

HM58 PS



programmable

- Programmable multiturn absolute encoder
- SSI interface
- 32 bit resolution (262,144 cpr x 16,384 rev.)
- Programmable scaling and TEACH-IN function
- Solid and hollow shaft versions
- Free-of-charge programming software

Suitable for the following models:

- HM58-18-14-PS2-...
- HM58S-18-14-PS2-...
- HMC58-18-14-PS2-...
- HMC59-18-14-PS2-...
- HMC60-18-14-PS2-...

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The logo for Lika Electronic s.r.l. consists of the word "lika" in a bold, lowercase, sans-serif font. The letter "i" has a dot above it. The logo is positioned in the bottom right corner of the page.

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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 **HM58 PS absolute multiturn programmable encoder equipped with SSI interface**.

HM58 PS programmable encoder from Lika Electronic is designed to maximize customization and versatility and allows the operator to get, along with the absolute position information, a complete parametrization and the better configuration that perfectly suit specific needs in a good many applications and machines. The operator in fact can configure not only the SSI interface by setting for instance the number of clocks, the type of protocol, the output code as well as the counting direction; but also to choose the desired resolution in the range of max. 18 bits singleturn (262,144 information per revolution) and 14 bits multiturn (16,384 revolutions).

HM58 PS programmable encoder is available in both hollow and solid shaft versions.

The parametrization and set up of the HM58 PS programmable encoder is achieved through a software expressly developed and released by Lika Electronic. The program is supplied for free and can be installed in any PC fitted with a Windows operating system (Windows XP or later). It allows the operator to set the working parameters of the device and monitor whether the device is running properly. Communication is established using **RS-232 serial cable and port**. The software tool is compatible with the whole series of HM- and EM- programmable encoders: programmable encoder with SSI serial output (...-PS2-... code), programmable encoder with parallel output (...-PN2-... and ...-PY2-... codes), programmable encoder with analogue output (...-PA2-... code).

To make it easier to read and understand the text, this guide is 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 this section the interface features and the parameters implemented in the unit are fully described.

In the third section both general and specific information is given on the programming interface. In this section the software tool features and the parameters implemented in the unit are fully described.

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 "Electrical connection" section on page 17;
- the wires of unused output signals must be cut at different lengths and insulated singularly;
- in compliance with 2014/30/EU norm on electromagnetic compatibility, the 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 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.



1.3 Mechanical safety

- Install the device following strictly the information in the "Mechanical installation" section on page 12;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit 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 of the product;
- 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 purchasing spare parts or needing assistance. 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 Mechanical installation



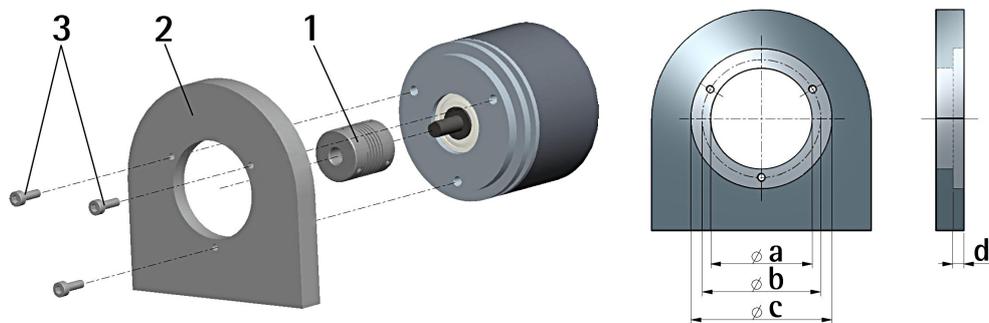
WARNING

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

3.1 Encoder with solid shaft HM58, HM58S

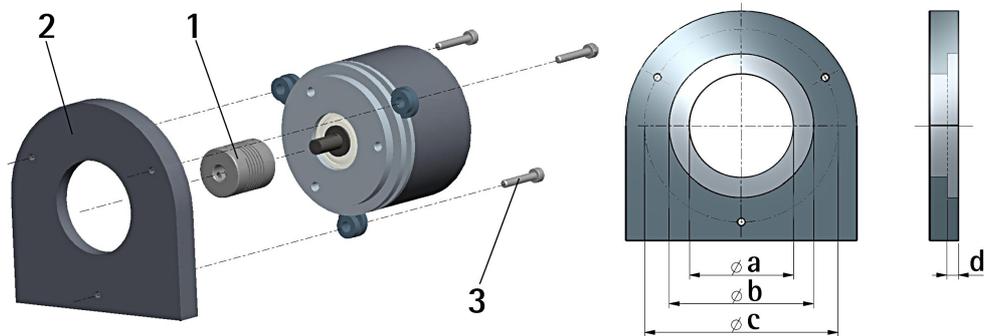
- Mount the flexible coupling **1** on the encoder shaft;
- fix the encoder to the flange **2** (or to the mounting bell) by means of the screws **3**;
- secure the flange **2** to the support (or the mounting bell to the motor);
- mount the flexible coupling **1** on the motor shaft;
- make sure the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

3.1.1 Customary installation



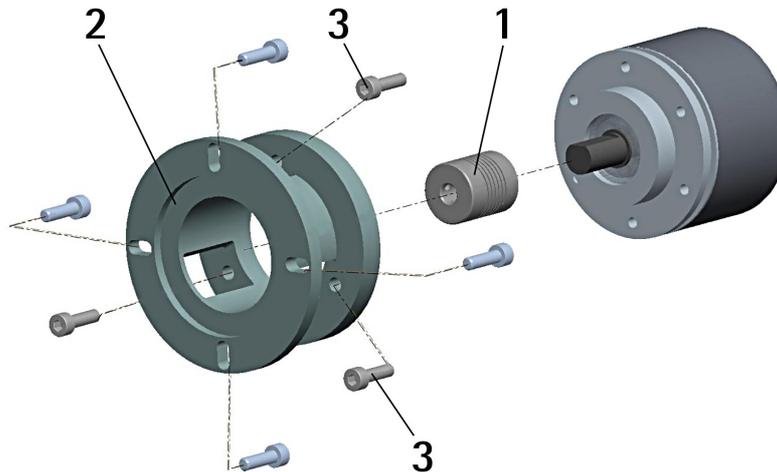
| | a [mm] | b [mm] | c [mm] | d [mm] |
|----------|-----------|-----------|-----------|-----------|
| HM58 PS | - | 42 | 50 F7 | 4 |
| HM58S PS | 36 H7 | 48 | - | - |

3.1.2 Installation using fixing clamps (optional kit code LKM-386)



| | a [mm] | b [mm] | c [mm] | d [mm] |
|----------|-----------|-----------|-----------|-----------|
| HM58 PS | - | 50 F7 | 67 | 4 |
| HM58S PS | 36 H7 | - | 67 | - |

3.1.3 Installation using a mounting bell (optional kit code PF4256)



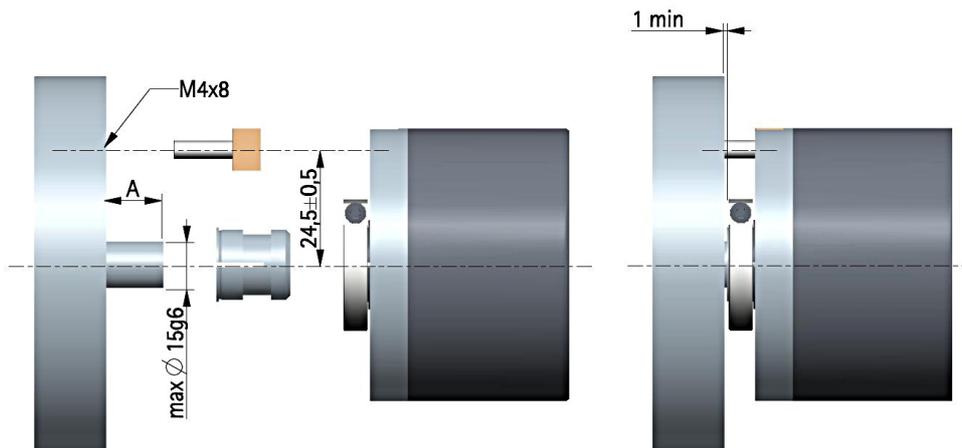
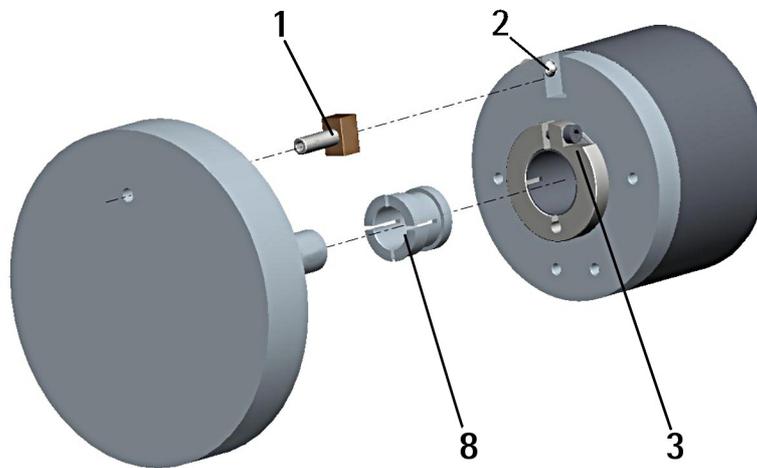
NOTE

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. Make sure the misalignment tolerances of the flexible coupling are respected.

3.2 Encoder with hollow shaft

3.2.1 HMC58 PS installation using the antirotation pin

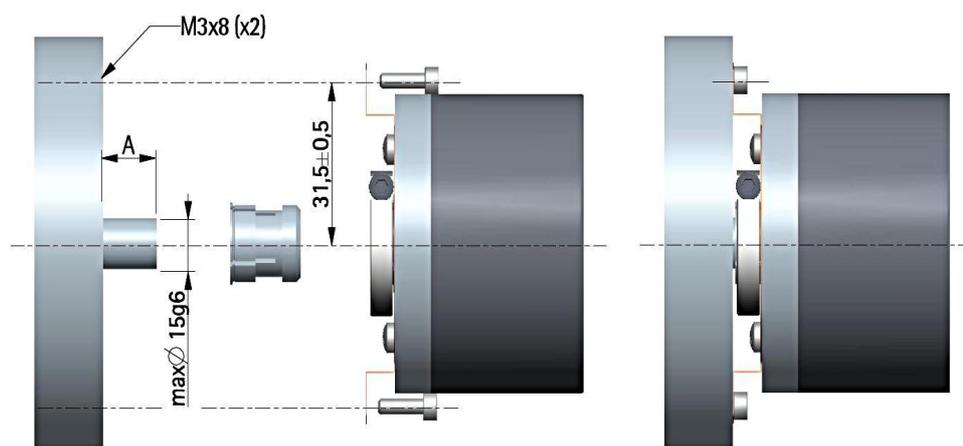
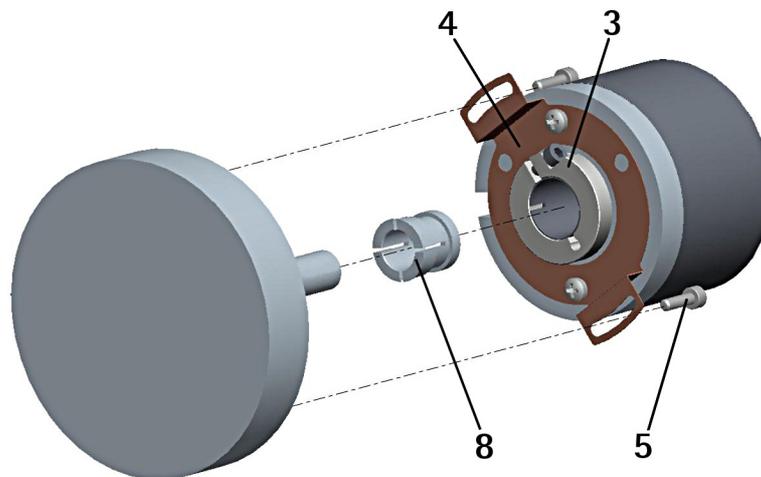
- Fasten the anti-rotation pin **1** to the rear of the motor (secure it using a locknut);
- mount the encoder on the motor shaft using the reducing sleeve **8** (if supplied). Avoid forcing the encoder shaft;
- insert the anti-rotation pin **1** into the slot on the flange of the encoder; this secures it in place by grub screw **2**, preset at Lika;
- fix the collar **3** to the encoder shaft.



A = min. 8, max. 18 mm

3.2.2 HMC59 PS installation using the fixing plate

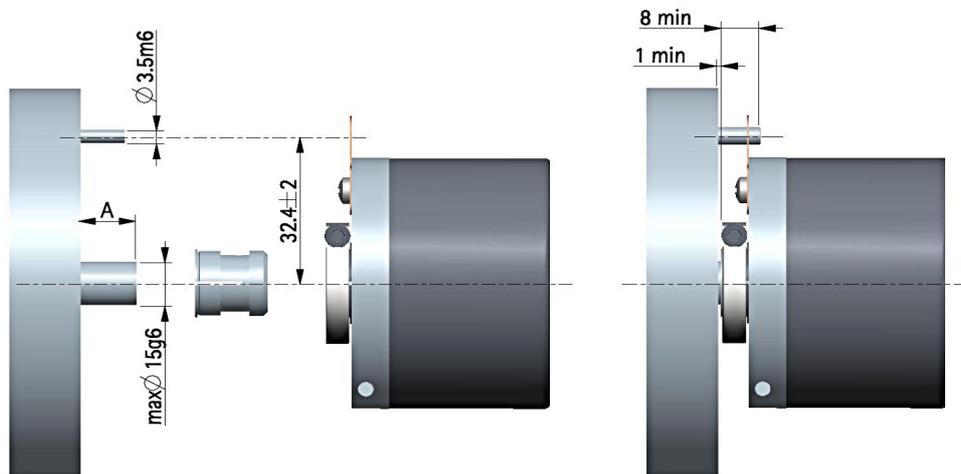
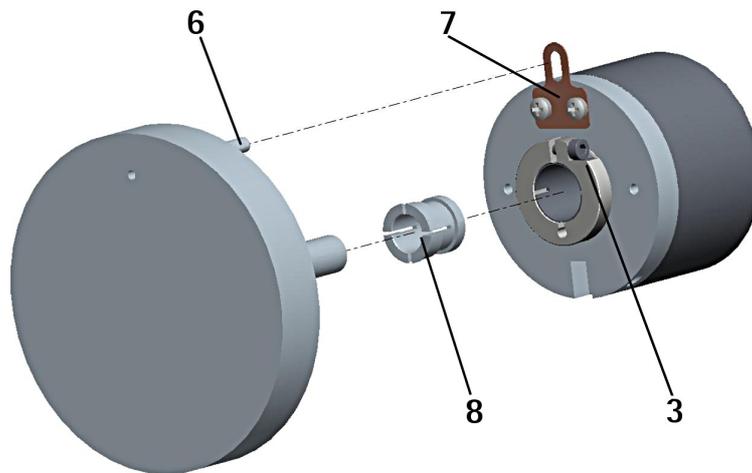
- Remove the antirotation pin **1** (see the Figure in the previous page);
- mount the encoder on the motor shaft using the reducing sleeve **8** (if supplied). Avoid forcing the encoder shaft;
- fasten the fixing plate **4** to the rear of the motor using two M3 x 8 cylindrical head screws **5**;
- fix the collar **3** to the encoder shaft.



