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PLX51-DNPM

DNP3 Master / Concentrator Communications Gateway with SAv5

September 25, 2026

USER MANUAL

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PLX51-DNPM User Manual
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September 25, 2026

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1 Preface

1.1 Introduction to the PLX51-DNPM

This manual describes the installation, operation, and diagnostics of the ProSoft Technology PLX51-DNPM gateway. This module provides intelligent data routing between DNP3 (serial, Ethernet UDP, or Ethernet TCP) and either EtherNet/IP or Modbus (TCP/IP or RTU). The PLX51-DNPM allows the user to integrate DNP3 devices over a secure link into a Rockwell Logix platform (for example, ControlLogix or CompactLogix) with minimal effort.

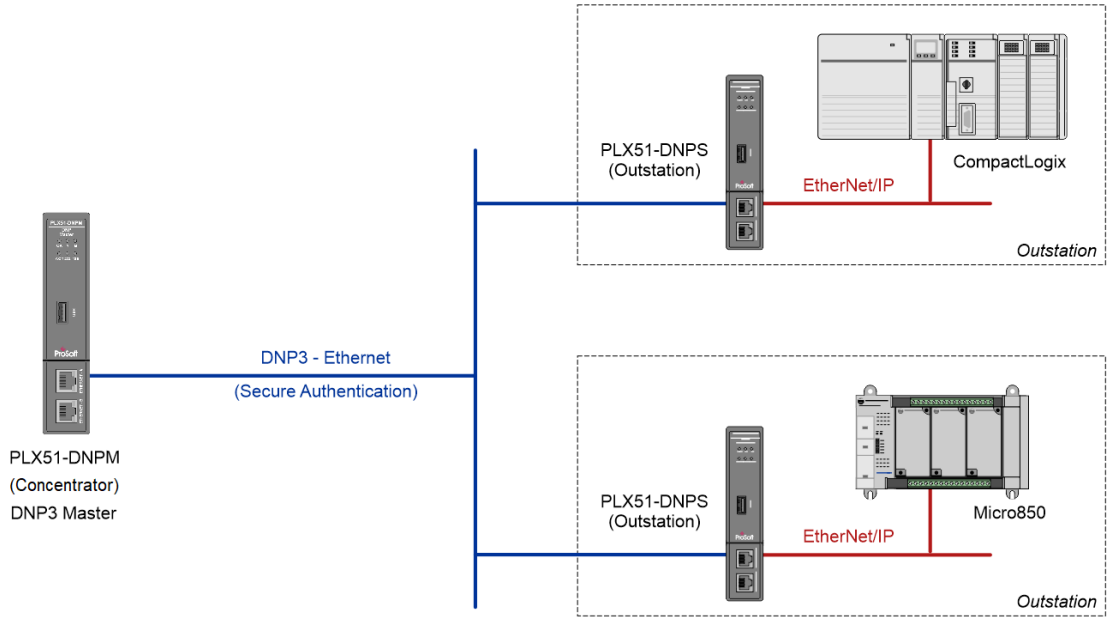


Figure 1.1. – Typical Setup

1.2 Features

The PLX51-DNPM is able to transfer data from various DNP3 devices to a maximum of three Logix controllers when using EtherNet/IP. The module operates in one of three modes, simplifying the configuration for all applications.

Mode	Description	Message Initiator
Master	The PLX51-DNPM transfers data between a DNP3 device and a number of Logix tags or Modbus registers, using a preconfigured schedule.	PLX51-DNPM
Concentrator	In this mode the PLX51-DNPM is both a DNP3 Master and an Outstation. The module collects data from the configured Outstations and exchanges that with another Master. The object indexes are remapped as required.	Remote Master & PLX51-DNPM
Unscheduled	The PLX51-DNPM transfers messages received from a Logix Message Instruction (DNP3 Master).	Logix (Msg)

Table 1.1. – Modes of Operation

The PLX51-DNPM is configured using the ProSoft Technology PLX50 Configuration Utility. This software can be downloaded free of charge. The PLX50 Configuration Utility offers various configuration methods, including a controller tag browser.

In this document the PLX51-DNPM is also referred to as the **module**.

When the ***Operating Interface*** is configured for EtherNet/IP, the module can operate in both a Logix "owned" and standalone mode. With a Logix connection the input and output assemblies will provide additional diagnostics information which will be available in the Logix controller environment.

The PLX51-DNPM allows the user to integrate DNP3 devices into a Logix system with minimal effort. No copying or mapping of data in the Logix controller is required as the PLX51-DNPM writes directly into Logix tags.

When the ***Operating Interface*** is configured for one of the Modbus options the module can exchange DNP3 data with any Modbus device, operating in either a Modbus Master or Modbus Slave capacity.

The PLX51-DNPM module also provides DNP3 Secure Authentication 5 which enables the user to connect DNP3 devices to a Logix platform securely. The module also provides a range of diagnostics, statistics and a DNP3 traffic analyzer to assist with fault-finding.

The PLX51-DNPM supports DNP3 on three ports which can be configured from the PLX50 Configuration Utility: RS232, RS485 and Ethernet (TCP or UDP).

Previously complicated data mapping is made easy by precompiled UDTs that convert the various DNP3 data formats into meaningful data in the Logix environment.

The module's serial ports (both RS232 and RS485) are electrically isolated providing better noise immunity. Their connections use a terminal block for convenient installation.

A built-in webserver provides detailed diagnostics of system configuration and operation, including the display of DNP3 operation and communication statistics, without the need for any additional software.

1.3 Architecture

The figure below provides an example of the typical network setup in ***Master*** mode.

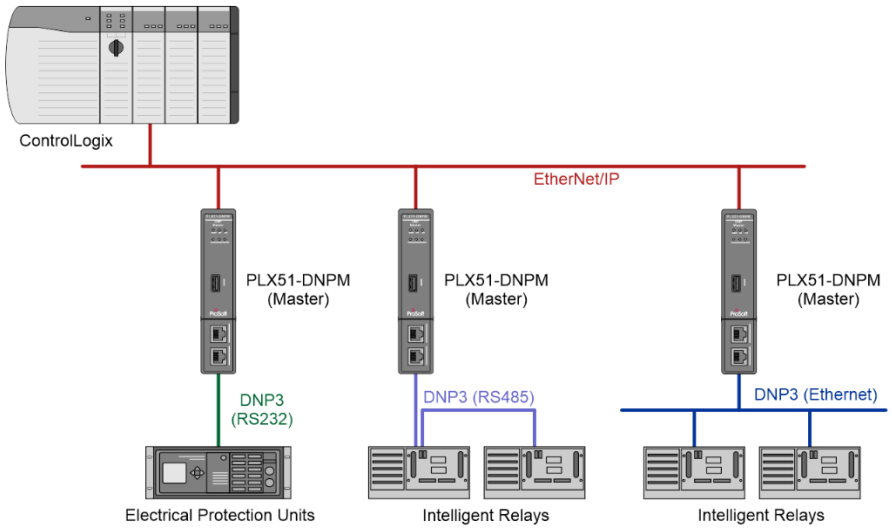


Figure 1.2. - Example of a typical network setup in Master mode

Systems that rely on a central ControlLogix communicating to a number of remote DNP3 devices, (for example, Electrical Protection Units or Intelligent Relays), may find the PLX51-DNPM useful as shown in the image above. The module will exchange data between the DNP3 device and Logix platform at a configured interval without any need for additional coding or mapping.

When operating as a DNP3 Concentrator, the PLX51-DNPM collects data from multiple DNP3 outstations, remaps their DNP3 object indexes and makes this data available to another DNP3 master. The underlying outstations thus appear as a single outstation to the remote DNP3 master. An example of this is illustrated in the figure below.

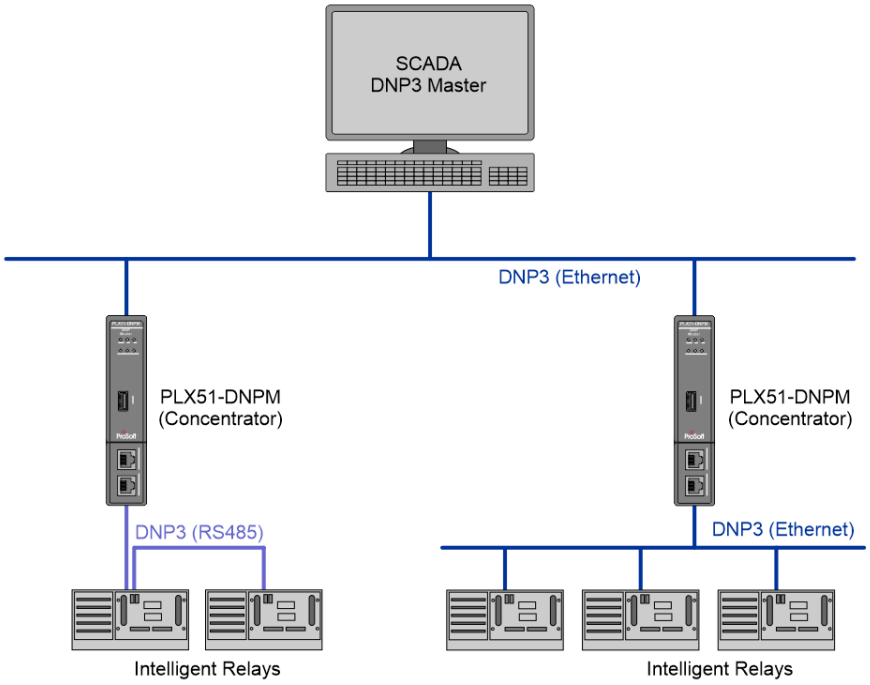


Figure 1.3. – Example of a typical network setup when using Concentrator mode

The PLX51-DNPM provides the latest DNP3 Secure Authentication 5 standard which allows for secure authentication across the DNP3 network (Serial or Ethernet). The need for network security is essential to utility installations and operations to prevent unwanted attacks from outsiders. The PLX51-DNPM allows the user to configure the type and level of security needed with minimal effort.

1.4 Additional Information

The following documents contain additional information that can assist the user with the module installation and operation.

Resource	Link
PLX50 Configuration Utility Installation	www.prosoft-technology.com
PLX51-DNPM User Manual PLX51-DNPM Datasheet Example Code & UDTs	www.prosoft-technology.com
Ethernet wiring standard	www.cisco.com/c/en/us/td/docs/video/cds/cde/cde205_220_420/installation/guide/cde205_220_420_hig/Connectors.html
CIP Routing	The CIP Networks Library, Volume 1, Appendix C:Data Management
DNP3	http://www.dnp.org

Table 1.2. - Additional Information

1.5 Support

Technical support is provided via the Web (in the form of user manuals, FAQ, datasheets etc.) to assist with installation, operation, and diagnostics.

For additional support, use either of the following:

Resource	Link
Contact Us link	www.prosoft-technology.com
Support email	ps.support@belden.com

Table 1.3. – Support Details

2 Installation

2.1 Module Layout

The PLX51-DNPM module has two Ethernet ports located at the lower front of the module. The Ethernet cable must be wired according to industry standards which can be found in the "Additional Information" section.

There are also two ports at the bottom of the module for Power and Serial communication (RS232 and RS485).

The power port uses a three-way connector which is used for the DC power supply positive and negative (or ground) rails as well as the earth connection.

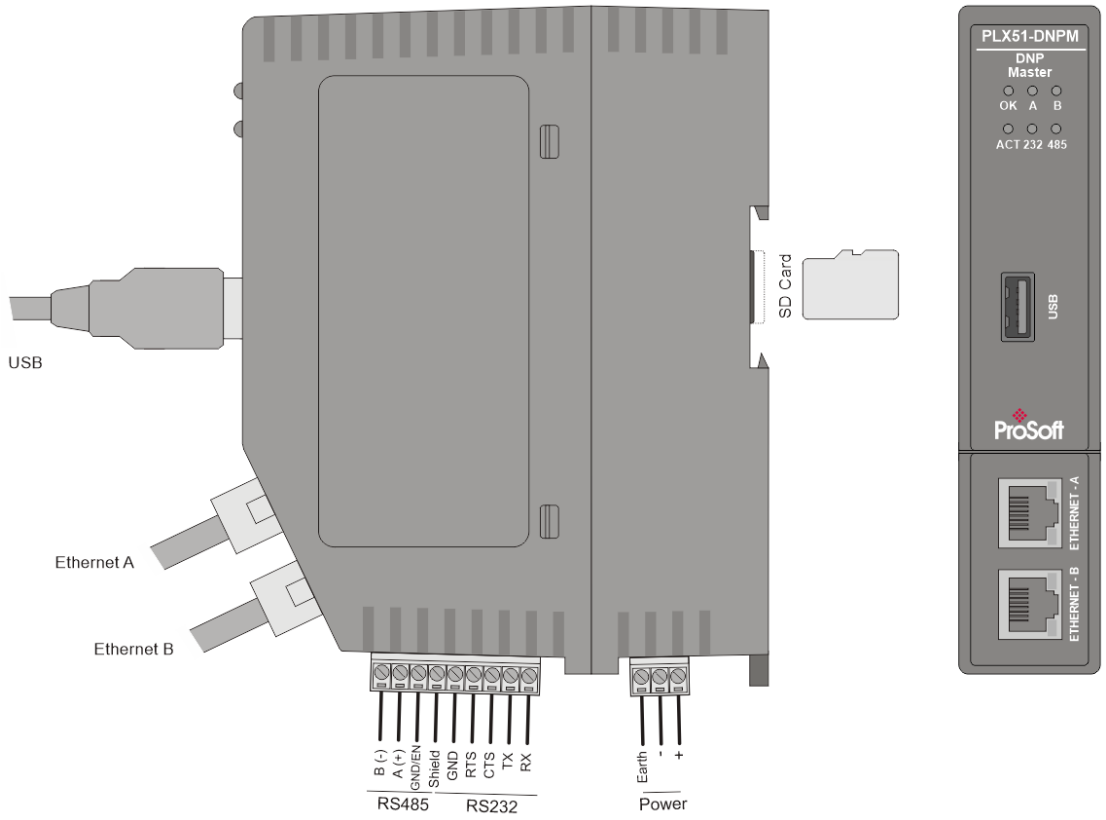


Figure 2.1 – PLX51-DNPM side and front view

The module provides six diagnostic LEDs as shown in the front view figure above. These LEDs are used to provide information regarding the module system operation, the Ethernet interface, and the auxiliary communication interface (RS232 or RS485).

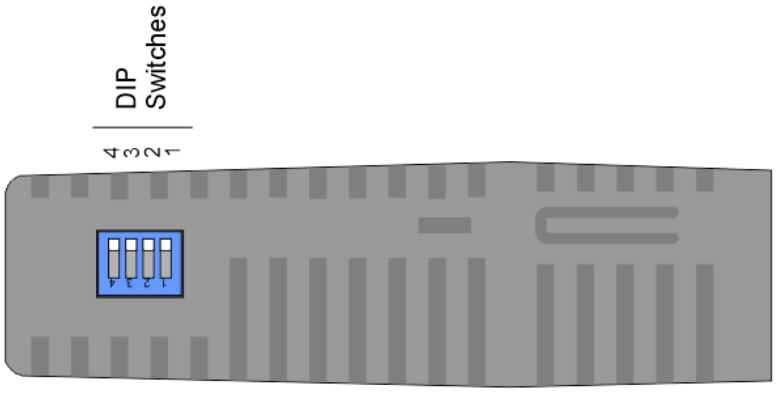


Figure 2.2 – PLX51-DNPM top view

The module provides four DIP switches at the top of the enclosure as shown in the top view figure above.

DIP Switch	Description
DIP Switch 1	Used to force the module into “Safe Mode.” When in “Safe Mode” the module will not load the application firmware and will wait for new firmware to be downloaded. This should only be used in the rare occasion when a firmware update was interrupted at a critical stage.
DIP Switch 2	This will force the module into DHCP mode, which is useful when the IP address of the module is unknown.
DIP Switch 3	This DIP Switch is used to lock the configuration from being overwritten by the PLX50 Configuration Utility.
DIP Switch 4	When this DIP Switch is set at bootup it will force the module Ethernet IP address to 192.168.1.100 and network mask 255.255.255.0. The user can then switch the DIP switch off and assign the module a static IP address if needed.

Table 2.1 - DIP Switch Settings

2.2 Module Mounting

The module provides a DIN rail clip to mount onto a 35mm DIN rail.

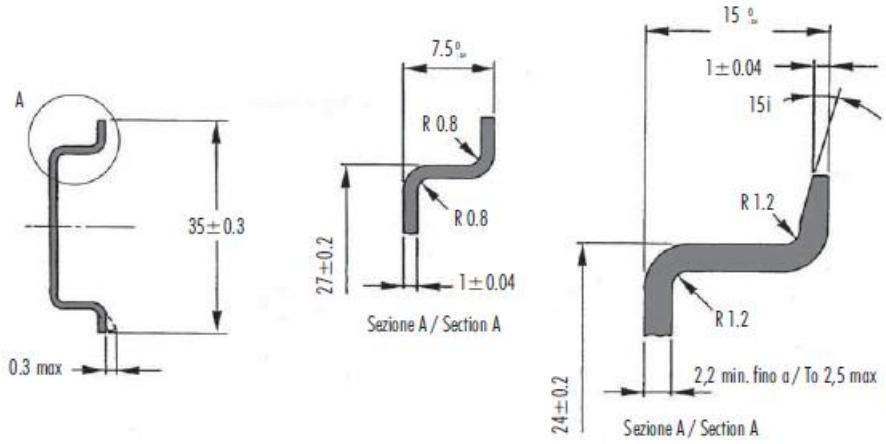


Figure 2.3 - DIN rail specification

The DIN rail clip is mounted on the bottom of the module at the back as shown in the figure below. Use a flat screwdriver to pull the clip downward. This will enable the user to mount the module onto the DIN rail. Once the module is mounted onto the DIN rail the clip must be pushed upwards to lock the module onto the DIN rail.

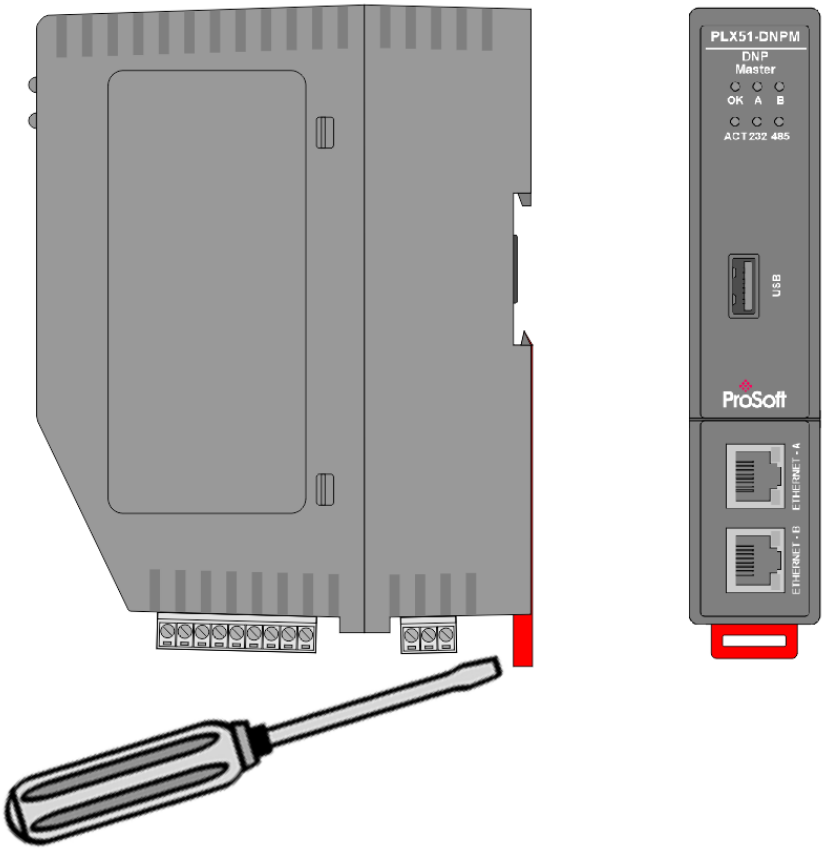


Figure 2.4 - DIN rail mouting

2.3 Power

A three-way power connector is used to connect Power+, Power– (GND), and earth. The module requires an input voltage of 10 – 32Vdc. Refer to the technical specifications section in this document.

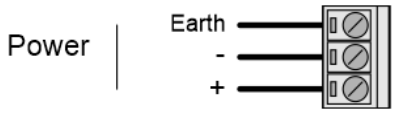


Figure 2.5 - Power connector

2.4 RS232/RS485 Port

The nine-way connector is used to connect the RS232 and RS485 conductors for serial communication. The shield terminal can be used for shielded cable in high noise environments.

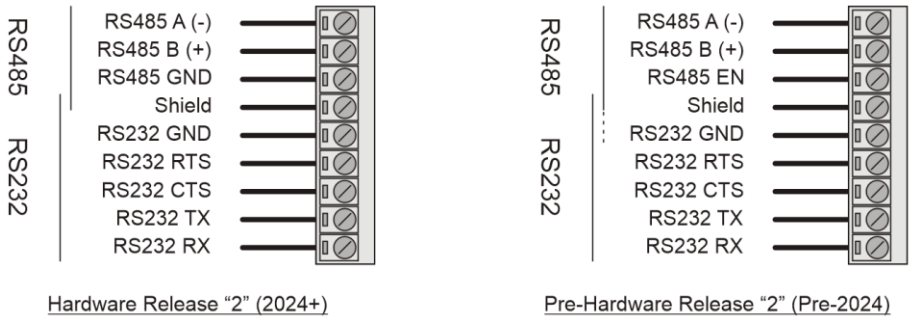


Figure 2.6 - RS232/RS485 connector

The RS485 port provides the standard A and B conductors.

The (RS485 EN/GND) conductor function depends on the hardware release:

- **Pre-Hardware Release "2"** – The (EN) transmit drive enable is provided to allow the PLX51-DNPM gateway to be used with repeaters and radios that may require a transmit enable line. (Note that the EN line is referenced to RS232 GND)
- **Post-Hardware Release "2"** - RS485 GND.

The RS232 port provides the standard communication conductors (RX, TX, and GND) as well as hardware handshaking lines for legacy systems (RTS – Request to Send, CTS – Clear to Send).

Both RS232 and RS485 share a common cable shield connection which should be connected to the shield of the outgoing cable (RS232 and/or RS485).

Important: The shield of the RS232/RS485 port is internally connected to the power connector earth. Thus, when using a shield, it is important to connect the Earth terminal on the power connector to a clean earth. Failing to do this can lower the signal quality of the RS232/RS485 communication.

Important: When using a shielded cable, it is important that only one end of the shield is connected to earth to avoid current loops. It is recommended to connect the shield to the PLX51-DNPM gateway, and not to the other DNP device.

2.5 RS485 Termination

All RS485 networks are required to be terminated at the extremities (start and end point) of the communication conductor. The termination for the RS485 network can be enabled or disabled via the module configuration. Enabling the termination will connect an internal 150 Ohm resistor across the positive (+) and negative (-) conductors of the RS485 network.

2.6 Ethernet Ports

The Ethernet connectors should be wired according to industry standards. Refer to the additional information section in this document for further details.

The module has an embedded switch connecting the two Ethernet ports.

2.7 USB Port

The module supports USB2.0 on its USB port and will operate as a USB Host device. A USB Type-A connector is required on the DNP module side and generally a USB Type-B connector on the device side (i.e. Logix Controller).

Note: The USB interface can only be used with Logix Controllers that have a USB port. The module cannot route (via USB) across the backplane from another module (for example. EN2T) to a Logix controller.



Figure 2.7 – USB 2.0 Type-A to USB Type-B cable

3 Setup

3.1 Install Configuration Software

All the network setup and configuration of the module is achieved by means of the ProSoft PLX50 Configuration Utility. This software can be downloaded from:

www.prosoft-technology.com



Figure 3.1. - ProSoft Technology PLX50 Configuration Utility Software

3.2 Network Parameters

The module will have Dynamic Host Configuration Protocol (DHCP) enabled as factory default. A DHCP server must be used to provide the module with the required network parameters (IP address, subnet mask, etc.). There are a number of DHCP utilities available. However, it is recommended that the DHCP server in the PLX50 Configuration Utility be used.

Within the PLX50 Configuration Utility environment, the ***DHCP Server*** can be found under the ***Tools*** menu.

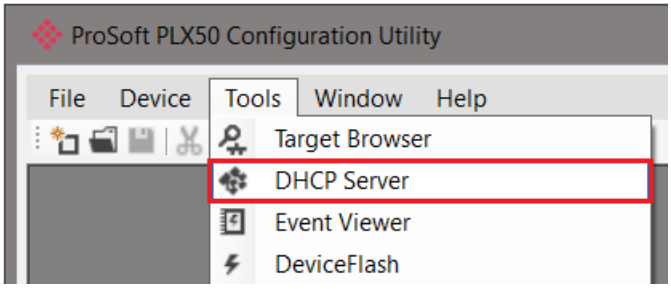


Figure 3.2. - Selecting DHCP Server

Once opened, the DHCP server will listen on all available network adapters for DHCP requests and display their corresponding MAC addresses.

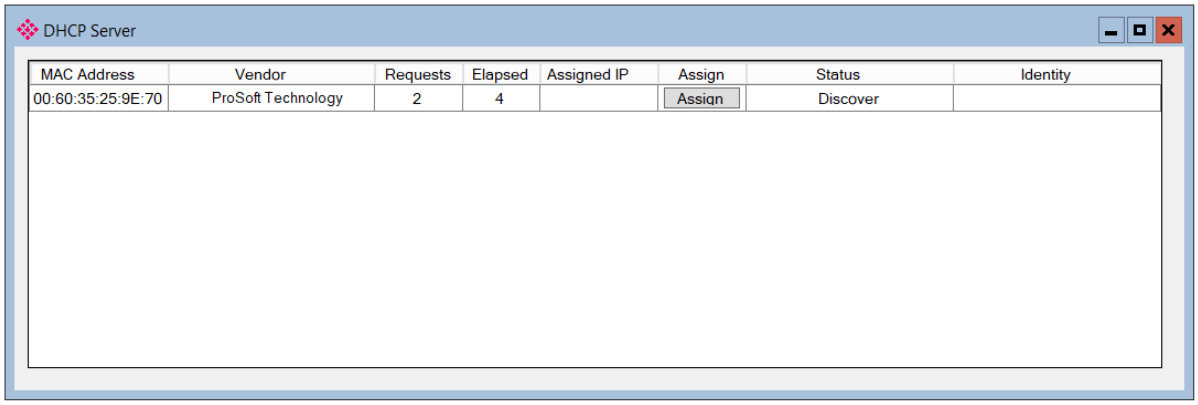


Figure 3.3. - DHCP Server

Note: If the DHCP requests are not displayed in the DHCP Server it may be due to the local PC's firewall. During installation the necessary firewall rules are automatically created for the Windows firewall. Another possibility is that another DHCP Server is operational on the network, and it has assigned the IP address.

To assign an IP address, click on the corresponding **ASSIGN** button. The *Assign IP Address for MAC* window will open.

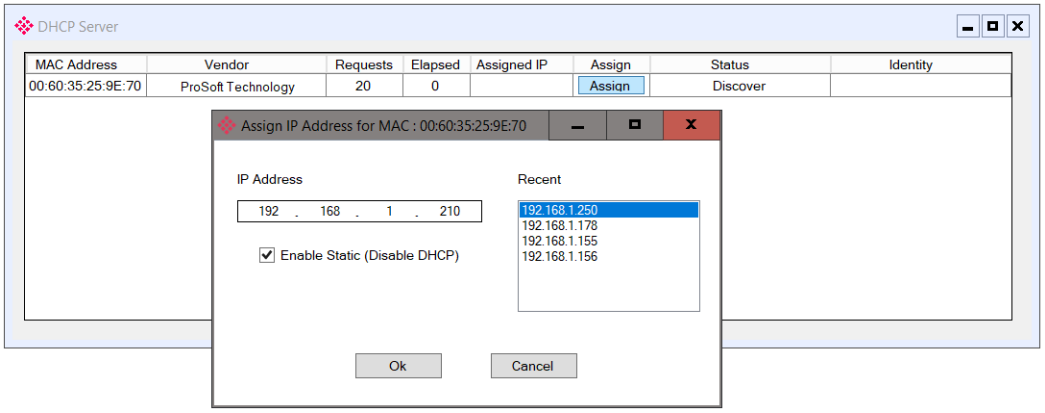


Figure 3.4. - Assigning IP Address

The required IP address can then be either entered, or a recently used IP address can be selected by clicking on an item in the Recent List.

If the **ENABLE STATIC** checkbox is checked, then the IP address will be set to static after the IP assignment, thereby disabling future DHCP requests.

Once the IP address window has been accepted, the DHCP server will automatically assign the IP address to the module and then read the Identity object Product name from the device.

The successful assignment of the IP address by the device is indicated by the green background of the associated row.

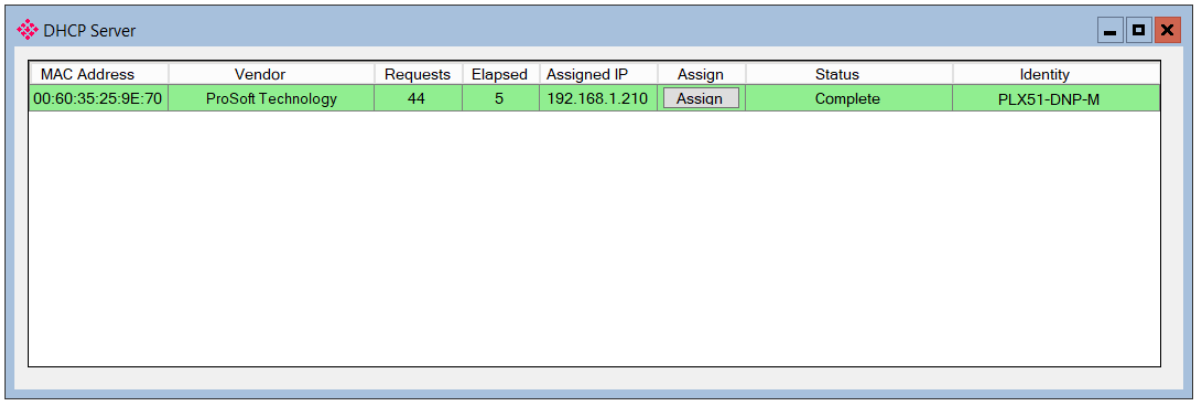


Figure 3.5. - Successful IP address assignment

It is possible to force the module back into DHCP mode by powering up the device with DIP switch 2 set to the On position.

A new IP address can then be assigned by repeating the previous steps.

Important: It is important to return DIP switch 2 back to the Off position, to avoid the module returning to a DHCP mode after the power is cycled again.

In addition to the setting the IP address, a number of other network parameters can be set during the DHCP process. These settings can be viewed and edited in PLX50 Configuration Utility's Application Settings, in the **DHCP SERVER** tab.

Once the DHCP process has been completed, the network settings can be set using the Ethernet Port Configuration via the Target Browser.

To access the Target Browser, select **TARGET BROWSER** under the **TOOLS** menu.

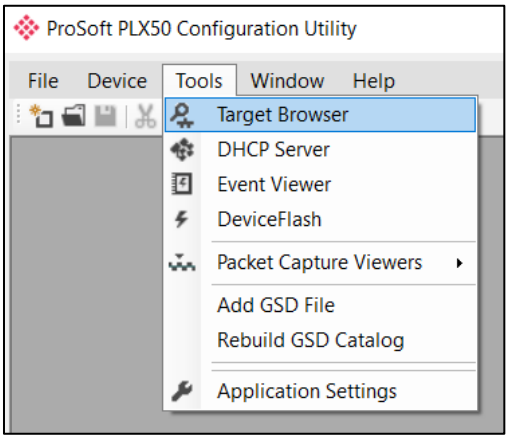


Figure 3.6. - Selecting the Target Browser

The Target Browser automatically scans the Ethernet network for EtherNet/IP devices.

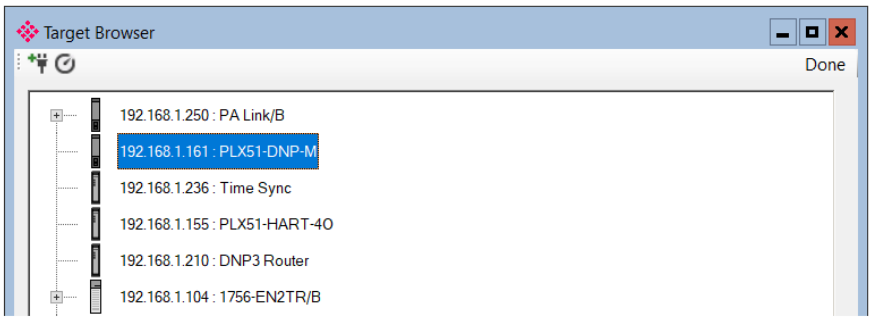


Figure 3.7. - Target Browser

Right-clicking on a device, reveals the context menu, including the **PORT CONFIGURATION** option.

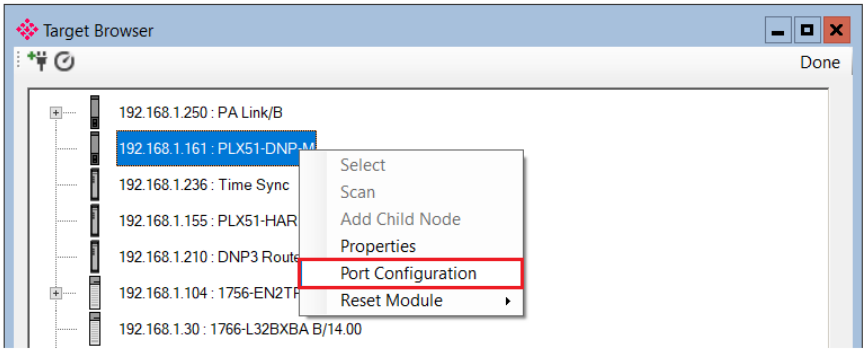


Figure 3.8. - Selecting Port Configuration

All the relevant Ethernet port configuration parameters can be modified using the *Port Configuration* window.

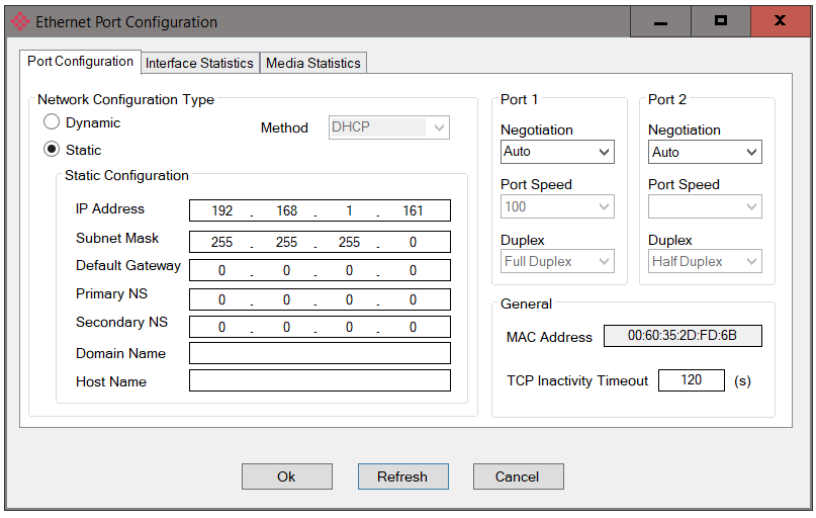


Figure 3.9. - Port Configuration

Alternatively, these parameters can be modified using Rockwell Automation's RSLinx software.

3.3 Creating a New Project

1 Before the user can configure the module, a new PLX50 Configuration Utility project must be created. Under the **FILE** menu, select **NEW**.

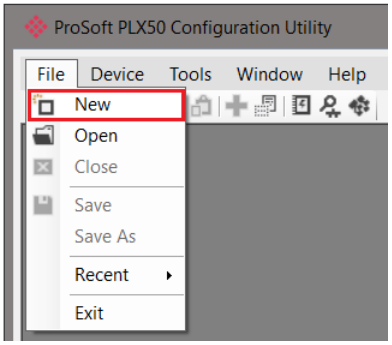


Figure 3.10. - Creating a new project

2 A PLX50 Configuration Utility project will be created, showing the *Project Explorer* tree view. To save the project, use the **SAVE** option under the **FILE** menu.

3 A new device can now be added by selecting **ADD** under the **DEVICE** menu.

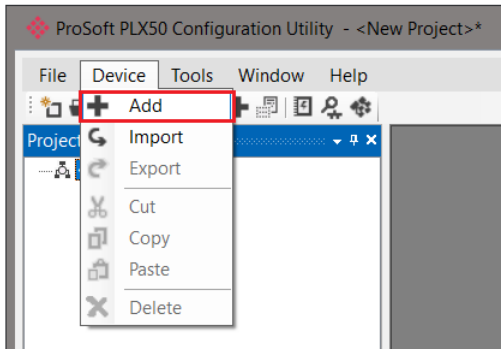


Figure 3.11. - Adding a new device

4 In the *Add New Device* window, select **PLX51-DNPM**, and click the **OK** button.

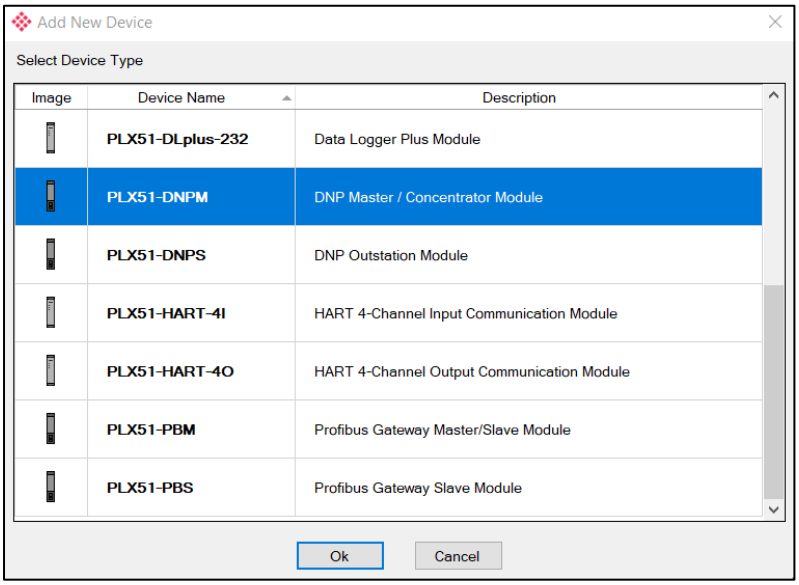


Figure 3.12 – Selecting a new PLX51-DNPM module

5 The device will appear in the ***Project Explorer*** tree as shown below, and its configuration window opened.

6 The device configuration window can be reopened by either double-clicking the module in the Project Explorer tree or right-clicking the module and selecting **CONFIGURATION**.

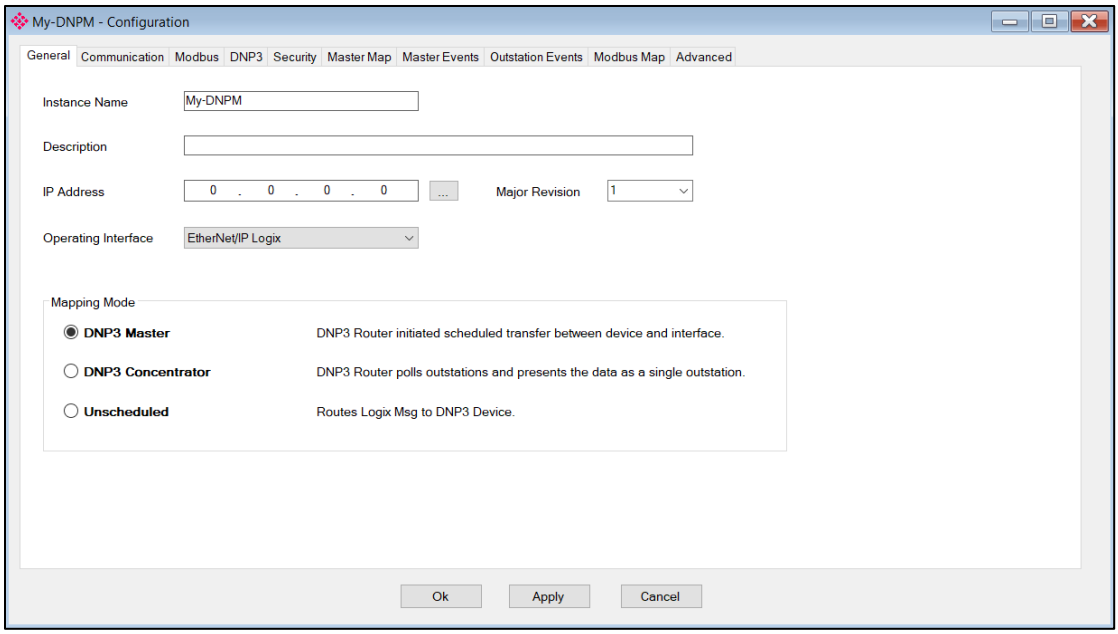


Figure 3.13. – PLX51-DNPM configuration

3.4 PLX51-DNPM Configuration

The PLX51-DNPM is configured by means of the PLX50 Configuration Utility. Refer to the "Additional Information" section for documentation and installation links for ProSoft Technology PLX50 Configuration Utility.

The configuration consists of multiple configuration tabs. When downloading this configuration into the module, it will be saved in non-volatile memory that persists when the module is powered down.

Important: When a firmware upgrade is performed, the module will clear all DNP3 configuration and routing maps.

3.4.1 General

The general configuration is shown in the figure below. The general configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

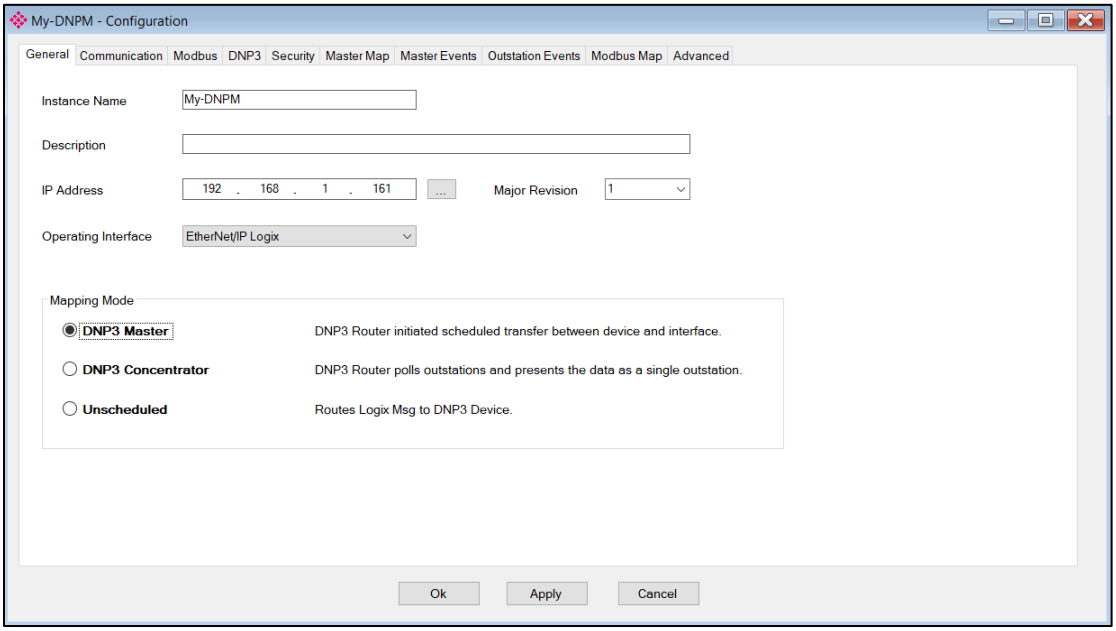


Figure 3.14. - General Configuration

The general configuration consists of the following parameters:

Parameter	Description
Instance Name	This parameter is a user defined name to identify between various PLX51-DNPM modules.
Description	This parameter is used to provide a more detail description of the application for the module.
IP Address	The IP address of the module.
Major Revision	The major revision of the module
Operating Interface	This is the network the PLX51-DNPM will interface with the DNP3 network. ▪ EtherNet/IP Logix ▪ CIP USB Logix **Note:** CIP USB can only be used on Logix Controllers with USB Ports. The module cannot route via USB from another module (for example, EN2T) to a Logix controller. ▪ Modbus TCP Master ▪ Modbus RTU Master – RS232 ▪ Modbus RTU Master – RS485 ▪ Modbus TCP Slave ▪ Modbus RTU Slave – RS232 ▪ Modbus RTU Slave – RS485 This parameter is not used in Concentrator Mode.
Mapping Mode	The mapping mode will determine how the DNP3 messages are routed. In **Master mode**, the PLX51-DNPM will initiate the exchange between the remote DNP3 device and the Operating Interface. Either by reading data from a DNP3 device and writing it into a preconfigured Logix tag or Modbus address or vice versa. DNP3 communication in this mode is initiated by the PLX51-DNPM. In **Concentrator mode** the PLX51-DNPM collects data from multiple DNP3 outstations, remaps their DNP3 object indexes and makes this data available to another DNP3 master. The underlying outstations thus appear as a single outstation to the remote DNP3 master. An example of this is illustrated in the figure below. In **Unscheduled mode** the PLX51-DNPM routes Logix messages to the remote DNP3 device and returns the result. There is little configuration required in the PLX51-DNPM as the routing information is configured by Logix for each message transaction. DNP3 communication in this mode is initiated by Logix. Refer to the "Message Routing" section for a detailed explanation of the routing operation.

