✛DATALOGIC

Absolute Encoders

AMT58...16x14 DN

DeviceNet™

Instruction Manual

DATALOGIC

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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 ORANGE;
- alarms are coloured in RED;
- states are coloured in FUCSIA.

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

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

1. Norme di sicurezza

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

Electrical safety
• Turn off power supply before connecting the device;
• connect according to explanation in section "4 – Electrical connections";
• in compliance with the 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.

Mechanical safety

- Install the device following strictly the information in the section "3 – Mounting instructions";
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the encoder;
- do not tool the encoder or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics declared by manufacturer;
- solid shaft: use a flexible coupling to connect the encoder to motor shaft. Make sure the misalignment tolerances of the flexible coupling are respected.

2. Identification

Device can be identified through the ordering code and the serial number printed on the label applied to its body.
Information is listed in the delivery document too.

Please always quote the ordering code and the serial number when reaching Datalogic Automation s.r.l. for purchasing spare parts or needing assistance.

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

3.　Mounting instructions

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

3.1 Solid shaft encoders

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

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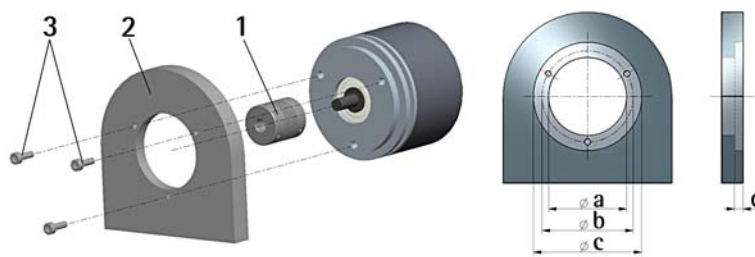
	a [mm]	b [mm]	c [mm]	d [mm]
AMT58	36 H7	48	-	-

3.1.2 Fissaggio con graffe (codice ST-58-KIT)
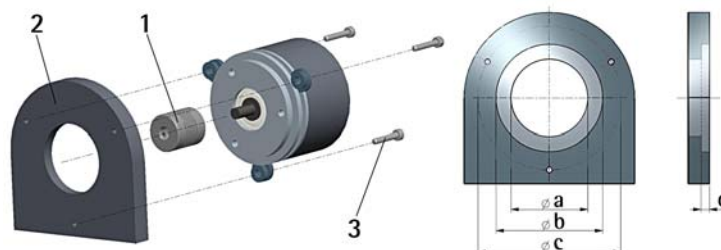
	a [mm]	b [mm]	c [mm]	d [mm]
AMT58	36 H7	-	67	-

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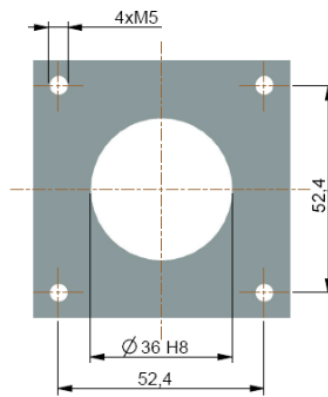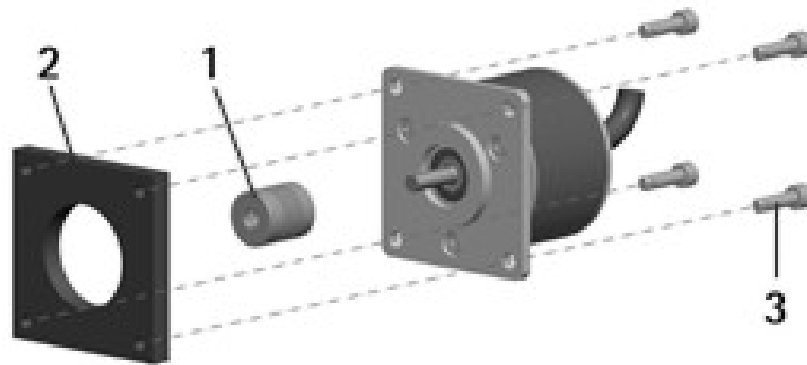
3.2 Hollow shaft encoders

3.2.1 AMT58-H15

- Mount the encoder on the motor shaft using the reducing sleeve 8 (if supplied). Avoid forcing the encoder shaft;
- fasten the fixing plate 4 to the rear of the motor using two M3 cylindrical head screws 5;
- fix the collar 3 to the encoder shaft (apply threadlocker to screw 3).
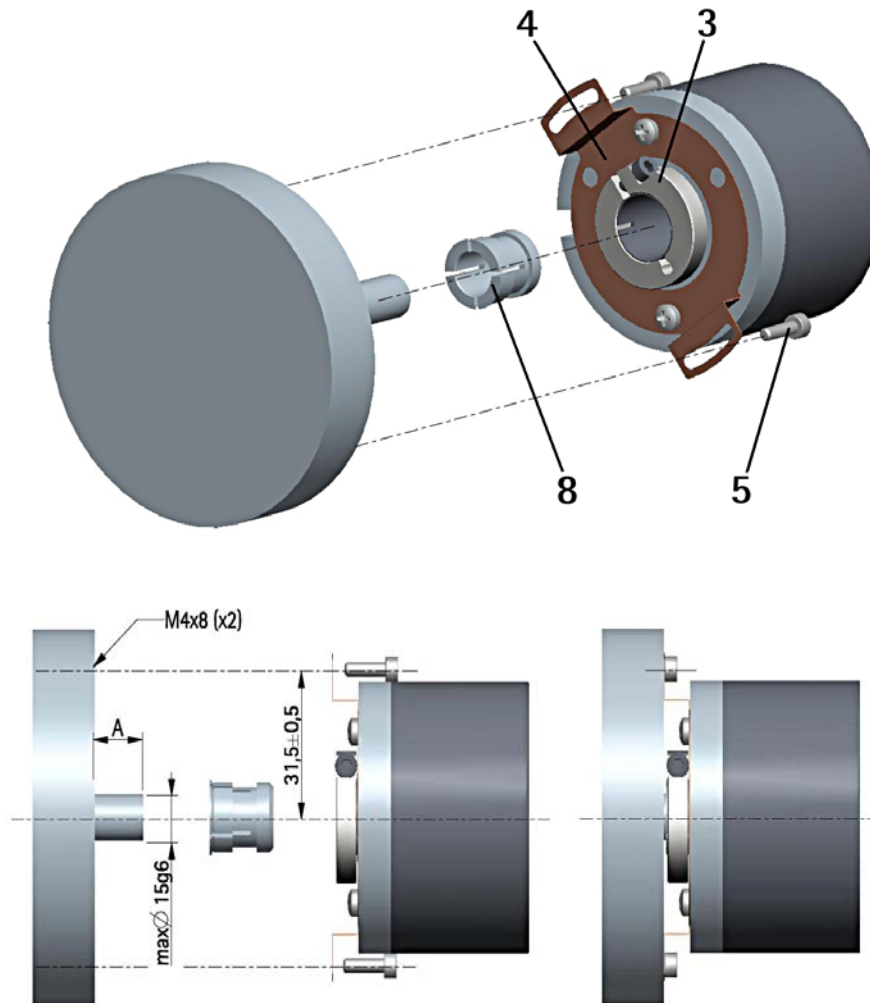
4. Electrical connections

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 (connection cap) as well as the dip-switches meant to set the baud rate and the node ID and activate the termination resistance are located inside the encoder connection cap. Thus you must remove the connection cap to access any of them.

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

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

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

Grounding point
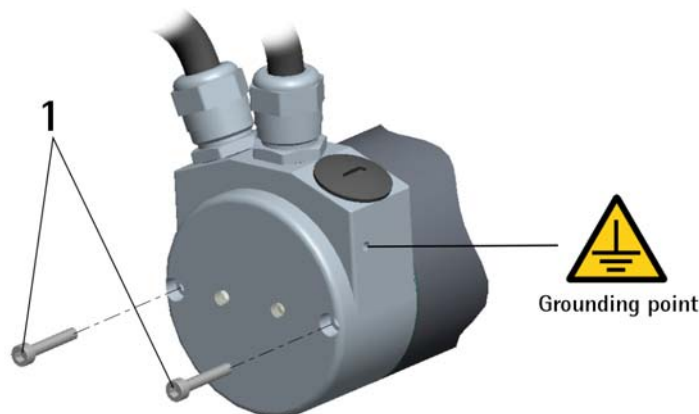
4.2 Ground connection

Minimize noise by connecting the shield and/or the connector housing and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user. You are advised to provide the ground connection as close as possible to the encoder. We suggest using the ground point provided in the cap (see Figure, use 1 TCEI M3 x 6 cylindrical head screw with 2 tooth lock washers).

