AQTIVATE CONFIGURATION TOOL

FOR AQ-300 DEVICES

Revision	1.00
Date	April 2011
Changes	• The first revision.

Revision	1.01
Date	13.2.2015
Changes	• Added IEC101/104, IEC103 and SPA descriptions.

Read these instructions carefully and inspect the equipment to become familiar with it before trying to install, operate, service or maintain it.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. Local safety regulations should be followed. No responsibility is assumed by Arcteq for any consequences arising out of the use of this material.

We reserve right to changes without further notice.

TABLE OF CONTENTS

1 AQTIVATE CONFIGURATION TOOL FOR AQ-300 DEVICES

1.1 APPLICATION

The AQ-300 product line of Acrteq Relays Ltd. has been designed to perform all

- protection,

- supervision,

- monitoring,

- communication and

- automatic control functions of the electric power system.

The AQ-300 type complex protection - in respect of hardware and software - is a modular device. The modules must be assembled and configured according to the requirements, then the functions of the device are determined by the software and the preset parameter values.

The AQtivate software is the general configuration tool for the AQtivate devices. This program is used to manage the hardware and software included in the device. This document describes the application of the tool. Arcteq Relays Ltd. assembles the usual protective tasks in factory configurations using this software tool.

In these devices, the user activates the loaded software modules, then the parameters and the required additional services of the device must be set. The AQ-300 devices communicate on standard Ethernet networks; **parameter setting can be performed using any "standard" browser** (Internet Explorer, Mozilla Firefox, etc.). Further information on parameter setting can be found in a separate document.

1.2 STARTING THE SOFTWARE

The configuration tool is started by clicking the icon . The usual Windows operating techniques can be used in the application. This description assumes that the user is familiar with the Windows operating system.

1.3 MODE OF OPERATION

The AQtivate configuration tool has four "views", three of them password-protected:

- Normal View basic functionality (no password is required)

- Master View extended functionality (password-protected)

- Designer View full functionality (password-protected)

- Administrator View system management (password-protected)

The "Change View Mode" dialog can be opened by clicking the ⬛ icon on the toolbar or by opening the View/Normal View (Ctrl/M) menu item. See Figure *1-1*.

For the AQ-300 devices, customers need the "Master View"; consequently, this document describes the details of this mode only. (The "Normal View" is the subset of this mode. If a function is accessible in this mode, then the description below expressly indicates this fact.)

Only Arcteq can provide a password but the owner of the password can manage the stored information (using the "Manage Password" option, see Figure *1-1*, or clicking the ⚿ icon on the toolbar, or opening the View/Manage Passwords menu item).

Figure 1-1 *The "Change View Mode" dialog*

1.4 THE CONFIGURATION

1.4.1 ACTIVE ICONS AT STARTING THE SOFTWARE

After starting the program, two main icons are active:

- for opening a stored file. The alternative method of opening is to select File / Open Ctrl+O from the menu.

In this case, an *.epc AQ-300 configuration file can be opened for further processing using the usual Windows selection method.

- for uploading the configuration from a device connected to the Ethernet network. The alternative method of opening is to select Project / Upload configuration from the menu.

In this case, one of the devices connected to the Ethernet network can be selected for processing. It takes a short time to find these devices, then the "Select device" window is opened. (See Figure *1-2*). This window lists the responding devices together with their IP address, device name, firmware identifier and MAC address. The selection is performed using the usual Windows methods.
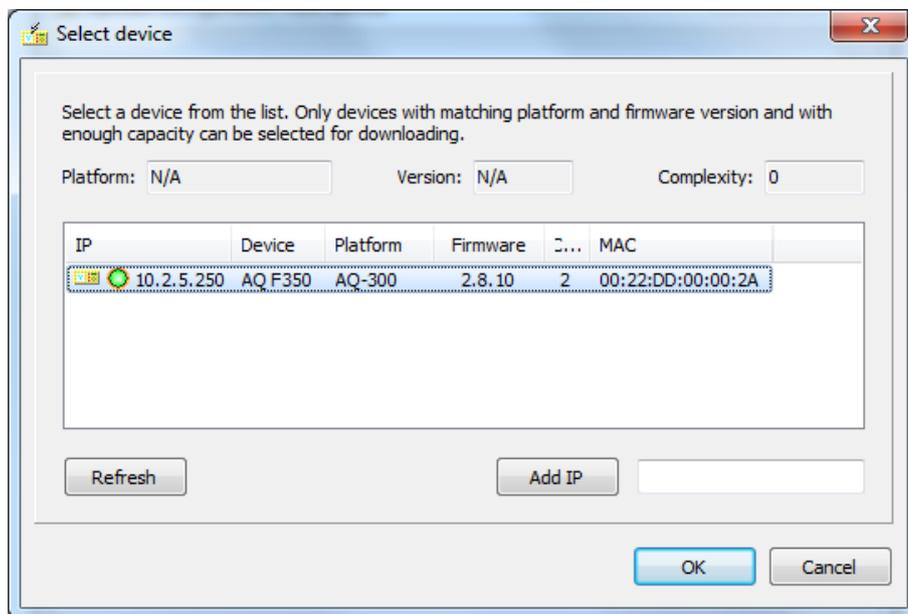
Figure 1-2 *The "Select device" dialog*

After selection and successful uploading (or after opening a stored *.epc file), the window shown in Figure *1-3* opens automatically.
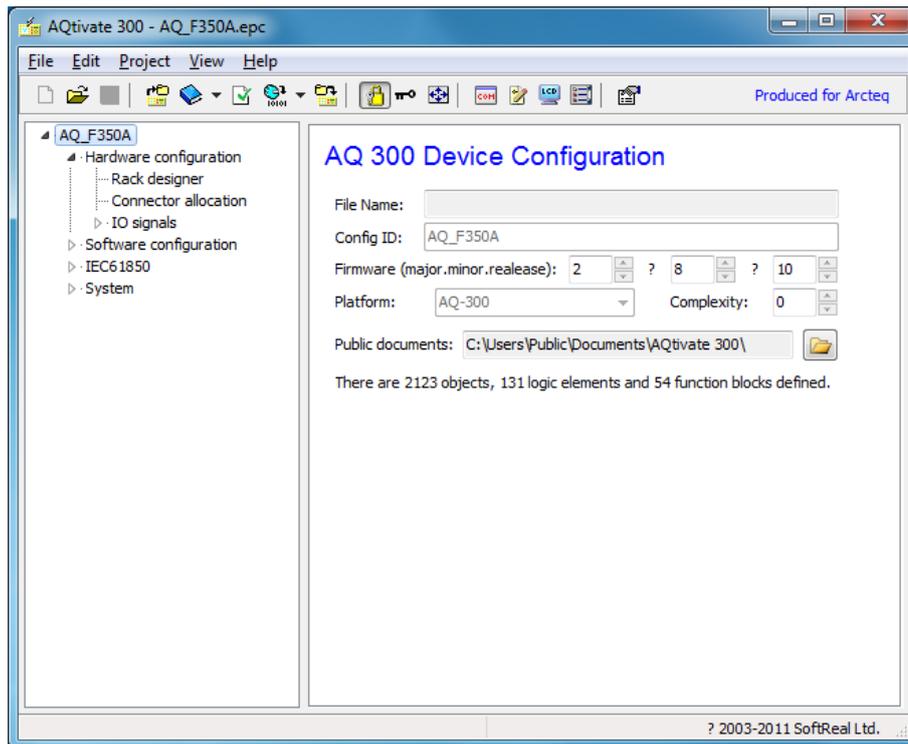
Figure 1-3 *The "AQ-300– New configuration" main window*

The main changes of the window, as compared to its starting state are:

- the activation of new icons on the toolbar (See below)

- a menu in the window on the left side: the Configuration menu (See Chapter 1.6)

- some basic information about the configuration (right side of the window, see Figure *1-3*)

Additional active icons are:

- for managing the mode of operation of the AQtivate software. The alternative method of opening is to select View / Normal View Ctrl+M from the menu.

The modes of operation are described in Paragraph 1.3.

- for managing the passwords for modes of operation of the AQtivate software. The alternative method is to select View / Manage Passwords from the menu.

The modes of operation are described in Paragraph 1.3.

The password manager program is embedded software in the AQtivate system; it is described in detail in Chapter 2

- for setting the default window size of the AQtivate software. The alternative method of setting is to select View / Default Window Size from the menu.

- for directly accessing the Arcteq server to download the latest version of the AQtivate software. The alternative method of opening is to select Help / Check for Updates from the menu.

- for opening the "About" information Window. The alternative method of opening is to select Help / About menu from the menu.

Additional information available through the Help menu:

- Version info, for opening a list of the changes applied in previous versions;

- Arcteq on the WEB for opening the Arcteq homepage;

- SoftReal on the WEB for opening the SoftReal homepage.

1.4.2 ACTIVE ICONS WHEN A CONFIGURATION IS ACTIVE

If a configuration is active (a configuration file is opened or the configuration is uploaded from a device), then in addition to the basic icons (see paragraph 1.4.1), the following main icons are also activated:

- see Chapter 1.4.1.

- for saving the file on the computer. The alternative method saving is to select File / Save Ctrl+S from the menu.

In this case, an *.epc AQ-300 configuration file can be saved using the usual Windows selection method.

- see Chapter 1.4.1.

- for translation of the displayed text. By default, the text displayed on the LCD of the device and in the Ethernet communication is generated in English. If the display needs to be in a different language, these dropdown menus (see Figure *1-4*) are used to export the original English text and import the translated versions. These menus are not available in "Master view".
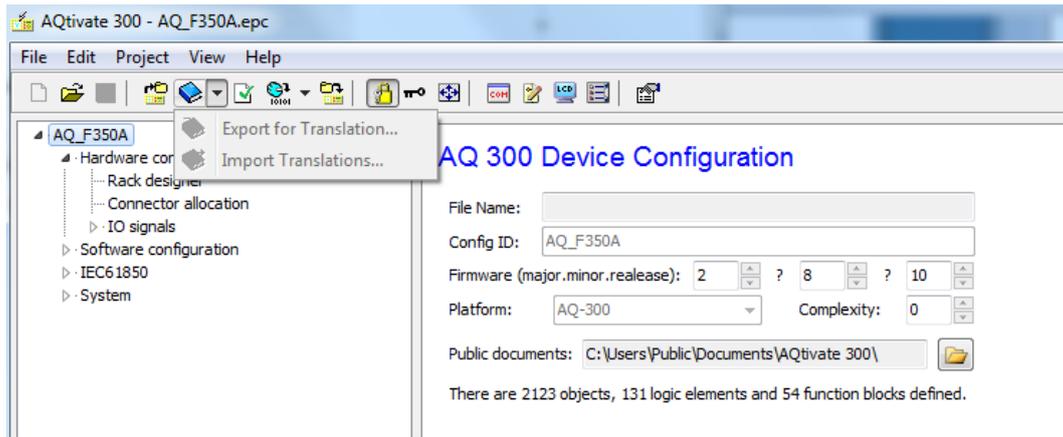
Figure 1-4 The "Translation" menu

- for checking the active configuration. The alternative method of checking is to select Project / Check configuration from the menu.

Before saving the *.epc AQ-300 configuration file or building a downloadable version, it is advisable to check the file for syntactic errors using this icon or menu item.

- for building a downloadable version of the configuration. The alternative method of building is to select Project / Building Files from the menu.

This icon or menu item opens a selection menu (see Figure *1-5*): This menu offers generating the BLK+GRF files to be stored on the computer and the downloadable code and parameter files.
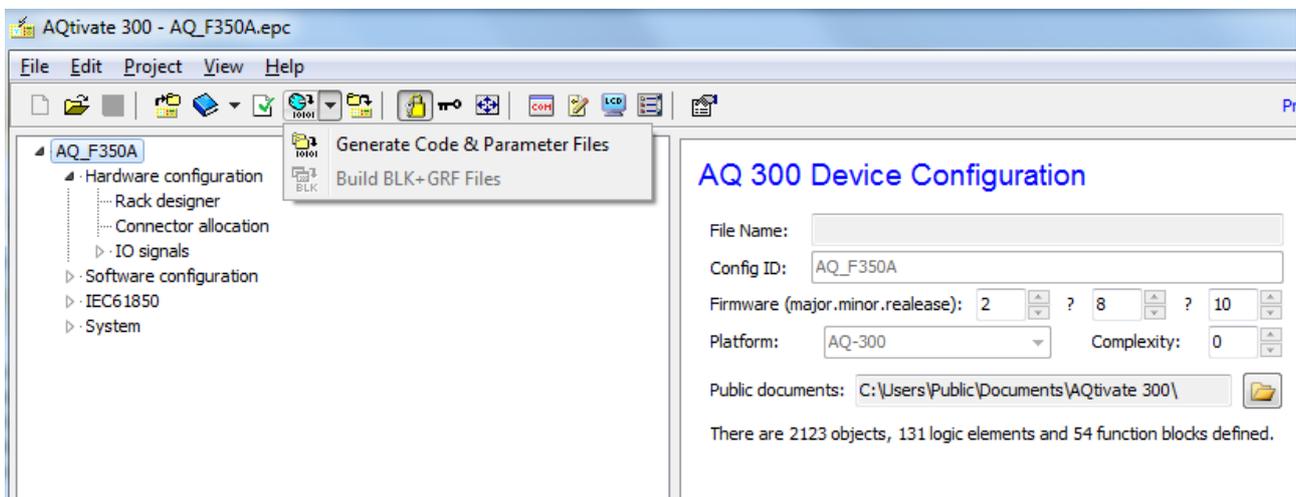
Figure 1-5 The "Building" menu

- for downloading the code and parameter files. The alternative method of downloading is to select Project / Download Files from the menu.

Before downloading the files, the "Building" procedure must be run. If it has not been done yet, the software offers to do the processing.

- 🔒 see Chapter 1.4.1

- 🗝 see Chapter 1.4.1

- ✥ see Chapter 1.4.1

- IEC for invoking the IEC61850 configuration

The IEC61850 configuration program is embedded software in the AQtivate system; it is described in detail in Chapter 6.

- ✎ for invoking the Graphical editor for composing and modifying logic equations with the graphical method to extend the "PLC-like" functionality of the AQ-300 devices.

The Graphical editor program is embedded software in the AQtivate system; it is described in detail in Chapter 6

- LCD for modifying the screens of the LCD on the front panel of the device. The alternative method of modifying is to select Project / LCD parameters from the menu.

The LCD editor program is embedded software in the AQtivate system; it is described in detail in Chapter 3.

- ▤ for setting the operating parameters of the AQ-300 devices. The alternative method of parameter setting is to select Project / Parameters Set Editor from the menu.

The aim of this option is to provide various kinds of access to the device within a single software. The usual method of parameter setting for users is the internet browser mentioned in Paragraph 1.1. The Parameter Set Editor setting program is embedded software in the AQtivate system; it is described in detail in Chapter 4.

- ⚡ see Chapter 1.4.1

- ▤ see Chapter 1.4.1

1.4.3 INFORMATION ABOUT THE ACTIVE CONFIGURATION

On the right side of the window, information about the active configuration is displayed. (See Figure *1-6*.) Here, the "File Name" shows the path and file name of the saved configuration document (assigned at saving). The "File ID" is the identifier displayed also on the local LCD of the device. The Firmware data, the "Platform" and the "Functionality" may not be changed, they belong to the factory configuration.

The "Public documents" show where the generated documents, e.g.: "cid" and "icd" files belonging to the IEC 6185 communication are (or will be) stored.

Figure 1-6 *Information about the active configuration*

1.5 UNDERSTANDING THE CONFIGURATION

1.5.1 THE OPERATION OF THE AQ-300 DEVICES

Figure *1-7* below shows the simplified HW and SW structure of the AQ-300 devices.

The functions of the device operate in the hardware environment, which provides inputs and outputs for the functions. To receive the required number of analog and binary inputs and to send the output signals to the primary equipment of the electric power system, the device is assembled of hardware modules (see hardware configuration below).

The functionality of the device is determined by the software configuration. This configuration means the assembly of functions blocks the device and assignment of the physical inputs to software inputs (see software configuration below).

The software consists of function blocks (e.g., overcurrent protection function, distance protection function, etc.). The "heart" of the function block consists of several "DSP functions" (e.g., Fourier component calculation, RMS value evaluation, function logic, etc.) These function blocks are described in other documents. They are developed, compiled and downloaded to the device by Arcteq. Their correct operation is thoroughly tested by Arcteq, type-tested by an accredited laboratory and can also be checked by the users.

A DSP function (performed by the dedicated Digital Signal Processor DSP) needs

- status signals,
- parameters,
- constants
- measured values.

They are stored in the "data bank" of the function block. A DSP function generates

- binary status signals,
- events and
- measured values.

All these values are stored in the "data bank" of the function block, too. The "data bank" of the function block is also used by the following function block elements:

- factory equations,
- internal timers,

- event channels and

- IEC61850 data.

The binary results of a function block stored as status variables can be processed by special function blocks available in all AQ-300 configurations:

- disturbance recorder

- matrix

- graphic equation editor

- counters

The events are

- processed by the Event recorder function block.

The measured values, events, recorded disturbances and counter values can be

- sent to the supervising computer via Ethernet

- communicated by serial channels

- involved in IEC 61850 communication

- displayed on the LCD of the device (except disturbance records).

The physical outputs of the device are

- binary outputs

- Goose messages

- remote output channels

    - Ethernet messages

    - serial channels

    - the channels of IEC 61850 communication.

1.6 THE CONFIGURATION MENU

1.6.1 THE FULL CONFIGURATION MENU

The configuration menu is on the left side of the window. The displayed and active menu items depend on the mode of operation of the software (For the operation modes see Chapter 1.4).

Figure *1-8* below shows the full structure of the configuration menu (in Master view only a limited part of this menu is accessible; that subset is discussed in Chapter 1.6.2 below). As an example: on the left side of the Figure the "Software configuration" menu is closed, the right side expands this part of the menu.

The "+" characters indicate that the menu item can be extended, opening sub-menus, by clicking on the "+" character.

The four main menu items are:

- Hardware configuration

- Software configuration

- IEC 61850

- System

When opening any of the main menu entries, the elements of

Figure 1-7 can be identified as items of the menu.

Most of the menu items are used in "Designer view" and in "Administrator view" only.sdfadasda
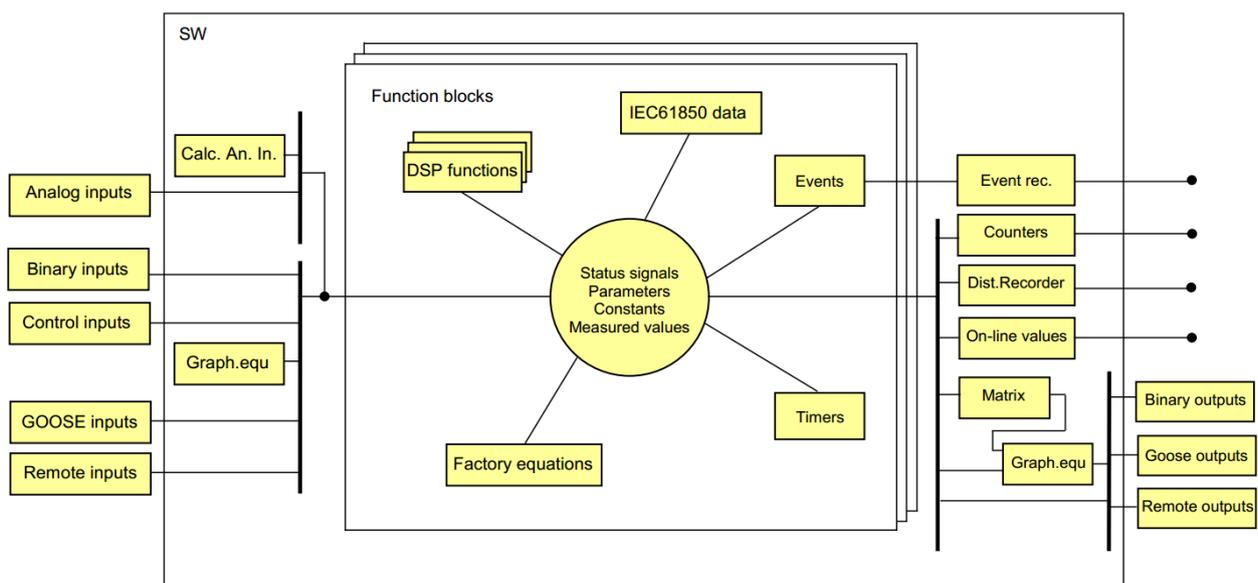
Figure 1-7 *The HW and SW structure of the AQ-300 devices.*

Figure *1-8* below shows the "Master view" of the configuration menu. In this figure, the menu items are fully expanded. The menu items can be closed by clicking on the " ◢ "character.
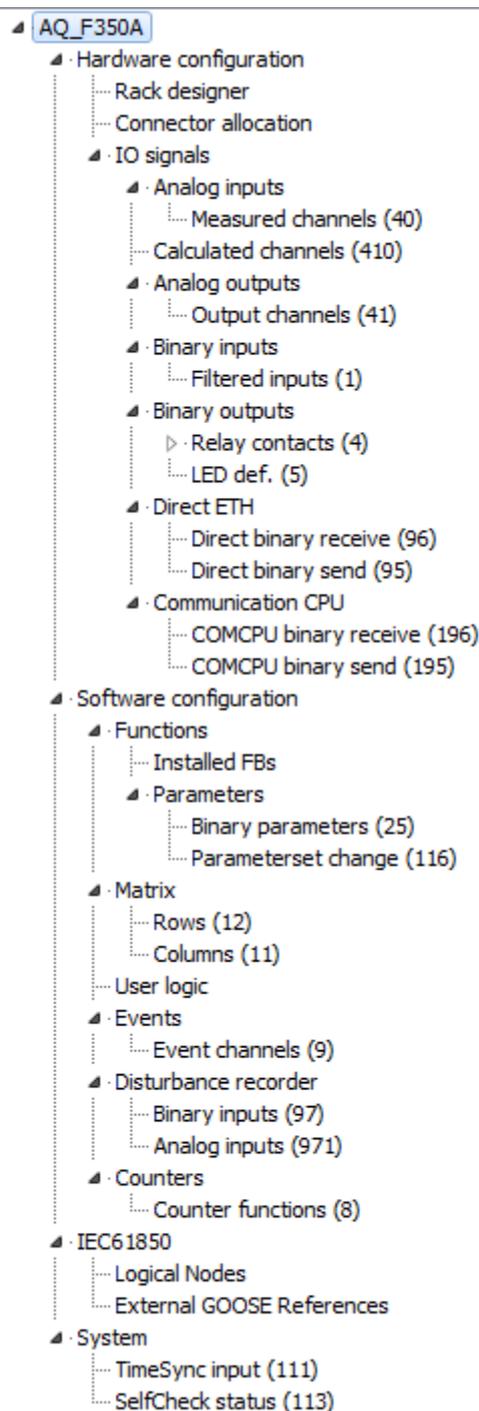

Figure 1-8 *The "Master view" of the configuration menu with fully expanded menu structure*

The items of the configuration menu serve the purpose of checking and modification of the active configuration. The available menu items depend on the selected "View level". These levels are password-protected (see Paragraph 1.3). The paragraphs of this chapter describe the menu items available in "Master View".

1.7 HARDWARE CONFIGURATION

The functions of the device operate in the hardware environment, which provides inputs and outputs for the functions. To receive the required number of analog and binary inputs and to send the output signals to the primary equipment of the electric power system, the device is assembled of hardware modules.

In Master View, the hardware configuration can be displayed and extended by clicking on the "Hardware configuration" menu.

The AQ-300 device is composed of modules; each of these is designed to fit into a slot of the rack structure. The slots are identified by letters from A to J in a small (half-size) rack and from A to U in a full rack. This structure is clearly shown when clicking on the "Rack designer" menu and launching the "Rack designer" using the button.

The user can assign a Design No. freely. This text will be printed in the header.

The submenus of Hardware configuration are:

- Rack designer
- Connector allocation
- IO signals (with several submenus)

1.7.1 THE RACK DESIGNER

The "Rack designer" program is embedded software in the AQtivate system; it is described in detail in Chapter 5. The role of this part of the AQtivate software system is to select and assemble the hardware modules needed to perform the required protection and control tasks.

This software is launched after opening the "Rack designer" menu and clicking the "Launch Designer" active button.

Rack Design

V1 analog inputs are identified by connector number (A/D #1 to #16 on CPU card). Other I/O objects require an additional geographical address (set on the card).

Module Database is needed to define or modify cards and wiring. In Designer View you may use Manage Hardware button on Hardware Configuration property sheet to import database.

After modifications I/O objects are created or removed as necessary. You may use the Check I/O Allocations button on Hardware Configuration property sheet any time to match I/O signals with hardware.

Launch Designer

Note: Don't confuse I/O signal connectors with module connectors shown on Connector Allocations sheet. I/O signal connectors are simply logical numbers from 1 to 16 to identify an I/O channel in the software.

Figure 1-1 The "Rack designer" window starting screen

Each device contains a "Front panel", a "BUS panel" connecting the individual modules and several modules called "cards". A power supply card (a double-size module usually located on the left side of the rack in rear view) and a CPU card (usually located on the right side of the rack in rear view) are compulsory. Usually there are current inputs, voltage inputs, binary inputs and relay outputs. These modules are selected from the "library" automatically invoked by the AQtivate software. The user can select them one by one and insert them in a slot.

The working method with the "Rack designer is explained in detail in Chapter 5.

1.7.2 THE CONNECTOR ALLOCATION

The "Connector allocation" program is embedded software in the AQtivate system; it is described in detail in Chapter 5.

The connectors available in the individual slots (identified by capital letters on the tabs in the bottom of the list, see 1.7) can be seen in this menu.

1.7.3 THE IO SIGNALS

When a module is inserted in the rack using the "Rack Designer", all information is automatically stored in the data bank of the device. The individual cards have default names for the connector; the user has possibility to rename these physical in- and outputs here.

The menu "IO signals" contains the following items:

- (Analog inputs / Measured channels)

- (Calculated channels)

- (Analog outputs)

- Binary inputs / Filtered inputs

- Binary outputs / Relay contacts and …/LED def.

- (Control inputs / Control channels)

- (Goose inputs)

- Remote IO

  The items in brackets are not available in "Master view", or only the "Title" field may be modified when clicking on the modify button; for example, the analog inputs are hidden and the user cannot access them; they are arranged during the factory configuration procedure.

1.7.3.1 BINARY INPUTS

The "Binary inputs" menu contains the "Optocoupler inputs" menu item. When clicking the available "Modify" button, the following modifications are allowed:

- **Title**   This is a free-text field; the text will be the identifier of the input in the documentation (e.g., "CB phase L3 status")

- **Rising edge delay**   This value is given in ms. The status change from 0 to 1 is accepted only if the initial state is 0 and during the delay time, all checking indicate status 1.

- **Falling edge delay**   This value is given in ms. The status change from 1 to 0 is accepted only if the initial state is 1 and during the delay time all checking indicate status 0.

- **Show order**   This value organizes the "On-line" sequence of displaying the binary status values. If 0 is given, the status is not displayed. All figures above 0 mean that the signals with identical figures are grouped (e.g., all signals of Show order = 2 are grouped in group No.2).

For "Binary outputs," the "Relay contacts" with the "L1 contacts" sub-menu and the "LED definition" are displayed.

1.7.3.2 BINARY OUTPUTS

For "Relay contacts," clicking the available "Modify" button, the following modifications are allowed:

- **Title:** This is a free-text field; the text will be the identifier of the output in the documentation (e.g., "CB phase L3 close")

The "L1 relay contacts" (meaning "level1" or "fast contacts") are special contacts, selected to be operated with priority. The normal relay contacts are operated in a processing cycle longer than the 1 ms sampling (and calculation) cycle (e.g., 3-4 ms). If fast tripping (without delay, within 1 ms) is needed, then this kind of contact operation is to be prescribed by clicking the

- **"Add",**

- **"Insert" or**

- **"Modify"**

active buttons. In this case, the data input window shown in Figure *1-10* is opened.

Here the

- **"Title"** can be renamed freely. This is a free-text field; the text will be the identifier of the output in the documentation (e.g., "Fast trip contact")

- **"Contact"** a selection from the dropdown menu. E.g.:

   - "0004 Contacts" the only choice here

   - "Contact 1101 (Trip)" is a contact selected from the second dropdown menu, "(Trip)" is the Title of the contact named by the user as described above

- **"On Item name"** identifies the binary signal to operate the relay. Any internal signal can be selected from the dropdown menu. The user must select these signals first by the signal type according to (Figure *1-11* left side) then the selected signal itself (Figure *1-11* right side).
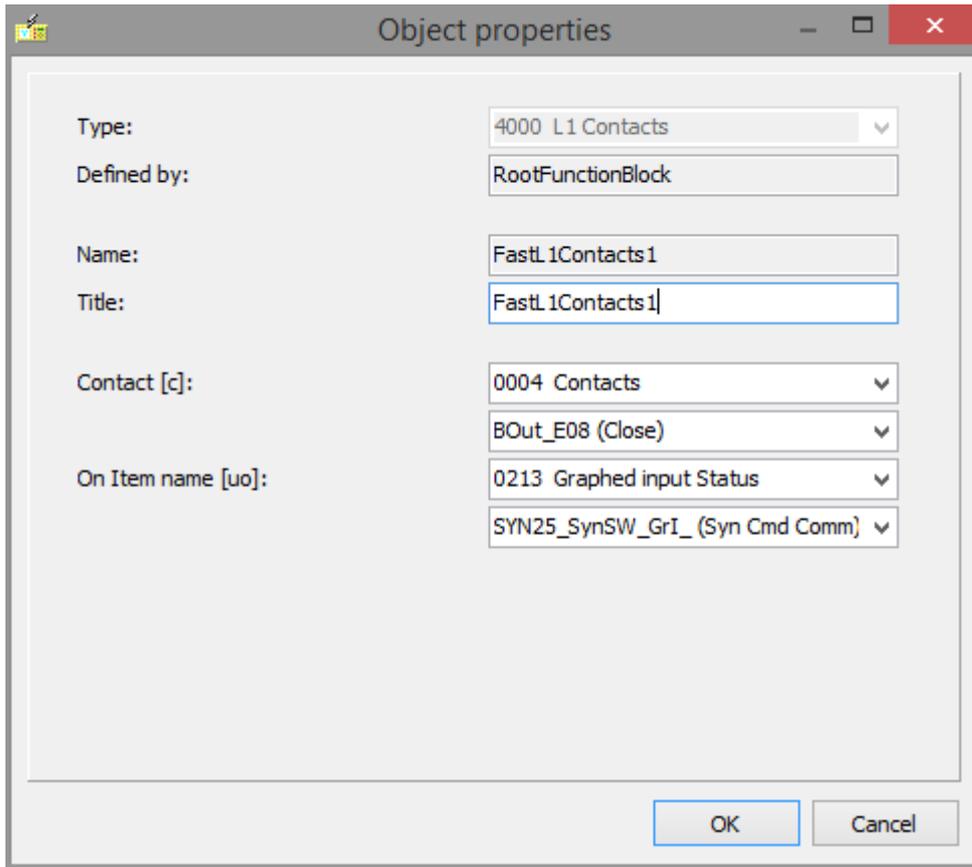
Figure 1-10 *The "Object property" window for fast relay contacts*
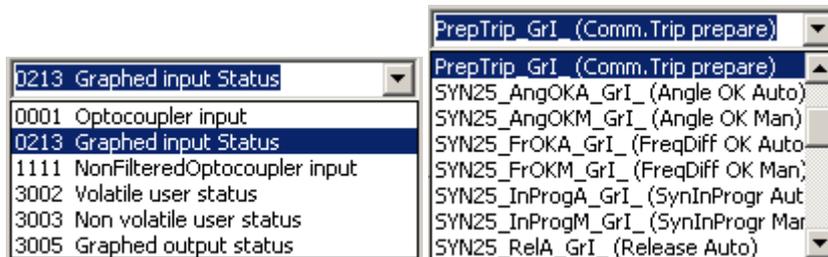
Figure 1-11 *Details of the "Object property" window for fast relay contacts*

For the "LED def." when clicking the available "Modify" button, the data input window of Figure *1-12* is opened. Here, the following modifications are allowed:

- **Title** This is a free-text field; the text will be the identifier of the LED in the documentation (e.g., "OC start L1")

- **On Item name** means the selection of an output signal, the 1 state of which results in continuous ON state of the LED. The selection method is similar to Figure *1-11*.

