Smart encoders & actuators

User's guide

SMAZ

- Cost-effective absolute linear encoder
- 1250 mm / 49.212" measuring length
- Resolution down to 0.1 mm
- SSI and voltage/current analogue interfaces
- Up to IP69K protection rate

Suitable for the following models:

- SMAZ-BG-...
- SMAZ-GG-...
- SMAZ-AI1-...
- SMAZ-AV2-...

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Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters and objects both of Lika device and interface are coloured in **GREEN**;
- alarms are coloured in **RED**;
- states are coloured in **FUCSIA**.

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

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

Preliminary information

This guide is designed to provide the most complete and exhaustive information the operator needs to correctly and safely install and operate the **SMAZ absolute linear encoder with SSI and analogue interfaces**.

This encoder is designed to measure linear displacements in industrial machines and automation systems. The measurement system includes a magnetic tape and a magnetic sensor with conversion electronics. The tape is magnetized with a coded sequence of North-South poles generating a pseudo-random absolute pattern. As the sensor is moved along the magnetic tape, it detects the displacement and yields the absolute position information through the SSI interface (SMAZ-BG..., SMAZ-GG...) or the voltage (SMAZ-AV2...) / current (SMAZ-AI1...) analogue interface or the Modbus interface (SMAZ-MB...). The Modbus sensor is provided with its own technical documentation.
It is mandatory to pair the sensor with the **MTAZ type magnetic scale**. The measuring length is 1250 mm / 49.212", see the order code.

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 **Analogue interface**, both general and specific information is given on the analogue interface.

1 - Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- 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 power supply before connecting the device;
- connect the unit according to the explanation in the "Electrical connections"section;
- connect Zero Setting and Counting direction inputs to 0Vdc, if not used;
  - to zero set the encoder, connect Zero setting input to +Vdc for 100 µs at least, then disconnect +Vdc; normally voltage must be at 0Vdc; zero set must be performed after Counting direction setting; we suggest performing the zero set when the encoder is in stop;
  - Counting direction: increasing count (count up information) = connect to 0Vdc; decreasing count (count down information) = connect to +Vdc;
- in compliance with 2014/30/EU norm on electromagnetic compatibility, following precautions must be taken:
  - before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise; install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;
  - minimize noise by connecting the shield and/or the connector housing and/or the sensor to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device

side and on user's side. The best solution to minimize the interference must be carried out by the user;
- do not stretch the cable; do not pull or carry by cable; do not use the cable as a handle.

1.3 Mechanical safety

- Install the device following strictly the information in the "3 - Mounting instructions" section on page 9;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit;
- delicate electronic equipment: handle with care; do not subject the device to knocks or shocks;
- protect the unit against acid solutions or chemicals that may damage it;
- respect the environmental characteristics of the product;
- we suggest installing the unit providing protection means against waste, especially swarf as turnings, chips, or filings; should this not be possible, please make sure that adequate cleaning measures (as for instance brushes, scrapers, jets of compressed air, etc.) are in place in order to prevent the sensor and the magnetic scale from jamming.

2 - Identification

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

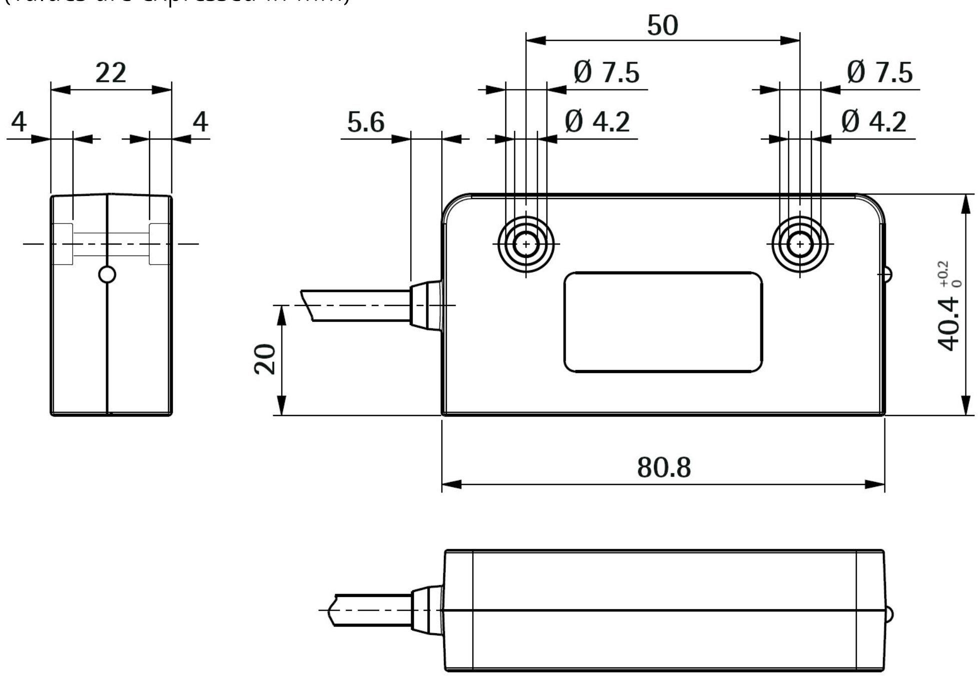
Warning: devices having order code ending with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical Info).

