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Where Automation Connects.

MVI56E-61850C

IEC 61850 Client Communication Module

ControlLogix® Platform

October 17, 2023

USER MANUAL

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MVI56E-61850C User Manual
For Public Use.

October 17, 2023

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1 Start Here

1.1 Overview

This user manual explains the features of the MVI56E-61850C module and guides you through the installation and configuration of the module. This includes using the ProSoft MVI56E-61850C Configuration Manager software to map data for Intelligent Electronic Devices (IEDs) on the IEC 61850 network for use with a Rockwell Automation® ControlLogix® processor. The configuration software creates files to import into Studio 5000 Logix Designer programming software, simplifying the integration of the module into your system.

The high-level steps for the process of configuring the IEC 61850 network are as follows:

1. Add the MVI56E-61850C to your Studio 5000 Logix Designer project. See *Adding the Module to Studio 5000 Logix Designer®* on page 12.
2. Configure the module Ethernet settings through the Add-On Profile. See *Configure the IP Address* on page 16.
3. Launch the ProSoft MVI56E-61850C Configuration Manager and take the following steps to configure client functionality:
   a. Import the IED configuration files (CID or SCD files). See *Import IED Configuration Files* on page 25.
   b. Add the IEDs to the IEC 61850 network. See *Configure the IED Network* on page 28.
   c. Map the desired data attributes for each IED. See *IED Data Mapping* on page 30.
4. Configure GOOSE Publish (server) functionality (if applicable). See *Configure GOOSE Publish* on page 49.
5. Export the configuration to the MVI56E-61850C Add-On Profile. See *Export the Configuration to the Add-On Profile* on page 59.
6. Import the MVI56E-61850C Program into Studio 5000 Logix Designer. See *Import the MVI56E-61850C Program into Studio 5000 Logix Designer* on page 68.

1.2 System Requirements

The MVI56E-61850C module requires the following minimum hardware and software components:

- Rockwell Automation Studio 5000 Logix Designer software version 32 or higher
- Rockwell Automation ControlLogix 5580 controller (catalog numbers starting with 1756-L8X) running firmware with the same major revision as Logix Designer, with compatible power supply and one free slot in the rack, for the MVI56E-61850C module. The module requires 1.4 A of backplane current (@5.1VDC).
- For remote rack applications, the MVI56E-61850C at the remote rack must be connected to the ControlLogix processor through a 1756-EN4TR module.
- MVI56E-61850C Add-On Profile (AOP)
- ProSoft MVI56E-61850C Configuration Manager configuration software
- Supported operating systems:
  - Microsoft Windows 10

1.3 Installing the Module in the Rack

If you have not already installed and configured your ControlLogix processor and power supply, please do so before installing the MVI56E-61850C module. Refer to your Rockwell Automation product documentation for installation instructions.

Warning: You must follow all safety instructions when installing this or any other electronic devices. Failure to follow safety procedures could result in damage to hardware or data, or even serious injury or death to personnel. Refer to the documentation for each device you plan to connect to verify that suitable safety procedures are in place before installing or servicing the device.

Insert the MVI56E-61850C into the ControlLogix chassis using the same technique recommended by Rockwell Automation to remove and install the Rockwell Automation modules.

Note: You can install up to four MVI56E-61850C modules in the same ControlLogix rack.

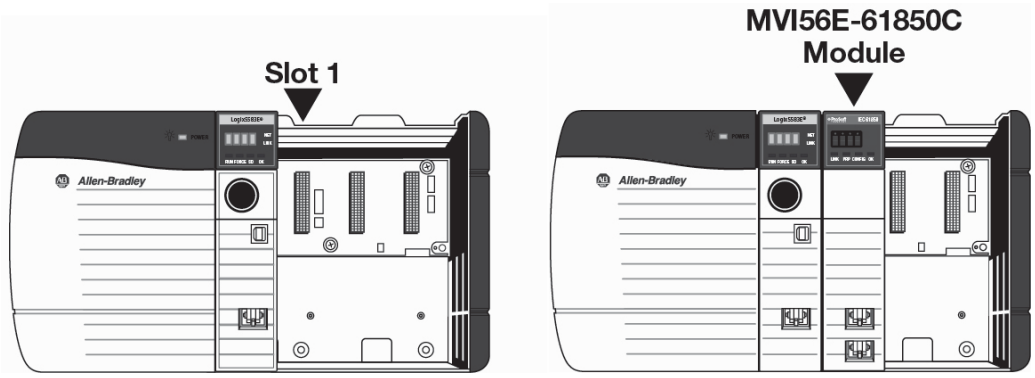
Note: If you are using the module in a ControlLogix Redundancy System, the module must be located in a remote rack. For more information, see "Using the Module with a ControlLogix Redundancy System" on page 81.

You can install or remove ControlLogix system components while chassis power is applied and the system is operating. However, please note the following warning.

Warning: When you insert or remove the module while backplane power is on, an electrical arc can occur. An electrical arc can cause personal injury or property damage by sending an erroneous signal to your system's actuators. This can cause unintended machine motion or loss of process control. Electrical arcs may also cause an explosion when they happen in a hazardous environment. Verify that power is removed or the area is non-hazardous before proceeding.

Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

1 Align the module with the top and bottom guides, and then slide it into the rack until the module is firmly against the backplane connector.



2 With a firm, steady push, snap the module into place.
3 Check that the holding clips on the top and bottom of the module are securely in the locking holes of the rack.
4 Make a note of the slot location. You must identify the slot in which the module is installed in order for the sample program to work correctly. Slot numbers are identified on the green circuit board (backplane) of the ControlLogix rack.
5 Turn power ON.

Note: If you insert the module improperly, the system may stop working or may behave unpredictably.

1.4 Installing the Software

Install the MVI56E-61850C required software, which is available in the *Downloads* section of the MVI56E-61850C product page on the ProSoft Technology website (https://www.prosoft-technology.com):

- MVI56E-61850C Add-On Profile (AOP): This program includes the IEC 61850 communication module profile and associated files.
- ProSoft MVI56E-61850C Configuration Manager: This program is used to configure all aspects associated with data communication between the MVI56E-61850C module and remote Intelligent Electronic Devices (IEDs) according to the IEC 61850 communication protocol.
- ProSoft MVI56E-61850C Diagnostics Tool: This application allows you to monitor diagnostics and configuration data for the module.

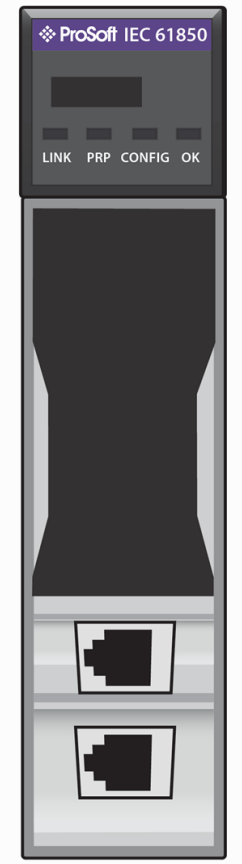
Note: The same install will set up both Configuration Manager and Diagnostics Tool.

2 Module Overview

2.1 Overview

The ProSoft Technology® IEC 61850 communication module allows Rockwell Automation® ControlLogix® PACs to interface with IEC 61850 Intelligent Electronic Devices (IEDs) such as substation power monitors and protective relays. The module operates as an IEC 61850 Client supporting the polling of devices using MMS messaging and reports. Additionally, support for GOOSE messaging as both a publisher and subscriber allows for fast data transfer between devices on an IEC 61850 network.

The dual Ethernet ports on the module provide support for Parallel Redundancy Protocol (PRP), and the module fully supports C37.238 Ed 2017 for precision time synchronization of field devices.



2.2 Ethernet Ports

Port	Description
Ports	2 GbE
Ethernet Port 1	Application port
Ethernet Port 2	Redundant port (if redundancy is enabled)

2.3 IEC 61850 Specifications

Specification	Value
Supported Standard	IEC 61850 Ed 2.0
Maximum Number of IEDs	40
Supported Reports	Buffered Report Control Block (BRCB) Unbuffered Report Control Block (URCB)
Control	Direct-with-Normal-Security SBO-with-Normal-Security Direct-with-Enhanced-Security SBO-with-Enhanced-Security
Maximum Number of Reports per IED	10
GOOSE	GOOSE Subscription GOOSE Publish
Maximum Number of GOOSE Subscription per IED	4
Maximum Number of GOOSE Publish	8
Maximum Number of Tags per IED	500
Maximum Number of Tags	20,000
Status	Status available per node Report and GOOSE status available High-level status data available within Studio 5000

2.4 Backplane Specifications

Specification	Value
Maximum Number of Class 1 Connections	225
Maximum Number of Class 1 High Priority Connections	50
High Priority Connection RPI Range	4 to 9999 ms
Normal Priority Connection RPI Range	100 to 9999 ms
Maximum Class 1 Connection Input Size	500 bytes
Maximum Class 1 Connection Output Size	496 bytes

2.5 Time Synchronization Specifications

Specification	Value
Time Synchronization Standard	C37.238-2017
Supported Modes	Ordinary Clock, Boundary Clock

2.6 LEDs

The module provides four diagnostic LEDs. These LEDs are used to provide information regarding link status, parallel redundancy protocol (PRP) mode, configuration error detection, and module operation. More information about these LEDs is in Chapter 8, "Diagnostics and Troubleshooting."

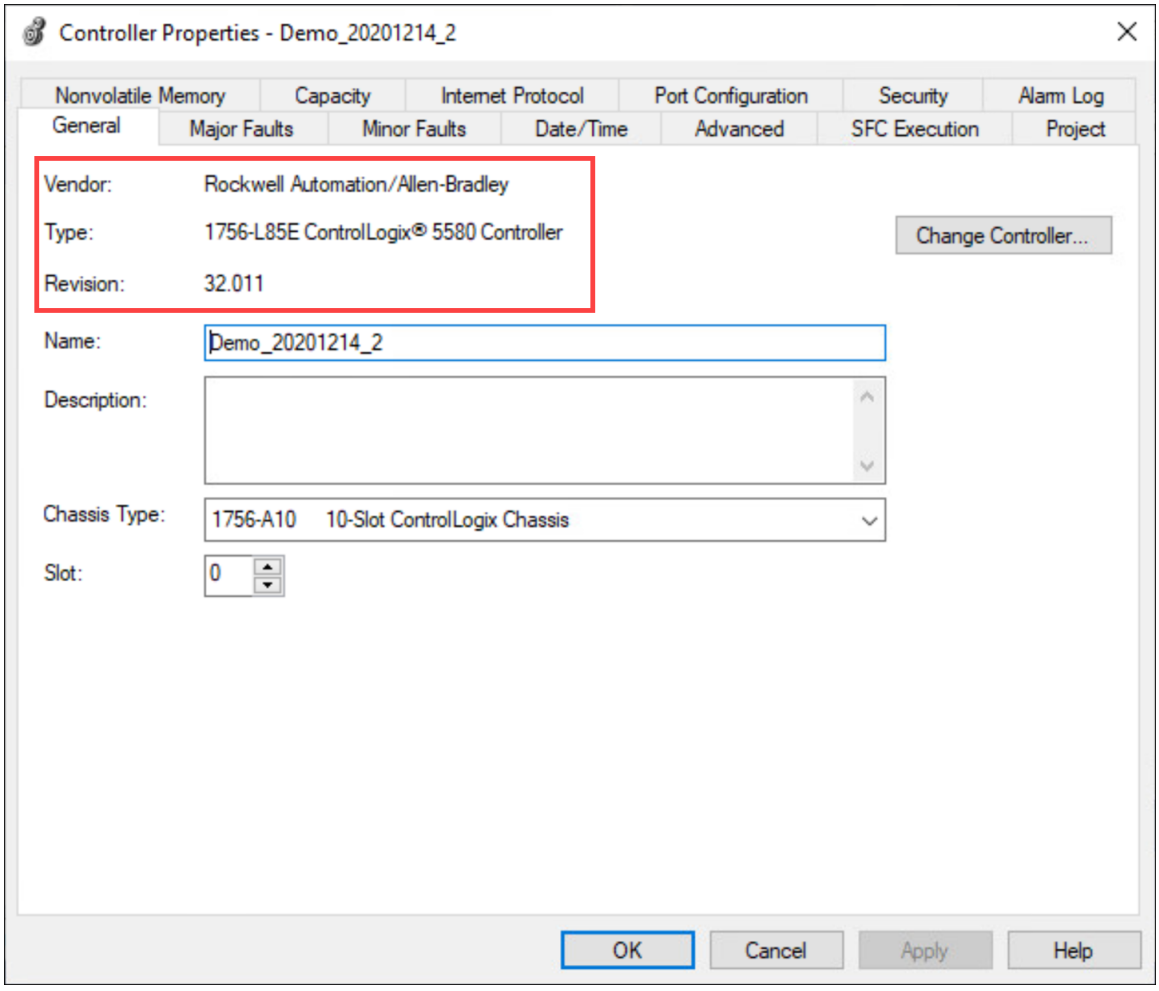
3 Configuring the MVI56E-61850C Add-On Profile

3.1 Adding the Module to Studio 5000 Logix Designer®

3.1.1 Open the Studio 5000 Logix Designer Project

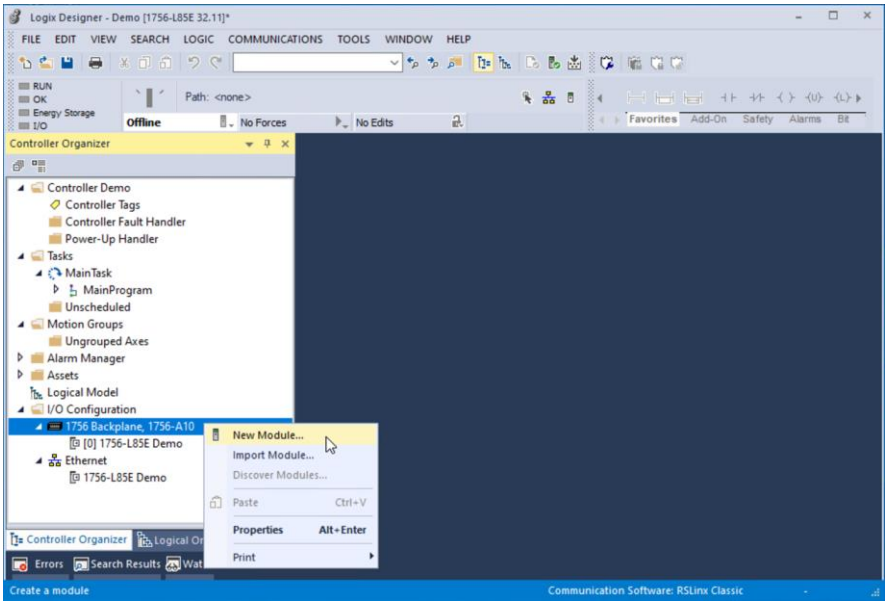
The first step in setting up the IEC 61850 network is opening the Studio 5000 Logix Designer project to which you will be adding the MVI56E-61850C module.

Note: The MVI56E-61850C module requires Studio 5000 Logix Designer version 32 or higher and a ControlLogix 5580 processor, firmware with the same major revision as Logix Designer. To check the firmware version, right-click the controller in the *Controller Organizer* and select **PROPERTIES**.



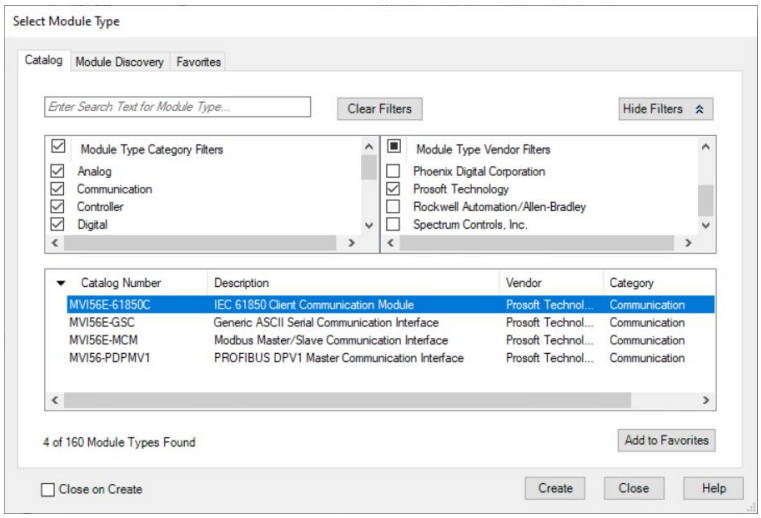
3.1.2 Add the MVI56E-61850C to the Studio 5000 Project

1 In the *I/O Configuration* section of the *Controller Organizer*, right-click the backplane and select **NEW MODULE**.



2 Select the **MVI56E-61850C** module type and click **CREATE** (or double-click the module type).

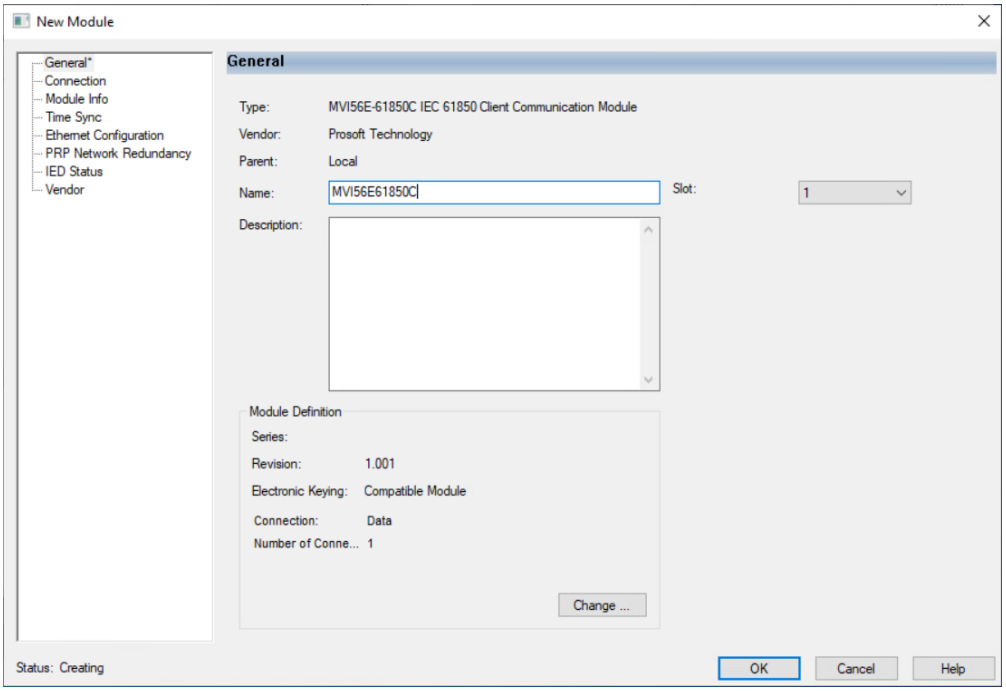
Tip: To locate the module in the list, clear the **MODULE TYPE VENDOR FILTERS** check box and then select the **PROSOFT TECHNOLOGY** filter.



Note: If you do not see the MVI56E-61850C in the list of modules, this means that the MVI56E-61850C AOP may not have been installed properly.

The *New Module* dialog box displays.

3 Enter a name for the module and a description if desired.

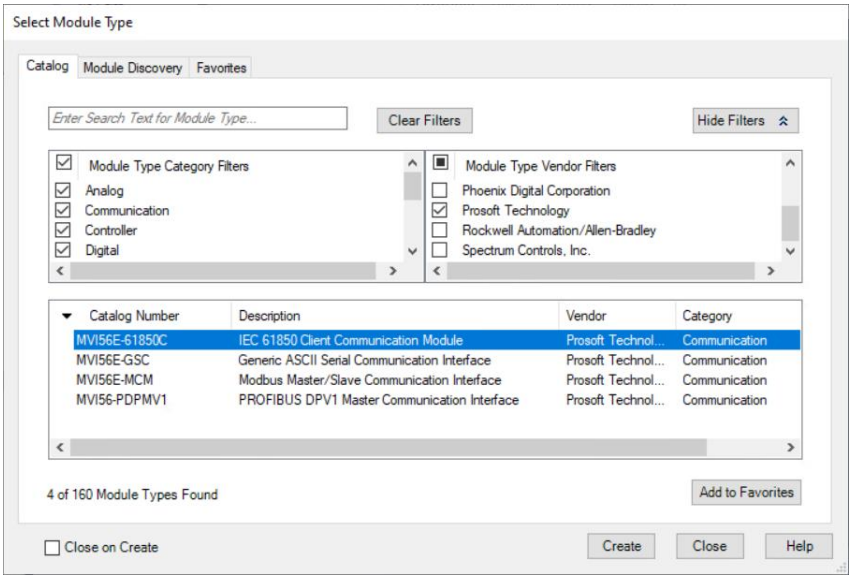


4 Make sure the correct slot number is selected. If the module is installed in slot 1, you can keep the default value *1*. If the module is installed in a different slot, change this value to the appropriate slot number.

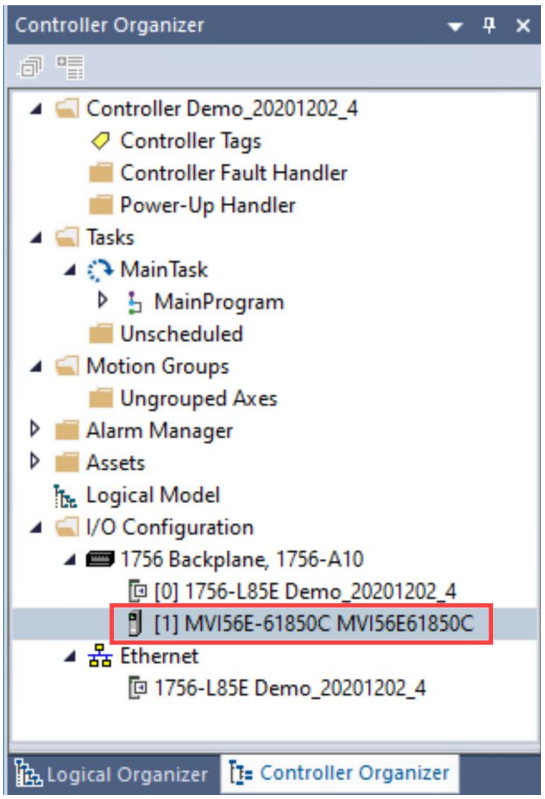
5 In the *New Module* window, click **OK**.

The *New Module* window closes.

6 In the *Select Module Type* window, click **CLOSE**.



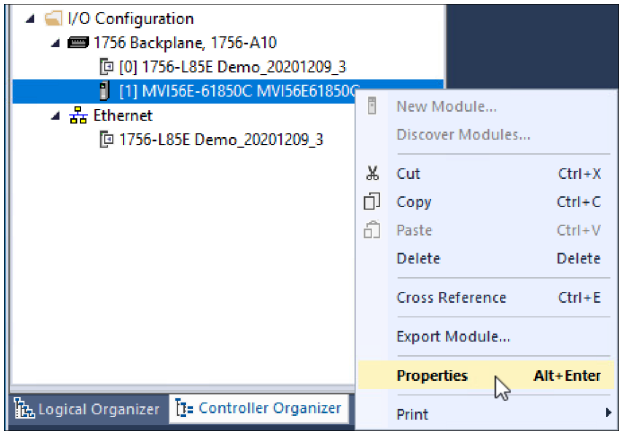
The new module appears under the backplane in the *Controller Organizer* panel in Logix Designer.



3.2 Configure the IP Address

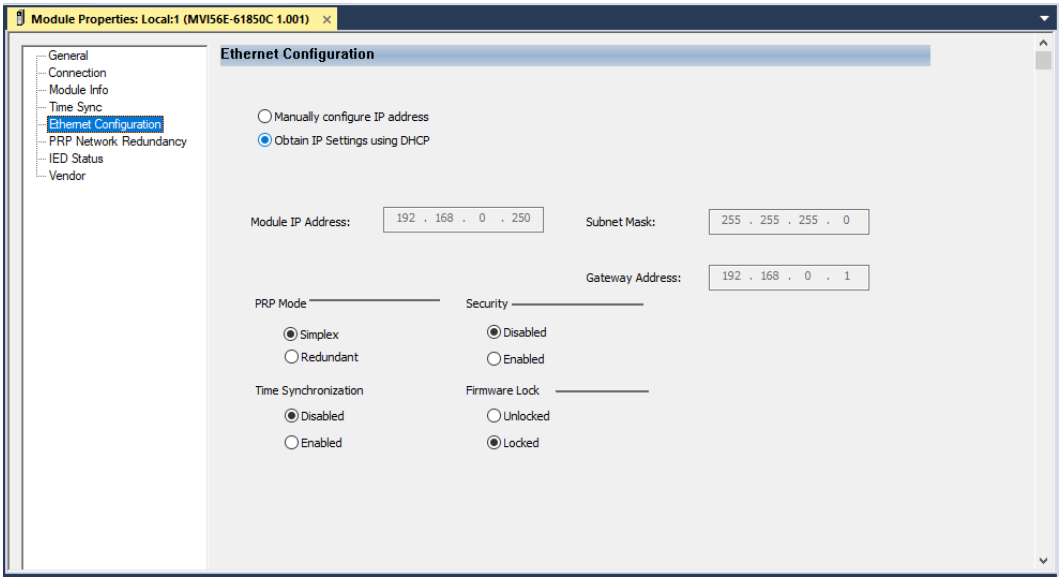
Take the following steps to configure the IP address of the MVI56E-61850C.

1 In the *I/O Configuration* section of the *Controller Organizer*, right-click the MVI56E-61850C module and select **PROPERTIES**. (Or double-click the module icon.)



The *Module Properties* dialog box displays.

2 Select **ETHERNET CONFIGURATION**.



3 Select one of the following options:

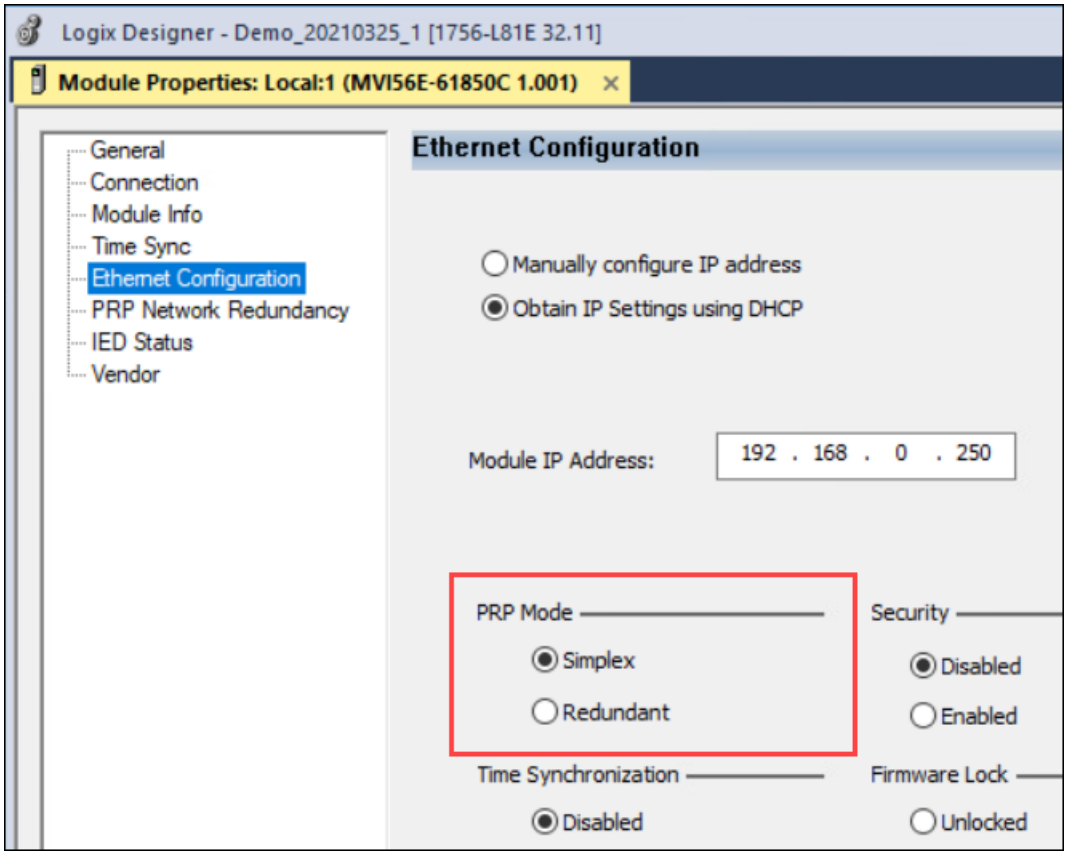
- **MANUALLY CONFIGURE IP ADDRESS:** If you select this option, you must manually enter values for *Module IP Address*, *Subnet Mask*, and *Gateway Address*.
- **OBTAIN IP SETTINGS USING DHCP:** IP settings are configured automatically via Dynamic Host Configuration Protocol (DHCP).

4 Click **OK**.

3.3 Configure Parallel Redundancy Protocol (PRP)

Parallel Redundancy Protocol (PRP) allows failover protection against failure of network components. The MVI56E-61850C provides the following two PRP modes:

- *Simplex*: In simplex mode, only Ethernet port 1 is used for data communication.
- *Redundant*: In redundant mode, both Ethernet ports 1 and 2 are used for data communication with redundancy.



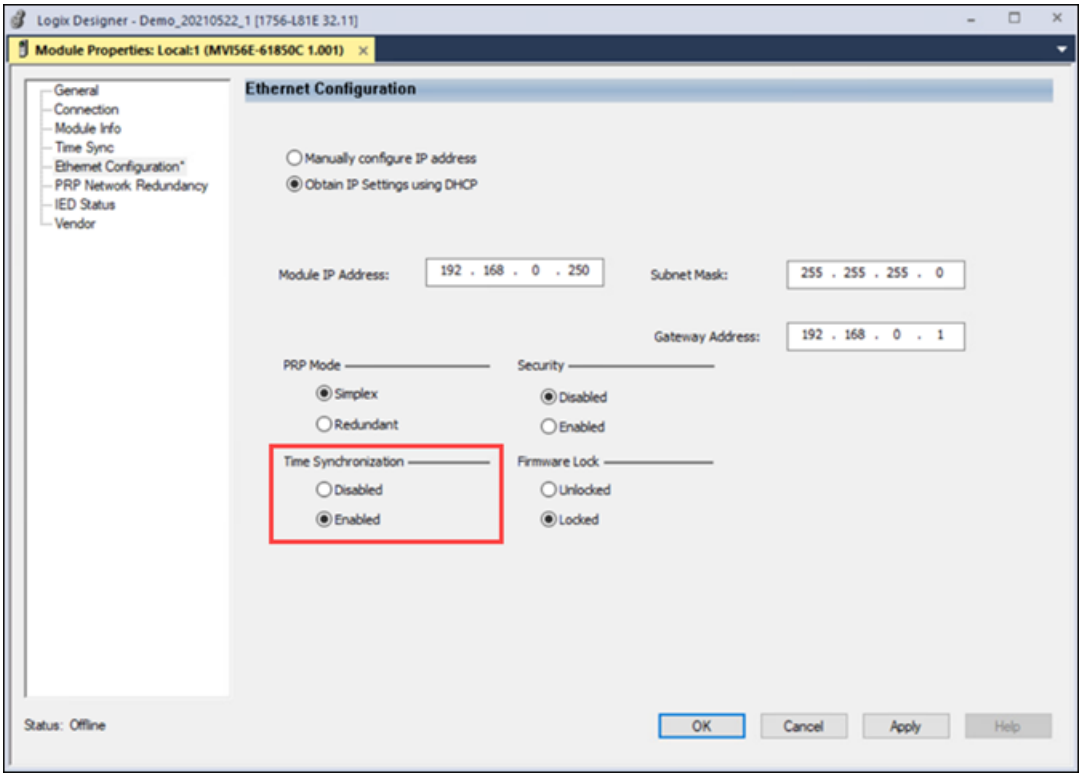
When redundant mode is enabled, you can the monitor the status of LAN A (Ethernet port 1) and LAN B (Ethernet port 2) on the *PRP Network Redundancy* tab of the *Module Properties* dialog box, as explained in "PRP Diagnostics" on page 113.

For more information on PRP, see "Parallel Redundancy Protocol (PRP)" on page 81.

3.4 Enable Time Synchronization (Ethernet)

The module supports time synchronization over three different ports: the backplane, Ethernet Port 1, and Ethernet Port 2 (if redundancy is enabled). Time synchronization over the backplane is always enabled. The following procedure explains how to enable time synchronization over the Ethernet ports. If time synchronization over Ethernet is disabled, the module operates as an ordinary clock. If time synchronization over Ethernet is enabled, the module operates as boundary clock. For more information regarding this feature, see "Time Synchronization" on page 83.

1 In the *Module Properties* dialog box, select **ETHERNET CONFIGURATION**.
2 Under *Time Synchronization*, select **ENABLED**.



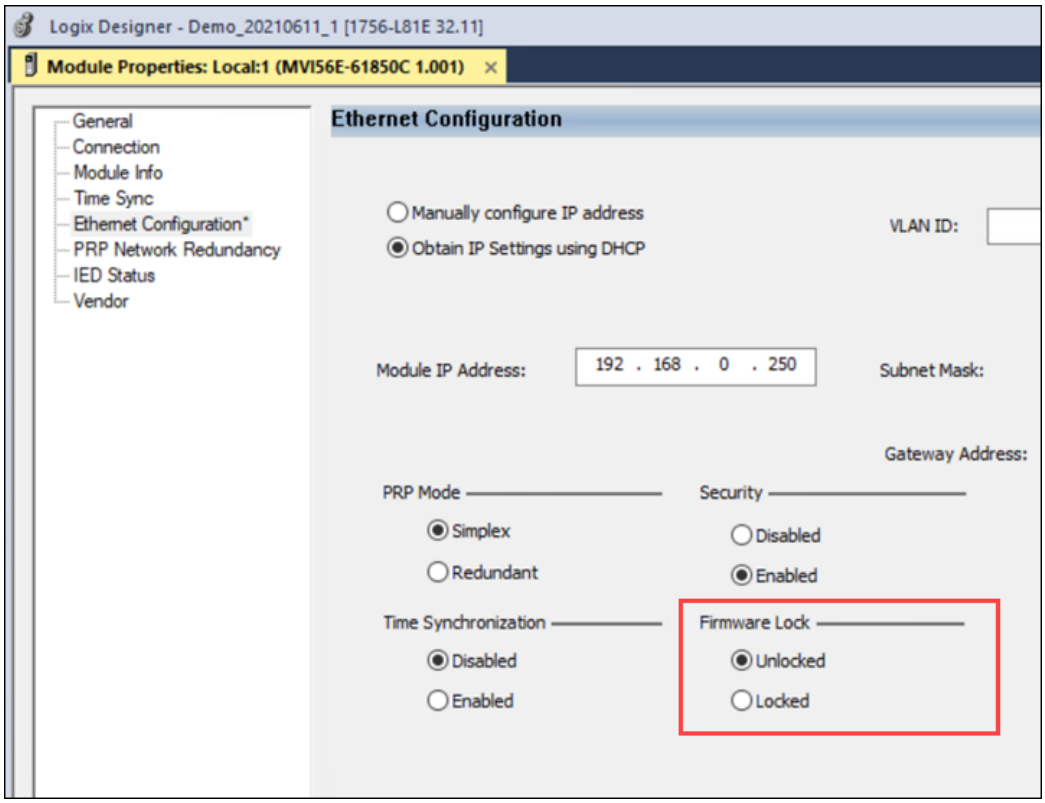
3 Click **OK**.

3.5 Firmware Lock

The module firmware is locked by default for security purposes to prevent the firmware upgrade. In case a firmware upgrade is required, you will have to unlock the firmware through the *Firmware Lock* parameter.

For more information about firmware upgrades, see the *Downloads* section of the MVI56E-61850C product page on the ProSoft Technology website (https://www.prosoft-technology.com).

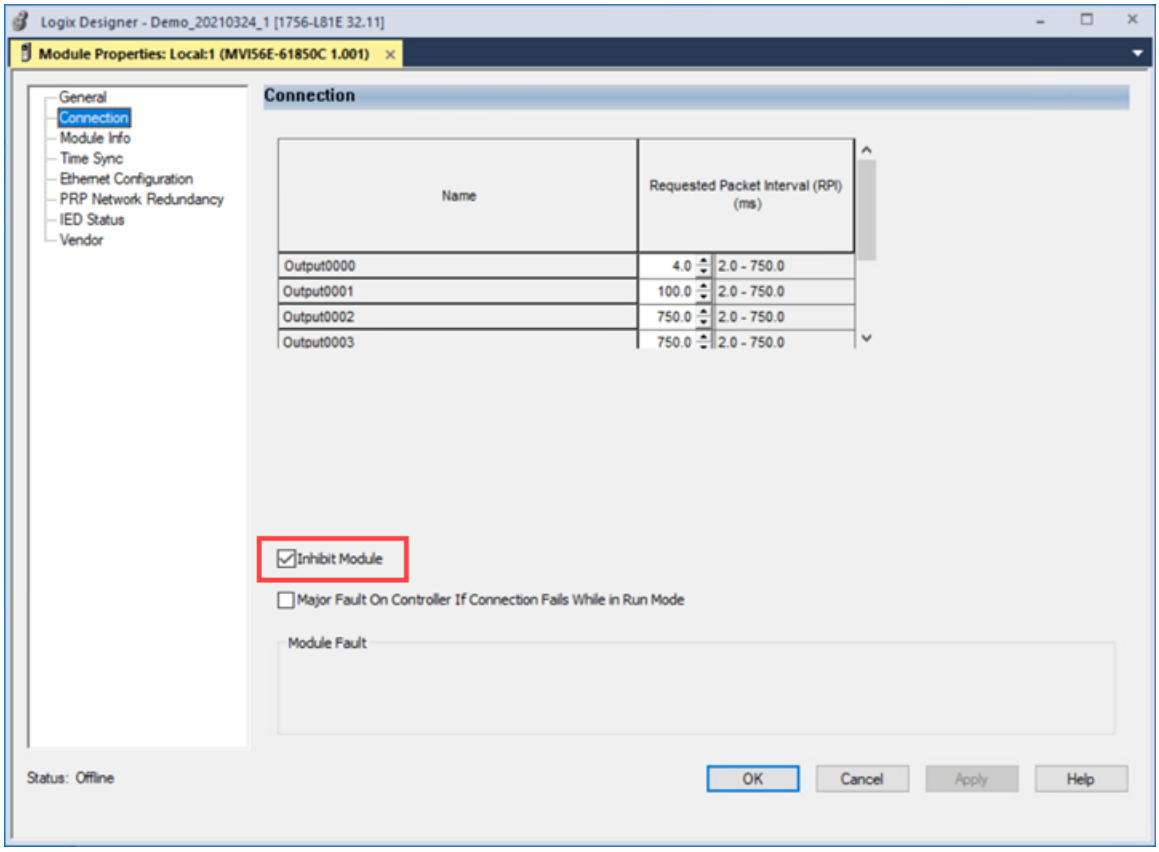
1. In the *Module Properties* dialog box, select **ETHERNET CONFIGURATION**.
2. Under *Firmware Lock*, select **UNLOCKED**.



3. Click **OK**.
4. Before upgrading the firmware, set the ControlLogix processor to PROGRAM mode.
5. Once you are finished with the Ethernet configuration, you are ready to launch the ProSoft MVI56E-61850C Configuration Manager software. Refer to the following section for details.

3.6 Disabling Backplane Communication

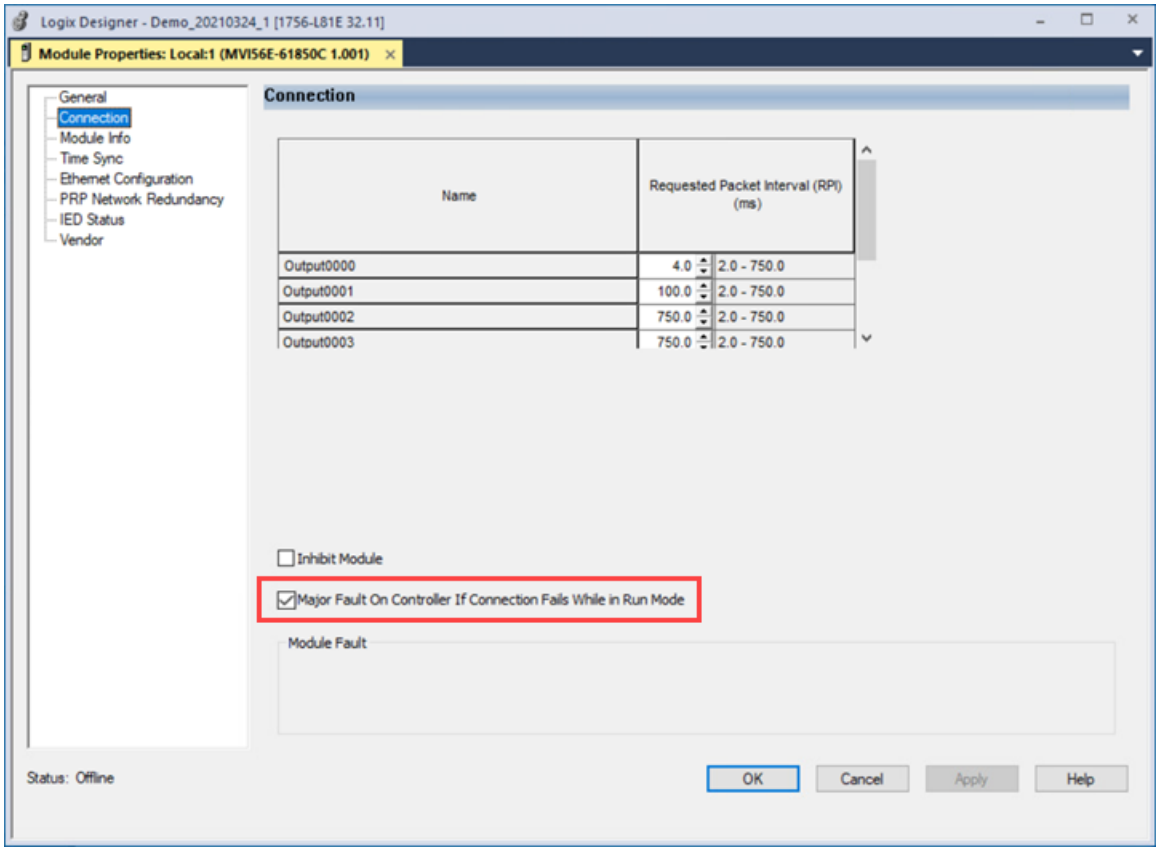
To disable backplane communication between the ControlLogix processor and the MVI56E-61850C module, open the *Connection* tab of the *Module Properties* dialog box, select **INHIBIT MODULE**, and click **OK**.



3.7 Generating a Major Fault on the Controller

To generate a ControlLogix major fault when a backplane communication failure is detected, open the *Connection* tab of the *Module Properties* dialog box, select **MAJOR FAULT ON CONTROLLER IF CONNECTION FAILS WHILE IN RUN MODE**, and click **OK**.

If a module fault has occurred, this will be noted in the *Module Fault* area of the *Connection* tab.

