User's guide

Hx58, Hx58S HxC58 PB

BC-PB, BC-PB-C

PROFIBUS®
PROCESS FIELD BUS

Profibus-DP Profile for Encoders

lika

Smart encoders & actuators

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Typographic and iconographic conventions

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

- parameters and objects both of the device and the interface are coloured in ORANGE;
- alarms are coloured in RED;
- states are coloured in FUCSIA.

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

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

Preliminary information

This guide is designed to describe the technical characteristics, installation and use of the **Profibus encoders of the Hx58x series**. For any further information please refer to the product datasheet.

To make it easier to read the text, this guide can be divided into two main sections.
In the first section 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 **Profibus Interface**, both general and specific information is given on the Profibus interface. In this section the interface features and the parameters implemented in the unit are fully described.

1   Safety summary

Safety

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

Electrical safety

- Turn off power supply before connecting the device;
- connect according to explanation in section "4 - Electrical connections";
- in compliance with the 2004/108/EC norm on electromagnetic compatibility, following precautions must be taken:
  - before handling and installing, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise, install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source, shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;
  - minimize noise by connecting the shield and/or the connector housing and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

	Mechanical safety

- Install the device following strictly the information in the section "3 - Mounting instructions";
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the encoder;
- do not tool the encoder or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics declared by manufacturer;
- unit with solid shaft: in order to guarantee maximum reliability over time of mechanical parts, we recommend a flexible coupling to be installed to connect the encoder and user's 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, when requested, the anti-rotation pin.

2   Identification

Device can be identified through the **ordering 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 ordering code and the serial number when reaching Lika Electronic s.r.l. for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product underline refer to the technical catalogue.

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

3 Mounting instructions

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

3.1 Solid shaft encoders

- Mount the flexible coupling **1** on the encoder shaft;
- fix the encoder to the flange **2** (or to the mounting bell) by means of 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
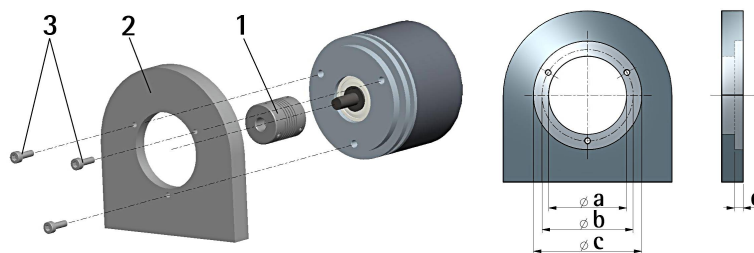
	a [mm]	b [mm]	c [mm]	d [mm]
HS58, HM58	-	42	50 F7	4
HS58S, HM58S	36 H7	48	-	-

3.1.2 Installation using fixing clamps (code LKM-386)
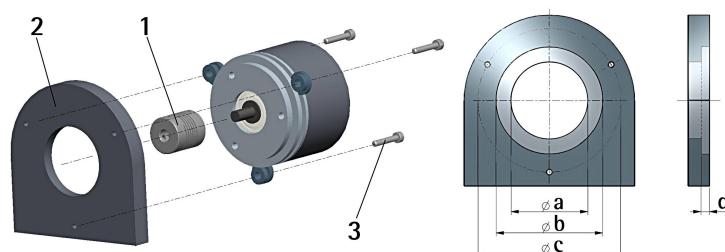
	a [mm]	b [mm]	c [mm]	d [mm]
HS58, HM58	-	50 F7	67	4
HS58S, HM58S	36 H7	-	67	-

3.1.3 Installation using a mounting bell (code PF4256)
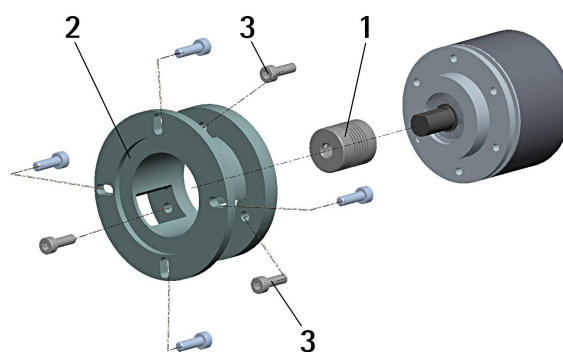
3.2 Hollow shaft encoders

3.2.1 HSC58, HMC58

- 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 (apply threadlocker to screw **3**).
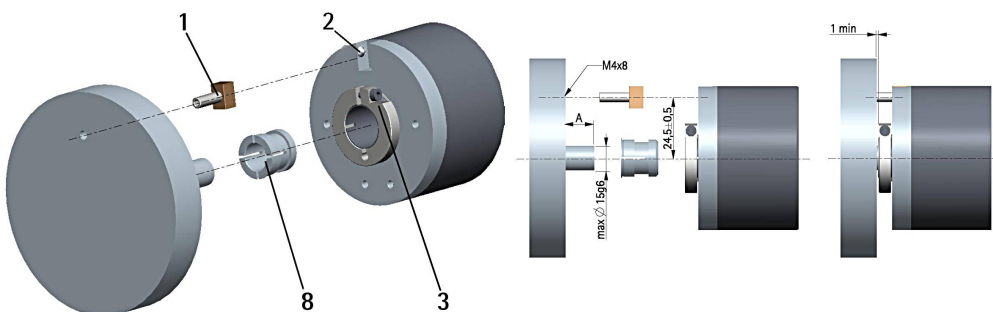
3.2.2 HSC59, HMC59

- 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 cylindrical head screws **5**;
- fix the collar **3** to the encoder shaft (apply threadlocker to screw **3**).
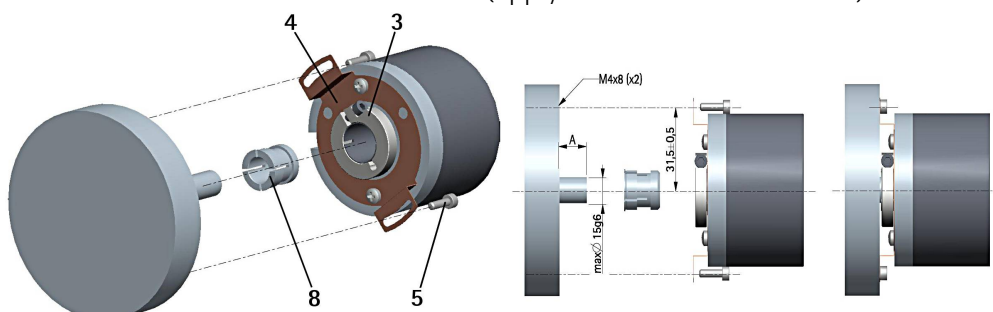
3.2.3 HSC60, HMC60

- 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 (apply threadlocker to screw **3**).

4.3 Connection cap with PG gland (BC-PB)

BC-PB connection cap is fitted with three PG9 cable glands for bus-IN and bus-OUT connections and power supply connection. The bus cables can be connected directly to the terminal connectors located in front of each cable gland.
We recommend Profibus-DP certificated cables to be used. Core diameter should not exceed Ø 1.5 mm (0.06 inches).

Terminal connector	Description
-	0 VDC Supply voltage
+	+10VDC +30VDC Supply voltage
G	Profibus GND [1]
B	Profibus B (Red)
A	Profibus A (Green)
PG	Shield [2]

[1] Profibus GND is the 0V reference of Profibus signals, it is not connected to 0VDC supply voltage.
[2] Connect the cable shield to cable gland.

