Smart encoders & actuators

User's guide

AS58 PB
AM58 PB
ASC58 PB
AMC58 PB
CC-PB, CC-PB-C

Profibus-DP profile for encoders

- AS58 up to 13-bit singleturn encoder (8,192 cpr)
- AM58 up to 25-bit multiturn encoder (8,192 cpr x 4,096 rev.)
- CC-PB and CC-PB-C connection caps
- Profibus DP configurable as Class 1 and Class 2 Slave

Suitable for the following models:

- AS58 PB, AS58S PB
- ASC58 PB, ASC59 PB, ASC60 PB
- AM58 PB, AM58S PB
- AMC58 PB, AMC59 PB, AMC60 PB
- CC-PB
- CC-PB-C

General Contents

Table of contents

Subject index

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 **GREEN**;
- alarms are coloured in **RED**;
- states are coloured in **FUCSIA**.

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

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

Preliminary information

This guide is designed to provide the most complete information the operator needs to correctly and safely install and operate the following encoders **fitted with Profibus interface**:

ASxxx12/PB-xx **(12 bit singleturn encoder)**
ASxxx13/PB-xx **(13 bit singleturn encoder)**
AMxxx12/4096PB-xx **(12 + 12 bit multiturn encoder)**
AMxxx13/4096PB-xx **(13 + 12 bit multiturn encoder)**

* + Profibus connection cap as follows (to be ordered separately):

CC-PB Profibus-DP interface with PG output
CC-PB-C Profibus-DP interface with M12 connection output

To make it easier to read the text, this guide can be divided into three main sections.

In the first section (from chapter 1 to chapter 4) general information concerning the safety, the mechanical installation and the electrical connection is provided.

In the second section (chapter 5) information on how to install and configure the encoder under the Siemens STEP7 development environment as well as tips for setting up and running properly and efficiently the unit are provided.

In the third section (chapter 6) 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.

Glossary of Profibus terms

Profibus, like many other networking systems, has a set of unique terminology. Table below contains a few of the technical terms used in this guide to describe the Profibus interface. They are listed in alphabetical order.

Address (Station)	IEC 61158-2: Medium attachment unit identification - unique number of a station connected to a segment (participant).
Address Space	Within PROFIBUS DP the maximum possible number of addressable network nodes per segment, e.g. 127.
Alarm	Notification of an abnormal or unexpected event within a system. Alarms in PROFIBUS DP require in addition to the standard diagnosis event mechanism within the cyclic data exchange a separate acyclic acknowledgement procedure between a host and a Slave application. Since DP-V1, "Device related diagnosis" is the basis for the "Alarm" and "Status" types of diagnosis events (GSD: "DPV1"=1). PROFIBUS DP defines the following alarm types: Diagnosis, Status, Process, Update, Pull and Plug Alarm. See "Device Related Diagnosis". The PNO maintains a Profile Guideline, Part3: Diagnosis, Alarms and Time Stamping, order no. 3.522.
Alert	Alert is a generic term for two different types of notifications within a PROFIBUS DP/PA network especially arranged but not exclusively for the process automation: • alarm; • event. Both alert types may be used with or without a user acknowledgement mechanism. The PNO maintains a PROFIBUS guideline "Time Stamp", order no. 2.192.
Application Profile	Within PROFIBUS a specified agreement within families of field devices on how to use the general PROFIBUS communication platform and its subsystems (e.g. device integration via GSD, EDD, FDT/DTM and Communication Function Blocks). Communication profiles are not a part of the PROFIBUS DP application profiles. See "Profile".
Baud rate (Data Rate)	Other common terms are "data transfer rate" and "transmission rate". Within PROFIBUS DP this is the amount of data transferred across a fieldbus segment per second. A data rate is measured in units of bits per second ("b/s" or "bps"), or baud.
Bus Cycle	The period of time the bus Master needs to poll every participant (Slave) once. More bus Masters can be activated by using the token principle which consequently prolong the bus cycle.

Class	See "DP Master", "DP Master Class 1 (DPM1)" and "DP Master Class 2 (DPM2)".
Class 1 encoder	Encoder class must be set when you configure the device. Mandatory Class 1 provides the basic functions of the device and can be used for: • sending the position value (see **Position** parameter); • changing the counting direction (see **Code sequence** parameter); • setting the preset value (see **Preset** parameter); • acquiring reduced diagnostic information.
Class 2 (+VEL) encoder	Encoder class must be set when you configure the device. Class 2 (+VEL) provides all the Class 1 and Class 2 functions and additional velocity-related functions: • transmission of the velocity value; • setting of the velocity measuring unit.
Class 2 encoder	Encoder class must be set when you configure the device. Class 2 provides all the Class 1 functions and additional advanced functions such as: • scaling function (see **Scaling function**, **Counts per revolution** and **Total resolution** parameters); • extended diagnostic information.
Communication Function Block (Comm FB)	A basic function block defined for PROFIBUS DP and supplied by the PLC manufacturer for the standardized access of user programs to field devices. The standardization is based on IEC 61131-3. The PNO maintains a guideline "PROFIBUS Communication and Proxy Function Blocks acc. to IEC 61131-3", order no. 2.182.
Communication Parameter	Communication parameters are parameters, which adjust the communication protocol function to the current net configuration. Communication parameters exist for all phases of the communication protocols. Examples are bus address, token rotation time, idle time. See "Slave parametrization" and "Device parametrization".
Communication Profile	IEC 61158 comprises a summary of layer stacks of several different fieldbusses. IEC 61784 defines the useful combinations of these stacks via communication profiles CPF3/1 up to CPF3/3 (PROFINET). One of these is PROFIBUS DP. Within this communication profile three different physical profiles are defined: • RS 485 (RS 485-IS); • MBP-IS (MBP-LP, MBP); • Fibre Optics.
Cyclic Data Exchange	IEC 61158-3: Term used to describe events which repeat in a regular and repetitive manner. The MS0 services of PROFIBUS DP are based on cyclic data exchange. See "State machine".
Cyclic Redundancy Check (CRC)	Error-checking technique in which the frame recipient calculates a remainder by dividing frame contents by a prime

	binary divisor and compares the calculated remainder to a value stored in the frame by the sending node.
Data Rate (Baud rate)	Other common terms are "data transfer rate" and "transmission rate". Within PROFIBUS DP this is the amount of data transferred across a fieldbus segment per second. A data rate is measured in units of bits per second ("b/s" or "bps"), or baud.
Decentralized Peripherals (DP)	The term "Decentralized Peripherals" and the acronym "DP" stand for the simple, fast, cyclic and deterministic I/O data exchange between a bus Master and its assigned Slave devices. The corresponding PROFIBUS communication protocol is called PROFIBUS DP.
Device Identifier	Ident number: The primary device identification is an ident number of data type Unsigned16. This number is unique and assigned by the PNO business office upon application. It is stored within the device and defined in the corresponding GSD file via keyword. In addition it is part of the GSD file name. At runtime the ident number is used within: • the set Slave address procedure; • the parametrization telegram (octet 5 + 6); • the standard part of a diagnosis message (octet 5 + 6). The ident number explicitly cannot be retrieved from a device. Its main purpose is to make sure that a GSD file and configuration/parametrization data between Master Class 1 and its Slave are matching. The PNO maintains a technical guideline "Specification for PROFIBUS device description and device integration, Volume 1: GSD", Version 5.0, order no. 2.122. For a secondary identification possibility see the identification & maintenance functions (I&M). See "Ident Number".
Device Parametrization	The device parametrization within PROFIBUS DP consists of three phases. The first phase takes place during start-up of the communication system and provides basic communication parametrization and simple additional device parameters. Both are defined within the GSD file of a device, stored within a Master Class 1 after configuration in an engineering tool, and transmitted to the Slave at start-up time. Most of the automation cases in factory automation are covered by this method. More complex devices such as drives, laser scanners, scales, robots, transmitters, etc. require further individual parametrization before final production start. This is done in a second phase. In process automation certain device parameters such as value limits, value range, gain, etc. need to be adjusted even at run-time. For this second and third phase PROFIBUS DP provides two ways to accomplish the task: DTM/FDT and EDD. See "Slave parametrization" and "Communication parameter".
Device Profile	See "Profile".

DP Master	IEC 61158-5: Within PROFIBUS DP a fieldbus node that can be either Master Class 1 or Master Class 2. A Master Class 1 is a controlling device which controls several DP Slaves (field devices). NOTE: This is usually hosted by a programmable controller or a process controller. A Master Class 2 is a controlling device which manages configuration data (parameter sets) and diagnosis data of a DP Master Class 1, and that additionally can perform all communication capabilities of a DP Master Class 1.
DP Master Class1 (DPM1)	IEC 61158-5: A controlling device which controls several DP-Slaves (field devices). Usually programmable (logic) controllers or process control systems are hosts for Master Class 1.
DP Master Class2 (DPM2)	IEC 61158-5: A controlling device which manages configuration data (parameter sets) and diagnosis data of a DP-Master (Class 1). Additionally the DP-Master (Class 2) can perform all communication capabilities of a DP-Master (Class 1). Usually personal computers are hosts for DP Master Class 2 for programming, parametrizing, diagnosing and monitoring purposes.
DP Slave	IEC 61158-5: A field device that is assigned to one DP Master Class 1 as a provider for cyclic I/O data exchange. In addition acyclic functions and alarms could be supported.
Event	Within PROFIBUS DP/PA this is a signal or I/O data or process value within a certain field device at that point in time where a trigger condition arises. The values are associated with a time stamp and stored in a buffer. The time-stamped sample values are used to archive and visualize significant changes over the course of the production process. Such an event mechanism does not prevent from the cyclic transmission of these signals. A separate event alarm is requesting the transfer of the events to the main system.
Frame	A single set of data transmission from a device.
General Station Description (GSD)	A GSD is an electronically readable ASCII text file and contains both general and device-specific parameters for communication and network configuration. By means of keywords, a configuration tool allows to: • read device information (manufacturer, type, versions, bitmaps, etc.); • read texts for comfortable and easy to use configuration; • select transmission rates; • select modules and their I/O data length (configuration identifier); • read texts to assign diagnosis IDs to HMI displays; • select supported services (freeze, sync, etc.); from the GSD for the configuration of the device. A GSD replaces the previously conventional manuals or data sheets and thus already supports plausibility checks during the

	configuration phase. Distinction is made between a device GSD (for an individual device only) and a profile GSD, which may be used for devices that comply exactly with a profile such as a "PA device". GSDs for different languages may be provided in separate files with corresponding file extensions (*.gse for English, *.gsg for German, etc.) or altogether in one file (*.gsd). The device manufacturers are responsible for the scope and quality of the GSD of their devices.
Ident Number	See "Device Identifier". Notes: • the ident number is necessary for all DP devices except for Master Class 2; • the same ident number may be used for modular devices as long as the device can be described in the GSD file as a modular device.
Identifier	In general: a symbol that establishes the identity of the one bearing it. Within this context here it represents an absolute value of a parameter such as a physical address. It is intended for systematic and performance handling capabilities within computer systems, e.g. sorting, consistency checking, physical localization and alike. Usually an absolute value is associated with a logical value to represent the particular deployment of the identifier. Typical abbreviation for identifier is ID. IEC 61131-3: A combination of letters, numbers and underline characters, which begins with a letter or underline and which names a language element. Some of the major identifiers within PROFIBUS DP are: - Data type numeric identifier; - Configuration identifier (Cfg); - Device identifier (ident number); - Manufacturer identifier (MANUFACTURER ID); - Profile ident number (PROFILE ID).
Index	IEC 61158-5: Address of an object within an application process. The permitted range in PROFIBUS DP is 0 - 255. Indexes are used to address records of data (parameters, variables, state information, commands, etc.) within modules of a field device.
PDU (Protocol Data Unit)	A packet of data passed across a network via telegrams. The term implies a specific layer of the OSI seven layer model and a specific protocol. Each layer has its own PDU that is extended subsequently from the physical layer up to the application layer: • Physical layer protocol data unit (PhPDU); • Data link protocol data unit (DLPDU); • Application protocol data unit (APDU).
PI	The *PROFIBUS Nutzerorganisation e.V.* (PROFIBUS User Organisation, or PNO) was created in 1989. This group was composed mainly of manufacturers and users from Europe. In 1992, the first regional PROFIBUS organization was founded

