❖DATALOGIC

Absolute Encoders

AMT58...13x12 PB

Instruction Manual

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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 AMT58-PB series. For any further information please refer to the product datasheet.

To make it easier to read the text, this guide is 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;

• Datalogic Automation 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 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 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 Datalogic Automation s.r.l. for purchasing spare parts or needing assistance.

For any information on the technical characteristics of the product refer to the technical catalogue.

3 - Mounting instructions

WARNING

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

Never force the rotation of the shaft manually, it could cause irreparable damage!

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
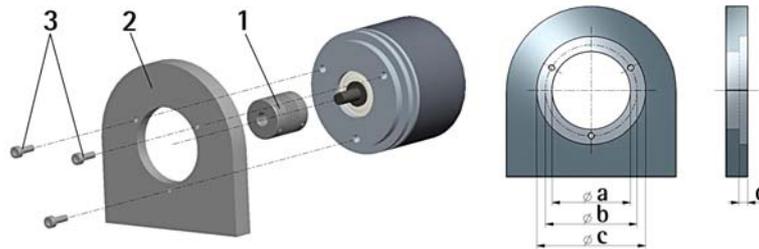
	a [mm]	b [mm]	c [mm]	d [mm]
AMT58	36 H7	48	-	-

3.1.2 Installation using fixing clamps (optional kit code ST-58-KIT)
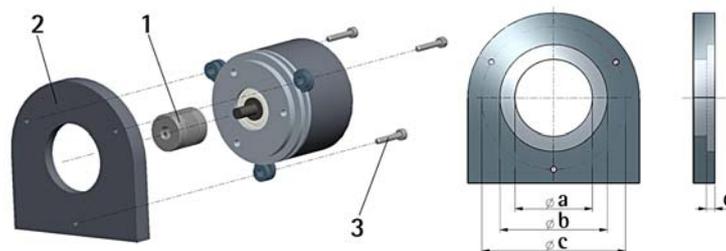
	a [mm]	b [mm]	c [mm]	d [mm]
AMT58	36 H7	-	67	-

3.1.3 Installation using a flange (code ST-58-FLNG)
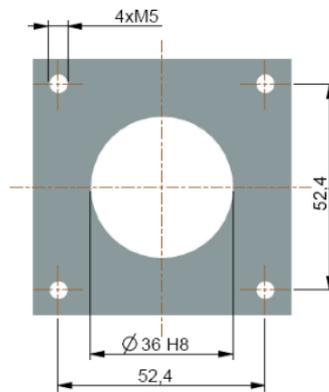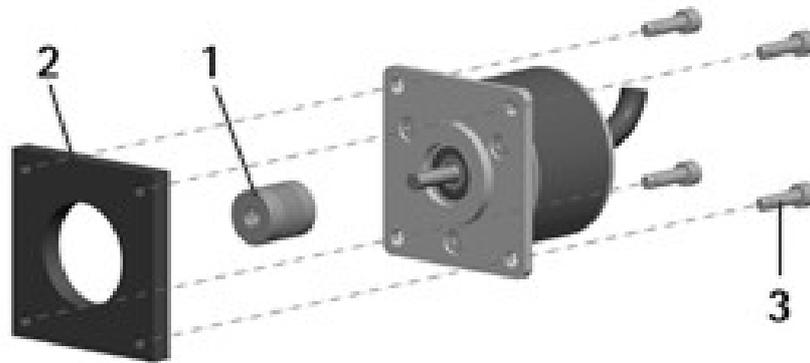
3.2 Hollow shaft encoders

3.2.1 AMT58-H15

- 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).
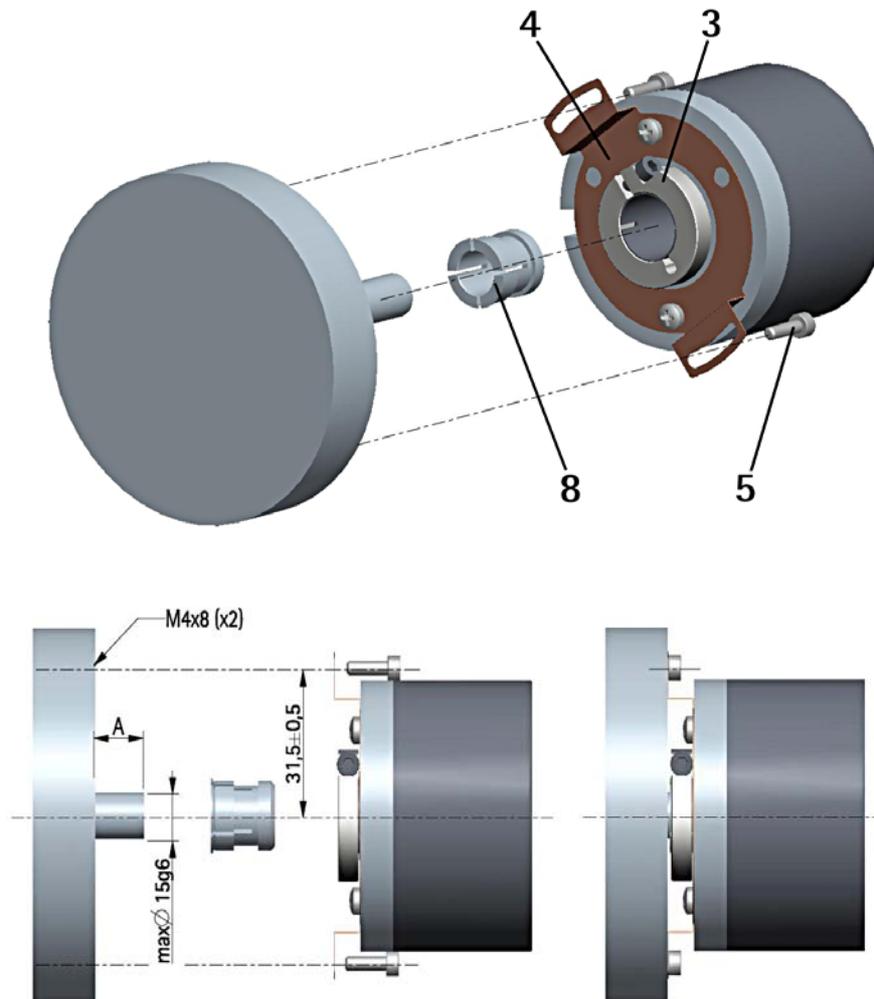
4 - Electrical connections

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

4.1 Connection cap

WARNING
Do not remove or mount the connection cap with power supply switched ON. Damage may be caused to internal components.

The terminal connectors for connecting the power supply and the BUS IN and BUS OUT cables as well as the dip-switches meant to set the node ID and activate the termination resistance are located inside the encoder connection cap. Thus you must remove the connection cap to access any of them.

NOTE
Be careful not to damage the internal components when you perform this operation.

To remove the connection cap loosen the two screws 1.
Please be careful with the internal connector.
Always replace the connection cap at the end of the operation.
Take care in re-connecting the internal connector. Tighten the screws 1 using a tightening torque of approx. 2.5 Nm.

WARNING
You are required to check that the encoder body and the connection cap are at the same potential before replacing the connection cap!

Grounding point
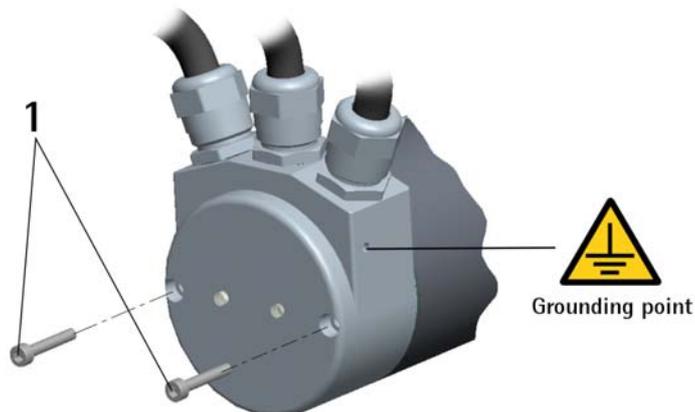
4.2 Ground connection

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. You are advised to provide the ground connection as close as possible to the encoder. We suggest using the ground point provided in the cap (see Figure, use 1 TCEI M3 x 6 cylindrical head screw with 2 tooth lock washers).

