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# *Protocol Gateway IEC60870-5-103 Master/Slave*

Protocol and  
eNode Designer configuration

## **eNode Configuration Manual**

V1.2

April 17<sup>th</sup>, 2017

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  - [Interoperability](#)
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# 1 Introduction

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Thank you for Buying Atop's Protocol Gateway. The product is bundled with the following three user manuals:

- 1) Hardware specific installation user manual, **not covered in this document**. It covers Atop's hardware installation procedure, wiring, power connection etc.
- 2) Getting started with Atop's Protocol Gateway user manual – configuration tool introduction, web configuration, software architecture introduction– **not covered in this document**. This manual covers the introduction, installation, network set-up maintenance and using of the configuration tool software, including the procedure to be followed for uploading new configurations to Atop's device.
- 3) Protocol specific user manual (**This Manual**). **One protocol-specific manual will be provided for each protocol installed on the device**. This manual covers:
  - a. Basic device network configuration
  - b. Step-by-step protocol set-up for in eNode designer
  - c. Description of the protocol-specific software features, the device profile and the implementation table of supported functionalities.

This manual is for **IEC-60870-5-103 master/slave** and describes how to use the **IEC-60870-5-103 eNode Designer Module** to configure Atop's *IEC 60870-5-101/103 ADH Application* within the eNode Designer configuration tool.

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## 1.1 Scope

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This document is divided into 3 major sections:

- **General Description**;
- **Configuration Guide**; and
- **Interoperability**

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## 1.2 Document Reference

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- [1] Document Title: eNode Designer User Manual  
Revision: Version 1.00
- [2] Document Title: IEC 60870-5-103 International Standard  
Revision: First Edition, December 1997

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## 1.3 List of Abbreviations

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ADH	= Application Data Hub
IEC	= International Electrotechnical Commission
IED	= Intelligent Electronic Device

## 2 General Description

The IEC 60870-5-103 eNode Module can be used to configure the IEC 60870-5-103 ADH Application as a master or slave. For naming consistency across eNode Designer, the master is called a client, and the slave is called a server.

The client can communicate with many servers, whose data point details can be configured using this module. Atop's Protocol Gateway supports one server/slave per protocol per device.

### 2.1 IEC 60870-5-103 Standard

IEC 60870-5-103 is an international standard, released by IEC(International Electrotechnical Commission), used for telecontrol(supervisory control and data acquisition)in electrical engineering and power system automation applications.

This manual assumes that reader has some basic knowledge of the IEC 60870 standard documents and the IEC 60870-5-103 protocol.

IEC 60870 Document Part	Description
IEC 60870-5-1	Transmission Frame Formats
IEC 60870-5-2	Data Link Transmission Services
IEC 60870-5-3	General Structure of Application Data
IEC 60870-5-4	Definition and Coding of Information Elements
IEC 60870-5-5	Basic Application Functions
IEC 60870-5-6	Guidelines for conformance testing for the IEC 60870-5 companion standards
IEC 60870-5-103	Transmission Protocols, companion standard for the informative interface of protection equipment

### 2.2 ISO/OSI of IEC 60870-5-103

Data Unit	Layer	Functional
Data	7. Application Layer	IEC 60870-5-4 IEC 60870-5-5 IEC 60870-5-103 standard
	6. Presentation Layer	N/A



	5. Session Layer	N/A
Segments	4. Transport Layer	N/A
Packet/Datagram	3. Network Layer	N/A
Bit/Frame	2. Data Link Layer	Unbalanced IEC 60870-5-2 IEC 60870-5-1(FT 1.2)
	1. Physical Layer	RS232, RS422, RS485

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## 2.3 Configuration Theory

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Most configuration properties describe a *server*. When configuring the ADH application server, you are configuring the properties of the server itself. When configuring the ADH application client, you are describing the properties of all the remote servers with which the client is communicating.

Configuring the protocol specific information (such as object addressing) is handled in the module. This is explained in this document.

Communication port properties (such as Baud Rate) are configured on the communication port itself. The Device module handles the communication port properties, so heavy details are outside the scope of this document. Port configuration instructions are provide in the eNode Designer general user manual. However, screenshots of the typical configuration method are shown in [section 4](#).

## 2.4 General Screen Description

A small configuration example is shown below to better help describe the layout of the screen.

The screenshot displays the IED configuration interface. At the top, the 'Settings' tab is active, showing the 'IED [1: 1]' configuration. A red box labeled '1' highlights the tab area. Below the tab, a 'Common Address' field is set to '1', highlighted by a red box labeled '2'. The main area is divided into two sections: 'Data' and 'Commands'. The 'Data' section contains a table with columns: Tag, Description, Function Type, Type, Information Number, Data Object, and Class. It lists various data points like 'Auto Recloser Status', 'Teleprotection Status', 'Start pickup L1', and current/voltage measurements. A red box labeled '3' highlights the 'Data' table. Below the 'Data' table are buttons for 'Add', '+1', 'Delete', 'Modify Selected Points', 'Move Up', 'Move Down', and 'Sort'. The 'Commands' section contains a table with columns: Tag, Description, Function Type, and Information Number. It lists commands like 'Cmd Auto Recloser on/off', 'Cmd Teleprotection on/off', and 'Cmd Characteristic 1 Activate'. A red box labeled '4' highlights the 'Commands' table. Below the 'Commands' table are similar buttons: 'Add', '+1', 'Delete', 'Modify Selected Points', 'Move Up', 'Move Down', and 'Sort'.

Tag	Description	Function Type	Type	Information Number	Data Object	Class
Auto Recloser Status	Switch	128 Distance Protect...	Time Tag Message	16 Auto Recloser St...	DPI: Double point inf...	Class 1
Auto Recloser SIN	Status	128 Distance Protect...	Time Tag Message	16 Auto Recloser St...	SIN: Supplementary i...	Class 1
Teleprotection Status	Switch	128 Distance Protect...	Time Tag Message	17 Teleprotection St...	DPI: Double point inf...	Class 1
Teleprotection SIN	Status	128 Distance Protect...	Time Tag Message	17 Teleprotection St...	SIN: Supplementary i...	Class 1
Start pickup L1	DPI	128 Distance Protect...	Relative Time Tag M...	64 Start Pickup L1	DPI: Double point inf...	Class 1
I: Current L2	MVAL	160 Overcurrent Prot...	Measurands I	145 Measurands I V	I: Current L2	Class 2
V: Voltage L1-L2	MVAL	160 Overcurrent Prot...	Measurands I	145 Measurands I V	V: Voltage L1-L2	Class 2
Fault SCL	SCL	128 Distance Protect...	Relative Time Tag M...	73 Fault Location	SCL: Short circuit loc...	Class 1
Fault Number	FAN: Fault number	128 Distance Protect...	Relative Time Tag M...	73 Fault Location	FAN: Fault number	Class 1
M2 I: current L1	MVAL	128 Distance Protect...	Measurands II	148 Measurands II12...	I: Current L1	Class 2
M2 I: Current L2	MVAL	128 Distance Protect...	Measurands II	148 Measurands II12...	I: Current L2	Class 2
M2 I: current L3	MVAL	128 Distance Protect...	Measurands II	148 Measurands II12...	I: Current L3	Class 2

Tag	Description	Function Type	Information Number
Cmd Auto Recloser on/off	Sample command 1	128 Distance Protection	16 Auto Recloser on/off
Cmd Teleprotection on/off	Sample command 2	128 Distance Protection	17 Teleprotection on/off
Cmd Protection on/off	Sample command 3	128 Distance Protection	18 Protection on/off
Cmd LED Reset	Sample command 4	128 Distance Protection	19 LED Reset
Cmd Characteristic 1 Activate	Sample command 5	128 Distance Protection	23 Characteristic 1 Activate
Cmd Characteristic 2 Activate	Sample command 6	128 Distance Protection	24 Characteristic 2 Activate
Cmd Characteristic 3 Activate	Sample command 7	128 Distance Protection	25 Characteristic 3 Activate
Cmd Characteristic 4 Activate	Sample command 8	128 Distance Protection	26 Characteristic 4 Activate

Figure 2-1 - Example screen.