4.4 Connection cap with M12 connectors (BC-PB-C)
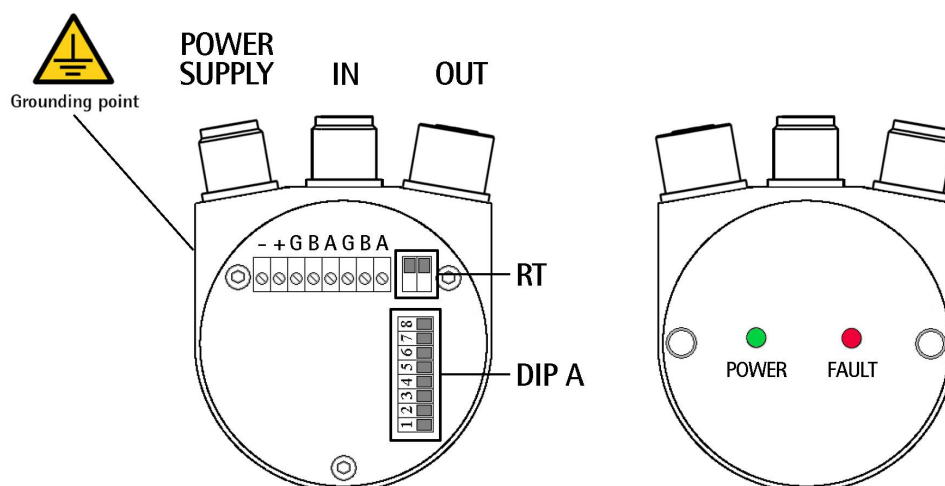
BC-PB-C connection cap is fitted with three M12 connectors with pin-out in compliance with Profibus standard. Therefore you can use standard Profibus cables commercially available.

Power supply
M12 connector
A coding
(frontal side)
male

Pin	Function
1	+10VDC +30VDC
2	n.c.
3	0 VDC GND
4 [1]	Shield
Case	

n.c. = not connected
[1] Shield is also connected to pin 4 to allow the connection of the shield even if the plug connector has a plastic case.

Profibus signals
M12 connector
B coding
(frontal side)
male (BUS IN)   female (BUS OUT)
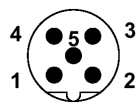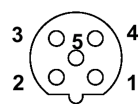
Pin	Function
1	n.c.
2	Profibus A (Green)
3	n.c.
4	Profibus B (Red)
5	n.c.
Case	Shield

n.c. = not connected

4.5 Connection of the shield

Disentangle and shorten the shielding **1** and bend it over the part **2**; then place the ring nut **3** of the connector. Be sure that the shielding **1** is in tight contact with the ring nut **3**.
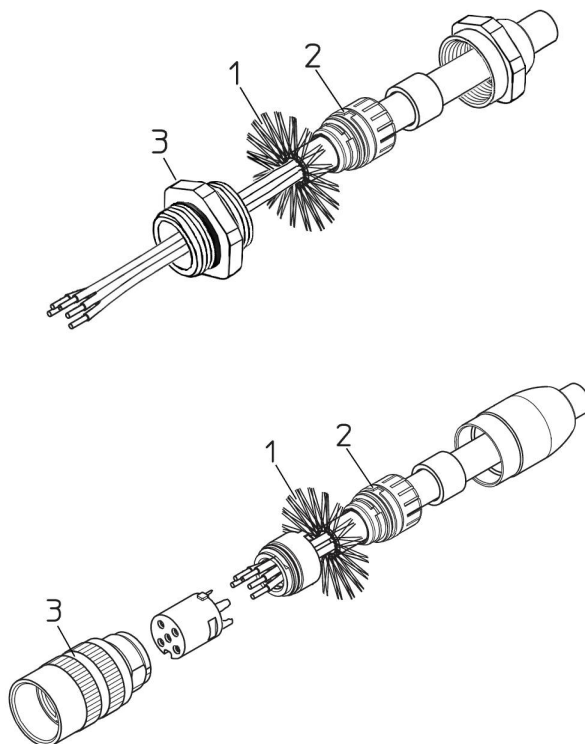
4.6 Bus termination resistance

A bus termination resistance is provided in the connection cap. This has to be activated as line termination in the last device.
Use RT Switch to activate or deactivate the bus termination.

RT	Description
1 = 2 = ON	Activated: if the encoder is the last device in the transmission line
1 = 2 = OFF	Deactivated: if the encoder is not the last device in the transmission line
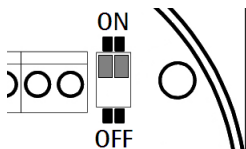
4.7 Baud rate

The baud rate is set by the Master via software during configuration of the node (slave).
Supported baud rates are listed in the enclosed GSD file.

4.8 Node address setting: DIP A

WARNING
Power supply must be turned off before performing this operation!

The node number must be set via hardware using DIP A dip-switches.
Allowed addresses are from 0 to 125. The default value is 1. Value 126 is reserved to enable the use of the internal address and the SAP55 service (see below in this section).

DIP A:
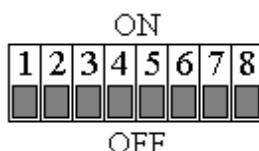
Turn the power supply off and set the node address in binary value; consider that: ON=1, OFF=0

bit	1 LSB	2	3	4	5	6	7 MSB	8 not used
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	

Example

Set node address = 25:
25_{10} = 0001 1001$_2$ (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
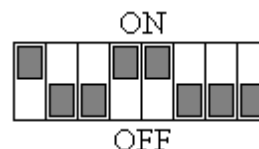
Set node address = 55:
55_{10} = 0011 0111$_2$ (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	ON	ON	OFF	ON	ON	OFF	OFF
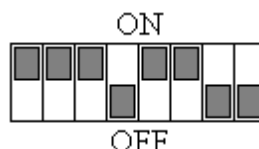
WARNING
This device is designed to allow the node address setting also via software by means of the Service Access Point SAP55 Set_Slave_Address. For any information please refer to the section "5.4 Setting the node address via BUS (SAP55 service)" on page 25 and to the section "6.8 Set_Slave_Address command (SAP55 service)" on page 39.

4.9 Diagnostic LEDs

Two LEDs installed in the connection cap of the device are designed to show the operating or fault status of the Profibus-DP interface.

Fault (red)	Power (green)	Event
OFF	OFF	No power supply or hardware fault
OFF	ON	Correct operation (correct communication)
OFF	Flashing	Red Zone, see section "6.9 "Red Zone""
ON	Flashing	Configuration parameters not valid
ON	OFF	Transmission time-out error
Flashing	ON	Bus communication failure
Flashing	Flashing	Flash memory error

5   Quick reference

5.1 STEP7 configuration

5.1.1 Importing GSD file

Profibus encoders are supplied with their own GSD file **Hx58_Vx.GSD** (see enclosed documentation or click **www.lika.biz > ROTARY ENCODERS > ABSOLUTE ENCODERS > PROFIBUS**).
HM58_Vx.GSD: for multi-turn encoders
HS58_Vx.GSD: for single-turn encoders

In the menu bar of the **HW Config** window, press **Options** and then **Install New GSD...** command.
Select the correct GSD file in the installation window and install it.
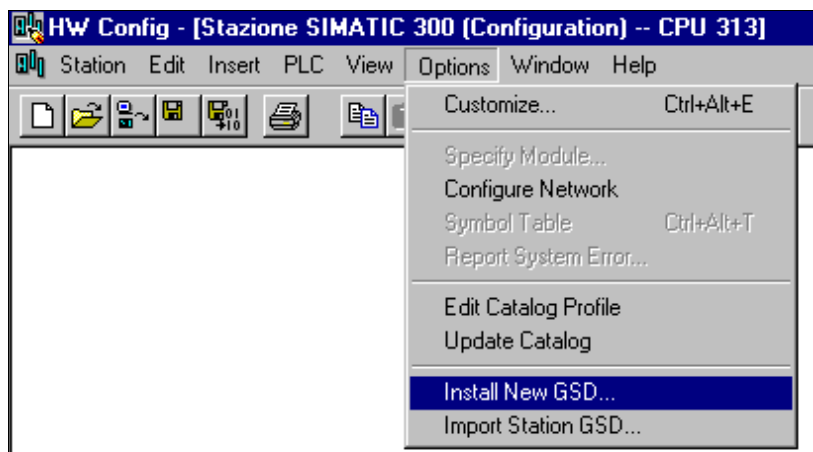
5.1.2 Adding a node to the project

