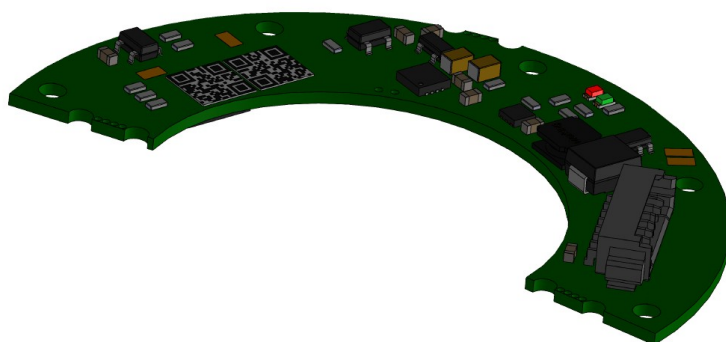


SMAR49A



Absolute modular encoder

- Off-axis modular encoder with magnetic scanning
- Singleturn and multiturn versions available
- Absolute SSI, BiSS, & SPI interfaces
- Singleturn resolution up to 524,288 cpr, 65,536 revolutions
- Direct integration into robots, motors, and OEM applications

Suitable for the following models:

- SMAR49A-BG1-...
- SMAR49A-SC1-...
- SMAR49A-SP1-...

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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.

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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, 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 **SMAR49A modular encoder** and the **MRA/49A-25-S-E-32NC-A magnetic ring**.

The **SMAR49A** is an **off-axis absolute modular encoder** that combines an **open PCB readhead** with the **MRA/49A-25-S-E-32NC-A magnetic ring**.

This encoder is available with either SSI, BiSS C-mode, or SPI absolute interfaces (SMAR49A-BG1-..., SMAR49A-SC1-..., and SMAR49A-SPI1-... respectively). It can be either singleturn or multiturn, see the order code. For example: SMAR49A-SC1-017/... is a 17 bit singleturn encoder; SMAR49A-SC1-17M/... is a 17 + 16 bit multiturn encoder. The absolute resolution is up to 19 bit singleturn (524,288 cpr) and 16 bit multiturn (65,536 turns). It is ideal for direct integration into space critical applications such as robots, robotic joints, hollow shaft motors (direct drive torque motors, ...), brushless and servo motors, drones / UAVs, video surveillance systems, OEM equipment.

The SMAR49A modular encoder must be compulsory paired with the MRA/49A-25-S-E-32NC-A magnetic ring.

The MRA/49A-25-S-E-32NC-A magnetic ring features two tracks: a Nonius track and a Master track. The ring's external diameter is 49 mm (1.929 inches), the diameter of the through hollow shaft is 25 mm (0.984 inches).

The ring comes with a hub supporting the elastomer disc and needs four screws for fixing.

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 both the encoder and the ring are provided.

In the second section, entitled **SSI interface**, both general and specific information is given on the SSI interface, see on page 26.

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 30.

In the fourth section, entitled **SPI interface**, both general and specific information is given on the SPI interface, see on page 40.

1 – Safety summary



1.1 Safety

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



1.2 Electrical safety

- Turn off the power supply before connecting the device;
- connect according to the explanation in the "4 – Electrical connections" section on page 21;
- the wires of unused output signals must be cut at different lengths and insulated singularly;
- in compliance with the 2014/30/EU norm on electromagnetic compatibility, the following precautions must be taken:
 - before handling and installing, discharge electrical charge from your body and tools which may come in touch with the device;
 - power supply must be stabilized without noise, install EMC filters on device power supply if needed;
 - always use shielded cables (twisted pair cables whenever possible);
 - avoid cables runs longer than necessary;
 - avoid running the signal cable near high voltage power cables;
 - mount the device as far as possible from any capacitive or inductive noise source, shield the device from noise source if needed;
 - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;
 - minimize noise by connecting the shield and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.
- 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 this guide, ensure that it is in electrical contact with the drive shaft.





1.3 Mechanical safety

- Install the device following strictly the information in the "3 - Mounting instructions" section on page 14;
- mechanical installation has to be carried out with stationary mechanical parts;
- 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 manufacturer, use the product according to the indicated degree of IP protection;
- the encoder and the magnetic ring must be adequately protected in order to be able to cope with the industrial environment where they are to be installed;
- 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 discharges



Please ensure that the following safety precautions and instructions are strictly observed before handling and installing the 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 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; they are further used not to dirty the code disk while mounting;

- always handle the encoder by grasping the plastic enclosure on the sides;
- the code disk must always be handled by grasping its outer edges;
- avoid flexing the disk, exposing it to direct sunlight, excessive heat and/or humidity;
- if dust gets on to the disk, wipe with a soft dry cloth; wipe the disk using circular motions; more stubborn stains can be removed using a soft cloth lightly moistened with a few drops of alcohol; do not use gasoline, kerosene, benzene or other solvents, as they damage the disk.



CAUTION

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

1.5 Cleaning the elastomer-bonded ferrite material

Should the elastomer-bonded ferrite material require surface cleaning, we suggest using a soft and clean cloth with some drops of detergent, then wait for the surface to dry.



WARNING

- 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.



WARNING

Protect the ring from acid solutions and chemicals that may damage it. Please check in the following table the chemicals that have no or low impact, the chemicals that have low to medium impact and the chemicals that have high impact on the magnetic material of the tape.

Low impact chemicals	
Detergent	23°C x 72 h
Hydraulic oil	23°C x 72 h
Weak alkali	23°C x 72 h

Low to medium impact chemicals	
Alcohol	23°C x 72 h
Water	60°C x 72 h
High impact chemicals	
Aether	23°C x 72 h
Aliphatic solvent	23°C x 72 h
Aromatic solvent	23°C x 72 h
Benzene	23°C x 72 h
Gasoline	23°C x 72 h
Hydrocarbon cleaning solvent	23°C x 72 h
Ketones	23°C x 72 h
Organic, inorganic acid	23°C x 72 h
Thinner	23°C x 72 h
Trichloromethane	23°C x 72 h
Tricloroethylene	23°C x 72 h


NOTE

Tolerances also depend on temperature, air supply, duration of impact, liquid consistency, and several other factors. Therefore it is always advisable to test the material under real conditions.

2 - Identification

The device can be identified by the **order code** and **serial number** printed on the label applied 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 whose order code ends with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical Info).

The order code of the magnetic ring must be interpreted as follows:

MRA / 56A-38-S-P-64NA-A

(a) (b) (c) (d) (e) (f) (g) (h) (i)

where:

(a)	ring model (MRA = Magnetic Ring with Absolute coding)
(b)	outer diameter in mm
(c)	type of hub: A = simple hub to support the magnetic layer (without a complete mechanical mounting support); B = Lika hub (fixing collar) with grub screws; C = Lika hub (fixing collar) without screws or grub screws; D = Bogen hub (fixing collar) without screws or grub screws
(d)	inner diameter in mm
(e)	material of the hub: A = aluminium; M = metal; S = stainless steel
(f)	material of the magnetic layer: E = elastomer rubber; F = ferrite; P = plastroferrite
(g)	magnetic coding / number of pole pairs
(h)	pole pitch: A = 1.28 mm; B = 1.50 mm; C = 2.00 mm
(i)	magnetization surface: A = axial; R = radial

3 - Mounting instructions



WARNING

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



WARNING

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



WARNING

Install the unit providing protection means against waste, especially swarf as turnings, chips or filings; should this not be possible, please ensure 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.

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

3.1 Encumbrance sizes of the SMAR49A encoder

(values are expressed in millimetres)

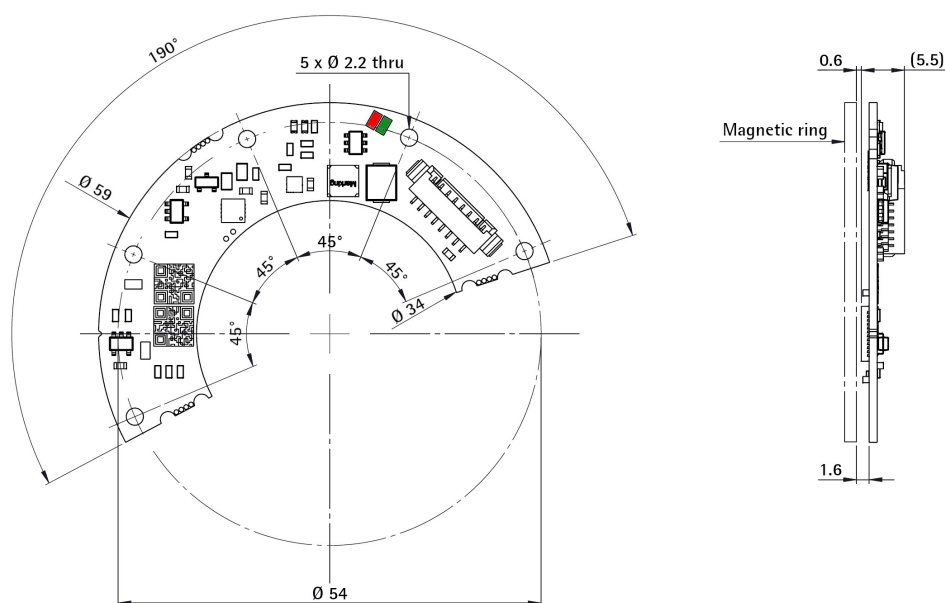


Figure 1 - SMAR49A-...-X2

3.2 Encumbrance sizes of the MRA/49A-25-S-E-32NC-A

(values are expressed in millimetres)

