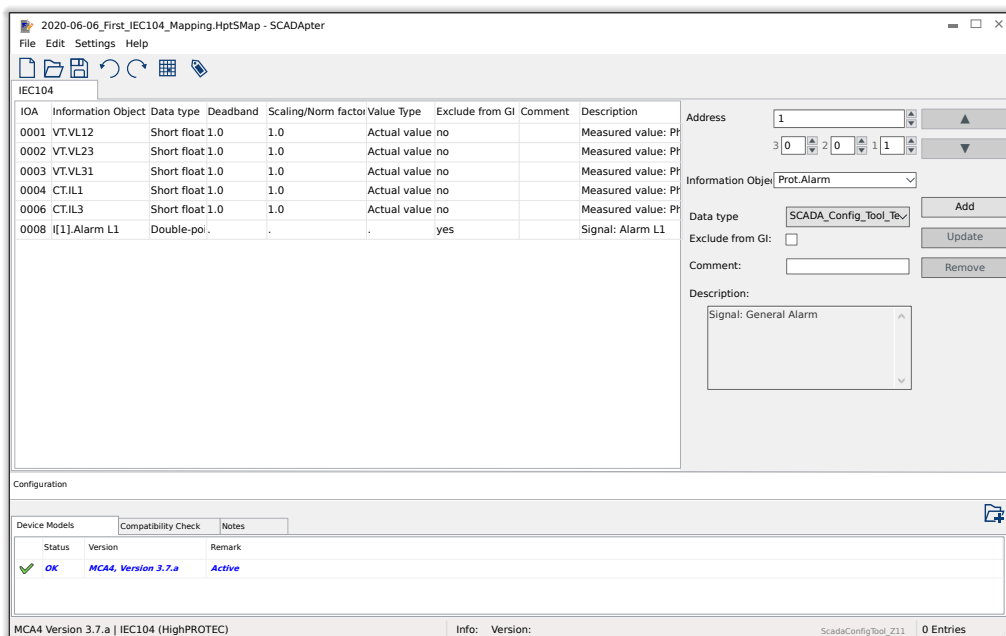# MANUAL

SCADApter | SCADA PROTOCOL CONFIGURATION TOOL

SCADA PROTOCOL CONFIGURATION TOOL

Version: 1.5

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English

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Table of Contents

1 Safety Messages and Proper Use of the SCADApter

1.1 Important Definitions

The types of messages shown below serve the safety of life and limb as well as for the appropriate operating life of the device.

⚠️	**DANGER!**
	DANGER! indicates an immediately dangerous situation that will result in death or serious injury if it is not avoided.

⚠️	**WARNING!**
	WARNING! indicates a hazardous situation that can result in death or serious injury if it is not avoided.

⚠️	**CAUTION!**
	CAUTION! indicates a possibly hazardous situation that can result in minor or moderate injuries if it is not avoided.

❗	**NOTICE!**
	NOTICE! is used to address practices not related to personal injury.

ℹ️	This symbol indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

1.2 Proper Use of the Device and of This Manual

WARNING!
FOLLOW INSTRUCTIONS Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

1.3 Important Information

Out-of-Date Documentation?

> This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, please visit the download section of our website:
>
> - **https://docs.SEGelectronics.de/smart_view**
>
> Please check this download area for the latest revision of this Technical Manual and whether there is an Errata Sheet with updated information. (The ID of every document is printed on its cover page.)

2 Application Overview

The *SCADApter* is a graphical SCADA Protocol Mapping Tool. It allows for defining a mapping from the measured values and logical states of a protection device to the protocol-specific object data.

NOTICE!

Currently only **HighPROTEC** devices as of Release 3.6 support configurable SCADA protocols. For a detailed compatibility list, see ⮑▷ "Compatibility".

A configurable SCADA protocol allows the protection device to be fully compatible with some previously used protection device, so that there is no need to make any changes to the existing SCADA communication.

These defined mappings are saved in a special SCADA configuration file with the filename extension *.HptSMap. Finally the *.HptSMap can be accessed after having established an connection between *Smart view* and the protection device, so that *Smart view* can transfer the mappings and make them effective within the protection device.

It is possible to launch the *SCADApter* the usual way, (for example) via the Windows Start button. But if you have *Smart view* already running it is probably more convenient to use the menu item *[Tools → SCADApter]*.

If DLLs should be Missing

If *SCADApter* should refuse to start because of missing DLLs then your Windows PC needs to have the *"Visual C++ 2017 Redistributable (x86)"* package installed.

You can get this package either from our download area at docs.SEGelectronics.de/vc_redist_x86, or directly from Microsoft.
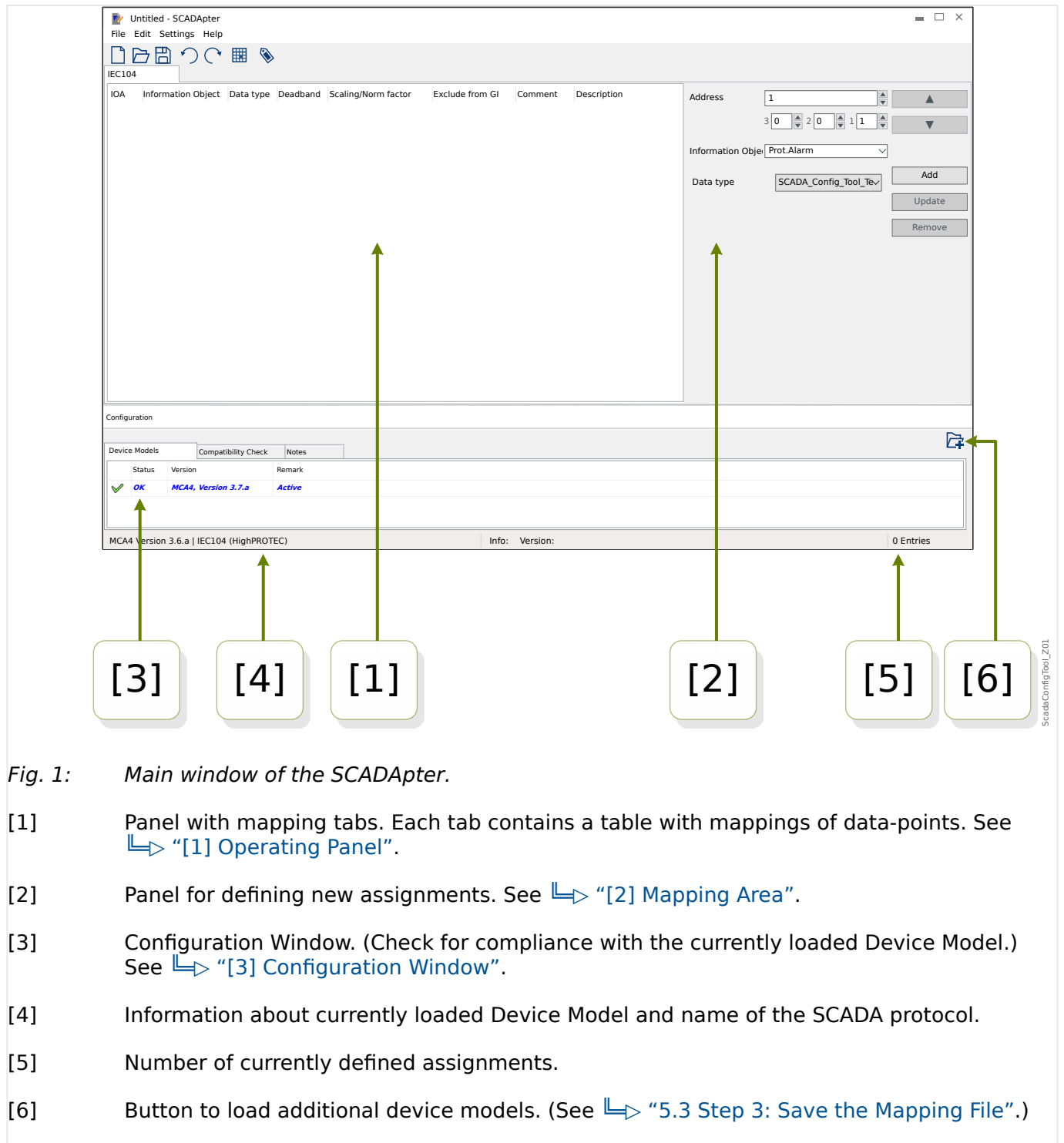
Fig. 1:   Main window of the SCADApter.

[1]   Panel with mapping tabs. Each tab contains a table with mappings of data-points. See ⤷ "[1] Operating Panel".

[2]   Panel for defining new assignments. See ⤷ "[2] Mapping Area".

[3]   Configuration Window. (Check for compliance with the currently loaded Device Model.) See ⤷ "[3] Configuration Window".

[4]   Information about currently loaded Device Model and name of the SCADA protocol.

[5]   Number of currently defined assignments.

[6]   Button to load additional device models. (See ⤷ "5.3 Step 3: Save the Mapping File".)

- More details about the panels and buttons and their functionality: ⤷ "3 Panels of SCADApter's Main Window"

- Description of the menu items: ⤷ "4 SCADApter's Main Menu"

Compatibility

For the general steps to be followed for creating a mapping, see ⤷ "5 Creation of a Protocol Mapping".

The *SCADApter* supports the following SCADA protocols and protection devices:

SCADA Protocols:

- Modbus (see ⮫ "6 Modbus Protocol")

- Profibus (see ⮫ "7 Profibus Protocol")

- IEC 60870-5-103 (see ⮫ "8 IEC 60870-5-103 Protocol")

- IEC 60870-5-104 (see ⮫ "9 IEC 60870-5-104 Protocol")

Protection Devices:

- All HighPROTEC devices as of Release **3.6** (only Modbus and IEC 60870-5-104).

- All HighPROTEC devices as of Release **3.7** (all these SCADA protocols).

Installation of the SCADApter

System requirements:

Windows 7, Windows 8.x or Windows 10

The *SCADApter* does not need a separate installation process, because it is always installed along with *Smart view*.

Uninstalling SCADApter

The *SCADApter* does not need a separate uninstall process, because it is always removed together with *Smart view*.
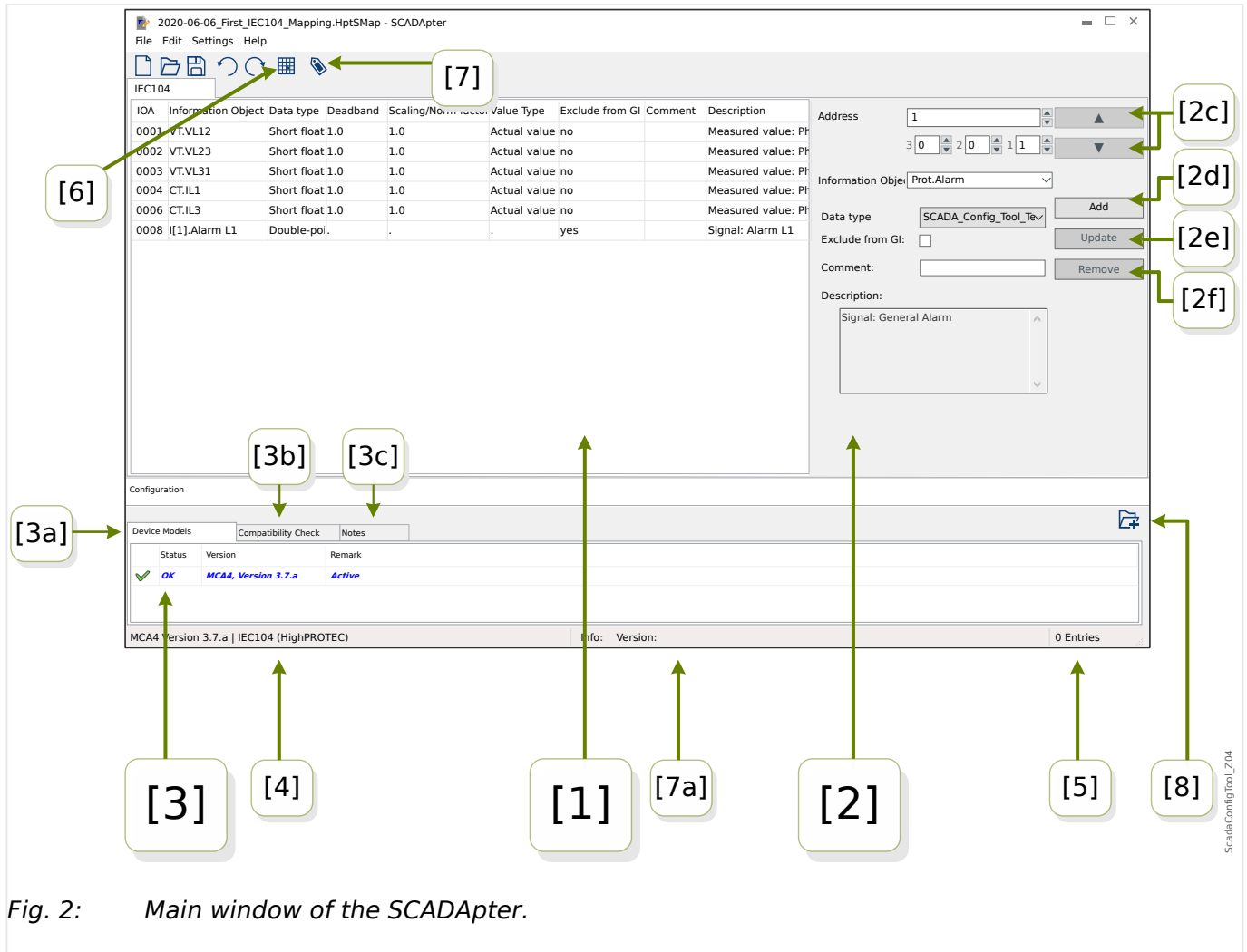
3   Panels of SCADApter's Main Window

Fig. 2:   *Main window of the SCADApter.*

- [1] – Panel with mapping tabs. The number of function of visible tab depends on the selected SCADA protocol. See ⌐▷ "[1] Operating Panel".

- [2] – Panel for defining or changing assignments. See ⌐▷ "[2] Mapping Area".

- [3] – Configuration Window. (Check for compliance with the currently loaded Device Model.) See ⌐▷ "[3] Configuration Window".

- [3a] – Information about currently loaded Device Model and name of the SCADA protocol. (See ⌐▷ "5.1 Step 1: Create a new Mapping or open a previously created *.HptSMap file".)

- [3b] – Tab with a detailed list of compatibility issues. (See ⌐▷ "5.3 Step 3: Save the Mapping File".)

- [3c] – Tab with additional notes that can be entered by the user. (See ⌐▷ "5.3 Step 3: Save the Mapping File".)

- [4] – Information about currently active Device Model and name of the SCADA protocol.

- [5] – Number of currently defined assignments. (For Profibus: Byte lengths of the assignments in the "Input" and "Output" tabs.)

- [6] – Button that allows for saving all mappings to a file in *Microsoft Excel* (`*.xlsx`) format or as comma-separated values (`*.csv`).

- [7] – Button that open a dialog where you can enter "Config version" and "Config info". (See also ⮩ "Add Notes – Add Metadata".)

  These are both text-values that can be set without restrictions. They are intended for useful metadata with respect to the mapping. For the SCADA protocol itself, however, they do not have any technical effect.

  They are displayed in the status bar "[7a]", and they are stored with the `*.HptSMap` file.

  After transfer to the protection device they are visible within the device menu [Device Para / »SCADA-protocol-name« / Config. Data Obj.].

  The function of this button is identical with the menu [Edit / Version Info], see ⮩ "Edit Menu".

- [8] – Button to load additional device models. (See ⮩ "5.3 Step 3: Save the Mapping File".)

[1] Operating Panel

The Operating Panel shows all assignments that have already been defined. For each Function Code of the SCADA protocol, there is a specific tab, which lists the mappings for this Function Code in form of a table.

Note that the mapping always depends on a particular device model, because the telegrams of some SCADA protocol may reference only data that are actually supported by the protection device. (You cannot have a mapping for voltage measurement values, for example, if you are configuring a protection device without voltage transformers.) So, after all, it is important to always select a device model first, because all the mappings that are going to be saved in a `*.HptSMap` file do always reference a particular device model file. (For details see ⮩ "5 Creation of a Protocol Mapping".)

[2] Mapping Area

This is a panel for entering the properties of a new mapping. The actual fields where the properties shall be entered are dependent on the selected SCADA protocol and of the type of device data that shall be mapped. (Some measurement value, for instance, has different properties than a binary state value.)

These fields and elements, however, do always appear:

- [2a] – *Start Address* – Enter the protocol-internal numeric address for which you want to create an assignment. Its presentation can vary depending on the protocol or type of data object.

  For example, for IEC 60870-5-104: Since this numeric address is the result of the values of three bytes there are also three number fields for the individual byte values. A change of the any of these values automatically updates all affected other fields. (For example, if you enter the number **1** into the "byte 2" field the »IOA« gets increased by **256**.)

- [2b] – *Data Object* – The device-internal data that shall be mapped to the protocol address.

  All the available data are defined in the referenced device model and can be accessed if one clicks on the small "▼" triangle at the right right margin of the input field: Then a tree structure unfolds that shows all available data, subordinated in

categories such as "Measured Values", "Statistics", "Status Display", etc. From there one can select the data object to be mapped. Depending on the selection some more input fields for the properties of the object might become visible.

- [2c] – Buttons »▲« (Previous), »▼« (Next) – Click these buttons to (re-)select the previous or next row from the table of assignments, respectively.

- [2d] – Button »Add« – Click this button after all properties of an assignment have been specified. This adds the mapping to the table of assignments as a new row. An assignment can be "new" only if the start address has not been mapped yet.

- [2e] – Button »Update« – Click this button after you have selected an existing row from the table of assignments and made some changes to the properties. This modifies the existing table row.

- [2f] – Button »Remove« – Click this button after you have selected an existing row from the table of assignments. This removes the table row.

[3] Configuration Window

This panel comprises the following tabs (sub-elements):

- [3a] – *Device Models* – Overview of all loaded Device Models. Definition of the active Device Model. The active Device Model controls which data objects and value types are available to the user. The status field reports if the created mapping is compatible to the Device Model.

- [3b] – *Compatibility Check* – Compatibility Table between the loaded Device Model and all defined mappings.

- [3c] – *Notes* – User-defined text to describe the purpose of the protocol mappings under construction.

The creation process of a protocol mapping is detailed in ⮫ "5 Creation of a Protocol Mapping".

4   SCADApter's Main Menu

[File] *Menu*

- [File / New] – This option creates a new mapping file. The user is asked for a device model, then for a SCADA protocol, finally he/she is able to create the assignments. See ⮡▷ "5.1 Step 1: Create a new Mapping or open a previously created *.HptSMap file".

- [File / Open] – This option opens an existing mapping file, so that he/she can check and/or or modify the assignments. See ⮡▷ "5.1 Step 1: Create a new Mapping or open a previously created *.HptSMap file".

- [File / Save] – This option saves the assignments that are currently in work to an (existing) mapping file.

- [File / Save As] – This option saves the assignments that are currently in work to a (new) mapping file. The user is asked to specify a filename.

- [File / Recent Files] – This is a list of recently opened mapping files, for quick access.

- [File / Quit] – This option terminates the *SCADApter*.

[Edit] *Menu*

- [Edit / Undo] – Undo the last mapping-related editing step.

- [Edit / Redo] – Undo the last Undo step.

- [Edit / Version Info] – Open a dialog where you can enter the "Config version" (version information of the mapping) and the "Config info" (user/author information).

  These are both text-values that can be set without restrictions. They are stored with the `*.HptSMap` file, and after transfer to the protection device they are visible within the menu [Device Para / »SCADA-protocol-name« / Config. Data Obj.]. For the SCADA protocol itself, however, they do not have any technical effect.

  This menu item is actually the same as the button "[7]" in the main window ⮡▷ Fig. 2.

[Settings] *Menu*

- [Settings / Application Language] – The language that *SCADApter* uses for its graphical user interface can be selected.

  A change, however, becomes effective only after a restart of the *SCADApter*.

- [Settings / Device Model Language] – Select the language that *SCADApter* uses for displaying the data objects that are available with the protection device. See also ⮡▷ "5.2 Step 2: Add Assignments and/or Modify the Existing Ones"

  This setting is available only after a valid device model or an existing mapping file has been loaded.

  A change of the device model language becomes effective only after a restart of the *SCADApter*.

The choice of language does not mean any restriction for later use of the SCADA protocol assignments. Every device model of a HighPROTEC device always has all parameters, values and states named in various languages, which are already built in. This means the language can always be changed at any time (to any of the supported languages).

The set of languages supported by a device model can be different from the set of languages that is available for the graphical user interface of the *SCADApter*.

[Help] **Menu**

The [Help / Help] menu item launches the *SCADApter* online-help.

The [Help / Program Information] menu item launches a window that displays *SCADApter*-related version and copyright information.

5 Creation of a Protocol Mapping

Creating a mapping file is a procedure involving the following steps:

- Step 1: Create a new Mapping or open a previously created *.HptSMap file.

- For a new file the *SCADApter* asks for the Device Model of the target device and for the SCADA protocol.

- Step 2: Add assignments and/or modify the existing ones.

- Step 3: Save the mapping file.

The transfer of the protocol mappings onto the protection relay is done with *Smart view*:

- Step 4: Connect the target device to *Smart view*.

- Step 5: Open the »SCADA Point Mapping Configuration« dialog and select the mapping file.

5.1 Step 1: Create a new Mapping or open a previously created *.HptSMap file

Option 1: Start from Scratch – Create a new Mapping

In order to create a new mapping select the menu item [File / New].

- Select a Device Model: The *SCADApter* asks you to select the Device Model of your target device. If you do not know the Device Model of your protective relay yet, you can read it out by using the relay's HMI or *Smart view*. There you can find the Device Model [Device Para / Version] »DM-Version«. The selected Device Model provides all the information that the *SCADApter* needs to check compatibility of the protocol definition.

  Please note that only device models can be loaded that are installed or loaded (from devices) on your computer.

- Next, the *SCADApter* asks to specify the SCADA protocol for which the mapping shall be defined. See ⮡▷ "Compatibility" for the supported protocols.

*Option 2: Open/Edit an Existing *.HptSMap Mapping Page*

- Select the menu item [File / Open].

- The *.HptSMap file already contains a reference to a device model and a protocol selection, so that you need to specify these again. But note that in case you have created the *.HptSMap file on some other computer you have to make sure that the device model has been installed or can be loaded from a connected device.

5.2 Step 2: Add Assignments and/or Modify the Existing Ones

FC1 … FC6 (Modbus) / IEC104:

If you have selected Modbus as SCADA protocol, you can see several tabs labeled "FCx". See ⮡▷ "6 Modbus Protocol" for details.

If you have selected Profibus as SCADA protocol, you can see two tabs labeled "Input" and "Output". See ⤷ "7 Profibus Protocol" for details.

If you have selected IEC 60870-5-103 as SCADA protocol, you can see different tabs, representing the existing data types. See ⤷ "8 IEC 60870-5-103 Protocol" for details.

If you have selected IEC 60870-5-104 as SCADA protocol, there is one tab with a table that holds all mapped data objects.

The Mapping Panel

On the Mapping Panel (⤷ "3 Panels of SCADApter's Main Window", ⤷ "[2] Mapping Area") you have to enter the *Start Address* first. This is the protocol-internal address to which the data object shall be assigned. The address is usually a decimal number, and you can either type it in directly, or use the small "▲" and "▼" buttons to increase or decrease the previously selected address number. But note that its presentation can vary depending on the protocol or type of data object. For example, for IEC 60870-5-104: Since the address number is the result of the values of three bytes there are also three number fields for the individual byte values. A change of the any of these values automatically updates all affected other fields. (For example, if you enter the number **1** into the "byte 2" field the »IOA« gets increased by **256**.)

Then a click on the "▼" of the field »Information Object« expands the selection list. You can select the data object that you want to assign to the protocol address, e. g. [Operation / Measured Values / Voltage] »VX meas«.
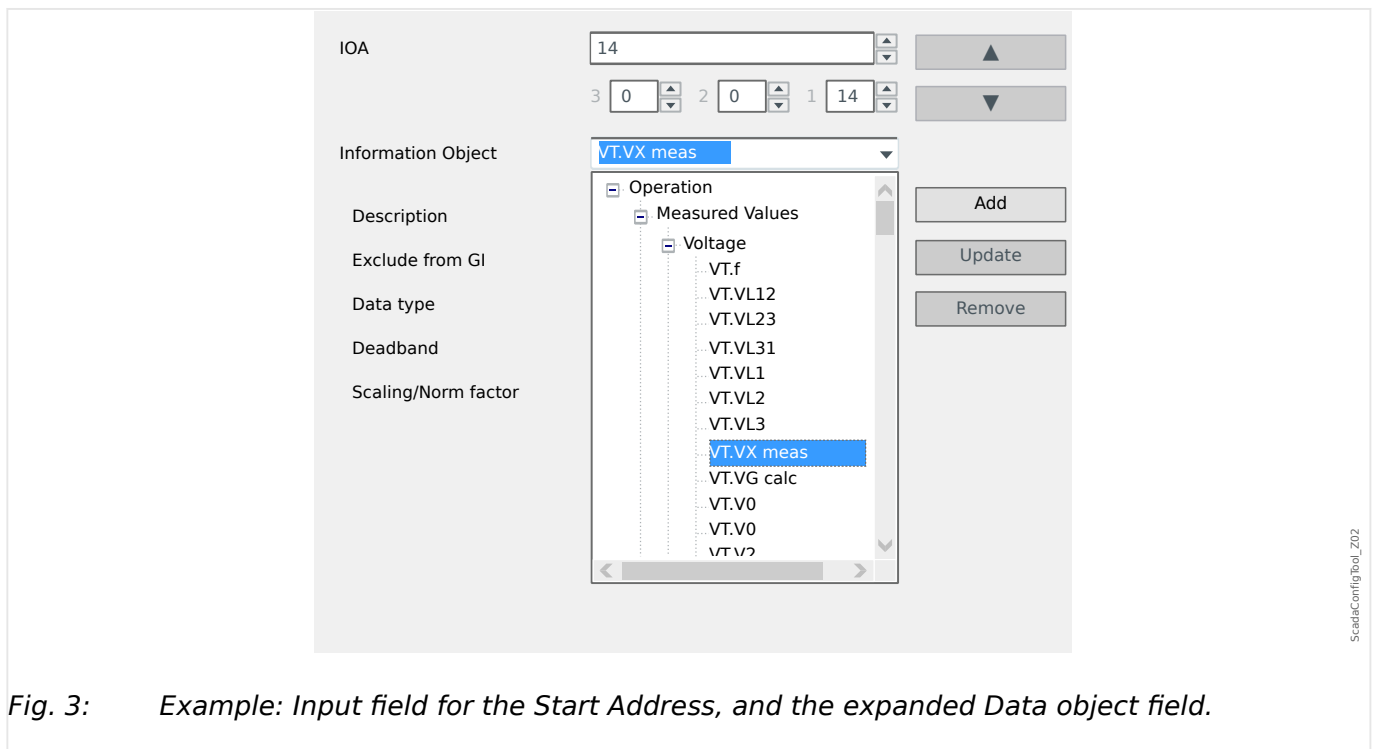

Fig. 3:   Example: Input field for the Start Address, and the expanded Data object field.

After the data object has been selected, some more input fields become visible, depending on the type of data object and depending on the selected SCADA protocol.

Depending on the type and variant of your protection device, the following protocols can be configured via SCADApter:

- Modbus (see ⤷ "6 Modbus Protocol"), or

- Profibus (see ⤷ "7 Profibus Protocol"), or

- IEC 60870-5-103 (see ⤷ "8 IEC 60870-5-103 Protocol"), or

- IEC 60870-5-104 (see ⮑▷ "9 IEC 60870-5-104 Protocol").

5.3 Step 3: Save the Mapping File

Compatibility Check

Before you can transfer the Protocol Definition into the target device, you have to check whether it is compatible with your protection relay. The compatibility check of your created mapping file with the target device is done by means of the device model that has been loaded at the beginning.

NOTICE!

!

It is possible to load additional device models, so that the compatibility check is performed for all of them in one go.

Click the button with the folder symbol and the plus sign ("[6]" in the "Main Window" diagram, ⮑▷ "2 Application Overview").

Alternatively, a right-mouse-button click into the »Device Models« field shows a context-menu, and from that you can select [Load New Device Model].

This context-menu also allows for selecting one of the loaded device models as the "active" one (i. e. the device model from which you select the available data objects to be mapped).

And of course, there is also the option to remove one of the loaded device models.

- Check the overall status in the Configuration window on tab »Device Models«. If the status is OK, proceed with the next step. If the status shows any problems, proceed as follows:

- Select the tab »Compatibility Check«. Here you can see which assignments are incompatible with your target device. Resolve the incompatibilities.

Resolve Device Incompatibilities

You have the following options to solve incompatibilities:

- Remove incompatible assignments from your mapping table.

- Adapt the settings so that they fit to your loaded device model(s).

- Then execute the page validation tests again (see above).

Add Notes – Add Metadata

You should now add some description to your protocol definition within the »Notes« tab of the Configuration window, so that it is possible to trace at a later time what has been done.

Moreover, we recommend to add an appropriate bit of information ("Config info") and some version info ("Config version") via the menu item [Edit / Config Info], ⮑▷ "Edit Menu", or the button "[7]", ⮑▷ Fig. 2. (This "Config Info" is then displayed in the status bar, see "[7a]" in ⮑▷ Fig. 2.)

Save the Mapping Definitions

In order to save the protocol definitions as a file select the menu item [File / Save]. In case that there are still any pending incompatibilities between your assignments and the active Device Model, a warning will pop up. You can either resolve the incompatible settings first (see above) or save the incompatible assignments. Please note that incompatible files cannot be transferred to the target device.

NOTICE!

! A protocol definition file that does not fulfill the compatibility checks cannot be transferred to the target relay.

When all incompatible settings and validation errors are resolved, the assignments are ready to be transferred into the device.

5.4   Step 4: Connect the Target Device

Access the mapping file in *Smart view*. This can be done while the target protection device is connected:

- Connect the protection relay to the PC (please refer to the *Smart view* manual). Receive the parameter settings from the device using *Smart view*.

5.5 Step 5: Select the Mapping File

In order to load the mapping file proceed as follows:

⚙

1. ▷ In *Smart view*, open the menu item [Device planning].

2. ▷ A double-click on the entry *»Scada . Protocol«* opens the dialog for selecting the SCADA protocol to be used.

Of course, you have to set this to the same protocol as you have used for the mapping file.

3. ▷ Click on the button »Apply« to actually set the protocol.

▶ Within the menu branch [Device Para], a sub-menu becomes visible that belongs to the selected protocol. (The menu item [Device Para / IEC104], for example, or [Device Para / Modbus].)

This sub-menu contains (among others) a menu item [Config. Data Obj.].

4. ▷ Double-click [Config. Data Obj.].

▶ A dialog window is opened that features a »SCADA Configuration Transfer« button. (See **(1)** in the example figure below.)

5. ▷ Clicking on this button opens another dialog, »SCADA Point Mapping Configuration«. There are two buttons there, **(2)** and **(a)** in the figure below.

For our purpose, we have to click button **(2)**, »Select a SCADA Mapping File from Disk and send it to the connected Device.«.

▶ Then a file-select dialog opens.

6. ▷ Navigate to the *.HptSMap file that keeps the required SCADA definitions and click »Open«.

▶ *Smart view* opens and checks the *.HptSMap file. If it is compatible with the connected protection device a dialog asks the user whether the protocol definitions shall be transferred to the protection device **(3)**.

7. ▷ After clicking »yes« (and entering the password for the access level »Supervisor-Lv3«) the data is transferred.

▶ Afterwards, the user is informed about the success **(4)**.

8. ▷ The user may now click »Close« **(5)** in the »SCADA Point Mapping Configuration« dialog, to return to the *Smart view* main window.

9. ▷ Finally the user-specific mapping must be activated by the setting [Device Para / (protocol-name) / Config. Data Obj.] *»Type of SCADA mapping«* = "User-defined".

Do not forget to transfer all (or all changed) settings (from *Smart view*) to the protection device.
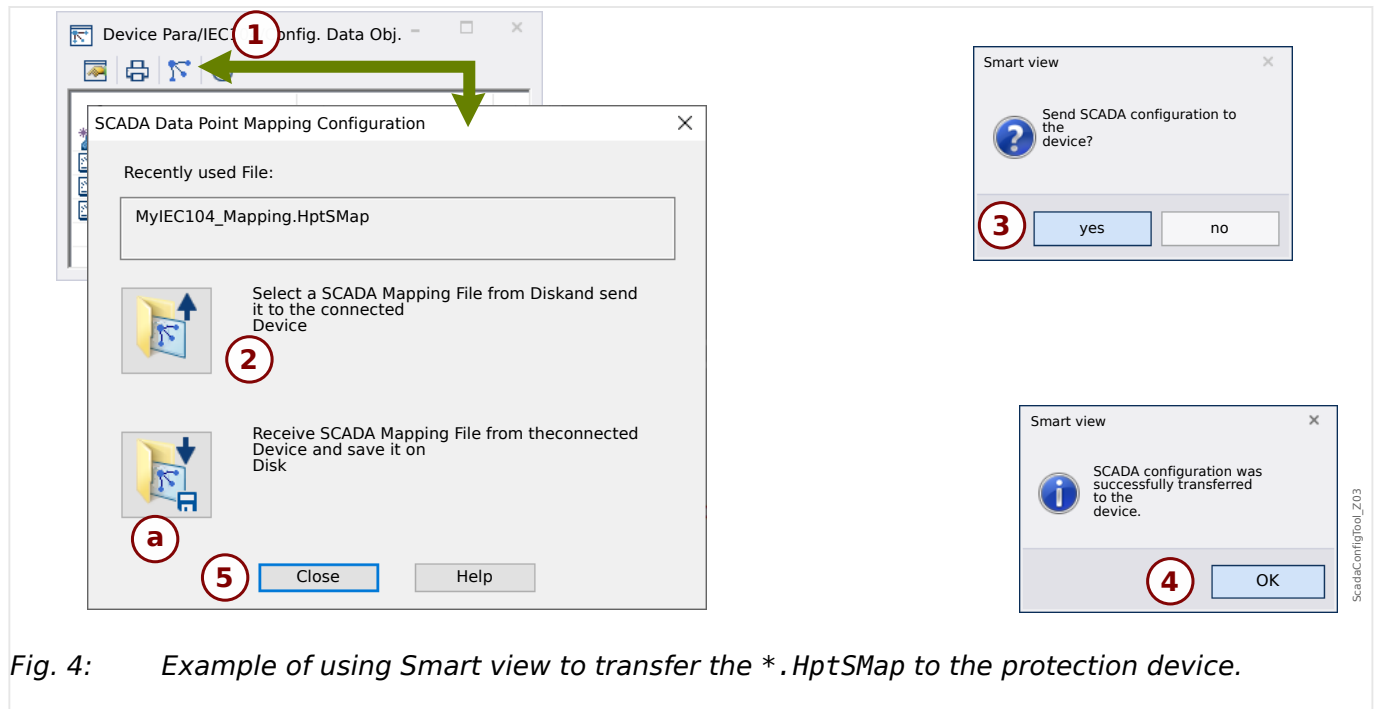
Fig. 4:   *Example of using Smart view to transfer the *.HptSMap to the protection device.*

> The other button, **(a)**, performs a transfer in the opposite direction: The protection devices sends its (user-defined) SCADA protocol mapping to the »SCADA Point Mapping Configuration«, then a »Save as« file-dialog appears, that allows the user to create a new *.HptSMap file from these protocol definitions.
>
> This download is not possible for the (factory default) standard mapping.

6 Modbus Protocol
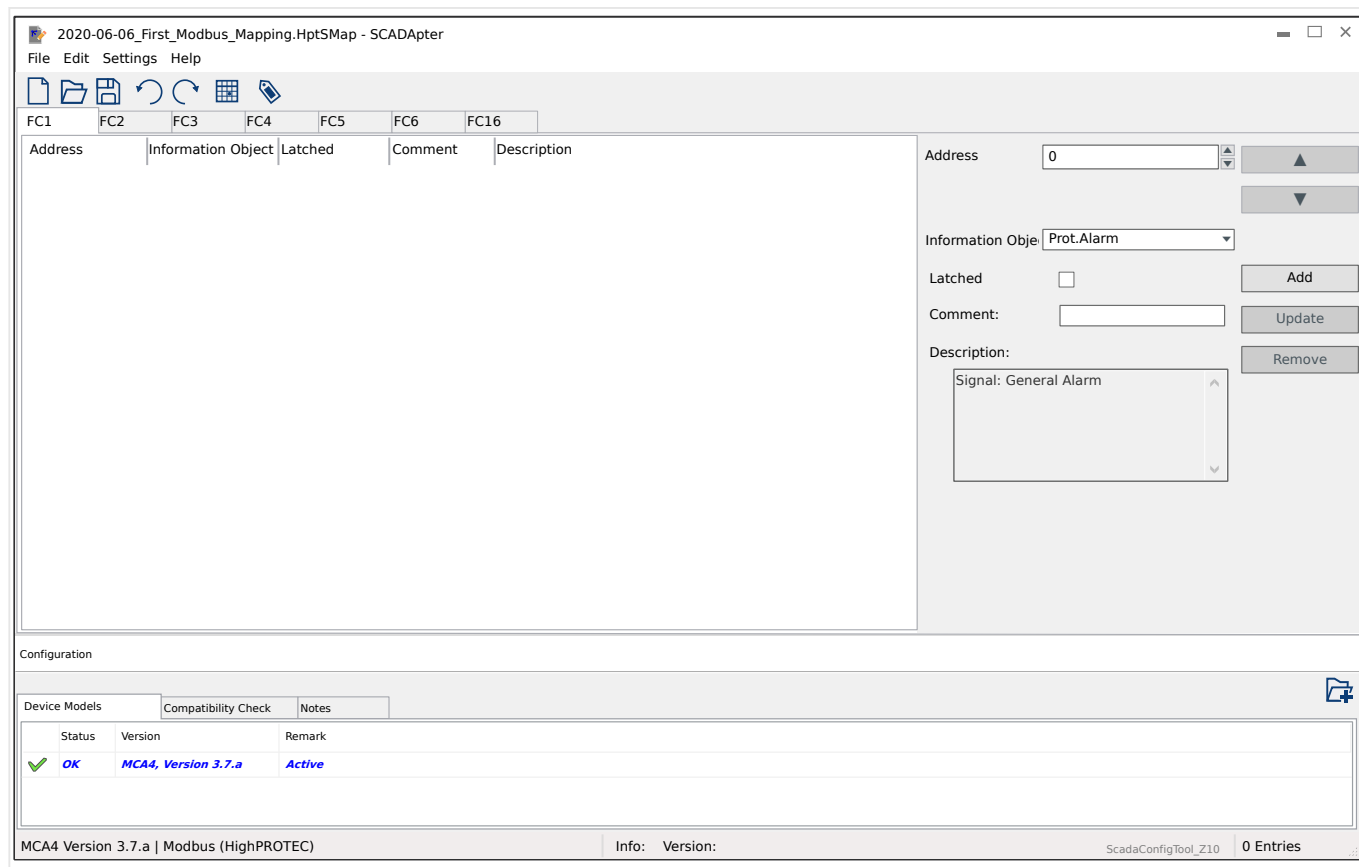
If you have selected Modbus as SCADA protocol, you can see several tabs labeled "FCx". Each of these tabs represents a Modbus Function Code and features a table that holds the mapped data objects.

The "Function Code" number decides about the type of data-objects that it can hold:

- FC1, FC2 hold states (but no measurement values).

- FC3, FC4 can hold all types except commands.

- FC5, FC6 are for commands.

- FC16 is for special multi-word messages (essentially for time-synchronization).

The following additional input fields become visible on the mapping panel (⤷ "5.2 Step 2: Add Assignments and/or Modify the Existing Ones") in case of the Modbus protocol:

- *Comment* – User-defined text without any technical functionality. It can be used for archiving some background information of the mapping.

- *Description* – Additional explanatory text for the selected data object (if available in the Data Model).

- *Latched* – The "Latched" checkbox decides whether the Modbus information shall be latched (until an explicit acknowledgment).

- *Format* – Select the format of the data-object:

    ○ Int16 — Integer number with 16 bit length

- ◦ `Uint16` — Unsigned (i.e. non-negative) integer number with 16 bit length

- ◦ `Int32` — Integer number with 32 bit length

- ◦ `Uint32` — Unsigned (i.e. non-negative) integer number with 32 bit length

- ◦ `Float` — Number in floating point representation (according to IEEE 754)

- *Bit position* – The bit position appears only where it makes sense to select it (in particular with binary states of 1 bit length).

- *Bit size* – The bit size is automatically set according to the format of the data-object.

- *Factor*, *Scaling* – For measured values and statistical data, specify the factor and the scaling of the data (if these input fields are visible). The scaling can be as follows:

    - ◦ `Primary` — Scaling of the information object to primary value

    - ◦ `Secondary` — Scaling of the information object to secondary value

    - ◦ `Relative` — Scaling of the information object relative to nominal value

- *Fault value* – If ticked then the fault value is used, instead of the ongoing / actual measured value.

7   Profibus Protocol
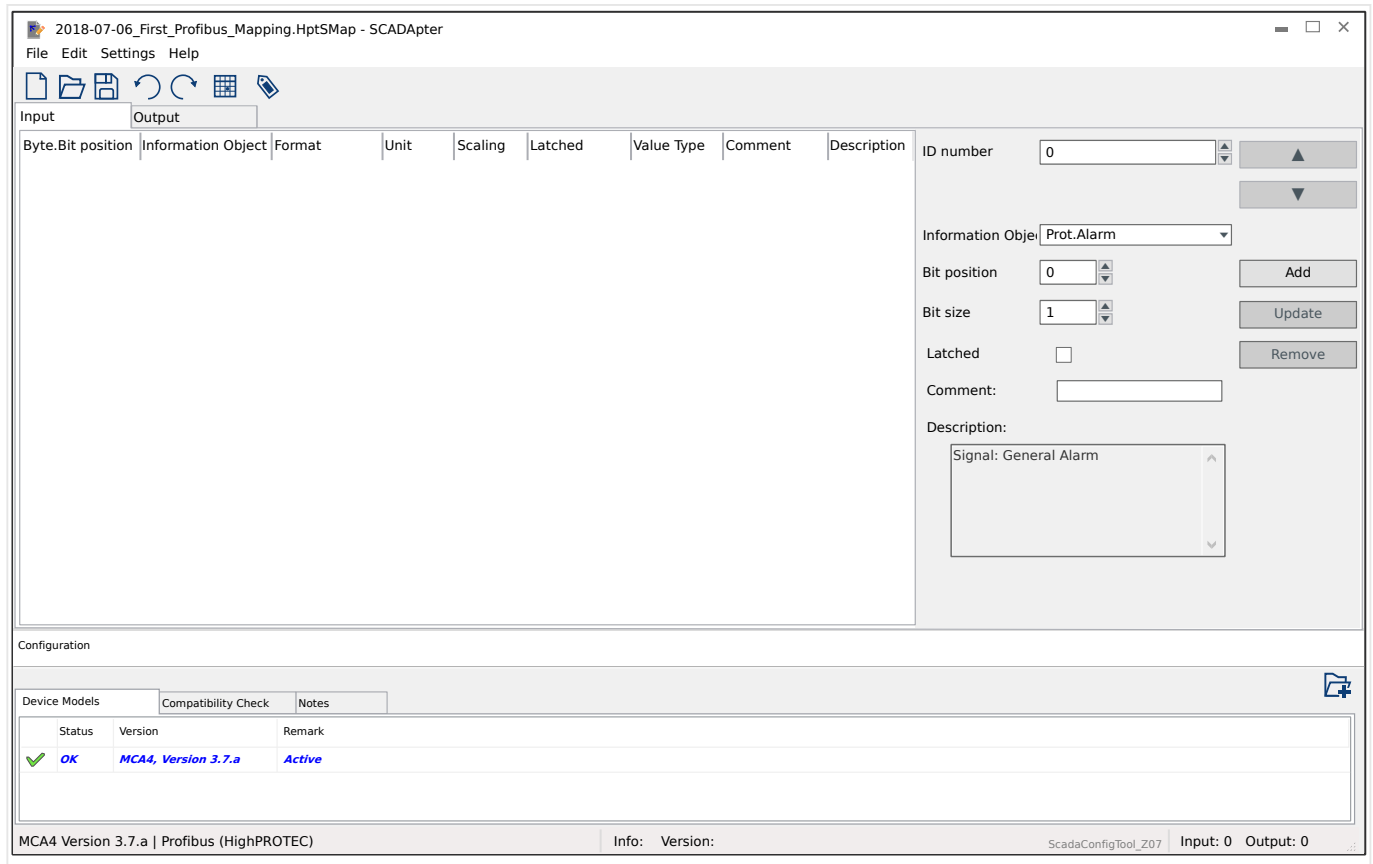
The mapping table is distributed over two tabs, "Input" and "Output". The data-points listed in "Output" will be sent by the Master to the Slave (and the slave, in our case, is the protection device), and the data-points listed in "Input" will be sent by the Slave to the Master.

- The tab "Output" is dedicated to Profibus commands and SCADA commands that are specific to the protection device (e. g. commands to acknowledge LEDs, output relays or latched trip commands).

- All data-points that the substation receives from the protection device can be found on the "Input" tab.

The choice of data-points being visible at the select field »Information Object« of the mapping panel (⇨ "5.2 Step 2: Add Assignments and/or Modify the Existing Ones") is automatically restricted according to the active tab, and the additional input fields with object properties are dependent on the selected data-point.

> **NOTICE!**
>
> **!**
>
> For HighPROTEC protection devices, there are some constraints due to the implementation of the Profibus protocol:
>
> - The total length of all data-point entries in the "Input" tab must be **min. 8** Bytes.
>
>   (The current total lengths for both tabs are displayed on the right-hand side of the bottom status line.)
>
> - The "Input" tab must contain at least one *Measured Value* and at least one *Status Display*.
> - The "Output" tab must contain at least one data-point.
> - Duplicate data-points are not allowed, i. e. assigning the same data-point more than once is not permitted.
>
> The *SCADApter* issues an error message if you try to save a mapping as a *.HptSMap file although any of these conditions is not met.

General input fields (available with both tabs):

- Byte pos. – On the Mapping Panel (↳▷ "3 Panels of SCADApter's Main Window", ↳▷ "[2] Mapping Area") you have to enter the protocol-internal address first. You can either type it in directly, or use the small "▲" and "▼" buttons to increase or decrease the current value.

- *Comment* – User-defined text without any technical functionality. It can be used for archiving some background information of the mapping.

- *Description* – Additional explanatory text for the selected data object (if available in the Data Model).

- *Bit position* – The bit position appears only where it makes sense to select it (e. g. with binary states of 1 bit length).

- *Bit size* – The bit size is automatically set according to the format of the data-object.

Properties (input fields) for the tab "Input":

- *Latched* – This checkbox decides whether the Profibus information shall be latched (until an explicit acknowledgment).

- *Format* – The format of the data-object is shown:

    - `Int16` — Integer number with 16 bit length

    - `Uint16` — Unsigned (i.e. non-negative) integer number with 16 bit length

    - `Int32` — Integer number with 32 bit length

    - `Uint32` — Unsigned (i.e. non-negative) integer number with 32 bit length

    - `Float` — Number in floating point representation (according to IEEE 754)

- *Scaling*, *Factor* – For measured values and statistical data, specify the factor and the scaling of the data (if these input fields are visible). The scaling can be as follows:

   - `Primary` — Scaling of the information object to primary value

- ◦ `Secondary` — Scaling of the information object to secondary value

- ◦ `Relative` — Scaling of the information object relative to nominal value

- *Unit* – The unit is shown, if applicable.

NOTICE!
❗ The total field lengths (for "Input" and "Output") must be included in the configuration of the Master, otherwise the communication will not be established correctly, but stop with a "configuration error". The right-hand side of the bottom status line displays these lengths (number of Bytes) as decimal numbers. The Master configuration, however, expects these numbers in a special hexadecimal representation. Although it is not difficult to manually convert the decimal numbers into this representation it is surely useful that they can also simply be found in the Excel export that SCADApter creates. (Excel export: See "[6]" in ⮑▷ Fig. 2.)

8 IEC 60870-5-103 Protocol
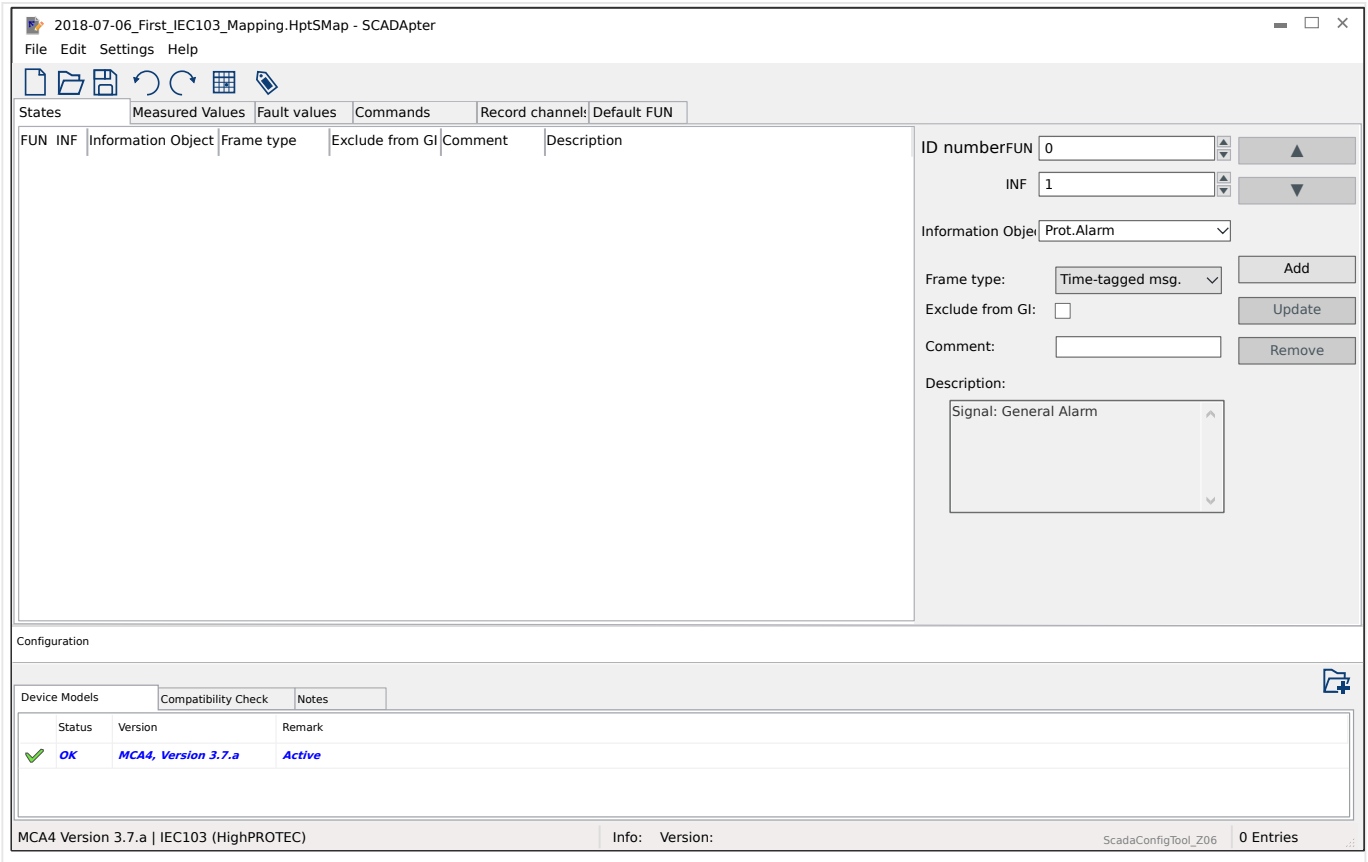
The mapping table is distributed over different tabs, representing the existing data types for the IEC 60870-5-103 protocol.

The choice of data-points being visible at the select field »Information Object« of the mapping panel (⤷ "5.2 Step 2: Add Assignments and/or Modify the Existing Ones") is automatically restricted according to the active tab.

The input fields on the Mapping Panel are dependent on the preselected tab and the selected data-point.

General input fields (available with every tab):

- ID number – On the Mapping Panel (⤷ "3 Panels of SCADApter's Main Window", ⤷ "[2] Mapping Area") you have to enter the protocol-internal address first. For the IEC 60870-5-103 protocol, the address consists of two integer numbers, the Function Type ("FUN") and the Information Number ("INF"). You can either type these in directly, or use the small "▲" and "▼" buttons to increase or decrease the current value.

- *Comment* – User-defined text without any technical functionality. It can be used for archiving some background information of the mapping.

- *Description* – Additional explanatory text for the selected data object (if available in the Data Model).

Properties (input fields) for tab "States":

- Frame type – ASDU frame type. For states, the following types are possible:

    ○ "Time-tagged msg." – Time-tagged message

- ○ "Msg. with rel. time" – Time-tagged message with relative time

- *Exclude from GI* – If ticked then the data object shall not be part of a general interrogation.

Properties (input fields) for tab "Measured Values":

- *Index* – Position/index of measurement data within a frame

- Frame type – ASDU frame type. For measured and statistical values, the following types are possible:

  - ○ "Meas-II" – Measurement-II, ASDU 9

  - ○ "Meas-I" – Measurement-I, ASDU 3

  - ○ "Energy Type 195" – Energy, ASDU 195, proprietary type available only for energy values, see ↳ "10.1 IEC 60870-5-103 Type Identification ASDU 195".

  - ○ "Energy Type 41" – Energy values (as float numbers), type 41, compatible to CSP, proprietary type available only for some energy values, see ↳ "10.2 IEC 60870-5-103 Type Identification ASDU 41".

- *Data type* – Select the type of data that this data object represents.

  The IEC 103 protocol defines the following data types for measured (and statistical) values:

  - ○ `Normalized` — Measured value, normalized value,

  - ○ `Scaled` — Measured value, scaled value,

  - ○ `Short float` — Measured value, short floating point number.

  The IEC 103 protocol defines the following data types for binary states:

  - ○ `Single-point` — Single-point information,

  - ○ `Double-point` — Double-point information,

  - ○ `Bitstring` — Bitstring of 32 bit.

  The IEC 103 protocol defines the following data types for commands:

  - ○ `Single-point` — Single-point information,

  - ○ `Double-point` — Double-point information.

- Scaling/Norm factor – Define the scaling factor for the value of this data object.

Properties (input fields) for tab "Fault values":

- Frame type – ASDU frame type. For fault values, the type is fixed as follows:

  - ○ "Meas with rel. time" – Time-tagged measurands with relative time, ASDU 4

- *Data type* – For fault values, the data type is fixed as follows:

  - ○ `Short float` — Measured value, short floating point number.

Properties (input fields) for tab "Commands":

- Frame type – ASDU frame type. For commands, the type is fixed as follows:

  ○ "Common Cmd." – Common command, ASDU 20

Properties (input fields) for tab "Record channels":
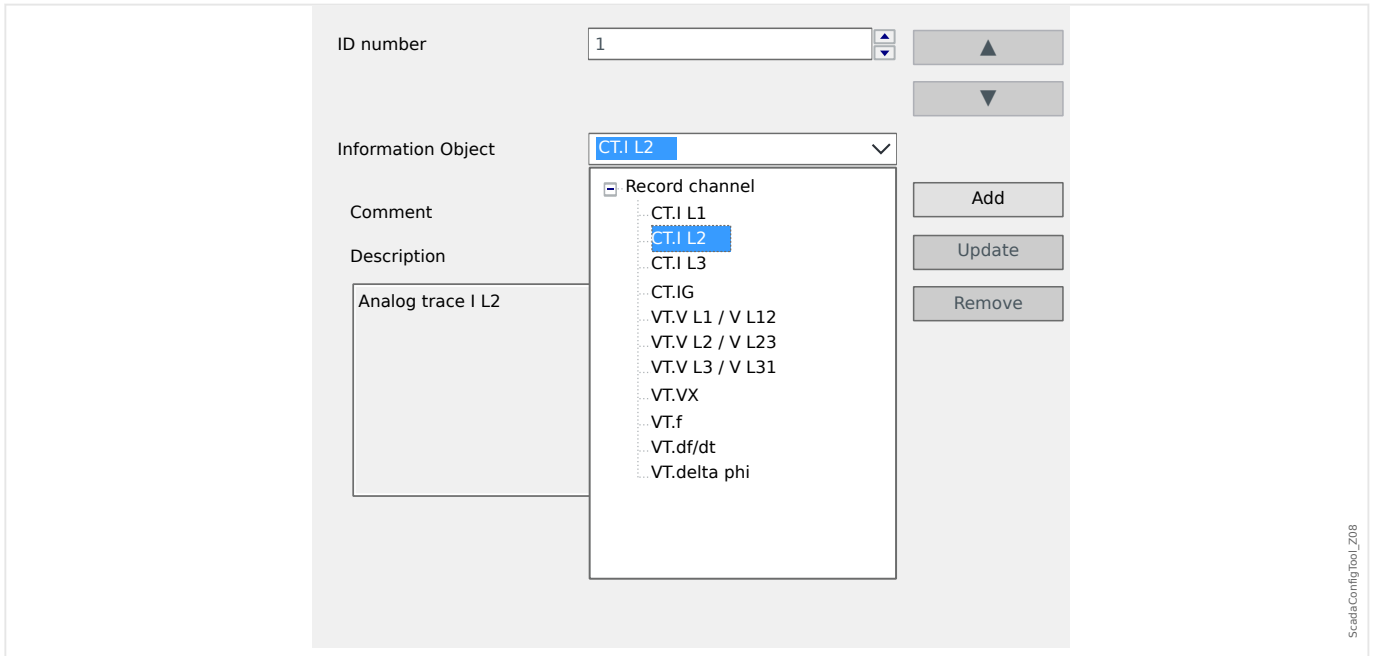
- The input field »Information Object« makes all analog recording channels, i. e. measured data being recorded in the Trend Recorder, accessible.

- »ID number« – The measured value selected at »Information Object« can be assigned to an "Actual Channel" ("ACC", see Section 7.2.6.1 in the IEC 60870-5-103).

**Properties (input fields) for tab "Default FUN":**
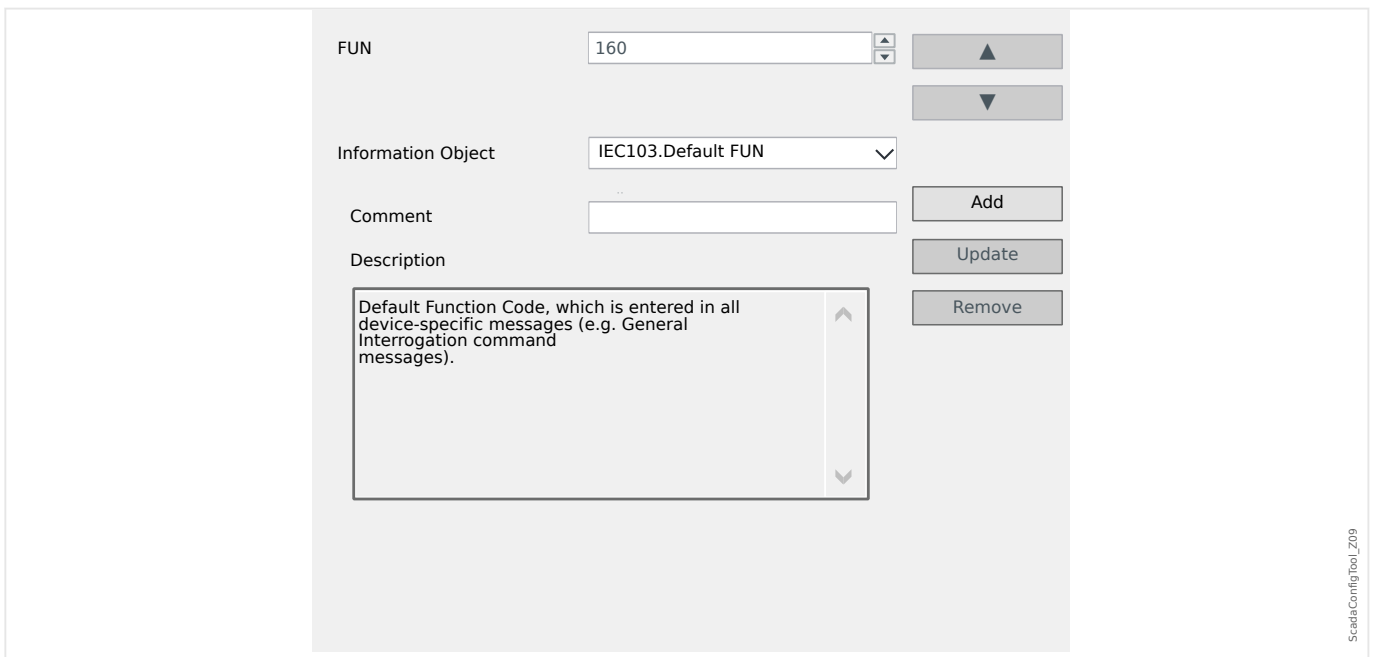
- The input field »Information Object« offers only one entry, »IEC103 . Default FUN«.

- »ID number« – The definition of the Function Type (see Section 7.2.5.1, Table 7 in the IEC 60870-5-103) requires a value that is specific of the type of protection device, and this Function Type is also part of several protocol-specific messages.

  These special messages are not part of the Device Model and are therefore not accessible under the previously mentioned tabs. This tab, "Default FUN", allows for defining the Function Type that is transmitted as part of all these messages.

9 IEC 60870-5-104 Protocol
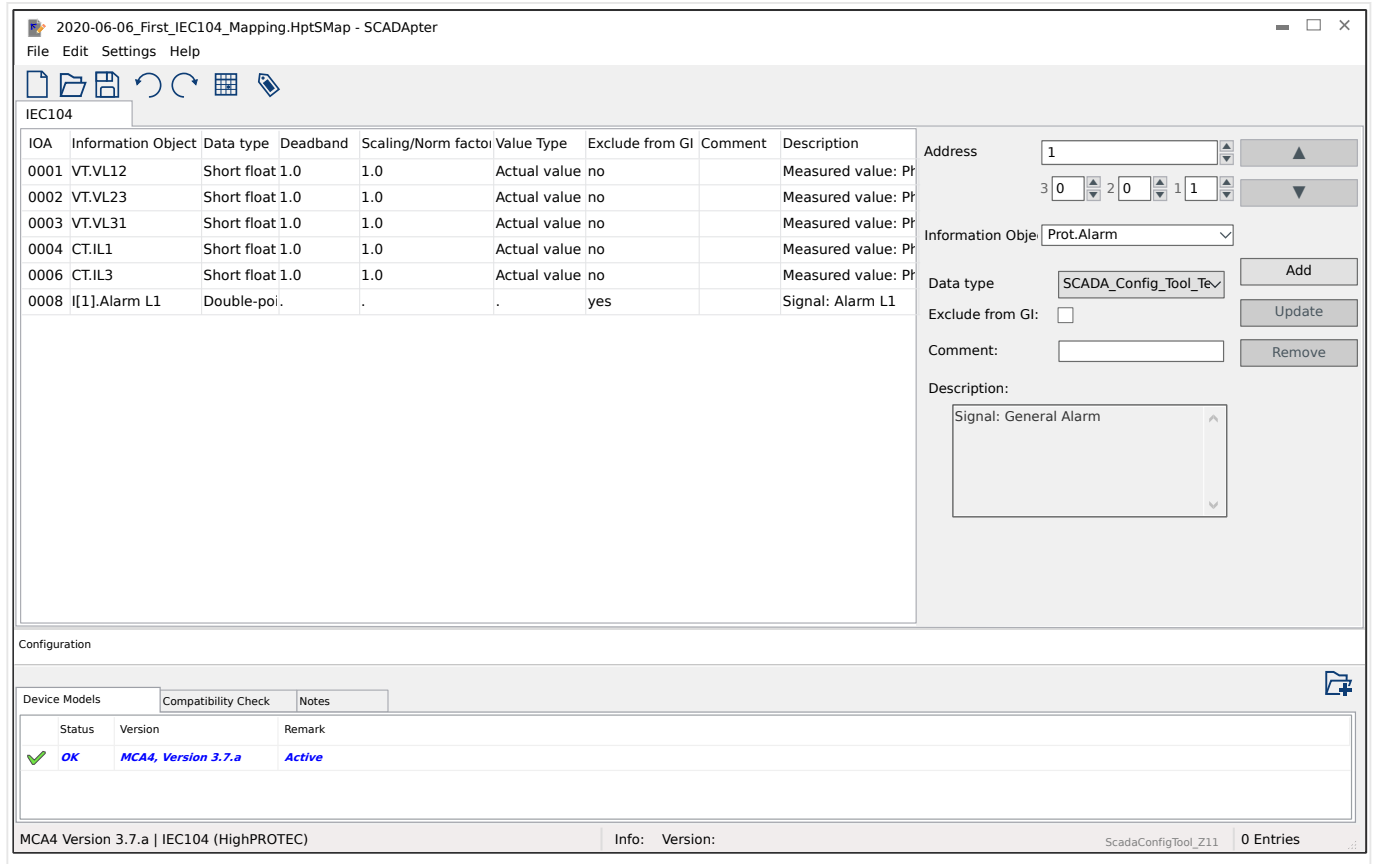
If you have selected IEC 60870-5-104 as SCADA protocol, there is one tab with a table that holds all mapped data objects.

The following additional input fields become visible on the mapping panel (⌦ "5.2 Step 2: Add Assignments and/or Modify the Existing Ones") in case of the IEC 60870-5-104 protocol:

- *Comment* – User-defined text without any technical functionality. It can be used for archiving some background information of the mapping.

- *Description* – Additional explanatory text for the selected data object (if available in the Data Model).

- *Exclude from GI* – If ticked then the data object shall not be part of a general interrogation.

- *Data type* – Select the type of data that this data object represents.

  The IEC 104 protocol defines the following data types for measured (and statistical) values:

    ◦ Normalized — Measured value, normalized value (M_ME_TD_1),

    ◦ Scaled — Measured value, scaled value (M_ME_TE_1),

    ◦ Short float — Measured value, short floating point number (M_ME_TF_1).

  The IEC 104 protocol defines the following data types for binary states:

    ◦ Single-point — Single-point information (M_SP_TB_1),

- ○ `Double-point` — Double-point information (M_DP_TB_1),

- ○ `Bitstring` — Bitstring of 32 bit (M_BO_TB_1).

The IEC 104 protocol defines the following data types for commands:

- ○ `Single-point` — Single-point information (C_SC_NA_1),

- ○ `Double-point` — Double-point information (C_DC_NA_1).

- Deadband – For measured (and statistical) values: Define the value change for this data object (in percent of the maximum value) that will cause the protection device to re-send the changed value. See also the examples given at ⮡ "9.1 Deadband Settings in IEC 60870-5-104".

  Deadband – For counter values (integer numbers): Define the value increment that will cause the protection device to re-send the changed value.

- Scaling/Norm factor – Define the scaling factor for the value of this data object.

- *Fault value* – If ticked then the fault value is used, instead of the ongoing / actual measured value.

9.1 Deadband Settings in IEC 60870-5-104

The Deadband setting *»Deadband«* specifies for a measured (or statistical) value, for which value change the updated value is transmitted again.

Cyclic transmission is defined for a measured value by setting the Deadband percentage for this measured value to zero.

A non-zero Deadband percentage always refers to the *maximum* value of the respective measured value, see the following examples.

Examples for Deadband Settings

The Deadband setting shall be detailed by some examples.

☀ **Voltage (via "TU" Voltage Measuring Card)**

- The voltage transformer card "TU" covers the voltage range 0 – 800 V. (See the "Technical Data" chapter in the manual.) In other words, the **maximum** value is **800 V**.
- The **rated** value (secondary) is **100 V**.
- Therefore the conversion factor from the percentage of the rated voltage to the *Deadband setting* is:

  q = 100 V / 800 V = **0.125**

- For example, a deadband value of **10%**, given as a percentage of the *rated* voltage, is required.
- Then the Deadband setting value must be as follows:

  10% · q = 0.0125 = **1.25%**
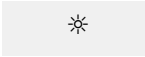
☼ **Currents (1 A CT)**

- The 1 A current transformers cover the range 0 – 40 A.
- The **rated** current (secondary) is **1 A**.
- Therefore the conversion factor from the percentage of the rated current to the *Deadband setting* is:

  q = 1 A / 40 A = **0.025**
- For example, a deadband value of **10%**, given as a percentage of the *rated* current, is required.
- Then the Deadband setting value must be as follows:

  $10\% \cdot q = 0.0025 = $ **0.25%**

☼ **Currents (5 A CT)**

- The 5 A current transformers cover the range 0 – 200 A.
- The **rated** current (secondary) is **5 A**.
- Therefore the conversion factor from the percentage of the rated current to the *Deadband setting* is:

  q = 5 A / 200 A = **0.025**
- For example, a deadband value of **10%**, given as a percentage of the *rated* current, is required.
- Then the Deadband setting value must be as follows:

  $10\% \cdot q = 0.0025 = $ **0.25%**

☼ **Earth (Ground) Current (1 A CT)**

- The standard current transformer card "TI" covers the range 0 – 25 A.
- The **rated** current (secondary) is **1 A**.
- Therefore the conversion factor from the percentage of the rated current to the *Deadband setting* is:

  q = 1 A / 25 A = **0.04**
- For example, a deadband value of **10%**, given as a percentage of the *rated* current, is required.
- Then the Deadband setting value must be as follows:

  $10\% \cdot q = 0.004 = $ **0.4%**

☼ **Sensitive Earth (Ground) Current (1 A CT)**

- The sensitive current transformer card "TIs" covers the range 0 – 2.5 A.
- The **rated** current (secondary) is **1 A**.
- Therefore the conversion factor from the percentage of the rated current to the *Deadband setting* is:

  q = 1 A / 2.5 A = **0.4**
- For example, a deadband value of **1%**, given as a percentage of the *rated* current, is required.
- Then the Deadband setting value must be as follows:

  1% · q = 0.004 = **0.4%**

☼ **Power (1 A CT and "TU" Voltage Measuring Card)**

- The value range is 0 – 32000 VA.
- The **rated** power (secondary) is based on the rated voltage and the rated current (secondary): 100 V · 1 A · $\sqrt{3}$ = **173.21 VA**.
- Therefore the conversion factor from the percentage of the rated power to the *Deadband setting* is:

  q = 173.21 VA / 32000 VA = **0.00541**
- For example, a deadband value of **10%**, given as a percentage of the *rated* power, is required.
- Then the Deadband setting value must be as follows:

  10% · q = 0.000541 = **0.0541%**

☼ **Power (5 A CT and "TU" Voltage Measuring Card)**

- The value range is 0 – 160000 VA.
- The **rated** power (secondary) is based on the rated voltage and the rated current (secondary): 100 V · 5 A · $\sqrt{3}$ = **866.05 VA**.
- Therefore the conversion factor from the percentage of the rated power to the *Deadband setting* is:

  q = 866.05 VA / 160000 VA = **0.00541**
- For example, a deadband value of **10%**, given as a percentage of the *rated* power, is required.
- Then the Deadband setting value must be as follows:

  10% · q = 0.000541 = **0.0541%**

☼ **Frequency (50 Hz Network)**

- The value range is 40 – 70 Hz.
- The **rated** frequency is: **50 Hz**.
- Therefore the conversion factor from the percentage of the rated frequency to the *Deadband setting* is:

  q = 50 Hz / 70 Hz = **0.714**
- For example, a deadband value of **0.1%**, given as a percentage of the *rated* frequency, is required.
- Then the Deadband setting value must be as follows:

  0.1% · q = 0.000714 = **0.0714%**

☼ **Frequency (60 Hz Network)**

- The value range is 40 – 70 Hz (i. e. the same as for 50 Hz).
- The **rated** frequency is: **60 Hz**.
- Therefore the conversion factor from the percentage of the rated frequency to the *Deadband setting* is:

  q = 60 Hz / 70 Hz = **0.857**
- For example, a deadband value of **0.1%**, given as a percentage of the *rated* frequency, is required.
- Then the Deadband setting value must be as follows:

  0.1% · q = 0.000857 = **0.0857%**

☼ **cos(φ)**

This value is special because there is no rated value.

- The maximum value is 1.0.
- For example, a deadband value of **0.01** is required. (It makes not much sense to talk of percentages here.)
- Then the Deadband setting value must be as follows:

  0.01 / 1.0 = **1%**.

☼ **φ**

- All angle values are given in degree units, i. e. the maximum value is 360°.
- For example, a deadband value of **1°** is required. (It makes no sense to talk of percentages here.)
- Then the Deadband setting value must be as follows:

  1° / 360° = **0.278%**

10 Appendix

10.1 IEC 60870-5-103 Type Identification ASDU 195

(The Type Identification ASDU 195 has been derived from IEC 60870-5-103 Type Identification 4.)

1	1	0	0	0	0	1	1	= 195	Type Identification
1	0	0	0	0	0	0	1	= 129	Variable Structure Qualifier
= 1 or = 7									Cause of Transmission
...									Device Address (Common Address of the ASDU)
...									Function Type ("FUN"), as defined in the SCADApter mapping table
...									Information Number ("INF"), as defined in the SCADApter mapping table
Data byte 1.1									Counter value 1
Data byte 1.2									(currently not used)
Data byte 1.3									
Data byte 1.4									
Data byte 2.1									Counter value 2
Data byte 2.2									
Data byte 2.3									
Data byte 2.4									
milliseconds									Timestamp
minutes									(4 octet binary time)
hours									
summer time									

SCADApter mappings for the IEC 60870-5-103 communication protocol: See ↳▷ "8 IEC 60870-5-103 Protocol"

10.2   IEC 60870-5-103 Type Identification ASDU 41

(The Type Identification ASDU 41 has been derived from IEC 60870-5-103 Type Identification 9.)

0	0	1	0	1	0	0	1	= 41	Type Identification
= number of measured values									Variable Structure Qualifier
…									Cause of Transmission
…									Device Address (Common Address of the ASDU)
0	1	1	0	0	1	0	1	= 101	Function Type
…									Information Number ("INF")
Short Floating Point Number, STD 754 acc. to IEC 60870-5-4. Invalid values are coded as +32767 (0x7FFF).									Measured value 1
…									
Short Floating Point Number, STD 754 acc. to IEC 60870-5-4. Invalid values are coded as +32767 (0x7FFF).									Measured value n, the number n of values is defined by the Variable Structure Qualifier.

SCADApter mappings for the IEC 60870-5-103 communication protocol: See ⮫ "8 IEC 60870-5-103 Protocol"

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Smart view SE

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