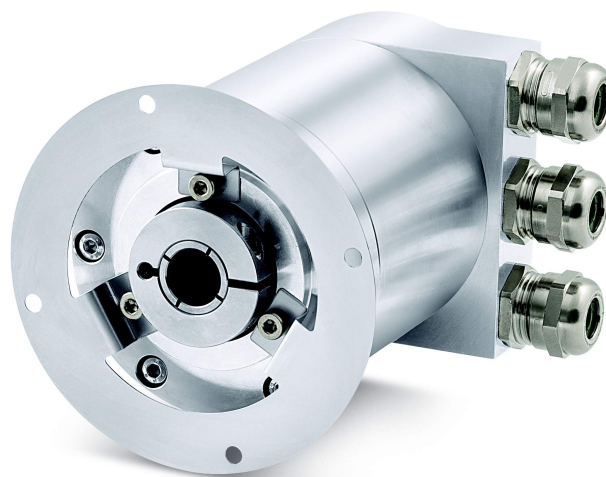


User's guide

XAC80 PB

ATEX certification category 3
for use in zones 2, 22
and temperature class T5 (T100°C)



Profibus-DP profile for encoders



II 3GD, Ex nA IIB T5 Gc
II 3GD, Ex tc IIIC T100°C Dc, IP65

- 18-bit singleturn encoder for high precision demands
- 27-bit multiturn encoder for standard purposes
- 30-bit multiturn encoder for high end applications
- Profibus DP configurable as Class 1, Class 2 or Class 2(+VEL) Slave
- Heavy-duty construction for harsh environments

Suitable for the following models:

- XAC8018/1PB
- XAC8013/16384PB
- XAC8016/16384PB

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The logo for Lika Electronic s.r.l. features the word "lika" in a bold, lowercase, sans-serif typeface. The letters are black and the font is modern and clean.

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

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

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

Preliminary information

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

XAC8018/1PB-xx	(18 bit singleturn encoder)
XAC8013/16384PB-xx	(13 +14 bit multiturn encoder)
XAC8016/16384PB-xx	(16 +14 bit multiturn encoder)

For technical specifications please refer to the product datasheet.

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

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

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 (chapters 6 and 7) 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	<p>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:</p> <ul style="list-style-type: none">• alarm;• event. <p>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.</p>
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: <ul style="list-style-type: none"> • sending the position value (see Position value parameter); • changing the counting direction (see Code sequence parameter); • setting the preset value (see Preset value parameter); • acquiring reduced diagnostic information (see Diagnostic type parameter = "16 bytes fixed (6+10)").
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: <ul style="list-style-type: none"> • transmission of the velocity value (see Position and velocity values parameter); • setting of the velocity measuring unit (see Velocity measure unit parameter).
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: <ul style="list-style-type: none"> • scaling function (see Scaling function control, Counts per revolution and Total resolution parameters); • extended diagnostic information (see Diagnostic type parameter = "16 bytes (6+10)" or "63 bytes (6+57)").
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: <ul style="list-style-type: none"> • RS 485 (RS 485-IS); • MBP-IS (MBP-LP, MBP);

	<ul style="list-style-type: none"> • Fibre Optics.
Cyclic Data Exchange	IEC 61158-3: Term used to describe events which repeat in a regular and repetitive manner. The MSO 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	<p>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:</p> <ul style="list-style-type: none"> • the set Slave address procedure; • the parametrization telegram (octet 5 + 6); • the standard part of a diagnosis message (octet 5 + 6). <p>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".</p>
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: <ul style="list-style-type: none"> • read device information (manufacturer, type, versions, bitmaps, etc.); • read texts for comfortable and easy to use configuration; • select transmission rates;

	<ul style="list-style-type: none"> • 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.); <p>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.</p>
Ident Number	<p>See "Device Identifier".</p> <p>Notes:</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> - Data type numeric identifier; - Configuration identifier (Cfg); - Device identifier (ident number); - Manufacturer identifier (MANUFACTURER ID); - Profile ident number (PROFILE ID).
Index	<p>IEC 61158-5: Address of an object within an application process.</p> <p>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.</p>
PDU (Protocol Data Unit)	<p>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:</p>

	<ul style="list-style-type: none"> Physical layer protocol data unit (PhPDU); Data link protocol data unit (DLPDU); Application protocol data unit (APDU).
PI	<p>The <i>PROFIBUS Nutzerorganisation e.V.</i> (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.</p>
PNO	<p>The <i>PROFIBUS Nutzerorganisation e.V.</i> (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.</p>
PROFIBUS	<p>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.</p> <p>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.</p>
PROFIBUS DP	<p>Acronym for "PROFIBUS for Decentralized Peripherals". Specification of an open fieldbus system with the following characteristics:</p> <ul style="list-style-type: none"> polling Master-Slave-system (cyclic communications, MSO); flying Masters with robin round token passing coordination (MM);

	<ul style="list-style-type: none"> • connection based (MS1) and connectionless (MS2, MS3) acyclic communication between Masters and Slaves. <p>Options (e.g.):</p> <ul style="list-style-type: none"> • Data exchange broadcast (DXB), i.e. Slave to Slaves communication; • isochronous mode of Slaves; • clock synchronization; • redundancy. <p>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.</p>
PROFIdrive	<p>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.</p>
Profile	<p>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:</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <p>(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".</p> <p>(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.</p> <p>(3) I&M functions: Besides its basic I&M information devices -</p>

	following a certain profile - are enabled to provide more detailed profile specific information.
Protocol Data Unit (PDU)	<p>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:</p> <ul style="list-style-type: none"> • Physical layer protocol data unit (PhPDU); • Data link protocol data unit (DLPDU); • Application protocol data unit (APDU).
Slave Parametrization	<p>For a DP Slave several levels of parametrization exist.</p> <p>(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 PROFI-safe. This parametrization is fixed for a given operational life cycle after start-up.</p> <p>(2) More complex devices may be parametrized via EDD and/or FDT/DTM technology via an acyclic communication service (MS2).</p> <p>(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.</p>
State Machine (DP)	<p>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:</p> <ul style="list-style-type: none"> - 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. <p>On top of this basic communication layer state machine application profiles are defining their own additional state machines, e.g. PA devices, PROFIdrive, PROFI-safe, Ident Systems, Weighing and Dosage Systems.</p> <p>State machines are best modelled and documented with the help of the "Unified Modelling Language (UML)".</p>
Station Address	<p>Within PROFIBUS DP the address of a communication participant (Master or Slave). The permitted range is 0 to 127, with:</p>

	<ul style="list-style-type: none"> - 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 rate)	The signalling rate of a digital communication line. It is the 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 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;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.



1.2 Electrical safety

- Turn off power supply before connecting the device;
- connect according to explanation in the "5 – Electrical connections" section on page 27;
- 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 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 screw provided in the cap (see Figure 1);
- the rated supply voltage must not exceed 30Vdc;
- in classified areas the electrical connection of the device must be carried out in compliance with the methods stated in the EN IEC 60079-0:2018-07 regulation;



- the user has to take suitable measures in order to prevent longer or continuous disturbances that cause the supply voltage to exceed by 10% or more;
- the product must be protected against overheating due to mechanical or electrical overloading.



1.3 Mechanical safety

- Install the device following strictly the information in the section "4 - Mounting instructions" on page 25;
- 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.



1.4 Operational safety

- The described products are category 3 certified and are designed for use in potentially explosive zones 2 (according to EN60079-15) and 22 (according to EN60079-31). They are suitable for a safe use and a normal level of protection in areas in which explosive atmospheres caused by mixture of gases and vapors (zone 2) or dust (zone 22) are unlikely to occur and if they do occur do so for a short period of time. They comply with the constructional safety requirements of the temperature class T5 (T100°C = +212°F). **They are not to be used in Zones 0, 1, 20 and 21;**
- protection requirements: Zone 2, gas explosion protection (G): protection by non sparking equipment: the construction minimizes the occurrence of sparks, arcs or hot surfaces, which in normal operation might give the risk of explosion; Zone 22, dust explosion protection (D): the construction of the product protects against the penetration of dust in hazardous quantities (min. IP5x) and guarantees that the surface temperature is under the ignition temperature of dust/air mixture as well as under the smoldering temperature of dust deposits;
- the manufacturer's specifications (temperature, speed, ...) must under no circumstances be exceeded;
- max. permissible environmental temperature: -20°C +40°C (-4°F +104°F) at continuous rotational speed of max. 6000 rpm;
- the maximum surface temperature (in °C) of the product must not exceed 2/3 of the ignition temperature of the dust/air mixture;
- in continuous operation the plastic parts must be able to withstand a temperature 10°C higher than the maximum temperature that can be reached in the hottest point of the product while the environmental temperature is the highest allowed during operation.

