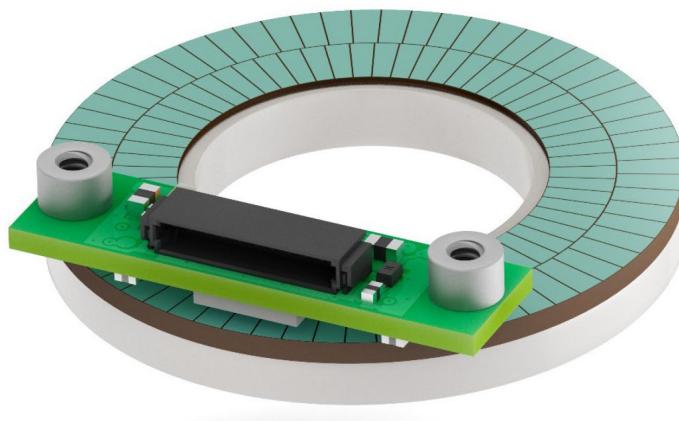


SMAR4A SMAR4B SMAR4C



Absolute off-axis modular encoder

- Ultra-flat and miniature off-axis modular encoder
- Absolute operation with magnetic scanning
- SSI and BiSS C-mode interfaces
- Single-turn resolution, up to 1,048,576 cpr (20 bits)
- Direct integration into robots, motors, and OEM applications

Suitable for the following models:

- SMAR4x-BG1-...
- SMAR4x-SC1-...

General contents

Preliminary information	7
1 - Safety summary	9
2 - Identification	12
3 - Mounting instructions	13
4 - Electrical connections	18
5 - Calibration procedure	24
6 - SSI interface	36
7 - BiSS C-mode interface	40
8 - Diagnostic LED	51
9 - Warnings and errors	53
10 - Maintenance	55

This publication was produced by Lika Electronic s.r.l. 2026. All rights reserved. Tutti i diritti riservati. Alle Rechte vorbehalten. Todos los derechos reservados. Tous droits réservés.

This document and information contained herein are the property of Lika Electronic s.r.l. and shall not be reproduced in whole or in part without prior written approval of Lika Electronic s.r.l. Translation, reproduction and total or partial modification (photostat copies, film and microfilm included and any other means) are forbidden without written authorisation of Lika Electronic s.r.l.

The information herein is subject to change without notice and should not be construed as a commitment by Lika Electronic s.r.l. Lika Electronic s.r.l. reserves the right to make all modifications at any moments and without forewarning.

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 s.r.l. features the word "lika" in a bold, lowercase, sans-serif typeface. The letters are black and the font is modern and clean.

Table of Contents

User's guide.....	1
Table of Contents.....	3
Subject Index.....	5
Typographic and iconographic conventions.....	6
Preliminary information.....	7
1 – Safety summary.....	9
1.1 Safety.....	9
1.2 Electrical safety.....	9
1.3 Mechanical safety.....	9
1.4 Specific handling and cleaning instructions and safety information against electrostatic discharges.....	10
2 – Identification.....	12
3 – Mounting instructions.....	13
3.1 Encumbrance sizes.....	13
3.2 Mounting the code disc / ring.....	14
3.3 Mounting the encoder.....	15
4 – Electrical connections.....	18
4.1 Amphenol FCI 10144041-10 connector (Minitex).....	18
4.2 Cable connections.....	19
4.3 B8A cable specifications (KABL-00005 Bogen).....	19
4.4 Connection of the shield.....	20
4.5 Ground connection.....	20
4.6 SSI interface.....	20
4.7 BiSS C-mode interface.....	20
4.8 SLI+ and SLI– signals.....	20
4.9 Absolute resolution.....	20
4.10 Counting direction.....	21
4.11 Zero setting / Preset (BiSS interface encoders only).....	21
4.12 Diagnostic LED.....	21
4.13 Daisy chain arrangement (BiSS interface encoders only).....	22
5 – Calibration procedure.....	24
5.1 Brief information on the software tool.....	24
5.2 Items needed for connection.....	24
5.3 Before launching the calibration procedure.....	25
5.4 Installing the USB drivers of the IF100 adapter.....	26
5.5 Encoder calibration interface.....	26
5.5.1 Establishing a connection to the interface and the encoder.....	27
5.5.2 Configuration section.....	30
5.5.3 Orientation section.....	31
5.5.4 Position section.....	32
5.5.5 Calibration procedure section.....	33
6 – SSI interface.....	36
6.1 SSI (Synchronous Serial Interface) – General Information.....	36
6.2 MSB Left Aligned protocol.....	37
6.3 Recommended transmission rates.....	38
6.4 Helpful information.....	38

6.5 Recommended SSI input circuit.....	39
7 - BiSS C-mode interface.....	40
7.1 Communication.....	40
7.2 Single Cycle Data SCD.....	41
7.2.1 SCD structure.....	41
Position.....	41
Error.....	41
Warning.....	42
CRC.....	42
7.3 Control Data CD.....	43
Register address.....	43
RW.....	43
DATA.....	43
CRC.....	43
7.4 Implemented registers.....	44
Preset setting enable.....	44
Serial number.....	44
Preset.....	45
Command.....	48
Save parameters.....	48
Save parameters and activate Preset.....	48
Device ID.....	48
Manufacturer ID.....	49
7.5 Application notes.....	49
7.6 Recommended BiSS input circuit.....	50
8 - Diagnostic LED.....	51
9 - Warnings and errors.....	53
9.1 Warnings.....	53
Signal warning.....	53
Frequency warning.....	53
9.2 Errors.....	53
Startup error.....	53
Command execution in progress.....	53
Consistency error.....	54
Communication error.....	54
Invalid checksum.....	54
10 - Maintenance.....	55
11 - Troubleshooting.....	56
12 - Default parameters list.....	57

Subject Index

A

Accuracy.....34

C

Command.....48

Command execution in progress.....53

Communication error.....54

CONNECT.....28

Consistency error.....54

CRC.....42, 43

D

DATA.....43

DEC.....32

Device ID.....48

DISCONNECT.....29

E

Error.....33, 41

F

Frequency warning.....53

I

INTERFACE.....28

Interface Absolute.....30

Interface Incremental.....30

Invalid checksum.....54

M

Manufacturer ID.....49

Multiturn.....32

P

Position.....41

Preset.....45

PRESET.....32

Preset setting enable.....44

R

READ.....32

Register address.....43

Resolution.....30

RW.....43

S

Save parameters.....48

Save parameters and activate Preset.....48

SENSOR.....28

Serial number.....44

Signal warning.....53

Singleturn.....32

START CALIBRATION.....29, 33

Startup error.....53

Status.....33

STOP.....32

W

Warning.....33, 42

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, you will find some icons on the side of the page. These icons are expressly designed to highlight the sections of the text that are of great interest and importance to the user. Sometimes, they serve as warnings about dangers or potential hazards associated with using the device. It is strongly advised to follow the instructions in this guide carefully to ensure user safety and optimal device performance. The following symbols are used in this guide:

	This icon, followed by the word WARNING , is used to highlight sections of the text containing information of critical importance to the user. The user must pay close attention to these section! Instructions must be followed strictly to ensure the user's safety and the proper operation of the device. Failure to heed a warning or comply with instructions may result in personal injury and/or damage to the unit or other equipment.
	This icon, followed by the word NOTE , is used to highlight sections of the text containing important information necessary for the correct and reliable use of the device. Users must pay close attention to these notes! Failure to follow the instructions may result in incorrect device settings, leading to malfunction or improper operation.
	This icon highlights sections of the text containing suggestions to simplify device setup and enhance performance and reliability. Sometimes, this symbol is followed by the word EXAMPLE when parameter-setting instructions are accompanied by examples to clarify the explanation.

Preliminary information

This guide is designed to provide comprehensive and detailed information that the operator needs to correctly and safely install and operate the **SMAR4A, SMAR4B, and SMAR4C off-axis modular encoders**.

The **SMAR4x** is an **off-axis absolute modular encoder** that combines an **open PCB readhead** with the MRA magnetic rings in a very compact assembly. It is engineered and shrunk down in size and weight to be directly integrated into **high-performance, space- and weight-critical applications**. This design aligns with the latest trends and is suitable for use in robots, robotic joints, hollow shaft motors (such as direct drive torque motors, ...), brushless and servo motors, as well as video surveillance systems, drones/UAVs, gimbals, 3D printers, electro-medical and laboratory devices, and OEM equipment. **Its readhead measures only a few millimetres in size** (22.5 mm x 6 mm x 3.9 mm H / 0.886" x 0.236" x 0.153" H) to fit into the smallest installation spaces. Additionally, the ring is very thin, **axially magnetized**, and can have a **through bore with a maximum diameter of 47.4 mm (1.866")**.

The rotational speed can reach up to 24,000 rpm, and the operating temperature range is from -40°C to +100°C (-40°F to +212°F). The construction is frameless and bearingless, meaning the encoder does not include a shaft, bearings, flange, and housing. It operates without contact, so no components are subject to wear and mechanical fatigue.

The SMAR4x can be equipped with **SSI and BiSS C-mode absolute interfaces**. The available resolutions are up to 20 bits (up to 1,048,576 cpr).

The SMAR4x modular encoder is available in three options:

- **SMAR4A**: it is designed to read magnetic pole pitches with a width of 1.28 mm and must be paired with MRA/xx**A** rings.
- **SMAR4B**: it is designed to read magnetic pole pitches with a width of 1.50 mm and must be paired with MRA/xx**B** rings.
- **SMAR4C**: it is designed to read magnetic pole pitches with a width of 2.00 mm and must be paired with MRA/xx**C** rings.

To ensure optimal performance of the encoder, Lika Electronic has developed and released a dedicated calibration software called "SMARx_AKx1X_calibration Vx.x.x.exe". This software is available for free download from the Lika Electronic website and can be installed on any PC running Windows 10 or later. The program enables the operator to calibrate the SMAR4 modular encoder after mechanical installation, ensuring the highest signal quality.

The connection between the encoder and the PC is established using the following items. They must be ordered separately unless otherwise indicated:

- | | |
|---|---|
| • IF100 | SMAR4-to-PC USB Adapter |
| • USB Standard-A Mini-B 150 mm long cable | USB connection cable with Standard-A and Mini-B connectors (<u>supplied with the adapter</u>) |
| • EXC-X29-LK-B8A-L005-D9F-S86 cable | IF100-to-SMAR4 connection cable |



IF100 adapter



USB Standard-A Mini-B 150 mm long cable
(supplied with the adapter)

For complete information please refer to the "5 - Calibration procedure" section on page 24.

To make it easier to read and understand the text, this guide can be divided into some 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, see on page 36.

In the third section, entitled **BiSS C-mode interface**, both general and specific information is given on the BiSS C-mode interface, see on page 40.

1 – Safety summary



1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable in your country during device installation and operation.
- Installation and maintenance operations must be carried out only by qualified personnel, with the power supply disconnected and mechanical parts stationary.
- The device must be used only for the purpose for which it was designed: using it for any other purposes could result in serious personal injury and/or environment damage.
- High current, voltage, and moving mechanical parts can cause serious or fatal injuries.
- Warning! Do not use in explosive or flammable areas.
- Failure to comply with these precautions or with specific warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the equipment.
- Lika Electronic accepts 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 it in accordance with the instructions in the "4 – Electrical connections" section on page 18.
- The wires of unused signals must be cut to different lengths and individually insulated.
- In compliance with the 2014/30/EU directive on electromagnetic compatibility, the following precautions must be taken:
 - Before handling and installing the equipment, discharge any electrical charge from your body and tools that may come in contact with the device.
 - The power supply must be stable and free from noise. Install EMC filters on the device's power supply, if necessary.
 - Always use shielded cables, preferably 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 sources; shield the device from noise source if necessary.
 - To ensure the device functions correctly, avoid using strong magnets on or near the unit.
 - Minimize noise by connecting the shield and/or the frame to ground. Ensure that ground connection is not affected by noise. The grounding point can be located both on the device side and on user's side. The user should determine the best solution to minimize the interference.



