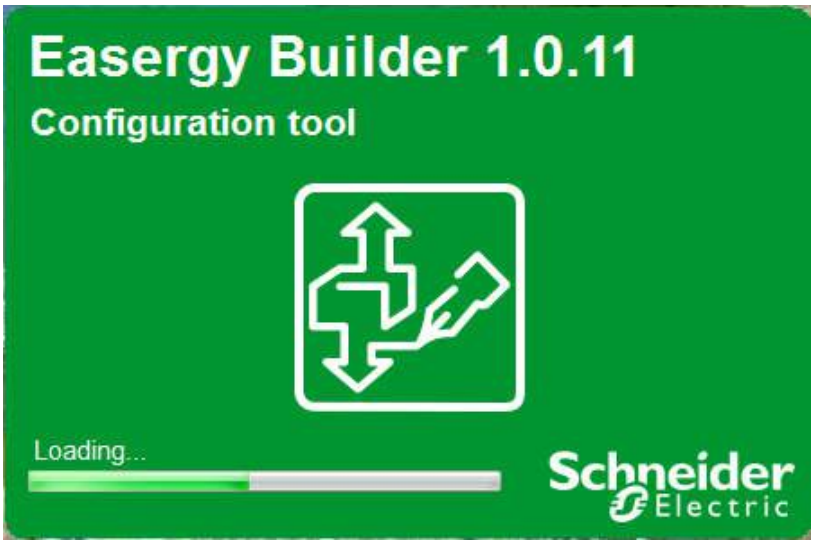
Baseline Software Platform

ISaGRAF Devices (v3.1 & v5)

03/2016



Schneider Electric

Relevant information for the user

As a result of the multiple uses of the product, the personnel in charge of the application and use of this control device must ensure these usages comply with all safety and performance requirements applicable in each application. The requirements include the applicable industry-related laws, norms, regulations and standards.

Throughout this manual some notes are included in order to alert the user about specific circumstances:

NOTICE
NOTICE identifies information about practices and circumstances which could result in a malfunction of the equipment..

Restricted Liability

Electrical equipment should be serviced and maintained only by qualified personnel.

No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this manual. This document is not intended as an instruction manual for untrained persons.

The illustrations, dialog boxes, programming models and examples shown in this manual are intended for exemplary purposes. As there are installation-specific variables and requirements, Telvent will not be held responsible for the misuse of the equipment based on the examples herein published.

NOTICE
An inadequate use of the equipment, or misuse by ignoring these specifications, may comprise the system's security.

It is highly recommended to backup the application programs frequently using the appropriate storage media to avoid potential data loss.

The Saitel platform and all its components have been developed in accordance to the requirements for a quality management system, complying with the ISO 9001 Norm	
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For any request, problem report or suggestion about the equipment, please contact us through the following email:

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I. Objective

This manual provides information about the configuration of ISaGRAF 3 and ISaGRAF 5 devices in Easergy Builder.

II. Arrangement

This manual is divided in the following chapters.

Chapter 1 – Easergy Builder & ISaGRAF

This chapter describes the main elements and software architecture of the Baseline Software Platform.It gives a general description of the tool Easergy Builder and ISaGRAF.

Chapter 2 – ISaGRAF 3

Description of the interface to configure the information exchange between ISaGRAF3 and Easergy Builder.

Chapter 3 – ISaGRAF 5

Description of the interface to configure the information exchange between ISaGRAF5 and Easergy Builder.

III. Reference Manuals

The following documents, which could be used for further reference, are provided to supplement the information included in this manual:

Manual's name	Document
Easergy Builder User Manual	TE-HG-0000-MSS-S856
Saitel Webtool User Manual	TE-HG-0000-MCW-S856

Table 1-1. Reference manuals

IV. Software Versions

The information in this manual applies to software versions listed in the following table and subsequent:

Module	Software version (HU/CPU)	Plugin version (Easergy Builder)
coreDb	coreDb - 10.00.11	-
ISaGRAF	isgBinC - 10.00.00	ISaGRAF - 1.0.1
ISaGRAF5	isgBinC - 10.00.02	ISaGRAF5 - 1.0.5
Supervision	SupBinC - 10.00.13	-
Saitel DP Acquisition	laqBinC - 10.00.02	LAQ – 1.0.3.0
Saitel DR Acquisition	claqBinC - 10.00.06	CLAQ – 1.0.4.0

Table 1-2. Software versions which this manual applies

V. Hardware/Software Compatibility

The controllers supported by the CPU modules of the different hardware platforms are the following:

Software	SM_CPU866	SM_CPU866e	HU_B/HU_BI	HU_A/HU_AF	HU 250
Easergy Builder	√	√	√	√	√
ISaGRAF3	√	√	×	√	√
ISaGRAF5	√	√	×	√	√
Saitel DP Acquisition	√	√	×	×	×
Saitel DR Acquisition	×	×	√	√	×
Saitel Webtool	√	√	×	√	×

Table 1-3. Hardware/ Software compatibility.

Chapter 1. Easergy Builder & ISaGRAF

The Baseline Software Platform of Schneider Electric consists of:

- VxWorks & Linux operating systems.
- Real-time applications and configuration files.
- Configuration, management, supervision and monitorization tools.

NOTICE
HU_B do not load VxWorks nor Linux. They operate with a tailored-made software which includes the OS, database and applications. These basic HU can not run ISaGRAF.

The following figure shows the different applications included in the software platform, as well as additional applications that implement protocols to upgrade Easergy Builder:

