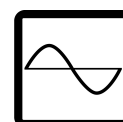
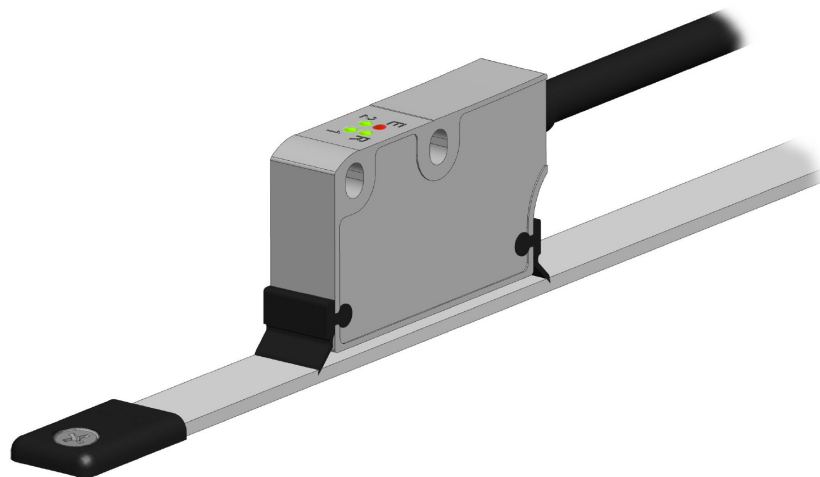


SMS12



- Incremental linear encoder for 1-mm pole pitch tape
- Resolution 1 mm / 0.039"
- Measuring length up to 100 m / 328 ft
- IP67 protection rate
- 1Vpp sinusoidal outputs
- With external limit switches to mark off the travel

Suitable for the following models:

- SMS12

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The logo for Lika Electronic s.r.l. consists of the word "lika" in a bold, lowercase, sans-serif font. The letter 'i' has a dot, and the 'a' has a tail that extends to the right.

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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 WARNING , 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 NOTE , 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 EXAMPLE 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 **SMS12 incremental linear encoder**.

SMS12 linear encoder is designed to measure linear or angular displacements on industrial machines and automation systems. The measurement system includes a magnetic tape / magnetic ring and a magnetic sensor. The tape / ring has alternating magnetic north/south poles that are magnetized at a fixed distance called the pole pitch. The pole pitch is 1 mm. The conversion electronics inside the sensor translates the magnetic fields of the tape / ring into sinusoidal electrical signals (1Vpp) equivalent to those of an incremental encoder or a linear scale. The readhead must be paired with the appropriated magnetic tape / ring (see the "3.2 Sensor and scale / ring combination" section on page 10).

SMS12 encoder is equipped with two sensors for detecting external limit switches (order code LKM-1309/LS). They are designed to mark out the travel of the application. The activation of the sensors is shown through LEDs.

In addition it also integrates a sensor for detecting an external Reference magnet (order code LKM-1309/1) and is equipped with four diagnostic LEDs.

The flexibility of the scale allows the sensor to be used for both linear and angular applications. Furthermore it can be installed also on round surfaces and magnetic rings.

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 18;
- 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 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