- 1 Tabs** – There is one single “Settings” tab in both client and server. The server is allocated to a single tab. The client may communicate with many servers of different protocols, so there may be many server tabs. In a server application, there is only one server tab that is used to describe the properties of the local server itself.
- 2 Server IED Properties** – Describes the protocol-specific properties of the server IED.
- 3 Data Table and buttons** – Shows all (information) data associated with the IED, and buttons used to modify them.
- 4 Commands Table and buttons** – Shows all commands associated with the IED, and buttons used to modify them.

The user is able to add, delete and organise data points using buttons. The user may also edit the contents of the data and command tables freely after points are created.

Each tab is named “IED [{X}: {Y}]” where {X} is the link address and {Y} is the common address.

## 3 IEC60870-5-103 Configuration Guide

### 3.1 Adding the Module in eNode Designer

The IEC 60870-5-103 module can be added to *Serial* ports only.

The application can be set up as a Client or a Server. The choice will be presented when adding it to the project.

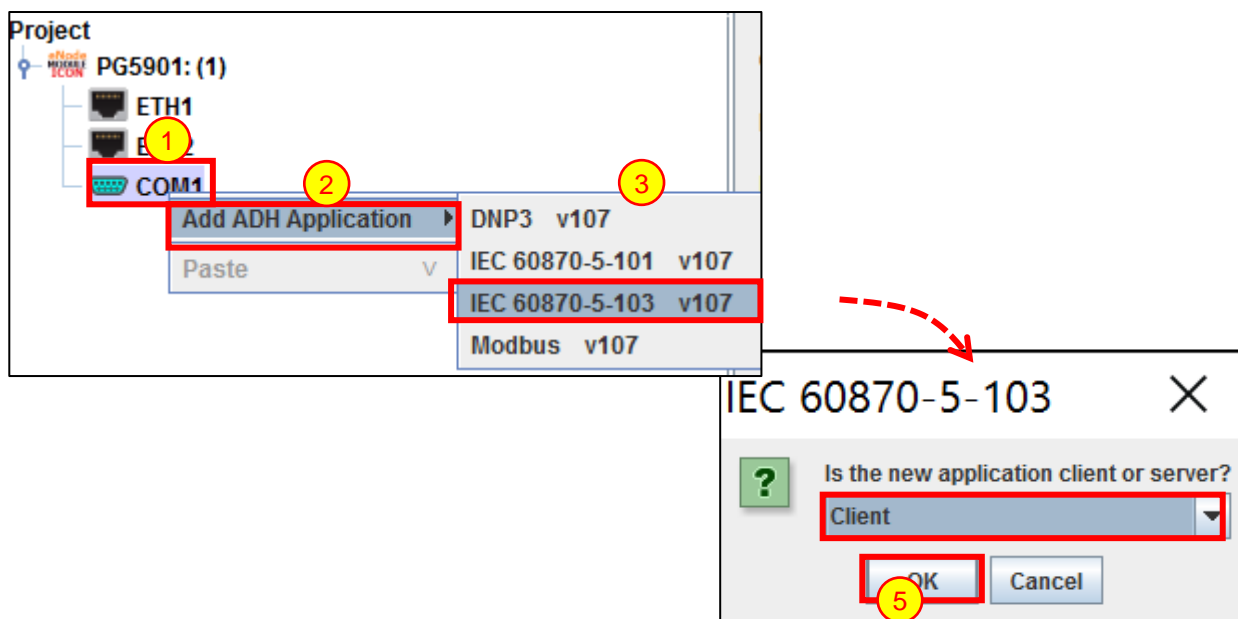


Figure 3-1 - Adding the module in eNode Designer.

- 1 Right click the desired **communication port**.
- 2 Open the **Add ADH Application** menu.
- 3 Select **IEC 60870-5-103**.
- 4 Select **Client** or **Server** from the drop-down menu.
- 5 Click **OK**.

### 3.2 Server IED Properties

The server IED properties are at the top of the module screen. It has a single configurable item: the common address of the slave.

Common Address:

**3.2.1.1 Common Address**

<b>Description</b>	The common address of the server (slave) IED. For server application it describes its own common address. For clients, it describes the common address of the remote server.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 255
<b>Input Option</b>	Mandatory

### 3.3 Client Configuration

Adding a client application will immediately show the following figure. The first tab shows the settings that apply to the whole client application. Each tab after this represents a single IEC 60870-5-103 server with which the client is communicating.

Settings IED [1: 1] × +

Link Address: 1

Link Layer Timeout (ms): 1000

Station Initialisation: Reset CU

Time Sync Interval (s): 3600

General Interrogation Interval (s): 60

Poll Class Interval (ms): 1000

Command Timeout (ms): 3000

Figure 3-2 - Client settings panel.

Selecting the IED tab will show the following view.

Settings IED [1: 4] × +

Common Address: 4

Data

Tag	Description	Function Type	Type ID	Information Nu...	Data Object	Class
-----	-------------	---------------	---------	-------------------	-------------	-------

Add +1 Delete Modify Selected Points Move Up Move Down Sort

Commands

Tag	Description	Function Type	Information Number
-----	-------------	---------------	--------------------

Add +1 Delete Modify Selected Points Move Up Move Down Sort

Figure 3-3 - Client IED panel.

Here the “Add” and “+1” button can be used to add data points. Adding data points is explained in the “Add data points” section, and the other buttons are described in section 7: [Reference Guide](#).

### 3.3.1 Client Settings

Listed below are details about each client setting.

#### 3.3.1.1 Link Address

<b>Description</b>	The link address address to use.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 255
<b>Input Option</b>	Mandatory

#### 3.3.1.2 Link Layer Timeout (ms)

<b>Description</b>	The timeout for a data link layer confirmation in milliseconds.
<b>Data Entry</b>	Integer
<b>Range</b>	100 to 65535
<b>Input Option</b>	Mandatory

#### 3.3.1.3 Station Initialisation

<b>Description</b>	The option to use in the station initialisation (reset communications) command. CU = Communications unit, FCB = Frame count bit.
<b>Data Entry</b>	Drop down menu
<b>Options</b>	Reset CU, Reset FCB
<b>Input Option</b>	Mandatory

#### 3.3.1.4 Time Sync Interval (s)

<b>Description</b>	The interval that the time synchronisation commands are sent, in seconds.
<b>Data Entry</b>	Integer
<b>Range</b>	1 to 65535. Default: 3600
<b>Input Option</b>	Mandatory

#### 3.3.1.5 General Interrogation Interval (s)

<b>Description</b>	The interval that general interrogation commands are sent, in seconds.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 65535
<b>Input Option</b>	Mandatory

#### 3.3.1.6 Poll Class Interval (ms)

<b>Description</b>	The interval at which the classes are polled, in milliseconds.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 65535
<b>Input Option</b>	Mandatory

3.3.1.7 Command Timeout (ms)

Description	The timeout to wait for a command to complete, in milliseconds.
Data Entry	Integer
Range	0 to 65535
Input Option	Mandatory

### 3.3.2 Adding Data Points

To add data points, left click the **"Add"** button beneath the tables in the main view. . Doing so will show the following window. The window is used to add many data points at once with the specified values. For details on the meaning of each column, see section 7.2.

