Baumer

Passion for Sensors

# Manual

## Absolute encoder with EtherNet/IP (with bus cover)

Firmware Version 1.07 and up

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# Content

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# 1. Introduction

## 1.1. Scope of delivery

Please check the delivery upon completeness prior to commissioning.
Depending on encoder configuration and part number delivery is including:
Basic encoder with~~,~~ bus cover.

~~ and CD with d~~Describing file and manual ~~(also~~are available as download in the Internet at www.baumer.com~~)~~.

## 1.2. Product allocation

| Product mechanics | E-IP Product-Code | EDS-File | Description | Suitable input in hardware-catalogue |
|---|---|---|---|---|
| HMG10 / PMG10 Multiturn | 30 | Baumer_EIP_Encoder_HMG10_PMG10_MT.eds | ~~MT, Optical,~~ 16 Bit MT, 13 Bit ST | GXMMW |
| HMG10 / PMG10 Singleturn | 31 | Baumer_EIP_Encoder_HMG10_PMG10_ST.eds | ST, Optical, 13 Bit ST | GXAMW |

**Explanation:**

| | |
|---|---|
| MT | Multiturn encoder |
| ST | Singleturn encoder |
| 16 Bit MT | Max. 16 bit number of countable revolutions, i.e. $2^{16}$ revolutions |
| 13 Bit ST | Max. 13 bit physical singleturn resolution, i.e. $2^{13}$ steps / revolution |

# 2. Safety and operating instructions

**Intended use**

- The encoder is a precision measuring device that is used to record positions and speeds. It provides measuring values as electronic output signals for the subsequently connected device. It must not be used for any other purpose. Unless this product is specially labeled, it may not be used for operation in potentially explosive environments.
- Make sure by appropriate safety measures, that in case of error or failure of the encoder, no danger to persons or damage to the system or operating facilities occurs.

**Maintenance**

- The encoder is maintenance-free and must not be opened up nor mechanically or electronically modified. Opening up the encoder can lead to injury.

**Disposal**

- The encoder contains electronic components. At its disposal, local environmental guidelines must be followed.

**Mounting**

- Solid shaft: Do not connect encoder shaft and drive shaft rigidly. Connect drive and encoder shaft with a suitable coupling.
- Hollow shaft: Open clamping ring completely before mounting the encoder. Foreign objects must be kept at a sufficient distance from the stator coupling. The stator coupling is not allowed to have any contact to the encoder or the machine except at the mounting points.
- Avoid any twist or torsion on the housing.
- Avoid impacts or shocks on housing and shaft/end shaft.
- Do not open the encoder or proceed any mechanical modifications.

*Shaft, ball bearings, glass disc or electronic components can be damaged thereby and a safe and reliable operation is no longer ensured.*

**Commissioning**

- Installation and assembly of this product may be performed only by a person qualified in electronics and precision mechanics.
- Observe the operating instructions of the machine manufacturer.

**Electrical commissioning**

- Do not proceed any electrical modifications at the encoder.
- Do not proceed any wiring work while encoder is live.
- Never plug or unplug connector while encoder is live (the bus cover however may be removed or docked to the basic encoder when live).
- Ensure that the entire system is installed in line with EMC/EMI requirements. Operating environment and wiring have an impact on the electromagnetic compatibility of the encoder. Install encoder and supply cables separately or far away from sources with high emitted interference (frequency converters, contactors, etc.).
- When working with consumers with high emitted interference provide separate encoder supply voltage.
- Completely shield encoder housing and connecting cables.
- Connect encoder to protective earth (PE) using shielded cables. The braided shield must be connected to the cable gland or connector. Ideally, aim at dual connection to protective earth (PE), i.e. housing by mechanical assembly and cable shield by the downstream devices. In case of earth loop problems, earth at least on one side.

*Failure to observe these instructions can result in malfunctions, material damage or personal injury!*

**Supplementary information**

- The present manual is intended as a supplement to already existing documentation (e.g. catalogues, data sheets or mounting instructions).
- The manual must be studied carefully prior to initial commissioning of the equipment

**Safety instructions**

- Check all electrical connections prior to commissioning of the equipment.
- If mounting, electrical connections or any other work performed at the encoder and the equipment is not correctly executed this can result in malfunction or failure of the encoder.
- Corresponding safety precautions must be provided and observed to exclude any risk of personal injury, damage to material or operating equipment as a result of encoder failure or malfunction.
- Encoders must not be operated outside the specified limited values (see further documentation).

*Failure to observe these safety instructions can result in malfunctions, material damage or personal injury.*

**Transport and storing**

- Only ever transport or store the encoder in its original packaging.
- Never drop the encoder nor expose it to major shocks.

# 3. Device profile

## 3.1. Introduction

As an application layer, EtherNet/IP uses the Common Industrial Protocol (CIP) released by the ODVA. CIP is transmitted as an “encapsulated” protocol in the data section of standard Ethernet frames. Depending on the assignment and type of connection, the data transmission mechanisms UDP/IP or TCP/IP are used.

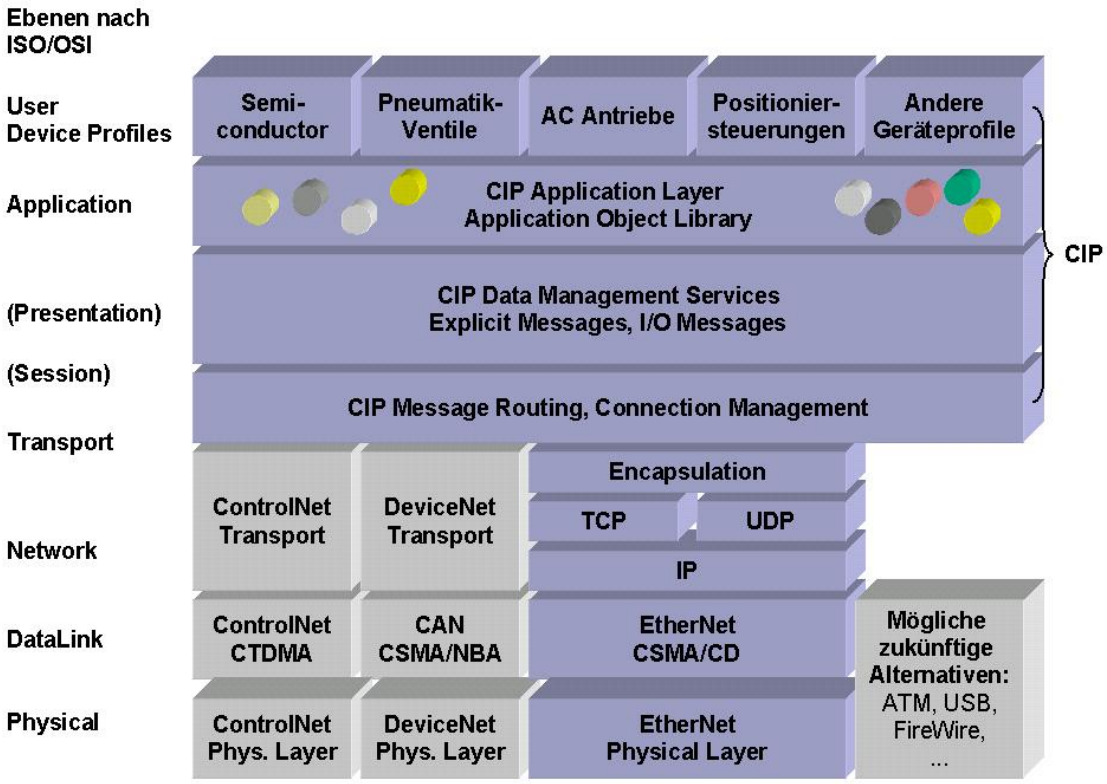



Fig. 1: EtherNet/IP and CIP levels in accordance with the OSI reference model

CIP is an object-oriented protocol. The device characteristics are described by objects (such as a parameter object) which have one or more instances. Each instance in turn has one or more attributes. Attributes describe individual characteristics of objects (such as parameter value or parameter unit).

In device profiles, the ODVA defines which CIP objects and attributes have to be supported by a certain device class. In addition, optional and manufacturer-defined objects and attributes are also possible.

Baumer encoders with Baumer EtherNet/IP bus cover support the Encoder Device Profile, device type 22 hex in accordance with the “Common Industrial Protocol Specification”, Volume 1 of the ODVA, Edition 3.7, November 2009.

Data transmission of CIP messages in EtherNet/IP networks takes place by means of implicit and explicit messages.

Typically, implicit messages are smaller data packages for time-critical data transmissions. When transmitting I/O data, implicit connections with long-term viability are generally involved. I/O data is transmitted by means of UDP and uses port 2222.

Non time-critical data is transmitted by means of explicit messages. Examples of explicit messages are configuration or information data, which use the TCP/IP transmission mechanism.
More detailed information on the Common Industrial Protocol (CIP) or on EtherNet/IP can be obtained from the ODVA (www.odva.org).

### 3.2. Object model

The object model describes the used object classes of the encoder and their mutual relationship. This is defined in the 22Hex device profile of the ODVA for encoder devices and depicted in the diagram below. Objects made available by the Baumer bus cover but which are only an optional component of the device profile are shaded in grey in this diagram.

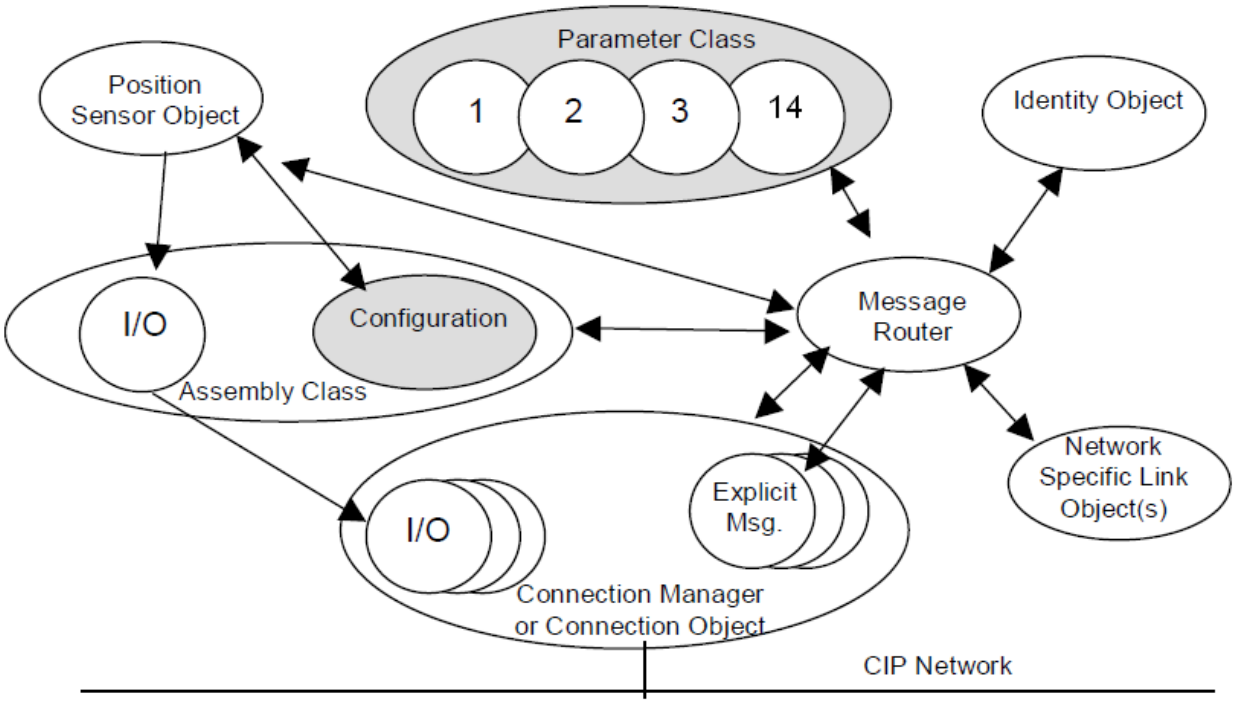



Fig. 2: Object model of the encoder device profile as a component of the Baumer bus cover

The following table indicates the object classes and the number of instances available in each class.

| Object class | Number of instances |
|---|---|
| 01h: Identity Object | 1 |
| 02h: Message Router Object | 1 |
| 04h: Assembly Object | 6, the instances present are 1, 2, 3, 100, 105, 110 |
| 06h: Connection Manager Object | 1 |
| 0Fh: Parameter Object | 14 |
| 23h: Position Sensor Object | 1 |
| F4h: Port Object | 2 |
| F5h: TCP/IP Interface Object | 1 |
| F6h: Ethernet Link Object | 3 |

Table 3: Available objects

The characteristics of these objects are described in the following sections and/or the relevant EDS file.

### 3.3. Identity Object – 01hex

The identity object is implemented in accordance with the Common Industrial Protocol Specification. The object revision is 1, and the class code is 01h.

Table 4 lists the available class attributes. Class attributes are addressed via instance 0.

For the class attributes of the identity object, the services
- 01h Get Attribute all
- 0Eh Get Attribute single
are supported.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 1 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 1 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 1 |
| 4 | read | Optional attribute list | STRUCT of | List of supported optional instance attributes | |
| | | number of attributes | UINT | Number of supported optional instance attributes | 2 |
| | | optional attributes | ARRAY of UINT | Number of optional instance attribute numbers | 11, 12 |
| 6 | read | Maximum ID Number Class Attributes | UINT | Attribute number of last class attribute | 7 |
| 7 | read | Maximum ID Number Instance Attributes | UINT | Attribute number of last instance attribute | 12 |

Table 4: Class attributes of the identity object

The table below contains all supported instance attributes of the identity object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Vendor ID | UINT | Manufacturer identification | 468 = Baumer Vendor ID |
| 2 | read | Device Type | UINT | Product type identification (device profile) | 34 = 22hex |
| 3 | read | Product Code | UINT | Identification of a manufacturer's part product | |
| 4 | read | Revision | STRUCT of | Product revision | |
| | | Major Revision | USINT | | |
| | | Minor Revision | USINT | | |
| 5 | read | Status | WORD | Summarized device status (see description below the table) | |
| 6 | read | Serial Number | UDINT | Device serial number | |
| 7 | read | Product Name | SHORT_STRING | Readable product identification | |
| 11 | read / write | Active Language | STRUCT of | Language currently supported by the device | Based on ISO 639-2/T) STRINGI Data type |
| | | | USINT | Field 1 of STRINGI type | |
| | | | USINT | Field 2 of STRINGI type | |
| | | | USINT | Field 3 of STRINGI type | |
| 12 | read | Supported Language List | ARRAY of STRUCT of | List of supported languages as field of individual elements as described in attribute 11 | |
| | | | USINT | Field 1 of STRINGI type | |
| | | | USINT | Field 2 of STRINGI type | |
| | | | USINT | Field 3 of STRINGI type | |

Table 5: Identity object, instance attributes

The status attribute (attribute number 5) is defined as a bit string. The meanings of the individual bits are described in Table 6.

| Bit(s) | Name | meaning |
|---|---|---|
| 0 | Owned | = 1: at least 1 object of the device has an owner.<br>The bit is set if at least a class 1 or a class 3 connection is in the "established status". |
| 1 | | Reserved, value = 0 |
| 2 | Configured | = 1: at least 1 application attribute has been changed as against the default settings.<br>The bit is set if at least 1 writable attribute of the position sensor object has been changed. |
| 3 | | Reserved, value = 0 |
| 4-7 | Extended Device Status | = 0000: Self-test<br>= 0001: Firmware update is active<br>= 0010: At least 1 I/O connection is in Error status (timeout detected)<br>= 0011: There are no I/O connections in the Established status. This bit refers to Class 1 connections.<br>= 0100: The saved configuration is defective. This bit is set if errors are detected when reading the data saved in the internal flash.<br>= 0101: A serious error has been detected. Bit 10 or Bit 11 is additionally set<br>= 0110: There is at least 1 I/O connection in the Run status (active). The bit refers to Class 1 connections.<br>= 0111: There is at least 1 I/O connection in the Established status, but all connections are in the Idle Mode. Display of this status is not supported.<br>All other bit combinations are reserved for manufacturer-defined information. These bit combinations are not used. |
| 8 | Minor Recoverable Fault | The device has detected a non-serious and reparable fault. This bit is set if a class 1 I/O connection has detected a timeout. |
| 9 | Minor Unrecoverable Fault | This fault category is not supported by the device. |
| 10 | Major Recoverable Fault | This bit is set if<br>- an error is detected when reading the internal flash memory<br>- an inadmissible jump of the position value has occurred (Position Error). |
| 11 | Major Unrecoverable Fault | This bit is set if no connected base encoder is detected when switching on the bus cover. |
| 12-15 | | Reserved, value = 0 |

Table 6: Status attribute description

For the instance attributes of the identity object, the following services are supported:
- 01h Get Attribute all
- 05h Reset Service
  The parameter values 0 and 1 are supported. After completed service, both parameter values bring about a reset of all connection configurations. No reset of application parameters to factory default takes place!
- 0Eh Get Attribute single
- 10h Set Attribute single

### 3.4. Position Sensor Object – 23hex

The position sensor object is implemented in accordance with the Common Industrial Protocol Specification. The object revision is 2 and the class code is 23h.