2 - Identification

Device can be identified through the **order code** and the **serial number** printed on the label applied to the enclosure. 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 – Certificates

3.1 Declaration of ATEX Conformity

lika Lika Electronic Srl
Via S. Lorenzo, 25
36010 Carrè (VI) • Italy
Smart encoders & actuators

Carrè, 17.05.2021

Declaration of Conformity

The manufacturer:
LIKA ELECTRONIC SRL
Via S. Lorenzo, 25
36010 Carrè (VI) – Italy

hereby declares that the following products (only when correctly assembled):

- | | | |
|------------------|----------------------|----------------------|
| • XAC8018/1PB-14 | • XAC8013/16384PB-14 | • XAC8016/16384PB-14 |
| • XAC8018/1CB-14 | • XAC8013/16384CB-14 | • XAC8016/16384CB-14 |
| • XAC8018/1FD-14 | • XAC8013/16384FD-14 | • XAC8016/16384FD-14 |
| • XAC8118/1PT-14 | • XAC8113/16384PT-14 | • XAC8116/16384PT-14 |
| • XAC8118/1EC-14 | • XAC8113/16384EC-14 | • XAC8116/16384EC-14 |
| • XAC8118/1MT-14 | • XAC8113/16384MT-14 | • XAC8116/16384MT-14 |
| • XAC8118/1PL-14 | • XAC8113/16384PL-14 | • XAC8116/16384PL-14 |
| • XAC8118/1EP-14 | • XAC8113/16384EP-14 | • XAC8116/16384EP-14 |

with the marking:

Ex II 3G Ex nA IIB T5 Gc
EX II 3D Ex tc IIIC T100° Dc IP65

may be used in Zone 2 and Zone 22 hazardous areas.

Gas explosion protected equipment for Zone 2, according to EN60079-15

Zone 2 includes areas in which an explosive atmosphere consisting of a mixture of air and flammable substances in the form of gas or vapour is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Dust explosion protected equipment for Zone 22, according to EN60079-31

Zone 22 includes areas in which an explosive atmosphere in the form of a cloud of dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

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R.E.A. 165423/Vicenza

Protection requirements:
Zone 22, dust explosion protection (D)

Protection by means of the housing: the construction of the product protects against the penetration of dust in hazardous quantities (min. IP5x) and guarantees that the surface temperature is under the ignition temperature of dust/air mixtures as well as under the smouldering temperature of dust deposits.

Zone 2, gas explosion protection (G)

Protection by non sparking equipment: the construction minimizes the occurrence of sparks, arcs or hot surfaces, which in normal operation might give the risk of explosion.

The manufacturer's specification of the purchased product such as operating temperature, shaft rotational speed, shaft load, max. supply voltage, etc. must under no circumstances be exceeded.

Protection requirements for rotary encoders of category 3GD:

- The product must be correctly assembled (encoder body and connection cap)
- The degree of protection in the installation condition must be at least IP6x.
- The maximum surface temperature of the product (in °C) must not exceed two-thirds of the ignition temperature of the dust/air mixture.
- During normal operation no sparks, arcs and non-permissible temperatures should occur.
- The upper continuous operating temperature of plastic parts must be 10°C higher than the maximum temperature that can arise at the hottest point of the product, based on the highest environmental temperature possible in service.

Obligations of the user:

- The rated supply voltage must not exceed 30Vdc.
- The manufacturer's specification concerning the range of the operating temperature (see product data sheet) has to be fully observed.
- The product must be protected against overheating due to mechanical or electrical overloading.
- The user has to take suitable measures in order to prevent longer or continuous disturbances that cause the supply voltage to be exceeded by 10% or more.
- The user has the obligation to protect in an appropriate way the area where electrical connections are carried out (make sure that the product is not connected to power supply when connecting) and ensure that this area also complies with Zone 2/22 requirements.
- The listed products do not meet the "impact test" requirements of EN IEC 60079-0:2018, section 26.4.2, but can however be used in Zone 2/22 areas where the user ensures that impacts are avoided by appropriate protection.

LIKA Electronic SRL



 Marco CALABRESE
 Managing Director

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3.2 EU Declaration of Conformity



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

Smart encoders & actuators

EU Declaration of Conformity encoders series XAC80-XAC81

- 1) Certificate: Nr. 5
- 2) Manufacturer: LIKA ELECTRONIC SRL
Via S. Lorenzo, 25
36010 Carrè (VI) - Italy
VAT# IT00817760242
- 3) Scope of the certificate: encoder series

• XAC8018/1PB-14	• XAC8013/16384PB-14	• XAC8016/16384PB-14
• XAC8018/1CB-14	• XAC8013/16384CB-14	• XAC8016/16384CB-14
• XAC8018/1FD-14	• XAC8013/16384FD-14	• XAC8016/16384FD-14
• XAC8118/1PT-14	• XAC8113/16384PT-14	• XAC8116/16384PT-14
• XAC8118/1EC-14	• XAC8113/16384EC-14	• XAC8116/16384EC-14
• XAC8118/1MT-14	• XAC8113/16384MT-14	• XAC8116/16384MT-14
• XAC8118/1PL-14	• XAC8113/16384PL-14	• XAC8116/16384PL-14
• XAC8118/1EP-14	• XAC8113/16384EP-14	• XAC8116/16384EP-14
- 4) This certificate has been issued under the responsibility of the manufacturer indicated in point 2).
- 5) The scope of the certificate indicated in point 3) is in conformity with the essential Health and Safety regulations and legislative regulations of the directives:

2014/34/EU	"ATEX"
2014/30/EU	"Electromagnetic compatibility"
- 6) Compliance with harmonized regulations, technical specifications and other documents is assured by compliance with the following norms:

EN IEC 60079-0:2018-07
EN 60079-31:2014-07
EN 61000-6-4, EN 61000-6-2
EN 60079-15

- 7) ATEX marking on the equipment:



II 3 GD, Ex nA IIB T5 Gc, Ex tc IIIC T100° Dc, IP65

Carrè, 17.05.2021


Marco CALABRESE
Legal representative

Lika Electronic Srl
Smart encoders & actuators



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3.3 Safety instructions



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

Smart encoders & actuators

SAFETY INSTRUCTIONS encoders series XAC80-XAC81

1) Marking:



II3 GD, Ex nA IIB T5 Gc, Ex tc IIIC T100° Dc, IP65

Explosion-proof encoder manufactured in compliance with the following regulations:

EN IEC 60079-0:2018-07
EN 60079-31:2014-07
EN 61000-6-4, EN 61000-6-2
EN 60079-15

- **Ex:** Equipment for use in potentially explosive atmospheres.
- **d:** Protection by explosion-proof housing.
- **IIB:** Electrical apparatus for use in potentially explosive atmospheres other than mines susceptible to firedamp.
- **T5:** Maximum housing surface temperature 100°C.
- **Gc:** Level of protection (EPL). The equipment can be used in Zone 2.
- **tc:** Electrical apparatus with protective housing for use in the presence of combustible dust.
- **IIIC:** Equipment or protective housing intended for use in potentially explosive atmospheres with presence of combustible dust.
- **T100°C:** Maximum surface temperature.
- **Dc:** Level of protection (EPL). The equipment can be used in Zone 22.
- **IP65:** Degree of IP protection for dust-proof housing.

Equipment intended for use in the following Zones:

Zone 2: Mixture of gas/air, vapour/air, mist/air

Zone 22: Mixture of dust/air

ATTENTION: Equipment not to be used in Zones 0, 1 and 21

Lika Electronic Srl
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35 YEARS
YOUNG
1982.2017

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Smart encoders & actuators

- 2) The equipment has to be installed only by qualified personnel and according to the applicable regulations.
- 3) Do not tool or drill the equipment.
- 4) If the connection cap needs to be opened, please carefully replace it after and ensure that the seal is as tight as it was before
- 5) After connection, please carefully tighten the cable glands and the connectors.
- 6) Use the encoder's fixing plate for installation and against rotation.
- 7) Protect the device against shock and mechanical damages.
- 8) Use the product according to the indicated degree of IP protection.
- 9) Maximum permissible environmental temperature -20°C to +40°C (at continuous rotational speed of max. 6000 rpm).
- 10) In classified areas the electrical connection of the device has to be carried out according to the methods of EN IEC 60079-0:2018-07.
- 11) Connect the device according to the electrical connections scheme on the user manual.
- 12) Provide a ground connection (GND) using the ground screw on the housing.