The screenshot shows the 'Add Data Points' window with the following components:

- 1 Preview:** A table showing a preview of the data points to be added.
- 2 New values:** A table for entering new values.
- 3 Number of rows:** A counter set to 4.
- 4 Auto-increment:** Radio buttons for 'None', 'Information Number' (selected), and 'Data Object'.
- 5 Counters:** Three sections for defining counters [X], [Y], and [Z] with 'Start At' and 'Step by' fields.
- 6 OK button:** A button to accept the new data points.

Tag	Description	Function Type	Type ID	Information Number	Data Object	Class
Ex 1	Description 1	128 Distance Protection	Time Tag Message	16 Auto Recloser Stat...	DPI: Double point infor...	Class 1
Ex 2	Description 2	128 Distance Protection	Time Tag Message	17 Teleprotection Stat...	DPI: Double point infor...	Class 1
Ex 3	Description 3	128 Distance Protection	Time Tag Message	18 Protection Status	DPI: Double point infor...	Class 1
Ex 4	Description 4	128 Distance Protection	Time Tag Message	19 LED Reset	DPI: Double point infor...	Class 1

Tag	Description	Function Type	Type ID	Information Number	Data Object	Class
Ex [X]	Description [X]	128 Distance Protecti...	Time Tag Message	16 Auto Recloser Sta...	DPI: Double point infor...	Class 1

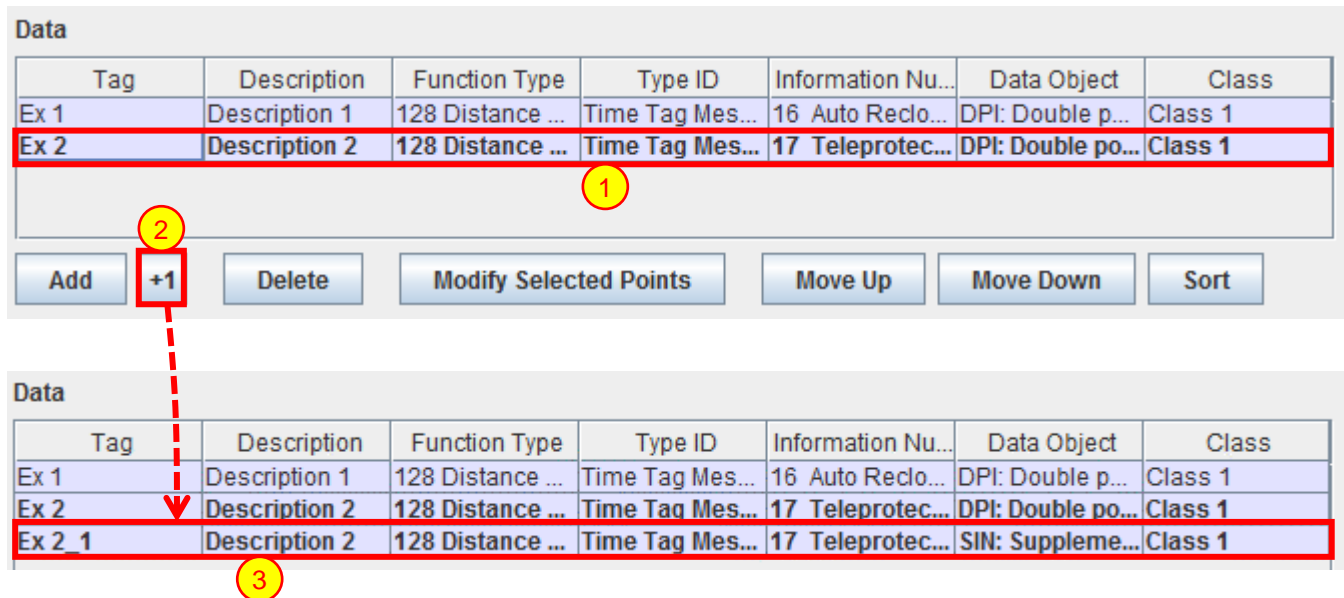
Figure 3-4 - Add data points window.

- 1 Preview Area** – Shows the preview of the data points that will be added.
- 2 New values** – This area is used to enter values. Tag and description use manual data entry (click the box and type new values). Data type and class use drop-down menus.
- 3 Number of rows** – This counter can be used to add many data points at once.
- 4 Auto-increment** – Chooses what increment type to use in each successive row.
  - None* No increments in any row
  - Information Number* Increments the information number by one per row
  - Data Object* Increments the data object by one per row. When no more data objects for that information number exist, the next information number is used and the data object index resets to the first item.
- 5 Counters** – The starting values and step values of counters can be set in this area. Counters are used in the input areas resulting in the substituted values appearing in the preview area. See also [5 Using Counters](#).
- 6 OK button** – to accept the new data points.



### 3.3.2.1 Add a Single Data Point

A single data point can be added at a time using the “+1” button beneath the desired table. Clicking “+1” will copy the information of the selected row, and automatically increase the address field to the next unused address. This means increasing the data object, or if the data object is at the last value, it increases the information number and uses the first data object in the new information number. This process continues until it finds an unused address.



**Figure 3-5 - Adding a single data point with +1 button.**

- ① (Optional) **Select the data point to copy.** Using no selection will just add a default data point.
- ② Click the **+1** button– This will add a new data point with details copied from the selected data point, with an automatically increased *Address*. eNode Designer will make sure that a new unique tag name is generated for the point.
- ③ A new point has been added. You may want to change the tags, descriptions etc. as required.

### 3.3.3 Connected Servers (Remote IEDs)

Each slave IED is represented by a single tab and a tree node in the eNode Designer project tree.

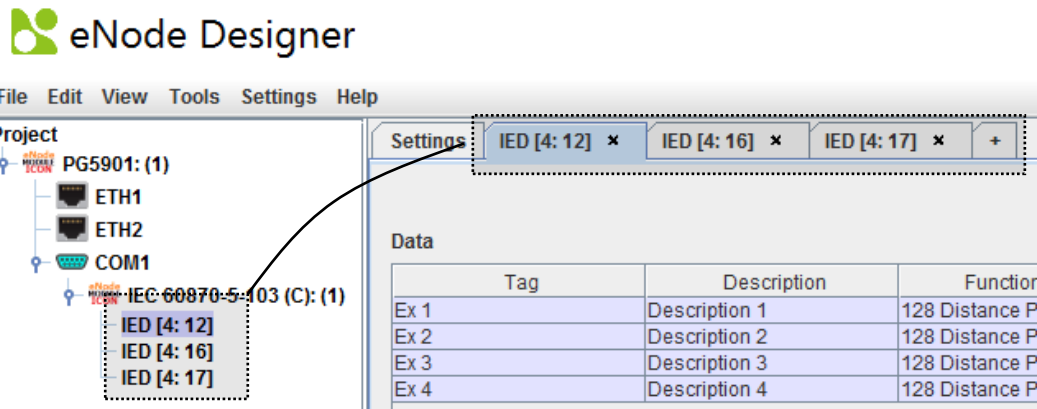


Figure 3-6 - Multiple connected servers example.

To modify the connected IEDs list follow the instructions below:

- 1 To **add** a new remote IED, click the "+" tab at the end of the list of existing remote servers.

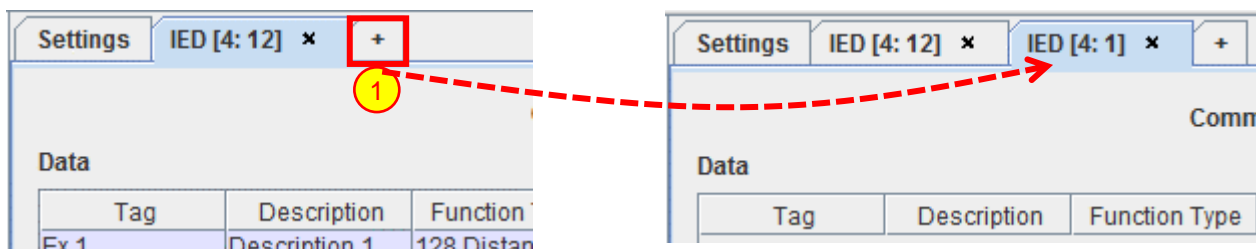


Figure 3-7 - Add a connected server.