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 Overall dimensions

(values are expressed in mm)



3.2 Magnetic tape

The sensor has to be paired with the **MTAZ type magnetic tape** only. For detailed information on the MTAZ type tape and how to mount it properly, please refer to the specific technical documentation.
Install the unit providing protection means against waste, especially swarf as turnings, chips or filings; should this not be possible, please make sure that adequate cleaning measures (as for instance brushes, scrapers, jets of compressed air, etc.) are in place in order to prevent the sensor and the magnetic scale from jamming.
Make sure the mechanical installation meets the system's requirements of distance, planarity and parallelism between the sensor and the scale indicated in Figure 2 all along the whole measuring length.
MTAZ magnetic scale can be provided with a cover strip to protect its magnetic surface (see the order code).
Figure 1 shows how the sensor and the scale must be installed; the arrow indicates the **standard counting direction** (increasing count when the sensor

moves in the direction indicated by the arrow; further information in the "4.1.6 Counting direction input" section on page 15).

WARNING
The system cannot operate if mounted otherwise than illustrated in Figure 1.

3.3 Mounting the sensor

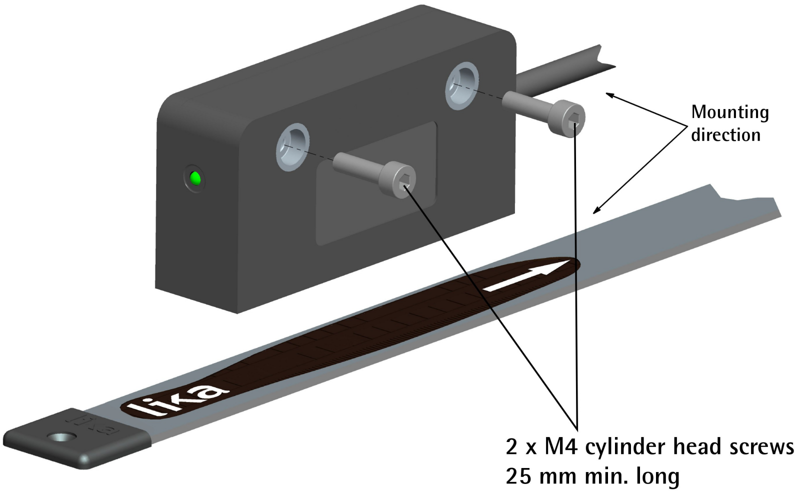


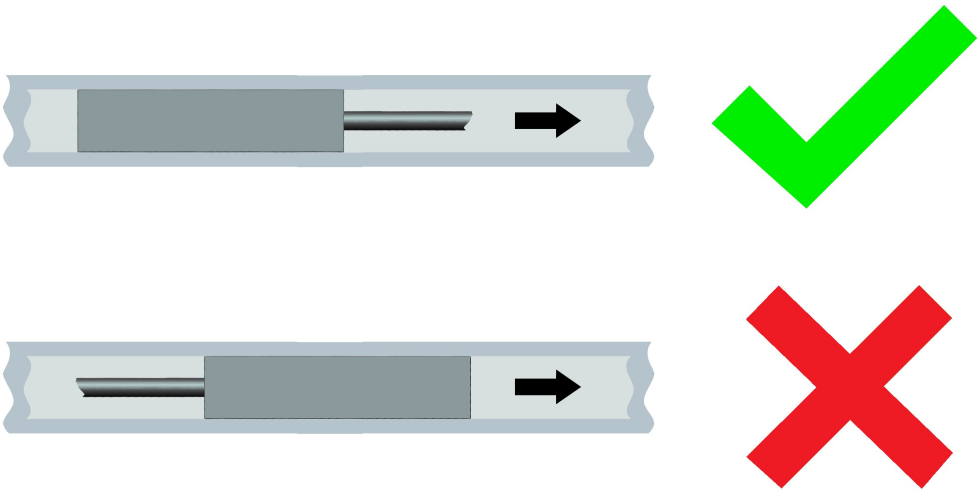
Figure 1

Make sure the mechanical installation complies with the system requirements concerning distance, planarity and parallelism between the sensor and the scale as shown in Figure 2. Avoid contact between the parts. Sensor is fixed by means of **two M4 25 mm min. long cylinder head screws** inserted in the provided holes. Recommended **minimum bend radius** of the cable: **R ≥ 27 mm** (static installation); **R ≥ 41 mm** (dynamic installation). Install the sensor and the magnetic scale as shown in the Figure. The system does not operate if mounted otherwise than illustrated in the Figure. The arrow is intended to indicate the standard counting direction (count up information).
Please note that the MTAZ magnetic scale can be provided with a cover strip to protect its magnetic surface (see the order code). Therefore the distance between the sensor and the magnetic scale is different whether the cover strip is applied.

The distance D (see Figure 2) between the centre of the screw fixing holes and the MTAZ magnetic scale has to be as follows:

without cover strip	with cover strip
31.7 mm ÷ 33.2 mm (1.248" ÷ 1.307")	31.3 mm ÷ 32.8 mm (1.232" ÷ 1.291")

For better operation the suggested distance D is 32.2 mm (1.267").



WARNING
Make sure the mechanical installation complies with the system requirements concerning distance, planarity and parallelism between the sensor and the scale as shown in Figure 2 all along the whole measuring length.