Table 3.1 - General configuration parameters

3.4.2 Communication

The communication configuration is shown in the figure below.

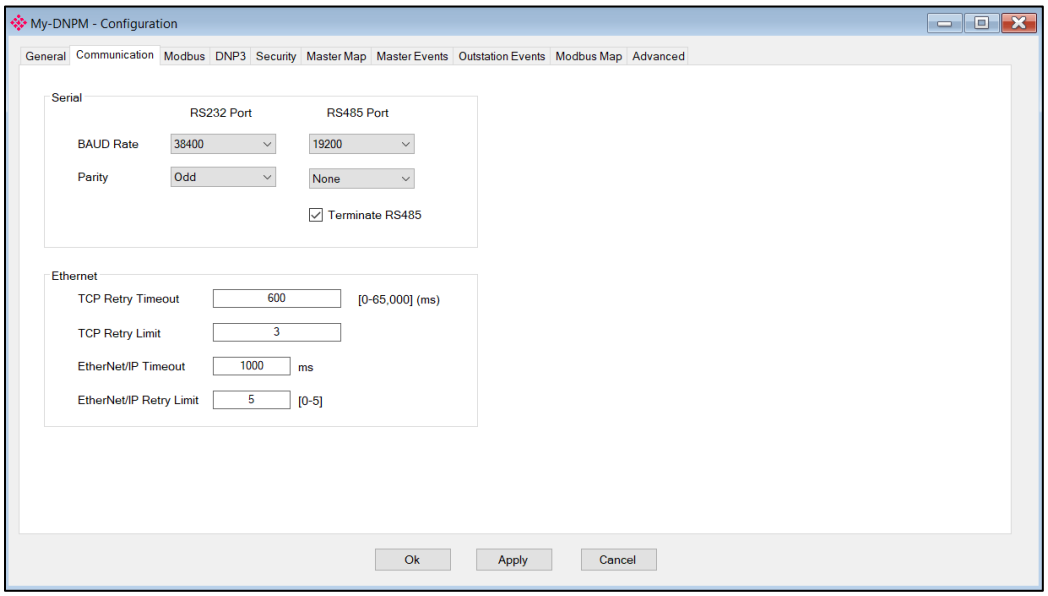


Figure 3.15. - Communication Configuration

The communication configuration consists of the following parameters:

Parameter	Description
RS232 Port	
BAUD Rate	BAUD Rate for the RS232 serial communication (DNP3 / Modbus-RTU). **Note:** When a baud rate below 9600 has been set (for either DNP3 or Modbus), the user will need to increase the timeout or response timeout for the specific protocol (for example, DNP3 or Modbus) in the PLX50CU. It is recommended to set the timeout to 2000+ms for any baud rate below 9600 bps.
Parity	Parity setting for the RS232 serial communication (DNP3 / Modbus-RTU).
RS485 Port	
BAUD Rate	BAUD Rate for the RS485 serial communication (DNP3 / Modbus-RTU). **Note:** When a baud rate below 9600 has been set (for either DNP3 or Modbus), the user will need to increase the timeout or response timeout for the specific protocol (for example, DNP3 or Modbus) in the PLX50CU. It is recommended to set the timeout to 2000+ms for any baud rate below 9600 bps.
Parity	Parity setting for the RS485 serial communication (DNP3 / Modbus-RTU).
Terminate RS485	Enables the on-board 124Ω RS485 terminating resistor.
Ethernet	
TCP Retry Timeout	If the PLX51-DNPM (with Protocol TCP) has sent a request or a response to another node and no TCP ACK has been received after the retry timeout, then the TCP layer will be sent again.
TCP Retry Limit	This parameter is the number of TCP retries that will be sent before the response is flagged as failed.
EtherNet/IP Retry Timeout	The timeout is used to determine the interval between retries when an EtherNet/IP message exchange has failed.

EtherNet/IP Retry Limit	The retry limit determines how many times the module must retry the EtherNet/IP message exchange before failing it.

Table 3.2 - Communication configuration parameters

Note: In bad communication areas or applications, the TCP retry (when using TCP protocol) can help with responses that are lost due to intermittent communication.

Note: The module supports 8 data bits and 1 stop bit.

3.4.3 Modbus

The Modbus configuration is shown in the figure below.

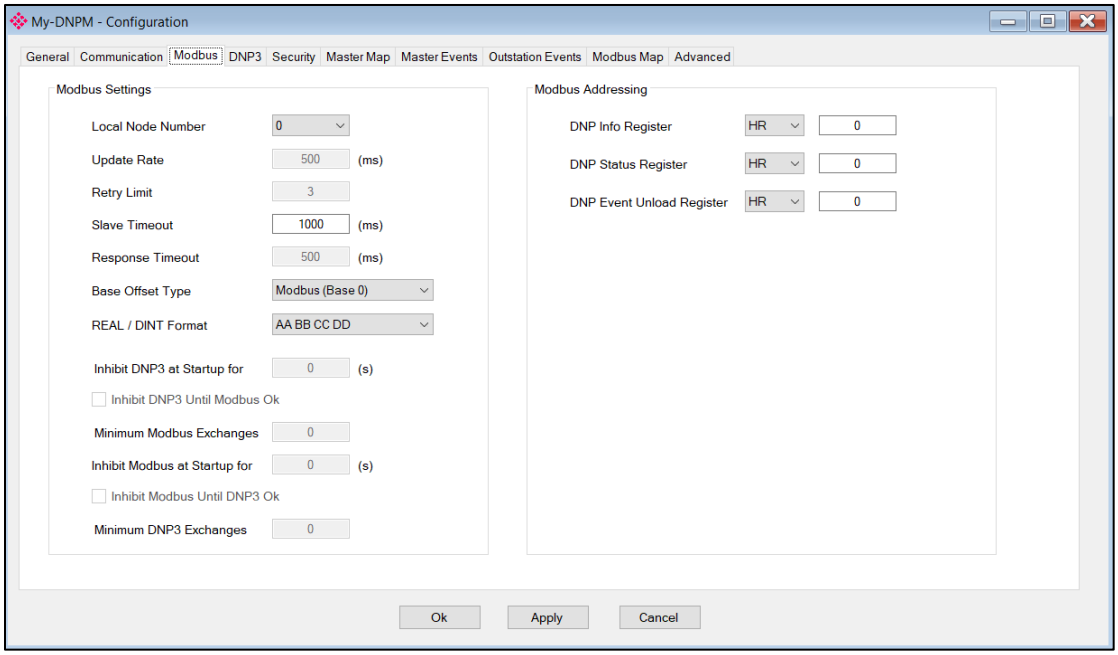


Figure 3.16. - Modbus Configuration

The Modbus configuration consists of the following parameters:

Parameter	Description
Modbus Settings	
Local Node Number	The Modbus Node Number that will be used by the PLX51-DNPM.
Update Rate	The period (in milliseconds) between master requests to the target Modbus device. (Modbus Master only)
Retry Limit	The number of successive Modbus request retries (Modbus Master only)
Slave Timeout	The slave timeout time in milliseconds (Modbus Slave only).
Response Timeout	The time (in milliseconds) the module will wait for a Modbus response (Modbus Master only)
Base Offset Type	Base Address Offset Type Modbus (Base 0) – Conventional Modbus addressing where the first address is 0. PLC (Base 1) – PLC addressing, where the first address is 1.

REAL / DINT Format	For a Real (single floating point) number this setting shows the format of the data will be presented when using a Modbus Primary Interface. The format (byte re-ordering) options are as follows: AA BB CC DD BB AA DD CC DD CC BB AA CC DD AA BB
Inhibit DNP3 at Startup for	Reserved for Outstation mode.
Inhibit DNP3 Until Modbus Ok	Reserved for Outstation mode.
Minimum Modbus Exchanges	Reserved for Outstation mode.
Inhibit Modbus at Startup for	Reserved for Outstation mode.
Inhibit Modbus Until DNP3 Ok	Reserved for Outstation mode.
Minimum DNP3 Exchanges	Reserved for Outstation mode.
Modbus Addressing	
DNP Info Register	The Modbus Register for module Information. See the Modbus section for more information.
DNP Status Register	The Modbus Register for DNP3 Status. See the Modbus section for more information.
DNP Event Unload Register	The Modbus Register for DNP3 Event unloading index. See the Modbus section in the Events - Master section.

Table 3.3 - Modbus configuration parameters

3.4.4 DNP3 Configuration

The DNP3 configuration is shown in the figure below.

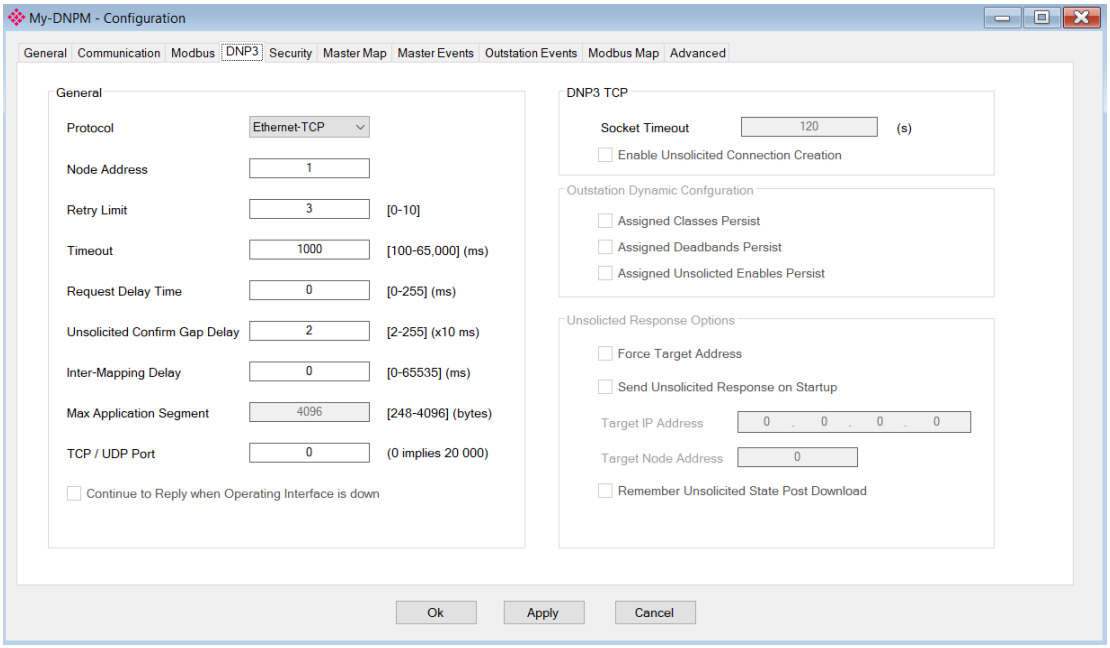


Figure 3.17. – DNP3 Configuration

The DNP3 configuration consists of the following parameters:

Parameter	Description
General	
Protocol	The PLX51-DNPM can interface with the DNP3 device(s) using any of the following protocols: ▪ Ethernet-TCP ▪ Ethernet-UDP ▪ Serial RS232 ▪ Serial RS485
Node Address	The node address is only configurable in Unscheduled mode. In all other modes, the node address is dynamically changed to suite the required mapping.
Retry Limit	The retry limit determines how many times the module must retry the message exchange before failing it.
Timeout	The timeout is used to determine the interval between retries when a message exchange has failed.
Request Delay Time	The reply message wait is the minimum delay before the DNP3 reply is transmitted to the DNP3 device.
Unsolicited Confirm Gap Delay	The amount of time the execution of the next scheduled mapped item is delayed after a confirm message has been sent to an Outstation. This is useful in low bandwidth network where repeaters are used, or unsolicited responses are received.
Inter-Mapping Delay	In Master mode, this is the time delay between executing consecutive mapped items. This is useful in low bandwidth network where repeaters are used, or unsolicited responses are received.

Max Application Segment	The maximum application segment size that will be sent per response. For example, if the DNP3 response is 1000 bytes in size and the application segment max is 500, then the PLX51-DNPM will send an application segment of 500 bytes and request a confirm. Once the confirm has been received from the DNP3 Master the next 500 bytes of application data will be sent.
TCP / UDP Port	The DNP3 TCP and UDP port numbers can be configured using this parameter. If the user enters 0, the port will default to the standard 20000 for DNP3.
Continue to Reply when Operating Interface is down	Reserved for Outstation mode.
DNP3 TCP (Outstation Mode only)	
Socket Timeout	When using DNP3 TCP, the user can set the timeout of the TCP socket. This will allow for unsolicited communication over the same TCP sockets from the DNP3 Master over an extended period of time. This value defaults to 120s.
Enable Unsolicited Connection Creation	When using DNP3 TCP, the module has the ability to create a TCP connection to the DNP3 master when unsolicited responses must be sent. This will allow for unsolicited communication without the need to worry about TCP socket timeouts. **Note:** Certain DNP3 Masters will not allow a DNP3 Outstation to create a TCP connection on the DNP3 Master.
Outstation Dynamic Configuration	
Assigned Classes Persist	Reserved for Outstation Mode.
Assigned Deadbands Persist	Reserved for Outstation Mode.
Assigned Unsolicited Enables Persist	Reserved for Outstation Mode.
*Unsolicited Response Options (**Outstation Only**)*	
(N/A) Force Target Address	This will force all unsolicited responses to be sent to a specific target address (which is set in the parameters below).
(N/A) Send Unsolicited Response at Startup	When this option is set, the module will send a wake up unsolicited response to the target address.
(N/A) Target IP Address	The IP Address of the target devices for unsolicited responses.
(N/A) Target Node Address	The DNP3 Node Address of the target devices for unsolicited responses.
(N/A) Remember Unsolicited State Post Download	Reserved for Outstation Mode.

Table 3.4 – DNP3 configuration parameters

Note: In bad communication areas or applications, it is recommended to set the Max Application Segment size lower. This will result in a higher probability of packets successfully arriving at the destination address because of the packet confirmation.

3.4.5 DNP3 Security

The DNP3 security configuration is shown in the figure below.

Note: The actual pre-shared key cannot be included in the configuration. It can only be written to the PLX51-DNPM module when online via the ***Status*** window.

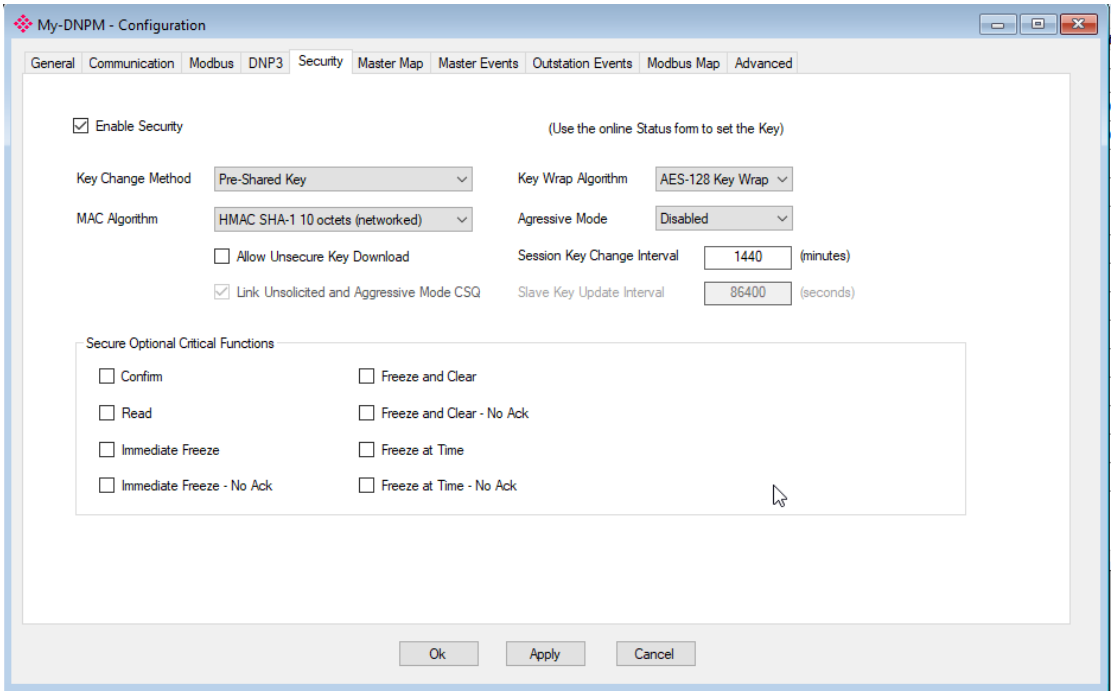


Figure 3.18 - Security configuration

The Security configuration consists of the following parameters:

Parameter	Description
Enable Security	DNP3 Secure Authentication can be enabled or disabled. When enabled there will be no exchange of data (for critical functions).
Key Change Method	This setting determines the method by which security keys are exchanged between two devices. The PLX51-DNPM supports only the Pre-Shared Key method. When using this method both devices need to have update keys entered by means outside the DNP3 protocol. **Note:** There are two options to be selected with the Key Change Method. **Pre-Shared Key** This is normal operation and the Update Keys will have to be changed locally for each PLX51-DNPM. **Pre-Shared Key – Allow Remote Update** This option allows the user to remotely change the update key over the DNP3 Network. See the Security section for more details regarding this.
MAC Algorithm	The MAC algorithm is used to encrypt the challenge data for secure authentication. DNP3 allows for various encryption standards in different formats to be used for secure authentication: ▪ HMAC SHA-1 encryption (4 octets – serial) – for legacy support ▪ HMAC SHA-1 encryption (8 octets – serial) ▪ HMAC SHA-1 encryption (10 octets – networked) ▪ HMAC SHA-256 encryption (8 octets – serial)

	▪ HMAC SHA-256 encryption (16 octets – networked) ▪ AES-GMAC (12 octets)
Key Wrap Algorithm	DNP3 uses various keys for secure authentication. The keys that are used for data exchange and called the session keys and these keys may be updated frequently. To exchange the session keys between two DNP3 devices the update key (refer to the Secure Authentication section for further detail) is used to encrypt the data and session keys before exchanging it between parties. DNP3 allows for two standards to encrypt the session keys: ▪ AES-128 Key Wrap ▪ AES-256 Key Wrap
Aggressive Mode	To reduce the bandwidth used for secure authentication, the user can select aggressive mode, which allows the message initiator to anticipate and provide the required authentication in the request message. Thus from a network point of view there is a two-message exchange for secure authentication compared to the normal four-message exchange for secure authentication.
Link Unsolicited and Aggressive Mode CSQ	Ensure that the Challenge Sequence Numbers (CSQ) of unsolicited requests and Aggressive Mode requests are the same.
Secure Optional Critical Functions	When secure authentication is enabled there are various mandatory and optional application functions that must be authenticated before data can be exchanged. The optional functions can be selected in the box. Mandatory functions (for example, Operate) are therefore not included in the options list.
Allow Unsecure Key Download	When this option is selected, the user will be able to change the Update and Transfer Keys (unsecure) using a Logix MSG instruction. See the "Security" section for more details regarding this.
Session Key Change Interval	This is the time (in minutes) when the PLX51-DNPM, in Master mode, is forced to update the session keys.
Slave Key Update Interval	N/A

Table 3.5 – Security configuration parameters

Note: For further information regarding the security settings, refer to the "Security" section.

3.4.6 Master Map

The Master Map configuration is shown below and is relevant only for the ***Master*** and ***Concentrator*** modes. The layout will differ depending on the selected Mode and Operating Interface selected.

See the "Message Routing" section for more details.

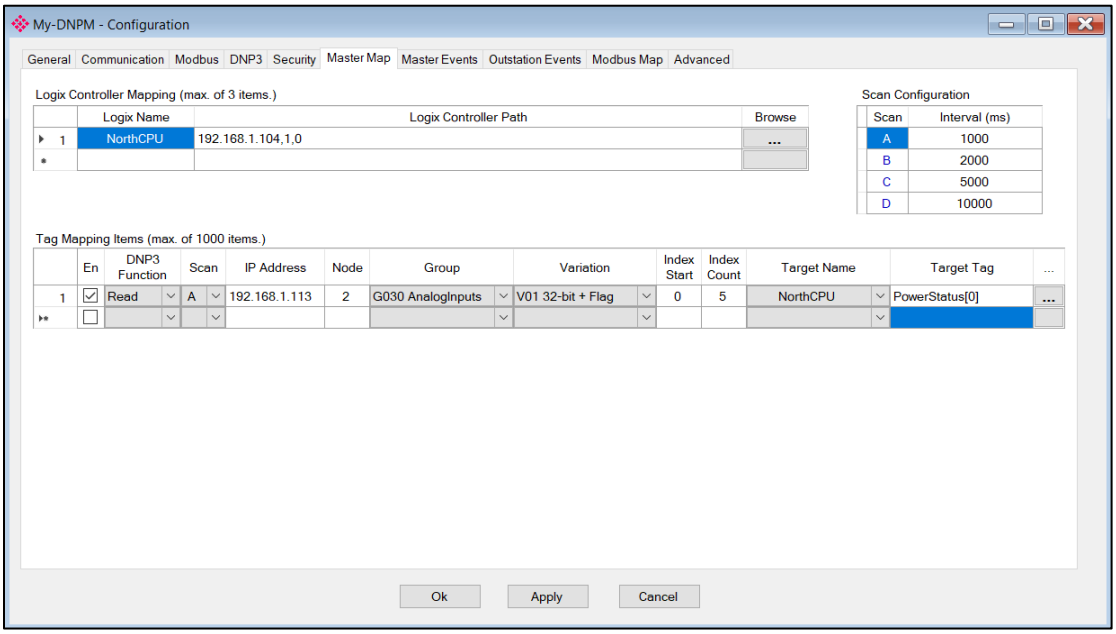


Figure 3.19 – Master Map configuration

Parameter	Description
Logix Controller Mapping (EtherNet/IP Only)	
Logix Name	Name of Logix Controller
Logix Controller Path	CIP Path to the Logix Controller
Scan Configuration	
Scan Class	Scan Class Group A, B, C or D
Interval	The interval or time (milliseconds) between successive scans.
Mapping Items	
En	Enable or Disable the mapped item.
DNP3 Function	The DNP3 Function: ▪ **Read** ▪ **Write** ▪ **Sel-Op** - Select Operate ▪ **Dir-Op** - Direct Operate ▪ **Dir-Op-NA** - Direct Operate with No Acknowledgement
Scan	Selected Scan Class, the interval at which the mapped item is executed.
IP Address	IP Address of the DNP3 Outstation target. (DNP3 TCP / UDP only)
Node	DNP3 Node Address of the Outstation target.
Group	DNP3 Group – See Appendix for valid DNP3 Groups
Variation	DNP3 Group Variation – See Appendix for valid DNP3 Group Variations
Index Start	DNP3 Object Start Index

Index Count	Number of DNP3 indexes (Object Count)
Target Name	Controller Target Name (EtherNet/IP Only)
Target Tag	Controller Tag name (EtherNet/IP Only)
Register Type	Modbus register type. ▪ **CS** – Coil Status ▪ **IS** – Input Status ▪ **IR** – Input Register ▪ **HR** – Holding Register
Modbus Offset	Starting Modbus address
Conc. Index	Concentrator Index. This is the re-mapped index that the remote DNP3 master will use to access these objects.

Table 3.6 – Master Map configuration parameters

3.4.7 Master Events Configuration

The ***Master Events*** configuration is shown in the figure below and is relevant only for the ***Master*** and ***Concentrator*** modes.

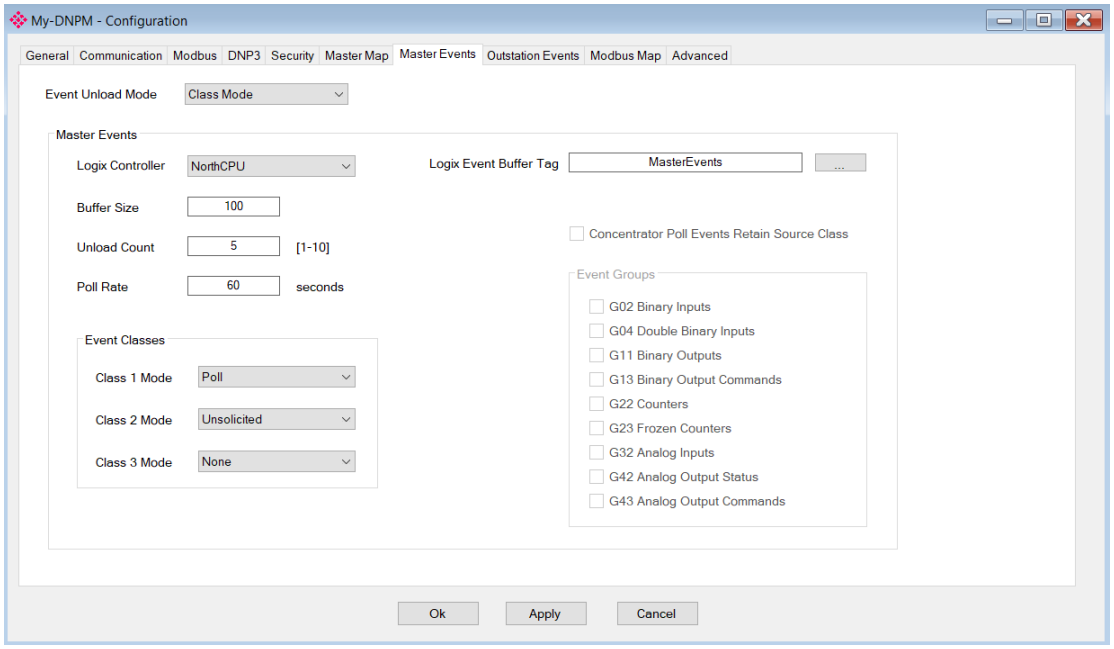


Figure 3.20 – Master Events configuration

The Master Events configuration consists of the following parameters:

Parameter	Description
Event Unload Mode	The PLX51-DNPM can unload Events from DNP3 Outstations in one of two ways: **Class Mode** Events will be unloaded by class (for example, class 1, 2, 3). Class mode supports both polled and unsolicited events. Selecting *Class Mode* for the Event Unload Mode will enable the Event Classes configuration on the setup form. **Group Mode** In this mode Events will be unloaded by group (for example, Group 32 Analog Inputs Events). Each group will be individually polled for new events for each Outstation. Unsolicited events are not supported in this mode. Selecting *Group Mode* for the Event Unload Mode will enable the Event Groups configuration on the setup form
Logix Controller	When the PLX51-DNPM (in Master mode) receives events (by polling or by unsolicited reporting) it will be unloaded into a Logix Event buffer array. The Logix Controller parameter is the controller selected from the Master Tag Map controller list which the PLX51-DNPM will use to update the events received.
Logix Event Buffer Tag	When the PLX51-DNPM (in Master mode) receives events (by polling or by unsolicited reporting) it will be unloaded into a Logix Event buffer array. The Logix Event Buffer Tag parameter is the Logix Tag selected from the selected Logix Controller which the PLX51-DNPM will use to update the events received. **Important:** This tag type must be an array of the buffer event UDT. See section DNP3 Events and Unsolicited Responses on page 100.
Buffer Size	The size of the Events Array defined in the Logix controller. **Important:** This value must not exceed the Logix controller tag array size. If this is the case the unloading of events to the Logix controller will not operate correctly.
Unload Count	This parameter is the maximum number of evens that will be uploaded per poll. This value is between 1 and 10.
Poll Rate	The rate (in seconds) at which the PLX51-DNPM polls for events from any of the classes (for example, Class 1) or groups (for example, Group 32 Analog Inputs).
Event Classes	When the Event Unload Mode is *Class Mode*, then the user can select how each event Class must operate. The following options are available: **None** This group will not be queried or allowed to unload events with unsolicited responses. **Poll** The event class will be polled for events at the poll rate. **Unsolicited** The PLX51-DNPM will enable Unsolicited Responses for that specific class for each DNP3 Outstation. This will allow the DNP3 Outstation to send new events as they are generated rather than being polled (reducing network traffic).
Event Groups	The groups are polled for events at the poll rate selected.

Concentrator Poll Events Retain Source Class	When the module is operating as a Data Concentrator, then the events received from a class event poll can either be saved as the class defined in the Outstation Events or retain the original class from the Outstation when being send to the DNP SCADA.

Table 3.7 – Master Events configuration parameters

Important: When the module is operating as a Data Concentrator, then the events received from a class event poll can either be saved as the class defined in the Outstation Event Groups or retain the original class from the Outstation when being sent to the DNP SCADA.

3.4.8 Modbus Map

The *Modbus Map* configuration is shown in the figure below. This table will be enabled when configured for Modbus Master. This will allow the user to read and/or write any internal PLX51-DNPM Modbus Register to any Modbus Slave. Up to 20 Modbus Slaves can be connected and up to 100 mapped items can be configured.

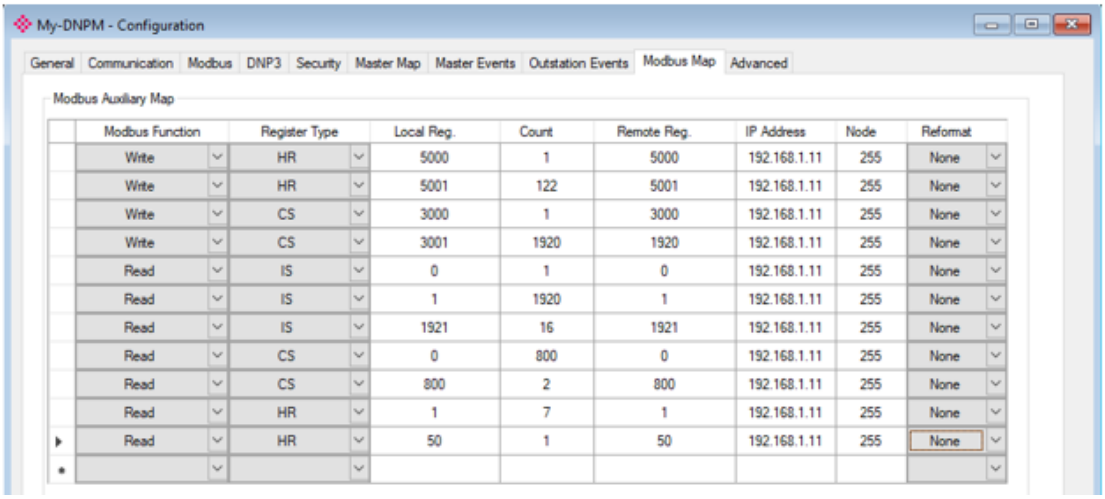


Figure 3.21 – PLX51-DNPM Modbus Auxiliary Map configuration

The Modbus Auxiliary Map configuration consists of the following parameters:

Parameter	Description
Modbus Function	This is the Modbus function used with the Modbus Slave. **Read** – Read a Modbus Register (eg. HR, IR, CS, or IS) from a Modbus Slave. **Write** – Write a Modbus Register (eg. HR or CS) to a Modbus Slave.
Register Type	Modbus Register Type: **CS** – Coil Status **IS** – Input Status **IR** – Input Register **HR** – Holding Register
Local Reg.	The local PLX51-DNPM Modbus address.
Count	The number of Modbus elements to read or write.
Remote Reg.	The remote slave Modbus address.
IP Address	The IP address of the remote Modbus TCP/IP slave.
Node	The Modbus Node address of the remote Modbus slave.
Reformat	How the data is formatted before reading or writing from/to the Modbus slave. **None** – No reformatting will be done. **BB AA** – 16bit Byte swap **BB AA DD CC** – 32bit Byte Swap **CC DD AA BB** – Word Swap **DD CC BB AA** – Word and Byte Swap

Table 3.8 - Modbus Auxiliary Map configuration parameters

3.4.9 Advanced

The Advanced configuration is shown in the figure below.

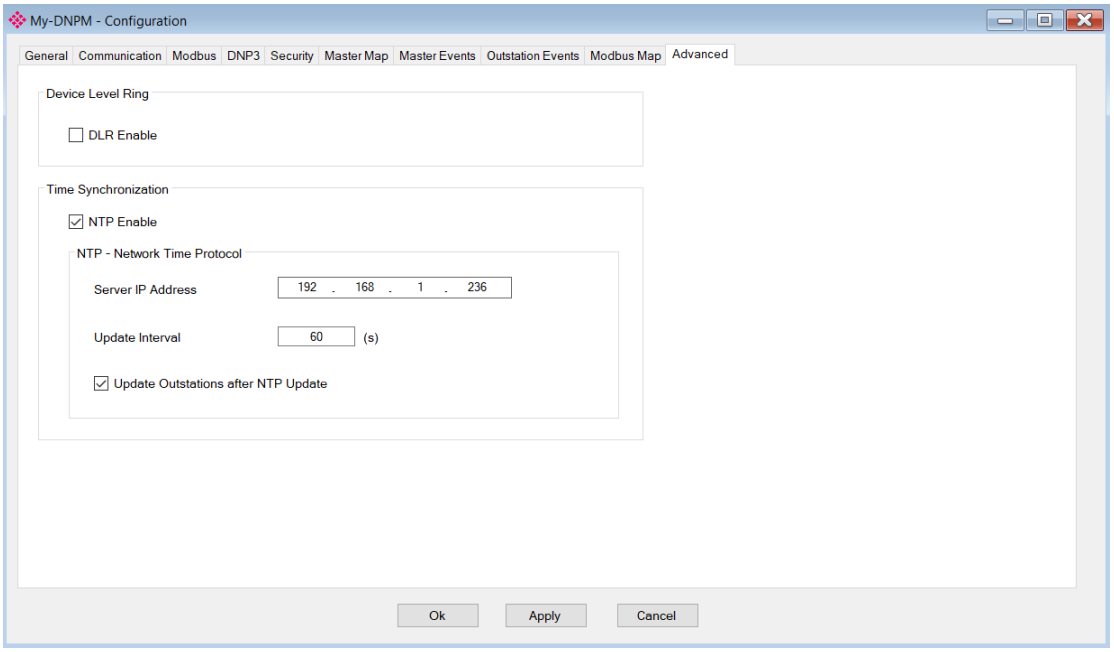


Figure 3.22 – Advanced configuration

The Advanced configuration consists of the following parameters:

Parameter	Description
DLR Enable	This must be set to enable Device Level Ring operation when the PLX51-DNPM will be operating in an Ethernet DLR.
NTP Enable	The PLX51-DNPM can synchronize its onboard clock to an NTP Server by enabling NTP.
NTP – Server IP Address	This setting is the IP address of the NTP Server which will be used as a time source.
NTP – Update Interval	This setting is the time interval (in seconds) that the PLX51-DNPM will use to request time from the NTP Server.
Update Outstations after NTP Update.	This will force the DNPM module to write the updated time received from the NTP server to all outstations, once the NTP response has been received.

Table 3.9 - Advanced configuration parameters

3.5 Message Routing

The module can be configured to route DNP3 data in one of three modes:

- Master mode
- Concentrator mode
- Unscheduled mode

3.5.1 Master Map

The Master mode transfers data between remote DNP3 devices and either Logix tags or Modbus registers. When in Master mode, the PLX51-DNPM initiates the DNP3 messaging.

If the ***Operating Interface*** is set to EtherNet/IP, then the module will transform the DNP3 reply into a tag read or write action to a Logix controller at a preconfigured path.

If the ***Operating Interface*** is set to CIP USB, then the module will transform the DNP3 message into a tag read or write action to a Logix controller using a USB connection.

Note: The PLX51-DNPM will need to be directly connected to the Logix controller USB port.

If the ***Operating Interface*** is set to Modbus, then the module will transform the DNP3 message reply into a Modbus register read or write function.

Master Mode with EtherNet/IP

In this mode the PLX51-DNPM module transfers data between a Logix controller and DNP3 devices without any configuration or programming required in either the DNP3 device or the Logix controller. The data will be exchanged at the interval configured in Scan Configuration.

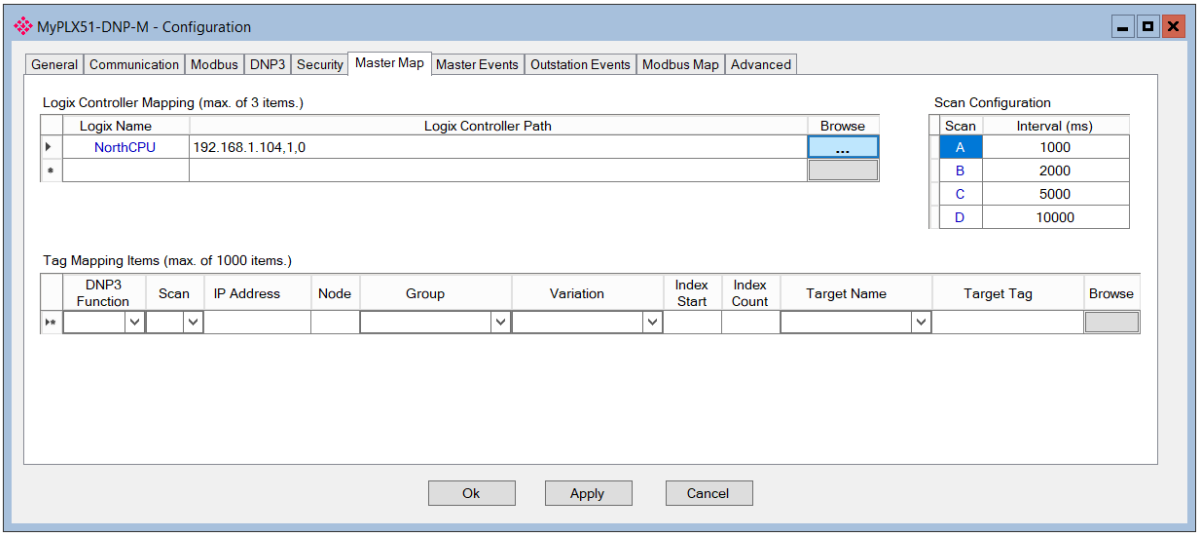


Figure 3.23 - Master configuration

The Master mode is configured in three steps. First the user must create a Target Name (CIP path to the destination Logix controller) which will be used to link the DNP3 group, variation, and range to the destination Logix tag.

The Logix controller paths can be either entered manually or browsed to them by clicking the ***Browse*** button. The ***Target Browser*** will open and automatically scan for all available EtherNet/IP devices.

If the Ethernet/IP module is a bridge module, it can be expanded to reveal the underlying backplane.

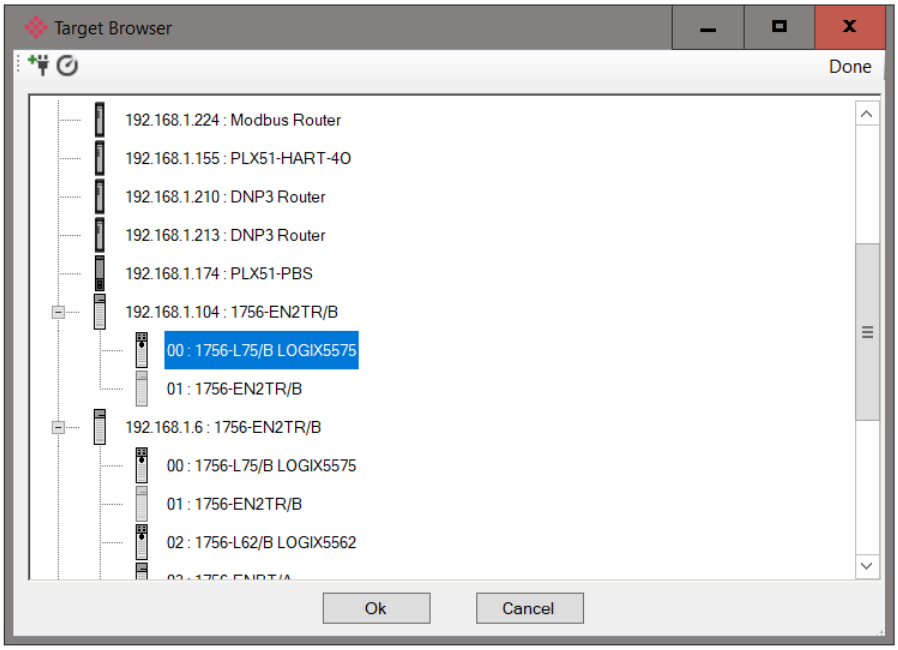


Figure 3.24 - Target Browser selection

The required Logix controller can then be chosen by selecting it and clicking the ***Ok*** button, or by double-clicking on the controller module.

A maximum number of 3 controller mapping entries can be added.

The second part of the Master mode setup is to configure the scan intervals. The scan intervals allow different data items to be transferred at different rates. There are 4 scan classes; A, B, C and D. The intervals for each can be adjusted by entering the scan time in milliseconds. The interval must be between 200 milliseconds and 60 seconds.

Scan Configuration

Scan	Interval (ms)
A	1000
B	2000
C	5000
D	10000

Figure 3.25 – Scan Configuration

The third part of the Master mode mapping setup is to configure the link between a DNP3 group, variation, and range combination to a Logix tag, and the associated action and scan required.

Tag Mapping Items (max. of 1000 items.)

	DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Target Name	Target Tag	Browse
▸	Read	A	1	G030 AnalogInputs	V05 Single Float + Flag	0	5	NorthCPU	VoltageInputs[0]	...
*										

Figure 3.26 – Master Tag Mapping

The Function field specifies whether the transaction will result in a read or write to the Logix controller tag.

Note: The PLX51-DNPM supports nine different DNP3 functions in Master mode. The Read function will translate into a Logix tag write.

The Scan field specifies at what rate the transaction will be executed. Select a scan class letter that matches the required interval. Care must be taken to select a realistic scan interval, taking into account the configured Baud rate and message size.

The IP address and Node is the remote device's IP address and node number. This field is hidden if DNP3 serial (RS232 or RS485) is selected.

Note: The IP address is only relevant if the protocol selected is either Ethernet TCP or Ethernet UDP. The Node address is relevant for both the previously mentioned Ethernet protocols as well as serial.

The DNP3 group and variation selected is that of the remote device. The user must ensure that the remote device supports both the selected group as well as the data format (variation). The range of data to be accessed from the remote device must also be specific. This is done by selecting a start index as well as the number of elements (index count).

One of the Target Names configured in the first step can be selected by means of the target Name combo box.

The Target Tag can be either entered manually or selected using the ***Tag Browser*** in PLX50 Configuration Utility. The Tag Browser requires the controller to be available on the network.

To browse to the tag, click on the ***Browse*** button. The ***Tag Browser*** will open and scan all the tags inside that controller. If the controller has been recently scanned in this PLX50 Configuration Utility session, then a cached version of the tags will be displayed. A rescan of the tags can be triggered by selecting the ***Refresh*** button in the ***Tag Browser***'s toolbar.

Only tags of a relevant type will be enabled, guiding the user to select a suitable tag.

