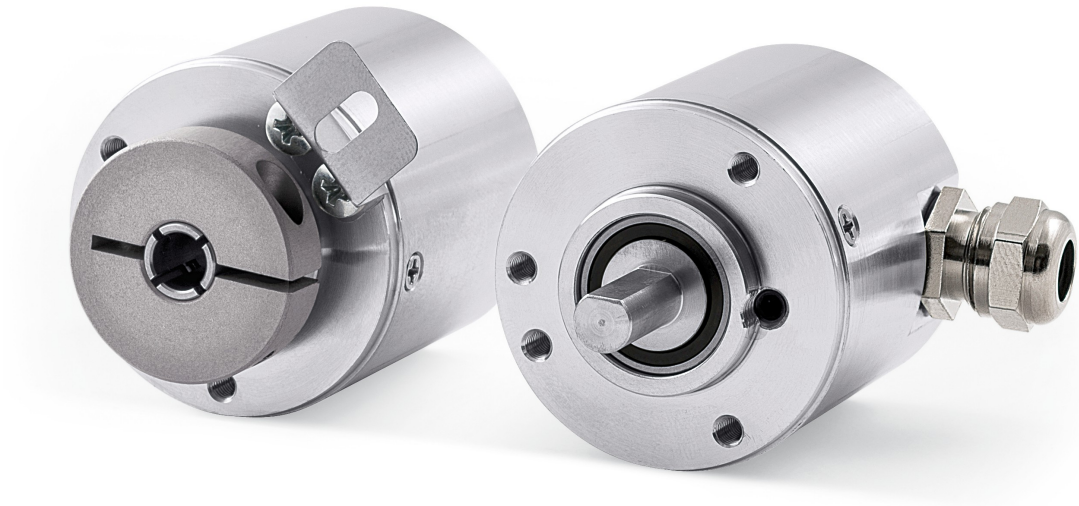
User's guide

AS36

ASC36



Smart encoders & actuators

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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 ORANGE;
- alarms are coloured in RED;
- states are coloured in FUCSIA.

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

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

Preliminary information

This guide is designed to provide the most complete and exhaustive information the operator needs to correctly and safely install and operate the **AS36 and ASC36 series absolute encoders**.

To make it easier to read and understand the text, this guide can be divided into three main sections.
In the first section some general information concerning the safety, the mechanical installation and the electrical connection as well as tips for setting up and running properly and efficiently the unit are provided.
In the second section, entitled **SSI interface**, both general and specific information is given on the SSI interface.
In the third section, entitled **BiSS C-mode interface**, both general and specific information is given on the BiSS C-mode interface. In this section the parameters implemented in the unit are fully described.

1 - Safety summary

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 s.r.l. assumes no liability for the customer's failure to comply with these requirements.

Electrical safety

- Turn off power supply before connecting the device;
- connect according to explanation in section "4 - Electrical connections";
- if not used, connect Zero setting/Preset and Counting direction inputs to 0Vdc;
  - to set the zero/preset, connect Zero setting/Preset input to +Vdc for 100 µs at least, then disconnect +Vdc; normally voltage must be at 0Vdc; zero/preset must be set after Counting direction; we suggest setting the zero/preset when the encoder shaft is not running;
  - Counting direction: CW increasing count (viewed from shaft side): connect to 0Vdc; CCW increasing count: connect to +Vdc;
- in compliance with the 2004/108/EC norm on electromagnetic compatibility, 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 connector housing 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.

Mechanical safety

- Install the device following strictly the information in section "3 - Mounting instructions";
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the encoder;
- do not tool the encoder or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics declared by manufacturer;
- unit with solid shaft: in order to guarantee the maximum reliability over time of the mechanical parts, we recommend a flexible coupling to be installed to connect the encoder and the installation shaft; make sure the misalignment tolerances of the flexible coupling are respected;
- unit with hollow shaft: the encoder can be mounted directly on a shaft whose diameter has to respect the technical characteristics specified in the purchase order and clamped by means of the collar and the fixing plate into which an anti-rotation pin has to be inserted.

