GE Fanuc Automation
Programmable Control Products

PACSystems® RX3i

Max-ON Hot Standby Redundancy

User's Manual, GFK-2409

June 2006

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CIMSTAR	Modelmaster	PowerTRAC	VersaPoint
Field Control	Motion Mate	Series 90	VersaPro
GEnet	PACSystems	Series Five	VuMaster
	Proficy	Series One	Workmaster

Chapter 1 Introduction

Welcome

Thank you for choosing Max-ON RX3i Hot Standby Redundancy software and GE Fanuc PACSystems™ RX3i controllers to implement your critical control project.

Max-ON RX3i Software consists of several software components, some of which execute in a pair of Hot Standby PACSystems Max-ON RX3i Controllers, and some of which execute upon your programming workstation.

The PACSystems controller-based software consists of a set of application blocks that perform the Redundancy portion of the Hot Standby application. These application blocks are provided as part of a Proficy™ Machine Edition Project that is the starting point of your redundant automation application. Using GE Fanuc's Proficy Logic Developer PLC programming software, you add your application logic to this project, and then store the overall project to each of the Hot Standby controllers.

The Max-ON RX3i Configuration Utility, which is launched from the Logic Developer PLC Project, provides a utility to allow the control system designer to customize the functionality of the redundant system.

A Proficy View Max-ON RX3i Project is also provided to monitor the status of the Redundant System and to display diagnostic information.

With the Max-ON RX3i LD Project , you can:

- Create a Hot Standby system that operates using a combination of GE Fanuc Genius™ I/O, Field Control™, Series 90™-30 remote Genius drops, and Genius VersaMax™ I/O, as well as Series 90-30 and PACSystems RX3i Ethernet NIUs.
- Provide data synchronization using an Ethernet LAN.

With the Max-ON RX3i Configuration Utility software, you can:

- View and Modify the parameters of the Hot Standby Redundancy system:
  - Redundant System Parameters
  - Synchronization Data Groups
  - Synchronization Network Interface Parameters
  - Genius I/O Bus definitions

With the Max-ON RX3i View Project, you can:

- Establish a communication link to the Hot Standby CPUs to:
  - Monitor system-level alarms in real-time
  - Monitor performance characteristics in real-time
  - Display information about the Redundant system: Max-ON driver version, CPU modules

Installing Max-ON RX3i Software

System Requirements

Max-ON RX3i Software may be installed on a PC that has the minimum requirements shown below:

- 1 GHz Pentium class processor
- 256 MB RAM or more
- Windows NT 4.0 (Service pack 6a or later), Windows 2000 Professional (Service Pack 3 recommended), or Windows XP Professional (Service Pack 1 recommended)
- 50 MB of free disk space

***NOTE**: Max-ON RX3i Software requires Logic Developer PLC Professional Edition Release 5.50 LD PLC SIM 1 or later.*

To Install Max-ON RX3i Software

1. Make sure that you have installed Proficy Machine Edition release 5.5 SIM 1 or later. This is required to configure and program the Max-ON RX3i CPU.
2. It is recommended that you close all applications including virus checking, Internet Explorer, and HMI software that might be running in the background. You may need to check the task manager to determine if other applications are running. As a further precaution, it is also recommended that you re-boot the PC to make sure components that Max-ON RX3i Configuration Utility needs to update are not running during the installation process.
3. Put the Max-ON RX3i Software CD in CD-ROM Drive.
4. Select the CD drive from Windows Explorer.
5. Double click Setup.exe.
6. Follow the user prompts to complete the installation.

Uninstalling Max-ON RX3i Software

Max-ON RX3i Software can be uninstalled only from the computer upon which it is installed. It cannot be uninstalled over a network. You can uninstall Max-ON RX3i Software from the Add/Remove Programs option on the Windows Control Panel or from the Windows Start Menu.

If the computer has other GE Fanuc software products installed, Max-ON RX3i Software can be uninstalled without removing any files needed by those applications. To uninstall Max-ON RX3i Software, do the following:

1. Choose Uninstall from the Start Menu or the Control Panel.
2. A dialog box appears asking if you are sure you want to uninstall.
3. Confirm the Uninstall.

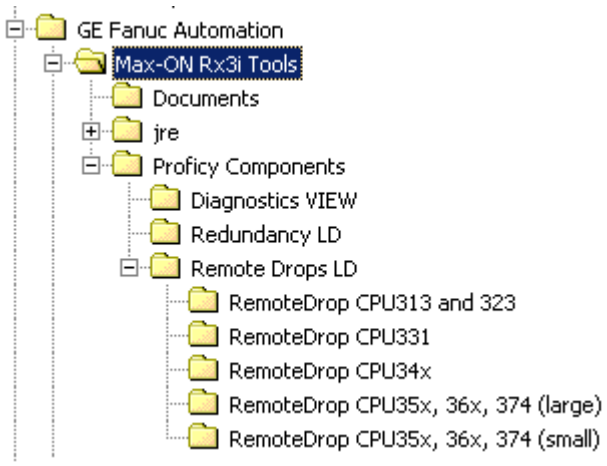
- All files relating to Max-ON RX3i Software will be removed from the hard drive. Any files used by both Max-ON RX3i Configuration Utility and another application will be left on the system.
- All registry entries relating to Max-ON RX3i Software will be removed from the systems registry.
- Icons for Max-ON RX3i Software will be removed from the Start Menu.
- Any data you created (for example, Project that you have created) will be left on the system.

Note: You may also uninstall Max-ON RX3i Software by choosing Add/Remove Programs from the Control Panel, then selecting Max-ON RX3i Tools.

Max-ON RX3i Component Installation

The default settings for the Max-ON RX3i software installation places the Max-ON RX3i Software and the associated project components in the GE Fanuc Automation directory.

The Max-ON RX3i components are installed in the tree structure as shown below:



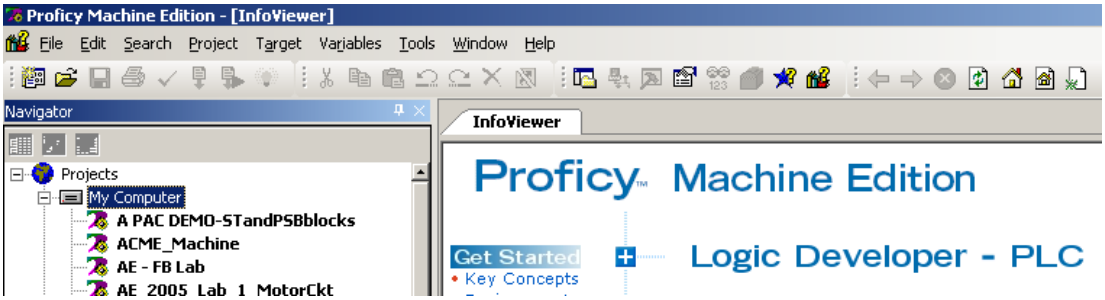
The Max-ON RX3i Configuration Utility is located in *Max-ON RX3i Tools* directory. It is launched by double-clicking on the Max-ON RX3i configuration file (config.mx3) located in the Proficy Logic Developer PLC project.

The default Max-ON RX3i Hot Standby Redundancy application project, named *Max-ON RX3i LD Project vx_yy.zip*, is located in the *Redundancy LD* directory. This project must be brought into your Proficy Machine Edition development environment using Proficy Machine Edition's *File > Restore Project…* menu.

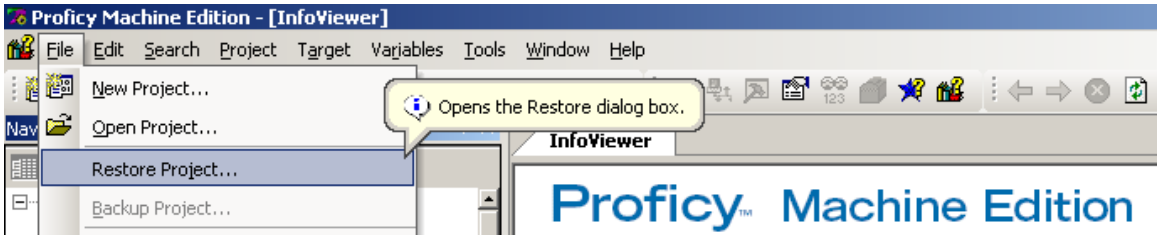
A Proficy View Diagnostic project is located in the *Diagnostics VIEW* directory. When it is active, this diagnostic utility displays key information regarding the operation and state of the redundant CPU pair. This project must also be brought into your Proficy Machine Edition development environment using Proficy Machine Edition's *File > Restore Project…* menu.

Adding the Max-ON RX3i Hot Standby Redundancy Application Project to Proficy Machine Edition

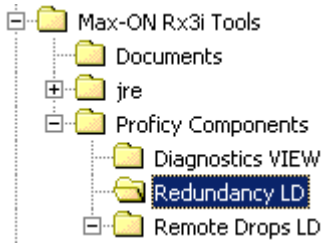
The default Max-ON RX3i LD project is added to the Machine Edition project Navigator by using the *File* > *Restore Project*…menu item. Select the Project Navigator window making certain that there is no project open at this time.



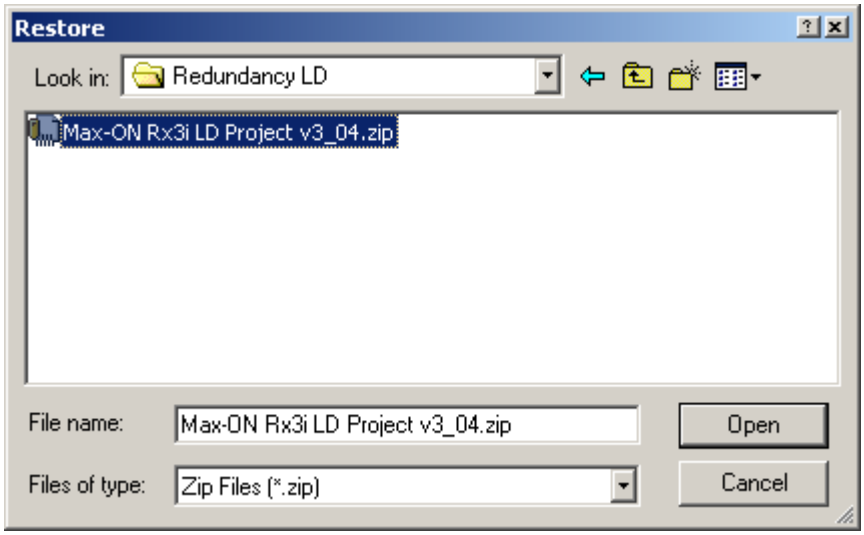
Using the *File* menu, click on *Restore Project...*



Navigate to the *Proficy Components* directory, then to the *Redundant LD* directory. Make certain that the selection for **Files of Type** has been set to *Proficy Machine Edition (*.zip)*.



Select the *Max-ON RX3i LD Project vx_yy.zip* file.

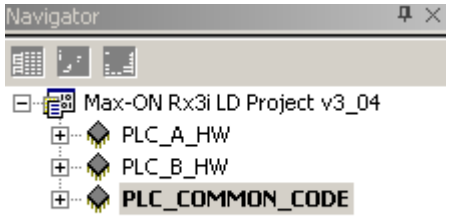


When you click on *Open*, a new project will be added to the Proficy Navigator window.

Now you may give this new Project a descriptive project name. You may also use this project to create a Machine Edition project template that can me used as a starting point for future Max-ON Rx3i projects.

Launching the Max-ON RX3i Configuration Utility

The Max-ON RX3i Configuration Utility is launched from the Machine Edition project. Open the project that you restored in the previous section. There are three targets in the project:

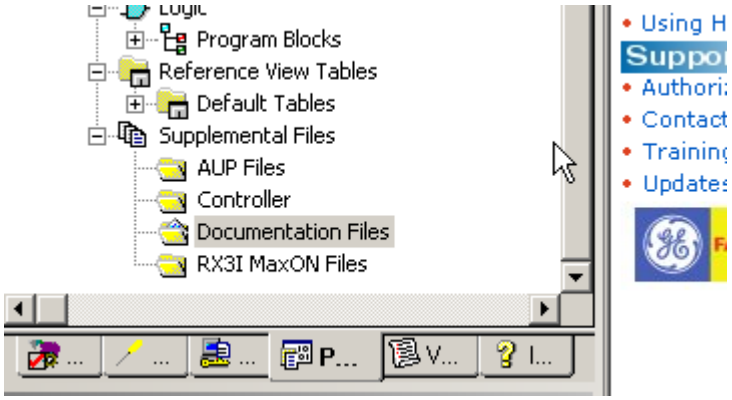


- *PLC_A_HW* – This target contains the hardware configuration for PLC A. It must be edited to reflect the hardware settings and components in your system. Then it must be downloaded to PLC A (only).
- *PLC_B_HW* – This target contains the hardware configuration for PLC B. It must be edited to reflect the hardware settings and components in your system. It will be very similar to PLC A hardware configuration, except for certain items such IP addresses, Genius bus controller settings, etc. In a similar fashion, this configuration must be downloaded to PLC B (only).

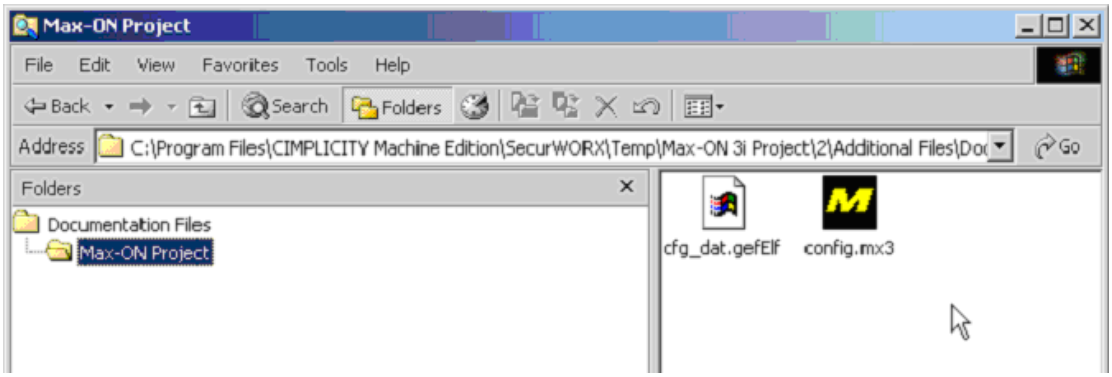
- *PLC_COMMON_CODE* – This target contains the core logic for the Max-ON RX3i redundancy application. You must add your application logic starting in the rung that follows the call to the core Max-ON RX3i logic (hbr_000). The logic from this target will be downloaded to both PLC A and PLC B. Note that the download consists of the PLC Logic Only, the Hardware Configuration option must be unchecked.

You navigate to the Max-ON RX3i Configuration Utility by following these steps:

1. Select the target *PLC_COMMON_CODE*.
2. Expand the tree structure so that the *Supplemental Files* folder named *Documentation Files* is visible.



3. Double-click on *Documentation Files*. This will launch *Windows Explorer* for this directory.
4. Click on the *Max-ON Project* directory to display its contents. The Explorer window will be similar to what is shown below.



5. Double-click on the Max-ON RX3i Configuration file named *config.mx3*. This launches the Max-ON RX3i Configuration Utility.
6. You may now examine and edit the parameters of the Max-ON RX3i redundant system.

Technical Support

Technical Support is available at no charge for 90 days after purchase. A support agreement can be purchased from your local GE Fanuc distributor if extended support is required.

If problems arise that can't be solved using the information in your product manual, online Help system, Proficy GlobalCare knowledge base, or the GE Fanuc Technical Advisor knowledge base, contact us by telephone, fax, or mail. When contacting us, call from a telephone near your computer and have your Machine Edition software running. Have the following information handy to help us assist you as quickly as possible:

- Proficy Machine Edition software installation serial number, the Proficy Machine Edition software Product name, and version number from the **Help >About** dialog box.
- The brand and model of any hardware in your system.
- Operating system and version number.
- The steps you performed prior to the problem occurring.

GE Fanuc Global Care Web Site

The GE Fanuc Global Care Web Site offers product, service, and support information for GE Fanuc hardware and software products. The Global Care web site is located at:
http://globalcare.gefanuc.com/
Visit this site for the latest up-to-date technical information.

North America

Support Hotline: 1-800-GEFANUC (1-800-433-2682) **Fax:** (780) 420-2049
Internet: http://globalcare.gefanuc.com/ **Email:** support@gefanuc.com
Comments about our manuals and help: doc@gefanuc.com
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Online Help

If you have a question about Max-ON RX3i, first consult the online help. This may be accessed from the main menu in Max-ON RX3i Configuration Utility software. To obtain help, select the main menu item *Help*, then *Contents & Index*.

For PLC hardware questions, consult the documentation that was shipped with the hardware product.

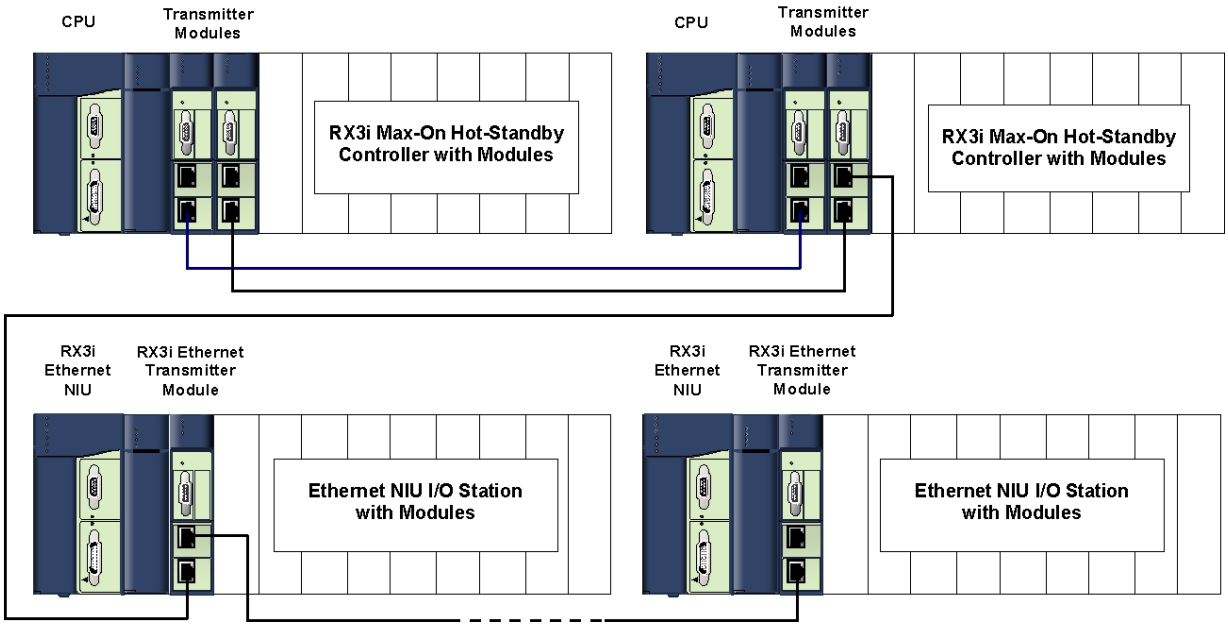
Chapter 2 System Overview

Architecture

A Max-ON RX3i Hot Standby Redundancy system consists of two PACSystems Max-ON RX3i Controllers, at least one dedicated Ethernet Synchronization link, and an I/O system comprised of at least one I/O LAN.

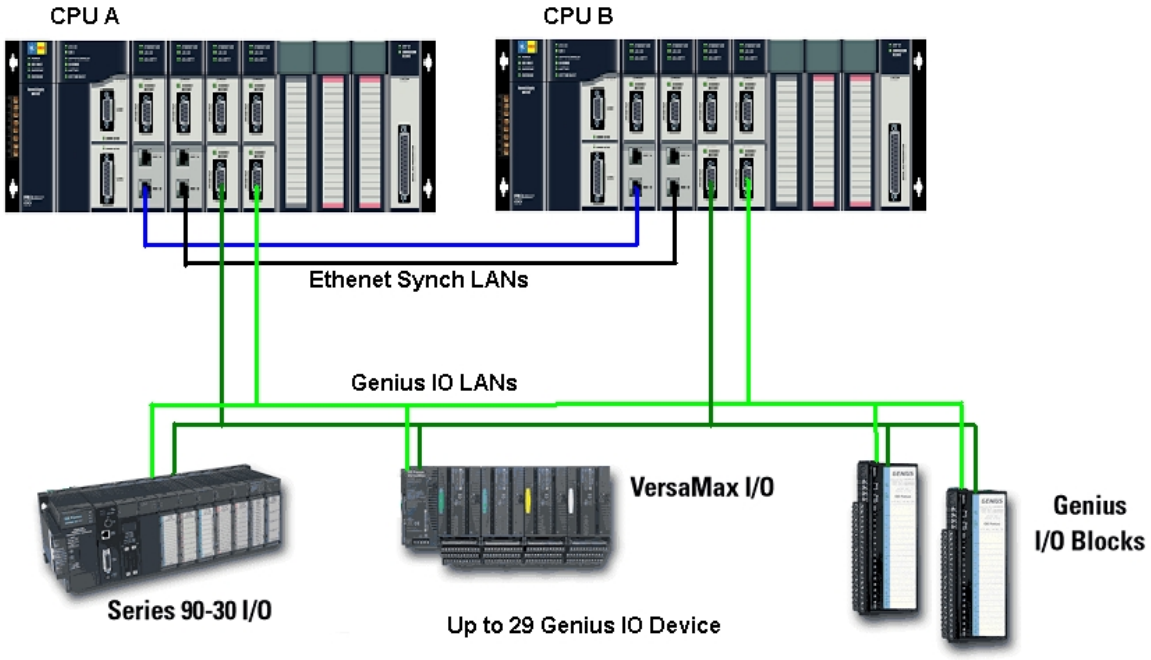
The Ethernet Synchronization link is used to exchange status and synchronization data between the two Max-ON RX3i Controllers. For higher system availability, dual redundant LANs may be employed.

The I/O LAN is used to communicate with the I/O devices that are attached to it. The I/O system may be implemented using a combination of Ethernet drops (Series 90-30 ENIU or PACSystems RX3i ENIU); or Genius drops (Genius I/O, Field Control I/O, VersaMax I/O, or Remote I/O drops based upon Series 90-30 I/O). The example below shows the Max-ON RX3i controllers connected to a single Ethernet I/O LAN.



Max-ON Rx3i has been designed to satisfy applications that have high performance requirements. It has support for up to 8 simplex or 4 dual Genius I/O busses, and up to 3 Ethernet I/O busses.

The example below shows the Max-ON RX3i controllers connected to a single Genius I/O LAN. This example includes dual Ethernet synchronization LANs:



Max-ON Rx3i provides the following functionality:

Discrete Inputs (%I)	2048
Discrete Outputs (%Q)	2048
Analog Inputs (%AI)	1024
Analog Outputs (%AQ)	256
Synchronized Internal Coils (%M)	4096
Synchronized Registers (%R)	8000
I/O Busses	Up to eight simplex Genius busses, or Up to four dual Genius busses Up to 29 devices per simplex or dual bus; Up to 3 simplex Ethernet busses, or one dual Ethernet bus
Synchronizing LANs	One or two Ethernet LANs
CPU Model	IC695CMU310
I/O Families	Ethernet: Series 90-30 Ethernet NIU or PACSystems RX3i Ethernet NIU Genius: Genius Block, Field Control, VersaMax, Remote 90-30 Drop

Software Components

Max-ON RX3i software consists of several components, some of which execute in the Hot Standby Controllers, and some of which execute in your programming workstation. A base Logic Developer PLC Project provides the basic template for the Logic of the Redundant System. This project is modified by the system designer to add the other necessary Logic to perform the user application, and then the final application is stored in the Controllers using Proficy Logic Developer PLC.

You may think of the software provided in the Project template for the Controllers as “drivers” that handle the complex tasks associated with Hot Standby redundancy. These drivers allow the two Controllers to behave as a single Controller from the perspective of your application.

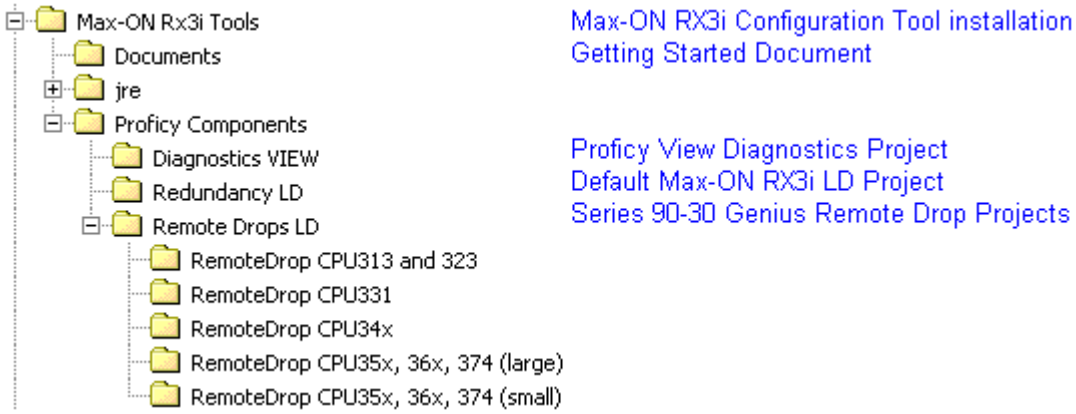
The Max-ON RX3i Configuration Utility allows the system designer to customize the parameters of the Max-ON RX3i drivers and to specify the hardware that is contained within the system. The Max-ON Configuration Utility software operates in Windows XP Professional, Windows NT4.0, and Windows 2000 Professional.

The Max-ON RX3i Configuration Utility software allows you to define the way your system is constructed and how you want the system to operate. It provides additional information that is not included in the Hardware Configuration files produced by Logic Developer PLC.

The Max-ON RX3i software includes a Proficy View Diagnostic Project that allows you to observe the way your system is operating and helps you to diagnose problems. This Project displays the operational status of the redundant system in real time.

The Max-ON RX3i software also includes a set of projects to configure Series 90-30 Remote Genius Drops.

The Max-ON RX3i software components are organized as follows:



A Max-ON RX3i Quick Start Project is also included on the Max-ON RX3i Software CD. This Quick Start Project also includes 3 RX3i ENIU targets.

Hot Standby Redundancy Operation

During each controller scan, the Max-ON RX3i redundancy drivers are solved first, and then your application logic is solved. The Max-ON RX3i redundancy drivers handle the following functions:

- **Determine Mastership** – One CPU operates as the Master. The other operates as the Backup. Output devices use the output states from the Master only. In a Max-ON RX3i system, the user may specify either PLC to be the preferred Master. If no preference is specified, then Mastership "floats" between the PLCs. The current Master retains its status until it fails or until the user switches Mastership, at which time the Master and Backup exchange their roles.
- **Transfer Synchronization Data** – If the Master fails, the Backup must be prepared to control the process using the latest internal states from the ex-Master. These states may represent such things as latched coils, timer/counter values, PID values, system set points, and perhaps user-calculated values.
- **Enforce an Orderly PLC Startup** – When a failed PLC is returned to service, it must not attempt to assume control of the system prior to being synchronized to the current Master. If both PLCs startup simultaneously, then whichever one was the last valid Master assumes the Mastership.
- **Process Genius Dual Bus I/O Devices** – When the system uses dual Genius I/O busses, input devices are mapped automatically from the active I/O LAN into the PLC's input reference tables.
- **Auto-configure Genius VersaMax I/O** – One of the Max-ON RX3i drivers generates configuration messages that are sent automatically to any Genius VersaMax network interface units. The messages configure the interfaces for Hot Standby operation, Single or Dual Bus operation, expansion transmitter being present, and Genius bus baud rate.
- **Execute Diagnostic Tests** – Automatically post time-stamped fault messages into the Max-ON RX3i Alarm Table. Identify system problems such as bus faults, loss of devices, change of Mastership, program restart, and power-up event.

Failover Time

The Mastership Time of the Max-ON RX3i system determines the Failover Time. The Failover Time is the time required for control of the system to transfer from the Master Controller to the Backup Controller.

Mastership Time: This is the time interval for the Backup Controller to recognize that the Master Controller has failed. It takes one or two CPU scans plus one Synchronized Data Transfer period to determine that the Master has failed. Then it takes an additional scan to activate the output data stream in the Backup Controller.

For the Ethernet I/O LAN, the Remote Ethernet drop will start using the data from the Backup Controller as soon as it detects that:

1. The Backup is now the Master
2. The Master is no longer sending data

For the Genius IO LAN, lacking output data from the current Master's GBC, each output circuit on each device on the Genius I/O LANs will hold its last state for up to 2.5 seconds before it assumes the Default State unless there is output data from the Backup GBC. (This assumes that each device has been configured for either BSM present or for long timeout.) Then the output device will begin using output data from the other GBC.

Synchronized Data Transfers

Data may be synchronized from the Master to the Backup on a continuous basis in order to assure that the Backup controller's data is always in sync with the Master's. Max-ON RX3i supports up to 6 groups of synchronization data for each data type listed below. The groups do not have to be contiguous. Each group is specified by a starting reference address and a length. For each data type, the lengths are added together and the sum must not exceed the value in the corresponding column below.

	Registers ***%R***	***Discrete Outputs*** ***%Q***	***Internal Coils*** ***%M***	***Analog Outputs*** ***%AQ***
Max Length	8000	2048	4096	256
Range	1 - 8000	1 - 2048	1 - 4096	1 - 256

I/O Bus Topologies

The Max-ON RX3i application supports the use of single (non-redundant) and/or dual (redundant) busses interfacing to the I/O devices.

- A Max-ON Rx3i controller supports up to four Ethernet LANs. At least one Ethernet Interface must be dedicated to the Synchronization Link. This allows up to 3 additional Ethernet Interfaces that may be used as dedicated Ethernet I/O LANs. Support is also available for a single duplex Ethernet I/O LAN.

Simplex Ethernet I/O Busses	*Dual Ethernet I/O Busses*
Up to 3	1

- Max-ON Rx3i supports up to four redundant Genius LANs or up to eight non-redundant Genius LANs, or a mixture of the two. However, the system may not have more than eight Genius bus controllers in a Controller.

Simplex Genius I/O Busses	*Dual Genius I/O Busses*
Up to 8	Up to 4

Redundant busses are superior to non-redundant busses when there is a requirement to protect against cable failures or Genius bus controller failures.

When the primary consideration is to protect against cable failures, then the system designer should consider separating the cables so that a single mechanical failure does not damage both cables.

Genius Dual Bus I/O Capacity

The maximum allowable I/O capacity for Max-ON RX3i redundant system that is configured for Genius Dual busses is as follows:

Discrete Inputs	*Discrete Outputs*	*Analog Inputs*	*Analog Outputs*
2048	2048	1024	256

Selecting the I/O

Max-ON RX3i systems may be implemented using any combination of the following I/O:

Ethernet NIUs	Ethernet NIUs are remote I/O drops that as based on standard 90-30 or PACSystems RX3i hardware. These remote drops communicate to the redundant controllers using Ethernet Global Data. These NIUs are configured using Logic Developer PLC.
Genius Block	Genius blocks are intelligent, self-contained, configurable I/O modules. The blocks are available as discrete, analog, and special purpose types, such as the high-speed counter. Many of the blocks offer advanced diagnostic capabilities such as open circuit, short circuit, and overload detection. Each block is configured using a hand-held monitor.
Genius Field Control	Genius Field Control is a family of versatile, modular I/O devices. The I/O modules are small and rugged and are available in both discrete and analog versions. I/O Terminal Blocks provide universal field wiring terminals for the I/O modules, allowing I/O module types to be mixed on the same I/O Terminal Block. The I/O Terminal block is mounted on a DIN rail. As many as eight Field Control I/O modules (four I/O terminal blocks) can be connected to one Bus Interface Unit. Together, they make up a Field Control "station". The bus interface unit provides either a single or a dual, redundant LAN connection to the Hot Standby PLCs. Each station is configured using a hand-held monitor.
Genius Remote 90-30 Drop	Genius Remote 90-30 drops consist of a Series 90-30 CPU, power supply, base plate, and one Genius bus controller for a single LAN connection or two bus controllers for a dual, redundant LAN connection. Normally, input and output modules are installed in the base. A Scanner routine executes in the drop's CPU. This routine scans all input devices and transmits the input states to the Hot Standby PLCs. The routine also monitors outputs (%Q and %AQ) in the Synchronized Data stream from the Hot Standby PLCs. Any output data that is configured to be active in the remote drop is captured from the data stream and then is mapped into the Drop's output reference tables. Configuration of the remote drop is accomplished using the Logic Developer PLC software package. Also, a few rungs of ladder logic must be edited in order to characterize the outputs in the drop.
Genius VersaMax	Genius VersaMax I/O products feature DIN-rail mounted modules with up to eight I/O and option modules per "rack" and up to 8 racks per VersaMax I/O Station system. Expansion racks can be located up to 750 meters from the main VersaMax I/O Station rack. Expansion racks can include any VersaMax I/O, option, or communications module.
Genius Third Party	In some cases, third party devices may be used on the LAN as well. These devices must comply with the Genius I/O specification relating to Controller Redundancy.

With a Max-ON RX3i system, you may select I/O devices based upon functionality, cost, physical design, items carried in spare parts inventory, or personnel expertise.

Demo Mode Operation

A Max-ON RX3i application will operate in demo mode for 22 days on standard PACSystems RX3i CPU hardware (IC695CPU310). In this mode, all of the system's capabilities are fully operational. At the end of the demo period, PLC A will either stop immediately, if it is the backup, or begin an orderly transfer of Mastership to PLC B. If the transfer is successful, then PLC A will shut down automatically. ***At this point, the system will be operating in a non-redundant manner.***

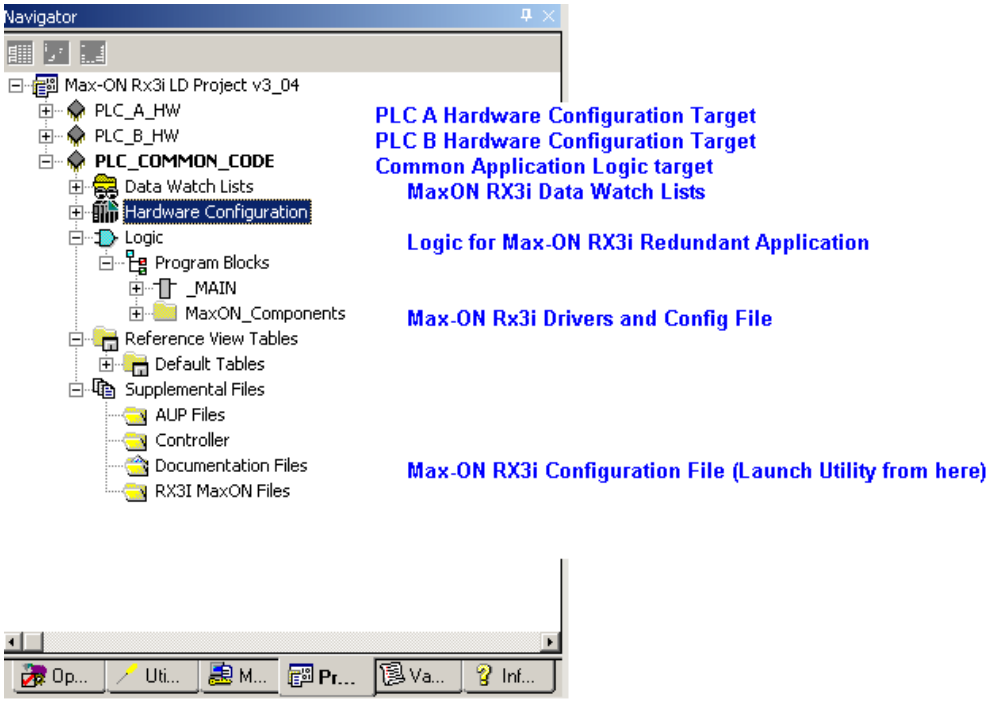
A Max-ON RX3i system that is installed in a production environment MUST be running on a Max-ON RX3i CPU (IC695CMU310) in order to allow PLC A to run indefinitely.

Running Max-ON RX3i on a standard RX3i CPU is helpful for short times in case of a hardware failure or for non-production demonstration purposes.