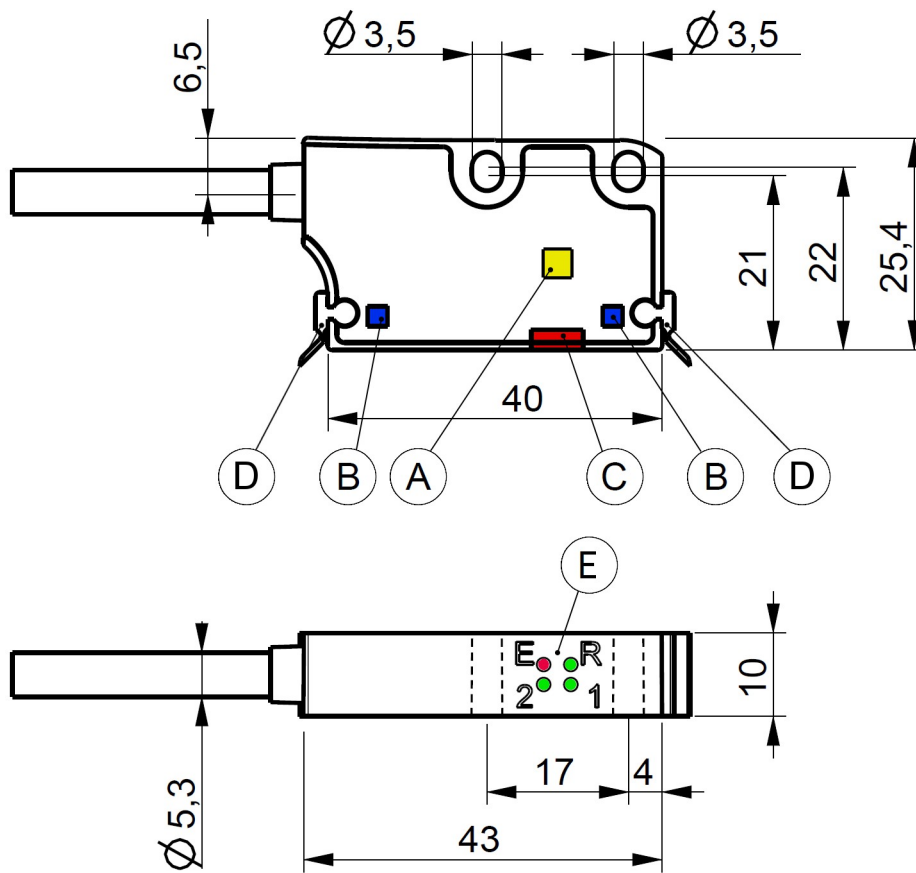


WARNING

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" / "T" (page 22)	D	Optional cleaning wipers (page 17)
B	Limit switch sensors "LS" (page 23)	E	Diagnostic LEDs (page 25)
C	Incremental sensor		

3.2 Sensor and scale / ring combination

The sensor has to be compulsorily paired with its specific type of magnetic scale or ring as indicated in the table below. For any information on the scale or ring please refer to the specific documentation.

Sensor	MT tape	MRI ring
SMS12	MT10	MRI/xxx-xxx-1

3.3 Magnetic tape

As stated, the sensor model must be compulsorily paired with its specific type of magnetic scale (see the previous section). For detailed information on the tape and how to mount it properly, please refer to the specific technical documentation.

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.

MT 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 "4.6 Counting direction" section on page 21.

The external "R" / "T" Reference magnet order code **LKM-1309/1** and the limit switches "LS" order code **LKM-1309/LS** must be compulsorily installed as shown in Figure 3 and Figure 4. For complete information please refer to the "3.6 Mounting the sensor with "R" / "T" Reference" section on page 13; and to the "3.7 Mounting the sensor with LS1 and LS2 limit switches" section on page 14.

3.4 Magnetic rings

The flexibility of the scale allows the sensor to be used for both linear and angular applications. Furthermore it can be installed also on round surfaces and magnetic rings.

As stated, the sensor model must be compulsorily paired with its specific type of magnetic ring (see the "3.2 Sensor and scale / ring combination" section).

3.5 Mounting the sensor with magnetic tape

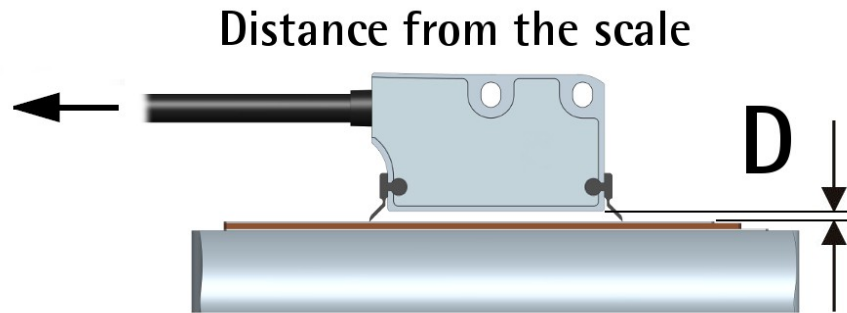


Figure 1 - Encoder / tape mounting gap

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.

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**.

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

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

The recommended **minimum bend radius** of the cable is: **R ≥ 42 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 MT 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 MT magnetic scale must be as follows:

Sensor	Distance D between sensor and MT tape	Distance D between sensor and cover strip
SMS12	0.1 mm ÷ 0.5 mm 0.004" ÷ 0.019"	0.1 mm ÷ 0.3 mm 0.004" ÷ 0.012"

For better operation we suggest the following distance D:

Sensor	Recommended distance D between sensor and MT tape
SMS12	0.25 mm \div 0.010"



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.

