User Manual
MasterTool Hadron XE
HD8000

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altus

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Summary

1. Introduction

MasterTool Hadron XE Software

MasterTool Hadron XE HD8000 software is the configuration, programming, commissioning and maintenance tool of the Hadron HD3002 RTU (remote terminal unit). This tool also permits the process monitoring, module configuration and report generation. It runs on Windows® 2000, Windows® XP and Windows® 7 operatinig systems (all 32bits).

Documents Related to this Manual

For further information about MasterTool Hadron XE HD8000, other documents can be consulted (manuals and technical characteristics). Those documents are available in their most recent versions at www.altus.com.br.

The following documents are recommended as additional information source:

- HADRON RTU – HD3002 Technical Characteristics
- HADRON RTU – HD3002 User Manual
- HD8000 Technical Characteristics
- MasterTool Extended Edition Ladder Programming Manual
- MasterTool Extended Edition ST Programming Manual
- Technical Characteristics of the following products:
    - AL-2005 - Real Time Multitasking Processor
    - AL-3130 - 32 DI 125 Vdc Opto with Event Log Module
    - AL-3132 - 32 DI 48 Vdc Opto with Event Log Module
    - AL-3138 - 32 DI 24 Vdc Opto with Event Log Module
    - AL-3150 - 16 AI Isolated V/I Module
    - AL-3150/8 - 8 AI Isolated V/I Module
    - AL-3151 - 16 AI Isolated RTD/Thermocouple Module
    - AL-3151/8 - 8 AI Isolated RTD/ Thermocouple Module
    - AL-3202 - 32 DO Relay NO Check Before Operate Module
    - AL-3406 - PROFIBUS Master Network Interface
    - AL-3412 - Ethernet 10-100 Mbits Interface
    - AL-3414 - Redundant Ethernet MODBUS TCP Interface
    - AL-3415 - IEC-60870-5-104 Server Ethernet Interface
    - AL-3416 - Slave PROFIBUS Network Interface
    - AL-3417 - DNP3 Server Ethernet Interface

Visual Inspection

Before proceeding to installation, it is recommended to make a visual inspection of the material, verifying no damages have been caused by transportation. Verify if CD-ROM is in perfect conditions. In case of damages, notify the transportation company and the nearest Altus representative or distributor.

It is important to record the serial number of each of the equipment received, as well as the software revision, if existing. This information is required if you need to contact Technical Support Altus.

Technical Support

To contact Altus Technical Support in São Leopoldo, RS, dial +55-51-3589-9500. To know about Altus Technical Support in other locations, see our site (www.altus.com.br) or send an e-mail to altus@altus.com.br.

If the software is already installed, please have the following information available when calling for assistance:

- MasterTool Hadron Extended Edition software version
- The software key version used on MasterTool Hadron Extended Edition software
- Revision of the equipment and the version of the executive software, fixed in the side label of the product, if the question refers to communication with devices
- The application software contents (program modules)
- Windows operating system version (including its Service Pack) of the computer which is running the software

Warning Messages Used in this Manual

In this manual, warning messages will show the following forms and means:

DANGER:
Report potential causes, not observed, which take to damages to physical and health integrity, patrimony, environment, and production loss.

CAUTION:
Report configuration, application and installation details, which must be followed to avoid conditions, which can lead to a system failure and is related consequences.

ATENTION:
Indicate important details for configuration, application or installation in order to obtain the maximum operational performance of the system.

2. Technical Description

System Requirements

MasterTool Hadron XE, for any of its distribution versions, has as requirements for its installation the following products:

	MasterTool Hadron XE
Platform	PC with Windows® 2000 SP4, Windows® XP SP2 (32bits) or Windows® 7 (32bits).
.Net Framework	Version 2.0 SP2 and 1.1 SP1
Processor	Pentium 1.8 GHz (recommended)
Disk Space	300 MB (recommended)
RAM Memory	1 GB (recommended)
Resolution	1024 x 768 (recommended)

Table 2-1. System requirements

Ordering Information

Included Items:

The product can be ordered in two ways:

- In a product package which contains the following items:
  - MasterTool Hadron XE Software recorded in CDROM
  - Altus Sofware License Contract
- In a package of the product which contains the License for further download of the software at Altus Site: www.altus.com.br (Versions / Licenses)

Product Code

The following codes must be used for product purchase:

Code	Name
HD8000	MasterTool Hadron XE
HD8000 /L	MasterTool Hadron XE /L (License)

Table 2-2. Product code

3. General Overview

MasterTool Hadron XE is an application that runs on a Windows operating system, having all the facilities and standards offered by such environment. Its operation, as other Windows applications, is oriented to menu commands and dialogue boxes, allowing to perform tasks and to choose options.

MasterTool Hadron XE has, in addition, specific edition windows for the Configuration Module, Program Module and each of other modules and files used in projects. Such windows allow an efficient edition and an adequate view of the several components of each specific module.

MasterTool Hadron XE software main environment is presented in the following figure:

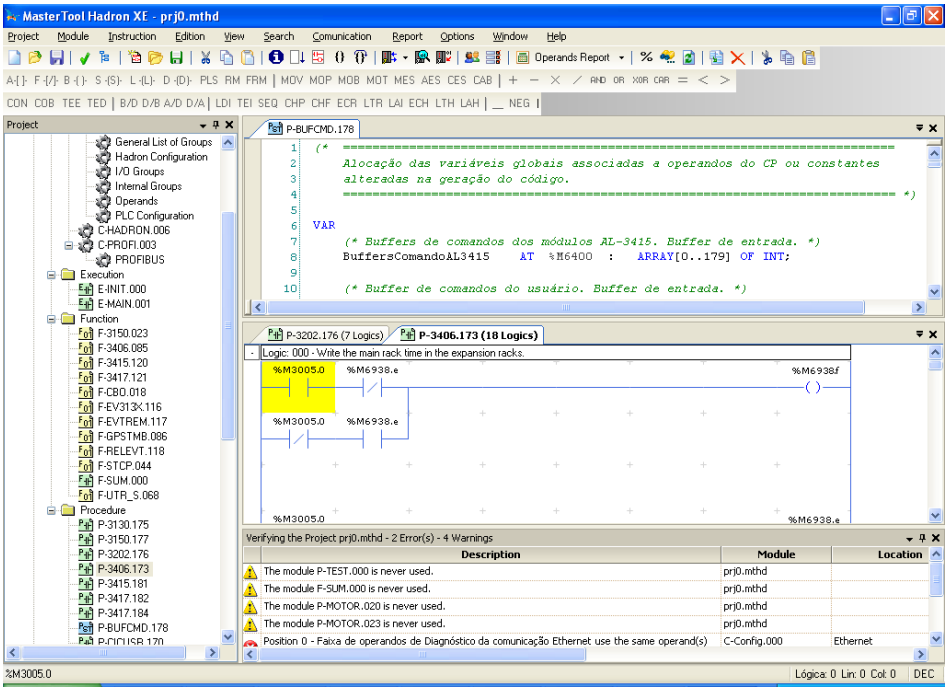


Figure 3-1. MasterTool Hadron XE environment

It is clearly noted that the environment has three divisions, which are:

- **Project Treeview:** This window can be used to increase the agility in using MasterTool Hadron XE, since just a double-click opens a module, configuration or any project. In addition, many functionalities of the software can be started throughout this window.
- **Project check:** In this window is presented the result of the verification of a module or of the project, and errors of configuration / programming are indicated. Also, alerts are shown to warn the user that a configuration / programming may not have the expected result.
- **Edition Area:** Edition and/or viewing area of one or more program module(s), reports, monitoring window(s) or any other file or configuration made by MasterTool Hadron XE.

Project Treeview

The Project Treeview has as objective to visualize modules and documents used in the project, allowing quick accessing to their contents and speeding up many functions which can be run in MasterTool Hadron XE. All files visualized in this window are part of the project. Therefore, through this window files and/or modules of the project can be added or removed. This can be easily done with a right-click of the mouse.

The window has several levels, represented by folders. The main folder refers to a present open project, where the name of the project can be seen followed by the CPU used. The other levels are

divided into multiple folders, which aim to separate the files and documents types and capabilities, in order to organize and facilitate handling of the project.

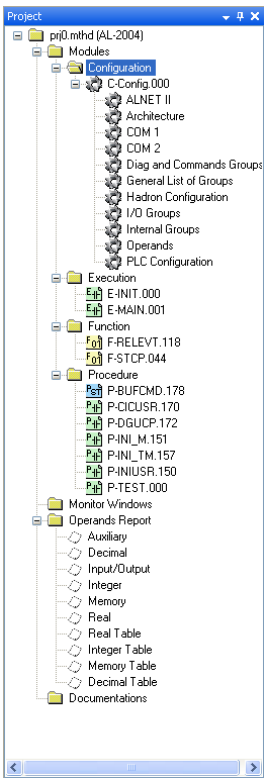


Figure 3-2. A project treeview

The treeview folders are:

- **Modules:** This folder contains all application modules, as for configuration, running, function or procedure. Throughout the Treeview, with a right-click over the module it's possible to open it, to make cross-reference, operands replacement, module verification, module sending, etc **.**
- **Monitoring Window:** This folder contains files related to the monitoring windows. Such windows can be readily opened with a double-click over the respective file.
- **Operands Reports:** This folder contains the operands reports, one for each type of operand supported by the CPU. This way, any report can be easily accessed at any time.
- **Documentations:** This folder can have any kind of file that user wants to attach to the project. Therefore, the project documentations can be easily available. To open an attached document, just a double-click over the desired document is required. To remove it, just right-click over it and the option will be available.

ATTENTION: Removing the document link from the project does not remove the file from the project directory.

Verification Window

The verification window has as an objective to help the job of the programmer, allowing the visualization of all errors and warnings contained in configuration and programming. The warning messages and information related to such occurrences are shown in a clear and objective way, in order to report to the programmer what is the error and where it is located.

The verification window is filled and modified every time that a project is open or when requested through the Verify Project / Verify Module command. At the window title bar it is informed what was verified (project or module, and in this last case, which specific module), and the number of

errors and warnings found in the verification. Each error or warning is represented by a line and will be present in the window until a new verification process is done.

An error is any configuration and/or programming which will surely result in a dysfunction. A warning is an indication of a dangerous or incomplete programming and/or configuration that can be intentional, or that not necessarily will affect the correct functioning of the project. A project with one or more errors cannot be sent to the AL-2004, since it could cause a serious problem.

CAUTION:
It is suggested that all projects loaded in AL-2004 have no warnings, in order to avoid unwanted behaviors.

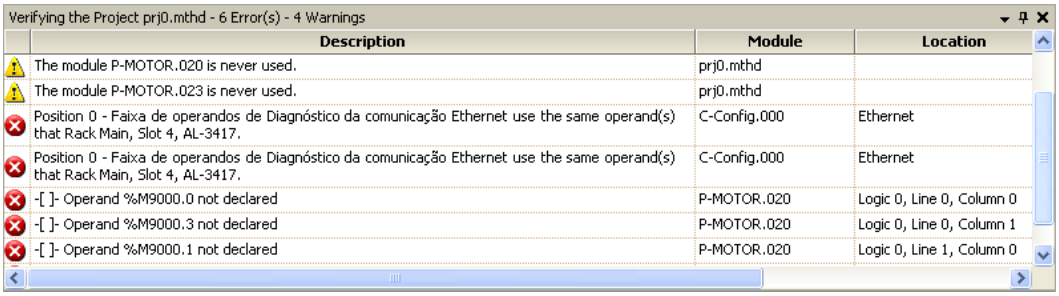


Figure 3-3. Verification window

The verification window has the following columns:

- **Icon Column:** Graphic indication whether it is an error or an warning.
- **Description:** Description of the occurrence that quickly indicates the wrong configuration and /or programming.
- **Module:** Indicates the module name in which the occurrence is located. Some of them are in the project, and, in this case the name of the project is shown.
- **Location:** Indicates, in a more specific way, the location of the occurrence within a module.

ATENTION:
By double-clicking the left button of the mouse over the occurrence line, for both error and warning, it will open the module at the corresponding location. If the message shows a "**Ethernet**" location, the occurrence refers to some Ethernet communication interface of the Hadron architecture.

Edition Area

MasterTool Hadron XE works with a new concept of project. A project represents the programming and configuration of a HD3002 RTU, which uses several modules and other documents, like the following:

- Configuration Module
- Extended Configuration Module
- Program Module
- Monitoring Window

All these documents and other reports are shown in the Edition Area. In such space are found these open modules, when requested, as a window for each module. Thus, several windows can be opened simultaneously, allowing more agility to the job.

Configuration Module Window

The window for configuration module edition allows visualizing and changing the many configuration values in AL-2004. The following figure shows an example of screen used do edit the architecture. This is one of the several screens used to edit the configuration module.

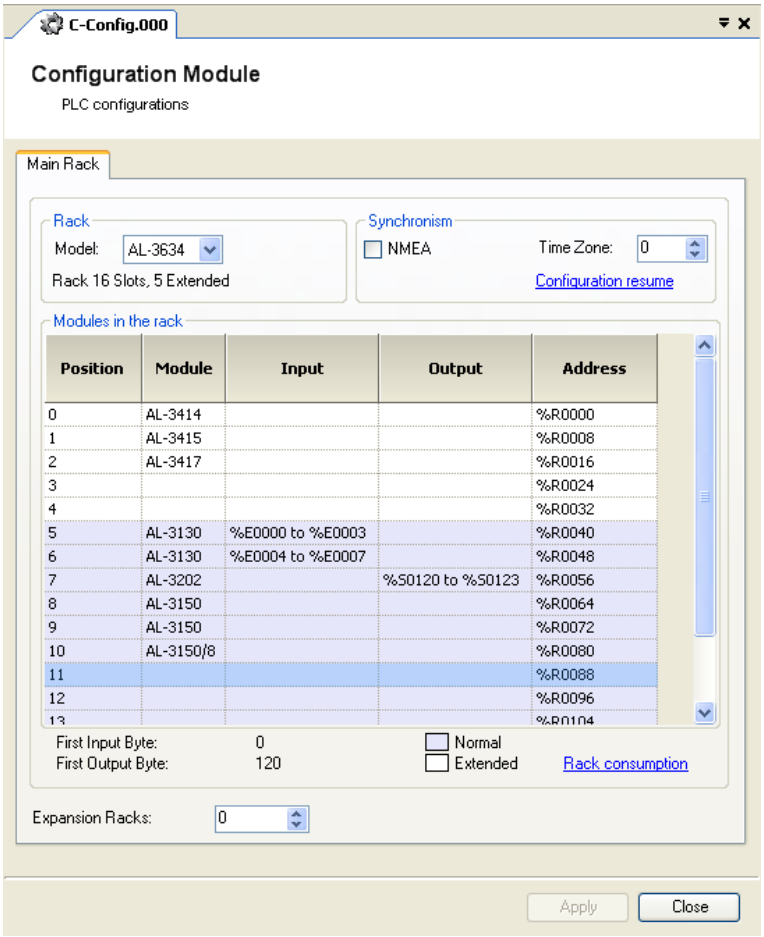


Figure 3-4. Example of a configuration module screen

To get more information about the configuration module, see the *Configuration Module* chapter in this manual.

Extended Configuration Module Window

An Extended Configuration module edition window varies according to the type of the Extended Configuration module. However, they are similar to the Configuration Module window. To get information about each of the Extended Configuration modules see *Extended Configuration Module* chapter in this manual.

Program Module Window

The Program module window shows the modules which contain the programming in fact (or part of it) of the HD3002 RTU. This window varies according to the language of each module, which can be Ladder Diagram or ST Language. An example of those windows is shown in the following figure:

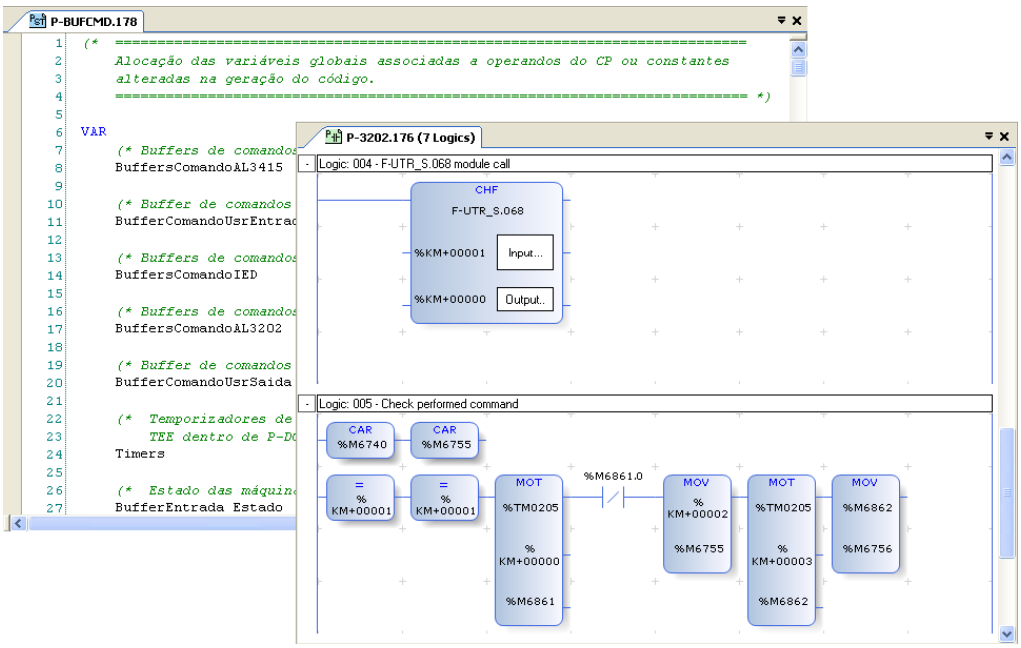


Figure 3-5. Program module edition window in ST and ladder languages

For more information about how to configure the Program module, see *Ladder Program Module* and *ST Program Module* in this manual.

Monitoring Window

The Monitoring window visualizes the values of the AL-2004 operands in real time. Any type of operand can be monitored in several numerical bases, such as Decimal, Binary, Octal or Hexadecimal. The following figure illustrates a monitoring window:

Monitoration* 2 IP: 192.168.15.75

	Operand	Value	Base
1	%M6242	0	Decimal
2	%M6243	0	Decimal
3			
4	%M6250	17972	Decimal
5	%M6253	9AEE	Hexadecimal
6	%M6259	0011 0011 1100 1100	Binary
7			
8			

Figure 3-6. Monitoring window

For more information about how to monitor operands and handle the Monitoring Window, see *Monitoring Operands* in this manual.

ATTENTION: Use F4 key to change the numerical base of selected lines.

4. Project in MasterTool Hadron XE

What is a Project?

MasterTool Hadron XE works with the concept of project in order to better attend and represent the applications. A project establish a relationship between several files creating a work environment, making the development easier, significantly decreasing the creation time, and preventing the most common configuration errors to be made using a verification process.

The project filename uses a .MTHD extension. Some characters, such as * / : have special meanings for the used operating system, so they are considered invalid for naming a project. So, this information must be considered when choosing the project name.

A project is used to put together all necessary modules to run the tasks of a HD3002 RTU, making itself an application program. In addition, a project has documents and reports used in development and in future preventive maintenance.

ATENTION:
All modules that are part of the project are located in the same directory, which is indicated in the project creation. If modules from other directories are inserted, a copy of the module is automatically made to the current project directory.

Files Generated by MasterTool Hadron XE

MasterTool Hadron XE generates and uses several files, which compose its projects. Some of them are the Project Modules and others are general documentation and reports. The following table shows the filename formats used by MasterTool Hadron XE and their respective meanings:

Name Format	Meaning
*.MTHD	Main file of the project. It has the name of the project followed by .MTHD extension.
*.MTHDX	File with the project architecture configuration and the points groups. It has the name of the project followed by the extension .MTHDX
T-XXXXXX.NNN	Project module file of the MasterTool Hadron XE, where: • **T** – Module type (C, E, F or P) • **XXXXXX** – Name of the project with up to six characters • **NNN** – Module number
*.Notas	Project Modules Notes and Description files. They have the corresponding module name, followed by the extension .Notas
*.Tags	File containing the Saved Operand Reports. It has the name of the project followed by the extension .Tags
*.mnt	Monitoring windows files. The names, before the extension. Mnt are freely attributed by the user.
Directory Exp00 to Exp03.	These directories store the configurations of the expansion racks from 0 to 3, since they are present. A HD3002 RTU can have up to four expansion racks numbered from 0 to 3. All configurations of expansion racks are automatically generated by MasterTool Hadron XE, from the information that the user enters in the configuration screen.

Table 4-1 Files used by MasterTool Hadron XE

Creating a Project

To create a new project, its name and the directory where it will be stored must be informed. For doing it, in **Project/New** menu, the following screen is showed:

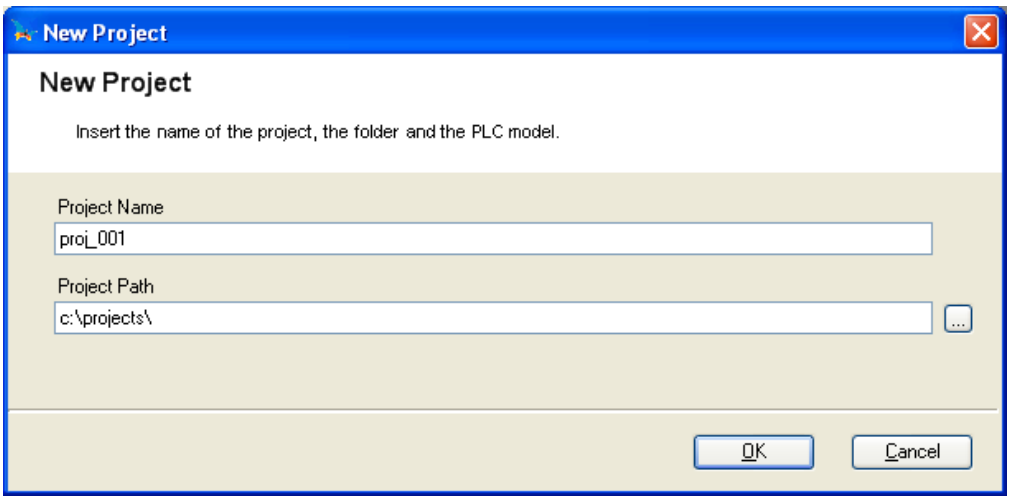


Figure 4-1. Creating a new project

Opening an Existing Project

To perform the edition of a project it is necessary that such project is open in MasterTool Hadron XE. When a project is open in MasterTool Hadron XE and it has been already edited previously, all project windows will return to what they were before the project was closed, i.e. MasterTool Hadron XE restores the configuration of the whole project.

To open a project, just access the **Project/Open...** menu and select a MasterTool Hadron XE project with extension *.MTHD in the browser.

ATENTION: Use the menu option **Project/Last Projects** to quickly open the most recent projects opened.

When opening in MasterTool Hadron XE a project created in a previous version of the software, a window will appear asking to convert the project to the version of the installed software, as shown on the following figure:

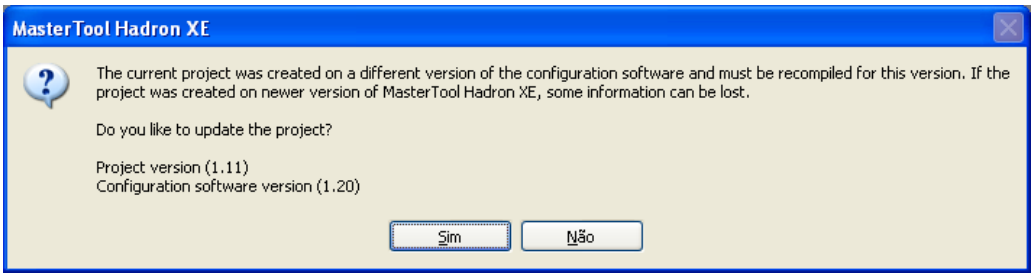


Figure 4-2. Project update window

If the project is not updated, it will not be possible to compile it and the following warning will be shown:

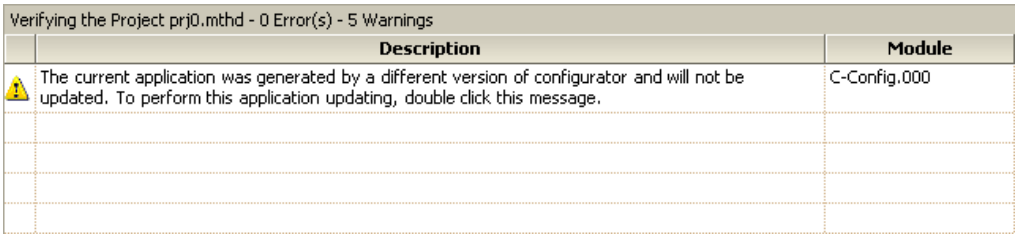


Figure 4-3. Warning indicates the outdated status of the project

As indicated in the text of the warning message, to perform the updating of the project, just double-click over the message that the project will be updated and then it will be possible to compile it.

Inserting and Removing Project Modules

The project modules of a project can be removed, as well as previous Project Modules can be inserted. To perform these commands, use the Treeview of the project using the right button of the mouse.

To insert a module:

1. Click with the right button in **Modules** folder in the Treeview of the Project, as the following figure shows:

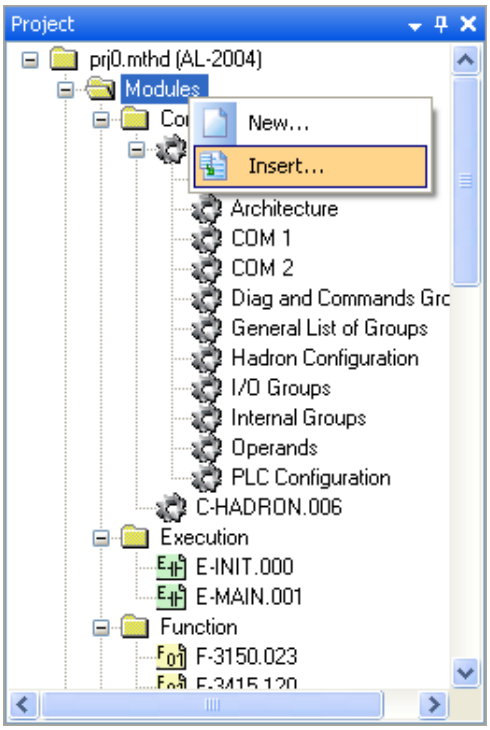


Figure 4-4. Including a project module

2. Select a file using the open browser. The file will be copied to the Project directory, if it is not at the same folder.

To remove a Project Module:

1. Click with the right button of the mouse exactly over the module that will be removed from the project, as shown in the following figure, and click the option Remove:

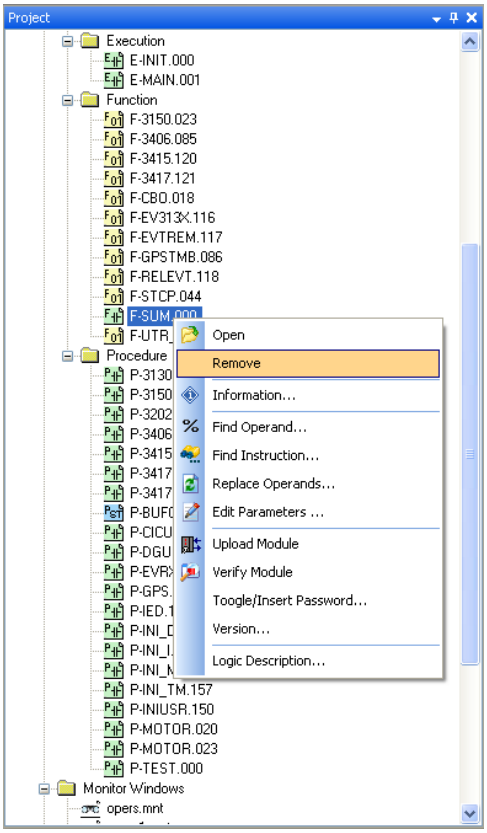


Figure 4-5. Removing a project module

ATENTION: The removed module in a project is not deleted; it is only not considered by the project.

Inserting and Removing Other Documents

Insertion and removal of Monitoring and Documents Windows works in a similar way as in insertion and removal of Project Modules. The project Treeview contains folders as Documents and Monitoring Windows where these attached elements can be found.

In the Operands Report folder in Treeview, it is not possible to include or remove any element, since these reports are fixed. Only their contents can be modified.

Creating a Module for a Project

Besides inserting existing modules in the project, another way to add more modules is creating a new one. Such procedure can be done with any project open, clicking in **Module/New Module...** A new window will open, as shown on the following figure:

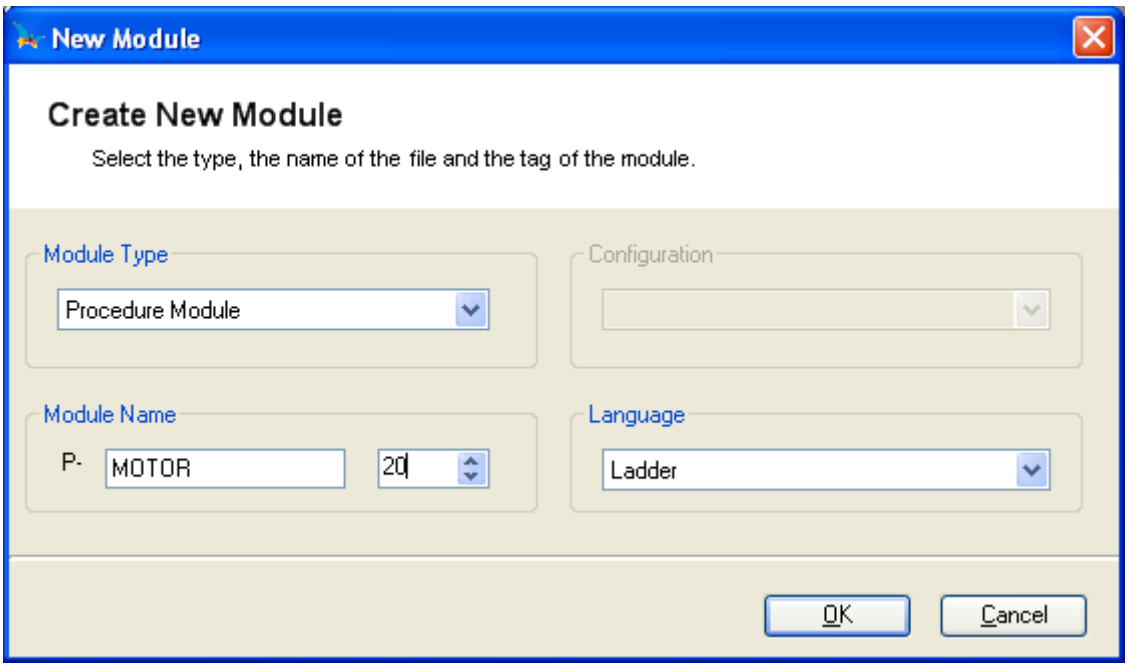


Figure 4-6. Creating a new module

Depending on the type of the selected module, some parameters of the window will not be available for changing or the restriction values will change. This happens because some modules have restrictions, as shown in the table below:

Module Type	File	Access	Language	Description
Starting Module	E-INIT.000	Blocked	Ladder	Runs only in the first CPU cycle.
Main Module	E-MAIN.001	Blocked	Ladder	Runs every CPU cycle.
Time interrupt Module	E-xxxxxx.018	Free	Ladder	Runs in the time interval configured in Module C.000. See **CPU Configurations** Section.
Procedure Module	P-xxxxxx.000 to P-xxxxxx.149	Free	Ladder or ST	Procedure modules used to organize the application program.
	P-xxxxxx.151 to P-xxxxxx.169 and P-xxxxxx.171 to P-xxxxxx.199	Blocked	Ladder	Procedure Modules managed by MasterTool Hadron XE.
	P-INIUSR.150	Free	Ladder	Procedure module that runs only in the first cycle of the CPU. It is automatically created by MasterTool Hadron XE and must be used by the user to initialize the variables of its application program.
	P-CICUSR.170	Free	Ladder	Procedure module that runs every CPU cycle. It is automatically created by MasterTool Hadron XE and must be used by the user to create its application program.
Function Module	F-xxxxxx.000 to F-xxxxxx.228	Free	Assembly Ladder or ST	Function Modules, used when there are program routines that are repeated. Modules in assembly are blocked.
Extended Configuration Module	C-PROFI.003	Blocked	Binary	Configuration of the AL-3406 used for communication with the expansion racks.
	C-xxxxxx.004 and C-xxxxxx.005	Free	Binary	Used for the manual configuration of the AL-3406 modules by the user

Module Type	File	Access	Language	Description
	C-xxxxxx.006 to C-xxxxxx.009	Blocked	Binary	Used for the configuration of the AL-3415/17 communication interface

Table 4-2 Restrictions for names and uses in the project modules

Blocked modules must not be used by the user since they are automatically generated by MasterTool Hadron XE according to the configured parameters. Some function modules are either blocked by the user and must not be used. This modules are generated by Altus in Assembly and they are:

- F-3416.011
- F-2005.016
- F-CBO.018
- F-3150.023
- F-STCP.044
- F-UTR_S.068
- F-3406.085
- F-GPSTMP.086
- F-EV313X.116
- F-EVTREM.117
- F-RELEVT.118
- F-3415.120
- F-3417.121

Inserting Project Notes and Descriptions

In MasterTool Hadron XE, several documentations can be made to help in development and maintenance of a project. Among them, there are the Project Notes and Descriptions, which can be visualized and edited throughout the **Report/Project Notes...** menu. The following figure shows these documentations:

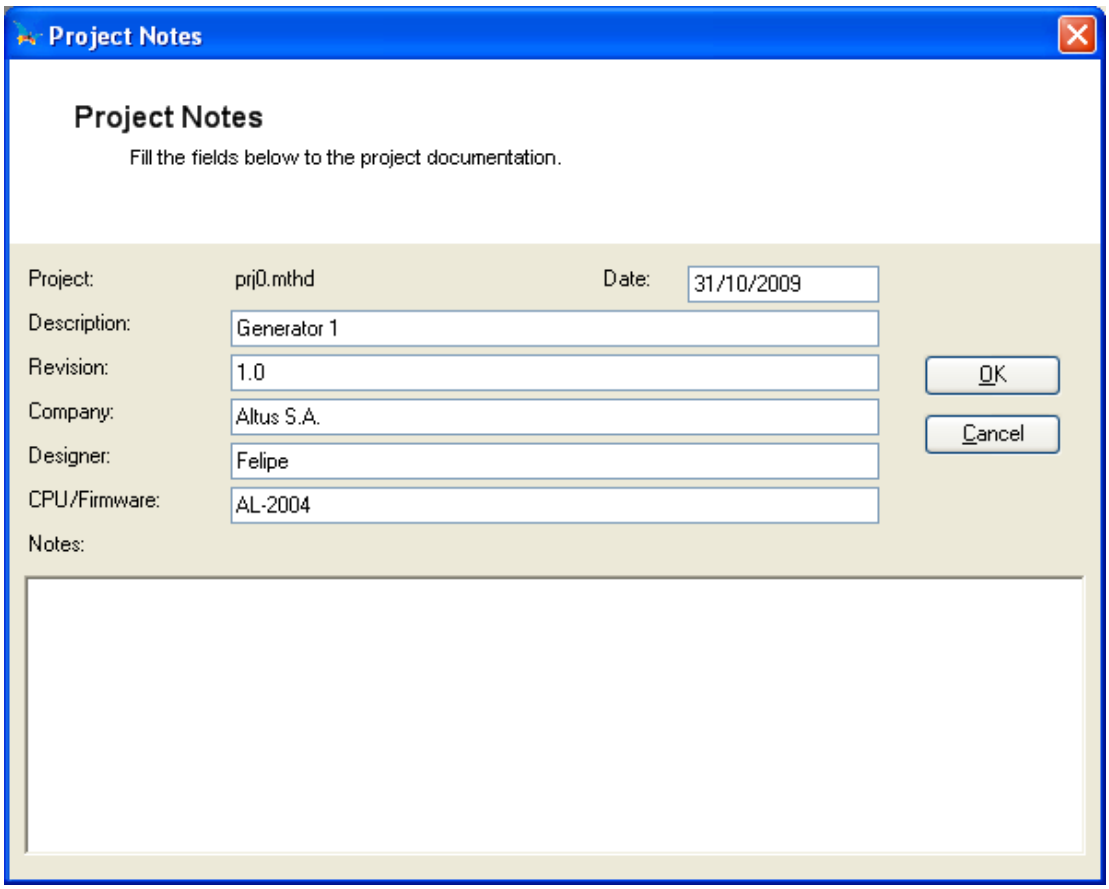


Figure 4-7. Visualization window and project notes edition

Project Verify

To verify the project in order to detect errors or dangerous behaviors in programming and/or configuration, just click in **Project/Verify Project** menu. The result of this can be visualized in the Verify Window.

In an analogous way to the project verifying, a verification of a module can also be done individually, just going to the **Module/Verify Module** menu.

CAUTION:
The project verifier checks for syntax errors in configuration and programming of a project. This does not mean that the application will work as expected, since the user can make programming errors on the program logic. The algorithms used in programming are responsibility of the user.

Searching Operands – Cross Reference

Search for operands used in the project, also known as Cross Reference, can search for one or more operands (Operands Range) in all modules of the project, i.e., in Configuration Module, in all Extended Configuration Modules, Function Modules, Procedure Modules, etc. To perform this search, just go to **Search/Operands...** menu and select the range of operands you wish to look for. Bellow is an illustrative figure

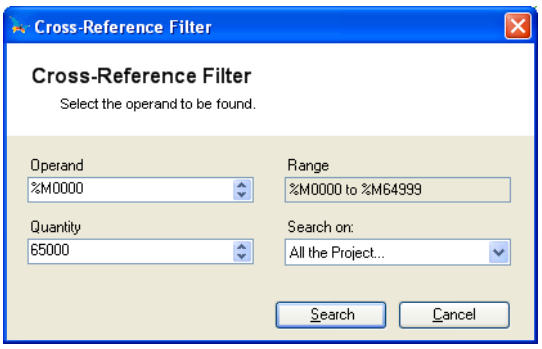


Figure 4-8. Selecting the operands range to perform a search in the project

This screen is where the user selects the operands range which will be searched, informing the **Operand** and the **Quantity**. If wanted to limit the search location for the operand range, just select from the list **Search on** a specific module. This way, the search will be made only in the selected module. After selecting the operands range, which can be visualized in the **Range** field, just click on the **Search** button. The result of the search will appear in a screen as shown below:

Cross Reference - Search band: %M6240 to %M6399 (31 Occurrences)

Operand	Access	Module	Location	Comment
%M6251	Writing	E-MAIN.001	Logic 0, Line 1, Colum	MOV - Target Operand
%M6250	Reading	E-MAIN.001	Logic 0, Line 0, Colum	SOM - 1ª Parcel
%M6250	Writing	E-MAIN.001	Logic 0, Line 2, Colum	SOM - Result
%M6250	Writing	E-MAIN.001	Logic 0, Line 2, Colum	MOV - Target Operand
%M6240 to %M6241	Writing	P-INI_M.151	Logic 1, Line 0, Colum	CAB
%M6244 to %M6245	Writing	P-INI_M.151	Logic 1, Line 0, Colum	CAB
%M6256 to %M6258	Writing	P-INI_M.151	Logic 1, Line 0, Colum	CAB
%M6330 to %M6334	Writing	P-INI_M.151	Logic 1, Line 0, Colum	CAB
%M6242 to %M6243	Writing	P-INI_M.151	Logic 4, Line 0, Colum	CAB
%M6260 to %M6275	Writing	P-INI_M.151	Logic 4, Line 0, Colum	CAB
%M6252	Reading\Writi	P-DGUCP.172	Logic 3, Line 1, Colum	CHF - Input parameter 0
%M6330	Reading\Writi	P-DGUCP.172	Logic 3, Line 1, Colum	CHF - Input parameter 1
%M6334.0	Reading	P-DGUCP.172	Logic 3, Line 1, Colum	-[ ]-
%M6334.0	Writing	P-DGUCP.172	Logic 3, Line 3, Colum	-(D)-
%M6257.0	Reading	P-DGUCP.172	Logic 4, Line 0, Colum	-[/]-
%M6257.0	Reading	P-DGUCP.172	Logic 5, Line 0, Colum	-[ ]-
%M6257.0	Writing	P-DGUCP.172	Logic 5, Line 0, Colum	-(D)-
%M6242	Writing	P-DGUCP.172	Logic 6, Line 1, Colum	MOV - Target Operand
%M6260 to %M6275	Writing	P-DGUCP.172	Logic 6, Line 0, Colum	CAB
%M6258.0	Writing	P-DGUCP.172	Logic 6, Line 1, Colum	-( )-
%M6243	Writing	P-DGUCP.172	Logic 6, Line 3, Colum	MOV - Target Operand
%M6256	Writing	P-DGUCP.172	Logic 7, Line 1, Colum	MOV - Target Operand
%M6256	Writing	P-DGUCP.172	Logic 7, Line 3, Colum	MOV - Target Operand
%M6252	Reading	P-3406.173	Logic 2, Line 0, Colum	MOV - Start Operand
%M6254	Reading	P-3406.173	Logic 2, Line 0, Colum	MOV - Start Operand
%M6253	Reading	P-3406.173	Logic 2, Line 2, Colum	MOV - Start Operand

Figure 4-9. Results for an operands search

The window has several columns:

- **Operand:** This column shows the operand found.
- **Access:** This column determines how the occurrence uses the operands range: if it uses the data range (Read) or if it writes the content of the operand (Write).
- **Module:** the Project Module in which the occurrence is.
- **Location:** It is a more precise indication, within the module, of where the occurrence is.
- **Comment:** This column describes the purpose of the use of the operand.

ATTENTION:
By double-clicking the line with the mouse left button, the module is open (if not so) selecting the location where the operand is.

It is very important to know how this operands search works to interpret its result properly. For this, the example that follows illustrates when an operand is contained in the search result window.

Searched operands range: %M0010 a %M0020

Operand	Captured by Search?
%M0000	No
%M0013.5	Yes
%M0013n2	Yes
%M0013b1	Yes
M0013	Yes

Table 4-3. Example of an operand search

Replacing Operands

The Operands Replacement in a project can replace an operand range, with their respective subdivisions, by other range of the same type of operand, in all modules of the project, i.e., in the Configuration Module, in all Extended Configuration Modules, Function Modules, Procedure Modules, etc.

To perform this replacement, just go to **Search/Replace...** and inform the operand range which you wish to replace and by which range it will be replaced. The following figure shows this operation.

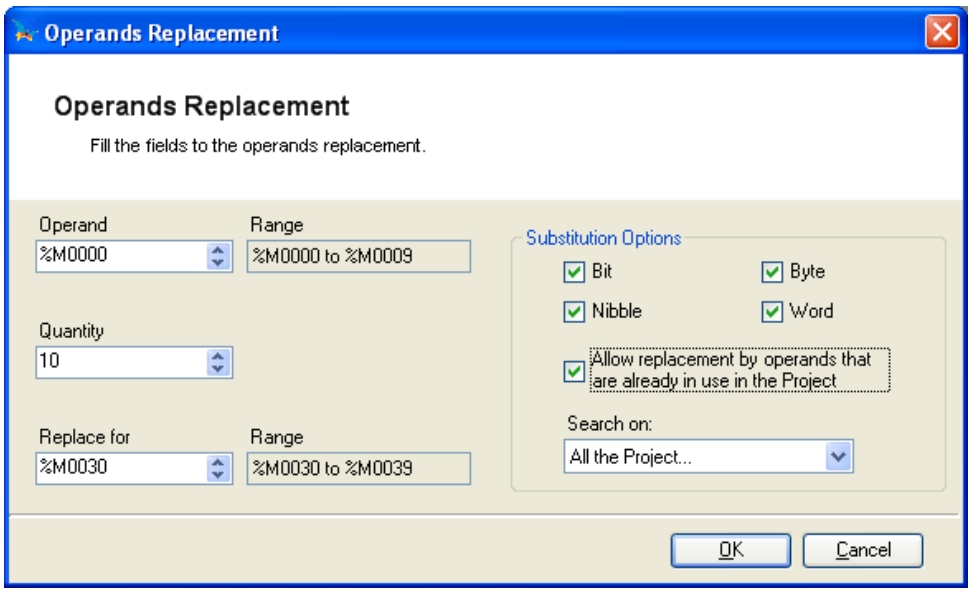


Figure 4-10. Selecting the operands range that will be replaced by its substitute

The screen above has the objective of informing the operands range that will be replaced, using the **Operand** and **Quantity** fields. The replacer operand is formed in the **Replace for** field and in the **Quantity** field, since the ranges must have the same size. There are also the options to replace or not the operands with subdivision, which are within the range. These options can be determined in the **Bit, Nibble, Byte and Word** checkboxes.