1.3 Mechanical safety

- Install the device strictly in accordance with the instructions in the "3 – Mounting instructions" section on page 13.

- Mechanical installation must be carried out with power supply disconnected and mechanical parts stationary.
- Do not disassemble the encoder.
- Do not tool the encoder.
- 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 declared by the manufacturer.
- The encoder and the code disc / ring must be adequately protected to withstand the industrial environment in which they will be installed.
- We recommend installing the unit providing protective measures against waste, particularly swarf, such as turnings, chips, or filings. If this is not feasible, please ensure that adequate cleaning methods (for example, brushes, scrapers, jets of compressed air, etc.) are implemented to prevent the sensor and the magnetic ring from becoming jammed.



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



Please ensure that you strictly observe the following safety precautions and instructions before handling and installing the kit encoder.

- Open the box and handle the electronic components only within an EPA (Electrostatic Protective Area) and while properly grounded.
- Before handling the kit encoder, the operator must wear appropriate protective equipment.
 - A wrist strap must be worn on the hand and connected to the ground through a 1-megohm resistor.
 - An ESD smock made from dissipative material.
 - Dissipative gloves are also used to prevent contaminating the code disc / ring during mounting.
- Always handle the encoder by holding the plastic enclosure on the sides.
- The code disc / ring must always be handled by grasping its outer edges.
- Avoid bending the code disc / ring, protect it from direct sunlight, excessive heat, and humidity.

- If dust settles on to the code disc / ring, gently wipe it off with a soft, dry cloth using circular motions. For more stubborn stains, use a soft cloth lightly moistened with a few drops of detergent. Do not use gasoline, kerosene, benzene, or other solvents, as these can damage the code disc / ring.

**CAUTION**

Keep magnets away from the code disc / ring, as strong magnetic fields could damage it.

2 - Identification

The device can be identified by the **order code** and **serial number** printed on the label attached to its housing. This information is also listed in the delivery document. Please always provide the order code and serial number when contacting Lika Electronic for purchasing spare parts or requesting assistance. For detailed information on the product's technical characteristics, please refer to the technical catalogue.



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

3 - Mounting instructions



WARNING

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



WARNING

Before handling and mounting the device, please ensure that you carefully read the handling instructions and safety information provided in the "1.4 Specific handling and cleaning instructions and safety information against electrostatic discharges" section on page 10.



WARNING

Install the unit providing protective measures against waste, particularly swarf, such as turnings, chips, or filings. If this is not feasible, please ensure that adequate cleaning methods (for example, brushes, scrapers, jets of compressed air, etc.) are implemented to prevent the sensor and the magnetic ring from becoming jammed.

Ensure that the mechanical installation complies with the system requirements for both the sensor and the ring as specified in this guide.

3.1 Encumbrance sizes

(values are expressed in mm)

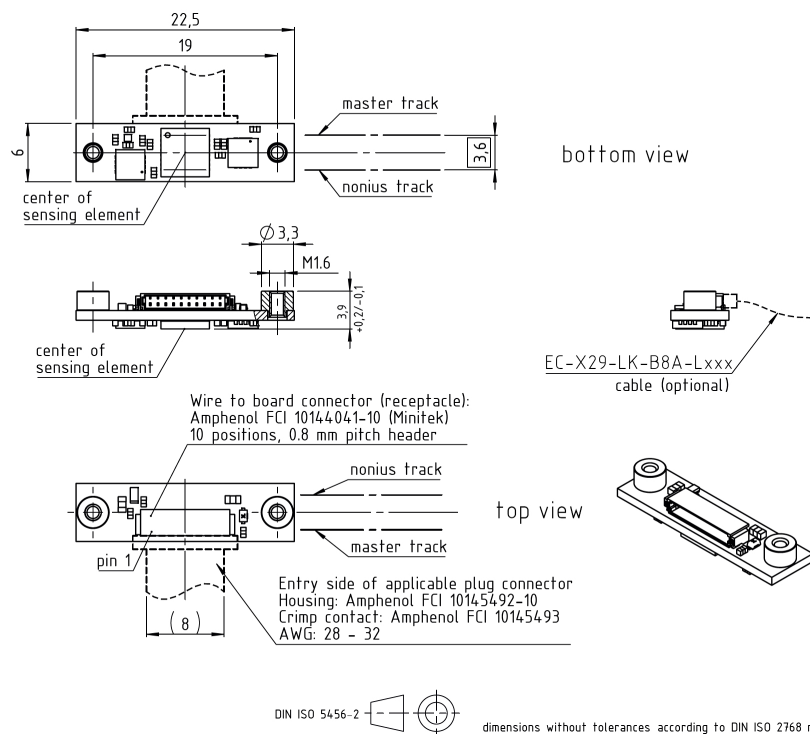


Figure 1 - SMAR4A and SMAR4B

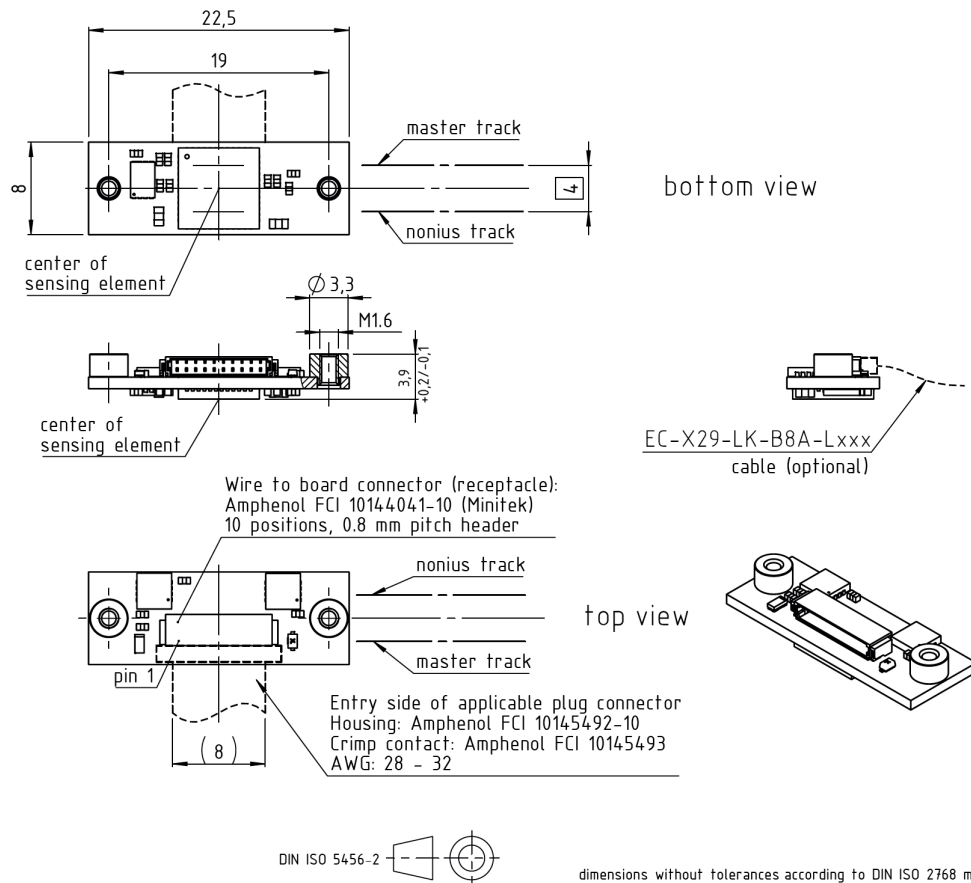


Figure 2 – SMAR4C

3.2 Mounting the code disc / ring



WARNING

Ensure that the MRA ring is correctly paired with the suitable SMAR4 encoder.

- The MRA/xx**A** rings must be paired with the SMAR4**A** encoder.
- The MRA/xx**B** rings must be paired with the SMAR4**B** encoder.
- The MRA/xx**C** rings must be paired with the SMAR4**C** encoder.



WARNING

- To clean the code disc / ring from dust, gently wipe it off with a soft, dry cloth using circular motions. For more stubborn stains, use a soft cloth lightly moistened with a few drops of detergent. Do not use gasoline, kerosene, benzene, or other solvents, as these can damage the code disc / ring.
- The code disc / ring must always be handled by grasping its outer edges.
- Protect the code disc / ring from scratching.
- Avoid bending the code disc / ring.
- Always handle the encoder unit by holding the PCB on the sides.

For comprehensive information on the code disc / ring, please refer to the specific documentation.

3.3 Mounting the encoder



WARNING

Ensure that the SMAR4 encoder is correctly paired with the suitable MRA ring.

- The SMAR4A encoder must be paired with the MRA/xxA rings.
- The SMAR4B encoder must be paired with the MRA/xxB rings.
- The SMAR4C encoder must be paired with the MRA/xxC rings.



WARNING

Always handle the encoder unit by holding the PCB on the sides.

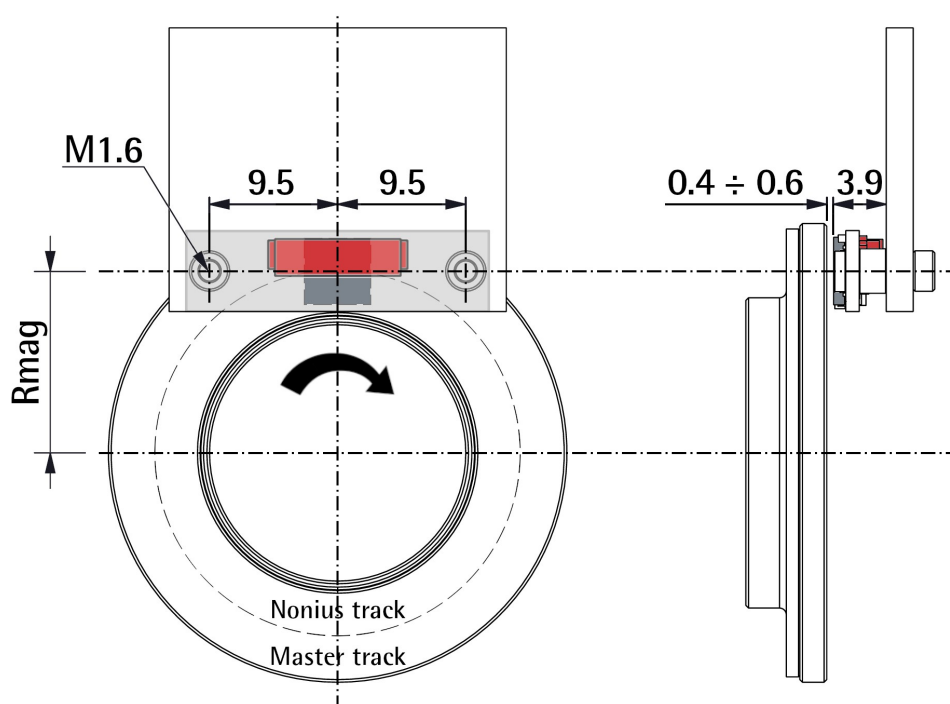


Figure 3 - Mounting requirements (with MRA/xxA, ...B, ...C)



WARNING

To know the RMAG magnetic radius value, please see the user's guide of the paired code disc / ring.

The Master track is always the outer section of the code disc.

The Nonius track is always the inner section of the code disc.