- **Blink Item name** means the selection of an output signal, the 1 state of which results in the blinking state of the LED. The selection method is similar to Figure *1-11*.

- **Color** means that the color of the LED can be selected as red (r), green (g) or yellow (y) by writing 0, 1 or 2 in this input field.

- **Latch** means that the on or blinking state of the LED can be latched until reset. The method of resetting is simply pressing the front panel button **X** below the front panel LEDs.
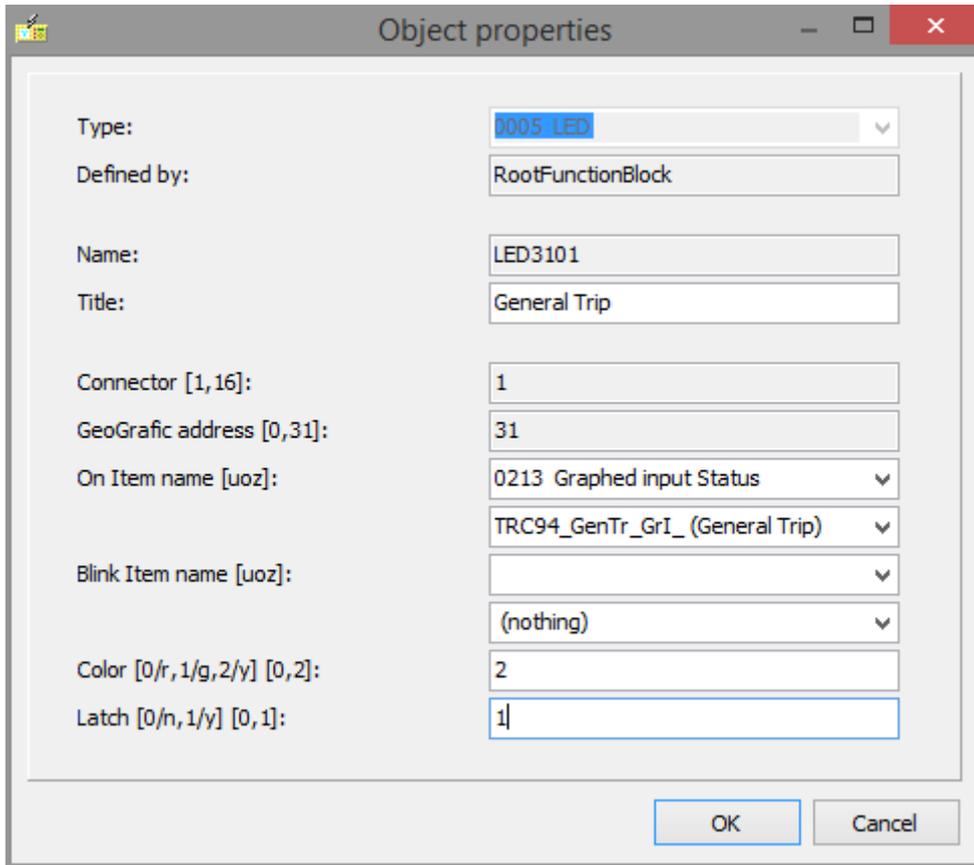
Figure 1-12 *The "Object property" window for LED definitions*

1.8 SOFTWARE CONFIGURATION

The functionality of the device is determined by the software configuration. This configuration means the assembly of functions blocks for the device and assignment of physical inputs to software inputs (see software configuration below).

The software consists of function blocks (E.g., overcurrent protection function, distance protection function, etc.). Arcteq selects the function blocks in the procedure of factory configuration. In "Master view" the user has the possibility to deactivate/activate the various function blocks. For a deactivated block, no parameter setting is needed and no output signals are generated.

1.8.1 FUNCTIONS/ INSTALLED FUNCTION BLOCKS

Figure *1-13* shows a possible (test) configuration when opening the "Software configuration/Functions/Installed FBs" menu. The green checkmarks indicate active blocks, the red X means that the function block (in the example the VTS voltage transformer supervision) is not needed and it is deactivated. The grayed checkmark means that the operation of the function block cannot be deactivated.
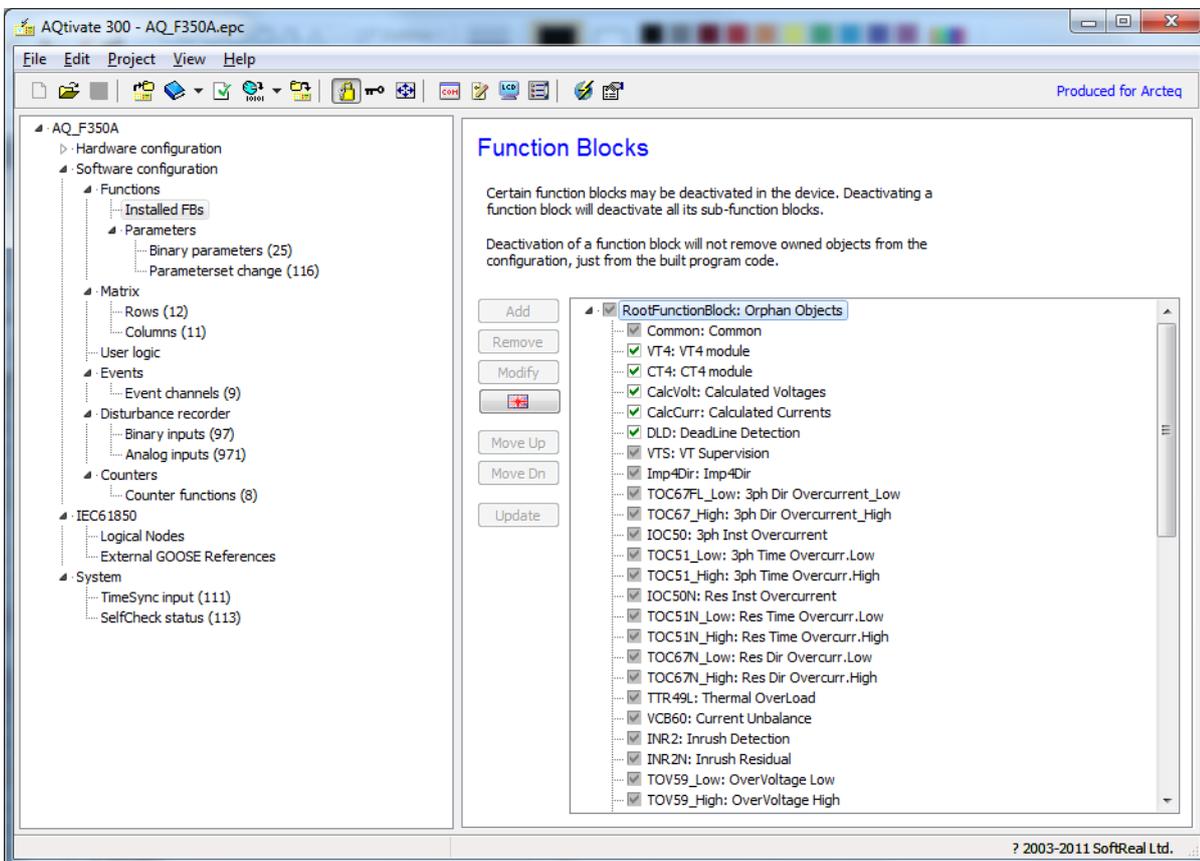
Figure 1-13 *The "Function Blocks" window in software configuration*

Activation/ deactivation of function blocks

The user can activate or deactivate the functions blocks simply by clicking on the checkmark field.

WARNING: Be careful when deactivating functions! If, for instance, an output of the function is used in a graphic equation (or in any other parts of the software system), then the signal flow may be disrupted. To check for errors, apply the ☑ icon, which will start the "Check Configuration" procedure. The result is acceptable, if the summary of the check is similar to Figure *1-14*: 0 errors found.
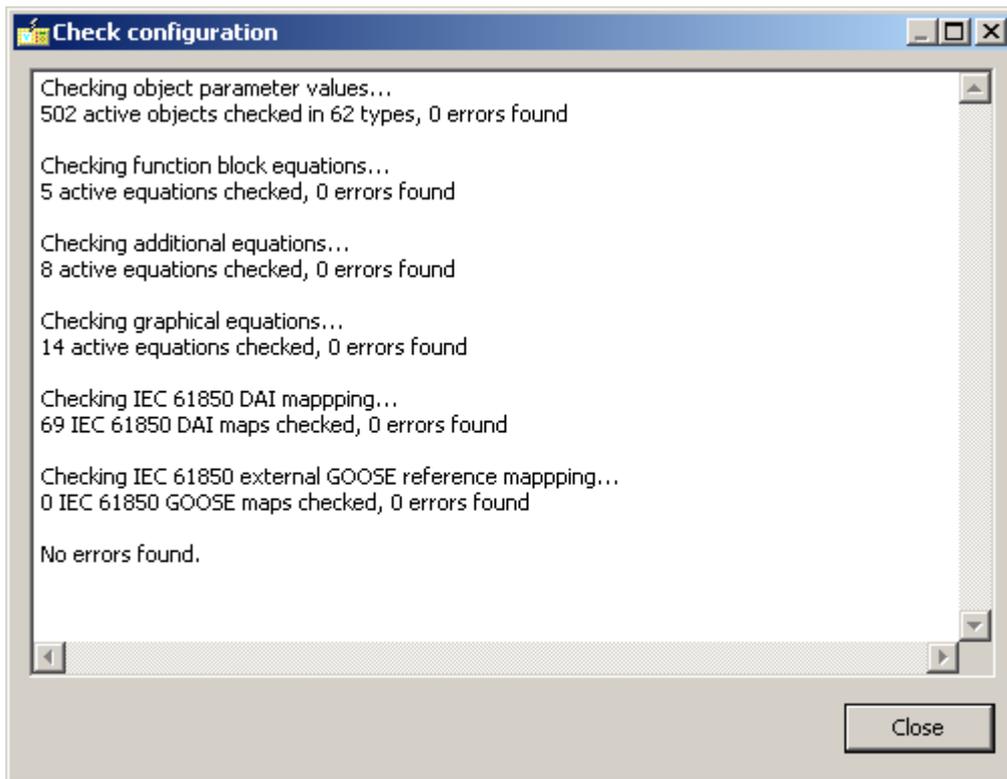
Figure 1-14 *The result of "Check Configuration"*

Modification of function blocks

In some exceptional cases, the user can perform some modifications in the function blocks in "Master view". When the "Modification" active button is pressed, the window shown in Figure *1-15* is opened.
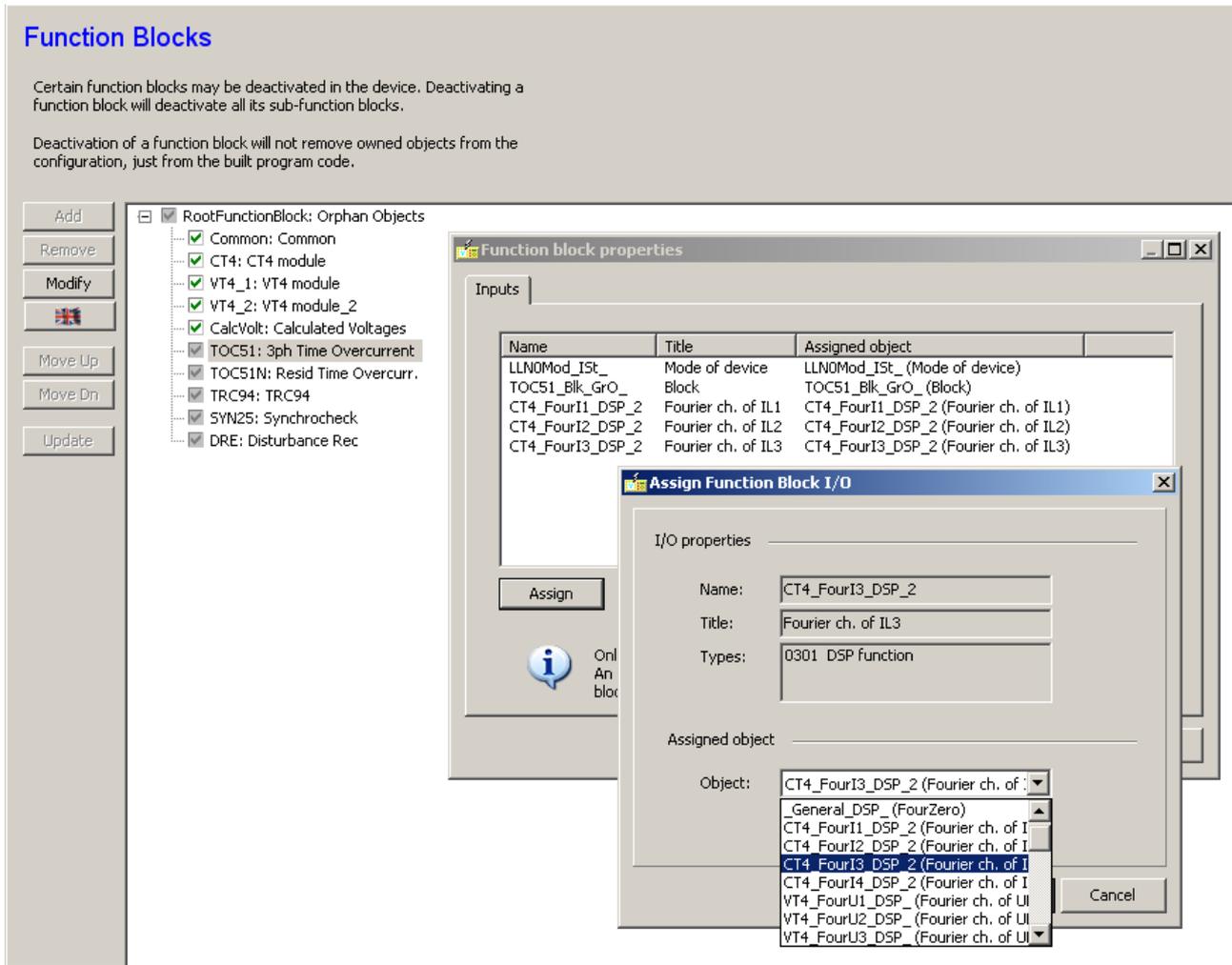
Figure 1-15 *The "Function block properties" window*

As an example, this window shows the procedure of assigning inputs to an overcurrent protection function (TOC51). When the "Assign" button is clicked, the "Assign Function Block I/O" window is opened. In our example the last assignment was selected (the name "CT4_FourI3_DSP_2" is factory configuration), then one of the calculated Fourier values is assigned to this input channel from the dropdown list.

In most cases, however, the user has no access to the function block and thus he cannot modify anything.

1.8.2 FUNCTIONS/PARAMETERS

The Software configuration/Functions/Parameters menu has two submenus (see Figure *1-8*)

- Binary parameters

- Parameter set change

All other necessary parameters are part of the factory configuration; the user has no access to them.

When opening the **Binary parameters** menu, Figure *1-16* is displayed. In this example a parameter is already defined with the name "ParBin1" with the user-defined title "Equ En/Dis". This parameter value must be set in the device, and the parameter can be applied when editing the graphical equations. (See Chapter 6)

If no parameter has been defined yet, then the active "Add" button can be clicked and the "Object properties" window is also opened (see Figure *1-16*). The same window is displayed when several defined parameters exist and the button "Insert" or "Modify" is clicked. The "Remove" button is also active.
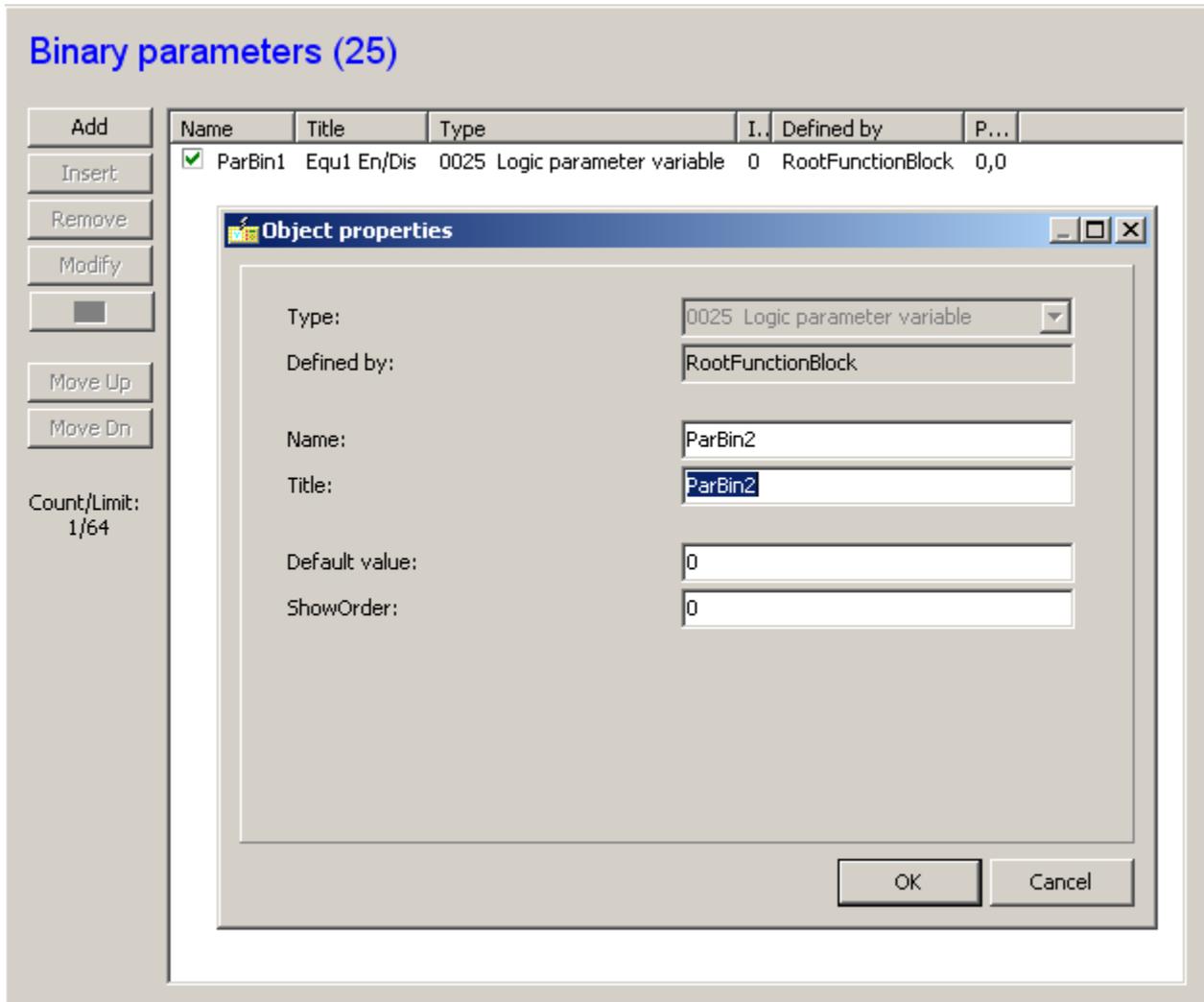
Figure 1-16 *The "Binary parameters" window and the "Object properties" data block*

When adding a new binary parameter, the following must be defined:

- **Name**   the freely editable name of the new parameter displayed in the graphical editor

- **Title**   the freely editable title of the new parameter displayed in the graphical editor (in brackets)

- **Default value**   the value without parameter modification

- **ShowOrder**   This value organizes the "Parameter" sequence of displaying the parameter values. If 0 is given, the status is not displayed. All figures above 0 mean that the signals with identical figures are grouped (e.g., all signals of Show order = 2 are grouped in group No.2).

When opening the **Parameterset change** menu, Figure *1-17* is displayed. In this example, one parameter set is already defined and a new one is to be added. The ParSet2 (Second parameter set) is active if the Opto1202 binary input receives an active signal. In the example, a new set is "Add"-ed, and the Opto1213 binary input is prepared for selection to activate that set.

ATTENTION: The number of parameter sets is defined by the number of the parameter sets added plus the original one. If any condition for parameter set changes is set in the "Parameter set change" window, then this operation cannot be performed in any other way. If the "Condition" input field is empty, the command via serial communication channel can change the available parameter sets.

If no new parameter has been defined yet, then the active "Add" button can be clicked and the "Object properties" window is also opened (see Figure *1-17*). The same window is displayed when several defined parameters exist and the button "Insert" or "Modify" is clicked. The "Remove" button is also active.
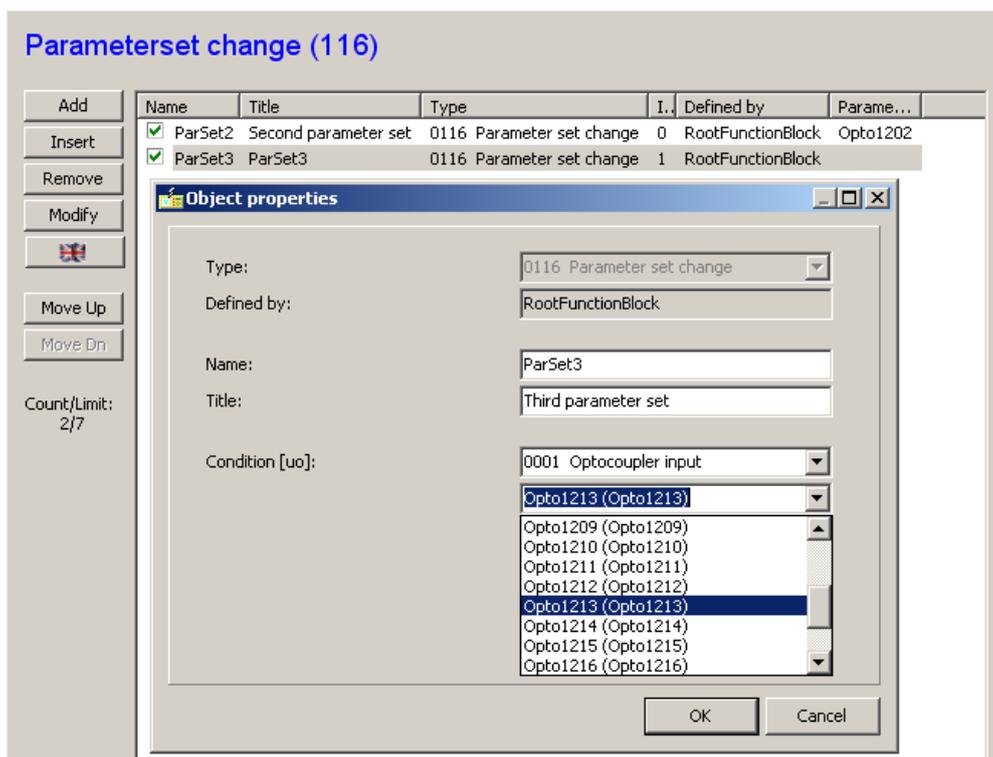
Figure 1-17 *The "Parameterset change" window and the "Object properties" data block*

1.8.3 MATRIX

The rows of the software matrix are binary status signals selected by the user. The columns of the matrix are the outputs, which can be applied in the graphical equation editor (See Chapter 6) as input signals. The user defines the assignments between rows and columns during the parameter setting procedure.

1.8.3.1 MATRIX/ROWS MENU

When the "Matrix/Rows" menu is opened, Figure *1-18* is displayed. In this example two rows are already defined; one with the name "MxRow1" and with the user-defined title "VTS Block". This signal is selected to be "VTS_Blk_GRO_". Now the procedure is displayed for a second row modification, where the second row input will be the input signal received on the Opto1206 binary input.
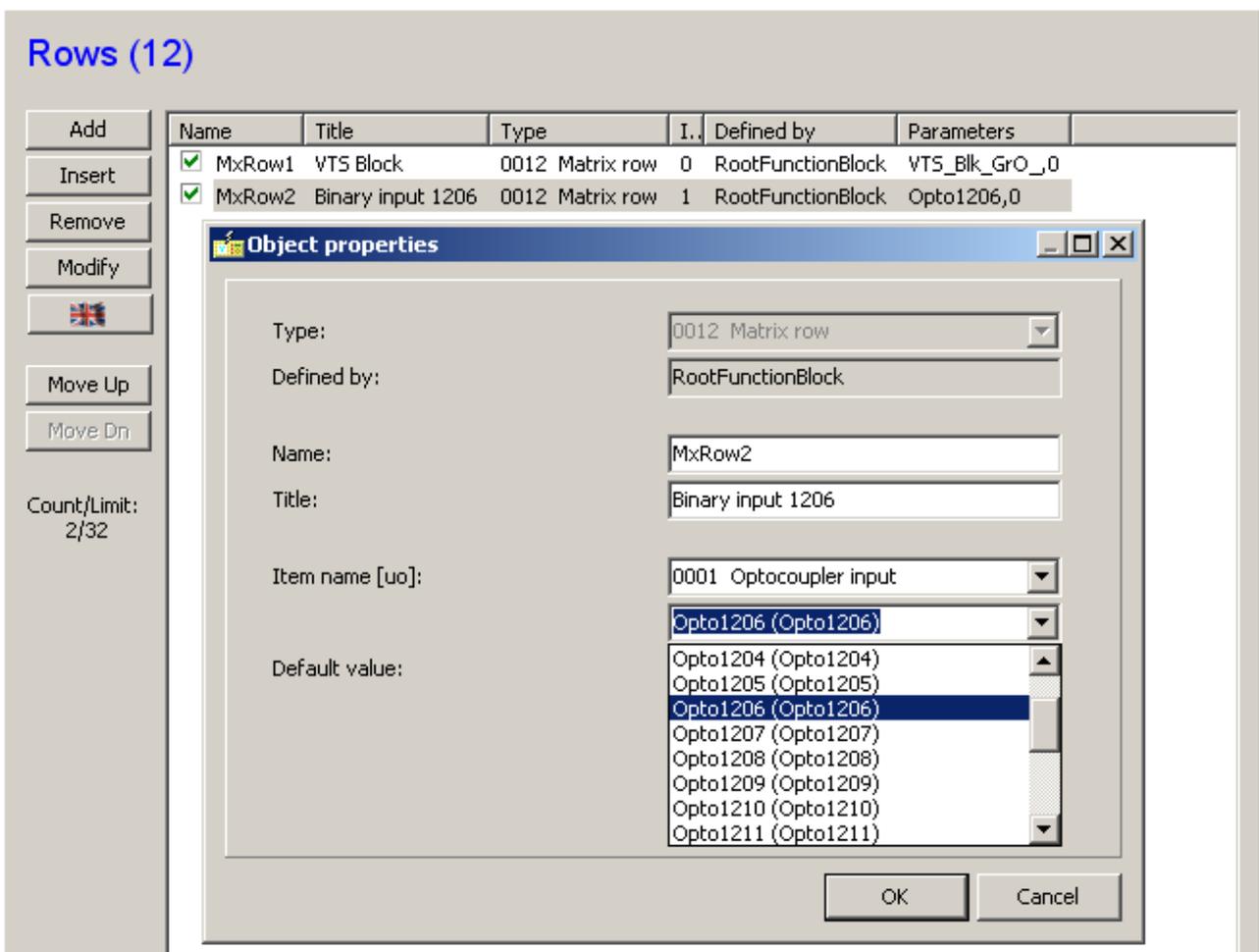
Figure 1-18 *The "Matrix Row" window and the "Object properties" data block*

The user can define

- Name   the freely editable name of the row

- Title   the freely editable title of the row

- Item name   the type of the signal (here a binary input) and the name of the signal
  (here the binary input Opto1206)

- Default value   the value at starting the device.

1.8.3.2 MATRIX/COLUMNS MENU

The columns of the matrix are the outputs, which can be applied in the graphical equation editor (See Chapter 6) as input signals. The user defines the assignments between rows and columns during the parameter setting procedure.
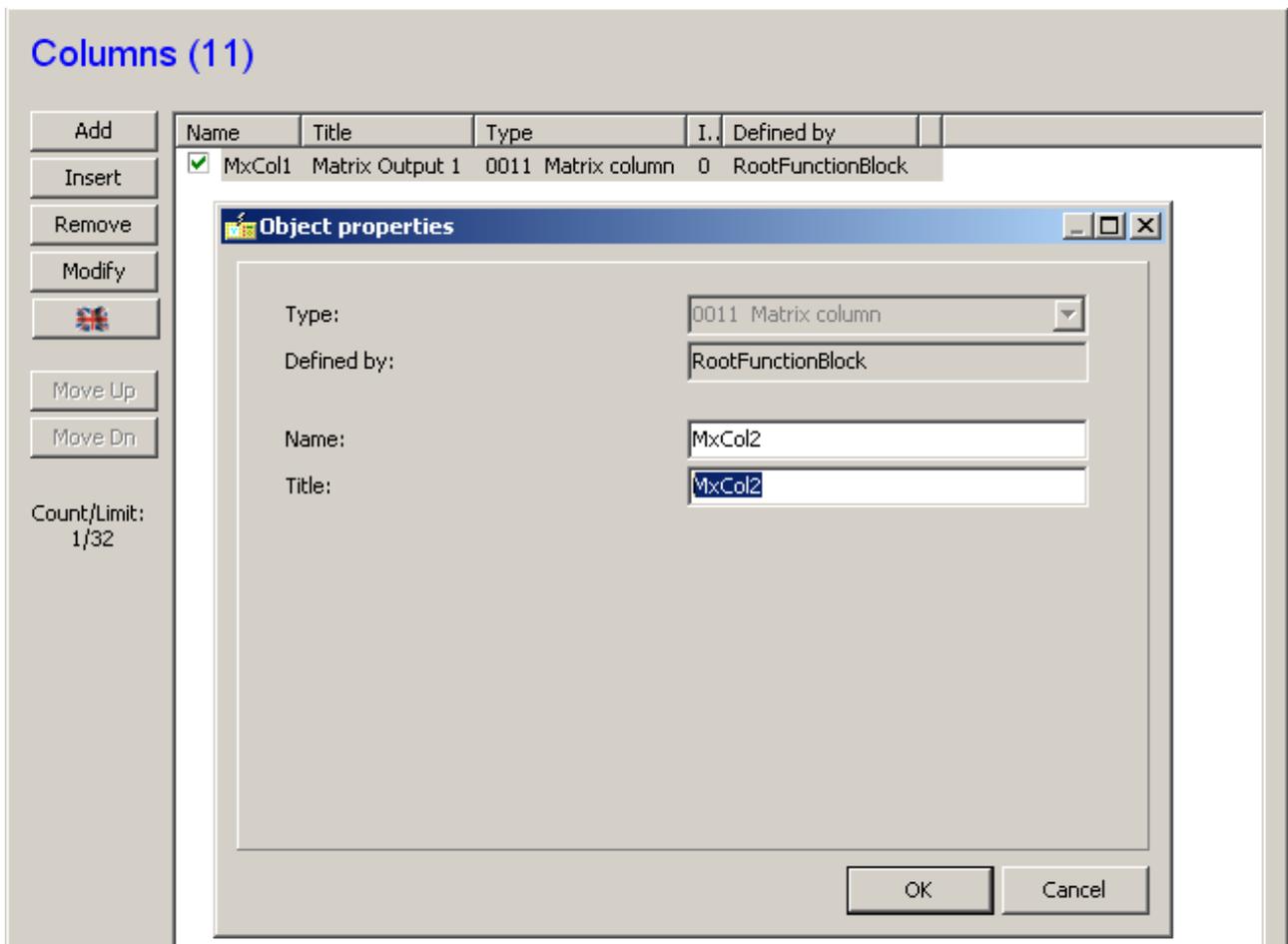
Figure 1-19 The "Matrix Columns" window and the "Object properties" data block

When the "Matrix/Columns" menu is opened, Figure *1-19* is displayed. In this example a column is already defined with the name "MxCol11" and with the user-defined title "Matrix output 1". Now the procedure for adding a second column is displayed, where the second column name will be MsCol2 and the title is being modified.