In Table 7 the available class attributes are listed. Class attributes are addressed via the instance 0.

For the class attributes of the position sensor object, the services
- 0Eh Get Attribute single
are supported.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 2 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 1 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 1 |
| 4 | read | Optional Attribute List | STRUCT of | List of supported optional instance attributes | |
| | | Number of Attributes | UINT | Number of supported optional instance attributes | 18 |
| | | Optional Attributes | ARRAY of UINT | Number of optional instance attribute numbers | 1,2, 11, 16, 17, 19, 24, 42, 43, 44, 45, 46, 47, 48, 49, 51,100, 101 |
| 6 | read | Maximum ID Number Class Attributes | UINT | Attribute number of last class attribute | 7 |
| 7 | read | Maximum ID Number Instance Attributes | UINT | Attribute number of last instance attribute | 101 |

Table 7: Class attributes of the position sensor object

The following table contains all supported instance attributes of the position sensor object.
For a detailed description of individual instance attributes, see the table.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Number of Attributes | USINT | Number of supported attributes | 20 |
| 2 | read | Attribute List | Array of USINT | List of supported attributes | 1,2, 10, 11, 12, 16, 17, 19, 24, 42, 43, 44, 45, 46, 47, 48, 49, 51,100, 101 |
| 10 | read | Position Value Signed | DINT | Current position value | |
| 11 | read | Position Sensor Type | UINT | Specifies the sensor type | |
| 12 | read / write | Direction Counting Toggle | BOOL | Defines the sense of rotation in which the position value rises. | CW = 0<br>CCW = 1 |
| 16 | read/ write | Measuring Units per Span | UDINT | Number of required measuring units per revolution | |
| 17 | read/ write | Total Measuring Range in Measuring Units | UDINT | Number of required measuring units over the entire measuring range | |
| 19 | read / write | Preset Value | DINT | Position value is set to the reset value | |
| 24 | read | Velocity Value | DINT | Current speed value | |
| 42 | read | Physical Resolution Span | UDINT | Number of maximum distinguishable measuring units per revolution | |
| 43 | read | Number of Spans | UINT | Maximum number of revolutions | |
| 44 | read | Alarms | WORD | Indicates a detected error which can result in an incorrect position value or requires user intervention | |
| 45 | read | Supported Alarms | WORD | Information on supported alarms | |
| 46 | read | Alarm Flag | BOOL | Indicates whether an alarm has occurred. | |
| 47 | read | Warnings | WORD | Indicates any existing warnings | |
| 48 | read | Supported Warnings | WORD | Information about supported warnings | |
| 49 | read | Warning Flag | BOOL | Indicates if a warning is active | |
| 51 | read | Offset Value | DINT | The offset is calculated with the preset function. The actually measured position is displaced by this value. | |
| 100 | Read / write | Velocity Sample Rate | USINT | Velocity sample rate in ms | 1..255 |
| 101 | Read / write | Velocity Filter | USINT | Number of samples for calculating moving average value | 1..255 |

Table 8: Position sensor object, instance attributes

**Position Value Signed – attribute 10**
Absolute position of the sensor. Zero correction of the preset function is taken into consideration in the displayed value. The unit of measurement for the position value is increments or scanning steps or counts.

**Position Sensor Type – attribute 11**
Depending on the used base encoder, one of the following values is displayed:
01 – Singleturn absolute encoder
02 – Multiturn absolute encoder

**Direction Counting Toggle – attribute 12**
Behaviour of the position data depending on the sense of rotation of the encoder when rotating the encoder shaft seen looking at the flange.
Setting CW (clockwise) = rising values when rotating clockwise
Setting CCW (counterclockwise) = rising values when rotating counterclockwise
The parameter value is saved in a non-volatile memory in case of changes.

**Measuring Units per Span – attribute 16**
The attribute defines the number of distinguishable steps per revolution of the sensor.
The value is an indication of the required single turn resolution ("measuring units per revolution").
Values between 1 and the maximum resolution of the encoder per revolution (attribute 42) are admissible.

Re-parameterization can result in a change of attribute 17 to the value of the equations (1) or (2), if the value of attribute 17 is smaller than the minimum value or greater than the maximum value.

Re-parameterization deletes the previous offset value (attribute 51), so that the previous position reference is lost. The parameter value is saved in a non-volatile memory in the event of a change.

**Total Measuring Range in Measuring Units – attribute 17**
This attribute defines the total number of distinguishable steps over the entire measurement range.
The minimum setting value is calculated as:
*Minimum value attr.. 17 = Set value attr. 16* *(1)*

The maximum setting value is calculated as:
*Maximum value attr. 17 = Set value attr. 16 x value attr. 43* *(2)*

If the number of revolutions is programmed to a value unequal to $2^n$ (1, 2, 4, - 65536) then after traversing the sensor zero in a de-energized status, re-parameterization must be carried out.
The number of counted revolutions is calculated as:

*Number of counted revolutions = Set value attr. 17 ÷ Set value attr. 16* *(3)*

Re-parameterization deletes the previous offset value (attribute 51), so that the previous position reference is lost. The parameter value is stored in a non-volatile memory in the event of a change.

**Preset value – attribute 19**
**Offset value – attribute 51**
The preset function supports adjustment of the encoder zero at the mechanical zero point of the system. In the event of a "set attribute" at attribute 19, the current position of the encoder is set to the preset value. The internal offset value (attribute 51) is calculated and stored in the encoder.
The following rule applies:

*Preset value (attribute 19) = position value (attribute 10) + offset value (attribute 51)* *(4)*

Note: The preset function should only be used when the encoder is at a standstill.
A preset must always be carried out after the following attributes have been changed:

- Measuring units per span – attribute 16,
- Total measuring range in measuring units – attribute 17

When carrying out the preset function, an offset value (attribute 51) is internally calculated and stored as a non-volatile value in the flash memory, ensuring that the encoder retains the same unchanged position after switching off and back on. The flash memory is typically rewritable 100,000 times. However, despite the high number of possible write cycles, frequent program or event-controlled setting of the preset could foreshorten

the service life. When configuring the control software, a certain amount of care is consequently called for here. The preset can be selected in a range between zero and a value smaller than the set overall measurement range (attribute 17).

**Velocity Value – attribute 24**
The current velocity value of the encoder. The velocity value is read out in the unit “counted scanning steps / second”.

**Physical Resolution Span – attribute 42**
Using this attribute, the physical resolution of the encoder can be read out in the form of scanning steps per revolution.

**Number of Spans – attribute 43**
Maximum number of distinguishable revolutions. The physical measurement range is made up of:

*Physical measurement range = attribute 42 (Physical Resolution Span) x attribute 43 (Number of Spans) (5)*

**Alarms – attribute 44**
**Supported Alarms – attribute 45**
**Alarm Flag – attribute 46**
Attribute 44 delivers alarm messages. An alarm is set if the encoder has detected a status which can result in an incorrect encoder position. As soon as an alarm status is detected, the relevant bit is set to logical high. The alarm is automatically reset after 5 seconds. The alarm flag (attribute 46) is also set with each alarm.

The following alarms are supported:
0001 - Bit 0: Position error
0002 - Bit 1: Diagnostic error
1000 - Bit 12: Illegal jump detected in the position value. (Jump between 2 position values corresponds to an inadmissible velocity of more than 6200 revolutions/minute)
4000 - Bit 14: Flash error (unable to read saved data)
8000 - Bit 15: No encoder is detected

The alarm messages of bits 12, 14 and 15 are defined on a manufacturer-specific basis.

**Warnings – attribute 47**
**Supported Warnings – attribute 48**
**Warning Flag – attribute 49**
Attribute 47 delivers warning messages. Warnings are signaled by the encoder if internal parameters of the encoder are out of tolerance. In contrast to alarm messages, warnings do not indicate an incorrect position. Warnings are reset as soon as the parameter which was out of tolerance is restored to the correct value. The warning flag (attribute 49) is also set with each warning.
The following warnings are supported:

2000 – Bit 13: The encoder is operating with default settings. No valid encoder data was found in the flash.

The warning message of bit 13 is defined on a manufacturer-specific basis.

**Velocity Sample Rate – attribute 100**
Min Value: 1 Max Value: 255 Default Value: 1
Time in ms between two measuring samples (delta Steps and delta Time)

**Velocity Filter – attribute 101**
Min Value: 1 Max Value: 255 Default Value: 1
Number of sampled values for calculating moving average value

The position sensor object supports the following instance services:

| Code | Service | Description |
|---|---|---|
| 0Eh | Get_Attribute_Single | Supplies the content of a selected attribute |
| 10h | Set_Attribute_Single | Changes the value of a selected attribute.<br>If the value can be stored, it is filed in the non-volatile memory. |

Table 9: Position sensor object supported attribute services

**Note: Attributes with "write" access rights are stored as non-volatile data immediately subject to valid write access.**

| Product | Measuring Units per Span | | | Number of Spans | | | Total Measuring Range in Measuring Units | | |
|---|---|---|---|---|---|---|---|---|---|
| | Decimal | Hex | Bit | Decimal | Hex | Bit | Decimal | Hex | Bit |
| **HMG10 / PMG10 Singleturn** | 8192 | 2000 | 13 | 1 | 1 | 0 | 8192 | 2000 | 13 |
| **HMG10 / PMG10 Multiturn** | 8192 | 2000 | 13 | 65536 | 10000 | 16 | 536870912 | 20000000 | 29 |

Table 9a: Encoder resolution default

Product configurations of the same product family come with identical default settings.

### 3.5. Assembly Object – 04hex

The assembly object is created in accordance with the Common Industrial Protocol Specification. The object revision is 2. The class code is 04h.

The provided class attributes are listed in table 10. Class attributes are addressed via the instance 0.
All instances of the assembly object are static instances. Dynamic instances are not supported.

The service
- 0Eh Get Attribute single
can be applied on the class attributes of the assembly object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 2 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 110 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 6 |
| 4 | read | Optional attribute list | STRUCT of | List of supported optional instance attributes | |
| | | number of attributes | UINT | Number of supported optional instance attributes | 1 |
| | | optional attributes | ARRAY of UINT | List of optional instance attribute numbers | 4 |
| 6 | read | Maximum ID Number Class Attributes | UINT | Attribute number of last class attribute | 7 |
| 7 | read | Maximum ID Number Instance Attributes | UINT | Attribute number of last instance attribute | 4 |

Table 10: Class attributes of the assembly object

The following table contains all supported instance attributes of the assembly object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 3 | read | Data | ARRAY of BYTE | Data of the assembly instance | |
| 4 | read | Size | UINT | Number of bytes in attribute 3 | See table 13 |

Table 11: Assembly object, instance attribute

The service
- 0Eh Get Attribute single
can be applied on the instance attributes of the assembly object.

### 3.6. Assembly Instances

The encoder supports 6 I/O assembly instances.
I/O assembly instances are also called connection points. A distinction is made between the following connection point types:

- Originator -> Target (O->T). These connection points represent output assembly instances for the encoder from the viewpoint of the network.
- Target -> Originator (T->O). These connection points represent input assembly instances for the encoder from the viewpoint of the network. These instances contain for instance the position value of the encoder.

For cyclical reading of the encoder input data, from the viewpoint of an EtherNet/IP scanner, the following connection types can be used:

- ***Exclusive owner uses O->T connection point 100. (max. 1 simultaneous connection is allowed).***
- ***Input Only, uses the O->T connection point 254.***
- ***Listen Only, uses the O->T connection point 255.***
  *The requirement for construction of listen-only connections is that at least 1 exclusive owner or one input only connection exists for the required T->O connection point.*

The encoder supports up to 128 simultaneous connections. These connections can be implemented as class 1 or class 3 connections.

**Note Instance class 1 connections can only be generated to one input assembly simultaneously.**

According to the Encoder Device Profile, assembly instances 1, 2 and 3 are provided for input data. The input data of the Baumer-defined assembly instances 110 can also be used.

The object instance 105 is defined as the configuration assembly instance. Use of this assembly instance when establishing class 1 connections is one possibility for configuration of the encoder (see also section 8, Device configuration).

The output assembly instance 100 is implemented for use in exclusive owner connections.

