

ENERGY MANAGEMENT SOFTWARE



Version 3.0

TUTORIAL

03-10B

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PowerStudio SCADA v3.0. Tutorial

1.- OBJECTIVE:

The object of this tutorial is to guide you through the learning process of the PowerStudio SCADA energy management programme through real time communications with the CIRCUTOR practice Kit (code M59506. DEMO-EXPERT Kit). This tutorial indicates the steps you will need to follow for a practical application of PowerStudio SCADA in order to familiarise yourself with how the CIRCUTOR programme and equipment work.

2.- REQUIREMENTS:

In order to use this tutorial you should have the CIRCUTOR **DEMO-EXPERT Kit** (code M59506.) which simulates a typical real installation. Obviously, you must be careful using the kit once it is plugged in.

You will also need a PC with a recent version of the Windows installed, PowerStudio SCADA 3.0 or latest, an Ethernet cable with RJ-45 connectors and cross pairs to connect to the **LM50-TCP** unit of the **-DEMO-EXPERT Kit**.

2.1.- CIRCUTOR WEBSITE FOR POWERSTUDIO

[PowerStudio on the WEB](#)

http://www.circutor.es/Noticias/powerstudio-software-de-supervision-y-control-energeticos_N_168.aspx

2.2.- DOWNLOAD POWERSTUDIO SCADA DELUXE:

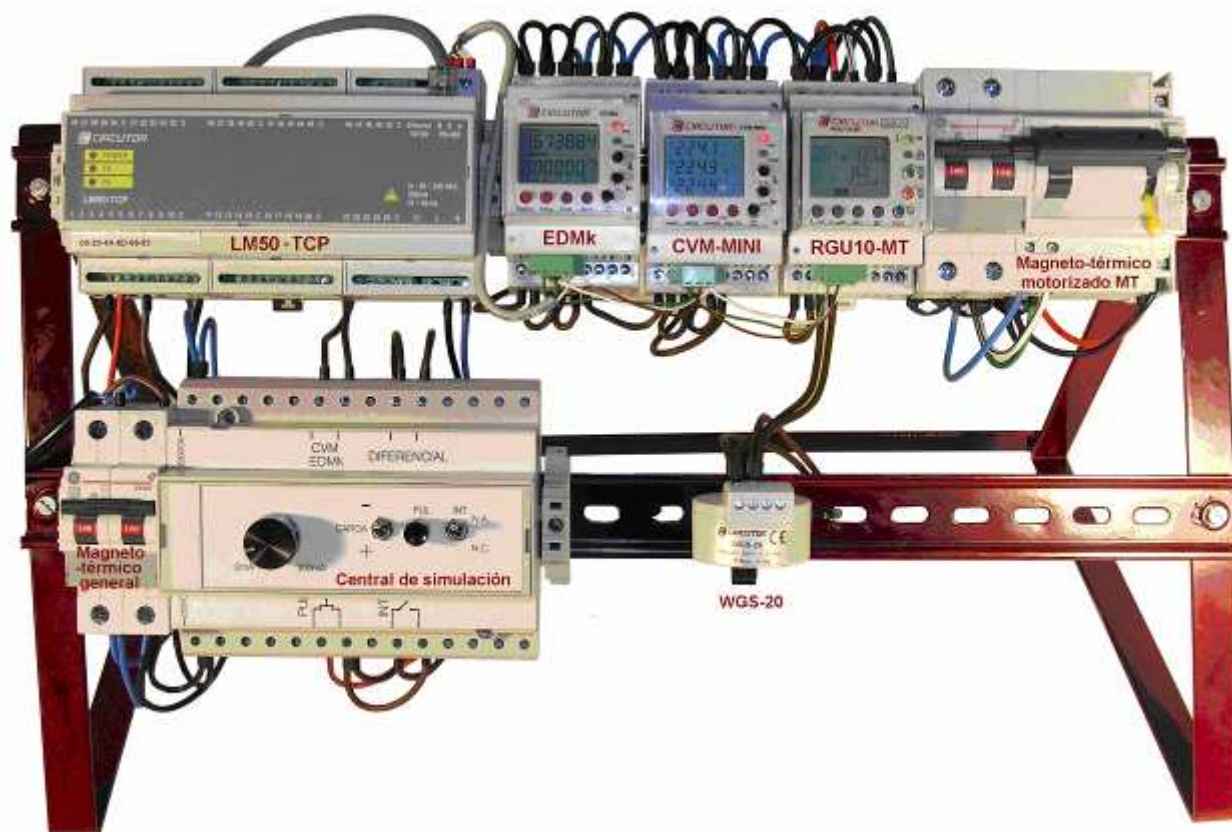
[PowerStudio SCADA Deluxe 32bits](#)

<http://img.icnea.net/Forum/E3032/ftp/PSS-Deluxe-v301a-040810.exe>

[PowerStudio SCADA Deluxe 64bits](#)

<http://img.icnea.net/Forum/E3032/ftp/PSS-Deluxe-x64-v301a-040810.exe>

3.- DESCRIPTION OF THE DEMO-EXPERT KIT:



DEMO-EXPERT Kit

The **DEMO-EXPERT Kit** includes the following components:

3.1.- LM50-TCP

A digital impulse centralising and logical status device of 50 input channels. There is also an Ethernet connection to computers or networks and an RS-485 for communicating with other MODBUS devices, creating a gateway between the two connection types.

In the **DEMO-EXPERT Kit** the **LM50-TCP** performs 3 functions:

- 1.- It detects the logical status (0 or 1) of the “PUL” button and the “INT” switch on the simulation device using the channel 2 and 3 inputs.
- 2.- It acts as an Ethernet/RS-485 communication gateway. It allows Ethernet communications with the rest of the kit's RS-485 equipment.
- 3.- It receives energy impulse signals from a CIRCUTOR **EDMk-ITF-RS485-C2** type energy counter on channel 1. To enable this function, input 1 of the **LM50-TCP** must be wired to terminal 9 of the **EDMk** and terminal 8 of the **EDMk** to terminal C of the **LM50-TCP**.

3.2.- EDMK-ITF-RS485-C2

Active/reactive energy meter for three-phase networks with 2 digital outputs. Terminals 9-8 for ACTIVE energy and Terminals 7-8 for REACTIVE energy.

In the **DEMO-EXPERT Kit** the **EDMk-ITF-RS485-C2** performs 2 functions:

- 1.- It generates a string of impulses proportionate to the active energy consumed simulated in digital output no. 1.
- 2.- It integrates the simulated active and reactive energy consumed (kW.h) which is displayed in PowerStudio through communications.

3.3.- CVM-MINI-ITF-RS485-C2

Three-phase electrical network analyses and energy counter. Installed in distribution panels to measure and calculate up to 230 network electrical parameters.

In the **DEMO-EXPERT Kit** the **CVM-MINI-ITF-RS485-C2** communicates the parameters to PowerStudio via RS-485.

3.4.- RGU-10-MT

Differential protection with automatic reconnection and RS-485 communications.

In the **DEMO-EXPERT Kit** the **RGU-10-MT** measures the current leakage caused by the simulation device with the help of the WGS-20 transformer. Performs the function of a magnetothermal **MT** deactivator when there is a leak that meets the trigger conditions, based on the programmed orders for current triggers and times. Using the potentiometer to adjust the simulation unit we can simulate the differential leak level to cause the magnetothermal **MT** device to trigger.

We can use the **PowerStudio SCADA** software to monitor the instant current, the current detected in the trigger and the relay status. It is also possible to programme an automatic reconnection cycle thanks to the monitoring of the magneto-thermal device which can be used as a remote control to activate or deactivate a charge. In this example of the **PowerStudio SCADA** application we will programme an event that will deactivate this same megneto-thermal relay under certain conditions.

3.5.- WGS – 20

Differential Protection Transformer.

3.6.- MT-C-E62-6A

Motorised magneto-thermal device governed by the RGU-10-MT general protection magneto-thermal device.

3.7.- SIMULATION DEVICE.

This is a custom-built unit designed especially for the **DEMO-EXPERT Kit**. This unit makes it possible to:

1.- Using the "CHARGE" switch, you can change the level of consumed intensity measured by EDMk and CVM-MINI and consequently the power and usage measured by these units.

2.- Using the potentiometer, simulate a differential leak from 0mA to 300mA measured by RGU-10.

3.- With the "PUL" button and the "INT" switch, you can change the logical status of the digital inputs (0/1) on channel 2 and 3 of the **LM50-TCP**

4.- CONFIGURATION OF DEMO-EXPERT KIT EQUIPMENT

The basic communication parameters of **EDMk**, **CVM-MINI** and **RGU-10-MT** need to be configured using the programmable keypads in order to communicate with **Powerstudio SCADA**. Once the devices are configured and can communicate with **PowerStudio SCADA**, there are other parameters that can be reprogrammed remotely using the software.

Communications SET-UP

Before configuring the communication parameters, you must read the manuals carefully since each device has a different menu configuration depending on the measurement or control characteristics or parameters.

In the case of the **DEMO-EXPERT Kit**, the equipment must be configured with the following communication parameters:

LM50-TCP = Peripheral No. 1 (the peripheral number cannot be changed since it is the MASTER of BUS RS-485), speed 19200 bps. It can be configured as RTU or TCP. In the case of the **DEMO-EXPERT Kit** it would be configured as TCP.

As a learning exercise, access the configuration menus of each one of the devices using the corresponding keypad and verify the following peripheral numbers on the display. To do so, follow the instructions in the corresponding manuals.

EDMk = Peripheral no. 2, speed 19200 bps
 CVM-MINI = Peripheral no. 3, speed 19200 bps.
 RGU-10-MT = Peripheral no. 4, speed 19200 bps.

Remember that this step is essential for the software to be able to identify each device on the network. Make sure that the communication parameters of the equipment are the same as far as bus speed, parity, data bits and shutdown.

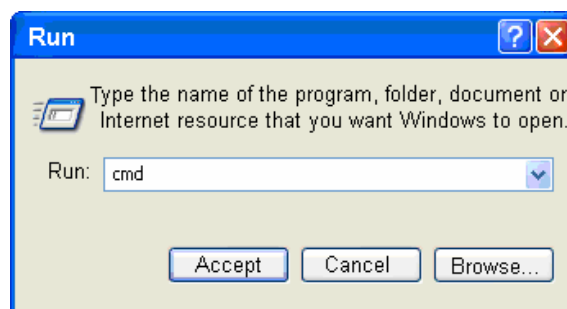
5.-PROGRAMMING IP ADDRESSES.

5.1.- CONSULT THE IP ADDRESS OF THE PRACTICE COMPUTER.

Follow these instructions to identify the IP address of the practice computer:



- click START and then RUN.
- Enter "CMD" on the line and click Accept.



An MS-DOS screen will appear (see figure).

- Write "IPCONFIG" to see the information on the computer's current IP address.

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Versión 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\labora>IPCONFIG

Configuración IP de Windows

Adaptador Ethernet Conexión de área local :

    Sufijo de conexión específica DNS :
    Dirección IP. . . . . : 172.16.10.30
    Máscara de subred . . . . . : 255.255.240.0
    Puerta de enlace predeterminada : 172.16.0.1