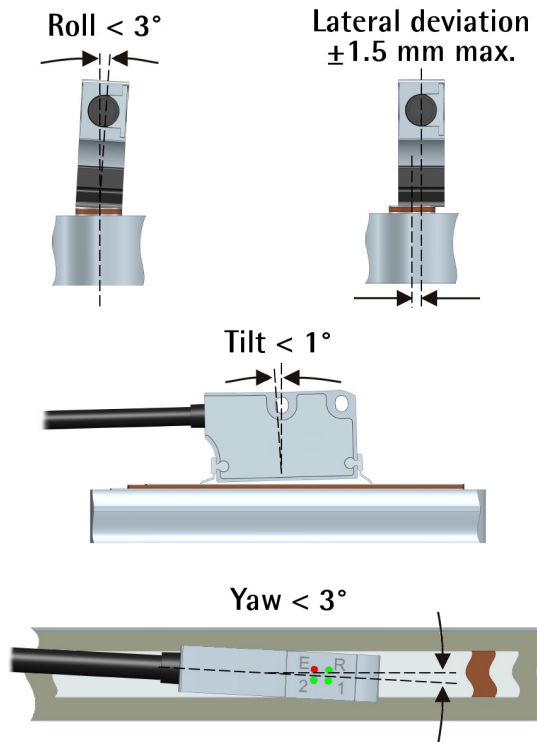
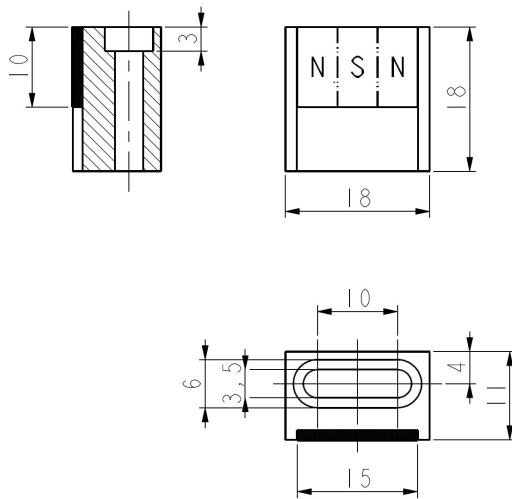


Figure 2 - Encoder / tape mounting tolerances

3.6 Mounting the sensor with "R" / "T" Reference



The Reference signal is available with "R" order code (RS-422 level signals) or "T" order code (1Vpp level signals) and in combination with **LKM-1309/1** Reference pole support. It provides a single 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-1309/1 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-1309/1) of about half a pole length to align it with the scale while keeping the same distance from the sensor. Further information in the "4.7 Reference "R" / "T"" section on page 22.

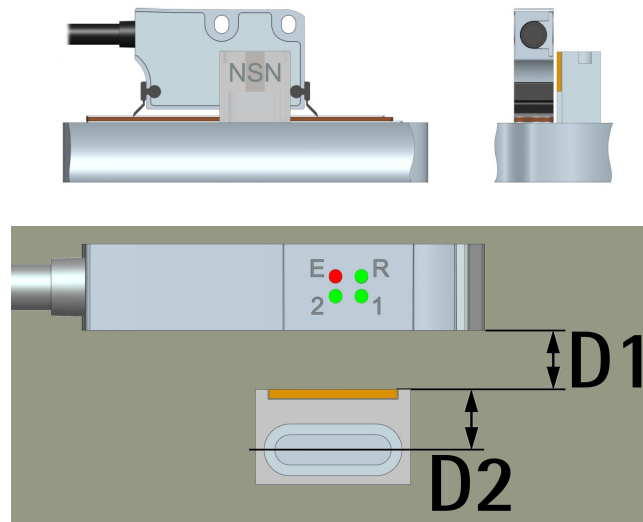


Figure 3 - External Reference

D1: gap to be compliant with between the sensor and the LKM-1309/1 external magnet.

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

	D1	D2
SMS12 / LKM-1309/1	0.1 – 0.3 mm 0.004" - 0.012"	7.3 mm 0.287"

3.7 Mounting the sensor with LS1 and LS2 limit switches

SMS12 linear encoder integrates two sensors designed to detect external limit switches (code LKM-1309/LS). They allow to detect the ends in the travel. External references LS1 and LS2 must be installed at either/both ends of the sensor's travel on the side shown in the Figure respecting the indicated tolerances. In this way at power-up or during operation the controller can determine whether the encoder is at an end-of-travel and in which direction to drive the axis. Further information on page 23.