The user can define

- Name   the freely editable name of the column

- Title   the freely editable title of the title

1.8.4 GRAPHICAL EQUATIONS

When the active "Edit" button is clicked in the "Software configuration/Graphical equations" menu, the symbols of function blocks with in- and outputs, timers and logical gates (AND, OR etc.) can be inserted and logic equations can be drawn. An example is shown in Figure *1-20*. Graphical equations are described in detail in Chapter 6.

The logic equations belonging to the function blocks are factory edited; here the user has the possibility to extend the functionality of the device with "Programmable Logic Controller (PLC)"- like functions.
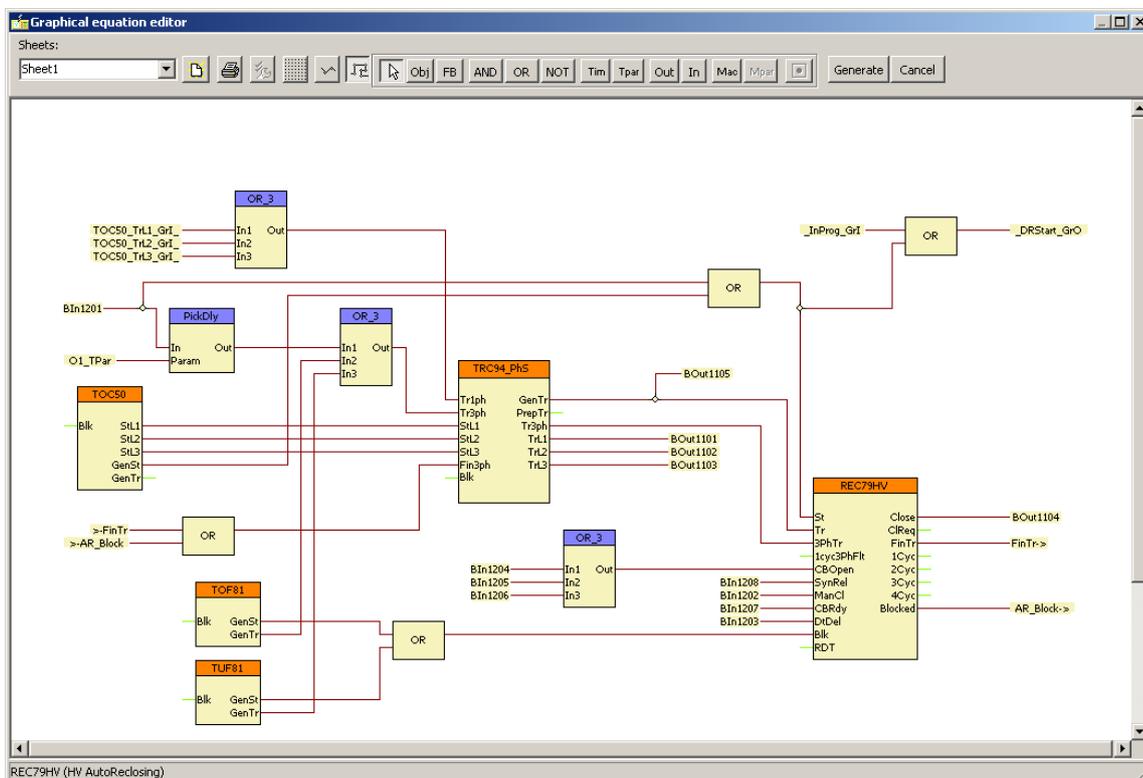
Figure 1-20 *Example: a graphic equation during editing*

1.8.5 EVENTS

The AQ300 protection devices log the events with a time stamp of 1 ms time resolution. The list of the possible events is populated in the factory configuration procedure; the user has possibility to modify the "Title", the text identifier of the event. This Title is shown in the event list. NOTE: The user can add events not included in the configured event list with the application of the function block GGIO.

1.8.6 DISTURBANCE RECORDER

The disturbance recorder function records binary and analog signals; these signals can be selected (and modified) by the user.

1.8.6.1 SELECTING A BINARY SIGNAL FOR DISTURBANCE RECORDING

Figure 1-21 shows the selection method of binary signals.

The user can define

- Name the freely editable name of the signal

- Title the freely editable title of the signal

- Item name the item to be recorded

The item selection method is similar to the method encountered elsewhere in the AQtivate software:

First, the type of the signal must be selected from the drop-down list (in this case, "Graphed output status," which is an output signal of the graphic equation editor). The second step is the selection from another drop-down list displaying all signals of the selected type. (Here, DIS21_VTS_GRO, which is the voltage transformer supervision signal related to the distance protection function DIS21. This signal is defined by the user in the graphic equation editor.)
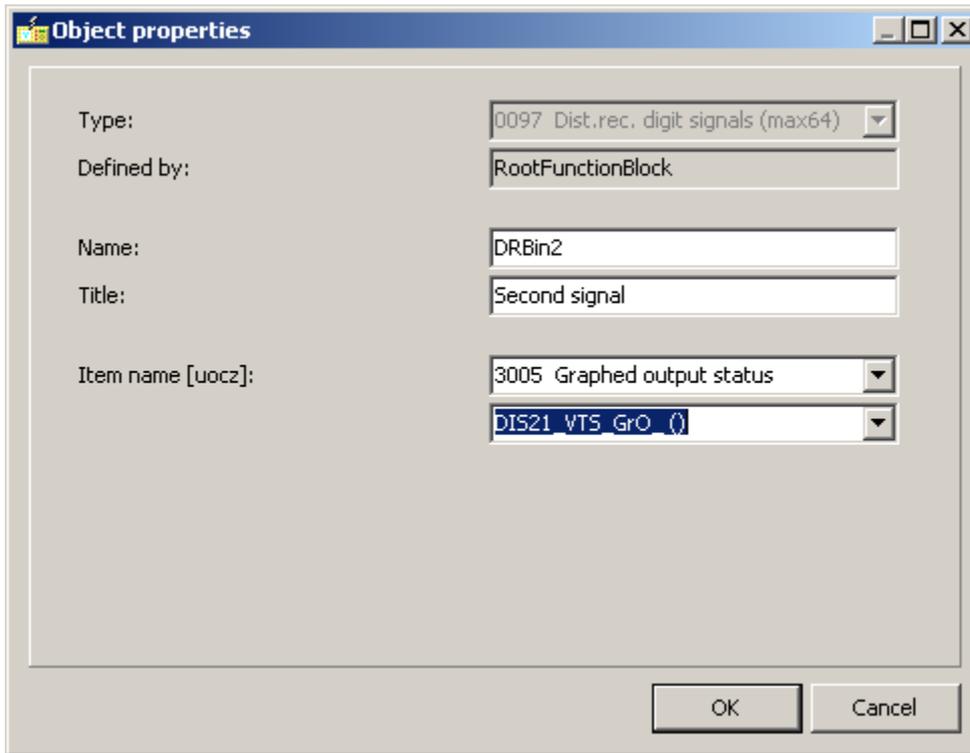
Figure 1-21 *Example: selecting the binary signal for disturbance recording*

The available binary signal types for the disturbance recording (Item name) are:

- *Filtered Binary Inputs* These are the signals from the binary inputs of the device. Filtering means that the transient changes within a limited time span are not considered as status changes.

- *Contacts* The binary status of the output contacts

- *Graphed input Status* These are the binary output status signals of the function blocks. These status signals are explained in details in the documents of the individual function blocks.

- *NonFiltered Binary Inputs* These are the signals from the binary inputs of the device. These signals are the non-filtered versions; they can reflect also the transient changes of the inputs.

- *Volatile user status* When editing the user logic in the Graphic logic editor (see the details in Chapter 6) the user may define new binary output status signals, and compose logic relationship resulting these signals.

- *Non volatile user status* When editing the user logic in the Graphic logic editor (see the details in Chapter 6) the user may define new binary output status signals, and compose logic relationship resulting these signals. These signals are defined to be stored in non-volatile memory. If the supply voltage of the device is switched off then it is switched on

again, these signal preserve their logic status assigned during the previous energized state of the device.

1.8.6.2 SELECTING AN ANALOG SIGNAL FOR DISTURBANCE RECORDING

Figure *1-22* shows the selection method of analog signals.

The user can define

- Name the freely editable name of the signal

- Title the freely editable title of the signal

- Item name the item to be recorded

- Nominal value the nominal value of the signal

- Unit the unit of measure.

The item selection method is similar to the method encountered elsewhere in the AQtivate software:

First, the type of the signal must be selected from the drop-down list (in this case, "Analog channel definitions" is selected, which is an input analog value). The second step is the selection from another drop-down list displaying all signals of the selected type. (Here, Man_U4, which is the fourth voltage input signal, e.g., the zero sequence voltage directly connected to the U4 input.)
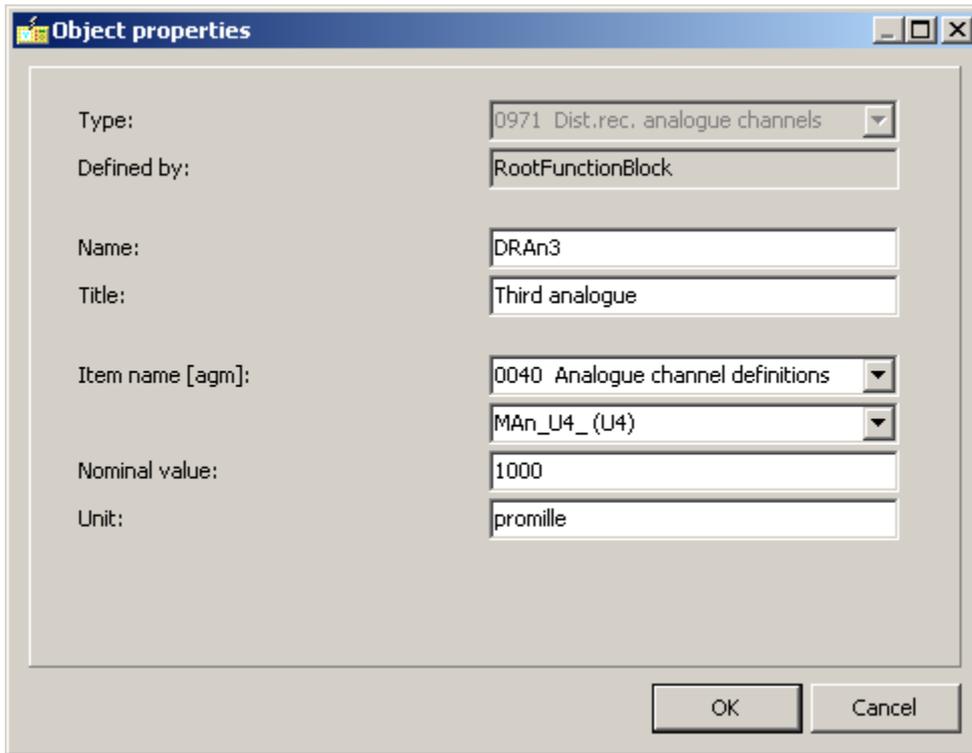
Figure 1-22 *Example: selecting the analog signal for disturbance recording*

The starting of the disturbance recorder ("DRE" function block, input "Start") can be programmed using the graphic equation editor (see Chapter 6). One simple example is shown in Figure *1-23* Example: Starting the disturbance recorder function.
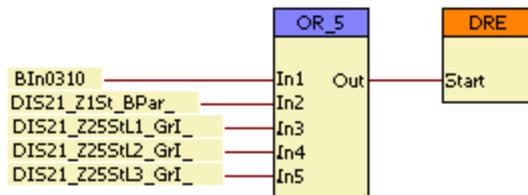
Figure 1-23 *Example: Starting the disturbance recorder function*

The pre-fault time, the post-fault time and the total duration (max fault time) depend on parameter setting.

1.8.7 COUNTERS

The software of the AQ-300 devices can count events and display the counted values (e.g., performed close command of the circuit breaker in phase L2). The signals to be counted can be selected by the user using the method encountered elsewhere in the AQtivate300 software:

In the menu Software configuration/Counters.

Figure *1-24* shows the selection method of binary signals the changes of which are to be counted.

The user can define

- Name   the freely editable name of the counter

- Title   the freely editable title of the counter

- Item name   the item to be counted

- ShowOrder   this value organizes the sequence of the counters.
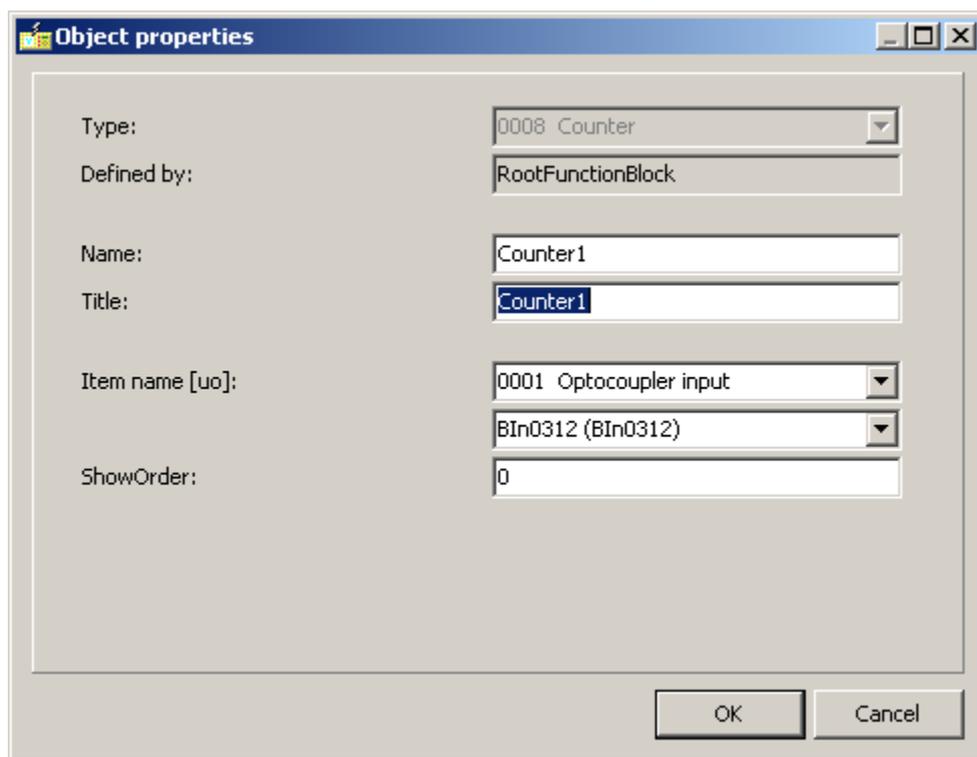
Figure 1-24 *Example: selecting the analogue signal for disturbance recording*

Note: This example shows a selection of a counter without any reference to IEC 61850. If this kind of modification of the configuration is needed, please contact Arcteq.

The available signal types for counting (Item name) are:

- *Filtered Binary Inputs* These are the signals from the binary inputs of the device. Filtering means that the transient changes within a limited time span are not considered as status changes.

- *Graphed input Status* These are the binary output status signals of the function blocks. These status signals are explained in details in the documents of the individual function blocks.

- *NonFiltered Binary Inputs* These are the signals from the binary inputs of the device. These signals are the non-filtered versions; they can reflect also the transient changes of the inputs.

- *Volatile user status* When editing the user logic in the Graphic logic editor (see the details in Chapter 6) the user may define new binary output status signals, and compose logic relationship resulting these signals.

- *Non volatile user status* When editing the user logic in the Graphic logic editor (see the details in Chapter 6) the user may define new binary output status signals, and compose logic relationship resulting these signals. These signals are defined to be stored in non-volatile memory. If the supply voltage of the device is switched off then it is switched on again, these signal preserve their logic status assigned during the previous energized state of the device.

- *Graphed output Status* These are the binary input status signals of the function blocks. These status signals are explained in details in the documents of the individual function blocks. They are defined in the factory or by the user, using the graphic logic editor.

2 THE PASSWORD MANAGER

The AQtivate configuration tool requires a password. Out of the four operating modes (Normal View, Master View, Designer View, Administrator View), the user is entitled to apply Normal View (no password is required) or Master View. The other operating modes are reserved for Arcteq's designers and developers. This guide describes password management for Master View.

Any company using the AQtivate configuration tool is assigned a "Serial number". The person in possession of this serial number is the "Password Administrator". This person generates a "AQ-300 password file" (.epw), which is the password database. This database is to be distributed among all computers and users applying the configuration tool. The path for storing the database file is displayed as shown in Figure *2-1*. When the Password Administrator starts the AQtivate configuration tool for the first time, the software for Master View must be activated using this serial number.

When this icon on the toolbar   is clicked, the Password Manager window is opened. See Figure *2-1*. The serial number must be copied here, then the "Log in" button starts the process.
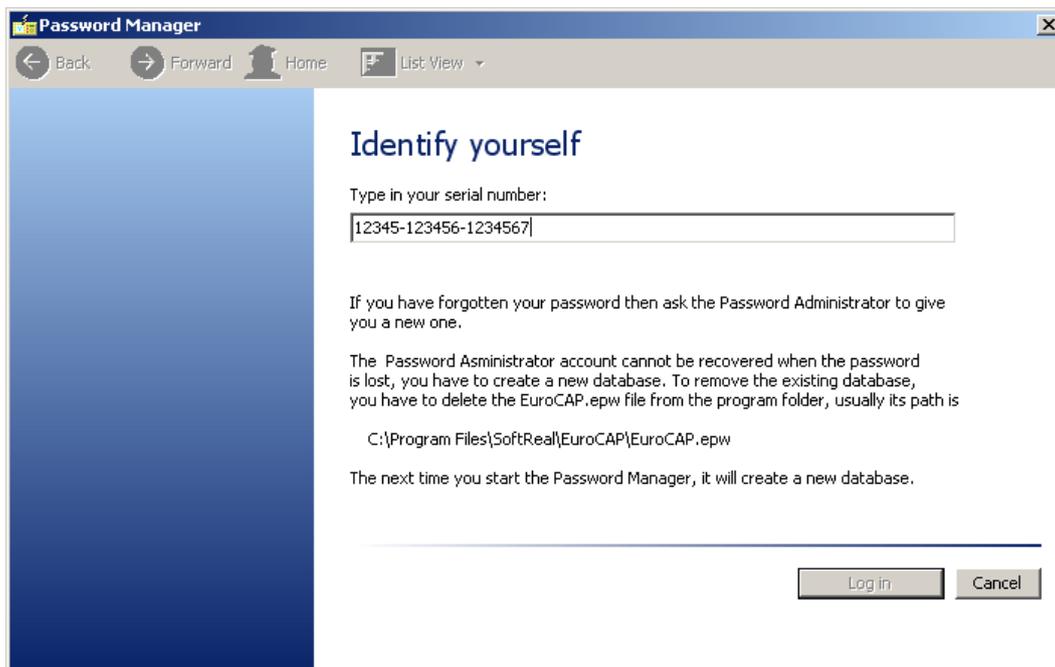
Figure 2-1 *Starting the Password Manager window for the Password Administrator*

The "Welcome" message of the opening window explains that first an account is to be generated for the Password Administrator. In the subsequent steps, the Password Administrator will be able to generate accounts for all users of the AQtivate configuration tool.
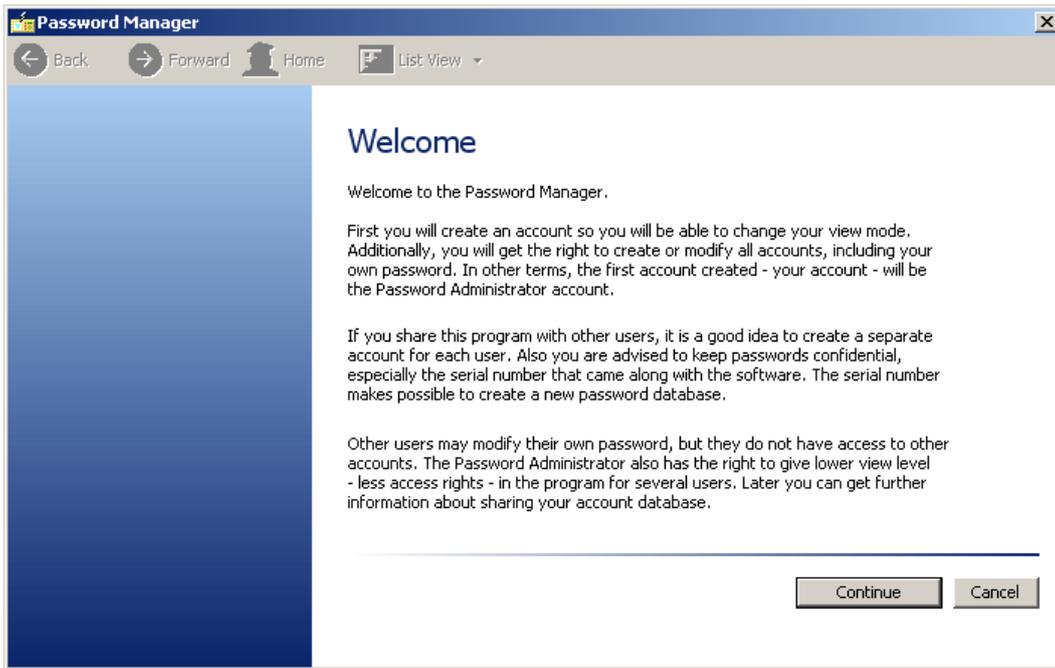
Figure 2-2 The Welcome message

The window shown in Figure *2-3* guides the Password Administrator through account generation. The name of the user (on the first occasion, the name of the Password Administrator) must be entered, then the freely chosen password must be typed identically in two fields. (The Master view level may not be modified.)
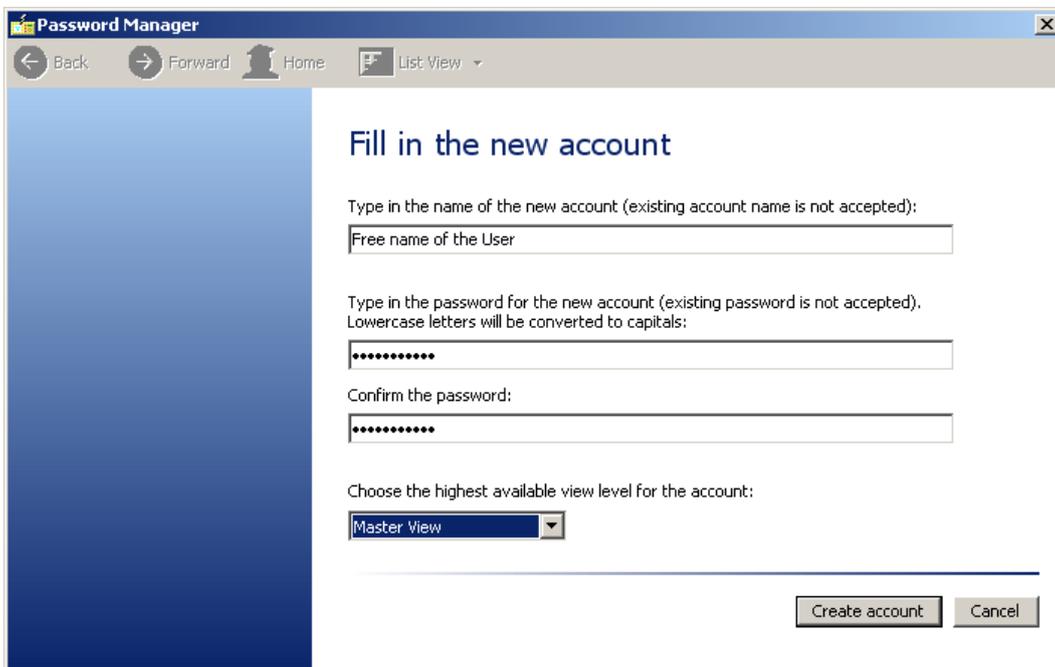
Figure 2-3 The account generation

After the creation of the account, a dialog window shows the available tasks according to Figure *2-4*.

Figure 2-4 Password management

The available tasks are as follows:

- Modify an account   Here account can be selected and the name and/or the password can be modified

- Create a new account   Here a new account can be created similarly to the account of the Password Administrator

- Remove account   Any account can be deleted except for the Password Administrator's

- Share my account with others   For sharing the account, no further steps are needed

- Close the Password Manager

As an example: when the "Modify an account" option is selected, the new window shown in Figure *2-5* is opened. This is what the window looks like when the Report option is selected as "List View"

 in the toolbar.

Figure 2-5 Password management

The icon steps back to Figure *2-4*, while the arrows step one step back or forward in the procedure.

3 THE LCD EDITOR

The "LCD editor" is embedded software used for picture generation for the LCD, integrated in the front panel of the AQ-300 devices.

The factory configuration usually contains the basic pictures that may be needed:

- **Main** usually displaying basic information about the configuration

- **Param** for processing the available parameter sets
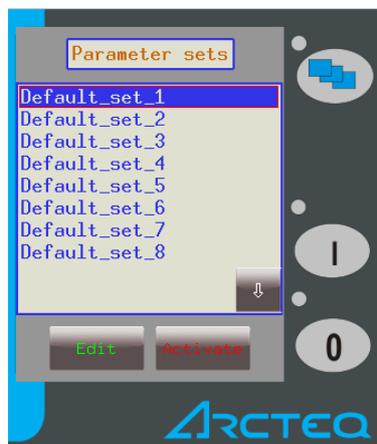
- **On-line** for displaying on-line information
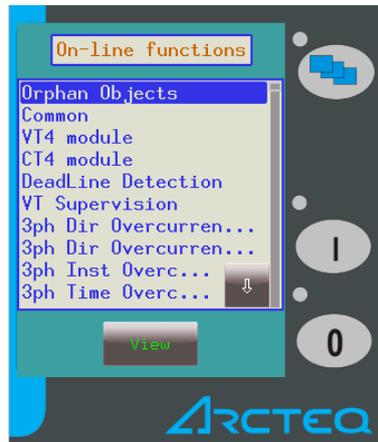
- **Events** for displaying the logged event information

- **Settings** for supporting the "On-site" parameter setting of the device
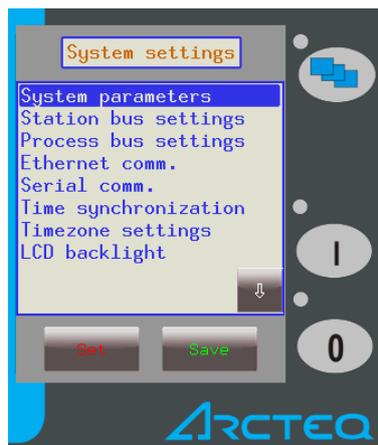
- **Any other** displays ordered by the user. E.g.:
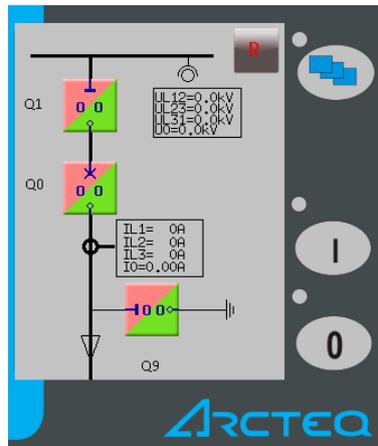
Using the LCD editor, the user can generate similar pictures for the LCD.

3.1 OPENING THE LCD EDITOR

The LCD editor is opened by clicking the [icon] icon on the toolbar of the AQtivate configuration tool.
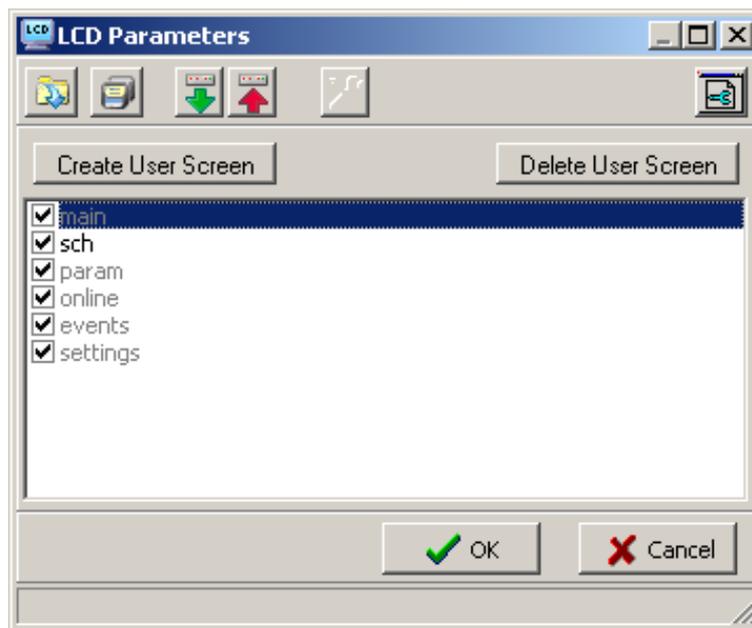
Figure 3-1 *The starting screen of the LCD editor*

The list contains the available screens. The checkmarks indicate the screens that can be activated on the LCD (in Figure *3-1* all of them are active). The basic screens cannot be modified or deleted by the user, the [icon] icon is inactive.

The user at *Master level* can create new screens or modify the *User screens* (in Figure *3-1* "Sch" – meaning "Scheme" - is a pre-defined user screen. It can be modified; the [icon] icon also becomes active.)

The buttons of the toolbar are used to create user screens or to delete a selected user screen.

3.1.1 THE ICONS OF THE TOOL-BAR

- ![icon] for opening a user screen from a file

- ![icon] for saving a user screen to a file

- ![icon] for getting the user screen from a connected device

- ![icon] for loading the user screen to a connected device

- ![icon] for editing the selected user screen

- ![icon] for setting the display properties (size)

3.1.2 CREATING NEW USER SCREENS

A new user screen can be created by pressing the ![Create User Screen] button. This adds a new "User" screen to the list with a new serial number.

Opening the user screen:

A user screen in the list can be opened by double-clicking on the relevant row of the list, or by right- clicking with the mouse, then selecting the / Edit User Screen command or by clicking the ![icon] button on the toolbar.

Relocating the user screen:

The sequence of the displayed screens can be modified by left-clicking on the row of the selected screen, and dragging the row up or down on the list to the required position.

Renaming the user screen:

When the user screen is selected and the item is right-clicked, the Rename command is available for this purpose.

```
Edit Screen...
Create New Screen
Rename
Delete              Del
```
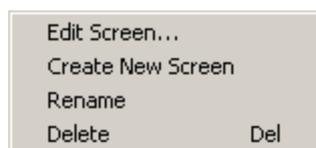
Deleting a user screen:

There are three methods for deleting a user screen: the DEL button on the keyboard, right-clicking then selecting Delete or using the ⬛ Delete User Screen ⬛ button on the toolbar.

Saving the screens into a file:

For saving the screens into a file the 🗐 button of the menu bar can be clicked. Here a dialog window serves the purpose of selecting the path and name to save the information to. All selected and not factory-made User Screens will be saved additionally to the "lcd.conf" file into the selected directory. After successful saving, a message is displayed. This message can be acknowledged by clicking the "OK" button.

Reading the screens from a file:

To read the screens from a file, the 📥 button of the menu bar can be clicked. Here a dialog window serves the purpose of selecting the path and name of the file to be read. Only one User Screen may be loaded. If the name of the screen already exists on the list of screens, the program asks for permission to overwrite the information.

Downloading the screens to the device:

The User Screen pictures selected in the "LCD Parameters" window can be downloaded to the device using the 🔺 button. When this button is clicked, the "ProtectionHood" routine searches for devices connected to the network. A device can be selected by left-clicking on the row of the device. The downloading of the new information starts when the ✔ OK button is pressed. Information about the downloading process is displayed in a separate window (FtpLog). If the required device is not displayed on the list, then press the Refresh button. If this attempt is not successful, check whether the required device is connected and energized.

Uploading the screens from the device:

The User Screen pictures stored in the device can be uploaded to the computer using the button. When this button is clicked, the "ProtectionHood" routine searches for devices connected to the network. A device can be selected by left-clicking on the row of the device. The downloading of the new information starts when the button is clicked. For each picture to be uploaded, the program asks for confirmation if the picture is already in the computer.
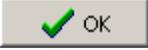
If the required device is not displayed on the list, then press the button. If this attempt is not successful, check whether the required device is connected and energized.