Chapter 3 Building a Max-ON RX3i Hot Standby Application

Max-ON RX3i Project

- Max-ON RX3i encapsulates your entire application within a single Machine Edition Project. Using a generic Max-ON RX3i Project, you can create a new Max-ON RX3i Redundancy project. The generic project contains all of the base Max-ON RX3i redundancy application components needed to perform the redundant application. You add the hardware configuration information for each PLC in your application, add your application logic, and define the parameters of the Redundant System using the Max-ON RX3i Configuration Utility that us launched from the Logic Developer PLC Project.



Project Workflow

Step 1 - Gather Information

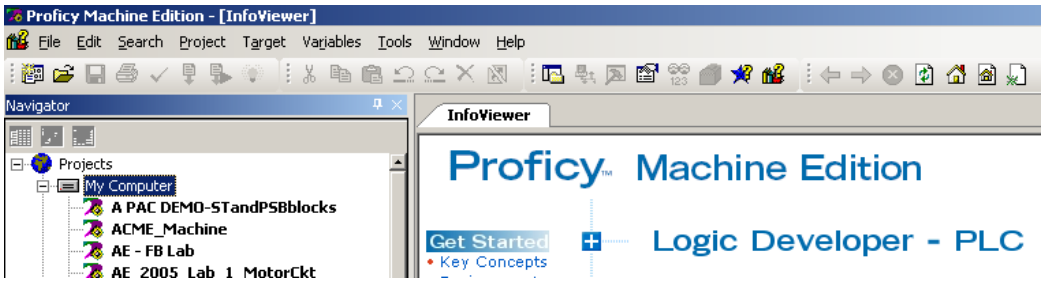
Gather the information about your system:

- I/O Bus topologies and addresses
- Synchronization LAN locations
- Module types and locations
- I/O Devices including bus assignment, bus addresses, circuit references, number of circuits and I/O family type.

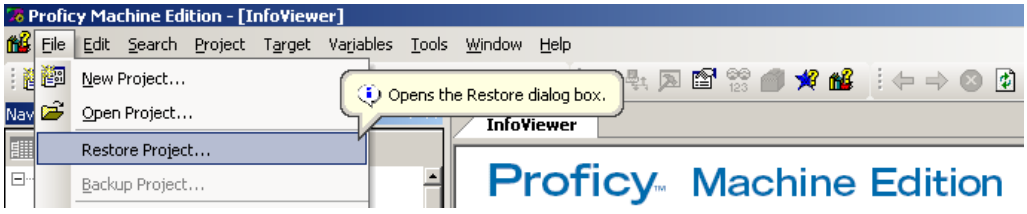
Step 2 - Create a New Max-ON RX3i Project

In Proficy Logic Developer PLC:

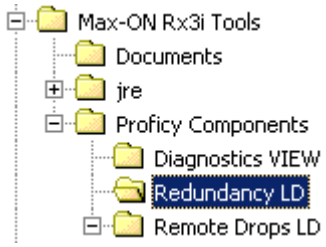
1. Create a new project based on the Generic Max-ON RX3i Project. The redundant ladder project is added to the Machine Edition project Navigator by using the *File* > *Restore Project…* menu item. Select the Project Navigator window making certain that there is no project open at this time.



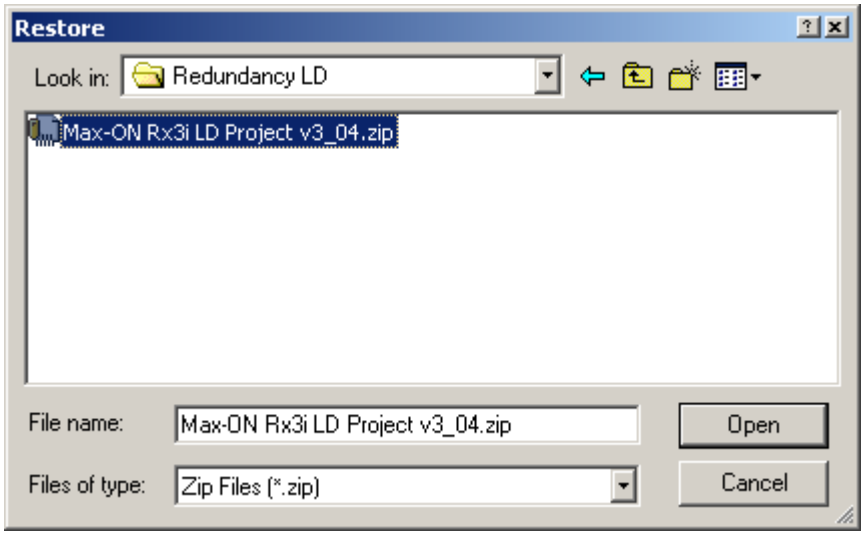
2. Using the *File* menu, click on *Restore Project...*



3. Navigate to the *Proficy Components* directory, then to the *Redundant LD* directory. Make certain that the selection for **Files of Type** has been set to *Proficy Machine Edition (*.zip)*.



When you click on *Open*, a new project will be added to the Proficy Navigator window.



4. Give your project a descriptive name in the Machine Edition Navigator.
5. Configure the Project Information in the Max-ON RX3i Configuration Utility, using the information you gathered in step 1. (Refer to Chapter 4 for more information.)

Enter *Project Setting* information by launching the Project Settings dialog in the Max-ON RX3i Configuration Utility. . (Refer to Chapter 4 for more information.)

6. Enter *Developer* and *End User Information* by launching the Biographical Information dialog in the Max-ON RX3i Configuration Utility. . (Refer to Chapter 4 for more information.)

Step 3 - Configure the Controller Hardware

In Logic Developer PLC:

For CPU A:

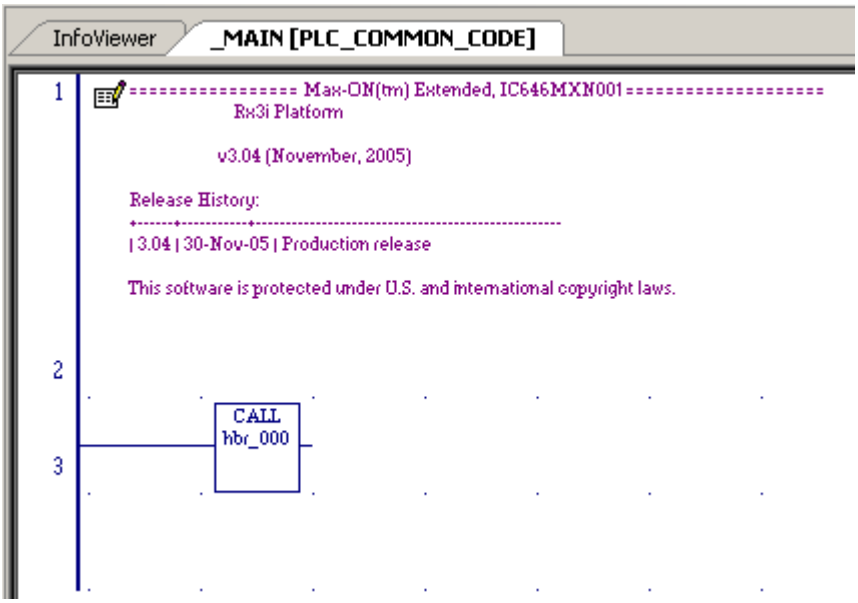
1. Open the Hardware Configuration for PLC_A_HW target in the Max-ON RX3i Project.
2. Configure the PLC hardware for PLC A:
   - CPU Memory
   - CPU SNP ID
   - Genius Bus Controllers
   - I/O Devices on the Genius Bus (or Busses)
   - Ethernet Modules
     - Ethernet IP Address and Subnet Mask
     - Device Status Address
   - Ethernet Global Data (EGD) Exchanges for Ethernet NIUs
3. Store the new hardware configuration into CPU A
4. Set the time and date for CPU A.

For CPU B:

1. Open the Hardware Configuration for PLC_B_HW target in the Max-ON RX3i Project.
2. Configure the PLC hardware for PLC B.
   - CPU Memory
   - CPU SNP ID
   - Genius Bus Controllers
   - I/O Devices on the Genius Bus (or Busses)
   - Ethernet Modules
     - Ethernet IP Address and Subnet Mask
     - Device Status Address
     - Ethernet Global Data (EGD) Exchanges for Ethernet NIUs
3. Store the new hardware configuration into CPU B.
4. Set the time and date for CPU B.

Step 4 - Add Your Application Logic

Using Logic Developer PLC, open the PLC_COMMON_CODE Target folder and add your application logic **after** the call to the subroutine named *HBR_000*.



If you are using an Existing Project

If you have developed the application previously, then you may copy and paste the Max-ON RX3i logic into the existing Project. A Machine Edition Toolchest drawer is also provided that may be used to copy the Max-ON Blocks into the Project.

If this is a New Application

Add your application logic into the project folder directly after the CALL to the hbr_000 Block in _MAIN Rung 3.

Step 5 - Configure the I/O Devices

Ethernet NIUs

If you are using Ethernet NIUs, then you will need to create Ethernet NIU targets, configure the I/O in the remote drop, and then download the ENIU information to the remote drop using Logic Developer PLC.

Genius or Field Control

If you are using Genius or Field Control, then set the appropriate parameters for Serial Bus Address, I/O Settings, I/O Quantities, Redundant Controllers, BSM present (always set to yes), BSM Controller (set to yes when a dual I/O bus is used), etc.

Genius VersaMax I/O

If you are using Genius VersaMax NIU, then set the Serial Bus Address, Bus Baudrate, etc. The Max-ON RX3i drivers in the Controller will set the parameters for Redundant Controllers, BSM present, and BSM controller.

Remote Genius 90-30 Drops

If you are using Remote Genius 90-30 Drops, then configure the Genius bus controller(s), and edit the configuration rungs in the remote's I/O driver. Make certain that Syncronized Data has been configured for the range of outputs used by the Remote Drop.

Step 6 - Start the System

Divide the system into manageable subsystems that may be verified as independent entities.

I/O Bus

- Make certain that the Ethernet LAN(s) have been installed and configured correctly.
- Make certain that the Genius LAN(s) have been installed correctly... LAN polarity and shield IN/OUT are connected consistently and correctly. Also make certain that terminating resistors are installed at each end of the LAN(s).
- *Genius and Field Control* – Using a Handheld Monitor, verify that output devices may be turned ON or OFF from the LAN.
- Use the Handheld Monitor check the LAN for any Bus Error activity.

I/O Devices

When Interfacing to CPU A:

With the I/O operating, place CPU A in RUN mode and CPU B in STOP mode.

- Verify that the system input devices return real-time values properly.
- Verify that system output devices may be controlled from the Output Reference Tables.

Note: This might require that you place a temporary JUMP in your application. The JUMP should be placed immediately after the CALL to *HBR_000*. The companion label should be placed at the end of _MAIN.

When Interfacing to CPU B:

With the I/O operating, place CPU A in STOP mode and CPU B in RUN mode.

- Verify that the system input devices return real-time values properly.
- Verify that system output devices may be controlled from the Output Reference Tables.

Hot Standby Operation

1. Place both CPUs into RUN mode.
2. Make certain that there is only one Master and only one Backup.
3. Make certain that there is no preferred Master.
4. Place CPU B into STOP mode, and then into RUN mode.
5. Make certain that Synchronized Data is transferred properly to CPU B.
6. Transfer Mastership from A to B by placing the CPU A into STOP mode.
7. Make certain that the I/O did not dropout during the transfer.
8. Place CPU A into RUN mode.
9. Make certain that it becomes a Backup properly.
10. Transfer Mastership from B to A by placing the CPU B into STOP mode.
11. Make certain that the I/O did not dropout during the transfer.
12. Place CPU B into RUN mode.
13. Make certain that it becomes a Backup properly.
14. Make certain that Synchronized Data is transferred properly to CPU B.

Step 7 - Debug the System

Use the Max-ON Rx3i View Diagnostic Project

- Restore the Proficy View Project from the installation directory into Proficy Machine Edition.
- Enter the Ethernet Addresses of PLC A and PLC B into the Proficy View Project.
- Download and Run the View Project on your workstation.
- Examine the Alarm and the Real-time Status displays.

Simplify the System

Here are a few suggestions from other system developers that have worked well.

- Turn OFF one PLC and troubleshoot the system using the remaining one.
- Disable Max-ON RX3i drivers by placing an #ALW_OFF contact prior to the call to HBR_000. Now determine if input/output devices operate properly. This will require that you modify the hardware configuration for the Genius bus controllers. Place them in “Enable at Start”. Don’t forget to change the configuration to “Disable at Start” when it is time to place the system into its final, redundant operation.
- Disable your application code and troubleshoot the Max-ON functionality. Check to make certain that synchronized data items transfer properly. Check to make certain that the Hot Standby CPUs will exchange mastership properly.

Chapter 4 The Max-ON RX3i Configuration Utility

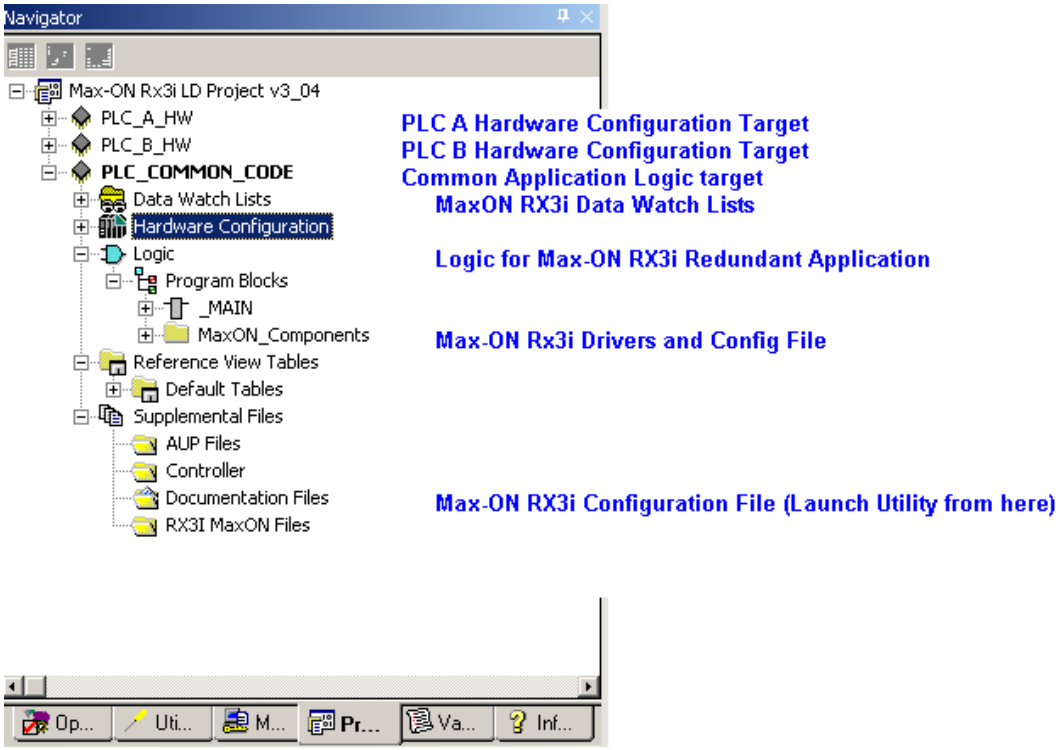
The Max-ON RX3i Configuration Utility is used to create or edit the operating parameters used by the Max-ON RX3i redundancy drivers. These parameters specify such things as, bus topologies, I/O addresses, and definitions for the ranges of synchronized data transfers.

Max-ON RX3i Projects

A Max-ON RX3i Project is a collection of items needed to define the elements of a redundant system. If you inspected a Max-ON RX3i Project using Logic Developer PLC, you would see that it consists of a Machine Edition Project with 3 Targets:

- *PLC_A_HW* – This target contains the hardware configuration for PLC A. It must be edited to reflect the hardware settings and components of PLC A in your system. Then it must be downloaded to PLC A (only).
- *PLC_B_HW* – This target contains the hardware configuration for PLC B. It must be edited to reflect the hardware settings and components of PLC B in your system. It will be very similar to PLC A hardware configuration, except for certain items such IP addresses, and Genius bus controller settings. In a similar fashion, this configuration must be downloaded to PLC B (only).
- *PLC_COMMON_CODE* – This contains the core redundancy logic for the Max-ON RX3i redundancy application. You must add your application logic starting in the rung that follows the call to the core Max-ON RX3i logic (hbr_000). The logic from this target will be downloaded to both PLC A and PLC B. Note that the download consists of the PLC Logic Only, the Hardware Configuration option must be unchecked.

The diagram below illustrates how the Max-ON RX3i Project is organized:

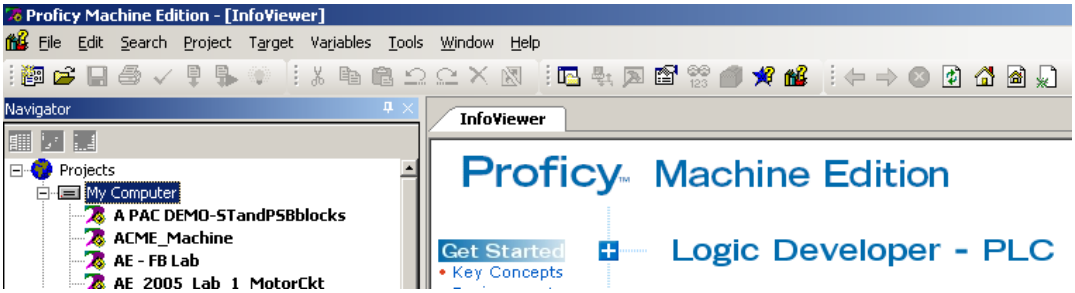


When creating a Max-ON RX3i Project, the best approach is to start with the generic project that is supplied with the Max-ON RX3i software. This assures that all of the basic components of the Max-ON RX3i redundant application are included in the project.

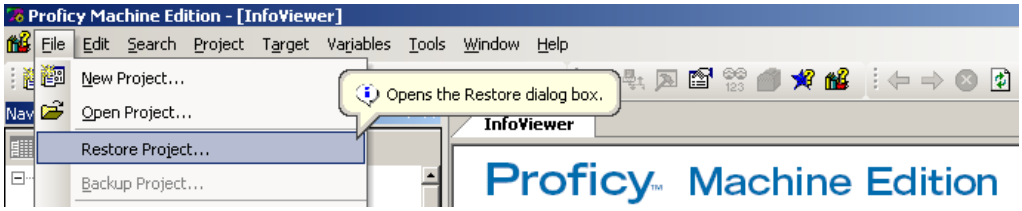
Creating a New Max-ON RX3i Project

To create a new Max-ON RX3i Project in Proficy Logic Developer PLC:

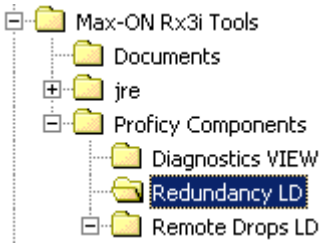
1. Create a new project based on the generic Max-ON RX3i Project. A new Max-ON RX3i Project is added to the Machine Edition project Navigator by using the *File* > *Restore Project…* menu item. Select the Project Navigator window, making certain that there is no project open at this time.



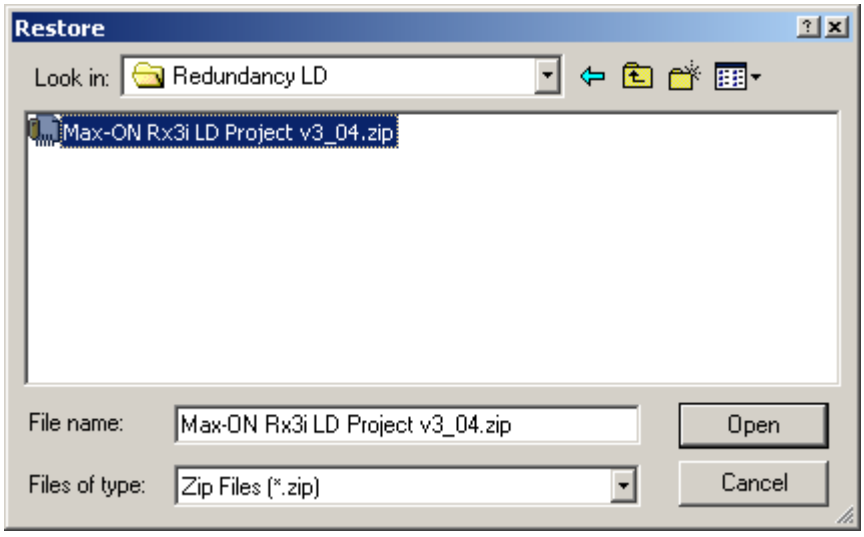
2. Using the *File* menu, click on the *Restore Project...* menu.



3. Navigate to the *Proficy Components* directory where the Max-ON RX3i Tools software has been installed, then to the *Redundant LD* directory. Make certain that the selection for **Files of Type** in the Restore dialog has been set to *Proficy Machine Edition (*.zip)*.



4. When you click on *Open*, a new project will be added to the Proficy Navigator window.

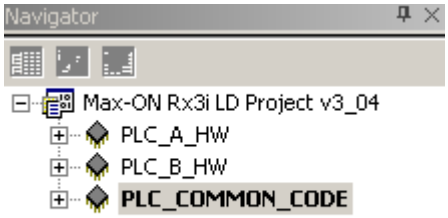


5. Give your project a descriptive name in the Machine Edition Navigator.

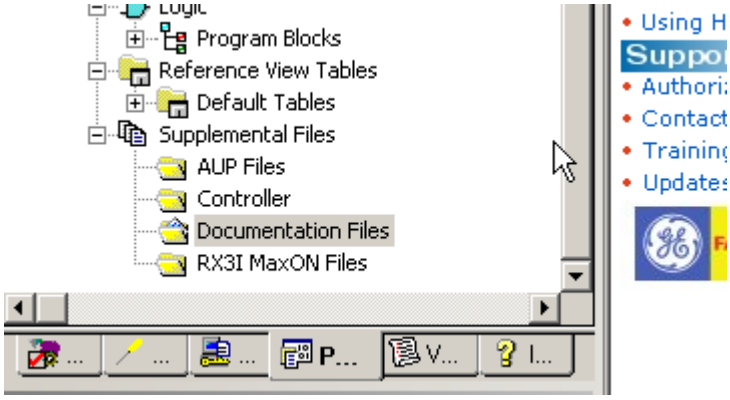
Launching the Max-ON RX3i Configuration Utility

The Max-ON RX3i Configuration Utility is launched from the Max-ON RX3i Machine Edition Project. For example, open the project that you created in the previous section. Navigate to the Max-ON RX3i Configuration Utility by following these steps:

1. Select the target *PLC_COMMON_CODE* node in the Navigator.

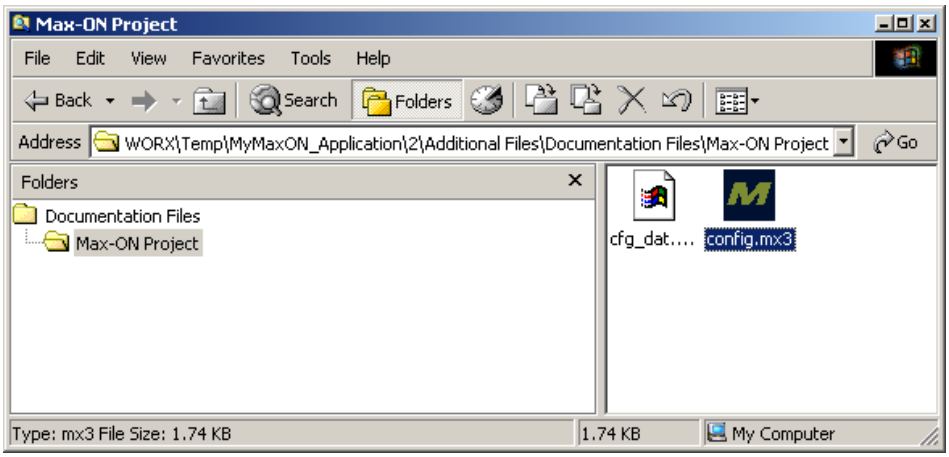


2. Expand the tree structure so that the *Supplemental Files* folder named *Documentation Files* is visible.



3. Double-click on *Documentation Files*. This will launch *Windows Explorer* for this directory.

4. Click on the *Max-ON Project* directory to display contents. The Explorer window will be similar to what is shown below.

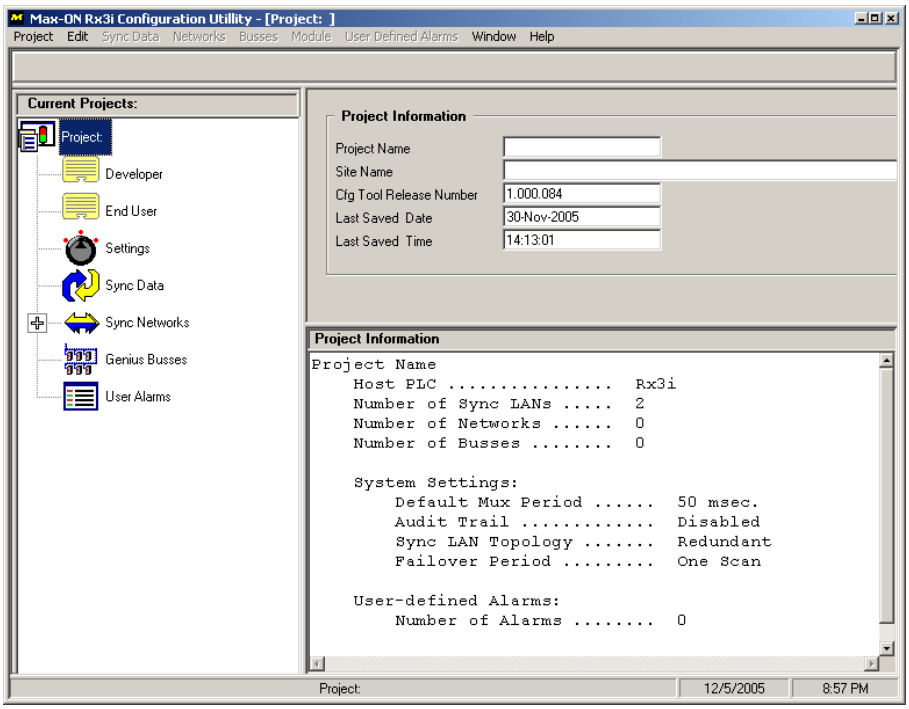


5. Double-click on the Max-ON RX3i Configuration file named *config.mx3*. This launches the Max-ON RX3i Configuration Utility. You may now examine and edit the parameters of the Max-ON RX3i redundant system.

The *cfg_dat.gefelf* file in the Max-ON Project directory is the C Block that is created and modified by the Max-ON RX3i Configuration Utility. After the utility has updated this file, you must update the *cfg_dat* C Block that is located in the PLC_COMMON_CODE target in the Max-ON RX3i Project.

Working with the Max-ON RX3i Configuration Utility

Now that you have created a Max-ON RX3i Project and launched the Max-ON RX3i Configuration Utility, you can set the parameters of the redundant system. When the Max-ON RX3i Configuration Utility is launched it will display the following:

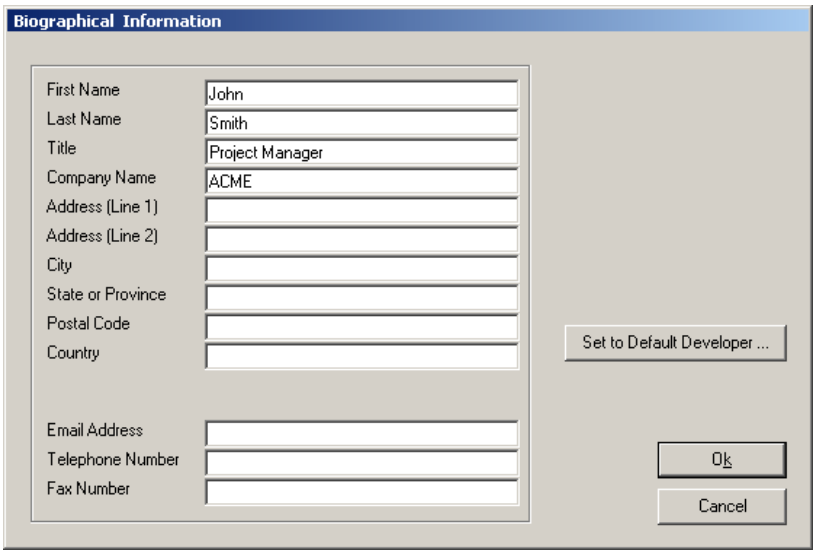


As you can see from the Project Navigator, the utility allows you to specify the following information about the Max-ON RX3i redundant system:

- **Developer**: Biographical information of the engineer who developed the application.
- **End User**: Biographical information about the end user.
- **Settings**: Specifies the Max-ON RX3i System Parameters.
- **Sync Data**: Specifies the synchronization data that is to be transferred from the Master CPU to the Backup CPU in order for the redundant system to be synchronized.
- **Sync Networks**: Specifies the Ethernet LAN configuration to be used to transfer the Synchronized Data.
- **Genius Busses**: Specifies the Genius Busses used by the redundant system for Genius I/O.
- **User Alarms**: Allows the user to create self-defined faults that can be logged by the Max-ON RX3i redundant application.
  Note: User Alarms are not available in the current version of Max-ON RX3i Diagnostics.

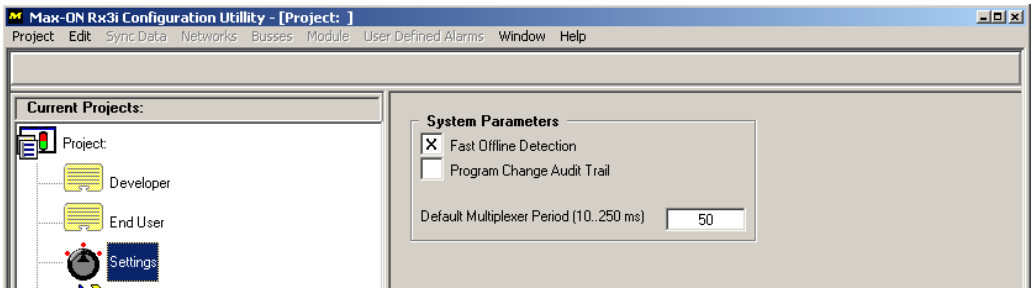
Developer and End User Information

By selecting the *Developer* and *End User* items in the Project tree, the information about the engineer who developed the application –and- the end user may be displayed and modified. To edit this biographical information, double-click on the *Developer* or *End User* item in the project tree or select the *Edit* > *Properties* menu item. The Biographical Information dialog is now displayed and the detailed information may be entered and saved.



Settings

By selecting the *Settings* item in the Project tree, the Max-ON RX3i System Parameters settings may be displayed and modified. These parameters are defined as follows.



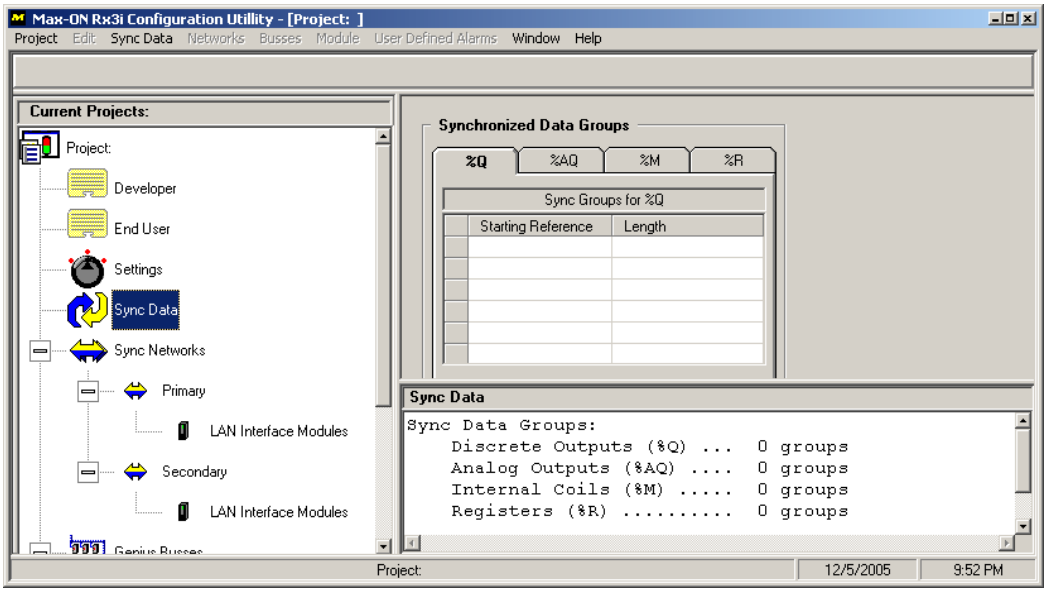
Fast Offline Detection - Enabling this option directs the CPUs to detect an offline condition within one CPU scan. If the option is not enabled, then it will require two consecutive scans to produce an offline condition.

Program Change Audit Trail - Checking this box instructs the Max-ON RX3i redundancy system to monitor the program for changes to logic. If there is a change, the value in the change counter, UR_N1 (%R9003/9004; DINT), will be incremented by one, and a date/time, PDAT_01 (%R9005.9007, packed BCD), will be posted for the moment at which the change was detected.

Default Multiplexer Period - This value is the default time period used to advance the Synchronized Data multiplexer. This is used when there are Remote 90-30 Drops present on a Genius I/O LAN.

Sync Data

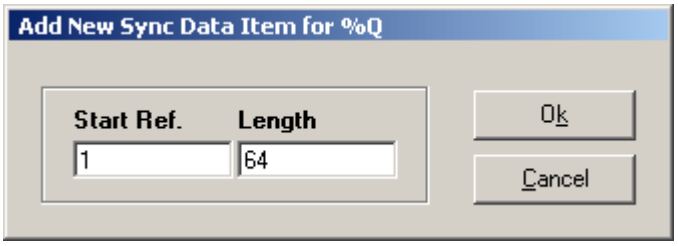
Synchronization data from the %M, %Q, %AQ, and %R reference tables may be transferred from the Master CPU to the Backup CPU in order for the redundant system to be synchronized. By selecting the *Sync Data* item in the Project tree, the Max-ON RX3i Sync Data settings may be displayed and modified.

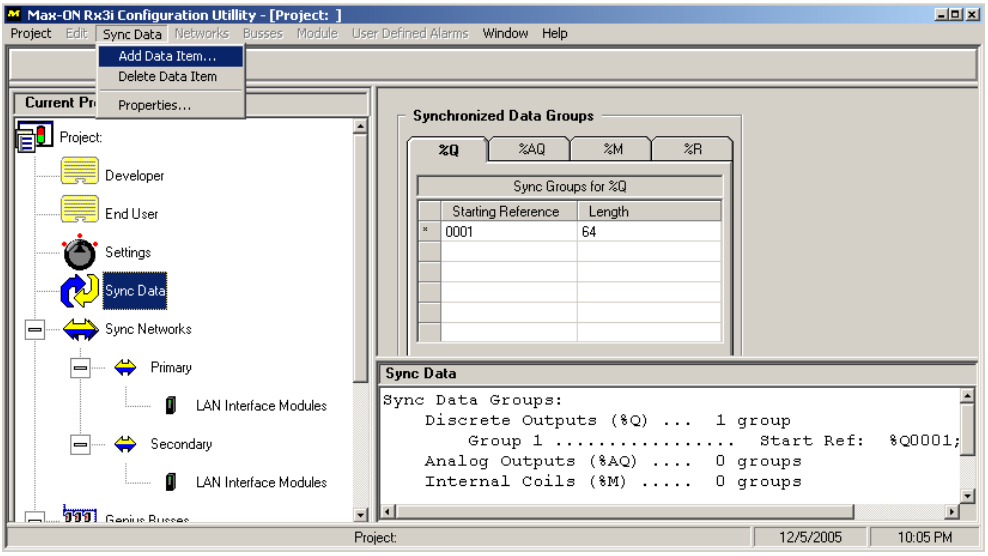


Synchronized data may be transferred in up to 6 groups for each of the reference tables listed above. This allows transfer of non-contiguous data areas. The general format uses a Start Reference and a Length.

To add a new address range to a data group, select the Data Group tab in the table, and then select the *Sync Data -> Add Data Item…* menu.