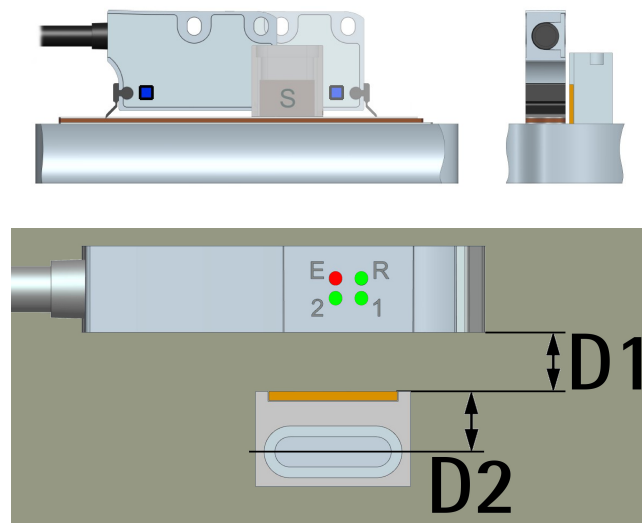


Figure 4 - External limit switches

D1: gap to be respected between the sensor and the LKM-1309/LS external magnet.

D2: distance from the centre of the fixing hole to the edge of Limit Switch Mark.

	D1	D2
SMS12 - LKM-1309/LS	0.5 – 1.0 mm 0.020" - 0.039"	7.5 mm 0.295"

3.8 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 1 mm (the length of two pole pitches of MT10 tape for safety reasons) = 542 mm / 21.338".

3.9 Mounting the sensor with MRI magnetic rings

As previously stated, the flexibility of the tape allows the sensor to be used also for angular applications. Furthermore it can be installed also on round surfaces or MRI type magnetic rings.

When the sensor is installed on magnetic rings having a 10 mm / 0.4" wide magnetic surface, line up both the sensor and the ring on the central axis. When magnetic rings having a 5 mm / 0.2" wide magnetic surface are used, line up the sensor and the ring as shown in Figure 5; please consider that the incremental sensor is located laterally in the sensing head. With 5 mm rings the mounting direction of the ring makes no difference (but ascertain that the sensor is properly aligned on the correct side!).

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.

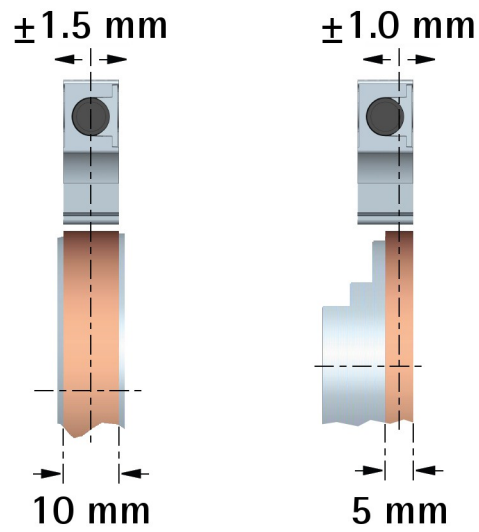


Figure 5 - Sensor / ring alignment

To learn about the mounting tolerances refer to the tables below as well as to Figure 5 and Figure 6.

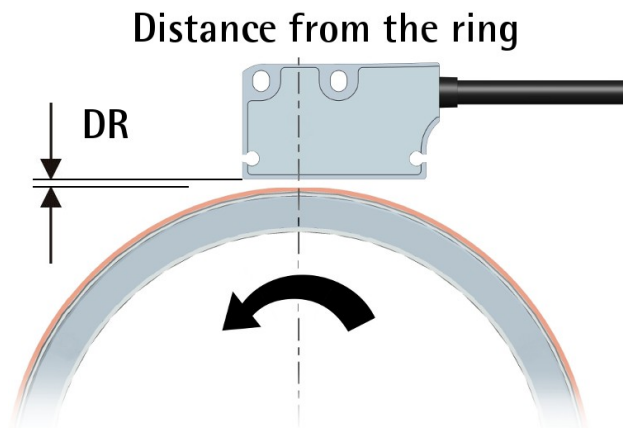


Figure 6 - Sensor / ring mounting gap

Sensor	Distance DR between sensor and MRI ring
SMS12	0.1 mm ÷ 0.5 mm 0.004" ÷ 0.019"

Sensor	Recommended distance DR between sensor and MRI ring
SMS12	0.25 mm ÷ 0.010"

3.10 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; or when the ring turns according to the arrow shown in Figure 6. For further information see the "4.6 Counting direction" section on page 21.