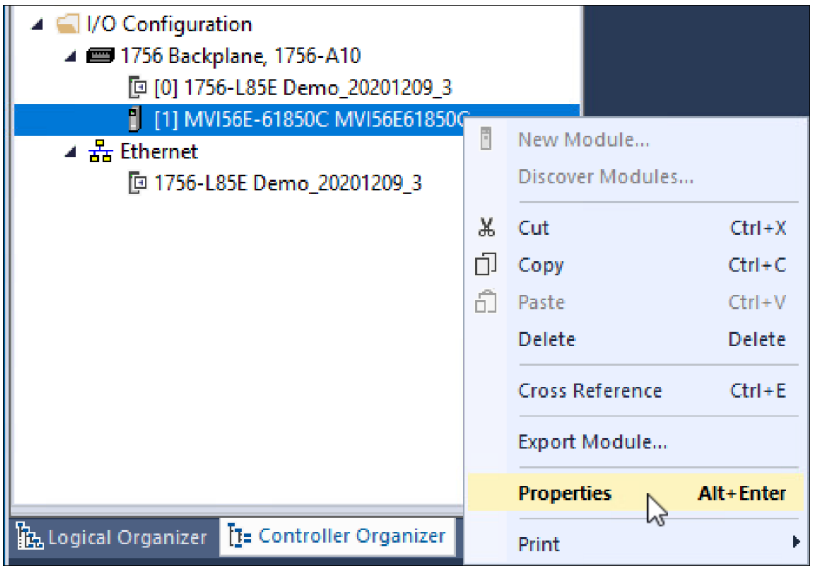


4 Configuring the MVI56E-61850C Module

4.1 Configuration in the ProSoft MVI56E-61850C Configuration Manager

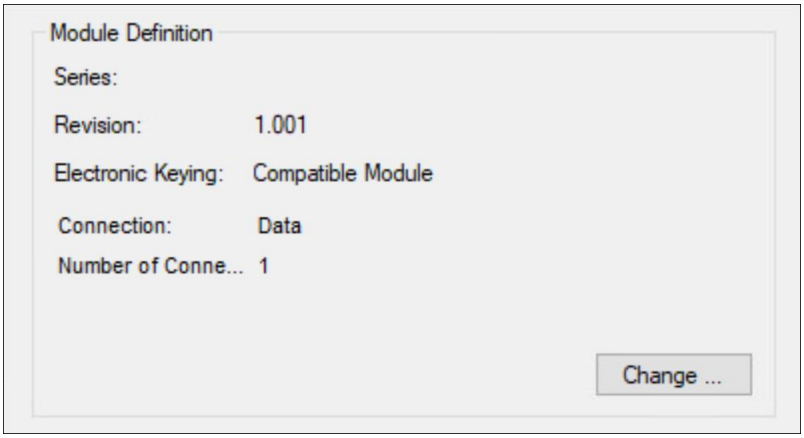
4.1.1 Launch the ProSoft MVI56E-61850C Configuration Manager

1 In the *I/O Configuration* section of the *Controller Organizer*, right-click the MVI56E-61850C module and select **PROPERTIES**. (Or just double-click the module.)



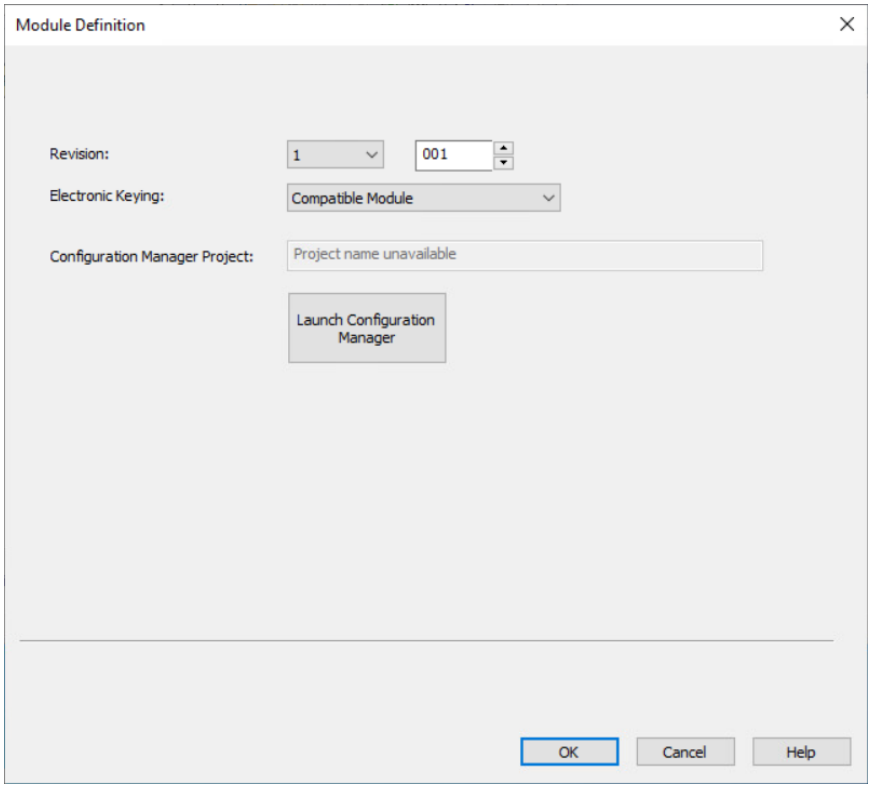
The *General* tab of the *Module Properties* dialog box displays.

2 In the *Module Definition* area, click Change.

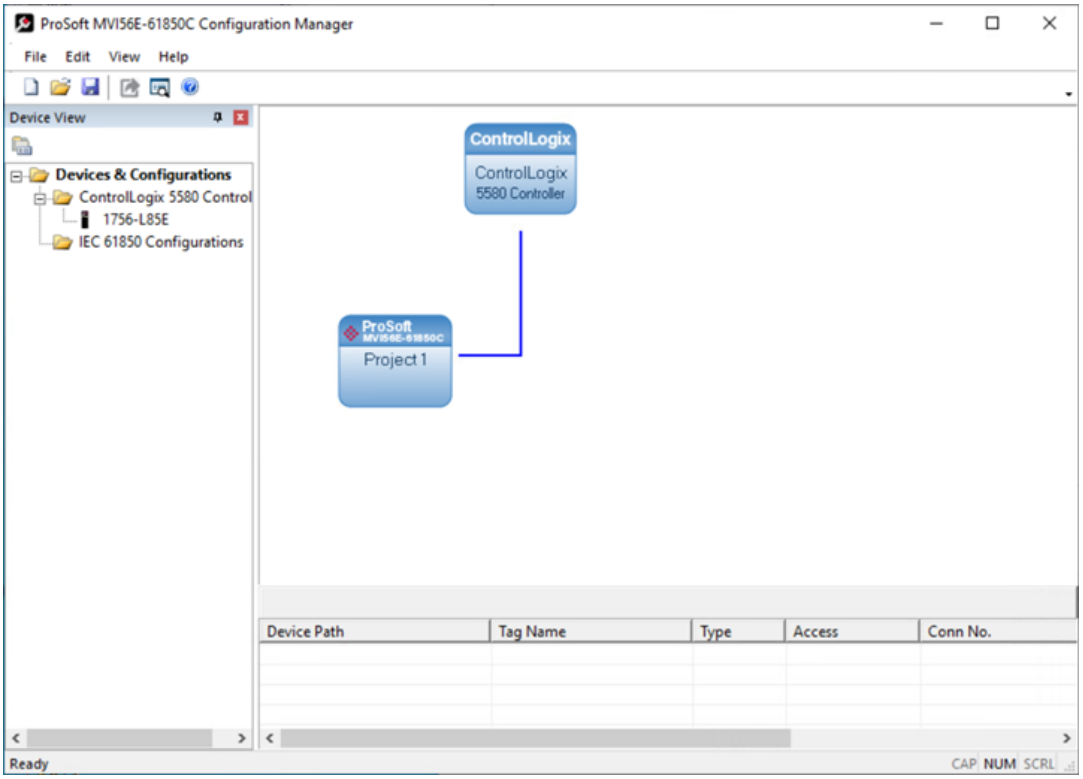


The *Module Definition* window displays.

3 Select **LAUNCH CONFIGURATION MANAGER**.

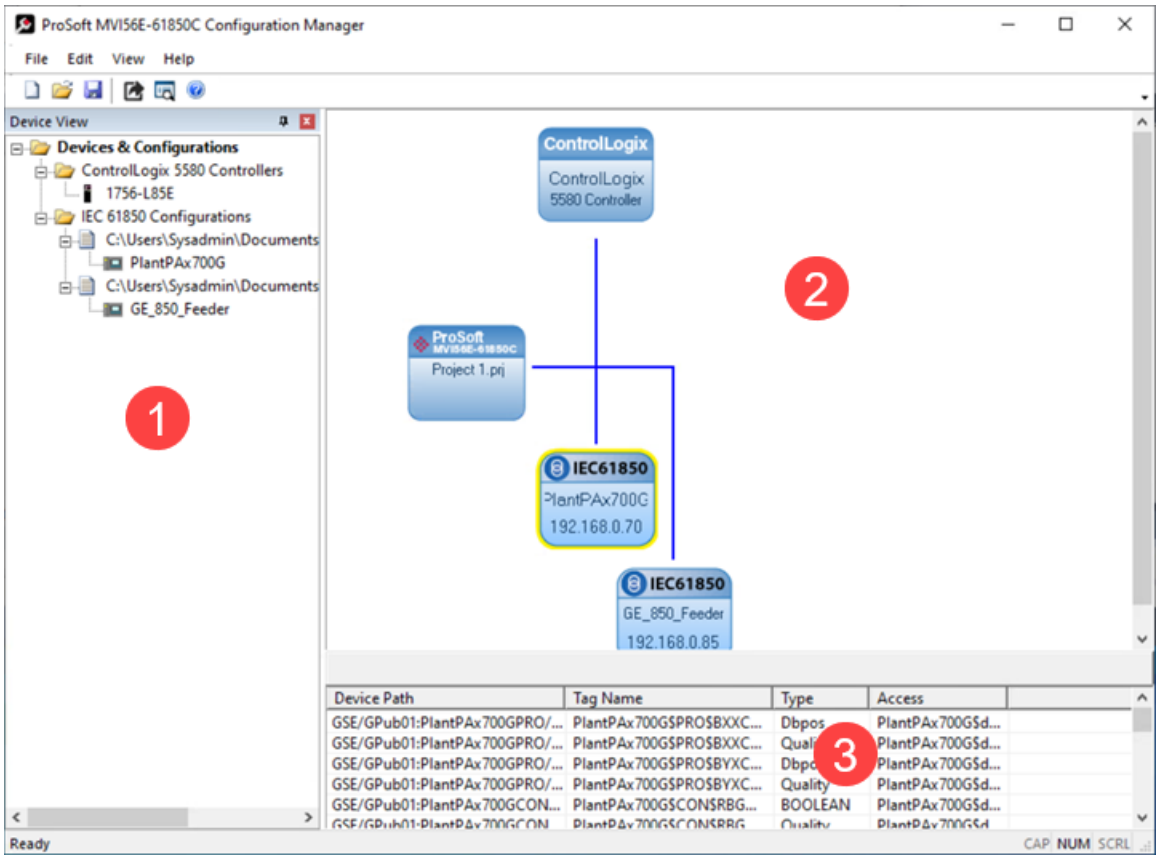


After a brief pause, the ProSoft MVI56E-61850C Configuration Manager launches.



4.1.2 Overview of the ProSoft MVI56E-61850C Configuration Manager Interface

The ProSoft MVI56E-61850C Configuration Manager window consists of three panes:



1	The *Device View* tree shows the IEC 61850 configurations, including the imported IEDs. The *IEC 61850 Configurations* folder is a list of IED configuration files. This folder is empty until you import the CID/SCD files associated with the IEDs.
2	The *Network View* pane shows a graphic representation of the devices connected to the IEC 61850 network. Each device appears as a "bubble". The *ControlLogix* bubble represents the ControlLogix processor. The project bubble (*ProSoft MVI56E-61850C*) represents the module itself. The *IEC61850* bubbles represent the IEDs connected to the network.
3	The *Configured Tags* pane shows the configured tags associated with the currently selected IED in the *Network View* pane.

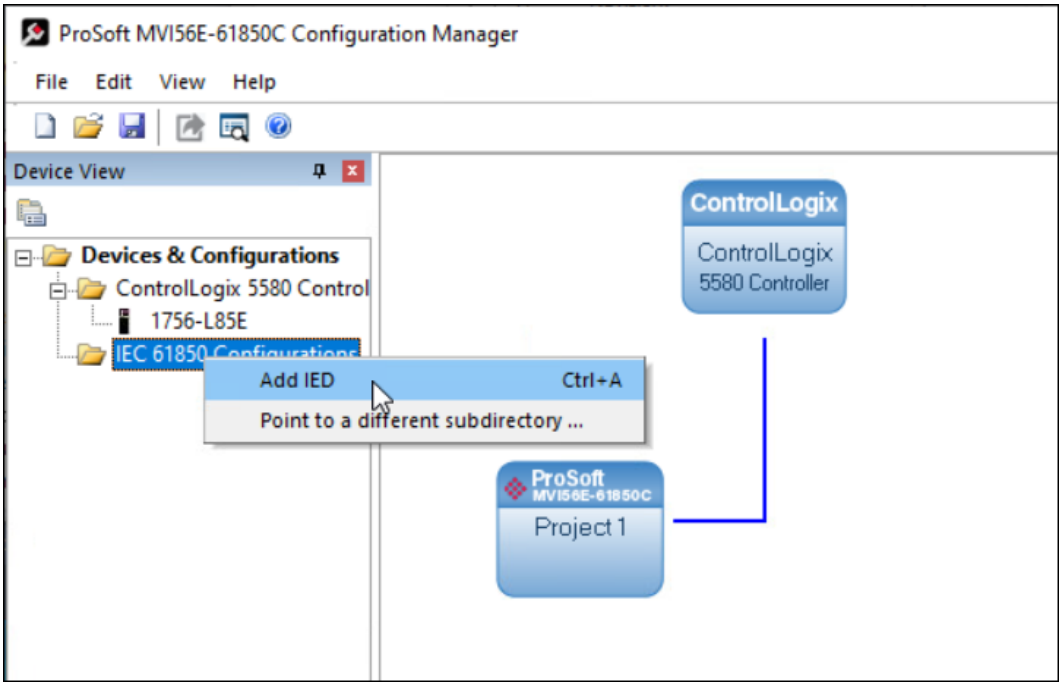
4.1.3 Import IED Configuration Files

Note: Only configured ICD, CID, and SCD files can be imported. These files must be fully configured and saved in the software used to configure the IEDs. The configured file includes all required information to access the IED such as IP address and device name. It also includes the data supported by the IED such as the supported data attributes, data sets, GOOSE, reports and controls.

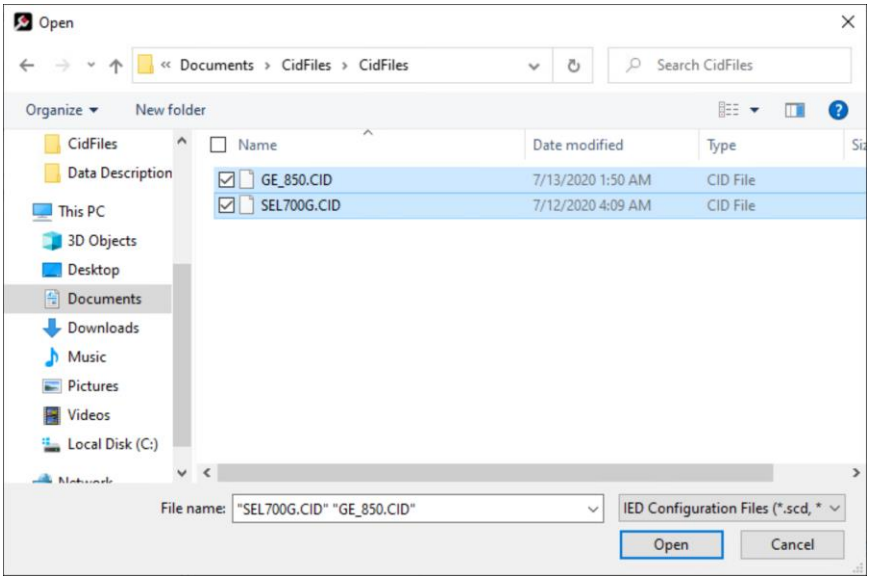
If the IED is set with a valid IP address, the MVI56E-61850C module will attempt to establish a TCP connection with the IED before exchanging data with the IED. If the TCP connection attempt fails, the MVI56E-61850C will not exchange any data with the IED (MMS read, control, reports or GOOSE published by the IED).

In case the IED only supports GOOSE publishing, but it does not support MMS communication (MMS read, control or reports), the IED IP address must be set as **0.0.0.0** through its configured file. The module will consume the subscribed GOOSE data published by the IED without attempting to establish a TCP connection.

1 In the *Device View* pane of the ProSoft MVI56E-61850C Configuration Manager, right-click **IEC 61850 CONFIGURATIONS** and select **ADD IED**.

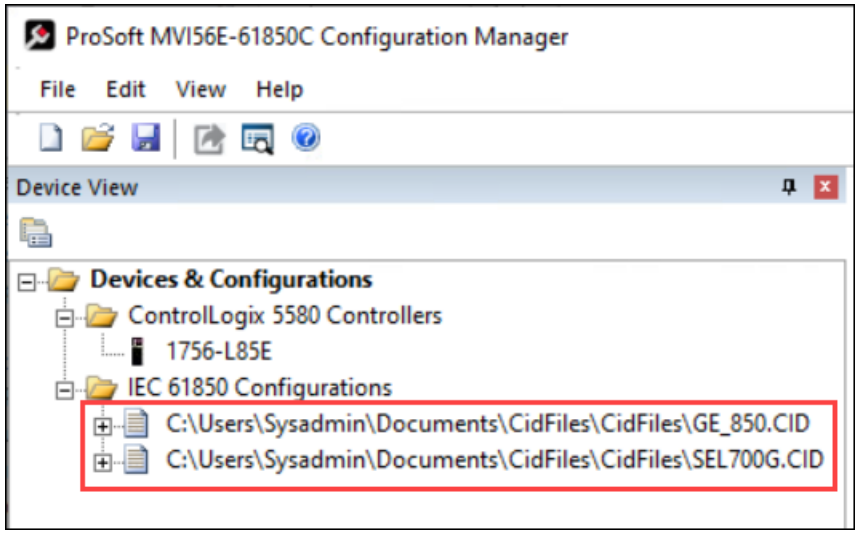


2 In the *Open* dialog box, browse to the directory containing the ICD, CID, or SCD file.



3 Make sure the selected file type is IED CONFIGURATION FILES (*.SCD, *.ICD, *.CID).

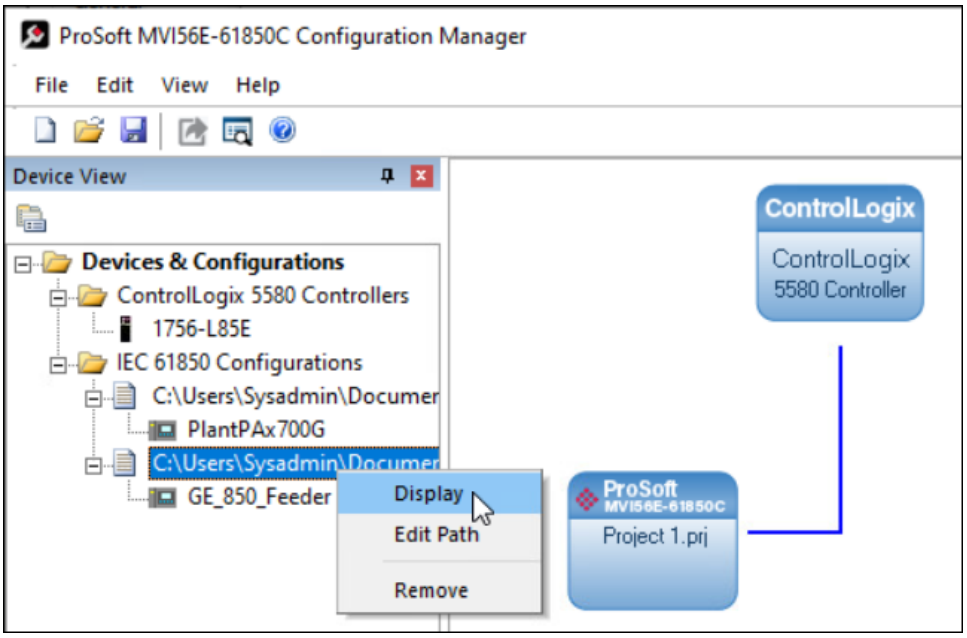
4 Each IED has its own CID/ICD file, except for SCD files which can contain more than one IED. Select one or more configuration files to import and click **OPEN**. The imported IED files appear in the *Device View* tree under **IEC 61850 CONFIGURATION**.



5 Repeat the steps above to import the rest of your IED files.

6 If you are familiar with the contents of CID, SCD, and ICD files, you can right-click the file name and then choose **DISPLAY** to see the contents of the file in the default text editor.

Note: Normally you only view the configuration files in the text editor for reference if you are familiar with these files. If you want to change the IED configuration, use the configuration software for the IED.

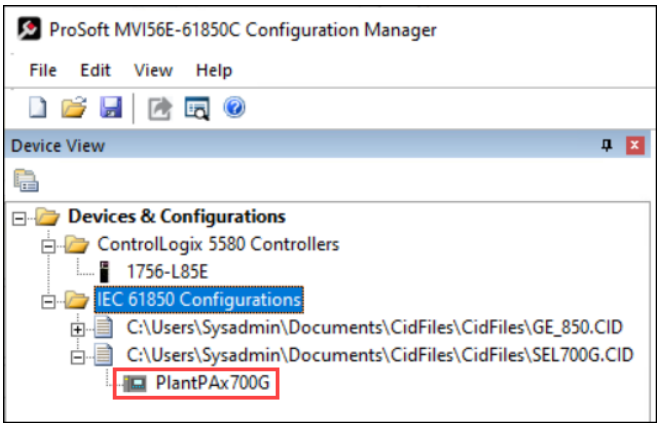


4.1.4 Configure the IED Network

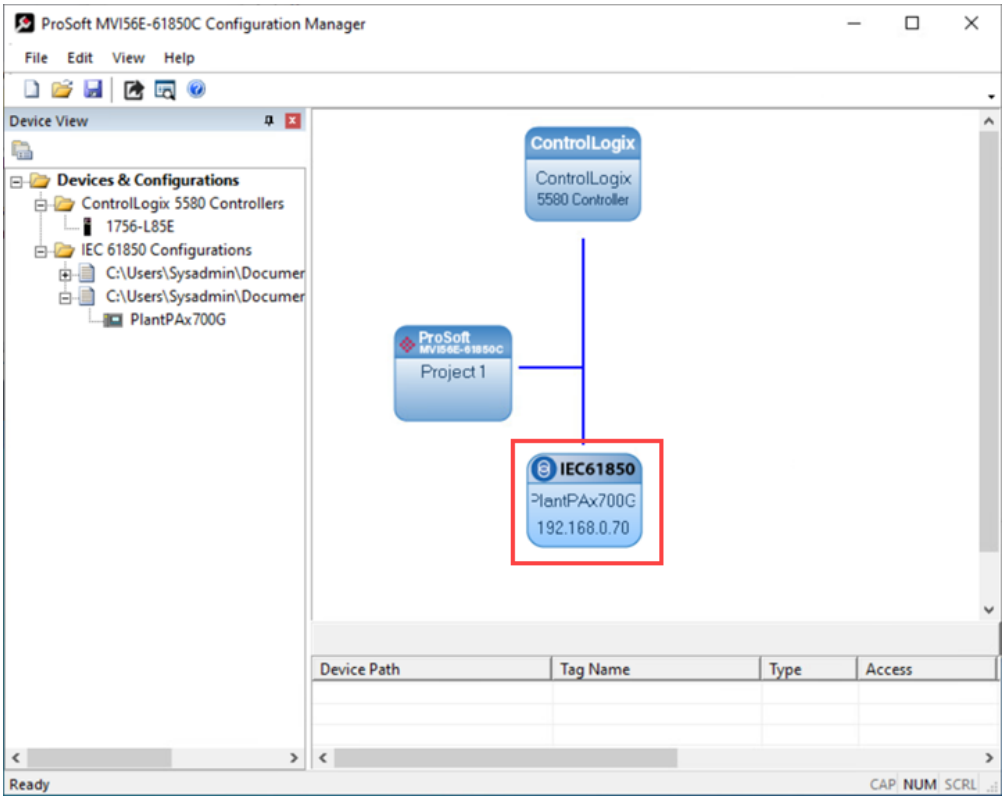
After you have imported the IED configuration files, you can add these IEDs to the IEC 61850 network in the ProSoft MVI56E-61850C Configuration Manager.

To configure the IED network:

1 In the *Device View* pane of the Configuration Manager, expand the IED file name by clicking the [+] sign next to the file name.



2 Click and drag the IED name from the *Device View* pane into the *Network View*. When you release the mouse button, the IED is added to the view in an *IEC61850* bubble. The bubble shows the IED Device Name and IP address. These values are from the IED file and cannot be changed in the Configuration Manager.

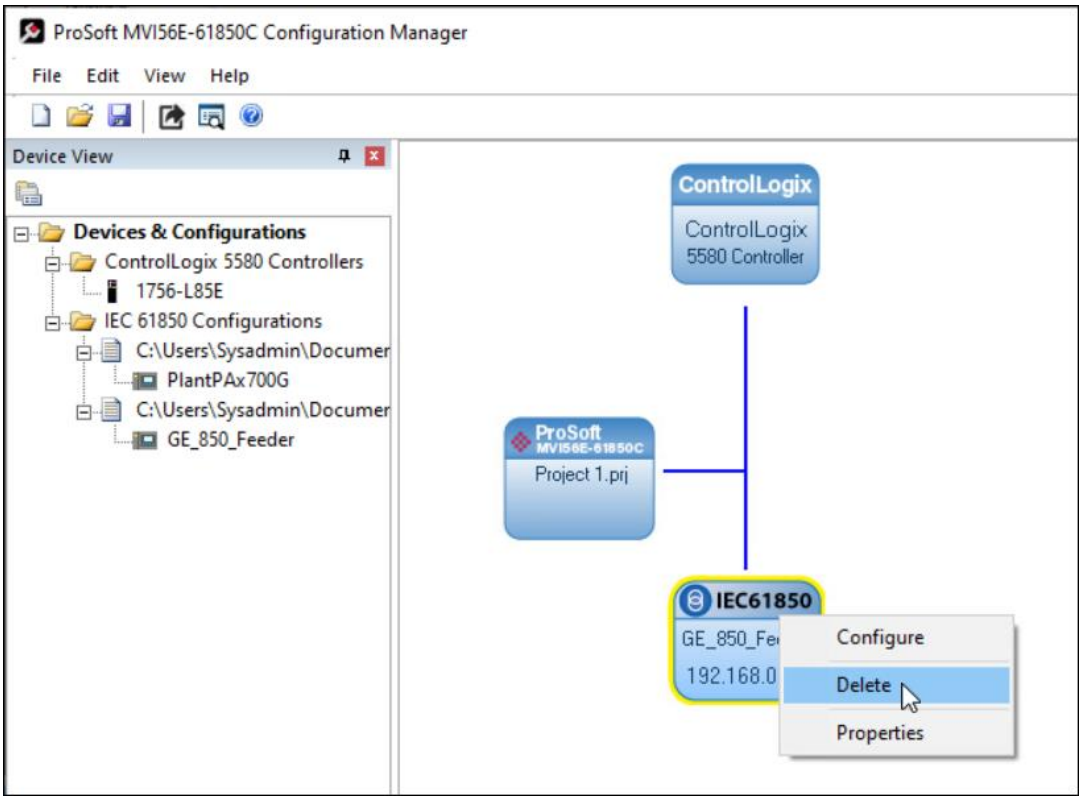


3 Repeat the steps above to add more IEDs to the *Network View* pane.

> **Note:** The MVI56E-61850C module supports a maximum of 40 IEDs.

To delete an IED from the Network View:

1 Right-click the IED bubble in the *Network View* and select **DELETE**.

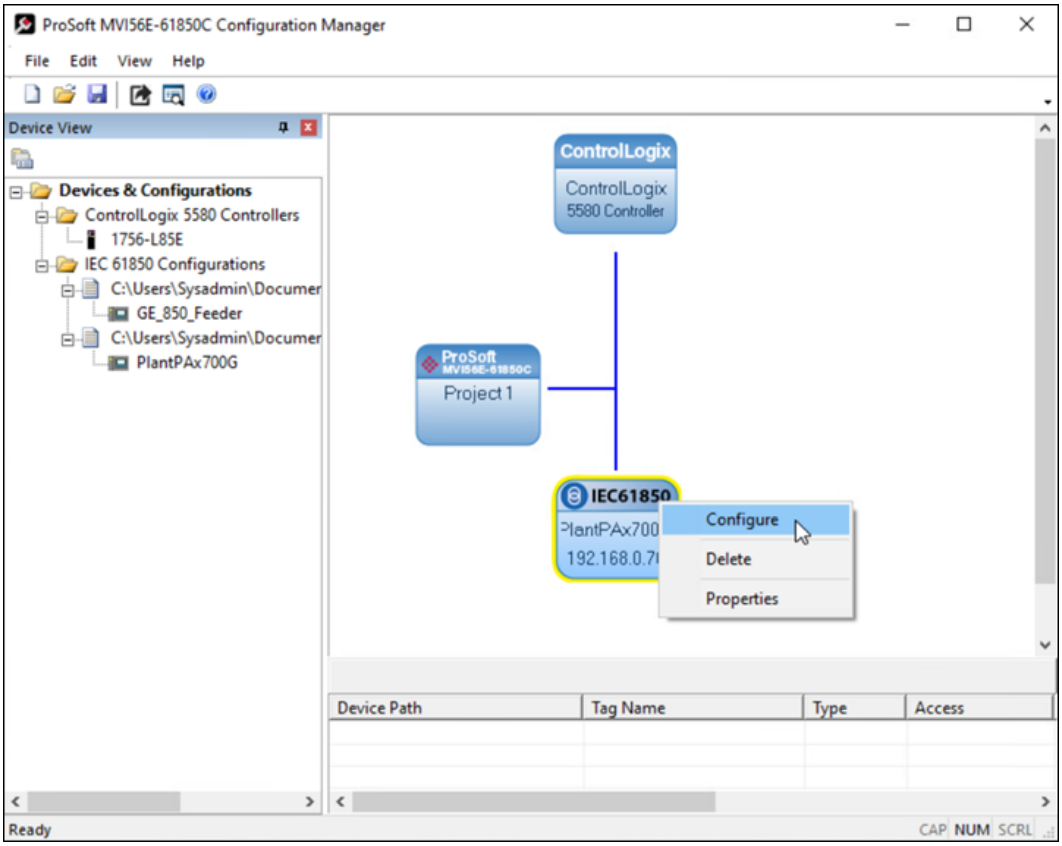


2 In the confirmation dialog that displays, select **YES**.

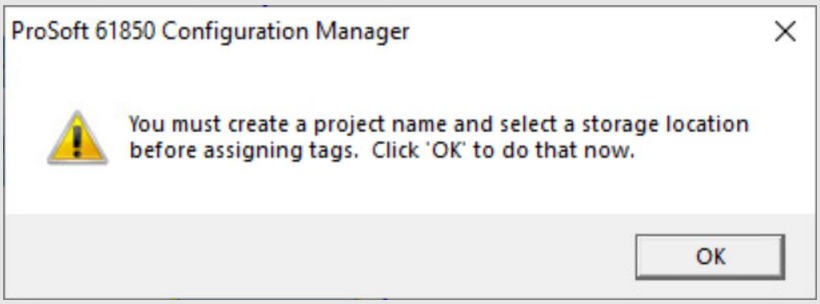
4.1.5 IED Data Mapping

For each IED added to the network, you must select the data to be mapped between the IED and ControlLogix processor.

1 In the *Network View* pane in the ProSoft MVI56E-61850C Configuration Manager, right-click the *IED* that you want to map, and select **CONFIGURE**. (Or just double-click the IED.)

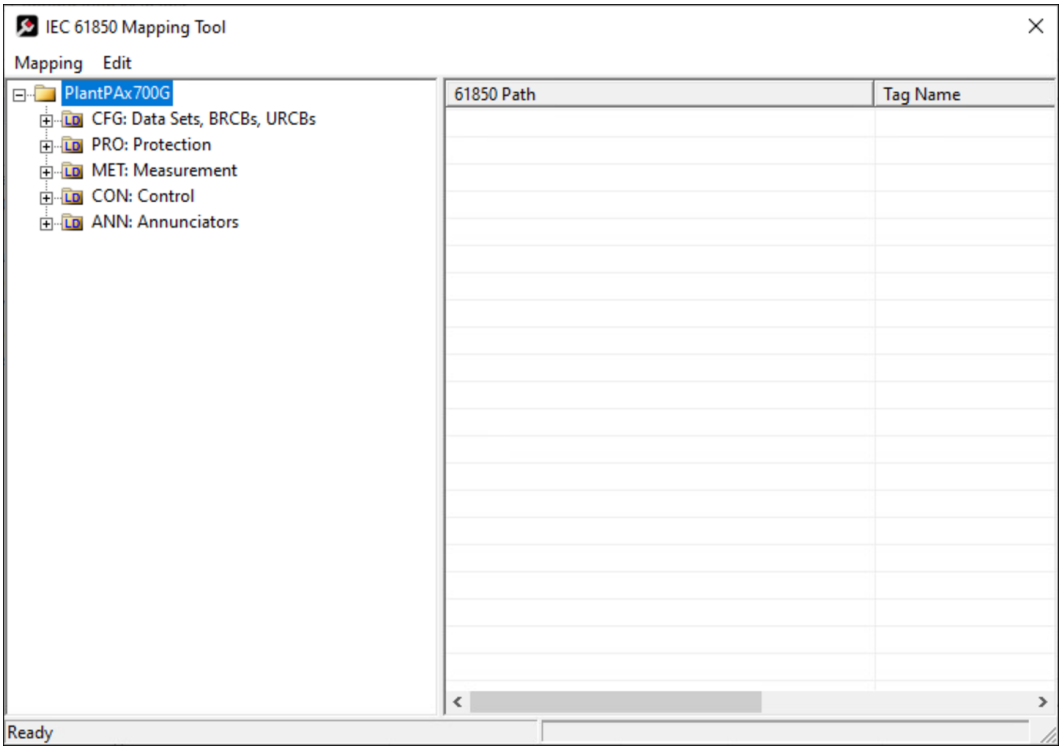


Note: If you have not yet saved the Configuration Manager project, a dialog will inform you that you must do so before assigning tags. Click **OK** and in the *Save As* dialog, enter a project name and save the project in the desired location.

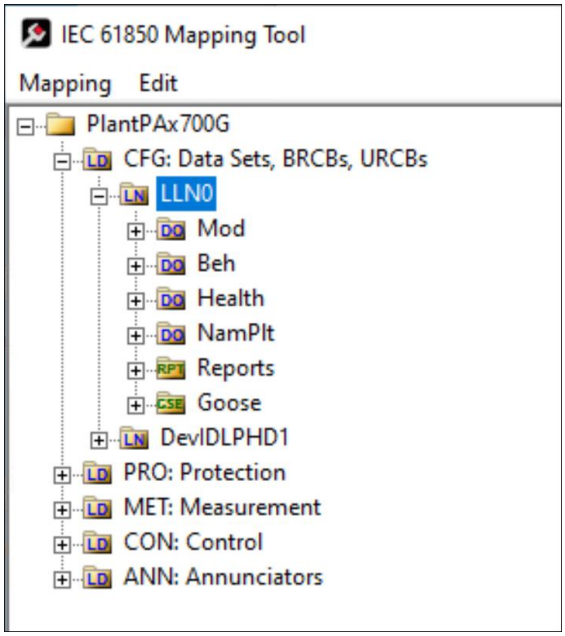


The IEC 61850 Mapping Tool window displays. The window contains the tree view on the left, and the mapping table on the right.

2 In the tree view on the left, expand the root folder (click the [+] sign). This shows the Logical Devices in the IED (notice the *LD* on the folder icon).

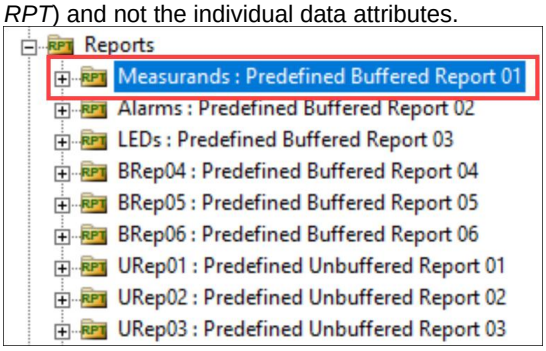
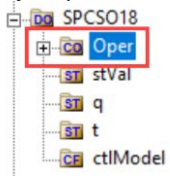
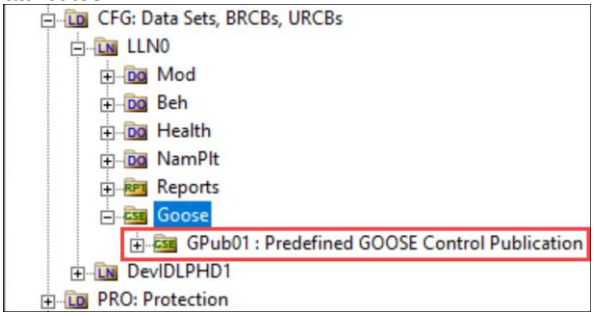


3 Expand one of the logical devices in the IED (click the [+] sign) to see the logical nodes within it (notice the *LN* on the folder icons).



4 Expand a logical node to display data objects (*DO*), reports (*RPT*), GOOSE messages (*GSE*), and control data (functional constraint = *CO*). You may have to drill down a few layers to find the data you are seeking.

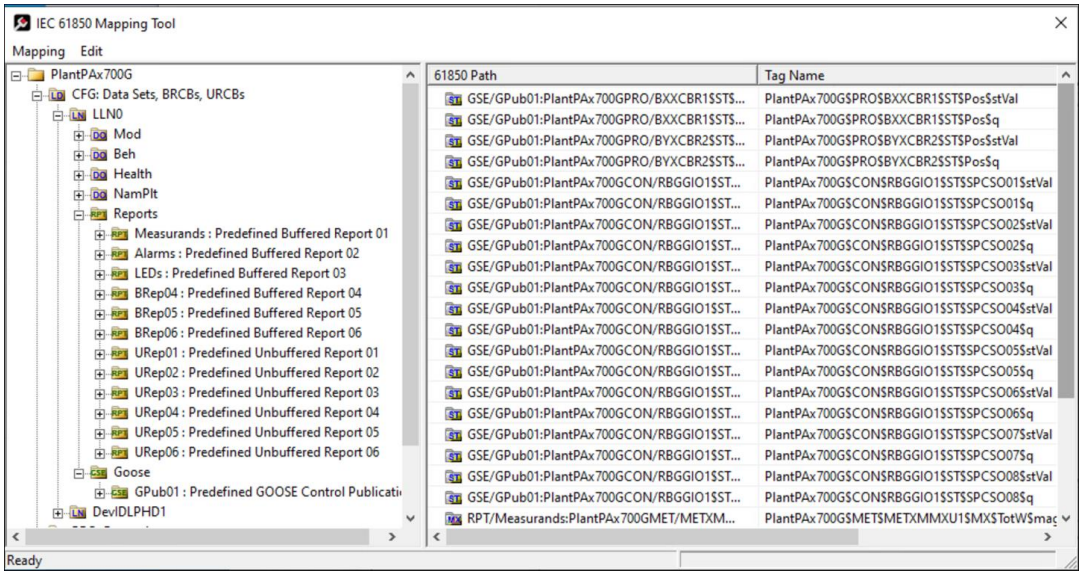
5 Click and drag a data object, dataset, or data attribute from the tree and drop it into the mapping table on the right. You can select the following four types of data:

Data Type	Description
Reports	Reports are located under the *LLN0* logical node. When selecting a report, you must select the entire report (yellow folder labeled *RPT*) and not the individual data attributes.  You may select up to 10 reports per IED. You may select either buffered or unbuffered reports.
MMS Read messages	When selecting any data object or data attribute (except for functional constraint as *CO*) will set the module to read the tag over periodic MMS Read command. You cannot select the entire logical node (*LN*). You must select a data object or an attribute within a data object.
Control	You must select the entire *Oper* structure for the controllable object (functional constraint = *CO*). 
GOOSE messages	GOOSE data is located under the *LLN0* logical node. You must select the entire data structure and not the individual data attributes.  You may select up to 4 GOOSEs per IED.

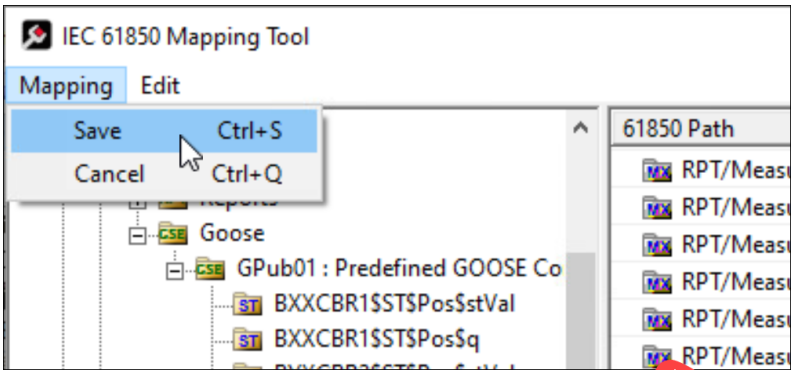
The Configuration Manager populates the table with one row for each data attribute included in your selection.

Tip: To delete tags, select the tag or tags in the table, then right-click the selected tags and choose **DELETE**.

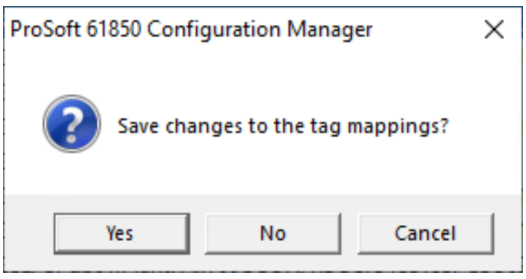
6 Repeat these steps until you have completed the mapping for the IED.



