

SMLAX



IECEX and ATEX certification category 3
for use in Zone 2, Gas group IIC



Ex mc IIC T4 Gc, Zone 2, Gas group IIC



II 3 G, Ex mc IIC T4 Gc, Zone 2, Gas group IIC

- SMLAX absolute and incremental magnetic encoder
- Absolute resolution: up to 16,384 cpr
- Incremental resolution: 1,024 PPR or custom
- SSI interface / Push-Pull and Line Driver output

Suitable for the following models:

- SMLAX-B0...
- SMLAX-G0...
- SMLAX-B5...
- SMLAX-G5...
- SMLAX-BS...
- SMLAX-GS...
- SMLAX-L...
- SMLAX-Y...

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This manual is periodically reviewed and revised. As required we suggest checking if a new or updated edition of this document is available at Lika Electronic s.r.l.'s website. Lika Electronic s.r.l. assumes no responsibility for any errors or omissions in this document. Critical evaluation of this manual by the user is welcomed. Your comments assist us in preparation of future documentation, in order to make it as clear and complete as possible. Please send an e-mail to the following address info@lika.it for submitting your comments, suggestions and criticisms.

The logo for Lika Electronic, featuring the word "lika" in a bold, lowercase, sans-serif font. The letter "i" has a dot above it.

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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 and objects both of Lika device and interface 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 **SMLAX reading head**. The SMLAX reading head must be paired with an **MRx series magnetic ring**. For information on MRx series magnetic rings please refer to the specific documentation.

SMLAX is a bearingless encoder for position and speed feedback on applications with large rotating shaft in potentially explosive atmospheres.

SMLAX rotary encoder is available with an SSI absolute interface, with an incremental output, and with a dual output (absolute + incremental). An absolute sensor, an incremental sensor, and a reference sensor can be installed in the same package. Thus the magnetic ring can be equipped with two or three tracks according to model.

The absolute measuring system can have a 12-, 13-, and 14-bit resolution (4,096 cpr, 8,192 cpr, 16,384 cpr) over the complete circumference and provides the absolute position through the SSI interface.

The incremental resolution can be 1,024 PPR (order codes -B0..., -G0..., -B5..., -G5) or custom (order codes -L..., -Y...); square wave signals are provided via Push-Pull and Line Driver output circuits.

Specific models also include a reference mark information once per revolution (order codes -B0..., -G0..., -B5..., -G5, -L...; -Y...).

It is mandatory to pair each sensor with its own **MRx** series segmented magnetic ring.



SMLAX rotary encoder is IECEx and ATEX certified. For complete information and certificates please refer to the sections "3 - IECEx ULD 19.0002X Certificate of Conformity", "4 - DEMKO 19 ATEX 2195X Examination Certificate", and "5 - Safety instructions".

To make it easier to read and understand the text, this guide can be divided into two main sections.

In the first section some general information concerning the safety, the mechanical installation, and the electrical connection as well as tips for setting up and running properly and efficiently the unit are provided.

In the second section, entitled **SSI interface**, both general and specific information is given on the SSI interface.

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;
- 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 power supply before connecting the device;
- connect the unit according to the explanation in the "7 - Electrical connections" section on page 29;
- in classified areas the electrical connection of the device must be carried out in compliance with the methods indicated in the EN 60079-0 directive and according to the EN 60079-14 directive;
- before using provide a safe ground connection (GND) using the ground screw on the housing of the SMLAX sensor;
- before using provide a safe ground connection (GND) to the magnetic ring;
- always comply with the power supply voltage level as per the order code and the data sheet;
- current absorbed per each channel must not exceed 20 mA;
- comply with the range of permissible environmental temperature -10°C +85°C (+14°F +185°F);
- in compliance with 2014/30/EU norm on electromagnetic compatibility, 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;
- it is mandatory to connect the sensor enclosure to ground. Make sure that ground is not affected by noise. Use the ground point provided in the sensor enclosure. Use one TCEI M3 x 6 UNI5931 cylindrical head screw with 2 tooth lock washers DIN 6798-A;
- ensure that the ring is connected to ground. Minimize noise by connecting the drive shaft to ground; the ring must be installed as described in the guide, ensure that it is in electrical contact with the drive shaft;
- 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 "6 - Mounting instructions" section on page 23;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool or drill the unit, do not tamper with the unit;
- do not loosen the screws which fasten the enclosure;
- 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, use the product according to the indicated degree of IP protection;
- we suggest installing 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 ring from jamming.



1.4 Specific handling and cleaning instructions and safety information against electrostatic charging



Please be sure to strictly observe the following safety precautions and instructions before handling and installing the modular encoder.

- Open the box and handle the electronic components only within an EPA (Electrostatic Protective Area) and when you are properly grounded;
- before handling the modular encoder the operator must wear:
 - a wrist strap; it must be worn on the hand and connected to ground through a 1 megohm resistor;
 - an ESD smock made of dissipative material;
 - dissipative gloves;
- access to the equipment must be limited or prevented in order to avoid charging or discharging electrostatic charges;
- in order to prevent the accumulation of electrostatic charges while cleaning the equipment, the unit (and especially the magnetic tape of the ring and any other non metallic part that is exposed) must be cleaned only with a damp cloth or a cloth soaked in a damp solution; compressed air cannot be used. Any rubbing with non-conductive materials must be strictly avoided;
- any other step intended to avoid electrostatic charging and/or discharging must be taken in compliance with all local provisions and national regulations as well as the relevant safety regulations and in particular the EN 60079-0 directive and the EN 60079-14 directive.

**CAUTION**

Keep magnets away from the ring, it could be damaged by strong magnetic fields.

2 - Identification

Device can be identified through the **order code** and the **serial number** printed on the label applied to its body. 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 datasheet.

3 - IECEx ULD 19.0002X Certificate of Conformity

		<h2>IECEx Certificate of Conformity</h2>	
<p>INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification Scheme for Explosive Atmospheres <small>for rules and details of the IECEx Scheme visit www.iecex.com</small></p>			
Certificate No.:	IECEx ULD 19.0002X	Issue No: 0	Certificate history: Issue No. 0 (2019-08-21)
Status:	Current	Page 1 of 4	
Date of Issue:	2019-08-21		
Applicant:	LIKA Electronic s.r.l. Via San Lorenzo 25 Carrè, VI, 36010 Italy		
Equipment:	ROTAMAG, Bearingless magnetic ring encoder, Series SMLAX <i>Optional accessory:</i>		
Type of Protection:	Encapsulation "mc"		
Marking:	Ex mc IIC T4 Gc -10°C ≤ Ta ≤ +85°C		
Approved for issue on behalf of the IECEx Certification Body:	Lucy Frieders		
Position:	Staff Engineer		
Signature: (for printed version)	_____		
Date:	_____		
1. This certificate and schedule may only be reproduced in full. 2. This certificate is not transferable and remains the property of the issuing body. 3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website .			
Certificate issued by:	UL International DEMKO A/S Borupvang 5A, DK-2750 Ballerup Denmark		



IECEx Certificate of Conformity

Certificate No:	IECEX ULD 19.0002X	Issue No: 0
Date of Issue:	2019-08-21	Page 2 of 4
Manufacturer:	LIKA Electronic s.r.l. Via San Lorenzo 25 Carrè, VI, 36010 Italy	

Additional Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:

The apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2017 Edition:7.0	Explosive atmospheres - Part 0: Equipment - General requirements
IEC 60079-18 : 2014 Edition:4.0	Explosive atmospheres – Part 18: Equipment protection by encapsulation "m"

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

TEST & ASSESSMENT REPORTS:

A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:

DK/ULD/ExTR19.0002/00

Quality Assessment Report:

IT/CES/QAR19.0001/00



IECEx Certificate of Conformity

Certificate No:	IECEx ULD 19.0002X	Issue No: 0
Date of Issue:	2019-08-21	Page 3 of 4

Schedule

EQUIPMENT:

Equipment and systems covered by this certificate are as follows:

SMLAX is a series of bearingless encoders for position and speed feedback on applications with large rotating shaft in potentially explosive atmospheres. The SMLAX reading head must be paired with an MRx series magnetic ring.