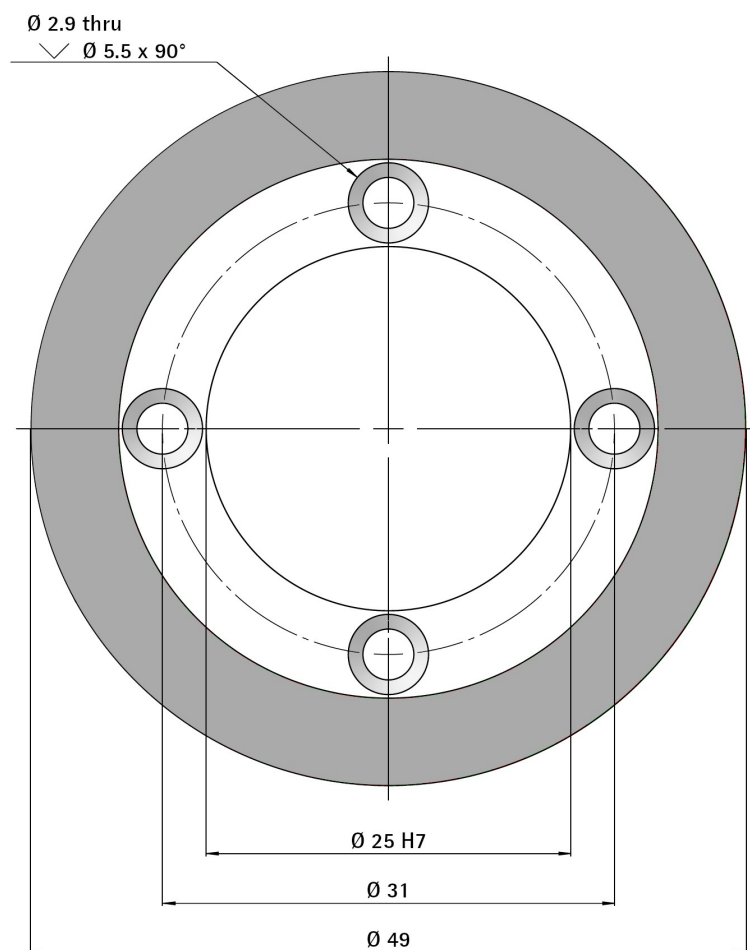


Figure 2 - Overall dimensions of the ring

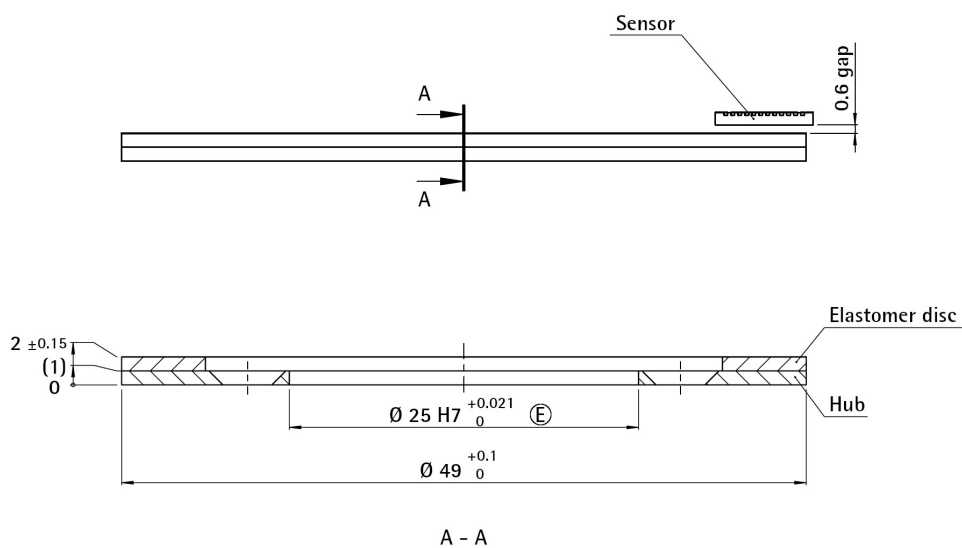


Figure 3 - Lateral views of the ring

3.3 Mounting the code disc / ring



WARNING

Ensure that the SMAR49A encoder is correctly paired with the MRA/49A-25-S-E-32NC-A ring.



WARNING

- To clean the code disc / ring from dust, wipe it with a soft dry cloth; more stubborn stains can be removed using a soft cloth lightly moistened with a few drops of detergent; do not use gasoline, kerosene, benzene, or other solvents;
- the code disc / ring must always be handled by grasping its outer edges;
- protect the code disc / ring from scratching;
- avoid flexing the code disc / ring;
- always handle the encoder unit by grasping the PCB on the sides.

3.3.1 Mounting the magnetic ring

1. Mount the magnetic ring on the motor shaft.
2. Fasten the ring to the motor shaft using four countersunk head screws type M2.5 ISO 7046.
3. Recommended tightening torque: **0.8 Nm**.
4. The length of the screws depends on the thickness of the mounting support. Please ensure that the screws are screwed in at least 4 mm.

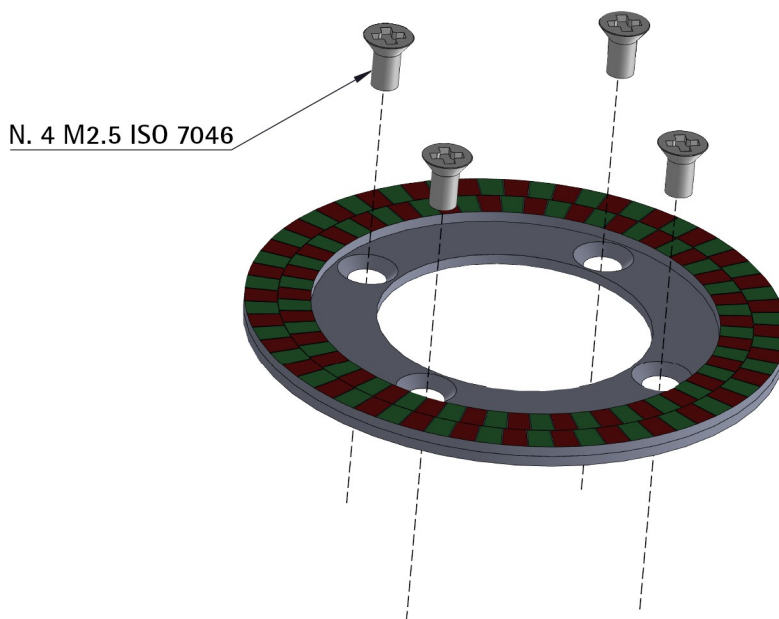


Figure 4 – Mounting the magnetic ring

3.4 Mounting the encoder



WARNING

Ensure that the SMAR49A encoder is correctly paired with the MRA/49A-25-S-E-32NC-A ring.



WARNING

Always handle the encoder unit by grasping the PCB on its sides.

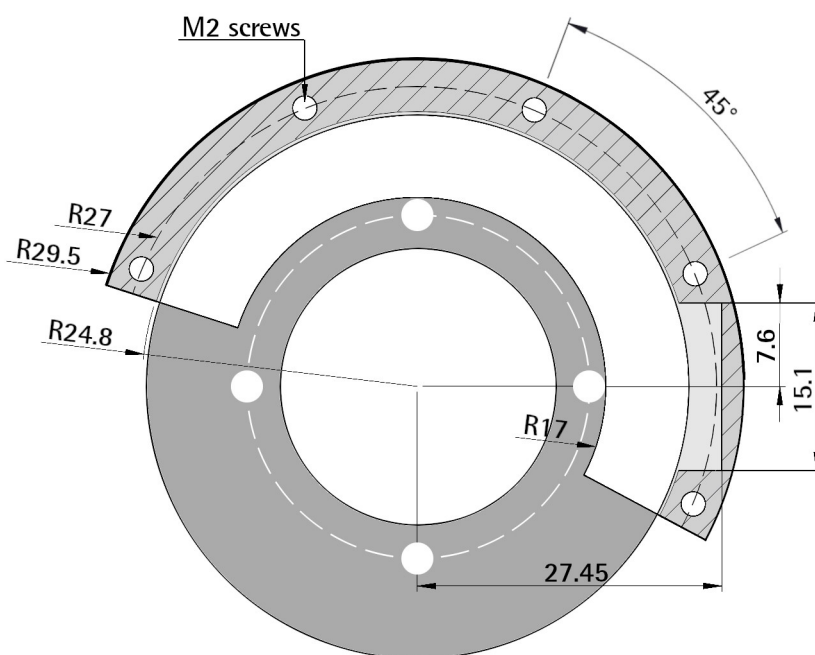


Figure 5 - Mounting support

Mount the encoder unit over the code disc / ring ensuring 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 grasping its outer edges. Use five **M2 ISO 1207 screws** inserted into the through holes (Figure 6), tighten the screws down to firmly fix the encoder unit to the mounting support, torque to **0.4 Nm** max. The length of the screws depends on the thickness of the mounting support. Please ensure that the screws are screwed in at least 3 mm. Furthermore, please ensure that the screws do not hit the code disc / ring.

