## User Manual

# DeviceNet

## Introduction

The integrated LIKA ELECTRONIC CANbus interface supports all DeviceNet properties.
The encoder can send information in two ways:
Polled Mode (encoder send the position value on master request)
Change Of State (encoder send the position value on changement)
The protocol supports the programming of following parameters:
Code sequence (complementary)
Resolution per revolution
Total resolution
Preset value

c UL us File E211871

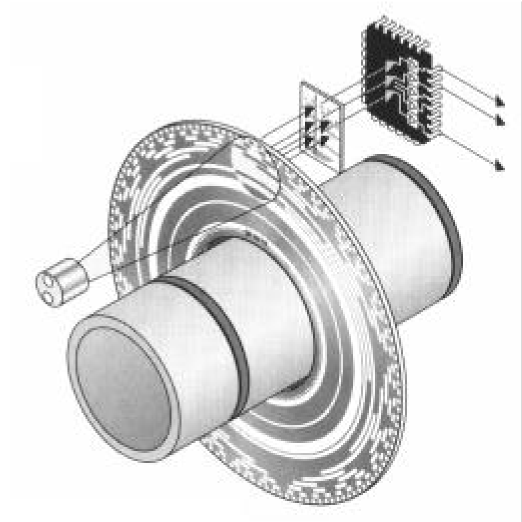
## Summary



## 1 – Description of an absolute encoder

We usually make use of absolute encoder when we have to convert the angular position of a shaft into a number. This number is then transferred onwards in a digital form.
The basic principle is that light from a LED is transmitted through a transparent coded disc, and the bright-dark pattern is converted into digital signals.

Fig. 1: basic principle of absolute encoder



In this manner each angular position corresponds univocally to a sequence of zeros and ones This is the decisive difference to incremental encoders, which only sense the change in the angular position, but not assign a number to every position.

If an incremental encoder is rotated when it's in power off condition, when the equipment is powered-on again, the angular position information is lost, and it is necessary to home the machine. An absolute encoder will always sense position changes, even without a power supply available, and, after the power is switched-on again, transfers the angular position information to the higher-level control system. The coded disk allows individual revolutions to be measured standard resolutions available now are 4096 steps ($=2^{12}$) and 8192 steps ($= 2^{13}$) per revolution.

For multi-turn versions, a special gearbox is integrated in the absolute encoder. This system can sense up to 4096 revolutions. This is a configuration non available with an absolute assignment of the angular range of 4096 steps/revolution x 4096 revolutions: the total number of steps is 16.777.216. These values are absolute, i.e. there is an absolute zero point, and after 4096 revolutions, the same values are repeated.

The user can influence this angular range in various ways, and therefore adapt the output values to his requirements. The output values can be modified as follows:

1. **Direction of rotation (CMP)**: This defines whether the angular encoder counts up when rotating clockwise, or when rotating counter-clockwise.
2. **Resolution per revolution (RPR)** : Number of steps by which the value increases per revolution.
3. **Total resolution (TR)** : This parameter specifies the highest number, which the output position values can assume.
4. **Preset value (PV)** : The user can assign a value to any position of the encoder shaft: the preset value. The preset value must lie within the total resolution.

## 2 – Data transmission

A DeviceNet network Data transmission is realized by message telegrams.
Like showed in following diagram, those telegrams can be spared in two fields:
CAN-ID
followings 8-bytes

| COB-ID | Message header | Message body |
|---|---|---|
| 11 Bit | 1 Byte | 7 Byte |

## 2.1 - Object Dictionary

Class code: 23 hex

| ID Attribute (hex) | Access | Name | Data type | Description |
|---|---|---|---|---|
| 01 | Read | Number of attributes | USINT | Number of manned attributes |
| 02 | Read | Attribute | USINT Array | Attribute list |
| 03 | Read | position Value | DINT | Current position |
| 0B | Read /Write | Code sequence | Boolean | Clockwise or CounterCW revolution |
| 2C | Read / Write | Resolution per revolution | INT | Information in a revolution |
| 2D | Read / Write | Total resolution | DINT | Total measurable information |
| 2E | Read / Write | Preset value | DINT | To set a defined position value |

## 3 – Encoder Parameters

## 3.1 – Code sequence

The Code sequence defines the counting direction when the position value output, as the shaft rotates clockwise CW or counter-clockwise CCW viewing from the shaft.
To select the code sequence the operating parameters can be used.

| ID Attribute | default value | Range | Data type |
|---|---|---|---|
| 0B hex | 1 hex | 0 hex – 1 hex | Boolean |

| Bit 0 | Code sequence |
|---|---|
| 1 | ClockWise |
| 0 | Counter-ClockWise |

## 3.2 - Measuring units per revolution

The Measuring units per revolution' parameter is used to program the angular encoder so that a required number of steps can be realized, referred to one revolution.

| ID Attribute | default value | Range | Data type |
|---|---|---|---|
| 2C hex | (*) | 0 hex – 2000 hex | Unsigned integer 16 |

(*) depending of encoder type:

Encoder 12/24 Bit: 1000hex (4096)
Encoder 13/25 Bit: 2000hex (8192)
If a value greater than the basic resolution of the absolute value encoder is selected as resolution per revolution, the output code is no longer in single steps. Thus, it should be observed, that the required resolution does not exceed the hardware resolution of the absolute encoder.