2 - Identification

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

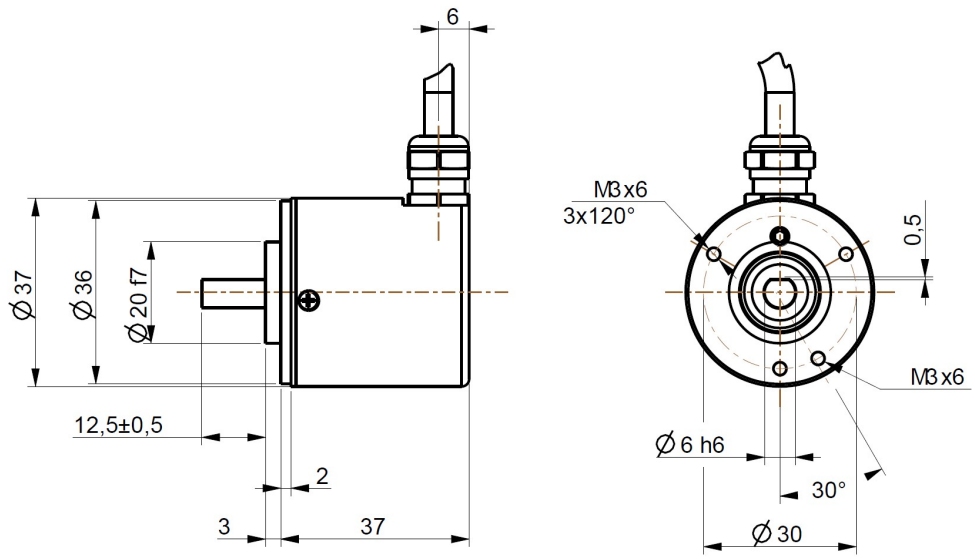


Warning: encoders having order code ending with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical Info).

