scale or the sensor has been mounted incorrectly (the active part of the scale does not match the active side of the sensor).
- A magnetic piece or an inappropriate strip is in between the sensor and the scale. Only non-magnetic materials are allowed between the sensor and the scale.
- The sensor touches the scale: the mounting tolerances are not met. Check if the active side of the sensor is damaged.
- The sensor has been damaged by a short circuit or a wrong connection.

**Fault:**

The measured values are inaccurate.

**Possible cause:**

- The mounting tolerances between the sensor and the scale are not met all along the whole measurement length.
- The connection cable runs near to high voltage cable or shield is not connected correctly. See the "4 -Electrical connection" section on page 15.
- The max. counting frequency of your receiving device is too low.
- A section of the magnetic scale has been damaged mechanically or magnetically along the measuring length.
- The measuring error is caused by torsion of the machine structure. Check parallelism and symmetry of machine movement.



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Document release	Release date	Description	HW	SW	Interface
1.0	23.05.2017	First issue	1	1.0	-



Dispose separately

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