## 3.3 - Total resolution

Using the 'Total measuring range' parameter, the user can program the angular encoder, so that after a specific number of revolutions, it starts to count again at zero. Normally, this would be 4096 revolutions, however using the 'Total measuring range' parameter, even shorter periods can be selected.
Maximum output value, for a 24 bit encoder is 16.777.216.(25 bit = 33.554.432).

| ID Attribute | Default value | Range | Data type |
|---|---|---|---|
| 2D hex | (*) | 0 hex – 2.000.000 hex | Unsigned integer 32 |

(*)depending of encoder type:

12/24 Bit Encoder: 1000hex (4096)
13/25 Bit Encoder: 2000hex (8192)

## NOTE

PGA = Physical total resolution
PAU = Physical resolution per revolution
GA = Total resolution
AU = resolution per revolution

If desired resolution per rev. is less than physical resolution per revolution, than the total resolution must be entered as follows:

Total resolution: GA = PGA * AU / PAU
( if AU < PAU )

## 3.4 - Preset value

The preset value is the process actual value, which should then be output when the axis is in a certain physical position. Using the preset value parameter, the value output from the angular encoder, is defined at a specific angular position. The preset value may not exceed the total resolution parameter.

| ID Attribute | Default value | Range | Data type |
|---|---|---|---|
| 2E hex | 0 | 0 hex – total measuring range | Unsigned integer 32 |

## 4 – Transmission of actual position

The process value is transferred according to the following table

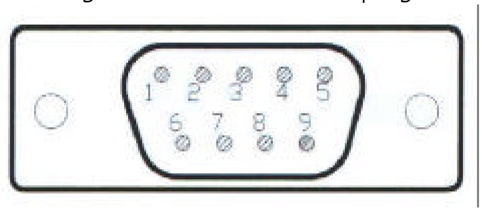
| CAN ID | Process value | | | |
|---|---|---|---|---|
| 11 Bit | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| | $2^7$ - $2^0$ | $2^{15}$ - $2^8$ | $2^{23}$ - $2^{16}$ | $2^{31}$ - $2^{17}$ |

## 5 – Installation

The device is to be supplied by a Class 2 Circuit or Low-Voltage Limited Energy or Energy Source not exceeding 30 Vdc.

## 5.1 – Electrical connections

Fig. 2: 9 Pin D-Sub male plug



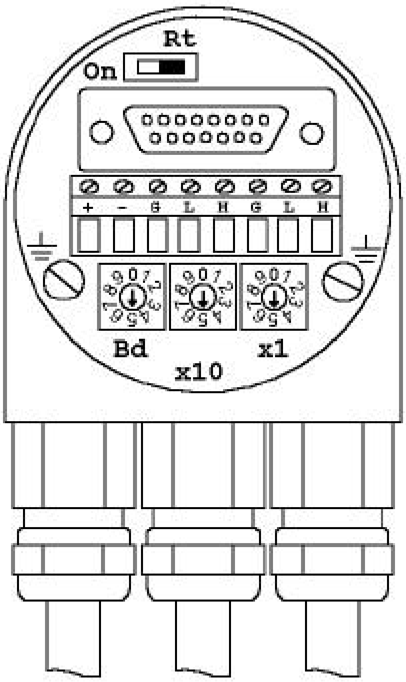



Fig.3: connection/switches side view .

| Pin | signal | Description |
|---|---|---|
| 1 | - | Reserved |
| 2 | CAN_L | Bus line (dominant low) |
| 3 | - | |
| 4 | - | Reserved |
| 5 | GND | 0 V power supply |
| 6 | - | |
| 7 | CAN_H | Bus line (dominant high) |
| 8 | - | Reserved |
| 9 | Vcc | Power supply |

Switch:

Bd = Baud Rate selection

X10 e x1 = node address (Tenths and Units of MAC-ID) from 0 to 63

Rt = active the term resistance

| Clamp | Description |
|---|---|
| | Ground |
| + | 24 V power supply |
| - | 0 V power supply |
| G | Screen |
| CL | CAN LOW input |
| CH | CAN HIGH |
| G | Screen |
| CL | CAN LOW output |
| CH | CAN HIGH |

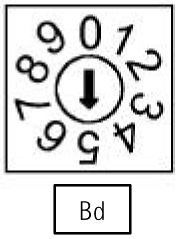
## 5.2 – Hardware setup

By means of rotary switches x10 and x1 is possible to set right MAC-ID which may be addressed from 0 up to 63 (ex. Address 34: x10 placed on 3 and x1 placed on 4)

In the network can't to be Node with the same MAC-ID .