LIKA ELECTRONIC SRL
Carrè, 17.05.2021

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4 - Mounting instructions

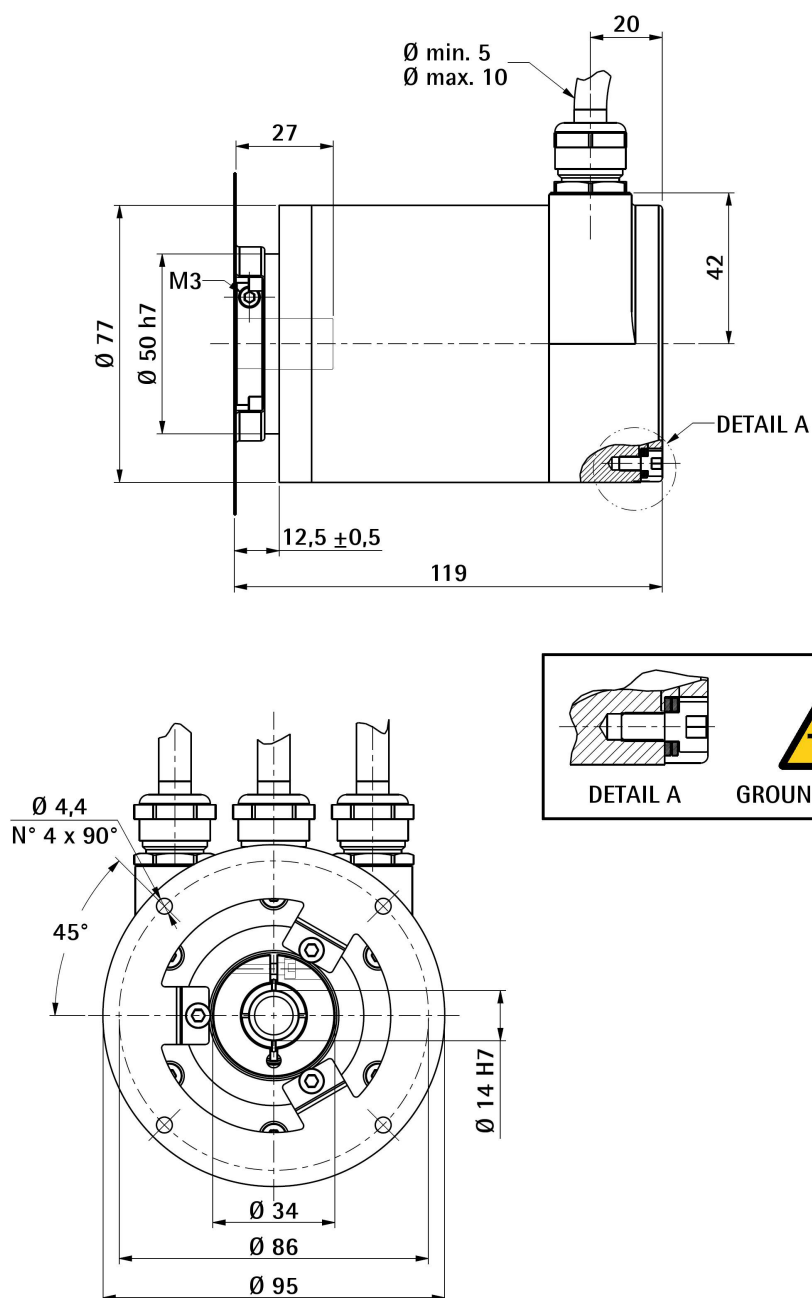


WARNING

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

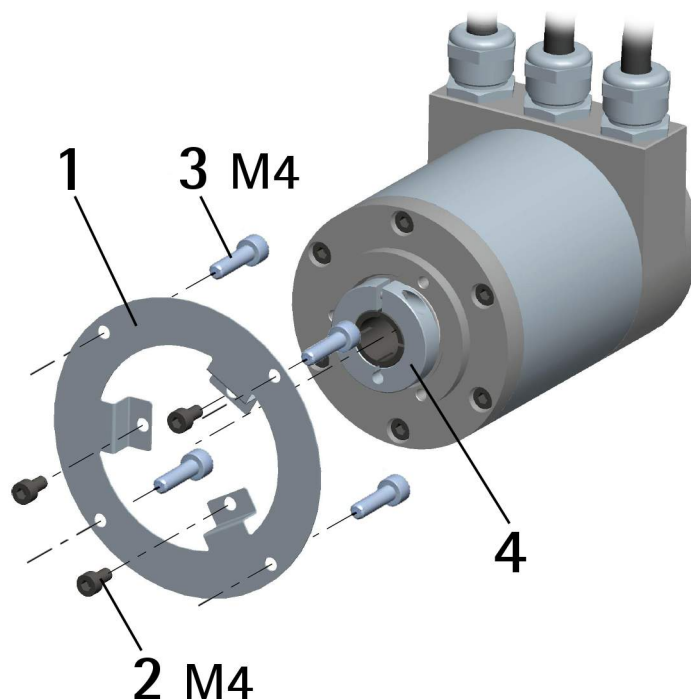
4.1 Encumbrance sizes

(values are expressed in mm)



4.2 Mounting the encoder

- Fasten the fixing plate **1** to the encoder using the three M4 screws **2** provided with the device;
- mount the encoder on the motor shaft using the reducing sleeve (if supplied); avoid forcing the encoder shaft;
- fasten the fixing plate **1** to the rear of the motor using four M4 cylindrical head screws **3**;
- fix the collar **4** to the encoder shaft (apply threadlocker to screw).



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 out technical personnel for the complete availability of custom made shafts.

5 - Electrical connections



WARNING

Electrical connections must be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop.

5.1 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 connector 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 six screws **1**. Please be careful with the internal 15-pin D-SUB connector.

Always replace the connection cap at the end of the operation. Take care in re-connecting the internal 15-pin D-SUB 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!

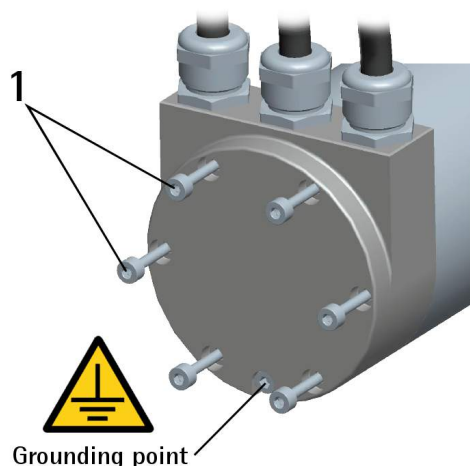


Figure 1 - Removing the connection cap

5.2 Connection cap with PG gland (cable output)

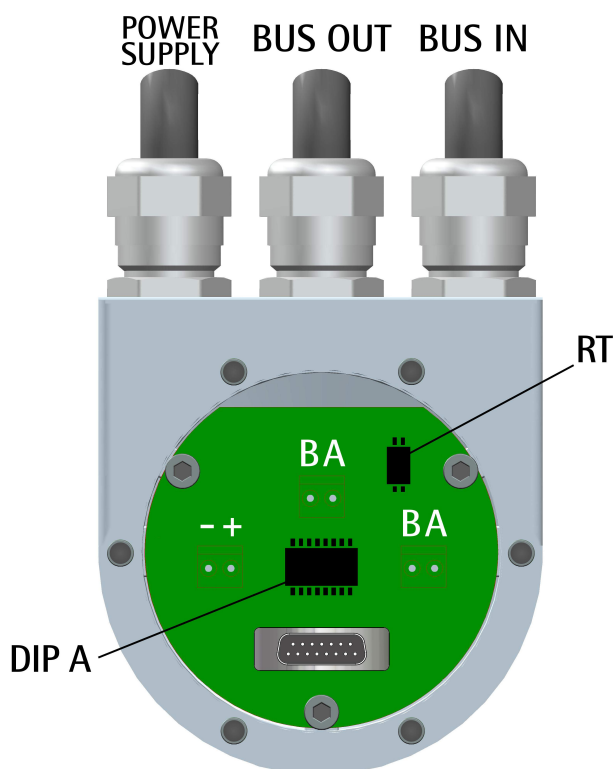


Figure 2 - Connection cap

The connection cap is fitted with three PG9 cable glands for BUS IN and BUS OUT connections and power supply connection. The bus cables can be connected directly to the terminal connectors located in front of each cable gland.

We recommend Profibus-DP certified cables to be used. Core diameter should not exceed Ø 1.5 mm (0.06 inches). Please note that BUS IN and BUS OUT connections are actually the same and so interchangeable.

Terminal connector	Description
-	0Vdc 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

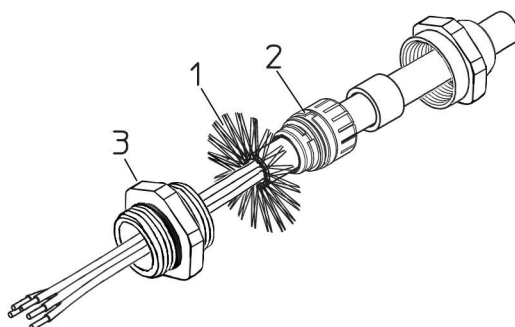
5.3 Ground connection

Minimize noise by connecting the shield and/or the encoder frame to ground (GND). Make sure that ground (GND) 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. It is recommended to provide the ground connection as close as possible to the encoder. We suggest using the ground screw provided in the cap (see Figure 1).

5.3.1 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**.