In the left pane of the **HW Config** window, open the directory tree and select **Catalog\PROFIBUS_DP\Additional Field Devices\Encoders**; drag the "LIKA Hx58" module to the window on the right and drop it on "BUS".
Then drag the desired submodule (Class 1, Class 2 or Class 2(+VEL)) to the variables table in the bottom right; in this way you set the class of the device (for further details see section "6.2 Classes of the Device profile").
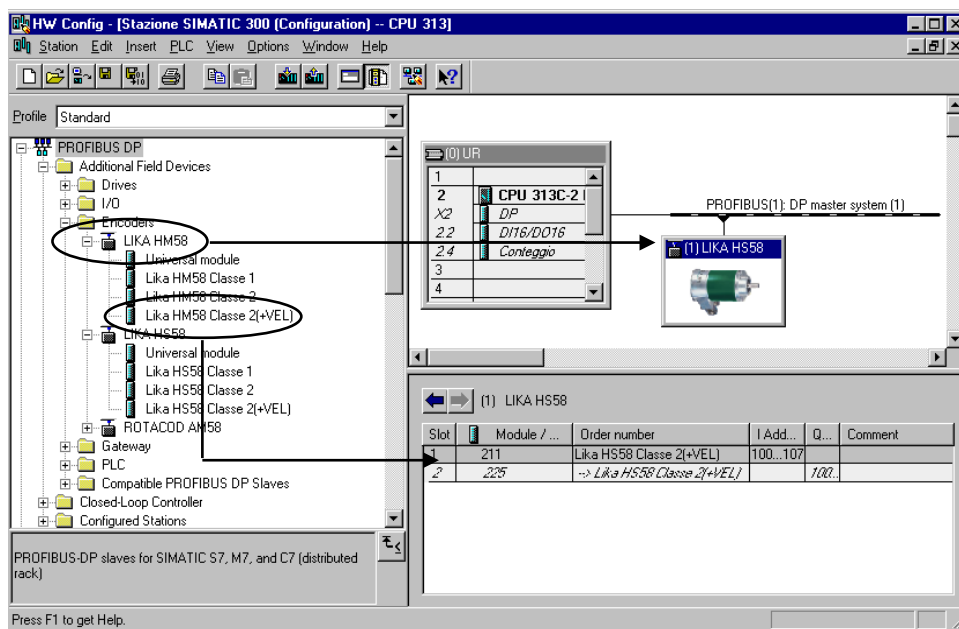
5.1.3 Encoder configuration parameters

To enter the Encoder configuration parameters window, select the device in the bottom right of the **HW Config** window and right-click to open the menu; then choose the **Object Properties...** command.
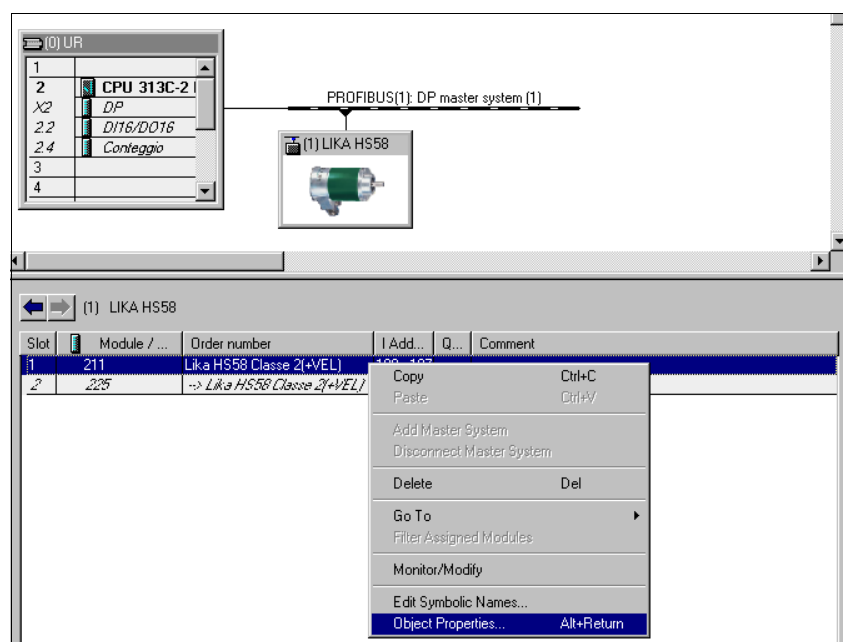
Properties – DP slave window will appear; in the **Parameter Assignment** page the list of all encoder parameters is available.

For any information on using and setting each parameter refer to section "6.4 DDLM_Set_Prm".
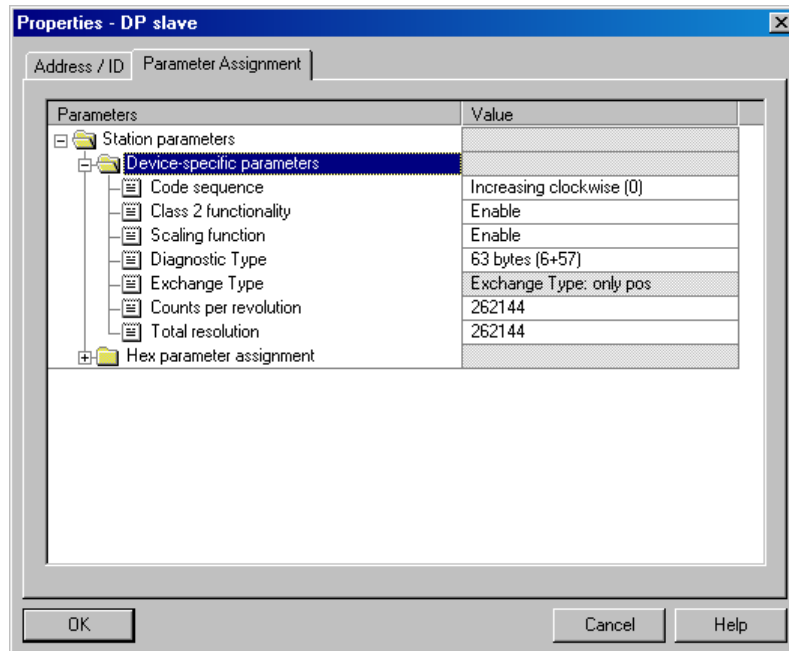
Class 2 example
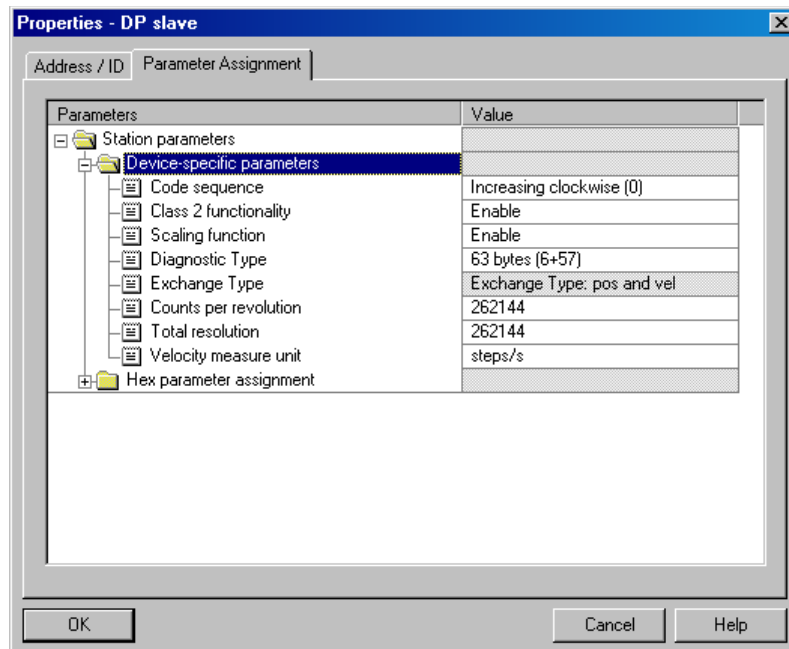
Class 2(+VEL) example

After having set new parameter values, click the **OK** button to close the **Properties – DP slave** window and then the **Download** button (see icon on the left) in the toolbar of the **HW Config** window to download set parameters.