The following table compiles all assembly instances defined in the encoder.

| Instance | Typ | Name | Size /Byte |
|---|---|---|---|
| 1 | Input | Position Value | 4 |
| 2 | Input | Position Value & Warning Flag | 5 |
| 3 | Input | Position Value & Velocity | 8 |
| 110 | Input | Vendor specific: Pos,Velocity,Warning,Alarm | 9 |
| 100 | Output | EIPScan | 0 |
| 105 | Configuration | Configuration | 10 |

Table 12: Baumer bus cover – assembly instances

The data formats of the assembly instances are listed in the table below.

| Instance | Byte | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | Position LSB | | | | | | | | Input Assembly Instances |
| | 1 | Position | | | | | | | | |
| | 2 | Position | | | | | | | | |
| | 3 | Position MSB | | | | | | | | |
| 2 | 0 | Position LSB | | | | | | | | |
| | 1 | Position | | | | | | | | |
| | 2 | Position | | | | | | | | |
| | 3 | Position MSB | | | | | | | | |
| | 4 | | | | | | | Warn Flag | Alarm Flag | |
| 3 | 0 | Position LSB | | | | | | | | |
| | 1 | Position | | | | | | | | |
| | 2 | Position | | | | | | | | |
| | 3 | Position MSB | | | | | | | | |
| | 4 | Velocity LSB | | | | | | | | |
| | 5 | Velocity | | | | | | | | |
| | 6 | Velocity | | | | | | | | |
| | 7 | Velocity MSB | | | | | | | | |
| 110 | 0 | Position value LSB | | | | | | | | |
| | 1 | Position value | | | | | | | | |
| | 2 | Positionswert | | | | | | | | |
| | 3 | Positionswert MSB | | | | | | | | |
| | 4 | Velocity LSB | | | | | | | | |
| | 5 | Velocity | | | | | | | | |
| | 6 | Velocity | | | | | | | | |
| | 7 | Velocity MSB | | | | | | | | |
| | 8 | | | | | | | Warn Flag | Alarm Flag | |

| Instance | Byte | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 0 | Measuring Units per Span LSB | | | | | | | | Configuration Assembly Instance |
| | 1 | Measuring Units per Span | | | | | | | | |
| | 2 | Measuring Units per Span | | | | | | | | |
| | 3 | Measuring Units per Span MSB | | | | | | | | |
| | 4 | Total Measuring Range LSB | | | | | | | | |
| | 5 | Total Measuring Range | | | | | | | | |
| | 6 | Total Measuring Range | | | | | | | | |
| | 7 | Total Measuring Range MSB | | | | | | | | |
| | 8 | Direction Counting Toggle | | | | | | | | |
| | 9 | reserved | | | | | | | | |

Table 13: Assembly instance data formats.

### 3.7. Parameter Object – 0Fhex

The parameter object is implemented in compliance with the CIP Specification.
The object revision is 1. The class code is 0Fh.

In Table 14, the provided class attributes are listed. Class attributes are addressed via instance 0.

The service
- 0Eh Get Attribute single
can be applied on the class attributes of the parameter object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 1 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 16 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 16 |
| 4 | read | Optional attribute list | STRUCT of | List of supported optional instance attributes | |
| | | Number of attributes | UINT | Number of supported optional instance attributes | 0 |
| | | Optional attributes | ARRAY of UINT | Number of optional instance attribute numbers | 0 |
| 8 | read | Parameter Class Descriptor | WORD | Bit information which describes the parameters | 0x000B |
| 9 | read | Configuration Assembly Instance | UINT | Instance number of the configuration assembly instance | 105 |

Table 14: Class attributes of the parameter object

The class attribute 8 Parameter Class Descriptor provide the following bit information:

*Bit 0: = 1 A parameter object instance is available for each parameter.*
*Bit 1: = 1 Each parameter instance contains all attributes.*
*Bit 2:= 0 Automatic data saving upon writing of error-free response*
*Bit 3: = 1 Non-volatile saving of all parameters*

The following table contains all supported instance attributes of the parameter object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read / write | Parameter Value | Defined in attributes 4, 5 and 6 | Current value of the parameter. The attribute is read only if bit 4 of attribute 4 is set. | |
| 2 | read | Link Path Size | USINT | Size of the link path (attribute 3) | No. of bytes |
| 3 | read | Link Path | Packed EPATH | CIP path to object, instance and attribute from which the parameter value is received | |
| 4 | read | Descriptor | WORD | Description of parameter object instance characteristics | |
| 5 | read | Data Type | EPATH | Data type code | |
| 6 | read | Data Size | USINT | No. of bytes of the parameter value (attribute 1) | |
| 7 | read | Parameter Name String | SHORT STRING | ASCII string with prefixed length of the parameter name | |
| 8 | read | Units String | SHORT STRING | ASCII string with prefixed length of the parameter unit (00 if the parameter value has no unit) | |
| 9 | read | Help String | SHORT STRING | ASCII string with prefixed length of the help description | |
| 10 | read | Minimum Value | Defined in attributes 4, 5 and 6 | Minimum value on which the parameter can be set | |
| 11 | read | Maximum Value | Defined in attributes 4, 5 and 6 | Maximum value on which the parameter can be set | |
| 12 | read | Default Value | Defined in attributes 4, 5 and 6 | Default value of the parameter if no change has been carried out | |
| 13 | read | Scaling Multiplier | UINT | Value for scaling factor | 1 |
| 14 | read | Scaling Divisor | UINT | Divisor for scaling calculation | 1 |
| 15 | read | Scaling Base | UINT | Basis for scaling calculation | 1 |
| 16 | read | Scaling Offset | INT | Offset for scaling formula | 0 |
| 17 | read | Multiplier Link | UINT | Parameter Instance of the multiplier value (0, if no parameter) | 0 |
| 18 | read | Divisor Link | UINT | Parameter instance of the divisor values (0, if no parameter) | 0 |
| 19 | read | Base Link | UINT | Parameter instance of the basis values (0, if no parameter) | 0 |
| 20 | read | Offset Link | UINT | Parameter instance of the offset values (0, if no parameter) | 0 |
| 21 | read | Decimal Precision | USINT | Specifies the number of decimal places where an integer value has to be interpreted with decimal places in the used unit. | 0 |

Table 15: Parameter object, instance attribute

The services
- 01h Get Attribute all
- 0Eh Get Attribute single
-10h Set Attribute single
can be used on the instance attributes of the parameter object

The following bits of the instance attribute 4, descriptor can be set in the parameter instances of the Baumer bus cover and have the following meaning:

***Bit 4: The parameter value is read only and can only be read.***
***Bit 5: The parameter value is updated in real time by the device.***

> ***Note***
> ***Writable parameter values are saved as non-volatile data in the device after a successful write access. Writing to the internal flash takes place when the new parameter value is distinguished from the old one and is accepted by the system as valid.***

By means of the scaling attributes (instance attributes 13 to 16 and 21), integer parameter values can be displayed in other formats. The following formula applies for calculation of the value to be depicted:

$$\text{Value to be depicted} = \frac{(\text{Actual Value (Attr. 1)} + \text{Offset (Attr. 16)}) \times \text{Mult (Attr. 13)} \times \text{Base (Attr. 15)}}{\text{Div (Attr. 14)} \times 10^{\text{Precision (Attr. 21)}}} \quad (6)$$

> ***Note***
> ***In the current firmware, only the default units (C = Count for position values) and CPS = Counts per second for velocity values) are supported by the encoder. Consequently the formula (6) always results in: Value to be depicted = Actual value (attr. 1)***

Parameter instances always contain attributes from instances of other objects (for path see parameter instance attribute 3) as a source. In table 16, the individual parameter instances are named with their sources and important characteristics.
The functional significance of the parameter values corresponds to the functional description of the respective instance attributes of the source objects and is described in the relevant sections of the manual.

.

| Para-meter instance | Source object | Source instance | Source attribute | Parameter name | Minimum value | Maximum value | Default value |
|---|---|---|---|---|---|---|---|
| 1 | Position Sensor Object | 1 | 12 | DirCountToggle | 0 | 1 | 0 |
| 2 | Position Sensor Object | 1 | 16 | MeasUnitsPerSpan | 1 | See table 9.a | See table 9.a |
| 3 | Position Sensor Object | 1 | 17 | TotMeasRangeinUn | See table 9.a | See table 9.a | See table 9.a |
| 4 | Position Sensor Object | 1 | 19 | PresetValue | 0 | Smaller than set overall measurement range (see parameter instance 3) | 0 |
| 5 | Position Sensor Object | 1 | 10 | PositionValue | 0 | Set overall measurement range (see parameter instance 3) | 0 |
| 6 | Position Sensor Object | 1 | 42 | PhysResolSpan | See table 9.a | See table 9.a | See table 9.a |
| 7 | Position Sensor Object | 1 | 43 | NumberOfSpan | See table 9.a | See table 9.a | See table 9.a |
| 8 | Position Sensor Object | 1 | 46 | AlarmFlag | 0 | 1 | 0 |
| 9 | Position Sensor Object (23h) | 1 | 44 | Alarms | 0 | D003hex | 0 |
| 10 | Position Sensor Object | 1 | 45 | SupportedAlarms | D003hex | D003hex | D003hex |
| 11 | Position Sensor Object | 1 | 49 | WarningFlag | 0 | 1 | 0 |
| 12 | Position Sensor Object (23h) | 1 | 47 | Warnings | 0 | 2010hex | 0 |
| 13 | Position Sensor Object | 1 | 48 | SupportedWarnings | 2010hex | 2010hex | 2010hex |
| 14 | Position Sensor Object | 1 | 24 | Velocity | 0 | FFFFFFFFhex | 0 |
| 15 | Position Sensor Object | 1 | 100 | Velocity Sample Rate | 1 | 255 | 1 |
| 16 | Position Sensor Object | 1 | 101 | Velocity Filter | 1 | 255 | 1 |

Table 16: Parameter object instances - characteristics

# 4. EtherNet/IP-specific objects

## 4.1. Introduction

The Baumer bus cover has two physical Ethernet ports P1 and P2 with integrated switch technology.
Both physical ports use a common MAC address and a common IP address.
Both ports support auto-negotiation and automatically set the duplex mode and the interface speed.

The EtherNet/IP-specific objects existing in the bus cover and their mutual relationships.

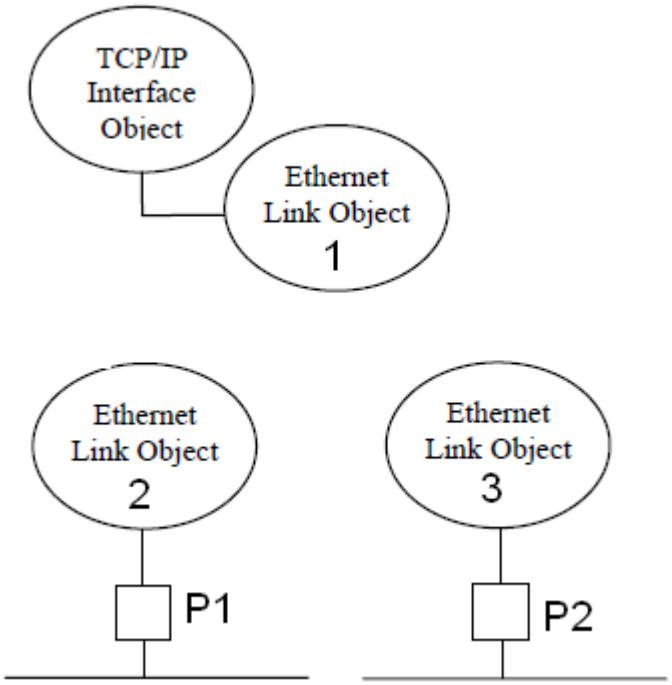



Fig. 3: Illustration of the existing EtherNet/IP-specific objects

Writing to the communication interface of the Baumer bus cover is carried out by an instance of the TCP / IP interface object and a total of 3 instances of the Ethernet link object.
Writing to the two physical Ethernet ports P1 and P2 is carried out by the instances 2 and 3 of the Ethernet link object. Instance 1 of the Ethernet link object is required for writing to the internal device port of the integrated switch.

## 4.2. Ethernet Link Object – F6hex

The Ethernet link object is created in accordance with the Common Industrial Protocol Specification. The object revision is 3. The class code is F6h.

In Table 17, the available class attributes are listed. Class attributes are addressed via the instance 0.

The services
- 01h Get Attribute all
- 0Eh Get Attribute single

can be applied on the class attributes of the Ethernet link object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 3 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 3 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 3 |
| 4 | read | Optional attribute list | STRUCT of | List of supported optional instance attributes | |
| | | number of attributes | UINT | Number of supported optional instance attributes | 3 |
| | | optional attributes | ARRAY of UINT | Number of optional instance attribute numbers | 7, 8, 10 |
| 6 | read | Maximum ID Number Class Attributes | UINT | Attribute number of last class attribute | 7 |
| 7 | read | Maximum ID Number Instance Attributes | UINT | Attribute number of last instance attribute | 10 |

Table 17: Class attributes of the Ethernet link object

Instances of the Ethernet link Object

| Instance | Significance |
|---|---|
| 1 | intern |
| 2 | Port P1 |
| 3 | Port P2 |

Table 17.a: Instances of the Ethernet link Object

The following table contains all supported instances of the Ethernet link object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Interface Speed | UDINT | Current speed of the interface | |
| 2 | read | Interface Flags | DWORD | Interface status flags, see also the description below | |
| 3 | read | Physical Address | ARRAY of 6 USINT | MAC address | |
| 7 | read | Interface Type | USINT | Interface type, see also the description below | |
| 8 | read | Interface State | USINT | General interface status, see also the description below | |
| 10 | read | Interface Label | SHORT_ STRING | Readable interface identification | |

Table 18: Ethernet link object, instance attributes

Instance attribute 2 (interface flags) has the following meaning:

***Bit 0: Link Status:*** ***= 1 Active link exists***
***Bit 1: Half/Full Duplex:*** ***= 0 Half duplex***
***= 1 Full duplex***
***Bits 2-4: Status Negotiation:*** ***= 0 Auto negotiation in execution***
***= 1 Error in auto negotiation and speed detection. Default values are used.***
***= 2 Error in auto negotiation but speed detected. The default value for the duplex mode is used.***
***= 3 Auto negotiation successfully completed. Duplex Mode and speed detected.***
***= 4 Auto negotiation not completed. Values for speed and duplex mode forced.***
***Bit 5 Manual Settings required Reset:*** ***= 0 The interface can automatically adopt changes of attributes of the Ethernet link objects and does not require a reset for activation***
***Bit 6: Local Hardware Fault*** ***= 0 No hardware error detected***
***= 1 Hardware error detected***

***Bits 7-31: reserved***

The interface type (instance attribute 7) has the value 1 for internal interfaces (corresponds to instance 1 of the Baumer bus cover) or the value 2 (twisted pair interface for object instances 2 and 3).

The interface state attribute (instance attribute 8) has the following meaning:
***0: The interface status is unknown***
***1: The interface is ready to transmit and receive data***
***2: The interface is switched off***
***3: The interface is in the test mode***
***4-256: reserved***

The services
- 0Eh Get Attribute single
- 01h Get Attribute all

can be applied on the instance attribute of the Ethernet link object.

### 4.3. TCP/IP Interface Object – F5hex

Das TCP/IP interface object is created in accordance with the CIP Specification.
The object revision is 1. The class code is F5h.

In Table 19, the available class attributes are listed. Class attributes are addressed via the instance 0.