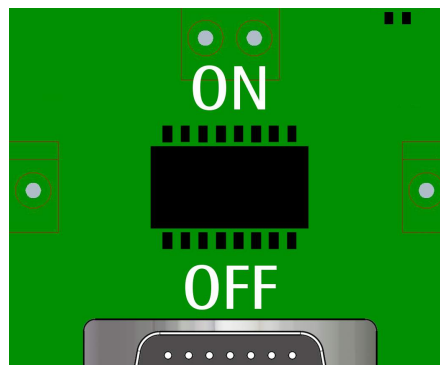
5.4 Setting the node number: DIP A (Figure 2)



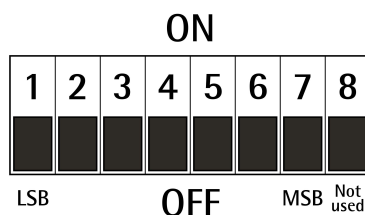
WARNING

Power supply must be turned off before performing this operation!

The node number must be set via hardware using DIP A dip-switches. Allowed addresses are from 0 to 125. The default value is 1.



DIP A:



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

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

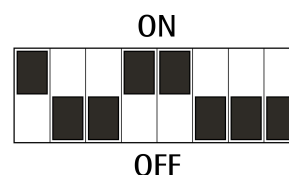


EXAMPLE

Set node address = 25:

$25_{10} = 0001\ 1001_2$ (binary value)

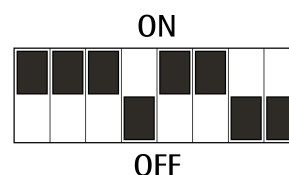
bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	OFF	OFF	ON	ON	OFF	OFF	OFF



Set node address = 55:

$55_{10} = 0011\ 0111_2$ (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	ON	ON	OFF	ON	ON	OFF	OFF



NOTE

After having set the device address, please check the position of the bus termination switch (see the "5.6 Bus termination resistance (Figure 2)" section on page 31).

5.5 Baud rate

The baud rate is set by the Master via software at configuration of the node (Slave).

The 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	1,500	12,000
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

5.6 Bus termination resistance (Figure 2)

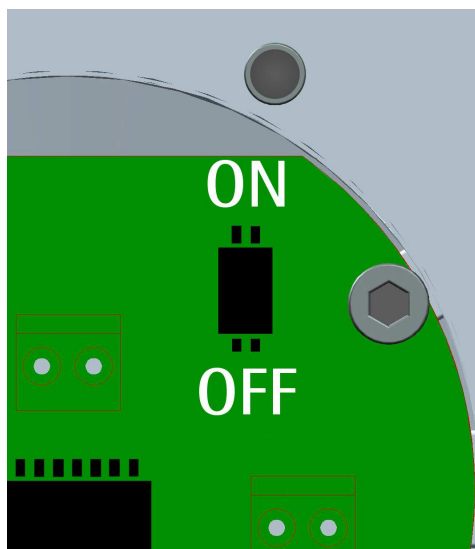


WARNING

Power supply must be turned off before performing this operation!

A bus termination resistance is provided inside the connection cap and must 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 RT Switch to activate or deactivate the bus termination.

RT	Description
1 = 2 = ON	Activated: if the encoder is either the first or the last device in the transmission line
1 = 2 = OFF	Deactivated: if the encoder is not either the first or the last device in the transmission line



6 – Quick reference

6.1 STEP7 configuration

6.1.1 Importing the GSD file

Profibus encoders are supplied with their own GSD file, they are specific for each encoder model. To download the file enter **www.lika.biz**.

The GSD file must be installed in the Profibus Master device.

The available GSD files are:

xac80_18.GSD:	XAC8018/1PB	(18 bit singleturn encoder)
xac80_27.GSD:	XAC8013/16384PB	(13 + 14 bit multiturn encoder)
xac80_30.GSD:	XAC8016/16384PB	(16 + 14 bit multiturn encoder)

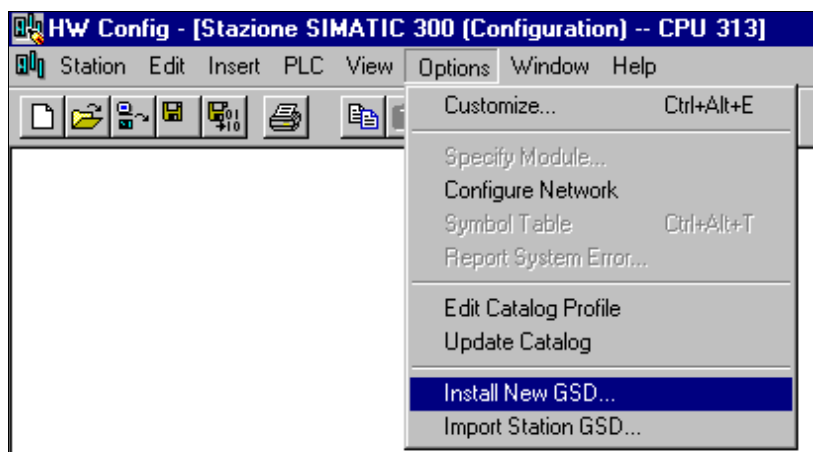


WARNING

Please pay attention to install the right GSD file in the matching encoder model.

In the menu bar of the **HW Config** window, press **Options** and then **Install New GSD...** command.

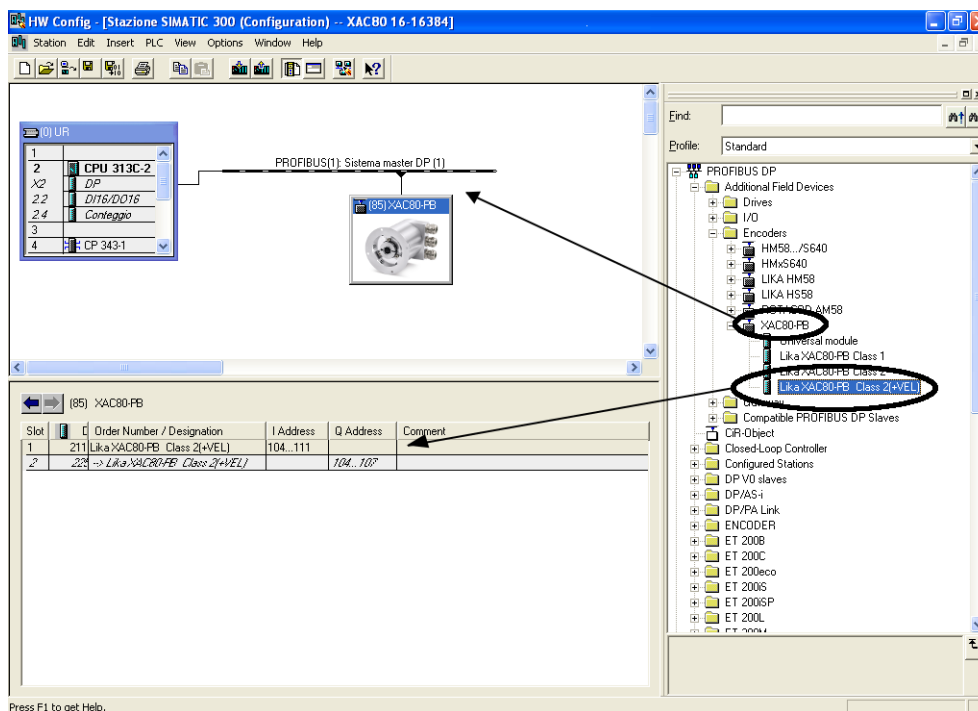
Select the correct GSD file in the installation window and install it.



6.1.2 Adding a node to the project

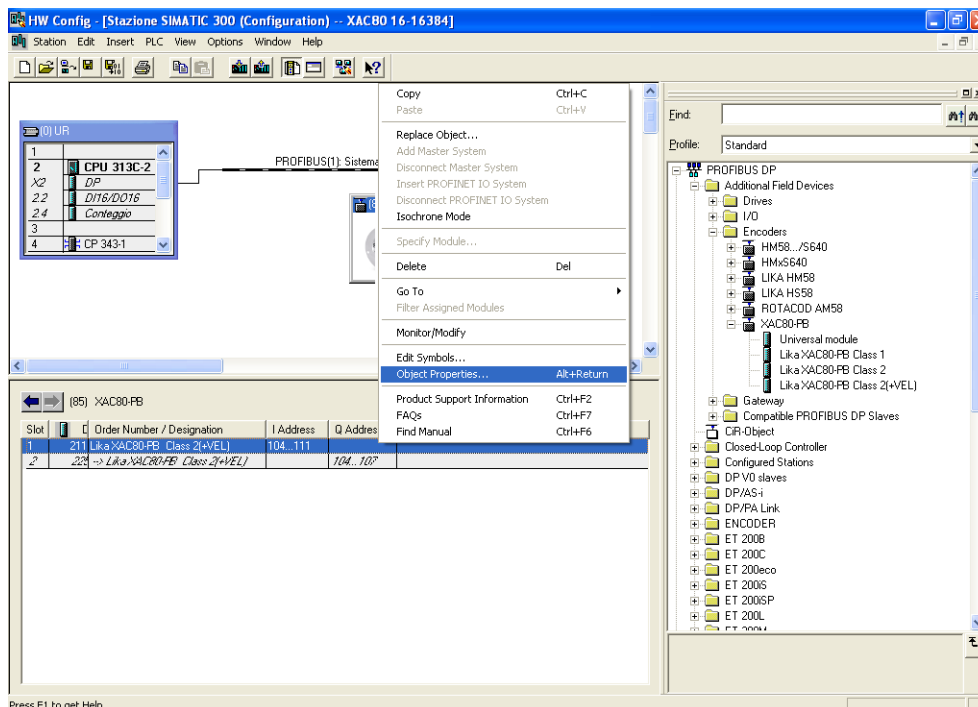
In the left pane of the **HW Config** window, open the directory tree and select **Catalog\PROFIBUS_DP\Additional Field Devices\Encoders**; drag the required module (for instance "LIKA XAC8016/16384PB" module to the window on the left and drop it on "PROFIBUS(1): DP master system (1)".