5.2 Reading diagnostic information

The diagnostic information message can be set either to 16 or 63 bytes, see **Diagnostic type** in encoder parameters.

Before entering the diagnostic page, it is necessary to connect to the unit (enter online status). To do this, select **Station\Open online** in the **HW Config** window or click the **Online<->Offline** button (see icon on the left). Then select **PLC\Module information...** to enter the **Module information** window. Finally open the **DP Slave Diagnostic** page.
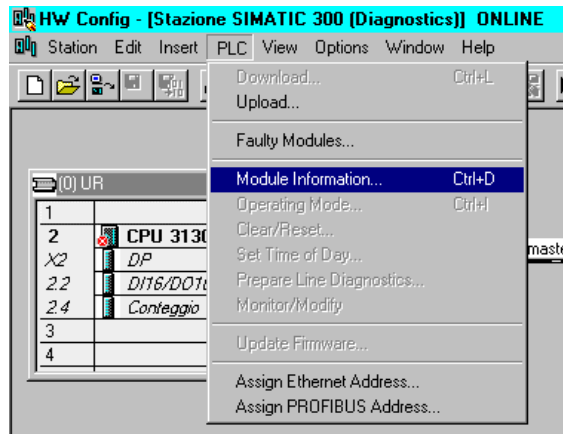
Click the **Hex. Format...** button to display diagnostic information:
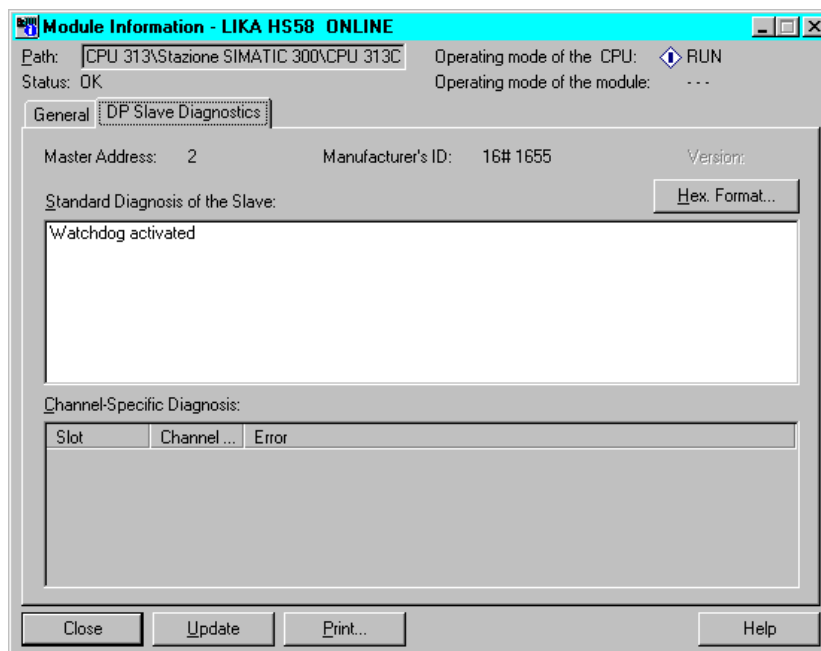
16-byte Diagnostic:
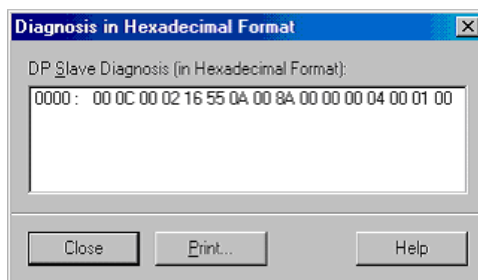
63-byte Diagnostic:
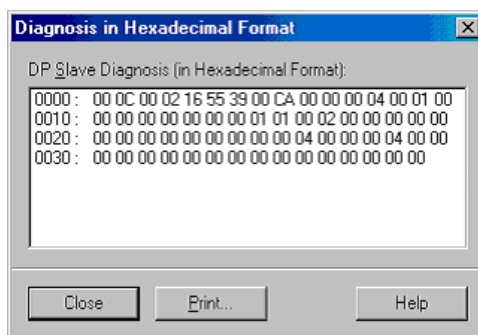
NOTE

Should the 63-byte diagnostic not work properly using STEP7 software we suggest setting the 16-byte diagnostic.

If diagnostic information is not used, it is recommended to set 16-byte diagnostic (see "5.1.3 Encoder configuration parameters" section).

See section "6.7 DDLM_Slave_Diag" for a complete list and meaning of each diagnostic byte.

5.3 Setting the Preset value

Example

The encoder having device address 1 transmits the position value to the Master.
Position value is loaded into variables ED 100...103 (4 bytes).
Speed value is loaded into variables ED 104...107 (4 bytes).
The **Preset value** is sent to the encoder using variables AD 100...103 (4 bytes).
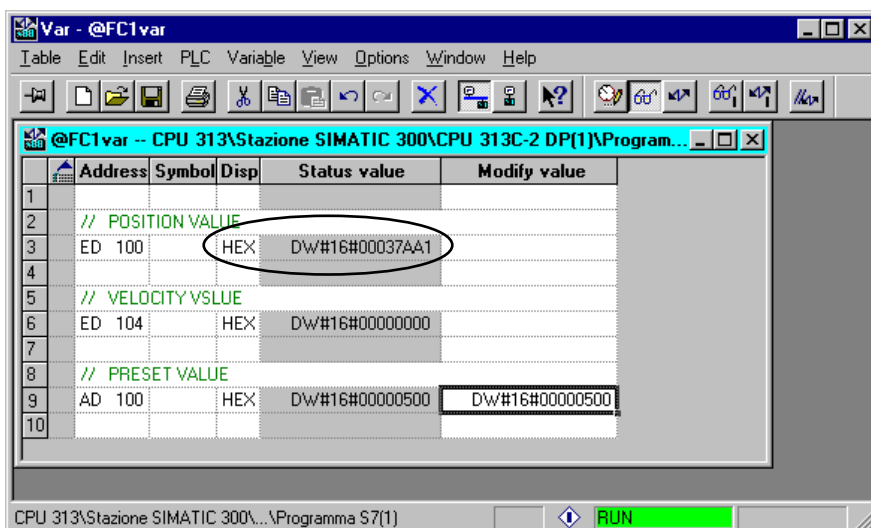
The current position of the encoder is 0003 7AA1hex.
To set the **Preset value** = 0000 0500hex, set bit 31 of variable AD 100 = "1"
(8000 0500hex).
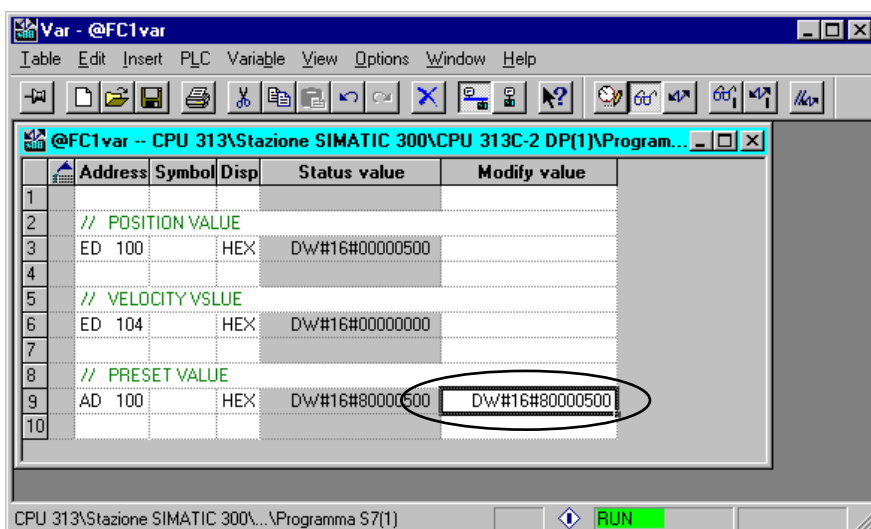
Finally click **Command variables** button in the Toolbar (see right icon).