4.3 Connection cap with PGs (Figure 1)
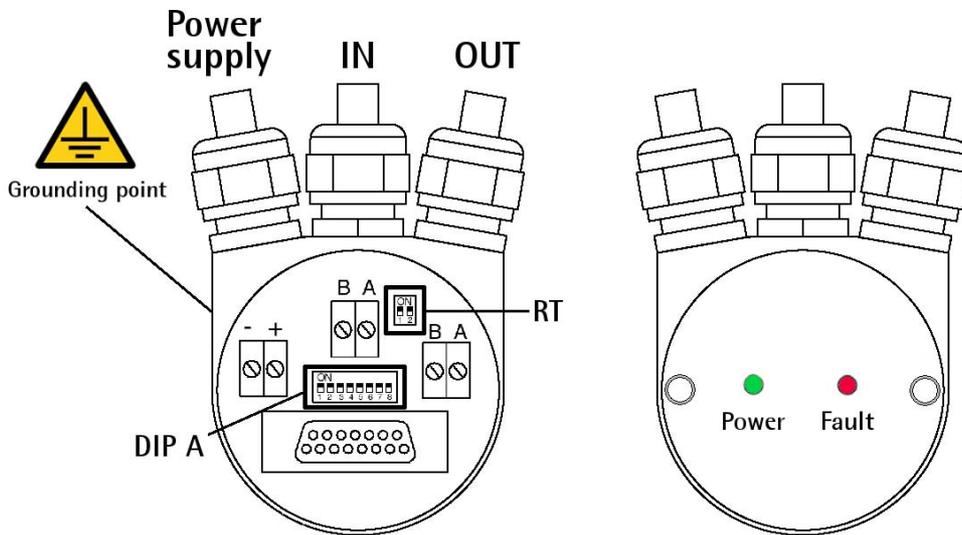
Figure 1

Connection cap is fitted with three PG9 cable glands for bus-IN, bus-OUT connections as well as 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 inch).

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

[1] Connect the cable shield to cable gland.

4.4 Connection cap with M12 connectors (Figure 1)

Connection cap is fitted with three M12 connectors with pin-out in compliance with the Profibus standard. Therefore you can use standard Profibus cables commercially available.

Power supply
M12 connector
A coding
(frontal side)

male
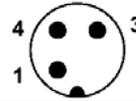
Pin	Function
1	+10VDC +30VDC
3	0 VDC GND
4 [1]	Shield
Case	

[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   female
(BUS IN)   (BUS OUT)
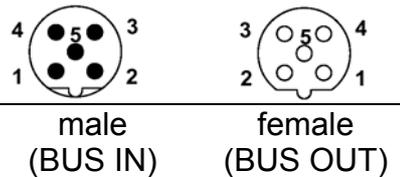
Pin	Function
1	n.c.
2	Profibus A (Green)
3	n.c.
4	Profibus B (Red)
5	n.c.
Case	Shield

n.c. = not connected

4.5 Connection of the shield

Disentangle and shorten the shielding 1 and 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.
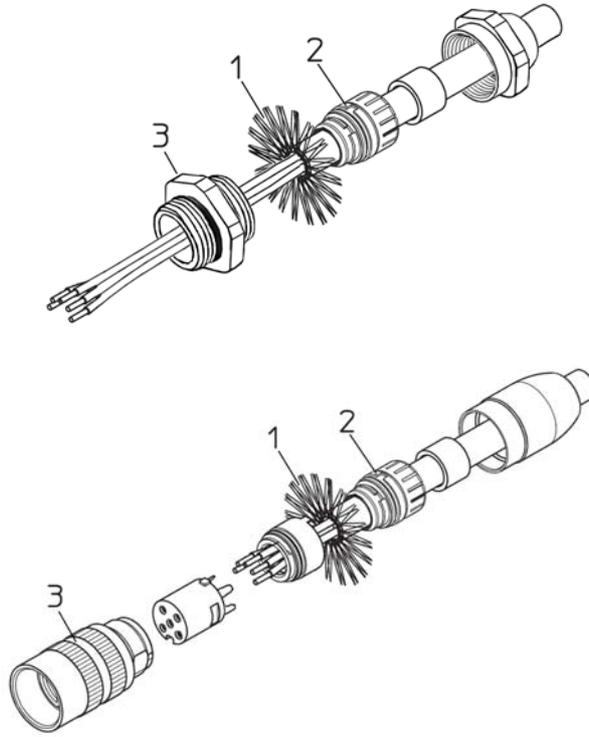
4.6 Node address: DIP A (Figure 1)

WARNING
Power supply must be turned off before performing this operation!
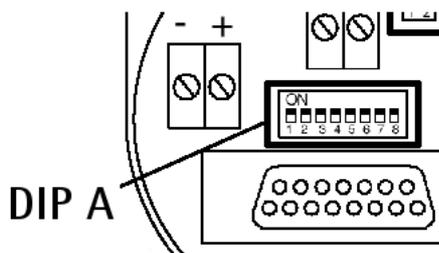
The node address must be set via hardware using the DIP A dip-switches located inside the connection cap.
Allowed addresses are from 0 to 125. The default value is 1.
The node address must be entered also in the software interface, please refer to section "5.1.2 Adding a node to the project" on page 16.

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

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

Example
Set node number = 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
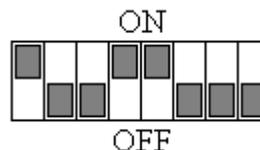
Set node number = 55:
$55_{10} = 0011\ 0111_2$ (binary value)

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
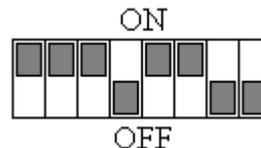
NOTE
After having set the device address, please check the bus termination switch position (see section "4.8 Bus termination (Figure 1)" on page 12).

4.7 Baud rate

The baud rate is set by the Master via software during the configuration of the node (Slave).
This device supports the following baud rates (they are listed in the .GSD file too):
9.6 kbit/s, 19.2 kbit/s, 93.75 kbit/s, 187.5 kbit/s, 500 kbit/s, 1.5 Mbit/s, 3 Mbit/s, 6 Mbit/s, 12 Mbit/s.

The following table shows the maximum transmission rates in relation to permissible line length:

Baud rate [Kbit/s]	9,6	19,2	93,75	187,5	500	1500	12000
Max. cable length	1200 m 4000 ft	1200 m 4000 ft	1200 m 4000 ft	1000 m 3300 ft	400 m 1300 ft	200 m 660 ft	100 m 330 ft

To set the baud rate please refer also to section "5.1.2 Adding a node to the project" on page 16.

4.8 Bus termination (Figure 1)
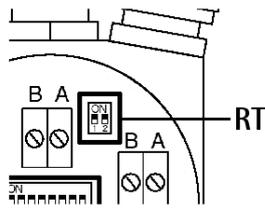
A bus termination resistance is provided inside the connection cap. This has to be activated as line termination on the last device in the transmission line.

Use the 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

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4.9 Diagnostic LEDs (Figure 1)

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

Fault (red)	Power (green)	Event
OFF	OFF	Power supply is turned off or hardware breakdown not recognized
OFF	ON	Correct function (communication is on, the device is sending / receiving messages)
OFF	Flashing	The encoder is operating within the limits of the "Red Zone", for any information see section "6.8 "Red zone""
ON	Flashing	Configuration parameters are not valid
ON	OFF	Transmission time-out error
Flashing	ON	Bus communication failure
Flashing	Flashing	Flash memory error, unrestorable error

5 - Quick reference

5.1 Configuring the encoder via Siemens STEP7

5.1.1 Importing GSD file

Profibus encoders are supplied with their own GSD file **AMT58-xxx-13x12-PB** (see the enclosed documentation, if supplied, or click www.datalogic.com).

WARNING
Install the AMT58_Vx.GSx in the AMT58 series multiturn encoders GSD installation file is further available in both Italian (.GSI) and English (.GSE) versions (texts and comments are in the supported language).

WARNING
For AMT58 multiturn encoders the default value preset by Datalogic in the Counts per revolution item of the **AMT58-xxx-13x12-PB** GSD file is 4096 (12 bits); for this reason, if you have a 25-bit multiturn encoder and you want to use the overall resolution, you must set the Counts per revolution item to 8192 (13 bits). See EXAMPLE 2 on page 20.