There is also the possibility to automatically check whether the operands range of the replacement contain operands already in use in the project. If this happens, the replacement is prevented to go on. Such consistence is disabled clicking in **Allow replacement by operands already in use in the Project.**

After these data are informed, by clicking OK, a screen like the one shown below will appear:

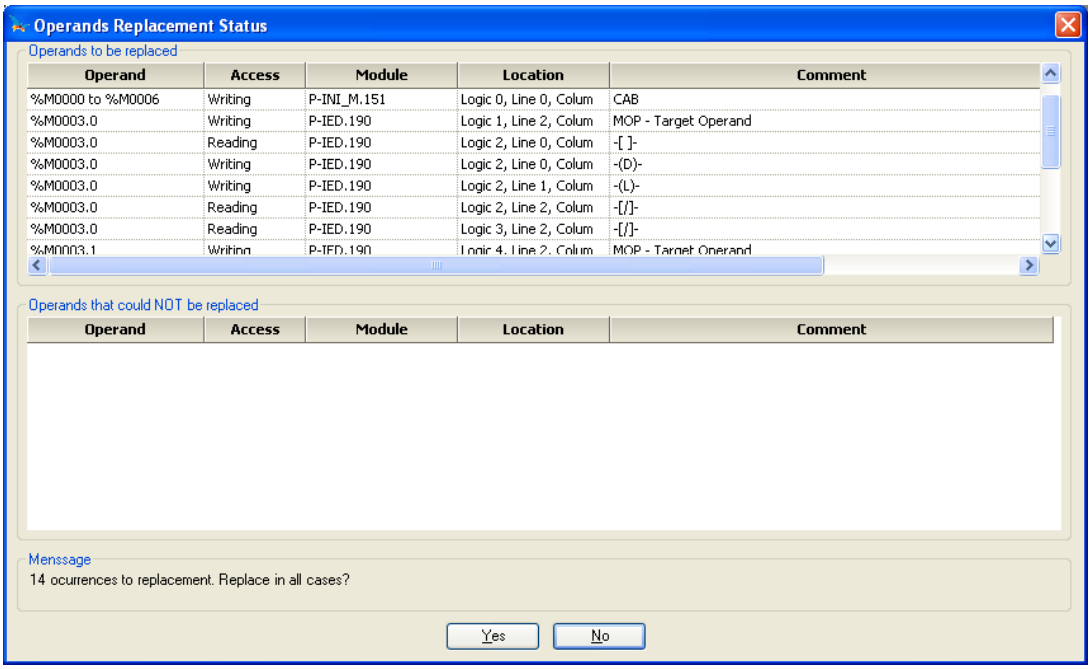


Figure 4-11. Reporting of the operands range to be replaced

This window informs the operands range in the project or in the selected module, which will be replaced and the ones that will not be replaced. It also shows the respective locations where they are located. After reading carefully the content of this window, press Yes button and the replacement will be performed.

Searching for an Instruction

In a similar way used for operands, a Ladder Language instruction in the Program Modules can be searched. For this, just go to **Search/Instruction...** menu and the following screen will be shown:

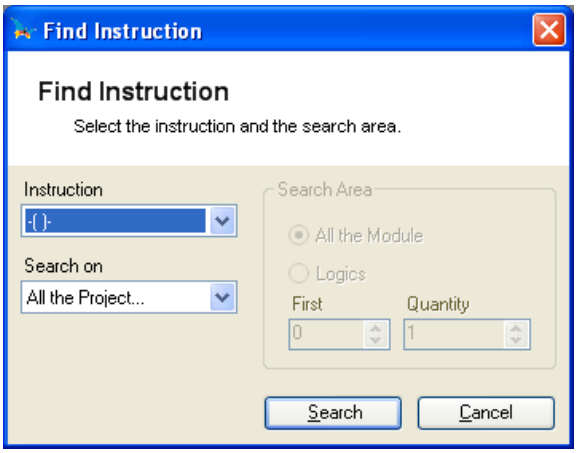


Figure 4-12. Searching for an instruction in the project

After selecting the Instruction and clicking on Search, a window similar to the one for searching operands will be opened.

Viewing the Modules Hierarchy

Modules Hierarchy is considered the order in which the modules are executed, i.e., which module calls another module and where it happens. MasterTool Hadron XE shows such information

graphically, through the **Project/View Modules Hierarchy** menu command. Clicking on this menu, a window opens as shown below:

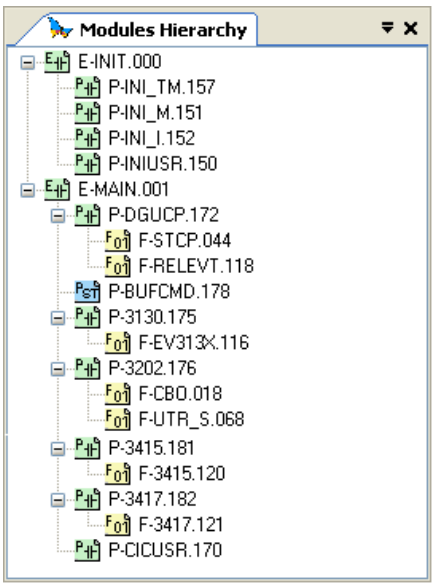


Figure 4-13. Modules hierarchy in a project

To view the location where each of these modules are called, just right-click the mouse and select the option in **Show Location** menu. A double-click over a module opens the Program module in the location where the selected module is.

Operands Report

Each operand, operand bit, table or table position can have a tag and a description associated. Each operand tag can have up to 25 characters and only letters and numbers can be used(the letter always converted to capitals). It is not possible to create repeated tags for any operands.

The description of each operand can have up to 65 characters in size and any character can be used in its edition.

There is one report for each kind of operand. Each one of these reports can be accessed through the **Report/Operand** menu. A new submenu opens containing all the reports present in the project. Clicking one of these menus, a window opens as shown below:

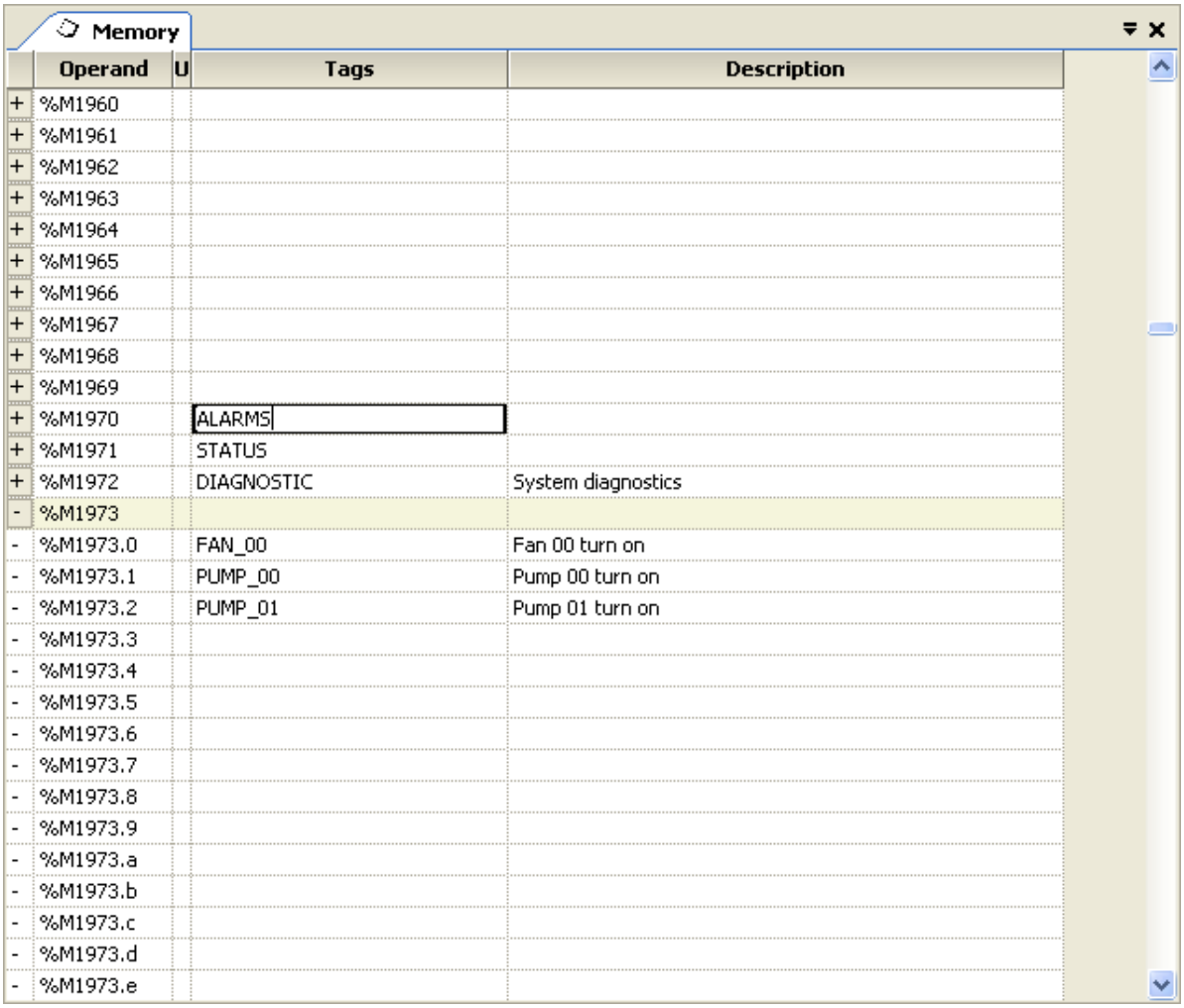


Figure 4-14. Memory operand report

Each line in the table corresponds to an operand, operand bit, table our table position. This window has the following columns:

- **Operand:** operand associated to the line.
- **U:** indicates whether the operand is in use in any point in the project. This column is updated only on window opening.
- **Tags:** indicates the tag of the respective operand. It can contain up to 25 characters.
- **Description:** description of the operand, which contains up to 65 characters.
- **WireInfo:** this column is available only for the Input/Output Operand Report. Wire-info is a label used in the electrical installation wiring to identify the wire, cable, connector or any other related information. Thus, the corresponding input or output point can be located by its wire-info, in the electrical cabinet, checking the relation of tags, operand and wire-info.

ATENTION: The wire-info label is used only for the system documentation, and cannot be used in operand forcing operations and for instruction monitoring or editing, although it can be visualized in the logic.

Importing and Exporting Tags and Descriptions

MasterTool Hadron XE has functions to export and import tags and descriptions for Excel value files (.CSV). Such procedures make the project documentation easier, and also help the tag edition and description, since the user can edit them in Excel and import to MasterTool Hadron XE.

To export the tags and descriptions, i.e., save such information of the project in a CSV file, just click the **Report/Export Tags and Descriptions...** menu. By doing this, a browser window opens in order to select the folder and the filename to be saved.

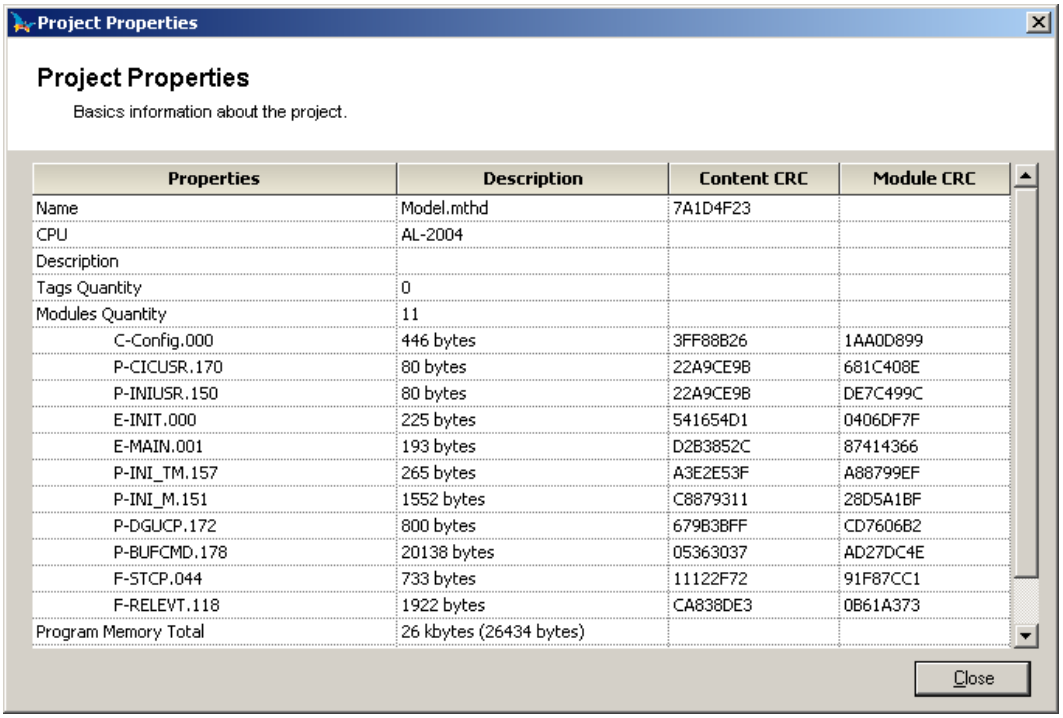
For importing tags and descriptions of operands, just click the **Report/Import Tags and Descriptions...** A window like the one shown bellow opens, in order to choose some options for the tags import.

Figure 4-15. Importing tags and descriptions from a CSV file

After clicking OK, a browser window opens for choosing the desired file for importing the information.

Project Properties

MasterTool Hadron XE has a window to visualize the project properties. For accessing it, just click on **Project/Project Properties** menu. This window shows a brief of project information, as shown on the following figure:



Properties	Description	Content CRC	Module CRC
Name	Model.mthd	7A1D4F23	
CPU	AL-2004		
Description			
Tags Quantity	0		
Modules Quantity	11		
C-Config.000	446 bytes	3FF88B26	1AA0D899
P-CICUSR.170	80 bytes	22A9CE9B	681C408E
P-INIUSR.150	80 bytes	22A9CE9B	DE7C499C
E-INIT.000	225 bytes	541654D1	0406DF7F
E-MAIN.001	193 bytes	D2B3852C	87414366
P-INI_TM.157	265 bytes	A3E2E53F	A88799EF
P-INI_M.151	1552 bytes	C8879311	28D5A1BF
P-DGUCP.172	800 bytes	679B3BFF	CD7606B2
P-BUFCMD.178	20138 bytes	05363037	AD27DC4E
F-STCP.044	733 bytes	11122F72	91F87CC1
F-RELEVT.118	1922 bytes	CA838DE3	0B61A373
Program Memory Total	26 kbytes (26434 bytes)		

Figure 4-16. Project properties window

This window has the following columns:

- **Properties:** This column shows the item that will be described on the other columns
- **Description:** This column have the description of the Properties column.
- **Content CRC:** This field indicates the content CRC of each module present on the project, without considering the information that is attached to the modules by MasterTool Hadron XE like date/time of sending, and others.
- **Module CRC:** This field indicates the CRC of each module present on the project, and in this case it considers the information that is attached to the modules by MasterTool Hadron XE like date/time of sending, and others.

Exporting Project to HTML Format

The MasterTool Extended Edition allows exporting the main project information to a report in HTML format, allowing the viewing in any computer with an internet browser installed.

To perform the project export to HTML format, just click the menu **Project** / **Project Export** / **HTML format**. A window opens as shown in Figure 4-17 to select the items to be exported. In this window, the information that will be exported to HTML and its format is defined.

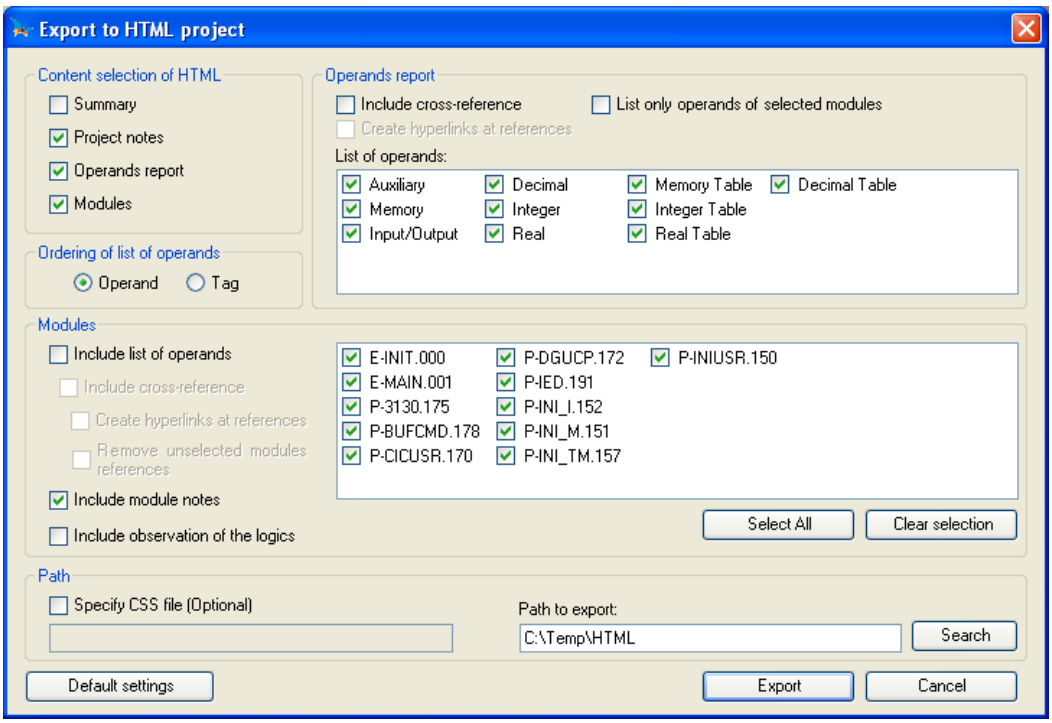


Figure 4-17. Export project window to HTML

Content Selection of HTML

In the top left of the screen, there is one of the main groups of this window, called the Content selection of HTML, which allows the selection of the sections that will compose the generated HTML document. The sections Report Operands and Modules still have other configuration options detailed below.

Sorting Lists of Operands

This group is defined as the ordering of the operands tables. The default option is to order by **Operating**, but can also be sorted by **Tag**.

Report Operands

In group Report Operands, it is possible to select the types of operands that will be exported within this section . The configuration options are:

- **Include cross-reference**: Includes cross-references of reading and writing of each operand listed.
- **Creating hyperlink in references**: Transforms the cross-reference pointing to hyperlink on the logic where the operand is referenced.
- **List only operands of selected modules**: Filters only those operands that are being used in selected modules in Modules section.

Modules

In the **Modules** group, there are listed all modules present in the project and have options such as:

- **Include list of operands**: Includes list of operands used in each logic.
- **Include cross-reference**: Includes cross-references of reading and writing of each operand listed.

- **Creating hyperlinks in references**: Transforms the cross-reference pointing to Hyperlink on the logic where the operand is referenced.
- **Remove unselected modules references**: Remove the cross-references of modules that were not selected.
- **Include notes module**: Includes note of each module, if exists.
- **Include observation of the logics**: Includes observation of each module, if exists.

Path

The field **Export Directory,** selects the directory where the files are generated. In this folder, the following is generated: an HTML file with content selected for export, a CSS for formatting and Logics folder with the image of the logic used in the export. HTML and CSS files always have the same name of the project.In the field **Specifying CSS**, you can specify a custom CSS style file. The contents of this file will be copied to the CSS file generated in the export.

ATTENTION: In case of very large projects, we recommend to export the project in stages, due to the large amount of information that can be generated, with the result, generating an HTML file too large, which in some cases make impracticable to open it by some browsers.

5. Communication Points Groups

A communication points group is a set of communication points, which, necessarily, has consecutive addresses and share the same type and variation.

The objectives for the creation of such groups are the following:

- Decreasing the configuration effort and memory occupation. I.e., it allows the description of common properties of multiple similar points, instead individual descriptions to each point. Following on this chapter, the communication points groups descriptors and proprieties are described.
- Economy of the AL-2004 CPU memory for storing the quality information. There are Communication Points Groups in which all points have a common quality information.

ATENTION: For a better understanding about the communication points groups, it is recommended to read *Basics Concepts* chapter in the Hadron HD3002 RTU user manual.

The configuration of the communication points groups can be performed in several parts of the MasterTool Hadron XE, but each one supposed to be for a specific purpose, like for communication points groups of I/O modules, for example. Throughout this manual such and other communication points groups will be described in details.

Despite the existence of several types of communication points groups, part of their configuration is common to all the groups. The figures bellow shows the configuration window for I/O groups and MODBUS TCP detailing the common field in the windows.

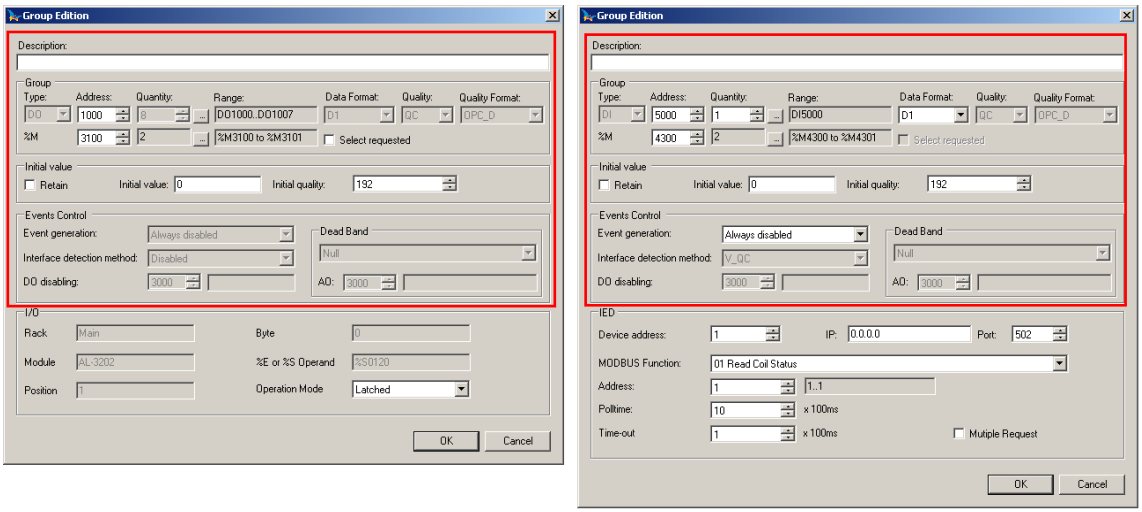


Figure 5-1. Comparing communication points group windows

The fields inside the marked area have the same behavior and function in any window for the configuration of communication point groups, and may have restrictions for the use of some configuration options. For instance, the options for **Data Format** for a DI type group are the values D1, D2 and D8. The window for internal or MODBUS communication points has all these options available for the **Data Format** field for a DI type group, however if it is a DNP3 master group, only the option D1 will be available.

Accessing the Points Allocation Bar

To help in the allocation of the address of the first point of the communication group, the Points Allocation Bar can be used, where it is possible to view the points that are already in use in other

communication Points Group an also which ones are free for allocation. To access the Points Allocation Bar, just click the button at the left side of quantity of points of the group.

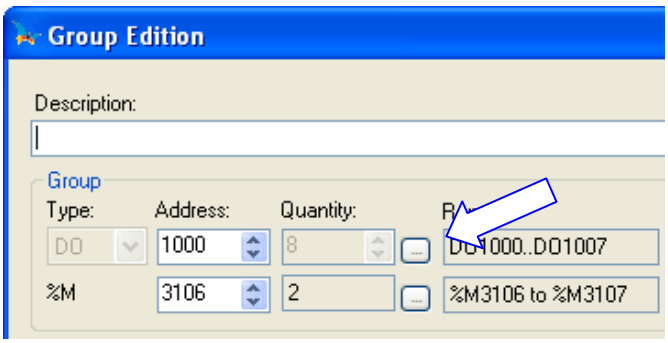


Figure 5-2. Accessing the points allocation bar

The points allocation bar shows an horizontal bar that represents the range of addresses where the group can be allocated. The limits of the addresses range are detailed in the upper right corner above the bar.

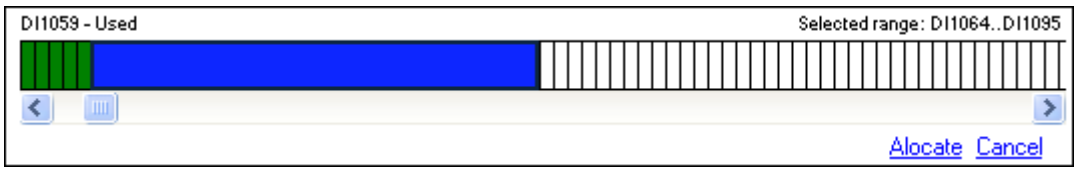


Figure 5-3. Points allocation bar

Each box in the bar represents a communication point. By passing the mouse over a point, its address is shown at the upper left corner. If the point is in use, the configuration of the group of which it belongs is shown. To select the new initial address of the group, just click on the desired point and then click **Allocate**.

The color of the operand represents its use. The following colors can be shown:

- White: the point is not in use
- Green: the point is in use by some group
- Blue: the point was selected for the group that is being edited
- Yellow: two or more groups are using the same point
- Red: the point is in use by the group that is being edited and also by another group

Accessing the Operands Allocation Bar

To help in allocation of operands of the groups of communication points, the operands allocation bar can be used, where it is possible to view the operands already in use for other groups of communication points and which are free to allocate. To access the map of the configured operands, just click the button next the number of operands of the group.

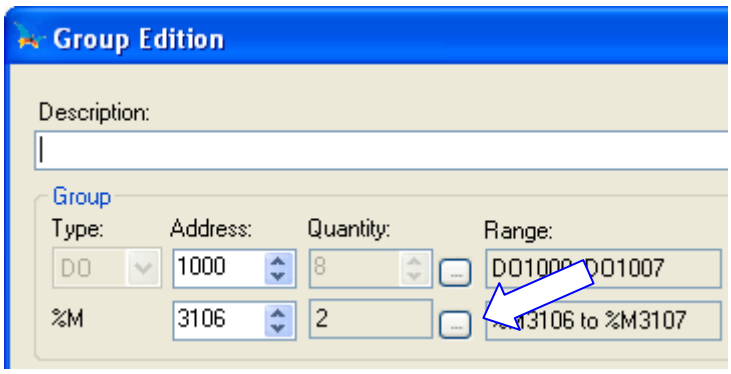


Figure 5-4. Accessing the operands allocation bar

The operands allocation bar shows an horizontal bar that represents the range of operands where the group can be allocated. The limits of the operands range are detailed in the upper right corner above the bar. This range is configured in the screen "Allocation Operands", as seen before.

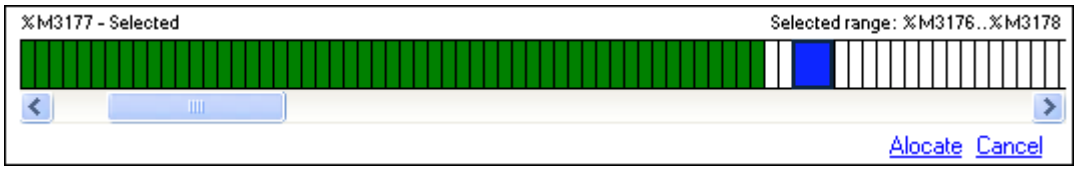


Figure 5-5. Operands allocation bar

Each box in the bar represents an operand. By passing the mouse over a operand, its value is shown at the upper left corner. If the operand is in use, the configuration of the group of which it belongs is also shown. To select the new initial operand of the group just click on the desired point and then click **Allocate**.

The color of the operand represents its use. The following colors can be shown:

- White: the point is not in use
- Green: the point is in use by some group
- Blue: the point was selected for the group that is being edited
- Yellow: two or more groups are using the same point
- Red: the point is in use by the group that is being edited and also by another group

6. Project Modules

MasterTool Hadron XE uses several types of project modules for several purposes, always with the objective of programming and/or configuring a AL-2004. Each of these types of modules has details, which make them different, and this will be seen later. However, many common features are demonstrated next.

Opening a Module

In order to a module to be viewed or edit, it must be open in the edition area. There are many ways to open a Module:

- Through the **Module/Open...** With this method the module opened does not necessarily belongs to the project and if this is the case, it will not belong to the project until the module is inserted in the project.
- Through the Treeview of the project by double-clicking on the desired module.
- Through the check window by double-clicking on the occurrence corresponding to an error. Therefore, the module that contains the error opens.

Saving a Module

A created or edited module must be saved to recover the information contained in it. Always you want to save a module, it will be saved in the same location from where it was opened or created. To save a module, do one of the following:

- Click the **Module/Save** menu
- Check Module or Check Project (in this case, saving all open modules)
- By closing an edited module window, but not saved, you will asked if you want to save it

Inserting Notes and Descriptions of Modules

Similar to project, to insert notes and descriptions to a module just open the module desired and, with it open, go to **Report/Modules Notes...** A window very similar to project notes opens.

Module Information in Disk

It is possible to verify information about a module in disk with no need to open it. There are two practical ways to do this:

- Click in **Module/Information...** and chose the module in the browser shown. This way you can visualize the information of a module, which belongs, or not to the project.
- Through the project Treeview, by clicking the corresponding module with the right button of the mouse and selecting the option **Information...**

Regardless the way used to ask for information about a module, the result is something similar to the screen shown below:

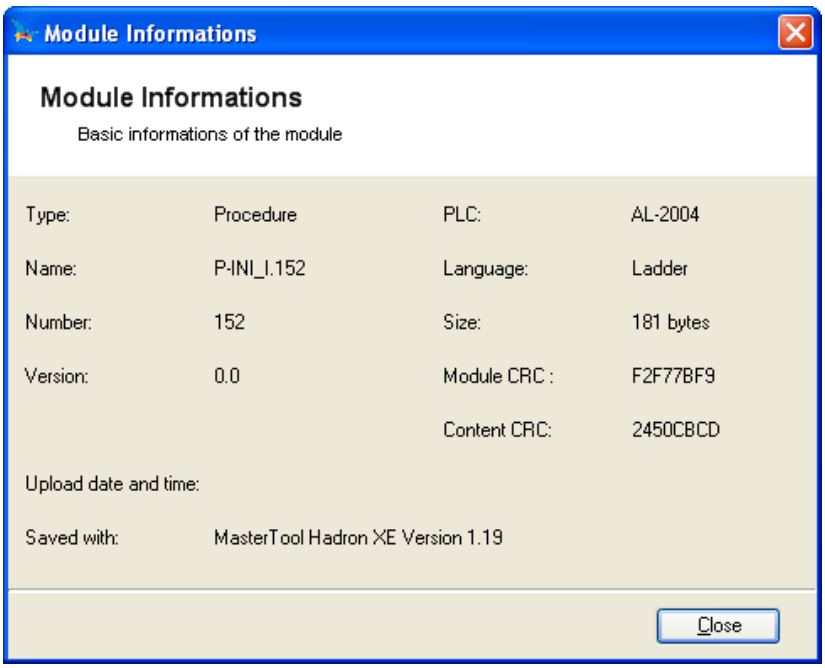


Figure 6-1. Information screen of a project module

Since the version 1.10 of the MasterTool Hadron XE this screen shows the *Content CRC*, which is composed only by the content of the respective module. It is also shown, in this screen, the *Module CRC* which incorporates all information of the modulo as **Date and Time of sending to PLC.**

Editing a Version of the Module

In order to keep a better organization of the versions of files and modules sent to a AL-2004, there is the module version, which can be edited. In the case of Function Module in assembly, such data cannot be changed.

To edit and view the version of a module, it must be open and then go to **Module/Version...** or right clicking on the module in Treeview. Therefore, the following window opens in order to editing or viewing of this parameter:

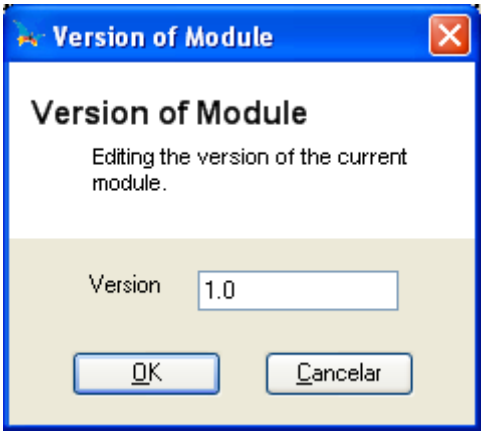


Figure 6-2. Editing the version of a module of the project

Configuration Module

The Configuration Mode, or simply the C Module, is the module that ensembles all the configurations needed for the use of a programming project. This module is created as soon as a new project is created and it cannot be removed from the project. In this module are the main

configurations of each CPU, as operands declaration, bus, networks, etc. The name of this module is in the following format: C-Config.000.

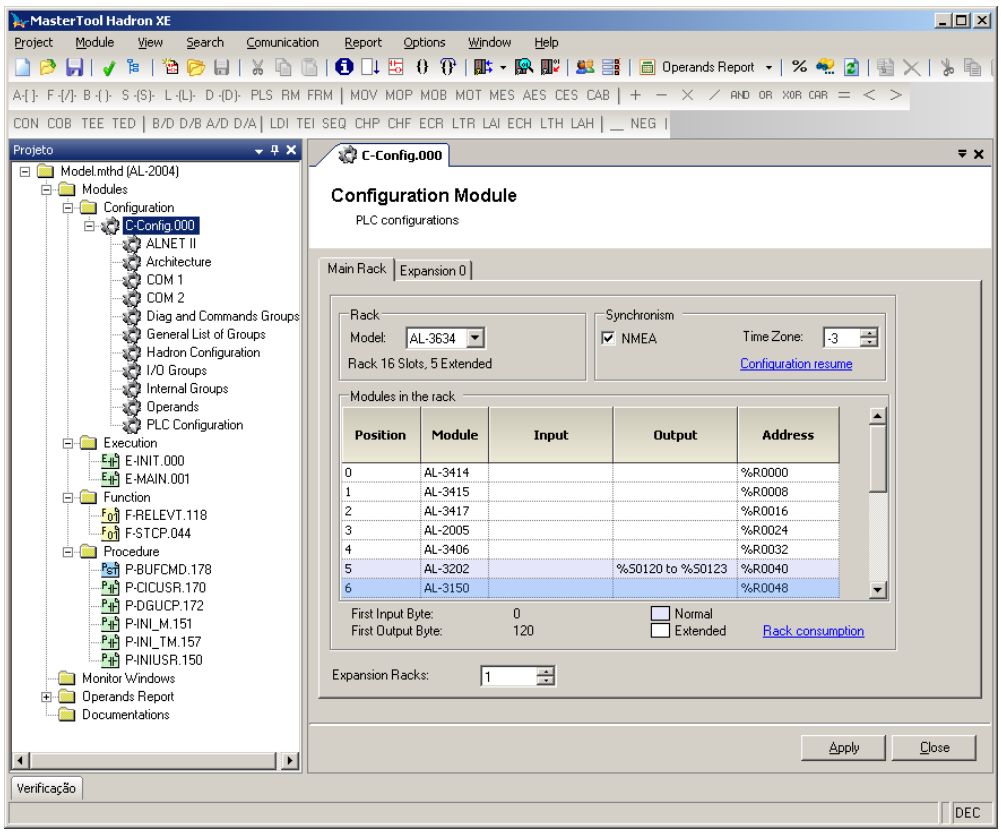


Figure 6-3. Configuration module editing window

Since the Configuration Module contains all information of configuration for a specific remote, its configurations have been subdivided and are viewed in the list in the left side of the window. Each one of these subdivisions is called Configuration Module Item. According to the selection in this list, the Configuration Module window changes, showing to which item it is related. Therefore, it is very easy to navigate through the information of the Configuration Module.

When a Configuration Module Item is modified, the **Apply** button becomes available. The configurations will be effective only after clicking this button, confirming the change. If any change has been made with error or by accident, just click the button **Close** and the window will keep the same values it has when was opened or when the button **Apply** was clicked for the last time.

By changing Configuration Module Item in the list, it must be effectuated a confirmation or not of the application of the changes before changing visualized Configuration Module Item. The change will take place only if the values are discarded or applied.

ATENTION: Since items of the configuration module are used to configure Hadron remote, the change of some options does not necessarily changes physically the file C-Config.000.

Architecture

This item allows configuring the architecture of Hadron remote. It is possible to insert and remove rack modules, configure the rack model, add or remove expansion racks and configure the synchronism method of the CPU clock by GPS in the CPU AL-2004.

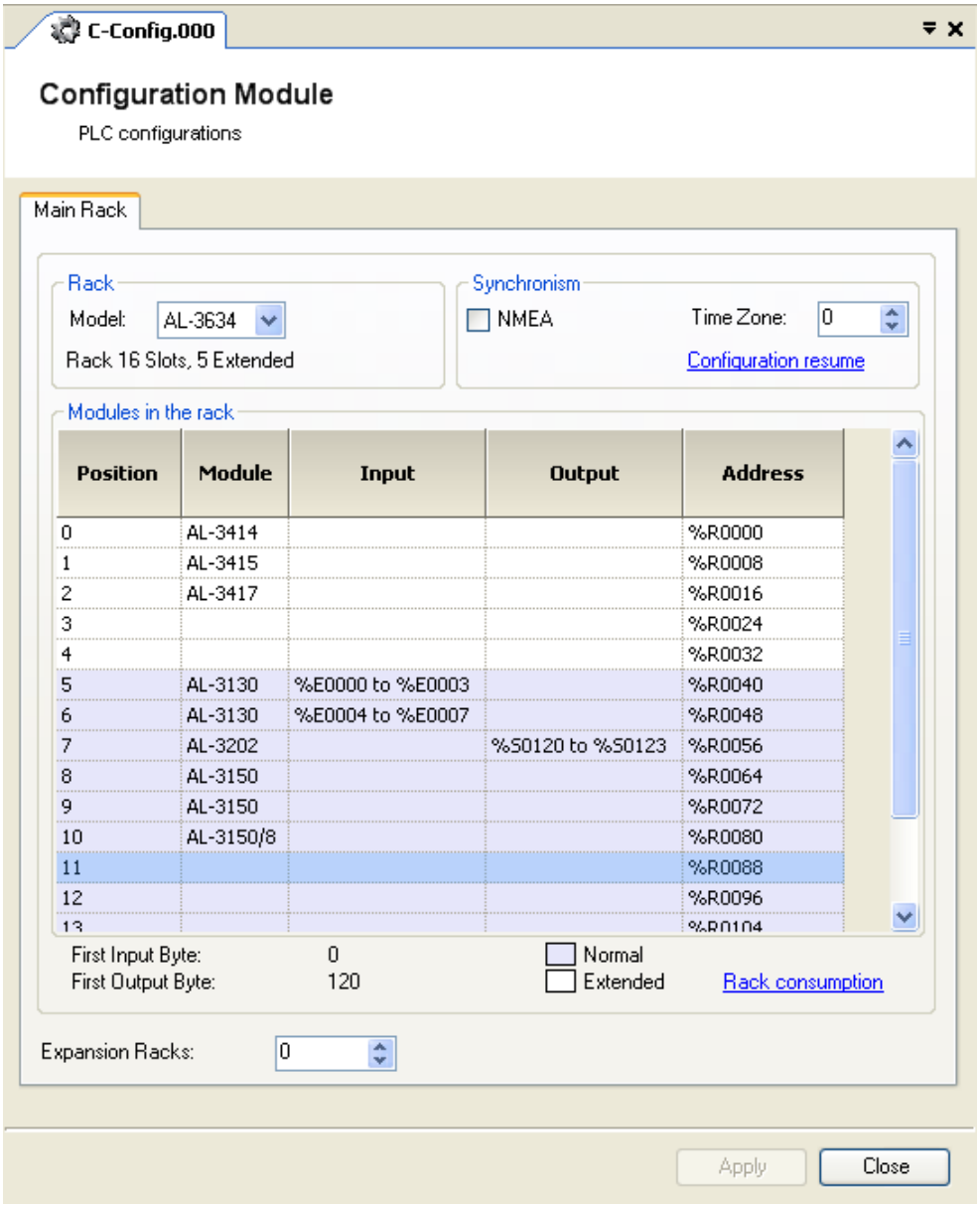


Figure 6-4. Architecture configuration window for the Hadron RTU

This module can be inserted by double-clicking on the desired position. It is also possible to insert a module using the right button of the mouse or pressing ENTER key over an empty position. The module to be inserted must be selected in the list of possible modules. Such list can vary depending on the position where the module is inserted, the rack model or if it is a main or expansion rack. The following figure shows the window with the possible modules to insert a determined selection.

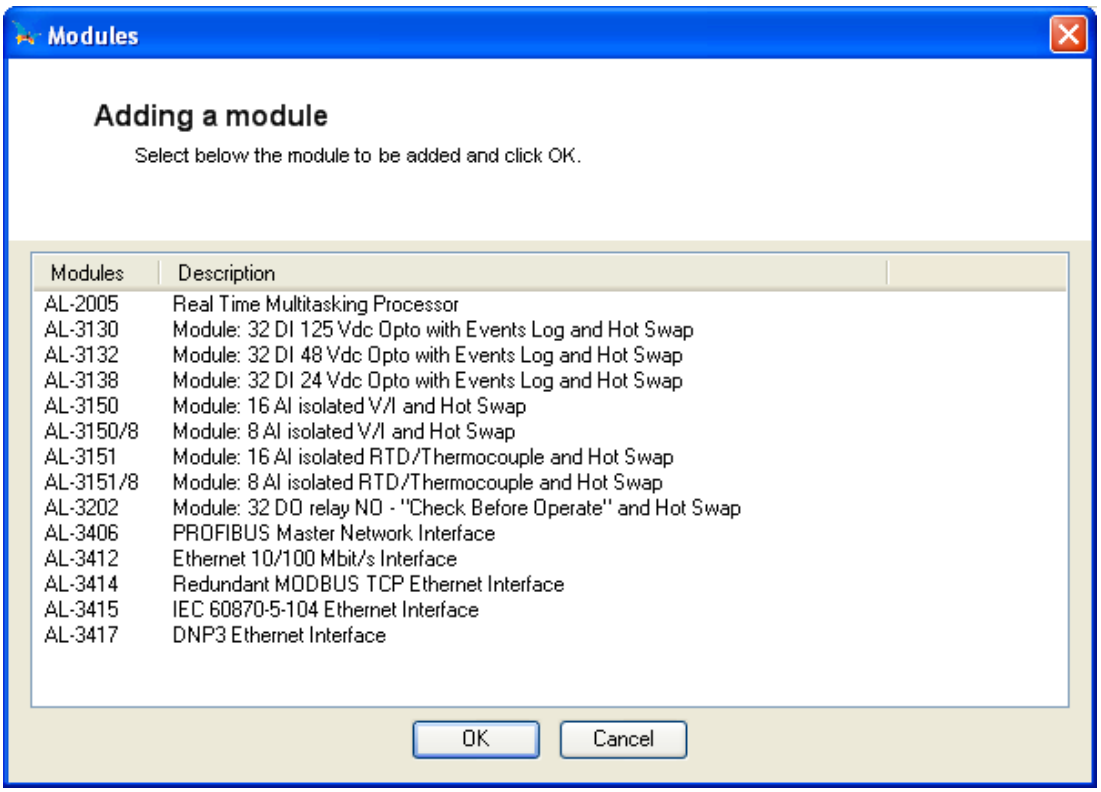


Figure 6-5. Adds a module in the rack

Some modules have an additional configuration, which must be performed for its correct performing. To configure the module just double-click on the module or press the ENTER key on the selected module. For further information about the configuration of each module, see *Module Configuration* chapter.

The modules are removed from the rack using de DEL key or through the context menu of the mouse.

ATENTION: When a module is removed from the rack, all its configuration is lost.