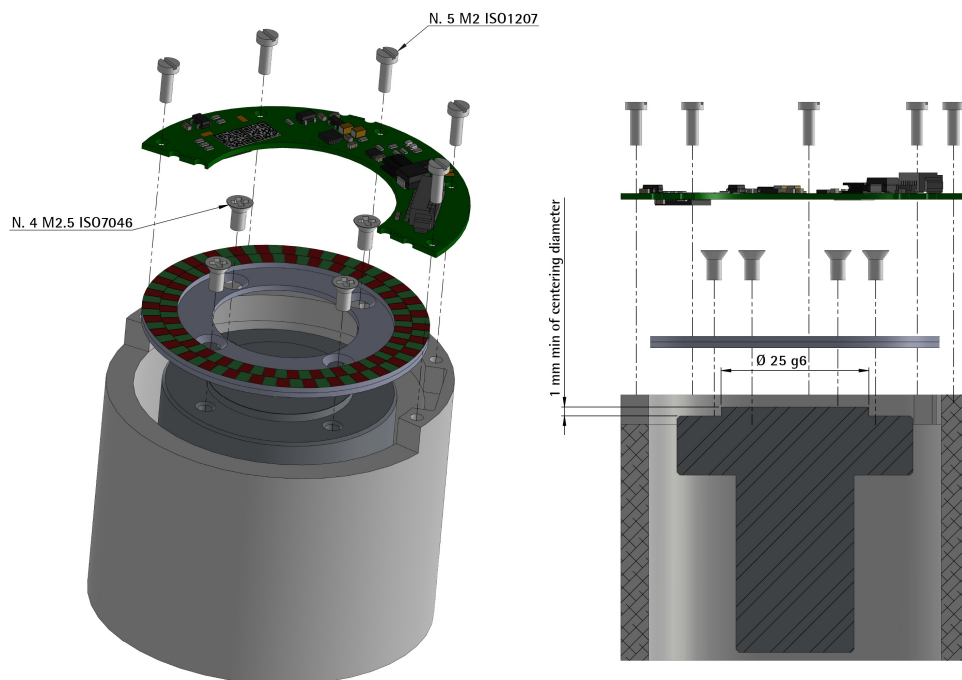


Figure 6 - Mounting the encoder

You must always comply with the following tolerance values.

X [mm]	± 0.5
Y [mm]	± 0.5
Z [mm], see Figure 1	$0.6 (1.6) \pm 0.05$
$\theta X [^\circ]$	± 1
$\theta Y [^\circ]$	± 1
$\theta Z [^\circ]$	± 1

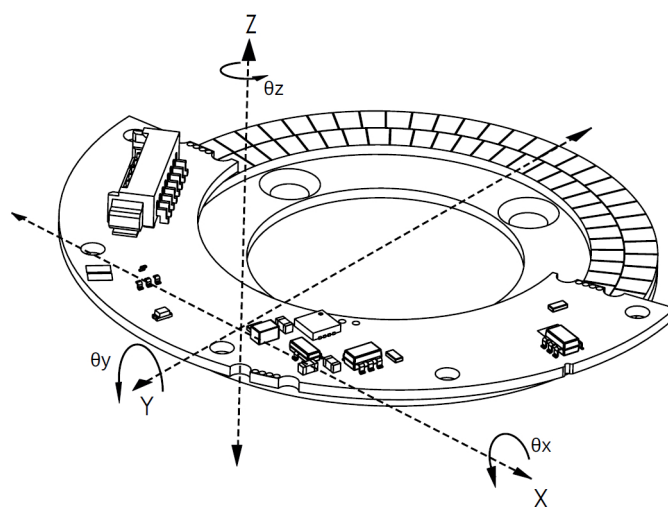


Figure 7 - Mounting tolerances

3.5 Installing the spacer

In specific applications where the mechanics are already set up, installing a spacer may be useful. For such applications, we suggest using the tool order code SMAR49A-SPACER, which must be ordered separately. Mount the spacer under the PCB. Align the holes on the spacer with the corresponding holes in the PCB.

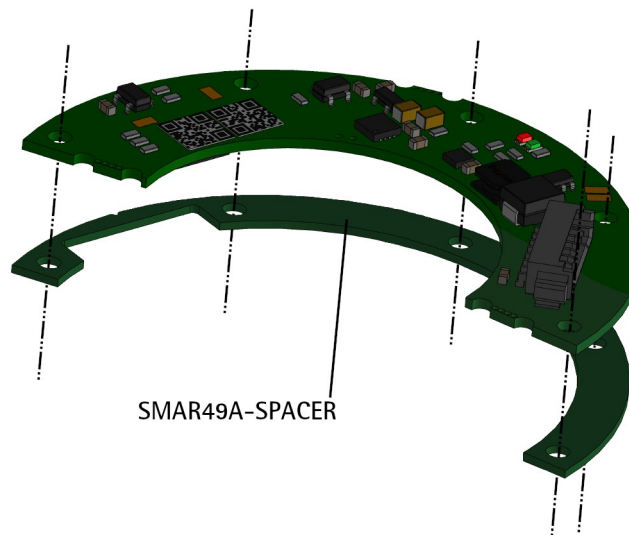


Figure 8 - SMAR49A-SPACER

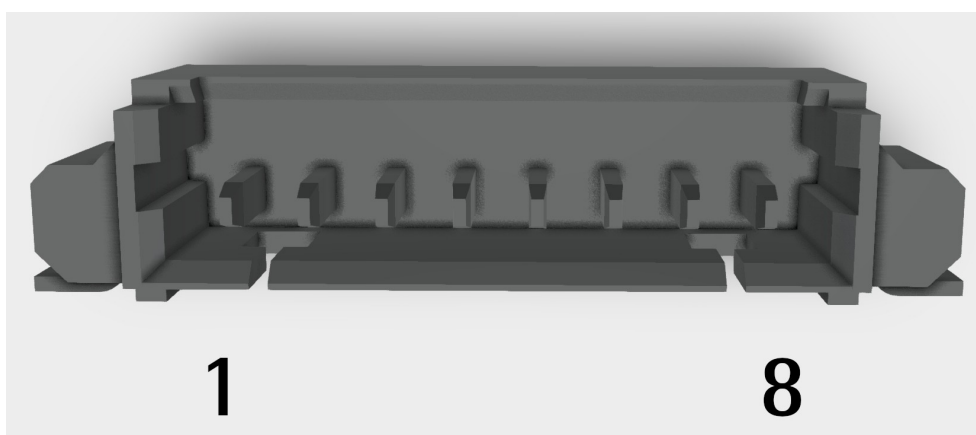
4 - Electrical connections



WARNING

Power supply must be turned off before performing any electrical connection!
If wires of unused signals come in contact, irreparable damage could be caused to the device. Thus they must be cut at different lengths and insulated singularly.

4.1 Amphenol FCI 10114830-11108LF connector



Mating connector: Amphenol FCI 10114826-0008LF + terminals 10114827-002LF

4.1.1 Connection of the SMAR49A SSI / BiSS encoder

The following pinout refers to the order codes: SMAR49A-BG1-... and SMAR49A-SC1-...

Function	Pin
+5Vdc $\pm$ 5%	1
0Vdc	2
Temperature sensor pin 1	3
Temperature sensor pin 2	4
Clock IN + / MA +	5
Clock IN - / MA -	6
Data OUT + / SLO +	7
Data OUT - / SLO -	8

4.1.2 Connection of the SMAR49A SPI encoder

The following pinout refers to the order code: SMAR49A-SP1-...

Function	Pin
+5Vdc $\pm 5\%$	1
0Vdc	2
Temperature sensor pin 1	3
Temperature sensor pin 2	4
SCLK	5
NCS	6
MISO	7
MOSI	8

4.2 Cable connections

EC-X32-LK-TF12-Lxxx cordset

4.2.1 SMAR49A SSI / BiSS encoder wiring

The following wire connection refers to the order codes: SMAR49A-BG1-... and SMAR49A-SC1-...

Function	TF12 cable
+5Vdc $\pm 5\%$	White_Green
0Vdc	Brown_Green
Temperature sensor pin 1	White
Temperature sensor pin 2	Blue
Clock IN + / MA +	Violet
Clock IN - / MA -	Yellow
Data OUT + / SLO +	Grey
Data OUT - / SLO -	Pink
not connected	Black, Brown, Green, Red

4.2.2 SMAR49A SPI encoder wiring

The following wire connection refers to the order code: SMAR49A-SP1-...