In the main window HW Config of STEP7 select Install GSD File…
command from Options menu bar.
In the window that appears you can select the GSD file specific to the
unit you need to install in your Siemens control system.
Choose among the available files the one you need: GSD file for
AMT58 multiturn encoder, in either Italian or English language.
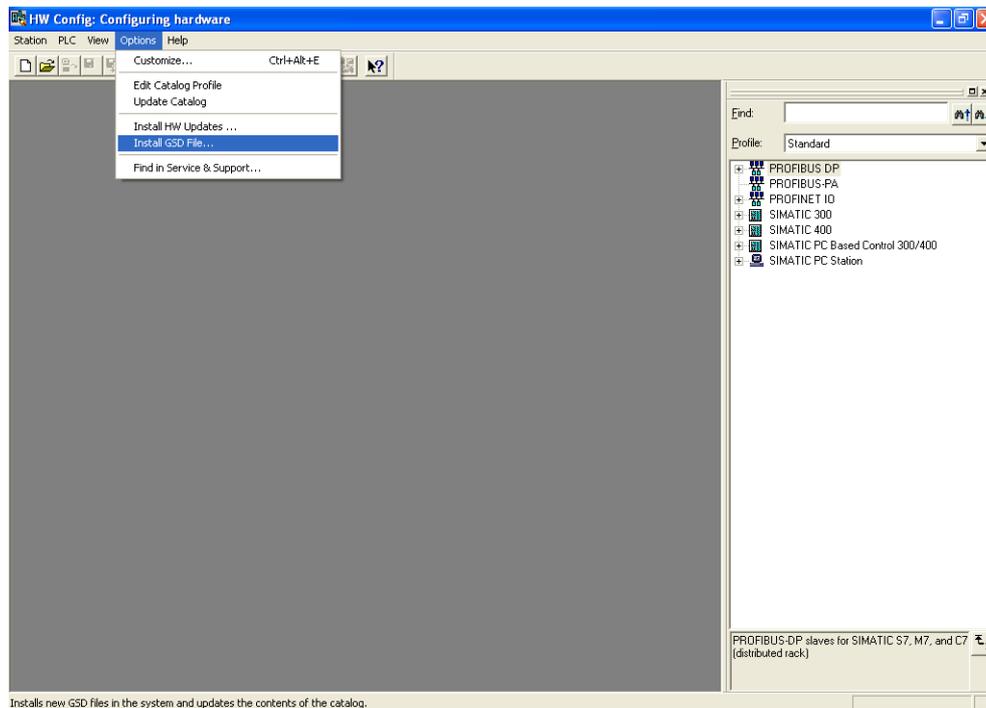
5.1.2 Adding a node to the project

To add a node to the project, extend the directory tree in the right panel of the STEP7 HW Config main window and select either the AMT58 module available in Catalog > PROFIBUS-DP > Additional Field Devices > Encoders (if both GSD files have been installed); drag the required module to the pane on the left and drop it on the "BUS". For instance, drag the AMT58 module.

Then drag the AMT58 Class 1 or the AMT58 Class 2 submodule to the variables table in the bottom left; for instance, install the AMT58 Class 2 submodule. In this way you set the class of the device (for further details on available classes see section "6.2 Classes of the Device profile" on page 29).
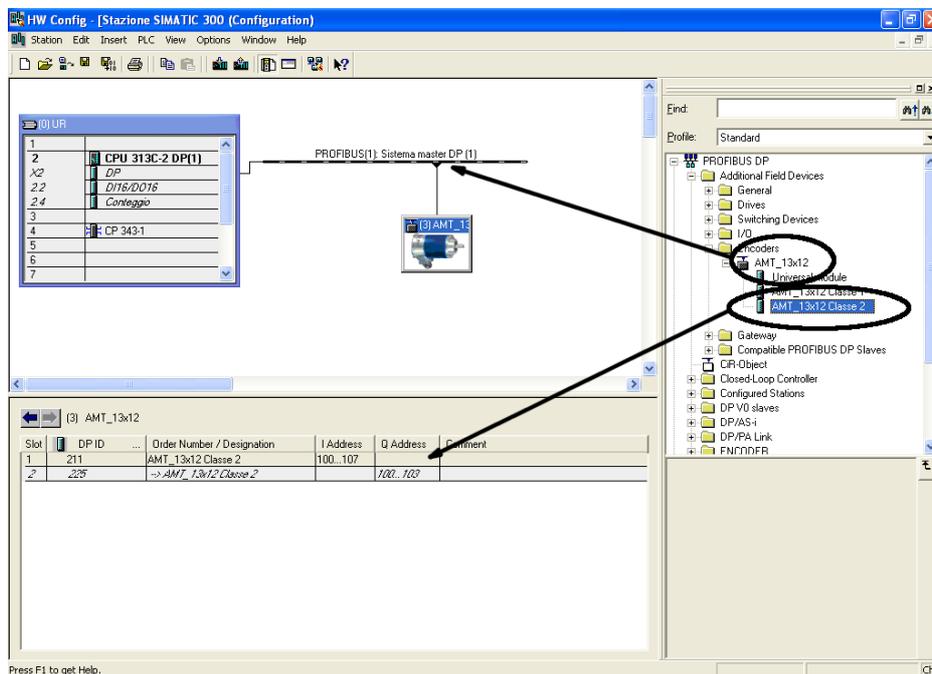
After having installed the node, by double-clicking on the graphic icon of the unit you have just installed you enter the page designed to configure the bus properties. In this page you can both enter the node address configured via hardware and set the bus transmission rate. For any information on setting the node address via hardware please refer to the section "4.6 Node address: DIP A (Figure 1)" on page 10. For any information on setting the baud rate please refer to the section "4.7 Baud rate" on page 11.

5.1.3 Encoder configuration parameters

To access the parameters configuration window, first enter the STEP7 HW Config main window and select the AMT58 item just installed (AMT58 Class 2 in the example) available in the variables table in the bottom left; then right-click the item and press the Object Properties... command in the shortcut menu.
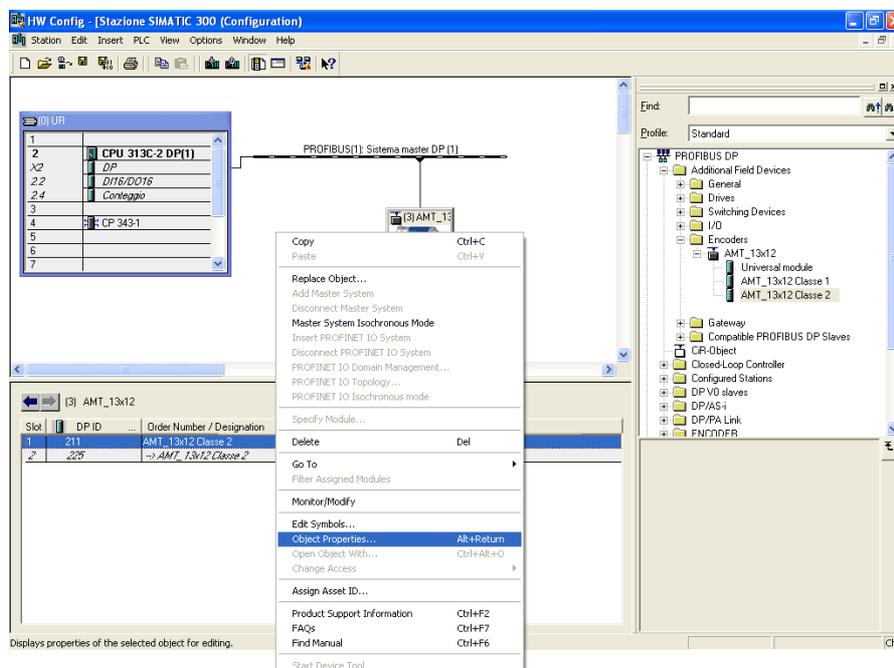
The Properties - DP slave window will appear. In the Parameter Assignment page all configuration data parameters available for the device are listed.

