THERMAL SOLUTIONS®
Innovative Equipment for Hot Water Systems

FPC-N34-0643
BACnet Protonode

FPC-N35-0644
LonWorks Protonode

ProtoNode FPC-N34 and ProtoNode FPC-N35 Start-up Guide

For Interfacing Thermal Solutions Product Models EVA/EVAW/EVO/EVOW with RWF40, RWF55 and RM7800 Controls

To Building Automation Systems: BACnet MS/TP, BACnet/IP, Modbus TCP/IP, Metasys N2 and LonWorks

SMC sierra monitor

Document Revision: 7.A
Web Configurator
Template Revision: 70

Technical Support

Thank you for purchasing the ProtoNode for Thermal Solutions.

Please call Thermal Solutions for technical support of the ProtoNode product.

Sierra Monitor Corporation does not provide direct support. If Thermal Solutions needs to escalate the concern, they will contact Sierra Monitor Corporation for assistance.

Support Contact Information:
Thermal Solutions Products, LLC
1175 Manheim Pike
Lancaster, PA 17601

Customer Service:
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Website: www.thermalsolutions.com

Quick Start Guide

1. Record the information about the unit. (**Section 3.1**)

2. Set the device's COM settings and Node-ID for each of the devices that are to connect to the ProtoNode. (**Section 3.3**)

3. FPC-N34: Select the protocol configuration on the S Bank DIP switches. (**Section 3.4**)

4. BACnet MS/TP (FPC-N34): Set the MAC Address on the A Bank DIP switches. (**Section 3.5.1**)

5. BACnet MS/TP (FPC-N34): Set the baud rate of the BACnet MS/TP field protocol on the B Bank DIP switches. (**Section 3.5.2**)

6. Connect the ProtoNode 6 pin RS-485 connector to the RS-485 network that is connected to each of the devices. (**Section 4.2**)

7. **Connect the ProtoNode FPC-N34** 3 pin RS-485 port to the field protocol cabling, (**Section 4.3**)
   or connect the ProtoNode FPC-N35 2 pin LonWorks port to the field protocol cabling. (**Section 4.4**)

8. Connect power to the ProtoNode 6 pin connector. (**Section 4.5**)

9. Use a web browser to access the ProtoNode Web Configurator page to select the profiles of the devices attached to the ProtoNode and input the Node-ID from each device. Once the devices are selected, the ProtoNode automatically builds and loads the appropriate configuration. (**Section 5**)

10. Ethernet Network (FPC-N34): Use a web browser to access the ProtoNode Web Configurator page to change the IP Address. No changes to the configuration are necessary. (**Section 5.4**)

11. LonWorks (FPC-N35): The ProtoNode must be commissioned on the LonWorks Network. This needs to be done by the LonWorks administrator using a LonWorks commissioning tool. (**Section 8**)

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1   CERTIFICATIONS

1.1   BTL Mark – BACnet[®][1] Testing Laboratory

The BTL Mark on ProtoNode is a symbol that indicates that a product has passed a series of rigorous tests conducted by an independent laboratory which verifies that the product correctly implements the BACnet features claimed in the listing. The mark is a symbol of a high-quality BACnet product.

Go to www.BACnetInternational.net for more information about the BACnet Testing Laboratory. Click here for the BACnet PIC Statement.

1.2   LonMark Certification

LonMark International is the recognized authority for certification, education, and promotion of interoperability standards for the benefit of manufacturers, integrators and end users. LonMark International has developed extensive product certification standards and tests to provide the integrator and user with confidence that products from multiple manufacturers utilizing LonMark devices work together. Sierra Monitor has more LonMark Certified gateways than any other gateway manufacturer, including the ProtoCessor, ProtoCarrier and ProtoNode for OEM applications and the full featured, configurable gateways.

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[1] BACnet is a registered trademark of ASHRAE

2   INTRODUCTION

2.1   ProtoNode Gateway

The ProtoNode is an external, high performance **building automation multi-protocol gateway** that is preconfigured to automatically communicate between Thermal Solutions' products (hereafter called "device") connected to the ProtoNode and automatically configures them for BACnet MS/TP, BACnet/IP, Metasys[2] N2 by JCI, Modbus TCP/IP or LonWorks[3].

It is not necessary to download any configuration files to support the required applications. The ProtoNode is pre-loaded with tested profiles/configurations for the supported devices.

FPC-N34 Connectivity Diagram:
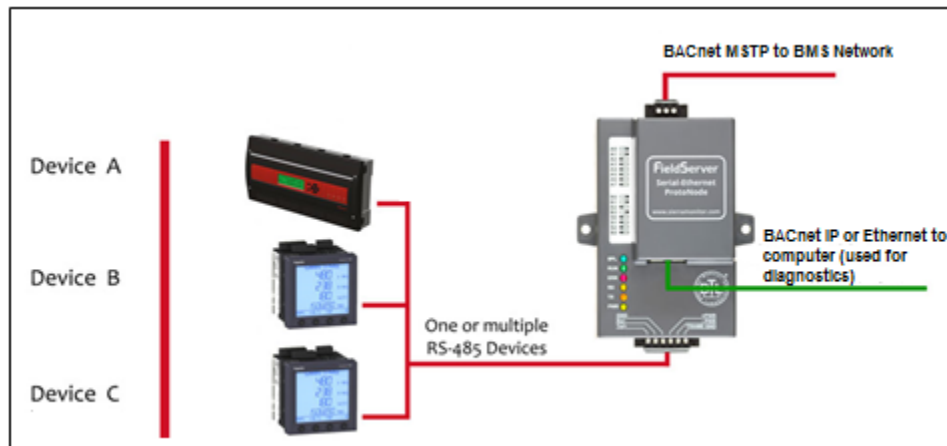
FPC-N35 Connectivity Diagram:

3   SETUP FOR PROTONODE

3.1   Record Identification Data

Each ProtoNode has a unique part number located on the side or the back of the unit. This number should be recorded, as it may be required for technical support. The numbers are as follows:

Model	Part Number
ProtoNode FPC-N34 BACnet	FPC-N34-0643
ProtoNode FPC-N35 LonWorks	FPC-N35-0644
Figure 1: ProtoNode Part Numbers	

- FPC-N34 units have the following 3 ports: BACnet RS-485 + Ethernet + Modbus RS-485

- FPC-N35 units have the following 3 ports: LonWorks + Ethernet + Modbus RS-485

3.2   Point Count Capacity and Registers per Device

The total number of registers presented by all the devices attached to the ProtoNode cannot exceed:

Part number	Total Registers
FPC-N34-0643	1,500
FPC-N35-0644	1,500
Figure 2: Supported Point Count Capacity	

Devices	Registers Per Device
RWF40	15
RM7800	37
RWF55	10
Figure 3: Registers per Device	

3.3 Configuring Device Communications

3.3.1 Input COM Settings on All Devices Connected to the ProtoNode

- **All of the connected serial devices MUST have the same baud rate, data bits, stop bits, and parity settings as the ProtoNode.**

- **Figure 4** specifies the device serial port settings required to communicate with the ProtoNode.

Port Setting	RWF40, RWF55, RM7800
Protocol	Modbus RTU RS-485
Baud Rate	19,200
Parity	None
Data Bits	8
Stop Bits	1
Figure 4: COM Settings	

3.3.2 Set Node-ID for Each Device Attached to the ProtoNode

- Set Node-ID for each of the devices attached to ProtoNode. The Node-ID's need to be uniquely assigned between 1 and 255.

- Document the Node-ID assigned for each device. The Node-ID's assigned are used for deriving the Device Instance for BACnet/IP and BACnet MS/TP. (**Section 3.5.2**)

NOTE: The Metasys N2 and Modbus TCP/IP field protocol Node-IDs are automatically set to be the same value as the Node-ID of the device.

3.4   Selecting the Desired Protocol Configuration

- ProtoNode FPC-N34 BACnet units use the "S" bank of DIP switches (S0 – S3) to select the protocol configuration.

    o   See the table in **Figure 5** for the switch settings to select

    o   The OFF position is when the DIP switches are set closest to the outside of the box

- ProtoNode FPC-N35 LonWorks units do not use the "S" bank DIP switches (S0 – S3) to select a field protocol.

    o   On ProtoNode FPC-N35 units, these switches are disabled; the field protocol is always LonWorks
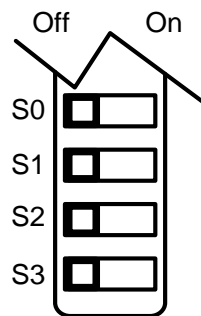
S0 – S3 DIP Switches
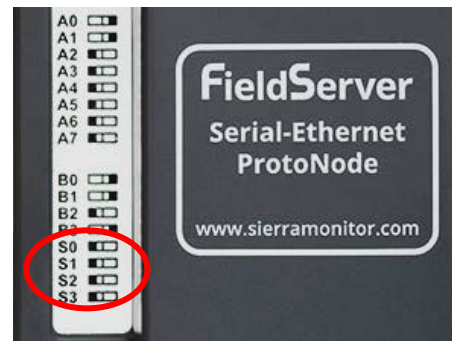
S Bank DIP Switch Location

ProtoNode FPC-N34	S Bank DIP Switches			
Profile	S0	S1	S2	S3
BACnet/IP	Off	Off	Off	Off
BACnet MS/TP	On	Off	Off	Off
Metasys N2	Off	On	Off	Off
Modbus TCP/IP	On	On	Off	Off
BACnet MS/TP (single node)	Off	Off	On	Off

Profile Settings for ProtoNode

Figure 5: S Bank DIP Switches

NOTE: When setting DIP switches, ensure that power to the board is OFF.

3.5   BMS Network Settings: MAC Address, Device Instance and Baud Rate

3.5.1 BACnet MS/TP (FPC-N34): Setting the MAC Address for BMS Network

- Only 1 MAC Address is set for ProtoNode regardless of how many devices are connected to ProtoNode.

- Set the BACnet MS/TP MAC Address of the ProtoNode to a value between 1 to 127 (Master MAC Address); this is so that the BMS front end can find ProtoNode via BACnet Auto-Discovery.

NOTE: Never set a BACnet MS/TP MAC Address of the ProtoNode to a value from 128 to 255. Addresses from 128 to 255 are Slave Addresses and can not be discovered by BMS front ends that support Auto-Discovery of BACnet MS/TP devices.

- Set "A" bank DIP switches A0 – A7 to assign a MAC Address to the ProtoNode for BACnet MS/TP.

- Refer to Appendix D.1 for the complete range of MAC Addresses and DIP switch settings.

NOTE: When using Metasys N2 and Modbus TCP/IP, the A Bank of DIP switches are disabled and not used. They should be set to OFF.
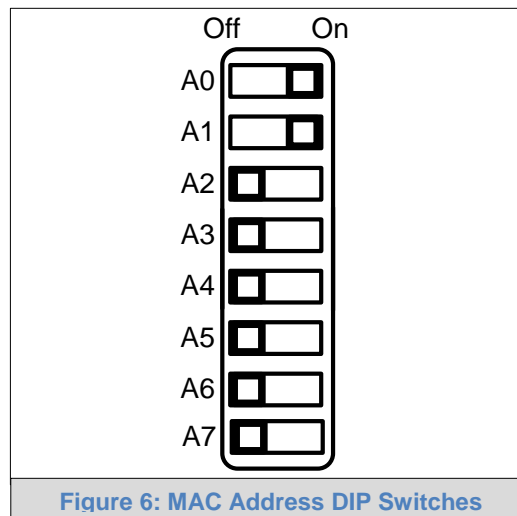
Figure 6: MAC Address DIP Switches

NOTE: When setting DIP switches, ensure that power to the board is OFF.

3.5.2 BACnet (FPC-N34): Calculating the Default Device Instance

- The Device Instance value is automatically generated using the following formula:

  BACnet Device Instance = (Device Node ID) + (Default Node Offset)

NOTE: The default Node Offset is 50,000.

For example, if Device A has a Node ID of 1 and Device B has a Node ID of 2, then:

BACnet Device Instance A = (1) + (50000) = 50001

BACnet Device Instance B = (2) + (50000) = 50002

NOTE: The Node ID is set in Section 3.3.2.

- To reach a specific BACnet Device Instance result, refer to **Section 6**.

3.5.3 BACnet MS/TP (FPC-N34): Setting the Baud Rate for BMS Network

- DIP switches B0 – B3 can be used to set the field baud rate of the ProtoNode to match the baud rate required by the BMS for BACnet MS/TP.

- The ProtoNode baud rate for Metasys N2 is set for 9600. DIP switches B0 – B3 are disabled for Metasys N2 on ProtoNode FPC-N34.

- DIP switches B0 – B3 are disabled on ProtoNode FPC-N35 (LonWorks).
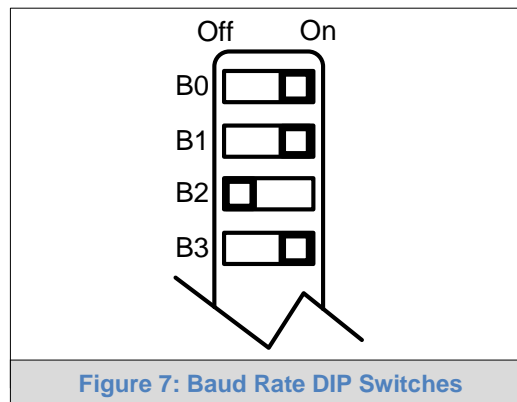
Figure 7: Baud Rate DIP Switches

NOTE: When setting DIP switches, ensure that power to the board is OFF.