Now the position of the encoder is 0000 0500hex.
To close "Preset" procedure set bit 31 of variable 100 back to "0" and then click the "Command variables" button again.

NOTE

It may occur that data variables having index higher than 127 or data greater than 4 bytes are not treated properly in STEP7 software. Should this happen, we recommend "MD" reference operators (pointers) for encoder position, speed and Preset to be used.

5.4 Setting the node address via BUS (SAP55 service)

WARNING

SAP55 service can only be accomplished by a **Class 2 DP Master (DPM2)**. Class 1 Masters (DPM1) cannot accomplish the SAP55 service.

Lika encoders of the H- series are designed to allow the slave address setting via hardware switches (see the section "4.8 Node address setting: DIP A" on page 17) and via a bus command by means of the SAP55 service.
The Service Access Point SAP55 Set_Slave_Address allows to change the address stored in the internal memory of a slave device. SAP55 service is part of the Profibus specifications and allows to change the internal memory address in the event that the device does not provide switches for setting its address or they are not usable. The address stored in the internal memory of the slave is used only if the hardware switches are set to "126". The internal memory address stored at factory by Lika Electronic is "125". On the contrary, if the hardware switches are set to any value between 0 and 125, then the external switches will determine the slave address.

At power-up the system checks the node address setting in the dip-switches.

If the dip-switches value is between 0 and 125, then the system uses the dip-switches address (factory value: 1)

If the dip-switches value is 126, then the system uses the address stored in the internal memory (factory value: 125)

Via SAP55 it is possible to change the slave address currently stored in the internal memory.

WARNING

Please note that the node address set via hardware switches and the node address stored in the internal memory are independent from each other! The node address stored in the internal memory can be changed only by means of the SAP55 service and the Set_Slave_Address command.

As previously stated, SAP55 service and the use of the node address stored in the internal memory are allowed only if the hardware switches DIP A are set to the value **126** (0111 1110$_2$):

In this way you set that the slave address will be read from the internal memory. As stated, the value stored at factory by Lika Electronic is "125".

To change the node address stored in the internal memory, open the **SIMATIC Manager** window and press the **Assign PROFIBUS Address...** command in the **PLC\PROFIBUS** menu. The **Assign PROFIBUS Address** window will appear on the screen.
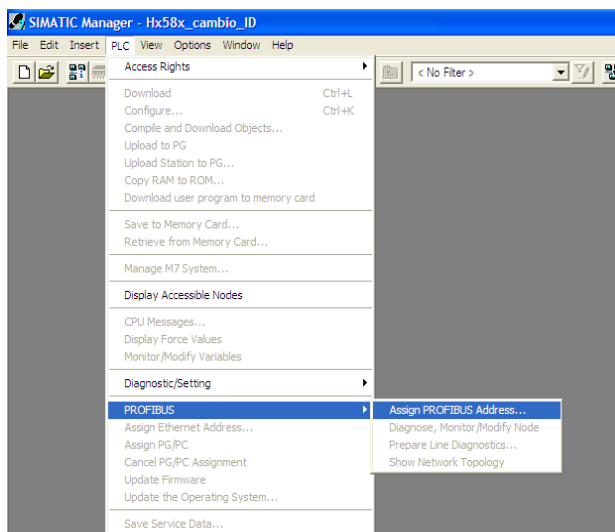
In the **Assign PROFIBUS Address** window select the node address currently stored in the internal memory (factory setting = 125) in the **Current PROFIBUS Address** combo box and then select the new address you want to set in the **New PROFIBUS Address** combo box (for instance: "6"). Press the **Apply** button and then the **OK** button to confirm.
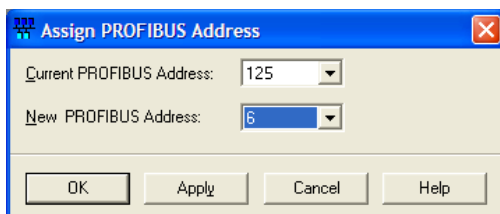
Please refer also to the section "6.8 Set_Slave_Address command (SAP55 service)" on page 39.

6   Profibus® interface

Lika units are slave devices and comply with "Profibus-DP Profile for Encoders"; they can be set as Class 1, Class 2 or Class 2(+VEL) devices (see section "6.2 Classes of the Device profile").
For any omitted information refer to the official Profibus website **www.profibus.com**.

6.1 GSD file

Profibus encoders are supplied with their own GSD file **Hx58_Vx.GSD** (see enclosed documentation or click www.lika.biz > ROTARY ENCODERS > ABSOLUTE ENCODERS > PROFIBUS). GSD file has to be installed on your Profibus master device.
HM58_Vx.GSD: for multiturn encoders
HS58_Vx.GSD: for singleturn encoders

6.2 Classes of the Device profile

Encoder class must be set when configuring the device.
Class 1 allows basic functions of the device and should be used for:
- sending the position value (see parameter Position value);
- changing the counting direction (see parameter Code sequence);
- setting the preset value (see parameter Preset value).

Class 2 allows to use Class 1 functions and extended functions such as:
- scaling function (see parameter Scaling function control);
- diagnostic type (see parameter Diagnostic type).

Class 2(+VEL) allows to use Class 2 functions and extended functions such as:
- transmission of velocity value (see parameter Position and velocity values);
- velocity measure unit (see parameter Velocity measure unit).

6.3 Modes of operation

Profibus-DP devices allow operation using different communication modes (see Figure below):
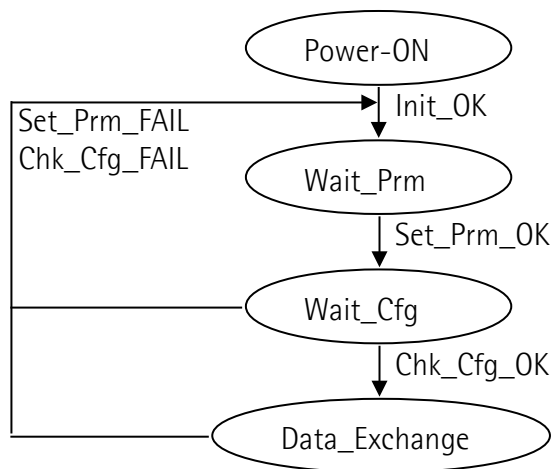
NOTE

All parameters -except for the **Preset value**- are transmitted in **Set_Prm** mode. **Preset value** is transmitted only in **Data_Exchange** mode.

Types of communication

Transmission of data between Master and Slave is carried out using the following types of messages:

- **DDLM_Set_Prm:**
  Used for configuring the slave. This communication mode is active immediately after power is turned ON and used to send parameters from Master to Slave (see section "6.4 DDLM_Set_Prm").