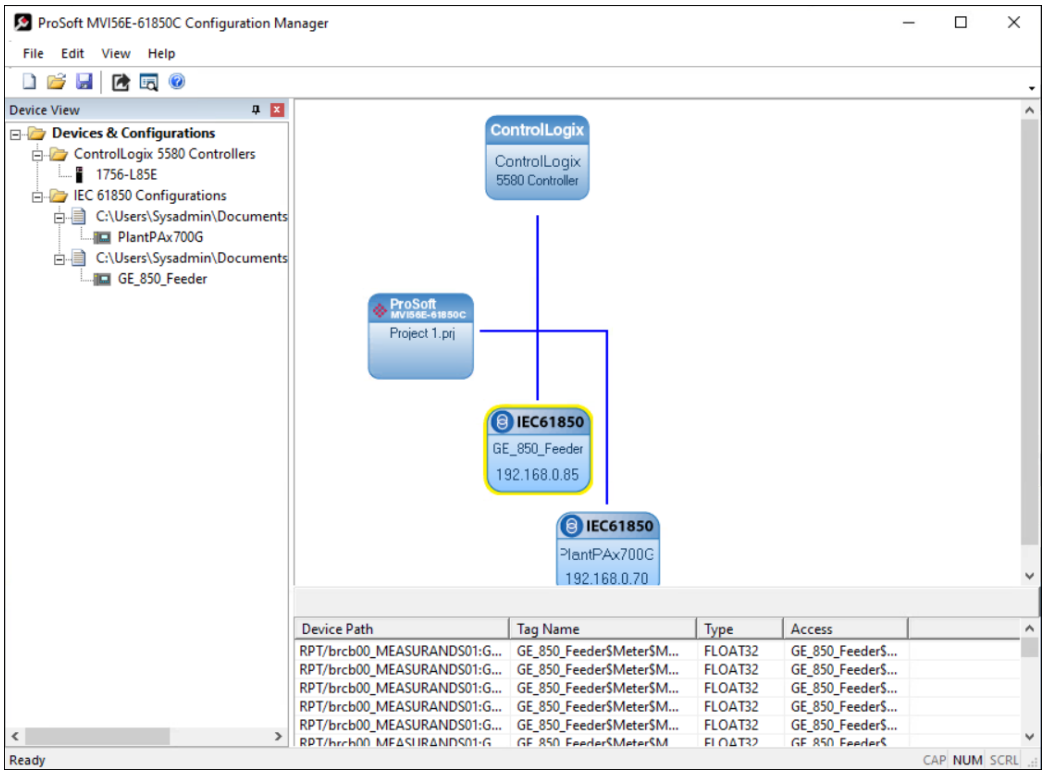
7 Once your mapping is complete, from the **MAPPING** menu, select **SAVE**.



8 In the confirmation message that displays, click **YES**.



The *IEC 61850 Mapping Tool* window closes, and the *ProSoft MVI56E-61850C Configuration Manager* window redisplays with the tags selected for the IED appearing in the *Configured Tags* pane.



9 To create a data mapping for another IED, double-click it in the *Network View* pane diagram. Repeat these steps for all IEDs requiring a mapping.

Note: You may select up to 20,000 data attributes for all IEDs in the project.

4.1.6 IED Group Feature

For applications with similar IED models and identical mapped tags, the *IED Group* feature allows the grouping of similar IEDs to expedite the configuration process and reduce the number of UDTs generated in the .L5X export file.

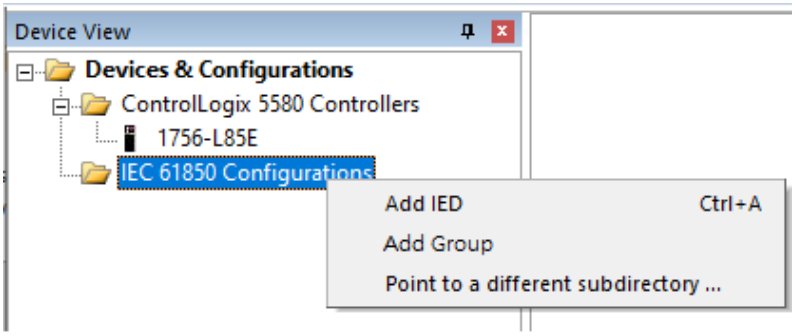
The IEDs in the same group will be automatically configured with the same mapped tags and will share the same UDTs. The IEDs in the same group must have the same vendor and type, and the CID files must define the same logical devices, logical nodes, data objects, datasets, reports, control blocks, and GOOSE control blocks.

Note: A maximum of 20 groups can be created per project.

Note: A maximum of 40 IED's (individual or within groups) can be created per project.

Note: When using the Rockwell Automation Library of Electrical Protection Devices with 2 or more of the same IED types (Example: Two SEL 700G protection relays), the group must be configured such that the same UDT is used for both relays. It must match the group name as defined in the supported Rockwell Automation Add-On Instructions and Faceplates.

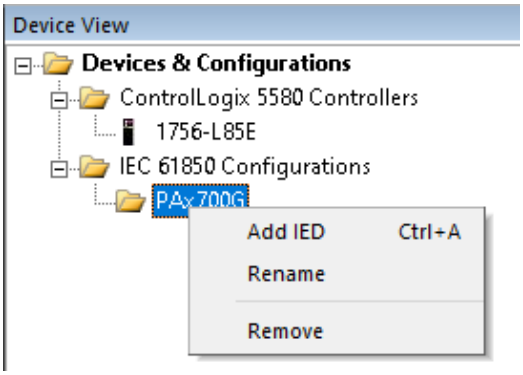
1 In the Device View of the *MVI56E-61850C Configuration Manager*, right-click on **IEC 61850 CONFIGURATIONS** folder and select the **ADD GROUP** option.



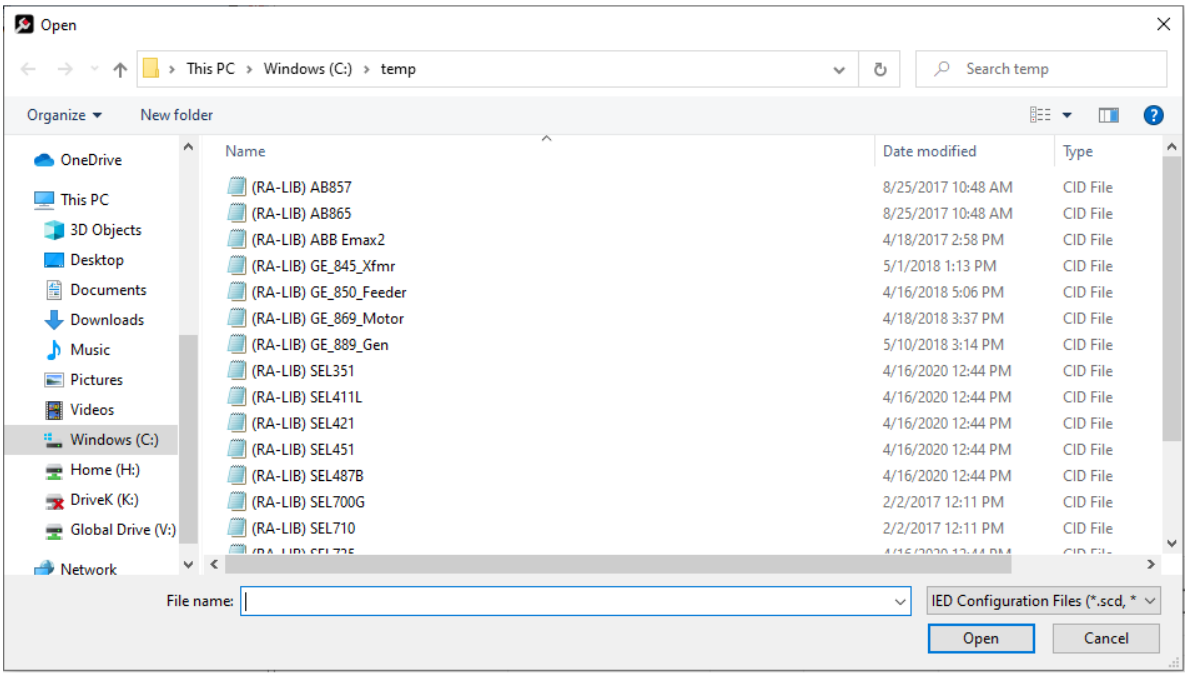
2 A new group folder is created.

3 If needed, rename the group folder – it must be alphanumeric (letters, digits, underscore; first character a letter).

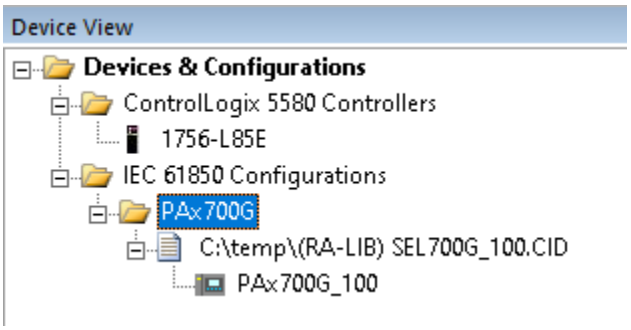
4 Right-click on the group folder and select **ADD IED** to add an IED to the group.



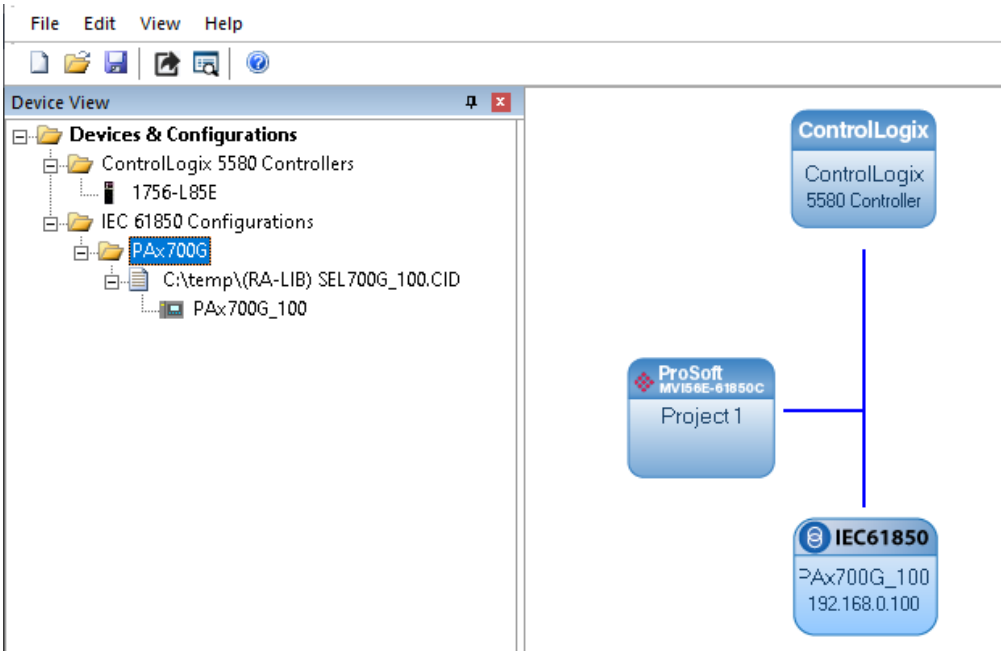
5 Browse and open the CID file to be used for the group.



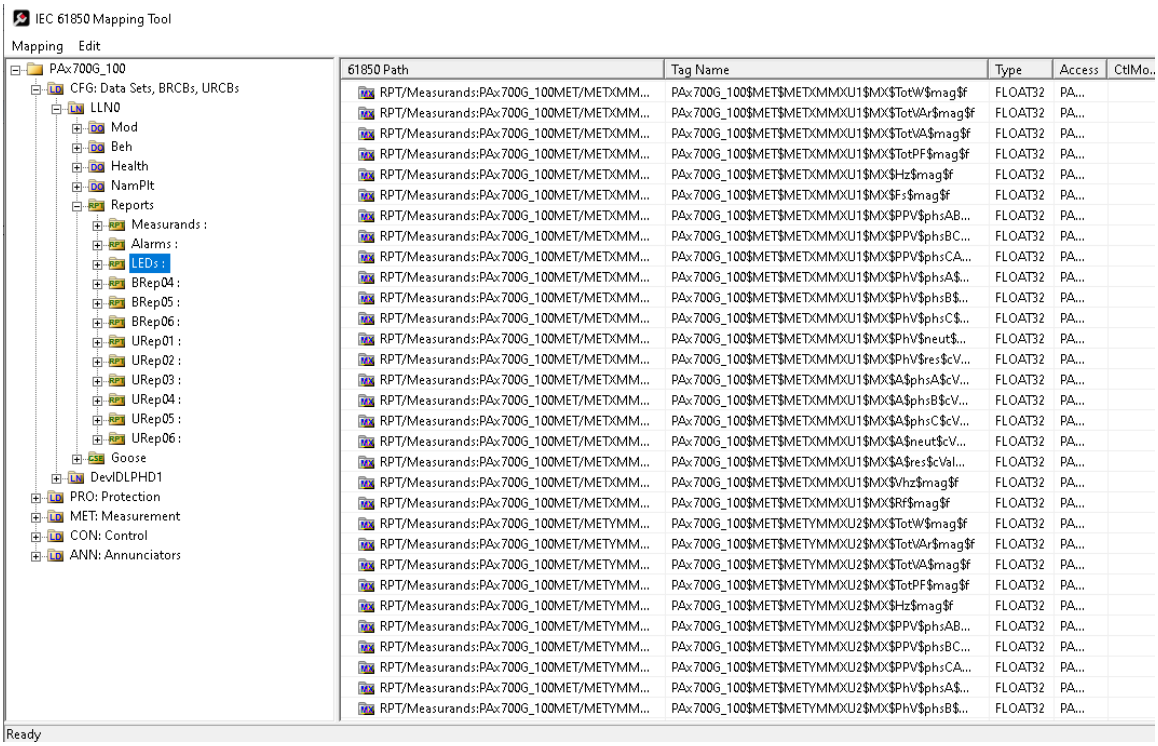
6 The IED is displayed under the group folder.



7 Drag and drop the IED from the *Device View* pane to the network area:



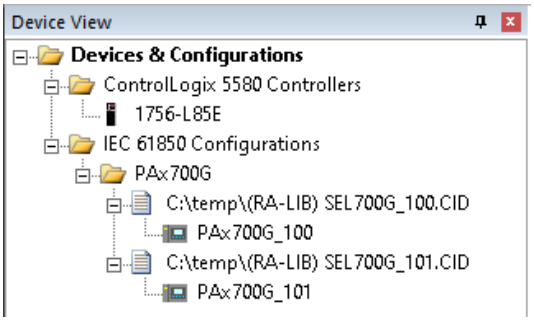
8 Double-click on the IED icon to open the *Mapping Tool* window. Drag and drop to map the data tags:

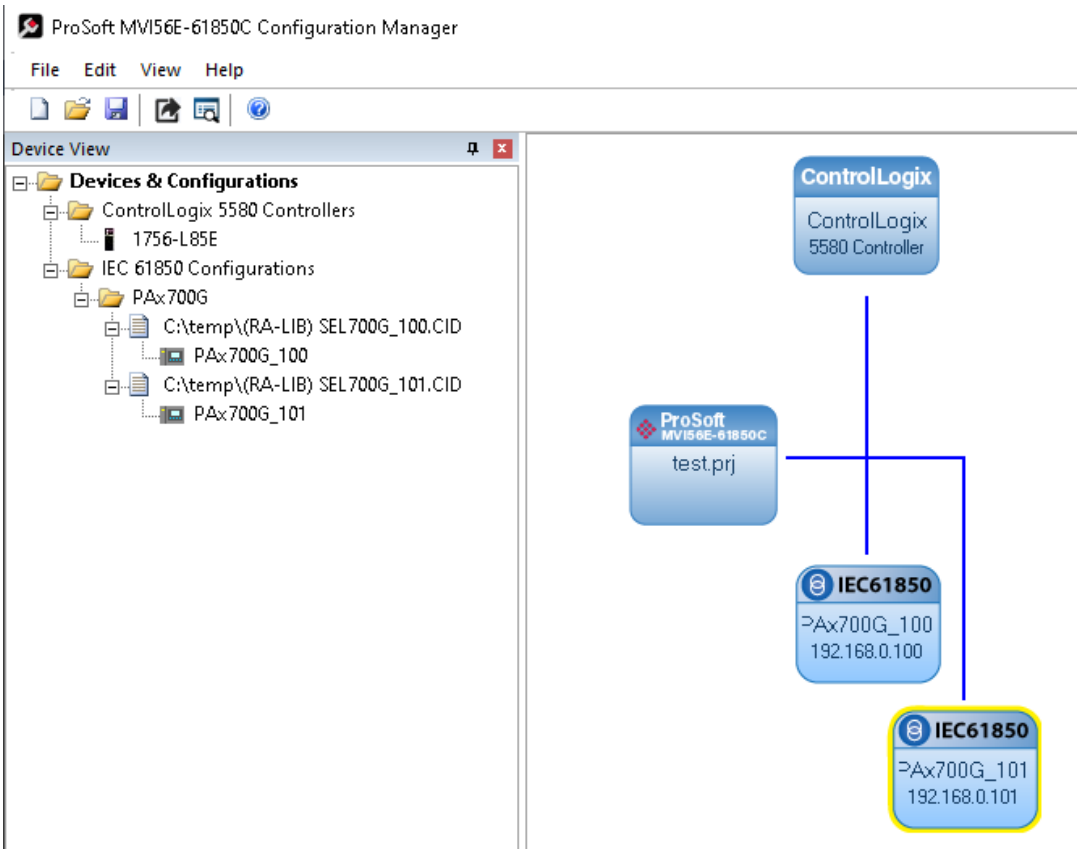


9 Save and close the *Mapping Tool* window.

10 To add another IED to the same group, repeat steps **4** to **7**.

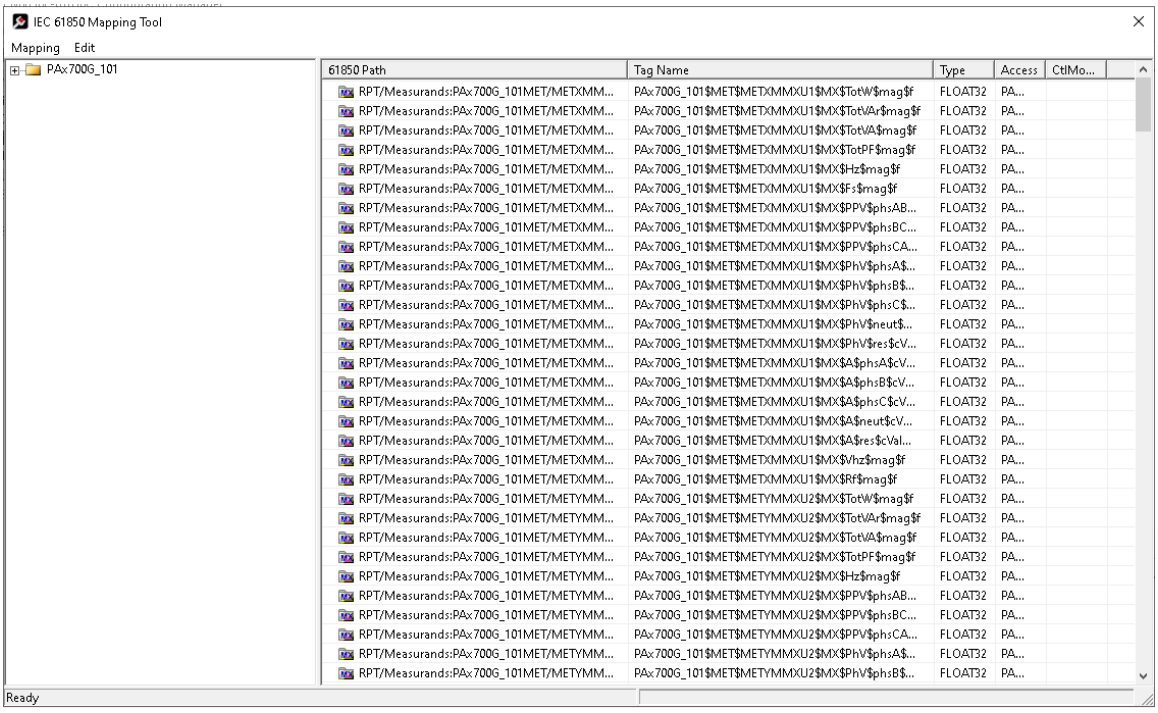
Note: Tags will be automatically mapped for all subsequent IED's with the same mapping as defined for the first device.





Caution: Ensure that all CID files for the same group define the same logical devices, logical nodes, data objects and data attributes. Otherwise, it can result in communication errors between the module and the IEDs.

- In the example above, the **PAx700G_101** IED is automatically configured with the same tags that were configured for the **PAx700G_100** IED.

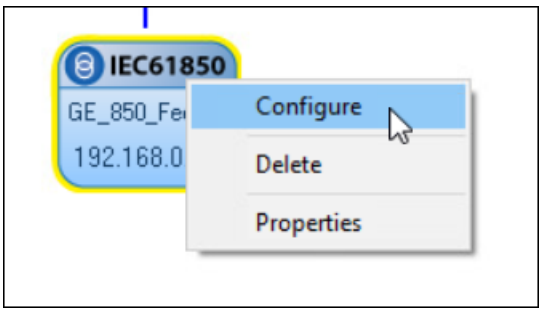


- If a tag is added or deleted for one IED in the group, then all other configured IEDs for the same group will be automatically updated accordingly. All IEDs in the group will always have the same tags configured.
- All IEDs for this group will use the same UDTs for the .L5X export. The L5X UDT names for this group will use the same prefix matching the assigned group name.

4.1.7 Deleting one or more IEC 61850 mappings

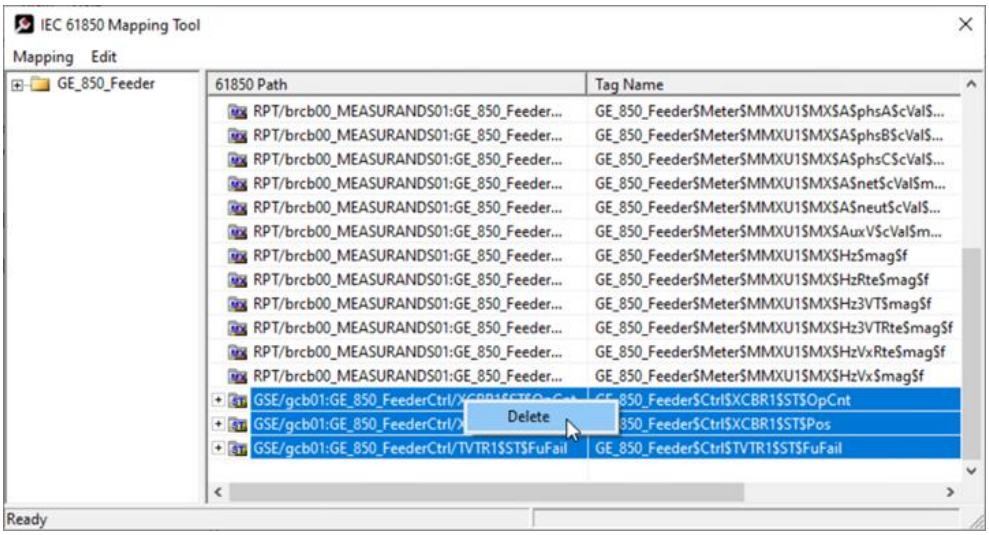
You can delete one or more MMS messages, Report, and GOOSE mappings from an IED's configuration.

1 In the *Network View* pane in the MVI56E-61850C Configuration Manager, right-click the *IED* bubble, and choose **CONFIGURE**.

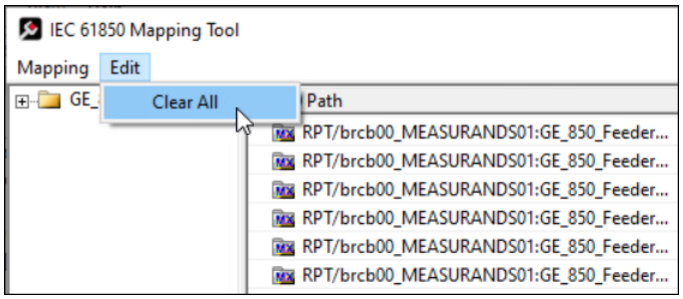


The IEC 61850 Mapping Tool window displays. The mappings are listed in the table on the right side of the window.

2 To delete only some of the mappings, select them from the table on the right, then right-click the selected mappings and choose **DELETE**.



3 To delete all the mappings, select **EDIT** > **CLEAR ALL**.



4 From the **MAPPING** menu, select **SAVE**.

4.1.8 Set the MMS Scan Delay and MMS Ping for an IED

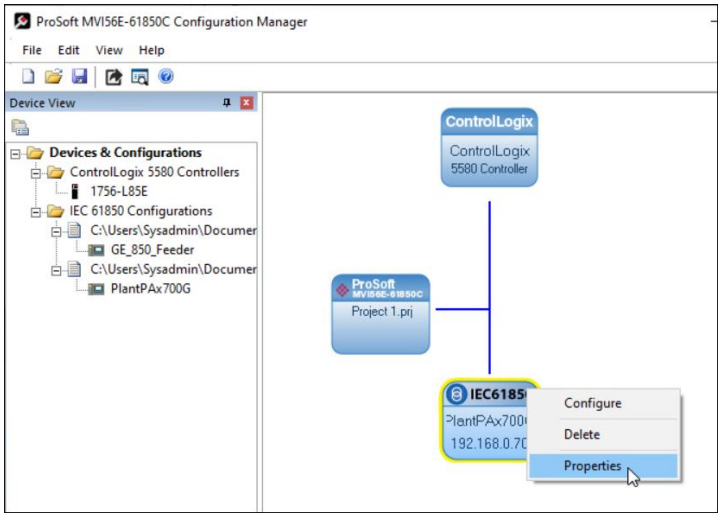
You can change the *MMS Scan Delay* and *MMS Ping* for any IED.

MMS Scan Delay value determines how often the MVI56E-61850C module will issue an MMS read command.

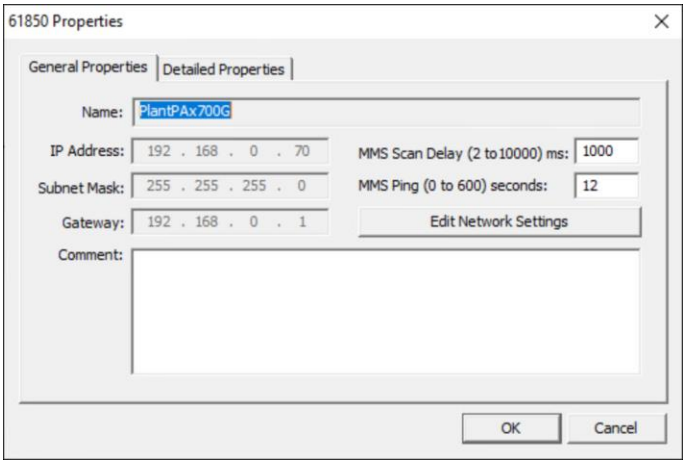
MMS Ping value configures the frequency of the keepAlive message issued by the module to confirm that the IED is still connected. These are the only properties you can change for an IED, as everything else is set in the IED configuration file.

IEC 61850 Reports and GOOSE messages are generated by the IED and are not affected by the *MMS Scan Delay*. The *MMS Scan Delay* parameter also has no impact on MMS writes. The lower you set the *MMS Scan Delay* value, the more network capacity is consumed by MMS Read network traffic. If you do not configure an IED to read any data attributes using MMS messages, then this parameter has no effect.

1 Right-click an IED and select **PROPERTIES**.



The *61850 Properties* dialog displays.

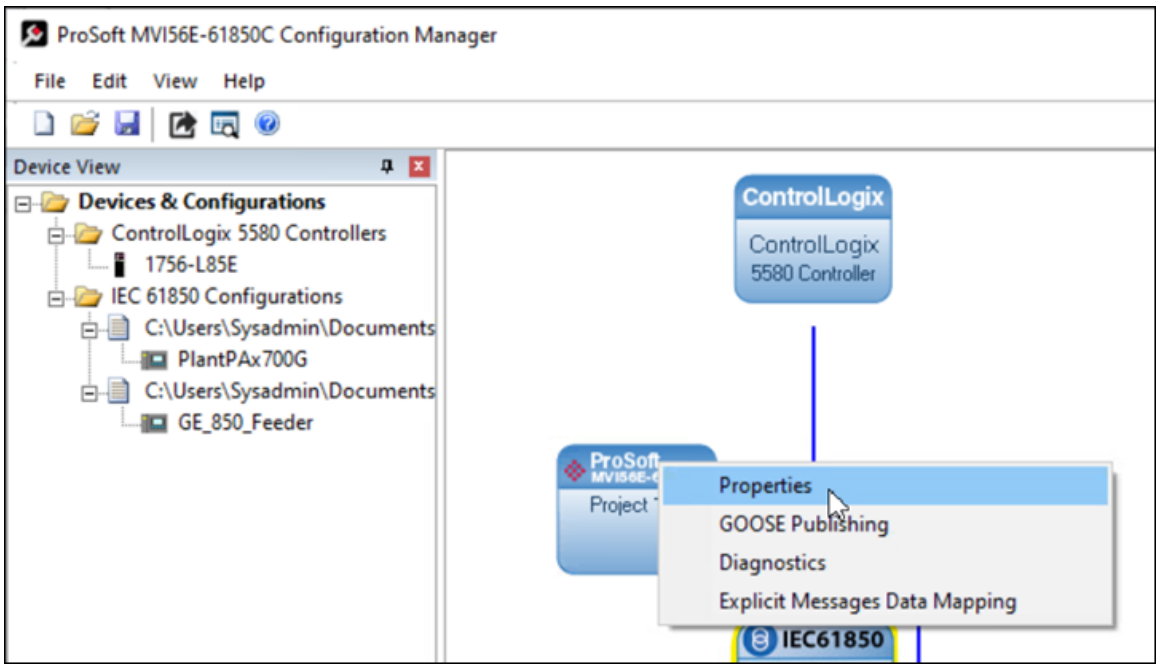


The **EDIT NETWORK SETTINGS** button is for troubleshooting under the direction of ProSoft Technical Support.

2 The network settings (*IP Address*, *Subnet Mask*, and *Gateway*) should already be filled in, because ProSoft 61850 Configuration Manager reads this from the CID file. You should not need to edit these settings.
3 By default, the *MMS SCAN DELAY* is set to 1000 milliseconds. You can change this value if necessary.
4 Click **OK**.

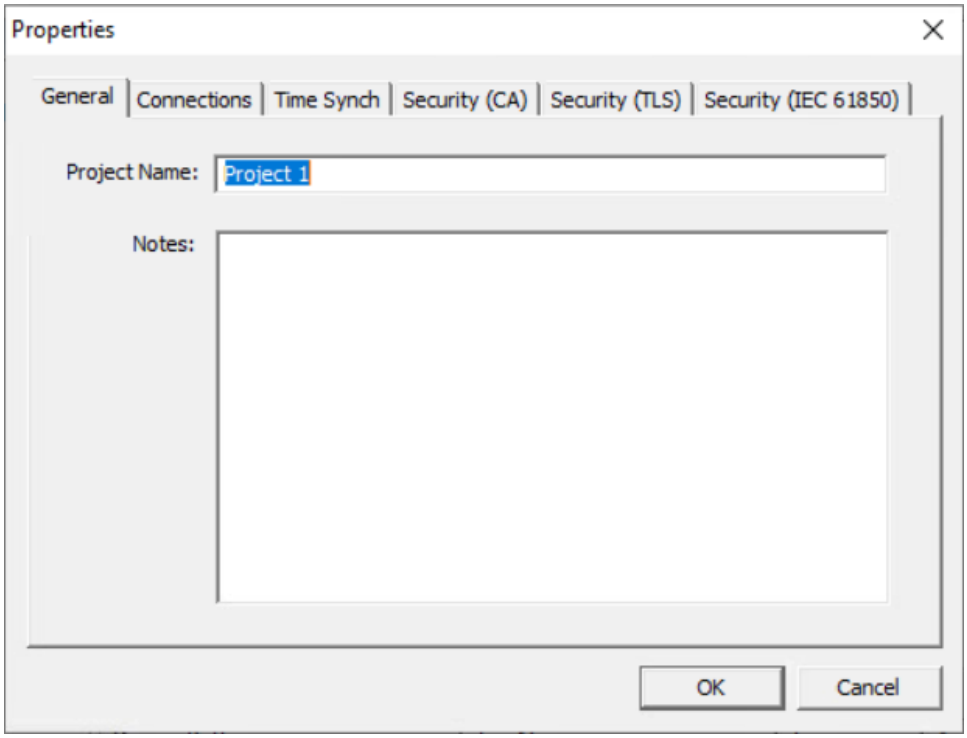
4.1.9 Module Properties in Configuration Manager

From within MVI56E-61850C Configuration Manager, you can view and edit various properties of the MVI56E-61850C module. To do so, right-click the module and select **PROPERTIES**.



General

On the *General* tab of the *Properties* dialog, you can view and edit the name of the MVI56E-61850C Configuration Manager project and add notes as appropriate.



Connections

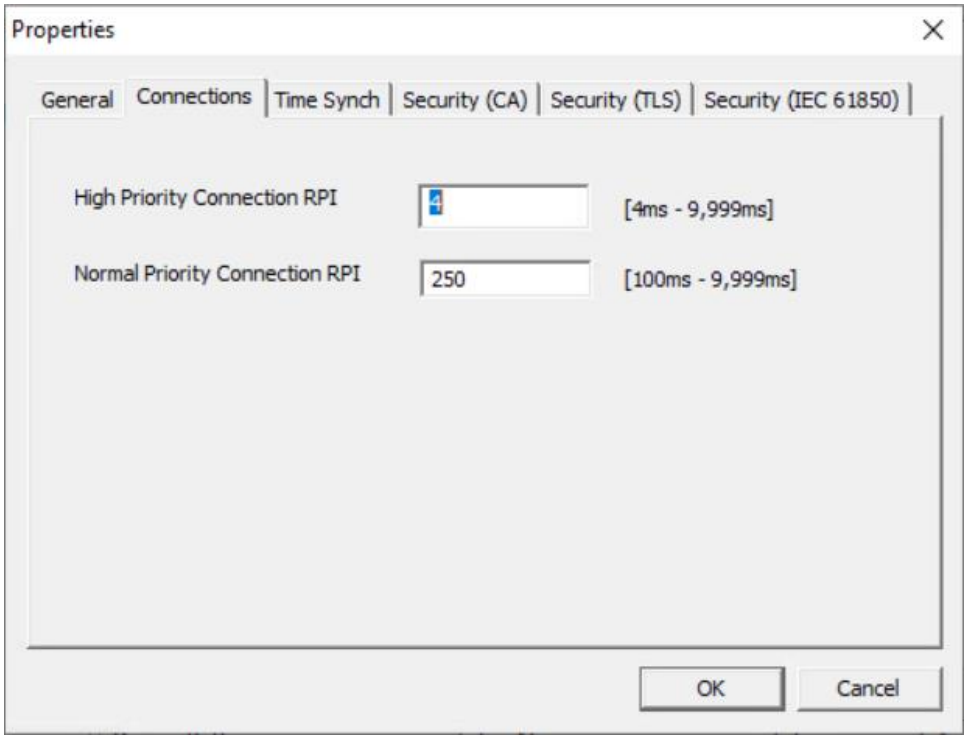
The *Connections* tab of the *Properties* dialog displays the backplane connection RPI settings. The backplane connections are used to exchange data between the ControlLogix processor and the MVI56E-61850C module. Each connection is limited to 500 input bytes and 496 output bytes.

The IEC 61850 data selected by the user is automatically mapped to the backplane connections (max 225 connections) for data transfer between the ControlLogix processor and MVI56E-61850C module.

There are two categories of backplane connections: high priority and normal priority. The high priority connections support faster transfer rates. The selected IEC 61850 data is automatically mapped to a backplane category depending on the IEC 61850 communication method as follows:

High Priority Connections	**Input**	GOOSE Subscribe
	Output	Control, GOOSE Publish
Normal Priority Connections	**Input**	Report, MMS Read
	Output	N/A

This information is also found on the *Connection* tab of the MVI56E-61850C Add-On Profile.

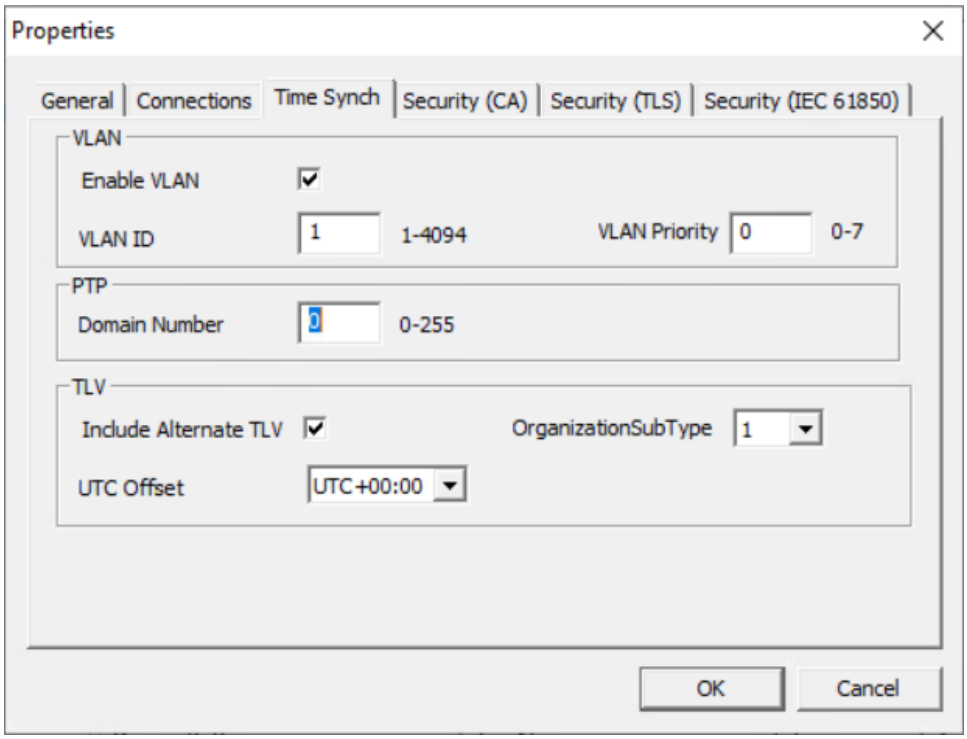


Note: The module supports up to 225 connections. From this total a maximum of 55 high priority connections are supported.

Time Synch

The *Time Synch* tab of the *Properties* dialog displays properties of the module's Time Synchronization feature.

This feature is always enabled over the backplane (between the ControlLogix processor and the MVI56E-61850C module). You can also enable time synchronization over Ethernet through the *Ethernet Configuration* tab of the MVI56E-61850C Add-On Profile.



The following are the parameters on the *Time Synch* tab.

Parameter	Description
Enable VLAN	This parameter allows the configuration of the VLAN header for PTP data communication. If enabled, the MVI56E-61850C module will add the VLAN header to the outgoing PTP data communication over Ethernet. Additionally, the module will also process incoming PTP data with the VLAN header. If disabled, the VLAN header will not be included in the PTP frames, nor will PTP data with the VLAN header be accepted.
VLAN ID	VLAN Identification. Valid values are between 1 and 4094.
VLAN Priority	VLAN priority number. Valid values are between 0 and 7. **Note:** IEDs supporting the Power Profile standard C37.238 Ed 2011 may require the VLAN header and parameters to accept time synchronization communication.
Domain Number	Domain identification. The domain consists of one or more PTP devices communicating with each other as defined by the protocol. Valid values are between 0 and 255.

Parameter	Description
Include Alternate TLV	This option configures the inclusion of the Alternate Time Offset Indicator TLV to the announce frames if missing from the announce frames received by the grandmaster clock. **Note:** IEDs supporting the Power Profile standard C37.238 Ed 2011 require the Alternate Time Offset Indicator TLV to accept time synchronization communication. However, according to standard C37.238 Ed 2017, the Alternate Time Offset Indicator TLV is no longer required. If you configure the module in boundary clock mode (AOP Time Synch Ethernet enabled), with the ControlLogix processor as the time Grandmaster and the IED supporting standard C37.238 Ed 2011 Edition, then you should enable this feature, so the module will insert the TLV section to the Announce frame received from the ControlLogix processor before it gets sent to the IED.
OrganizationSubType	Defines a subtype within the scope of the organizationID field. Depending on the C37.238 standard edition supported by the IEDs, the parameter value must be set as follows:
UTC Offset	The difference between Coordinated Universal Time and local time.

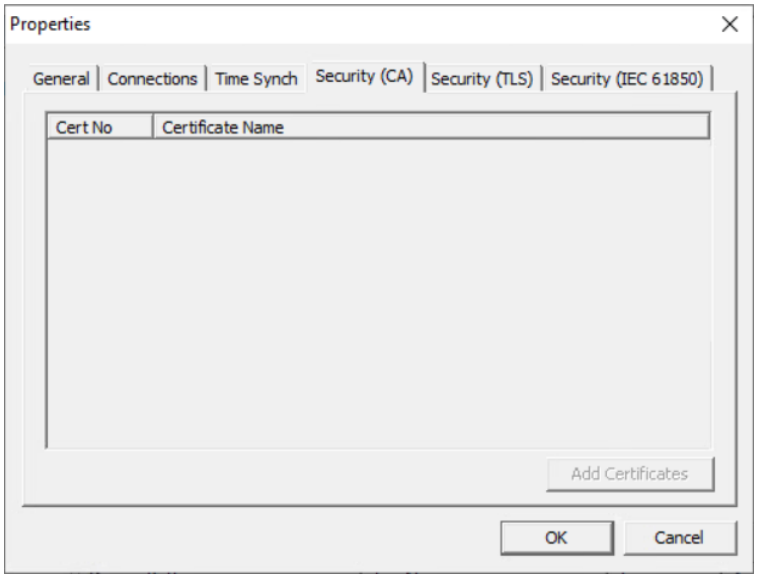
Standard C37.238 Edition	OrganizationSubType Value
2011	1
2017	2

For more information on the Time Synch feature, see "Time Synchronization" on page 83.

Security (CA)

Note: The Security feature is not currently supported.

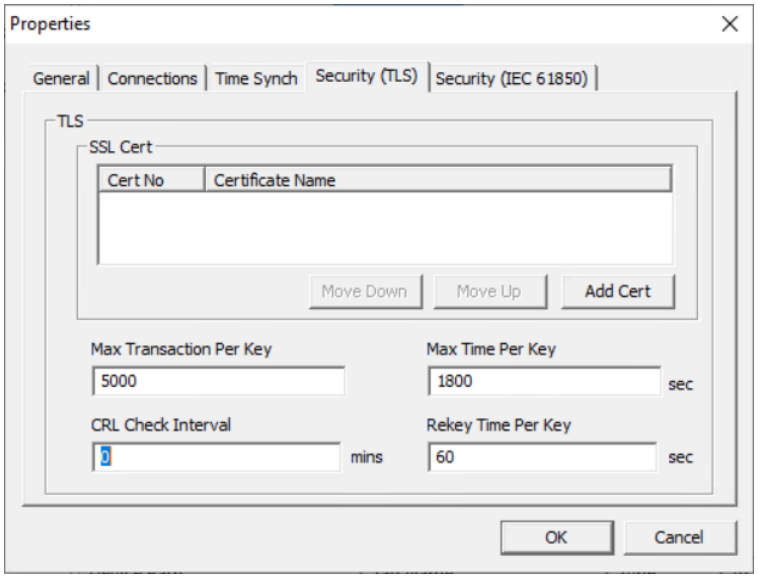
The *Security (CA)* tab of the *Properties* dialog allows you to manage security certificates issued by certificate authorities.



Security (TLS)

Note: The Security feature is not currently supported.