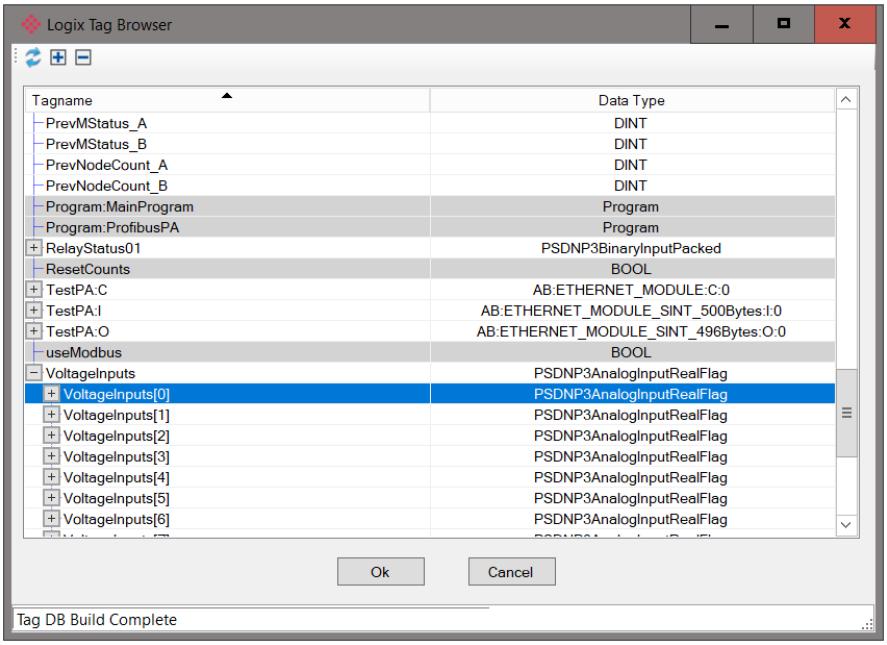


Figure 3.27 – Tag Browser tag selection

Important: Ensure that the Logix tag data type/UDT and size matches that of the DNP3 message requests. Failing to do this can cause unexpected results and communication faults. A list of recommended data types for each Group – Variant combination is listed in Appendix A.

Master Mode with CIP USB

In this mode the PLX51-DNPM module transfers data between a Logix controller and DNP3 devices without any configuration or programming required in either the DNP3 device or the Logix controller. The data will be exchanged at the interval configured in Scan Configuration.

Important: The PLX51-DNPM must be directly connected to the Logix controller (via USB) when the operating is set to CIP USB.

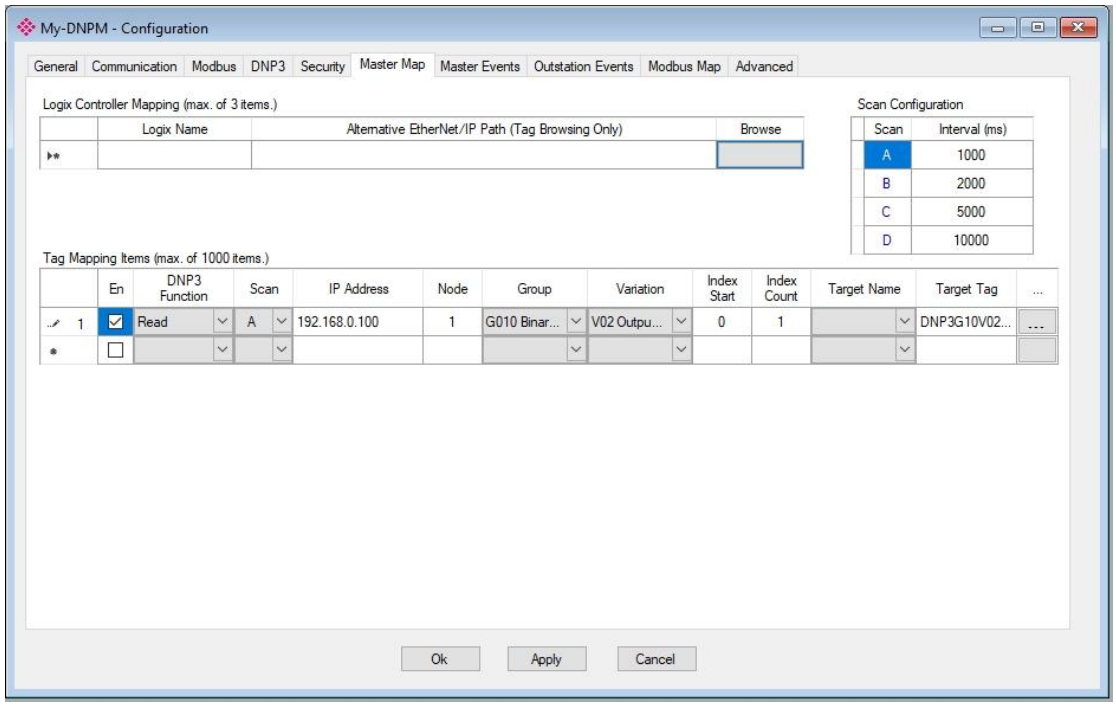


Figure 3.28 – Master configuration with CIP USB Logix

The Master mode is configured in three steps. First the user must create a **Target Name** (CIP path to the destination Logix controller). This will be used to allow the PLX50CU to browse the destination controller for tags to be used. It is **not used** by the PLX51-DNPM for message routing because the USB is directly connected.

Important: The user **does not** need to enter the Logix Controller path in the mapping, because the PLX51-DNPM is directly connected to the Logix Controller (via USB). The Logix Controller Path will **only** be used for browsing the tags of the Logix Controller when connected on the same network.

Important: The user will need to ensure that if a Controller is being scanned for tags, that the CIP Path entered is to the same Logix Controller directly connected to the PLX51-DNPM (via USB).

The Logix controller paths can be either entered manually or browsed to them by clicking the ***Browse*** button. The ***Target Browser*** will open and automatically scan for all available EtherNet/IP devices.

If the Ethernet/IP module is a bridge module, it can be expanded to reveal the underlying backplane.

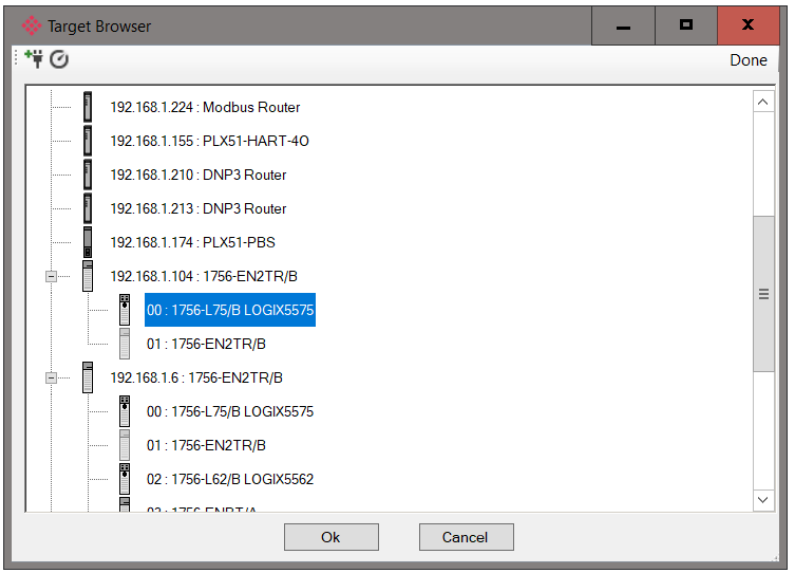


Figure 3.29 - Target Browser selection

Important: The PLX51-DNPM can only communicate with a **single** Logix Controller when the operating interface is set to CIP USB.

The second part of the Master mode setup is to configure the scan intervals. The scan intervals allow different data items to be transferred at different rates. There are 4 scan classes; A, B, C and D. The intervals for each can be adjusted by entering the scan time in milliseconds. The interval must be between 200 milliseconds and 60 seconds.

Scan Configuration

Scan	Interval (ms)
A	1000
B	2000
C	5000
D	10000

Figure 3.30 – Scan Configuration

The third part of the Master mode mapping setup is to configure the link between a DNP3 group, variation, and range combination to a Logix tag, and the associated action and scan required.

Tag Mapping Items (max. of 1000 items.)

DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Target Name	Target Tag	Browse
Read	A	1	G030 AnalogInputs	V05 Single Float + Flag	0	5	NorthCPU	VoltageInputs[0]	...

Figure 3.31 – Master Tag Mapping

The Function field specifies whether the transaction will result in a read or write to the Logix controller tag.

Note: The PLX51-DNPM supports nine different DNP3 functions in Master mode. The Read function will translate into a Logix tag write.

The Scan field specifies at what rate the transaction will be executed. Select a scan class letter that matches the required interval. Care must be taken to select a realistic scan interval, taking into account the configured Baud rate and message size.

The IP address and Node is the remote device's IP address and node number. This field is hidden if DNP3 serial (RS232 or RS485) is selected.

Note: The IP address is only relevant if the protocol selected is either Ethernet TCP or Ethernet UDP. The Node address is relevant for both the previously mentioned Ethernet protocols as well as serial.

The DNP3 group and variation selected is that of the remote device. The user must ensure that the remote device supports both the selected group as well as the data format (variation). The range of data to be accessed from the remote device must also be specific. This is done by selecting a start index as well as the number of elements (index count).

One of the Target Names configured in the first step can be selected by means of the target Name combo box.

The Target Tag can be either entered manually or selected using the ***Tag Browser*** in PLX50 Configuration Utility. The Tag Browser requires the controller to be available on the network.

To browse to the tag, click on the ***Browse*** button. The ***Tag Browser*** will open and scan all the tags inside that controller. If the controller has been recently scanned in this PLX50 Configuration Utility session, then a cached version of the tags will be displayed. A rescan of the tags can be triggered by selecting the ***Refresh*** button in the ***Tag Browser***'s toolbar.

Only tags of a relevant type will be enabled, guiding the user to select a suitable tag.

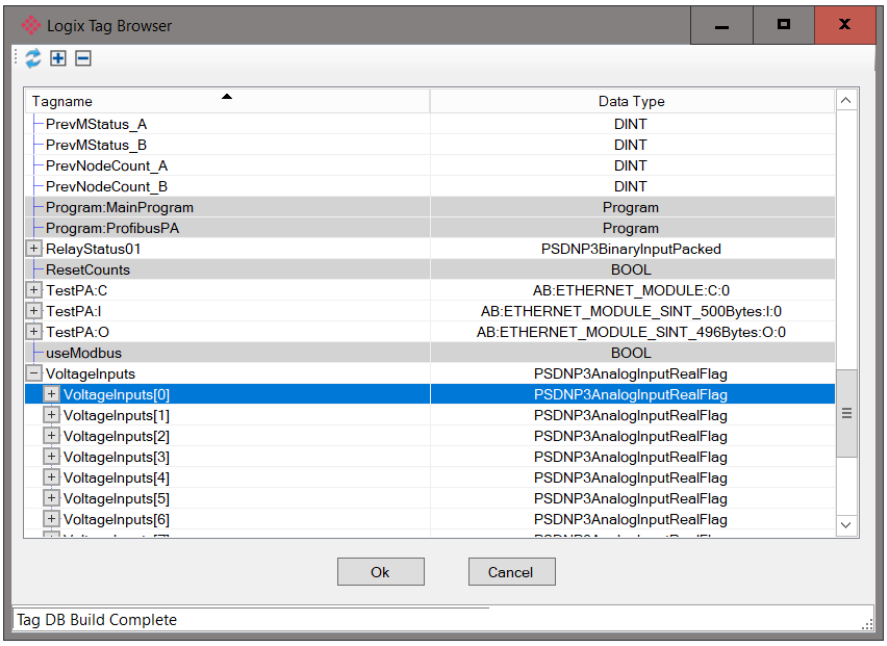


Figure 3.32 – Tag Browser tag selection

Important: Ensure that the Logix tag data type/UDT and size matches that of the DNP3 message requests. Failing to do this can cause unexpected results and communication faults. A list of recommended data types for each Group – Variant

Master Mode with Modbus

When using DNP3 Master mode with the ***Operating Interface*** set to Modbus (Master or Slave), the routing of the DNP3 group, variation, and range will be mapped to internal Modbus registers.

In the case of the module being set as a Modbus Slave, a remote Modbus master must be configured to read and write the configured registers.

In the case of the module being configured as a Modbus Master, it is the user's responsibility to configure the Modbus Auxiliary Map, which will transfer the information contained within the module's internal Modbus registers to one or more external Modbus slave devices.

When using Modbus, the ***Controller Mapping*** is not relevant and can be ignored.

The master mode mapping is configured in two steps.

The first step is to setup the Scan Configuration. The scan intervals allow different data items to be transferred at different rates. There are 4 scan classes; A, B, C and D. The intervals for each can be adjusted by entering the scan time in milliseconds. The interval must be between 200 milliseconds and 60 seconds.

Scan Configuration

Scan	Interval (ms)
A	1000
B	2000
C	5000
D	10000

Figure 3.33 – Scan Configuration

The second part of the Master mode mapping setup is to configure the link between a DNP3 group, variation, and range combination, to a Modbus register, and the associated action and scan required.

Modbus Mapping Items (max. of 1000 items.)

	DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Register Type	Modbus Offset
	Read	A	1	G030 AnalogInputs	V05 Single Float + Flag	0	5	HR	500
**									

Figure 3.34 – Master Modbus Mapping

The Function field specifies whether the transaction will result in a read or write to the Logix controller tag.

Note: The PLX51-DNPM supports nine different DNP3 functions in Master mode. The Read function will translate into a Logix tag write.

The Scan field specifies at what rate the transaction will be executed. Select a scan class letter that matches the required interval. Care must be taken to select a realistic scan interval, taking into account the configured Baud rate and message size.

The IP address and Node is the remote device's IP address and node number. This field is hidden if DNP3 serial (RS232 or RS485) is selected.

Note: The IP address is only relevant if the protocol selected is either Ethernet TCP or Ethernet UDP. The Node address is relevant for both the previously mentioned Ethernet protocols as well as serial.

The DNP3 group and variation selected is that of the remote device. The user must ensure that the remote device supports both the selected group as well as the data format (variation). The range of data to be accessed from the remote device must also be specific. This is done by selecting a start index as well as the number of elements (index count).

DNP3 allows the user to select from a range of different formats (called variations) for each group. This will allow the user to access additional information for a specific group (for example, timestamp, status, etc.). The DNP3 data will be automatically padded to match the 16-bit nature of Modbus.

Next the range of data to be accessed must be specified. This is done by selecting a start index as well as the index count which is the number of elements needed to access.

An appropriate Modbus register type (HR, IR, CS or DI) in relation to the DNP3 object type should be selected. The Modbus Offset is the starting register address of the DNP3 object's data.

The DNP3 data will be formatted as shown below for Modbus Registers.

DNP3 Group	DNP3 Variation	DNP3 Description	Modbus Format
1	1	Packed	No Padding
1	2	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
3	1	Packed	No Padding
3	2	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
10	1	Packed	No Padding
10	2	Status + Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
12	1	CROB	2 Bytes Transmit Flag + 11 Bytes Data + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
20	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
20	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
20	5	32bit + No Flag	No Padding
20	6	16bit + No Flag	No Padding
21	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
21	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
21	5	32bit + Flag + Time	1 Byte Flag + 1 Byte Pad + 4 Bytes Data + 6 Bytes Time

21	6	16bit + Flag + Time	1 Byte Flag + 1 Byte Pad + 2 Bytes Data + 6 Bytes Time
21	9	32bit + No Flag	No Padding
21	10	16bit + No Flag	No Padding
30	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
30	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
30	3	32bit + No Flag	No Padding
30	4	16bit + No Flag	No Padding
30	5	Float + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
40	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
40	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
40	3	Float + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
41	1	32bit	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	2	16bit	2 Bytes Transmit Flag + 2 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	3	Float	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
102	1	8bit	No Padding
110	1	8bit	There is no padding for the octet strings. The string value will be read or written to the Modbus Registers on a per byte basis (up to 255 bytes per octet string). Once the string ends, a zero will be written to the last byte. This zero must be used as the delimiter for the string.

Table 3.10 – Modbus Format for DNP3 Group/Variation Data

3.5.2 Concentrator Mapping Mode

In Concentrator mode the PLX51-DNPM collects data from multiple DNP3 outstations, remaps their DNP3 object indexes, and makes this data available to another DNP3 master. The underlying outstations thus appear as a single outstation to the remote DNP3 master.

In this mode the ***Operating Interface*** selection not required and is disabled.

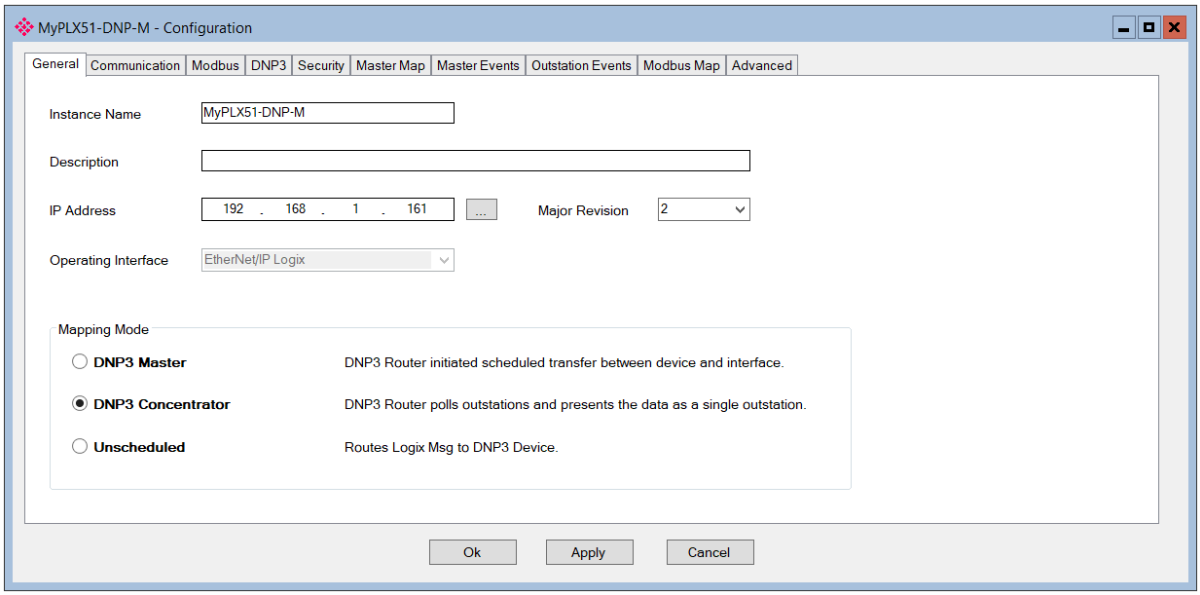


Figure 3.35 – Selecting Concentrator Mode

The configuration of the Concentrator mode mapping is similar to that of the Master mode mapping. It is done in two steps.

The first step is to setup the ***Scan Configuration***. The scan intervals allow different data items to be transferred at different rates. There are 4 scan classes; A, B, C and D. The intervals for each can be adjusted by entering the scan time in milliseconds. The interval must be between 200 milliseconds and 60 seconds.

Scan Configuration

Scan	Interval (ms)
A	1000
B	2000
C	5000
D	10000

Figure 3.36 – Scan Configuration

The second part of the Concentrator mode mapping setup is to configure the link between a DNP3 group, variation, and range combination for a particular Outstation and the new (remapped) index it will appear as to the remote DNP3 master.

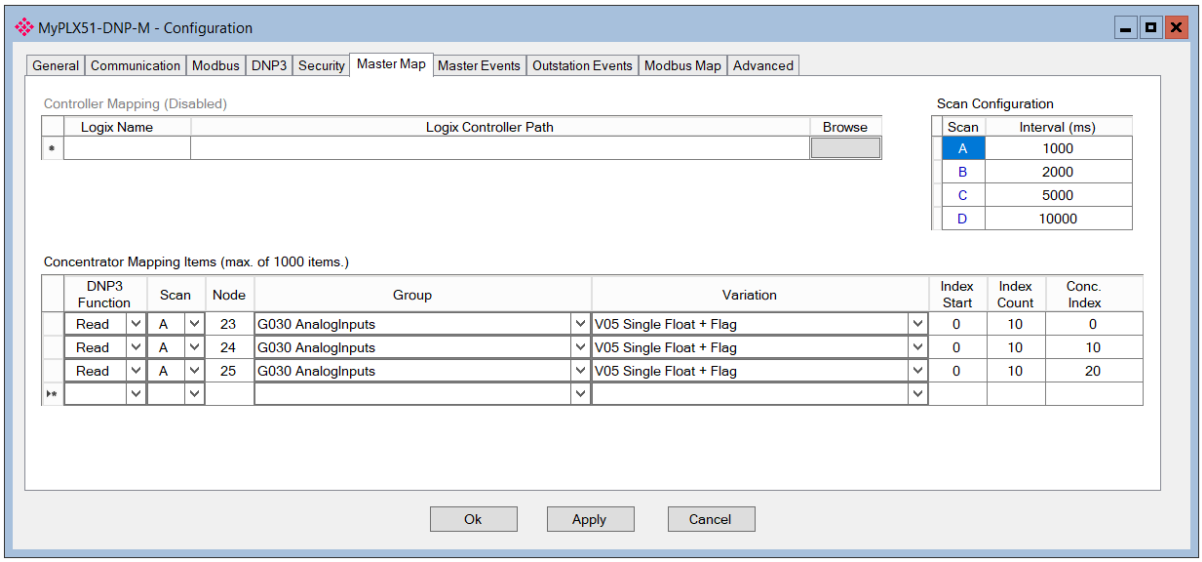


Figure 3.37 – Concentrator Mapping

The *DNP3 Function* field specifies the action to be applied to the remote outstation.

The Scan field specifies at what rate the action will be executed. Select a scan class letter that matches the required interval. Care must be taken to select a realistic scan interval, taking into account the configured Baud rate and message size.

The *IP Address* and *Node* is the remote device's IP address and node number. These fields are hidden if DNP3 serial (RS232 or RS485) is selected.

Note: The IP address is only relevant if the protocol selected is either Ethernet TCP or Ethernet UDP. The Node address is relevant for both the previously mentioned Ethernet protocols as well as serial.

The DNP3 group and variation selected is that of the remote device. The user must ensure that the remote device supports both the selected group as well as the data format (variation). The range of data to be accessed from the remote device must also be specific. This is done by selecting a start index as well as the number of elements (index count).

DNP3 allows the user to select from a range of different formats (called variations) for each group. This will allow the user to access additional information for a specific group (for example, timestamp, status, etc.).

Next the range of data to be accessed must be specified. This is done by selecting a start index as well as the index count which is the number of elements needed to access.

The Concentrator Index (Conc. Index) is the new remapped index the object will appear as to the remote DNP3 master.

In the example illustrated below there are 3 identical DNP3 Outstations each with 10 Analog inputs. The PLX51-DNPM module (in Concentrator mode) functions as a local DNP3 Master and polls these outstations at nodes 23, 24 and 25 respectively, each time reading their Analog inputs (0-9). The PLX51-DNPM then internally maps these to their new object indexes.

When the remote DNP3 master (SCADA) reads, the PLX51-DNPM behaves as an outstation and presents the SCADA with 30 Analog inputs (index 0-29).

DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Conc. Index
Read	A	23	G030 AnalogInputs	V05 Single Float + Flag	0	10	0
Read	A	24	G030 AnalogInputs	V05 Single Float + Flag	0	10	10
Read	A	25	G030 AnalogInputs	V05 Single Float + Flag	0	10	20

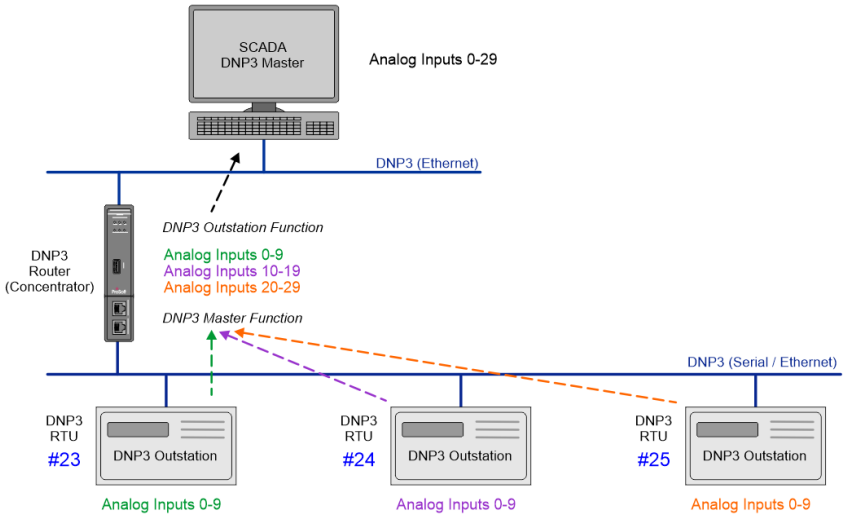


Figure 3.38 – Concentrator Example

Note: In Concentrator mode, the communication from the PLX51-DNPM to the underlying outstations can be Serial (RS232 / RS485) or Ethernet TCP/UDP.

Note: In Concentrator mode, the communication from the PLX51-DNPM to master DNP must be Ethernet TCP.

Note: In Concentrator mode, if secure authentication is employed, the security settings and keys must be the same for all devices, and aggressive mode must be enabled.

Note: In Concentrator mode, the following functions are not supported; Assign Class or Analog Deadband.

3.5.3 Unscheduled Mode

There is no additional configuration required when using the Unscheduled Mode. The configuration required for the DNP3 message is contained within the Message Block data, configured in Logix. Refer to the "DNP3 Operation" section for more information.

Note: Unscheduled mode is available only on the PLX51-DNPM module and is only applicable to the EtherNet/IP Logic Operating Interface.

Important: In this mode the PLX51-DNPM does support Secure Authentication, but Aggressive mode is **NOT** supported. The DNP3 Master will also change session keys each time the request destination is different from the previous request.

Important: In this mode the PLX51-DNPM does **NOT** support unsolicited responses from DNP3 Outstations.

3.6 DNP3 Events

3.6.1 Master Mode

The PLX51-DNPM (in Master mode) can extract or receive DNP3 events from various DNP3 Outstations. This is achieved by enabling the Event Unload Mode in the *Master Events* configuration tab.

Master Mode – EtherNet/IP

Once the PLX51-DNPM has received a DNP3 event, it will attempt to update the specified Logix UDT array or Modbus Register array.

Note: Refer to the Logix example code which provides a mechanism to extract the DNP3 Events from the Logix Master Events Tag.

When using Logix, once there is confirmation from the Logix controller that the event has successfully been written to an index offset of the Logix Master Event Array, the PLX51-DNPM will then send a confirm to the DNP3 Outstation that the event has been received and it can be removed from its internal log.

The configuration below shows the Logix Controller selected (from the list of controllers in the Master Logix Controller Map). Once this is done, the user can browse to the required Logix tag (using the Tag browser) to enable the PLX51-DNPM to unload DNP3 events into the Logix controller.

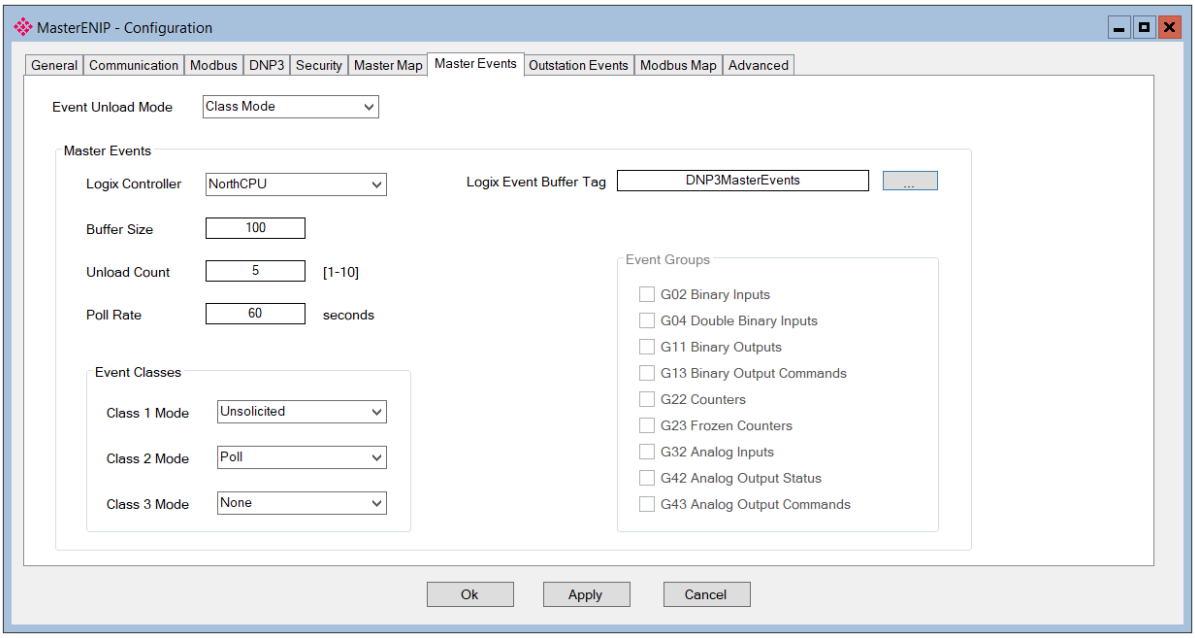


Figure 3.39 – DNP3 Master Event Unloading Configuration

The buffer size in the configuration must match the array size of the Master Event Tag in the Logix controller.

Important: This buffer size value must not exceed the Logix controller tag array size. If this is the case the unloading of events to the Logix controller will not operate correctly.

Below is an example of how the PLX51-DNPM would unload events from the DNP3 Outstations (based on the configuration in the image above). DNP3 events can be unloaded from DNP3 Outstations either by one of the following methods:

- Polling each Event Class (Class1, Class2, Class3).
- Enabling Unsolicited Responses from each DNP3 Outstation.
- Polling individual Groups for each DNP3 Outstation (for example, Group 32 – Analog Input Events).

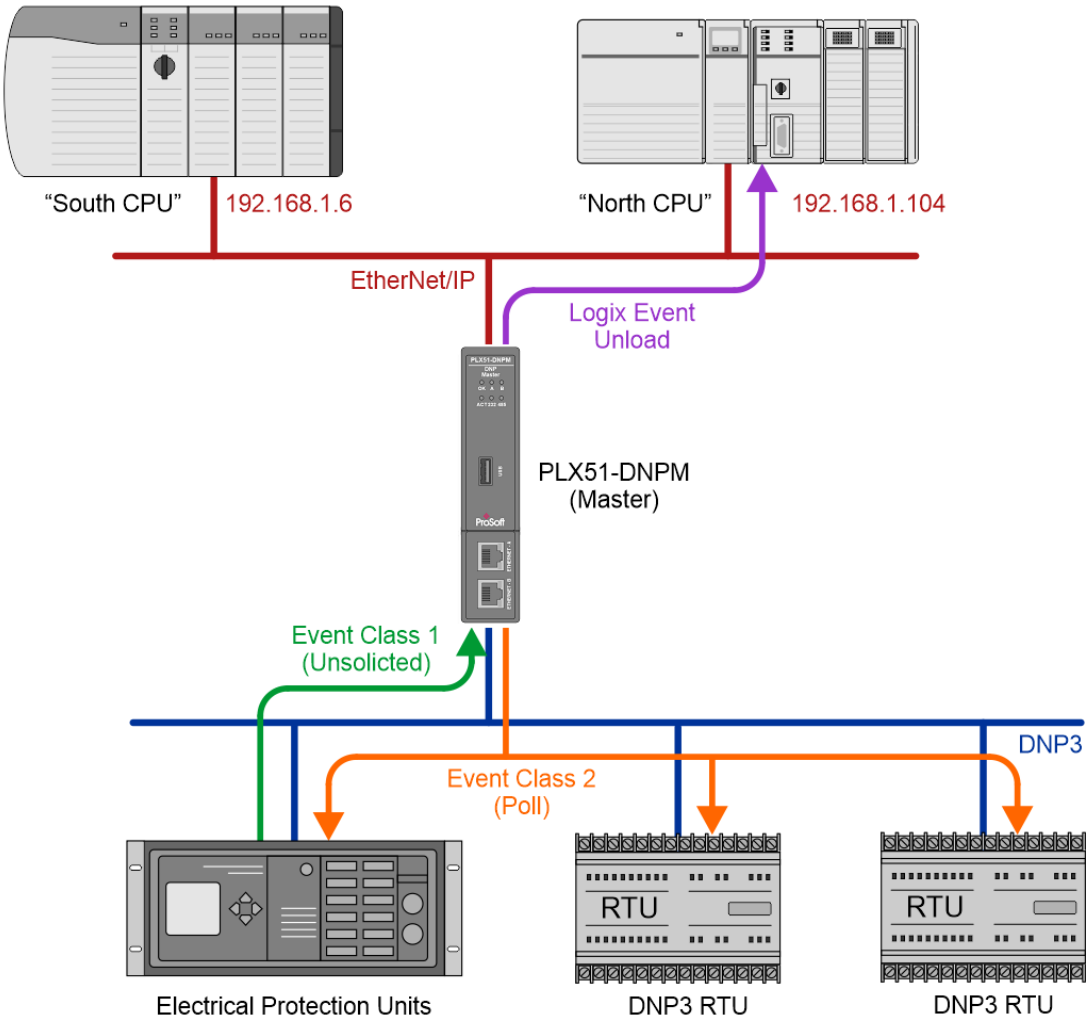


Figure 3.40 – DNP3 Master Event Unloading

The unloading of buffered events into a Logix controller is explained in section 6.

Master Mode – Modbus

When a Modbus Operating interface has been selected, once the PLX51-DNPM has received a DNP3 event, it will attempt to update the specified internal Modbus register.

The starting Modbus register of the event buffer is configured on the Modbus tab, illustrated in the figure below.

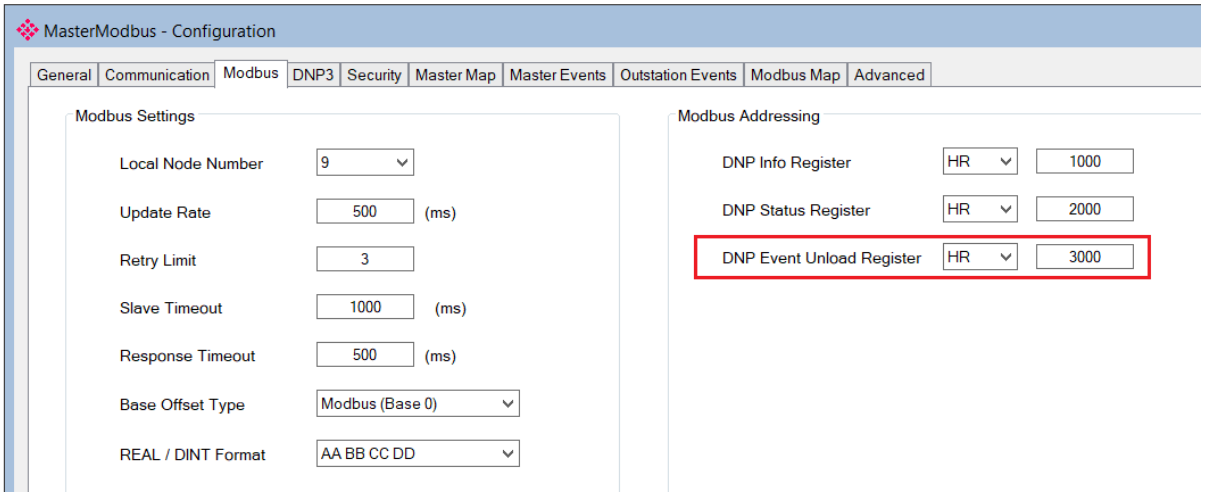


Figure 3.41 – DNP3 Master Event Unloading Register

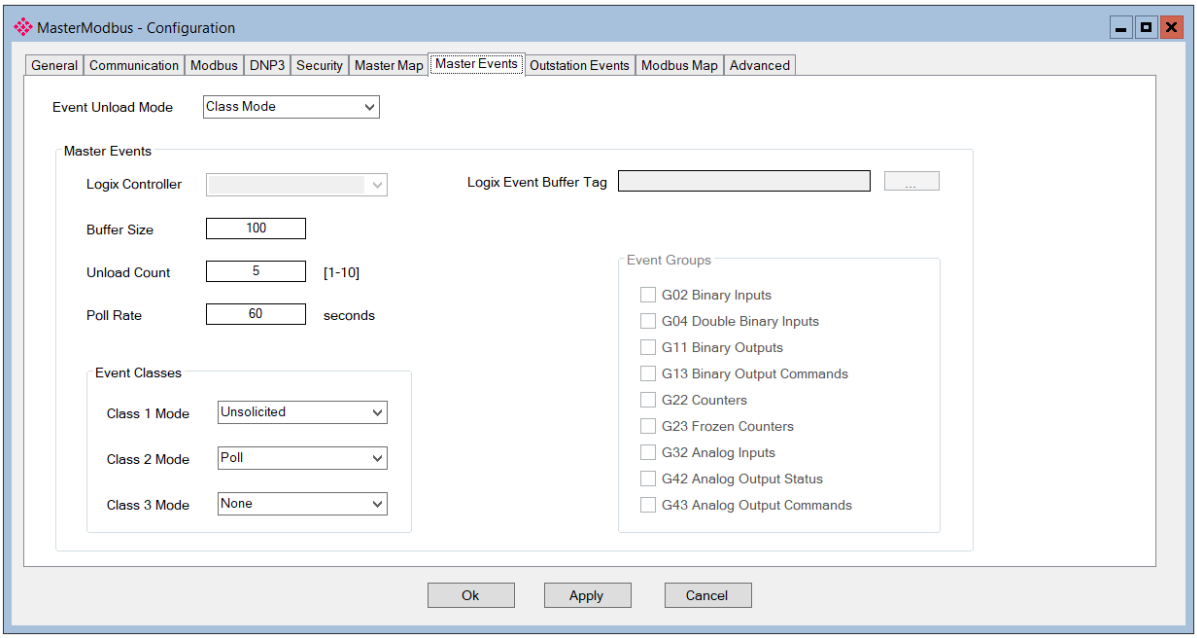


Figure 3.42 – DNP3 Master Event Unloading Configuration

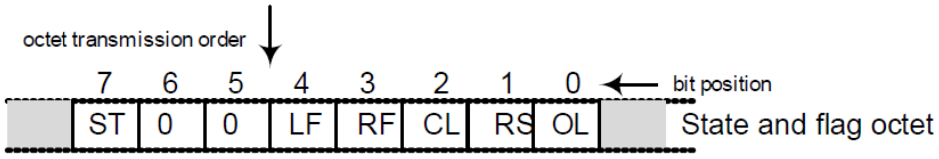
Important: This buffer size value and Modbus unload register must be carefully selected to not overwrite any other registers.

Each event consumes 16 Modbus registers. The total size of the Modbus Event buffer is therefore 16 multiplied by the ***Buffer Size***. The structure is as follows:

Description	HR/IR Reg Offset	Element Size	Data Type
Event Pending	0	1	BOOL
Event Group	1	1	SINT
Event Flags	2	1	SINT
Event Source Node Address	3	1	INT
Event Source IP Address	4	2	SINT[4]
Event Element Index	6	2	DINT
Event Time Stamp	8	4	LINT
Event Real Data Value	12	2	REAL
Event Integer Data Value	14	2	DINT

Table 3.11 – Event Structure Modbus

When unloading events using binary data with flags (Example: Group 10 Variation 2), the data and the flags are both located in the same byte. In the event buffer, the flags will be on bits 0 to 6, and the value state (which is either a 1 or a 0) will be on bit 7.



A.6.2.2.2 Formal structure

BSTR8: Flag Octet

Bit 0: ONLINE

Bit 1: RESTART

Bit 2: COMM_LOST

Bit 3: REMOTE_FORCED

Bit 4: LOCAL_FORCED

Bit 5: Reserved, always 0

Bit 6: Reserved, always 0

Bit 7: STATE—Value is 1 or 0, where 1 indicates that the output signal is active and 0 indicates that the output signal is not active. When the output state is not meaningful, the STATE flag shall be 0.

3.6.2 Concentrator Mode

In Concentrator mode, the PLX51-DNPM collects the events from the underlying outstations based on the rules configured in the ***Master Events*** configuration tab.

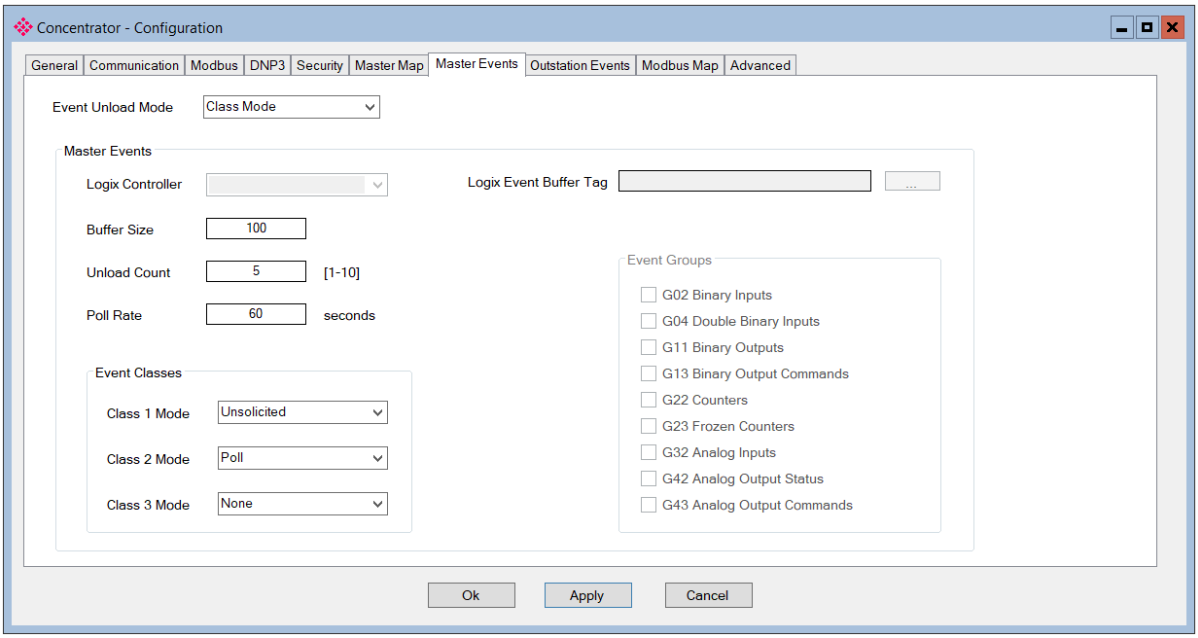


Figure 3.43 – Master Events

These events are stored in the PLX51-DNPM's event buffer and are then unloaded asynchronously to the DNP3 master. This subsequent event unloading is managed and specified by the remote DNP3 master.

Note that the event indexes will be automatically remapped according to the Concentrator mapping items.

In the example below the PLX51-DNPM unloads Analog Input events (Group 30) from 3 outstations. These events are unloaded using a combination of Class 2 Polls and Unsolicited Class 1 messages, based on each outstation's configuration.

Before the events are stored in the local concentrator's event buffer, the indexes are remapped. Since these are Analog Input Events (Group 32) they are based on the underlying Analog Input objects (Group 30), so the Group 30 remapping rules are applied.

In this example:

The event from node #23, has no mapping offset and so the index remains 1.

The event from node #24 has a mapping offset of 10, and so the index of 3 is remapped to 13.

The event from node #25 has a mapping offset of 20, and so the index of 5 is remapped to 25.

DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Conc. Index
Read	A	23	G030 AnalogInputs	V05 Single Float + Flag	0	10	0
Read	A	24	G030 AnalogInputs	V05 Single Float + Flag	0	10	10
Read	A	25	G030 AnalogInputs	V05 Single Float + Flag	0	10	20

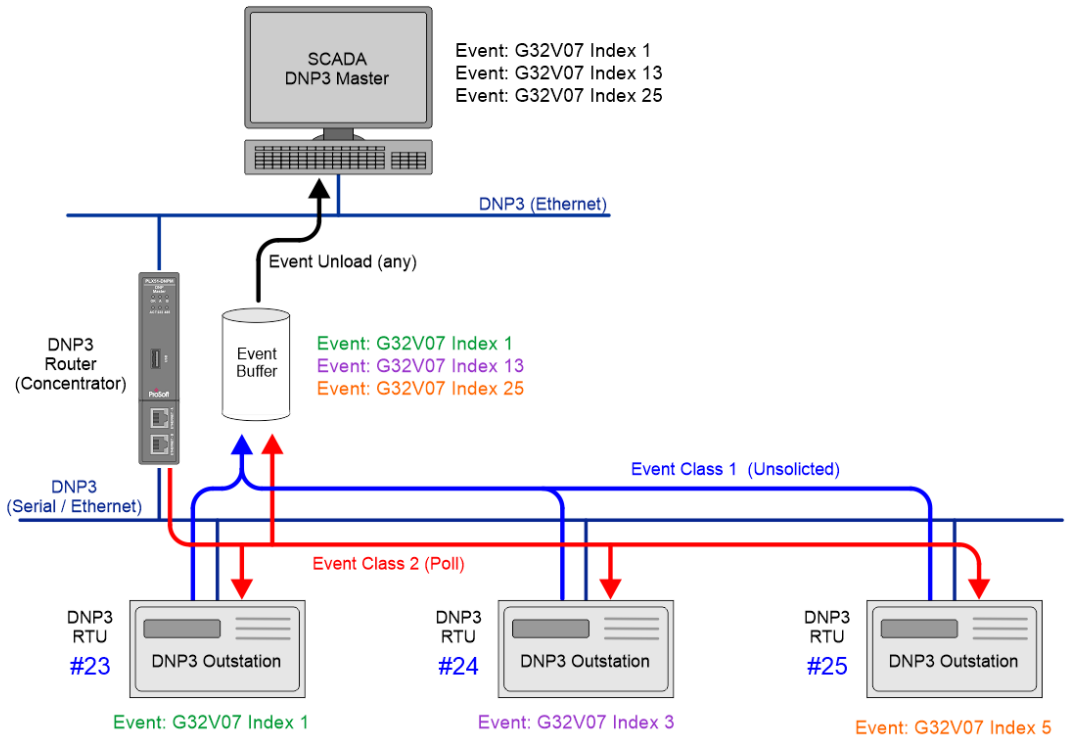


Figure 3.44 – Concentrator Event Example

3.7 Configuration Download

Once the DNP3 configuration has been completed, it must be downloaded to the module.