- **DDLM_Chk_Cfg:**
  Sets the number of bytes used for data transmission in **Data_Exchange** mode (see section "6.5 DDLM_Chk_Cfg").

- **DDLM_Data_Exchange:**
  Used as "standard operation mode".
  Used by Master to send the **Preset value**; used by Slave to transmit position and velocity values (see section "6.6 DDLM_Data_Exchange").

- **DDLM_Slave_Diag:**
  Used when power is turned on and whenever Master needs to know diagnostic information from Slave device (see section "6.7 DDLM_Slave_Diag").

- **Set_Slave_Address:**
  Used to set a new node number via BUS (service SAP55, see section "6.8 Set_Slave_Address command (SAP55 service)").

6.4 DDLM_Set_Prm

When system is turned on, configuration data set by the operator is sent to the absolute encoder by the controller. Parameters transmission depends on the configuration chosen by the operator. Customarily data is sent automatically while data setting is carried out through a user's interface available in the controller's software (for instance, STEP7, see section "5.1 STEP7 configuration"). However sometimes it is necessary to set some bits and bytes according to the working specifications you want to set.

Data transmission is carried out in compliance with values set for the encoder profile and shown in the following tables.

DDLM_Set_Prm with Class 1:

Byte	Parameter	
0...9	Reserved for PROFIBUS network	
10	Operating parameters	
	bit 0	Code sequence
	bit 1	Class 2 functionality
	Bits 2 ... 5	Reserved
	bit 6	Diagnostic type
	bit 7	Exchange type
11...20	Reserved	

DDLM_Set_Prm with Class 2:

Byte	Parameter	
0...9	Reserved for PROFIBUS network	
10	Operating parameters	
	bit 0	Code sequence
	bit 1	Class 2 functionality
	bit 2	Reserved
	bit 3	Scaling function control
	bits 4, 5	Reserved
	bit 6	Diagnostic type
	bit 7	Exchange type
11...14	Counts per revolution	
15...18	Total resolution	
19...20	Reserved	

DDLM_Set_Prm with Class 2 (+VEL):

Byte	Parameter		
0...9	Reserved for PROFIBUS		
10	Operating parameters		
	bit 0		Code sequence
	bit 1		Class 2 functionality
	bit 2		Reserved
	bit 3		Scaling function control
	bits 4, 5		Reserved
	bit 6		Diagnostic type
	bit 7		Exchange type
11...14	Counts per revolution		
15...18	Total resolution		
19	Velocity measure unit		
20	Reserved		

6.4.1 Byte 10 – Operating parameters

Bit	Function	bit = 0	bit = 1
0	Code sequence	CW	CCW
1	Class 2 functionality	disabled	enabled
2	Reserved		
3	Scaling function control	disabled	enabled
4, 5	Reserved		
6	Diagnostic type	reduced	large
7	Exchange type	pos	pos + vel

Code sequence

It defines whether the position value output by the transducer increases when the encoder shaft rotates clockwise (CW) or counterclockwise (CCW). When Code sequence = 0, the position value increases when the encoder shaft rotates clockwise; on the contrary, when Code sequence = 1, the position value increases when the encoder shaft rotates counterclockwise. CW and CCW rotations are viewed from shaft end.
Default = 0 (min. = 0, max. = 1)

Class 2 functionality

Two device classes are defined in the encoder profile, one mandatory class (Class 1) and one class with optional functions (Class 2). This encoder implements functions of both Class 1 and Class 2. For any information on the available encoder classes see the section "6.2 Classes of the Device profile" on page 27.
0 = Disabled   = Encoder Class 1 is set.
1 = Enabled   = Encoder Class 2 (or Class2(+VEL)) is set.
Default = 1 (min. = 0, max. = 1)

Scaling function control

When this option is disabled (0), device uses the hardware resolution, i.e. the hardware counts per revolution and the hardware number of revolutions, see the encoder data on the label applied to the device; when it is enabled (1), device uses the resolution transmitted through bytes from 11 to 18 (**Counts per revolution** and **Total resolution**).

For a correct use of this function see sections "6.4.2 Bytes 11...14" and "6.4.3 Bytes 15...18".

Default = 1 (min. = 0, max. = 1)

WARNING

You can set new values next to the **Counts per revolution** and **Total resolution** items only if **Class 2 functionality** = ENABLED; if **Scaling function control** = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if **Scaling function control** = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the default values uploaded from the GSD file, NOT the new entered values, until you enable the **Scaling function control**.

Diagnostic type

0 = Reduced   = 16-byte diagnostic information
1 = Extended   = 63-byte diagnostic information

Encoder Class 1 provides only reduced diagnostic.

The meaning of each diagnostic byte is detailed in the section "6.7 DDLM_Slave_Diag".

Default = 0 (min. = 0, max. = 0) for Class 1
Default = 0 (min. = 0, max. = 1) for Class 2 and Class 2 (+VEL)

Exchange type

0 = Pos = device transmits only position value (Class 1 and Class 2).
1 = Pos + vel = device transmits both position and velocity values (Class 2(+VEL)).

Default = 0 (min. = 0, max. = 0) for Class 1 and Class 2
Default = 1 (min. = 1, max. = 1) for Class 2 (+VEL)

6.4.2 Bytes 11...14

Counts per revolution

WARNING

You can set a new value next to the **Counts per revolution** item only if **Class 2 functionality** = ENABLED; if **Scaling function control** = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if

Scaling function control = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the default values uploaded from the GSD file, NOT the new entered values, until you enable the **Scaling function control**. See the section "6.4.1 Byte 10 - Operating parameters" on page 30.

Counts per revolution parameter allows to program a user specific singleturn resolution (i.e. the desired number of information per revolution).

Byte	11	12	13	14
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Allowed values are equal to or lower than **Hardware counts per revolution** value. We suggest setting power of 2 values (1, 2, 4, ... 2048, 4096, ...).
Setting a value greater than allowed causes the resolution to be forced to **Hardware counts per revolution** value.
Default = 262144 (min. = 1, max. = 262144) for HS58
Default = 65536 (min. = 1, max. = 65536) for HM58

WARNING
When you set a new value next to the **Counts per revolution** item, please always check also the **Total resolution** item value and be sure that the resulting number of revolution complies with the **Hardware number of revolutions** of the device.
Let's say our encoder is programmed as follows:
Counts per revolution: 8192
Total resolution = 33554432_{10} = 8192 (cpr) * 4096 (rev.)
Let's set a new singleturn resolution, for instance: **Counts per revolution** = 360.
If we do not change the **Total resolution** value at the same time, we will get the following result:

$$\text{Number of revolutions} = \frac{33554432 \ (\text{Total resolution})}{360 \ (\text{Counts per revolution})} = 93206.755...$$

As you can see, the encoder is required to carry out more than 93000 revolutions, this cannot be as the hardware number of revolutions is, as stated, 16384. When this happens, the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 18).

6.4.3 Bytes 15...18
Total resolution

WARNING

You can set a new value next to the **Total resolution** item only if **Class 2 functionality** = ENABLED; if **Scaling function control** = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if **Scaling function control** = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the default values uploaded from the GSD file, NOT the new entered values, until you enable the **Scaling function control**. See the section "6.4.1 Byte 10 - Operating parameters" on page 30.

This parameter is intended to set the number of distinguishable steps over the total measuring range. The total resolution of the encoder results from the product of **Counts per revolution** by **Number of revolutions**.