SMLAX rotary encoder is available with an SSI absolute interface, with an incremental output, and with a dual output (absolute + incremental). An absolute sensor, an incremental sensor, and a reference sensor can be installed in the same package. Thus the magnetic ring can be equipped with two or three tracks according to model.

The absolute resolution does not affect the safety requirements of the system and can be typically 12 bits (4.096 cpr), 13 bits (8.192 cpr), and 14 bits (16.384 cpr) or according to customer's request and the physical characteristics of the measuring system. The absolute position is provided through the SSI interface.

Also the incremental resolution is according to customer's request and the physical characteristic of the measuring system; square wave signals are provided via Push-Pull and Line Driver output circuits.

Please see Annex for additional information.

SPECIFIC CONDITIONS OF USE: YES as shown below:

- Care shall be taken to prevent accumulation of electrostatic charges. See installation instructions.



IECEx Certificate of Conformity

Certificate No: IECEx ULD 19.0002X Issue No: 0

Date of Issue: 2019-08-21 Page 4 of 4

Additional information:

Annex:

Annex to IECEx ULD 19.0002X Issue 0.pdf



IECEx Certificate of Conformity

Certificate No.: IECEx ULD 19.0002X

Issue No.: 0

Page 1 of 3

TYPE DESIGNATION

Nomenclature:

Series SMLAX:

Type 1 Sensor (Absolute + incremental version):

SMLAX	-	B0	1	-	XX	-	L1	/SXXX
I		II	III		IV		V	VI

I – Series: SMLAX

II – Output circuits:

B0 = SSI, Binary + 1024 PPR Line Driver

G0 = SSI, Gray + 1024 PPR Line Driver

B5 = SSI, Binary + 1024 PPR Push Pull

G5 = SSI, Gray + 1024 PPR Push Pull

III – Supply Voltage:

1 = +5V±5% (not for B5, G5)

2 = +10V±30V


IV – Resolution: Two numeric character to indicate resolution, not safety relevant.

V – Connections – Cable length:

L1 = cable output 1 m

Lx = cable output x meters

VI – Customer version: Three numeric character to indicate specific customer requirements, not safety relevant.

	<h2 style="margin: 0;">IECEX Certificate of Conformity</h2>																						
<p>Certificate No.: IECEx ULD 19.0002X</p>	<p>Issue No.: 0 Page 2 of 3</p>																						
<p>Type 2 Sensor (Absolute or incremental version):</p>																							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">SMLAX</td> <td style="width: 5%;">-</td> <td style="width: 10%;">L</td> <td style="width: 5%;">1</td> <td style="width: 5%;">-</td> <td style="width: 10%;">XXX</td> <td style="width: 5%;">-</td> <td style="width: 5%;">R</td> <td style="width: 5%;">-</td> <td style="width: 10%;">L1</td> <td style="width: 10%;">/SXXX</td> </tr> <tr> <td style="text-align: center;">I</td> <td></td> <td style="text-align: center;">II</td> <td style="text-align: center;">III</td> <td></td> <td style="text-align: center;">IV</td> <td></td> <td style="text-align: center;">V</td> <td></td> <td style="text-align: center;">VI</td> <td style="text-align: center;">VII</td> </tr> </table>	SMLAX	-	L	1	-	XXX	-	R	-	L1	/SXXX	I		II	III		IV		V		VI	VII	
SMLAX	-	L	1	-	XXX	-	R	-	L1	/SXXX													
I		II	III		IV		V		VI	VII													
<p>I – Series: SMLAX</p>																							
<p>II – Output circuits: L = Line Driver (RS422) Y = Push-Pull AB0 /AB0 BG = SSI binary coded GG = SSI Gray coded</p>																							
<p>III – Supply Voltage: 1 = +5V±5% (not for B5, G5) 2 = +10V± +30V</p>																							
<p>IV – Resolution: Three numeric character to indicate resolution, not safety relevant.</p>																							
<p>V – Index: R = unique reference signal (no output for BG, GG)</p>																							
<p>VI – Connections – Cable length: L1 = cable output 1 m Lx = cable output x meters</p>																							
<p>VII – Customer version: Three numeric character to indicate specific customer requirements, not safety relevant</p>																							
<p><u>PARAMETERS RELATING TO THE SAFETY</u></p>																							
<p>Power supply: +5Vdc ± 5%, +10Vdc ± +30Vdc</p>																							
<p>Output current (each channel): 20 mA</p>																							

		<h2 style="margin: 0;">IECEX Certificate of Conformity</h2>	
Certificate No.: IECEX ULD 19.0002X		Issue No.: 0	
		Page 3 of 3	
MARKING			
Marking has to be readable and indelible; it has to include the following indications:			
	II 3 G Ex mc IIC T4 Gc, Zone 2 DEMKO 19 ATEX 2195 X	Ex mc IIC T4 Gc, Zone 2 IECEX ULD 19.0002 X	
Mod. SMLAX-xxx-xx-xx/xxxx		 <small>lika electronics s.r.l. Via S. Lorenzo 25 38010 Corme' (VI) ITALY</small>	
Serial n° xxxxxxxx			
V= xxxxx	P= xxxxx		
-10°C ≤ Ta ≤ 85°C			
The equipment must also carry the marking normally stipulated by its construction standards.			
ROUTINE EXAMINATIONS AND TESTS			
Each piece of equipment defined above has to have successfully passed before delivery:			
<ul style="list-style-type: none"> Each SMLAX bearingless encoder shall be subjected to a visual inspection to determine such as cracks in the compound, exposure of the encapsulated parts, flaking, inadmissible shrinkage, swelling, decomposition, failure of adhesion or softening per Cl. 9.1 of IEC 60079-18. 			

4 - DEMKO 19 ATEX 2195X Examination Certificate

[1] **TYPE EXAMINATION CERTIFICATE**

[2] **Equipment or Protective System intended for use in Potentially Explosive Atmospheres Directive 2014/34/EU**

[3] Type Examination Certificate Number: **DEMKO 19 ATEX 2195X Rev. 0**

[4] Product: **ROTAMAG, Bearingless magnetic ring encoder, Series SMLAX**

[5] Manufacturer: **LIKA Electronic s.r.l.**

[6] Address: **Via San Lorenzo 25, Carrè, VI, 36010, Italy**

[7] This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

[8] UL International Demko A/S certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014.

The examination and test results are recorded in confidential report no. **4788483617.2.1**

[9] Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN IEC 60079-0:2018 EN 60079-18:2015

except in respect of those requirements listed at item 18 of the Schedule.

[10] If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.

[11] This Type examination certificate relates only to the design of the specified product, and not to specific items of product subsequently manufactured.

[12] The marking of the product shall include the following:

Ex II 3 G Ex mc IIC T4 Gc

Certification Manager
Jan-Erik Storgaard

Jan Erik Storgaard

Date of issue: 2019-08-21

This is to certify that the sample(s) of the Product described herein ("Certified Product") has been investigated and found in compliance with the Standard(s) indicated on this Certificate, in accordance with the ATEX Product Certification Program Requirements. This certificate and test results obtained apply only to the product sample(s) submitted by the Manufacturer. UL did not select the sample(s) or determine whether the sample(s) provided were representative of other manufactured product. UL has not established Follow-Up Service or other surveillance of the product. The Manufacturer is solely and fully responsible for conformity of all product to all applicable Standards, specifications, requirements or Directives. The test results may not be used, in whole or in part, in any other document without UL's prior written approval.

Certification Body UL International Demko A/S, Borupvang 5A, 2750 Ballerup, Denmark
Tel. +45 44 85 65 65, info.dk@ul.com, www.ul.com

[13]
[14]

Schedule
TYPE EXAMINATION CERTIFICATE No.
DEMKO 19 ATEX 2195X Rev. 0

[15]

Description of Product:
SMLAX is a series of bearingless encoders for position and speed feedback on applications with large rotating shaft in potentially explosive atmospheres. The SMLAX reading head must be paired with an MRx series magnetic ring.