4.3 Connection cap with PGs
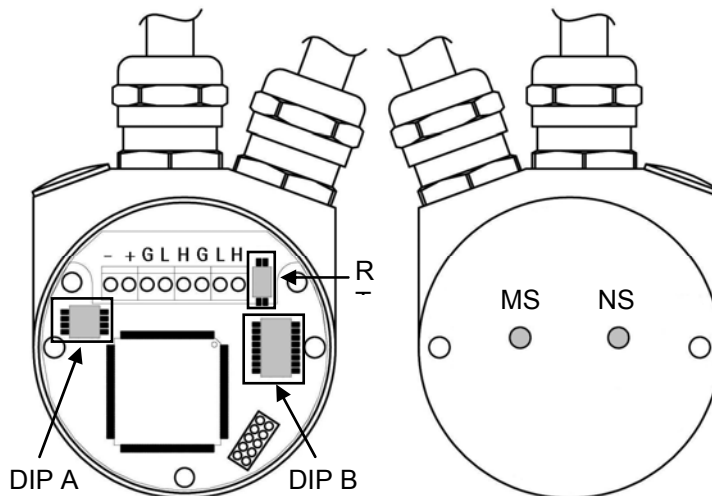
The connection cap is fitted with two cable glands PG9 type for bus-IN and bus-OUT connections. The bus cables can be connected directly to the terminal connectors placed in front of each cable gland.

We recommend DeviceNet certificated cables to be used. Core diameter should not exceed Ø 1,5 mm (0.06 inches).

Terminal connector	Description
-	0 VDC Supply voltage
+	+10VDC +30VDC Supply voltage
G	CAN GND [1]
L	CAN Low
H	CAN High
PG	CAN Shield [2]

[1] CAN GND is the 0V reference of CAN signals, it is not connected to 0VDC supply voltage.

[2] Connect cable shield to cable gland.

4.4 Connection cap with M12 connectors

BC-FD-C connection cap is fitted with two M12 connectors with pin-out in compliance with DeviceNet standard.
Therefore you can use standard DeviceNet cables commercially available.

M12 connector
A coding
(frontal side)

| male | female |
| (BUS IN) | (BUS OUT) |
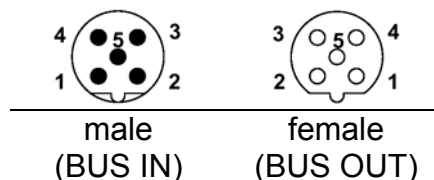
Pin	Function
Case	CAN Shield
1 [1]	
2	+10VDC +30VDC Supply voltage
3	0 VDC Supply voltage
4	CAN High
5	CAN Low

[1]   CAN Shield is also connected to pin 1 to allow the connection of the shield even if the plug connector has a plastic case.

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.
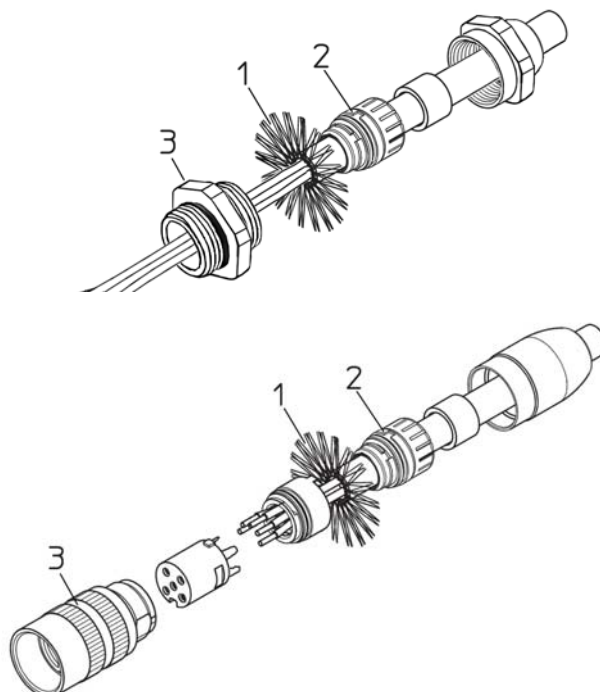
4.6 Baud rate: DIP A

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

Bit rate must be set using DIP A dip-switches:
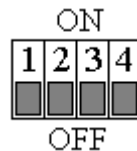
Set binary value of transmission rate considering that: ON=1, OFF=0.

bit	1	2	3	4
	2^1	2^0	OFF	OFF

Baud rate values table:

Binary value	Baud rate
00	125 Kbit/s
10	250 Kbit/s
01	500 Kbit/s (default)

NOTE
Bits 3 and 4 must be always set to OFF.

Examples

Set the baud rate to 250 Kbit/s:
10 (binary value, see table above)

bit	1	2	3	4
	ON	OFF	OFF	OFF
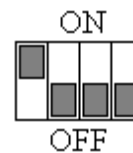
Set baud rate to 500 Kbit/s:
01 (binary value, see table above)

bit	1	2	3	4
	OFF	ON	OFF	OFF
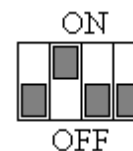
4.7 Node address: DIP B

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

The node number must be set via hardware using DIP B dip-switches.
Allowed addresses range between 0 and 63. The default value is 1.
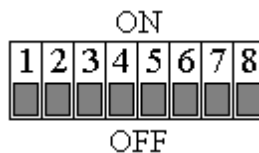
Set the node number in binary value: ON=1, OFF=0

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

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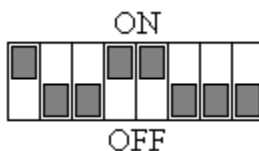
Set node number = 55:
55_{10} = 0011 0111$_2$ (binary value)

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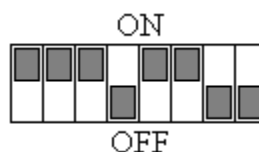
4.8 Diagnostic LEDS

Two diagnostic LEDs located in the rear side of the connection cap are designed to show the operating or fault status of the DeviceNet interface and the system as well.

NS Led Network Status LED:　this LED shows the status of the communication network.

MS Led Module Status LED:　this LED shows the status of the device.

NS Led	Description
OFF	Not powered or not on-line
Red ON	Encoder communication failure
Flashing red	Connection time-out
Green ON	Device on-line and connected
Flashing green	Device on-line but not connected
Flashing green / red	Communication error

MS Led	Description
OFF	No power supply
Red ON	Unrecoverable fault (see attribute on page 44)
Flashing red	Recoverable fault, may need replacing (see attribute on page 44)
Green ON	Device operational
Flashing green	Device on-line but not connected (standby)
Flashing green / red	Device self test

4.9 Bus termination

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

RT	Description
1 = 2 = ON	Activated: if the encoder is the last device in the transmission line
1 = 2 = OFF	Deactivated: if the encoder is not the last device in the transmission line
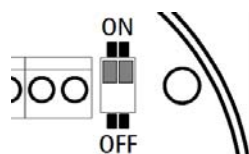
5. Quick reference (using RSNetWorx)

5.1 Import EDS file

DeviceNet encoders are supplied with their own EDS file **AMT58-xxx-16x14-FBUS-DN** (see enclosed documentation or click www.datalogic.com).
EDS file has to be installed on the Master device.

In this section the installation and configuration of the device using Rockwell Automation's RSNetWorx program are described.

On the menu bar of the RSNetWorx window, select the Tools menu and then press the EDS Wizard… command.
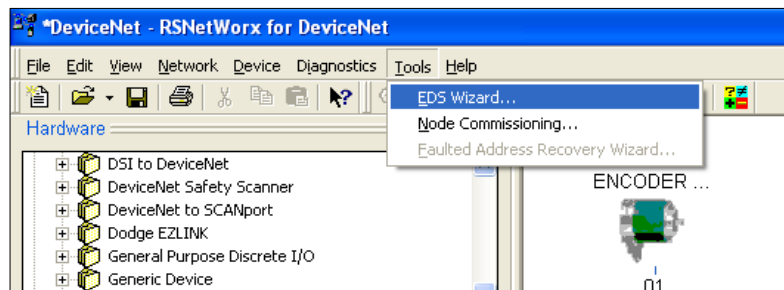
In the EDS Wizard window select Register an EDS file(s) option and then press Next > button.
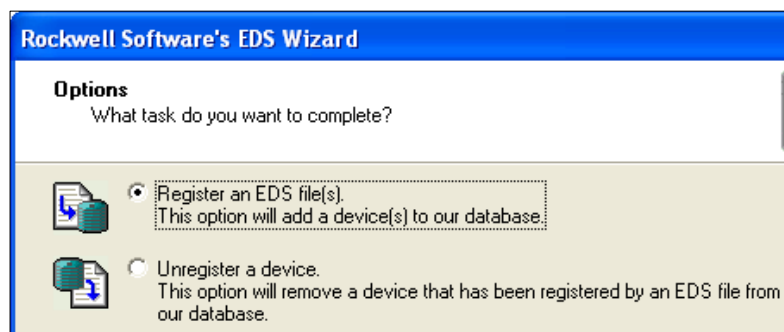
Press the Browse... button to browse through the folders and select the .eds file to be installed:
CD drive:\ROTACOD\DeviceNet\ **AMT58-xxx-16x14-FBUS-DN** if the file is in the enclosed CD or a different path; finally press the Next > button.
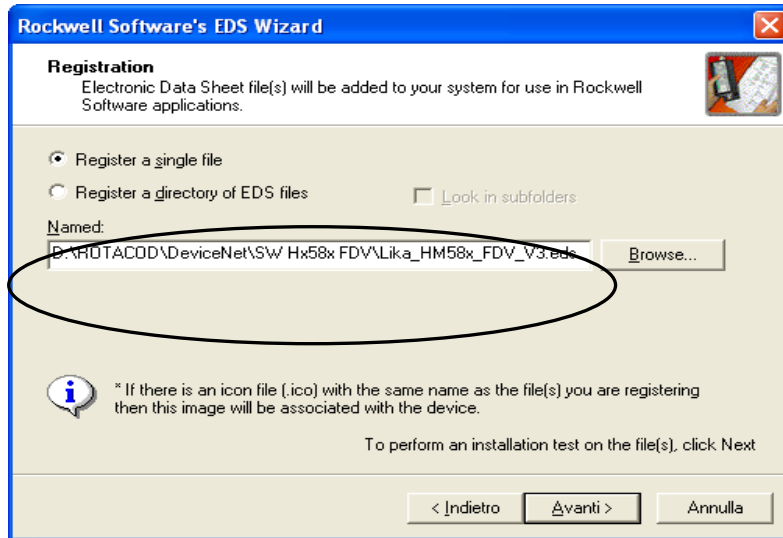
Then, follow the remaining steps to complete the EDS wizard.