Byte	15	16	17	18
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^8	2^7 to 2^0

Allowed values are equal to or lower than the **Total hardware resolution** value. Setting a value greater than allowed causes the resolution to be forced to the **Total hardware resolution** value.

$$\text{Number of revolutions} = \frac{\text{Total resolution}}{\text{Counts per revolution}}$$

We recommend the **Number of revolutions** to be set to a power of 2. This is meant to avoid problems when using the device in endless operation (when crossing the physical zero) and entering the "Red Zone" (see the section "6.9 "Red Zone""").
Default = 262144 (min. = 1, max. = 262144) for HS58
Default = 1073741824 (min. = 1, max. = 1073741824) for HM58

WARNING

When you set a new value next to the **Total resolution** item, please always check also the **Counts per revolution** item value and be sure that the resulting number of revolutions complies with the **Hardware number of revolutions** of the device.
Let's say our encoder is programmed as follows:
Counts per revolution: 8192
Total resolution = 33554432_{10} = 8192 (cpr) * 4096 (rev.)
Let's set a new total resolution, for instance: **Total resolution** = 360.
As the **Total resolution** must be greater than or equal to the **Counts per revolution**, the above setting is not allowed. When this happens, the encoder

falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 18).

Example

"HS58**18**/FB-xx": singleturn encoder
- **Hardware counts per revolution** = **18** bit/turn (2^{18} = 262144 cpr)
- **Hardware number of turns** = 1
- **Total hardware resolution** = 18 bit (262144 ∗ 1 = 262144)

"HM58**16/16384**/FB-xx": multiturn encoder
- **Hardware counts per revolution** = **16** bit/turn (2^{16} = 65536 cpr)
- **Hardware number of turns** = 14 bit (**16384** turn)
- **Total hardware resolution** = 30 bit (65536 ∗ 16384 = 2^{30} = 1073741824)

Example

Multiturn encoder "HM58**16/16384**/FB-6" with "BC-PB-C" connection cap.

Resolution is:
- **Hardware counts per revolution** = 65536 (2^{16})
- **Hardware number of turns** = 16384 (2^{14})
- **Total hardware resolution** = 1073741824 (2^{30})

2048 steps per revolution ∗ 1024 turns are required:
- Enable **Scaling function control**: byte 10 = 0A hex (bit 1 = bit 3 = "1")
- **Counts per revolution** = 2048: byte 11...14 = 0000 0800 hex
- **Total resolution** = 2048 ∗ 1024 = 2097152: byte 15...18 = 0020 0000 hex.

NOTE

When new values are set next to the items **Counts per revolution** and/or **Total resolution**, a new **Preset value** and zero-setting values are required according to the new resolution.

6.4.4 Byte 19

Velocity measure unit

This byte is available only when Class 2(+VEL) is set (see also **Class 2 functionality** and **Exchange type** items). It defines the unit of measurement for speed value transmitted by the device.
00 = rpm (revolutions per minute);
01 = step/s (steps per second).
Default = 0 (min. = 0, max. = 1)

6.5 DDLM_Chk_Cfg

Configuration function allows the Master to send configuration data to the Slave for any check operation. The main purpose of this function is to set the number of bytes used for the Data_Exchange as viewed from Master side.

Chk_Cfg message structure (1 byte):

bit 7 = Consistency (="1")
bit 6 = Word format ("0"=byte,"1"=word=4byte)
bit 5...4 = In/out data ("01"=Input, "10"=output)
bit 3...0 = Length code

Example

bit	7	6	5	4	3	2	1	0	
	1	1	0	1	0	0	0	1	D1h
Data	1	1	0	1	0	0	1	1	D3h
	1	1	1	0	0	0	0	1	E1h

Class 1 and Class 2:
D1hex = 4 byte input
E1hex = 4 byte output

Class 2(+VEL):
D3hex = 8 byte input
E1hex = 4 byte output

6.6 DDLM_Data_Exchange

This is the normal operation status of the system. The Slave (for both Class 1 and Class 2) can transmit the position value (and speed value if Class 2+VEL is set) and receive the **Preset value** from the Master.

Position value

when Class 1 and Class 2 are set (Encoder → Master)

Byte	1	2	3	4
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Position and velocity values

when Class 2 (+VEL) is set (Encoder → Master)

Byte	1	...	4	5	...	8
Bit	31-24	...	7-0	31-24	...	7-0
	Position			Velocity		

Preset value

when any Class is set (Master → Slave)

Byte	1	2	3	4
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

The Preset function is meant to assign a desired value to a physical position of the encoder. The chosen 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 in the moment when the preset value is sent. The **Preset value** value is sent by the Master to the Slave in **Data_Exchange** mode by setting bit 31 = "1" for 3 cycles.

The MSB of the preset value controls the preset function in the following way:

Normal operating mode: MSB = 0 (bit 31): the encoder will make no change in preset value.

Preset mode: MSB = 1 (bit 31): with the MSB = 1 the encoder accepts the transferred value (bits 0 ... 30) as a preset value in binary code.

- If **Scaling function control** = DISABLED, then
  Preset value must be less than the **Total hardware resolution**.
- If **Scaling function control** = ENABLED, then
  Preset value must be less than the **Total resolution**.

Example

Preset value to be set = 0000 1000hex
Current **Position value** = 0005 5000hex

Cycle	Byte	1	2	3	4
	Bit	31-24	23-16	15-8	7-0

1°	M→S	80	00	10	00
	S→M	00	05	50	00

2°	M→S	80	00	10	00
	S→M	00	05	50	00

3°	M→S	80	00	10	00
	S→M	00	00	10	00

NOTE
We suggest setting the **Preset value** when the shaft is in stop.
The new **Preset value** is saved immediately after receipt.

6.7 DDLM_Slave_Diag

The Master device can send a request for diagnostic information at any time to the Slave device.
Lika devices provide two types of diagnostics:
- reduced (16 bytes)
- extended (63 bytes).
Set the diagnostic type during DDLM_Set_Prm, operating parameters (byte 10), see section "6.4.1 Byte 10 - Operating parameters".

16-byte Diagnostic:
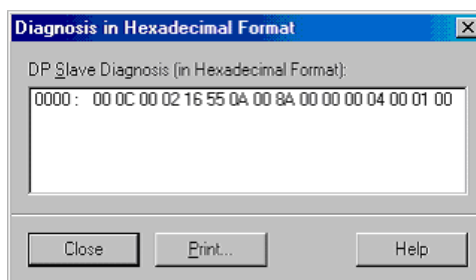
Byte	Description
0	Status 1
1	Status 2
2	Status 3
3	Master ID
4	Manufacturer ID
5	
6	Extended diagnostic header
7	Alarms

Byte	Description
8	Operating status
9	Encoder type
10	Hardware single-turn resolution
11	
12	
13	
14	Hardware number of revolution
15	

63-byte Diagnostic:
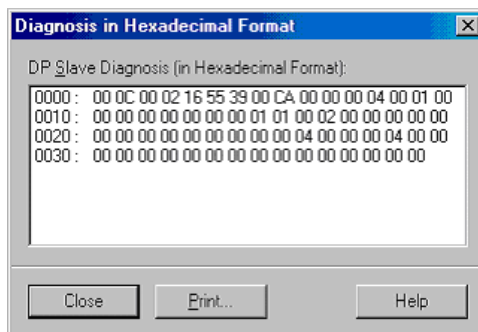
Byte	Description		Byte	Description
0	Status 1		31	Offset
1	Status 2		32	
2	Status 3		33	
3	Master ID		34	
4	Manufacturer ID		35	Manufacturer offset value
5			36	
6	Extended diagnostic header		37	
			38	
7	Alarms		39	Programmed single-turn resolution
8	Operating status		40	
9	Encoder type		41	
10	Hardware single-turn resolution		42	
11			43	Programmed total resolution
12			44	
13			45	
14	Hardware number of revolution		46	
15			47	Serial number
16	Additional alarms		48	
17	Supported alarms		49	
18			50	
19	Warnings		51	
20			52	
21	Supported warnings		53	
22			54	
23	Profile version		55	
24			56	
25	Software version		57	Reserved
26			58	Reserved
27	Operating time		59	Reserved
28			60	Reserved
29			61	Reserved
30			62	Reserved