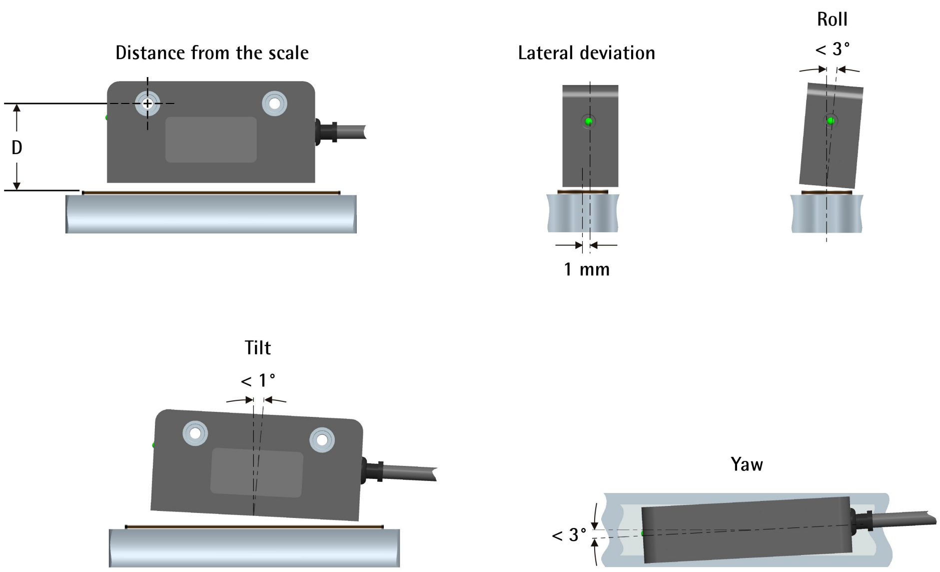


Figure 2

WARNING
After having installed the sensor on the magnetic scale a zero setting operation is compulsorily required. The zero setting operation is further required every time either the sensor or the scale is replaced. For any information on the zero setting operation please refer to the "4.1.5 Zero setting input" section on page 14. The Zero setting function is not available for the analogue interface (SMAZ-AI1-..., SMAZ-AV2-...).

3.4 Measuring length

The **maximum length of the tape L** is 1330 mm / 52.362" (for further information refer the order code in the product datasheet). As the sensor area has always to be fully within the limits of the tape magnetic surface, then the **maximum measuring length ML** is the maximum length of the tape minus the length of the sensor head = L – 80 mm / 3.149" (1250 mm / 49.212").

3.5 Standard counting direction

The positive counting direction (count up information) is achieved when the sensor moves on the tape according to the white arrow shown in Figure 1. For further information see the "4.1.6 Counting direction input" section on page 15.

4 - SSI interface

Order codes: SMAZ-BG-...
SMAZ-GG-...

4.1 SSI interface electrical connections

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

WARNING
If wires of unused signals come in contact, irreparable damage could be caused to the device. Please insulate them singularly.

Function	M8 cable	M12 8-pin
0Vdc	Black	1
+10Vdc +30Vdc	Red	2
Clock IN +	Yellow	3
Clock IN -	Blue	4
Data OUT +	Green	5
Data OUT -	Orange	6
Zero setting	White	7
Counting direction	Grey	8
Shield	Shield	Case

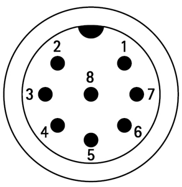
4.1.1 M8 cable specifications

Model : LIKA HI-FLEX sensor cable type M8
Wires : 2 x 0.25 mm² + 6 x 0.14 mm² (24/26 AWG)
Jacket : Polyurethane (PUR, ether base)
Shield : tinned copper braid, coverage ≥ 85%
Outer diameter : 5.5 mm ±0.2 mm (0.216" ±0.008")
Min. bend radius : Ø x 5 (static); Ø x 7.5 (dynamic)
Work temperature : -50°C +90°C (-58°F +194°F) – static installation
-40°C +90°C (-40°F +194°F) – dynamic installation
Conductor resistance : ≤ 84.7 Ω/km / ≤ 152 Ω/km

4.1.2 M12 8-pin connector

Male, frontal side

A coding



4.1.3 Connection of the shield

For signals transmission always use shielded cables. The cable shielding must be connected properly to the metal ring nut of the connector in order to ensure a good earthing through the frame of the device.

4.1.4 Ground connection

Minimize noise by connecting the shield and/or the connector housing and/or the sensor to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

4.1.5 Zero setting input

The output value can be set to zero (reset) via an external signal issued by a PLC or other controller device. When the internal microprocessor receives the signal it resets the output information. This can be very useful for setting the zero position of both the sensor and the machine. To zero set the encoder position, connect Zero setting input to +Vdc for 100 µs at least, then disconnect +Vdc; normally voltage must be at 0Vdc; zero set must be performed after Counting direction setting; we suggest performing the zero set when the encoder is in stop. Connect to 0Vdc if not used.

WARNING

It is necessary to zero set the sensor after having set a new counting direction.

WARNING

After having installed the sensor on the magnetic tape a zero setting operation is compulsorily required. The zero setting operation is further required every time either the sensor or the tape is replaced.

NOTE

Please note that, after setting the zero point, the positive counting will be from 0 towards the max. value (see the table below); if you move the axis before the 0 point, the detected value will be the max. number of information – 1 down.

EXAMPLE

Let's suppose we are using the SMAZ-GG-100-... model, it is paired with the MTAZ-1330-... profile. The system is able to provide 12,500 information for the overall travel, see the table below). If you set the 0 along the path, starting from the 0 point, the output values will be from 0 towards the max. number of information (12,500) when the measuring system moves according to the arrow shown in Figure 1; when the system moves back, the value immediately after 0 will be the max. value (16,383).