5.2 Adding a node to the project

In the Hardware pane of the RSNetworx window, open the directory tree and select \Generic Device; drag the "AMT58" module to the Graph pane on the right.
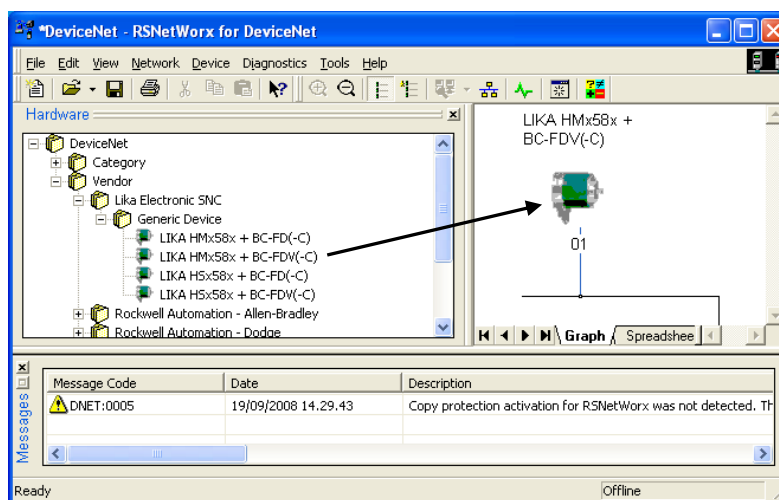
5.3 Encoder parameters configuration

Double-click the encoder icon in the Graph pane and open the Properties window.
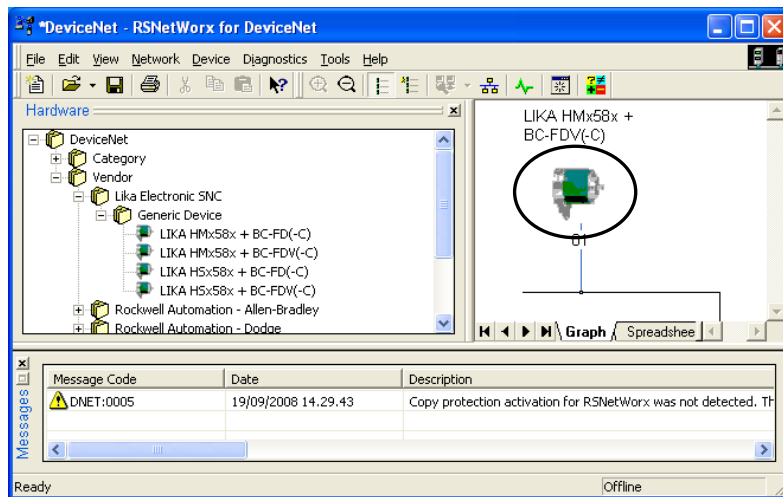
Open the General page of the Properties window and set the address node in the Address box.
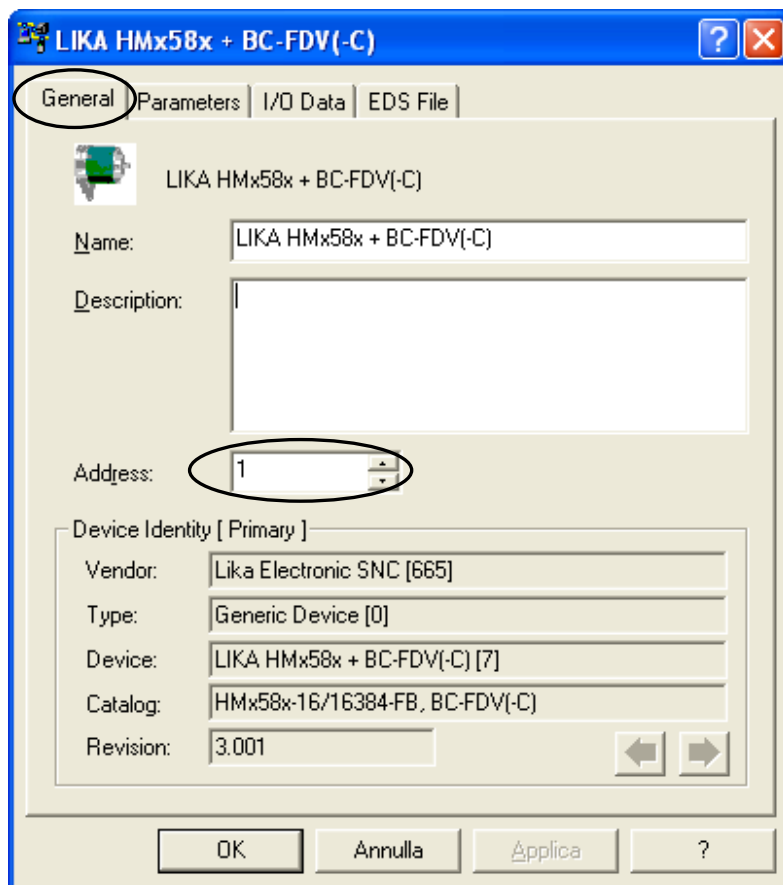
Open the Parameters page of the Properties window if you need to read, set and save the encoder parameters.
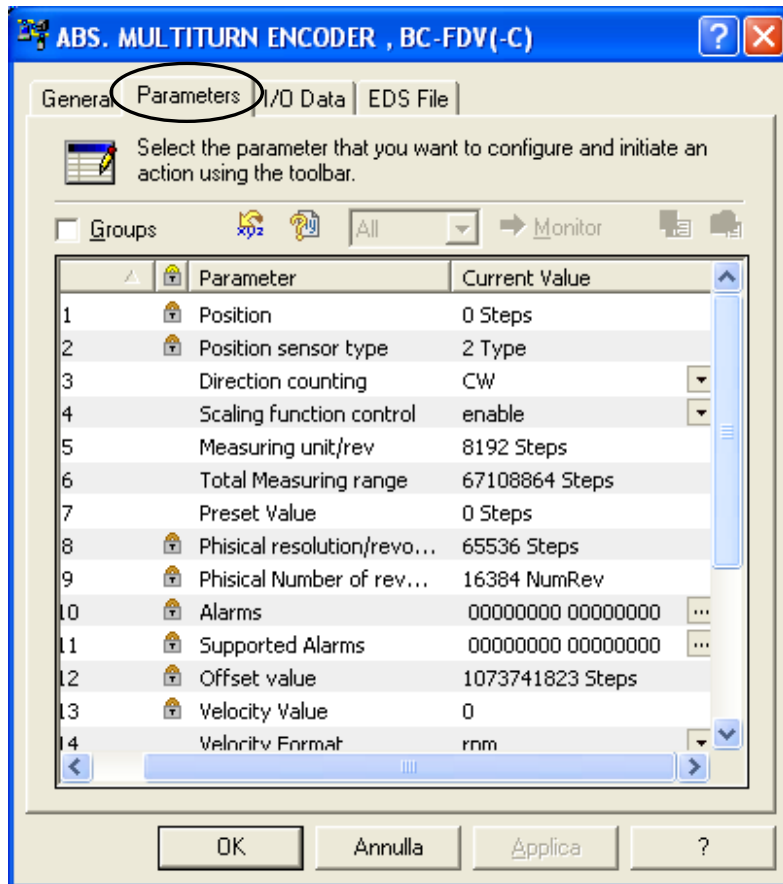
Please pay particular attention to parameters 16 Data Tx in Poll mode, 17 Data Tx in COS/Cyclic mode and 20 Auto-save parameters.
Parameters 16 Data Tx in Poll mode and 17 Data Tx in COS/Cyclic mode must be set in accordance with the scanner module settings (si see section "5.5 Using scanner module").
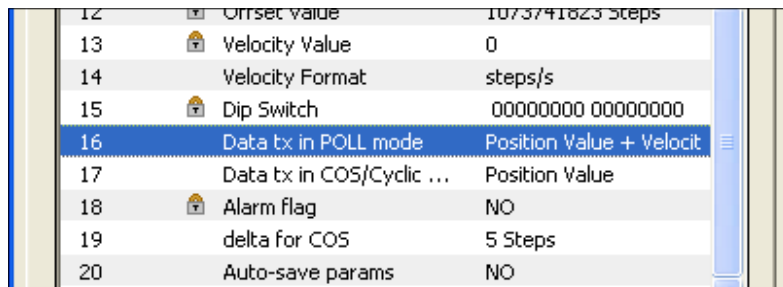
Example
Parameter 16:
16 Data Tx in Poll mode = "Position Value + Velocity"
                                                    (position and velocity)