To remove a remote IED, it must have no data points specified. If there are data points in the table and you still wish to remove the IED, you will have to remove such data points first.

- 1 To **remove** a remote IED, click the cross on the right side of the tab of the IED you wish to remove.

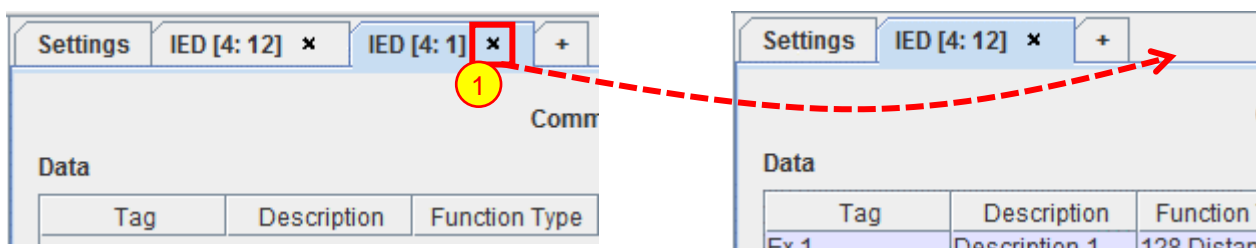


Figure 3-8 - Remove a connected server.

### 3.4 Server Configuration

A server application outputs data from the ADH database, receives commands and passes them into the ADH system to command another application to perform the operation. Therefore, all server operations use data point *references* to already existing data points that have been created by other application clients or client-servers.

The options describe the local server itself. The settings tab can be used to set the local settings, while the IED tab is used to configure data points and appears similar to the client. Example figures of both are shown below.

Settings Server [1]

Common Address: 1

Link Address: 1

Link Layer Timeout (ms): 1000

Command Timeout (ms): 3000

Class 1 Event Buffer: Size: 1000 Overflow Percentage: 90

Class 2 Event Buffer: Size: 1000 Overflow Percentage: 90

Figure 3-9 - Server settings panel.

Settings Server [1]

Data Point

Tag	Description	Function Type	Type ID	Information Numb...	Data Object	Class	Cyclic Trans Time
-----	-------------	---------------	---------	---------------------	-------------	-------	-------------------

Add Reference Delete Modify Selected Points Move Up Move Down Sort

Commands

Tag	Description	Function Type	Information Number
-----	-------------	---------------	--------------------

Add Reference Delete Modify Selected Points Move Up Move Down Sort

Figure 3-10 – Server IED panel.

Here the “Add Reference” button can be used to add data point references. The procedure is explained fully in the next section. The other buttons are described in section 7: Reference Guide.

### 3.4.1 Server Settings

All server settings are explained in the headings below.

#### 3.4.1.1 Link Address

<b>Description</b>	The link address to use.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 255 (default 1)
<b>Input Option</b>	Mandatory

#### 3.4.1.2 Common Address

<b>Description</b>	The common address to use.
<b>Data Entry</b>	Integer
<b>Range</b>	0 to 255 (default 1)
<b>Input Option</b>	Mandatory

#### 3.4.1.3 Link Layer Timeout (ms)

<b>Description</b>	The timeout for a data link layer confirmation in milliseconds.
<b>Data Entry</b>	Integer
<b>Range</b>	100 to 65535 (default 1000)
<b>Input Option</b>	Mandatory

#### 3.4.1.4 Command Timeout (ms)

<b>Description</b>	The timeout for a command in milliseconds.
<b>Data Entry</b>	Integer
<b>Range</b>	100 to 10000 (default 3000)
<b>Input Option</b>	Mandatory

#### 3.4.1.5 Class {X} Event Buffer Size

<b>Description</b>	The buffer size for class {X}: the maximum number of events to store.
<b>Data Entry</b>	Integer
<b>Range</b>	0 - 65535
<b>Input Option</b>	Mandatory

#### 3.4.1.6 Class {X} Event Buffer Overflow Percentage

<b>Description</b>	If the buffer for class {X} fills to this percent full, a buffer overflow event is sent to the master station.
<b>Data Entry</b>	Integer
<b>Range</b>	0-100. Recommended 50-95. Default: 90
<b>Input Option</b>	Mandatory

### 3.4.2 Adding Data Point References

To add new data point references, left click the “Add Reference” button underneath the tables in the main view. This will bring up the Add References window defined by the eNode Designer main application. It should appear similar to the following figure. Here we are adding references to data points created by an IEC 60870-5-104 client.

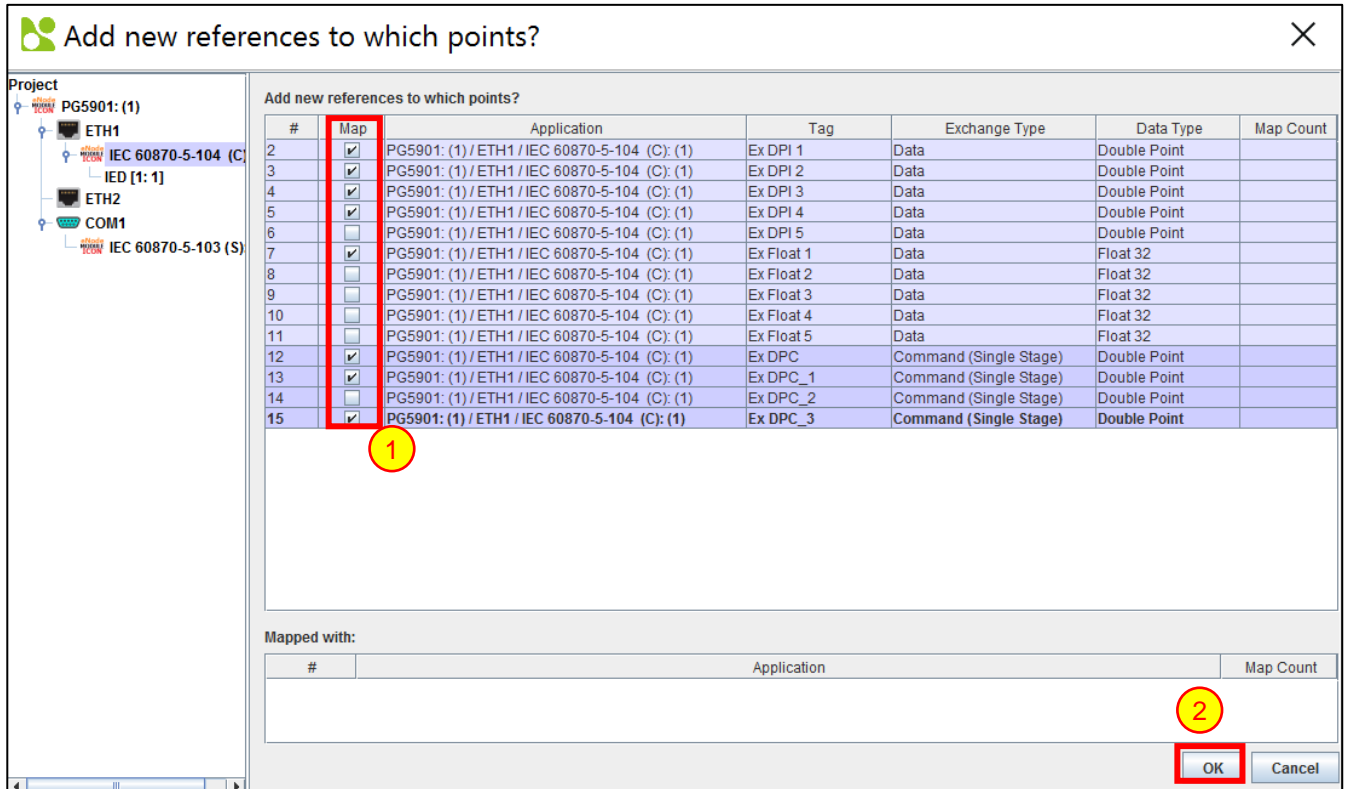


Figure 3-11 - Add new references window.