...	**16,382**	**16,383**	**0**	**1**	**2**	**...**	**12,500**

Model	Length of the word (max. value)	Max. number of information
SMAZ-xx-1250-... + MTAZ-1330	10 bits (1,023)	1,000
SMAZ-xx-1000-... + MTAZ-1330	11 bits (2,047)	1,250
SMAZ-xx-500-... + MTAZ-1330	12 bits (4,095)	2,500
SMAZ-xx-100-... + MTAZ-1330	14 bits (16,383)	12,500

4.1.6 Counting direction input

The **standard counting direction** is to be intended with sensor moving as indicated by the arrow in Figure 1. The counting direction circuit allows to reverse the counting direction. In other words it allows the count up when the sensor moves in reverse of the standard direction, i.e. in the opposite direction to the one shown by the arrow in Figure 1. Connect the Counting direction input to 0Vdc if not used. Connect the counting direction input to 0Vdc to have an increasing count when the sensor moves as indicated by the arrow in Figure 1; connect the counting direction input to +Vdc to have an increasing count when the sensor moves in reverse of the standard direction, i.e. in the opposite direction to the one shown by the arrow in Figure 1.

WARNING

After having set the new counting direction it is necessary to zero set the sensor.

4.2 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.

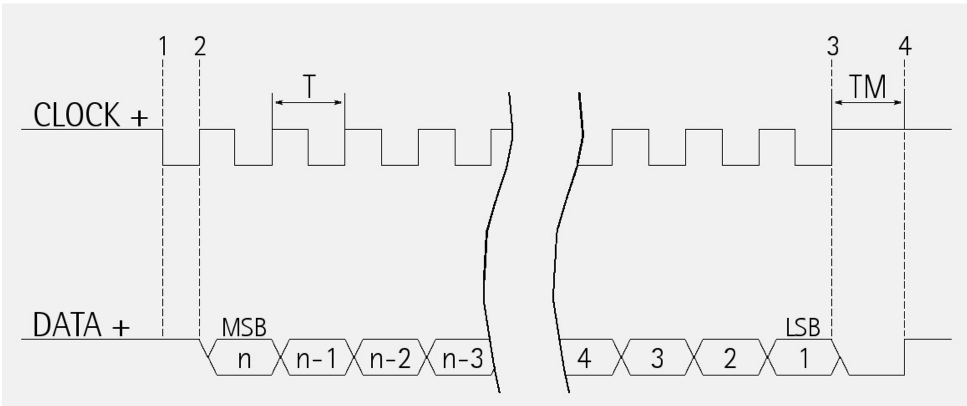
The main advantages in comparison with parallel or asynchronous data transmissions are:

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

4.2.1 MSB left aligned protocol

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

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

Model	Resolution	Length of the word	Max. number of information *
SMAZ-BG-1250-... SMAZ-GG-1250-...	1.25 mm	10 bits	1,000
SMAZ-BG-1000-... SMAZ-GG-1000-...	1.0 mm	11 bits	1,250
SMAZ-BG-500-... SMAZ-GG-500-...	0.5 mm	12 bits	2,500
SMAZ-BG-100-... SMAZ-GG-100-...	0.1 mm	14 bits	12,500

* When the profile is 1330 mm / 52.362" long. See also the table on page 15

The output code of the sensor can be GRAY or BINARY (see the order code).
The length of the measuring step is equal to the resolution.

Structure of the transmitted position value:

SMAZ-xx-1250-...	bit	10	...	1
SMAZ-xx-1000-...	bit	11	...	1
SMAZ-xx-500-...	bit	12	...	1
SMAZ-xx-100-...	bit	14	...	1
	value	MSB	...	LSB

* When the profile is 1330 mm / 52.362" long. See also the table on page 15

WARNING
The position value issued by the sensor is expressed in pulses; to convert the pulses into a metric measuring unit you must multiply the number of detected pulses by the resolution.

EXAMPLE 1
SMAZ-BG-500-...
resolution: 500 µm = 0.5 mm
detected pulses = 123
position value = 123 * 500 = 61,500 µm = 61.5 mm

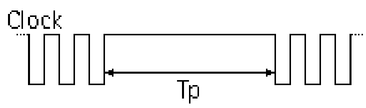
EXAMPLE 2
SMAZ-BG-100-...
resolution: 100 µm = 0.1 mm
detected pulses = 1569
position value = 1569 * 100 = 156,900 µm = 156.9 mm

4.2.2 Recommended transmission rates

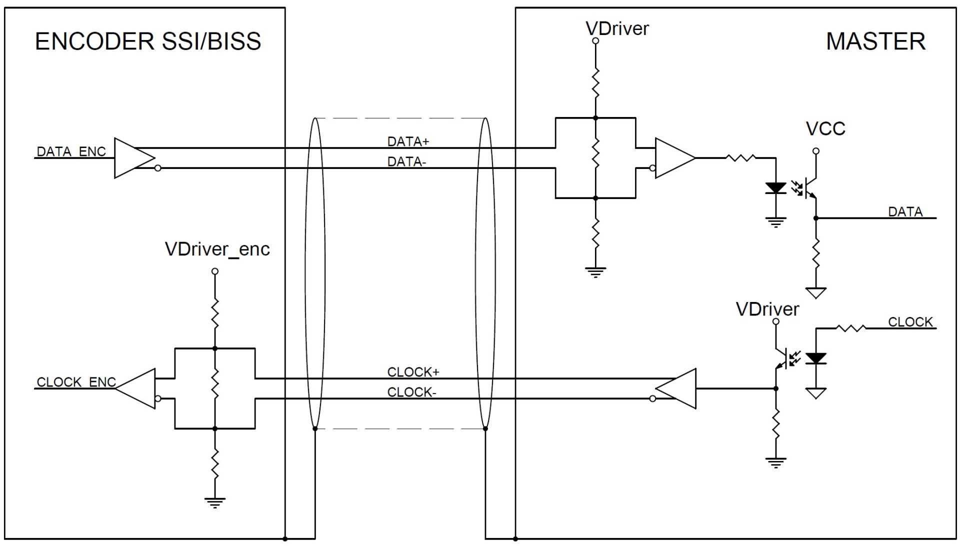
The SSI interface has a frequency of data transmission ranging between 100 kHz and 1.5 MHz.
The CLOCK signals and the DATA signals comply with the "EIA standard RS-422".
The clock frequency (baud rate) depends on the length of the cable and must comply with the technical information reported in the following table:

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

The time interval between two Clock sequence transmissions must be at least 16 µs (Tp = pause time > 16 µs).



4.3 Recommended SSI circuit



5 - Analogue interface

Order codes: SMAZ-AI1-... (4-20 mA)
SMAZ-AV2-... (0-10 V)

5.1 Analogue interface electrical connections

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

WARNING
If wires of unused signals come in contact, irreparable damage could be caused to the device. Please insulate them singularly.

Functions		M8 cable	M12 8-pin
AI1	AV2		
0Vdc Power Supply		Black	1
+13Vdc +30Vdc		Red	2
0Vdc analogue		Yellow	3
START ▶		Blue	4
+Iout	+Vout	Green	5
STOP ■		Orange	6
n. c.		White	7
FAULT	n. c.	Grey	8
Shield		Shield	Case

n. c. = not connected

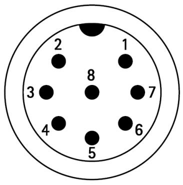
5.1.1 M8 cable specifications

Model : LIKA HI-FLEX sensor cable type M8
Wires : 2 x 0.25 mm^2 + 6 x 0.14 mm^2 (24/26 AWG)
Jacket : Polyurethane (PUR, ether base)
Shield : tinned copper braid, coverage ≥ 85%
Outer diameter : 5.5 mm ±0.2 mm (0.216" ±0.008")
Min. bend radius : Ø x 5 (static); Ø x 7.5 (dynamic)
Work temperature : -50°C +90°C (-58°F +194°F) – static installation
-40°C +90°C (-40°F +194°F) – dynamic installation
Conductor resistance : ≤ 84.7 Ω/km / ≤ 152 Ω/km

5.1.2 M12 8-pin connector

Male, frontal side

A coding



5.1.3 Connection of the shield

For signals transmission always use shielded cables. The cable shielding must be connected properly to the metal ring nut of the connector in order to ensure a good earthing through the frame of the device.

5.1.4 Ground connection

Minimize noise by connecting the shield and/or the connector housing and/or the sensor to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

5.2 Signals description

5.2.1 0Vdc

0Vdc Power Supply and 0Vdc analogue are internally connected.

5.2.2 START ▶ input

It is used to execute the TEACH-IN procedure. It is active at HIGH logic level (voltage greater than 10V must be applied). For any further information on using the **START ▶** and **STOP ■** inputs refer to the "5.3 TEACH-IN procedure" section on page 23.

5.2.3 +Iout current analogue output

+Iout provides the current analogue signal.

AI1 output range is: min. quote = 4 mA, max. quote = 20 mA

The increment at each step is as follows:

10-bit DAC 4-20 mA: 16000/1024 = 15.625 µA

5.2.4 +Vout voltage analogue output

+Vout provides the voltage analogue signal.

AV2 output range is: min. quote = 0 V, max. quote = 10 V

The increment at each step is as follows:

10-bit DAC 0-10 V: 10000/1024 = 9.765 mV

5.2.5 STOP ■ input

It is used to execute the TEACH-IN procedure. It is active at HIGH logic level (voltage greater than 10V must be applied). For any further information on using the **START ▶** and **STOP ■** inputs refer to the "5.3 TEACH-IN procedure" section on page 23.

5.2.6 Fault output

This Fault output is only available for AI1 current analogue output and is intended to signal an error condition such as a circuit break.
To connect the Fault signal please refer to the examples in the sections hereafter: "5.2.6.1 Fault output connected to a PLC input" and "5.2.6.2 Fault output connected to a relay".

Please pay attention to the value of the R2 resistor (Figure 3 and Figure 4).
Imax = 50 mA
R1 = 47 Ω

$$R2 = \left(\frac{Vdc}{I}\right) - R1$$

No encoder error = transistor ON (conducting)
Encoder error = transistor OFF (open)

5.2.6.1 Fault output connected to a PLC input

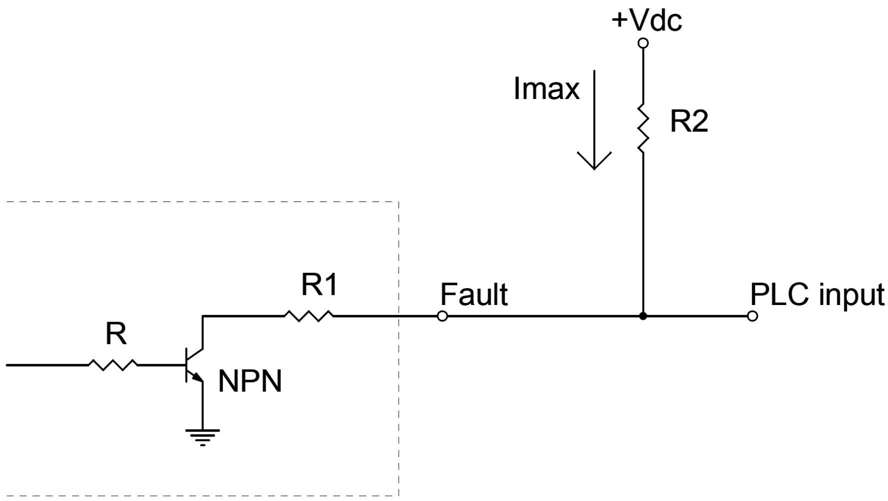


Figure 3

No encoder error = PLC input Low (0 VDC)
Encoder error = PLC input High (+VDC)

EXAMPLE
Vdc = +24 V
R1 = 47 Ω

$$R2 = \left(\frac{Vdc}{I}\right) - R1$$

I = 4.7 mA
R2 = 5 kΩ

5.2.6.2 Fault output connected to a relay

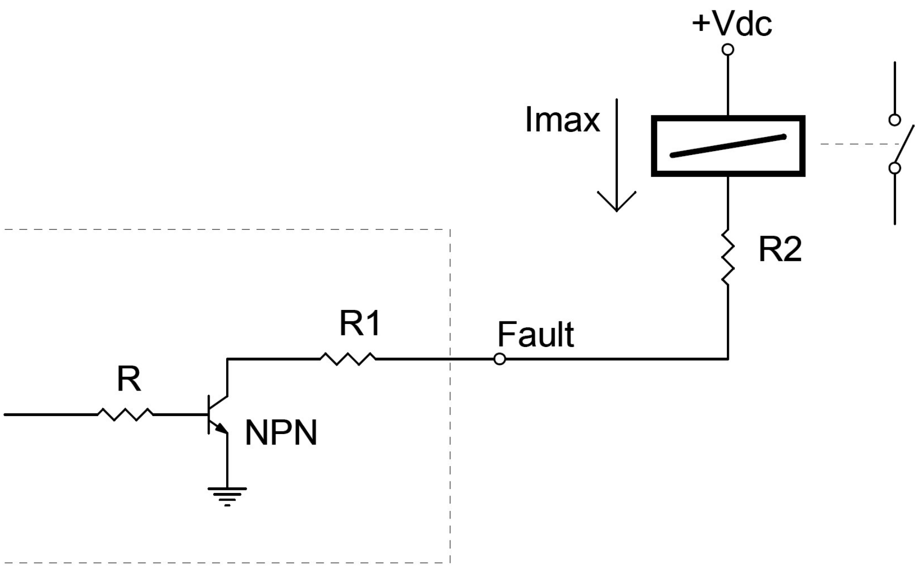


Figure 4

No encoder error = coil energized
Encoder error = coil de-energized

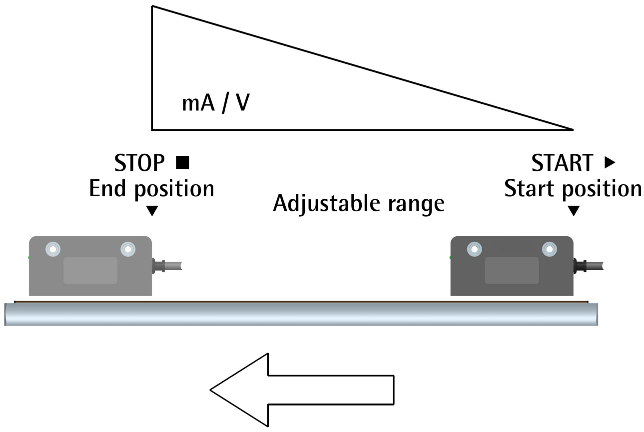
EXAMPLE
Vdc = +24 V
R1 = 47 Ω

$$R2 = \left(\frac{Vdc}{I}\right) - R1$$

I = 30 mA (current needed to energize a small relay coil)
R2 = 750 Ω

5.3 TEACH-IN procedure

The TEACH-IN function allows to easily and intuitively set by means of two external signals both the furthermost points in the travel of an axis, then the available analogue range will be scaled automatically within the set limits.

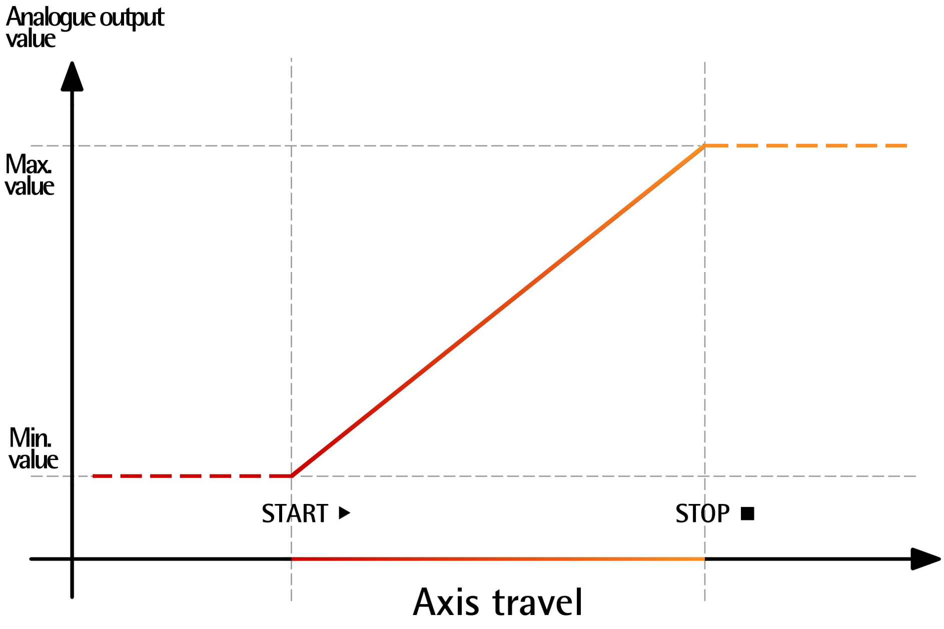


It allows to programme the encoder by considering directly the physical travel of the application you need to measure and control.

The travel is defined in either an ascending or a descending ramp (see the "5.3.2 Ascending and descending ramp" section on page 25):

- with ascending ramp the initial position of the travel is the minimum value of the output range and the final position is the maximum value of the output range;
- with descending ramp the initial position of the travel is the maximum value of the output range and the final position is the minimum value of the output range;
- beyond the travel limits the current / voltage signal level is kept at the minimum / maximum value of the selected range (4-20 mA for SMAZ-AI1-...; 0-10 V for SMAZ-AV2-...).

The set output range (the overall information to be output) is defined over the travel of the specific application and is comprised between the ends of the axis: the origin of the axis, i.e. the point where you activate either the **START** ▶ or the **STOP** ■ input, and the end of the axis, i.e. the point where you activate the **START** ▶ or the **STOP** ■ input (see the "5.3.2 Ascending and descending ramp" section on page 25). For the positions beyond the travel limits the current / voltage signal level will be kept at the minimum / maximum value of the selected range. With ascending ramp (see the Figure below), before the initial position of the travel the encoder will provide the minimum current / voltage signal level of the output range (4 mA for SMAZ-AI1-...; 0 V for SMAZ-AV2-...); after the last position of the travel the encoder will provide the maximum current / voltage signal level of the output range (20 mA for SMAZ-AI1-...; 10 V for SMAZ-AV2-...).



On the contrary, with descending ramp, before the initial position of the travel the encoder will provide the maximum current / voltage signal level of the output range (20 mA for SMAZ-AI1-...; 10 V for SMAZ-AV2-...); after the last position of the travel the encoder will provide the minimum current / voltage signal level of the output range (4 mA for SMAZ-AI1-...; 0 V for SMAZ-AV2-...).

So for instance, if you have a SMAZ-AV2-... sensor (its output range is 0-10 V) and you program an ascending ramp, then the encoder will provide a fixed voltage level of 0 V for the positions before the origin of the travel (i.e. the point where you activate the **START ▶** input); a voltage level increasing from 0 V (origin of the travel, position 0) to 10 V (end of the travel) for the 1024 positions of the axis; a fixed voltage level of 10 V for the positions after the last point of the travel (i.e. the point where you activate the **STOP ■** input).

NOTE
For any further information on the **START ▶** and **STOP ■** input signals refer to the section "5.2 Signals description" on page 20.

5.3.1 TEACH-IN procedure

WARNING
It is mandatory to activate the **START ▶** input first and then the **STOP ■** input.

To programme the encoder using the TEACH-IN procedure act as follows. The steps to define a ramp with increasing output values are described hereinafter;

please refer to the following section for information on defining a ramp with decreasing output values.

- Move the axis to the origin of the physical travel of the application you want to measure and control; in other words, move it to the point where the travel starts;
- switch the **START ▶** input to HIGH logic level +Vdc for 3 seconds at least; the LED in the sensor switches off; in this way you set the point where, during normal operation, the encoder will provide the minimum current / voltage signal level available in the output range (4 mA for SMAZ-AI1-...; 0 for SMAZ-AV2-...);
- now move the axis to the end of the physical travel of the application you want to measure and control; in other words, move it to the point where the travel stops;
- switch the **STOP ■** input to HIGH logic level +Vdc for 3 seconds at least; the LED in the sensor switches on again; in this way you set the point where, during normal operation, the encoder will provide the maximum current / voltage signal level available in the output range (20 mA for SMAZ-AI1-...; 10 V for SMAZ-AV2-...).

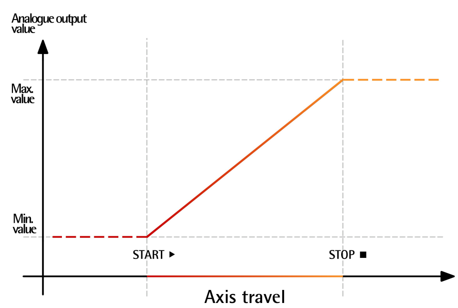
WARNING

If you set a wrong point for the initial position of the travel by activating the **START ▶** input, you have to turn off and then on again the power supply to reset the sensor; then repeat the procedure from the first step.
Otherwise, if you set a wrong point for the final position of the travel by activating the **STOP ■** input (this means that you have already set the initial position of the travel by activating the **START ▶** input), you have to switch the **STOP ■** input to 0Vdc; then move the axis to the right final position and activate the **STOP ■** input.