Now enter the new range for the new data group for this reference table.





Maximum Sync Data

For each Synchronized Data type, the system will sum the lengths in each configured group to arrive at a total amount for that data type. The total must not exceed the size listed in the table below:

Registers ***%R***	***Discrete Outputs*** ***%Q***	***Internal Coils*** ***%M***	***Analog Outputs*** ***%AQ***
8000	2048	4096*	256

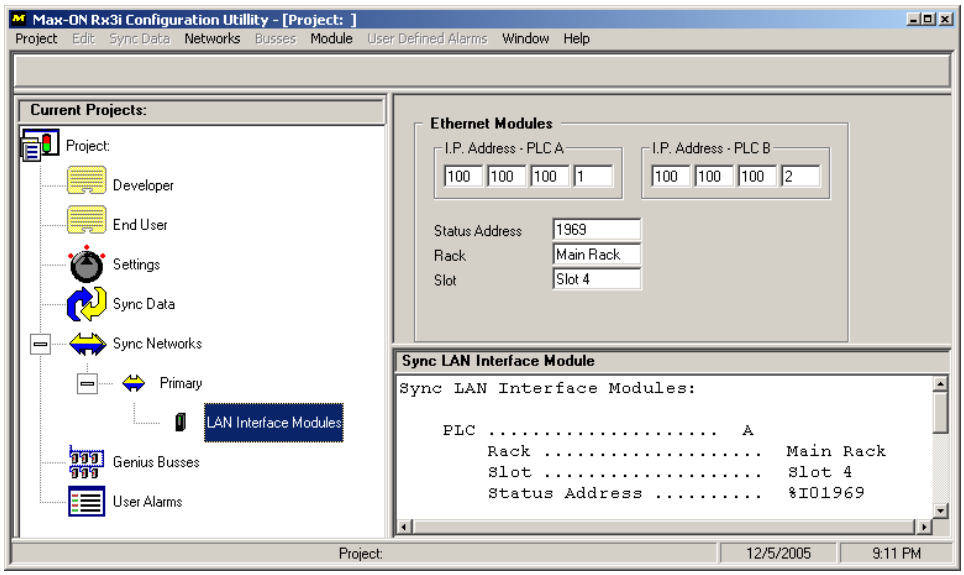
*The system flags, although included in this number, are not transferred.

Sync Networks

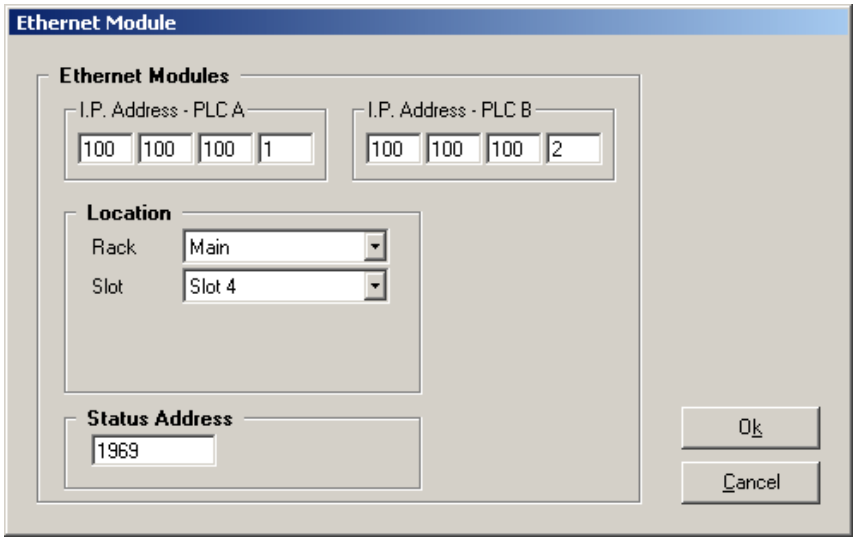
When using Max-ON RX3i, one or two Ethernet LANs may be configured using an IC695ETM001 interface card to transfer the Synchronization Data. If you are using a dual Ethernet LAN topology, then you may use two ETM001 modules in each PLC for the Sync LANs. When the Ethernet module has been configured in the Logic Developer PLC hardware configuration, you must assign the module a device status address. Generally, it is a good practice to place these in the upper area of the %I reference memory. (Note: The address must be set to %I01969 or lower.)

When dual Ethernet LANs are used, you must specify which device is to be the Primary device and which is to be the Secondary device. The Ethernet Modules must be in the same slot positions in each of the two RX3i main racks.

To display the configuration of the Sync Networks Interface Modules, expand the *Sync Networks* node in the Project tree. Now the configurations of the two Primary Interface modules are displayed.

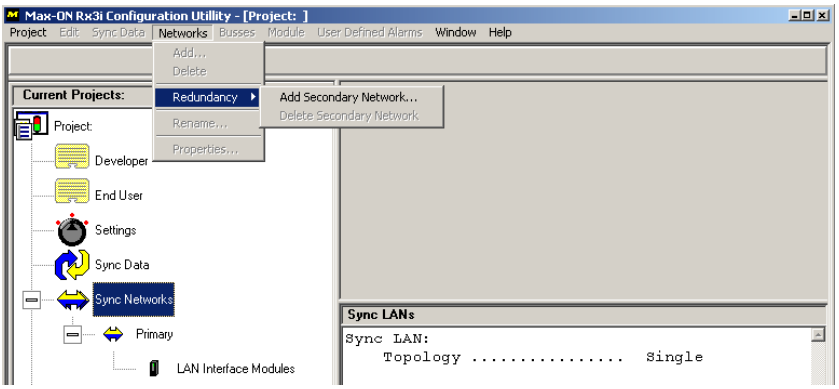


To edit this information, double-click on the LAN Interface Modules item in the project tree or select the *Module* > *Properties…* menu item. The Ethernet Modules configuration dialog is now displayed and the information about them can be entered.

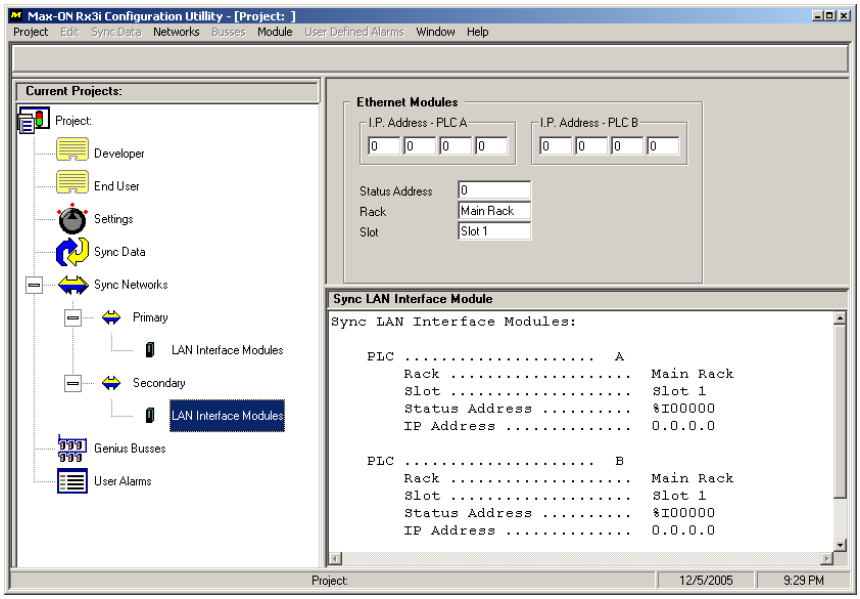


Configuring Dual Sync Networks

If you want to use a dual Ethernet Sync Networks, then you must use two ETM001 modules in each PLC for the Sync Network. In this case, you need to define the Secondary Sync network. To add a Secondary Sync Network to the Max-ON RX3i system, select the Sync Networks node in the project tree. Then select the *Networks* > *Redundancy* > *Add Secondary Network…* menu item.



Now the Secondary Network will be added to the system, and parameters may be configured.



To edit the Secondary LAN information, double-click on the LAN Interface Modules item in the project tree or select the *Module* > *Properties…* menu item.

Note: The Ethernet LAN information that is placed in the Max-ON RX3i Configuration must match the configuration information that is placed in PLC_A_HW and PLC_B_HW hardware configurations in order for the system to operate properly.

Genius Busses

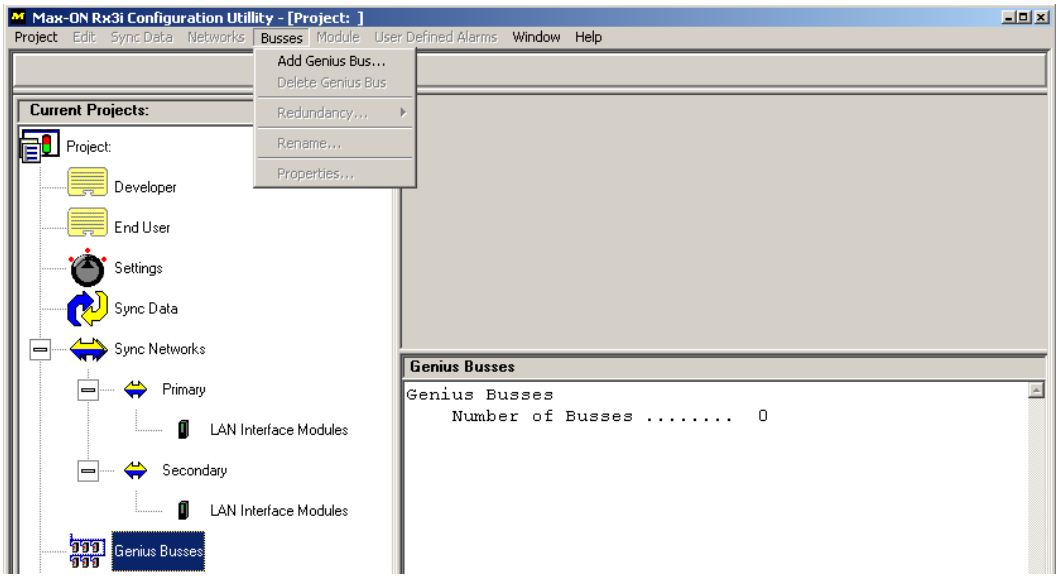
By selecting the *Genius Busses* item in the Project tree, the Max-ON RX3i Genius busses may be displayed and their settings may be modified. By default, no Genius busses are defined, so you must configure the bus definitions to match your hardware configuration. Genius busses can be defined as a Simplex or a Duplex bus.

Simplex Genius Bus

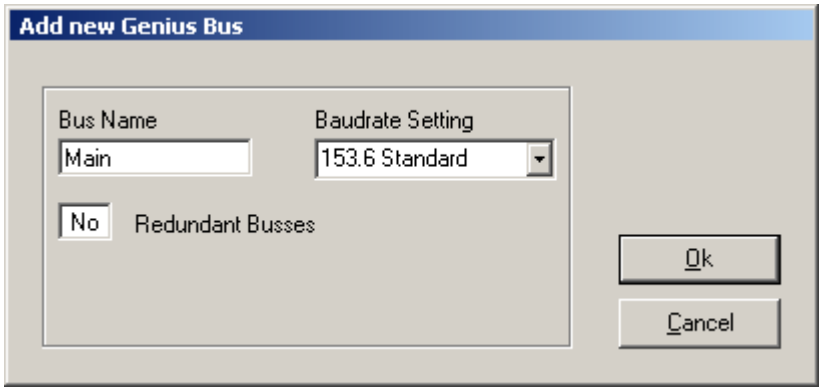
A simplex Genius Bus is a non-redundant I/O bus that connects to one or more Genius I/O devices.

To Add a Genius Bus

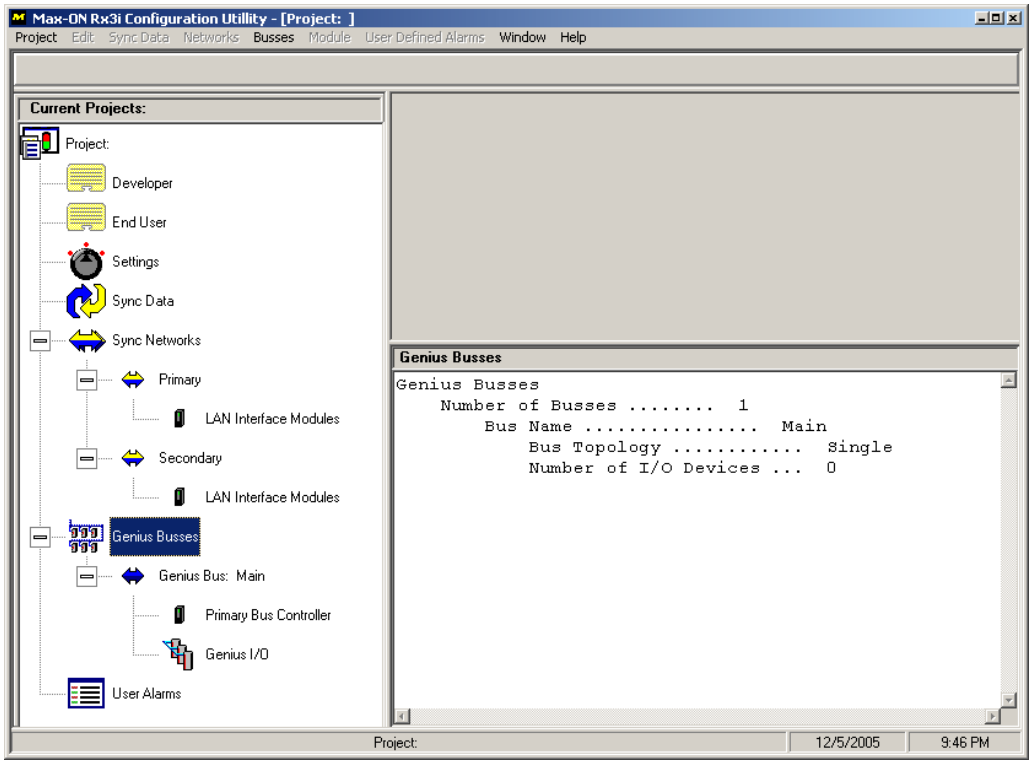
1. To add a new Genius Bus, select the *Genius Busses* item in the Project tree, then select the *Busses >Add Genius Bus..* menu item.



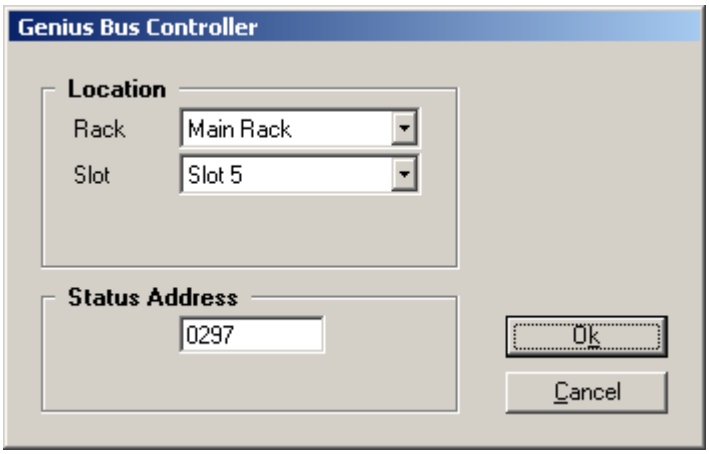
2. Give the Genius bus a descriptive name, such as “Main”, and change the Baudrate setting if necessary.



3. After the Genius bus has been created, it is added to the Project tree and now Genius devices may be added to this bus.



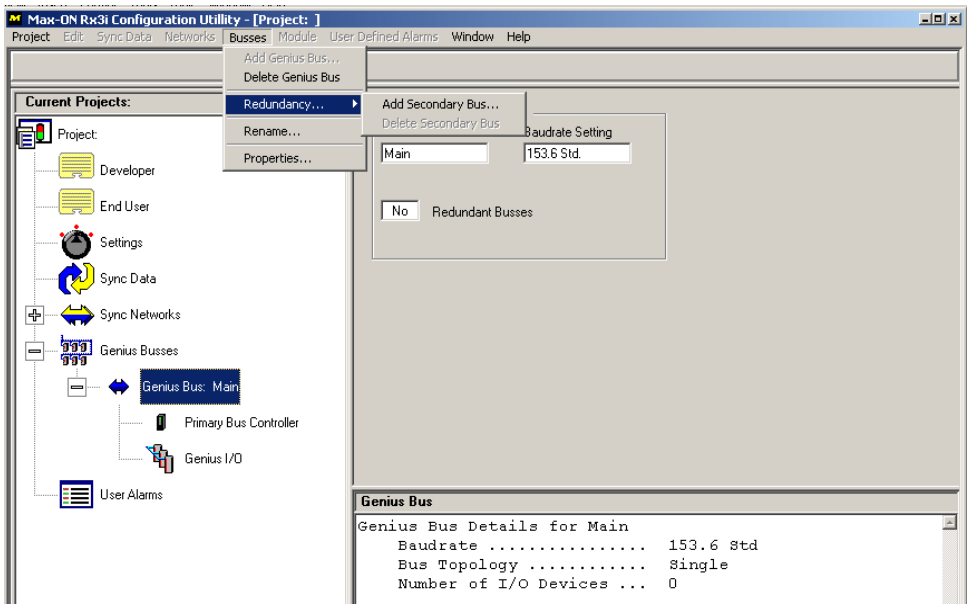
4. Double-click on the Primary Bus Controller item in order to configure parameters, or select the *Busses* > *Properties…* or *Module* > *Properties…* menus. Enter the module's location in the RX3i main rack and it's status address. A suggested practice is to address devices such as Genius bus controllers and Ethernet modules at high addresses. This leaves the low addresses available for Input devices such as field sensors.



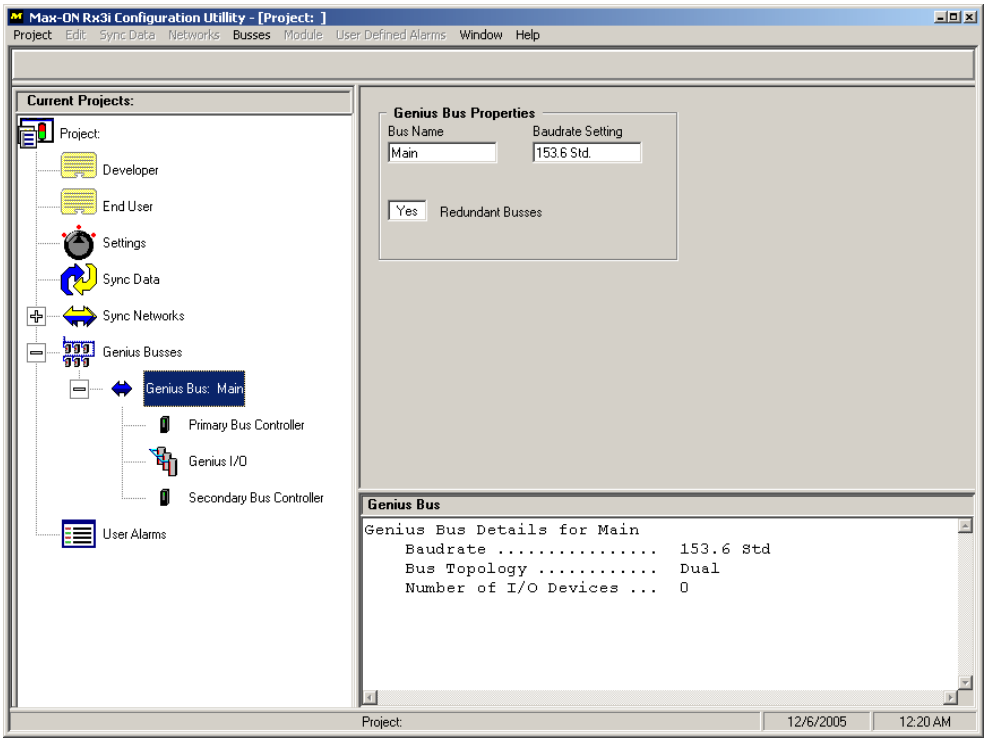
Adding a Secondary Genius Bus

To add a Secondary Genius Bus to an Existing Genius Bus

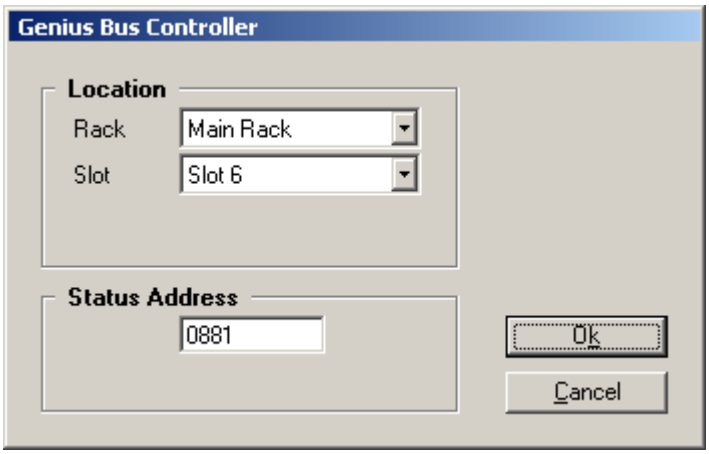
1. Select the Genius Bus in the Project tree, and then select the *Busses* > *Redundancy…* > *Add Secondary Bus..* menu item to add a Secondary Genius Bus.



2. A Secondary Genius Bus Controller is added to the Project tree.

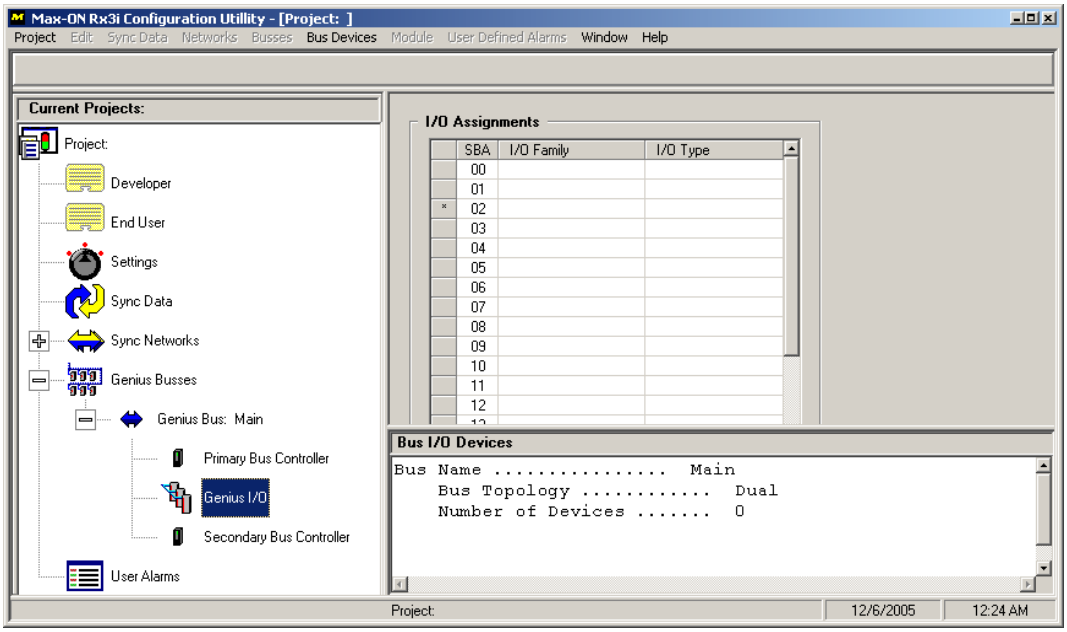


3. Double-click on the Secondary Bus Controller in order to configure it's parameters, or select the *Busses* > *Properties…* or *Module* > *Properties…* menus. Enter the module's location in the RX3i main rack and it's status address. A suggested practice is to address Genius bus controllers at high addresses. This leaves the low addresses available for Input devices such as field sensors. (Note: The input address must be set to less than %I02017.)



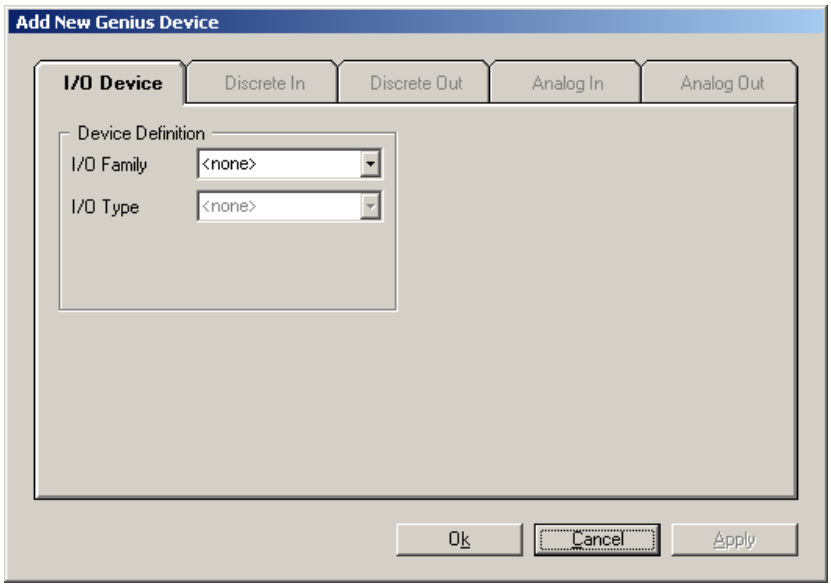
Adding Genius I/O Devices

To add Genius devices to a Genius Bus, select the *Genius I/O* item in the Project tree. Now the I/O Assignments table is displayed which lists the Genius Devices that are assigned to the various SBAs (Serial Bus Addresses).

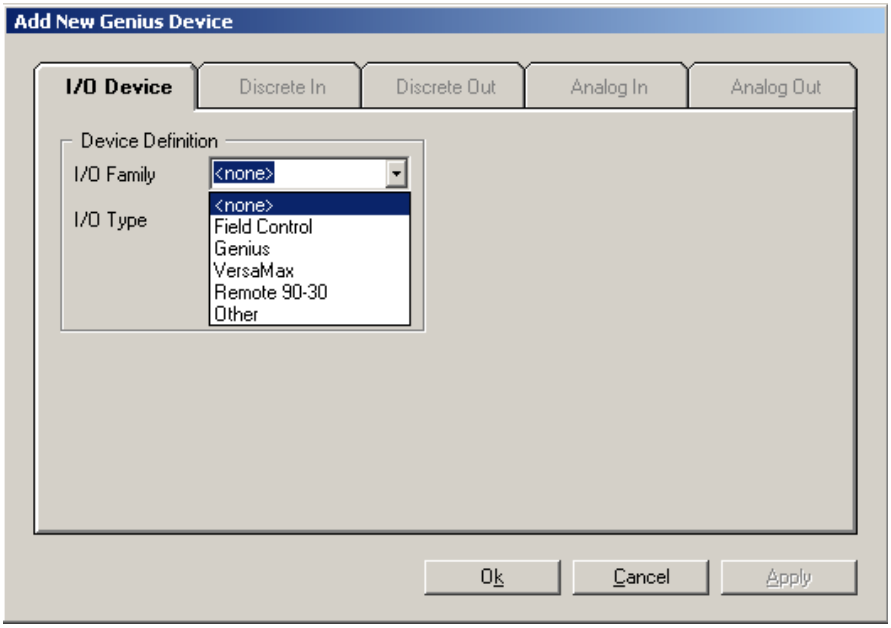


To add a Genius I/O device to this Genius Bus:

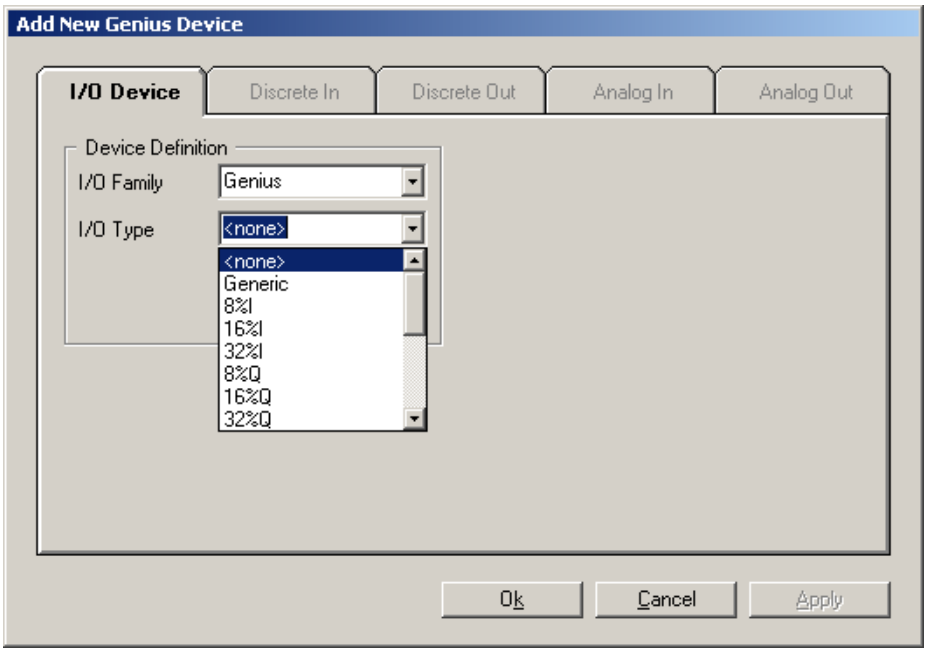
1. Select an SBA for the new Genius device by clicking on the gray button to the left of the SBA number. A "*" will be placed on the button to indicate it's selection.
2. Select the *Bus Devices* > *Add Device…* menu item. The Add New Genius Device dialog is displayed.



3. Click in the cell labeled *I/O Family*. A dropdown list will appear:

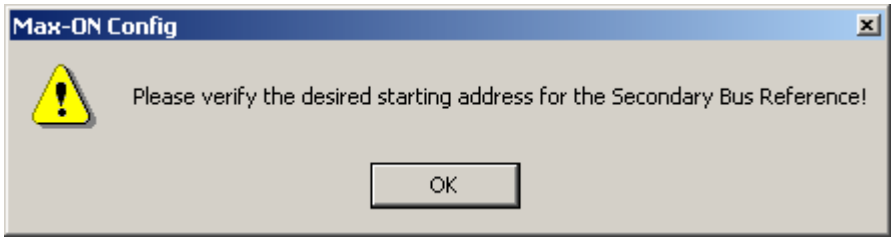


4. If the I/O Family is Genius, then select the I/O Type for the I/O device. Click in the cell labeled *I/O Type*. A dropdown list will appear:

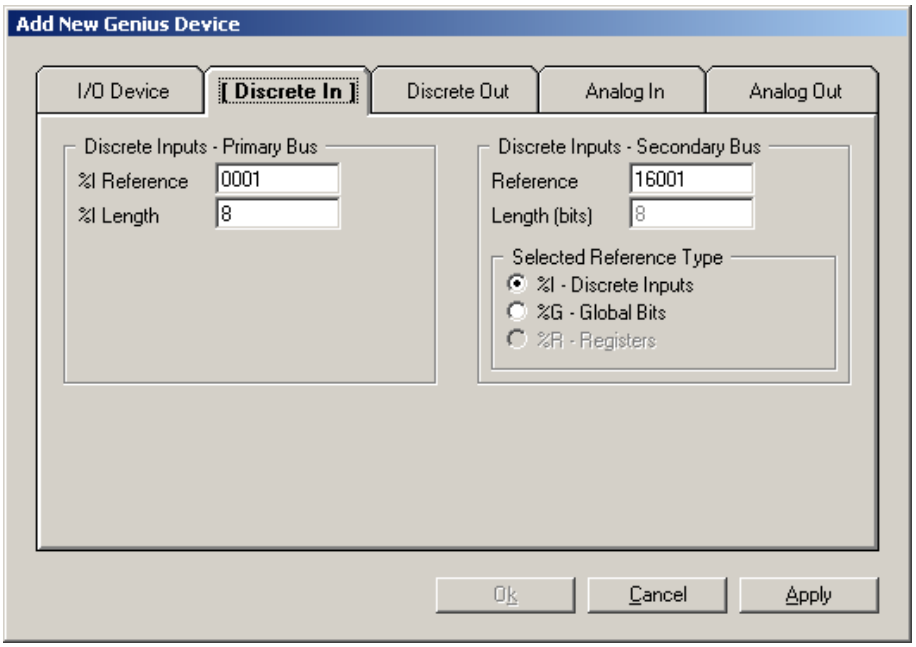


5. Select the *I/O* Type for the device, using the drop down list selections. If your I/O device does not match with any of the selections, then select *Generic*. Also, you should select *Generic* if the device is a *Remote 90-30 Genius* drop.

6. Click the Apply button to assign the I/O Family and I/O Type. (Note: If this is a dual bus, a reminder may be displayed to ask you to verify the starting address for the Secondary Bus Reference.) Click Ok.



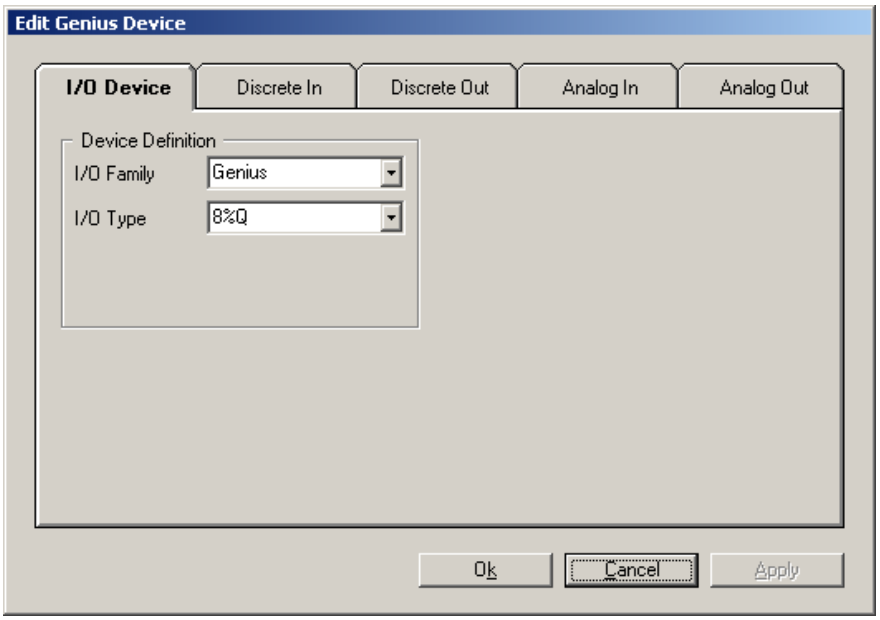
7. Click on the I/O Device type tab that is now active, [Discrete In], for example.



8. Edit the device properties for both the Primary and Secondary busses.
9. Click *Apply* and *Ok* to complete the changes or *Cancel* to leave without making any changes.

Editing Genius I/O Devices

1. To edit a Genius device's parameters, select the *Genius I/O* item in the Project tree for a specific Genius Bus.
2. Select a Genius device by clicking on the gray button to the left of the SBA number. A "*" will be placed on the button to indicate it's selection.
3. Select the *Bus Devices* > *Properties…* menu item. The Edit Genius Device dialog is displayed.