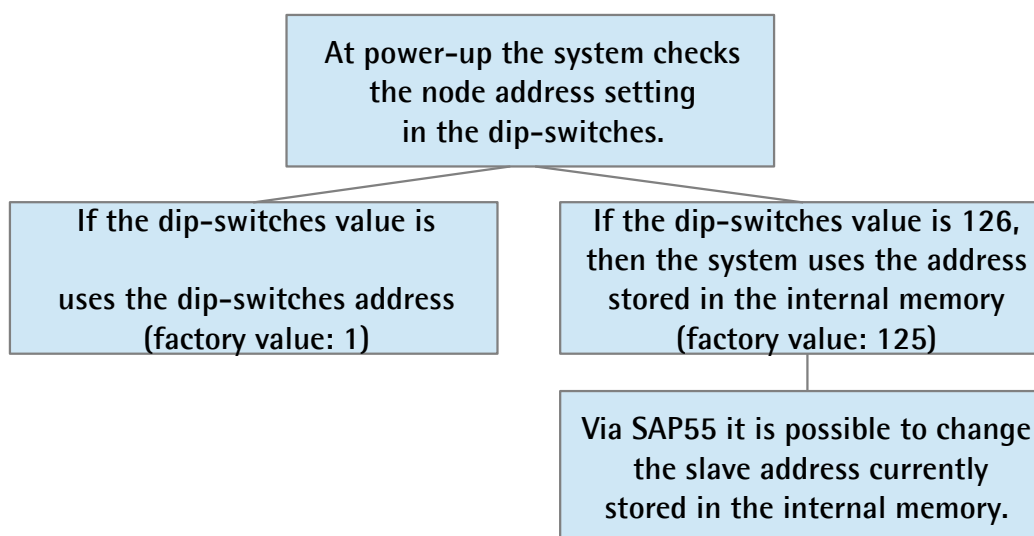**6.8 Set_Slave_Address command (SAP55 service)**

WARNING

SAP55 service can only be accomplished by a **Class 2 DP Master (DPM2)**. Class 1 Masters (DPM1) cannot accomplish the SAP55 service.

Lika encoders of the H- series are designed to allow the slave address setting either via hardware switches (see the section "4.8 Node address setting: DIP A" on page 17) or via a bus command by means of the SAP55 service.
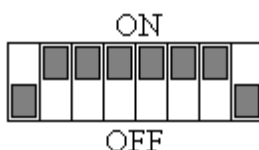The Service Access Point SAP55 Set_Slave_Address allows to change the address stored in the internal memory of a slave device. SAP55 service is part of the Profibus specifications and allows to change the internal memory address in the event that the device does not provide switches for setting its address or they are not usable. The address stored in the internal memory of the slave is used only if the hardware switches are set to "126". The address stored at factory by Lika Electronic is "125". On the contrary, if the hardware switches are set to any value between 0 and 125, then the external switches will determine the slave address.

> **At power-up the system checks the node address setting in the dip-switches.**
>
> **If the dip-switches value is uses the dip-switches address (factory value: 1)**
>
> **If the dip-switches value is 126, then the system uses the address stored in the internal memory (factory value: 125)**
>
> **Via SAP55 it is possible to change the slave address currently stored in the internal memory.**

WARNING

Please note that the node address set via hardware switches and the node address stored in the internal memory are independent from each other! The node address stored in the internal memory can be changed only by means of the SAP55 service and the Set_Slave_Address command.
As previously stated, SAP55 service and the use of the node address stored in the internal memory are allowed only if the hardware switches DIP A are set to the value **126** ($0111\ 1110_2$):

In this way you set that the slave address will be read from the internal memory. As stated, the value stored at factory by Lika Electronic is "125".

The message has the following DATA bytes:

| Byte	Description
0	New node number
1	Manufacturer ID
2	
3	Lock node number (= 0: not supported)

6.9 "Red Zone"

The so-called "Red Zone" occurs when:

$$\text{Number of revolutions} = \frac{\text{Total resolution}}{\text{Counts per revolution}}$$

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 **Total resolution** value from the **Hardware total resolution** of the device as many times as until the difference is less than the the set **Total resolution** value. When the encoder crosses the limit of the last **Total resolution** section thus entering the "red zone", a counting error occurs, i.e. a jump in the position count. The problem can be represented graphically in the Figure below.
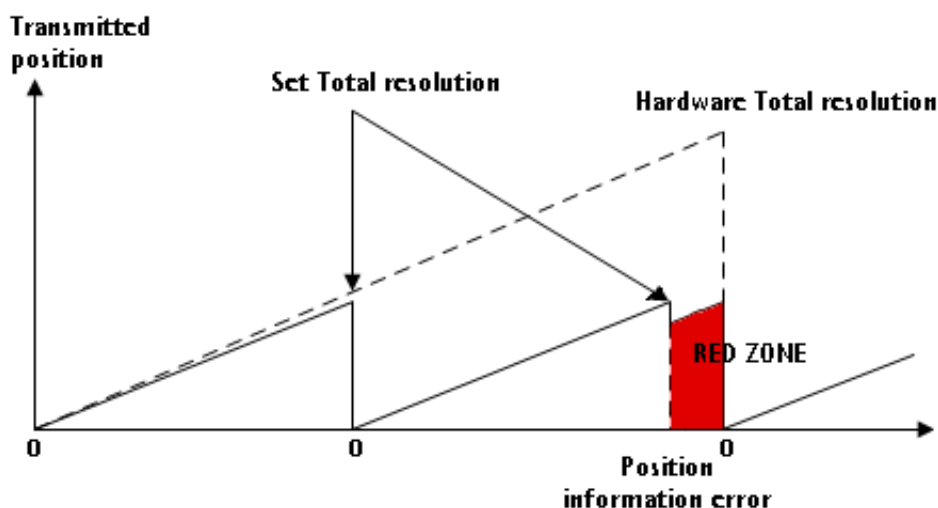
Example
"HM58**16/16384**/FB-xx": multiturn encoder
- **Hardware counts per revolution** = 65536 (2^{16})
- **Hardware number of turns** = 16384 (2^{14})
- **Total hardware resolution** = 1073741824 (2^{30})

Set parameters values:
- **Counts per revolution** = 50000
- **Number of revolutions** = 8000
- **Total resolution** = 400000000

$$\frac{\text{Hardware number of turns}}{\text{Number of revolutions}} = \frac{16384}{8000} = 2.048$$

It follows that, for 384 revolutions (16384 - 2 * 8000 = 384), the encoder will work within the "Red Zone" limits.

NOTE
- The "Red Zone" status is indicated by the green LED flashing while the red LED is OFF (see the section "4.9 Diagnostic LEDs" on page 18).
- Within the limits of the "Red Zone", the transmitted position is coherent with setting resolution: it is calculated so that the last position transmitted before zero position is **Total resolution** -1.
- Make attention using the values sent by the encoder while working in "Red Zone". When the encoder changes from normal status to "Red Zone" status (and vice versa) a jump of position occurs.

Document release	Description
1.0	1st issue
1.1	Added "Set node number via BUS" (sections 3.4 and 5.8) Section 4 update
1.2	Added section "Mounting instructions", general review
1.3	General review, added table of contents and index, added section 7, Italian / English separate edition
1.4	"4.8 Node address setting: DIP A" section updated, "5.4 Setting the node address via BUS (SAP55 service)" section updated; "6.8 Set_Slave_Address command (SAP55 service)" section updated

c🆄®US	This device is to be supplied by a Class 2 Circuit or Low-Voltage Limited Energy or Energy Source not exceeding 30 Vdc. Refer to the product datasheet for supply voltage rate.

Dispose separately
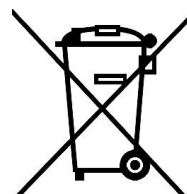
·······. lika

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