Then drag the desired submodule (Class 1, Class 2 or Class 2(+VEL)) to the variables table in the bottom; in this way you set the class of the device (for further details on the available classes see the "7.2 Classes of the Device profile" section on page 39).



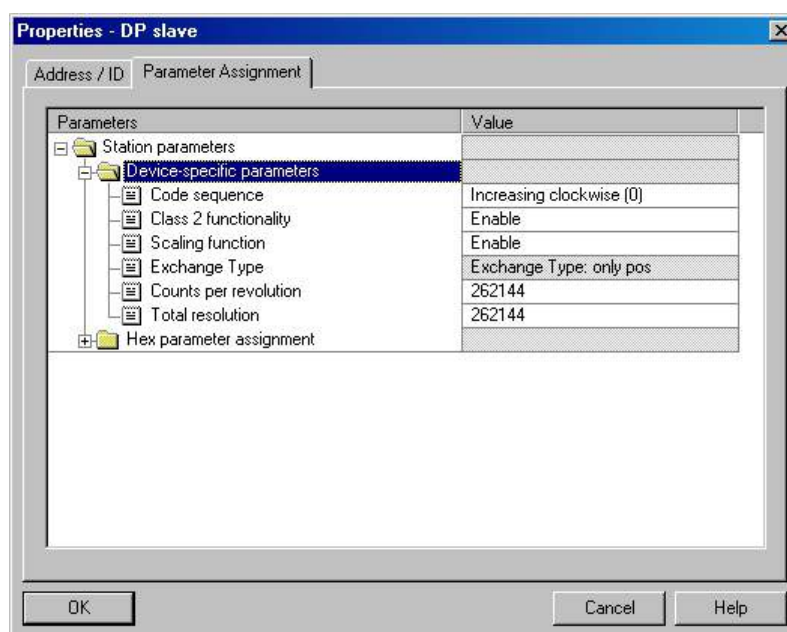
6.1.3 Encoder configuration parameters

To enter the Encoder configuration parameters window, select the device in the submodule page in bottom of the **HW Config** window and right-click to open the menu; then choose the **Object Properties...** command.

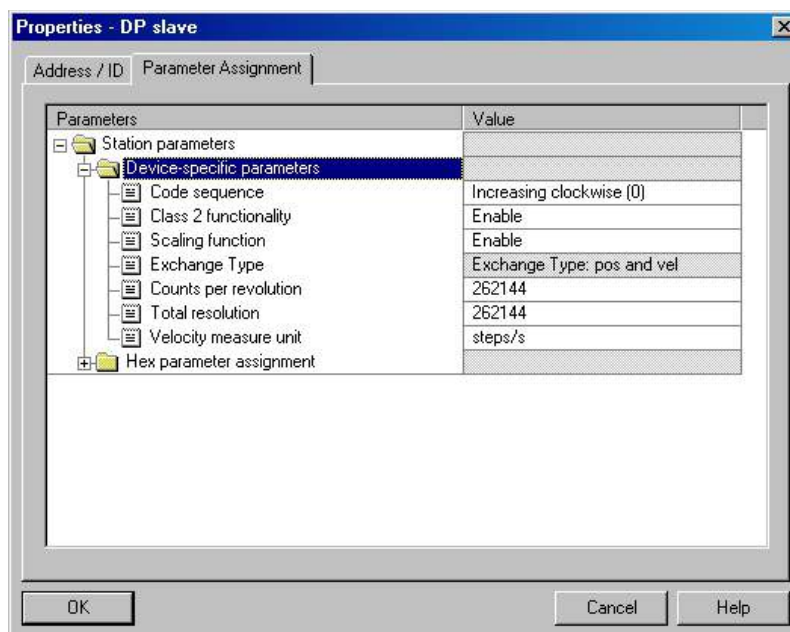


The **Properties – DP slave** window will appear; in the **Parameter Assignment** page the list of all encoder parameters is available.

For any information on using and setting each parameter refer to the "7.4 DDLM_Set_Prm" section on page 41.



Class 2 example



Class 2(+VEL) example



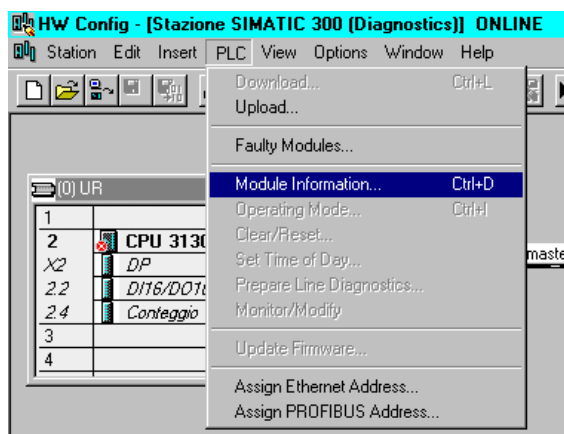
After having set new parameter values, press the **OK** button to close the **Properties – DP slave** window and then press the **Download** button (see the icon on the left) in the toolbar of the **HW Config** window to download the set parameters.

6.2 Reading the diagnostic information

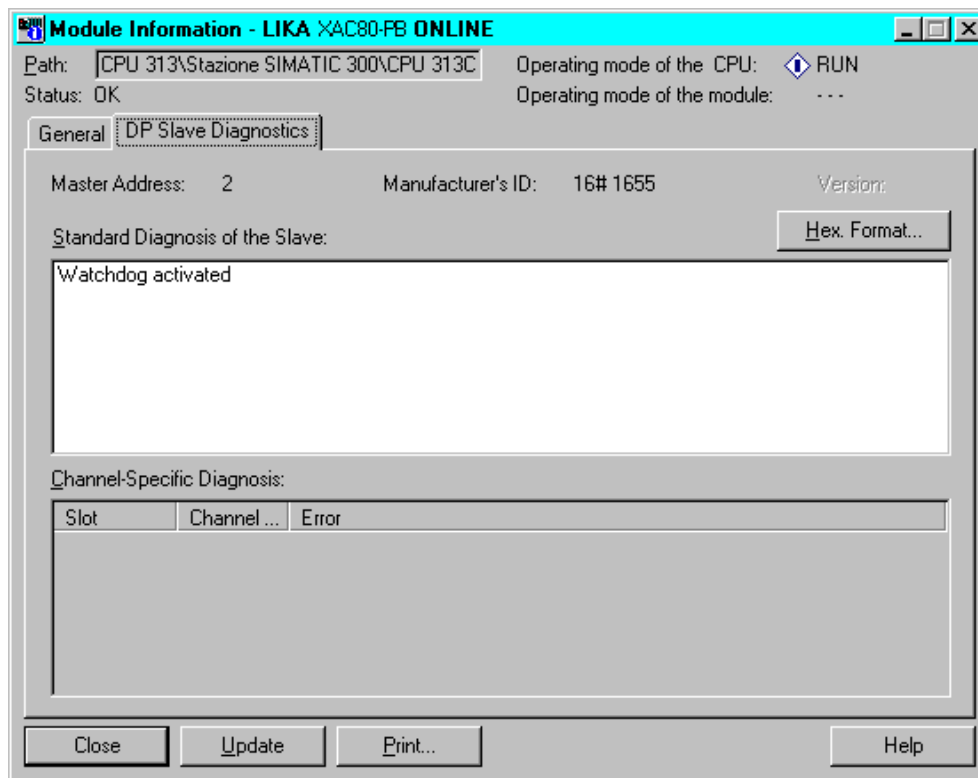
The system implements 16-byte diagnostic messages, for any further information refer to the "7.7 DDLM_Slave_Diag" section on page 52.