The reading head must be installed over the disc. Ensure that the centre of the magnetic sensor aligns with the centre line that separates the Master track and the Nonius track, as defined by the RMAG magnetic radius value.

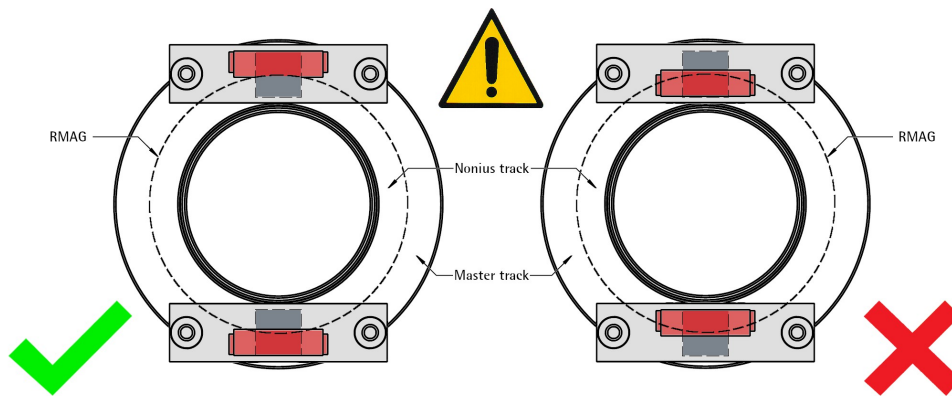


Figure 4 - Mounting direction

Mount the encoder unit over the code disc / ring and ensure that the encoder unit does not hit or touch the code disc / ring. Check the mounting tolerances shown in the Figure below. Always handle the encoder unit by holding the outer edges. Use two **M1.6 screws** inserted into the threaded holes (Figure 3), tighten both screws down to firmly fasten the encoder unit to the mounting support, torque to **0.2 Nm** max. The length of the screws depends on the thickness of the mounting support. Please ensure that the screws do not hit the code disc / ring.

You must always comply with the following tolerance values.

X	$\pm 0.5 \text{ mm}$
Y	$\pm 0.5 \text{ mm}$
Z	0.4 mm $\pm 0.05 \text{ mm}$ for 1.28 mm pole pitch 0.5 mm $\pm 0.05 \text{ mm}$ for 1.50 mm pole pitch 0.6 mm $\pm 0.05 \text{ mm}$ for 2.00 mm pole pitch
θX	$\pm 1^\circ$
θY	$\pm 1^\circ$
θZ	$\pm 1^\circ$

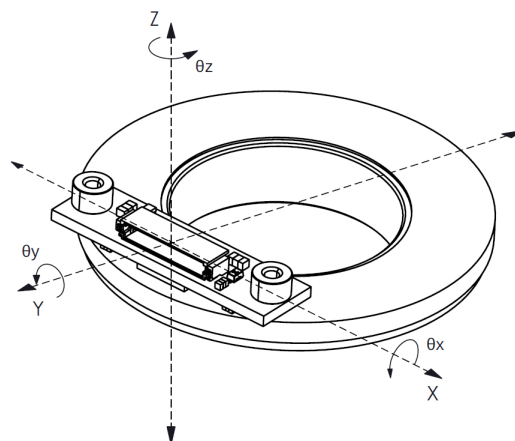


Figure 5 - Mounting tolerances

If required, execute the calibration procedure, see the "5 - Calibration procedure" section on page 24.

Finally connect the **EC-X29-LK-B8A-Lxxx** cable to the FCI connector of the encoder unit.

**WARNING**

The encoder and the code disc / ring must be adequately protected to withstand the industrial environment in which they will be installed.

**CAUTION**

Keep magnets away from the code disc / ring, as strong magnetic fields could damage it.

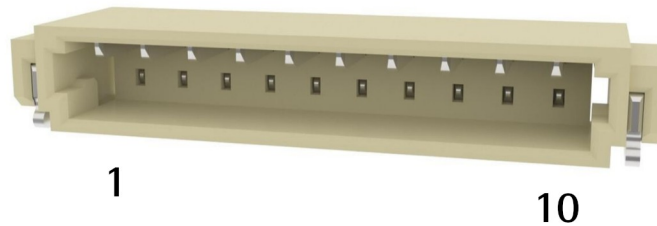
4 - Electrical connections



WARNING

The power supply must be turned off before making any electrical connections! If wires of unused signals come into contact, they could cause irreparable damage to the device. Therefore, these wires must be cut to different lengths and individually insulated.

4.1 Amphenol FCI 10144041-10 connector (Minitex)



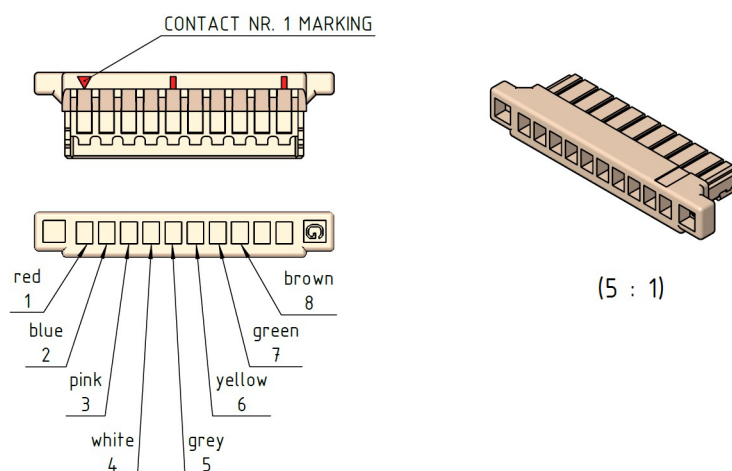
Mating connector: Amphenol FCI 10145492-10
Crimp contact: Amphenol FCI 10145493 AWG 28-32

Pin	Function
1	+5Vdc
2	0Vdc
3	Clock IN + / MA +
4	Clock IN - / MA -
5	Data OUT + / SLO +
6	Data OUT - / SLO -
7	SLI + *
8	SLI - *
9	0Vdc
10	+5Vdc

* BiSS interface encoders only. Refer to the "4.8 SLI+ and SLI- signals" section on page 20.

4.2 Cable connections

EC-X29-LK-B8A-Lxxx cable



Pin	B8A 8-wire cable	Function
1	Red	+5Vdc
2	Blue	0Vdc
3	Pink	Clock IN + / MA +
4	White	Clock IN - / MA -
5	Grey	Data OUT + / SLO +
6	Yellow	Data OUT - / SLO -
7	Green	SLI + *
8	Brown	SLI - *
9, 10	-	-
-	Shield	Shielding

* BiSS interface encoders only. Refer to the "4.8 SLI+ and SLI- signals" section on page 20.

4.3 B8A cable specifications (KABL-00005 Bogen)

Model:	KABL-00005 – Bogen extremely compact, shielded cable
Cross section:	8 x 0.05 mm ² (26 AWG)
Jacket:	PVC
Shield:	Bare copper spiral shield, coverage min. 95%
Outer diameter:	~3.10 mm / ~0.122"
Min. bend radius:	Outer diameter x 8, fixed application Outer diameter x 12, dynamic application
Work temperature:	-40°C +105°C / -40°F +221°F, fixed application -20°C +105°C / -4°F +221°F, dynamic application
Conductor resistance:	> 200 MΩ/Km at +20°C / +68°F

4.4 Connection of the shield

For signals transmission, always use shielded cables. The cable shielding must be connected properly to ensure earthing.

4.5 Ground connection

Minimize noise by connecting the shield and/or the frame of the measuring system to ground. See above for the pins/wires to be used for shield connection. Ensure that ground connection is not affected by noise.

4.6 SSI interface

For complete information on the SSI interface, please refer to the "6 - SSI interface" section on page 36.

4.7 BiSS C-mode interface

For complete information on the BiSS C-mode interface, please refer to the "7 - BiSS C-mode interface" section on page 40.

4.8 SLI+ and SLI- signals

The SLI+ and SLI- signals are used only in the BiSS interface encoders. They are not used in the SSI interface encoders. In the BiSS interface, connect the SLI+ signal to the MO+ pin on the Master BiSS; connect the SLI- signal to the MO- pin. In the SSI interface, we recommend leaving the SLI+ and SLI- signals disconnected and insulated. Alternatively, connect both the SLI+ and SLI- signals to 0Vdc.

4.9 Absolute resolution

The SMAR4 measuring system can provide a single-turn resolution of 131,072 cpr (17 bits), 262,144 cpr (18 bits), 524,288 cpr (19 bits), and 1,048,576 cpr (20 bits).

The angular resolution is 0.00274° (0° 0' 10") for 17-bit model.

It is 0.00137° (0° 0' 5") for 18-bit model.

It is 0.00068° (0° 0' 2.45") for 19-bit model.

It is 0.00034° (0° 0' 1.22") for 20-bit model.



NOTE

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

$$1 \text{ STEP} = 360^\circ / 262,144 \text{ cpr} = 0.00137^\circ$$

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



EXAMPLE

Position value = 3,000

$$\text{Angular position} = 3,000 * 0.00137^\circ = 41.1^\circ = 41^\circ 6' 0''$$

4.10 Counting direction

The **standard counting direction** corresponds to the ring turning as indicated by the arrow in Figure 6. When the ring rotates in the direction shown by the arrow, the count is up. The counting direction cannot be changed.

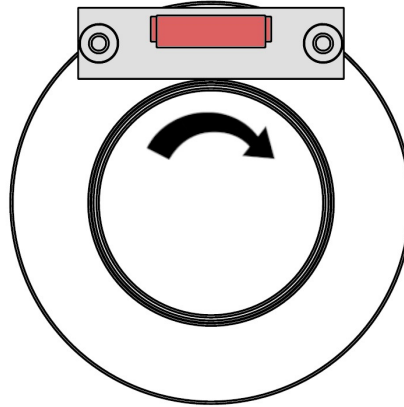


Figure 6 – Counting direction

4.11 Zero setting / Preset (BiSS interface encoders only)

The output position information at a specific point in the shaft rotation can be set to zero or to a desired value called the preset. The preset value must be entered in the **Preset** registers, see on page 45. The Zero setting/Preset function is active only when the **Preset setting enable** register is set to 01; otherwise, the function is disabled. The preset must be activated by using the **Save parameters and activate Preset** function in the **Command** register. For detailed information, please refer to the **Preset** registers on page 45 and the **Command** register on page 48.



NOTE

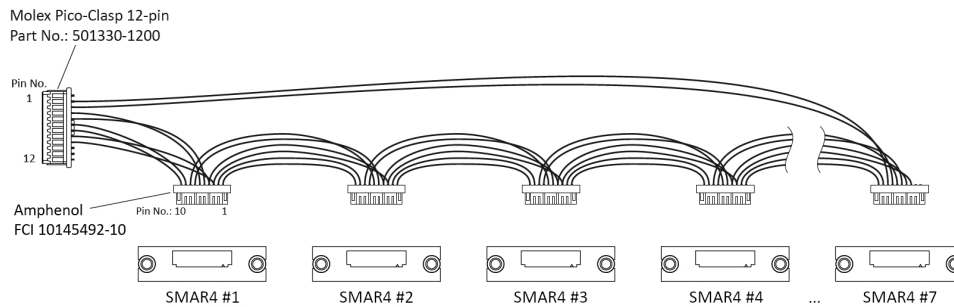
In the SSI encoder the position value cannot be zero set.

4.12 Diagnostic LED

The encoder is equipped with a diagnostic LED. For complete information on the diagnostic LED, please refer to the "8 - Diagnostic LED" section on page 51.