Before downloading, the ***Connection Path*** of the module should be set. This path will automatically default to the IP address of the module, as set in the module configuration. It can however be modified should the PLX51-DNPM not be on a local network.

The Connection Path can be set by right-clicking on the module and selecting the ***Connection Path*** option.

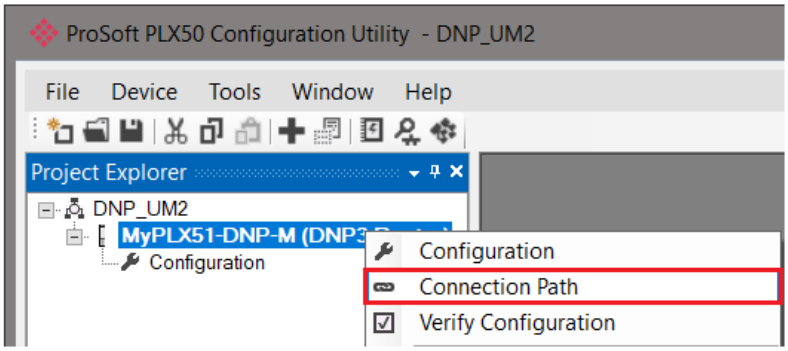


Figure 3.45 - Selecting Connection Path

The new connection path can then be either entered manually or selected by means of the ***Target Browser***.

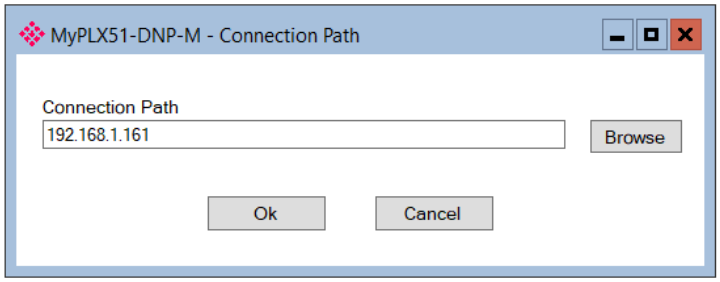


Figure 3.46 - Connection Path

To initiate the download, right-click on the module and select the Download option.

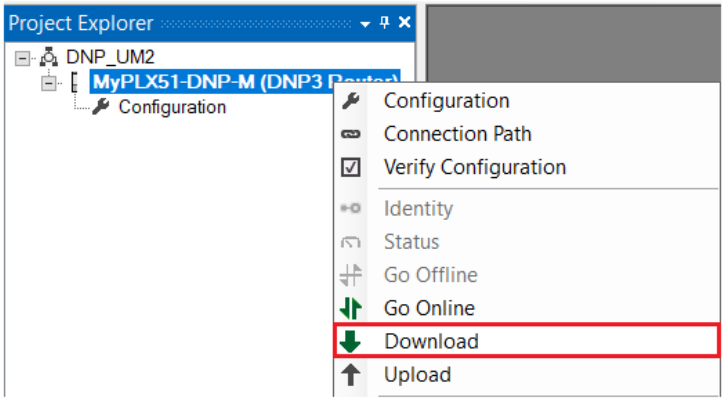


Figure 3.47 - Selecting Download

Once the download is complete, the user will be notified that it was successful.

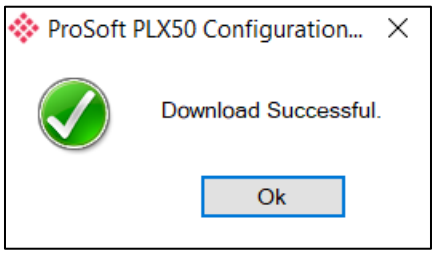


Figure 3.48 - Successful download

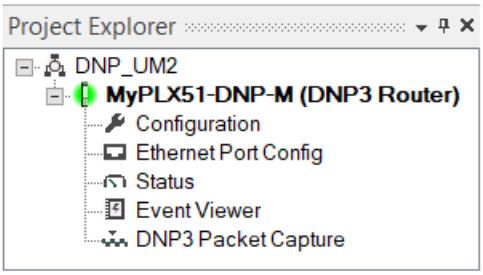


Figure 3.49 - Module online

3.8 RSLogix 5000 Configuration

The PLX51-DNPM modules can be easily integrated with Allen-Bradley Logix family of controllers.

For Logix versions 20 and beyond, the modules can be added using the EDS Add-On-Profile (AOP), which is described in section 3.8.1.

For older versions (19 and below), the module must be added using a Generic Profile which is described in section 3.8.2.

3.8.1 Studio 5000 Configuration (Version 20+)

Integration with the Logix family in Studio5000 makes use of the EDS AOP. Before the module can be added to the tree the module's EDS file must be registered. Using RSLinx, the EDS file can be uploaded from the device after which the EDS Hardware Installation tool will be invoked to complete the registration.

Alternatively, the EDS file can be downloaded from the product web page at www.prosoft-technology.com and registered manually using the EDS Hardware Installation Tool shortcut under the Tools menu in Studio 5000.

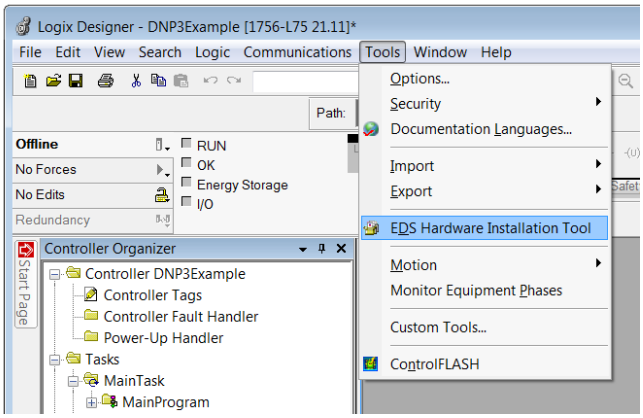


Figure 3.50 - EDS Hardware Installation Utility

After the EDS file has been registered, the module can be added to the Logix IO tree in Studio 5000. Under a suitable Ethernet bridge module in the tree, select the Ethernet network, right-click and select the New Module option.

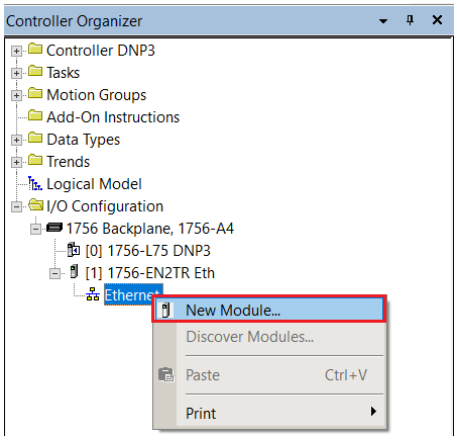


Figure 3.51 – Adding a module

The module selection dialog will open. To find the module more easily, use the Vendor filter to select only the ProSoft Technology modules as shown in the figure below.

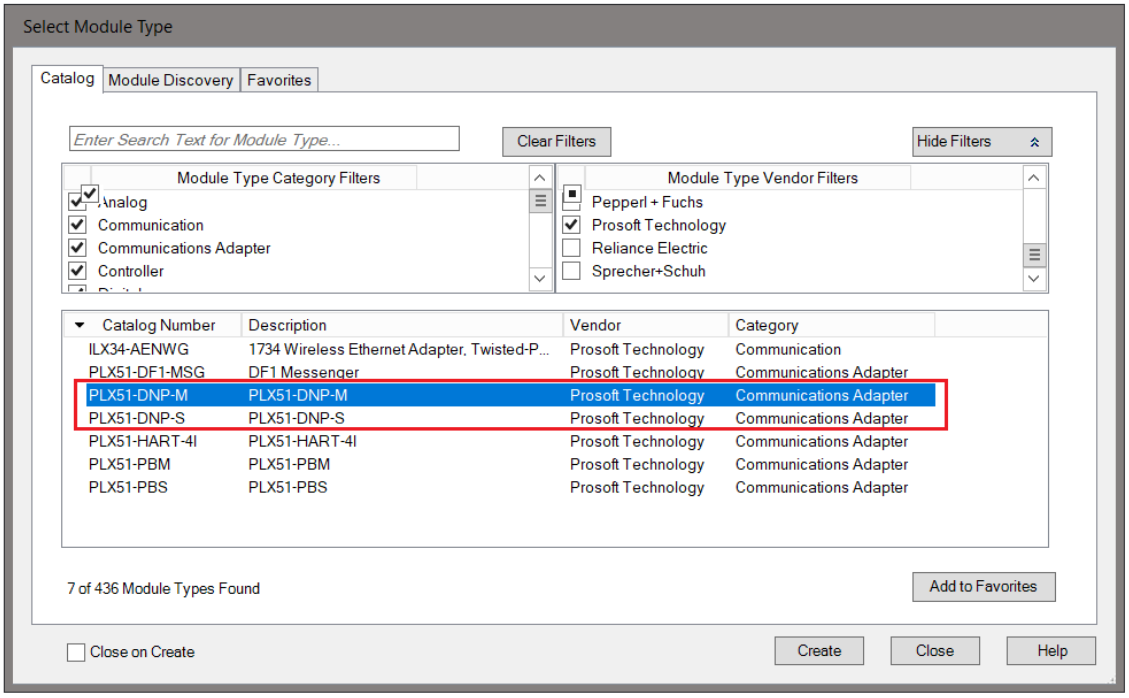


Figure 3.52 – Selecting the module

Locate and select the PLX51-DNPM module and select the ***Create*** option. The module configuration dialog will open, where the user must specify the ***Name*** and ***Ethernet Address*** as a minimum to complete the instantiation.

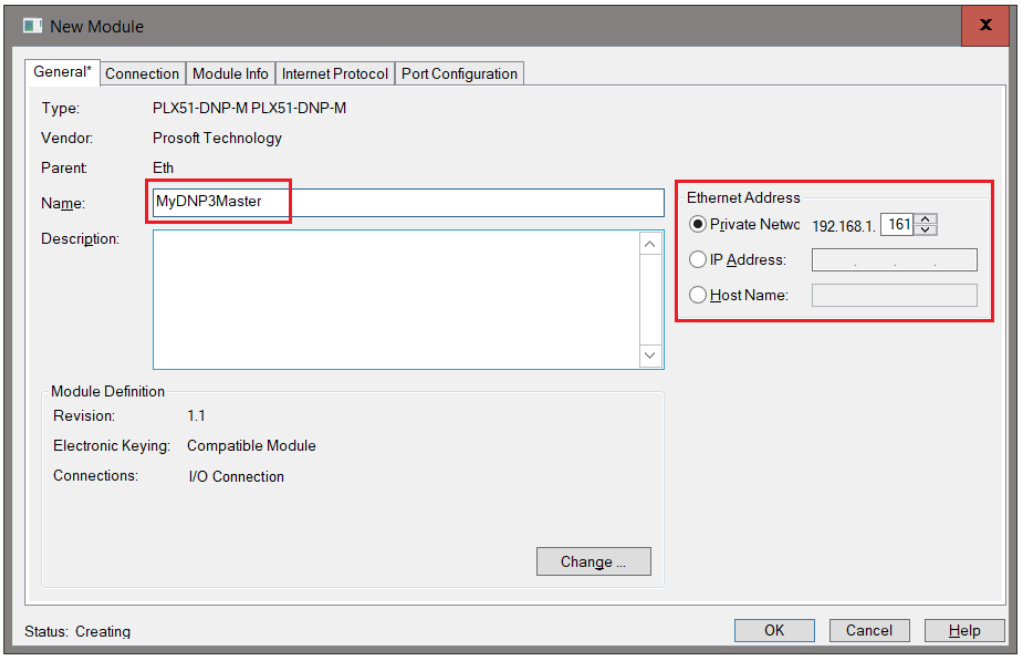


Figure 3.53 – Module instantiation

In the Connection tab, set the Requested Packet Interval (RPI).

Important: Although the module can run with an RPI of 10ms, it is recommended to set the RPI to 500ms, to avoid unnecessary loading of the module processor.

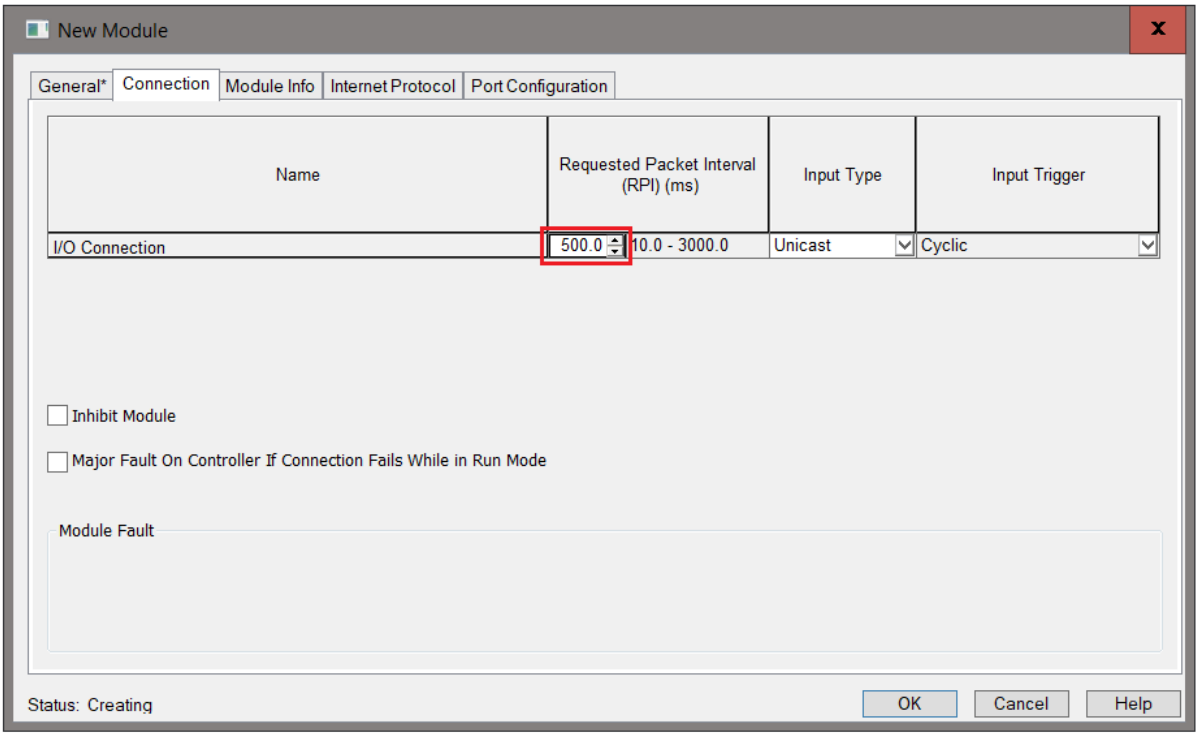


Figure 3.54 – Connection RPI

Once the instantiation is complete the module will appear in the Logix IO tree.

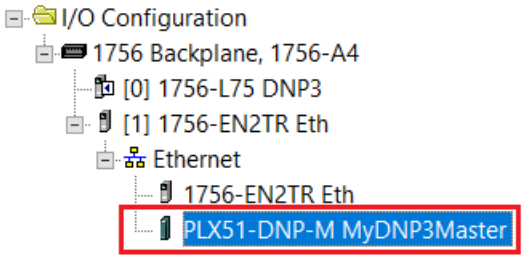


Figure 3.55 – Logix IO tree

The Module Defined Data Types will automatically be created during the instantiation process. These data types provide meaningful structures to the module data. An excerpt of the Input Image is shown in the following figure.

Note: The module defined data types are the data types required for the EtherNet/IP class 1 connection in the Logix IO tree. These data types do not include the data types required for the Logix DNP Objects (e.g., DNP 32bit Analog Input + Flag G30V01). The DNP object data types are provided in the example code and will need to be copied from the example code or imported to the user's application code.

⊟ MyDNP3:I	{...}	{...}		_055A:A_DNP3R_CB23...
MyDNP3:I.ConnectionFaulted	0		Decimal	BOOL
⊞ MyDNP3:I.InstanceNameLength	0		Decimal	DINT
⊞ MyDNP3:I.Status	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNP3:I.ReactiveTagMode	0		Decimal	BOOL
MyDNP3:I.ScheduledTagMode	0		Decimal	BOOL
MyDNP3:I.UnscheduledMode	0		Decimal	BOOL
MyDNP3:I.ConfigurationValid	0		Decimal	BOOL
MyDNP3:I.RoutingInhibited	0		Decimal	BOOL
⊞ MyDNP3:I.MasterTagStatus	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNP3:I.ScheduledTagStatus00	0		Decimal	BOOL
MyDNP3:I.ScheduledTagStatus01	0		Decimal	BOOL
MyDNP3:I.ScheduledTagStatus02	0		Decimal	BOOL
MyDNP3:I.ScheduledTagStatus03	0		Decimal	BOOL
• • •				
MyDNP3:I.ScheduledTagStatus27	0		Decimal	BOOL
MyDNP3:I.ScheduledTagStatus28	0		Decimal	BOOL
MyDNP3:I.ScheduledTagStatus29	0		Decimal	BOOL
⊞ MyDNP3:I.TransactionRate	0		Decimal	DINT
MyDNP3:I.Temperature	0.0		Float	REAL
⊞ MyDNP3:I.DNP3RxPacketCount	0		Decimal	DINT
⊞ MyDNP3:I.DNP3TxPacketCount	0		Decimal	DINT
⊞ MyDNP3:I.DNP3ChecksumErrors	0		Decimal	DINT
⊞ MyDNP3:I.DNP3MsgTimeout	0		Decimal	DINT
⊞ MyDNP3:I.AuthenticationFailures	0		Decimal	DINT
⊞ MyDNP3:I.SessionKeyChanges	0		Decimal	DINT
⊞ MyDNP3:I.TagReads	0		Decimal	DINT
⊞ MyDNP3:I.TagWrites	0		Decimal	DINT
⊞ MyDNP3:I.TagConnectionFailures	0		Decimal	DINT
⊞ MyDNP3:I.TagErrors	0		Decimal	DINT
⊞ MyDNP3:I.MasterEventBufferIndex	0		Decimal	DINT

Figure 3.56 – Module Defined Data Type

3.8.2 Importing DNP3 UDTs and AOIs

To assist with the Logix integration, AOI and UDTs can be imported using the provided Objects Routine Import. This is provided for Logix V21 where the user can upgrade the V21 project to the desired Logix revision.

The user can also use the example Logix code (.ACD file) which is a stand-alone Logix example project for the PLX51-DNPM module. Both the routine import and stand-alone Logix files are available to download at: www.prosoft-technology.com.

The import will create the required UDTs (user-defined data types) and AOIs (Add-On Instructions).

Below are the steps to import the AOIs and UDTs into a Logix project.

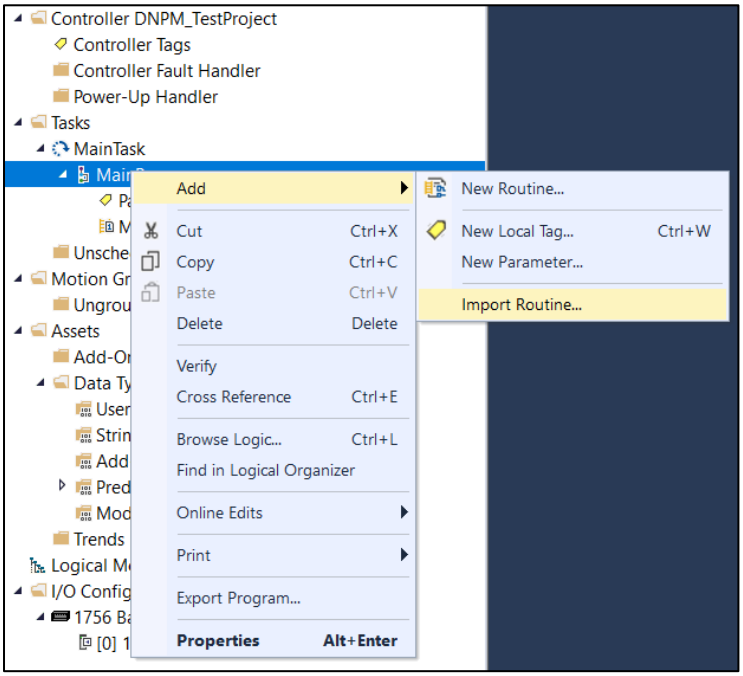


Figure 3.57 – Logix Routine Import

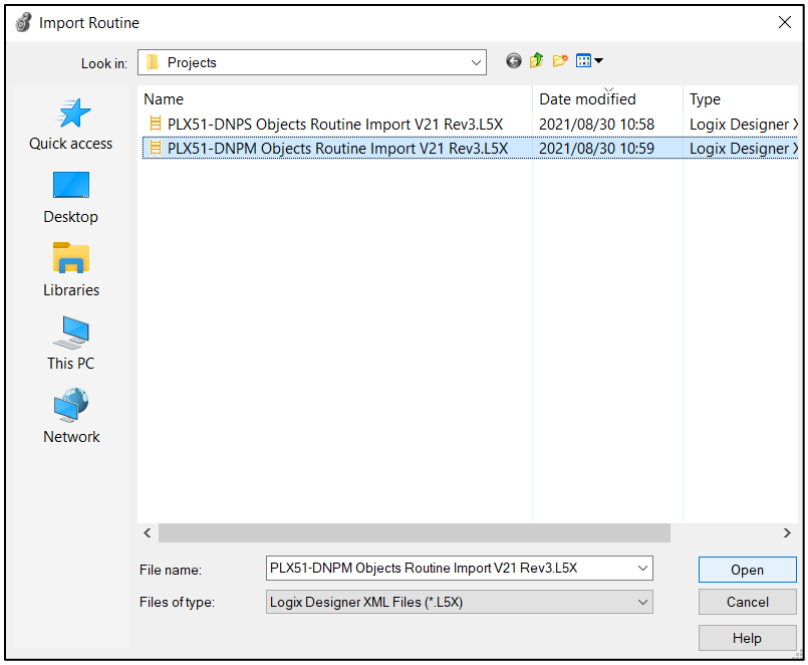


Figure 3.58 – Select Object Routine Import for the DNPM module

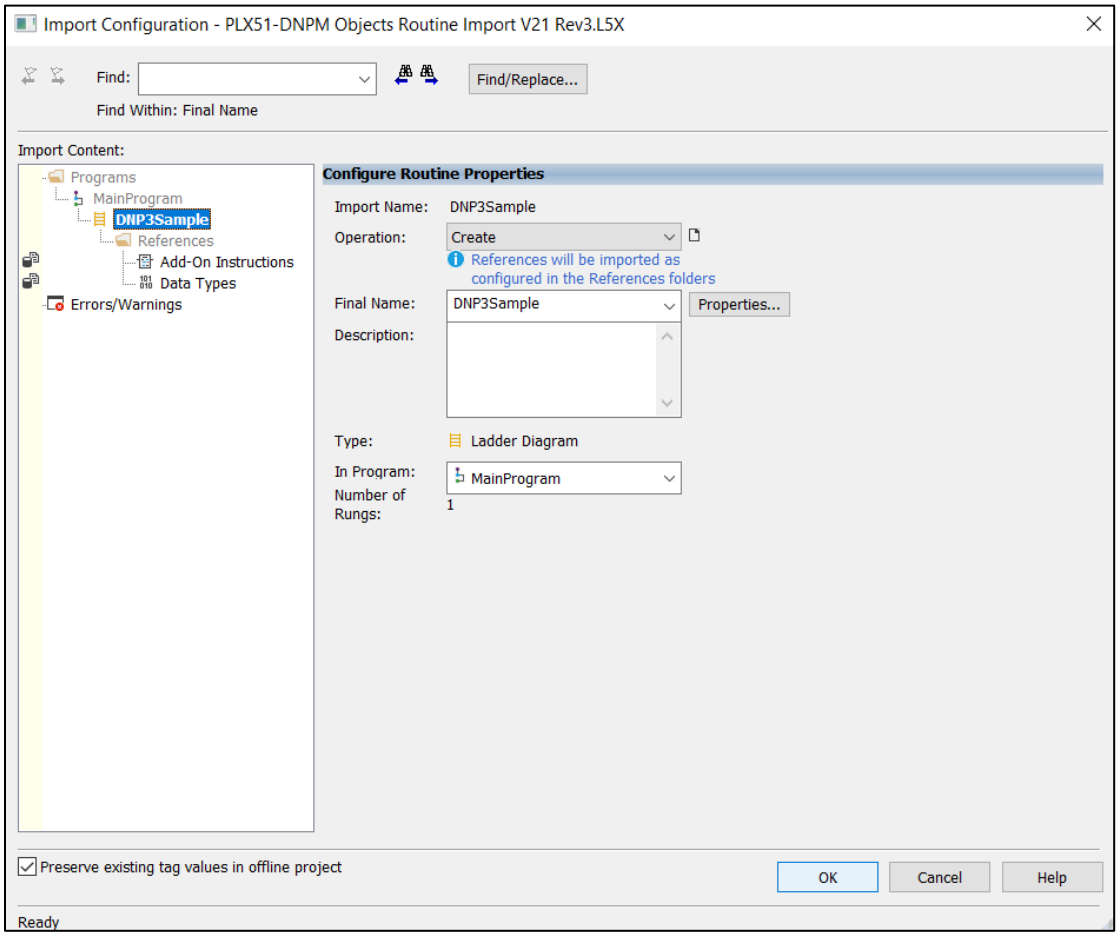


Figure 3.59 – Select Ok for Studio to create the required AOIs and UDTs

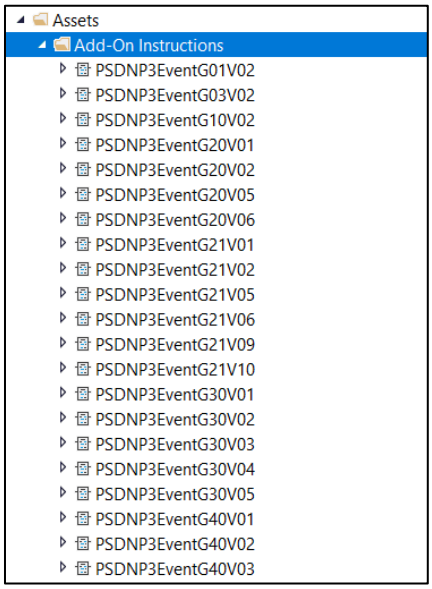


Figure 3.60 – Created AOIs



Figure 3.61 – Created UDTs

Note: Once the UDTs have been imported, the user will need to add the necessary Controller Tags (using the required UDTs) to exchange DNP3 data with the DNPM module.

3.8.3 RSLogix 5000 Configuration (Pre-Version 20)

Add Module to I/O Configuration

The module can operate in both a Logix "owned" and standalone mode. When the module operates in a Logix "owned" mode the PLX51-DNPM will need to be added to the RSLogix 5000 IO tree. The module will need to be added as a generic Ethernet module. This is done by right clicking on the Ethernet Bridge in the RSLogix 5000 and selecting *New Module* after which the *ETHERNET-MODULE* is selected to be added as shown in the figure below.

Note: See the next section for importing the configuration (L5X).

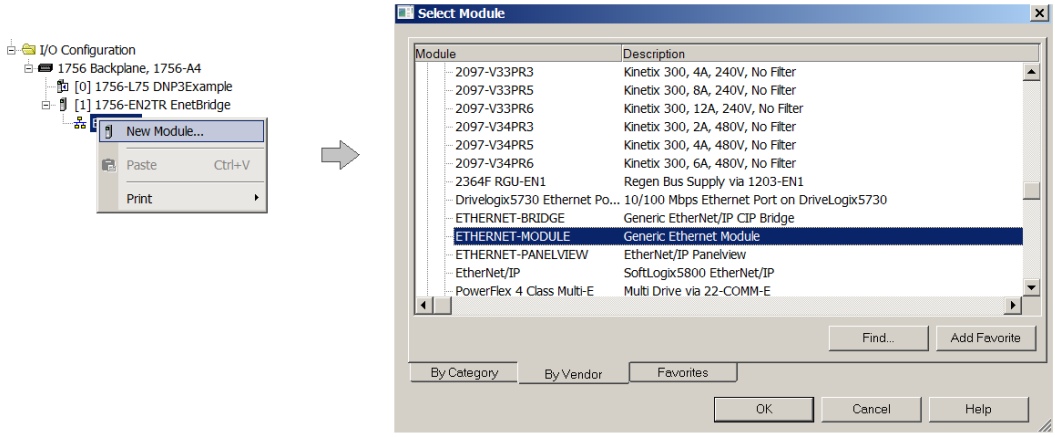


Figure 3.62 - Add a Generic Ethernet Module in RSLogix 5000

The user must enter the IP address of the PLX51-DNPM module that will be used. The assembly instance and size must also be added for the input, output, and configuration in the connection parameters section. Below are the required connection parameters.

Connection Parameter	Assembly Instance	Size
Input	165	68 (32-bit)
Output	101	1 (32-bit)
Configuration	102	0 (8-bit)

Table 3.12 - RSLogix class 1 connection parameters for the PLX51-DNPM module

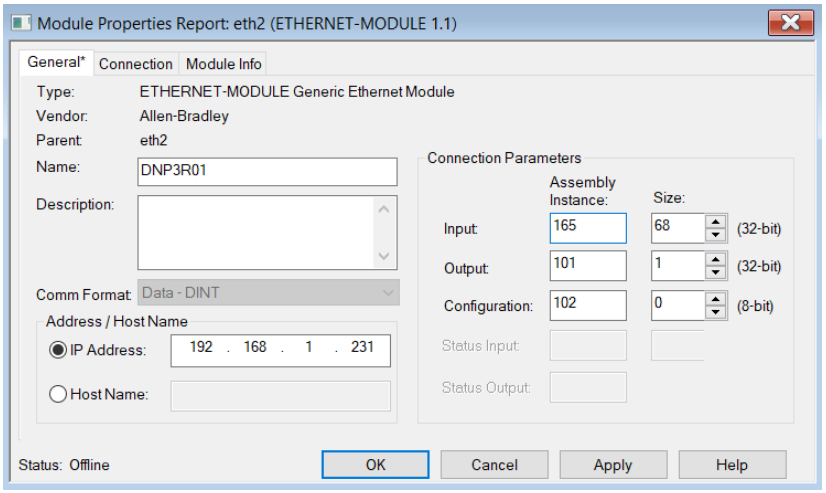


Figure 3.63 - RSLogix General module properties in RSLogix 5000

Important: Enter the exact connection parameters before the module establishes a class 1 connection with the Logix controller.

Next, add the connection requested packet interval (RPI). This is the rate at which the input and output assemblies are exchanged. The recommended value is 500ms. Refer to the technical specification section in this document for further details on the limits of the RPI.

Important: Although the module can run with an RPI of 10ms, it is recommended to set the RPI to 500ms, to avoid unnecessary loading of the module processor.

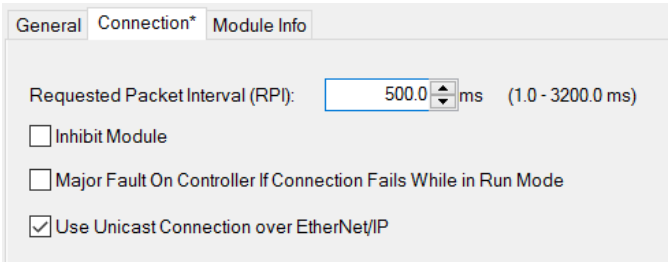


Figure 3.64 - Connection module properties in RSLogix 5000

Once the module has been added to the RSLogix 5000 IO tree, the user must assign the User Defined Types (UDTs) to the input and output assemblies. The user can import the required UDTs by right-clicking on *User-Defined* sub-folder in the *Data Types* folder of the IO tree and selecting *Import Data Type*. The assemblies are then assigned to the UDTs with a ladder copy instruction (COP) as shown in the figure below.

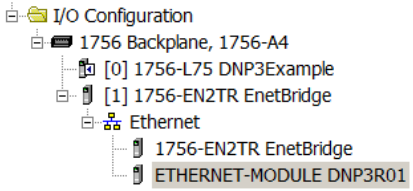


Figure 3.65 – RSLogix 5000 I/O module tree

Importing UDTs and Mapping Routines

To assist with the Logix integration, AOI and UDTs can be imported using the provided Objects Routine Import. This is provided for Logix V19.

The user can also use the example Logix code (ACD file) which is a stand-alone Logix example project for the PLX51-DNPM module. Both the routine import and stand-alone Logix files are available to download from the ProSoft website (www.prosoft-technology.com).

Below are the steps to import the AOIs and UDTs into a Logix project.

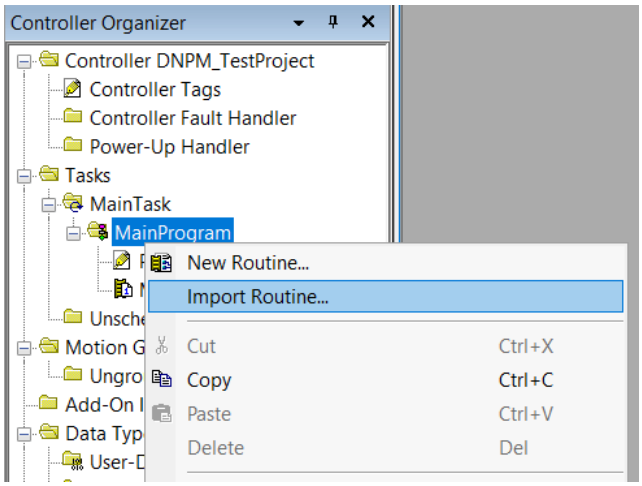


Figure 3.66 – RSLogix 5000 Importing PLX51-DNPM specific routine, UDTs, and AOIs

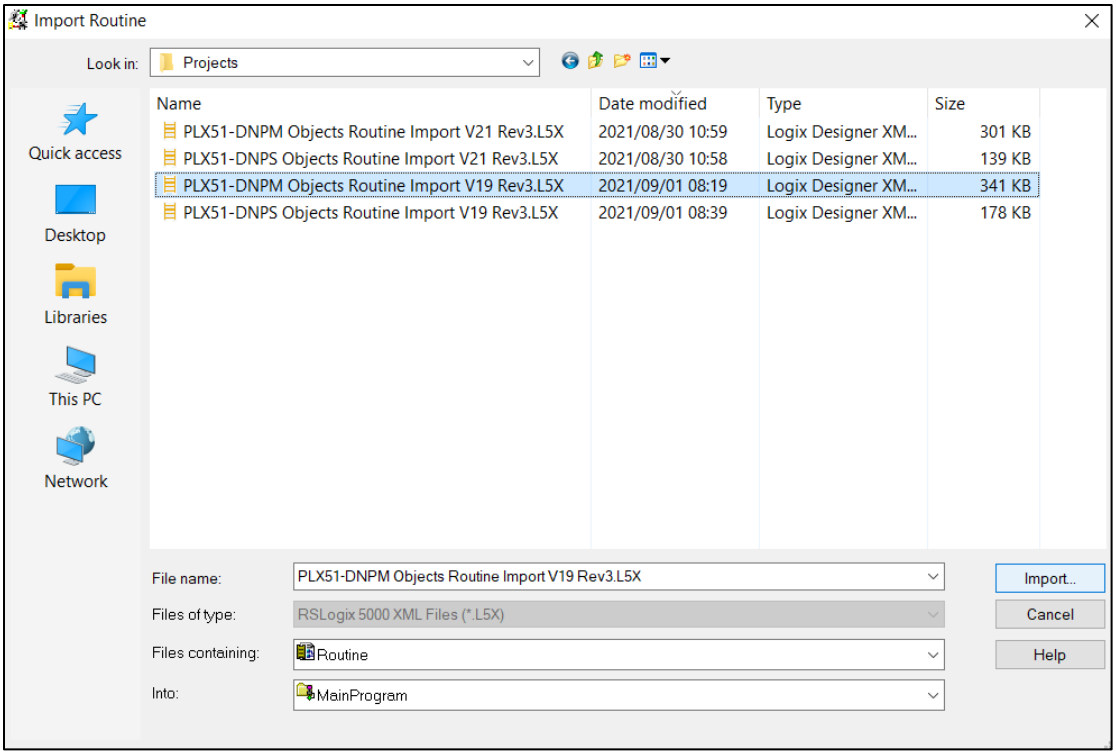


Figure 3.67 - Selecting partial import file

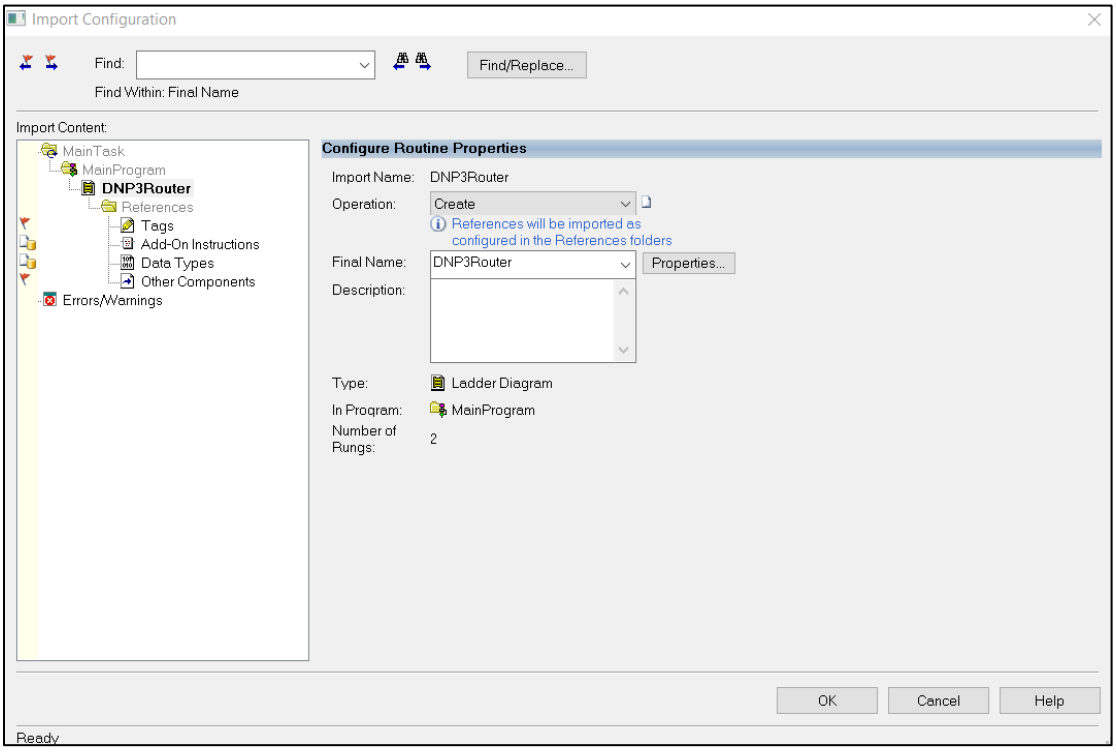


Figure 3.68 – Creating the UDTs, AOIs, and Routines

The import will create the following:

- The required UDTs (user-defined data types) and AOIs (Add-On Instructions)
- Two controller tags representing the Input and Output assemblies.
- A routine mapping the PLX51-DNPM module to the tags.
- An example Unscheduled Message instruction with the associated tags

The user may need to change the routine to map to the correct PLX51-DNPM module instance name and make sure that the mapping routine is called by the Program's Main Routine.

Note: Once the UDTs have been imported, the user will need to add the necessary Controller Tags (using the required UDTs) to exchange DNP3 data with the DNPM module.

Refer to the additional information section of this document for an example RSLogix 5000 project as well as the required UDTs.

4 microSD Card

The PLX51-DNPM supports a microSD Card (see below) which can be used for disaster recovery. The microSD Card can be pre-loaded with the required firmware and/or application configuration.

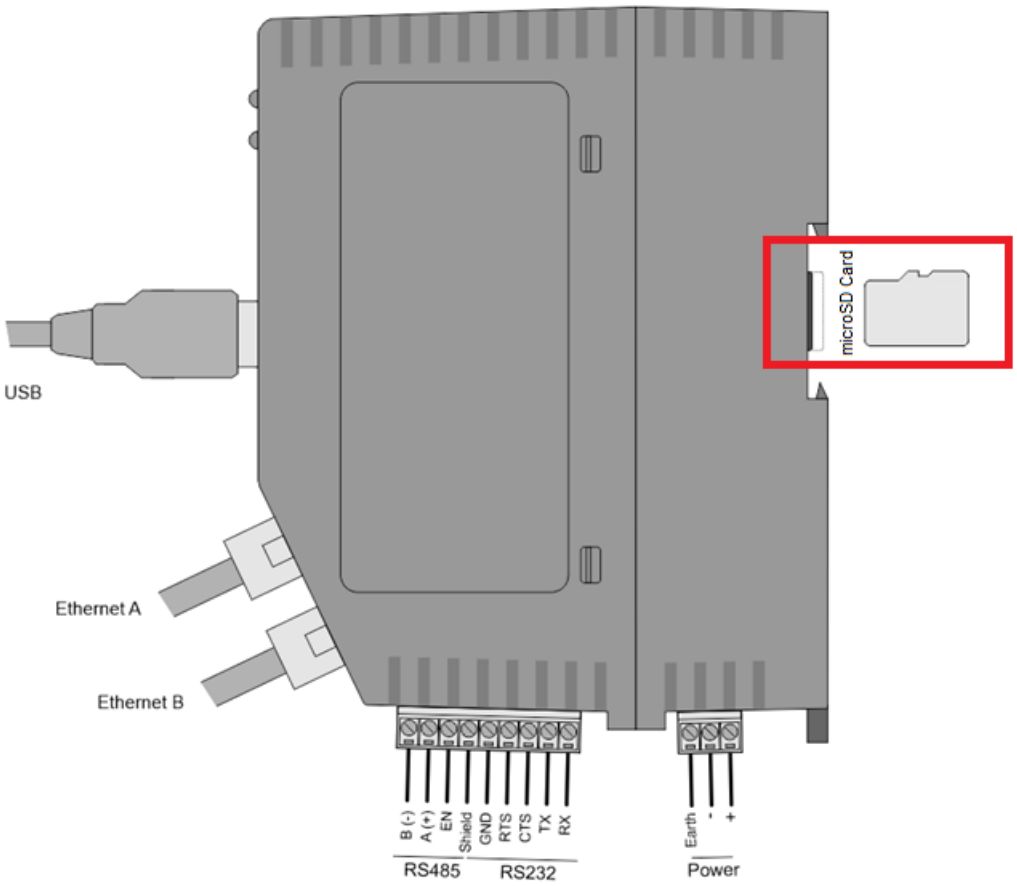


Figure 4.1 – Module side view – microSD Card Slot

Important: Ensure that the microSD Card has been formatted for FAT32.

Important: All needed files must be copied into the root directory of the microSD Card. The module will not use files which are in folders.

4.1 Firmware

The user can copy the required firmware (Download at: www.prosoft-technology.com) onto the root directory of the microSD Card.