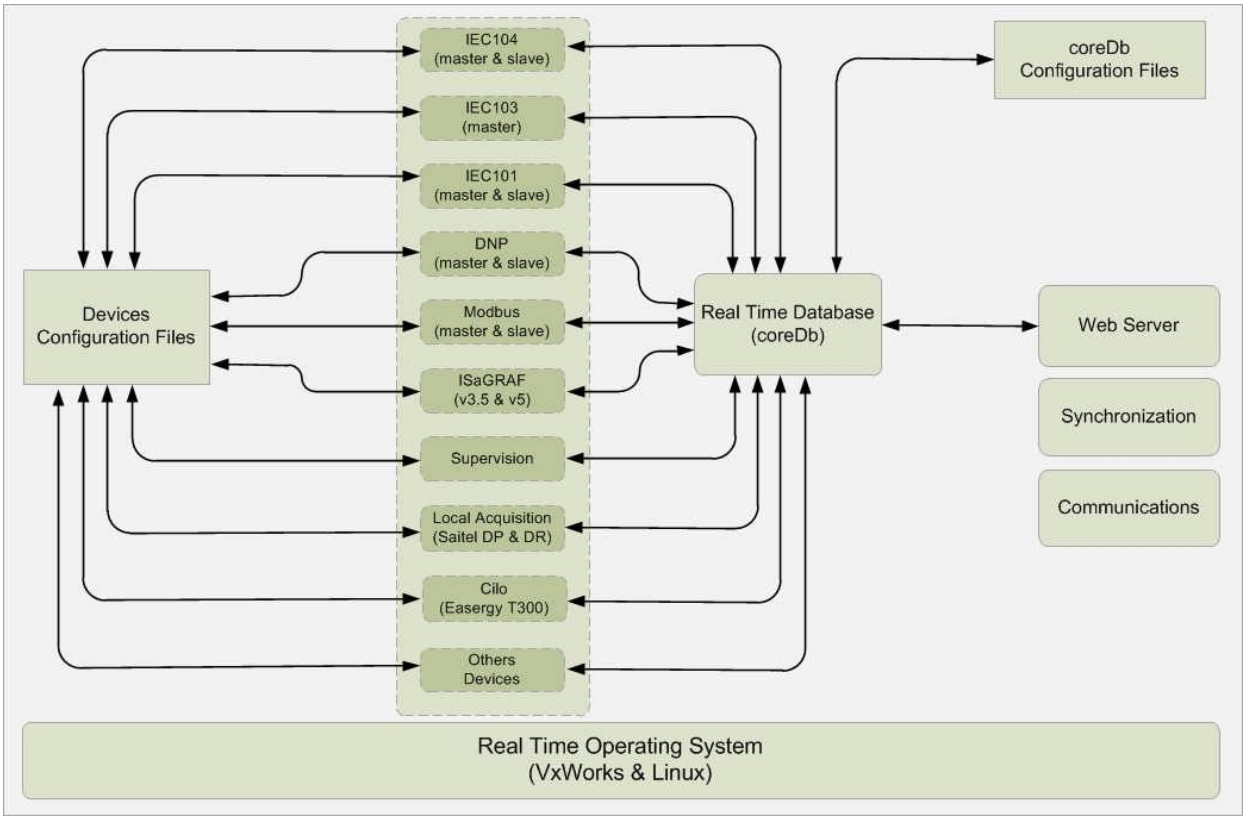


Figure 1-1. Saitel RTU software architecture.

The real time operating system (RTOS) isolates the hardware from the software applications and manages the applications in real time. It integrates the basic protocols to access the remote unit (SFTP, SSH, etc.) and manage multiple users.

The RTOS provides a command interface to show the system status in real time and executing commands manually.

The real-time database (coreDb) is the main element, so the rest are developed around this core:

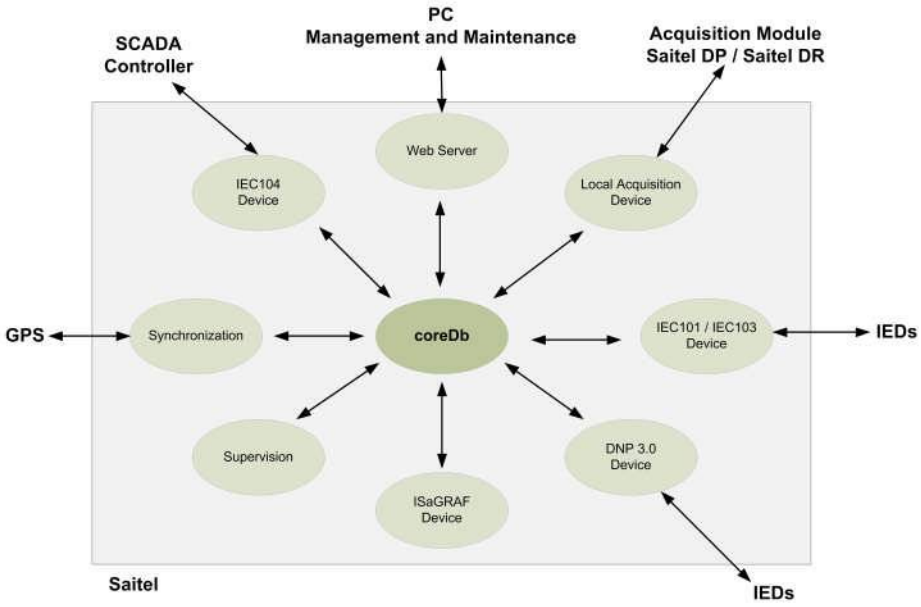


Figure 1-2. Relation between coreDb and other applications.

The coreDb performs the real-time management of the RTU signals. This real-time database is associated with data producing and consuming Devices. The Devices define all the different data acquisition and processing applications software which access coreDb.

For more information about the Baseline Software Platform, please refer to the Easergy Builder and Saitel Webtool user manuals.

1.1 Easergy Builder v1.0.11

1.1.1 Environment Description

The access to Easergy Builder is done through the Windows® Home Menu, or through a shortcut created on the desktop.

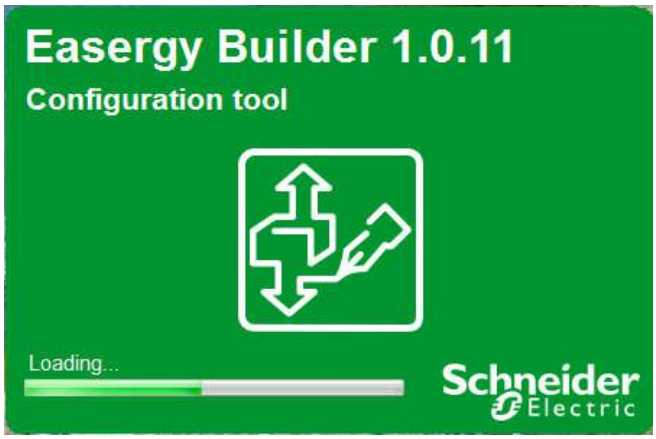


Figure 1-3. Startup window of Easergy Builder.

The initial interface is as follows:

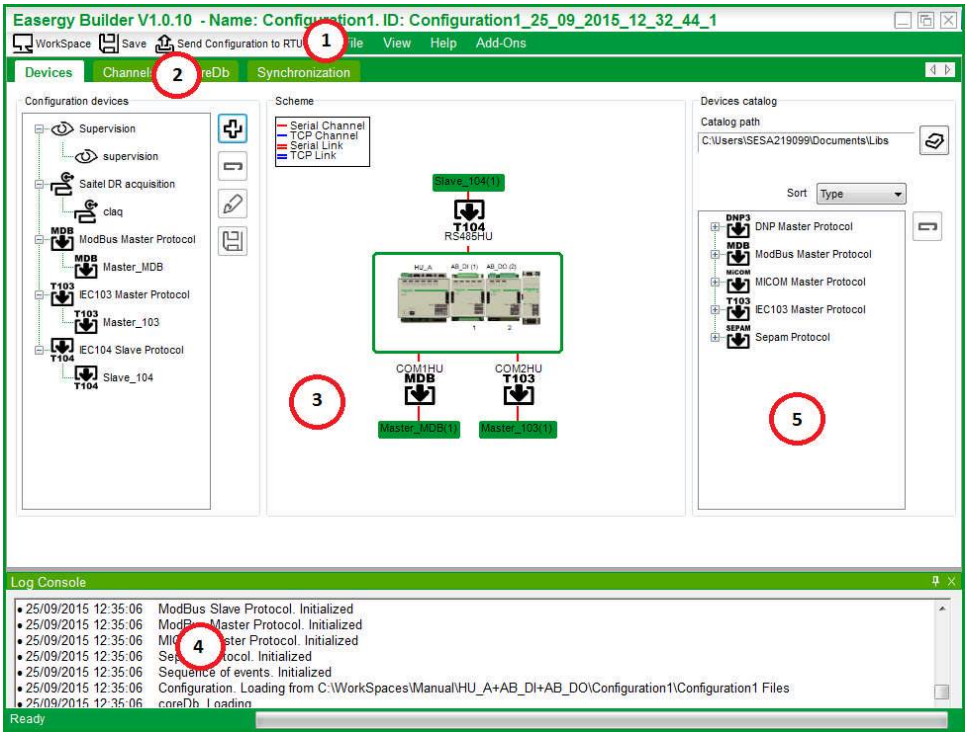


Figure 1-4. Easergy Builder interface.