Setting the LCD setup:

The window where the properties of the LCD can be set is opened using the button. Two pre-configured resolutions can be selected (240*320, 320*240) or others can be set. When resorting to the latter option, please check if the LCD can display the format of the modified resolution.
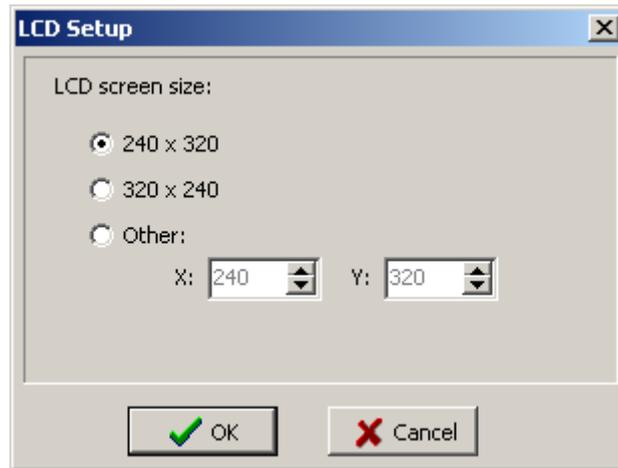
Exit from the LCD editor:

- Save changes:

To save changes, press the [✓ OK] button. As a result, all changes are saved.

- Cancel changes:

If there is no need to save the modifications, press [✗ Cancel] . In this case, the program asks for confirmation to reject the changes.

- Direct exit:

To quit the program, click on [✗]. If there are unsaved changes, the program asks for confirmation to reject the changes.

- Confirmation:

In the dialog window asking for confirmation, there are two choices: the [OK] and the [Cancel] buttons. If the [OK] button is clicked, the changes will be lost. If the [Cancel] button is clicked, the program returns to the LCD Parameters window. Similarly: when the button is clicked, confirmation is also needed.
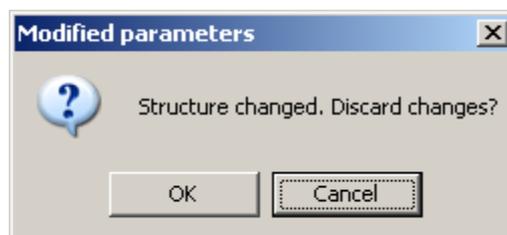
Editing User Screens:

The LCD screen editor is composed of windows. The window in the middle is the graphic area showing the screen picture to be edited. The left side window is the Object List, showing the

objects located on the graphic area. The window on the right side displays the properties of the selected objects. This window is also used for modification. The toolbar is located in the upper part of the window. The icons on the toolbar are for cutting, copying and pasting existing objects. Additionally, new static and dynamic objects can be placed on the graphic area, too.
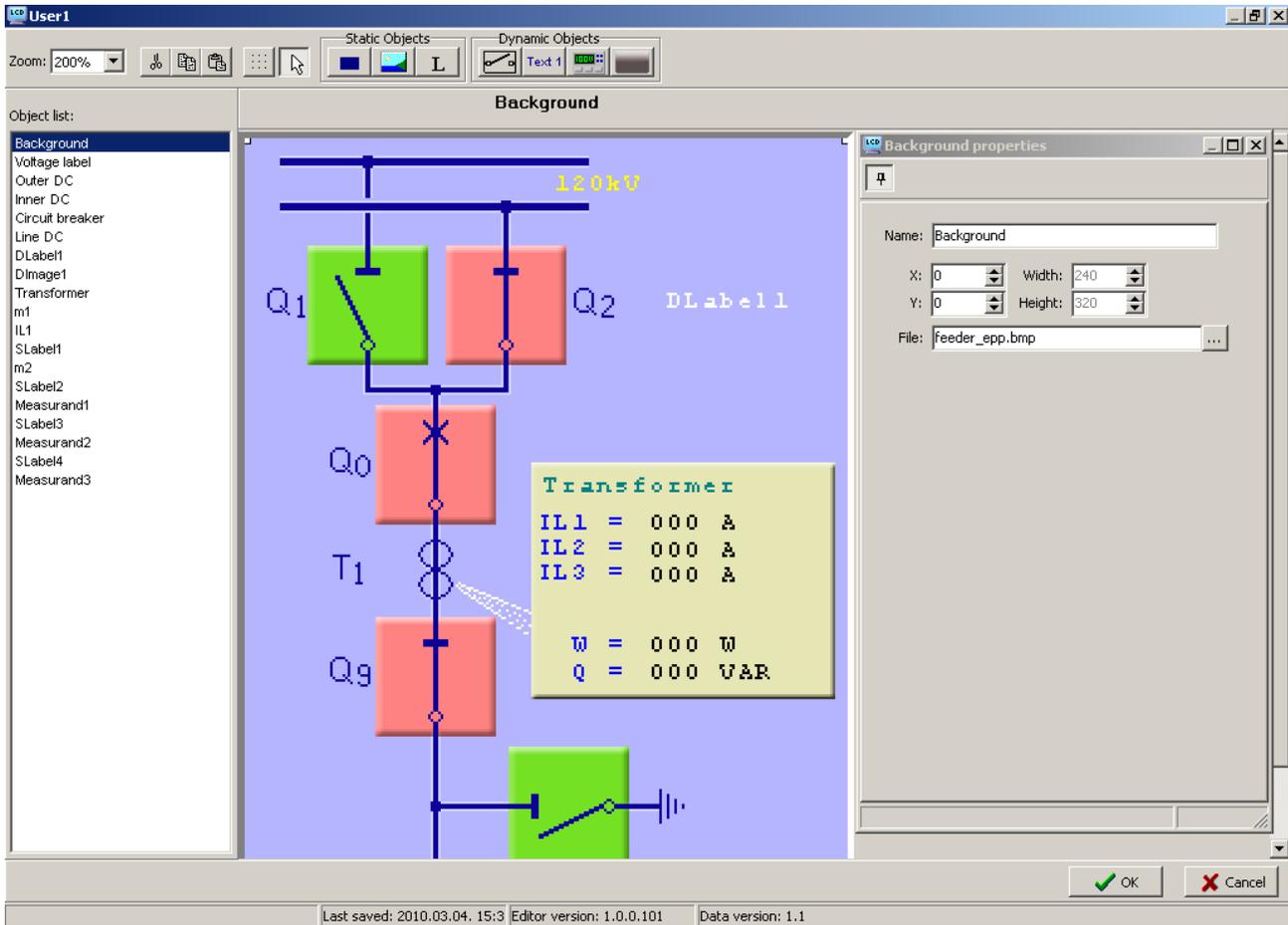
Zoom:

The Zoom dropdown menu supports selecting the zoom mode. The enlargement is expressed in percent.

Copying objects:

The selected object can be copied by clicking on the button or by using the Ctrl + C key combination, or by right-clicking on the object, then selecting the Copy command. The selected object remains on the original location.

Cutting objects:

The selected object can be cut out by clicking on the button or by using the Ctrl + X key combination, or by right-clicking on the object, then selecting the Cut command. The selected object disappears from the original location; it can be found on the clipboard.

Inserting objects:

The objects placed previously on the clipboard can be inserted by clicking on the ⬚ button or by using the Ctrl + V key combination, or by right-clicking on the working area, then selecting the Paste command. The location of the inserted object will be 10 pixels down and 10 pixels to the right of the original object, but it can be dragged freely. The object remains on the clipboard, too, and it can be inserted again.

Moving objects:

The selected objects can be dragged keeping the left mouse button depressed. The new location can be defined directly in the object properties window, too.

Grid:

Using the grid (or raster), the objects can be placed more accurately on the User Screen. For toggling the grid, use the ⬚ button. The distance between grid points is 4 pixels. They are invisible but if the grid is switched on, then the objects will match the grid positions.

New objects: (see below for details)

- Static objects:

- Static rectangle (Rectangle),

- Static picture (Image),

- Static text (Label),

- Dynamic objects:

- Dynamic picture (Dynamic Image),

- Dynamic text (Dynamic Text),

- Measured values (Measurand),

- Switch for mode selection: (SysCtrl)

Placing a new object:

Click on the symbol (icon) of the selected object type on the toolbar, then click on the graphic area. The contour of the object will appear in the editor area. The new object can be moved as required.

The Object List:

The left side window is the Object List, showing the objects located on the graphic area. The sequence of the objects is of great importance. If an object is located at the top of the list, then the subsequent objects will overlap and cover the preceding ones. The position of the objects on the list can be modified by clicking and dragging the object while keeping the left mouse button depressed. The object names can be also overwritten by clicking on the name, then using the object properties window or by double-clicking the name.

The objects:

Static rectangle:

(Rectangle) Using this icon, a rectangle can be placed on the screen, the size and color of which can be modified as required. The *Name* field contains the identifier, which is shown on the Object List, too. Additionally to the size and the color, the position can be defined as well. When the *Fill* option is ticked, the area of the rectangle will be filled with the selected color.

Static image: (Image)

The first step is to place a symbolic rectangle on the screen, the properties of which can be defined additionally. A name and the starting position can be given, then if the *Select Image* button is pressed, the LCDPictureAdd form will guide you through the selection of a picture from the available database.

Static text: (Label) L

The name of the label, its size and position can be defined here. The *Text*: field contains the text to be displayed, then the *Font:* dropdown menu can be used to define the character size. The color of the text is selected using *Font Color*, the background can be colored using the *Back Color* button. To show the background color, *Fill* must be ticked.
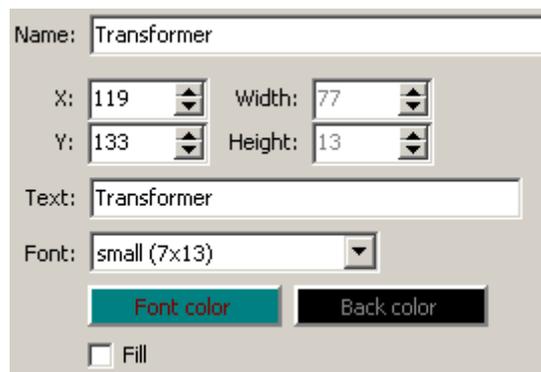
Dynamic picture: (Dynamic Image)

The difference between dynamic and static pictures is that several states can be assigned to a dynamic picture based on external information. This external information can be selected in the *Source* dialog box. The pictures assigned to different states can be selected from the *Files* list. The serial number of the selected file (usually bit-map) means the value of the variable the file is assigned too. A control command can be assigned to these dynamic images in the *Command* dialog box. First *Control Channel (43)* must be selected, then the On and Off commands must be assigned. If confirmation is required, then check the *Confirm Before Execute* box, too.
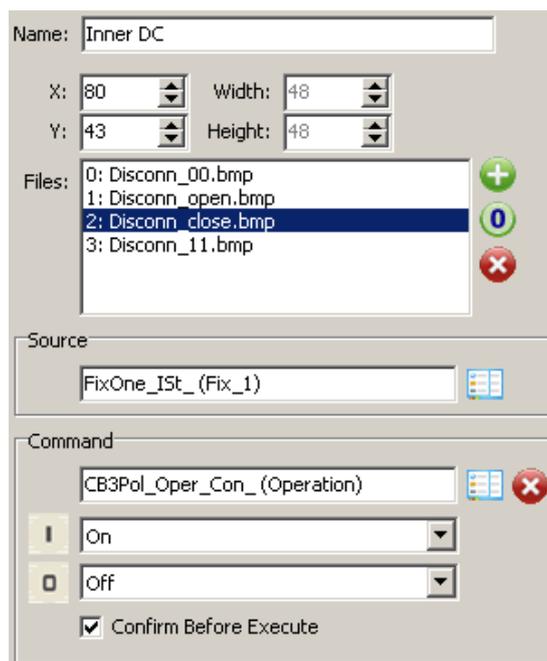
Dynamic: (Dynamic Text)

The treatment of dynamic text is similar to that of dynamic pictures: several states can be assigned and displayed based on external information. Here, different text rather than images can be selected. The command assignment is also similar: in the *Command* dialog box, a *Control Channel (43)* can be assigned, then the text, its size and color can be selected.
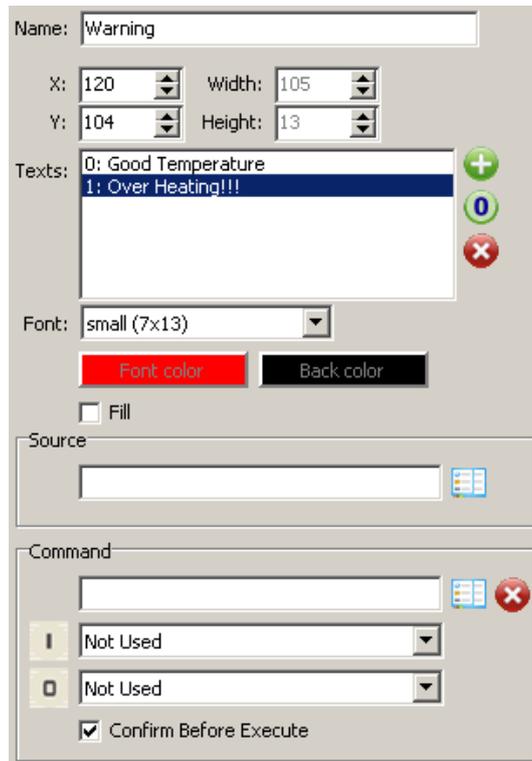
Measured value: (Measurand)

To display measured values, the following information must be assigned: name, location and size. *Prefix* means the short text to be displayed as static text before the displayed value, *Suffix* means the short text added to the displayed value. The number of the displayed digits can also be defined under *Spacing*. The source of the measured value is selected using the *Source* dropdown list.

Toggle mode of operation: (SysCtrl)

This button on the user screen is used to set the mode of operation of the control function.

The list of available operating modes:

- Disable all

> This option disables all operations.

 - Local only

> This option enables local operation only.

- Remote only

> This option enables remote operation only.

- Both enable

> This option enables both local and remote operation.

- Invert Remote

> This option is for toggling remote operation.

- → Local → Remote →

> This option is for switching between operating modes.

- → None → Remote →Local → Both →

> This option sets disabled, remote, local and full enabled operating modes in turn.

Additionally to mode selection, it is also possible to set confirmation, channel selection for command generation and the command to be generated.

Apart from the "usual" information (name, position, file of the image), some additional information can also be defined: there are three options available for *Button Width*: 40, 70 or 85 pixels. The button width determines the required size of the image as well: for a width of 40 pixels, it is 40*40, for 70 it is 40*70, and for 85 it is 40*85. No other sizes can be applied, and if the size is wrong, the database cannot be closed.

Status bar:

The Status bar contains three important bits of information: date and time of the last saving, the version identifier of the software and the version identifier of the database.

The object properties window:

This is a separate window located on the right side of the computer's screen, displaying the properties of the selected object. If this window is not needed, it can be closed using the button. To re-open this window, simply double-click on one of the objects.

Right-clicking on an object:

When right-clicking on an object, the following menu is displayed:
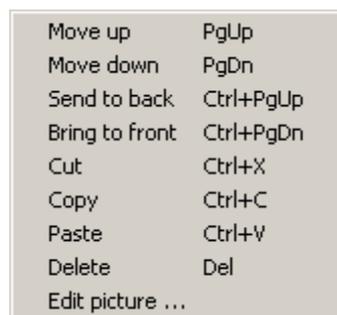
- **Move up**: This menu item moves the selected object one position up on the object list. This means that all objects located lower on the object list will be on top of the selected object.

- **Move down**: This menu item moves the selected object one position down on the object list. This means that the selected object will be on top of all objects located higher on the object list.

- **Send to back**: The selected object will be sent to the background and covered by all other objects. - Bring to front: The selected object will be sent to the foreground covering all other objects on the list.

- **Cut**: This menu item cuts the selected object and places it on the clipboard.

 - **Copy**: This menu item copies the selected object to the clipboard.

- **Paste**: This menu item inserts the object previously placed on the clipboard to a new location, which is 10 pixels down and 10 pixels to the right from its original position. This inserted new object can be moved freely to any other position.

- **Delete**: This menu item deletes the selected object.

- **Edit picture**: This menu item serves to edit the active picture element. Editing will be performed by the Windows-default graphic editor. All required changes can be made here.

Quitting the LCD Parameters window:

- **Saving changes**: To save changes, press the [✔ OK] button.

- **Canceling changes**: If there is no need to save the changes, press the [✗ Cancel] button. In this case, repeated confirmation is needed to quit the editor because all changes made since the last save will be lost.

- **Quitting immediately**: To quit immediately, simply click on the [✗] button. If there is any unsaved information on the screen, confirmation must be repeated before you can quit the editor because all changes made since the last save will be lost.

- **Confirmation**: There are three options offered in the confirmation dialog box: The [OK] , the [Cancel] and the [✗] button. If the [OK] button is clicked, the changes will be discarded. If the [Cancel] button is clicked, the LCD Parameters window is opened again. If the [✗] button is selected, the confirmation window is closed and the LCD Parameters window is opened again.
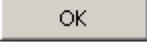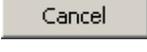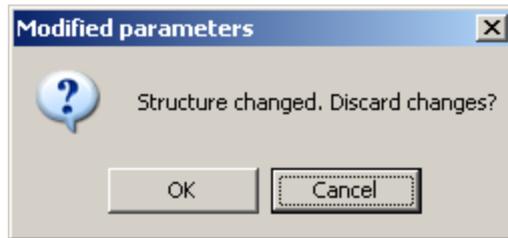
Source selection:

If a source is to be selected, then the software automatically imports the characteristic states needing picture assignments. If there are assignments in the *Files* dialog, then confirmation is needed to overwrite the assignments.

The LCD Picture Database:

The LCD Picture Database contains all pictures applicable on User Screens. The unused pictures may be deleted, new pictures can be added for future application and the modified database can be saved. A saved database can be invoked from the database file. The content of the database is displayed if a static or dynamic picture or a SysCtrl switch needs picture assignment.
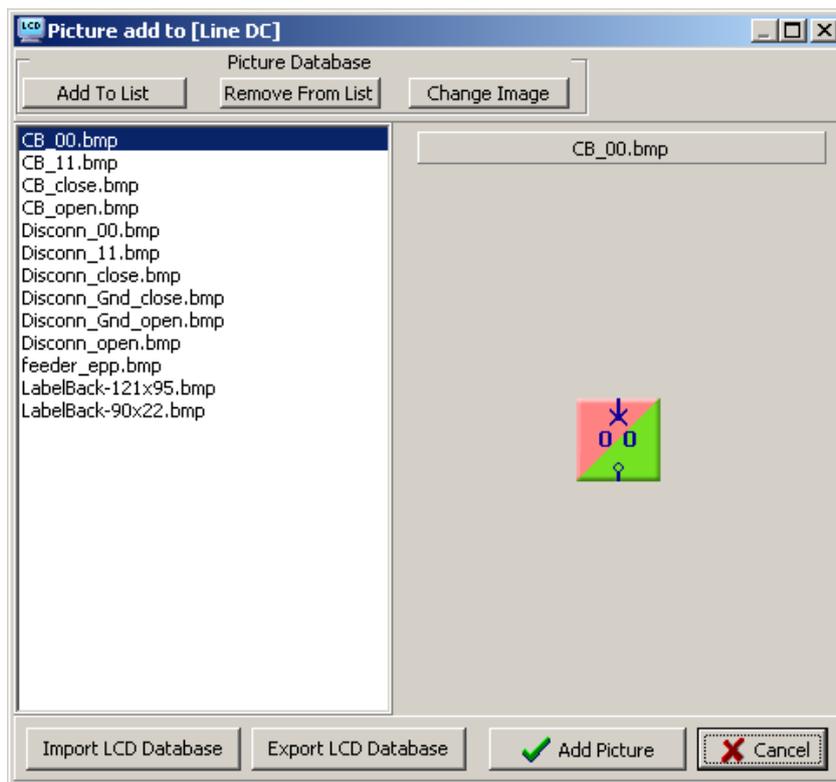
Importing a new picture to the database:

The ` Add To List ` button is for importing a picture to the database. After pressing this ` Change Image ` button, a file selection dialog serves the purpose of locating the required picture.

Replacing a picture in the database:

A picture can be changed by pressing the button and replacing it with another one.

Editing a picture: To edit a picture, simply right-click on the selected picture and activate the „Edit Picture" menu item. The windows-default picture editor will be opened to perform the required modifications.

Deleting a picture from the database: A picture can be deleted from the database by selecting the picture and pressing the Remove From List button. Only pictures not applied on the user screen may be deleted.
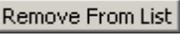
Importing the LCD database: An existing database can be imported by clicking on the Import LCD Database button. The database must be selected in a dialog window, then the „Open" button performs the import. If the file is already used in the database, it will be overwritten. To keep the existing file for future use, rename the file.
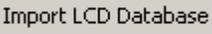
Exporting the LCD database: To export the database into a file, press the Export LCD Database button. The file dialog window will guide you through naming and locating the database file.
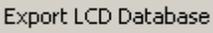
Inserting a selected picture: A selected picture can be inserted by pressing the Add Picture button.

Discarding changes: If there is no need to save the performed changes, simply press the Cancel button. The LCD Picture Database will be closed and the changes will be lost.

3.2 COMPOSING A NEW USER SCREEN

The procedure of composing a new screen is best explained through an example.

Let's compose a screen for the following task:

EXAMPLE: *A transformer bay for a 20 kV substation will be composed. The applied scheme is shown in* Figure *3-2.*
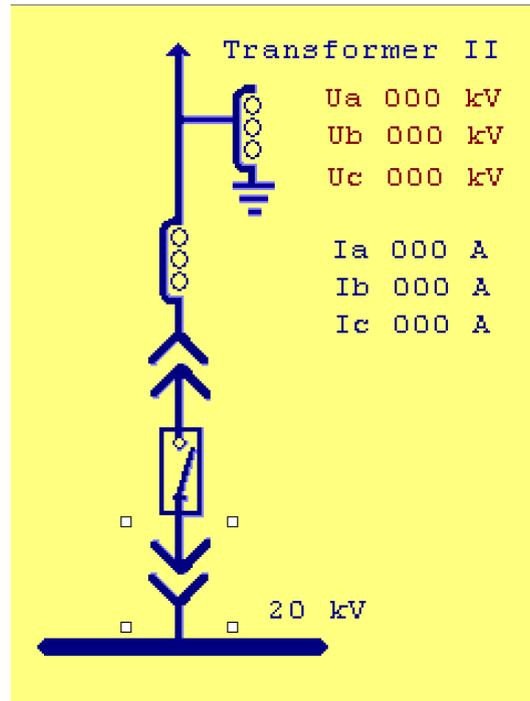
Figure 3-2 Required user screen for a transformer bay

The scheme contains:

- A voltage transformer; the measured phase voltages will be displayed

- A current transformer; the measured phase currents will be displayed

- An active circuit breaker

  o   The status is received on two bits (ON, OFF)

  o   Position indication: ON, OFF, ERROR

  o   Active element to support switching on/off from the screen with command confirmation

- A pair of active disconnectors

  o   The status is received on two bits (ON, OFF)

  o   Position indication: ON, OFF, ERROR

The proposed steps are as follows:

1. **The required hardware environment**

There must be at least one voltage transformer input module and one current transformer input module configured in the device. (See HW configuration.)

There must be at least one relay (trip) binary output module in the device. (See HW configuration.)

There must be at least one binary input module in the device. (See HW configuration.)

2. The required software environment

The software configuration of the device must include

- a module for generation of measured voltage and current values

- a module to process the information related to the circuit breaker

- a module to process the information related to the disconnector

The inputs of the software module MXU_L are the calculated Fourier components and true RMS values of the voltages and currents, and these values are offered for displaying, logging, etc. This example is going to display the true RMS values of phase voltages and phase currents. These are:

MXU_U1_OLM_ (Voltage L1)

MXU_U2_OLM_ (Voltage L2)

MXU_U3_OLM_ (Voltage L3)

MXU_I1_OLM_ (Current L1)

MXU_I2_OLM_ (Current L2)

MXU_I3_OLM_ (Current L3)

The CB1Pol circuit breaker module inputs the status signals received from the circuit breaker, and calculates the values of the enumerated variable:

CB1Pol_stVal_ISt__CB   Intermediate, Off, On, Bad

The outputs of the CB1Pol circuit breaker module are the switching commands to the circuit breaker:

CB1Pol_Oper_Con_CB   Command

The DisConn_LineDC disconnector module input inputs the status signals received from the disconnector and calculates the values of the enumerated variable:

DisConn_stVal_ISt__LineDC   Intermediate, Off, On, Bad

3. Preparation of graphic elements

The graphic elements must be prepared using any external graphic editor program (e.g., Paint). These elements will be stored in a directory using the indicated file names. The following elements are needed:

The passive background contains the scheme (recommended size is 240 x 320) (the grey rectangles are the prepared positions for the active elements; Recommended size is 48 x 48). The freely selected file name is *tr_epp.bmp.*
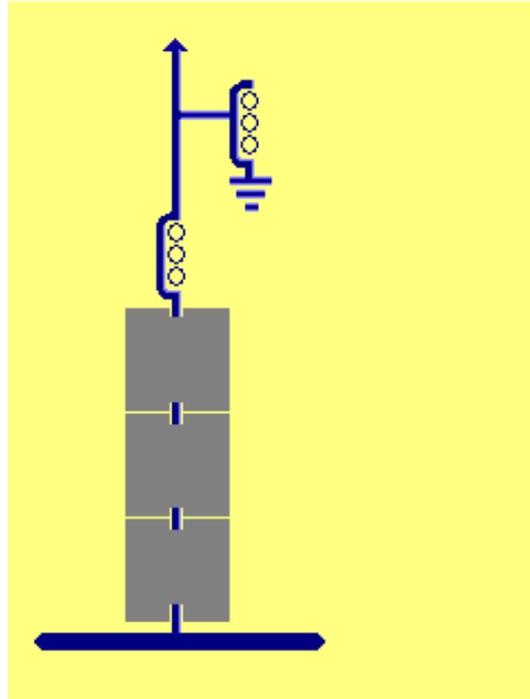
tr_epp.bmp

The active scheme of the circuit breaker can display the closed position, the open position and a common symbol for intermediate and bad status.
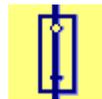
CB_closed.bmp   *CB_open.bmp*   *CB_indef.bmp*

The active scheme of the disconnector can display the upper and lower component in the closed position, in the open position and a common symbol for intermediate and bad status for both positions.

Disc_closed_up.bmp   Disc_open_up.bmp   Disc_indef.bmp

Disc_closed_dwn.bmp   Disc_open_dwn.bmp   Disc_indef.bmp
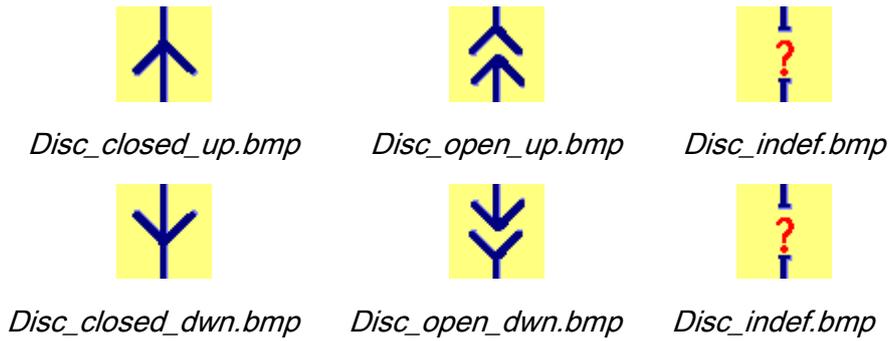
4. Working in the graphic LCD editor

Open the graphic LCD editor clicking on the ⊞ icon. You will see the window shown in Figure *3-1*, then start with *Create User Screen*. A new item will appear on the list: *User1*. Navigate the cursor to this item; then you have three options for opening the editor window:

- double-clicking on *User1* (only user screens are available for editing)

- clicking the ⚒ icon (when the cursor is on "User1")

- right-clicking on *User1* and then selecting *Edit Screen*.

You will get an empty editor window (Figure *3-3*) (or the window displays the preciously edited screen).
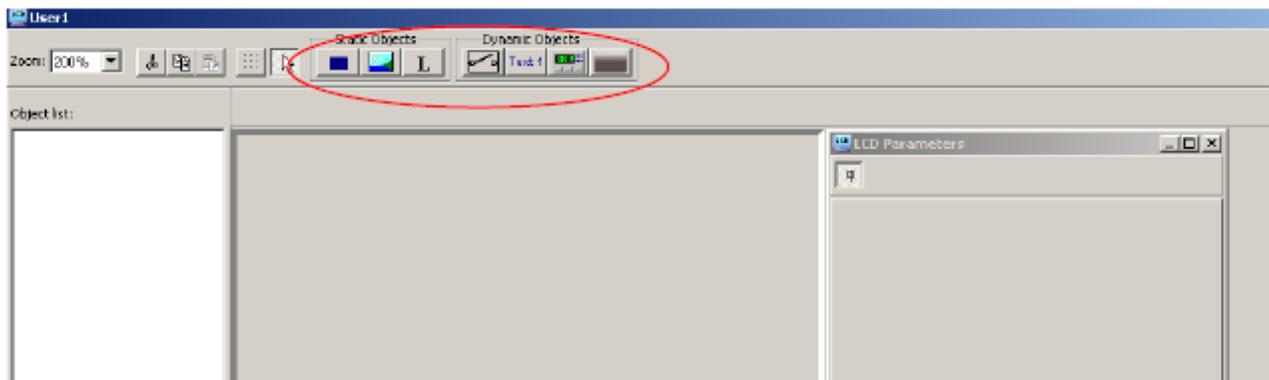
Figure 3-3 *The empty LCD editor window*

In this procedure, the *Static Object* icons and the *Dynamic Objects* icons will be used.
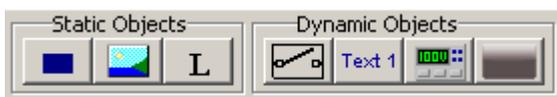
First create the passive background. Click on the static ⊞ icon, and then click on the area in the middle of the screen (the editor window). In the editor window, a square symbol is drawn with black

lines, the LCD Parameters window is filled with the dialog boxes. The *tr_epp.bmp* file should be selected but, unfortunately, it is missing from the *Picture Database*.