3.11 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 M10 cable connection

Function	M10 cable
0Vdc	Black
+5Vdc \pm 5%	Red
A	Yellow
/A	Blue
B	Green
/B	Orange
0 ¹	White
/0 ¹	Grey
LS1 ²	Brown
LS2 ²	Violet
Shield	Shield

- 1 Reference "R" or "T" signals (see the "4.7 Reference "R" / "T"" section on page 22), see the order code.
- 2 LS1 / LS2 limit switch signals (see the "4.9 LS1 and LS2 limit switches" section on page 23).



NOTE

All sensors can provide inverted signals.

A = A signal;

/A = inverted A signal (or complementary signal).

All Lika's magnetic sensors can provide ABO, /ABO output signals. You are advised to always connect the inverted signals if the receiving device will accept them. Otherwise each output should be insulated singularly.

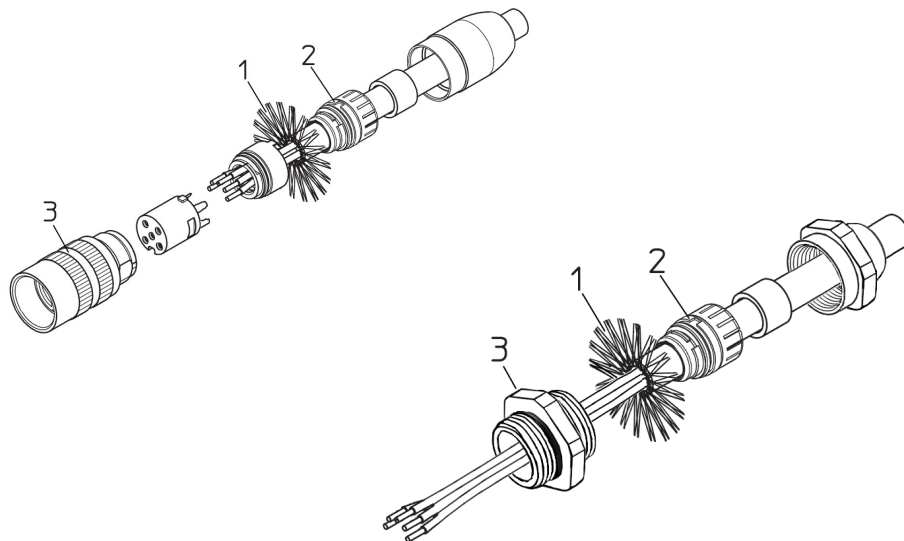
4.2 M10 cable specifications

Model	: LIKA HI-FLEX sensor cable type M10
Cross section	: $2 \times 0.22 \text{ mm}^2 + 8 \times 0.14 \text{ mm}^2$ (24/26AWG)
Jacket	: Matt Polyurethane (TPU) halogen free, oil, hydrolysis, abrasion resistant
Shield	: Tinned copper braid, coverage > 85%
Outer diameter	: $5.7 \pm 0.2 \text{ mm}$ ($0.224" \pm 0.008"$)
Min. bending radius	: outer diameter x 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 mm^2), $<148 \Omega/\text{Km}$ (0.14 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.

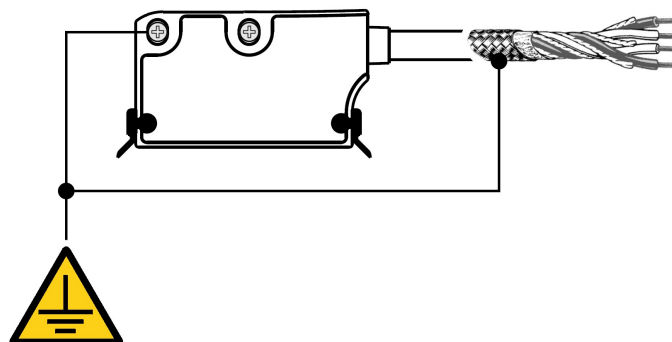
4.3 Connection of the shield

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**.



4.4 Ground connection

Minimize noise by connecting the cable shield 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.