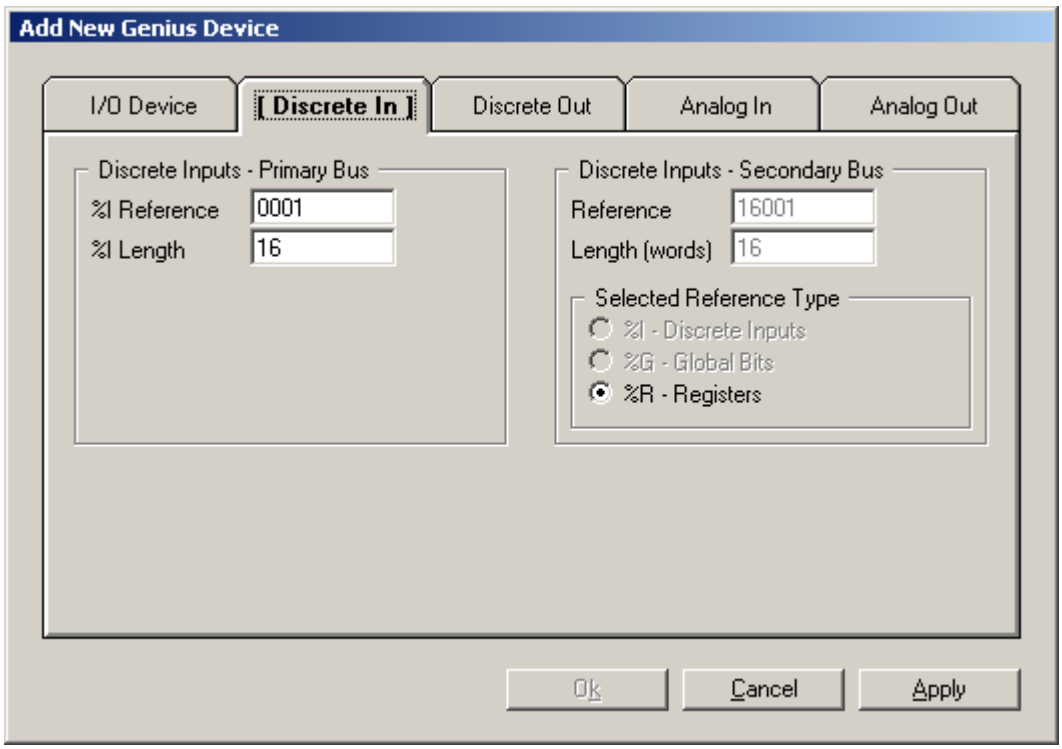
4. *Edit* the device properties
5. Click *Apply* and *Ok* to complete the changes or *Cancel* to leave without making any changes.

Deleting Genius I/O Devices

1. To delete a Genius device, select the *Genius I/O* bus from the Project tree for the item to be deleted.
2. In the device table, select the Genius device by clicking on the gray button to the left of its SBA number. A "*" will be placed on the leftmost column and row to indicate that the device has been selected.
3. Select the *Bus Devices* > *Delete Device…* menu item. The device will be deleted.

Configuring Genius Discrete Inputs

The Genius Device dialog allows you to configure Genius discrete inputs. If the bus to which this device is attached has been configured to have a Secondary bus controller, then both the Primary Bus and Secondary Bus information will be displayed. If this is a single (non-redundant) bus, then only the Primary Bus information will be displayed.



Discrete Inputs – Primary Bus

This field defines the base address assigned to the discrete inputs. This address establishes the references that the input devices will use while they are connected to the Primary bus. These are the same references that will be used throughout the user application logic.

%I Reference	The first reference address used within the discrete input group.
%I Length	The number of discrete references that are to be included on this device.

Discrete Inputs – Secondary Bus

When a dual bus is used, there must be an alternate location for the Genius discrete inputs to report their status. The alternate location is the reference area in which the inputs will appear while they are connected to the Secondary Genius I/O bus.

Max-ON RX3i redundancy drivers detect when the Primary inputs are unavailable. If the Secondary inputs are reporting into the Secondary reference area, the drivers will map the data automatically from the Secondary area into the Primary address locations. This permits the user-application to be written with references to the Primary addresses only.

Reference The first reference address used in the Secondary (alternate) reference table.

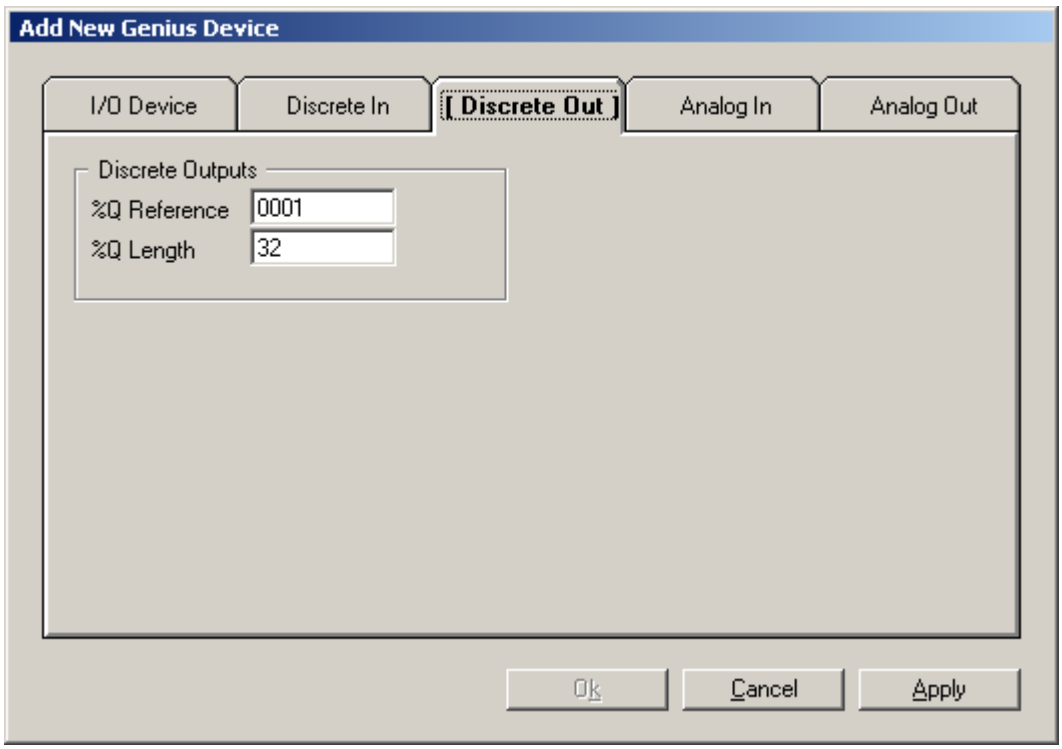
If the Primary Bus %I Length is a multiple of 16, then the inputs will be mapped into the RX3i register table. This value is read-only.

If the Length is an odd multiple of 8, then the inputs may be mapped into either %I or %G references. You may select the desired reference type and address for the Secondary location.

Length (words) The number of discrete references that are to be included on this device. This is a read-only value that is generated from the number that was entered into the Primary Bus %I Reference.

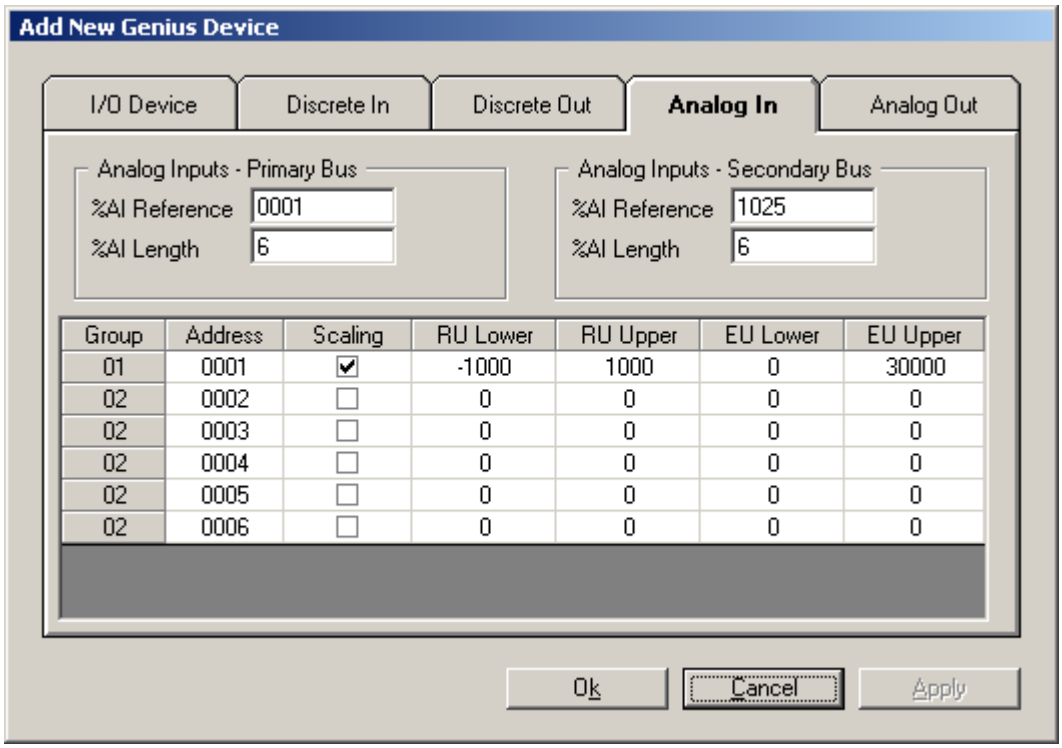
Configuring Genius Discrete Outputs

The Genius Device dialog allows you to configure the Genius discrete outputs. The main purpose of this configuration is to identify the device and the circuit reference so that online status may be monitored. Any offline/online activity will be reported in the Max-ON Rx3i Fault Table.



Configuring Genius Analog Inputs

The Genius Device dialog allows you to configure how the Max-ON RX3i redundancy driver will process Genius analog inputs. The analog inputs may be configured on a per circuit basis.



Analog Inputs - Primary Bus

The Primary Bus addressing is the base address assigned to the analog inputs. This address establishes the references that the analog input devices will use while they are connected to the Primary Bus. These are the same references that will be used throughout the user application logic.

%AI Reference	The first reference address used within the discrete input group.
%AI Length	The number of discrete references that are to be included on this device.

Analog Inputs - Secondary Bus

When a dual bus is employed, there must be an alternate location for the analog inputs to report their values. The alternate location is the reference area in which the inputs will appear while they are connected to the Secondary Genius I/O bus.

Max-ON RX3i redundancy drivers detect when the Primary inputs are unavailable. If the Secondary inputs are reporting into the Secondary reference area, the drivers will map the data automatically from the Secondary area into the Primary address locations. This permits the user-application to be written with references to the Primary addresses only.

%AI Reference The first reference address used in the secondary (alternate) reference table. This value is read-only. The reference will always be equal to the Primary reference plus an offset of 1024.

%AI Length The number of discrete references that are to be included on this device. This is a read-only value that is generated from the number that was entered for the Primary Bus.

Circuit Configurations

Analog input scaling may be used to convert raw values received from the input device into scaled values. Because many bus devices are able to perform their own scaling, this option may be enabled for devices that do not provide scaling inherently. Please be aware that enabling this option adds to overall scan time and consumes additional configuration memory.

The circuit configuration parameters are as follows:

Address The analog circuit reference. This item is read-only.

Scaling Enables scaling from raw units (RU) to engineering units (EU) for the corresponding analog input circuit.

RU Lower The lowest raw count value (RU) that the analog circuit will produce.

RU Upper The highest raw count value (RU) that the analog circuit will produce.

EU Lower The desired lowest value expressed in the sensor's measurement unit (EU).

EU Upper The desired highest value expressed in the sensor's measurement unit (EU).

The acceptable range of values for any of the units is –32768 to +32767.

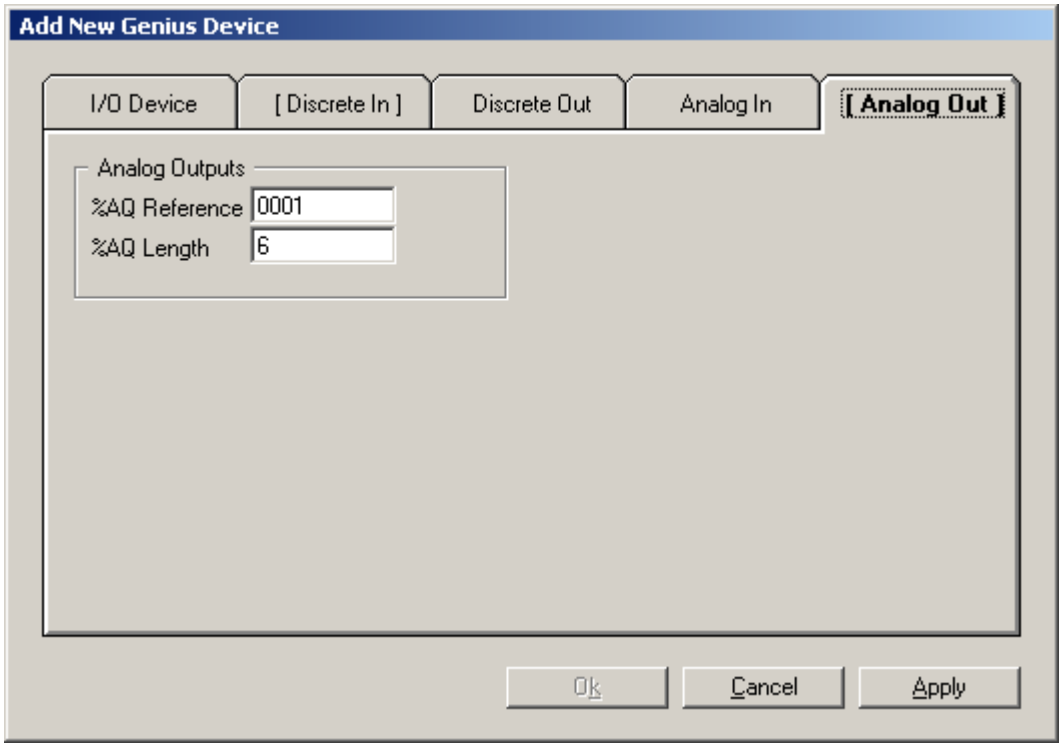
If the raw value produced by the analog circuit is less than the RU Lower value OR if the value is greater than the RU Upper value, then an alarm will be generated for the analog circuit.

Notes:

- Many of the GE Fanuc analog input devices are capable of performing scaling independently. It is better to use the built-in capabilities of the devices. This will reduce the CPU scan time by eliminating the extra processing associated with the scaling function. Also, it reduces the amount of configuration memory consumed.
- If the device is configured to be on a dual bus, then the Secondary analog input addresses will be at the Primary address plus an offset of 1024. For example, %AI00001 will have an associated Secondary address at %AI01025.

Configuring Genius Analog Outputs

The Genius Device dialog allows you to configure Genius analog outputs. The main purpose of this configuration is to identify the device and the circuit reference so that online status may be monitored. Any offline/online activity will be reported in the Max-ON Rx3i Alarm Table.



Configuring the Secondary Address

On dual bus systems, discrete and analog inputs are mapped from the Primary bus controller's buffers into the normal input reference tables.

Inputs from the Secondary bus controller are placed into an alternate area and then the Max-ON Rx3i redundancy driver remaps the alternate states into the table area used by the Primary. Remapping occurs whenever the device is detected as being present on the Secondary bus, but not present on the Primary. (In most instances the data will be available on one of the busses, but not both. The exception is for Remote 90-30 Genius drops, in which case, there are bus controllers on each bus.)

Analog Inputs

For analog inputs, the Secondary addressing is fixed at the primary's address reference plus 1024. Thus an analog input circuit addressed at %AI00001 will have a Secondary address at %AI01025.

Discrete Inputs

For discrete inputs, the addressing is more flexible.

- If the Primary address is on a word multiple (i.e. 1, 17, 33, etc.) AND the length is a word multiple (i.e., 16, 32, 48, etc.), then the Secondary address will be mapped into %R space.
- If the primary address does not meet the criteria above, then the user may select an alternate address at either a %G reference or a %I reference.

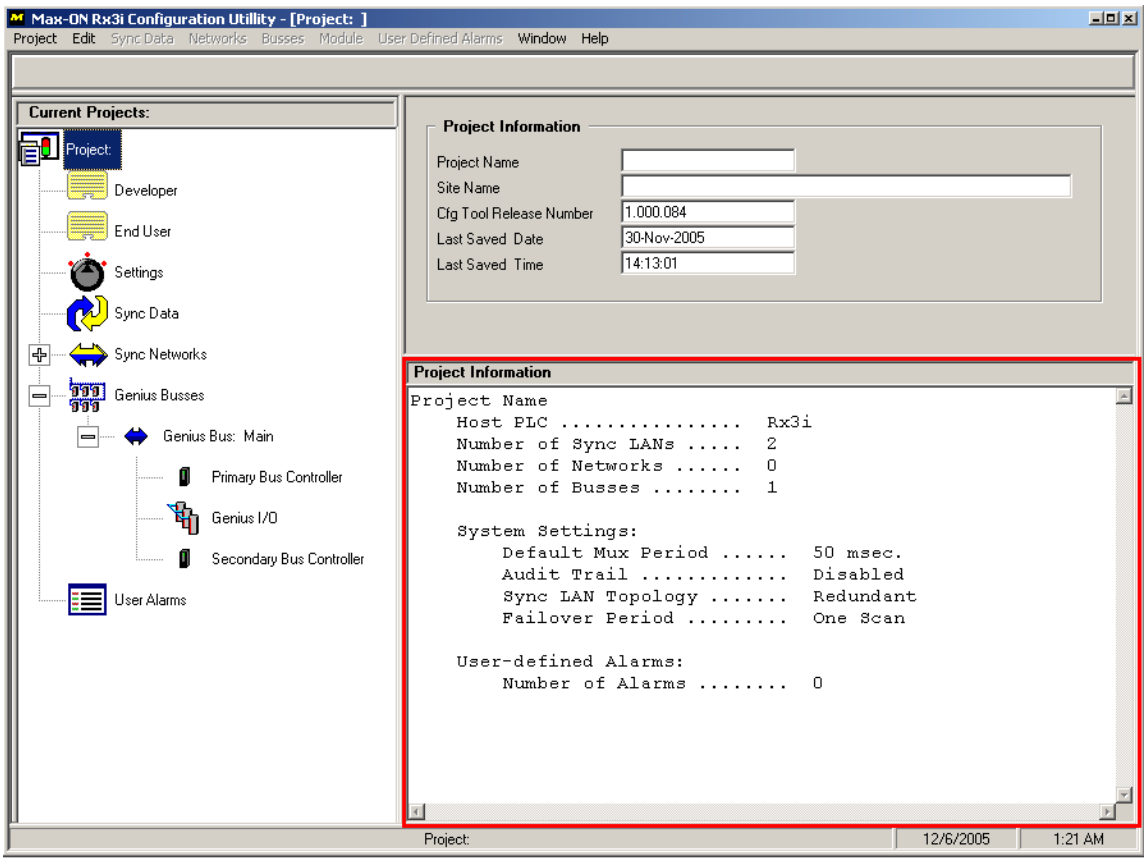
Secondary Bus References

The configuration utility will display the configuration options for the Secondary bus references automatically. Please use the configuration information displayed in the text window to obtain the information that is needed to configure the Secondary bus controllers for discrete and analog inputs.

Project Information

Configuration Summary

The configuration summary provides information about your project. You determine the content of this report by the item that is selected in the project tree. Each time an item is selected in the project tree, the configuration summary will update automatically.



The configuration summary window text can be selected (use the Select All right mouse button), and pasted into a text editor for archiving and printing.

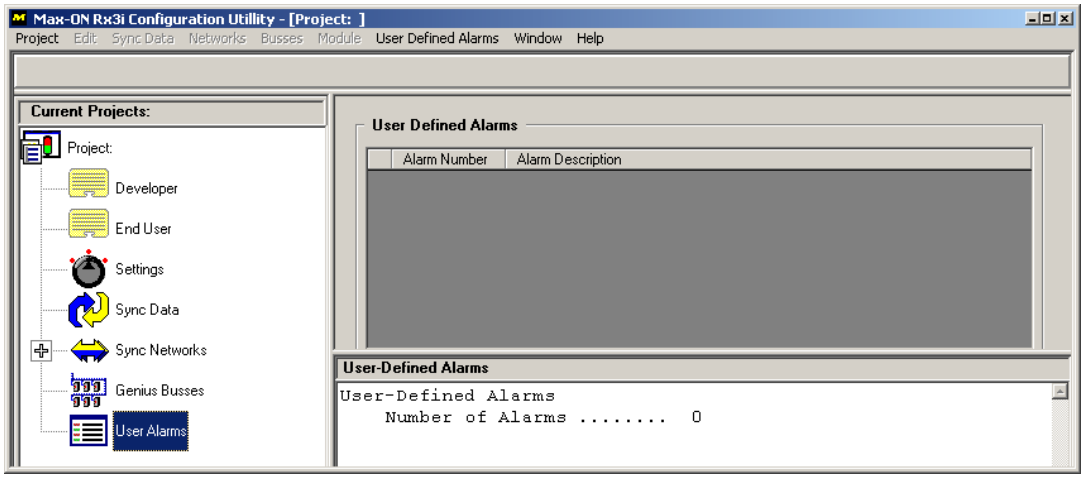
User Defined Alarms

The user may post user defined faults from within the application. However, before the Max-ON RX3i Diagnostics can display the user alarms, they must be configured.

NOTE: User Defined Alarms are not available in the current version of the Max-ON RX3i Diagnostics.

Adding a User Alarm

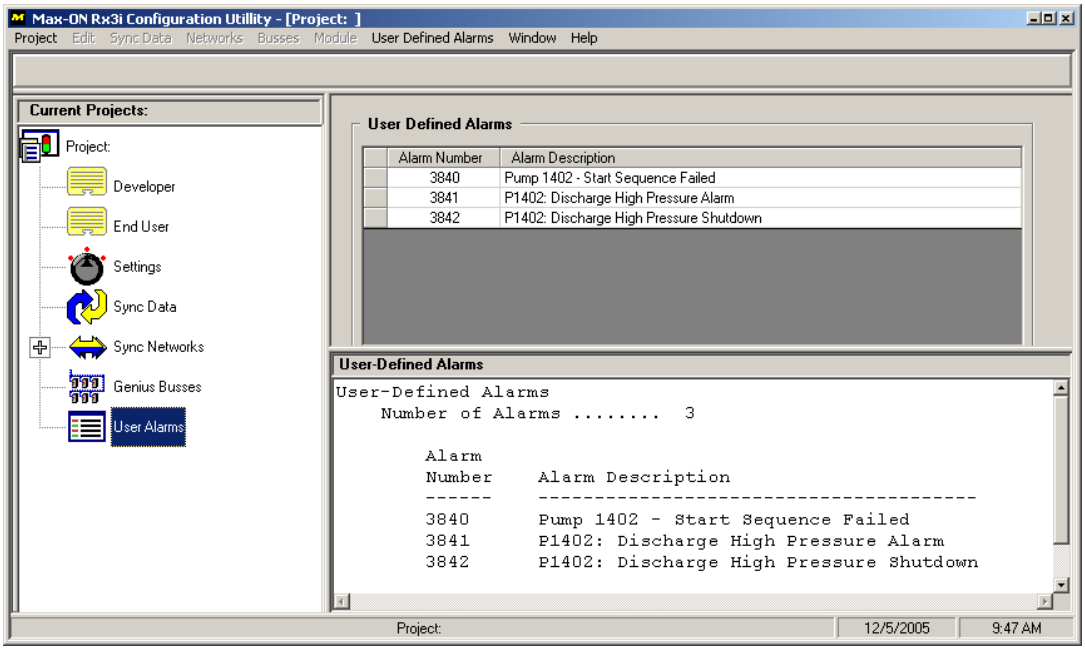
1. Select the User Alarms item in the Max-ON RX3i Configuration Utility Project tree.



2. Select the *User Defined Alarms* > *Add Alarm…* menu item.

3. Enter an Alarm Number and the corresponding Alarm Description. Note: The Alarm Number must be within the numerical range 3840..4095. The descriptor may be up to 60 characters in length.

4. Enter any additional alarms.



5. Save your Max-ON RX3i Configuration, update the cfg_dat C Block in the Max-ON Project.

6. Download the new Max-ON RX3i Configuration to the CPUs.

Deleting a User Alarm

1. Select the User Alarms item in the Max-ON RX3i Configuration Utility Project tree.
2. Select a User Alarm by clicking on the gray button to the left of the User Alarm number. A "*" will be placed on the button to indicate it's selection.
3. Select the *User Defined Alarms* > *Delete Alarm* menu item. The alarm has now been removed.
4. Repeat steps 2 and 3 for any additional user-defined alarms.
5. Save your Max-ON RX3i Configuration, update the cfg_dat C Block in the Max-ON Project.
6. Download the new Max-ON RX3i Configuration to the CPUs.

Note: In order for User-Defined Alarms to be active, ladder logic must be added to the application. The logic passes the user specified alarm number to the Alarm handler. (See Max-ON RX3i Advanced Programming topic: User-Defined Alarms.)

Chapter 5 Programming Considerations

This chapter provides additional information on programming considerations and system resources for the Max-ON RX3i product. In many cases, Max-ON RX3i System Variables have been predefined to use in application logic in order to interact with the Max-ON RX3i redundancy driver.

Reserved References

Max-ON RX3i redundancy drivers make use of a small number of variable references. Some of these references are used for the internal operation of the drivers to hold system state information. Many are available to your application logic to provide both information on the system and to control the operation of the redundancy drivers.

I/O References	
%I00001 to 2048	Available to all applications
%Q00001 to 2048	Available to all applications
%AI00001 to configured limit	Available to all applications
%AQ00001 to configured limit	Available to all applications
Boolean References	
%G00001 to 1024	Available to all applications
%G01025 to 1280	Reserved by Max-ON RX3i
%M00001 to 0928	Available to all applications
%M00929 to 1024	Reserved by Max-ON RX3i
%M01025 to 4096	Available to all applications
%S (all)	Available to all applications
%T00001 to 256	Available to all applications
Word References	
%R00001 to 8000	Available to all applications
%R08001 to 16384	Reserved by Max-ON RX3i
%R16385 to configured limit	Available to all applications
%W00001 to %W29999	Available to all applications
%W30000 to %W50000	Reserved by Max-ON RX3i

System Status Flags

The System Status Flags indicate key operating characteristics of a Max-ON RX3i system. These flags may be monitored by an HMI to display such things as current Master. Optionally, the system designer may use the status flags to control the operation of the application.

Variable Name	***Reference***	***Description***
ID_A	%M01017	ID Flag for CPU A
ID_B	%M01018	ID Flag for CPU B
CPU_RUN	%M01019	CPU is in RUN Mode
MASTER	%M01020	Master Flag
SYNC_OK	%M01021	All Data has been Synchronized
	%M01022 – %M01024	Reserved

%M01017 ***ID Flag for CPU A*** (ID_A) – This flag is ON in the CPU identified as PLC A. (Setting the CPU Identity)

%M01018 ***ID Flag for CPU B*** (ID_ B) – This flag is ON in the CPU identified as PLC B. (Setting the CPU Identity)

%M01019 ***CPU is in RUN Mode*** (CPU_RUN) – This flag is ON if the CPU is in RUN Mode. It is OFF if the CPU is in STOP/Disabled or STOP/Enabled.

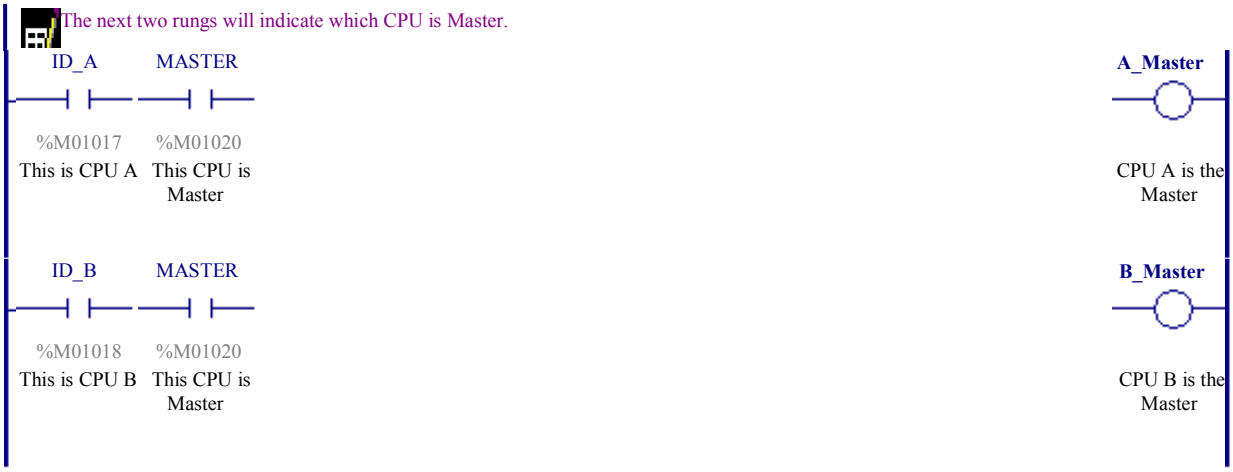
%M01020 ***Master Flag*** (MASTER) – This flag is ON in whichever CPU is the current Master.

%M01021 ***All Data has been Synchronized*** (SYNC_OK) – This flag is always ON in the CPU identified as the current Master. It is ON in the Backup CPU at the moment when all Synchronized Data items have been updated.

Indicating Mastership

Using the System Status Flag %M01020 (Master) and the System Status Flags %M01017 and %M01018 (the CPU Identity flags), you may determine which PLC is the current Master. By combining these flags it is possible to link discrete outputs to indicator lamps, link to internal coils to provide status points to an HMI, or even link discrete outputs to data switches to route communications lines from a peripheral to the CPU serial ports.

In the example below, the Flags are used to control discrete outputs that are attached to indicator lamps.



Local Status Flags – Instantaneous

The following status flags represent the instantaneous (not latched) state corresponding to the associated descriptors.

Variable Name	Reference	Description
AUTH_ALM	%M00961	Authorization Alarm
REM_OFF	%M00962	Remote CPU Offline
PROG_CHG	%M00963	Program Changed
HWC_CHG	%M00964	HW Configuration Changed
	%M00965 - %M00968	Reserved

%M00961 ***Authorization Alarm*** (AUTH_ALM) – This alarm bit indicates that the corresponding PLC is operating in DEMO mode on a standard PACSystems RX3i CPU (IC695CPU310). In a system that has been properly authorized, this flag will be OFF.

%M00962 ***Remote CPU Offline*** (REM_OFF)– The companion PLC is offline. This may be due to the CPU being in STOP, Fault, or Power-OFF. Also, it may be due to a cable problem or Ethernet Interface failure.

%M00963 ***Program Changed*** (PROG_CHG) – The program in the Local CPU has changed.

%M00964 ***HW Configuration Changed*** (HWC_CHG) – The hardware configuration in the Local CPU has changed.

Local Status Flags – Instantaneous (cont.)

Variable Name	*Reference*	*Description*
PWR_UP	%M00969	Power Up
PRG_RST	%M00970	Program Restart
E1_OFFL	%M00971	System Ethernet Bus Primary Offline
E2_OFFL	%M00972	System Ethernet Bus Secondary Offline
	%M00973 - %M00992	Reserved

%M00969 ***Power Up*** (PWR_UP) – The Local CPU has undergone a power-up event.

%M00970 ***Program Restart*** (PRG_RST) – The Local CPU has been switched from STOP mode to RUN mode.

%M00971 ***System Ethernet Bus Primary Offline*** (E1_OFFL) – The primary Ethernet LAN is offline. This may be due to a cable problem, a transceiver problem, a hub/switch problem, an ETM001 module failure or a LAN configuration error.

%M00972 ***System Ethernet Bus Secondary Offline*** (E2_OFFL) – The secondary Ethernet LAN is offline. This may be due to a cable problem, a transceiver problem, a hub/switch problem, an ETM001 module failure or a LAN configuration error.

%M00973 - %M00992 Reserved

Local Status Flags – Latched

The following status flags represent the latched state corresponding to the associated descriptors. The states are set by the first instance of the associated event. The flags are reset by either a Local Alarm Clear (RST_LOC or %M01015) or a Master Alarm Clear (RST_ALL or %M01016). If the underlying alarm condition is persistent, then the flag will be set again.

Reference	*Description*
%M00993	Authorization Alarm (A-Only)
%M00994	Authorization Fault (A-Only)
%M00995	Remote CPU Offline
%M00996	Program Changed
%M00997	HW Config Changed
%M00998	Programs Miscompare
%M00999	Reserved
%M01000	Reserved

%M00993 ***Authorization Alarm*** – This alarm bit indicates that the corresponding PLC is operating in DEMO mode on a standard PACSystems RX3i CPU (IC695CPU310). When the CPU is replaced by a Max-ON CPU (IC695CMU310), this flag may be reset using the RST_LOC or RST_ALL variables.

%M00994 ***Authorization Fault*** – This fault bit indicates that the system was operating in DEMO mode for over 22 days and has subsequently shutdown. The PLC Fault Table will indicate shutdown due a Service Request.

%M00995 ***Remote CPU Offline*** – The companion CPU is offline. This may be due to the CPU being in STOP, Fault, or Power-OFF. Also, it may be due to a cable problem or Ethernet Interface failure.

%M00996 ***Program Changed*** – The program in the Local CPU has changed.

%M00997 ***HW Config Changed*** – The hardware configuration in the Local CPU has changed.

%M00998 ***Programs Miscompare*** – The program in CPU A is not the same as the program in CPU B.

Local Status Flags – Latched (cont.)

Reference	*Description*
%M01001	Power Up
%M01002	Program Restart
%M01003	Max-ON Alarm (Fault) Present
%M01004	Max-ON Alarm (Fault) Table Full
%M01005	Config Fault
%M01006 – %M01008	Reserved

%M01001 ***Power Up*** – The Local CPU has undergone a power-up event.

%M01002 ***Program Restart*** – The Local CPU has been switched from STOP mode to RUN mode.

%M01003 ***Max-ON Fault Present*** – There is at least one fault entry in the Local CPU's Max-ON Alarm Table.

%M01004 ***Max-ON Fault Table Full*** – The Local CPU's Max-ON Alarm Table is full.

%M01005 ***Config Fault*** – The Max-ON configuration has exceeded one or more limits for the allowable size of Synchronized Data transfers.

%M01006 - %M01008 Reserved

Remote Status Flags - Latched

The following flags indicate the status as received from the companion (remote) CPU. For instance, if you are attached to CPU A in Logic Developer PLC, then these bits in CPU A will depict system status received from CPU B.

The flags below are latched. They may be cleared by resetting the alarms (see Command Flags). If the alarm condition persists, then the flag(s) will be set again.

Reference	*Description*
%M00929	Remote is Offline
%M00930	Remote Forces (Overrides) Present
%M00931	Remote PLC Low Battery
%M00932	Remote Config Mismatch
%M00933	Remote Loss of I/O Module
%M00934	Remote Loss of Option Module
%M00935	Remote Option Module Hard Fault
%M00936	Remote Option Module Soft Fault

%M00929 ***Remote is Offline*** – CPU is offline, or there has been a bus failure on a system that uses a single Ethernet Sync bus, or on a system using dual Sync busses, both have failed.

%M00930 ***Remote Forces (Overrides) Present*** – There is at least one force (override) present in the remote, same as #OVR_PRE (%S0011) in the remote.

%M00931 ***Remote PLC Low Battery*** – Same as #PLC_BAT (%S0014) in the remote.

%M00932 ***Remote Config Mismatch*** – Same as #CFG_MM (%SA0009) in the remote.

%M00933 ***Remote Loss of I/O Module*** – Same as #LOS_IOM (%SA0014) in the remote.

%M00934 ***Remote Loss of Option Module*** – Same as #LOS_SIO (%SA0015) in the remote.

%M00935 ***Remote Option Module Hard Fault*** – Same as #HRD_SIO (%SA0027) in the remote.

%M00936 ***Remote Option Module Soft Fault*** – Same as #SFT_SIO (%SA0031) in the remote.

Remote Status Flags – Latched (cont.)

Reference	*Description*
%M00937	Remote System Fault Present
%M00938	Remote I/O Fault Present
%M00939	Remote Max-ON Fault Present
%M00940	Remote Max-ON Fault Table Full
%M00941	Remote Program Changed
%M00942	Remote HW Config Changed
%M00943	Remote Power Up
%M00944	Remote Program Restart
%M00945	Remote Authorization Alarm
%M00946 – %M00960	Reserved

%M00937 ***Remote System Fault Present*** – Same as #SY_PRES (%SC0012) in the remote.

%M00938 ***Remote I/O Fault Present*** – Same as #IO_PRES (%S0013) in the remote.

%M00939 ***Remote HBR Fault Present*** – there is at least one fault in the Max-ON fault table.

%M00940 ***Remote HBR Fault Table Full*** – The Max-ON fault table is full.

%M00941 ***Remote Program Changed*** – The user application in the remote has changed.

%M00942 ***Remote HW Config Changed*** – The hardware configuration in the remote has changed.