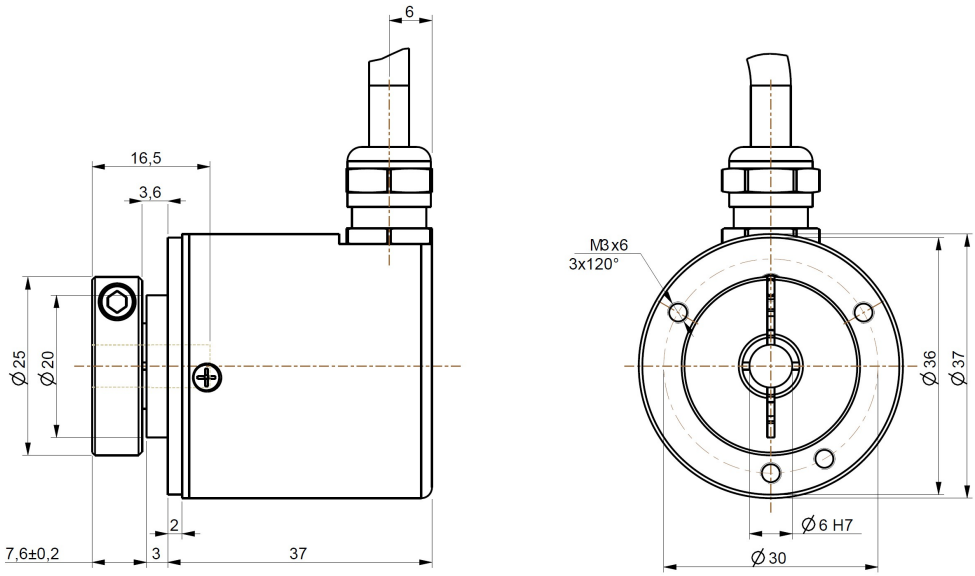
3 - Mounting instructions

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

3.1 AS36 encumbrance sizes

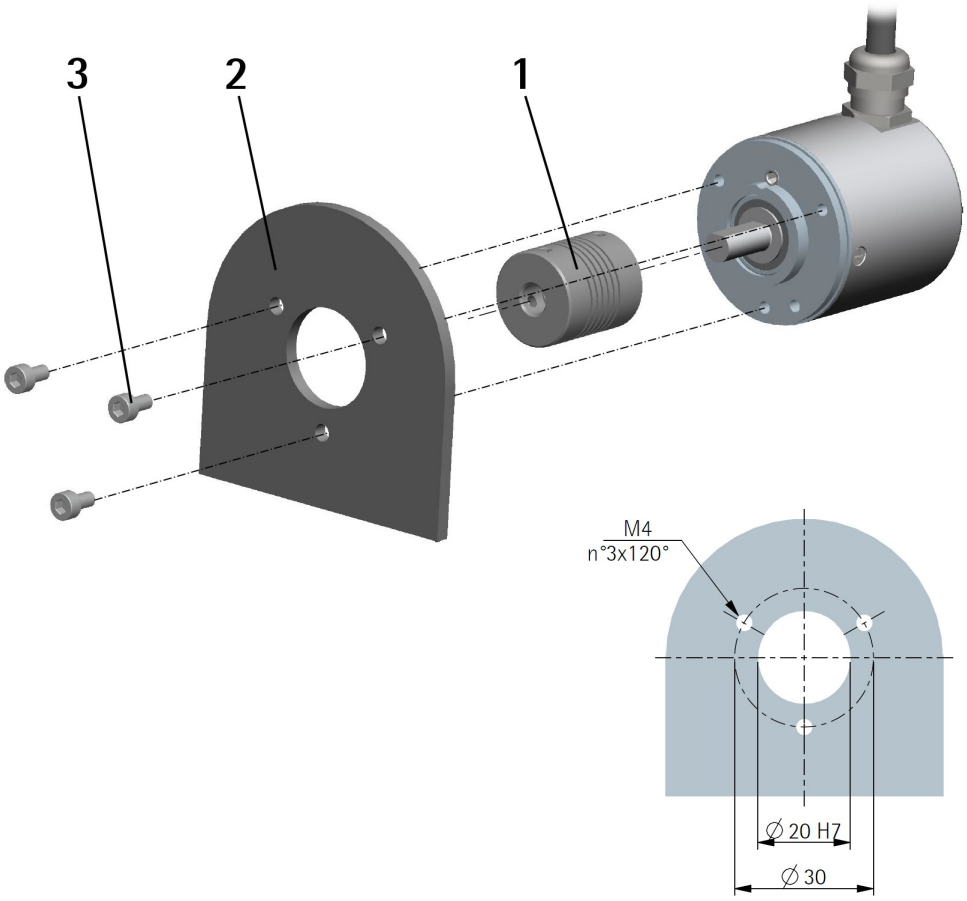


3.2 ASC36 encumbrance sizes



3.3 Solid shaft encoders AS36 model

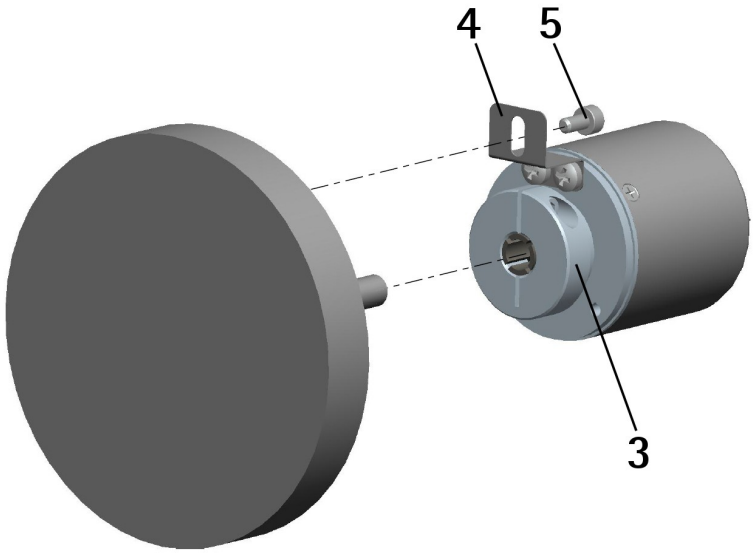
- Mount the flexible coupling **1** on the encoder shaft;
- fix the encoder to the flange **2** by means of screws **3**;
- secure the flange **2** either to the motor or to the mounting support;
- mount the flexible coupling **1** on the motor shaft;
- make sure the alignment tolerances of the flexible coupling **1** are respected.