When clicking on the [File: | ...] file selection, the screen in Figure *3-4* is displayed.
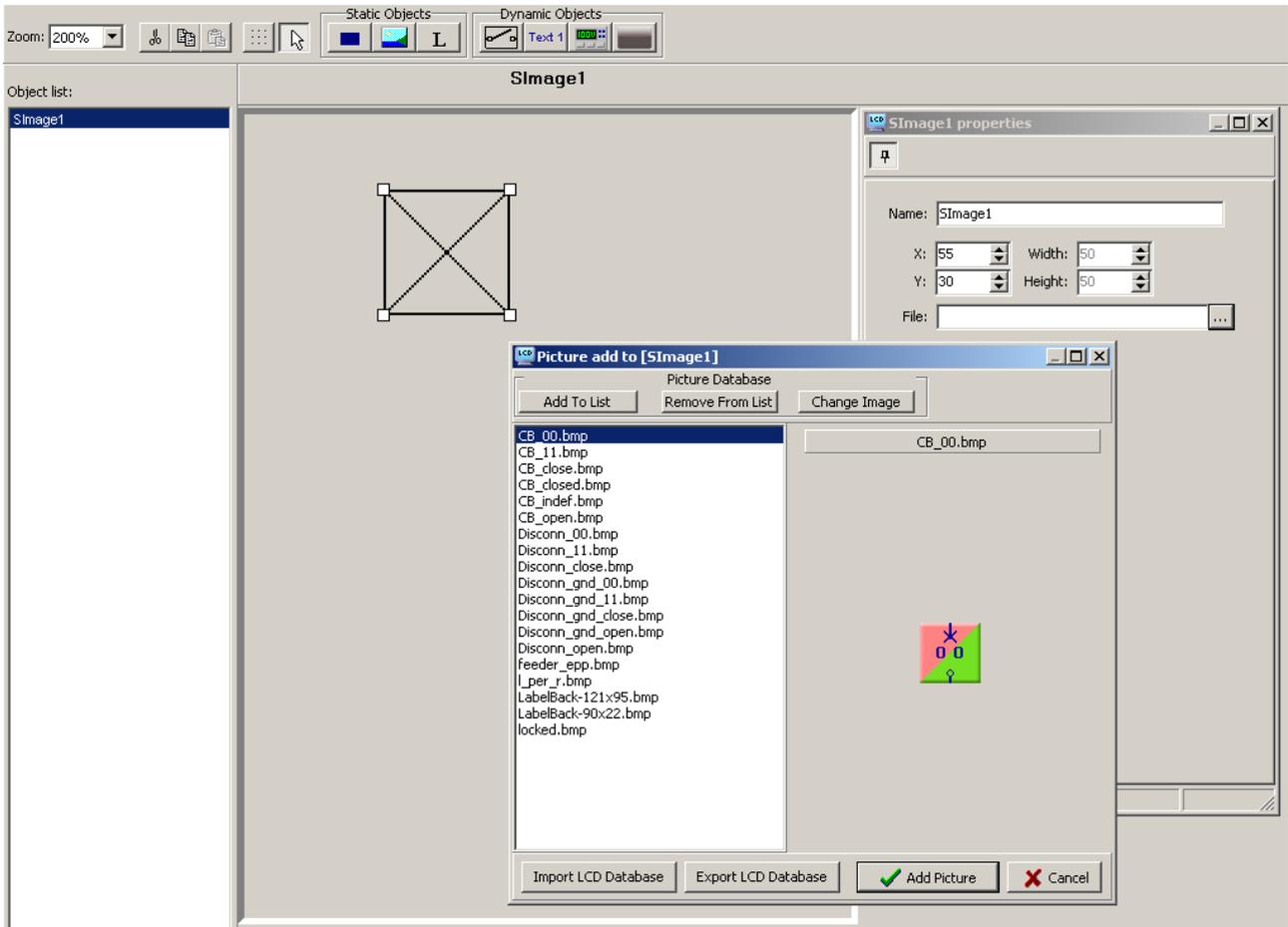
Figure 3-4 *The LCD editor window for picture selection*

To **import the previously prepared .bmp files**, click the *Add To List* button (see Figure *3-4*) and select the background file as shown in Figure *3-5* and click *Open*.
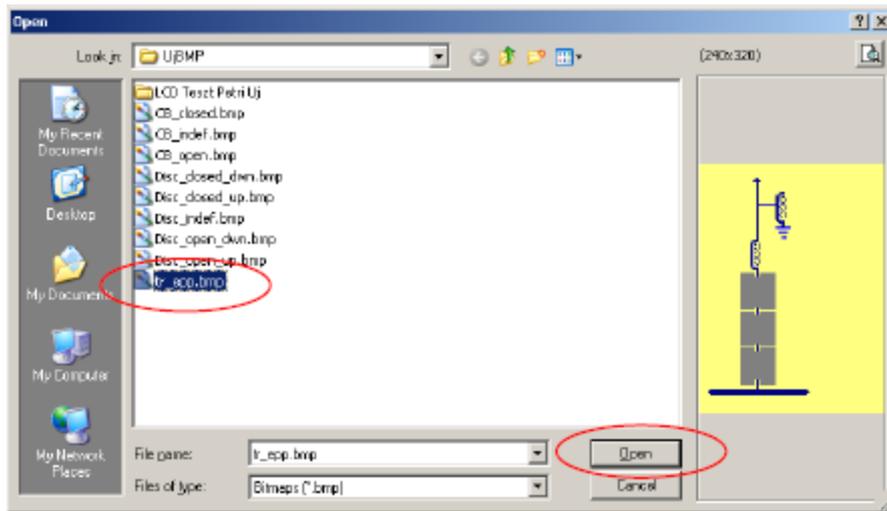
Figure 3-5 *Adding new pictures to the picture database*

This is the best time to **open all prepared pictures** to the database using the *Add To List* button (See Figure *3-4*).

Placing the background on the graphic editor window

Now that the database is complete, the background can be placed on the graphic editor window as shown in Figure *3-6*. Select *tr_epp.bmp* and click *Add picture*. Using the *Drag and drop* technique (or typing the X and Y coordinates), find the optimal location for the background.
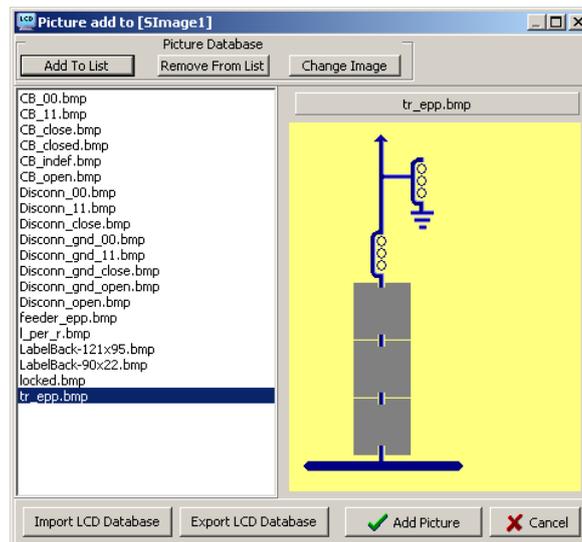
Figure 3-6 *Selecting the background*

Placing the CB dynamic object

As shown in Figure *3-7*, select the *Dynamic object* icon, then click on the desired location of the CB symbol in the graphic editor window. In the *DImage1 properties* window, select *Source*. In

the opened *Choose object* window, first select *Integer status*, then the CB1Pol_stVal_ISt__CB integer status variable. This will deliver the status of the CB, to be displayed with the prepared CB images.
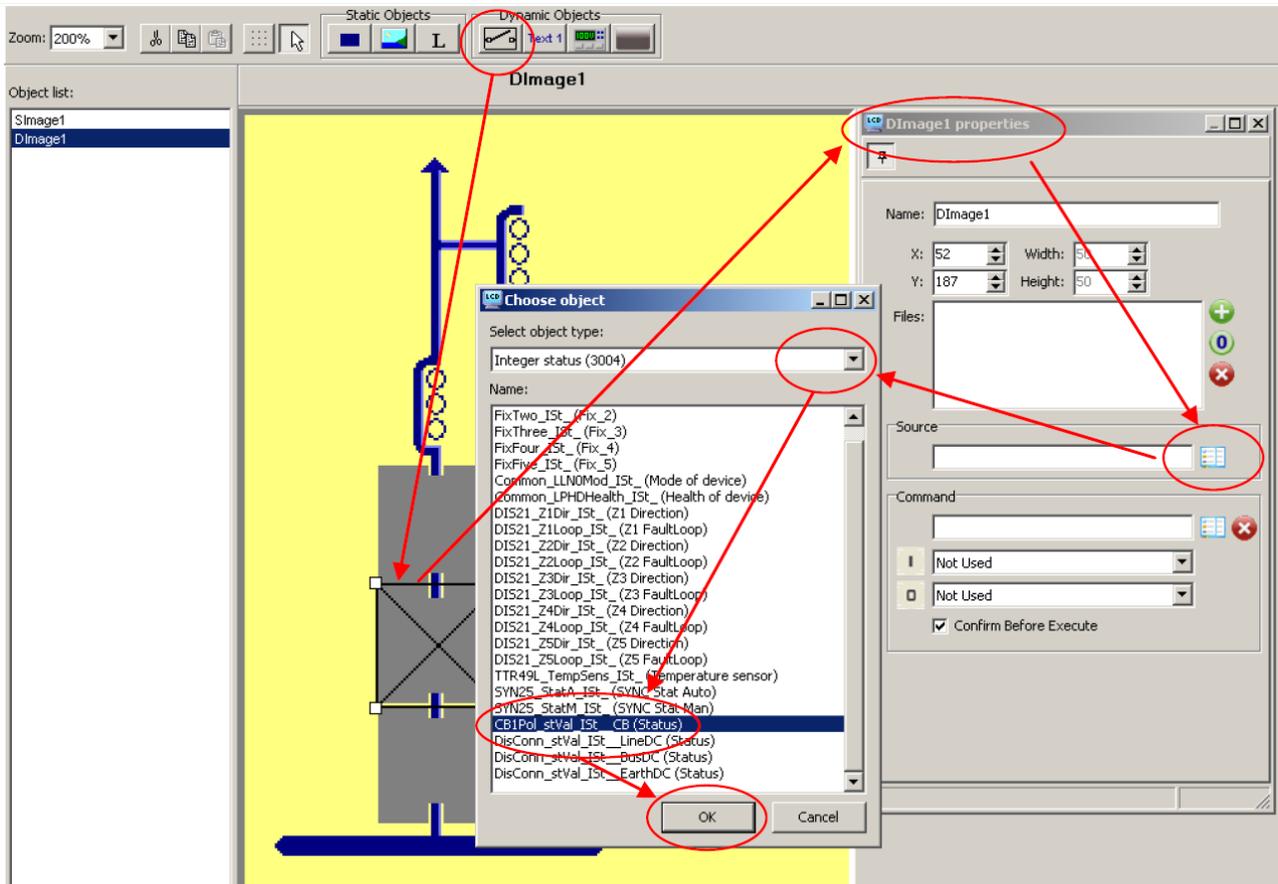
Figure 3-7 *Selecting the source of the CB status indication*

Selecting the CB symbols

Once the source of the CB status is selected, the *DImage1 properties* window requires 4 files (0-Intermediate, 1-Off, 2-On, 3-Bad). When on any of these rows is double-clicked, the *Picture add to* window is opened. Select the required .bmp file. Figure *3-8* shows the stage where *Intermediate* and *Off* have already been selected; now the picture for the *On* state is being selected. Finish all four files one by one using the *Add Picture* button.
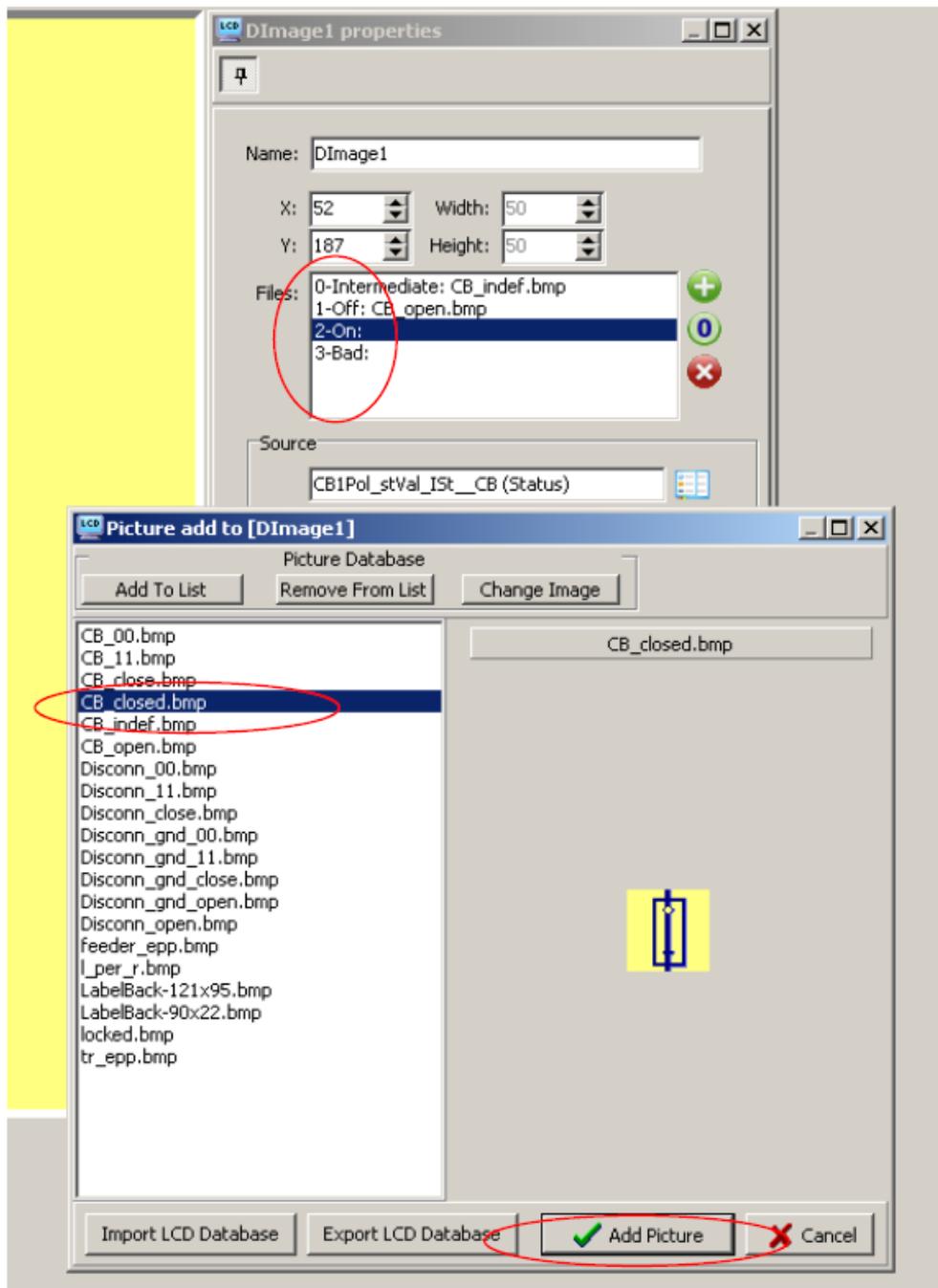
Figure 3-8 *Selecting the pictures for the CB status indication*

Selection ON and OFF commands

In the *DImage1 properties* window, select *Command*, then in the *Choose Object* window, first select *Control channels* and the *CB1Pol_Oper_Con_CB* control variable. See Figure *3-9*.
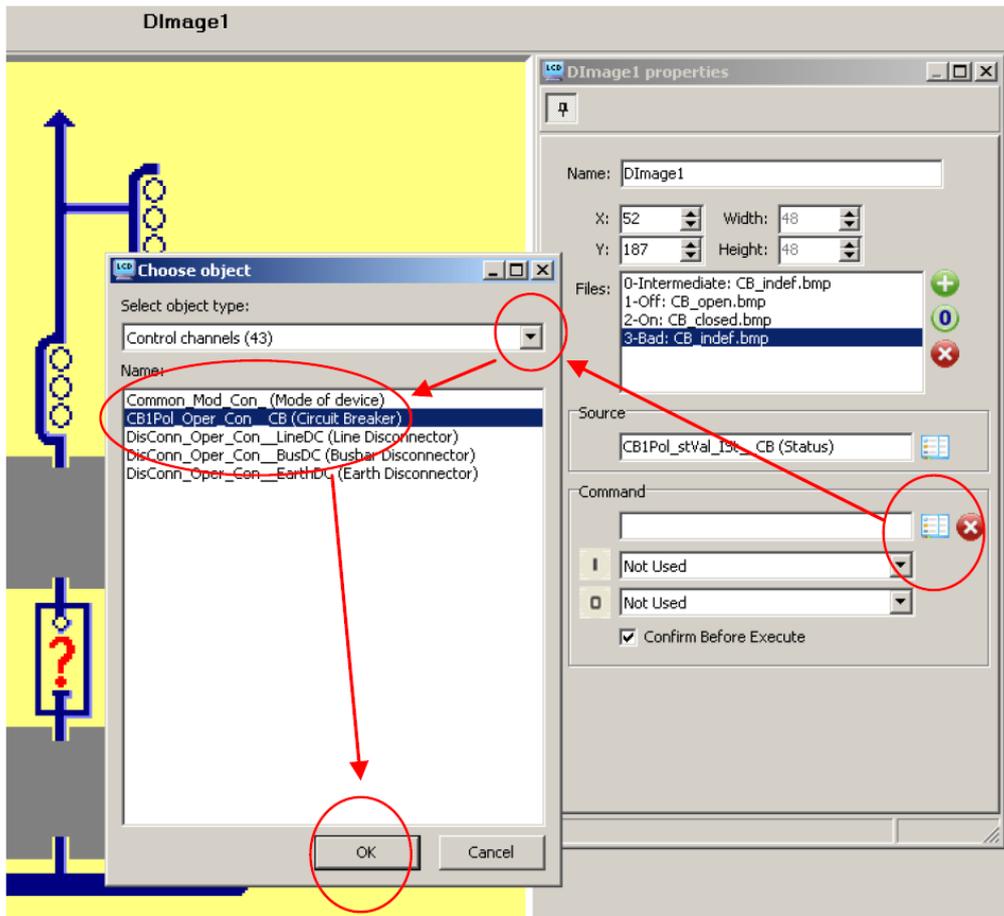
Figure 3-9 *Selecting command variable for the CB switching*

The on and off commands must be assigned to the buttons "0" and "1" on the front panel. This is done according to Figure *3-10*.
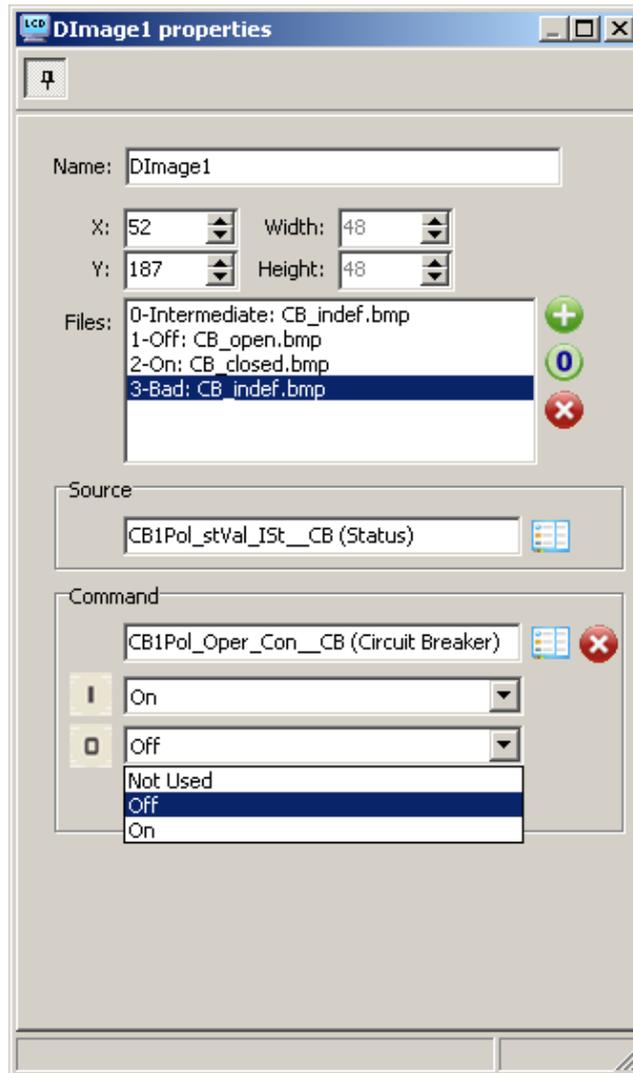
Figure 3-10 *Assigning the "0" and "1" buttons to CB switching*

Here the "On" command has been assigned to button "1" and the "Off" command is being assigned to button "0" using the dropdown menu.

Procedure for the "Disconnector" dynamic object

This procedure is similar to the one used for the CB but no remote command is possible; the operation is performed manually. Please repeat the referred procedure without command assignment.

Inserting measurements on the screen

Figure 3-11 shows the procedure. First select the measurement [icon] dynamic object. Click on the required location on the editor screen. The *Measurand properties* window requires the static text (Prefix, Suffix), Font color, Back color. Select them as needed. Clicking on the *Source* line opens the *Choose object* window. Select *Online measurands* from the dropdown menu, then select the

source (here MXU_I2_OLM). This figure shows that the three voltages and Ia have already been selected. Now Ib is being selected.
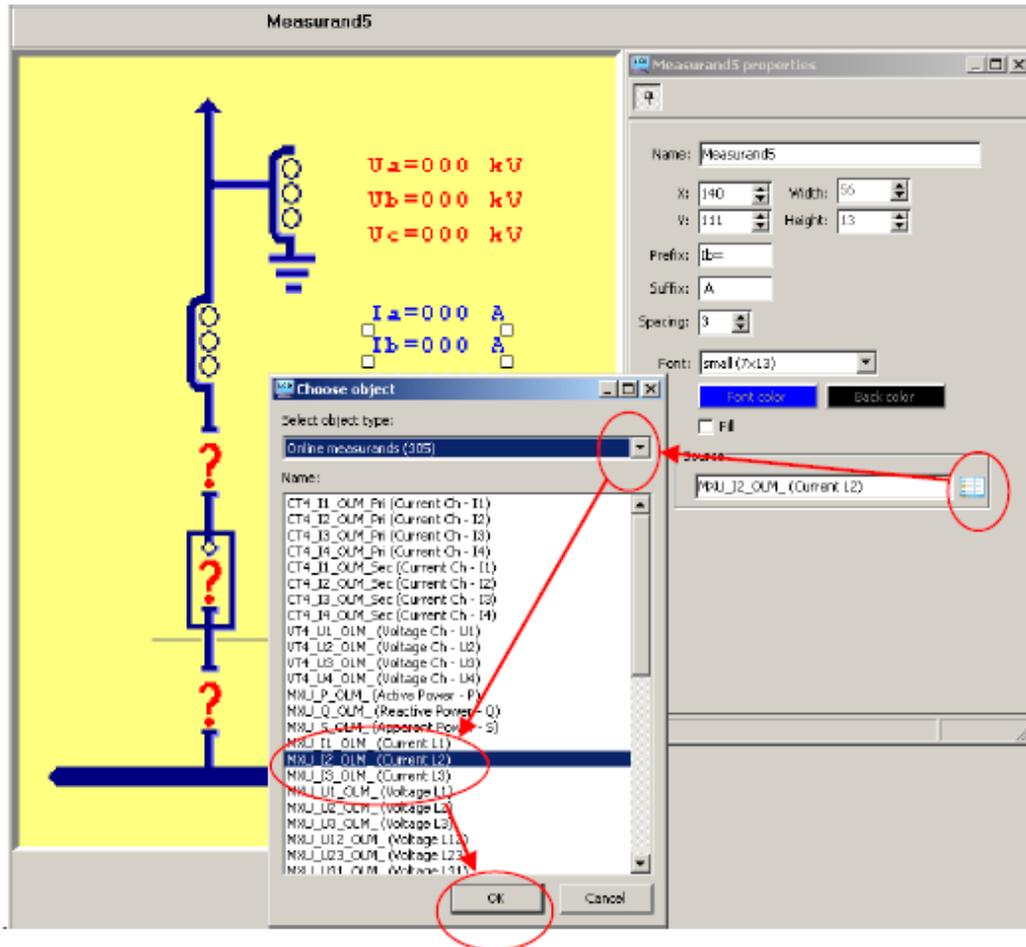
Figure 3-11 *Inserting measurements on the screen*

Finally, save the new screen and download it to the device.

(Based on this guide, the application of other elements should not cause any problem.)

For the detailed description of the LCD screen editor, see the Chapter 3.3 *User's manual for the LCD editor* below.

3.3 USER'S MANUAL FOR THE LCD EDITOR

The LCD editor is embedded software in the AQtivate configuration tool for creating, editing or deleting user screens of the AQ-300 protection devices. These user screens can be downloaded to the device via communication connections.

The windows of the LCD editor:

The LCD editor works in windows. These windows can be moved with the mouse, holding down the left mouse button on the headline. Resizing is also possible if the left mouse button is held down on the edge of the window and the ↔ symbol is dragged.

Pre-configured screens:

The AQtivate LCD editor is configured with several factory-made screens and an editable User Screen. Based on these pictures, the user can generate "tailor-made" user screens as well.

Screen elements:

- The elements of a user screen are: (for details, see below)

- Static rectangle (Rectange),

- Static image (Image),

- Static text (Label),

- Dynamic image (Dynamic Image),

- Dynamic text (Dynamic Text)

- Measured values (Measurand)

- Switch for changing the operating mode: (SysCtrl)

3.3.1 STARTING THE LCD EDITOR

The integrated LCD editor is started within AQtivate by clicking on the button of the toolbar. If the LCD button is inactive, then no AQ-300 configuration file is open. To open one, click the button.

Password protection:

The view modes of the software are password protected. The users can be entitled to perform various operations within the software, controlled by four pre-defined user profiles. When the AQtivate software is started and the password for the selected view mode is entered, the required AQ-300 configuration file can be opened and the LCD Parameters icon also becomes available.

The LCD editor is not available in „Normal View" mode.

The LCD Parameters-window

When clicking on the ▣ icon, a new window is opened displaying the list of available screens. They can be uploaded from the device or downloaded to the device from this window.

The screens can be classified into two groups: the factory integrated screens are displayed with gray letters; they may not be edited and the user screens are displayed in dark letters; they are also available for editing.
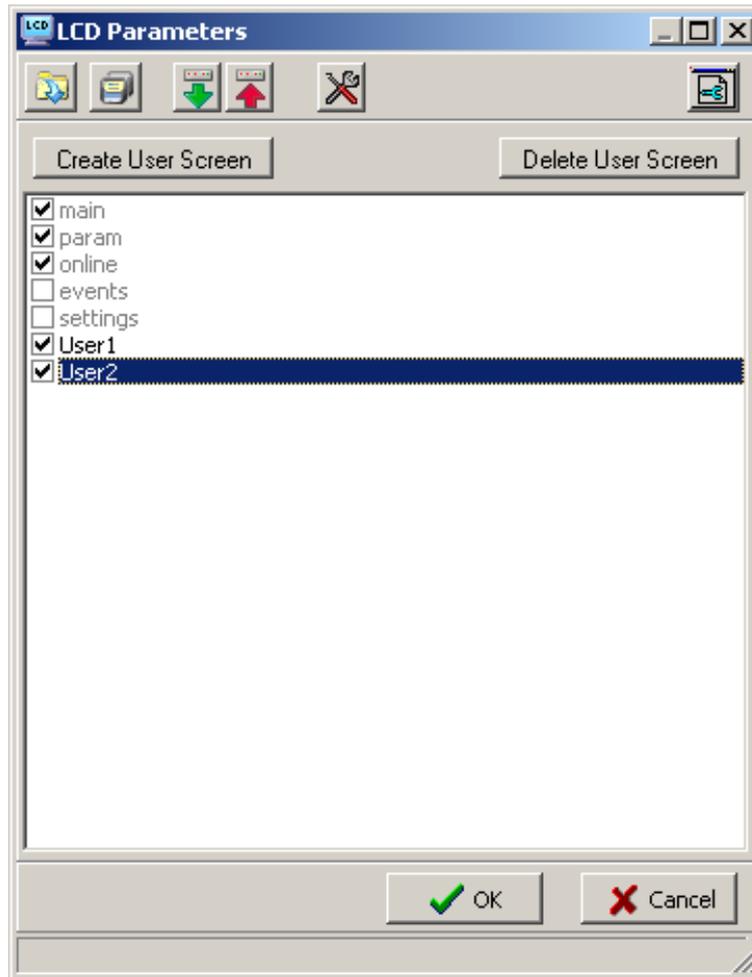
The factory integrated screens:

Displaying the factory integrated screens can be disabled; however, their application is advised to make the local operation of the device easier.

The basic screens are as follows:

Main: This screen displays the date and time, the names of the substations and that of the device, the IP address and the MAC address of the device.

Param: This screen supports the selection of the applicable parameter sets.

Online: This screen displays the measured values and the information collected.

Events: The events logged in the device can be displayed on this screen.

Settings: This screen serves the purpose of displaying and editing the parameters for the operation of all integrated functions.

4 THE PARAMETER SET EDITOR

The AQtivate300 configuration software provides a special tool for processing the parameter sets of the AQ-300 devices. The following operations are possible:

- Reading the parameter values from a file *****

- Modifying the parameter values off-line

- Saving the parameters to a file

- Preparing "RIO" files for testing the various protection functions implemented in the AQ-300 configurations.

* ATTENTION: when the parameter file is read from the device, the name of the processed .epc configuration file must be identical with the name of the .epc configuration file existing in the device.

* ATTENTION: Parameters can be read from the device itself only through web server. For more information please see the web server here.

At present, the AQtivate300 configuration tool cannot perform the following operations:

- Uploading the operating parameters from a AQ-300 device

- Downloading the operating parameters to a AQ-300 device

These tasks are supported by the software accessible via most internet browsers (Internet Explorer, Mozilla Firefox, Chrome etc.). To transmit parameters between the internet browsers and the AQtivate300 configuration software, please apply the file saving and loading possibilities of the browser.

4.1 STARTING THE PARAMETER SET EDITOR

The parameter set editor is started by clicking the [icon] icon on the toolbar of the AQtivate configuration tool. The alternative method of opening is to select Project / Parameter Set Editor from the menu.

When the Parameter Set Editor is started, the long window shown in Figure *4-1* is displayed. This window can be scrolled and contains all parameters of all implemented functions. The parameters are grouped in boxes (e.g. *Orphan Objects*, in this case, the VT correction factor, the CT4 module, etc., see Figure *4-1*.) The parameters at startup are the factory default parameters.
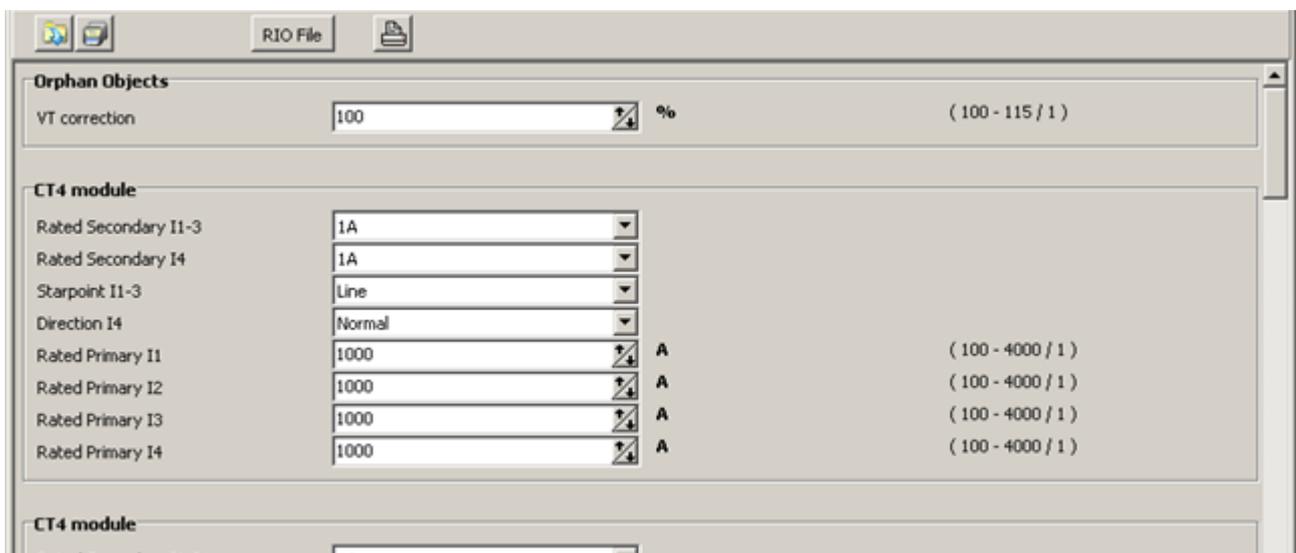
Figure 4-1 *The Parameter Set Editor window*

The available icons are:

- [icon] for reading the parameter values from a file

- [icon] for saving the parameter values to a file

- RIO File for generating input parameters for a relay test set

- [icon] for printing the parameter values

4.2 EDITING THE PARAMETER VALUES

After reading the parameters from a file (or having the factory default values), the parameter settings can be modified and the modified values can be saved to file.