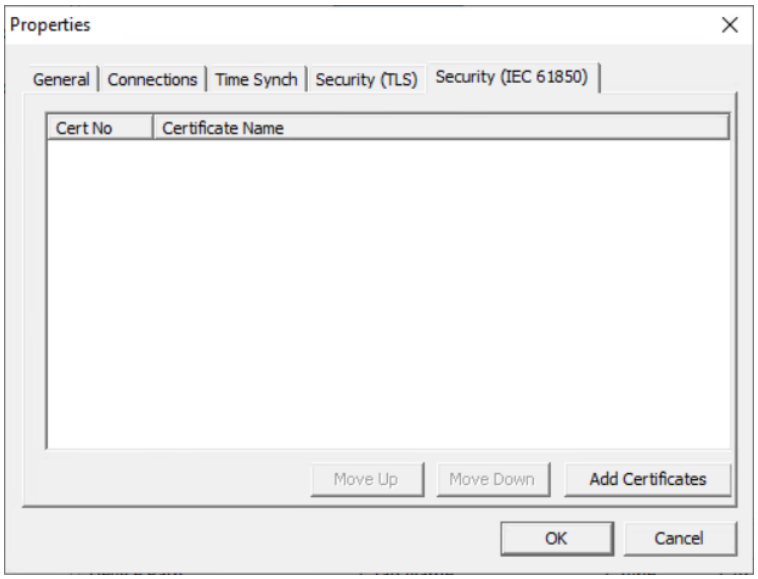
The *Security (TLS)* tab of the *Properties* dialog allows you to manage project security certificates and other related settings.



Security (IEC 61850)

Note: The Security feature is not currently supported.

The *Security (IEC 61850)* tab of the *Properties* dialog allows you to manage security certificates for IEDs on the IEC 61850 network.



4.1.10 Configure GOOSE Publish

Overview

The ProSoft MVI56E-61850C Configuration Manager allows for the configuration of GOOSE messages published out to the network from the MVI56E-61850C module. When you export the project to the MVI56E Add-On Profile, (see "Export the Configuration to the Add-On Profile" on page 59), the Configuration Manager creates a .CID file that contains the GOOSE configuration. You can import that .CID file into the application you are using to configure your IEDs so that you can set up those devices to consume the GOOSE messages.

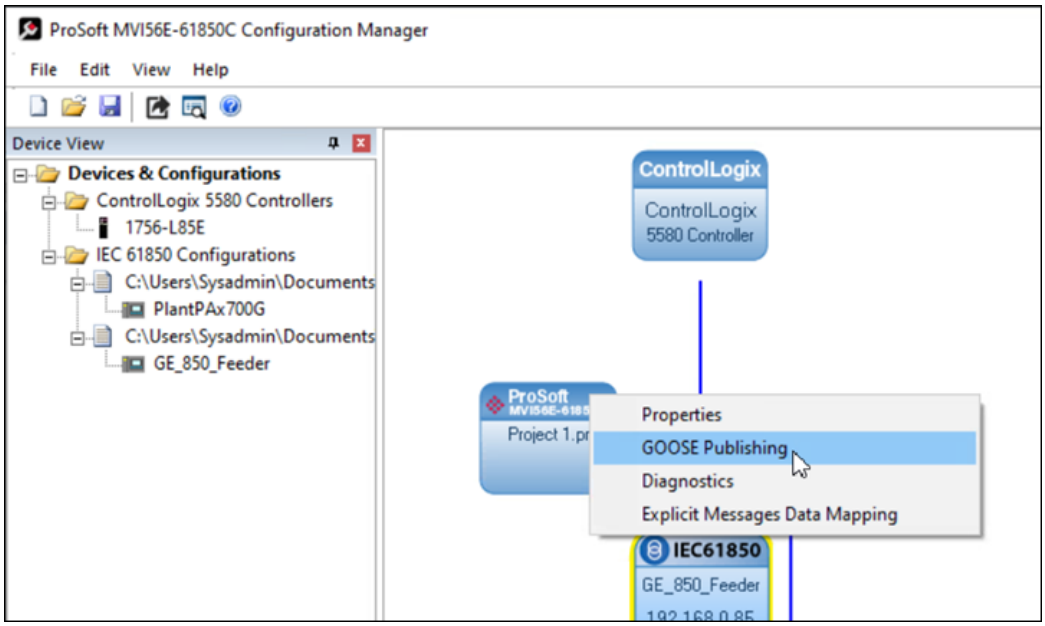
The tags associated with the GOOSE message configuration will be automatically mapped as part of the high priority output connections.

Configure the IED Name

The first step in configuring GOOSE Publish is to set the name that the module will assume for the IED on the IEC 61850 network.

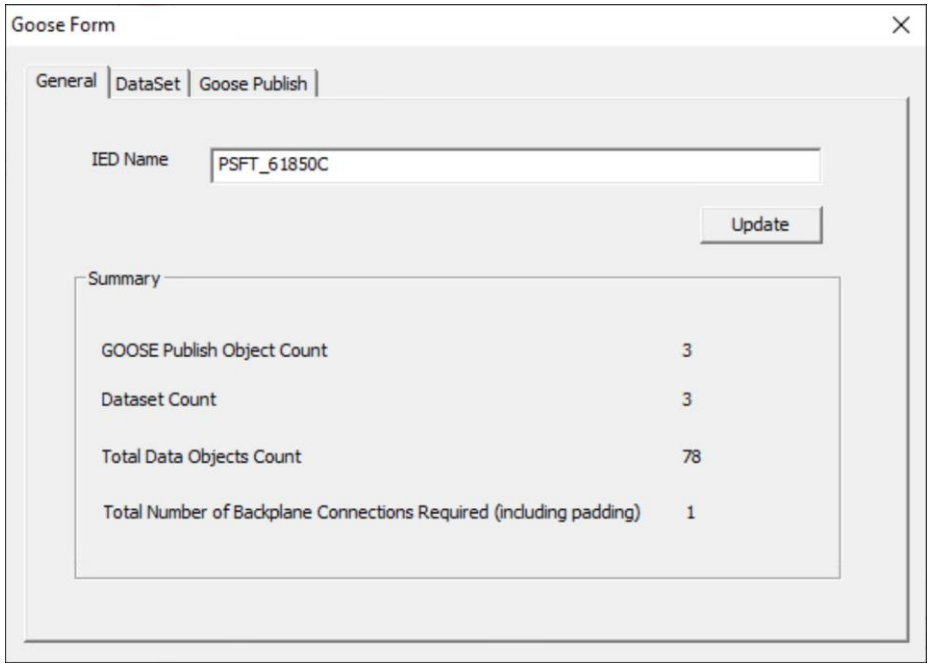
1 In Configuration Manager, right-click the MVI56E-61850C module and select **GOOSE PUBLISHING**.

Note: If you have not yet saved the Configuration Manager project, the system will prompt you to do so.



The *GOOSE Form* window displays.

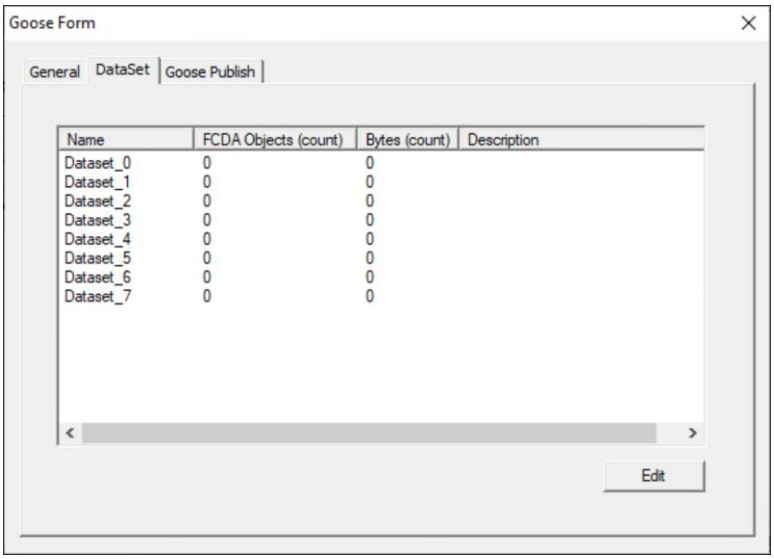
2 Edit the IED Name field as appropriate.



Create GOOSE Datasets

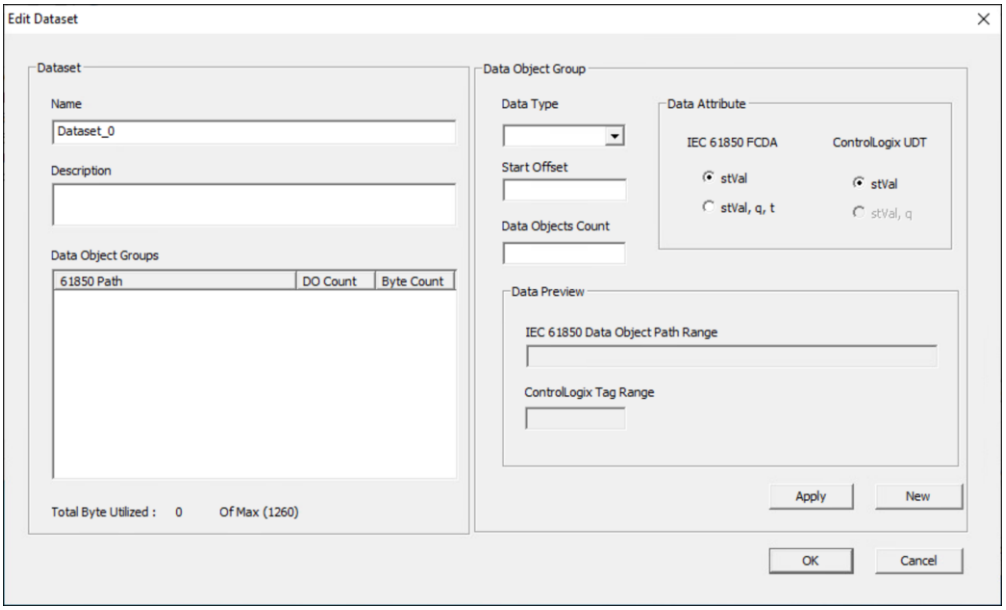
The next step in configuring GOOSE messages is to create the datasets that will contain the messages. Each dataset comprises a series of data groups, each of which can contain multiple data objects. You can configure up to 8 datasets.

1 From the GOOSE Form window, select the **DATASET** tab.



2 Select a dataset and click **EDIT**.

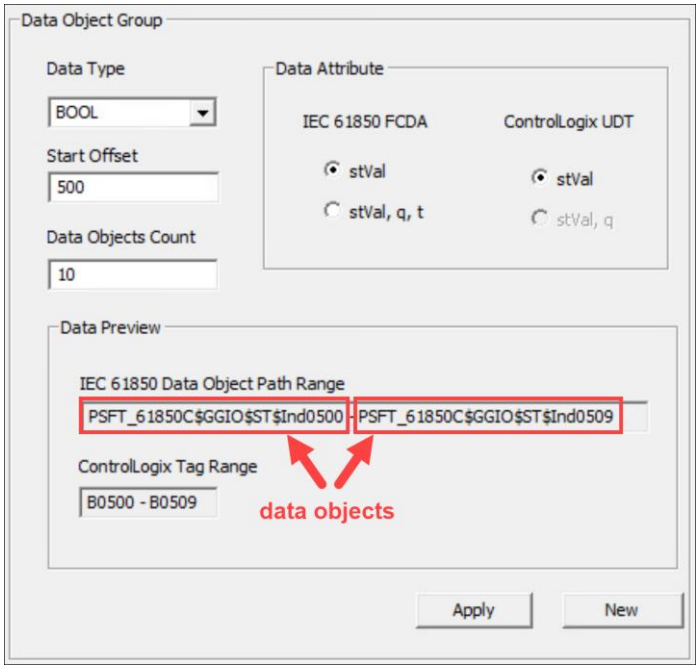
The *Edit Dataset* window displays.



3 If necessary, edit the name and description of the dataset as you see fit.

4 In the *Data Object Group* area, select a data type and enter the start offset and number of data objects.

The *Data Preview* area updates to show how the data will look when published out to the 61850 network (*IEC 61850 Data Object Path Range*) and how it will be stored in the module (*ControlLogix Tag Range*).



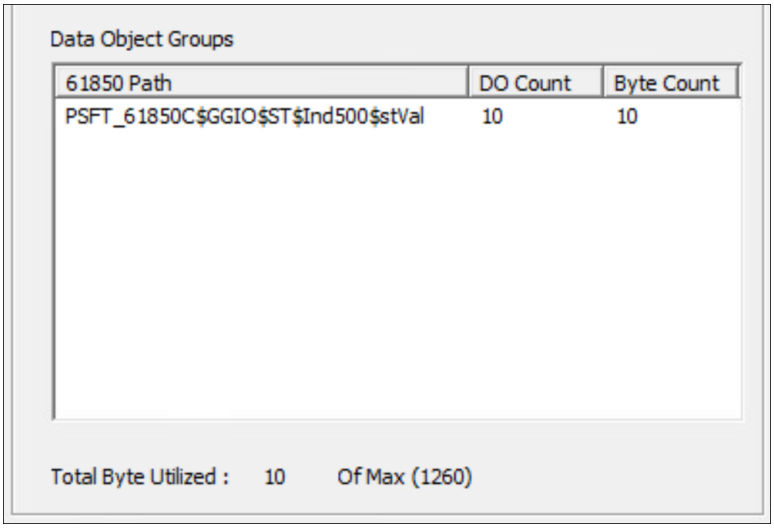
For this example, the GOOSE Publish data will be accessed as follows:

ControlLogix Tag	IEC 61850 Data Object
B0500	PSFT_61850$GGIO$ST$Ind0500
B0501	PSFT_61850$GGIO$ST$Ind0501
B0502	PSFT_61850$GGIO$ST$Ind0502
B0503	PSFT_61850$GGIO$ST$Ind0503
B0504	PSFT_61850$GGIO$ST$Ind0504
B0505	PSFT_61850$GGIO$ST$Ind0505
B0506	PSFT_61850$GGIO$ST$Ind0506
B0507	PSFT_61850$GGIO$ST$Ind0507
B0508	PSFT_61850$GGIO$ST$Ind0508
B0509	PSFT_61850$GGIO$ST$Ind0509

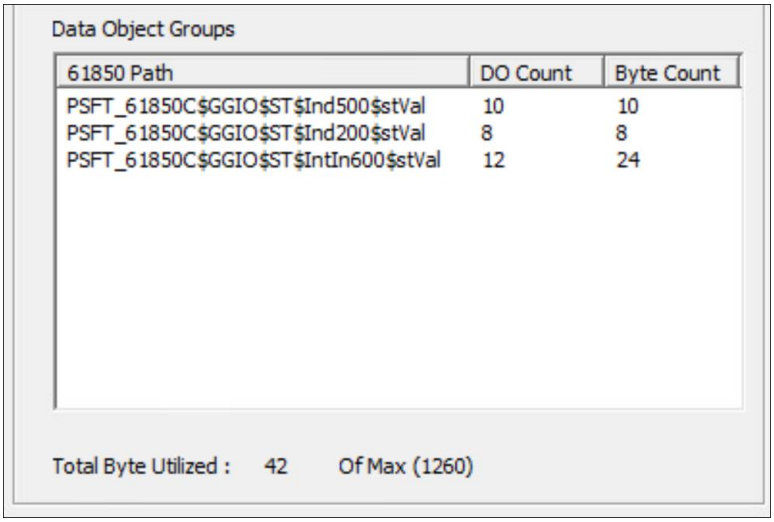
Therefore, updating the *B0500.stVal* value will also send the *PSFT_61850$GGIO$ST$Ind0500.stVal* value out to the IEC 61850 network.

5. In the *Data Attribute* area, select the appropriate attribute for *IEC 61850 FCDA* (*stVal* or *stVal, q, t*). Your selection determines whether the data objects will contain only the status value (*stVal*) or the status value plus the quality (*q*) and time (*t*) attributes when the MVI56E-61850C sends the GOOSE message out to the IEC 61850 network. The attributes *q* and *t* are defined as follows:
   - *q*: The 61850 quality, which is a 13-bit variable-length bit array, stored as 13 bits of a 16-bit (two-byte) object. This value is optionally delivered over the backplane from the ControlLogix processor to the module. Even when *stVal* is delivered alone from the ControlLogix processor, the processor still maintains *q* with valid settings out to the IEC 61850 network.
   - *t*: The timestamp of the last change to either *stVal* or *q*, having the type of 61850 "Timestamp," an 8-byte quantity. This value is updated from the module's system clock whenever either *stVal* or *q* is changed, either from delivery over the backplane or from recalculation of *q*.
6. In the *Data Attribute* area, select the appropriate attribute for *ControlLogix UDT* (*stVal* or *stVal, q*). Your selection determines how the data will be stored in the ControlLogix processor. Note that if you select *stVal* under *IEC 61850 FCDA*, the only option available for *ControlLogix UDT* is *stVal*. For more information on how the quality value is set, see "GOOSE Publish Quality Value" on page 54.
7. Select **APPLY**.

The data objects are added to the *Data Object Groups* list. Each item in this list represents a single group of data made up of one or more data objects.

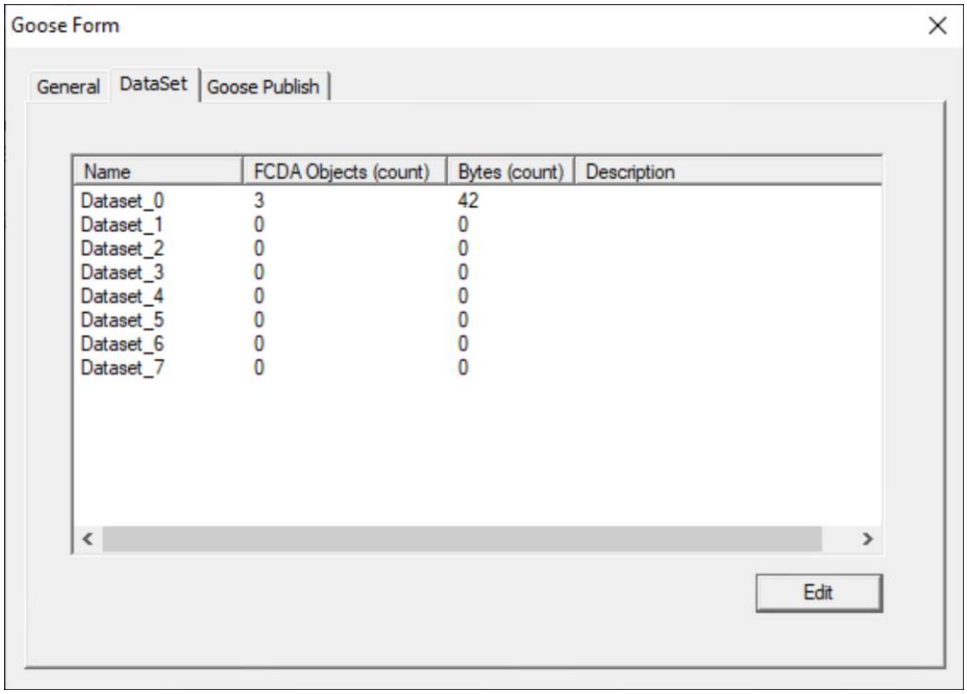


8 Repeat steps 5 to 8 to add additional data object groups to the dataset.



9 Click **OK**.

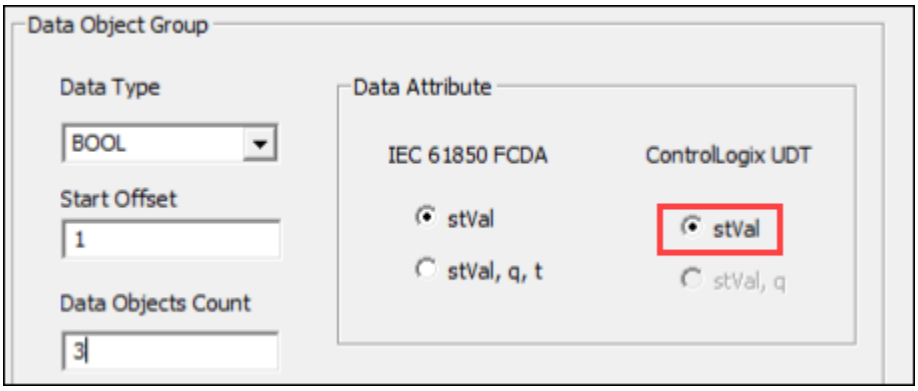
The *DataSet* tab redisplays with updated data based on your edits.



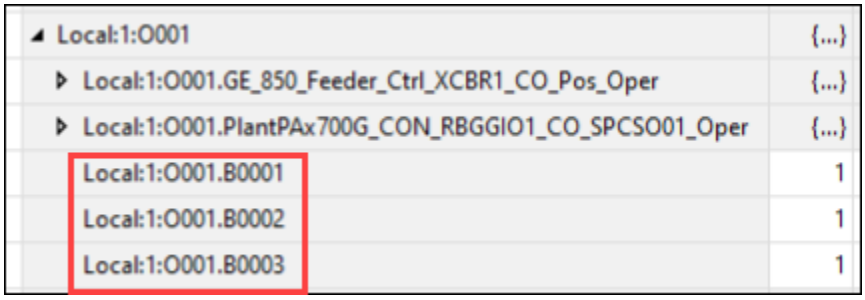
10 Repeat steps 3 to 10 to configure additional datasets.

GOOSE Publish Quality Value

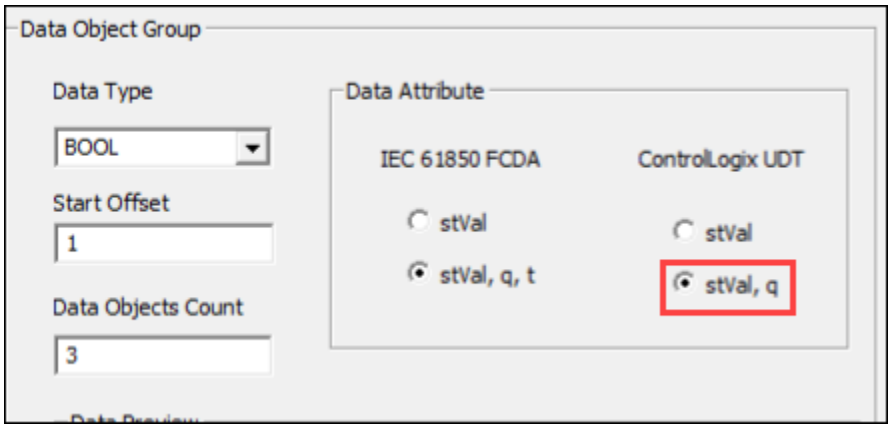
If you select *stVal* for *ControlLogix UDT*, the quality value (*q*) will not be included in the GOOSE Publish tags in Logix Designer.



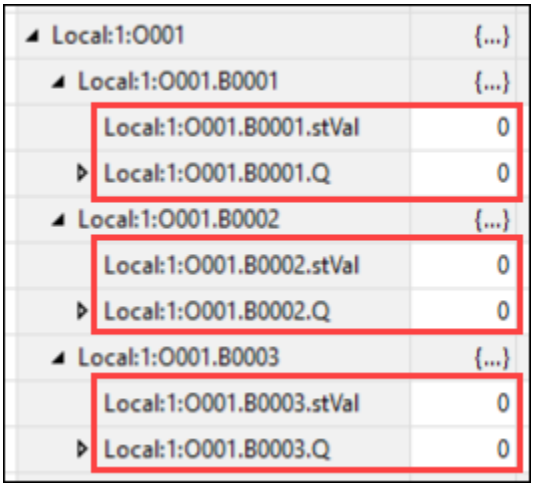
In this example, the GOOSE Publish tags will be generated as B0001, B0002, and B0003 (status value only), as illustrated in the following screen capture of the *Controller Tags* editor:



If you select *stVal, q* for *ControlLogix UDT*, the quality will be delivered with the status value.



In this example, the GOOSE Publish tags will be generated as structures of status value (*stVal*) and quality (*Q*).



The data type of *Q* is a byte (Logix datatype USINT, TagDB datatype UBYTE) whose two low-order bits have been assigned as follows:

- Bit 0: Source is off-line (for example, input card failure, rendering latest data “stale”).
- Bit 1: Source is chattering (therefore status value might not be reliable).

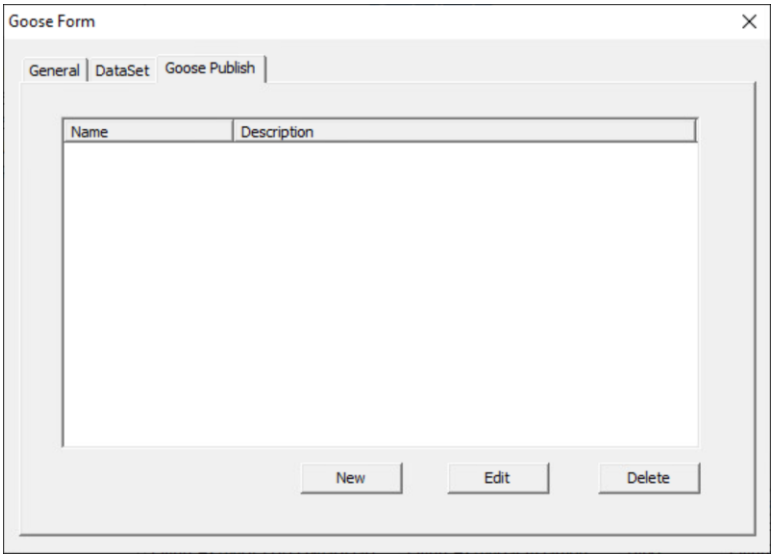
When the value of *Q* is set in Logix Designer, the ControlLogix processor passes the value to the MVI56E-61850C module and updates the quality (*q*) accordingly as follows:

- If *Q* bit 0 is set as 1 (offline), then *q* is set as c100 (old data).
- If *Q* bit 1 is set as 1 (chattering), then *q* is set as 4400 (oscillatory).

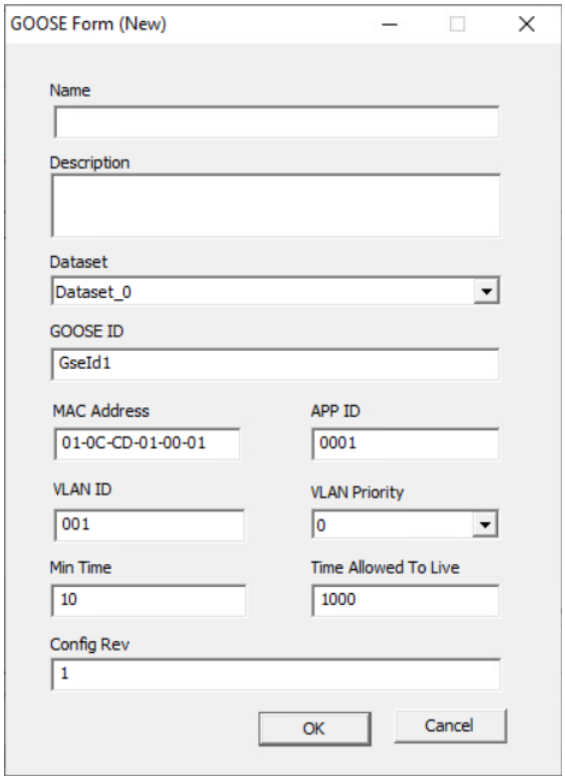
Configure the GOOSE Control Block

After configuring the datasets, the next step is to set the parameters for the GOOSE control block.

1 Select the **GOOSE PUBLISH** tab.
2 Click **NEW**.



The *GOOSE Form (New)* window displays.



3 Enter a name and description.

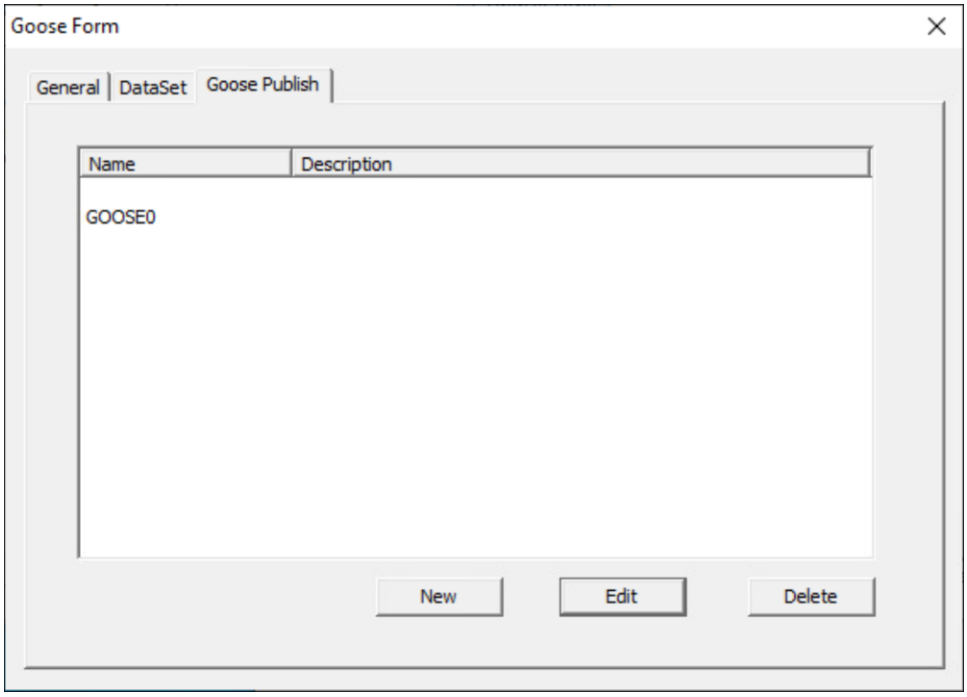
4 Select a dataset. This list contains all the datasets that you configured on the *DataSet* tab.

5 Enter values for the remaining parameters using the following table as a guide.

Parameter	Description
GOOSE ID	Identification string for the GOOSE control block
MAC Address	The destination multicast address to which the GOOSE message will be propagating
APP ID	Integer value that identifies the sender of the GOOSE message
VLAN ID	Value used to broadcast the GOOSE message only to a particular closed network
VLAN Priority	Priority of the GOOSE message broadcast to the VLAN
Min Time	GOOSE message frequency (in milliseconds) when a change occurs in the data
Time Allowed to Live	Sets how long the remote IED should wait for the next message before determining there was a communication issue (in milliseconds). The GOOSE message frequency when there is no new event (Max Time) is calculated as Time Allowed to Live divided by 2.
Config Rev	Configuration revision

6 Click **OK**.

The form closes, and the *GOOSE Publish* tab redisplays with the new GOOSE control block appearing in the list.

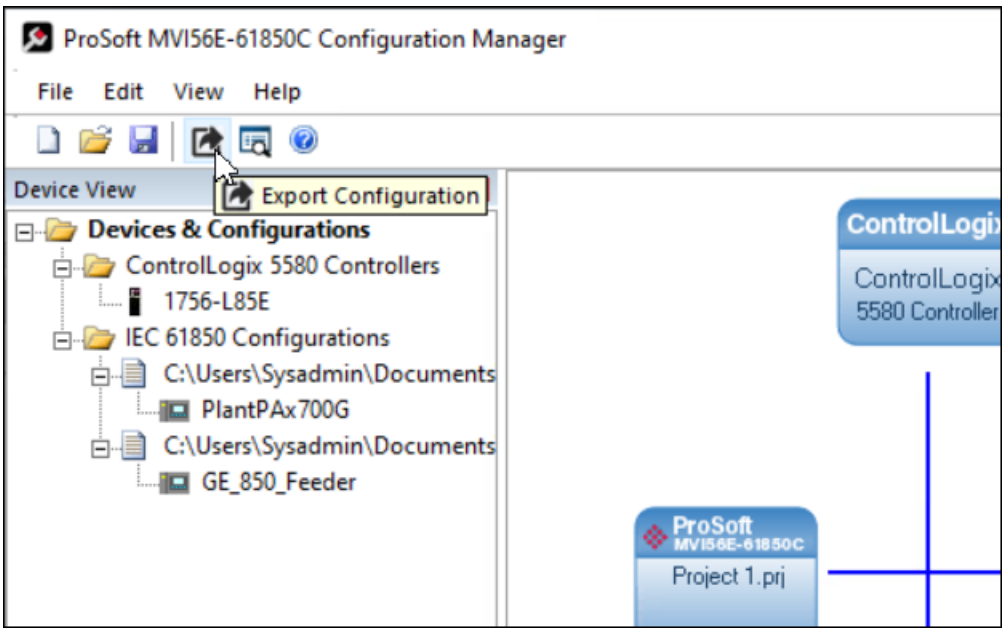


7 Repeat steps 2 to 6 to add additional GOOSE control blocks.

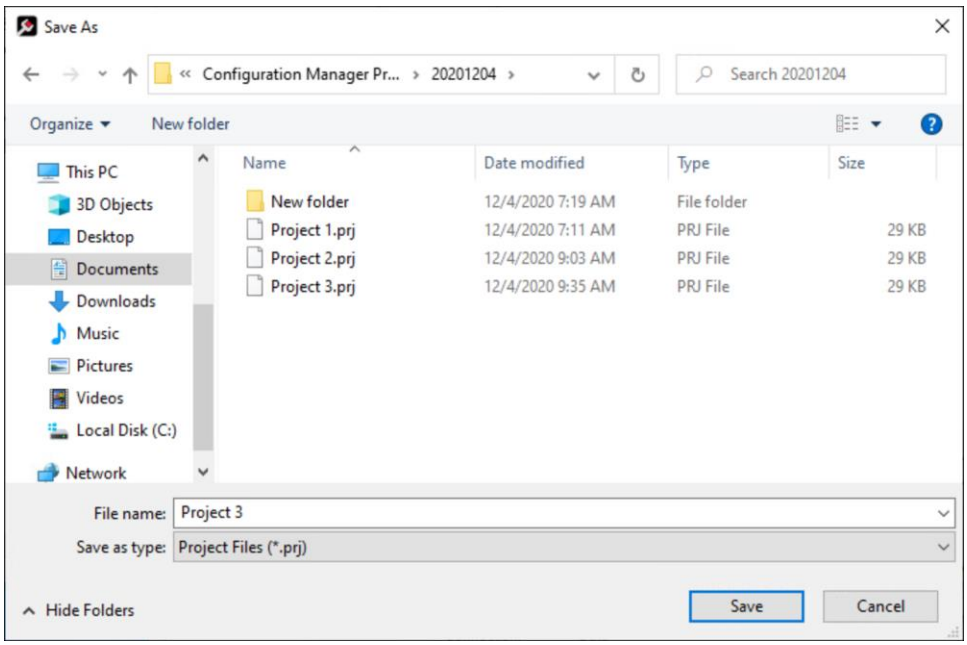
4.1.11 Export the Configuration to the Add-On Profile

After you have created the tag mappings, you are ready to export the configuration to the Add-On Profile, thereby passing the configuration to the ControlLogix processor.

1 Select the **EXPORT CONFIGURATION** icon from the ProSoft MVI56E-61850C Configuration Manager menu bar.

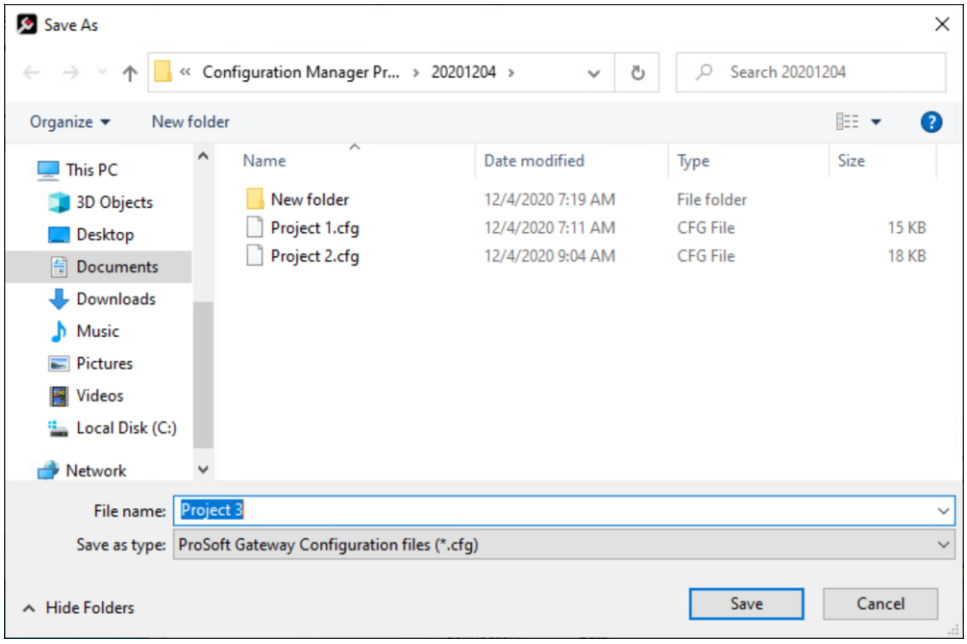


2 In the *Save As* dialog, navigate to the location where you want to save the project files and select **SAVE**.



A second *Save As* dialog displays.

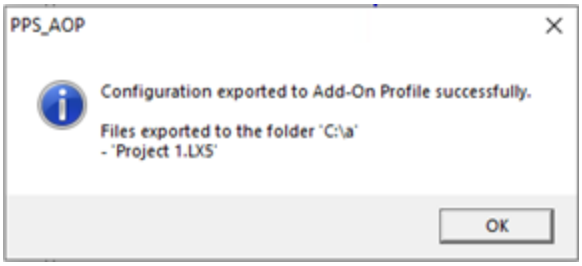
3 Navigate to the location where you want to save the configuration files and select **SAVE**.



The Configuration Manager saves the following configuration files:

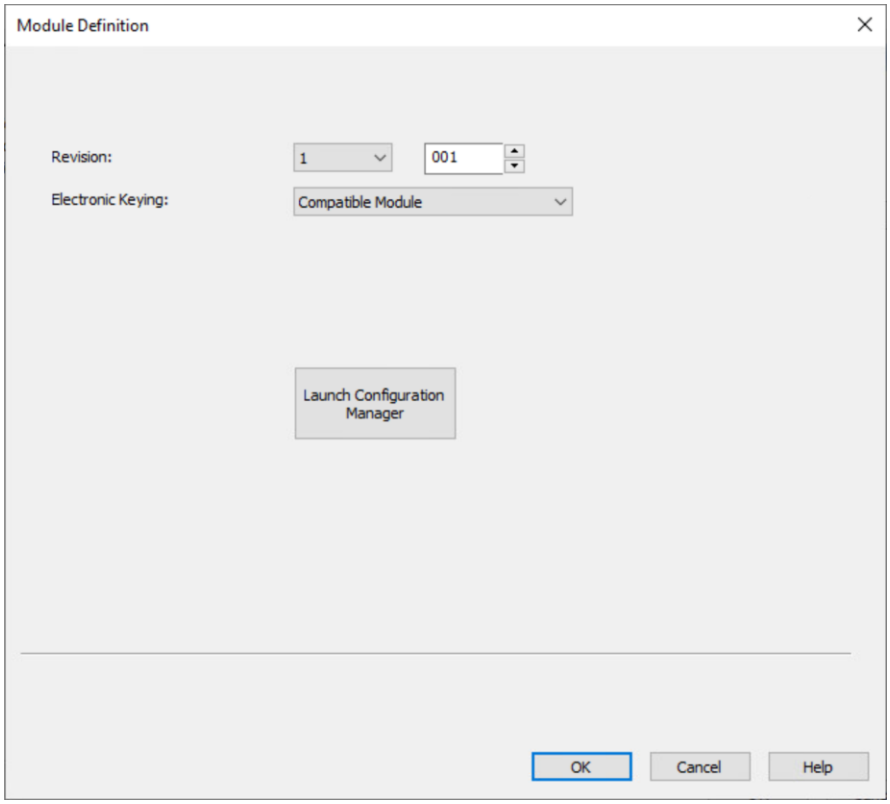
- Project backup (.cfg, .tlz, .xml, .prj, .prx, .db)
- MVI56E-61850C program for Studio 5000 Logix Designer (.L5X)
- IED configuration file (.CID) (only if you configure the GOOSE Publish feature)

Once the project export is successfully concluded, you should see a message similar to the following:

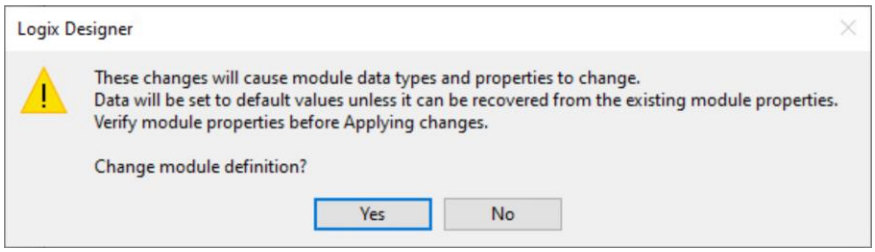


4 Click **OK** in the two confirmation dialogs that display.
5 Close the *Configuration Manager* window.

6 In the *Module Definition* window of the Add-On Profile, click **OK**.



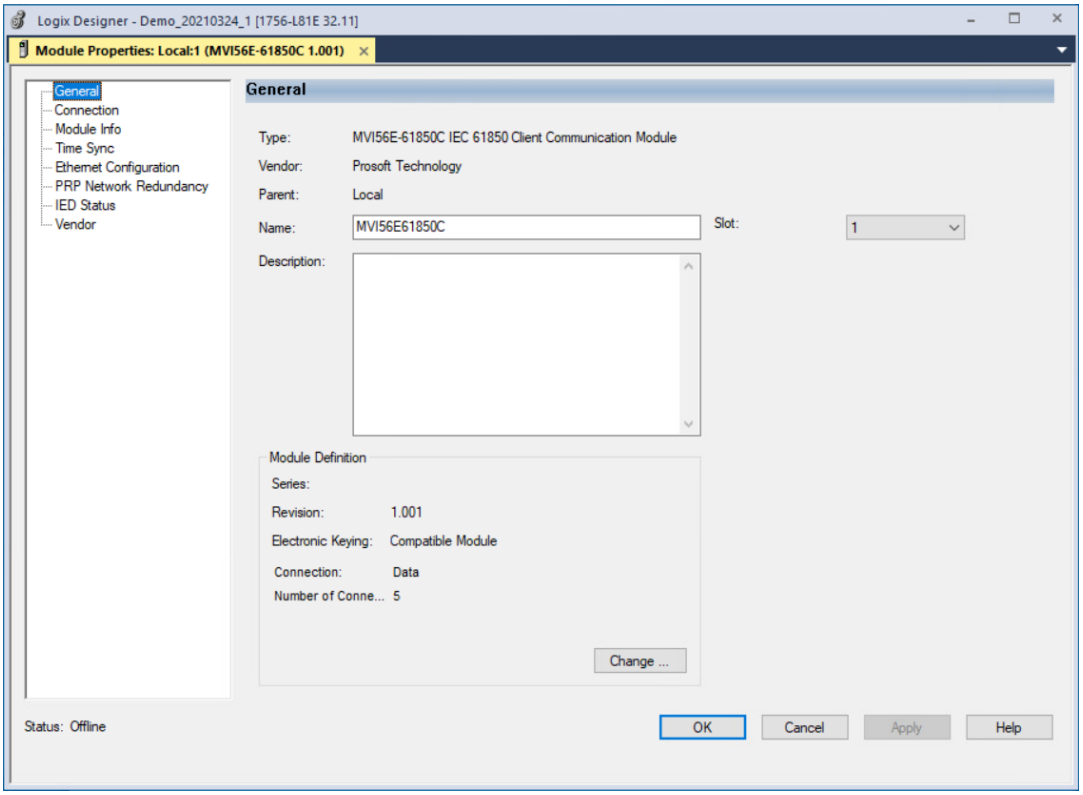
7 Click **YES** to confirm that you want to change the module definition.



Note: In some cases, it may take some time for the AOP to process the changes made to the module definition.

The *General* tab of the *Module Properties* dialog box displays again. Note that the *Number of Connections* field has been updated to the number of connections set by the Configuration Manager.