3.5.3.1 Baud Rate DIP Switch Selection

Baud	B0	B1	B2	B3
9600	On	On	On	Off
19200	Off	Off	Off	On
38400*	**On**	**On**	**Off**	**On**
57600	Off	Off	On	On
76800	On	Off	On	On
Figure 8: BMS Baud Rate				

* Factory default setting = 38400

4   INTERFACING PROTONODE TO DEVICES

4.1   ProtoNode FPC-N34 and FPC-N35 Showing Connection Ports
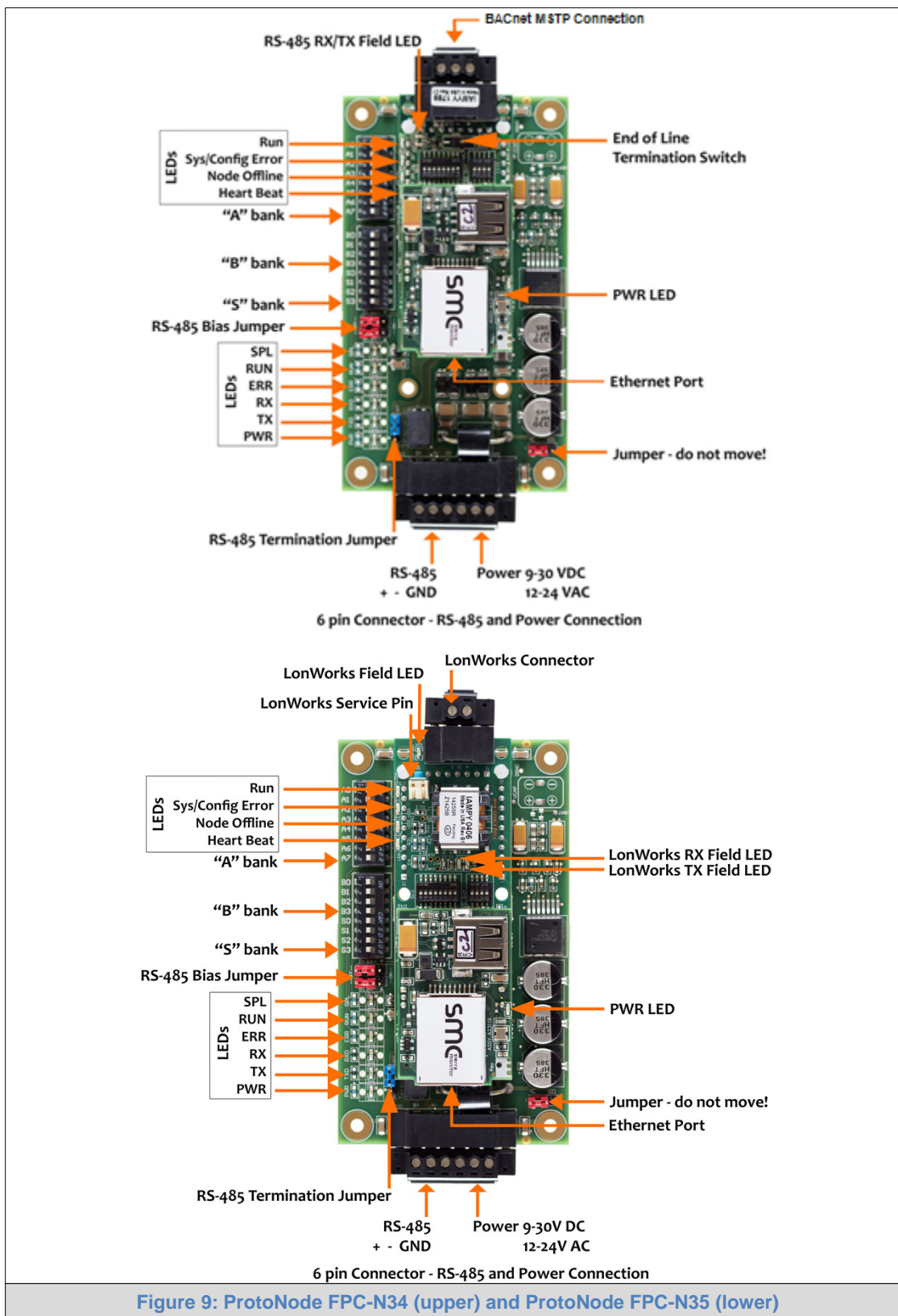
Figure 9: ProtoNode FPC-N34 (upper) and ProtoNode FPC-N35 (lower)

4.2 Device Connections to ProtoNode

ProtoNode 6 Pin Phoenix connector:

- The 6 pin Phoenix connector is the same for ProtoNode FPC-N34 (BACnet) and FPC-N35 (LonWorks).

- Pins 1 through 3 are for Modbus RS-485 devices (boiler side).

  o Use standard grounding principles for RS-485 GND

- Pins 4 through 6 are for power. **Do not connect power until Section 4.4**.

Device Pins	ProtoNode Pin #	Pin Assignment
Modbus RS-485 +	Pin 1	Tx/ +
Modbus RS-485 -	Pin 2	Rx/ -
Modbus GND	Pin 3	GND
9-30vDC or 12-24vAC(+)	Pin 4	PWR +
Neutral (-)	Pin 5	PWR -
Ground	Pin 6	FRAME GND

Figure 10: RS-485 and Power Connections
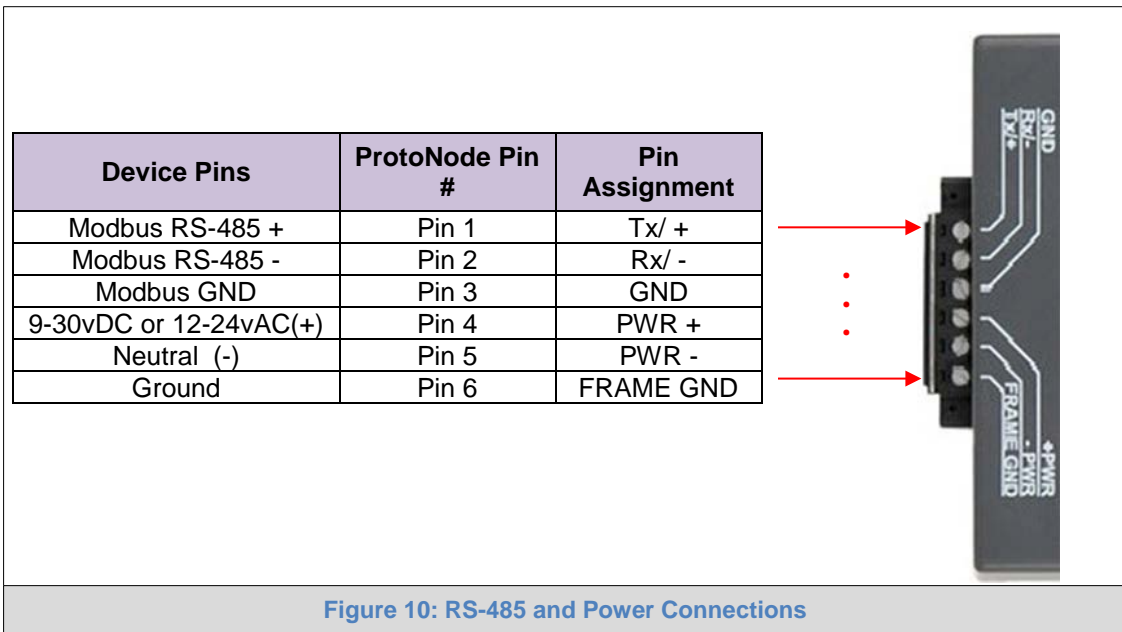
4.2.1 Wiring RWF40 individually to the ProtoNode

- On the RWF40; connect CA on terminal strip to Tx+ on the ProtoNode connector.
- Connect CB on terminal strip to Rx- on the ProtoNode connector.
- Connect CG on terminal strip to GND on the ProtoNode connector.
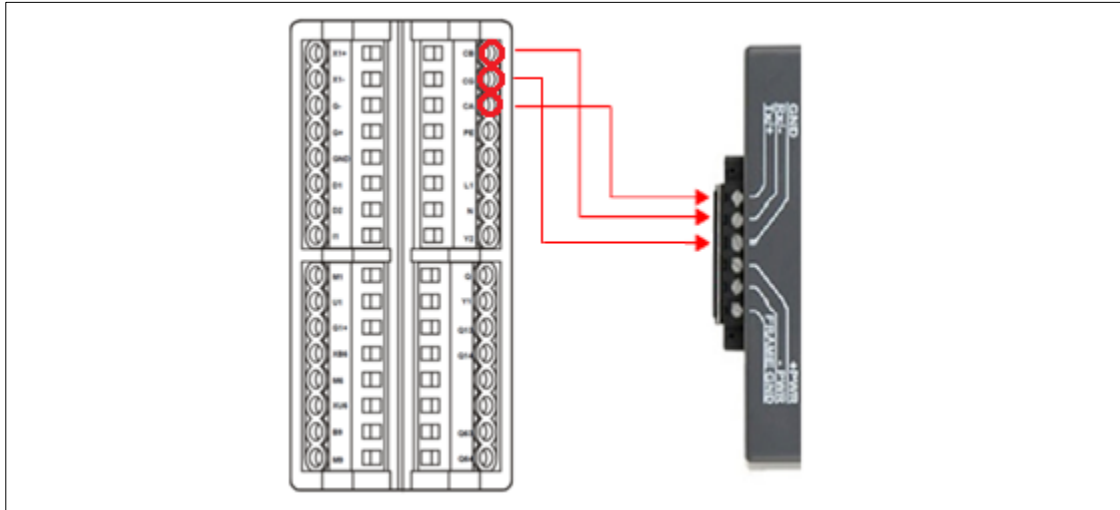
Figure 11: RWF40 Wiring to the ProtoNode

4.2.2 Wiring RWF55 individually to the ProtoNode

- On the RWF55; connect R+ on terminal strip to Tx+ on the ProtoNode connector.
- Connect R- on terminal strip to Rx- on the ProtoNode connector.
- RWF55 does not use a Ground.
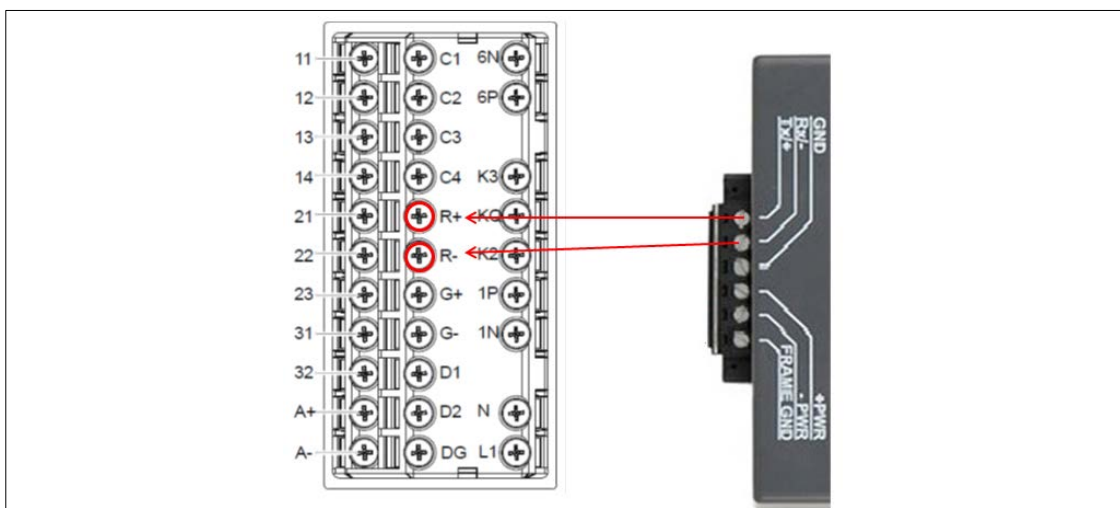
Figure 12: RWF55 Wiring to the ProtoNode

4.2.3 Wiring RM7800 Display Module individually to the ProtoNode

- On the RM7800 Series; connect A on terminal strip to Tx+ on the ProtoNode connector.

- Connect B on terminal strip to Rx- on the ProtoNode connector.

- Connect C (GND) on terminal strip to GND on the ProtoNode connector.