4.13 Daisy chain arrangement (BiSS interface encoders only)

It is possible to install up to seven SMAR4 BiSS encoders with wire-to-board connectors in a daisy chain connection. For easy installation and reliable operation, we recommend using the connectors specified in the drawing.



Molex Pico-Clasp 12-pin (501330-1200)		Amphenol FCI 10145492-10	
Pin	Signal	Pin	Signal
1	not used	1	+Vdc
2	MO -	2	0Vdc
3	MO +	3	MA +
4	SLO -	4	MA -
5	SLO +	5	SLO +
6	0Vdc	6	SLO -
7	+Vdc	7	SLI +
8	MA -	8	SLI -
9	MA +	9	0Vdc
10	not used	10	+Vdc
11	not used		
12	not used		

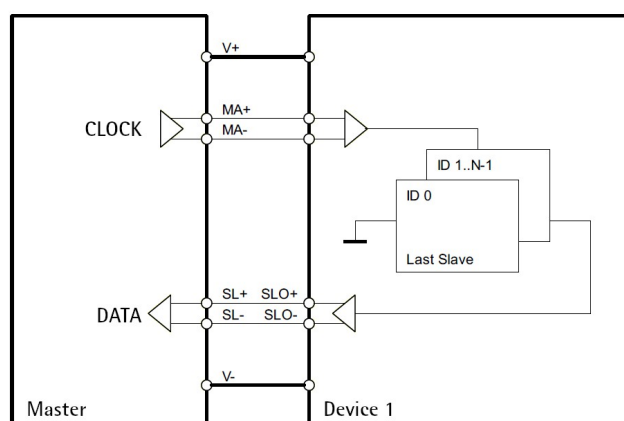


Figure 7 - Point-to-point connection: one or more Slaves per Device

In the **point-to-point connection**, only one sensor device is connected to the Master device using one clock line and one data output line. Within the sensor device, several sensors can be daisy-chained, e.g. to enable redundant data transmission for safety systems, smart sensor applications, or condition monitoring.

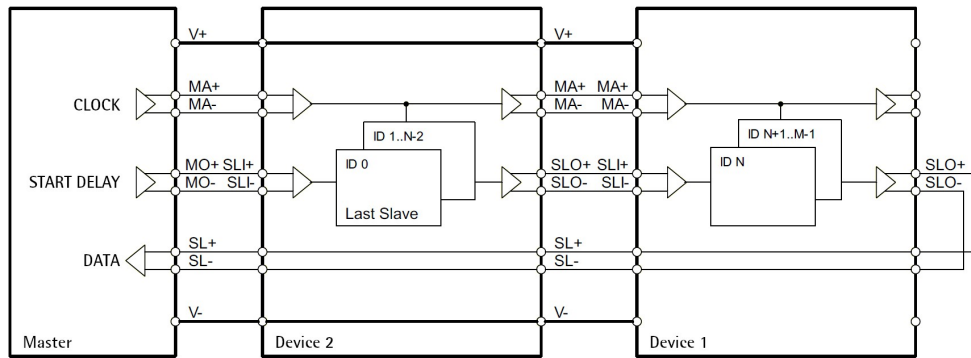


Figure 8 - Bus connection 2: queued Devices with multiple Slaves each

For systems with more than one sensor device, the **bus connection** is used. Unlike the point-to-point connection, the bus connection also enables data transmission to actuator devices. Therefore, a third line (data input) is connected to the BiSS Slaves.

For complete information about the drag chain connection and the function of the signals, please refer to the BiSS documentation.



CAUTION

Keep magnets away from the code disc / ring, as strong magnetic fields could damage it.

5 – Calibration procedure

5.1 Brief information on the software tool

To ensure optimal operation of the encoder, Lika Electronic has developed and released a dedicated calibration software called "SMARx_AKx1X_calibration Vx.x.x.exe". This software is available for free download from the Lika Electronic website. It can be installed on any PC running Windows 10 or later. The program enables the operator to calibrate the SMAR4 kit encoder after mechanical installation to achieve the highest signal quality.

As stated, the program executable file is named "SMARx_AKx1X_calibration Vx.x.x.exe", where "x.x.x" represents the release version. This is a portable application, designed to be installed simply by copying the executable file and the additional folders and files to the desired location. Therefore, no installation process is required. To launch the program, double-click the file icon. To close the program, press the **EXIT** button in the title bar.

5.2 Items needed for connection

The connection between the encoder and the PC is established using the following items, which must be ordered separately unless otherwise indicated:

- IF100 (BiSS & SSI)-to-PC USB Adapter
- USB Standard-A Mini-B 150 mm long cable USB connection cable with Standard-A and Mini-B connectors (supplied with the adapter)



IF100 adapter



USB Standard-A Mini-B 150 mm long cable
(supplied with the adapter)

- EXC-X29-LK-B8A-L005-D9F-S86 cable IF100-to-SMAR4 connection cable

For comprehensive information on the IF100 adapter, please refer to the specific user's guide.



NOTE

Before starting the calibration procedure, please ensure that the software tool and all the items listed above are readily available.

The drivers and the encoder calibration interface can be downloaded from <https://www.lika.it/eng/products/encoder-interfaces/encoder-interfaces>.

Refer also to the "4 - Electrical connections" section on page 18.



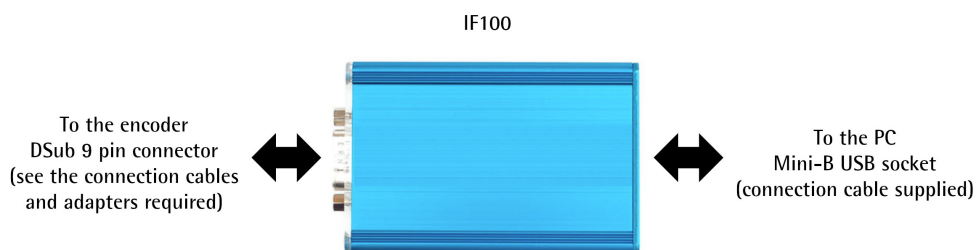
WARNING

A +5Vdc power supply is provided to both the adapter and the encoder through the USB connection. The USB power supply must be between 4.5V and 5.5V. Do not connect any external power supply sources.

5.3 Before launching the calibration procedure

Before you begin the calibration procedure, you must strictly follow the steps listed below.

1. Install the USB drivers of the IF100 adapter as explained in the next "5.4 Installing the USB drivers of the IF100 adapter" section on page 26.
2. Mount both the encoder and the code disc / ring, refer to the "3 - Mounting instructions" section on page 13.
3. Disconnect the EC-X29-LK-B8A-Lxxx cable from the Amphenol FCI connector of the encoder unit and connect the EXC-X29-LK-B8A-L005-D9F-S86 cable.
4. Connect the other end of the EXC-X29-LK-B8A-L005-D9F-S86 cable to the 9-pin D-Sub connector of the IF100 adapter.
5. Connect the USB Standard-A Mini-B 150 mm long cable to the Mini-B USB socket of the IF100 adapter.
6. Connect the other end of the USB cable to a Standard-A USB socket on your PC.
7. Start the motor and run it at an ideal speed of 50 rpm.
8. Launch the SMARx_AKx1X_calibration Vx.x.x.exe executable file and open the encoder calibration interface; for detailed information, refer to the "5.5 Encoder calibration interface" section on page 26.



5.4 Installing the USB drivers of the IF100 adapter

Launch the IF100 Driver-6.2_libusb1.0.21.exe executable file to install the IF100 drivers. Follow the instructions on the screen and complete the procedure.

5.5 Encoder calibration interface

After steps 1 to 7 (see the previous page) have been completed, you can launch the SMARx_AKx1X_calibration Vx.x.x.exe program. Please ensure that the MU_3SL_INTERFACE.dll file is located inside the same folder as the executable file. Double-click the SMARx_AKx1X_calibration Vx.x.x.exe executable file. The main page of the encoder calibration interface will appear.

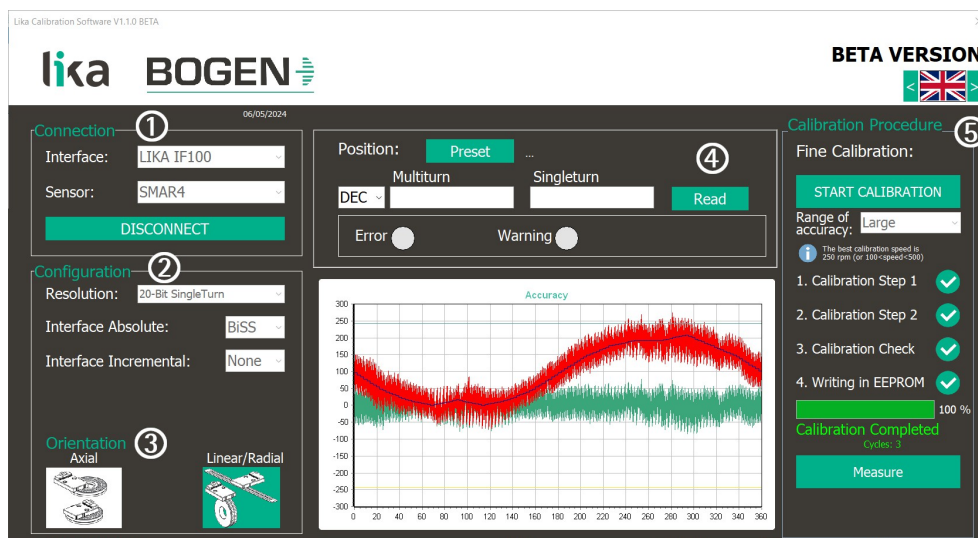


Figure 9 – Calibration interface (connected)

The interface consists of a single page that provides access to all features and diagnostic information.

The following sections can be found on the page.

1. **CONNECTION** section: the functions required to establish the connection are located in this section. Refer to the "5.5.1 Establishing a connection to the interface and the encoder" section on page 27 for more details.
2. **CONFIGURATION** section: the main characteristics (resolution and interface) of the connected encoder can be found in this section. See the "5.5.2 Configuration section" section on page 30 for more details
3. **ORIENTATION** section: it shows the orientation of the encoder module over the code disc. See the "5.5.3 Orientation section" section on page 31 for more details.
4. **POSITION** section: it displays the current single-turn and multi-turn position of the encoder along with some diagnostic information, including active errors and warnings (if available; for more details on

the errors and warnings, refer to the description of the specific interface). See the "5.5.4 Position section" section on page 32.

5. **CALIBRATION PROCEDURE** section: the functions necessary for calibration can be found in this section. See the "5.5.5 Calibration procedure section" section on page 33.

5.5.1 Establishing a connection to the interface and the encoder

After launching the program, the main page will be displayed, as shown in Figure 10.