Note: Configuration Manager automatically calculates the number of connections required by the mapping you created.



8 Click **OK** to close the *Module Properties* dialog box.

4.1.12 Files Generated by the MVI56E-61850C Configuration Manager

When you save a configuration project, the MVI56E-61850C Configuration Manager generates the following files in the directory that you specify.

Project backup files (.cfg, .tlz, .xml, .prj, .prx, .db, .cid)

These files are required if you need to contact ProSoft Technical Support. The support engineer may request these files to evaluate your application configuration. If you want to move the project to another computer, you will need the PRJ file as well as the IED CID files.

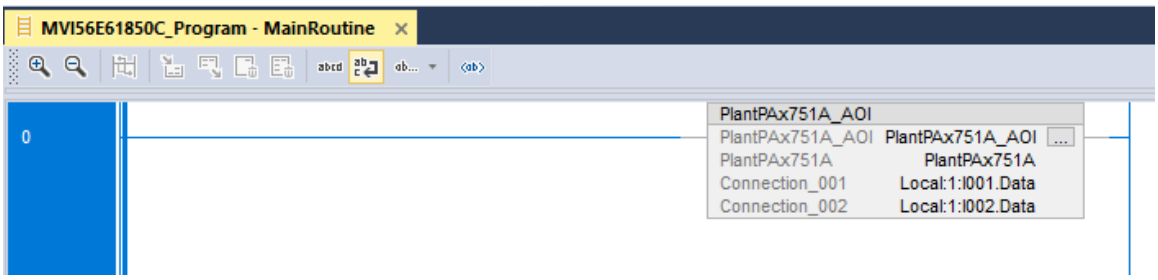
The .cid file will be exported by Configuration Manager only if GOOSE Publish is configured.

MVI56E-61850C Program (.L5X)

The MVI56E-61850C Program is the .L5X file generated by the ProSoft MVI56E-61850C Configuration Manager. This file is required by Studio 5000 to copy the user-defined tags that store the report data received by the IEDs.

The MVI56E-61850C Program contains the following:

- An Add-On Instruction is included for each IED. Following is one example of an Add-On Instruction associated with a configured IED:



  The Add-On instruction includes the logic used by Studio 5000 to copy the report data from the normal priority connections to the IED's user-defined tag.

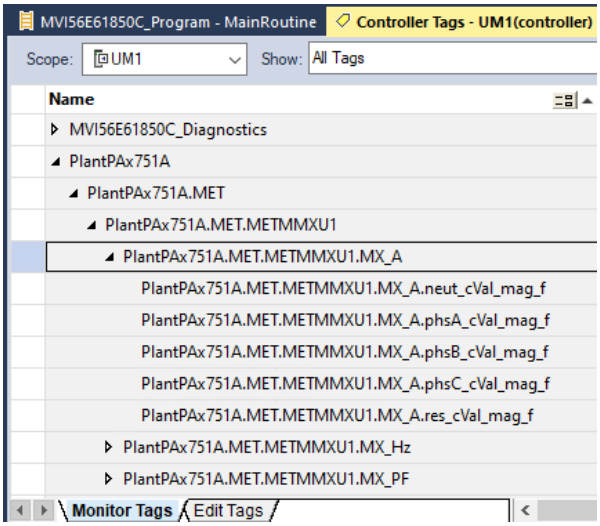
- For each configured IED, the MVI56E-61850C Program also contains a single user-defined tag that stores all report and MMS data for that IED. The IED tag follows the following syntax:

  [IED].[LD].[LN].[FC]_[DO].[DA]

  LD – Logical Device
  LN – Logical Node
  FC – Functional Constraint
  DO – Data Object
  DA – Data Attribute

  For example, if the phase A current value is selected from the IED PlantPAx751A, the controller tag will have the following syntax:
  PlantPAx751A.MET.METMMXU1.MX_A.phsA.cVal_mag_f

The following is an example of an IED tag:



- The MVI56E-61850C Program file also contains the Diagnostics Add-On Instruction, which includes the diagnostics tags used to monitor module operation. See section 8.3, "Diagnostics Controller Tags," on page 107 for descriptions of these tags.

Configured IED Description (CID) file (.CID)

This file is generated only if you configured the GOOSE Publish feature. The CID file can be imported into the IED vendor configuration software to allow the remote device to subscribe to the GOOSE messages published by the MVI56E-61850C module.

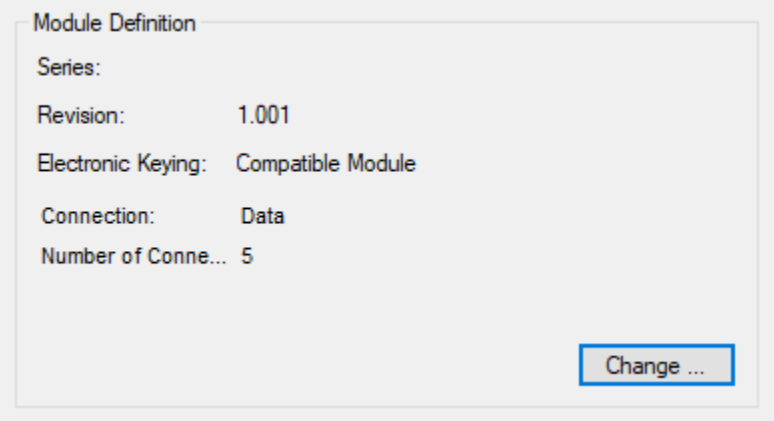
4.2 Configuration in Studio 5000 Logix Designer

The following subsections explain module configuration that takes place in Studio 5000 Logix Designer.

4.2.1 Data Mapping Over the Backplane Connections

Data is transferred between the ControlLogix processor and the MVI56E-61850C module through the backplane connections. Each backplane connection supports up to 500 input bytes and 496 output bytes. The module supports up to 225 backplane connections.

The selected IEC 61850 data is automatically mapped over the backplane connections. Once you export the configuration to the MVI56E-61850C Add-On Profile, you can open the *Module Properties* dialog box and look in the *Module Definition* section of the *General* tab to see the number of backplane connections automatically created for your application:

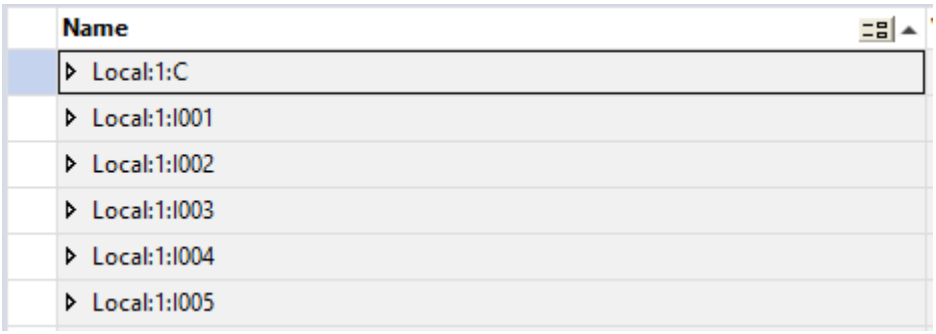


The selected data is mapped into two types of connections—normal priority data and high priority data, as follows:

IEC 61850 Data	I/O	Backplane Connection Priority	Default RPI Time
Report	Input	Normal priority connection	250 ms
MMS Read Command	Input	Normal priority connection	250 ms
GOOSE Subscribe	Input	High priority connection	4 ms
Control (MMS Write Command)	Output	High priority connection	4 ms
GOOSE Publish	Output	High priority connection	4 ms

All high priority connections are set by default with the RPI time as 4 ms, while the normal priority connections are set with the RPI time as 250 ms by default.

You can refer to the backplane connections in the *Controller Tags* editor in Studio 5000 Logix Designer:



Each backplane connection name uses the following syntax:

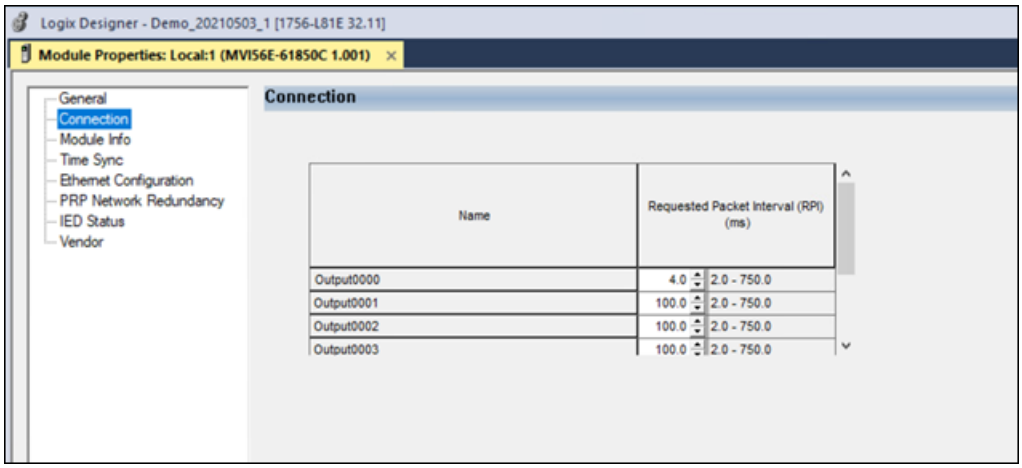
[Local/Remote]:[Slot Number]:[Connection Number]

The backplane connections are grouped based on priority category. The first backplane connections are always set as high priority connections, while the remaining backplane connections are set as low priority connections.

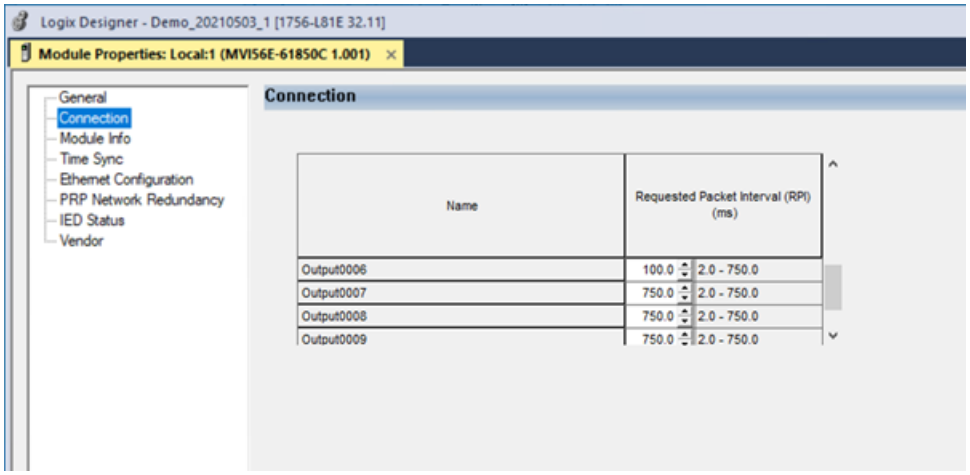
You may refer to the Add-On Profile (*Module Properties* > *Connection*) to view the backplane connections created for your application. You can recognize the backplane priority category based on the requested packet interval (RPI) timing.

Note: The RPIs are managed by the Configuration Manager software and should not be changed on the *Connection* tab.

For the example below, the first connection is a high (only) priority connection (RPI time = 4 ms), while the subsequent connections are normal priority connections (RPI time = 100 ms).

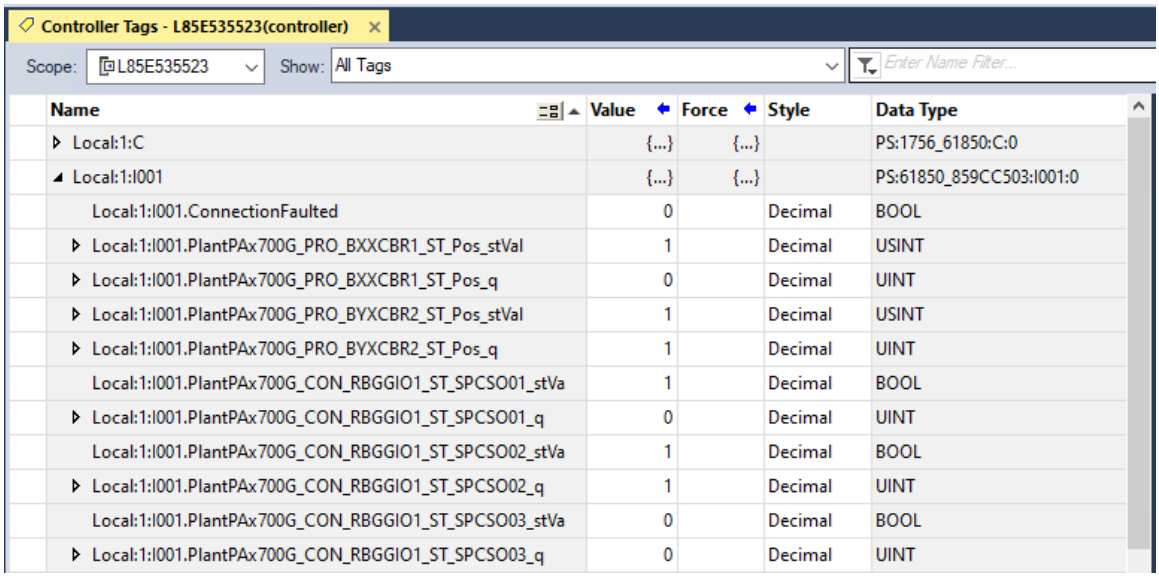


After the normal priority connections, there may be spare connections set with an RPI timing of 750 ms. The spare connections are not used for data communication.



4.2.2 Accessing GOOSE and Control Data

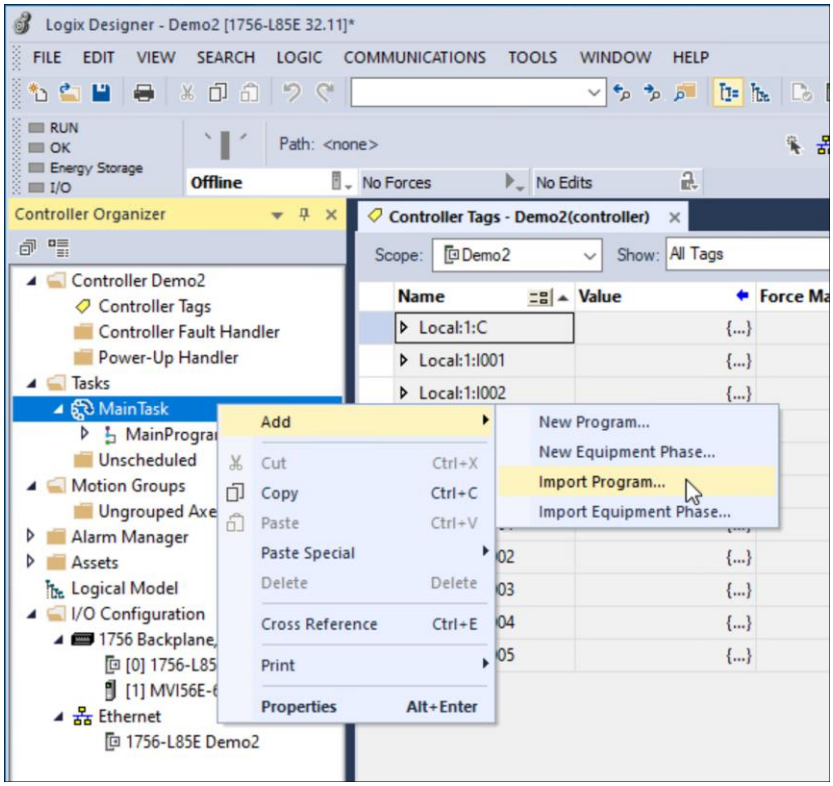
The GOOSE and control data tags can be monitored directly at the high priority connections:



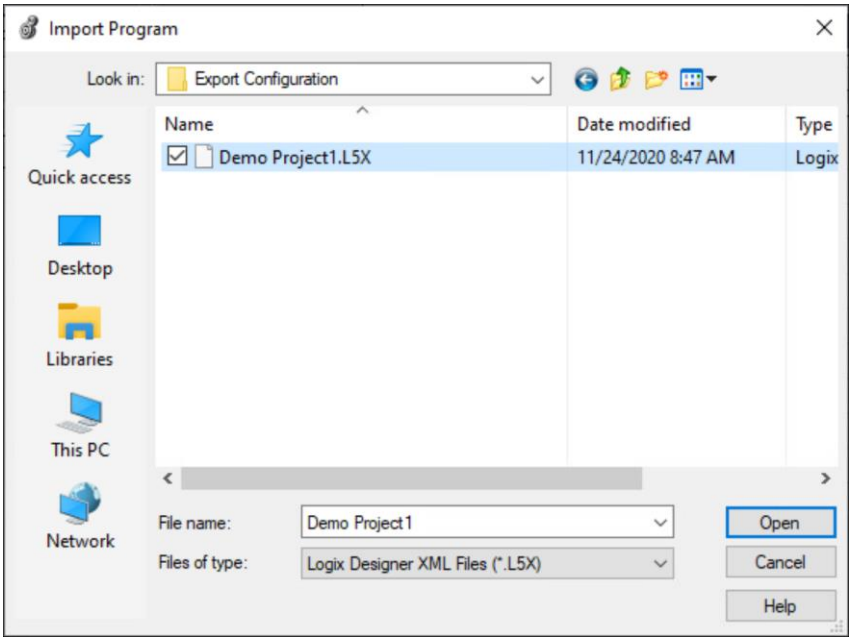
The report and MMS read command data tags are copied from normal priority connections to controller tags defined by the MVI56E-6180C program exported by the Configuration Manager software. The process of importing the MVI56E-61850C program into Studio 5000 is described in the following section.

4.2.3 Import the MVI56E-61850C Program into Studio 5000 Logix Designer

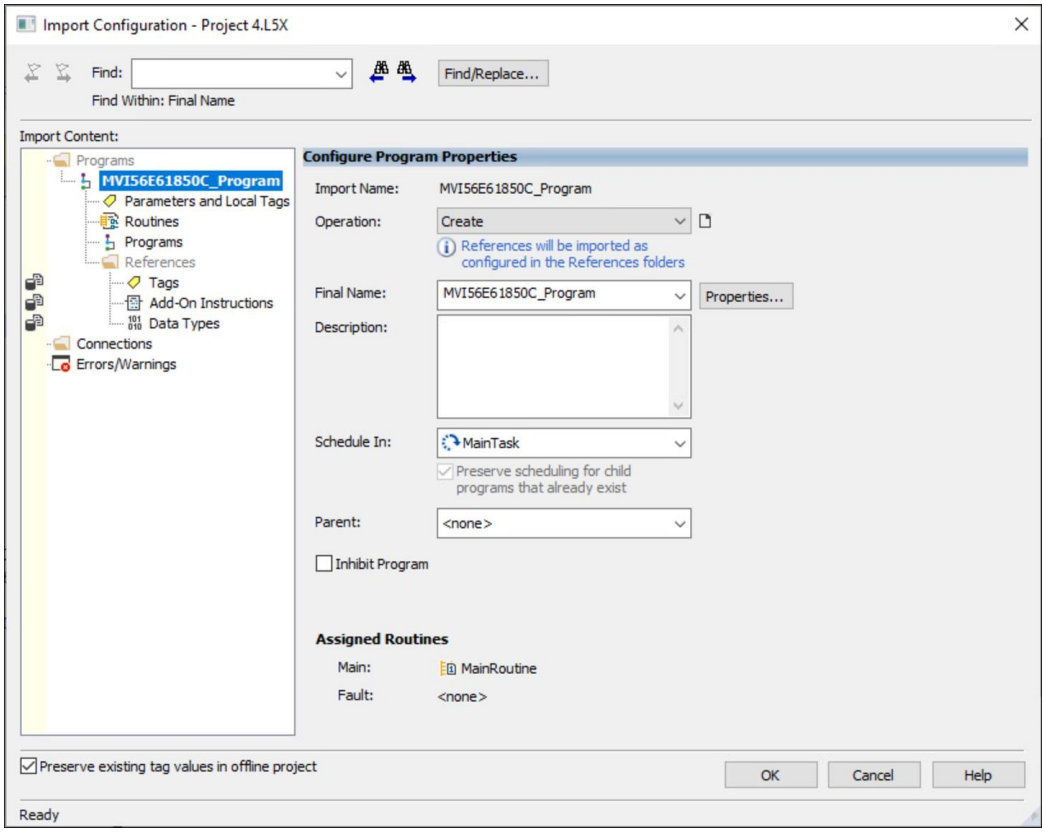
1 In the *Tasks* section of the *Controller Organizer*, right-click **MAIN TASK** and select **IMPORT PROGRAM**.



2 In the *Import Program* dialog, select the Logix5000 XML (.L5X) file that you exported from the Configuration Manager and click **OPEN**.

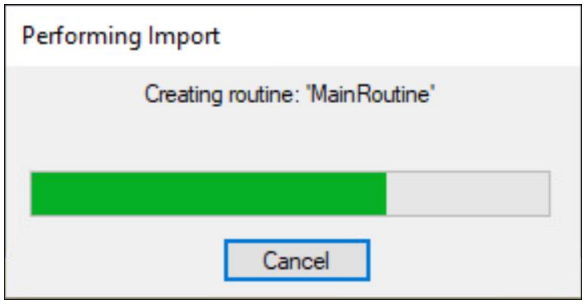


Logix Designer begins importing the program, and the *Import Configuration* window displays.



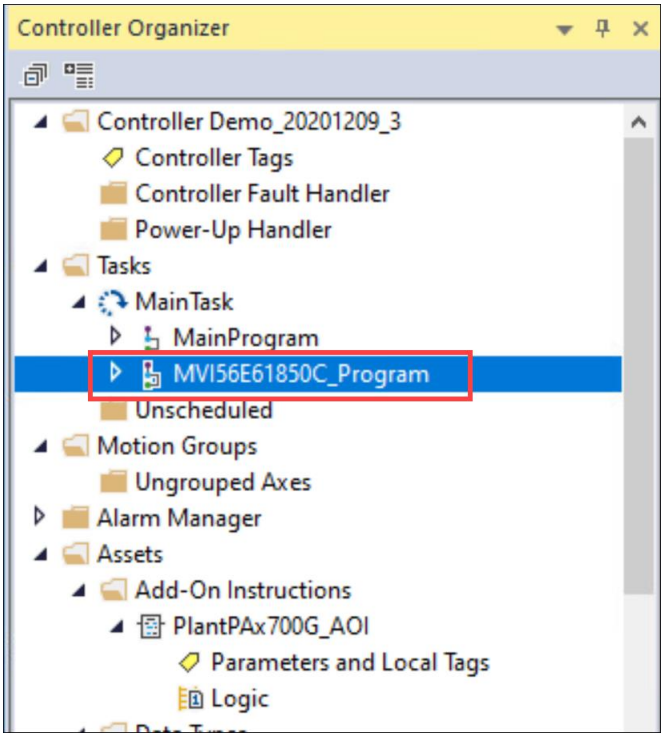
3 Click **OK**.

Logix Designer completes the import of the program. This may take a few moments.



Note: If any errors or issues occur during the import, they will display in the pane at the bottom of the Logix Designer window.

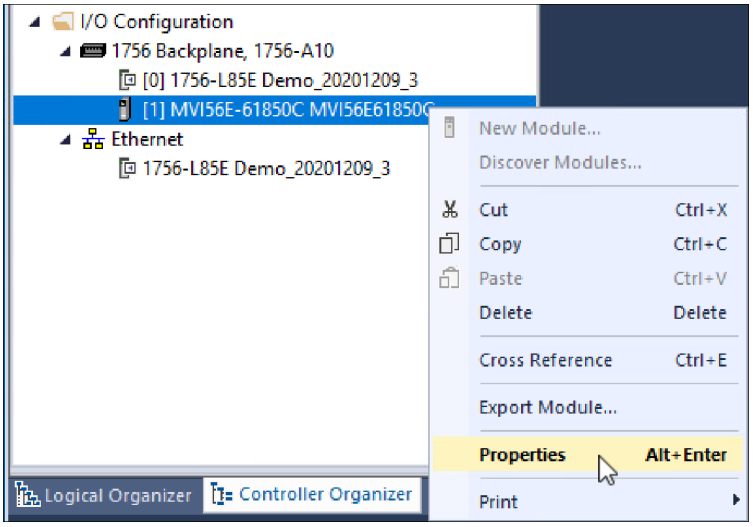
The imported program displays under the Main Task in the *Controller Organizer*.



4.2.4 Updating and Reimporting a Project

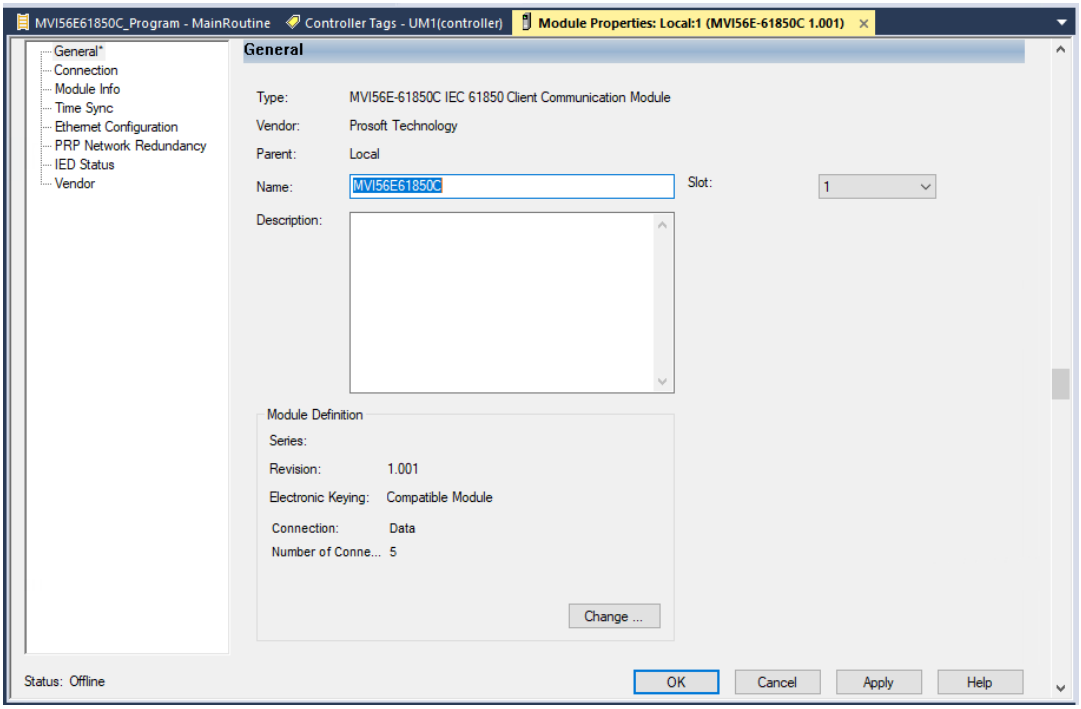
If you need to modify the configuration of the IEDs in the 61850 network, take the following steps to update and reimport the project.

1 In the *I/O Configuration* section of the *Controller Organizer*, right-click the MVI56E-61850C module and select **PROPERTIES**. (Or just double-click the module.)



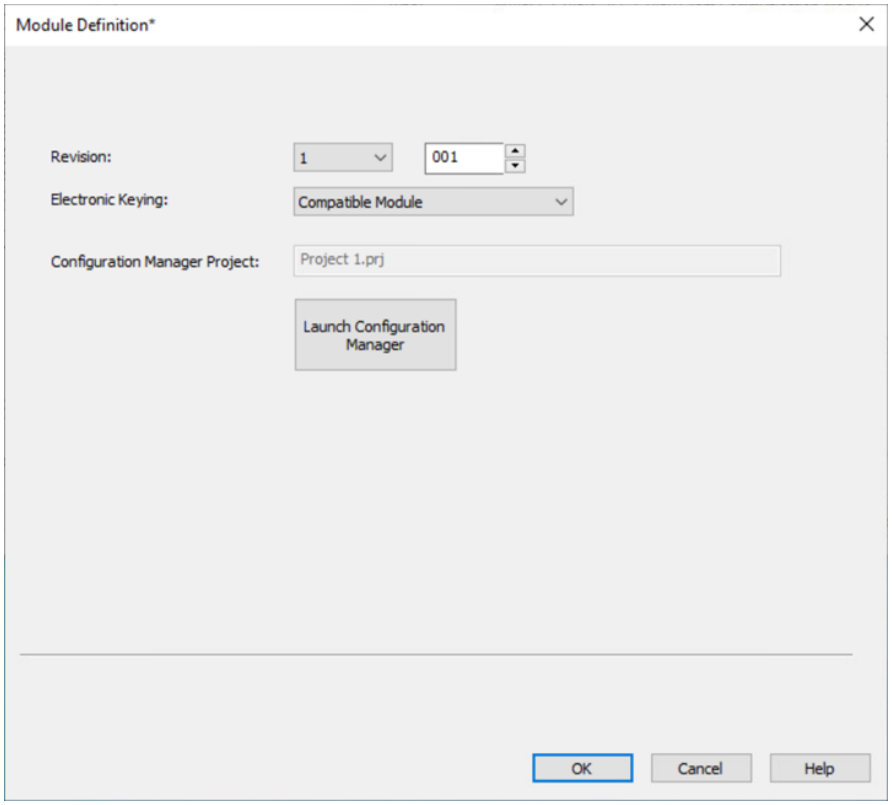
The *General* tab of the *Module Properties* dialog box displays.

2 In the *Module Definition* area, click **CHANGE**.



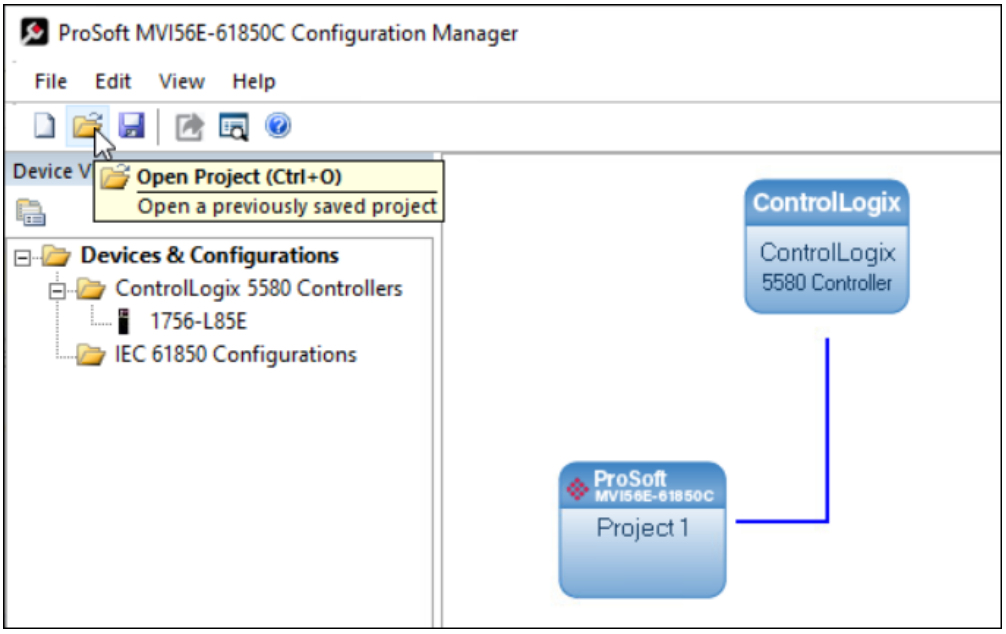
The *Module Definition* window displays.

3 Select **LAUNCH CONFIGURATION MANAGER**.

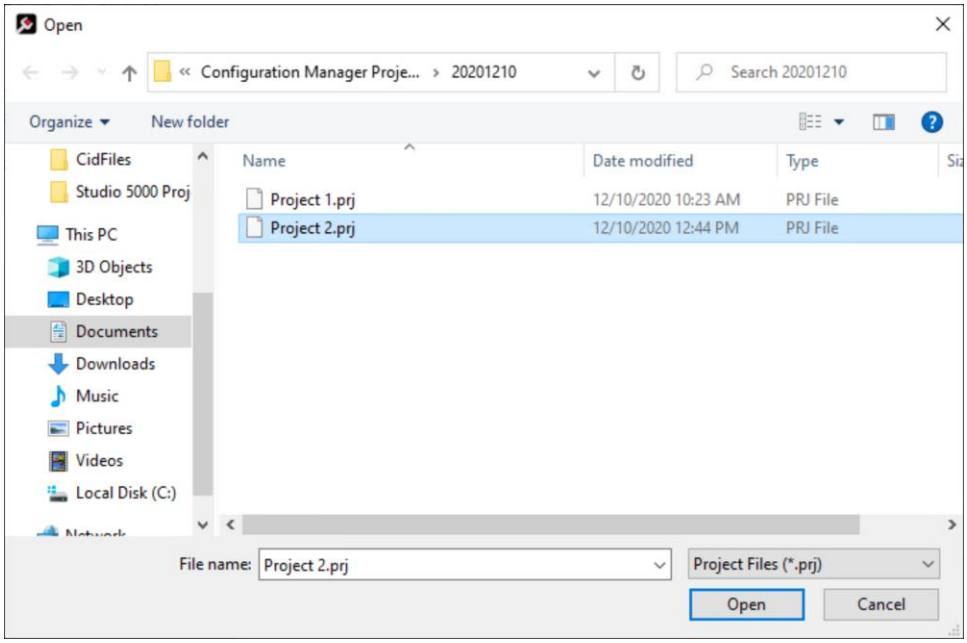


After a brief pause, the Configuration Manager displays.

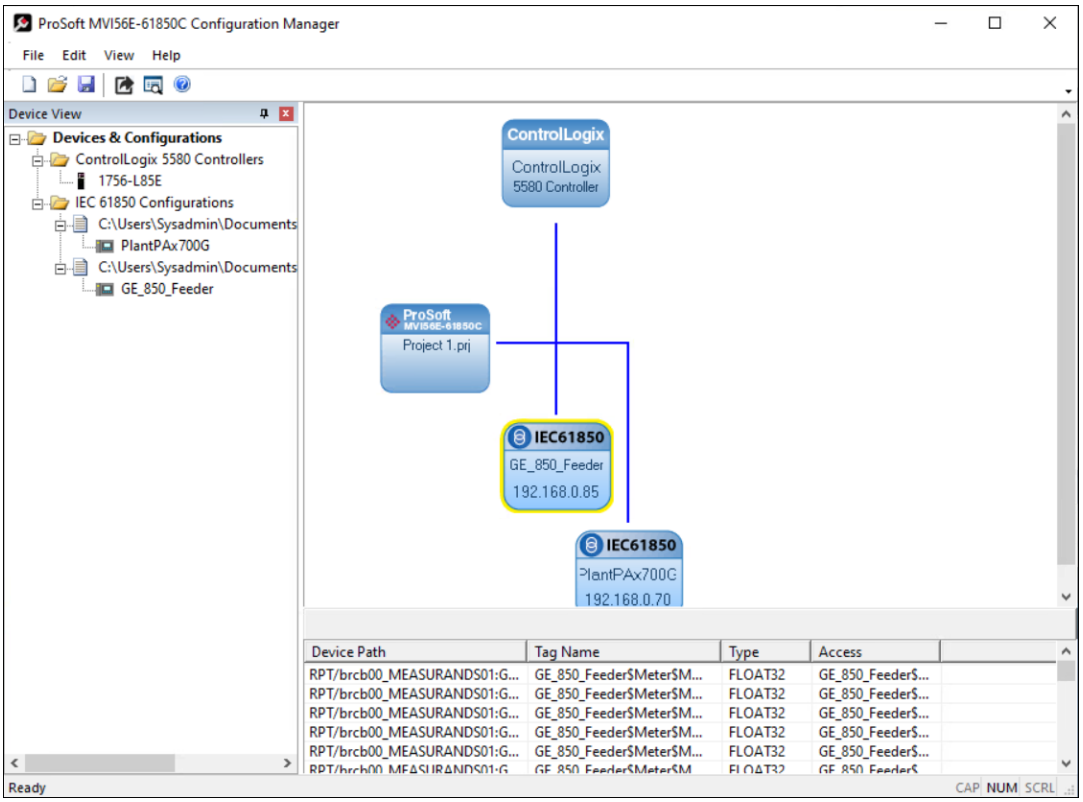
4 Click the **OPEN PROJECT** icon.



5 In the *Open* dialog box, select the Configuration Manager project you wish to update and click **OPEN**.



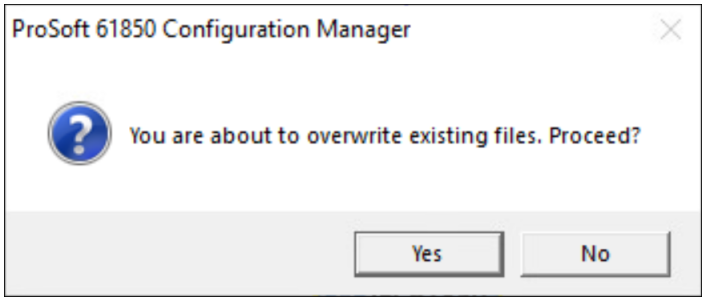
The Configuration Manager opens the project.



6 Edit the configuration as you see fit. For help with this, see "Configure the IED Network" on page 28 and "Map Data Attributes for the IEDs" on page 30.

7 Export the configuration by taking the steps in "Export the Configuration to the Add-On Profile" on page 59. During the export, the Configuration Manager will ask if you want to overwrite the PRJ file and the CFG file. Select **YES** in both cases.

The Configuration Manager will display an additional dialog asking you to confirm the deletion. Click **YES**.



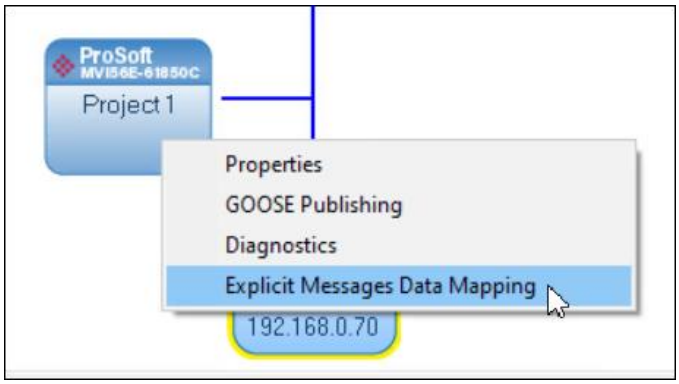
8 Reimport the project into Studio 5000 Logix Designer by taking the steps in section 4.2.3. In the *Import Configuration* dialog, you will need to select *Overwrite* for the *Operation* parameter to update the changes in the existing program.

4.2.5 Class 3 Explicit Messages

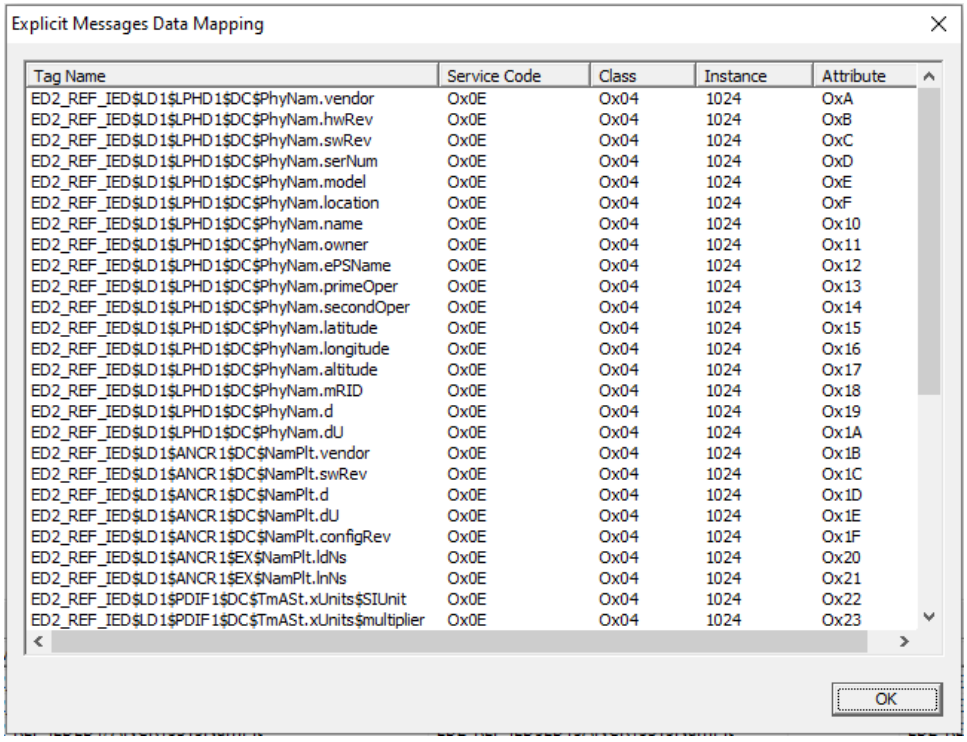
Certain IEC 61850 data attributes, such as strings and attributes with DC and EX functional constraints, are relatively large and infrequently updated. Because Class 1 connections have a limited size (500 bytes input) and involve continuous data transfer, these data attributes are better suited to Class 3 explicit messages rather than Class 1.

The ProSoft MVI56E-61850C Configuration Manager does not generate Class 3 messages, so you must create these in Studio 5000. The *Explicit Messages Data Mapping* window provides information you need to create the Class 3 messages.

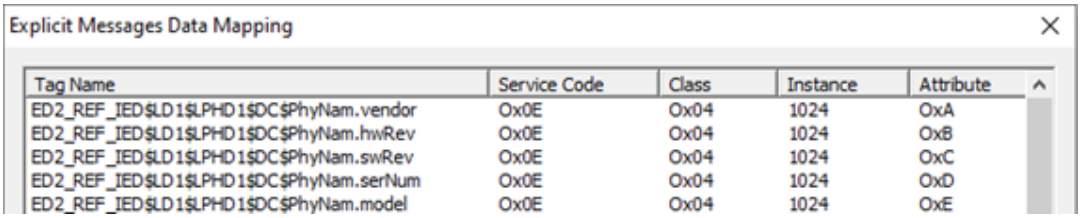
After completing the IEC 61850 data mapping with the ProSoft MVI56E-61850C Configuration Manager, you can access the *Explicit Messages Data Mapping* window by right-clicking the project bubble (labeled *ProSoft MVI56E-61850C*) and selecting **EXPLICIT MESSAGES DATA MAPPING**.