In the **Rack** field is possible to select the model of the rack used. The models differ from each other in amount of positions (slots) to insert modules and for positions for intelligent modules. To change to a rack with less positions it is necessary before removing the modules lied in the exceeding positions.

Within the group **Synchronism,** the field **NMEA** enables the synchronism of the RTU by any GPS system. It is also possible to use the field **Time Zone** to determine it, but its configuration is used only if NMEA synchronism is enabled. The GPS must be connected to CPU AL-2004 by means of the Synchronism Generator AL-1422. For further information about how to install the GPS in AL-2004, see AL-1422 *Technical Features.* For expansion racks there is, in addition, the possibility of enabling the synchronism via PROFIBUS protocol through the **PROFIBUS Net** checkbox.

In addition, more, within the group **Synchronism,** the button **Configuration Summary** shows where the sources of synchronism enabled for each rack are. The synchronism source of an AL-3415/17 module indicates that the interface also accepts protocol time synchronization commands, as shown on the following figure:

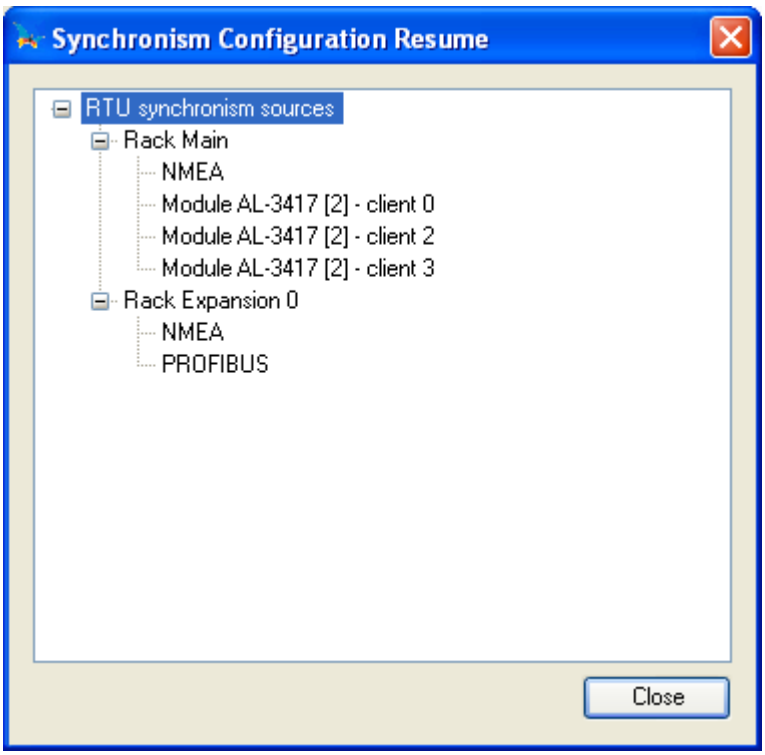


Figure 6-6. Synchronism configuration resume window

On the rack configuration window, there is the **Rack Consumption** button. Clicking on this button will open a window that shows the total current consumption on the rack power supply, informing the total current on each output of the power supply.

A larger amount of I/O Modules can be installed in the remote by the use of expansion racks. The amount of expansion racks is configured in **Amount of Extension Racks** field, up to four racks. For each of them it is possible to install more I/O modules the same way as in the main rack. The following figure illustrates the screen of an expansion rack configuration.

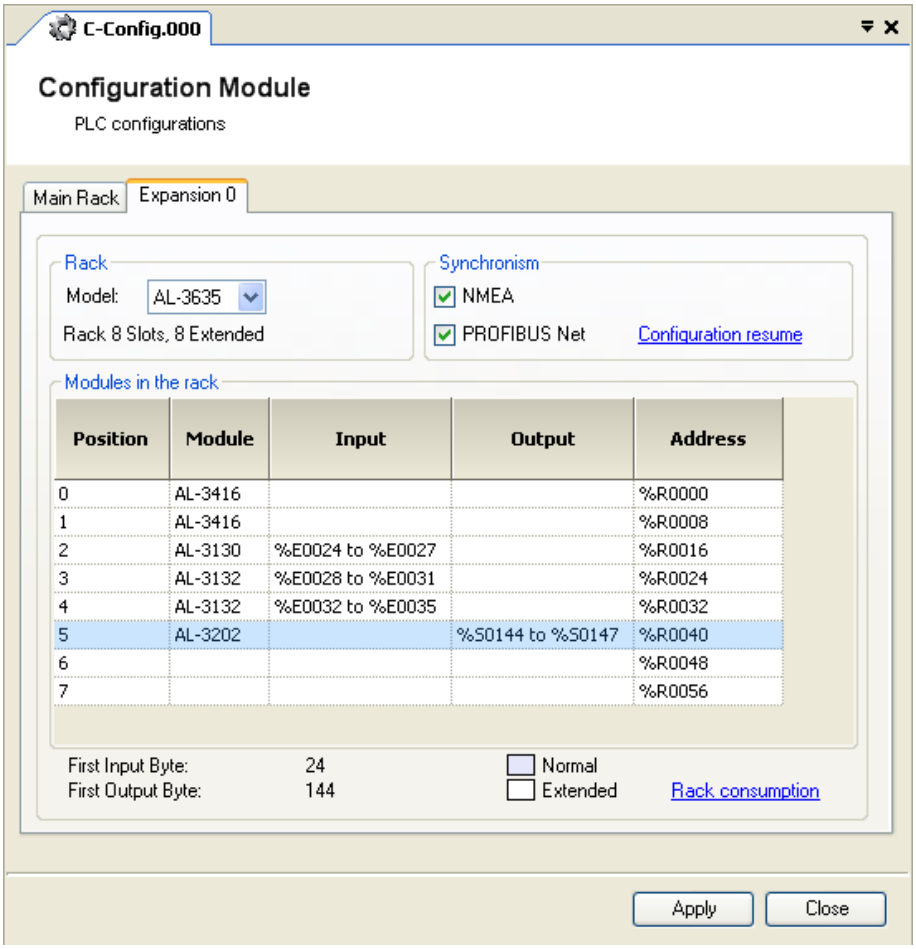


Figure 6-7. Expansion rack configuration window

For further information about rack models, I/O models, intelligent modules and expansion rack configuration see HADRON RTU HD3002 User Manual.

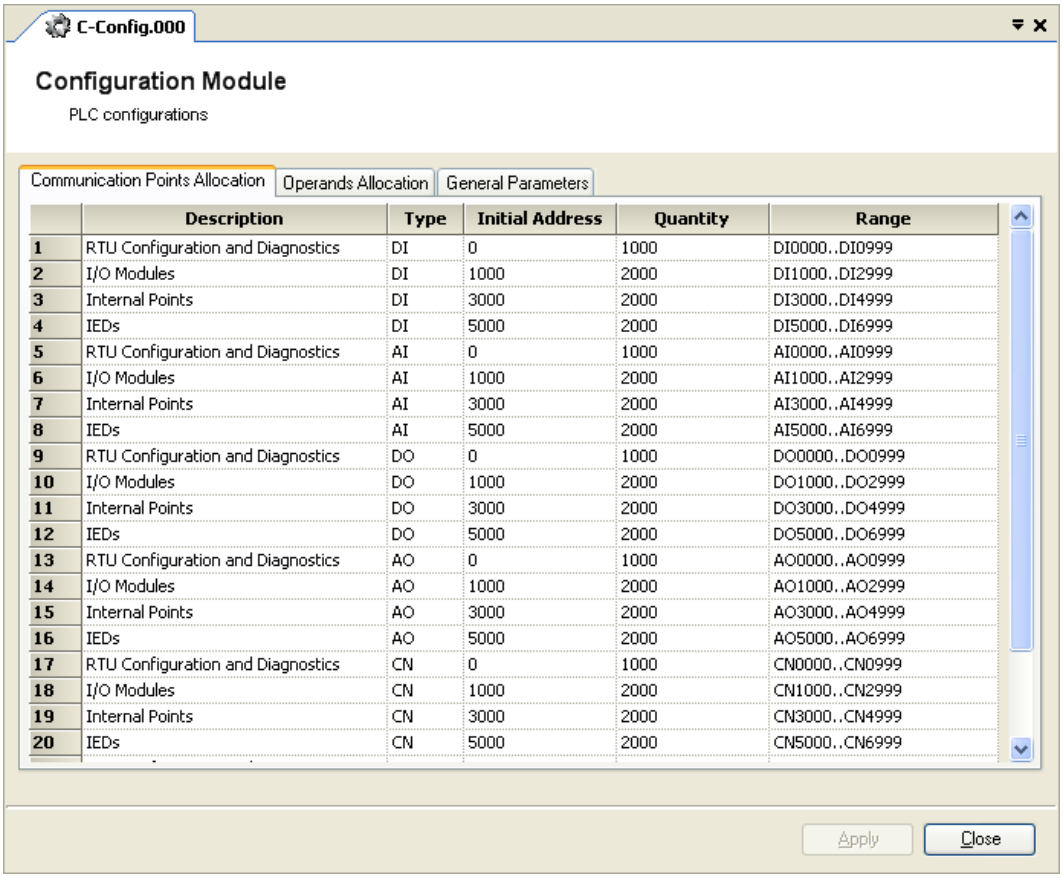
Hadron Configuration

This item allows performing general configurations in the project of the remote Hadron and changing the default project configurations. This item is subdivided in three parts: Communication Points Allocation, Operands Allocation and General Parameters.

Hadron Configuration – Allocation of Communication Points

This item allows changing the range of address of the communication points. The groups of communication points from a certain origin must be contained within such range.

The ranges must be edited by changing the amount of points, for this is the only editable column. The initial address of each range is automatically calculated from the previous range.



	Description	Type	Initial Address	Quantity	Range
1	RTU Configuration and Diagnostics	DI	0	1000	DI0000..DI0999
2	I/O Modules	DI	1000	2000	DI1000..DI2999
3	Internal Points	DI	3000	2000	DI3000..DI4999
4	IEDs	DI	5000	2000	DI5000..DI6999
5	RTU Configuration and Diagnostics	AI	0	1000	AI0000..AI0999
6	I/O Modules	AI	1000	2000	AI1000..AI2999
7	Internal Points	AI	3000	2000	AI3000..AI4999
8	IEDs	AI	5000	2000	AI5000..AI6999
9	RTU Configuration and Diagnostics	DO	0	1000	DO0000..DO0999
10	I/O Modules	DO	1000	2000	DO1000..DO2999
11	Internal Points	DO	3000	2000	DO3000..DO4999
12	IEDs	DO	5000	2000	DO5000..DO6999
13	RTU Configuration and Diagnostics	AO	0	1000	AO0000..AO0999
14	I/O Modules	AO	1000	2000	AO1000..AO2999
15	Internal Points	AO	3000	2000	AO3000..AO4999
16	IEDs	AO	5000	2000	AO5000..AO6999
17	RTU Configuration and Diagnostics	CN	0	1000	CN0000..CN0999
18	I/O Modules	CN	1000	2000	CN1000..CN2999
19	Internal Points	CN	3000	2000	CN3000..CN4999
20	IEDs	CN	5000	2000	CN5000..CN6999

Figure 6-8. Allocation of communication points window

ATENTION:
Changes in the address of the ranges does not change the group of configured points. This operation must be done by the user. The exception is for "RTU diagnostics and configuration" points, which are automatically changed by MasterTool Hadron XE. Groups declared out-of-range cause error in the verification.

Hadron Configuration – Allocation of Operands

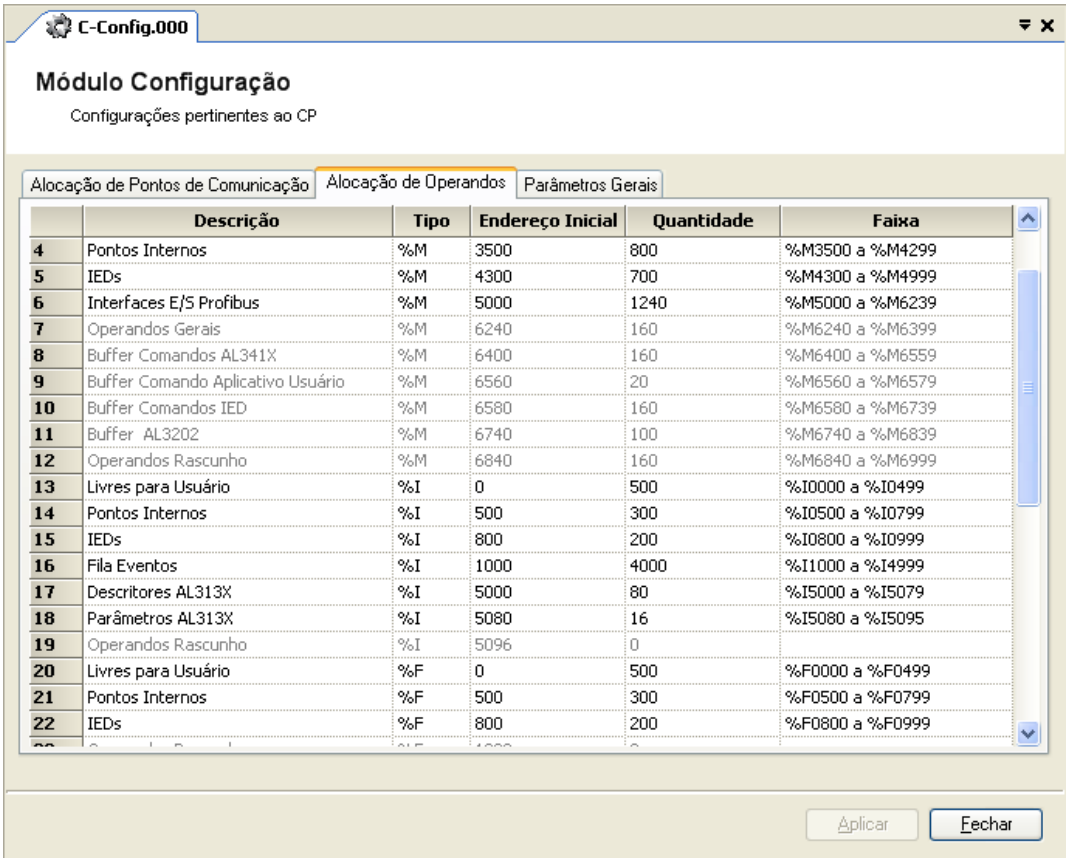
This item allows modifying the operands range used by the points groups and by the Ladder generation.

The operands range for the points groups delimit the operands, which can be used to configure the communication groups. The changes in the ranges does not change the groups already sent, such alteration must be done by the user manually. The operands configured in groups out-of-range cause errors in the project verification.

Operands range for Ladder generation instructs the generator which operands can be used. The alterations in ranges will be applied only in the next generation. Only in generated modules, the user programs, which use operands, will not be changed.

The ranges must be edited changing the operands amount. The initial address of each range is automatically calculated from the previous range.

The ranges in grey color are not editable by user.



	Descrição	Tipo	Endereço Inicial	Quantidade	Faixa
4	Pontos Internos	%M	3500	800	%M3500 a %M4299
5	IEDs	%M	4300	700	%M4300 a %M4999
6	Interfaces E/S Profibus	%M	5000	1240	%M5000 a %M6239
7	Operandos Gerais	%M	6240	160	%M6240 a %M6399
8	Buffer Comandos AL341X	%M	6400	160	%M6400 a %M6559
9	Buffer Comando Aplicativo Usuário	%M	6560	20	%M6560 a %M6579
10	Buffer Comandos IED	%M	6580	160	%M6580 a %M6739
11	Buffer AL3202	%M	6740	100	%M6740 a %M6839
12	Operandos Rascunho	%M	6840	160	%M6840 a %M6999
13	Livres para Usuário	%I	0	500	%I0000 a %I0499
14	Pontos Internos	%I	500	300	%I0500 a %I0799
15	IEDs	%I	800	200	%I0800 a %I0999
16	Fila Eventos	%I	1000	4000	%I1000 a %I4999
17	Descritores AL313X	%I	5000	80	%I5000 a %I5079
18	Parâmetros AL313X	%I	5080	16	%I5080 a %I5095
19	Operandos Rascunho	%I	5096	0	
20	Livres para Usuário	%F	0	500	%F0000 a %F0499
21	Pontos Internos	%F	500	300	%F0500 a %F0799
22	IEDs	%F	800	200	%F0800 a %F0999

Figure 6-9. Operands allocation window

Hadron Configuration – General Parameters

This item configures several RTU parameters, as shown in the following table:

Parameters	Default	Values	Notes
Buffered commands time-out for AL-3202 modules	5000	100 to 10000	Time that the P-BUFCMD.178 module waits for finishing the buffered commands addressed to AL-3202 module points. If the command is not finished within this time, the requesting client will receive an error. Unit: ms.
Buffered commands time-out for DNP3 IEDs	5000	100 to 10000	Time that the P-BUFCMD.178 module waits for finishing the buffered commands addressed to DNP3 IEDs points. If the command is not finished within this time, the requesting client will receive an error. Unit: ms.
Buffered commands time-out for users	1000	100 to 10000	Time that the P-BUFCMD.178 module waits for finishing the buffered commands addressed to user points. If the command is not finished within this time, the requesting client will receive an error. Unit: ms.
Selection time-out for AL-3202 modules	5000	100 to 25500	Time that the AL-3202 module keeps the point selected, waiting for the operation command. When this time is over, the point returns to the un-selected state.

Table 6-1. General parameters configuration

ATTENTION: Beside the previously described time-out parameters, there is another buffered commands time-out parameter that is configured on each AL-3415/17 interface. For the correct operation of the buffered commands, the user must set these parameters properly. The time-out parameters of AL-3202 modules, DNP3 IEDs and user must be lower than the ones set on the communication interfaces, which also must be lower than the time-out parameter set on the IEC-104 and DNP3 clients.

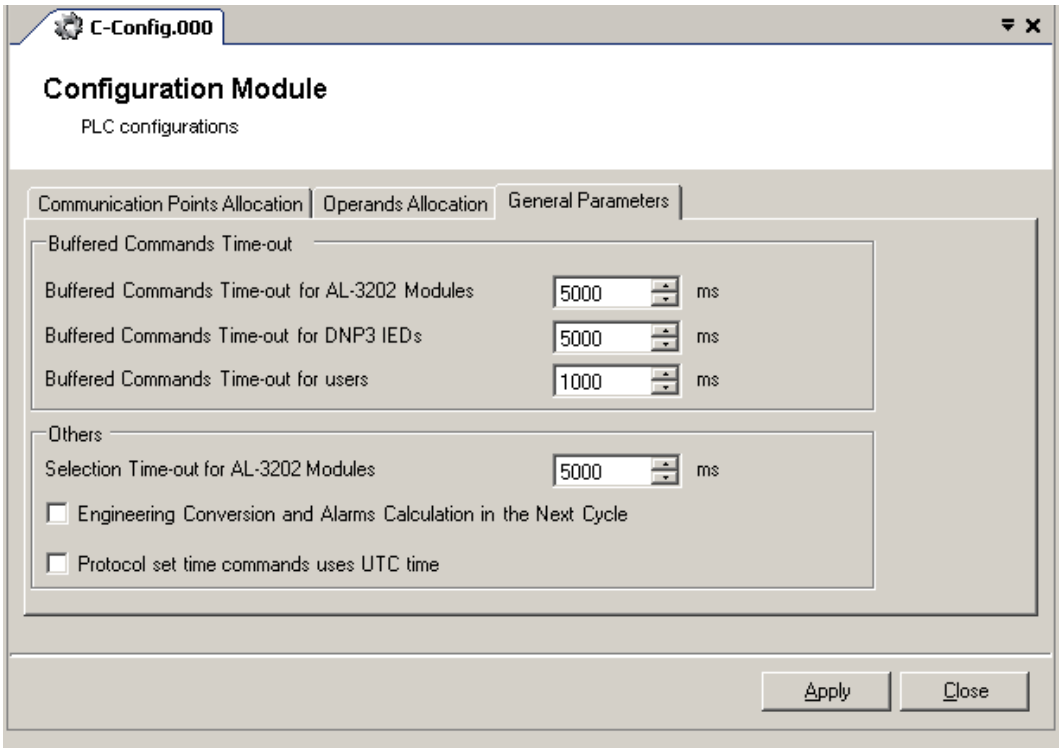


Figure 6-10. General parameters window

Engineering Conversion and Alarms Calculation in the Next Cycle: Enables the tasks of Engineering Conversion and Alarms Calculation to be executed in parallel with the user application. This option reduces the execution cycle time of the AL-2004 CPU. On the other side, the operands on the CPU memory will be updated only in the next cycle after the calculation, causing a 1 ladder cycle delay to the operands update.

Protocol set time commands uses UTC time: when this option is checked, it means that the time received on the protocol command will be on UTC standard, and then the time zone configured for the RTU will be summed to the time received by the protocol command. When this option is un-checked, the time that will be set is exactly the one received by the protocol command.

For more information about the configuration of the general parameters, see the HADRON RTU – HD3002 User Manual.

Diagnostics and Commands Groups

This item allows visualizing the RTU groups of diagnostics and commands points. Such groups are not configurable and are generated at each new generation of the application.

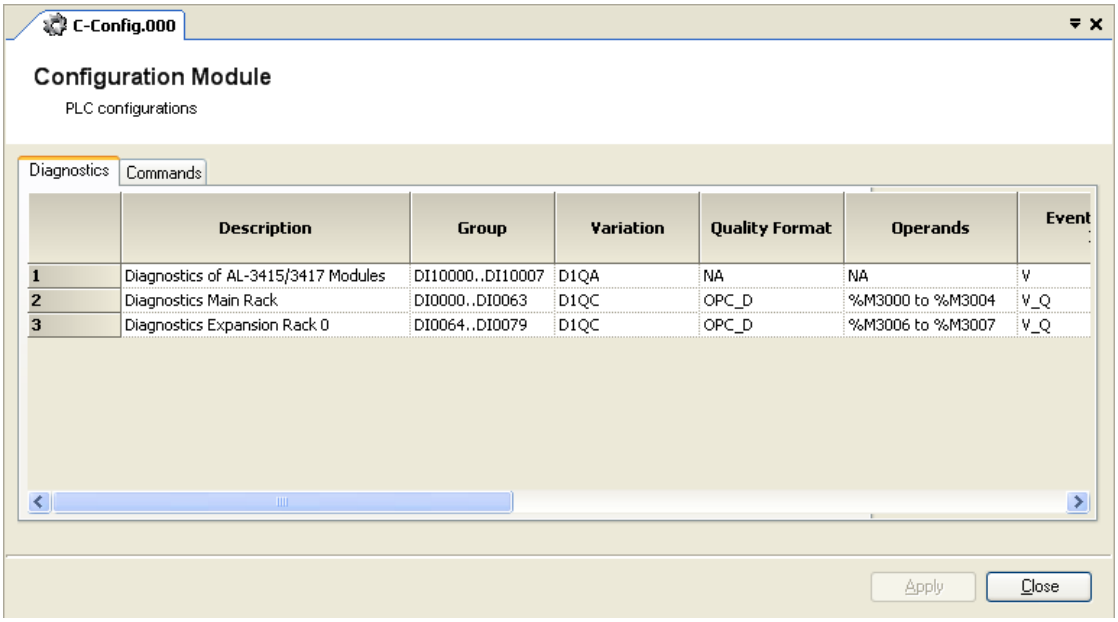


Figure 6-11. Configuration window for the diagnostics and commands groups

ATENTION:
The fact that a group of points is automatically configured does not implicate in being automatically mapped for a IEC104/DNP3 client. The mapping involves to define for which IEC/DNP clients, the information of these groups is pertinent, as well as which address range to be used.

ATENTION:
Despite these groups are not being configured, the address range of the operands can be indirectly changed through the tab Operands Allocation in Hadron Configuration window.

I/O Groups

This item allows configuring the groups or points related to the I/O modules installed in the main and in the extension racks. The groups are added and removed automatically when the project architecture is changed.

To edit a group, it is enough to select the desired group and click "Edit" button.

The amount of groups varies in accordance with the type of the module as shown in the following table:

Module	Description	Groups per Module	Points per group
AL-3130 **AL-3132** **AL-3138**	Digital Inputs	1	32
AL-3150 **AL-3151**	Analog Inputs	1	16
AL-3150/8 **AL-3151/8**	Analog Inputs	1	8
AL-3202	Digital Outputs	4	Latched Mode: 8 points per group Trip/Close Mode: 4 points per group

Table 6-2. Amount of groups vs module type

According to the next figure, each module will be present in the tab corresponding to its functionality.

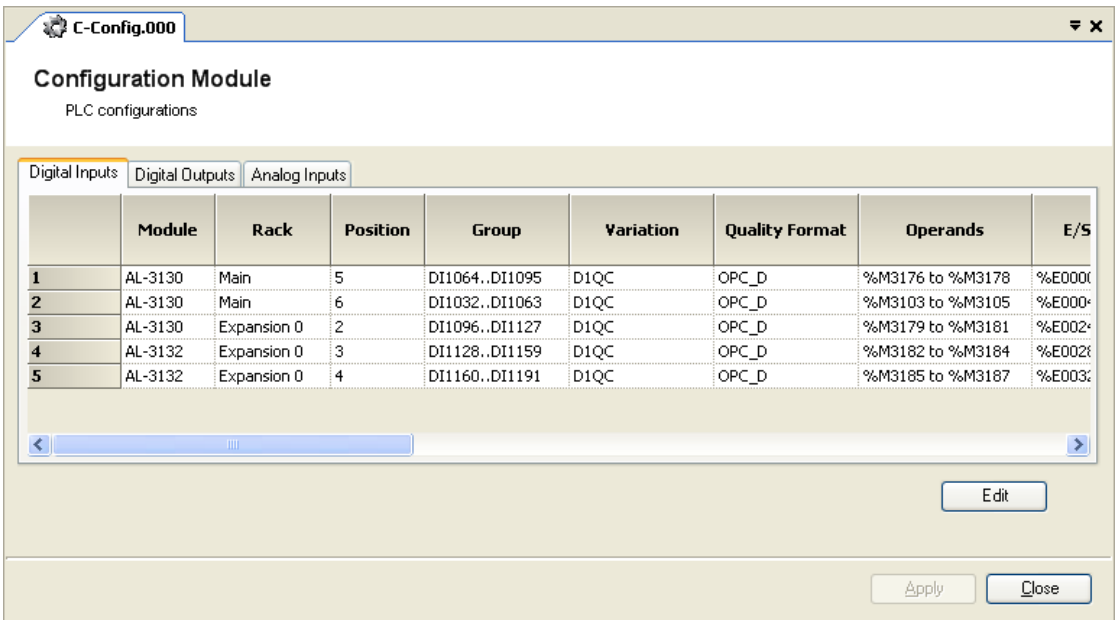


Figure 6-12. Configuration window for I/O groups

Internal Groups

This item allows including, editing our remove a group of internal communications points. The groups are divided in eight categories, each of them showed in a separate table. The categories of internal groups are:

- Digital Inputs
- Alarm Digital Inputs
- Digital Outputs
- Analog Inputs
- Analog Inputs with engineering conversion
- Analog Outputs
- Counters
- Frozen counters

A new group of communication points can be included by selecting the desired category and clicking in Include. A new window opens to configure the parameters of this group of points. To edit or exclude a group it is necessary to select the desired group with the mouse and then click the desired action button.

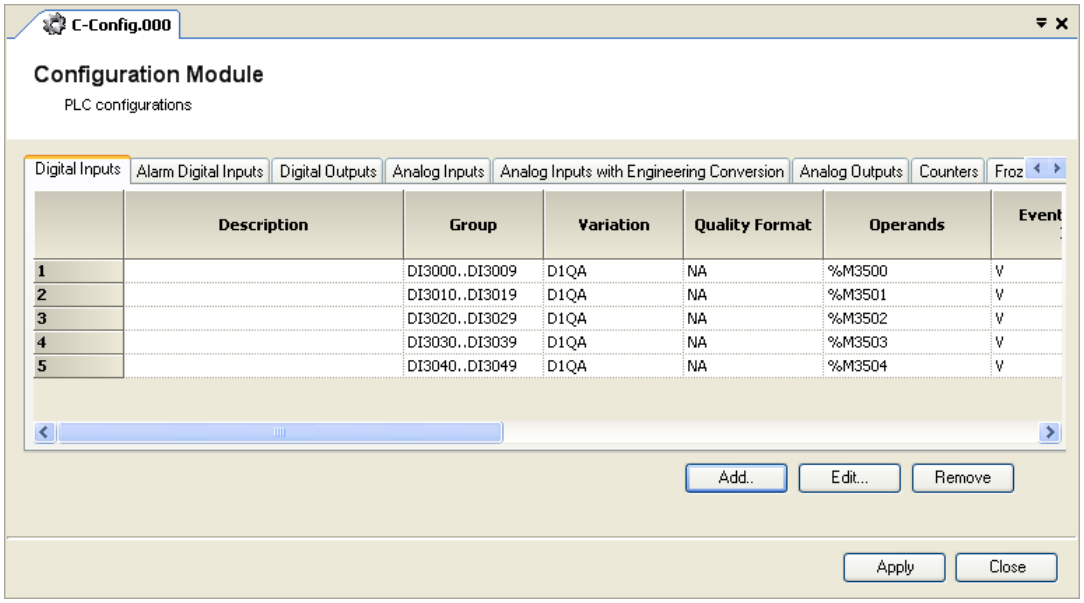


Figure 6-13. Configuration window for internal groups

For further information about the configuration of groups of communication points see HADRON RTU – HD3002 User Manual.

General List of Point Groups

This item allows visualizing all points declared in the RTU, and is useful to perform a general visualization on the groups of points configured.

The item is divided in two parts. In the upper one, all groups configured in the RTU are listed. When one of such groups is selected; in lower part, the configuration of each point of the group is shown. There, you find details about the operand ,where it is stored, its value and its quality, what are the event disabling DO point and the AO for dead band.

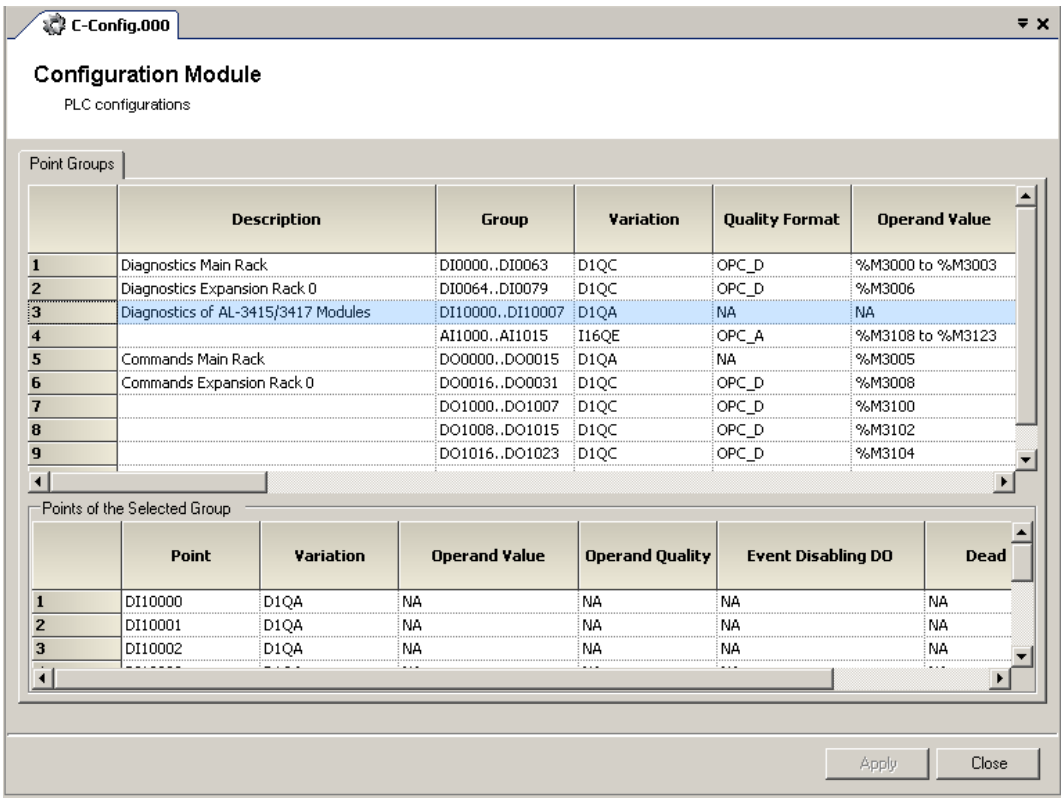


Figure 6-14. General window of groups and points

ATTENTION: Each module AL-3415 or AL-3417 have a 8 point group for internal diagnostics, starting from the address 10000, and each group is visible only for its own module. The General List of Point Groups shows only one group representing all diagnostics groups of the AL-3415/17 modules. The point range starting from 10000 is reserved exclusively for the internal points of the AL-3415/17 interfaces. This way, the diagnostics group is always showed, even when there are no interfaces on the architecture.

Operands

This configuration module item shows the amount of operands used along the project. The operands declaration is divided in three groups: Simple Operands, Retentive Operands and Table Operands. This idea becomes clear by observing next figure:

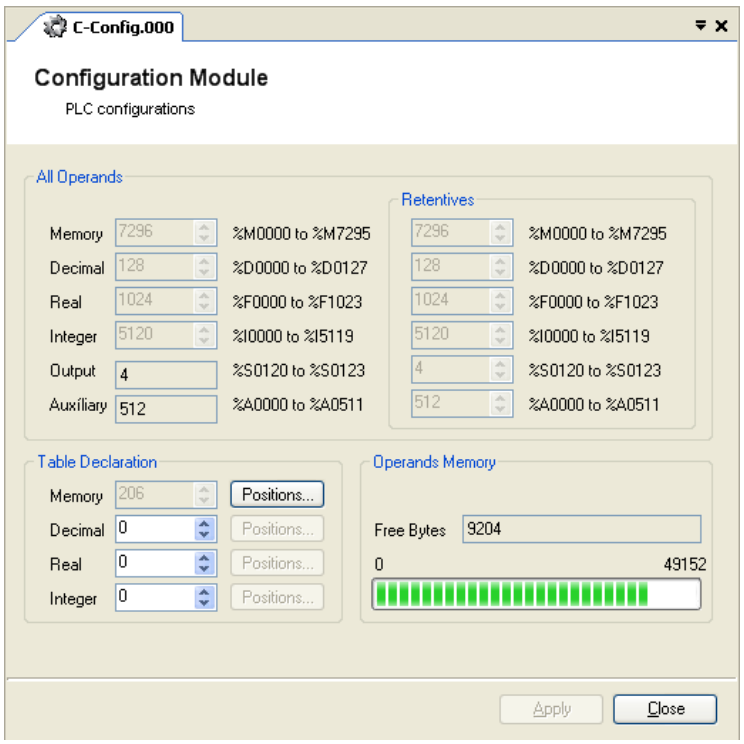


Figure 6-15. Operands Declaration

It is possible to edit table operands of memory (%TM), decimal (%TD), real (%TF) and integer (%TI) types. The edition of the simple operands is performed in the item Hadron Configuration / Operands Allocation; in this item, it is only possible to visualize the totality of operands declared.

ATENTION: In Hadron HD 3002 RTU, all simple operands of the CPU AL2004 are retentive.

In the lower right corner, it is shown the status of occupation of memory destined to the operands declaration, in order to illustrate the use of the memory.

The operands declaration table proceed in two steps: the first, in Table Declaration, the amount of tables of each type that will be used must be informed; the second step consists in determining the amount of positions that each table has and this is done by clicking the button **Positions…**, an so a screen opens as showed next:

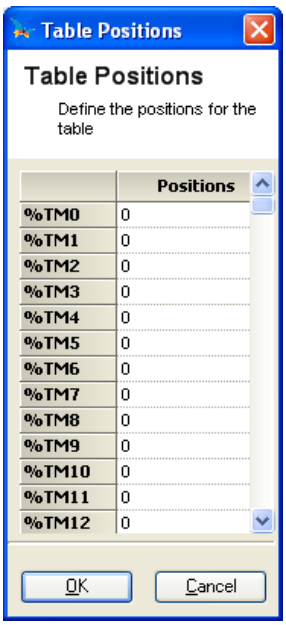


Figure 6-16. Amount declaration of table positions

ATENTION: The amount of table of memory type (%T/m) is configured in Configuration Module item: Hadron Configuration / Operands Allocation.

COM 1 / ALNET I

All PLCs has at least one serial channel with which it can communicate with the MasterTool Hadron XE supervisory and any other ALNET I Master device. The configuration of the parameters of such serial channels is done in the following window:

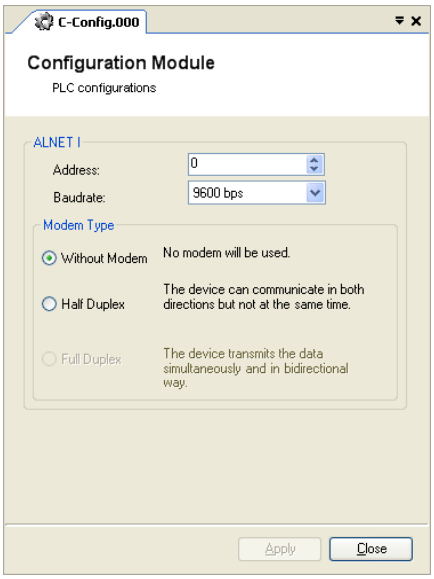


Figure 6-17. Configuring serial channel with ALNET I protocol

In this window, for example, the serial port speed can be configured, as well as the Station Address.

ALNET II

For CPU, which supports ALNET II, this Configuration Module Item provides the CPU configuration in this network, in a clear way. In this window, you can configure time-out times, communication speed, redundancy, etc. The following figure better illustrates this idea:

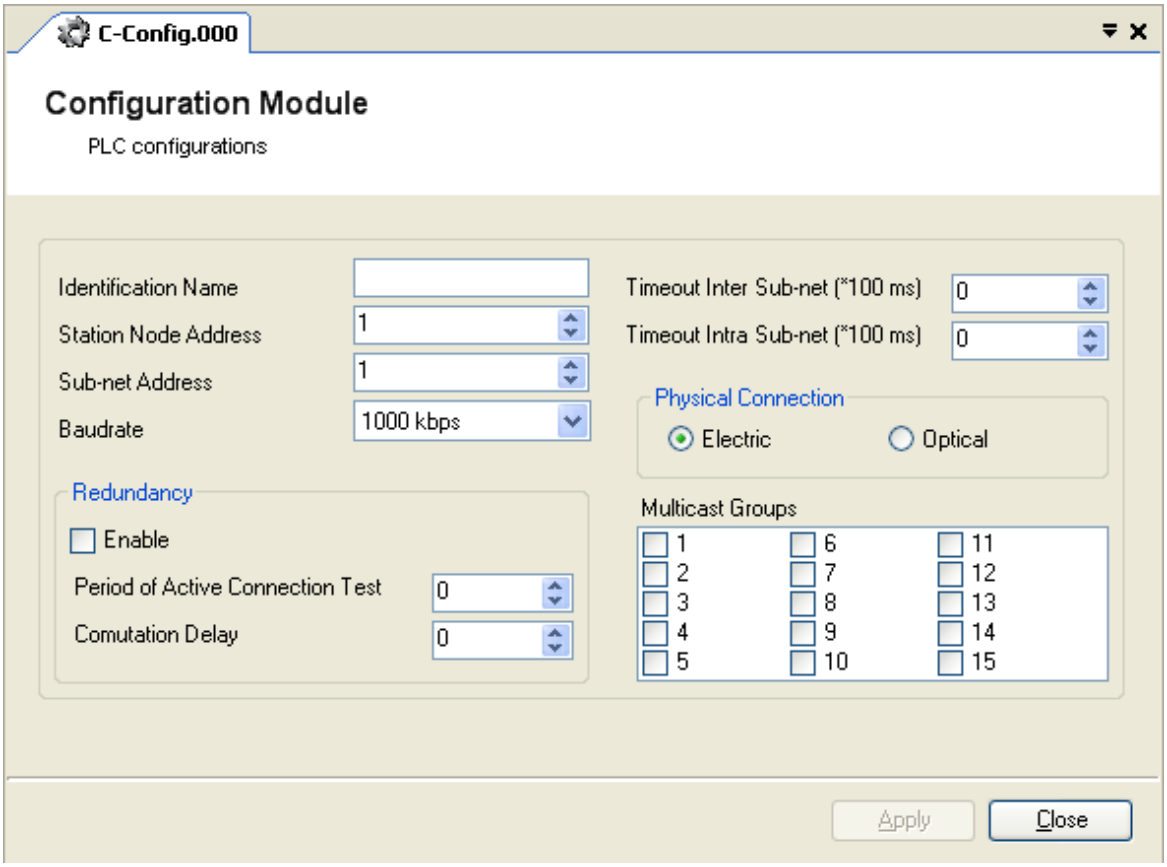


Figure 6-18. Configuration of ALNET II network

CPU Configurations

This configuration module item has as an objective to proceed to a quick visualization and configuration of the protocols used by CPU AL-2004 in its serial channels (COMs). The window basically shows a CPU picture in which, using the mouse, you can click on the serial channel of the picture that will be changed to the Configuration Module Item that corresponds to the selected COM as illustrated the following figure:

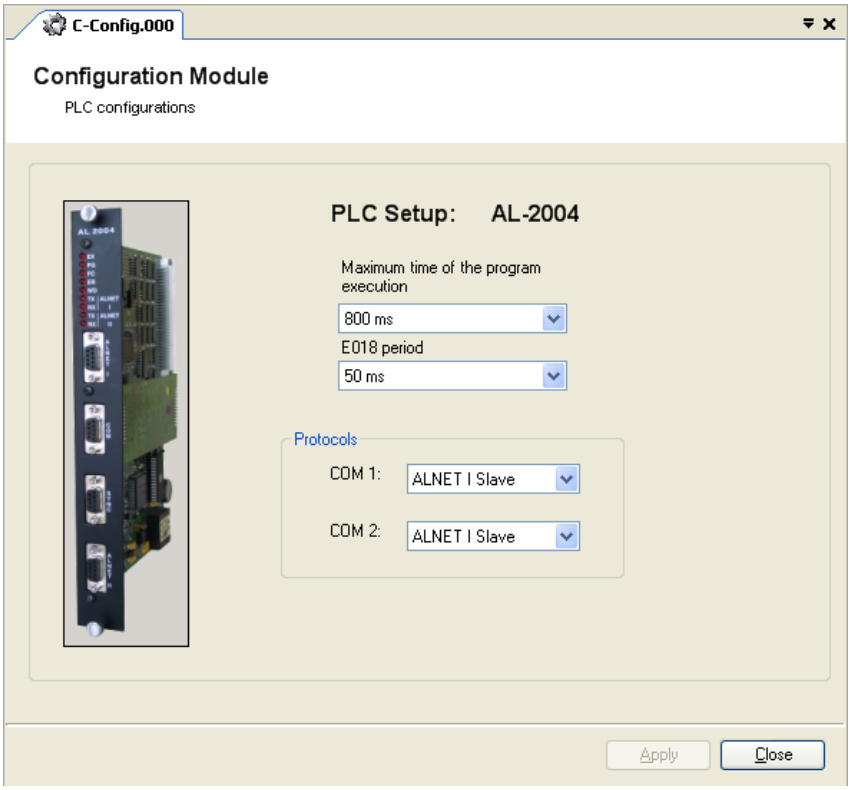


Figure 6-19. Configuring serial channels of the AL-2004

There also more detailed configurations as Maximum Time of Configuration of the Program, Starting Period of E-*.018 Module (Interruption Module) and the COMs protocols.

ATTENTION: **- E-*.018:** runs cyclically in a period set by the user in C-Config.000 configuration module and it can assume values between 50ms, 25ms, 10ms, 5ms, 3.125ms, 2,5ms, 1.25ms or 0.625ms.
- Maximum Time for the Configuration of the Program: is the maximum possible time for running a complete cycle of the application program in the configurable programmable controller from 100ms to 800ms. I.e. the complete execution of a scan of the E001 module cannot be longer than the value configured, including callings for P and F modules and driving of the E018 time interruption module. The executive software performs a continuous verification in the cycle time, automatically passing to the error status if such limit is overcome.