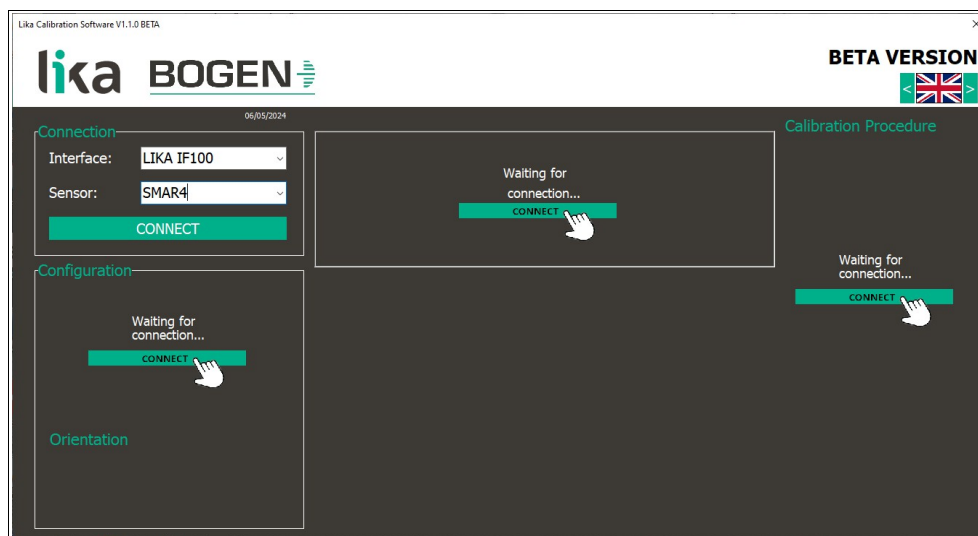


Figure 10 - Calibration interface (not connected)

As a preliminary action, the operator can choose the language to be used to display texts and items in the user interface. Select the Italian flag  icon to choose the Italian language; select the UK flag  icon to choose the English language; select the German flag  icon to choose the German language.

The first step is to establish a connection between the PC, the IF100 adapter, and the encoder. When you start the program, only the **CONNECTION** section is available; all the other sections remain empty until the connection to the encoder is established and data begins to populate them (see Figure 10).

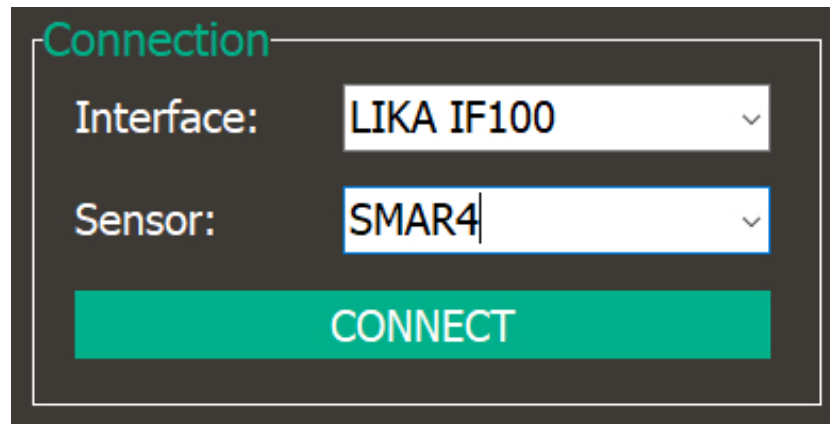


Figure 11 – Connection section (not connected)

In the **CONNECTION** section, you must select the interface type through the **INTERFACE** drop-down menu first.

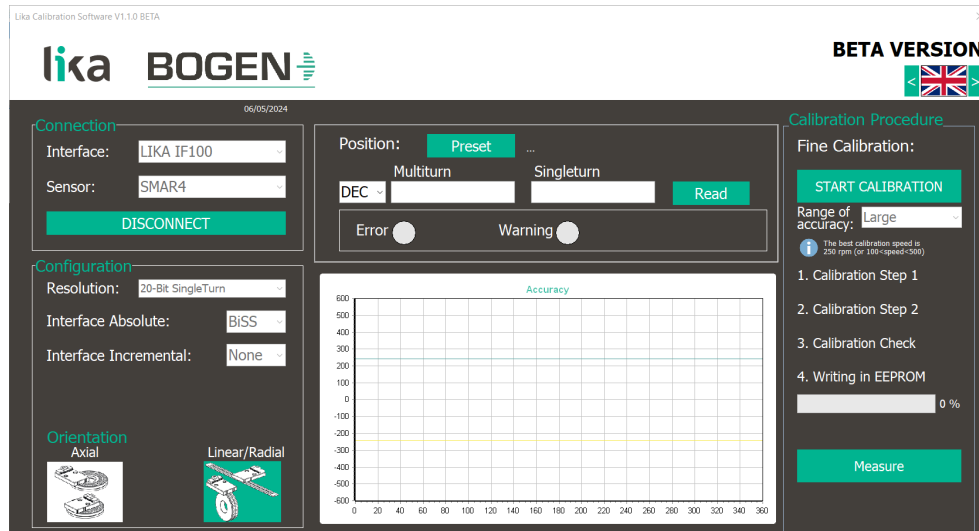
- Select the LIKA IF100 option if you need to connect to the SMAR4 encoder using the IF100 adapter.
- Select the MB4U option if you need to connect to an encoder with the SSI or BiSS interface that requires the MB4U adapter.
- Select the LIKA IF101 option if you need to connect to an encoder with the SPI interface that requires the IF101 adapter.
- Select the MB3U_SPI option if you need to connect to an encoder with the SPI interface that requires the MB3U adapter.

Then you must select the encoder model through the **SENSOR** drop-down menu. Please select the SMAR4 encoder option.

Finally press the **CONNECT** button to establish the connection.

If the connection is established properly, all the sections will be populated with data that describes the connected encoder. Furthermore, the **START CALIBRATION** button in the **CALIBRATION PROCEDURE** section will become active.

The label on the **CONNECT** button will change to **DISCONNECT**.



If the program is unable to establish a connection to the adapter and/or to the encoder, the **CONNECTION ERROR** message will be displayed under the **CONNECT** button. Simple checks may include:

- Ensure that both the IF100 interface and the encoder are properly connected and supplied.
- Ensure that the connection cables are securely connected on both ends.
- Check that the encoder's LED is solid green.
- Check the USB port on your PC.
- Check that the USB drivers are installed correctly.

For any information, please refer to the "5.3 Before launching the calibration procedure" section on page 25.

5.5.2 Configuration section

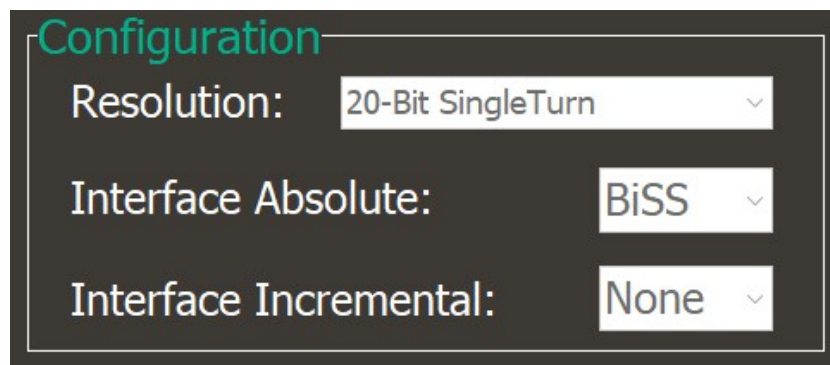


Figure 12 – Configuration section

As soon as the connection to the encoder is properly established, the **CONFIGURATION** section populates with data that describes the connected encoder.

In this section, the characteristics of the connected encoder are summarized. The following items are available, they are all read-only and cannot be changed.

- **Resolution:** this indicates the physical resolution of the connected encoder, expressed in bits.
- **Interface Absolute:** this indicates the type of the absolute interface the connected encoder is equipped with.
- **Interface Incremental:** this indicates the type of the incremental output the connected encoder is equipped with.

5.5.3 Orientation section

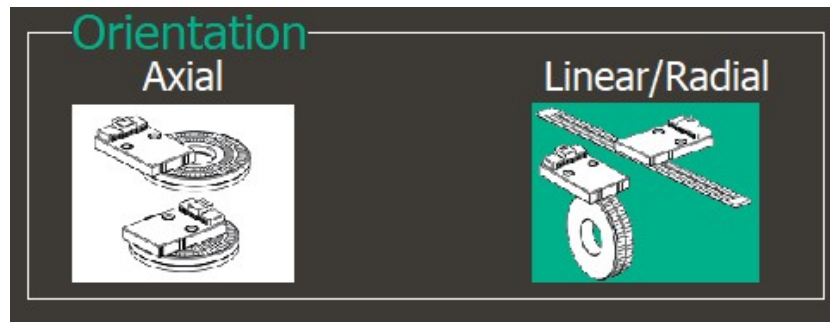
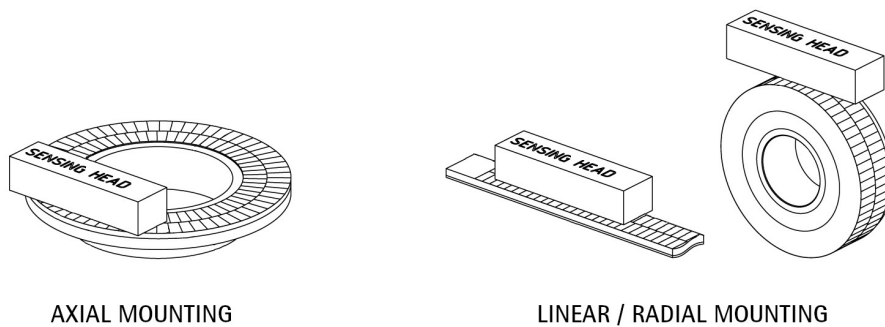


Figure 13 - Orientation section

This section is designed to display the orientation of the encoder module over the code disc or the magnetic tape. The orientation can be either AXIAL or LINEAR/RADIAL. The orientation of the connected encoder will be indicated by an image with a green background.



5.5.4 Position section

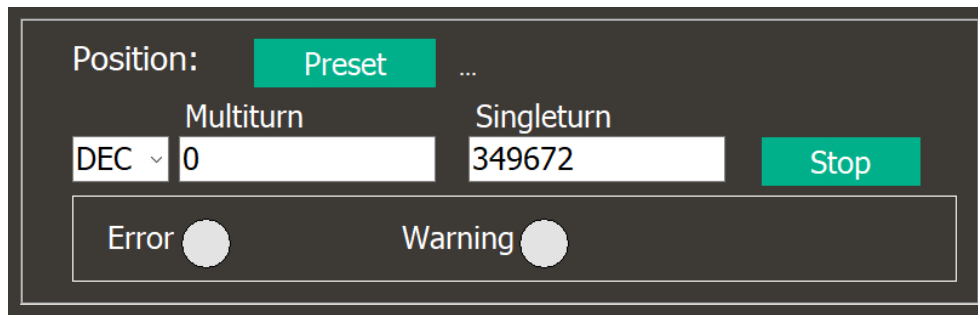


Figure 14 - Position section

The **POSITION** section displays the current single-turn and multi-turn position of the encoder along with some diagnostic information, including any active errors and warnings (if available). For more details on the errors and warnings, refer to the description of the specific interface. In addition, the **PRESET** button allows the operator to zero set the encoder position (only for BiSS interface encoders).

The following items are available.

- **PRESET** button: as previously stated, this button allows the operator to zero set the position of the BiSS absolute encoders (only SMAR4-SC1-... encoders). For complete information on the zero setting operation, please refer to the "4.11 Zero setting / Preset (BiSS interface encoders only)" section on page 21.
- **DEC** drop-down menu: scroll the drop-down menu to set the decimal (DEC) or hexadecimal (HEX) representation of the encoder position.
- **READ** button: press the **READ** button to begin reading the current position of the connected encoder, expressed in counts. After pressing the button, the label on the **READ** button will change to **STOP**. The current encoder position will be divided into the single-turn part and the multi-turn part and shown next to the **Singleturn** and **Multiturn** fields respectively. Press the **STOP** button to halt the reading of the encoder position. The encoder position reading must be stopped before starting the calibration procedure.
- **Multiturn** field: it shows the number of the turn for the current position. It is always 0 when the encoder is single-turn. As the SMAR4 is single-turn only, this value will always be 0.
- **Singleturn** field: it shows the current single-turn position of the encoder.