The services
- 0Eh Get Attribute single
- 01h Get Attribute all

can be applied on the class attributes of the Ethernet interface object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Revision | UINT | Object revision | 1 |
| 2 | read | Max Instance | UINT | Highest instance number existing in this class | 1 |
| 3 | read | Number of Instances | UINT | Number of existing instances | 1 |
| 4 | read | Optional attribute list | STRUCT of | List of supported optional instance attributes | |
| | | number of attributes | UINT | Number of supported optional instance attributes | 2 |
| | | optional attributes | ARRAY of UINT | List of optional instance attribute numbers | 8, 9 |
| 6 | read | Maximum ID Number Class Attributes | UINT | Attribute number of last class attribute | 7 |
| 7 | read | Maximum ID Number Instance Attributes | UINT | Attribute number of last instance attribute | 9 |

Table 19: Class attributes of the TCP/IP interface object

The following table contains all supported instance attributes of the TCP/IP interface object.

| Attribute ID | Access | Name | Data type | Description | Values |
|---|---|---|---|---|---|
| 1 | read | Status | DWORD | Interface status, see also the description below | |
| 2 | read | Configuration Capability | DWORD | Interface characteristics, see also the description below | 14hex |
| 3 | read / write | Configuration Control | DWORD | Interface control flags, see also the description below | |
| 4 | read | Physical Link Object | STRUCT of | Path to the physical link object | Path to the Ethernet link object, instance 1 |
| | | Path size | UINT | Size of the path (number 16 bit words in the path) | 2 |
| | | Path | Padded EPATH | Path | 20 F6 24 01 |
| 5 | read / write | Interface configuration | STRUCT of | TCP/IP network configuration | |
| | | IP Address | UDINT | IP address of the device | |
| | | Network Mask | UDINT | Network mask of the device | 0 = No network mask configured |
| | | Gateway Address | UDINT | Gateway address of the device | 0 = no gateway address configured |
| | | Name Server | UDINT | Primary name server of the device | 0 = No primary name server configured |
| | | Name Server 2 | UDINT | Secondary name server of the device | 0 = No secondary name server configured |
| | | Domain Name | STRING | Default domain name | ASCII characters, maximum length = 48 characters<br>Is padded to an even number of characters |
| 6 | read / write | Host Name | STRING | Host name of the device | ASCII characters, maximum length = 64 characters<br>Is padded to an even number of characters |
| 8 | read / write | TTL Value | USINT | TTL (Time to live) value for EtherNet /IP multicast frames | |

| | | | | | |
|---|---|---|---|---|---|
| 9 | read | Mcast Config | STRUCT of | IP Multicast address configuration, see also description below | |
| | | Alloc Control | USINT | Multicast address allocation control word, determines how addressed are allocated | |
| | | reserved | USINT | ODVA, reserved for possible future upgrades | 0 |
| | | Num Mcast | UINT | Number of IP multicast addresses allocated for EtherNet/IP | |
| | | Mcast Start Addr | UDINT | Start address from which the multicast addresses are allocated (class D address) | |

Table 20: TCP/IP interface object, instance attributes

Attribute 1 (status) has the following meaning:

***Bits 0 - 3: Interface configuration Status:***
***= 0: The interface configuration attribute (attribute 5) has not been configured.***
***= 1: The interface configuration attribute (attribute 5) contains valid values taken from the BOOTP, DHCP or from the internal flash memory.***
***= 2: The interface configuration attribute (attribute 5) contains valid values taken from the hardware settings (HEX Rotary-switches).***
***= 3-15: reserved***

***Bit 4: Mcast Pending:***
***= 1 This bit is set if the TTL value attribute (attribute 8) or the mcast config attribute (attribute 9) has been changed and is deleted on the next device start. The configuration changes carried out are stored in the device.***

***Bits 5 – 31: reserved***

Attribute 2 (configuration capability) has the following meaning:

***The device returns the value 14hex, which means:***
***04 hex: The bus cover has DHCP client functionality and can acquire the network configuration via DHCP.***
***10 hex: The interface configuration attribute is writable.***

***Note***
***The device does not have a DNS client and does not transmit the host name in the DHCP request.***

Using attribute 3 (configuration control) it is possible to set how the device acquires the initial setting of the interface configuration attribute (attribute 5). A change of attribute 3 (configuration control) without error message is immediately stored in the device's internal flash memory. The following values can be set:

***0: The device reads its configuration from the internal flash memory or from Hardware-Rotary switches.***
***2: The device acquires its configuration via DHCP (default setting).***

> ***Note***
> ***When changing the attribute value from 2 to 0, the interface configuration setting (attribute 5) is also stored in the internal flash memory of the device. For this reason, the attribute value 0 is only accepted if the interface configuration (attribute 5) contains valid values at this point in time.***

The value of alloc control as a component of the mcast config (attribute 9) has the following meaning:

***0: For generation of the multicast addresses, the specified allocation algorithm is used. If this value is written, the values for Num Mcast and Mcast Start Addr of the Attribute in the set access must be transferred with 0.***
***1: The multicast addresses are allocated in accordance with the value for Num Mcast and Mcast Start Addr of the attribute.***
***2: Reserved***

The services
- 0Eh Get Attribute single
- 01h Get Attribute all
- 10h Set Attribute single
- 02h Set Attribute all

can be applied on the instance attributes TCP/IP interface object.

# 5. Commissioning

## 5.1. Electrical connection

Ever store and transport the bus cover in the ESD bag only.

For electrical connection remove the bus cover as follows:

- Release the fastening screws of the bus cover
- Carefully loosen the bus cover and lift off in an axial direction

### 5.1.1. Cabling

EtherNet/IP utilizes Fast Ethernet cable (100MBit, Cat 5) composed of four wires AWG22 (white, yellow, blue and orange).
There are three types of EtherNet/IP cables:

- Type A – for fix or rigid cabling
- Type B – for occasional movements or vibrations (flexible)
- Type C – for permanent movements (highly flexible).

### 5.1.2. Connecting the bus cover

The bus cover provides three M12 connectors.
Two M12 connectors (D-coded, according IEC 61076-2-101) serve for EtherNet/IP implementation.

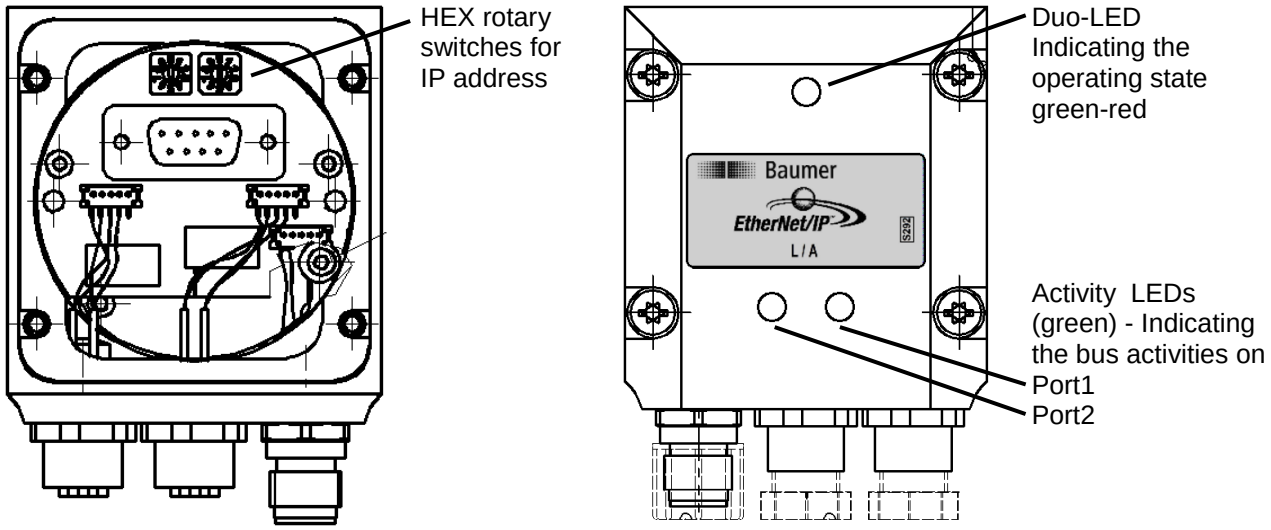



Fig. 4: Bus cover – electrical assignment and LEDs

- For voltage supply use A-coded M12 connector only.
- For the bus lines both D-coded M12 connectors may be used at will.
- Seal up the unused cable gland using a sealing bolt (included in the delivery).

*The IP address can be set via two HEX rotary switches inside the bus cover (see section 7). There is no need to carry out further manual settings inside the bus cover.*

**Pin assignment**

**Supply voltage**


1 x M12 (connector)
A-coded

| Pin | Assignment |
|---|---|
| 1 | UB (10...30 VDC) |
| 2 | N.C. |
| 3 | GND |
| 4 | N.C. |

**EtherNet/IP (data line)**


2 x mating M12 (female)
D-coded

| Pin | Assignment |
|---|---|
| 1 | TxD+ |
| 2 | RxD+ |
| 3 | TxD- |
| 4 | RxD- |

**Assembly of basic encoder and bus cover**

- Carefully plug the bus cover onto the D-SUB connector of the basic encoder, then press it over the seal and take care not to tilt.
- Tighten both fastening screws firmly in the same direction.
- The bus cover must fully rest on the housing of the basic encoder and be firmly screwed on.

*The encoder housing and braided shield of the connecting cable are only ideally connected if the bus cover is resting fully on the basic encoder (form-locking)..*

If bus cover was removed from basic encoder, make sure supply is stable for at least 2 seconds at next power-on. Otherwise MAC ID and serial number may be deleted.

## 5.2. Operating display (multi-colour LED)

A DUO LED (green and red) is located in the bus cover. This reflects the machine status of the position sensor object in accordance with Ethernet/IP specifications and provides information on the encoder status.

| LED status | Status | Description |
|---|---|---|
| Off | Not connected | No power supply |
| Green flashing | Device is active and online, no connection exists | The device is operating under normal conditions and is online. No connection has been established to a scanner.<br>- Encoder has not yet been configured by the scanner<br>- Configuration not complete or faulty |
| Green | Device is active and online Connections have been established | The device is operating under normal conditions and is online, connections are in the Established status |
| Red | Critical device fault or critical communication error | The device is in an irreparable error status |
| Red flashing | Recoverable fault | I/O connections are in the time-out status |
| 2 Hz green/red | Self-test | Immediately on connection of supply voltage, the device carries out a self-test. |

Table 22: LED operating display statuses

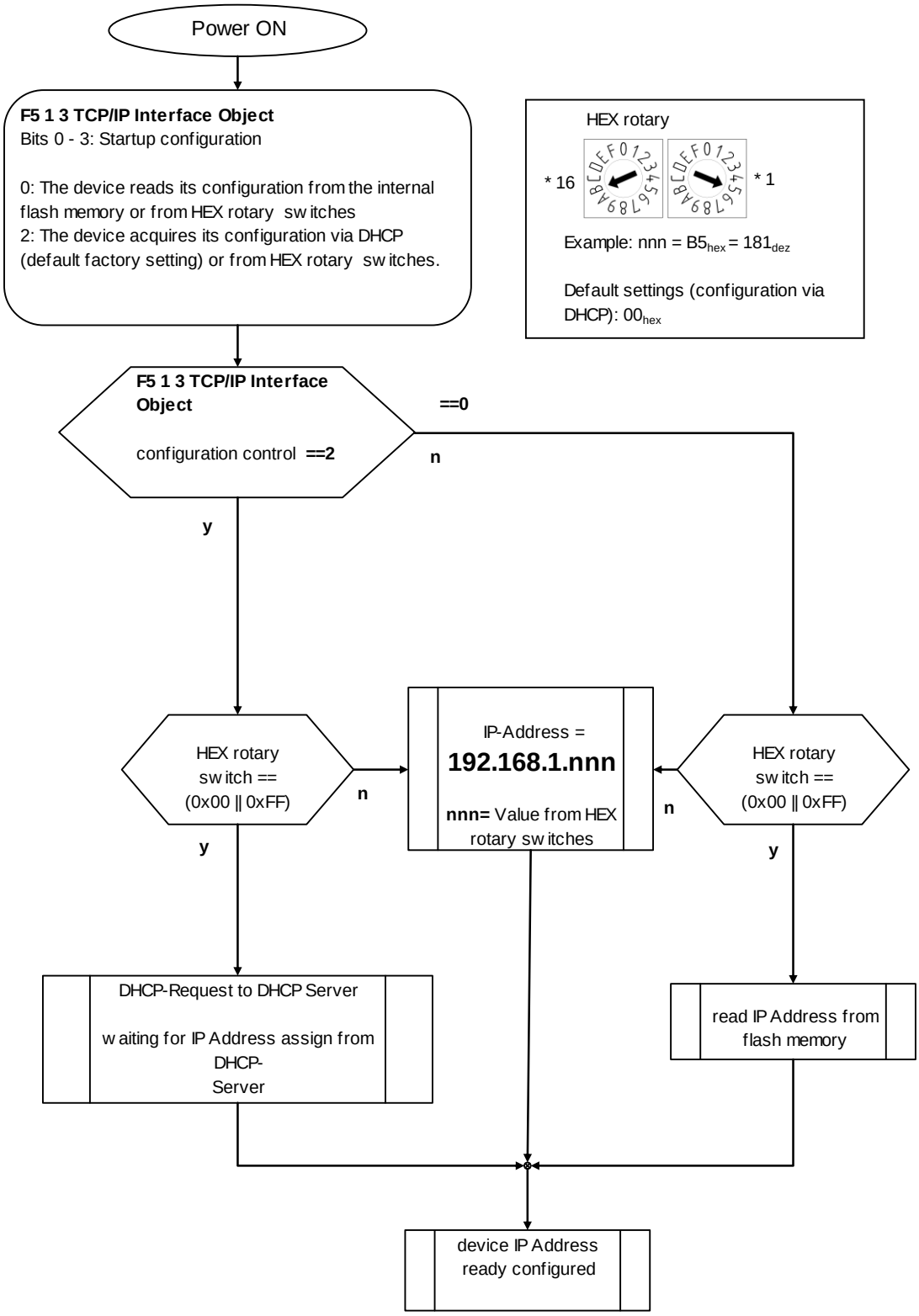
## 5.3. Activity display (green LEDs)

In the bus cover, another two green LEDs are integrated. These indicate data traffic at the two ports P1 and P2. In case of occasional data traffic (e.g. during ramp-up), the LEDs flash intermittently, but in the event of fast cyclical data exchange can appear as if permanently on.
Immediately after connection of the supply voltage, both LEDs carry out a self-test with a frequency of 2 Hz.

# 6. IP address allocation

For operation of the EtherNet/ IP encoder, the device must be allocated an IP address. This can be issued statically once only, or can be allocated again dynamically every time the device is switched on.
Devices featuring two HEX rotary switches will be allocated their IP address by the following procedure:

## 6.1. EtherNet/IP bus cover with HEX rotary switches: IP-assignment after Power On



## 6.2. Allocate IP address with BOOTP/DHCP configuration tool

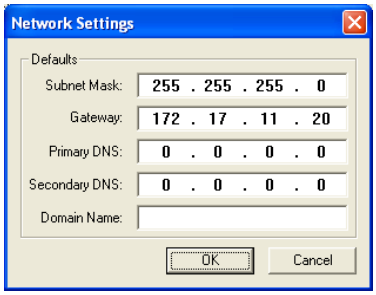
Factory Device default is mode **„IP Address over DHCP-Request“**

The IP address must be allocated by a DHCP server.
This DHCP server (software) can be obtained as freely available software from the Allen-Bradley Rockwell website.

www.ab.com/networks/ethernet/bootp.html

The DHCP server must be in the same network as the encoder.