The appearance of Easergy Builder's interface is different if a configuration is selectedor not. For example, the previous figure shows Easergy Builder when editing a configuration:

- 1: Information about the active configuration.
- 2: Toolbar and main menu.
- 3: Edition zone.
- 4: Log console
- 5: Device catalog

The toolbar, main menu and edition zone will be detailed for each device.

1.1.2 Catalog Devices

Editing a configuration, select the tab "**Devices**" in the zone 2 in order to show information about the devices available in your PC. At the right of the zone 2 you can see the catalog device window:

Figure 1-5. Catalog device window.

This window shows all configurations that have been stored as a template. More information in the Easergy Builder user manual.

1.2 Introduction to ISaGRAF

RTUs integrate the ISaGRAF package to execute the logic control sequences, following the IEC-61131-3 standard. The user can program the PLC application through ISaGRAF Workbench, in a very user-friendly environment, such as Windows®.

NOTICE
These Bins are not available for those ITB which has the HU_B module as CPU.

This application supports 5 programming languages:

- Ladder diagram (LD).
- flow diagram (FC).
- function block diagram (FDB).
- sequential function diagram (SFC).
- structured text (ST).
- instruction list (IL).

The user, using ISaGRAF Workbench, can meet the applications' automation requirements.

There are two versions:

- ISaGRAF3.
- ISaGRAF5.

Chapter 2. ISaGRAF 3

2.1 ISaGRAF Administration

This version is also known as ISaGRAF.

2.1.1 Signal Identification - Coordinates

The coordinates of ISaGRAF signals do not have a strict format. Coordinates are defined as:

ISaGRAF coordinate	**Name:X**

Where, "**Name**" is the variable's name associated to the ISaGRAF dictionary and "**X**" is an identifier of the variable's type.

Easergy Builder generates automatically the ISaGRAF dictionary from the signals defined in ISaGRAF Bin. When the dictionary is opened in the ISaGRAF Workbench, the name of the variables generated are as the tag "**Name**".

- The name must not exceed 16 characters.
- The first character must be a letter.
- The rest of the characters can be letters, numbers or the underscore character ('_').

In relation to the indicators of the types of variables,

- Boolean variables, use the extension "Name:B".
- Boolean variables as sources of COMMAND points, use the extension "Name:P". The meaning of this type will be explained in the chapter related to the possible mappings.
- Analog variables, use the extension "Name:A".
- Real analog variables, use use the extension "Name:F".

2.1.2 Relationship with coreDb

2.1.2.1 Possible Mappings

The possible mappings are summarized in the table below:

Type	Status	Analog	Command	SetPoint
Boolean Input	D		D	
Boolean Output	S		S	
Analog Input	D	D	D	D
Analog Output	S	S	S	S

Table 2-1. ISaGRAF3 - Mapping in coreDb.

S: Source, D: Destination

The input variables in ISaGRAF are read at the beginning of the cycle, while the output variables are updated at the end of the ISaGRAF cycle.

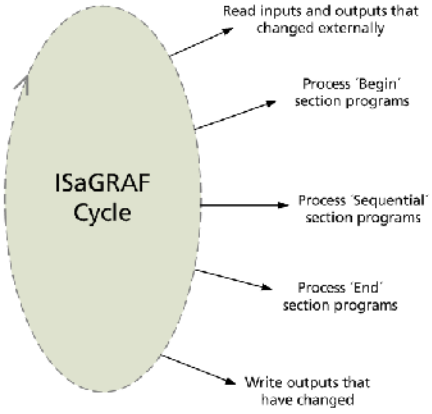


Figure 2-1. Execution diagram of an ISaGRAF cycle.

2.1.2.2 Acquiring the Boolean Input Variables of ISaGRAF

- Boolean variables configured as destination for status type points in coreDb: if the value its “0”, they are set to FALSE in ISaGRAF in other case it will be set to TRUE.
- Boolean variables configured as command points: the writing on ISaGRAF will be performed whenever a command point is written Due to the transient and temporary nature of command points, only if a non-zero value is allocated to the point, the respective boolean variable will take the TRUE value during a single ISaGRAF cycle.

In both cases the coordinates are “**Name:B**”.

2.1.2.3 Acquiring the Analog Input Variables of ISaGRAF

- The analog input variables of ISaGRAF can be configured as destination for the four types of coreDb points: status, command, analog and setpoint.
- If the variable is an analog integer, the value from any of the signals read from coreDb will be converted into an integer (signed 32 bits) before allocation. The coordinate must by of the type “Integer**Name:A**”.
- If the variable is a real analog variable, the value read from coreDb will be converted into a float value (standard IEEE format to represent variables in 32-bit float points) before allocation. The coordinate must by of the type “**Name:F**”.

2.1.2.4 Processing the Boolean Output Variables of ISaGRAF

- Boolean output variables are written in coreDb whenever the value of the variable change.
- Boolean output variables configured as source of a STATUS point in coreDb that are set to TRUE correspond to value “1” in the table of STATUS points, and 0 if FALSE. The coordinate shall be configured as “**Name:B**”.
- Boolean output variables configured as source of a COMMAND point with coordinate “**Name:B**”, will behave as described above.
- Boolean output variables configured as source of a COMMAND point with coordinate “**Name:P**”, will only be written into coreDb when the value of the boolean variable changes from FALSE to TRUE. This is only applicable to pulse signals.
- If the logic program is stopped through the ISaGRAF Workbench, all the boolean output variables with an associated point in coreDb will be set to FALSE.

2.1.2.5 Processing the Analog Output Variables of ISaGRAF

- Analog output variables are written in coreDb points whenever the value of the variable changes.
- ISaGRAF analog output variables can be configured as source of the four types of coreDb points: Status, Command, Analog, and Setpoint.
- If an ISaGRAF analog input variable is associated to an Analog point, it will be converted into a double point (as per the IEEE standard format, to represent float point variables with double precision and 64 bits) before being written into the table of Analog points.