EXAMPLE

In Figure 12 the current encoder position is: single-turn position = "349672", multi-turn position = 0 (as the SMAR4 encoder is only single-turn).

- **Status** area: it offers some diagnostic information on the active errors and warnings. For more information, refer to the description of the specific interface.
 - **Error** signal: it turns red when an error is active. Errors are available only in the BiSS interface and signalled through the ERROR diagnostic LED as well as the error bit. For detailed information, please refer to the "Error" section on page 41.
 - **Warning** signal: it turns red when a warning is active. Warnings are available only in the BiSS interface and signalled through the warning bit. For detailed information, please refer to the "Warning" section on page 42.

5.5.5 Calibration procedure section

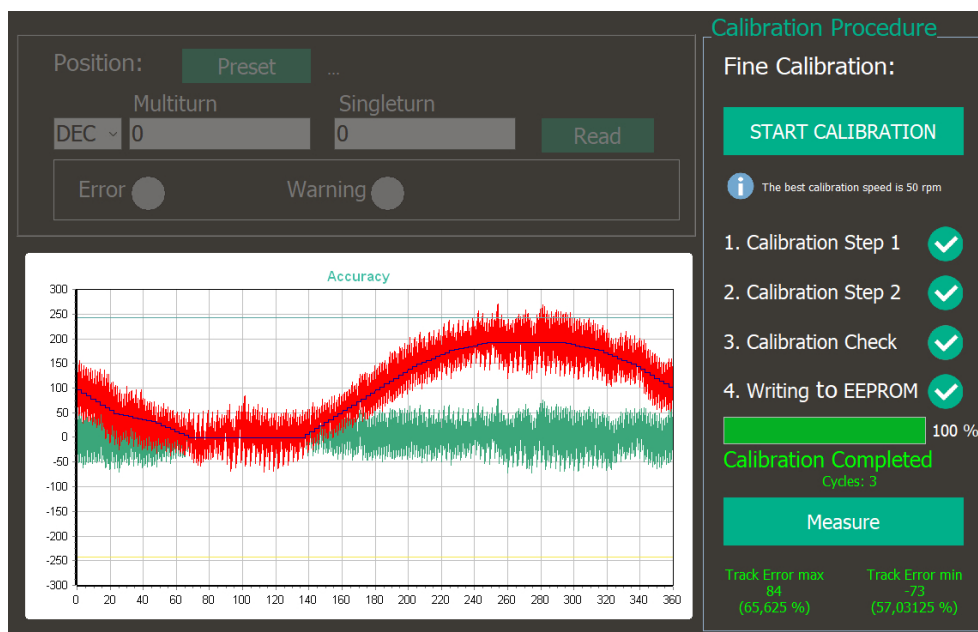


Figure 15 – Calibration Procedure section

Functions in the **CALIBRATION** section allow users to execute and monitor the calibration procedure.



NOTE

Before starting the calibration procedure, please ensure that the encoder is properly installed and that the motor is running at a low speed of about 50 rpm. Furthermore, the reading of the current encoder position must be stopped. Press the **STOP** button in the **POSITION** section.

As soon as you press the **START CALIBRATION** button, the program automatically begins the encoder calibration procedure.

The operation consists of four steps, as illustrated in Figure 11:

1. Calibration Step 1
2. Calibration Step 2
3. Calibration Check
4. Writing to EEPROM.

Steps are executed automatically and sequentially; no other action is required to the user beyond pressing the **START CALIBRATION** button.

At the end of each step, if the calibration is executed properly, a green check



mark will appear next to corresponding line.

The green progress bar below tracks the steps until the calibration procedure is carried out (100%). When the calibration procedure is complete, the message **Calibration completed** will be displayed.

The calibration procedure may include up to four consecutive automatic cycles to achieve the best calibration result. Once the first cycle is completed, if the result falls within certain internal tolerance values, the procedure is concluded. If not, the programme will automatically initiate a second cycle, and so on, up to a maximum of four cycles. In Figure 11, the operation was finalised at the third cycle (see the message "**Cycles: 3**").

The **Accuracy** diagram visually illustrates the results of the calibration procedure in relation to the quality of the signals obtained. The closer the peaks are to zero, the better the signal quality. The quality of the signals before calibration is shown in red, while the quality after calibration is shown in green.

If an error occurs during the execution of the steps that prevents the operation



from continuing, a red X will appear next to corresponding line, and an error message will be displayed below on the page (e.g., see the error message **Speed 0 detected** in Figure 16).

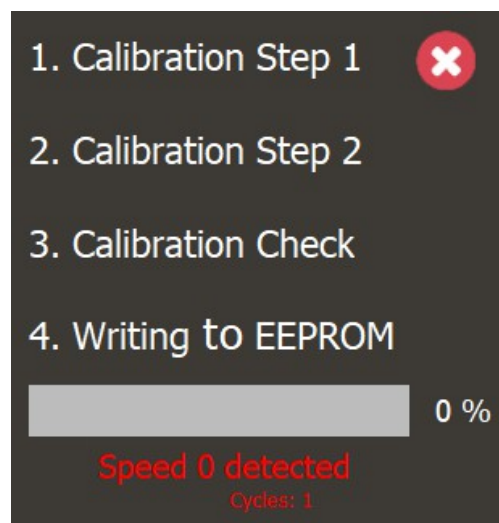


Figure 16 - Errors during calibration

If the calibration procedure fails after the four cycles, the **Calibration failed** error message will appear below in the page.

If this condition occurs, turn off the power supply by disconnecting the USB cable. Then, verify that the encoder is properly mounted and that all tolerances are met. Check all connections and the motor speed. Afterwards, try the calibration procedure again.

If you need assistance, please contact Lika Electronic After-Sales Service.

6 – SSI interface

Order code:

SMAR4x-BG1-... SSI Binary

6.1 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.

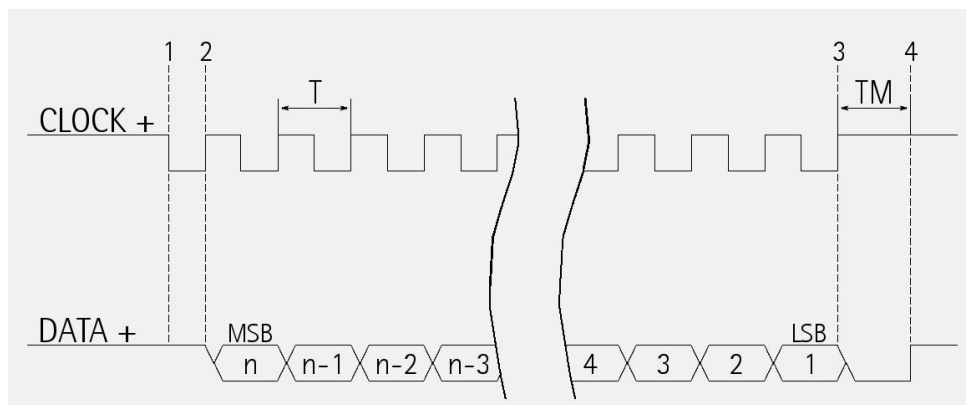
The main advantages in comparison with parallel or asynchronous data transmissions are:

- 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. Therefore, 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 μ sec, 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).

6.2 MSB Left Aligned protocol

The "MSB Left Aligned" left aligns the bits starting from the most significant bit (MSB) to the least significant bit (LSB) with the LSB transmitted during the last clock cycle. If the number of clock signals exceeds the number of data bits, the unused bits are forced to a low logic level (0) and follow the data word. This protocol can be applied to sensors of any resolution.

The word length varies according to the resolution, as shown in the following table.

Order code	Encoder resolution	Length of the word	Max. number of absolute information
SMAR4x-BG1-017/00000...	17 bits	17 bits	131,072 info/rev.
SMAR4x-BG1-018/00000...	18 bits	18 bits	262,144 info/rev.
SMAR4x-BG1-019/00000...	19 bits	19 bits	524,288 info/rev.
SMAR4x-BG1-020/00000...	20 bits	20 bits	1,048,576 info/rev.

The output code of the encoder is the BINARY code.

The transmitted position value has the following structure:

Order code	Bit structure		
SMAR4x-BG1-017/00000...	16	...	0
SMAR4x-BG1-018/00000...	17	...	0
SMAR4x-BG1-019/00000...	18	...	0
SMAR4x-BG1-020/00000...	19	...	0
	MSB	...	LSB

6.3 Recommended transmission rates

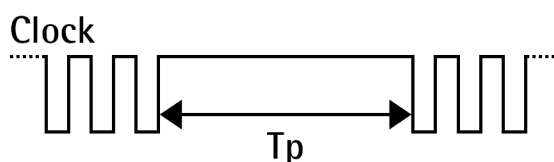
The SSI interface has a frequency of data transmission ranging between 100 kHz and 4 MHz.

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
< 50 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 20 μ s (T_p = pause time > 20 μ s).



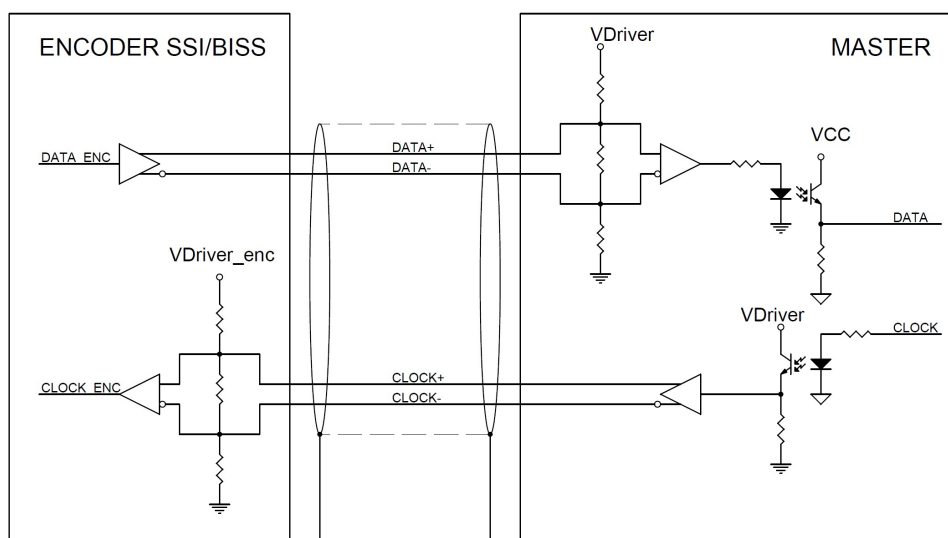
NOTE

For any information on the structure of the position information word, please refer to the "6.2 MSB Left Aligned protocol" section on page 37.

6.4 Helpful information

- The position information increases when the ring rotates as indicated by the arrow in Figure 6.
- At installation, always execute a zero setting operation of the absolute position in the subsequent electronics.

6.5 Recommended SSI input circuit



7 - BiSS C-mode interface

Order code:

SMAR4x-SC1-... BiSS C-mode

Lika encoders are always Slave devices and comply with the "BiSS C-mode interface" and the "Standard encoder profile".

Refer to the official BiSS website for all information not listed in this manual (www.biss-interface.com).