SMLAX rotary encoder is available with an SSI absolute interface, with an incremental output, and with a dual output (absolute + incremental). An absolute sensor, an incremental sensor, and a reference sensor can be installed in the same package. Thus the magnetic ring can be equipped with two or three tracks according to model.

The absolute resolution does not affect the safety requirements of the system and can be typically 12 bits (4.096 cpr), 13 bits (8.192 cpr), and 14 bits (16.384 cpr) or according to customer's request and the physical characteristics of the measuring system. The absolute position is provided through the SSI interface.

Also the incremental resolution is according to customer's request and the physical characteristic of the measuring system; square wave signals are provided via Push-Pull and Line Driver output circuits.

Nomenclature for Series SMLAX:

Type 1 Sensor (Absolute + incremental version):

SMLAX	-	B0	1	-	XX	-	L1	/SXXX
I		II	III		IV		V	VI

I – Series: SMLAX

II – Output circuits:

- B0 = SSI, Binary + 1024 PPR Line Driver
- G0 = SSI, Gray + 1024 PPR Line Driver
- B5 = SSI, Binary + 1024 PPR Push Pull
- G5 = SSI, Gray + 1024 PPR Push Pull

III – Supply Voltage:

- 1 = +5V±5% (not for B5, G5)
- 2 = +10V± +30V

IV – Resolution: Two numeric character to indicate resolution, not safety relevant.

V – Connections – Cable length:

- L1 = cable output 1 m
- Lx = cable output x meters

VI – Customer version: Three numeric character to indicate specific customer requirements, not safety relevant.

Type 2 Sensor (Absolute or incremental version):

SMLAX	-	L	1	-	XXX	-	R	-	L1	/SXXX
I		II	III		IV		V		VI	VII

I – Series: SMLAX

II – Output circuits:

- L = Line Driver (RS422)
- Y = Push-Pull AB0 /AB0
- BG = SSI binary coded
- GG = SSI Gray coded

III – Supply Voltage:

- 1 = +5V±5% (not for B5, G5)
- 2 = +10V± +30V

IV – Resolution: Three numeric character to indicate resolution, not safety relevant.

V – Index:

- R = unique reference signal (no output for BG, GG)

VI – Connections – Cable length:

- L1 = cable output 1 m
- Lx = cable output x meters

VII – Customer version: Three numeric character to indicate specific customer requirements, not safety relevant.

[13]
[14]

Schedule
TYPE EXAMINATION CERTIFICATE No.
DEMKO 19 ATEX 2195X Rev. 0

Temperature range:
The ambient temperature range is -10 °C to +85 °C.

Electrical data
Power supply: +5Vdc ± 5%, +10Vdc ± +30Vdc
Output current (each channel): 20 mA

Routine tests:
Each SMLAX bearingless encoder shall be subjected to a visual inspection to determine such as cracks in the compound, exposure of the encapsulated parts, flaking, inadmissible shrinkage, swelling, decomposition, failure of adhesion or softening per Cl. 9.1 of EN 60079-18.

[16]

Descriptive Documents
The scheduled drawings are listed in the report no. provided under item no. [8] on page 1 of this Type Examination Certificate.

[17]

Special Conditions of Use:

- Care shall be taken to prevent accumulation of electrostatic charges. See installation instructions.

[18]

Essential Health and Safety Requirements
The Essential Health and Safety Requirements (EHSRs) covered by the standards listed at item 9.

Additional information

The trademark  lika Electronic Srl
Via S. Lorenzo, 25
39010 Cane VV • Italy will be used as the company identifier on the marking label.

5 – Safety instructions

SAFETY INSTRUCTIONS SMLAX sensor

1) Marking:

IECEx: Ex mc IIC T4 Gc

ATEX: II 3 G Ex mc IIC T4 Gc

2) Nr. of certificate:

IECEx ULD 19.0002 X

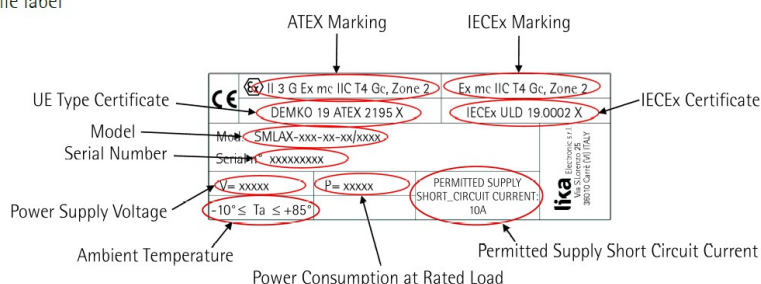
DEMKO 19 ATEX 2195 X

Encapsulated sensor manufactured in compliance with the regulations listed in the above certificates as well as with the following regulations:

IEC 61000-6-4:2006-07, IEC 61000-6-2:2016

- **II:** Equipment intended for use in surface environments, not in mines.
- **3G:** Category 3 equipment (enhanced level of protection) for gases (G).
- **Ex:** Equipment intended for use in potentially explosive atmospheres.
- **mc:** Protection by encapsulation.
- **IIC:** Electrical apparatus for use in potentially explosive atmospheres caused by gases of the group IIC (e.g. H₂, C₂H₂).
- **T4:** Temperature class for gases T4 = 135°C.
- **Gc:** Level of protection (EPL): equipment for explosive gas atmospheres, having an "enhanced" level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences in Zone 2.
- **X:** This symbol is intended to warn about specific conditions of use, see prescriptions at points 14 and 15.

3) Facsimile label



Equipment intended for use in the following Zones:

Zone 2: Mixture of gas/air, vapour/air, mist/air

WARNING: Equipment not to be used in Zones 0 and 1

- 4) The equipment must be installed only by qualified personnel and according to the applicable regulations.
- 5) Do not tool or drill the equipment, do not tamper with the equipment.
- 6) Do not open the equipment.
- 7) Do not loosen the screws that fasten the enclosure.
- 8) Protect the device against shock and mechanical damages.
- 9) Use the product according to the indicated degree of IP protection.
- 10) Comply with the range of permissible environmental temperature $-10^{\circ}\text{C} +85^{\circ}\text{C}$ ($+14^{\circ}\text{F} +185^{\circ}\text{F}$).
- 11) In classified areas installation and maintenance of the appliance must be carried out by specialist technical staff in compliance with the applicable reference standards EN/IEC 60079-0 and EN/IEC 60079-14 as well as the national standards and regulations.

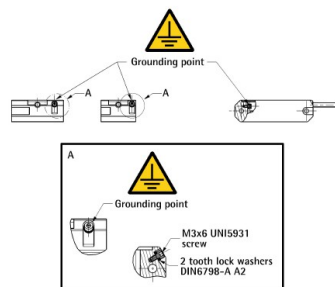
12) Connect the device according to the electrical connection scheme described in the user's guide.

13) It is mandatory to connect the enclosure of the sensor to ground. Make sure that ground is not affected by noise. Use the ground point provided in the enclosure of the sensor. Use one TCEI M3 x 6 UNI5931 cylindrical head screw with 2 tooth lock washers DIN 6798-A.

Connect to the grounding point by using a fork crimping lug or a closed-ring crimping lug, suitable for M3 screw and $\geq 4 \text{ mm}^2$ cross section PE wire (11AWG).

Ensure that the ring is connected to ground. Minimize noise by connecting the drive shaft to ground; the ring must be installed as described in the additional guide, ensure that it is in electrical contact with the drive shaft.

The minimum size of the protective earthing (PE) conductor connection must be 4 mm^2 .



14) Access to the equipment must be limited or prevented in order to avoid charging or discharging electrostatic charges.