A = min. 8, max. 18 mm

3.2.3 HMC60 PS installation using the antirotation pin and the fixing plate

- Remove the antirotation pin **1** (see the Figure on page 14);
- fix the tempered pin **6** to the rear of the motor;
- mount the encoder on the motor shaft using the reducing sleeve **8** (if supplied). Avoid forcing the encoder shaft;
- make sure the anti-rotation pin **6** is inserted properly into the fixing plate **7**;
- fix the collar **3** to the encoder shaft.



A = min. 8, max. 18 mm



NOTE

You are strongly advised not to carry out any mechanical operations (drilling, milling, etc.) on the encoder shaft. This could cause serious damages to the internal parts and an immediate warranty loss. Please contact our technical personnel for the complete availability of "custom made" shafts.

4 Electrical connection



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. Thus they must be cut at different lengths and insulated singularly.

4.1 Cable and connectors connections

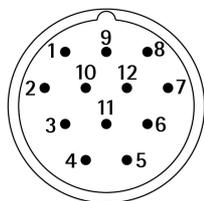
| Function | T12 cable | M23H 12-pin | M12 12-pin |
|--------------------|-------------|-------------|------------|
| Clock IN - | Yellow | 1 | 4 |
| Clock IN + | Violet | 2 | 3 |
| Data OUT + | Grey | 3 | 5 |
| Data OUT - | Pink | 4 | 6 |
| RD RS-232 | Green | 5 | 9 |
| 0Vdc RS-232 | Brown | 6 | 10 |
| TD RS-232 | Red | 7 | 11 |
| Counting direction | Blue | 8 | 8 |
| Preset / Offset | White | 9 | 7 |
| +10Vdc +30Vdc | Brown_Green | 11 | 2 |
| 0Vdc | White_Green | 12 | 1 |
| not used | Black | 10 | 12 |
| Shield | Shield | Case | Case |

4.2 T12 cable specifications

| | |
|-------------------|--|
| Model: | LIKA High-Flex Twisted Encoder cable type T12 |
| Cross section: | 4 x 2 x 0.14 mm ² + 4 x 0.25 mm ² twisted pairs (26/24 AWG) |
| Jacket: | Matt Polyurethane (TPU) halogen free, oil, hydrolysis, abrasion resistant |
| Shield: | Tinned copper braid, coverage ≥ 85% |
| Outer diameter: | 6.1 mm ± 0.10 mm / 0.24" ± 0.004" |
| Min. bend radius: | Outer diameter x 7.5 |
| Work temperature: | -50°C +90°C / -58°F +194°F, fixed application -40°C +90°C / -40°F +194°F, dynamic application |

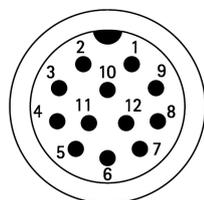
| | |
|-----------------------|---|
| Conductor resistance: | $\leq 148 \Omega/\text{km}$ (0.14 mm ²), $\leq 90 \Omega/\text{km}$ (0.25 mm ²) |
|-----------------------|---|

4.3 M23H 12-pin (counter-clockwise) connector specifications



M23H 12-pin connector
Male
Counter-clockwise

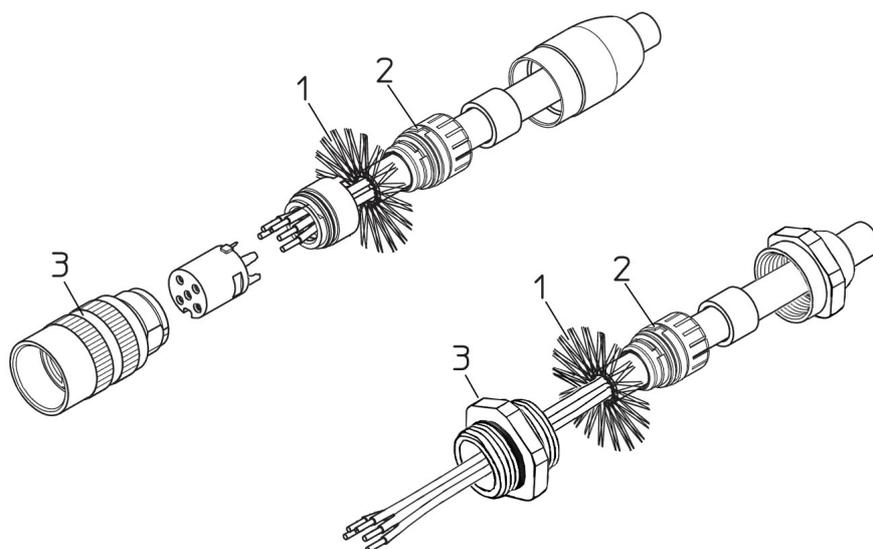
4.4 M12 12-pin connector specifications



Male
Frontal side
A coding

4.5 Connection of the shield

For signals transmission always use shielded cables. The cable shielding must be connected properly to the metal ring nut **3** of the connector in order to ensure a good earthing through the frame of the device. To do this disentangle and shorten the shielding **1** and then bend it over the part **2**; finally place the ring nut **3** of the connector. Be sure that the shielding **1** is in tight contact with the ring nut **3**.



4.6 Ground 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. We suggest providing the ground connection as close as possible to the encoder.

4.7 Preset / Offset input

The Preset / Offset input is active only when the **Enable preset / offset** software function in the **ENCODER CONFIGURATION** box is enabled (see on page 49); otherwise the hardware function is disabled. Furthermore it holds two different functions depending on whether the value of the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to PRESET or OFFSET. In the first case (**Select preset / offset** = PRESET) the input is used to set the preset (**Preset** parameter in the PRESET / OFFSET box, see on page 37); while in the second case (**Select preset / offset** = OFFSET) it is used to set the offset (**Offset** parameter in the PRESET / OFFSET box, see on page 37). For detailed information on the preset and offset functions refer to the "6.3.2 PRESET / OFFSET box" section on page 37.

The output information can be forced to zero or a preset value through an external command sent to the PRESET input via a PLC or a button. To set the preset stop the encoder in the desired position and then connect the Preset input to +Vdc for 100 µs at least.

After this, the position output by the encoder in that point will be the one set next to the **Preset** parameter in the PRESET / OFFSET box, see on page 37). By default the preset value is 0. Connect the Preset input to 0Vdc if not used. To set the preset, connect the Preset input to +Vdc for 100 µs at least, then disconnect +Vdc. Normally voltage must be 0Vdc. We suggest performing the preset setting when the encoder is in stop.



WARNING

Check the **Preset** and **Offset** parameters and activate the functions (either through the Preset / Offset input or by using the **Activate preset** or **Activate offset** commands) every time you change the value next to the **Counts per revolution** and/or **Number of revolutions** parameters when the **Programming mode: Scaling** option is set; or **Counts to be displayed** when the **Programming mode: Start / Stop** option is set; or **Counts to be displayed** when the **Programming mode: Prog** option is set.

4.8 Counting direction input

The counting direction function allows to choose the count up when the shaft is rotating clockwise or counter-clockwise. Connect the Counting direction input to 0Vdc if the function is not used. Connect the Counting direction input to 0Vdc to have an increasing count when the encoder is turning clockwise (CW); connect the Counting direction input to +Vdc to have an increasing count when the encoder is turning counter-clockwise (CCW). Clockwise and counter-clockwise directions are viewed from the shaft side.



WARNING

The counting direction can be set also through the programming tool. The **Positive counting direction** parameter in the CONFIGURATION page allows the operator to choose the CW (STANDARD) and CCW (INVERTED) options. When the counting direction is set to CW (STANDARD) -**Positive counting direction** = CW (STANDARD)-, if the Counting direction input (see on page 20) has LOW logic level (0Vdc) the encoder will provide the increasing count when the encoder is turning clockwise (and the decreasing count when the encoder is turning counter-clockwise); on the contrary if the Counting direction input has HIGH logic level (+Vdc) the encoder will provide the increasing count when the encoder is turning counter-clockwise (and the decreasing count when the encoder is turning clockwise). When the CCW (INVERTED) option is set -**Positive counting direction** = CCW (INVERTED)-, if the Counting direction input has LOW logic level (0Vdc) the encoder will provide the increasing count when the encoder is turning counter-clockwise (and the decreasing count when the encoder is turning clockwise); on the contrary if the Counting direction input has HIGH logic level (+Vdc) the encoder will provide the increasing count when the encoder is turning clockwise (and the decreasing count when the encoder is turning counter-clockwise).



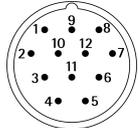
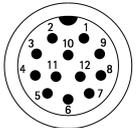
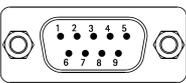
WARNING

After having set the new counting direction it is necessary to set also the preset / offset functions.

4.9 RS-232 serial connection

HM58 PS programmable encoder is equipped with a serial interface for the parametrization and set up of the device. A software tool is designed to program the encoder via RS-232 interface, it is available [at our website](#). Before starting the program, connect the device to the personal computer through a serial port. Should the personal computer not be equipped with a serial port, you must install a USB / RS-232 converter, easily available in the market.

The serial cable must be connected as shown in the table of the following page. See also the "Electrical connection" section on page 17.

| Function | T12 cable |  |  |  | Function |
|----------|-----------|---|---|--|----------|
| | | M23 12-pin | M12 12-pin | DSub 9-pin male | |
| TD | Red | 7 | 11 | 2 | RD |
| RD | Green | 5 | 9 | 3 | TD |
| 0Vdc | Brown | 6 | 10 | 5 | 0Vdc |

Please always make sure that the RD of the ENCODER is cross-wired to the TD of the PC while the TD is cross-wired to the RD.

An optional kit fitted with RS-232/USB adapter for the communication between the encoder and the PC is available.

The order codes are as follows:

- **IF92** + converter
- **EC-CR12F-S70-I5-L005** M23H mating cordset for IF92
or
- **EC-M12F12-S69-I5-L005** M12 mating cordset for IF92



NOTE

Encoders with T12 cable output require IF92 converter only.

Please note that the configuration parameters of the serial port have fixed values and the user cannot change them.

They are:

| RS-232 serial port settings | Value |
|------------------------------------|--------------|
| Baud rate | 9600 |
| Byte size | 8 |
| Parity | None |
| Stop bits | 1 |
| Flow control | None |

5 SSI interface

5.1 Main characteristics



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.

5.2 Working principle (Figure 1)

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 (Most Significant Bit).

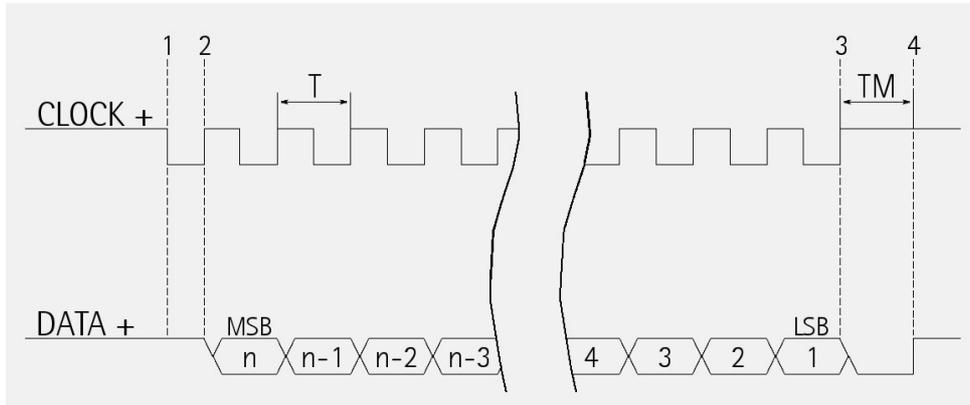


Figure 1 - Data word transmission scheme

At each change of the clock signal and at each subsequent rising edge (2) one bit is clocked out at a time, up to the LSB (Least Significant Bit), until the data word transmission is completed. 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.

The number of clocks can be set next to the **SSI clock number** parameter in the **CONFIGURATION** page. 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 the data word (TREE FORMAT protocol). After the period T_m monoflop time, having a duration ranging between 12 and 100 μsec (see the **SSI timeout** parameter in the **CONFIGURATION** page), 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.

SSI interface has a frequency of data transmission ranging between 100 kHz and 2 MHz. The clock frequency (baud rate) depends on the length of the cable and must comply with the technical information reported in the following table:

| | | | | | | | |
|--------------------------|------------|-----------|-----------|----------|----------|----------|---------|
| Frequency [kHz] | 100 | 200 | 300 | 400 | 500 | 900 | 1800 |
| Max. cable length m [ft] | 400 [1310] | 200 [655] | 100 [330] | 75 [245] | 60 [200] | 30 [100] | 15 [50] |

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.