By means of Bd it's possible to choose the followings baud rates:

| Baud rate In Kbit / s | Rotary switch |
|---|---|
| 125 | 0 |
| 250 | 1 |
| 500 | 2 |
| 125 | 3 |

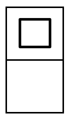



**Terminal resistance:**

Terminal resistance is activated by DIP-switch in the connection cap.

ON

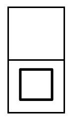
Rt



Device X

ON

Rt



Last device

After the configuration of baud rate, MAC-ID (Media Access Control - ID) and the terminal, if necessary, the encoder can be powered on.

# 6 – Encoder activation

## 6.1 - Operational Status

After power-on, the absolute rotary encoder send two times, on the bus, its MAC-ID telegram.

## 6.2 – Programming

This paragraph get useful information to modify encoder parameters.

Following tables contains hexadecimal values.

### 6.2.1 – Code sequence

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Service code | Class ID | Instance ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 0A | 10 | 23 | 01 |

| Attribute ID | Data | | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 0B | X | - | - |

X: 1=clockwise CW (default)
0 =counter-clockwise CCW

Encoder ⇒ Master Confirmation

| CAN ID | MAC ID | Service code |
|---|---|---|
| | Byte 0 | Byte 1 |
| 41B | 0A | 90 |

### 6.2.2 – Resolution per revolution

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Service code | Class ID | Instance ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 0A | 10 | 23 | 01 |

| Attribute ID | Data | | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 2C | X | X | - |

X: desired value of resolution per revolution.

Encoder ⇒ Master Confirmation

| CAN ID | MAC ID | Service code |
|---|---|---|
| | Byte 0 | Byte 1 |
| 41B | 0A | 90 |

### 6.2.3 Total resolution

Sending Total resolution to Encoder, the Master must make a fragmented transmission.
More messages (telegrams) are necessary.

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Fragment | Service code | Class ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 8A | 00 | 10 | 23 |

| Instance ID | Attribute ID | Data | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 01 | 2D | X | X |

X: desired value of total resolution

Encoder ⇒ Master Confirmation

| CAN ID | MAC ID | | |
|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 |
| 41B | 8A | C0 | 00 |

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Fragment | Service code | Class ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 8A | 81 | 10 | 23 |

| Instance ID | Attribute ID | Data | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 01 | 2D | X | X |

X: desired value of total resolution

Encoder ⇒ Master Confirmation

| CAN ID | MAC ID | | |
|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 |
| 41B | 8A | C1 | 00 |

Encoder ⇒ Master Confirmation

| CAN ID | MAC ID | Service code |
|---|---|---|

| | Byte 0 | Byte 1 |
|---|---|---|
| 41B | 0A | 90 |

### 6.2.4 – Preset value

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Fragment | Service code | Class ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 8A | 00 | 10 | 23 |

| Instance ID | Attribute ID | Data | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 01 | 2E | X | X |

Encoder ⇒ Master Confirmation

| **CAN ID** | **MAC ID** | **Data** | |
|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 |
| 41B | 8A | C0 | 00 |

Master ⇒ Encoder Set parameters

| CAN ID | MAC ID | Fragment | Service code | Class ID |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| 41C | 8A | 81 | 10 | 23 |

| Instance ID | Attribute ID | | |
|---|---|---|---|
| Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 01 | 2D | X | X |

X: desired preset value.

Encoder ⇒ Master Confirmation

| **CAN ID** | **MAC ID** | | |
|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 |
| 41B | 8A | C1 | 00 |

Encoder ⇒ Master Confirmation

| **CAN ID** | **MAC ID** | **Service code** |
|---|---|---|
| | Byte 0 | Byte 1 |
| 41B | 0A | 90 |

### 6.2.5 – Parameter saving

Master ⇒ Encoder Set parameters

| **CAN ID** | **MAC ID** | **Service code** | **Class ID** | **Instance ID** |
|---|---|---|---|---|
| | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
| | | 32 | 23 | 01 |

If parameters and values has been successfully transferred, the encoder respond, after two seconds, with a duplicate of MAC-ID.
Master must re-allocate the slave, then.
On transmission fault, a specific error message is generated.