Function	TF12 cable
+5Vdc $\pm$ 5%	White_Green
0Vdc	Brown_Green
Temperature sensor pin 1	White
Temperature sensor pin 2	Blue
SCLK	Violet
NCS	Yellow
MISO	Grey
MOSI	Pink
not connected	Black, Brown, Green, Red

4.2.3 TF12 cable specifications

Model:	LIKA TF12 encoder cable
Cross section:	6 x 2 x 28AWG twisted pairs
Jacket:	Special flame retardant PVC compound, RZ-TM2 quality
Shield:	Tinned copper braid, coverage > 80% with tinned copper drain wire
Outer diameter:	5.4 mm $\pm$ 0.1 mm / 0.213" $\pm$ 0.004"
Min. bend radius:	Outer diameter x 10
Work temperature:	-15°C +80°C / +5°F +176°F
Conductor resistance:	< 242.02 Ω /Km (+20°C / +68°F) (UL 758 table 5.2.1)

4.3 Connection of the shield

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

4.4 Ground connection

The five through holes used to fasten the encoder to the customer's mounting support also serve as five grounding points. These holes provide a metal surface on both the top and bottom layers. Ensure that the ground connection is not affected by noise.

4.5 Temperature sensor pin

The SMAR49A encoder provides two pass-through signals for connecting an external temperature sensor in your application. This can be a Pt100, Pt1000, NTC, 1-wire, or any other similar low-voltage analogue or digital sensor. The signals are isolated from the encoder circuit and are routed directly from the Temperature Sensor 1/2 pins on the connector to the soldering pads, where the external sensor in your application must be connected.

This feature is designed to add temperature monitoring to applications such as electric motors, gearboxes, and similar equipment where precise monitoring near the encoder is required. This solution simplifies cable management by allowing the existing encoder cable to carry these two signals. The voltage must be limited to $\pm 30V$ relative to the other encoder signals, and the current must be limited to ± 500 mA.

4.6 SSI interface

For complete information on the SSI interface, please refer to the "5 - SSI interface" section on page 26.

4.7 BiSS C-mode interface

For complete information on the BiSS C-mode interface, please refer to the "6 - BiSS C-mode interface" section on page 30.

4.8 SPI interface

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

4.9 Absolute resolution

The SMAR49A measuring system can provide a singleturn resolution of 32,768 cpr (15 bits), 131,072 cpr (17 bits), 262,144 cpr (18 bits), and 524,288 cpr (19 bits).

The angular resolution is 0.01098° ($0^\circ 0' 40''$) for 15-bit model.

It is 0.00274° ($0^\circ 0' 10''$) for 17-bit model.

It is 0.00137° ($0^\circ 0' 5''$) for 18-bit model.

It is 0.00068° ($0^\circ 0' 2.5''$) for 19-bit model.



NOTE

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

$1 \text{ STEP} = 360^\circ / \text{angular resolution}$

E.g. $360^\circ / 131,072 \text{ cpr} = 0.00274^\circ$

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



EXAMPLE

Position value = 3,000

Angular resolution of the 17-bit encoder = 0.00274°

Angular position = $3,000 * 0.00274^\circ = 8.22^\circ = 8^\circ 13' 12''$

4.10 Counting direction

The **standard counting direction** is to be intended with ring turning as indicated by the arrow in Figure 9. When the ring turns in the direction indicated by the arrow, the count is up. The counting direction cannot be changed.

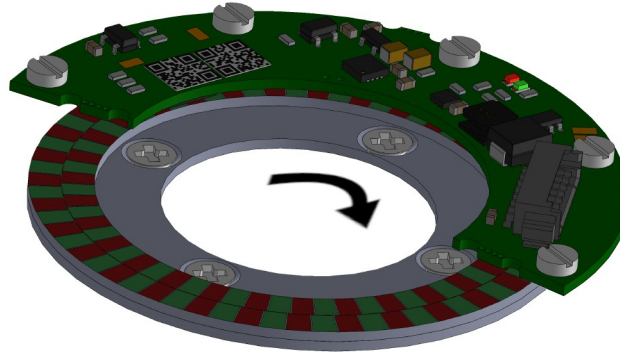


Figure 9 – Counting direction

4.11 Diagnostic LEDs

For complete information on the diagnostic LEDs, please refer to the "8 - Diagnostic LEDs" section on page 49.



CAUTION

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

5 - SSI interface

Order code:

SMAR49A-BG1-...

SSI Binary, MSB Aligned

5.1 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.

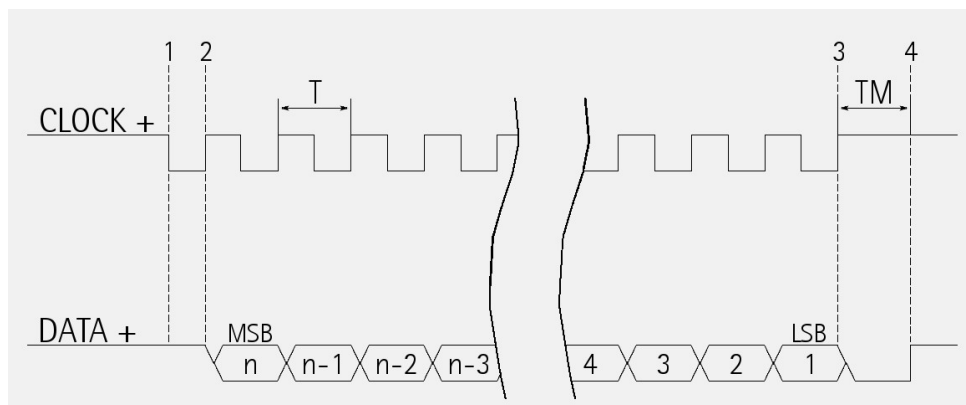
The main advantages in comparison with parallel or asynchronous data transmissions are:

- 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 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).

5.2 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
SMAR49A-BG1-017/...	17 bits	17 bits	131,072 info/rev.
SMAR49A-BG1-018/...	18 bits	18 bits	262,144 info/rev.
SMAR49A-BG1-019/...	19 bits	19 bits	524,288 info/rev.
SMAR49A-BG1-15M/...	15 + 16 bits	31 bits	2,147,483,648 info
SMAR49A-BG1-17M/...	17 + 16 bits	33 bits	8,589,934,592 info
SMAR49A-BG1-18M/...	18 + 16 bits	34 bits	17,179,869,184 info
SMAR49A-BG1-19M/...	19 + 16 bits	35 bits	34,359,738,368 info

The output code is the BINARY code.

The transmitted position value has the following structure:

Order code	Bit structure		
SMAR49A-BG1-017/...	16	...	0
SMAR49A-BG1-018/...	17	...	0
SMAR49A-BG1-019/...	18	...	0
SMAR49A-BG1-15M/...	30	...	0
SMAR49A-BG1-17M/...	32	...	0
SMAR49A-BG1-18M/...	33	...	0
SMAR49A-BG1-19M/...	34	...	0
	MSB	...	LSB

5.3 Recommended transmission rates

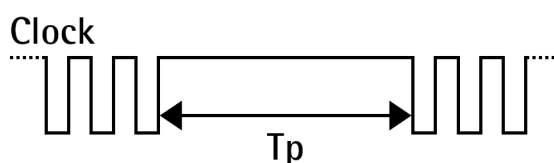
The SSI interface has a frequency of data transmission ranging between 100 kHz and 2 MHz.

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
< 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).



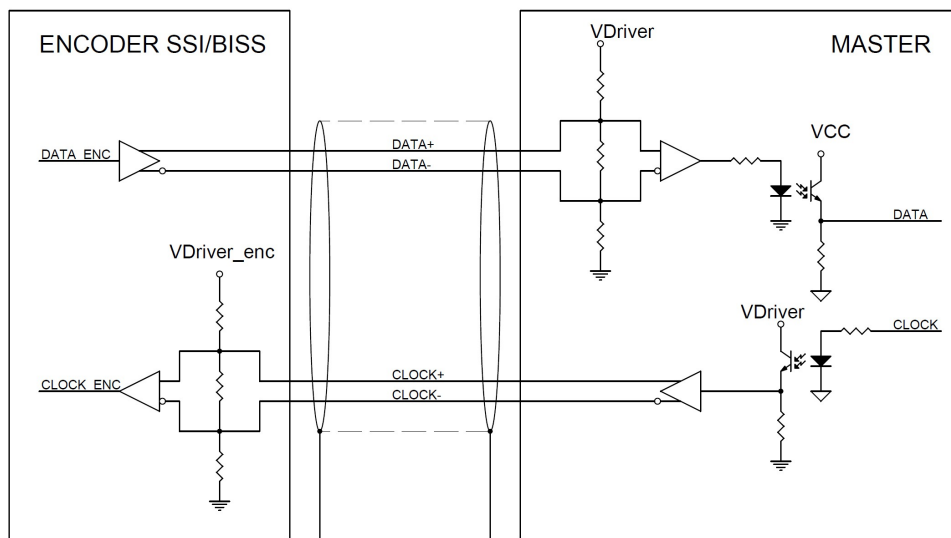
NOTE

For any information on the structure of the position information word, please refer to the "5.2 MSB Left Aligned protocol" section on page 27.

5.4 Helpful information

- The position information increases when the ring rotates as indicated by the arrow in Figure 9.
- At installation always execute a zero setting operation of the absolute position in the subsequent electronics.