Carry out the relevant settings under *Tools, Network Settings*




After installation, a connected Ethernet/IP encoder registers as follows:

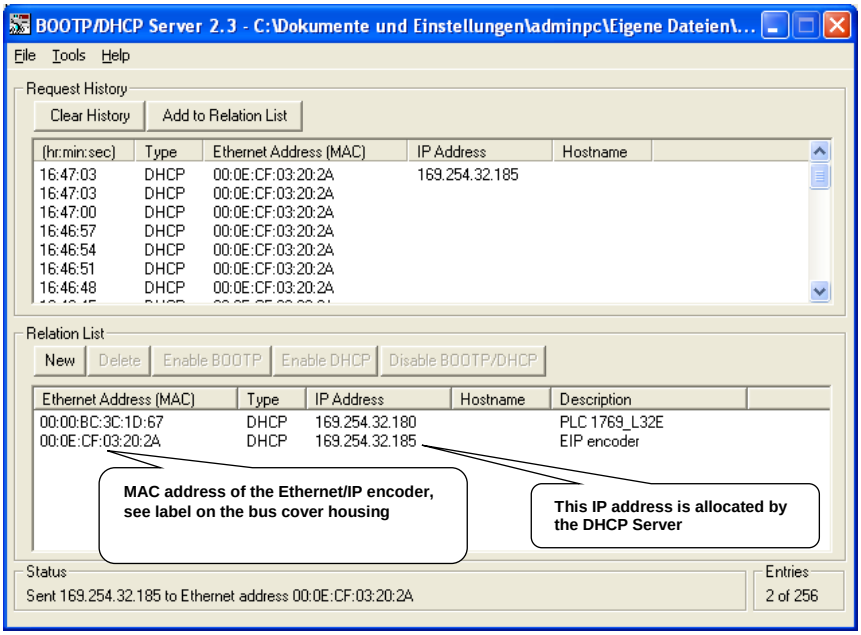
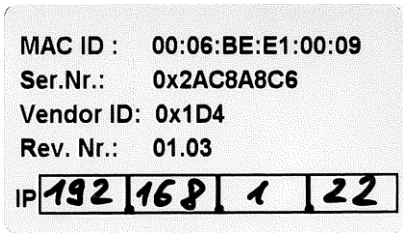



Fig. 5:DHCP server tool

Using the ***Disable BOOT/DHCP*** button (answer on successful execution: Command successful) this IP address can be statically allocated, i.e. the next time the encoder is switched on and off, no further request is sent to the DHCP Server. The encoder operates from now on with the previously assigned IP address. **„IP address out of internal flash“.**

***Note:***
***Please carefully put down any updated IP address in the field provided on the product label (to prevent any future problems in operation in other networks, refer also to annex FAQs.)***




Example: Product label with hand-written IP address

Instance attributes 3 of TCP/IP object, class code: $F5_{Hex}$ holds IP Addressing Mode

| Class ID | Attribute ID | Access | Name | Data type | Description |
|---|---|---|---|---|---|
| 0xF5 | 3 | read/ write | Configuration Attribute | DWORD | Determines how the device receives its initial configuration after switching on |

Table 23: Attribute 3 TCP/IP object

**Values**
**0 =** Interface configuration out of non-volatile memory **or** by Hardware (HEX rotary switch)
**2 =** Interface configuration via DHCP server (factory setting)

## 6.3. RSLinx Classic Lite

RSLinx Classic Lite for Rockwell Automation networks and devices is an operating communication solution for a large number of Rockwell Software and Allen-Bradley applications.
RSLinx Classic Lite has the minimum functionality required to support RSLogix and RSNetWorx.
This version is not commercially available, but is included in the scope of supply of products which only require direct access to RSLinx classic network drivers.

RSLinx classic lite can be used for the following processes:
- Programming of contact plan logic with the aid of RSLogix products.
- Network and device configuration and diagnosis with the aid of RSNetWorx.
- Configuration of Ethernet modules / devices (e.g. 1756-ENET, 1756-DHRIO etc.).
- Browsing networks and scanning device information (e.g. firmware version number).

## 6.4. RSWho

RSWho is the main window of RSLinx Classic Lite and is similar to the graphic display of networks and devices in the Windows Explorer.
The left-hand window area of RSWho is the directory control area which displays networks and devices.

In this example, the encoder previously configured with the DHCP server in the network is shown alongside the IP address.

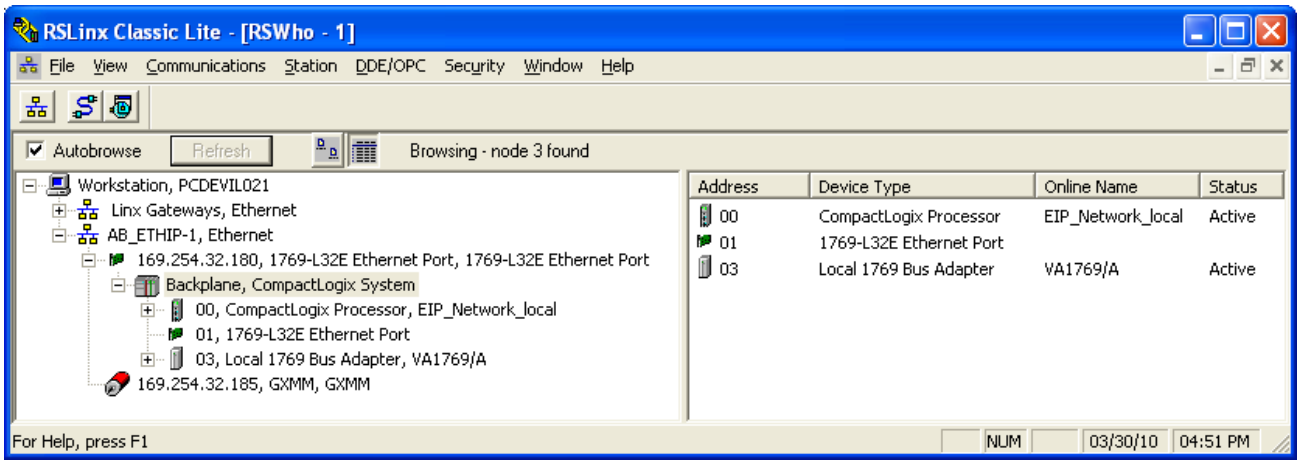



Fig. 6: View under RSLinx Classic Lite

# 7. Device configuration

## 7.1. Introduction

On principle, the encoder with the parameters preset in the factory is ready for operation. Despite this, after setting the IP address as described in section 7, it will be necessary to adjust the encoder configuration for the relevant application.

The encoder properties which will require adjusting include:

***- Sense of rotation / definition of the counting direction***
***- Measurement range within a rotation***
***- Total measurement range of the encoder***
***- Matching the encoder coordinate system with the coordinate system of the application (preset value)***

All the specified characteristics are saved immediately following an error-free transmission as non-volatile values in the device. However, the save process is only initiated if a value is changed. A repeat transmission of identical values does not initiate a save routine.

There are 3 independent mechanisms with identical rights available which can be used but which do not each individually have to be used. It makes sense and may be necessary to combine several different mechanisms (please observe the following note regarding setting the preset value).
The next 3 sections describe examples of the encoder configuration for each of these mechanisms.

***Note***
***Matching the coordinate systems using the preset value is not possible in the case of the configuration assembly instance, as transmission of the configuration assembly instance takes place with the Forward Open Frames function while establishing communication.***
***Setting the position value is not customarily linked to the time at which a cyclical connection is established.***
***The preset value can be set for instance by using the parameter object, while all other settings are carried out using the configuration assembly instance.***

## 7.2. Using the parameter object

When using the parameter object (class code 0Fhex), configuration takes place over the set attribute single service of the instance attribute (parameter value).
In order to check the required setting value, the admissible setting range of the parameter can be previously determined by reading the minimum value (instance attribute 10) and the maximum value (instance attribute 11).
As the setting limits of the encoder's total measurement range are calculated at a certain time from the currently set measurement range within a revolution, the measurement range should be set within a revolution before the encoder's total measurement range. Fig. 7 illustrates the schematic sequence of encoder configuration using the parameter object.

If invalid setting values are written (e.g. setting value outside the setting range of the parameter), the encoder rejects the value with an error message (see Fig. 8, status = 0x03hex).

If the set attribute single service is performed without errors, the status 0x00 hex is returned.

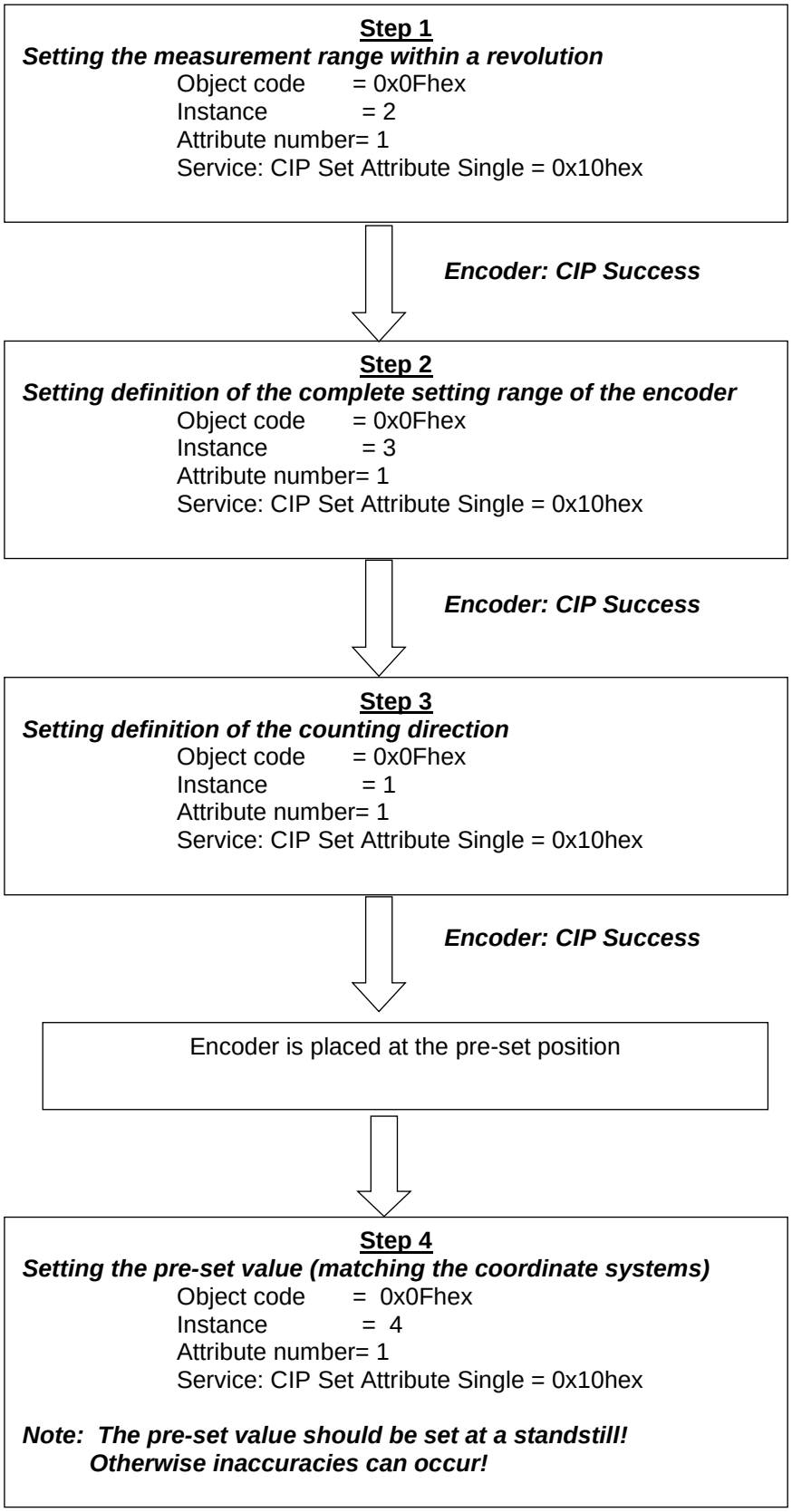



Fig. 7: Encoder configuration with the parameter object

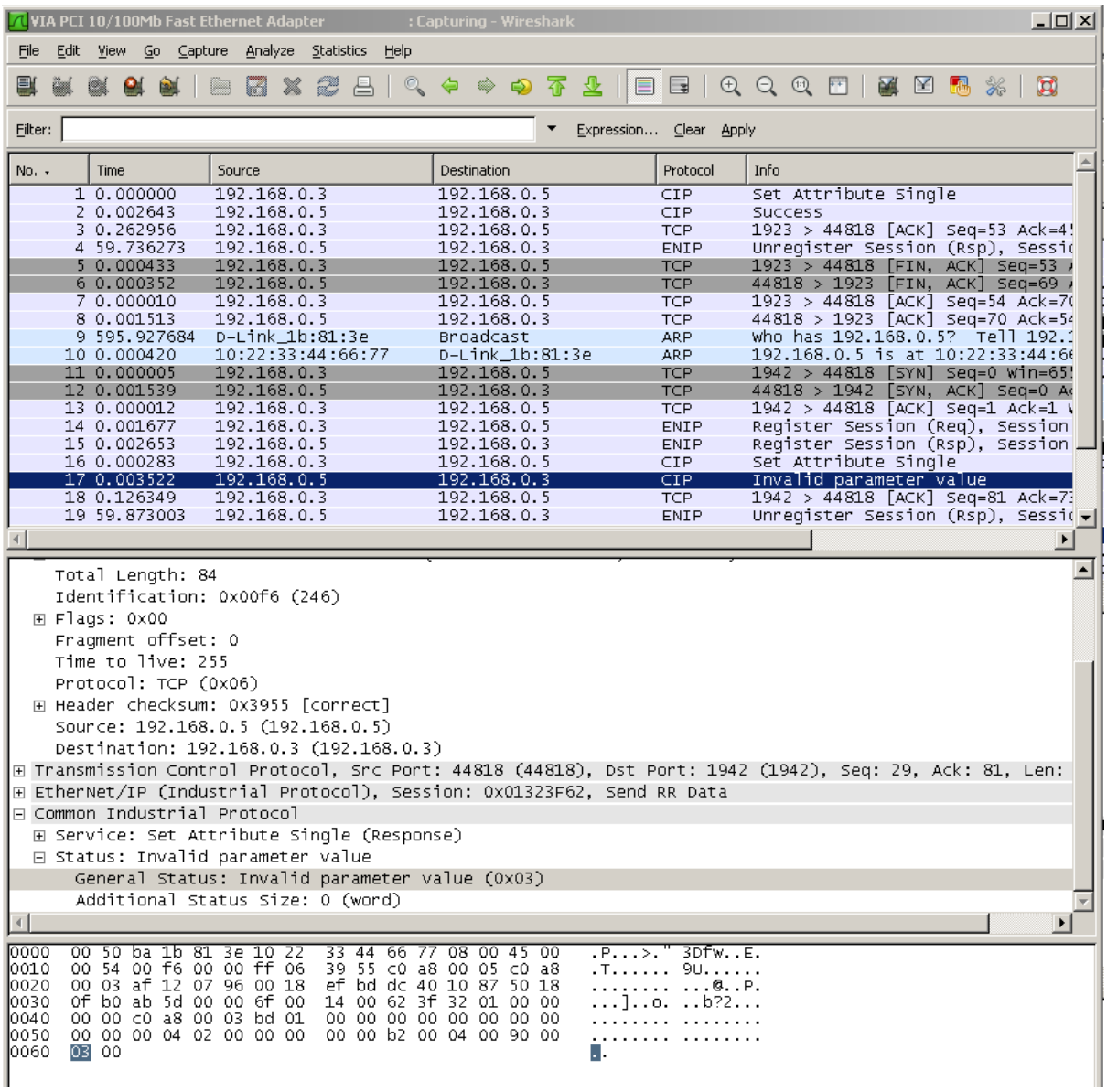



Fig. 8: Record of a faulty set attribute single service

From the viewpoint of the encoder, configuration of the setting values (steps 1-4 in Fig. 7) can only be carried out only once.
From the point of view of the application, it can also make sense to execute steps 1-3 for instance after switching on the encoder.