%M00943 ***Remote Power Up*** – The remote has undergone a power-up event.

%M00944 ***Remote Program Restart*** – The remote has undergone a Program Stop-to-Run event.

%M00945 ***Remote Authorization Alarm*** –The Remote CPU is operating in DEMO mode.

%M00946 - %M00960 Reserved

System Command Flags

Operation of the system may be influenced by interfacing to the Max-ON RX3i command flags. They may be accessed within application logic, and in some instances by an HMI.

Variable Name	***Reference***	***Description***
SEL_A	%M01009	Select A as Preferred
SEL_B	%M01010	Select B as Preferred
SW_MSTR	%M01011	Switch Master (self-resetting)
AUT_SWP	%M01012	Auto Sweep Mode
	%M01013	Not used
	%M01014	Clear Remote Alarms (self-resetting)
RST_LOC	%M01015	Clear Local Alarms (self-resetting)
RST_ALL	%M01016	Clear All Alarms (self-resetting)

The definitions of the flags are as follows:

%M01009 ***Select A as Preferred*** (SEL_A) - Used in conjunction with SEL_B (%M01010) to determine the manner in which Mastership operates. (See *Selecting the Master*)

%M01010 ***Select B as Preferred*** (SEL_B) - Used in conjunction with SEL_A (%M01009) to determine the manner in which Mastership operates. (See *Selecting the Master*)

%M01011 ***Switch Master (self-resetting)*** (SW_MSTR) - Used to exchange Mastership (See *Selecting the Master*). If it is set ON, the Max-ON driver will reset it to OFF automatically. (See *Switching the Master*)

%M01012 ***Auto Sweep Mode*** –When this is set to ON, the Backup CPU will be set to Constant Sweep mode automatically, and the Master will be set to Normal Sweep mode automatically. (See *PLC Sweep Mode*.)

%M01013 Not used.

%M01014 ***Clear Remote Alarms (self-resetting)*** - When issued to the Master, CLEARS the alarms in the Backup CPU only. If it is set ON, the Max-ON driver will reset it to OFF automatically.

%M01015 ***Clear Local Alarms (self-resetting)*** - Clears the alarms in the CPU to which it is directed. Is reset automatically.

%M01016 ***Clear All Alarms (self-resetting)*** - When issued to the Master, CLEARS the alarms in the Master and Backup CPUs. Is reset automatically.

Mastership Modes

You may specify the Mastership mode of operation for the Hot Standby CPUs. This may be accomplished by setting the states of the System Command Flags, SEL_A (%M01009) and SEL_B (%M01010). Both CPUs must have the states set identically in order to function properly. The truth table shown below illustrates the operation of the Mastership Command Flags.

SEL_A %M01009	*SEL_B %M01010*	*Description*
0	0	Float
1	0	A Preferred
0	1	B Preferred
1	1	Float

- **A Preferred** - In this mode, SEL_A (%M01009) is ON and SEL_B (%M01010) is OFF. Assume that CPU A is currently the Master. If CPU A fails or is placed in STOP, then CPU B will become the new Master. CPU B will remain the Master until CPU A is repaired or is restored to RUN mode. As soon as the all of the Synchronized Data has been updated in CPU A, the Mastership will return to CPU A.

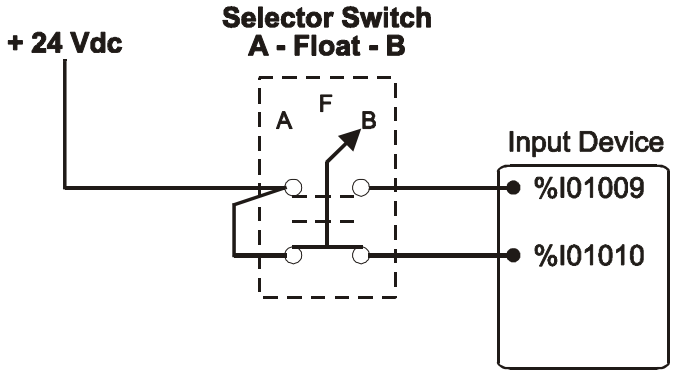
- **B Preferred** - In this mode, SEL_A (%M01009) is OFF and SEL_B (%M01010) is ON. The description is similar to A Preferred, except that the roles are transposed.

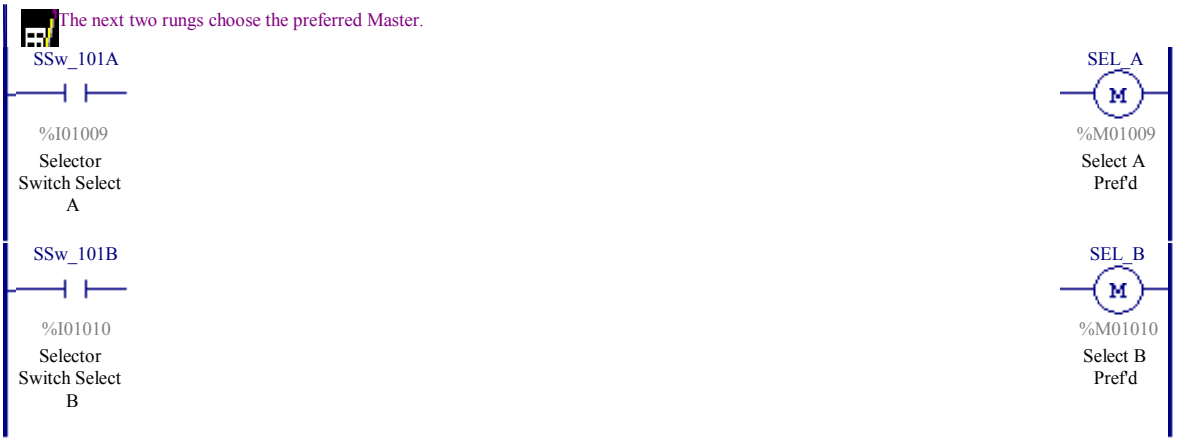
- **Float** - Either CPU may be the Master. Mastership will not change unless the current Master fails or is placed into STOP mode. When the failed/stopped CPU is restored to service, the current Mastership does not change. While the system is in Float Mode, Mastership may be changed by setting the System Command Flag, SW_MSTR (%M01011). Float Mode is required if you intend to switch Mastership using an HMI.

Setting the Master Using a Selector Switch

A three position, center-OFF, selector switch may be connected to a pair of discrete inputs shared by the two CPUs. This allows a system operator to chose either of the CPUs to be the Preferred Master, or the Mastership may float between the two controllers.

In the example that follows, the switch contacts are wired to discrete inputs SEL_A (%I01009) and SEL_B (%I01010). When the switch is in the ***A*** position, only SEL_A (%I01009) is ON. When the switch is in the ***B*** position, only SEL_B (%I01010) is ON. When the switch is in the center (***Float)*** position, SEL_A (%I01009) and SEL_B (%I01010) are both OFF.

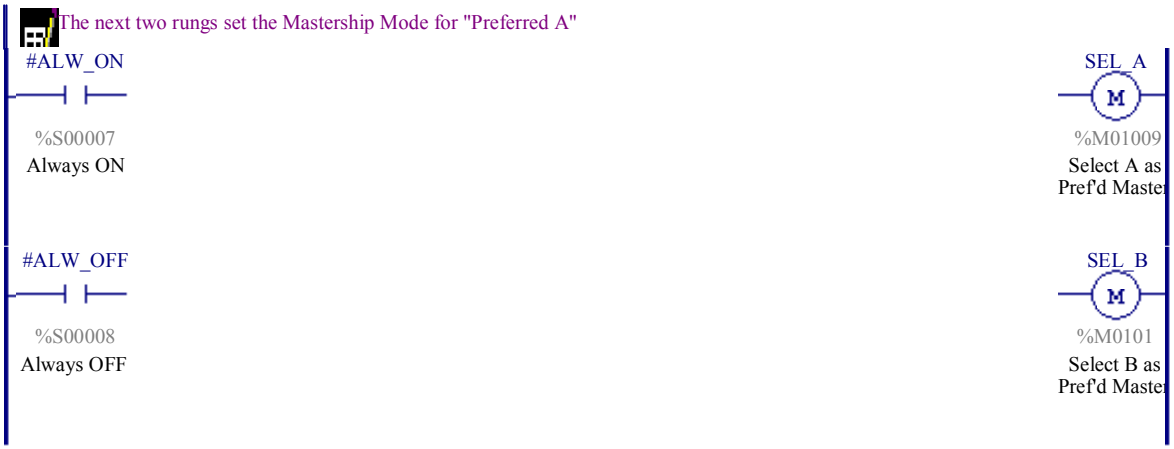




Setting a Preferred Master

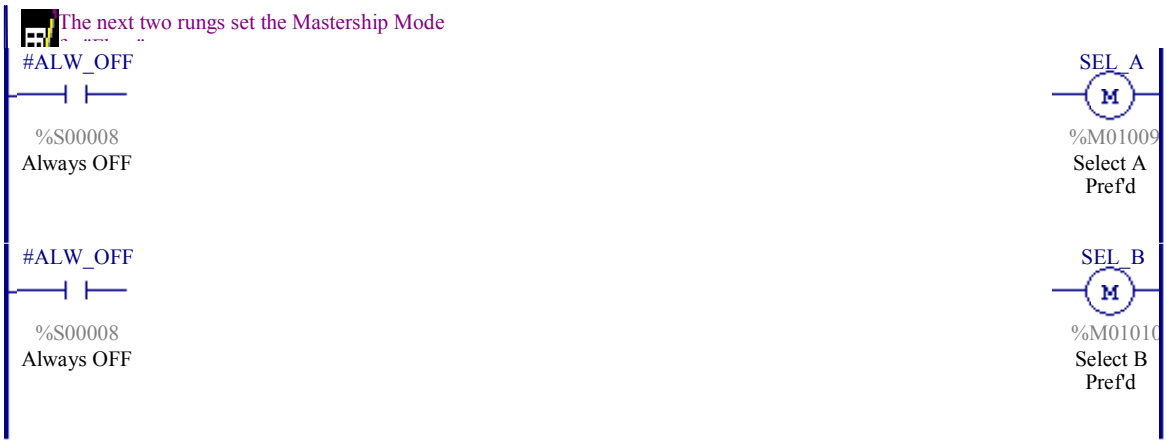
You may set a permanent, Preferred Master. In this mode, if the corresponding CPU fails (or is placed in STOP), then the companion CPU will assume Mastership. As soon as the Preferred Master resumes operating normally, and its Synchronized Data has been updated, then the Mastership will transfer.

The example shown below sets PLC A as the Preferred Master.



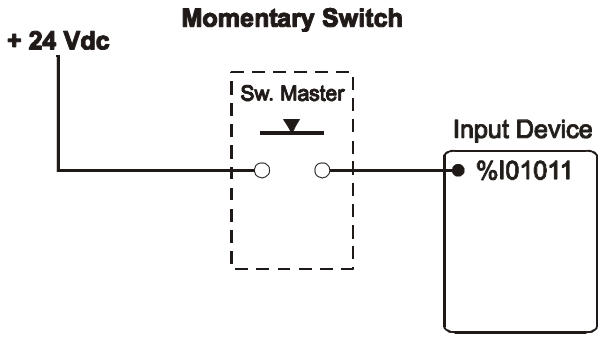
Setting the System for Floating Master

Set the system to Floating Master by including the logic shown below in your application. Include this logic in any system that must change mastership based upon a command initiated by either momentary pushbutton or HMI.



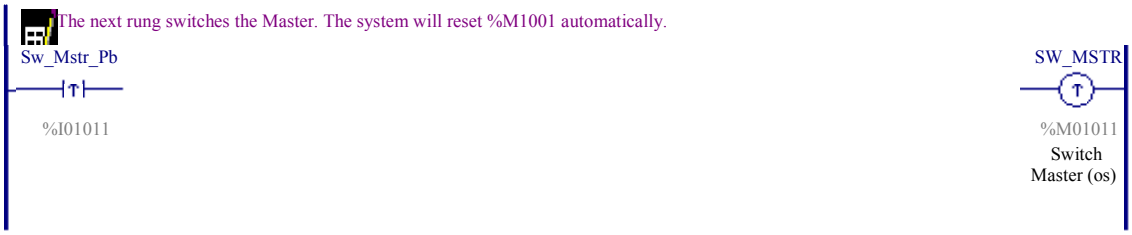
Switching Mastership Using a Momentary Pushbutton

You may switch Mastership using a momentary pushbutton switch that is wired to a discrete input shared by the Hot Standby CPUs. In the example that follows, the switch is wired to discrete input Sw_Mstr_Pb (%I01011). When this input transitions from Off to On, the System Command Flag SW_MSTR (%M01011) will be set. The system will reset SW_MSTR (%M01011) after it has completed processing the switchover.



First, you must set the system for Floating Mastership. (Refer to *Setting the System for Floating Master*.)

Then include the following logic to implement the Toggle Master function.



If a command to set SW_MSTR (%M01011) has been issued, then the system will operate in the following manner.

- If both CPUs receive the command, and there is no Preferred Master, then the Mastership will change as soon as data synchronization is complete.
- If only the Master receives the command, and the Backup is available, and there is no Preferred Master, and data synchronization is complete, then the transfer will occur.
- If one or both of the CPUs receive the command, and the Master is the Preferred Master, then the request is discarded.
- If only the backup receives the command, then no transfer will occur.
- After the relevant conditions above have been evaluated, SW_MSTR (%M01011) will be reset automatically.

Switching Mastership Using an HMI

In your HMI application, configure an operation that sets the command flag SW_MSTR (%M01011) in the current Master CPU. Note that the HMI must be aware of which CPU is the current master so that it know where to direct the command. The HMI must monitor MASTER (%M01020) in each PLC to determine current mastership.

Assuming that there is no preferred Master set in either CPU, then the transfer will occur as soon as data synchronization is complete. The system will reset SW_MSTR (%M01011) after it has completed processing the switchover.

You must set the system for Floating Mastership. (Refer to *Setting the System for Floating Master*.) No other logic is required.

System Data Registers

Variable Name	Reference	Function	Description
CAT_NUM	%R9001	Catalog Number	
REV_NUM	%R9002	Current Release Number	integer with implied decimal point (e.g., +00101 = v1.01)
USR_N1	%R9003 %R9004	User Version Number	(double precision) If audit trail has been enabled, Max-ON will increment this register pair each time a program change is stored or updated. If audit trail is not enabled, then the user may enter any value here.
PDAT_01	%R9005 - mm:ss %R9006 - dd:hh %R9007 - yy:mm	User Version Date	Related to above...this is a packed BCD date. yy/mm/dd | hh:mm:ss
	%R9008 %R9009	Program Size	(double precision) An approximate program size. Some users include this value with the checksum value for additional security in revision control.
	%R9010	Program Additive Checksum	
	%R9011 - %R9021	Reserved	
	%R9022..	Not used	
	%R9023	Not used	
	%R9024	Not used	
REM_SCN	%R9025	Remote CPU's Current Scan time	Instantaneous PLC Scan time in msec.
LOC_SCN	%R9026	Local CPU's Current Scan time	Instantaneous PLC Scan time in msec.
LOC_MUX	%R9027	Average Mux. Packet Interval	Average time interval for advancing to the next multiplexer packet. (msec.)
IOM_UPD	%R9028	%S, %M, %Q, %AQ Update Interval	Time to update all %S, %M, %Q, %AQ and time of day in the backup PLC (sec. X 0.01)
REG_UPD	%R9029	%R Update Interval	Time to update registers in the backup PLC (sec. X 0.01)
NUM_FLT	%R9030	Number of Faults in Fault Table	0 = empty; 33 = full
NUM_FLT[001]	%R9031.. %R9036	Fault Record #01	
NUM_FLT[007]	%R9037.. %R9041	Fault Record #02	
	…	…	
	…	…	
NUM_FLT[156]	%R9186.. %R9190	Fault Record #32	

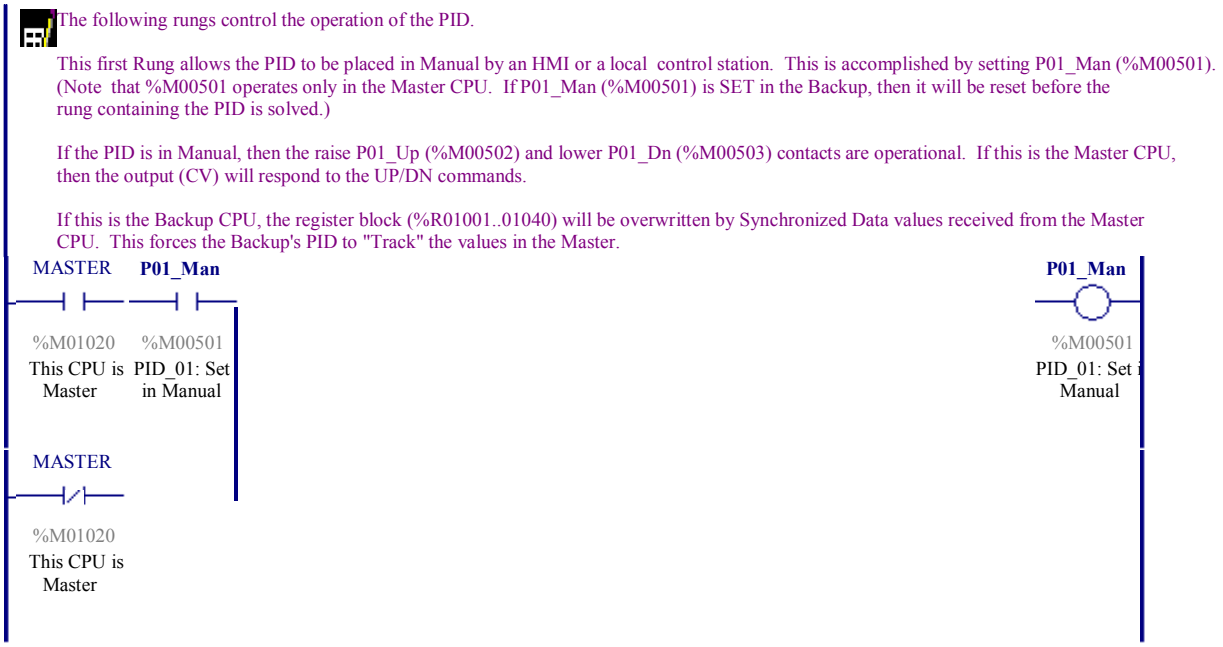
Advanced Topics

PID Function Blocks

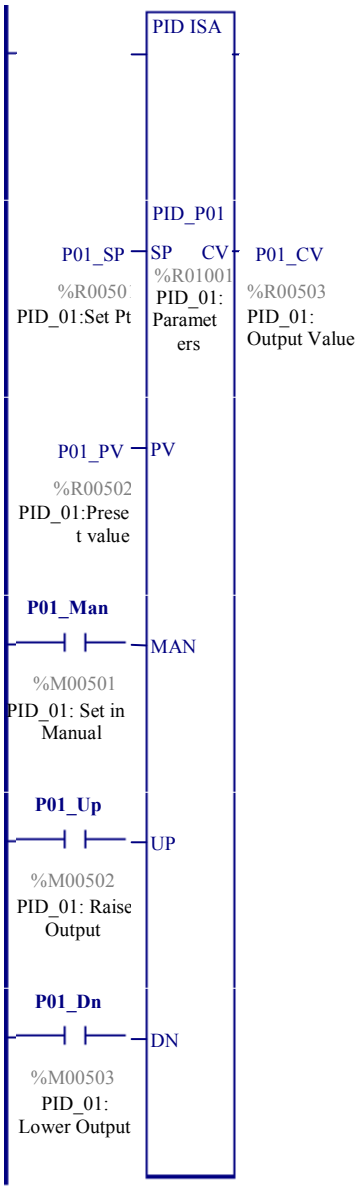
The PID function block uses a data structure consisting of 40 registers. These registers contain not only configuration parameters, but also intermediate and final terms used in the internal calculations. Some of the internal calculations are based upon values from the PLC's system clock. Because the internal clocks in the two CPUs are not synchronized precisely to each other, it is necessary to include a small amount of logic to compensate for the difference.

Also, it will be necessary to include the PID registers in one or more of the %R Synchronized Data Groups. This ensures that the PID in the Backup CPU tracks the Master.

The ladder logic is straightforward:



In this example, the PID parameters begin at PID_P01 (%R01001). For PID loop 01, there must be a synchronized data group configured that assures that registers %R01001 through %R01040 are transferred. You must include the registers associated with other PID function blocks as well.



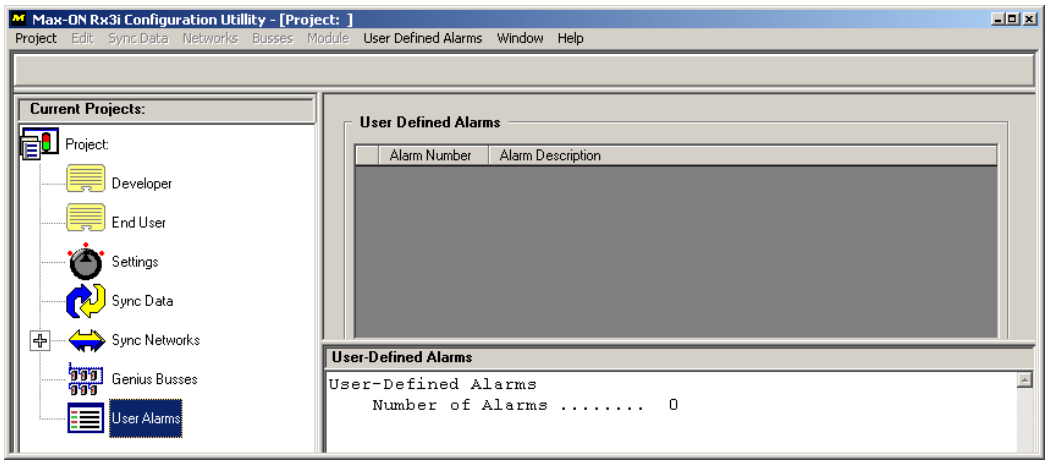
User-Defined Alarms

The user may post self-defined faults from within the application by performing the following steps.

Note: User defined Alarms are not available in this version the Max-ON RX3i Diagnostic Tool.

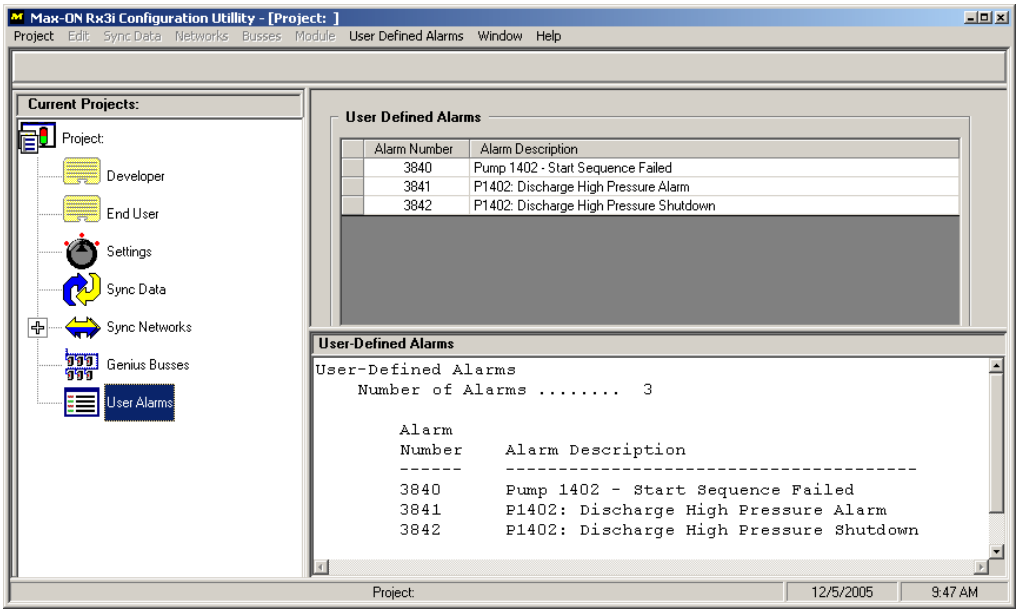
In Max-ON RX3i Configuration Utility

1. Select the User Alarms item in the Max-ON RX3i Configuration Utility Project tree.



2. Select the User Defined Alarms > Add Alarm… menu item.
3. Enter an Alarm Number and then the corresponding Alarm Description. Note: The Alarm Number must be within the numerical range 3840..4095. The descriptor may be up to 60 characters in length.

4. Enter any additional alarms.



5. Save your Max-ON RX3i Configuration, update the cfg_dat C Block in the Max-ON Project.

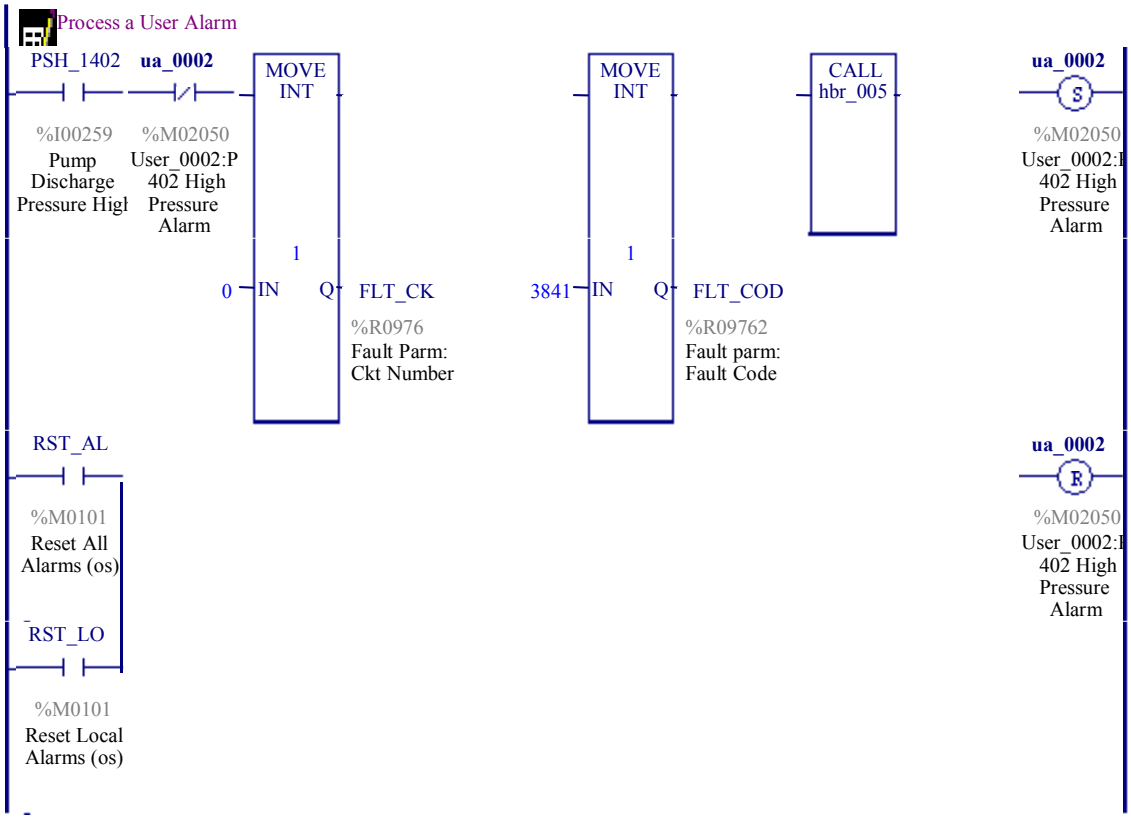
6. Download the new Max-ON RX3i Configuration to the CPUs.

In Your Application Folder

1. Move a user specified fault value into FLT_COD (%R9762). The fault value must be in the range 3840..4095 (decimal) inclusive, and should correspond to the equivalent user-defined fault created in Max-ON RX3i Configuration Utility.

2. In most cases, move a value 0 into FLT_CKT (%R9761). However, you may define your own identifier that may be MOVed into this register. The diagnostic tool will display this as a decimal value in the *Circuit Reference* position.

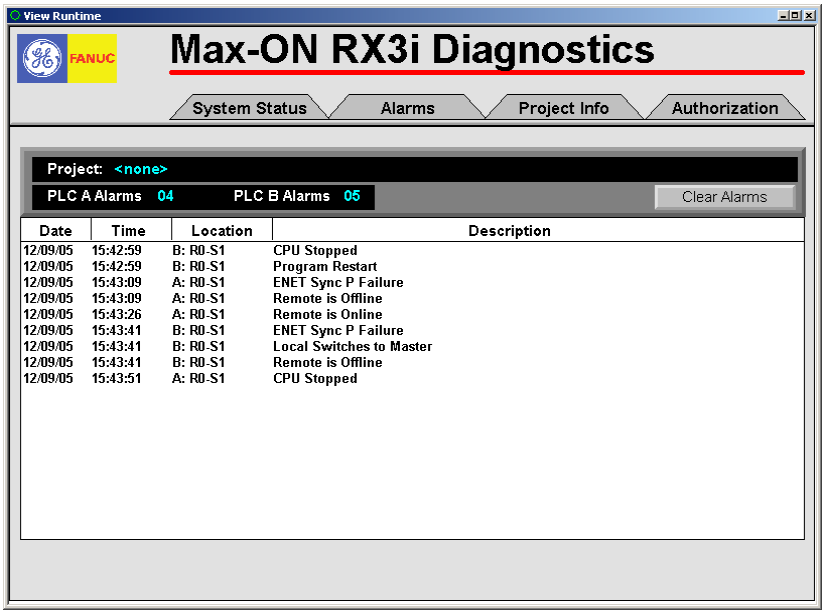
3. Call the subroutine named ***HBR_005***. This must be done for only once, otherwise each subsequent call will post an additional alarm into the alarm table. In the sample logic shown below, ua_0002 (%M02050) has been used as an alarm latch. The user-defined alarm will be posted only if the coil is not already set. Note that a setcoil is used so that the alarm state will be retained through a loss of power. Also, a rung has been provided that resets the coil if the alarm clear flags are invoked.



If a corresponding user-defined alarm has been entered during the ***Max-ON Rx3i Configuration Utility*** configuration session, then the fault time-stamps, along with appropriate descriptors will be displayed in the Max-ON RX3i Alarm Table in the Proficy View Diagnostics application.

Max-ON RX3i variables used by subroutine ***HBR_005*** to log a user defined alarm.

Variable Name	*Reference*	*Description*
FLT_CKT	%R09761	Fault Parameter: Circuit Number
FLT_COD	%R09762	Fault Parameter: Fault Code



Alarm Table Organization

The Alarm Table begins at %R9030 and ends at %R9190. The Alarm Table organization is shown below.

Variable Name	*Register*	*Description*
NUM_FLT	%R9030	Number of Faults in Table (0 = empty; 33 = full)
NUM_FLT[001]	%R9031	Record 1 – Fault Type
NUM_FLT[002]	%R9032	Record 1 – Fault Location
NUM_FLT[003]	%R9033	Record 1 – Time Stamp
NUM_FLT[004]	%R9034	Record 1 – Time Stamp
NUM_FLT[005]	%R9035	Record 1 – Time Stamp
NUM_FLT[006]	%R9036	Record 2 - Fault Type
NUM_FLT[007]	%R9037	Record 2 - Fault Location
	...	...
NUM_FLT[156]	%R9186	Record 32 - Fault Type

The value in NUM_FLT (%R09030) indicates the number of active faults (alarms) in the table. A value of zero indicates that the fault table is empty. A value of 33 indicates that the table is full. When the table is full, no further faults may be added to the table.

The first fault table entry is located in NUM_FLT[001..005] (%R9031..9035). The second fault entry is in NUM_FLT[006..010] (%R9036..9040). This pattern is repeated for a total of 32 fault records.

Alarm Record Structure

Each record in the Alarm Table consists of 5 registers. Each register may be interpreted as a pair of bytes whose definitions are shown in the table below. If the registers are displayed as hexadecimal values in Logic Developer PLC, then the interpretation may be simplified.

Byte Offset	*Description*
0	Timestamp: Seconds (BCD)
1	Timestamp: Minutes (BCD)
2	Timestamp: Hours (BCD)
3	Timestamp: Day of Month (BCD)
4	Timestamp: Month (BCD)
5	Timestamp: Year (BCD)
6	Circuit Reference - lsb
7	Circuit Reference - msb
8	Alarm Subclass
9	Alarm Class

Bytes 0..5 These contain date and time information stored as BCD values. The simplest way to view these in Logic Developer PLC is to display the fault table registers as hexadecimal numbers.

Bytes 6..7 Bytes 6 and 7 contain the decimal value of an I/O circuit reference. The value in this pair of bytes must be interpreted in the context of the Alarm Class that has generated the message. The Alarm Class is contained in Byte 9. The value will be zero for CPU or system-level hot standby faults.

Byte 8 This byte contains the Alarm Subclass code. The subclass contains the rack number in the upper nibble and the slot number in the lower nibble. This number implies different fault descriptions depending upon the value of the Alarm Class contained in byte 9.

Byte 9 This byte contains the Alarm Class code. The valid range is 0000..4095.

Alarm Class (Offset 9)	***Alarm Subclass (Offset 8)***	***Circuit Reference Range (Integer) (Offset 6/7)***	***Alarm Class Description***
00	00..FF	Always 0	System level faults
01	00..FF	0001..2048	Discrete input circuit
02	00..FF	0001..2048	Discrete output circuit
03	00..FF	0001..1024	Analog input circuit
04	00..FF	0001..0256	Analog output circuit
05	00..FF	00..31	I/O LAN device
06..0E	00..FF	- - -	Not defined
0F	00..FF	-32768..32767	User-defined

Alarm Class 00h - System Level Alarms

Decimal Code	*Hex Code*	*Description*	
001	0001	CPU Stopped	The CPU identified in the Source Column has transitioned from Run to Stop.
002	0002	Program Restart	The CPU identified in the Source Column has transitioned from Stop to Run.
003	0003	Power Up	Power has been restored to the CPU identified in the Source Column
004	0004	Invalid CPU ID	The CPU identified in the Source Column does not have a valid ID. Open the hardware configuration. Zoom into the CPU module and set the Checksum Length to 11 for CPU A or 12 for CPU B.
005	0005	Duplicate IDs	The CPUs have identical IDs. Verify that the hardware configuration has been stored to the proper CPUs. Verify the identities in the project have been set so that the Checksum Length for CPU A is 11 and 12 for CPU B.
006	0006	New Authorization	Not used.
007	0007	Authorization Alarm	This occurs after operating for a total of approximately 22 days in Demo mode.
008	0008	Authorization Fault	This occurs after operating for a total of approximately 22 days in Demo mode.
009	0009	Authorization Corruption	Not used.
010	000A	Program Changed	The application program in the identified CPU has changed either due to a program store or due to online editing.
011	000B	HW Config Changed	The hardware configuration in the identified CPU has changed.
012	000C	Program Checksum Mismatch	There is a discrepancy between the checksum in CPU A and CPU B. This implies that the programs in the two CPUs are not equivalent.
013	000D	Remote is Offline	The companion CPU has transitioned to an Offline mode.
014	000E	Remote is Online	The companion CPU has transitioned to an Online mode.
015	000F	Local Switches to Master	The CPU identified in the Source Column has become a Master.