5.5 Recommended SSI input circuit



6 - BiSS C-mode interface

Order code:

SMAR49A-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 is designed to work in a point-to-point configuration and must be installed in a "single Master, single Slave" network.

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



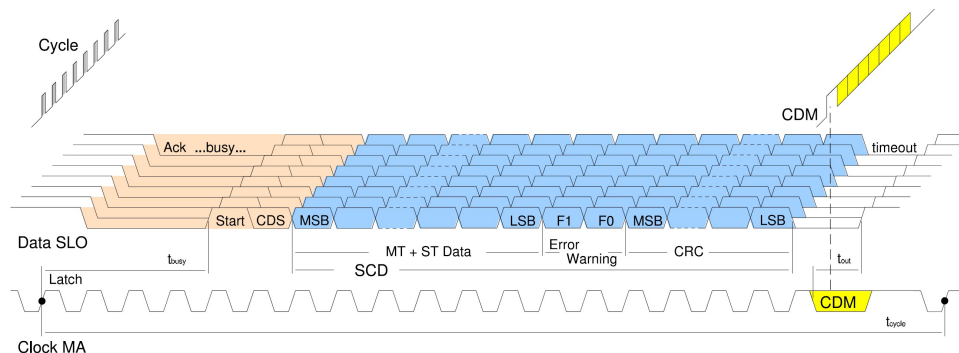
WARNING

Never install the encoder in a "single Master, multi Slave" network.

6.1 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 "6.2 Single Cycle Data SCD" section on page 31.



6.2 Single Cycle Data SCD

6.2.1 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 35 bits as shown in the following table.

Order code	Encoder resolution
SMAR49A-SC1-017/...	17 bits
SMAR49A-SC1-018/...	18 bits
SMAR49A-SC1-019/...	19 bits
SMAR49A-SC1-15M/...	15 + 16 bits
SMAR49A-SC1-17M/...	17 + 16 bits
SMAR49A-SC1-18M/...	18 + 16 bits
SMAR49A-SC1-19M/...	19 + 16 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 51.

$nE = "1"$: 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 51.

$nW = "1"$: no active warning

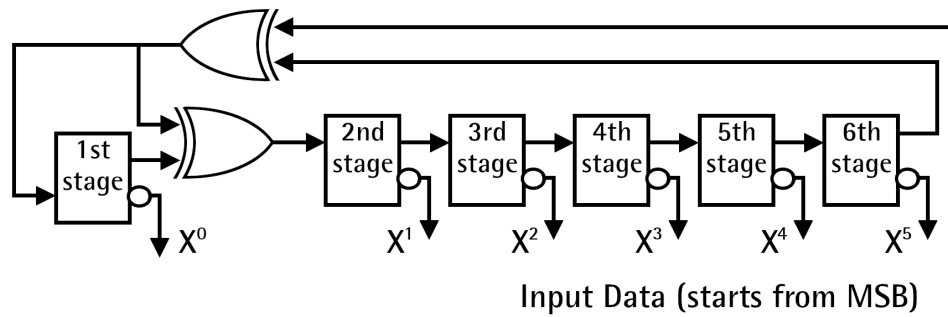
$= "0"$: warning status: a warning is active in the system.

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



6.3 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:

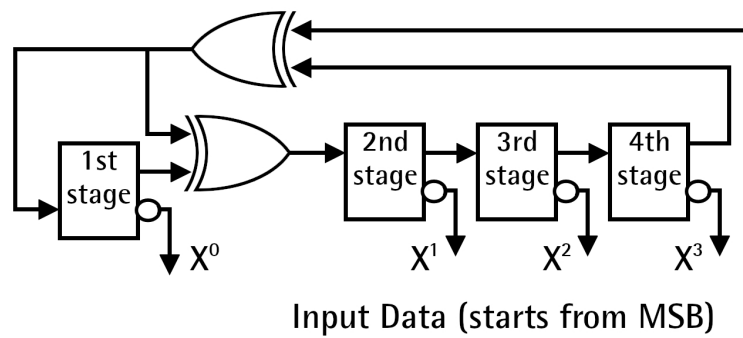
bit	7	...	...	0
	msb	...	...	lsb

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:



6.4 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 35). 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 meant to assign a desired value to a physical position of the encoder. The chosen physical position (i.e. the transmitted position value) will get the value set next to these registers and all the previous and following positions will get a value according to it. For instance, this can be useful for getting the zero point of the encoder and the zero point of the application to match. The preset value will be set for the position of the encoder in the moment when the command is sent through the **Save parameters and activate Preset** function of 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 lower than the "Total Hardware Resolution".
Default = 00 00 00 00 00h.



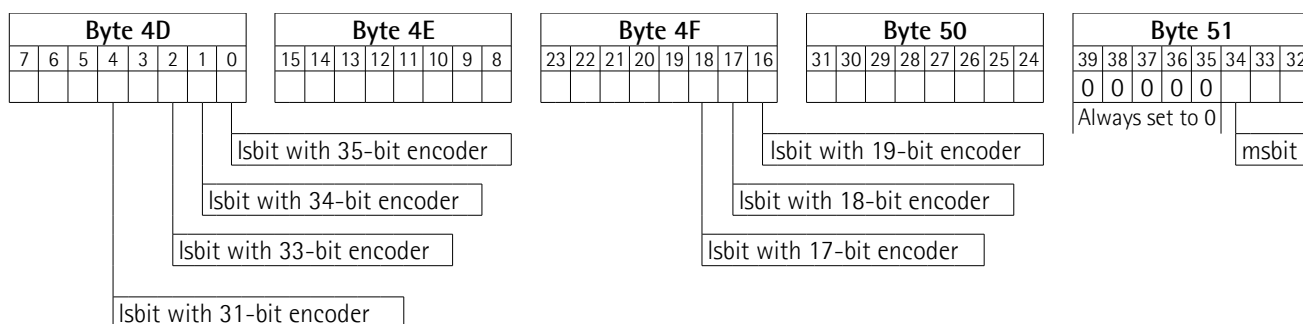
NOTE

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 that:

- msbit is always bit 34 of byte 51;
- lsbit changes depending on the encoder resolution;
- binary values must be entered:
 - from bit 34 to bit 32 in byte 51;
 - from bit 31 to bit 24 in byte 50;
 - from bit 23 to bit 18 (or to bit 17, or 16, depending on the encoder resolution) in byte 4F;
 - from bit 15 to bit 8 in byte 4E;
 - from bit 7 to bit 4 (or to bit 2, or 1, or 0 depending on the encoder resolution) in byte 4D;
- bits from 39 to 35 in byte 51 are always set to 0.

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



PRESET SETTING EXAMPLE

In the 19-bit resolution SMAR49A 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 4D	Byte 4E	Byte 4F	Byte 50	Byte 51
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 4D	Byte 4E	Byte 4F	Byte 50	Byte 51
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 ... 7D show the name of the device.

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	39
ASCII	S	M	A	R	4	9

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

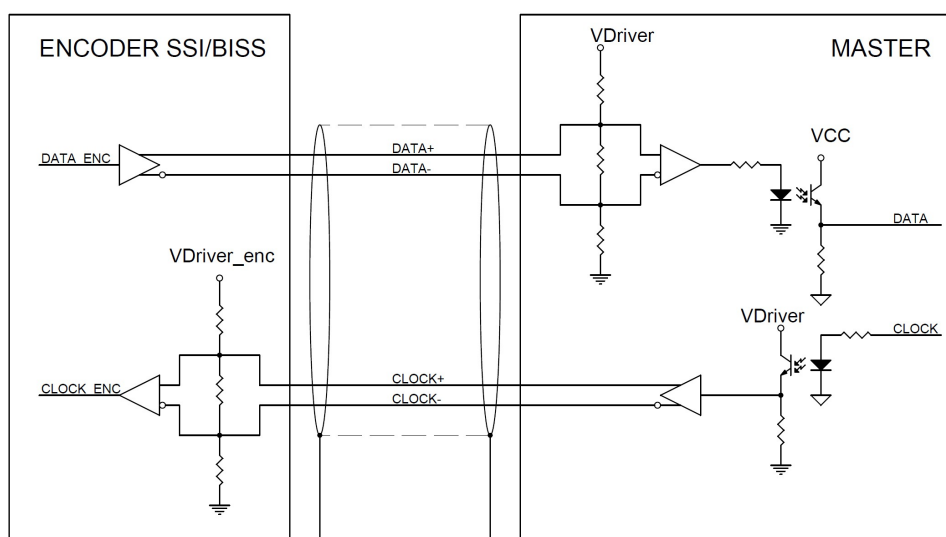
Li = Lika Electronic

6.5 Application notes

Data transmission:

Parameter	Value
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.

6.6 Recommended BiSS input circuit



7 - SPI interface

Order code:

SMAR49A-SP1-... SPI

7.1 Introduction to SPI interface

SPI is the acronym of Serial Peripheral Interface. It is one of the most widely used interfaces between microcontroller and peripheral ICs such as sensors, ADCs, DACs, shift registers, SRAM, and others. SPI is a synchronous, full duplex Master-Slave-based interface. Lika encoders are always Slave devices and support SPI modes 0 and 3. The data from the Master or the Slave is synchronized with the rising edge of the clock SCLK and the idle polarity of SCLK is insignificant. Although the SPI has become a de facto standard, it is not a de jure standard; in other words, it is not officially specified.