The *Explicit Messages Data Mapping* window appears as follows:

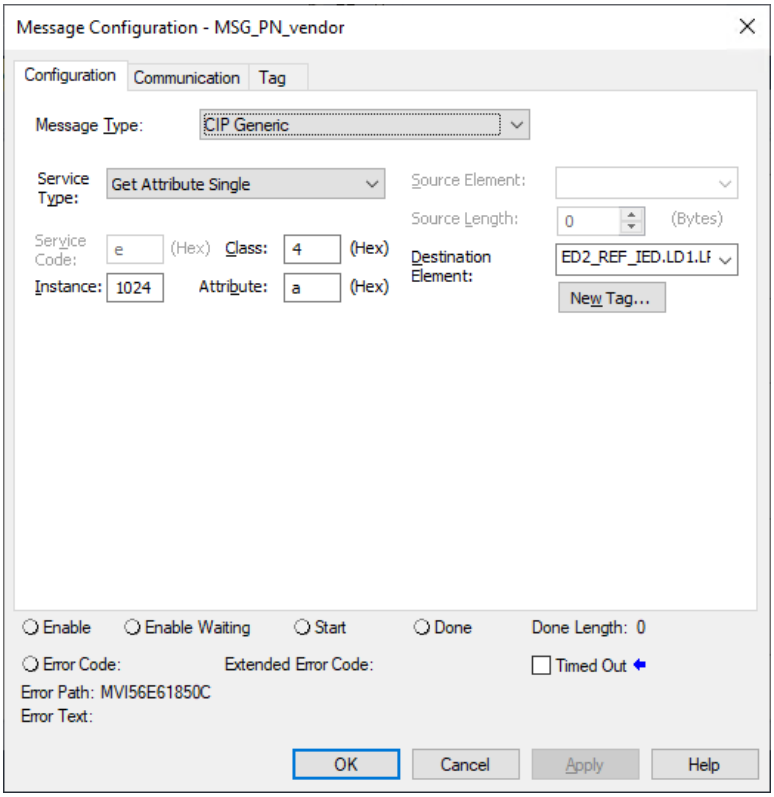


For example, suppose we wanted to create a class 3 message to poll the first data attribute in the following screen capture (*PhyNam.vendor*):



1 In Studio5000 Logix Designer, create a MESSAGE tag and then create the ladder logic with the message instruction to poll the vendor tag.

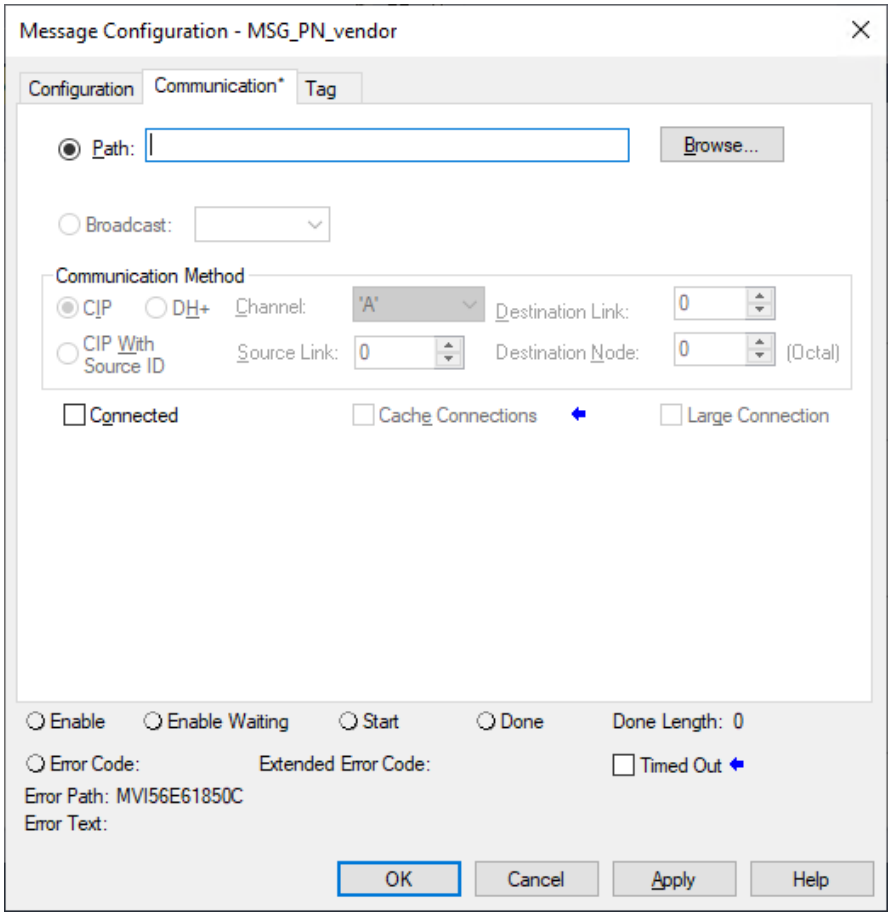
2 Configure the message tag as follows according to the *Explicit Messages Data Mapping* windows settings.



Note: All messages must be set with a *Service Type* of *Get Attribute Single* (*Service Code* = E hex).

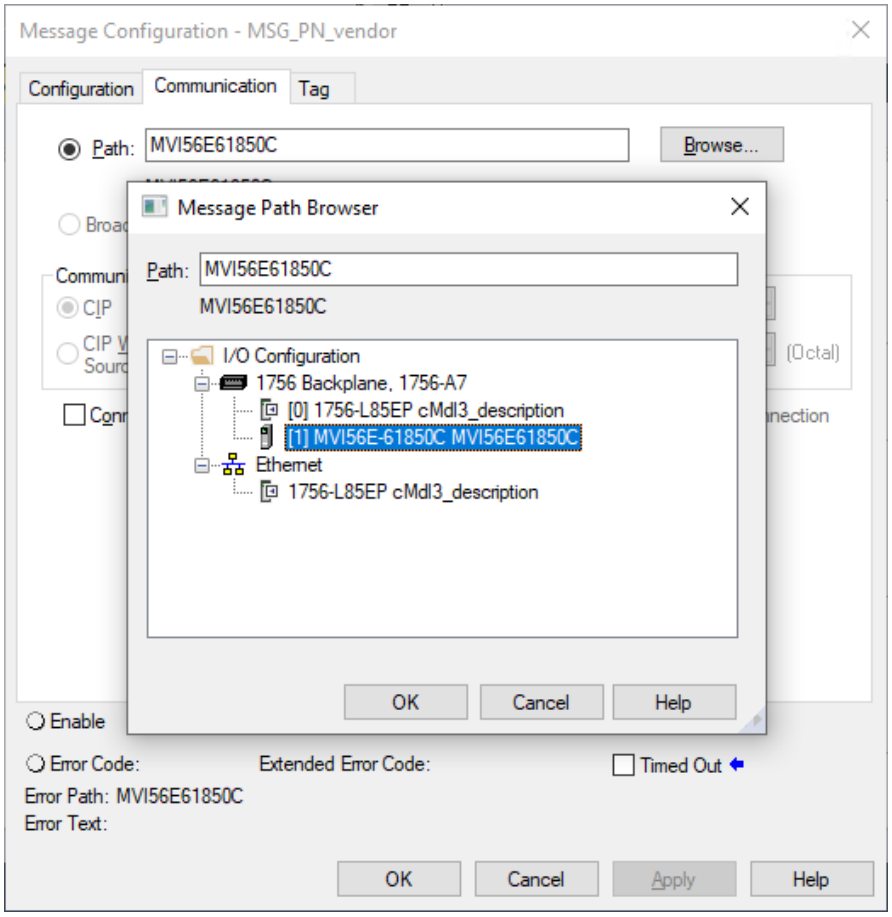
The destination element must match the Studio 5000 data attribute tag (in this example, ED2_REF_IED.LD1.LPHD1.DC_PhyNam.vendor).

3 Select the *Communication* tab.

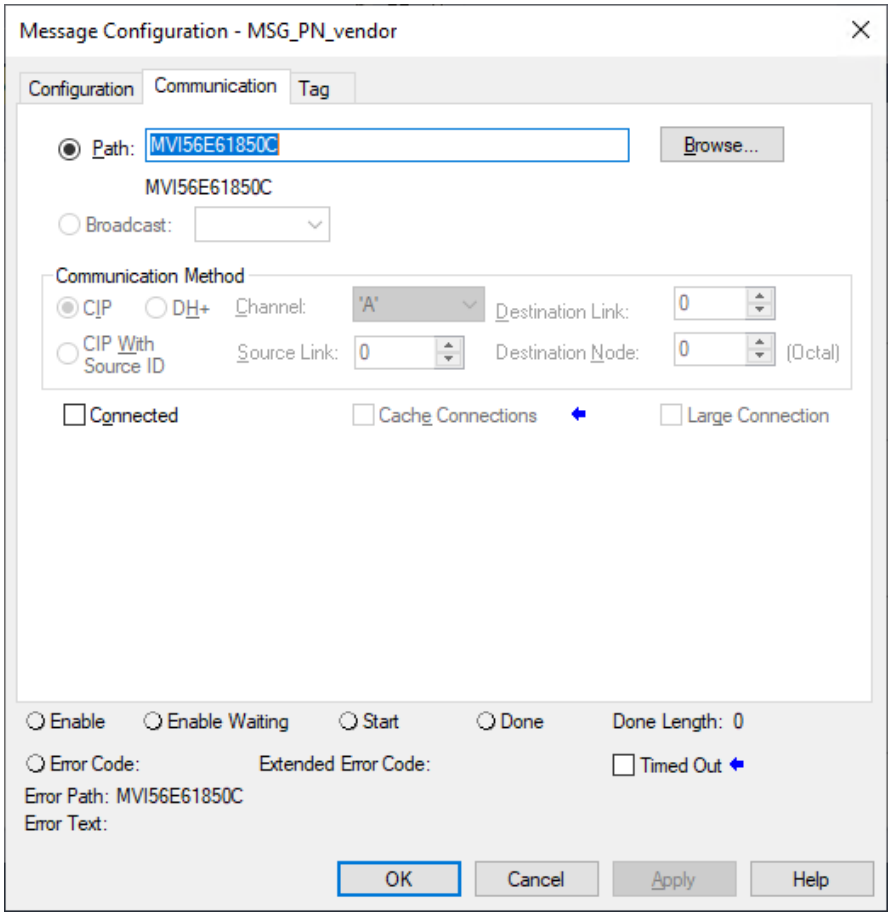


4 Click **BROWSE** to open the *Message Path Browser* dialog.

5 Select the MVI56E-61850C module and then select **OK**.



The *Message Configuration* dialog redisplays with the module appearing in the *Path* field.



6 Click **OK**.

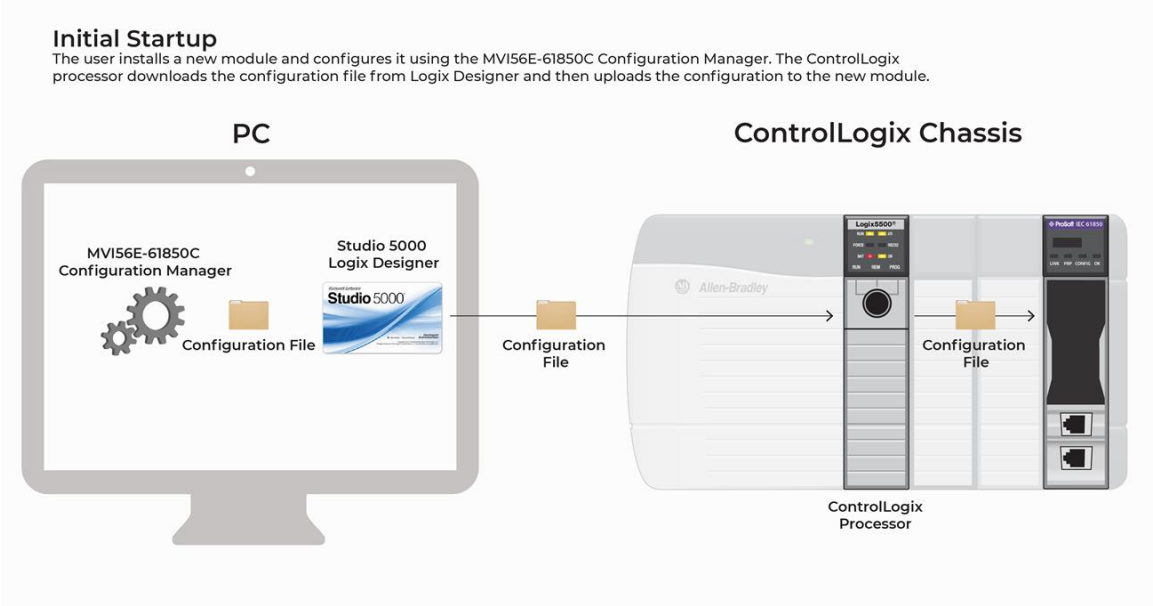
5 Automatic Device Replacement (ADR)

The MVI56E-61850C module supports automatic device replacement (ADR). This feature allows for the automatic configuration of a new MVI56E-61850C installed in place of a failed module, reducing the potential for downtime and errors typically associated with such a replacement.

As explained in "Configuring the MVI56E-61850C Module," the MVI56E-61850's configuration file resides in the ControlLogix processor. Upon the MVI56E-61850C initialization, the module reads the configuration file stored in the ControlLogix processor before starting in operation mode. If a module fails and the user replaces it with a new one, the processor will transfer the same configuration to the new module. Within a matter of seconds, the new module will be configured and in operation without any user intervention.

Important: If you make any changes to the IEC 61850 network in the MVI56E-61850C Configuration Manager, remember to save the configuration and export it to the Add-On Profile. Otherwise, the ControlLogix processor could configure a newly installed replacement module with an out-of-date configuration file.

The user installs a new module and configures it using the MVI56E-61850C Configuration Manager. Studio 5000 Logix Designer downloads the configuration file to the ControlLogix processor, which then uploads the configuration to the new module.



6 Parallel Redundancy Protocol (PRP)

Note: For instructions on enabling PRP, see "Enable Parallel Redundancy Protocol (PRP)" on page 17.

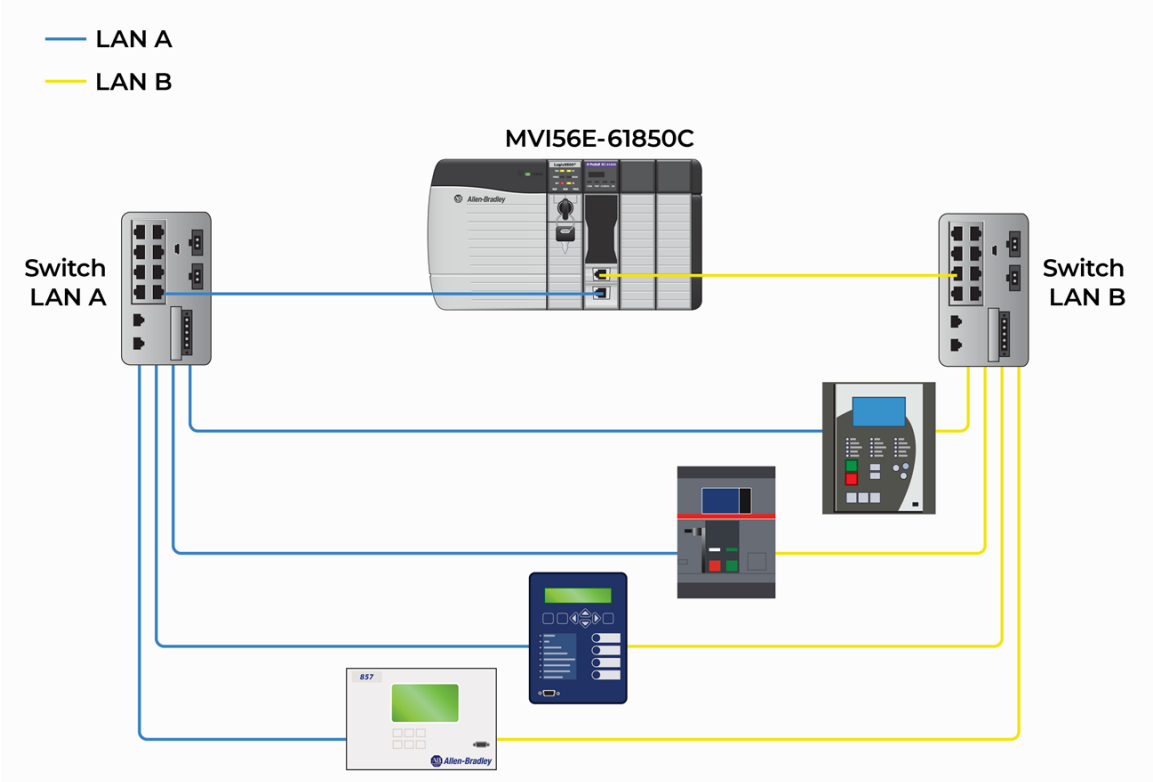
The MVI56E-61850C module supports Parallel Redundancy Protocol (PRP) according to standard IEC 62439-3:2016.

PRP mode eliminates the chance of disruption in operation in the event of a network issue by providing seamless redundancy for data traffic.

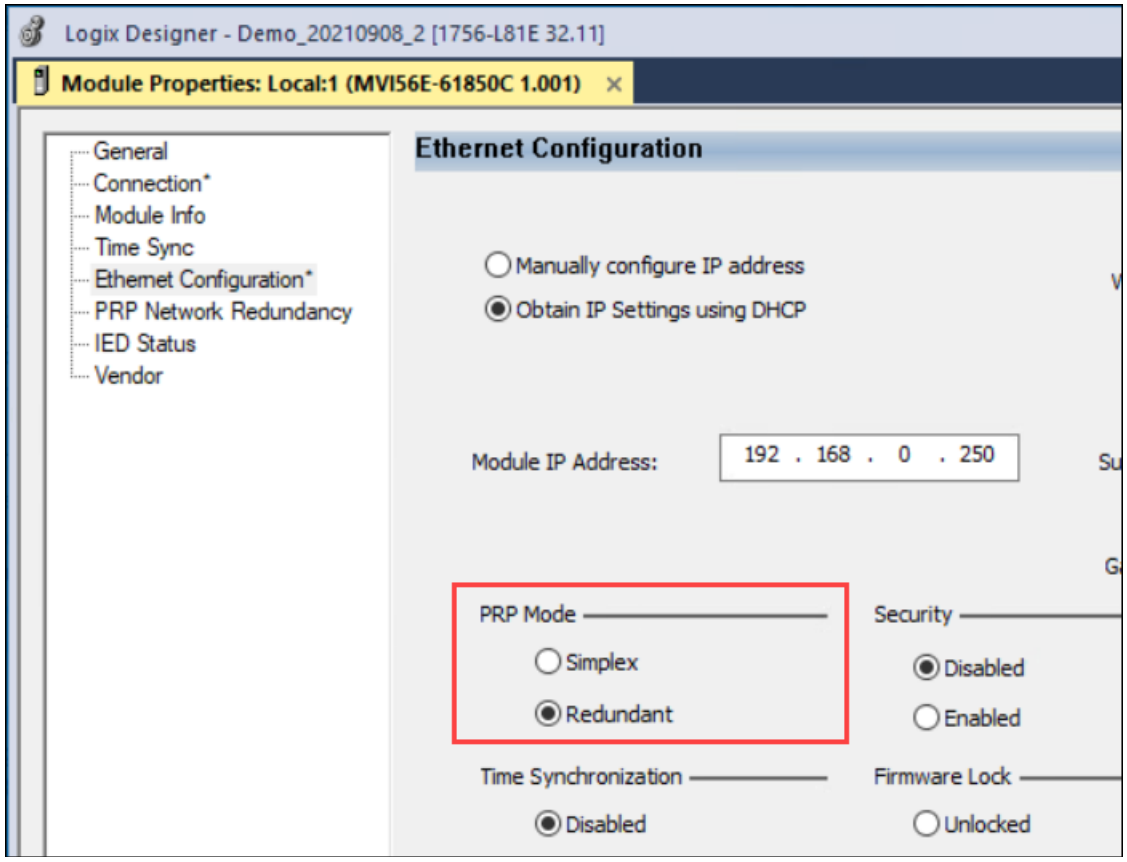
When PRP mode is enabled, the module's two Ethernet ports operate in parallel and connect to two independent networks, known as LAN A and LAN B. Both ports have the same MAC ID, IP address, subnet mask, and default gateway address.

The module simultaneously sends and receives duplicate Ethernet frames through both ports. When receiving frames, the module accepts whichever frame arrives first and discards the subsequent copy. If a failure occurs in one of the paths, data communication continues through the other path with no recovery time.

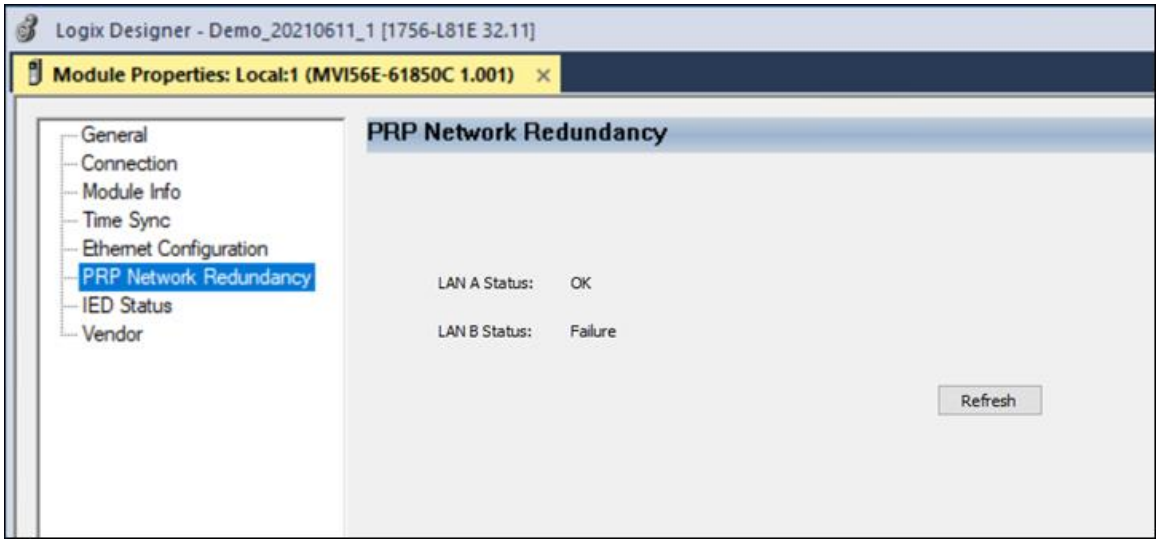
The following diagram illustrates the exchange of data between the MVI56E-61850C and remote IEDs when PRP mode is enabled:



You can enable PRP by setting *PRP Mode* to *Redundant* on the *Ethernet Configuration* tab of the *Module Properties* dialog box, as explained in "Enable Parallel Redundancy Protocol (PRP)" on page 17.



When PRP is enabled, you can the monitor the status of LAN A (Ethernet port 1) and LAN B (Ethernet port 2) on the *PRP Network Redundancy* tab of the *Module Properties* dialog box.



7 Time Synchronization

Note: This feature is always enabled over the backplane (between the ControlLogix processor and the MVI56E-61850C module). You can also enable time synchronization over Ethernet through the *Ethernet Configuration* tab of the MVI56E-61850C Add-On Profile.

7.1 Overview

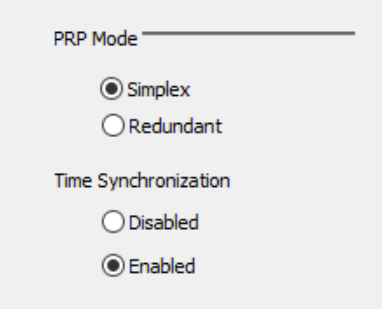
The MVI56E-61850C module supports the PTP Power Profile according to standard C37.238 Ed 2017 to propagate a time signal to the IEC 61850 network with peer-to-peer delay path mechanism.

The module supports time synchronization over three different ports: the backplane, Ethernet Port 1, and Ethernet Port 2 (if redundancy is enabled).

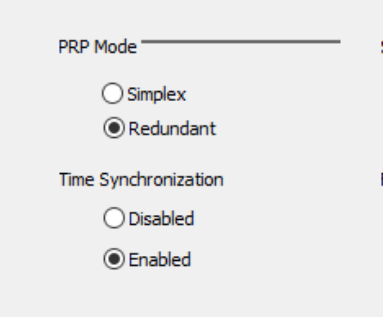
Time synchronization over the backplane is always enabled. If the MVI56E-61850C detects that the ControlLogix processor is the time master over the backplane, the module will automatically synchronize its clock based on the ControlLogix processor's time source.

You can configure time synchronization over Ethernet through the *PRP Mode* and *Time Synchronization* parameters in the Add-On Profile's *Ethernet Configuration* tab.

To enable time synchronization for Ethernet Port 1 only, configure these settings as follows (*PRP Mode* = *Simplex* and *Time Synchronization* = *Enabled*):



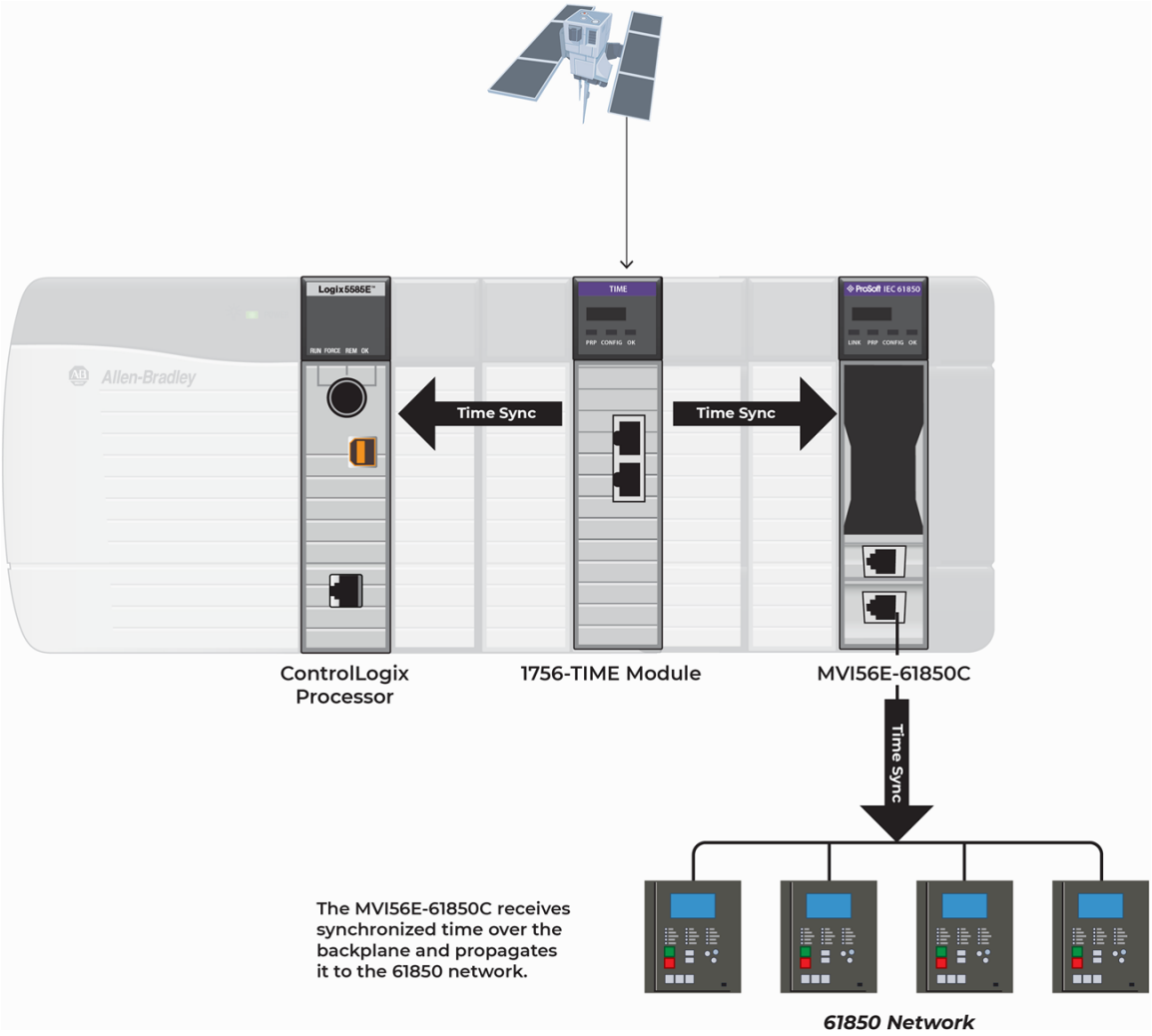
To enable time synchronization for both Ethernet ports (redundant mode), use the following configuration (*PRP Mode* = *Redundant* and *Time Synchronization* = *Enabled*):



If the Ethernet Time Synchronization parameter is disabled, the module will operate as an *ordinary clock* with a single port (backplane). The module can either operate as a time master or time slave in ordinary clock mode. If the module operates as a time master, the module becomes the time source over the backplane. If the module operates as a time slave, the time master device (for example, the ControLogix processor) will synchronize module time over the backplane.

If the Ethernet Time Synchronization parameter is enabled, the module will operate as a *boundary clock* with the backplane and Ethernet ports actively operating in time synchronization mode. In boundary clock mode, the module will pass the time received from the backplane to the Ethernet port or vice versa. In this case the MVI56E-61850C ports can have different time roles depending on whether the time master is located at the backplane or on the Ethernet network.

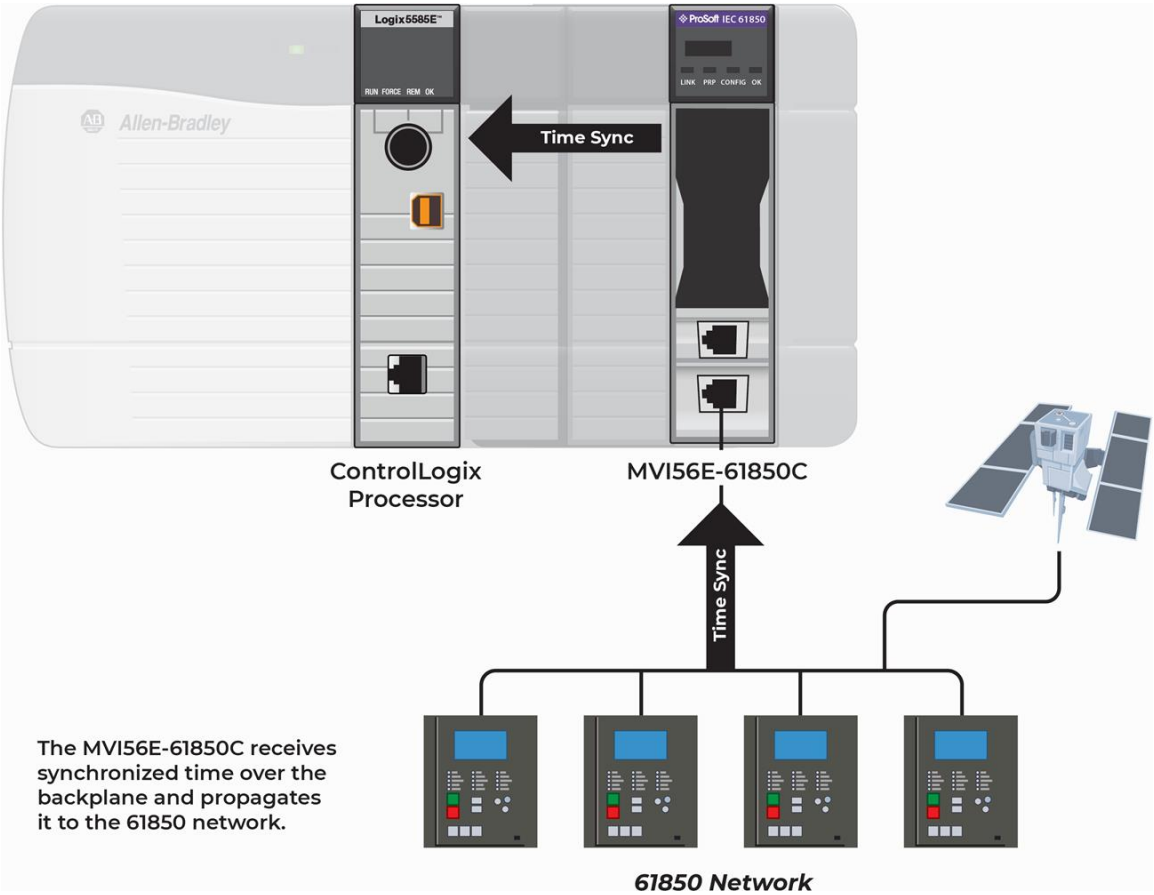
For example, the backplane port can operate as a time slave while the Ethernet port operates as a time master. This scenario is illustrated in the following diagram:



As shown in the diagram above, the 1756-TIME module is the time master by synchronizing time over the backplane. The MVI56E-61850C backplane port operates as a time slave, thus receiving the time source from the 1756-TIME card.

The time is passed to the MVI56E-61850C Ethernet port, which operates as a time master over the Ethernet network by synchronizing the IED clocks.

In case the MVI56E-61850C detects a better clock on the Ethernet network, it can automatically switch the port roles, so that the module's Ethernet port operates as a time slave receiving the time synchronization from another time master device on the Ethernet network. For this scenario, the backplane port operates as a time master synchronizing the other devices over the backplane.



7.2 Diagnostics

The *Time Sync* tab of the *Module Properties* dialog box displays diagnostics information related to the Time Synchronization feature of the module. For details see "Time Synchronization Diagnostics" on page 114.

8 Diagnostics and Troubleshooting

There are multiple ways to troubleshoot the MVI56E-61850C module:

- Use the LEDs located on the front of the module. See "LED Diagnostics" below for more information.
- Use the MVI56E-61850C Diagnostics Tool. See "ProSoft MVI56E-61850C Diagnostics Tool" on page 87.
- The MVI56E-61850C Add-On Profile displays diagnostics data in Studio 5000 Logix Designer. See "Diagnostics in the MVI56E-61850C Add-On Profile" on page 112
- Use the *Controller Tags* dialog in Studio 5000 to view tags related to diagnostics.

8.1 LED Diagnostics

8.1.1 Operating Status LEDs

The MVI56E-61850C provides four diagnostic LEDs, as shown in the following image:

The LEDs indicate the operating status of the MVI56E-61850C as follows:

LED	Indication	Off	Red	Green	Amber
LINK	Connection established with the configured IEDs	Power OFF No IEDs connected	Loss of all IEDs	**Solid:** All configured IEDs connected **Blinking:** Some IEDs connected	N/A
PRP	Module is operating in Redundant/PRP mode	Power OFF Not in PRP mode	Loss of LAN A and LAN B	PRP mode, LAN A and LAN B active	Lost link, LAN A or LAN B
CONFIG	Configuration error detected	Power OFF	Configuration error	Configuration OK	N/A
OK	Module running	Power OFF	**Solid:** Major fault **Blinking:** Minor fault	**Solid:** Normal operation **Blinking:** I/O not active	N/A

8.1.2 Ethernet LEDs

The link speed and status LEDs are driven directly by the Ethernet controllers. There is no user control. The following table explains their function:

LED Function	LED Color	LED State	Description
Link Speed	Green/Orange	Off	10 Mbps link speed
		Green	100 Mbps link speed
		Orange	1000 Mbps link speed
Link Status and Activity	Yellow	Off	No Link
		Steady On	Link established; no activity detected
		Blinking	Link established; activity detected

8.1.3 Scrolling LED

The following information is displayed during module operation or initialization:

Display Characters	Description	State	Examples
Boot/DDOK	Module is initializing	Initialization	Boot/DDOK
Waiting for Processor Connection	The module is waiting to connect to the ControlLogix processor	Initialization	Waiting for Processor Connection
Waiting for Configuration	Module is waiting for required module configuration data from the Controller	Initialization	Waiting for Configuration
Last Config <Date>	Last date/time the module was configured	Initialization	Last Config 2019-10-23
Project File <Name>	File name of project files stored on module	Operation	Project file Filename.prx
BP <Backplane Status>	OK: Module is communicating with the processor ERR <code>: Module is unable to communicate with the processor	Operation	BP OK BP ERR 99
<IP Address>	Module IP Address	Operation/Error	192.168.0.250
If DHCP is enabled:			
Waiting for IP	DHCP – MAC – [MAC Address]	Operation	DHCP – MAC – 192.168.0.250
After IP is set	DHCP – IP – [IP Address]	Operation	DHCP – IP – 00:0D:8D:00:10:A3

8.2 ProSoft MVI56E-61850C Diagnostics Tool

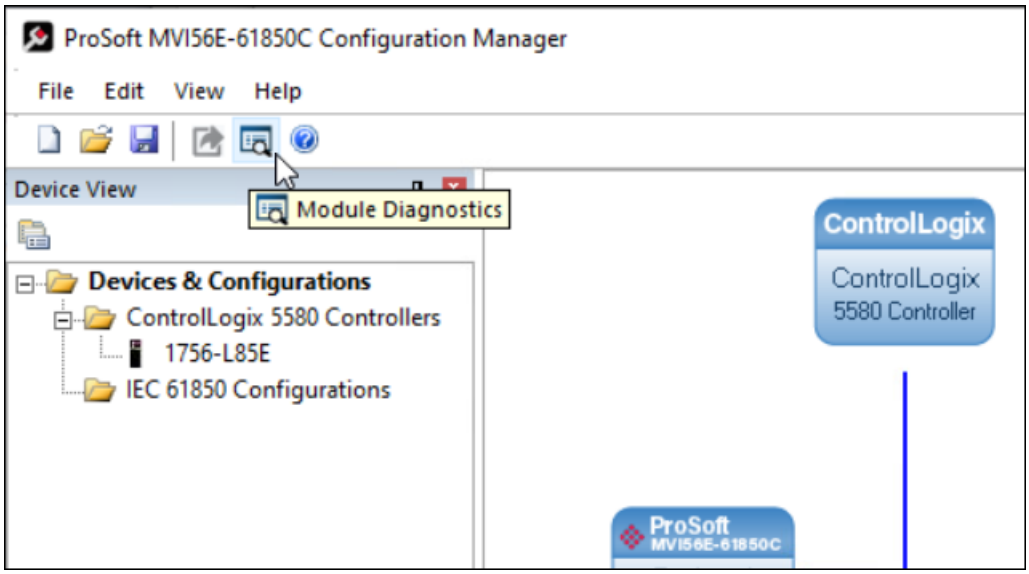
8.2.1 Diagnostics Tool Overview

The ProSoft MVI56E-61850C Diagnostics Tool is a standalone Windows application that displays diagnostics data and timestamped events.

Note: You must run the Diagnostics Tool on a computer connected to the IEC 61850 network, as the diagnostics data will be polled directly from the MVI56E-61850C module's Ethernet port.

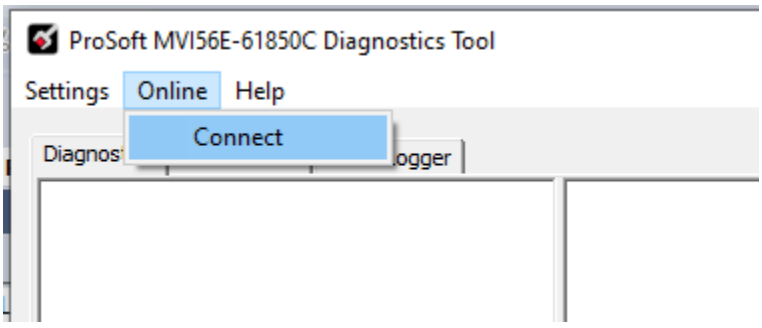
To launch the Diagnostics Tool and connect to the module:

1 Select the **MODULE DIAGNOSTICS** icon from the MVI56E-61850C Configuration Manager menu bar.

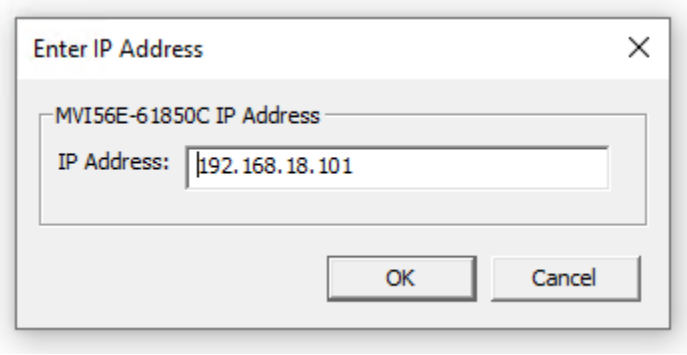


Tip: The Diagnostics Tool can also be launched from the Windows **START** menu.

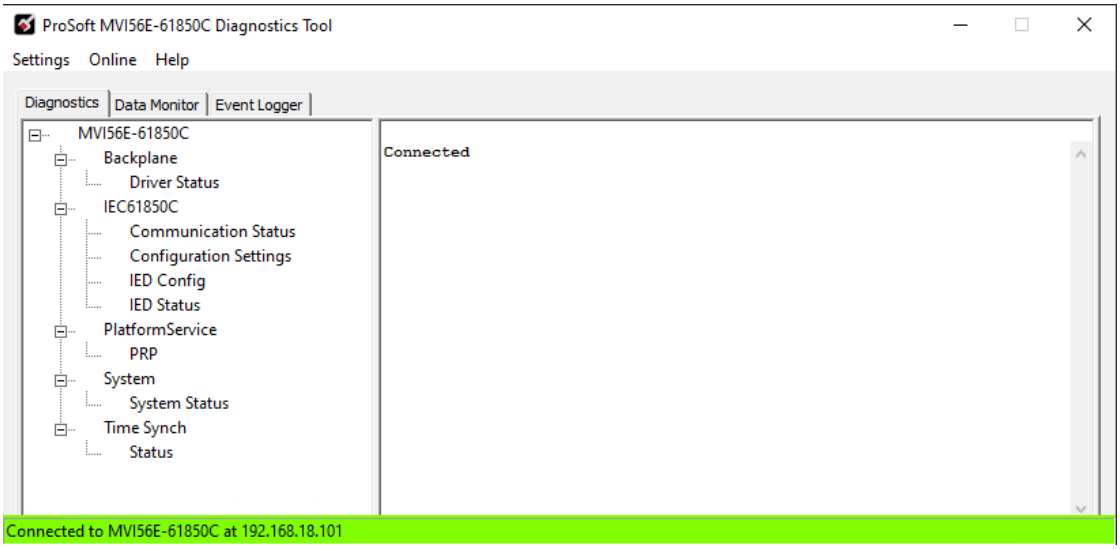
2 From the **ONLINE** menu, select **CONNECT**.



3 Enter the MVI56E-61850C module's IP address and click **OK**.



Once the Diagnostics Tool connects to the MVI56E-61850C module, the Diagnostics menu structure displays in the left pane of the window.
The status of the connection to the module is indicated in the status bar at the bottom of the window and in the right pane of the window.



The Diagnostics Tool provides the following three categories of diagnostics data, each appearing on a separate tab in the tool:

- *Diagnostics*
  The Diagnostics tab includes the configuration settings and data communication status information. You can monitor different aspects of the IEC 61850 data communication, such as which IEDs are connected to the module and which reports have been successfully subscribed.
- *Data Monitor*
  The *Data Monitor* tab allows you to monitor the configured tag data values. You can select and monitor any configured report, GOOSE Subscribe, control or MMS read tag.
- *Event Logger*
  The *Event Logger* tab allows you to monitor timestamped events logged by the module, including IED disconnection, IED connection, and report subscription failure.

These three tabs are explained in the following subsections.