Figure 13: RM7800 Series Wiring to the ProtoNode
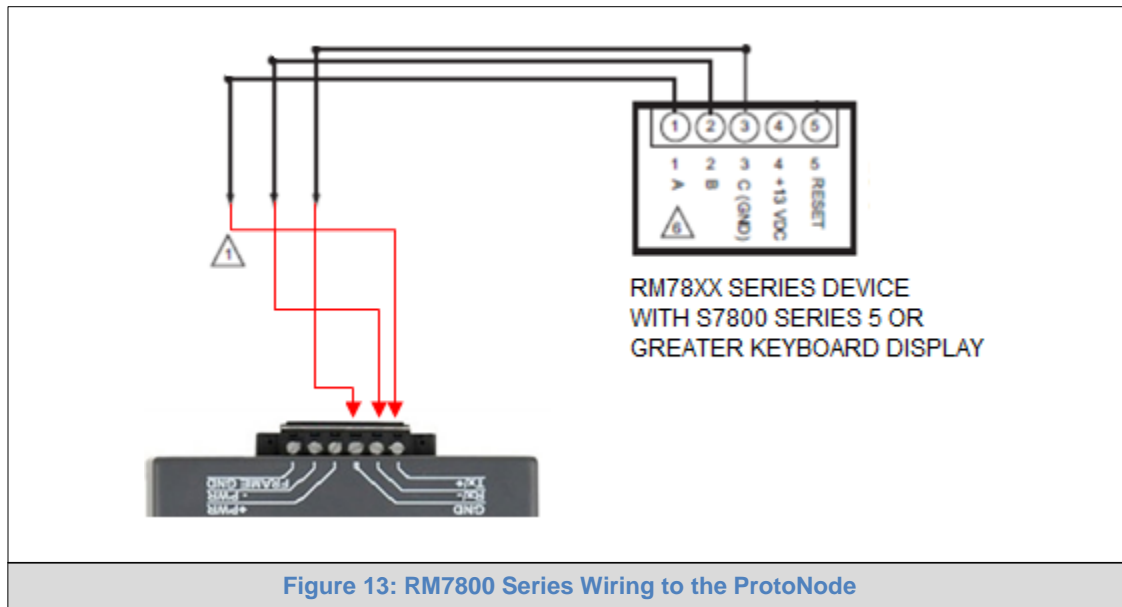
4.2.4 Optional Wiring RWF40 or RWF55 & RM7800 display to the ProtoNode

- If you have Optional Terminal Strip factory wired to RWF40 or RWF55 & RM7800 display module:

- On the Terninal Stip; connect AO on terminal strip to Tx+ on the ProtoNode connector.

- Connect BO on terminal strip to Rx- on the ProtoNode connector.

- Connect SO on terminal strip to the GND on the ProtoNode connector.

Figure 14: Optional Terminal Strip (RWF40 or RWF55 & RM7800 Series) Wiring to the ProtoNode
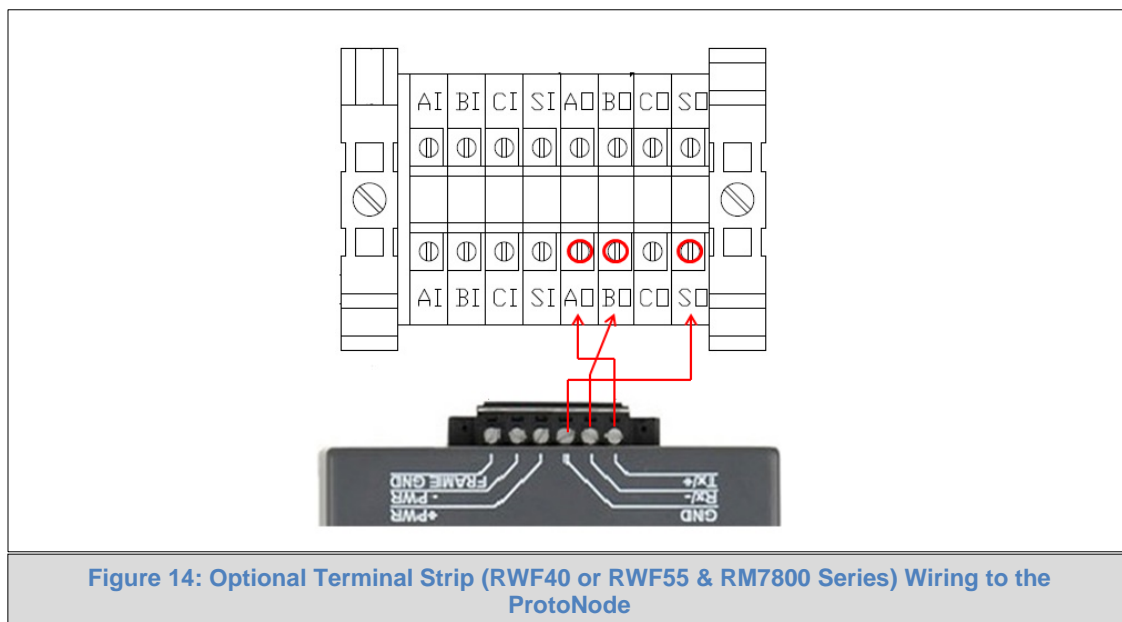
4.2.5 End of Line Termination Switch for the Modbus RS-485 Device Network

- On long RS-485 cabling runs, the RS-485 trunk must be properly terminated at each end.

- The ProtoNode has an End of Line (EOL) blue jumper. The default setting for this Blue EOL switch is OFF with the jumper straddling the pins closest to the inside of the board of the ProtoNode.
    - On short cabling runs the EOL switch does not to need to be turned ON

- **If the ProtoNode is placed at one of the ends of the trunk, set the blue EOL jumper to the ON position straddling the pins closest to the outside of the board of the ProtoNode.**

- **Always leave the single Red Jumper in the A position (default factory setting).**

Modbus RS-485 EOL Switch (off)

Leave in Position A

Figure 15: Modbus RS-485 End-Of-Line Termination Switch on the ProtoNode N34 (left) and ProtoNode N35 (right)
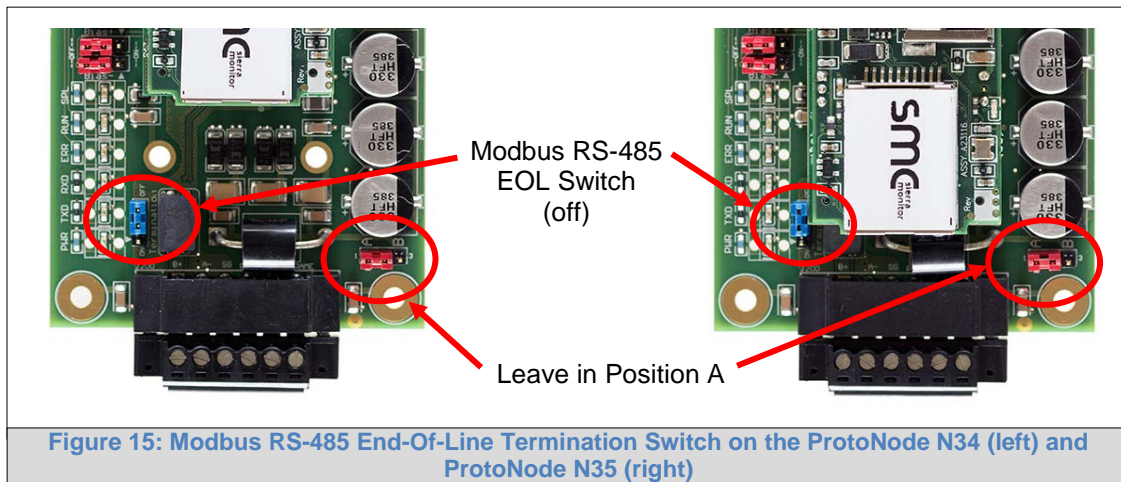
4.3   Serial Network (FPC-N34): Wiring Field Port for BACNET RS-485 Network

- Connect the BACnet RS-485 network wires to the 3-pin RS-485 connector on ProtoNode FPC-N34 as shown below in **Figure 16**.
    - Use standard grounding principles for RS-485 GND

- See **Section 5.4** for information on connecting to BACnet/IP network.

BACnet BMS Wiring	ProtoNode Pin #	Pin Assignment
RS-485 +	Pin 1	RS-485 +
RS-485 -	Pin 2	RS-485 -
-	Pin 3	RS-485 GND

Figure 16: Connection from ProtoNode to RS-485 Field Network
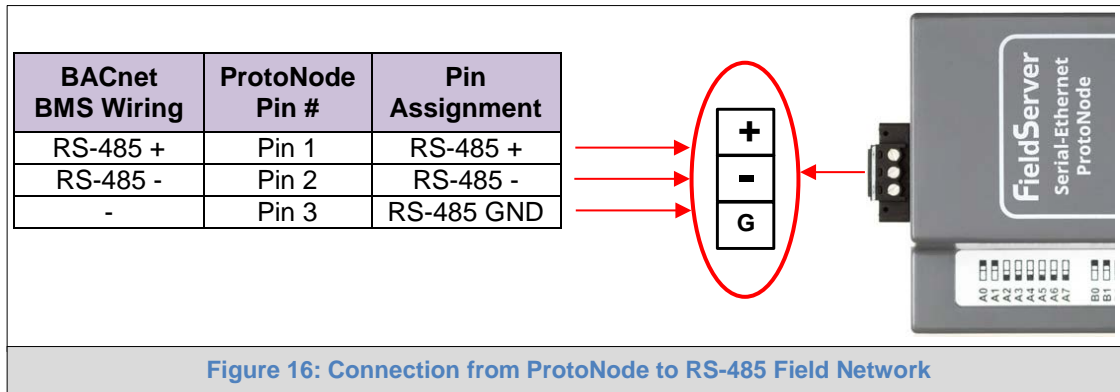
- If the ProtoNode is the last device on the trunk, then the End-Of-Line Termination Switch needs to be enabled (**Figure 17**).
    - The default setting from the factory is OFF (switch position = right side)
    - To enable the EOL Termination, turn the EOL switch ON (switch position = left side)

End-of-Line Switch

Figure 17: RS-485 BMS Network EOL Switch
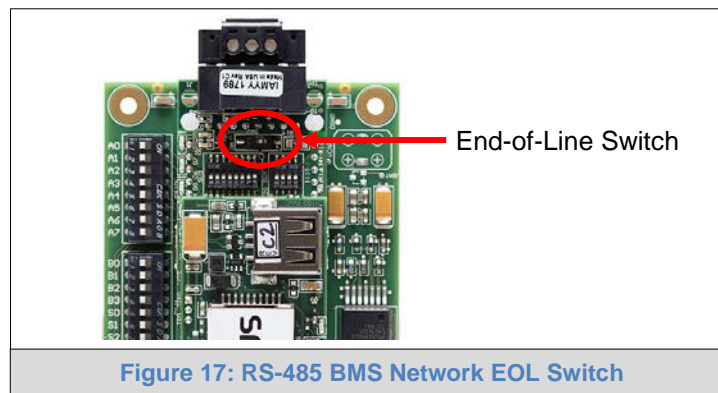
4.4   LonWorks (FPC-N35): Wiring LonWorks Devices to the LonWorks Terminal

- Wire the LonWorks device network to the ProtoNode LonWorks Terminal.
    - Use approved cable per the FT-10 installation guidelines
- LonWorks has no polarity.

Figure 18: LonWorks Terminal

4.5   Power-Up ProtoNode

Check power requirements in the table below:

Power Requirement for ProtoNode External Gateway			
	Current Draw Type		
ProtoNode Family	12V DC/AC	24V DC/AC	30V DC
FPC – N34 (Typical)	170mA	100mA	80mA
FPC – N34 (Maximum)	240mA	140mA	100mA
FPC – N35 (Typical)	210mA	130mA	90mA
FPC – N35 (Maximum)	250mA	170mA	110mA
NOTE: These values are 'nominal' and a safety margin should be added to the power supply of the host system. A safety margin of 25% is recommended.			
Figure 19: Required Current Draw for the ProtoNode			

Apply power to the ProtoNode as shown below in **Figure 20**. Ensure that the power supply used complies with the specifications provided in **Appendix E.1**.

- ProtoNode accepts either 9-30V DC or 12-24V AC on pins 4 and 5.

- Frame GND should be connected.

Power to ProtoNode	ProtoNode Pin #	Pin Assignment
9-30vDC or 12-24vAC(+)	Pin 4	V +
Neutral (-)	Pin 5	V -
Ground	Pin 6	FRAME GND

Figure 20: Power Connections
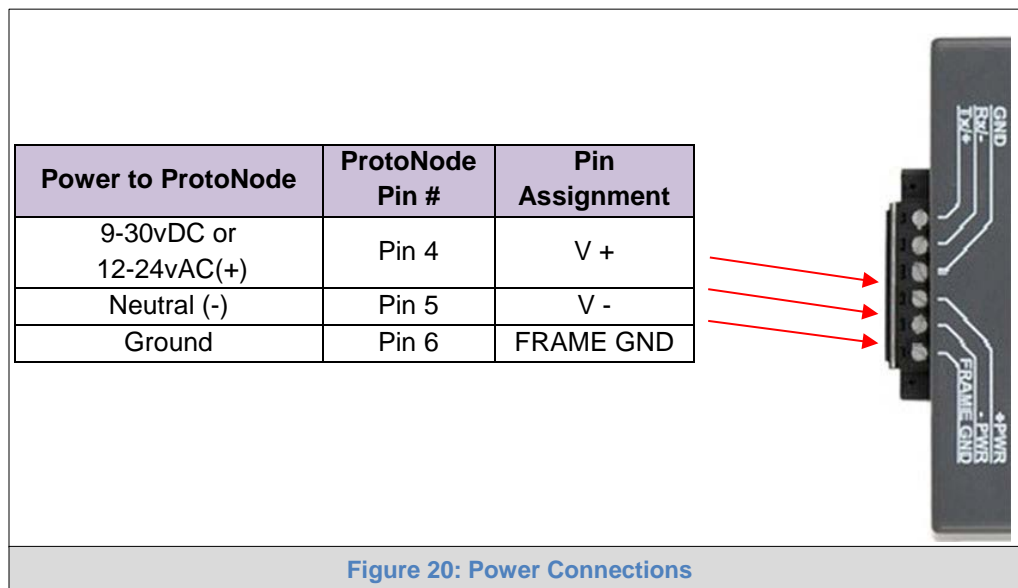
5   USE THE PROTONODE WEB CONFIGURATOR TO SETUP THE GATEWAY

5.1   Connect the PC to ProtoNode via the Ethernet Port

- Connect a CAT5 Ethernet cable (Straight through or Cross-Over) between the local PC and the ProtoNode.