In order to prevent the accumulation of electrostatic charges while cleaning the equipment, the unit (and especially the magnetic tape of the ring and any other non metallic part that is exposed) must be cleaned only with a damp cloth or a cloth soaked in a damp solution; compressed air cannot be used. Any rubbing with non-conductive materials must be strictly avoided.

Any other step intended to avoid electrostatic charging and/or discharging must be taken in compliance with all local provisions and national regulations as well as the relevant safety regulations and in particular the applicable reference standards EN/IEC 60079-0 and EN/IEC 60079-14.

15) Always comply with the power supply voltage level indicated in the data sheet, i.e.:

+5Vdc $\pm 5\%$ for SMLAX-B01..., ...-G01..., ...-B51..., ...-G51..., ...-B51..., ...-G51..., ...-L1...

+10Vdc +30Vdc for SMLAX-B02..., ...-G02..., ...-B52..., ...-G52..., ...-B52..., ...-G52..., ...-L2..., -Y2...

16) Current absorbed per each channel must not exceed 20 mA.

LIKA ELECTRONIC SRL
Carrè, 10.07.2019

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6 - Mounting instructions



WARNING

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



WARNING

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 ring from jamming.

Make sure the mechanical installation meets the system's requirements for both the sensor and the ring indicated in this guide.

6.1 Overall dimensions

(values are expressed in mm)

6.1.1 SMLAX-B0..., SMLAX-G0..., SMLAX-B5..., SMLAX-G5...

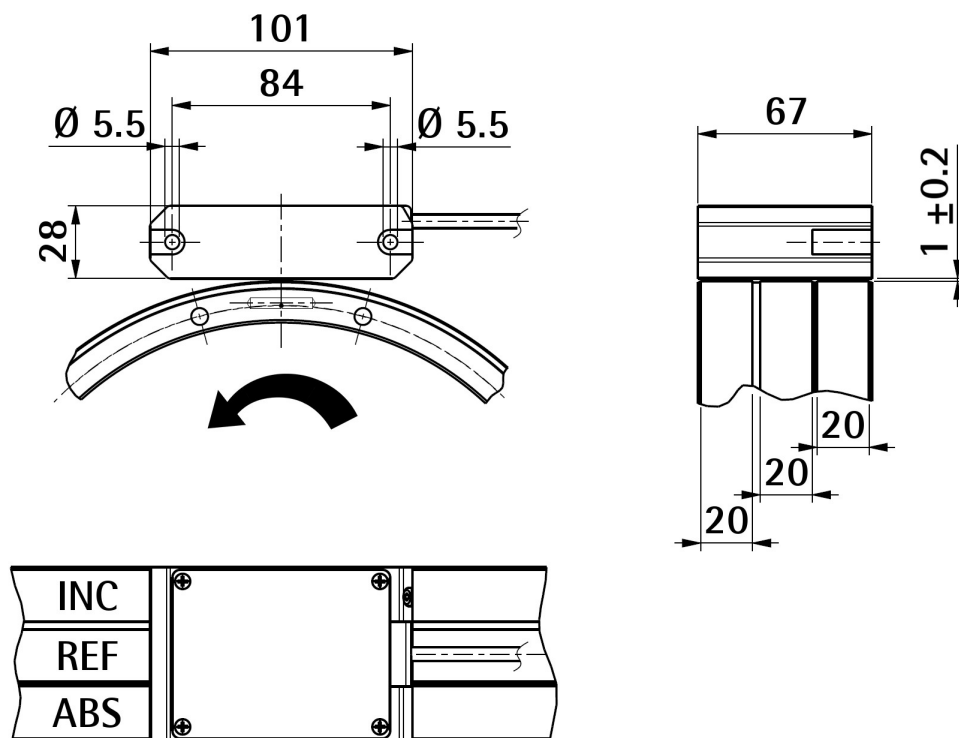


Figure 1 - Overall dimensions

6.1.2 SMLAX-BS..., SMLAX-GS...

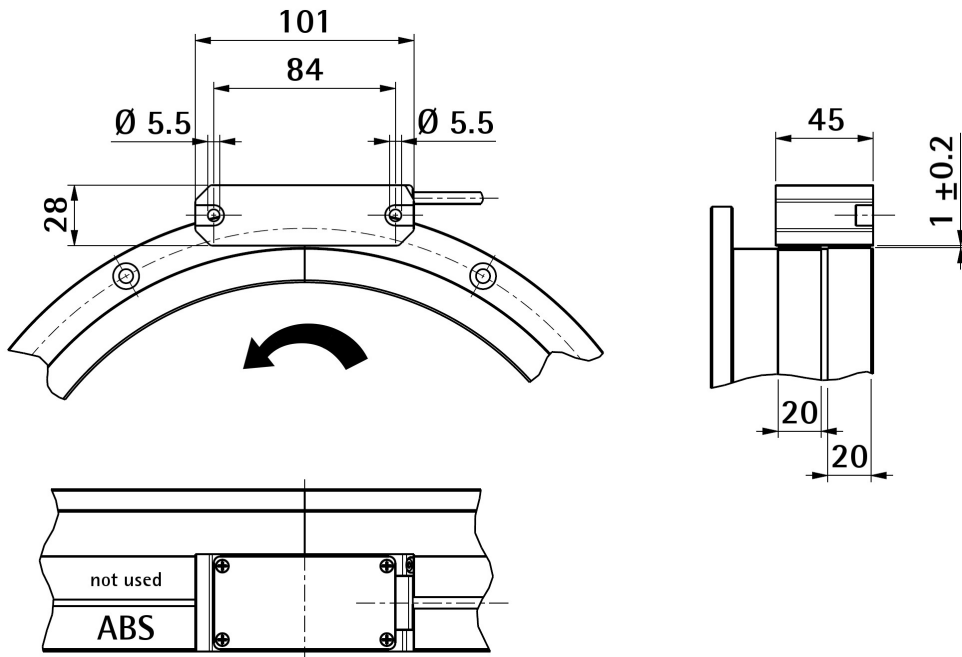


Figure 2 - Overall dimensions

6.1.3 SMLAX-L..., SMLAX-Y...

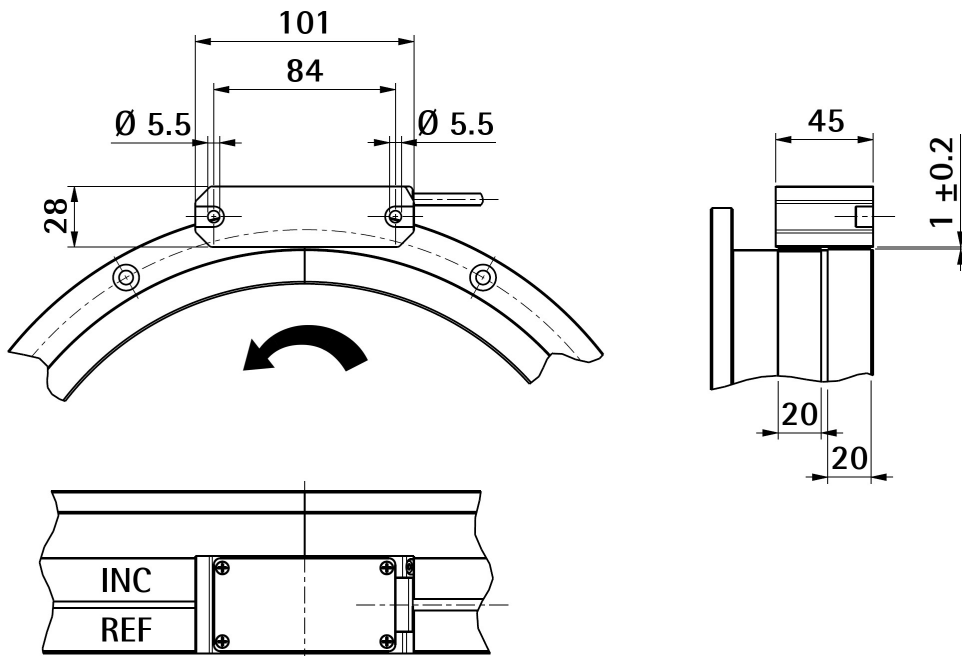


Figure 3 - Overall dimensions

6.2 Installing the system

6.2.1 Mounting the SMLAX-B0..., SMLAX-G0..., SMLAX-B5..., SMLAX-G5... sensor

1. Fix the sensor using 2 cylinder head screws UNI5931 M5 x 55 mm min. The recommended tightening torque is **4.9 Nm**. The **minimum bend radius** of the cable is **R ≥ 46 mm**.