For a comprehensive description of the parameters and how to set them properly refer to the specific explanation in section "6.4 DDLM_Set_Prm" on page 31.
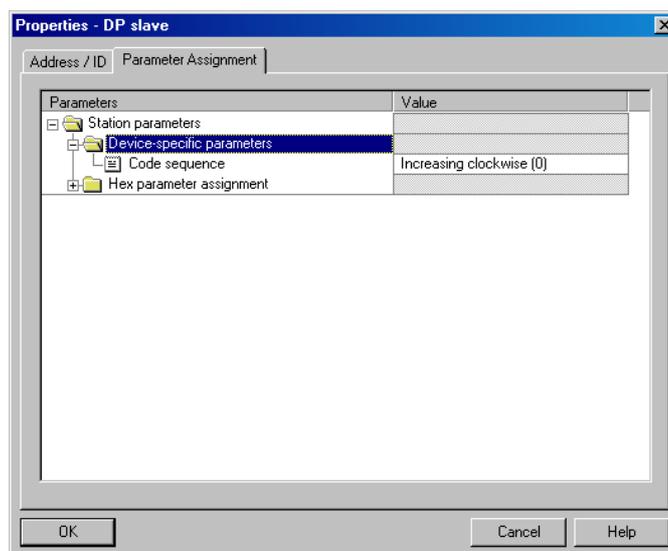
Class 1 example
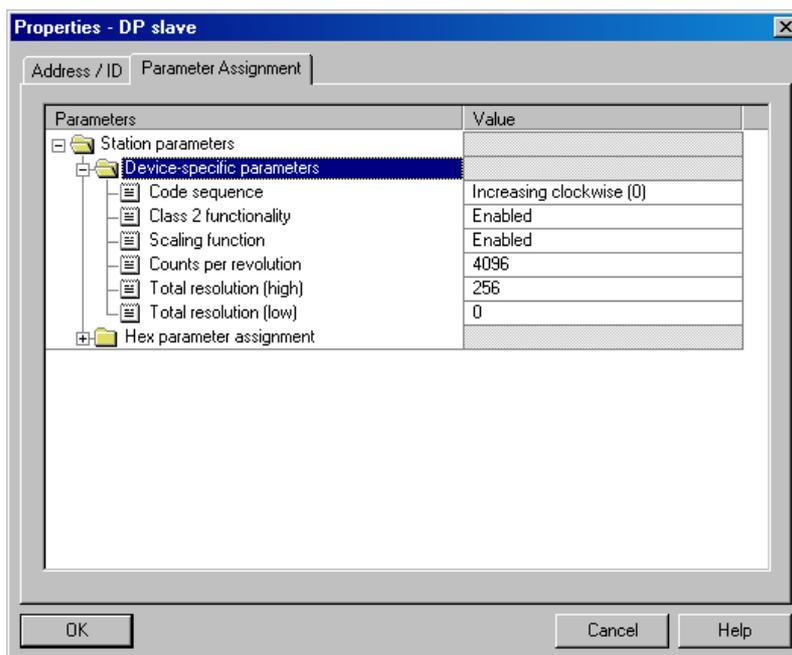
Class 2 example

In the Parameter Assignment page, some items (Code sequence, Class 2 functionality, Scaling function) are to be set by scrolling through the available options in the drop-down box. While the parameters concerning the resolution must be entered in decimal notation. Please note that the Total resolution value has to be split into two separate fields, namely Total resolution (high) and Total resolution (low). This value in fact must be entered in two words. Please refer to the following examples to understand how the Total resolution value has to be divided into two parts: a high part and a low part.

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 = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if Scaling function = 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.

EXAMPLE 1

Let's suppose we need to program the following encoder:
"AMT58" 24-bit multiturn encoder.

- Hardware counts per revolution = 12 bits/rev. (4096 cpr)
- Hardware number of revolutions = 12 bits (4096 rev.)
- Hardware total resolution = 24 bits (4096 $*$ 4096=16777216)

We want to set: 4096 counts per revolution and 4096 revolutions.
Thus we will set 4096 next to the Counts per revolution item.
The Total resolution value will be: 4096 (cpr) $*$ 4096 (rev.) = 16777216_{10} = 0x1000000
The value to be set in the Total resolution items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0100	0000	hexadecimal
256	0	decimal

EXAMPLE 2

Let's suppose we need to program the following encoder:
"AMT58" 25-bit multiturn encoder.

- Hardware counts per revolution   = 13 bits/rev. (8192 cpr)
- Hardware number of revolutions = 12 bits (4096 rev.)
- Hardware total resolution   = 25 bits (8192 $*$ 4096=33554432)

We want to set: 8192 counts per revolution and 4096 revolutions.
Thus we will set 8192 next to the Counts per revolution item.
The Total resolution value will be: 8192 (cpr) $*$ 4096 (rev.) = 33554432_{10} = 0x2000000
The value to be set in the Total resolution items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0200	0000	hexadecimal
512	0	decimal
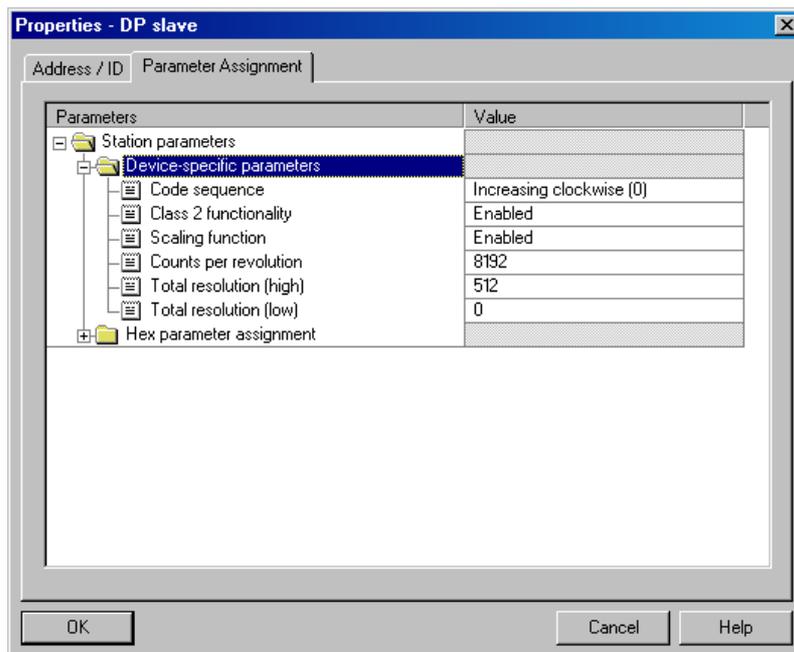
WARNING
When you set a new value next to the Counts per revolution item, please always check also the Total resolution items value and be sure that the resulting number of revolution complies with the Hardware number of revolutions of the device.
The same when you set a new value next to the Total resolution items, please always check also the Counts per revolution item 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 in EXAMPLE 2EXAMPLE :

Counts per revolution: 8192
Total resolution= 33554432_{10} = 8192 (cpr) * 4096 (rev.), so: Total resolution (high) = 512; Total resolution (low) = 0

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, 4096. When this happens, the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 13).

You are allowed to set any integer value less than or equal to the Hardware counts per revolution in the Counts per revolution item; while you are allowed to set any integer value less than or equal to the Hardware counts per revolution in the Counts per revolution item; however we suggest always setting values that are a power of 2 (1, 2, 4, …2048, 4096, …).

EXAMPLE 3

Let's suppose we need to program the following encoder:
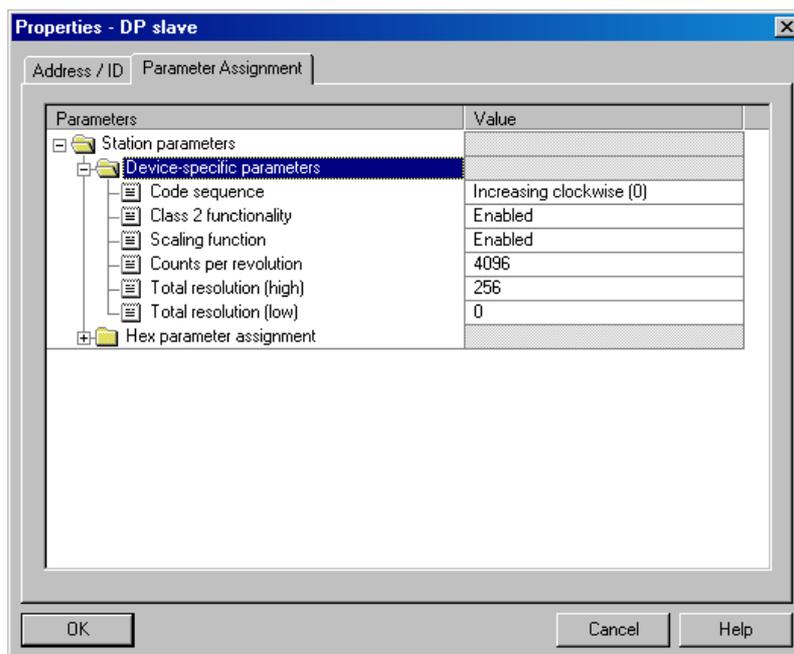"AMT58" 25-bit multiturn encoder.