- The Default IP Address of the ProtoNode is **192.168.1.24**, subnet mask is **255.255.255.0**. If the PC and the ProtoNode are on different IP Networks, assign a static IP Address to the PC on the 192.168.1.xxx network.

For Windows 10:

Right click on [Windows icon] > [Control Panel icon] Control Panel > [Network icon] Network and Internet

> [Network icon] Network and Sharing Center > Change adapter settings

Right-click on Local Area Connection > Properties

Highlight [☑] [Internet Protocol Version 4 (TCP/IPv4)] > [Properties]

Use the following IP Address:

Use the following IP address:	
IP address:	192 . 168 . 1 . 11
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	. . .

Click [OK] twice.

5.2   Connecting to the ProtoNode Web Configurator

After setting a local PC on the same subnet as the ProtoNode (**Section 5.1**), open a web browser on the PC and enter the IP Address of the ProtoNode; the default address is 192.168.1.24.

NOTE: If the IP Address of the ProtoNode was changed, the assigned IP Address can be discovered using the FS Toolbox utility. See Appendix A.1 for instructions.

5.3   Selecting Profiles for Devices Connected to ProtoNode

NOTE: If Modbus TCP/IP was selected in Section 3.4 for the Field/BMS protocol, skip this section. Device profiles are NOT used for Modbus TCP/IP.

- In the Web Configurator, the Active Profiles are shown below the Configuration Parameters.

- The Active profiles section lists the currently active device profiles, including previous Web Configurator additions. This list is empty for new installations, or after clearing all configurations. (**Figure 21**)

Figure 21: Web Configurator Showing no Active Profiles

- To add an active profile to support a device, click the Add button under the Active Profiles heading. This will present a drop-down box underneath the Current profile column that lists all the available profiles. (**Figure 22**)

- For every device that is added, assign a unique Node-ID. This specification must match the device's network settings.

NOTE: **If multiple devices are connected to the ProtoNode, set the BACnet Virtual Server Nodes field to "Yes"; otherwise leave the field on the default "No" setting.**

- Once the Profile for the device has been selected from the drop-down list, enter the value of the device's Node-ID which was assigned in **Section 3.3.2**.
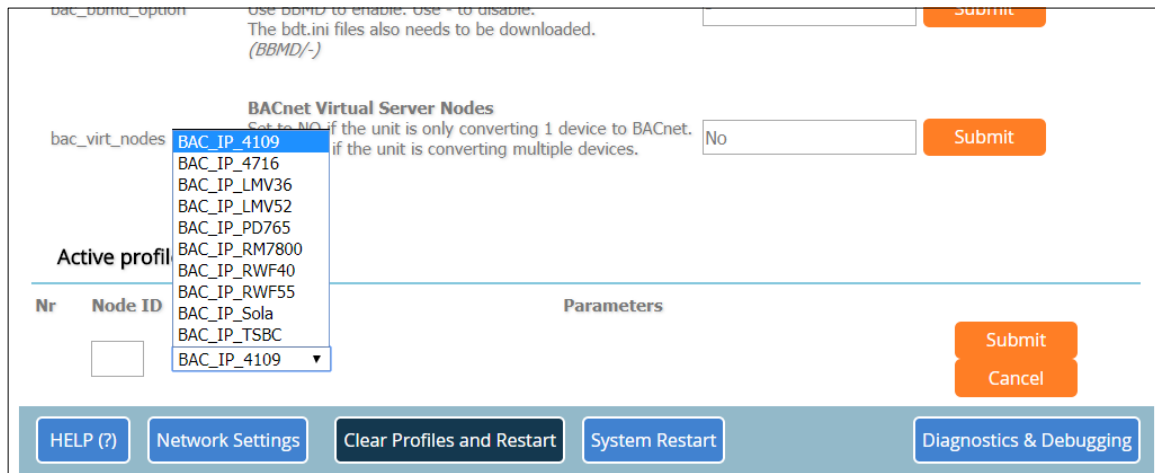
Figure 22: Web Configurator Showing Available Profiles for Selection

- Then press the "Submit" button to add the Profile to the list of devices to be configured.

- Repeat this process until all the devices have been added.

- Completed additions are listed under "Active Profiles" as shown in **Figure 23**.
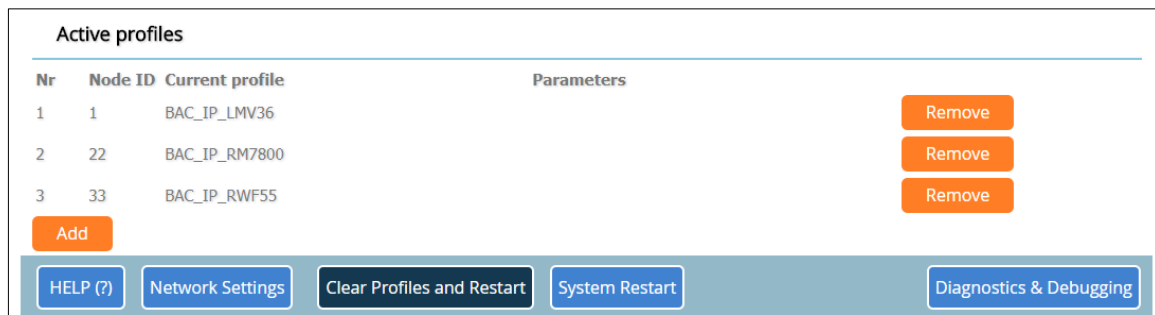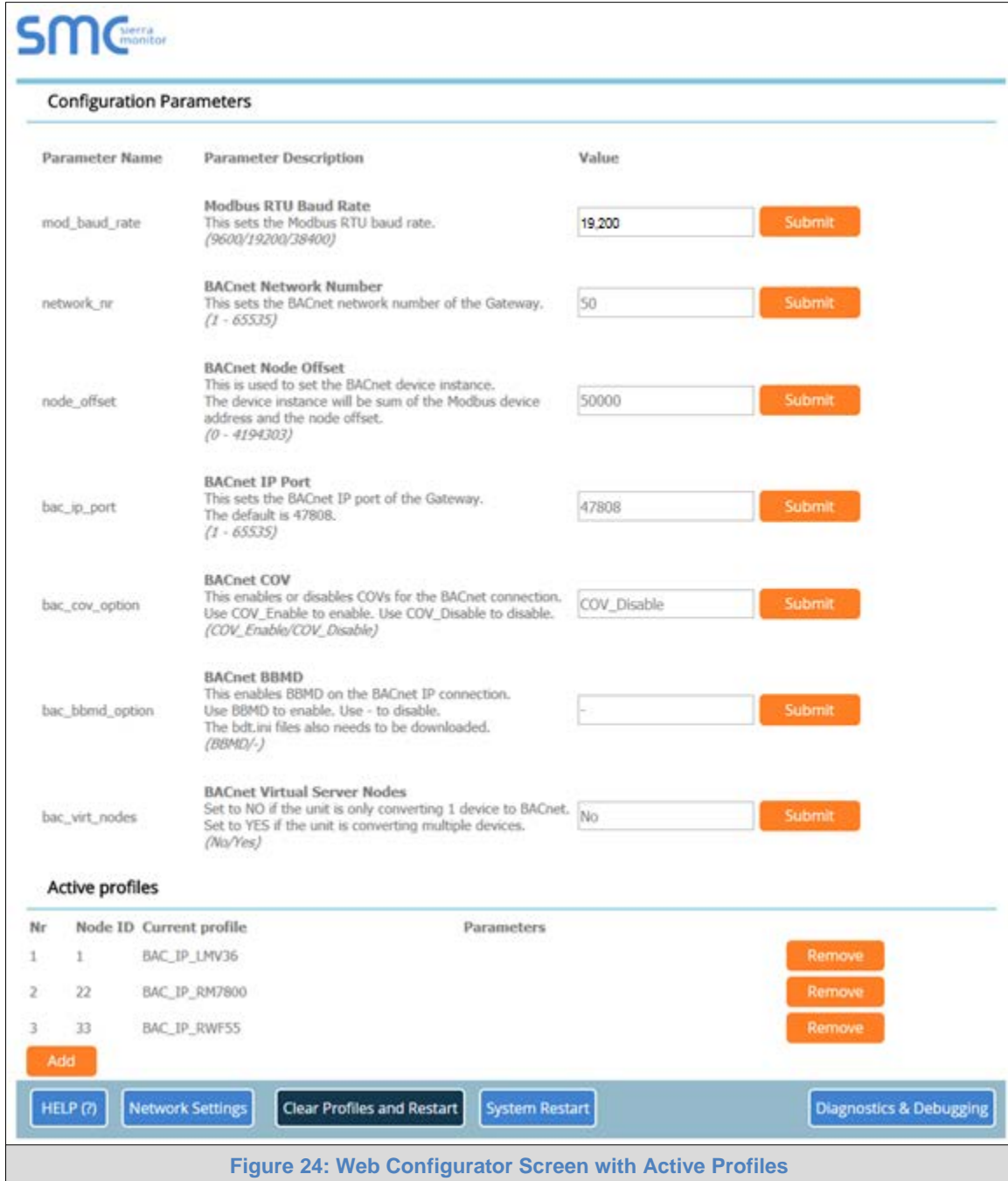
Figure 23: Web Configurator Showing Active Profile Additions

5.4 Ethernet Network: Setting IP Address for the Field Network

- After setting a local PC to the same subnet as the ProtoNode (**Section 5.1**), open a web browser on the PC and enter the IP Address of the ProtoNode; the default address is 192.168.1.24.

- The Web Configurator is displayed as the landing page. (**Figure 24**)

- To access the FS-GUI, click on the "Diagnostics & Debugging" button in the bottom right corner of the page.

Figure 24: Web Configurator Screen with Active Profiles

- From the FS-GUI landing page, click on "Setup" to expand the navigation tree and then select "Network Settings" to access the IP Settings menu. (**Figure 25**)

Figure 25: Changing IP Address via FS-GUI

- Modify the IP Address (N1 IP Address field) of the ProtoNode Ethernet port.

- If necessary, change the Netmask (N1 Netmask field).

- If necessary, change the IP Gateway (Default Gateway field).

NOTE: If the ProtoNode is connected to a managed switch/router, the IP Gateway of the ProtoNode should be set to the IP Address of that managed switch/router.

- Click the "System Restart" button at the bottom of the page to apply changes and restart the ProtoNode.

- Unplug Ethernet cable from PC and connect it to the network switch or router.

- Record the IP Address assigned to the ProtoNode for future reference.

NOTE: The FieldPoP™ button FieldPoP™ **(see Figure 25) allows users to connect to the SMC Cloud, Sierra Monitor's device cloud solution for IIoT. The SMC Cloud enables secure remote connection to field devices through a FieldServer and its local applications for configuration, management, maintenance. For more information about the SMC Cloud, refer to the SMC Cloud Start-up Guide.**

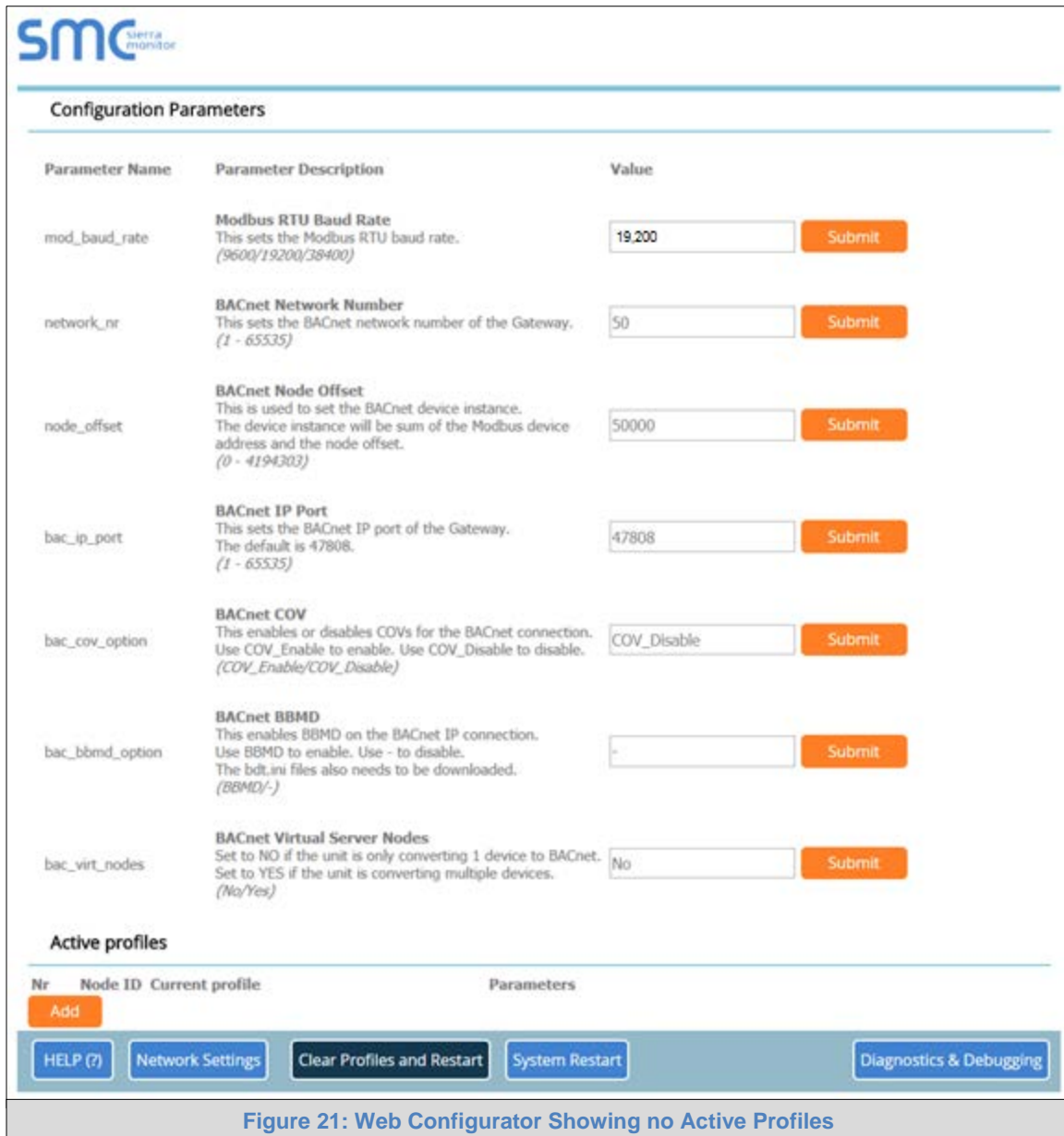# 6   BACNET: SETTING NODE_OFFSET TO ASSIGN SPECIFIC DEVICE INSTANCES

- After setting a local PC to the same subnet as the ProtoNode (**Section 5.1**), open a web browser on the PC and enter the IP Address of the ProtoNode.