4.5 ABO, /ABO output channels

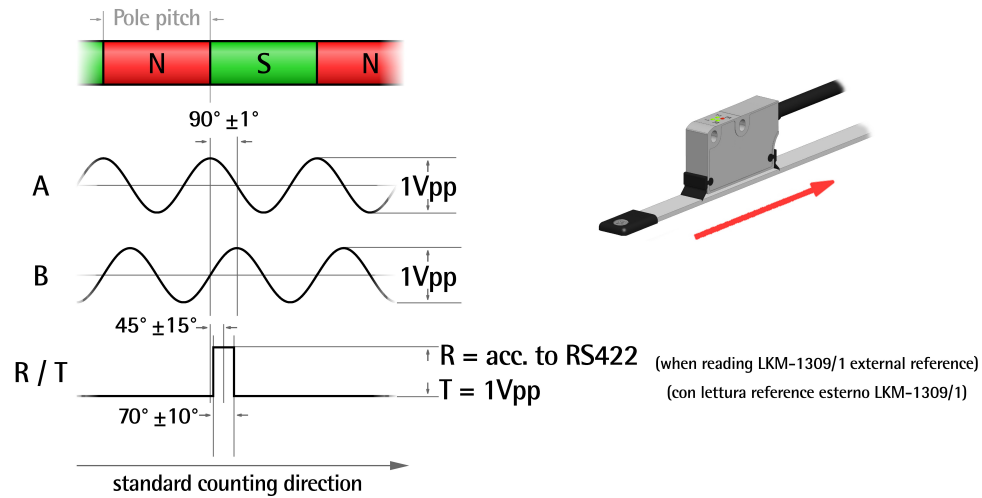


Figure 7 - Output signals

The conversion electronics inside the sensor translates the magnetic fields of the scale / ring 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.



NOTE

The **standard counting direction** (the channel A leads the channel B) is to be intended with sensor moving as shown in Figure 1 in a linear application; with ring turning as indicated by the arrow in Figure 6 in a rotary application.

4.6 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 1 in a linear application; or when the ring turns as indicated by the arrow in Figure 6 in a rotary application (see the "4.5 ABO, /ABO output channels" section on page 21). Thus the counter in the subsequent electronics will get a count up. It cannot be changed.

4.7 Reference "R" / "T"

Reference signals (0, /0) are available with "R" or "T" order codes and in combination with LKM-1309/1 support. They provide a single 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-1309/1 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 8) and has the indicated duration. Thus, it may be either not output yet or already output while the LED is lit.

"R" code Reference signals have an amplitude according to RS-422; while "T" code Reference signals have an amplitude of 1Vpp.

The typical repeatability of the signal is 1% of the period length.



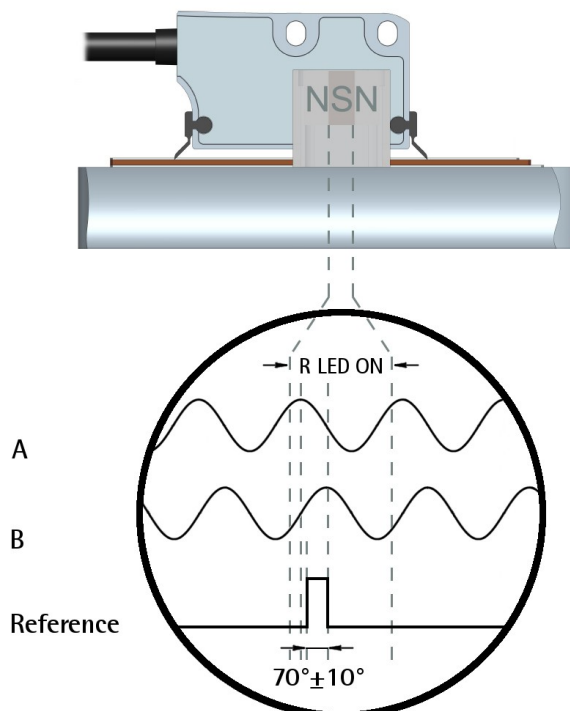
EXAMPLE

SMS12, 1 mm pole pitch: $1000 \mu\text{m} / 100 = 10 \mu\text{m}$

The Reference signal has a duration of 70 ± 10 electrical degrees.

The accuracy and the duration of the Reference pulse may vary depending on the alignment of the Reference magnet and the magnetic scale, see the Figure 8. For additional information refer to the "3.6 Mounting the sensor with "R" / "T" Reference" section on page 13.