The parameter object also offers the possibility of reading out text strings for the parameter names, the parameter unit and a help text from the encoder in compliance with the “Common Industrial Protocol Specification”. The language used is English.

## 7.3. Application of the configuration assembly instance 105

When using configuration assembly instance 105, configuration of the encoder takes place with transmission in the Forward Open Frame while establishing the connection (see Fig. 9).

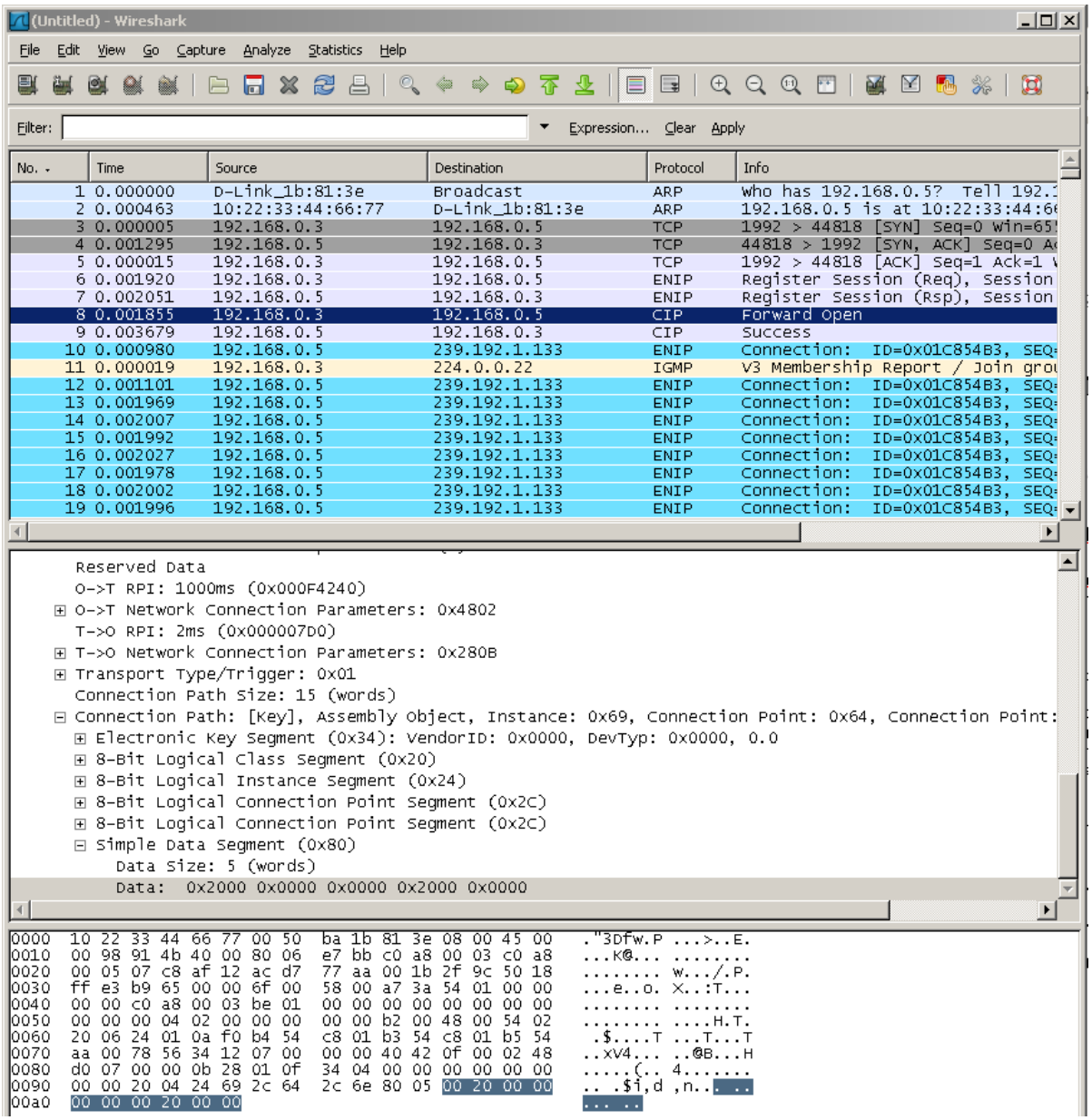



Fig. 9: Configuration assembly instance 105 in the Forward Open Frame

As only one exclusive owner connection is accepted at any time by the bus cover (see also section 4.6), this connection type can be used, for example, in order to transmit the configuration assembly instance.

The data structure of the assembly instance 105 is shown in table 13 on page 22. The data is taken individually from the bus cover in the following sequence:

***1. Setting the measurement range within a revolution (measuring units per span)***
***2. Setting the total measurement range of the encoder (total measuring range in measuring units)***
***3. Setting the definition of the counting direction (direction counting toggle)***

Transfer of the configuration data takes place internally in the device via the parameter object. This ensures that the transfer of configuration values takes place after the same checks as with direct utilization of the parameter object (see section 8.2).

If an error is detected in the data of the configuration assembly instance, no connection is established. The connection is rejected on the part of the encoder with a connection failure frame (see Fig. 10, status = 0x01, additional status = 0x0118).

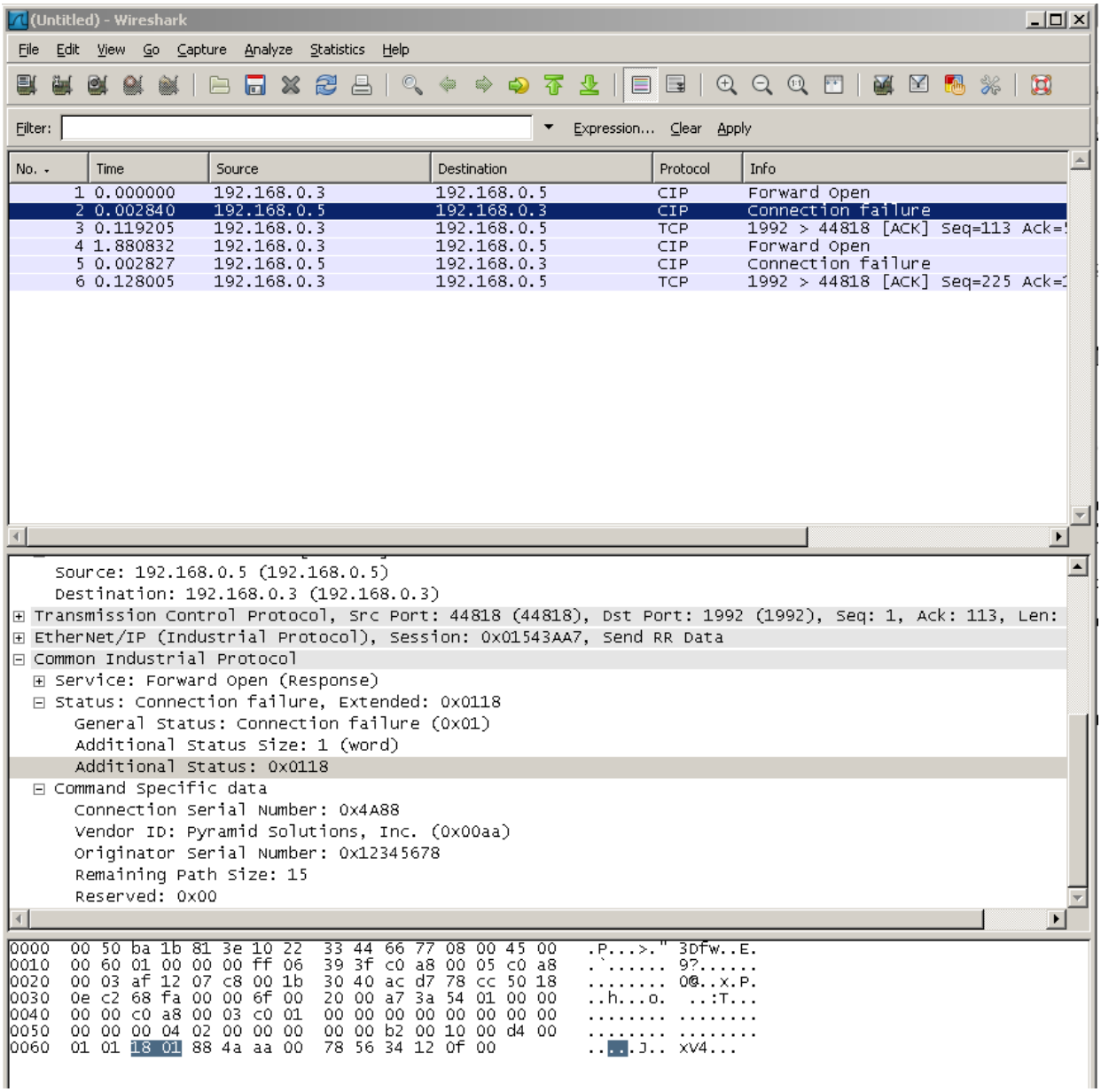



Fig. 10: Connection failure frame due to incorrect value in the assembly instance 105

***Note***
***Even with incorrect data in assembly instance 105, a part of the configuration data may have become effective!***
***If for instance an incorrect value were written for the counting direction, but the values for setting the measurement range within a revolution and for setting the total measurement range of the sensor were still valid, then these two values would already have been accepted by the encoder before the connection was rejected.***

When setting the preset value (matching the coordinate systems), note that the preset value has to be performed again with each change of the measurement range setting within a revolution, or of the encoder's total measurement range (see section 4.4).
For this reason, when using the assembly instance 105 for encoder configuration, ensure that before first setting the preset value (matching the coordinate system) error-free transmission of the assembly instance 105 has taken place at least once.

From the point of view of the encoder, it is also the case for utilization of the configuration assembly instance that the encoder configuration only has to be transmitted once.
From the point of view of the application, transmission must take place at least with each exclusive owner connection.

## 7.4. Direct application of the position sensor object

The procedure for direct utilization of the position sensor object to configure the encoder only differs marginally from utilization of the parameter object (see section 8.2).

Configuration takes place by means of the set attribute single service of the relevant instance attribute of the position sensor object (23hex).
Direct writing of the position sensor object uses the same control functions for data checking as the parameter object.
If invalid setting values are written (e.g. setting value outside the setting range of the attribute), the sensor rejects the value with an error message. (See also Fig. 8, status = 0x03hex).

In the event of error-free execution of the set attribute single service, the status 0x00 hex is returned.

From the point of view of the encoder, the configuration of setting values (steps 1 – 4 in Fig. 11) only needs to be performed once.
However, from the point of view of the application, it may make sense for example to carry out steps 1- 3 every time the encoder is switched on.

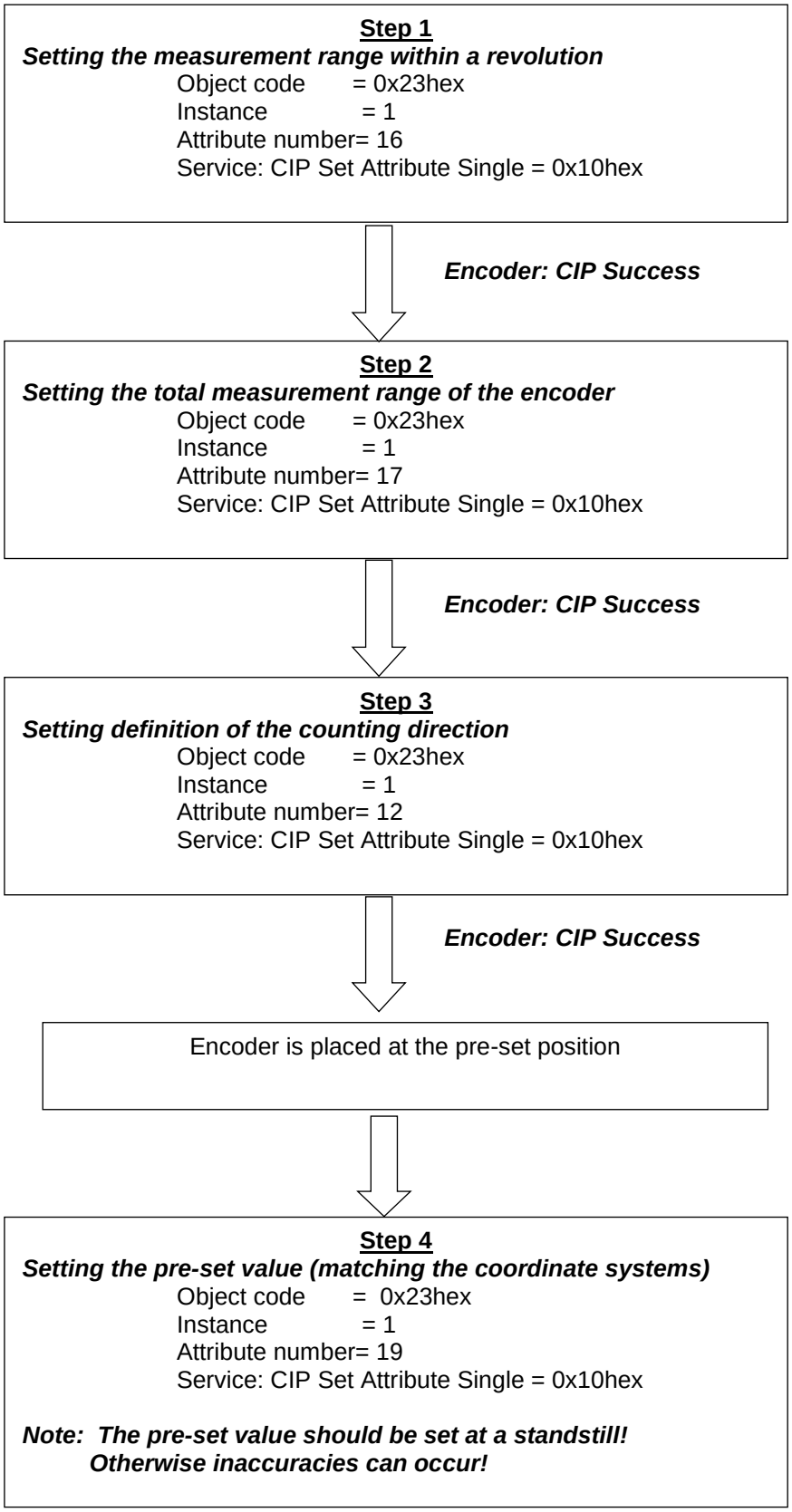



Fig. 11: Encoder configuration with the position sensor object

# 8. RSLogix5000 project example

## 8.1. Reading in the input data

- Create a new project under RSLogix5000
- Select New Module
- Select ETHERNET MODULE Generic Ethernet

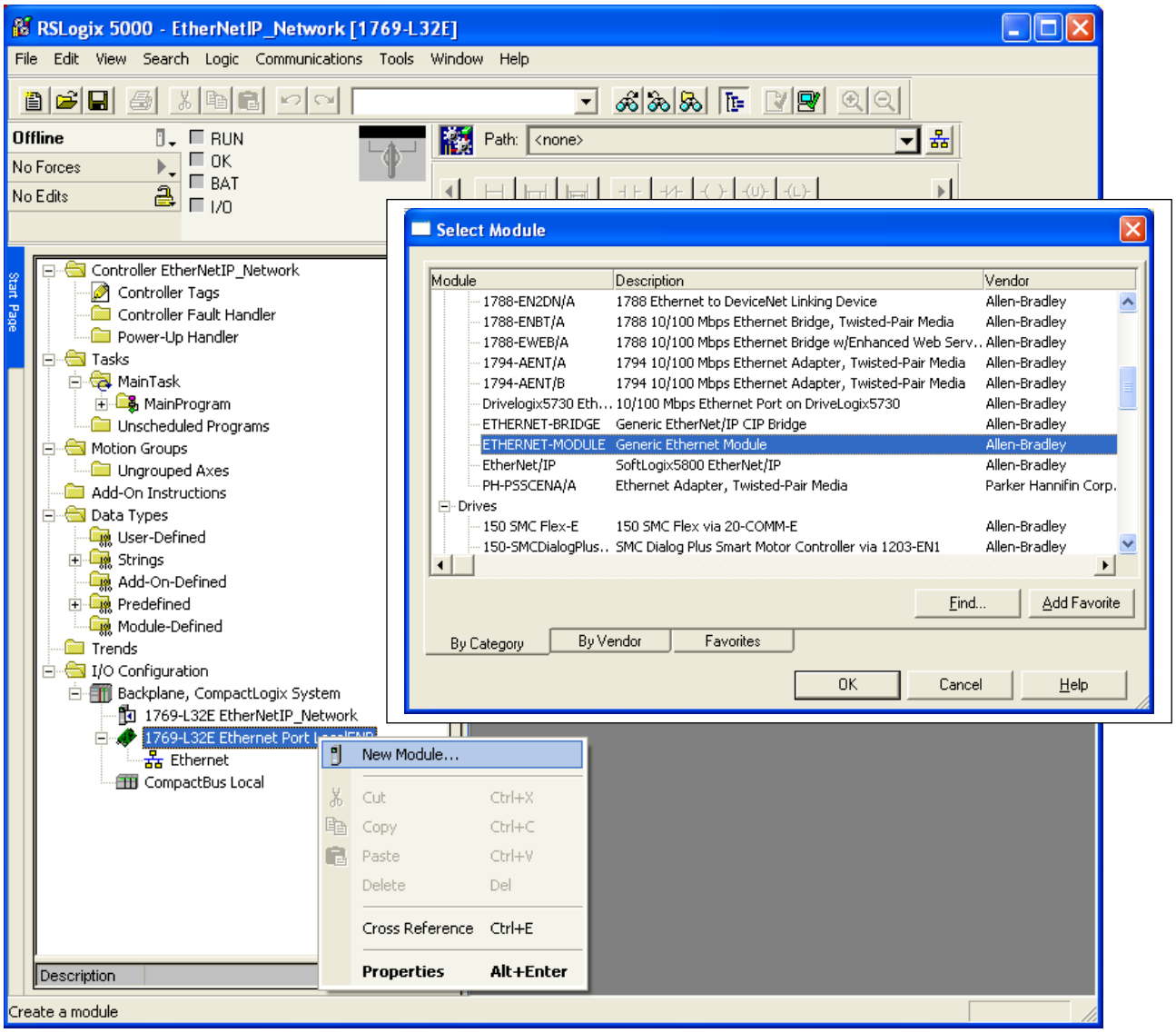



Fig. 12: Generic Ethernet Module

### 8.1.1. Configure Generic Ethernet Module

Select assembly instance (see chapter I/O assembly instances)

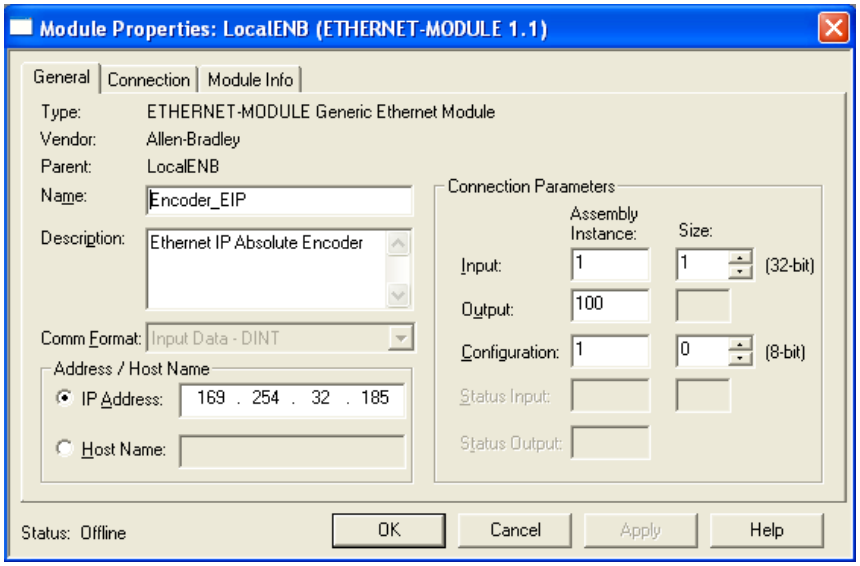



Fig. 13: Configuration assembly instances

Select requested packet interval

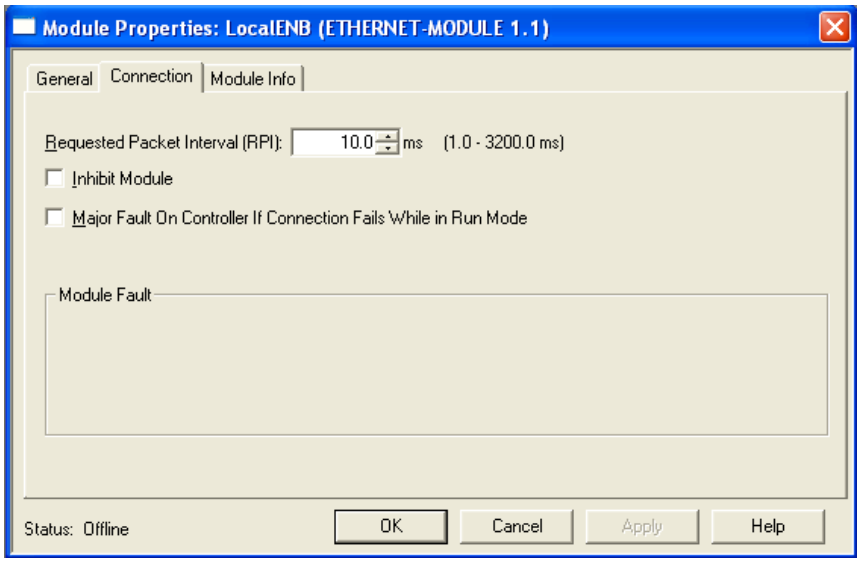



Fig. 14: Define cycle time inputs

Min. cycle time: 2 ms
Max. cycle time: 3200 ms

Select the network path by clicking on the symbol

Go Online
With Download, start transmission to the PLC and start the PLC program with RUN.