The gap between the sensor and the magnetic ring must be **1.0 mm ±0.2 mm (0.04" ±0.008")**.



WARNING

Please be sure that the mounting tolerances indicated in Figure 4 are always met. Avoid contact between the sensor and the ring.

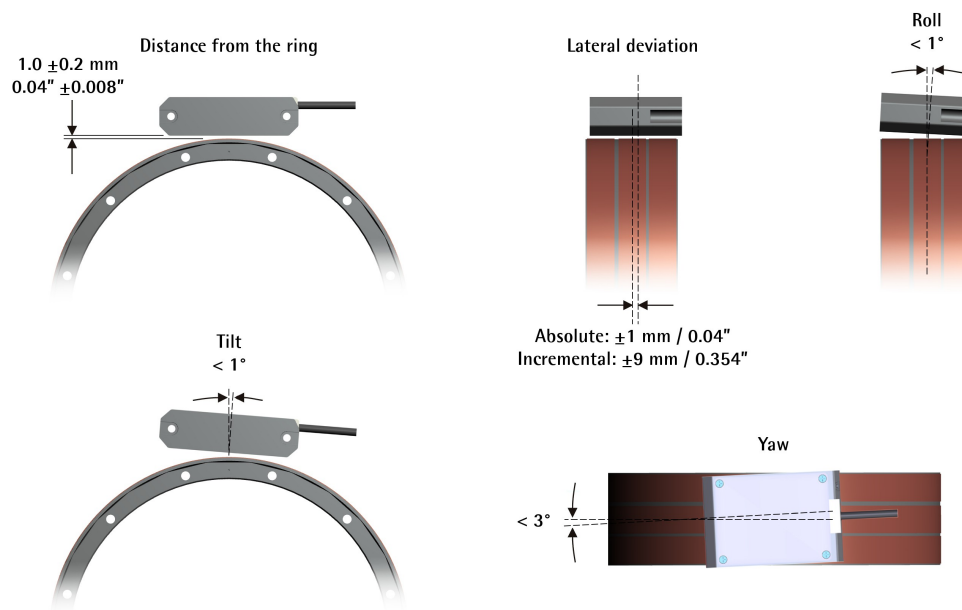


Figure 4 - Mounting tolerances



WARNING

Mount the sensor as shown in the Figures. Please mind the direction of the cable outlet. The system cannot operate if mounted otherwise than illustrated in the Figures.

**WARNING**

The arrow in Figure 1 is intended to indicate the **standard counting direction**, i.e. count is up when the ring turns in the direction indicated by the arrow -absolute measuring system-; the rising edge of A signal leads the rising edge of B signal -incremental measuring system-.



Figure 5 - Mounting direction of the sensor

6.2.2 Mounting the SMLAX-L..., SMLAX-Y..., SMLAX-BS..., SMLAX-GS... sensor

1. Fix the sensor using 2 cylinder head screws UNI5931 M5 x 45 mm min. The recommended tightening torque is **4.9 Nm**. The **minimum bend radius** of the cable is **$R \geq 46$ mm**.

The gap between the sensor and the magnetic ring must be **1.0 mm ± 0.2 mm (0.04" ± 0.008 ")**.

**WARNING**

Please be sure that the mounting tolerances indicated in Figure 6 are always met. Avoid contact between the sensor and the ring.

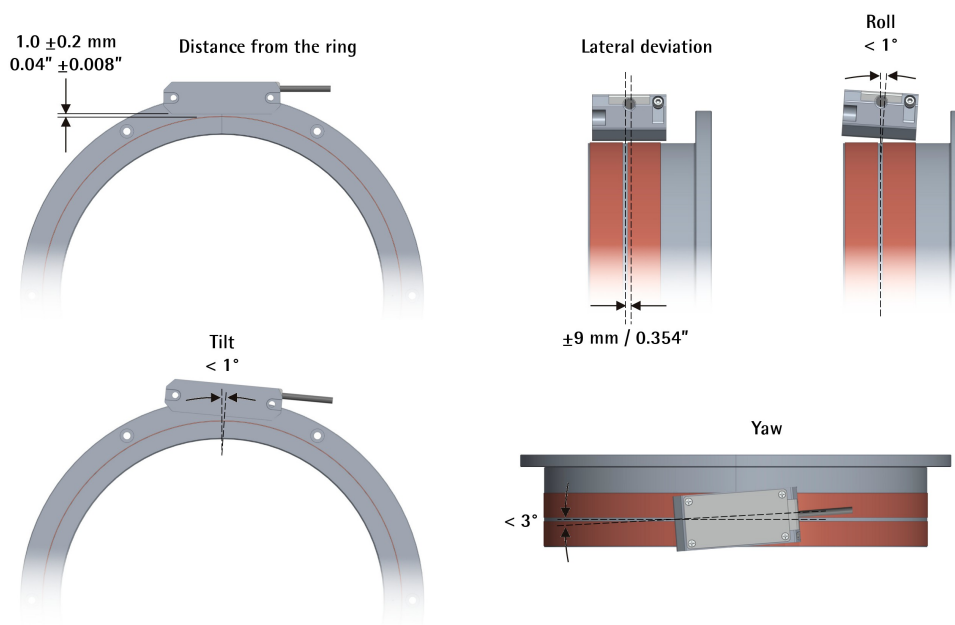


Figure 6 - Mounting tolerances



WARNING

Mount the sensor as shown in the Figures. Please mind the direction of the cable outlet. The system cannot operate if mounted otherwise than illustrated in the Figures.



WARNING

The arrow in Figure 2 is intended to indicate the **standard counting direction**, i.e. count is up when the ring turns in the direction indicated by the arrow -absolute measuring system-; the rising edge of A signal leads the rising edge of B signal -incremental measuring system-.

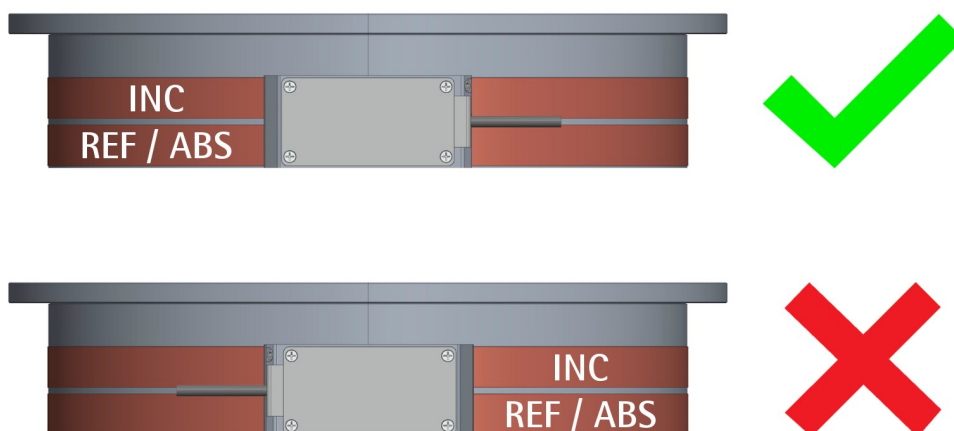


Figure 7 - Mounting direction of the sensor

6.2.3 Optional mounting tool

To ease the installation of the sensor we suggest using the optional mounting tool. It is specific for each measuring system. Please refer to the documentation of the magnetic ring.