- Hardware counts per revolution   = 13 bits/rev. (8192 cpr)
- Hardware number of revolutions = 12 bits (4096 rev.)
- Hardware total resolution   = 25 bits (8192 ∗ 4096=33554432)

- Hardware counts per revolution   = 13 bits/rev. (8192 cpr)

We want to set: 2048 counts per revolution and 1024 revolutions.
Thus we will set 2048 next to the Counts per revolution item.
The Total resolution value will be: 2048 (cpr) ∗ 1024 (rev.) = 2097152_{10} = 0x200000
The value to be set in the Total resolution items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0020	0000	hexadecimal
32	0	decimal
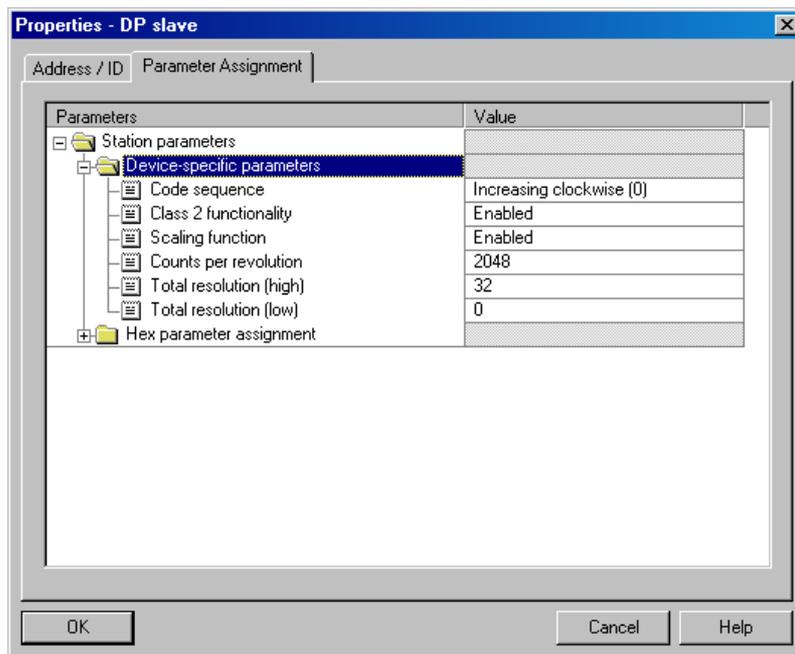
WARNING
We recommend the Number of revolutions to be set to a value that is a power of 2. If the set number of revolutions is not a power of 2, the so-called "Red Zone" will be created and the encoder will necessarily work inside its limits. For any information on the "Red Zone" refer to section "6.8 "Red zone"" on page 41.

EXAMPLE 4

Let's suppose we need to program the following encoder:
"AMT58" 24-bit multiturn encoder.

- Hardware counts per revolution   = 12 bits/rev. (4096 cpr)
- Hardware number of revolutions   = 12 bits (4096 rev.)
- Hardware total resolution   = 24 bits (4096∗4096=16777216)

We want to set: 4096 counts per revolution and 50 revolutions.
50 is NOT a power of 2.
Thus we will set 4096 next to the Counts per revolution item.
The Total resolution value will be: 4096 (cpr) ∗ 50 (rev.) = 204800_{10} = 0x32000
The value to be set in the Total resolution items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0003	2000	hexadecimal
3	8192	decimal
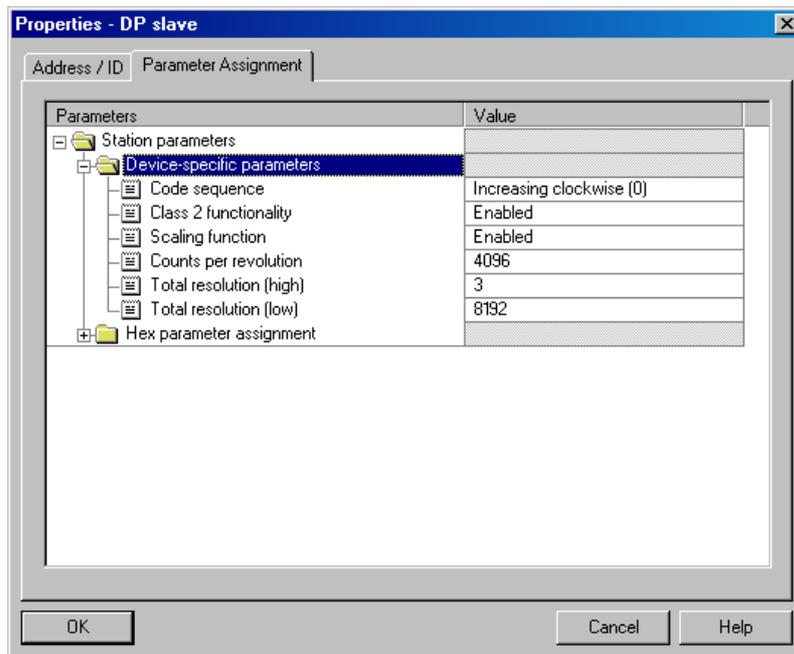
EXAMPLE 5

Let's suppose we need to program the following encoder:
"AMT58" 25-bit multiturn encoder.

- Hardware counts per revolution = 13 bits/rev. (8192 cpr)
- Hardware number of revolutions = 12 bits (4096 rev.)
- Hardware total resolution = 25 bits (8192 ∗ 4096=33554432)

We want to set: 360 counts per revolution and 4000 revolutions.
Neither 360 nor 4000 is a power of 2.
Thus we will set 360 next to the Counts per revolution item.
The Total resolution value will be: 360 (cpr) ∗ 4000 (rev.) = 1440000_{10}
= 0x15F900
The value to be set in the Total resolution items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0015	F900	hexadecimal
21	63744	decimal
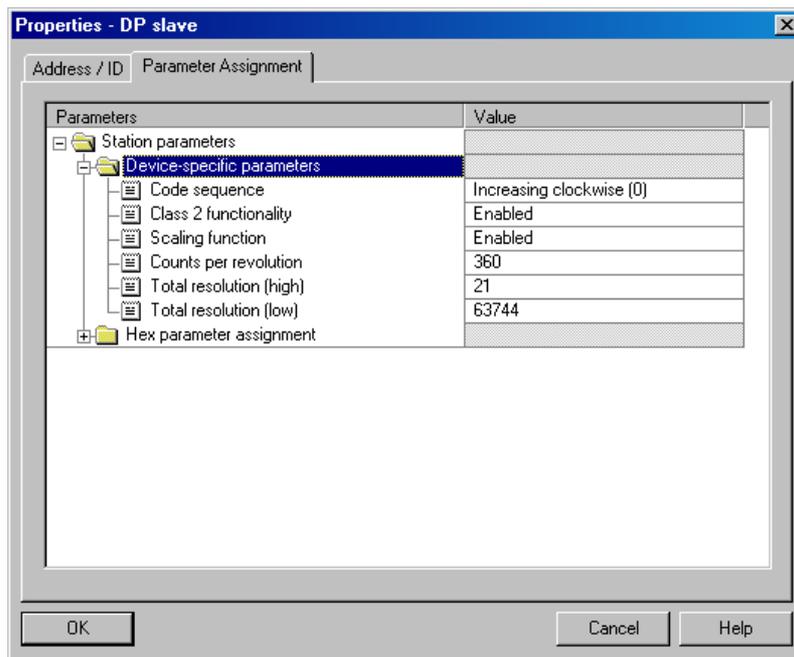
After having set new parameter values, click the OK button to close the Properties – DP Slave window and then the Download button (see icon on the left) in the toolbar of the HW Config window to download the set parameters.

5.2 Reading the diagnostic information

Datalogic encoder provides the standard diagnostic information. The diagnostic information message is 6-byte long. For any information on the DP Slave diagnostics please refer to the "Profibus Specification" document.