Extended Configuration Module

An extended configuration module is used to give additional configurations to the Hadron RTU. There are three types of extended configuration modules, as shown in the following table:

Extended Configuration Module	Function
C.003	To configure AL-3406 modules used for communication with the expansion racks. This module is automatically generated by MasterTool Hadron XE when at least one configured expansion rack exists.
C.004 **C.005**	Modules for free use by the user to configure PROFIBUS network manually.
C.006 **C.007** **C.008**	Configuration modules of AL-3415/17 modules. There are no relation between the amount of configuration modules and the amount of AL-3415/17 modules configured in the main rack.

Extended Configuration Module	Function
C.009	

Table 6-3. Extended configuration module

Extended Configuration Module – PROFIBUS AL-3406

In MasterTool Hadron XE, we have the Extended Configuration Module window, where it is possible to edit and view configurations of manually configured PROFIBUS networks. For this, we must insert the file .PB in the project using the **Import .PB file…** Such files with .PB extensions are generated through the ProfiTool application®**.** For the PROFIBUS networks that are created automatically by MasterTool Hadron XE, the edition is not possible.

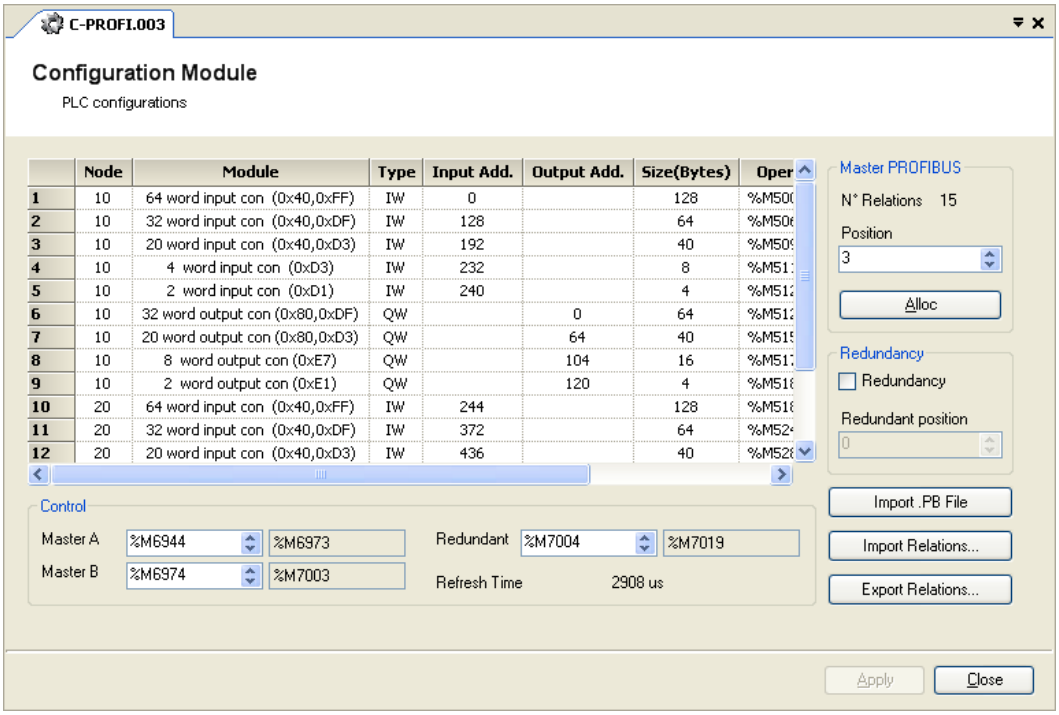


Figure 6-20. PROFIBUS extended configuration module

Details of the Configuration of the AL-3406 PROFIBUS Module

- **Diagnostics:** are configurable operands used to make the diagnosis of the interface and its related modules.
    - **Master A**: Range of memory operands (%M0 which receives information of the Master A diagnostics of the PROFIBUS Network.
    - **Master B**: Range of memory operands (%M0 that receives information of the Master B diagnostics of the PROFIBUS Network.
    - **Redundant**: Range of the memory operands (%M) that inform the status of the redundancy.
- **Redundancy:** Enables or not the option of redundancy

After importing a .PB file to the project, it will be possible to edit the fields in the grid.

Import/Export

The button **Export Relations** is used to export the configurations of the relations for a *.CSV file, which can be open in Microsoft® Excel. This can be used to make a backup of the relations configurations

Button **Import Relations** works in a similar way, importing *.CSV file to the configurations of relations PROFIBUS.

ATTENTION:
- The maximum number of relations, which can be allocated, is 2000.
- For more details on how to configure one of the PROFIBUS module, see the user manual of the respective equipment.

Program Module

The Program Module is a module that has routines developed to be executed in a AL-2004. The name of a Program module always has one of the following formats:

- **F-*.*:** Function Module
- **P-*.*:** Procedure Module
- **E-*.*:** Execution Module

There are two languages for developing the Program Modules: Ladder and Structure Text (ST).

Ladder language is a graphic programming language that reminds the diagrams of electrical panels used in industry before the entry of the CLP. This language is well accepted in the market due to its simplicity for programming and the use of almost the same symbols of the diagram of relays. For more details about this language, see the MasterTool XE Ladder Programming Manual.

Structure Text programming language, or simply ST, is a text language that join the classical programming elements to develop algorithms. For more details, see the MasterTool XE ST Programming Manual.

Both languages can be used simultaneously in the project, but they cannot be put together in a same Program Module.

Ladder Program Module

The Ladder Program Module is represented in MasterTool Hadron XE by a graphic editor, in which there are many concepts determined in MasterTool Ladder Programming Manual. This editor is divided by logics, as shown in the following figure:

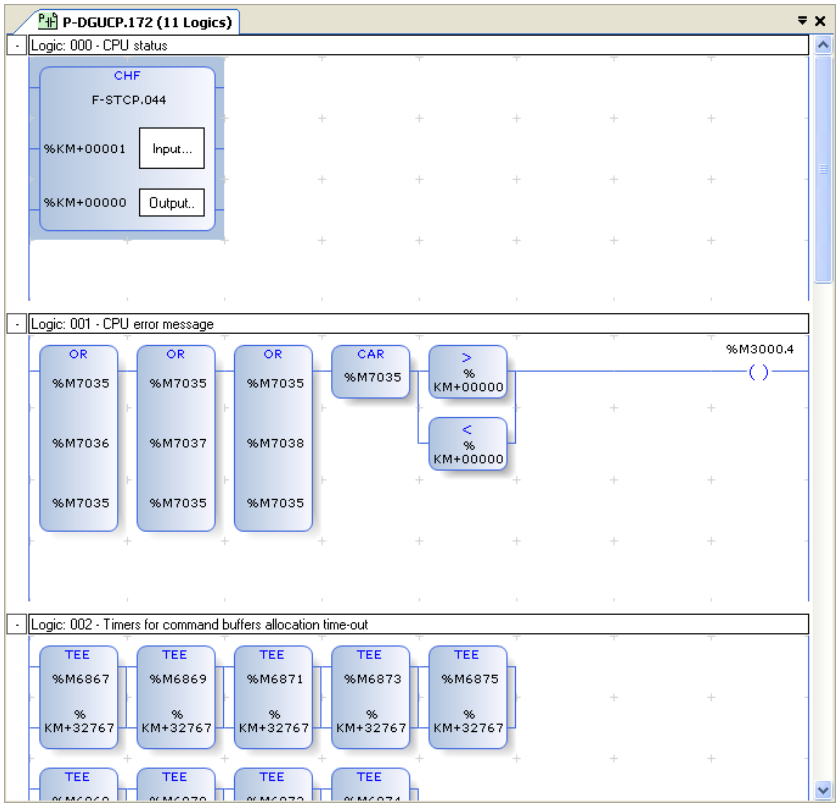


Figure 6-21. Window for editing the ladder program module

As a help for the language use, there is a left column where there is a button to minimize and maximize a logic.

Searching for a certain Logic

To roll the view window of a Ladder program module for a specific logic, just go to the **Search/Logics…** menu, with the program module open and inform the logic in the following window:

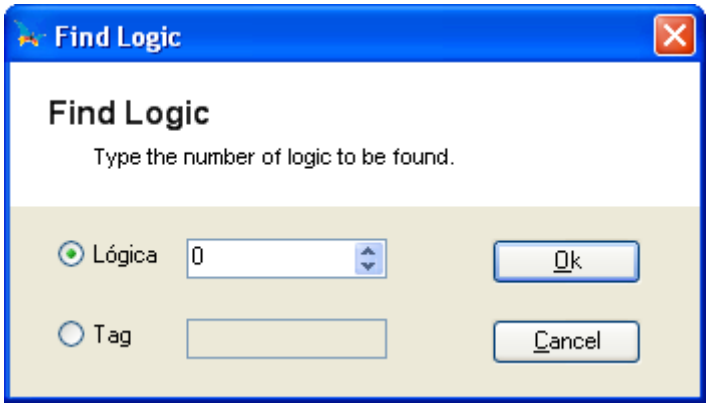


Figure 6-22. Searching for a logic

Inserting an Instruction

The procedure to insert an instruction is the same for all them. For instructions that have operands or any other parameter to be informed, a window is showed for the editing of them. This window reflects the picture of the instruction box, as shown in the following figure:

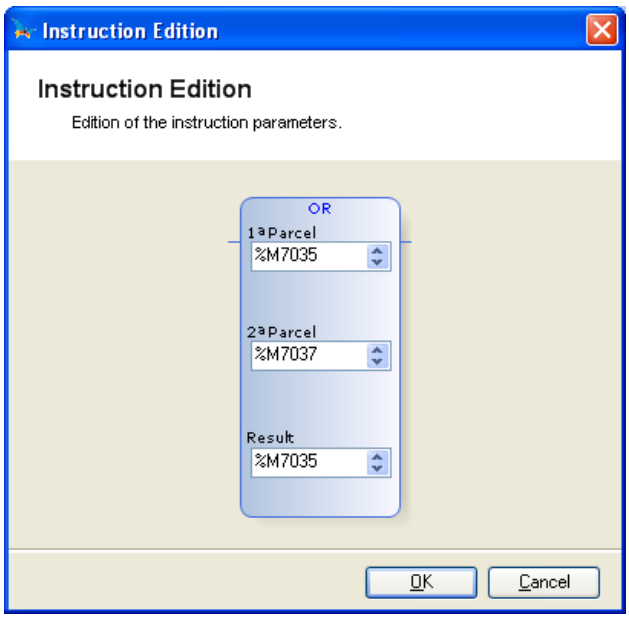


Figure 6-23. Inserting an instruction in ladder program module

To insert an instruction with the program module open, follow the next steps:

1. Position the logic cursor in the cell where the instruction has to be inserted;
2. Select in the instructions menu the group of instructions desired and select the instruction in the group or select the corresponding button in the tool bar. If it is not possible to insert an instruction due to the restrictions of the cell, the menu item and the button in the tool bar become disabled;
3. Edit the operands related to the selected instruction indicating the address or the tag of the operand.

Excluding an Instruction

The exclusion of an instruction is easily done, for you just have to select the instruction and press **DEL** key or, in the **Instruction/Remove** menu.

Editing an Instruction

To edit an instruction just double-click on the instruction you desire to edit. The same window used for inserting instructions opens, but with the current values in the corresponding fields.

ATTENTION: Also, the instruction can be replaced but keeping the operand using the shortcut CTRL+T. The instruction will be replaced by an equivalent. Each time that this shortcut is used over an instruction, it will performed a change for a different one. Example: an instruction SUM can be replaced by SUB and MUL

Cutting Instructions

An instruction or a group of instructions previously selected can be cut from a ladder program logic with the keyboard command CTRL+X. A copy of them is transferred to the transference area and can be again inserted in any point of a logic (since it does not overcome the limits of the logic) using the keyboard command CTRL+V.

Copying Instructions

Instructions copies in Ladder program is identical to cut instructions, but the copied instructions are not excluded from the module. To copy instruction(s), just use the command CTRL+C and it or them will be copied. To the transference area.

Pasting Instructions

Pasting instructions in a program module from instructions loaded in the transference area can be done using CTRL+V keys. The instructions will be added to empty cells and will replace the filled cells. It is not allowed to paste instructions in certain positions if they will put any pasted instruction in a non-valid position.

Cutting Logics

A group of logics can be erased from a ladder program module using the **Edition/Cut Logics…** menu. A copy of them will be put in the transference area, and can be again inserted in any point of the module using the **Edition/Paste Logics...** menu

By using the menu command to cut logics from a ladder program module, the following window will open to inform the logics to be cut:

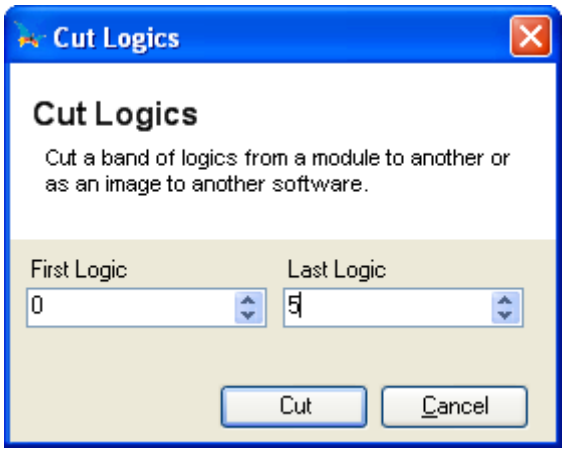


Figure 6-24. Cutting logics from a program module

Copying Logics

The copy of logics from a ladder program module to the transference area is identical to cut logics, but logics copied are not excluded from the module. To provide a copy of logics, just go to **Edition/Copy Logics…** and the following window will open:

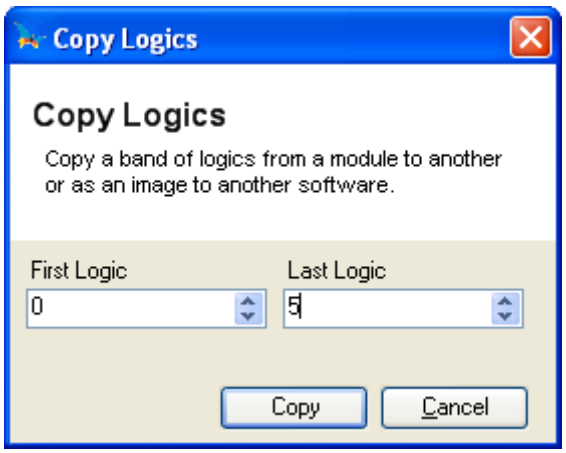


Figure 6-25. Copying logics from a program module

In this window, you inform the logics to be copied.

Pasting Logics

Pasting logics in a program module, from logics loaded in the transference area can be done using the **Edition / Paste Logics…** A window opens in which you inform the number of the logic is in which the logics will be pasted. If it is the last logic, new logics will be included in the end of the program module. If it is the first one or any in the middle, a displacement is done in the logics in order to rest the inserted logics.

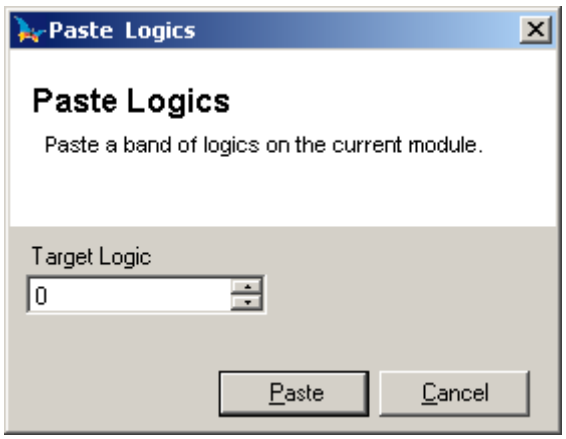


Figure 6-26. Pasting logics in the program module

Inserting or Editing Logics Tags and Comments

Each of the logics used in a ladder program module has a tag associated, a comment briefly describing the function of the logic and a field for notes to describe de logic in details. The tag and the comment of the logic are shown in the first line of the logic when a program module is being visualized in MasterTool Hadron XE.

To edit the tags and comments of a logic, just go to the **Report / Logic Description…** menu or right-click on the logic and select the same menu. The following windows open:

The first one shows al the tags of the module:

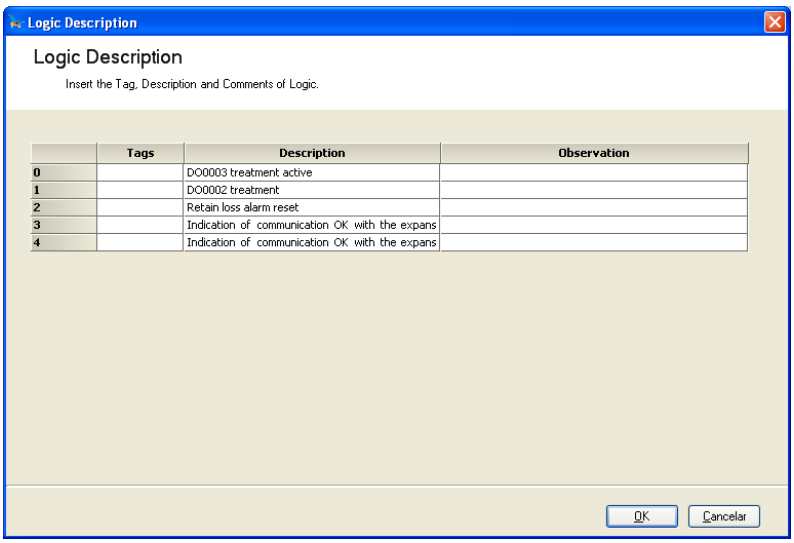


Figure 6-27. Description of the logic

To edit the logics just click in one of the lines in the grid at the window above. The following window will be shown:

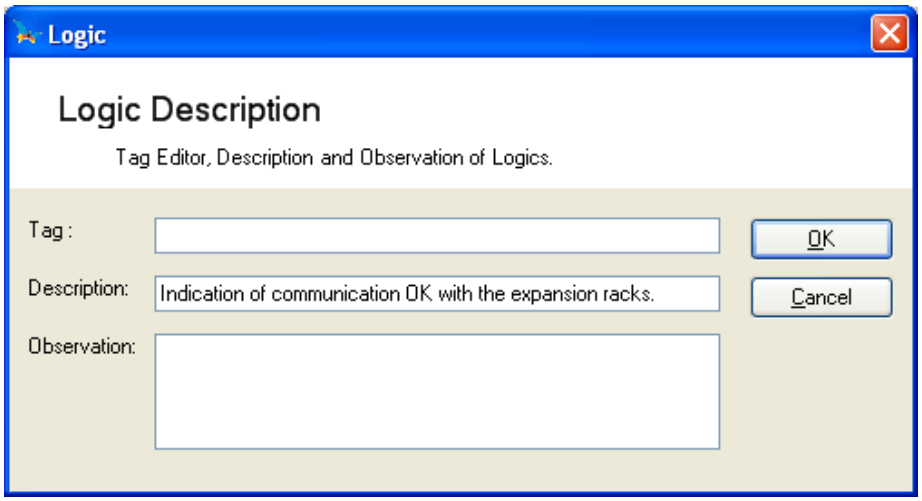


Figure 6-28. Inserting or editing logic tags and comments

Editing Inputs and Outputs in Function Modules

A ladder function module, unlike what happens in running and procedure modules, allow you use input parameters for the function and values to be returned after the same is executed. To edit such input and output parameters just go to the **Module / Edit Parameters…** (Only for ladder function modules). Clicking on this menu, the following window opens:

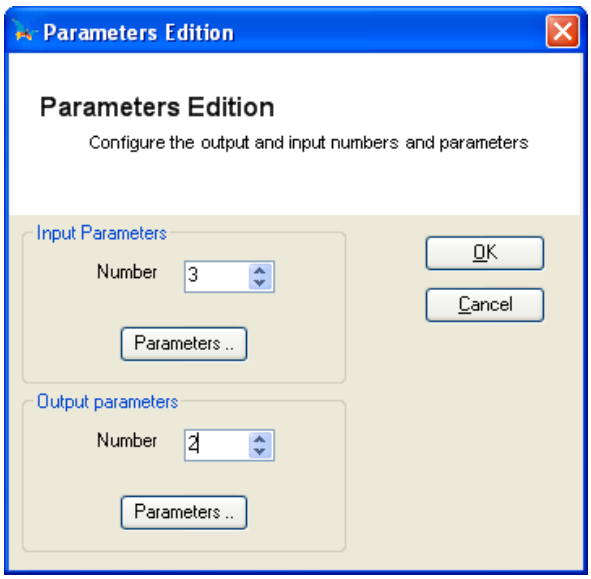


Figure 6-29. Defining de amount of input and output parameters

In this window, the amount of input and output parameters is set, up to 10 for each one. To edit any of these parameters, click the button **Parameters…** In any case, a window opens as shown in the figure for edition:

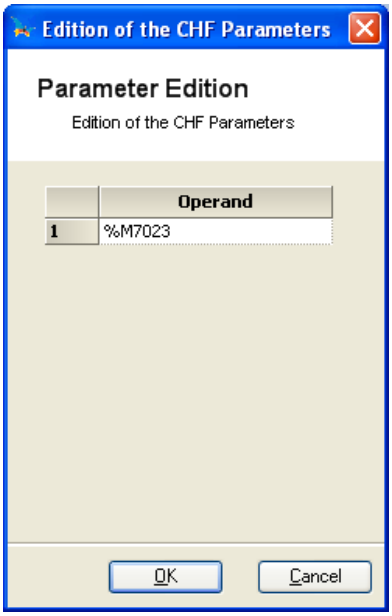


Figure 6-30. Editing parameters in a ladder function module

ST Program Module

The ST Structure Text Program module, or simply ST, is represented in MasterTool Hadron XE by a text editor, where you find several concepts determined in the ST Programming Manual of the MasterTool XE. Such editor is quite similar to a standard text editor, but once it is dedicated to ST language programming, it shows some characteristics, which distinguish it from other text editors. The edition window of a ST program module is shown below:

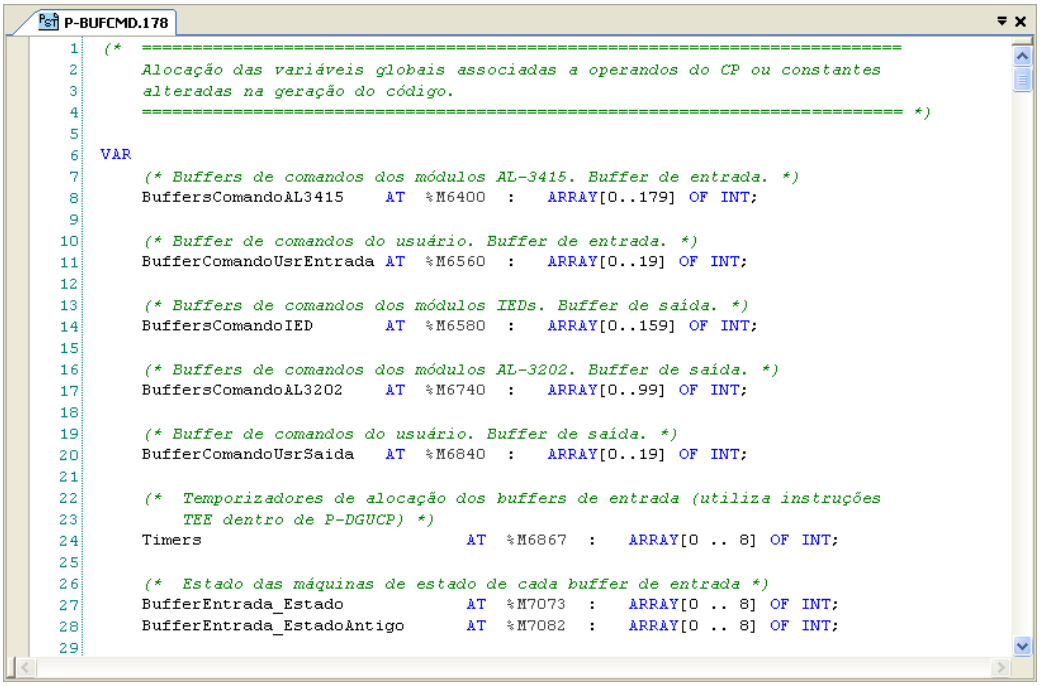


Figure 6-31. ST program module window

This editor highlights by the use of different colors the programming elements (variables, comments, keywords, etc) to facilitate the visualization and comprehension of the program.

Undoing and Redoing Changes

ST module allows undoing the last changes made in the module. Such operation can be done from the **Edition / Undo** menu or with the command CTRL+Z in the keyboard. The actions undone can also be redone using the **Edition / Redo** menu or CTRL+Y keyboard command.

Cutting, Copying and Pasting

ST module allows that selected patches from the source to be transferred between the editor and the transference area in Windows. Such operations are known s *cut*, *copy* and *paste* and can be accessed through the **Edition** menu a also through keyboard commands.

- **Cut:** this operation erases the whole selected text and sends a copy or it to the Windows transference area. It can be accessed from the **Edition / Cut** menu or through the keyboard commands CTRL+X or SHIFT+DEL.
- **Copy:** this operation copies the whole selected text to the Windows transference area. It can be accessed from the **Edition / Copy** or through the keyboard commands CTRL+C or CTRL+INSERT.
- **Paste:** this operation pastes the text that is within the Windows transference area to the position indicated by the keyboard cursor. Such operation can be accessed from the **Edition / Paste** menu or through the keyboard commands CTRL+V or SHIFT+INSERT.

Finding a Text within the ST Module

The toll **Find** allows the user to find a text inside the ST module. It is accessed from the **Edition / Find** menu or through the command CTRL+F in the keyboard.

- **Find what:** text to find.
- **Match case:** if selected, differs uppercase from lowercase and vice-versa during the search of the text.
- **Match whole word:** if selected, searches only for the entire word.
- **Search up:** if selected, searches for the text above the position of the cursor

- **Find next:** Finds the next occurrence of the text.
- **Replace:** enables the replacement of the text.
- **Mark all:** bookmark all lines where an occurrence of the text was found.

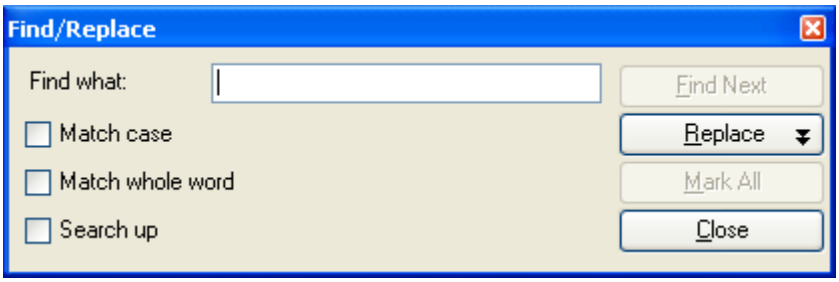


Figure 6-32. Find window

Replacing a Text within the ST Module

The Replace tool allows the user to locate and replace a text within the ST module. It is accessed from **Edition / Replace** menu or through the keyboard command CTRL+R.

- **Search for:** text to search.
- **Replace for:** text to replace.
- **Differ uppercase/lowercase:** if selected, differs uppercase from lowercase and vice-versa during the search of the text.
- **Search for entire word:** if selected, searches only for the entire word.
- **Locate above:** if selected, searches for the text above the position of the cursor.
- **Locate next:** finds the next occurrence of the text.
- **Replace:** replaces the current located occurrence of the text by the substitute text.
- **Replace all:** replaces all occurrences of the text by the replacing text.
- **Mark all:** bookmark all lines where an occurrence of the text was found.

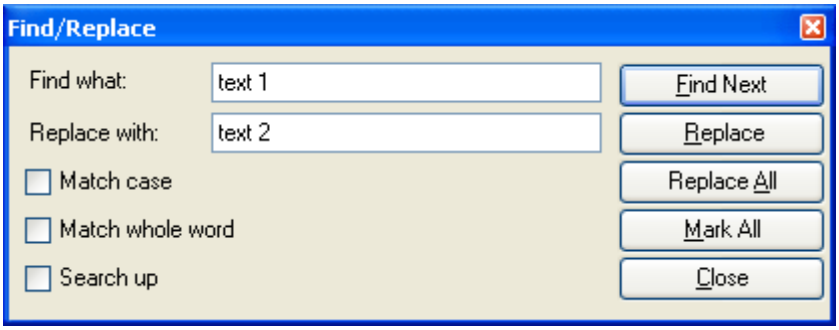


Figure 6-33. Replace window

Going to a Line

The toll *Go to Line* allows positioning the cursor in the desired line. It is accessed through the **Edition / Go**… menu or through the keyboard shortcut CTRL+G:

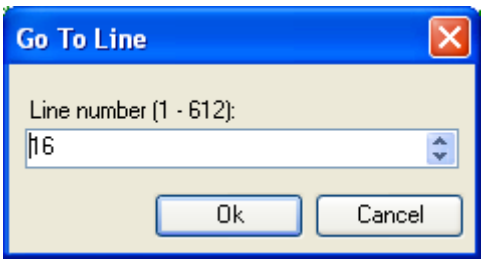


Figure 6-34. *Go to Line* window

Configuring the Diagnostics Operands

Each ST module makes available diagnostics for its functioning, as for instance, division by zero error. The error codes are listed in the ST Programming Manual. The window is accessed from **Module / Operands / Diagnostics.**

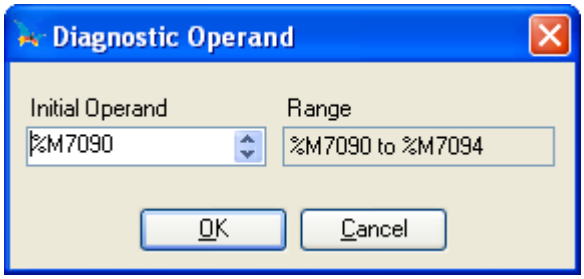


Figure 6-35. Window for the configuration of the diagnostic operands

Configuring Temporary Operands

Some arithmetic operations need operands to store some temporary calculations. The operand types can be enabled individually. If it is necessary the use of an operand which is not enabled, it will be generated a verification error. For each type of operand, it is possible to configure the initial address and the amount of operands, but currently it is only necessary to configure four operands. The window is accessed from **Modules / Operands / Temporary.**

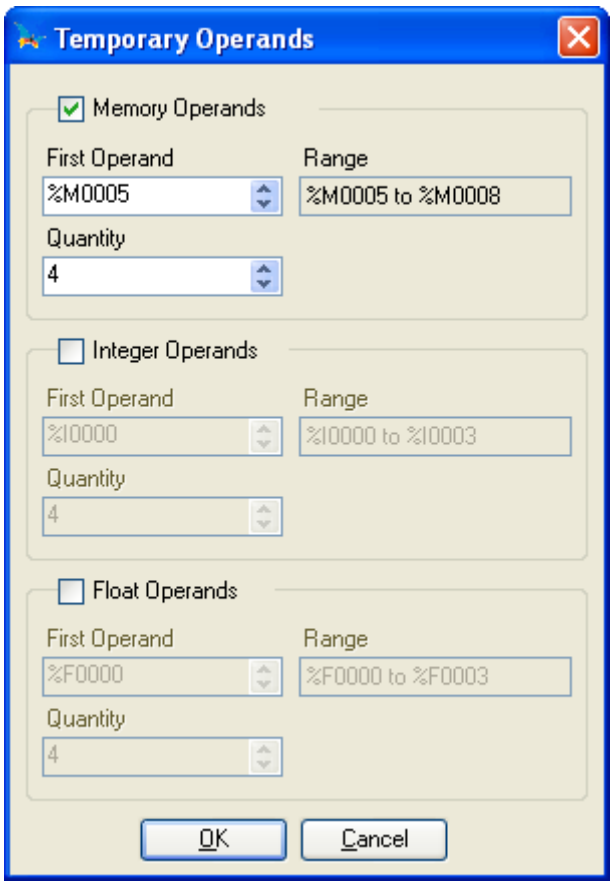


Figure 6-36. Temporary operands configuration window

7. Configuration of Hardware Modules

This section describes the configuration of each hardware module used by Hadron remote. These modules must be configured individually in order to correctly working.

AL-2005 – Multitask Coprocessor Module

AL-2005 is a coprocessor module used to communicate data with other devices. Each AL-2005 allows running from 0ne to two communication drivers. The configuration of the drivers is done in AL-2005 configuration window itself, as shown below:

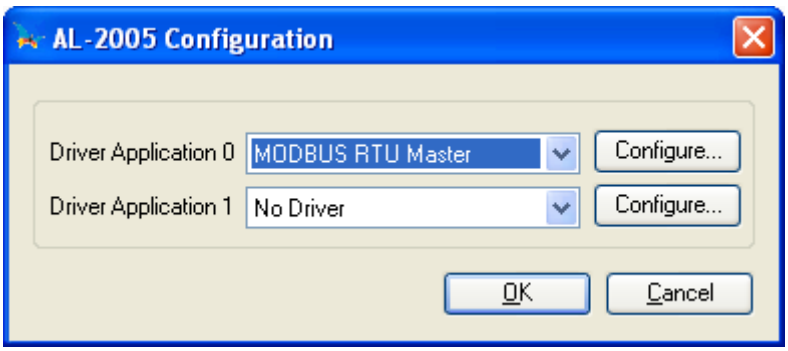


Figure 7-1. AL-2005 configuration module window

To configure a driver, you first have to select the type of protocol in the position where it was loaded. I.e. the first loaded driver in AL-2005 (ID zero) must be configured as **Driver Application 0.** For the second loaded driver, it must be configured as **Driver Application 1.**

To configure the driver you must click the **Configure** button.

ATTENTION: For more information about loading a communication driver in AL-2005, see AL-2005 User Manual.

MasterTool Hadron XE has the following options of communication drivers:

- **Master Serial DNP3:** Uses AL-2743 driver to implement DNP3.0 protocol. This module does not allow other drivers to be loaded in the same AL-2005.
- **Master MODBUS RTU:** Uses AL-2734 driver to implement MODBUST RTU master protocol.
- **Other driver:** This option must be used when a driver not supported by MasterTool Hadron XE is used, but is accepted by AL-2005. It is useful only for the calculation of the electric current consumption in the rack to be correct.
- **No driver:** To use only if no driver was loaded in this position.

The configuration for each driver is described in *Communication Protocol Configuration* chapter.

AL-3130, AL-3132 e AL-3138 – Digital Input with Event Register Module

AL-3130, AL-3132 e AL-3138 input modules are used in RTU for the acquisition of digital events. These input modules can be used as usual input modules and/or event register and has the feature of hot swapping. Each of them has 32 digital input points opt coupled with the following voltage levels:

- AL-3130: 125 Vdc
- AL-3132: 48 Vdc

- AL-3138: 24 Vdc

For each AL-313X is possible to configure the debounce time, filter and storage of events.

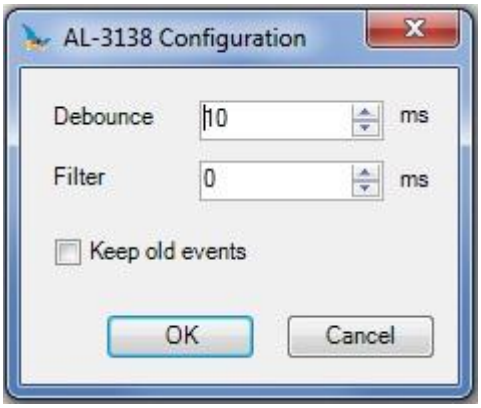


Figure 7-2. AL-313x module configuration window

The option of configurations of the AL-313X are in details in the following table:

Parameters	Default	Values	Notes
Debounce	10	0 to 255	Time in ms in which the interface ignores input variations after a change.
Filter	0	0 or an even interval between 10 and 254	Time in ms for the input filter
Keep old events	No		

Table 7-1. Configuration options for AL-313x module

To get more information about configuration parameters for AL-313X interface family, see the technical features of the product.

AL-3150, AL-3150/8, AL-3151 e AL-3151/8 – Analog Input Module

Input models AL-3150, AL-3150/8, AL-3151 e AL-3151/8 are used in Hadron RTU for the acquisition of analog values of voltage, current, temperature, and yet the feature of hot swap.

Module	Input channels	Function
AL-3150	16	Voltage / Current
AL-3150/8	8	Voltage / Current
AL-3151	16	Temperature
AL-3151/8	8	Temperature

Table 7-2. Configuration options for AL-315x module

For each channel, it is possible to configure the input type. Such configuration is made in module selection window.

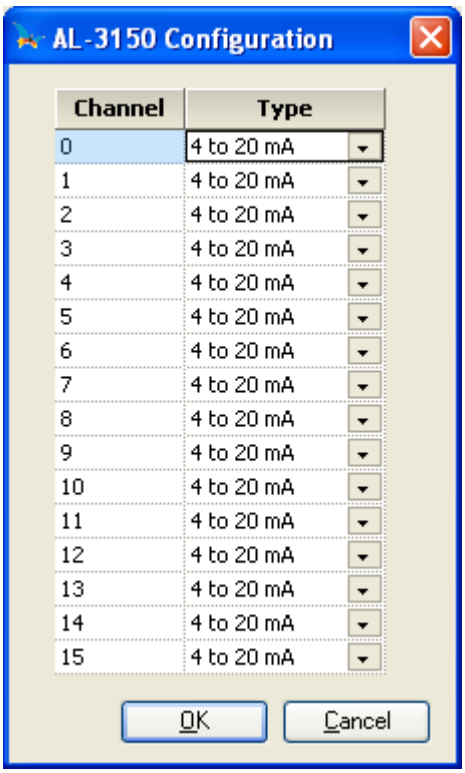


Figure 7-3. AL-3150 module configuration window

The table below describes the types of input, which can be configured, for each channel according to the module:

Module	Channel type
AL-3150 or AL-3150/8	• 0 a +10 V • -10 a +10 V • 0 a 5 V • -5 a 5 V • 0 a 20 mA • 4 a 20 mA • 0 a 10 mA • -1 a +1 mA • -5 a +5 mA
AL-3151 or AL-3151/8	• Thermocouple B, J, K, N, R, S or T • Scale ± 60 mV • Scale ± 30 mV • RTD Pt 100 • RTD Ni 10

Table 7-3. Inputs supported by AL-315x modules

AL-3202 – Digital Output Module

AL-3202 digital output module is used in Hadron RTU for commanding the equipment and can operate both as single or double output (latched or trip/close). This module does not contain a configuration window; the only configurations are executed in the edition window in the points group.

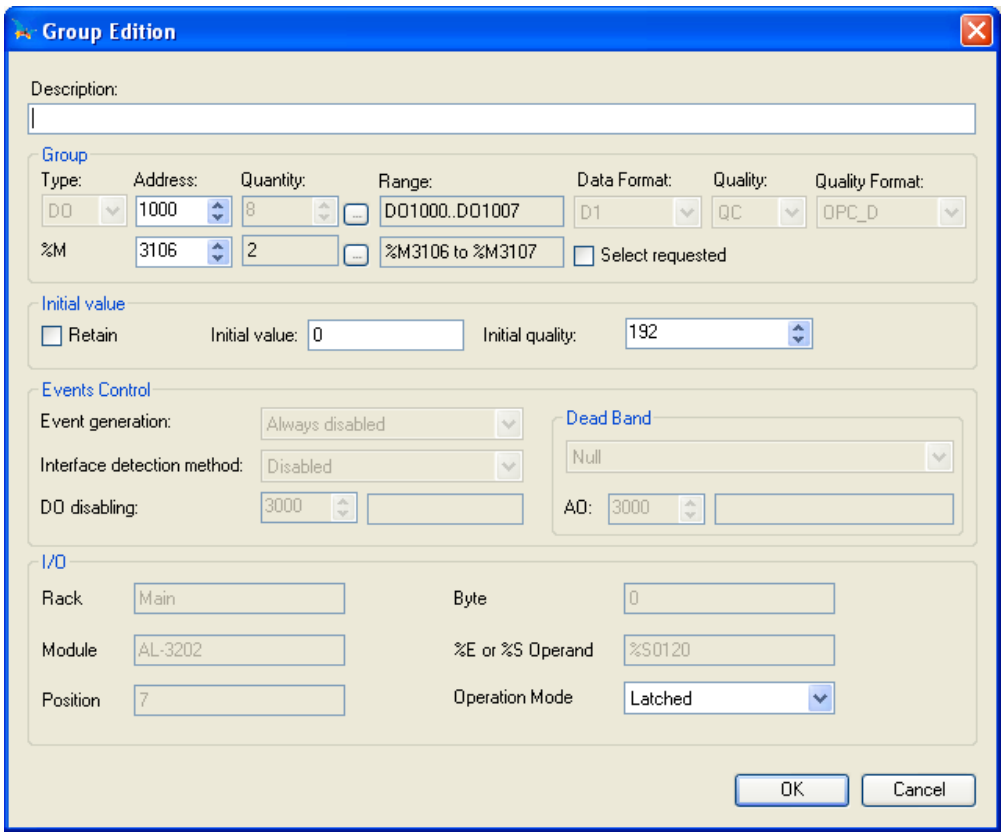


Figure 7-4. Point group edition window for AL-3202 module

Each AL-3202 has four communication points groups, one for each byte allowing so an individual configuration for them. In the edition window, the option *Operation Mode* defines the behavior of the outputs of the byte. In *Latched* mode outputs behave as simple outputs allowing the individual command for each of them. In *Trip/Close* mode, the outputs behave as double outputs allowing only double *Trip/Close* commands.

AL-3406 – PROFIBUS Network Interface

AL-3406 module is a PROFIBUS Master Communications interface. It is used in communication with PROFIBUS slave devices and with the expansion racks. This option of use must be selected by the user from the *Expansion Rack* options or *Manual Configuration* in the AL-3406 configuration window.

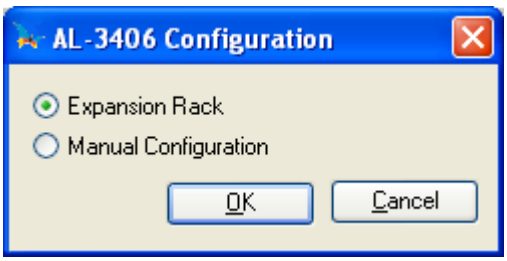


Figure 7-5. PROFIBUS network configuration window

When configured for the expansion rack the whole configuration is automatically performed by MasterTool Hadron XE. With the manual configuration option, this is done according to the described in the section **Extended Configuration Module – PROFIBUS AL-3406**.

AL-3412 – Ethernet Interface 10/100 Mbit/s.

AL-3412 module is an Ethernet 10/100 communication interface with support for ALNET II protocol on TCP/IP. This protocol is used to configuration, monitoring and diagnostics of Hadron RTU through MasterTool Hadron XE and for message interchange between the RTUs, through ladder ECR and LTR instructions.

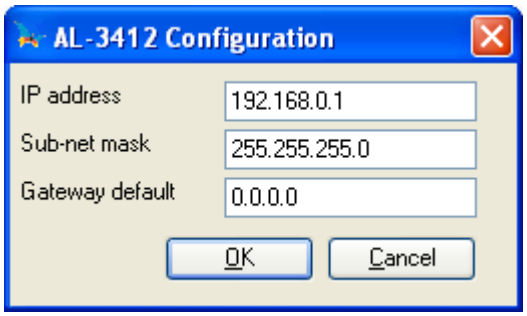


Figure 7-6. Configuration parameters for the AL-3412 network interface

ATTENTION: It is not possible the existence of more than one Ethernet module with ALNET II protocol enabled. Therefore, the use of one AL-3412 module prevents the ALNET II protocol to be enabled in AL-3414 module.