6.3 Magnetic ring

It is mandatory to pair the sensor with its own **MTx series magnetic ring**. For complete information on the dimensions of the ring and its installation please refer to the specific manual.



WARNING

The system cannot operate if mounted otherwise than illustrated in Figure 5 and Figure 7. Please mind the direction of the cable outlet.



WARNING

To minimize noise the drive shaft must be connected to ground and the ring must be in electrical contact with the drive shaft. For PE connection please refer to the "7.5 Ground connection" section on page 30.

7 – Electrical connections



WARNING

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



WARNING

Electrical connection must be carried out in compliance with the methods indicated in the EN 60079-0 directive and according to the EN 60079-14 directive.

7.1 Connection of the absolute encoder

The following pinout refers to the following order codes: SMLAX-B0..., SMLAX-G0..., SMLAX-B5..., SMLAX-G5..., SMLAX-BS..., SMLAX-GS...

Function	T12 cable
0Vdc power supply	White / Green
+Vdc power supply ¹	Brown / Green
Clock IN +	Violet
Clock IN -	Yellow
Data OUT +	Grey
Data OUT -	Pink
A ²	Green
/A ²	Brown
B ²	Red
/B ²	Black
0 ²	White
/0 ²	Blue
Shield	Shield

1 The power supply voltage level is according to the order code



EXAMPLE

SMLAX-B01... +Vdc = +5Vdc ± 5%
 SMLAX-B02... +Vdc = +10Vdc +30Vdc

2 Not available for SMLAX-BS... and SMLAX-GS... order codes

7.2 Connection of the incremental encoder

The following pinout refers to the following order codes: SMLAX-L..., SMLAX-Y...

Function	T12 cable
0Vdc power supply	White / Green
+Vdc power supply ¹	Brown / Green
A	Green
/A	Brown
B	Red
/B	Black
0	White
/0	Blue
Shield	Shield

1 The power supply voltage level is according to the order code



EXAMPLE

SMLAX-L1... +Vdc = +5Vdc ± 5%
 SMLAX-L2... +Vdc = +10Vdc +30Vdc

7.3 T12 cable specifications

Model	: LIKA HI-FLEX twisted encoder cable type T12
Wires	: 4 x 2 x 0.14 mm ² + 4 x 0.25 mm ² twisted pairs
Jacket	: Matt Polyurethane (TPU) halogen free, oil, hydrolysis, abrasion resistant
Shield	: tinned copper braid, coverage ≥ 85%
Outer diameter	: Ø 6.1 mm ± 0.10 mm (0.24" ± 0.0039")
Min. bend radius	: Ø x 7.5
Work temperature	: -40°C +90°C (-40°F +194°F) – dynamic installation -50°C +90°C (-58°F +194°F) – fixed installation
Conductor resistance	: ≤ 148 Ω/km (0.14 mm ²) / ≤ 90 Ω/km (0.25 mm ²)

7.4 Connection of the shield

For signals transmission always use shielded cables. The cable shielding is internally connected to the metal frame of the sensor.

7.5 Ground connection

It is mandatory to connect the enclosure of the sensor to ground. Make sure that ground is not affected by noise.

Use the ground point provided in the enclosure of the sensor. Use one TCEI M3 x 6 UNI5931 cylindrical head screw with 2 tooth lock washers DIN 6798-A.

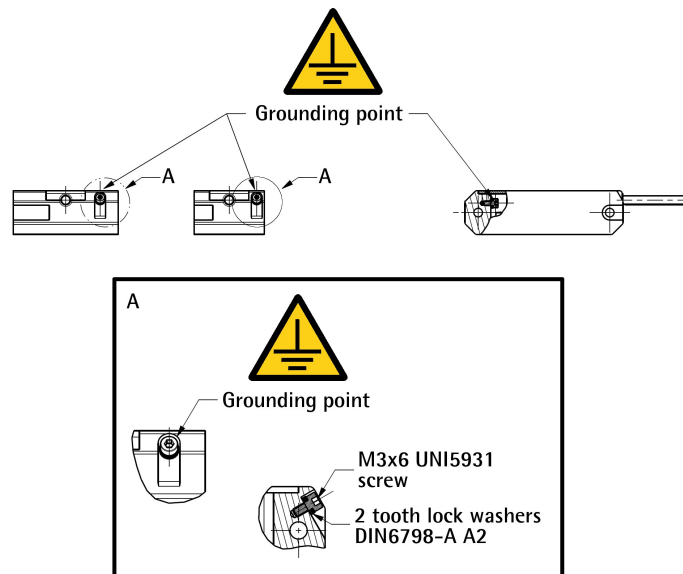
Connect to the grounding point by using a fork crimping lug or a closed-ring crimping lug, suitable for M3 screw and ≥ 4 mm² cross section PE wire.

Ensure that the ring is connected to ground. Minimize noise by connecting the drive shaft to ground; the ring must be installed as described in the additional guide, ensure that it is in electrical contact with the drive shaft.



WARNING

The minimum size of the protective earthing (PE) conductor connection must be 4 mm².



7.6 Absolute resolution and interface

SMLAX measuring system with absolute interface can have a resolution of 4,096 cpr (12 bits), 8,192 cpr (13 bits), and 16,384 cpr (14 bits).

The angular resolution is 0.08789° (0° 5' 16") for 12-bit model.

It is 0.04394° (0° 2' 38") for 13-bit model.

It is 0.02197° (0° 1' 19") for 14-bit model.



NOTE

To convert the absolute position value detected by the encoder into an angular position use the following formula:

$$1 \text{ STEP} = 360^\circ / 4,096 \text{ cpr} = 0.08789^\circ/\text{cpr}$$

$$\text{angular position} = \text{position value} * 1 \text{ step}$$



EXAMPLE

Position value = 3,000

$$\text{Angular position} = 3,000 * 0.08789 = 263.67^\circ = 263^\circ 40' 12''$$

The interface is SSI with "MSB Left Aligned" protocol and binary or Gray output code. It provides also an error bit. For complete information refer to the "8 - SSI interface" section on page 35.

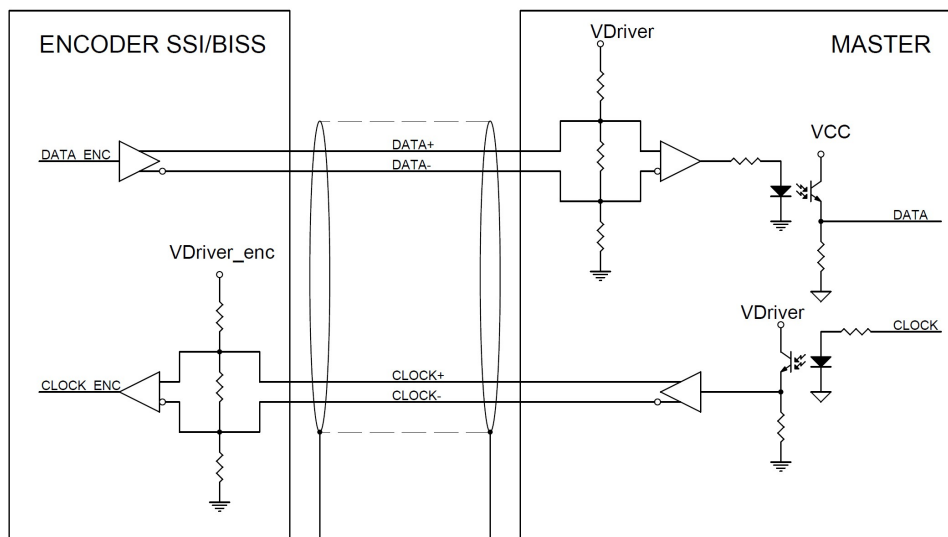


NOTE

Please note that there is no connection between the absolute position information and the Reference mark signal. At installation we recommend the

absolute position to be always set to zero or to a preset value in the subsequent electronics.