## 7 – Warnings

The following points should be observed:

- Do not drop the angular encoder or exposed it to excessive vibration. The encoder is a precision device.
- Do not open the angular encoder housing (this does not mean that you cannot remove the connection cap). If the device is opened and closed again, then it can be damaged and dirt may enter the unit.
- The angular encoder shaft must be connected to the shaft to be measured through a suitable coupling. This coupling is used to dampen vibrations and imbalance on the encoder shaft and also avoid inadmissible high forces. Suitable couplings are available from LIKA ELECTRONIC.
- Although LIKA ELECTRONIC absolute value encoders are rugged, when used in tough ambient conditions, they should be protected against damage using suitable protective measures.
- Only qualified personnel may commission and operate these devices. These are personnel who are authorized to commission, ground and tag devices, systems and circuits according to the current state of safety technology.
- It's forbidden to make any electrical changes to the encoder.
- Route the connecting cable to the angular encoder at a considerable distance away or completely separated from power cables with their associated noise. Completely screen cables

must be used for reliable data transfer and good grounding must be provided.

- Cabling, establishing and interrupting electrical connections may only be carried-out when the equipment is in a no-voltage condition. Short-circuits, voltage spikes etc. can result in erroneous functions and uncontrolled statuses which can even include severe personnel injury and material damage.
- Before powering-up the system, check all of the electrical connections. Connections, which are not correct, can cause the system to function incorrectly and fault connections can result in severe personnel injury and material damage.

## 8 – Appendix A

### Parameters saving on RSNetworx

With a click of right mouse button on a node we can select PROPERTIES control button and so edit encoder parameters. This operation store parameter changes only in encoder RAM.
To save new parameters values permanently needs to select CLASS INSTANCE EDITOR from the same menu of PROPERTIES option.

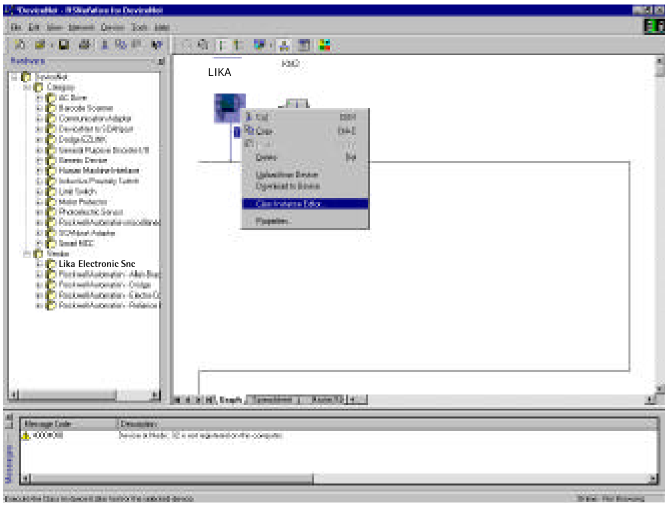



Fig. 1 Selection of Class Instance Editor

In this mask we set the followings hexadecimal values (see fig. 2).
Now we click on EXECUTE to store the data in encoder EEPROM. After that we see a message „The execution was completed" to confirm the upload process completed properly. Selecting the control button CLOSE we can close CLASS INSTANCE EDITOR window.

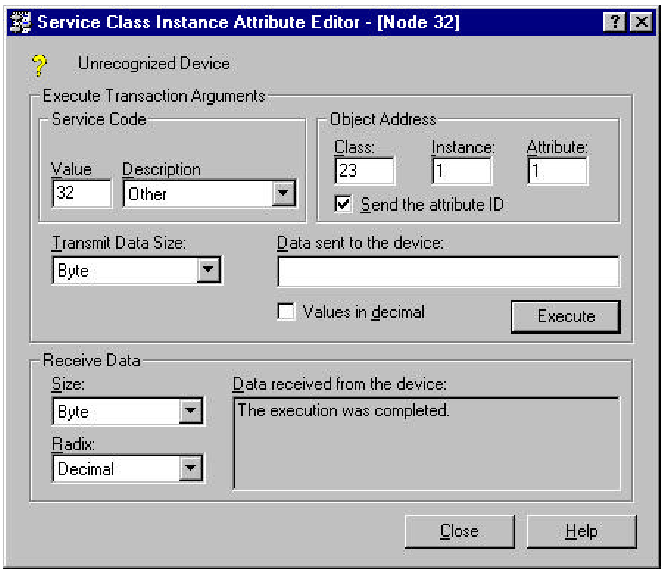



Fig. 2 Class Instance Editor mask