7.2 Interface

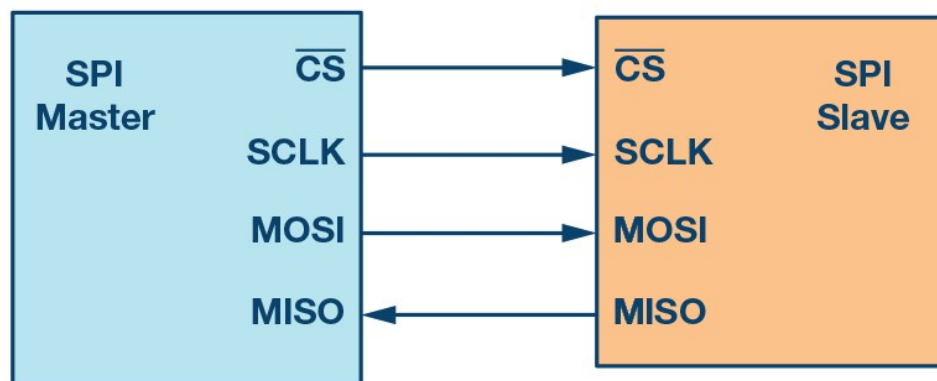


Figure 10 - SPI configuration with Master and one Slave

The SPI bus consists of four unidirectional wires.

Lika encoders are 4-wire SPI devices and carry the following signals:

- Clock: SPI CLK, SCLK
- Interface enable: Chip Select (CS)
- Data IN: MOSI (Master OUT, Slave IN)
- Data OUT: MISO (Master IN, Slave OUT)

7.2.1 SCLK SPI Clock signal

The device that generates the clock signal is called the Master. Data transmitted between the Master and the Slave is synchronized to the clock generated by the Master. As stated, SPI modes 0 and 3 are supported, i.e. idle level of SCLK is either 0 or 1 and data is accepted on a rising edge.

The mode depends on the SCLK level, sometimes called polarity (CPOL), when the transmission is initiated (CS is pulled low) and the sampling edge, called (CPHA), is as shown in the following table:

Mode	Polarity (CPOL)	Phase (CPHA)
0		
3		

SPI interface can have only one Master and can have one or multiple Slaves. Figure 10 shows the SPI connection between the Master and the Slave.

7.2.2 CS Chip Select signal

The CS Chip Select signal from the Master is used to select the Slave. This is an active low signal and is pulled high to disconnect the Slave from the SPI bus. When multiple Slaves are used, an individual CS Chip Select signal for each Slave is required from the Master. In Lika encoders the CS Chip Select signal is always an active low signal.

7.2.3 MOSI and MISO signals

MOSI and MISO are the data lines. MOSI transmits data from the Master to the Slave and MISO transmits data from the Slave to the Master. Data is sent byte by byte in packages of 8 bits and with the msb (most significant bit) first. Each data transmission starts when a 1-byte opcode is sent by the SPI Master (see the "7.2.5 Command byte" section on page 42).

7.2.4 Data Transmission

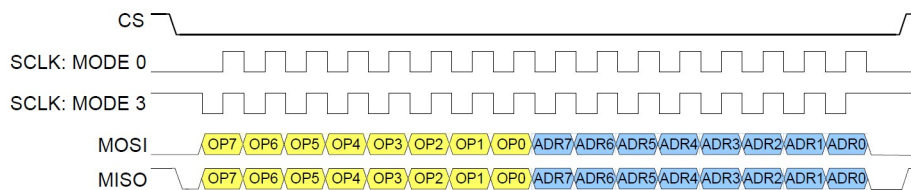


Figure 11 - SPI transmission SPI Mode 0 and 3, using opcode Read REGISTER (single) as an example

Here follows a description of a typical sequence of an SPI data transmission, assuming that the **Read REGISTER (single) command** is transmitted (see Figure 11).

1. To begin SPI communication, the Master initializes the transmission: it sends the SCLK clock signal and selects the Slave by enabling the CS Chip Select signal. CS Chip Select is an active low signal; hence, the Master must send a logic 0 on this signal to select the Slave.

2. The encoder changes its communication level from MOSI to MISO. SPI is a full-duplex interface; both Master and Slave can send data at the same time via the MOSI and MISO lines respectively. During SPI communication, the data is simultaneously transmitted (shifted out serially onto the MOSI bus) and received (the data on the bus -MISO- is sampled or read in). The serial clock edge synchronizes the shifting and sampling of the data. As previously stated, data is transmitted in packages of 8 bits. The output data length must be a multiple of 8 bits.
3. Now the Master transmits the opcode OP and the address ADR via MOSI.
4. The encoder immediately outputs OP and ADR via MISO.
5. The encoder transmits the requested data according to the address.
6. The Master ends the command with a rising edge at CS.
7. Finally the encoder switches its MISO output to 1.

7.2.5 Command byte

Each communication frame starts with a command byte. It consists of an operating code which specifies the type of operation and an 8 bit address. The available SPI codes are:

Code	Description
0xA6	SDAD transmission command (sensor data SD)
0xF5	SDAD status command (no latch)
0x97	Read REGISTER (single) command
0xAD	REGISTER status / data command

SDAD transmission command

SMAR1 latches the absolute position on the first rising edge at SCLK, when CS is at zero (REQ/LATCH). Because SMAR1 can output the sensor data (SD) immediately, the Master can transmit the **SDAD transmission command** directly. The sensor data shift register (the size of which is 8 to 40 bits in multiples of 8) is switched and clocked out between MOSI and MISO.

If invalid data is sampled in the shift register, the ERROR bit is set in the SPI STATUS byte (see the table in the **REGISTER status / data command** on page 45) and the output data bytes are set to zero.

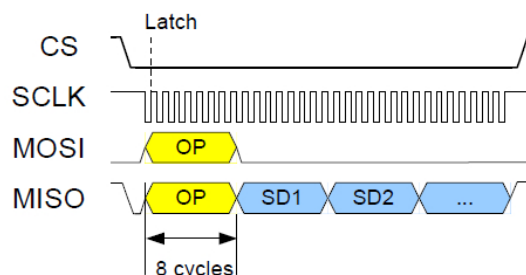


Figure 12 - SDAD transmission: read SD

SDAD status command

If the Master does not know the processing time of the connected Slaves, it can request sensor data using the **SDAD status command**. The command causes:

1. all Slaves are activated via PACTIVE to switch their SVALID register between MOSI and MISO;
2. the next request for sensor data started with the first rising edge at SCLK of the next SPI communication is ignored by the Slave.

The end of conversion is signalled by SVALID (SV). Using this command, the Master can poll to the end of conversion. The sensor data is read out via the **SDAD transmission command**.

SVALID (SV)	
Code	Description
0	Sensor data not valid
1	Sensor data valid

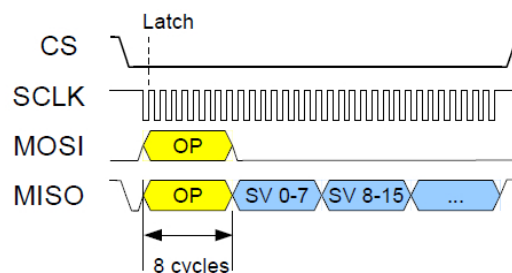


Figure 13 - SDAD status

Figure 14 shows the interaction of the two **SDAD status commands** and **SDAD transmission commands**. It is not necessary to start each sensor data communication with the **SDAD status command** (1). SMAR1 has no processing time and can therefore directly output valid sensor data. For this reason the command sequence can start with **SDAD transmission command** (2). Following this, the **REGISTER status / data command** should be executed to detect an unsuccessful SPI communication.

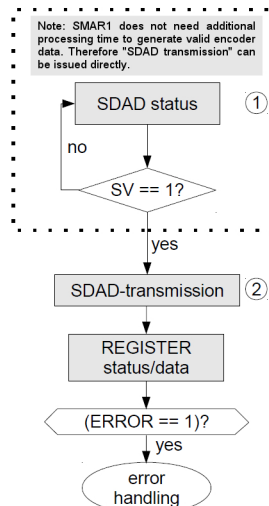


Figure 14 - Example sequence of the commands SDAD Status / SDAD transmission

Read REGISTER (single) command

This command enables register data to be read out from the Slave byte by byte. The Master transmits the **Read REGISTER (single) command** first and then the address ADR. The Slave immediately outputs the command and address at MISO.

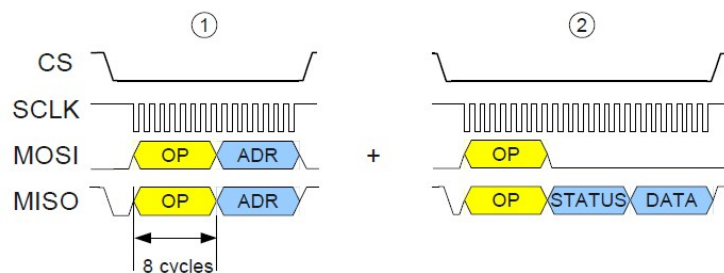


Figure 15 - Read REGISTER (single); set the read address (1) + command REGISTER status / data to read-out data (2)

Following this, using the **REGISTER status / data command** the Master can poll until the validity of the DATA following the SPI STATUS byte is signalled via SPI STATUS.