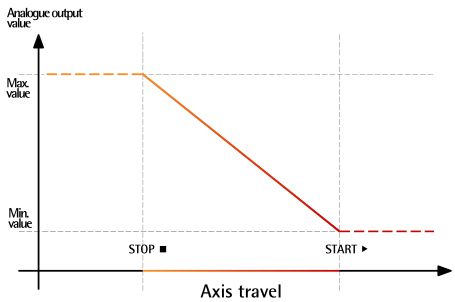
5.3.2 Ascending and descending ramp

NOTE

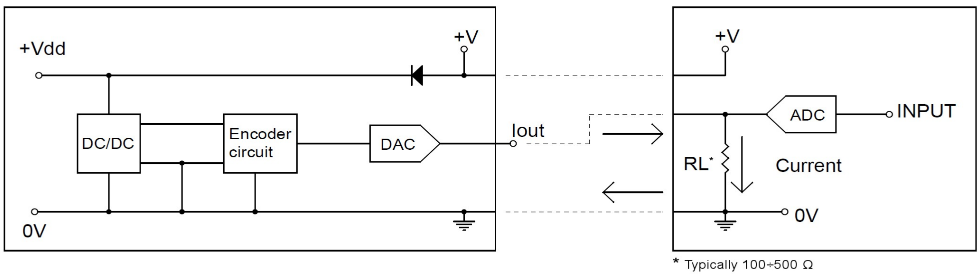
If you activate the **START ▶** input and then move forward the axis according to the direction of the travel before activating the **STOP ■** input, you define an ascending ramp as the one shown in the Figure on the right. The minimum value of the output range precedes the initial point of the ramp (i.e. the beginning of the axis travel); the maximum value of the output range follows the final point of the ramp (i.e. the end limit of the axis travel).



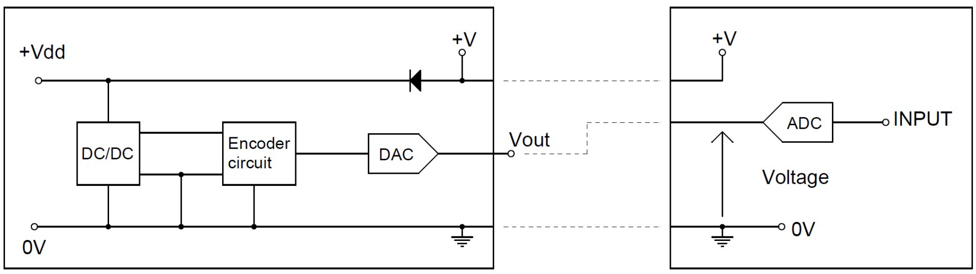
NOTE

On the contrary, if you activate the **START** ▶ input and then move backward the axis in reverse of the standard direction before activating the **STOP** ■ input (in other words you activate the **START** ▶ input when the axis is in the final position of its travel and then activate the **STOP** ■ input when the axis is in the first position of its travel), you define a descending ramp as the one shown in the Figure on the right. The maximum value of the output range precedes the initial point of the ramp (i.e. the beginning of the axis travel); the minimum value of the output range follows the final point of the ramp (i.e. the end limit of the axis travel).	

5.4 Recommended current analogue output circuit



5.5 Recommended voltage analogue output circuit



6 - Diagnostic LED

A LED is installed in the front side of the sensor and is designed to show visually the operating or fault status of the device, as explained in the following table.

LED	Description
ON	The sensor is running properly, there are no active errors
Blinking at high frequency (100 ms ON / 100 ms OFF)	Machine data parameters error
Blinking slowly (500 ms ON / 500 ms OFF)	Flash memory error
Blinking very slowly (1 s ON / 1 s OFF)	Error of the Hall sensors while reading the magnetic scale
Single flash (200 ms ON / 1 s OFF)	The sensor is installed too far from the magnetic scale, the installation does not comply with the tolerance values between the sensor and the scale (see Figure 2)
Double flash (200 ms ON twice / 1 s OFF)	Several errors are active in the same time

NOTE
When you execute the TEACH-IN procedure (this function is available only for SMAZ with analogue interface -AI1-, -AV2-), as soon as you activate the **START** ▶ input the LED switches off; as soon as you activate the **STOP** ■ input it switches on again. For any further information see the "5.3 TEACH-IN procedure" section on page 23.

For further information refer also to the "8 - Troubleshooting" section on page 29.

7 - Maintenance

WARNING

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

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

- periodically check the soundness of the structure and make sure that there are no loose screws; tighten them if necessary;
- check the gap between the sensor and the magnetic scale all along the whole measuring length. 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.

8 - Troubleshooting

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

Fault:
The system does not work (no pulse output).

Possible cause:
- The 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 is not oriented properly). For correct installation please refer to the "3 - Mounting instructions" section on page 9.
- 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 comply with the tolerance gap between the sensor and the scale indicated in this guide; the sensor hits the surface of the scale or is too far from it. Check whether the sensor sensitive part is damaged.
- 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.

Possible cause:
- The gap between the sensor and the scale is not respected all along the whole measuring length. See the "3 - Mounting instructions" section on page 9.
- The sensor is not installed properly on the scale. See the "3 - Mounting instructions" section on page 9.
- The connection cable runs near high voltage cables or the shield is not connected properly. Check the earthing point.
- The frequency of Master clock is set too high or too low and the transmission cannot be synchronized correctly. See the "4 - SSI interface" section on page 13.
- 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.

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Document release	Release date	Description	HW	SW	Installation file version
1.0	06.06.2014	1st issue	-	-	-
1.1	28.08.2014	"3 - Mounting instructions" section updated	-	-	-
1.2	19.11.2015	"General review, mounting tolerances correction	-	-	-
1.3	20.03.2017	General review, "3 - Mounting instructions" section updated	-	-	-
1.4	13.02.2019	"4 - SSI interface" section updated	-	-	-
1.5	25.02.2021	Information about M8 cable updated	-	-	-

Dispose separately

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