7.7 Recommended SSI circuit



7.8 Incremental resolution and output circuit

SMLAX-B0..., SMLAX-G0..., SMLAX-B5..., and SMLAX-G5... measuring systems provide additional incremental signals; the incremental resolution is 1,024 PPR. SMLAX-L..., and SMLAX-Y... measuring systems provide AB0, /AB0 incremental signals; the incremental resolution depends on the paired ring and the chosen interpolation. Please refer to the attached documentation.

The output circuit can be:

- Line Driver / Line Driver (RS-422)/TTL level type (-L order code). It is operated at 5Vdc \pm 5% or +10Vdc +30Vdc and the signal amplitude is according to the supply voltage (with 5Vdc \pm 5% it is in compliance with EIA RS-422 standard). It provides AB0 /AB0 signals.
- Push-Pull HTL level type (-Y order code). It is operated at +10Vdc +30Vdc and the signal amplitude is according to the supply voltage. It provides AB0 /AB0 signals.

For further information refer to following sections "7.9 AB0, /AB0 output channels" and "7.10 Reference signal".

7.9 ABO, /ABO output channels

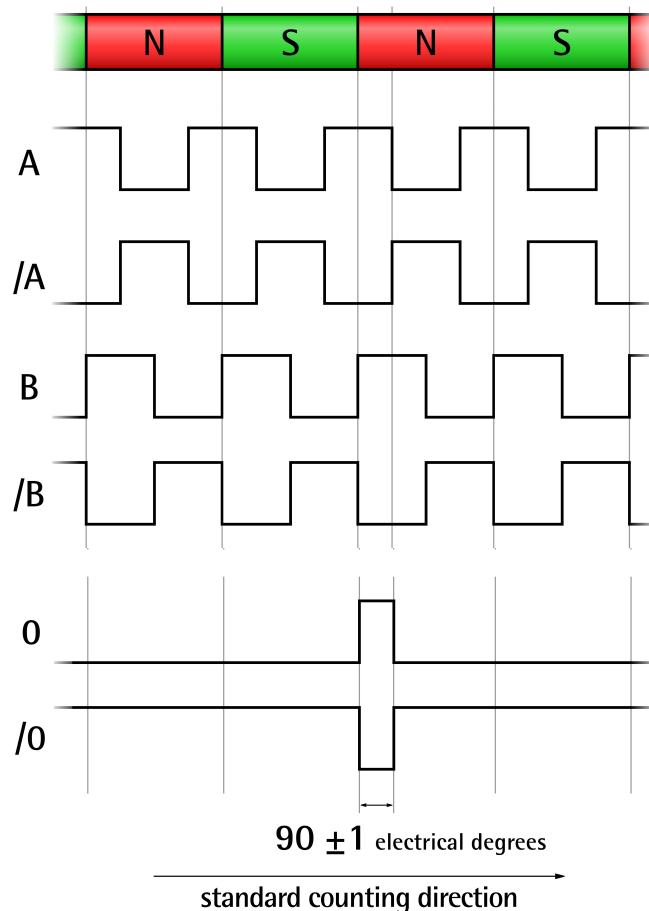


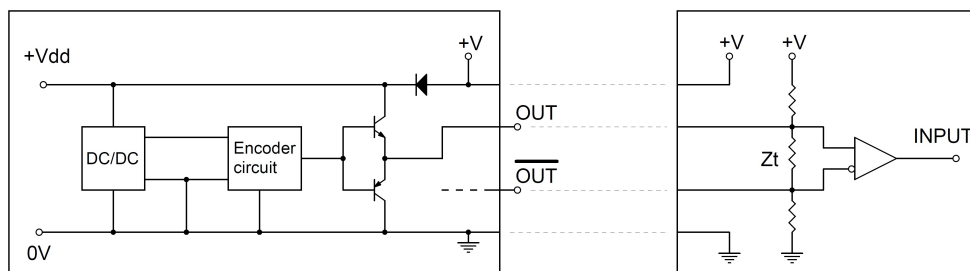
Figure 8 - Example with interpolation factor x4

The conversion electronics inside the sensor translates the magnetic fields of the ring into Line Driver / Push-Pull level electrical signals. The frequency of the output signals is proportional to the measuring speed while the number of output pulses is proportional to the mechanical displacement of the ring.

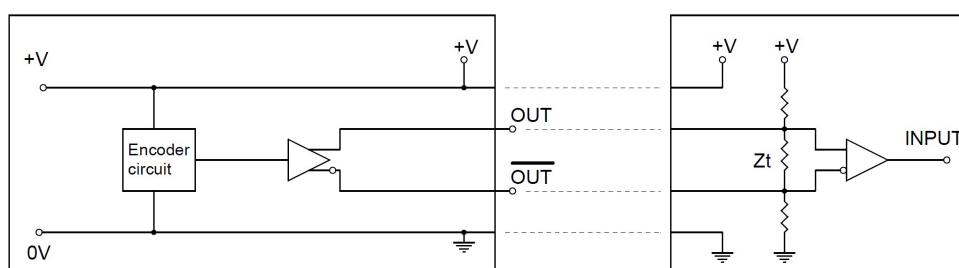
7.10 Reference signal

The Reference signal (0, /0) provides a single datum position in the revolution of the ring for use at power-up or following a loss of power. The signal is synchronized with A and B channels and has a duration of one measuring step (90 ± 1 electrical degrees), see Figure 8. The amplitude is according to the power supply voltage level (Line Driver 5Vdc ±5% is in compliance with EIA RS-422 standard). The REF label applied to the incremental track indicates the point where the Reference signal is supplied.

7.11 Recommended Push-Pull incremental input circuit



7.12 Recommended Line Driver incremental input circuit



7.13 Counting direction

As previously stated, the **standard counting direction** is to be intended with ring turning as indicated by the arrows in Figure 1, Figure 2, and Figure 3. When the ring turns in the direction indicated by the arrow, in the absolute measuring system the count is up; in the incremental measuring system the rising edge of A signal leads the rising edge of B signal.

8 - SSI interface

Order codes:

SMLAX-B0...	SSI Binary + Line Driver incremental output
SMLAX-G0...	SSI Gray + Line Driver incremental output
SMLAX-B5...	SSI Binary + Push-Pull incremental output
SMLAX-G5...	SSI Gray + Push-Pull incremental output
SMLAX-BS...	SSI Binary
SMLAX-GS...	SSI Gray

8.1 SSI (Synchronous Serial Interface) – General Information



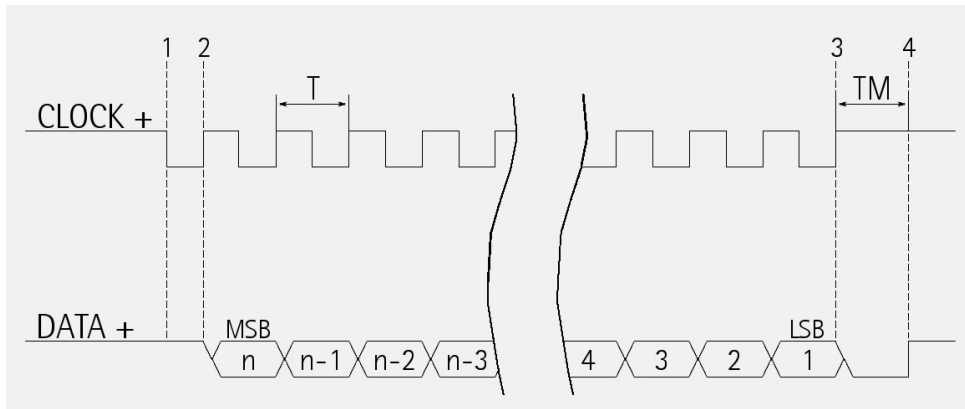
SSI (the acronym for **Synchronous Serial Interface**) is a synchronous point-to-point serial interface engineered for unidirectional data transmission between one Master and one Slave. Developed in the first eighties, it is based on the RS-422 serial standard. Its most peculiar feature is that data transmission is achieved by synchronizing both the Master and the Slave devices to a common clock signal generated by the controller; in this way the output information is clocked out at each controller's request. Furthermore only two pairs of twisted wires are used for data and clock signals, thus a six-wire cable is required. The main advantages in comparison with parallel or asynchronous data transmissions are:

- less conductors are required for transmission;
- less electronic components;
- possibility of insulating the circuits galvanically by means of optocouplers;
- high data transmission frequency;
- hardware interface independent from the resolution of the absolute encoder.