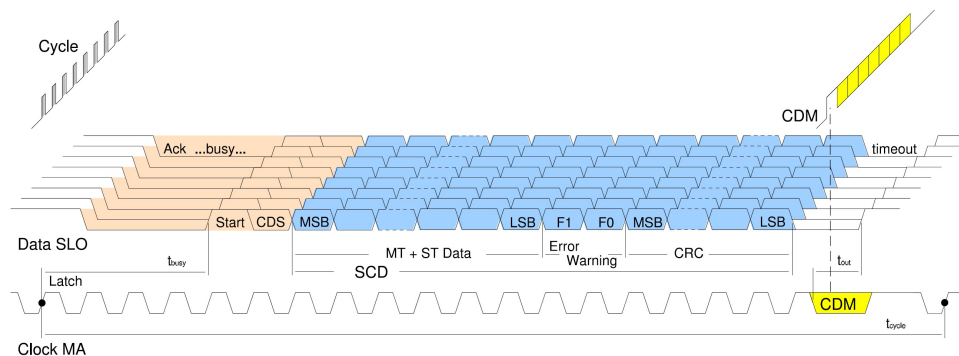
The device can work either in a point-to-point connection ("one Master, one or more Slaves per each device") or in a bus connection ("one Master, several devices connected to a bus line"). For daisy chain arrangement, please refer to the "4.13 Daisy chain arrangement (BiSS interface encoders only)" section on page 22.

CLOCK IN (MA), DATA OUT (SLO), and SLI signal levels are according to the "EIA standard RS-422".

7.1 Communication

The BiSS C-mode protocol uses one data transmission protocol:

- **Single Cycle Data (SCD):** it is the main data transmission protocol. It is used to send process data from the Slave to the Master. For any information refer to the "7.2 Single Cycle Data SCD" section on page 41.



7.2 Single Cycle Data SCD

7.2.1 SCD structure

SCD data has a variable length according to the resolution of the encoder. It is $n_{\text{bitres}}+7$ long where " n_{bitres} " is the resolution of the encoder expressed in bits. It consists of the following elements: position value (**Position**), 1 error bit nE (**Error**), 1 warning bit nW (**Warning**) and a 6-bit CRC Cyclic Redundancy Check (CRC).

bit	$n_{\text{bitres}}+7 \dots 8$	7	6	5 ... 0
function	Position	Error	Warning	CRC

Position

It is the process data transmitted from the Slave to the Master. It has a variable length, it is as long as the resolution of the encoder expressed in bits. It provides information about the current position of the encoder. The transmission starts with msb (most significant bit) and ends with lsb (least significant bit).

bit	$N_{\text{bitres}}+7$	...	...	8
value	msb	...	...	lsb

" N_{bitres} " is the resolution of the encoder expressed in bits. It is comprised between 17 bits and 20 bits as shown in the following table.

Order code	Encoder resolution
SMAR4x-SC1-017/...	17 bits
SMAR4x-SC1-018/...	18 bits
SMAR4x-SC1-019/...	19 bits
SMAR4x-SC1-020/...	20 bits

Error

(1 bit)

It is intended to communicate the normal or fault status of the Slave. When $nE = "0"$ (low active), an error is active in the system. For a comprehensive list of the available error messages and their meaning, please refer to the "9 – Warnings and errors" section on page 53.

$nE = "1"$: no active error

$= "0"$: error status: an error is active in the system.

Warning

(1 bit)

It is intended to communicate the normal or fault status of the Slave.

When $nW = "0"$ (low active), a warning is active in the system. For a comprehensive list of the available warning messages and their meaning, please refer to the "9 – Warnings and errors" section on page 53.

$nW = "1"$: no active warning

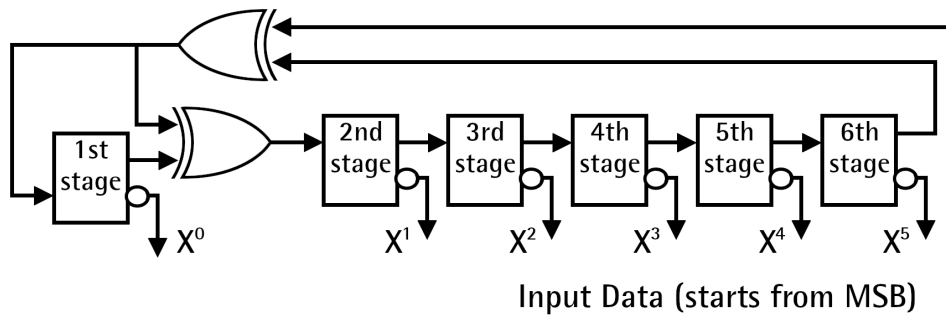
$= "0"$: warning status: a warning is active in the system.

CRC

Correct transmission control (inverted output). Cyclic Redundancy Check is an error checking which is the result of a "Redundancy Check" calculation performed on the message contents. This is intended to check whether transmission has been performed properly. It is 6-bit long.

Polynomial: $X^6 + X^1 + 1$ (binary: 1000011)

Logic circuit



7.3 Control Data CD

Main control data is described in this section. Please refer to the official BiSS documents for complete CD structure: "BiSS C Protocol Description" in the BiSS homepage.

Register address

It sets the number of the register you need either to read or to write. It is 7-bit long.

RW

RW = "01": when you need to write in the register.

RW = "10": when you need to read in the register.

It is 2-bit long.

DATA

When you need to write in a register (**RW** = "01"), it allows to enter the value to be written in the register (transmitted from the Master to the Slave).

When you need to read in a register (**RW** = "10"), it shows the value read in the register (transmitted from the Slave to the Master).

It is 8-bit long.

Data bit structure:

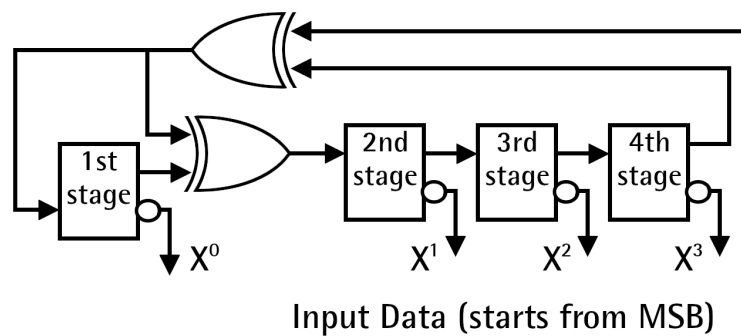
bit	7	...	...	0
	msb	...	...	lsb

CRC

Correct transmission control (inverted output). Cyclic Redundancy Check is an error checking which is the result of a "Redundancy Check" calculation performed on the message contents. This is intended to check whether transmission has been performed properly. It is 4-bit long.

Polynomial: $X^4 + X^1 + 1$ (binary: 10011)

Logic circuit:



7.4 Implemented registers

Register (hex)	Function
40	Preset setting enable
44 ... 47	Serial number
4D ... 51	Preset
75	Command
78 ... 7D	Device ID
7E - 7F	Manufacturer ID

All registers described in this section are listed as follows:

Function name

[Address, Attribute]

Description of the function and specification of the default value.

- Address: the register address is expressed in hexadecimal notation.
- Attribute: ro = read only
 rw = read and write
 wo = write only
- Default parameter value is written in **bold**.

Preset setting enable

[40, wo]

It allows the operator to enable the setting of the **Preset** registers (see on page 45). You are allowed to set a new preset value only after entering the value "01" next to this **Preset setting enable** register. Once you have entered the desired preset value, you must set the value "00" next to this **Preset setting enable** register and then save the data.

Serial number

[44 ... 47, ro]

These registers contain the serial number of the device expressed in hexadecimal notation. They are intended to inform about the year of production, the week of production, and the serial number.

Serial number registers structure:

Register	44	45	46	47
	Serial number			
	MSB	...	...	LSB
	$2^{31} \dots 2^{24}$	$2^{23} \dots 2^{16}$	$2^{15} \dots 2^8$	$2^7 \dots 2^0$

The conversion of the hexadecimal value into a decimal value will provide the information about the year of production, the week of production, and the serial number, as described in the example below.



EXAMPLE

The serial number 0A E8 69 EE has to be interpreted as follows:

Register	44	45	46	47
Hex	0A	E8	69	EE
Dec	18 30 03630			

18 = year of production (first two digits)

30 = week of production (third and fourth digit)

03630 = serial number in ascending order (remaining digits)

Preset

[4D ... 51, rw]



WARNING

You are allowed to enter a value next to the **Preset** registers only after setting the value "01" next to the **Preset setting enable** register. Once you have entered the desired preset value, you must set the value "00" next to the **Preset setting enable** register and then save the data.

These registers allow the operator to set the Preset value. The preset function is designed to assign a desired value to a specific physical position of the encoder. The selected physical position (i.e., the transmitted position value) will be assigned the value set next to these registers, and all the preceding and subsequent positions will be adjusted accordingly. For example, this feature can be useful for aligning the zero point of the encoder with the zero point of the application. The preset value is applied to the encoder's position at the moment the command is sent via the **Save parameters and activate Preset** function in the **Command** register.

After entering a value next to the **Preset** registers, you can either save it without activating the preset function, or both save and activate it at the same time. Use the **Save parameters** function (set "08" in the **Command** register) to save the new Preset value without activating it.

Use the **Save parameters and activate Preset** function (set "09" in the **Command** register) to both save and activate the new Preset value.

The Preset value must be less than the "Total Hardware Resolution".
Default = 00 00 00 00 00h.



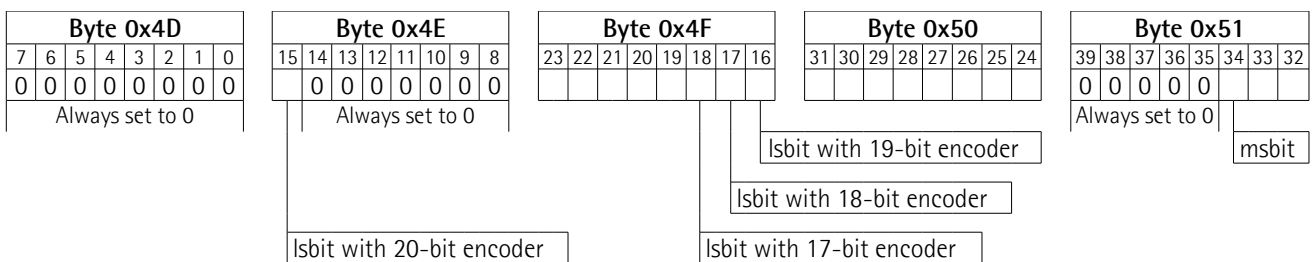
NOTE

We suggest setting the preset when the encoder shaft is in stop.



NOTE

Please note that the bit structure of the **Preset** registers is as follows:



NOTE

Please note the following:

- The most significant bit (MSB) is always bit 34 of byte 0x51.
- The least significant bit (LSB) changes depending on the encoder resolution.
- Binary values must be entered:
 - From bit 34 to bit 32 in byte 0x51.
 - From bit 31 to bit 24 in byte 0x50.
 - From bit 23 to bit 18 (or to bit 17 or 16, depending on the encoder resolution) in byte 0x4F.
 - Bit 15 (depending on the encoder resolution) in byte 0x4E.
- Bits 39 to 35 in byte 0x51 are always set to 0.
- Bits 14 to 8 in byte 0x4E are always set to 0.
- All bits in byte 0x4D are always set to 0.

To properly set the **Preset** value, see the following example.



PRESET SETTING EXAMPLE

In the 19-bit resolution SMAR4 encoder ($2^{19} = 524,288$ information), you want to set the following **Preset** value = $50,000_{10} = C350h = 1100\ 0011\ 0101\ 0000_2$.

1. As previously stated, first of all you must enable the setting of the **Preset** registers by entering the value "01" next to the **Preset setting enable** register.