8.2.2 Diagnostics Tab

The *Diagnostics* tab displays configuration and diagnostics data grouped into the following categories:

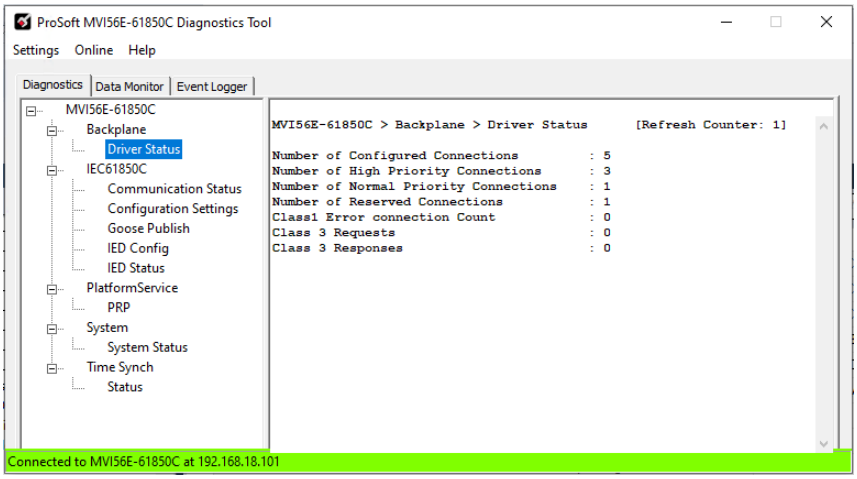
- Backplane
- IEC61850C
- PlatformService
- System
- Time Synch

These categories appear in the Diagnostics menu structure in the left pane of the window. Under each category is one or more subcategories that you can select to view the associated data.

Following are descriptions of these categories and their subcategories.

Driver Status

The *Driver Status* screen (*Backplane* > *Driver Status*) shows the data communication status between the MVI56E-61850C module and the ControlLogix processor.



The following table describes the data displayed on the *Driver Status* screen:

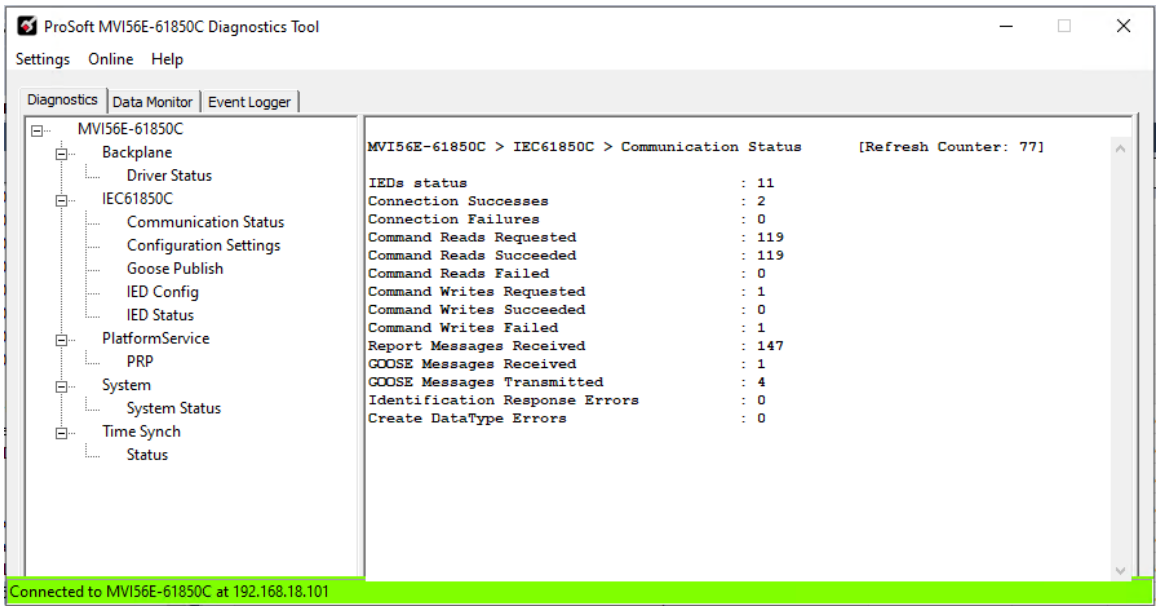
Parameter	Description
Number of Configured Connections	Total number of configured connections.
Number of High Priority Connections	Total number of high priority connections. The high priority connections are reserved for GOOSE and control data.
Number of Normal Priority Connections	Total number of normal priority connections. The normal priority connections are reserved for report and MMS read data.
Number of Reserved Connections	Total number of reserved connections. The reserved connections are not used by the module for data transfer.
Class 1 Error Connection Count	Total number of times a connection error is detected.
Class 3 Requests	The total number of times a class 3 request is received by the module. The module supports class 3 messaging for diagnostics and specific data read from ControlLogix processor such as string data.

Parameter	Description
Class 3 Response	The total number of times a class 3 response is sent by the module. The module supports class 3 messaging for diagnostics and specific data read from ControlLogix processor such as string data.

IEC 61850C

Communication Status

The *Communication Status* screen shows the global status for all configured IEDs.



The following table describes the data displayed on the *Communication Status* screen:

Parameter	Description

IEDs Status	Bitmap register where the number of bits correspond to the number of configured IED, where bit X indicates the connection status of IED X.
	For example, in case two IEDs are configured then the IED status is displayed as follows:
	`MVI56E-61850C > IEC61850C > Communication Status`
	`IEDs status : 11`
	Where:
	Bit 0 (IED 0) = 1
	Bit 1 (IED 1) = 1
	
	If IED 0 is disconnected, the IED status is updated as follows:
	`MVI56E-61850C > IEC61850C > Communication Status`
	`IEDs status : 01`
	Where:
	Bit 0 (IED 0) = 0
	Bit 1 (IED 1) = 1

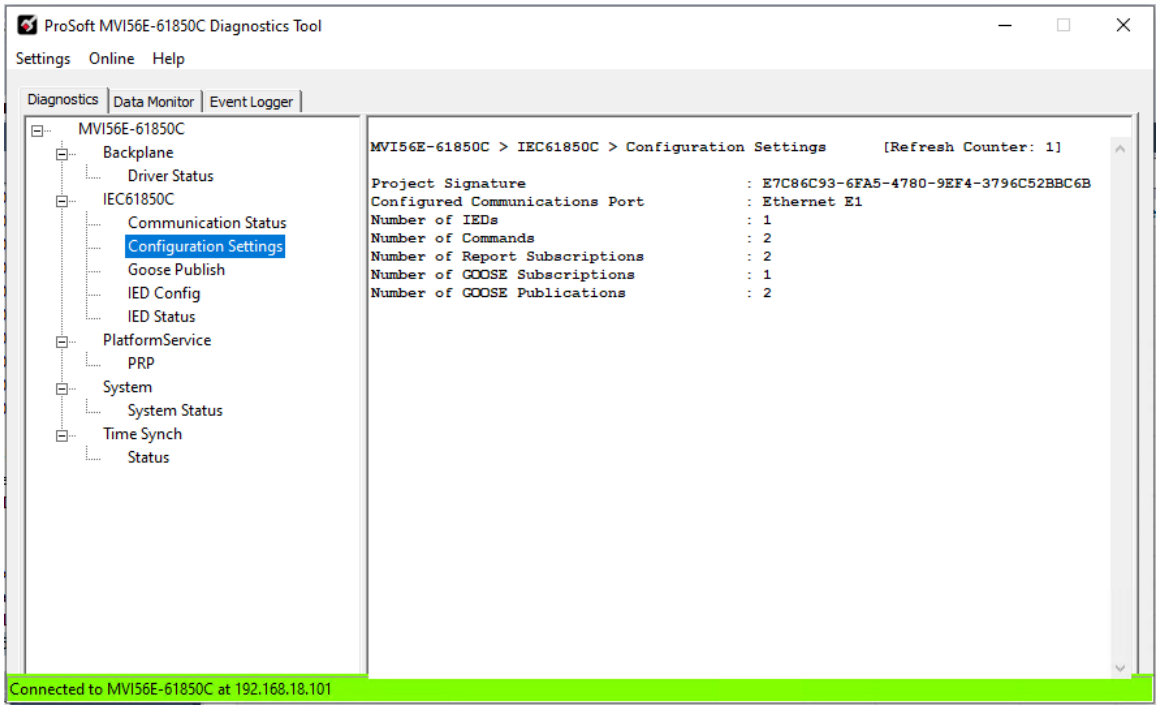
Connection Successes	Incremented every time a connection is successful established with an IED.
Connection Failures	Incremented every time a connection attempt with an IED fails.

Parameter	Description
Command Reads Requests	Incremented every time a MMS read command is sent to an IED
Command Reads Succeeded	Incremented every time a MMS read response is received from an IED.
Command Reads Failed	Incremented every time a MMS read response failure occurs.
Command Write Requests	Incremented every time a MMS write command is sent to an IED.
Command Write Succeeded	Incremented every time a MMS write response is received from an IED.
Command Writes Failed	Incremented every time a MMS write response failure occurs.
Report Messages Received	Incremented every time a report is received from an IED.
GOOSE Messages Received	Incremented every time a GOOSE message with new data is received from an IED.
GOOSE Messages Transmitted	Incremented every time a GOOSE message with new data is published by the MVI56E-61850C module.
Identification Response Errors	Incremented every time an identification error is received from an IED.
Create Data Type Errors	Incremented every time a data type error is received from an IED.

Configuration Settings

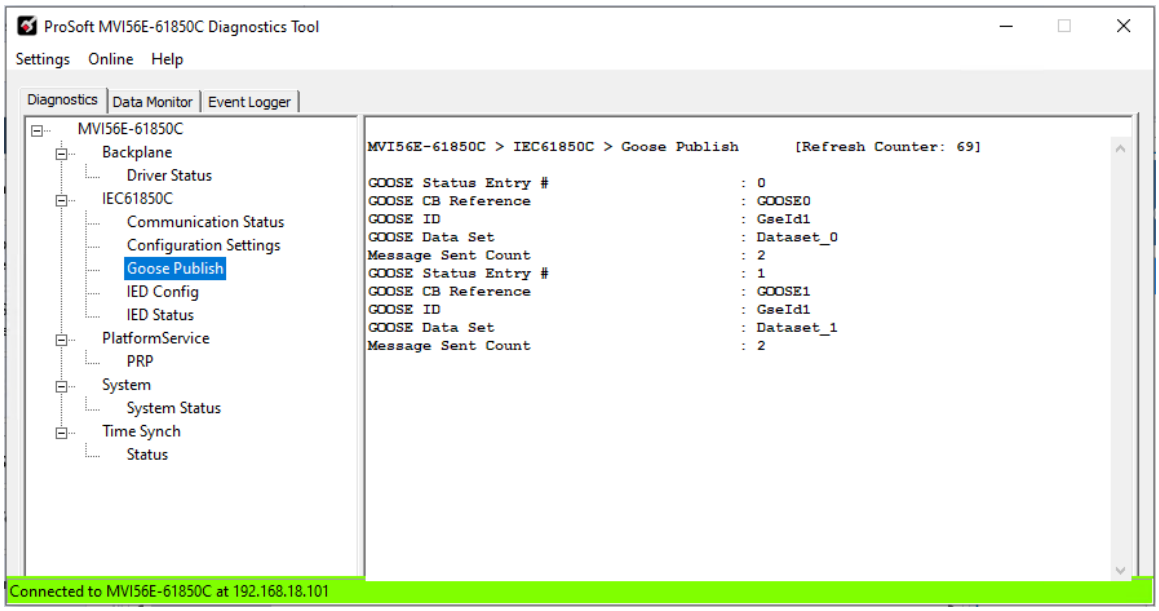
The *Configuration Settings* screen shows the global IEC 61850 configuration settings for all IEDs, including the following:

- Project signature
- Number of configured IEDs
- Number of reports configured
- Number of MMS commands configured
- Number of GOOSE subscriptions configured
- Number of GOOSE publications configured



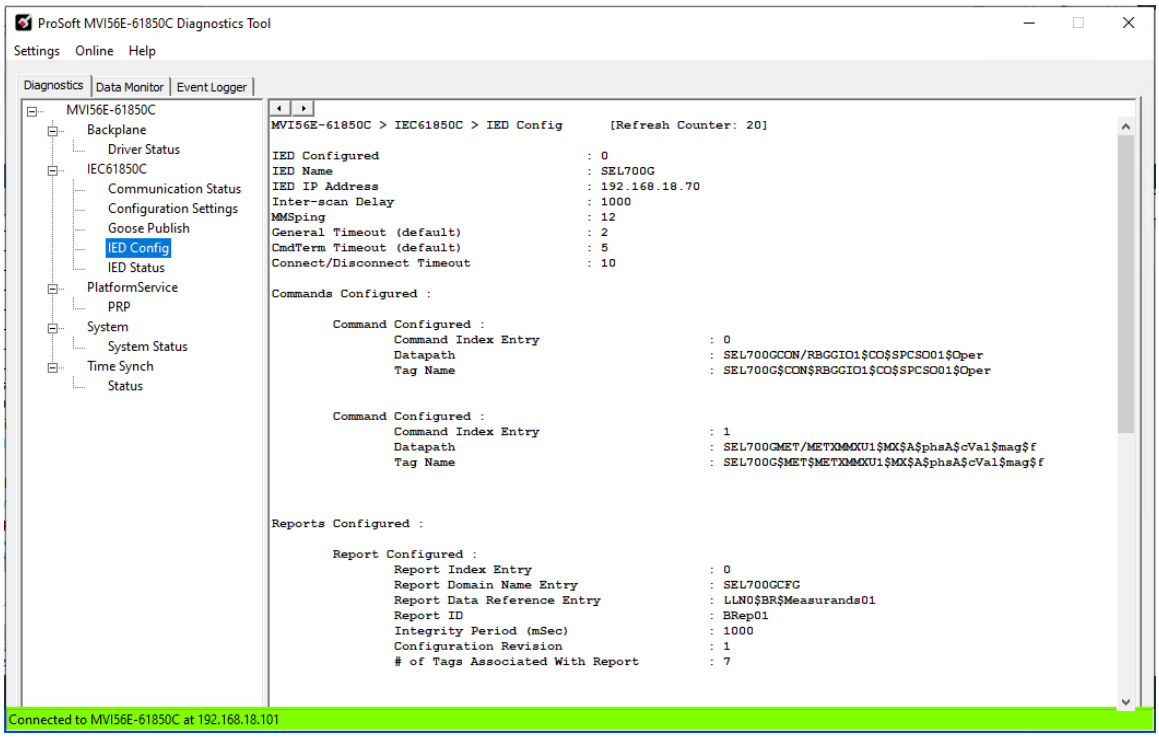
GOOSE Publish

The *GOOSE Publish* screen shows the configuration settings for all configured GOOSE Publish Objects (a maximum of 8).

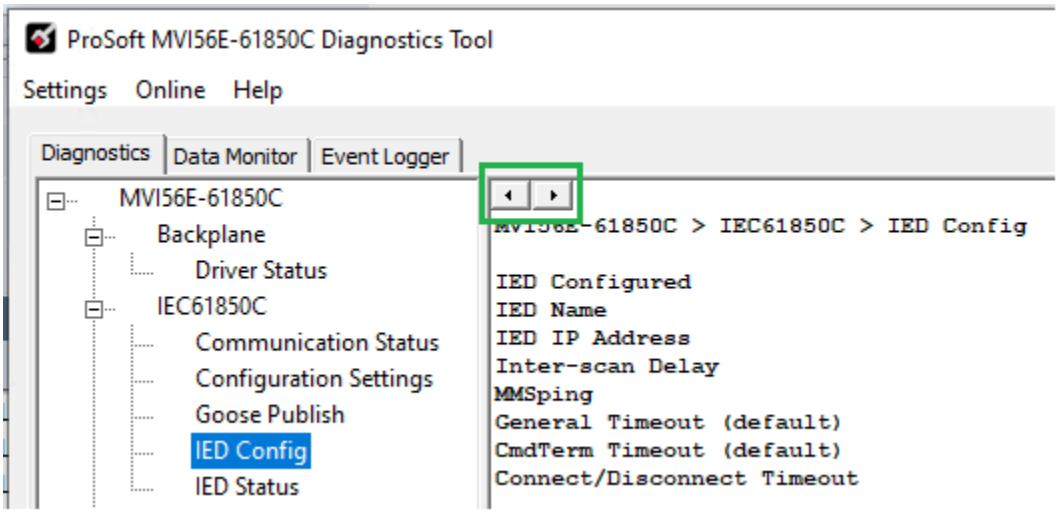


IED Config

The *IED Configuration* screen shows the configuration settings for each IED.



To navigate through the different IEDs, use the IED selection buttons at the top of the screen.



The *IED Configuration* screen is divided into the following sections:

IED Configuration Settings

```
IED Configured                          : 0
IED Name                                : SEL700G
IED IP Address                          : 192.168.18.70
Inter-scan Delay                        : 1000
MMSping                                 : 12
General Timeout (default)               : 2
CmdTerm Timeout (default)               : 5
Connect/Disconnect Timeout              : 10
```

MMS Commands Configured

```
Commands Configured :

        Command Configured :
                Command Index Entry             : 0
                Datapath                        : SEL700GCON/RBGGIO1$CO$SPCSO01$Oper
                Tag Name                        : SEL700G$CON$RBGGIO1$CO$SPCSO01$Oper


        Command Configured :
                Command Index Entry             : 1
                Datapath                        : SEL700GMET/METXMMXU1$MX$A$phsA$cVal$mag$f
                Tag Name                        : SEL700G$MET$METXMMXU1$MX$A$phsA$cVal$mag$f
```

Reports Configured

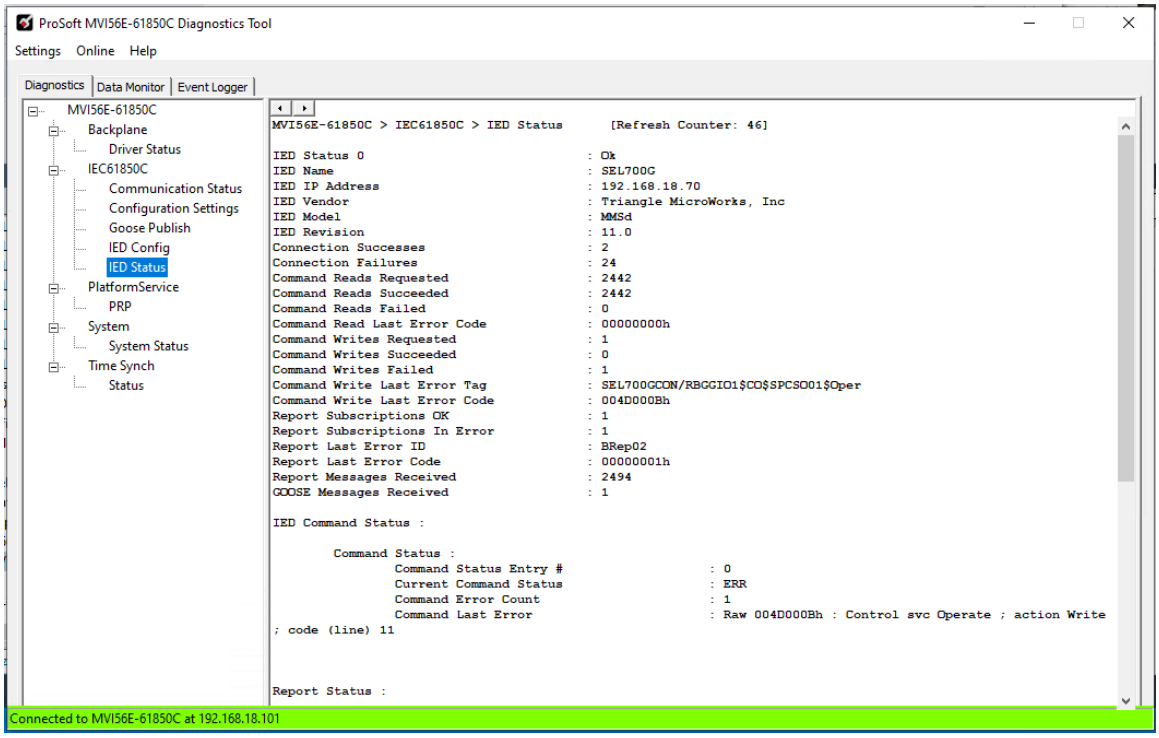
```
Reports Configured :

        Report Configured :
                Report Index Entry                      : 0
                Report Domain Name Entry                : SEL700GCFG
                Report Data Reference Entry             : LLN0$BR$Measurands01
                Report ID                               : BRep01
                Integrity Period (mSec)                 : 1000
                Configuration Revision                  : 1
                # of Tags Associated With Report        : 7


        Report Configured :
                Report Index Entry                      : 1
                Report Domain Name Entry                : SEL700GCFG
                Report Data Reference Entry             : LLN0$BR$Alarms
                Report ID                               : BRep02
                Integrity Period (mSec)                 : 5000
                Configuration Revision                  : 1
                # of Tags Associated With Report        : 252
```

GOOSE Subscriptions Configured

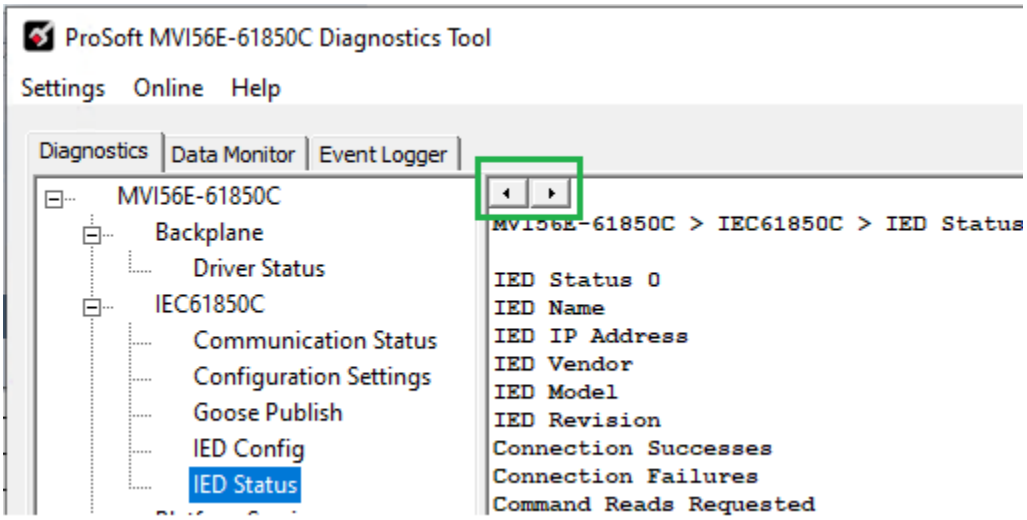
```
GOOSE Subscriptions Configured :
        GOOSE Index Entry                       : 0
        Data Set Reference                      : SEL700GCFG/LLN0$GPDSet01
        GOOSE CB Reference                      : SEL700GCFG/LLN0$GO$GPub01
        Application ID                          : Gen1
        Multicast Address                       : 01 0C CD 01 00 06
        Configuration Revision                  : 1

        tags :
                GOOSE FCDA Datapath                     : SEL700GPRO/BXXCBR1$ST$Pos$stVal
                GOOSE FCDA Datapath                     : SEL700GPRO/BXXCBR1$ST$Pos$q
                GOOSE FCDA Datapath                     : SEL700GPRO/BYXCBR2$ST$Pos$stVal
                GOOSE FCDA Datapath                     : SEL700GPRO/BYXCBR2$ST$Pos$q
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO01$stVal
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO01$q
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO02$stVal
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO02$q
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO03$stVal
                GOOSE FCDA Datapath                     : SEL700GCON/RBGGIO1$ST$SPCSO03$q
```

IED Status

The *IED Status* screen shows the status data for each configured IED.



To navigate through the different IEDs, use the IED selection buttons at the top of the screen.



The *IED Status* screen is divided into the following sections:

IED Status

```
IED Status 0                          : Ok
IED Name                              : SEL700G
IED IP Address                        : 192.168.18.70
IED Vendor                            : Triangle MicroWorks, Inc
IED Model                             : MMSd
IED Revision                          : 11.0
Connection Successes                  : 2
Connection Failures                   : 24
Command Reads Requested               : 2678
Command Reads Succeeded               : 2678
Command Reads Failed                  : 0
Command Read Last Error Code          : 00000000h
Command Writes Requested              : 1
Command Writes Succeeded              : 0
Command Writes Failed                 : 1
Command Write Last Error Tag          : SEL700GCON/RBGGIO1$CO$SPCSO01$Oper
Command Write Last Error Code         : 004D000Bh
Report Subscriptions OK               : 1
Report Subscriptions In Error         : 1
Report Last Error ID                  : BRep02
Report Last Error Code                : 00000001h
Report Messages Received              : 2732
GOOSE Messages Received               : 1
```

MMS Command Status

```
IED Command Status :

       Command Status :
              Command Status Entry #          : 0
              Current Command Status          : ERR
              Command Error Count             : 1
              Command Last Error              : Raw 004D000Bh : Control svc Operate ; action Write
; code (line) 11
```

Report Status

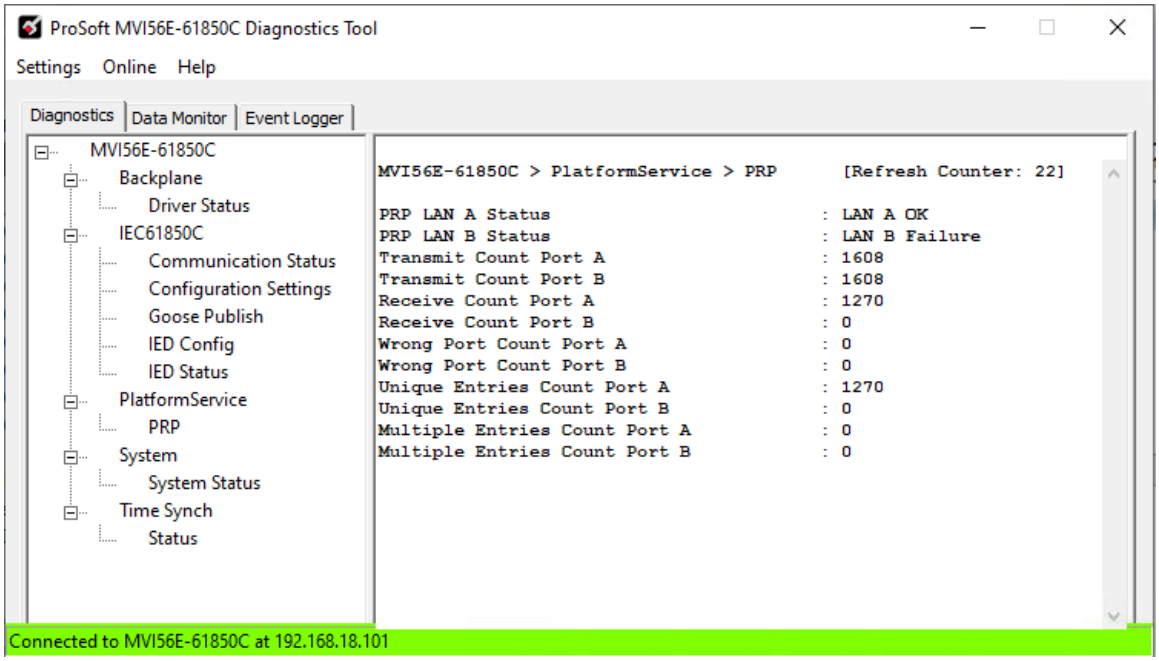
```
Report Status :

        Report Status :
                Report Status Entry #                   : 0
                Report Enable State                     : Enabled
                Reports Received Count                  : 2785


        Report Status :
                Report Status Entry #                   : 1
                Report Enable State                     : Error
                Reports Received Count                  : 0
```

GOOSE Subscription Status

```
GOOSE Subscription Status :

        GOOSE Status :
                GOOSE Status Entry #                    : 0
                GOOSE CB Reference                      : SEL700GCFG/LLN0$GO$GPub01
                Goose Messages Received Count           : 1
```

PRP Status

The *PRP Status* screen (*PlatformService* > *PRP*) shows the redundancy operation status in case the PRP feature is enabled through the Add-On Profile.

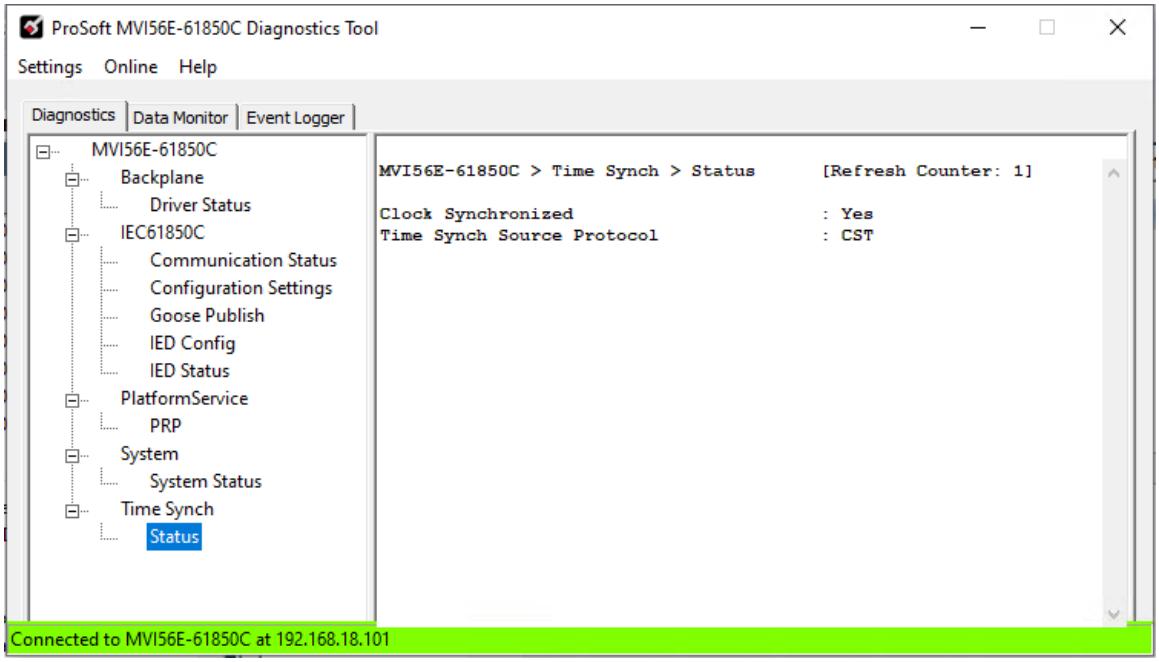


The following table describes the data displayed on the *PRP Status* screen:

Parameter	Description
PRP LAN A/B Status	LAN status (Not Configured/OK/Failure).
Transmit Count Port A/B	Messages transmitted
Receive Count Port A/B	Messages received.
Wrong Port Count Port A/B	Messages received at one port which was tagged for the other port.
Unique Entries Count Port A/B	Unique messages received. During normal operation this counter should be continuously incrementing, since the port should not detect multiple instances of the same message.
Multiple Entries Count Port A/B	Multiple messages received. This counter indicates that the port received multiple instances of the same message.

Time Synch Status

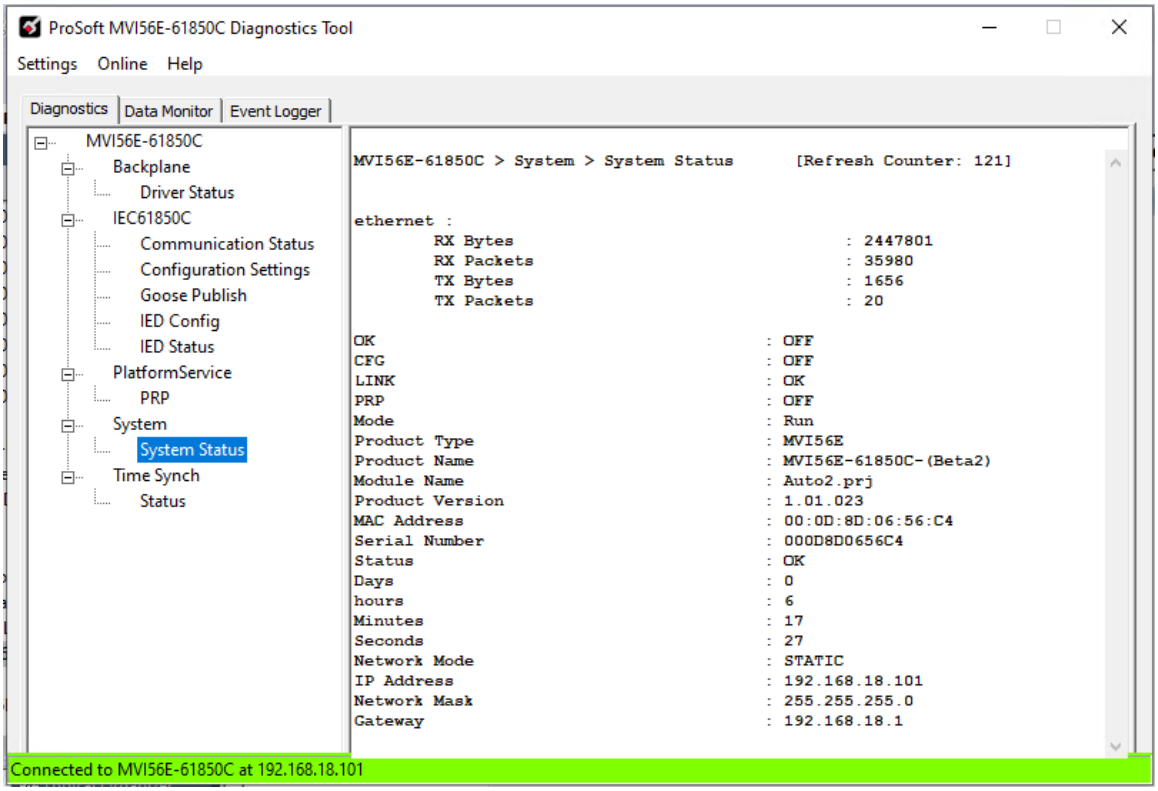
The time synch status screen shows whether the module clock is synchronized by another time source.



System Status

The System Status screen (*System > System Status*) shows the status of different module operating registers such as the following:

- Ethernet read/write counters
- LED status
- Product information
- Uptime
- IP settings



8.2.3 Data Monitor

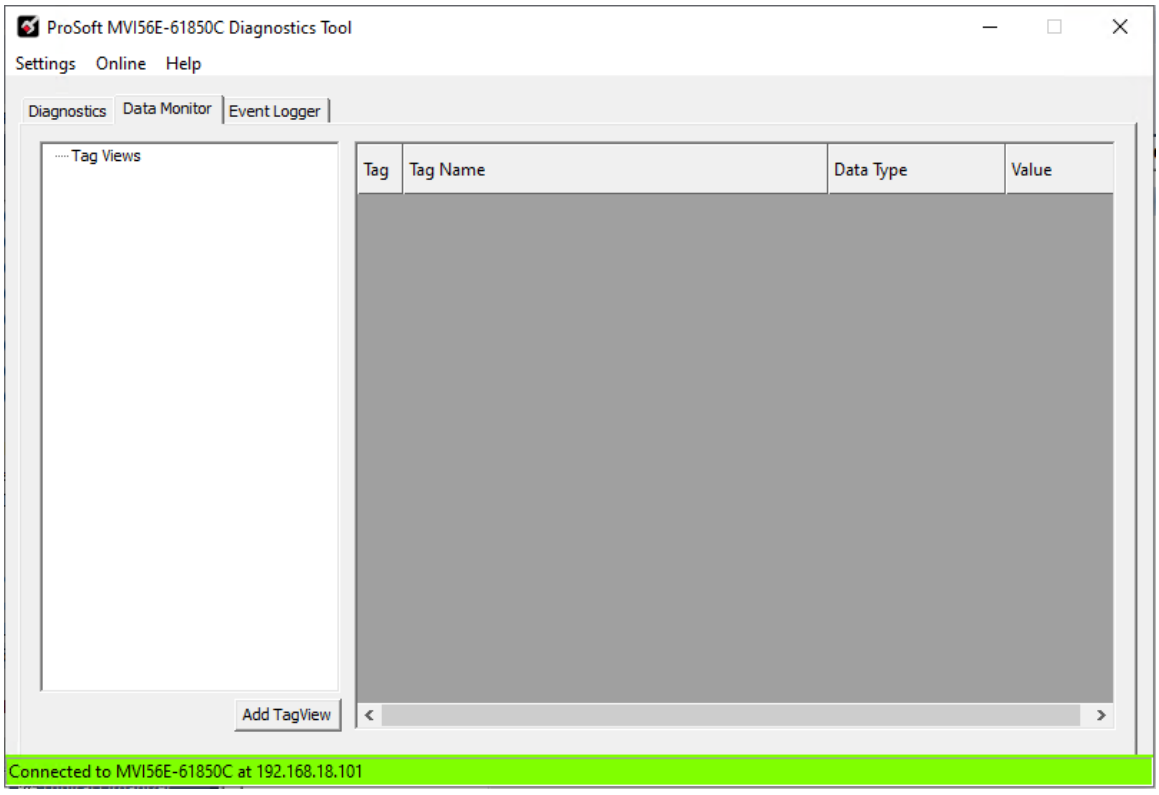
Overview

The *Data Monitor* feature allows you to monitor the configured data tag values as read directly from the module. To do so, you create a *tag view*, which is a consolidated table of tags that you select from all tags available for the IEDs on the network. You can create multiple tag views, each of which can contain any combination of available tags.

The *Data Monitor* screen is divided into two sections: the *Tag Views* list (left pane) and a list of tags (right pane).

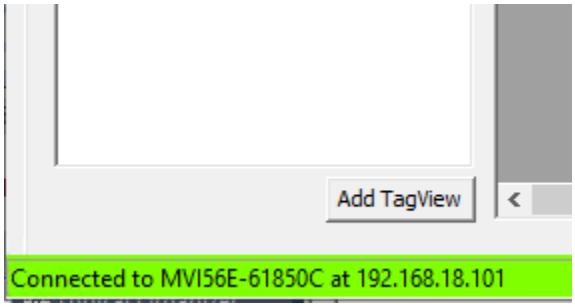
The *Tag Views* list (left pane) is a list of tag views that you have created. When you select a tag view from this list, its associated tags display in the list on the right.

The list of tags (right pane) shows the tags contained in the selected tag view. This list can include both data objects and data attributes. You can expand a data object to view its attributes.

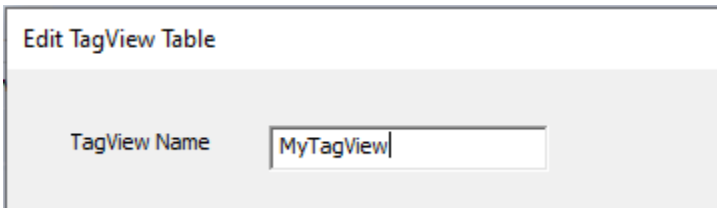


Create a Tag View

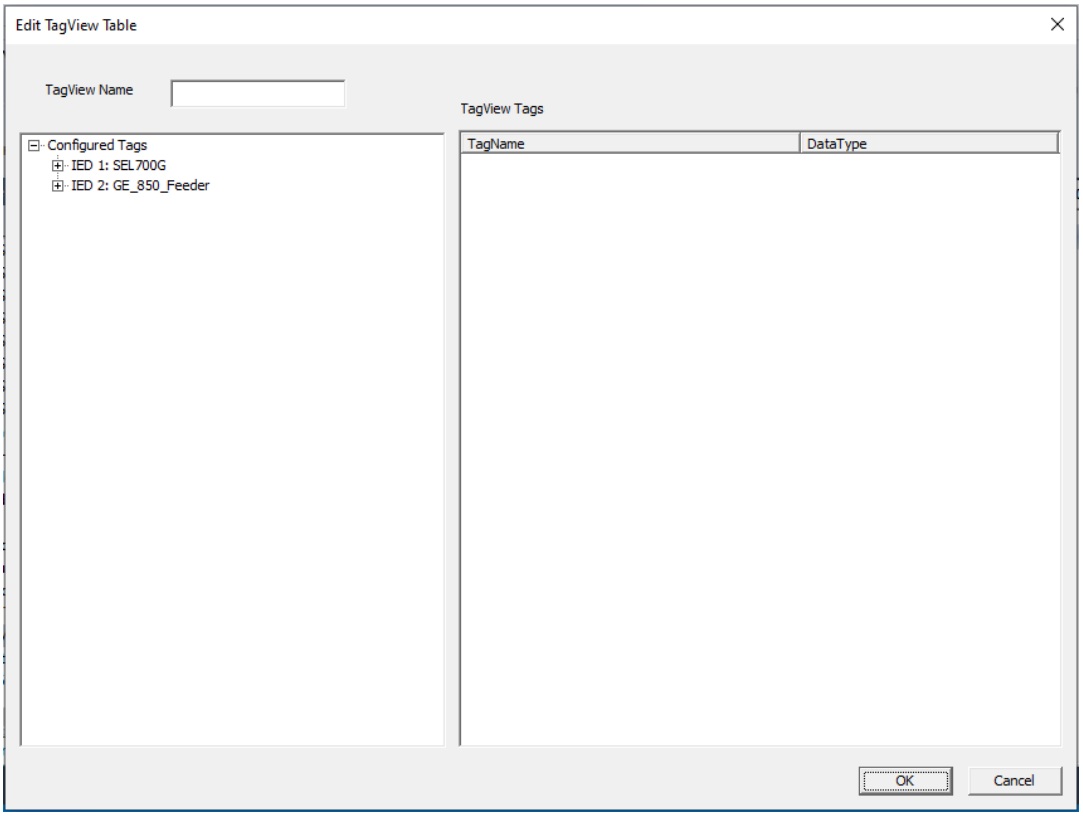
1 Click **ADD TAGVIEW**.



2 In the *Edit TagView Table* window, enter a name for the tag view.

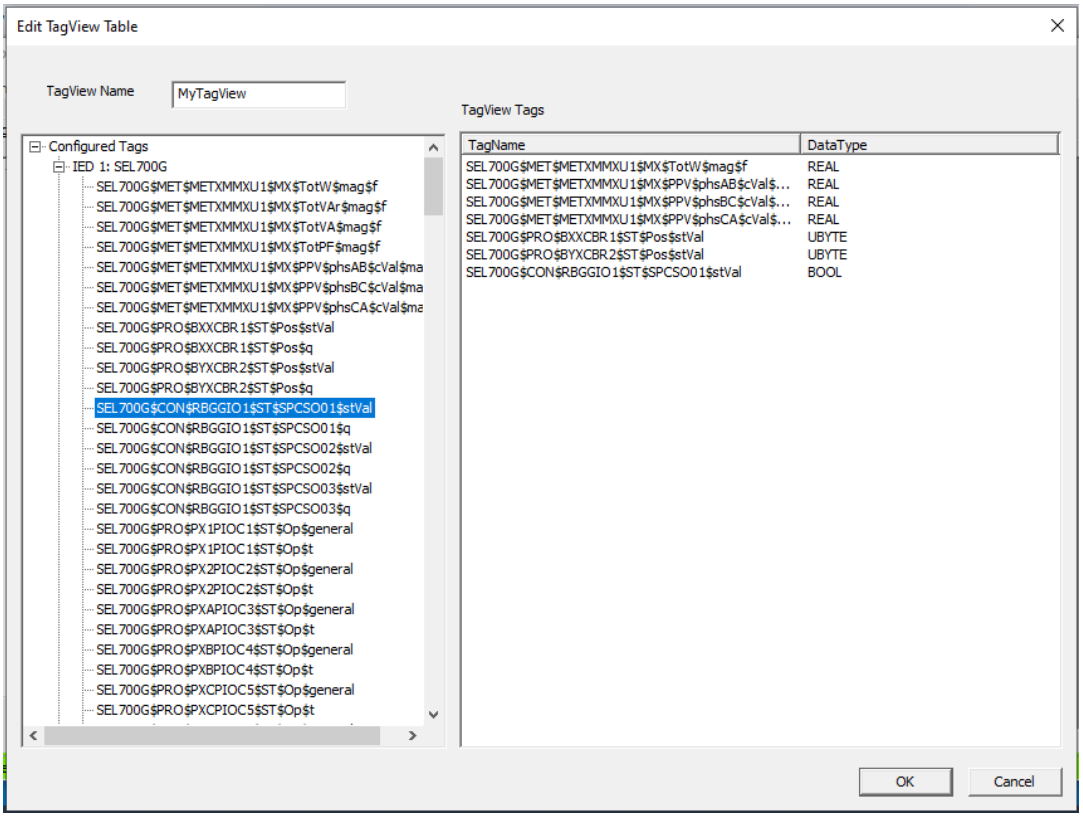


The left pane of the *Edit TagView Table* window shows each IED on the IEC 61850 network.