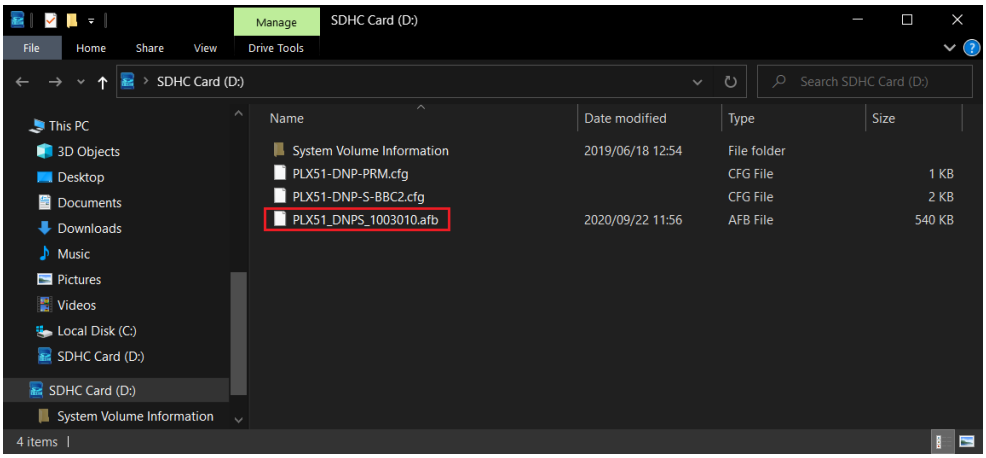


Figure 4.2 – microSD Card – firmware file

Important: The filename of the firmware file must not be changed.

Important: If more than one firmware file, with different firmware revisions, of the same product is on the microSD Card, it can cause the module to constantly upgrade the module.

If a faulty module is replaced, the user can insert the microSD Card with the firmware file on into the new module. While the module is booting, it can detect if the firmware on the new module is different from that on the microSD Card. If so, the firmware will either be upgraded or downgraded to the firmware revision on the microSD Card.

4.2 Configuration

If a faulty module is replaced, the user can insert the microSD Card with the configuration file on into the new module. The new module will determine if the configuration on the microSD Card is different than the currently loaded configuration (even when there is no configuration on the module). If different, the configuration on the microSD Card will be downloaded into the module's NV memory before the module starts executing.

The user can add the PLX50CU configuration file to the microSD Card root directory in one of two ways: Manual copy or a PLX50CU upload.

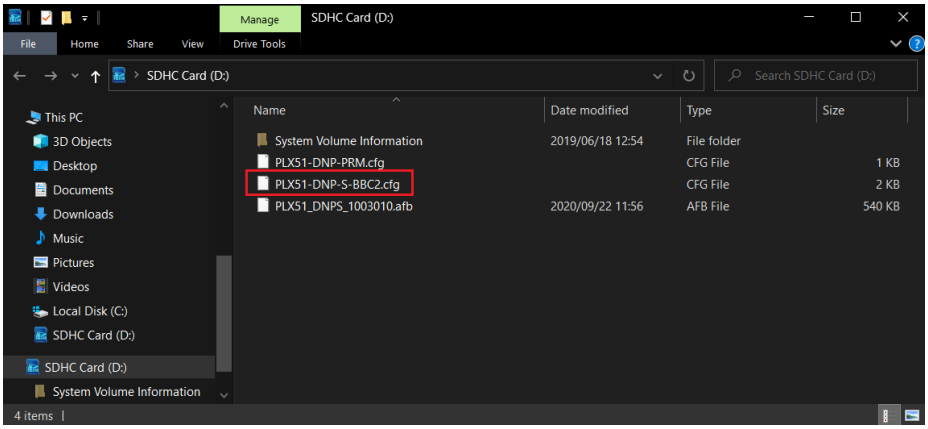


Figure 4.3 – microSD Card – configuration file

4.2.1 Manual Copy

Once the user has created the configuration in the PLX50CU, the configuration can be exported to a file to be used on the microSD Card. The user can copy this file into the root directory of the microSD Card.

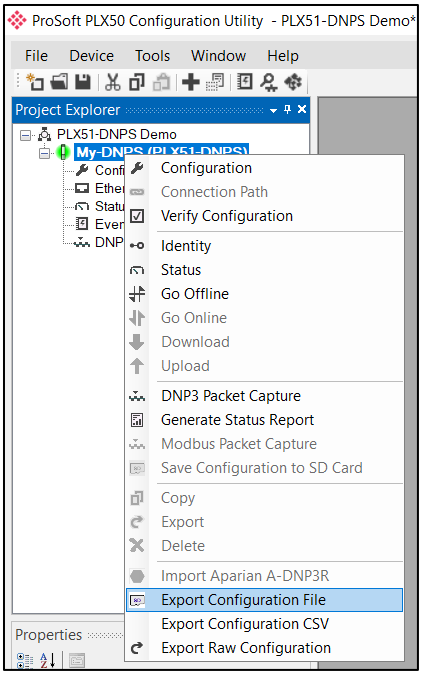


Figure 4.4 – Configuration export for microSD card

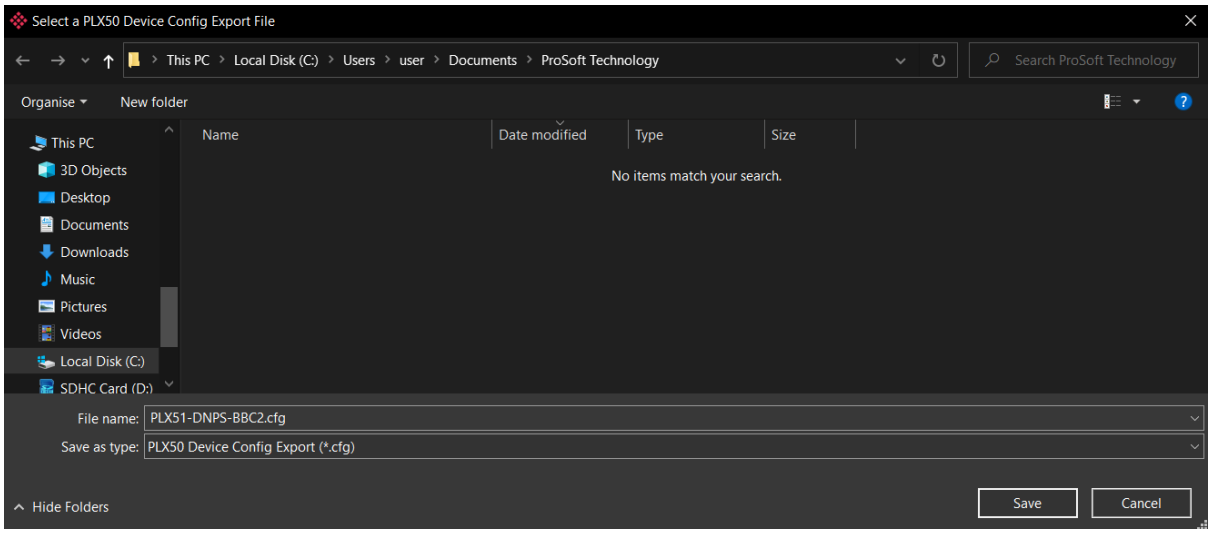


Figure 4.5 – Configuration export for microSD card

Important: The filename of the configuration file must not be changed.

Important: If more than one configuration file, with different configuration signatures, of the same product is on the microSD Card, then only the last configuration will be used.

4.2.2 PLX50CU Upload

When the microSD Card has been inserted into the module and is online with the module in PLX50CU, the user can directly upload the configuration to the microSD Card using the *Save Configuration to SD Card* option. This will copy the configuration that has been downloaded to the module directly to the microSD Card without the need to remove it from the module and inserted into a PC.

Important: All other configuration files in the microSD Card root directory will be deleted when the upload is complete.

Note: If the PLX51-DNPM module is using DNP3 Secure Authentication, then the Update Key will be encrypted and saved on the microSD Card. This will allow a replacement PLX51-DNPM to communicate using DNP3 Secure Authentication.

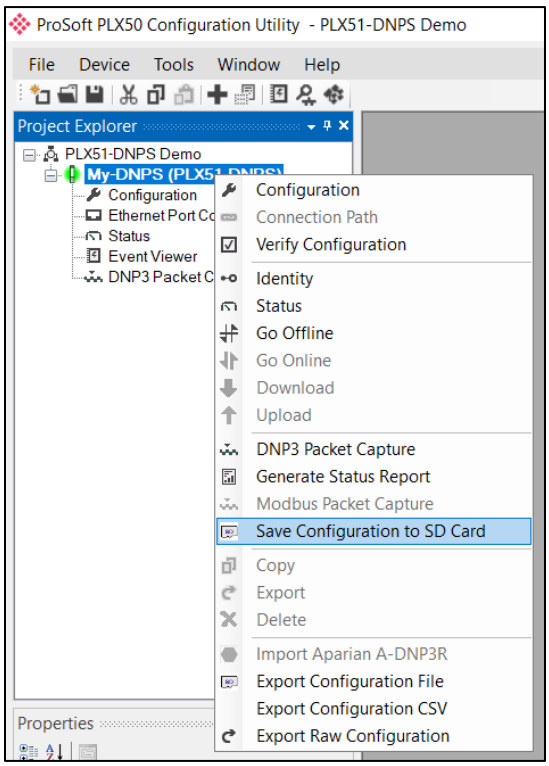


Figure 4.6 – Save configuration to microSD card

5 Logix Operation

5.1 Message Routing

When the module has been correctly set up, the DNP3 message initiator will send a read/write to a certain DNP3 group and variation which will then be routed to a Logix tag. The messages sent by the initiator must be completed with the correct data for successful operation. There are various indicators to determine if the mapping is routing the DNP3 messages correctly. Refer to the diagnostics section of this document for a more detailed explanation of the various indicators that can be used to diagnose the module.

5.2 RSLogix 5000 Assemblies

When the module operates in a Logix “owned” mode the Logix controller will establish a class 1 cyclic communication connection with the PLX51-DNPM. An input and output assembly is exchanged at a fix interval. The UDTs provided will convert the input and output arrays into tag based assemblies. Refer to the additional information section in this document for the input and output UDTs.

MyDNPM:I	{...}	{...}		_0135:PL
MyDNPM:I.ConnectionFaulted	0		Decimal	BOOL
MyDNPM:I.InstanceNameLength	0		Decimal	DINT
MyDNPM:I.Status	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNPM:I.ReactiveTagMode	0		Decimal	BOOL
MyDNPM:I.ScheduledTagMode	0		Decimal	BOOL
MyDNPM:I.UnscheduledMode	0		Decimal	BOOL
MyDNPM:I.ConfigurationValid	0		Decimal	BOOL
MyDNPM:I.RoutingInhibited	0		Decimal	BOOL
MyDNPM:I.DNP3EventlogOk	0		Decimal	BOOL
MyDNPM:I.DNP3EventlogOverflow	0		Decimal	BOOL
MyDNPM:I.ModbusCommsOk	0		Decimal	BOOL
MyDNPM:I.MasterTagStatus_0_31	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNPM:I.MasterTagStatus_32_63	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNPM:I.MasterTagStatus_64_95	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
■ ■ ■				
MyDNPM:I.MasterTagStatus_960_991	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNPM:I.MasterTagStatus_992_1023	2#0000_0000_0000_0000_0000_0000_0000_0000		Binary	DINT
MyDNPM:I.TransactionRate	0		Decimal	DINT
MyDNPM:I.Temperature	0.0		Float	REAL
MyDNPM:I.DNP3RxPacketCount	0		Decimal	DINT
MyDNPM:I.DNP3TxPacketCount	0		Decimal	DINT
MyDNPM:I.DNP3ChecksumErrors	0		Decimal	DINT
MyDNPM:I.DNP3MsgTimeout	0		Decimal	DINT
MyDNPM:I.AuthenticationFailures	0		Decimal	DINT
MyDNPM:I.SessionKeyChanges	0		Decimal	DINT
MyDNPM:I.TagReads	0		Decimal	DINT
MyDNPM:I.TagWrites	0		Decimal	DINT
MyDNPM:I.TagConnectionFailures	0		Decimal	DINT
MyDNPM:I.TagErrors	0		Decimal	DINT
MyDNPM:I.MasterEventBufferIndex	0		Decimal	DINT

Figure 5.1 - Input assembly structure

5.2.1 Input Assembly

The following parameters are used in the input assembly of the module.

Parameter	Data Type	Description
Instance	STRING	This parameter is the instance name of the module that was configured under the general DNP3 configuration in PLX50 Configuration Utility.
Status.OutstationTagMode	BOOL	Set if the module is operating in Outstation Tag mode.
Status.MasterTagMode	BOOL	Set if the module is operating in Master Tag mode.
Status.UnscheduledMode	BOOL	Set if the module is operating in Unscheduled mode.
Status.ConfigurationValid	BOOL	Set if a valid configuration is executing in the module.
Status.RoutingInhibited	BOOL	Set when the module's routing function has been inhibited. Routing can be inhibited by setting a bit in the output assembly of the module.
Status.DNP3EventLogOk	BOOL	The DNP3 event log was correctly loaded on startup.
Status.DNP3EventLogOverflow	BOOL	At least one of the DNP3 Groups have reached the maximum allowed DNP3 events of 100,000.
MasterTagStatus.MasterTagStatus0…999	BOOL[1024]	Each bit represents the status of the last scheduled transaction for that specific map item. A true value indicates success.
TransactionRate	DINT	The transaction rate is the number of DNP3 messages per second that the module is currently routing.
DeviceTemperature	REAL	The internal temperature of the module.
DNP3RxPacketCount	DINT	The total number of DNP3 packets received by the module.
DNP3TxPacketCount	DINT	The number of DNP3 packets sent by the module.
DNP3ChecksumErrors	DINT	The number of corrupted DNP3 packets received by the module.
DNP3MsgTimeout	DINT	The number of timed-out DNP3 packets sent by the module. Thus no reply was received.
Authentication Failures	DINT	The amount of authentication failures detected by the module. This could indicate the presence of a security threat in the form of an attacker.
Session Key Changes	DINT	The amount of session key changes done.
TagReads	DINT	The total number of tag reads executed by the module when operating in Tag Map mode.
TagWrites	DINT	The total number of tag writes executed by the module when operating in Tag Map mode.
TagConnectionFailures	DINT	The number of failed class 3 connection attempts when operating in Tag Map mode. Tag reading and writing requires the module to first establish a class 3 connection with the Logix Controller.
TagErrors	DINT	The number of failed tag access (read/write) requests when operating in tag Map mode. These may include privileged violations, non-existing tags, etc.
MasterEventBufferIndex	DINT	The Master Event Tag UDT array index number where the next event received from the master will be unloaded.

Table 5.1 - RSLogix 5000 input assembly parameters

5.2.2 Output Assembly

The following parameters are used in the output assembly of the module.

Parameter	Data Type	Description
RoutingInhibit	BOOL	This bit inhibits the module routing capabilities. When set, no DNP3 messages will be routed. This may be required in applications running a redundant DNP3 network where one of the PLX51-DNPMs is to run in a hot-standby mode.

Table 5.2 - RSLogix 5000 output assembly parameters

5.3 Unscheduled Messaging

When the PLX51-DNPM is configured in Unscheduled Mode, it will process DNP3 message requests sent from Logix via a message instruction.

Note: The user will need to build the DNP3 objects for the application layer in the request data of the unscheduled message. See Appendix A for more information on this.

To simplify the configuration of the required message, a number of UDTs have been preconfigured and are available on the ProSoft Technology webpage (see the "Additional Information" section).

Important: In this mode the PLX51-DNPM does support Secure Authentication, but Aggressive mode is **NOT** supported. The DNP3 Master will also change session keys each time the request destination is different from the previous request.

Important: In this mode the PLX51-DNPM does **NOT** support unsolicited responses from DNP3 Outstations.

The message instruction should be set up as follows:

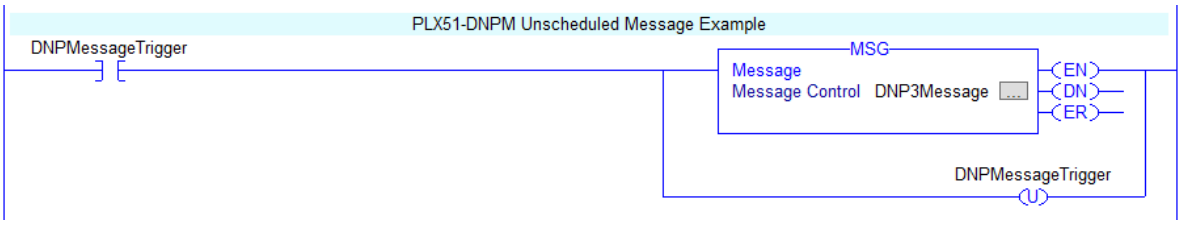


Figure 5.2 - Message Instruction

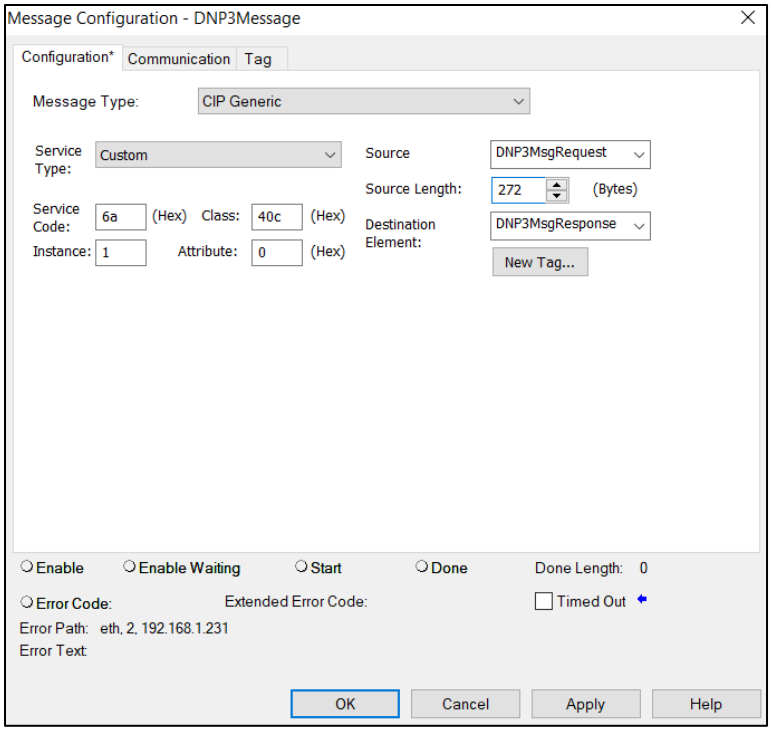


Figure 5.3 - Message Configuration

Parameter	Description
Message Type	CIP Generic
Service Type	Custom
Service Code	6A (Hex) - Unscheduled DNP3 Pass-through
Class	40C (Hex)
Instance	1
Attribute	0
Source Element	The request tag instance. Must follow the structure of the ***PSDNP3MsgRequest*** UDT.
Source Length	272
Destination Element	The response tag instance. Must follow the structure of the ***PSDNP3MsgResponse*** UDT.

Table 5.3. - Message Configuration Paramaters

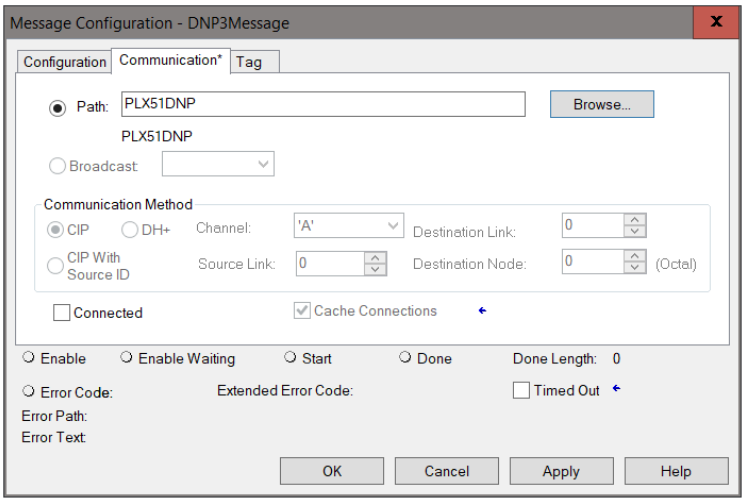


Figure 5.4 - Messsage Configuration - Communication

The Path must be configured to that of the PLX51-DNPM module. If the PLX51-DNPM has been added in the I/O tree, then the Browse option can be used to select the path.

Alternatively, enter the CIP path in the format **1,X,2,IP**, where:

1 represents the backplane port,
X represents the slot of the Ethernet bridge module,
2 represents the Ethernet port of the Ethernet bridge module and
IP represents the IP address of the PLX51-DNPM module.
For example: **1,1,2,192.168.1.41**

The request tag (for example, ***DNP3MsgRequest***) should be configured as follows:

Name	Value	Style	Data Type
DNP3MsgRequest	{...}		PSDNP3MsgRequest
DNP3MsgRequest.DestinationNode	1	Decimal	INT
DNP3MsgRequest.RequestDataSize	5	Decimal	INT
DNP3MsgRequest.IPAddress	{...}	Decimal	INT[4]
DNP3MsgRequest.IPAddress[0]	192	Decimal	INT
DNP3MsgRequest.IPAddress[1]	168	Decimal	INT
DNP3MsgRequest.IPAddress[2]	1	Decimal	INT
DNP3MsgRequest.IPAddress[3]	210	Decimal	INT
DNP3MsgRequest.Function	1	Decimal	DINT
DNP3MsgRequest.RequestData	{...}	Decimal	SINT[255]

Figure 5.5 - Unscheduled Message Request Tag

Parameter	Description
Destination Node	The DNP3 node address of the destination device.
Request Data Size	The size of the request data being sent
IP Address	The IP address of the remote device when an Ethernet port was selected above.
Function	The DNP3 application layer function that will be used. Refer to the DNP3 documentation in the Additional information section.
Request Data	DNP3 Object header and objects. Refer to the DNP3 documentation in the Additional information section.

Table 5.4. - Unscheduled Message Request Parameters

Name	Value	Style	Data Type
DNP3MsgResponse	{...}		PSDNP3MsgResponse
DNP3MsgResponse.DNP3Indicators	0	Decimal	INT
DNP3MsgResponse.ResponseDataSize	0	Decimal	INT
DNP3MsgResponse.ResponseData	{...}	Decimal	SINT[255]

Figure 5.6. - Unscheduled Message Response Tag

Parameter	Description
DNP3 Indicators	These 16bits will provide return information of the remote DNP3 device. Refer to the DNP3 documentation in the "Additional information" section. Bit 0 – Broadcast Bit 1 – Class 1 events Bit 2 – Class 2 events Bit 3 – Class 3 events Bit 4 – Need Time Bit 5 – Local control Bit 6 – Device trouble Bit 7 – Device restart Bit 8 – Function code not supported Bit 9 – Object unknown Bit 10 – Parameter error Bit 11 – Event buffer overflow Bit 12 – Already executing Bit 13 – Configuration corrupt Bit 14 – Reserved Bit 15- Reserved
Response Length	Length of the response data received.
Response Data	Response to the DNP3 application layer object request.

Table 5.5. - Unscheduled Message Response Parameters

After the message has been executed successfully (Msg.DN) the Response Data should be copied (using a COP instruction) to the required Data Tag of an appropriate data type.

5.3.1 Example

In the following example, the unscheduled message instruction is used to read three Analog Inputs in 32-bit no flag format, from a remote Ethernet DNP3 device located at IP address 192.168.1.65. The Analog Input points required are 0, 1 & 2.

The standard DNP3MessageRequest structure is populated as shown in the figure below.

DNP3MsgRequest	{...}	
DNP3MsgRequest.DestinationNode	2	
DNP3MsgRequest.RequestDataSize	7	
DNP3MsgRequest.IPAddress	{...}	
DNP3MsgRequest.IPAddress[0]	192	IP Address of DNP3 Device
DNP3MsgRequest.IPAddress[1]	168	
DNP3MsgRequest.IPAddress[2]	1	
DNP3MsgRequest.IPAddress[3]	65	
DNP3MsgRequest.Function	1	Function : 1 - Read
DNP3MsgRequest.RequestData	{...}	
DNP3MsgRequest.RequestData[0]	30	Group : 30 - Analog Inputs
DNP3MsgRequest.RequestData[1]	3	Variant : 3 - 32 bit value without flag
DNP3MsgRequest.RequestData[2]	1	Qualifier : 1 - No Prefix, 16-bit Start and Stop Indexes
DNP3MsgRequest.RequestData[3]	0	Start Index : 0
DNP3MsgRequest.RequestData[4]	0	
DNP3MsgRequest.RequestData[5]	2	Stop Index : 2
DNP3MsgRequest.RequestData[6]	0	

Figure 5.7. – DNP3 Message Request Example

The response to the message is shown in the next figure. The data values can them be copied (COP instruction) to the required tag destination. The DNP3 Group, Variant and Qualifier codes are shown in the Appendix.

DNP3MsgResponse	{...}	
DNP3MsgResponse.DNP3Indicators	0	Internal indicators : 0 - No issues
DNP3MsgResponse.ResponseDataSize	19	
DNP3MsgResponse.ResponseData	{...}	
DNP3MsgResponse.ResponseData[0]	30	Group : 30 - Analog Inputs
DNP3MsgResponse.ResponseData[1]	3	Variant : 3 - 32 bit value without flag
DNP3MsgResponse.ResponseData[2]	1	Qualifier : 1 - No Prefix, 16-bit Start and Stop Indexes
DNP3MsgResponse.ResponseData[3]	0	Start Index : 0
DNP3MsgResponse.ResponseData[4]	0	
DNP3MsgResponse.ResponseData[5]	2	Stop Index : 2
DNP3MsgResponse.ResponseData[6]	0	
DNP3MsgResponse.ResponseData[7]	103	Data Point 0 : Value = 103
DNP3MsgResponse.ResponseData[8]	0	
DNP3MsgResponse.ResponseData[9]	0	
DNP3MsgResponse.ResponseData[10]	0	
DNP3MsgResponse.ResponseData[11]	104	Data Point 1 : Value = 104
DNP3MsgResponse.ResponseData[12]	0	
DNP3MsgResponse.ResponseData[13]	0	
DNP3MsgResponse.ResponseData[14]	0	
DNP3MsgResponse.ResponseData[15]	105	Data Point 2 : Value = 105
DNP3MsgResponse.ResponseData[16]	0	
DNP3MsgResponse.ResponseData[17]	0	
DNP3MsgResponse.ResponseData[18]	0	

Figure 5.8. – DNP3 Message Response Example

6 DNP3 Operation

6.1 General

DNP3 supports various formats for each group of data points. The different formats can include additional data to that of the main requested variable needed (for example, Status, Time, etc.). For this reason, the Logix or Modbus controller needs to map the data for these formats to User-Defined Data Types (UDTs) or Modbus Registers.

6.1.1 EtherNet/IP

A range of UDTs have been provided, allowing for easy and seamless integration with the Logix Controller. Below are some examples of how these UDTs should be used.

When DNP3 group 30 (Analog Inputs) has been selected there is a range of variations that can be used providing different format and additional information. If variation 5 was selected this would indicate that the data returned will be a Single Floating Point number with a Flag (or Status bits) as shown below:

Logix Controller Mapping (max. of 3 items.)

	Target Name	Controller Path	Browse
▸	NorthCPU	192.168.1.104,1,0	...
	SouthCPU	192.168.1.6,1,0	...
*			

Tag Mapping Items (max. of 1000 items.)

	Group	Variation	Index Start	Index Count	Target Name	Target Tag	Browse	Enable Events	Event Variation	DB
▸	G030 AnalogInputs	V05 Single Float + Flag	0	5	NorthCPU	VoltageInputs[0]	...	☐		
*										

Figure 6.1 – DNP3 Group 30 selected with Variation 5

Next, select the correct UDT provided in the example RSLogix 5000 project (see the Additional Information section for further details). In this case the example project has a UDT called *PSDNP3AnalogInputRealFlag* which should be used as this will correctly map the additional information from the DNP3 Object as shown below. The UDT is shown below:

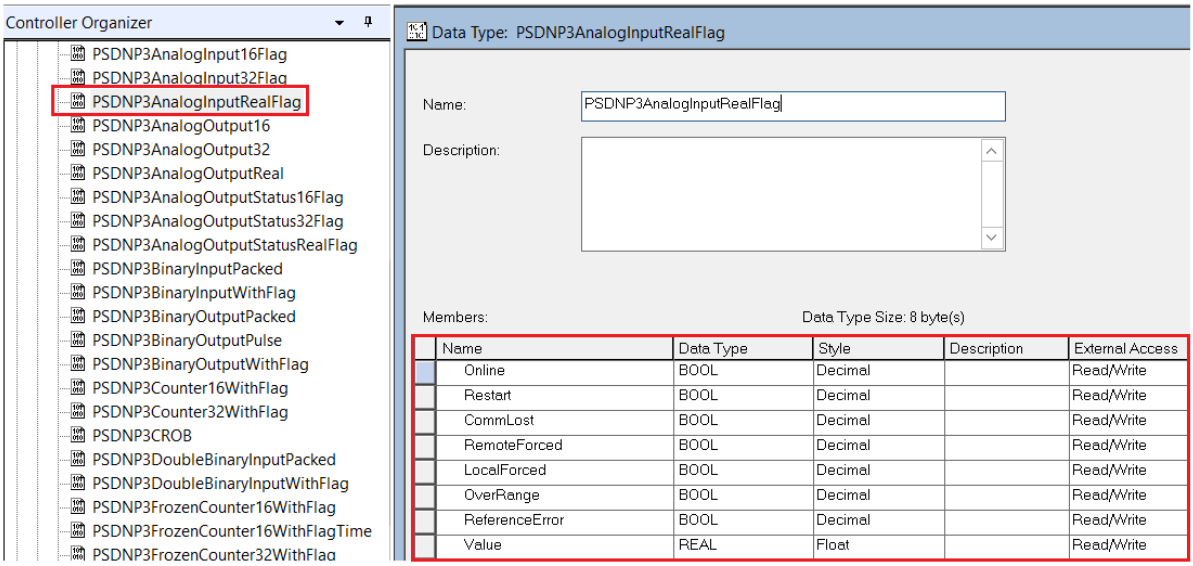


Figure 6.2 – Supported UDT for DNP3 Group 30 with Variation 5

A new tag or array must be created to match the DNP3 Group and Variation.

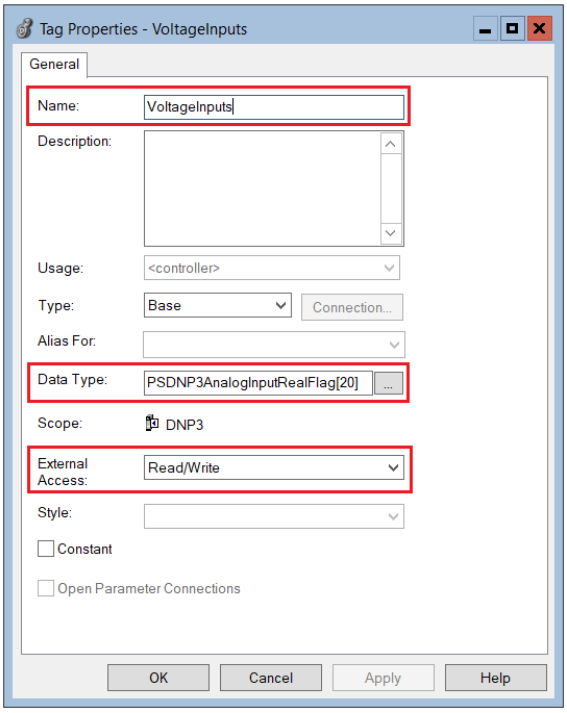


Figure 6.3 – New Tag with Supported UDT for DNP3 Group 30 with Variation 1

In PLX50 Configuration Utility the ***Target Tag*** selected must be the Tag or Array with Data Type ***PSDNP3AnalogRealFlag***.

The same procedure can be followed for numerous other DNP3 Group and Variation combinations.

Important: If an incorrect UDT is used, the PLX51-DNPM will either abandon the routing procedure once it detects the data types are different (the Logix Data Type Mismatch statistic will increase) or incorrect data will be received by the Logix Controller.

6.1.2 Modbus

When selecting Modbus, the DNP data will be mapped to the configured Modbus Register (HR, IR, IS, CS) based on the formatting below. The PLX51-DNPM supports the full Modbus range for each Modbus register.

The DNP3 data will be formatted as shown below for Modbus Registers.

DNP3 Group	DNP3 Variation	DNP3 Description	Modbus Format
1	1	Packed	No Padding
1	2	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
3	1	Packed	No Padding
3	2	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
10	1	Packed	No Padding
10	2	Status + Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
12	1	CROB	2 Bytes Transmit Flag + 11 Bytes Data + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
20	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
20	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
20	5	32bit + No Flag	No Padding
20	6	16bit + No Flag	No Padding
21	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
21	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
21	5	32bit + Flag + Time	1 Byte Flag + 1 Byte Pad + 4 Bytes Data + 6 Bytes Time
21	6	16bit + Flag + Time	1 Byte Flag + 1 Byte Pad + 2 Bytes Data + 6 Bytes Time
21	9	32bit + No Flag	No Padding
21	10	16bit + No Flag	No Padding
30	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
30	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
30	3	32bit + No Flag	No Padding
30	4	16bit + No Flag	No Padding
30	5	Float + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
40	1	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
40	2	16bit + Flag	1 Byte Flag + 1 Byte Pad + 2 Bytes Data
40	3	Float + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
41	1	32bit	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad

			Note: The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	2	16bit	2 Bytes Transmit Flag + 2 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	3	Float	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
102	1	8bit	No Padding
110	1	8bit	There is no padding for the octet strings. The string value will be read or written to the Modbus Registers on a per byte basis (up to 255 bytes per octet string). Once the string ends, a zero will be written to the last byte. This zero must be used as the delimiter for the string.

Table 6.1 – Modbus Format for DNP3 Group/Variation Data

6.1.3 Concentrator

When selecting Concentrator Mode, the DNP data will be collected from outstations (as per the configuration in the mapped items) and saved locally for the DNP SCADA Master to read. The data can be read from an outstation at a specific data point index and then saved at a different data point index.

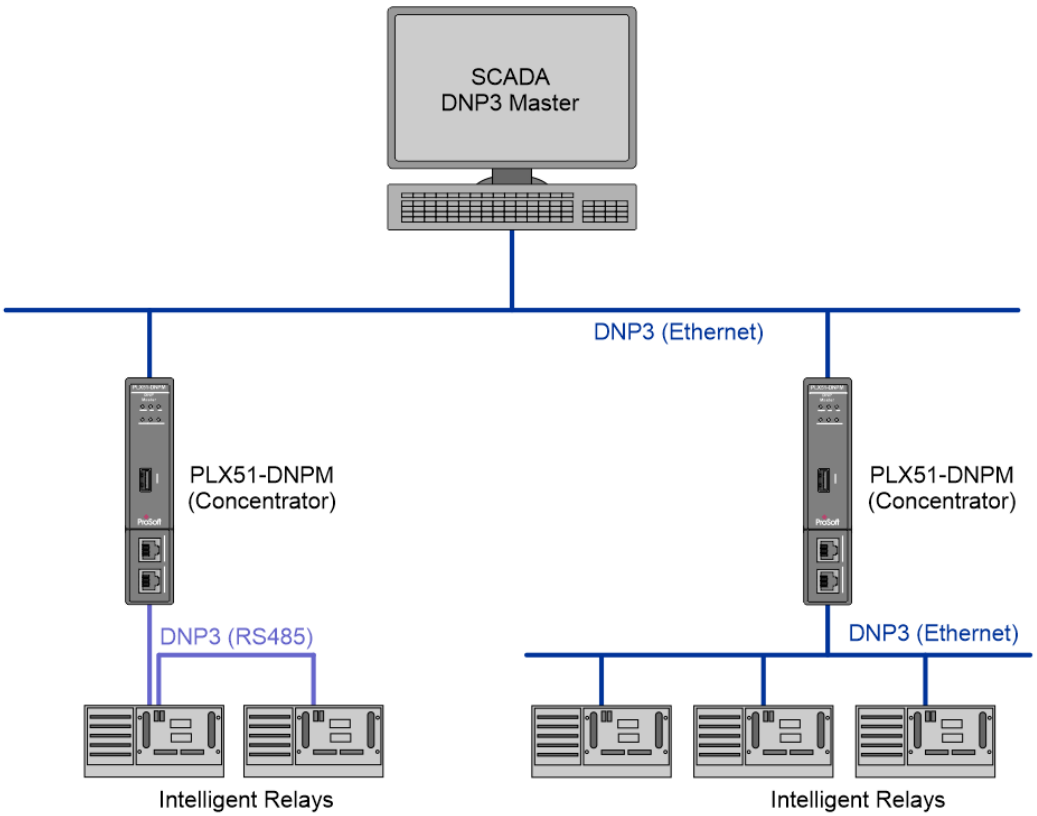


Figure 6.4 – PLX51-DNPM in concentrator mode with DNP SCADA Master

In the example below, the DNPM (in concentrator mode), will read 5 Analog Inputs (data point index 0 to 4) from outstation 4 at IP address 192.168.1.222 at a Scan Rate of A (which in this example is 1000ms). The data received from the outstation is stored locally and can then be accessed by the DNP SCADA Master at Analog Inputs data point index 5 – 9.

Concentrator Mapping Items (max. of 1000 items.)

	En	DNP3 Function	Scan	IP Address	Node	Group	Variation	Index Start	Index Count	Conc. Index
	☑	Read	A	192.168.1.222	4	G030 AnalogInputs	V05 Single Float + Flag	5	3	10
▸▸	☐									

Figure 6.5 – PLX51-DNPM in concentrator mode example

6.2 Analog/Binary Output Commands

The select/operate, direct-operate, and direct-operate with no response DNP3 application functions (which will collectively be referred to as operate commands) are command-based functions. Unlike a read function these functions only execute when the DNP3 Master triggers a change (for example, open a relay or change an analog output). These functions are typically used for Control Relay Output Blocks (CROB) and Analog Output Blocks (AOB). The three functions are described below:

Function	Description
Select/Operate	The select/operate function is a two-step operate where the Master first “Arms” the outputs with the select function before enabling the “Armed” output with the operate function.
Direct-Operate	The Direct-Operate function has a similar outcome to the Select/Operate function but is a one-step function. Thus, the outputs are “Armed” and executed in the same function.
Direct-Operate with no response	The Direct-Operate with no response function is similar to the Direct-Operate but does not require an acknowledgement that the operation has been executed.

Table 6.2 – Select/Operate, Direct-operate, and Direct-Operate no reponse functions

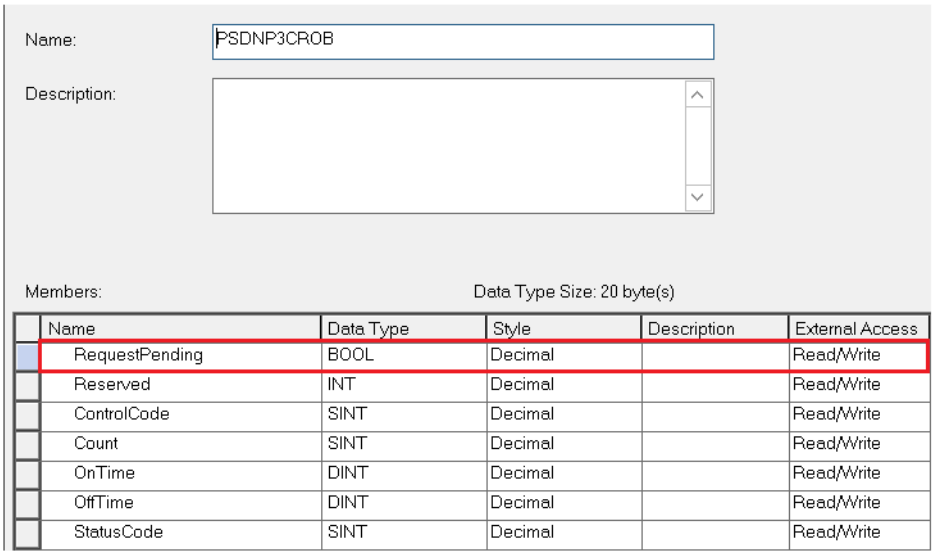
Important: The PLX51-DNPM can only send one Operate request at a time.

6.2.1 EtherNet/IP

The PLX51-DNPM uses a *RequestPending* bit in the Logix UDT tags (refer to the example code for provided UDTs) to inform the controller that a operate request must be executed (Master mode).

Important: When the PLX51-DNPM is in Master mode, command functions will only be executed once the *RequestPending* bit has been set. Once the command has been executed, the bit will automatically be cleared. The *RequestPending* bit must therefore be set only after all the other values have been set.

An example of a UDT with the *RequestPending* bit is shown below:



Name	Data Type	Style	Description	External Access
RequestPending	BOOL	Decimal		Read/Write
Reserved	INT	Decimal		Read/Write
ControlCode	SINT	Decimal		Read/Write
Count	SINT	Decimal		Read/Write
OnTime	DINT	Decimal		Read/Write
OffTime	DINT	Decimal		Read/Write
StatusCode	SINT	Decimal		Read/Write

Figure 6.6 – UDT for operate commands

Sending Output Commands

When the PLX51-DNPM is in Master mode the Logix mapped Tag will be read at the configured scheduled interval, but only once the *RequestPending* bit is set will the operate command be executed and sent to the DNP3 outstation. The automatic clearing of *RequestPending* bit provides Confirmation that the command executed correctly.

DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Target Name	Target Tag
Sel-Op	B	4	G012 BinaryOutputCommands	V01 CROB	0	5	NorthCPU	DNP3G12V01[0]
Read	B	4	G010 BinaryOutputs	V02 Output Status + Flags	0	5	NorthCPU	DNP3G10V02[0]
Sel-Op	B	4	G041 AnalogOutputs	V02 16-bit	0	5	NorthCPU	DNP3G41V02[0]
Read	B	4	G040 AnalogOutputStatus	V02 16-bit + Flag	0	5	NorthCPU	DNP3G40V02[0]

Figure 6.7 – Master Mapping for Output Commands

The master can either read the Output Status directly or process the resulting event to obtain the status of the output.

Control Relay Output Block (CROB) Parameters

An example of a CROB command (Group 12 Variation 1) tag is shown below.

Name	Value	Style	Data Type
DNP3G12V01[0]	{...}		PSDNP3CROB
DNP3G12V01[0].RequestPending	0	Decimal	BOOL
DNP3G12V01[0].Reserved	0	Decimal	INT
DNP3G12V01[0].ControlCode	4	Decimal	SINT
DNP3G12V01[0].Count	5	Decimal	SINT
DNP3G12V01[0].OnTime	200	Decimal	DINT
DNP3G12V01[0].OffTime	380	Decimal	DINT
DNP3G12V01[0].StatusCode	0	Decimal	SINT

Figure 6.8 - DNP3 CROB Group Variation 1

Below is a table of the valid CROB control codes.

Control Code	Description
0	Null
1	Pulse On
2	Pulse Off
3	Latch On
4	Latch Off

Table 6.3 - DNP3 CROB Control Codes

The Count, OnTime, and OffTime elements are only used when there is a pulse command (1 or 2). The count is the amount of pulses that must be executed whilst the OnTime and OffTime is the relevant duty cycle. Refer to the Logix example code for an implemented example.

See the *DNP3 Control Relay Output Block - CROB* section in the appendix for more information.

6.2.2 Modbus

The PLX51-DNPM uses Bit-0 of the 2 byte transmit flag to inform the controller that a operate request must be sent.

The DNP3 data will be formatted as shown below for Modbus Registers.

DNP3 Group	DNP3 Variation	DNP3 Description	Modbus Format
12	1	CROB	2 Bytes Transmit Flag + 11 Bytes Data + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	1	32bit	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	2	16bit	2 Bytes Transmit Flag + 2 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.
41	3	Float	2 Bytes Transmit Flag + 4 Bytes Data + 1 Byte Control + 1 Byte Pad **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new operate command must be sent.

Table 6.4 – Modbus format for DNP3 Operate group/variation data

Sending Output Commands

When the PLX51-DNPM is in Master mode the Modbus Register will be read at the configured scheduled interval, but only once *Bit-0* of the transmit flag is set will the operate command be executed and sent to the DNP3 outstation. The automatic clearing of *Bit-0* of the Transmit flag bit provides Confirmation that the command executed correctly.

Modbus Mapping Items (max. of 1000 items.)

	En	DNP3 Function	Scan	Node	Group	Variation	Index Start	Index Count	Register Type	Modbus Offset
	☑	Sel-Op	A	4	G012 BinaryOutputCommands	V01 CROB	0	5	HR	200
	☑	Read	A	4	G010 BinaryOutputs	V02 Output Status + Flags	0	5	HR	300
	☑	Sel-Op	A	4	G041 AnalogOutputs	V02 16-bit	0	5	HR	400
	☑	Read	A	4	G040 AnalogOutputStatus	V02 16-bit + Flag	0	5	HR	500
▸*	☐									

Figure 6.9 – Master Mapping for Output Commands

The master can either read the Output Status directly or process the resulting event to obtain the status of the output.