- Then enter the **Preset** value ($50.000_{10} = 1100\ 0011\ 0101\ 0000_2$) according to the structure explained above. Please note that you must enter the value in the 19-bit long format (according to the encoder resolution), therefore it is:

0001100001101010000 in binary notation. See the following table:

Byte 0x4D	Byte 0x4E	Byte 0x4F	Byte 0x50	Byte 0x51
7 6 5 4 3 2 1 0	15 14 13 12 11 10 9 8	23 22 21 20 19 18 17 16	31 30 29 28 27 26 25 24	39 38 37 36 35 34 33 32
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 1 0 1 0 0 0 0	1 1 0 0 0 0 1 1	0 0 0 0 0 0 0 0
		lsbit with 19-bit encoder		msbit

- It results that you must enter the following hexadecimal value:

Byte 0x4D	Byte 0x4E	Byte 0x4F	Byte 0x50	Byte 0x51
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 1 0 1 0 0 0 0	1 1 0 0 0 0 1 1	0 0 0 0 0 0 0 0
0 0	0 0	5 0	C 3	0 0

- Afterwards, before saving the entered data, set the value "00" next to the **Preset setting enable** register.
- To save the new Preset value, you must use the **Save parameters** function in the **Command** register (set "08" in the **Command** register).
- Otherwise, to both save and activate the new Preset value at the same time, you must use the **Save parameters and activate Preset** function in the **Command** register (set "09" in the **Command** register).

Function	ADDR	DATA Tx
Preset setting enable	40	01

Writing in the Preset registers	4D	00
	4E	00
	4F	50
	50	C3
	51	00

Preset setting enable	40	00
------------------------------	----	----

Save parameters function in the Command register	75	08
--	----	----

or

Save parameters and activate Preset function in the Command register	75	09
---	----	----

Command

[75, wo]

Value	Function
08	Save parameters
09	Save parameters and activate Preset

After setting a new value in any registers, use the **Save parameters** function in the **Command** register to save the new value. Set "08" in the **Command** register.

After setting a new value in any registers, use the **Save parameters and activate Preset** function in the **Command** register to both save the new value and activate the preset function at the same time. Set "09" in the **Command** register.

After sending the command, the register is set back to "00" automatically. Wait 30 ms at least (EPROM writing time) before activating a new function.

Device ID

[78 ... 7D, ro]

These registers show the identification specifications of the device (Device ID). The identification name is expressed in hexadecimal ASCII code.

Registers 78 ... 7C show the name of the device.

Register 7D show the version of the device (type of pitch: A, B, or C).

Device ID registers structure:

Reg.	78	79	7A	7B	7C	7D
	$2^{47} \dots 2^{40}$	$2^{39} \dots 2^{32}$	$2^{31} \dots 2^{24}$	$2^{23} \dots 2^{16}$	$2^{15} \dots 2^8$	$2^7 \dots 2^0$
Hex	53	4D	41	52	34	xx
ASCII	S	M	A	R	4	x

xx = device version: A = 41; B = 42; C = 43

Manufacturer ID**[7E – 7F, ro]**

These registers contain the Manufacturer ID. Identification name is expressed in hexadecimal ASCII code.

Register	7E	7F
Hex	4C	69
ASCII	L	i

Li = Lika Electronic

7.5 Application notes

Data transmission:

Parameter	Value
Protocol	BiSS-C mode
Clock Frequency	min 200 kHz, max 5 MHz
BiSS time-out	Self-adaptable to the clock, 0.3 μ s min., 8 μ s max.

7.6 Recommended BiSS input circuit

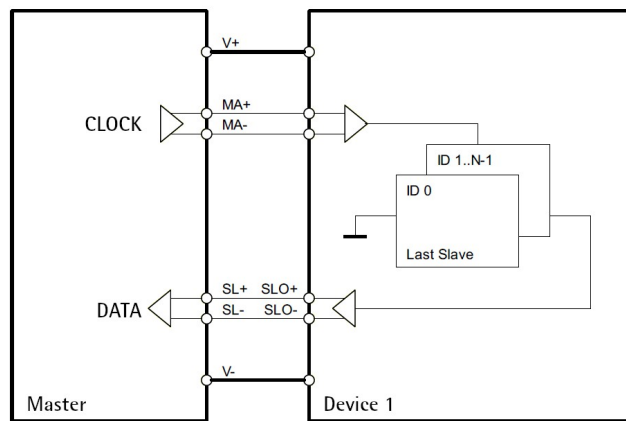


Figure 17 - Point-to-point connection: one or more Slaves per Device

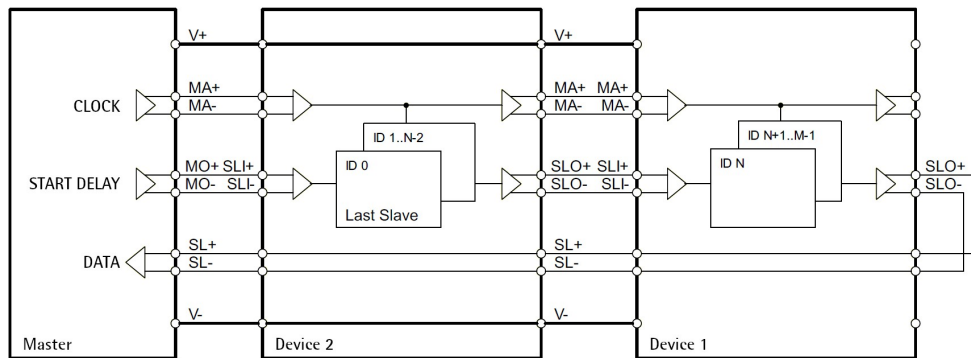
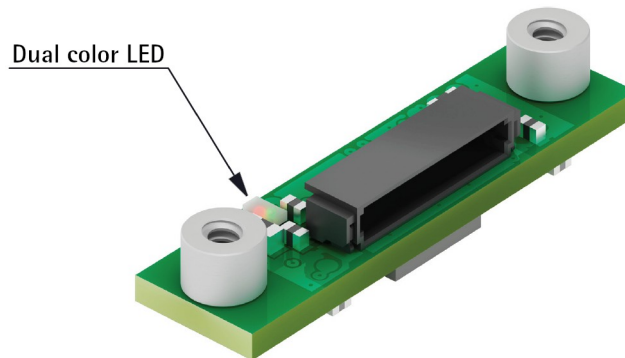


Figure 18 - Bus connection 2: queued Devices with multiple Slaves each

8 - Diagnostic LED



One dual colour LED is installed in the readhead. It is designed to show visually the operating or fault status of the device. In the BiSS interface, the operating or fault status of the device is also communicated through the nE error and nW warning bits, refer to page 41 ff.

LED status	Description
LED OFF	The power supply is OFF. The encoder is not supplied.
LED ON green	The power supply is ON. The encoder is supplied.
LED ON red	When the diagnostic LED lights up red, it indicates that an error or warning condition is active, such as an incorrect installation of the readhead and/or of the code disc / ring: • The gap between the readhead and the code disc / ring is out of tolerance (see Figure 3). • The readhead is not installed properly. • The readhead or the code disc / ring are installed contrariwise (see Figure 4). • A section of the code disc / ring has been damaged mechanically or magnetically.

In case of a wrong installation of the readhead and/or of the code disc / ring, at power on or during operation the following error conditions may occur:

When switching on the system or during operation, the diagnostic LED lights up red and an alarm/warning is triggered through the dedicated nE or nW bits (BiSS interface only): the code disc / ring is not read correctly; it may be due to one of the following reasons: the readhead and/or code disc / ring are not mounted properly (for instance: the readhead is mounted in reverse to the code disc / ring; see the "3 - Mounting instructions" section on page 13); the magnetic surface of the code disc is damaged somewhere; the readhead is not working properly; this may cause invalid data to be transmitted; as soon as the

measuring system is installed correctly, the error or warning bit switches to high logic level and the LED goes off.

9 – Warnings and errors

This section provides a comprehensive list of all warnings and errors, and then explains how to retrieve them.

Errors are signalled through the dual colour diagnostic LED as well as the error bit and are available only in the BiSS interface, refer to the "Error" section on page 41. Also warnings are available only in the BiSS interface and signalled through the warning bit, refer to the "Warning" section on page 42.

9.1 Warnings

Here follows the list of the available warnings.

Signal warning	The signals are not proper or their amplitude is too high or too low. 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 "3 - Mounting instructions" section on page 13); the ring magnetic surface is damaged somewhere; the sensor is not working properly; this may cause invalid data to be transmitted.
Frequency warning	The ring is rotating too fast. Slow down the speed of the ring to tolerance limits.

9.2 Errors

Here follows the list of the available errors.

Startup error	• An EEprom communication error or a CRC error occurred. Switch the power off and then on again. If the error is still active, please contact Lika's After-Sales Service. • The signals are not proper or their amplitude is too low. 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 "3 - Mounting instructions" section on page 13); the ring magnetic surface is damaged somewhere; the sensor is not working properly; this may cause invalid data to be transmitted.
Command execution in progress	A command is still under execution. Please wait for the command to be executed before sending further commands.

Consistency error	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 "3 - Mounting instructions" section on page 13); the ring magnetic surface is damaged somewhere; the sensor is not working properly; this may cause invalid data to be transmitted.
Communication error	Communication error. It may be due to the EEprom, it may be damaged; or it may be due to the I2C. Switch off the power supply and then on again. If the error is still active, please contact Lika's After-Sales Service.
Invalid checksum	An invalid checksum occurred in the internal RAM. Switch off the power supply and then on again. Try the command again. If the error is still active, please contact Lika's After-Sales Service.

10 - Maintenance

The magnetic measurement system does not need any particular 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 ensure that there are no loose screws. Tighten them, if necessary.
- Ensure that the mounting tolerances between the sensor and the magnetic scale are met all along the whole measuring length. Mechanical plays compromise the correct operation. The wear of the machine may increase the tolerances.
- The surface of the magnetic scale 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 count/pulse output).

Possible cause

- The scale and/or the sensor are not installed properly. The active surface of the scale does not match the sensitive part of the sensor; or the sensor installation does not comply with the mounting direction. For correct installation please refer to the "3 - Mounting instructions" section on page 13.
- A magnetic part or a protection surface is interposed between the sensor and the scale. Only non-magnetic materials are allowed between the sensor and the scale.
- Installation does not meet the mounting tolerances between the sensor and the scale indicated in this guide. During operation the sensor hits the surface of the scale (check whether the sensor sensitive part is damaged). Or the sensor is mounted too far from the scale.
- The sensor has been damaged by short circuit or wrong connection.

Fault

The measured values are either inaccurate or not provided in the whole length or jump along the travel.

Possible cause

- The mounting tolerances between the sensor and the scale are not met all along the whole measuring length. For correct installation, see the "3 - Mounting instructions" section on page 13.
- The sensor is not installed properly on the scale. See the "3 - Mounting instructions" section on page 13.
- The connection cable runs near high voltage cables or the shield is not connected properly.
- Frequency error: the sensor is travelling too fast on the scale.
- The frequency of the Master clock is set too high or too low and the transmission cannot be synchronized correctly.
- A section of the magnetic scale has been damaged mechanically or magnetically along the measuring length.
- The measuring error is caused by a torsion in the machine structure. Check parallelism and symmetry in the movement of the machine.

12 - Default parameters list

BiSS-C interface

Parameters list	Default value *		
Preset	00 00 00 00 00		
Preset setting enable	00		
Command	00		

* All values are expressed in hexadecimal notation.

This page intentionally left blank

This page intentionally left blank

Document release	Release date	Description	HW	SW	Interface
1.0	05.12.2025	First issue	-	-	1.0.3
1.1	06.07.2026	Description of the new calibration software, warnings and errors added	-	-	1.1.0 BETA VERSION



Dispose separately

lika

Lika Electronic

Via S. Lorenzo, 25 • 36010 Carrè (VI) • Italy

Tel. +39 0445 806600

Fax +39 0445 806699



info@lika.biz • www.lika.biz