- If an ISaGRAF analog output variable is associated to a Status, Command or Setpoint point, it will be converted into an integer (32 bits, signed) before being written into coreDb.

2.2 ISaGRAF in Easergy Builder

The tree view of the Devices that are being defined on a specific configuration are shown on the left side of the configuration view in Easergy Builder.

Use the button "Add" or the right-button of the mouse (on the tree) to create a new Device.

Figure 2-2. New Device

Where:

- **Type**: Type of the new Device. You must select ISaGRAF.
- **Name**: Name of the new Device (Only letter, numbers and '_' character are allowed for the name).
- **Description (optional)**: Description of the new Device.

Press  and you can see the new Device in the Device tree under the label ISaGRAF.

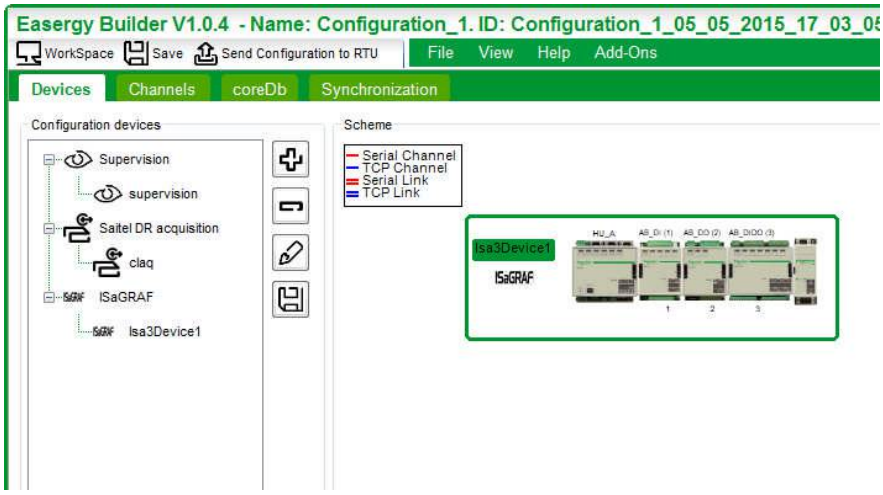


Figure 2-3. A new ISaGRAF Device

You can double click on the Device (or use the button Modify) in order to edit or consult the configuration.

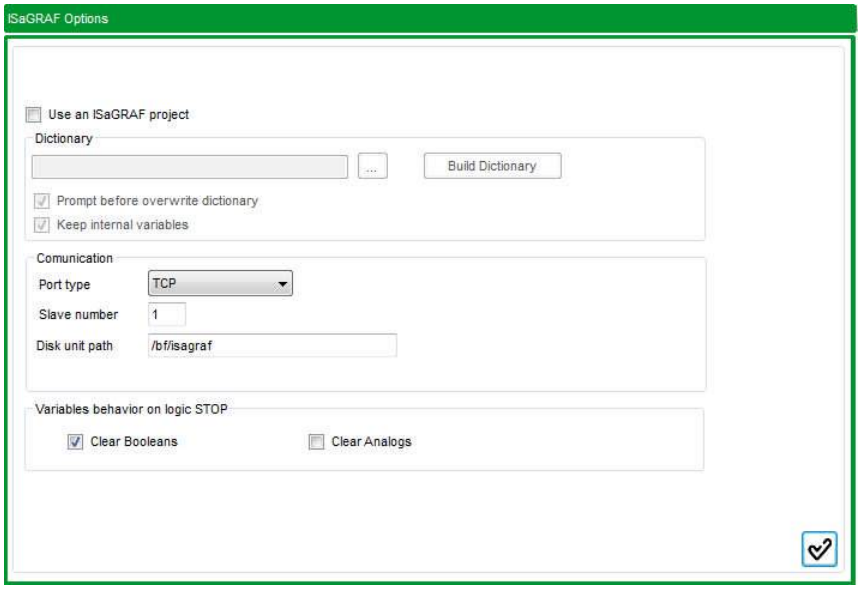


Figure 2-4. Configuration of an ISaGRAF Device

2.2.1 Configuration of the ISaGRAF Device

The configuration window shown in previous image is divided in three regions, that can only be edited if the checkbox "**Use an ISaGRAF project**" is selected. This indicates that an existing ISaGRAF project will be used. Following is the description of the fields to be completed in each region:

Dictionary

The The project's file can be selected by using the button "**...**".

If "**Prompt before overwrite dictionary**" is checked, the user will receive a warning message before overwriting any input of the project's library.

Check "**Keep internal variables**" to keep in the dictionary of the ISaGRAF project, all the internal variables that are not mapped or used in coreDb.

This window informs to Easergy Builder about the export destination and import source for ISaGRAF variables, as they will be used as sources and/or destinations of other signals.

Press "**Build Dictionary**" to create (if the ISaGRAF project is empty) or overwrite the dictionary of the ISaGRAF project including the coreDb variables.

Communication

The second region of the window is used to configure the ISaGRAF Bin Controller:

- **Port Type**: It defines the communication port used by ISaGRAF Workbench to communicate with the RTU order to download and debug the programs. Choose the option **TCP** for an Ethernet connection.
- **Slave Number**: It identifies the ISaGRAF Device in the RTU. The monitoring communication protocol used by ISaGRAF Workbench is Modbus. The slave number matches the number of the modbus slave. It is recommended keep the default value.
- **Disk Unit Path**: It defines the RTU path in which the ISaGRAF project files will be stored. It is recommended to keep the default value.

Variables behaviour on logic STOP

This option allows configuring the behavior of ISaGRAF after a logic stop.

- **Clear Booleans**: Check this option in order to set boolean variables to 0 after a logic stop.
- **Clear Analogs**: Check this option in order to set analog variables to 0 after a logic stop.

Chapter 3. ISaGRAF 5

3.1 ISaGRAF 5 Administration

3.1.1 Signal Identification - Coordinates

The coordinates of ISaGRAF5 signals do not have a strict format. Coordinates are defined as:

ISaGRAF5 coordinate	**Name:X**

Where, "**Name**" is the variable's name associated to the ISaGRAF5 dictionary and "**X**" is an identifier of the variable's type.

Easergy Builder generates automatically the ISaGRAF5 dictionary from the signals defined in ISaGRAF Bin. When the dictionary is opened in the ISaGRAF5 Workbench, the name of the variables generated are as the tag "**Name**".

The types of variables and possible mappings are summarized in the table below:

- **S**: Has to be defined as "source"
- **D**: Has to be defined as "destination"

Type (:X)	Status	Analog	Command	SetPoint
BOOL Input (:B)	D	D	D	D
BOOL input transitory (:BT)	D	D	D	D
BOOL output (:B)	S	S	S	S
BOOL output pulsant (:BP)	S	S	S	S
DINT input (:I)	D	D	D	D
DINT input transitory (:IT)	D	D	D	D
DINT output (:I)	S	S	S	S
DINT output pulsant (:IP)	S	S	S	S
REAL input (:F)	D	D	D	D
REAL input transitory (:FT)	D	D	D	D
REAL output (:F)	S	S	S	S
REAL output pulsant (:FP)	S	S	S	S
CPX_DINT input ()	D		D	
CPX_DINT input transitory (:T)	D		D	
CPX_DINT output ()	S		S	
CPX_DINT output pulsant (:P)	S		S	
CPX_LREAL input ()		D		D
CPX_LREAL input transitory (:T)		D		D
CPX_LREAL output ()		S		S
CPX_LREAL output pulsant (:P)		S		S

Table 3-1. ISaGRAF5 - Mapping in coreDb.