    o If the IP Address of the ProtoNode has been changed by previous configuration, the assigned IP Address must be gathered from the network administrator

    o The Web Configurator is displayed as the landing page

- Node_Offset field shows the current value (default = 50,000).

    o The values allowed for a BACnet Device Instance can range from 1 to 4,194,303

- To assign a specific Device Instance (or range); change the Node_Offset value as needed using the calculation below:

    Device Instance (desired) = Node_Offset + Node_ID

For example, if the desired Device Instance for the device 1 is 50,001 and the following is true:

- Device 1 has a Node-ID of 1
- Device 2 has a Node-ID of 22
- Device 3 has a Node-ID of 33

Then plug the device 1's information into the formula to find the desired Node_Offset:
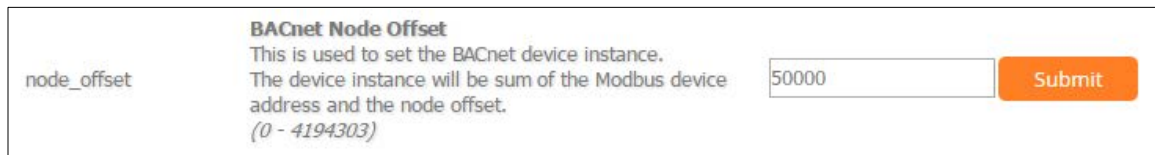
   50,001 = Node_Offset + 1

➢ **50,000 = Node_Offset**

Once the Node_Offset value is input, it will be applied to all devices as shown below:

- Device 1 Instance = 50,000 + Node_ID = 50,000 + 1 = 50,001
- Device 2 Instance = 50,000 + Node_ID = 50,000 + 22 = 50,022
- Device 3 Instance = 50,000 + Node_ID = 50,000 + 33 = 50,033
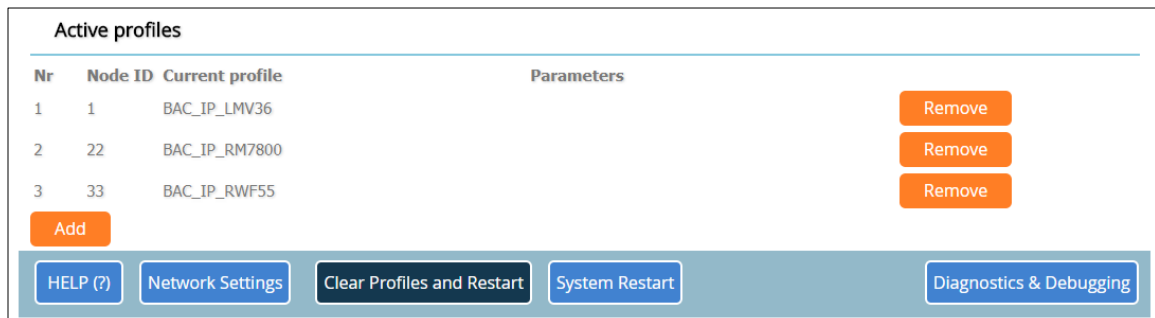
- Click "Submit" once the desired value is entered.

Figure 26: Web Configurator Node Offset Field

Figure 27: Active Profiles

7   HOW TO START THE INSTALLATION OVER: CLEARING PROFILES

- After setting a local PC to the same subnet as the ProtoNode (**Section 5.1**), open a web browser on the PC and enter the IP Address of the ProtoNode.

- If the IP Address of the ProtoNode has been changed by previous configuration, the assigned IP Address must be gathered from the network administrator.

- The Web Configurator is displayed as the landing page.

- At the bottom-left of the page, click the "Clear Profiles and Restart" button.

- Once restart is complete, all past profiles discovered and/or added via Web configurator are deleted. The unit can now be reinstalled.

8   LONWORKS (FPC-N35): COMMISSIONING PROTONODE ON A LONWORKS NETWORK

Commissioning may only be performed by the LonWorks administrator.

8.1   Commissioning ProtoNode FPC-N35 on a LonWorks Network

During the commissioning process, the LonWorks administrator may prompt the user to hit the service pin on the ProtoNode FPC-N35 at a specific point (this step occurs at different points of the commissioning process for each LonWorks network management tool).

- If an XIF file is required, see steps in **Section 8.1.1** to generate XIF.

Figure 28: LonWorks Service Pin Location

8.1.1   Instructions to Upload XIF File from ProtoNode FPC-N35 Using Browser

- Connect a CAT5 Ethernet cable (straight through or cross-over) between the PC and ProtoNode.

- The Default IP Address of ProtoNode is **192.168.1.24**, subnet mask is **255.255.255.0**. If the PC and ProtoNode are on different IP Networks, assign a static IP Address to the PC on the 192.168.1.xxx network.

- For Windows 10:

  Right click on [image] > [image] Control Panel > [image] Network and Internet

  > [image] Network and Sharing Center > Change adapter settings

  Right-click on Local Area Connection > Properties

  Highlight [image] Internet Protocol Version 4 (TCP/IPv4) > [image] Properties

- Once in the properties window, enter the following IP Address:

- Click [OK] twice.

- Open a web browser and go to the following address: [IP Address of ProtoNode]/fserver.xif
  - Example: 192.168.1.24/fserver.xif

- If the web browser prompts to save the file, save the file onto the PC. If the web browser displays the xif file as a web page, save the file onto the local PC as "fserver.xif".

```
File: fserver.xif generated by LonDriver Revision 1.30(d), XIF Version 4.0
Copyright (c) 2000-2012 by FieldServer Technologies
All Rights Reserved.  Run on Thu Jan  1 00:00:00 1970

90:00:95:47:1E:02:04:7C
2 15 1 4 0 14 11 3 3 12 14 11 11 11 11 3 0 16 63 0 1 11 4
32 5 19 13 28 0 0 15 5 3 109 63
1 7 1 0 4 4 4 15 200 0
78125 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1 5 8 5 12 14 15
*
"FFP-Lon Demo

VAR nviAnalog_01 0 0 0 0
0 1 63 0 0 0 0 0 0 0 0 0 0
*
51 * 1
4 0 4 0 0
VAR nvoAnalog_01 1 0 0 0
0 1 63 1 0 0 0 0 0 0 0 0 0
*
51 * 1
4 0 4 0 0
VAR nviBinary_01 2 0 0 0
0 1 63 0 0 0 0 0 0 0 0 0 0
*
95 * 2
1 0 0 0 0
1 0 0 1 0
VAR nvoBinary_01 3 0 0 0
0 1 63 1 0 0 0 0 0 0 0 0 0
*
95 * 2
1 0 0 0 0
1 0 0 1 0
```

Figure 29: Sample of Fserver.XIF File Generated

9   BACNET EXPLORER NG

A typical working example of a BACnet Explorer NG on a BACnet Network:

<p align="center">**Figure 30: BACnet Explorer NG on a BACnet Network**</p>

For additional details related to the BACnet Explorer NG, go to the Sierra Monitor website's Resource Center and download the BACnet Explorer NG Start-up Guide.

For purchasing information, look up the BACnet Explorer NG page on the Sierra Monitor website and click on the "BUY NOW" tab.

Appendix A. Troubleshooting

Appendix A.1. Lost or Incorrect IP Address

- Ensure that FieldServer Toolbox is loaded onto the local PC. Otherwise, download the FieldServer-Toolbox.zip via the Sierra Monitor Resource Center Software Downloads.

- Extract the executable file and complete the installation.

Figure 31: Ethernet Port Location
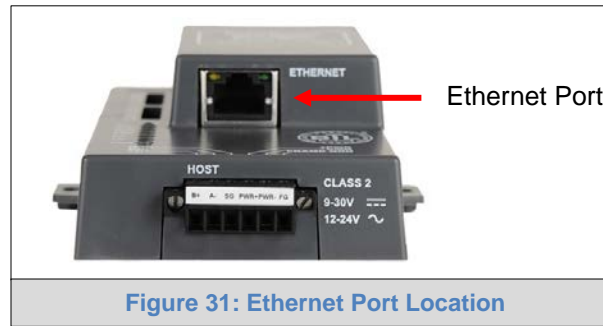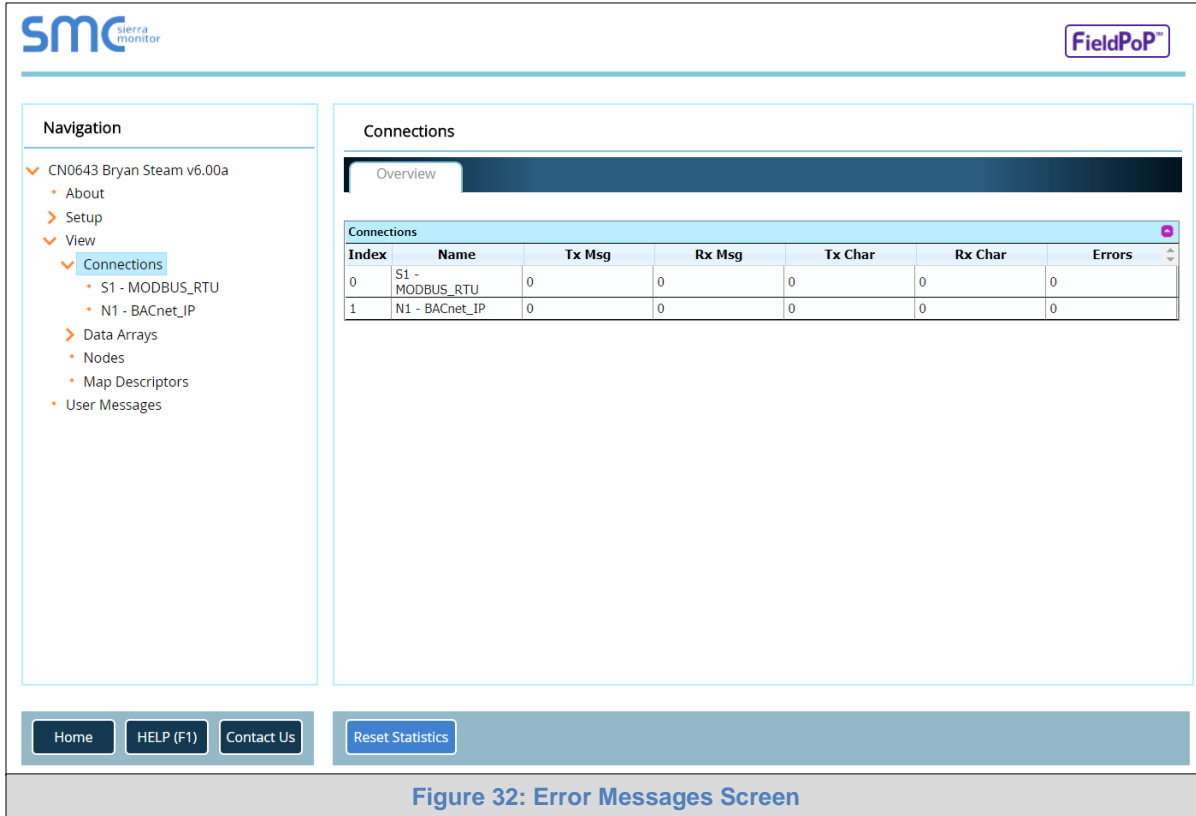
- Connect a standard CAT5 Ethernet cable between the user's PC and ProtoNode.

- Double click on the FS Toolbox Utility and click Discover Now on the splash page.