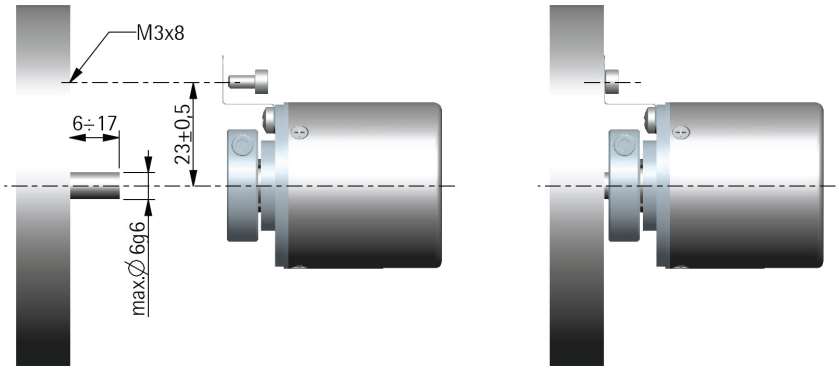


NOTE
In order to guarantee reliability over time of the encoder mechanical parts, we recommend a flexible coupling to be installed between the encoder and the motor shaft.

3.4 Hollow shaft encoder ASC36 model

- Mount the encoder on the motor shaft. Avoid forcing the encoder shaft;
- fasten the fixing plate **4** to the rear of the motor using a M3 cylindrical head screw **5**;
- fix the collar **3** to the encoder shaft by means of the screw.





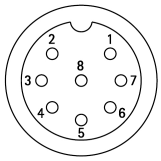
4 - Electrical connections

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.

Function	M12 8-pin	M8 type cable
0Vdc	1	Black
+10Vdc +30Vdc [1]	2	Red
CLOCK IN +	3	Yellow
CLOCK IN -	4	Blue
DATA OUT +	5	Green
DATA OUT -	6	Orange
Zero setting/Preset	7	White
Counting direction	8	Grey
Shield	Case	Shield

1 When the power is switched on, above 3V supply voltage +Vdc must be applied with a slew rate larger than 50V/s.

4.1 M12 connector



M12 8-pin connector
A coding
Male frontal side

4.2 Cable specifications

Model : LIKA HI-FLEX SENSOR CABLE (M8 type cable)
Wires : 6 x 0.14 mm^2 + 2 x 0.22 mm^2 (26/24 AWG)
Shield : tinned copper braid
External diameter : Ø 5.3mm ÷ 5.6mm
Impedance : 148 Ω/km (0.14 mm^2), 90 Ω/km (0.22 mm^2)
Minimum bend radius : Ø x 7.5

4.3 GND connection

Minimize noise by connecting the shield and/or the connector housing 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.

4.4 Zero setting/Preset input

The output position information at a point in the shaft rotation can be set either to 0 (SSI interface) or to a desired value called preset (BiSS C interface; the preset value has to be set next to the registers **Preset**, see on page 24). The Zero setting/Preset input allows the operator to activate the zero/preset value through an input signal sent by a PLC or other controller. To activate the zero setting/preset function, connect the Zero setting/Preset input to +Vdc for 100 µs at least, then disconnect +Vdc; normally voltage must be at 0Vdc; Zero setting/Preset must be set after Counting direction. We suggest setting the zero/preset when the encoder shaft is not running. If not used, connect the Zero setting/Preset input to 0Vdc.



WARNING
In the BiSS C interface model, the Zero setting/Preset input is active only when the **Preset setting enable** register is set to 01; otherwise the hardware function is disabled.



NOTE
In the BiSS interface the preset can be activated also by using the **Save parameters and activate Preset** function of the **Command** register. For detailed information please refer to the **Preset** registers on page 24 and the **Command** register on page 26.

4.5 Counting direction input

It is also known as Complementary input.
Counting direction input allows to set whether the position value output by the transducer increases when the encoder shaft rotates clockwise (CW) or counterclockwise (CCW). If the Counting direction input is connected to 0Vdc, the position value increases when the encoder shaft rotates clockwise; on the contrary, if the Counting direction input is connected to +Vdc, the position value increases when the encoder shaft rotates counterclockwise. CW and CCW rotations are viewed from shaft end. If not used, connect the Counting direction input to 0Vdc.