As previously stated, the number of clock signals (as well as the resolution of the encoder) can be set according to needs by setting the wished value next to the **SSI clock number** parameter in the **CONFIGURATION** page; there are some limits depending on the set protocol. For complete information please refer to each specific section regarding the protocols.

The output code can be either Binary, Gray, or BCD and can be set next to the **Output code** parameter in the **CONFIGURATION** page.

5.3 "TREE FORMAT" PROTOCOL (Figure 2 and Figure 3)

The TREE FORMAT protocol is activated by setting the value TREE next to the **Protocol** parameter in the **CONFIGURATION** page (see on page 48).

"Tree format" has been the most common protocol and the SSI standard for years. Nowadays, because of higher and higher resolutions, LSB RIGHT ALIGNED and MSB LEFT ALIGNED mainly are more popular. It is typically used in the singleturn encoders having a resolution up to 13 bits and in the multiturn encoders having an overall resolution up to 25 bits (13-bit singleturn + 12-bit multiturn). The whole transmitted data is divided into 12 bits on the left side of the central axes dedicated to the information on the number of revolutions; and into 13 bits on the right side of the axes dedicated to the information on the number of counts per revolution. Thus the multiturn information is transmitted first. In singleturn encoders in which the set number of clocks is equal to the resolution bits, the information transmitted with TREE FORMAT protocol is the same as the one transmitted with MSB LEFT ALIGNED protocol.

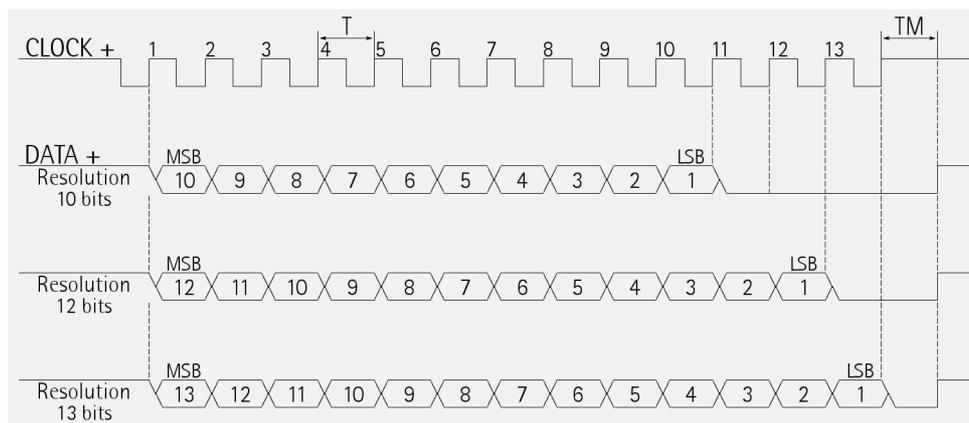


Figure 2 - Examples of Tree format protocol for singleturn models

If the resolution bits are less than the number of clocks (see the **SSI clock number** parameter in the **CONFIGURATION** page), then unused bits are forced to logic level low (0); they lead the multiturn information on one hand and

follow the singleturn information on the other hand. As you can easily assume, the "Tree format" protocol is not compatible with singleturn encoders having a resolution higher than 13 bits and with multiturn encoders having an overall resolution higher than 25 bits and a singleturn information higher than 13 bits anyway.

In the Figures some examples of the TREE FORMAT are available: they refer to 13-bit singleturn (Figure 2) and 25-bit multiturn (Figure 3) models with standard number of clocks (13 clocks and 25 clocks respectively).

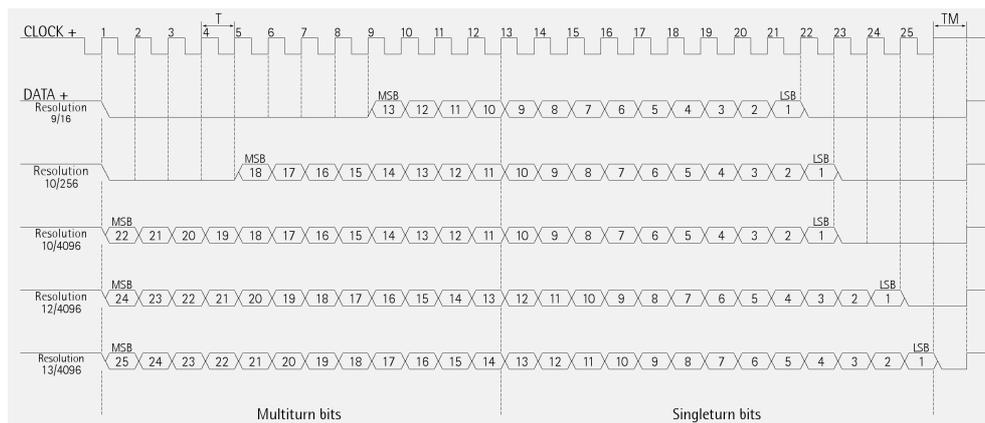


Figure 3 - Examples of Tree format protocol for multiturn models

5.4 "LSB RIGHT ALIGNED" PROTOCOL (Figure 4, Figure 5 and Figure 6)

The LSB RIGHT ALIGNED protocol is activated by setting the value RIGHT ALIGNED next to the Protocol parameter in the CONFIGURATION page (see on page 48); it is set as a default in the HM58 PS programmable encoder. It allows to right align the data bits, beginning from MSB to LSB; LSB is then sent at the last clock cycle. If the number of clock signals is higher than the data bits (see the SSI clock number parameter in the CONFIGURATION page), then unused bits are forced to logic level low (0) and lead the data word. This protocol can be used in encoders having resolution up to 32 bits. Information can be variously arranged for singleturn and multiturn versions. Here following are some examples of LSB RIGHT ALIGNED protocol with 13, 25, and 32 data bits and 13, 25, and 32 clocks respectively.

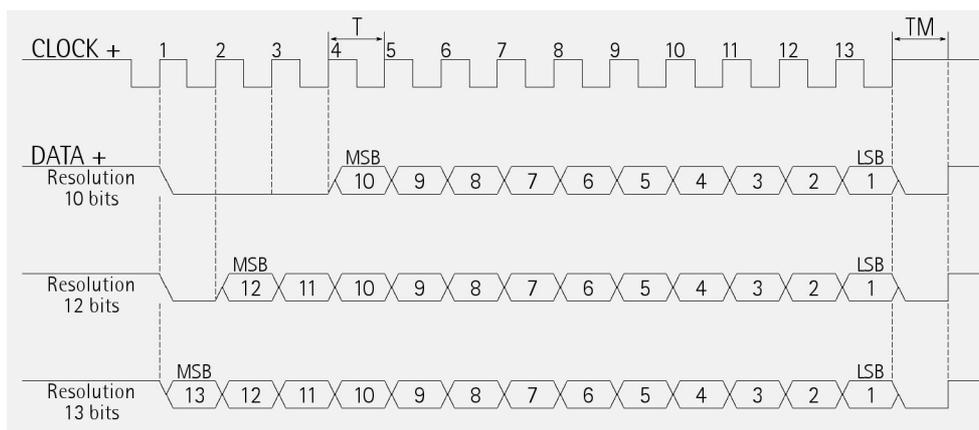


Figure 4 - Examples of LSB RIGHT ALIGNED protocol for up to 13-bit resolution models

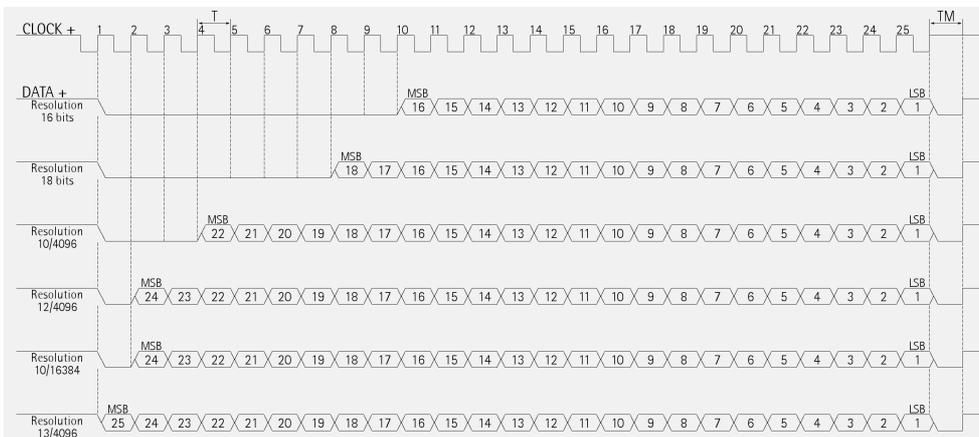


Figure 5 - Examples of LSB RIGHT ALIGNED protocol for up to 25-bit resolution models

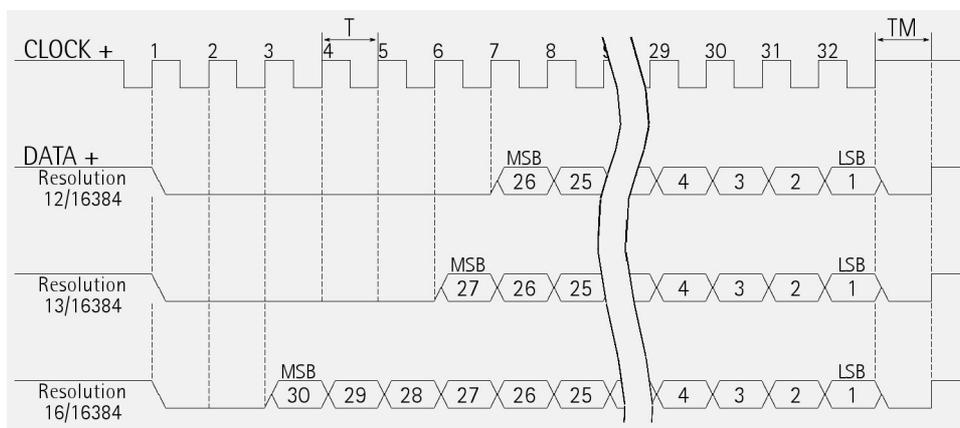


Figure 6 - Examples of LSB RIGHT ALIGNED protocol for up to 32-bit resolution models

5.5 "MSB LEFT ALIGNED" PROTOCOL (Figure 7)

The MSB LEFT ALIGNED protocol is activated by setting the value LEFT ALIGNED next to the **Protocol** parameter in the **CONFIGURATION** page (see on page 48). "MSB left aligned" protocol is a further alternative and allows to left align the data bits, beginning from MSB to LSB; MSB is then sent at the first clock cycle. If the number of clock signals is higher than the data bits (see the **SSI clock number** parameter in the **CONFIGURATION** page), then unused bits are forced to logic level low (0) and follow the data word. Information can be variously arranged for singleturn and multiturn versions. The number of clocks to be sent to the encoder must equal at least the number of data bits, anyway it can be higher, as needed. The great advantage of this protocol over the TREE format and the LSB RIGHT ALIGNED format is that data can be transmitted with a minimum time loss and the T_m monoflop time can immediately follow the data bits without any additional clock signal. Here following is an example of MSB LEFT ALIGNED protocol.

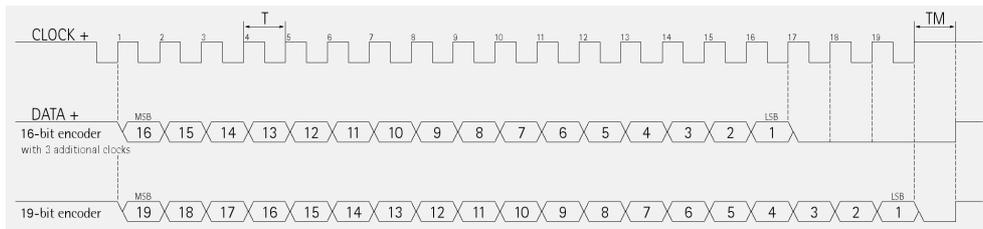
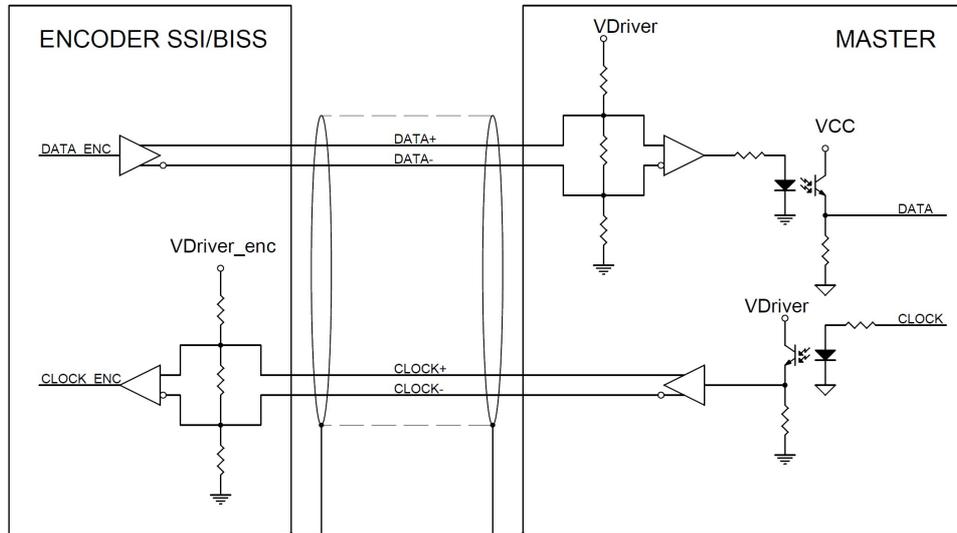


Figure 7 - Examples of MSB LEFT ALIGNED protocol

5.6 Recommended SSI input circuit



6 Software tool and configuration parameters

6.1 Configuring the device using the software tool

HM58 PS encoder with SSI interface is supplied with a software expressly developed and released by Lika Electronic in order to easily programme and configure the device. The software tool is compatible with the whole series of HM- and EM- programmable encoders from Lika Electronic: programmable encoder with SSI serial output (...-PS2-... code); programmable encoder with parallel output (...-PN2-... and ...-PY2-... codes); programmable encoder with analogue output (...-PA2-... code). It allows the operator to set the working parameters of the device and monitor whether the device is running properly. The program is supplied for free and can be installed in any PC fitted with a Windows operating system (Windows XP or later). The communication is established using **RS-232 serial cable and port**. The executable file **LIKA_PROGRAMMABLE_ENCODER_Vx_x.EXE** is available [at our website](#). The program is designed to be installed simply by copying the executable file to the desired location and there is **no installation** process. To launch it just double-click the file icon. To close the program press the **Exit** button in the **File** menu of the **CONFIGURATION** page.