AL-3414 – MODBUS TCP Redundant Ethernet Interface

AL-3414 is a Ethernet 10/100 Mbps communication interface with support to the protocols ALNET II over TCP/IP, MODBUS TCP and MODBUS RTU over TCP/IP. The configuration of the protocols is performed in AL-3414 configuration window itself, as shown in the following figure:

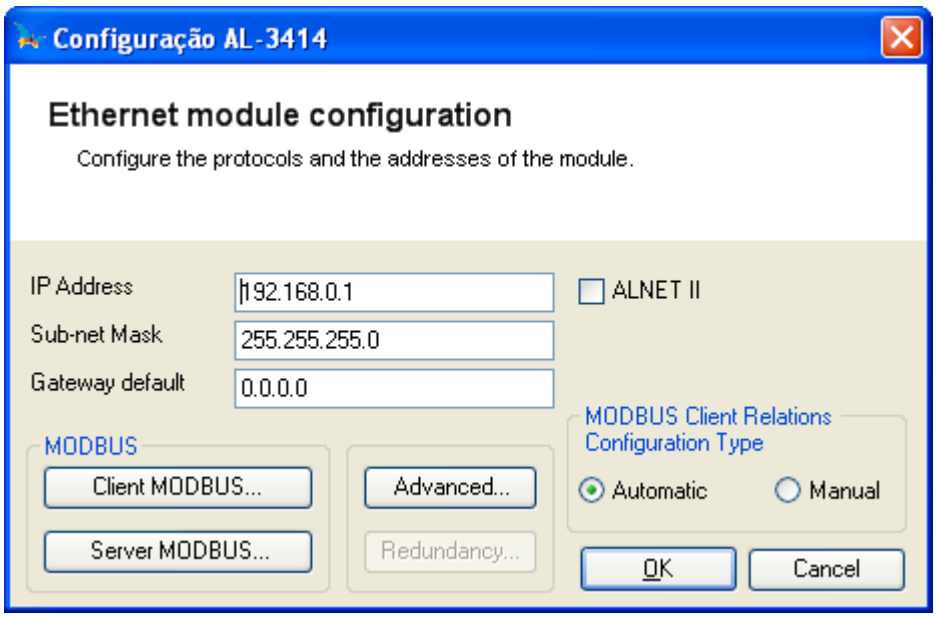


Figure 7-7. AL-3414 interface configuration window

ATTENTION: For further information about AL-3414 as advanced configuration and redundancy, see AL-3414 User Manual.

ALNET II Protocol

ALNET II protocol as server is used for configuration, monitoring and diagnostics of Hadron RTU though MasterTool Hadron XE. In addition, the ALNET II protocol allows several RTUs to interchange messages to each other, using for this LTR and ECR instructions.

Only one AL-3414 interface can be enabled to communicate with ALNET II. To enable the protocol, mark the option *ALLNET II Protocol* at the corresponding AL-3414 configuration window.

MODBUS Protocol

AL-3414 interface also implements server and client modes of the MODBUS RTU protocol on TCP. This protocol is used for interchanging messages between RTUs and for the acquisition of IEDs data, which implement a MODBUS server.

It is possible to use two types of MODBUS protocol: MODBUS TCP and MODBUS RTU over TCP. The user must choose only one type of protocol in the advanced configuration window of the AL-3414 module.

The MODBUS client has two configuration modes: automatic and manual. Automatic mode allows to create relation between a MODBUS reading or writing and portions of the Hadron RTU communication, allowing the accessed data form MODBUS servers to be easily configured to be rehearsed to AL-3415 module – IEC 60870-5-104 Interface. In addition, the automatic mode controls the connection, disabling for a minute the relations with communication problems by time-out. This should be the preferential use.

In manual mode, there is no control over the connections with problems, nor is it possible to directly configure the point read by MODBUS in AL-3414. However, in manual mode it is possible to manually control the execution of each relation through the relations control memory. In this mode, it is possible to use two more MODBUS functions: function 23 (Reading/Writing of Holding/Registers) and a generic function, which can be freely assembled by the user.

For detail about MODBUS Client configuration in the automatic mode, see the section **Configuring the Relations of the MODBUS Clients** in *Communications Protocols Configuration* chapter.

For detail about MODBUS Client configuration in the manual mode, MODBUS Server and MODBUS advanced configurations see AL-3414 User Manual.

AL-3415 – Ethernet IEC 60870-5-104 Interface

AL-3415 module is the interface for IEC 60870-5-104 protocol in server (slave) mode. Each AL-3415 allows connection with up to four clients, and each client can have an individual database.

AL-3415 configuration window has five tabs: general configuration and one tab for the database-mapping configuration of each of the four clients. For more information about the operation of AL-3415 interface, as well about its configuration parameters, see HADRON RTU – HD3002 User Manual.

AL-3415 General Configurations

The general configurations of the AL-3415 are performed in the *General* tab in "AL-3415 Configurations".

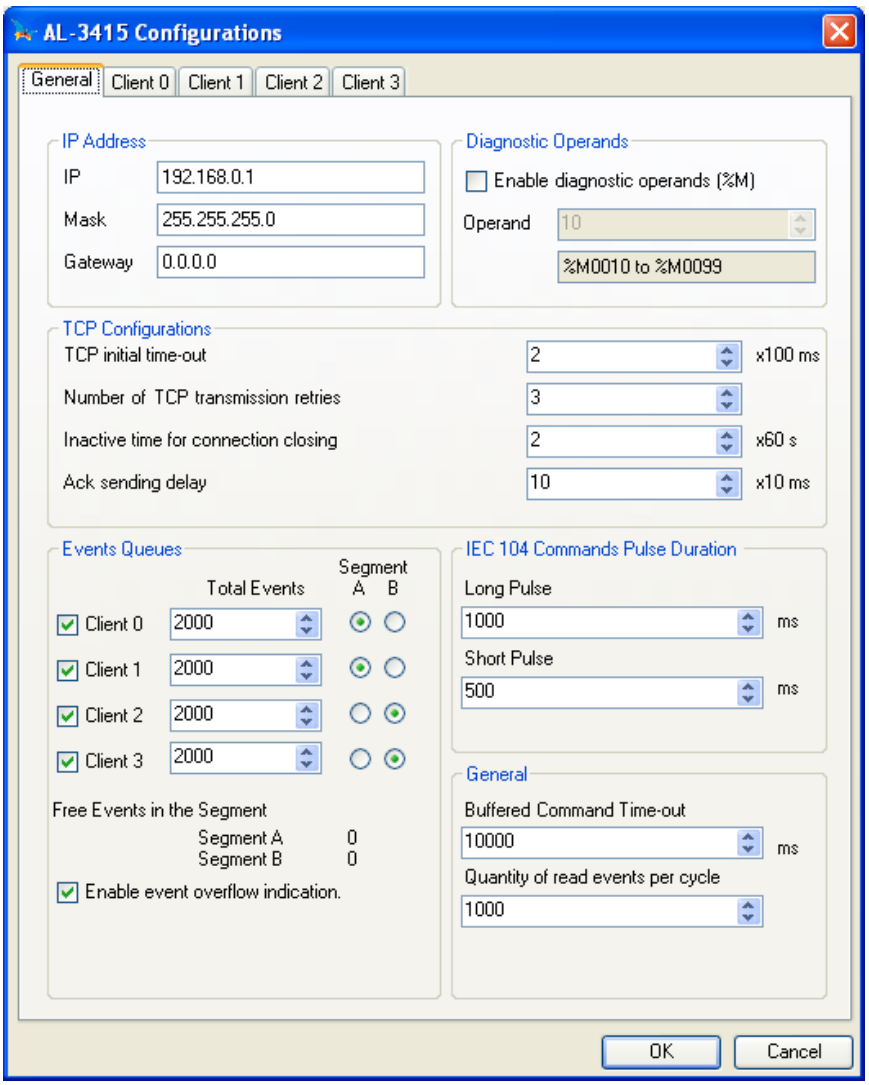


Figure 7-8. AL-3415 interface configuration window

Parameters in *General* tab can be configured as in the following table:

IP Address	**Default**	**Range**	**Note**
IP	192.168.0.1		
Mask	255.255.255.0		
Gateway	0.0.0.0		
Diagnostic Operands	**Default**	**Range**	**Note**
Operands	10	It must be within the operands area %M free for the user.	Uses the next 89 memory positions
TCP Configurations	**Default**	**Range**	**Note /Unit**
TCP Initial Time -out	2	1 a 250	x 100 ms
Number of TCP transmission retries	3	1 a 9	
Inactive time for connection closing	2	1 a 255	x 60 s
Ack Sending Delay	10	1 a 100	x 10 ms
IEC 104 Commands pulse duration	**Default**	**Range**	**Note /Unit**
Long Pulse	1000	1 a 32767	ms
Short Pulse	500	1 a 32767	ms
General	**Default**	**Range**	**Note /Unit**
Buffered Command Time-out	10000	100 a 25000	ms Maximum time for AL-3415 wait for the return of

			the buffered command sent to AL-2004. It must be greater than the time-out times configured in AL-3202, IED DNP3 and user modules
Quantity of read events per cycle	1000	1 a 1000	
Events Queues	**Default**	**Range**	**Note/Unit**
Client 0	2000 Segment A	10 a 4000	The sum of all the rows in a same segment must not be over 4000, as well as the sum of the event rows must not be over 8000 events.
Client 1	2000 Segment A	10 a 4000	
Client 2	2000 Segment B	10 a 4000	
Client 3	2000 Segment B	10 a 4000	

Table 7-4. Limit and default values for the parameters of configuration

Long and short pulse times are used to configure the buffered commands sent to AL-3202 modules and to DNP3 driver. For AL-3202 module, the minimal time of the pulses is 20 ms.

In this tab is also possible to dimension the event buffer for each of the clients. AL-3415 has two segments of memory destined to store events. Each segment can store up to 4000 events. For each client must be configured is there is a row of events, in which segment the row is and its size.

Each AL-3415 has a group of internal points for the warning of loss of events, or overflow. In order to they warn the loss of events, the option *Enables warning of loss of Events.*

AL-3415 can also perform two tasks in addition to the task of being an IEC 60870-5-104. It performs the tasks of conversion of engineering points and calculations of analog alarms. Those tasks are executed always when there are groups of internal points of *Analog Inputs with Engineering Conversion* and *Alarm Digital Inputs.* Only first AL-3415 module perform such operations.

The tasks are performed in atomic way, i.e., when they start, the user application stops until such tasks are completed. Since they demand a high time, in some cases, where there are many points, many AL-3415 in the rack, this operation can demand too much time of processing, and so it is necessary to disable the atomic processing of the tasks making these tasks parallel in relation with the user application.

ATTENTION:
Please consult the **Hadron Configuration – General Parameters** section for more information about the proper operation of the B*uffered Command Time-out parameter.*

ATTENTION:
The configuration of values between 1 and 250 in the *TCP Initial Time-out* parameter is only valid from version 1.13 of AL-3415. For earlier versions, the values for this parameter must be between 1 and 9.

Clients Configuration

The clients are configured in the tabs *Client 0, Client 1, Client 2* and *Client 3* in the configuration window. For each client is possible to configure the database mapping and the protocol configurations.

Configuring a Mapping

At the client configuration window it is possible to add, edit and rename a mapping. The following table shows what are the types of database mapping that can be established:

ASDU	Description	Type	Format
M_SP_NA_1	Single-point information	DI	D1
M_DP_NA_1	Double-point information	DI	D2
M_ST_NA_1	Step position information	DI	D8
M_ME_NA_1	Measured value, normalized value	AI	I16
M_ME_NB_1	Measured value, scaled value	AI	I16
M_ME_NC_1	Measured value, short floating point value	AI	F32
M_IT_NA_1	Integrated totals	FC	I32
C_SC_NA_1	Single command	DO	D1
			N
C_DC_NA_1	Double command	DO	D2
			N
C_RC_NA_1	Regulating step command	DO	D2
C_SE_NA_1	Set point command, normalized value	AO	I16
C_SE_NB_1	Set point command, scaled value	AO	I16
C_SE_NC_1	Set point command, short floating point value	AO	F32

Table 7-5. Types of data supported by AL-3415 interface

In the mapping edition mapping, you have to establish the mapping between a set of communication points and its respective point and IEC 60870-5-104 address. Only a subset entirely contained within a group of previously defined points can be mapped.

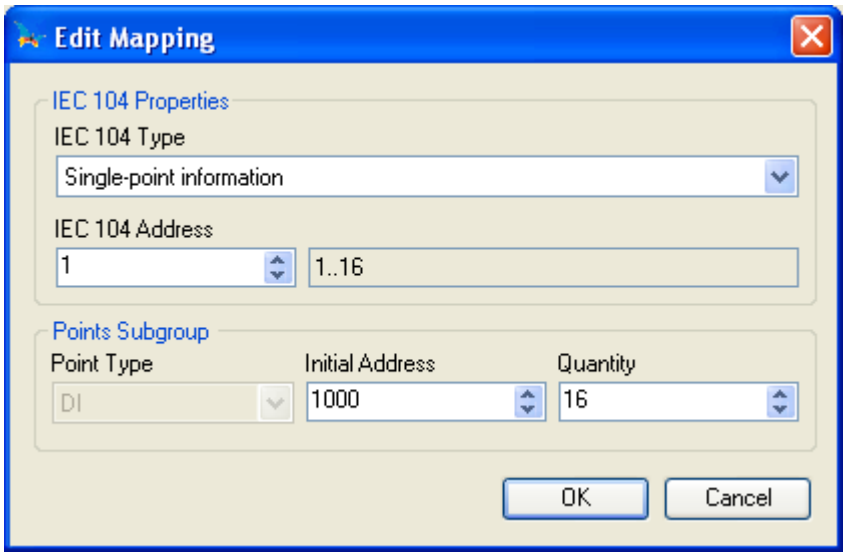


Figure 7-9. Window for mapping edition of a group of communication points

Configuring Clients Advanced Parameters

The advanced parameters are accessed by clicking in *Advanced Configurations.*

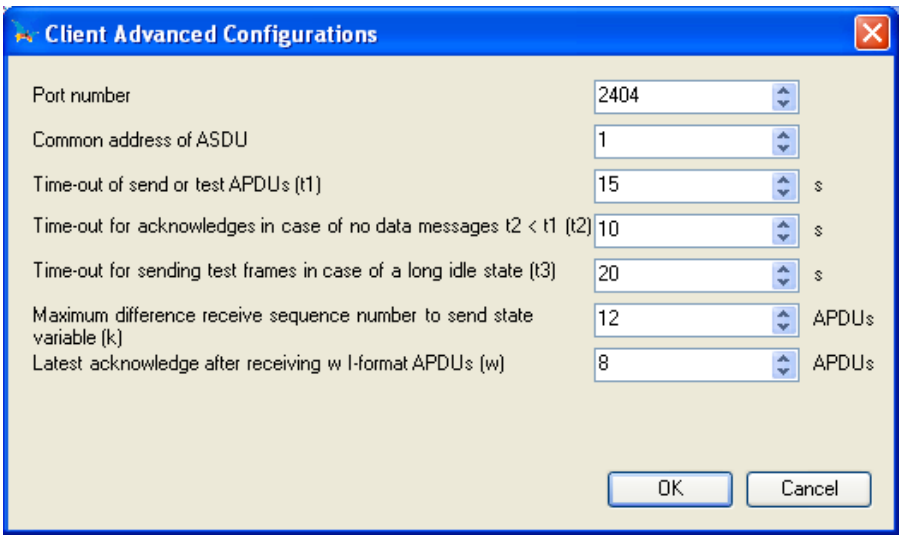


Figure 7-10. Advanced Configuration of an IEC104 client window

Advanced components can be configured as the following table shows:

AL-3415 Configuration Parameters	Default	Values	Notes / Unities
Port number	Client 0: 2404 Client 1: 2405 Client 2: 2406 Client 3: 2407	1 to 65535	
Common address of ASDU	Client 0: 1 Client 1: 2 Client 2: 3 Client 3: 4	1 to 65535	
Time-out of send or test APDUs (t1)	15	1 to 255	s
Time-out for ack now leads in case of no data messages (t2)	10	1 to (t1-1)	s
Time-out for sending test frames in case of long idle status (t3)	20	1 to 255	s
Maximum difference receive sequence number to send status variable (k)	12	1 to 32767	APDUs
Last acknowledge of/a receiving w I-format APDUs (w)	8	1 to 32767	APDUs

Table 7-6. Limit and Default values for the configuration parameters of an IEC104 client

AL-3416 – PROFIBUS Slave Interface

This module has no configuration options.

AL-3417 – Ethernet DNP3 Interface

AL-3417 module is the interface for DNP3 protocol in server (slave) mode. Each AL-3417 allows connection with up to four clients, and each client can have an individual database.

AL-3417 configuration window has five tabs: general configuration and one tab for the configuration of the database mapping of each of the four clients. For more information about operating AL-3417 interface, as well as its configuration parameters, see HADRON RTU – HD3002 User Manual.

AL-3417 General Configurations

General configurations of the Al-3417 are performed in the tab *General* in "AL-3417 Configurations"

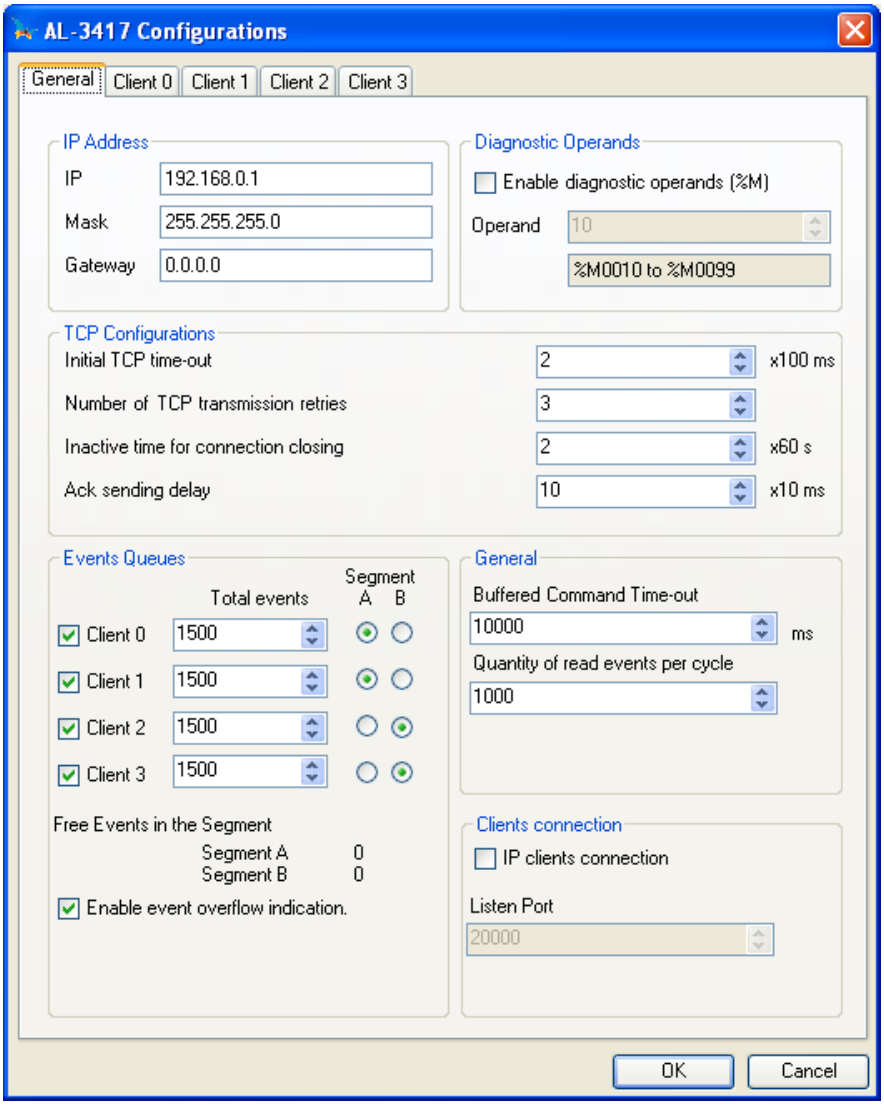


Figure 7-11. AL-3417 interface configuration window

Parameters in *General* tab can be configured according to the following table:

IP Address	**Default**	**Range**	**Note**
IP	192.168.0.1		
Mask	255.255.255.0		
Gateway	0.0.0.0		
Diagnostic Operands	**Default**	**Range**	**Note**
Operands	10	It must be within the operands area %M free for the user.	Uses the next 89 memory positions
TCP Configurations	**Default**	**Range**	**Note /Unit**
TCP Initial Time -out	2	1 a 250	x 100 ms
Number of TCP transmission retries	3	1 a 9	
Inactive time for connection closing	2	1 a 255	x 60 s
Ack Sending Delay	10	1 a 100	x 10 ms
Clients connection	**Default**	**Range**	**Notes**
Listen port	2000	1 to 65535	Connection port for DNP3 clients used when a connection with a

			client is by IP
General	**Default**	**Range**	**Note /Unit**
Buffered Command Time-out	10000	100 a 25000	ms Maximum time for AL-3417 wait for the return of the buffered command sent to AL-2004. It must be greater than the time-out times configured in AL-3202, IED DNP3 and user commands
Quantity of read events per cycle	1000	1 a 1000	
Events Queues	**Default**	**Range**	**Note/Unit**
Client 0	1500 Segment A	10 a 3000	The sum of all the rows in a same segment must not be over 3000, as well as the sum of the event rows must not be over 6000 events.
Client 1	1500 Segment A	10 a 3000	
Client 2	1500 Segment B	10 a 3000	
Client 3	1500 Segment B	10 a 3000	

Table 7-7. Limit and default values for the configuration parameters

In this tab, it is possible to dimension the event buffer for each of the clients. AL-3417 has two memory segments destined to storing the events. Each segment may store up to 3000 events. For each of the clients it must be configured is there is a row of events, in which segment the row is and its size.

Each AL-3417 has a group of internal points for the warning of loss of events, or overflow. In order to they warn the loss of events, the option **Enables warning of loss of Events**.

AL-3417 can also perform two tasks in addition to the task of DNP3 server. It performs the tasks of conversion of engineering points and calculations of analog alarms. Those tasks are executed always when there are groups of internal points of **Analog Inputs with Engineering Conversion and Alarm Digital Inputs.** All AL-3417 rack modules perform such operations, so, in case of failure of a module, the tasks continue to be performed by other modules in the same order they have been installed.

The tasks are performed in atomic way, i.e., when they start, the user application stops until such tasks are completed. Since they demand a high time, in some cases, where there are many points and many AL-3417 in the rack, this operation can demand too much time of processing and so it is necessary to disable the atomic processing of the tasks making these tasks parallel in relation with the user application.

To configure the engineering conversion and alarm calculation tasks to be parallel to the user application it is necessary to mark the option **Engineering Conversion and Alarms Calculation in Next Cycle.** This option reduces the time of the cycle of the AL-2004 CPU. As a collateral effect, the operands in the CPU memory are updated in the cycle after the calculation, causing a delay of a ladder cycle in the update of the operands.

AL-3417 allows DNP3 clients to connect themselves in two different ways. The first is each DNP3 client to connect in a separate listen port, when it is necessary to configure each of them in AL-3417. In the second, all a clients connect themselves in the same listen port, but to differentiate the clients it is necessary to configure an individual IP for each client. The option **Clients Connection by IP,** when selected, indicates that the first form of connection will be used.

ATTENTION:
Please consult the **Hadron Configuration – General Parameters** section for more information about the proper operation of the B*uffered Command Time-out parameter.*

ATTENTION:
The configuration of values between 1 and 250 in the *TCP Initial Time-out* parameter is only valid from version 1.04 of AL-3417. For earlier versions, the values for this parameter must be between 1 and 9.

Clients Configuration

Clients are configured in **Client 0**, **Client 1**, **Client 2** and **Client 3** tabs in the configuration window. For each client it is possible to configure the database mapping and the protocol configurations.

Clients Configuration – Configuring a Mapping

In the client configuration window it is possible to add, edit and rename a mapping. The following table shows which types of database mapping that can be established.

DNP Group	Description	Type	Format
1	Binary Input	DI	D1
3	Double-bit Binary Input	DI	D2
10	Binary Output	DO	D1
			N
20	Counter	CN	I16
			UI16
			I32
			UI32
30	Analog Input	AI	I16
			UI16
			I32
			UI32
			F32
40	Analog Input	AO	I16
			UI16
			I32
			UI32
			F32
			N

Table 7-8.. Types of data supported by AL-3417 interface

In the mapping edition window, you must establish the mapping between a set of communication points and its respective DNP3 point and address. It will only be allowed to map a subset entirely contained within a group of points previously defined.

There are two types of DNP group, which are automatically mapped. All mapping with group 10 *Binary Output* also maps group12 *Control Relay Output Block* for the same points of communication. Thus also by mapping for group 40 *Analog Output* they also map the same points of communication for the group 42 *Analog Output Command.*

For mapping of group 20 *Counter* it is possible to select if the respective group 22 *Frozen Counter* also must be mapped. This is performed by selecting the option **Map group FC.**

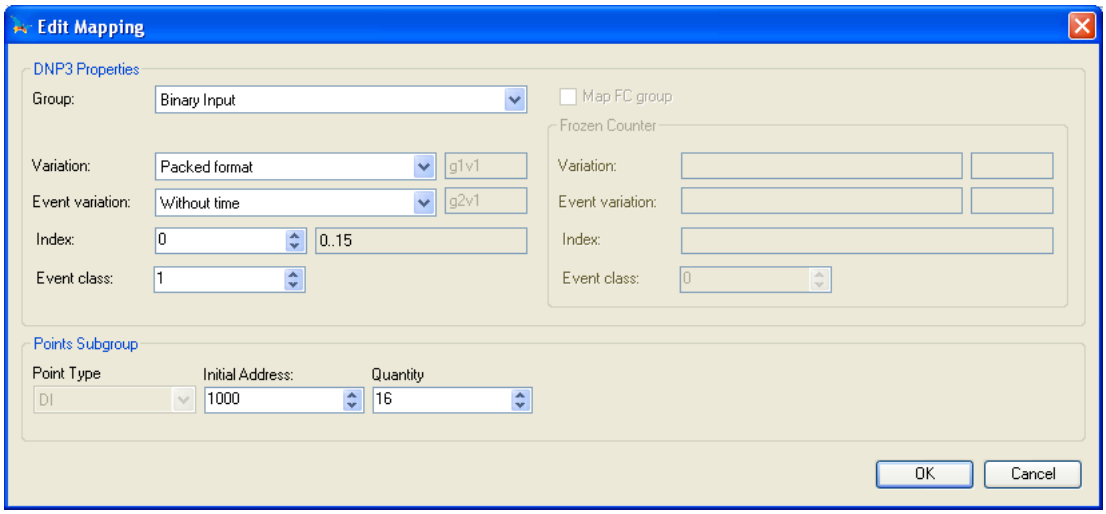


Figure 7-12. Mapping edition for a group of communication points window

In the mapping window within **DNP3 Properties** group, field **Group** is used to select which DNP3 group to which the mapping will be performed; the possible groups are listed in the Table 7-8.. Types of data supported by AL-3417 interface. Types of data supported by AL-3417 interface, **Variation** and **Event Variation** are used to configure the variation of the data which will be returned is the DNP3 client does not specify a variation in the requisition of data, or in the case of unsolicited messages. The field **Variation** is destined to configure static data variation and **Event Variation** is destined to configure the variations for the events.

Index field is used to configure the index of the first mapping point in DNP3 protocol.

Event Class field is used to configure in which class the event in current mapping will be stored. Remember that, is class 0 is configured, it will not be reported events for this mapping, and that groups 10 and 40 have the values for this field fixed in zero.

Client Configuration – Configuring the Advanced Parameter of the Client

Advanced parameters are accessed by clicking in **Advanced Configurations.** In the advanced configuration window is possible to configure the options of the Data Link layer and DNP3 protocol Applying and configure the options for unsolicited messages.

Configuring Data Link Layer

DNP3 Data Link layer configuration is performed in **Data Link Layer** tab.

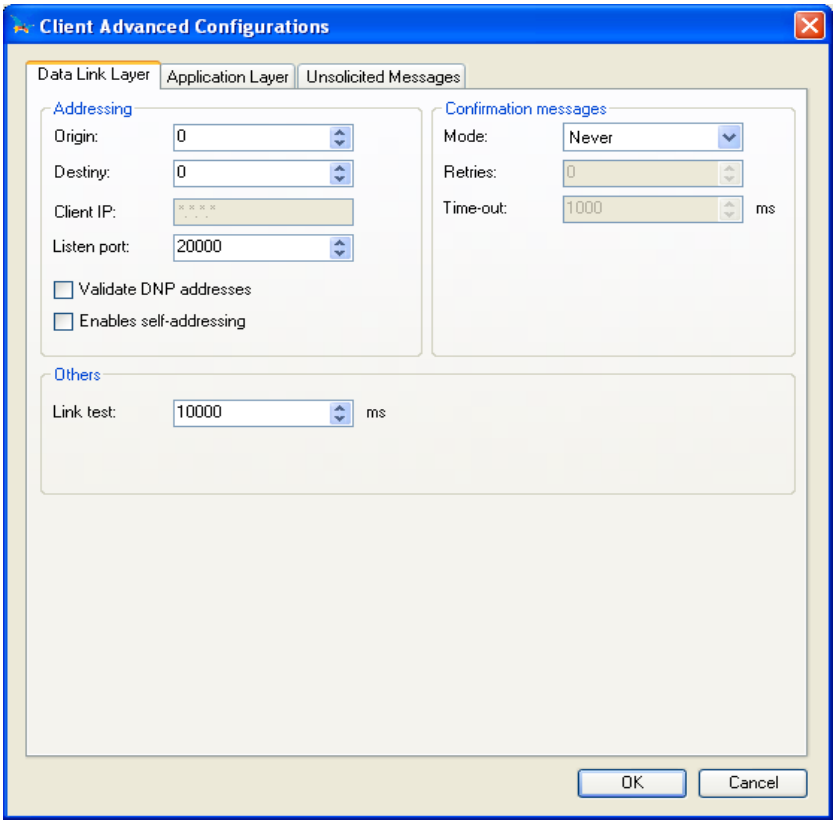


Figure 7-13. DNP3 Data Link layer configuration window

The parameters of **Data Link Layer** can be configured the way the following shows:

Addressing	**Default**	**Range**	**Note**
Source	0	0 to 65519	DNP3 Address of this server
Destination	0	0 to 65519	DNP3 address of the client connected
Client IP	*.*.*.*		Connected IP client used when the connection of the client is by IP
Listen Port	20000	1 to 65519	Address of the listen port for connection of the client. Used when the client connection is not by IP
Confirmation Message	**Default**	**Range**	**Note**
Mode	Never	• Never • Sometimes • Always	Controls the confirmation by the client of the messages transmitted through AL-3417
Retrials	0	0 to 10	Number of times AL-3417 will retransmit the message if it does not receive the confirmation from the client
Time-out	1000	0 to 4294967295	ms
Others	**Default**	**Range**	**Note**
Link test	10000	0 to 4294967295	Time in which a message will be sent for testing the link if there is no other transmission by both sides. Unit: ms.

Table 7-9. Configuration parameters for DNP3 Data Link layer

WARNING:
The link test must be enabled in only one of the two DNP3 communication devices, i.e., only on the client (master) or only on the server (interface).

In addition to these parameters, there are two more options, which control the DNP3 address. If the option **Validate Addresses** *DNP* is marked, AL-3417 will only accept messages whose source and destination addresses match with the values configured respectively in fields **Destination** and **Source.** I.e. field **Source** in the message must match the value of the field **Destination** configured by the client and vice-versa.

The option **enables self-addressing** enables the reception of messages with the address 65533 of the DNP3 client.

Configuring the Application Layer

DNp3 application layer configuration is performed in the tab **Application Layer.**

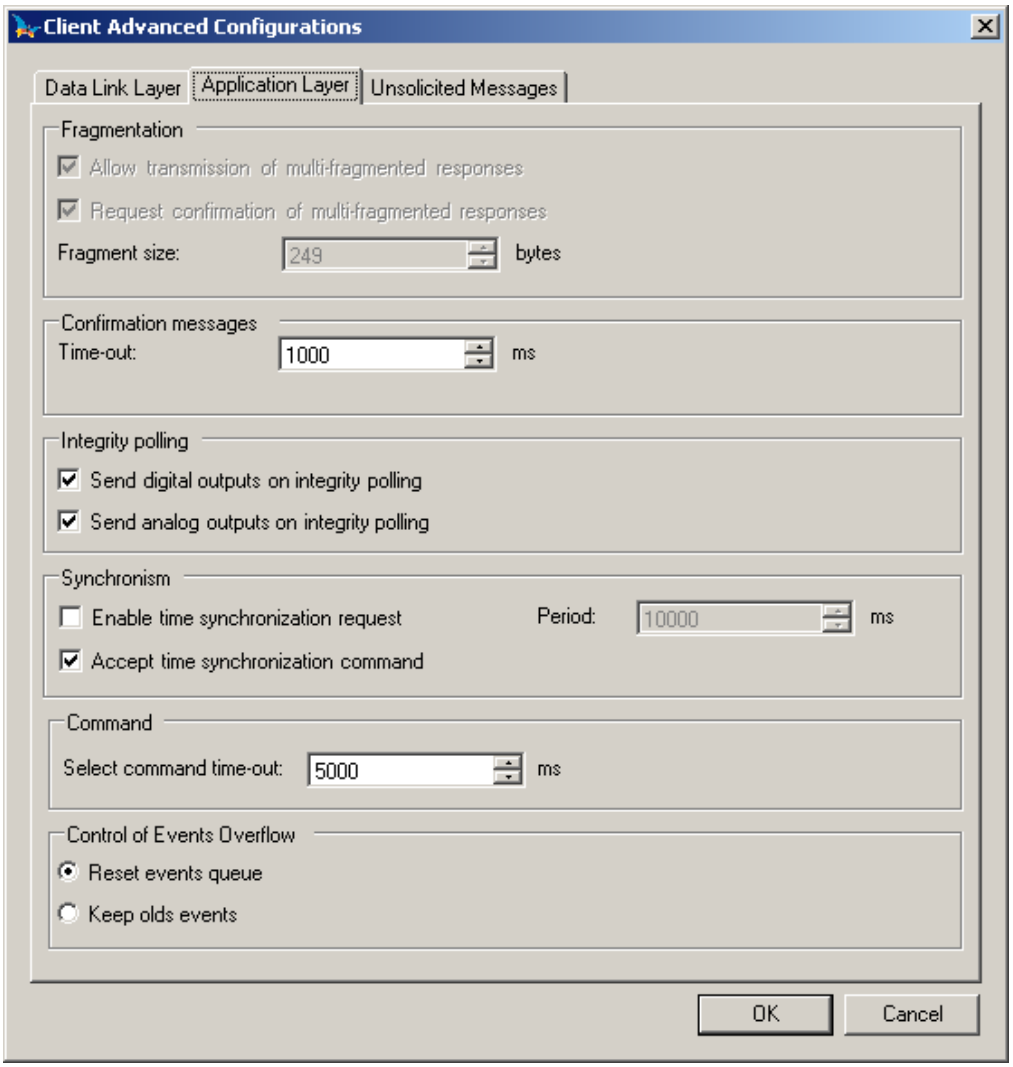


Figure 7-14. DNP3 application layer configuration window

The parameters in **Application Layer** tab can be configured as follows:

Fragmentation	**Default**	**Range**	**Note**
Fragment Size	249		Size of the application layer for messages sending
Confirmation Messages	**Default**	**Range**	**Note**

Time-out	1000	0 to 4294967295	ms
Synchronism	**Default**	**Range**	**Note**
Period	10000	0 to 4294967295	Period for AL-3417 to request the DNP client for the synchronism. It is enabled when the option **Enables Synchronism Request** is marked. Unit: ms.
Command	**Default**	**Range**	**Note**
Time-out command Select	10000	0 to 4294967295	Period for AL-3417 to request the DNP client for the synchronism. It is enabled when the option **Enables Synchronism Request** is marked. Unit: ms.

Table 7-10. DNP3 configuration parameters for the application layer

Parameters of the group **Fragmentation** are fixed and cannot be changed. They are shown only to exhibit which are the option used by AL-3417. The option ***Allow transmission of multi-fragmented messages*** allows to divide an application message that is larger than the size defined in **Fragment Size** in smaller messages and sending them one by one. The option **Request confirmation for multi-fragmented messages** enables AL-3417 to request to client a confirmation that he received the message with the fragment of the application message.

In the group **Integrity Polling,** the options for answering an integrity polling (requisition of reading of g60v1 object) are configured. The option **Send digital outputs on integrity polling** enables AL-3417 to insert mapping data of the objects 10 *Binary Output* with the data answered in the integrity polling. In option **Send analog outputs on integrity polling** enables AL-3417 to insert mapping data of the objects 40 *Analog Output* with the data answered in the integrity polling.

In the group **Synchronism,** the option **Enable time synchronization request** enables AL-3417 to request a synchronism from the client. This request is done in the first message transmitted to the client after the configured time in field **Period** is exceeded. The option **Accept Time Synchronization Command** enables AL-3417 to receive and run the synchronism setting commands.

The group **Control of Events Overflow** configures how AL-3417 will behave when a queue overflow occurs. The option Reset events queue works in the same way as AL-3415, i.e., when an overflow occurs all the events present on the queue will be removed. Optionally, an overflow event can be generated in the case of the option **Enables warning of loss of Events** is checked on the AL-3417 configuration window.

In the other way, the option Keep old events makes the client to ignore all new events that may occur while the overflow condition is present. This also includes the warning overflow event, configured on the option **Enables warning of loss of Events** on the AL-3417 configuration window. With this option, the only way of receiving and queue overflow warning is through the specific flag on IIN field of the DNP3 response message.

ATTENTION:
The **Select command time-out** field is applicable for any *Select* command received by AL-3417 module. Some command destinations have also a second *Select* command time-out setting. For the proper operation of the select command, the time-out value set for AL-3417 module must be greater or equal than the other time-out parameters. Selection commands for DNP IEDs have a fixed 5.000ms time-out value on the AL-2743 driver and the trip/close selection commands for AL-3202 modules have a configurable time-out setting available on the **General Parameters** tab of **Hadron Configuration** item on configuration module. The selection commands for MODBUS IEDs, latched commands for AL-3202 and user commands do not have a second time-out parameter and then use the time-out setting for the AL-3417 module.

Configuring Unsolicited Messages

Configuration of unsolicited messages is performed in **Unsolicited Messages** tab.

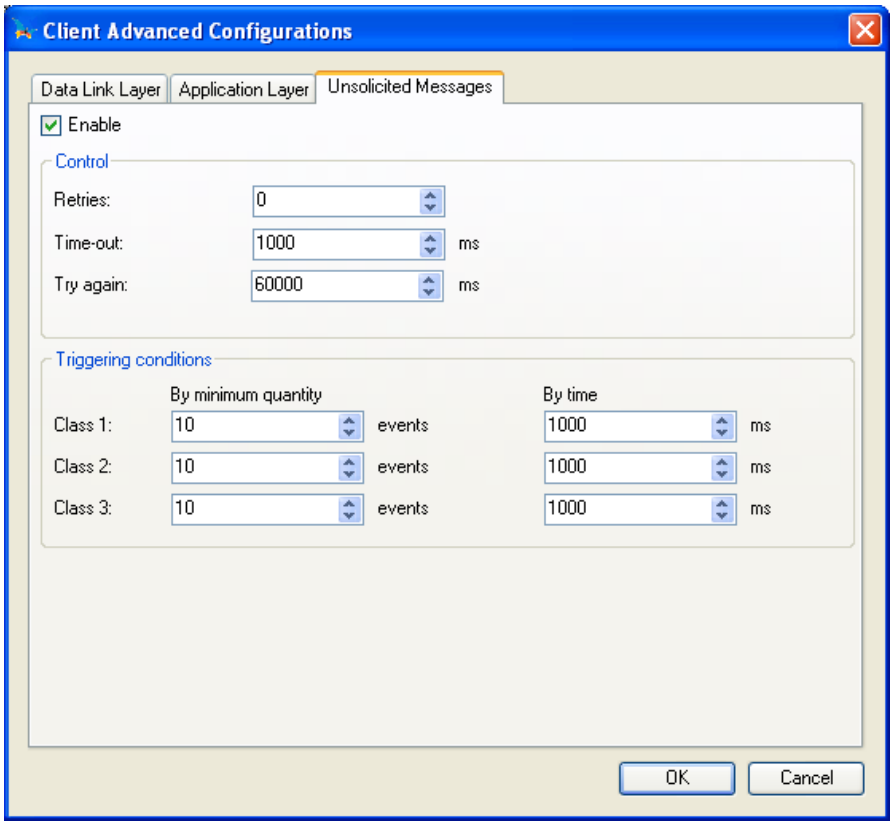


Figure 7-15. Unsolicited messages configuration window

The parameters of the **Unsolicited Messages** tab can be configured as next table shows:

Control	**Default**	**Range**	**Note**
Retrials	0	0 to 65535	Number of times AL-3417 will try to transmit the message
Time-out	1000	0 to 4294967295	ms
Try again	60000	0 a 4294967295	Period of time in which AL-3417 will try to transmit again the unsolicited messages after exhaust the retrials. Unit: ms.
Starting conditions	**Default**	**Range**	**Note**
Minimum amount	Class 1: 10 Class 2: 10 Class 3: 10	0 to 255	Minimal amount of events in a class to fire off unsolicited messages.

Time	Class 1: 1000 Class 2: 1000 Class 3: 1000	0 to 4294967295	Minimum time an event in a class can be stored and not being sent by a unsolicited message.

Table 7-11. Configuration parameters for unsolicited messages

In order to the unsolicited messages works it is necessary that in addition to enable the option **Enable** in the configuration window, it is also necessary that the DNP3 client send a request to enable using the function 20 *Enable Unsolicited Messages.*

8. Configurations of Communication Protocols

MODBUS RTU Master – AL-2734

The master protocol MODBUS RTU is implemented by the driver AL-2734, which runs on AL-2005 coprocessor module. In the configuration window of such protocol is possible to configure the groups of communication points, as well as the configuration of the serial channel.

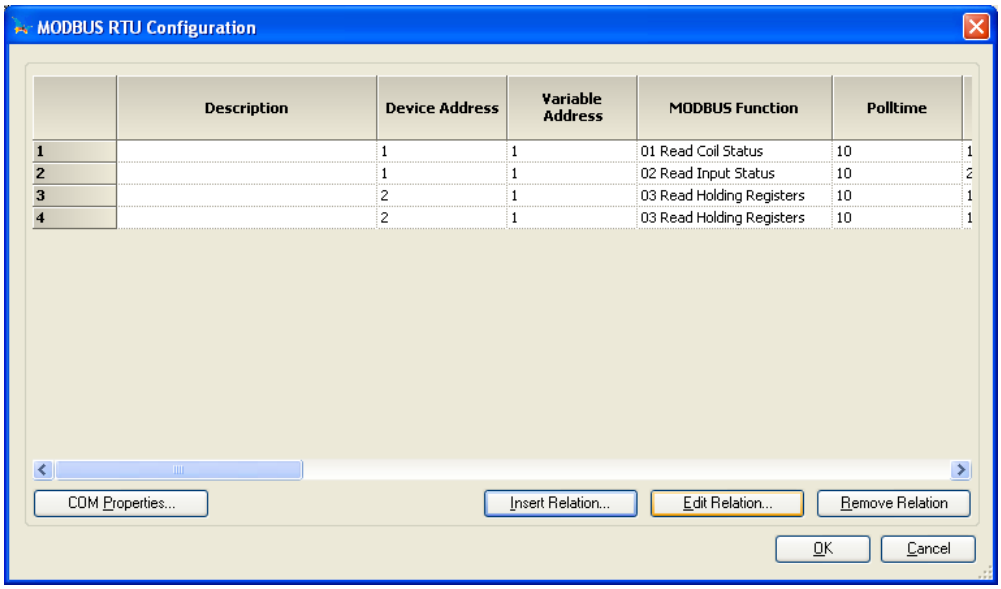


Figure 8-1. MODBUS RTU protocol configuration window

Configuring the Groups of Communication Points

In the MODBUS RTU configuration window is possible to insert, edit or remove relations. Each relations establish a MODBUS function to a group of communication points.

MODBUS Function	Description	Type	Format
01	Read Coil Status	DI	D1, D2, D8
02	Read Input Status	DI	D1, D2, D8
03	Read Holding Registers	DI	D1, D2, D8
		AI	I16, UI16, I32, UI32, F32
04	Read Input Registers	DI	D1, D2, D8
		AI	I16, UI16, I32, UI32, F32
05	Force Single Coil	DO	D1, D2, D8
06	Preset Single Registers	DO	D1, D2, D8
		AO	I16, UI16
15	Force Multiple Coils	DO	D1, D2, D8
16	Force Multiple Registers	DO	D1, D2, D8
		AO	I16, UI16, I32, UI32, F32

Table 8-1. Table MODBUS functions

MODBUS types of registers (Input registers and holding registers) are 16 bits integer numeral, but they can be associated to digital types or to 32 bits numerical types.