WARNING
After having set a new counting direction you are required to set a new zero/preset value.

5 - SSI interface

Order codes: ASx36xx/BG-...
ASx36xx/GG-...

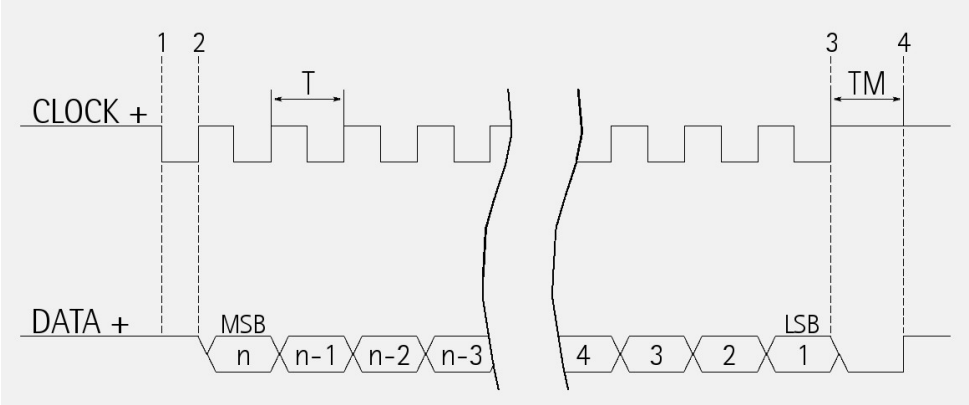
5.1 SSI (Synchronous Serial Interface)

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 insulting 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 Tm monoflop time, having a typical duration of 12 µsec, calculated from the end of the clock signal transmission, the encoder is then ready for the next transmission and therefore the data signal is switched high.
The clock signal has a typical logic level of 5V, the same as the output signal which has customarily a logic level of 5V in compliance with RS-422 standard.
The output code can be either Binary or Gray (see the order code).

5.2 "MSB left aligned" protocol

"MSB left aligned" protocol allows to left align the bits, beginning from MSB (most significant bit) to LSB (least significant bit); MSB is then sent at the first clock cycle. If the number of clock signals is higher than the data bits, then unused bits are forced to logic level low (0) and follow the data word. This protocol can be used in encoders having any resolution.
The number of clocks to be sent to the encoder must equal the number of data bits at least, anyway it can be higher, as stated previously. The great advantage of this protocol over the TREE format or the LSB RIGHT ALIGNED format is that data can be transmitted with a minimum time loss and Tm monoflop time can immediately follow the data bits without any additional clock signal.
The length of the word is variable according to the resolution, as shown in the following table.

Model	Length of the word	Max. number of information
ASx3616/...	16 bits	65,536
ASx3617/...	17 bits	131,072
ASx3619/...	19 bits	524,288

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

Structure of the position information

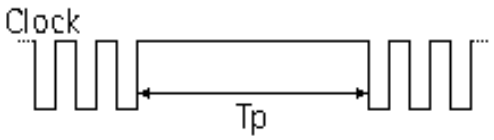
ASx3616/...	**bit**	**16**	**...**	**1**
ASx3617/...	**bit**	**17**	**...**	**1**
ASx3619/...	**bit**	**19**	**...**	**1**
	value	MSB	...	LSB