Parameter 17:
17 Data Tx in COS/Cyclic mode = "Position Value" (position)

Set scanner module parameters accordingly:

For any further information on the scanner module parameters refer to section "5.5 Using scanner module".

Click Upload button to upload and read the current configuration.

Click Download button to send the new parameters to the encoder.

NOTE
If 20 Auto-save parameters = YES, new parameters values are saved automatically; otherwise if 20 Auto-save parameters = NO, you must start manually the "save parameters" procedure; see section "5.4 Save parameter with RSNetWorx".

5.4 Save parameter with RSNetWorx

Properties window allows you to set device parameters.
After this operation is carried out, data is stored in RAM memory only. In case of "Node reset", "Node restore" or power off, parameters will be lost.
To save new parameters permanently you must start the CLASS INSTANCE EDITOR; to do this right-click the encoder icon in the Graph pane and select the Class Instance Editor... command.
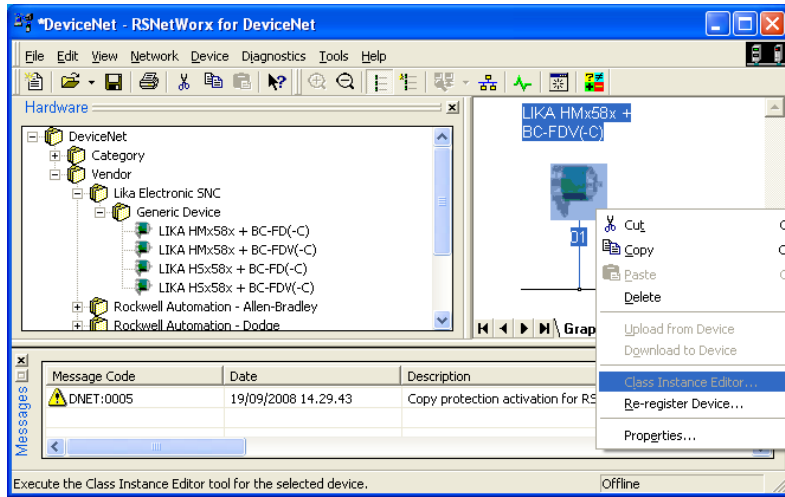
In the Class Instance Editor window enter values expressed in hexadecimal notation as shown in the Figure below. When setting up is carried out, press the Execute button: data will be downloaded to the encoder and saved.
Soon afterwards, The execution was completed message will appear to confirm that data has been downloaded and saved properly.
Close the Class Instance Editor window pressing the Close button.
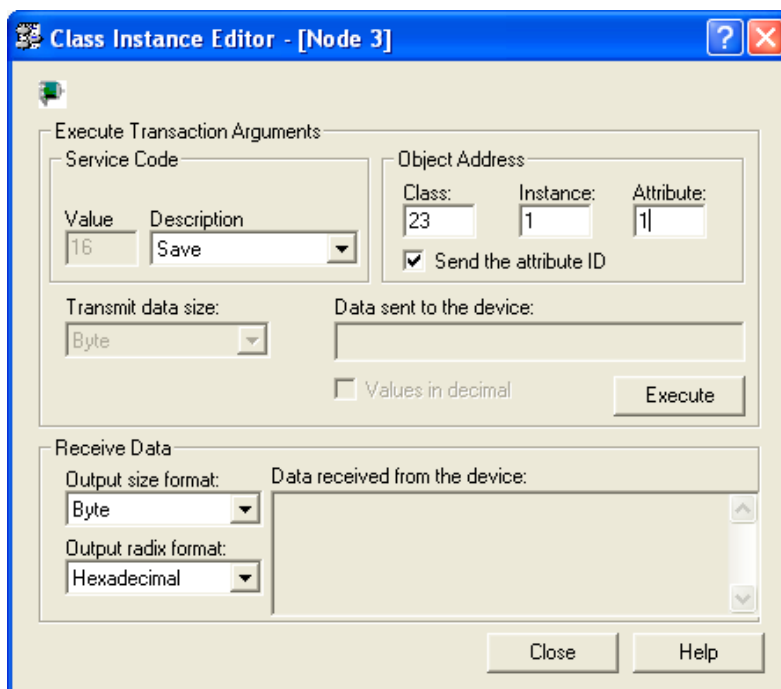
5.5 Using scanner module

To manage I/O data using the scanner module open the Properties window; if requested, upload the configuration and then open the Scanlist page.

Select Lika device in the Available Devices pane on the left and move it to the Scanlist pane on the right pressing the > button. Now double-click the item in the Scanlist pane to open the Edit I/O parameters window.

Now, set the Input Size value in both panes Polled and Change of State / Cyclic according to 16 Data Tx in Poll mode and 17 Data Tx in COS/Cyclic mode (see encoder parameters in section "5.6 Encoder parameters").

If "Position value" is set:　　　　　　　Input Size = 4 bytes
if "Position value + velocity" is set　　Input Size = 8 byte.

Click the OK button to confirm parameters.

The list of variables is available in the Input page.

Example
In the following example::
16 Data Tx in Poll mode = Position value + velocity
17 Data Tx in COS/Cyclic mode = Position value
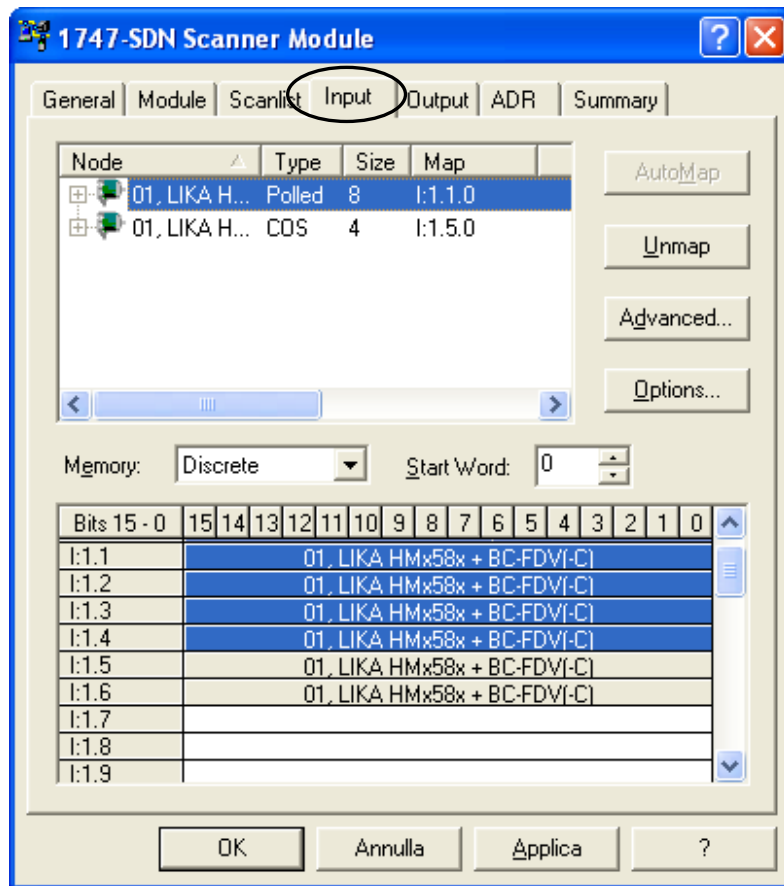
Polled messages:

Variables	Bytes	Input
1.1	1 2	Position value
1.2	3 4	
1.3	5 6	Velocity value
1.4	7 8	

COS: Messages:

Variables	Bytes	Input
1.5	1 2	Position value
1.6	3 4	

5.6 Encoder parameters

1 Position

This attribute represents the absolute position detected by the position sensor.

2 Position sensor type

Type of device.
1:   Single-turn absolute rotary encoder.
2:   Multi-turn absolute rotary encoder.