Decimal Code	Hex Code	Description	
016	0010	Local Switches to Backup	The CPU identified in the Source Column has become a Backup.
017	0011	Genius Sync P Failure	Not used.
018	0012	Genius Sync S Failure	Not used.
019	0013	Genius Sync P LRC Error	Not used.
020	0014	Genius Sync S LRC Error	Not used.
021	0015	%Q Configuration Fault	A defective configuration has been entered. There are either too many %Q groups, or the reference range exceeds the capacity of the system.
022	0016	%AQ Configuration Fault	A defective configuration has been entered. There are either too many %AQ groups, or the reference range exceeds the capacity of the system.
023	0017	%M Configuration Fault	A defective configuration has been entered. There are either too many %M groups, or the reference range exceeds the capacity of the system.
024	0018	%R Configuration Fault	A defective configuration has been entered. There are either too many %R groups, or the reference range exceeds the capacity of the system.
025	0019	Corrupted Config	A defective configuration has been entered.
026	001A	Ethernet Synchronization Primary Failure	The System's primary Ethernet LAN has failed. CPU A and CPU B are unable to transfer Synchronized Data via the primary Ethernet LAN.
027	001B	Ethernet Synchronization Secondary Failure	The System's secondary Ethernet LAN has failed. CPU A and CPU B are unable to transfer Synchronized Data via the secondary Ethernet LAN.
028	001C	Illegal Mastership State	There are either two Masters or two Backups in operation.
029	001D	Not used	
...	...	...	
032	0020	Not used	

Fault Class 01h - Discrete Inputs

Decimal Code	*Hex Code*	*Description*	
257	0101	Circuit Offline	The discrete input reference displayed in the Source Column has transitioned to an offline state.
258	0102	Not used	
259	0103	Remote Rack Offline	The remote drop corresponding to the discrete input reference displayed in the Source Column has transitioned to an offline state.
260	0104	Remote Rack Overrides Present	The corresponding remote drop has I/O overrides present.
261	0105	Remote Rack PLC Low Battery	The corresponding remote drop has an indication of low CPU Battery voltage. Replace or connect the battery in the remote drop.
262	0106	Remote Rack Config Mismatch	There is a configuration discrepancy between the modules installed in the remote rack and the hardware configuration that has been stored into the remote rack.
263	0107	Remote Rack Loss of I/O Module	An I/O module in the remote rack has failed.
264	0108	Remote Rack Loss of Opt Mod	
265	0109	Remote Rack Opt Mod Hard Fault	
266	010A	Remote Rack Opt Mod Soft Fault	
267	010B	Remote Rack Sys Fault Present	
268	010C	Remote Rack I/O Fault Present	
269	010D	Remote Rack Program Changed	
270	010E	Remote Rack HW Configuration Changed	
271	010F	Remote Rack Power Up	Power has been lost and then subsequently restored at the remote rack.
272	0110	Remote Rack Program Restart	The remote rack has transitioned from STOP to RUN.
273	0111	Remote Rack Gen Bus P LRC	
274	0112	Remote Rack Gen Bus S LRC	
275	011D	Not used	
...	...	...	
288	0120	Not used	

Fault Class 02h - Discrete Outputs

Decimal Code	Hex Code	Description	
513	0201	Circuit Offline	The device corresponding to the circuit reference number shown in the Source Column has transitioned to offline.
514	0202	Not used	
…	…	…	
544	0220	Not used	

Fault Class 03h - Analog Inputs

Decimal Code	Hex Code	Description	
769	0301	Circuit Offline	The device corresponding to the circuit reference number shown in the Source Column has transitioned to offline.
770	0302	Not used	
771	0303	Under-range	After scaling, the resulting value is less than the lower engineering unit limit.
772	0304	Over-range	After scaling, the resulting value is greater than the upper engineering unit limit.
773	0305	Not used	
…	…	…	
800	0320	Not used	

Fault Class 04h - Analog Outputs

Decimal Code	Hex Code	Description	
1025	0401	Circuit Offline	The device corresponding to the circuit reference number shown in the Source Column has transitioned to offline.
1026	0402	Not used	
…	…	…	
1055	0420	Not used	

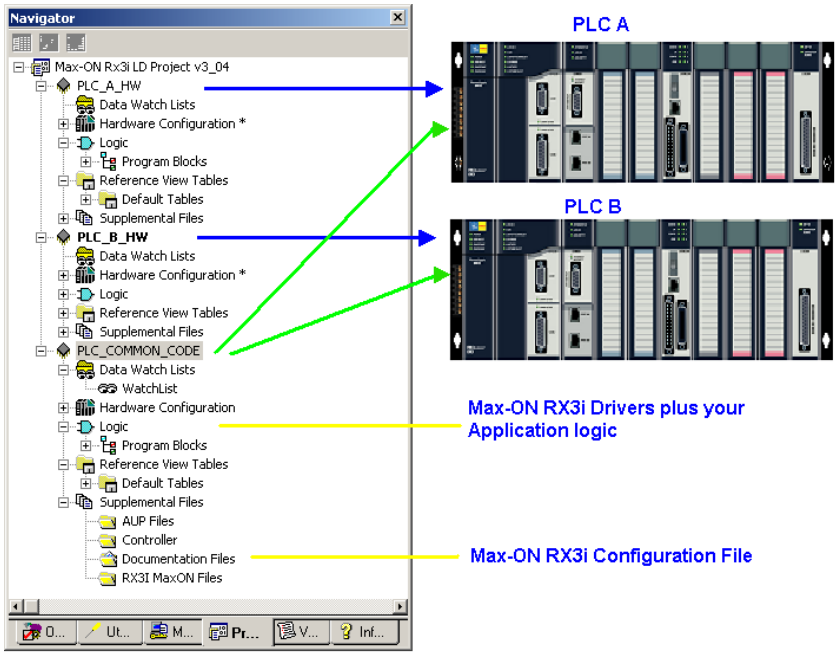
Fault Class 05h – I/O LAN Alarms

Decimal Code	*Hex Code*	*Description*	
1089	0501	Addition of Device	The device corresponding to the circuit reference number shown in the Source Column has transitioned to online.
1090	0502	Loss of Device	The device corresponding to the circuit reference number shown in the Source Column has transitioned to offline.
1091	0503	Not used	
...	...	...	
1120	0520	Not used	

Chapter 6 Configuring the Hot Standby Redundancy CPUs

A Max-ON RX3i Project contains three Targets that are used to distinguish between hardware configurations for CPU A, CPU B, and the user application that is common to both of the CPUs.

The figure shown below illustrates the various components contained in the Generic X3i Project named *Max-ON Rx3i LD Project vx_yy.zip*.



When a Max-ON RX3i project is created, a hardware configuration Target is provided for CPU A and one is provided for CPU B. In most aspects, these targets are very similar to each other. The significant differences between the two hardware configurations are:

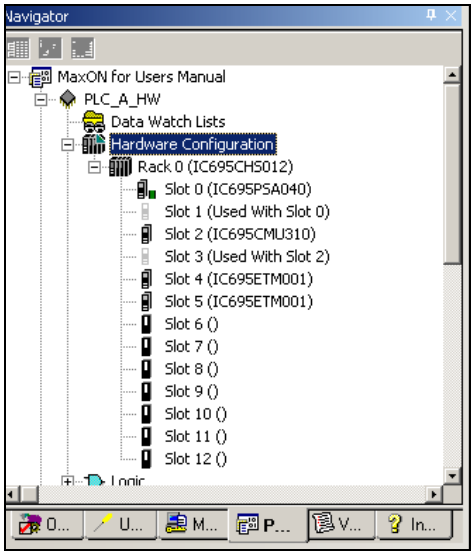
1. Identity settings for the CPUs (via logic checksum words)
2. Serial communication port settings and SNP ID
3. Ethernet interface IP addresses
4. Ethernet Global Data configuration for the Ethernet I/O LANs
5. Genius bus controllers configuration

Many of the configuration items are completed during the process of developing the Project. The following sections provide details on the configuration of these elements.

Configuring PLC A

Open the Hardware Configuration for PLC_A_HW

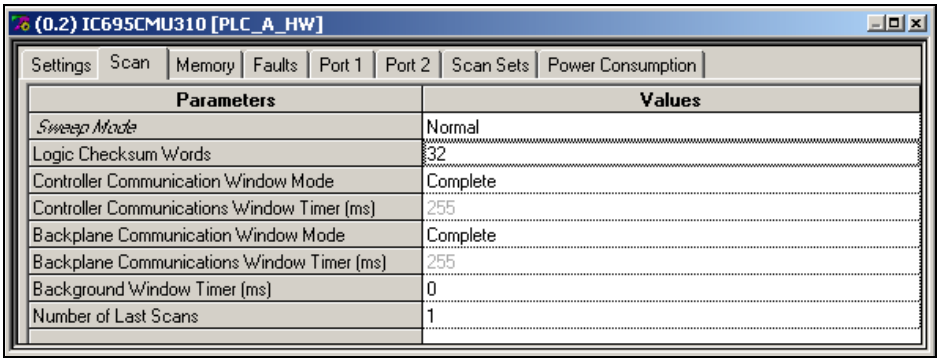
In the Max-ON RX3i Project, select and expand the Hardware Configuration node of the PLC_A_HW target.



Set the Max-ON Rx3i Identity for PLC A

The identity for CPU A is determined by the value set in the *Logic Checksum Words* CPU parameter located in the CPU's Hardware Configuration for CPU A.

1. Open the CPU module's Hardware Configuration by double-clicking on the IC695CMU310 module.
2. Click on the Scan tab to display the *Logic Checksum Words* parameter.
3. **Verify that the *Logic Checksum Words* parameter value is 32. If it is not 32, change the parameter to this value.**

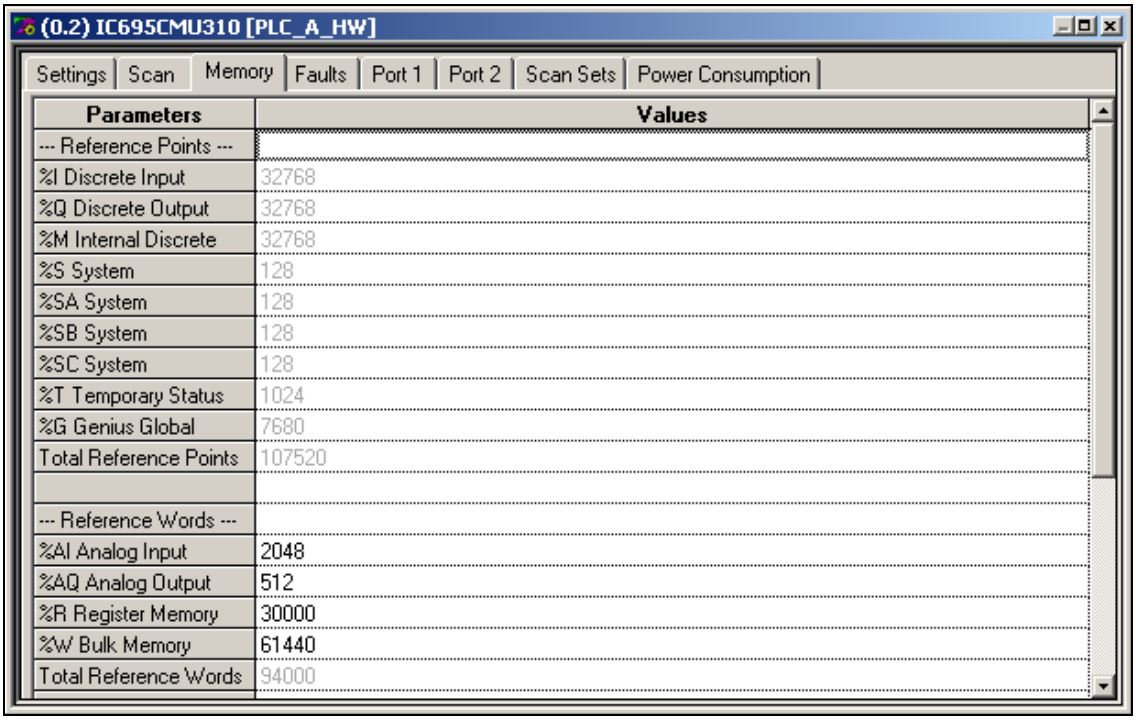


Set Memory Limits for PLC A

The Max-ON RX3i drivers have the minimum memory requirements shown below:

%W Registers	*%R Registers*	*%AI Analog In*	*%AQ Analog Out*
50000 (minimum)	16384 (minimum)	2048 (minimum)	512 (minimum)

Select the Memory tab of the CPU configuration and verify that these values have been configured. Please note the memory limits required for your application may be larger than these minimum values.



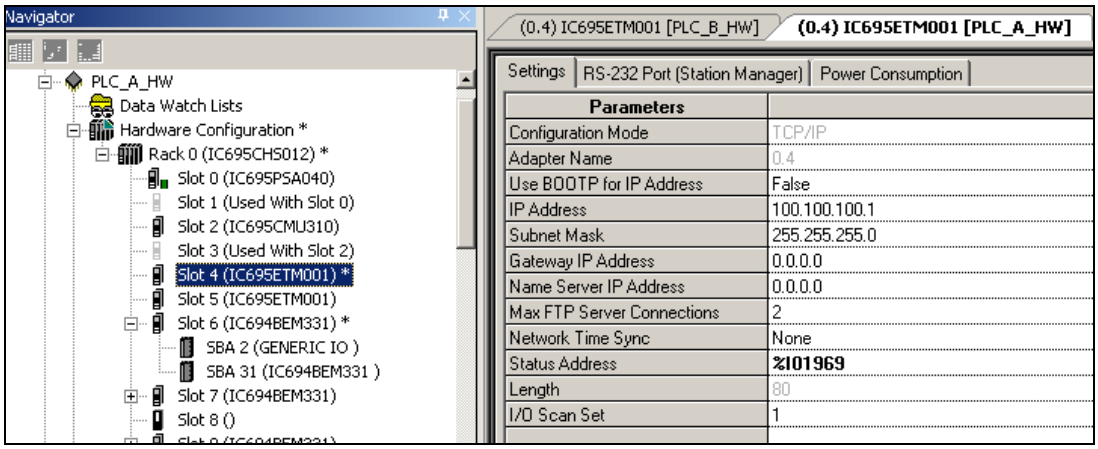
Configure Ethernet Sync Network for PLC A

Use the Sync LAN Interface Module configuration summary from the Max-ON Rx3i Configuration Utility as a guide for configuring the Ethernet synchronization interfaces in the system.

Sync LAN Interface Module

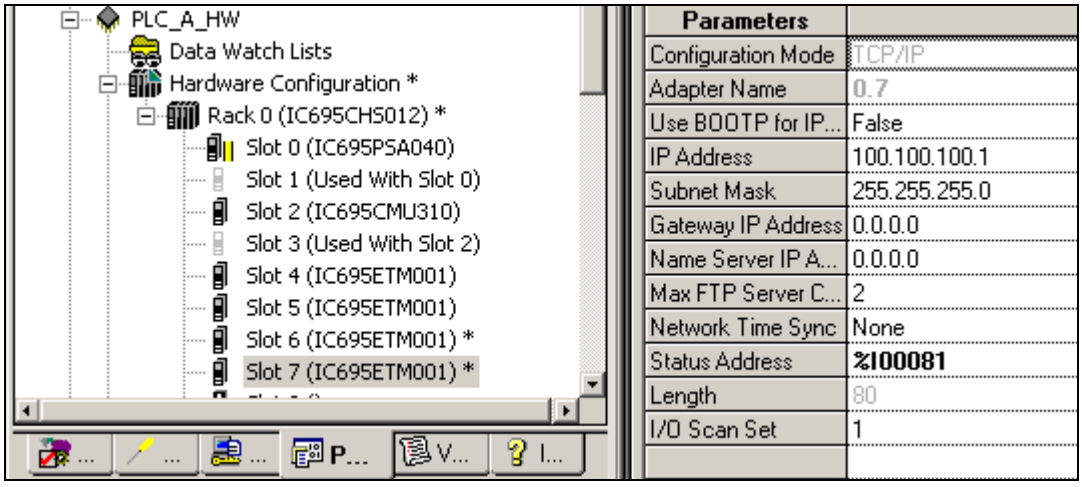
```
Sync LAN Interface Modules:

    PLC ..................  A
        Rack ..................  Main Rack
        Slot ..................  Slot 4
        Status Address ........  %I01969
        IP Address ............  100.100.100.1

    PLC ..................  B
        Rack ..................  Main Rack
        Slot ..................  Slot 4
        Status Address ........  %I01969
        IP Address ............  100.100.100.2
```

Add the Ethernet Interface module(s) to the appropriate slot(s) in the Hardware Configuration for PLC A, and configure its parameters to match the Max-ON RX3i Configuration Summary.



Configure Ethernet Interface for Ethernet I/O LANS for PLC A (if used)

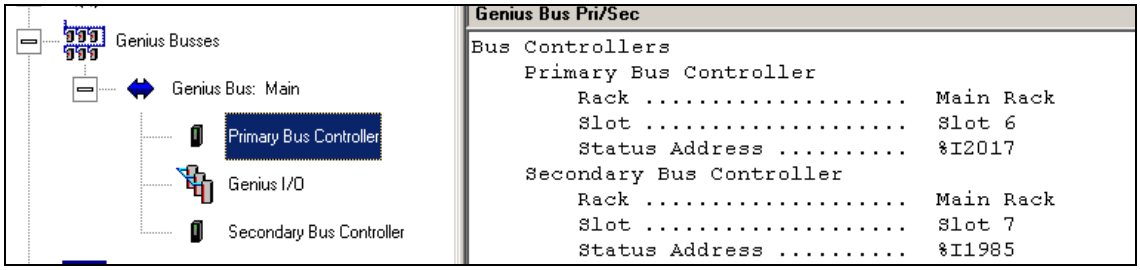
Configure the Ethernet Interfaces used in conjunction with the Ethernet NIUs. Add the Ethernet Interface module(s) to the appropriate slot(s) in the Hardware Configuration for PLC A. You will also need to configure this Module's EGD information to match the definitions of your ENIU EGD exchanges.



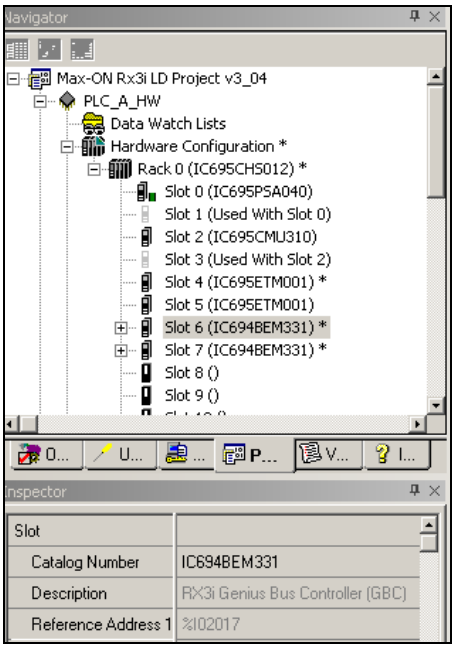
Please note that only 4 Ethernet Modules may be added to an RX3i Main Rack.

Configure Genius Bus Controllers for PLC A (if used)

Use the Genius Bus Primary/Secondary configuration summary from the Max-ON Rx3i Configuration Utility as a guide for configuring the Genius busses in the system.



Add the Genius bus controllers to the appropriate slot(s) in the Hardware Configuration for PLC A. Configure the parameters to match the Max-ON RX3i Configuration Summary.



Serial Bus Address (SBA)

All Genius bus controllers in PLC A must be configured to have their serial bus addresses set at 31.

Inputs Default

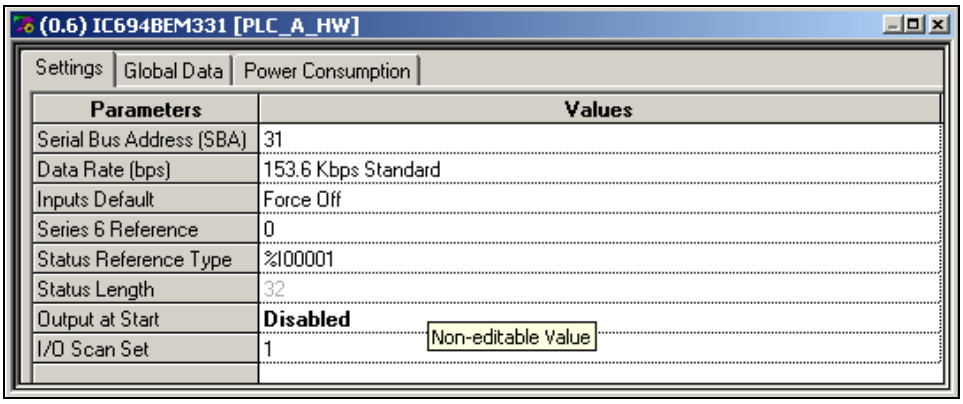
Inputs should be set to Force OFF.

Status Reference Type

The recommended practice is set the device status address at the high end of the discrete input status references. For instance, the first GBC might start at %I02017, length 32.

Output at Start

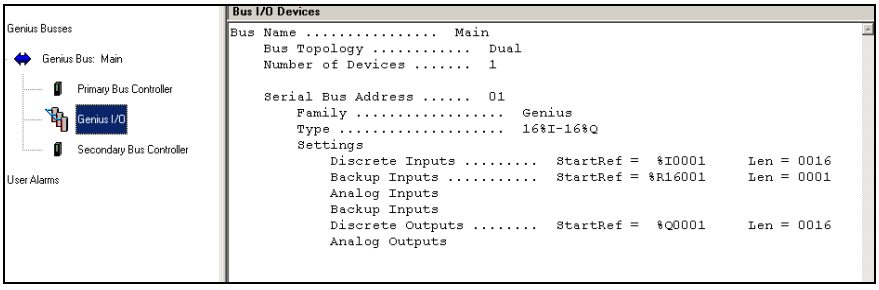
Outputs must be set to Disabled at Start.



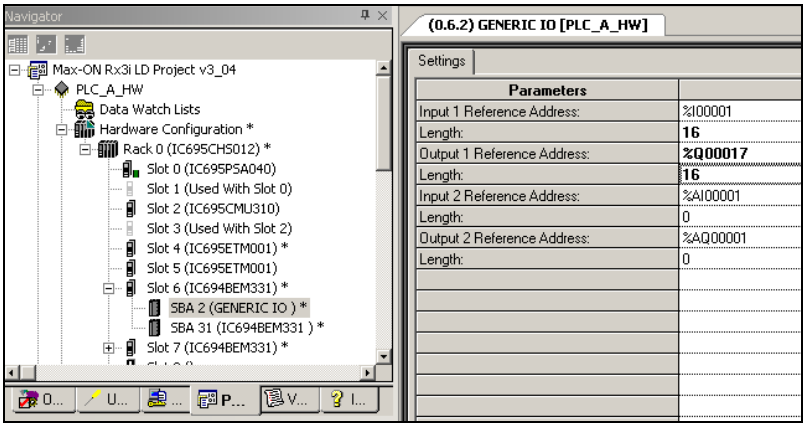
Configure I/O Devices on the Primary Bus for PLC A

Use the Bus I/O configuration summary from the Max-ON Rx3i Configuration Utility as a guide for configuring the Genius devices that reside on the Genius bus.

1. Add Genius devices to the GBC's configuration and configure the Genius device parameters to match. A sample is shown below.



2. Repeat this process for each Genius device in the Max-ON RX3i configuration.



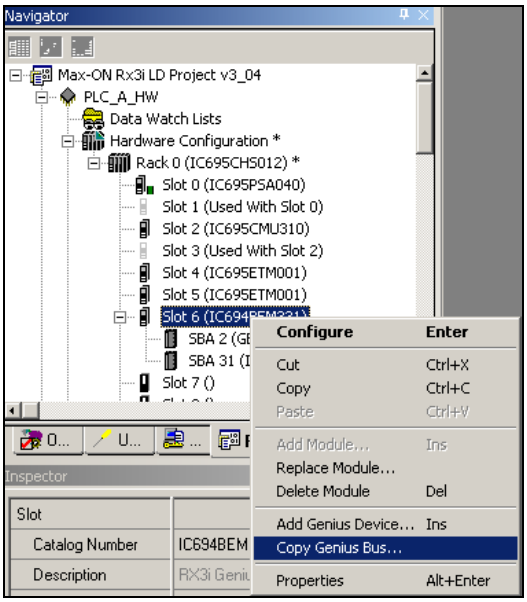
Repeat the above process until there are no more bus controllers to be configured.

If there are no Secondary busses in the system, store the configuration into CPU A.

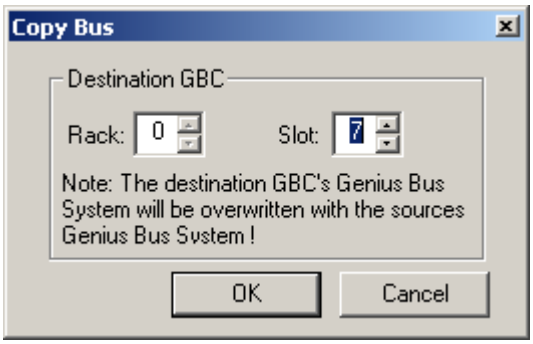
Configure I/O Devices on the Secondary Bus for PLC A

Use the Bus I/O configuration summary from the Max-ON Rx3i Configuration Utility as a guide for configuring the Genius devices that reside on the Secondary Genius bus.

You can use the *Copy Genius Bus* function in the hardware configuration to facilitate the speedy duplication of Genius bus configurations.



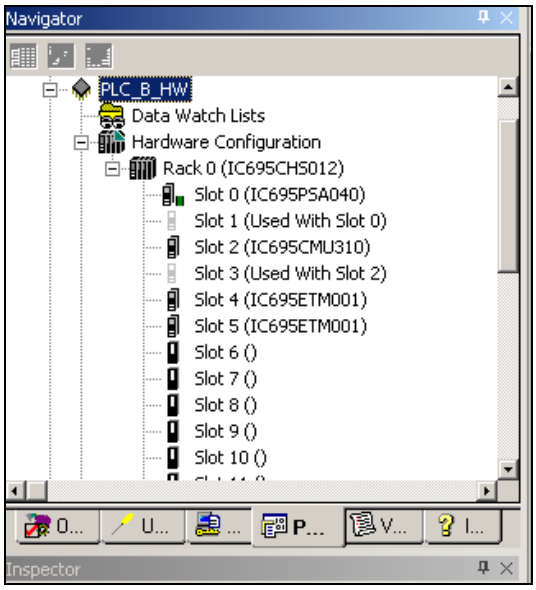
Select the location for the duplicate Genius Bus and an exact copy will be made to the destination slot location.



Configuring PLC B

Open the Hardware Configuration for PLC_B_HW

In the Max-ON RX3i Project, select and expand the Hardware Configuration node of the PLC_B_HW target.

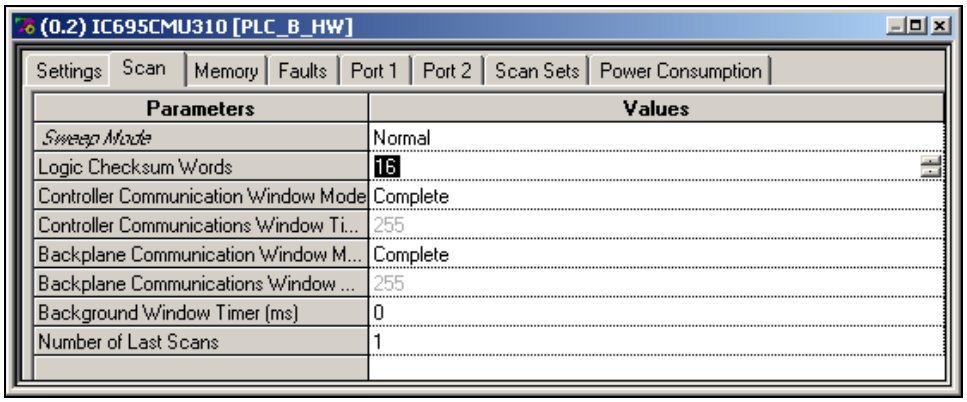


Set the Max-ON RX3i Identity for PLC B

The identity for CPU B is determined by the value set in the *Logic Checksum Words* CPU Parameter located in the CPU's Hardware Configuration for CPU B.

1. Open the CPU module's Hardware Configuration by double-clicking on the CMU310 module.
2. Click on the Scan tab to display the *Logic Checksum Words* parameter.

3. **Verify that the *Logic Checksum Words* parameter's value is 16. If it is not 16, change the parameter to this value.**



Set Memory for PLC B

Normally, the memory in CPU B is configured the same as for CPU A. Please refer to the information used for CPU A, and make adjustments to the CPU B memory configuration if necessary.

Configure Ethernet Sync Network for PLC B

Repeat the configuration process for the Ethernet synchronization interfaces in PLC B.

Configure Ethernet Interface for Ethernet I/O LANS for PLC B (if used)

Configure the Ethernet Interfaces used in conjunction with the Ethernet NIUs.

Configure Genius Bus Controllers for PLC B (if used)

Serial Bus Address

All Genius bus controllers in PLC B should be configured to have their serial bus addresses set at 30.

Input Default

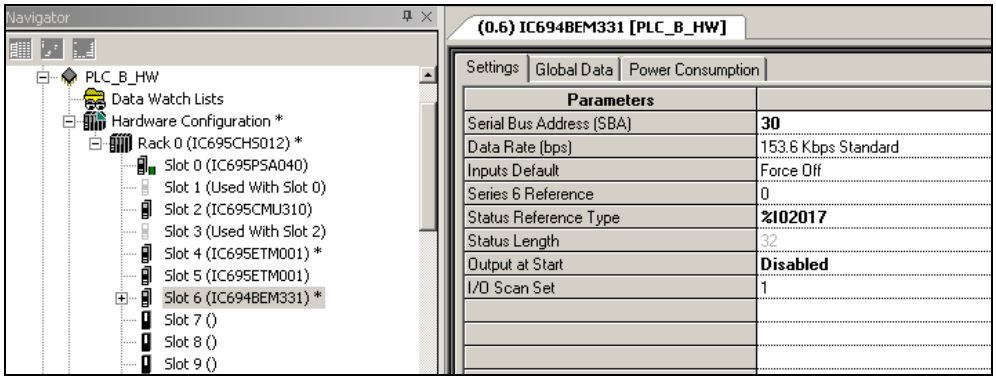
Inputs should be set to Force OFF.

Status Reference Type

The recommended practice is set the device status address at the high end of the discrete input status references. For instance, the first GBC might start at %I02017, length 32.

Output at Start

Outputs must be set to Disabled at Start.



Configure I/O Devices on the Primary and Secondary Busses for PLC B

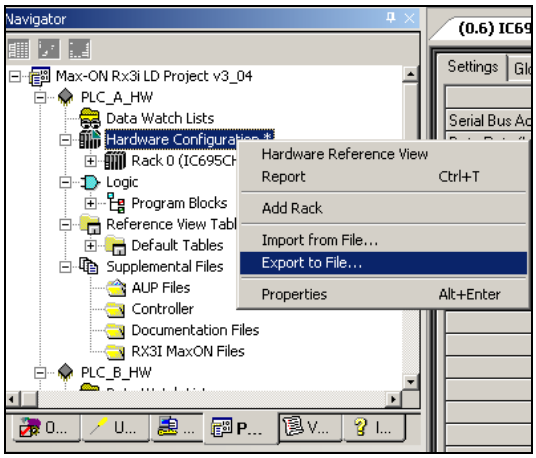
The I/O devices for CPU B are configured exactly the same as for CPU A. Please refer to the instructions earlier in this chapter to complete their configuration.

Copying PLC A Configuration to PLC B Configuration

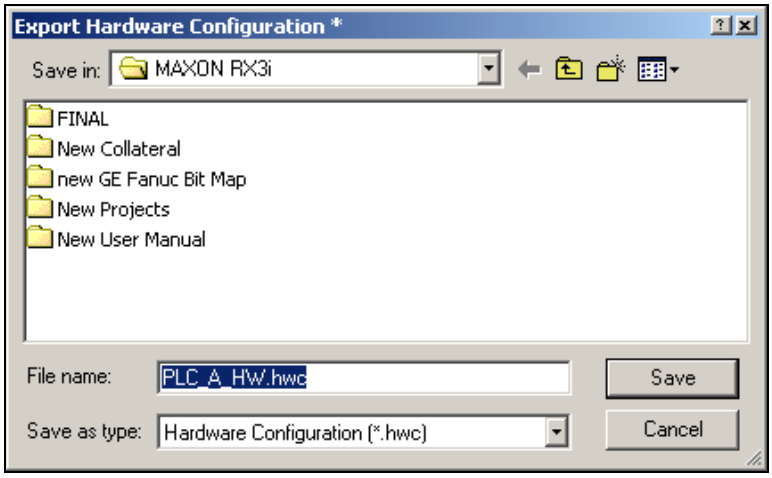
A productivity tool that can also be used to speed the duplication of the Hardware Configuration between PLC A and PLC B is to Export the Hardware Configuration from PLC A and Import it into PLC B. This will accelerate the configuration of the hardware configuration and you only need to modify the slight differences in PLC B.

To export the Hardware Configuration from the PLC_A_HW target and import it into the PLC_B_HW target:

1. Select the Hardware Configuration node for PLC_A_HW target.
2. Select the *Export to File…* right mouse menu item.

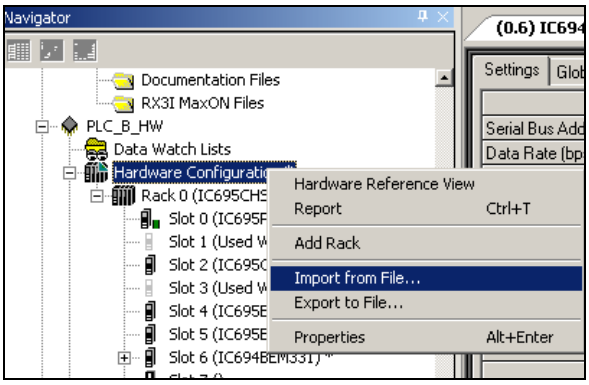


3. Specify a file name for the configuration, or use the default name PLC_A_HW.hwc.

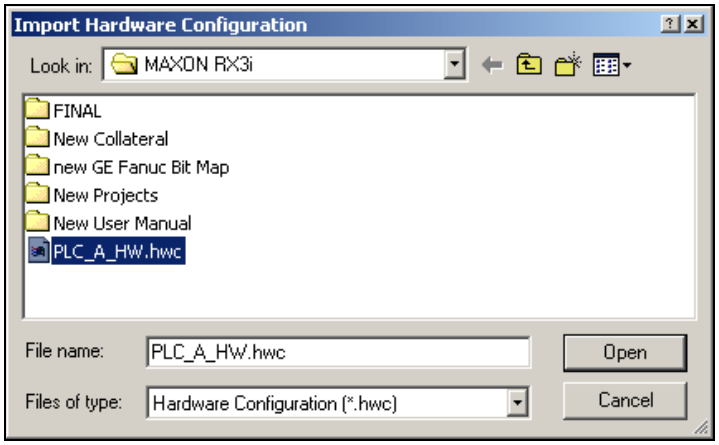


4. Select the Hardware Configuration node for PLC_B_HW target.

5. Select the *Import from File…* right mouse menu item.



6. Specify the file name used in Step 3 (default name PLC_A_HW.hwc).



7. Now modify the Hardware Configuration for PLC_B_HW Target to match the parameters of PLC B in your system.

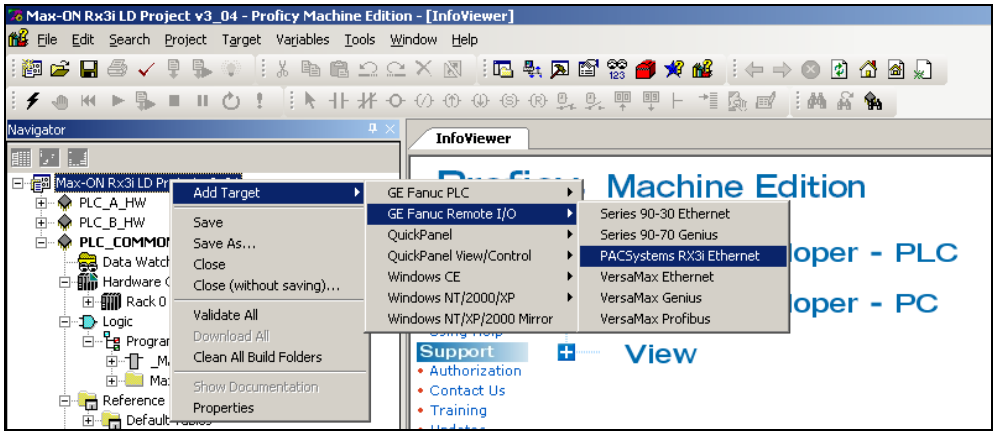
Chapter 7 Configuring the I/O Devices

Configuring the Ethernet I/O Devices

Before you may use your system, you must configure the Ethernet I/O devices that are to be installed on the Ethernet I/O bus. For Max-ON RX3i, the Ethernet devices may consist of PACSystems RX3i Ethernet NIUs and/or Series 90-30 ENIUs.