- 1 **Select Data Points** – Adding a reference to a point creates a “mapping” to that point. Select which data points the server application is interested in using.
- 2 Left click **OK** when done to accept the new references.

The data points that will appear in the list and that will be available for mapping are those whose data point type is compatible with the IEC 60870-5-103 application. For the table matching IEC 60870-5-103 data types to ADH types, see section 7.3.

The screenshot shows the 'Settings' window for IED [1:1]. At the top, there is a 'Common Address' field set to 1. Below this are two main sections: 'Data' and 'Commands'.

**Data Table:**

Tag	Description	Function Type	Type ID	Information Number	Data Object	Class	Cyclic Transmission T...
Ex DPI 1	Example					Class 2	
Ex DPI 2	Example					Class 2	
Ex DPI 3	Example					Class 2	
Ex DPI 4	Example					Class 2	
Ex Float 1	Float					Class 2	

Below the Data table are buttons: Add Reference, Delete, Modify Selected Points, Move Up, Move Down, Sort.

**Commands Table:**

Tag	Description	Function Type	Information Number
Ex DPC	DPC		
Ex DPC_1	DPC		
Ex DPC_3	DPC		

Below the Commands table are buttons: Add Reference, Delete, Modify Selected Points, Move Up, Move Down, Sort.

Figure 3-12 - Data point references added.

After the new points have been added, you can modify the data points directly in the table. Cyclic transmission time is a normal typed field, while the others use drop-down menus that are restricted based on which IEC 60870-5-103 types are valid for the ADH data point type. For example, 2-bit values can only be mapped to type IDs which have a 2-bit data type in the data object list: the protocol's "DPI" type.

The screenshot shows a close-up of the 'Data' table. The 'Type ID' column for 'Ex DPI 1' has a drop-down menu open, showing two options: 'Time Tag Message' and 'Relative Time Tag Message'. The other rows in the table are partially visible.

Tag	Description	Function Type	Type ID	Information Nu...
Ex DPI 1	Example 2-bit			
Ex DPI 2	Example 2-bit			
Ex DPI 3	Example 2-bit			
Ex DPI 4	Example 2-bit			

Figure 3-13 - Data type restricted drop down menu example.

A "complete" example is shown below.

The screenshot shows the full configuration interface. The 'Data' table is populated with specific data points, and the 'Commands' table is also populated.

**Data Table:**

Tag	Description	Function Type	Type ID	Information N...	Data Object	Class	Cyclic Trans...
Ex DPI 1	Example 2-bit	128 Distance...	Time Tag Me...	16 Auto Recl...	DPI: Double ...	Class 2	
Ex DPI 2	Example 2-bit	128 Distance...	Time Tag Me...	17 Teleprote...	DPI: Double ...	Class 2	
Ex DPI 3	Example 2-bit	128 Distance...	Time Tag Me...	18 Protectio...	DPI: Double ...	Class 2	
Ex DPI 4	Example 2-bit	128 Distance...	Time Tag Me...	19 LED Reset	DPI: Double ...	Class 2	
Ex Float 01	Example Flo...	160 Overcurr...	Relative Tim...	73 Fault Loc...	SCL: Short ci...	Class 1	

Buttons: Add Reference, Delete, Modify Selected Points, Move Up, Move Down, Sort.

**Commands Table:**

Tag	Description	Function Type	Information Number
Ex DPC 1	2-bit command	128 Distance Protection	16 Auto Recloser on/off
Ex DPC 2	2-bit command	128 Distance Protection	23 Characteristic 1 Activate
Ex DPC 4	2-bit command	128 Distance Protection	24 Characteristic 2 Activate

Figure 3-14 - Server data point configuration example.

### 3.5 Miscellaneous Common

#### 3.5.1 Incomplete, Conflicting and not needed Information

Incomplete or conflicting information is shown in red. This will cause warning symbols on the tab and in the project tree. Hovering over the warning icons will show further details about what is causing the warning. This allows the user to quickly fix invalid information.

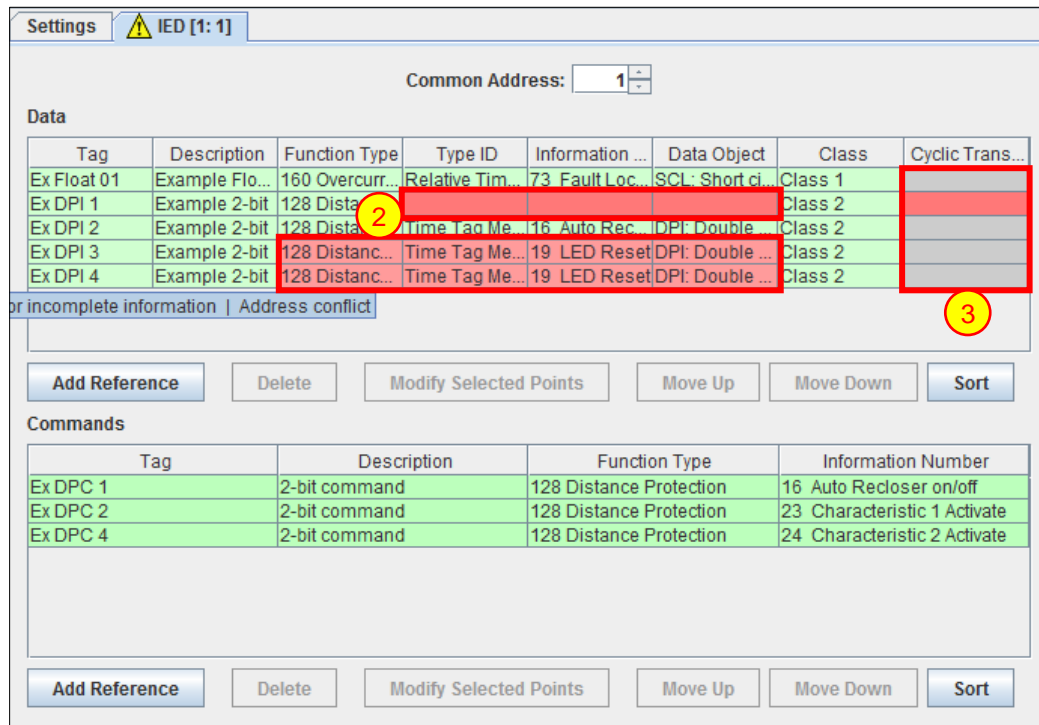


Figure 3-15 – Incomplete and missing information example.

- 1 **Mouse-over a warning** to show a tooltip explaining the warning.
- 2 **Invalid data** shows in red. The dark red color means the data is invalid, and the light red color means there is an address conflict.
- 3 **Unneeded data** is hidden and not editable. For example, the Cyclic transmission time is only used for Measurand types. So, non-measurand points have these table cells with a grey background, have no contents and cannot be edited.

### 3.5.2 Modify Selected Points Window

The “Modify Selected Points” window is used to change many row properties in one single step.

Select the data points you want to change, and then click the “**Modify Selected Points**” button beneath the tables. It will generate the following window.