WARNING

Please be aware that the following compatibilities between the hardware-software version of the device and the software version of the executable file have to be respected compulsorily.

| Compatibility | HW-SW | EXE FILE |
|---------------|----------|-----------|
| | 1.0, 1.1 | Up to ... |



NOTE

Before starting the program, connect the device to the personal computer through a serial port. The serial interface of the SSI programmable encoder is a RS-232 type. Should the personal computer not be equipped with a serial port, you must install a USB / RS-232 converter, easily available in the market. The serial cable must be connected as shown in the "4.9 RS-232 serial connection" section on page 21.

6.1.1 Available pages and commands

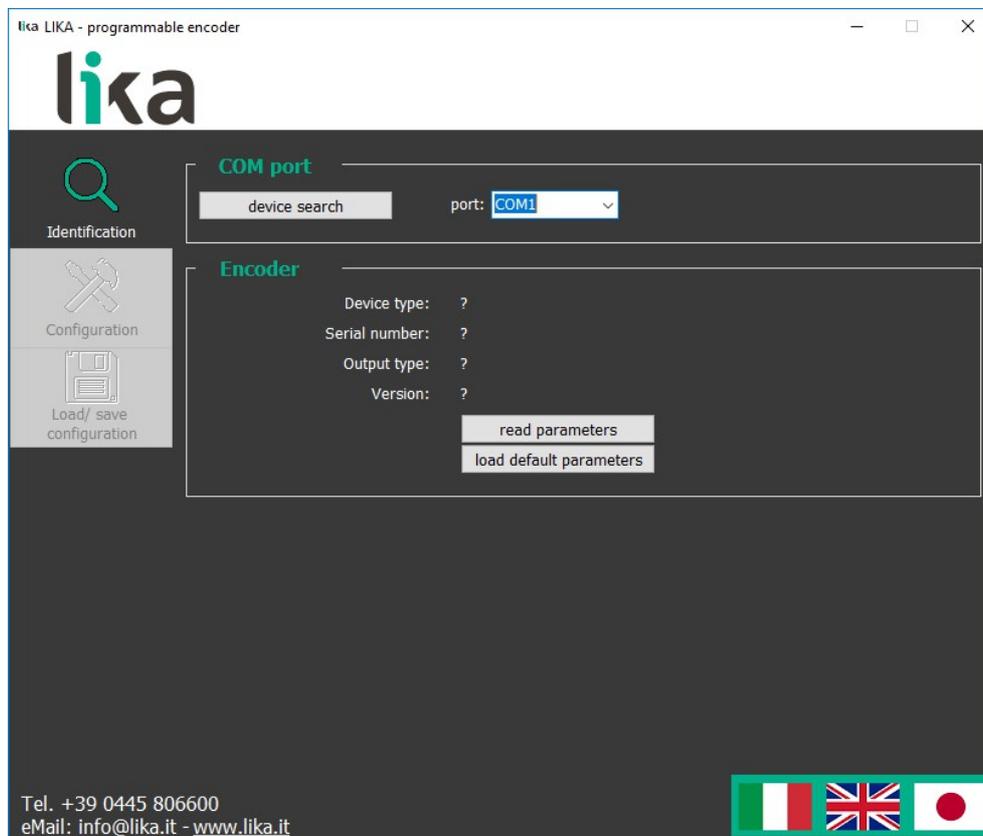
In each page of Lika Electronic configuration tool software there is a **left navigation bar**.

In the left navigation bar the following buttons are available:

- **Identification** button: it allows to enter the **IDENTIFICATION** page in order to search and activate the communication with the device connected through the serial port; see on page 31;
- **Configuration** button: it allows to enter the page where the configuration parameters are located; see on page 36;
- **Load / save configuration** button: it enters the page where the current configuration of the encoder can be saved; or a previously saved configuration can be loaded; see on page 60.

6.2 IDENTIFICATION page

When you start the program by double-clicking the **LIKA_PROGRAMMABLE_ENCODER_Vx_x.EXE** executable file, the **IDENTIFICATION** page is displayed.



First of all this page allows the operator to choose the language used to display texts and items in the user interface. Select the **Italian flag**  icon to choose the Italian language; select the **UK flag**  icon to choose the English language; select the **Japanese flag**  icon to choose the Japanese language.

If you click the www.lika.biz link below in the page, you enter the Lika Electronic web site page where the technical documentation and information on the device as well as the downloadable files for installing the software tool are available.

At this stage the buttons in the left navigation bar are not available; furthermore the fields in the **ENCODER** box show a question mark ("?") as the connected device has not been identified yet.

Before starting the identification process please make sure the unit is connected properly to the personal computer and the power is on. The software will force the settings of the personal computer serial port to the values required by the serial port of the connected device, thus it is not necessary to set the parameters of the serial port of the pc in the Windows **Device Manager** menu first.

For any information on the characteristics of the serial connection please refer to the "4.9 RS-232 serial connection" section on page 21.

**WARNING**

Make sure one only device is connected to the personal computer and switched on when you start a device searching process!

Now you are ready to establish the connection to the encoder: press the **DEVICE SEARCH** button in the **COM PORT** box. During the connection attempt a blue arrow appears inside the **DEVICE SEARCH** button.



If the connection is established properly, a green tick (✓) appears next to the **DEVICE SEARCH** button and the fields in the **ENCODER** box are filled with information about the connected device. Furthermore the buttons in the left navigation bar become active.

On the contrary, if the program is not able to establish a connection to the encoder, a red X (X) appears next to the **DEVICE SEARCH** button.

Should this happen, please check that the unit is connected properly and the power is on. Make sure the power supply voltage is correct. Also check that the serial cable characteristics meet the requirements described in the "4.9 RS-232 serial connection" section on page 21.



WARNING

Make sure one device only is connected to the personal computer and switched on when you start a device searching process!

6.2.1 COM PORT box

In the **COM PORT** box the following functions are available:

Device search

After having connected a device to the serial port of your personal computer and turned the power on, press this button to start establishing a communication and allow the program to detect it. During the connection attempt a blue arrow appears next to the button. If the connection is established properly, a green tick (✓) appears next to the **DEVICE SEARCH** button and the fields in the **ENCODER** box are filled with information about the connected device. Furthermore the buttons in the left navigation bar become active.

On the contrary, if the program is not able to establish a connection to the encoder, a red X (✗) appears next to the **DEVICE SEARCH** button.

Should this happen, please check the unit is connected properly and the power is on. Make sure that the power supply voltage is correct. Also check that the serial cable characteristics meet the requirements described in the "4.9 RS-232 serial connection" section on page 21.



WARNING

Make sure that only one device is connected to the personal computer and on when you start a device searching process!

Port

It shows the list of the serial ports available in the personal computer. It is not necessary either to choose the serial port where the unit is connected or to set the parameters of the pc serial port in the Windows **Device Manager** menu first as the program automatically scrolls through the available ports and searches in each one for a device which is connected and on. Furthermore it forces the settings of the personal computer serial port to the values required by the serial port of the connected device. For any information on the characteristics of the serial connection please refer to the "4.9 RS-232 serial connection" section on page 21.

6.2.2 ENCODER box

In the **ENCODER** box the following functions are available:

Device type

When the connection is established properly and the device is detected, the main characteristics of the unit are shown respecting the structure of the order code. They are: device series (HM or EM series); singleturn resolution - multiturn resolution (expressed in bits; for example: 18-14), output type (PN: programmable encoder with parallel output and NPN driver; PY: programmable encoder with parallel output and Push-Pull driver; PS: programmable encoder with SSI serial output; PA: programmable encoder with analogue output).

Serial number

When the connection is established properly and the device is detected, the univocal serial number of the device is shown next to this item.

Output type

When the connection is established properly and the device is detected, the type of output of the device is shown next to this item: PARALLEL, SSI or ANALOGUE.

Version

When the connection is established properly and the device is detected, the **software** and **hardware versions** of the device are shown next to this item.

Read parameters

This button allows the operator to force a new read of the device parameters. During the connection attempt a blue arrow appears inside the button. If the program is not able to establish a connection to the encoder, the fields in the **ENCODER** box and listed above show a question mark ("?").

Load default parameters

Default parameters are set at the factory by Lika Electronic engineers to allow the operator to run the device for standard operation in a safe mode. As soon as you press this button the default parameters are uploaded and activated. All parameters which have been set previously are overwritten, thus previously set values are lost. The complete list of machine data and relevant default parameters preset by Lika Electronic engineers is available on page 68.

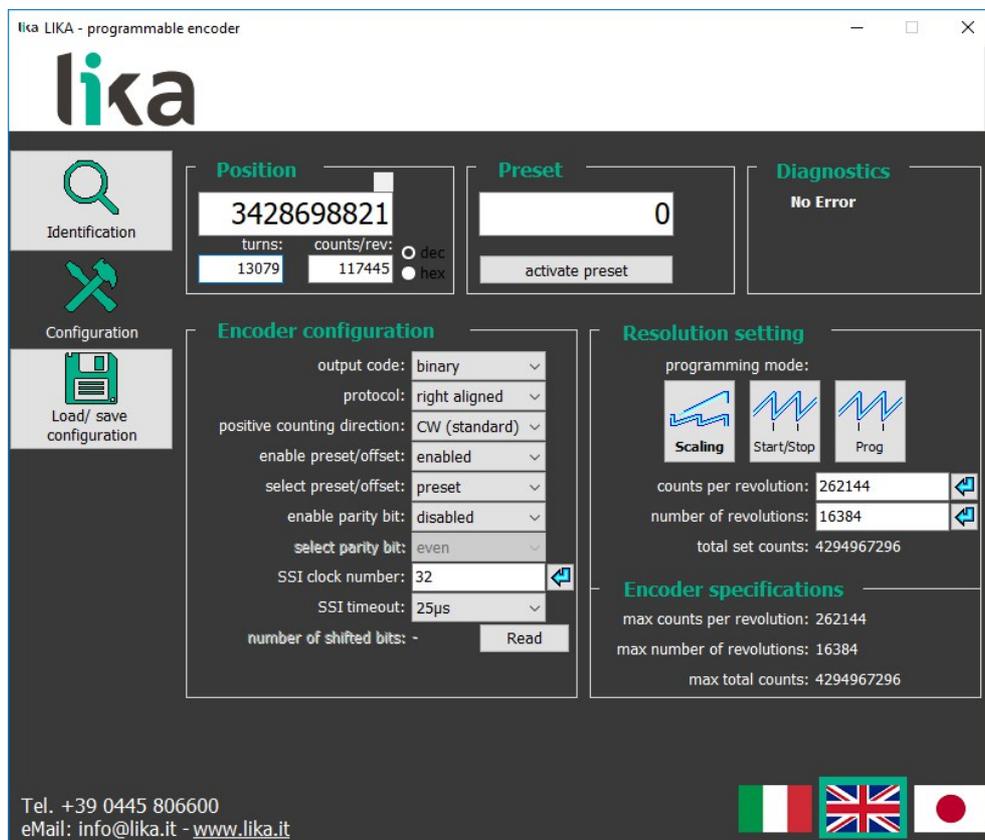


WARNING

As soon as you press this button, all parameters which have been set previously are overwritten, thus previously set values are lost!

6.3 CONFIGURATION page

When you press the **CONFIGURATION** button in the left navigation bar you enter the **CONFIGURATION** page. This page allows the operator to start programming and monitoring the unit. The following window will appear:



6.3.1 POSITION box

In the **POSITION** box at the top left of the page the following functions are available. The cyclical movement of the blue arrows located at the top right of the **Position** field is intended to show the proper communication with the device.

Position

It shows the current position information of the connected device; if enabled, the set scaling is applied. The value is expressed in counts. The value can be represented in either decimal or hexadecimal format, click the DEC or HEX option buttons in this box to choose the desired display format.

Turns

It shows the number of revolutions already performed by the encoder. As soon as the number of revolutions set next to the **Number of revolutions** parameter (multiturn resolution) is achieved, the counter zero sets and then restarts again the increasing count. The value can be represented in either decimal or hexadecimal format, click the DEC or HEX option buttons in this box to choose the desired display format.

Counts/rev

It shows the current position information in the revolution. As soon as the number of information per revolution (namely, counts per revolution, cpr) set next to the **Counts per revolution** parameter (singleturn resolution) is achieved, the counter restarts again the increasing count. The value is expressed in counts. The value can be represented in either decimal or hexadecimal format, click the DEC or HEX option buttons in this box to choose the desired display format.

6.3.2 PRESET / OFFSET box

The functions in this box are activated and thus available only if the **Enable preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to ENABLED; on the contrary, if DISABLED is set, they are not available. Furthermore they have a different meaning depending on the value of the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box whether it is set to PRESET or OFFSET. In the first case (**Select preset / offset** = PRESET) the functions in this box are used to set the preset, thus both the box and the button are labelled consequently; while in the second case (**Select preset / offset** = OFFSET) the functions in this box are used to set the offset, thus both the box and the button are labelled consequently.

Preset

This function is available only if the **Enable preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to ENABLED and the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to PRESET.

This parameter allows the operator to enter the preset value.

The Preset function is meant to assign a desired value to a physical position of the encoder. The physical position will get the value set next to this item and all the previous and following positions will get a value according to it. This function is useful, for example, when the zero position of the encoder and the zero position of the axis need to match. The preset value will be set for the position of the encoder (the current position is displayed next to the **Position** item in the **POSITION** box) in the moment when the preset value is activated. To activate the preset, stop the encoder in the desired position and then press the **Activate preset** button in this box (otherwise connect the Preset / Offset input as explained on page 19).

Default = 0 (min. = 0, max. = 4 294 967 296)



EXAMPLE

Here follows an example useful to better understand the preset function and the meaning of the related parameters and commands: **Preset** and **Activate preset**.