Control Relay Output Block (CROB) Parameters

An example of a CROB command (Group 12 Variation 1) tag is shown below.

Modbus Register	Parameter
x	Transmit Flag Bit 0 - When set a new operate must be sent
x + 1	Low Byte - Control Code High Byte - Count
x + 2	On-Time (lower 16bits)
x + 3	On-Time (upper 16bits)
x + 4	Off-Time (lower 16bits)
x + 5	Off-Time (upper 16bits)
x + 6	Low Byte - Status Code High Byte - Reserved

Table 6.5 - DNP3 CROB Group Variation 1

Below is a table of the valid CROB control codes.

Control Code	Description
0	Null
1	Pulse On
2	Pulse Off
3	Latch On
4	Latch Off

Table 6.6 - DNP3 CROB Control Codes

The Count, OnTime, and OffTime elements are only used when there is a pulse command (1 or 2). The count is the amount of pulses that must be executed whilst the OnTime and OffTime is the relevant duty cycle.

See the *DNP3 Control Relay Output Block - CROB* section in the appendix for more information.

6.2.3 Concentrator

When the PLX51-DNPM is operating in concentrator mode, the module will send a operate command to the respective outstation based on the configured *Start Index* and *Conc. Index*.

In the example below, the DNP3 SCADA Master will send an operate command to the DNPM (in concentrator mode) for data point 10 (the *Conc. Index)*. The DNPM module will in turn send that same operate command to the DNP outstation with IP Address 192.168.1.222 and node 4, for data point 5.

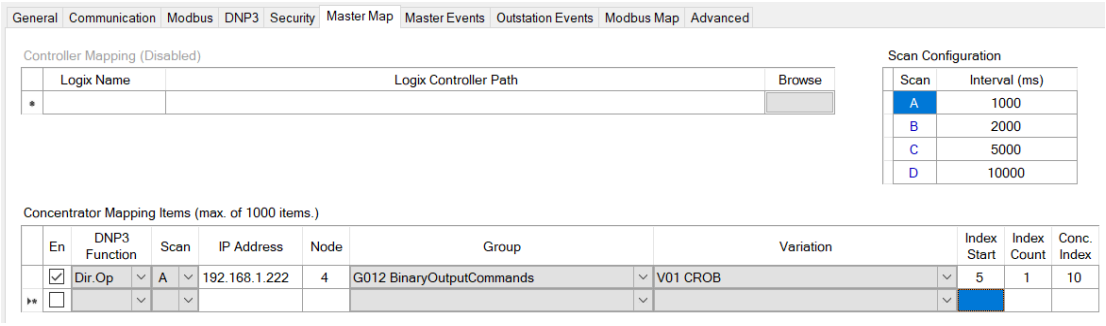


Figure 6.10 – DNPM Concentrator Operate Commands

6.3 Counter and Analog Input Freeze Commands

The PLX51-DNPM in Master mode, with the Operating Interface set to EtherNet/IP or Modbus, supports sending Freeze commands. This allows the operating interface to trigger a freeze command for DNP Counters or Analog Inputs. Unlike a read function these functions only execute when the DNPM triggers a change to the request flag.

Important: The PLX51-DNPM can only send one Freeze request at a time.

Important: The DNPM supports Freeze, Freeze with No-Ack, Freeze and Clear, and Freeze and Clear with No-Ack commands.

6.3.1 EtherNet/IP

The PLX51-DNPM uses a *RequestPending* bit in the Logix UDT tags (refer to the example code for provided UDTs) to inform the controller that a freeze request must be executed (Master mode).

Important: When the PLX51-DNPM is in Master mode, freeze functions will only be executed once the *RequestPending* bit has been set. Once the freeze has executed, the bit will automatically be cleared. The *RequestPending* bit must therefore be set only after all the other values have been set.

An example of a UDT with the *RequestPending* bit is shown below:

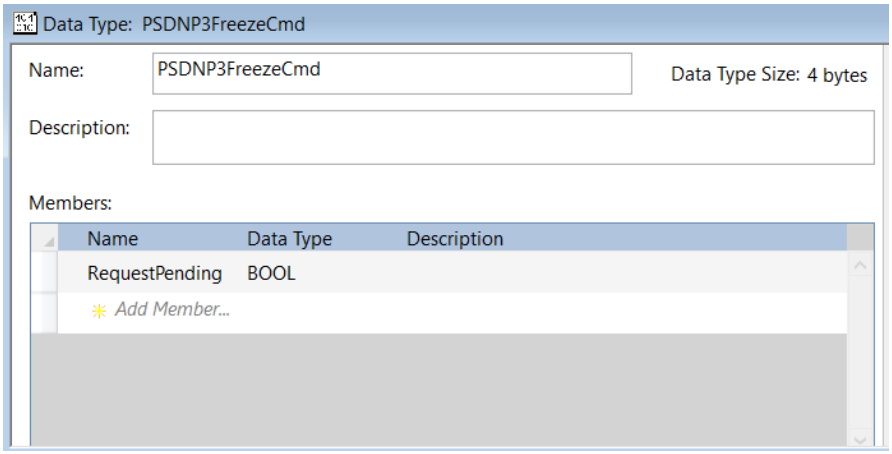


Figure 6.11 – UDT for freeze commands

Sending Freeze Commands

When the PLX51-DNPM is in Master mode the Logix mapped Tag will be read at the configured scheduled interval, but only once the *RequestPending* bit is set will the freeze command be executed and sent to the DNP3 outstation. The automatic clearing of *RequestPending* bit provides Confirmation that the command executed correctly.

Important: If there are, for example, 5 items mapped for the index counter, then setting the freeze request bit at offset 3 in the Logix tag will execute a freeze command for DNP counter object at index 3.

Tag Mapping Items (max. of 1000 items.)

	En	DNP3 Function	Scan	IP Address	Node	Group	Variation	Index Start	Index Count	Target Name	Target Tag	Browse
	☑	Freeze	A	192.168.0.222	4	G020 Count...	V01 32-bit +...	0	1	NorthCPU	DNP3G20_Free...	...
	☑	Read	A	192.168.0.222	4	G021 Froze...	V01 32-bit +...	0	1	NorthCPU	FrozenCounter[0]	...
▶*	☐											

Figure 6.12 – Master Mapping for Freeze Commands

The master can either read read the frozen values by reading the DNP Frozen Counters or DNP Frozen Analog in mapping.

6.3.2 Modbus

The PLX51-DNPM uses Bit-0 of the 2 byte transmit flag to inform the controller that a freeze request must be sent.

The DNP3 data will be formatted as shown below for Modbus Registers.

DNP3 Group	DNP3 Variation	DNP3 Description	Modbus Format
20	Any	Freeze Request	2 Bytes Transmit Flag **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new freeze command must be sent.
30	Any	Freeze Request	2 Bytes Transmit Flag **Note:** The transmit flag Bit 0 is used to indicate to the DNPM that a new freeze command must be sent.

Table 6.7 – Modbus format for DNP3 freeze commands

Sending Freeze Commands

When the PLX51-DNPM is in Master mode the Modbus Register will be read at the configured scheduled interval, but only once *Bit-0* of the transmit flag is set will the freeze command be executed and sent to the DNP3 outstation. The automatic clearing of *Bit-0* of the Transmit flag bit provides Confirmation that the command executed correctly.

Important: If there are, for example, 5 items mapped for the index counter, then setting the freeze request bit at offset 3 in the Modbus Registers will execute a freeze command for DNP counter object at index 3.

Modbus Mapping Items (max. of 1000 items.)

	En	DNP3 Function	Scan	IP Address	Node	Group	Variation	Index Start	Index Count	Register Type	Modbus Offset
	☑	Freeze	A	192.168.0.222	4	G020 Counters	V01 32-bit + Flag	0	1		100
	☑	Read	A	192.168.0.222	4	G021 FrozenCounters	V01 32-bit + Flag	0	1		200
*	☐										

Figure 6.13 – Master Mapping for Freeze Commands

The master can either read read the frozen values by reading the DNP Frozen Counters or DNP Frozen Analog in mapping.

6.3.3 Concentrator

When the PLX51-DNPM is operating in concentrator mode, the module will send a feeze command to the respective outstation based on the configured *Start Index* and *Conc. Index*.

In the example below, the DNP3 SCADA Master will send a freeze command to the DNPM (in concentrator mode) for data point 10 (the *Conc. Index)*. The DNPM module will in turn send that same freeze command to the DNP outstation with IP Address 192.168.1.222 and node 4, for data point 5.

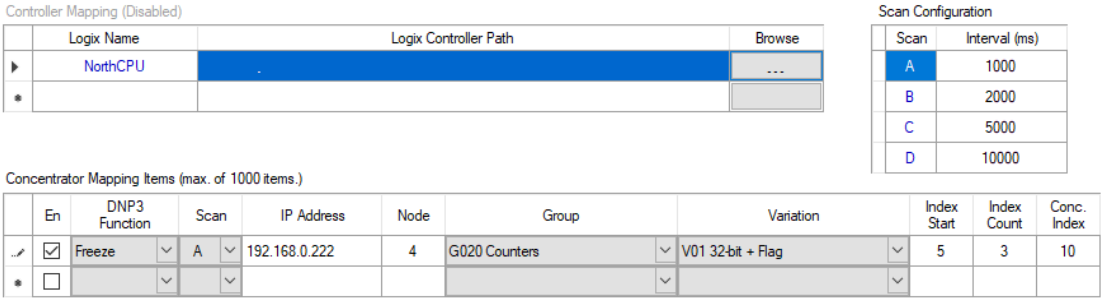


Figure 6.14 – DNPM Concentrator Freeze Commands

6.4 DNP3 Events and Unsolicited Responses

Events are generated in the Outstation and processed by the Master. Events can be grouped during the unloading process by either their assigned Class or Data Type Group (for example, Group 32 – Analog). Unloading can be initiated by the Master via a set interval poll or initiated by the Outstation via an Unsolicited Response message. The DNP3 Master controls each Outstation's ability to send Unsolicited Messages.

Unsolicited Events can be used to reduce network traffic by reducing or turning off polled data exchanges. This method is referred to as Report-By-Exception.

In Master mode, DNP3 events are either written by the PLX51-DNPM directly to an event array in the Logix Controller or to the specified internal Modbus buffer.

If the PLX51-DNPM (master mode) loses connectivity to the Logix controller, received Events will not be marked as received and therefore will not be removed from the outstation's storage.

6.4.1 Master Event Unloading

The PLX51-DNPM (Master mode) can extract or receive DNP3 events from remote DNP3 Outstations.

The Module does not provide priority to unloading events, it cycles through the classes and empties all the buffers before restarting.

The setup and extracting of DNP3 events from DNP3 outstations is explained in the *DNP3 Events* section. This section will focus on the event unloading from the PLX51-DNPM into a Logix Controller or Modbus addresses.

The Event unloading attempts to unload the oldest event first. Events are unloaded into a Logix UDT tag array (Logix interface), Modbus Holding Registers (Modbus interface), or stored locally (Concentrator mode) based on the operation selected.

EtherNet/IP

This is a circular buffer arrangement where the PLX51-DNPM will start writing at array index 0 and increment the array index each time a new event is written into the Logix Controller Master Event Tag array. Events that are not processed in the Logix Event Buffer Array will be overwritten. This Master Event Index (which shows the index to which the next event will be written) can be found in the Logix Input Assembly as well as the General Status page of the module in the PLX50 Configuration Utility.

Important: Downloading updated configuration to the PLX51-DNPM resets the Event Buffer Index to zero.

The structure of the event record is shown in the tag example below.

Name	Value	Style	Data Type
DNP3MasterEventBuffer	{...}		PSDNP3MasterEvent[100]
DNP3MasterEventBuffer[0]	{...}		PSDNP3MasterEvent
DNP3MasterEventBuffer[0].EvtPending	0	Decimal	DINT
DNP3MasterEventBuffer[0].EvtGroup	42	Decimal	SINT
DNP3MasterEventBuffer[0].EvtFlags	1	Decimal	SINT
DNP3MasterEventBuffer[0].EvtSrcNodeAddress	2	Decimal	INT
DNP3MasterEventBuffer[0].EvtSrcIPAddress	{...}	Decimal	INT[4]
DNP3MasterEventBuffer[0].EvtSrcIPAddress[0]	192	Decimal	INT
DNP3MasterEventBuffer[0].EvtSrcIPAddress[1]	168	Decimal	INT
DNP3MasterEventBuffer[0].EvtSrcIPAddress[2]	1	Decimal	INT
DNP3MasterEventBuffer[0].EvtSrcIPAddress[3]	232	Decimal	INT
DNP3MasterEventBuffer[0].EvtElementIndex	0	Decimal	DINT
DNP3MasterEventBuffer[0].Reserved	0	Decimal	DINT
DNP3MasterEventBuffer[0].EvtTimeStamp	DT#2019-11-01-08:35:02.000000(GMT+02:00)	Date/Time	LINT
DNP3MasterEventBuffer[0].EvtFloatValue	66.0	Float	REAL
DNP3MasterEventBuffer[0].EvtIntegerValue	0	Decimal	DINT

Figure 6.15 – Master Event Logix Tag (UDT)

Below is an explanation of each element in the structure:

Attribute	Description
EvtPending	This bit is set when the event is written into the controller. The application code can use this bit, and subsequently clear it, when the event has been processed.
EvtGroup	This is the DNP3 group which reported the event (for example, Group 32 – Analog Input Event)
EvtFlags	Each event group has a set of status flags which indicates the states, quality, etc. of the variable in the event. See the appendix for an explanation of each Group's set of flags.
EvtSrcNodeAddress	The Node Address of the Outstation which reported the event
EvtSrcIPAddress	The IP Address of the Outstation which reported the event (note this is only valid when the PLX51-DNPM is setup for either TCP or UDP).
EvtElementIndex	This is the element offset which generated the event (Analog Input 5).
Reserved	Required to ensure 64-bit alignment.
EvtTimeStamp	This is the time (in the Outstation) when the event occurred. Note that the appropriate variation must be selected in the DNP3 Outstation to allow for reporting of event time.
EvtFloatValue	When the event value is a 32-bit float the value will appear in this attribute.
EvtIntegerValue	When the event value is a 8-bit, 16-bit, or 32bit integer the value will appear in this attribute.

Table 6.8 – Master Event Logix UDT

Each time a new event is written into the Logix controller, bit 0 of the *EvtPending* DINT will be set to 1. This is an indication to the Logix application code that an event has not yet been processed. It is recommended to clear this bit once the event has been processed to avoid duplicate processing of events.

Note: Refer to the Logix example code which provides a mechanism to extract the DNP3 Events from the Logix Master Events Tag.

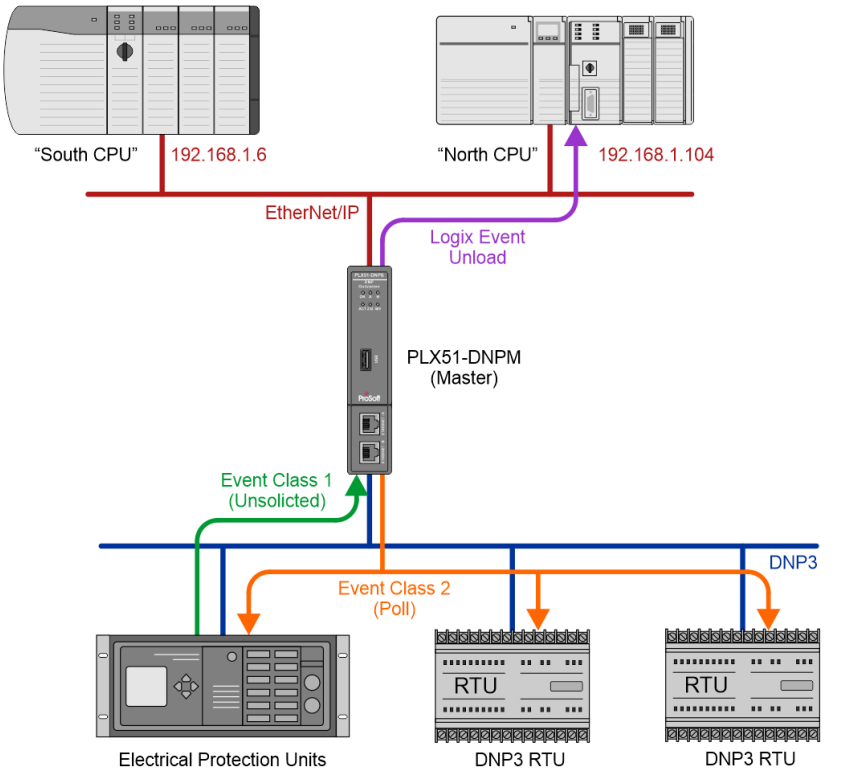


Figure 6.16 – DNP3 Master Event Unloading

Refer to the Logix Master Example code which can be found on the website at the following link www.prosoft-technology.com. The Logix Master Example code provides UDTs and AOIs to process events in the Master Event Buffer and copy the values to the respective static DNP3 objects.

Modbus

This is a circular buffer arrangement where the PLX51-DNPM will start writing at array index 0 (at the Modbus Event Unload Register) and increment the array index each time a new event is written into the internal Modbus Holding Registers. Events that are not processed in the internal Modbus Event Buffer Array will be overwritten. This Master Event Unload Index (which shows the index to which the next event will be written) can be found in the Modbus DNP Status registers (at offset 13) as well as the General Status page of the module in the PLX50 Configuration Utility.

Important: Downloading updated configuration to the PLX51-DNPM resets the Event Buffer Index to zero.

The structure of the event record is shown in the tag example below.

Description	HR/IR Reg Offset	Element Size	Data Type
Event Pending	0	1	BOOL
Event Group	1	1	SINT
Event Flags	2	1	SINT
Event Source Node Address	3	1	INT
Event Source IP Address	4	2	SINT[4]
Event Element Index	6	2	DINT
Event Time Stamp	8	4	LINT
Event Real Data Value	12	2	REAL
Event Integer Data Value	14	2	DINT

Table 6.9 – Event Structure Modbus

Each time a new event is written into the local Modbus Holding Registers, bit 0 of the *Event Pending* Modbus Holding Register (first register per event) will be set to 1. This is an indication to the Modbus interface device that an event has not yet been processed. It is recommended to clear this bit once the event has been processed to avoid duplicate processing of events.

The total size of the Modbus Event buffer is therefore 16 multiplied by the ***Buffer Size***.

Concentrator

See the *Concentrator Mode* section in the *DNP3 Events* section for information regarding the unloading and management of DNP3 events from DNP Outstations.

Important: When the module is operating as a Data Concentrator, then the events received from a class event poll can either be saved as the class defined in the *Outstation Default Event Classes* or retain the original class from the Outstation when being sent to the DNP SCADA.

6.5 Report-By-Exception

Reporting by Exception can considerably reduce network traffic by eliminating or reducing continuous polling.

Reporting by exception can be configured by, enabling Events in each Outstation for all relevant groups. The DNP3 Master needs to have Events enabled in Unsolicited Class mode.

At least one Logix Tag Mapping is required to set the Logix Target. This item's scan interval can be set to a large number if not other mapped items are required.

Refer to the Logix Master Example (*DNP3MasterExample*) code which can be found on the website at the following link www.prosoft-technology.com. The Logix Master Example code provides UDTs and AOIs to process events in the Master Event Buffer and copy the values to the respective static DNP3 objects.

6.5.1 Concentrator

When operating in Concentrator mode, the DNPM will need to enable the Unsolicited Responses for outstations based on the Event Classes configured in the Master Events tab in the PLX50CU. The DNPM will not relay Unsolicited Response Enable/Disabled commands from the DNP SCADA Master to the DNP3 outstations.

Important: When the module is operating as a Data Concentrator, the events received from unsolicited responses will be assigned an event class based on the configured event classes in the *Outstation Default Event Classes*.

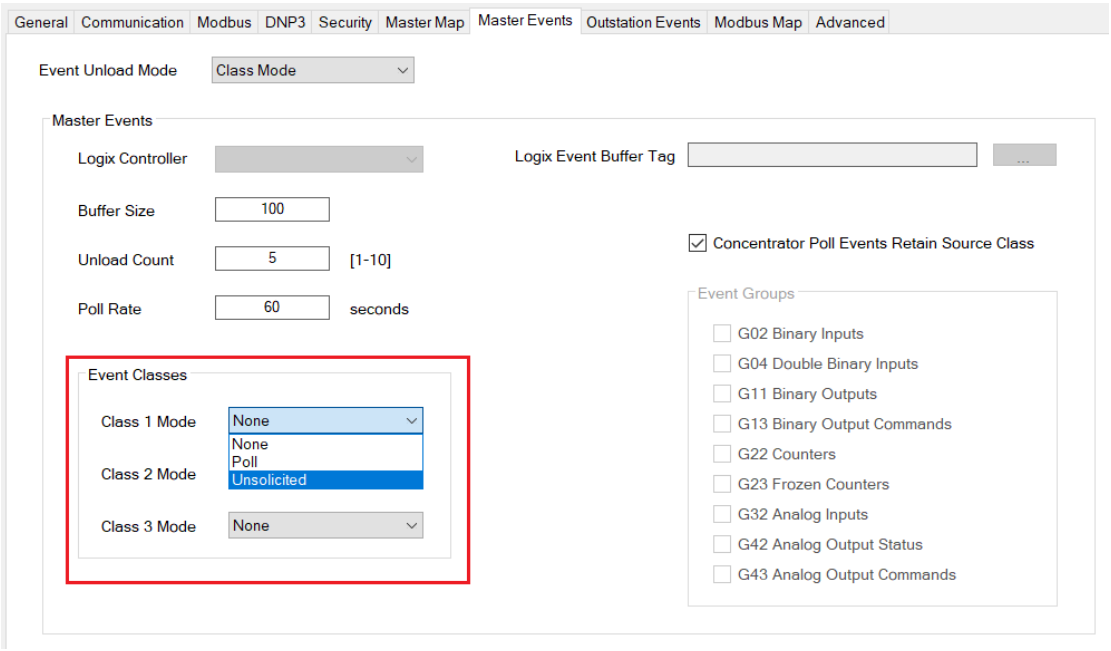


Figure 6.17 – DNP Concentrator Unsolicited Response Enable

6.6 Reading DNP objects with Variation 0

The DNPM in Master mode can be configured to read variation zero for certain DNP objects from an Outstation. Variation zero is used by a DNP Master to request data from a DNP outstation with any variation, which means the DNP outstations will reply with its default variation to the request.

Note: Reading of Variation 0 is not supported by the Master side of the Data Concentrator Mode.

For example, if the DNPM is configured to read Analog Inputs 0 to 4, with variation zero set (as shown below), then the DNP outstation can return (as an example) Analog Inputs 0 to 2 with variation 1 (32bit + flag) and Analog Inputs 3 to 4 with variation 5 (Float + flag).

Tag Mapping Items (max. of 1000 items.)

	En	DNP3 Function	Scan	IP Address	Node	Group	Variation	Index Start	Index Count	Target Name	Target Tag	Browse
	☑	Read	A	192.168.1.222	4	G030 AnalogInputs	V00 Any Variation	0	5	NorthCPU	DNP3G30V0	...
▸*	☐											

Figure 6.18 – DNP Master read using variation zero

The DNPM will require specific mapping formats to be used for Logix and Modbus operating interfaces to support any variation DNP objects to be mapped.

6.6.1 EtherNet/IP

When reading DNP groups with variation 0, the following Logix data types will need to be used.

Note: All the variables and data types used is in the PLX51-DNPM Logix example code.

Group	Logix Data Type	Logix Example Code Tag
1 – Binary Inputs	PSDNP3BinaryInputWithFlag	DNP3G1V0
3 – Double Binary Inputs	PSDNP3DoubleBinaryInputWithFlag	DNP3G3V0
10 – Binary Outputs	PSDNP3BinaryOutputWithFlag	DNP3G10V0
20 – Counters	PSDNP3Counter32WithFlag	DNP3G20V0
21 – Frozen Counters	PSDNP3FrozenCounter32WithFlagTime	DNP3G21V0
30 – Analog Inputs	PSDNP3AnalogInputVar0	DNP3G30V0
31 – Frozen Analog Inputs	PSDNP3FrozenAnalogVar0	DNP3G31V0
40 – Analog Output Status	PSDNP3AnalogOutputVar0	DNP3G40V0

Table 6.10 – Variation 0 Logix data types

Note: When configuring variation 0 data types, the maximum *Index Count* is 40.

The variations received from the DNP outstation will be formatted for the specific Logix data type. A single UDT is used for each DNP group to accommodate all DNP variations for that group. If certain data is not in the DNP response that is required for the specific UDT, then those variables in the UDT will be made zero.

For example, if a DNP Counter variation zero is requested and the DNP outstation replies with DNP Counter variation 1 (32-bit value with flag), then the time value in the Logix DNP Counter variation 0 UDT (*PSDNP3Counter32WithFlag*) will be made zero. Similar if the DNP Outstation replies with DNP Counter variation 5, then the DNP flags and time will be made zero in the Logix tag.

With the DNP Analog Input or Output responses, the Logix controller will need to check if either the *IntValue* or *FloatValue* is being populated (based on the variation in the response).

See the Logix example code for more details regarding the specific UDTs used for variation 0 responses.

When reading DNP Binary groups that are packed formatted or using variation 1, please refer to the following table when configuring the command tag location.

Group	Logix Data Type (Packed Format)	Logix Example Code Tag
1 – Binary Inputs	PSDNP3BinaryInputPacked	DNP3G01V01[0].BinaryValues[x]
3 – Double Binary Inputs	PSDNP3DoubleBinaryInputPacked	DNP3G03V01[0].BinaryValues[x]
10 – Binary Outputs	PSDNP3BinaryOutputPacked	DNP3G10V01[0].BinaryValues[x]

The following example shows the difference in the *Target Tag* parameter when configuring packed versus unpacked commands.

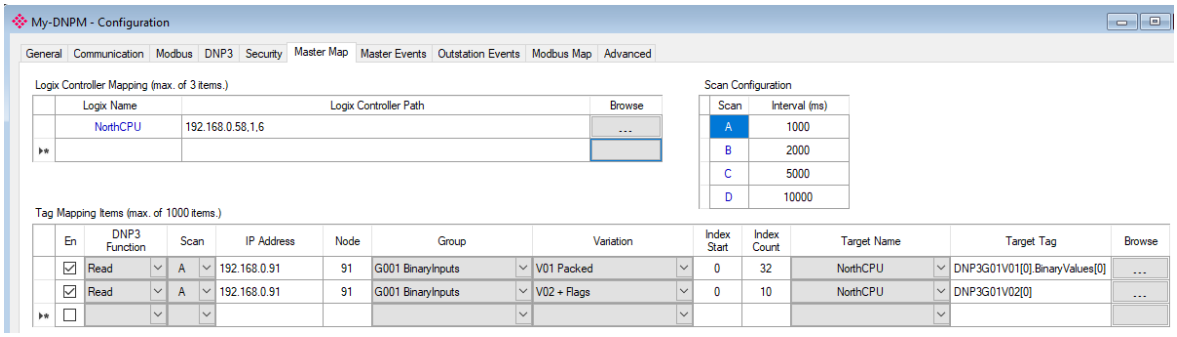


Figure 6.19 – DNP Master using packed binary types

6.6.2 Modbus

When reading DNP groups with variation 0, the following Modbus data structures will need to be used.

DNP3 Group	DNP3 Variation	DNP3 Description	Modbus Format
1	0	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
3	0	+ Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
10	0	Status + Flags	1 Byte Data&Flag + 1 Byte Pad **Note:** Byte Padding will only be applied for IR and HR register types.
20	0	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Data
21	0	32bit + Flag + Time	1 Byte Flag + 1 Byte Pad + 4 Bytes Data + 6 Bytes Time
30	0	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Integer Data + 4 Bytes Float Data
40	0	32bit + Flag	1 Byte Flag + 1 Byte Pad + 4 Bytes Integer Data + 4 Bytes Float Data

Table 6.11 – Variation 0 Modbus data structures

The variations received from the DNP outstation will be formatted for the specific Modbus data structure. A single Modbus structure is used for each DNP group to accommodate all DNP variations for that group. If certain data is not in the DNP response that is required for the specific structure, then those variables in the Modbus structure will be made zero.

For example, if a DNP Counter variation zero is requested and the DNP outstation replies with DNP Counter variation 1 (32-bit value with flag), then the time value in the Modbus DNP Counter variation 0 structure will be made zero. Similar if the DNP Outstation replies with DNP Counter variation 5, then the DNP flags and time will be made zero in the Modbus structure.

With the DNP Analog Input or Output responses, the Logix controller will need to check if either the *IntValue* or *FloatValue* is being populated (based on the variation in the response).

7 Modbus Operation

When the PLX51-DNPM has been setup for Modbus communication, it will function as a Modbus Master or Modbus Slave.

7.1 Message Routing

When the module has been correctly setup the DNP3 message initiator will send a read/write to a certain DNP3 group and variation which will then be read/written to the mapped Modbus registers. The messages sent by the initiator must be completed with the correct data for successful operation. There are various indicators to determine if the mapping is routing the DNP3 messages correctly. Refer to the diagnostics section of this document for a more detailed explanation of the various indicators that can be used to diagnose the module.

7.2 DNP Status

The PLX51-DNPM will provide the general module status at the configured *DNP Status Register* (see the *Modbus* section in the "PLX51-DNPM Configuration" section). The format of both HR/IR and CS/IS mapping is shown below.

Field	CS/IS Offset	HR/IR Offset	CS/IS Size	HR/IR Size	Data Type	Description
DNP Status - General	0	0	16	1	BOOL	Bit 0 - DNP Slave Mode Bit 1 - DNP Master Mode Bit 2 - DNP Unscheduled Mode Bit 3 - DNP Config Valid Bit 4 - DNP Event Log Load Ok Bit 5 - DNP Event Log Overflow Bit 6 to 15 - Reserved
DNP Status - Master Map Status	16	1	1024	64	BOOL	Bit x - DNP Mapped Index x is OK **Note:** Only for DNP Master Mode

Table 7.1 – Modbus DNP Status Format

Note: The CS/IS Offset or HR/IR Offset is the offset from the configured *DNP Info Register* in the Modbus Tab of the configuration as shown below:

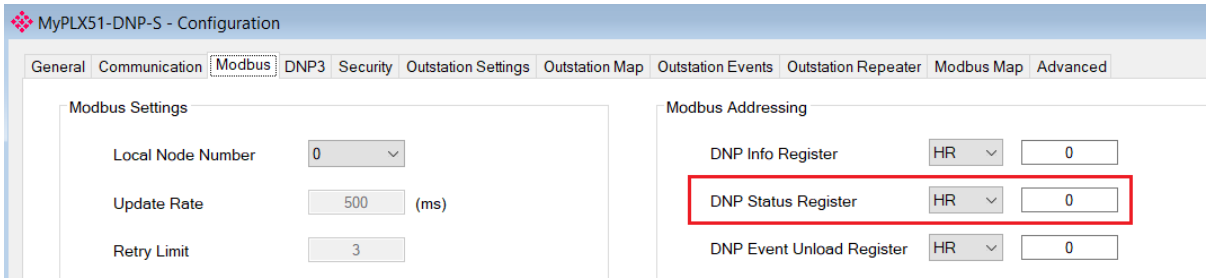


Figure 7.1 – Configured DNP Status Register

7.3 DNP Information

The PLX51-DNPM will provide the general module information at the configured *DNP Info Register* (see the *Modbus* section in the "PLX51-DNPM Configuration" section). The format is shown below.

Field	HR/IR Offset	HR/IR Size	Data Type
DNP Status - Info - DNP Temperature	0	1	INT
DNP Status - Info - Application Msg Rx Count	1	2	DINT
DNP Status - Info - Application Msg Tx Count	3	2	DINT
DNP Status - Info - Checksum Error Count	5	2	DINT
DNP Status - Info - Message Timeout Count	7	2	DINT
DNP Status - Info - Authentication Failure Count	9	2	DINT
DNP Status - Info - Session Key Failure Count	11	2	DINT
DNP Status - Info - Master Event Unload Index	13	2	DINT
DNP Status – Time – Year	15	1	INT
DNP Status – Time – Month	16	1	INT
DNP Status – Time – Day	17	1	INT
DNP Status – Time – Hour	18	1	INT
DNP Status – Time – Minute	19	1	INT
DNP Status – Time – Second	20	1	INT

Table 7.2 – Modbus DNP Info Format

Note: The HR/IR Offset is the offset from the configured *DNP Info Register* in the Modbus Tab of the configuration as shown below:

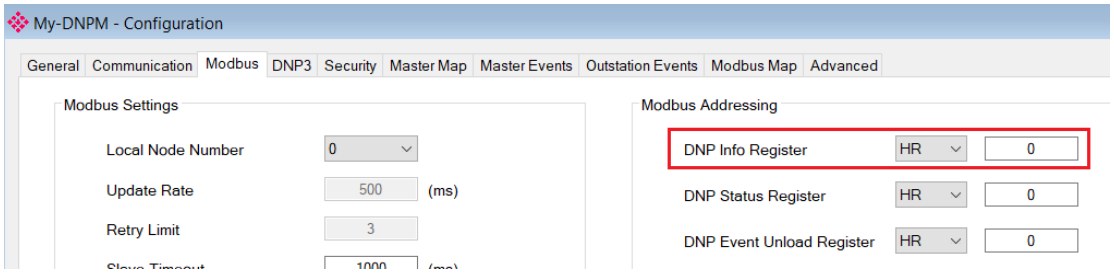


Figure 7.2 – Configured DNP Information Register

8 Security

DNP3 offers Secure Authentication for links at risk of being attacked. There are various Key Change methods, Message Authentication Code (MAC) algorithms, and Authentication methods provided in the DNP3 protocol specification.

Various keys are used in DNP3 Secure Authentication. **Session keys** are used most frequently as it is used for Authentication of the requests. These keys are updated by the DNP3 master at a certain interval or every time there has been a message failure. The DNP3 master encrypts these keys before sending them across the wire using the Key Wrap Algorithm selected and the **Update key**. The Update Key can be updated in numerous ways (including sending it across the wire with another set of Keys encrypting that message). The **Transfer Key** is used to remotely change the update key of a PLX51-DNPM (when operating in Concentrator mode). The Transfer Key is used to encrypt the Update Key being sent over the DNP3 network to the remote PLX51-DNPM.

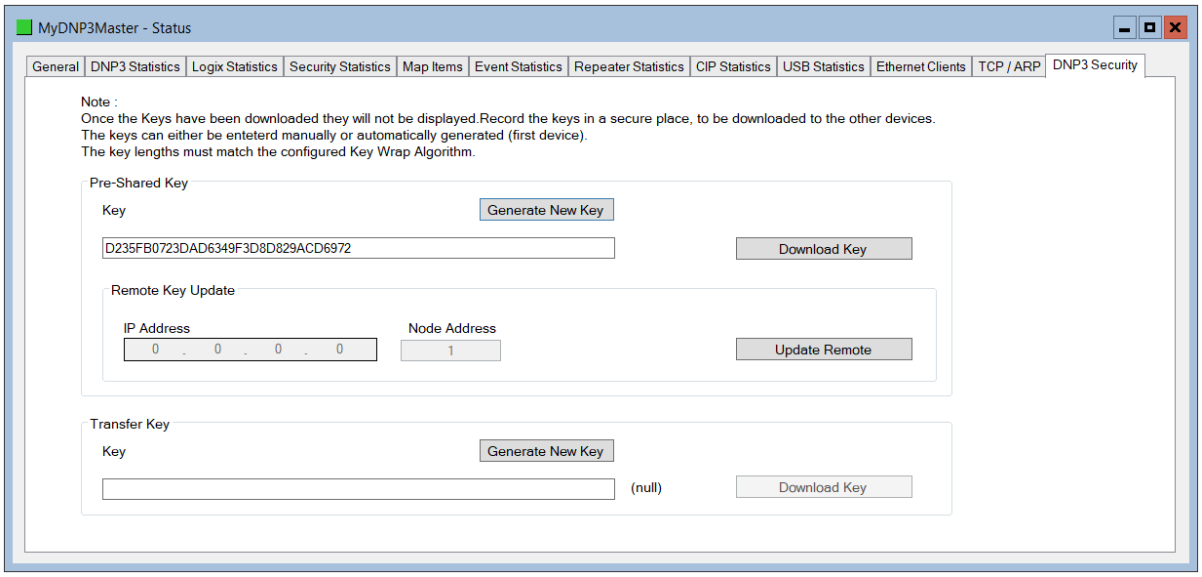


Figure 8.1 - PLX51-DNPM key update method.

The module supports all DNP3 MAC algorithms and Key Wrap algorithms. The module also supports Aggressive Authentication mode which reduces the amount of traffic on the network (which could be required on busy networks or serial communication).

Important: Ensure that the other DNP3 device with which it is communicating has the same security options configured as the PLX51-DNPM and that the selected options are supported in the device.

8.1 Key Updates

The PLX51-DNPM allows the user to change the update key in one of two ways:

8.1.1 Local Key Update

With this method the user will need to be connected to the actual PLX51-DNPM and will download the key directly from the PC to the module (over Ethernet).

In PLX50 Configuration Utility, the user can write the Update Key to the PLX51-DNPM module using the Key tab in the Online Status window. The key entered must match the Key Wrap Algorithm selected. Thus, if AES-128 Key Wrap was selected the Update Key must be 128-bit (16 bytes) long. If AES-256 Key Wrap was selected, the Update Key must be 256-bit (32 bytes) long. The user can either enter a predetermined hexadecimal code or create a new code in PLX50 Configuration Utility as shown below. This key is encrypted and sent to the PLX51-DNPM where it is saved into the NV memory of the module.

Important: The Key update method in PLX50 Configuration Utility is a **write-only** function. Thus, once the key has been downloaded, the user will not be able to view the key again. The user must make provisions to document or save the key in a secure manner.

Important: The other DNP3 device that is going to be communicated must have the same Update Key as that of the PLX51-DNPM. Failing to do this will result in failed data exchange for critical messages.

The user can also change the update key from a Logix controller by using a MSG instruction. Note that unlike the key update from PLX50 Configuration Utility (which is downloaded securely), the update from Logix will not be secure and if the network is exposed an attacker will be able to see the update key.

Important: The user will **NOT** be able to change the update key using the unsecure method unless the *Allow Unsecure Key Download* option has been selected in the Security tab of the Configuration form.

Below are the MSG Instruction parameters to be used as well as the structure:

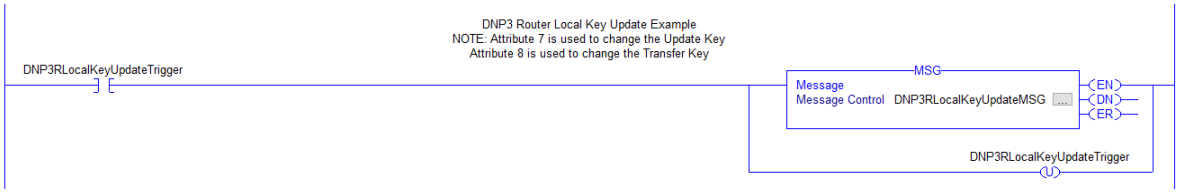


Figure 8.2 - Message Instruction

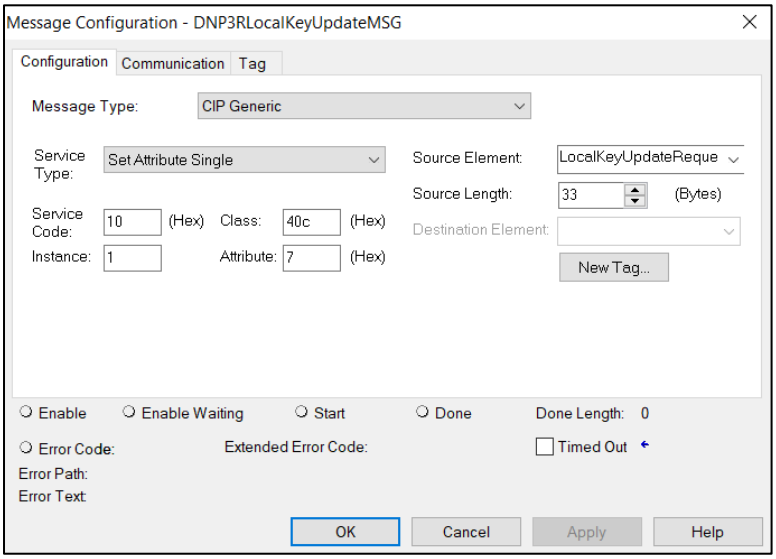


Figure 8.3 - Message Configuration

Parameter	Description
Message Type	CIP Generic
Service Type	Set Attribute Single
Service Code	10 (Hex) – Set Single Attribute
Class	40C (Hex)
Instance	1
Attribute	7 – Update Key 8 – Transfer Key
Source Element	The request tag instance. Must follow the structure of the ***PSDNP3LocalKeyUpdateRequest*** UDT.
Source Length	33
Destination Element	N/A

Table 8.1 - Message Configuration Paramaters

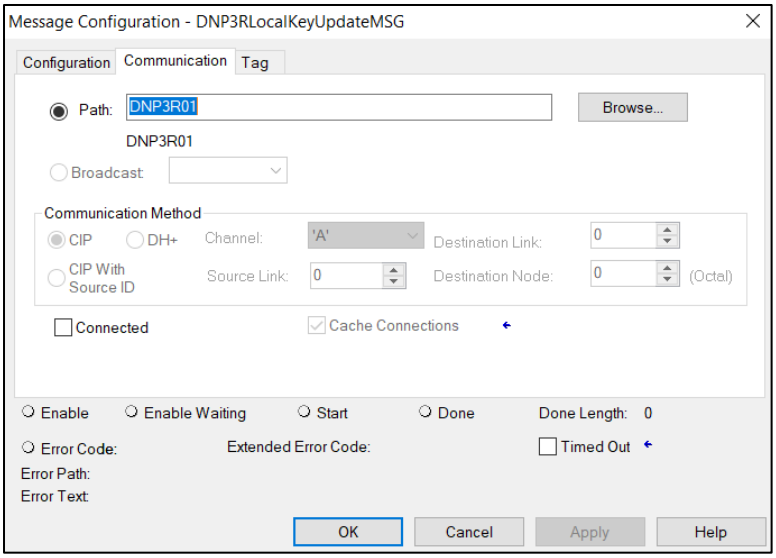


Figure 8.4 - Messsage Configuration - Communication

The Path must be configured to that of the PLX51-DNPM module. If the PLX51-DNPM has been added in the I/O tree, then the Browse option can be used to select the path.

Alternatively, enter the CIP path in the format **1,X,2,IP** where:

1 represents the backplane port,
X represents the slot of the Ethernet bridge module,
2 represents the Ethernet port of the Ethernet bridge module and
IP represents the IP address of the PLX51-DNPM module.
For example: **1,1,2,192.168.1.41**

The request tag (for example, ***PSDNP3RemoteKeyUpdateRequest***) should be configured as follows:

Name	Value	Style	Data Type
DNP3LocalKeyUpdateRequest	{...}		PSDNP3LocalKeyUpdateRequest
DNP3LocalKeyUpdateRequest.KeyLength	16	Decimal	SINT
DNP3LocalKeyUpdateRequest.KeyData	{...}	Decimal	SINT[32]

Figure 8.5 – Local Key Update Message Request Tag

Parameter	Description
Key Length	Size of the key data to follow.
Key Data	The data for the key to be updated.

Table 8.2 - Local Key Update Message Request Parameters

Like the update key, the transfer key can be changed from PLX50 Configuration Utility (securely) or from Logix (not-secured). The only difference is that the user will use attribute 8 to set the Transfer key and attribute 7 (shown previously) for setting the update key.

Important: The user will **NOT** be able to change the transfer key using the unsecure method unless the *Allow Unsecure Key Download* option has been selected in the Security tab of the Configuration form.

8.1.2 Remote Key Update

The remote key update method allows the user to remotely change the update key (used to create the session keys for authentication) by encrypting the update key with the transfer key. The user will not be able to update the transfer key remotely (it will need to be downloaded to the module directly from the source).

Important: The user will **NOT** be able to remotely change the update key unless the *Key Change Method* option in the Security tab of the Configuration form has been set to *Pre-Shared Key - Allow Remote Update* for both PLX51-DNPM Master and PLX51-DNPx Outstation.

Important: The remote key update will only work with ProSoft PLX51-DNPx modules and will not be supported by third-party vendors.

The PLX51-DNPM can operate in one of two Master modes when the Update keys are changed remotely.