When a register is associated to a digital type (DI or DO), the group of points must contain size multiple of 16 and each register is copied to the respective set of 16 points. In this case, the bit zero

(less significant) of the register is copied to the first point of the set, bit one is copied to the second point and so on.

When a register is associated to a 32 bits analog type (AI or AO) (I32, UI32, F32), two registers are read or written for each point of the group, where the first register is stored in the high part (bit 31 to 16) and the second register is stored in the lower part (bit 15 to 0) of the point. The moving order can be inverted by marking the option **Swap Word** in the group edition window.

ATTENTION: When a MODBUS register is associated to a group with a format different of 16 bits, the amount of points of the group does not correspond to the amount of register read or written.

The group edition window allows editing the MODBUS relation associated to the group of communication points. Items *Group*, *initial value and event control* have the same behavior than those in Standard Group Edition Window. For the edition of the relation, it was added item *IED* only.

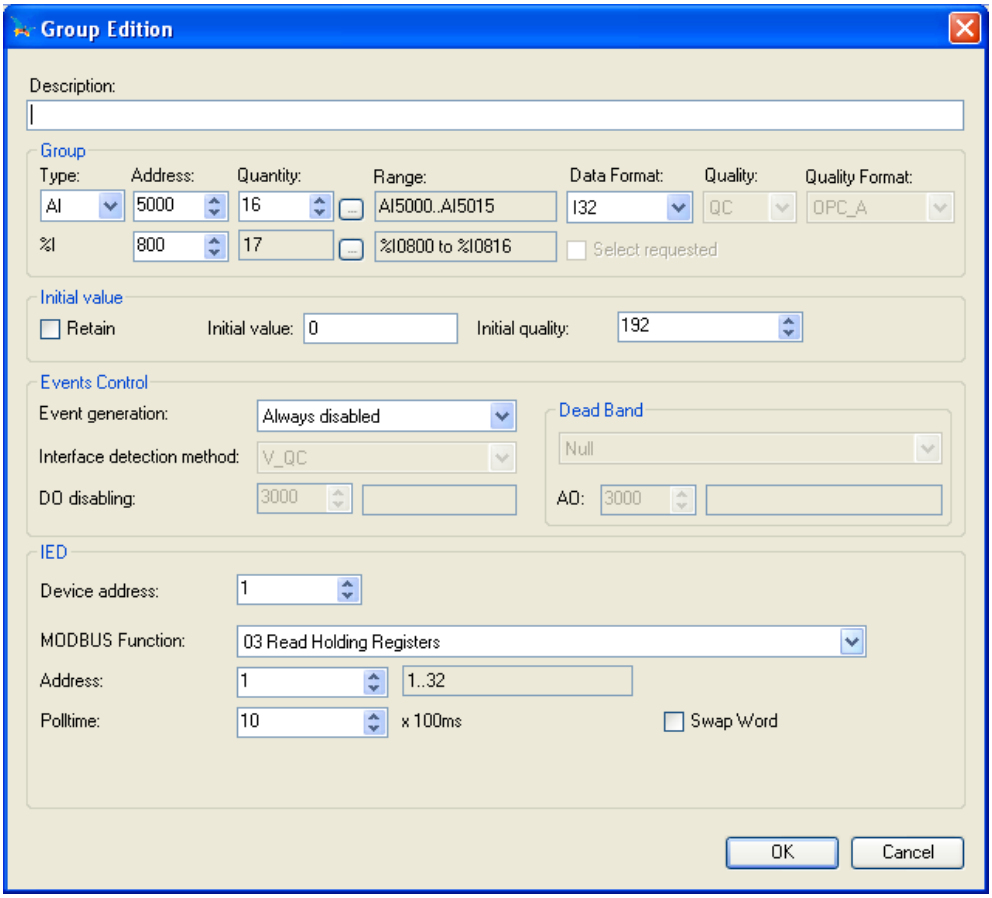


Figure 8-2. MODBUS RTU points group edition window

The options of item *IED* can be as in the following table:

IED Parameters	Default	Values	Notes
Device address	1	1 to 247	Address of the slave device.
Function			MODBUS function described in Table 8-1.
Address	1	1 to 65535	Address of the point in the device.
Poll time	10	0 to 10000	x 100 ms Note: Enables continuous polling

Table 8-2. IED MODBUS configuration parameters

ATTENTION:
Al-2734 driver has operand for disabling the relations, which are used to remove the scanning relations. Such operands are automatically configured by MasterTool Hadron XE within the draft operands area, and are initialized with the value zero at the startup of the RTU (relations always enabled). These operands must not be changed by user.

Configuring Serial Channel

In the group edition window is possible to configure the properties to the serial channel clicking in *COM Properties…*

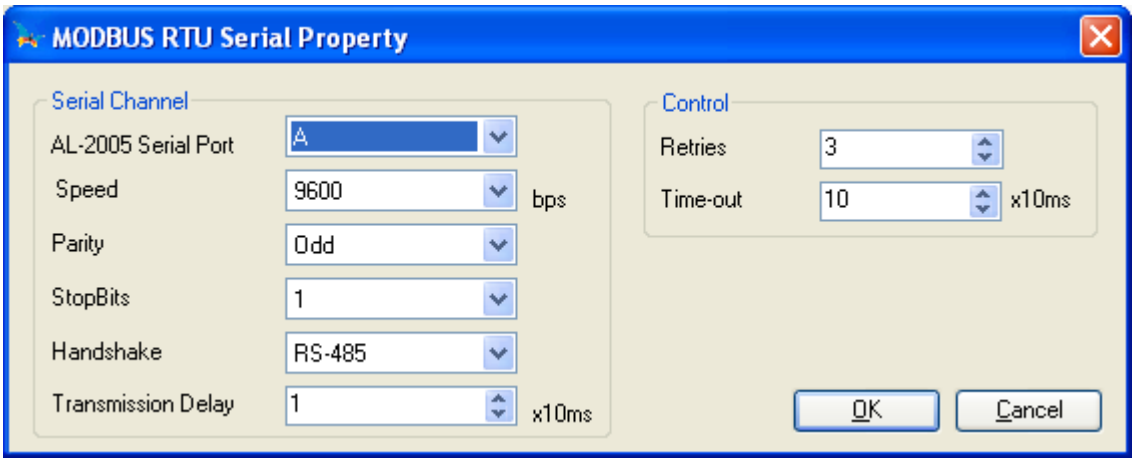


Figure 8-3. MODBUS RTU serial channel configuration window

Properties in the window can be configured like in the following table .

Serial Channel Parameters	Default	Values	Notes
AL-2005 serial port	A	A or B	
Speed	9600	• 38400 • 19200 • 9600 • 4800 • 2400 • 1200 • 600 • 300 • 150	bps
Parity	Odd	• No parity • Odd parity • Even parity • Always zeroed • Always on	
Stop bits	1	1 to 2	
Handshake	RS-485	• RS-485 • RTS always on • RTS/CTS	
Transmission delay	1	0 to 99	x 10 ms
Retrials	3	0 to 99	
Time-out	10	10 to 1000	x 10 ms

Table 8-3. Serial channel configuration parameters

DNP3 Serial Master

DNP3 master protocol is implemented by the driver AL-2743, which runs on AL-2005 coprocessor module. In the configuration or this protocol, it is possible to configure the groups of configuration points, as well as the serial channel configuration.

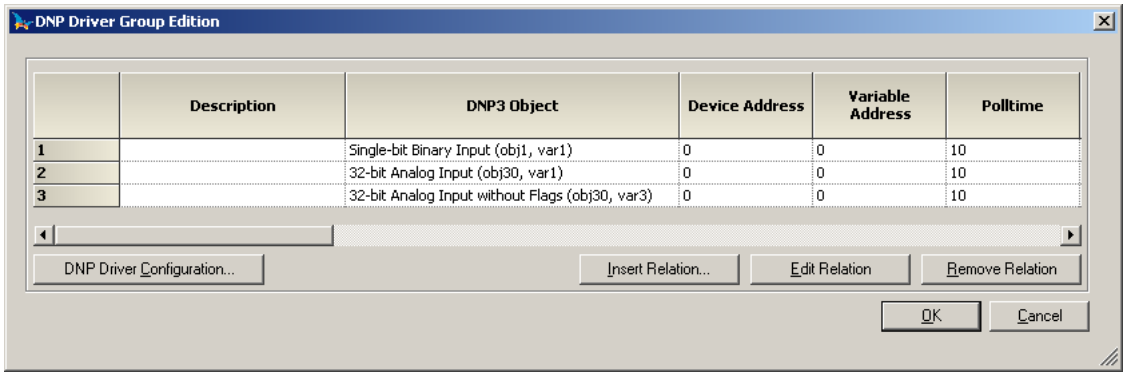


Figure 8-4. DNP3 driver group configuration

Configuring the Groups of the Communication Points

In DNP3, configuration window is possible to add, edit or remove relations. Each relation establishes a relation between a group of points of a DNP3 device and a group of communication points. The possible relation of groups is shown on the following table:

DNP3 Object and variation	Description	Type	Format	Quality
O1v1	Single-bit Binary Input	DI	D1	QA, QC or QE
O1v2	Binary Input with Status	DI	D1	QE
O10v2	Binary Output Status	DI	D1	QE
O12v1	Control Relay Output Block	DO	N	QA
O30v1	32 bit Analog Input	AI	I32	QE
O30v2	16 bit Analog Input	AI	I16	QE
O30v3	32 bit Analog Input without Flags	AI	I32	QA, QC or QE
O30v4	16 bit Analog Input without Flags	AI	I16	QA, QC or QE
O40v1	32 bit Analog Output Status	AI	I32	QE
O40v2	16 bit Analog Output Status	AI	I16	QE
O41v1	32 bit Analog Output Block	AO	N	QA
O41v2	16 bit Analog Output Block	AO	N	QA

Table 8-4. DNP3 Objects

The edit group window allows editing the DNP3 relation associated to the group of communication points. Items *group*, *initial value* and *events control*, have the same behavior as in the standard group edition window. For the edition of relations, it was only added item *IED*.

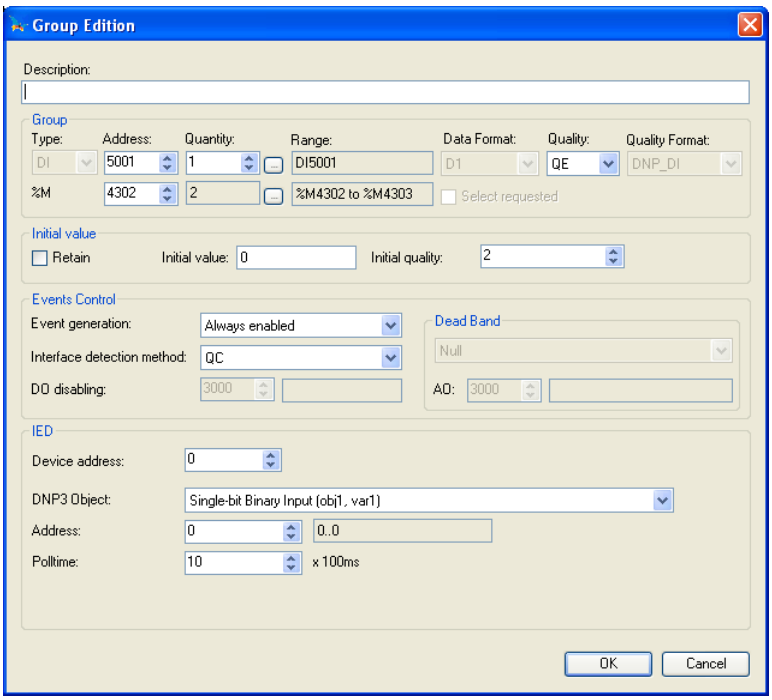


Figure 8-5. DNP3 Window for the edition of a group of communication points

Options of item *IED* can be configured as shown in the following table:

IED Parameters	Default	Values	Notes
Device address	0	0 to 65519	Address of the slave device
DNP3 Object			Object and value described in Table 7-4
Address	0	0 to 65535	Address of the object at the device
Pool time	10	0 to 65535	x 100 ms Note: disable polling for this group

Table 8-5. IED DNP3 options

Configuring DNP3 Driver Properties

In the window for group edition, it is possible to configure the properties of the driver by clicking in *DNP driver configuration.*

The window distributes the configuration options of the driver in four groups: Serial Channel, Link, Applications and Classes.

Configuring serial channel

The configuration of the serial channel is performed in *Serial Chanel* tab.

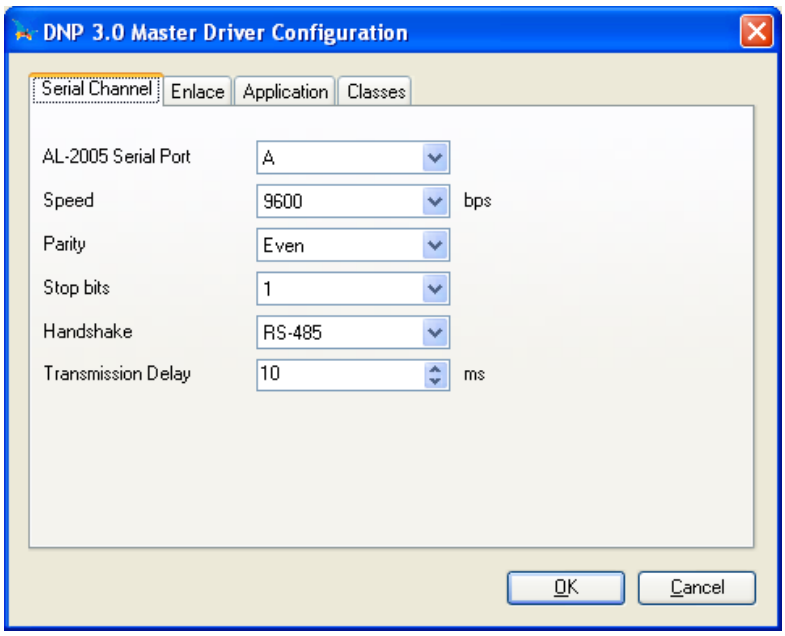


Figure 8-6. DNP3 master driver configuration window

The option of the serial channel can be configured as the table below shows:

Serial Channel parameters	Default	Values	Notes
AL-2005 serial port	A	A or B	
Speed	9600	• 38400 • 33600 • 28800 • 19200 • 14400 • 9600 • 4800 • 2400 • 1200 • 600 • 300 • 150 • 75 • 50	bps
Parity	Even	• No parity • Odd parity • Even parity	
Stop bits	1	1 to 2	
Handshake	RS-485	• RS-485; • RTS always on; • RTS/CTS	**RS-485**: RTS signal is turned on in the beginning of the transmission and turned off in the end. **RTS/CTS**: handshake for RS-232C modem
Transmission delay	10	0 to 32767	ms

Table 8-6. Serial channel parameters for Master DNP3 driver

Configuring Link Layer.

The configuration of the link layer of the DNP3 protocol is performed in the *Link* tab.

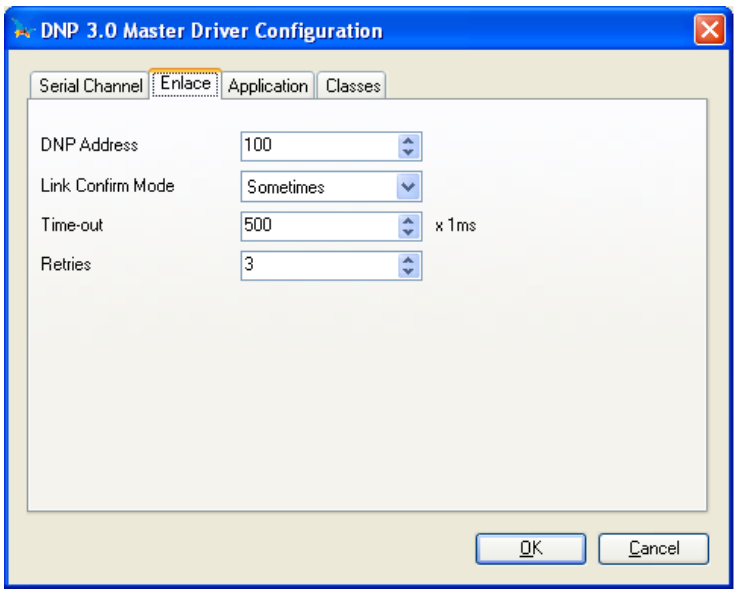


Figure 8-7. Window for the configuration of the link layer of DNP3 driver

The options for the link layer can be configured in according to the following table:

Link layer parameters	Default	Values	Notes
DNP3 Address	100	0 to 65519	Master address in **DNP3** network
Link confirm mode	Some times	• Never • Some times • Always	**None**: Driver never asks for link confirmation **Sometimes**: driver asks for link confirmation only in intermediary frames, i.e., which is not the last of a multi-frame segmented message **Always**: driver requests link confirmation for every transmitted frames.
Time-out	500	0 a 65535	x 1ms - time-out links request
Retrials	3	0 a 255	Number or retrials for link request

Table 8-7. Parameters for link layer of master DNP3 driver

Configuring Application Layer

The configuration of the application layer of DNP3 protocol is performed in *Application* tab.

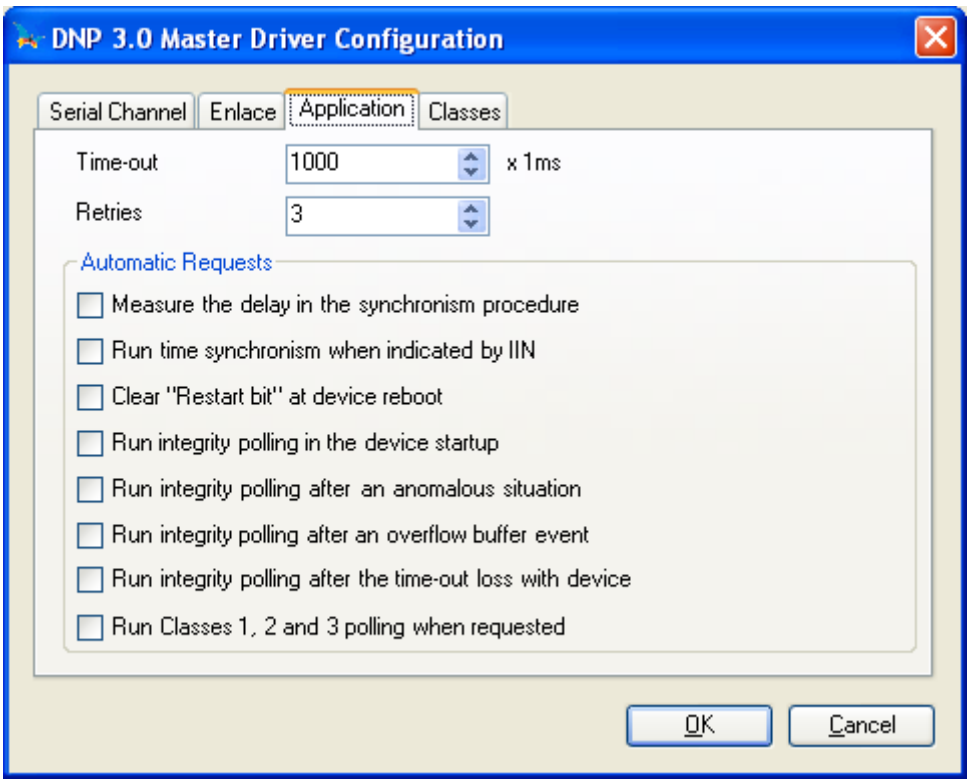


Figure 8-8. Master DNP3 driver configuration window

The options for the application layer can be configured according to the following table:

Application layer parameters	Default	Values	Notes
Time-out	1000	0 to 65535	x 1ms time-out for application request
Retries	3	0 to 100	Number of retries for application request

Table 8-8. Application layer parameters for Master DNP3 driver

Automatic requests are fired offs by the occurrence of a fire-of event. This feature allows configuring the behavior of DNP3 driver according to the characteristics of the slave devices. Automatic requests are detailed in the following table:

Automatic request	Description
Measure the delay in the synchronism procedure	Uses the function 23 *Delay Measurement* to measure the delay in the transition of message by physical mean before a time setting command in a slave device. It must be used together with the automatic request *Run Time synchronism when indicated by IIN.*
Run Time synchronism when indicated by IIN.	Runs setting time command in the slave device when indicated in the last answering message through the bit *NEED_TIME* in *INN* field.
Zeroes "Restart bit" when the device restarts	Sends the zeroing command of the bit *DEVICE_RESTART* when receiving a message with such bit in one. Some slave devices only restart the communication with the master after zeroing this bit.
Run integrity scan	Integrity scan or integrity polling runs in specific moments in order to update the values of all the points of the slave device and reading all events. The integrity scan is composed by a reading request of classes 0, 1, 2 and 3 shot in the following situations: • **When the slave device starts,** i.e., the *DEVICE_RESTART* of the INN is in one. It is recommended to use this automatic request together with the automatic request of zeroing the "Restart bit". • **After an abnormal situation,** like loss of configuration. It is indicated by the bit *CONFIG_CORRUPT* of the INN. • **After a blowup in the event buffer of the slave,** indicated by the bit *EVENT_BUFER_OVERFLOW* of the INN. • **After a time-out in the communication with the slave.**

Automatic request	Description
Run scan of classes 1, 2 and 3 when requested	Runs the reading of the events of the three classes when one of the bits *CLASS_1_EVENTS*, *CLASS_2_EVENTS* and *CLASS_3_EVENTS* of the INN is in one.

Table 8-9. Automatic requests of the master DNP3 driver

ATTENTION:
The field IIN (from internal indication) is a field of the response frame of a DNP3 slave device. It is present on every frame.

Configuring the Class Polling Period

The configuration of polling period of DNP3 classes is performed on *Classes* tab.

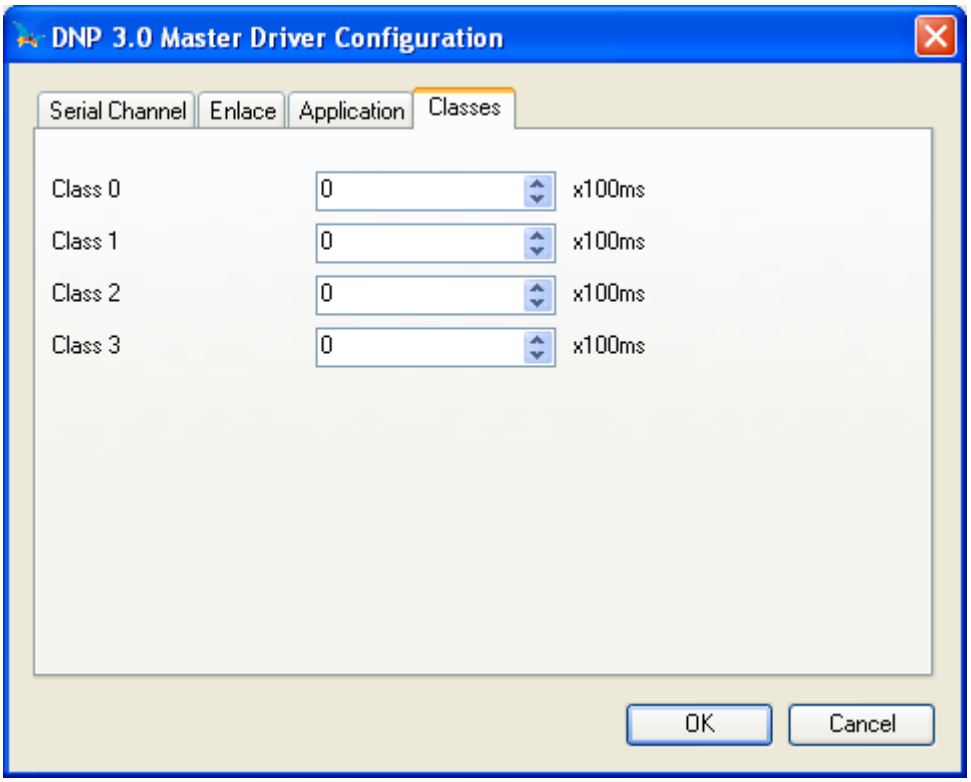


Figure 8-9. Class polling period configuration window

The polling period of DNP3 protocol classes can be configured according to the following table:

Polling Period	Default	Values	Notes
Class 0	0	0 a 65535	x100ms
Class 1	0	0 a 65535	x100ms
Class 2	0	0 a 65535	x100ms
Class 3	0	0 a 65535	x100ms

Table 8-10. Class polling period on DNP3 driver

Ethernet MODBUS Client – AL-3414

The protocol MODBUS over Ethernet Client is implemented in the AL-3414 module. It is possible to configure the AL-3414 to use two types of MODBUS protocol over Ethernet: *MODBUS TCP* and *MODBUS over TCP/IP*.

ATTENTION:
This section describes the automatic configuration of the relations of the MODBUS client. For other information about AL-3414, see also section **AL-3414 – MODBUS TCP Redundant Ethernet Interface**.

Configuring the Relations of the MODBUS Client

The configurations of the relations of the MODBUS client are performed in the *MODBUS TCP configuration* window, which is accessed by clicking *MODBUS client* in the configuration window of the AL-3414.

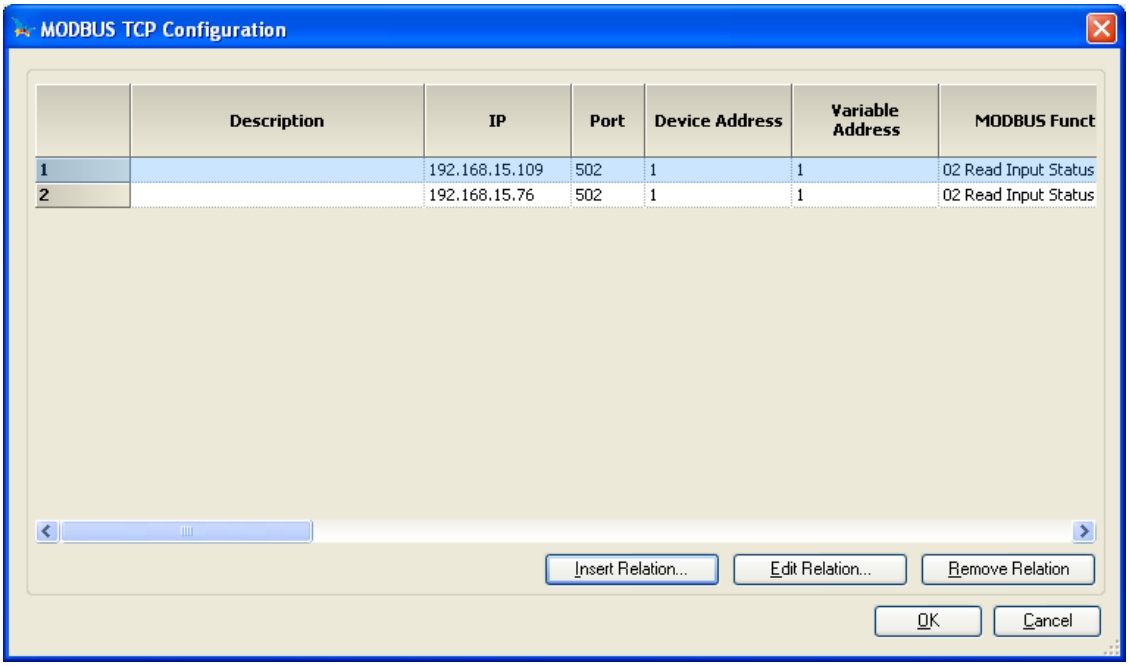


Figure 8-10. MODBUS TCP configuration window

Configuring the Group of Communication Points

In the MODBUS TCP configuration window is possible to insert, edit or remove relations. Each relation establishes a MODBUS function to a group of communication points.

MODBUS Function	Description	Type	Format
01	Read Coil Status	DI	D1, D2, D8
02	Read Input Status	DI	D1, D2, D8
03	Read Holding Registers	DI	D1, D2, D8
		AI	I16, UI16, I32, UI32, F32
04	Read Input Registers	DI	D1, D2, D8
		AI	I16, UI16, I32, UI32, F32
05	Force Single Coil	DO	D1, D2, D8
06	Preset Single Registers	DO	D1, D2, D8
		AO	I16, UI16
15	Force Multiple Coils	DO	D1, D2, D8
16	Preset Multiple Registers	DO	D1, D2, D8
		AO	I16, UI16, I32, UI32, F32

Table 8-11. MODBUS functions table

ATTENTION:
When a group is edited or inserted, the diagnostics operands of the associated communication modules are configured to %M000 and %M0001. Only after the verification of the project, such operands are configured to one of the operands in the draft area. The configurations of such operands are only possible using AL-3414 in the manual mode.

The registers MODBUS types (Input registers and holding registers) are integer numerals of 16 bits, but they can be associated to digital types or to numerical typos of 32 bits.

When a register is associated to a digital type (DI or DO), the group of points must contain a multiple of 16 size and each register is copied to the respective set of 16 points. In this case, the bit zero (less significant) of the register is copied to the first point of the set, the bit one is copied to the second and so forth.

When a register is associated to an analog type (AI or AO) of 32 bits (I32, UI32, F32), two register are read or written for each point of the group, where the first register is stored in the high part (bits 31 to 16) and the second register is stored in the low part (bits 15 to 0) of the point. The moving order can be inverted by marking the option **Swap Word** in the group edition window.

ATTENTION:
When a MODBUS register is associated to a group with a format different of 16 bits, the amount of points of the group does not match the amount of register read or written.

The window for edition of groups allows editing the MODBUS relation associated to the group of communication points. The items *Group*, *Initial Value* and *Event Control* have the same behavior of the standard window for edition of groups. For the edition of relation, it was added the item *IED* only.

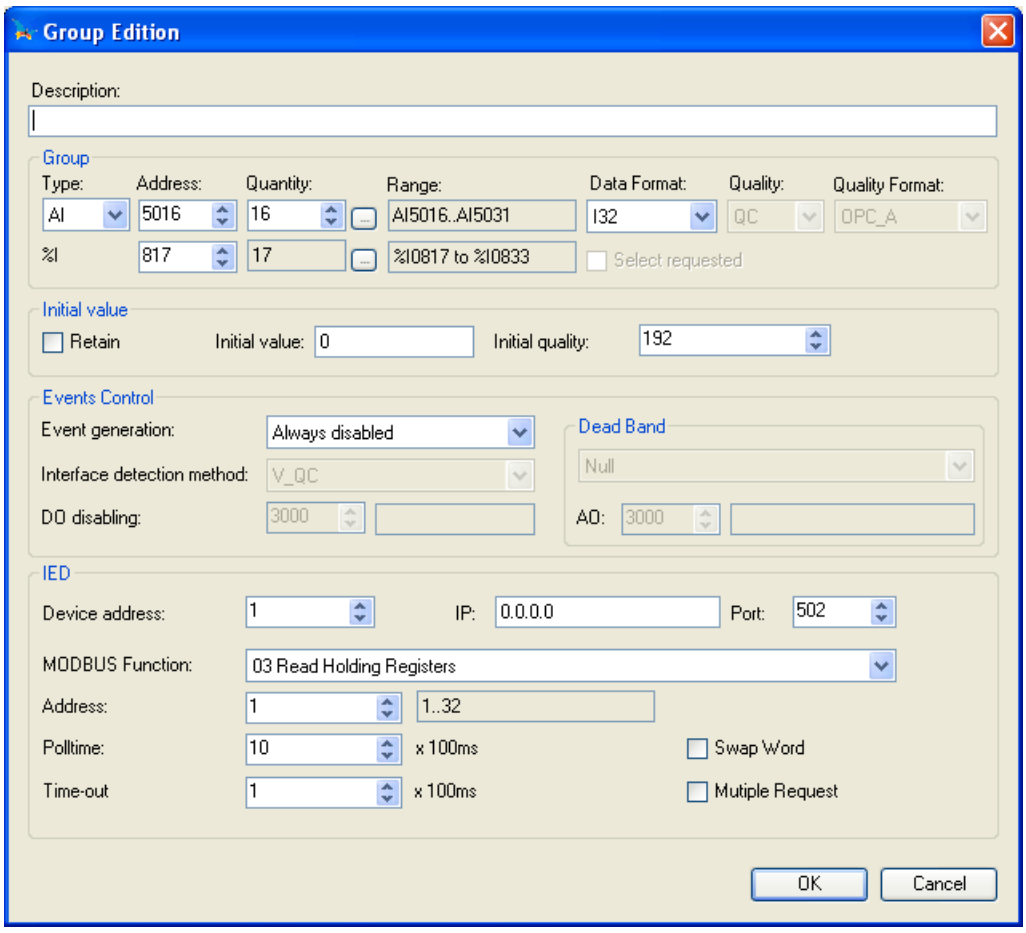


Figure 8-11. MODBUS TCP group configuration window

Options for *IED* item can be configured as shown below:

IED Parameters	Default	Values	Notes
Device Address	1	1 to 255	Address of the slave device.
IP	0.0.0.0		IP address of MODBUS server.
Port	502	0 to 65535	Connection port in MODBUS server.
Function			MODBUS functions as described in Table 7-10.
Address	1	1 to 65535	.Address of the point in the slave device.
Poll time	10	0 to 10000	x 100 ms Note: zero enables continuous polling
Time-out	30	1 to 255	x 100 ms

Table 8-12. Parameters of IED item for the edition of MODBUS TCP group

ATTENTION:
When a time-out in the communication of relation occurs, such relation will be disabled for a minute while a new retrial will take place. If the problem persists, the relation will again disabled for a minute. This procedure will be repeated until the communication normalizes.

The disabling control of relations is performed by operand configured by user in the configuration window of the AL-3414 module. The values of these operands must not be changed by user.

Configuring Multiple Requests Relations

To enable the option for multiple requests it is necessary to mark the option *Multiple Requests.*

When enabled, indicates that the respective server equipment supports receiving two or more MODBUS requests in parallel, i.e., the second or posterior requests may be sent even before the first has been answered.

In order to the requests for a certain server, equipment can be sent in a multiple way, it is necessary that all the relations associated to the IP address have this field enabled.

This field is meaningful only when a particular server machine has more than one addressed to the same ratio.

This parameter is valid only for MODBUS TCP protocol, since MODBUS RTU on TCP/IP protocol does not support the handling of multiple requests.

9. Installation

This chapter describes how MasterTool Hadron XE is distributed, hardware requirements and software needed to its execution, the procedure to installation in HD from distribution CD-ROM and how to initialize MasterTool Hadron XE running.

Distribution CD-ROM

O MasterTool Hadron XE is distributed in a pack containing:

- One CD-ROM
- License Contract for Altus Software

CD-ROM contains a folder called MasterTool Hadron XE that contains the Autorun.exe program. For more details about the installation see the section **Installing MasterTool Hadron XE** ahead in this chapter.

Internet Download

O MasterTool Hadron XE can also be obtained by downloading it from Altus page (www.altus.com.br).

It is recommended to user to, periodically, perform an update download of the software in order to, by doing this, he takes notices about new feature added to the new versions of MasterTool Hadron XE.

Hardware and Software Requirements

Minimum requirements for the use of MasterTool Hadron XE are described in *Technical Description* chapter.

ATENTION: Installation and use of MasterTool Hadron XE must be done using an user login belonged to the administrators group.

MasterTool Hadron XE Versions

Frequently, MasterTool Hadron XE software can have alterations, like the inclusion of new features, changes and so forth. As it happens, it is released a new version of the product. Users that have the MasterTool Hadron XE license will always have access to the use of the most recent versions from when the software has been acquired. However, new functionalities and features can be blocked, being free only for new software keys.

So, every time it is needed to download the MasterTool Hadron XE software from internet, this can normally be used with the existing software key.

Installing MasterTool Hadron XE

To install MasterTool Hadron XE in Windows:

1. Insert the CD-ROM in the drive D or according to the configuration of the computer.
2. An auxiliary program is automatically exhibited that asks which product to be installed. Click in **MasterTool Hadron XE** to continue the installation.

3. Follow the procedures shown in the screen.

ATTENTION: The user must install Microsoft Framework.NET. provided in the MasterTool Hadron XE CD in the first time the software is installed in the computer. The package of Function Modules is also provided in the installation of the MasterTool Hadron XE, but every time a MasterTool Hadron XE project is changed, it is suggested to update this package through the Altus site (www.altus.com.br). The MdacTyp installer is not necessary to be installed in Windows XP because this operational system already has the necessary features.

Uninstalling MasterTool Hadron XE

To uninstall MasterTool Hadron XE from Windows there are two ways to do it:

- Click in **Start** button, select **Programs**, **MasterTool Hadron XE**, and click in **Uninstall** MasterTool Hadron XE.
- Through Windows **Control Panel**, select **Add or Remove Programs.**

Starting MasterTool Hadron XE

To use MasterTool Hadron XE it is necessary to get a license, i.e., a software key that allows the use of MasterTool Hadron XE. This key is requested in the very first time MasterTool Hadron XE is executed, through a screen as shown:

Figure 9-1. Screen for the insertion of the software key

In the case, you do not have this key or you have an invalid key, there is the option of MasterTool Hadron XE to be executed in Demo mode (Demo). This way, the software will work normally but it will be not allowed:

- To communicate with devices both by serial and by Ethernet
- To save any document or module

Some functionalities are restricted according to the version of the software key, i.e., if the key of the software is the of same version of MasterTool Hadron XE, then all functionalities will be available. However, if the version of the software key is before the version of the MasterTool Hadron XE, it

enables only the functionalities released until the version of the software key. To check the version of the software key just, after installed and informed the key, to click in **Help** menu, item **About..** It will be shown a window like the next illustration that contains this information, together with the MasterTool Hadron XE version. For more details, see the chapter **MasterTool Hadron XE Versions.**

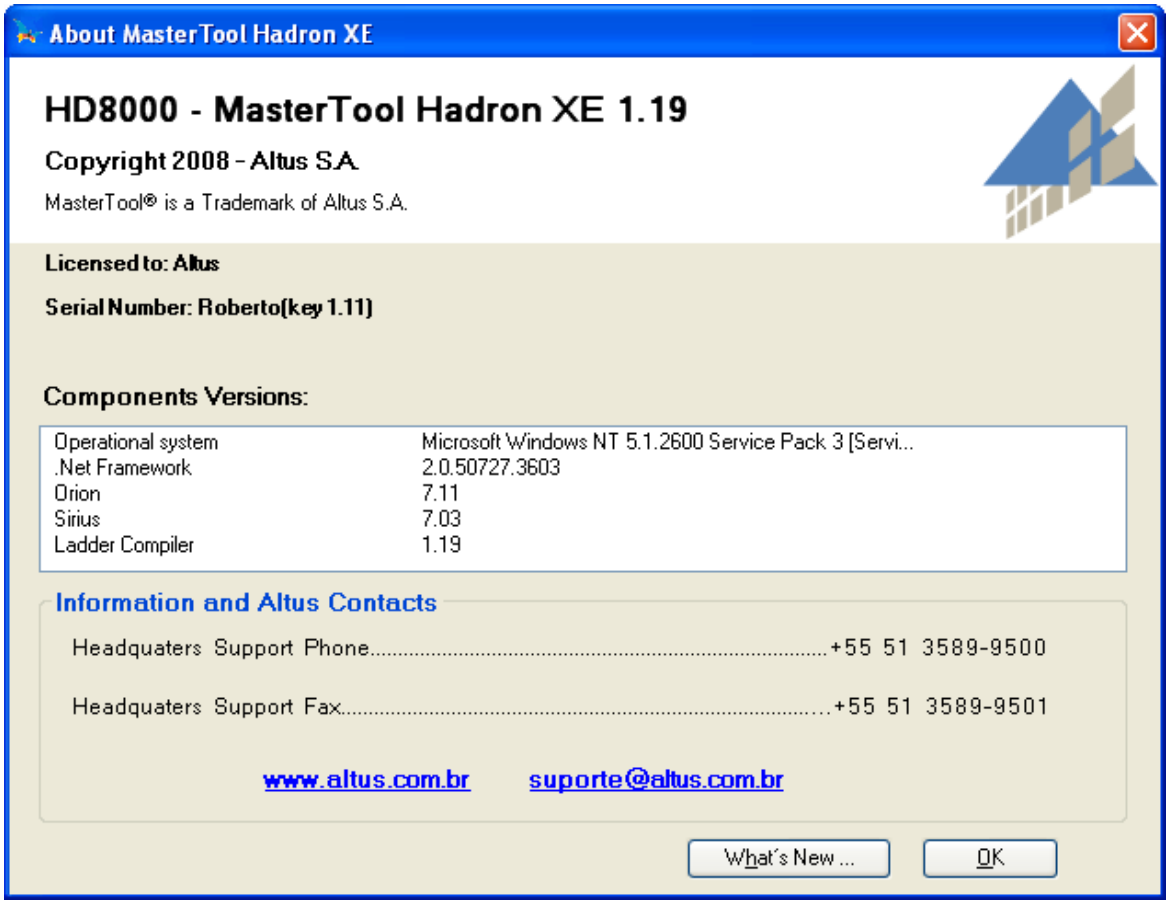


Figure 9-2. About window of MasterTool Hadron XE

Connections

MasterTool Hadron XE communicates with the AL-2004 CPU through the serial channel or via Ethernet by AL-3412 or AL-3414 modules.

If there is more than one serial interface of type RSJ-232C, MasterTool Hadron XE assumes the communication will be performed by the interface 1 (COM1). It is possible, however, to define other serial interface to perform the communication through MasterTool Hadron XE commands.

CAUTION:
The connecting or disconnecting of any equipment with the computer must be done with such equipments turned off the electrical power. Otherwise, there is the risk of damage the communication interfaces.

CAUTION:
It is mandatory the existence of grounding between the peripheral equipments and the computer.

Next table shows the connections allowed between the computer in which MasterTool Hadron XE runs and peripheral devices, as well as the Altus cables used for such connections.

Serial Interface	Connection type	Cable used
9 pin	MasterTool Hadron XE and AL-2004	AL-1342 or AL-1343
9 pin	MasterTool Hadron XE and communication adapter AL-1413 RS-232/RS-485	AL-1349
9 pin	MasterTool Hadron XE and standard MODEM RS232	AL-1346

Table 9-1. Types of connections

ATENTION:
Cables Al-1342 and AL-1343 allow communication with AL-2004 configured for the use of "half-duplex" MODEM.

Serial Channel Configuration

After the installation of MasterTool Hadron XE, during its first run, "**Configurations/Communication"** menu command must be selected in order to perform the configuration of the serial channel that will be used for the communication with the programmable controller. Next figure illustrates the configuration screen of the serial channel.

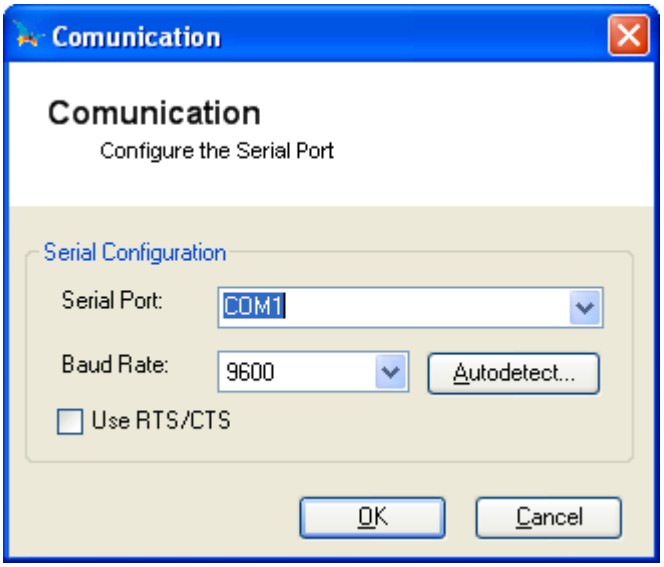


Figure 9-3. Window for configuration and selection of the serial channel

ATENTION:
If the mouse stops working, the communication of the programmable controller was configured to use the same serial channel of the mouse. In this case, the selection of the MasterTool Hadron XE serial channel or the serial channel of the mouse must be changed and Windows must be restarted.