3 Counting direction

Counting direction. attribute sets the rotation direction of the encoder shaft and consequently defines whether the position value output by the encoder increases when the encoder shaft rotates clockwise (CW) or counterclockwise (CCW). CW and CCW rotations are viewed from shaft end.
CW: turning the shaft CW the position will increase;
CCW: turning the shaft CCW the position will increase.

4 Scaling function control

Disabled: device uses the physical (hardware) resolution (see 8 Physical resolution/revolution and 9 Physical number of revolutions).

Enabled: device uses the resolution set in 5 Measuring   units/rev and 6 Total measuring range.

5 Measuring units/rev

This object sets the number of distinguishable steps per revolution.
Enabled if 4 Scaling function control = "Enabled".
Allowed values are equal to or lower than 8 Physical resolution/revolution value.

ATTENTION
We advise values which are power of 2 (2^n: 2, 4, …, 2048, 4096, 8192,…) to be set in 5 Measuring units/rev and 6 Total measuring range parameters in order to avoid counting errors.
If 5 Measuring units/rev and/or 6 Total measuring range parameters are changed, 7 Preset value parameter has to be set in accordance with new resolution.

6 Total measuring range

This parameter allows the operator to convert the measuring range of the encoder to a different measuring range required by the application.

Enabled if 4 Scaling function control = "Enabled".

Allowed values are equal to or lower than Physical total resolution.

Physical total resolution = 8 Physical resolution/revolution * 9 Physical number of revolutions.

ATTENTION

We advise values which are power of 2 (2^n: 2, 4, …, 2048, 4096, 8192,…) to be set in 5 Measuring units/rev and 6 Total measuring range parameters in order to avoid counting errors.

If 5 Measuring units/rev and/or 6 Total measuring range parameters are changed, 7 Preset value parameter has to be set in accordance with new resolution.

7 Preset value

7 Preset value function is meant to assign a certain value to a desired physical position of the encoder shaft. When the axis reaches the set physical position the 7 Preset value is transmitted.

7 Preset value must not be greater than the 6 Total measuring range to avoid run-time errors.

8 Physical resolution/revolution

This parameter defines the hardware number of distinguishable steps per revolution.

If you need to set a different resolution see 5 Measuring units/rev parameter.

9 Physical number of revolutions

This object defines the hardware number of revolutions.

Physical total resolution = 8 Physical resolution/revolution * 9 Physical number of revolutions.

If you need to set a different total resolution see 5 Measuring units/rev e 6 Total measuring range.

10 Alarms

An alarm is set when a bit indicating a fault is set to true (high).

See 11 Supported alarms values.

11 Supported alarms

This attribute contains information on supported alarms.

Bit 0 … 11	reserved	
Bit 12	Flash memory error	Internal error, it cannot be restored.
Bit 13	Machine data not valid	One or more parameters are not valid, set proper values to restore normal work condition.
Bit 14	Bus off	This bit is intended to warn that the communication in the bus network has broken (cable disconnected? Voltage drop? ...).

12 Offset value

The 12 Offset value attribute is calculated by the 7 Preset value function and shifts the 1 Position attribute using the calculated value.
Offset = 7 Preset value - "Internal Position Value".

13 Velocity value

This attribute represents the current speed detected by the position sensor and calculated every 100 ms.

14 Velocity format

This attribute sets the engineering units for the velocity value.
steps/s: number of steps per second (default value);
rpm: revolutions per minute.

15 Dip switch

This object shows the status of the dip switches.
Dip switches are located in the connection cap and used to set the baud rate and the node ID (see sections "4.6 Baud rate: DIP A" and "4.7 Node address: DIP B").

16 Data Tx in Poll mode

This parameter is meant to set which input data is sent when **Polled** mode connection is enabled.
Allowed values: Position value (default value)
                           Position value + velocity

17 Data Tx in COS/Cyclic mode

This parameter is meant to set which input data is sent when Change Of State (COS) / Cyclic mode connection is enabled.
Allowed values: Position value
Position value + velocity

18 Alarm flags

Indicates that a fault occurred and an alarm has been activated, see 11 Supported alarms object.

19 Delta for COS

When Change Of State .

1 - **Cyclic:** Slave sends an "I/O message" cyclically. The time between two subsequent transmissions is set in the 05-Inst-09 Expected packet rate object of the cyclic mode (see section "6.5.3 Class 05h: Connection Object").

Change Of State(COS) mode connection is enabled, this parameter sets the minimum gap between two I/O messages. Values too low could cause the Bus network to saturate.

20 Auto-save parameters

Yes: when a new parameter is set, the encoder waits 5 seconds and then saves automatically all new values on EPROM.

No: new parameters are not saved on EPROM automatically. To save new values Class Instance Editor must be used (default value; see section "5.4 Save parameter with RSNetWorx).

6. DeviceNet interface

Datalogic encoders are "Group 2 only server" devices and do not support UCMM messages.
For any omitted information refer to the "Open DeviceNet Vendor Association" documents or visit www.odva.org.

6.1 EDS file

DeviceNet encoders are supplied with their own EDS file **AMT58-xxx-16x14-FBUS-DN** (see enclosed documentation or click www.datalogic.com). EDS file has to be installed on Master device.

6.2 Communication messages

Structure of the communication messages:

CAN-ID	CAN Data bytes
11 bit	from 3 to 8 bytes

Datalogic DeviceNet encoders support two kinds of communication messages:

- I/O messages: I/0 messages are high priority messages. Their meaning is explained in the "Message-ID". Slave device uses these messages to send process data. For further information see section 6.3 I/O Messages (Msg group 1)" on page 27.

- Explicit messages: Explicit messages are low priority messages. They are used to start and close communications between Master and Slave, to read and write Slave configurations and to send diagnostic messages. For further information see section "6.4 Explicit Messages (Msg group 2)" on page 27.

Structure of Master-Slave communication:

```
                              power up
  communications error           │              reset node
  ┌────────────────────────────┐ ▼ ┌────────────────────────────────┐
  │                          ┌──┴───┴──────────────┐                 │
  ◄──────────────────────────┤  Duplicate MAC-ID check             │
  │                          │  (see section 6.4.1)                │
  │                          └──────────┬──────────┘                │
  │                                     │                           │
  │                                     ▼                 wait for new│
  │                          ┌─────────────────────┐      connection │
  ◄──────────────────────────┤  P2P connection     ◄──────┐         │
  │                          │  (see section 6.4.3)│       │         │
  │                          └──────────┬──────────┘       │         │
  │                                     │                  │         │
  │        ┌────────────────────────────────────────────┐ │         │
  │        │ ┌──────────────────┐  ┌──────────────────┐ │ │         │
  ◄────────┤ │ I/O Messages     │  │ Config.          │ │ │         │
  │        │ │ (see section 6.3)│  │ messages         │ │ │         │
  │        │ └──────────────────┘  └──────────────────┘ │ │         │
  │        └────────────────────┬───────────────────────┘ │         │
  │                             │                          │         │
  │                             ▼                          │         │
  │                  ┌─────────────────────┐               │         │
  └──────────────────┤  Close connection   ├───────────────┘         │
                     │  (see section 6.4.3)├─────────────────────────┘
                     └─────────────────────┘
```
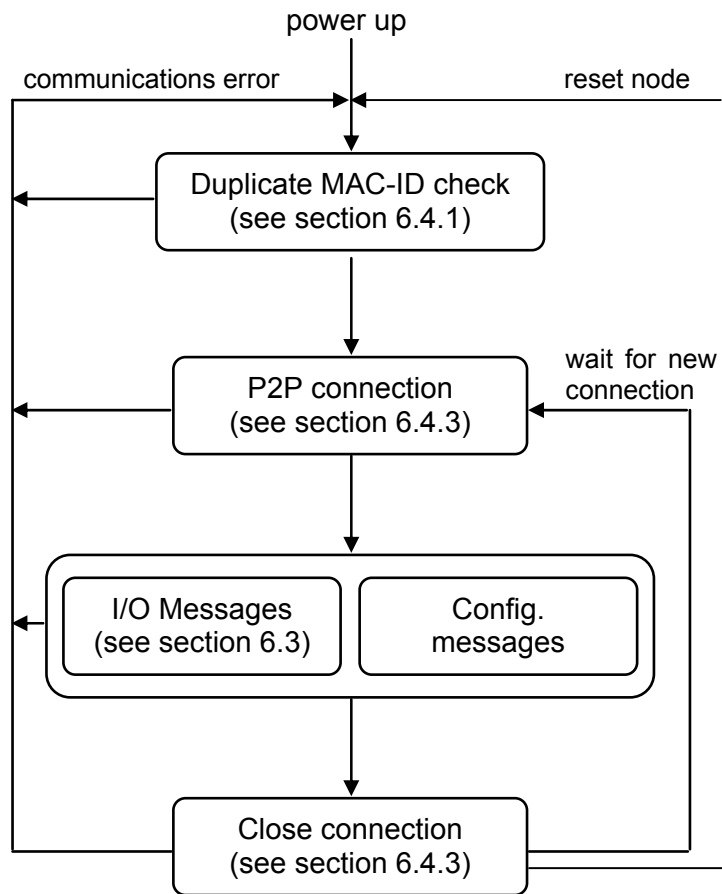
NOTE
Lika encoders accept only one P2P connection at a time.
Simultaneous or multiple P2P connections are rejected.