C:\Documents and Settings\labora>
```

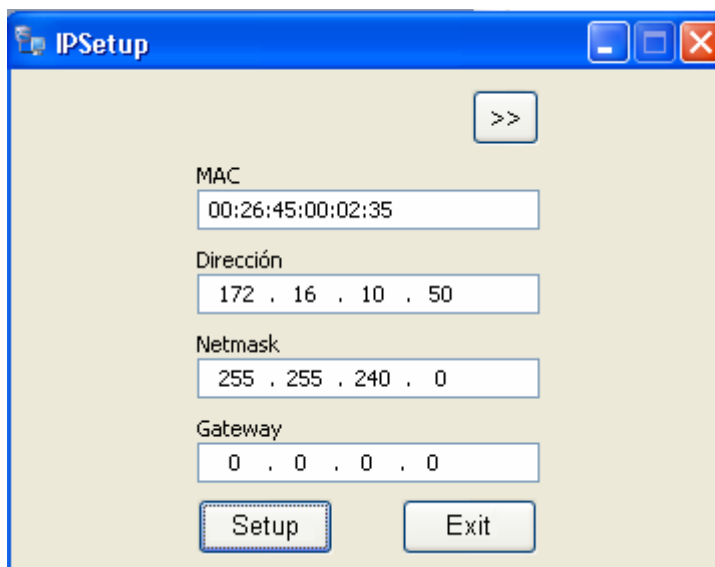
In the example, the computer's IP address is 172.16.10.30 with a subnetwork mask of 255.255.240.0.

This process is required to verify the IP addresses of our computer and programme the IP address of the **LM50-TCP** unit so that they are both in the same range.

5.2.- IP ADDRESS OF THE LM50-TCP.

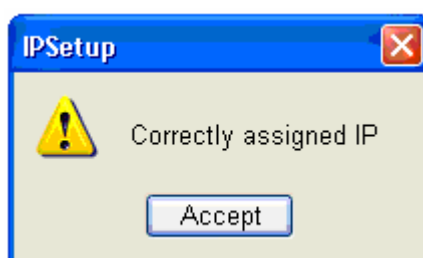
Once the IP address of the practice computer is known, you can change the IP address of the LM50-TCP unit by following these steps:

- Run the **IPSETUP.exe** application on the CD that comes with the equipment. The following window will appear:
- Type the MAC address of the LM50-TCP unit. This address identifies the equipment for Ethernet communications and can be found on the label located on the side of the unit. The format of the MAC address is as follows for **CIRCUTOR** equipment:
00:26:45:XX:XX:XX.

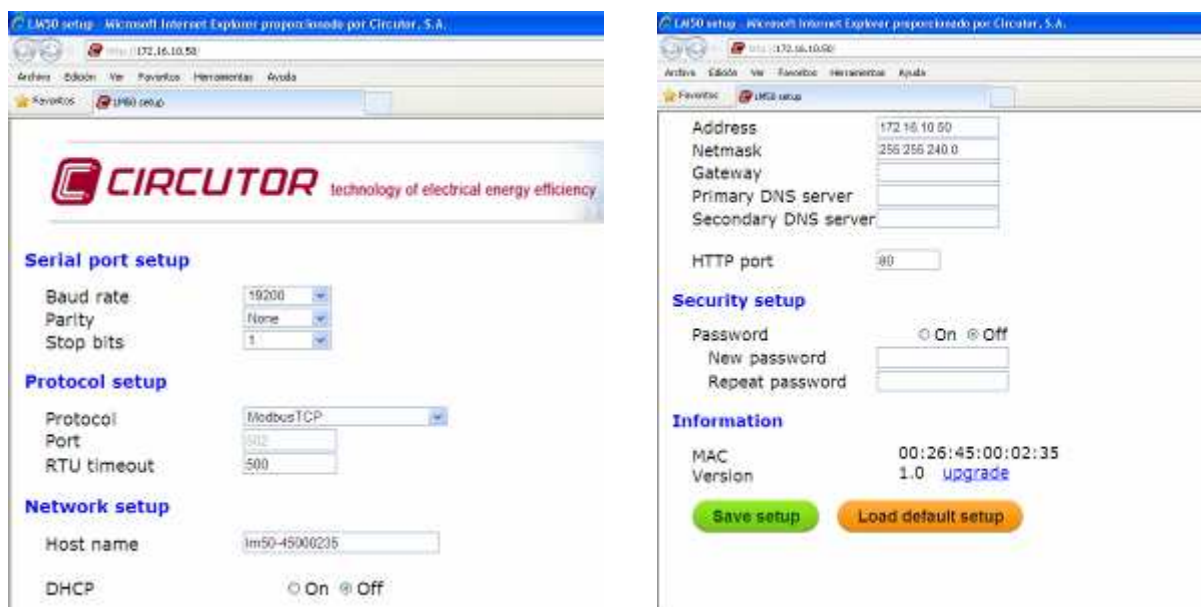


- Next, type the IP address you want to assign to the **LM50-TCP** unit. Remember that it must be within the same range as the IP address of the practice computer, which is our example is: 172.16.10.XX.
- Next, programme the subnetwork mask, in this case as shown in the image. In your system it might be different. Make sure you type it in correctly.
- If the unit needs to connect to the Internet or have access to a gateway IP, you can programme this in the GATEWAY field. Otherwise, leave it as it appears in the image.
- To conclude, click on "Setup".

The following message should appear after a few seconds:

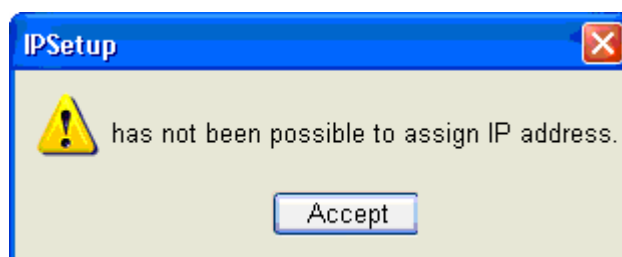


- Click on "Accept" and Internet Explorer should appear automatically showing the parameter configuration screen for the LM50-TCP.



Following the instructions in the manual that comes with the **LM50-TCP**, to programme these parameters. You can also change the parameters of the IP configuration with this utility. You also have the option of programming the IP address of the **LM50-TCP** using the PowerStudio assistant.

If an error occurs while programming the IP address, the following error message will appear.



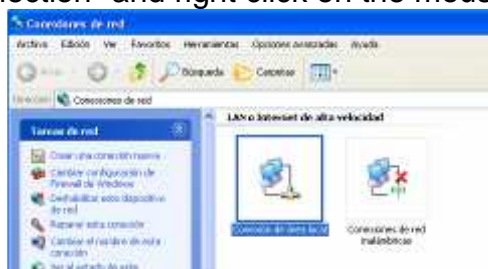
Please check the wiring and network configuration of your system and the IP and MAC addresses of the equipment and review the Windows Firewall programming or antivirus programmes you may have installed. Try deactivating both and repeat the previous steps until you manage to configure the IP address of the **LM50-TCP**.

For some systems connected to servers you may have to wait several minutes until the equipment is detected and accessible from other points on the same LAN.

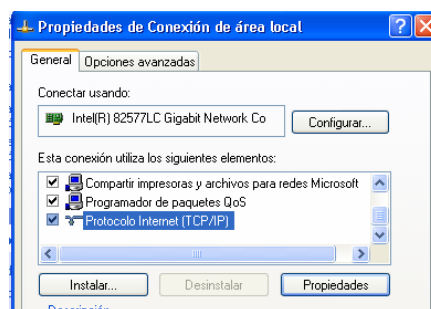
5.3.- COMPUTER'S IP ADDRESS TO THE RANGE OF THE LM50-TCP.

If you know the IP address of the **LM50-TCP** unit and you need to force the IP address of the practice computer into the same range as the unit, follow these steps:

- Go to the Start menu / control panel / network connections
- Choose "local area connection" and right click on the mouse.

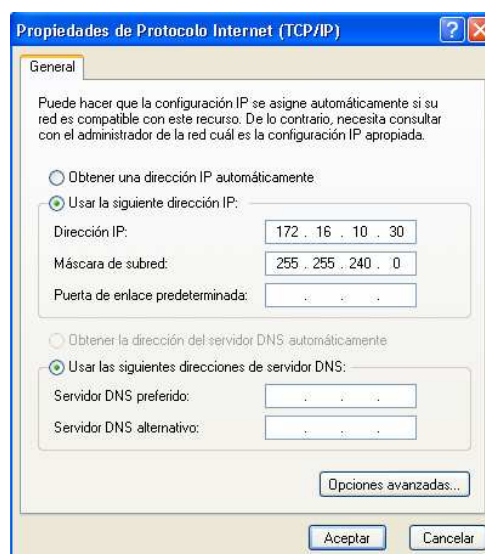


- Choose "**Properties**" from the menu and the following screen will appear.



- Choose "(TCP/IP) Internet Protocol" from the list and click on properties
- On the next screen, type a new IP address and subnetwork mask that is within the range of the **LM50-TCP**. In our case, 172.16.10.30 / 255.255.240.0. Leave the DNS server addresses blank.

Click "Accept" in all windows and your practice computer is now configured in the desired range of IP addresses.



6.-POWERSTUDIO SCADA 3.0.

The operating philosophy of the PowerStudio programme changed with version 3.0. There are 3 parts to the programme (ENGINE-EDITOR-CLIENT). Each one of them performs a different function as described below:

6.1.- SEARCH ENGINE



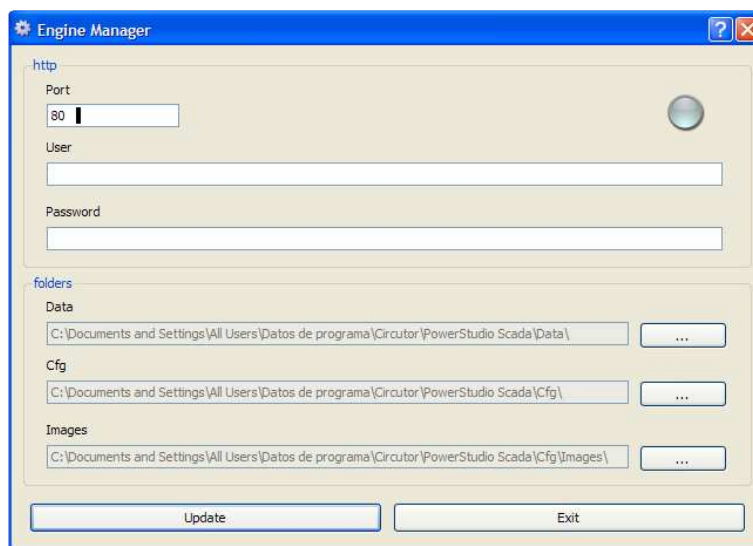
The search engine is responsible for communications, collecting information on the equipment and storing it on the computer's hard drive. It also acts as an XML SERVER. Starting with this version, it operates in the background as a Windows service, which means that it is not necessary to open a user session in order for the programme to collect information on the equipment.

The SEARCH ENGINE status is displayed using PSEngineManager which is accessible from start/programmes/circutor/PSEngineManager. From here you can programme the following configurations:

Web server port (80 by default). This option allow you to display using the Web or Java Applet.

cfg, data and image directory where the Search Engine saves the configuration, records and images exported from EDITOR.

Access to editing protected by Username and Password.



Note that diagram in the upper right hand corner. This indicates the status of the search engine based on the following colours:

Grey → The PowerStudio service or SEARCH ENGINE is inactive. No equipment data is being saved to the hard drive. This may be due to the fact that the licence (USB device) has not been installed or detected in the system and the 60-minute demonstration has ended.

Green → The service or SEARCH ENGINE is active and all of the application's equipment is communicating normally.

Red → The service or SEARCH ENGINE is active but some of the equipment is NOT communicating.

Yellow → The service or SEARCH ENGINE is active, the equipment is communicating normally but there are events (alarms) pending confirmation of notification by the user.

Red and yellow at the same time → One or more of the devices configured in the application is/are not communicating and their are events (alarms) pending confirmation of notification by the user.

Each SEARCH ENGINE is recognised by its IP address. The IP address is the same one as assigned to the PC or embedded PowerStudio device where the SEARCH ENGINE is installed. For direct applications between a PC and CIRCUTOR devices, the IP address is the local address by default, 127.0.0.1 and the communications port is 80. In some cases the PowerStudio application may have problems connecting. This may be due to the fact that port 80 is occupied by another Windows application. This problem can be solved by changing the port to different one that does not have as much traffic, e.g., 22222.

Obviously, when you first install PowerStudio there are no applications loaded in the SEARCH ENGINE. Use the "Export" option in PowerStudio EDITOR to do this. It is also possible to "IMPORT" an application from a SEARCH ENGINE that is already operating if you know the IP address, the port and the user name and password.

6.2.- EDITOR



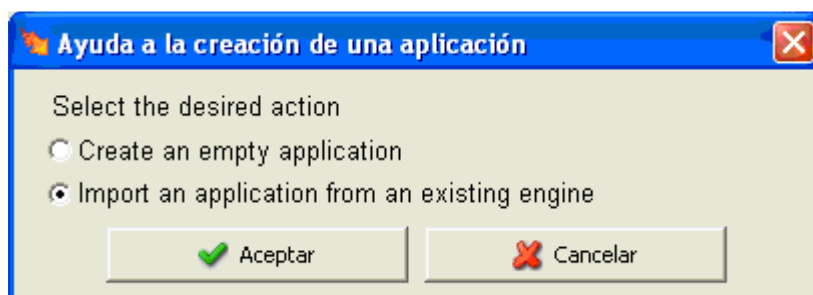
This part of the programme is used to create or modify the application(s) and allows you to:

- ✓ Register CIRCUTOR gateway equipment and configure TCP communications.
- ✓ Register CIRCUTOR RS-485 field equipment and configure the equipment network.
- ✓ Modify certain configuration parameters of CIRCUTOR EQUIPMENT.
- ✓ Create SCADA screens combining different parameters from different equipment on the same computer screen.

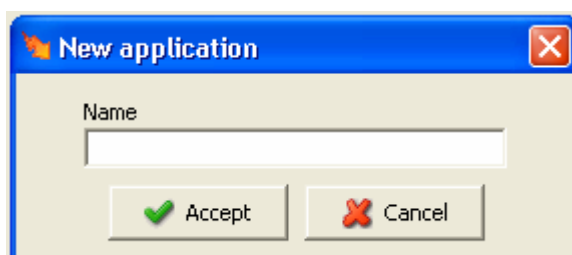
Import and export PowerStudio SEARCH ENGINE applications.

- ✓ Create report screens.
- ✓ Define events (alarms).
- ✓ - Etc.

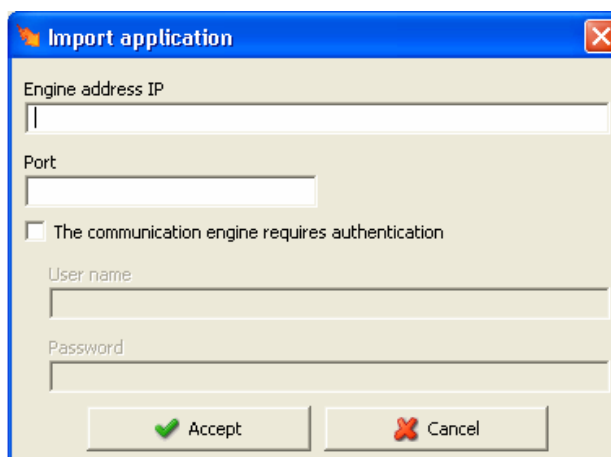
The first time you run EDITOR the following screen will appear:



- Choose "CREATE AN EMPTY APPLICATION". EDITOR allows you to "IMPORT" an application that is already running on a PowerStudio SEARCH.
- You must now choose a name for the application.



Next you will need to configure the search engine parameters in order to enable this to communicate with EDITOR and CLIENT.



Once you have finished creating one or more applications, you need to export the application(s) to the SEARCH ENGINE which is responsible for the communications with the different devices, saving data to the PC's hard drive, managing programmed events and operating as a WEB server, etc.

6.3.- CLIENT



In the display mode of the application you can:

- ✓ View the equipment data individually, in real time.
- ✓ View the SCADA screens created in EDITOR with updated equipment data in real time.
- ✓ View the reports created with EDITOR and the data obtained by the equipment (historical data).
- ✓ See the status of events and the possibility of recognising them.
- ✓ View graphs and tables.
- ✓ Export data or graphics to EXCEL in numeric format.

Once the application has been exported to SEARCH ENGINE it can be viewed from CLIENT mode. PowerStudio allows you to modify the SEARCH ENGINE application while it is being viewed by the CLIENT. The display is detained during the exportation process from EDITOR to SEARCH ENGINE and resumes when the process shows the changes made.

The PowerStudio CLIENT is a JAVA Applet. If it has an Internet explorer that is compatible with this technology, it can access any PowerStudio SEARCH ENGINE using that Internet explorer since the PowerStudio SEARCH ENGINE acts as an XML SERVER. Remember that the PowerStudio SEARCH ENGINE is accessed via the IP address and port. Therefore, typing in the IP address and the port on the browser bar of the Internet explorer will allow you to access the equipment data configured in the SEARCH ENGINE.

7.-ADD LM50-TCP TO POWERSTUDIO SCADA

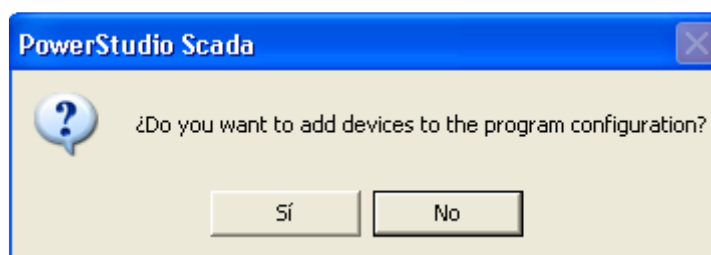
Another possibility for configuring the IP address of the **LM50-TCP** is to use the **CIRCUTORPowerStudio SCADA** if you know the unit's MAC address. To do so, you must first add the PowerStudio unit.

Run PowerStudio EDITOR. If the product is not licenced, it will run in DEMO MODE. When a licence is acquired, it comes with a USB device which must be plugged into the practice computer. If using the DEMO version, the programme will work for 60 minutes without any type of restriction. After that, the PowerStudio service in Windows will cease to operate. Restarting the PowerStudio service in Windows, the programme will work for another 60 minutes test mode, and so on.

- Run SCADA PowerStudio EDITOR. You can do this from the START MENU/PROGRAMMES/CIRCUTOR/ .



The following window for adding a device will appear.



- Click on "YES" to add the **LM50-TCP** device, which acts as an input and connection device (communications gateway). As a connection device, it is used to add devices to the programme. To continue, select TCP/IP devices and converters.



Possible connections:

Connection of the equipment to its own Ethernet port: **CVM-144 / 96** Ethernet, **TCP2RS** or **LM50-TCP**

Connection to Modbus equipment via **TCP2RS** or **LM50-TCP** (IP address of a Circutor NETWORK gateway)

In this case it will obviously be necessary to first add the **LM50-TCP** connection and device before adding the rest of the devices.

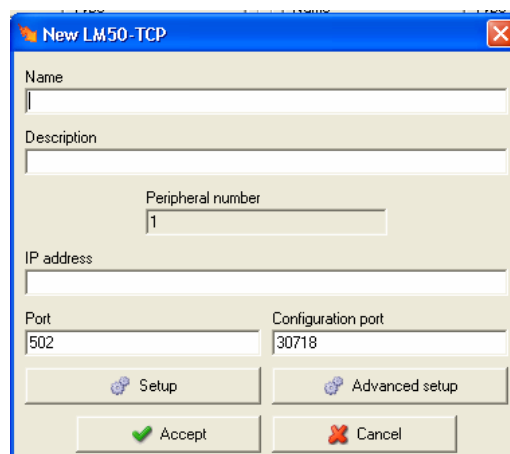
- Choose an **LM50-TCP** (Modbus TCP) to add:



Details of the INPUT/OUTPUT equipment available to PowerStudio SCADA

The different tabs contain all of the CIRCUTOR equipment that is compatible with PowerStudio SCADA based on the characteristics.

Define the name and description of the device. We recommend using a name or a description that clearly defines the measuring point at the facility or the equipment function so that the unit can be rapidly identified.



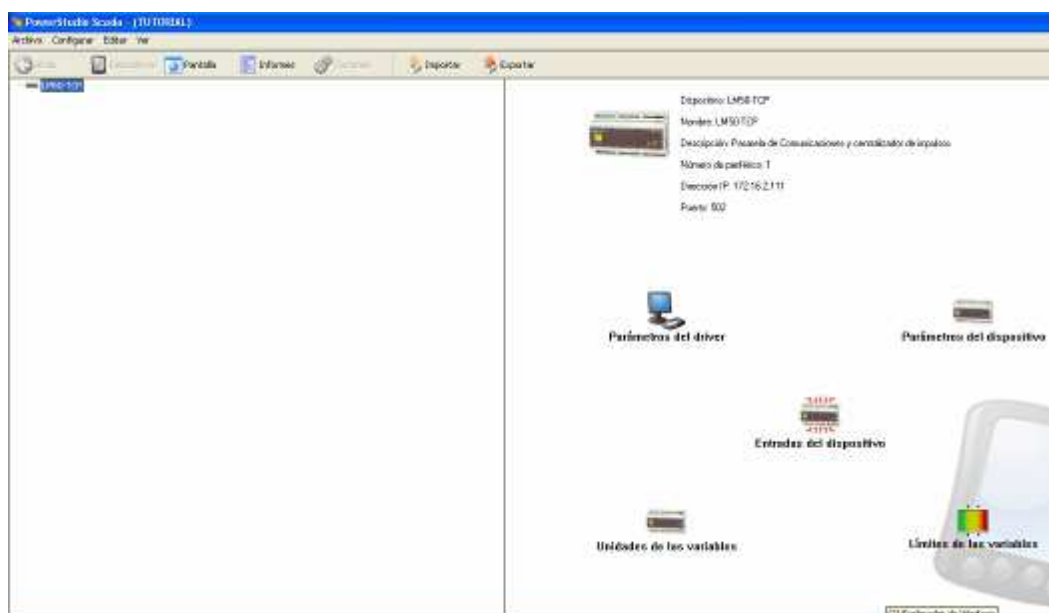
The 'New LM50-TCP' window contains the following fields and buttons:

- Name:** A text input field.
- Description:** A text input field.
- Peripheral number:** A text input field with the value '1'.
- IP address:** A text input field.
- Port:** A text input field with the value '502'.
- Configuration port:** A text input field with the value '30718'.
- Buttons:** 'Setup' (gear icon), 'Advanced setup' (gear icon), 'Accept' (green checkmark icon), and 'Cancel' (red X icon).

The name that is associated with the equipment here will be the name that is later used by the programme to define the variables available in SCADA, Reports and Events. The IPS NETWORK address is 172.16.10.99 and the port is 10001 for an RTU modbus or 502 for a TCP modbus, based on the way in which the **LM50- TCP** was previously configured.

On this screen the option to change the peripheral is deactivated since the **LM50-TCP** uses peripheral number 1 (parameter configured by default) which cannot be changed. In the **DEMO-EXPERT Kit**, the rest of the kit devices have been assigned peripheral numbers 2, 3 and 4 in logical order moving from left to right.

- Click ACCEPT and PowerStudio SCADA will detect the **LM50-TCP**:



IMPORTANT:

Once the LM50-TCP is correctly configured and online, you will need to export the application to the PowerStudio SEARCH ENGINE by clicking on "EXPORT". Remember that the IP address of the PC SEARCH ENGINE in local mode will always be 127.0.0.1 and the port will be 80 or whatever has been configured in EngineManager if the default configuration has been changed.

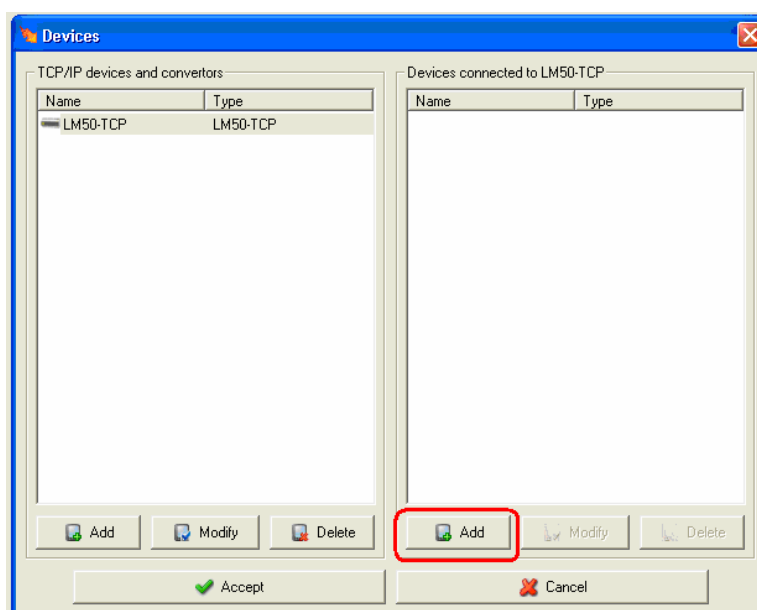
8.-DETECT AND COMMUNICATE WITH THE OTHER EQUIPMENT.

To continue building the application with the **DEMO-EXPERT Kit** you need to add the rest of the equipment that will communicate through **LM50-TCP** which will complete the communications network.

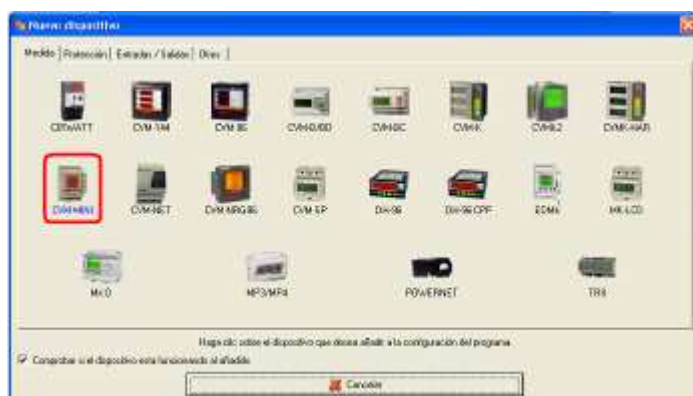
Add the following device: **CVM-MINI**:

- Access the CONFIGURE menu and choose DEVICES. A screen will appear with the devices that have been added to the application thus far.

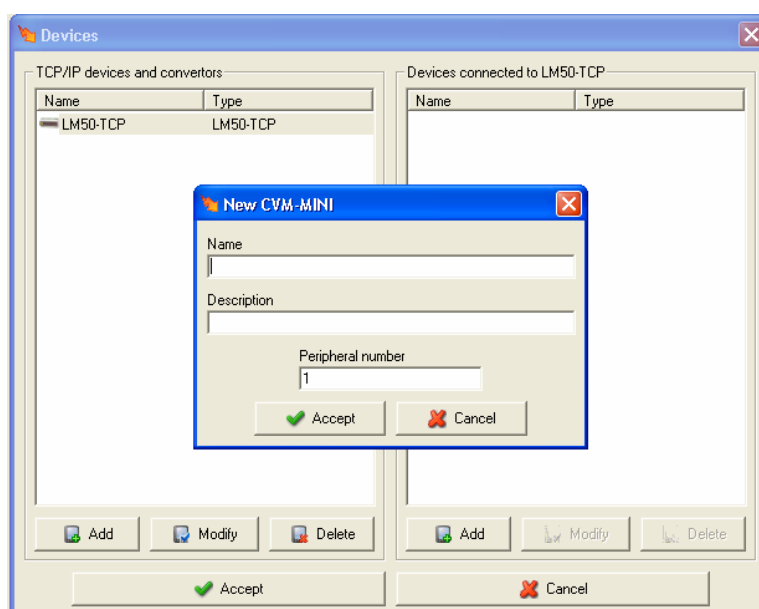
Choose the connection previously created for the **LM50-TCP** and the rest of the equipment will communicate through that connection.



- Click on ADD.

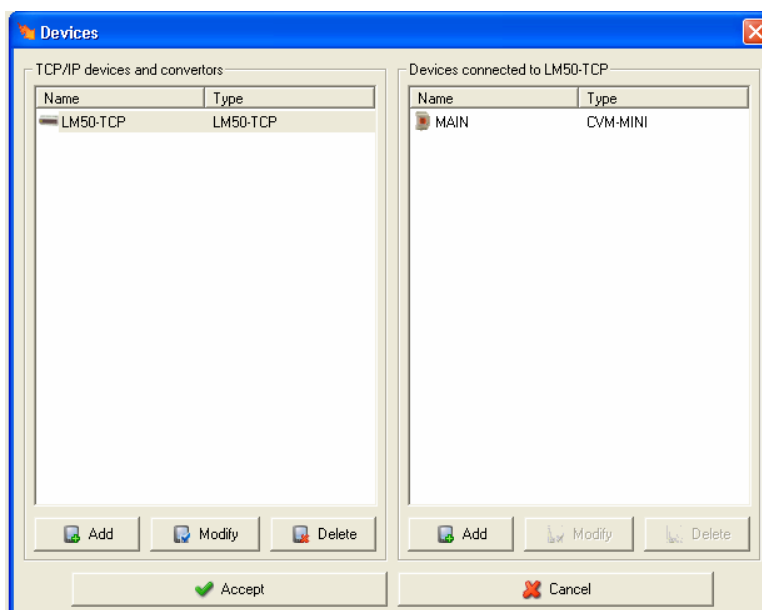


- Choose **CVM-MINI**. A screen will appear for configuring the identity of the device, name, description (optional) and the peripheral number assigned in the RS-485 BUS.



Type MAIN for the device name in order to use the databases that have already been created and saved in the practice computer. Add the peripheral number for this piece of equipment (3) and press Next.

If the physical connections are correct, the device will be detected immediately and will appear on the list of detected equipment.



- Follow the same steps as above for the rest of the equipment:

EDM-k = peripheral number 2, speed 19200 bauds

RGU10-MT = Peripheral no. 4, speed 19200 b.auds

- Enter a descriptive name for each one of them. Remember to save the changes in the applications once you have finished registering the **DEMO-EXPERT Kit.devices**.

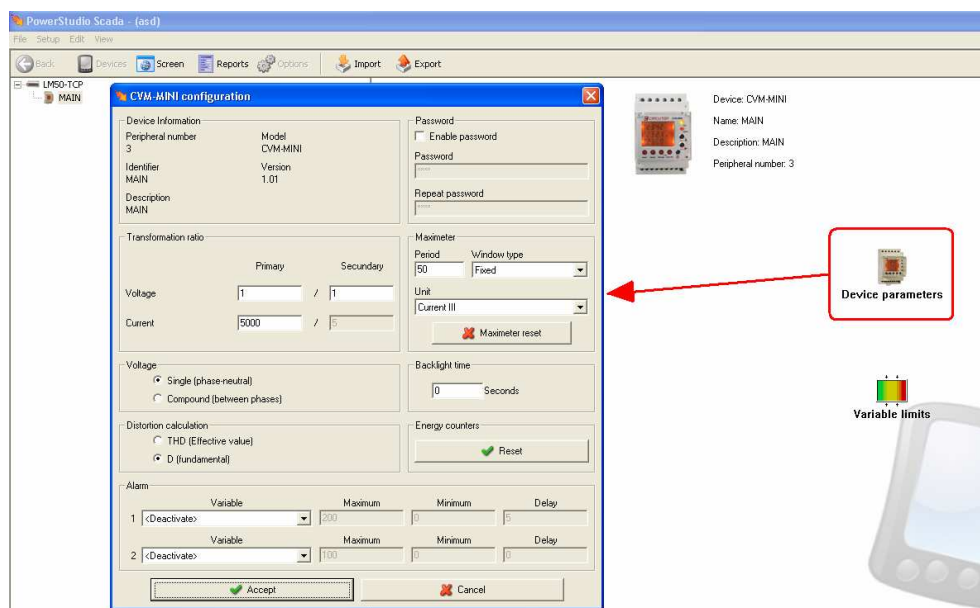
9.-CHANGING EQUIPMENT PARAMETERS IN POWERSTUDIO.

Obviously, the following configuration screens will be characteristic in each one of the CIRCUTOR devices.

9.1.- CONFIGURING DEVICE PARAMETERS

Allows you to modify some of the characteristic configuration parameters of each device.

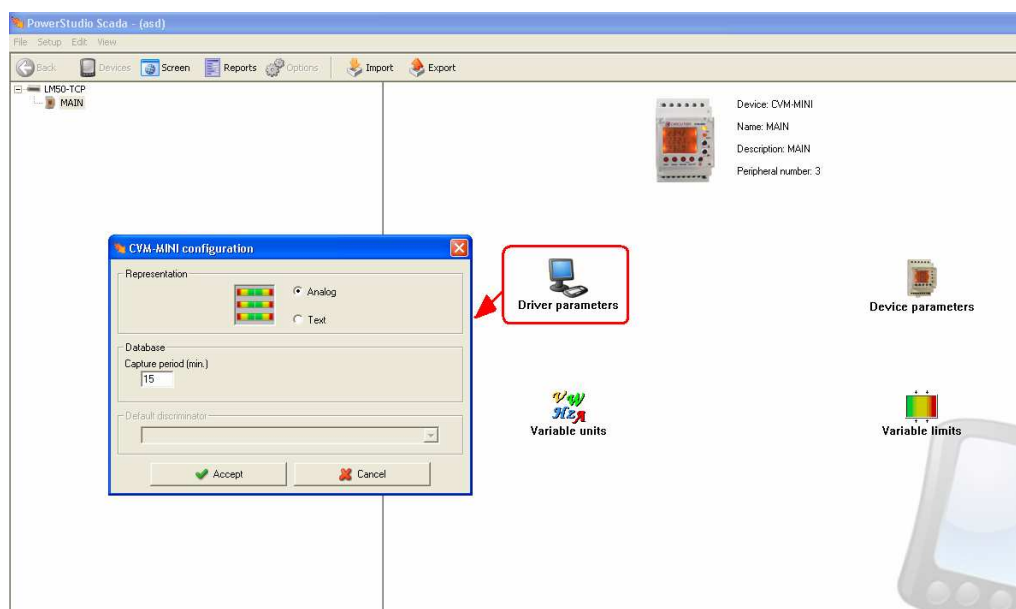
For example, double click on **CVM-MINI** device parameters. The following window will appear:



From here you can configure the **CVM-MINI** device just as though you were doing it from the keyboard. This screen will change depending on the equipment being configured. Each device has its own configuration screen.

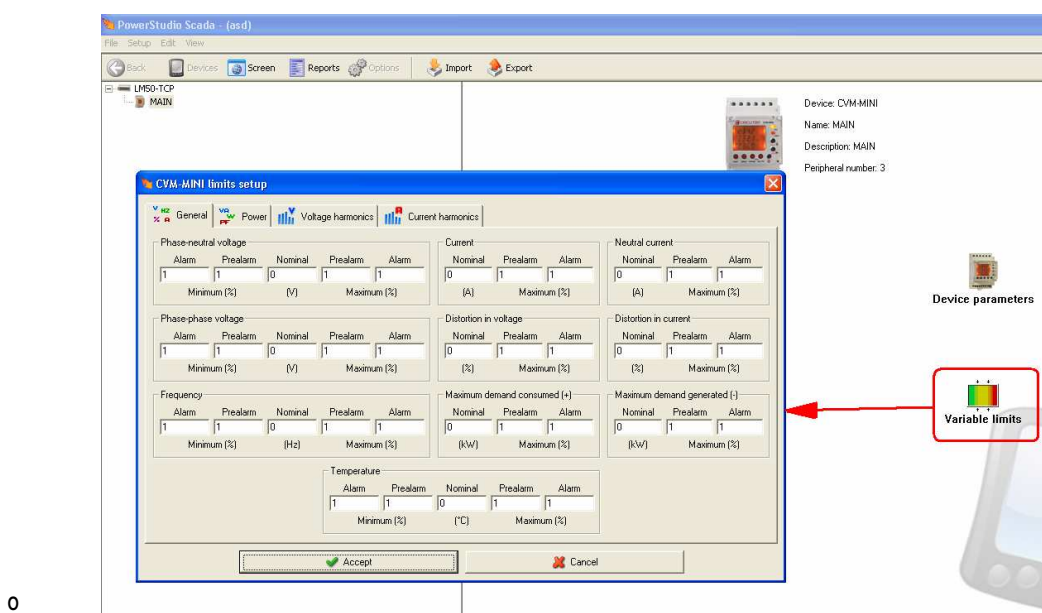
- Click ACCEPT and if you have made any changes to the configuration the changes will be sent to the device once the application is exported.

9.2.- CONFIGURING DRIVER PARAMETERS

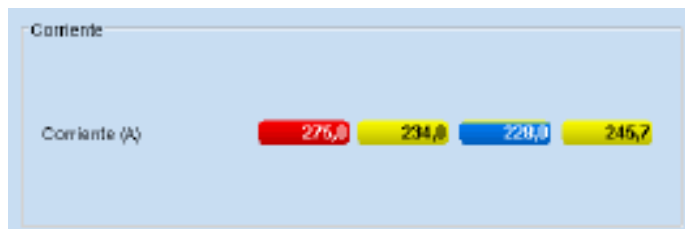


This part of the programme will also vary depending on the equipment chosen. Basically, you can select the period for collecting and logging data in the database (DATA-LOGGER) and the format for displaying the data in digital or analogue format. If the consumed energy is integrated into the equipment, you can assign a default discriminator (energy cost tariff) if this was previously programmed from the "Discriminator" menu. See section 22 of this tutorial

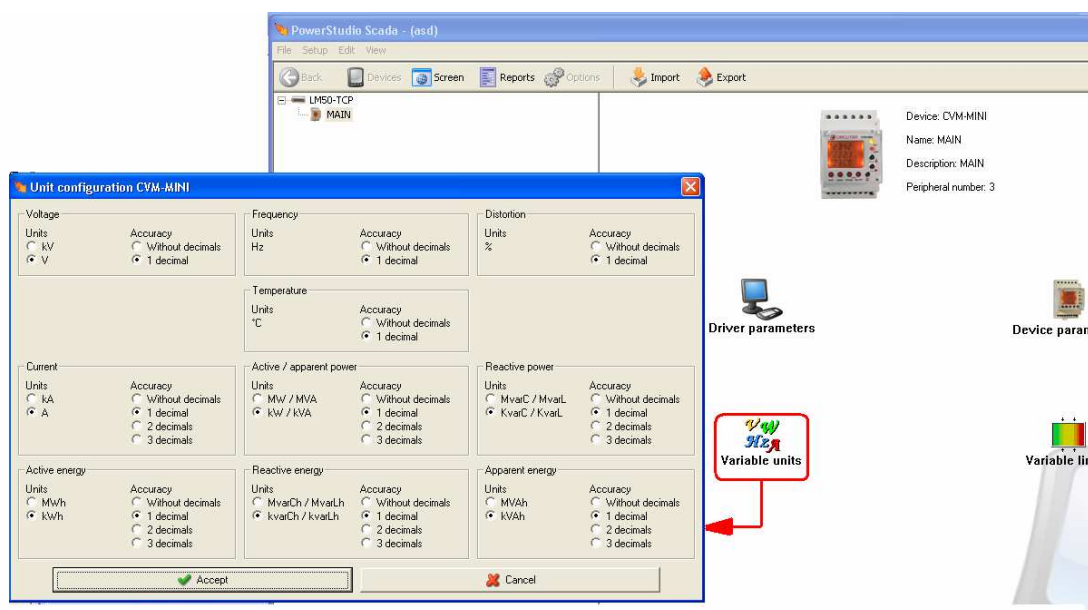
9.3.- CONFIGURING VARIABLE LIMITS:



This programming option allows you to set alarms for each parameter measured or calculated by the equipment. For example, if you configure a nominal voltage value for CVM-MINI and the voltage is % of the PRE-alarm or alarm (over the limit), when you display the device's parameters in real time you will see that the voltages appear in red, indicating a network anomaly. The SCADA alarms, which are a higher level of alarms known as events, will be explained below.



10.- CONFIGURING VARIABLE UNITS:

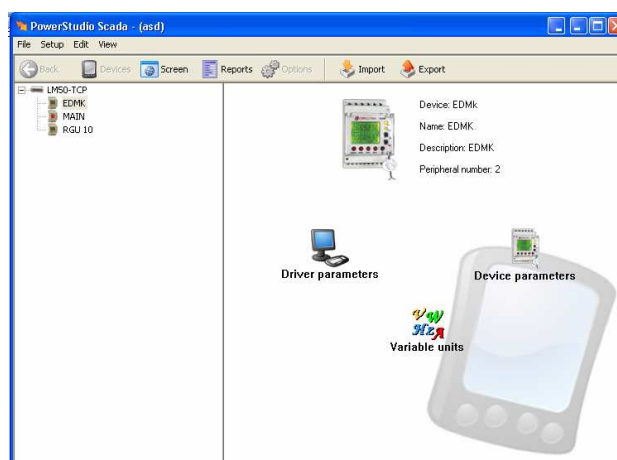


This menu allows you to modify the units of the devices displayed by the software.

11.- PARAMETERS OF THE LM50-TCP DEVICE

In the next step we will connect digital input no. 1 of the **LM50-TCP** as the energy counter input from the **EDMk**. But first we must configure the **EDMk** digital output to generate 1 impulse for each Kw-h. accumulated.

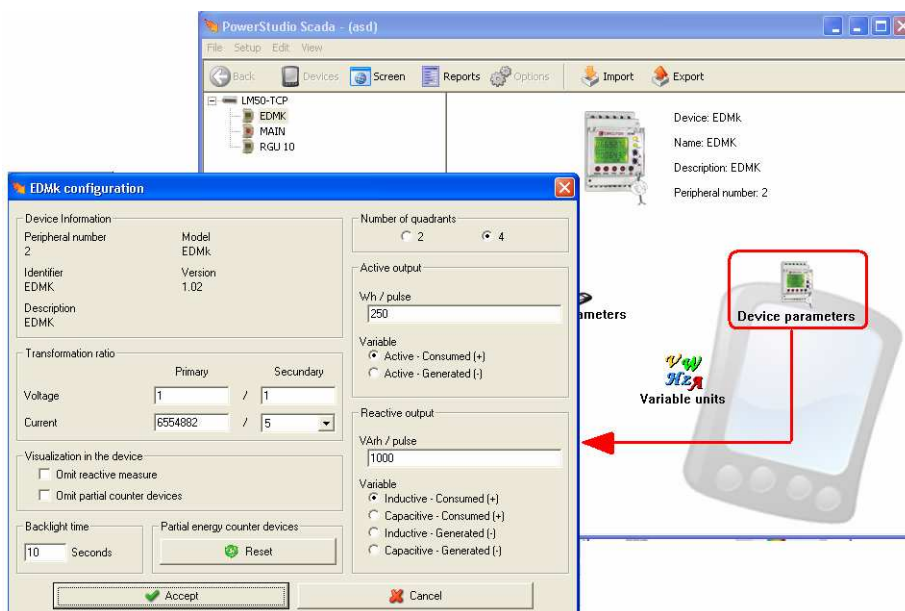
- Select **EDMk**



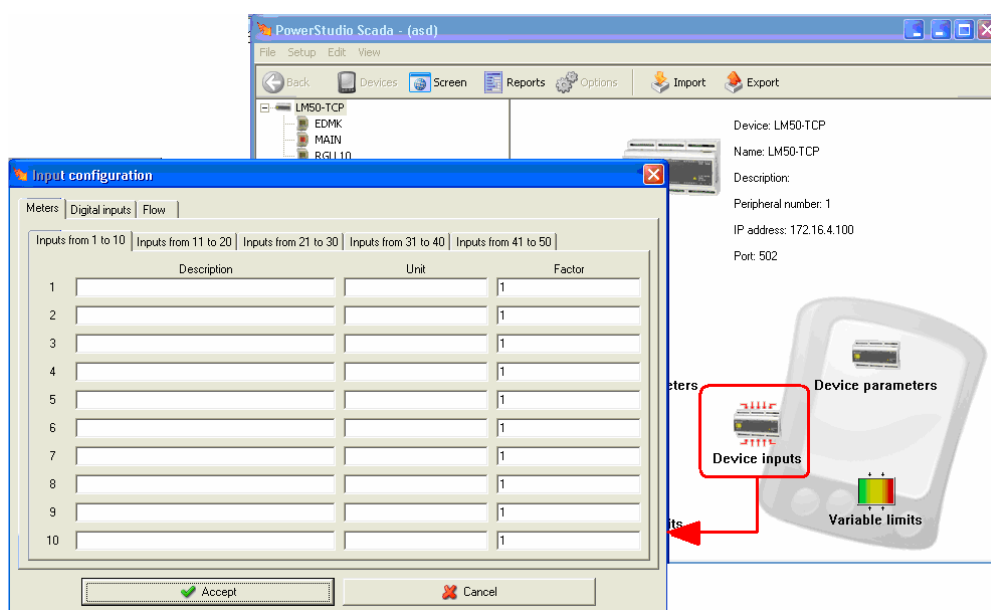
The possible configurations for this device will appear. As you can see, there is no "VARIABLE LIMITS" option. The reason is that the energy counter only displays the

usage accumulated in the counter. Since these variables are values that increase over time, the programme does not show alarm values.

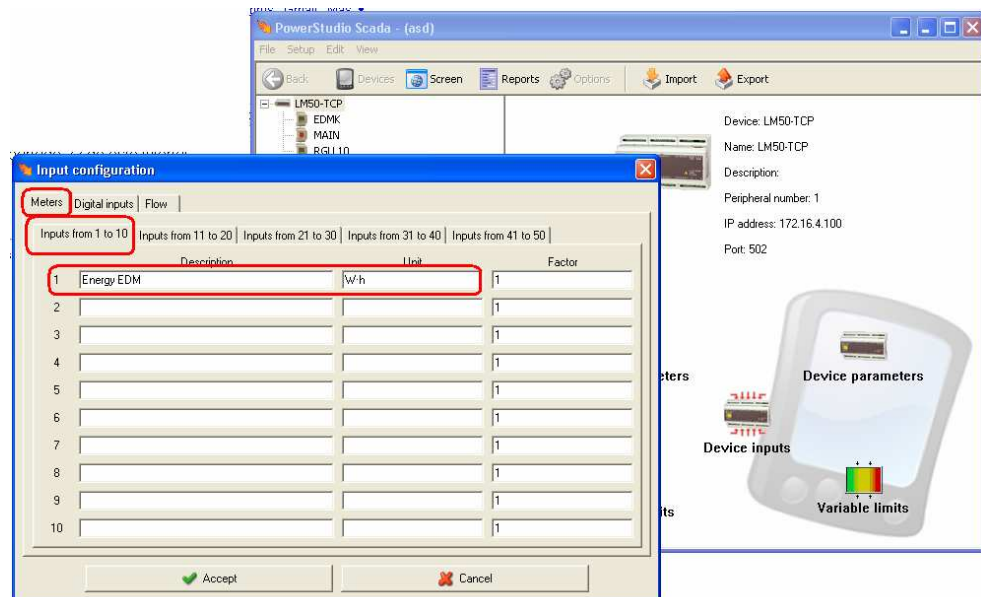
- Click on **DEVICE PARAMETERS** to access the equipment's SET-UP parameters. Remember that you can also do this using the device's keypad.



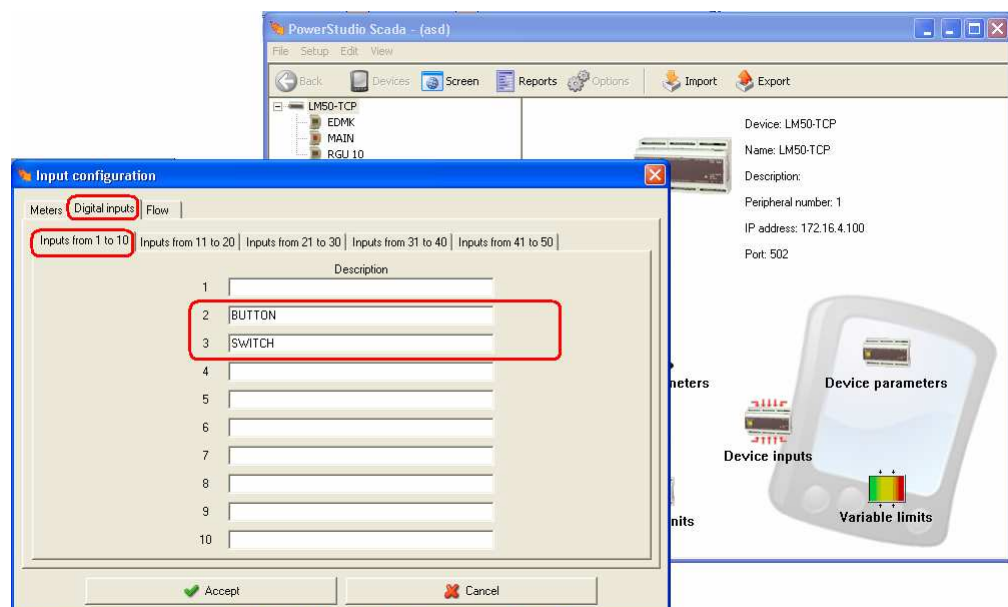
- Configure the active output at 1000 wh/pulse in order for the **LM50-TCP** to read the energy consumed by the **EDMk**.
- Click on **ACCEPT** and the changes will be sent to the device once the application is exported.
- Now, you need to configure the **LM50-TCP**



- Click on **DEVICE INPUTS**. Configure input 1 in Counters as **EDMk**, de W-h counter.



Digital inputs 2 and 3 are configured as digital signals corresponding to the simulator button and switch.

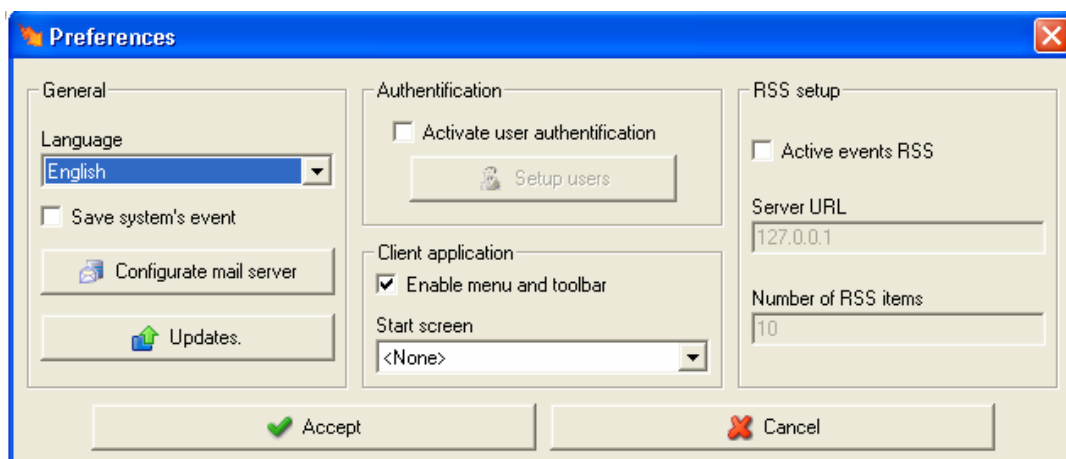


- ACCEPT the changes made.
- Observe the different configuration options of the devices to familiarise yourself with the programme.

In the MODBUS/TCP of **LM50-TCP** there is an option to configure flows. This option allows you to count the impulses during a specific period of time, assigning a particular magnitude to each impulse.

12.- PREFERENCES OF THE DEMO-EXPERT KITAPPLICATION.

Go "CONFIGURE, PREFERENCES":



The following options are also available under programme preferences:

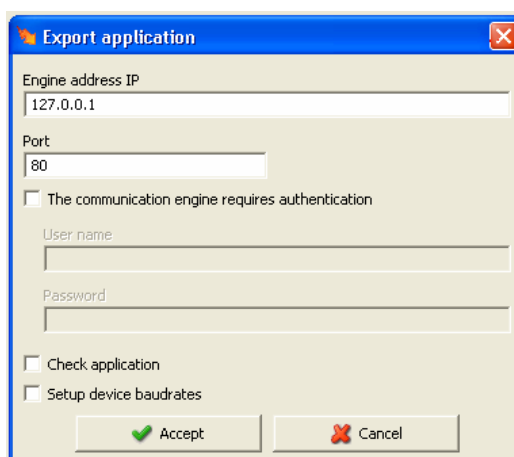
- ✓ **Activate EDITION password.** Protects the programme from being edited if the user does not know the previously defined password.
- ✓ **Language:** Choose the language.
- ✓ **Activate menus and toolbar on the display.**
- ✓ **Activate user authentication.** Allows you to establish users and privileges on the SCADA display. Useful for restricting the use of certain parts of the programme to certain users.
- ✓ **SCADA start screen:** Defines the screen that will be displayed when the application begins from among the SCADA screens previously created.
- ✓ **Activate event RSS:** Allows you to configure the event messages that appear as news items on the website.
- ✓ **Generate upgrade files** for future upgrades of the HASP licence.
- ✓ **Configure mail server:** Allows you to mail server configuration menu in order to send emails as alarms.

13.- EXPORTING TO THE POWERSTUDIO SEARCH ENGINE.

Whenever you create or modify an application, you must then export it. Simply click on the EXPORT button on the toolbar.



Once you have selected this option, type the IP address of the PC where the PowerStudio SEARCH ENGINE is installed. If you are editing the application in the same computer where the PowerStudio SEARCH ENGINE is installed and connected to the CIRCUTOR equipment, the IP address will be the Local Host (127.0.0.1) and the port configured in the ENGINE MANAGER window will be 80 by default.

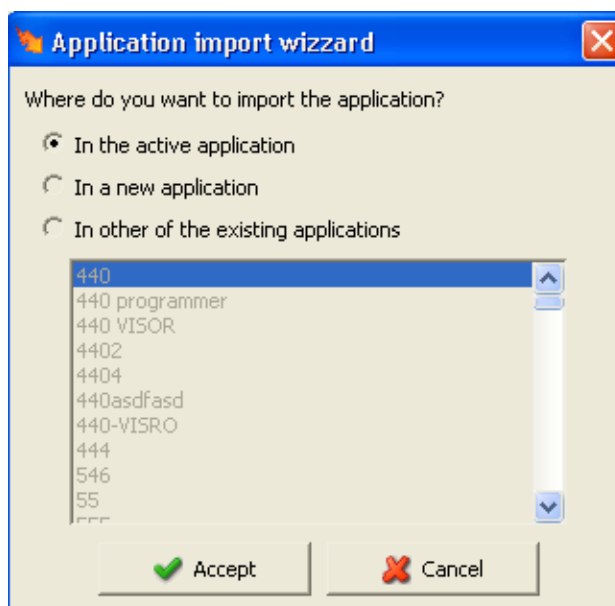


14.- IMPORING AN APPLICATION:

Likewise, it is possible to recover an existing application from the SEARCH ENGINE.



Choose one of the options offered by the program for recovering a PowerStudio application running in an existing SEARCH ENGINE.

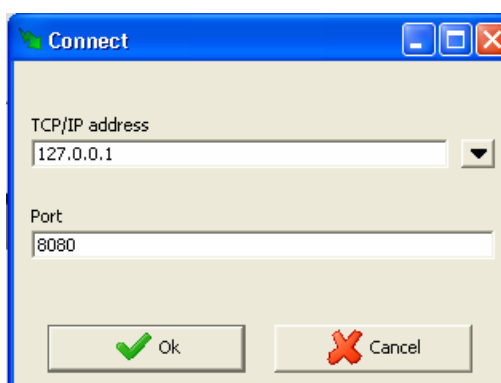


15.- VIEWING THE APPLICATION

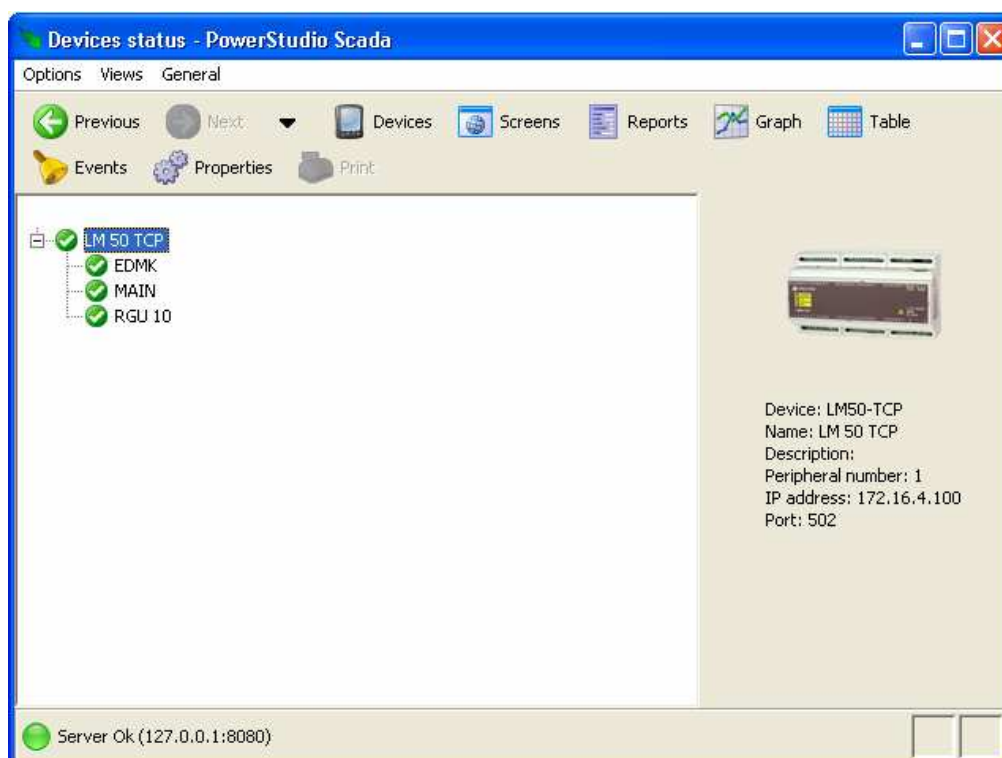
Using PowerStudio CLIENT and a JAVA-compatible Internet browser, you can monitor the equipment parameters, SCADA screens, events and historicals in table or graphic format.

15.1.- USING THE CLIENT OPTION

- Run Scada PowerStudio Client using the START/PROGRAMMES/CIRCUTOR menu
- Click on GENERAL / CONNECT.

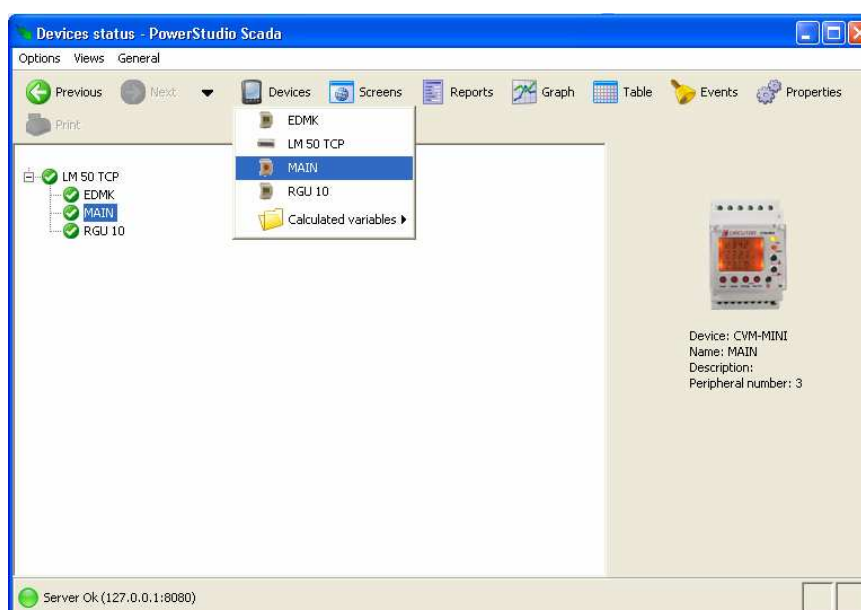


If you connect to IP address 127.0.0.1 (default) you are connecting to the “local host”, i.e., the local PC application. You can modify this IP address and connect to a remote PC application running on the same network or visible from the routers (correctly programmed).



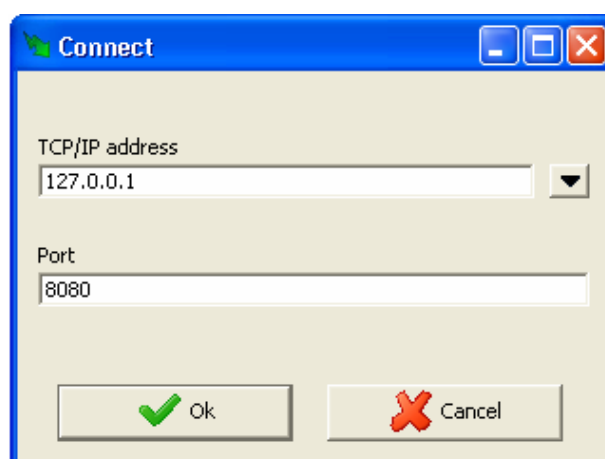
The home screen shows the status of the communications with the equipment. You can monitor the data in real time by selecting each one of the devices.

Using the DEVICES option, you can select the 4 devices available in the application one by one and see the instantaneous values measured by the equipment in real time. Modify the values of the signal generator to refresh the variables.





PowerStudio Client is a remote console that monitors the application housed in a particular SEARCH ENGINE. It can be installed in other PC and used at the same time to see the same application using the IP address of a particular SEARCH ENGINE or ENGINES. To do so, go to the GENERAL menu, click on CONNECT, enter the IP address of the main PC where the PowerStudio SCADA SEARCH ENGINE is installed and operating.



The 'Connect' dialog box has a title bar with a green arrow icon and standard window controls. It contains two input fields: 'TCP/IP address' with the value '127.0.0.1' and a dropdown arrow, and 'Port' with the value '8080'. At the bottom are 'Ok' and 'Cancel' buttons with green and red checkmark/cross icons respectively.

In this case, since the SEARCH ENGINE is installed in the same PC from which the application is being edited, we will use the default Local Host address and ports.

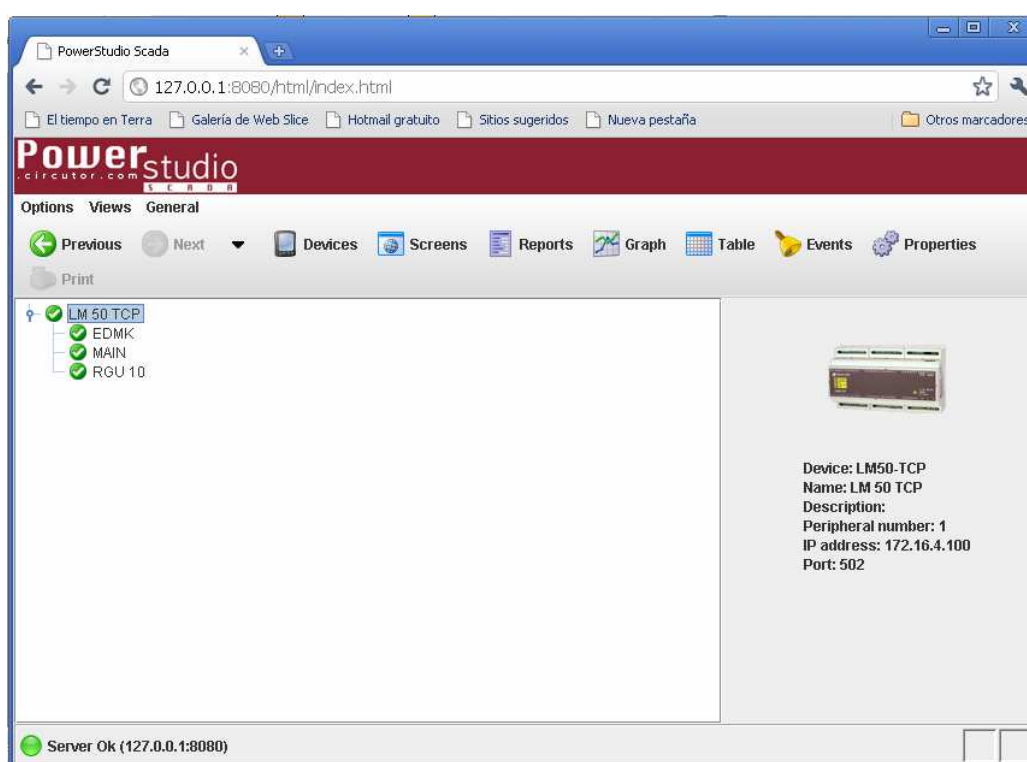
15.2.- USING INTERNET EXPLORER.

At this point you will see the PowerStudio SCADA SEARCH ENGINE application using Internet Explorer.

Run Internet Explorer

Enter the IP address of the practice computer on the address bar (in Internet Explorer). If you do not know the IP address of the computer, enter: //LOCALHOST or IP address **127.0.0.1**

The application is monitored from Internet Explorer, as shown in the figure:



16.- CREATING SCADA SCREENS

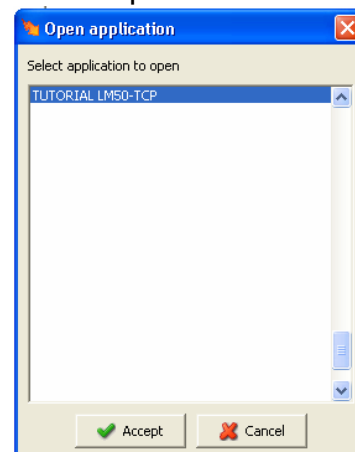
A SCADA screen or application is a software application that is specially designed to run on computers providing communications with field devices and facilitating the automatic control or supervision of a process from the computer screen. It also provides process-related information to different users at the same level and supervisory users within the organisational hierarchy (supervision, quality control, production control, data storage, etc.).

16.1.- CONFIGURING VISUAL APPEARANCE AND FUNCTIONALITY.

If you installed the tutorial's installation package, the sample application was installed on your PC's hard disk. You can open the sample application to follow the steps of this tutorial or continue using the application you've been using so far.

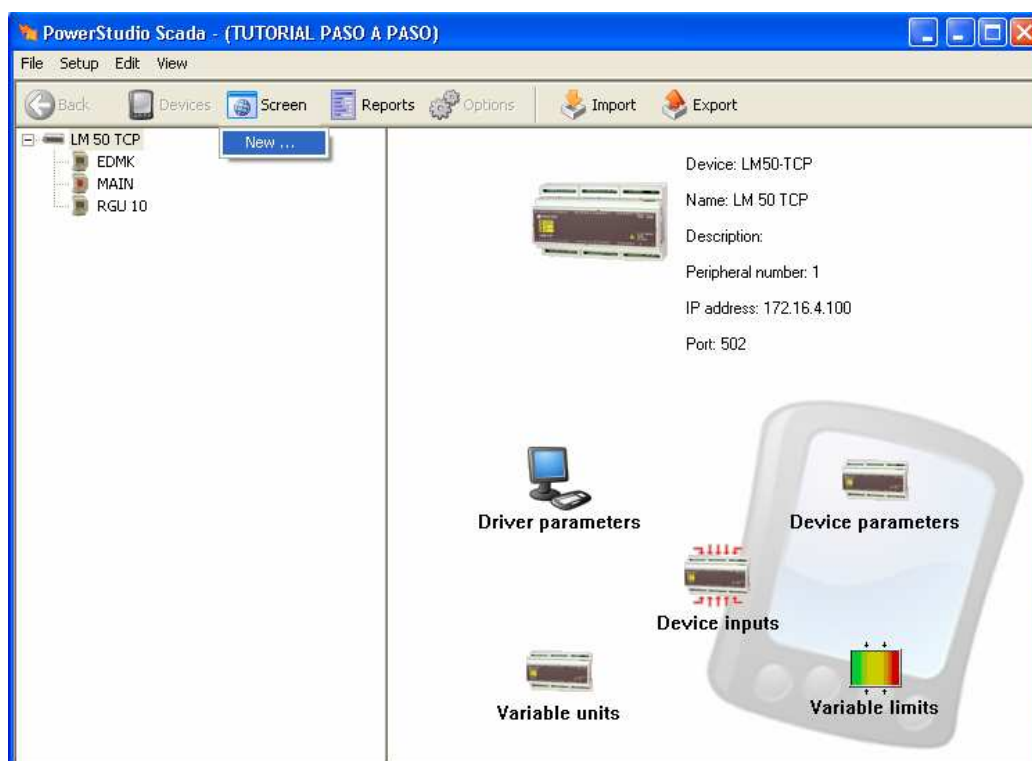
To load the sample application:

- Open an EDITOR session in PowerStudio SCADA.
- Click on "File" and select "Open".
- On the next screen choose TUTORIAL and click on "Accept".



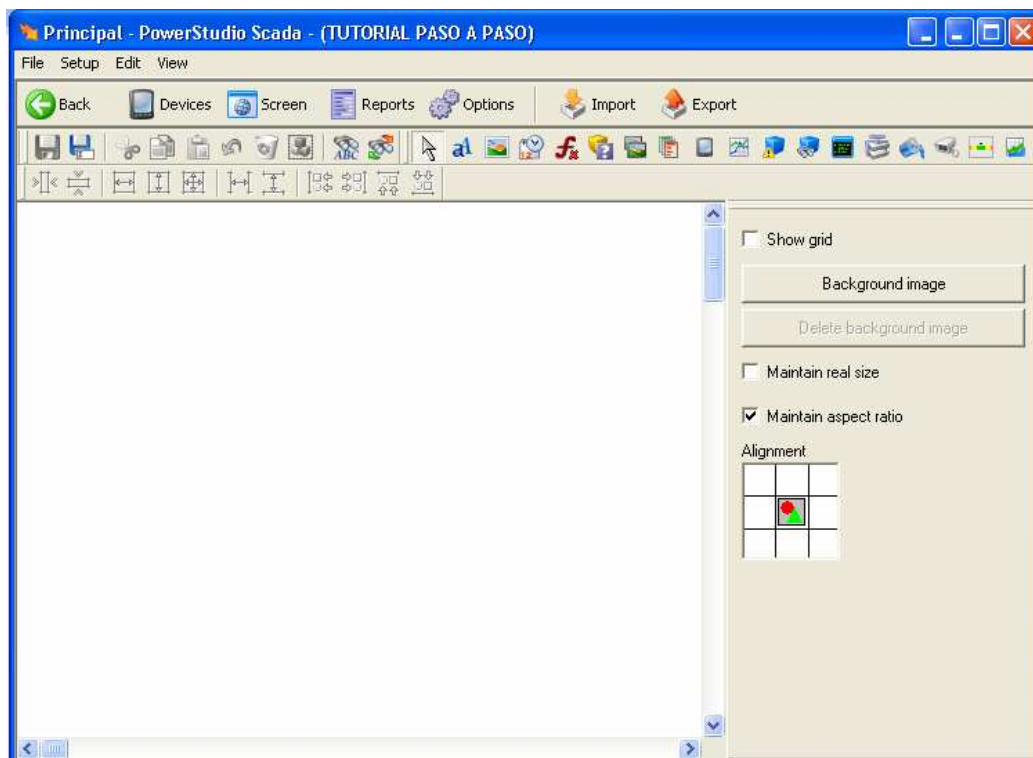
The next step is to create 2 SCADA screens using a previously edited background and the image editor. To do so you can use PowerStudio SCADA's EDITOR controls.

- Go to CONFIGURE and choose SCREEN, NEW



- Enter the name of the Screen, e.g., HOME, and ACCEPT

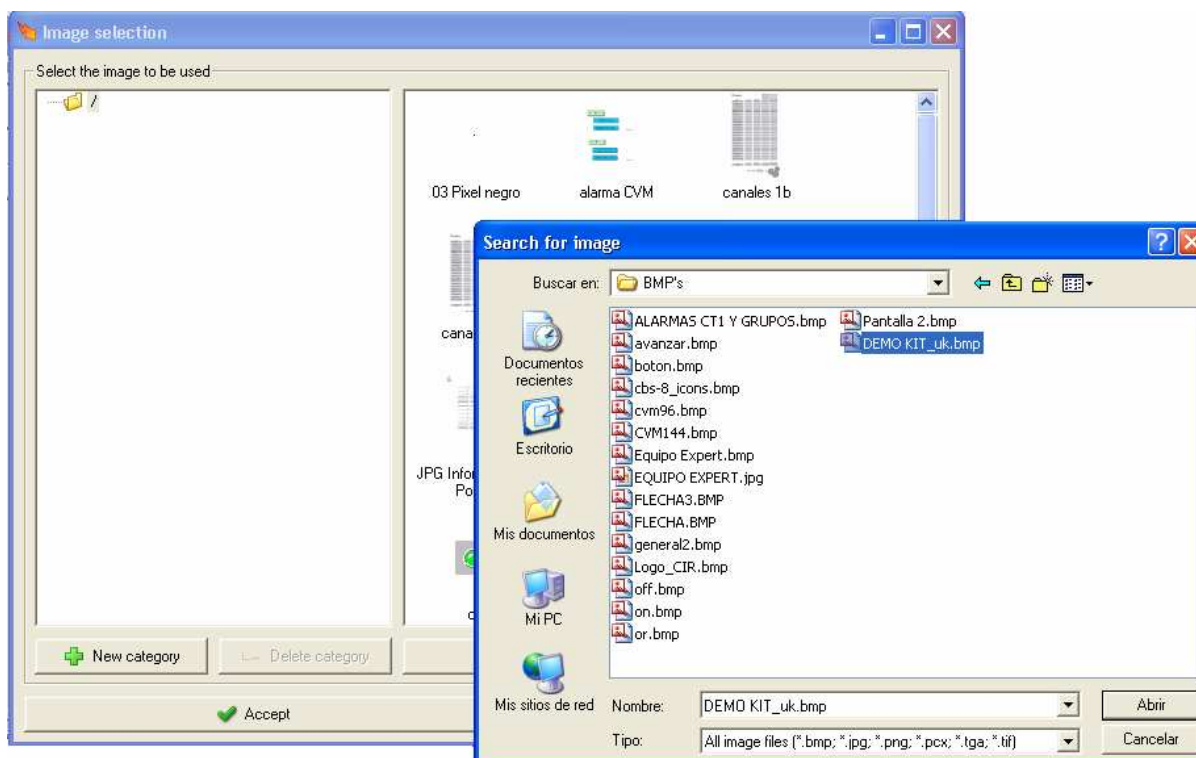
The SCADA Screens workspace will appear



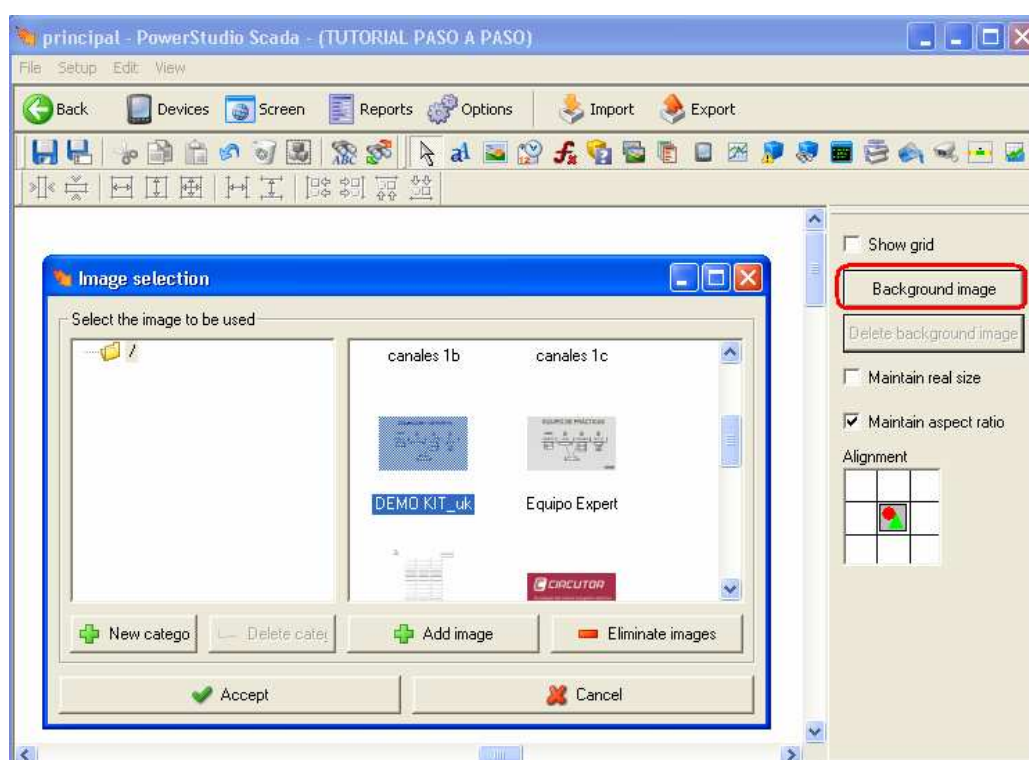
16.2.- APPLICATION BACKGROUND - IMAGE MANAGER:

Before associating an image and a background, you must tell the programme which images you are going to use and where they are located. If the tutorial is correctly installed, all of the image files are located in the directory **C:\Archivos de programa\Circutor\PowerStudio SCADA 3.0.2 TUTORIAL\BMP's**.

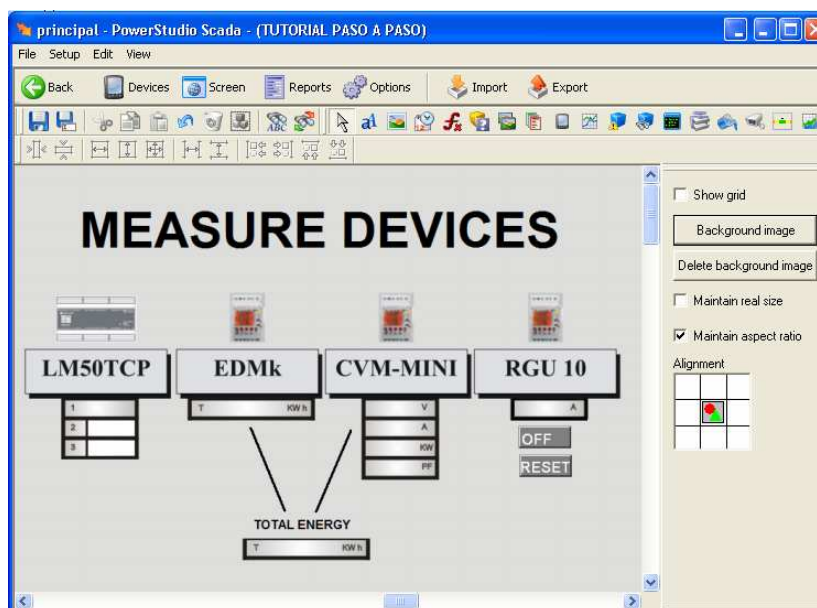
- Go to CONFIGURE and then IMAGE MANAGER
- Once in IMAGE MANAGER, right click on the blank screen that appears to the right of the folder and click ADD
- Search for and add all of the images pertaining to the **DEMO-EXPERT Kit** application as shown on the following figure:



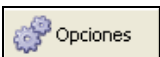
- Add all of the images and click EXIT.
- In the SCADA Screen design area, in order to associated the Background image with the SCADA Screen, go to the tools on the right side of the Screen and click on BACKGROUND IMAGE.

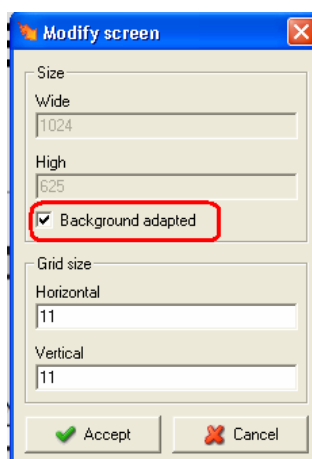


- Choose the image EQUIPO EXPERT.BMP



The option KEEP REAL SIZE or KEEP PROPORTIONS allows you to use the resolution of the original image or to expand it, if necessary, to adapt it to the size of the screen.

- Follow these steps to create another screen named SCREEN 2 and associate it with the image PANTALLA 2.BMP as the Screen Background
- Once the image has been added to the screen background, click on  and choose the option ADAPTED TO BACKGROUND, as shown in the figure:

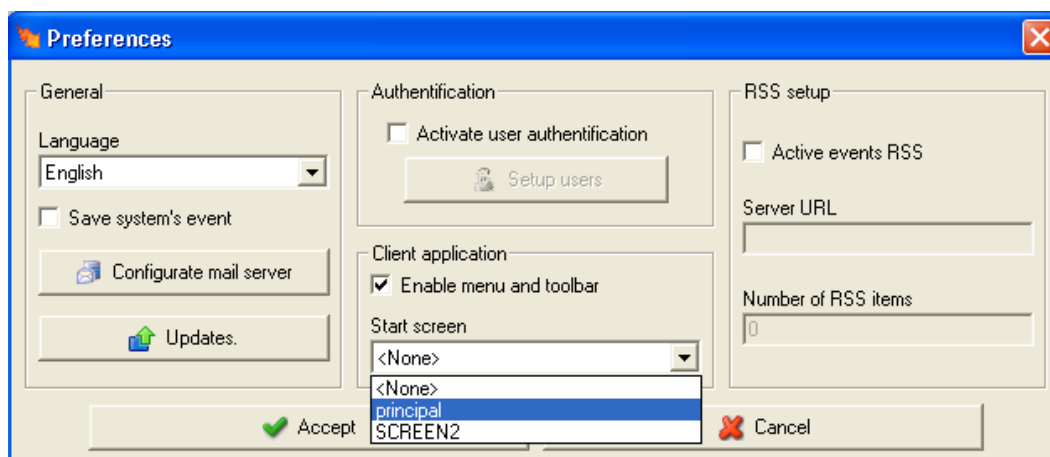


This option is required in order for the application to respect the resolution of the Screen background.

- If necessary, you can also apply this option to the home screen.

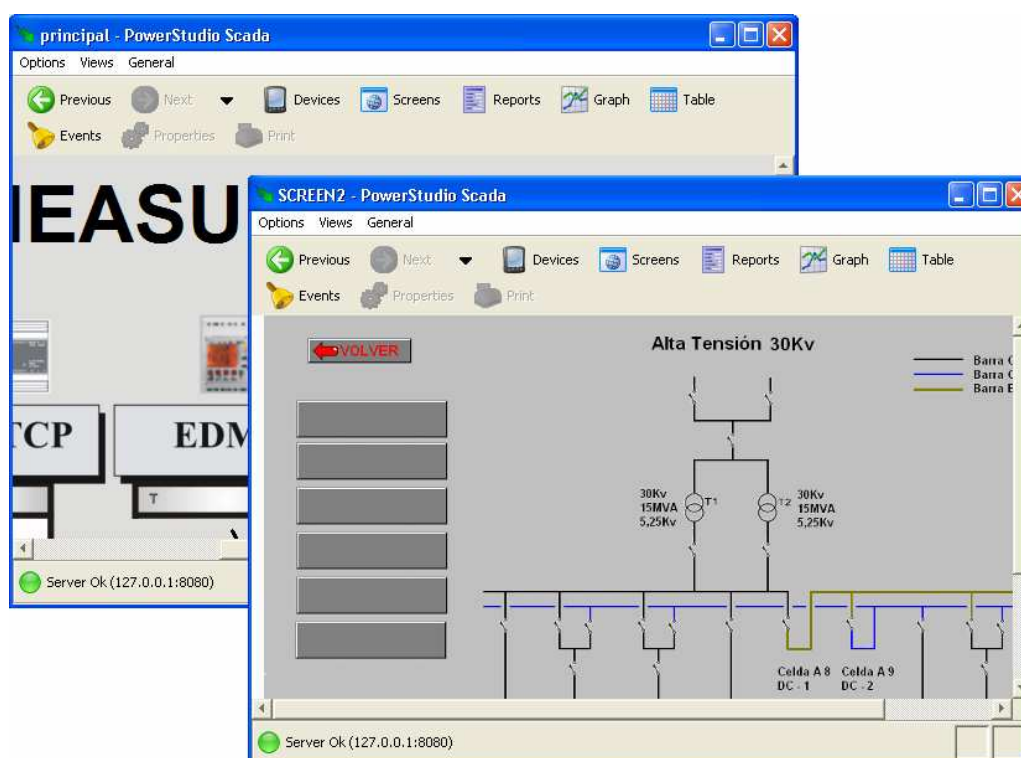
Once you have created the 2 screens with their respective backgrounds, you need to define which screen will be shown first by the CLIENT. Normally one screen is used as a home page, index or portal with access to other screens or devices.

- Go to the CONFIGURE menu and choose PREFERENCES.
- Choose the screen called HOME as the home screen.



- Click ACCEPT in Preferences to validate the home screen.

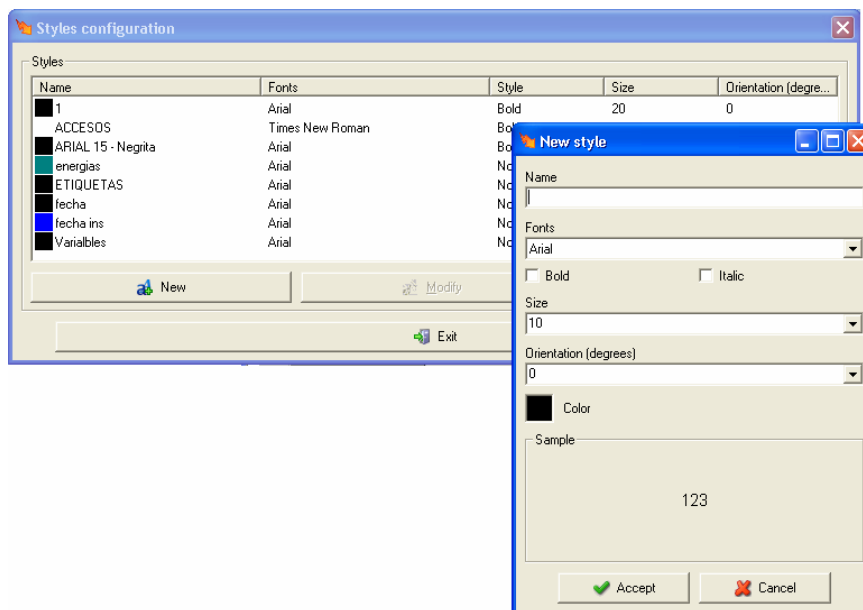
If you want to see the results so far, export the application to the local SEARCH ENGINE (IP 127.0.0.1 port 80) and run PowerStudio SCADA CLIENT. The chosen home screen will appear. You can choose the screen to be displayed by clicking on the SCREEN icon or the VIEW / SCREENS menu.



16.3.- DEFINE TEXT STYLES

PowerStudio SCADA can import any font installed in the computer's operating system. It also allows you to predefine a specific font type and size in order to associate the text controls with a certain style.

- Go to the CONFIGURE menu and choose STYLES.
- Add a new style, define the font type and size.



16.4.- SIDE TOOLBAR

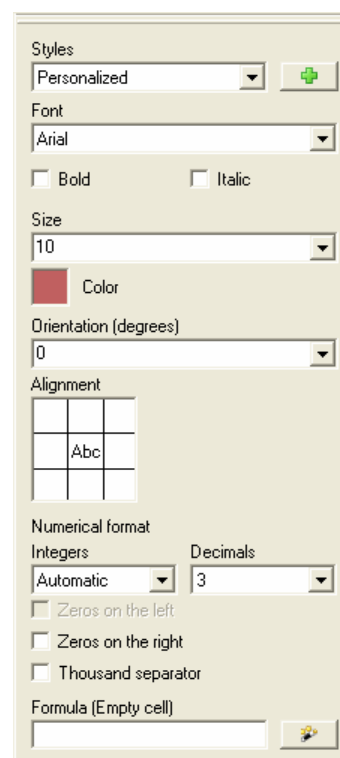
This toolbar changes depending on the control selected on the Edition screen of PowerStudio SCADA.

Here you can change the visual appearance of the control and assign the control to a variable.



“Wizard” button: This is the most important tool in PowerStudio SCADA Editor. It is used to open the assistance for searching through equipment variables, formulae, arithmetic functions, logical functions, etc.

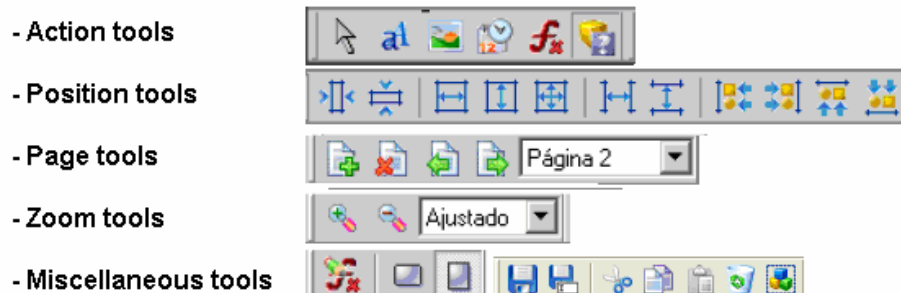
From this point on you will be using the different action tools to complete the 2 SCADA screens created previously. To facilitate the use of the programme, many of the controls available for designing SCADA screens are the same as those used to design REPORTS, which are explained in a separate section of this tutorial.



The examples described here refer to the SCADA HOME test screen. You can check the changes as you are making them using SCADA PowerStudio CLIENT.

In addition to the SCADA tools, there is a series of mathematical and time functions which can also be accessed using the “wizard” button.

16.5.- SCADA SCREEN TOOLBAR.



The function of each one of these tools will be explained throughout this tutorial. For more information, please see the PowerStudio EDITOR manual.

16.6.- CONTROL SELECTOR.



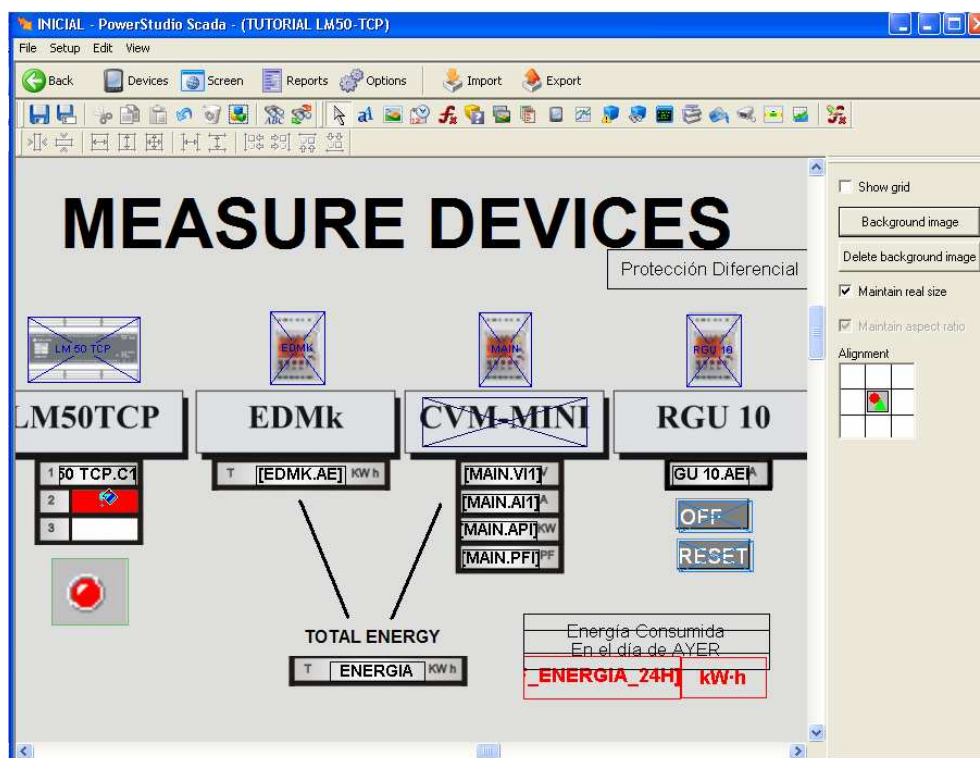
This is required to disable a different tool chosen previously.

16.7.- TEXT CONTROL



This is used to add text to the SCADA screens if it is not already included on the screen background.

- Go to PowerStudio SCADA EDITOR and choose the previously-created SCADA HOME screen.
- Choose the Text tool and type the text anywhere on the screen.
- Note that when you select the text box just added, the side toolbar appears on the right side of the screen with the different options related to the text format.



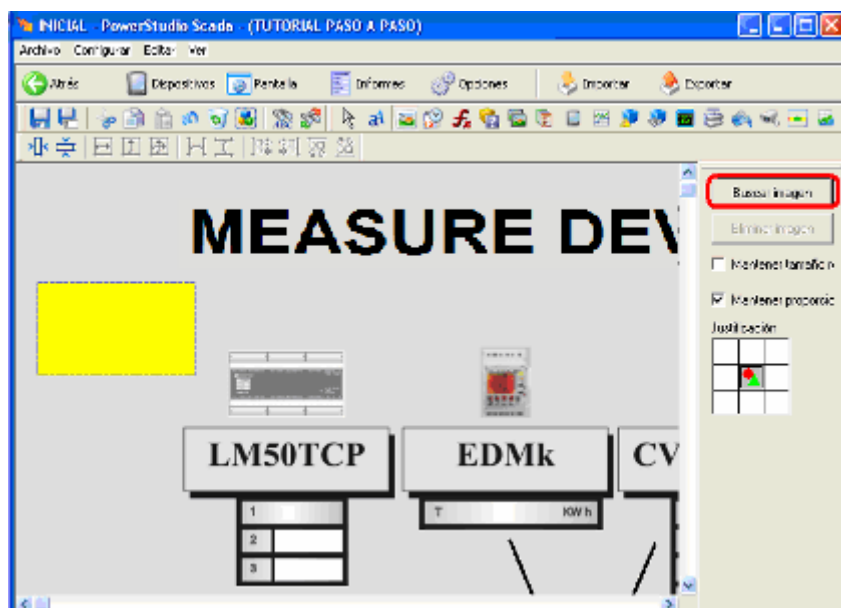
- Check the different tools associated with the text box.

16.8.- IMAGE CONTROL



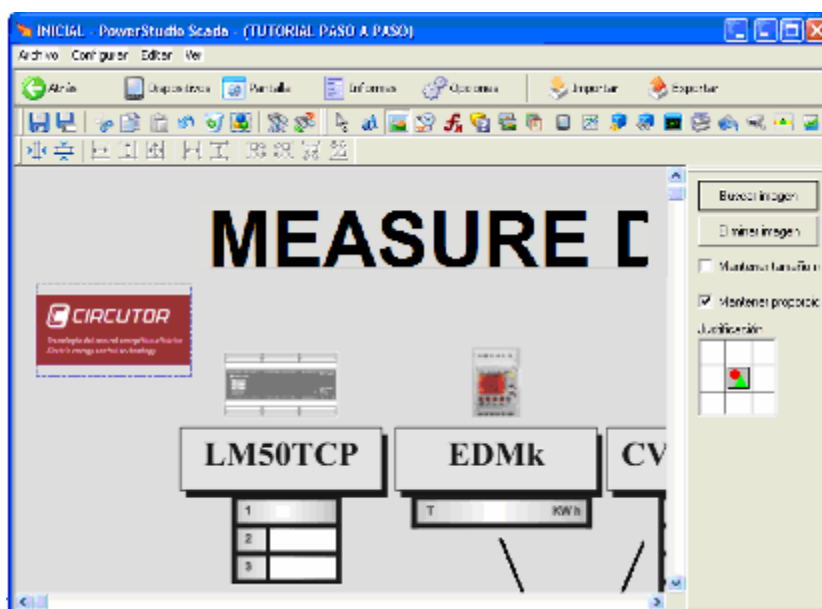
This is used to add images to the existing SCADA screen.

- Select the Image Control tool, click anywhere on the active window and drag it without releasing the mouse button. Part of the screen should be yellow. This means that the Image Control has no image associated with it and the dimensions will therefore be the ones you have chosen.
- Click SEARCH IMAGE on the side toolbar.



- If the tutorial was installed correctly on your PC, the Image Manager will appear with the images corresponding to the **DEMO-EXPERT Kit**. application. Select the **LOGO_CIR.BMP** image and **ACCEPT**.

The screen will look like this:

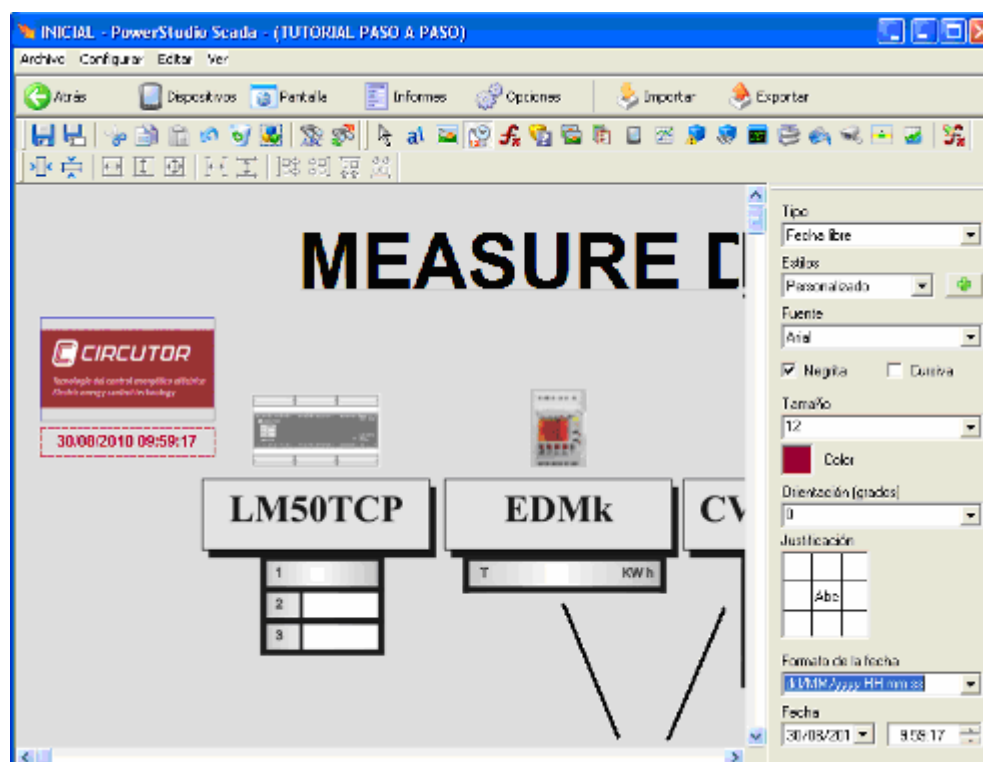



16.9.- DATE AND TIME CONTROL:

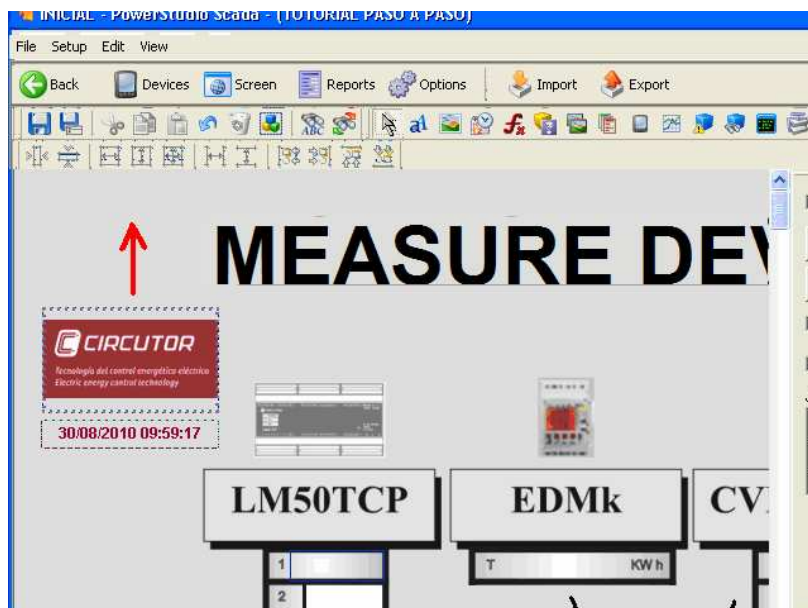


This control allows us to view the current time and date or a different date on a SCADA screen.

- Choose the date and time control and place it underneath the Circutor logotype in a small rectangle.



- Choose CURRENT DATE from the tools associated with the date and time control (on the right). The current date will now appear on the SCADA CLIENT screen.
- Note that the date and time control tools offer the possibility of modifying the font and layout and that these options are common to most of the Action Controls:
- Align the logo and the time/date field with the title on the HOME screen. To do so, choose "select controls" . Position the cursor in the upper left hand corner of the CIRCUTOR logo. Click and drag the mouse pointer to encompass the image and date control at the same time. Both controls will be surrounded by a dynamic dotted line indicating that both controls are selected.
- Position the mouse on the selected area and the pointer will change to an open hand. When you click on the area, the icon of the hand will change. Drag the logo and the date with the mouse until they are aligned with the title of the HOME window.



16.10.- FORMULA CONTROL.



This control is used to show the SCADA screens the variables measured by the devices and/or the formulae created with FORMULA EDITOR. The role of Formula control is basically to display the real time parameters of the installed equipment on the SCADA screens.

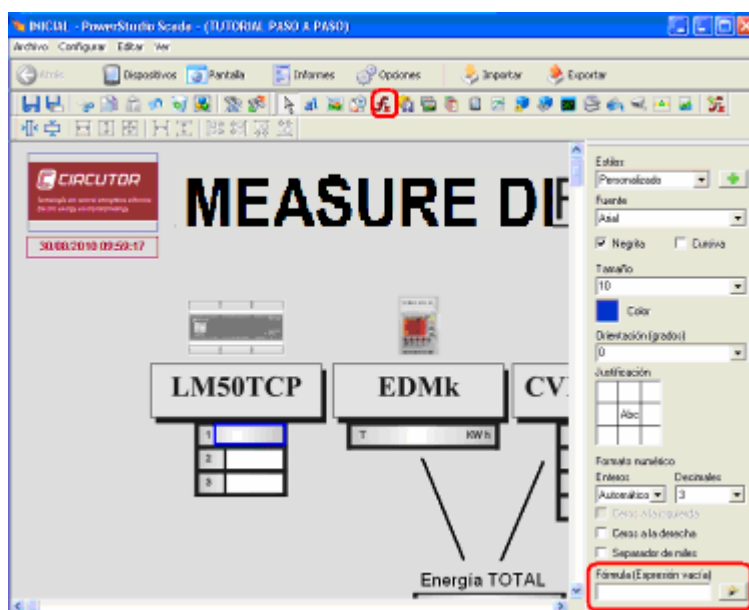
- Next we will edit the SCADA HOME screen to show the following information in real time:

LM50-TCP Show digital input 1 meter

EDMk Show cumulative Kwh.

CVM-MINI Show Phase 1 Volts, Phase 1 Amps, KWIII and Power Factor III.

- Choose the Formula Control tool and generate a label in the space Reserved for Input 1 just below the **LM50-TCP** sign. See figure:

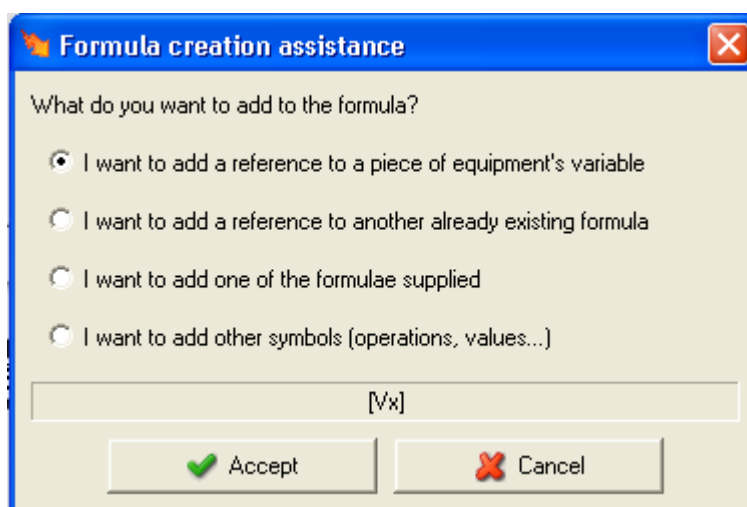


- Once you have created the area where the data will be displayed (shown in blue on the image above), go to the Formula Control toolbar.



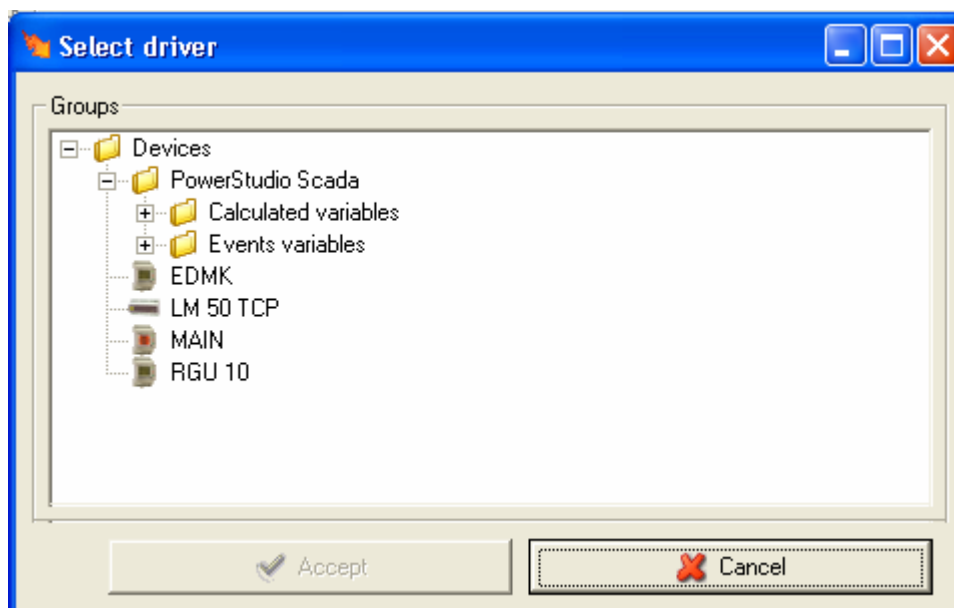
- Click on the “Wizard” button.

The variable search assistant will appear:



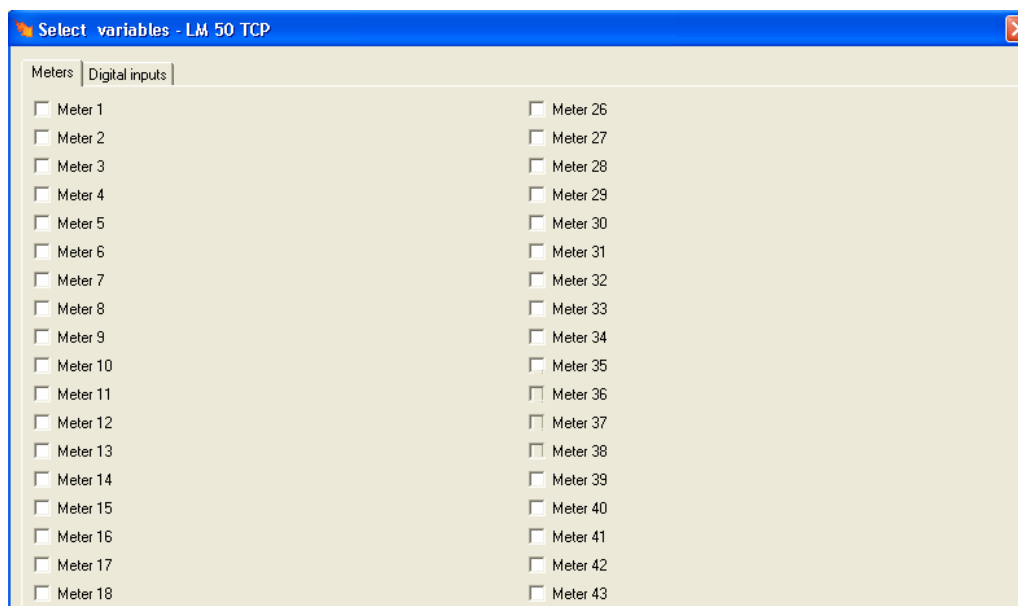
- Choose the first option: **ADD A REFERENCE TO A VARIABLE OF A DEVICE** and click **ACCEPT**.

- A new screen will then appear where you can choose the device for which you wish to show the variable. In the DEMO-EXPERT Kit application, choose **LM50-TCP**.

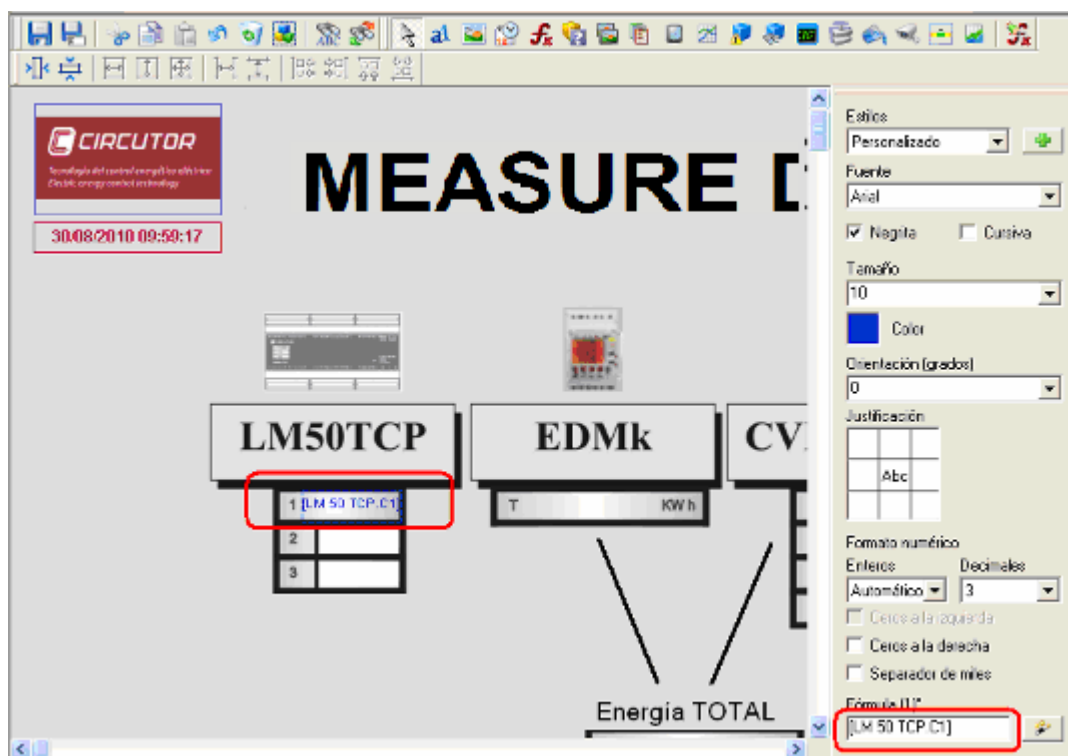


As you can see, not only is it possible to add equipment parameters. Using this control, you can also add previously configured calculated variables or event variables. See section 19 for the configuration procedure for calculated variables and section 22 for the creation of events.

- Click on accept and the variables measured or calculated by LM50-TCP will appear.



- Select the meter 1 variable. Remember that in the **DEMO-EXPERT Kit**, the **LM50-TCP** counts the impulses generated by **EDMk** based on the energy consumed.
- Click ACCEPT.

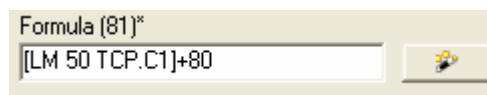


Note the appearance of the COMMAND that defines the variable to be displayed in the Formula box and on the label added on the SCADA screen. This command corresponds to the name associated with the equipment and an extension that defines the particular variable, in brackets.

If you know the variable to be entered, you can type it in the formula space using the keypad.

The programme allows you to enter simple operations in the space for inputting the Formula.

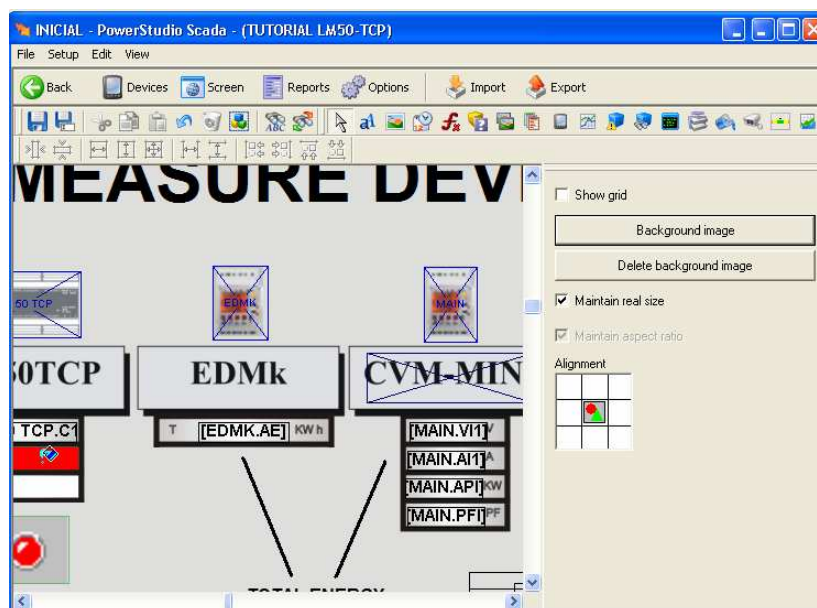
For example:



The value 7108, which appears in parentheses next to "Formula" refers to the result of the ADDING operation, having already taken the value of the meter 1 input from the LM50-TCP + 80. The operations can also be based on the variables from different devices.

If the contents of a Formula entry are incorrect, the programme will show the message SYNTAX ERROR.

- Following the same steps as above, create the parameter displays for the remaining devices, **EDMk**, **CVM-MINI** and **RGU-10**



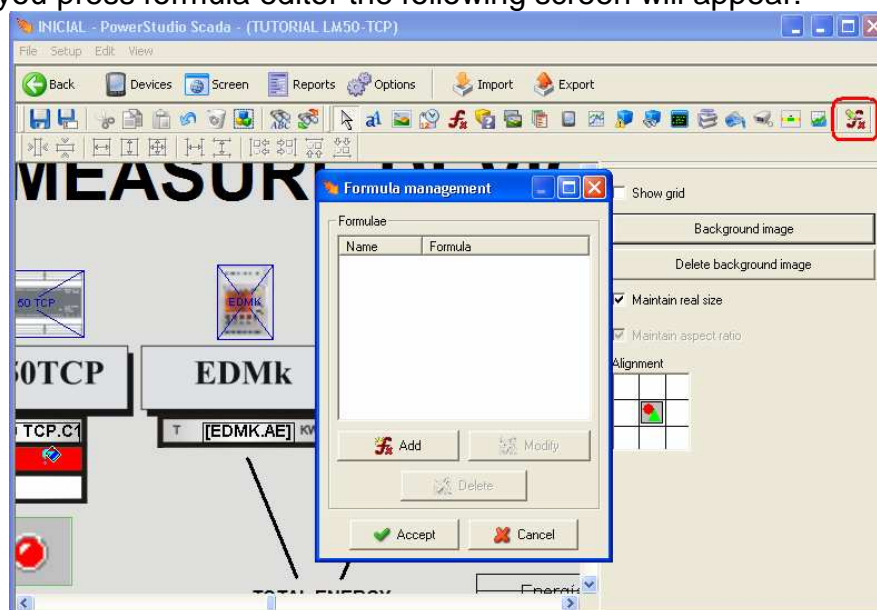
16.11.- FORMULA CONFIGURATION:



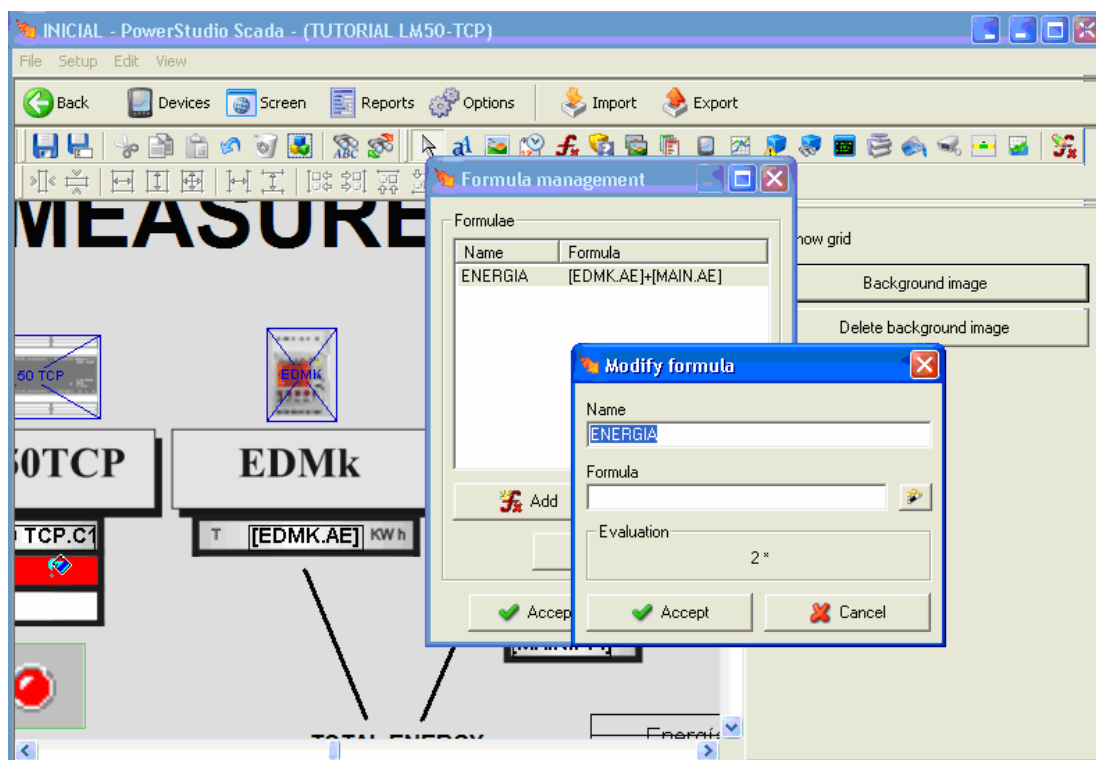
The Formula editor allows you to define new variables to be displayed based on arithmetic calculations between equipment variables and/or constants defined in formula editor.


For the **DEMO-EXPERT Kit**, you will define a formula that adds the cumulative Kwh recorded by **EDMk** and **CVM-MINI** to obtain the total energy in order to simulate a facility's total usage.

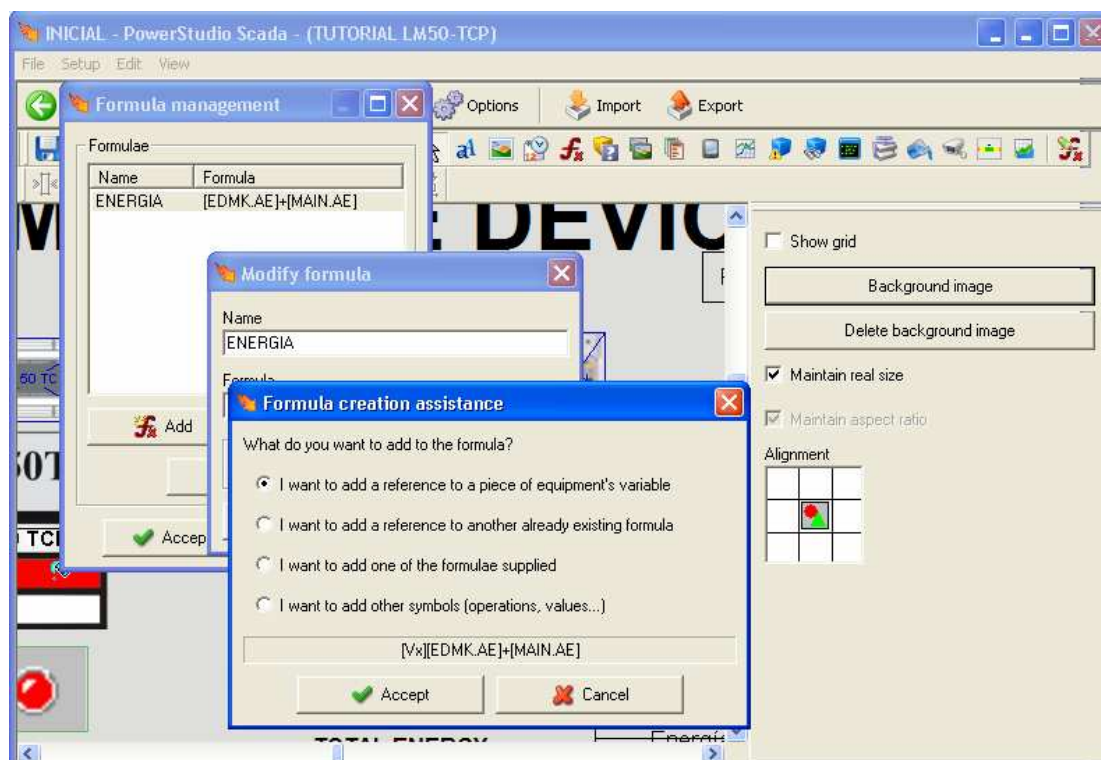
- When you press formula editor the following screen will appear:



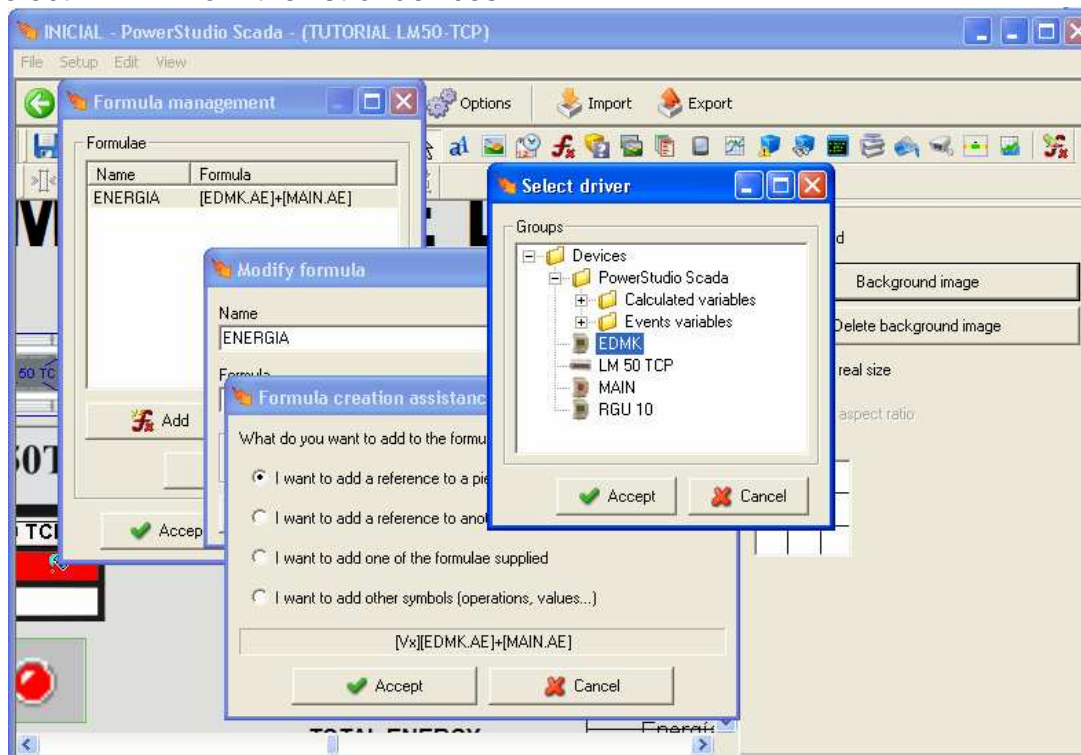
- Press ADD to define the formula



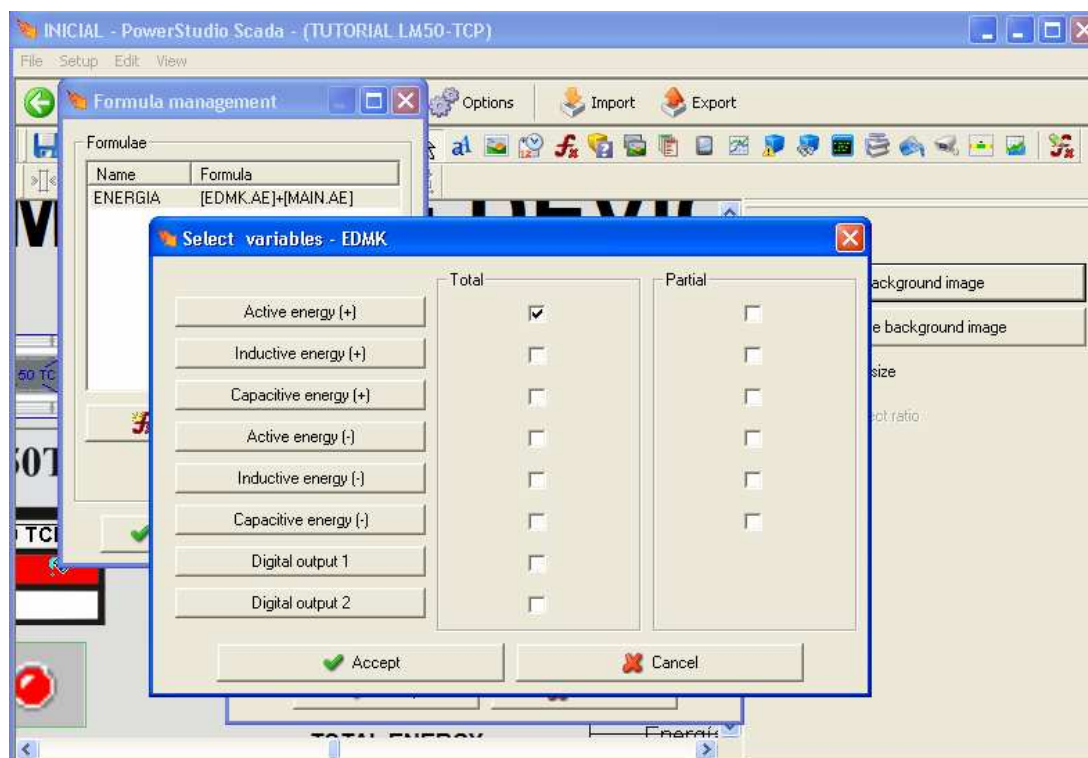
- Enter a formula name such as: ENERGY
- Next, press the button next to Formula  and the "Wizard" will appear to link the formula to the origin of the formula data.



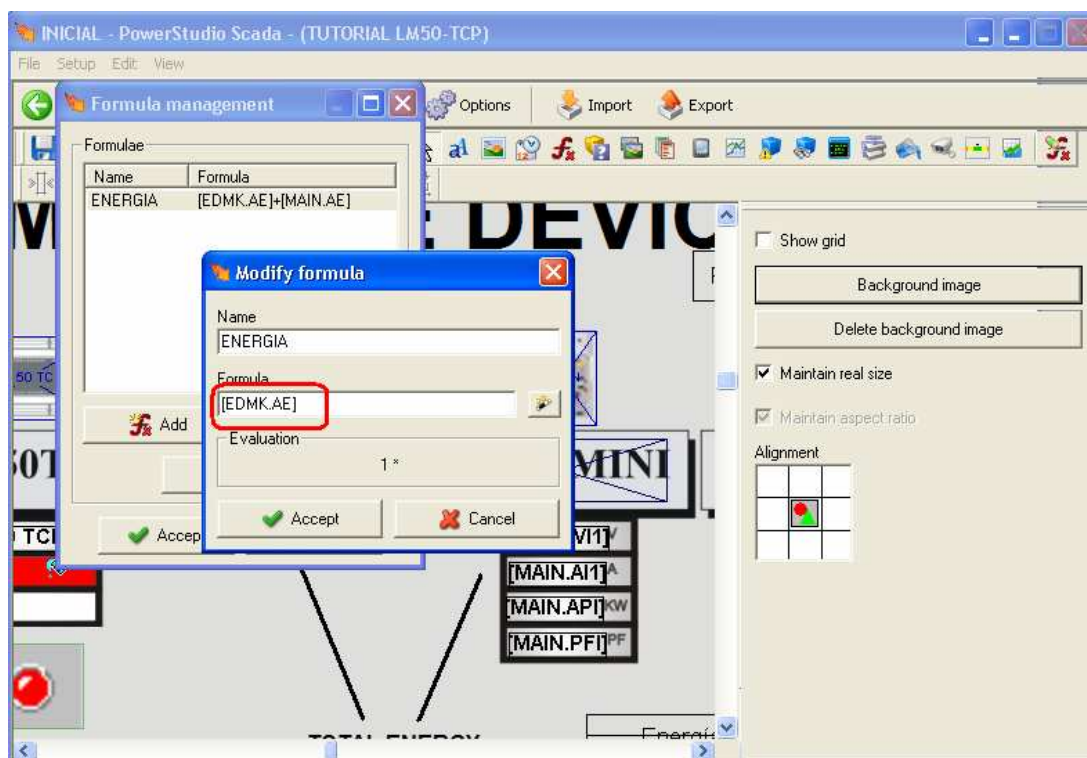
- Choose "ADD A REFERENCE TO A VARIABLE OF A DEVICE".
- Select **EDMK** from the list of devices.



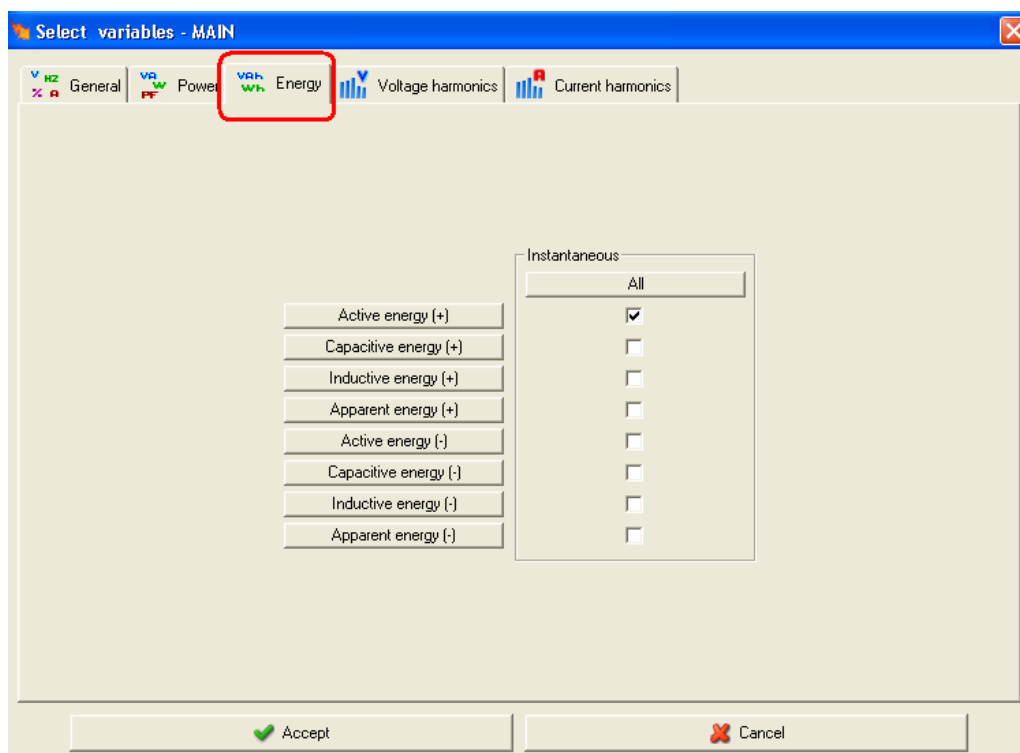
- Select the “energy +” variable for the EDMk device.



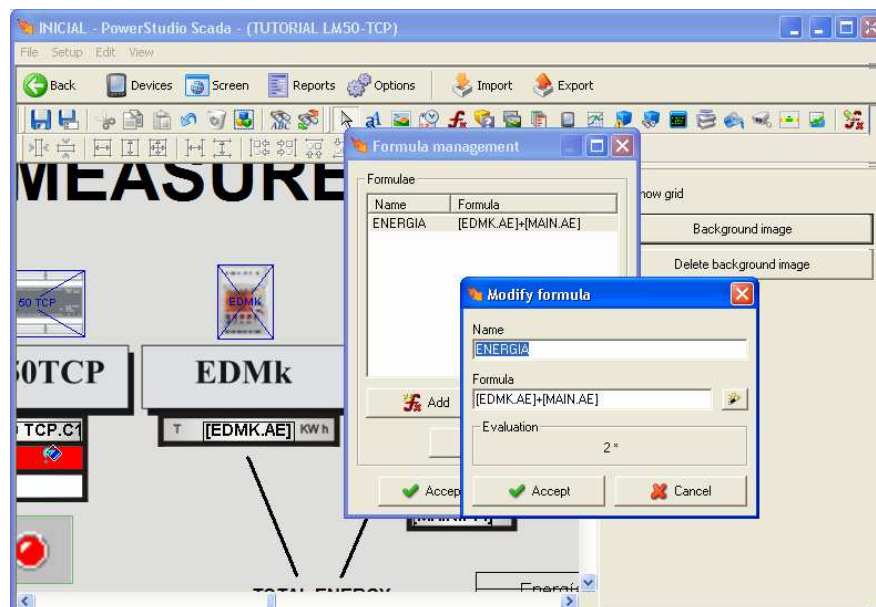
- The link to the energy from **EDMK** to be added will appear in the formula editor.



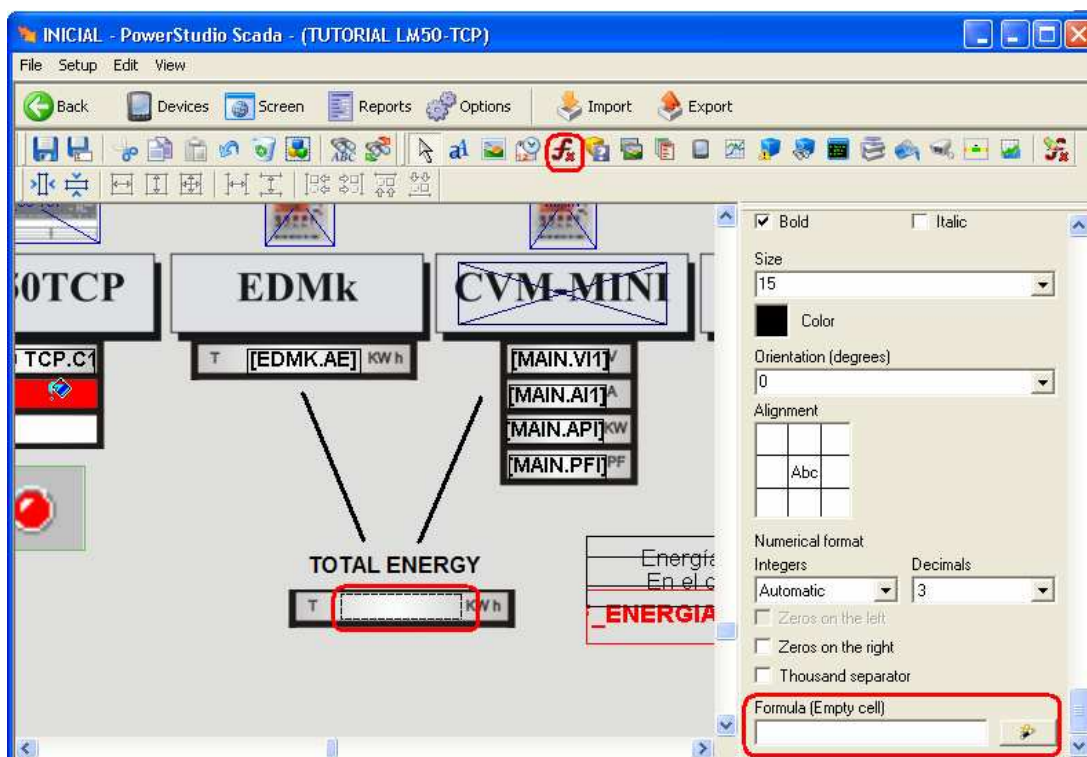
- Along with the energy command for **EDMK** you must also enter a plus sign +.
- To continue, click on the variable search “Wizard” again and follow the same steps as above to add the consumed energy from the MAIN device (**CVM-MINI**).



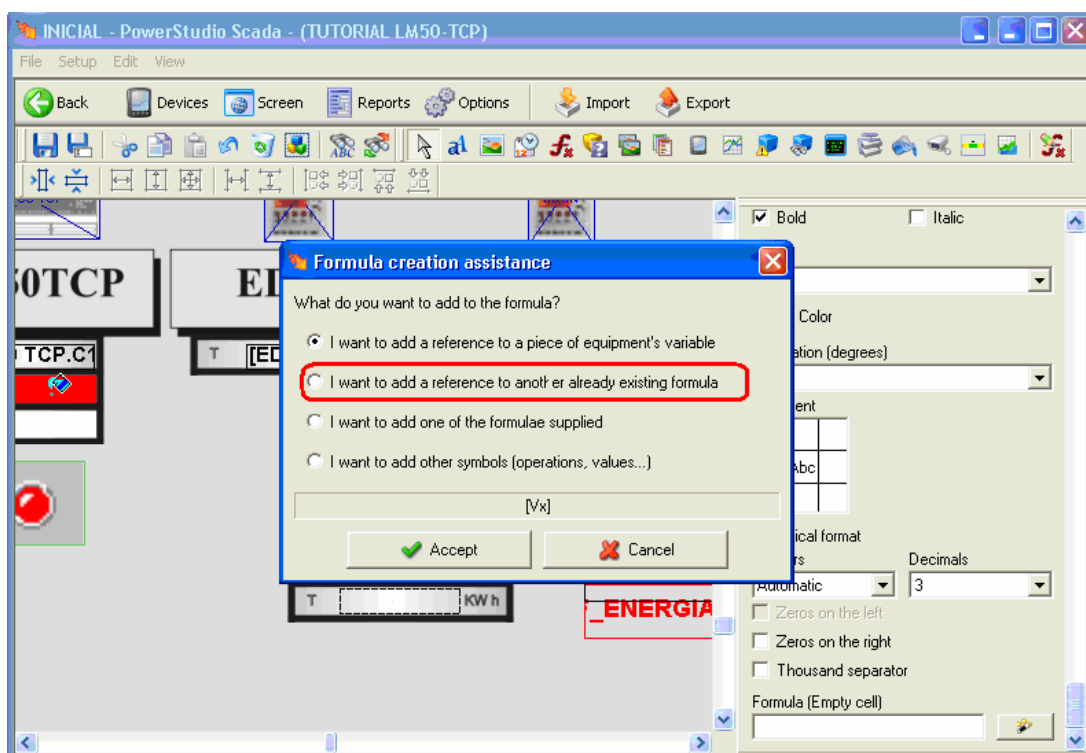
- Once you have selected the energy variable for CVM MINI, the formula is defined as an additional variable and is now available.



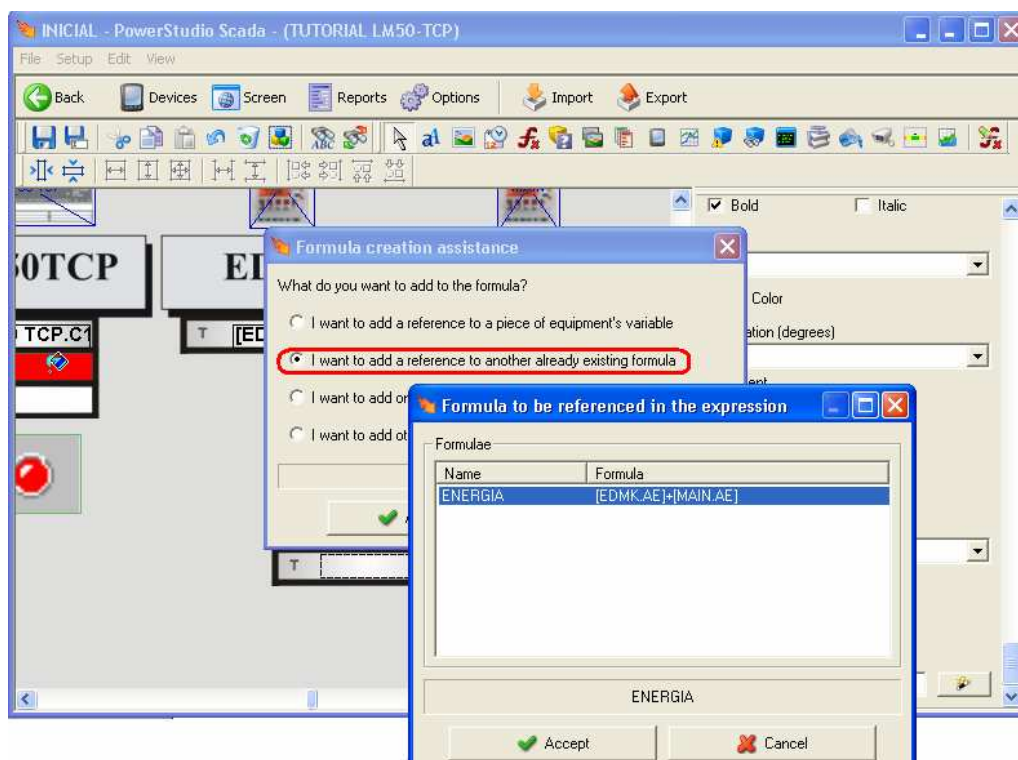
- Click on ACCEPT in the open windows to exit the Formula assistant.
- Use FORMULA CONTROL to make the formula you have just edited visible. On the SCADA screen created previously called HOME, place a formula field on the "TOTAL Energy" box just as you did before with the variables of the **LM50-TCP**, **EDMk** and **CVM-MINI** devices.



- Associate the Formula control with the ENERGY formula as shown on the following screen:

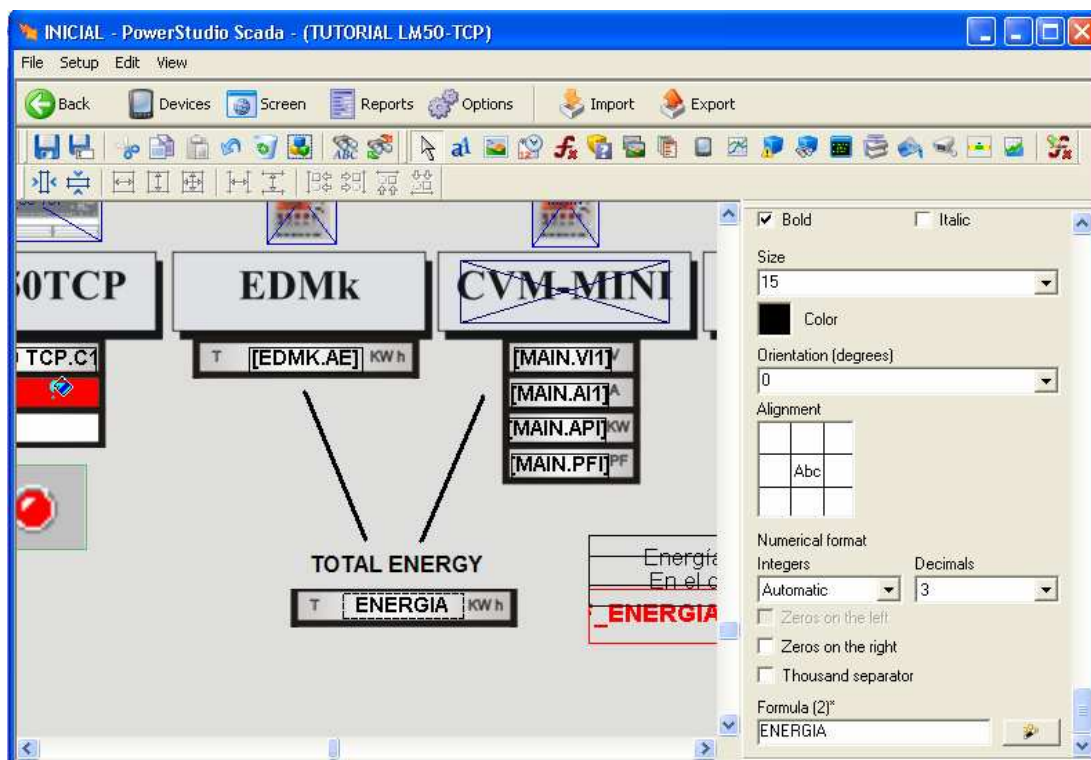


- Choose the formula just created:



To check the operation of the application thus far, export the application to the PowerStudio SCADA SEARCH ENGINE. Remember that the local IP address of the SEARCH ENGINE is 127.0.0.1 and the port is 80 if the configuration was not changed in the EngineManager configuration.

Once the exportation is complete, run PowerStudio Scada CLIENT. Make sure that the IP address of the SEARCH ENGINE is configured in local mode (127.0.0.1) and the default port is 80 in the GENERAL / CONNECT menu.



16.12.- CONDITIONED CONTROL




This control allows you to perform various ? and is used primarily to:

- ✓ Display an image or a text when a condition is met.
- ✓ Perform a calculation when a condition is met.
- ✓ Show a sequence of images such as a movement or blinking.
- ✓ - Etc.

In the following steps you will use conditioned control to display a sequence of images when the simulation device selector is ON (LM50-TCP input channel 3) in the DEMO-EXPERT Kit. The switching time is 1 second and the control will display a total of 3 different images.

First, you will need to add the images you want to convert to the image manager. If the tutorial is correctly installed, all of the image files are located in the directory **C:\Archivos de programa\Circutor\PowerStudio SCADA 3.0 TUTORIAL\BMP's**.

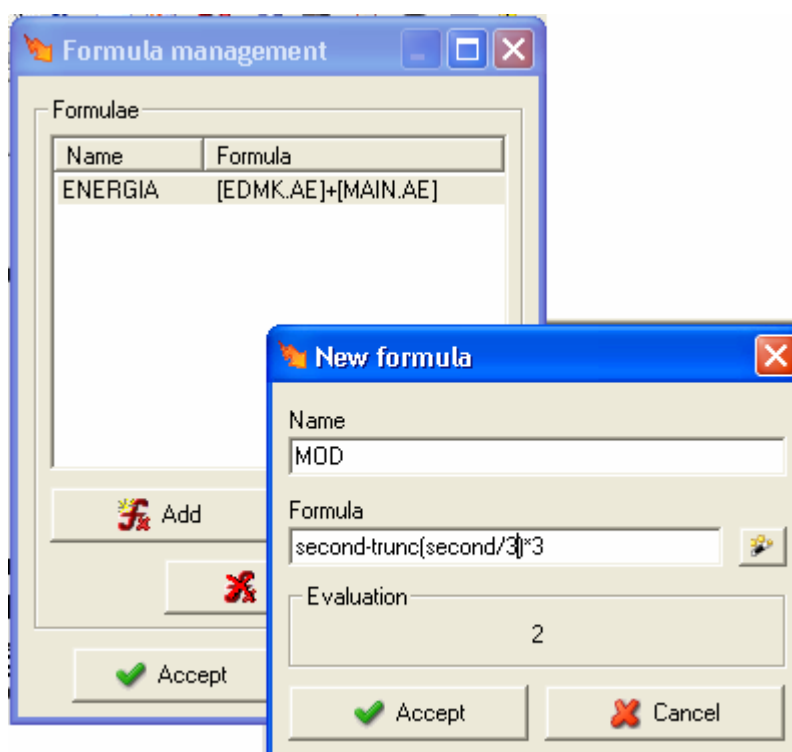
- ✓ Go to CONFIGURE, IMAGE MANAGER and add the images ON.bmp, OFF.bmp and OR.BMP:
- ✓ Select Configure formulae  and add the formula named MOD which will contain the following code:

`second-trunc(second/x)*x`

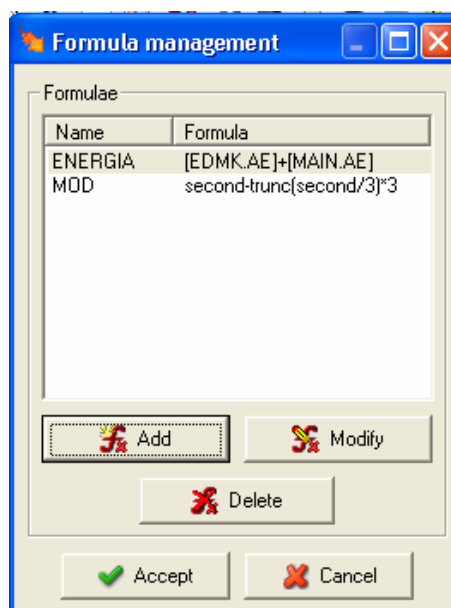
(Where x can be any value. If the value of x is 3, the function will take on 3 values, if x=4 the function will take on 4 values and so on)

The formula is properly entered, in our case `second-trunc(second/3)*3`, if a value appears in the evaluation rather than a message such as "Sytnax Error".

The result of the instructions is that a sequence of values, 0, 1 and 2 is generated for the MOD variable.



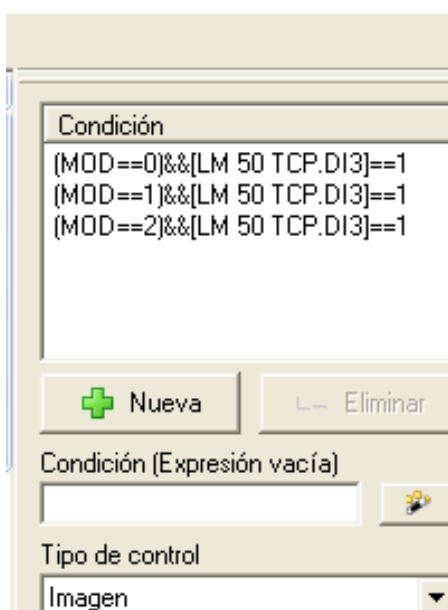
- Click on ACCEPT and check to make sure that the new formula has been added to the formula manager list.



- You can now create the conditioned control.
- Select the conditioned control, create a rectangle with the control near the image of the **LM50-TCP** on the SCADA screen named HOME.

Edit the properties of the conditioned control using the side toolbar.

Use the "CONDITION" field and the "Wizard" button to create each one of the conditions. When you have completed one "CONDITION" field, add the condition to the list using the plus sign +.



Where:

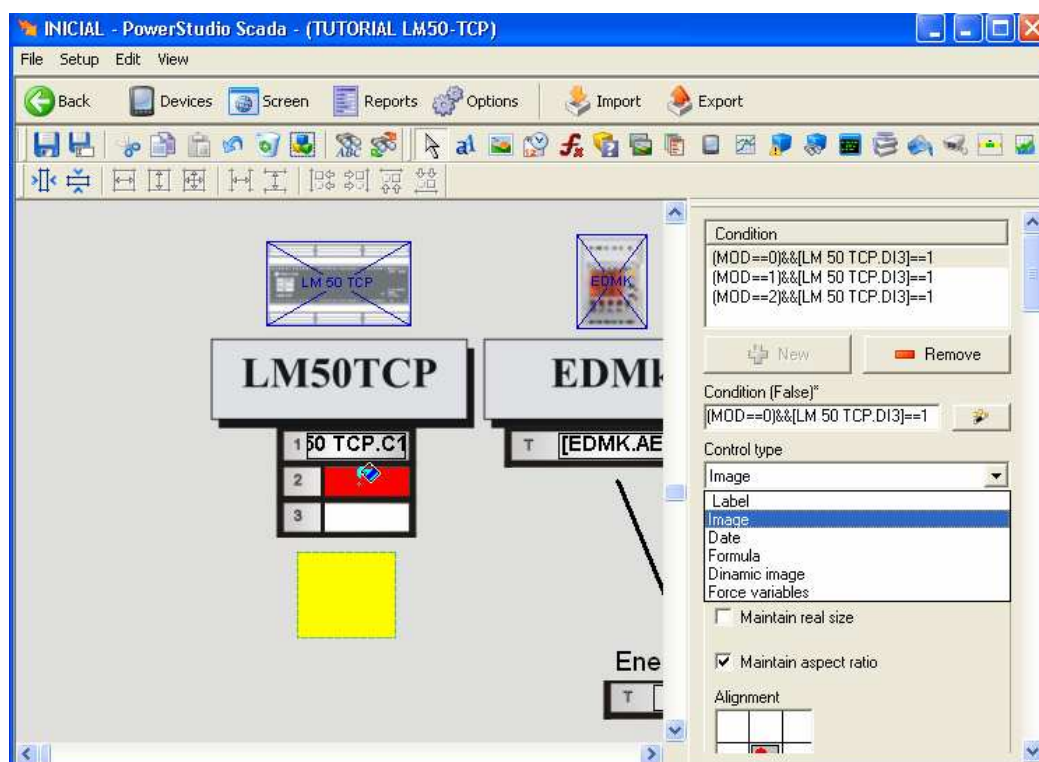
$(MOD==0) \&\& (LM\ 50\ TCP.DI3)==1$. If the result of the formula created previously is equal to 0 and the **LM50-TCP** input is set to ON, it will show the selected image in that condition.

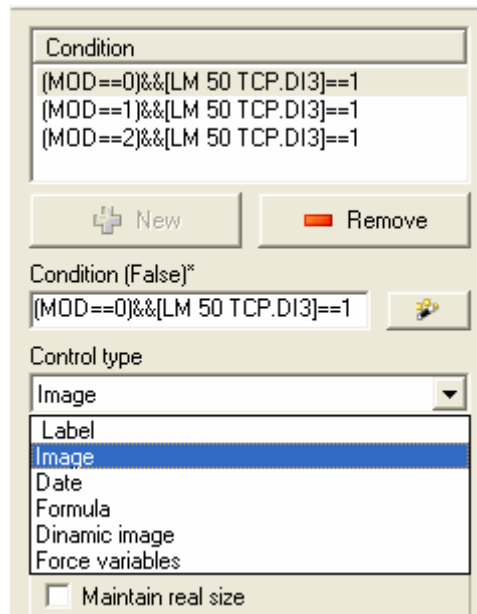
$(MOD==1) \&\& (LM\ 50\ TCP.DI3)==1$. If the result of the formula created previously is equal to 1 and the **LM50-TCP** input is set to ON, it will show the selected image in that condition.

$(MOD==2) \&\& (LM\ 50\ TCP.DI3)==1$. If the result of the formula created previously is equal to 2 and the **LM50-TCP** input is set to ON, it will show the selected image in that condition.

To select an image for each condition, proceed as follows:

- Choose the desired condition from the list.






- Display the CONTROL TYPE field and select "Image". Note that there are other control possibilities for the selected condition.
- Click on SEARCH IMAGE and add the selected image to the condition using the image manager.

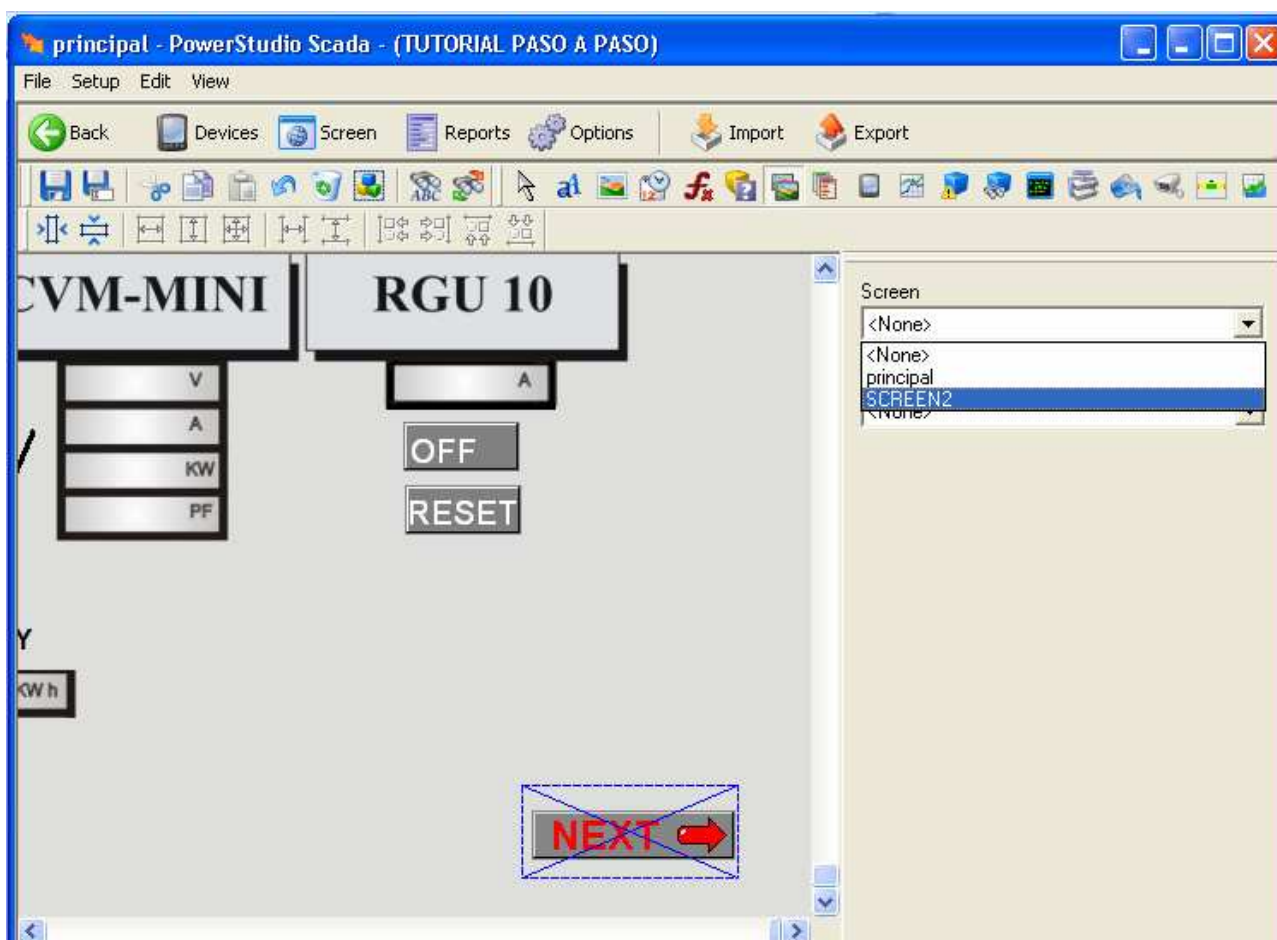
As can be seen, there are multiple combinations to be carried out and a large variety of opportunities to exploit using conditioned control.

16.13.- SCREEN CONTROL



This control allows you to create links to other SCADA screens. This area that is sensitive to the clicking of the mouse will display the programmed screen.

- Edit the SCADA HOME screen and choose Screen Control.
- Cover the image  with the Screen control. The area of this image will be used as the button to access the next screen in the DEMO-EXPERT Kit application.
- Use the screen control side toolbar to define the jump to SCREEN 2 as shown in the figure.



- Perform the same operation on SCREEN 2. Add a screen control for access to the HOME screen over the RETURN image.



The "Display" dropdown allows you to configure the visual part of the access component, giving it the appearance of a 3D button, image or text if there is not background image programmed for this utility.

Check the work done so far by exporting the application to the SEARCH ENGINE and run PowerStudio CLIENT. Check the links created between the two screens.

16.14.- REPORT CONTROL



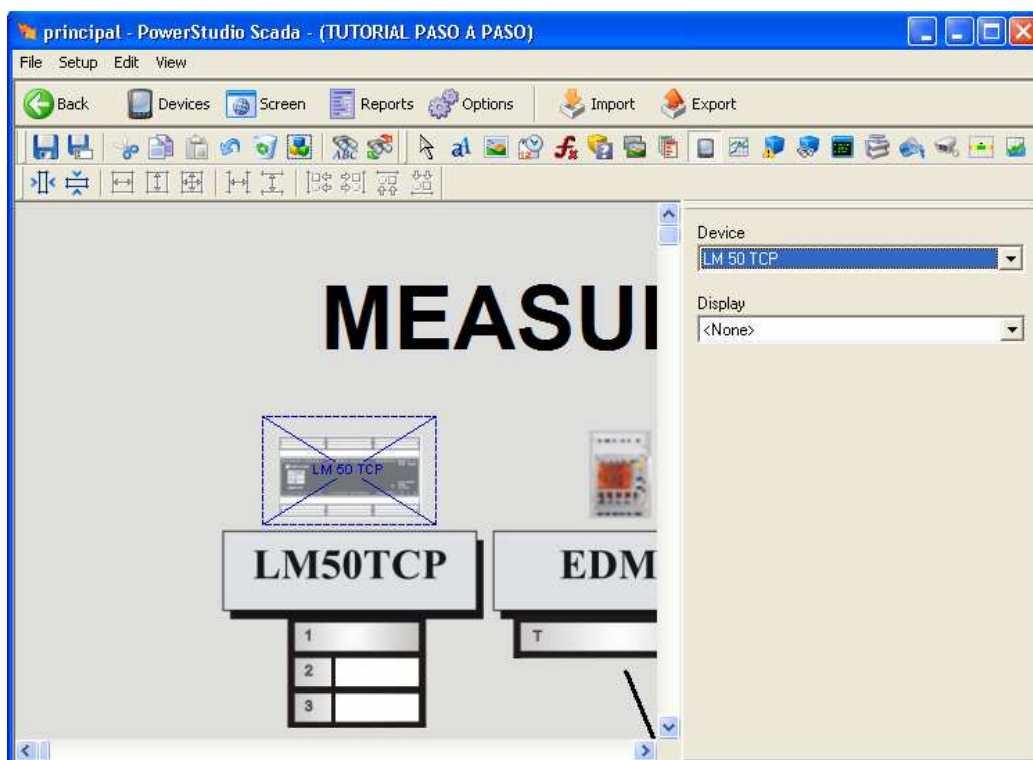
This simple control allows you to link a SCADA screen with the on-screen display of a previously-created report. It is a mouse-sensitive area.

16.15.- DEVICE CONTROL



This control allows you to link a SCADA screen with the display of the parameters of an application device. It is a mouse-sensitive area.

- Continue with the device control of the DEMO-EXPERT Kit application by creating a link to display the measurement or calculation parameters of each unit by following the steps described below:
- Select the device control tool.
- Left click the mouse and drag it over the image of the LM50-TCP to generate an area that encompasses the image of the device.
- On the side toolbar, display the DEVICES option and select LM50-TCP as shown in the following image.



The DISPLAY option allows you to change the visual appearance of the control. If no background image has been created for the link to the device, you can configure the appearance of the control as a 3D button, an image or text.

- Follow the same steps to add links to the rest of the devices, **EDMk**, **CVM-MINI** and **RGU-10**.

Verify the changes made so far by exporting the application to the SEARCH ENGINE and running CLIENT. Click on each one of the equipment images and check to see what the data screens look like in real time.

16.16.- GRAPH / TABLE CONTROL

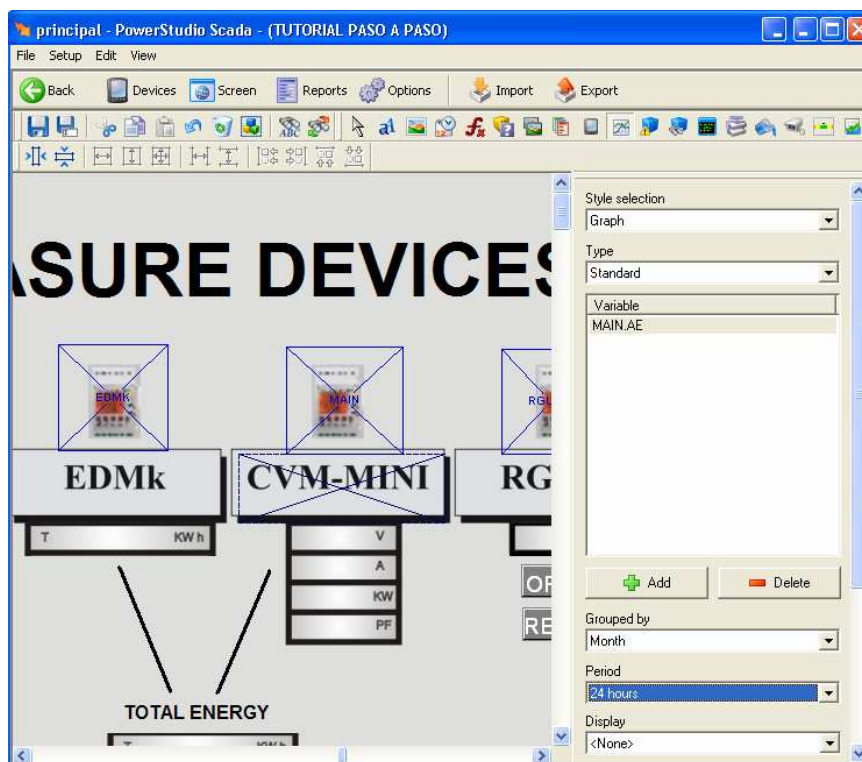


This control allows you to create a pre-established link, graph or table.

In the DEMO-EXPERT kit application, you will create a link to a graph showing the energy consumed daily by the MAIN device (**CVM-MINI**). The graph will show the data grouped by months, with the energy grouped daily.

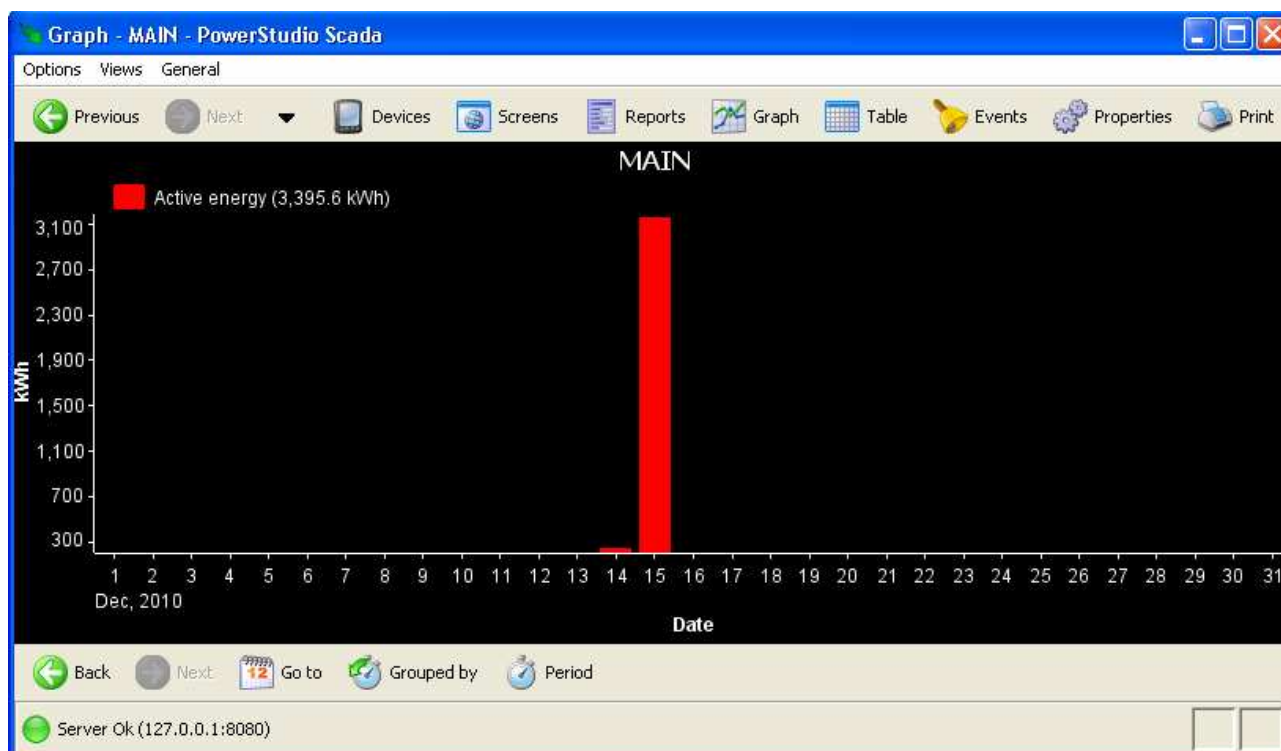
- Select the Graph or Table Control and then click and drag the mouse over the text of the CVM-MINI device to establish the control area.
- Select the desired style (graph or table) and the type of display from the side toolbar.

- Use the ADD button to select the variable to be represented in the control. In the case of the **DEMO-EXPERT kit**, search for “Energy +” in the MAIN device (**CVM-MINI**). This control allows you to display up to 10 different variables on one graph.
- Next, configure the control parameters by choosing GROUPED BY = Month, PERIOD = 24 hours on the side toolbar as shown in the image:



The "Display" option allows you to change the visual appearance of the control if no image has been created in the application background.

Export the application to the PowerStudio SEARCH ENGINE, run CLIENT and verify the changes made so far. When you click on the new control from CLIENT, a window will open with the graph or table you have just configured. To return to the SCADA window, click on "BACK".



NOTE. As the **CVM-MINI** collects energy usage data, those data will be represented in the form of a graph or table of historical data as long as it is "online" with the PowerStudio SEARCH ENGINE.

16.17.- EVENT DISPLAY CONTROL:



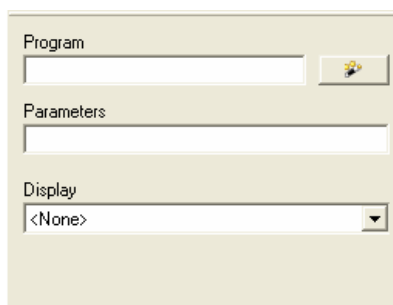
These controls allow you to create a SCADA screen area that will be linked to:

- ✓ Active Events Control Active system alarms.
- ✓ Event browser control: Historical list of events
- ✓ These options will be examined in closer detail in the section on events.

16.18.- CONTROL EXECUTION OF EXTERNAL PROGRAMME:



This control is used to run an external application with pre-defined parameters.



- Use the “Wizard” button to add the directory where the programme to be run is located. *This example runs the ACROBAT READER programme.*

C:\Program Files\Adobe\Reader 8.0\Reader\AcroRd32.exe

In Parameters, enter a parameter associated with running the programme. These parameters change according to the programme being configured. Please consult the programme documentation.

There are programmes, unrelated to PowerStudio, that allow you to send SMS or emails automatically. This control can be used to run the external programme for sending SMS or emails following an alarm. This way, a notice will be sent to a mobile telephone number or email address when the pre-programmed conditions of an event are met.

16.19.- FORCE VARIABLE CONTROL:

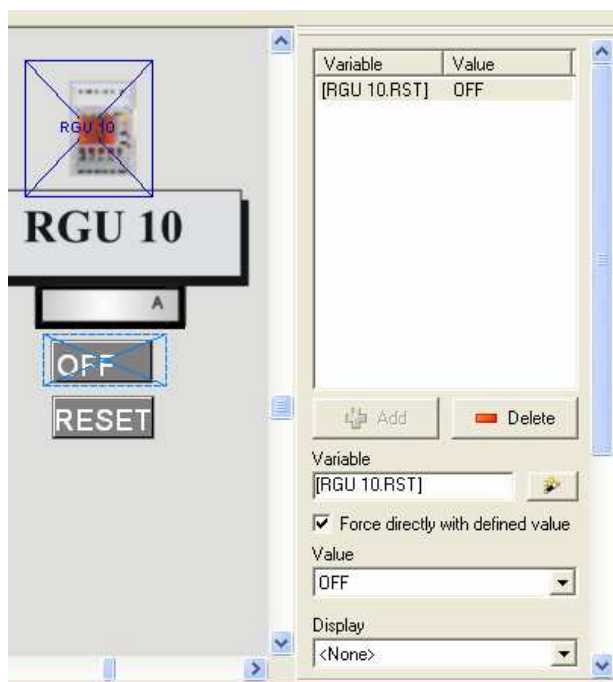


This control allows you to activate or deactivate the digital outputs for all CIRCUTOR devices that have them. It is a mouse-sensitive area.

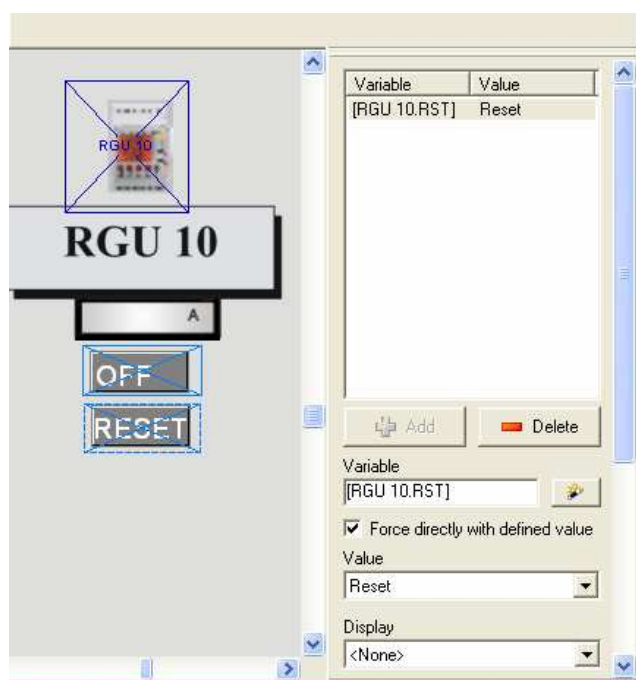
In the **DEMO-EXPERT Kit** application we will see an example of a forced variable. Close and open the switch associated with **RGU-10**, from 2 mouse-sensitive areas on the SCADA screen.

- Select the force variable control.
- In the **RGU-10** area, add a control to the OFF zone.
- Use the “Wizard” button to link to a the digital output of **RGU-10**. RGU10

- Set the "Value" field to OFF.



- Follow the same procedure to generate the force variable control for the Reset button, selecting the **RGU-10** digital output and RESET as the value of the variable.



The action of forcing digital outputs can be used in any device that has these outputs.

One or more conditions or events can be associated with a forced relay as a way of generating an alarm signal using the software.

16.20.- AREA FILL CONTROL:



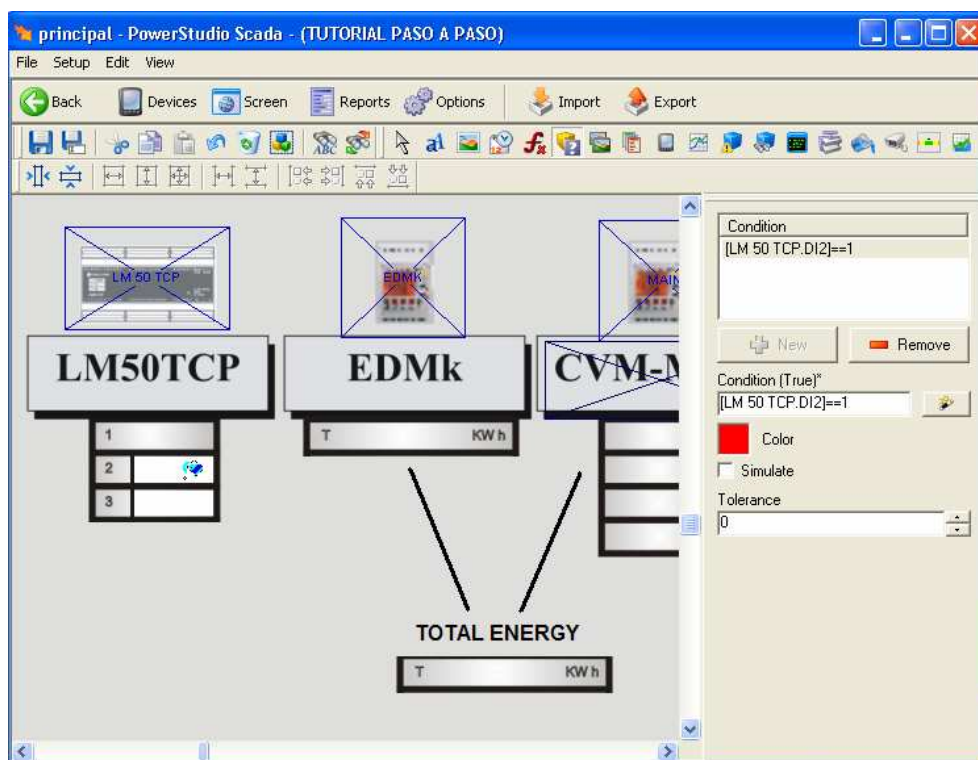
This control fills a particular area of the screen background when a particular condition is met.

The condition does have to be strictly digital; it can be a maximum/minimum. This is a graphic display control.

In the **DEMO-EXPERT Kit** you will practice using this control. On the SCADA HOME screen, paint the white box in input number 2 of the **LM50-TCP** either Red or Green depending on whether the input is Open or Closed.

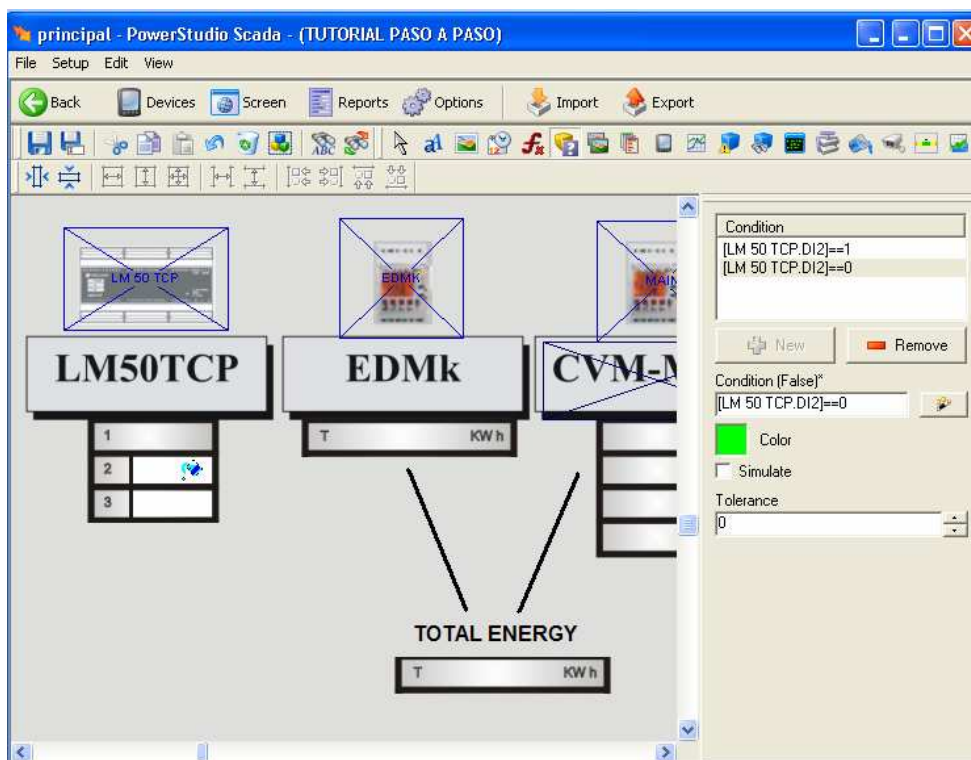
- Add an area fill control to the white space in input 2.
- For the fill control properties, click on the “Wizard” button to add the fill condition.
- Look for DIGITAL ENTRY no 2 variable of the **LM50-TCP**. Remember that this is a REFERENCE TO A VARIABLE OF A DEVICE.
- The CLOSED condition will be $[LM\ 50\ TCP.DI2]==1$
- Associate the colour Red to this condition and click NEW

The control is set as follows:



- Now configure the Open condition

- On the CONDITION input line which contains the previous condition, change the condition to: [LM 50 TCP.DI2]==0 and the colour will change to green.



Once you have made these changes, export the application to the PowerStudio SEARCH ENGINE, run CLIENT and verify the changes made so far.

Note: The "Tolerance" parameter, programmable from 0 to 100%, allows you to configure the control from least to greatest fill power, i.e., a value of 0 would be very restrictive and would only fill the image zone with the same colour as the pixel selected in the image. If the image has pixels with different tones, for example, different shade of white, you will need a greater tolerance to apply the desired colour to create the desired contours of the image.

17.- HISTORICAL GRAPHS

You can display the historical data, tables, data and total application data using Internet Explorer or PowerStudio CLIENT. Obviously, the data shown on the graphs and tables refer to the devices that have been connected for a period of time and which Powerstudio SCADA has saved to the computer's hard drive.

To view a graph of the equipment parameters, proceed as follows:

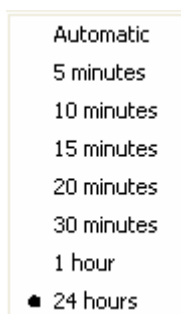
- Run PowerStudio CLIENT.
- Click on the "GRAPH" icon.
- Select the device whose data you want to view.

- Finally, choose the variable(s) to be viewed.



Create different types of graphs for the MAIN device (**CVM-MINI**). Note that using the options "Grouped by" and "Period" you can change the resolution of the graph.

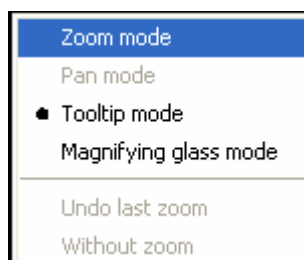
Modify the data period to display more or less information on the graph. When you choose a period for the graph that is longer than the period for which historical data exist, the programme calculates the average of the data shown.



Using the BACK and NEXT arrows on the menu at the bottom, you can jump to different positions within the period previously selected for the Group. In the example, you can jump from one year to the next.






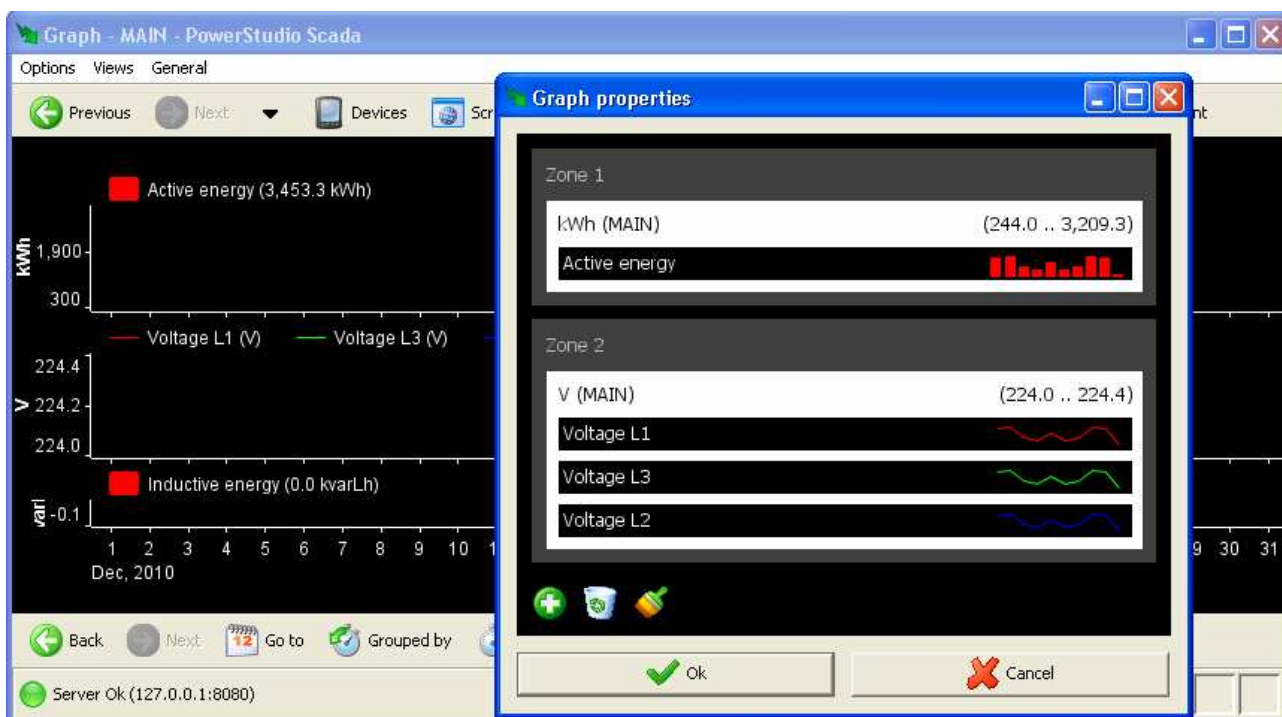
- Right click the mouse on the graph and you will see the options, MAGNIFY, PAN and ZOOM.



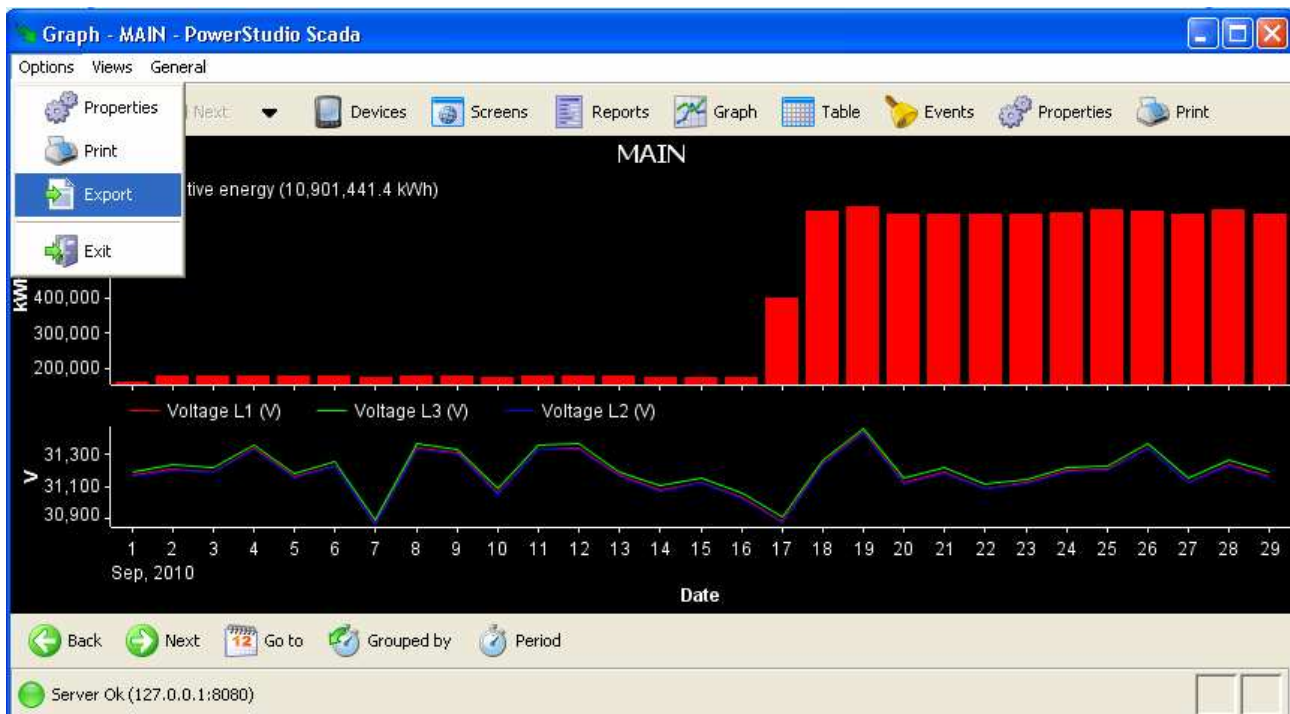
Graphs can be created for numerous variables simultaneously, choosing all of the variables for which you wish to create a graph on the MAIN display screen.



Clicking on PROPERTIES you can create various graphs in one, add  more variable to the same graph (which may be from other devices) modify the colour of the variables  and eliminate the variables  displayed.



The graphs can be printed and exported to files with a *.PNG extension using "Export".

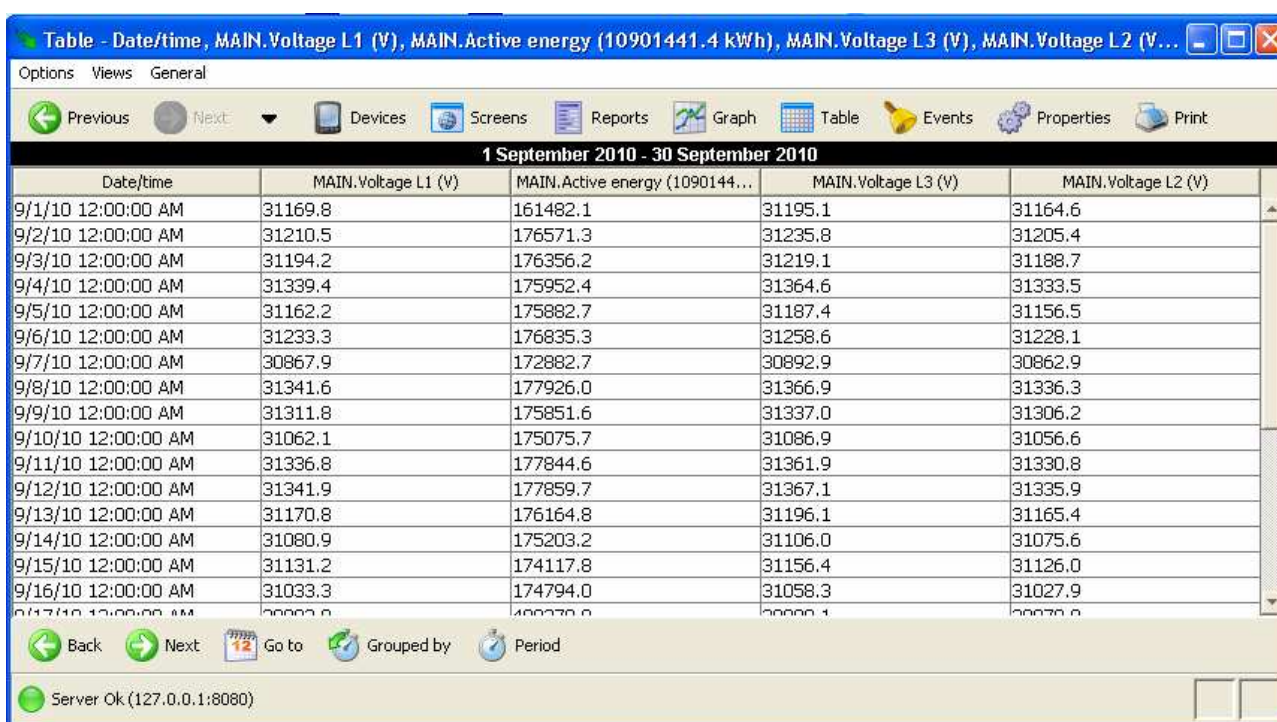


18.- HISTORICAL TABLES

The process for creating tables is identical to the process for creating graphs.

- With the last graph created still on screen, click on the "Table" icon. All of the data included on the graph will also appear on the table. You can also create a table and then create a graph from that table.

If you want to see variables other than those on the table/graph, click on devices, choose the device for which you wish to create the table, choose table and then the desired variables.



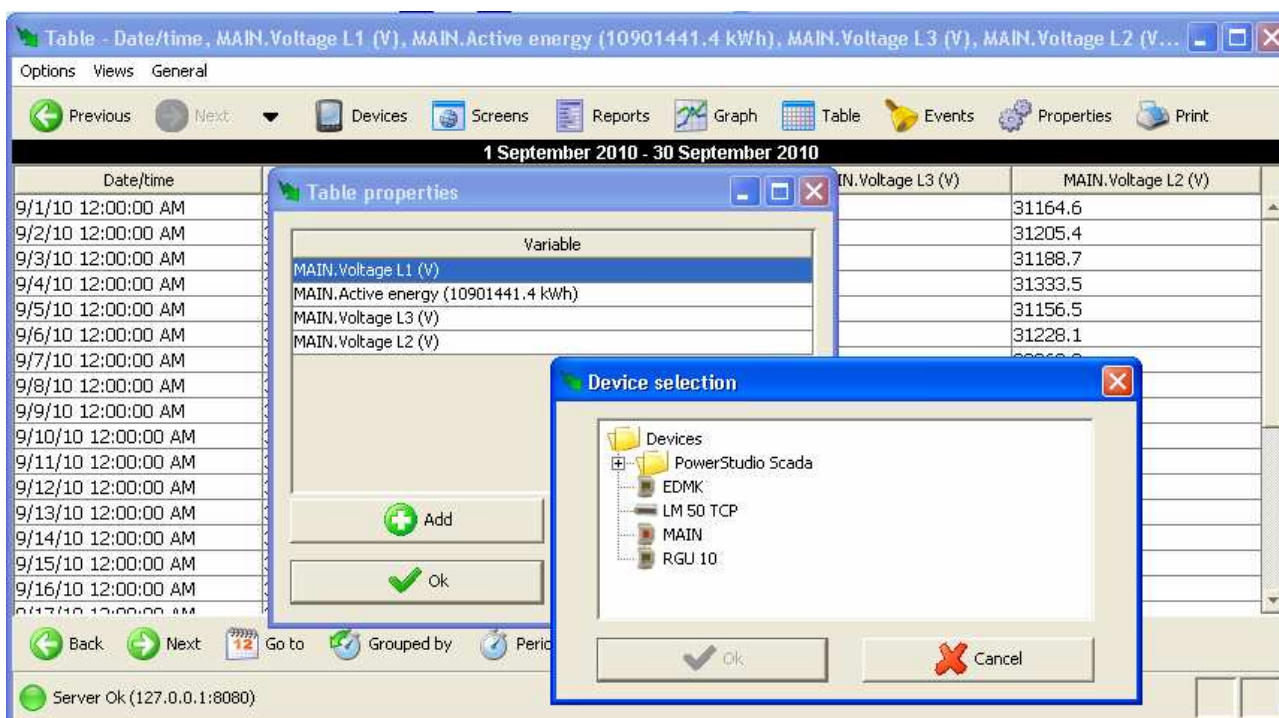
The screenshot shows the 'Table' window in Powerstudio SCADA. The title bar reads: 'Table - Date/time, MAIN.Voltage L1 (V), MAIN.Active energy (10901441.4 kWh), MAIN.Voltage L3 (V), MAIN.Voltage L2 (V)'. The window has tabs for 'Options', 'Views', and 'General'. Below the tabs is a toolbar with icons for 'Previous', 'Next', 'Devices', 'Screens', 'Reports', 'Graph', 'Table' (selected), 'Events', 'Properties', and 'Print'. The main area displays a table for the period '1 September 2010 - 30 September 2010'. The table has five columns: 'Date/time', 'MAIN.Voltage L1 (V)', 'MAIN.Active energy (1090144...', 'MAIN.Voltage L3 (V)', and 'MAIN.Voltage L2 (V)'. The data is recorded every 5 minutes. At the bottom, there are controls for 'Back', 'Next', 'Go to', 'Grouped by', and 'Period'. A status bar at the very bottom shows 'Server Ok (127.0.0.1:8080)'.

Date/time	MAIN.Voltage L1 (V)	MAIN.Active energy (1090144...	MAIN.Voltage L3 (V)	MAIN.Voltage L2 (V)
9/1/10 12:00:00 AM	31169.8	161482.1	31195.1	31164.6
9/2/10 12:00:00 AM	31210.5	176571.3	31235.8	31205.4
9/3/10 12:00:00 AM	31194.2	176356.2	31219.1	31188.7
9/4/10 12:00:00 AM	31339.4	175952.4	31364.6	31333.5
9/5/10 12:00:00 AM	31162.2	175882.7	31187.4	31156.5
9/6/10 12:00:00 AM	31233.3	176835.3	31258.6	31228.1
9/7/10 12:00:00 AM	30867.9	172882.7	30892.9	30862.9
9/8/10 12:00:00 AM	31341.6	177926.0	31366.9	31336.3
9/9/10 12:00:00 AM	31311.8	175851.6	31337.0	31306.2
9/10/10 12:00:00 AM	31062.1	175075.7	31086.9	31056.6
9/11/10 12:00:00 AM	31336.8	177844.6	31361.9	31330.8
9/12/10 12:00:00 AM	31341.9	177859.7	31367.1	31335.9
9/13/10 12:00:00 AM	31170.8	176164.8	31196.1	31165.4
9/14/10 12:00:00 AM	31080.9	175203.2	31106.0	31075.6
9/15/10 12:00:00 AM	31131.2	174117.8	31156.4	31126.0
9/16/10 12:00:00 AM	31033.3	174794.0	31058.3	31027.9

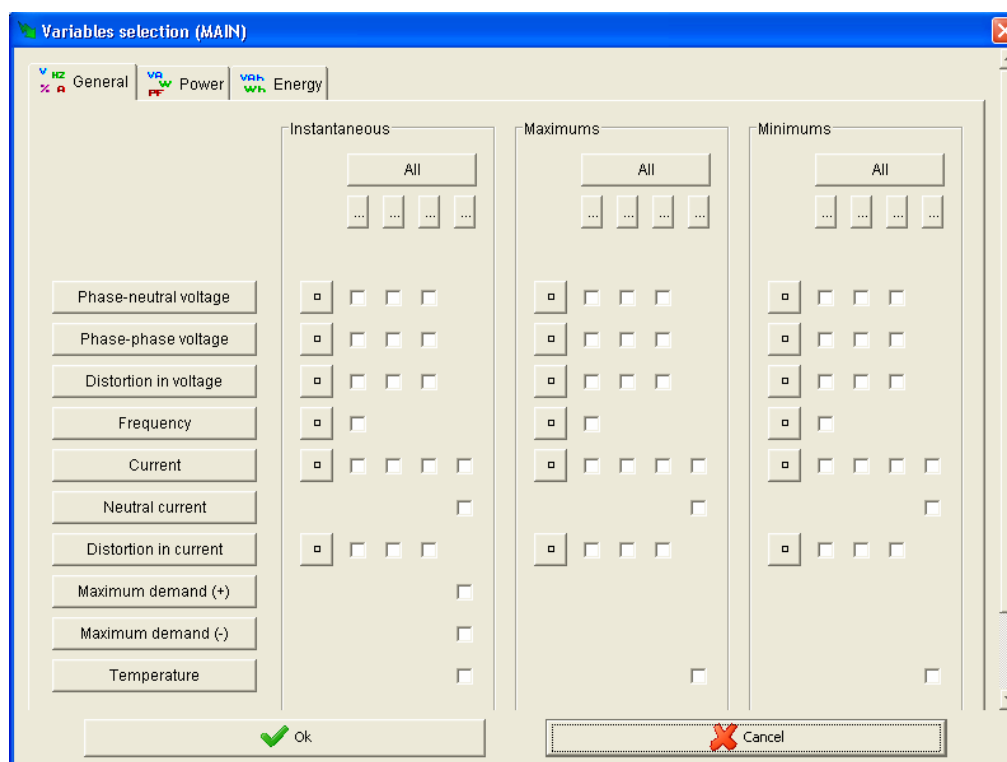
Example of a table showing the voltages and currents recorded every 5 minutes.

The same options that are available for the graphs are available for the tables. You can modify the table data and the group and you can move between the periods using the "Back" and "Next" arrows".

You can also add other parameters for the same equipment or different equipment to a table by clicking on the "Properties" icon and then "Add".



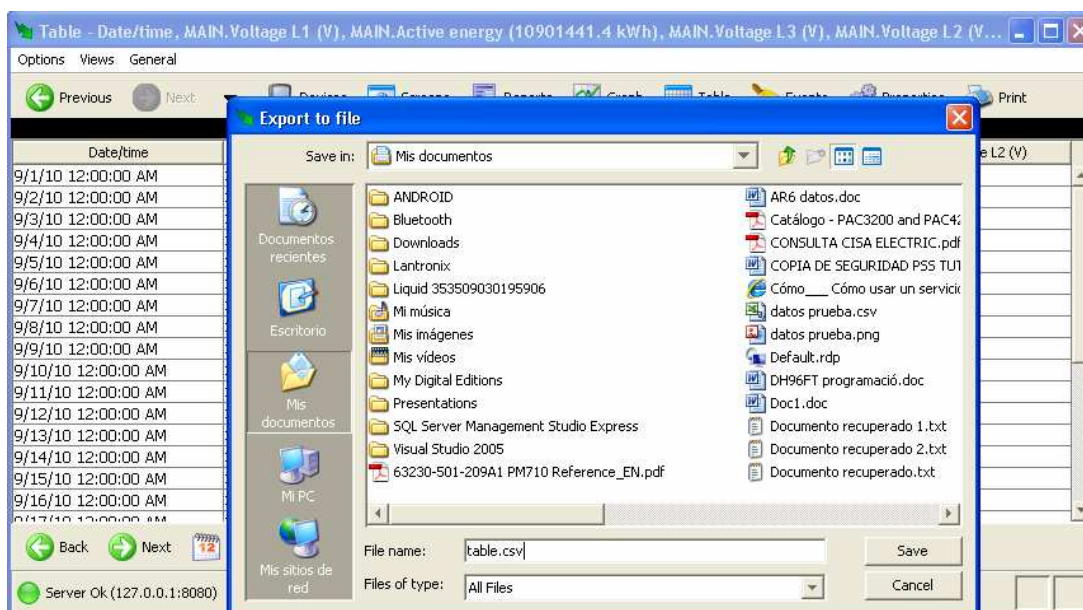
Another way of creating a table is by clicking on "Table" directly and then selecting the parameter and/or device for which you want to create the table:



19.- EXPORT DATA TO AN EXCEL FILE

- Create a text file with the information from the table and export it to EXCEL.
- Create a table.
- Open the "Options" menu and choose "Export".

The file assistant for saving the file will appear. Save the file with the extension CSV as in the figure:

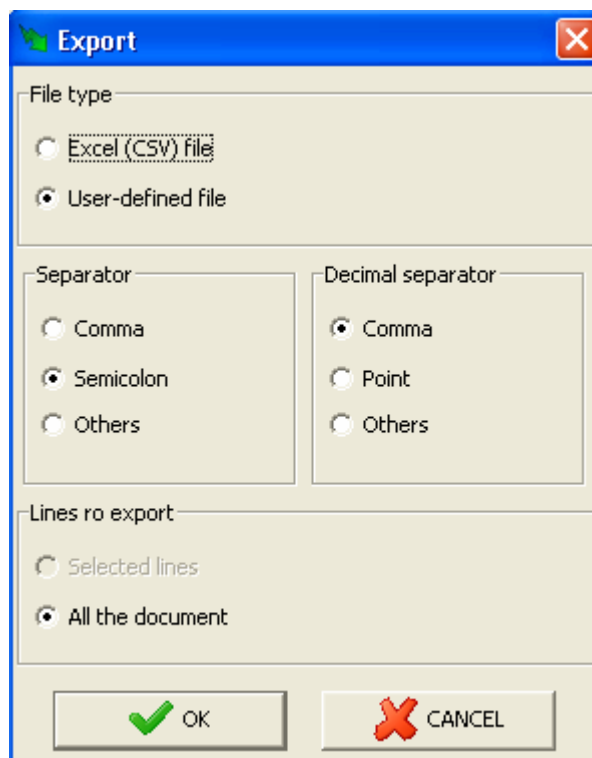


- Enter a file name, such as DATOS.CSV, and save it to the desktop by clicking on "Save".

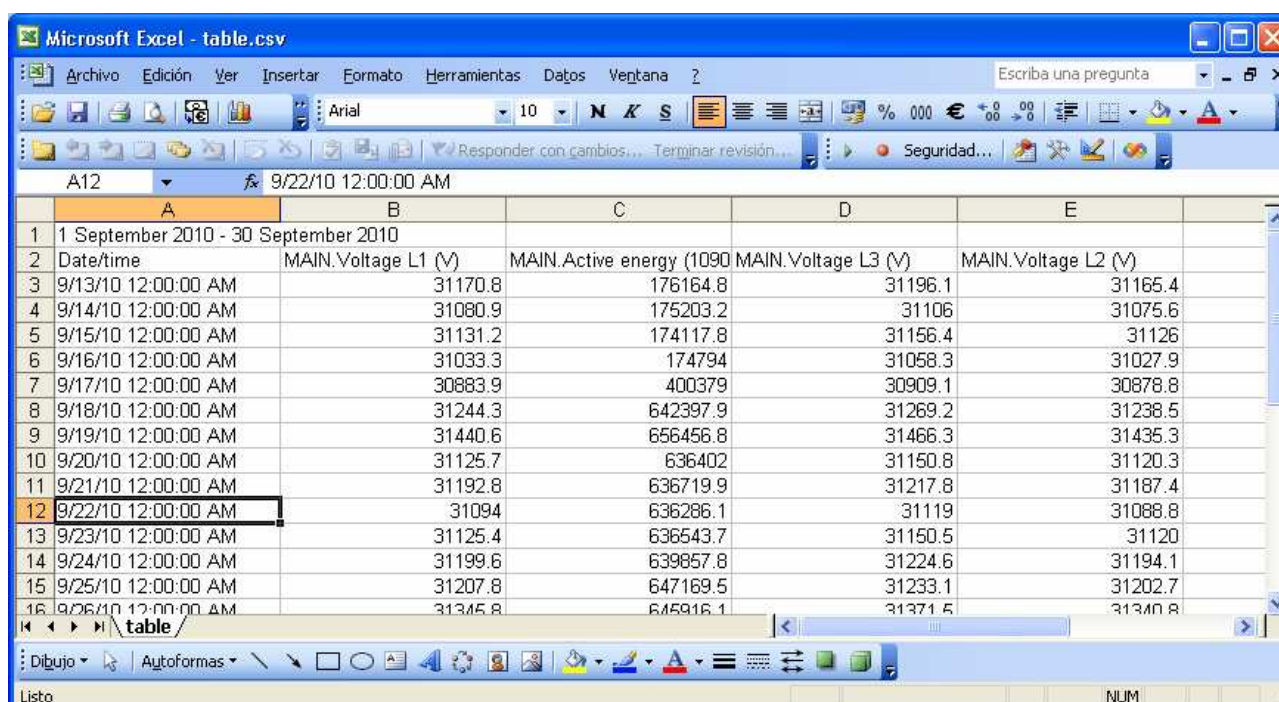
The following screen will automatically appear where you can configure the parameters for the compatible format.

- In file type, choose "Excel File (CSV)".

The "Personalised File" option allows you to change the character "Separator" and "Decimal separator" to adapt the data formats in the file to the different configuration options depending on the language version of Excel and Windows.



Using the file explorer, look for the file stored on the desktop and double click on it. Excel will automatically appear with the data from the PowerStudio table.



	A	B	C	D	E
1	1 September 2010 - 30 September 2010				
2	Date/time	MAIN.Voltage L1 (V)	MAIN.Active energy (1090)	MAIN.Voltage L3 (V)	MAIN.Voltage L2 (V)
3	9/13/10 12:00:00 AM	31170.8	176164.8	31196.1	31165.4
4	9/14/10 12:00:00 AM	31080.9	175203.2	31106	31075.6
5	9/15/10 12:00:00 AM	31131.2	174117.8	31156.4	31126
6	9/16/10 12:00:00 AM	31033.3	174794	31058.3	31027.9
7	9/17/10 12:00:00 AM	30883.9	400379	30909.1	30878.8
8	9/18/10 12:00:00 AM	31244.3	642397.9	31269.2	31238.5
9	9/19/10 12:00:00 AM	31440.6	656456.8	31466.3	31435.3
10	9/20/10 12:00:00 AM	31125.7	636402	31150.8	31120.3
11	9/21/10 12:00:00 AM	31192.8	636719.9	31217.8	31187.4
12	9/22/10 12:00:00 AM	31094	636286.1	31119	31088.8
13	9/23/10 12:00:00 AM	31125.4	636543.7	31150.5	31120
14	9/24/10 12:00:00 AM	31199.6	639857.8	31224.6	31194.1
15	9/25/10 12:00:00 AM	31207.8	647169.5	31233.1	31202.7
16	9/26/10 12:00:00 AM	31345.8	645916.1	31371.5	31340.8

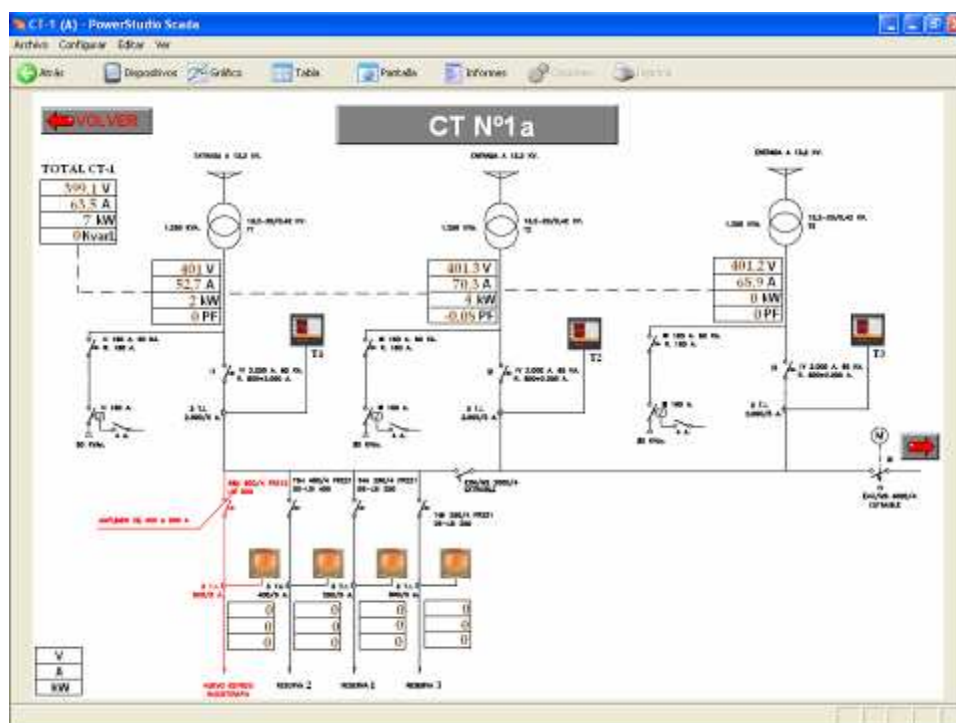
20.- DEFINE CALCULATED VARIABLES (VIRTUAL VARIABLES)

This option allows you to define new variables by combining other variables, as in the formula editor. The difference between calculated (virtual) variables and formulae is that the calculated (virtual) variables can later be shown on graphs and tables as through they were direct variables of a device. On the other hand, the formulae defined in formula editor or formula control cannot be displayed on a graph or table.

Depending on the needs of our application and the formulae and calculations that are necessary, the variables will be defined as formulae or as calculated (virtual) variables.

Example of a virtual variable:

Suppose that in an energy efficiency application the facility's unifilar electrical wiring looks like the one in the figure:

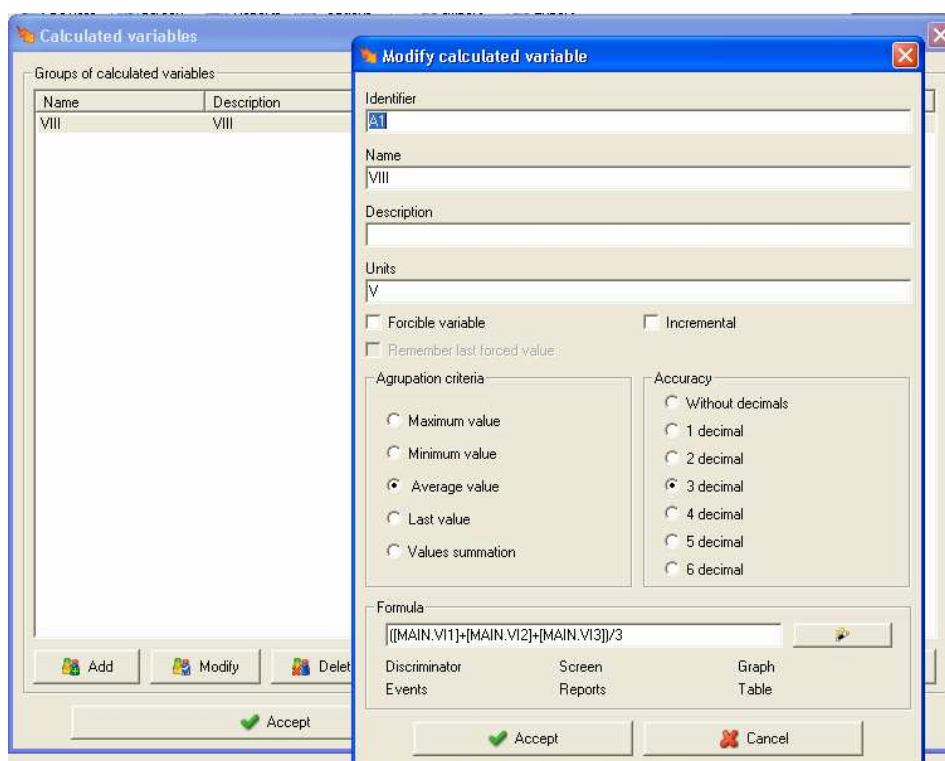


The plant has 3 power transformers in the transformation centre and an analyser that measures the electricity usage of each one of the transformers but no device that measures the total for the 3 transformers.

Virtual variables allow you to define a new piece of equipment (which does not physically exist) to perform the tasks needed to calculate the electrical parameters of the 3 partial pieces of equipment. (sum of powers, sum of energies, total Cos phi calculations, average voltages, etc.)

This allows you to create graphics, tables, screens, reports and events associated with the facility's total usage without having a physical device. Calculated (virtual) variables = TOTAL CT1 device (see figure above). Virtual variables can be defined just like any other parameter read by Circutor devices, whether electric parameters or process signals.

- We will now look at an example of a simple virtual variable using data from the MAIN equipment. We will define the three-phase voltage which is obtained by averaging the 3 single voltages.
- Go to Editor in Powerstudio SCADA.
- Go to the "Setup" menu and select "Calculated Variable".
- In the "Calculated Variables Assistant", add a new calculated variable group. In the example, the group is called VIII.
- Define a name and description for the variable, e.g. VIII.
- ACCEPT on the following screens.
- When the group of variables has been added to the list, click on "Add variable", selecting the device created previously and clicking on ADD.
- Define the different fields as shown in the figure.
- Enter the following averaging formula: $([MAIN.VI1]+[MAIN.VI2]+[MAIN.VI3])/3$.



The meaning of each field is as follows:

Identifier

The virtual variable identifier, which is used to uniquely identify each of the variables of the virtual device to be used in expressions and conditions, see Section 13.2 Expressions and conditions PowerStudio Manual.

Name

Virtual variable name used for better identification of the variable.

Units

Text of the units in which the value is expressed.

Agrupation criteria

- ☐ Maximum value
- ☐ Minimum value
- ☒ Average value
- ☐ Last value
- ☐ Values summation

Allows you to select the criterion for grouping the virtual variable values in charts, tables and reports. For example, if we value every 5 minutes (ie 10.12 and 7) and group the values every 15 minutes, this is a group of 3 values 1 only, the value would be:

- Maximum value: This will display the maximum value of 3 (12).
- Minimum value: This will display the minimum value of 3 (7).
- Average value: This will display the average value of 3 $(10 + 12 + 7) / 3 = 9.66$
- Last value: last value is displayed (7).
- Sum of Values: It displays the sum of the values $(10 + 12 + 7 = 29)$.

Formula (Empty cell)

Discriminator Screen Graph
 Events Reports Table

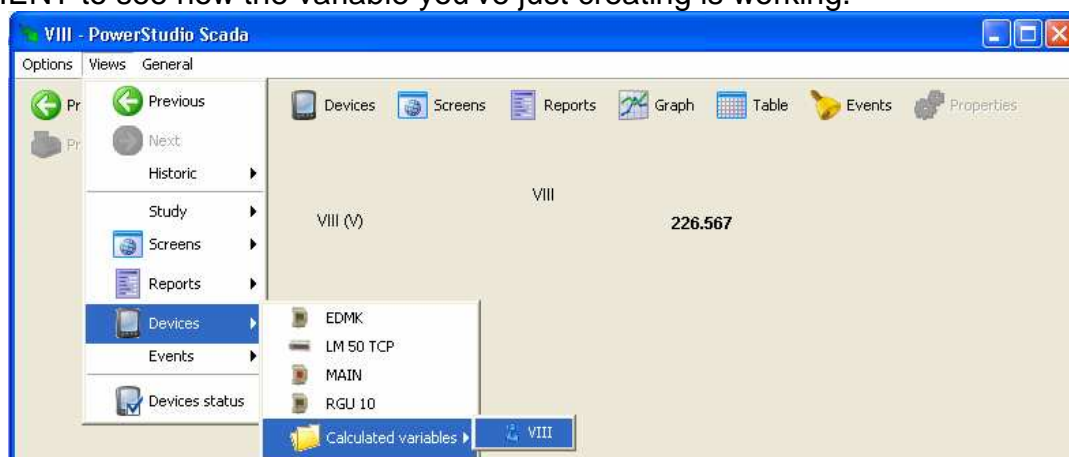
Here you specify the formula that will lead to the result of the virtual variable. May be entered manually or by pressing the "Wizard"

See Appendix 13.2 Expressions and conditions PowerStudio Manual. When you enter the formula automatically analyze and display where it can be used.

- Click on "Accept" and the calculated variable is now defined.

The device and the virtual variable will not appear as yet another devices on the list of PowerStudio SCADA devices. They can only be displayed in PowerStudio SCADA CLIENT.

Remember to export the application to the PowerStudio SCADA SEARCH ENGINE and run CLIENT to see how the variable you've just creating is working.



How to display the calculated variable in PowerStudio SCADA CLIENT.

21.- CREATING REPORTS.

PowerStudio SCADA reports allow you to control the parameters measured by the CIRCUTOR equipment for specific periods of time. You can obtain energy reports, cost control reports, production cost control reports, etc.

The steps for creating an energy report are explained below:

21.1.- CREATING AN ENERGY REPORT.

In the following example, we will use the DEMO-EXPERT Kit to obtain the data for the MAIN (CVM-MINI) device.

Report structure:

- ✓ Creation dates, start and end of report data.
- ✓ Active Energy Consumed, price per kW/h and cost calculation.
- ✓ Reactive Energy.
- ✓ Formula for calculating the cos phi and displaying the contracted power.
- ✓ Maximeter value.
- ✓ Simulation of an invoice if the contracted power is 1000 kW and the price of the power is 4.65€ per kW.

In addition to this subtotal, there should be a fixed amount for the meter rental which is 54.30€. Electricity tax (currently $1.05113 \times 4.864\%$ x subtotal). These calculations will give you the taxable base of the report. To obtain the total, simply add the VAT.

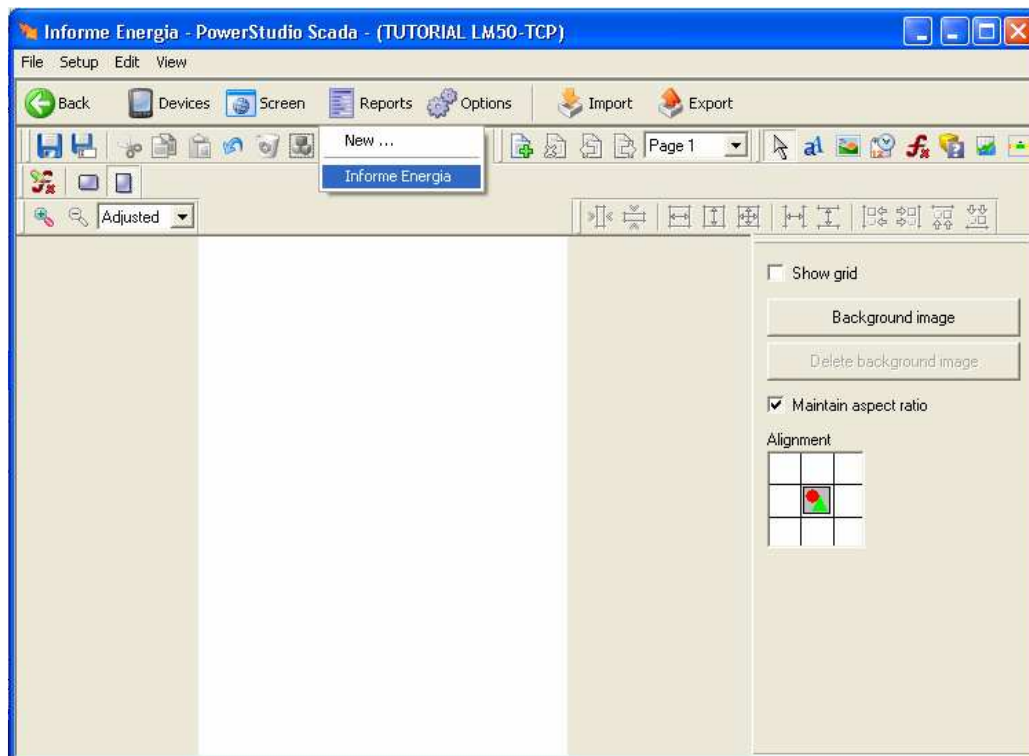
If the tutorial is correctly installed, once you have created the report you can simulate a report from the period 1-30 September.


To create the report, follow the steps described below:



21.2.- INSERTING DATES.

In PowerStudio EDITOR, go to configure>reports>new or click on "Reports" on the toolbar.

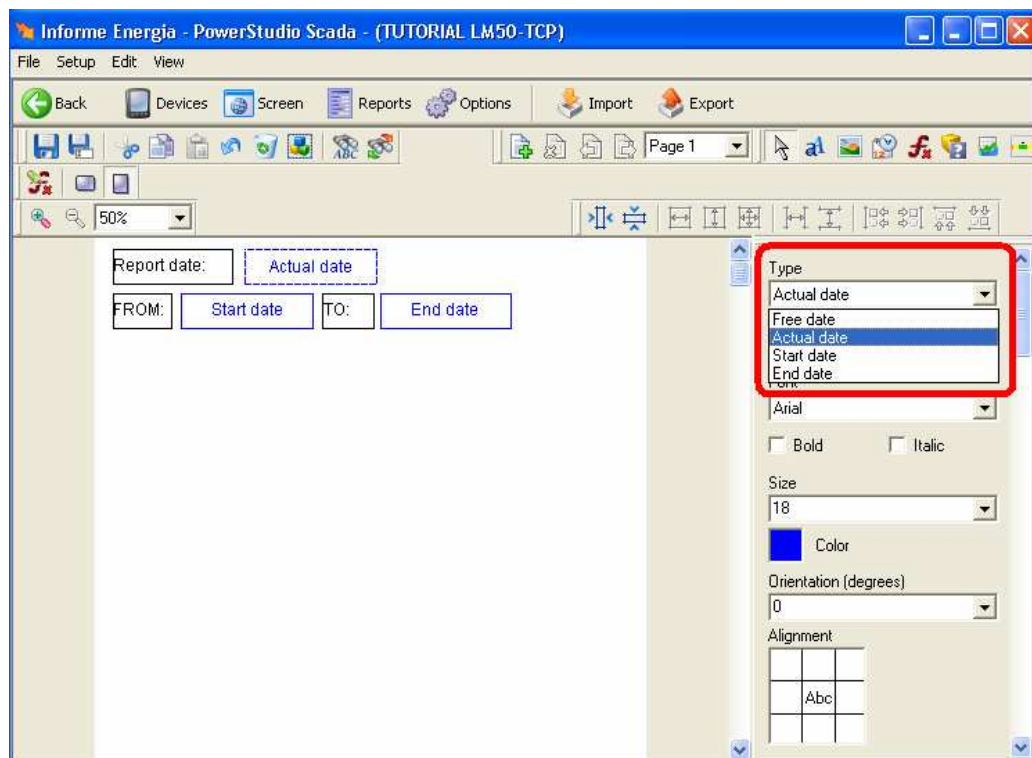
Assign a name to the report, e.g. "Energy Report".



The first step is to insert the creation date of the report. To do so, use the "Date Control" tool. There is an icon for this tool on the toolbar. 

Use text control  to add different labels such as the black one shown in the image below and use date control  to generate the blue ones.

You can use the Insert Image tool to create lines but you must first generate a file with an image of the line using the text edition programme. Once you have inserted the image, you can change the size of the image using the mouse to drag the edges.

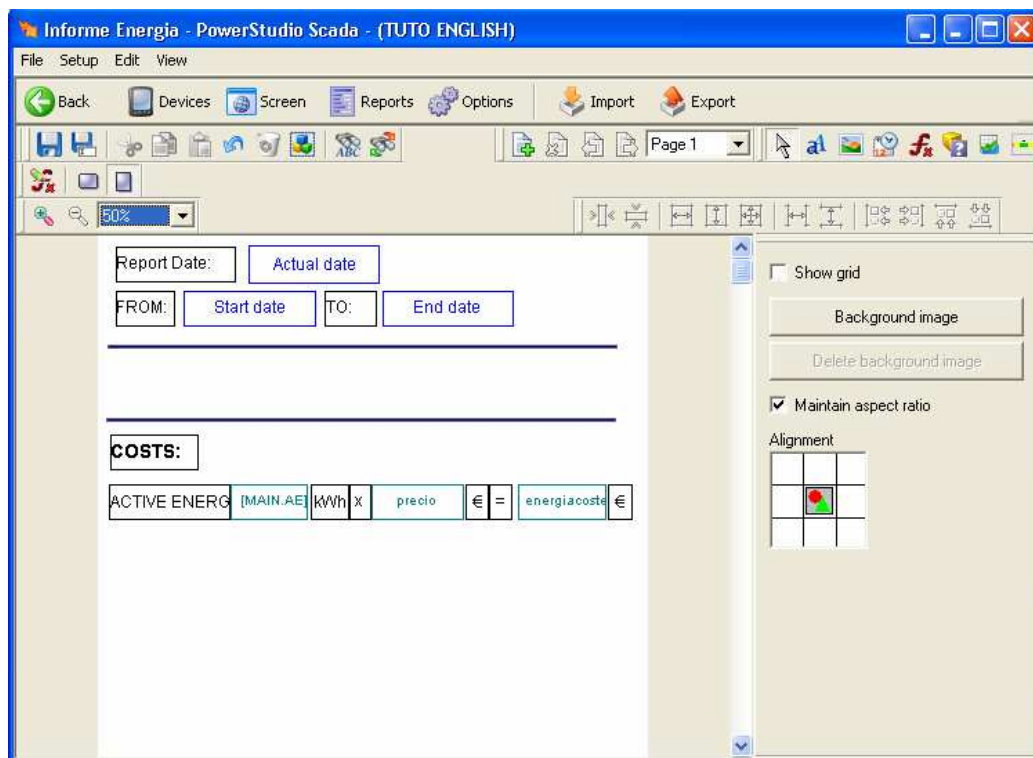


- To show the creation date of the report, choose the corresponding area and select "Current Date" from the "type" dropdown menu.
- To show the start date of the report, choose the corresponding area and select "Start Date" from the "type" dropdown menu.
- To show the end date of the report, choose the corresponding area and select "End Date" from the "type" dropdown menu.

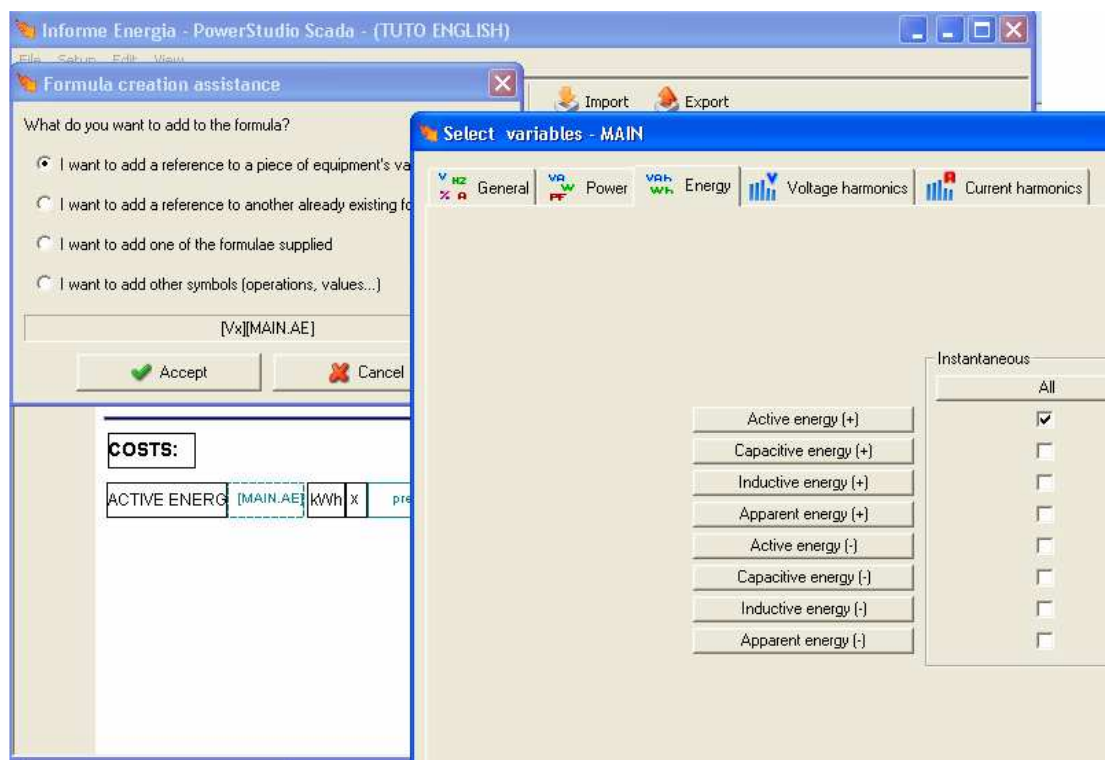
21.3.- CALCULATING ENERGY COSTS.

The next step in the report creation process is to display the active energy consumed. To do so we will link a function control to the energy parameter of the **CVM-MINI** called MAIN using the “wizard”.

- You can generate the required labels using text control (black) and the fields to display the variables (light blue) using function control.

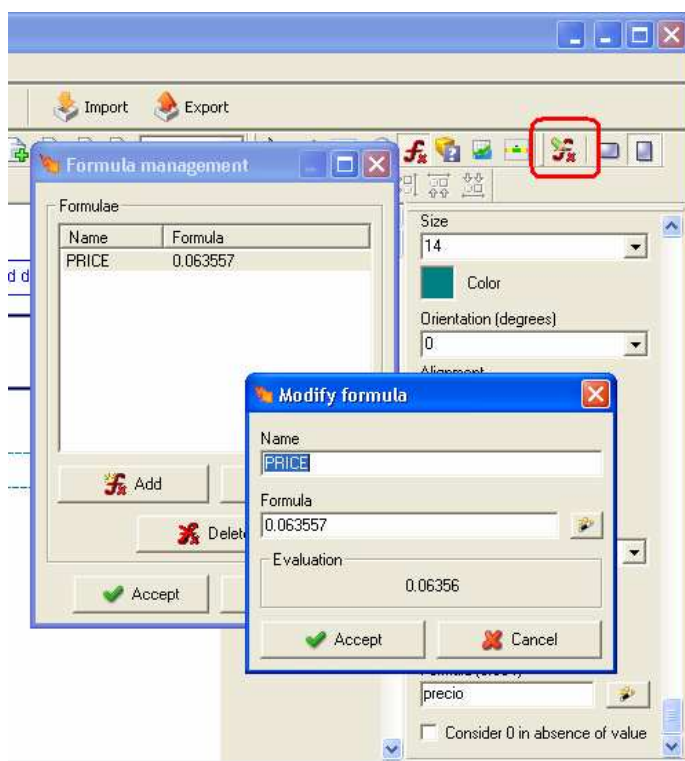


Link the function control to the energy data for the **CVM-MINI** device using the “wizard” and then click accept in all of the windows that appear.

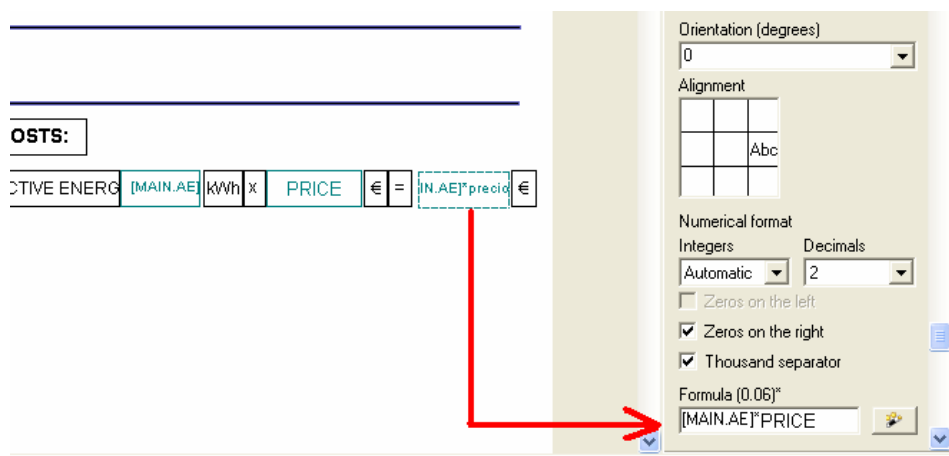


The next step is to generate a variable containing the energy cost. To do so we will use the formula calculation control so that if we need this information for any other calculation,

- Create a variable called "price" and programme it with the required value.



The next step is to perform a simple multiplication of the CVM-MINI energy and the "price" variable programmed above. You can either perform this calculation directly in the "FORMULA" field where the result will be displayed or generate a formula as you did for the "price" variable. Remember that if you choose the second option the calculation will be accessible for new screens or reports.



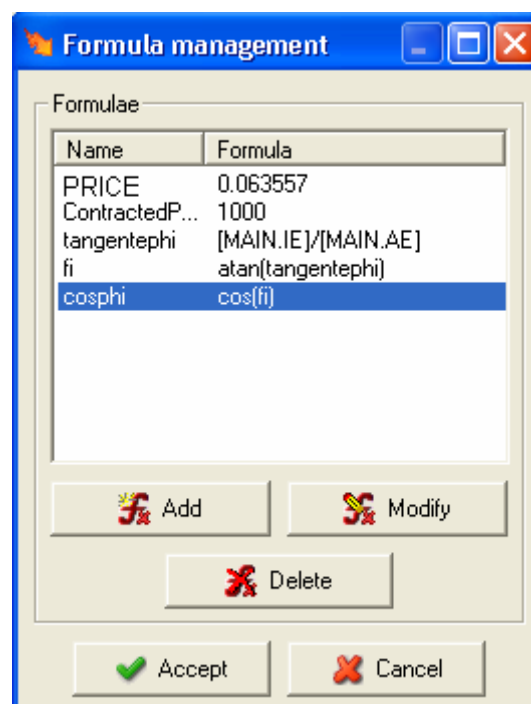
21.3.1.- REACTIVE ENERGY.

- To display the reactive energy, follow the same steps as you did for active energy.

21.3.2.- COS PHI AND CONTRACTED POWER

A simple formula for calculating cos phi is as follows:

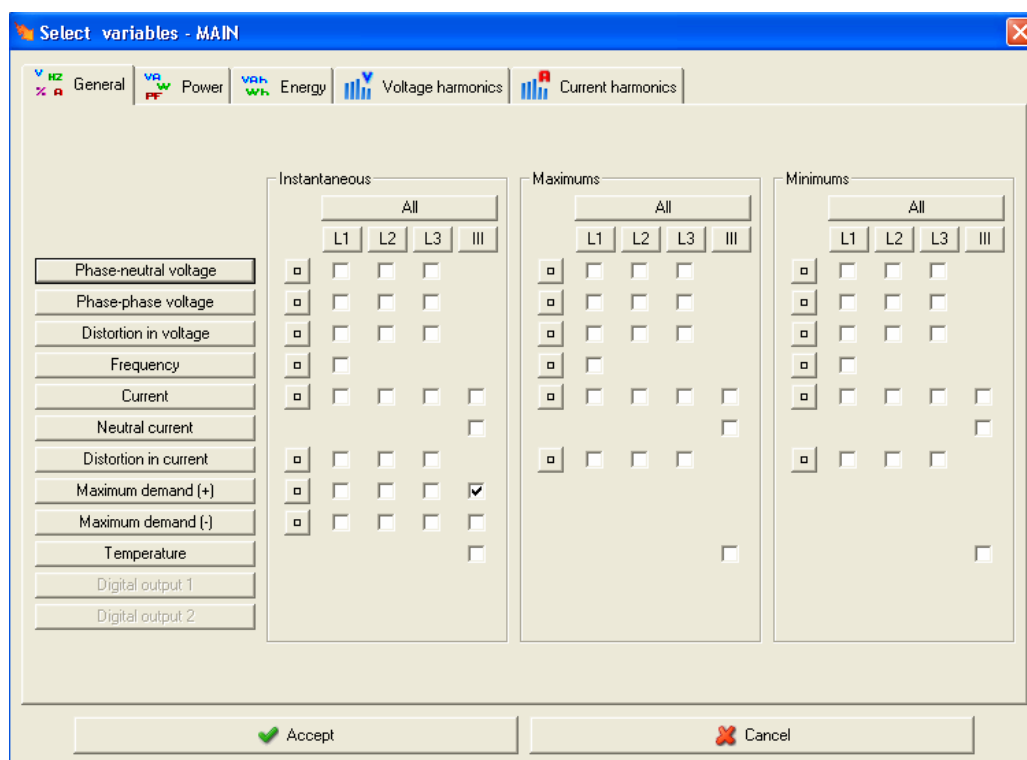
- Create the following variables using the formula manager.
- $\tan fi = \text{Reactive energy} / \text{active energy of CVM-MINI called MAIN}$
- $fi = \text{atan}(\tan fi)$
- $\cos phi = \cos(fi)$
- Create a variable called "PowerC" and assign a contracted power value to be displayed in the report.
- Link the formula controls to display the result of the cosphi calculation and the data programmed as the contracted power.





21.3.3.- MAXIMETER VALUE.

The **CVM-MINI** can provide the maximeter data. Link a formula filed to the maximeter parameter of the CVM-MINI. The default demand integration period is 15 min. This parameter can be configured in the equipment using the unit's keypad.

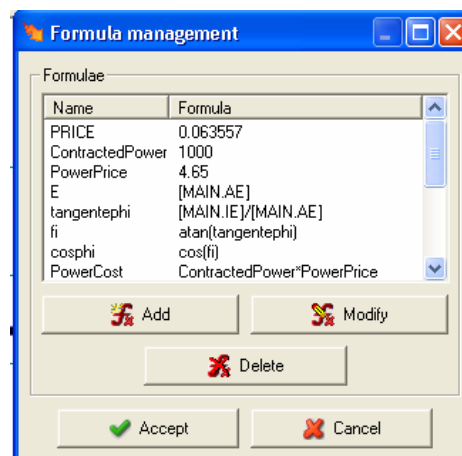


21.3.4.- BILLING SIMULATION:

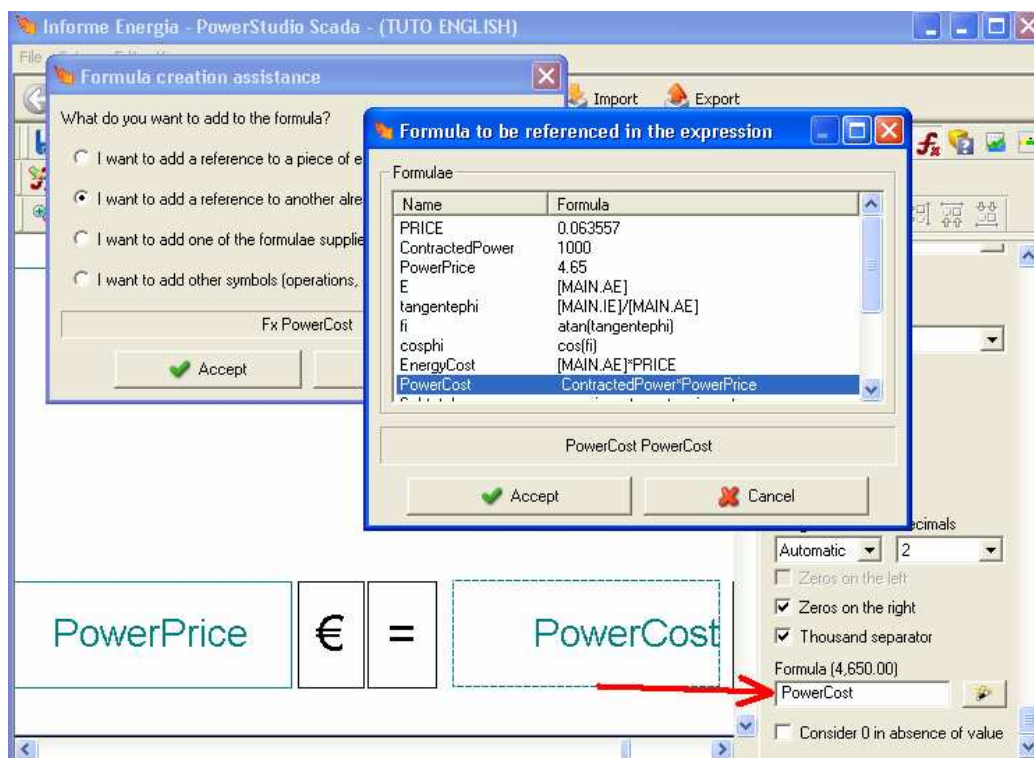
The simulation of an invoice would not be possible without the power value. Therefore, you need to generate the part that defines the contracted power and the cost part of that power.

The price of the power is defined year after year, creating a variable that can be easily modified. It is not very common to change a facility's power term but it is created as a variable just the same.

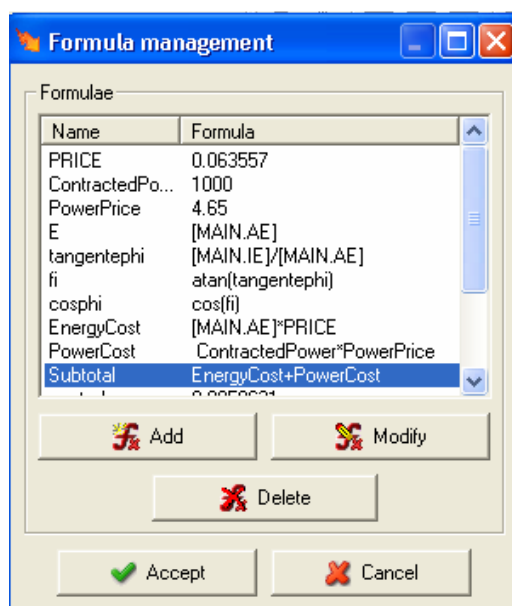
- Programme a variable called "PowerPrice" using the formula manager and assign a value for the cost of contracted power.
- Create another one called "PowerCost" and programme a multiplication of the "ContractedPower" variable and the "PowerPrice" variable.
- Accept the changes.



- Select the control where you want to represent this calculation and use the "wizard" button to link it to the "PowerCost" variable.

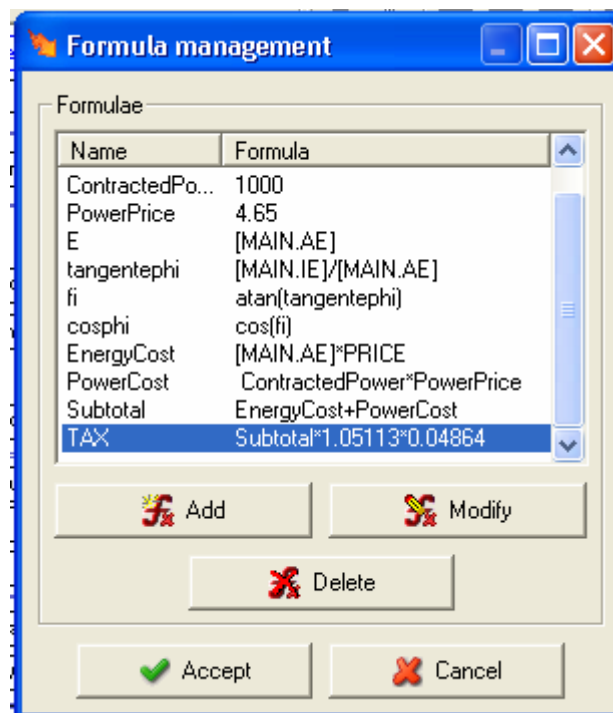


- Create the "subtotal" calculation as the sum of the previous independent variables, "EnergyCost" and "PowerCost"



The tax on electricity must appear as part of the taxable base.

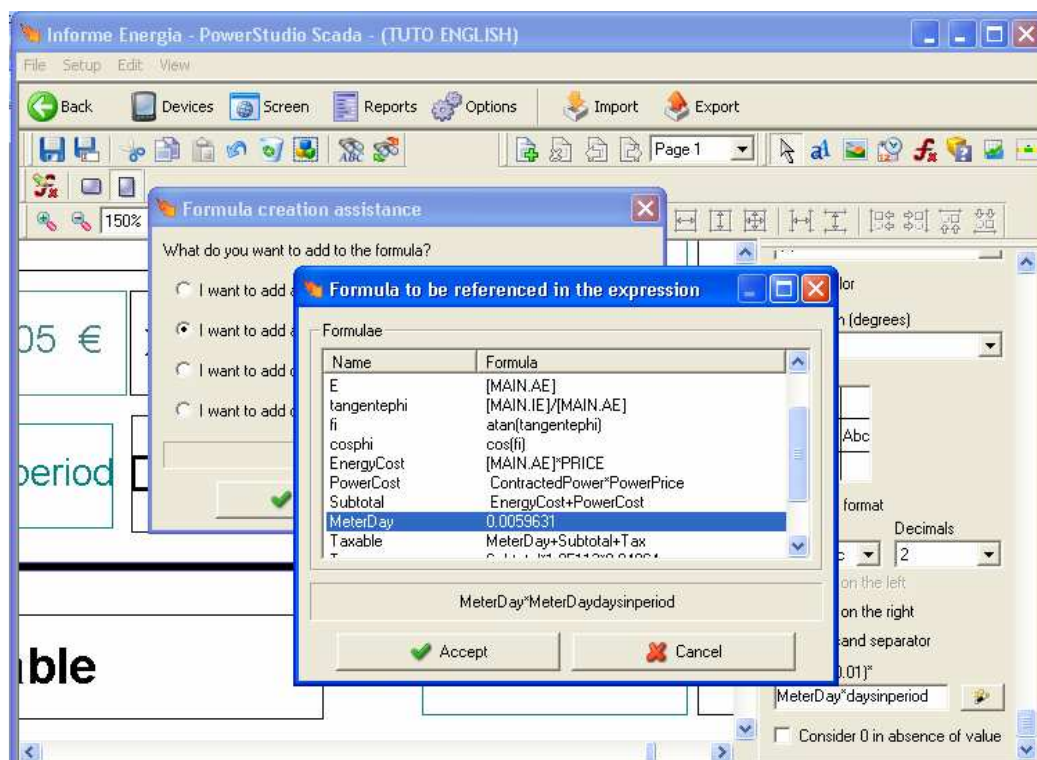
- Create a formula called "tax" to multiply the "subtotal" variable by the applicable electricity tax percentage (%). (4,8664 %)



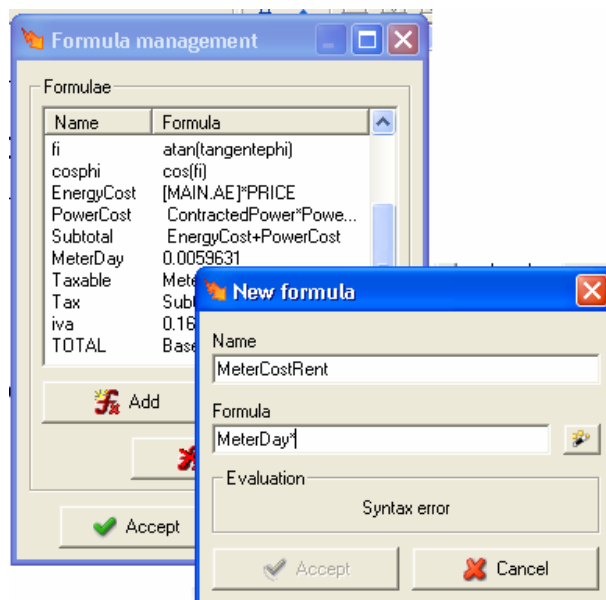
- Accept in all windows and assign the field where you want this formula to be displayed using the “wizard”.

Another aspect that must be included in the taxable base is the meter rental.

- Add a variable called "MeterDay" with the daily rental price.
- Programme a formula called “MeterCostRent” to multiply the previous “MeterDay” variable by the **days in the billing period**. To do this, follow the steps described below:
- First, add the formula and programme the first piece of information, “MeterDay” by choosing "Add a reference to a previously-defined formula".

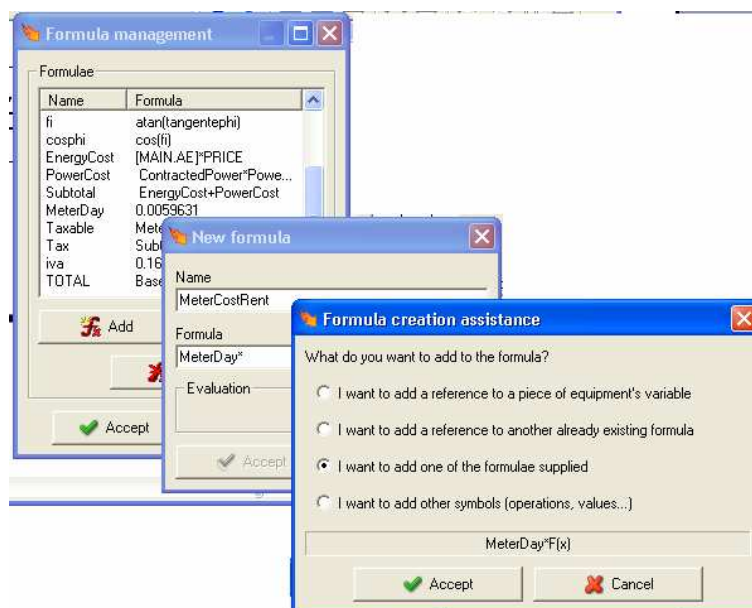


- Add a multiplication sign after that parameter:

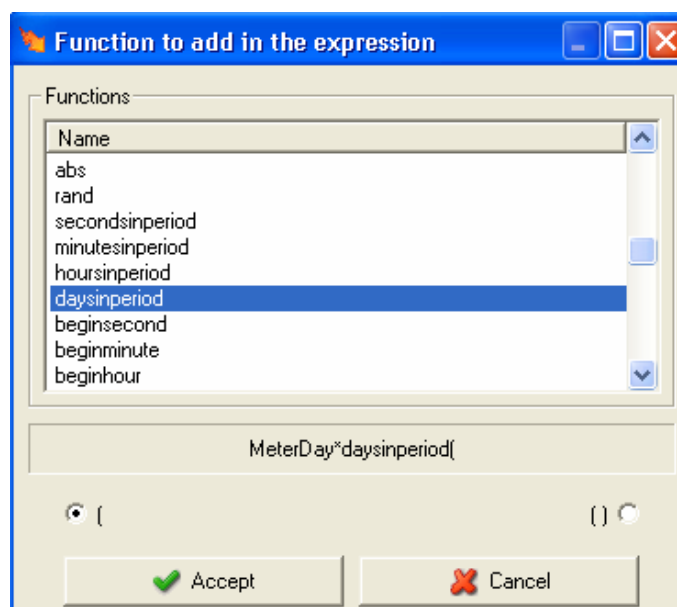


- Repeat the steps to add the number of days in the billing period.

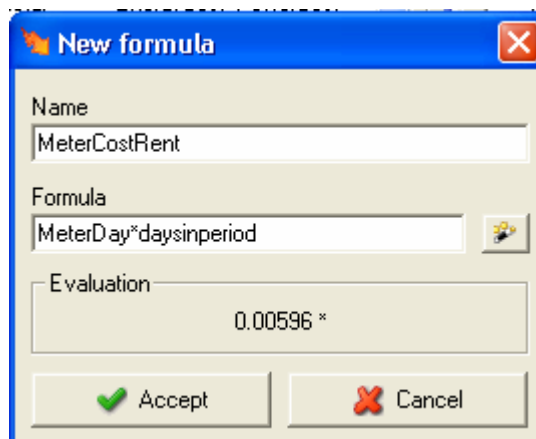
- When the programme asks you, choose "Add one of the functions provided".



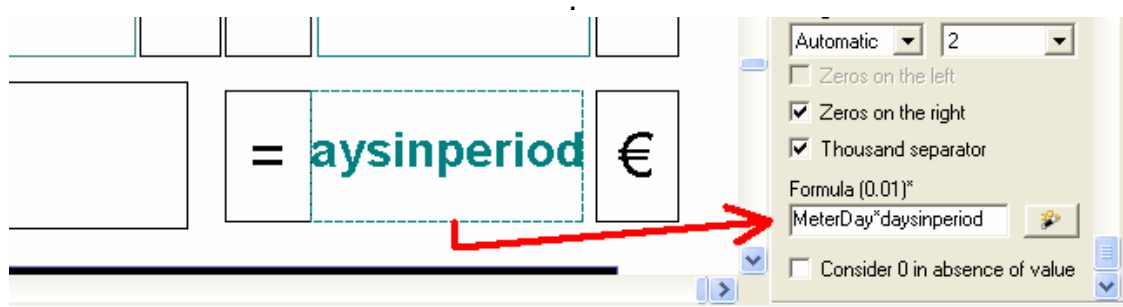
- From the list of "functions provided", choose the "daysinperiod" function:



Eliminate the last parentheses, after which the formula should look like this:



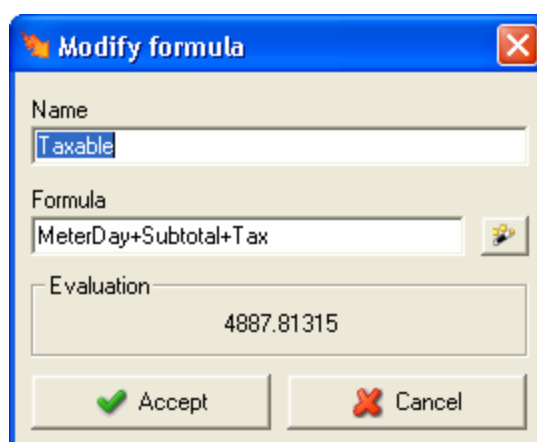
- Accept in all windows and assign the field where you want this formula to be displayed using the “wizard”.



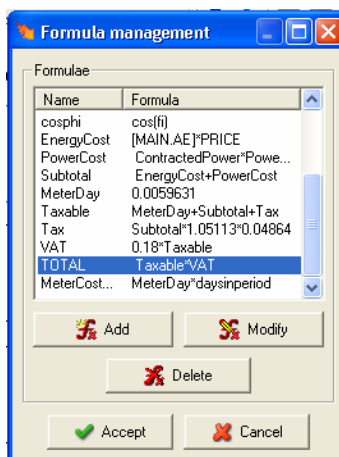
With these terms you can generate the taxable base, which will be the sum of the subtotal, electricity tax and meter rental.

- Generate a formula called “Baselmpoible” to add the 3 parameters mentioned above.

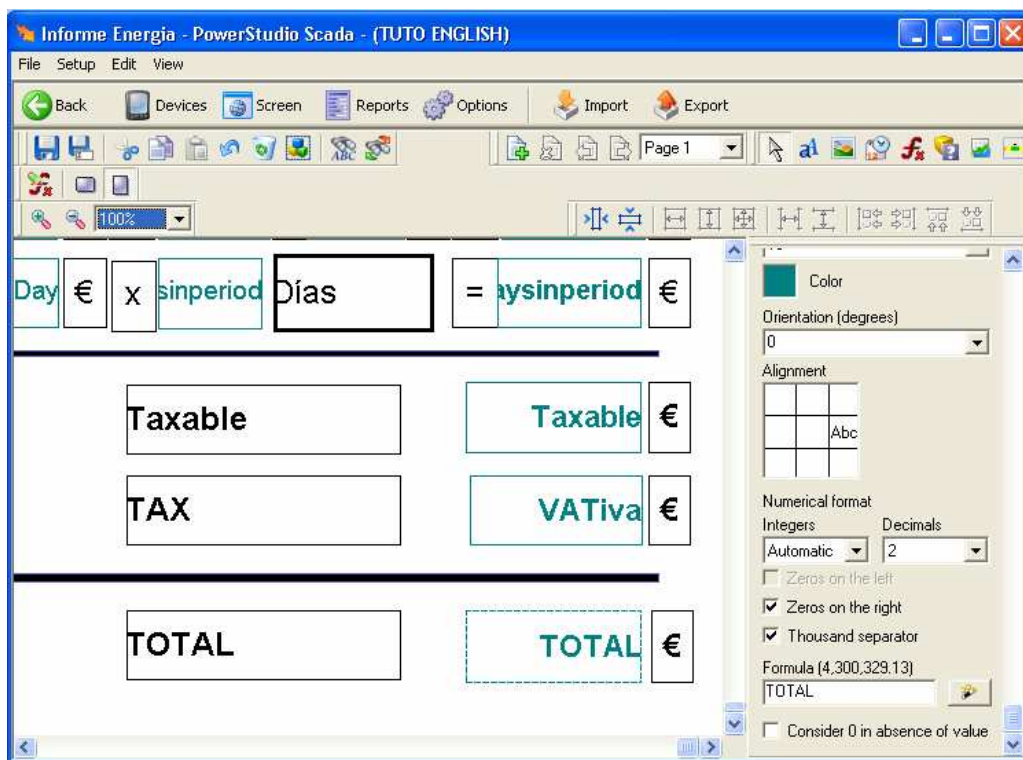
Remember that you can use the “wizard” button to choose the variables of this new calculation.



- Add the term VAT as 0.18x (taxable base) in another formula and calculate the total amount, including VAT.



- Accept in all windows and assign the field where you want this formula to be displayed using the “wizard”.



Finally, export the application to the PowerStudio SCADA SEARCH ENGINE and run CLIENT. Click on the "REPORTS" icon and choose the report you've just created called "Energy Report".

Informe Energia - PowerStudio Scada

Options Views General

Previous Next Devices Screens Reports Graph Table Events Properties Print

Report Date: 15/12/2010

FROM: 01/09/2010 TO: 30/09/2010

cos(phi): 1 Contr.Power.: 1,000 kW

COSTS:

Active Energy: 10,901,441.587 kWh x 0.064 € = 697,512.92 €

Reactive Energy: 0 kVArh

MAXIMETER: 308 kW

Contr.POWER: 1,000 kW x 4.65 € = 4,650.00 €

Subtotal 697,512.92 €

TAX 697,512.92 € x 1.05 € x 4.86 % = - €

Rent METER: 0.006963 € x 29.00 Dias = 0.17 €

Taxable 733,174.65 €

TAX 131,971.44 €

If the tutorial was installed correctly, you should be able to view the information in the report from 1 through 30 September 2010. To do so, choose "go to" in the report, open the calendar and choose the start and end dates. Observe how the system recalculates using the date recorded for the days in the date range.

Select interval

From date 9/1/10 To date 9/30/10

From time 12:00:00 AM To time 12:00:00 AM

Ok Cancel

Next Go to Grouped by Zoom

At this point, the only thing left is to print the report. Go to File/Print in PowerStudio CLIENT and follow the instructions of the Windows printing assistant.

Remember that you can select any time range to consult or print the report. Run some tests by changing the date range using different start and end dates between 1 and 30 September.

Report Date:	15/12/2010									
FROM:	02/09/2010				TO:	10/09/2010				
<hr/>										
cos(phi):	1		Contr.Power.:		1,000		kW			
<hr/>										
COSTS:										
Active Energy:	1.408		kWh		x	0.064		€	=	89,504.67 €
Reactive Energy:	0		kVArh							
MAXMETER:	81.3		kW							
Contr.POWER:	1,000		kW		x	4.65		€	=	4,650.00 €
<hr/>										
Subtotal										94,154.67 €
TAX	94,154.67		€	x	1,05	€	x	4,86	%	= 4,813.84 €
Rent METER:	0.005963		€	x	8.00		Days	=		0.05 €
<hr/>										
Taxable										98,968.51 €
TAX										17,814.33 €
<hr/>										
TOTAL										116,782.85 €

Print the report

22.- TIME DISCRIMINATORS (RATES).

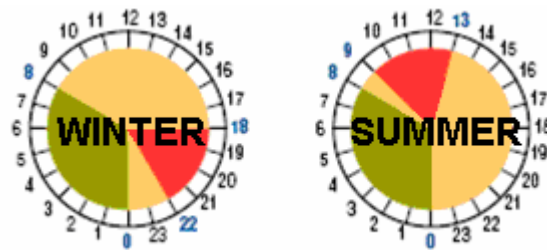
22.1.- PROGRAMMING

In this section you will learn how to create various time discriminators. The example that goes with the **DEMO-EXPERT Kit** meets the following conditions:

Daily conditions:

■ 4 hours of peak ■ 12 hours daily flat ■ 8 hours daily valley

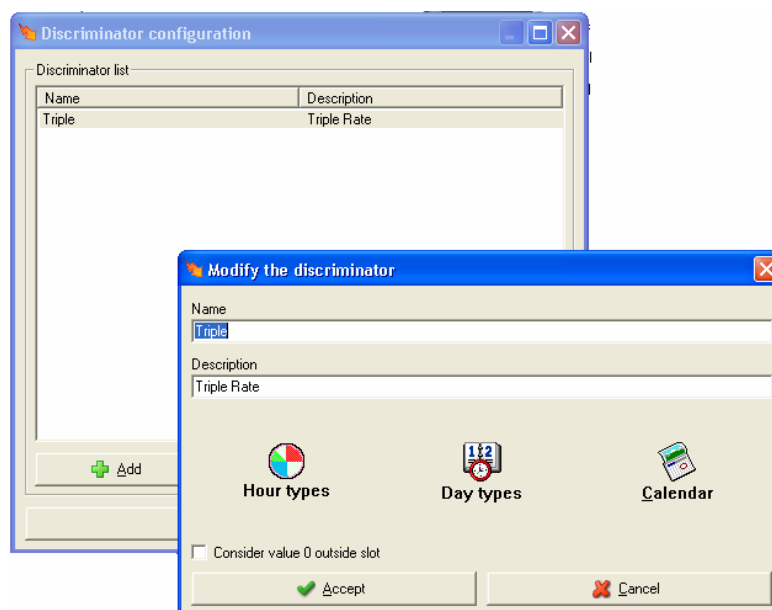
These daily periods vary from winter to summer:



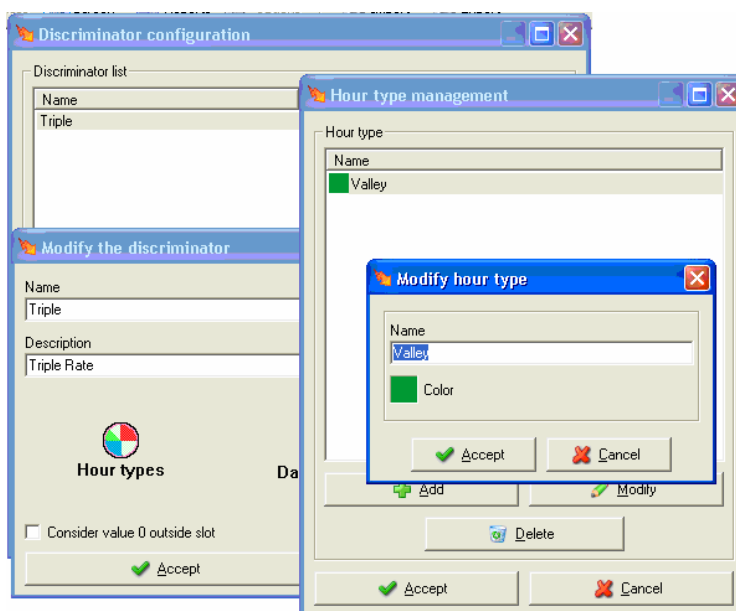
Where:

The winter period runs from the last Sunday in October to the last Sunday in March. The summer period runs from the last Sunday in March to the last Sunday in October.

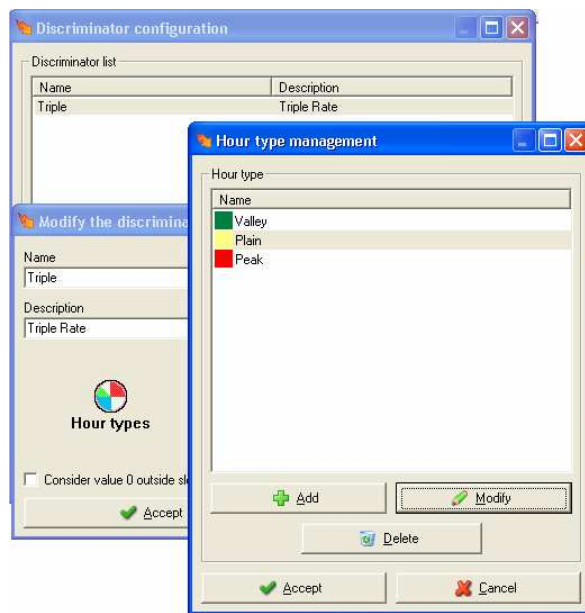
- In **PowerStudio SCADA.EDITOR**, open the discriminator manager, go to the Configure menu and choose the "Discriminator" option.
- Once open, click on "Add" and on the next screen configure a name and a description. In the case of the DEMO-EXPERT Kit, use the name "Triple" and the description "Triple rate"



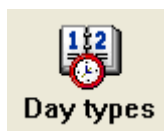
- You must now programme the calendar starting with the type of hour. Click on the "Hour types" icon and add the first type of hour: "Valley". Select a colour for this type of hour, which in the example is dark green.



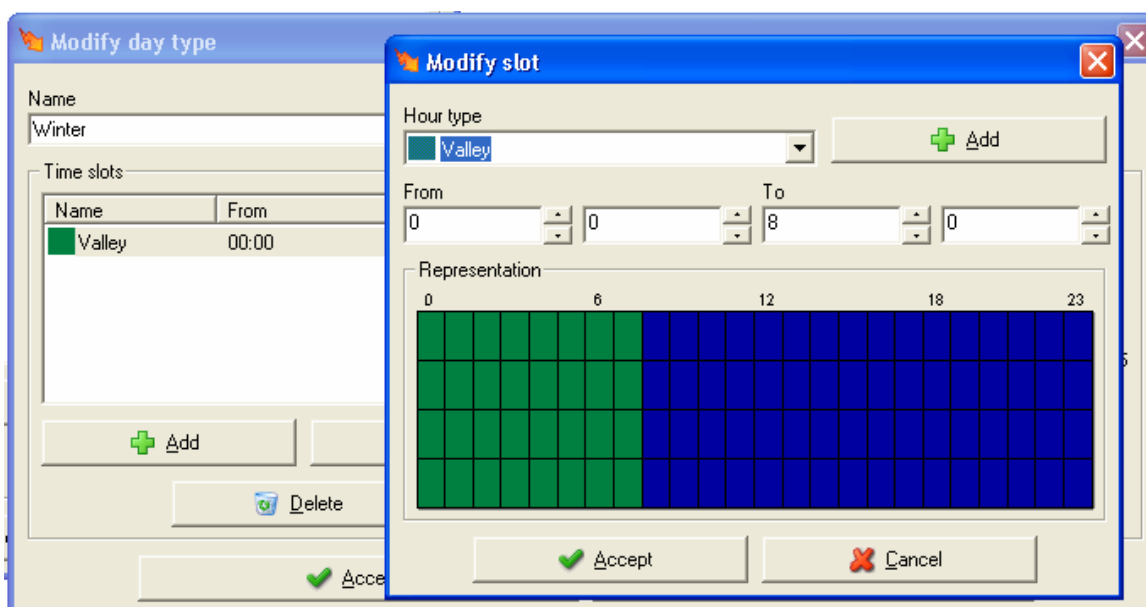
- Click on Accept to add the programmed hour type.
- Follow the same steps to programme the other 2 types of hours with their corresponding identifying colours.



- The next step is to create the type of day: Winter and summer. Return to the "Modify discriminator" screen and click on the "Day Types" icon.

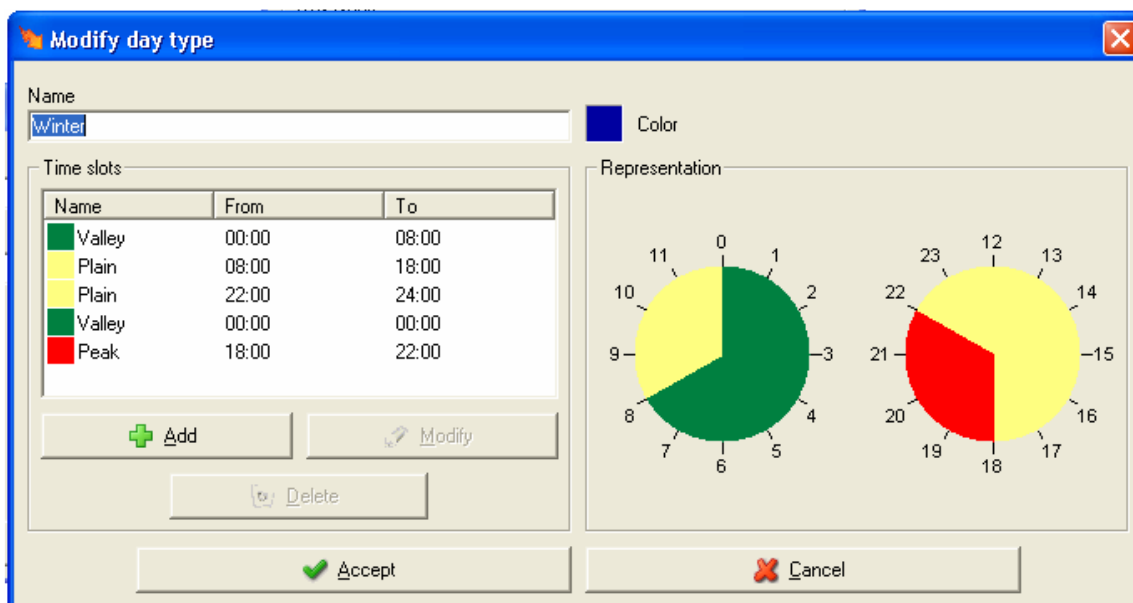


- Add the first type of day called "Winter" and click on "Add" inside the "Time slot" box.



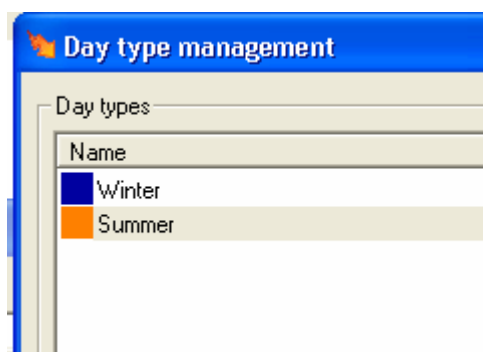
- The types of hours programmed previously will appear in the "Hour type" field. Choose the first type - trough - and programme the hours and minutes "FROM" and "TO". In the example, the time slot runs from 00:00 to 08:00 a.m. Once you have configured this parameter, click on "Accept".

Following the same steps as above, configure the remainder of the 24-hour winter day. The screen thus configured should look like this:



- Check the correlation between the different hours of the day in order to ensure that you have programmed the hours as desired. Once you have done this, click on "Accept".
- The next step is to programme the summer hours. Follow the same steps as described above to do this.

The types of days are now defined:

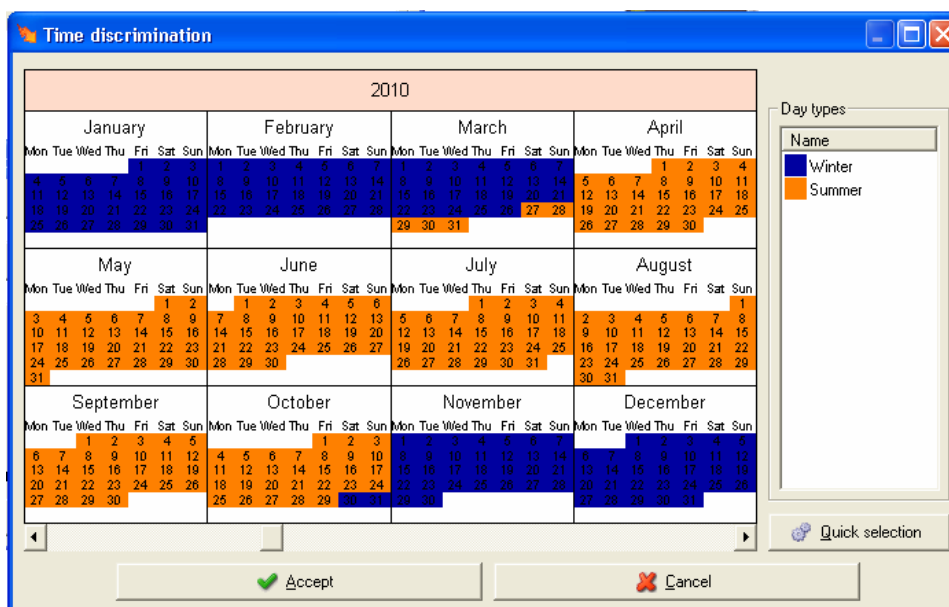


Finally, you must configure the calendar by defining which days of the year correspond to each type of day.

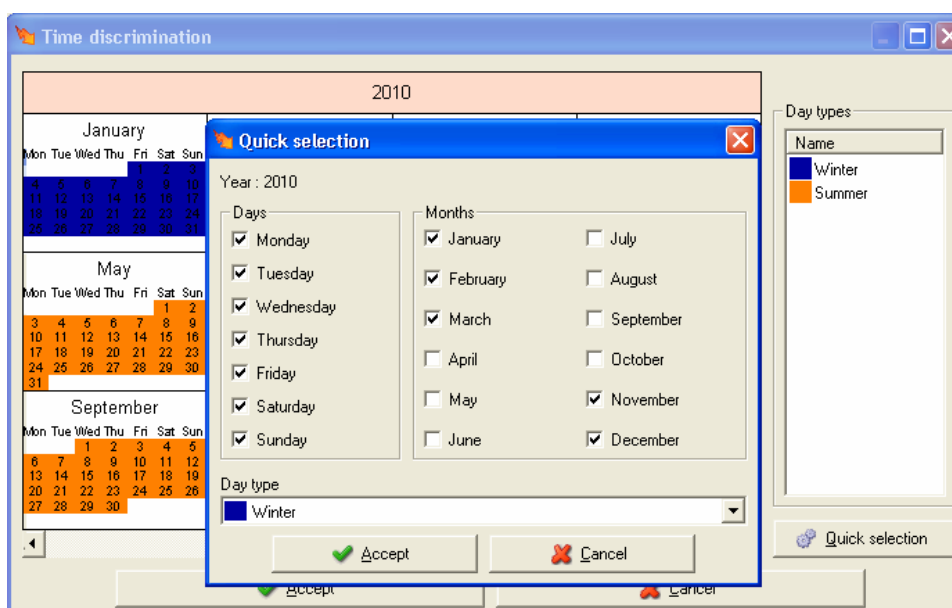
- Click on the "Calendar" icon.



- On the next screen, select the type of day - "Winter" or "Summer" - and click on the different days of the calendar year to make your selection. In this case, the winter runs from 30 October through 26 March and the summer runs from 27 March to 29 October, as shown in the image.



- To facilitate the calendar programming task, use the "Quick Selection" button.

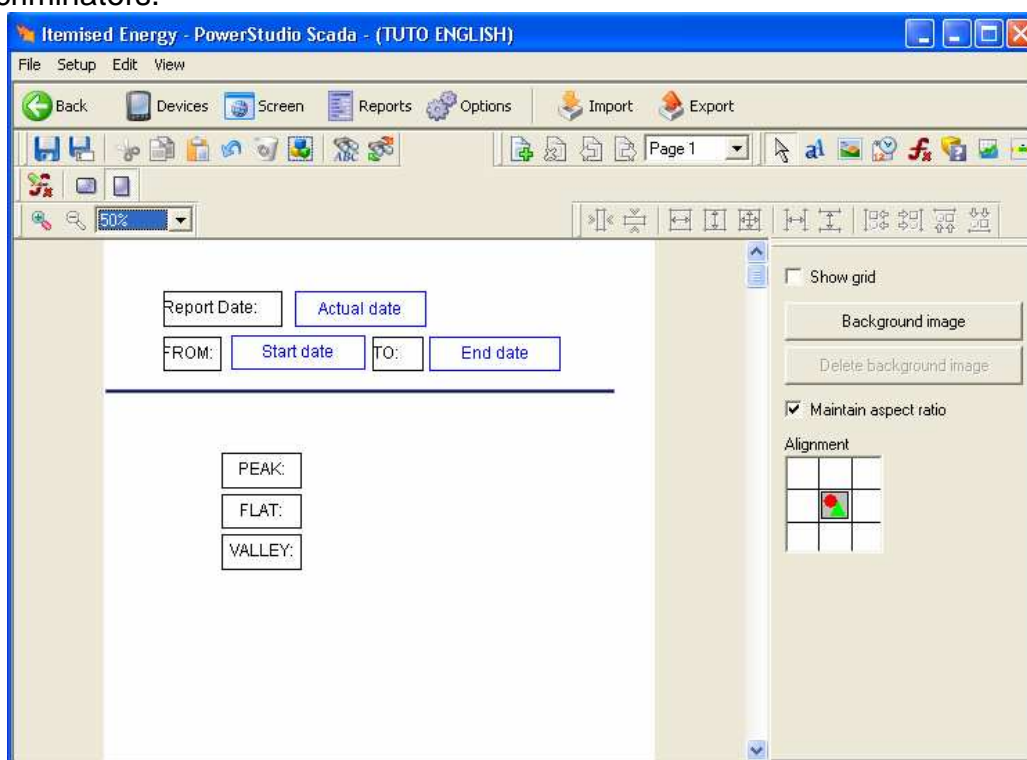


- Configure the programming as desired and click on “Accept”. You can make adjustments in the future by clicking on each one of the days in question and either selecting or deselecting it.
- Once you have finished programming the calendar, click on "Accept" in all windows.

22.2.- APPLYING DISCRIMINATORS TO REPORTS.

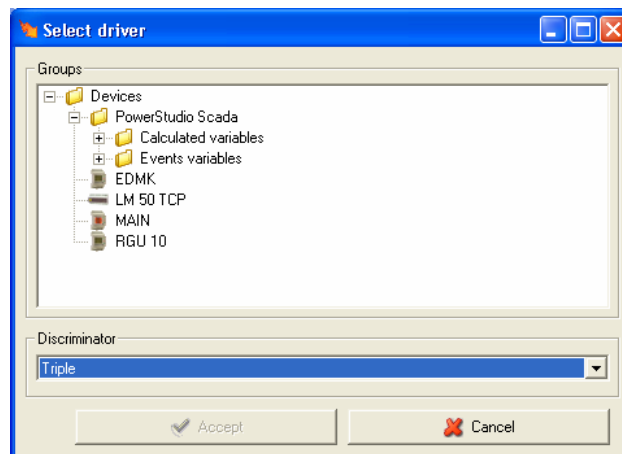
Proceed as follows to apply the discriminators programmed above:

- Generate a new energy report called "Itemised Energy" following the same steps you used to generate the previous report.
- Configure it as desired in terms of generation dates and start and end dates of the report.
- Generate the text labels for the new data to be displayed and name them “Peak”, “Flat”, “Valley”. These labels refer to the three previously-programmed discriminators.

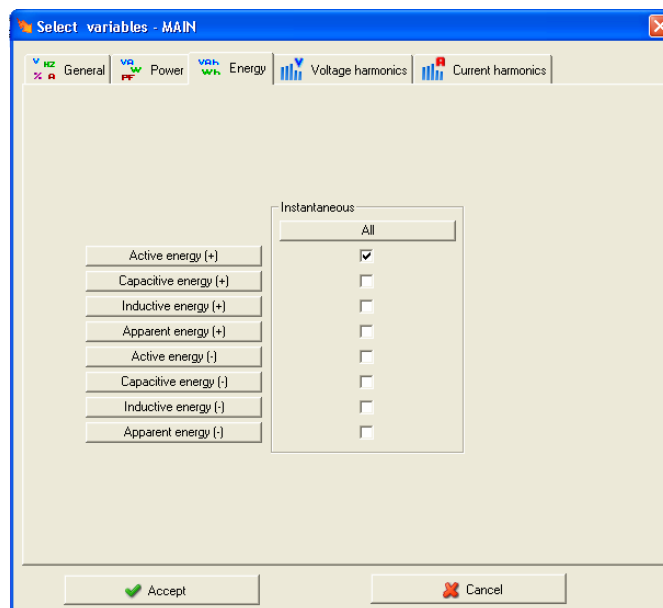


- Once you have applied the discriminator to the three energy boxes and obtained the desired result, proceed as follows to create the link.
- Select Formula Control and past a field of the desired dimensions in the report area.
- Click on the “wizard” button on the side toolbar and select "Add a reference to a variable of a device".

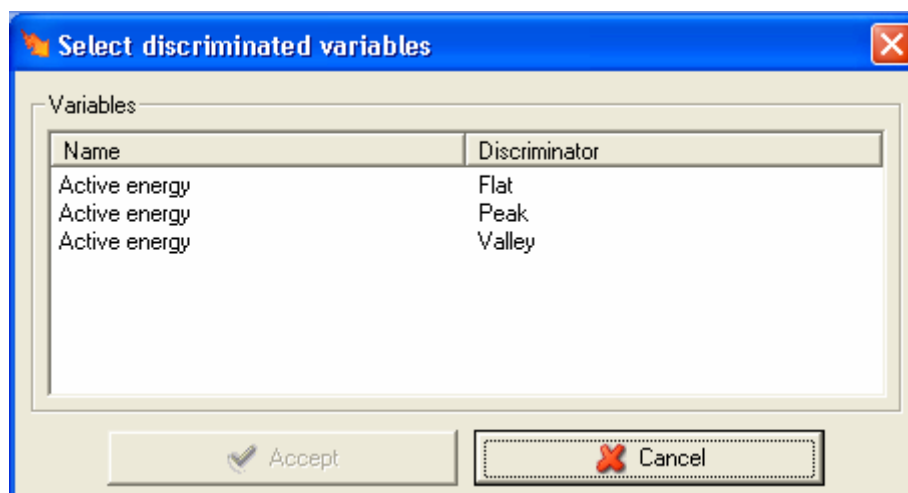
- Click on Accept and select the MAIN device. On the same screen, choose the previously-programmed discriminator named "TRIPLE".



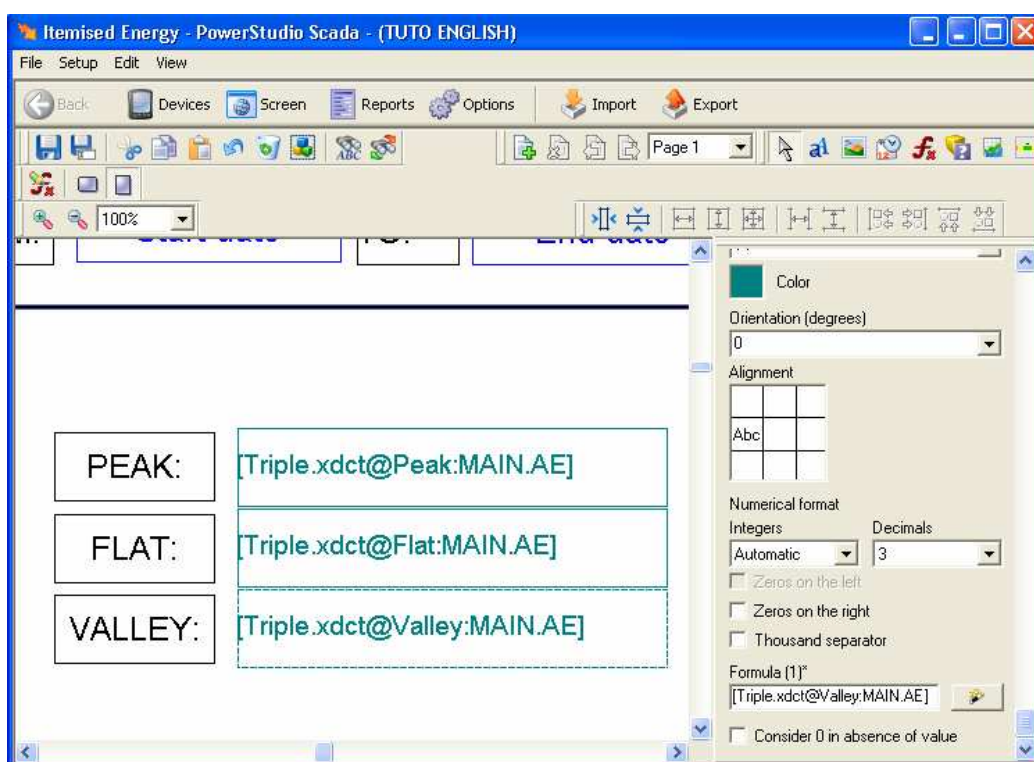
- Click on "Accept" and then search for the Active Energy parameter of the device.



- Click on "Accept". A screen will appear where you can select the type of day previously programmed in the discriminator called "Triple".



- Choose the type of variable for each one of the formula controls and click on "Accept". The control will be linked to the equipment parameter, filtering the data based on the programmed discriminators (Rates). In other words, the active energy consumed on the programmed days will appear in each field.



23.- EVENTS IN POWERSTUDIO SCADA (ALARMS)

Events are user-programmed security or control parameters which, when detected, trigger actions.

The programming of events in PowerStudio SCADA is very flexible and provides for the generation of visible and invisible alarms using different options such as pop-ups and audio warnings. This can be done by running an external programme (.EXE), by means of a digital output in one of the devices connected to our energy-efficiency network or even by means of email notifications.

The programming of events in PowerStudio SCADA is very intuitive and flexible: all of the options for configuring an event for detection and treatment are found in a single assistant.

PowerStudio SCADA allows you to classify the programmed events in different groups based on certain criteria. The events can be programmed in the form of:

- ✓ Alarms sent to the user on the parameters measured or calculated for the supervised or controlled facility.
- ✓ Calculations of a particular value at a particular time. For example, the data on the energy consumed in a 24-hour period, i.e. from 00 hours one day to 00 hours the next day, which are later shown on a SCADA screen.
- ✓ Automation of risk-free or non-hazardous processes such as the activation or deactivation of known loads such as air conditioners in offices during a particular time slot.

PowerStudio SCADA also allows you to enable or disable programmed events for a particular time slot. In other words, it allows you to have two events with an overlapping detection parameters and assign them to different time slots. As a result, even if the conditions for both events are met, one of them will not be activated since it will not be in the time slot assigned for that event.

Events are logged in the application and can be consulted in PowerStudio SCADA CLIENT.

23.1.- ALARM WITH POWER CUT-OFF.

In the **DEMO-EXPERT Kit0** application, you will programme an event to generate an alarm when the intensity of the **CVM-NINI** (MAIN) exceeds a certain value. Use the switch on the simulation device to configure the event. When the switch is in the “-” position, **CVM-MINI** will show a value that will depend on the transformation ratio programmed in the equipment. Remember that these values are simulated using the transformation ratio programmed in the equipment. When the switch is in the “+” position, **CVM-MINI** will show a value that is higher than the previous one, bearing in mind that the two values are used to determine an intermediate value that is used as a reference for activating the event.

In the example, the following values are used.

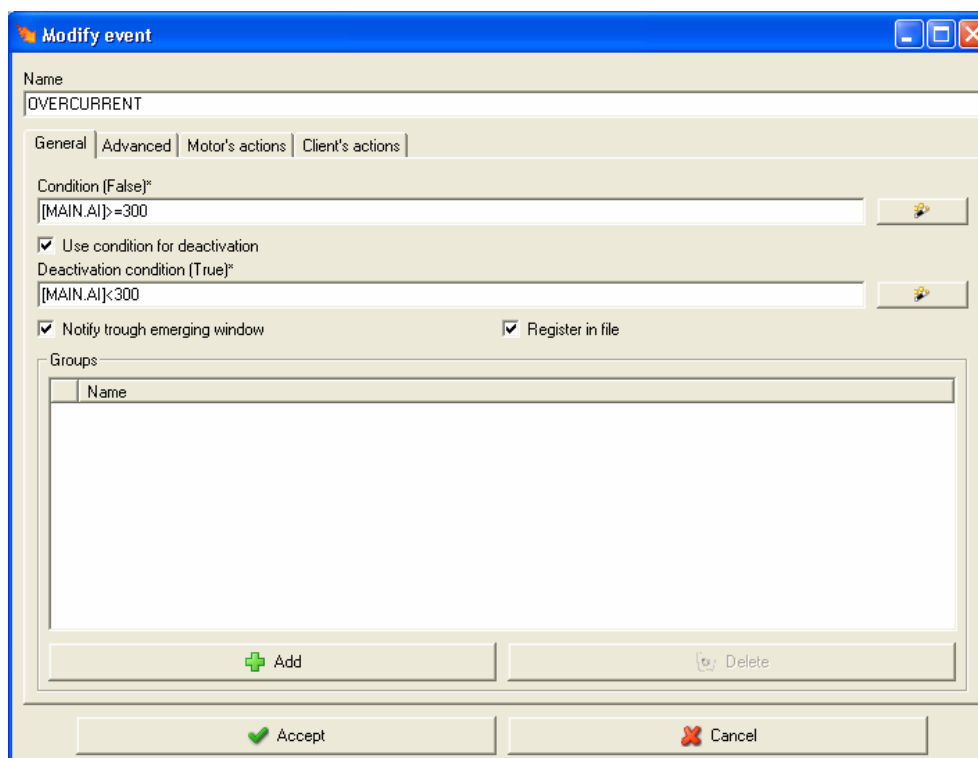
Switch in “-“ position. Three-phase current value set to 256 A
Switch in “+” position. Three-phase current value set to 356 A
Value of reference for the event: 300 A.

To programme an event in PowerStudio SCADA, proceed as follows:

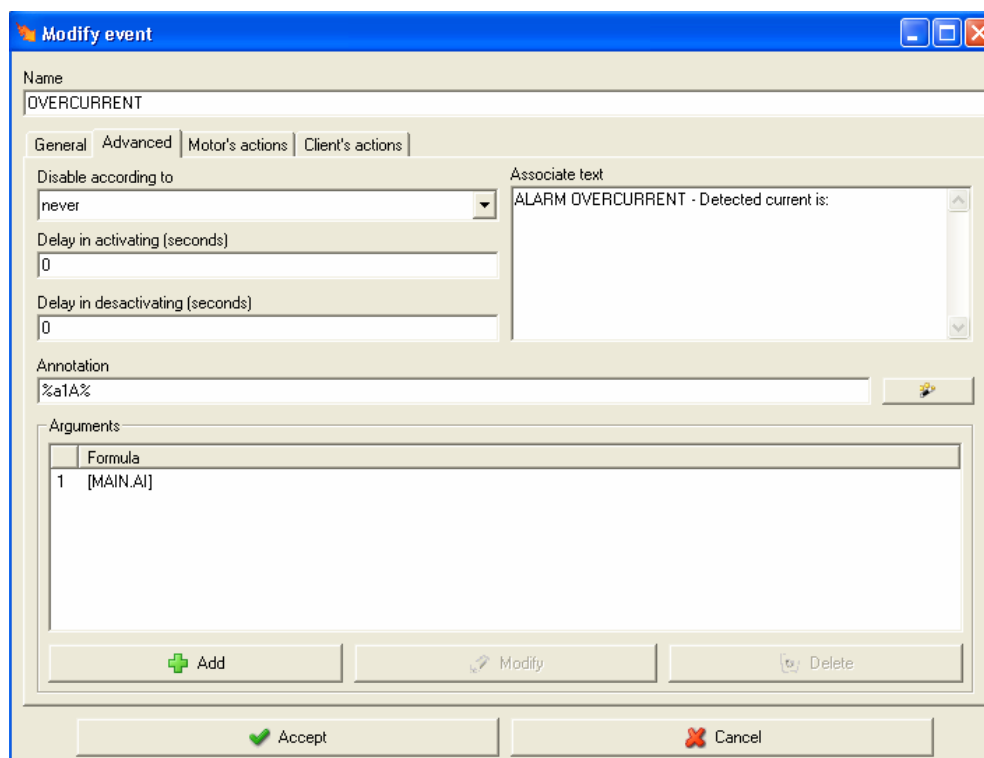
- In PowerStudio SCADA EDITOR, click on " Configure" / "Events"
- In the "Event Configuration" window, click on Add.
- Assign a name to the event you are creating, e.g., "OVERCURRENT"
- Under the "General" tab in the "Condition" field, programme an event-activating condition using the following code `[MAIN.AI]>=300`. Remember that you can use the "Wizard" to link it to the equipment parameter and to build the condition sentence. Check the current TRUE/FALSE status of the condition you are programming which appears in parentheses alongside the field label. If the message "Syntax Error" appears, it means that there is an incorrect character or sentence format.
- Mark the option "Use condition for deactivation" to deactivate the event when the condition is met. For example, when `[MAIN.AI]<300`. (average intensity of CVM-MINI less than 300 A). If this option is deactivated and the option "Notify by pop-ups" is enabled, the system will display a window showing the historical events in PowerStudio SCADA CLIENT and will wait for an acknowledgement of receipt of the event by the application user. The date and time of the event and the date and time of the acknowledgement of receipt of the event by the user are shown in this window.

NOTE - Remember that in the DEMO-EXPERT Kit this intensity is simulated in a simulation box and the transformation ratio is programmed in the equipment.

- On this screen, the "Groups" window allows you to assign this event to a previously-created group of events. Later on in this manual you will generate a group of events and assign a time slot so that the event can only be activated at certain times of the day.

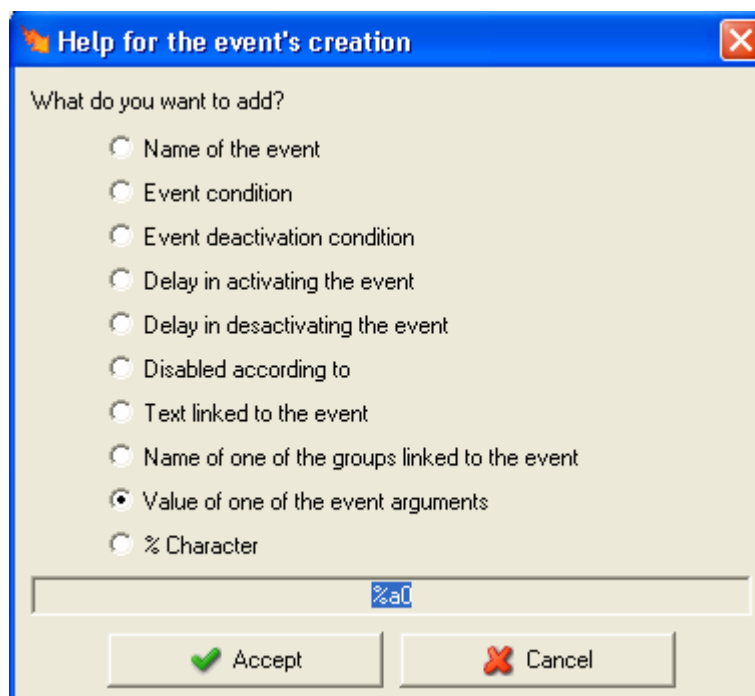


- You can mark the "Notify by trough emerging window" option. When an event is detected, a window will appear in PowerStudio SCADA CLIENT informing the user of the event(s) activated. The texts or annotations that will be programmed in the steps below will appear in this window and the user of the application will be forced to select the activated event(s) and to acknowledge receipt by clicking on "Recognise event". The date and time of this action are also logged in the historical events file if you select the parameter that is explained below.
- You can select the "Record in file" option if you want PowerStudio SCADA to do this. If you do not select "Record in file", the event cannot be consulted using the historical events option in PowerStudio SCADA CLIENT.
- Continue programming the event. Click on "Advanced".



- The first field to be configured would be "Disable according to". In this field you can select a time to switch off event activation. You will see the time discriminators for events in successive sections of this tutorial.
- Programme a delay in the activation of the event to ensure that the condition that triggers the event is stable. This delay is useful for avoiding rapid activations and deactivations.
- If you wish, you can also programme a delay for deactivating the event.
- In the section titled "Associated Text", you can write a descriptive text or instructions for the user of the application to follow in relation to the event being programmed.
- At this point, you can link the event to a device or variable that measures or calculates the parameter controlled by the event. Click on "Add".
- Follow the steps in Assistant to link it to the three-phase current of the "MAIN" CVM-MINI device. Click on "Accept" in all windows of the Assistant until you are back to the event creation window.

- Now, in "Annotation" field, use the "Wizard" to select an event parameter to appear in the text that will be shown to the user of the application. Choose "Value of one of the arguments of the event" and click on "Accept".



- A new window should appear where you can select the equipment previously linked to "MAIN" CVM-MINI. Select it and click "Accept".
- Observe the characters %s1 that appear in the "Annotation" field. This is the value of the equipment at the time when the event is detected. If you want to view the units for this data, you can enter them with the character % at the end. In this example, we will enter A% for a total value of %a1A%. This is the value of the current in CVM-MINI at the time when it exceeds 300 A in XXXA format. Bear in mind that if you programmed an event detection delay, the value shown will be considerably higher than 300 A. Similarly, if you programmed a short delay, the figure will be closer to the programmed value.
- Once you have configured this option and become familiar with it, try configuring other "Annotation" options so that the event shows more parameters or parameters for other equipment added to the list of "Arguments".

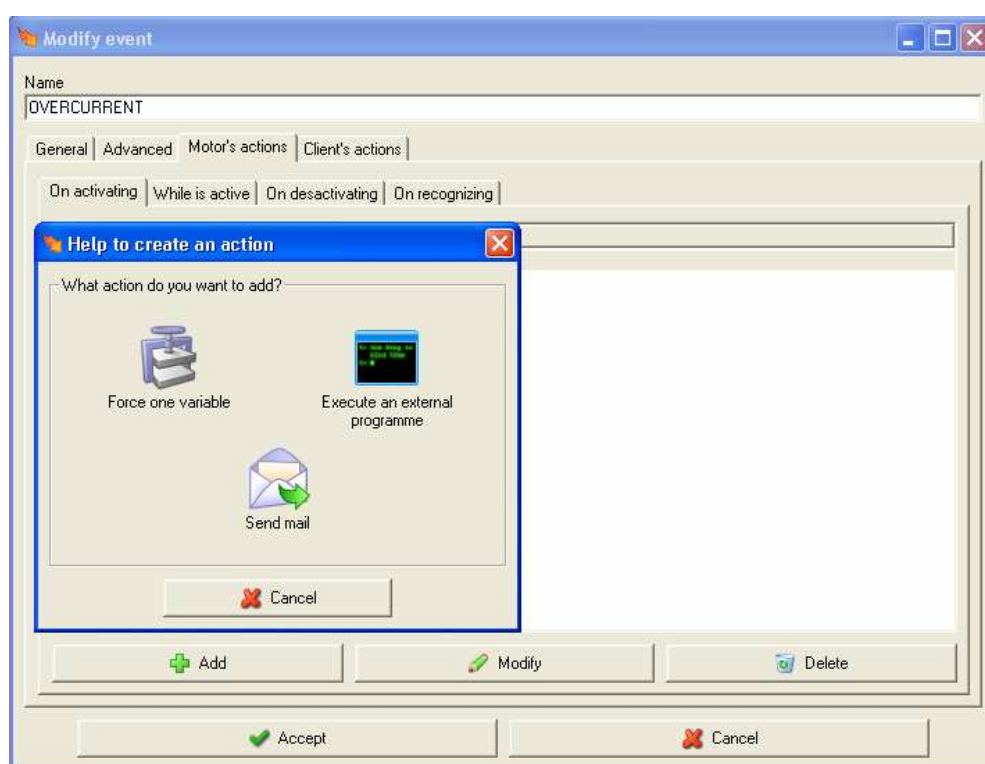
Continue configuring event. Up to now you have configured the parameters of the conditions for detecting an event and the information that will be shown to the user when the event is detected. In the following steps you will configure the actions to be taken by PowerStudio SCADA if the event is activated.

- Click on the "Search Engine Actions" tab.

The actions that you programme in this section do not have a direct effect on the PowerStudio SCADA SEARCH ENGINE. In other words, it will be managed in the background in Windows. These actions will run even if PowerStudio SCADA CLIENT is not active. The only condition for these actions being taken is that the PowerStudio SCADA SEARCH ENGINE be activated. Remember that you can check this in EngineManager. See section 6.1 of this tutorial.

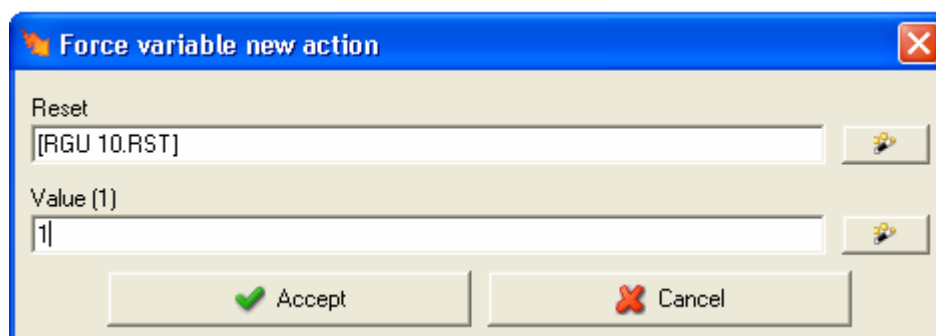
As you can see, there are four additional tabs that can be configured:

- Actions related to the activation of events
- Actions while the event is active
- Actions when the condition of the event is deactivated
- Actions when the event is recognised by the user of the application.



- In the tab titled "Motor's actions" click on "Add" and on the next screen click on "Force a variable". Note that there are two other options that can be useful for generating actions once the event is detected.

- On the next screen, use the “Wizard” to select a digital output for the **RGU-10** device. And set the value of that output to 1.



- Accept the changes until you are brought back to the configuration screen of the search engine actions.
- At this point, click on tab A "When deactivated". Following the previous steps to create the reverse effect, that is, when the event is deactivated, the PowerStudio SCADA SEARCH ENGINE will force the digital output of **RGU-10** to 0.
- The mechanism is the same for CLIENT's actions, although in order for these to be run by CLIENT they must be run in the control PC.
- Click on "Accept" in all windows of the Assistant until you are back to the event creation window.
- Make sure the switch on the simulation device is set to the “-” position and export the application to the PowerStudio SEARCH ENGINE.
- Once you have exported the application, run PowerStudio SCADA CLIENT and view the HOME screen. Look at the current shown for the **CVM-MINI**. It should be about 256 A.
- Move the switch to the “+” position. You should "skip over" the motorised magneto-thermal device that controls the **RGU-10** and the CVM-MINI current should be around 356 A. If you programmed an event detection delay, the magneto-thermal device will "go off" at the end of the delay.
- Once an event is detected, a "Notified Event" window will immediately appear showing the text of the event. This window cannot be closed. It will remain active from the time the first event is detected and while the event remains active and unrecognised. It can be minimised so that you can continue to have a complete view of PowerStudio SCADA CLIENT.
- Select the event from the list and the descriptive text will appear and the previously-programmed notes.
- Click on "Recongnise Events" to register the date and time when the user of the application or his/her supervisor recognises the programmed event.

- Next, move the switch on the simulation device to the “-” position.

Observe that the motorised magneto-thermal device is rearmed and that the event window has disappeared. If you programmed a delay for the deactivation of the event, the device will be rearmed when the programmed time elapses.

Whether or not to programme an event is more complicated than setting clear parameters to be considered when programming an alarm or the actions to be taken.

23.2.- EVENT FOR CALCULATING A VARIABLE

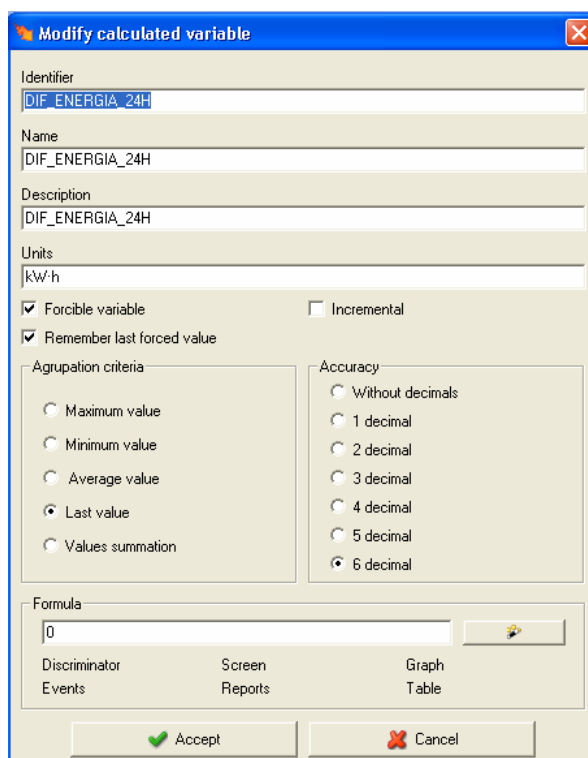
In the **DEMO-EXPERT Kit** you will programme an event for collecting the energy value for EDMK at 0 hours every day, storing the data in a variable and subtracting the energy value from the day before from that variable. By programming this event we will obtain the energy consumed in the last 24 hours, which can be multiplied by the cost of the energy to obtain the energy cost for the last 24 hours. This information can be useful as an indicator for overseeing the energy used in repetitive daily processes.

As you may have guessed, you can modify this example by changing the time interval in order to obtain the energy used in a week or a month or at different times of the day, on different shifts, etc.

Remember that this example refers to programming an event. The historical energy data and the equipment parameters are consulted in PowerStudio CLIENT recorded by the PowerStudio SEARCH ENGINE and do not require any programming in order to be stored on the computer's hard drive. This information will be available simply by registering the PowerStudio devices as explained in section 8.

Proceed as follows to configure this event and run the calculations:

- In PowerStudio EDITOR, add three new "Calculated Variables". Click on “Setup” / “Calculated Variable”. See section 19 of this tutorial for more information on calculated variables.
- Name the calculated variables “ENER_FIN_DIA”, “ENER_INI_DIA” and “DIF_ENERGIA_24H”. Configure the parameters of the variables as follows.



- Accept the changes.
- Generate a new event. In PowerStudio EDITOR, click on " Configure" / "Events"
- Assign a descriptive name. "CAP_ENER_INICIO_DIA", for example.
- Use the "wizard" to set the event detection condition.
- Select "Add one of the functions provided"
- Select the "hour" function from the list of functions.
- As you can see, one or two parentheses will appear after the selected parameter. Remove them.
- Next, click on the "Wizard" again and this time select "Add other symbols"
- Select "==" (equal condition) from the among the options that appear on the screen and accept.
- Type the value that this condition must meet, in this case 00 (for 00 hours)
- You have now configured the hour but must continue configuring the condition for the activation of this event by entering the minutes and seconds.
- Click on the "Wizard" and choose "Add other symbols ..." again.

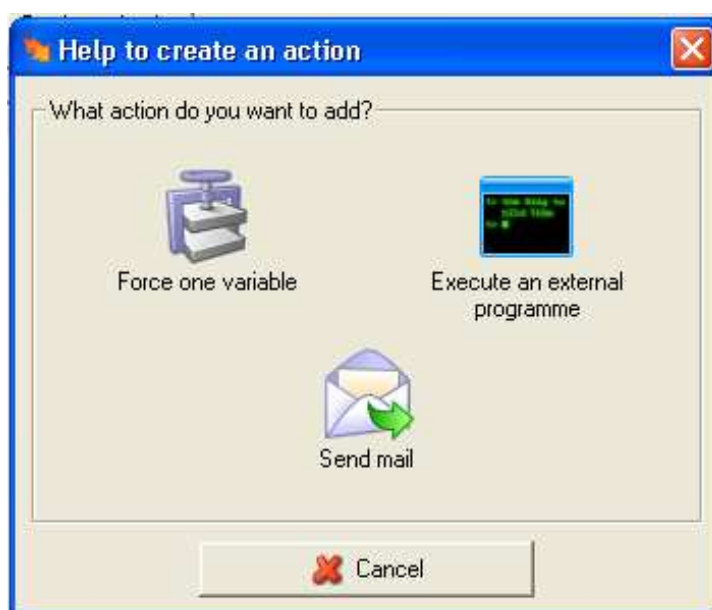
- Select “&&” (AND condition) from the options shown on the window and accept.
- Click on the “Wizard” again and select "Add one of the functions provided".
- Search for "minutes" in the options shown on the window and accept.
- Use the “Wizard” again to configure the condition to be met by the minutes or simply type in two equal signs in a row “==” and then set the value to be met by the "minutes" variable, in this case 01
- Repeat the same steps for the seconds. In the end you should have a formula that looks like this:
hour==00&&minute==00&&second==01
- Do not configure any deactivation condition.

The event will be activated at 00 hours 00 minutes and 01 seconds each day.

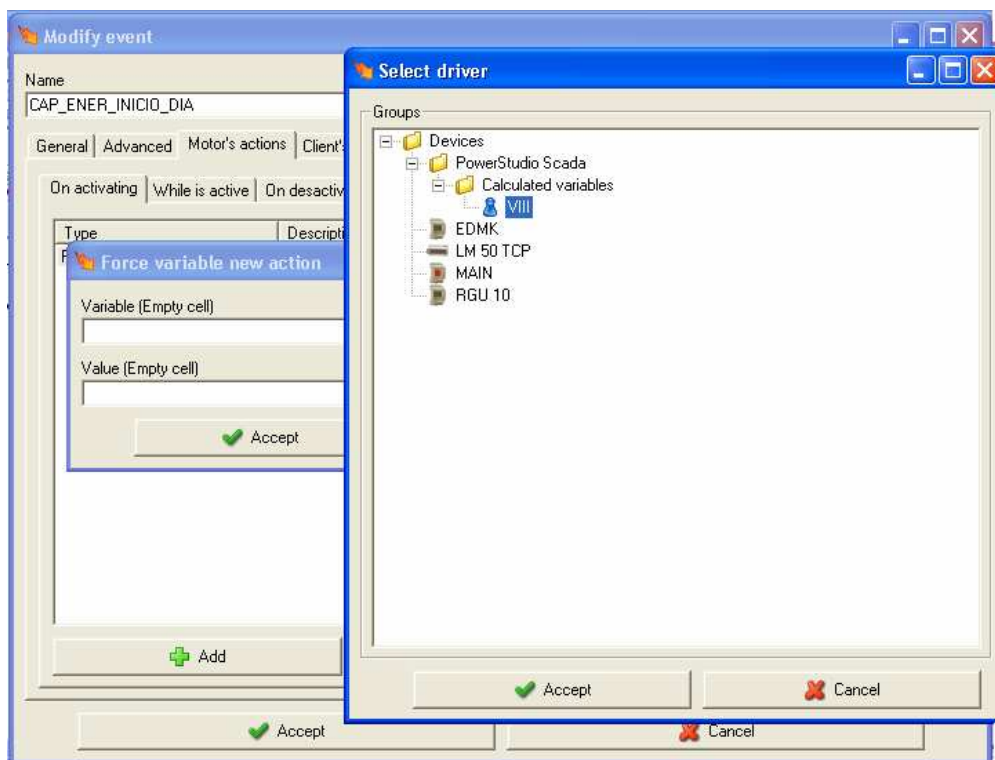
As you will have seen while going through the steps above, multiple functions are provided along with multiple symbols for logical functions. Please see the PowerStudio manuals for more information on each one of them.

To programme the actions for this event, follow the steps below:

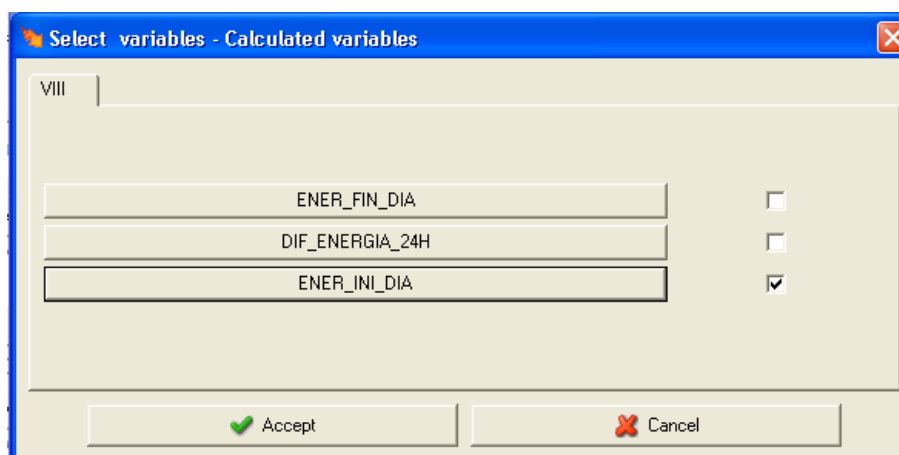
- Click on the "Search Engine Actions" tab and then on the "When activated" tab.
- Click on “Add”
- Select "Forcing a Variable”



- Select the “Wizard” button in the field titled "Variable expression empty".
- Click on "Calculated Variables" on the list that appears.

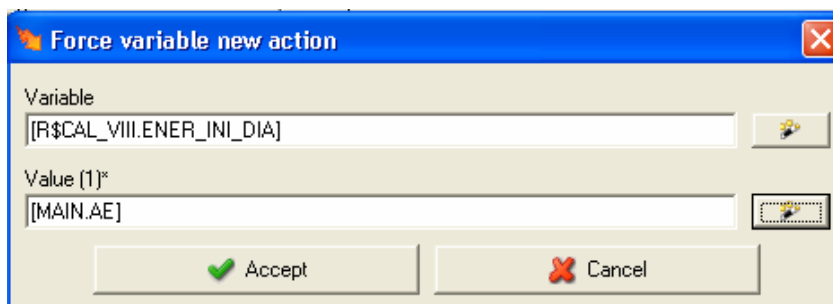


- Next click on the programmed group of calculated variables. See section 19 of this tutorial for more information on calculated variables.
- On the window that appears next, choose the variable “ENER_INI_DIA” that you created when you began programming this event and accept.



- In the window for forcing a variable, click on the “Wizard” in the "value" field and link this field to the active energy data for the EDMK. If you have any questions about this step, please see section apartado15.5.5 of this tutorial.

The Force Variable screen should look like this:



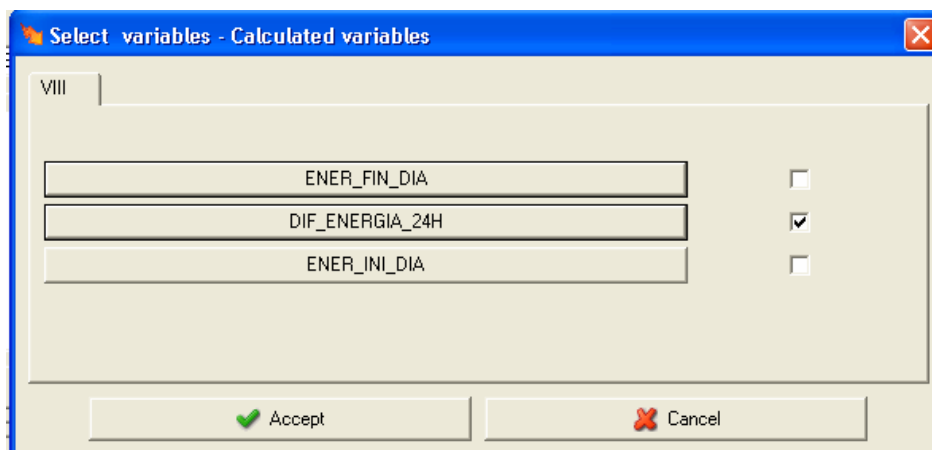
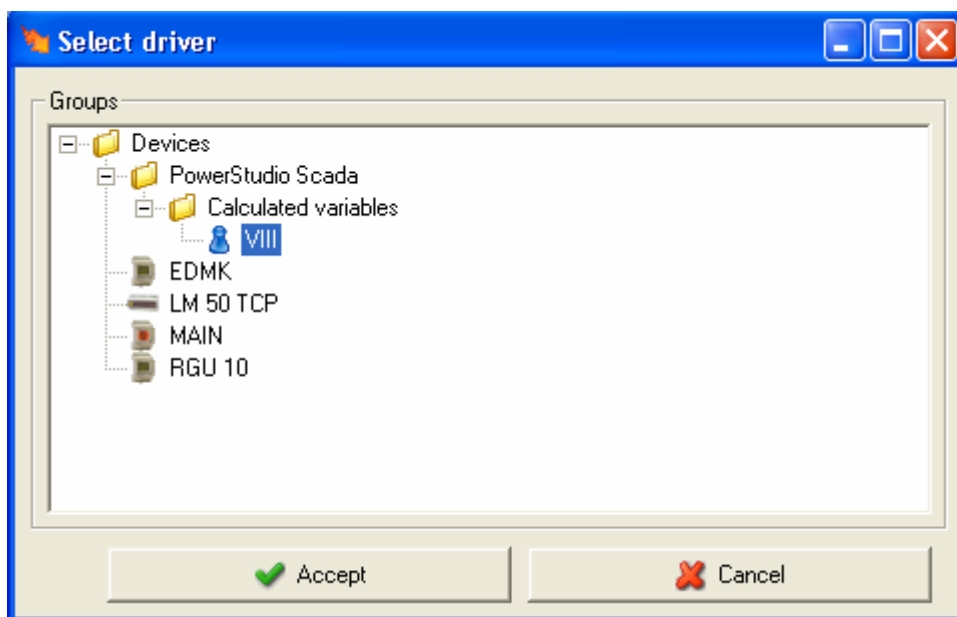
- Accept the changes.
- At this point, the event is configured as follows. At 00 hours, 00 minutes and 00 seconds, the energy data for **EDMK** will be collected and loaded into the calculated variable “ENER_INI_DIA”.

The next step is to record the energy at the end of the day and to calculate the difference between this value and the value recorded at the beginning of the day in order to obtain the energy consumed in the last 24 hours. To do so, follow these steps.

- Generate a new event, “Setup” / "Events"
- Name the event “CAP_ENER_FIN_DIA_Y_CALCULO”
- Programme the activation conditions as follows:

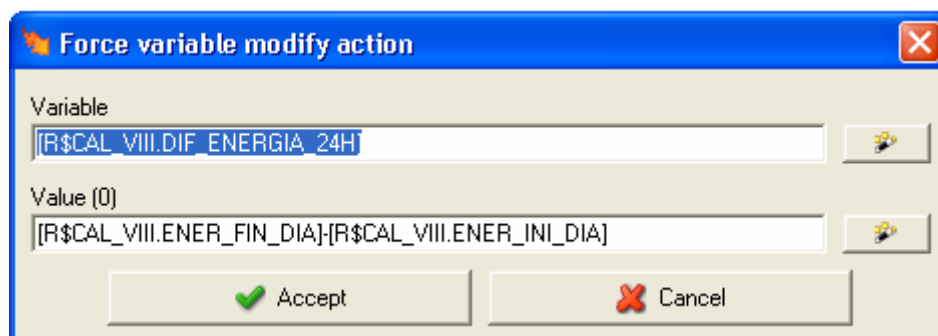
hour==23&&minute==59&&second==59

- Do not programme any event deactivation conditions.
- In "Search Engine Actions", "When Activated", link the variable “ENER_FIN_DIA” to the energy of **EDMK**. These are the exactly the same steps that you used to obtain the energy data at the beginning of the day in the previous event.
- Now, in Search Engine Actions, "When Deactivated", programme the calculation of the difference between the two energy readings as follows:
- Add a new action
- Select the “Force Variable” icon
- Using the “Wizard”, select the variable “DIF_ENERGIA_24H” that you configured at the beginning of this event.



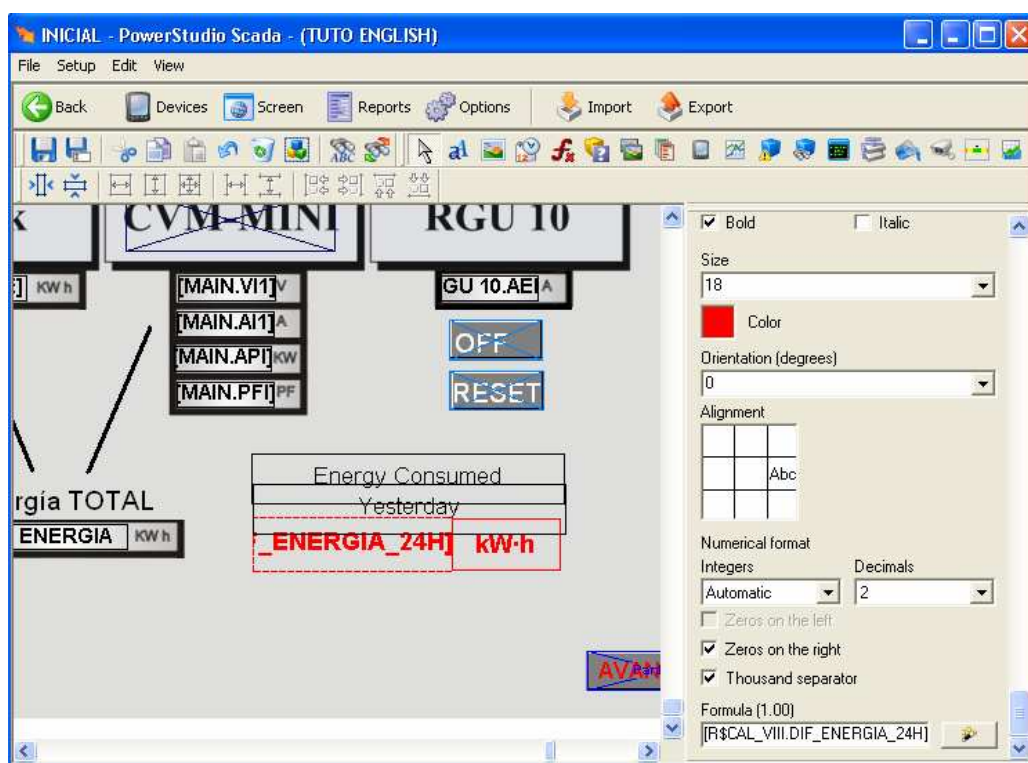
- Click on "Accept".
- Use the "Wizard" again in the "Value" field to link the variable to the end of day variable "ENER_FIN_DIA" and click on "Accept".
- Next, make sure to position the cursor at the end of the formula you are creating and type a minus sign "-".
- Click on the "Wizard" again in the "Value" field and link it to the following calculation parameters, the calculated variable "ENER_INI_DIA".
- Click on "Accept".
- In the end, the configuration of the forced variable should look like this.

[R\$CAL_VIII.ENER_FIN_DIA]-[R\$CAL_VIII.ENER_INI_DIA]



- Accept all changes and return to the main screen of the PowerStudio SCADA EDITOR.

Use the formula control to add the results of the previous event in order to obtain the energy consumed in the last 24 hours on a SCADA screen. If you have any questions please refer to section 15.5.5 of this tutorial.



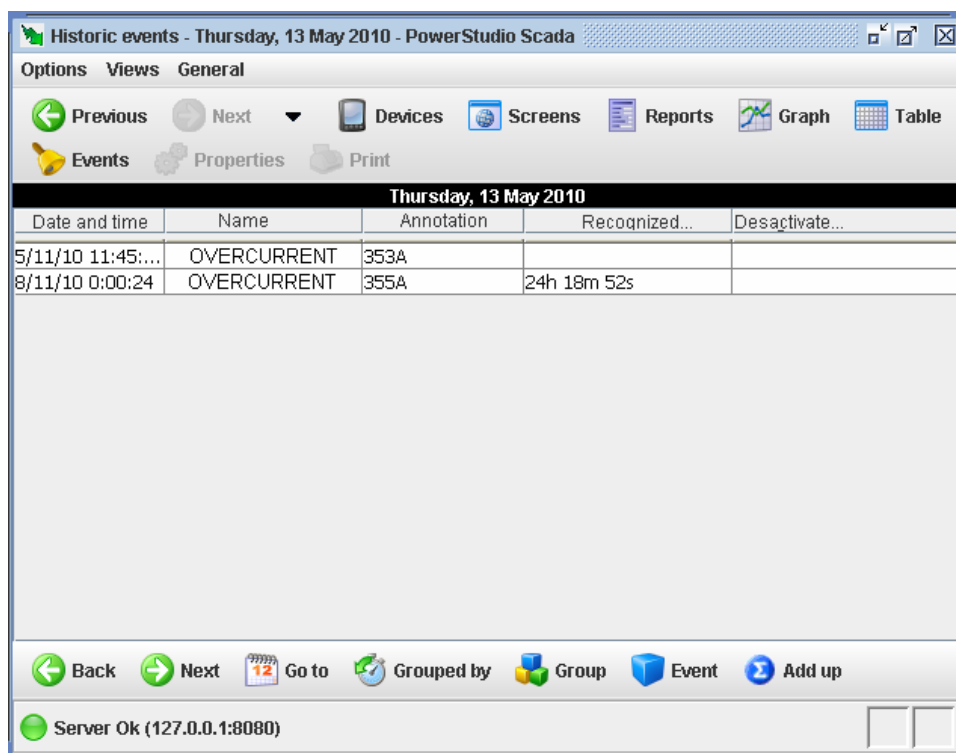
23.3.- CONSULT HISTORICAL EVENTS

If you programmed the option "Record in File" in the event configuration, the event will be logged in the historical file of PowerStudio SCADA events.

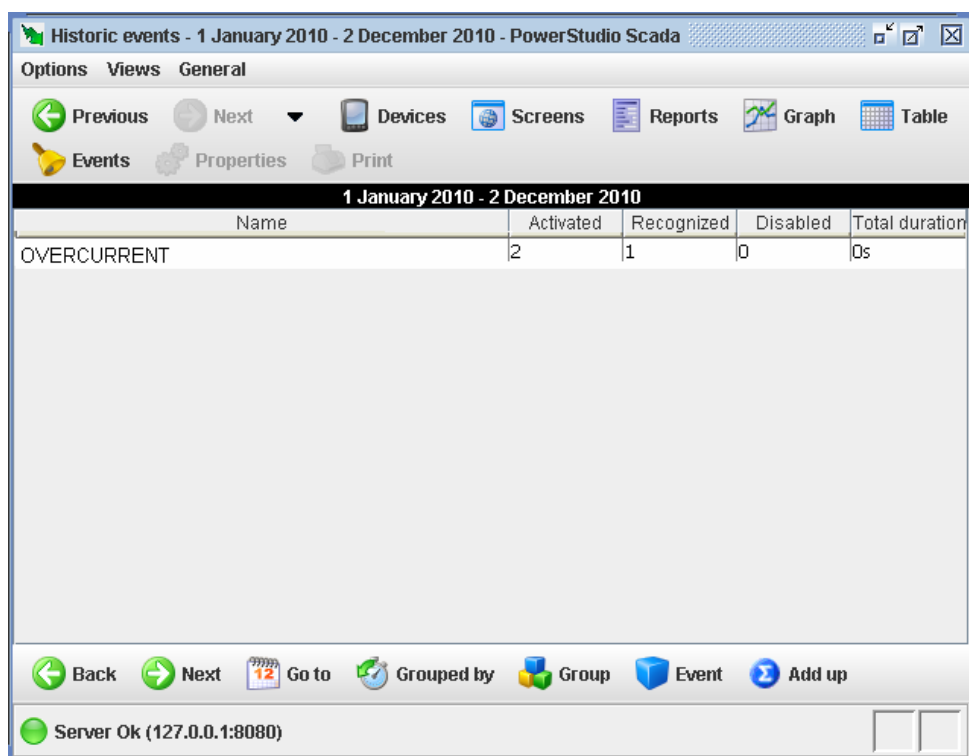
Follow the steps below to consult the historical file:

In PowerStudio SCADA CLIENT, click on "EVENTS" on the icon bar.





Use the lower icon bar to select different filtering options to display the events you are interested in seeing. The TOTAL icon allows you to activate this option which will be very useful for knowing how many times an event has occurred.



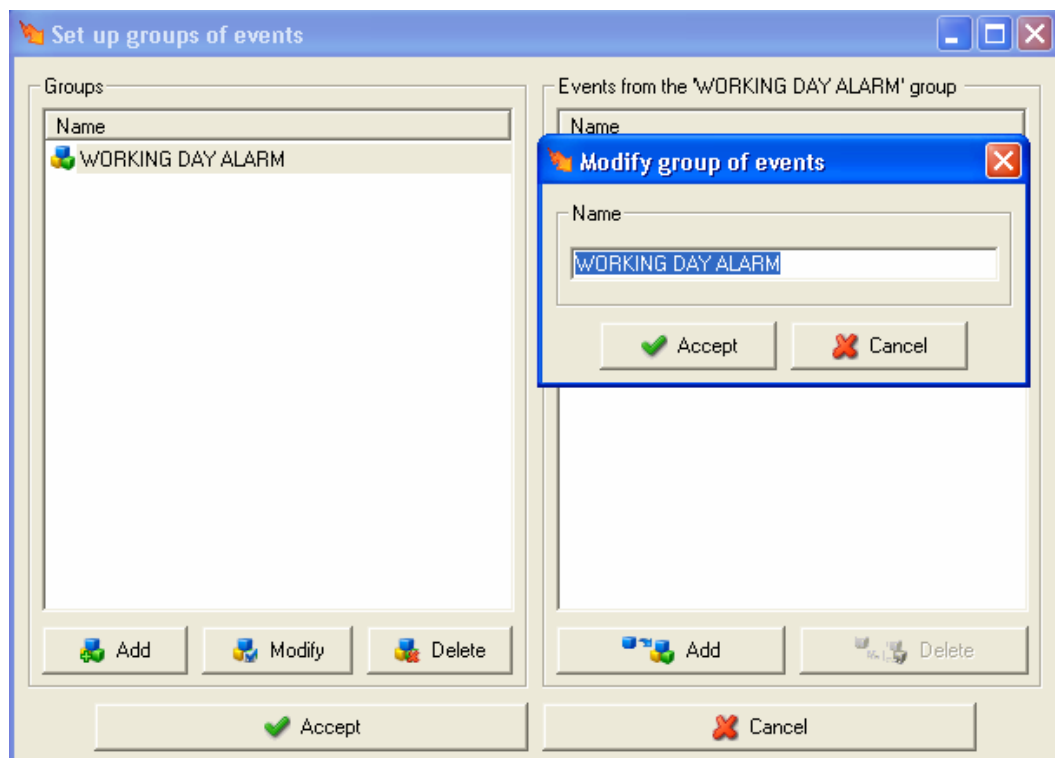
23.4.- GROUPING OF EVENTS

The events can be classed into groups and these groups can be configured based on time discriminators. This makes it possible to quickly enable events for different time slots or different date ranges.

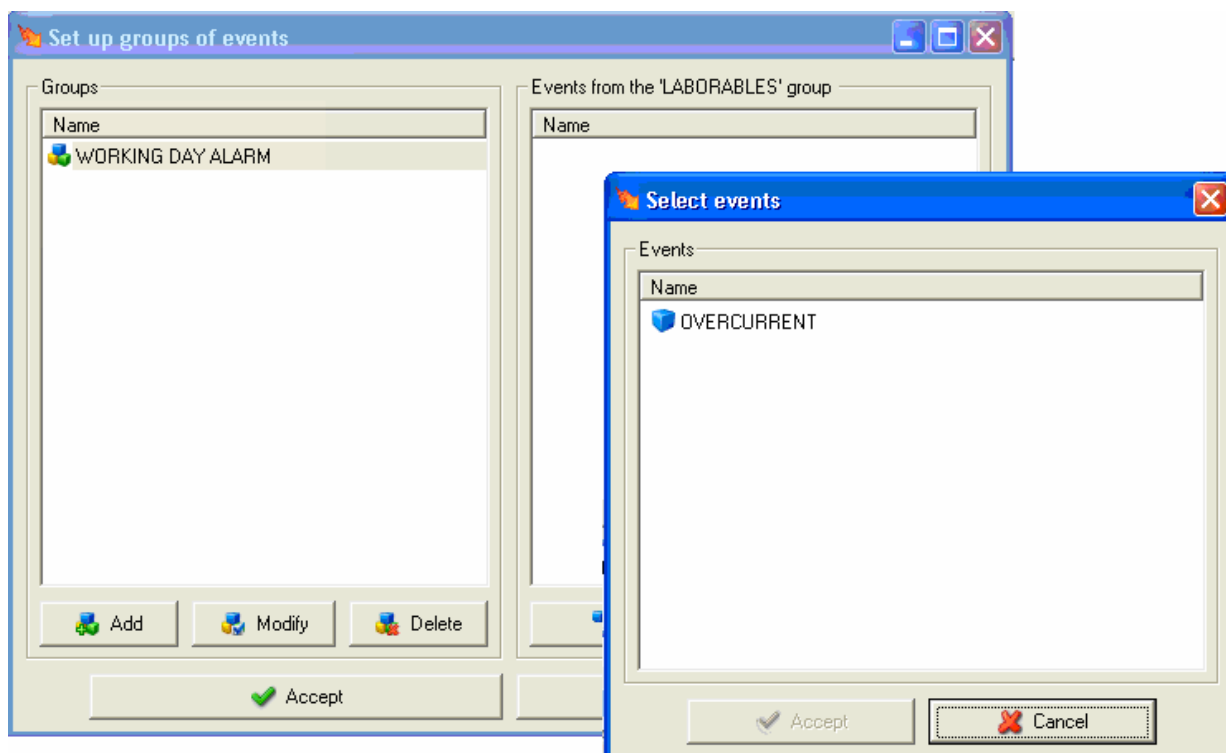
Obviously, in order to group the events together you must first create them.

Once created:

- Go to the "Setup" menu and select "Groups of events".
- On the next screen, click on "Add" and type a descriptive name for this group of events. In the example: "ALARMAS_DIAS_LABORABLES"



- Click on "Accept".
- Select the new group you have just added and on the list to the right click on "Add".
- A new window will appear with a list of the events programmed so far.



- Select the desired event or events and accept the changes.

You can generate as many groups and assign as many events as you wish. You can also assign the same event to more than one group.

23.5.- CREATING EVENT SCHEDULES

Using this assistant you can quickly, simply and intuitively configure the time slots when an event should be enable and when it should not. The schedule creation assistant for events allows you to generate time slots for different days and different weeks and to apply these to an annual calendar.

The example that is explained below will guide you step by step through the calendar scheduling process for events and will then show you how to enable an event in a particular time slot. Remember that the first step to correctly programming events calendars is having a clear and well define event structure.

To configure event discriminators, proceed as follows.

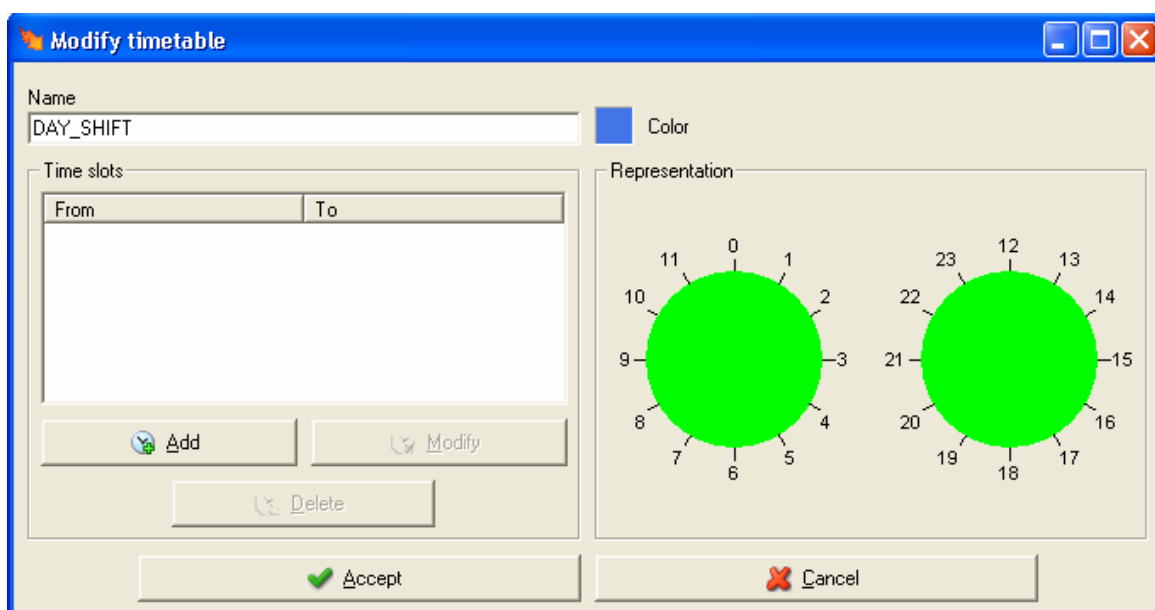
- Go to the “Setup” menu and select “Events timetables”
- Click on “Add”



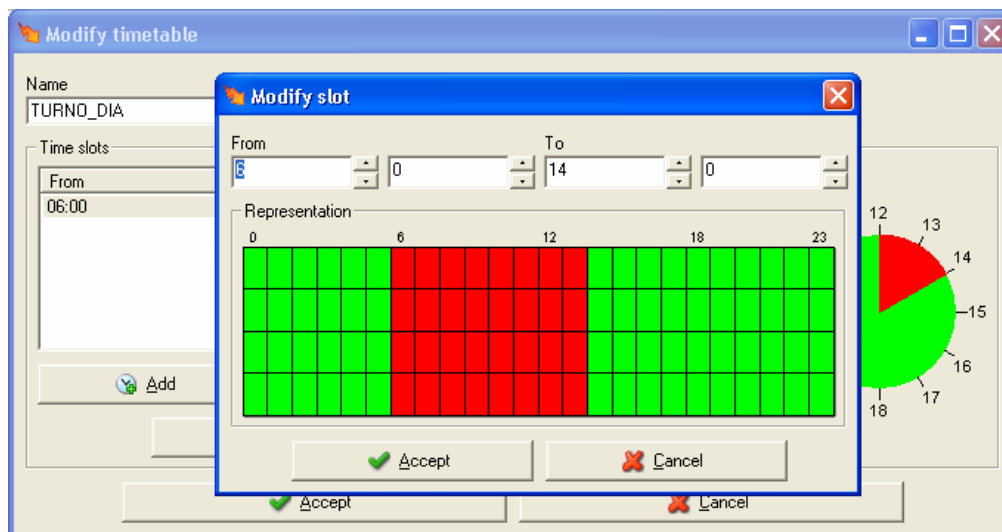
- Click on the "Daily" icon.



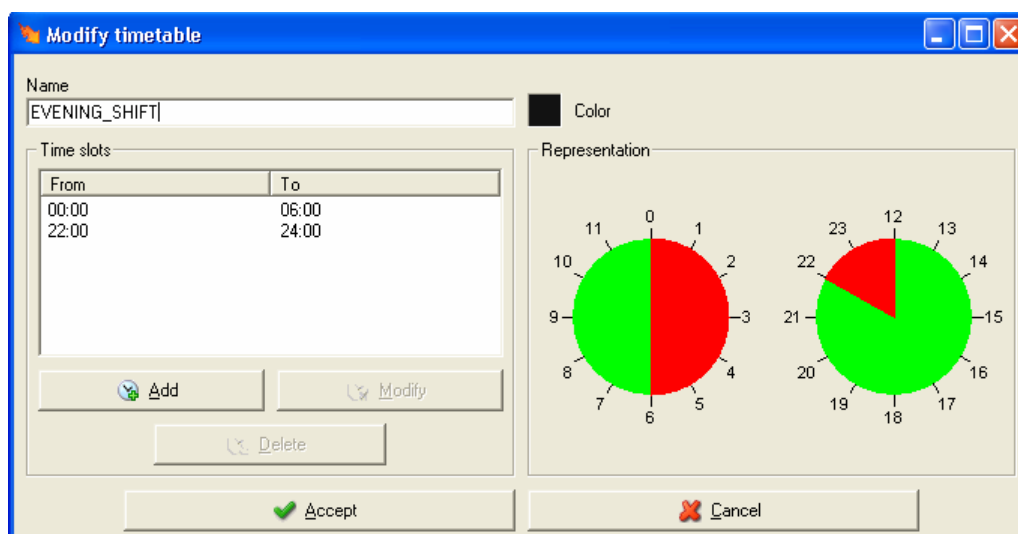
- On the next screen, type a descriptive name for the time slot. In the example, this is "DAY_SHIFT".
- Next, click on the COLOUR option to assign a colour to this time slot. In the example, this is light blue.



- Click on “Add”



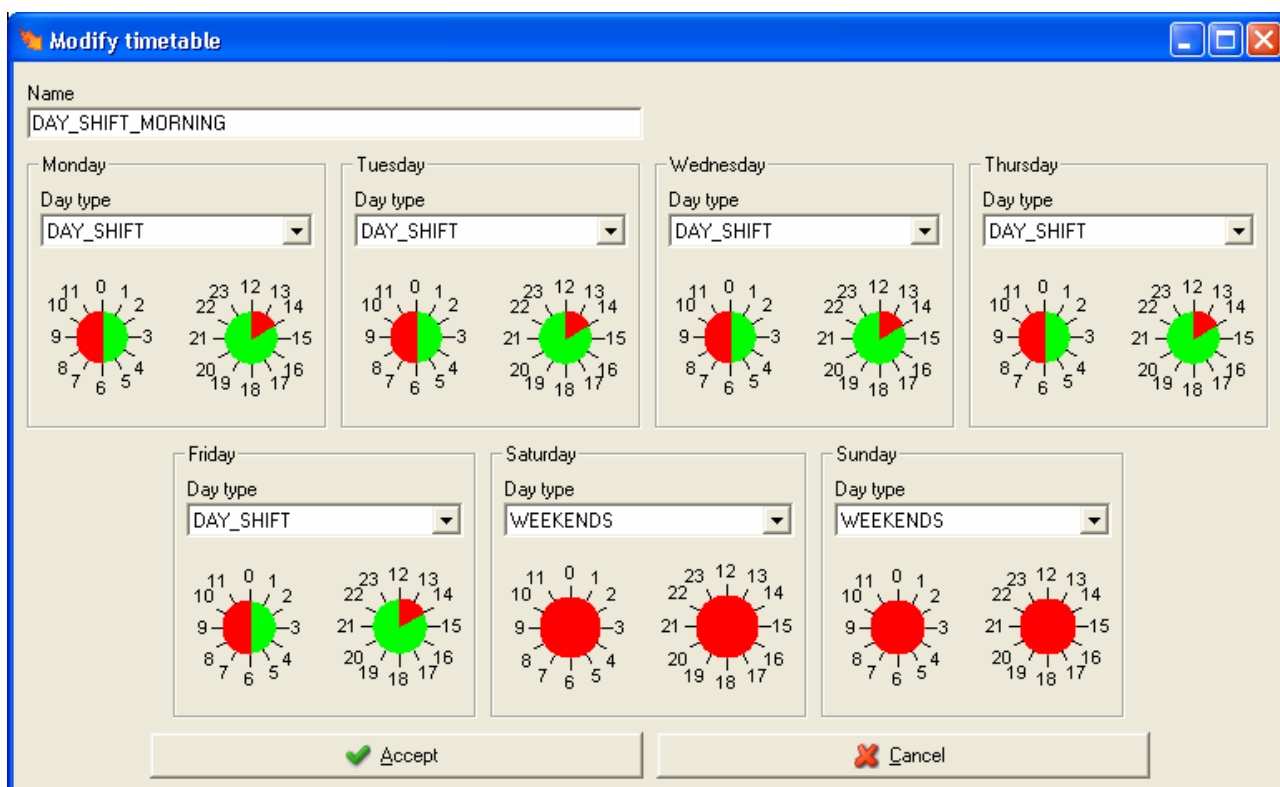
- On the next screen you can assign the start and end times for this time slot. Type the starting time and hour in "From" and the ending hour and minutes in "To". You can also make a selection by clicking on a "Representation" box and, without releasing the mouse button, dragging the pointer to highlight the desired selection. On the graphic representation, each box represents 15 minutes.
- Once you have made your selection, accept the changes and return to the schedule configuration screen.
- Following the same steps as above, generate 2 more time slots called "AFTERNOON_SHIFT" and "EVENING_SHIFT". For the last one, remember that you must assign two time slots, one from 2200 hours to 00 hours and the other from 00 hours to 600 hours, as shown below:



- Next, programme two more time slots with the name "WEEKENDS". AND "HOLIDAYS". Configure the starting time from 00 hours 00 minutes to 24 hours 00 minutes. Remember to assign them colours so that you can easily identify the time slots.
- Accept the changes and return to the schedule configuration screen for events.
- Click on the "Weekly" icon.



- Type a descriptive name for the weekly schedule. In the example, this is "DAY_SHIFT_MORNING".

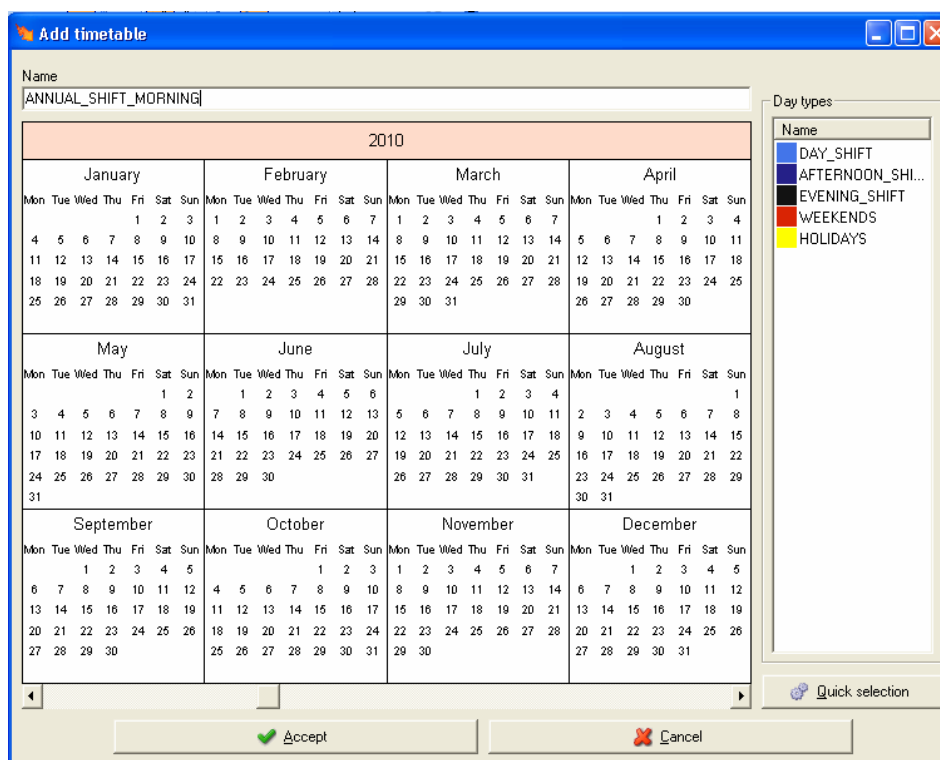


- Assign a previously-configured "Type of Day" to each day. Following the example, choose "DAY_SHIFT" and on Saturday and Sunday choose the Type of Day named "WEEKEND".
- Configure two more weekly schedules assigning a type of day to each one - "AFTERNOON_SHIFT" or "EVENING SHIFT" and weekends.
- Once you have configured the daily and weekly schedules, you can proceed to create the annual calendar.

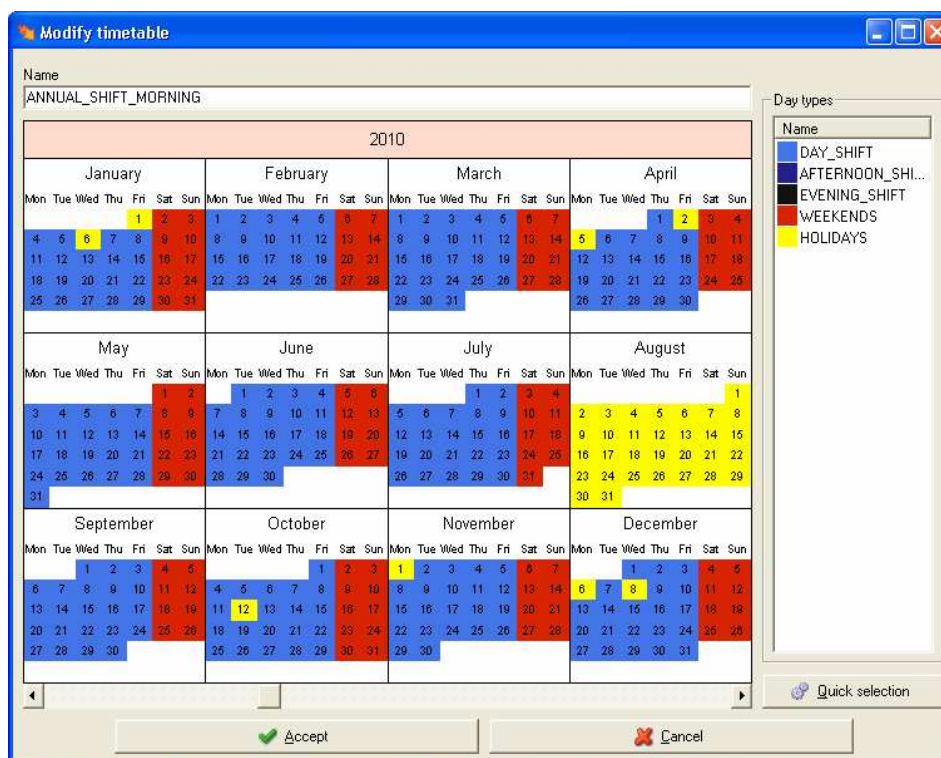
- Return to the schedule configuration screen for events and select the annual calendar icon.



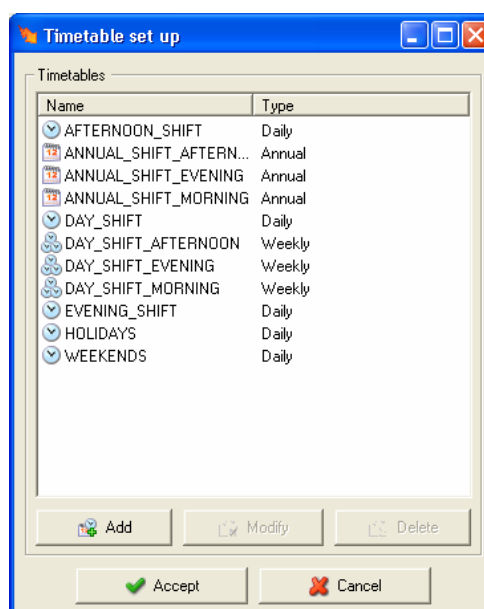
On the next screen, note the different time slots programmed in the previous steps that appear on the list to the right.



- Write a descriptive name for the calendar you are configuring in the "Name" field. In the example, this is "ANNUAL_SHIFT_MORNING".
- Select a time slot for the calendar you are creating. Following the example, select "DAY_SHIFT".
- To associate this time slot with the calendar day, simply click on the day of the months in question and drag the mouse over the rest of the days. You can also select the days one by one by clicking on the different days of the month. To facilitate this task, you can use the quick selection button to select a greater number of days within a particular range encompassing different types of day. You can later select a different time slot from the list to change one or more of the days included previously.



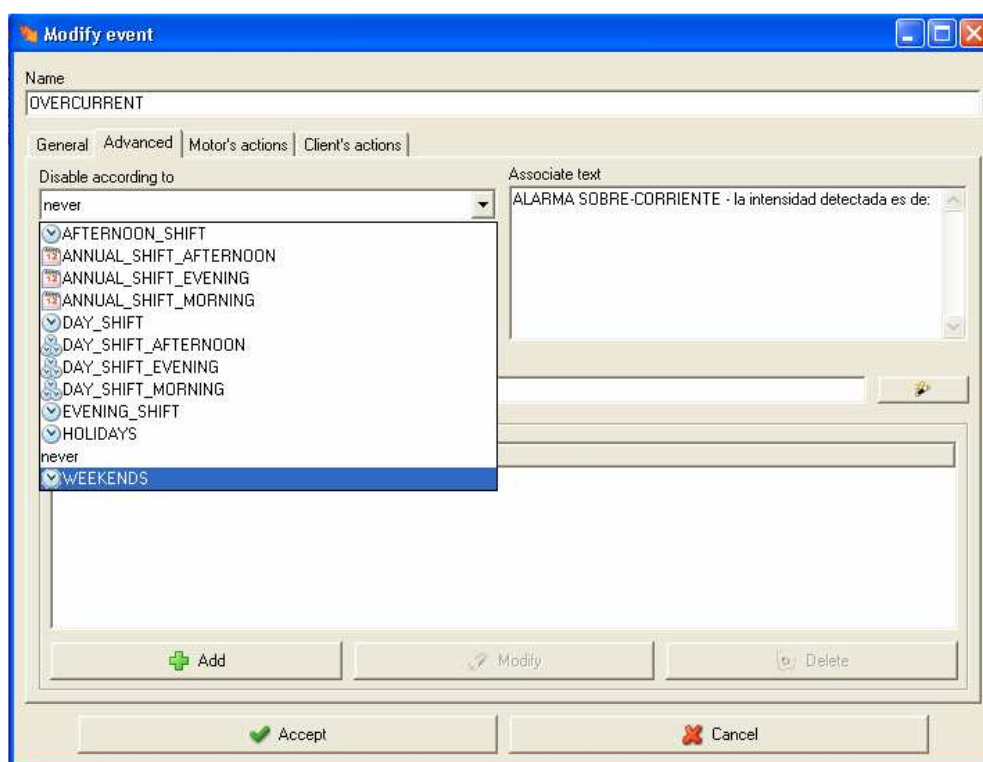
As you can see, programming the calendar is very easy and versatile. We recommend that you have a clear structure in mind before you start programming your own daily, weekly and yearly calendars.



The purpose of the preceding steps is to enable the events according to the time slots and the weekly, monthly and yearly calendars you have programmed. To do so, proceed as follows:

- Go to “Setup” in PowerStudio EDITOR and select “Events”

- Select the "OVERCURRENT" alarm event. Remember that this event was programmed in section 22.1 of this tutorial.
- Click on "Modify" event and go to the "Advanced" tab.
- Display the option "Disable by".
- Choose the option for filtering this event so that it is not enabled in the chosen time slot.



- Remember that in section 23.4 of this tutorial you added the "OVERCURRENT" event to the event group called "WORKDAY_ALARMS". In keeping with this, you must select the type of day called "WEEKEND" in order to disable this event for this type of day.
- Once you have selected the times slot for which you want the event to be disabled, accept the changes.

Remember to export the application to the PowerStudio SEARCH ENGINE to verify the changes made in these steps. Run PowerStudio STUDIO to verify that the event is not enabled during the selected time slot.



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