To know the position information which will be transmitted by the encoder, first of all we must calculate the so-called **stored preset value**.

The stored preset value is equal to the encoder position read in the moment when the **Activate preset** command is sent minus the value set next to the **Preset** parameter.

For instance, if you set the value "=50" next to the **Preset** parameter and the position of the encoder when the **Activate preset** command is sent is "=1000", then the stored preset value will be: $1000 - 50 = 950$.

Thus the encoder position information to be transmitted will result from the following calculation:

if current encoder position \geq stored preset value, then:

Transmitted position information = current encoder position - stored preset value.

Otherwise, if current encoder position $<$ stored preset value, then:

Transmitted position information = current encoder position - stored preset value + overall set resolution (Total set counts in Programming mode: Scaling).

If a **Preset** value has been never set previously and anyway the **Activate preset** command has been never sent, the transmitted position information and the current position information necessarily match as **Preset** = 0 and stored preset value = 0.

When you enter a **Preset** value and then execute the **Activate preset** command, the system saves the so-called stored preset value. It follows that the

transmitted position information and the **Preset** value match as the current encoder position – stored preset value = **Preset**; in other words, for the desired encoder position the value set next to the **Preset** item is output and displayed.

For instance, let's suppose that we set the value "50" next to the **Preset** item and then we execute the **Activate preset** command after having stopped the encoder at position "1000" (**Position** = 1000; after having sent the command by pressing the **Activate preset** button, **Position** = 50; **Turns** = 0; **Counts/rev** = 50). So we need the encoder to output the value "50" when it reaches the actual position "1000". The stored preset value will be "950".

Thus it follows that:

Transmitted position information = **current encoder position** (= "1000") - stored preset value (= "950") = **50**.

The following transmitted position information will be:

Transmitted position information = **current encoder position** (= "1001") - stored preset value (= "950") = **51**.

...

Transmitted position information = **current encoder position** (= "998") - stored preset value (= "950") = **48**.

Transmitted position information = **current encoder position** (= "999") - stored preset value (= "950") = **49**.

And so on.

Please pay attention to the following condition! As previously stated, if current encoder position < stored preset value, then:

Transmitted position information = **current encoder position** - **stored preset value** + **overall set resolution**.

For instance, if the overall set resolution is 2,048 (**Total set counts** in **Programming mode: Scaling** = 2,048), when the current encoder position is lower than "950", it will be as follows:

Transmitted position information = **current encoder position** (= "948") - stored preset value (= "950") + overall set resolution (2048) = **2046**.

Transmitted position information = **current encoder position** (= "949") - stored preset value (= "950") + overall set resolution (2048) = **2047**.

Transmitted position information = **current encoder position** (= "950") - stored preset value (= "950") = **0**.

And so on.



NOTE

- When **Programming mode: Scaling** is set, then **Preset** must be less than or equal to **Total set counts** (**Counts per revolution** * **Number of revolutions**).
- When **Programming mode: Start / Stop** is set, then **Preset** must be less than or equal to **Counts to be displayed**.

- When **Programming mode: Prog** is set, then **Preset** must be less than or equal to **Counts to be displayed**).

If you set a greater value, the **Value not valid: preset greater than the maximum position** error message is displayed.



WARNING

Check the **Preset** parameter value and then execute the **Activate preset** command every time you enter new values next to the following parameters: **Counts per revolution** and/or **Number of revolutions** in **Programming mode: Scaling**; **Counts to be displayed** in **Programming mode: Start / Stop**; and **Counts to be displayed** in **Programming mode: Prog**.

Activate preset

This function is active only when the **Enable preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to ENABLED and the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to PRESET.

Press this button to activate the preset function. The preset value (it is set next to the **Preset** item above) will be set for the position of the encoder in the moment when the preset value is activated. To activate the preset, stop the encoder in the desired position and then press this **Activate preset** button. The chosen physical position will get the value set next to the **Preset** item and all the previous and following positions will get a value according to it. For any further information on the preset function and the meaning of the related parameters and commands **Preset** and **Activate preset** refer to page 37.



WARNING

The **Preset / Offset** hardware input works in parallel with the **Activate preset** command. For any information on using the **Preset / Offset** input refer to the "4.7 Preset / Offset input" section on page 19.

Offset

This function is available only if the **Enable preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to ENABLED and the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to OFFSET.

This parameter allows the operator to enter the offset value.

The offset function is meant to assign a value to a desired physical position of the encoder so that the output position information will be shifted according to the value set next to this **Offset** item. The number of transmitted values will match the set resolution (**Total set counts**), but the output information will

range between the **Offset** value (minimum value) and the sum of the set resolution + the **Offset** value (maximum value). The offset value will be set for the position of the encoder (the current position is displayed next to the **Position** item in the **POSITION** box) in the moment when the offset value is activated. To activate the offset, stop the encoder in the desired position and then press the **Activate offset** button in this box (otherwise connect the Preset / Offset input as explained on page 19).



EXAMPLE

Here follows an example useful to better understand the offset function and the meaning of the related parameters and commands: **Offset** and **Activate offset**.

To know the position information which will be transmitted by the encoder, first of all we must calculate the so-called **stored preset value** (see the explanation for the **Preset** parameter on page 37); the preset value is always "=0" in the moment when we press the **Activate offset** command.

The stored preset value is equal to the encoder position read in the moment when the **Activate offset** command is sent minus the preset value; as stated, when we activate the offset function, the preset value is always 0.

For instance, if the position of the encoder when the **Activate offset** command is sent is "=0", then the stored preset value will be: $0 - 0 = 0$.

Thus the encoder position information to be transmitted will result from the following calculation:

Transmitted position information = current encoder position - stored preset value + Offset value.

Here is a positive example concerning the so-called "Shifted Gray code" or "Gray Excess code"; we are going to deal with it in the following "Shifted Gray code or Gray Excess code" section; let's suppose that the overall set resolution is "=360" (**Total set counts** in **Programming mode: Scaling** = 360).

Thus in the example it follows that:

Transmitted position information = current encoder position (= "0") - stored preset value (= "0") + Offset value (= "76") = 76.

The following transmitted position information will be:

Transmitted position information = current encoder position (= "1") - stored preset value (= "0") + Offset value (= "76") = 77.

...

Transmitted position information = current encoder position (= "358") - stored preset value (= "0") + Offset value (= "76") = 434.

Transmitted position information = current encoder position (= "359") - stored preset value (= "0") + Offset value (= "76") = 435.

And so on.

Shifted Gray code or Gray Excess code

The offset function is very useful when we need to set the values for the so-called "Shifted Gray code" or "Gray Excess code".

As Binary code, the Gray code (for any information refer to the **Output code** parameter on page 46) represents the information through the base-2 number system; but the binary strings are ordered so that two successive values always differ in one bit only; and this property is preserved even at transition from the last to the first position of the sequence, provided that the number of information (namely, the resolution) is a power of 2.

When the number of information (resolution) is not a power of 2, the main feature of the Gray code (i.e. successive values differ in exactly one bit) is lost at transition from the last position of the sequence back to the first position. This could lead to the same measuring errors affecting the Binary code. Let's suppose, for instance, that an encoder has a resolution of 360 information per turn. The sequence of the Gray code is shown in the following Figures (HIGH logic level is represented in black).

| | | | | | | | | | | |
|---------|-----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|
| Decimal | ... | 356 | 357 | 358 | 359 | 0 | 1 | 2 | 3 | ... |
| Gray | ... | 111010110 | 111010111 | 111010101 | 111010100 | 000000000 | 000000001 | 000000011 | 000000010 | ... |

| | | | | | | | | | | |
|-------------|-----|-----|-----|-----|-----|---|---|---|---|-----|
| Bit 1 (LSB) | | | ■ | ■ | | | ■ | ■ | | |
| Bit 2 | | ■ | ■ | | | | | ■ | ■ | |
| Bit 3 | | ■ | ■ | ■ | ■ | | | | | |
| Bit 4 | | | | | | | | | | |
| Bit 5 | | ■ | ■ | ■ | ■ | | | | | |
| Bit 6 | | | | | | | | | | |
| Bit 7 | | ■ | ■ | ■ | ■ | | | | | |
| Bit 8 | | ■ | ■ | ■ | ■ | | | | | |
| Bit 9 (MSB) | | ■ | ■ | ■ | ■ | | | | | |
| Decimal | ... | 356 | 357 | 358 | 359 | 0 | 1 | 2 | 3 | ... |

As you can easily see in the Figures, more than one bit changes from position 359 to position 0 and this disagrees with the main rule of the Gray code. To compensate for this "hitch", the so-called "Shifted Gray" or "Gray Excess" code has to be used. This is a method intended to calculate a new sequence of Gray code values so that the Gray code rule is always respected.

The Δ value (first output information in the "Shifted Gray" code instead of using 0) results from the following algorithm:

$$\Delta = \frac{\text{Integral Gray} - \text{Shifted Gray}}{2}$$

where:

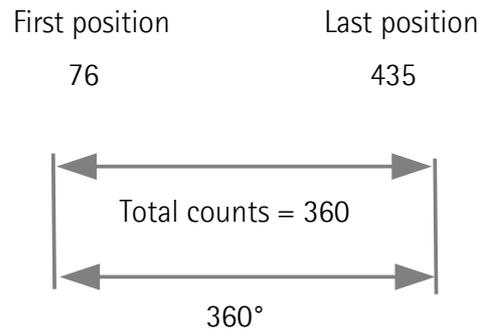
- Integral Gray: it represents the number of counts expressed in power of 2 immediately higher than the resolution involved (in the example: $512 = 2^9$);
- Shifted Gray: it represents the resolution involved (even numbers only; 360 in the example).

So:

$$\Delta = \frac{512 - 360}{2} = 76$$

It follows that the first output information (instead of 0) will be 76, while the last position will be $360 + (\Delta - 1) = 435$. In this way shifting from 435 back to 76 does not cause the main feature of the Gray code to be lost, as shown in the following Figure.

| | | | | | | |
|-------------|-----|-----|-----|----|----|-----|
| Bit 1 (LSB) | | | | | | |
| Bit 2 | | | | | | |
| Bit 3 | | | | | | |
| Bit 4 | | | | | | |
| Bit 5 | | | | | | |
| Bit 6 | | | | | | |
| Bit 7 | | | | | | |
| Bit 8 | | | | | | |
| Bit 9 (MSB) | | | | | | |
| Decimal | ... | 434 | 435 | 76 | 77 | ... |
| Position | ... | 358 | 359 | 0 | 1 | ... |



Please note that:

- the initial count value is not zero (in the example the first output value is 76);
- the final count value does not coincide with the max. value of the information requested (in the example, the last value is 435, while the number of requested information is 360).

See also the **EXAMPLE** in the explanation concerning the **Offset** parameter on page 40.



NOTE

The following relation must be always considered to know the maximum value which is allowed in this parameter:

Offset value ≤ **Max total counts** (4 294 967 296) – set overall resolution (**Total set counts** or **Counts to be displayed**).

If you set a greater value, the **Value not valid, offset + maximum set position greater than the maximum transmitted position** error message is displayed.



WARNING

Check the **Offset** parameter value and then execute the **Activate offset** command every time you enter new values next to the following parameters: **Counts per revolution** and/or **Number of revolutions** in **Programming mode: Scaling**; **Counts to be displayed** in **Programming mode: Start / Stop**; and **Counts to be displayed** in **Programming mode: Prog**.

Default = 0 (min. = 0, max. = ≤ **Max total counts** (4 294 967 296) – set overall resolution (**Total set counts** or **Counts to be displayed**))

Activate offset

This function is active only when the **Enable preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to ENABLED and the **Select preset / offset** parameter in the **ENCODER CONFIGURATION** box is set to OFFSET.

Press this button to activate the offset function. The offset value (it is set next to the **Offset** item above) will be used to calculate the information to be output for the position of the encoder in the moment when the offset value is activated. To activate the offset, stop the encoder in the desired position and then press this **Activate offset** button. The chosen physical position will get the value according to the **Offset** item and all the previous and following positions will get a value according to it. For any further information on the offset function and the meaning of the related parameters and commands **Offset** and **Activate offset** refer to page 40.



WARNING

The Preset / Offset hardware input works in parallel with the **Activate offset** command. For any information on using the Preset / Offset input refer to the section "4.7 Preset / Offset input" on page 19.

6.3.3 DIAGNOSTICS box

This box is designed to show the error messages which could be triggered while programming the encoder.

Here are the available error messages.

No error

There are not active errors.

6.3.4 ENCODER CONFIGURATION box

Output code

The absolute encoder provides the absolute position information in a code format. Thus the output information can be represented in **BINARY, GRAY, or BCD code**. Select the required code format in the drop-down box.

BINARY CODE

In the base-2 number system only two digits are used: 0 and 1. For this reason it is the base of data processing in computing and electronic systems where 0 and 1 can be represented, electronically, as states "off" and "on". Binary code represents the information through the base-2 number system. It is very efficient, but has a great disadvantage from the point of view of the measuring equipment: more than one digit at a time often changes in consecutive positions. Because of the variations caused by gate delays, line impedances, etc., transitions do not occur simultaneously and this could result in erroneous readings and therefore lead to significant measuring errors. Consider, for instance, the following sequence:

| | | | | | | | | |
|-----------------|------|------|------|------|------|------|------|------|
| Decimal | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Binary (4 bits) | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 |
| Gray (4 bits) | 0000 | 0001 | 0011 | 0010 | 0110 | 0111 | 0101 | 0100 |

From position 1 to 2 (decimal), the last two digits both change in the binary representation (0 → 1; 1 → 0). The same happens from position 3 to 4, where the last three digits all change (0 → 1; 1 → 0; 1 → 0). During operation, a sensing error of the detection elements could result in a positioning command error. For instance, let's suppose the following wrong sequence: 0001 → 0011 → 0010 (position 1 → 3 → 2 instead of 1 → 2 → 3). Motion controller would command position 1, then position 3 and then a reverse motion to position 2.



NOTE

Please consider that Lika encoders are designed to ensure that only consecutive position values are always transmitted.