6.3 I/O Messages (Msg group 1)

I/0 messages are used by Lika devices to send the position and the velocity values. The "Message-ID" shows how the message is transmitted.

Position:

CAN-ID			4 CAN Data bytes			
10	9…6	5…0	Byte 0	Byte 1	Byte 2	Byte 3
0	Msg ID	Sourc e ID	$2^7…2^0$	$2^{15}…2^8$	$2^{23}…2^{16}$	$2^{31}…2^{24}$
			Low	…	…	High

Position and velocity:

CAN-ID			8 CAN Data bytes							
10	9…6	5…0	Position				Velocity			
0	Msg ID	Sourc e ID	B 0	B 1	B 2	B 3	B 4	B 5	B 6	B 7
			Lo	…	…	Hi	Lo	…	…	Hi

Msg-ID:
1100_2: Slave's I/O Multicast Poll Response Msg
1101_2: Slave's I/O Change Of State or Cyclic Msg
1111_2: Slave's I/O Poll Rsp/COS/Cyclic Ack Msg

Source-ID: device address.
Byte 0 … Byte 3: position value.

Available Slave transmission modes:
2 - **Polled**: Master device sends a polled request and Slave device replies sending its position value.
    If the expected packet rate of polled mode is null (see 05-Inst-09 Expected packet rate), communication is always active and time-out status is never triggered; otherwise if the Slave does not receive any message from the Master within the time set in the 05-Inst-09 Expected packet rate object, then communication is closed (time-out status).
3 - **Cyclic:** Slave sends an "I/O message" cyclically. The time between two subsequent transmissions is set in the 05-Inst-09 Expected packet rate object of the cyclic mode (see section "6.5.3 Class 05h: Connection Object").
4 - **Change Of State**: Slave sends an "I/O message" every time its status changes or at every heartbeat rate.

Slave can use one of the afore-mentioned "I/O messages" transmission modes only if a peer-to-peer (P2P) connection is arranged with the Master (using an "Explicit Messages Connection", see section "6.4..3 Explicit Messages Connection").

6.4 Explicit Messages (Msg group 2)

These messages are used to:

- perform a duplicate MAC-ID check (see section "6.4.1 Duplicate MAC-ID check")
- send error messages (see section "6.4.2 Error messages")
- arrange an explicit message connection: peer-to-peer (P2P) between Master and Slave (see section "6.4.3 Explicit Messages Connection");
- arrange a message data transfer: send/receive data configuration (see section "6.4.4 Message data transfer"").

CAN-ID table of explicit message:

bit	10	9	8	7	6	5	4	3	2	1	0
	1	0			MAC-ID				Msg-ID		

MAC-ID: device address.

Msg-ID:
000_2: Master's I/O Bit-Strobe Command Msg
001_2: Master's I/O Multicast Poll Command Msg
010_2: Master's I/O COS / Cyclic Acknowledge Msg
011_2: Slave's Explicit / Unconnected Response Msg
100_2: Master's Connected Explicit Request Msg
101_2: Master's I/O Poll Command / COS
110_2: Group 2 only Unconnected Explicit Request Msg
111_2: Duplicate MAC-ID Check Msg

6.4.1 Duplicate MAC-ID check

This function is used to check, when a device is connected to the DeviceNet network, whether its serial number, node-ID and vendor-ID are single (univocal) in the network.

Message structure:

CAN-ID										
bit	10	9	8	7	6	5	4	3	2	1	0
	1	0		MAC-ID					1	1	1

7 CAN Data bytes								
Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	R/R		port number					
1	vendor-ID - Low byte							
2	vendor-ID - High byte							
3	serial number - Low byte							
4	serial number							
5	serial number							
6	serial number - High byte							

R/R bit = 0: duplicate MAC-ID check request. This message is sent by a device to all nodes in the network.

1: duplicate MAC-ID check response. This message is sent back to sender by the node in the network having the same MAC-ID.

Port number = 0: device that allows only one P2P connection.

When serial number, node-ID and vendor-ID are not single (univocal) in the network, an error message is generated and the device that sent the "duplicate MAC-ID check request" switches to "Unrecoverable fault" status (MS LED = red, see section "4.8 Diagnostic LEDS" and attribute 01-01-05 Status).

6.4.2 Error messages

These messages are meant to warn about device faults.

Message structure:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=1	Service Code = 14h						
2	General error code							
3	Specific service error code							

General error codes

General Status Code (in hex)	Status name	Description of Status
00h	No error	Service was successfully performed by the object specified.
02h	Resource unavailable	Resources needed for the object to perform the requested service were unavailable.
03h	Invalid parameter value	A parameter associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an Application Object Specification.
08h	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
09h	Invalid attribute value	Invalid attribute data detected
0Bh	Already in requested mode / state	The object is already in the mode/state being requested by the service.
0Ch	Object state conflict	The object cannot perform the requested service in its current mode/state.
0Eh	Attribute not settable	A request to modify a non-modifiable attribute was received.

10h	Device state conflict	The device's current mode/state prohibits the execution of the requested service.
13h	Not enough data	The service did not supply enough data to perform the specified operation.
14h	Attribute not supported	The attribute specified in the request is not supported.
15h	Too much data	The service supplied more data than was expected.
16h	Object does not exist	The object specified does not exist in the device.
20h	Invalid parameter	A parameter associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an Application Object Specification.

For any further information on general error codes refer to the publication "The CIP Networks Library. Volume I. Common Industrial Protocol (CIP™)".

6.4.3 Explicit Messages Connection

These messages are meant to open and close P2P connections between Master and Slave. This is necessary to allow the Slave both to communicate process data using "I/O Messages" and communicate or change parameters using "Data transfer" messages.

Open connection request:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=0	Service Code = 4Bh						
2	Class ID = 03h							
3	Instance ID = 01h							
4	Allocation Choice *							
5	Master MAC-ID							

Open connection response:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=1	Service Code = 4Bh						
2	General error code							

Close connection request:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=0	Service Code = 4Ch						
2	Class ID = 03h							
3	Instance ID = 01h							
4	Release choice = Allocation Choice *							

Close connection response:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=1	Service Code = 4Ch						
2	General error code							

* Allocation choice:

bit 7	Reserved		bit 3	Multi polled
bit 6	Ack suppression		bit 2	Bit strobe
bit 5	Cyclic		bit 1	Polled
bit 4	Change of status		bit 0	Explicit message

Example

Allocation choice =

01h: used to read and write configuration parameters without "I/O Messages".

03h: activate Polled communication.

61h: activate Cyclic mode communication without ACK.

6.4.4 Message data transfer

These messages are meant to set, read, save or restore configuration parameters.

Data transfer request:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=0	Service Code						
2	Class ID							
3	Instance ID							
4	Attribute ID							
5…7	Data byte							

Data transfer response:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=1	Service Code						
2…7	Data byte							

Service code, Class ID, Instance ID and Attribute ID are meant to set the type and content of data bytes. They must be specified according to the "Object dictionary" (see section "6.5 Object dictionary").

6.5 Object dictionary

In the following pages the objects implemented are listed and described as follows:

Class-Instance-Attribute Object name
[var, access]

- Class, instance and attribute are expressed in hexadecimal notation.
- Var: data type variable
  - USINT: unsigned single integer 8 bit (1 byte)
  - UINT: unsigned integer 16 bit (2 bytes)
  - UDINT: unsigned double integer 32 bit (4 bytes)
  - WORD: 16 bit specify (2 bytes)
- Access type: ro = read only access
  - rw = read and write access

NOTE
All data bytes are sent from less significant byte (LSB) to most significant byte (MSB).

Example

UDINT (4 data bytes):

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	F=0	0	Master MAC-ID					
1	R/R=1		Service Code					
2		Data byte - Low byte						
3		Data byte						
4		Data byte						
5		Data byte - High byte						

6.5.1 Class 01h: Identity Object

This object provides identification and general information on the device.

Supported Service codes:
0Eh = Get_Attribute_Single: used to read the connection class attribute value.

Supported Instances: 01h = Explicit Message

01-01-01 Vendor-ID

[UINT, ro]
Identification of each vendor by number.
Default = 0299h

01-01-02 Device type

[UINT, ro]
Default = 00h: general type.

01-01-03 Product code

[UINT, ro]
Identification of a particular product of an individual vendor.