3.2 ISaGRAF5 in Easergy Builder

The tree view of the Devices that are being defined on a specific configuration are shown on the left side of the configuration view in Easergy Builder.

Use the button "Add" or the right-button of the mouse (on the tree) to create a new Device.

Figure 3-1. New Device

Where:

- **Type**: Type of the new Device. For ISaGRAF5 you must select “ISaGRAF5”.
- **Name**: Name of the new Device (Only letter, numbers and ‘_’ character are allowed for the name).
- **Description** (optional): Description of the new Device.

NOTICE
Only for ISaGRAF5, the name of the Device must be written with capital letters.

Press  and you can see the new Device in the Device tree under the label “ISaGRAF5”.

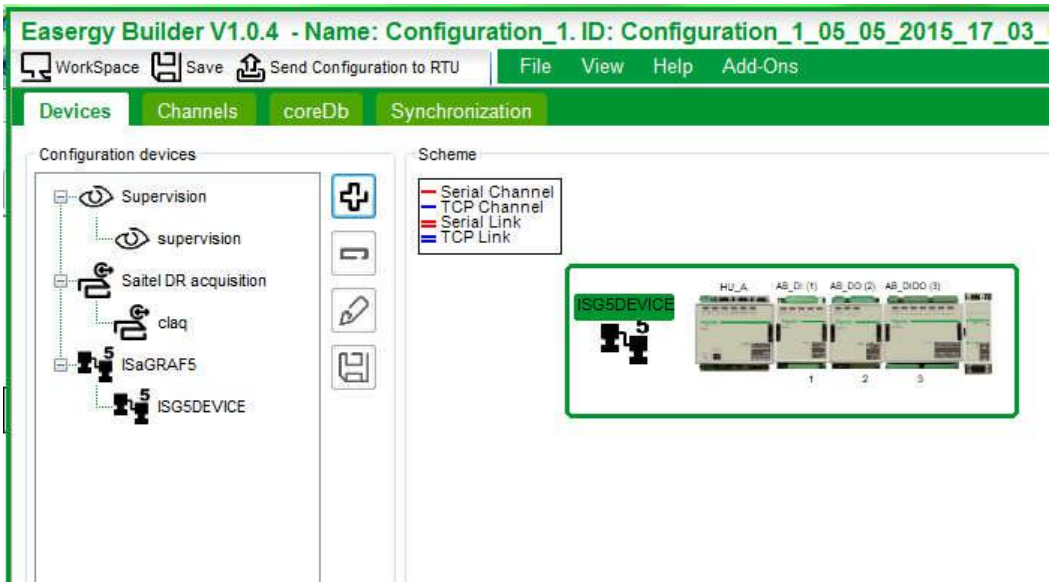


Figure 3-2. A new ISaGRAF5 Device

You can double click on the Device (or use the button Modify) in order to edit or consult the configuration.

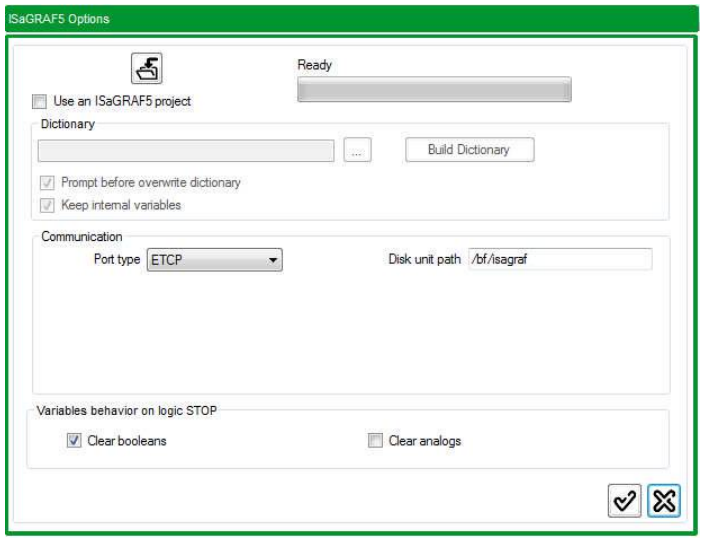


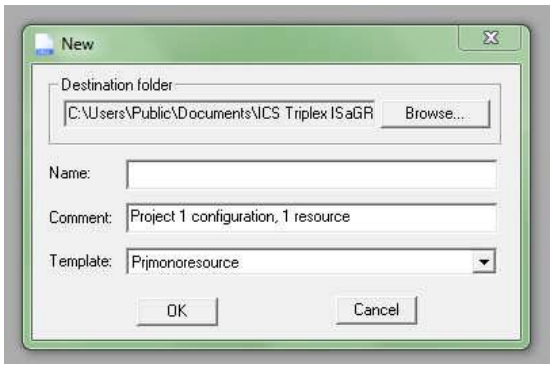
Figure 3-3. Configuration of an ISaGRAF 5 Device

3.2.1 Preparing the ISaGRAF5 Project

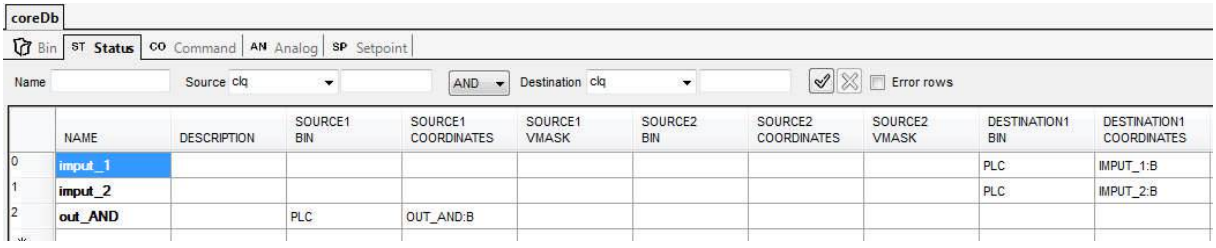
In order to avoid failures with the ISaGRAF 5 application it is very important to follow all the steps described below.

NOTICE
If the version of ISaGRAF5 is earlier than 5.22.121, the patch of the Workbench must be installed on the PC.

- Create an ISaGRAF project using the template for one resource (Prjmonoresource).



- Configure coreDb creating each point with source and destination in ISaGRAF5, so that all the necessary points are mapped in coreDb.



- Access the ISaGRAF5 configuration window by double clicking on the Device (tree view).