NOTE

To know the status of the encoder and whether there are active errors, you must read **registers 76 and 77**. For more information please refer to the "9.3 Status registers – SPI interface" section on page 52.

Write REGISTER (single) command

(not used at the moment)

This command enables data to be written to the Slave byte by byte.

The Master first transmits the **Write REGISTER (single) command** and then address ADR and the data (DATA). The Slave immediately outputs the command, address, and data at MISO.

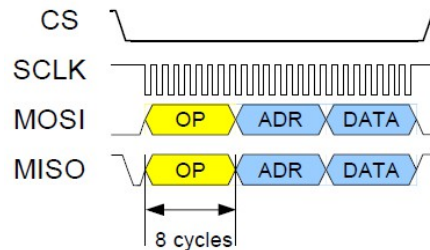


Figure 16 - Write REGISTER (single); set write address and data

Using the **REGISTER status / data command**, the Master can poll to the end of the register communication (signalled via the SPI STATUS byte).

REGISTER status / data command

The **REGISTER status / data command** can be used to request the status of the last register communication and/or the last data transmission. The SPI status byte contains the information summarized in the following table.

Bit	Name	Description of the status report
7	ERROR	Opcode not implemented, sensor data was invalid on readout
6 ... 4	Reserved	
3	DISMISS	Address rejected
2	FAIL	Data request has failed
1	BUSY	Slave is busy because of a previous request
0	VALID	DATA is valid

Logic level: 1 = true; logic level 0 = false

All SPI status bits are updated at each register access.

The exception to the rule is the ERROR bit; this bit indicates whether an error occurred during the last SPI communication with the Slave.

The Master transmits the **REGISTER status / data command**. The Slave immediately passes the opcode on to MISO. Then the Slave transmits the SPI STATUS byte and a DATA byte.

Following the **Read REGISTER (single) command** and the **Write REGISTER (single) command**, the validity of the DATA byte is signalled with the VALID status bit.

The requested data byte is sent back via DATA following the **Read REGISTER (single) command**. Following the **Write REGISTER (single) command**, the data to be written is repeated in the DATA byte. With all other opcodes, the DATA byte is not defined.

Figure 17 shows the interaction of the **Read REGISTER (single) command**, **Write REGISTER (single) command**, and **REGISTER status / data command**.

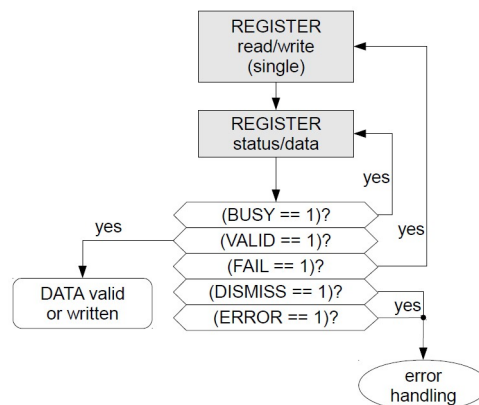
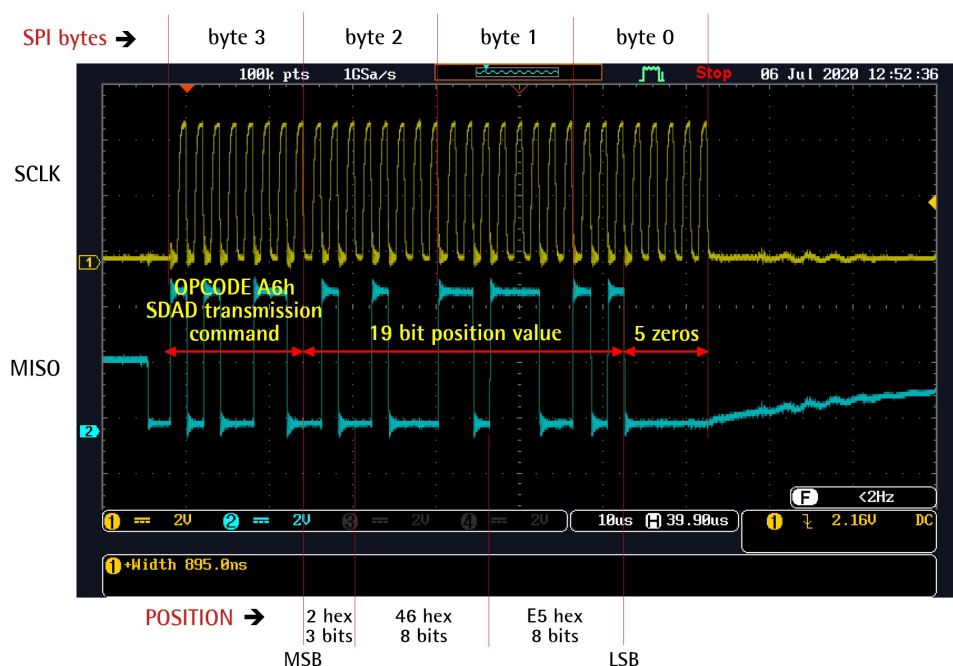


Figure 17 - Example sequence of commands REGISTER read/write and REGISTER status/data

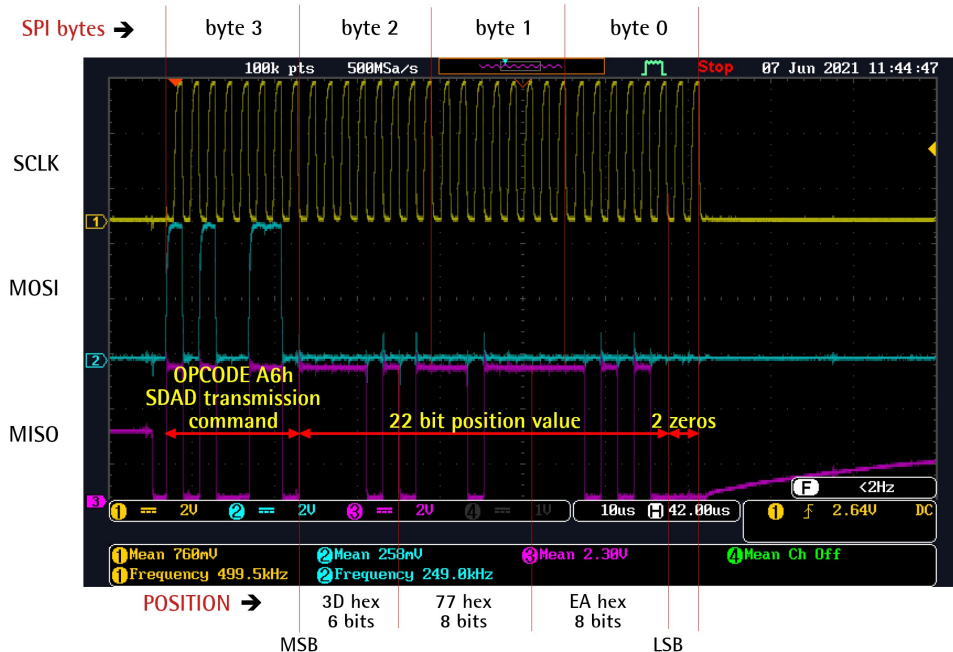
7.2.6 Reading the position value 149,221 dec

Here follows an example of reading the position value 149,221 dec = 2 46E5 hex = 0100100011011100101 bin in a 19 bit singleturn encoder. Send the OPCODE SDAD transmission command (see on page 42).



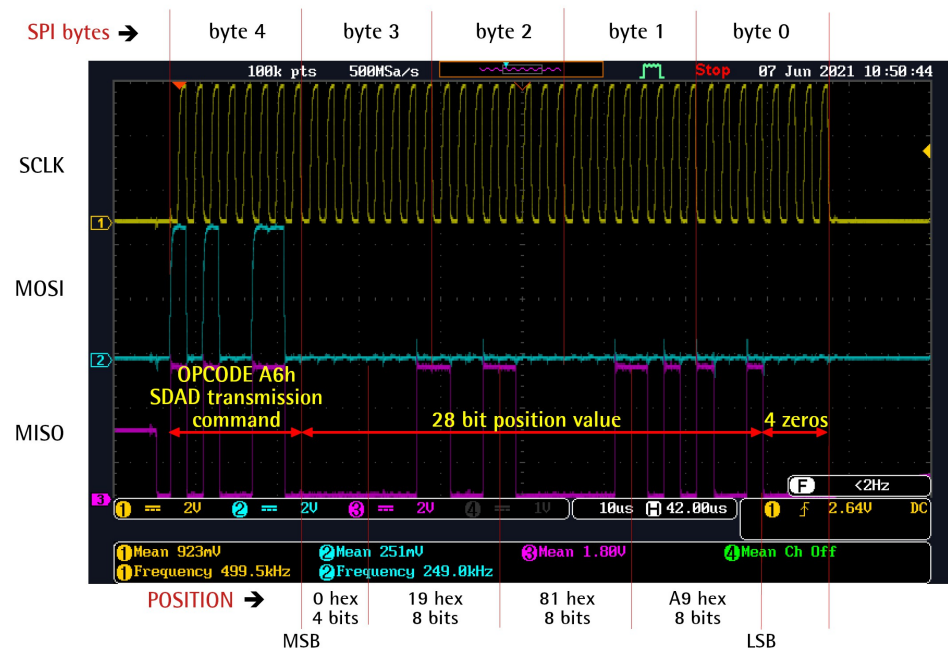
7.2.7 Reading the position value 4,028,394 dec

Here follows an example of reading the position value 4,028,394 dec = 3D 77EA hex = 00111101011101111101010 bin in a 22 bit multiturn encoder (12 bit singleturn resolution + 1024 revolutions). Send the OPCODE **SDAD transmission command** (see on page 42).