01-01-04 Revision

[UINT, ro]
Hardware and software revisions, the Identity Object represents:

LSByte	MSByte
major revision	minor revision

01-01-05 Status

[WORD, ro]
This attribute represents the current status of the device. Its value changes as the state of the device changes. Bit definitions are as follows:

Bit(s)	Called	Definition
0	Owned	TRUE indicates the device (or an object within the device) has an owner. Within the Master/Slave paradigm the setting of this bit means that the Predefined Master/Slave Connection Set has been allocated to a Master. Outside the Master/Slave paradigm the meaning of this bit is TBD.
1	Reserved	Reserved, shall be 0
2	Configured	TRUE indicates the application of the device has been configured to do something different than the "out–of–box" default. This shall not include configuration of the communications.
3	Reserved	Reserved, shall be 0

4-7	Extended Device status	Bits are defined as follows:
		0000 Self-Testing or Unknown
		0 Firmware Update in Progress
		0 At least one faulted I/O connection
		0 No I/O connections established
		0 Non-Volatile Configuration bad
		0 Major Fault – either bit 10 or bit 11 is true (1)
		0 At least one I/O connection in run mode
		0 At least one I/O connection established, all in idle mode
		1 0 0 0 Reserved, shall be 0 1 0 0 1
		1 0 1 0 Vendor/Product specific … 1 1 1 1
8	Minor Recoverable fault	TRUE indicates the device detected a problem with itself, which is thought to be recoverable. The problem does not cause the device to go into one of the faulted states.
9	Minor Unrecoverable fault	TRUE indicates the device detected a problem with itself, which is thought to be unrecoverable. The problem does not cause the device to go into one of the faulted states.
10	Major Recoverable fault	TRUE indicates the device detected a problem with itself, which caused the device to go into the "Major Recoverable Fault" state.
11	Major Unrecoverable fault	TRUE indicates the device detected a problem with itself, which caused the device to go into the "Major Unrecoverable Fault" state.
12-15	Reserved	Reserved, shall be 0

For any further information on status instance attribute refer to the publication "The CIP Networks Library. Volume I. Common Industrial Protocol (CIP™)".

01-01-06 Serial number

[UDINT, ro]
This attribute is a number used in conjunction with the Vendor ID to form a unique identifier for each device on any CIP network.

01-01-07 Product name

[SHORT_STRING, ro]
Default = 05 4C 49 4B 41 20h = "AMT58"

6.5.2 Class 03h: DeviceNet Object

This DeviceNet Object is meant to provide the configuration and status of the physical node connected to DeviceNet network.

Supported Service code:
0Eh = Get_Attribute_Single: used to read connection class attribute value.
10h = Set_Attribute_Single: used to write connection class attribute value.
Supported Instance: 01h = Explicit Message

03-01-01 Node Address
[USINT, ro]
This attribute contains the MAC-ID of the device.
To set the node address see section "4.7 Node address: DIP B"

03-01-02 Baud rate
[USINT, ro]
This attribute sets the baud rate.

Binary value	Baud rate
00	125 Kbit/s
10	250 Kbit/s
01	500 Kbit/s (default)

To set the baud rate see section "" on page 10.

03-01-03 Bus-off interrupt
[BOOL, ro]
This attribute sets how the device has to act after a bus-off event.
00: when a bus-off event occurs, device resets and hold the bus-off (reset) status.
01: when a bus-off event occurs, device resets and then tries to get the previous communication status.
Default = 01h

03-01-04 Bus-off counter
[USINT, ro]
This attribute shows the number of triggered bus-off events.
Default = 00h

03-01-05 Allocation information
[UINT, ro]
1st byte: "Allocation choice": indicates which "Predefined Master/Slave Connections" is active.
2nd byte: "Master's MAC-ID" contains the MAC-ID of the device that has allocated the "Predefined Master/Slave Connection".
The FFh value means the "Predefined Master/Slave Connection" has not been allocated (no communication active).

6.5.3 Class 05h: Connection Object

The Connection Class allocates and manages the internal resources associated to both "I/O Messages" and "Explicit Messaging Connections".

Supported Service code:
0Eh = Get_Attribute_Single: used to read connection class attribute value.
10h = Set_Attribute_Single: used to write connection class attribute value.

Supported Instance: 01h = Explicit Message
                           02h = **Polled**
   04h =   .
5 - **Cyclic:** Slave sends an "I/O message" cyclically. The time between two subsequent transmissions is set in the 05-Inst-09 Expected packet rate object of the cyclic mode (see section "6.5.3 Class 05h: Connection Object").
                  Change Of State (COS) / Cyclic**Errore. L'origine riferimento non è stata trovata.**

05-Inst-01 Connection status
[USINT, ro]
This attribute defines the current status of the Connection instance. Value = 03 means the connection has been configured correctly.

05-Inst-02 Instance type
[USINT, ro]
00h: Explicit messaging
01h: I/O messaging

05-Inst-03 TransportClass_trigger
[BYTE, ro]
Defines whether this is a producing only, consuming only, or both producing and consuming connection.

05-Inst-04 Produced connection ID
[UINT, ro]
This is the value that will be specified in the CAN Identifier Field when this Connection transmits.

05-Inst-05 Consumed connection ID
[UINT, ro]
This is the CAN Identifier Field value that is associated to the messages this Connection Object receives.
05-Inst-06 Initial comm. Characteristics
[USINT, ro]
Defines the Message Group(s) the sent and received messages are related to.

Default = 21h

05-Inst-07 Produced connection size

[UINT, ro]
Maximum number of bytes transmitted in this connection.

05-Inst-08 Consumed connection size

[UINT, ro]
Maximum number of bytes received in this connection.

05-Inst-09 Expected packet rate

[UINT, rw]
This attribute is meant to set the time between two subsequent "I/O message" transmissions (Transmission Trigger Timer) and the Inactivity/Watchdog Timer.

05-Inst-0C Watchdog time-out action

[USINT, ro]
This attribute defines the action the Connection Object should perform when the Inactivity/Watchdog Timer gap has expired.
Default = 01h: the Connection Class automatically closes the connection after the Inactivity/Watchdog Timer gap has expired.

05-Inst-0D Produced connection path length

[UINT, ro]
This attribute specifies the number of bytes the 05-Inst-0E Produced connection path attribute is fitted with.

05-Inst-0E Produced connection path

[EPATH, ro]
This attribute is fitted with a byte stream which defines the Application Object(s) whose data is to be produced by this Connection Object.

05-Inst-0F Consumed connection path length

[UINT, ro]
This attribute specifies the number of bytes the 05-Inst-10 Consumed connection path attribute is fitted with.

05-Inst-10 Consumed connection path

[EPATH, ro]

This attribute is fitted with a byte stream which defines the Application Object(s) whose data is to be received by this Connection Object.

05-Inst-11 Production inhibit time

[UINT, ro]

Default = 00h: no inhibit time

NOTE

To save the parameters execute the "Save parameters" function (see Save parameter in the section "7.1 Read and set parameters").

When the power is turned off or in case of "Reset node" and "Restore node" commands, parameters not saved are lost.

6.5.4 Class 23h: Position Sensor Object

This class is meant to describe the objects used by the device to calculate the transmitted position values.

Supported Service code:
05h = Reset: resets all parameter values to the factory default values (without saving them on flash memory).
0Eh = Get_Attribute_Single: used to read connection class attribute value.
10h = Set_Attribute_Single: used to write connection class attribute value.
15h = Restore: restores all parameter values from flash memory (without saving them).
16h = Save: saves all parameters to non-volatile memory.

Supported Instance: 01h = Explicit Message

23-01-03 Position value
[UDINT, ro]
This attribute represents the absolute position detected by the position sensor.

23-01-0B Device type
[UINT, ro]
0001h: single-turn absolute rotary encoder;
0002h: multi-turn absolute rotary encoder.

23-01-0C Code sequence
[BOOL, rw]
23-01-0C code sequence attribute sets the rotation direction of the encoder shaft and consequently defines whether the position value output by the encoder increases when the encoder shaft rotates clockwise (CW) or counterclockwise (CCW). CW and CCW rotations are viewed from shaft end.
00: turning the shaft CW the position will increase;
01: turning the shaft CCW the position will increase.

23-01-0E Scaling function control
[BOOL, rw]
If this object is disabled (OFF=00), device uses the physical resolution (see attributes 23-01-2A Hardware counts per revolution and 23-01-2B Hardware number of turns); if it is enabled (ON=01), it uses the resolution set in attributes 23-01-10 Resolution per revolution and 23-01-11 Total measuring range with the following relation:

$$posTx = \frac{"23\text{-}01\text{-}10"}{"23\text{-}01\text{-}2A"} \cdot posReale \leq "23\text{-}01\text{-}11"$$

Default = 00h

23-01-10 Resolution per revolution

[UDINT, rw]

This object sets the number of distinguishable steps per revolution.
Enabled if = "1".

To avoid counting errors, check $\dfrac{"23\text{-}01\text{-}2A"}{"23\text{-}01\text{-}10"}$ is an integer value.

Allowed values are equal to or lower than value.

23-01-11 Total measuring range

[UDINT, rw]

This parameter sets the number of distinguishable steps over the total measuring range.
Enabled if = "1".
Allowed values are equal to or lower **Total hardware resolution** value.