Through the button **Autodetect…** is possible to detect the speed (baud-rate) of the serial port selected. Clicking this button, the next window opens:

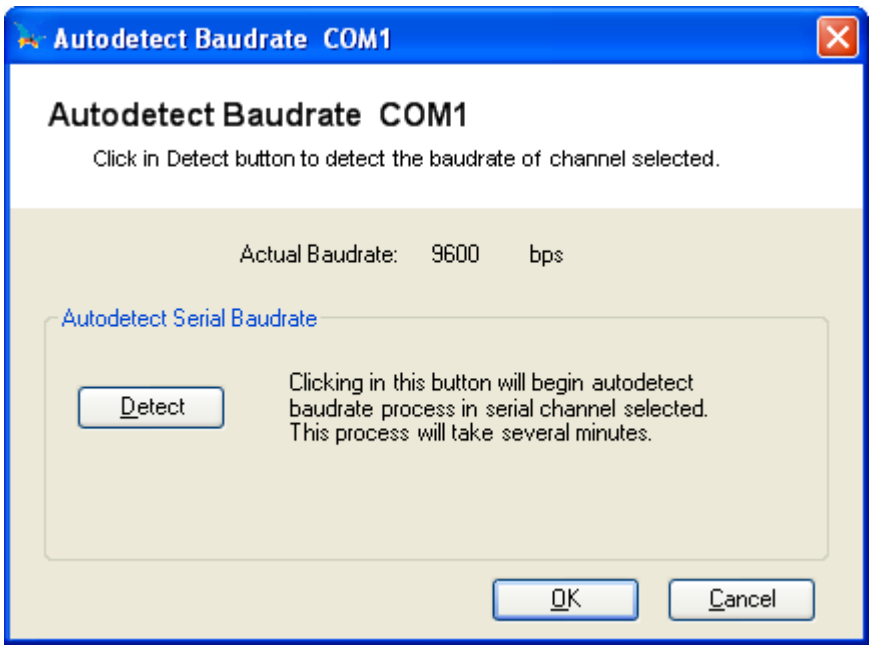


Figure 9-4. Self detect: speed of the serial channel

Clicking on ***"Detect"…*** a scan is executed of all the communication speeds available until the adequate speed is found, as seen below:

Figure 9-5. Speed detected

ATENTION: This detection automatic of speed of the communication of the serial port will work only id the computer is linked with a AL-2004, which must be energized.

10. Communicating with the RTU

MasterTool Hadron XE can use any of the serial interfaces or can be used also an Ethernet channel of the computer, in order to perform communications with several equipments. These communications can be used to reading or sending modules to/from PLCs, monitoring application programs, change the status of the CPU, monitoring or forcing operand, among other tasks.

These communications always use the ALNET I protocol for serial communication or ALNET II for communication via Ethernet. Both protocols are of Altus.

Selecting the AL-2004 of the Communication Network

Before performing a communication with a AL-2004, it is necessary to configure in MasterTool Hadron XE the physical mean used and the address of the AL-2004 in the network. The physical mean, here called Channel must be chosen between **Serial** and **Ethernet.**

The configuration of the address is done through the **Communication/Address…** menu and when this menu is selected, a configuration screen is shown like the following figure:

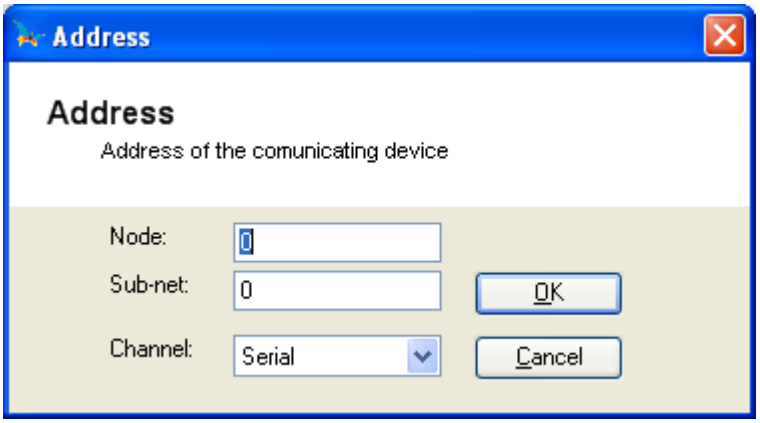


Figure 10-1. Configuring communication and address of the AL-2004

The address configured in this window is used for all commands of communication of the MasterTool Hadron XE, except some commands, which uses their own addresses in each window, such as operand monitoring. The configuration of this window is saved together with the project (when it is open).

Address of the AL-2004 with Serial Channel

Before performing a serial communication, it is necessary to configure the **Knots** and **Sub-network** with which the communication is to be performed. These addresses identify the AL-2004 to which MasterTool Hadron XE perform the communications. Only the address 000 must be used for the knot and the sub-net, this address is for point-to-point communication between MasterTool Hadron XE and the AL-2004. Other values for the address are used only for ALNET II serial communication using gateways AL-2004; however, this network is not part of the Hadron HD3002 architecture.

Address of the AL-2004 with Ethernet Channel

The same way the serial channel, Ethernet channel needs an IP address in the Ethernet network to perform communication with it. The valid addresses to use in this type of communication are the same as used in an Ethernet network.

Sending the Project to the RTU

The project needs many tools for its sending to the RTU. The definition of the tool depends on the module. There are three modules, which need separate tools for sending the module.

- **AL-2004**: is used as a CPU of the main rack and the expansion racks. HD8000 itself is used for sending of the modules C, E, P and F created by the user or generated. See section **Sending Modules to CPU AL-2004** for more details.
- **AL-3406**: used as PROFIBUS master interface. This module must receive the .PB file containing the communications relations. For this, it is used the tool AL-3865. See section **Sending the Configuration File to AL-3406** form more details.
- **AL-2005**: is used as a coprocessor to run drivers of communication. The drivers are loaded using the tool AL-3860. See section **Sending Communication Drivers to AL-2005**.

Sending Modules to CPU AL-2004

A project in Hadron RTU is divided in up to five smaller projects, one for each rack. MasterTool Hadron XE exhibits only the project of the main rack, but all projects must be sent to their respective rack.

For sending modules to a rack, you must first select the proper programming channel. Serial and Ethernet channels are available. However, the last is functional only when an Ethernet interface in the rack, with ALNET II protocol enabled and configured.

ATENTION: To send the modules to the expansion racks only serial channel is available.

After selecting the communication channel, it is necessary to choose the rack desired to send the module through the *Communication* Download/Upload Modules. After the rack is selected, it is shown in the window Upload or Download Modules.

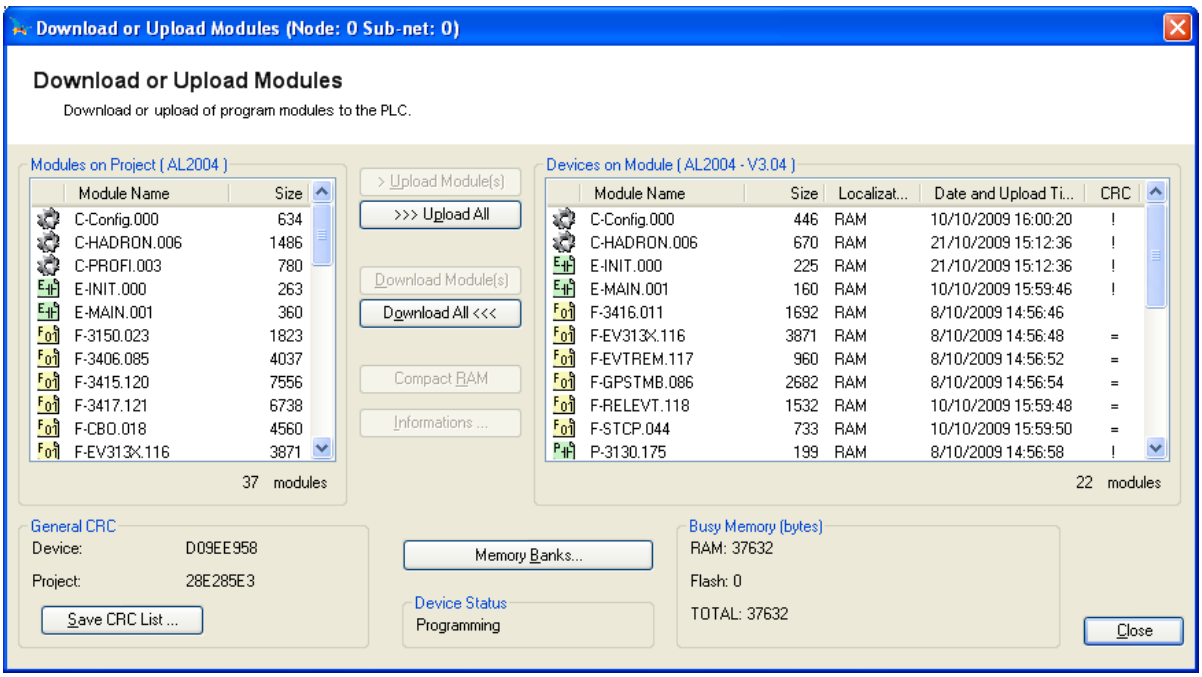


Figure 10-2. Download or upload modules window

This window shows many information, both of the MasterTool Hadron XE project in disk and in AL-2004. There are two lists of modules in the screen: the first shows the **Modules in Project**, where there are listed all modules saved in the project, and the second list, **Modules in Device**, shows exactly the module in the memory of the AL-2004.

The list of **Modules in Device** contains one line for each module contained in its memory, and the following columns:

- **Name of the Module**: name of the module that is in the memory of the Al-2004
- **Size**: Size of the module in bytes
- **Location**: informs whether the module is in RAM or EPROM
- **Sending Date and Time**: date and time in which the module was sent to AL-2004
- **CRC**: this column indicates whether a module is equal (=) or different (!) of the respective module in the project. If there is no indication, then it is because the module only exists in AL-2004 and that in the project there is no project with the same name

The list of Modules in Project contains a line for each module belonged by the project, and has only two columns: Name of the Module and Size, with the same meanings of the other list.

In the lower part of the Download or Upload Modules screen, there are the status of the memories used by AL-2004, as well as its status and the CRC of the project in disk and of the project in AL-2004.

To send a module from the window Download or Upload Module just select the module from the list of the **Module in Project** and click in > **Upload Module(s).** One or more modules can be selected. In the case of sending all the modules of the project to the CPU just click on >>> **Upload All** button. In addition, you can send a module though the Treeview of the project, by right clicking on the module and selecting the option **Upload Module.** The process of sending of module automatically performs a verification of the project using, in this case, also the data from the AL-2004 that is communicating. If there is any error or warning, a window will open indicating the abnormalities. In case of existing error, the modules will not be sent to the AL-2004 until the errors are corrected. If there are only warnings, a window opens containing the occurrences, and asking whether the user really wants to send. The verification window is shown below:

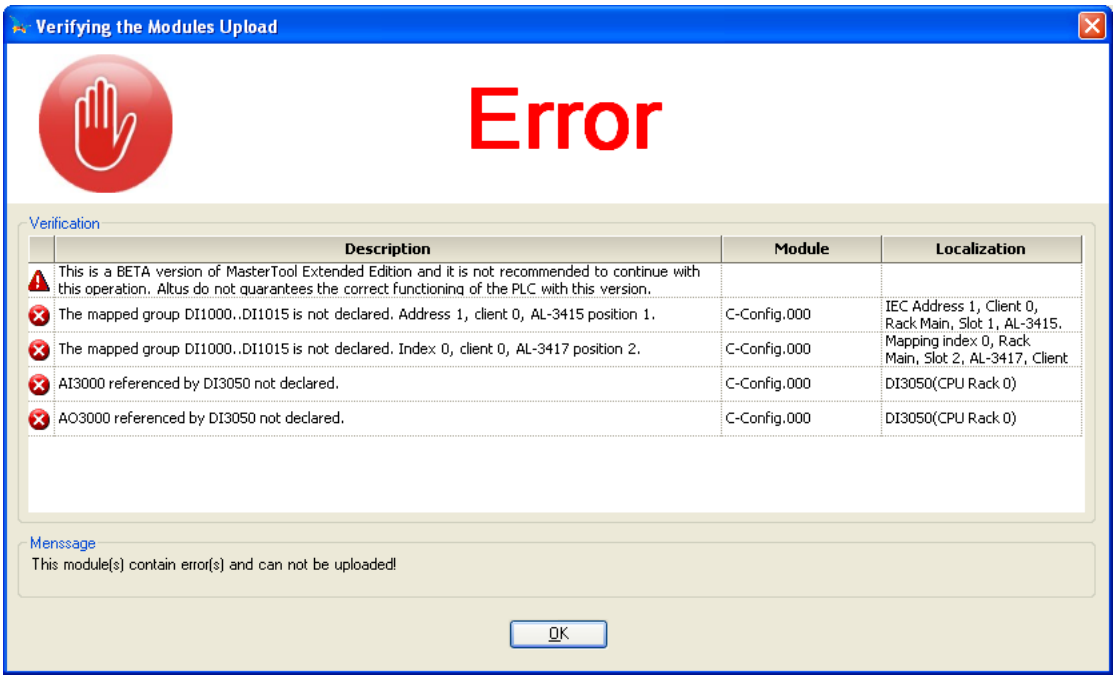


Figure 10-3. Error example while uploading a module to AL-2004

If the sending of module(s) is concluded, the sent modules will be shown in the list of Modules in AL-2004. When a module is sent and if there is an equivalent one in AL-2004, this will be overwritten.

To upload modules which compose the architecture of the Hadron, it is necessary that the CPU AL-2004 to be in programming. If not, the following message will be shown:

Figure 10-4. Hadron modules cannot be sent if AL-2004 is in programming

It is extremely important that all modules of the architecture Hadron are equal, between the computer and the CPU. If any Hadron module is not selected for sending, the following window opens asking if the other changed modules is to be sent. If **Yes** is clicked in all listed modules in the window and the module selected for sending will be to AL-2004. If the choice is **No** only modules selected will be sent.

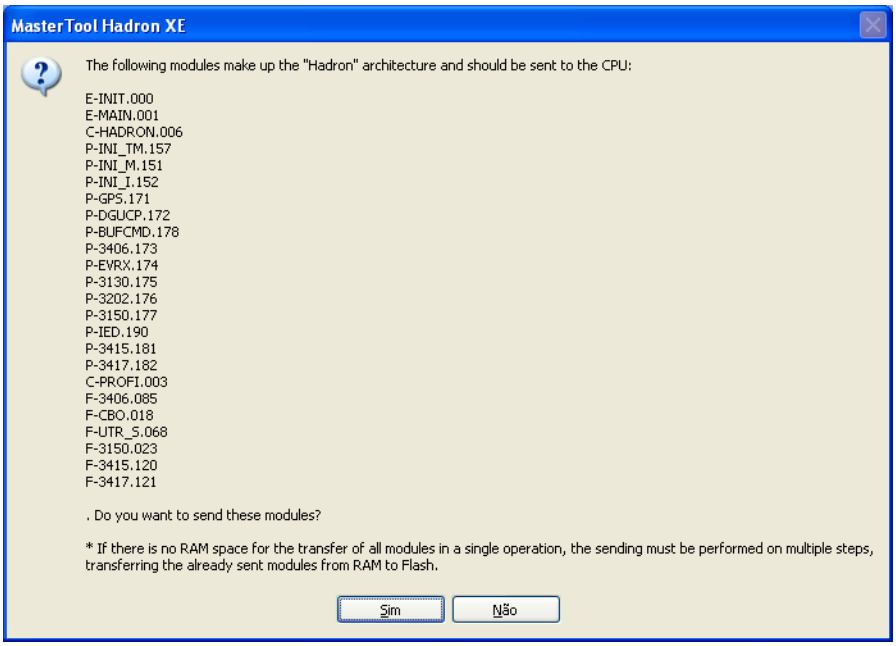


Figure 10-5. Warning window indicating there are modified Hadron modules which were not selected for uploading

ATENTION: The configuration file of Hadron RTU is not sent to AL-2004, so it is not possible to restore the configuration of the RTU by only reading the modules that are in AL-2004.

ATENTION: Only module that is part of the project can be sent to AL-2004. Before sending the project, make sure that any other module not related to the Hadron architecture was deleted from the AL-2004 memory.

ATENTION: Module sending is not allowed if AL-2004 is in error mode.

Reading AL-2004 Modules

To read an AL-2004 module, from the window Read or Send Module, just select the module in the list **Modules in Device** and click in **Upload Module(s).** One or more modules can be selected. In the case of reading all AL-2004 modules, just click the **Upload All** <<< button. The AL-2004 module read will be included in the project, overwriting, if it is the case, an equivalent module.

ATENTION: It is only possible to read modules created by the user himself. It is not possible, for instance, to restore an Hadron project from the reading of all AL-2004 modules.

Sending the Configuration File to AL-3406

The module AL-3406 needs the configuration file of the PROFIBUS to be loaded in order to its correct performance. Configuration file has the extension .**PB**.

In manual configuration AL-3406, the file is created manually by the user through the AL-3865 tool. In addition, in AL-3406 for communication with the expansion racks, the file is automatically created by MasterTool Hadron XE. In both cases, AL-3865 is used to send the configuration file.

The configuration file for the expansion racks is always sent by AL-3865 when there is an expansion rack configured. This file is saved in the project directory and has the name **Profibus.pb**. It is not necessary to send this file by each new generation of the architecture, except in the following conditions:

- At the initial configuration when AL-3406 is not configured
- When an extension rack is added or removed
- When the PROFIBUS network turns from simple to redundant and from redundant to simple
- When the amount of AL-3416 modules in the expansion racks changes

ATENTION: If AL-3406 does not have the correct configuration file, it will not work.

ATENÇÃO: If the project already have a file named **Profibus.pb**, it will be overwritten.

ATENTION: Do not alter the configuration file used to configure AL-3406 of the expansion racks.

To send the file, run ProfiTool and open the file through the *File/Open* menu. In the work area of the ProfiTool the PROFIBUS network architecture will appear as shown in the following figure:

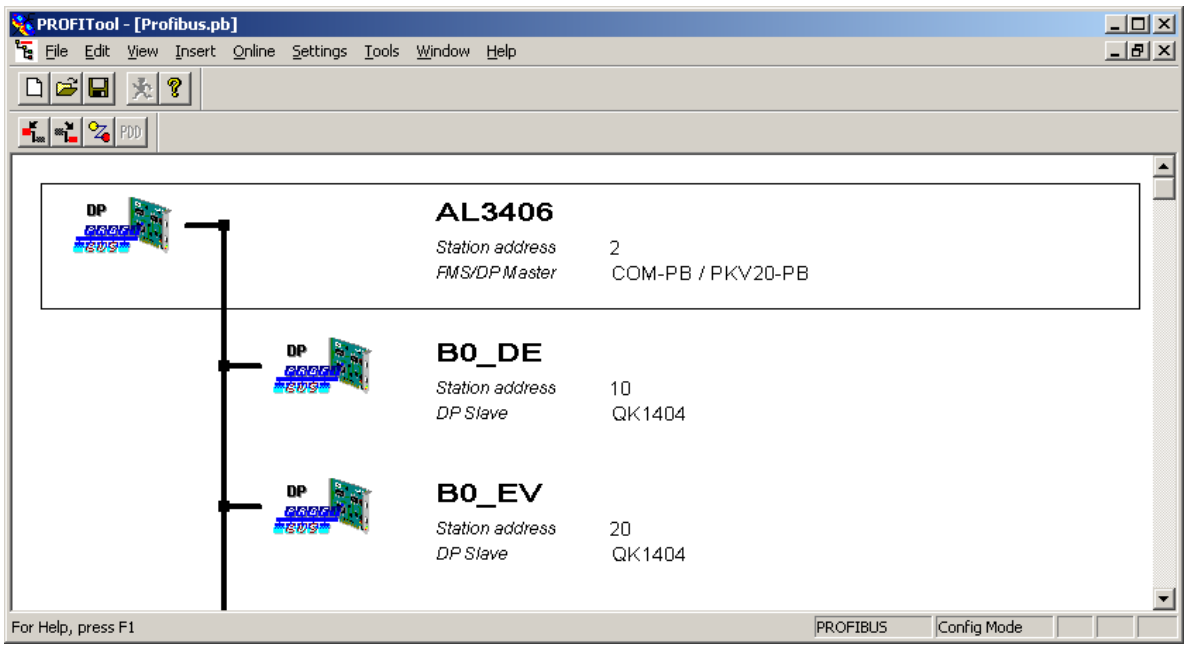


Figure 10-6. Configuring an expansion rack

Open *Online/Download* menu and select the appropriate serial port. If using COM1, close MasterTool Hadron XE since it always use this serial port.

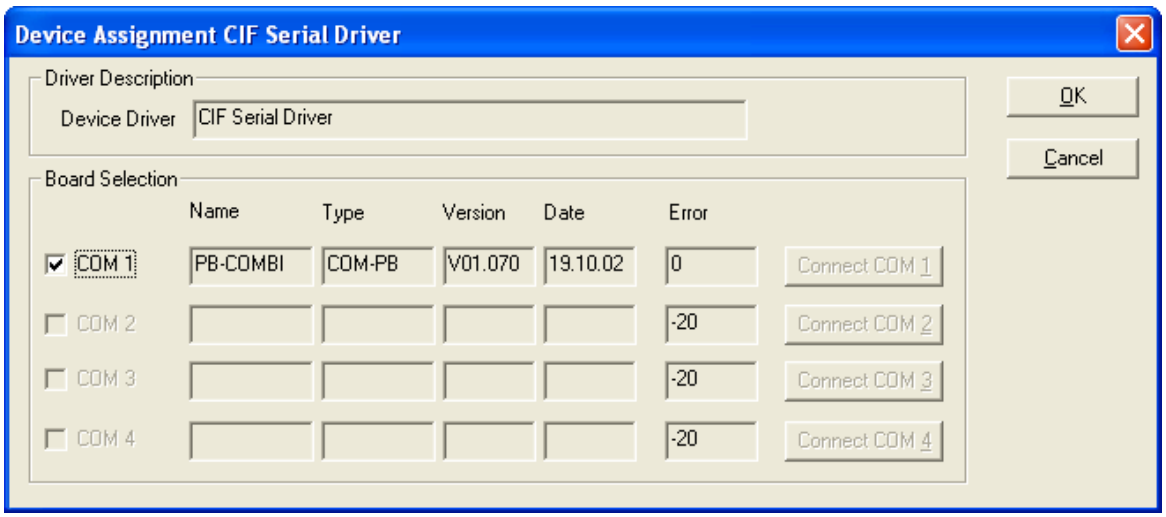


Figure 10-7. Selecting the serial channel used by ProfiTool

The selection of the serial port is only necessary in the first time you transfer. In other operations, the serial port already selected is used.

Before sending, a message is exhibited noticing that the communications with the PROFIBUS slaves will be interrupted during the sending. Click *Yes* to continue.

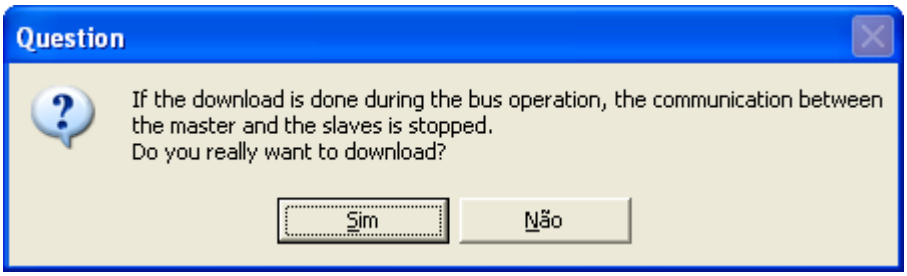


Figure 10-8. Warning of the working interruption of the AL-3406 module

After sending, it is only necessary to wait for the sending of the configuration.

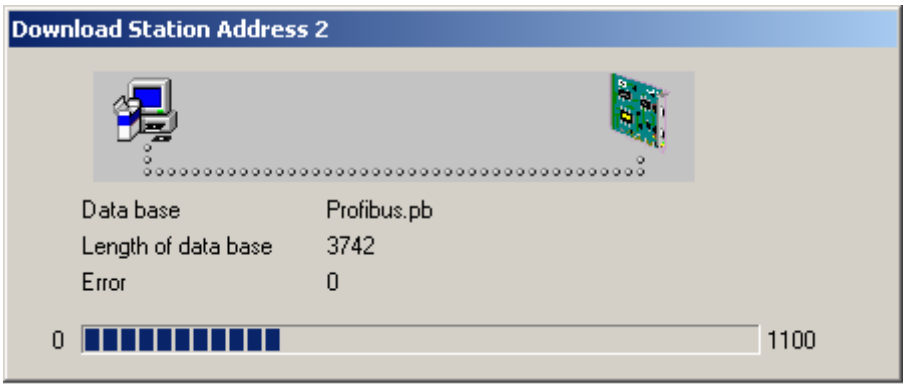


Figure 10-9. Sending the configuration to AL-3406

For more information about AL-3406 or ProfiTool, see the respective user manuals.

ATTENTION: After sending the Profibus.pb file, it must be closed on ProfiTool using the *File/Close* menu.

Sending communication drivers to AL-2005

The module AL-2005 needs the communication drivers to be loaded manually. For loading the drivers, the AL-3860 loader is used. This loader follows with AL-2005.

Running AL-3860, click *Select...* to select the driver to send.

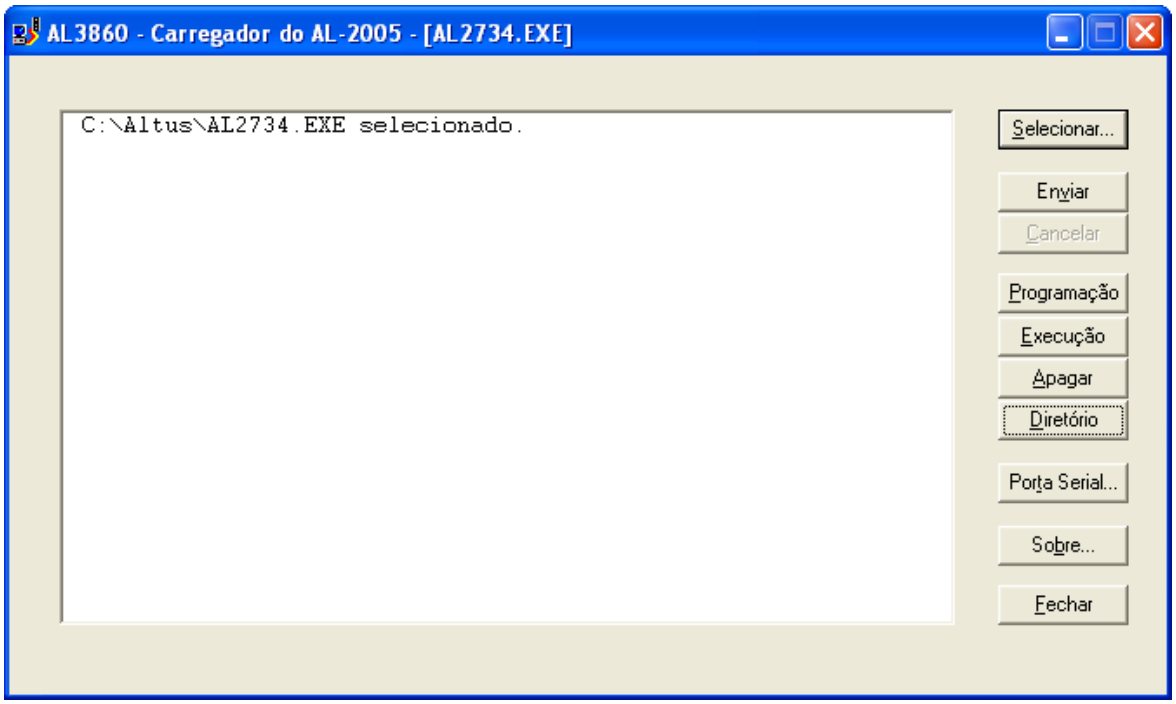


Figure 10-10. AL-2005 Loader

After selecting the driver, select the serial port that will be used, by clicking in *Serial Port...* If you use COM1, close MasterTool Hadron XE, since it always uses this same serial port.

Figure 10-11. Selecting the serial port for communication with AL-2005

Click *Programming* to turn AL-2005 to programming status. By the moment, the drivers loaded in the AL-2005 directory are exhibited. Click *Clear* to clean up the directory if there are drivers not in use.

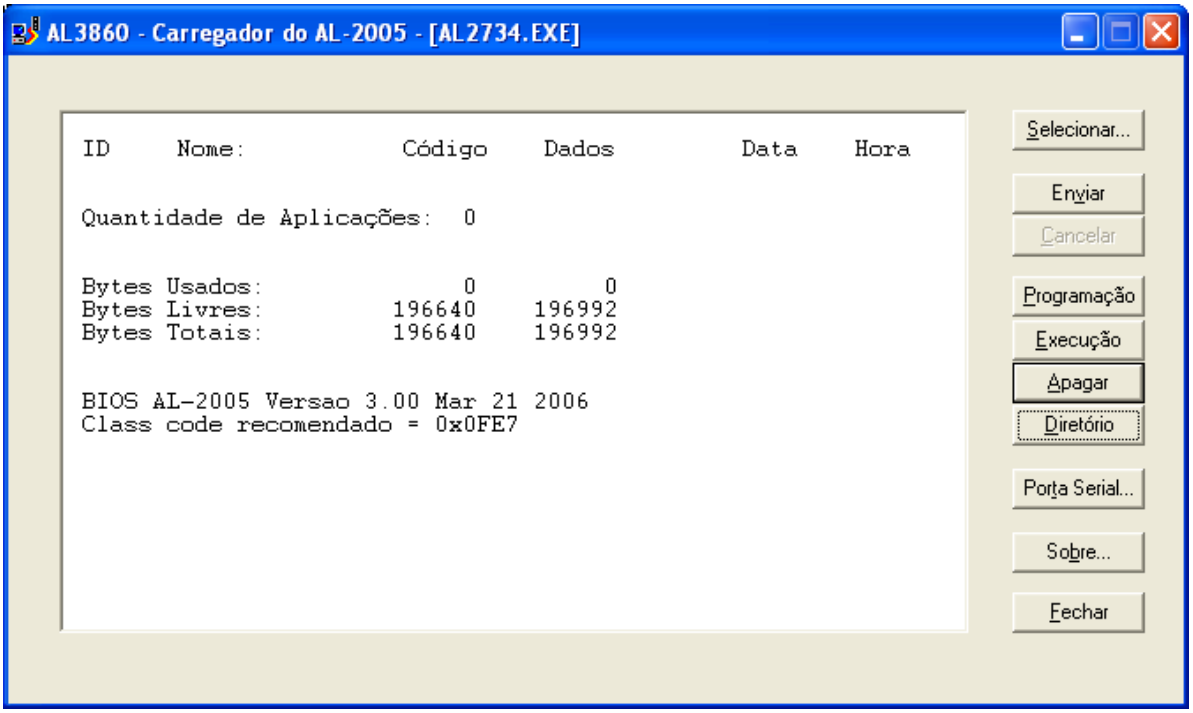


Figure 10-12. Empty application directory of the AL-2005

Click *Send* to load the driver in AL-2005 and wait for the end of the process.

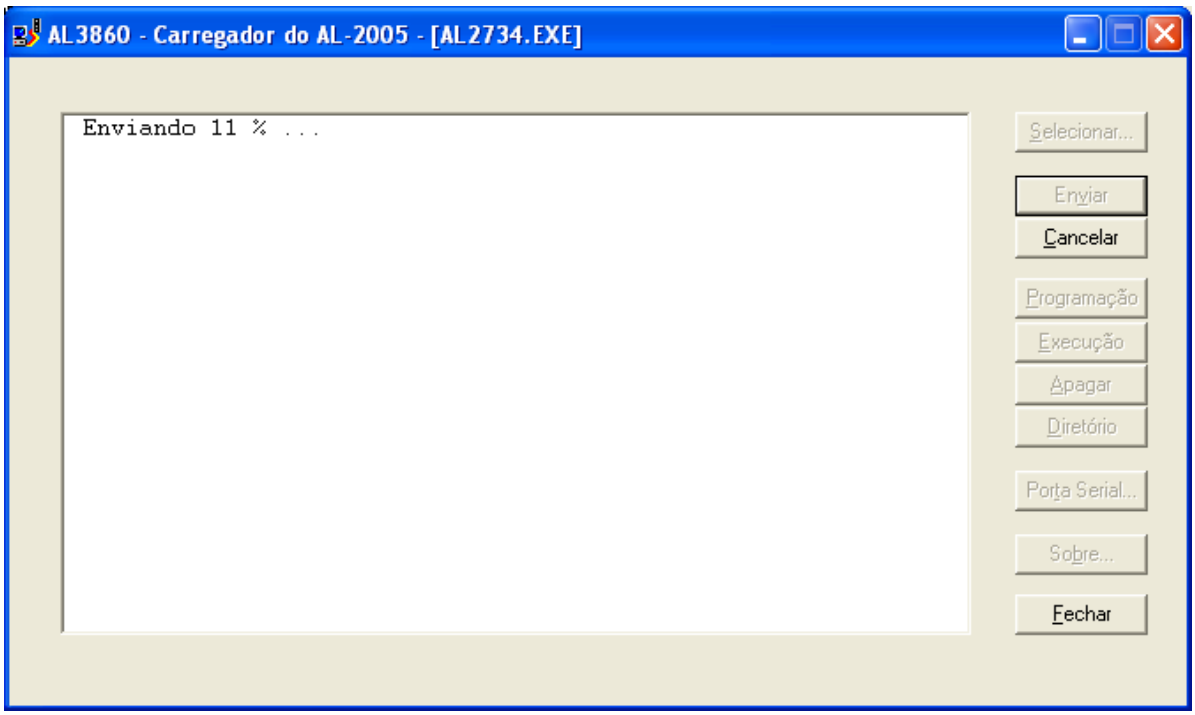


Figure 10-13. Sending module to the AL-2005

If AL-2005 is configured for two drivers, it is necessary to select the new driver and send it to AL-2005.

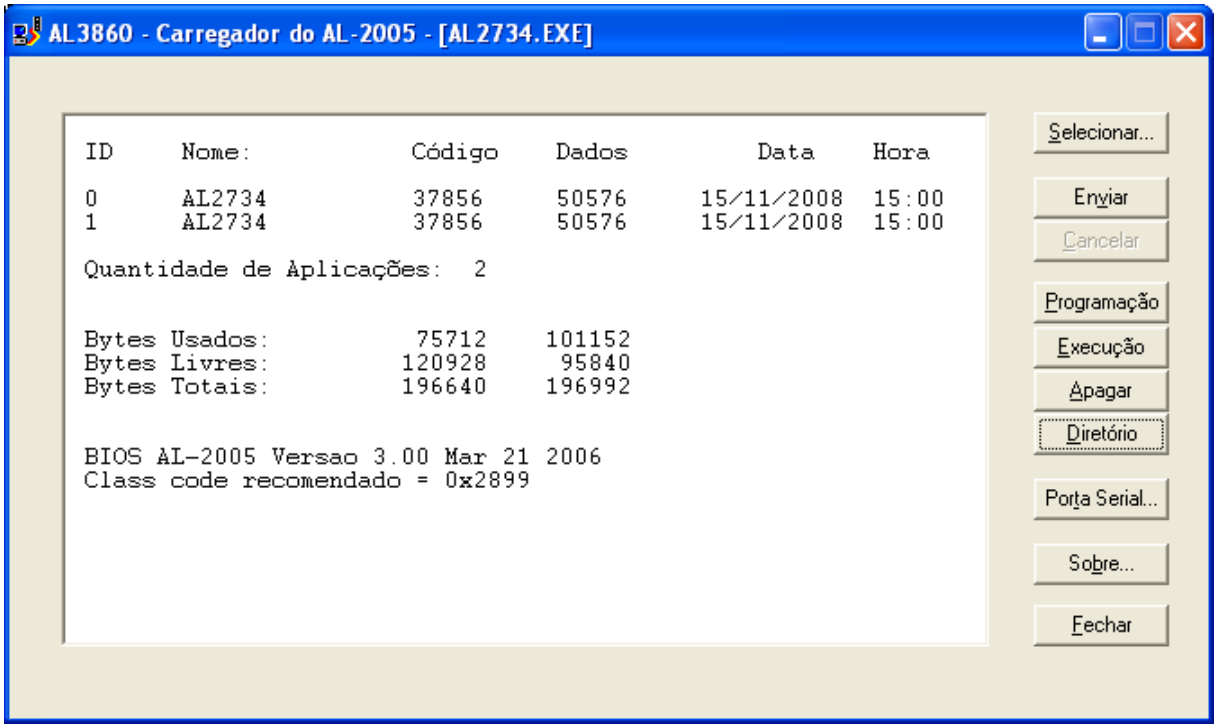


Figure 10-14. AL-2005 application directory with two AL-2734 MODBUS drivers loaded

ATENTION : The drivers must be loaded in the same order in which they were configured in AL-2005.

Modules Window

MasterTool Hadron XE has a window which visualizes the main information about the program memory of the AL-2004, the modules that are in RAM and FLASH and control can be made from where the module will remain. (RAM or FLASH), whether it will be cleared from the AL-2004 memory, etc.

This Modules window can be obtained from **Communications / Modules** menu. Clicking this item, a window opens, as shown below:

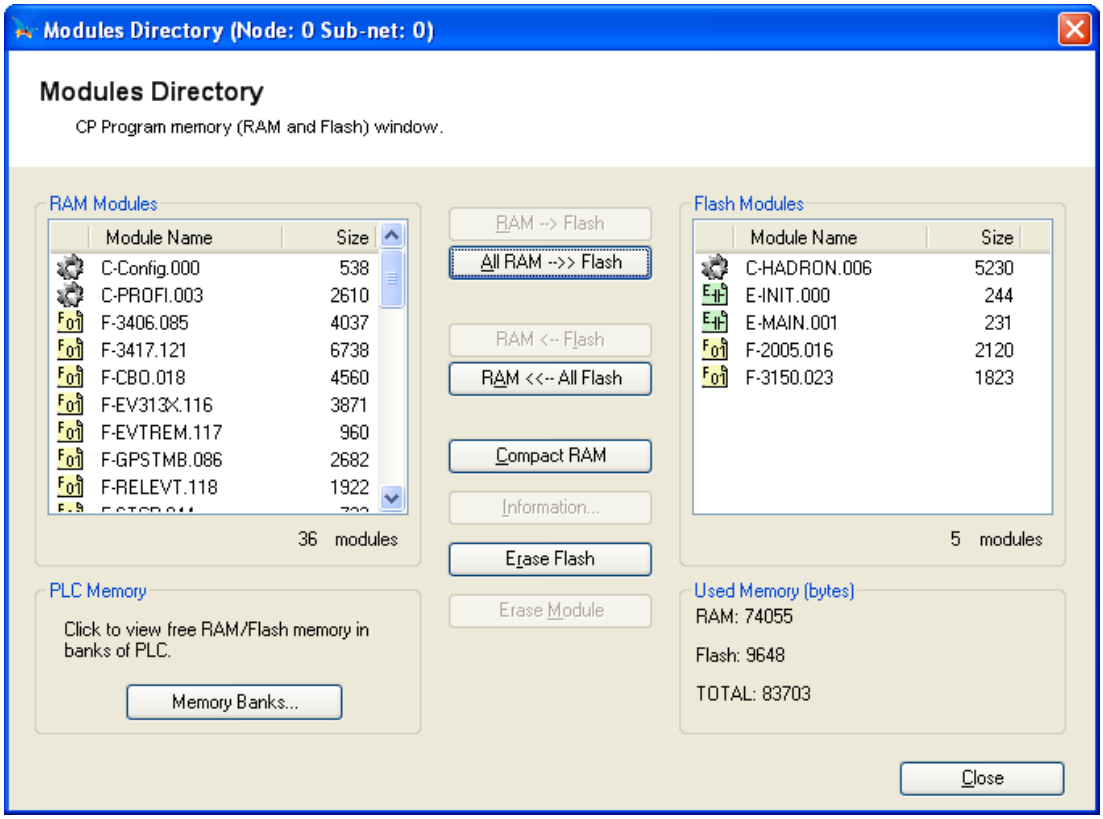


Figure 10-15. AL-2004 Modules window

In upper part of this window, there are two lists: the left one contain the modules that are in the RAM memory of the AL-2004. In addition, the right one represents the modules that are in the FLASH memory of the AL-2004. Each of those lists has two columns, so each line that represents a module indicates the name and size of the module.

In lower part of the window through "Memory Bank" button, the AL-2004 memory banks can be visualized, as well as the size of free and busy memory of the AL-2004.

By this window many other commands can be performed, clicking their buttons the way following described.

Transferring Modules from RAM to FLASH

To transfer a module from the RAM memory to the FLASH memory of the AL-2004 from the Modules window, just click on the module in the list **Modules in RAM** and click **RAM->FLASH.** One or more modules can be selected. If you desire to transfer all modules of the AL-2005, just click **All RAM->FLASH** button.

ATTENTION:
The transference of modules from RAM to FLASH can take several seconds according to the size and amount of program modules existing. This time is necessary to update the windows with the module directory. This operation can be accelerated by turning AL-2004 into programming mode.

Transferring Modules from FLASH to RAM

To transfer a module from the FLASH memory to RAM memory of the AL-2004, from the Modules window, just select the module in the list **Modules in FLASH** and click **FLASH->RAM.** One or more can be selected. In the case of transferring all modules, click **All FLASH->RAM** button.

Erasing a Module

To clear a module off the AL-2004 memory, both RAM and FLASH just select one or more modules in the list **Modules in RAM** or **Modules in FLASH** and click the button **Erase Module**. You will be asked only once for the confirmation of the procedure and clicking OK, the command will be executed.

Erasing the FLASH Memory

To clear the completely FLASH memory, i.e. all module in the FLASH memory of the AL-2004, just click **Erase FLASH** button in the Modules window. You will be asked only once for the confirmation of the procedure and clicking OK, the command will be executed.

ATENTION:
This operation is possible only when AL-2004 is in programming mode.

Compacting the RAM Memory

RAM memory is automatically compressed by AL-2004 each time it is turned into programming mode. When in running status, the RAM is compressed only by performing the correspondent command in MasterTool Hadron XE, since such task increases the time of the cycle of the application program.

To compress the RAM just click the button **Compact RAM** in the Module window.

Getting Information of a Module in AL-2004

In the Modules in Device window, in order to get information about a module in AL-2004 just select a module in any of the lists and click the **Info…** button. This functionality also can be made by double-clicking on the module in any of the lists. Regardless the form it is done, an information window opens just like the module information window in disk.

Memory Bank

By clicking **Memory Banks** button in the Modules Directory Window, the amount of free banks in AL-2004 internal RAM and FLASH memories are shown.

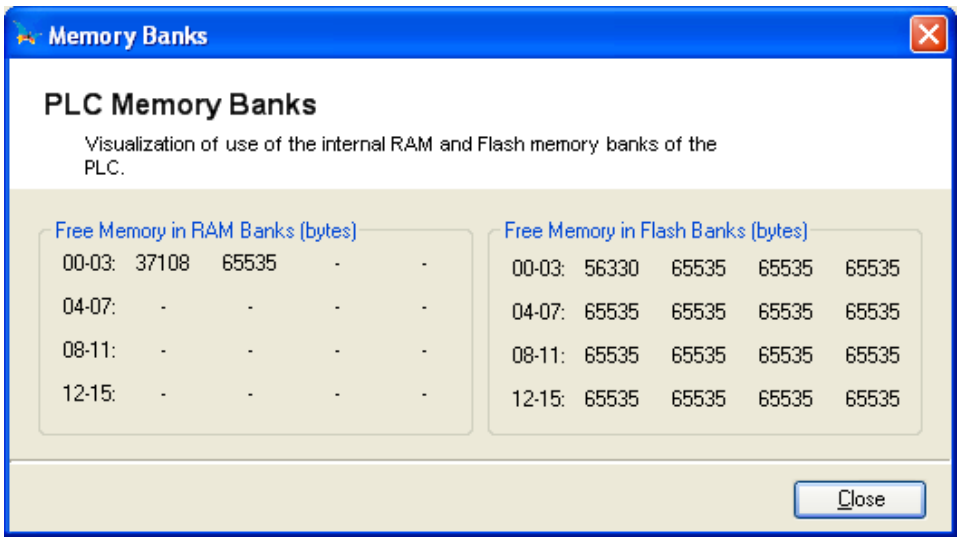


Figure 10-16. Memory bank window

ATTENTION: When the communication is performed through Ethernet network, ALNET II protocol, some memory banks can show a trace (-), indicating the tool is no able to define the free space in such banks. This happens due to a limitation of the commando when run by the Ethernet network.