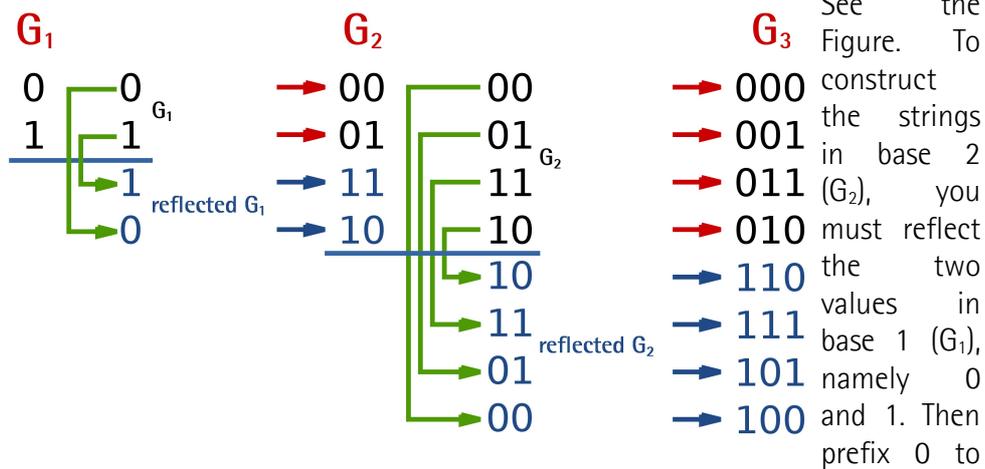
Binary code 4-bit representation (high logic level is represented in black)

| | | | | | | | | | | | | | | | | |
|-------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
| Bit 1 (LSB) | | | ■ | | ■ | | ■ | | ■ | | ■ | | ■ | | ■ | |
| Bit 2 | | | ■ | ■ | | | ■ | ■ | | | ■ | ■ | | | ■ | |
| Bit 3 | | | | | ■ | ■ | ■ | ■ | | | | | ■ | ■ | ■ | |
| Bit 4 (MSB) | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Decimal | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

GRAY CODE

As binary code, also Gray code, patented by Bell Laboratories researcher Frank Gray in 1947, represents the information through the base-2 number system; but the binary strings are ordered so that two successive values always differ in one bit only (see the table here below); and this property is preserved even at transition from the last to the first position of the sequence, provided that the number of information (namely, the resolution) is a power of 2 (otherwise, we must exploit the property of the so-called "Shifted Gray" code or "Gray Excess" code, see the "Shifted Gray code or Gray Excess code" section on page 42 where the **Offset** function is explained). This is a safer method than binary code, because any sequence where more than one bit at a time changes can be easily and immediately detected by the control unit. Anyway, the maximum error is always the value of the LSB.

It was originally called "reflected binary code" as it "may be built up from the conventional binary code by a sort of reflection process". The Gray sequence in base 2 (G_2) in fact is constructed starting from the operation of reflecting the strings in base 1 (G_1); and the Gray sequence in base 3 (G_3) is constructed starting from the operation of reflecting the strings in base 2 (G_2); and so on.



the normal G_1 strings (above the line) and prefix 1 to the reflected G_1 strings (below the line). To have the strings in base 3 (G_3), you must reflect the values in base 2 (G_2), namely 00, 01, 11 and 10. Then prefix 0 to the normal G_2 strings (above the line) and prefix 1 to the reflected G_2 strings (below the line). And so on, in a recursive and iterative way.

Gray code 4-bit representation (high logic level is represented in black)

| | | | | | | | | | | | | | | | | |
|-------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|
| Bit 1 (LSB) | | | | | | | | | | | | | | | | |
| Bit 2 | | | | | | | | | | | | | | | | |
| Bit 3 | | | | | | | | | | | | | | | | |
| Bit 4 (MSB) | | | | | | | | | | | | | | | | |
| Decimal | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

BCD CODE

BCD code (the acronym for binary-coded decimal) represents the decimal numbers using for each digit the corresponding 4-bit binary value. This means that only binary numbers from 0 (0000) to 9 (1001) are used. For instance: decimal number 123_{10} is represented as: 0001 0010 0011 (1111011 in binary code). The main advantage of the BCD code is its straight relation with the decimal code which allows to easily convert the binary numbers into decimal numbers and vice versa. On the other hand it requires more memory. BCD code is more and more rarely used, in particular in outdated electronics and spare parts now.

Default = binary



WARNING

Make sure that the Master and the Slave are configured exactly the same.

Protocol

It allows to set the SSI protocol for the transmission of the output information: RIGHT ALIGNED (= LSB RIGHT ALIGNED); TREE (= TREE FORMAT); LEFT ALIGNED (= MSB LEFT ALIGNED). For any information on the characteristics and the transmission mode of each implemented protocol refer to the specific point in the "SSI interface" section on page 23.

Default = RIGHT ALIGNED



WARNING

Make sure that the Master and the Slave are configured exactly the same.

Positive counting direction

It allows to set whether the position information output by the encoder increases (count up information) when the shaft rotates clockwise or counter-clockwise. Clockwise and counter-clockwise rotations are viewed from the shaft side. It is possible to choose the following options: CW (STANDARD) and CCW (INVERTED). When the counting direction is set to CW (STANDARD) - **Positive counting direction** = CW (STANDARD)-, if the Counting direction input (see on page 20) has LOW logic level (0Vdc) the encoder will provide the increasing count when the encoder is turning clockwise (and the decreasing count when the encoder is turning counter-clockwise); on the contrary if the Counting direction input has HIGH logic level (+Vdc) the encoder will provide the increasing count when the encoder is turning counter-clockwise (and the

decreasing count when the encoder is turning clockwise). When the option CCW (INVERTED) is set **-Positive counting direction = CCW (INVERTED)-**, if the Counting direction input has LOW logic level (0Vdc) the encoder will provide the increasing count when the encoder is turning counter-clockwise (and the decreasing count when the encoder is turning clockwise); on the contrary if the Counting direction input has HIGH logic level (+Vdc) the encoder will provide the increasing count when the encoder is turning clockwise (and the decreasing count when the encoder is turning counter-clockwise). For any information on the Complementary input refer to the "Electrical connection" section on page 17 and in particular to the "4.8 Counting direction input" section on page 20.

Default = CW (standard)



WARNING

After having set the new counting direction it is necessary to set also the preset / offset functions.

Enable preset / offset

It enables / disables the preset / offset functions. When this parameter is set to ENABLED, the functions available in the **PRESET / OFFSET** box are active and can be set; otherwise they are disabled. For any information on the preset and offset functions refer to the "6.3.2 PRESET / OFFSET box" section on page 37.

Default = enabled

Select preset / offset

This item is available only if the **Enable preset / offset** parameter is set to ENABLED. It allows to activate either the preset function (**Select preset / offset = PRESET**) or the offset function (**Select preset / offset = OFFSET**) by using the items available in the **PRESET / OFFSET** box. After having enabled the preset / offset functions (**Enable preset / offset = ENABLED**), this item allows to activate either the preset function or the offset function. The parameters in the **PRESET / OFFSET** box will have a different meaning depending on the value of this parameter whether it is set to PRESET or OFFSET. In the first case (**Select preset / offset = PRESET**) the functions in the box are used to set the preset, thus both the box and the button are labelled consequently; while in the second case (**Select preset / offset = OFFSET**) the functions in the box are used to set the offset, thus both the box and the button are labelled consequently. For any information on the preset and the offset functions refer to the "6.3.2 PRESET / OFFSET box" section on page 37.

Default = preset

Enable parity bit

It enables / disables the use of the parity bit for checking in a very basic way whether errors occur during transmission. The parity bit is the simplest form of error detecting code and offers the advantage that only one bit is required for error detection. On the other hand it only indicates that a parity error occurred in the transmission and there is no way to determine which particular bit is corrupted. Furthermore the parity bit is only guaranteed to detect an odd number of bit errors. If an even number of bits have errors, the parity bit records the correct number of ones, even though the data is corrupted. It can be either even or odd (see the following **Select parity bit** parameter). When even parity bit is set (**Select parity bit** = EVEN), the sum of the bits having HIGH logic level (=1) in the character has to be even; therefore if, for instance, the sum of the bits having logic level 1 in the character is 3, parity bit 1 will be added before transmission in order to have an even number of bits, namely 4 bits, having logic level 1; on the contrary if the sum is 4, parity bit 0 will be added as an even number of bits already have logic level 1. The reverse when odd parity bit is set (**Select parity bit** = ODD). In this case the sum of the bits having HIGH logic level (=1) in the character has to be odd. See also the following **Select parity bit** parameter.

Default = disabled

Select parity bit

This parameter is available only if **Enable parity bit** = ENABLED. It sets whether the parity bit has to be even or odd. For complete information on the parity bit refer to the explanation of the previous **Enable parity bit** parameter.

Default = even



WARNING

Make sure that the Master and the Slave are configured exactly the same.

SSI clock number

It sets the number of SSI clock signals required by the Master for the transmission of the data word. Enter the needed value and then press the confirmation button on the right.

In the SSI serial transmission the data bits are clocked out once at a time at each rising edge of the clock signal sent by the controller, starting from the MSB (Most Significant Bit) up to the LSB (Least Significant Bit), until the completion of the data word transmission. 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 set for the device); for instance, a 13-bit encoder (**Total set counts** = $8192 = 2^{13}$) needs minimum 14 clock edges. The additional clock over the n

value is intended to activate the pause time TM (time monoflop). This parameter allows to set the number of SSI clock signals required by the Master for the transmission of the data word. You have to set at least the number of clocks equal to the set bit resolution as the clock signal for the activation of the time monoflop is triggered by default. Consider that the number of clock signals can be higher than the set resolution, higher does not matter at all, but never lower (of course this must comply with the characteristics of the chosen protocol)! 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 RIGHT ALIGNED protocol) or follow (MSB LEFT ALIGNED protocol) or lead and/or follow the data word (TREE FORMAT protocol).
Default = 32 (min. = 1, max. = 32)

**WARNING**

Make sure that the Master and the Slave are configured exactly the same.

SSI timeout

It sets the minimum pause time Tm (Time Monoflop) between the transmission of two data words. After the monoflop time has expired (it is 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 value is expressed in μ s. For complete information refer to the "SSI interface" section on page 23.

Default = 12 (min. = 12, max. = 100)

**WARNING**

Make sure that the Master and the Slave are configured exactly the same.

Number of shifted bits

It shows the number of positions the LSB is shifted with respect to the last clock of the word. Press the **READ** button to read the value.

**EXAMPLE**

Let's suppose the MSB LEFT ALIGNED protocol is set; when you enter an overall resolution of 1 073 741 824 information (2^{30}) = 2^{18} singleturn resolution + 2^{12} multiturn resolution), the value "2" will be displayed next to this item.

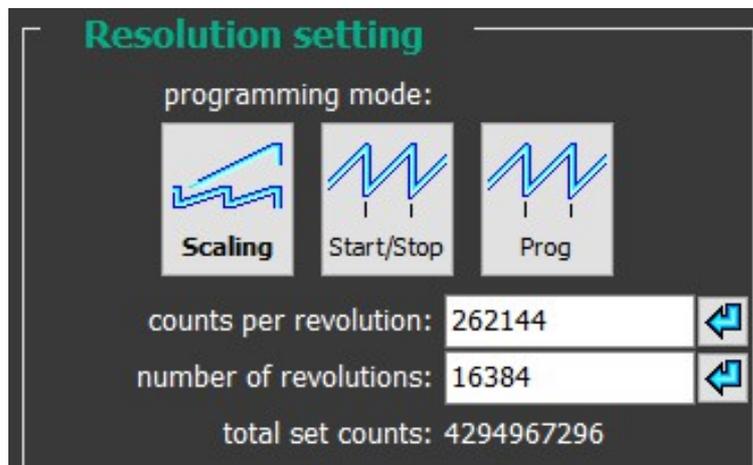
6.3.5 RESOLUTION SETTING box

The three graphic buttons available in the **RESOLUTION SETTING** box under the **PROGRAMMING MODE** label allow to programme the encoder work mode and to set its resolution in the way that best suits the requirements of the specific application. The functions available in the box under the three graphic buttons are different depending on the selected programming mode.

The available programming modes are:

- **Programming mode: Scaling:** it allows to set the number of information per revolution and the number of revolutions needed by the specific application, see below in the page.
- **Programming mode: Start / Stop:** TEACH IN, it allows to programme the encoder by considering directly the physical travel of the application you need to measure and control, see on page 55.
- **Programming mode: Prog:** it allows to programme the encoder when you exactly know the number of encoder information (counts) for the physical travel of the application you need to measure and control, see on page 58.

6.3.5.1 Programming mode: Scaling



Programming mode: Scaling

Press this button to enter the SCALING programming mode and activate the relevant functions.

The SCALING programming mode allows to set the number of information per revolution (**Counts per revolution** parameter) and the number of revolutions (**Number of revolutions** parameter) according to the requirements of the specific application. Thanks to this characteristics the HM58 PS programmable encoder can be interchangeable with the whole series of SSI encoders manufactured by Lika Electronic.

Counts per revolution

This parameter is available only when the **Programming mode: Scaling** is enabled.

This parameter sets the number of information per revolution (counts per revolution, cpr) needed by the application (singleturn resolution). Enter the needed value and then press the confirmation button on the right.

You are allowed to set whatever integer value less than or equal to the **number of physical information per revolution** or **hardware counts** (**Max counts per revolution** in the **ENCODER SPECIFICATIONS** box below) as the encoder is able to manage dynamically the resolutions which are not a power of 2 (see the "6.6 "Red zone" compensation" section on page 64). If you set a value greater than the number of physical information per revolution, then the **Value higher than the hardware resolution, please set a lower value** error message is displayed.

For any information on the number of physical information per revolution and the number of physical revolutions refer to the encoder specifications listed in the **ENCODER SPECIFICATIONS** box below.

Default = 262,144 (min. = 1, max. = 262,144)



NOTE

If the preset / offset functions are active, after having set a new value next to this **Counts per revolution** item, then you must check the value in the **Preset / Offset** parameter and activate it by sending the relevant **Activate preset / Activate offset** command.