- Check for the IP Address of the desired gateway.
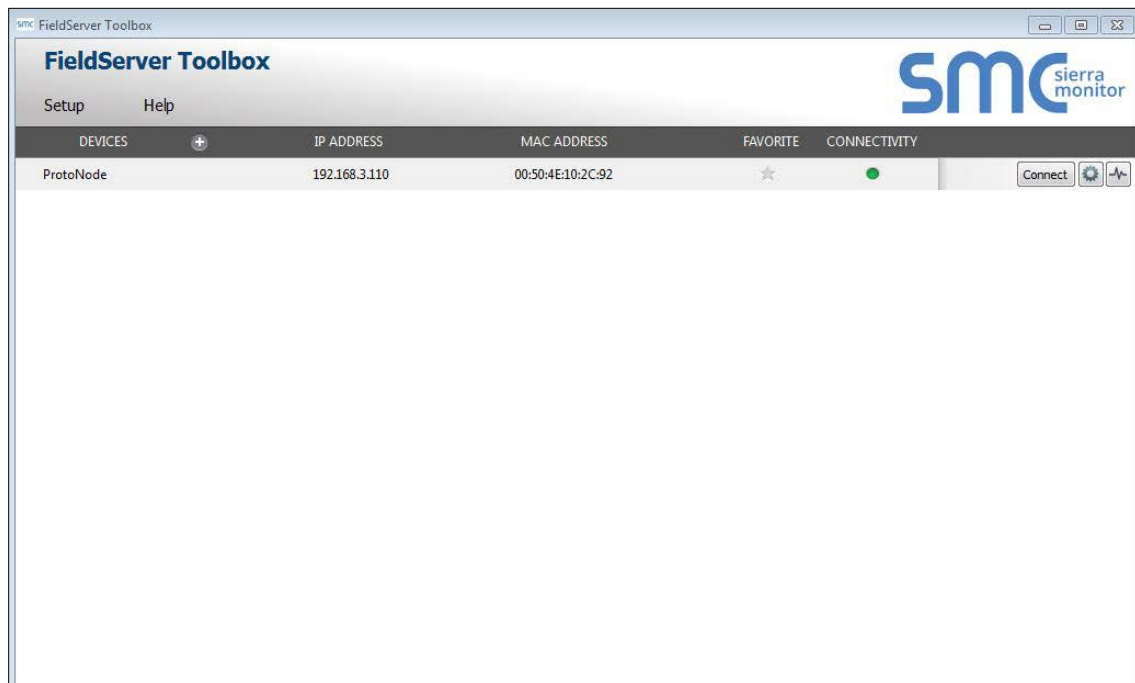
- If correcting the IP Address of the gateway: click the settings icon ⚙ on the same row as the gateway, then click Network Settings, change the IP Address and click Update IP Settings to save.

Appendix A.2. Viewing Diagnostic Information

- Type the IP Address of the ProtoNode into the web browser or use the FieldServer Toolbox to connect to the ProtoNode.

- Click on Diagnostics and Debugging Button, then click on view, and then on connections.

- If there are any errors showing on the Connection page, refer to **Appendix A.3** for the relevant wiring and settings.

Figure 32: Error Messages Screen

Appendix A.3. Check Wiring and Settings

- No COMS on Modbus RTU side. If the Tx/Rx LEDs are not flashing rapidly then there is a COM issue. To fix this, check the following:
    - Visual observations of LEDs on ProtoNode (**Appendix A.4**)
    - Check baud rate, parity, data bits, stop bits
    - Check device address
    - Verify wiring
    - Verify device is connected to the same subnet as the ProtoNode
    - Verify the Modbus device was discovered in Web Configurator (**Section 5.2**)

- Field COM problems:
    - If Ethernet protocols are used, observe Ethernet LEDs on the ProtoNode (**Appendix A.4**)
    - Check dipswitch settings (using correct baud rate and device instance)
    - Verify IP Address setting
    - Verify wiring

NOTE: **If the problem persists, a Diagnostic Capture needs to be taken and sent to support.** (**Appendix A.5**)

Appendix A.4. LED Diagnostics for Communications Between ProtoNode and Devices

See the diagram below for ProtoNode FPC-N34 and FPC-N35 LED Locations.

Diagnostic LEDs

Tag	Description
SPL	The SPL LED will light if the unit is not getting a response from one or more of the configured devices. **For LonWorks units**, LED will light until the unit is commissioned on the LonWorks network.
RUN	The RUN LED will start flashing 20 seconds after power indicating normal operation.
ERR	The SYS ERR LED will go on solid 15 seconds after power up. It will turn off after 5 seconds. A steady red light will indicate there is a system error on the unit. If this occurs, immediately report the related "system error" shown in the error screen of the GUI interface to support for evaluation.
RX	The RX LED will flash when a message is received on the serial port on the 6-pin connector. **If the serial port is not used,** this LED is non-operational.
TX	The TX LED will flash when a message is sent on the serial port on the 6-pin connector. **If the serial port is not used,** this LED is non-operational.
PWR	This is the power light and should show steady green at all times when unit is powered.
Figure 33: Diagnostic LEDs	

Appendix A.5. Take Diagnostic Capture with the FieldServer Toolbox

- **Once the Diagnostic Capture is complete, email it to technical support. The Diagnostic Capture will accelerate diagnosis of the problem.**

- Ensure that FieldServer Toolbox is loaded onto the local PC. Otherwise, download the FieldServer-Toolbox.zip via the Sierra Monitor Resource Center Software Downloads.

- Extract the executable file and complete the installation.

Figure 34: Ethernet Port Location
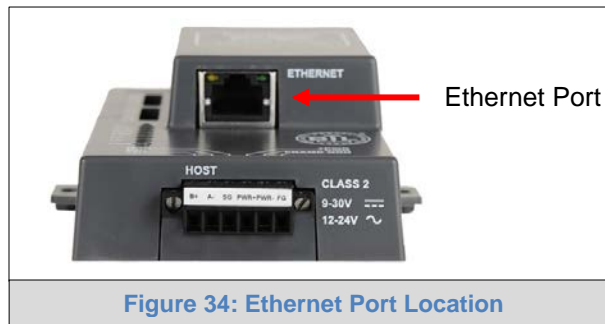
- Connect a standard CAT5 Ethernet cable between the PC and ProtoNode.
- Double click on the FS Toolbox Utility.
- **Step 1:** Take a Log
  - o Click on the diagnose icon of the desired device
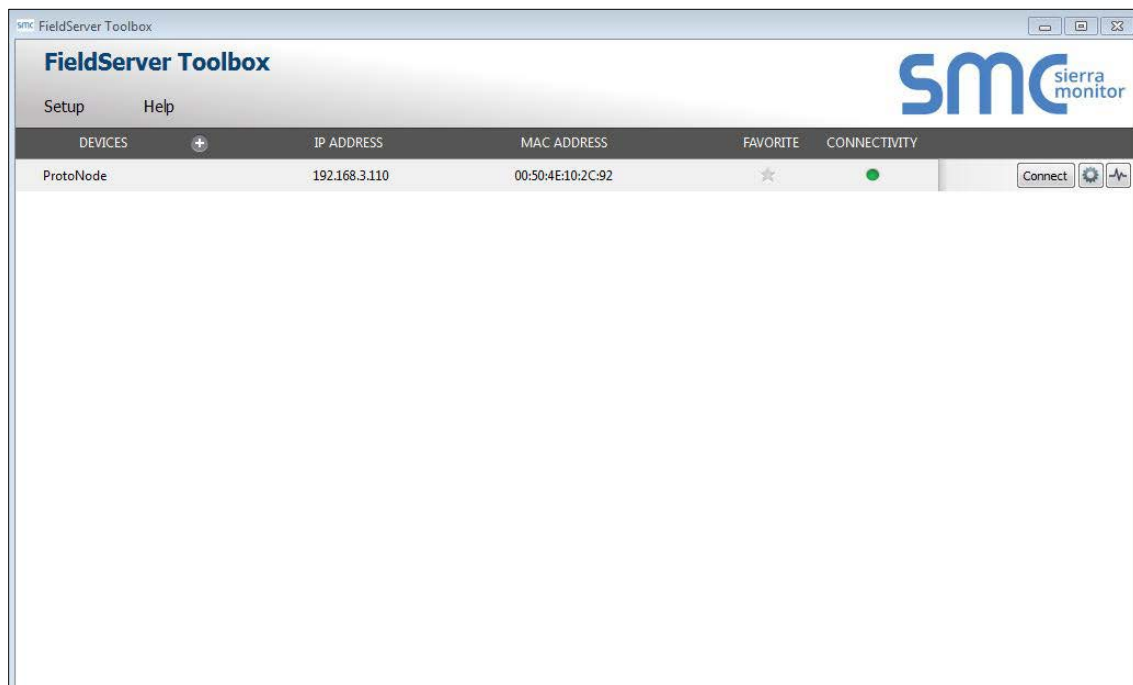
o Ensure "Full Diagnostic" is selected (this is the default)

NOTE: If desired, the default capture period can be changed.

o Click on "Start Diagnostic"
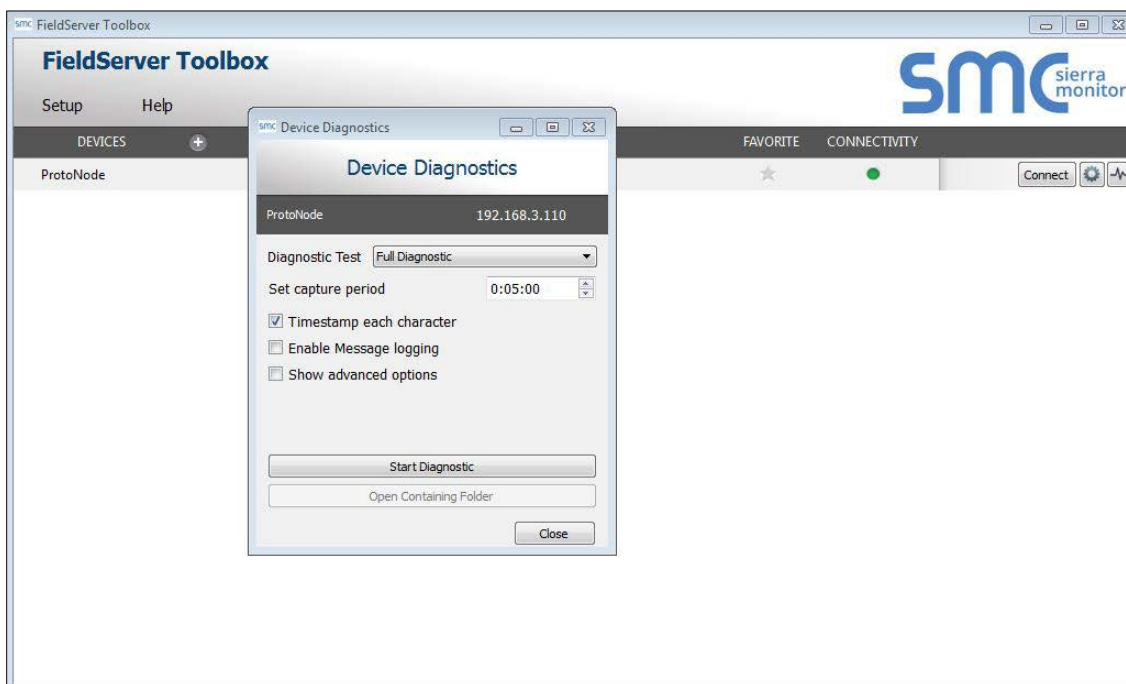
o When the capture period is finished, the "Diagnostic Test Complete" window will appear

- **Step 2**: Send Log

    o   Once the diagnostic test is complete, a .zip file is saved on the PC
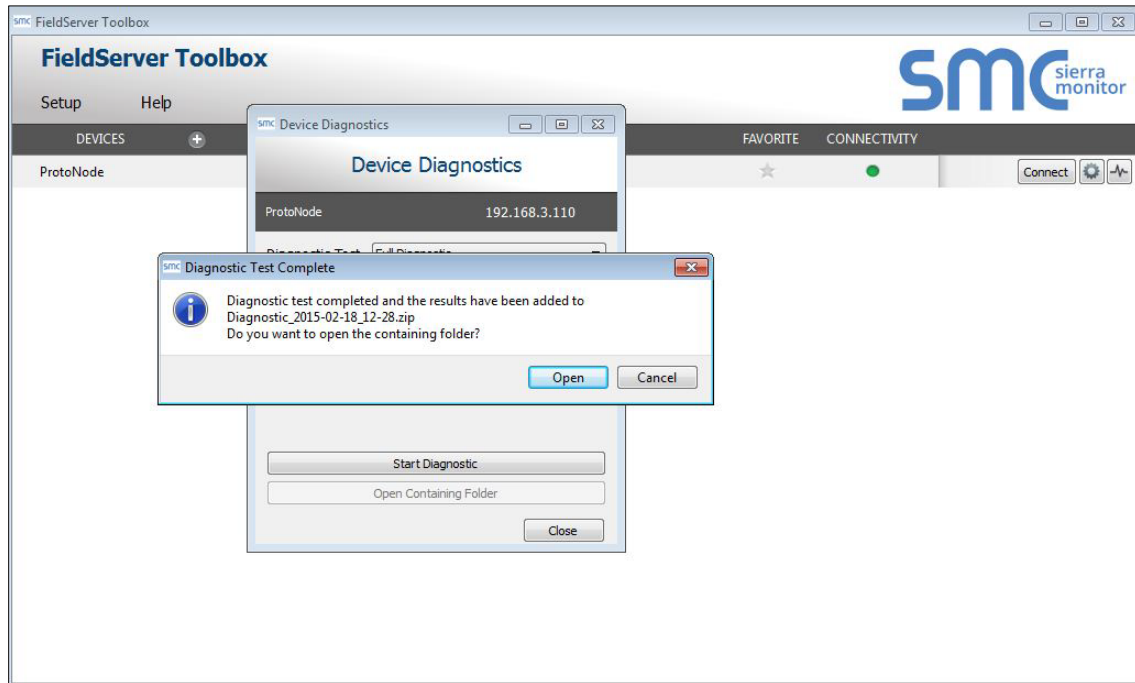
    o   Choose "Open" to launch explorer and have it point directly at the correct folder
    o   Send the Diagnostic zip file to technical support (jvino@tssalesco.com)

Appendix A.6. Take a Diagnostic Capture via FS-GUI

Diagnostic Capture via FS-GUI is only available on FieldServers with a bios updated/released on November 2017 or later. Completing a Diagnostic Capture through the FieldServer allows network connections (such as Ethernet and Wi-Fi) to be captured.