The screenshot shows the 'Modify Selected Points' window with the following sections and callouts:

- Original:** (Callout 1) A table with 7 columns: Tag, Description, Function Type, Type ID, Information Number, Data Object, and Class. It contains 4 rows of existing data.
- Preview:** (Callout 2) A table with the same 7 columns, showing 4 rows of new data that will be used if modifications are accepted.
- New values:** (Callout 3) A table with the same 7 columns, showing 1 row of new values for the selected points.
- Auto-increment:** (Callout 4) Radio buttons for 'None', 'Information Number', and 'Data Object'. 'Data Object' is selected.
- Define counter [X], [Y], and [Z]:** (Callout 5) Three sections for defining counters. Each has 'Start At' and 'Step by' fields. Counter [X] starts at 1 with a step of 1. Counter [Y] starts at 0 with a step of 0. Counter [Z] starts at 0 with a step of 10.
- OK and Cancel buttons:** (Callout 6) Located at the bottom right of the window.

Figure 3-16 - Modify data points window example.

- 1 **Original table data** – Shows the original table data.
- 2 **Preview** – Shows the new table data that will be used if the modifications are accepted. These fields update according to the contents of (3).
- 3 **New values** – The new values for the table cells. “[N]” can be used to maintain the original value of the cell, and the auto-incrementing counters [X], [Y] and [Z] can be used to add numbers. For details, see [Using Counters](#).
- 4 **Auto-increment:** Chooses what increment type to use in each successive row.
  - None* No increments in any row
  - Information Number* Increments the information number by one per row
  - Data Object* Increments the data object by one per row. When no more data objects for that information number exist, the next information number is used and the data object index resets to the first item.
- 5 **Counter properties** – Sets the initial values and step amounts of the counters [X], [Y] and [Z].
- 6 **OK button** – to accept the modifications.



## 4 Communication Port Properties

The device module handles how the communication port properties are displayed. However, the typical method is briefly described below.

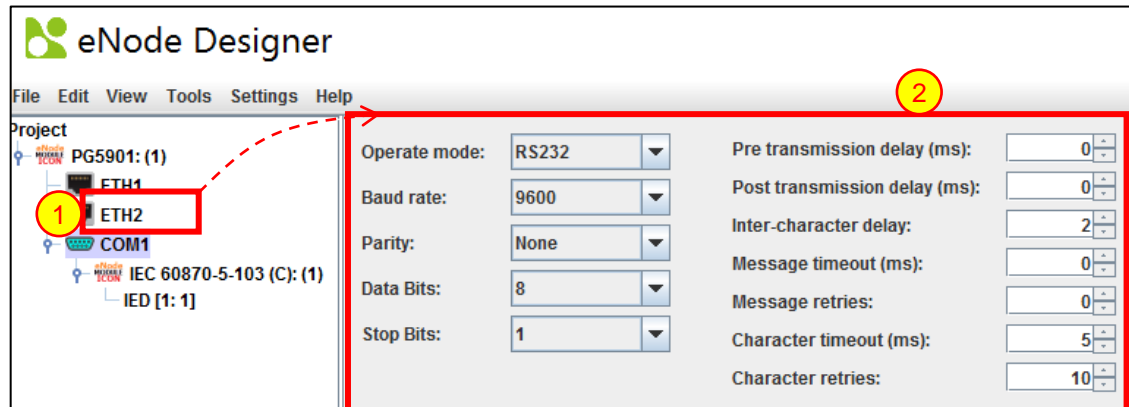


Figure 4-1 - Serial port properties.

- 1 **Select the communication port in the project tree** – This will typically let the central panel show the port's properties.
- 2 **Properties** – The communication port's properties can be set.

## 5 Using Counters

The following is a full example that shows how auto-increment works. The example given shows the IEC 60870-5-104 window. The IEC 60870-5-103 auto-increment works in the same way.

**Add Points**

Preview

Tag	Description	Data Type	Time Stamp	IOA	COT
example_tag_0	example_desc_0000	Single Point	CP24Time2a	1	General Interrogation
example_tag_2	example_desc_0010	Single Point	CP24Time2a	2	General Interrogation
example_tag_4	example_desc_0020	Single Point	CP24Time2a	3	General Interrogation
example_tag_6	example_desc_0030	Single Point	CP24Time2a	4	General Interrogation
example_tag_8	example_desc_0040	Single Point	CP24Time2a	5	General Interrogation

New values:

Tag	Description	Data Type	Time Stamp	IOA	COT
example_tag [X]	example_desc [4Y]	Single Point	CP24Time2a	[Z]	General Interrogation

Number of rows: 5

You can use "[X]" as an auto increment counter. [Y] and [Z] work similarly. Use [3X] to produce values like "001".

Define counter [X]

Start At: 0 Step by: 2

Define counter [Y]

Start At: 0 Step by: 10

Define counter [Z]

Start At: 1 Step by: 1

Figure 5-1 – Using Auto Increment when adding Data Points or Commands.

- 1 The *Number of Rows* can be modified to set the number of data points or commands created from the *New values* section. As shown in the example above, five data points/commands are created and shown in the preview section as the *Number of Rows* is set to 5.

When using the auto increment counters by default, they will start at one and increment by one. Anyway auto-increment value has its own section for configuration. Adjusting *Start At* will change the value that the first data point/command receives. Adjusting *Step By* will change the value that the second and subsequent values will be incremented by.

- 2 In this example, the [X] counter is used. The *Start At* value has been set to 0 and the *Step By* value has been set to 2. This results in the values seen in the preview section.

It is also possible to include a number within the square brackets and before the X, Y or Z while using auto increment. This will produce values that contain the entered number of digits. Any digit that is not taken up by the value determined by the *Start At* and *Step By* values will be shown as zeros.

- 3 In this example, the [Y] counter has been used with the integer 4 to indicate the number structure. This results in the values shown in the preview section.
- 4 In this example, the [Z] counter has been used. The *Start At* and *Step By* values have been left at default, this results in the values shown.

If no auto increment value is entered in any field, each data point/command field value will be created the same with the exception of *Tag* and *IOA*. The first new data point/command's *Tag* value will represent what was entered in the *New value* section. However, the subsequent data points/commands will contain the initial *Tag* value followed by an underscore and a number incrementing by one from 1 onwards. (Example: tag, tag\_1, tag\_2 etc.). This is an artefact of eNode Designer ensuring all data point tag names are unique.

## 6 Interoperability

This interoperability list refers to section 8 of the IEC 60870-5-103 International Standard (reference number CEI/IEC 60870-5-103:1997, pages 159 to 171).

The selected parameters should be marked in the white boxes as follows:

<input type="checkbox"/>	Function or ASDU is not used
<input checked="" type="checkbox"/>	Function or ASDU is used as standardized (default)
<input type="checkbox"/>	Function or ASDU is not support
<input type="checkbox"/> R	Function or ASDU is used in reverse mode
<input type="checkbox"/> A	Function or ASDU supported in addition to the standard

### 6.1 Physical layer

#### 6.1.1 Electrical Interface

- ☒ EIA RS-485
- ☐ Number of loads \_\_\_\_\_ for one protection equipment
- ☒ RS-232
- ☒ RS-422

#### 6.1.2 Optical Interface

- ☐ Glass fibre
- ☐ Plastic fibre
- ☐ F-SMA type connector
- ☐ BFOC/2,5 type connector

#### 6.1.3 Transmission speed

- ☒ 300 bit/s    ☒ 9600 bit/s    ☒ 57600 bit/s
- ☒ 1200 bit/s    ☒ 14400 bit/s    ☒ 115200 bit/s
- ☒ 2400 bit/s    ☒ 19200 bit/s    ☒ 230400 bit/s
- ☒ 4800 bit/s    ☒ 38400 bit/s

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## 6.2 Link Layer

---

There are no choices for the link layer.