Figure *4-2* shows the usual setting methods:

- Dropdown menu

- Checkbox

- Numerical value
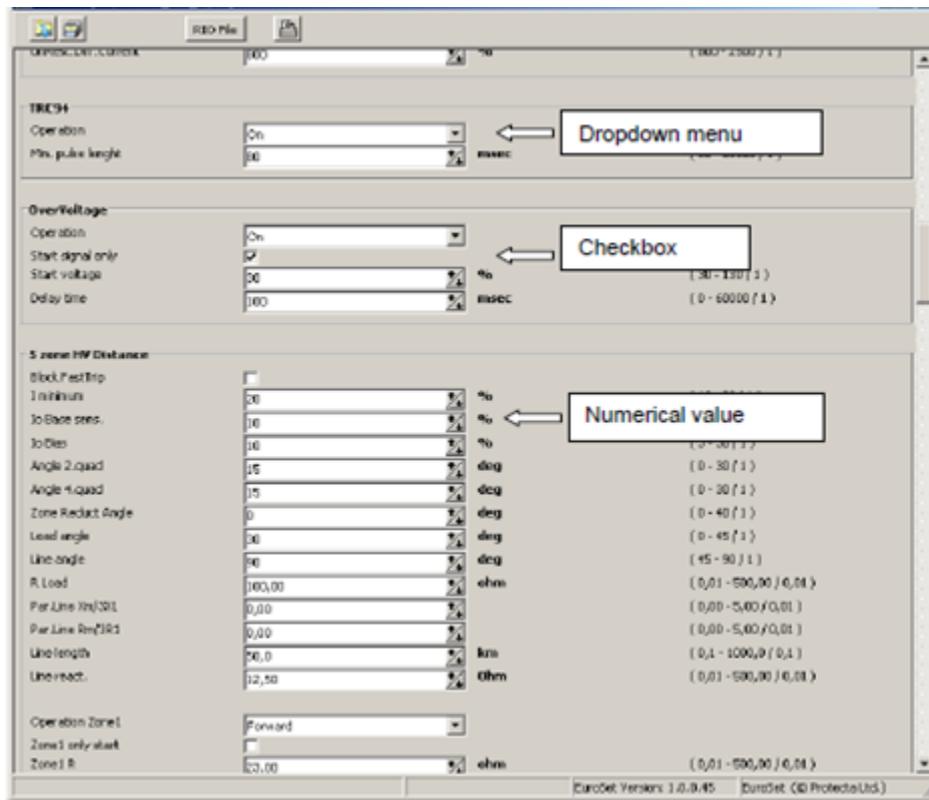
Figure 4-2 Setting methods in Parameter Set Editor

Figure *4-3* shows an example of selecting an alternative from a drop-down menu (in this case, power swing detection: if at least two phases out of three detect a power swing at the same time, the function acts according to power swing requirements). The name of the changed parameter value is indicated by the red color to warn the user of unsaved modification.
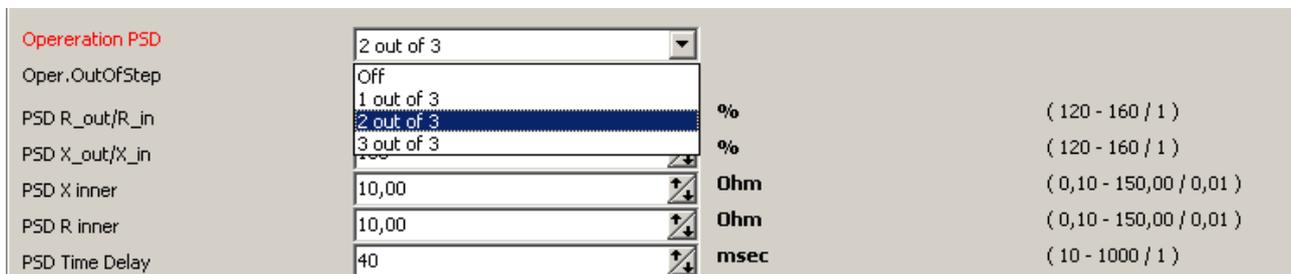
Figure 4-3 Example: dropdown menu

4.3 APPLICATION OF RIO FILES FOR TESTING

When a function is to be tested, the parameters of the function and the parameters of the testing device must be set to the same parameter values. The purpose of testing is the verification of correct operation.

To make the test procedure error-free and easy, RIO files are applied. The Parameter Set Editor supports the generation of RIO files for the various protection functions. To start the procedure of RIO file generation, simply press the RIO File button.

Figure *4-4* shows the RIO file generation window. Here the RIO Template for the distance protection function is selected

- phs: positive sequence impedance calculation, or

- loop: loop impedance calculation.
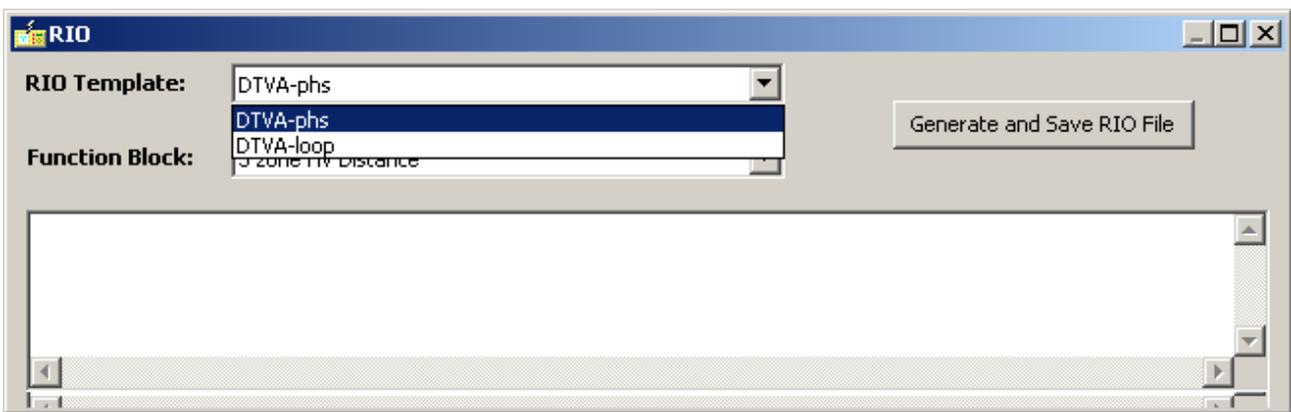
Figure 4-4 *Example: RIO Template selection*

Figure *4-5* shows, on an example, how the five-zone distance protection function is selected for testing.
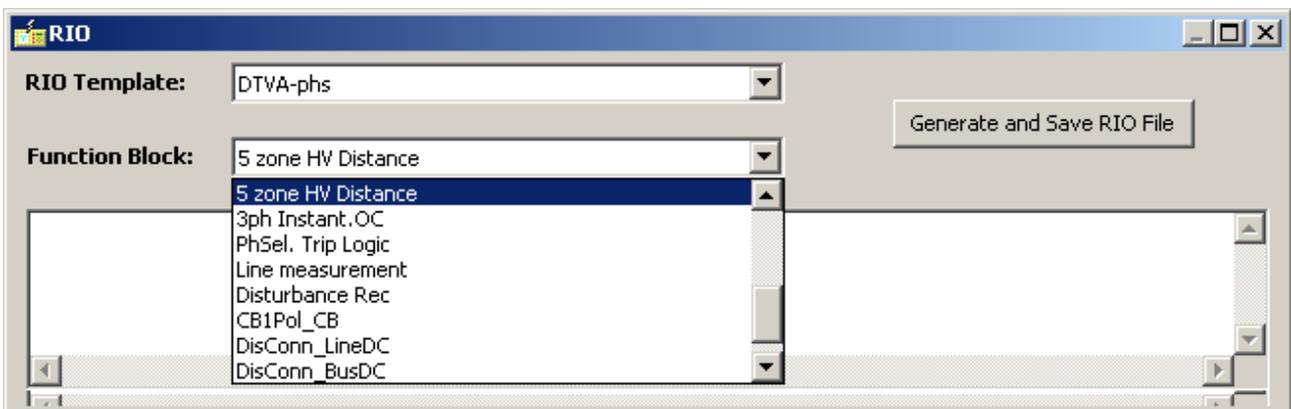
Figure 4-5 *Example: RIO Template selection*

When the "Generate and Save RIO file" is pressed, first the file name and location must be selected in the usual file selection dialog window, then the file is saved and the RIO window also shows the generated file. Figure 4-6 shows the contents of the generated RIO file. The file can be checked, but generally this text is not meant for humans to understand; the test set will set the test parameters according to this information.

(For further details, see the manual for the relay test set.)

Figure 4-6 Example: RIO file for distance protection function

5 THE RACK DESIGNER

The "Rack designer" is embedded software needed for assembling the hardware modules of a AQ-300 device (or of a "traditional" AQ-300 device, the design of which is not covered by this document).

- A device consists of:

- a rack, the size of which can be selected (84TE = full size, 42TE = half size)

- a front panel, the size of which is to be matched to the rack

- a bus panel, the size of which is to be matched to the rack

- several hardware modules.

5.1 OPENING THE RACK DESIGNER

Figure *5-1* shows the opening procedure of the rack designer:

1 Select *Rack designer* on the left-side menu

2 Press *Launch Designer*

3 Work in the *Rack designer* window
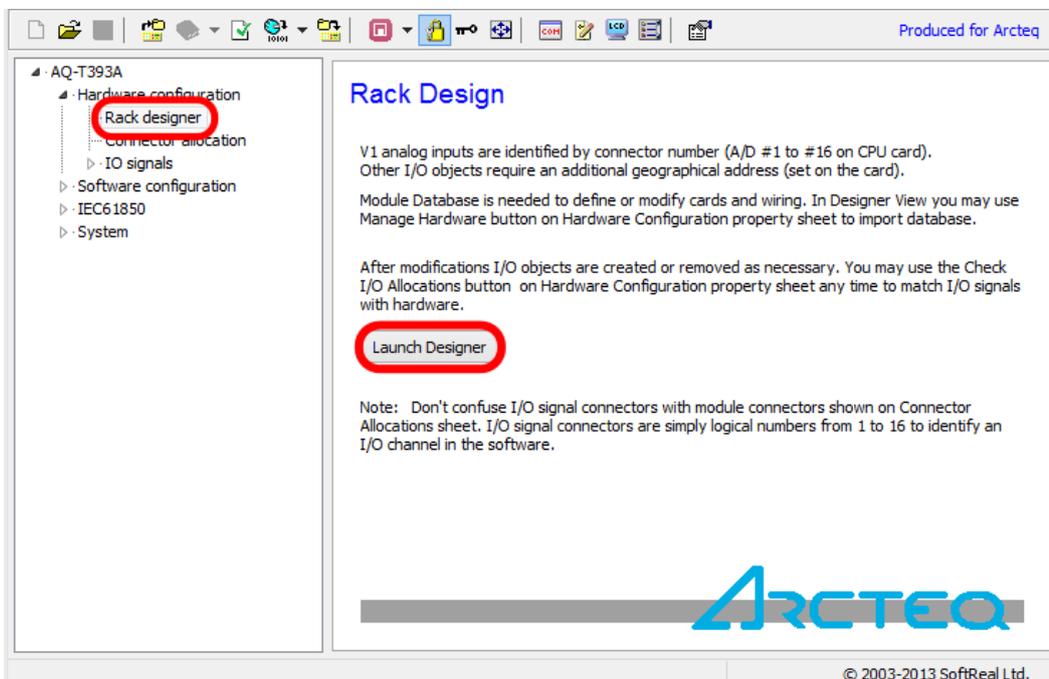
Figure 5-1 *Opening the rack designer*

5.2 DESIGNING THE RACK

Arcteq provides factory configurations, the module arrangement of which can be changed or extended by the user. For an example, see Figure *5-2*. A design can be "viewed" both from the rear and from the front. These are shown on the two main tabs of the window.
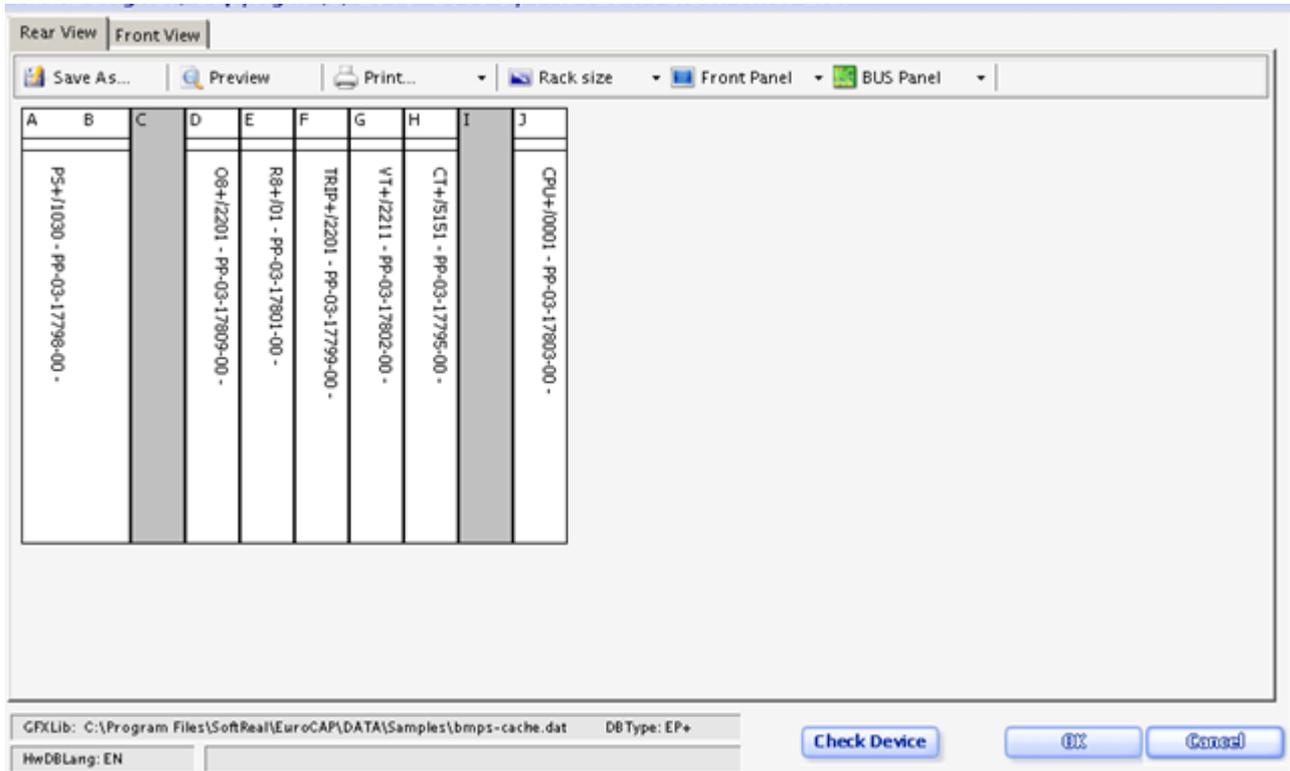
Figure 5-2 *A factory configuration in the rack designer* The basic steps are the selection of:

- the rack size

- the front panel

- the bus panel

These are dropdown menus offering choices for the selection. (At the moment of writing this guide, there are two sizes available, with one front panel and one bus panel for each size. For future versions, the software preserves the possibility of extending the dropdown menus.)

Figure *5-2*, as an example, shows a "half-size" version, containing (from right to left in rear view):

- CPU module in position J

- CT input module in position H

- VT input module in position G

- Trip relay module in position F

- Signal relay module in position E

- Binary (optocoupler) input module in position D

- Power supply module in positions A and B

- Two empty slots in positions C and I

The technical details of hardware modules are described in the hardware documentation; this document discusses only the selection method.

When clicking on a module or on an empty position (e.g., position C in the example), a small

symbolic menu shows the possible actions :

Here the icon opens the module selection window, offering the main selection menu of

- CPU modules (if none of them is selected yet)

- Current transformer modules

- Voltage transformer modules

- Binary output modules

- Binary input modules

- CB monitor modules

- Power supply modules

- Other modules

In the factory configurations, the CPU module is in the rightmost position in rear view (J in a half-size rack and Y in a full-size rack); the power supply unit is located on the left side (positions A and B). Changing these locations is not advised.

Figure 5-3 shows, as an example, the selection of the binary output modules. Here, type R16+/0001 is selected to be inserted in an empty position.
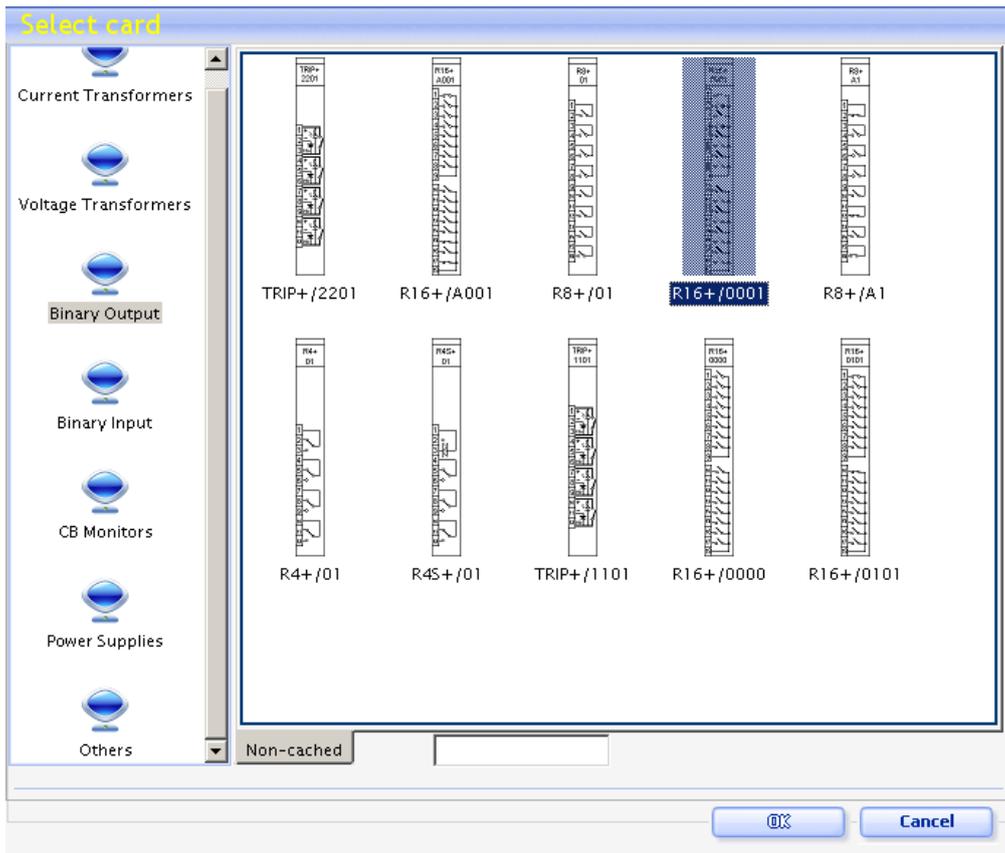
Figure 5-3 *Module selection window showing the choice of the binary output modules*
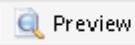
Selecting [🔍 Preview] on the toolbar shows the arrangement familiar to the user, according to Figure *5-4*. The connectors and the symbolic functions of the modules are also shown.
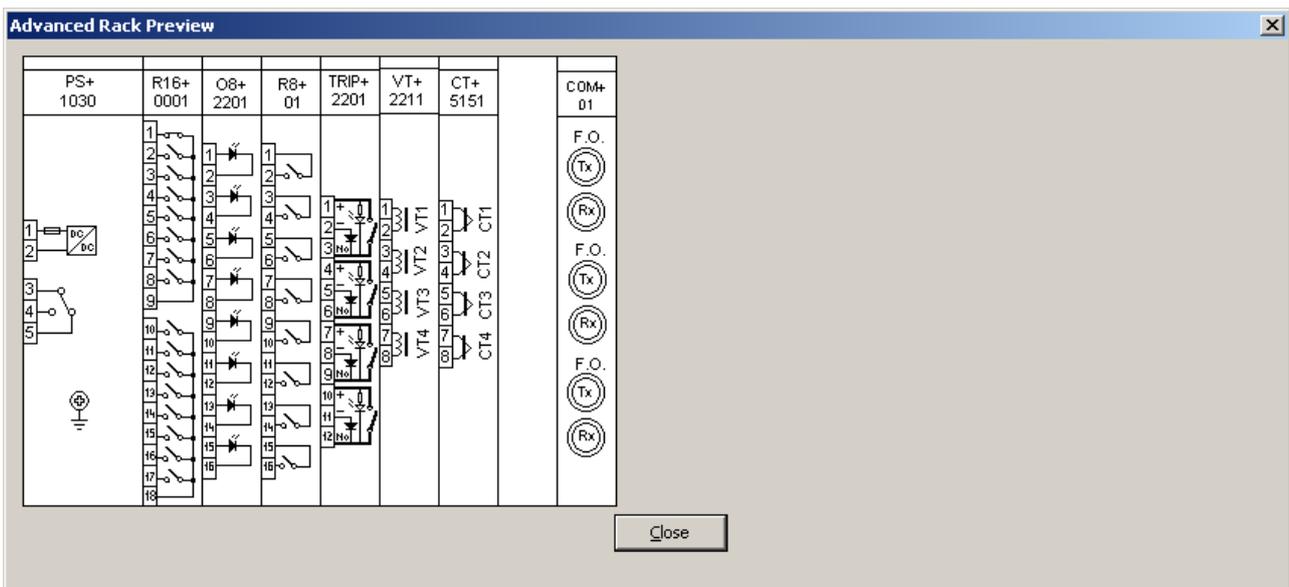
Figure 5-4 *The rack preview*

When attempting to leave the Rack designer by pressing the *OK* button (Figure *5-2*), a warning message window is displayed. Select *Yes* to check the I/O allocations.
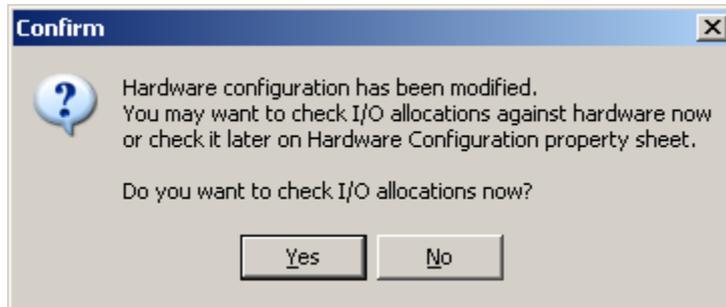
Figure 5-5 *A message window warning the user to check the modified configuration*

Another message window warns that after inserting a new module, the connectors have not been allocated.
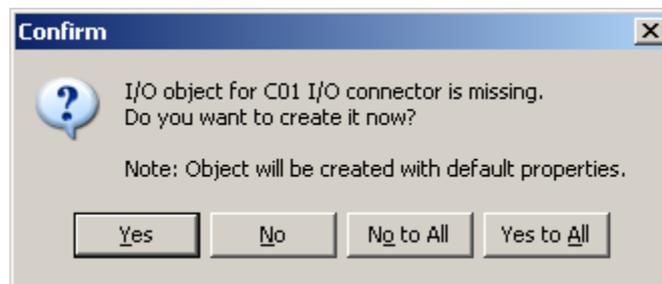
Figure 5-6 *A message window warning the user to allocate the I/O-s* Select

Yes to All and the allocation will be made automatically using the default properties. Renaming will be possible in the subsequent steps.

5.3 MANAGING THE I/O SIGNALS

Figure *5-7* shows the opened I/O signals menu, displayed on the left side of the window. When in the rack designer a hardware module is placed in the rack, then the default names and default parameters are assigned to the various elements. Managing the I/O signals means modifying the names and some parameters.
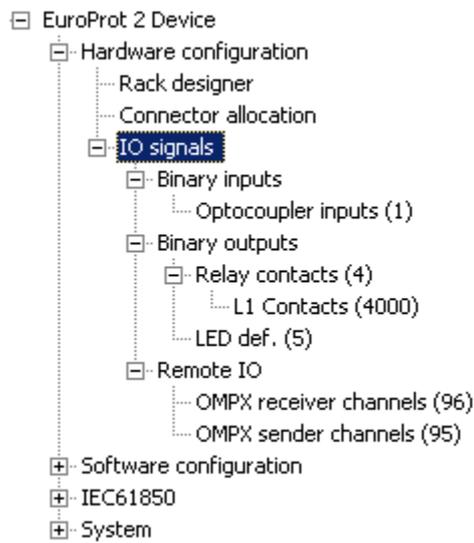
Figure 5-7 *The opened (full) I/O signals menu*

5.3.1 THE BINARY INPUTS

Figure *5-8* shows the list of available binary input signals in a hardware configuration.
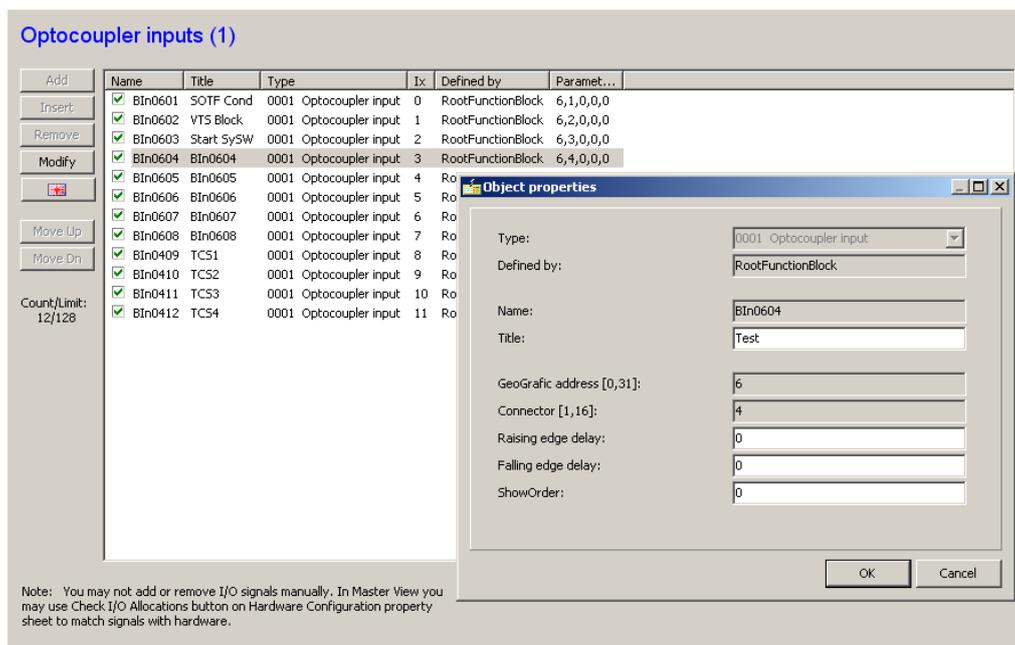
Figure 5-8 *Binary input signals*

You can see that the hardware module in position 6 (GeoGraphic address = 6) provides 16 input connectors. The *Title* of the first three connectors has already been changed by the user according to the intended application (COTF cond, VTS block, StartSySW). Now connector No. 4 is being modified. (In the "Optocoupler inputs" window, the cursor is positioned on BinIn0604 and the *Modify* button is clicked.)

The *Object properties* window is opened showing that the Title is changed for *Test*, (the name, the address and the connector No. may not be modified,). The edge delays mean the number of repeated checking before a status change is accepted. *Show order* determines the location of this status signal on the On-line screen.

(Figure *5-8* also shows that the titles of signals 4 … 8 are the titles assigned automatically when, leaving the rack designer, if we answered yes to the question Do you want to check the I/O allocations now?" and then "Yes to all" to the subsequent question.)

5.3.2 THE BINARY OUTPUTS

Figure *5-9* shows the list of available binary output signals in a hardware configuration.
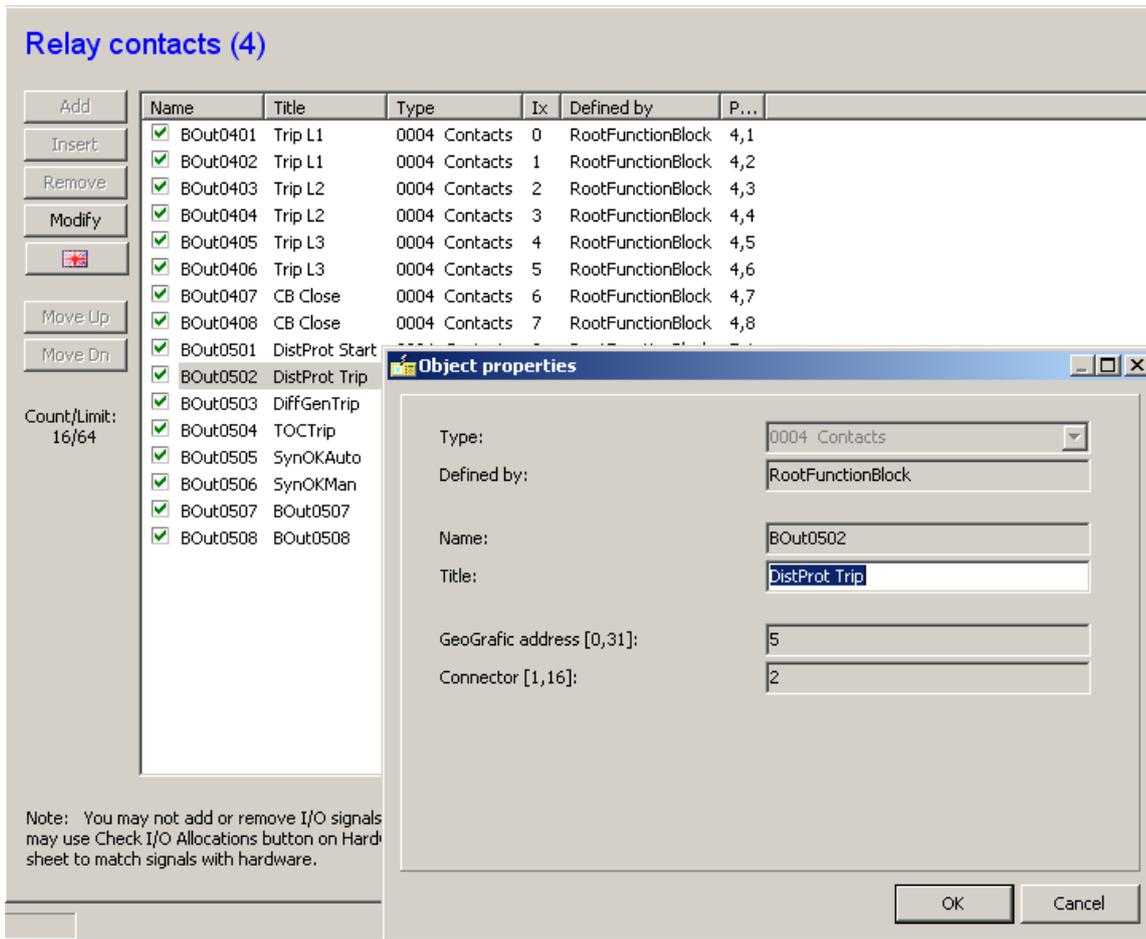
Figure 5-9 *Binary output signals*

It can be seen that the hardware module in positions 4 and 5 (GeoGraphic address = 4 and 5) provide 8 + 8 output connectors. The "Titles" of the first 8 + 6 connectors are already changed according to the intended application. Now connector No. 2 in position No. 5 is being modified. (In the *Relay contacts* window, the cursor is positioned on Binout0502 and the *Modify* button is clicked.) The last two relays are not assigned yet.