Furthermore the differential transmission increases the noise immunity and decreases the noise emissions. It allows multiplexing from several encoders, thus process controls are more reliable with simplified line design and easier data management.

Data transmission is carried out as follows.

At the first falling edge of the clock signal (1, the logic level changes from high to low) the absolute position value is stored while at the following rising edge (2) the transmission of data information begins starting from the MSB.



At each change of the clock signal and at each subsequent rising edge (2) one bit is clocked out at a time, up to LSB, so completing the data word transmission. The cycle ends at the last rising edge of the clock signal (3). This means that up to $n + 1$ rising edges of the clock signals are required for each data word transmission (where n is the bit resolution); for instance, a 13-bit encoder needs 14 clock edges. If the number of clocks is greater than the number of bits of the data word, then the system will send a zero (low logic level signal) at each additional clock, zeros will either lead (LSB ALIGNED protocol) or follow (MSB ALIGNED protocol) or lead and/or follow (TREE FORMAT protocol) the data word. After the period T_m monoflop time, having a typical duration of 16 μsec , calculated from the end of the clock signal transmission, the encoder is then ready for the next transmission and therefore the data signal is switched high.

The clock signal has a typical logic level of 5V, the same as the output signal which has customarily a logic level of 5V in compliance with RS-422 standard.

The output code can be either Binary or Gray (see the order code).

8.2 MSB left aligned protocol

"MSB left aligned" protocol allows to left align the bits, beginning from MSB (most significant bit) to LSB (least significant bit); LSB is then sent at the last clock cycle. If the number of clock signals is higher than the data bits, then unused bits are forced to logic level low (0) and follow the data word. This protocol can be used in sensors having any resolution.

The word has a variable length according to resolution, as shown in the following table.

Encoder resolution	Length of the word	Max. number of information
12 bits	13 bits	4,096 info/rev.
13 bits	14 bits	8,192 info/rev.
14 bits	15 bits	16,384 info/rev.

The number of information per revolution results from:

interpolation expressed in a power of 2 * number of ring poles



EXAMPLE

SMLAX-G02-05-...: interpolation = 05;
 MRA/262B-128N-...: number of poles = 128.

Hence: $2^5 * 128 = 32 * 128 = 4,096$ information per revolution

The output code of the sensor can be BINARY or GRAY (see the order code).

The transmitted position value has the following structure:

Bit (4,096 cpr)	12	...	1	0
Bit (8,192 cpr)	13	...	1	0
Bit (16,384 cpr)	14	...	1	0
value	MSB	...	LSB	Error bit

8.3 Recommended transmission rates

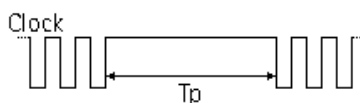
The SSI interface has a frequency of data transmission ranging between 100 kHz and 2 MHz.

The CLOCK IN and the DATA OUT signals comply with the "EIA standard RS-422".

The clock frequency (baud rate) depends on the length of the cable and must comply with the technical information reported in the following table:

Cable length	Baud rate
< 60 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

The time interval between two Clock sequence transmissions must be at least 16 μ s ($T_p = \text{pause time} > 16 \mu\text{s}$).



8.4 Error bit

The error bit is intended to communicate the normal or fault status of the encoder.

"1": correct status (the sensor is working properly, there are no active errors)

"0": an error is active:

- position calculation error, invalid position value; the sensing electronics is not able to read the ring; this problem may be caused, for instance, by an excessive distance between the sensor and the ring, by a wrong/reversed assembly of the elements, by a damage to the magnetic surface of the ring; see the sections "6.2.1 Mounting the SMLAX-B0..., SMLAX-G0..., SMLAX-B5..., SMLAX-G5... sensor" on page 25 and "6.2.2 Mounting the SMLAX-L..., SMLAX-Y..., SMLAX-BS..., SMLAX-GS... sensor" on page 26; refer also to the documentation of the ring;
- the power supply is not as required, please refer to the order code;
- EEPROM error.



NOTE

For any information on the structure of the position information word, please refer to the "8.2 MSB left aligned protocol" section on page 36.

For any information on errors and their solution please refer to the sections "9 - Error and fault diagnostics" on page 39 and "11 - Troubleshooting" on page 41.

8.5 Helpful information

- The position information increases when the ring rotates as indicated by the arrow in Figure 1, Figure 2, and Figure 3.
- At installation always execute a zero setting or preset operation of the absolute position in the subsequent electronics.

9 - Error and fault diagnostics

At power on or during operation the following errors may occur:

- when switching on the system an alarm is triggered through the dedicated bit (refer to the "8.4 Error bit" section on page 38): the ring is not read correctly; it may be due to one of the following reasons: the ring and/or the sensor are not mounted properly (see the "6 - Mounting instructions" section on page 23); the ring magnetic surface is damaged somewhere; the sensor is not working properly; this may cause invalid data to be transmitted; as soon as the problem is solved the error bit switches to high logic level;
- during operation an alarm is triggered through the dedicated bit (refer to the "8.4 Error bit" section on page 38): as previously stated, the ring is not read correctly; it may be due to one of the following reasons: the ring and/or the sensor are not mounted properly (see the "6 - Mounting instructions" section on page 23); the ring magnetic surface is damaged somewhere; the sensor is not working properly; furthermore, the alarm may be caused by a position calculation error so that the resulting position value is invalid. The last valid position is "frozen" (kept in memory) until the next valid position is detected on the ring.

For any further information refer also to the "11 - Troubleshooting" section on page 41.

10 - Maintenance



WARNING

Maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop.

The magnetic measurement system does not need any special maintenance; anyway it has to be handled with the utmost care as any delicate electronic equipment. From time to time we recommend the following operations:

- periodically check the soundness of the structure and make sure that there are no loose screws; tighten them if necessary;
- check the gap between the sensor and the magnetic ring. The wear of the machine may increase the tolerances;
- the surface of the magnetic ring has to be regularly cleaned using a soft and clean cloth to remove dust, chips, moisture etc.

11 - Troubleshooting

The following list shows some typical faults that may occur during installation and operation of the magnetic measurement system.

Fault:

The system does not work (no pulse output).

Possible cause:

- The ring and/or the sensor are not installed properly. The ring and the sensor need to be coupled as explained in the mounting instructions. The system cannot operate if mounted otherwise. For correct installation please refer to the "6 - Mounting instructions" section on page 23.
- Installation does not meet the mounting tolerances between the sensor and the ring indicated in this guide; the sensor hits the surface of the ring or is too close to/far from it. Check whether the sensor sensitive part is damaged.
- A magnetic part has been placed between the sensor and the magnetic surface of the ring.
- The sensor has been damaged by short circuit or wrong connection.

Fault:

The measured values are either inaccurate or not provided in the whole circumference of the ring.

Possible cause:

- The sensor is not installed properly on the ring. See the "6 - Mounting instructions" section on page 23.
- The connection cable runs near high voltage cables or the shield is not connected properly. Check the earthing point.
- The frequency of Master clock is set too high or too low and the transmission cannot be synchronized correctly. See the "8 - SSI interface" section on page 35.
- A section of the magnetic surface has been damaged mechanically or magnetically; this may cause a failure to read the position or a position calculation error so that the resulting position value is invalid.
- The measuring error is caused by a torsion or plays in the machine structure. Check for movements in the mechanics of the machine.

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Document release	Release date	Description	HW	SW	Interface
1.0	15.07.2019	First issue	-	-	-



Dispose separately

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