Before entering the diagnostic page, it is necessary to connect to the unit (i.e. enter the online status). To do this, select Station\Open online in the HW Config window or click the Online<->Offline button (see the icon on the left). When the unit is online, select the AMT58 module first and then the PLC\Module Information... command to enter the Module Information window. Finally open the DP Slave Diagnostics page.
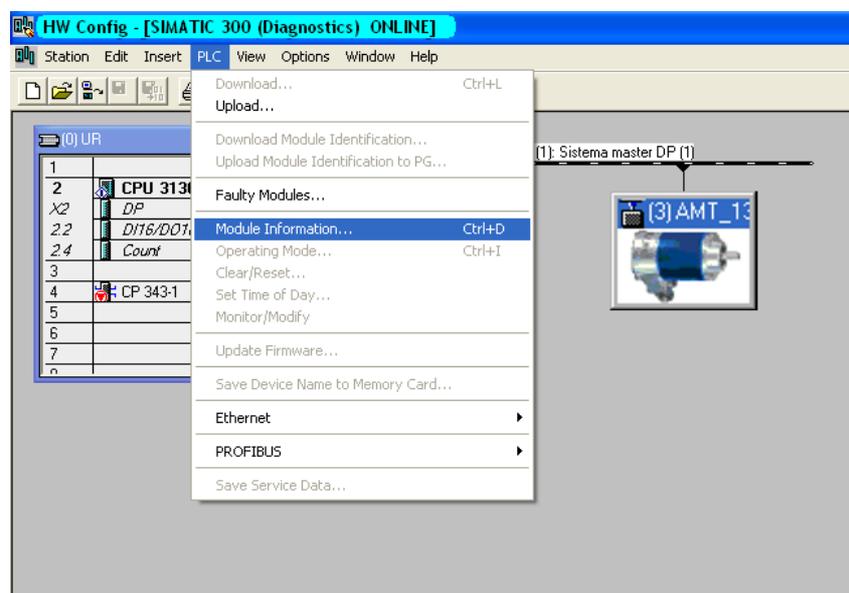
Click the Hex Format… button to display the diagnostic information:
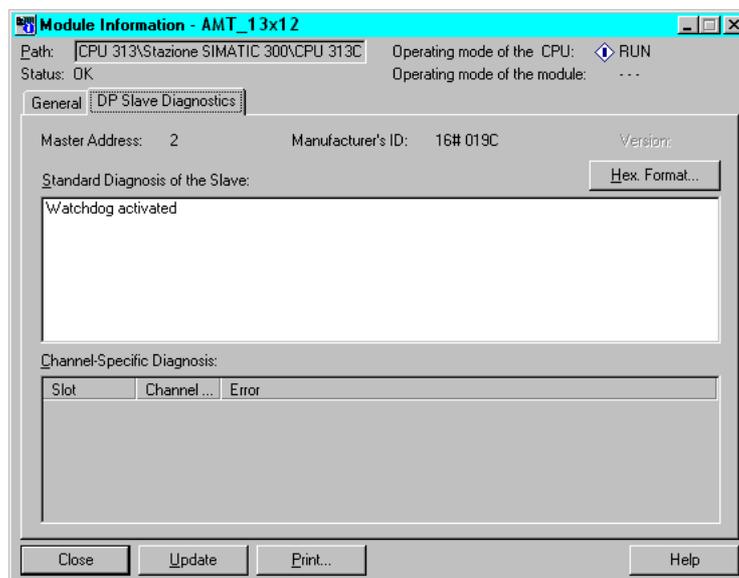
6-byte diagnostics
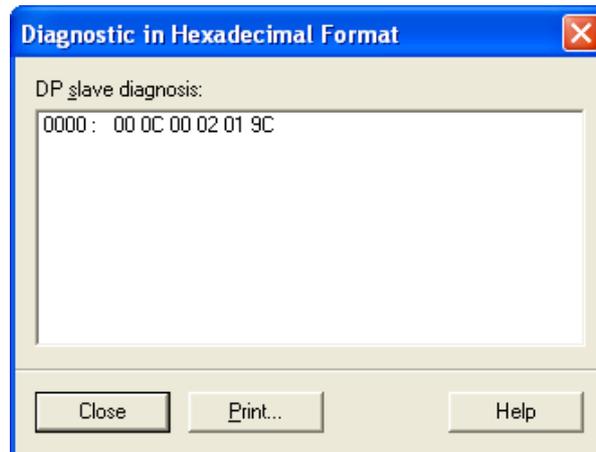
Byte	Description
0	status 1
1	status 2
2	status 3
3	Master ID
4	manufacturer ID
5	

5.3 Setting the Preset value

Example
The encoder having device address 1 transmits the Position value to the Master.
It is loaded into variables ED 100 … ED103 (4 bytes).
The Preset value is sent to the encoder by using the variables AD 100 … AD103 (4 bytes).
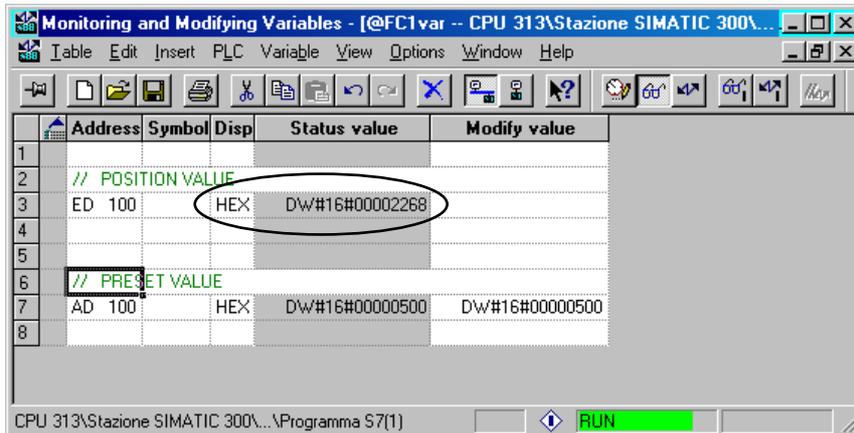
The current position of the encoder is 0000 2268hex.
To set the Preset value = 0000 0500hex, set the bit 31 of the variable AD 100 = "1" (8000 0500hex). See also the example in the paragraph "Preset" on page 38.
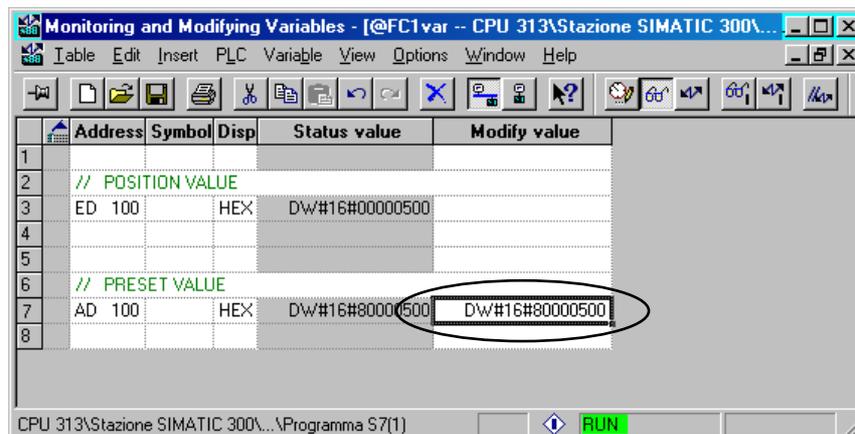
Finally click the Command variables button in the Toolbar (see the right icon).

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

NOTE
It may occur that some 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) to be used for encoder position and Preset value.

6 - Profibus interface

Datalogic units are slave devices and comply with the "Profibus-DP Profile for Encoders"; they can be set to either Class 1 or Class 2 devices (see section "6.2 Classes of the Device profile" on page 29). Refer to the official Profibus website for any information not reported in this manual (www.profibus.com).

6.1 GSD file

Profibus encoders are supplied with their own GSD file Ax58_Vx.GSx (see the enclosed documentation, if supplied, or click www.datalogic.com).

WARNING

Install the AMT58-xxx-13x12-PB.GSx in the AMT58 series multiturn encoders.
Vx is intended to indicate the GSD file version.
GSD installation file is further available in both Italian (AMT58-xxx-13x12-PB.GSI) and English (AMT58-xxx-13x12-PB.GSE) versions (texts and comments are in the supported language).

WARNING

For AMT58 multiturn encoders the default value preset by Datalogic in the Counts per revolution item of the AMT58-xxx-13x12-PB.GSx GSD file is 4096 (12 bits); for this reason, if you have a 25-bit multiturn encoder and you want to use the overall resolution, you must set the Counts per revolution item to 8192 (13 bits).

6.2 Classes of the Device profile

The encoder class must be set when you configure the device.
See also the Class 2 functionality operating parameter on page 32.

Class 1 allows basic functions of the device and can be used:
- to send the position information (see the Position parameter);
- to change the counting direction (see the Code sequence parameter);
- to set the preset value (see the Preset parameter).

Class 2 allows to use all Class 1 functions and further extended functions, they are:
- scaling function (see the Scaling function parameter).

6.3 Operating modes

Profibus-DP devices allow operation using different communication modes (see Figure below):
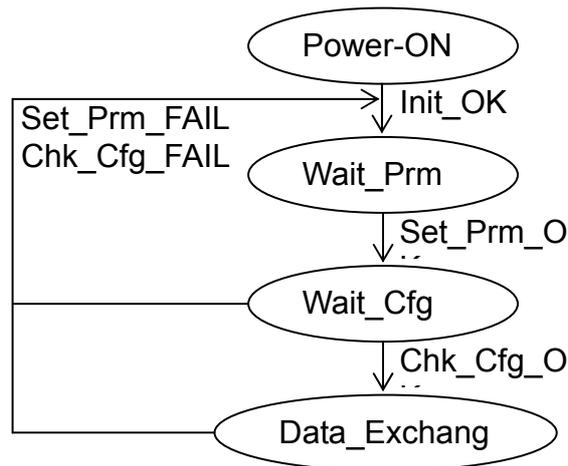
NOTE
All parameters are transmitted when the Set_Prm mode is active with the exception of the Preset value.
Preset value is transmitted only when the unit is in Data_Exchange mode.

Types of communication messages

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 is used to send parameters from the Master to the Slave (see the section "6.4 DDLM_Set_Prm" on page 31).

- **DDLM_Chk_Cfg:**
  It sets the number of bytes used for data transmission in Data_Exchange mode (see section "6.5 DDLM_Chk_Cfg" on page 37).

- **DDLM_Data_Exchange:**
  This is the "standard operation mode".
  It is used either by the Master to send the Preset value and by the Slave to transmit the Position value (see the section "6.6 DDLM_Data_Exchange" on page 38).

- **DDLM_Slave_Diag:**
  It is used when the power is turned on and whenever the Master needs to know diagnostic information from the Slave device (see the section "6.7 DDLM_Slave_Diag" on page 40).

6.4 DDLM_Set_Prm

When the system is turned on, configuration data set by the operator is sent to the absolute encoder by the controller (DDLM_Set_Prm mode). 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 Configuring the encoder via Siemens STEP7" on page 14).
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 according to the specifications of the encoder profile, as shown in the following tables.

DDLM_Set_Prm:

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
	Bits 4 … 7	Reserved
11 … 12	Counts per revolution	
13 … 16	Total resolution	
17 … 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	disabled	enabled
4, 5, 6, 7	Reserved		

Default values are highlighted in bold.

Code sequence

The Code sequence parameter defines whether increasing position values are output when the encoder shaft rotates clockwise (CW) or when the encoder shaft rotates counter-clockwise (CCW). When Code sequence = CW (0) the position information increases as the encoder shaft rotates clockwise; on the contrary, when Code sequence = CCW (1) the position information increases as the encoder shaft rotates counter-clockwise CW and CCW rotations are viewed from the shaft end.
If Class 2 functionality = DISABLED, this is the only parameter which can be set.
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 29.
0 = Disabled = Encoder Class 1 is set.
1 = Enabled = Encoder Class 2 is set.
Default = 1 (min. = 0, max. = 1)

Scaling function

When this option is disabled (Scaling function = 0), the 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 the option is enabled (Scaling function = 1), the device uses the resolution set in the bytes 11 … 16 (Counts per revolution and Total resolution).
For a correct use of this function see sections "6.4.2 Bytes 11 - 12" e "6.4.3 Bytes 13 … 16" below in the page.
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 = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if Scaling function = 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.

6.4.2 Bytes 11 - 12
Counts per revolution

WARNING
You can set a new value next to this Counts per revolution item only if Class 2 functionality = ENABLED; if Scaling function = ENABLED the set resolution value is enabled and used by the encoder; on the contrary, if Scaling function = DISABLED you are allowed to set a new resolution value, however it is not enabled even if sent to the encoder: the encoder still goes on using the default value uploaded from the GSD file, NOT the new entered value, until you enable the Scaling function. See the section "6.4.1. Byte 10 – Operating parameters" on page 31.

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

Byte	11	12
Bits	15-8	7-0
Data	2^{15} to 2^{8}	2^{7} to 2^{0}

You are allowed to set any integer value less than or equal to the Hardware counts per revolution. However we suggest setting a value that is a power of 2 (1, 2, 4, … 2048, 4096, ...).
Default = 4096 (min. = 1, max. = 8192) for AMT58 multiturn encoder

WARNING
If you set a value greater than the maximum allowed value (i.e. greater than the Hardware counts per revolution value), the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 13).

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 resolutionvalue 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, 4096. When this happens, the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 13).

6.4.3 Bytes 13 … 16
Total resolution

WARNING

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

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	13	14	15	16
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}

You are allowed to set any integer value less than or equal to the Hardware total resolution. However we suggest setting a value that is a power of 2.
Default = 16777216 (min. = 1, max. = 33554432) for AMT58 multiturn encoder

NOTE
Please note that

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

WARNING

If you set a value greater than the maximum allowed value (i.e. greater than the Hardware total resolution value), the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 13).

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 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 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 13).

WARNING
We recommend the Number of revolutions to be set to a value that is a power of 2. If the set number of revolutions is not a power of 2, the so-called "Red Zone" will be created and the encoder will necessarily work inside its limits. For any information on the "Red Zone" refer to section "6.8 "Red zone"" on page 41.

WARNING
The AMT58 multiturn encoder can be configured so that it works exactly as the singleturn encoder.
This is achieved by setting Total resolution = Counts per revolution.
Let's suppose the encoder is set as follows:
Counts per revolution= 8192
Total resolution = 8192

So it follows that:

$$\text{Number of revolutions} = \frac{8192 \ (\text{Total resolution})}{8192 \ (\text{Counts per revolution})} = 1$$

This is exactly the configuration of the singleturn encoder.
It is of course obvious that the contrary is not possible.

Example
multi-turn encoder with 24-bit resolution
- Hardware counts per revolution   = 12 bit/turn (4096 cpr)
- Hardware number of revolutions = 12 bit (4096 rev.)
- Hardware total resolution   = 24 bit (4096 ∗ 4096 = 16777216)

multi-turn encoder with 25-bit resolution
- Hardware counts per revolution   = 13 bit/turn (8192 cpr)
- Hardware number of revolutions = 12 bit (4096 rev.)
- Hardware total resolution   = 25 bit (8192 ∗ 4096 = 33554432)

Example
Multiturn encoder AMT58 with connection cap.

The hardware resolution is:
- Hardware counts per revolution   = 4096 (2^{12})
- Hardware number of revolutions   = 4096 (2^{12})
- Hardware total resolution   = 16777216 (2^{24})

We need to set the following custom resolution: 2048 counts per revolution ∗ 1024 revolutions.
To do this proceed as follows:
- Enable Class 2 functionality:
- Enable Scaling function: byte 10=0A hex (bit 1=bit 3= "1")
- Counts per revolution = 2048:   bytes 11-12 = 0800 hex
- = 2048 ∗ 1024 = 2097152: bytes 13 … 16 = 0020 0000 hex.

NOTE
When new values are set next to the Counts per revolution and/or Total resolution items, also a new Preset value is required. It has to comply with the new resolution you have set.

WARNING
Please note that the in Step 7 the Total resolution value has to be split into two separate fields, namely Total resolution (high) and Total resolution (low). This value in fact must be entered in two words. Please refer to the examples on page 19 to understand how the Total resolution value has to be divided into two parts: a high part and a low part.
The following values are allowed:
multiturn model
Total resolution (high): default   = 256 (min. = 0, max. = 512)
Total resolution (low): default   = 0 (min. = 0, max. = 65535)

6.5 DDLM_Chk_Cfg

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

Chk_Cfg message structure (1 byte):

bit 7   = Consistency (= "1")
bit 6   = Word format ("0" = byte, "1" = word = 4 bytes)
bits 5 - 4   = In/out data ("01" = Input, "10" = Output)
bits 3 … 0   = Length code

Example

bit	7	6	5	4	3	2	1	0	
Dat	1	1	0	1	0	0	0	1	D1h
a	1	1	1	0	0	0	0	1	E1h

D1hex = 4-byte input
E1hex = 4-byte output

6.6 DDLM_Data_Exchange

This is the normal operational status of the system. The Slave (no matter if set to Class 1 or Class 2) can both transmit the Position value to the Master and receive the Preset value from the Master.

Position
(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}

This is the position information output by the encoder. The value is right aligned in the data field.

Preset
(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 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 = DISABLED, then
  Presetmust be less than the Hardware total resolution.

- If Scaling function = ENABLED, then
  Preset must be less than the Total resolution

Example

Preset value to be set = 0000 0500hex
Current encoder Position = 0000 2267hex

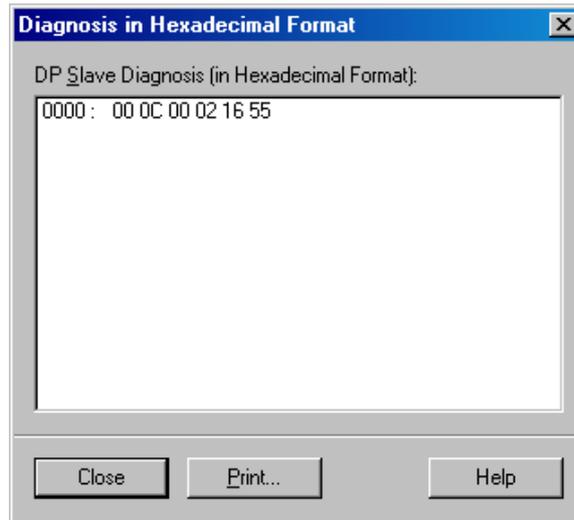| Cycle	Byte Bit	1 31-24	2 23-16	3 15-8	4 7-0
1°	M→S	80hex 10000000_2	00hex 00000000_2	05hex 00000101_2	00hex 00000000_2
	S→M	00hex 00000000_2	00hex 00000000_2	22hex 00100010_2	67hex 01100111_2
2°	M→S	80	00	05	00
	S→M	00	00	22	67
3°	M→S	80	00	05	00
	S→M	00	00	05	00

WARNING
Always set the Preset value when the encoder shaft is in stop. The new Preset value is saved immediately after receipt.

Please refer also to the example for setting the preset value via Step7; refer to the section "5.3 Setting the Preset value" on page 27.

6.7 DDLM_Slave_Diag

The Master device can send a request for diagnostic information at any time to the Slave device. Datalogic encoders implement the standard diagnostic information (6 bytes). For any information on the DP Slave diagnostics please refer to the "Profibus Specification" document.

6-byte Diagnostic:

Diagnosis in Hexadecimal Format

DP Slave Diagnosis (in Hexadecimal Format):

```
0000 :   00 0C 00 02 16 55
```

Close   Print...   Help

| Byte	Description
0	status 1
1	status 2
2	status 3
3	Master ID
4	manufacturer ID
5	

6.8 "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.
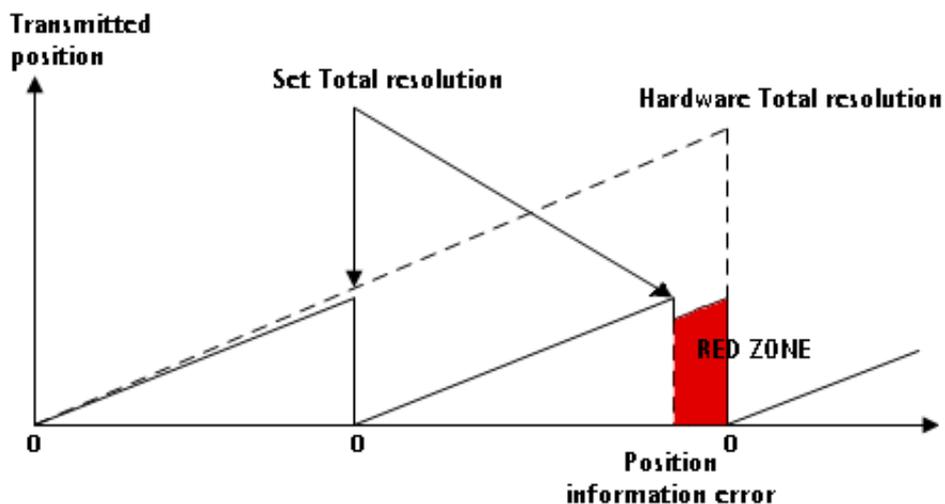
Example
25-bit resolution multiturn encoder
- Hardware counts per revolution $= 8192 \ (2^{13})$
- Hardware number of revolutions $= 4096 \ (2^{12})$
- Hardware total resolution $= 33554432 \ (2^{25})$
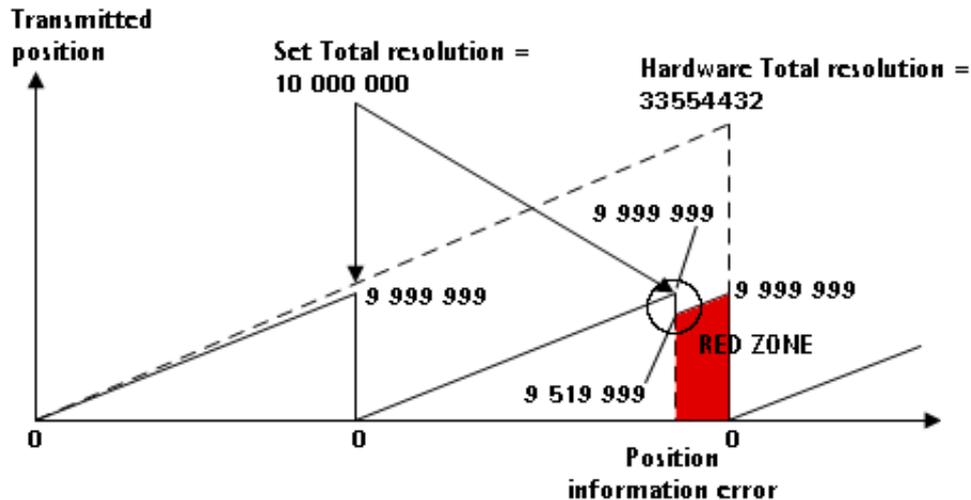
Set parameters values:
- Counts per revolution   = 5000
- Total resolution   = 10000000
- Number of revolutions   = 2000

$$\frac{\textbf{Hardware number of revolutions}}{\textbf{Set number of revolutions}} = \frac{4096}{2000} = 2.048$$

It follows that the encoder will work within the limits of the "read zone" for 96 revolutions (4096 - 2 * 2000 = 96), i.e. for 480000 counts (96 * 5000).
The problem can be explained graphically:

NOTE
- When the encoder is operating within the limits of the "red zone", the status is indicated by the green LED flashing while the red LED is OFF (see the section "6.8 "Red zone"" on page 13).

- When the encoder is operating within the limits of the "red zone" (i.e. for 5000 cpr * 96 revolutions = 480000 counts: 9519999 … 9999999), the transmitted position is consistent with the set resolution: it is calculated so that the last position within the "red zone" before crossing the zero position is "Total resolution -1".

- Please be careful using the position information sent by the encoder when it is operating within the limits of the "red zone". When the encoder crosses from the normal status to the "red zone" status (and vice versa), a position information error occurs. See the Figure above: when entering the "red zone" the position information jumps from 9999999 to 9519999!

7 – Default parameters list

Default values preset in the GSD file for AMT58 multiturn encoder (AMT58-xxx-13x12-PB.GSx)

Lista parametri	Valore di default
Code sequence	0
Class 2 functionality	1
Scaling function	1
Counts per revolution	8196
Total resolution	33554432