Number of revolutions

This parameter is available only when the **Programming mode: Scaling** is enabled.

This parameter sets the number of revolutions needed by the application (multiturn resolution). Enter the needed value and then press the confirmation button on the right.

You are allowed to set whatever integer value less than or equal to the **number of physical revolutions** (**Max number of revolutions** in the **ENCODER SPECIFICATIONS** box) as the encoder is able to manage dynamically the resolutions which are not a power of 2 (see the "6.6 "Red zone" compensation" section on page 64). If you set a value greater than the number of physical revolutions, then the **Value higher than the hardware resolution, please set a lower value** error message is displayed.

For any information on the number of physical information per revolution and the number of physical revolutions refer to the encoder specifications listed in the **ENCODER SPECIFICATIONS** box below.

Default = 16,384 (min. = 1, max. = 16,384)

**NOTE**

If the preset / offset functions are active, after having set a new value next to this **Number of revolutions** item, then you must check the value in the **Preset / Offset** parameter and activate it by sending the relevant **Activate preset / Activate offset** command.

**EXAMPLE**

HM58 PS **18-14** multiturn encoder.

Physical resolution (refer to the specifications listed in the **ENCODER SPECIFICATIONS** box):

- **Max counts per revolution** = 262,144 info per turn = 18 bits (2^{18})
- **Max number of revolutions** = 16,384 revolutions = 14 bits (2^{14})
- **Max total counts** = 4 294 967 296 = 32 bits (2^{32})

You need to set an **11-bit singleturn resolution** (**Counts per revolution** = **2,048**); and a **10-bit multiturn resolution** (**Number of revolutions** = **1,024**):

- Activate **Programming mode: Scaling**
- Set the number of information per revolution: **Counts per revolution** = 2,048 (2^{11})
- Set the number of revolutions: **Number of revolutions** = 1,024 (2^{10})

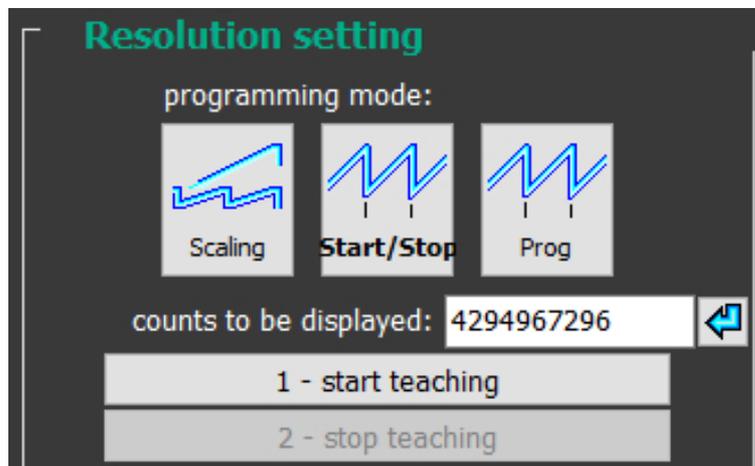
In the **Total set counts** field below the overall programmed resolution will be displayed: 2 097 152 ($2,048 * 1,024$).

Total set counts

It is available only when the **Programming mode: Scaling** parameter is enabled.

It shows the overall programmed resolution which results from the number of information per revolution **Counts per revolution** multiplied by the number of revolutions **Number of revolutions**, as set in the two previous parameters.

6.3.5.2 Programming mode: Start / Stop



Programming mode: Start / Stop

Press this button to enter the START / STOP programming mode and activate the relevant functions.

The START / STOP programming mode (TEACH IN) allows to programme the encoder by considering directly the physical travel of the application you need to measure and control; the set output range (the overall information to be output which is set next to the **Counts to be displayed** item) 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 press the **1 – Start teaching** button, and the end of the axis, i.e. the point where you press the **2 – Stop teaching** button; this is then repeated cyclically.

To programme the encoder using the START / STOP programming mode proceed as follows:

- set the number of information you need for measuring and controlling your axis travel next to the **Counts to be displayed** item;
- move to the origin of the axis travel you need to measure; in other words, move the axis to the point where it starts the travel, i.e. to the 0 point;
- now press the **1 – Start teaching** button; at this stage the display fields in the **POSITION** box are "frozen" and not available;
- move to the end of the axis travel you need to measure; in other words, move the axis to the final point where it stops the travel;
- now press the **2 – Stop teaching** button.



EXAMPLE 1

Here follows a first example useful to better understand how to programme the encoder using the START / STOP programming mode.

Let's suppose you need to measure and control the linear travel of an axis; the length of the travel is known, it is 3 metres. We need the information to be displayed with a resolution of thousandths of a metre (i.e. millimetre-resolution).

So, let's proceed as follows:

- set the number of information you need to display next to the **Counts to be displayed** item; as the travel is 3 metre long and we need thousandth resolution (millimetre-resolution), then set **Counts to be displayed** = 3000;
- now move the axis to the 0 point; in other words, move it to the point where the travel starts; in this point the displayed position value will be "0";
- press the **1 – Start teaching** button;
- move the axis to the end of the travel; in other words, move it to the point where the travel stops; in this point the displayed position value will be "2999";
- press the **2 – Stop teaching** button to close the programming procedure.



EXAMPLE 2

Here follows a second example useful to better understand how to programme the encoder using the START / STOP programming mode.

Let's suppose you need to measure and control the angular movement of a device; the magnitude of the displacement is known, it is 90°, but we need the position to be displayed with an angular resolution of one arcsecond.

So, let's proceed as follows:

- set the number of information you need to display next to the **Counts to be displayed** item; as the magnitude of the movement is 90° and we need the information to be displayed in arcseconds, we must set: **Counts to be displayed** = 324000;
- now move the axis to the 0 point; in other words, move it to the point where the travel starts; in this point the displayed position value will be "0";
- press the **1 – Start teaching** button;
- move the axis to the end of the travel; in other words, move it to the point where the travel stops; in this point the displayed position value will be "323999";
- press the **2 – Stop teaching** button to close the programming procedure.

For instance, when the position of the axis will be "7201" (**Position** = 7201), then the angular position of the device will be 2° 0' 1".

Counts to be displayed

This parameter is available only when the **Programming mode: Start / Stop** is enabled.

It sets the overall information to be output for the travel comprised between the ends of the axis: the origin of the axis, i.e. the point where you press the **1 – Start teaching** button, and the end of the axis, i.e. the point where you press the **2 – Stop teaching** button; in other words it sets the output range of the information to be displayed.

Default = 4 294 967 296 (min. = 1, max. = 4 294 967 296)

1 – Start teaching

This button is available only when the **Programming mode: Start / Stop** is enabled.

After having moved the axis to the start position (0 position), i.e. the point where the travel we need to measure starts, press this button in order to relate the first value of the output range to the physical position where you have moved the axis to (origin of the axis). As soon as you press this button, the display fields in the **POSITION** box are "frozen" and not available.

2 – Stop teaching

This button is available only when the **Programming mode: Start / Stop** is enabled.

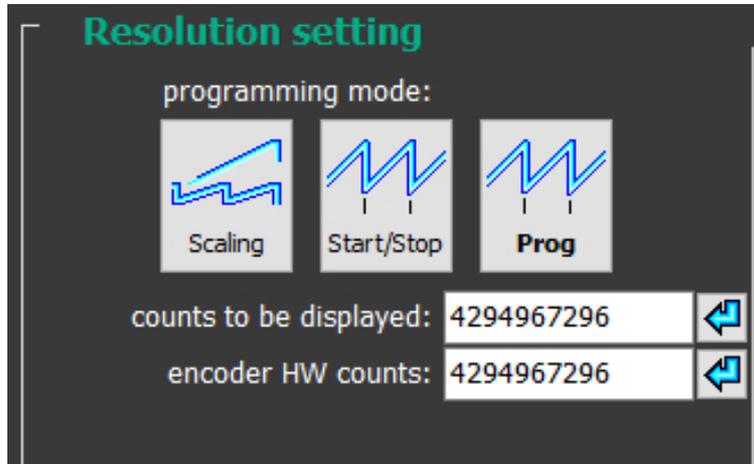
After having moved the axis to the end position, i.e. the point where the travel we need to measure stops, press this button in order to relate the last value of the output range to the physical position where you have moved the axis to (end of the axis).



WARNING

- If the start position (**1 – Start teaching**) and the final position (**2 – Stop teaching**) match (i.e., you do not change the position of the axis during the programming process and press both the buttons when the axis is in the same exact position), then the error message is displayed.
- If the travel is over the maximum encoder limits, then the error message is displayed.
- If you set the start position, move the axis towards a direction and then reverse the movement of the axis so going back over the start position, then the error message is displayed.

6.3.5.3 Programming mode: Prog



Programming mode: Prog

Press this button to enter the PROG programming mode and activate the relevant functions.

The PROG programming mode allows the operator to programme the encoder when you know the exact number of encoder information (counts) for the physical travel of the application you need to measure and control. The length of the travel you need to measure and control must be set next to the **Encoder HW counts** item and is expressed in counts. While the output range to be displayed must be set next to the **Counts to be displayed** item. Information is repeated cyclically.



EXAMPLE

Here follows an example useful to better understand how to programme the encoder using the PROG programming mode.

Let's suppose we need to measure and control the angular displacement of a device; the magnitude of the displacement is 27°. We can easily calculate the number of encoder information corresponding to a 27 degree rotation. If the maximum number of information per turn (i.e. in the 360 degrees) is 262,144 (the **Max counts per revolution** field in the **ENCODER SPECIFICATIONS** box = 262,144), we can set the following ratio: $262,144 : 360 = x : 27 \Rightarrow 262,144 * 27 / 360 = 19,661$. So the number of encoder information in the 27 degree rotary displacement will be 19,661.

Now let's proceed as follows:

- set the number of information you need to display next to the **Counts to be displayed** item; let's suppose we need to express the displacement in degrees; thus set: **Counts to be displayed** = 27;
- now enter the number of encoder information corresponding to a 27 degree rotation, thus set: **Encoder HW counts** = 19661.

Counts to be displayed

This parameter is available only when the **Programming mode: Prog** is enabled. It allows to enter the number of information you need to display for the travel whose length is set next to the following **Encoder HW counts** item, in other words it sets the output range to be displayed.

Default = 4 294 967 296 (min. = 1, max. = 4 294 967 296)

Encoder HW counts

This parameter is available only when the **Programming mode: Prog** is enabled. It sets the length of the displacement you need to measure and control expressed in encoder information (counts). When needed, calculate the portions of a turn by considering the **Max counts per revolution**. For instance: if the displacement is 1.8 turn long, enter: $262,144 * 1.8 = 471,859$ counts.

Default = 4 294 967 296 (min. = 1, max. = 4 294 967 296)

6.3.6 ENCODER SPECIFICATIONS box



Max counts per revolution

It displays the number of physical information per revolution the device is able to output (namely, the singleturn resolution: 262,144 cpr -counts per revolution-, i.e. 2^{18}).

If you need to set a custom singleturn resolution refer to the **Counts per revolution** parameter in the SCALING programming mode page, see on page 53.

Max number of revolutions

It displays the number of physical revolutions the device is able to output (namely, the multiturn resolution: 16,384 turns, i.e. 2^{14}).

If you need to set a custom multiturn resolution refer to the **Number of revolutions** parameter in the SCALING programming mode page, see on on page 53.

Max total counts

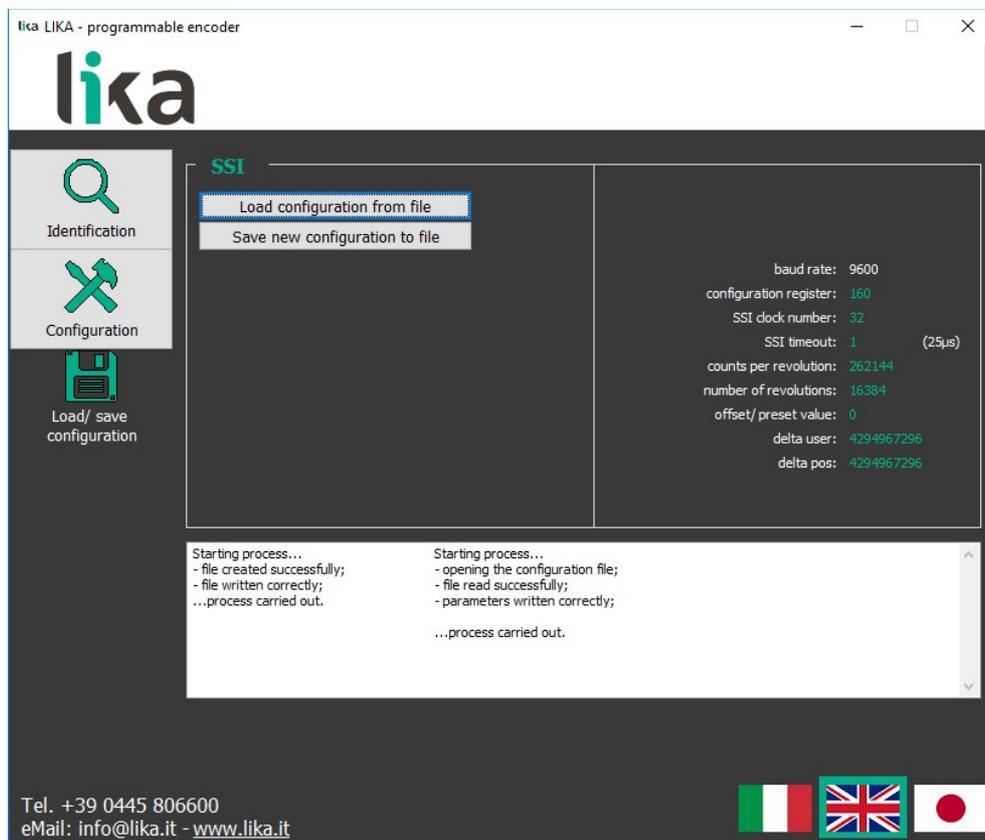
It displays the overall physical resolution of the device (4 294 967 296, i.e. 2^{32}).
The overall physical resolution results from the following calculation:

$$\text{Max total counts} = \text{Max counts per revolution} * \text{Max number of revolutions.}$$

If you need to set a custom overall resolution refer to the parameters **Counts per revolution** on page 53 and **Number of revolutions** on page 53.