Operating Mode	Update Key Change Description
Master	Once the transfer key has been downloaded, the user can click the **Update Remote** button in the DNP3 Security tab of the online status form in PLX50 Configuration Utility. This will inform the DNP3 Master to automatically change the update keys in each outstation mapped.
Unscheduled	In unscheduled mode the user will need to manually change the key in each outstation. Once the transfer key has been downloaded, the user can click the **Update Remote** button in the DNP3 Security tab of the online status form in PLX50 Configuration Utility. The user will need to provide the IP address (if the Ethernet-TCP/UDP protocol has been selected) as well as the Node address of the outstation whose update key must be changed.

Table 8.3 – Operating mode for Key updates

Important: The PLX51-DNPM module will not be able to remotely change the update key if the transfer keys of the master and the outstation do not match.

The remote update key method can also be done from Logix controller using the below message instruction. Note that unlike the key update from PLX50 Configuration Utility (which is downloaded securely), the update from Logix will not be secure and if the network is exposed an attacker will be able to see the update key.

Below are the MSG Instruction parameters to be used as well as the structure:

The message instruction should be setup as follows:

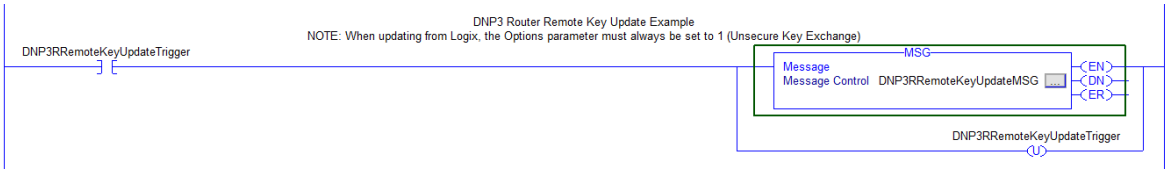


Figure 8.6 - Message Instruction

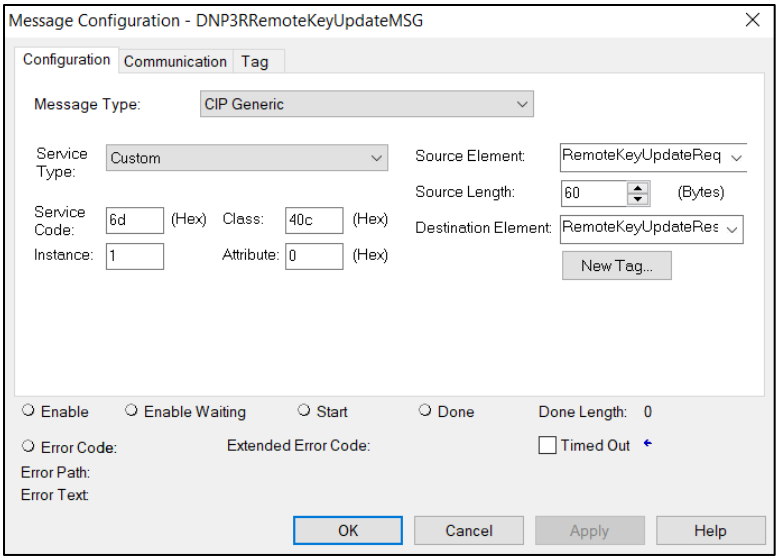


Figure 8.7 - Message Configuration

Parameter	Description
Message Type	CIP Generic
Service Type	Custom
Service Code	6D (Hex) – Remote Key Update
Class	40C (Hex)
Instance	1
Attribute	0
Source Element	The request tag instance. Must follow the structure of the ***ProSoftTechnologyDNP3RemoteKeyUpdateRequest*** UDT.
Source Length	60
Destination Element	The response tag instance (DINT).

Table 8.4 - Message Configuration Paramaters

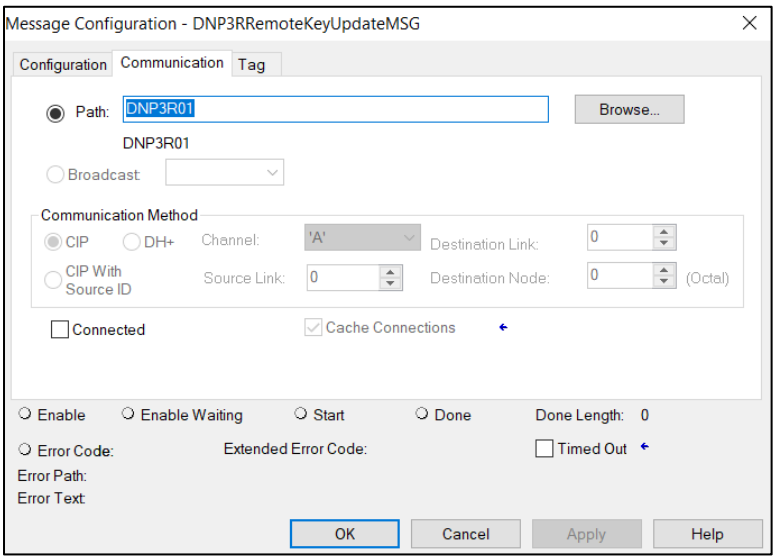


Figure 8.8 - Messsage Configuration - Communication

The Path must be configured to that of the PLX51-DNPM module. If the PLX51-DNPM has been added in the I/O tree, then the Browse option can be used to select the path.

Alternatively, enter the CIP path in the format **1,X,2,IP** where:

1 represents the backplane port,
X represents the slot of the Ethernet bridge module,
2 represents the Ethernet port of the Ethernet bridge module and
IP represents the IP address of the PLX51-DNPM module.
For example: **1,1,2,192.168.1.41**

The request tag (for example, ***PSDNP3RemoteKeyUpdateRequest***) should be configured as follows:

Name	Value	Style	Data Type
DNP3RemoteKeyUpdateRequest	{...}		PSDNP3RemoteKeyUpdateRequest
DNP3RemoteKeyUpdateRequest.Command	1	Decimal	SINT
DNP3RemoteKeyUpdateRequest.Option	1	Decimal	SINT
DNP3RemoteKeyUpdateRequest.DestinationNode	3	Decimal	INT
DNP3RemoteKeyUpdateRequest.IPAddress	{...}	Decimal	INT[4]
DNP3RemoteKeyUpdateRequest.IPAddress[0]	192	Decimal	INT
DNP3RemoteKeyUpdateRequest.IPAddress[1]	168	Decimal	INT
DNP3RemoteKeyUpdateRequest.IPAddress[2]	1	Decimal	INT
DNP3RemoteKeyUpdateRequest.IPAddress[3]	222	Decimal	INT
DNP3RemoteKeyUpdateRequest.KeyData	{...}	Decimal	SINT[255]

Figure 8.9 – Remote Key Update Message Request Tag

Parameter	Description
Command	One of two commands can be selected: **0** – Update Master Clients **1** – Update Unscheduled Client
Option	One of two options can be selected: **0** – Secure Key Exchange (not relevant for Logix MSG) **1** – Unsecure Key Exchange
Destination Node	When selecting Update Unscheduled Client Command this parameter will be used to indicate the DNP3 outstation Node number.
IP Address	When selecting Update Unscheduled Client Command this parameter will be used to indicate the DNP3 outstation IP Address (when using TCP/UDP).
Key Data	SINT[0 – 14] – Reserved SINT[15] – Key length SINT[16-47] – Key Data

Table 8.5 - Remote Key Update Message Request Parameters



Figure 8.10 - Remote Key Update Message Response Tag

Parameter	Description
DNP3 Indicators	These 16bits will provide return information of the remote DNP3 device. Refer to the DNP3 documentation in the Additional information section. Bit 0 – Broadcast Bit 1 – Class 1 events Bit 2 – Class 2 events Bit 3 – Class 3 events Bit 4 – Need Time Bit 5 – Local control Bit 6 – Device trouble Bit 7 – Device restart Bit 8 – Function code not supported Bit 9 – Object unknown Bit 10 – Parameter error Bit 11 – Event buffer overflow Bit 12 – Already executing Bit 13 – Configuration corrupt Bit 14 – Reserved Bit 15- Reserved

Table 8.6 - Remote Key Update Message Response Parameters

9 Diagnostics

9.1 LEDs

The PLX51-DNPM modules provide three LEDs for diagnostics purposes as shown in the front view figure below. A description of each LED is given in the table below.



Figure 9.1 - PLX51-DNPM front view

LED	Description
Ok	The module LED will provide information regarding the system-level operation of the module. If the LED is **red**, then the module is not operating correctly. For example, if the module application firmware has been corrupted or there is a hardware fault the module will have a red Module LED. If the LED is **green (flashing)**, then the module has booted and is running correctly **without** any application configuration loaded. If the LED is **green (solid)**, then the module has booted and is running correctly **with** application configuration loaded.
A / B	The Ethernet LED will light up when an Ethernet link has been detected (by plugging in a connected Ethernet cable). The LED will flash every time traffic is detected. This module has two Ethernet ports A and B. Each LEDs represents each specific port.
Act	The activity LED is used for the DNP3 Routing. Every time there is a successful DNP3 routing transaction the LED will flash green. The LED will flash red if the routing was unsuccessful (e.g. Logix Tag does not exist).

Table 9.1 - Module LED operation

9.2 Module Status Monitoring in PLX50 Configuration Utility

The PLX51-DNPM module provides a range of statistics which can assist with module operation, maintenance, and fault finding. The statistics can be accessed in full by PLX50 Configuration Utility or using the web server in the module.

To view the module's status in the ProSoft Technology PLX50 Configuration Utility environment, the module must be Online. If the module is not already Online (following a recent configuration download), then right-click on the module and select the ***Go Online*** option.

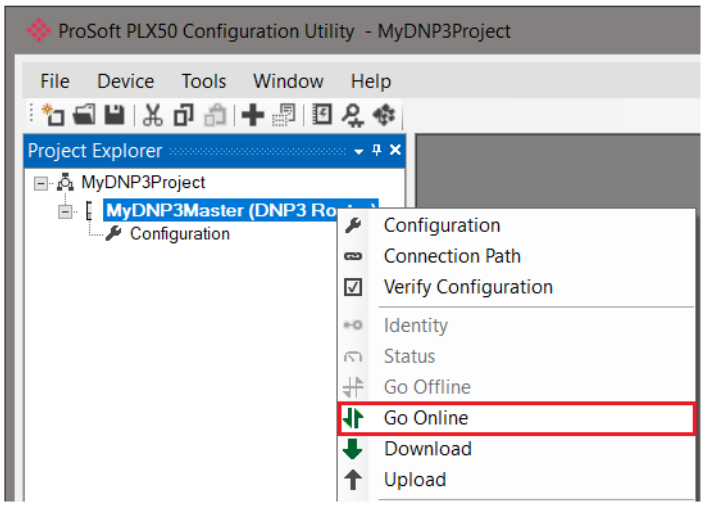


Figure 9.2 - Selecting to Go Online

The Online mode is indicated by the green circle behind the module in the Project Explorer tree.

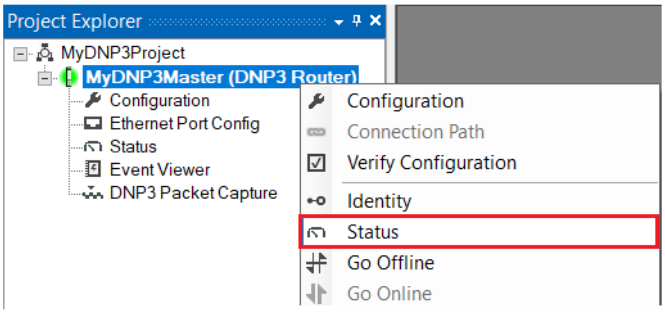


Figure 9.3 - Selecting online Status

The Status monitoring window can be opened by either double-clicking on the ***Status*** item in the Project Explorer tree, or by right-clicking on the module and selecting ***Status***.

The status window contains multiple tabs to display the current status of the module.

9.2.1 General

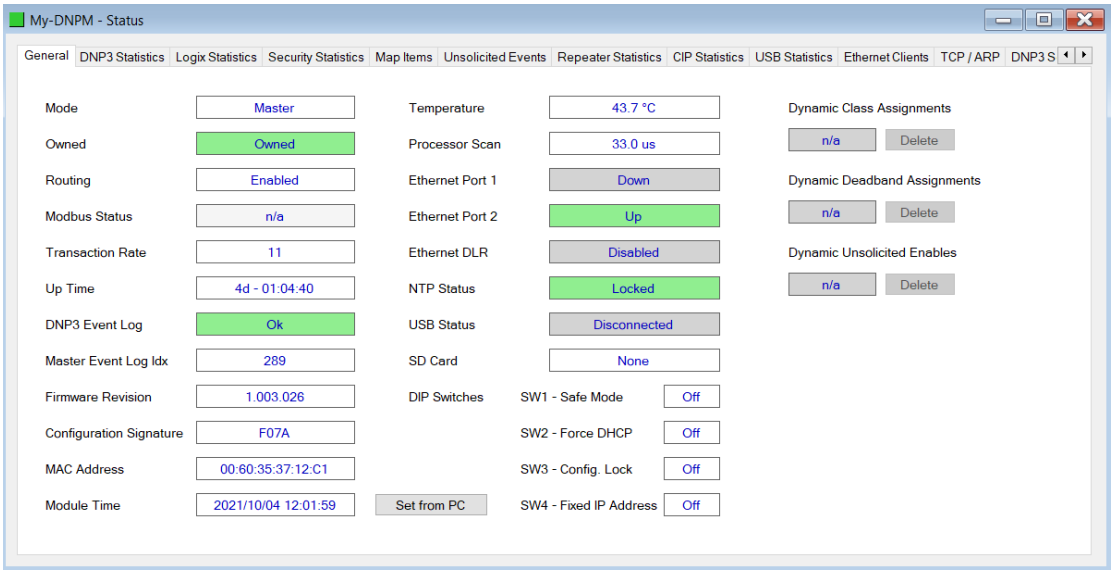


Figure 9.4 – General Status

The General tab displays the following general parameters:

Parameter	Description
Mode	Indicates the current operating mode: Outstation Master Concentrator Unscheduled
Owned	(EtherNet/IP only) Indicates whether or not the module is currently owned (Class 1) by a Logix controller.
Routing	(EtherNet/IP only) Indicates whether the routing of module is enabled or inhibited. The routing operation can be inhibited in the output assembly of the module.
Modbus Status	(Modbus only) Indicates the Status of the Modbus communication: Ok Fail
Transaction Rate	The transaction rate is the number of DNP3 messages per second that the module is currently routing.
Up Time	Indicates the elapsed time since the module was powered-up.
DNP3 Event Log	This is the current status of the DNP3 Event Log. It will indicate if there was a fault whilst loading the DNP3 Event Log or if there is an overflow on any of the Event Buffers.
Master Event Log Index	The Master Event Tag UDT array index (EtherNet/IP) or the Modbus buffer index (Modbus) number where the next event received from the master will be unloaded.
Firmware Revision	The revision of the main application firmware.
Configuration Signature	The CRC of the module's current configuration.
MAC Address	Displays the module's unique Ethernet MAC address.
Module Time	Indicates the module's internal time. The module time is stored in UTC (Universal Coordinate Time) but displayed on this page according to the local PC's Time Zone settings.

Parameter	Description
Temperature	The internal temperature of the module.
Processor Scan	The amount of time (microseconds) taken by the module's processor in the last scan.
Ethernet Port 1 / 2	This is the status of each Ethernet port. **Down** The Ethernet connector has **not been** successfully connected to an Ethernet network. **Up** The Ethernet connector has successfully connected to an Ethernet network. **Mirror Enabled** The Ethernet port is mirroring the traffic on the other Ethernet port.
Ethernet DLR	The status of the Ethernet DLR. **Disabled** Device Level Ring functionality has been disabled. **Linear** The DLR functionality has been enabled and the Ethernet network architecture is linear. **Ring – Fault** The DLR functionality has been enabled and the Ethernet network architecture is ring, but there is a fault with the network. **Ring – Ok** The DLR functionality has been enabled and the Ethernet network architecture is ring and is operating as expected.
NTP Status	The status of the local NTP Client. **Disabled** The NTP time synchronization has been disabled. **Locked** NTP time synchronization has been enabled and the PLX51-DNPM has locked onto the target time server. **Not Locked** NTP time synchronization has been enabled and the PLX51-DNPM has not locked onto the target time server.
USB Status	The status of the USB connection. **Connected** The USB cable is connected to the PLX51-DNPM and partner. **Disconnected** The USB cable is not connected to either the PLX51-DNPM or partner.
SD Card	Indicates if a SD Card is present or not.
DIP Switch Position	The status of the DIP switches when the module booted. Note that this status will not change if the DIP switches are altered when the module is running.

Table 9.2 - General Status

9.2.2 DNP3 Statistics

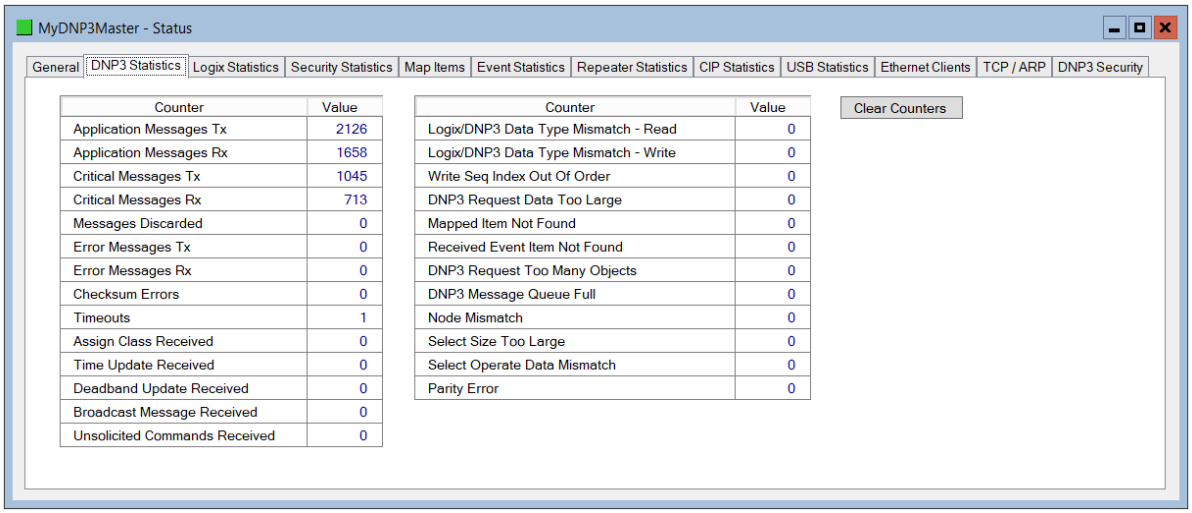


Figure 9.5. – DNP3 Statistics

The DNP3 tab displays the DNP3 communication statistics:

Statistic	Description
Application Messages Tx	The number of application DNP3 packets sent by the module.
Application Messages Rx	The number of application DNP3 packets received by the module.
Critical Messages Tx	The number of critical DNP3 packets sent by the module when security is enabled.
Critical Messages Rx	The number of critical DNP3 packets received by the module when security is enabled.
Messages Discarded	The number of DNP3 packets discarded by the module.
Error Messages Tx	The number of error DNP3 packets sent by the module.
Error Messages Rx	The number of error DNP3 packets received by the module.
Checksum errors	The number of corrupted DNP3 packets received by the module.
Timeouts	The number of message response timeouts the module has encountered.
Assign Class Received	The number of assign class messages received.
Time Update Received	This number is the amount of times the DNP3 Master has sent a time update command to the DNP3 Outstation.
Deadband Update Received	Currently N/A.
Broadcast Message Received	This is the number of DNP3 Broadcast messages received.
Unsolicited Command Received	This is the number of DNP3 Unsolicited (enable or disable) commands received.
Logix Data Type Mismatch - Read	The data type in Logix (atomic or UDT) did not match the DNP3 data type during a read operation.
Logix Data Type Mismatch - Write	The data type in Logix (atomic or UDT) did not match the DNP3 data type during a write operation.
Write Seq Index Out Of Order	DNP3 allows the user to write data in a non-sequential manner by using DNP3 object prefixes. For example, a single write operation can be targeted to array offset 2, 3, 4, and 8. This is not allowed in the PLX51-DNPM due to the nature of the CIP communication protocol.

Statistic	Description
	The user will need to write array offset 2, 3, and 4 and then in a separate write function write to offset 8.
DNP3 Request Data Too Large	The request data is too big. The PLX51-DNPM allows for a maximum of 1000 bytes per transaction.
Mapped Item Not found	The DNP3 request has a range that is outside of the configured DNP3 mapping bounds for the specific group and variation.
Received Event Item Not Found	Currently N/A.
DNP3 Request Too Many Objects	The PLX51-DNPM supports a maximum of 100 DNP3 objects in a single DNP3 request. These statistics indicates that more than 100 DNP3 objects were found in a single request.
DNP3 Message Queue Full	The PLX51-DNPM has received too many simultaneous messages to process.
Node Mismatch	The received message node number did not match the PLX51-DNPM configured node address.
Select Size Too Large	When the Select/Operate functionality is used the PLX51-DNPM supports a maximum of 255 bytes per transaction (or one full DNP3 message).
Select Operate Data Mismatch	The Select/Operate functionality requires that the response to the Select function matches the Select request.
Parity errors	The number of bytes with parity errors received by the module.

Table 9.3 – DNP3 Statistics

9.2.3 Logix Statistics

The following Logix statistics are only relevant when the module is running in Master mode.

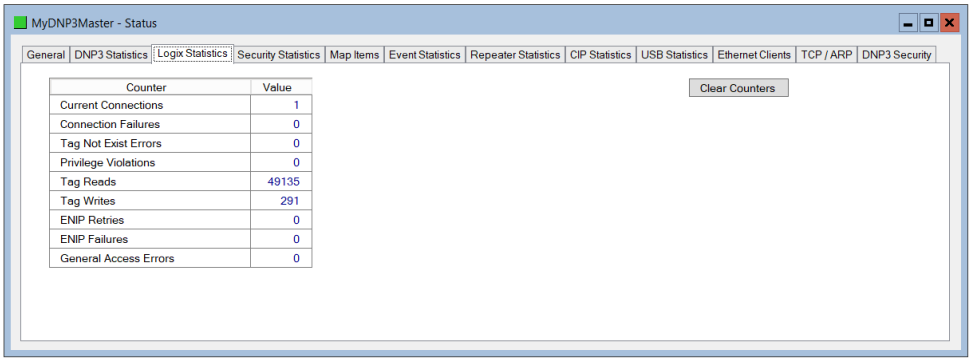


Figure 9.6 - Logix Statistics

Statistic	Description
Current Connections	The number of current open class 3 connections.
Connection Failures	The number of failed attempts at establishing a class 3 connections with a Logix controller.
Tag Not Exist Errors	The number of tag read and tag write transactions that failed due to the destination tag not existing.
Privilege Violation Errors	The number of tag read and tag write transactions that failed due to a privilege violation error. This may be caused by the External Access property of the Logix tag being set to either None or Read Only.
Tag Reads	The number of tag read transactions executed by the PLX51-DNPM module.
Tag Writes	The number of tag write transactions executed by the PLX51-DNPM module.
ENIP Retries	This count increases when no response was received from the Logix Controller by the time the ENIP timeout is reached.
ENIP Failures	This count increases when the ENIP Retry Limit is reached and no response has been received from the Logix Controller.
General Access Errors	This is the number of non-specific errors received from the Logix controller.

Table 9.4 – Logix Statistics

9.2.4 Security Statistics

The following Security statistics are only relevant when DNP3 Security has been enabled in the module configuration.

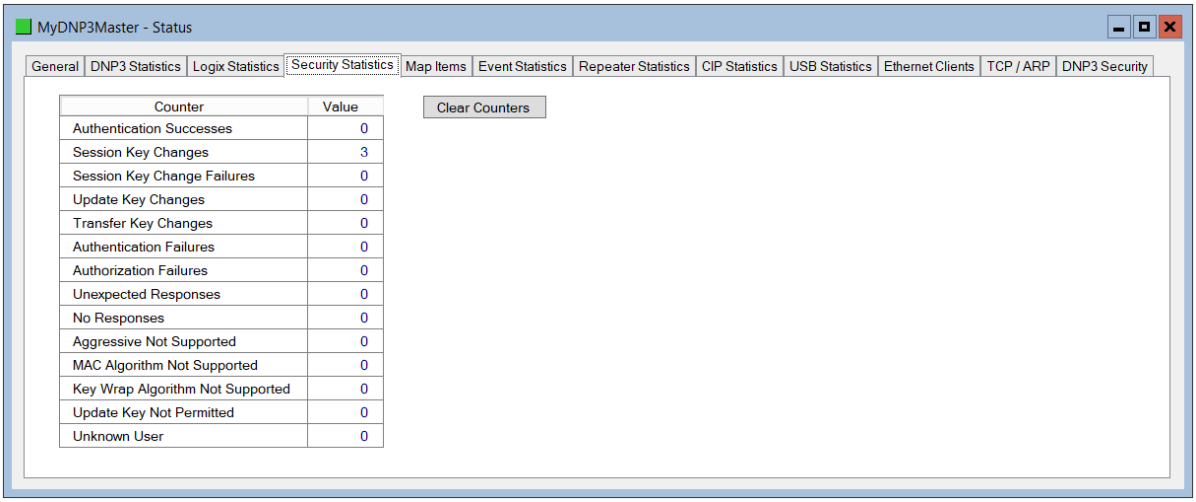


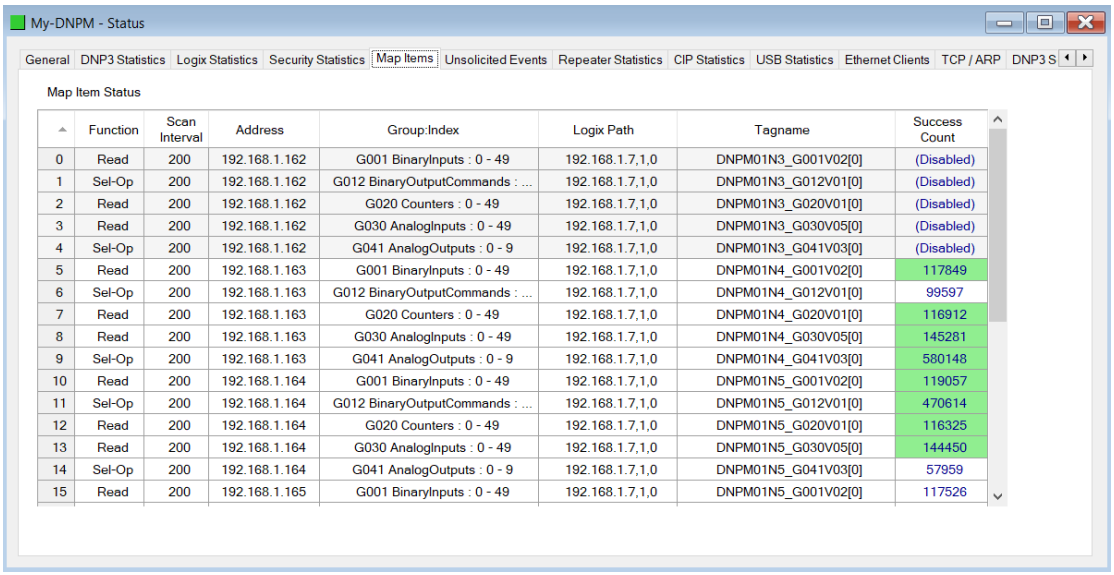
Figure 9.7 - Security Statistics

Statistic	Description
Authentication Successes	Increases every time the device successfully authenticates a message.
Session Key Changes	When the session keys have been successfully updated.
Session Key Change Failures	When the session keys have failed to update.
Update Key Changes	The Update Key has changed.
Transfer Key Changes	The Transfer Key has changed.
Authentication Failures	The other device has provided invalid authentication information such as an incorrect MAC.
Authorization Failures	Increases when a user is not authorized to perform a requested operation.
Unexpected Responses	The other device has responded with a message that was not expected during the authentication process.
No Responses	The other device has not replied during the authentication process.
Aggressive Not Supported	When Aggressive Mode Authentication is not supported this will increase.
MAC Algorithm Not Supported	The MAC algorithm requested is not supported
Key Wrap Algorithm Not Supported	The Key Wrap algorithm requested is not supported.
Update Key Not Permitted	Updating of a key was not permitted.
Unknown User	The user used for authentication was unknown. The default user (1) is the only user supported.

Table 9.6 - Security Statistics

9.2.5 Map Items

The Map Items tab will display the successful packet counts processed by each mapping item. If an item count changes, then the success count field will be displayed with a green background for approximately 3 seconds. This provides quick visual feedback as to which items are currently active. The fields in the map items will adjust to suite the appropriate mode. No items are displayed in Unscheduled mode.



	Function	Scan Interval	Address	Group:Index	Logix Path	Tagname	Success Count
0	Read	200	192.168.1.162	G001 BinaryInputs : 0 - 49	192.168.1.7,1,0	DNPM01N3_G001V02[0]	(Disabled)
1	Sel-Op	200	192.168.1.162	G012 BinaryOutputCommands : ...	192.168.1.7,1,0	DNPM01N3_G012V01[0]	(Disabled)
2	Read	200	192.168.1.162	G020 Counters : 0 - 49	192.168.1.7,1,0	DNPM01N3_G020V01[0]	(Disabled)
3	Read	200	192.168.1.162	G030 AnalogInputs : 0 - 49	192.168.1.7,1,0	DNPM01N3_G030V05[0]	(Disabled)
4	Sel-Op	200	192.168.1.162	G041 AnalogOutputs : 0 - 9	192.168.1.7,1,0	DNPM01N3_G041V03[0]	(Disabled)
5	Read	200	192.168.1.163	G001 BinaryInputs : 0 - 49	192.168.1.7,1,0	DNPM01N4_G001V02[0]	117849
6	Sel-Op	200	192.168.1.163	G012 BinaryOutputCommands : ...	192.168.1.7,1,0	DNPM01N4_G012V01[0]	99597
7	Read	200	192.168.1.163	G020 Counters : 0 - 49	192.168.1.7,1,0	DNPM01N4_G020V01[0]	116912
8	Read	200	192.168.1.163	G030 AnalogInputs : 0 - 49	192.168.1.7,1,0	DNPM01N4_G030V05[0]	145281
9	Sel-Op	200	192.168.1.163	G041 AnalogOutputs : 0 - 9	192.168.1.7,1,0	DNPM01N4_G041V03[0]	580148
10	Read	200	192.168.1.164	G001 BinaryInputs : 0 - 49	192.168.1.7,1,0	DNPM01N5_G001V02[0]	119057
11	Sel-Op	200	192.168.1.164	G012 BinaryOutputCommands : ...	192.168.1.7,1,0	DNPM01N5_G012V01[0]	470614
12	Read	200	192.168.1.164	G020 Counters : 0 - 49	192.168.1.7,1,0	DNPM01N5_G020V01[0]	116325
13	Read	200	192.168.1.164	G030 AnalogInputs : 0 - 49	192.168.1.7,1,0	DNPM01N5_G030V05[0]	144450
14	Sel-Op	200	192.168.1.164	G041 AnalogOutputs : 0 - 9	192.168.1.7,1,0	DNPM01N5_G041V03[0]	57959
15	Read	200	192.168.1.165	G001 BinaryInputs : 0 - 49	192.168.1.7,1,0	DNPM01N5_G001V02[0]	117526

Figure 9.8 - Map Item status

Statistic	Description
Operation	The DNP3 Operation (Read, Write, Sel-Op etc.)
Scan Interval	The Scan Interval (ms)
Address	The target DNP3 address for the operation
Group:Index	The DNP3 Group and Object Index Range
Controller	The associated Controller name (EtherNet/IP)
Path	The CIP Path to the associated Controller (EtherNet/IP)
Tagname	The tagname (EtherNet/IP) or Modbus Register (Modbus) of the mapped item.
Success Count	The number of successful transactions associated with this mapped item.

Table 9.5 – Map Item Status

9.2.6 Event Statistics

The following Event statistics are relevant only when the module is operating in Concentrator mode:

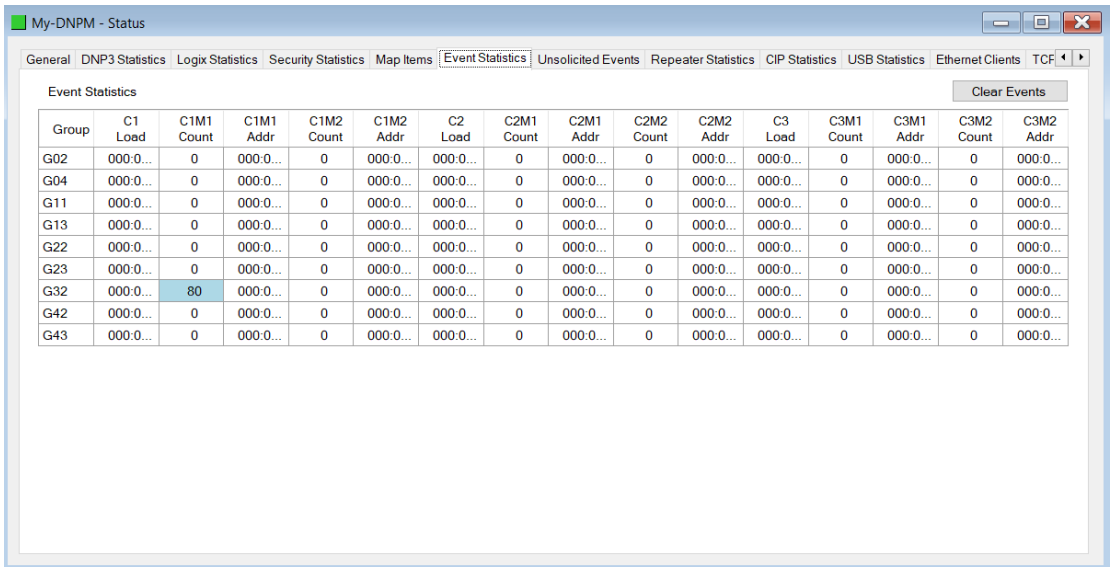


Figure 9.9 - Event Statistics

Statistic	Description
Group	The specific DNP3 Group used.
C1 Load	Memory address of event load index for class 1 events for the specific group.
C1M1 Count	The number of outstanding events for class 1 events for the specific group for Master 1.
C1M1 Addr	Memory address of event load index for class 1 events for the specific group for Master 1.
C1M2 Count	N/A. Only for Outstation mode.
C1M2 Addr	N/A. Only for Outstation mode.
C2 Load	Memory address of event load index for class 2 events for the specific group.
C2M1 Count	The number of outstanding events for class 2 events for the specific group for Master 1.
C2M1 Addr	Memory address of event load index for class 2 events for the specific group for Master 1.
C2M2 Count	N/A. Only for Outstation mode.
C2M2 Addr	N/A. Only for Outstation mode.
C3 Load	Memory address of event load index for class 3 events for the specific group.
C3M1 Count	The number of outstanding events for class 3 events for the specific group for Master 1.
C3M1 Addr	Memory address of event load index for class 3 events for the specific group for Master 1.
C3M2 Count	N/A. Only for Outstation mode.
C3M2 Addr	N/A. Only for Outstation mode.

Table 9.6 - Event statistics

9.2.7 Unsolicited Events

The following Unsolicited Events Statistics are relevant only when the module is operating in Concentrator mode:

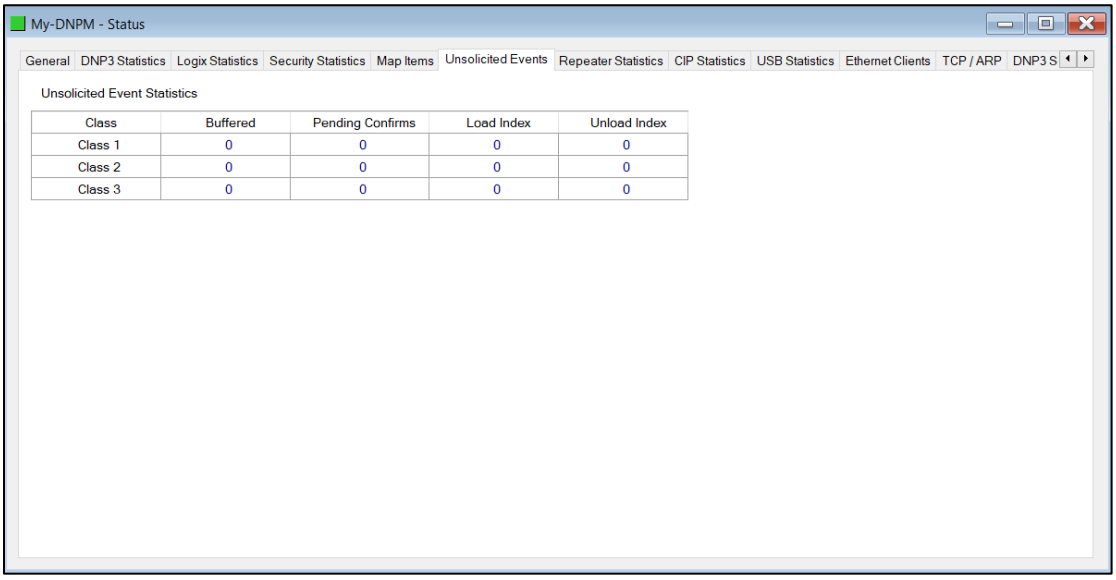


Figure 9.10 – Unsolicited Events

Statistic	Description
Buffered	For each event class, this is the number of unsolicited responses that are currently buffered to send to the DNP Master.
Pending Confirms	For each event class, this is the number of confirms still required for the unsolicited responses that have been sent.
Load Index	For each event class, the load index for the 100 unsolicited response circular buffer.
Unload Index	For each event class, the unload index for the 100 unsolicited response circular buffer.

Table 9.7 – Unsolicited Events

9.2.8 Repeater Statistics

Important: This is not relevant for the PLX51-DNPM module.

9.2.9 CIP Statistics

Each PLX51-DNPM provides a set of Common Industrial Protocol (CIP) communication statistics as shown below:

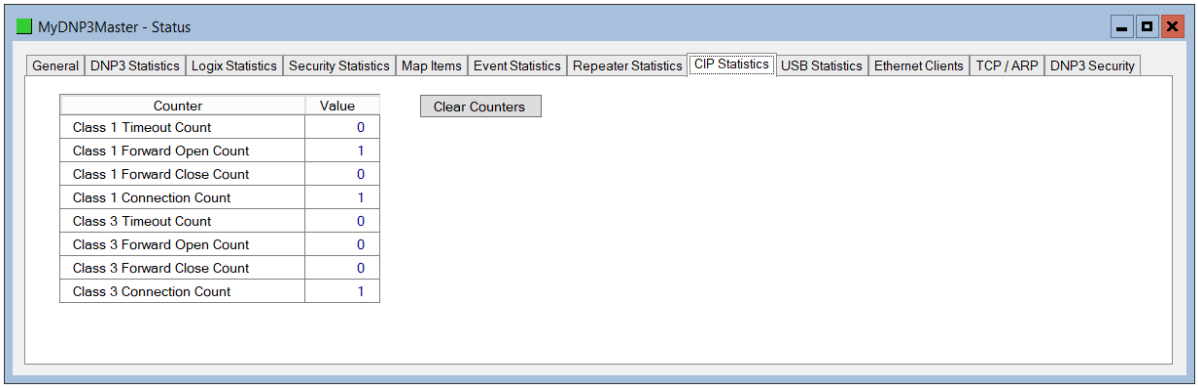


Figure 9.11 - CIP Statistics

Statistic	Description
Class 1 Timeout Count	Number of times a Class 1 connection has timed out
Class 1 Forward Open Count	Number of Class 1 Connection establish attempts
Class 1 Forward Close Count	Number of Class 1 Connection close attempts
Class 1 Connection Count	Number of Class 1 Connections currently active
Class 3 Timeout Count	Number of times a Class 3 connection has timed out
Class 3 Forward Open Count	Number of Class 3 Connection establish attempts
Class 3 Forward Close Count	Number of Class 3 Connection close attempts
Class 3 Connection Count	Number of Class 3 Connections currently active

Table 9.8 - CIP Statistics

9.2.10 USB Statistics

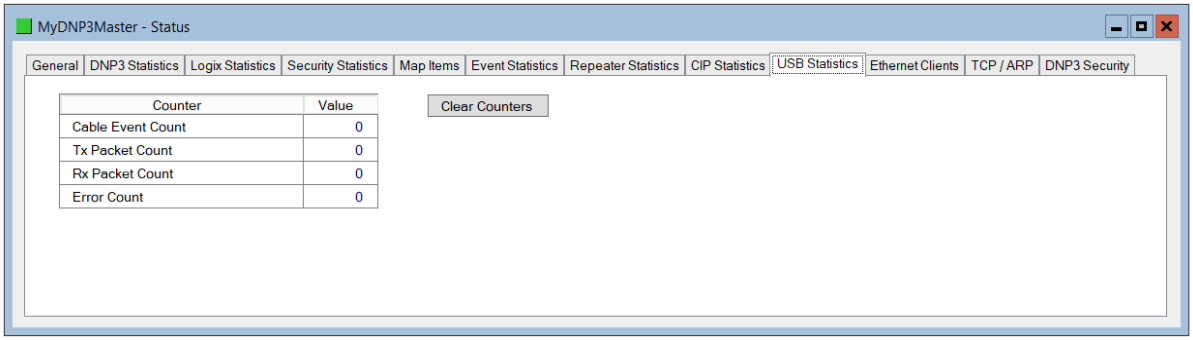


Figure 9.12 - USB Statistics

Statistic	Description
Cable Event Count	This is the number of times the USB cable has either been removed or inserted from the Host or Client.
Tx Packet Count	The number of packets sent on the USB port.
Rx Packet Count	The number of packets received on the USB port.
Error Count	The number of errors that have occurred on the USB port. The user will need to open the module event log for more detail regarding the error.

Table 9.9 - USB Statistics

9.2.11 Ethernet Clients

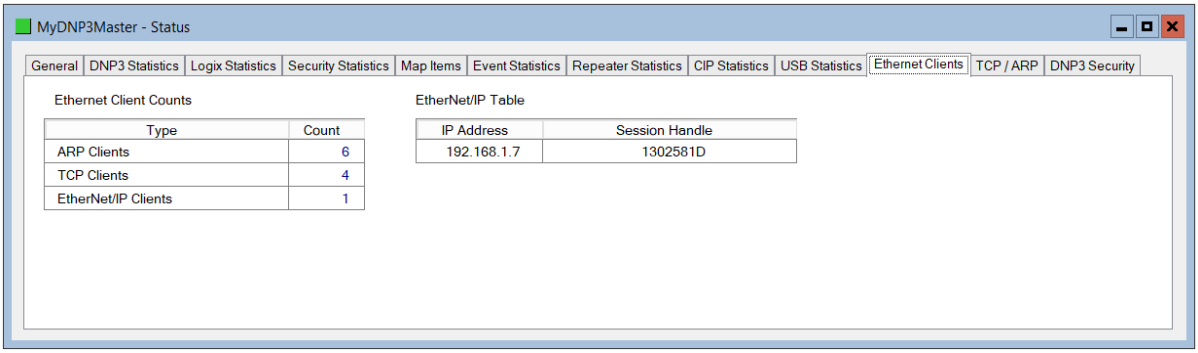


Figure 9.13 - Ethernet Clients

Statistic	Description
Ethernet Clients	
ARP Clients	The number of ARP (Address Resolution Protocol) Clients
TCP Clients	The number of TCP (Transmission Control Protocol) Clients
EtherNet/IP Clients	The number of EtherNet/IP Clients
EtherNet/IP Table	
IP Address	IP Address of the remote EtherNet/IP client
Session Handle	Session Handle associated with the EtherNet/IP connection

Table 9.10 – Ethernet Clients

9.2.12 TCP / ARP Tables

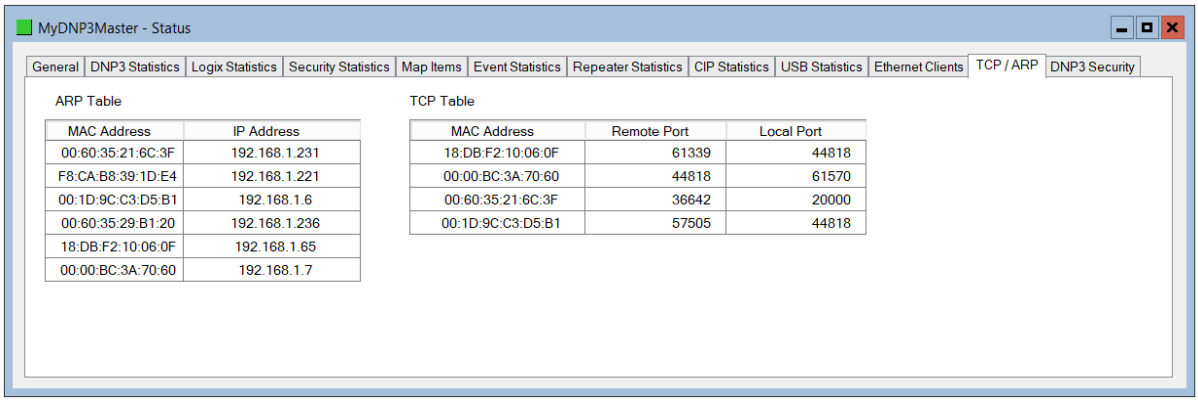


Figure 9.14 - TCP / ARP Tables

Statistic	Description
ARP (Address Resolution Protocol) Table	
MAC Address	The MAC address of the remote Ethernet interface
IP Address	The IP (Internet Protocol) address
TCP (Transmission Control Protocol) Table	
MAC Address	The MAC address of the remote Ethernet interface
Remote Port	The TCP Port of the remote device
Local Port	The TCP port of the local device

Table 9.11 – TCP / ARP Tables

9.3 DNP3 Packet Capture

The PLX51-DNPM module provides the capability to capture the DNP3 traffic for analysis. This will assist the user and the support team to diagnose any possible issues.