	(PROFIBUS Schweiz in Switzerland). In the following years, additional Regional PROFIBUS & PROFINET Associations (RPAs) were added. In 1995, all the RPAs joined together under the international umbrella association PROFIBUS & PROFINET International (PI). Today, PROFIBUS is represented by 25 RPAs around the world (including PNO) with over 1400 members, including most if not all major automation vendors and service suppliers, along with many end users.
PNO	The *PROFIBUS Nutzerorganisation e.V.* (PROFIBUS User Organisation, or PNO) was created in 1989. This group was composed mainly of manufacturers and users from Europe. In 1992, the first regional PROFIBUS organization was founded (PROFIBUS Schweiz in Switzerland). In the following years, additional Regional PROFIBUS & PROFINET Associations (RPAs) were added. In 1995, all the RPAs joined together under the international umbrella association PROFIBUS & PROFINET International (PI). Today, PROFIBUS is represented by 25 RPAs around the world (including PNO) with over 1400 members, including most if not all major automation vendors and service suppliers, along with many end users.
PROFIBUS	PROcess FIeldBUS. PROFIBUS is a manufacturer independent fieldbus standard for applications in manufacturing, process and building automation. The PROFIBUS family is composed of three types of protocol, each of which is used for different tasks. The three types of protocols are: PROFIBUS FMS, DP and PA. IEC 61784-1: Communication network according to communication profile family 3 (CPF3); incorporating application profiles and system integration aspects like interfaces and languages for engineering tools and HMI. PROFIBUS is an open, digital communication system with a wide range of applications, particularly in the fields of factory and process automation. PROFIBUS is suitable for both fast, time-critical applications and complex communication tasks. The PROFIBUS logo is a registered trademark.
PROFIBUS DP	Acronym for "PROFIBUS for Decentralized Peripherals". Specification of an open fieldbus system with the following characteristics: • polling Master-Slave-system (cyclic communications, MS0); • flying Masters with robin round token passing coordination (MM); • connection based (MS1) and connectionless (MS2, MS3) acyclic communication between Masters and Slaves. Options (e.g.): • Data exchange broadcast (DXB), i.e. Slave to Slaves communication; • isochronous mode of Slaves;

	• clock synchronization; • redundancy. PROFIBUS DP is standardized within IEC 61158 and IEC 61784, communication profile families 3/1 and 3/2. The term "PROFIBUS DP" is also a synonym for the RS-485 based deployments within factory automation.
PROFIdrive	Communication technology especially adopted to the requirements of position and speed controlled drive applications (e.g. speed synchronized axis). Within the scope of PROFIBUS, "PROFIdrive" is used for the application of the PROFIBUS DP protocol (DP-V2) in motion control automation together with the corresponding application profiles ("PROFIdrive - Profile for variable speed drives" and "PROFIdrive - Profile drive technology") for the transmission technology RS-485.
Profile	Besides other things profiles in common define agreements on how to use communication means in a standardized manner. Within the context of fieldbusses several types of profiles are known: • communication profiles (e.g. IEC 61784); • physical profiles (MBP-IS, RS-485); • application profiles (see PROFIBUS TC3); • device profiles (e.g. robots); • branch profiles (e.g. extruder).
Profile Ident Number	Identifier of a particular profile definition. The profile ident number is taken from the pool of ident numbers handled by the PNO. It plays a role within the following scenarios. (1) In cases where the device of a manufacturer A should be replaceable by an equivalent device, the PNO is assigning number ranges to dedicated device types (Profile specific IDs) in combination with certain "Profile GSDs". Profiles using this methodology are e.g. "PA Devices" and "PROFIdrive". (2) Usually these Slave devices are designed to communicate with a Master Class 2 application (e.g. profile application or profile DTM). In order to ensure a Master application is communicating with an appropriate Slave, it is sending a profile specific ID during the establishment of the connection (MS2 Initiate Service). The Slave may answer with the same profile specific ID (if it is supporting this profile), with another ID (if it is supporting another profile) or with "0000h" if it is not supporting any profile. (3) I&M functions: Besides its basic I&M information devices - following a certain profile - are enabled to provide more detailed profile specific information.
Protocol Data Unit (PDU)	A packet of data passed across a network via telegrams. The term implies a specific layer of the OSI seven layer model and a specific protocol. Each layer has its own PDU that is extended subsequently from the physical layer up to the application layer:

	• Physical layer protocol data unit (PhPDU); • Data link protocol data unit (DLPDU); • Application protocol data unit (APDU).
Slave Parametrization	For a DP Slave several levels of parametrization exist. (1) The parameters on the DP communication level can be defined via a GSD file and comprise features such as baud rates, timing constraints, identification, options, transferable data structures, publisher subscriber links, etc. This level supports parametrization of simple modular Slaves and also special common additional communication layers such as PROFIsafe. This parametrization is fixed for a given operational life cycle after start-up. (2) More complex devices may be parametrized via EDD and/or FDT/DTM technology via an acyclic communication service (MS2). (3) For parameter changes at run-time such as batch operation (recipes) or motion control, special "parameter channels" associated with the cyclic data structures may be added or the MS1 services together with proxy function blocks may be used.
State Machine (DP)	An abstract machine consisting of a set of states (including the initial state), a set of input events, a set of output events, and a state transition function. A state machine describes the behaviour of a field device how to react in different situations. The state machine for DP Slaves comprises the following states/actions: - Power_On_Reset --> Set Slave address --> if successful, a transition follows to: - Wait_Prm --> Parametrization, diagnosis (optional) --> if successful, a transition follows to: - Wait_Cfg --> Configuration, diagnosis (optional) --> if successful, a transition follows to: - Data_Exch --> Normal operation: cyclic data exchange. On top of this basic communication layer state machine application profiles are defining their own additional state machines, e.g. PA devices, PROFIdrive, PROFIsafe, Ident Systems, Weighing and Dosage Systems. State machines are best modelled and documented with the help of the "Unified Modelling Language (UML)".
Station Address	Within PROFIBUS DP the address of a communication participant (Master or Slave). The permitted range is 0 to 127, with: - 126 intended to be used for the "soft" addressing of Slave devices; - 127 intended to be used for broadcast messages to all the Slaves.
Topology	In a communication network, the pattern of interconnection between network nodes; e.g. bus, ring, star configuration.
Transmission Rate (Baud	The signalling rate of a digital communication line. It is the

rate)	switching speed, or number of transitions (voltage or frequency changes) that are made per second. Within PROFIBUS DP the possible transmission rates depend on the MAU (Medium Attachment Unit) in use.
Watchdog Control	IEC 61158-6: This timer is part of the DP layer within a Slave. It is restarted by received requests from the bus Master and will set the outputs of a Slave to a fail-safe state after the expiration of the timer.
Watchdog Time (Twd)	IEC 61158-5: The watchdog timer is part of the DP layer within a Slave. The watchdog time is set by parametrization at run-up and consists of a watchdog time base (1 or 10 ms) and 2 factors. A selection can be made during configuration via the GSD file of a Slave. This is a Slave parameter. See "Watchdog control".

1 - Safety summary

1.1 Safety

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

1.2 Electrical safety

- Turn off the power supply before connecting the device;
- connect according to explanation in the "4 - Electrical connections" section on page 25;
- in compliance with the 2014/30/EU 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. Provide the ground connection as close as possible to the encoder. We suggest using the

ground point provided in the cap, use one TCEI M3 x 6 cylindrical head screw with two tooth lock washers.

1.3 Mechanical safety

- Install the device following strictly the information in the "3 - Mounting instructions" section on page 20;
- 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 meet 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 **order code** and the **serial number** printed on the label applied to its body. Information is listed in the delivery document too. Please always quote the order code and the serial number when reaching Lika Electronic for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product refer to the technical catalogue.

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

3 - Mounting instructions

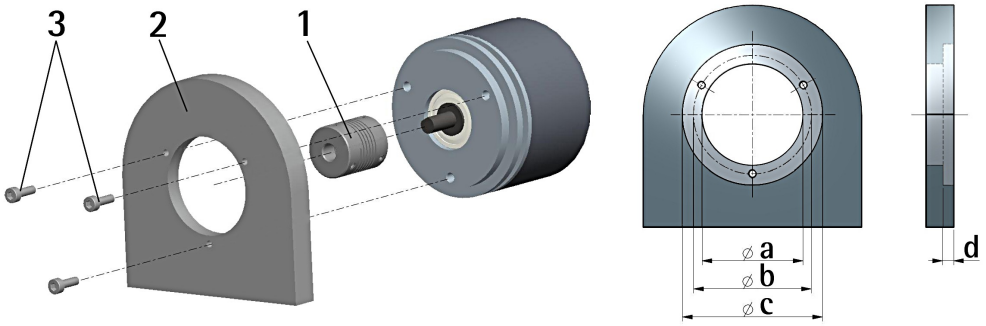
WARNING
Installation and maintenance operations must be carried out by qualified personnel only, with power supply disconnected and mechanical parts absolutely in stop.

For any information on the mechanical data and the electrical characteristics of the encoder please refer to the technical catalogue.

3.1 Solid shaft encoders

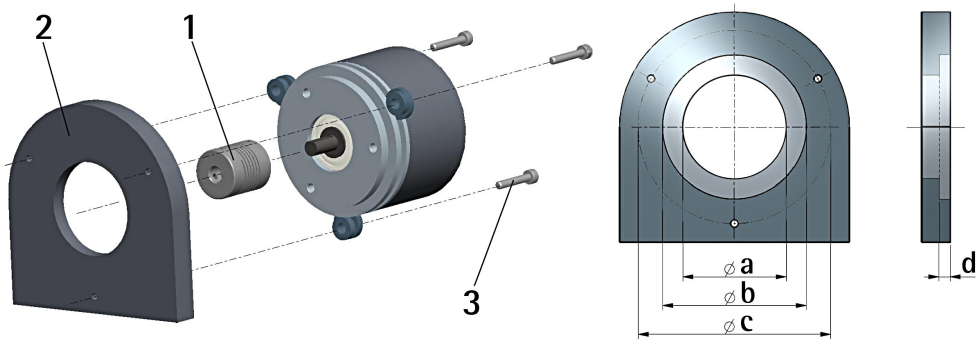
- Mount the flexible coupling **1** on the encoder shaft;
- fix the encoder to the flange **2** (or to the mounting bell) by means of screws **3**;
- secure the flange **2** to the support (or the mounting bell to the motor);
- mount the flexible coupling **1** on the motor shaft;
- make sure the misalignment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

3.1.1 Customary installation



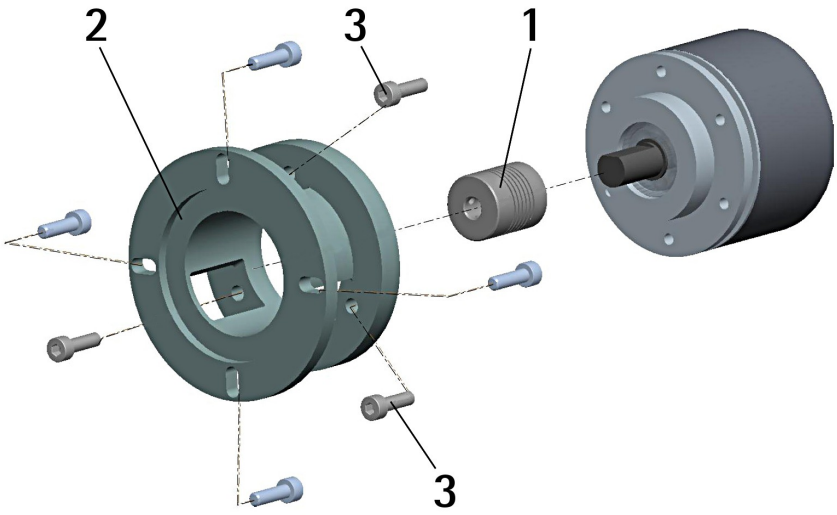
	a [mm]	b [mm]	c [mm]	d [mm]
AS58, AM58	-	42	50 F7	4
AS58S, AM58S	36 H7	48	-	-

3.1.2 Installation using fixing clamps (code LKM-386)



	a [mm]	b [mm]	c [mm]	d [mm]
AS58, AM58	-	50 F7	67	4
AS58S, AM58S	36 H7	-	67	-

3.1.3 Installation using a mounting bell (code PF4256)

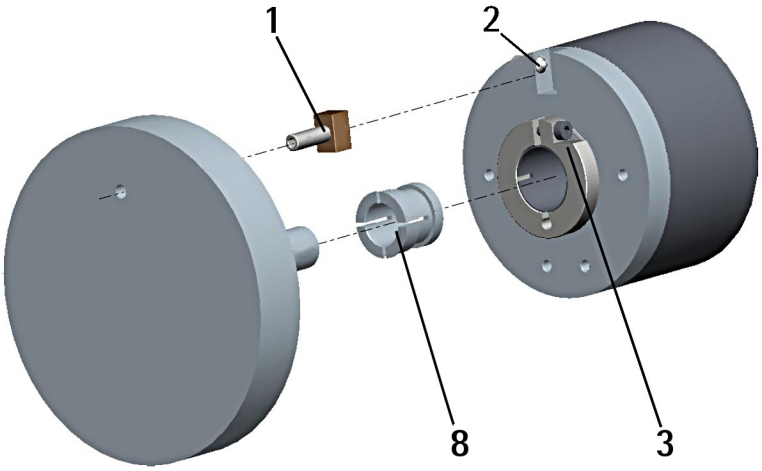


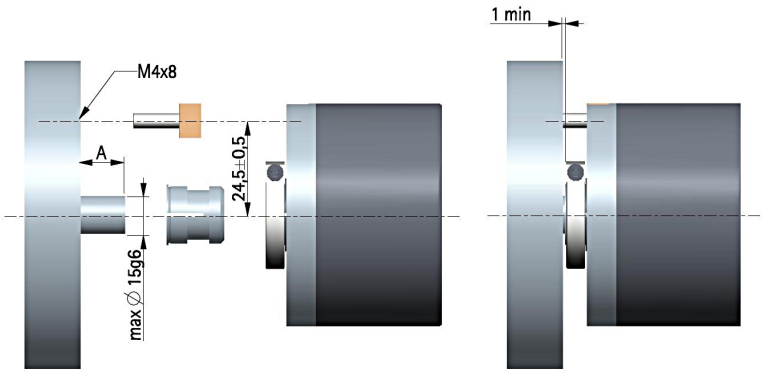
NOTE
In order to guarantee reliability over time of the encoder mechanical parts, we recommend a flexible coupling to be installed between the encoder and the motor shaft. Make sure the misalignment tolerances of the flexible coupling are respected.

3.2 Hollow shaft encoders

3.2.1 ASC58, AMC58 with antirotation pin

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

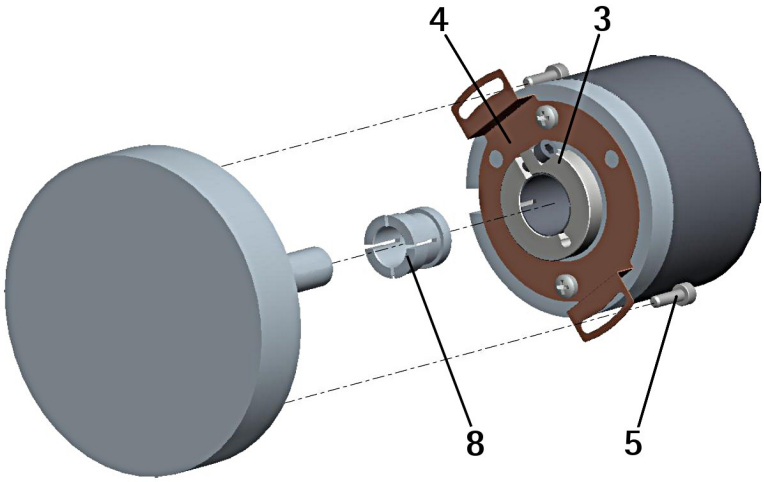


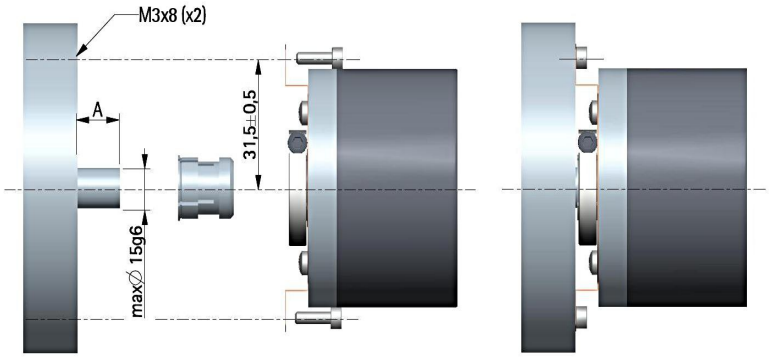


A = min. 8, max. 18

3.2.2 ASC59, AMC59 with fixing plate

- 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**).

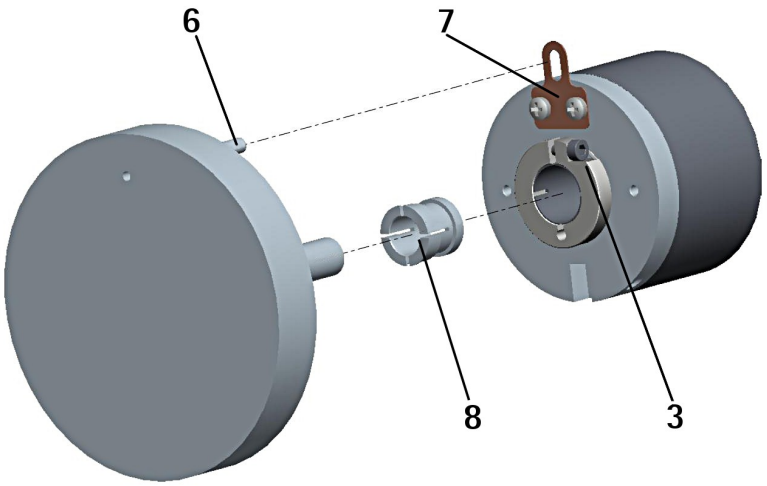


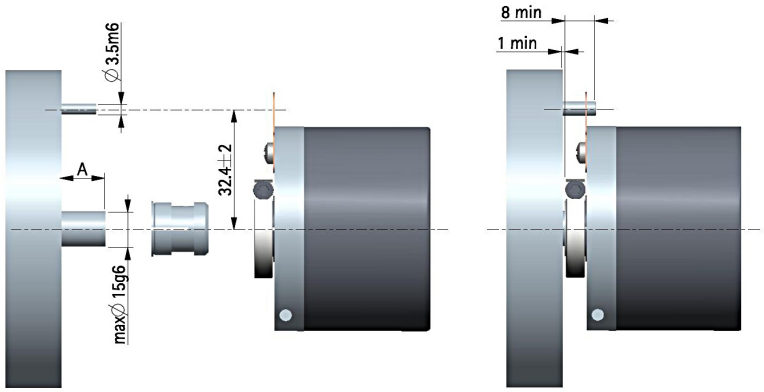


A = min. 8, max. 18

3.2.3 ASC60, AMC60 with antirotation pin and fixing plate

- 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**).





A = min. 8, max. 18

NOTE

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

4 - Electrical 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

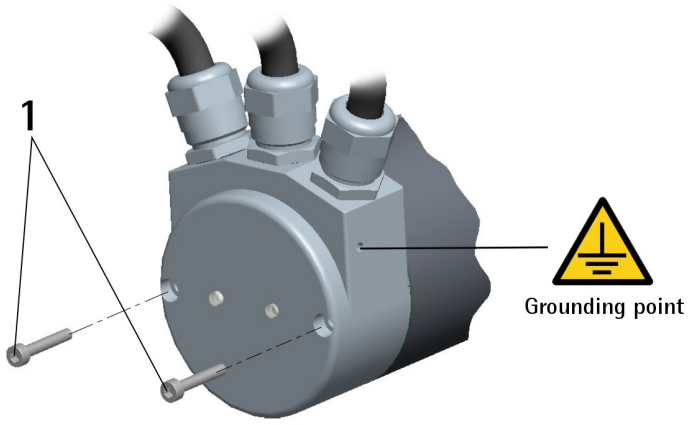
WARNING
Do not remove or mount the connection cap with power supply switched ON. Damage may be caused to internal components.

The terminal connectors for connecting the power supply and the BUS IN and BUS OUT cables (CC-PB connection cap) as well as the DIP switches meant to set the node ID and activate the termination resistance (cable and connector versions) 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!



4.2 CC-PB connection cap with PGs (Figure 1)

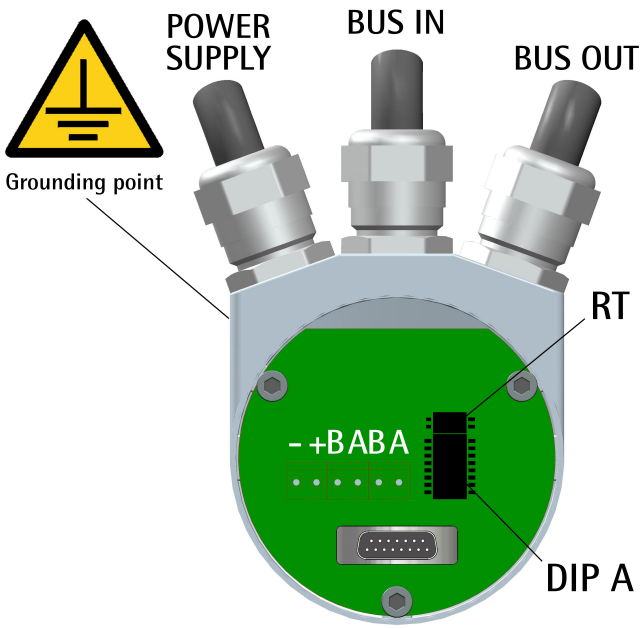


Figure 1

Cable output versions (CC-PB connection cap) are equipped with three PG9 cable glands for BUS IN and BUS OUT connections as well as for power supply connection. The bus cables can be connected directly to the terminal connectors located by 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
-	0Vdc power supply voltage
+	+10Vdc +30Vdc power supply voltage
B	Profibus B (Red)
A	Profibus A (Green)
PG	Shield [1]

[1] Connect the cable shield to cable gland.

4.3 CC-PB-C connection cap with M12 connectors (Figure 2)

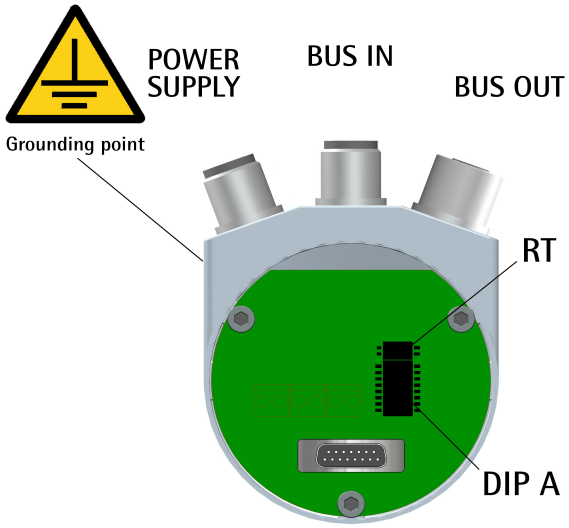
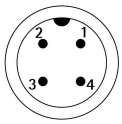


Figure 2

Connector output versions (CC-PB-C connection cap) are equipped 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)



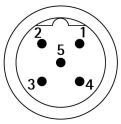
male

Pin	Function
1	+10Vdc +30Vdc power supply voltage
2	n.c.
3	0Vdc power supply voltage
4 [1]	Shield
Case	

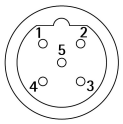
n.c. = not connected

[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)

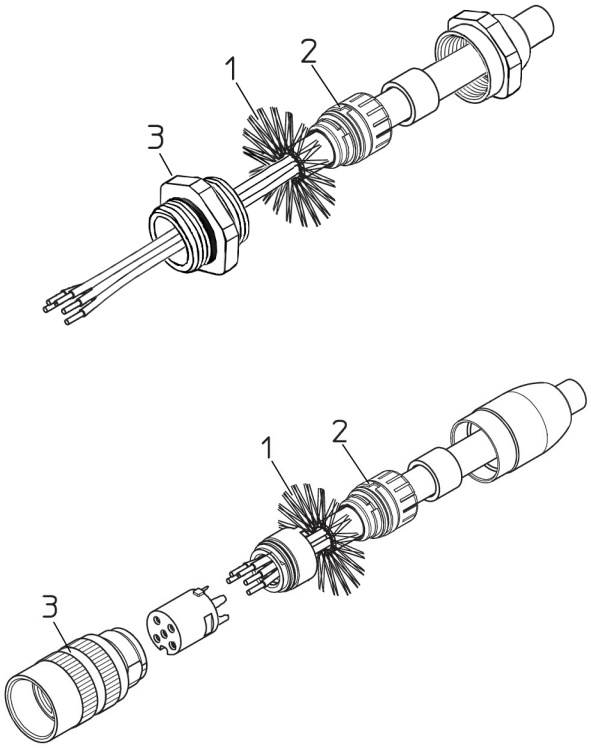
Pin	Function
1	not connected
2	Profibus A (Green)
3	not connected
4	Profibus B (Red)
5	not connected
Case	Shield

4.4 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 connection cap (see the Figures, use 1 TCEI M3 x 6 cylindrical head screw with 2 tooth lock washers).

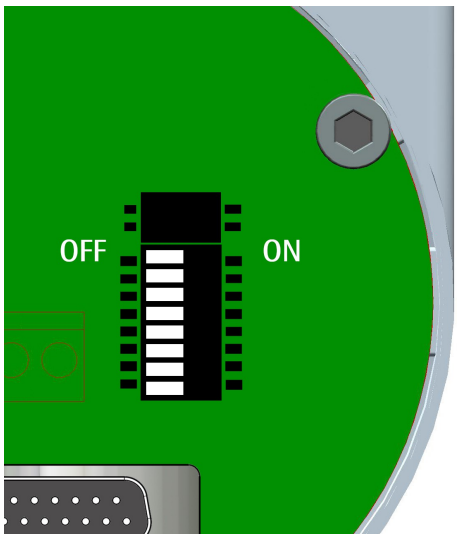
4.5 Connection of the shield

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 and Figure 2)

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



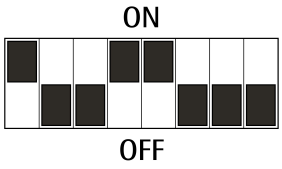
The node address must be set via hardware using the DIP A dip-switches located inside the connection cap.
Allowed addresses are from 0 to 125. The default value is 1.
The node address must be entered also in the software interface, please refer to the "5.1.2 Adding a node to the project" section on page 34.

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 used
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	

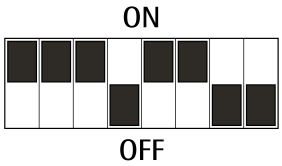
EXAMPLE
Set node number = 25:
25_{10} = 0001 1001$_2$ (binary value)

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 address of the device, please check the bus termination switch position (see the "4.8 Bus termination" section on page 30).

4.7 Baud rate

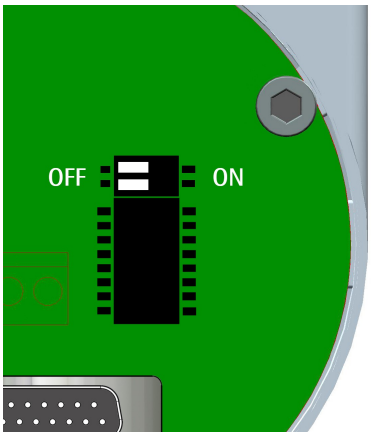
The baud rate is set by the Master via software during the configuration of the node (Slave).
This device supports the following baud rates (they are listed in the .GSD file too):
9.6 kbit/s, 19.2 kbit/s, 93.75 kbit/s, 187.5 kbit/s, 500 kbit/s, 1.5 Mbit/s, 3 Mbit/s, 6 Mbit/s, 12 Mbit/s.

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 the "5.1.2 Adding a node to the project" section on page 34.

4.8 Bus termination

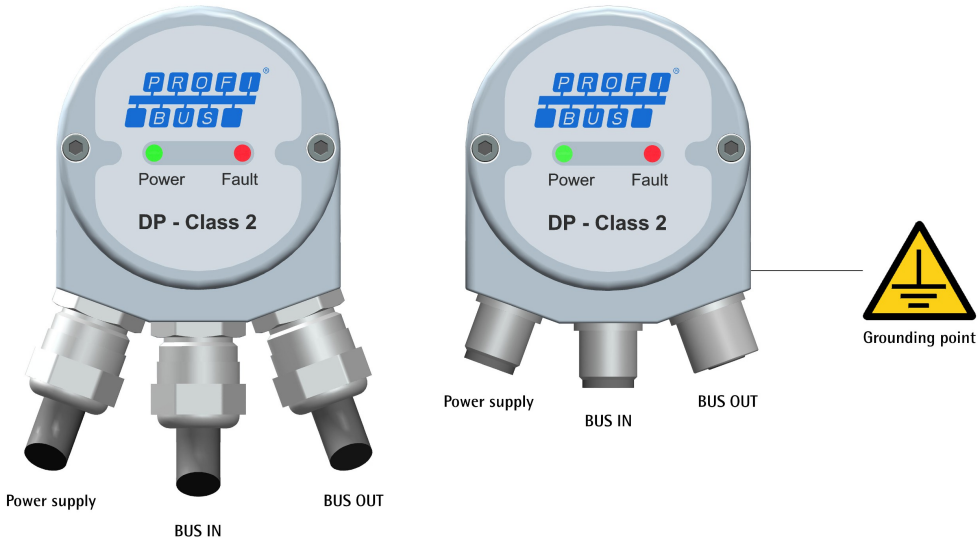


WARNING
Power supply must be turned off before performing this operation!

A bus termination resistance is provided inside the connection cap. This has to be activated as line termination if the encoder is at the ends of the transmission line (i.e. it is either the first or 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 first or the last device in the transmission line
1 = 2 = OFF	Deactivated: if the encoder is not the first or the last device in the transmission line

4.9 Diagnostic LEDs



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 operation (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 the "6.8 "Red zone"" section on page 64
ON	Flashing	Configuration parameters are not valid
ON	OFF	Transmission time-out error
Flashing	ON	Bus communication failure
Flashing	Flashing	Flash memory error, the error cannot be restored

5 - Quick reference

5.1 Configuring the encoder via Siemens STEP7

5.1.1 Importing the GSD file

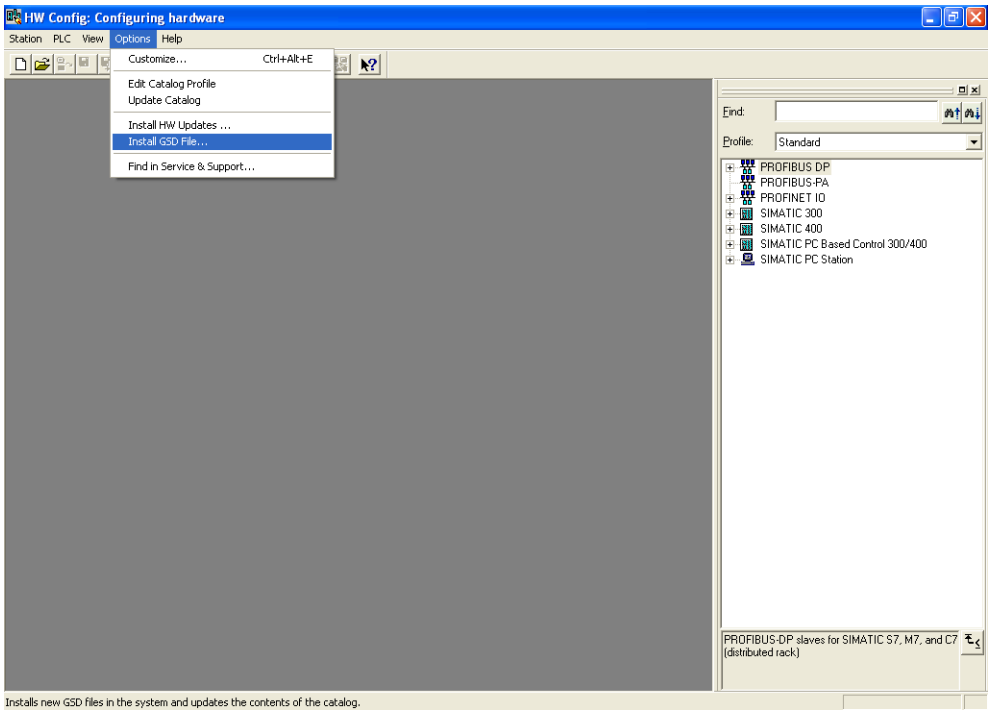
Profibus encoders are supplied with their own GSD file **Ax58_Vx.GSx** (see at the address **www.lika.biz > PRODUCTS > ROTARY ENCODERS > ABSOLUTE ENCODERS > PROFIBUS DP**).

WARNING
Install the **AS58_Vx.GSx** in the **ASx58x series singleturn encoders** (order code: ASx58xx/PB-xx).
Install the **AM58_Vx.GSx** in the **AMx58x series multiturn encoders** (order code: AMx58xx/4096PB-xx).
Vx is intended to indicate the GSD file version.
GSD installation files are further available in both Italian (**Ax58_Vx.GSI**) and English (**Ax58_Vx.GSE**) versions (texts and comments are in the supported language).

WARNING
For **ASx58x singleturn encoders** (order code: AS58xx/PB-xx): the default value preset by Lika in the **Counts per revolution** item of the **AS58_Vx.GSx** GSD file is 4096 (12 bits); for this reason, if you have a 13-bit singleturn encoder (order code: AS58**13**/PB-xx) 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 38.

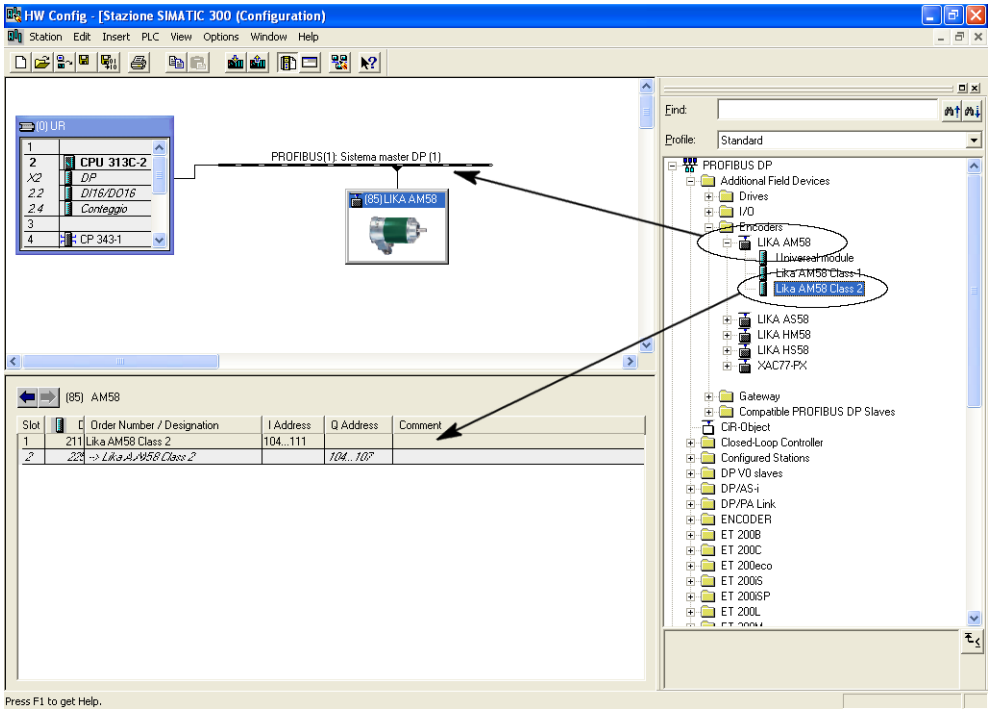
For **AMx58x multiturn encoders** (order code: AM58xx/4096-PB-xx): the default value preset by Lika in the **Counts per revolution** item of the **AM58_Vx.GSx** GSD file is 4096 (12 bits); for this reason, if you have a 25-bit multiturn encoder (order code: AM58**13/4096**PB-xx) and you want to use the overall resolution, you must set the **Counts per revolution** item to 8192 (13 bits). See EXAMPLE 4 on page 40.

In the menu bar of the **HW Config** window of STEP7, select **Install GSD File...** command from the **Options** menu.
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 AS58 singleturn encoder or GSD file for AM58 multiturn encoder, in either Italian or English language.