Figure 8 - Reference



4.8 Voltage signals

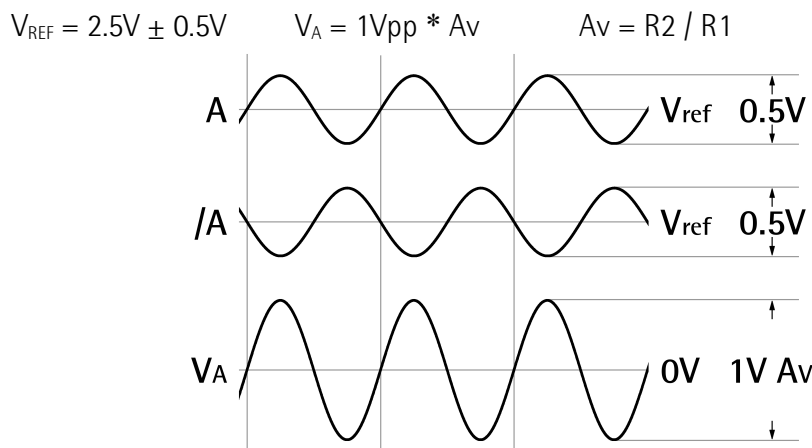
The voltage level refers to the differential value between normal and inverted signal (differential).

Level of A, /A, B and /B signals

signals	amplitude
A, /A, B, /B	Min 0.4Vpp - Max 0.6Vpp
V_{REF}	2.5V

Level of differential signals

signals	amplitude
V_A, V_B	1Vpp: Min 0.8Vpp - Max 1.2Vpp
"R"	according to RS-422
"T"	1Vpp: Min 0.5Vpp - Max 1.0Vpp



4.9 LS1 and LS2 limit switches

SMS12 linear encoder integrates two sensors designed to detect external limit switches (code LKM-1309/LS). They allow to detect the ends in the travel. External references LS1 and LS2 must be installed at either/both ends of the sensor's travel on the side shown in the Figure and according to the indicated tolerances. In this way at power-up or during operation the controller can

determine whether the encoder is at an end-of-travel and in which direction to drive the axis.

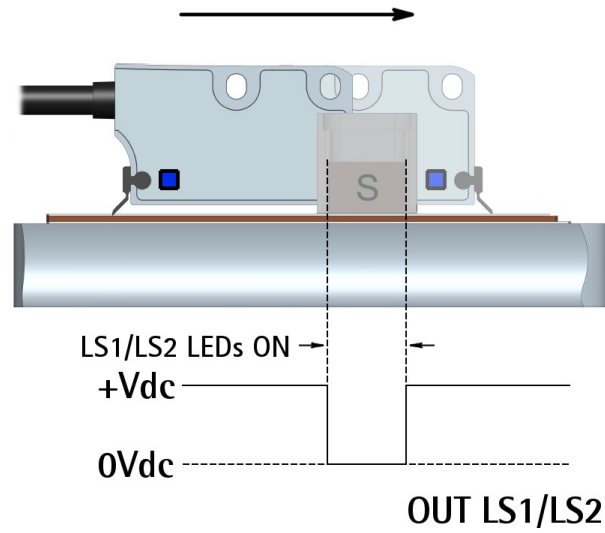
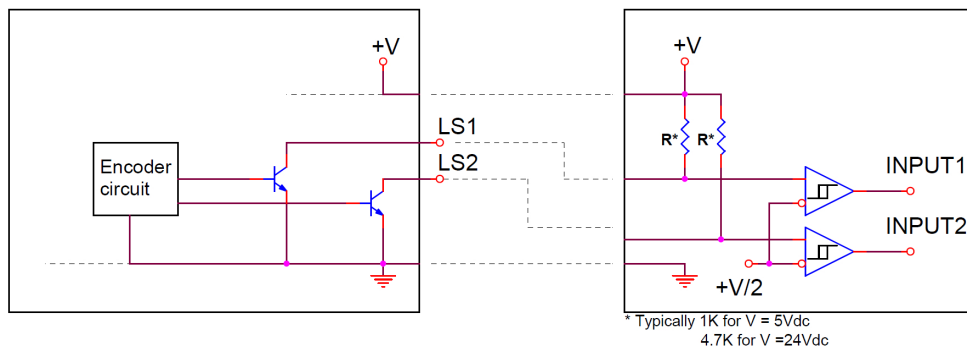


Figure 9 - LS limit switches

Outputs of limit switches LS1 and LS2 are open collector type and have $I_{max} = 50 \text{ mA}$. The signal is normally at logic level high (+Vdc) and switches to logic level low (0Vdc) as soon as the external limit switch is detected. The signal is kept at logic level low (0Vdc) as long as the sensor is within the active area of the external limit switch.

LS1 and LS2 LEDs light up when the sensor detects the relevant LKM-1309/LS external limit switch.