---

## 6.3 Application Layer

---

### 6.3.1 Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

### 6.3.2 Common address of ASDU

- ☒ One COMMON ADDRESS OF ASDU (identical with station address)
- ☒ More than one COMMON ADDRESS OF ASDU

### 6.3.3 Selection of standard information numbers in monitor direction

#### 6.3.3.1 System functions in monitor direction

##### INF Semantics

- ☐ <0> End of general interrogation
- ☒ <0> Time synchronization
- ☒ <2> Reset FCB
- ☒ <3> Reset CU
- ☒ <4> Start/restart
- ☐ <5> Power on

#### 6.3.3.2 Status indications in monitor direction

##### INF Semantics

- ☒ <16> Auto-recloser active
- ☒ <17> Teleprotection active
- ☒ <18> Protection active
- ☒ <19> LED reset
- ☒ <20> Monitor direction blocked
- ☒ <21> Test mode
- ☒ <22> Local parameter setting
- ☒ <23> Characteristic 1
- ☒ <24> Characteristic 2
- ☒ <25> Characteristic 3
- ☒ <26> Characteristic 4
- ☒ <27> Auxiliary input 1

- ☒ <28> Auxiliary input 2
- ☒ <29> Auxiliary input 3
- ☒ <30> Auxiliary input 4

#### 6.3.3.3 *Supervision indications in monitor direction*

##### **INF Semantics**

- ☒ <32> Measurand supervision I
- ☒ <33> Measurand supervision V
- ☒ <35> Phase sequence supervision
- ☒ <36> Trip circuit supervision
- ☒ <37> I>> back-up operation
- ☒ <38> VT fuse failure
- ☒ <39> Teleprotection disturbed
- ☒ <46> Group warning
- ☒ <47> Group alarm

#### 6.3.3.4 *Earth fault indications in monitor direction*

##### **INF Semantics**

- ☒ <48> Earth fault L1
- ☒ <49> Earth fault L2
- ☒ <50> Earth fault L3
- ☒ <51> Earth fault forward, i.e. line
- ☒ <52> Earth fault reverse, i.e. busbar

#### 6.3.3.5 *Fault indications in monitor direction*

##### **INF Semantics**

- ☒ <64> Start /pick-up L1
- ☒ <65> Start /pick-up L2
- ☒ <66> Start /pick-up L3
- ☒ <67> Start /pick-up N
- ☒ <68> General trip
- ☒ <69> Trip L1
- ☒ <70> Trip L2
- ☒ <71> Trip L3
- ☒ <72> Trip I>> (back-up operation)
- ☒ <73> Fault location X in ohms
- ☒ <74> Fault forward/line
- ☒ <75> Fault reverse/busbar
- ☒ <76> Teleprotection signal transmitted
- ☒ <77> Teleprotection signal received
- ☒ <78> Zone 1
- ☒ <79> Zone 2
- ☒ <80> Zone 3
- ☒ <81> Zone 4
- ☒ <82> Zone 5
- ☒ <83> Zone 6
- ☒ <84> General start/pick-up
- ☒ <85> Breaker failure
- ☒ <86> Trip measuring system L1
- ☒ <87> Trip measuring system L2
- ☒ <88> Trip measuring system L3
- ☒ <89> Trip measuring system E

- ☒ <90> Trip I>
- ☒ <91> Trip I>>
- ☒ <92> Trip IN>
- ☒ <93> Trip IN>>

#### 6.3.3.6 Auto-reclosure indications in monitor direction

##### INF Semantics

- ☒ <128> CB 'on' by AR
- ☒ <129> CB 'on' by long-time AR
- ☒ <130> AR blocked

#### 6.3.3.7 Measurands in monitor direction

##### INF Semantics

- ☒ <144> Measurand I
- ☒ <145> Measurands I, V
- ☒ <146> Measurands I, V, P, Q
- ☒ <147> Measurands IN, VEN
- ☒ <148> Measurands IL1,2,3, VL1,2,3, P, Q, f

#### 6.3.3.8 Generic functions in monitor direction

##### INF Semantics

- ☐ <240> Read headings of all defined groups
- ☐ <241> Read values or attributes of all entries of one group
- ☐ <243> Read directory of a single entry
- ☐ <244> Read value or attribute of a single entry
- ☐ <245> End of general interrogation of generic data
- ☐ <249> Write entry with confirmation
- ☐ <250> Write entry with execution
- ☐ <251> Write entry aborted

#### 6.3.4 Selection of standard information numbers in control direction

##### 6.3.4.1 System functions in control direction

##### INF Semantics

- ☒ <0> Initiation of general interrogation
- ☒ <0> Time synchronization

##### 6.3.4.2 General commands in control direction

##### INF Semantics

- ☒ <16> Auto-recloser on/off
- ☒ <17> Teleprotection on/off
- ☒ <18> Protection on/off
- ☒ <19> LED reset

- ☒ <23> Activate characteristic 1
- ☒ <24> Activate characteristic 2
- ☒ <25> Activate characteristic 3
- ☒ <26> Activate characteristic 4

#### 6.3.4.3 General functions in control direction

##### INF Semantics

- ☐ <240> Read headings of all defined groups
- ☐ <241> Read values or attributes of all entries of one group
- ☐ <243> Read directory of a single entry
- ☐ <244> Read value or attribute of a single entry
- ☐ <245> End of general interrogation of generic data
- ☐ <248> Write entry
- ☐ <249> Write entry with confirmation
- ☐ <250> Write entry with execution
- ☐ <251> Write entry abort

#### 6.3.5 Basic application functions

- ☒ Test mode
- ☒ Blocking of monitor direction
- ☐ Disturbance data
- ☐ Generic services
- ☐ Private data

#### 6.3.6 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Measurand	Max. MVAL = rated value times 1,2	Max. MVAL = rated value times 2,4
Current L1	<input type="checkbox"/>	<input type="checkbox"/>
Current L2	<input type="checkbox"/>	<input type="checkbox"/>
Current L3	<input type="checkbox"/>	<input type="checkbox"/>
Voltage L1-E	<input type="checkbox"/>	<input type="checkbox"/>
Voltage L2-E	<input type="checkbox"/>	<input type="checkbox"/>
Voltage L3-E	<input type="checkbox"/>	<input type="checkbox"/>
Active power P	<input type="checkbox"/>	<input type="checkbox"/>
Reactive power Q	<input type="checkbox"/>	<input type="checkbox"/>
Frequency f	<input type="checkbox"/>	<input type="checkbox"/>
Voltage L1 – L2	<input type="checkbox"/>	<input type="checkbox"/>

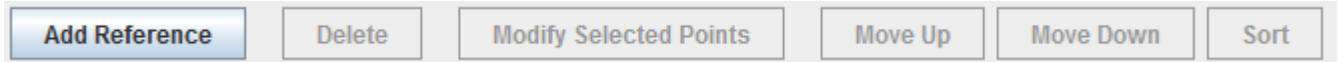
## 7 Reference Guide

### 7.1 Table Buttons

#### Client Options:



#### Server Options:



<i>Add</i>	Adds new data points in the client. See section <a href="#">3.3.2</a> .
<i>+1</i>	Adds a single new data point in the client. See section <a href="#">3.3.2.1</a> .
<i>Add Reference</i>	Adds a new data point reference in the server. See section <a href="#">3.4.2</a> .
<i>Delete</i>	Deletes the selected data points.
<i>Modify Selected Points</i>	Modify the properties of the selected data points. See section <a href="#">3.5.2</a> .
<i>Move Up</i>	Moves the selected data points up one row in the table.
<i>Move Down</i>	Moves the selected data points down one row in the table.
<i>Sort</i>	Sorts the table. Groups by Type ID, Function Type, Information Number, Data Object.