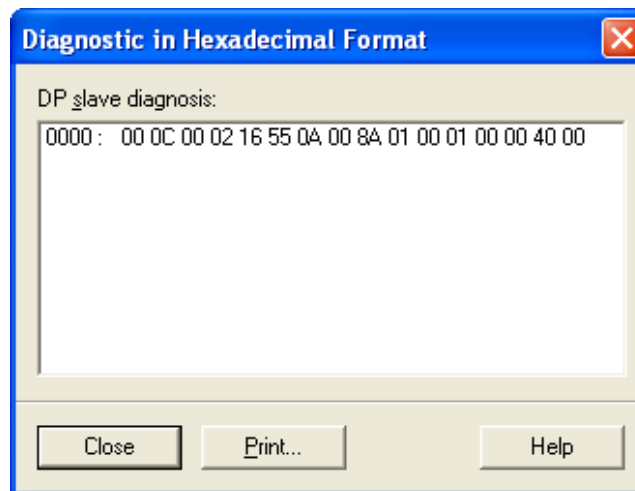
Before entering the diagnostic page, it is necessary to connect to the unit (enter online status). To do this, select **Station\Open online** in the **HW Config** window or click the **Online<->Offline** button (see the icon on the left). Then select **PLC\Module information...** to enter the **Module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



Press the **Hex. Format...** button to display diagnostic information:



16-byte Diagnostic:



NOTE

Refer to the "7.7 DDLM_Slave_Diag" section on page 52 for a complete list and meaning of each diagnostic byte.

6.3 Setting the Preset value



EXAMPLE

The encoder having device address 1 transmits the position value to the Master. The **Position value** is loaded into variables ED 100...103 (4 bytes). The **Velocity value** is loaded into variables ED 104...107 (4 bytes). The **Preset value** is sent to the encoder using the variables AD 100...103 (4 bytes).

	Address	Symbol	Disp	Status value	Modify value
1					
2		// POSITION VALUE			
3	ED 100		HEX	Dw#16#00037AA1	
4					
5		// VELOCITY VSLUE			
6	ED 104		HEX	Dw#16#00000000	
7					
8		// PRESET VALUE			
9	AD 100		HEX	Dw#16#00000500	Dw#16#00000500
10					

CPU 313\Stazione SIMATIC 300...\Programma S7(1) RUN

The current **Position value** of the encoder is 0003 7AA1hex.

To set the **Preset value** = 0000 0500hex, set the bit 31 of variable AD 100 = "1" (8000 0500hex).

	Address	Symbol	Disp	Status value	Modify value
1					
2		// POSITION VALUE			
3	ED 100		HEX	Dw#16#00000500	
4					
5		// VELOCITY VSLUE			
6	ED 104		HEX	Dw#16#00000000	
7					
8		// PRESET VALUE			
9	AD 100		HEX	Dw#16#80000500	Dw#16#80000500
10					

CPU 313\Stazione SIMATIC 300...\Programma S7(1) RUN



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 bit 31 of variable AD 100 back to "0" and then press the "Command variables" button again.



NOTE

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

7 - Profibus® interface

Lika encoders are Slave devices and comply with "Profibus-DP Profile for Encoders"; they can be set as Class 1, Class 2 or Class 2(+VEL) devices (see the "7.2 Classes of the Device profile" section on page 39).

For any omitted information refer to the official Profibus website www.profibus.com.

7.1 GSD file

Profibus encoders are supplied with their own GSD file, they are specific for each encoder model. To download the file enter www.lika.biz.

The GSD file must be installed in the Profibus Master device.

The available GSD files are:

xac80_18.GSD:	XAC8018/1PB	(18 bit singleturn encoder)
xac80_27.GSD:	XAC8013/16384PB	(13 + 14 bit multiturn encoder)
xac80_30.GSD:	XAC8016/16384PB	(16 + 14 bit multiturn encoder)



WARNING

Please pay attention to install the right GSD file in the matching encoder model.

7.2 Classes of the Device profile

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 (refer to the **Position value** parameter on page 49);
- changing the counting direction (refer to **Code sequence** parameter on page 43);
- setting the preset value (refer to **Preset value** parameter on page 50).

Class 2 provides all the Class 1 functions and additional advanced functions such as:

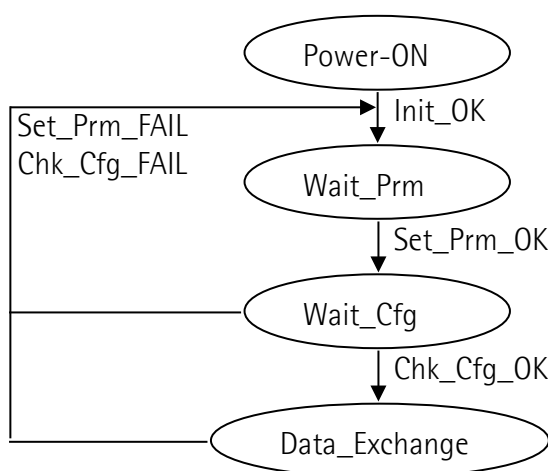
- scaling function (see **Scaling function control** parameter on page 44; **Counts per revolution** parameter on page 45; and **Total resolution** parameter on page 46).

Class 2(+VEL) provides all the Class 1 and the Class 2 functions and additional velocity-related functions:

- transmission of the velocity value (see the **Position and velocity values** parameter on page 50);
- setting of the unit of measurement for velocity (see the **Velocity measure unit** parameter on page 48).

7.3 Modes of operation

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



NOTE

All parameters –except **Preset value**– are transmitted in **Set_Prm** mode. **Preset value** is transmitted only in **Data_Exchange** mode.

7.3.1 Types of communication

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

- **DDL_M_Set_Prm:**
It is used to configure the Slave. This communication mode is active immediately after the power is turned ON and used to send parameters from the Master to the Slave (see the "7.4 DDL_M_Set_Prm" section on page 41).
- **DDL_M_Chk_Cfg:**
It sets the number of bytes used for data transmission in **Data_Exchange** mode (see the "7.5 DDL_M_Chk_Cfg" section on page 49).

- **DDLML_Data_Exchange:**
It is used as "standard operation mode".
Used by the Master to send the **Preset value**; used by the Slave to transmit the position and velocity values (see the "7.6 DDLML_Data_Exchange" section on page 49).
- **DDLML_Slave_Diag:**
It is used when the power is turned ON and whenever the Master needs diagnostic information from the Slave device (see the "7.7 DDLML_Slave_Diag" section on page 52).

7.4 DDLML_Set_Prm

When the system is turned ON, configuration data set by the operator is sent to the absolute encoder by the controller. Transmission of parameters 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 "6.1 STEP7 configuration" 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 in compliance with values set for the encoder profile and shown in the following tables.

DDLML_Set_Prm with Class 1

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

DDL_M_Set_Prm with Class 2

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

DDL_M_Set_Prm with Class 2 (+VEL)

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

7.4.1 Byte 10 - Operating parameters

Bit	Function	bit = 0	bit = 1
0	Code sequence	Count up information with clockwise rotation	Count up information with counter-clockwise rotation
1	Class 2 functionality	disabled	enabled
2	Reserved		
3	Scaling function control	disabled	enabled
4 ... 6	Reserved		
7	Exchange type	position	position + velocity

Code sequence

This is intended to set whether the position value output by the transducer increases (count up information) when the encoder shaft rotates clockwise (CW) or counter-clockwise (CCW). When **Code sequence** = 0, the position value increases when the encoder shaft rotates clockwise; on the contrary, when **Code sequence** = 1, the position value increases when the encoder shaft rotates counter-clockwise. CW and CCW rotations are viewed from the shaft end.

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



WARNING

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

Class 2 functionality

This is only available when the encoder Class 2 or the encoder Class 2(+VEL) are 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 "7.2 Classes of the Device profile" section on page 39.

0 = Disabled = Encoder Class 1 is set.

1 = Enabled = Encoder Class 2 (or Class 2(+VEL)) is set.

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

Scaling function control

This is only available when the encoder Class 2 or the encoder Class 2(+VEL) are installed.

When this option is disabled (bit 3 **Scaling function control** = 0 = DISABLED), the device uses the hardware resolution, i.e. the hardware counts per revolution and the hardware number of revolutions to arrange the absolute position information, see the encoder data on the label applied to the device.

On the contrary, when it is enabled (bit 3 **Scaling function control** = 1 = ENABLED), the device uses the custom resolution transmitted through the bytes from 11 to 18 to calculate the position information (see the **Counts per revolution** and **Total resolution** parameters).

For a correct use of this function see the "7.4.2 Bytes 11 ... 14" and "7.4.3 Bytes 15 ... 18" sections.

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



WARNING

When you enable the scaling function (**Scaling function control** = 1), 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.



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 a new preset value (see the **Preset value** parameter).



WARNING

You can activate the custom values set next to the **Counts per revolution** and **Total resolution** parameters only if **Class 2 functionality** = ENABLED.

If **Scaling function control** = ENABLED the set custom resolution values are enabled and used by the encoder; on the contrary, if **Scaling function control** = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the physical values, NOT the new entered values, until you enable the **Scaling function control**.

Exchange type

0 = Position = the device transmits only the position value (Class 1 and Class 2).

1 = Position + velocity = the device transmits both position and velocity values (Class 2(+VEL)).

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

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

7.4.2 Bytes 11 ... 14

Counts per revolution



WARNING

This is only available when the encoder Class 2 or the encoder Class 2 (+VEL) are installed.