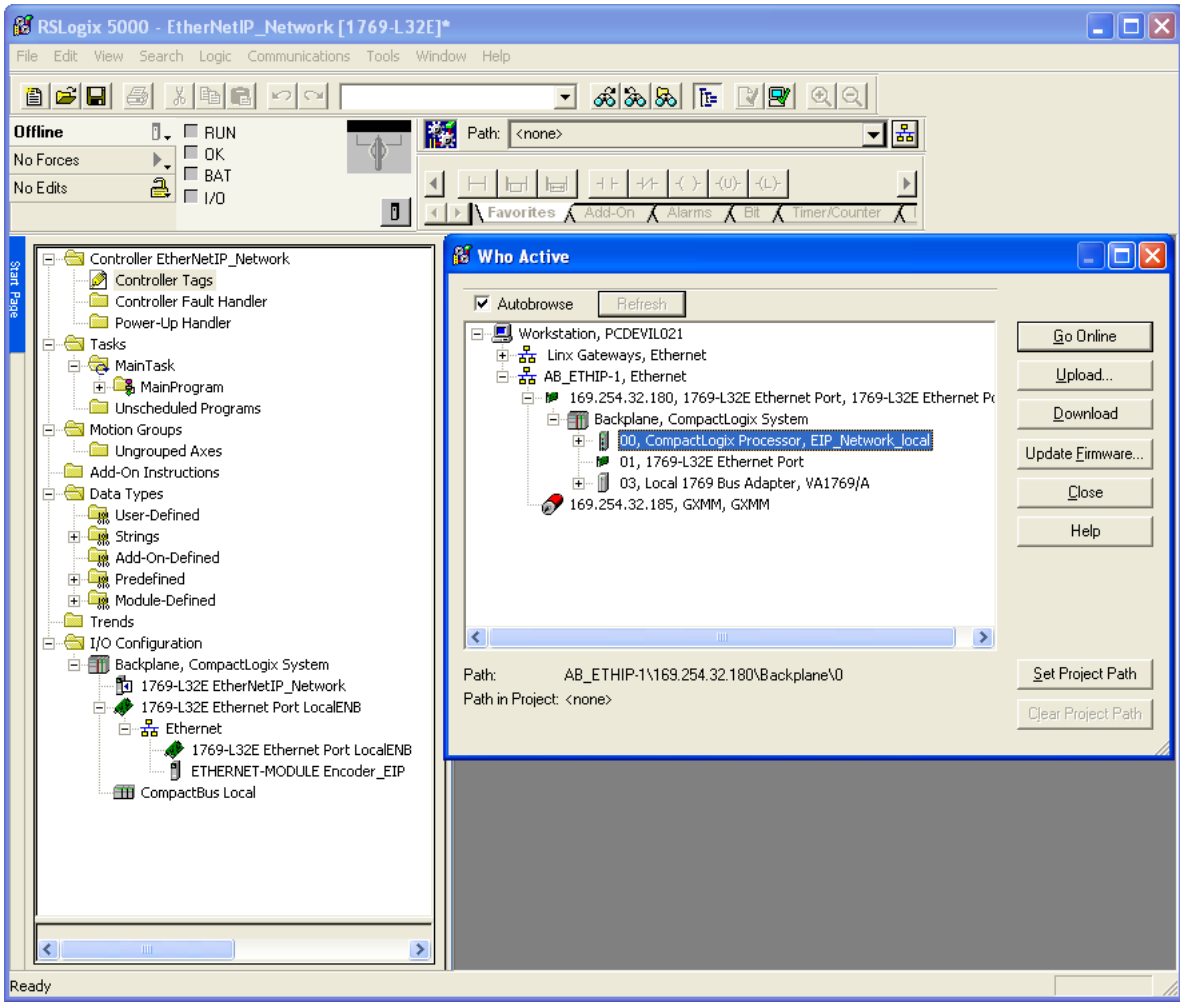



Fig. 15: Select network path

Observe encoder position (input data) with monitor tags

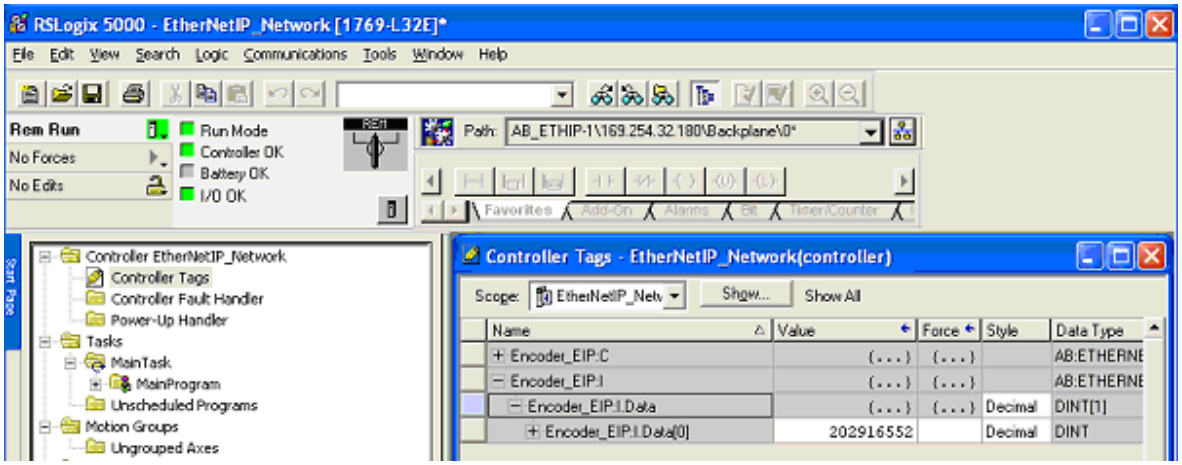



Fig. 16: Monitor tags position data

## 8.2. Explicit Messaging, PLC Program Example, Set Preset

Here: Set attribute single to class 0x23, instance 1, attribute 0x13

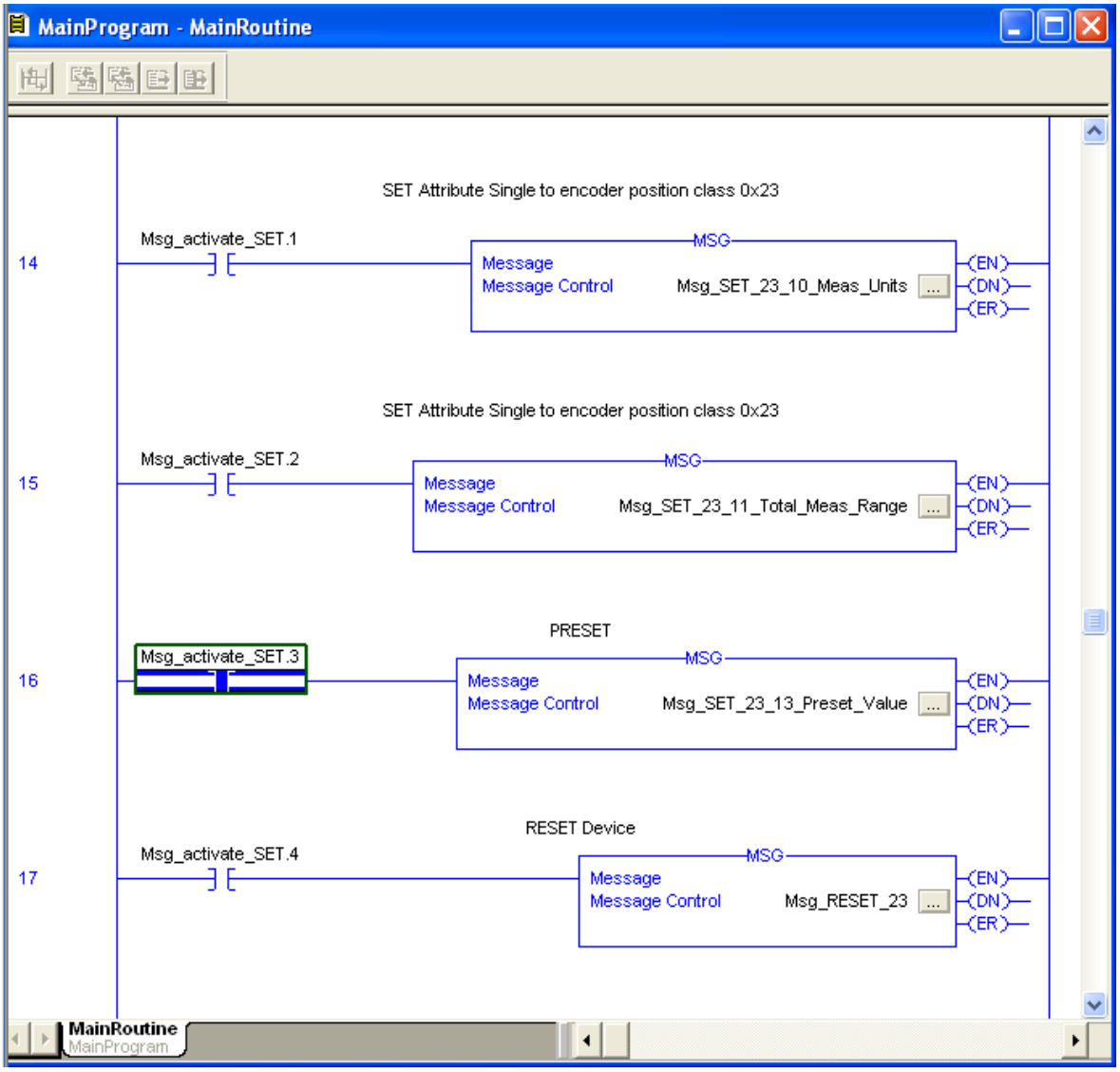



Fig. 17: Ladder logic depiction

### 8.2.1. Create program tags

Create Msg_activate_SET for activation of the preset command

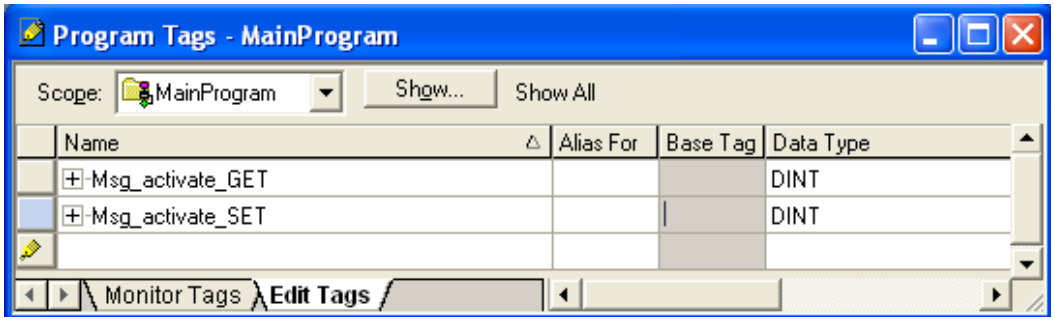



Fig. 18: Structure of Msg_activate_SET

### 8.2.2. Create Controller Tags

1. MESSAGE-type tag for the preset set command
2. DINT-type tag for input of the required values

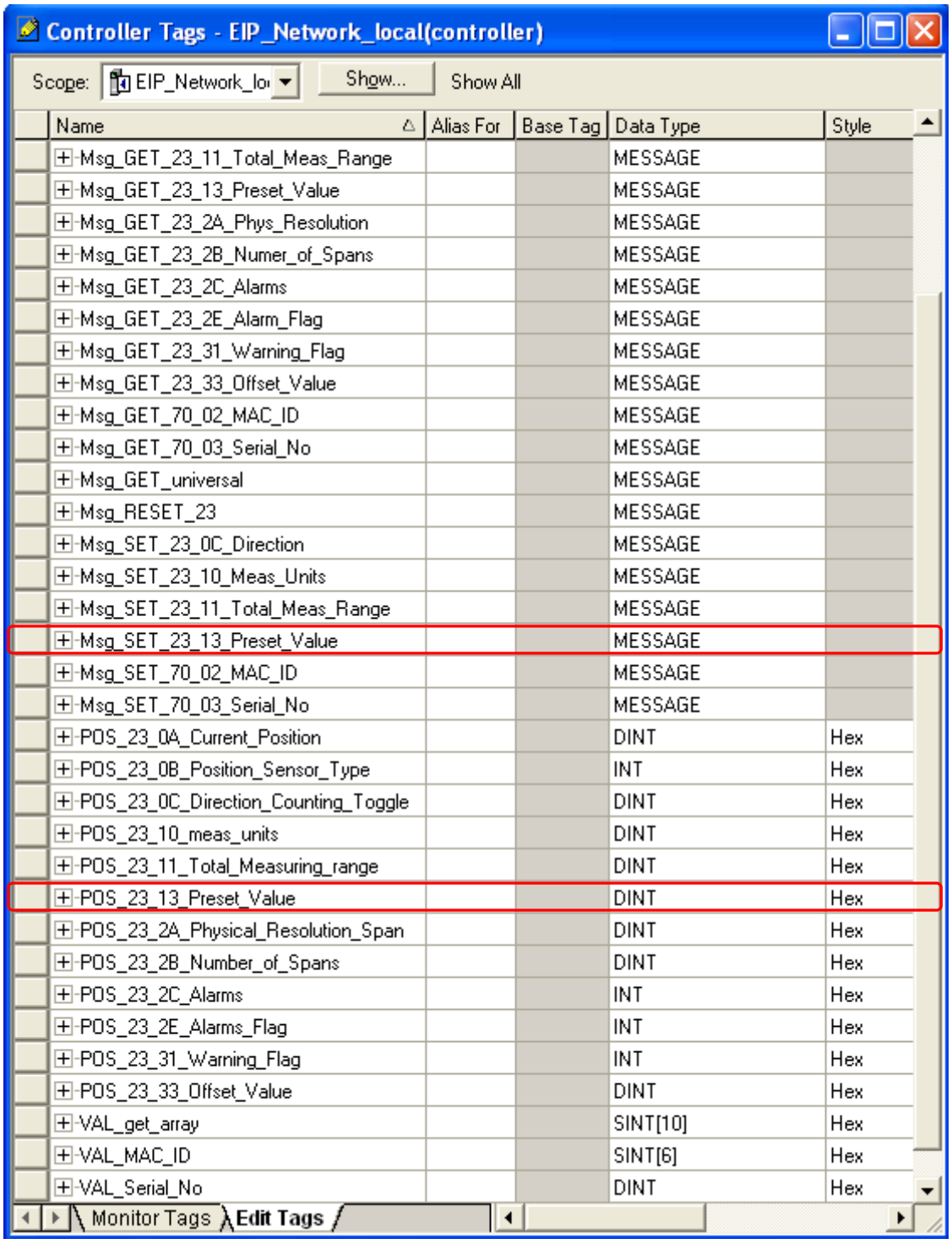



Fig. 19: Controller tags

### 8.2.3. Configuration of the message tag

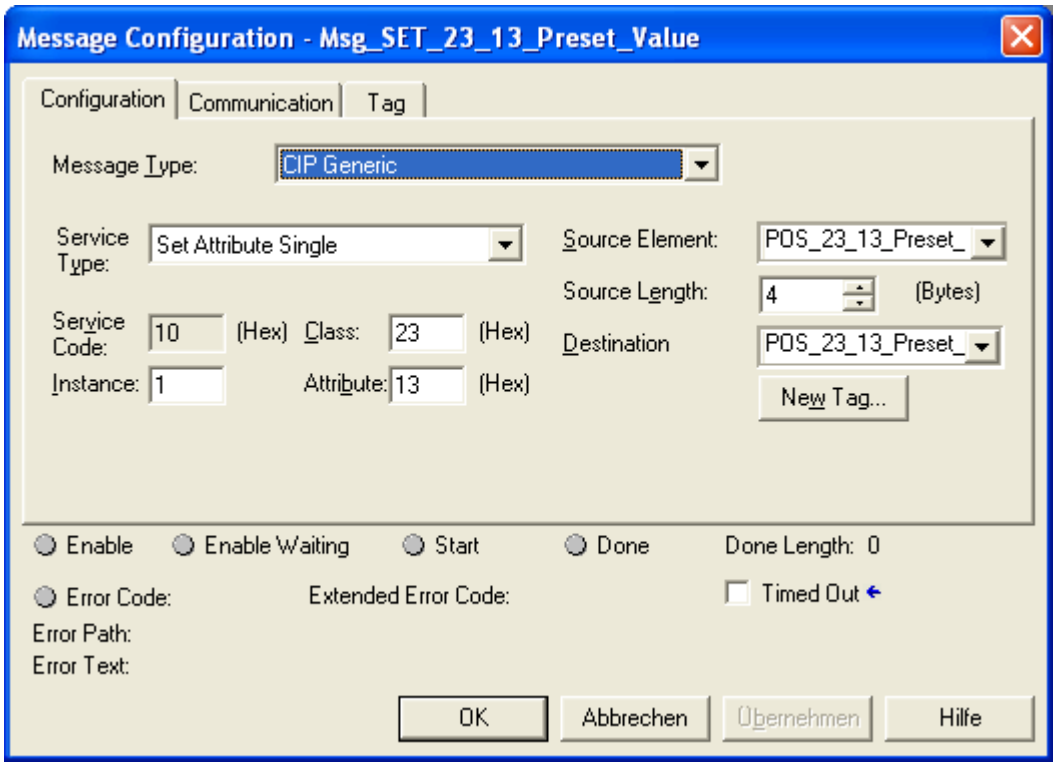



Fig. 20: Set Attribute Single message configuration

After downloading and running the PLC program, the preset command can now be executed with the button combination STRG-T.


Fig. 21: Activation of the preset command

Here, the current position of the encoder is set to the preset value.

# 9. **Used abbreviations and terms**

| | |
|---|---|
| ARRAY | Field data tape |
| Attr. | Attribute |
| BOOL | Data type which can only accept the values TRUE or FALSE |
| BYTE | Data type – 8 bit |
| CIP | Common Industrial Protocol |
| DINT | Signed 32-bit integer value |
| DWORD | Bit field – 32 bits |
| EMC | Electromagnetic compatibility |
| ERTEC | Enhanced Real-Time Ethernet Controller |
| h | Abbreviation for hexadecimal representation |
| hex | Abbreviation for hexadecimal representation |
| I/O | Input / output |
| IP | Internet protocol in conjunction with EtherNet/IP but industrial protocol |
| OSI reference model | Open Systems Interconnection Reference Model |
| ODVA | Open Device-Net Vendor Association |
| Packed EPATH | Data type – CIP path segments |
| PE | Potential earth |
| SHORT_STRING | Character string (1 byte per character, 1 byte length indicator) – Data type |
| STRING | Data type -.character string (1 byte per character) |
| STRINGI | International character string |
| STRUCT | Structure - data type |
| TCP | Transmission Control Protocol |
| UDINT | Unsigned 32-bit integer value |
| UDP | User Datagram Protocol |
| UINT | Unsigned 16-bit integer value |
| USINT | Unsigned 8-bit integer value |
| WORD | Bit field – 16 bits |

# 10. **FAQ‘s**

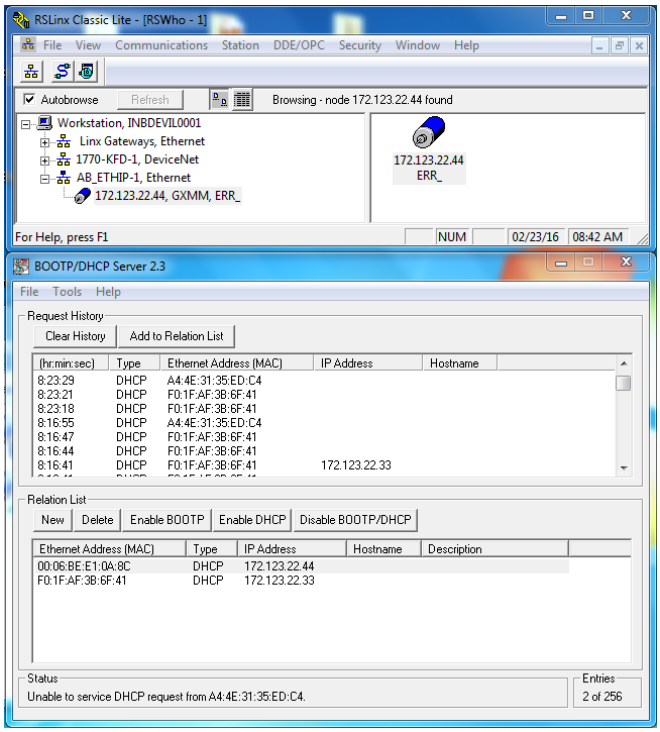
## 10.1. Device not responding / IP address unknown

Device operation mode „IP address out of internal flash“.
The IP address is saved in the flash but unknown.
Encoder is not recognised in RSLinx. (Device not responding to PING command)

Troubleshooting:

- Disconnect device from power supply (device power off).
- Carefully undock the bus cover.
- At bus cover power-on (when undocked from basic encoder) the activity indicator (Duo- LED) is red continuous.
- Bus cover operational in mode „IP address via DHCP request“.
- In the NIC (network card) configuration, set „dynamic“ (DHCP enable).
- Run bus cover and NIC at BOOTP/DHCP server.
- NIC and bus cover IP address to be allocated within the same network.
- Bus cover now appears as bus user under RSLinx (device name: ERR_ see illustration below).
- Address bus cover as described under 7.2.
- Press button „**Enable DHCP**“.
- Device logs on with message „**Command successful**“.
- Disconnect bus cover from power supply.
- Dock bus cover onto basic encoder again.
- After power on, the device is operational in mode „IP address via DHCP request“.

IP addressing in operation „bus cover without basic encoder“ to RSlinx and BOOTP/DHCP server




Devices with rotary switches:

- Carefully undock bus cover from basic encoder.
- Rotary switch setting unequally 00, for example 22.
- Device now in mode „IP address by HEX rotary switch“.
- In the present example, the encoder will respond again to address 192.168.1.22.