### 7.2 Table Columns

#### 7.2.1.1 Tag

<b>Description</b>	A unique Tag name for each data point. Since data point references use the tag name of the "real" point, the tag cannot be changed in the server instance.
<b>Data Entry</b>	String
<b>Min Length</b>	1
<b>Max Length</b>	N/A
<b>Input Option</b>	Mandatory

#### 7.2.1.2 Description

<b>Description</b>	User defined description for each data point. Since data point references use the description of the "real" point, the description cannot be changed in the server instance.
<b>Data Entry</b>	String
<b>Min Length</b>	1
<b>Max Length</b>	N/A
<b>Input Option</b>	Mandatory

#### 7.2.1.3 Function Type

<b>Description</b>	The IEC 60870-5-103 function type.
--------------------	------------------------------------



<b>Data Entry</b>	Drop Down Menu
<b>Types</b>	<i>128 Distance Protection</i> <i>160 Overcurrent Protection</i> <i>176 Transformer Differential Protection</i> <i>192 Line Differential Protection</i> <i>254 Generic Function Type</i> <i>255 Global Function Type</i>
<b>Input Option</b>	Mandatory

#### 7.2.1.4 Type ID

<b>Description</b>	The IEC 60870-5-103 Type ID. This can be used to restrict the available items in shown in the "Information Number" menu.
<b>Data Entry</b>	Drop Down Menu
<b>Types</b>	<i>Time Tag Message</i> <i>Relative Time Tag Message</i> <i>Measurands I</i> <i>Relative Time Tag Measurands</i> <i>Identification</i> <i>Measurands II</i>
<b>Input Option</b>	Mandatory

#### 7.2.1.5 Information Number

<b>Description</b>	The IEC 60870-5-103 information number. The drop down menus will only show relevant information numbers for the data point (usually, just shows information numbers with the given type ID).
<b>Data Entry</b>	Drop Down Menu
<b>Types</b>	<p>===== Data =====</p> <p>2     <i>Info Reset FCB</i></p> <p>3     <i>Info Reset CU</i></p> <p>4     <i>Info Start Restart</i></p> <p>5     <i>Info Power On</i></p> <p>16    <i>Auto Recloser Status</i></p> <p>17    <i>Tele Protection Status</i></p> <p>18    <i>Protection Status</i></p> <p>19    <i>Led Reset</i></p> <p>20    <i>Monitor Direction Blocked</i></p> <p>21    <i>Test Mode Info</i></p> <p>22    <i>Local Parameter Setting</i></p> <p>23    <i>Characteristic 1</i></p> <p>24    <i>Characteristic 2</i></p> <p>25    <i>Characteristic 3</i></p> <p>26    <i>Characteristic 4</i></p> <p>27    <i>Auxiliary Input 1</i></p> <p>28    <i>Auxiliary Input 2</i></p> <p>29    <i>Auxiliary Input 3</i></p> <p>30    <i>Auxiliary Input 4</i></p> <p>32    <i>Measurand Supervision I</i></p> <p>33    <i>Measurand Supervision V</i></p> <p>35    <i>Phase Sequence Supervision</i></p>

36	<i>Trip Circuit Supervision</i>
37	<i>Over I Backup Operation</i>
38	<i>Vt Fuse Failure</i>
39	<i>Teleprotection Disturbed</i>
46	<i>Group Warning</i>
47	<i>Group Alarm</i>
48	<i>Earth Fault L1</i>
49	<i>Earth Fault L2</i>
50	<i>Earth Fault L3</i>
51	<i>Earth Fault Forward</i>
52	<i>Earth Fault Reverse</i>
64	<i>Start Pickup L1</i>
65	<i>Start Pickup L2</i>
66	<i>Start Pickup L3</i>
67	<i>Start Pickup N</i>
68	<i>General Trip</i>
69	<i>Trip L1</i>
70	<i>Trip L2</i>
71	<i>Trip L3</i>
72	<i>Trip Over I Backup</i>
73	<i>Fault Location</i>
74	<i>Fault Forward</i>
75	<i>Fault Reverse</i>
76	<i>Teleprotection Signal Transmitted</i>
77	<i>Teleprotection Signal Received</i>
78	<i>Zone 1</i>
79	<i>Zone 2</i>
80	<i>Zone 3</i>
81	<i>Zone 4</i>
82	<i>Zone 5</i>
83	<i>Zone 6</i>
84	<i>General Start Pickup</i>
85	<i>Breaker Failure</i>
86	<i>Trip Measuring System L1</i>
87	<i>Trip Measuring System L2</i>
88	<i>Trip Measuring System L3</i>
89	<i>Trip Measuring System E</i>
90	<i>Trip I</i>
91	<i>Trip Over I</i>
92	<i>Trip In</i>
93	<i>Trip Over In</i>
128	<i>CB On By AR</i>
129	<i>CB On By Long Time AR</i>
130	<i>Auto Recloser Blocked</i>
144	<i>Measurand I</i>
145	<i>Measurands I V</i>
146	<i>Measurands I V P Q</i>
147	<i>Measurands In Ven</i>
148	<i>Measurands II123 VI123 P Q F</i>
===== Commands =====	
16	<i>Auto Recloser on/off</i>
17	<i>Teleprotection on/off</i>
18	<i>Protection on/off</i>
19	<i>LED Reset</i>
23	<i>Characteristic 1 Activate</i>
24	<i>Characteristic 2 Activate</i>
25	<i>Characteristic 3 Activate</i>

	26 <i>Characteristic 4 Activate</i>
Input Option	Mandatory

**7.2.1.6 Data Object**

<b>Description</b>	The IEC 60870-5-103 data object instance of the information number. The drop down menus will only show data objects relevant to the data point. Usually, this means it will show the data objects given the information number / type ID. Though in application servers, the ADH data point type must also match for it to appear in the list.
<b>Data Entry</b>	Drop Down Menu <i>DPI: Double point information</i> <i>SIN: Supplementary information</i> <i>COL: Compatibility level</i> <i>SCL: Short circuit location</i> <i>FAN: Fault number</i> <i>RET: Relative time</i>
<b>Types</b>	<p>===== MVAL (Measurand values) =====</p> <p><i>I: Current L<sub>N</sub></i>  <i>I: Current L1</i>  <i>I: Current L2</i>  <i>I: Current L3</i>  <i>V: Voltage V<sub>EN</sub></i>  <i>V: Voltage L1-L2</i>  <i>V: Voltage L1-E</i>  <i>V: Voltage L2-E</i>  <i>V: Voltage L3-E</i>  <i>P: Active power</i>  <i>Q: Reactive power</i>  <i>f: Frequency</i></p>
<b>Input Option</b>	Mandatory

**7.2.1.7 Class**

Data only

<b>Description</b>	The IEC 60870-5-103 class.
<b>Data Entry</b>	Drop down menu
<b>Options</b>	<i>Class 1, Class 2</i>
<b>Input Option</b>	Mandatory

**7.2.1.8 Cyclic Transmission Time (s)**

Server, data only

<b>Description</b>	Every "cyclic transmission time" amount of time, the Measurand values are sent back to the client. Measured in seconds.
<b>Data Entry</b>	Integer
<b>Types</b>	<i>0 to 65535</i>
<b>Input Option</b>	Mandatory for Measurand types only

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### 7.3 IEC 60870-5-103's Related ADH Types

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The IEC 60870-5-103 data types correspond to the ADH types given in the table below.

IEC 60870-5-103 Point Type	ADH Data Type	ADH Exchange Type
COL: Compatibility level	Unsigned 8	Data
DCO: Double point command	Double Point	Command (Single Stage)
DPI: Double point information	Double Point	Data
FAN: Fault number	Unsigned 16	Data
MVAL: Measurand value	Integer 16	Data
RET: Relative time	Unsigned 16	Data
SCL: Short circuit location	Float 32	Data
SIN: Supplementary information	Unsigned 8	Data

**Table 7-1 – IEC 60870-5-103 data types relation to ADH data point types.**



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