5.1.2 Adding a node to the project

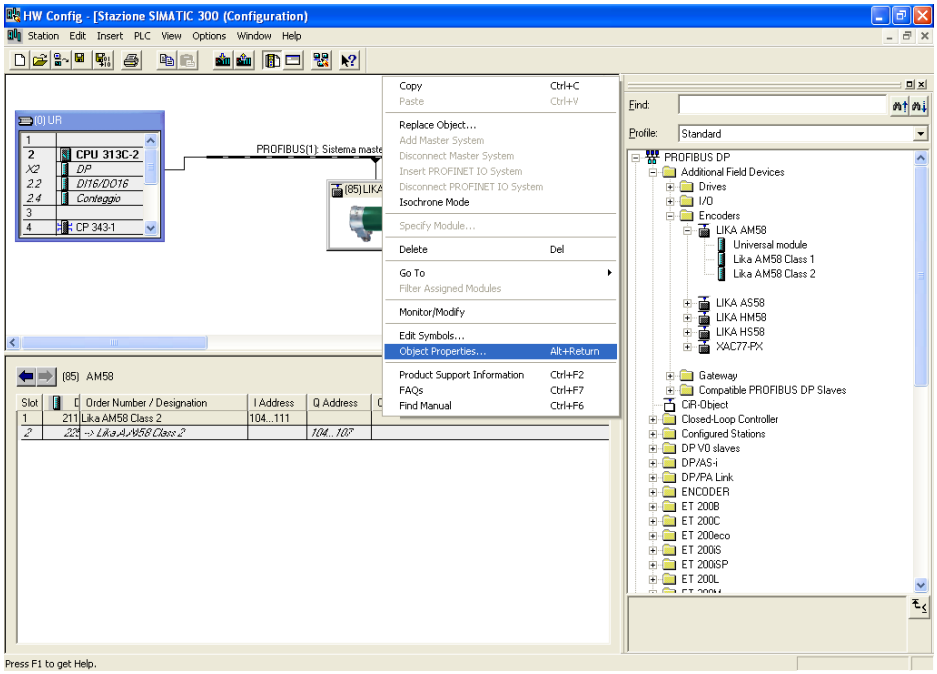
To add a node to the project, extend the directory tree in the side pane of the STEP7 **HW Config** main window and select either the **LIKA AS58** module (when you have to install a singleturn encoder) or the **LIKA AM58** module (when you have to install a multiturn encoder), they are available under **Catalog > PROFIBUS-DP > Additional Field Devices > Encoders** (if both GSD files have been installed); drag the required module to the main window and drop it on the "BUS". For instance, drag the **LIKA AM58** module.
Then drag the **Lika AM58 Class 1** or the **Lika AM58 Class 2** submodule to the variables table at the bottom of the main window; for instance, install the **Lika Lika AM58 Class 2** submodule. In this way you set the class of the device (for further details on available classes see the "6.2 Classes of the Device profile" section on page 51).



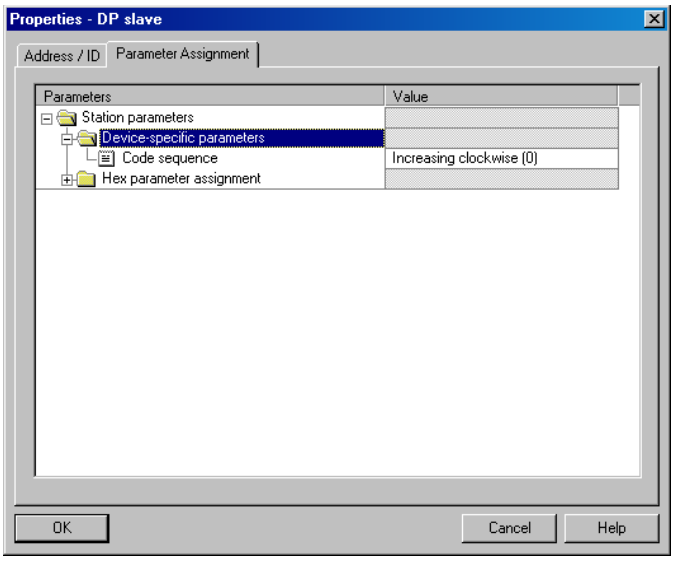
After having installed the node, by double-clicking on the graphic icon of the unit you have just installed you enter the page designed to configure the bus properties. In this page you can both enter the node address configured via hardware and set the bus transmission rate. For any information on setting the node address via hardware please refer to the section "4.6 Node address: DIP A (Figure 1 and Figure 2)" on page 29. For any information on setting the baud rate please refer to the section "4.7 Baud rate" on page 30.

5.1.3 Encoder configuration parameters

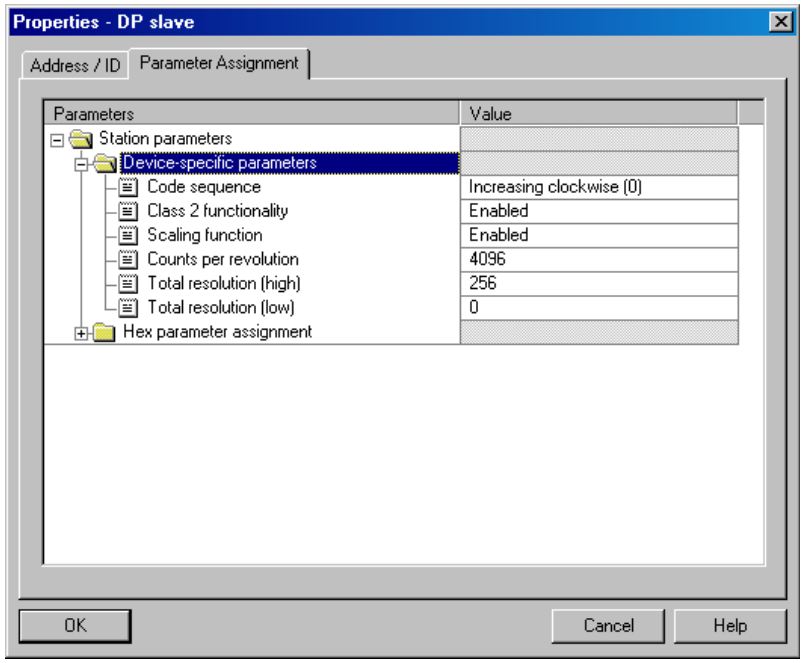
To access the parameters configuration window, first enter the STEP7 **HW Config** main window and select the **LIKA AM58** item you have just installed (**Lika AM58 Class 2** in the example), it is available in the variables table at the bottom of the main window; then right-click the item and press 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 the "6.4 DDLM_Set_Prm" section on page 53.



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 they are 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**.

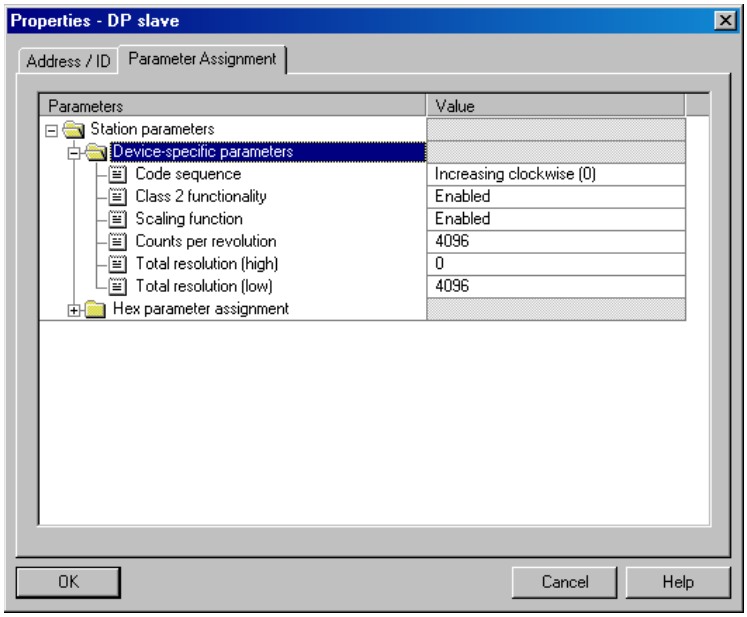
EXAMPLE 1

Let's suppose we need to program the following encoder:
"AS58**12**/PB-xx" 12-bit singleturn encoder.

- **Hardware counts per revolution** = **12** bits/rev. (4096 cpr)
- **Hardware number of revolutions** = 1 rev.
- **Hardware total resolution** = 12 bits (4096 * 1 = 4096)

We want to set: **4096 counts per revolution**.
Thus we will set 4096 next to the **Counts per revolution** item.
The **Total resolution** value will be: 4096 (cpr) * 1 (rev.) = 4096_{10} = 0x1000
The value to be set in the **Total resolution** items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0000	1000	hexadecimal
0	**4096**	decimal



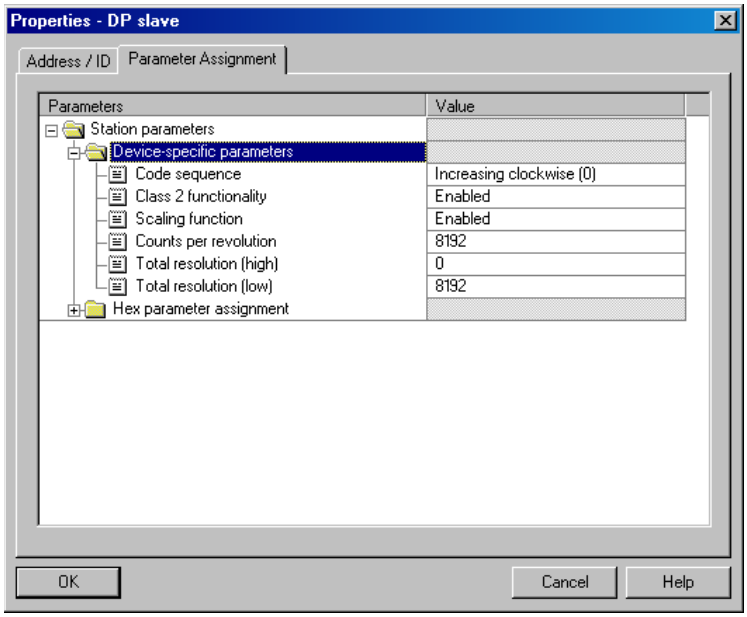
EXAMPLE 2

Let's suppose we need to program the following encoder:
"AS58**13**/PB-xx" 13-bit singleturn encoder.

- **Hardware counts per revolution** = **13** bits/rev. (8192 cpr)
- **Hardware number of revolutions** = 1 rev.
- **Hardware total resolution** = 13 bits (8192 * 1 = 8192)

We want to set: **8192 counts per revolution**.
Thus we will set 8192 next to the **Counts per revolution** item.
The **Total resolution** value will be: 8192 (cpr) * 1 (rev.) = 8192_{10} = 0x2000
The value to be set in the **Total resolution** items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0000	2000	hexadecimal
0	**8192**	decimal



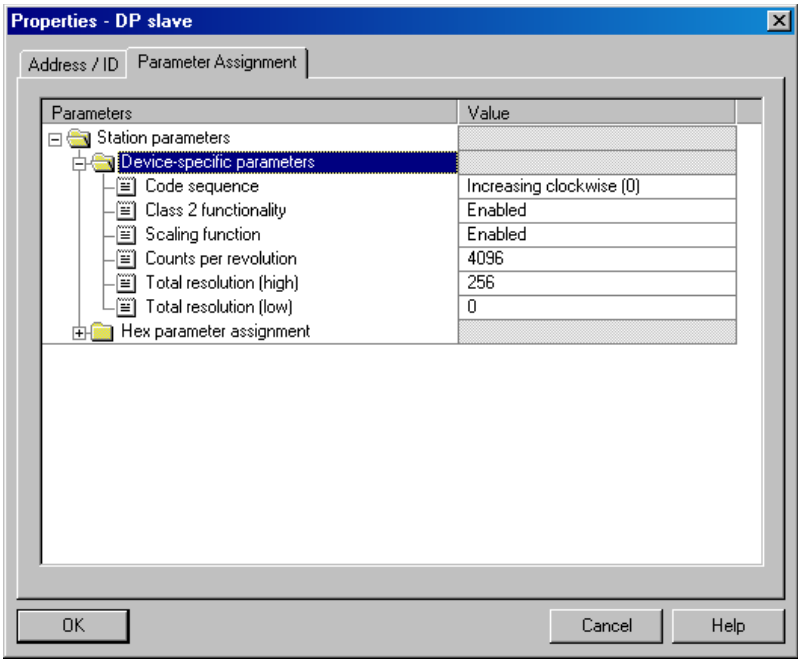
EXAMPLE 3

Let's suppose we need to program the following encoder:
"AM58**12/4096**PB-xx" 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 = 16,777,216)

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.) = $16{,}777{,}216_{10}$ = 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



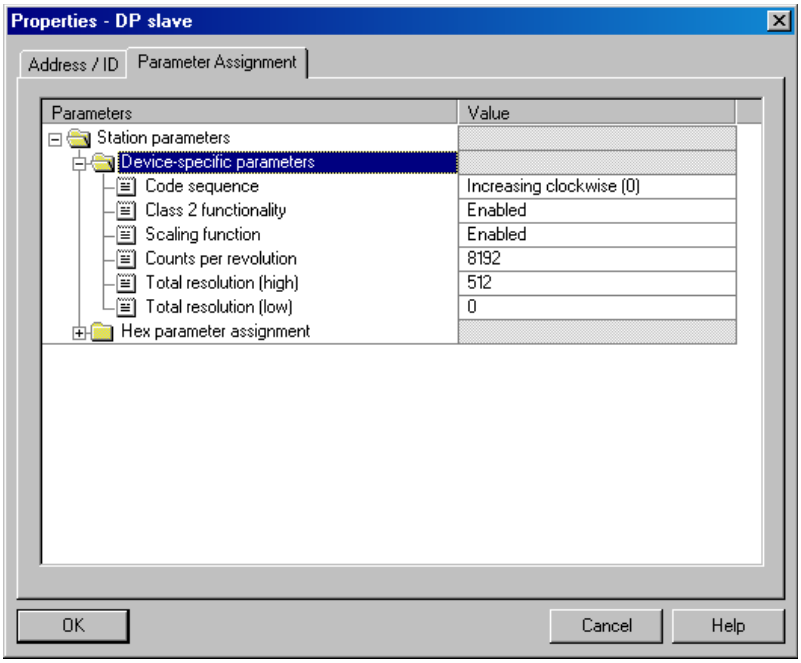
EXAMPLE 4

Let's suppose we need to program the following encoder:
"AM58**13/4096**PB-xx" 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 = 33,554,432)

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.) = $33{,}554{,}432_{10}$ = 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 4:
Counts per revolution: 8192
Total resolution= $33{,}554{,}432_{10}$ = 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:

$$\textbf{Number of revolutions} = \frac{33{,}554{,}432\ (\textbf{Total resolution})}{360\ (\textbf{Counts per revolution})} = 93{,}206.755...$$

As you can see, the encoder is required to carry out more than 93,000 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 31).

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, ...).

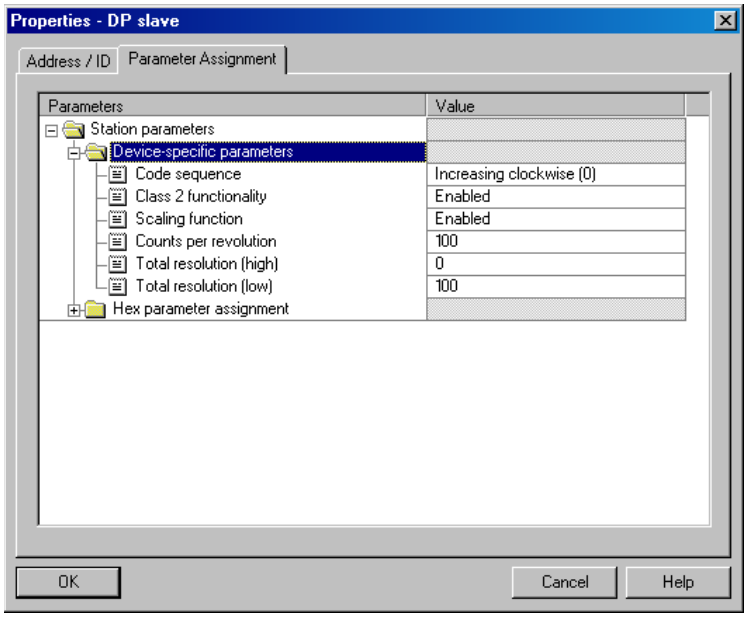
EXAMPLE 5

Let's suppose we need to program the following encoder:
"AS58**13**/PB-xx" 13-bit singleturn encoder.

- **Hardware counts per revolution** = **13** bits/rev. (8192 cpr)
- **Hardware number of revolutions** = 1 rev.
- **Hardware total resolution** = 13 bits (8192 * 1 = 8192)

We want to set: **100 counts per revolution**.
Thus we will set 100 next to the **Counts per revolution** item.
The **Total resolution** value will be: 100 (cpr) * 1 (rev.) = 100_{10} = 0x0064
The value to be set in the **Total resolution** items will be as follows:

Total resolution (high)	Total resolution (low)	Value
0000	0064	hexadecimal
0	**100**	decimal



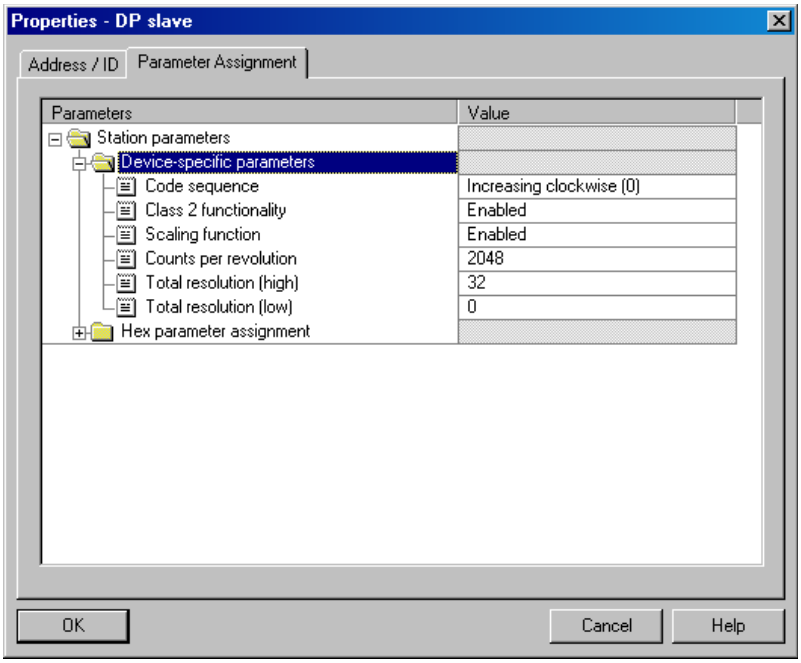
EXAMPLE 6

Let's suppose we need to program the following encoder:
"AM58**13/4096**PB-xx" 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 = 33,554,432)

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.) = $2{,}097{,}152_{10}$ = 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 the "6.8 "Red zone"" section on page 64.

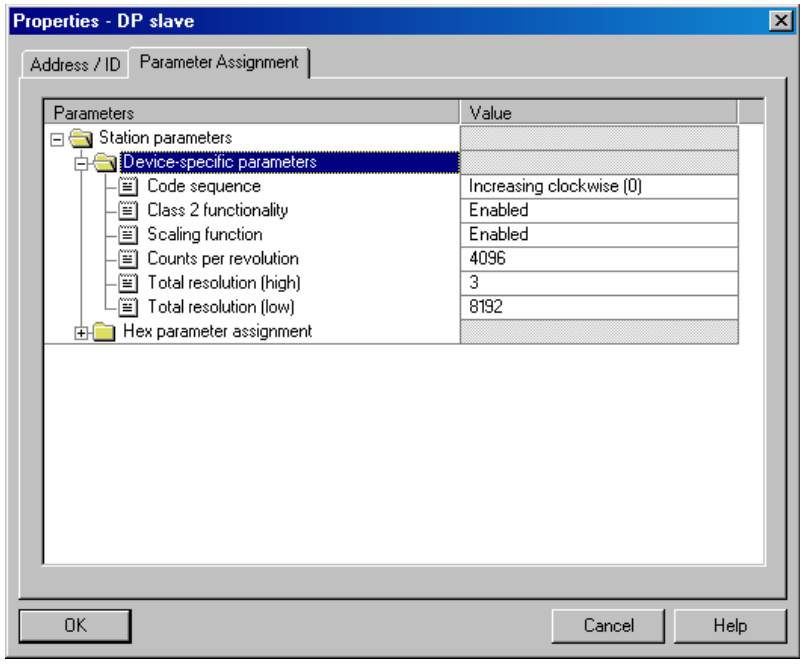
EXAMPLE 7

Let's suppose we need to program the following encoder:
"AM58**12/4096**PB-xx" 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 = 16,777,216)

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.) = $204{,}800_{10}$ = 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



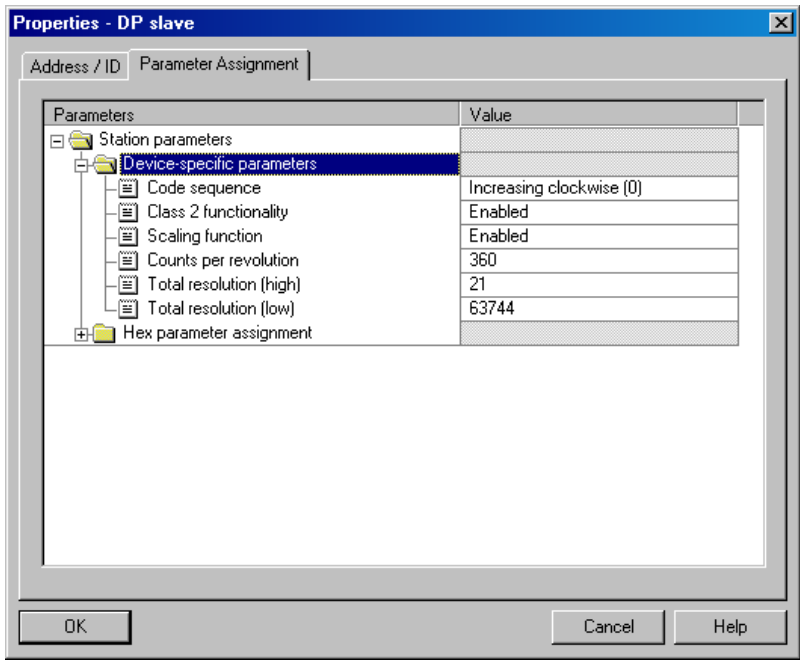
EXAMPLE 8

Let's suppose we need to program the following encoder:
"AM58**13/4096**PB-xx" 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 = 33,554,432)

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.) = $1{,}440{,}000_{10}$ = 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

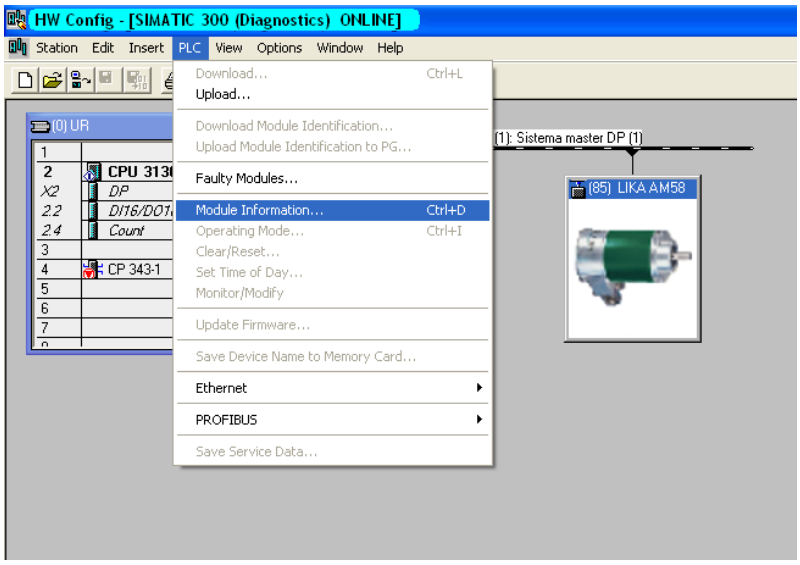


After having set new parameter values, press the **OK** button to close the **Properties – DP Slave** window and then the **Download** button (see icon on the left) in the toolbar of the **HW Config** window to download the set parameters.

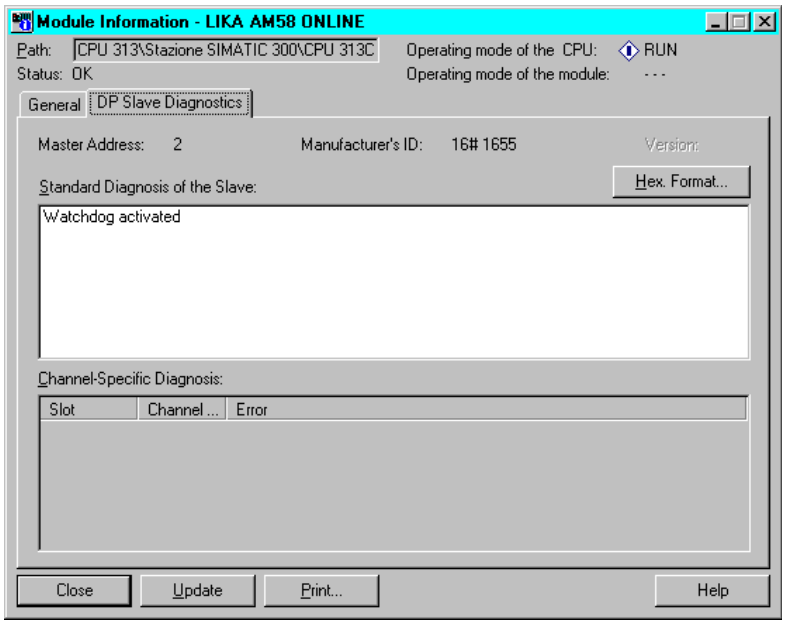
5.2 Reading the diagnostic information

Lika 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.

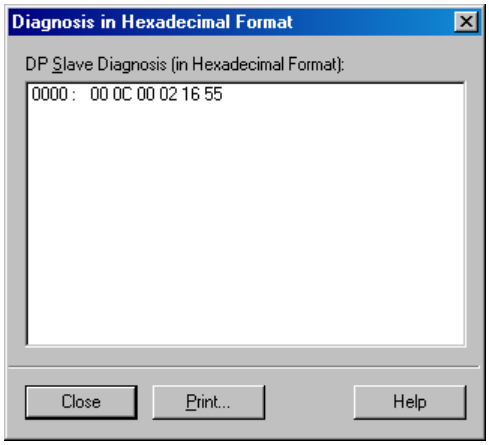
Before entering the diagnostic page, it is necessary to connect to the unit (i.e. to enter the online status). To do this, select **Station\Open online** in the **HW Config** window or press the **Online<->Offline** button (see the icon on the left). When the unit is online, select the LIKA AM58 module 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

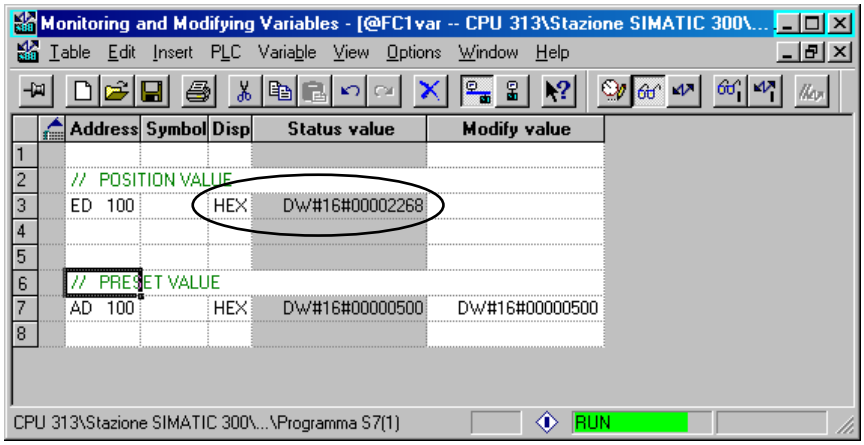


Byte	Description
0	Status 1
1	Status 2
2	Status 3
3	Master ID
4	Manufacturer ID
5	

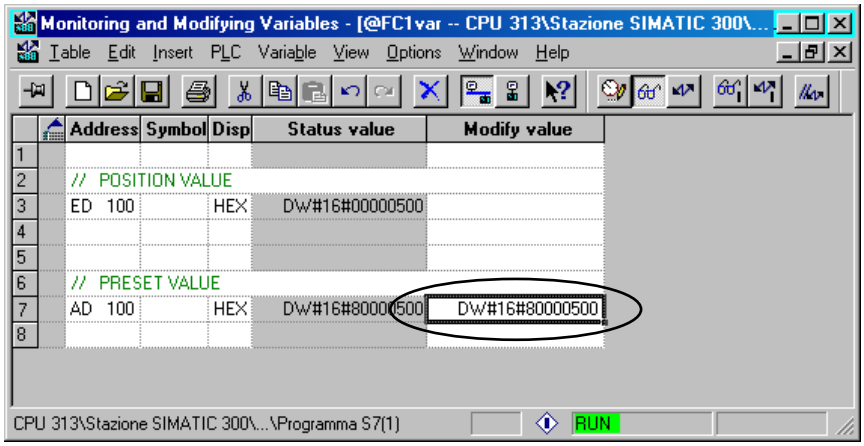
5.3 Setting the Preset value

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 "Preset" section on page 61.



Finally press the **Command variables** button in the Toolbar (see the icon here on the right).

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 press 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

Lika encoders 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 the "6.2 Classes of the Device profile" section on page 51).
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 at the address **www.lika.biz > PRODUCTS > ROTARY ENCODERS > ABSOLUTE ENCODERS > PROFIBUS DP**).

WARNING
Install the **AS58_Vx.GSx** in the **ASx58x series singleturn encoders** (order code: ASx58xx/PB-xx).
Install the **AM58_Vx.GSx** in the **AMx58x series multiturn encoders** (order code: AMx58xx/4096PB-xx).
Vx is intended to indicate the GSD file version.
GSD installation files are further available in both Italian (**Ax58_Vx.GSI**) and English (**Ax58_Vx.GSE**) versions (texts and comments are in the supported language).

WARNING
For **ASx58x singleturn encoders** (order code: AS58xx/PB-xx): the default value preset by Lika in the **Counts per revolution** item of the **AS58_Vx.GSx** GSD file is 4096 (12 bits); for this reason, if you have a 13-bit singleturn encoder (order code: AS58**13**/PB-xx) 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 38.

For **AMx58x multiturn encoders** (order code: AM58xx/4096-PB-xx): the default value preset by Lika in the **Counts per revolution** item of the **AM58_Vx.GSx** GSD file is 4096 (12 bits); for this reason, if you have a 25-bit multiturn encoder (order code: AM58**13/4096**PB-xx) and you want to use the overall resolution, you must set the **Counts per revolution** item to 8192 (13 bits). See EXAMPLE 4 on page 40.

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 54.

Class 1 allows basic functions of the device and can be used:

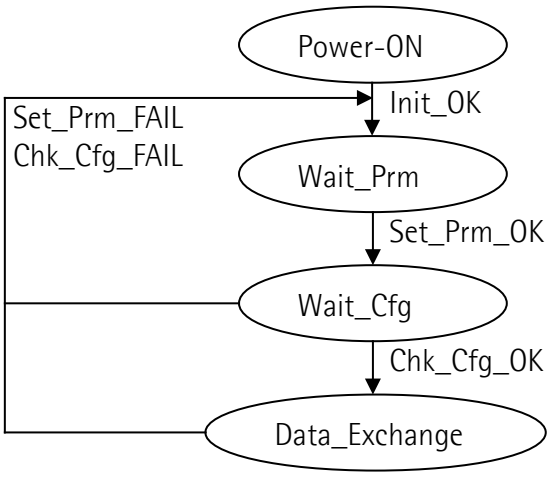
- to send the position information (see the **Position** parameter);
- to change the counting direction (see the **Code sequence** parameter);
- to set the preset value (see the **Preset** parameter).

Class 2 allows to use all Class 1 functions and additional extended functions, they are:

- scaling function (see **Scaling function**, **Counts per revolution** and **Total resolution** parameters).

6.3 Operating modes

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



NOTE

All parameters -except the **Preset** value- are transmitted when the **Set_Prm** mode is active.

Preset value is transmitted only when the unit is in **Data_Exchange** mode.

Types of communication messages

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

- **DDLM_Set_Prm:**
  It is used to configure the Slave. This communication mode is active immediately after the power is turned ON and is used to send parameters from the Master to the Slave (see the "6.4 DDLM_Set_Prm" section on page 53).

- **DDLM_Chk_Cfg:**
  It sets the number of bytes used for data transmission in **Data_Exchange** mode (see the "6.5 DDLM_Chk_Cfg" section on page 60).

- **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 "6.6 DDLM_Data_Exchange" section on page 61).

- **DDLM_Slave_Diag:**
  It is used when the power is turned ON and whenever the Master needs diagnostic information from the Slave device (see the "6.7 DDLM_Slave_Diag" section on page 63).

6.4 DDLM_Set_Prm

When the system is turned On, the controller sends configuration data set by the operator to the absolute encoder (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 the "5.1 Configuring the encoder via Siemens STEP7" section on page 32).
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 = clockwise rotation**	CCW = counter-clockwise rotation
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 sets whether the position value output by the transducer increases (count up information) 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 when 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** = 0 = DISABLED, this is the only parameter that can be set.
Default = 0 (min. = 0, max. = 1)

WARNING
Every time you change the **Code sequence**, then you are required to set and activate a new preset (see the **Preset** parameter).

Class 2 functionality

This is only available when the encoder Class 2 is installed.
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 encoders. For any information on the available encoder classes see the "6.2 Classes of the Device profile" section on page 51.
0 = Disabled = Encoder Class 1 is set.
1 = Enabled = Encoder Class 2 is set.
Default = 1 (min. = 0, max. = 1)

Scaling function

This is only available when the encoder Class 2 is installed.
When this option is disabled (bit 3 **Scaling function** = 0 = DISABLED), the device uses the hardware resolution, i.e. the hardware counts per revolution and the number of hardware revolutions to arrange the absolute position information, see the encoder data on the label applied to the device.
On the contrary, when the option is enabled (**Scaling function** = 1 = ENABLED), the device uses the custom resolution set in the bytes 11 ... 16 to calculate the position information (see the **Counts per revolution** and **Total resolution** parameters).
For a correct use of this function see the "6.4.2 Bytes 11 and 12" and "6.4.3 Bytes 13 ... 16" sections in the next page.
Default = 1 (min. = 0, max. = 1)

WARNING
When you enable the scaling function (**Scaling function** = 1 = ENABLED), please enter scaled values next to the **Counts per revolution** and **Total resolution** parameters that are consistent with the physical values. In the case

of inconsistent values, the system does not go online and visually warns about the wrong parametrization and fault condition by means of the diagnostic LEDs.

WARNING
Every time you enable the scaling function and/or change the scaled values (see the **Counts per revolution** and **Total resolution** parameters), then you are required to set and activate a new preset (see the **Preset** parameter).

WARNING
You can activate the custom values set next to the **Counts per revolution** and **Total resolution** parameters only if **Class 2 functionality** = 1 = ENABLED.
If **Scaling function** = 1 = ENABLED, the set resolution values are enabled and used by the encoder; on the contrary, if **Scaling function** = 0 = 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 and 12

Counts per revolution

WARNING
This is only available when the encoder Class 2 is installed.
You can activate a new value next to this **Counts per revolution** parameter only if **Class 2 functionality** = 1 = ENABLED; if **Scaling function** = 1 = ENABLED, the set resolution value is enabled and used by the encoder; on the contrary, if **Scaling function** = 0 = 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 "6.4.1 Byte 10 - Operating parameters" section on page 53.

If **Class 2 functionality** = 0 = DISABLED or **Scaling function** = 0 = DISABLED, then the system uses the default values to arrange the position information.

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

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

The custom singleturn resolution must be less than or equal to the physical singleturn resolution (value of the hardware counts per revolution).
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, ...). This is meant to avoid counting errors (refer also to the "6.8 "Red zone"" section on page 64).
Default = 4096 (min. = 1, max. = 8192) for AS58 singleturn encoder
Default = 4096 (min. = 1, max. = 8192) for AM58 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 31).

WARNING
When you set a new value next to the **Counts per revolution** parameter, please always check also the **Total resolution** parameter value and be sure that the resulting number of revolutions complies with the **Hardware number of revolutions** of the device (1 or 4,096, see the order code).
Let's suppose that our encoder is programmed as follows:
Counts per revolution: 8192 cpr
Total resolution = $33{,}554{,}432_{10}$ = 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:

$$\textbf{Number of revolutions} = \frac{33{,}554{,}432\ (\textbf{Total resolution})}{360\ (\textbf{Counts per revolution})} = 93{,}206.755...$$

As you can see, the encoder is required to carry out more than 93,000 revolutions, this cannot be as the hardware number of revolutions is, as stated, max. 4,096. When this happens, the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 31).

WARNING
When you enable the scaling function (**Scaling function** = 1 = ENABLED), please enter scaled values next to the **Counts per revolution** and **Total resolution** parameters that are consistent with the physical values. In the case of inconsistent values, the system does not go online and visually warns about the wrong parametrization and fault condition by means of the diagnostic LEDs.

WARNING
Every time you change the value in this parameter, then you are required to set and activate a new preset (see the **Preset** parameter).

6.4.3 Bytes 13 ... 16

Total resolution

WARNING
This is only available when the encoder Class 2 is installed.
You can activate a new value next to this **Total resolution** item only if **Class 2 functionality** = 1 = ENABLED. If **Scaling function** = 1 = ENABLED the set resolution value is enabled and used by the encoder; on the contrary, if **Scaling function** = 0 = 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 "6.4.1 Byte 10 - Operating parameters" section on page 53.

If **Class 2 functionality** = 0 = DISABLED or **Scaling function** = 0 = DISABLED, then the system uses the default values to arrange the position information.

This parameter is intended to set a custom number of distinguishable steps over the total measuring range. The total resolution of the encoder results from the product of **Counts per revolution** by the required **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. This is meant to avoid counting errors (refer also to the "6.8 "Red zone"" section on page 64).
Default = 4096 (min. = 1, max. = 8192) for AS58 singleturn encoder
Default = 16,777,216 (min. = 1, max. = 33,554,432) for AM58 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 value of the **Hardware total resolution**), the encoder falls into an error signalling the faulty condition through the diagnostic LEDs (see on page 31).

WARNING
When you set a new value next to the **Total resolution** parameter, please always check also the **Counts per revolution** parameter 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 = $33{,}554{,}432_{10}$ = 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 31).

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 the "6.8 "Red zone"" section on page 64.

WARNING
The AM58 multiturn encoder (order code: AM58xx/4096PB-xx) 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:

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

This is exactly the configuration of the singleturn encoder.
Of course it is clear that the contrary is not possible.

EXAMPLE

"AS58**12**/PB-xx": single-turn encoder with 12-bit resolution

- **Hardware counts per revolution** = **12** bit/turn (4096 cpr)
- **Hardware number of revolutions** = 1 rev.
- **Hardware total resolution** = 12 bit (4096 * 1 = 4096)

"AS58**13**/PB-xx": single-turn encoder with 13-bit resolution

- **Hardware counts per revolution** = **13** bit/turn (8192 cpr)
- **Hardware number of revolutions** = 1 rev.
- **Hardware total resolution** = 13 bit (8192 * 1 = 8192)

"AM58**12/4096**PB-xx": 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 = 16,777,216)

"AM58**13/4096**PB-xx": 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 = 33,554,432)

EXAMPLE

Multiturn encoder "AM58**12/4096**PB-6" with "CC-PB-C" connection cap.

The hardware resolution is:

- **Hardware counts per revolution** = 4096 (2^{12})
- **Hardware number of revolutions** = 4096 (2^{12})
- **Hardware total resolution** = 16,777,216 (2^{24})

We need to set the following custom resolution: 2048 counts per revolution * 1024 revolutions.
To do this proceed as follows:

- Enable the **Class 2 functionality**:
- Enable the **Scaling function**: byte 10 = 0A hex (bit 1 = bit 3 = "1")
- **Counts per revolution** = 2048: bytes 11-12 = 0800 hex
- **Total resolution** = 2048 * 1024 = 2,097,152: bytes 13 ... 16 = 0020 0000 hex.

NOTE

When new values are set next to the **Counts per revolution** and/or **Total resolution** parameters, 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 37 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:
AS singleturn model
Total resolution (high): default = 0 (min. = 0, max. = 0)
Total resolution (low): default = 4096 (min. = 1, max. = 8192)
AM multiturn model
Total resolution (high): default = 256 (min. = 0, max. = 512)
Total resolution (low): default = 0 (min. = 0, max. = 65,535)

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 and 4 = In/out data ("01" = Input, "10" = Output)
bits 3 ... 0 = Length code

EXAMPLE

bit	7	6	5	4	3	2	1	0	
Data	1	1	0	1	0	0	0	1	D1h
	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}

It has a mandatory length of 32 bits and is right aligned in the data field.
This parameter contains the current position information output by the encoder. If the scaling function is enabled, the output value is scaled according to the scaling parameters (see **Scaling function** on page 54).

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}

This parameter allows to set the encoder position to a Preset value. 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 the 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 the preset value.
Preset mode: MSB = 1 (bit 31): when the MSB = 1 the encoder accepts the transferred value (bits 0 ... 30) as a preset value in binary code.

- If **Scaling function** = 0 = DISABLED, then
  the **Preset** value must be less than or equal to the **Hardware total resolution** - 1.

- If **Scaling function** = 1 = ENABLED, then
  the **Preset** value must be less than or equal to the **Total resolution** - 1.

EXAMPLE

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

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

WARNING

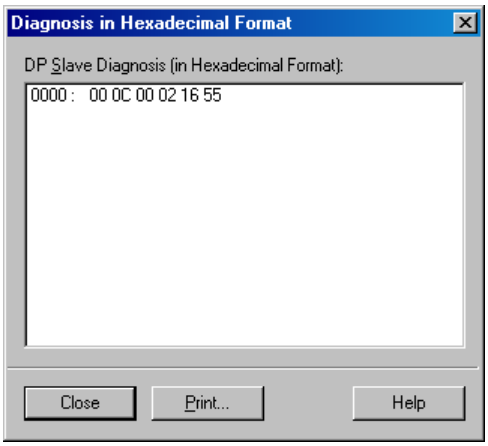
Check the value in the Preset parameter and perform the preset operation every time you change the value next to the Code sequence, Counts per revolution and Total resolution parameters.

Please refer also to the example for setting the preset value via Step7; refer to the "5.3 Setting the Preset value" section on page 48.

6.7 DDLM_Slave_Diag

The Master device can send a request for diagnostic information at any time to the Slave device. Lika 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:



Byte	Description
0	Status 1
1	Status 2
2	Status 3
3	Master ID
4	Manufacturer ID
5	

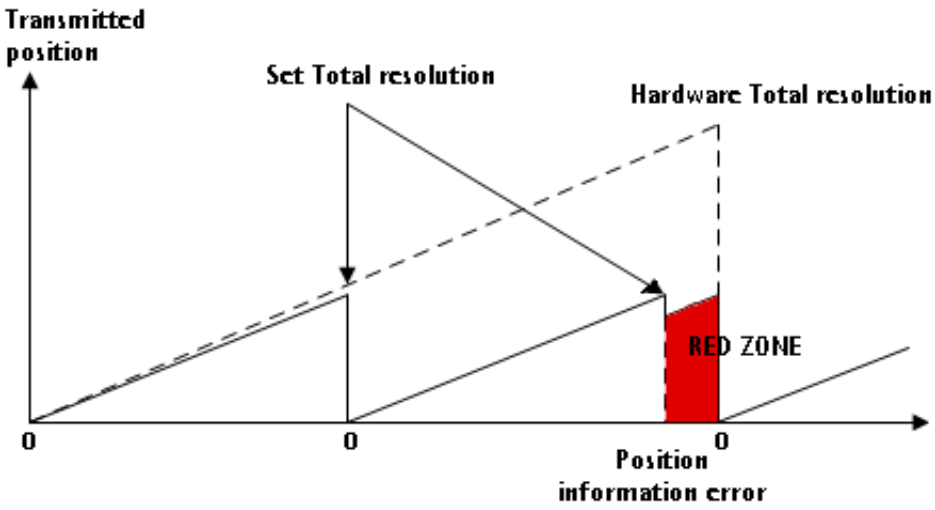
6.8 "Red zone"

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 as in the Figure below.



EXAMPLE

"AM58**13/4096**PB-xx: 25-bit resolution multiturn encoder

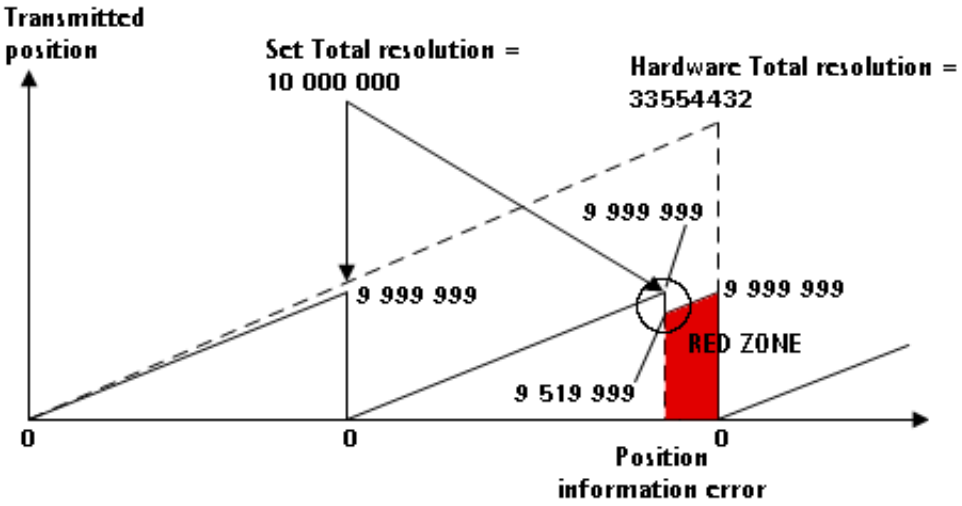
- **Hardware counts per revolution** = 8192 (2^{13})
- **Hardware number of revolutions** = 4096 (2^{12})
- **Hardware total resolution** = 33,554,432 (2^{25})

Set parameters values:

- **Counts per revolution** = 5000
- **Total resolution** = 10,000,000
- **Number of revolutions** = 2000

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

It follows that the encoder will work within the limits of the "read zone" for 96 revolutions (4096 - 2 * 2000 = 96), i.e. for 480,000 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 "4.9 Diagnostic LEDs" section on page 31).
- When the encoder is operating within the limits of the "red zone" (i.e. for 5000 cpr * 96 revolutions = 480,000 counts: 9,519,999 ... 9,999,999), 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 9,999,999 to 9,519,999!

7 – Default parameters list

Default values preset in the GSD file for **AS58 singleturn encoder** (AS58_Vx.GSx)

Parameters list	Default value		
Code sequence	0		
Class 2 functionality	1		
Scaling function	1		
Counts per revolution	4096		
Total resolution	4096		

Default values preset in the GSD file for **AM58 multiturn encoder** (AM58_Vx.GSx)

Parameters list	Default value		
Code sequence	0		
Class 2 functionality	1		
Scaling function	1		
Counts per revolution	4096		
Total resolution	16 777 216		

This page intentionally left blank

Document release	Release date	Description	HW	SW	GSD file version
1.0	19.12.2002	1st issue			LIKA1655
2.0	29.05.2009	General revision			LIKA1655
2.1	14.10.2010	"5 - Quick reference" section updated			LIKA1655
2.2	05.11.2012	General revision, "3 - Mounting instructions" section added, "4 - Electrical connections" section updated			LIKA1655 V2
2.3	30.01.2014	Step7 examples, "7 – Default parameters list" section, general revision			V2
2.4	12.02.2014	General revision, table of contents and index, Italian / English separate editions			V2
2.5	27.11.2014	"4 - Electrical connections" section updated			V2
2.6	10.03.2021	"4 - Electrical connections" section updated, general review			V2

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

Dispose separately

Lika Electronic
Via S. Lorenzo, 25 • 36010 Carrè (VI) • Italy

Tel. +39 0445 806600
Fax +39 0445 806699

info@lika.biz • www.lika.biz