Once the Diagnostic Capture is complete, email it to technical support. The Diagnostic Capture will accelerate diagnosis of the problem.

- Open the FieldServer FS-GUI page.

- Click on Diagnostics in the Navigation panel.
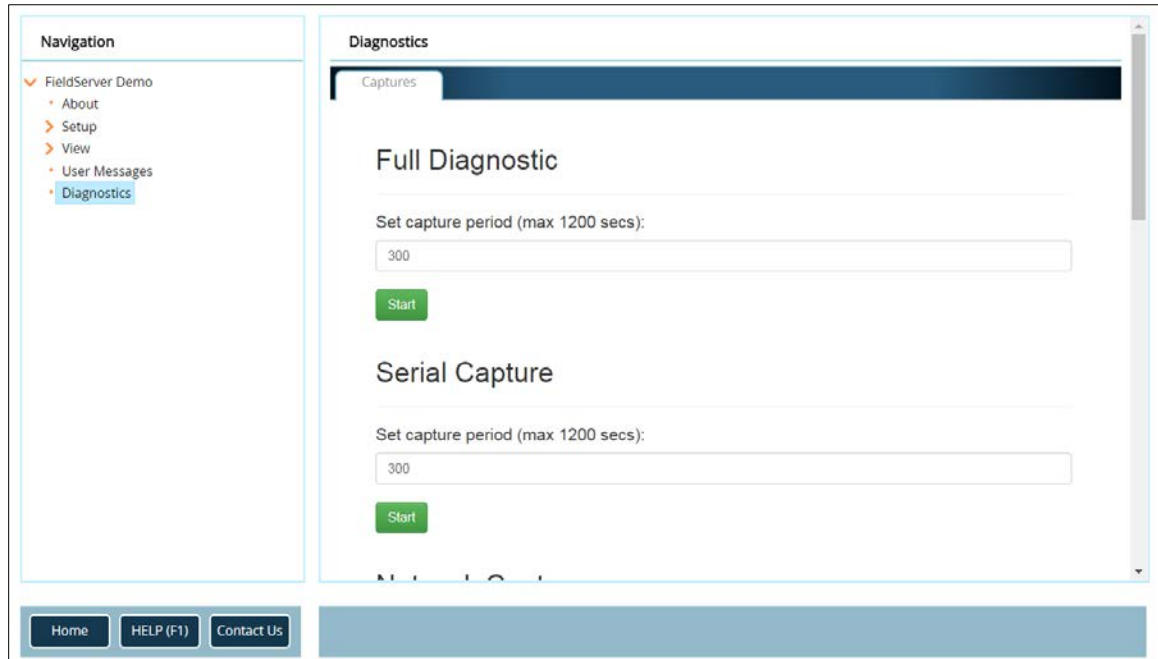
- Go to Full Diagnostic and select the capture period.

- Click the Start button under the Full Diagnostic heading to start the capture.

  o When the capture period is finished, a Download button will appear next to the Start button

- Click Download for the caputure to be downloaded to the local PC.

- Send the diagnostic zip file to technical support.

Appendix B. Additional Information

Appendix B.1. Update Firmware

To load a new version of the firmware, follow these instructions:

1. Extract and save the new file onto the local PC.

2. Open a web browser and type the IP Address of the FieldServer in the address bar.

   o Default IP Address is 192.168.1.24
   o Use the FS Toolbox utility if the IP Address is unknown (Appendix A.1)

3. Click on the "Diagnostics & Debugging" button.

4. In the Navigation Tree on the left hand side, do the following:

   a. Click on "Setup"

   b. Click on "File Transfer"

   c. Click on the "General" tab

5. In the General tab, click on "Choose Files" and select the web.img file extracted in step 1.

6. Click on the orange "Submit" button.

7. When the download is complete, click on the "System Restart" button.

Appendix B.2. BACnet: Setting Network_Number for More Than One ProtoNode on the Subnet

For both BACnet MS/TP and BACnet/IP, if more than one ProtoNode is connected to the same subnet, they must be assigned unique Network_Number values.

On the main Web Configuration screen, update the BACnet Network Number field and click submit. The default value is 50.

network_nr	**BACnet Network Number** This sets the BACnet network number of the Gateway. *(1 - 65535)*	50	Submit

Figure 35: Web Configurator – Network Number Field
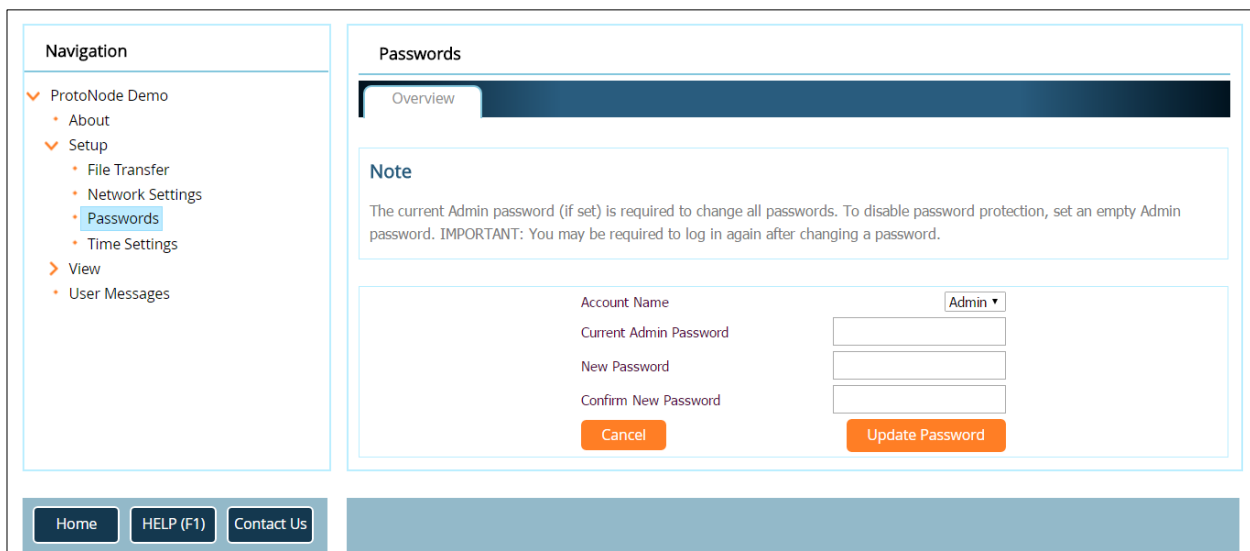
Appendix B.3. Securing ProtoNode with Passwords

Access to the ProtoNode can be restricted by enabling a password on the FS-GUI Passwords page – click Setup and then Passwords in the navigation panel. There are 2 access levels defined by 2 account names: Admin and User.

- The Admin account has unrestricted access to the ProtoNode.

- The User account can view any ProtoNode information, but cannot make any changes or restart the ProtoNode.
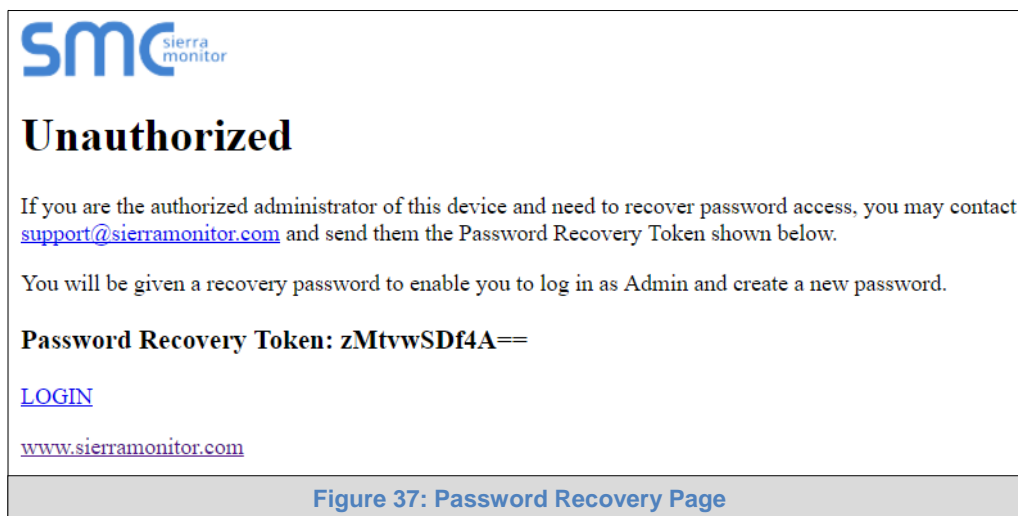
The password needs to be a minimum of eight characters and **is case sensitive**.

If the password is lost, click cancel on the password authentication popup window, and email the password recovery token to technical support to receive a temporary password from the support team. Access the ProtoNode to set a new password.

Figure 36: FS-GUI Passwords Page

Figure 37: Password Recovery Page

Appendix C. Vendor Information – Thermal Solutions

NOTE: All Modbus TCP/IP registers are the same as the Modbus RTU registers for the serial device. If this point list is needed, contact Thermal Solutions technical support. The Modbus TCP/IP node address of the device is also the same as the Modbus RTU node address.

Appendix C.1. RWF40 Modbus RTU Mappings to BACnet, Metasys N2 and LonWorks

Point Name	BACnet Object Type	BACnet Object ID	N2 Data Type	N2 Address	LonWorks Name	LonWorks SNVT
Com Status	BI	1	DI	1	nvoComStatus_XXX	SNVT_switch
Input 1	AI	1	AI	1	nvoInput1_XXX	SNVT_count_inc_f
Input 2	AI	2	AI	2	nvoInput2_XXX	SNVT_count_inc_f
Input 3	AI	3	AI	3	nvoInput3_XXX	SNVT_count_inc_f
First Setpoint	AV	4	AO	4	nvoFirstSP_XXX	SNVT_count_inc_f
Second Setpoint	AV	5	AO	5	nvoSecondSP_XXX	SNVT_count_inc_f
Operation Mode	AV	6	AO	6	nvoOpMode_XXX	SNVT_count_inc_f
Process Enable	BV	7	DO	7	nvi/nvoProcEnbl_XXX	SNVT_switch
Process Setpoint	AV	8	AO	8	nvi/nvoProcSP_XXX	SNVT_count_inc_f
Enable K1	BV	9	DO	9	nvi/nvoEnableK1_XXX	SNVT_switch
Enable K2	BV	10	DO	10	nvi/nvoEnableK2_XXX	SNVT_switch
Enable K3	BV	11	DO	11	nvi/nvoEnableK3_XXX	SNVT_switch
Enable K6	BV	12	DO	12	nvi/nvoEnableK6_XXX	SNVT_switch
Step Control	AV	13	AO	13	nvi/nvoStepCtrl_XXX	SNVT_count_inc_f
Modulation	AV	14	AO	14	nvi/nvoModulatn_XXX	SNVT_lev_percent

Appendix C.2. RM7800 Modbus RTU Mappings to BACnet, Metasys N2 and LonWorks

Point Name	BACnet Object Type	BACnet Object ID	N2 Data Type	N2 Address	LonWorks Name	LonWorks SNVT
Com Status	BI	1	DI	1	nvoComStatus_XXX	SNVT_switch
Flame Signal	AI	1	AI	1	nvoFlameSig_XXX	SNVT_count_f
Burner Cycles	AI	2	AI	2	nvoBrnCyc_XXX	SNVT_count_f
Burner Hours	AI	3	AI	3	nvoBrnHrs_XXX	SNVT_time_hour
Burner Fault Code	AI	4	AI	4	nvoBrnFltCod_XXX	SNVT_count_f
Initiate	AI	53	AI	53	nvoInitiate_XXX	SNVT_switch
Standby	AI	54	AI	54	nvoStandby_XXX	SNVT_switch
Purge	AI	55	AI	55	nvoPurge_XXX	SNVT_switch
Pilot Ignition	AI	56	AI	56	nvoPilotIgn_XXX	SNVT_switch
Main Ignition	AI	57	AI	57	nvoMainIgn_XXX	SNVT_switch
Run	AI	58	AI	58	nvoRun_XXX	SNVT_switch
Postpurge	AI	59	AI	59	nvoPostpurge_XXX	SNVT_switch
Pre-Ignition	AI	60	AI	60	nvoPreIgntn_XXX	SNVT_switch
Valve Proving	AI	61	AI	61	nvoVlvProv_XXX	SNVT_switch
Alarm	AI	62	AI	62	nvoAlarm_XXX	SNVT_switch
Hold	AI	63	AI	63	nvoHold_XXX	SNVT_switch
Lockout	AI	64	AI	64	nvoLockout_XXX	SNVT_switch
First Out Code	AI	65	AI	65	nvo1stOutCod_XXX	SNVT_count_f
Main Valve Proof of Closure	BI	66	DI	66	nvoMnVlvCls_XXX	SNVT_switch
Burner Switch	BI	67	DI	67	nvoBrnrSw_XXX	SNVT_switch
Operating Control	BI	68	DI	68	nvoOpCtrl_XXX	SNVT_switch
Auxiliary Limit 1	BI	69	DI	69	nvoAuxLim1_XXX	SNVT_switch
Auxiliary Limit 2	BI	70	DI	70	nvoAuxLim2_XXX	SNVT_switch
Low Water Cutoff	BI	71	DI	71	nvoLoWtrCut_XXX	SNVT_switch
High Limit	BI	72	DI	72	nvoHiLim_XXX	SNVT_switch
Auxiliary Limit 3	BI	73	DI	73	nvoAuxLim3_XXX	SNVT_switch
Oil Select Switch	BI	74	DI	74	nvoOilSelSw_XXX	SNVT_switch
High Oil Pressure	BI	75	DI	75	nvoHiOilPrs_XXX	SNVT_switch
Low Oil Pressure	BI	76	DI	76	nvoLoOilPrs_XXX	SNVT_switch
High Oil Temperature	BI	77	DI	77	nvoHiOilTmp_XXX	SNVT_switch
Low Oil Temperature	BI	78	DI	78	nvoLoOilTmp_XXX	SNVT_switch
Gas Select Switch	BI	79	DI	79	nvoGasSelSw_XXX	SNVT_switch
High Gas Pressure	BI	80	DI	80	nvoHiGasPrs_XXX	SNVT_switch
Low Gas Pressure	BI	81	DI	81	nvoLoGasPrs_XXX	SNVT_switch
Air Flow Switch	BI	82	DI	82	nvoAirFLoSw_XXX	SNVT_switch
Auxiliary Interlock 4	BI	83	DI	83	nvoAuxIntlk4_XXX	SNVT_switch
Auxiliary Interlock 5	BI	84	DI	84	nvoAuxIntlk5_XXX	SNVT_switch