7.2.8 Reading the position value 1,671,593 dec

Here follows an example of reading the position value 1,671,593 dec = 19 81A9 hex = 0000000110011000000110101001 bin in a 28 bit multiturn encoder (19 bit singleturn resolution + 512 revolutions). Send the OPCODE **SDAD transmission command** (see on page 42).

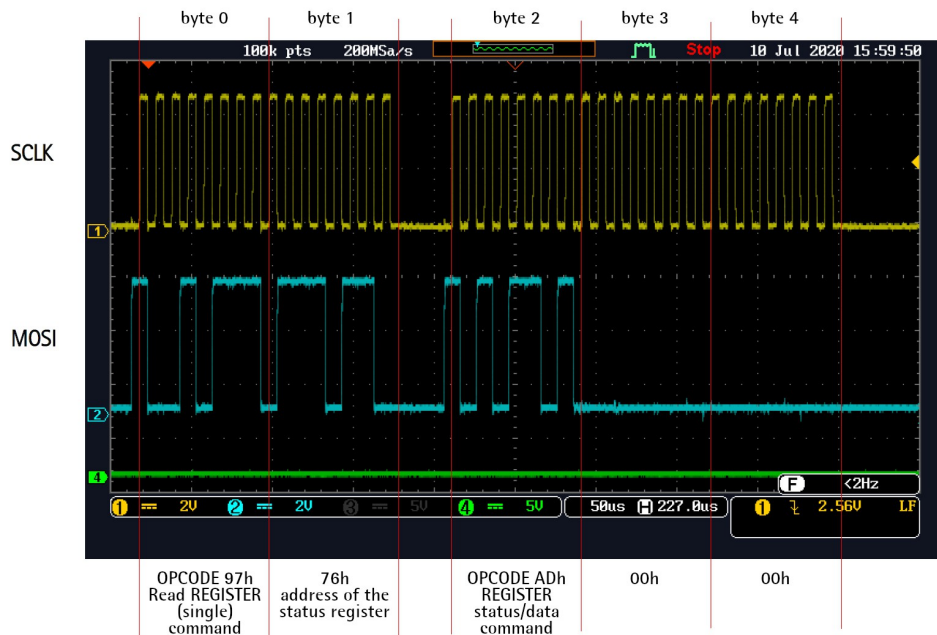


7.2.9 Reading the register 76 hex (Status 0)

Here follows an example of reading the register 76 hex (Status 0), see the "9.3 Status registers – SPI interface" section on page 52.

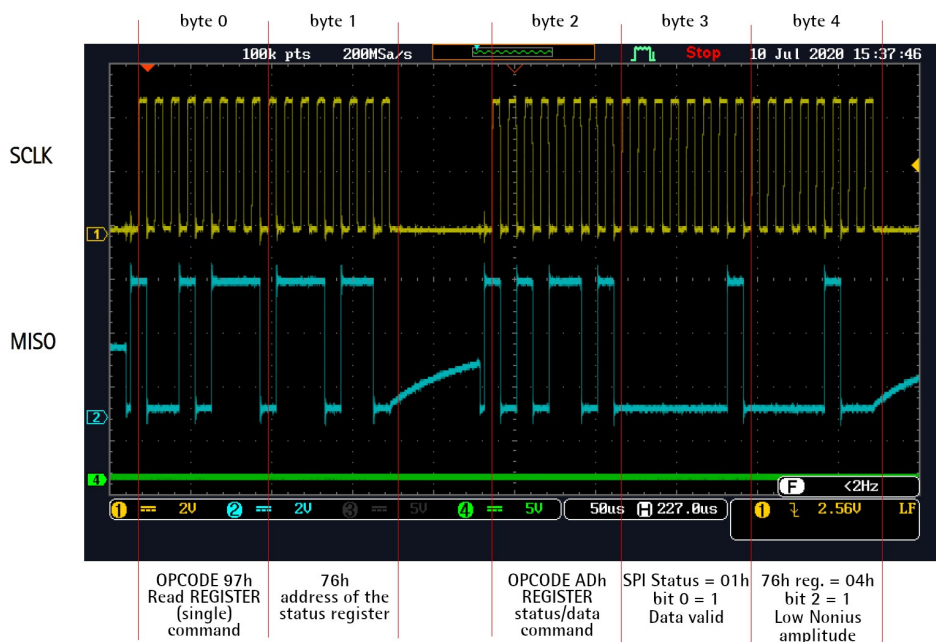
When you need to read a register you must carry out the following operations:

1. Send the OPCODE **Read REGISTER (single) command** (see on page 42) and then send the Address of the register to read;
2. execute another transaction and send the OPCODE **REGISTER status / data command**.

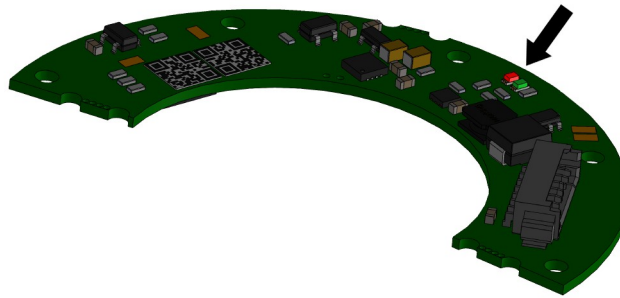


Two bytes are sent back: SPI_STATUS and DATA.

In the Figure below, the SPI Status has bit 0 = 1 (VALID, DATA is valid, see on page 45); and the Register 76h (Status 0) has 1 error (bit 2 = **Signal warning**, signal amplitude too low in the nonius track, see on page 52).



8 - Diagnostic LEDs



Two LEDs are installed in the sensor. They are designed to show visually the operating or fault status of the device, as explained in the following table. They operate alternatively to each other. In the BiSS and SPI interfaces, the operating or fault status of the device is also communicated through the error bit / status register, refer to the "Error" section on page 31 (BiSS interface), and to the "REGISTER status / data command" section on page 45 (SPI interface).

POWER SUPPLY LED 1 + ERROR LED 2	Description
OFF	When both the POWER SUPPLY LED 1 and the ERROR LED 2 are off, the power supply is OFF. The encoder is not supplied.

POWER SUPPLY LED 1 (GREEN)	Description
ON lit green	The power supply is ON. The encoder is supplied and working properly. There are no active errors.

ERROR LED 2 (RED)	Description
ON lit 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 7). • The readhead is not installed properly. • The readhead or the code disc / ring are installed contrariwise. • 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 ERROR LED lights up red and an alarm/warning is triggered through the dedicated nE or nW bits (BiSS interface) or through the **REGISTER status / data command** (SPI interface): 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 14); 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 information is cleared and the RED 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 ERROR diagnostic LED as well as the error bit / status register and are available in the BiSS and SPI interfaces, refer to the "Error" section on page 31 (BiSS interface), and to the "REGISTER status / data command" section on page 45 (SPI interface). Warnings are available in the BiSS interface only and signalled through the warning bit, refer to the "Warning" section on page 32.

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 14); 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 14); 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 14); 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 the power off 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 the power off and then on again. Try the command again. If the error is still active, please contact Lika's After-Sales Service.

9.3 Status registers – SPI interface

Status information can be read out via status bytes at addresses 76 and 77 in the SPI interface.

Register 76

Bit	Warning / Error
0	Signal warning , signal amplitude too low in the master track, see on page 51
1	Signal warning , signal amplitude too high in the master track, see on page 51
2	Signal warning , signal amplitude too low in the nonius track, see on page 51
3	Signal warning , signal amplitude too high in the nonius track, see on page 51
4	Startup error , see on page 51
5 ... 7	Not used

Register 77

Bit	Warning / Error
0	Command execution in progress , see on page 51
1	Frequency warning , signal frequency of internal 12 bit converter too high, see on page 51
2	Frequency warning , signal frequency of AB0 converter too high, see on page 51

3	Consistency error , see on page 52
4 & 5	Not used
6	Communication error , see on page 52
7	Invalid checksum , see on page 52

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 make sure 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 14.
- 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 14.
- The sensor is not installed properly on the scale. See the "3 - Mounting instructions" section on page 14.
- 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.

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Document release	Release date	Description	HW	SW	Interface
1.0	19.12.2025	First issue	-	-	-



Dispose separately

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