4.10 Diagnostic LEDs (Figure 10)

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.

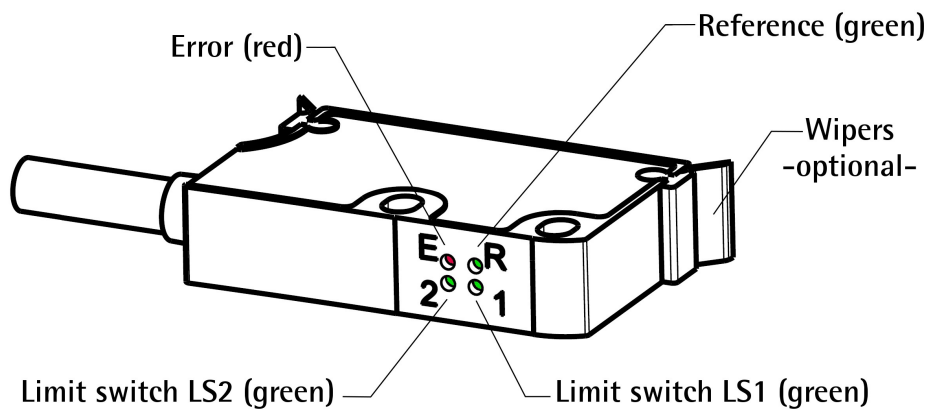


Figure 10 - Diagnostic LEDs and optional cleaning wipers

1 GREEN LED (Limit Switch LS1)	Description
ON Green	It lights up when the LS1 sensor detects the external LKM-1309/LS1 limit switch. It is

	equivalent to the logic level low (0) of the LS1 open collector signal. Refer to the "4.9 LS1 and LS2 limit switches" section on page 23. It is on for the whole period length (Figure 9).
OFF	External limit switch not detected.

2 GREEN LED (Limit Switch LS2)	Description
ON Green	It lights up when the LS2 sensor detects the external LKM-1309/LS2 limit switch. It is equivalent to the logic level low (0) of the LS2 open collector signal. Refer to the "4.9 LS1 and LS2 limit switches" section on page 23. It is on for the whole period length (Figure 9).
OFF	External limit switch not detected.

E RED LED (Error status)	Description
ON Red	It warns of the presence of an error. <ul style="list-style-type: none"> Distance error: the specified mounting tolerances between sensor and tape (or ring) are not met; please refer to the "Mechanical installation" section on page 9.
OFF	No error is active currently.

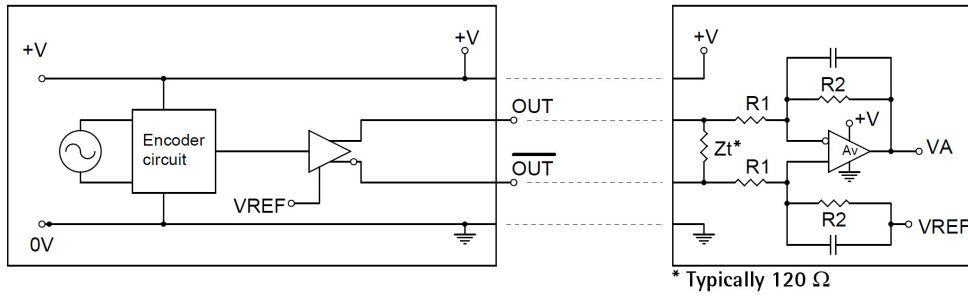
R GREEN LED (Reference)	Description
ON Green	It is ON as long as the external Reference is detected (see Figure 7 and Figure 8). Refer to the "4.7 Reference "R" / "T"" section on page 22. It is on for the whole period length (Figure 8).
OFF	External Reference not detected.



NOTE

If an error occurs switch off and then on again the encoder and check whether the problem is cleared up and the LED turns off.

4.11 Recommended circuit



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 / magnetic ring all along the measuring length. Wear of the machine may increase the tolerances.
- The surface of the magnetic scale / magnetic ring 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 10)" section on page 25.

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 / ring. Only non-magnetic materials are allowed between the sensor and the scale / ring.
- The sensor touches the scale / ring: 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 / ring 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 18.
- A section of the magnetic scale / ring 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.

**NOTE**

If an error occurs switch off and then on again the encoder and check whether the problem is cleared up and the LED turns off.

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Document release	Release date	Description	HW	SW	Interface
1.0	16.06.2016	First issue	-	-	-
1.1	10.07.2018	New mechanical version	-	-	-



Dispose separately

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