You can activate a new value next to the **Counts per revolution** parameter only if **Class 2 functionality** = ENABLED. If **Scaling function control** = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if **Scaling function control** = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the physical values, NOT the new entered values, until you enable the **Scaling function control**. See the "7.4.1 Byte 10 - Operating parameters" section on page 43.

If **Class 2 functionality** = DISABLED or **Scaling function control** = DISABLED, then the system uses the physical 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	13	14
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^8	2^7 to 2^0

The custom singleturn resolution value must be less than or equal to the physical singleturn resolution (hardware counts per revolution value).

Setting a value greater than allowed causes the resolution to be forced to the **Hardware counts per revolution** value.

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, ... 2,048, 4,096, ...). This is meant to avoid counting errors (refer also to the "7.8 "Dead Zone"" section on page 55).

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

for XAC8018/1

Default = 8,192 (min. = 1, max. = 8,192)

for XAC8013/16384

Default = 65,536 (min. = 1, max. = 65,536)

for XAC8016/16384



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 16,384, see the order code).

Let's suppose that our encoder is programmed as follows:

Counts per revolution: 8,192 cpr

Total resolution = $134,217,728_{10} = 8,192 \text{ (cpr)} * 16,384 \text{ (rev.)}$

Let's set a new singleturn resolution, for instance: **Counts per revolution** = 360.

If we do not change the **Total resolution** value at the same time, we will get the following result:

$$\text{Number of revolutions} = \frac{134,217,728 \text{ (Total resolution)}}{360 \text{ (Counts per revolution)}} = 372,827.0\bar{2}$$

As you can see, the encoder is required to carry out almost 373,000 revolutions, this cannot be as the hardware number of revolutions is, as stated, max. 16,384. When this happens, the encoder falls into an error.



WARNING

When you enable the scaling function (**Scaling function control** = 1), 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.



WARNING

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

7.4.3 Bytes 15 ... 18

Total resolution



WARNING

This is only available when the encoder Class 2 or the encoder Class 2 (+VEL) are installed.

You can activate a new value next to the **Total resolution** item only if **Class 2 functionality** = ENABLED. If **Scaling function control** = ENABLED the set resolution values are enabled and used by the encoder; on the contrary, if **Scaling function control** = DISABLED you are allowed to set new resolution values, however they are not enabled even if sent to the encoder: the encoder still goes on using the physical values, NOT the new entered values, until you enable the **Scaling function control**. See the "7.4.1 Byte 10 - Operating parameters" section on page 43.

If **Class 2 functionality** = DISABLED or **Scaling function control** = DISABLED, then the system uses the physical 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	15	16	17	18
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^8	2^7 to 2^0

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

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

We recommend the **Number of revolutions** to be set to a power of 2. This is meant to avoid problems when using the device in endless operation (when crossing the physical zero) and entering the "Red Zone" (see the "7.8 "Dead Zone"" section on page 55).

Default = 262 144 (min. = 1, max. = 262 144) for XAC8018/1
 Default = 134 217 728 (min. = 1, max. = 134 217 728) for XAC8013/16384
 Default = 1 073 741 824 (min. = 1, max. = 1 073 741 824) for XAC8016/16384



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 suppose our encoder is programmed as follows:

Counts per revolution: 8,192

Total resolution = $33,554,432_{10} = 8,192 \text{ (cpr)} * 4,096 \text{ (rev.)}$

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.



WARNING

When you enable the scaling function (**Scaling function control** = 1), 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.



WARNING

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



EXAMPLE

"XAC8018/1": singleturn encoder

- **Hardware counts per revolution** = 18 bits/turn ($2^{18} = 262\,144$ cpr)
- **Hardware number of turns** = 1
- **Total hardware resolution** = 18 bits ($262\,144 * 1 = 262\,144$)

"XAC8016/16384": multiturn encoder

- **Hardware counts per revolution** = 16 bits/turn ($2^{16} = 65,536$ cpr)
- **Hardware number of turns** = 14 bit (16,384 turn)
- **Total hardware resolution** = 30 bits ($65,536 * 16,384 = 2^{30} = 1\,073\,741\,824$)



EXAMPLE

Multiturn encoder "XAC8016/16384".

The resolution is:

- **Hardware counts per revolution** = 65,536 (2^{16})
- **Hardware number of turns** = 16,384 (2^{14})
- **Total hardware resolution** = 1 073 741 824 (2^{30})

2,048 steps per revolution * 1,024 turns are required:

- Enable the scaling function (**Class 2 functionality** = 1; **Scaling function control** = 1); byte 10 = 0A hex (bit 1 = bit 3 = "1")
- Custom resolution per turn = **Counts per revolution** = 2,048 cpr; bytes 11 ... 14 = 0000 0800 hex
- **Total resolution** = 2,048 * 1,024 = 2 097 152: byte 15 ... 18 = 0020 0000 hex.



NOTE

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

7.4.4 Byte 19

Velocity measure unit

This byte is available only when Class 2 (+VEL) is set (see also **Class 2 functionality** and **Exchange type** items).

It defines the unit of measurement for the speed value transmitted by the device.

00 = step/s (steps per second);

01 = rpm (revolutions per minute).

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

7.5 DDLM_Chk_Cfg

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

Chk_Cfg message structure (1 byte):

bit 7 = Consistency (= "1")
 bit 6 = Word format ("0"=byte, "1"=word=4 bytes)
 bit 5 and 4 = In/out data ("01"=Input, "10"=output)
 bit 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	0	1	0	0	1	1	D3h
	1	1	1	0	0	0	0	1	E1h

Class 1 and Class 2:

D1hex = 4 byte input

E1hex = 4 byte output

Class 2(+VEL):

D3hex = 8 byte input

E1hex = 4 byte output

7.6 DDLM_Data_Exchange

This is the normal operation status of the system. The Slave (for both Class 1 and Class 2) can transmit the **Position value** (and the speed value -**Position and velocity values**- if Class 2+VEL is set) and receive the **Preset value** from the Master. See also the **Exchange type** parameter on page 44.

Position value

when either Class 1 or Class 2 is set (Encoder → Master)

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

See also the **Exchange type** parameter.

It has a mandatory length of 32 bits and is right aligned in the data field.

This parameter contains the current position of the encoder.

If the scaling function is enabled, the output value is scaled according to the scaling parameters (see **Scaling function control** on page 44).

Position and velocity values

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

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

For more information on the position value refer to the previous **Position value** parameter.

See also the **Exchange type** parameter.

The velocity value is expressed according to the setting in the **Velocity measure unit** parameter.

Preset value

when any Class is set (Master → Slave)

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

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

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



EXAMPLE

Preset value to be set = 0000 1000hex

Current **Position value** = 0005 5000hex

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

1°	M→S	80	00	10	00
	S→M	00	05	50	00

2°	M→S	80	00	10	00
	S→M	00	05	50	00

3°	M→S	80	00	10	00
	S→M	00	00	10	00


NOTE

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


WARNING

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

7.7 DDLM_Slave_Diag

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

This encoder provides 16-byte diagnostic information.

Diagnostic information consists of two parts: a standard diagnostic information (bytes 0 ... 5) and an extended diagnostic information (bytes 6 ... 15). The standard diagnostic information complies with the guidelines contained in the "Profibus specification – Normative parts according to the European Standard EN 50 170 volume 2" publication. While the extended diagnostic information contains the device related encoder diagnostic information; the DP-Slave specific diagnostic is entered in this area. The extended diagnostic information complies with the specifications contained in the "Profibus-DP Profile For Encoders" publication. The length of the extended diagnostic information for encoder is specified in byte 6 of the diagnostic message.

16-byte diagnostic information:

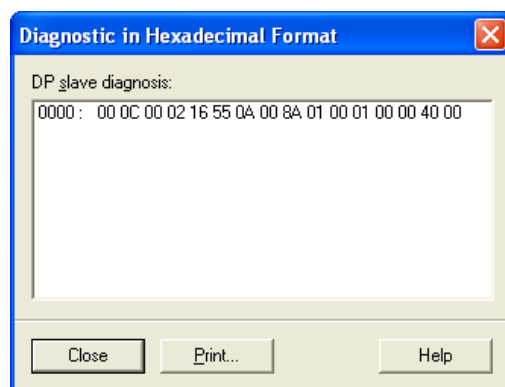


Figure 3 - 16-byte Diagnostic information

Byte	Description
0	Station_Status_1
1	Station_Status_2
2	Station_Status_3
3	Master_Add
4 MSB	Ident_Number
5 LSB	
6	Extended diagnostic header
7	Alarms

Byte	Description
8	Operating status
9	Encoder type
10 MSB	Singleturn resolution
11	
12	
13 LSB	Number of distinguishable revolutions
14 MSB	
15 LSB	

Station_Status_1

Byte 0. The first 5 bytes are defined in the "Profibus specification" document in compliance with the European Standard EN 50170 volume 2. For any information on the meaning of the individual bits in the **Station_Status_1** byte refer to the "Profibus specification" document.