The "L1" contacts provide fast relay operation for the user. In this case, the driving signal does not need to wait for the relatively slow processing of the logic equations available for the users; the selected relays get the status of the assigned signal in every millisecond.
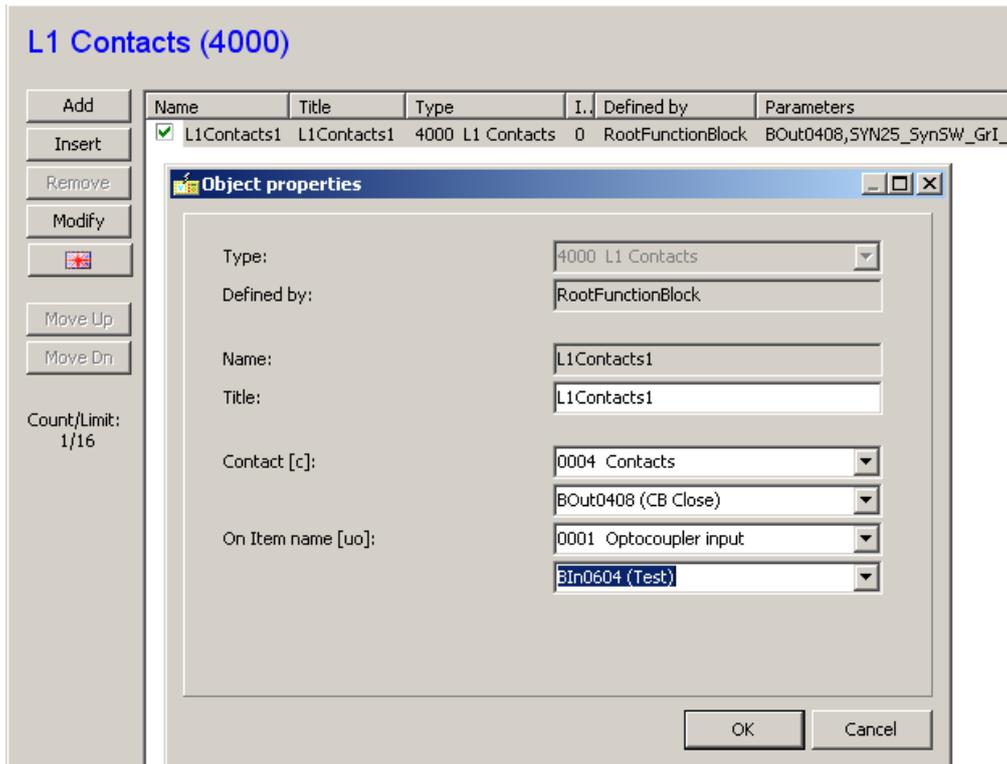
Figure 5-10 *Assignment of the L1 contacts*

Figure *5-10* shows that the Bout0408 (CB Close) contact gets the status of the Bin0604(Test) in every millisecond. The selection of both the output contact and the driving signal is supported by dropdown menus.

5.3.3 THE LED DEFINITION

Figure *5-11* shows the procedure of LED definition. In the demonstrated version, LED No. 12 is on if the input Bin0607 is active and it is blinking if only the input Bin0608 is active.
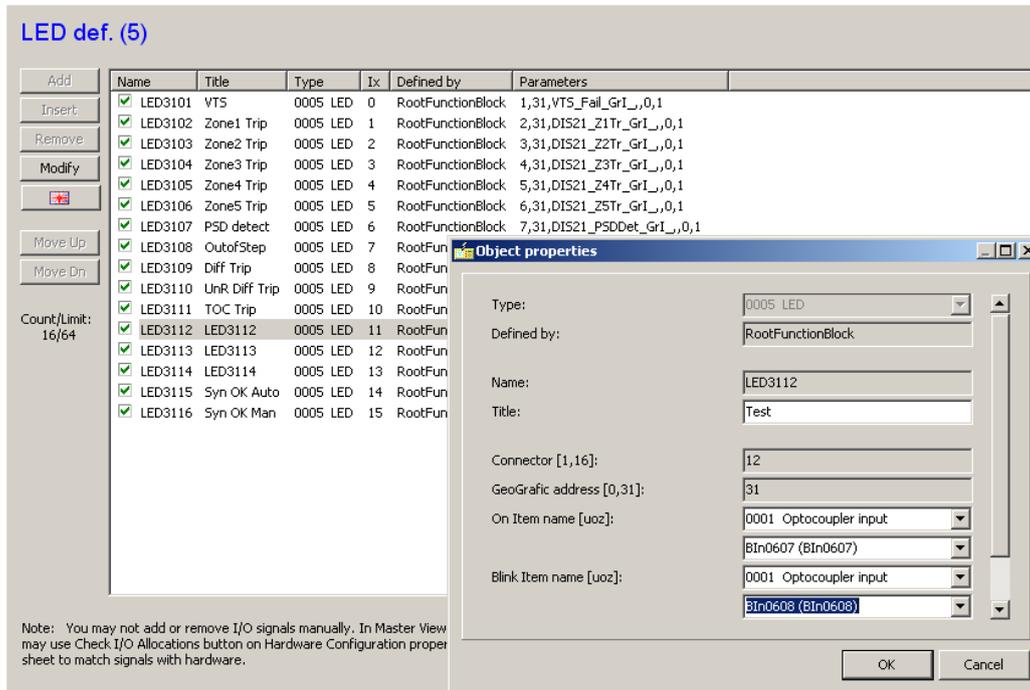
Figure 5-11 *LED definition*

5.4 DISPLAYING THE DETAILS OF THE I/O SIGNALS

The details of the I/O signals can be checked in the left-side configuration menu by selecting *Connector allocation*.

6 THE GRAPHICAL EQUATION EDITOR

6.1 APPLICATION

The graphical editor is a powerful tool available for the user to compose logic equations based on the binary signals of a factory configuration. The inputs of the logic equations can be:

Non-filtered optocoupler inputs

- Optocoupler inputs

- Graphed input statuses

- Logic parameter variables

- Matrix columns

The outputs of the logic equations can be:

- Contacts

- Graphed output statuses

The applicable logic operators are:

- AND

- OR

- NOT

The functional objects are:

- Function blocks

- Timers

- Macros

6.2 STARTING THE GRAPHICAL EDITOR

Open the logic editor by clicking the *Graphical Editor* icon 🖹 on the toolbar.

6.2.1 ACTIVE ICONS AT STARTING THE GRAPHICAL EDITOR

After starting the graphical editor, the window opens showing a drop-down menu and the icons on the toolbar.

The editor is divided into "sheets", each of them contains one or more graphic equations. The names of the sheets are free to define. At the first opening, "Sheet 1" and "MACRO EDITOR" are available.

The **drop-down menu** provides a tool for selection among the sheets; Figure *6-1* shows an opened drop-down menu, using names given in the factory configuration.

Figure 6-2 *The toolbar of the graphical editor*

- The **icons on the toolbar** are as follows (the details of their use are described in this chapter below):

- 🗋 *New sheet* icon for adding an empty sheet to the list. A name is given automatically but it can be modified easily in the "Sheet properties" dialog.

- 🖨 This icon is for printing the graphic equation. It opens a dialog that controls printing the way familiar from any Windows-based software.

- 🔧 The properties of the sheet (colors, size, parameters for printing, etc) can be set using this icon.

- ▦ The sheet can be viewed with or without grids; this icon serves for toggling.

- ⌇ When connecting the elements of the graphs, the line can be vertical/horizontal or free in any angle. If this mode is active, any straight line can be drawn.

- ⌐ When connecting the elements of the graphs, the line can be vertical/horizontal or free in any angle. If this mode is active, only horizontal and vertical lines can be drawn.

- Using this "Selection tool," elements on the sheet can be grouped and moved as a single unit.

- With this icon, the inputs and outputs of the graphic equation can be selected from drop-down lists.

- The function blocks configured in the device can be placed on the sheet and the related binary inputs and outputs can be included in graphical equations.
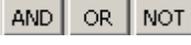
- Selection of simple AND, OR, NOT "gates" for processing the binary signals.

- Selection of timers and related timer parameters for processing the binary signals.

- These icons are used to transfer signals from one sheet to another.
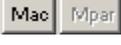
- These icons serve the purpose of processing "macros" (pre-defined parts of logic equations) to simplify the most common operations.

- Macro compilation if the MACRO_EDIOR sheet is active.

The active buttons of the toolbar:

- Using this button, the graphic equation can be checked for errors and compiled for executable format.

- Using this button, un-compiled modifications can be rejected.

The detailed description below explains the application of these icons for editing logic equations in a graphical format.

6.3 DRAWING NEW GRAPHIC EQUATIONS

The working of the graphic equation editor is best explained through an example.

Let's compose an equation for the following task:

EXAMPLE: *The under-frequency protection function must be blocked by dead line detection or by any of two dedicated binary inputs.*

The start signal of the under-frequency protection function must be delayed by a timer parameter, and then a pulse of a given duration must be directed to a free binary output of the device.

The proposed steps are as follows:

1   Open a new sheet and name it "Uf_pulse". Using the [icon] icon and the [icon] icon, fill in the dialog boxes as shown in Figure *6-3*. The contents of the boxes are defined by the user at his discretion.

- The left-side box of Figure *6-3* shows the definition of the sheet name, size and color on the "Sheet" tab;

- The box in the middle shows the definition of printing details;

- The right-side box shows the definition of the identifiers of the printed page.

(These definitions are not compulsory but advised.)

Figure 6-3 *Example for defining the graphic sheet*

2   Place the graphic elements on the sheet:

- The required function blocks are DLD (dead line detection) and TUF 81. Click the icon [FB] (Function blocks), then click on the empty sheet. A selection window is opened (showing the selection of the function block TUF81 according to Figure *6-4*). Clicking "OK" and the block is placed on the sheet. Repeat the procedure with the function block DLD as well.

Note: if the desired function block cannot be found on the list, then either the configuration excludes this block (it cannot be applied) or the block is already used on some other sheets. In the second case, use the [Out] [In] icons to transfer the required signal for further processing.
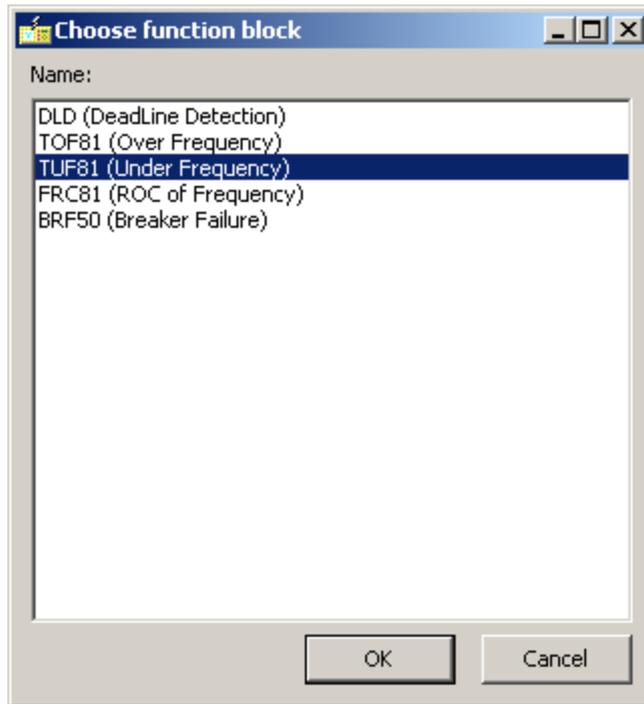
Figure 6-4 *Example for FB selection*

- The example needs OR connection of three signals (two binary inputs and the DLD function output). This can be achieved using two OR gates, or simply using a pre-defined macro clicking the [Mac] icon, then selecting from the list of factory-defined macros according to Figure *6-5*.

Note: See paragraph 6.5 below for details on macros.
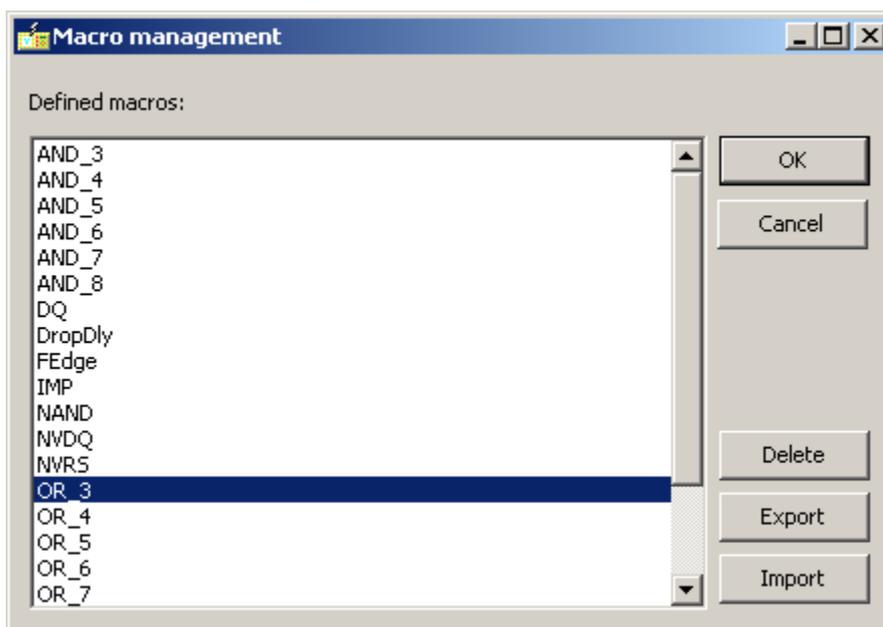
Figure 6-5 *Example for macro selection*

- The example needs two timers: one for the delay and one for pulse duration. This can be solved with two timers of general purpose; however, it is more convenient to select the predefined macros *PickDly* for pick-up delay and *IMP* for pulse duration. (The selection method is similar to *OR_3* selection, see above.)

- The two timers need timer parameters. These are defined using the icon Tpar (timer parameter). The window of Figure *6-6* must be filled in. This figure shows the selection of the "Named" timer parameter. In this case, the delay is defined in a normal parameter setting session. (The *ShowOrder* information indicates the location of this parameter on the parameter list; all other information is self-explanatory.) The parameters to be defined are: *TUF_PickDelay* and *TUF_Imp* (See Figure *6-7*.)
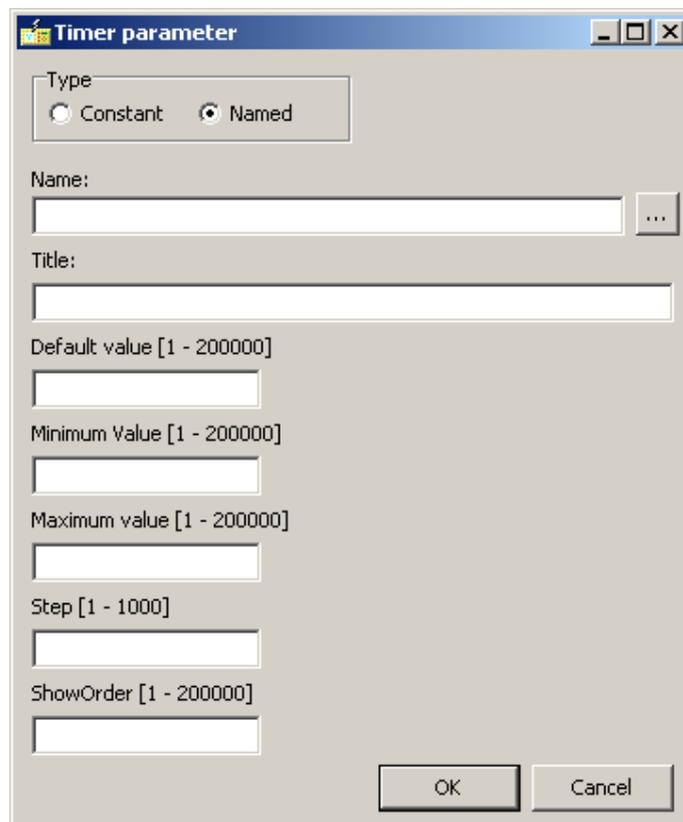
Figure 6-6 *Example for timer parameter selection*

- The equation needs two binary inputs and one binary output. Select them using the Obj icon. The selected inputs are "BIn0310" and "BIn0311" found on the dropdown list, the selected output is "BOut0308" (See Figure *6-7*.).

The result of these steps is shown in Figure *6-7*. Here the icon is depressed: the grid is visible on the sheet. The location of the elements can be altered using the drag-and-drop technique.
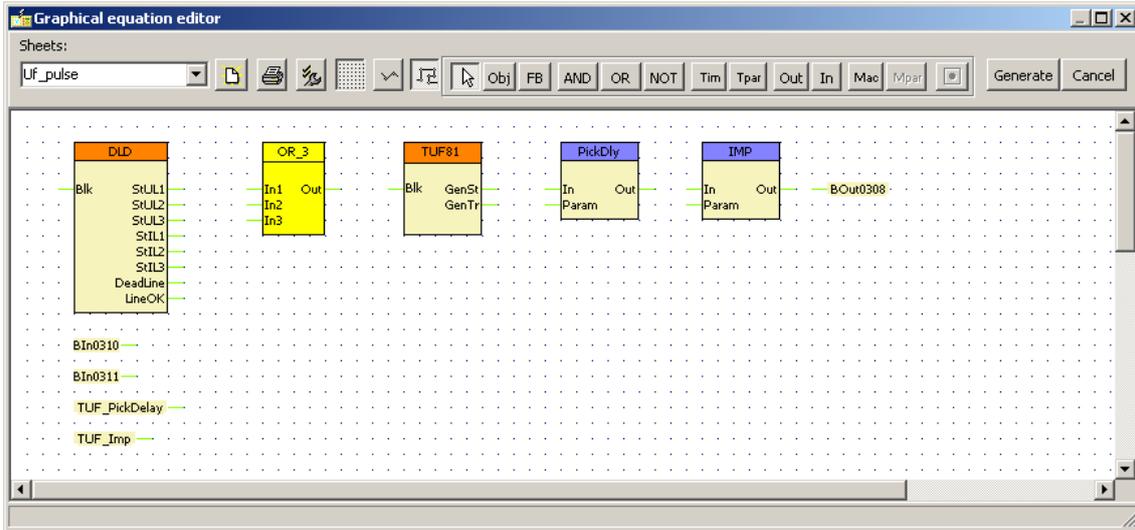
Figure 6-7 *Example for placing the elements on an empty sheet*

3 Draw the interconnections: As Figure *6-7* shows, the elements placed have green connection points. Draws a line by double-clicking on a green start point, clicking on the required corners and double-clicking on the green end point. A finished line and corners can be rearranged using the drag-and-drop technique. (The line can also be deleted.)

4 The finished equation needs the "generation" of the executable format. This is done automatically when pressing the *Generate*-button on the toolbar.

The result is shown in Figure *6-8*.
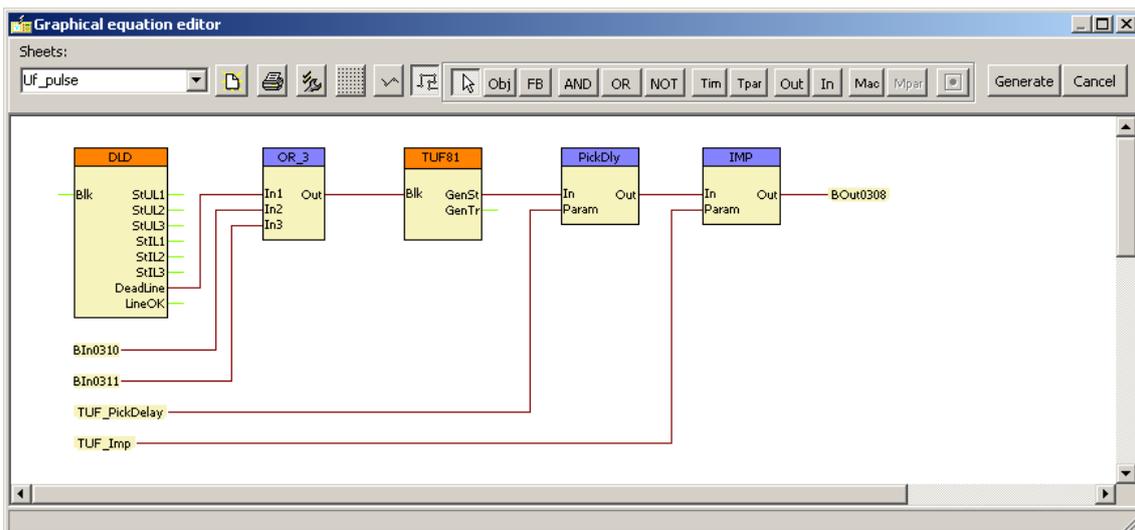
Figure 6-8 *Example for a defined graphic equation*

When double-clicking on a line, a potential break point can be inserted. When double-clicking on a break point, a branching can be inserted. When right-clicking on a branching, the properties of the automatic new binary variable can be modified.

6.4 PRINTING GRAPHIC EQUATIONS

The graphic equations can be printed using the 🖨 icon. The required settings for printing were made using the icon, as shown in Figure *6-3*.
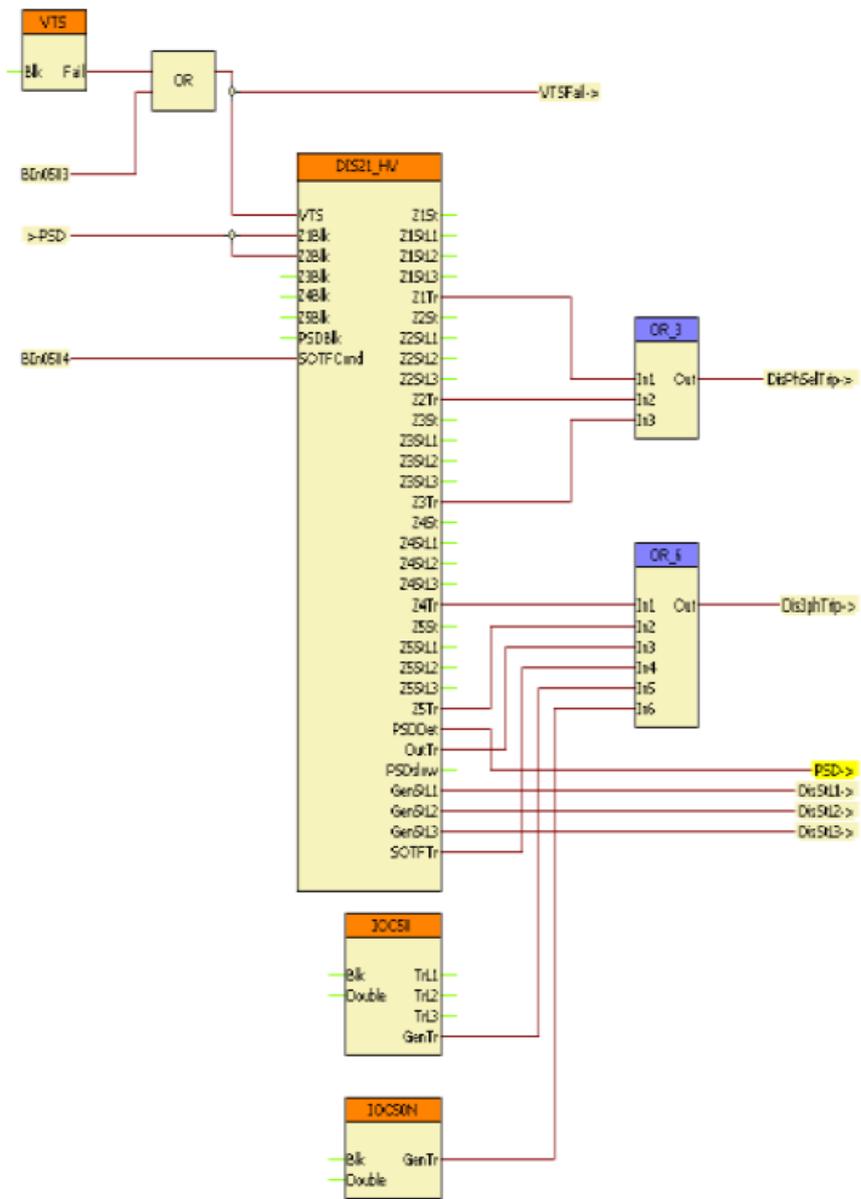
Figure 6-9 *Example for a printed graphic equation*

6.5 USING MACROS

For the most common protection tasks Arcteq prepares "macros", which can be applied by the user in the graphic equations. The details are hidden from the user, which promotes the readability of the defined equations. Examples were shown in Figure *6-7*. The details of macros are described below.

6.6 MACRO DEFINITION AND MODIFICATION

Figure *6-11* shows, as an example, the macro for impulse generation. These details can be seen if the *MACRO_EDITOR* sheet is selected in the dropdown menu of the graphic editor's toolbar. If there is a graphic equation here, then it is advisable to mark the whole picture using the selection tool , then to delete it using the *Del* key on the keyboard. When right-clicking on the empty "MACRO_EDITOR" sheet, a dialog appears, see Figure *6-10*.

Figure 6-10 *The MACRO_EDITOR sheet*

Here:

Paste   (any details marked elsewhere with the selection tool can be pasted here)

- Properties are similar those described in connection to Figure *6-3*

- Create macro a new macro can be defined

- Load macro the details of an existing macro can be viewed and edited.

When "Load macro" is selected, a list of the existing macros can be seen and any of them can be selected. (In this case, the *IMP* macro is shown.)

(The short explanation of the IMP macro:

The timer is the "general" timer, selected by the icon. (This timer can be started   by several inputs, the "Running", "Expired" or "Stopped" state can be used for further

processing, timer parameter can be assigned, it can be named, etc.) For pulse generation, the "Start if Stopped" input is used for starting, and the "Stop" input is used for stopping. Additionally, a timer parameter is assigned using the [Mpar] icon. The stop condition is that the input starting signal is FALSE, AND the timer is "Expired". The output is the running state, the duration of which is defined by the parameter. During the running state it cannot be restarted, and the expired state is not sufficient to reset in "Stopped" state if the input signal is still active.)

The application of this input timer is demonstrated in Figure *6-8*.
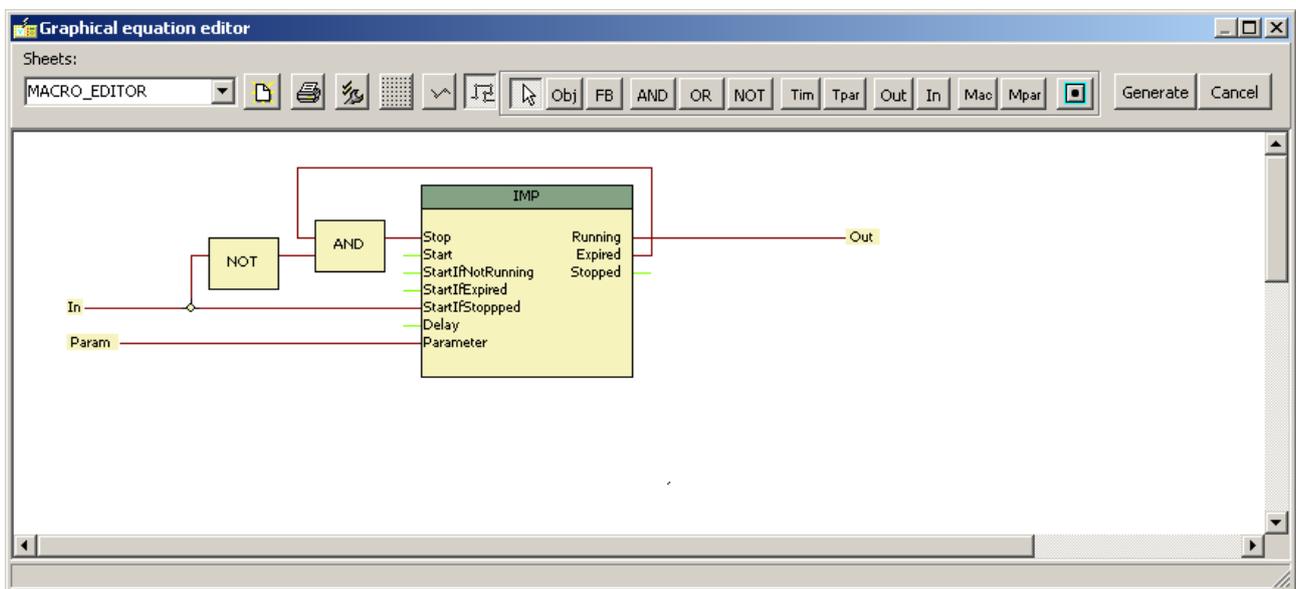
Figure 6-11 *Example of a factory-defined macro for impulse generation*

The edited macro must be tested for syntactic error and "compiled" using the [icon]. (The same procedure can be started by right-clicking on the sheet and selecting the "Create macro" menu item.) For compilation, the graph to be compiled needs to be marked using the selection tool [icon]. See Figure *6-12*.
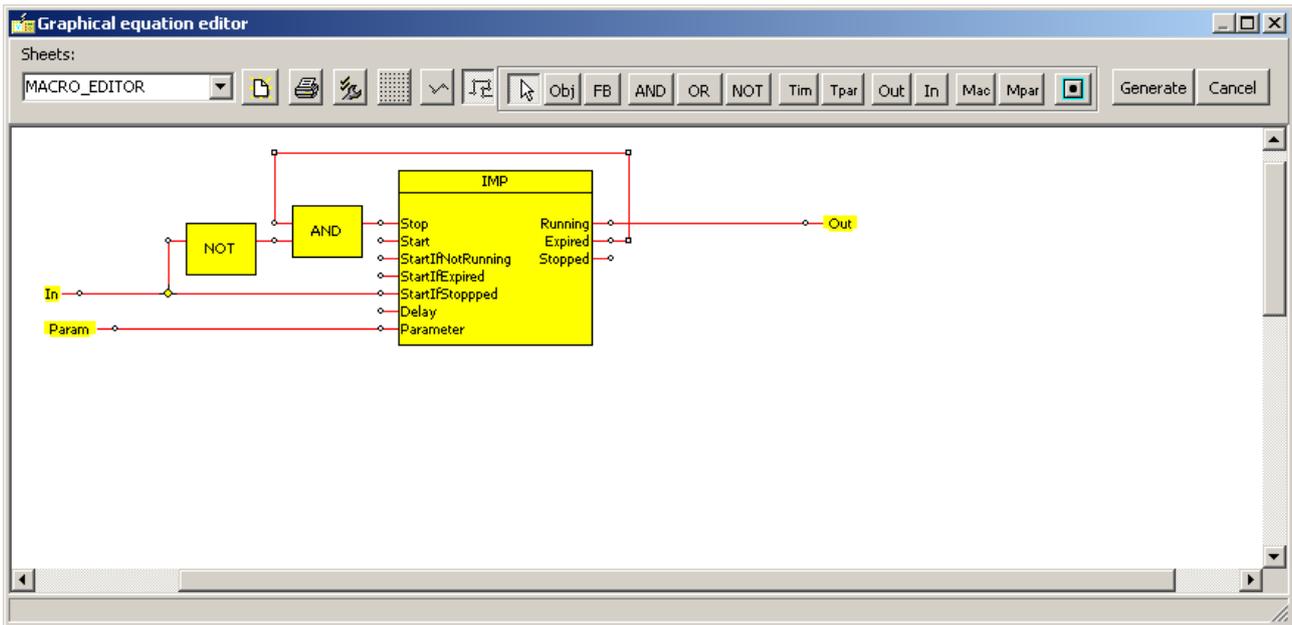
Figure 6-12 *Selection a macro for "compilation"*

During compilation, a special window is opened, as seen in Figure *6-13*.
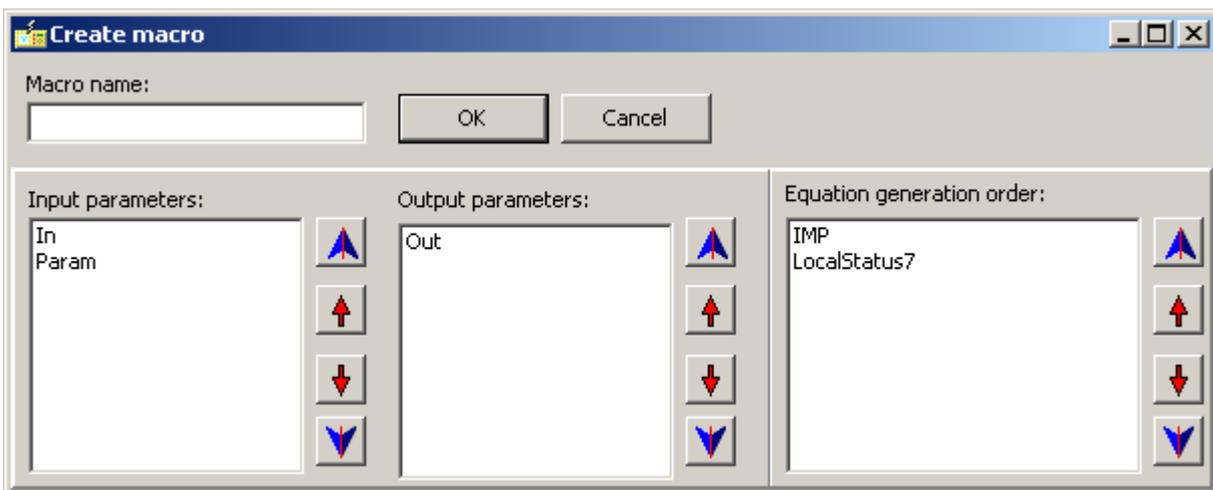
Figure 6-13 *Macro "compilation"*

The macro must be named in the *Macro name* dialog box, then the "OK" button is to be pressed for compilation. As a result, the macro can be found on the list of the available macros when the icon
Mac is selected on a sheet. See Figure *6-5*. In the window shown in this figure, "Export" means saving the selected macro in a file for application in other configurations, while "Import" means that a ready-made macro stored in a file can be imported to the active configuration's list of available macros. The imported macros must be generated by clicking on the "Generate" button on the toolbar, then saved in the configuration file (.cfg).