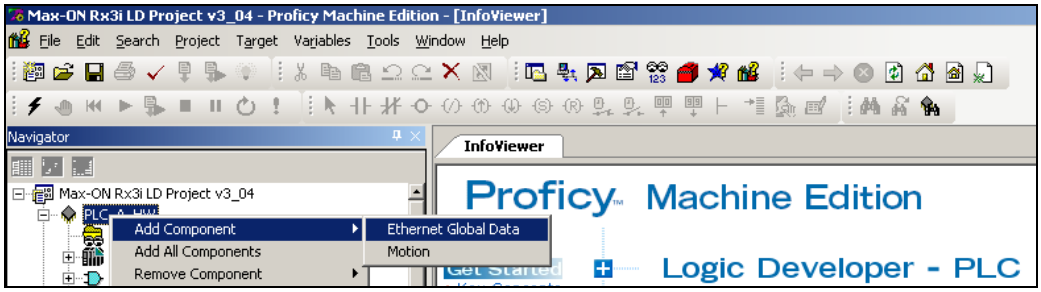
For a complete description of how to configure and use the PACSystems RX3i ENIUs, please see GFK-2434, the *PACSystems RX3i Ethernet Network Interface Unit* manual. A summary of the process to configure this ENIU is as follows:

1. Determine the IP Addresses for the Primary (PLC A) and Secondary (PLC B) Controllers and the Ethernet NIU.
2. Add the PACSystems ENIU target(s) to your Machine Edition Project by selecting the *Add Target* > *GE Fanuc Remote I/O* > *PACSystems RX3i Ethernet* menu.



3. Set the IP Address and Subnet Mask on the Ethernet Transmitter module(s) ETM001 in the Ethernet NIU target. Set the Gateway IP Address if required.
4. Set the Ethernet Global Data Local Producer ID in the Ethernet NIU.
5. Add the input and output modules to the Ethernet NIU configuration. If you add or change modules later in the project, EGD Exchanges in the ENIU and controller may need to be updated.
6. Complete the Ethernet Global Data Exchanges for the ENIU.

7. If the ENIU has any Local Logic, develop this logic for the ENIU target. The RX3i Ethernet NIU allows the addition of up to 20K bytes of logic to be executed locally in the I/O Station. A LD logic block named “Local User Logic” is provided for this purpose.
8. Repeat steps 2 through 7 for each ENIU.
9. Store this information to each ENIU.
10. Add the Ethernet Global Data component to the Primary (PLC_A_HW target) and Secondary (PLC_B_HW target) Controllers.



11. Set the EGD Local Producer ID in the controllers.
12. Create EGD Exchanges in the Primary controller (PLC A) to match the EGD exchanges in each ENIU.
13. Create EGD Exchanges in the Secondary controller (PLC B) to match the EGD exchanges in each ENIU.
14. If Remote COMMREQ Calls will be used with the ENIUs, add the RCC Parameterized C Block to the PLC_COMMON_CODE target’s application, and add any logic needed to execute these commands.
15. Store the Hardware Configurations (PLC_A_HW and PLC_B_HW targets) to PLC A and PLC B.
16. Store the Application Logic (PLC_COMMON_CODE target) to PLC A and PLC B.
17. Verify that the EGD Exchanges are working.
18. Verify that any RCC commands are working.
19. Verify that any Local Logic is working.

Configuring the Genius I/O Devices

Before you can use your system, you must configure the Genius I/O devices that are to be installed on the Genius I/O bus.

You must configure each device for:

- Serial Bus Address (SBA)
- Type of I/O (Input, Output, Combination)
- Scaling
- Defaults

Additionally, you must set the I/O to operate properly for redundancy:

- Dual I/O busses
- Hot Standby controller

Genius and Field Control I/O

While you are configuring the Genius I/O, you must configure extra parameters that govern system operation with respect to redundant PLCs and redundant (dual) Genius I/O busses. Please note that for Genius and Field Control I/O, you must have a Handheld Monitor available to set these parameters.

Redundant Controllers

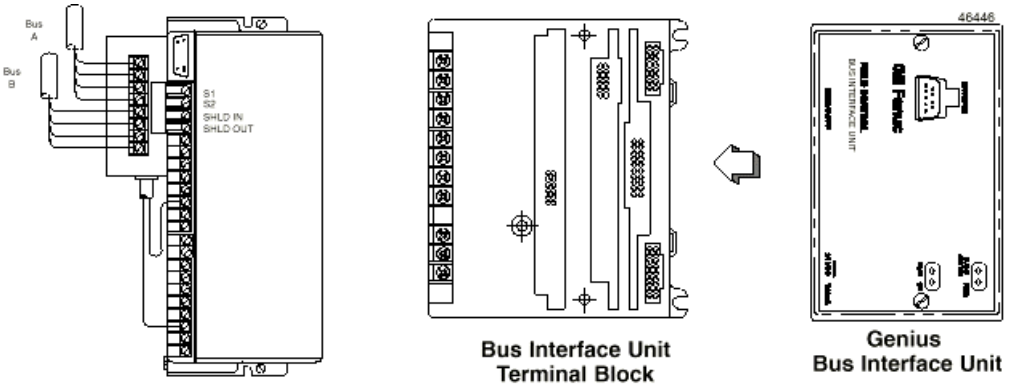
Using the Genius Handheld Monitor (HHM), set each Genus device for *Redundant Controllers = YES*.

BSM Present

Using the Genius Handheld Monitor (HHM), set the *BSM Present* configuration parameter to YES. **This is required whether or not a dual Genius I/O bus is being used.**

When this parameter is configured as YES, then the output default period is extended from 3 token rotation time periods to 2.5 seconds. The extra time allows the RX3i PLCs to exchange mastership correctly.

BSM Controller



If the Genius I/O device is attached directly to a dual bus, either by a Bus Switching Module (BSM) or a Bus Interface Unit (BIU), then you must configure this device to be a BSM Controller.

Genius Block with BSM

In the case of a Genius Block connecting to the BSM, setting the block to be a BSM Controller allocates its first output to the control of the BSM. It is assumed that the BSM is connected to the first output circuit.

In the case of Field Control connecting to the BIU, setting the parameter to be a BSM Controller directs the BIU to activate its internal bus switching circuitry.

If the device is connected to a “stub” downstream of another device that controls the switching, then set BSM Controller to NO.

Genius VersaMax I/O

Set the serial bus address and baud rate using the rotary switches on the Genius Network Interface Unit.

The Max-ON RX3i PLC drivers will set the remaining parameters associated with redundancy:

- Controller Redundancy = YES
- Default Time = 2.5 seconds
- BSM Controller = YES, if the device is interfaced to dual busses
- BSM Controller = NO, if the device is interfaced to a simplex bus

Each time a VersaMax device logs onto the system, the Max-ON RX3i driver will issue a Write Device Datagram with the proper configuration parameters.

Note: In order for VersaMax I/O to work properly in a Max-ON Rx3i system, you must configure the I/O in the Max-ON RX3i Configuration Utility. Make certain that the I/O Family has been identified as VersaMax.

Remote 90-30 Genius Drops

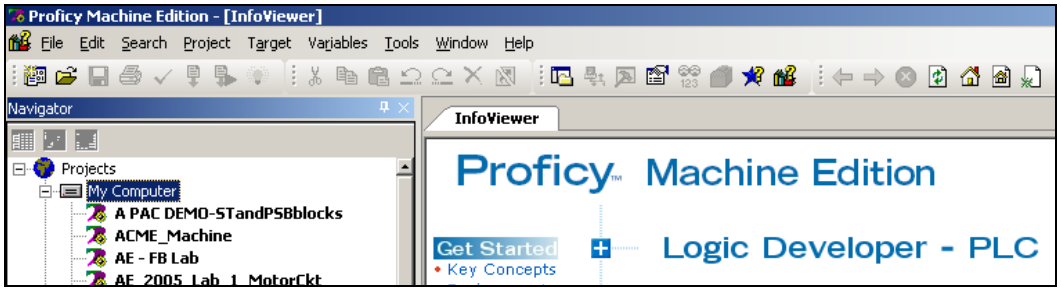
A Remote 90-30 Genius Drop consists of a Series 90-30 CPU, power supply, base, and one or more Genius bus controllers. Input and output modules are installed in the CPU base. Modules also may be installed in an I/O Expansion base.

A Scanner routine executes in the drop's CPU. This routine scans all input devices and transmits the input states to the Hot Standby PLCs by way of the I/O bus.

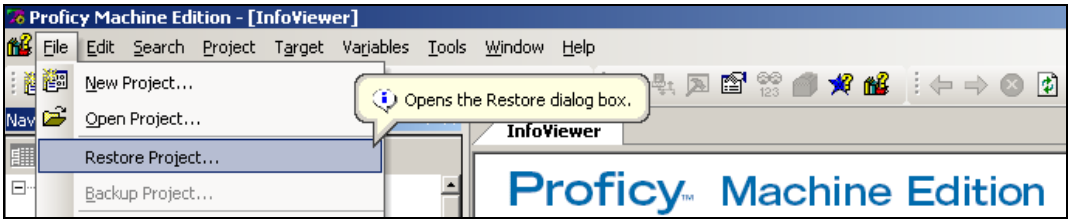
Creating the Remote 90-30 Genius Drop Project

Follow these steps to create a Remote 90-30 Genius Drop Project in Proficy Logic Developer PLC:

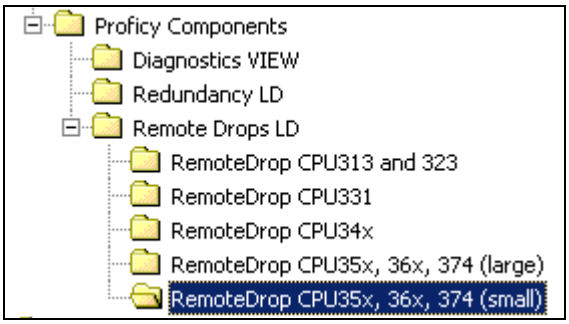
1. Create a new project based on the appropriate Remote 90-30 Genius Drop template. The Remote 90-30 Genius Drop project is added to the Machine Edition project Navigator by using the *File* > *Restore Project…* menu item. Select the Project Navigator window making certain that there is no project open at this time.

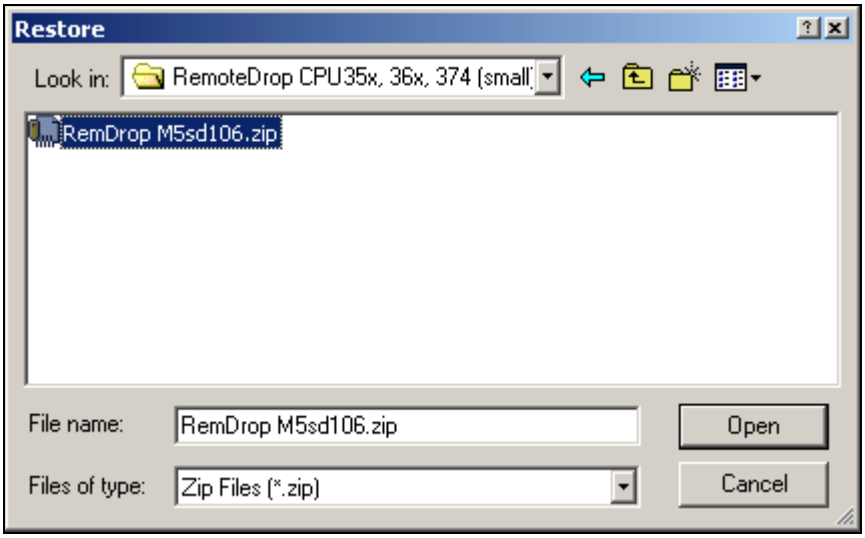


2. Using the *File* menu, click on *Restore Project*...



3. Navigate to the *Proficy Components* directory, then to the *Remote Drops LD* directory. Open the desired Remote Drop directory, *RemoteDrop CPU35x, 36x, 374 (small)*, for example. Make certain that the selection for **Files of Type** has been set to *Proficy Machine Edition (*.zip)*. Select the Remote Drop project backup file.





When you click on *Open*, a new project will be added to the Proficy Navigator window.

4. Give your project a descriptive name in the Machine Edition Navigator.

Remote Drop Status Word

A remote drop always places important status information into its local references at %I00001 through %I00016 inclusive. The definition of these inputs is shown in the table below.

Bit Offset	*Description*
1	Offline
2	Overrides Present
3	PLC Low Battery
4	Config Mismatch
5	Loss of I/O Module
6	Loss of Option Module
7	Option Module Hard Fault
8	Option Module Soft Fault
9	System Fault Present
10	I/O Fault Present
11	Program Changed
12	HW Config Changed
13	Power Up
14	Program Restart
15	Bus 1 LRC Error
16	Bus 2 LRC Error

To ensure proper operation of the remote drop, you must not configure any local module such that it overlaps these discrete input addresses. Make certain that addressing for your modules begins at %I00017 or above.

Configuring the Drop's GBC

The Genius bus controller in the remote drop must be configured to transmit the input data to the Hot Standby PLCs and also to receive global data from the Hot Standby PLCs. In the Remote Drop, global data contains the discrete and analog output data.

Primary Bus

The Genius bus controller should be configured as follows:

In the Settings Tab

Serial Bus Address (SBA):	Any address from 0 to 29 is acceptable. (Note: a Genius Handheld Monitor normally is set for SBA=0. It is standard practice to avoid 0 when using Field Control or Genius I/O.)
Status Reference Type:	%I00481 for M23, M31, and M40 drop folders %I02017 for M5S and M5L drop folders

In the Global Data Tab

At the GBC's Address:

Input 1 Address	%I00001
Input 1 Length	always 0
Input 2 Address	%AI00001
Input 2 Length	always 0
Output 1 Address	%I00001
Output 1 Length	16 plus the number of Discrete Inputs installed
Output 2 Address	%AI00001
Output 2 Length	The number of Analog Inputs installed

At SBA 30:

Input 1 Address	See Buffer Registers
Input 1 Length	62
Input 2 Address	%AI00001
Input 2 Length	always 0
Output 1 Address	%Q00001
Output 1 Length	always 0
Output 2 Address	%AQ00001
Output 2 Length	always 0

At SBA 31:

Input 1 Address	See Buffer Registers
Input 1 Length	62
Input 2 Address	%AI00001
Input 2 Length	always 0
Output 1 Address	%Q00001
Output 1 Length	always 0
Output 2 Address	%AQ00001
Output 2 Length	always 0

Secondary Bus (optional)

The Genius bus controller should be configured as follows:

In the Settings Tab

Serial Bus Address (SBA):	Any address from 0 to 29 is acceptable. (Note: a Genius Handheld Monitor normally is set for SBA=0. It is standard practice to avoid 0 when using Field Control or Genius I/O.)
Status Reference Type:	%I00449 for M23, M31, and M40 drop folders %I01985 for M5S and M5L drop folders

In the Global Data Tab

At the GBC's Address:

Input 1 Address	%I00001
Input 1 Length	always 0
Input 2 Address	%AI00001
Input 2 Length	always 0
Output 1 Address	%I00001
Output 1 Length	16 plus the number of Discrete Inputs installed
Output 2 Address	%AI00001
Output 2 Length	The number of Analog Inputs installed

At SBA 30:

Input 1 Address	See Buffer Registers
Input 1 Length	62
Input 2 Address	%AI00001
Input 2 Length	always 0
Output 1 Address	%Q00001
Output 1 Length	always 0
Output 2 Address	%AQ00001
Output 2 Length	always 0

At SBA 31:

Input 1	See Buffer Registers
Input 1 Length	62
Input 2	%AI00001
Input 2 Length	always 0
Output 1	%Q00001
Output 1 Length	always 0
Output 2	%AQ00001
Output 2 Length	always 0

The table shown below should be used to configure the Genius bus controller(s) in a remote drop. The table lists the register references that must be entered into the Logic Developer PLC hardware configuration based upon the template folder that was used to create the remote drop.

	Remote 90-30 Genius Drop Project Name				
Description	**RemDrop M23dxyy.zip**	**RemDrop M31dxyy.zip**	**RemDrop M4xdxyy.zip**	**RemDrop M5sdxyy.zip**	**RemDrop M5ldxyy.zip**
Receive Buffer Primary Bus, CPU A SBA-31	%R00705	%R01729	%R09680	%R09680	%R16065
Receive Buffer Secondary Bus, CPU A SBA-31	%R00833	%R01857	%R09808	%R09808	%R16193
Receive Buffer Primary Bus, CPU B SBA-30	%R00769	%R01793	%R09744	%R09744	%R16129
Receive Buffer Secondary Bus, CPU B SBA-30	%R00897	%R01921	%R09872	%R09872	%R16257

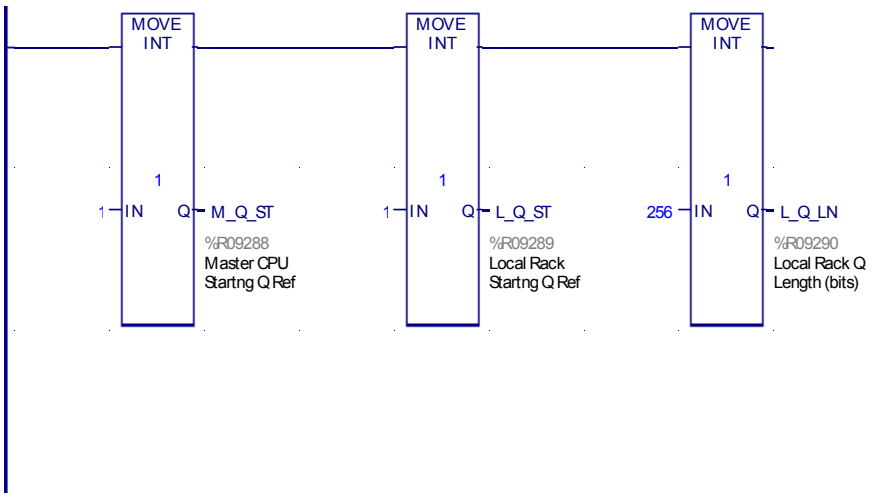
Configuring the Discrete Output Range

Discrete output states are broadcast as global data from the Hot Standby PLCs. The global data is intercepted by the Remote Drop and then mapped to local output states. The mapping process allows output references from the Hot Standby PLCs to be translated to a different set of output references in the remote drop.

For example, assume that your Remote Drop is implemented using a model IC693CPU323. This CPU supports a maximum of 512 discrete output addresses. Your Hot Standby CPUs are each a model IC695CMU310. This CPU supports 32640 output addresses. The mapping process allows a portion of the output addresses in the range %Q00001...02048 to be mapped into the range %Q00001...00512 at the remote drop.

Configuring the Range

1. In Logic Developer PLC, open the Remote Drop project.
2. Using the navigator, open the Block named *mxn_cfg*.
3. Edit the first rung of data moves.
4. In the first MOVE function, a constant is moved into the reference named M_Q_ST (Master CPU Starting Q Ref). Enter the starting reference for the outputs that are to be received from the Hot Standby PLCs.
5. In the second MOVE function, a constant is moved into the reference named L_Q_ST (Local Rack Starting Q Ref). Enter the starting reference for the outputs in the Remote Drop in that you wish to place the Hot Standby values.
6. In the third MOVE function, a constant is moved into the reference named L_Q_LN (Local Rack Q Length (bits). Enter the number of outputs that are to be mapped into the Remote Drop.
7. Save the Project.



8. Store the Project to the Remote Drop.

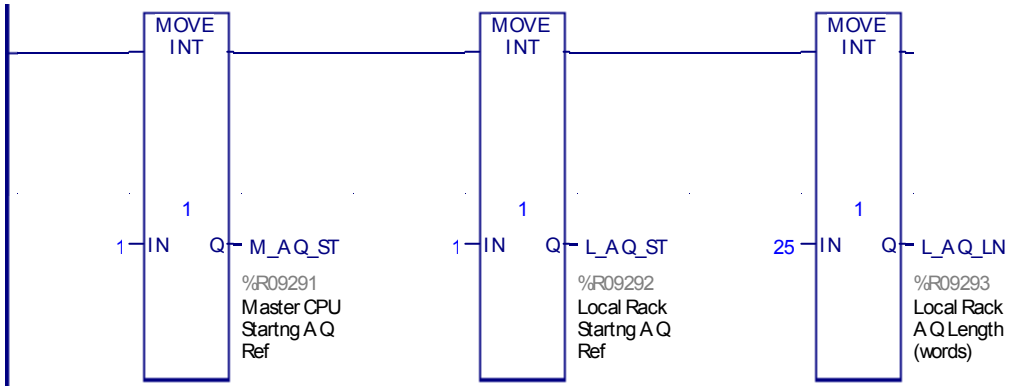
Configuring the Analog Output Range

Analog output values from the Hot Standby PLCs are intercepted by the Remote Drop and then mapped (i.e. the output reference may be modified) to local output references.

For example, assume that your Remote Drop is implemented using a model IC693CPU323. This CPU supports a maximum of 512 analog output addresses. Your Hot Standby CPUs are each a model IC695CMU310. This CPU supports up to 32640 analog output addresses. The mapping process allows a portion of the output addresses in the range %AQ00001...32640 to be mapped into the range %AQ00001...00032 at the remote drop.

Configuring the Range

1. In Logic Developer PLC, open the Remote Drop project.
2. Using the navigator, open the Block named *mxn_cfg*.
3. Edit the second rung of data moves.
4. In the first MOVE function, a constant is moved into the reference named M_AQ_ST (Master CPU Starting AQ Ref). Enter the starting reference for the outputs that are to be received from the Hot Standby PLCs.
5. In the second MOVE function, a constant is moved into the reference named L_AQ_ST (Local Rack Starting Q Ref). Enter the starting reference for the outputs in the Remote Drop in that you wish to place the Hot Standby values.
6. In the third MOVE function, a constant is moved into the reference named L_AQ_LN (Local Rack Q Length (words). Enter the number of outputs that are to be mapped into the Remote Drop.
7. Save the Project.
8. Store the Project to the Remote Drop.



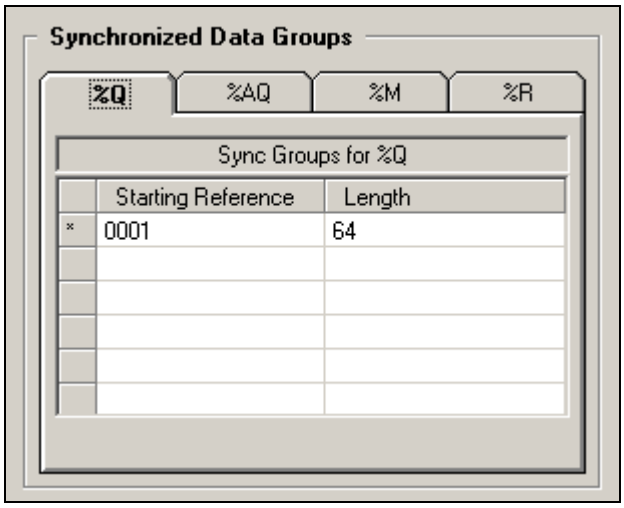
Configuring the Hot Standby GBCs

The bus controllers should be configured in the same fashion as other I/O devices.

Configuring the Synchronized Output Variables

Discrete and analog outputs in a Remote Drop receive values from the Hot Standby CPUs by way of the Synchronized Variables data exchange. In order for outputs to update properly, there must be a corresponding range of Synchronized Variables that has been configured in Max-ON RX3i Configuration Utility.

For example, in the configuration shown below, remote drops would be able to access discrete outputs only within the range %Q00001...00064. No other discrete output data is being broadcast in the global data exchange, and thus no other discrete output data is available for the remote drops.



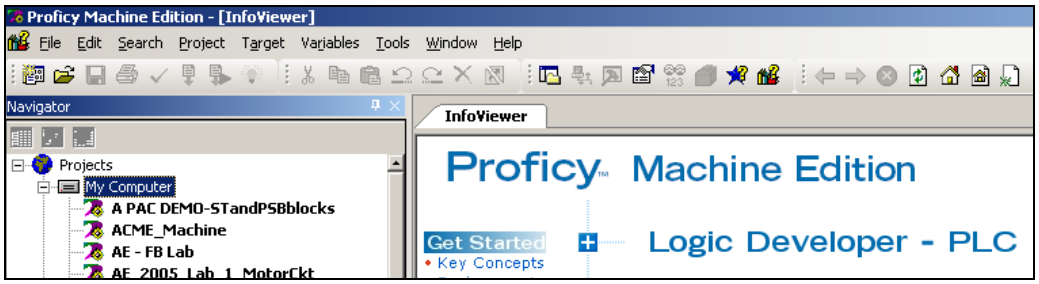
Chapter 8 Diagnostic Tools

Max-ON RX3i Diagnostic Tools software provides diagnostic functions that may be used to obtain both real-time and historical operating information from your Hot Standby system. The Diagnostic Tools are provided by a Proficy View project that is used to monitor the redundant system.

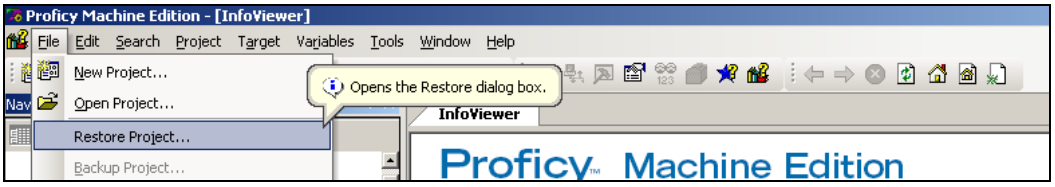
Step 1 - Create a Max-ON RX3i Diagnostic Tool View Project

In Proficy Logic Developer PLC:

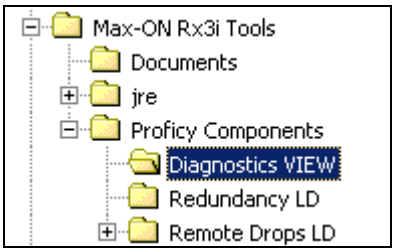
1. Create a new project based on the generic Max-ON RX3i Diagnostic Tool project. This project is added to the Machine Edition project Navigator by using the *File* > *Restore Project…* menu item. Select the Project Navigator window, making certain that there is no project open at this time.



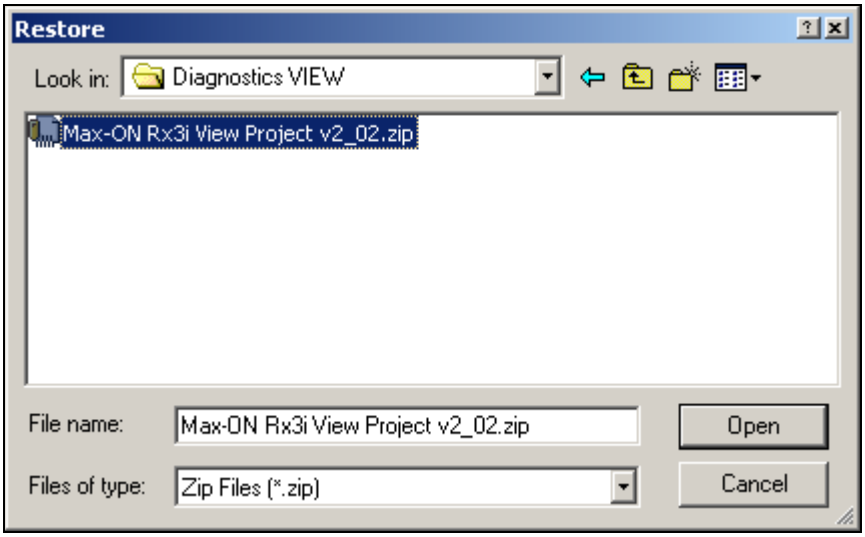
2. Using the *File* menu, click on *Restore Project...*



3. Navigate to the *Proficy Components* directory, then to the *Diagnostics VIEW*. Make certain that the selection for **Files of Type** has been set to *Proficy Machine Edition (*.zip)*.



When you click on *Open*, a new project will be added to the Proficy Navigator window.

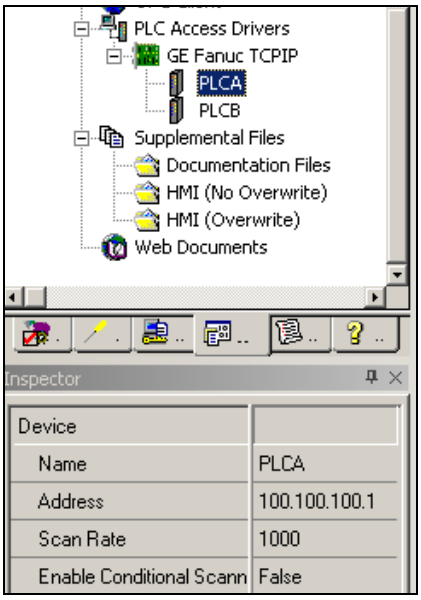


4. Give your View project a descriptive name in the Machine Edition Navigator.

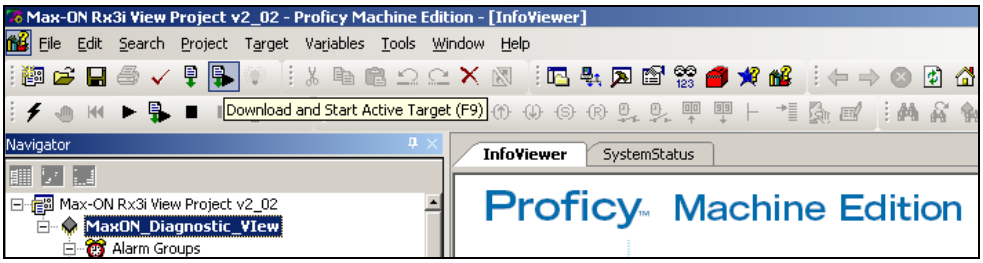
Step 2 – Configure Ethernet Connections to the PLCs

In order to conduct data transfers between Max-ON RX3i Diagnostics and the Hot Standby PLCs, you need to establish an Ethernet communication connection to the PLCs. To configure the Ethernet addresses of the PLCs in the View Project:

1. Open the View project that was restored in Step 1.
2. Expand the PLC Access Drivers node in the Navigator for the View target and select the PLCA device.



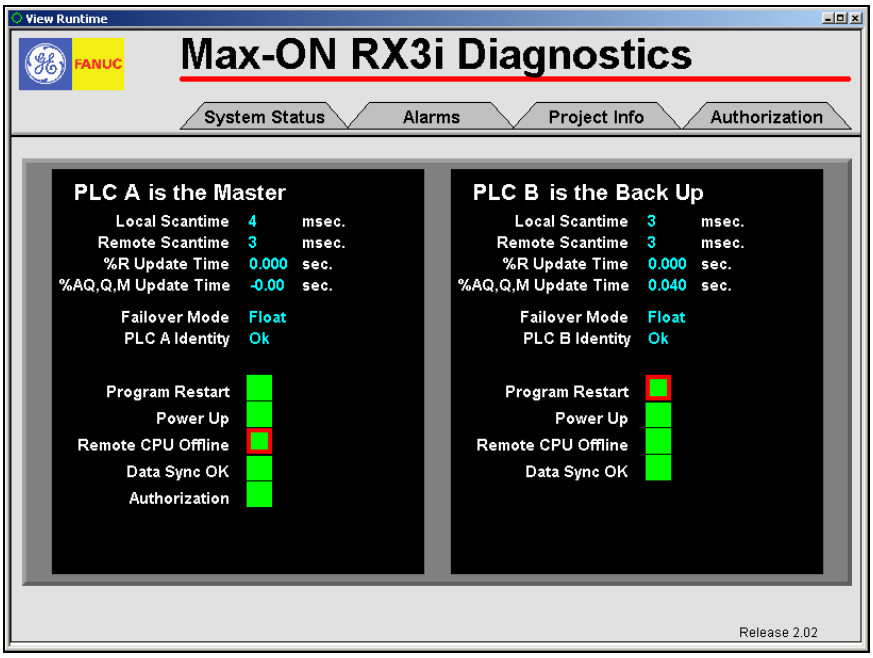
3. Modify the Address of PLCA in the Inspector to match the IP address of PLC A in your Max-ON RX3i system.
4. Repeat step 3 for PLCB.
5. Select the Download and Start Active Target toolbar button to start the Max-ON RX3i Diagnostic program, or press the F9 key.



This will launch the View project to run on your PC.

Step 3 – Use the Max-ON RX3i Diagnostic Tool

Once the Diagnostic Tool starts on your PC, the main Diagnostics page will be displayed:



System Status	Clicking on this tab displays the Real-time Status page. The page contains information on scan times, update rates, and PLC status.
Alarms	Clicking on this tab will bring up the Alarm Table display page. This page lists any alarms that have been archived within the PLCs that have active connections. Alarms may be cleared from this display page.
Project Info	Clicking on this tab will display the Project Information page. Catalog number, version number, program checksum, and other items are displayed.
Authorization	Clicking on this tab will display the Authorization page that indicates if the system is operating in Demo mode or not.

Please note that if the Diagnostic Tool is not communicating with the PLCs, a  will be displayed for the items.

The  symbol indicates a Latched Alarm condition, where a  symbol indicates a current Alarm condition.

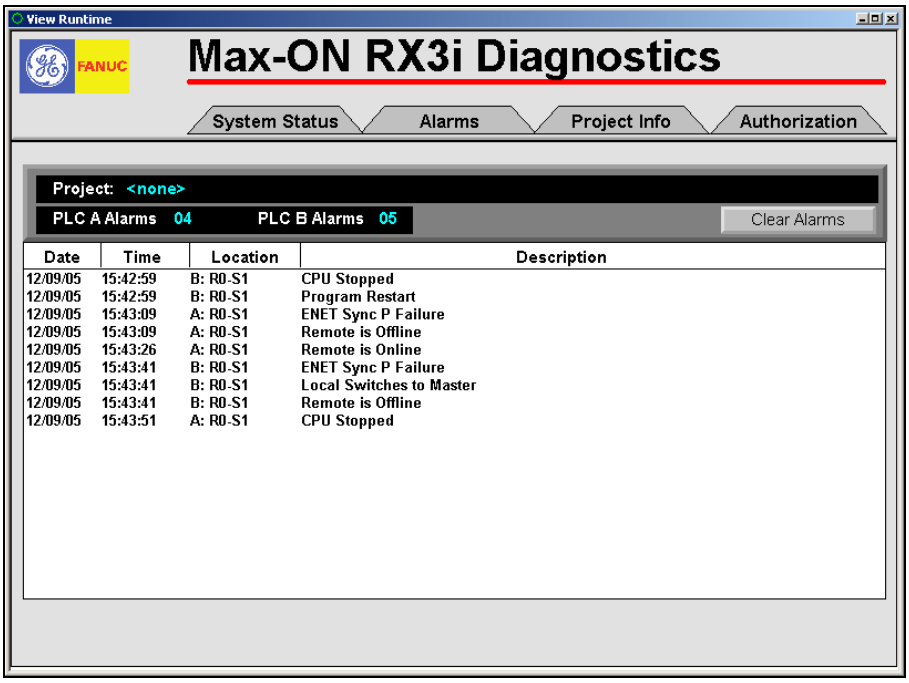
System Status

You may view items that relate to the current operating characteristics of your system on the System Status page. An example is shown in the picture above.

PLC A and PLC B Status	Indicates the operating status of the corresponding PLC, either Running or Stopped.
Local Scan Time	The scan time, in milliseconds, for the Local PLC.
Remote Scan Time	The scan time, in milliseconds, for the Remote PLC.
%R Update Time	This is the time required to update synchronized data of type %R. The time is reported in seconds.
%AQ, Q, M Update Time	This is the time required to update all configured synchronized data of the types %AQ, %M, and %Q. The time is reported in seconds.
Failover Mode	This field indicates the mastership status of the corresponding PLC, either Master or Backup. There never should be two Masters or two Backups in a system that is operating properly.
PLC A and PLC C Identity	A-Preferred, B-Preferred, or Float
Program Restart	The local CPU has been switched from STOP mode to RUN mode.
Power Up	The local CPU has undergone a power-up event**.**
Remote CPU Offline	The companion PLC is offline. This may be due to the CPU being in STOP, Fault, or Powered Off. Also it may be due to a cable problem or Ethernet Interface failure.
Data Sync OK	This field indicates the completion status for the transfer of synchronized data. The Backup CPU will indicate either Synced (all Synchronized Variables have been received) or Not Synced. The Master CPU always indicates Synced (ON). It is ON in the Backup CPU at the moment when all Synchronized Data items have been updated.
Authorization	This indicates that the corresponding PLC is running on a Max-ON RX3i CPU, or operating in DEMO mode. In a system that is running on a Max-ON RX3i CPU, this flag will be OFF.