5.3 Recommended transmission rates

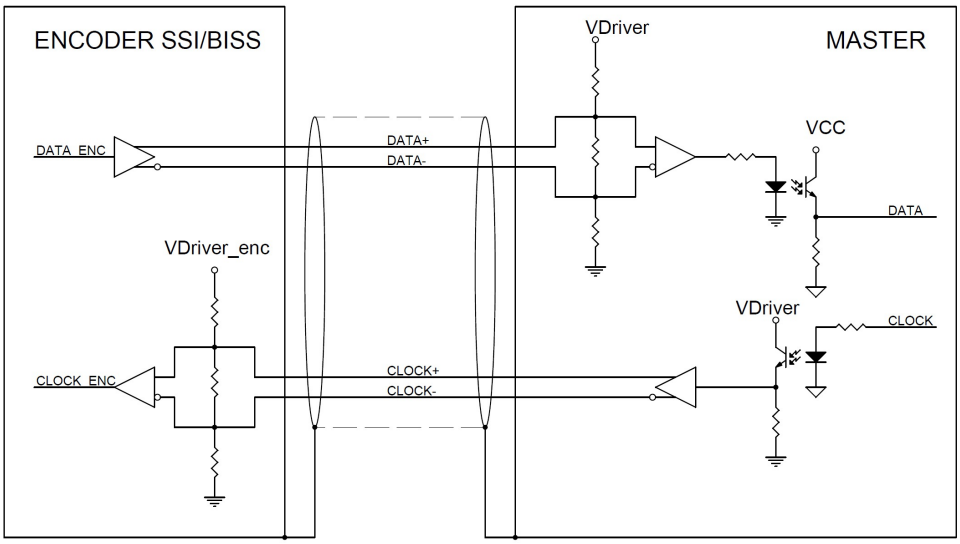
The SSI interface has a frequency of data transmission ranging between 100 kHz and 4 MHz.
CLOCK IN and DATA OUT signals comply with the "EIA standard RS-422".
The SSI clock frequency (baud rate) depends on the length of the cable and must comply with the technical information reported in the following 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 16 µs (Tp > 16 µs).



5.4 Recommended SSI input circuit



6 - BiSS C-mode interface
Order code: ASx36xx/I7-...

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 has to 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.

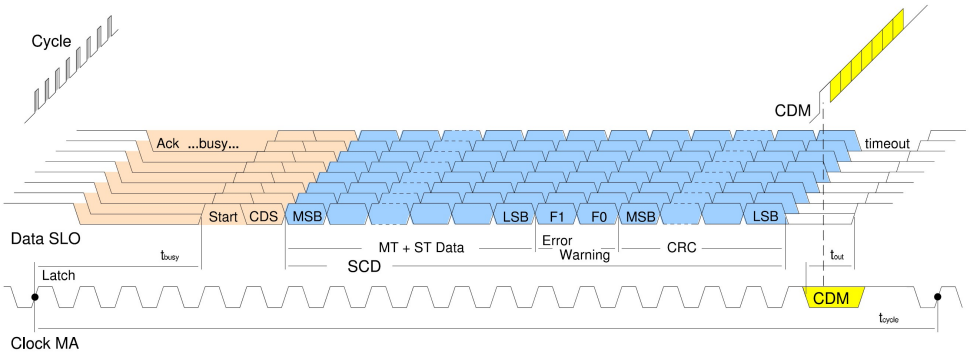
6.1 XML file

BiSS C-mode encoders are supplied with a XML file **idbiss4C69.xml**, it must be installed in your BiSS master device. Download the XML file from www.lika.it > Rotary encoders > Absolute encoders > SSI and BiSS interface.

6.2 Communication

The BiSS C-mode protocol uses two types of data transmission protocols:

- **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 section "6.3 Single Cycle Data SCD" on page 21.
- **Control Data (CD):** transmission of a single bit following the SCD data. It is used to read or write data into the registers of the Slave. For any information refer to the section "6.4 Control Data CD" on page 22.



6.3 Single Cycle Data SCD

SCD structure is different according to the resolution of the ASx36 model encoder.

6.3.1 SCD structure

SCD data has variable length according to the resolution of the encoder. It consists of the following elements: position value (**Position**), 1 error bit nE (**Error**), 1 warning bit nW (**Warning**) and a 6-bit CRC Cyclical Redundancy Checking (**CRC**).

16-bit encoder model (ASx36 16)

bit	23...8	7	6	5...0
function	Position	Error	Warning	CRC

17-bit encoder model (ASx36 17)

bit	24...8	7	6	5...0
function	Position	Error	Warning	CRC

19-bit encoder model (ASx36 19)

bit	26...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 according to the resolution of the encoder.
The transmission starts with MSB (most significant bit) and ends with LSB (less significant bit).

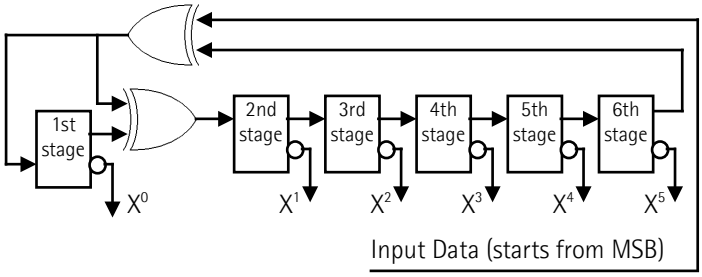
Error
Not used (nE = "1"). It is 1-bit long.

Warning
Not used (nW = "1"). It is 1-bit long.

CRC

Correct transmission control (inverted output). Cyclical Redundancy Checking is an error checking which is the result of a "Redundancy Checking" 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



6.4 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 what register you need 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 from the register.
It is 2-bit long.

DATA

When you need to write in a register (**RW** = "01"), it allows to set the value to be written in the register (transmitted from the Master to the Slave).
When you need to read from a register (**RW** = "10"), it shows the value read in the register (transmitted from the Slave to the Master).
It is 8-bit long.

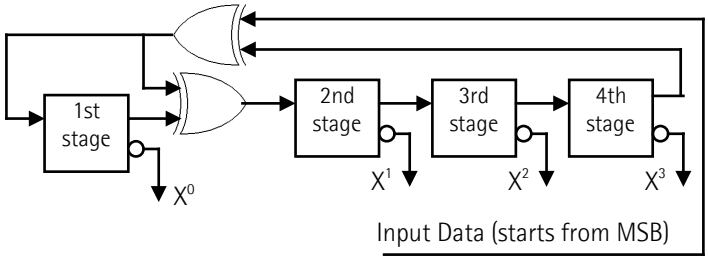
Data bit structure:

bit	7	...	...	0
	MSB	...	...	LSB

CRC

Correct transmission control (inverted output). Cyclical Redundancy Checking is an error checking which is the result of a "Redundancy Checking" 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:



6.5 Implemented registers

Register (hex)	Function
12 ... 14	**Preset**
40	**Preset setting enable**
60 ... 63	**Serial number**
77	**Command**
78 - 79	**Device ID**
7C	**Time-out**
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

[12 ... 14, rw]

WARNING

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

These registers allow the operator to set the Preset value. Preset function is meant to assign a certain value to a desired 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 (or through the Preset input signal, see on section "4.4 Zero setting/Preset input" page 15).

After having entered 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 "01" in the **Command** register) to save the new Preset value without activating it.

Use the **Save parameters and activate Preset** function (set "02" 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 00h**.

NOTE

We suggest setting the preset when the encoder shaft is not running.

Preset register structure:

Register	12	13	14
	MSB	...	LSB
	2^7 - 2^0	2^{15} - 2^8	2^{23}- 2^{16}

NOTE

The Preset value must be expressed in a 19-bit format, thus the Preset value you want to set must be adjusted by multiplying it by the factor $2^{19\text{-nbit}}$, where nbit is the number of bits relating to the resolution of the encoder. See the following example.

PRESET SETTING EXAMPLE

In a 16-bit resolution encoder (2^{16} = 65536 information), you want to set the following **Preset** value = 50.000_{10}.

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.

2. Then multiply the desired **Preset** value (50.000_{10}) by the factor $2^{19-nbit}$, i.e. 2^3 (19 – 16 = 3).
   Thus the **Preset** value to be set will be:
   $50.000_{10} * 2^{19-16} = 400.000_{10}$ = 61A80 hex.

3. Then, before saving the entered data, set the value "00" next to the **Preset setting enable** register.

4. To save the new Preset value, you must use the **Save parameters** function in the **Command** register (set "01" in the **Command** register).

5. Otherwise, to both save and activate the the new Preset value at the same time, you must use the **Save parameters and activate Preset** function in the **Command** register (set "02" in the **Command** register).

Function	ADDR	DATA Tx
Preset setting enable	40	01
Writing in the Preset register	12	80
	13	1A
	14	06
Preset setting enable	40	00
Save parameters function in the **Command** register	77	01
or		
Save parameters and activate Preset function in the **Command** register	77	02

Preset setting enable

[40, wo]

It allows the operator to enable the setting of the **Preset** registers. You are allowed to set a new preset value only after having entered the value "01" next to this **Preset setting enable** register. As soon as you have entered the desired preset value, you must set the value "00" next to this **Preset setting enable** register and then save data.

Serial number

[60 ... 63, ro]

These registers contain the serial number of the device expressed in hexadecimal notation.
Register 60: year of production.
Register 61: week of production.
Registers 62 and 63: serial number in ascending order.

Command

[77, wo]

Value	Function
01	**Save parameters**
02	**Save parameters and activate Preset**

After having set a new value in any register use the **Save parameters** function in the **Command** register to save the new value. Set "01" in the **Command** register.
After having set a new value in any register 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 "02" in the **Command** register.
After having sent 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 – 79, ro]

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

Register	78	79
Hex	41	53
ASCII	A	S

Time-out

[7C, rw]

It allows to set the minimum interval time between two transmission sequences. After having set the desired time-out value, save data using the **Save parameters** function (**Command** register = "01").

Time-out	Bit 7 ... bit 2	Bit 1	Bit 0
16 µs	0 ... 0	0	0
8 µs	0 ... 0	0	1
2 µs (default)	0 ... 0	1	0
1 µs	0 ... 0	1	1



NOTE

You can save the entered time-out value also by using the **Save parameters and activate Preset** function in the **Command** register (**Command** register = "02"). Please note that in this case you both save time-out data and activate the preset function (see on page 24).

Manufacturer ID

[7E – 7F, ro]

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

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

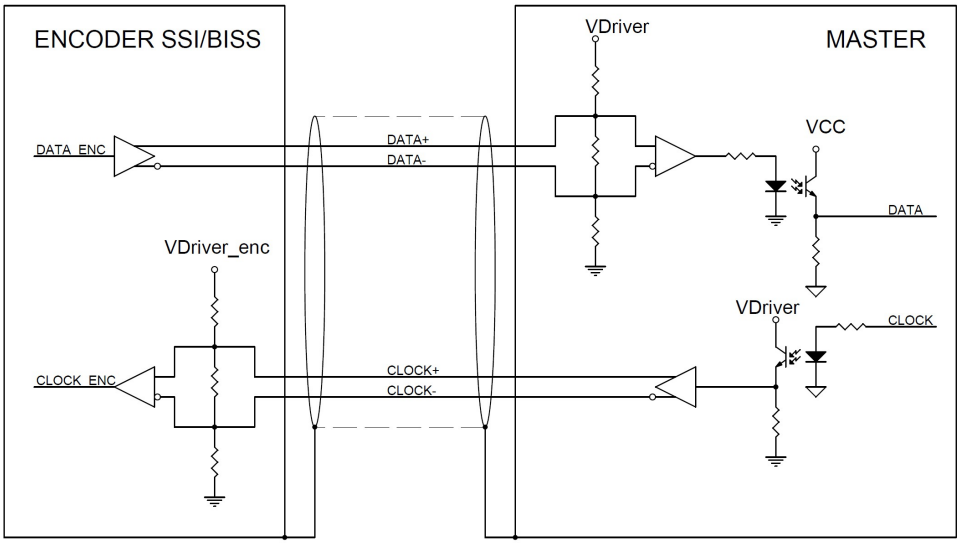
Li = Lika Electronic

6.6 Application notes

Data transmission:

Parameter	Value
Clock Frequency	min 200KHz, max 10MHz
BiSS time-out	It can be set up, see **Time-out** register

6.7 Recommended BiSS input circuit



7 - Default parameters list

BiSS C-mode interface

Parameters list	Default value *		
Preset	00 00 00		
Preset setting enable	00		
Time-out	02		

* All values are expressed in hexadecimal notation.

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Document release	Description
1.0	First issue
1.1	SSI information, general update
1.2	BiSS interface XML installation file available

c UL us	This device is to be supplied by a Class 2 Circuit or Low-Voltage Limited Energy or Energy Source not exceeding 30 Vdc. Refer to the order code for supply voltage rate. Ce dispositif doit être alimenté par un circuit de Classe 2 ou à très basse tension ou bien en appliquant une tension maxi de 30Vcc. Voir le code de commande pour la tension d'alimentation.



Dispose separately

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