6.4 LOAD / SAVE CONFIGURATION page

When you press the **LOAD / SAVE CONFIGURATION** button in the left navigation bar you enter the **LOAD / SAVE CONFIGURATION** page.



This page allows the operator to save the current encoder configuration to a .dat file; and to load a desired configuration previously saved to a .dat file. The current encoder configuration is listed in the pane on the right.

6.4.1 Saving the encoder configuration to a file

To save the current encoder configuration just press the **SAVE NEW CONFIGURATION TO FILE** button. As soon as you press the button the **Save as** dialogue box appears on the screen and the "Starting process..." message appears on the display box below in the page. The operator must type the .dat file name and specify the path where the file has to be located. When you press the **SAVE** button to confirm, the dialogue box closes. If the process is carried out properly, then the "- file created successfully; - file written correctly; ...process carried out" message appears on the display box. Otherwise the **Error creating the file** warning message appears on the display box.

6.4.2 Loading the encoder configuration from a file

When you need to load an encoder configuration you have previously saved to a file, press the **LOAD CONFIGURATION FROM FILE** button. As soon as you press the button, the **Open** dialogue box appears on the screen and the "Starting process..." message appears on the display box below in the page. The operator must select the folder and then the file where the configuration has been saved. When you press the **OPEN** button to confirm, the dialogue box closes. If the process is carried out properly, then the "- opening the configuration file; - file read successfully; - parameters written correctly; ...process carried out" message appears on the display box. Otherwise the **Error reading the file** warning message appears on the display box.

6.5 Error messages

(in alphabetical order)

Attention: enabling the parity bit with the resolution currently set requires an "SSI clock number" greater than the set one

As previously stated (see the **SSI clock number** parameter on page 50), in the SSI serial transmission $n + 1$ rising edges of the clock signals are required for each data word transmission (where n is the bit resolution set for the device); for instance, a 13-bit encoder (**Total set counts** = $8,192 = 2^{13}$) needs minimum 14 clock edges. The additional clock over the n value is intended to activate the pause time T_M (time monoflop). Please note that you have to set at least the number of clocks equal to the set bit resolution as the clock signal for the activation of the time monoflop is triggered by default. When you enable the parity bit (**Enable parity bit** = ENABLED) the system requires a further bit for the error detection; thus the data word will be necessarily one bit longer. If the number of set clock signals is equal to the overall requested resolution, then the system needs a further SSI clock for the activation of the parity bit.

EXAMPLE

Set singleturn resolution = **Counts per revolution** = 2,048 (2^{11});

Set multiturn resolution = **Number of revolutions** = 1,024 (2^{10});

Set overall resolution = **Total set counts** = 2 097 152 (2^{21});

Minimum number of SSI clock signals to be set = **SSI clock number** = 21

If **Enable parity bit** = ENABLED, the minimum number of SSI clock signals to be set will be = **SSI clock number** = 22 (21 + 1)

Attention: the maximum transmitted position requires an SSI clock number greater than the set one

The operator has tried to enter next to the **SSI clock number** item in the **ENCODER CONFIGURATION** box a number of SSI clock signals lower than the set overall resolution (**Total set counts**). The operator has to set next to the **SSI clock number** item at least the number of clocks equal to the set bit resolution. For example, for a 13-bit encoder (**Total set counts** = 8,192 = 2^{13}) you must set **SSI clock number** \geq 13.

Carattere non ammesso. E' possibile digitare soltanto un numero

You entered an invalid character or comma (such as , \ / : * ? " < > |). All the fields only allow integer values.

Character not allowed. Please enter numbers only

You entered an invalid character or comma (such as , \ / : * ? " < > |). All the fields only allow integer values.

Counts to be displayed must be lower than the hardware counts of the encoder

While configuring the encoder in the PROG programming mode (see on page 58), the operator has set next to the **Counts to be displayed** item a value higher than the number of encoder information which defines the application displacement as set next to the **Encoder HW counts** parameter.

Error creating the file

If an error occurs while saving the encoder configuration to a file (see the "6.4.1 Saving the encoder configuration to a file" section on page 61), then this error message is displayed.

Error reading the file

If an error occurs while uploading an encoder configuration file (see the "6.4.2 Loading the encoder configuration from a file" section on page 61), then this error message is displayed.

Value higher than the hardware resolution, please set a lower value

The operator entered next to the **Counts per revolution** parameter in the **RESOLUTION SETTING** box a value greater than the number of physical information per revolution (see **Max counts per revolution** in the **RESOLUTION SETTING** box); or: he entered next to the **Number of revolutions** parameter in the **RESOLUTION SETTING** box a value greater than the number of physical revolutions (see **Max number of revolutions** in the **RESOLUTION SETTING** box).

Value not valid, offset + maximum set position greater than the maximum transmitted position

The operator entered next to the **Offset** parameter in the **OFFSET** box a value greater than the one resulting from the following calculation:

Max total counts (4 294 967 296) – set overall resolution (**Total set counts** or **Counts to be displayed**).

Please enter a lower offset value.

Value not valid: preset greater than the maximum position

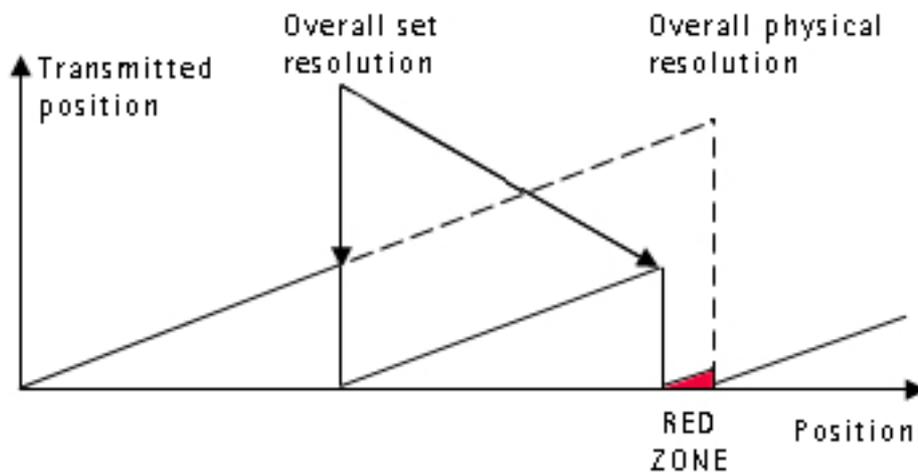
The operator has entered next to the **Preset** parameter in the **PRESET** box a value greater than the set overall resolution.

- When **Programming mode: Scaling** is set, then **Preset** must be less than or equal to **Total set counts** (**Counts per revolution** * **Number of revolutions**).
- When **Programming mode: Start / Stop** is set, then **Preset** must be less than or equal to **Counts to be displayed**.
- When **Programming mode: Prog** is set, then **Preset** must be less than or equal to **Counts to be displayed**.

6.6 "Red zone" compensation

Most of the encoders suffer the problem of the so-called "red zone". This problem occurs when the overall resolution (i.e. the number of information per revolution * the number of revolutions) is not a power of 2.

When this problem arises, the device must operate within the "red zone" for a certain number of positions. The size of the "red zone" is variable. To calculate it we must subtract the overall set resolution from the overall physical resolution of the device as many times as until the difference is less than the overall set resolution. When the encoder crosses the limit of the last value in the overall physical resolution, a counting error occurs, i.e. a jump in the position count. The problem is represented graphically in the following Figure.



EXAMPLE

HM58 PS 18-14 multiturn encoder.

Physical resolution:

- **Singleturn physical resolution** = 262,144 counts/turn = 18 bits (2^{18})
- **Multiturn physical resolution** = 16,384 revolutions = 14 bits (2^{14})
- **Overall physical resolution** = 4 294 967 296 = 32 bits (2^{32})

Set values:

- **Information per revolution** = 262,144 = 2^{18}
- **Number of revolutions** = 6,748 = it is NOT a power of 2
- **Overall set resolution** = 1 768 947 712 = it is NOT a power of 2

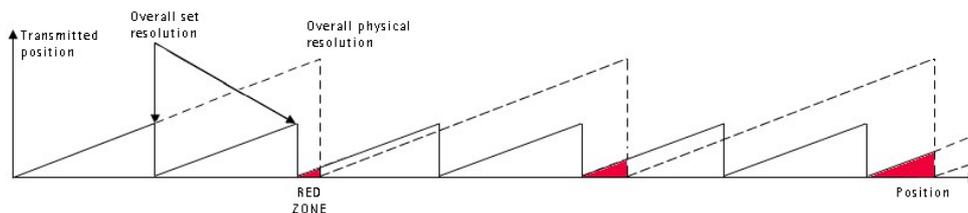
This can be proved easily:

$$\frac{\text{Overall physical resolution}}{\text{Overall set resolution}} = \frac{4\,294\,967\,296}{1\,768\,947\,712} = 2.427\dots$$

It follows that for 757 071 872 positions ($4\,294\,967\,296 - 1\,768\,947\,712 * 2 = 757\,071\,872$), i.e. for 2,888 revolutions, the encoder will work within the limits of the so-called "red zone". After position 757 071 871 (i.e. at the end of the "red zone") a position error (namely, a "jump" in the position count) would happen as the following position would be "0". See the Figure in the previous page.

This encoder from Lika Electronic was designed to dynamically compensate the problem of the "red zone". An algorithm developed by Lika Electronic in fact allows to recognize the "red zone" so adding a compensation; in this way at the counting overflow where the max. physical resolution point is located, namely 4 294 967 296, a counting error does not occur.

The matter is overcome as shown in the following Figure.



As you can easily understand, the transmitted position is consistent although the encoder is working within the limits of the "red zone".



WARNING

Please mind the following limitation.

It concerns the number of revolutions you are allowed to carry out while the encoder is switched off; if this value is exceeded, the compensation of the "red zone" is lost as well as the counting position.

This value is variable and depends on the set number of revolutions ($N_{\text{number of revolutions}}$, see the **Number of revolutions** parameter in the SCALING programming mode page (see on on page 53) and has to be calculated in two different ways depending on whether the set number of revolutions is greater than or less than 8,192.

CASE 1

If the set number of revolutions ($N_{\text{number of revolutions}}$) is $\leq 8,192$, then the maximum number of revolutions you will be allowed to carry out while the encoder is switched off ($N_{\text{max revolutions}}$) will be as follows:

$$N_{\text{max revolutions}} = \frac{N_{\text{cycles}}}{2} * N_{\text{number of revolutions}}$$

where

$$N_{\text{cycles}} = \text{INTEGER} \left(\frac{\text{Multiturn physical resolution}}{N_{\text{number of revolutions}}} \right) = \text{INTEGER} \left(\frac{2^{14}}{N_{\text{number of revolutions}}} \right)$$

CASE 2

Otherwise, if the set number of revolutions ($N_{\text{number of revolutions}}$) is $> 8,192$, then the maximum number of revolutions you will be allowed to carry out while the encoder is switched off ($N_{\text{max revolutions}}$) will be as follows:

$$N_{\text{max revolutions}} = \text{SIZE}_{\text{red zone}}$$

where

$$\text{SIZE}_{\text{red zone}} = \text{RESIDUAL} \left(\frac{\text{Multiturn physical resolution}}{N_{\text{number of revolutions}}} \right) = \text{RESIDUAL} \left(\frac{2^{14}}{N_{\text{number of revolutions}}} \right)$$

Thus, if we use the values already reported in the example above in this paragraph, we will have as follows:

Physical resolution:

- **Singleturn physical resolution** = 262,144 counts per turn = 18 bits (2^{18})
- **Multiturn physical resolution** = 16,384 revolutions = 14 bits (2^{14})
- **Overall physical resolution** = 4 294 967 296 = 32 bits (2^{32})

Set values:

- **Counts per turn** = 262,144 = 2^{18}
- **Number of revolutions** = 6,748 = it is NOT a power of 2
- **Overall set resolution** = 1 768 947 712 = it is NOT a power of 2

The set number of revolutions ($N_{\text{number of revolutions}}$) is $\leq 8,192$, thus $N_{\text{max revolutions}}$ will result from the following calculations:

$$N_{\text{cycles}} = \text{INTEGER} \left(\frac{2^{14} = 16,384}{6,748} \right) = 2 (2.427978\dots)$$

So:

$$N_{\text{max revolutions}} = \frac{N_{\text{cycles}}}{2} * N_{\text{number of revolutions}} = \frac{2}{2} * 6,748 = \mathbf{6,748}$$

From the example above it follows that the number of revolutions you are allowed to carry out while the encoder is switched off will be 6,748.

7 Default parameters list

| Parameters list | Default value | | |
|--|--------------------------------------|--|--|
| Preset | 0 | | |
| Offset | 0 | | |
| Output code | binary | | |
| Protocol | right aligned (LSB Right Aligned) | | |
| Positive counting direction | CW (standard) | | |
| Enable preset / offset | enabled | | |
| Select preset / offset | preset | | |
| Enable parity bit | disabled | | |
| Select parity bit | even | | |
| SSI clock number | 32 | | |
| SSI timeout μ s | 12 | | |
| Programming mode: Scaling | Scaling | | |
| Counts per revolution PPR | 262,144 | | |
| Number of revolutions R | 16,384 | | |
| Total set counts P | 4 294 967 296 | | |
| Counts to be displayed in Programming mode: Start / Stop | 4 294 967 296 | | |
| Counts to be displayed in Programming mode: Prog | 4 294 967 296 | | |
| Encoder HW counts P in Programming mode: Prog | 4 294 967 296 | | |

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| Document release | Release date | Description | HW | SW | Interface |
|------------------|--------------|---|----|----|-----------------------|
| 1.0 | 15.01.2014 | First issue | - | - | V1210 |
| 1.1 | 15.11.2019 | General review, new programming software tool | - | - | V1911 |
| 1.2 | 14.01.2021 | Information about IF92 kit updated | - | - | V1911, V2105, V3.6 |
| 1.3 | 09.03.2023 | New order code, minor amendments, general revision, interface updated | - | - | V3.7 |



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

lika

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