Appendix C.3. RWF55 Modbus RTU Mappings to BACnet, Metasys N2 and LonWorks

Point Name	BACnet Object Type	BACnet Object ID	N2 Data Type	N2 Address	LonWorks Name	LonWorks SNVT
Com Status	BI	1	DI	1	nvoComStatus_XXX	SNVT_switch
Analog Input InP1	AI	1	AI	1	nvoInP1_XXX	SNVT_count_inc_f
Analog Input InP2	AI	2	AI	2	nvoInP2_XXX	SNVT_count_inc_f
Analog Input InP3	AI	3	AI	3	nvoInP3_XXX	SNVT_count_inc_f
Actual Setpoint	AI	4	AI	4	nvoActSP_XXX	SNVT_count_inc_f
Setpoint 1	AV	5	AO	5	nvi/nvoSP_1_XXX	SNVT_count_inc_f
Setpoint 2	AV	6	AO	6	nvi/nvoSP_2_XXX	SNVT_count_inc_f
Analog Input InP3	AI	7	AI	7	nvoInP3Unfil_XXX	SNVT_count_inc_f
Actual Angular Positioning	AI	8	AI	8	nvoActAngPos_XXX	SNVT_count_inc_f
Burner Alarm	AI	9	AI	9	nvoBrnrAlm_XXX	SNVT_count_inc_f

Appendix D. "A" Bank DIP Switch Settings

Appendix D.1. "A" Bank DIP Switch Settings

Address	A0	A1	A2	A3	A4	A5	A6	A7
1	On	Off	Off	Off	Off	Off	Off	Off
2	Off	On	Off	Off	Off	Off	Off	Off
3	On	On	Off	Off	Off	Off	Off	Off
4	Off	Off	On	Off	Off	Off	Off	Off
5	On	Off	On	Off	Off	Off	Off	Off
6	Off	On	On	Off	Off	Off	Off	Off
7	On	On	On	Off	Off	Off	Off	Off
8	Off	Off	Off	On	Off	Off	Off	Off
9	On	Off	Off	On	Off	Off	Off	Off
10	Off	On	Off	On	Off	Off	Off	Off
11	On	On	Off	On	Off	Off	Off	Off
12	Off	Off	On	On	Off	Off	Off	Off
13	On	Off	On	On	Off	Off	Off	Off
14	Off	On	On	On	Off	Off	Off	Off
15	On	On	On	On	Off	Off	Off	Off
16	Off	Off	Off	Off	On	Off	Off	Off
17	On	Off	Off	Off	On	Off	Off	Off
18	Off	On	Off	Off	On	Off	Off	Off
19	On	On	Off	Off	On	Off	Off	Off
20	Off	Off	On	Off	On	Off	Off	Off
21	On	Off	On	Off	On	Off	Off	Off
22	Off	On	On	Off	On	Off	Off	Off
23	On	On	On	Off	On	Off	Off	Off
24	Off	Off	Off	On	On	Off	Off	Off
25	On	Off	Off	On	On	Off	Off	Off
26	Off	On	Off	On	On	Off	Off	Off
27	On	On	Off	On	On	Off	Off	Off
28	Off	Off	On	On	On	Off	Off	Off
29	On	Off	On	On	On	Off	Off	Off
30	Off	On	On	On	On	Off	Off	Off
31	On	On	On	On	On	Off	Off	Off
32	Off	Off	Off	Off	Off	On	Off	Off
33	On	Off	Off	Off	Off	On	Off	Off
34	Off	On	Off	Off	Off	On	Off	Off
35	On	On	Off	Off	Off	On	Off	Off
36	Off	Off	On	Off	Off	On	Off	Off
37	On	Off	On	Off	Off	On	Off	Off
38	Off	On	On	Off	Off	On	Off	Off
39	On	On	On	Off	Off	On	Off	Off
40	Off	Off	Off	On	Off	On	Off	Off
41	On	Off	Off	On	Off	On	Off	Off
42	Off	On	Off	On	Off	On	Off	Off
43	On	On	Off	On	Off	On	Off	Off
44	Off	Off	On	On	Off	On	Off	Off
45	On	Off	On	On	Off	On	Off	Off
46	Off	On	On	On	Off	On	Off	Off

Address	A0	A1	A2	A3	A4	A5	A6	A7
47	On	On	On	On	Off	On	Off	Off
48	Off	Off	Off	Off	On	On	Off	Off
49	On	Off	Off	Off	On	On	Off	Off
50	Off	On	Off	Off	On	On	Off	Off
51	On	On	Off	Off	On	On	Off	Off
52	Off	Off	On	Off	On	On	Off	Off
53	On	Off	On	Off	On	On	Off	Off
54	Off	On	On	Off	On	On	Off	Off
55	On	On	On	Off	On	On	Off	Off
56	Off	Off	Off	On	On	On	Off	Off
57	On	Off	Off	On	On	On	Off	Off
58	Off	On	Off	On	On	On	Off	Off
59	On	On	Off	On	On	On	Off	Off
60	Off	Off	On	On	On	On	Off	Off
61	On	Off	On	On	On	On	Off	Off
62	Off	On	On	On	On	On	Off	Off
63	On	On	On	On	On	On	Off	Off
64	Off	Off	Off	Off	Off	Off	On	Off
65	On	Off	Off	Off	Off	Off	On	Off
66	Off	On	Off	Off	Off	Off	On	Off
67	On	On	Off	Off	Off	Off	On	Off
68	Off	Off	On	Off	Off	Off	On	Off
69	On	Off	On	Off	Off	Off	On	Off
70	Off	On	On	Off	Off	Off	On	Off
71	On	On	On	Off	Off	Off	On	Off
72	Off	Off	Off	On	Off	Off	On	Off
73	On	Off	Off	On	Off	Off	On	Off
74	Off	On	Off	On	Off	Off	On	Off
75	On	On	Off	On	Off	Off	On	Off
76	Off	Off	On	On	Off	Off	On	Off
77	On	Off	On	On	Off	Off	On	Off
78	Off	On	On	On	Off	Off	On	Off
79	On	On	On	On	Off	Off	On	Off
80	Off	Off	Off	Off	On	Off	On	Off
81	On	Off	Off	Off	On	Off	On	Off
82	Off	On	Off	Off	On	Off	On	Off
83	On	On	Off	Off	On	Off	On	Off
84	Off	Off	On	Off	On	Off	On	Off
85	On	Off	On	Off	On	Off	On	Off
86	Off	On	On	Off	On	Off	On	Off
87	On	On	On	Off	On	Off	On	Off
88	Off	Off	Off	On	On	Off	On	Off
89	On	Off	Off	On	On	Off	On	Off
90	Off	On	Off	On	On	Off	On	Off
91	On	On	Off	On	On	Off	On	Off
92	Off	Off	On	On	On	Off	On	Off

Address	A0	A1	A2	A3	A4	A5	A6	A7
93	On	Off	On	On	On	Off	On	Off
94	Off	On	On	On	On	Off	On	Off
95	On	On	On	On	On	Off	On	Off
96	Off	Off	Off	Off	Off	On	On	Off
97	On	Off	Off	Off	Off	On	On	Off
98	Off	On	Off	Off	Off	On	On	Off
99	On	On	Off	Off	Off	On	On	Off
100	Off	Off	On	Off	Off	On	On	Off
101	On	Off	On	Off	Off	On	On	Off
102	Off	On	On	Off	Off	On	On	Off
103	On	On	On	Off	Off	On	On	Off
104	Off	Off	Off	On	Off	On	On	Off
105	On	Off	Off	On	Off	On	On	Off
106	Off	On	Off	On	Off	On	On	Off
107	On	On	Off	On	Off	On	On	Off
108	Off	Off	On	On	Off	On	On	Off
109	On	Off	On	On	Off	On	On	Off
110	Off	On	On	On	Off	On	On	Off
111	On	On	On	On	Off	On	On	Off
112	Off	Off	Off	Off	On	On	On	Off
113	On	Off	Off	Off	On	On	On	Off
114	Off	On	Off	Off	On	On	On	Off
115	On	On	Off	Off	On	On	On	Off
116	Off	Off	On	Off	On	On	On	Off
117	On	Off	On	Off	On	On	On	Off
118	Off	On	On	Off	On	On	On	Off
119	On	On	On	Off	On	On	On	Off
120	Off	Off	Off	On	On	On	On	Off
121	On	Off	Off	On	On	On	On	Off
122	Off	On	Off	On	On	On	On	Off
123	On	On	Off	On	On	On	On	Off
124	Off	Off	On	On	On	On	On	Off
125	On	Off	On	On	On	On	On	Off
126	Off	On	On	On	On	On	On	Off
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Address	A0	A1	A2	A3	A4	A5	A6	A7
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Address	A0	A1	A2	A3	A4	A5	A6	A7
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255	On	On	On	On	On	On	On	On

Appendix E. Reference

Appendix E.1. Specifications

	ProtoNode FPC-N34	ProtoNode FPC-N35
Electrical Connections	One 6-pin Phoenix connector with: RS-485 port (+ / - / gnd) Power port (+ / - / Frame-gnd) One 3-pin Phoenix connector with RS-485 port (+ / - / gnd) One Ethernet 10/100 BaseT port	One 6-pin Phoenix connector with: RS-485 port (+ / - / gnd) Power port (+ / - / Frame-gnd) One 2-pin Phoenix connector with: One FTT-10 LonWorks port One Ethernet 10/100 BaseT port
Approvals	CE Certified; TUV approved to UL 916, EN 60950-1, EN 50491-3 and CSA C22-2 standards; FCC Class A Part 15; DNP 3.0 Conformance Tested; RoHS Compliant; CSA 205 Approved	
	BTL Marked	LonMark Certified
Power Requirements	Multi-mode power adapter: 9-30V DC or 12 - 24V AC	
Physical Dimensions	11.5 cm L x 8.3 cm W x 4.1 cm H (4.5 x 3.2 x 1.6 in.)	
Weight	0.2 kg (0.4 lbs)	
Operating Temperature	-40°C to 75°C (-40°F to167°F)	
Surge Suppression	EN61000-4-2 ESD EN61000-4-3 EMC EN61000-4-4 EFT	
Humidity	5 - 90% RH (non-condensing)	
(Specifications subject to change without notice)		
Figure 38: Specifications		

Appendix E.1.1. Compliance with UL Regulations

For UL compliance, the following instructions must be met when operating ProtoNode.

- The units shall be powered by listed LPS or Class 2 power supply suited to the expected operating temperature range.

- The interconnecting power connector and power cable shall:
    o Comply with local electrical code
    o Be suited to the expected operating temperature range
    o Meet the current and voltage rating for ProtoNode

- Furthermore, the interconnecting power cable shall:
    o Be of length not exceeding 3.05m (118.3")
    o Be constructed of materials rated VW-1, FT-1 or better

- If the unit is to be installed in an operating environment with a temperature above 65 °C, it should be installed in a Restricted Access Area requiring a key or a special tool to gain access.

- This device must not be connected to a LAN segment with outdoor wiring.

Appendix F. Limited 2 Year Warranty

Sierra Monitor Corporation warrants its products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. Sierra Monitor Corporation will repair or replace any equipment found to be defective during the warranty period. Final determination of the nature and responsibility for defective or damaged equipment will be made by Sierra Monitor Corporation personnel.

All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without Sierra Monitor Corporation's approval or which have been subjected to accident, improper maintenance, installation or application, or on which original identification marks have been removed or altered. This Limited Warranty also will not apply to interconnecting cables or wires, consumables or to any damage resulting from battery leakage.

In all cases Sierra Monitor Corporation's responsibility and liability under this warranty shall be limited to the cost of the equipment. The purchaser must obtain shipping instructions for the prepaid return of any item under this warranty provision and compliance with such instruction shall be a condition of this warranty.

Except for the express warranty stated above, Sierra Monitor Corporation disclaims all warranties with regard to the products sold hereunder including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of Sierra Monitor Corporation for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.