Status Window

MasterTool Hadron XE has a window to show the major status information of the AL-2004, in the moment the opening of this window is called. This window can be open from **Communication / Status…** menu. Within it many information related to AL-2004 are shown as the next window presents:

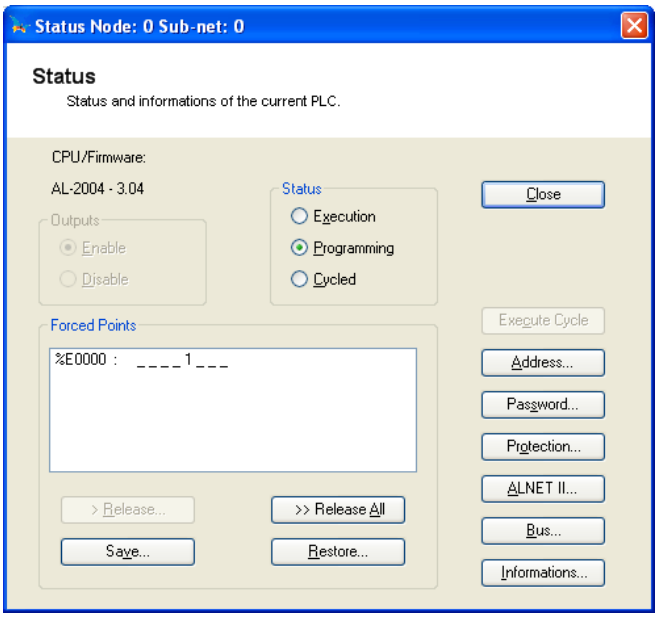


Figure 10-17. AL-2004 Status window

In this window the model of the AL-2004 is shown and the executive version, the current status of the AL-2004, the list of forced operands. In addition, there are many functionalities that can be accessed in this window, using the available buttons in the left side of the screen. This functionalities are discussed next.

Changing the Status of the AL-2004

AL-2004 status can be altered by MasterTool Hadron XE through the selection of the available status:

- Execution
- Programming
- Cycled

For more information about the AL-2004 status see item AL-2004Operation Status, in **Programming Project** section in the Programming Manual of the MasterTool XE.

In cycled mode, the button **Run Cycle** will be enabled for, when clicked, it develops a scan cycle of the AL-2004.

Enabling or Disabling the Outputs

The enabled outputs determine that AL-2004 updates the output points with the values of the image memory. Otherwise, disabled outputs determine AL-2004 that all its digital outputs to be unpowered. However, this operation does not change the status of the corresponding operands in the image memory.

ATENTION: If AL-2004 is unpowered, the disabling of the output points is removed. I.e. when AL-2004 becomes powered again, the status of the memory operands will be normally transferred, at the end of each scan.

The enabled outputs determine AL-2004 to update the output point with the values of

ATENTION: Enable/Disable command of the outputs was blocked in HD8000 since the version 1.20.

Getting Information of the AL-2004

During the execution of an application program in AL-2004, it is possible to verify the status of the Al-2004 at a certain point. Getting information of AL-2004 allows that items to be verified as current mode (programming, execution, cycled or error), error or warning messages, and instantaneous, medium, minimal and maximum cycle times among other parameter shown in the following AL-2004 Status Window.

To obtain all those information just click **Info…** button or from **Communication / Info…** menu. Regardless the used way to get information of the AL-2004, a window opens, as shown below:

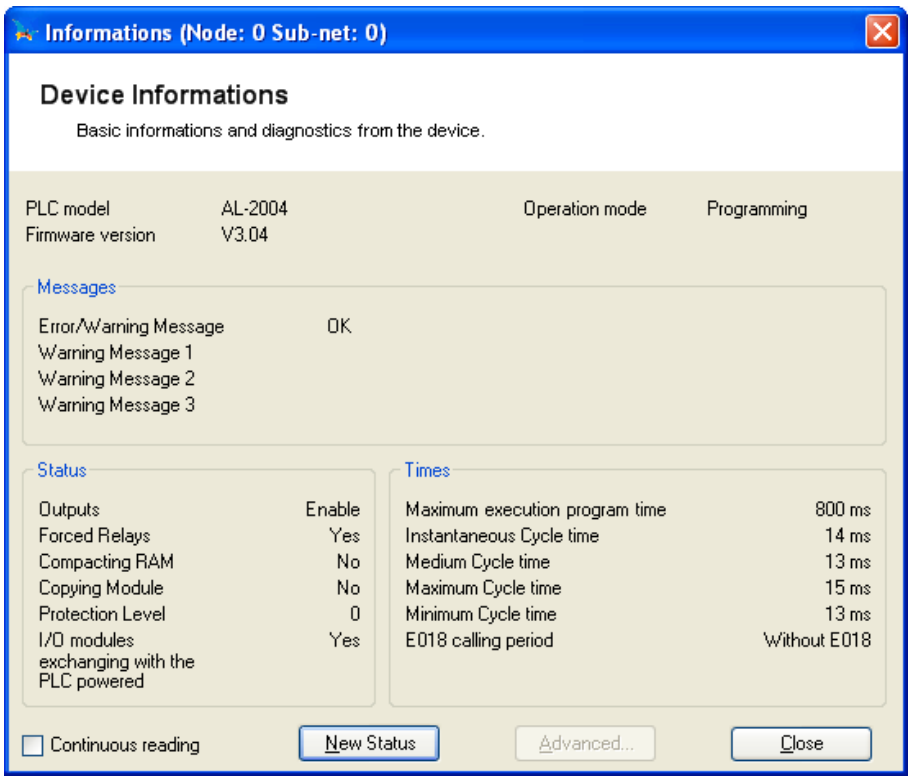


Figure 10-18. AL-2004 Informations window

While the window is open, to update the values contained there, just click **New Status** button or mark the option **Continuous Reading** for a constant update of the screen.

Getting the Status of the Bus

Some computers available some information about the status of the bus of AL-2004. This can be obtained in the Status screen of the AL-2004, through the button **Bus…** By clicking this button, a window like the one below opens:

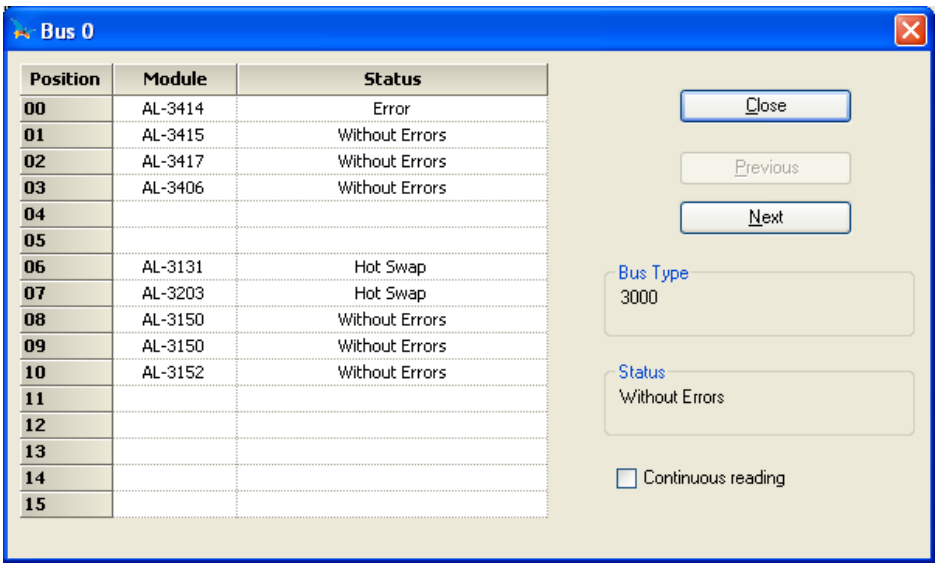


Figure 10-19. Bus status

Obtaining the Status of the ALNET II Network

The status of the ALNET II network can be seen directly from MasterTool Hadron XE. Values related to the statistics of the transmission, receptions and parameters of the device are shown. The status of the ALNET II can be seen only once or in continuing reading. The statistical data can be restarted at any moment.

To obtain the status of the ALNET II just, in the Status window, click **ALNET II…** and a window opens, as the figure shows:

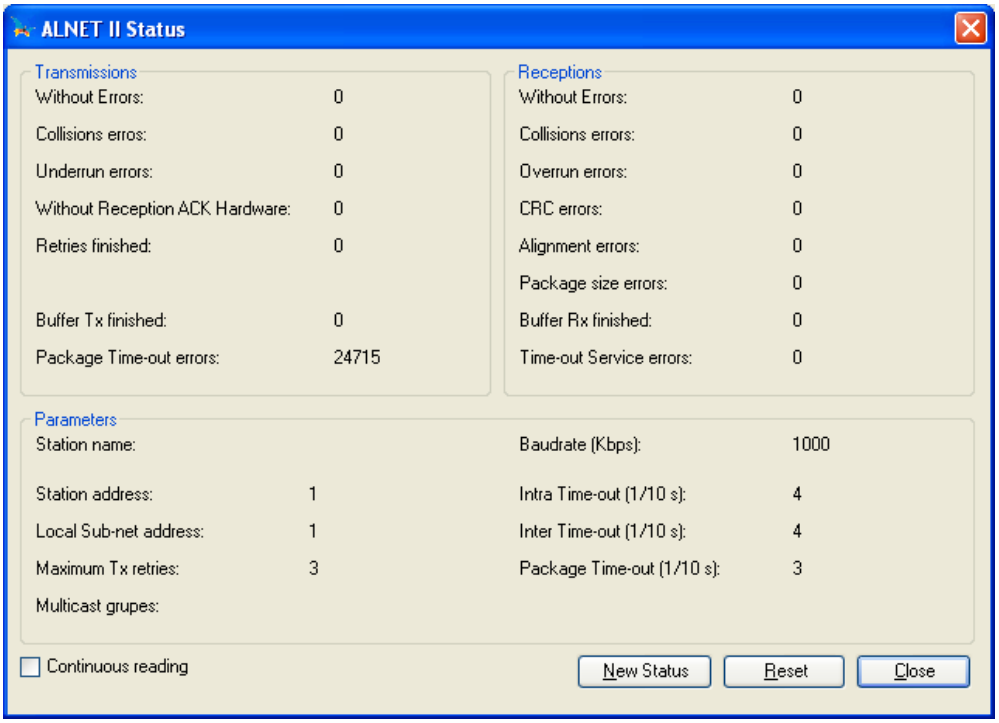


Figure 10-20. Status of ALNET II network

Protecting AL-2004

A number from zero to three identifies the protection level of AL-2004. Each one of such levels provides a set of commands which can be executed in AL-2004 and which cannot. At level zero there are no restrictions, all commands can be executed in AL-2004. As the level of protection increases, the set of possible commands decreases. For more information about the protection levels, see Protection Levels in AL-2004 in the section **Programming Project of the MasterTool XE**.

To change the protection level in AL-2004, from the Status screen of the AL-2004 just click the **Protection...** button and the following window appears:

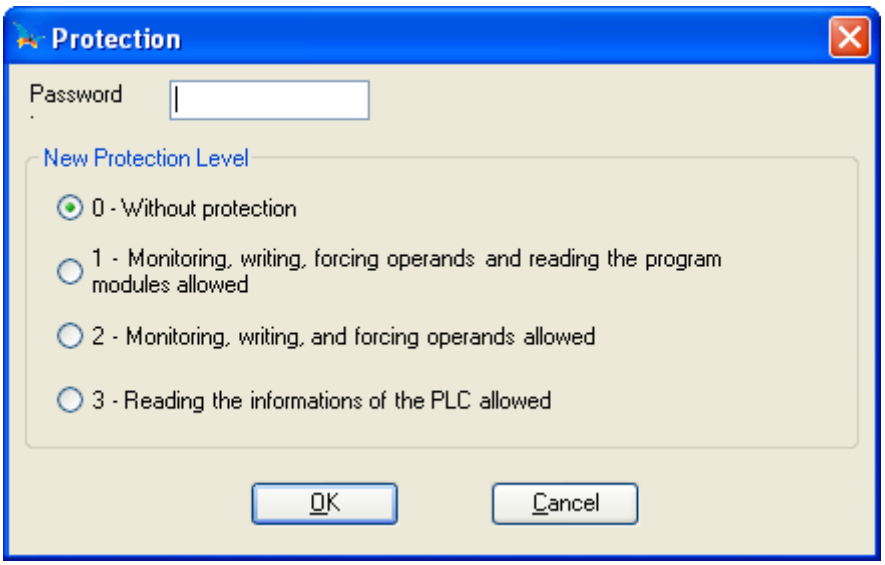


Figure 10-21. Screen for choosing the level of protection of the AL-2004

ATENTION: In case of AL-2004 is protected by a password, it will be necessary to proceed to the change in status.

Inserting / Changing the Password in AL-2004

Changing or inserting a password is done in the Status window of the AL-2004 through the button **Password...** The password is needed to define the protection level of the controller. It may have from one to eight characters. For changing the password, it is necessary to type the current password of the AL-2004 and twice the new desired password.

ATENTION: From factory, the controllers have no defined password, and it is not necessary to type the current password to define the first one. It is recommended that the password to be written and kept in a safe place. In case of loss of the programmed password in AL-2004, contact Altus.

Te screen for changing the password is shown below:

Figure 10-22. Changing a password

For more information about Password, see item Protection Levels of the AL-2004 in the section **Programming Project of the MasterTool XE**.

Forced Operands Status

The Status window of the AL-2004 has in the lower part a list with the status of the force operands points %E and %S. The values are shown in a box with the name of the operand followed by the Status of each point of the operand. The status for each point can be:

- 1 – forced point for the value one
- 0 - forced point for the value zero
- _ - non-forced point

For more information about forcing, see Project Clearance of Forcing Programming in MasterTool XE Programming Manual.

To release operands from forcing, from the Status screen of the AL-2004, just select one line from the list of Forced Points, which represents the operand you wish to release. If you want to release the whole operand, click the button **Release All**, but if you want to release only one bit, click on **Release…** This last option, when clicked, opens a window like presented below, to release only one bit:

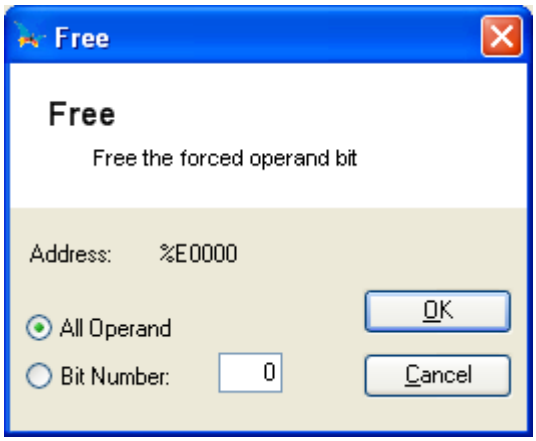


Figure 10-23. Releasing one bit of a forced operand

Monitoring

Monitoring consists in showing in MasterTool Hadron XE, in real time, the values contained in modules or logics instruction. There are three types of monitoring: **Operands and Modules**.

Following, each type of monitoring is detailed.

Monitoring Operands

Monitoring of operands consists in showing in MasterTool Hadron XE, in real time, the values contained in the operands in AL-2004 after the cycle end. The values of the operands are shown in an edition window that has a list of the operands that should be monitored. It can be used several monitoring windows, identified by the address and sub-network node or by the IP address of it and by the name of the monitoring window file, if it was saved. In the monitoring list window, it is allowed to directly inserting of an operand or table position.

If monitoring is made for a block of operands or for more than one table position, for each block of operands it is shown a monitoring window, whose edition is not allowed.

A monitoring window can be created from the **Communication / Monitor…** specifying in the following window the operand and the amount of monitored operands.

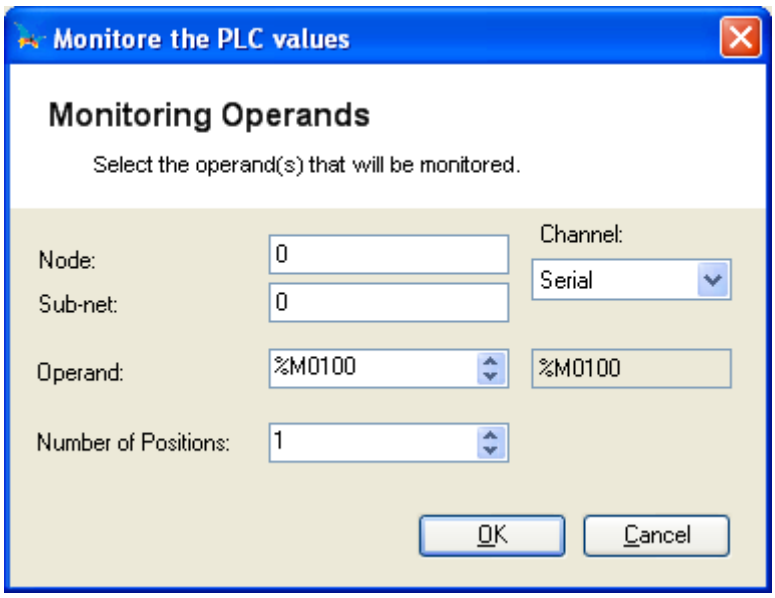
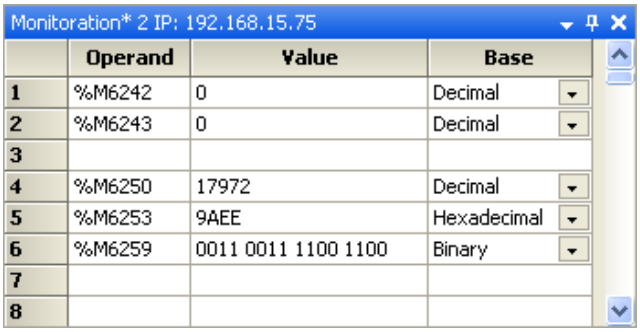


Figure 10-24. Selecting operands for monitoring

In this window, the communication channel of the monitoring window can also be chosen, for, in this case, several monitoring windows can be used for different PLCs. By clicking OK, a new monitoring window opens, created with the parameters informed in this window. Next figure illustrates a monitoring window:



	Operand	Value	Base
1	%M6242	0	Decimal
2	%M6243	0	Decimal
3			
4	%M6250	17972	Decimal
5	%M6253	9AEE	Hexadecimal
6	%M6259	0011 0011 1100 1100	Binary
7			
8			

Figure 10-25. Example of a monitoring window

In the title of each of the monitoring window the window title, node address and sub-network or IP address of the device that is being monitored are exhibited. In each of the monitoring windows there is a table containing the monitored operands, with the following columns:

- **Operand**: When monitored, whichever they are, even in subdivisions
- **Value**: Value of the monitored operand in AL-2004
- **Base**: Numerical base that will be used to visualize the value monitored

A monitoring window can be saved and attached to the project. For this, the name of the window must be inserted, which must be n the same folder as the project. Operands being monitored will be saved, as well as the respective numerical bases. To open such windows, just go to Treeview window of the project and open the desired window.

Monitoring Modules

In monitoring of Module, the whole content of the module is monitored, using the operands monitoring, aforementioned, to fill the contents of this monitoring. To access this functionality in **MasterTool Hadron XE**, click in **Communication/Monitor Modules.** Note that through this path all active modules (open) in the system will be monitored.

For an individual monitoring of the module, it is necessary to access the **Module/Monitor Module** menu. This item can also be accessed through the context menu (right clicking the module area).

Forcing Operands

AL-2004 operands can have their values directly changed from **MasterTool Hadron XE.** Such procedure called forcing is very important in the clearance of the projects, since you can determine the status of the inputs and outputs in order to detect problems and checking the installations among other functionalities.

To force operands click in **Communication/Force…** menu, opening the following window:

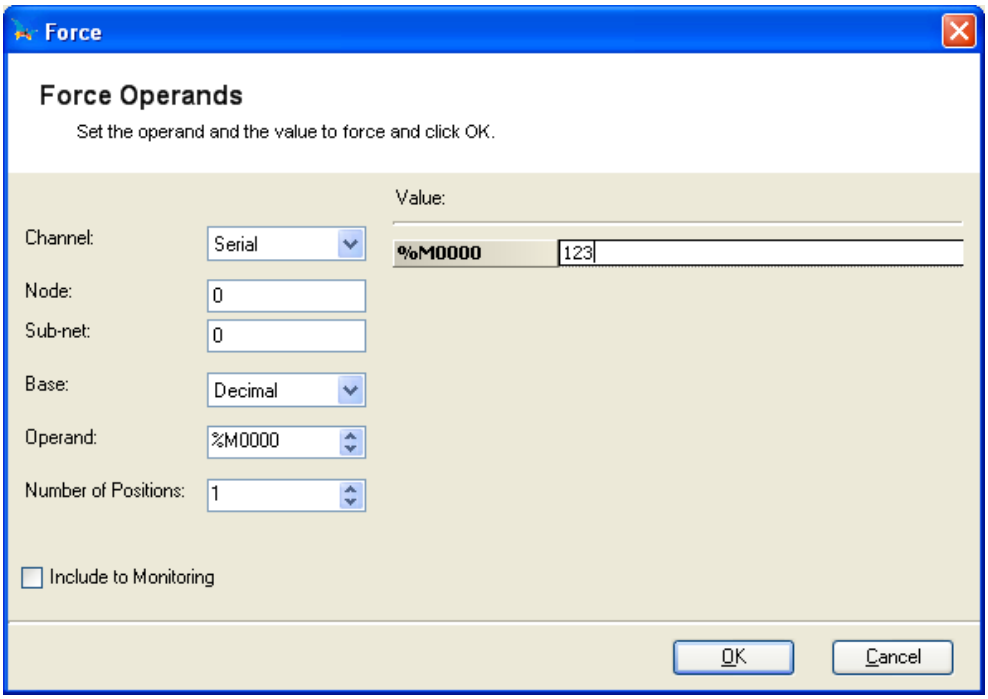


Figure 10-26. Forcing operands window

Through this window you can define the operands and their respective values to force and also determine which AL—004 to be forced, through the communication channel. If the amount of operand is greater than one, a table with a line for each forced operand is open. The maximum number of operands to be opened simultaneously is 63.

Forcing operands is performed only for %E and %S operands. For the others, %A, %M. %D, %I, %F, %TM. %TD, %TI and %TF, the operation is converted to writing, since CPUs don support these types of operands.

11. Document Printing

MasterTool Hadron XE allows the impression of its most important documents and reports, providing resources and options for printing configuration, as well as what to be printed.

Selection of Documents to Print Window

In **MasterTool Hadron XE,** there is a window in which the documents you want to print can be configured and selected:

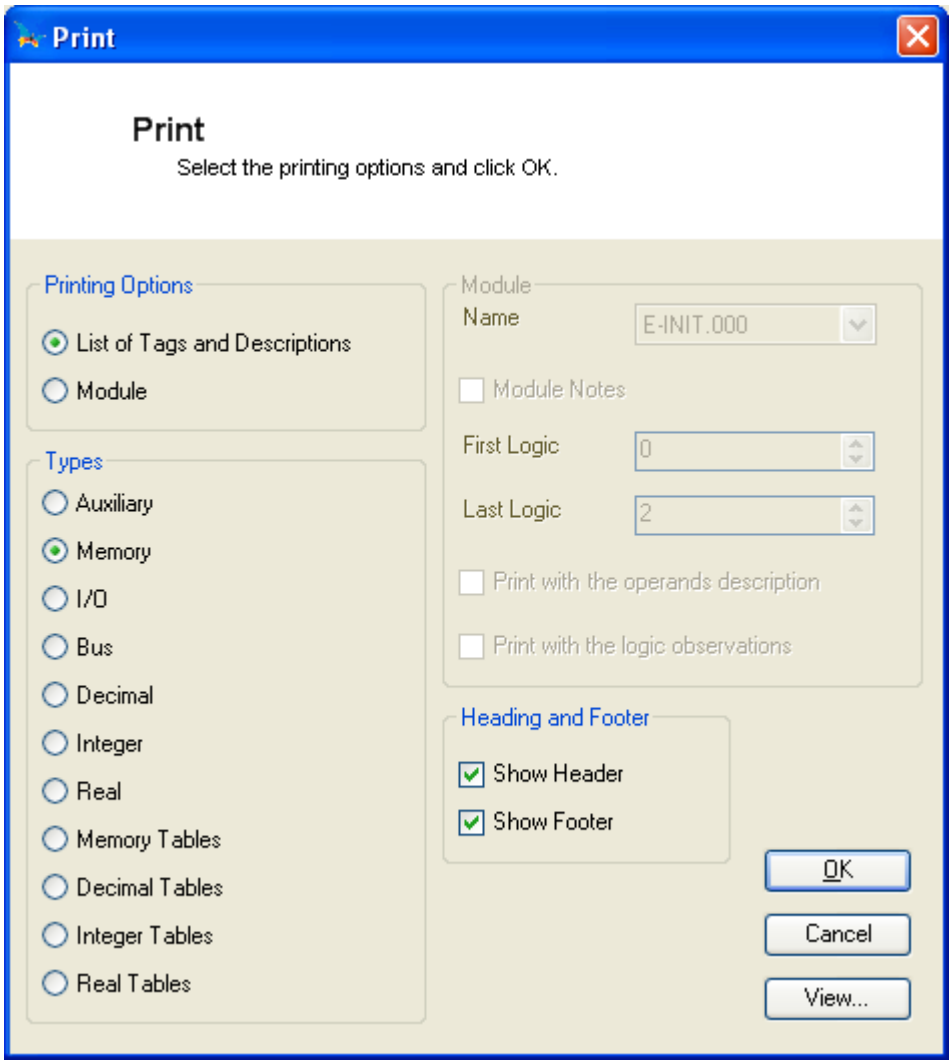


Figure 11-1. Window for selecting the documents to print

In the upper left corner you sect the type of document that will be printed: Tags Report and Descriptions or Program Modules. In the case of printing tags and description reports, you must inform which of them will be printed, through the type of operand.

If you desire to print a program module, you must choose one module in the list Name and, in the case of ladder program module, to inform the logics to be printed.

In this screen you can also determine whether the header and footer for pages will be printed.

Independent of the selections and options you have done, you can see in the monitor a sample of the printing. For this, just click the button **View…** after selecting and configuring the printing options.

Configuring the Printer

After clicking **OK**, in Selection of Documents to Print window, a printing and printer configuration window opens, as shown:

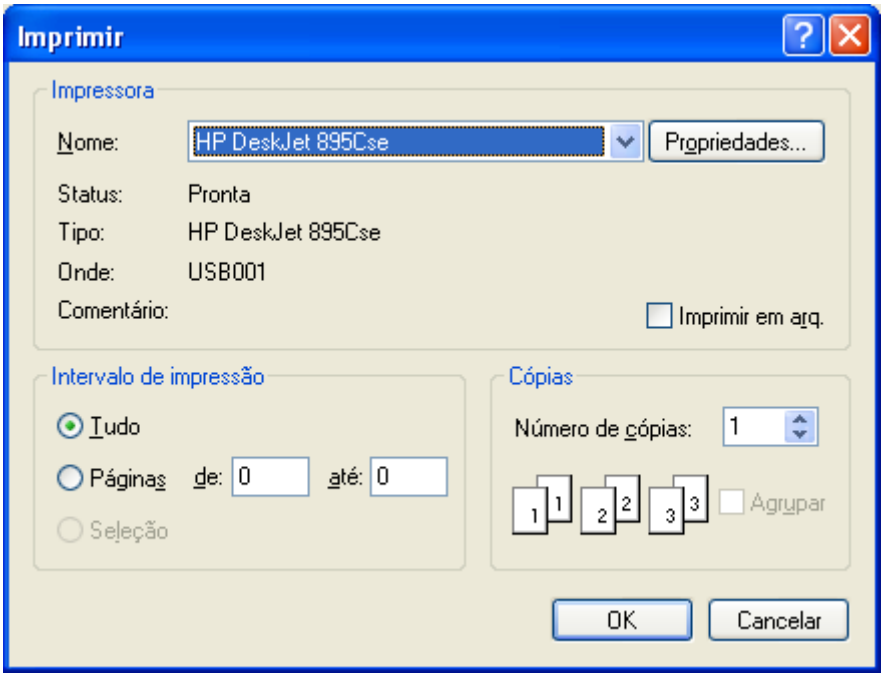


Figure 11-2. Printing configuration

Clicking the button **Properties…** the screen for the selected printer opens.

12. Options Configuration

In **MasterTool Hadron XE,** it is possible to change the configurations of the user options. This is possible by accessing the **Configuration/Options** menu.

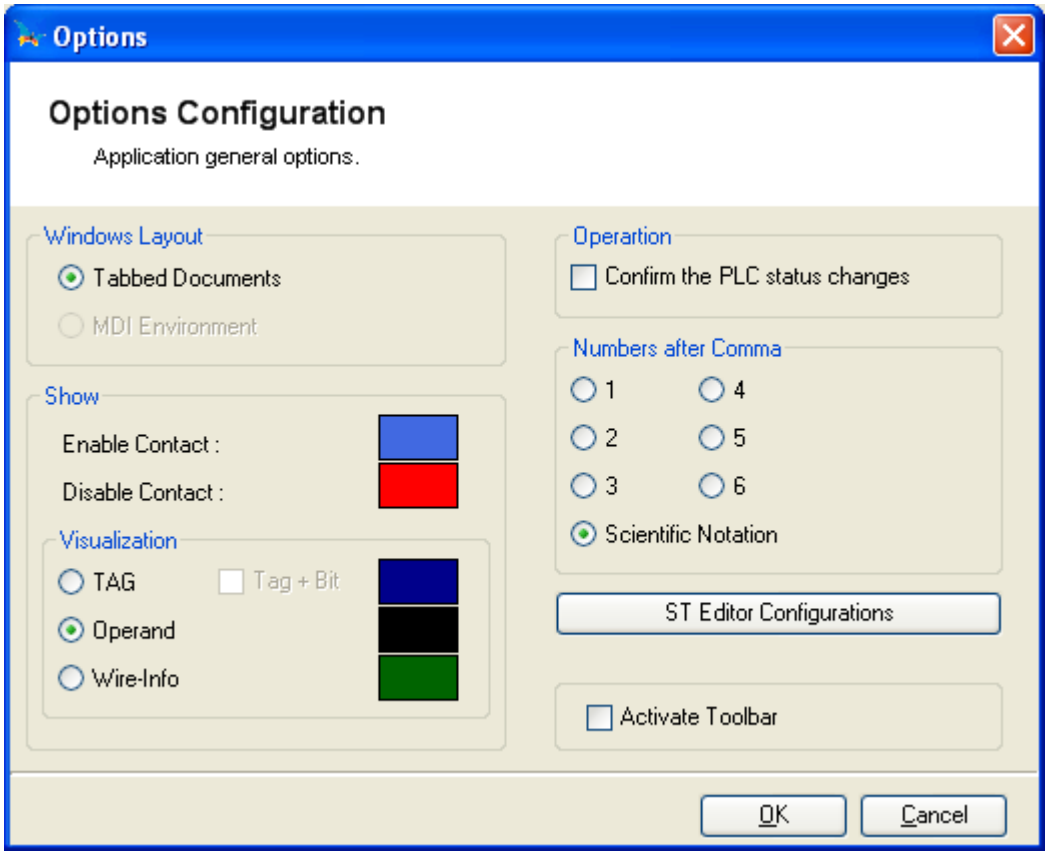


Figure 12-1. Options configuration

This window provides the following options:

- **Show:** Allows configuring the view mode of the addresses used in the program modules and the color used for each one of them. The options are:
  - Active Contact: Color configuration related to the active contacts in the ladder monitoring;
  - Inactive Contact: Color configuration related to the inactive contacts in ladder monitoring
  - Tag: Allows the visualization of the address by the used tag, if existing. It is possible also to mark the box Tag + Bit; in this way, the tag created for an address will automatically used for all bits of that address, in the case they are used in the program;
  - Operand: Allows the visualization of the address of the operand itself;
  - Wire-Info: Allows the visualization of addresses by the description of Wire-Info used in the Input/Output Operands Report window.
- **Operate:** Allows inhibit/allow the opening of the window for confirmation of changing in the status of AL-2004. This option can be useful for preventing the undue change of AL-2004 status
- **Decimals after dot:** Allows configuring the number of decimals used by the operand type %F or %TF
- **Editor ST Configurations:** Configuration of the text colors for edition of ST programs
- **Enable Toolbar Instructions:** enables or not the set of toolbars with shortcuts related the ladder instructions and other auxiliary functions

13. Expanding Hadron RTU Capacity

New functionalities can be easily added to the Hadron RTU using Ladder or ST programming languages. This chapter describes on the following section a practical example of how to use the programming to create events from commands.

Creating Events for Immediate Commands

In applications where there are several connected clients, it can be useful to one client to know when some command was executed by another client. This example shows how to generate events when an immediate command is executed by the other clients. For the example, the events are going to be for the main rack commands.

On the standard configuration, these commands are configured on DO0000 to DO0015 point range. For sending the events, it´s just need to create a digital input point group with the same configuration of the rack commands group. Next is presented a step-by-step description of how to perform this task.

The first step is to create an internal digital input point group with the same size and configuration of the main rack commands, i.e., with 16 points, D1 format and QA quality.

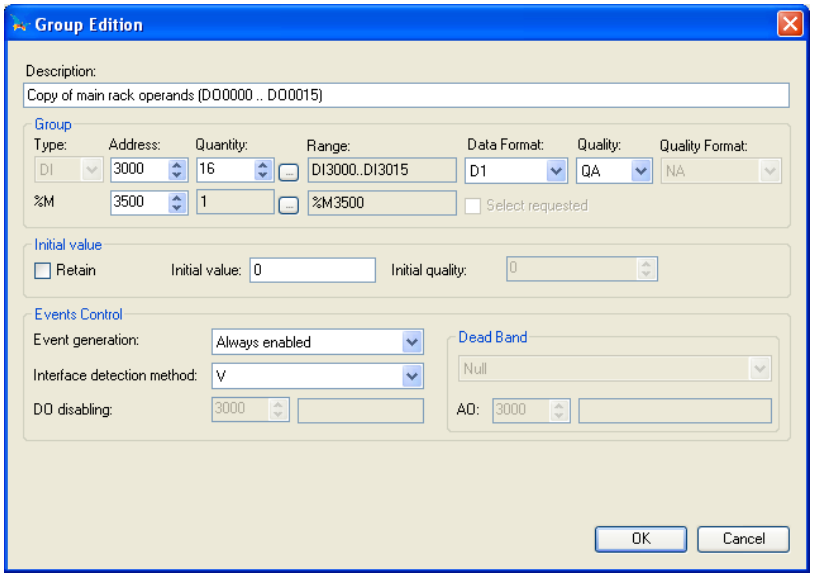


Figure 13-1. Configuring the digital input point groups

After this, it´s necessary to insert one logic on P-CICUSR.170 (or in another user module) to make the copy of the command values for the digital inputs at each RTU execution cycle.

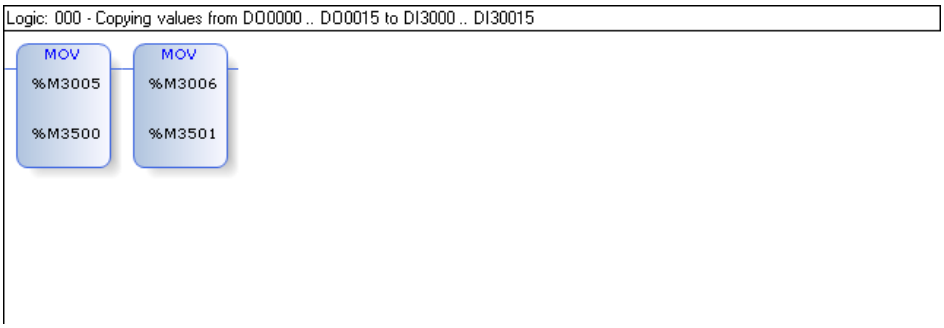


Figure 13-2. Copying the command values to the digital inputs

The next step is to map the digital inputs on all clients that are wanted to send the main rack events. This example shows the mapping for one DNP3 client using the AL-3417 interface.

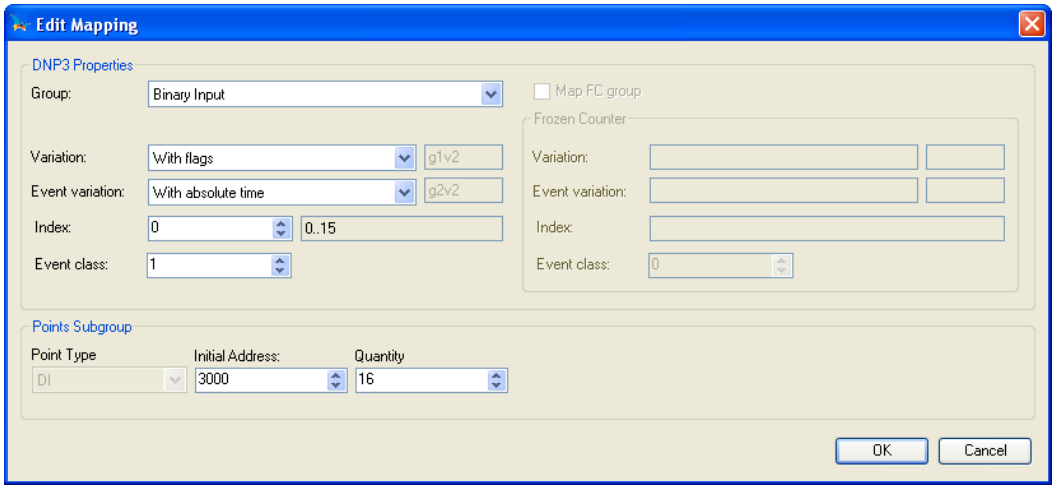


Figure 13-3. Mapping the digital inputs on the DNP3 client

In addition, it´s possible to create events for analog immediate commands just following the same steps of this example, but in this case the commands must be copied for an AI group instead of an DI group.

ATTENTION: In the case of the RTU receives multiple simultaneous commands for the same point, the event will be sent only for the last interface installed on the rack.

14. Glossary

Active CPU	In a redundant system is the CPU that is controlling the system – reading the inputs, executing the application program and activating the outputs.
Algorithm	Finite sequence of well-defined instructions, aiming to the resolution of problems.
Altus Relay and Blocks Language	Set of rules, conventions and syntaxes used when building a application program to run in a Altus PLC.
Application Program	Program downloaded into the PLC and has the instructions that define how the machinery or process will work.
Assembly Language	Microprocessor programming language, it is also known as machine language
Backup CPU	In a redundant system, it is the CPU supervising the active CPU. It does not control the system, but it is ready to take control if the main CPU fails.
Bit	Basic unity of information, which can be in status zero or one.
BT	Acronym for battery test
Bus	Set of electrical signals logically grouped with the function of transferring information and control between different elements of a subsystem.
Byte	Information unity composed by eight bits
C-Module	See Configuration Module.
Commercial Code	Product code formed by the letters PO and followed by four digits.
Configuration Module	Also referred to as C-Module. Unique module in a remote application program that carries several needed parameters for its operation, such as the operands quantity and disposition of I/O modules in the bus
Diagnostic	Procedures to detect and isolate failures. It also relates to the data set used for such tasks, and serves for analysis and correction or problems.
E2PROM	Electrically Erasable Programmable Read-Only Memory. Non-volatile memory that may be electrically erased by the electronic circuit.
E-Module	See Execution Module
Encoder	Normally refers to position measurement transducer.
EPROM	Erasable Programmable Read Only Memory. Memory for read only that may be erased and programmed out of the circuit. The memory does not lose its contents when powered off.
ER	Acronym used on LEDs to indicate error
ESD	Electrostatic Discharge.
Execution Module	Application program modules. May be one of three types: E000, E001 and E018. The E000 module is executed just once upon system powering or when setting programming into execution mode. The E001 module has the main program that is executed cyclically, while the E018 module is activated by the time interruption.
Executive Program	Operational system of a programmable controller. Controls the basic functions of the controller and the execution of application programs.
FLASH EPROM	Non-volatile memory that can be electrically cleared and programmed.
F-Module	See Function Module.
Function Module	Application software module called from the main module (E-module) or from another function module or procedure module. It passes parameters and return values. Works as a subroutine.
Hardware	Physical equipment used to process data where normally programs (software) are executed
Hot swap	Procedure of replacing modules in a system without powering it off. It is a normal procedure for I/O modules.
I/O	See Input/Output
I/O Module	Hardware module that is part of the Input/Output (I/O) subsystem.
I/O Subsystem	Set of digital or analog I/O modules and interfaces of a PLC
IEC 61131	Generic international standard for operation and use of programmable controllers.
IEC Pub. 144 (1963)	International standard for protection of accidental access and sealing the equipment from water, dust and other foreign objects.
IEC-536-1976	International standard for electrical shock protection.
IEC-801-4	International standard for tests of immunity against interference by pulses burst
IEEE C37.90.1 (SWC)	SWC stands for Surge Withstand Capability. This is the international standard for oscillatory wave noises protection.
In March	Final clearance procedure of the control system, when the programs of all remote stations and CPUs are executed together, after have been developed and checked individually
Input/Output	Also known as I/O. Data input or output devices in a system. In PLCs these are typically the digital or analog modules that monitor or actuate the devices controlled by the system.
Interface	Normally used to refer to a device that adapts electrically or logically the transferring of signals between

	two equipments.
Interruption	Priority event that temporarily halts the normal execution of a program. The interruptions are divided into two generic types: hardware and software. The former is caused by a signal coming from a peripheral, while the later is caused within a program
ISOL.	Acronym used to indicate isolation or isolated.
Jumper	Selection key of addresses or configuration composed by pins present in the circuit plate and a small removable connector used for selection.
kbytes	Memory size unit. Represents 1024 bytes.
LED	Light Emitting Diode. Type of semiconductor diode that emits light when energized. It is used for visual feedback.
Logic	A graphic matrix in Altus Relay and Blocks Language where are inserted the relay diagram language instructions that are part of an application program are inserted. A set of sequentially organized logics makes up a program module.
Menu	Set of available options for a program, they may be selected by the user in order to activate or execute a specific task
Module (hardware)	Basic element of a system with very specific functionality. It is normally connected to the system by connectors and may be easily replaced.
Module (software)	Part of a program capable of performing a specific task. It may be executed independently or in conjunction with other modules through information sharing by parameters.
Module address	Address used by the CPU in order to access a specific I/O module.
Nibble	Information unit composed of four bits.
Not operand CPU	In a redundant system this is the CPU that is neither active nor backup. May not take control of the system.
Operands	Elements on which software instructions work. They may represent constants, variables or set of variables.
PA	See Jumpers.
PLC	See Programmable Controller
PLC	See Programmable Controller.
CPU	Central Processing Unit. It controls the data flow, interprets and executes the program instructions as well as monitors the system devices.
P-Module	See Procedure Module.
Procedure Module	PLC application software module called from the main module (E-module) or from another procedure module or function module that does not have parameters.
PROFIBUS PA	Means PROFIBUS Process Automation.
Programmable Controller	Also, know as PLC. Equipment controlling a system under the command of an application program. It is composed of a CPU, a power supply and I/O modules.
Programming Language	Set of rules, conventions and syntaxes utilized when writing a program.
RAM	Random Access Memory. Memory where all the addresses may be accessed directly and in random order at the same speed. It is volatile, in other words, its content is erased when powered off, unless there is a battery to keep its contents.
Redundant system	System with a backup or double elements to execute specific tasks. Such system may suffer certain failures without stopping the execution of its tasks.
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Ripple	Oscillation present in continuous voltages.
RX	Acronym used to indicate serial reception.
Scan Cycle	A complete execution of the application program of a programmable controller (PLC).
Software	Computer programs, procedures and rules related to the operation of a data processing system
Soquete	Part to plug in integrated circuits or other components, thus facilitating their substitution and maintenance.
Supervisory Station	Equipment connected to a PLC network with the goal of monitoring and controlling the process variables
Tag	Name associated to an operand or to a logic that identifies its content.
Toggle	Element with two stable status that are switched at each activation.
TX	Acronym used to indicate serial transmission.
Upload	Reading a program or configuration from the PLC.
Varistor	Protection device against voltage spikes.
Watchdog Circuit	Electronic circuit destined to check the integrity of the performance of an equipment.
WD	Acronym for watchdog. See Watchdog timer
Word	Information unit composed by 16 bits.