To invoke the capture of the module, double-click on the DNP3 Packet Capture item in the Project Explorer tree.

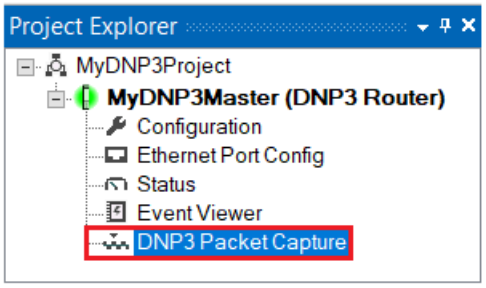


Figure 9.15 - Selecting DNP3 Packet Capture

The DNP3 Packet Capture window will open and automatically start capturing all DNP3 packets.

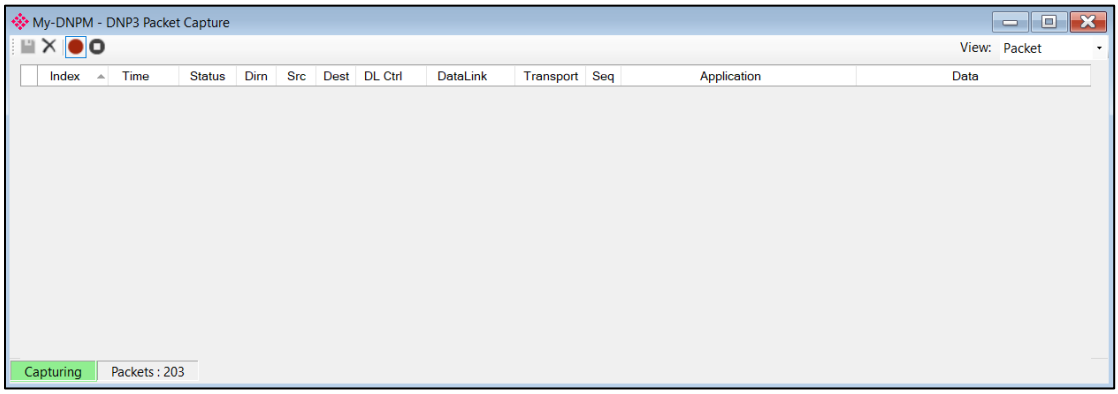


Figure 9.16 – DNP3 packet capture

To display the captured DNP3 packets, the capture process must first be stopped, by pressing the ***Stop*** button.

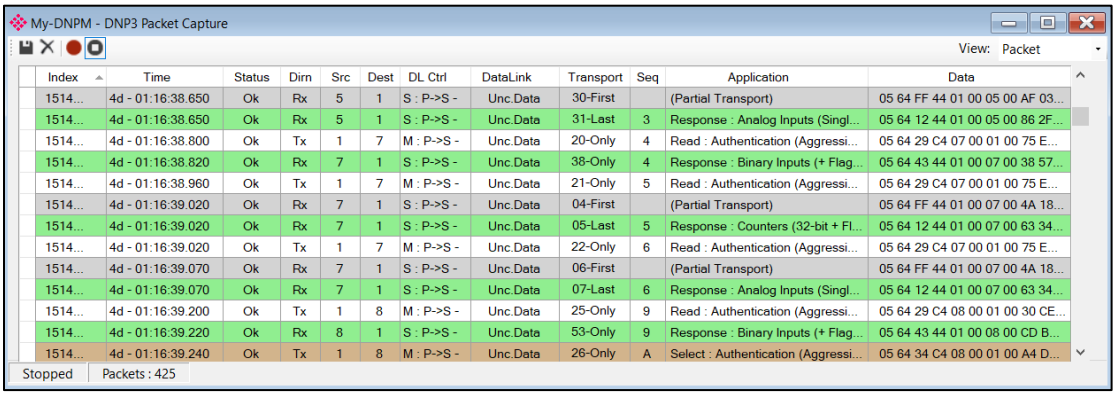


Figure 9.17 – DNP3 Packet Capture complete

The captured DNP3 packets are tabulated as follows:

Statistic	Description
Index	The packet index, incremented for each packet sent or received.
Time	The elapsed time since the module powered up.
Status	The status of the packet. Received packets are checked for valid DNP3 constructs and valid checksums.
Dirn	The direction of the packet, either transmitted (Tx) or received (Rx).
Src	DNP3 node address of the message source.
Dest	DNP3 node address of the message destination.
DL Ctrl	Data Link layer control. Part 1 **: M** – Master / **S** – Slave Part 2 : **P->S** : Primary to Secondary / **S->P** : Secondary to Primary Part 3 : **Frame Count** **-** : FCV = 0 (Frame count ignored) **0** : FCV = 1, FCB = 0 (Frame Count = 0) **1** : FCV = 1, FCB = 1 (Frame Count = 1)
Data Link	Data Link function.
Transport	Transport sequence numbers.
Seq	Application sequence numbers
Application	Application Layer

Table 9.12 – DNP3 Packet Capture fields

The packet capture can be saved to a file for further analysis, by selecting the ***Save*** button on the toolbar. Previously saved DNP3 Packet Capture files can be viewed by selecting the DNP3 ***Packet Capture Viewer*** option in the ***Tools*** menu.

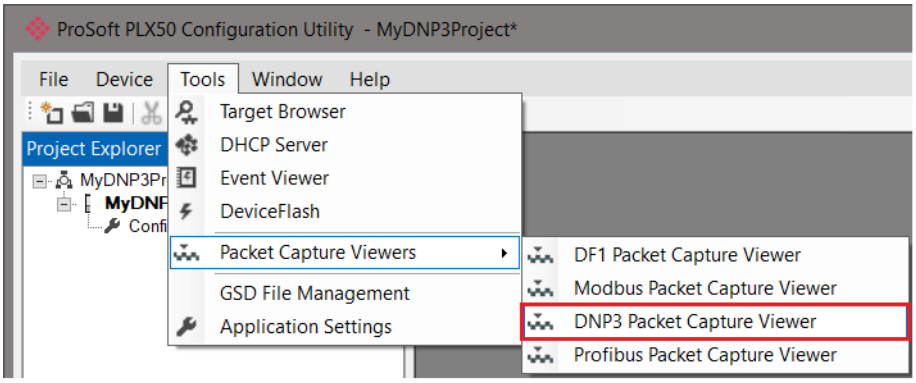


Figure 9.18 - Selecting the DNP3 Packet Capture Viewer

9.4 Module Event Log

The PLX51-DNPM module logs various diagnostic records to an internal event log. These logs are stored in non-volatile memory and can be displayed using the PLX50 Configuration Utility or via the web interface.

To view them in PLX50 Configuration Utility, select the ***Event Viewer*** option in the Project Explorer tree.

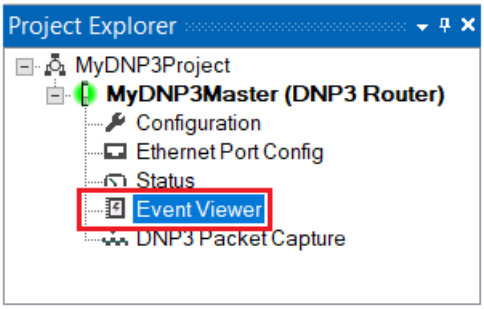
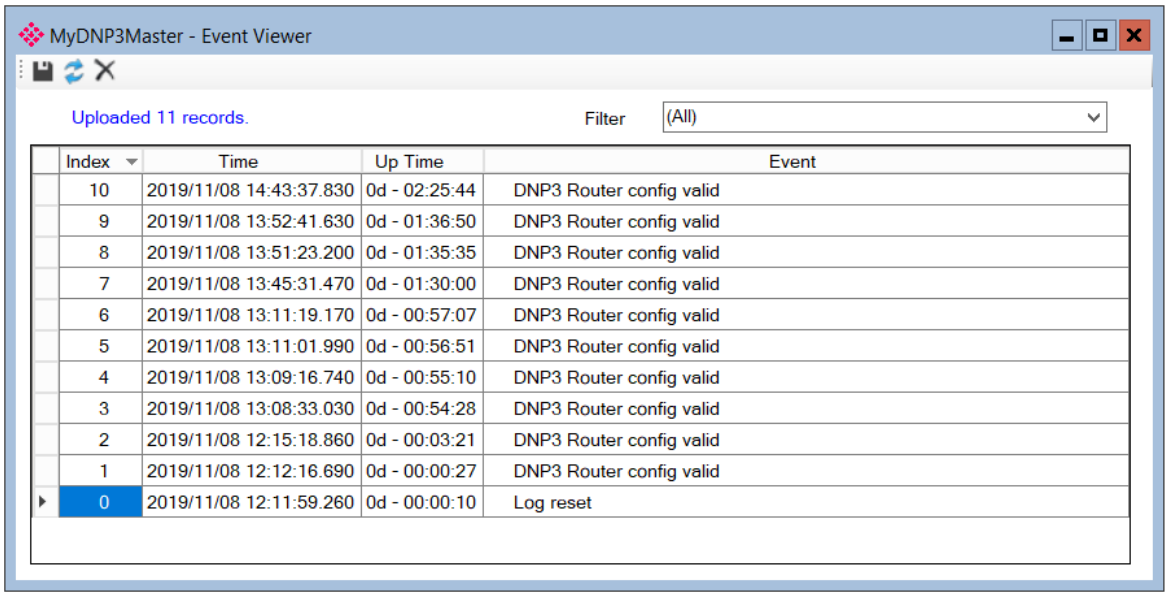


Figure 9.19 - Selecting the module Event Log

The Event Log window will open and automatically read all the events from the module.

The log entries are sorted so as to have the latest record at the top. Custom sorting is achieved by double-clicking on the column headings.



Index	Time	Up Time	Event
10	2019/11/08 14:43:37.830	0d - 02:25:44	DNP3 Router config valid
9	2019/11/08 13:52:41.630	0d - 01:36:50	DNP3 Router config valid
8	2019/11/08 13:51:23.200	0d - 01:35:35	DNP3 Router config valid
7	2019/11/08 13:45:31.470	0d - 01:30:00	DNP3 Router config valid
6	2019/11/08 13:11:19.170	0d - 00:57:07	DNP3 Router config valid
5	2019/11/08 13:11:01.990	0d - 00:56:51	DNP3 Router config valid
4	2019/11/08 13:09:16.740	0d - 00:55:10	DNP3 Router config valid
3	2019/11/08 13:08:33.030	0d - 00:54:28	DNP3 Router config valid
2	2019/11/08 12:15:18.860	0d - 00:03:21	DNP3 Router config valid
1	2019/11/08 12:12:16.690	0d - 00:00:27	DNP3 Router config valid
0	2019/11/08 12:11:59.260	0d - 00:00:10	Log reset

Figure 9.20 – Module Event Log

The log can also be stored to a file for future analysis, by selecting the ***Save*** button in the tool menu.

To view previously saved files, use the ***Event Log Viewer*** option under the ***Tools*** menu.

9.5 Web Server

The PLX51-DNPM module hosts a web server allowing a user without PLX50 Configuration Utility or RSLogix 5000 to view various diagnostics of the module. This includes Ethernet parameters, the system event log, advanced diagnostics, and application diagnostics (DNP3 diagnostics).

Note: The web server is view **only** and thus no parameters or configuration can be altered from the web interface.

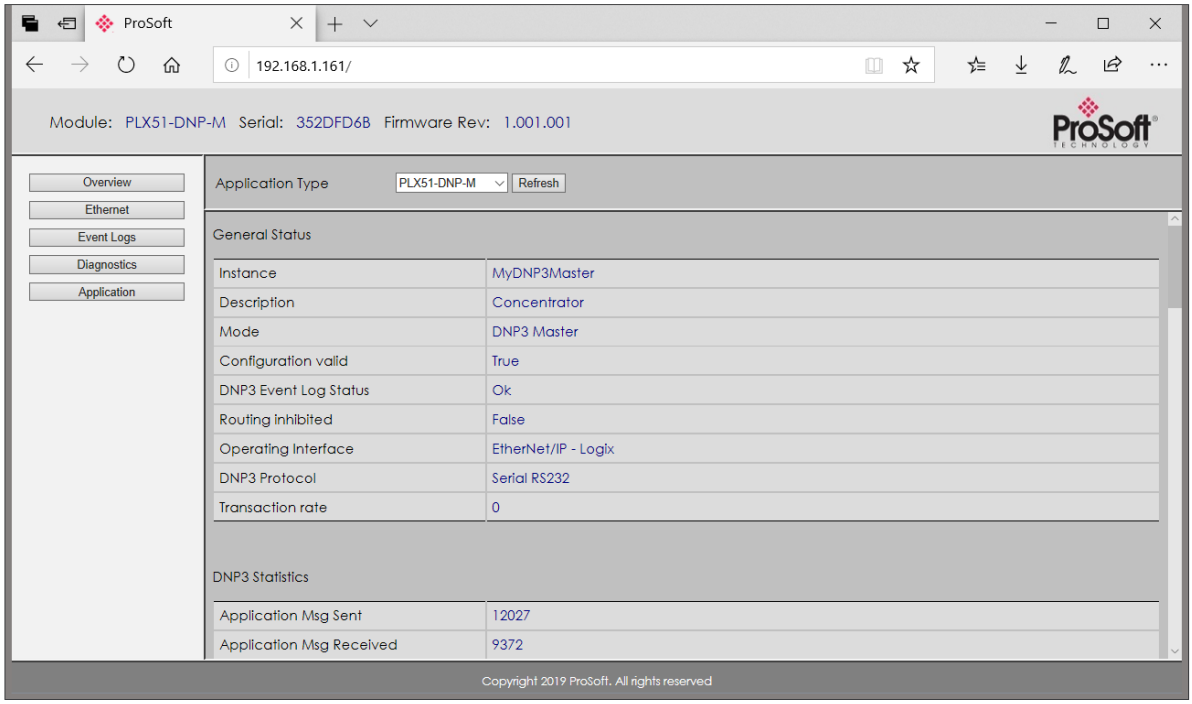


Figure 9.21 - Web interface

10 Technical Specifications

10.1 Dimensions

Below are the enclosure dimensions as well as the required DIN rail dimensions. All dimensions are in millimeters.

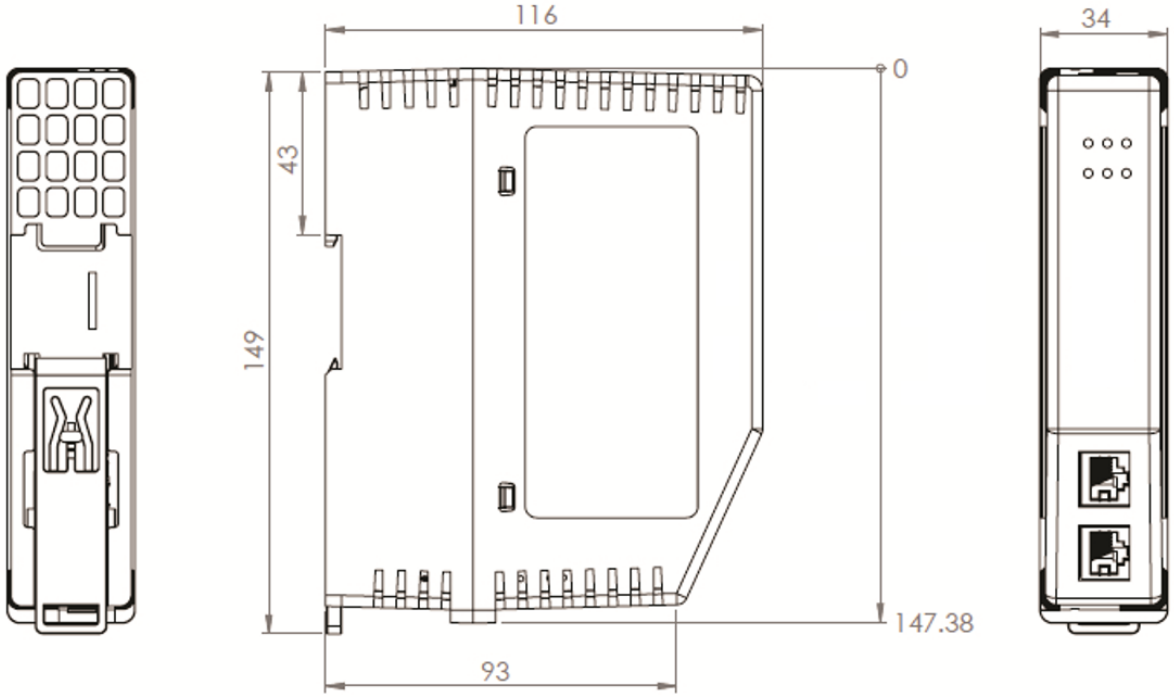


Figure 10.1 – DNP module enclosure dimensions

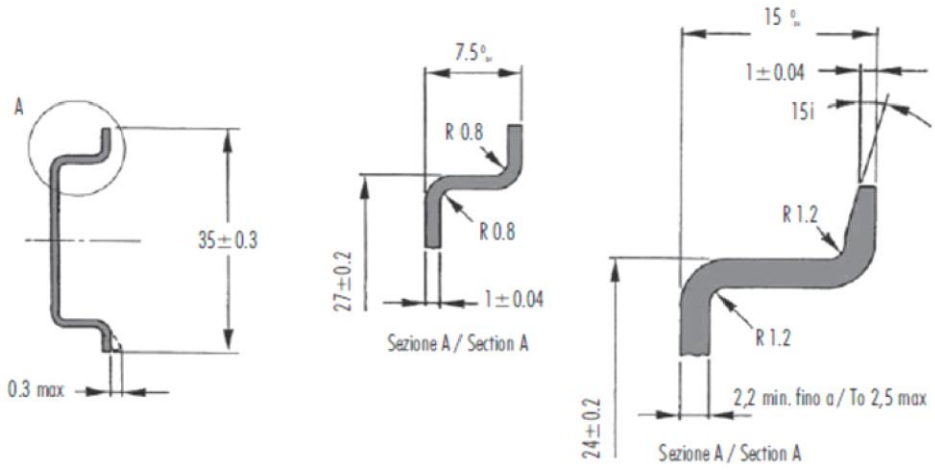


Figure 10.2 - Required DIN dimensions

10.2 Electrical

Specification	Rating
Power requirements	Input: 10 – 32V DC, (121 mA @ 24 VDC)
Voltage Fluctuations	Voltage fluctuations < ±10% Transient Over-voltages up to the levels of OVERVOLTAGE CATEGORY I
Power consumption	3.1 W (Including full load on USB of 200mA) 300 mA maximum
USB Power	5V, maximum load of 200 mA (1W).
Connector	3-way terminal
Conductors	24 – 18 AWG
Earth connection	Yes, terminal based
Emissions	IEC61000-6-4
ESD Immunity	EN 61000-4-2
Radiated RF Immunity	IEC 61000-4-3
EFT/B Immunity	EFT: IEC 61000-4-4
Surge Immunity	Surge: IEC 61000-4-5
Conducted RF Immunity	IEC 61000-4-6

Table 10.1 - Electrical specification

10.3 Environmental

Specification	Rating
Enclosure rating	IP20, NEMA/UL Open Type Indoor use only
Temperature	-20 to 70 °C
Relative Humidity	5% to 90% - No condensation
Pollution Degree	2
Altitude	< 2000 m

Table 10.2 - Environmental specification

10.4 Ethernet

Specification	Rating
Connector	RJ45
Conductors	CAT5 STP/UTP
ARP connections	Max 250
TCP connections	Max 250
CIP connections	Max 10
Communication rate	10/100Mbps
Duplex mode	Full/Half
Auto-MDIX support	Yes
Embedded switch	Yes, 2 x Ethernet ports
DLR supported	Yes

Table 10.3 - Ethernet specification

10.5 Serial Port (RS232)

Specification	Rating
RS232 Connector	9-way terminal (shared with RS485)
RS232 Conductor	24 to 18 AWG
Electrical Isolation	1000 Vdc
BAUD	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, Even, Odd
Data bits	8
Stop bits	1

Table 10.4 – RS232 Serial Port specification

10.6 Serial Port (RS485)

Specification	Rating
RS485 Connector	9-way terminal (shared with RS485)
RS485 Conductor	24 to 18 AWG
Electrical Isolation	1500 Vrms for 1 minute.
BAUD	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, Even, Odd
Data bits	8
Stop bits	1

Table 10.5 – RS485 Serial Port specification

10.7 USB Port

Specification	Rating
USB supported	USB2.0 **Note:** The USB interface can only be used with Logix Controllers that have a USB port. The module cannot route (via USB) across the backplane from another module (for example, EN2T) to a Logix controller.
Module USB Connector	Type-A
Recommended USB Cable	Type-A (male) to Type-B (male)

Table 10.6 – USB Port specification

10.8 DNP3

Specification	Rating
Outstation mode	Max 1000 mapping items
Master mode	Max 1000 mapping items
Concentrator mode	Max 1000 mapping items
Application Functions Supported	Read Write Select/Operate Direct-Operate Direct-Operate-No-Response Freeze Freeze with No Ack Freeze and Clear Freeze and Clear with No Ack Authentication Request Authentication Response
Maximum DNP3 objects per request	30
Maximum DNP3 request size per mapped item in Outstation Tag Mode	1000 bytes
Maximum DNP3 request size per mapped item in Master Tag Mode	230 bytes
Maximum Logix Controller support	3
Unsolicited Response support	Yes
Maximum event buffer per DNP3 group	50,000 (total of 1,350,000)
Number of Commands per Request	1
Event Read Interval	10ms

Table 10.7 – DNP3 specification

10.9 DNP3 Secure Authentication

Specification	Rating
Key Change Method Supported	Pre-shared
MAC Algorithms Supported	HMAC SHA-1 encryption (4 octets – serial) – for legacy support HMAC SHA-1 encryption (8 octets – serial) HMAC SHA-1 encryption (10 octets – networked) HMAC SHA-256 encryption (8 octets – serial) HMAC SHA-256 encryption (16 octets – networked) AES-GMAC (12 octets)
Key Wrap Algorithms Supported	AES-128 Key Wrap AES-256 Key Wrap
Aggressive Mode Supported	Yes

Table 10.8 – DNP3 Secure Authentication specification

11 Appendix A - DNP3 Reference

11.1 DNP3 Functions

Code	Function
00	Confirm
01	Read
02	Write
03	Select
04	Operate
05	Direct Operate
06	Direct Operate - No Response
07	Freeze
08	Freeze - No Response
09	Freeze Clear
0a	Freeze Clear - No Response
0b	Freeze At Time
0c	Freeze At Time - No Response
0d	Cold Restart
0e	Warm Restart
0f	Initialize Data
10	Initialize Application
11	Start Application
12	Stop Application
13	Save Configuration
14	Enable Unsolicited
15	Disable Unsolicited
16	Assign Class
17	Delay Measurement
18	Record Current Time
19	Open File
1a	Close File
1b	Delete File
1c	Get File Information
1d	Authenticate File
1e	Abort File
1f	Activate Config
20	Authenticate Request
21	Authenticate Request - No Ack
81	Response
82	Unsolicited Response
83	Authentication Response

Table 11.1 – DNP3 Functions

11.2 DNP3 Groups

Group	Description
0	Device Attributes
1	Binary Inputs
2	Binary Input Events
3	Double Bit Binary Inputs
4	Double Bit Binary Input Events
10	Binary Outputs (Status)
11	Binary Output Events
12	Binary Output Commands
13	Binary Output Command Events
20	Counters
21	Frozen Counters
22	Counter Events
23	Frozen Counter Events
30	Analog Inputs
31	Frozen Analog Inputs
32	Analog Input Events
33	Frozen Analog Input Events
34	Analog Input Reporting Deadbands
40	Analog Output Status
41	Analog Outputs (Commands)
42	Analog Output Events
43	Analog Output Command Events
50	Time And Date
51	Time And Date Of Occurrence
52	Time Delays
60	Class Objects
70	File Control
80	Internal Indications
81	Device Storage
82	Device Profiles
83	Data Sets
85	Data Set Prototypes
86	Data Set Descriptors
87	Data Sets Present Value
88	Data Set Events
90	Applications
91	Status Of Requested Operations
100	Floating Point
101	BCD Integers
102	Unsigned Integers
110	Octet Strings

Group	Description
111	Octet String Events
112	Virtual Terminal Output Blocks
113	Virtual Terminal Event Data
120	Authentication
121	Security Statistics
122	Security Statistic Events

Table 11.2 – DNP3 Groups

11.3 Supported DNP3 Group Variations

Group	Group Description	Supported Functions	Var. Code	Variation Description	Recommended Data Type
1	Binary Inputs	Read	0	Any	PSDNP3BinaryInputWithFlag
			1	Packed Format	PSDNP3BinaryInputPacked
			2	With Flags	PSDNP3BinaryInputWithFlag
3	Double Bit Binary Inputs	Read	0	Any	PSDNP3DoubleBinaryInputWithFlag
			1	Packed Format	PSDNP3DoubleBinaryInputPacked
			2	With Flags	PSDNP3DoubleBinaryInputWithFlag
10	Binary Outputs	Read	0	Any	PSDNP3BinaryOutputWithFlag
			1	Packed Format	PSDNP3BinaryOutputPacked
			2	Output Status With Flags	PSDNP3BinaryOutputWithFlag
12	Binary Output Commands	Operate*	1	Control Relay Output Block	PSDNP3CROB
20	Counters	Read Freeze Clear	0	Any	PSDNP3Counter32WithFlag
			1	32-bit With Flag	PSDNP3Counter32WithFlag
			2	16-bit With Flag	PSDNP3Counter16WithFlag
			5	32-bit Without Flag	DINT
			6	16-bit Without Flag	INT
21	Frozen Counters	Read	0	Any	PSDNP3FrozenCounter32WithFlagTime
			1	32-bit With Flag	PSDNP3FrozenCounter32WithFlag
			2	16-bit With Flag	PSDNP3FrozenCounter16WithFlag
			5	32-bit With Flag And Time	PSDNP3FrozenCounter32WithFlagTime
			6	16-bit With Flag And Time	PSDNP3FrozenCounter16WithFlagTime
			9	32-bit Without Flag	DINT
			10	16-bit Without Flag	INT
30	Analog Inputs	Read	0	Any	PSDNP3AnalogInputVar0
			1	32-bit With Flag	PSDNP3AnalogInput32Flag
			2	16-bit With Flag	PSDNP3AnalogInput16Flag

			3	32-bit Without Flag	DINT
			4	16-bit Without Flag	INT
			5	Single Floating Point With Flag	PSDNP3AnalogInputRealFlag
31	Frozen Analog Inputs	Read	0	Any	PSDNP3FrozenAnalogVar0
			1	32-bit With Flag	PSDNP3FrozenAnalog32WithFlag
			2	16-bit With Flag	PSDNP3FrozenAnalog16WithFlag
			3	32-bit With Time of Freeze	PSDNP3FrozenAnalog32WithFlagTime
			4	16-bit With Time of Freeze	PSDNP3FrozenAnalog16WithFlagTime
			5	32-bit Without Flag	DINT
			6	16-bit Without Flag	INT
			7	Single Floating Point With Flag	PSDNP3FrozenAnalogRealWithFlag
40	Analog Output Status	Read	0	Any	PSDNP3AnalogOutputVar0
			1	32-bit With Flag	PSDNP3AnalogOutputStatus32Flag
			2	16-bit With Flag	PSDNP3AnalogOutputStatus16Flag
			3	Single Floating Point With Flag	PSDNP3AnalogOutputStatusRealFlag
41	Analog Outputs	Operate*	1	32-bit	PSDNP3AnalogOutput32
			2	16-bit	PSDNP3AnalogOutput16
			3	Single Floating Point	PSDNP3AnalogOutputReal
102	Unsigned Integers	Read Write	1	8-bit	SINT
110	Octet String	Read Write	x	Length of the string	STRING

Table 11.3 - Supported DNP3 Group Variations

Note: The Operate function refers to all the Operate functions: Select, Operate, Direct Operate and Direct Operate without Acknowledge.

Note: The *Supports Events* column is only relevant for PLX51-DNPM Concentrator mode.

11.4 DNP3 Qualifier Code

The qualifier code (byte) is made up of the Object Prefix nibble and the Range Field nibble as described in the table below.

Bit Number -->	7	6	5	4	3	2	1	0
	0	Prefix Code			Range Specifier Code			

Table 11.4 – DNP3 Qualifier Code

Prefix Code	Object Prefix
0	Objects packed without a prefix
1	Objects prefixed with 8-bit index
2	Objects prefixed with 16-bit index
3	Objects prefixed with 32-bit index
4	Objects prefixed with 8-bit size
5	Objects prefixed with 16-bit size
6	Objects prefixed with 32-bit size
7	Reserved

Table 11.5 – DNP3 Object Prefix Code

Range Code	Range Specifier
0	8-bit Start-Stop index
1	16-bit Start-Stop index
2	32-bit Start-Stop index
3	8-bit Start-Stop virtual address
4	16-bit Start-Stop virtual address
5	32-bit Start-Stop virtual address
6	No range - implies All
7	8-bit Count of objects
8	16-bit Count of objects
9	32-bit Count of objects
A	Reserved
B	8-bit Count of objects, variable format
C	Reserved
D	Reserved
E	Reserved
F	Reserved

Table 11.6 – DNP3 Range Field Specifier Code

Qualifier Code	Object Prefix	Range Specifier	Preferred
00	Objects packed without a prefix	8-bit Start-Stop index	●
01	Objects packed without a prefix	16-bit Start-Stop index	●
02	Objects packed without a prefix	32-bit Start-Stop index	
03	Objects packed without a prefix	8-bit Start-Stop virtual address	
04	Objects packed without a prefix	16-bit Start-Stop virtual address	
05	Objects packed without a prefix	32-bit Start-Stop virtual address	
06	Objects packed without a prefix	No range - implies All	●
07	Objects packed without a prefix	8-bit Count of objects	●
08	Objects packed without a prefix	16-bit Count of objects	●
09	Objects packed without a prefix	32-bit Count of objects	
17	Objects prefixed with 8-bit index	8-bit Count of objects	●
18	Objects prefixed with 8-bit index	16-bit Count of objects	
19	Objects prefixed with 8-bit index	32-bit Count of objects	
27	Objects prefixed with 16-bit index	8-bit Count of objects	
28	Objects prefixed with 16-bit index	16-bit Count of objects	●
29	Objects prefixed with 16-bit index	32-bit Count of objects	
37	Objects prefixed with 32-bit index	8-bit Count of objects	
38	Objects prefixed with 32-bit index	16-bit Count of objects	
39	Objects prefixed with 32-bit index	32-bit Count of objects	
4B	Objects prefixed with 8-bit size	8-bit Count of objects, variable format	
5B	Objects prefixed with 16-bit size	8-bit Count of objects, variable format	●
6B	Objects prefixed with 32-bit size	8-bit Count of objects, variable format	

Table 11.7 – DNP3 Valid Qualifier Range Codes

11.5 DNP3 Event Status Flags

Group	Flag Description
2 – Binary Input Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Chatter Filter Bit 6 – Reserved Bit 7 – Input State
4 – Double-bit Binary Input Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Chatter Filter Bit 6 – Input State 0 Bit 7 – Input State 1
11 – Binary Output Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Reserved Bit 6 – Reserved Bit 7 – Output State
13 – Binary Output Command Events	Bit 0 –> 6 ▪ 0 – Success ▪ 1 – Timeout ▪ 2 – No Select ▪ 3 – Format Error ▪ 4 – Not Supported ▪ 5 – Already Active Bit 7 – Commanded State
22 – Counter Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Rollover Bit 6 – Discontinuity Bit 7 – Reserved
23 – Frozen Counter Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Rollover Bit 6 – Discontinuity Bit 7 – Reserved
32 – Analog Input Events	Bit 0 – Online

	Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Over range Bit 6 – Reference Error Bit 7 – Reserved
42 – Analog Output Events	Bit 0 – Online Bit 1 – Restart Bit 2 – Communication Lost Bit 3 – Remote Forced Bit 4 – Local Forced Bit 5 – Over range Bit 6 – Reference Error Bit 7 – Reserved
43 – Analog Output Command Events	Bit 0 –> 6 ▪ 0 – Success ▪ 1 – Timeout ▪ 2 – No Select ▪ 3 – Format Error ▪ 4 – Not Supported ▪ 5 – Already Active Bit 7 – Reserved

Table 11.8 – DNP3 Event Group Status Flags

11.6 DNP3 Control Relay Output Block (CROB)

Below is the format of the CROB request data:

Byte	Parameter	Description
0	Bit 0 to 3 Op Type	0 – Nul 1 – Pulse On 2 – Pulse Off 3 – Latch On 4 – Latch Off
	Bit 4 Control Code	Reserved
	Bit 5 Control Code, Clear Field	Reserved
	Bit 6 to 7 Control Code, Trip-Close Code	This is used in conjunction with the Op Type to specify the control operation. 0 – Nul 1 – Close 2 – Trip 3 - Reserved
1	Count	The number of times the operation must be executed (e.g., a number of pulses).
2 – 5	On-Time	The duration (in milliseconds) that the output must be on when pulsed.
6 – 9	Off Time	The duration (in milliseconds) that the output must be off when pulsed.
10	Status Code	In the request this must be zero.

Table 11.9 – DNP3 CROB parameters

11.7 DNP3 Device Indicators

Bit	Indicator	Condition
IIN.0	Broadcast	Set when a broadcast message was received. Cleared after the first message sent with this bit set.
IIN.1	Class 1 Events	Set more than one Class 1 event is buffered in the PLX51-DNPM (Concentrator mode). Cleared when there are no Class 1 events in the PLX51-DNPM (Concentrator mode) event buffer.
IIN.2	Class 2 Events	Set more than one Class 2 event is buffered in the PLX51-DNPM (Concentrator mode). Cleared when there are no Class 2 events in the PLX51-DNPM (Concentrator mode) event buffer.
IIN.3	Class 3 Events	Set more than one Class 3 event is buffered in the PLX51-DNPM (Concentrator mode). Cleared when there are no Class 3 events in the PLX51-DNPM (Concentrator mode) event buffer.
IIN.4	Need Time	Set when the PLX51-DNPM (Concentrator mode) requires time from the DNP3 Master.

		Cleared when an update time message was received from the DNP3 Master.
IIN.5	Local Control	Not used by the PLX51-DNPM.
IIN.6	Device Trouble	Set when there is an issue with the operating interface (EtherNet/IP or Modbus). For example, if one of the Modbus mapped items (when operating as a Modbus Master) has failed to read or write. Cleared when all operating interface communication is ok.
IIN.7	Device Restart	Set when the PLX51-DNPM (Concentrator mode) was rebooted or when the DNP3 Master writes to the Device Indicator bits. Cleared if the DNP3 Master writes a zero to this bit in the internal indicators.
IIN.8	Function code not supported	Set when a function was received by the DNP3 Master which is not supported by the PLX51-DNPM (Concentrator mode).
IIN.9	Object Unknown	Set when a DNP3 object was received by the DNP3 Master which is not supported by the PLX51-DNPM in Concentrator mode. (e.g., request for an Analog Input which cannot be found in the PLX51-DNPM DNP3 mapping).
IIN.10	Parameter Error	Set when a non-specific error occurred when processing the request. This includes the following: The operate request message received is too big. Incorrect class or qualifier received. Error received when trying to read or write to a Logix tag. For more detail on which error occurred, refer to the PLX51-DNPM module statistics in the status window in the PLX50CU.
IIN.11	Event Buffer Overfow	Set when any of the Event Class Buffers (1, 2, or 3) has reached the maximum number of events that can be buffered. Cleared when there are less than the max events.
IIN.12	Already Executing	Not used by the PLX51-DNPM.
IIN.13	Config Corrupt	Not used by the PLX51-DNPM.
IIN.14	Reserved	Not used by the PLX51-DNPM.
IIN.15	Reserved	Not used by the PLX51-DNPM.

Table 11.10 – DNP3 Device Indicators

12 Appendix B - CIP Object Reference

12.1 General Status

Request:

Parameter	Description
Service	Get Attribute Single
Class	0x40C (Hex)
Instance	1
Attribute	1

Table 12.1 – General Status - Request

Response:

Offset	Parameter	Data Type	Comments
0	Status	INT	
0.0	Configuration Valid	BIT	
0.1	Routing Inhibited	BIT	
0.2	DNP3 Event Log Load Ok	BIT	
0.3	DNP3 Event Log Overflow	BIT	
0.4	Modbus Communications Ok	BIT	
0.5	Assign Class Dynamic Memory	BIT	Event Classes have been updated from dynamic assignments
0.6	Deadband Dynamic Memory	BIT	Deadbands have been updated from dynamic assignments
0.7	Unsolicited Dynamic Memory	BIT	Unsolicited Enables have been updated from dynamic assignments
2	Configuration Checksum	INT	
4	Mode	SINT	1 – Outstation (Fixed for DNPS)
5	Reserved	SINT	
6	Transaction Rate	INT	Number of complete Transactions per second
8	Reserved	DINT	
12	Operating Interface	SINT	0 - (EtherNet/IP) Logix 2 - (CIP USB) Logix 3 - Modbus TCP Slave 4 - Modbus RTU 232 Slave 5 - Modbus RTU 485 Slave 6 - Modbus TCP Master 7 - Modbus RTU 232 Master 8 - Modbus RTU 485 Master
13	DNP3 Protocol	SINT	0 - Serial RS232 1 - Ethernet TCP 2 - Ethernet UDP 3 - Serial RS485

Table 12.2 – General Status - Response

12.2 Time Status

Request:

Parameter	Description
Service	Get Attribute Single
Class	0x404 (Hex)
Instance	1
Attribute	1

Table 12.3 – Time Status - Request

Response:

Offset	Parameter	Data Type	Comments
0	Uptime	DINT	
4	Year	INT	
6	Month	SINT	
7	Day	SINT	
8	Hour	SINT	
9	Minute	SINT	
10	Second	SINT	
11	Process Cycles	DINT	
15	Device Temperature	REAL	

Table 12.4 – Time Status - Response

12.3 DNP3 Statistics

Request:

Parameter	Description
Service	Get Attribute Single
Class	0x40C (Hex)
Instance	1
Attribute	2

Table 12.5 – DNP3 Statistics - Request

Response:

Offset	Parameter	Data Type	Comments
0	AppMsgSent	DINT	Operational Statistics
4	AppMsgReceived	DINT	
8	CriticalMsgReceived	DINT	
12	CriticalMsgSent	DINT	
16	DiscardedMsg	DINT	
20	ErrorMsgSent	DINT	
24	ErrorMsgReceived	DINT	
28	ChecksumError	DINT	
32	Timeout	DINT	
36	AssignClassReceived	DINT	
40	TimeUpdateReceived	DINT	
44	DeadbandUpdateReceived	DINT	
48	BroadcastMessageReceived	DINT	
52	UnsolicitedEventReceived	DINT	
56	SuccessAuthentication	DINT	Security Statistics
60	SessionKeyChanges	DINT	
64	FailedSessionKeyChanges	DINT	
68	UpdateKeyChanges	DINT	
72	AuthenticationFailure	DINT	
76	AuthorizationFailure	DINT	
80	UnexpectedResponse	DINT	
84	NoResponse	DINT	
88	AggressiveNotSupp	DINT	
92	MacAlgorithmNotSupp	DINT	
96	KeywrapAlgorithmNotSupp	DINT	
100	UpdateKeyNotPermitted	DINT	
104	Unknown User	DINT	
108	LogixDNP3DataTypeMismatchRead	DINT	Exception Statistics

112	LogixDNP3DataTypeMismatchWrite	DINT	
116	WriteSequenceIndexOutOfOrder	DINT	
120	TooMuchDataInDNP3Request	DINT	
124	MappedItemNotFound	DINT	
128	ReceivedEventItemNotFound	DINT	
132	TooManyDNP3ObjectsInRequest	DINT	
136	DNP3MessageQueueFull	DINT	
140	NodeNumberMismatch	DINT	
144	SelectSizeTooBig	DINT	
148	SelectOperateDataMismatch	DINT	
152	ParityError	DINT	
156	TransferKeyChanges	DINT	Enhanced Security Statistics

Table 12.6 – DNP3 Statistics - Response

12.5 DNP3 Event Statistics

Request:

Parameter	Description
Service	Get Attribute Single
Class	0x40C (Hex)
Instance	1
Attribute	3

Table 12.7 – DNP3 Event Statistics - Request

Response:

Offset	Parameter	Data Type	Comments
0	DNP3 Group	SINT	
	Event Class 1		
1	Reserved	INT	
3	Reserved	SINT	
4	Reserved	SINT	
5	Master 1		
5	Event Count	INT	
7	Reserved	INT	
9	Reserved	SINT	
10	Reserved	SINT	
11	Master 2		
11	Event Count	INT	Repeat this structure (49 bytes) for all 9 groups G02 - Binary Input Events G04 - Double-bit Binary Input Events G11 - Binary Output Events G13 - Binary Output Command Events G22 - Counter Events G23 - Frozen Counter Events G32 - Analog Input Events G42 - Analog Output Events G43 - Analog Output Command Events
13	Reserved	INT	
15	Reserved	SINT	
16	Reserved	SINT	
	Event Class 2		
17	Reserved	INT	
19	Reserved	SINT	
20	Reserved	SINT	
21	Master 1		
21	Event Count	INT	
23	Reserved	INT	
25	Reserved	SINT	
26	Reserved	SINT	
27	Master 2		
27	Event Count	INT	
29	Reserved	INT	
31	Reserved	SINT	
32	Reserved	SINT	
	Event Class 3		

33	Reserved	INT	
35	Reserved	SINT	
36	Reserved	SINT	
37	Master 1		
37	Event Count	INT	
39	Reserved	INT	
41	Reserved	SINT	
42	Reserved	SINT	
43	Master 2		
43	Event Count	INT	
45	Reserved	INT	
47	Reserved	SINT	
48	Reserved	SINT	

Table 12.8 – DNP3 Event Statistics - Response

12.6 DNP3 Tag Mapping Statistics

Request:

Parameter	Description
Service	Get Attribute Single
Class	0x40C (Hex)
Instance	1
Attribute	4

Table 12.9 – DNP3 Tag Mapping Statistics - Request

Response:

Offset	Parameter	Data Type	Comments
0	Current Class 3 Connections	DINT	
4	Connection Failures	DINT	
8	Tag Not Exist Errors	DINT	
12	Privilege Violations	DINT	
16	Tag Reads	DINT	
20	Tag Writes	DINT	
24	EtherNet/IP Retries	DINT	
28	EtherNet/IP Failures	DINT	
32	General Access Error	DINT	

Table 12.10 – DNP3 Tag Mapping Statistics – Response

13 Support, Service & Warranty

13.1 Contacting Technical Support

ProSoft Technology, Inc. is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1. Product Version Number
2. System architecture
3. Network details

If the issue is hardware related, we will also need information regarding:

1. Module configuration and associated ladder files, if any
2. Module operation and any unusual behavior
3. Configuration/Debug status information
4. LED patterns
5. Details about the interfaced serial, Ethernet or Fieldbus devices

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For additional ProSoft Technology contacts in your area, please see:
www.prosoft-technology.com/About-Us/Contact-Us

13.2 Warranty Information

For details regarding ProSoft Technology's legal terms and conditions, please see:
www.prosoft-technology.com/ProSoft-Technology-Legal-Terms-and-Conditions

For Return Material Authorization information, please see:
www.prosoft-technology.com/Services-Support/Return-Material-Instructions