7 IEC 61850 CONFIGURATION

The AQ-300 family is a native IEC61850 platform, which means that this new communication standard was a fundamental consideration during the development. There is no protocol converter implemented but all the function blocks contain the logical nodes necessary for correct data modeling. This data model is factory-defined and not modifiable by the master user; control blocks, however, are available for customization.

7.1 EXPORT TO AND IMPORT FROM THE SYSTEM INTEGRATOR

The factory default configuration contains the logical nodes describing the data model as well as the default datasets and report control blocks. A maximum of four datasets with the report control blocks are created by default, depending on the data model of the configuration. Those datasets contain the most important data object (protection start and operate signals, statuses and measurands). If this default arrangement is acceptable to the user than no further communication engineering is needed. Otherwise, if customization is needed, the IEC61850 configurator serves as an advanced engineering tool.

An ICD file for a system integrator is automatically generated together with the other run-time files by clicking "Generate code & parameter files". An SCD file from the system integrator can also be accepted using the Import/IED Description menu.
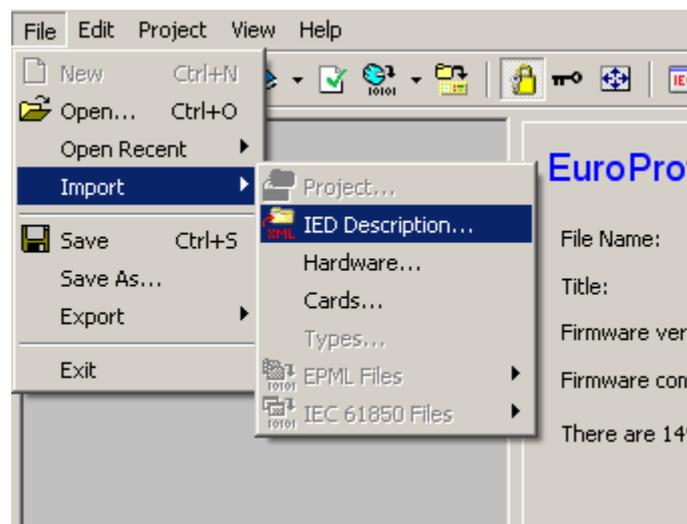
Figure 7-1

Once an SCD file is selected, AQtivate seeks out the Arcteq protections in it and it shows the list of the names of these IEDs. The user must select the IED corresponding to the configuration. The IEC61850 configuration is updated according to the imported information. If the data model of the

configuration and the imported IED do not match, an error message is given and no update is carried out.

7.2 LOGICAL NODES

The configuration-dependent list of logical nodes is in the right panel in the Logical Nodes menu.
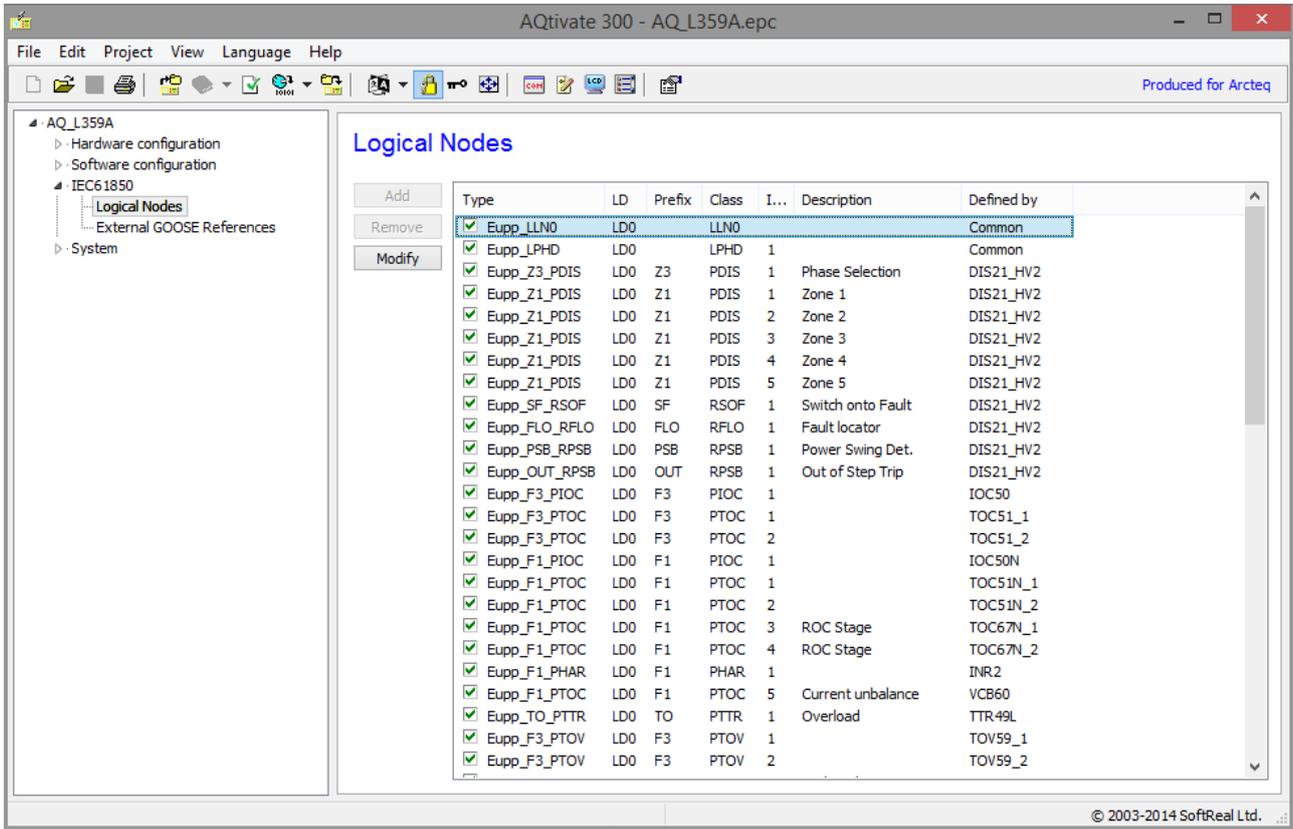
Figure 7-2

The "Defined by" column shows the owner of the function block designation of the corresponding logical node. Clicking the Modify button brings up the following dialog:
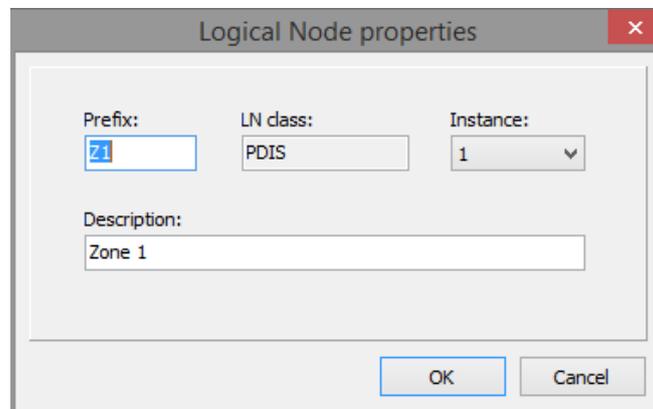
Figure 7-3

In this dialog, the factory default prefix and the instance number can be modified. It is also possible to edit the description attribute of the logical node. At the same time, the free text entered here is mapped to the attribute of the Namplt data object of the edited LN. It is important to note that these elements must not be modified after system integration (importing an SCD file) because such an action would change the Logical Node references.

7.3 GOOSE INPUT MAPPING

The "External GOOSE References" menu lists the input references subscribed by the IED. Goose subscription can be configured by means of the SCD file, i.e., the list of external references appears only after a valid SCD file is imported. Other advanced methods to configure GOOSE subscription are available in the IEC61850 configurator.
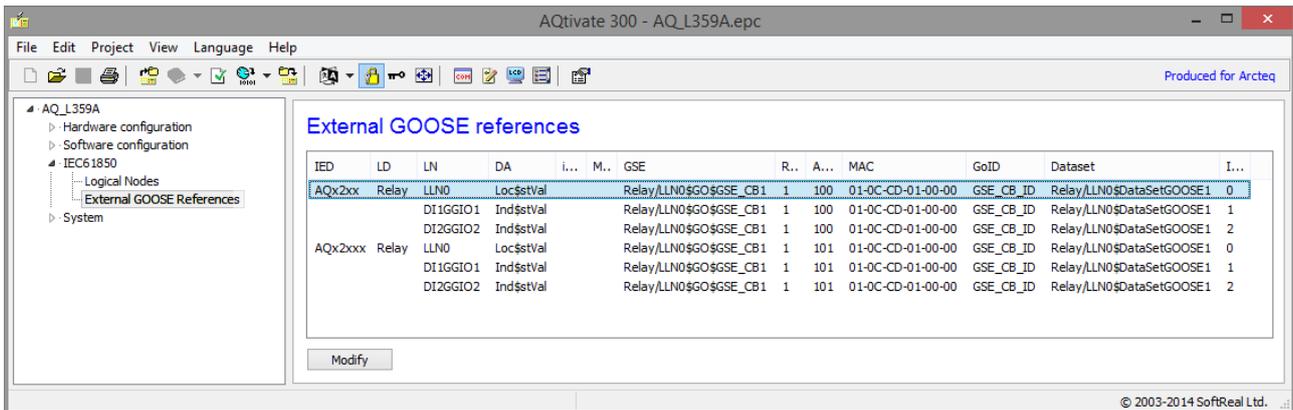

Figure 7-4

When the Modify button is clicked, the property dialog of the selected external reference appears and the user can map the subscribed input to one of the predefined Goose receiver channels.
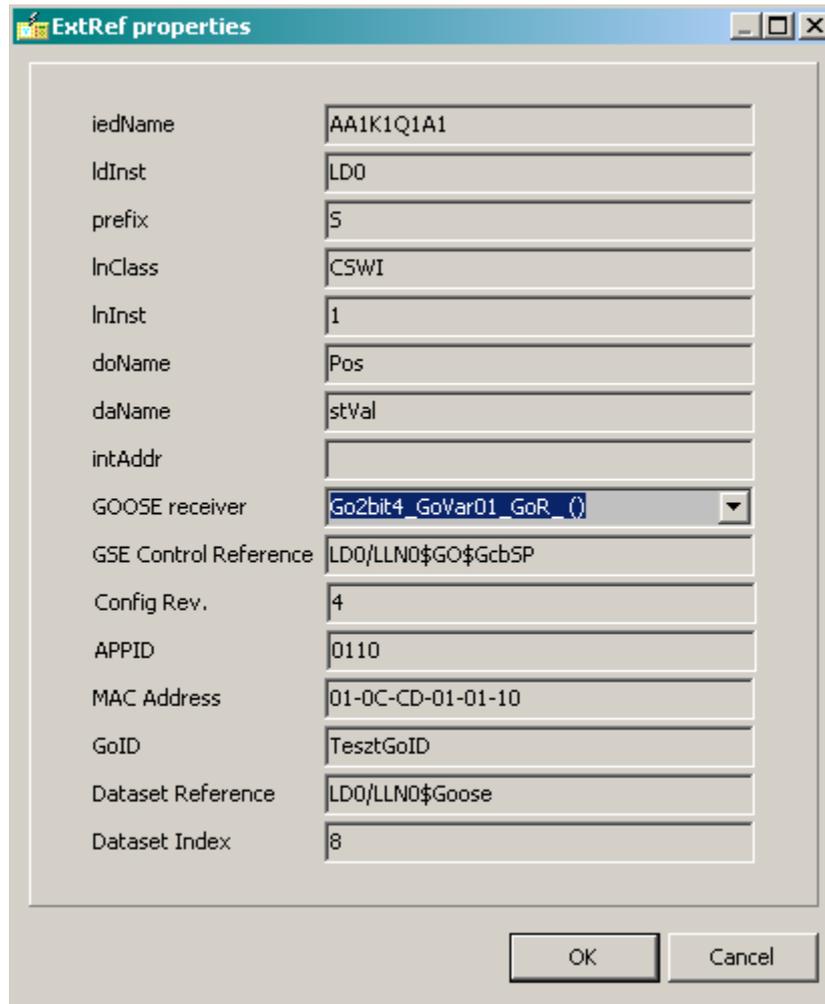
Figure 7-5

There are two types of predefined receiver channels: a 2-bit type typically for switchgear statuses and a 1-bit type typically for protection signals. Please note that AQ-300 devices accept only data attributes as external reference. Data objects cannot be subscribed by the tool. External references containing a q attribute are automatically mapped to the same receiver channel as the status value of the corresponding data object.

Receiver channels are grouped into function blocks. Currently two function block types are available: one with eight 1-bit channels and one with four 2-bit channels.

```
Go1bit8

stVal01
Valid01
stVal02
Valid02
stVal03
Valid03
stVal04
Valid04
stVal05
Valid05
stVal06
Valid06
stVal07
Valid07
stVal08
Valid08
```

```
Go2bit4

open01
close01
Valid01
open02
close02
Valid02
open03
close03
Valid03
open04
close04
Valid04
```
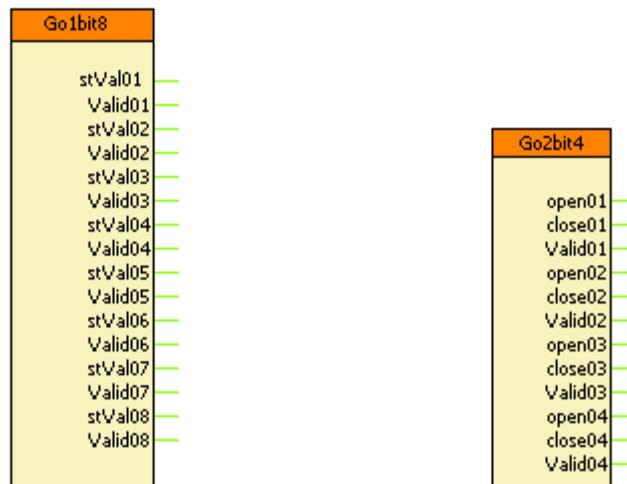
Figure 7-6

All channels have a Validity output, which is logical TRUE if the IED receives the mapped Goose messages within the maximum time period; otherwise, it goes to FALSE. The validity output of one channel also goes to FALSE if the q data attribute is mapped to this channel as well and its validity bits are not 00. The output variables of these function blocks are available both in the Graphical editor and in the L1 Contacts menu.

8 COMMUNICATION PROTOCOLS

8.1 IEC60870-5-101/104

Legacy communication protocols IEC61870-5-101 and 104 (in short form IEC101 and IEC104) have common configuration sheet since their application level is the same. The tree of the configuration software has sub-nodes of the differentiated base data types. The tree menu is fixed, user specific data can be added below the sub-nodes. The context menu provide the following operations:

- New Object [Insert] – adds new item to the selected sub-node (type), limitation is the maximal number of objects
- Add All – adds all available items for the selected data type with a single click
- Sort by Address – objects below the selected node will be sorted by their address
- Readdressing Objects – deletes existing addresses and creates new ones for all object (sorted)

Property editor of a selected object displays the parameters. Some of them is allowed to change, others are read-only. Using multi selection with Ctrl button hold down is possible and allows changing the same type of parameters of the selected items.

By selecting the root of the tree the basic IEC101/IEC104 parameters appear. By default structured addressing is used, it means bit masking to differentiate data types. Every address value is displayed in decimal and hexadecimal format also.

It is possible to delete selected objects by pressing Del button. Multi selection is also possible.
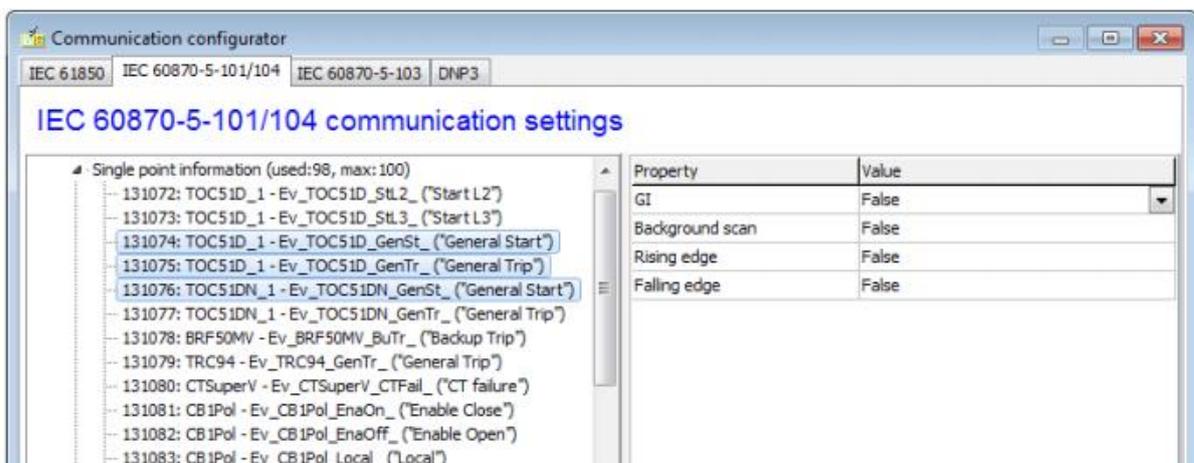
Figure 8-1 Multi selection allows to change the same type of objects

The parameters for an IEC101/104 object:

Address: in decimal form, hexadecimal is read only

Name, Function Title: parameters of the source data object of the device (selected by combobox: Name)

Message type: standard frame type selection (for supported types check interoperability list)

GI: if true, signal takes part in the general interrogation

Background scan: if true, signal will be included in the background message sent cyclically Rising/Falling edge: trigger event type for spontaneous data sending

8.2 IEC60870-5-103

The IEC60870-5-103 communication protocol has been designed for single-function protection devices. It is implemented in the AQ300 device and needs application engineering. The sheet labeled with the protocol name contains a fixed tree object. Since the protocol specifies fixed address for the commonly used functions, sub-nodes lists these addresses prepared. User should assign the data objects to the corresponding address. By clicking on any address the property editor opened on the right side allows the user to select the desired data object. The Source field is a combo-box with the available data objects. Addresses from 164 to 239 is a free range, it can be used for any binary data object of any function selected from the device's database.
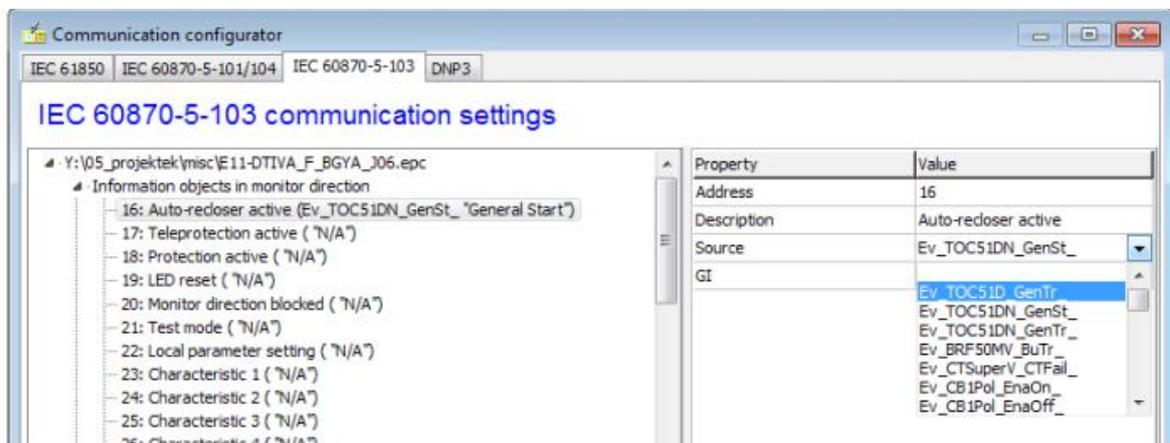
Figure 8-2 Selection of standard data item of IEC103 protocol

To delete a data object from the **Source** field double-click on it or select the empty row at the beginning of the list.

The **GI** parameter true means that data should be included in the general interrogation. It is allowed to change in case of the free addresses. In the standard range it is fixed. According to the standard measurements are specified as class 2 messages. The

assignment of the standard frame items should be defined by the user. The protocol's root node contains a parameter called **Measurements** which is used for selecting the class 2 message type. User can choose either the standard message format or can define user-specific message. Standard formats are the different variations of the **Measurands I** (ASDU type 3) and can be the **Measurands II** format (ASDU type 9). The items of sub-node Measurands depend on the selected frame type. It is the user's responsibility to select the right data object for the right data item of the class 2 message to keep the system conformity to the standard. For not assigned items the communication software of the device will transmit zero with invalid flag (ER=true).

By selecting the **User-defined** value of the **Measurements** parameter user is allowed to build non-standard message. It will be transmitted with ASDU 9 type frame without gaps (no empty item enabled). Protocol software transmits only one type of class 2 message selected as described.

Any measurands has its own source data object parameter in the property editor. Additionally it is possible to define the scaling factor here. Standard values are the nominal value of the specific data multiplied by 1.2 or 2.4. User can define non-standard value also. Please note that the measurement objects in the device are represented as floating point analog values in base SI units (e.g. volts, amperes, etc.)

The AQ300 device is a native IEC61850 device. As a consequence all process calculating measurements as floating point objects and there is no prefixes used. It ensures more accuracy in the data communication and eliminates the using of scales. These values are available via generic services of the IEC103 standard. Data object description can be found below the **Measurands group generic service entries and Counters group generic service entries.** For more information please read the standard.

8.3 DNP3

The standard DNP3 communication has its own definition sheet. Sub-nodes contains the supported DNP3 object types. Detailed list of supported frames and object types can be found in the EuroProt+ DNP3 Device Profile document. Context menu of a sub-node contains two commands:

- **New object** adds a single data to the node. The data source property will be automatically assigned to the next available object. Index will be the last used index value plus one.
- **Add all** command adds all available objects to the selected tree node.

For DNP3 protocol uses indices instead of addresses. The AQ300 device doesn't allow gaps. By clicking with right mouse button on a single data item the context menu allows the following operations:

- **Delete** will delete the selected object and make a trigger for an automatic indexrearrangement to ensure gap-free indices.
- **Move Object**... is an index manipulation command with sub-commands. Selected item can be moved in the indexed list.

Property editor allows the user to change the source of the selected data object. The listed data points are in a filtered list. This way user can select compatible data object only. Index can not be changed directly in the property editor; it can be changed by moving the data item. DNP3 protocol defines a kind of classification parameter. This parameter is also available in the property editor. The allowed range is 0..3, and empty value also enabled. Multi selection for class changing is also possible.
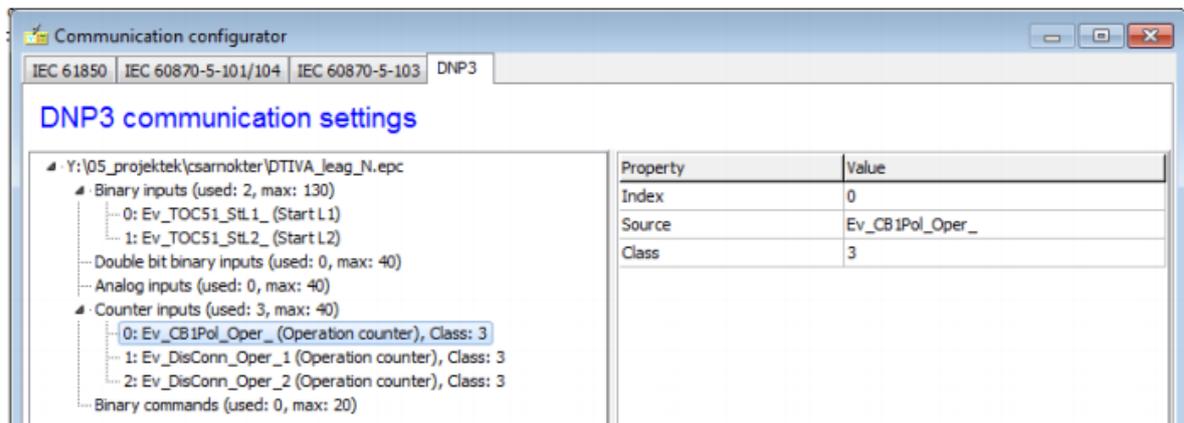
Figure 8-3 DNP3 setting sheet

9 REFERENCE INFORMATION

Manufacturer information:

Arcteq Ltd. Finland

Visiting and postal address:

Wolffintie 36 F 11

65200 Vaasa, Finland

Contacts:

Phone, general and commercial issues (office hours GMT +2): +358 10 3221 370

Fax: +358 10 3221 389

url: www.arcteq.fi

email sales: sales@arcteq.fi

email technical support: support@arcteq.fi

APPENDIX 1 COMMUNICATION WITH THE IED

For communicating with the device and download/upload configurations is needed free Ethernet port in the PC and standard RJ-45 cable or AQx-001 Optical Ethernet cable for local panel communication. The IED can be connected in to LAN network also for communication.

To set the IP address in the device to match your local IP address range go to the device HMI and press the Menu-button [icon] until the "System Settings" menu appears (4 times from the default view).

Select "Station bus settings" and press [Set] key. and IP address window will open for the station bus.

These addresses here define the Ethernet communication of the station bus. Here most important addresses are the IP address and Default gateway (if used). Also if DNS is used in the network it is set here.

To check your IP-addres range navigate to your programming PC network settings. In Microsoft Windows 7 this can be found by following.
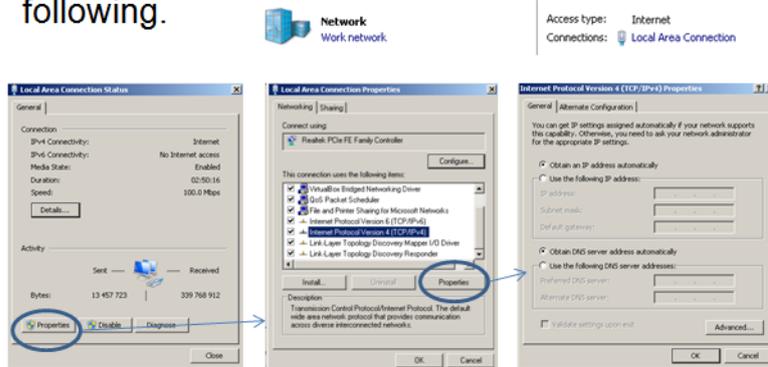
If you have fixed IP address it would be shown here. However in this example case the IP address in this network is automatically given.

If you are directly connecting to the IED without having simultaneous Internet/Network connection then you need to set IP address for your programming PC in this location.
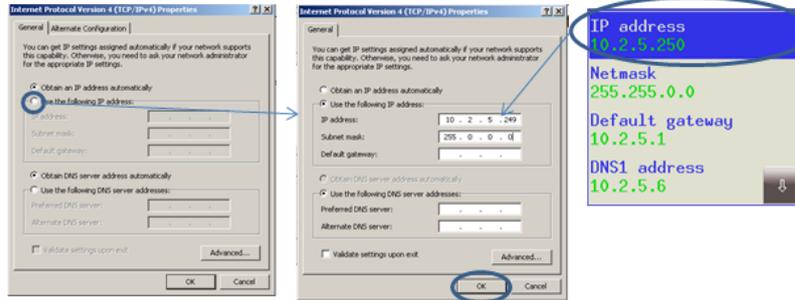
Set the programming PC:s IP address to same range with the IED you are connected to. (other wise the same but 3 last digits need to be different).

If you have network connection and you are connecting the IED into the same network.

Open windows command prompt by typing cmd into the Start -> run menu
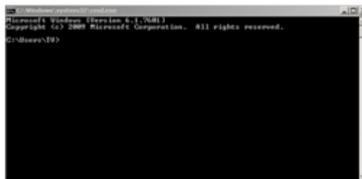
type into the command prompt ipconfig and press enter
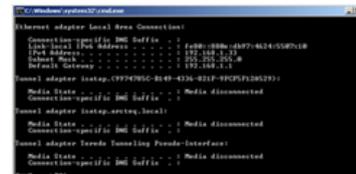
Check your programming PC IP address from the information, in this case it is 192.168.1.33

Select IP address for you IED you want to connect to the network.

In this case we select 192.168.1.34

Before setting the new IP address to IED check that the address you selected is available. Do this by typing ping 192.168.1.34 into the command prompt and press enter.
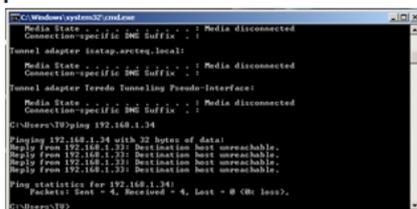
Set the new IP address to the IED with HMI and test the connection
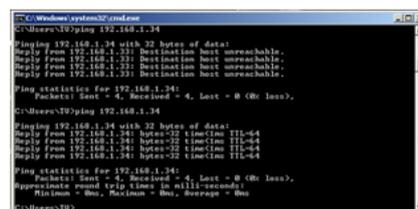
To read configuration from the IED open AQtivate software suite.

From the main toolbar select Upload... button or Project -> Upload Configuration and Select Device –window will appear.
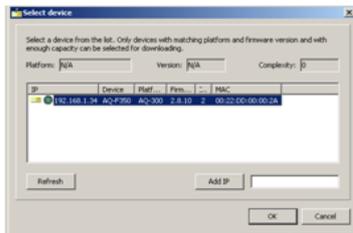
Press the Refresh button until you can find and select the IED from the list. (can be 3 or 4 times needed to get the device updated into the list) and select Ok.
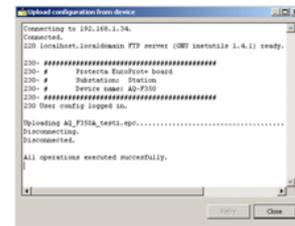
AQtivate will read the configuration from the device. After finished click Close. You have possibility to save the read configuration to the programming PC.

After the configuration is read to the programming PC it is ready to be modified. Configuration can also be loaded from previously saved files.
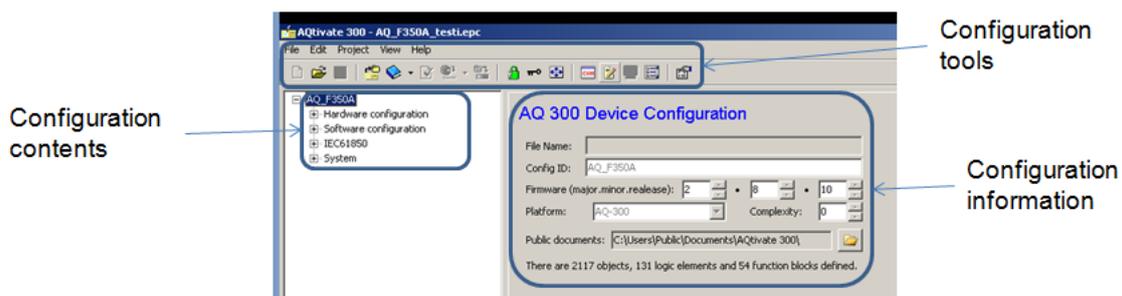

Figure 0-1 Ethernet communication options.

For front panel communication can be used AQx-001 communication cable. It is connected to the programming PC Ethernet port. For the IED end the programming cable is connected to left side of the front panel. It uses optical communication and is aligned automatically. Without this cable normal RJ-45 CAT4-5 Ethernet cable can be used to communicate with the device from the communication port in the backside of the IED.