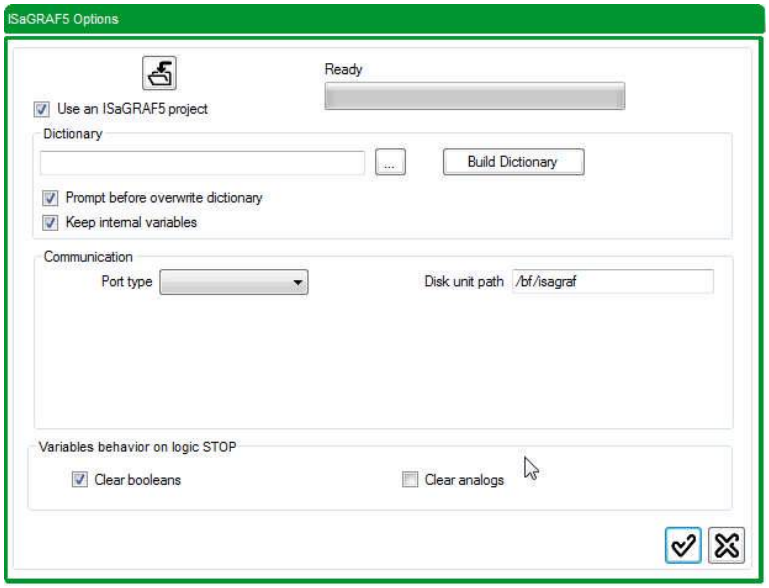
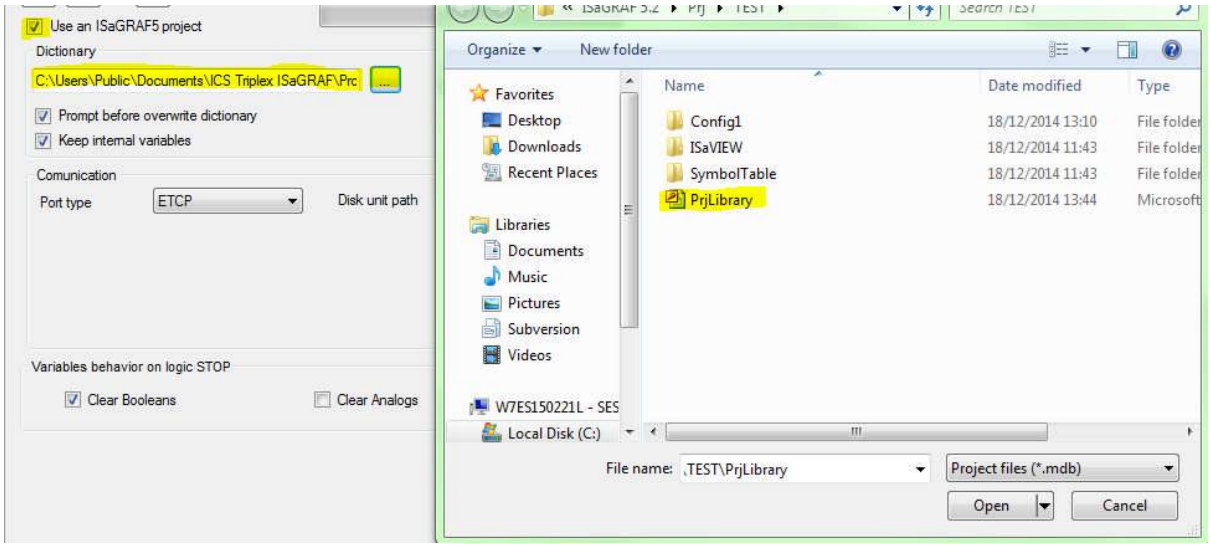
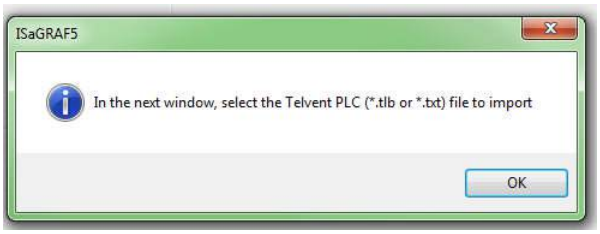


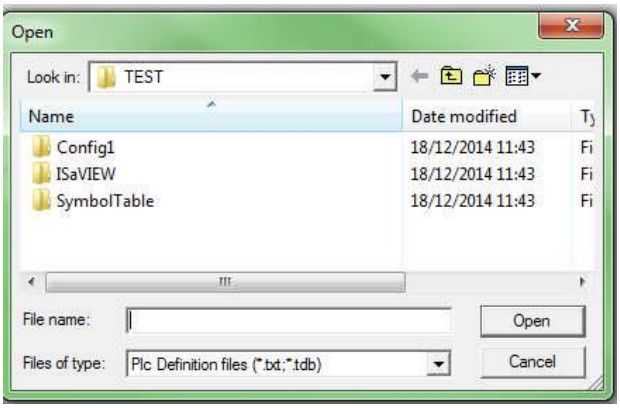
Figure 3-4. Configuration of ISaGRAF5 in Easergy Builder.

- Check "**Use an ISaGRAF5 project**".
- Find the path of the ISaGRAF 5 project and select the **PrjLibrary** of the project.

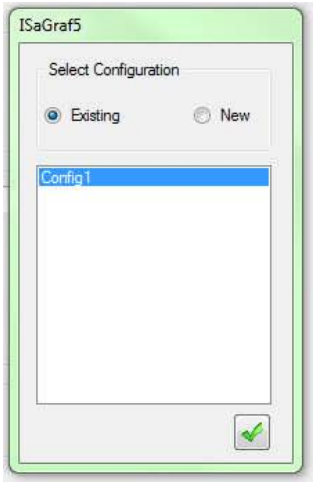


- Press Build Dictionary. **The first time that you do this you'll have to choose the ISaGRAF5 installation folder**
- The system will request you to select the hardware description file "*.dtb":





- In case of using the HU_A with VxWorks, select the file "**VXW-TELVENT_L.tdb**", which shall have been previously copied into the "TEST" folder.
- Select the default configuration "Config1". At this point, the dictionary has been created.



- In order to use specific functions in the logic program such as IPIDController, FlipFlop, AnalogAlarm,etc. it is necessary functions to import the file "**ISaAFB_VXW_TELVENT_L.txt**" by selecting in the ISaGRAF 5 menu: "File -> Import -> PLC definition "

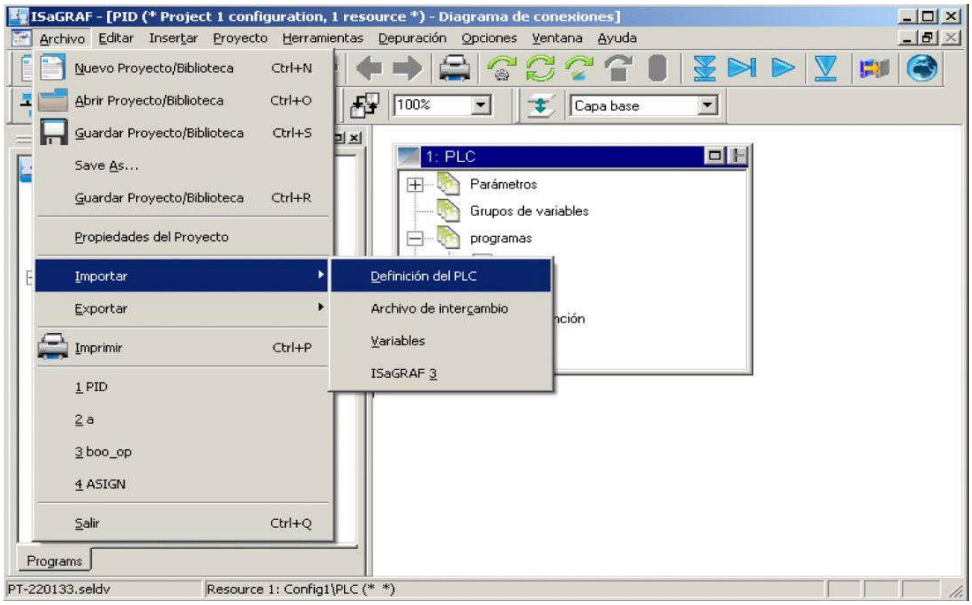


Figure 3-5. Import of the PLC definition file in ISaGRAF5.

- There is another file "IsaNDT_VXW-TELVENT_L.txt" that may be interesting to be imported, in order to add the following functions to the logic implemented in the RTU:

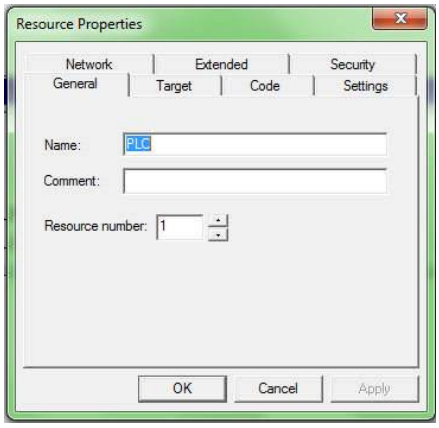
Function block	Description
XOR_MASK_DWORD	DWORD exclusive OR bit-to-bit mask
ROR_WORD	Make the bits of a WORD rotate to the right
OR_MASK_DWORD	DWORD OR bit-to-bit mask
SHR_WORD	Make the bits of a WORD shift to the right
ROR_DWORD	Make the bits of a DWORD rotate to the right
TAN_LREAL	Tangent (arithmetic LREAL)
SHL_DWORD	Make the bits of a DWORD shift to the left
ROL_BYTE	Make the bits of a BYTE rotate to the left
NOT_MASK_DWORD	DWORD bit-to-bit negation mask
EXPT_LREAL	Exponent (arithmetic LREAL)
SIN_LREAL	Sine (arithmetic LREAL)
OR_MASK_BYTE	BYTE OR bit-to-bit mask
ATAN_LREAL	Arc tangent (arithmetic LREAL)
SHL_BYTE	Make the bits of a BYTE shift to the left
ASIN_LREAL	Arc sine (arithmetic LREAL)
AND_MASK_BYTE	BYTE AND bit-to-bit mask
POW_LREAL	Power calculation (arithmetic LREAL)
SHR_DWORD	Make the bits of a DWORD shift to the right
ROL_WORD	Make the bits of a WORD rotate to the left
SQRT_LREAL	Square root (arithmetic LREAL)
OR_MASK_WORD	WORD OR bit-to-bit mask
SHL_WORD	Make the bits of a WORD shift to the left
LOG_LREAL	Logarithm (arithmetic LREAL)
AND_MASK_WORD	WORD AND bit-to-bit mask
ABS_LREAL	Absolute value (arithmetic LREAL)
XOR_MASK_BYTE	BYTE exclusive OR bit-to-bit mask
NOT_MASK_BYTE	BYTE bit-to-bit negation mask
AND_MASK_DWORD	DWORD AND bit-to-bit mask
ROR_BYTE	Make the bits of a BYTE rotate to the right
COS_LREAL	Cosine (arithmetic LREAL)
SHR_BYTE	Make the bits of a BYTE shift to the right
ROL_DWORD	Make the bits of a DWORD rotate to the left
ACOS_LREAL	Arc cosine (arithmetic LREAL)
XOR_MASK_WORD	WORD exclusive OR bit-to-bit mask
TRUNC_LREAL	Truncate decimal part (arithmetic LREAL)
NOT_MASK_WORD	WORD bit-to-bit negation mask

Table 3-2. Advanced function for new data types.

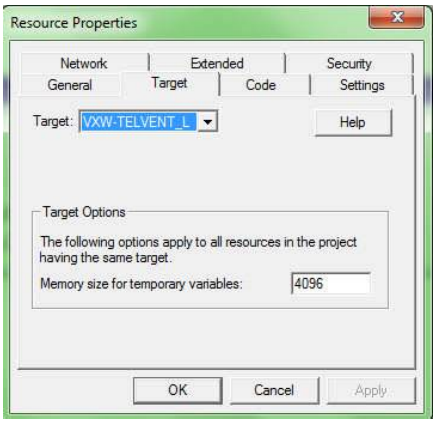
3.2.2 Resource Configuration

In addition to developing the logic, the user must define the resource settings by right-clicking in the ISaGRAF interface and selecting "Properties":

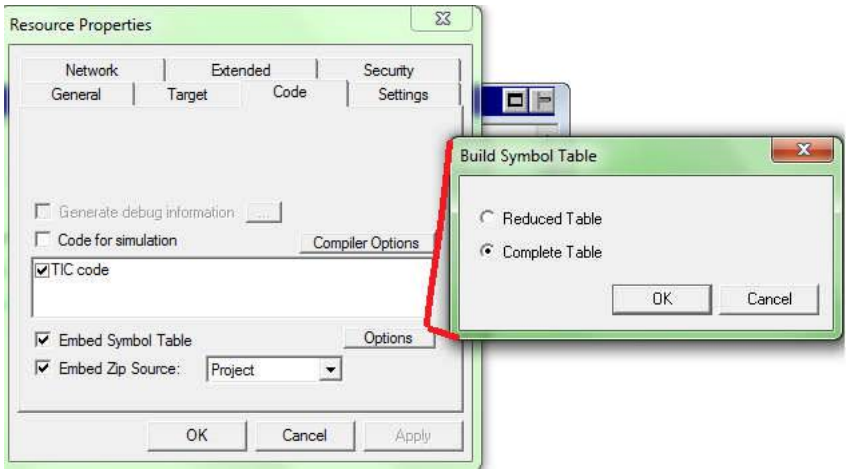
- **General**: It includes the Resource's name, comments, and a resource identification number.



- **Target**: The target options of a resource define the target operating system on which the resource will run: VXW-TELVENT_L.



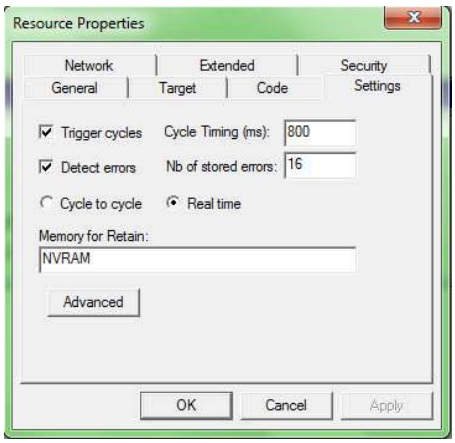
- **Code**: Configure as shown below:



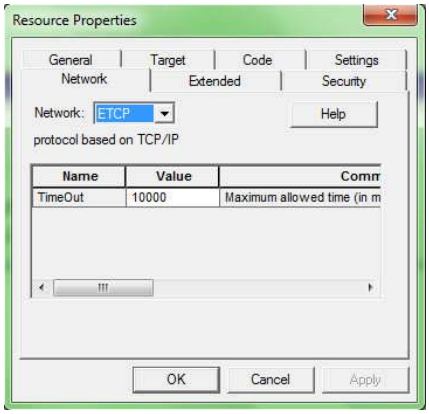
- **Settings**: The run-time settings include the logic's cycle and others when the resource is executed.

  Variables declared as retained should be stored in a non-volatile device, so that they can be reloaded if the resource is restarted. This happens, i.e. when the RTU is booted after a power-off. In the "Memory for Retain:" field the user can choose between two options:

  - "/nvRam" file. Two files (IsaVMxxA and ISaVMxxB) will be created in the root directory of the /nvRam device, where ISaVMxx is the name of the task that has been assigned to the resource.
  - NVRAM. 16 KB reserved in NVRAM for all the Bin Controllers.

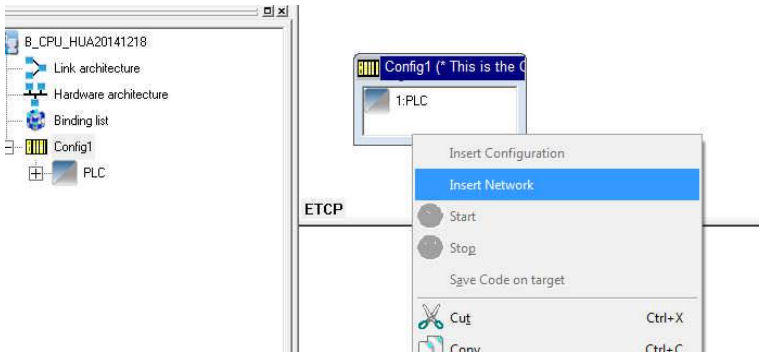


- **Network**: Configuration shall be done as shown below:

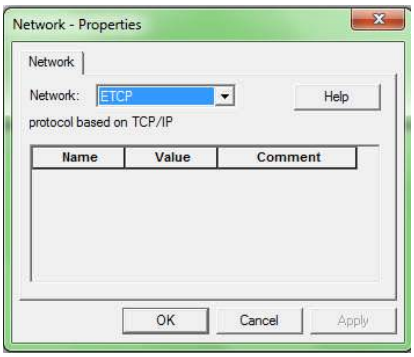


3.2.3 Configure Hardware Architecture

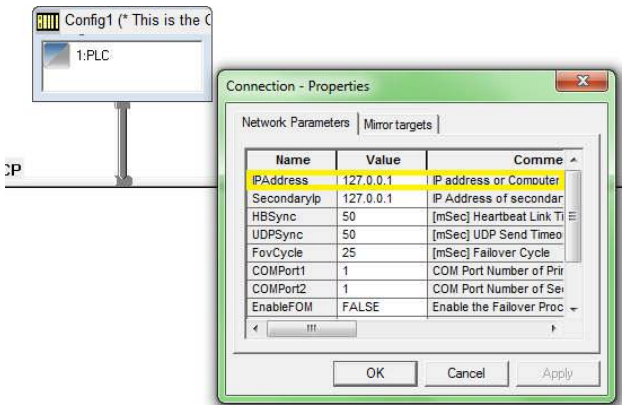
To configure the communication between PC and RTU in the ISaGRAF workbench, double click on **Config1**, locate the mouse over the window that has popped up press the right button . Choose the option “Insert Network”.



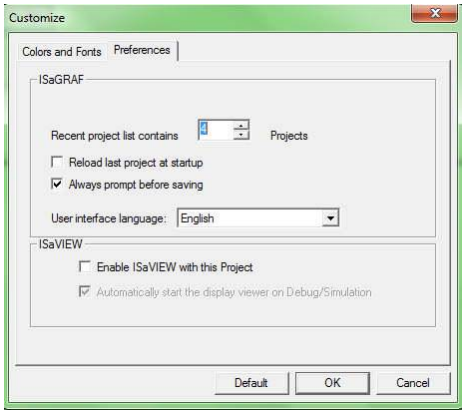
Select ETCP:



Connect the ETCP network line with the Config1 window, by dragging the pointer of the mouse from the Config1 window to the network (the horizontal line) and then, enter the RTU IP address:



It is important to disable the ISAVIEW function, through the menu **Options/customize/preferences -→ Uncheck Enable ISAVIEW**.



This preference will be saved and it will not be necessary to repeat this step on other projects.

3.2.4 Configuration of the ISaGRAF5 Device

The ISaGRAF5 Device configuration is similar to the process described for ISaGRAF3 in the previous chapter. However, there is an exception, the button  can be used in order to load information and variables of the ISaGRAF project.

NOTICE
If the version of ISaGRAF5 is earlier than 5.22.121, a patch of the Workbench must be installed on the PC.

Glossary

coreDb	Real time database of the Baseline Software Platform.
CPU	Unidad Central de Procesamiento.
DB	Base de datos, también BD.
EN	English language.
HU_A	Saitel DR advanced HU.
HU_AF	Saitel DR advanced HU with acquisition.
HU_B	Saitel DR basic HU.
IEC	International Electrotechnical Commission.
IED	Intelligent Electronic Device.
I/O	Input / Output.
ITB	Intelligent Terminal Block.
LAN	Local Area Network.
LSB	Least Significant Bit.
mm	Millimetre.
MSB	Most Significant Bit.
OS	Operating System.
PC	Personal Computer.
PLC	Programmable Logic Controller.
RAM	Random Access Memory.
Rev	Review.
RTC	Real Time Clock.
RTOS	Real Time Operating System.
RTU	Remote Terminal Unit.
SBO	Select Before Operate.
SCADA	Supervisory Control and Data Acquisition.
SM_CPU866	Saitel DP CPU (standard).
SM_CPU866e	Saitel DP CPU (advanced).
SP	Spanish language.

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