Station_Status_2

Byte 1. The first 5 bytes are defined in the "Profibus specification" document in compliance with the European Standard EN 50170 volume 2. For any information on the meaning of the individual bits in the **Station_Status_2** byte refer to the "Profibus specification" document.

Station_Status_3

Byte 2. The first 5 bytes are defined in the "Profibus specification" document in compliance with the European Standard EN 50170 volume 2. For any information on the meaning of the individual bits in the **Station_Status_3** byte refer to the "Profibus specification" document.

Master_Add

Byte 3. The address of the DP-Master which has parametrized this DP-Slave is entered in this byte, in the example (Figure 3): 02 hex. The first 5 bytes are defined in the "Profibus specification" document in compliance with the European Standard EN 50170 volume 2. For any information on the meaning of the **Master_Add** byte refer to the "Profibus specification" document.

Ident_Number

Bytes 4 and 5. The manufacturer identifier is given for a DP-Device. This identifier can be used both for verification purpose and for the exact identification. In the example (Figure 3): 16 55 hex. The first 5 bytes are defined in the "Profibus specification" document in compliance with the European Standard EN 50170 volume 2. For any information on the meaning of the **Ident_Number** bytes refer to the "Profibus specification" document.

Extended diagnostic header

Byte 6. The Extended diagnostic header specifies the length of the Encoder diagnostics (extended diagnostic information) including the header byte, in the example (Figure 3): 0A hex = 10 dec. The value is expressed in hexadecimal format. For any information on the meaning of the **Extended diagnostic header** byte refer to the "Profibus-DP Profile For Encoders" document.

Alarms

Byte 7. This byte is intended to show the status of the alarms specified in the "Profibus-DP Profile For Encoders" document. This device does not provide the specified alarms management, thus this byte is set to logical low (00 hex). For any information on the meaning of the individual bits in the **Alarms** byte refer to the "Profibus-DP Profile For Encoders" document.

Operating status

Byte 8. This byte is intended to give information on the Encoder internal parameters, in other words it informs on the status of DDLM_Set_Prm byte 10 Operating parameters (refer to the "7.4.1 Byte 10 - Operating parameters" section on page 43). In the example of Figure 3: 8A hex = 10001010 bin, that is:

bit 0 = 0: **Code sequence** = count up information with clockwise rotation

bit 1 = 1: **Class 2 functionality** = enabled

bit 2 = 0 = not used

bit 3 = 1: **Scaling function control** = enabled

bits 4 ... 6 = 0 = not used

bit 7 = 1: **Exchange type** = Position + velocity information transmission

For any information on the meaning of the individual bits in the **Operating status** byte refer to the "Profibus-DP Profile For Encoders" document.

Encoder type

Byte 9. This byte is intended to give information on the Encoder type. The value is expressed in hexadecimal format. In the example of Figure 3: 01 hex = "Multi-turn absolute rotary encoder". For any information on the meaning of the **Encoder type** byte refer to the "Profibus-DP Profile For Encoders" document.

Singleturn resolution

Bytes 10 ... 13. These bytes are intended to provide the number of measuring steps per revolution that are output for the absolute singleturn position value (physical singleturn resolution). In the example of Figure 3: 00 01 00 00 hex = 65,536 dec, 16-bit physical singleturn resolution. For any information on the meaning of the **Singleturn resolution** bytes refer to the "Profibus-DP Profile For Encoders" document.

Number of distinguishable revolutions

Bytes 14 and 15. These bytes are intended to provide the number of distinguishable revolutions that the encoder can output. In the example of Figure 3: 40 00 hex, i.e. 16,384 revolutions. For any information on the meaning of the **Number of distinguishable revolutions** bytes refer to the "Profibus-DP Profile For Encoders" document.

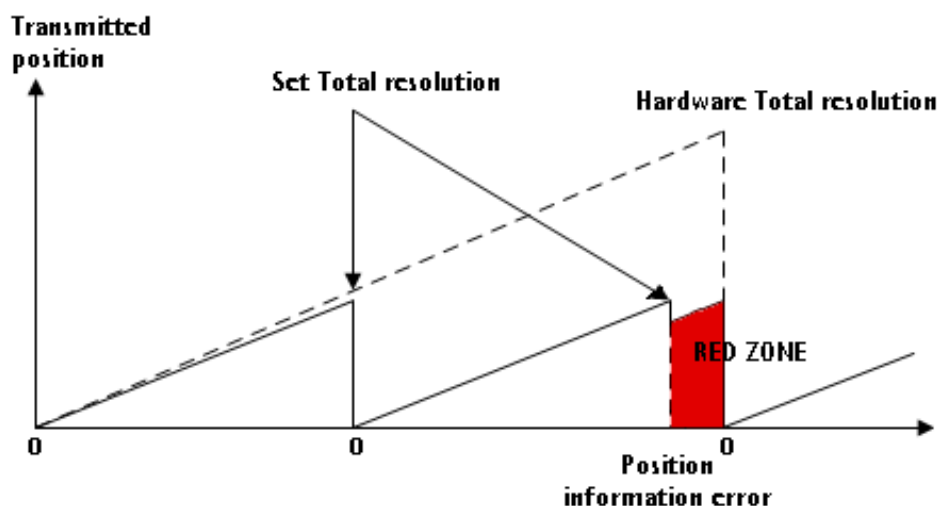
7.8 "Dead Zone"

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

"XAC8016/16384PB...": multiturn encoder

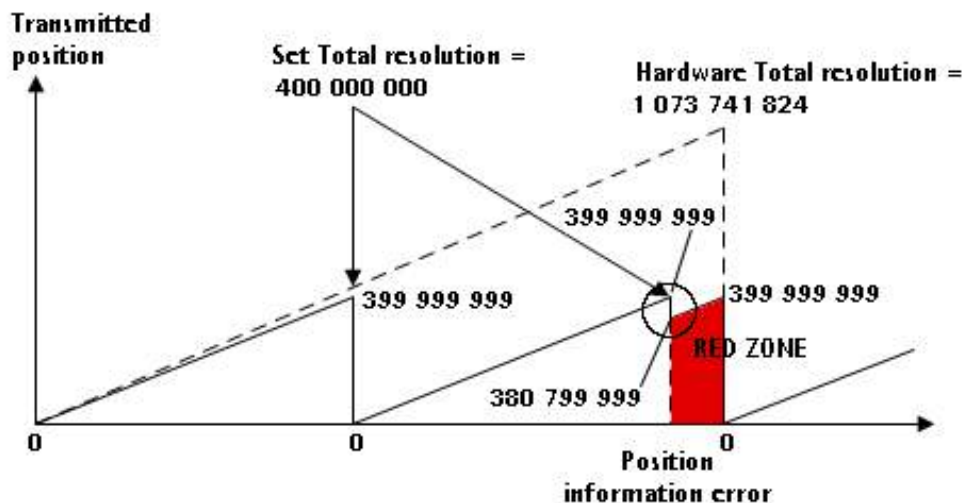
- **Hardware counts per revolution** = 65,536 (2^{16})
- **Hardware number of turns** = 16,384 (2^{14})
- **Total hardware resolution** = 1 073 741 824 (2^{30})

Set parameter values:

- **Counts per revolution** = 50,000
- **Number of revolutions** = 8,000
- **Total resolution** = 400 000 000

$$\frac{\text{Hardware number of turns}}{\text{Number of revolutions}} = \frac{16,384}{8,000} = 2.048$$

It follows that, for 384 revolutions ($16,384 - 2 * 8,000 = 384$), the encoder will operate within the "Red Zone" limits.



NOTE

- When the encoder is operating within the limits of the "Red Zone" (i.e. for $50,000 \text{ cpr} * 384 \text{ revolutions} = 19\,200\,000$ counts, from 380 799 999 to 399 999 999), 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 changes from normal status to the "Red Zone" status (and vice versa) a jump of position occurs. See the Figure above: when entering the "red zone" the position information jumps from 399 999 999 to 380 799 999.

8 - Default parameters list

Parameters list	Default values		
Code sequence	0 = CW = count up information with clockwise rotation		
Class 2 functionality	1 = Encoder Class 2 or Encoder Class 2 (+VEL)		
Scaling function control	1 = ENABLED		
Exchange type	0 = position (Class 1 and Class 2) 1 = position + velocity (Class 2 (+VEL))		
Counts per revolution	XAC8018/1 = 262,144 XAC8013/16384 = 8,192 XAC8016/16384 = 65,536		
Total resolution	XAC8018/1 = 262,144 XAC8013/16384 = 134,217,728 XAC8016/16384 = 1,073,741,824		
Velocity measure unit	0 = steps/s		

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Document release	Release date	Description	HW	SW	GSD file version
1.0	08.08.2018	1st issue	R1	2.0	V1
1.1	04.08.2021	ATEX Declaration of Conformity, EU Declaration of Conformity and Safety Instructions updated	R1	2.0	V1



Dispose separately

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