Example

Multiturn encoder HM5816/16384FB-6 with connection cap "BC-FDV-C".

Resolution is:
- 23-01-2A Hardware counts per revolution = 65536 (216)
- 23-01-2B Hardware number of turns   = 16384 (214)
- **Total hardware resolution**:   = 1073741824 (230)

2048 counts/rev. * 1024 turns are required:
- Enable 23-01-0E Scaling function control = 01
- 23-01-10 Resolution per revolution   = 2048 (0000 0800h)
- 23-01-11 Total measuring range   =2048*1024=2097152
                                               (0020 0000h)

ATTENTION
To avoid counting errors we recommend values which are power of 2 (2^n: 2, 4,…, 2048, 4096, 8192,…) to be set in 23-01-10 Resolution per revolution and 23-01-11 Total measuring range parameters.
If 23-01-10 Resolution per revolution and/or 23-01-11 Total measuring range values change, then also 23-01-13 Preset value attribute should be updated and set according to the new resolution.

23-01-13 Preset value

[UDINT, rw]

23-01-13 Preset value function is meant to assign a certain value to a desired physical position of the encoder shaft. When the axis reaches the set physical position, then the 23-01-13 Preset value value is transmitted. 23-01-13 Preset value must not be greater than the **Total hardware resolution** to avoid runtime errors.

23-01-14 Delta for COS

[UDINT, rw]

When .

Cyclic: Slave sends an "I/O message" cyclically. The time between two subsequent transmissions is set in the 05-Inst-09 Expected packet rate object of the cyclic mode (see section "6.5.3 Class 05h: Connection Object").

Change Of State (COS) mode connection is enabled, this parameter sets the minimum gap between two I/O messages. Values too low could cause the Bus network to saturate.

Default = 05h.

23-01-18 Velocity value

[UDINT, ro]

This attribute represents the current speed detected by the position sensor and calculated every 100 ms.

23-01-19 Velocity format

[USINT, rw]

This attribute identifies the engineering units for the velocity value.

00: steps/s   number of steps per second
01: rpm   revolutions per minute

23-01-2A Hardware counts per revolution

[UDINT, ro]

This object defines the hardware number of distinguishable steps per revolution. To set different values see 23-01-10 Resolution per revolution attribute.

23-01-2B Hardware number of turns

[UINT, ro]

This object defines the hardware number of distinguishable revolutions.

Total hardware resolution =   .

To set different values see attributes 23-01-10 Resolution per revolution and 23-01-11 Total measuring range.

23-01-2C Alarms

[WORD, ro]

An alarm is set when a bit indicating a fault is set to true (high).

See 23-01-2D Supported alarms values.

23-01-2D Supported alarms

[WORD, ro]

This attribute contains information on supported alarms.

Bits 0…11	Reserved	
Bit 12	Flash memory error	Internal error, it cannot be restored.
Bit 13	Machine data not valid	One or more parameters are not valid, set proper values to restore normal work condition.
Bit 14	Bus off	This bit is intended to warn that the communication in the bus network has broken (cable disconnected? Voltage drop? ...).

23-01-2E Alarm flags

[BOOL, ro]

Indicates that a fault occurred and an alarm has been triggered, see 23-01-2D Supported alarms object.

23-01-33 Offset

[DINT, ro]

The 23-01-33 Offset attribute is calculated by the preset function and shifts the 23-01-03 Position value attribute using the calculated value.

Offset = 23-01-13 Preset value - "Internal Position Value"

23-01-65 Dip switch

[UINT, ro]

This object shows the status of the dip switches.

Dip switches are located in the connection cap and used to set the baud rate and the MAC-ID (see sections "4.6 Baud rate: DIP A" and "4.7 Node address: DIP B").

MAC-ID: bits 0 … 5;

Baud Rate: bits 8 … 9.

23-01-66 Data Tx in Poll mode

[USINT, rw]

This parameter is meant to set which input data is sent when **Polled** mode connection is enabled.

00: Position value

01: Position value + velocity

23-01-67 Data Tx in COS/Cyclic mode

[USINT, rw]

This parameter is meant to set which input data is sent when Change Of State

(COS) / Cyclic mode connection is enabled.

00: Position value

01: Position value + velocity

23-01-68 Auto-save parameters

[BOOL, rw]

Yes: when new parameters are set, the encoder waits 5 seconds and then saves automatically all new values on EPROM.

No: new parameters are not saved on EPROM automatically. To save new values, Class Instance Editor must be used (default value; see section "5.4 Save parameter with RSNetWorx").

NOTE

To save new parameters execute the "Save parameters" function (see **Errore. L'origine riferimento non è stata trovata.**section "7.1 Read and set parameters").

When the power is turned off or in case of "Reset node" and "Restore node" commands, parameters not saved are lost.

6.5.5 Class 2Bh: Acknowledge Handler Object

This class is meant to manage the receipt of acknowledgement messages.

Supported Service code:
0Eh = Get_Attribute_Single: used to read connection class attribute value.
10h = Set_Attribute_Single: used to write connection class attribute value.

Supported Instance: 01h = Explicit Message

2B-01-01 Acknowledge timer
[UINT, rw]
After a Master request, Slave waits for the set acknowledgement time before sending back a reply.
Default = 10h: 16ms

2B-01-02 Retry Limit
[USINT, rw]
Number of Ack Timeouts after which the application informs the Master that a RetryLimit_Reached event occurred.

2B-01-03 Connection Instance of COS
[UINT, rw]
Connection Instance which contains the path where the Ack Handler events will be notified.

7   Setup

Here follow some examples of parameters reading and setting; data exchange between Master and Slave device is highlighted. A generic "ID" value is used to indicate the encoder address; Master address is always assumed to be 0.

All values are written in hexadecimal notation.
Abbreviations: (ID<<3): 3 bits left logic shift
                 Ms: Master ID
                 FC: Fragmented message counter
                 SC: Service Code
                 Cl: Class
                 Ins: Instance
                 AC: Allocation Choice
                 At: Attribute
                 Err: Error code

7.1 Read and set parameters

P2P Master/Slave connection (without I/0 msg)

Master → Encoder (request)

CAN-ID	6 Data byte						
406+(ID<<3)	Ms	SC	Cl	Ins	AC	Ms	
	00	4B	03	01	01	00	

Encoder → Master (response)

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	00	CB	00				

Read position 23-01-03 Position value (in "Object dictionary")

Master → Encoder

CAN-ID	5 Data byte						
404+(ID<<3)	Ms	SC	Cl	Ins	At		
	00	0E	23	01	03		

Encoder → Master

CAN-ID	6 Data byte						
403+(ID<<3)	Ms	SC	position				
	00	8E	Low	…	…	High	

7.1.1 Set 23-01-13 Preset value

Master → Encoder (1ˢᵗ message)

CAN-ID	8 Data byte							
404+(ID<<3)	Ms	FC	SC	Cl	Ins	At	preset	
	80	00	10	23	01	13	Low	…

Encoder → Master (1ˢᵗ message received)

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	80	C0	00				

Master → Encoder (2ⁿᵈ message)

CAN-ID	4 Data byte						
404+(ID<<3)	Ms	FC	preset				
	80	81	…	Hi			

Encoder → Master (2ⁿᵈ message received)

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	80	C1	00				

Encoder → Master (parameter value accepted)

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	00	90	00				

7.1.2 Save parameter

Master → Encoder

CAN-ID	5 Data byte							
404+(ID<<3)	Ms	SC	Cl	Ins	At			
	00	16	23	01	01			

Encoder → Master

CAN-ID	3 Data byte							
403+(ID<<3)	Ms	SC	Err					
	00	96	00					

7.1.3 Close Master/Slave connection

Master → Encoder

CAN-ID	5 Data byte							
406+(ID<<3)	Ms	SC	Cl	Ins	AC			
	00	4C	03	01	01			

Encoder → Master

CAN-ID	3 Data byte							
403+(ID<<3)	Ms	SC	Err					
	00	CC	00					

7.2 Set Cyclic mode without velocity

P2P Master/Slave connection

Master → Encoder (request)

CAN-ID	6 Data byte						
406+(ID<<3)	Ms	SC	Cl	Ins	AC	Ms	
	00	4B	03	01	61	00	

Encoder → Master (response)

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	00	CB	00				

Set 05-Inst-09 Expected packet rate for Cyclic mode (milliseconds)

Master → Encoder

CAN-ID	7 Data byte						
404+(ID<<3)	Ms	SC	Cl	Ins	At	Ctime	
	00	10	05	04	09	Low	Hi	

Encoder → Master

CAN-ID	3 Data byte						
403+(ID<<3)	Ms	SC	Err				
	00	90	00				

From now on, the encoder sends I/0 message at intervals set in Ctime object until the connection will be closed or 05-Inst-09 Expected packet rate attribute will be modified.

Encoder → Master

CAN-ID	4 Data byte						
340+ID	position						
	Low	…	…	Hi			