3 Expand an IED to see its configured tags that can be selected for data monitoring.

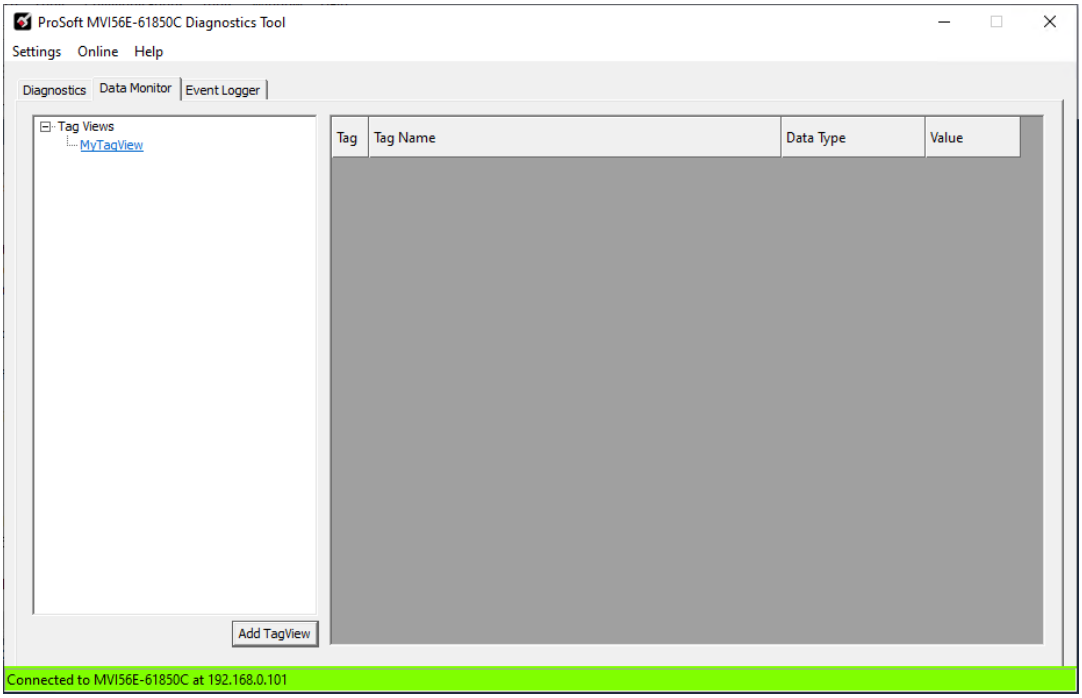
4 Drag the tags that you wish to monitor from the left pane and drop them into the right pane.



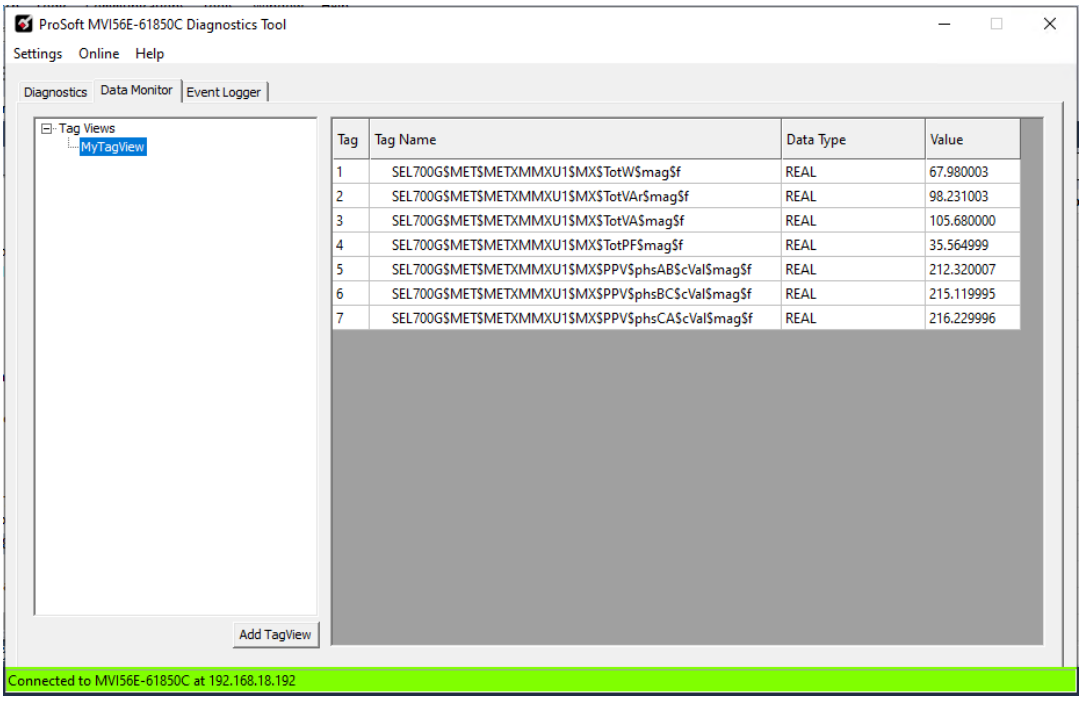
5 Repeat steps 3 and 4 to select tags from other IEDs.

6 After you have selected all tags to be included in the tag view, click **OK** to close the window.

The new tag view appears in the left pane of the *Data Monitor* tab.



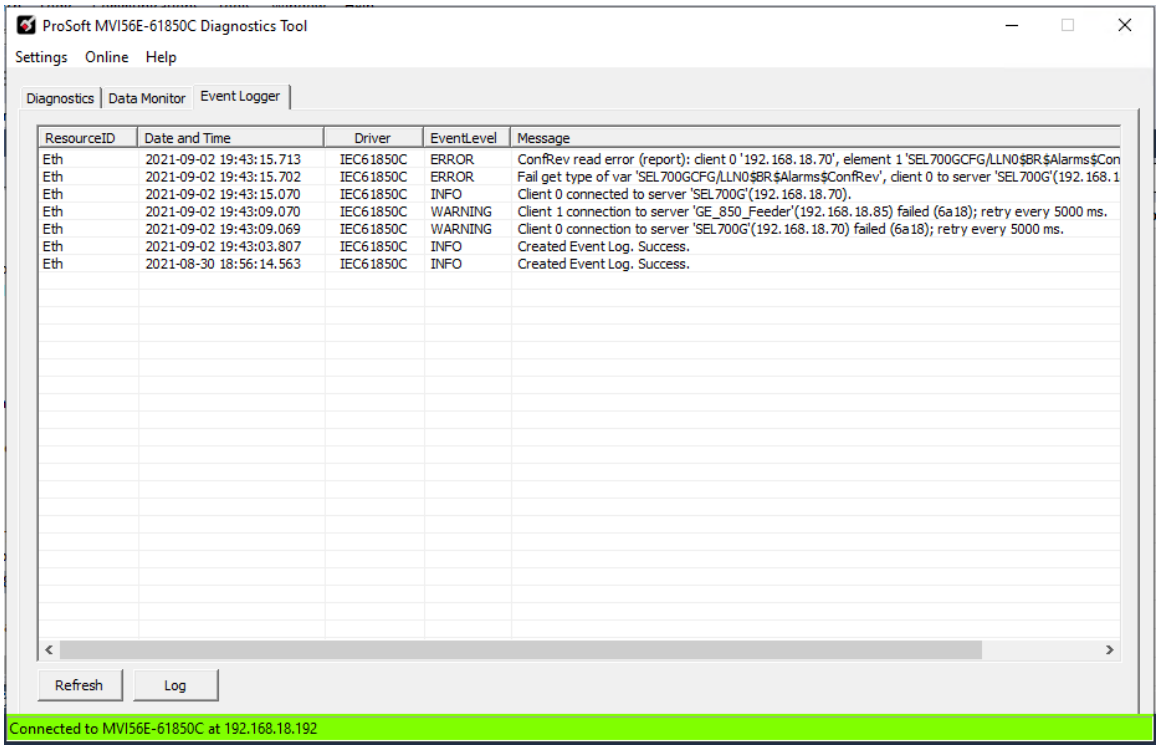
7 Select the new tag view. The associated data tags and values display on the right.



8.2.4 Event Logger

The *Event Logger* tab of the ProSoft MVI56E-61850C Diagnostics Tool shows a list of timestamped events, including the following:

- IED connection and disconnection
- Module initialization
- Report subscription errors

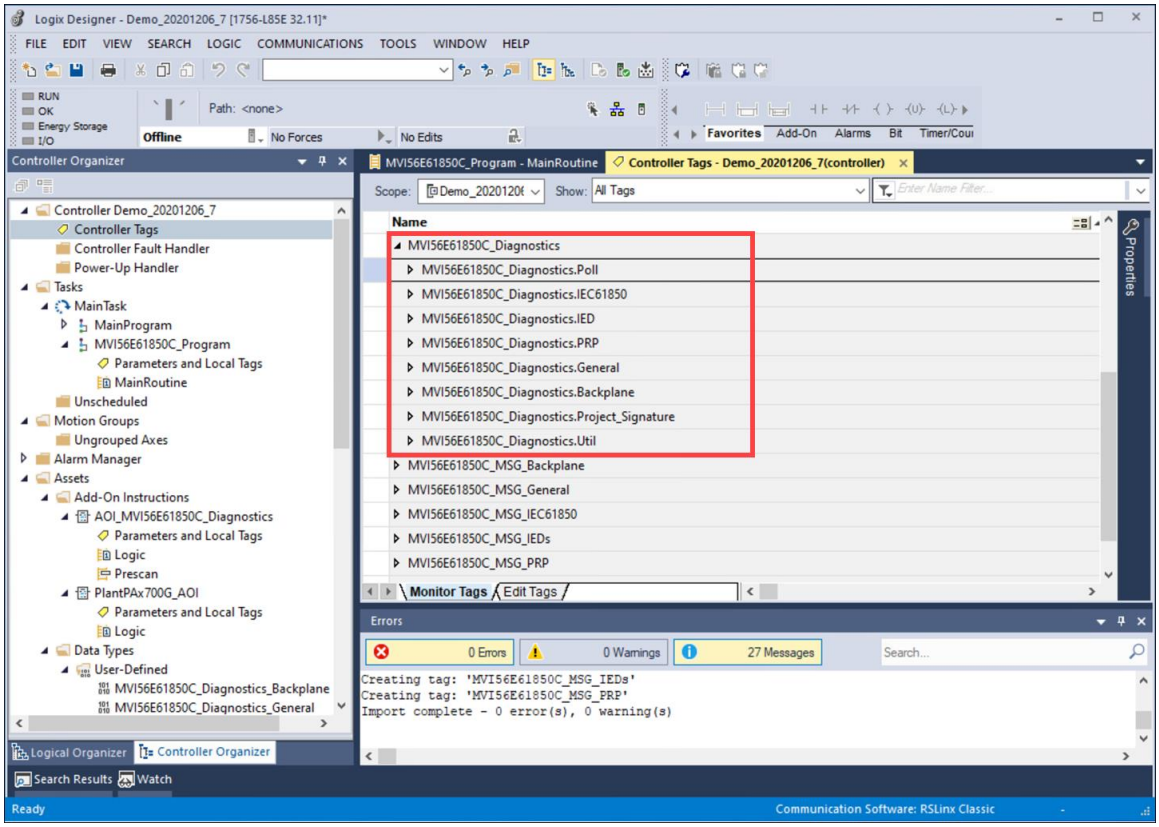


8.3 Diagnostics Controller Tags

When you import the MVI56E-61850C program into Studio 5000 (see section 4.2.3), the ProSoft MVI56E-61850C Configuration Manager generates controller tags related to module diagnostics.

8.3.1 MVI56E61850C_Diagnostics

Open the *Controller Tags* editor to view the diagnostics tags.



Expand *MVI56E61850C_Diagnostics* to view the following categories of tags:

- MVI56E61850C_Diagnostics.Poll
- MVI56E61850C_Diagnostics.IEC61850
- MVI56E61850C_Diagnostics.IED
- MVI56E61850C_Diagnostics.PRP
- MVI56E61850C_Diagnostics.General
- MVI56E61850C_Diagnostics.Backplane
- MVI56E61850C_Diagnostics.Project_Signature
- MVI56E61850C_Diagnostics.Util

The following section describes the data contained in these tags.

8.3.2 Diagnostics Data Reference

MVI56E61850C_Diagnostics.Poll

Name	Data Type	Description
Auto_Poll	BOOL	Enables the automatic polling of diagnostics data at the rate set in Auto_Poll_Interval.
Auto_Poll_Interval	DINT	The rate at which diagnostics data contained within Diagnostics.IEC61850 will be refreshed. The minimum is 5000 ms.
Poll_Once	BOOL	Entering a value of 1 will cause a one-time refreshing of diagnostics data, after which the value will automatically reset to 0.

MVI56E61850C_Diagnostics.IEC61850

Name	Data Type	Description
Active_IED_Connection_Count	USINT	Number of IEDs connected with the module
IED_Connection_OK_Counter	UINT	How many connections have been established successfully
IED_Connection_Error_Counter	UINT	Number of times an IED connection was terminated with the module
IEDs_Configured_Count	USINT	Number of configured IEDs
IEDs_Online_Status	ULINIT	The online status bitmap – bit 0 refers to IED 0, bit 1 to IED 1, etc. If IED is connected, value will be 1, if not then 0. Online bitmap status 1=online, 0=offline
MMS_Read_Cmd_Request_Counter	UINT	Number of times the module issued a MMS read command request
MMS_Read_Cmd_Response_OK_Counter	UINT	Number of times the module received an OK response to a MMS
MMS_Read_Cmd_Response_Error_Counter	UINT	Number of times the module received an error response to a MMS Read request.
MMS_Write_Cmd_Request_Counter	UINT	Number of times the module issued a MMS write command request
MMS_Write_Cmd_Response_OK_Counter	UINT	Number of times the module received an OK response to a MMS Write request.
MMS_Write_Cmd_Response_Error_Counter	UINT	Number of times the module received an error response to a MMS Write request.
Report_Subscription_OK_Counter	UINT	Number of times the module subscribed to a report
Report_Subscription_Error_Counter	UINT	Number of times the report subscription attempt failed
Report_Received_Counter	UINT	Number of times a report was received
GOOSE_Received_Counter	UINT	Number of times a GOOSE message was received with data change
GOOSE_Published_Counter	UINT	Number of times module published a GOOSE message with data change
Last_IED_In_Error	UINT	IED number of the IED that sent the latest message response with error.
Last_Error_Code	UINT	Last error code associated with the latest error message received from an IED

MVI56E61850C_Diagnostics.IED

This data structure is an array of 40 IEDs that can be expanded to show information about each device.

Name	Data Type	Description
[IED#].Index.Code	USINT	IED Code (0-based)
[IED#].Name	STRING	IED Name
[IED#].IP_Address	USINT[4]	IED IP Address
[IED#].Status_Code	USINT	IED Status Code (-1 = Initialization, -2 = Fault, 1 = OK)
[IED#].Connection_OK_Count	UINT	Number of times the connection was established with the IED
[IED#].Connection_Error_Count	UINT	Number of times the connection was terminated with the IED
[IED#].MMS_Read_Cmd_Request_Counter	UINT	Number of times the module issued a MMS read command request
[IED#].MMS_Read_Cmd_Response_OK_Counter	UINT	Number of times the module received an OK response to a MMS Read request
[IED#].MMS_Read_Cmd_Response_Error_Counter	UINT	Number of times the module received an error response to a MMS Read request.
[IED#].MMS_Read_Last_Error_Code	SINT	Error code associated with the last mms read error response received
[IED#].MMS_Write_Cmd_Request_Counter	UINT	Number of times the module issued a MMS write command request
[IED#].MMS_Write_Cmd_Response_OK_Counter	UINT	Number of times the module received an OK response to a MMS Write request.
[IED#].MMS_Write_Cmd_Response_Error_Counter	UINT	Number of times the module received an error response to a MMS Write request.
[IED#].MMS_Write_Last_Error_Tag	STRING	Tag name which generated an error response from the IED
[IED#].MMS_Write_Last_Error_Code	SINT	Error code associated with the last error response from the IED
[IED#].Report_Subscription_OK_Counter	UINT	Number of times the module subscribed to a report Read/Write
[IED#].Report_Subscription_Error_Counter	UINT	Number of times the report subscription attempt failed
[IED#].Report_Subscription_Last_Error	STRING	Report name of report control block that failed the subscription operation
[IED#].Report_Subscription_Last_Error_Code	SINT	Error code associated with the last report subscription error
[IED#].Report_Received_Counter	UINT	Number of report messages received
[IED#].GOOSE_Received_Counter	UINT	Number of times a GOOSE message was received with data change

MVI56E61850C_Diagnostics.PRP

Name	Data Type	Description
LAN_A_Status	SINT	LAN A Status Code (-1 = LAN A Failure, 0 = PRP Disabled, 1 = LAN A OK)
LAN_B_Status	SINT	LAN B Status Code (-1 = LAN B Failure, 0 = PRP Disabled, 1 = LAN B OK)
LAN_A_Fault_Count	UINT	Number of times LAN A failure was detected
LAN_B_Fault_Count	UINT	Number of times LAN B failure was detected
LAN_A_TX_Count	UDINT	Number of frames transmitted to LAN A
LAN_B_TX_Count	UDINT	Number of frames transmitted to LAN B
LAN_A_RX_Count	UDINT	Number of frames received from LAN A
LAN_B_RX_Count	UDINT	Number of frames received from LAN B
LAN_A_Unique_Entry_Count	UDINT	Number of tagged frames received on LAN A but not received on LAN B
LAN_B_Unique_Entry_Count	UDINT	Number of tagged frames received on LAN B but not received on LAN A
Duplicate_Entry_Count	UDINT	Number of tagged frames received on LAN A and LAN B. This number should increment during normal operation and it is not an indication of error.
Reserved	UDINT	

MVI56E61850C_Diagnostics.General

Name	Data Type	Description
Timestamp_Last_Startup	LINT	Date/Time of latest module initialization
Program_Scan_Count	UINT	Incremented upon the end of each module program cycle
State_Code	SINT	Module state code (-1 Initialization, -2 = Configuration, 1 = Operation)
General_Configuration_Error_Code	SINT	Configuration Error Code (0 = No Error, <1 = Configuration Error)

MVI56E61850C_Diagnostics.Backplane

This data is related to communication between the ControlLogix processor and the MVI56E-61850C module. “Class 1” refers to implicit messaging connections, while “Class 3” refers to explicit messaging between the MVI56E-61850C Add-On Profile and the module and also between the Diagnostics Add-On Instruction and the module.

Name	Data Type	Description
Class_1_Connection_Established_Count	UINT	Number of times each implicit (Class 1) connection is established
Class_1_Connection_Error_Count	UINT	Number of implicit (Class 1) connections in error
Class_3_Message_Request_Received_Count	UINT	Number of times the module received a explicit (class 3) message
Class_3_Message_Responses_OK_Count	UINT	Number of times the module sent an explicit (class 3 response) OK
Class_3_Message_Responses_Error_Count	UINT	Number of times the module sent an explicit (class 3 response) error

MVI56E61850C_Diagnostics.Project_Signature

Project signatures ensure that the data in Studio 5000 Logix Designer is synchronized with the data in the MVI56E-61850C module. The Synchronization_Status flag indicates the synchronization status of the two project signatures.

Name	Data Type	Description
Studio5000_Program	SINT[36]	Project signature associated with the Studio 5000 program. Configuration Manager automatically sets the values in this array.
Module_Configuration	SINT[36]	Project signature associated with the module configuration
Synchronization_Status	SINT	If the Studio5000_Program signature is equal to the Module_Configuration signature, the value of Synchronization_Status will be 1. If they are not equal, the value will be -1.

For more information on project signatures, see "Project Signature" on page 115.

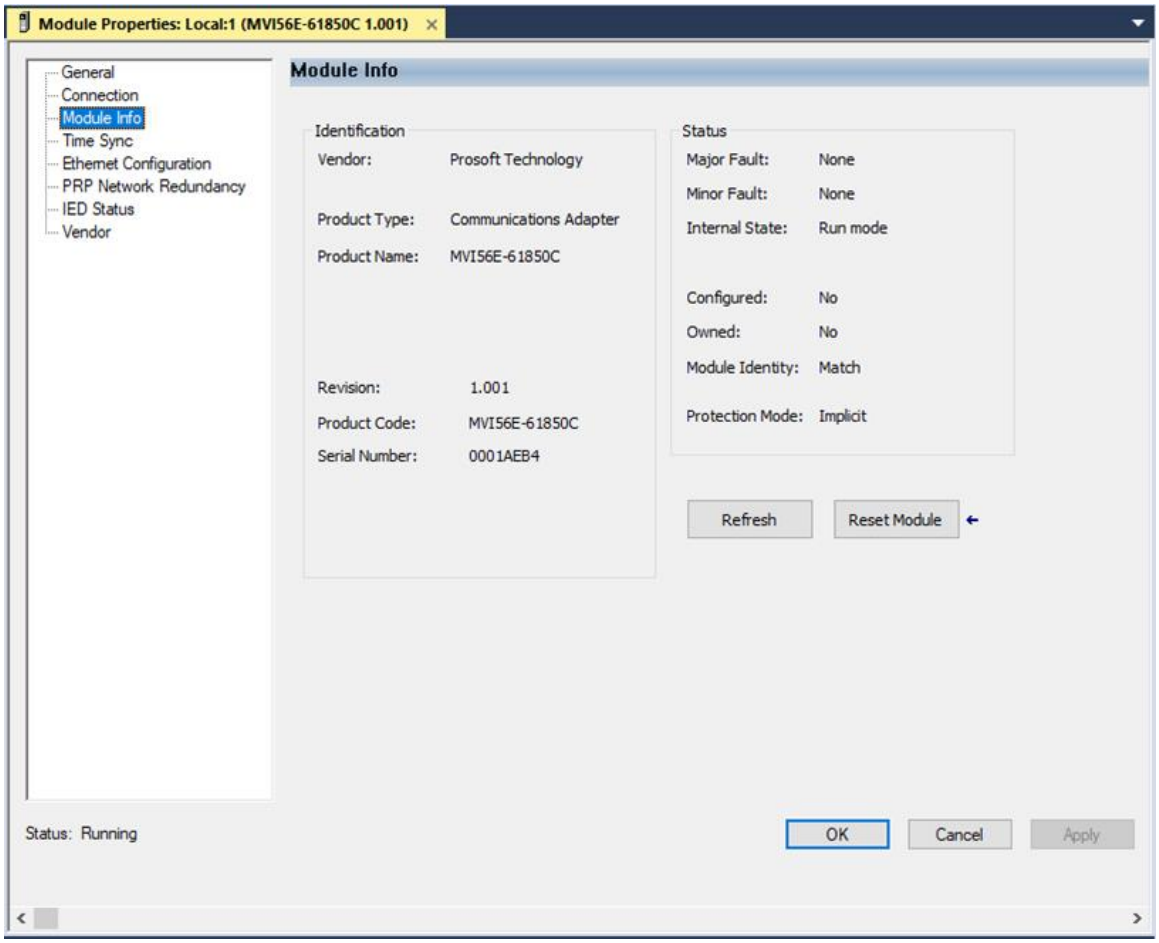
MVI56E61850C_Diagnostics.Util

The tags in the MVI56E61850C_Diagnostics.Util section are for internal processing use only.

8.4 Diagnostics in the MVI56E-61850C Add-On Profile

8.4.1 Module Info

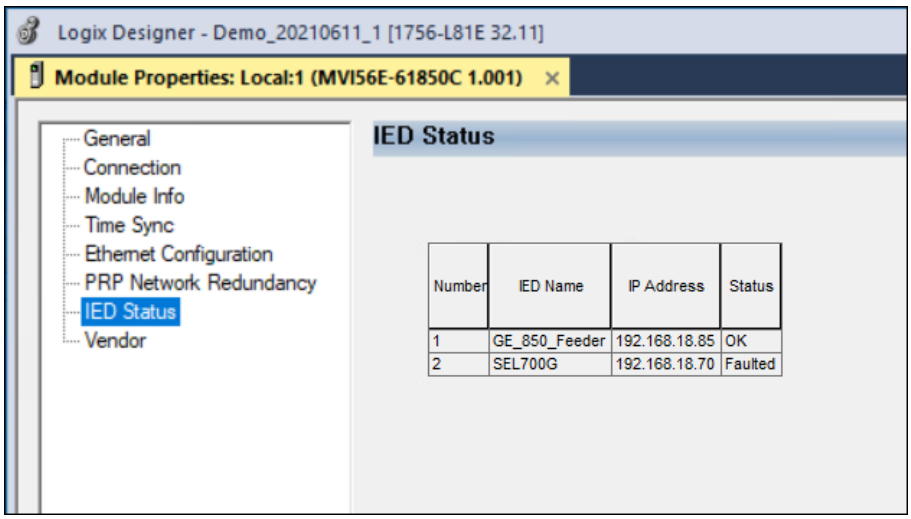
The *Module Info* tab of the *Module Properties* dialog box displays information regarding the current status of the MVI56E-61850C module.



8.4.2 IED Status

The *IED Status* tab of the *Module Properties* dialog box in the MVI56E-61850C Add-On Profile lists all IEDs connected to the 61850 network and provides the status of each. The IEDs will show as connected only when configured for MMS data communication (report, control, or MMS read). If an IED is configured only for GOOSE, it will not show as connected, since GOOSE does not require a TCP connection.

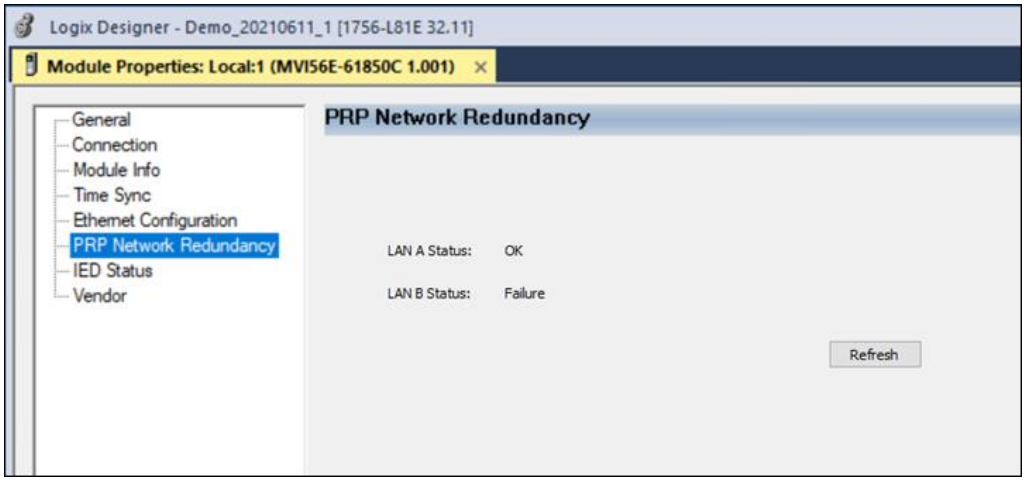
Note: The *IED Status* tab displays data only when Logix Designer is online with the Logix controller.



8.4.3 PRP Diagnostics

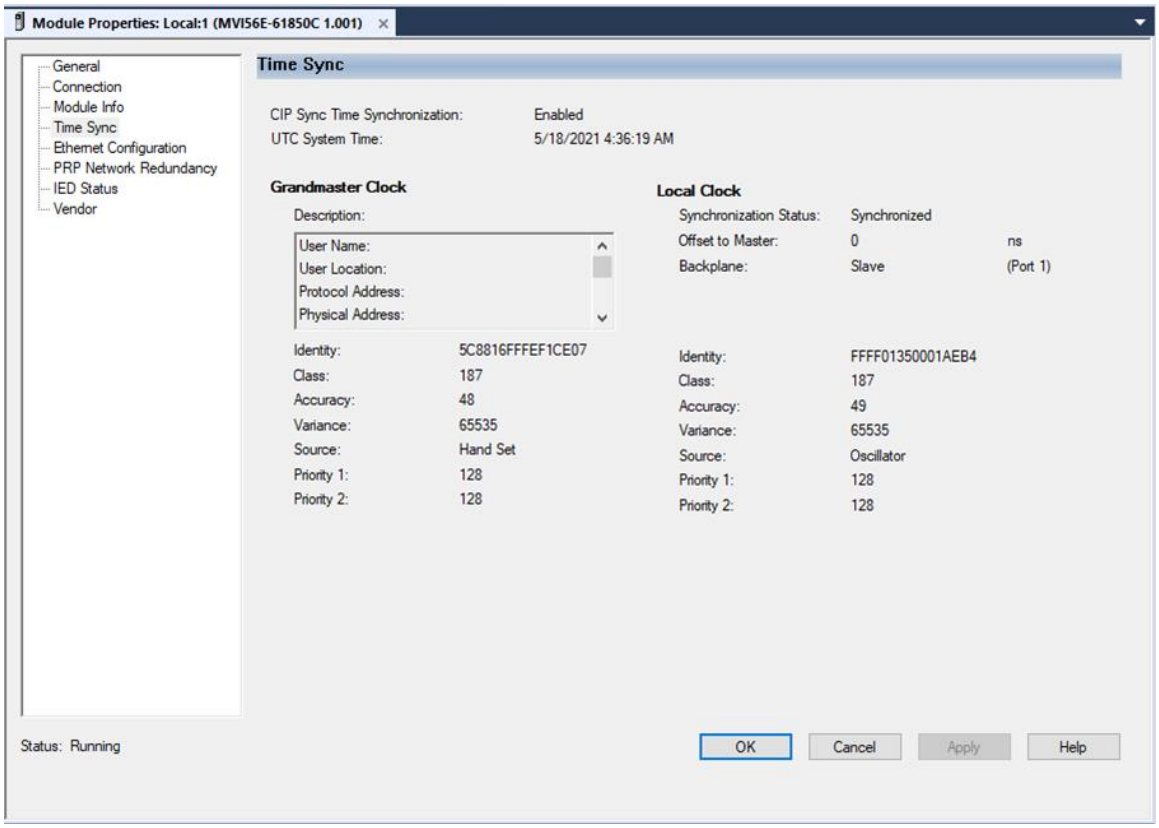
When PRP redundant mode is enabled, as explained in "Enable Parallel Redundancy Protocol (PRP)" on page 17, you can the monitor the status of LAN A (Ethernet port 1) and LAN B (Ethernet port 2) on the *PRP Network Redundancy* tab of the *Module Properties* dialog box.

Note: The *PRP Network Redundancy* tab displays data only when Logix Designer is online with the Logix controller.



8.4.4 Time Synchronization Diagnostics

Time Synchronization diagnostics are available on the *Time Sync* tab of the *Module Properties* dialog box.



Following are descriptions of the parameters on the *Time Sync* tab:

Parameter	Description
CIP Sync Time Synchronization	Indicates if time synchronization is enabled or disabled on the device.
UTC System Time	The current system time in Universal Coordinated Time (UCT). The time does not include time zone or Daylight Savings Time offsets.
Grandmaster Clock	
Description	Displays information about the clock. The grandmaster clock is controlled by the vendor of the grandmaster clock.
Identity	Unique identifier for the clock. The format depends on the network protocol. Ethernet network encodes the MAC address into the identifier while ControlNet and DeviceNet networks encode the vendor ID and serial number into the identifier.
Class	A measure of the traceability of the clock to primary reference sources. This is predefined by the hardware manufacturer. Values are defined from 0 through 255 with 0 as the best clock. Clocks with Class values below 128 may only be master clocks.
Accuracy	The expected absolute accuracy of the clock relative to the clock epoch of January 1, 1970. The accuracy is specified as a graduated scale starting at 25 nanoseconds (ns) and ending at greater than 10 seconds or unknown. The lower the accuracy value, the better the clock.

Parameter	Description
Variance	The measure of the inherent stability properties of the clock. The value is represented in offset scaled log units. The lower the variance, the better the clock.
Source	The time source of the clock. The available values are Atomic clock, GPS, Radio, PTP, HAND set, Other, and Oscillator.
Priority 1 / Priority 2	The relative priority of the clock to other clocks in the system. Values range from 0 to 255. The highest priority is 0. The default value for both settings is 128.
Local Clock	
Synchronization Status	Specifies whether the local clock is synchronized or not synchronized with the grandmaster reference clock. A clock is synchronized if it has one port in the slave state and is receiving updates from the time master.
Offset to Master	The amount of deviation between the local clock and the grandmaster clock in nanoseconds, updated every sync interval.
Backplane	Current state of the backplane. Available values are Initializing, Faulty, Disabled, Listening, PreMaster, Master, Passive, Uncalibration, Slave, and None.
Identity, Class, Accuracy, Variance, and Source	Definitions for these parameters are the same for the local clock and the grandmaster clock. Refer to the descriptions above.

8.5 Project Signature

When you save and export a project from the ProSoft MVI56E-61850C Configuration Manager software, the following associated files are assigned the same project signature value in one of the XML data members:

- Configuration File (.cfg)
- MDDT File (.xml)
- Studio 5000 Program Export (.L5X)
- CID File (.CID)

You can use this signature to confirm that the files were generated from the same project save/export operation.

Following is an example of the configuration file section that includes the project signature value at the beginning of the file:

<?xml version="1.0" encoding="UTF-8"?>

<DeviceConfig moduleName="SampleProject.prj" productName="MV156E-61850C" DriverAutoRestart="Yes" ProjectSignature="55DB80D1-4891-4070-BD9B-1A7D33054120">

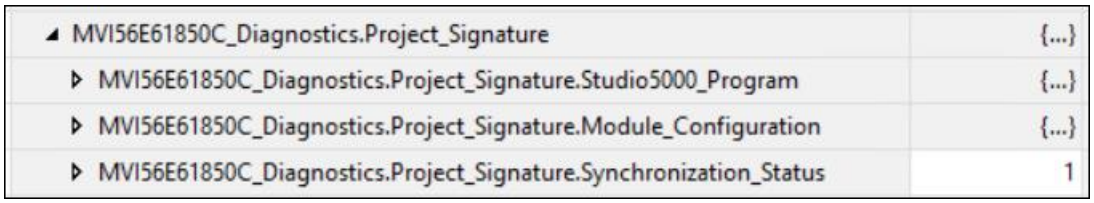
Every time you edit and save or export a new project in the ProSoft MVI56E-61850C Configuration Manager, a new project signature value is automatically generated.

One application of the project signature is to allow you to confirm whether the configuration file exported to the Add-On Profile is consistent with the MVI56E-61850C program imported into Studio 5000 (that is, both files are from the same project). If these files are inconsistent, it might prevent data transfer between the ControlLogix processor and the module.

The MVI56E-61850C Program file includes the following tags that allow you to confirm whether the configuration file is consistent with Studio 5000:

Name	Data Type	Description
Studio5000_Program	SINT[36]	Project signature associated with the Studio 5000 program. Configuration Manager automatically sets the values in this array.
Module_Configuration	SINT[36]	Project signature associated with the module configuration
Synchronization_Status	SINT	If the Studio5000_Program signature is equal to the Module_Configuration signature, the value of Synchronization_Status will be 1. If they are not equal, the value will be -1.

In the following example, the configuration file and Studio 5000 Programs are consistent, as evidenced by a Synchronization Status value of 1:



If you reconfigure the module but forget to reimport the Studio 500 program, then the Synchronization Status will be automatically updated as -1, indicating that the configuration and the Studio 5000 program do not match.

8.6 CIP Diagnostics Tags

Following are the CIP objects implemented by the CIP Diagnostics Add-On Instruction.

8.6.1 Identity

Class (hex) = 1, Instance (hex) = 1

Attribute (dec)	Description	Data Type	Bytes
1	Vendor ID	UINT	2
2	Device Type	UINT	2
3	Product Code	UINT	2
4	Fw Version Major	USINT	1
4	Fw Version Minor	USINT	1
5	Status	UINT	2
	Pad	INT	2
6	Serial Number	UDINT	4
7	Product Name (LEN)	DINT	4
	Product Name (DATA)	SINT[82]	

8.6.2 Module

Class (hex) = 4, Instance (hex) = 300

Attribute (dec)	Description	Data Type	Bytes
0	All Data		
1	Timestamp Last Startup	LINT	8
2	Reserved	UINT	2
3	Reserved	SINT	1
4	Reserved	SINT	1
	Pad	DINT	4
		Total	16

8.6.3 PRP

Class (hex) = 4, Instance (hex) = 303

Attribute (dec)	Description	Data Type	Bytes
0	All Data		
1	LAN A Status	SINT	1
2	LAN B Status	SINT	1
3	LAN A Fault Count	UDINT	2
4	LAN B Fault Count	UDINT	2
	Pad	INT	2
5	LAN A Tx Count	ULINT	4
6	LAN B Tx Count	ULINT	4
7	LAN A Rx Count	ULINT	4
8	LAN B Rx Count	ULINT	4
9	LAN A Unique Entry Count	ULINT	4
10	LAN B Unique Entry Count	ULINT	4
11	LAN A Duplicate Entry Count	ULINT	4
12	LAN B Duplicate Entry Count	ULINT	4
		Total	40

8.6.4 Backplane

Class (hex) = 4
Instance (hex) = 310

Attribute (dec)	Description	Data Type	Bytes
0	All Data		
1	Class 1 Connection Established Count	UINT	2
2	Class 1 Connection Error Count	UINT	2
3	Class 3 Message Requests Received Count	UINT	2
4	Class 3 Message Responses OK Count	UINT	2
5	Class 3 Message Responses Error Count	UINT	2
	Pad	INT	2
		Total	12

8.6.5 IEC61850C, General

Class (hex) = 4
Instance (hex) = 320

Attribute (dec)	Description	Data Type	Bytes
0	All Data		
1	Active IED Connection Count	USINT	1
	Pad	SINT	1
2	IED Connection OK Count	UINT	1
3	IED Connection Error Count	UINT	2
4	IEDs Configured Count	USINT	1
	Pad	SINT	1
5	IEDs Online Status (bitmap): 1=online, 0=offline	ULINT	8
6	MMS Read Command Request Count	UINT	2
7	MMS Read Command Response OK Count	UINT	2
8	MMS Read Command Response Error Count	UINT	2
9	MMS Write Command Request Count	UINT	2
10	MMS Write Command Response OK Count	UINT	2
11	MMS Write Command Response Error Count	UINT	2
12	Report Subscription OK Count	UINT	2
13	Report Subscription Error Count	UINT	2
14	Report Received Count	UINT	2
15	New GOOSE Received Count	UINT	2
16	New GOOSE Published Count	UINT	2
17	Last Error Received IED # (1-based)	USINT	1
		Total	40

8.6.6 IEC61850C, IED Status

Class (hex) = 4
Instance (hex) = 321 to 348

Attribute (dec)	Description	Data Type	Bytes
0	All Data		
1	IED Index Code (1-based): =Instance-321h+1	USINT	1
	Pad	SINT x 3	3
2	IED Name (truncated to 14 characters) LEN	DINT	4
	IED Name (truncated to 14 characters) DATA	SINT[82]	82
	Pad	INT	2
3	IP Address (IPv4, Network Byte Order)	USINT[4]	4
4	IED Status Code: -1=Init, -2=Fault, 1=OK	SINT	1
	Pad	SINT	1
5	IED Connection OK Count	UINT	2
6	IED Connection Error Count	UINT	2
7	MMS Read Command Request Count	UINT	2
8	MMS Read Command Response OK Count	UINT	2
9	MMS Read Command Response Error Count	UINT	2
10	MMS Read Last Error Code	DINT	1
	Pad	SINT	1
11	MMS Write Command Request Count	UINT	2
12	MMS Write Command Response OK Count	UINT	2
13	MMS Write Command Response Error Count	UINT	2
14	MMS Write Command Last Error Tag LEN	DINT	4
	MMS Write Command Last Error Tag DATA	SINT[82]	82
15	MMS Write Last Error Code	DINT	1
16	Report Subscription OK Count	UINT	2
17	Report Subscription Error Count	UINT	2
	Pad	INT	2
18	Report Subscription Last Error RptId LEN	DINT	4
	Report Subscription Last Error RptId DATA	SINT[82]	82
19	Report Subscription Last Error Code	DINT	1
20	Report Received Count	UINT	2
21	New GOOSE Received Count	UINT	2
		Total	300

9 Reference

9.1 Specifications

9.1.1 IEC 61850 Client

Supports up to 40 IEDs on the network with a maximum of 300 data attributes each (max number of data attributes is determined by user-configured data types and size of user-configured data points).

Specification	Description
ACSI Basic Conformance	
SCSMs supported	SCSM: IEC 61850 8.1(MMS) used
ACSI Model Conformance	
Reporting	Buffered Report Control Block (BRCB) Unbuffered Report Control Block (URCB)
GOOSE	entryID, DataReflnc
Control	Direct-with-Normal-Security SBO-with-Normal-Security Direct-with-Enhanced-Security SBO-with-Enhanced-Security
Logical Nodes	IEC 61850 Logical Nodes, including Logical Nodes for Hydro Power Plants and Logical Nodes for Wind Power Plants
Configurable Parameters	MMS Command Delay
Status Data	Status available per node Report and GOOSE status available High-level status data available within Studio 5000

9.1.2 Hardware Specifications

Specification	Description
Backplane Current Load	1.4 A @ 5.1 VDC
Operating Temperature IEC 60068-2-1 (Test Ad, Operating Cold) IEC 60068-2-2 (Test Bd, Operating Dry Heat) IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25°C to 60 ºC (Series C Chassis) -25°C to 50 ºC (Series B Chassis)
Temperature, non-operating IEC 60068-2-1 (Test Ab, Unpackaged Cold) IEC 60068-2-2 (Test Bb, Unpackaged Dry Heat) IEC 60068-2-14 (Test Na, Unpackaged Thermal Shock)	-40°C to 85°C (-40°F to 185°F)
Relative Humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5 to 95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2g @ 10 to 500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30g
Shock, non-operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30g
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	4 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80 to 2000 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000 to 2700 MHz

Specification	Description
EFT/B immunity IEC 61000-4-4	+/- 2 kV at 5 kHz on Ethernet ports
Surge transient immunity IEC 61000-4-5	+/- 2 kV line-earth (CM) on Ethernet ports
Conducted RF immunity IEC 61000-4-6	10V rms with 1 kHz sine-wave 80% AM from 150 kHz to 80 MHz
Ethernet Ports (E1, E2)	(2) 10/100/1000 Base-T half duplex RJ45 Connector Link and Activity LED indicators
Dimensions	Standard 1756 Single-slot module

10 Support, Service & Warranty

10.1 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:

- Product Version Number
- System architecture
- Network details

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

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

Note: For technical support calls within the United States, ProSoft Technology's 24/7 after-hours phone support is available for urgent plant-down issues.

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

10.2 Warranty Information

For complete details regarding ProSoft Technology's TERMS & CONDITIONS OF SALE, WARRANTY, SUPPORT, SERVICE AND RETURN MATERIAL AUTHORIZATION INSTRUCTIONS, please see the documents at: www.prosoft-technology/legal