Alarms

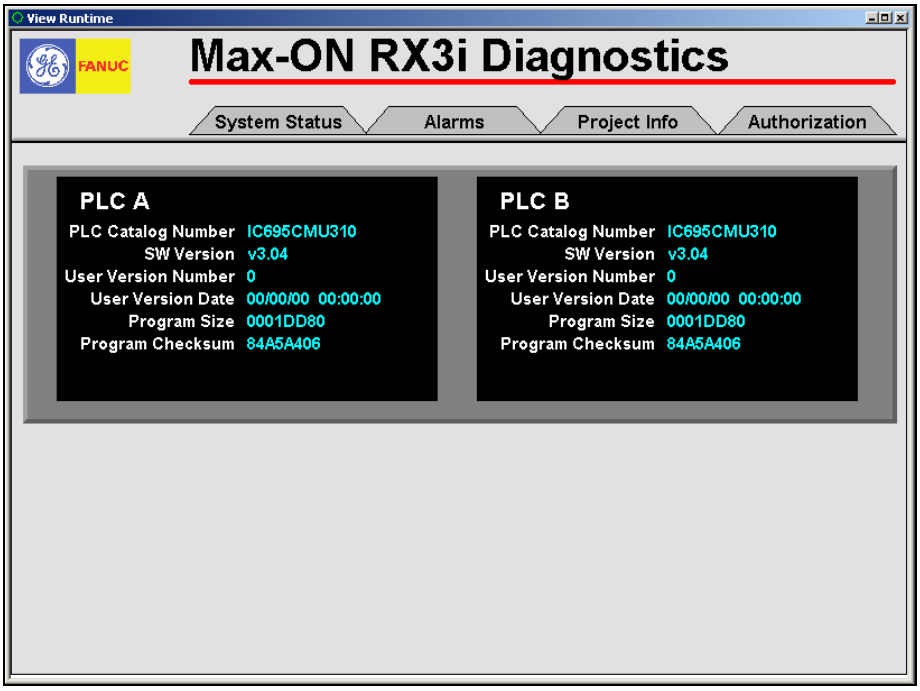
Historical information is stored in the alarm table. This table contains archived information for up to 32 alarm records for each PLC. The records store information for both system alarms and optional user-defined alarms. Each alarm record consists of an identifier for the event that initiated the entry, along with a date/time stamp to indicate when the event occurred. Typical events include change of Hot Standby mastership, loss of PLC power, program restart, and loss of I/O devices.



Note: User defined alarms are not available in the current version of Max-ON RX3i Diagnostic Tools.

Project Information

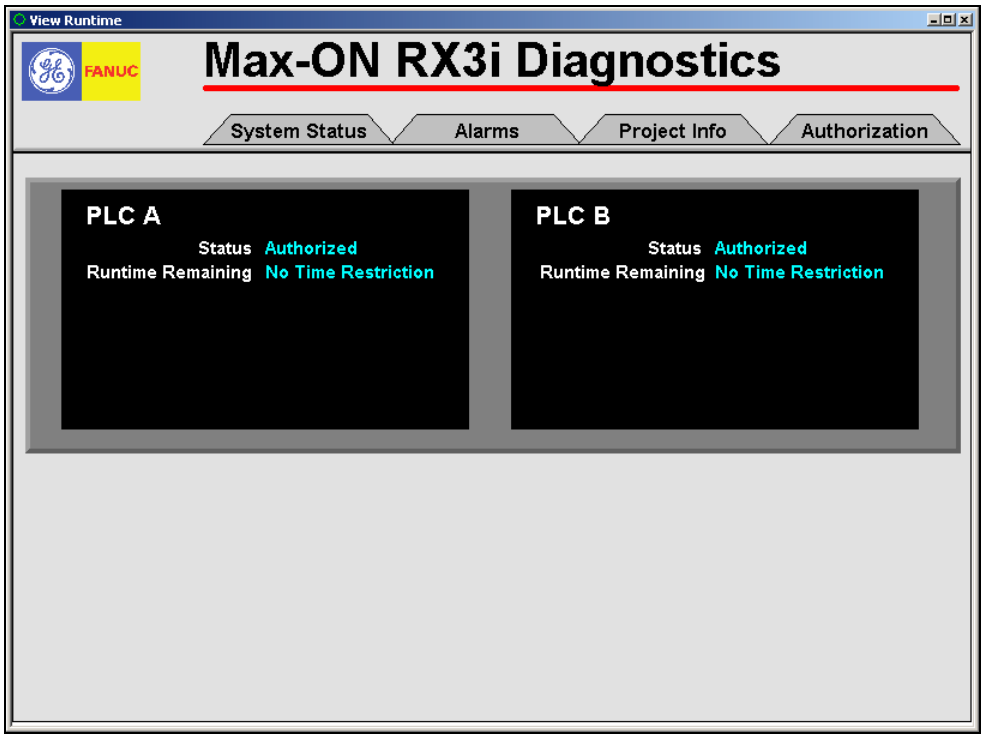
You may view certain items that relate to the general nature of your system. Select the *Project Info* tab.



PLC Catalog Number	The catalog number of the GE Fanuc controller that is running the Max-ON Rx3i project.
SW Version	The current version number of the Max-ON RX3i PLC drivers
User Version Number	If Audit trail has been enabled, then this represents the number of times the application logic has been changed. If Audit trail has not been enabled, the Max-ON RX3i drivers will not update any value here.
User Version Date	If Audit trail has been enabled, then the current date and time will be posted here each time the application logic is changed. If Audit trail has not been enabled, then the Max-ON RX3i drivers will not update any value here.
Program Size	An approximate program size. There will be a slight difference between the value displayed in Logic Developer PLC and the value displayed here. The Max-ON RX3i value includes the memory overhead associated with subroutines.
Program Checksum	The additive checksum for the Program.

Authorization

You may view the information related to the authorization of your system by selecting the *Authorization* tab.



Status The Status field indicates whether the system is running on a Max-ON RX3i CPU (IC695CMU310), or running in Demo mode on a standard RX31 CPU (IC695CPU310).

Runtime Remaining The Runtime Remaining field indicates how much demo time remains when the system is in Demo mode.

Appendix A System Considerations

General Max-ON RX3i Considerations

There are a number of considerations and recommendations that should be taken into account when defining a Max-ON RX3i system. This appendix summarizes the main items that the application developer should keep in mind when planning and developing such a system.

1. Ethernet Synchronization LAN should use dedicated Ethernet Interface Modules. If other devices such as I/O or HMIs are placed on the Sync LAN, they can have a negative impact on the performance of the system in terms of Failover and Synchronization time. Therefore, it is recommended that the Sync LAN be isolated. Adding a single device like the Logic Developer PLC programmer or the Max-ON RX3i Diagnostic tool should be acceptable and also useful when diagnosing the system.
2. Ethernet I/O LANs should use dedicated Ethernet Interface Modules and be isolated from a main Ethernet network. Again, if other devices are placed on the I/O LAN, they can have a negative impact on the performance of the I/O system in terms of IO update time. Therefore, it is recommended that the I/O LAN be isolated.

Improving Ethernet Synch Efficiency Using PLC Sweep Mode

For the Ethernet Synchronization interfaces to work efficiently, it is necessary to extend the Scan Time in one or both of the PLCs. The extra time is used to transfer Synchronized Variables through the CPU Communications Window. There are two approaches. Each has its own advantage.

Automatic Mode Selection

In this approach, the system detects which CPU is the Backup and then sets the Backup to *Constant Sweep*. If there is a transfer in Mastership, then the Max-ON RX3i driver will set the new Master CPU into *Normal Sweep* and the new Backup to *Constant Sweep*.

Why you should consider this approach:

- The Master always operates with the fastest Scan Time possible.
- The Backup will adjust its timing regularly to meet current system requirements.

The period for *Constant Sweep* is determined automatically once per second. The value is calculated by adding 75 milliseconds to the Master's Scan Time and then rounding downward to the nearest multiple of 5 milliseconds.

To enable this mode of operation:

1. Using Logic Developer PLC, open your Max-ON RX3i Project.
2. Select the PLC_COMMON_CODE Target as the Active Target.
3. Prior to the call to HBR_000 in the *_MAIN Block, enter a rung that sets AUT*SWP (%M1012) to ON.
4. Store the Logic into CPU A.
5. Store the Logic into CPU B.

Manual Mode

The second method is to configure the CPUs to execute in *Constant Sweep* mode. The configuration is entered via the Logic Developer PLC Hardware Configuration. Both of the hardware configurations for targets PLC_A_HW and PLC *B_HW* must be set and then stored into the corresponding CPUs.

Why you should consider this approach:

- By having the Master in *Constant Sweep* mode, Ethernet communications with HMIs may be improved dramatically.

Prerequisite: The system has been commissioned and is operating in its normal fashion:

- All application logic has been completed and is being executed in the hot-standby CPUs
- HMIs are attached and communicating
- All peripherals are connected and operating normally

The procedure is as follows:

Using Logic Developer PLC, record the peak CPU Scan Time in the Master CPU. You should observe the system for several minutes to obtain this value.

1. Add 75 to the value you obtained in step 1. Round this value down to the nearest multiple of 5.
2. Open the hardware configuration for CPU A.
3. Zoom into the CPU module. Click on the Scan tab.
4. Set the Sweep Mode to Constant Sweep.
5. Set the Sweep Timer to the value calculated in step 2.
6. Store the configuration into CPU A.
7. Open the hardware configuration for CPU B.
8. Repeat steps 3through 6.
9. Store the configuration into CPU B.
10. Using Logic Developer PLC, Select the PLC_COMMON_CODE Target as the Active Target.
11. Prior to the call to HBR_000 in the _MAIN Block, enter a rung that resets AUTSWP (%M1012) to OFF.
12. Store the Logic into CPU A.
13. Store the Logic into CPU B.

Appendix B Frequently-Asked Questions

Do Max-ON RX3i Configuration Tools generate my Logic Developer PLC hardware configuration?

No. You must create the Hardware Configuration in the Logic Developer PLC project to match the parameters defined in the Max-ON RX3i Configuration Tool.

How is the hardware configuration in the Max-ON RX3i Project used in an application?

The memory limits on the CPU must be set to be compatible with your application requirements. Note that you may have to adjust these in the PLC_A_HW and PLC_B_HW targets as well.

Can Max-ON Configuration Tools append the drivers onto one of my existing application folders?

No. You must start by creating a Max-ON Rx3i Project and then add your application to it. You can add the Max-ON RX3i driver blocks to an existing Project using the Toolchest drawer supplied with the Max-ON RX3i software.

My two CPUs will not start. What is wrong?

There are several possibilities. You should use Max-ON Rx3i Diagnostic Proficy View Project to display the Fault Tables in the PLCs.

Error Message	*Possible Cause*
Invalid CPU ID, Duplicate IDs	The checksum word lengths are incorrect. CPU A should be configured to have a checksum word length of 32. CPU B should be configured to have a checksum word length of 16.
%Q Configuration Fault, %AQ Configuration Fault, %M Configuration Fault, %R Configuration Fault	One or more of the Synchronized Data types that you have configured is greater than the maximum quantity allowed for the product on which the project is based.

My system indicates that both PLCs are Masters. What is wrong?

The two PLCs are not exchanging Ethernet Sync LAN data properly.

- If the system is being started up for the first time, there may be a problem with the hardware configuration for the Ethenet Interface modules. Or, there may be a problem with the LAN cabling.

I stopped one of my CPUs and then disabled the Max-ON RX3i PLC drivers in the remaining CPU. Now my Genius output devices aren't working. What has happened?

You will need to change the configuration in the Genius bus controllers. In the Logic Developer PLC Hardware Configuration, open your Max-ON RX3i Project, zoom into the bus controller and set *Output at Start* to *Enabled*. Store the new configuration into the CPU. Make certain that you do this for both CPUs. Redundant operation is affected adversely by these settings. Don't forget to change the configuration to *Disabled* when you are ready to run the Max-ON RX3i drivers again.

CPU A has stopped. I know that the demo period has expired, but I can't get the CPU running again. What can I do?

Make certain that you turn ON %M1016 while the CPU is in STOP. Then restart the CPU. This will re-initialize the CPU to run in Demo Mode for an additional 22 days.

Can I use my existing Max-ON RX3i Configuration Tools to create new projects or do I need to re-install the software each time?

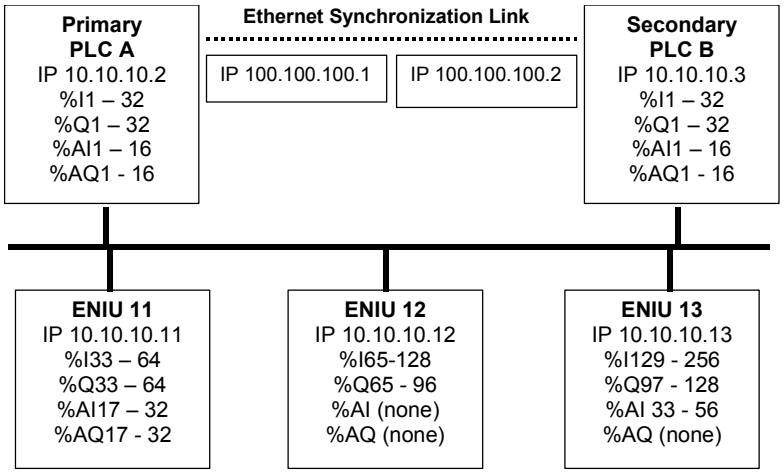
You may use the Max-ON RX3i Configuration Tools as often as you like. However, you will need to purchase a copy for each PC that you want to run the Configuration Tool on. The software license for IC646MXN001 is a single-user license.

Appendix C Quick Start Guide Using Ethernet I/O

This appendix uses an example Max-ON RX3i Redundant system with two controllers to give an overview of the steps needed to set up Max-ON RX3i systems with Ethernet NIUs for the I/O.

1. Create List of ENIUs and I/O like the example shown below. The list should include:
   - Controller(s) with IP addresses and local I/O (if used).
   - Each ENIU with IP Address, and the I/O for the ENIU. Leave expansion space for additional I/O if the system is likely to change or grow.

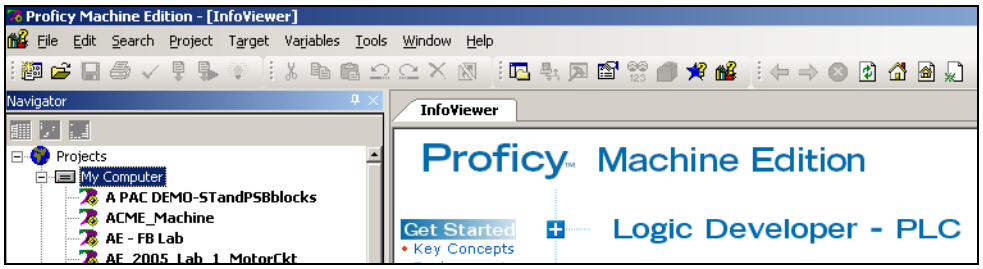
Example System with Redundant Controllers



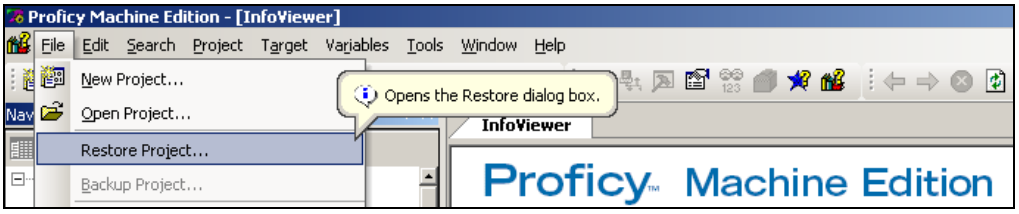
A Machine Edition backup folder to start from is provided with the Max-ON RX3i Software:

- Max-ON RX3i Quick Start 3 ENIUs

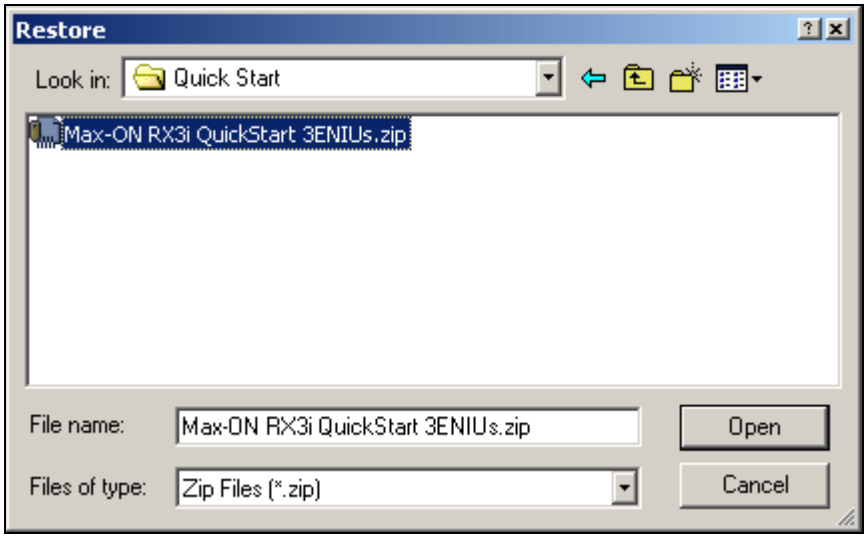
2. In Proficy Logic Developer PLC, create a new project based on the Project named above. This project is added to the Machine Edition project Navigator by using the *File > Restore Project…* menu item. Select the Project Navigator window making certain that there is no project open at this time.



3. Using the *File* menu, click on *Restore Project...*



4. Place the Max-ON RX3i Installation CD in your CD drive and navigate to the *Quick Start* directory. Make certain that the selection for **Files of Type** has been set to *Proficy Machine Edition (*.zip)*.



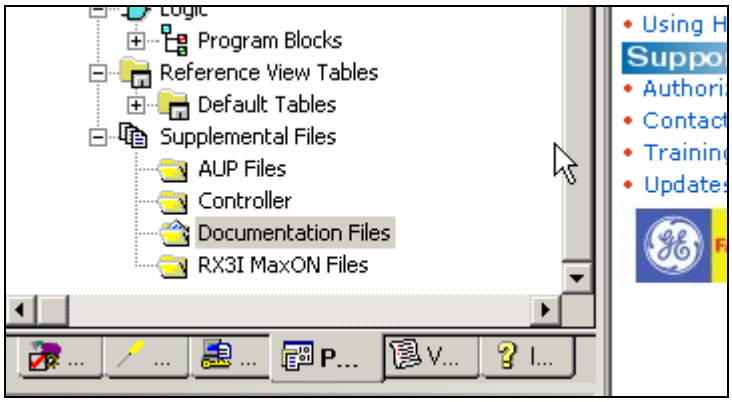
When you click on *Open*, a new project will be added to the Proficy Navigator window.

5. Give your project a descriptive name in the Machine Edition Navigator.
6. The Quick Start project is set up with controller targets named Primary_Controller (PLC A) and Secondary_Controller (PLC_B), and 3 Ethernet NIUs named ENIU11, ENIU12, ENIU13. You can rename the Targets as appropriate. If you need fewer ENIUs, delete the ones you don't need. If you need more ENIUs, select hardware configuration of a ENIU, right click and export the configuration. Create a new ENIU target, select hardware configuration, right click and import the hardware configuration. You will need to adjust the IP address before proceeding to the next step.
7. Using the list you created in step 1, change the hardware configuration for the controllers and ENIU to match the I/O in your project. Make sure the I/O reference addresses are correct.
8. Adjust the Produced exchange of the ENIUs and the Consumed exchange of the Controller(s) to match the %I and %AI in the hardware configuration of the ENIUs.
9. If you are changing the IP addresses of the devices, you need to change the following items:
   - IP address of each device. This must be done in two places: in the properties of the Target (how programmer connects) and in the Ethernet settings in hardware configuration.
   - Subnet mask of each device (if required).
   - Gateway IP address of each device (if required).
   - Check the Local Producer ID of each device and verify it is the IP address.
   - For Consumed Exchanges, change the Producer ID of the Exchange
10. Set default values for variables.
11. Download configurations to the Targets.

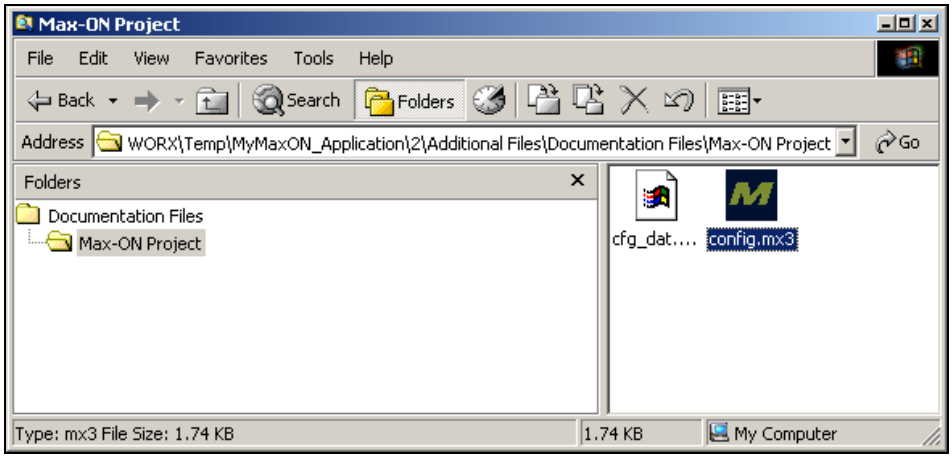
    When downloading to new or unknown hardware, first set the physical port property of the device in the programmer to a serial comm port (com1) and connect via a serial cable to the power supply port. After the initial store of the configuration sets the IP Address, the physical port property can be set to Ethernet and the IP address entered. This will allow connection of the programmer via Ethernet.

    If you know the device's MAC Address, an alternative process is to use the Set IP Utility in Machine Edition to set a temporary IP address so that you can connect to the devices from Logic Developer PLC.

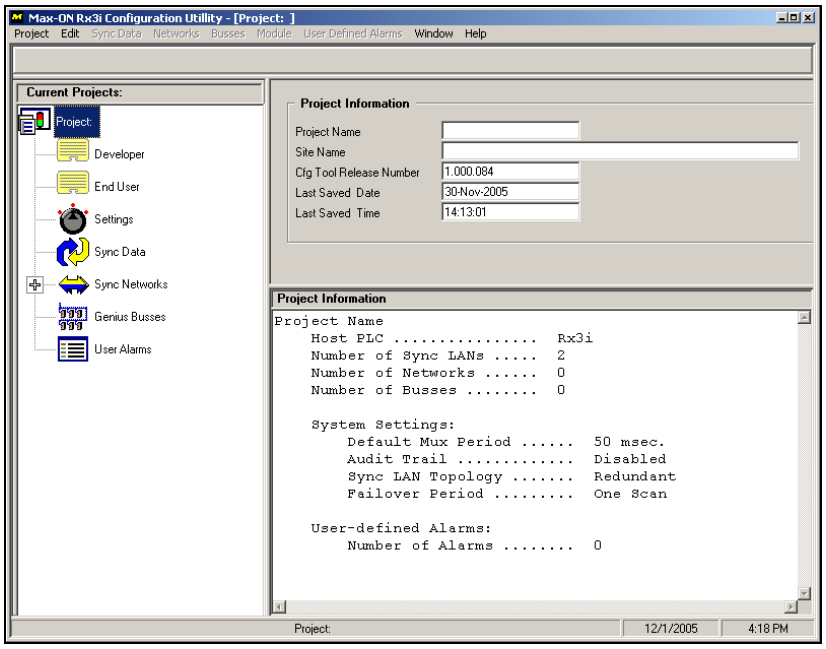
12. To launch the Max-ON RX3i Configuration Utility, Open the Supplemental Files, Documentation Files directory of the PLC_COMMON_CODE Target:



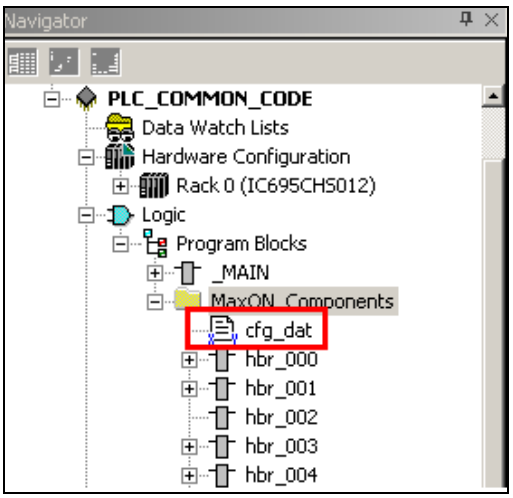
13. Select the Max-ON Project directory:



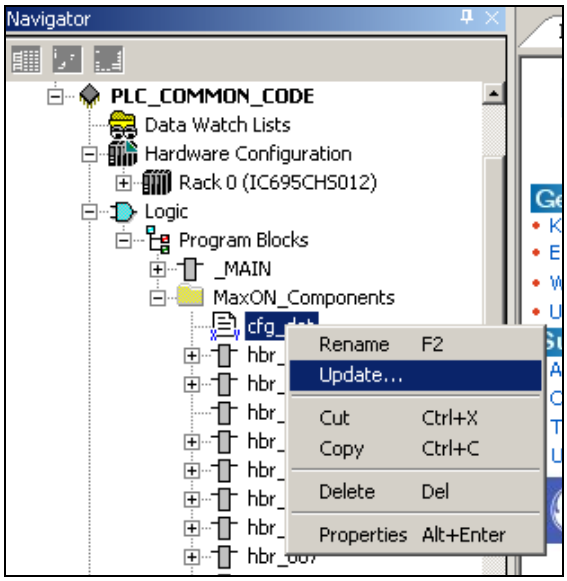
14. Double-click on the config.mx3 file. This will launch the Max-ON RX3i Configuration Utility that can used to define the parameters of the Redundant System.

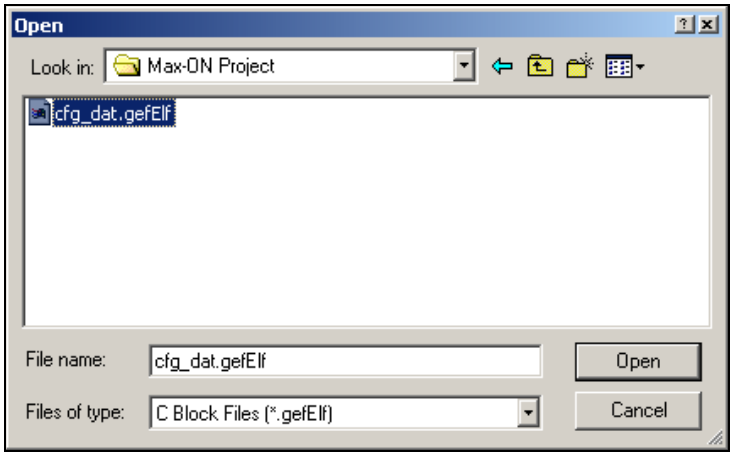


15. When the parameters of the Redundant Systems are entered or modified using the Configuration Utility, the cfg_dat C block is updated in the *Max-ON Project* directory. This block then must be used to update the C Block in the PLC_COMMON_CODE of the Project.



16. Select the C Block *Update…* right mouse menu and select the cfg_dat C Block gefelf file.





17. At this point the updated Configuration Utility parameters have been added to the Max-RX3i project. Now download the updates to the Primary and Secondary controllers.

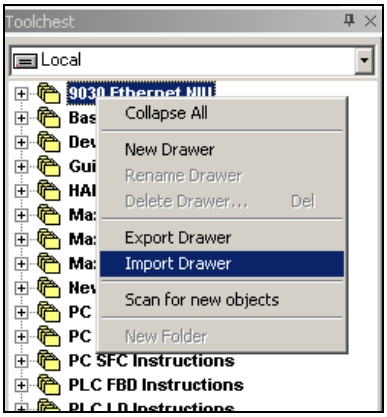
Appendix D Updating the Max-ON Application

This appendix explains how to upgrade the Max-ON program blocks in your application to a newer version of Max-ON using the Proficy Machine Edition Toolchest.

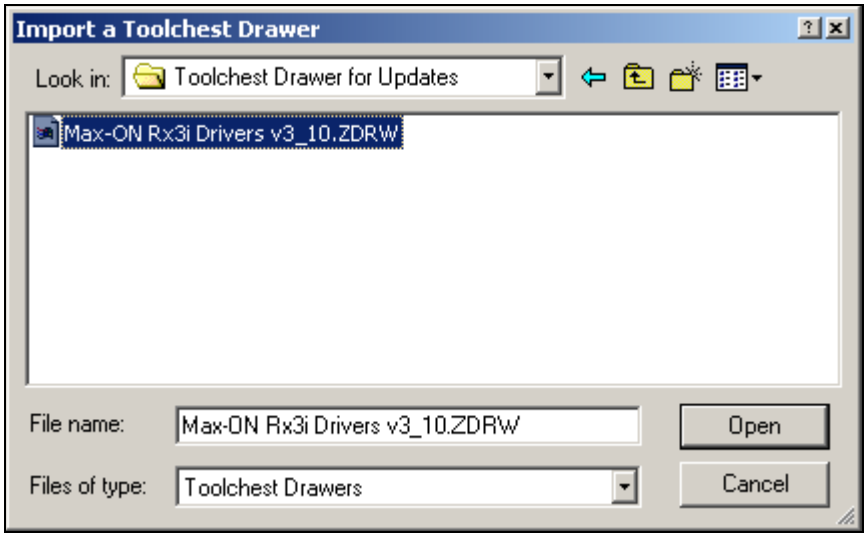
If you have a Max-ON RX3i application that was created with an earlier version of Max-ON RX3i software, such as version 3.04, you **must** update the Max-ON Drivers in your application to take advantage of the issue resolutions in a later version, version 3.10, for example. A Machine Edition Toolchest drawer is provided on the Max-ON RX3i Software Release to aid in the upgrade process.

To upgrade an existing Max-ON RX3i application to a later version perform the following steps:

1. **Back-up your Max-ON RX3i application using the Backup feature in Machine Edition**.
2. Import the latest Max-ON RX3i Driver Toolchest drawer into Machine Edition.
    a. Open your Max-ON RX3i Project in Machine Edition.
    b. Open the Toolchest by pressing the Toolchest button on the Toolbar –or- by pressing Shift+F9.
    c. Select a node in the Toolchest.
    d. Select the Import Drawer Toolchest right-mouse menu selection:

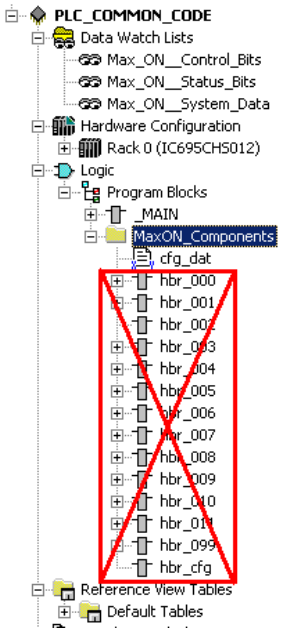


e. Navigate to the Max-ON RX3i Driver Toolchest drawer located on the Max-ON RX3i Software Release CD. This file is named: Max-ON RX3i Drivers vx_yy.ZDRW, and Max-ON RX3i Drivers v3_10.ZDRW in the example below:



Press the **Open** button. This will add the drawer to your Toolchest.

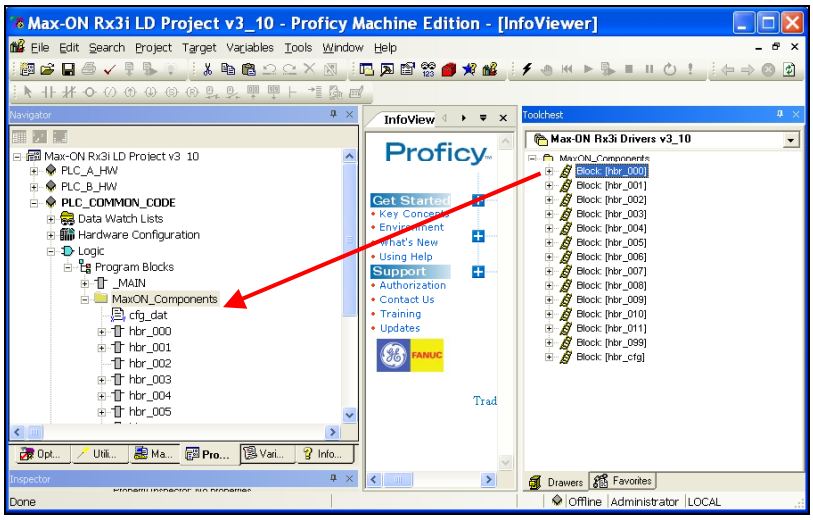
3. Expand the MaxON_Components folder in the PLC_COMMON_CODE Target in your project to display the current set of Max-ON Drivers. If you examine the Block Properties of each Block, you can see the Block revision, such as v3.04.



4. Delete the Max-ON Driver blocks that start with “hbr_” from the MaxON_Components folder.

   DO NOT delete the cfg_dat C Block.

5. Add the latest Max-ON RX3i Drivers to the MaxON_Components folder directory using the Ctrl-Drag-and Drop operation from the Toolchest.



The Blocks must be added to the Machine Edition Project in the following order:

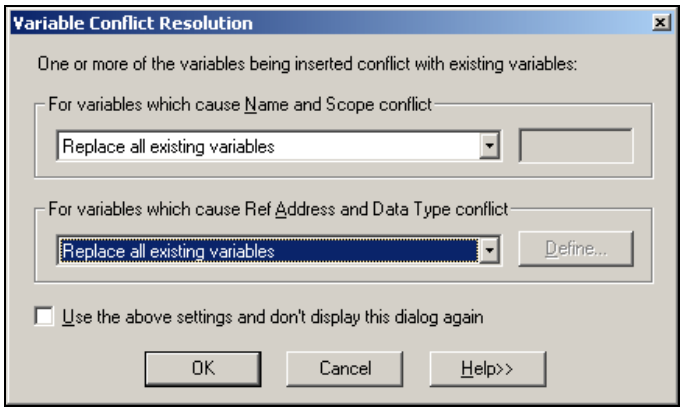
a. hbr_001, hbr_005, hbr_008

b. hbr_099

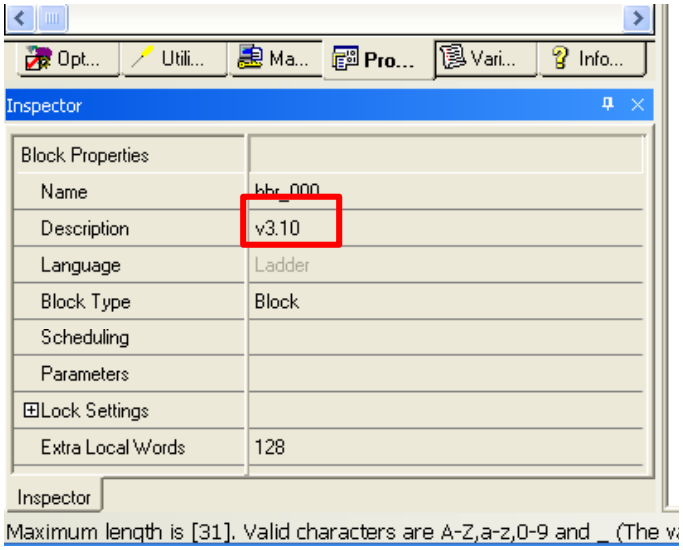
c. hbr_002 hbr_003, hbr_004, hbr_006, hbr_007, hbr_009, hbr_010, hbr_011, hbr_cfg

d. hbr_000

6. When performing the Ctrl+Drag-and-Drop Toolchest operation, when the Variable Conflict Resolution dialog is displayed, you must select the "**Replace all existing variables**" option to ensure that the new MaxON RX3i variables are properly defined.



7. A MaxON_RX3i_MAIN Block is also available in the Toolchest Drawer. This Block has a comment in the first rung that details the revision history.
8. Validate your Max-ON RX3i application to verify that all Max-ON Driver blocks are properly located in the Project.



9. You can also verify the version of each hbr_ Block by checking the description in the Block Properties: