

Universal Gateway LonWorks ProtoNode Instruction Manual

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Application

The Universal Gateway (LonWorks ProtoNode) provides monitoring, remote setpoint, firing rate and burner on/off control to the Energy Management Systems/ Building Automation System/ Building Management System (EMS). The Universal Gateway ProtoNode is compatible with the following brands and models:

Burnham Commercial Models: Products using Sage Boiler Control (SBC™)

Bryan Boilers Models: BFIT, FreeFlex, boilers using following control components: RWF40, RWF55, RM7800, LMV36, LMV52, PD765, LMV2_3, YB110

Thermal Solutions Models: APEX, AMP, Evolution, Arctic, Conductor

U.S. Boiler Company Models: Alpine, ASPEN, ALTA, Citadel

Velocity Boiler Works Models: Phantom-X, Raptor, Phantom II, Phantom-XL

There are two Universal Gateway options:

ProtoAir: Provides BACnet MS/TP, BACnet/IP, N2, Modbus TCP communications, refer to "Universal Gateway ProtoAir" Instruction Manual.

LonWorks ProtoNode: Provides LonWorks communication.

Intent

This document provides the necessary information to facilitate Gateway installation. This Instruction Manual includes practical, installation and setup detailed information. The intended users are contractors and factory support personnel.



**FPC-N35-0817
LonWorks ProtoNodes**

The following term is used throughout this manual to bring attention to special instructions:

NOTICE: Indicates special instructions on installation, operation, or service which are important but not related to personal injury hazards.

NOTICE:

If Building Automation System input fails, some models and controls will revert to local start command, setpoint, and firing rate. However, building may lose heat for models without this feature (Models with application “Thermal Solutions and Bryan Boiler Control System Components” in Table 1-1).

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1 INTRODUCTION

Universal Gateway (ProtoNode) is an external, high performance Energy Management System (EMS) multi-protocol gateway that uses the **FieldServer ProtoNode Technology**. The ProtoNode can support multiple boilers/water heaters. It has been pre-programmed to communicate between boiler devices listed in Table 1-1 and LonWorks®¹.

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.

1.1 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.

¹ LonWorks is a registered trademark of Echelon Corporation

1.2 Universal Gateway Available Configurations

The ProtoNode is shipped with the below listed configurations pre-configured and loaded. There is no need to download any configuration. The user simply selects the configuration from a list or Auto-Discovers the configuration.

Table 1-1: Universal Gateway Available Configurations

Application	Available Profiles (Example: Lon_4109)	Wiring Section #	BACnet, N2 Points List Section #	Type Configuration Discovery
EVS and EVCA Boilers with Thermal Solutions Boiler Control (TSBC) or Burnham Commercial Models with Sage Boiler Control (SBC)	TSBC	3.3	12.1	Auto-Discovery
Older Apex, Alpine, ASPEN, Phantom-X or Raptor with Sage 2.1 Control and Panasonic Display (To check software, press the "i" button on home screen.)	4109 ^{note1}	3.4	12.2	Auto-Discovery
AMP/BFIT/Citadel/Phantom-XL 400-1000L, Apex, Alpine, ASPEN Phantom-X or Raptor Sage 2.2, 2.3 Control, Concert Control, Concert 4-inch Display or Panasonic Display	4716 ^{note1}	3.5	12.3	Auto-Discovery
Older Arctic or FreeFlex	4716	3.6	12.3	Web-Configurator
Arctic, FreeFlex, AMP/BFIT 1000-4000, or Citadel 1250-1500 with Concert Control & Concert 7-inch Display and Sola	4716	3.7	12.3	Web-Configurator
Thermal Solutions and Bryan Boiler Control System Components	RWF40	3.8	12.4	Web-Configurator
	RWF55	3.8	12.5	Web-Configurator
	RM7800	3.9	12.6	Web-Configurator
	LMV52	Note 2	12.7	Web-Configurator
	LMV36	Note 2	12.8	Web-Configurator
	PD765	Note 2	12.9	Web-Configurator
	LMV2_3	Note 2	12.10	Web-Configurator
YB110	Note 2	12.11	Web-Configurator	
ALTA, ALTAC, Phantom II and Phantom Combi II Control	ALTA	3.10	12.12	Web-Configurator
Conductor	Conductor_EMS	3.11	12.13	Web-Configurator

NOTE 1: Go to Delta or Panasonic screen home page, select information "i" button. Read software version 4109 or 4716.

NOTE 2: Refer to instruction manuals supplied with boiler and control system for wiring details.

2 SETUP

Each ProtoNode has a unique part number located on the underside of the unit. This number should be recorded, as it may be required for technical support. The number is shown below:

Table 2-1: ProtoNode Part Number

Model	Part Number
ProtoNode LER - LonWorks	FPC-N35-0817

2.1 Boiler Setup

2.1.1 Apex Alpine, ASPEN, Phantom-X, Raptor Boilers with Panasonic Display

On Apex Boilers with **Panasonic GT02 display**, using the boiler mounted display, set a unique “Boiler Address” for each boiler that will be connected to the network.

- To change “Boiler Address” on Boiler Mounted Display; go to “Adjust” menu.
- In “Adjust” menu, enter “Sequencer Slave” menu to edit “Boiler Address”

NOTICE: For Apex boilers with a Panasonic GT02 display, all boilers must have Sequencer Master disabled.

2.1.2 Apex, Arctic, AMP, FreeFlex, BFIT, Citadel, Phantom-XL with Concert Display

On Apex, Arctic/FreeFlex, or AMP/BFIT/Citadel/Phantom-XL boilers/water heaters with Concert Displays, assign a unique Comm HMI Station ID for each boiler connected directly to the ProtoNode.

- To change “Comm HMI Station ID” select “Menu” on Concert Display
- On the “Main Menu” select “EMS Interface” and select “Modbus Setup”
- Select “EMS Modbus Parameter” and follow on screen instructions to edit “Comm HMI Station ID”

2.1.3 EVS and EVCA boilers with TSBC or Burnham Commercial Models with SBC

On EVS and EVCA Boilers with TSBC or Burnham Commercial models with SBC, from the Communication Menu set the following:

Table 2-2: TSBC/SBC Communication Settings

Parameter	Selection
Protocol	Modbus
Modbus Address	Between 1 and 20
Baud Rate	38.4 kbps
Parity	None

- To edit Communication Parameters, hold the “Menu” button down until the screen changes to the Main Menu of the TSBC/SBC
- Scroll through the main menu and select “COMMUNICATIONS” by pressing “Enter”.
- Edit Communication Parameters as needed.

Refer to the Boiler’s instruction manual for password and menu navigation instructions.

2.1.4 RWF40, LMV52, RM7800, LMV36, PD765, RWF55, LMV2_3 or YB110

Refer to the Boiler's instruction manual for password and menu navigation instructions to make the following settings:

Table 2-3: RWF40, LMV52, RM7800, LMV36, PD765, RWF55, LMV2_3 or YB110 Com. Settings

Model	Port Setting	Selection
RWF55, YB110	Baud Rate	38400
RWF40, RM7800, LMV36, LMV52, PD765, LMV2_3	Baud Rate	19200
All	Protocol	Modbus RTU
	Parity	None
	Data Bits	8
	Stop Bits	1

2.1.5 Settings for Conductor Sequencing Panel

On Conductor, from the Modbus/BACnet Setup menu set the following:

Table 2-4: Conductor Communication Settings

Parameter	Selection
EMS Communication	Modbus
Conductor RS485-1 Address	Between 1 and 20
EMS Baud Rate	38400
EMS Parity	None

- To edit Communication Parameters, select "Menu" from the home screen.
- On the "Main Menu" select "EMS Interface" and select "Modbus/BACnet Setup".
- Enter the password by pressing the lock icon.
- Press the line for each parameter and enter the new selection.
- Once all parameters have been set to the correct selection, cycle power to the panel to enact the changes.

2.2 ProtoNode Setup

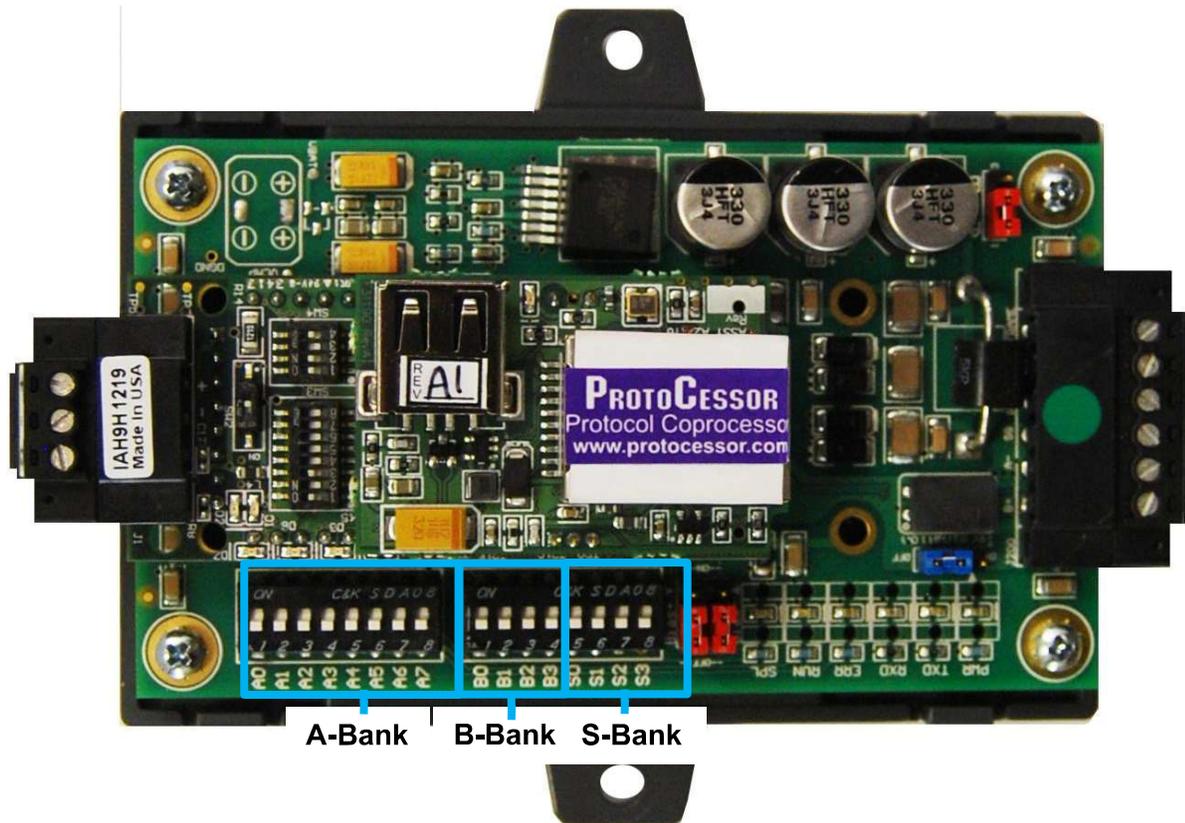


Figure 2-1: ProtoNode showing DIP switch “Banks” on bottom

2.2.1 Select EMS Protocol

Set Dipswitches to match Protocol of EMS. Remove ProtoNode cover and check protocol dip switch settings:

- The “S0 – S2” bank of DIP switches on the ProtoNode LER LonWorks are disabled.

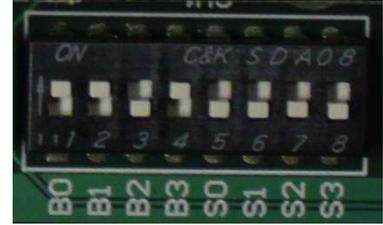
2.2.2 Enable Auto-Discovery

Table 2-5 describes “S3” DIP Switch setting for the Enabling Auto-Discovering of known devices attached to the ProtoNode RER or LER.

- Power down ProtoNode.
- Ensure all boilers are powered and connected to the ProtoNode.
- Set “S3” DIP switch to “On” position and power the ProtoNode to Auto-Discover Boilers. It will take 3 minutes to discover all Modbus RTU devices attached to the ProtoNode.
- Once the ProtoNode has discovered all of the Modbus RTU devices, set the S3 DIP switch to the OFF position to save the recently built configuration.

Table 2-5: ProtoNode Auto-Discovery Settings

LonWorks ProtoNode	
S3 DIP Switch Auto-Discovery Mode	S3
Auto-Discovery ON – Build New Configuration	On
Auto-Discover OFF – Load Current Configuration	Off



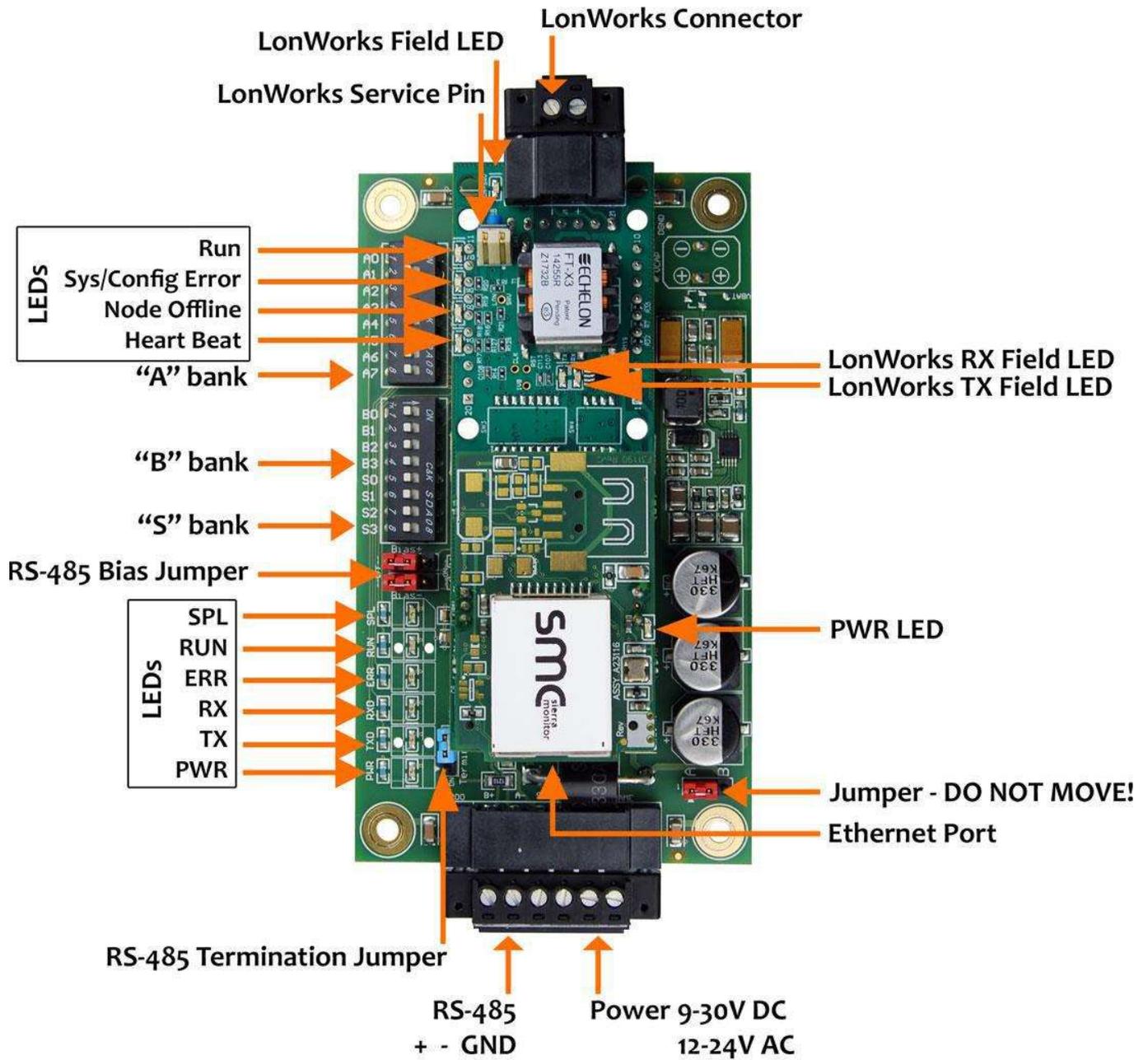
NOTICE: Initial Auto Discovery Cycle - All boilers **MUST** be **POWERED** and **CONNECTED** to the ProtoNode before cycling power to the ProtoNode. The ProtoNode will auto discover only connected boilers. If a boiler is connected after the ProtoNode has completed auto discovery it will not “find” the new boiler.

2.2.3 Commission the ProtoNode for LonWorks

This needs to be done by the LonWorks administrator use a LonWorks Commissioning tool. (See Section 6.6)

3 WIRING

3.1 ProtoNode Overview



6 pin Connector - RS-485 and Power Connection

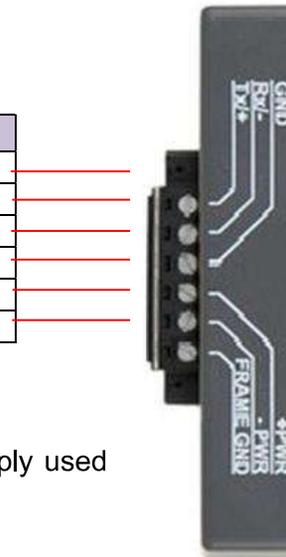
Figure 3-1: ProtoNode LonWorks

3.2 Wiring to the ProtoNode 6 Pin Connector

- Pins 1 through 3 are for Modbus RS-485 devices. The RS-485 GND (Pin 3) is not typically connected.
- Pins 4 through 6 are for power.

Table 3-1: ProtoNode Pin Assignments

Device Pins	ProtoNode Pin #	Pin assignment
Pin RS-485 +	Pin 1	RS-485 +
Pin RS-485 -	Pin 2	RS-485 -
Pin GND	Pin 3	RS-485 GND
Power In (+)	Pin 4	24 VAC +
Power In (-)	Pin 5	24 VAC -
Frame Ground	Pin 6	FRAME GND



Apply power to ProtoNode as shown below. Ensure that the power supply used complies with the specifications provided in Section 7.

- ProtoNode accepts either 9-30VDC or 12-24 VAC on pins 4 and 5.

Table 3-2: ProtoNode Power Requirements

Power Requirements	
Input Voltage	9-30VDC or 12-24VAC
Current Draw	210mA @ 12VDC/VAC 130mA @ 24VDC/VAC
Max Power	2.5 Watts

3.2.1 Biasing the Modbus RS-485 Device Network

- The ProtoNode has 510 Ohm resistors that can be used to set the biasing. The ProtoNode's default positions from the factory for the Biasing jumpers are OFF.
- The OFF position is when the 2 RED biasing jumpers straddle the 4 pins closest to the outside of the board of the ProtoNode. See Figure 3-2.
- Only turn biasing ON:
 - IF the BMS cannot see more than one device connected to the ProtoNode
 - AND you have checked all the settings (Modbus COM settings, wiring, and DIP switches).
- To turn biasing ON, move the 2 RED biasing jumpers to straddle the 4 pins closest to the inside of the board of the ProtoNode.

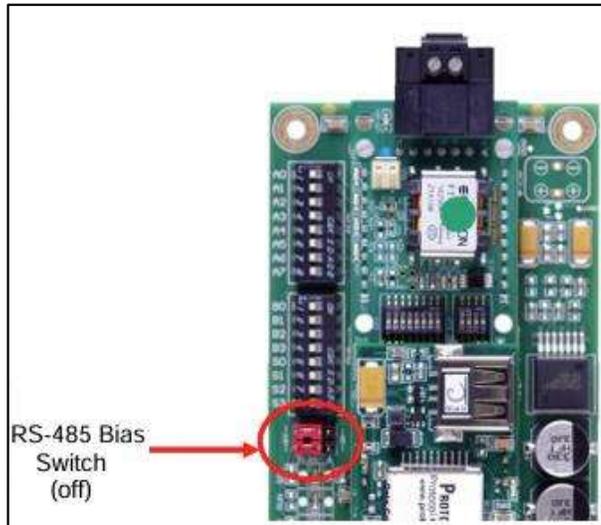


Figure 3-2: Modbus RS-485 Biasing Switch on the ProtoNode

3.2.2 End of Line Termination Switch for the Modbus RS-485 Device Network

- 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 need to be turned ON.
 - On long RS-485 cabling runs, the RS-485 trunk must be properly terminated at each end.
- 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).**

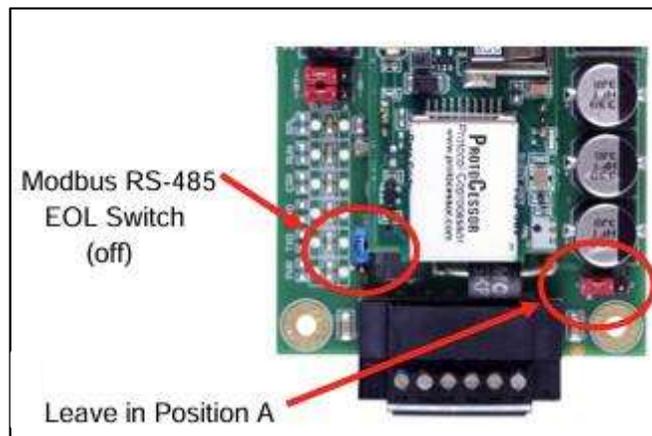


Figure 3-3: Modbus RS-485 End-Of-Line Termination Switch on the ProtoNode

3.3 Thermal Solutions Boiler Control (TSBC) and Sage Boiler Control (SBC)

- The Modbus communication connects to the same RJ11 port that is used by the boiler-to-boiler communication.
- Connect one end of the RJ11 cable to the TSBC and cut off the other end of the cable to access the individual wires of the RJ11 cable. Wire the RJ11 cable as shown above.

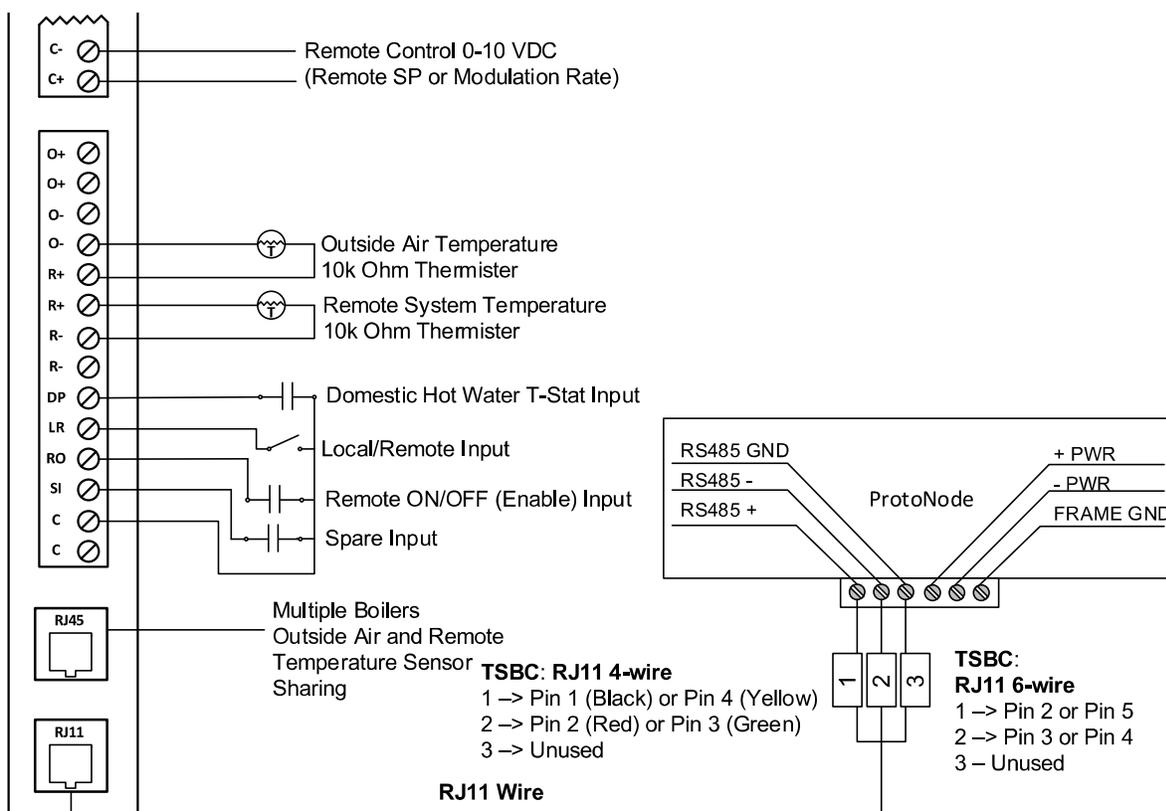


Figure 3-4: RJ11 connection, from the back, on right-hand side of TSBC/SBC Control

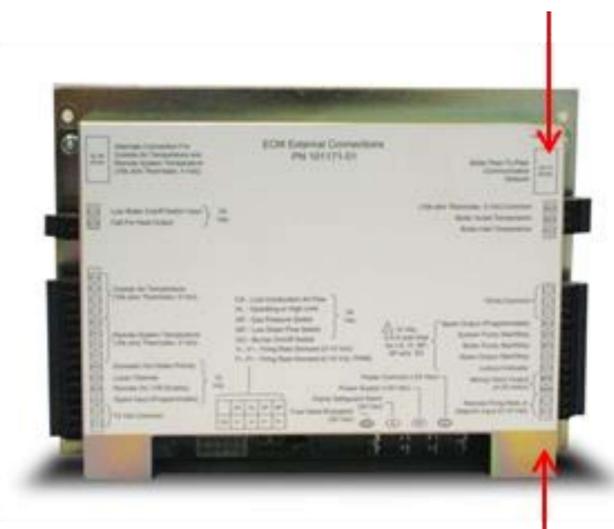


Figure 3-5: Jumper LR to C if you are writing to the boiler controls.

3.4 Apex, Alpine, ASPEN, Phantom-X or Raptor with Panasonic Display

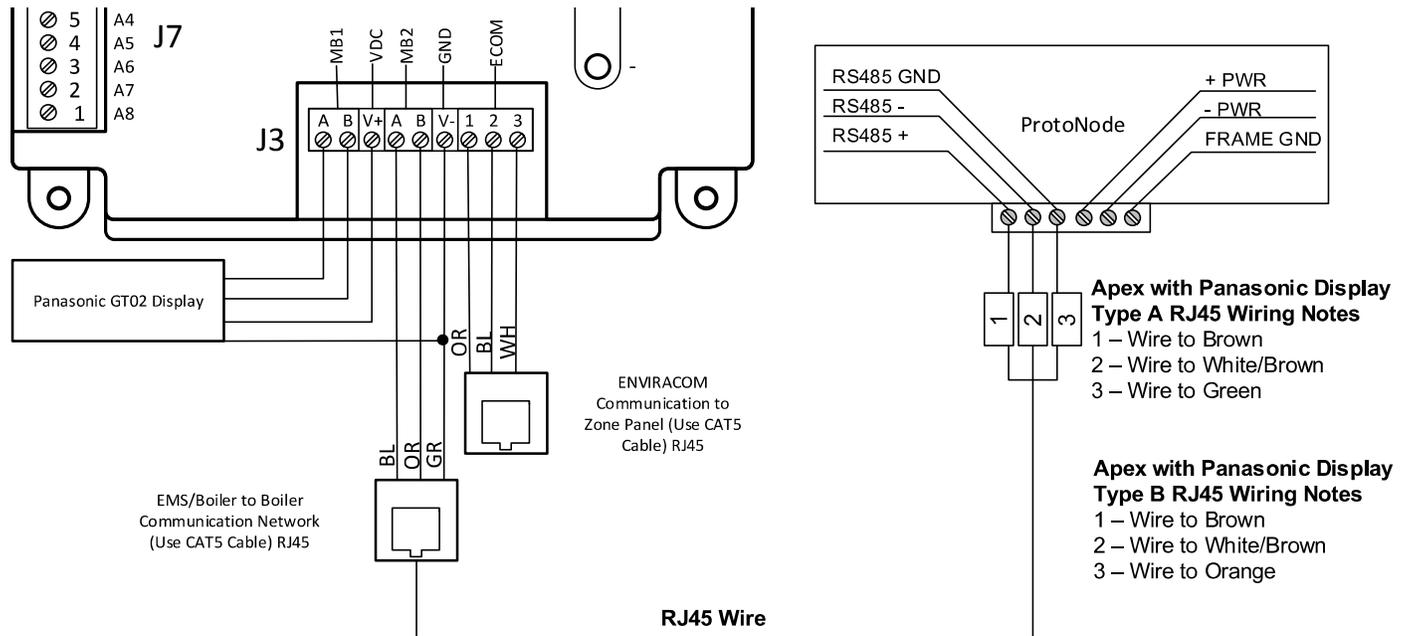


Figure 3-7: Apex, Alpine, ASPEN, Phantom-X or Raptor with Panasonic Display Modbus RS485 Wiring

The Modbus communication connects to the same RJ45 port that is used by the boiler-to-boiler communication. Connect one end of the RJ45 cable to the boiler and cut off the other end of the cable to access the individual wires of the RJ45 cable. Wire the RJ45 cable as shown above.

When wiring to Sage/Sola without the RJ45 cable make the following connections:

- Connect MB2's terminal A (RS-485+) to Pin 1 (RS-485+) on the ProtoNode.
- Connect MB2's terminal B (RS-485-) to Pin 2 (RS-485-) on the ProtoNode.
- Connect MB2's terminal C (ground) to Pin 3 (ground) on the ProtoNode.



Figure 3-8: RJ45 Boiler to Boiler/EMS RJ45 Communication Port on Side of Boiler

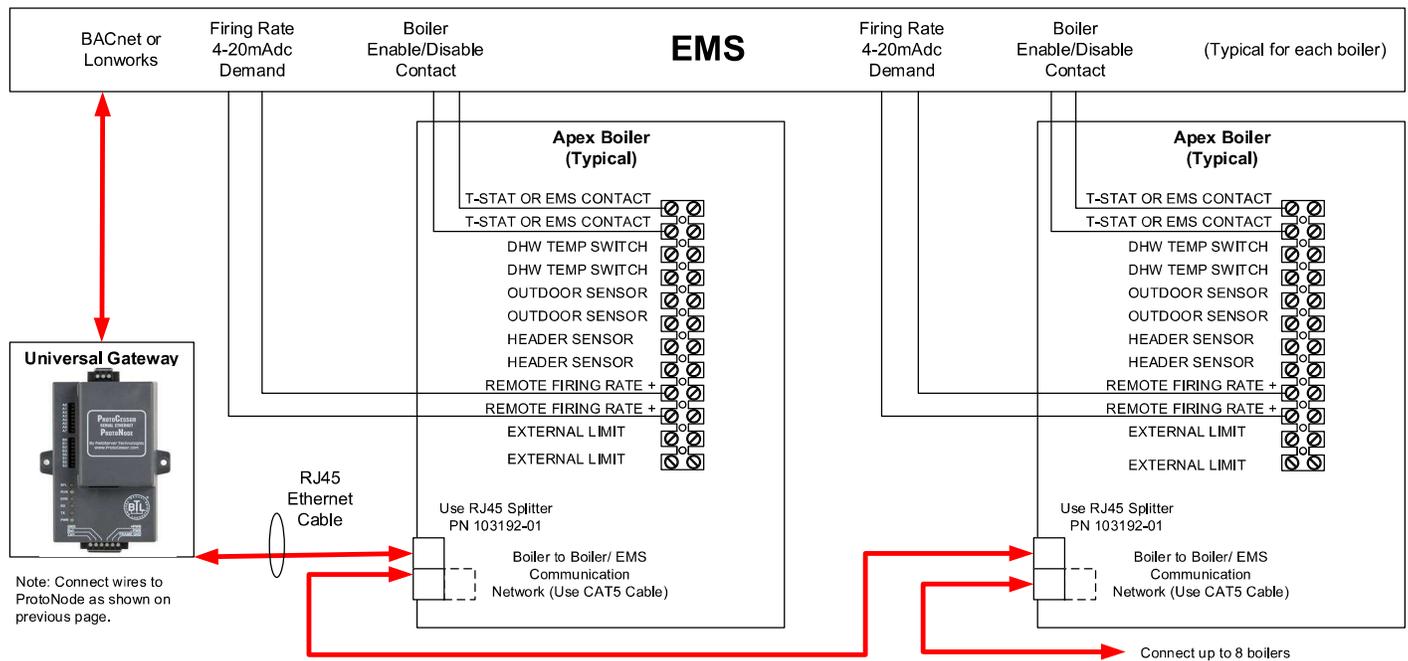


Figure 3-9: Apex, Alpine, ASPEN, Phantom-X or Raptor with Panasonic Display Network Wiring

IMPORTANT NOTES for Apex with Panasonic display Connections:

1. When the Energy Management system is connected, boiler sequencing (multiple boiler lead/lag) must be done external to the boiler controls, by other means.
2. Both Enable/Disable and Remote Firing Rate must be wired to the boilers to provide boiler sequencing (multiple boiler lead/lag).
3. If the burner on/off Modbus signal is used instead of the Enable / Disable contact input the boiler will be turned off, but the system pump may remain running.
4. The Sequencer must be disabled while communicating with EMS (i.e. no Master Boilers).

3.5 Apex & AMP/BFIT/Citadel/Phantom-XL 400-1000L with Concert Display

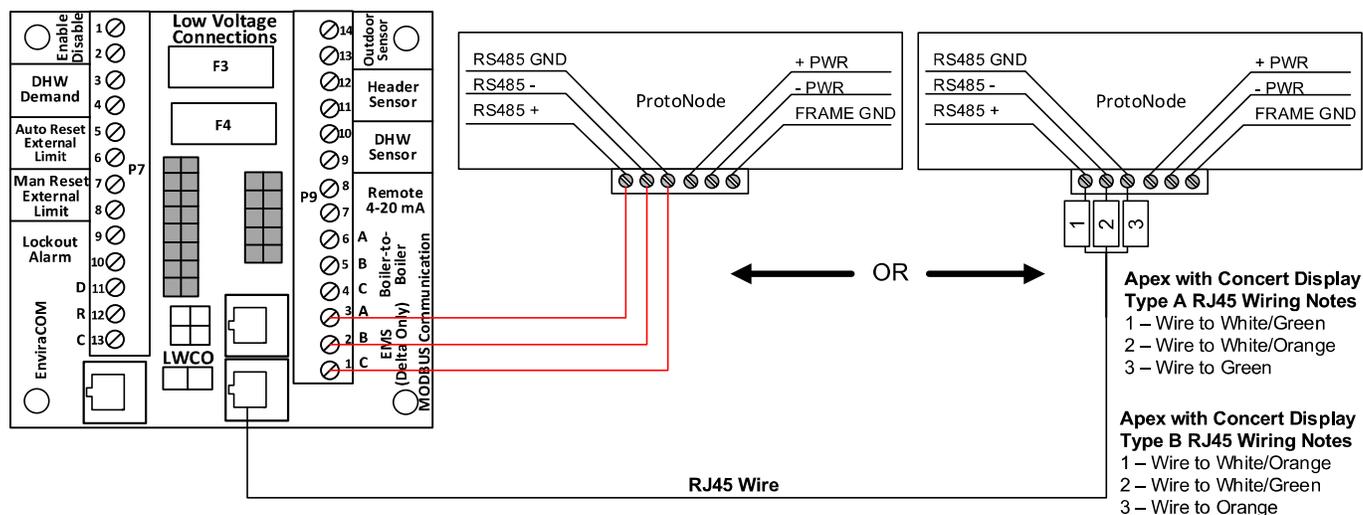


Figure 3-10: Apex and AMP/BFIT/Citadel/Phantom-XL 400-1000L with Concert Modbus RS485 Wiring

There are two options for wiring the ProtoNode to an Apex or AMP/BFIT/CTD/PHX 400-1000L with Concert Display.

1. Connect one end of an RJ45 cable to the boiler PCB and cut off the other end of the cable to access the individual wires of the RJ45 cable. Wire the RJ45 cable as shown above.
2. Wire the ProtoNode to the PCB using the EMS (Delta Only) terminals.

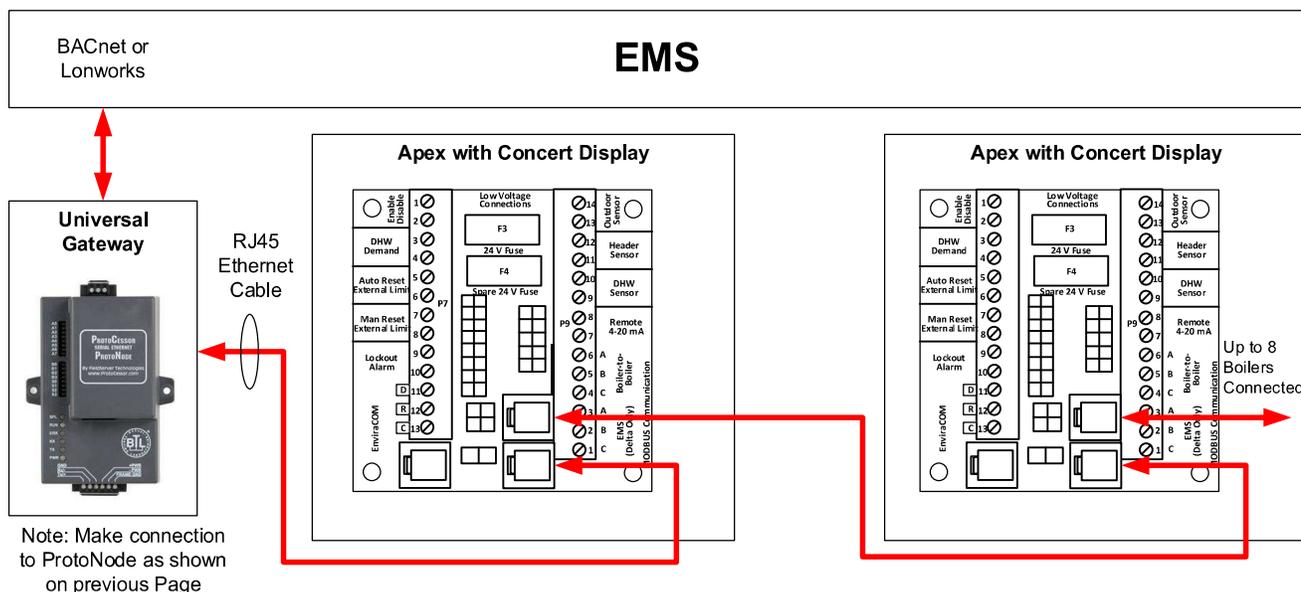


Figure 3-11: Multiple Apex and AMP/BFIT/CTD 400-1000L Modbus RS485 Wiring

NOTICE:

1. All Apex and AMP/BFIT/CTD/PHX 400-1000L with Concert Display are equipped with a PCB to easily establish communication with an EMS.
2. These models can do both Lead Lag (Sequencer) and EMS communication at the same time.

3.6 Older Arctic or FreeFlex 1000 with Concert Display

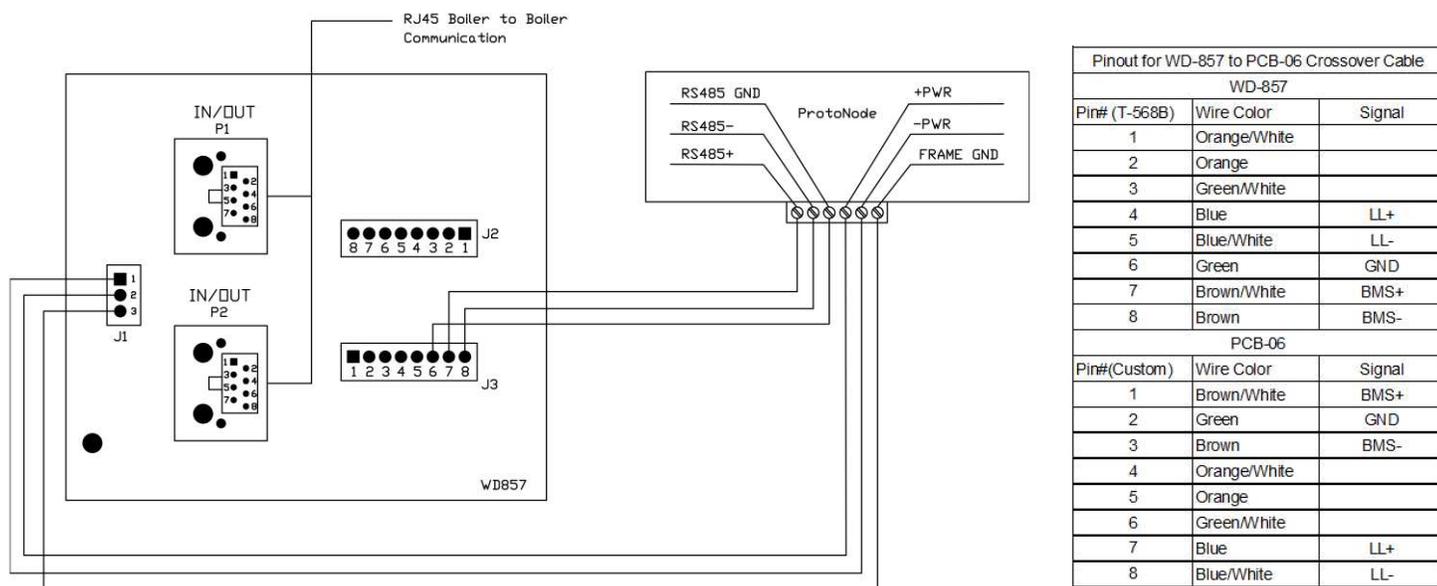


Figure 3-12: Older Arctic/FreeFlex 1000 with Concert Modbus RS485 Wiring

NOTICE:

1. Arctic/FreeFlex with Concert Display can do both Lead Lag (Sequencer) and EMS communication at the same time.
2. For Arctic/FreeFlex Boilers not equipped with PCBs refer to 4109 profile (Apex, Alpine or ASPEN) wiring.
3. Older Arctic/FreeFlex 1500 – 3000 boilers equipped with this PCB may use this wiring.
4. When connecting Arctic/FreeFlex 1000 to Arctic/FreeFlex 1500 – 3000 use the pinout table shown above to create a proper cable.

3.7 Arctic, AMP, FreeFlex, BFIT & Citadel with Concert Display

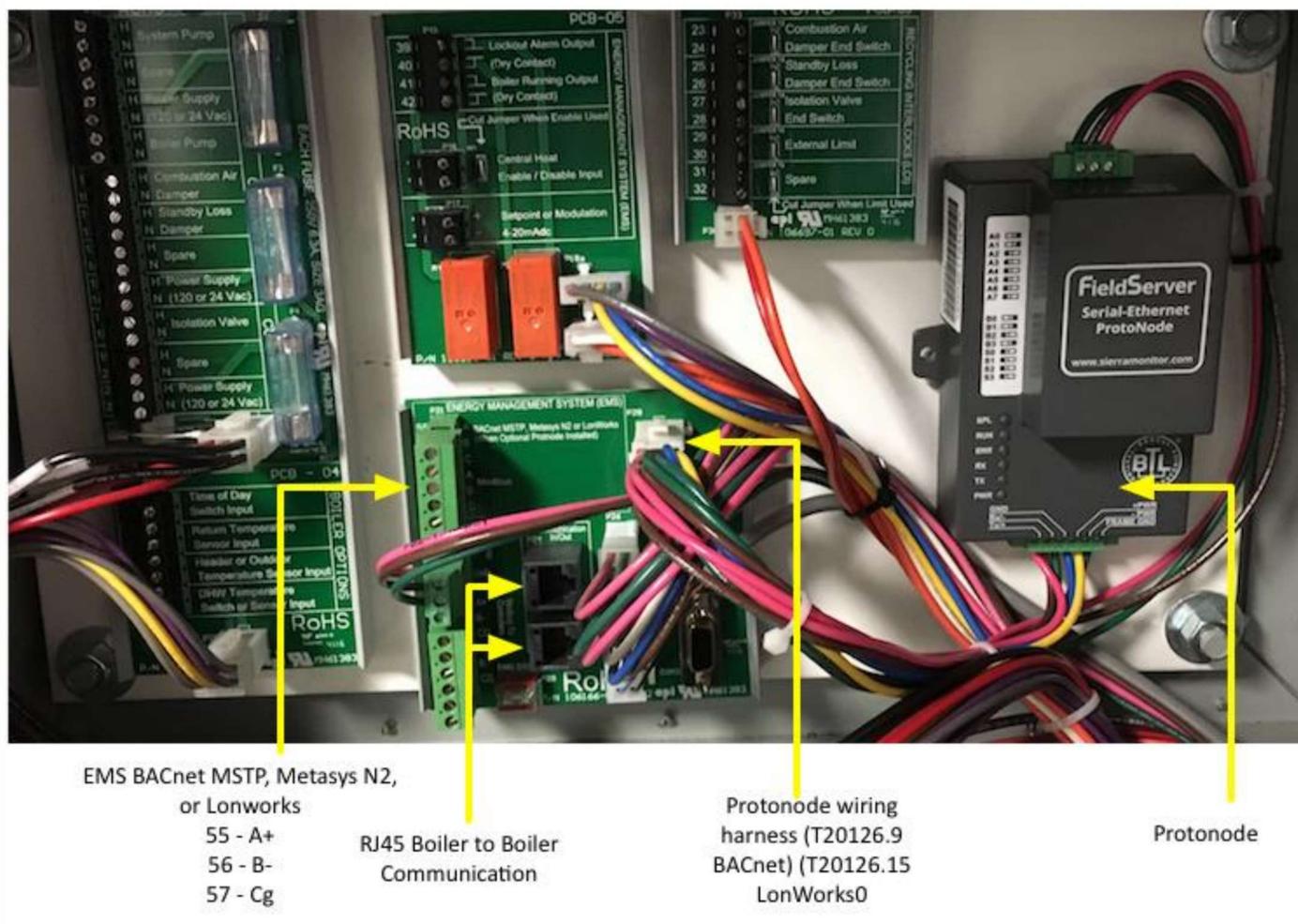
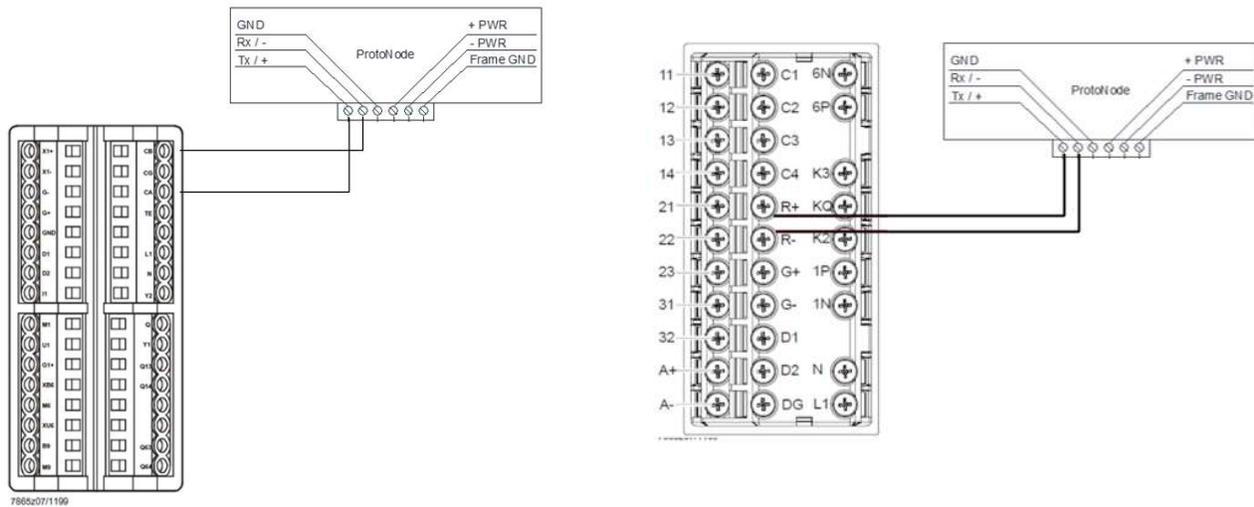


Figure 3-13: Arctic, AMP, FreeFlex, BFIT & Citadel with Concert Modbus RS485 Wiring

NOTICE:

1. Arctic/FreeFlex, AMP/BFIT 1000-4000, & Citadel 1250-1500 with Concert Displays can do both Lead Lag (Sequencer) and EMS communication at the same time.
2. The Gateway ProtoNode kit (P/N: 106433-02) for these units is equipped with a wire harness which connects the Sola, Communications Board (PCB-06), and ProtoNode.

3.8 RWF40 or RWF55



RWF40 Wiring

RWF55 Wiring

Figure 3-14: RWF40 and RWF55 Modbus RS485 Wiring

NOTICE:

- Connect terminal CA (RWF40) or R+ (RWF55) to Pin 1 (RS-485+) on the ProtoNode.
- Connect terminal CB (RWF40) or R- (RWF55) to Pin 2 (RS-485-) on the ProtoNode.
- CG (Ground) terminal does not need to be grounded to the RS-485 Ground port of ProtoNode.

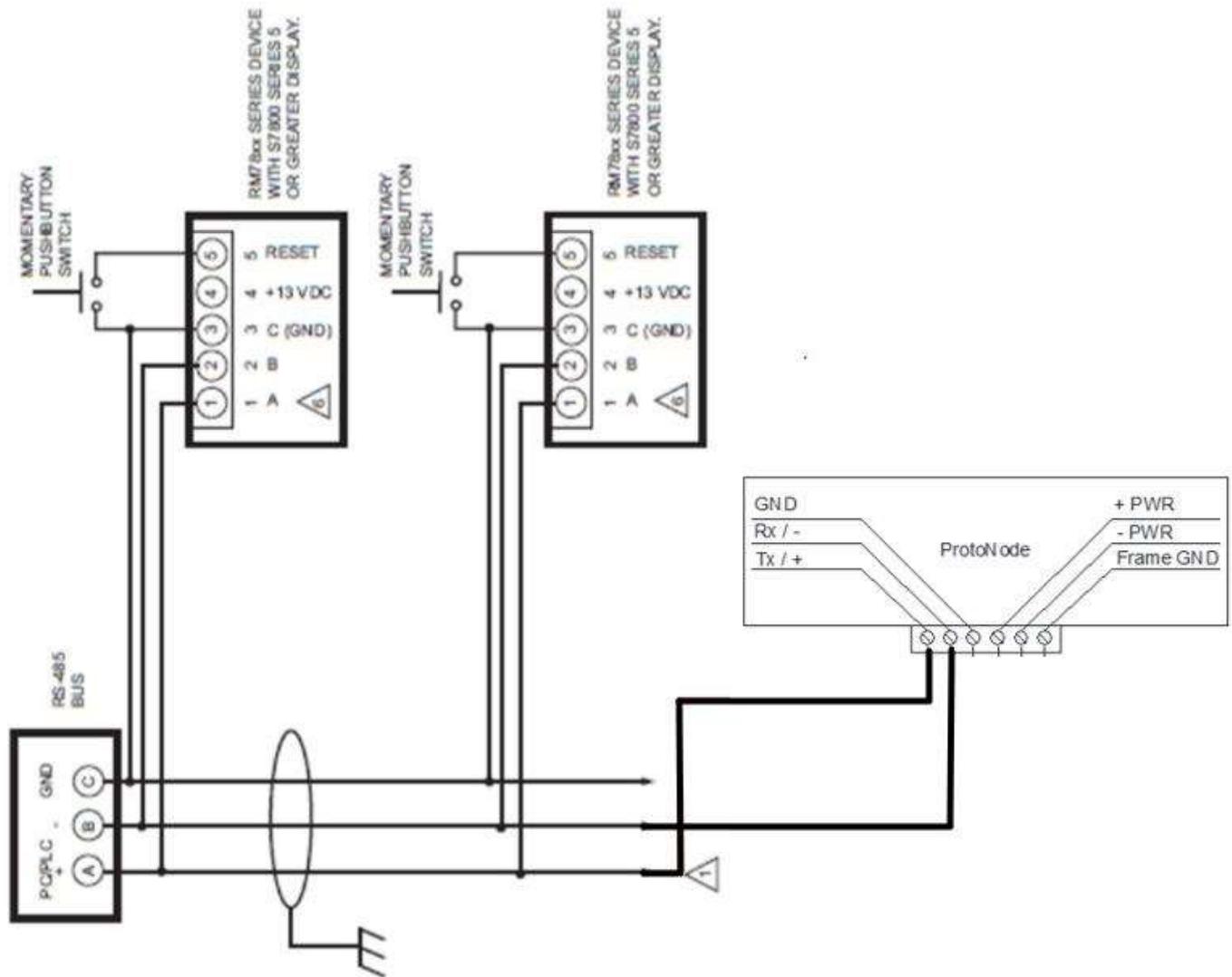


Figure 3-15: RM7800 Modbus RS485 Wiring

NOTICE:

- Connect terminal A (RS-485+) to Pin 1 (RS-485+) on the ProtoNode.
- Connect terminal CB RxD / TxD- (RS-485-) to Pin 2 (RS-485-) on the ProtoNode.
- CG Ground terminal does not need to be grounded to the RS-485 Ground port of ProtoNode.

3.10 ALTA, ALTAC, Phantom II, Phantom Combi II Control

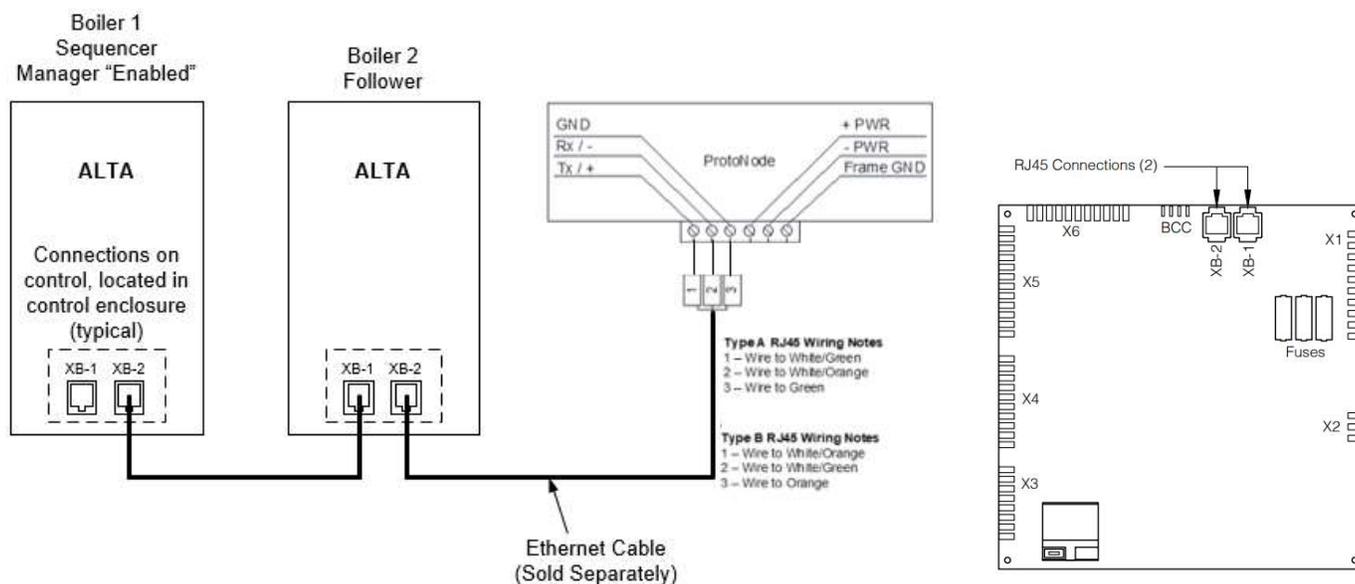


Figure 3-16: ALTA, ALTAC, Phantom II, Phantom Combi II Control Modbus RS485 Wiring

The control system has a full featured ability to interface with an Energy Management System (EMS). The control system allows remote control and monitoring via RS485 Modbus or through direct wiring. The EMS connection is separate from the Boiler-to-Boiler communication network and may be used simultaneously. Modbus communication connects to the same RJ45 port that is used by the Boiler-to-Boiler communication network. Connect one end of the ethernet cable to the control and cut off the other end of the cable to access the individual conductors. The control is a 3 wire Modbus communication, labeled as Modbus 2 (MB2) in Table 4-1 below:

Table 3-3: ALTA, ALTAC, Phantom II, Phantom Combi II Termination details

RJ45	Modbus Signal	Ethernet Type B Color	Ethernet Type A Color	Description
1	D+(A)	Orange w/ white stripe	Green w/ white stripe	Modbus 2 (MB2) Energy Management Interface
2	GND (C)	Orange	Green	
3	D-(B)	Green w/ white stripe	Orange w/ white stripe	
4	--	Blue	Blue	Not used.
5	--	Blue w/ white stripe	Blue w/ white stripe	Not used.
6	--	Green	Orange	Not used.
7	D-(B)	Brown w/ white stripe	Brown w/ white stripe	Modbus 3 (MB3) Boiler-To-Boiler Communication Network
8	D+(A)	Brown	Brown	NOTICE: Do not connect EMS system to pin 7 or 8.

NOTICE: If the first and second pin are orange, the cable is 568B. If the first and second pins are green, the cable is 568A.

3.11 Conductor Wiring

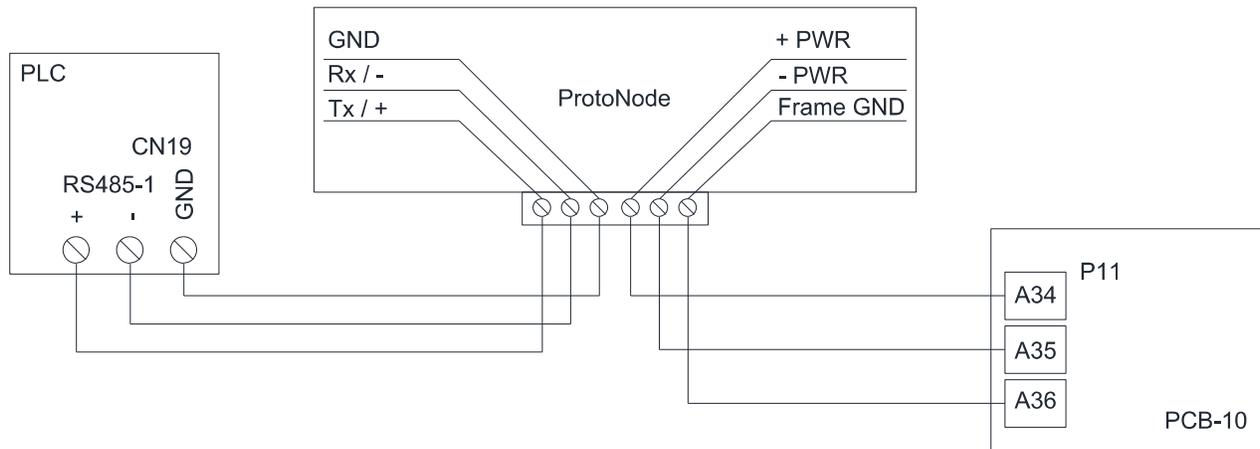


Figure 3-17: RM7800 Modbus RS485 Wiring

NOTICE: Conductor-to-ProtoNode wiring is a separate Modbus network from Conductor-to-Boiler wiring. The ProtoNode should only be wired to Conductor and EMS.

3.12 ProtoNode LonWorks Wiring

- Connect the ProtoNode to the field network with the LonWorks terminal using a twisted pair non-shielded cable. LonWorks has no polarity.



Figure 3-18: ProtoNode LonWorks Terminal

4 INITIAL CONNECTION TO PROTONODE

4.1 Record Identification Data

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

Table 4-1: ProtoNode Identification Data

Model	ProtoNode
Part Number	FPC-N35-0817
Serial Number	Unique
Default Password	Unique

4.2 Use the ProtoNode Web Configurator to setup the Gateway

First, connect a standard CAT5 Ethernet cable (straight through or cross-over) between the local PC and ProtoNode.



Figure 4-1: ProtoNode Ethernet Port

There are two methods to access the ProtoNode via Ethernet connection, either by changing the subnet of the connected PC (Section 4.2.1) or using the FieldServer Toolbox to change the IP Address of the ProtoNode (Section 4.2.2).

4.2.1 Changing the Subnet of the Connected PC

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:

- Use the search field in the local computer's taskbar (to the right of the windows icon ) and type in "Control Panel".
- Click "Control Panel", click "Network and Internet" and then click "Network and Sharing Center".
- Click "Change adapter settings" on the left side of the window.
- Right-click on "Local Area Connection" and select "Properties" from the dropdown menu.

- Highlight [Internet Protocol Version 4 \(TCP/IPv4\)](#) and then click the Properties button.
- Select and enter a static IP Address on the same subnet. For example,

Use the following IP address:

IP address: 192 . 168 . 1 . 11

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

- Click the Okay button to close the Internet Protocol window and the Close button to exit the Ethernet Properties window.

For Windows 7:

- Go to > Control Panel > Network and Internet > Network and Sharing Center > [Change adapter settings](#)
- Right-click on Local Area Connection > Properties
- Highlight [Internet Protocol Version 4 \(TCP/IPv4\)](#) >
- Select: Use the following IP address

Use the following IP address:

IP address: 192 . 168 . 1 . 11

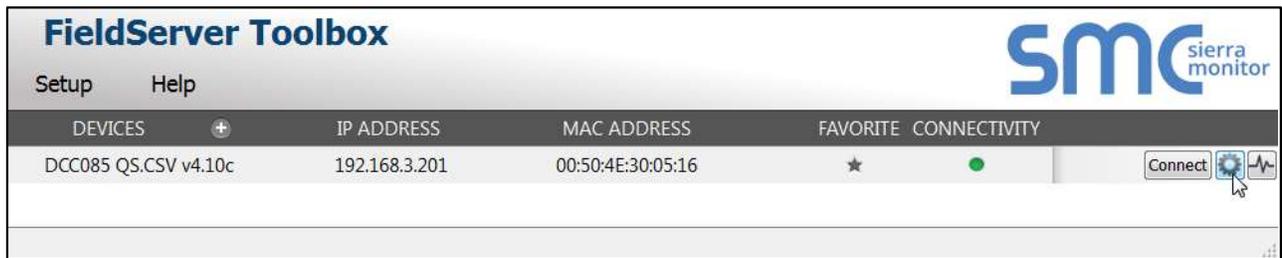
Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

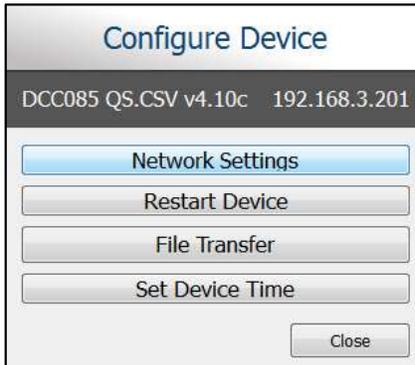
- Click twice

4.2.2 Changing the IP Address of the ProtoNode with FieldServer Toolbox

- Ensure that FieldServer Toolbox is loaded onto the local PC. Otherwise, download the FieldServer-Toolbox.zip via the Sierra Monitor website's [Software Downloads](#).
- Extract the executable file and complete the installation.
- Double click on the FS Toolbox Utility and click Discover Now on the splash page.
- Find the desired gateway and click the Configure Device button (gear icon) to the right of the gateway information.



- Select Network Settings in the Configure Device window.



- Modify the IP Address (N1 IP Address field) of the gateway Ethernet port.
 - The following fields may also be changed as needed: Netmask (N1 Netmask field), DHCP Client State (N1 DHCP Client State field), IP Gateway (Default Gateway field) and DNS 1 & 2 (Domain Name Server fields)



NOTICE: If the gateway is connected to a router, the Default Gateway field of the gateway should be set to the IP Address of the connected router.

NOTICE: Do not change the DHCP Server State (N1 DHCP Server State field).

NOTICE: If DNS settings are unknown, set DNS1 to “8.8.8.8” and DNS2 to “8.8.4.4”.

- Click Update IP Settings, then click on the Change and Restart to restart the Gateway and activate the new IP Address.

4.3 Connecting to the ProtoNode Web Configurator

After setting a local PC on the same subnet as the ProtoNode (Section 4.1), open a PC web browser, and enter the IP address of the ProtoNode (default: 192.168.1.24)

NOTICE: If the IP Address of the ProtoNode was changed, the assigned IP Address can be discovered using the FS Toolbox utility.

- Username: admin
- Password is printed on label of ProtoNode and should be located on the cover by the Ethernet port

5 SETUP WEB SERVER SECURITY

5.1 Login to the FieldServer

The first time the FieldServer GUI is opened in a browser, the IP Address for the gateway will appear as untrusted. This will cause the following pop-up windows to appear.

- When the Web Server Security Unconfigured window appears, read the text and choose whether to move forward with HTTPS or HTTP.



Figure 5-1: First Login Security Warning

- When the warning that "Your connection is not private" appears, click the advanced button on the bottom left corner of the screen.

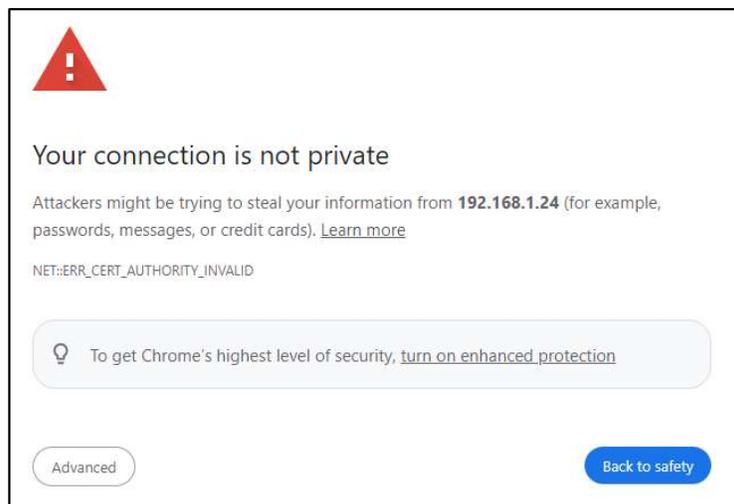


Figure 5-2: First Login Security Advanced Button

- Additional text will expand below the warning, click the underlined text to go to the IP Address. In the example below this text is "[Proceed to 192.168.1.24 \(unsafe\)](#)".

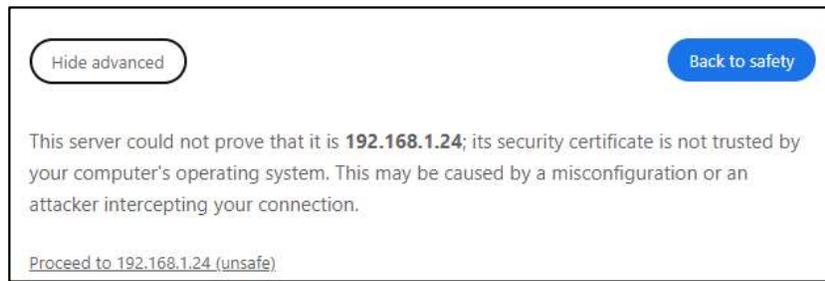


Figure 5-3: Proceed to 196.168.1.24 Button

- When the login screen appears, put in the Username (default is “admin”) and the Password (found on the label of the FieldServer).

NOTICE: There is also a QR code in the top right corner of the FieldServer label that shows the default unique password when scanned.

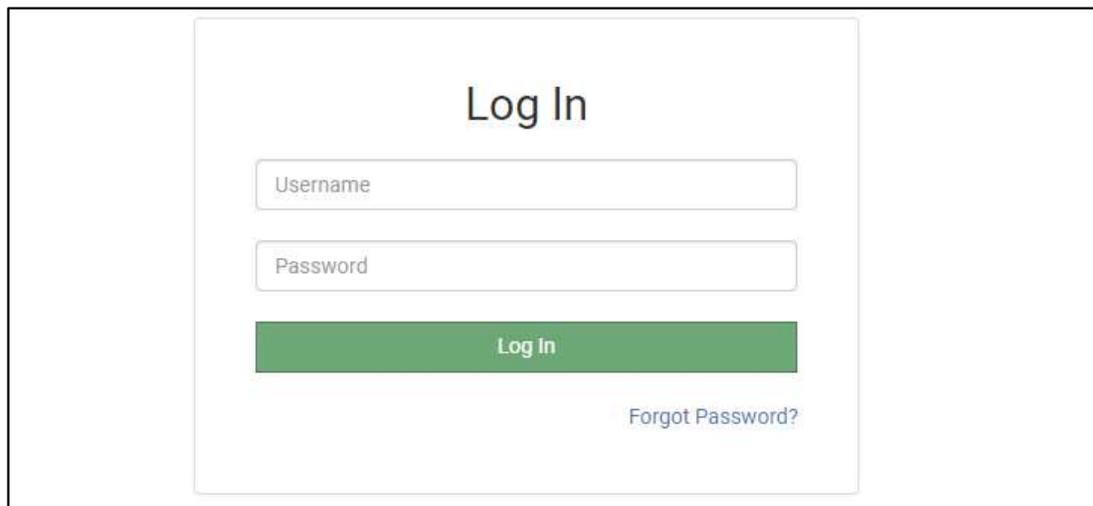


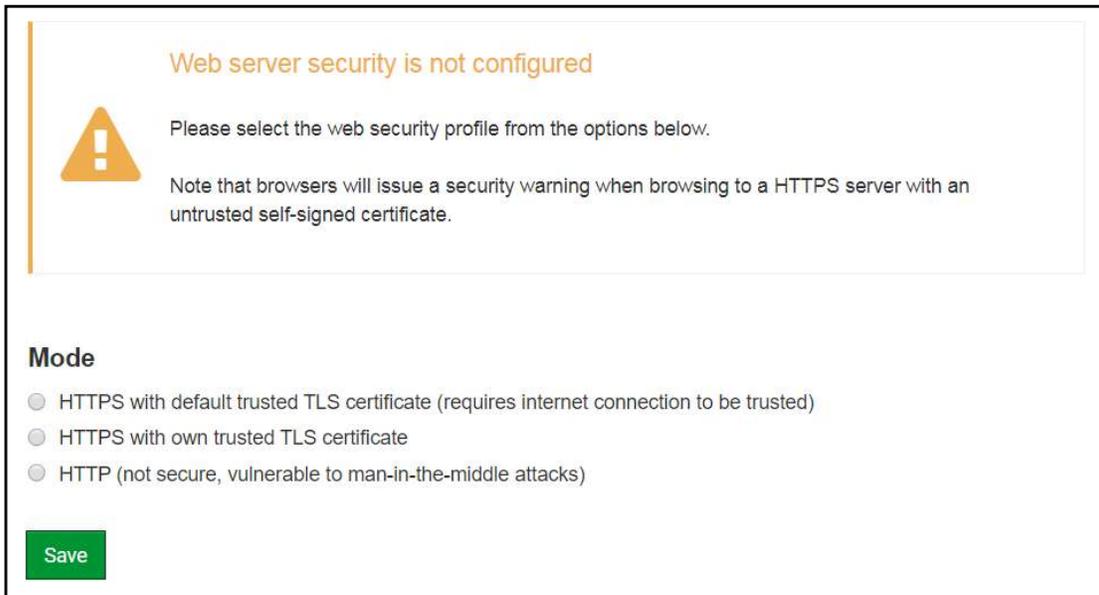
Figure 5-4: Login Page

NOTICE: A user has 5 attempts to login then there will be a 10-minute lockout. There is no timeout on the FieldServer to enter a password.

NOTICE: To create individual user logins, go to [Appendix B.5 Change User Management Settings](#).

5.2 Select the Security Mode

On the first login to the FieldServer, the following screen will appear that allows the user to select which mode the FieldServer should use.



Web server security is not configured

Please select the web security profile from the options below.

Note that browsers will issue a security warning when browsing to a HTTPS server with an untrusted self-signed certificate.

Mode

- HTTPS with default trusted TLS certificate (requires internet connection to be trusted)
- HTTPS with own trusted TLS certificate
- HTTP (not secure, vulnerable to man-in-the-middle attacks)

Save

Figure 5-5: Web Security Selection Page

NOTICE: Cookies are used for authentication.

NOTICE: To change the web server security mode after initial setup, [go to Section 9.2 Change Web Server Security Settings After Initial Setup.](#)

The sections that follow include instructions for assigning the different security modes.

5.3 HTTPS with Own Trusted TLS Certificate

This is the recommended selection and the most secure. **Please contact your IT department to find out if you can obtain a TLS certificate from your company before proceeding with the Own Trusted TLS Certificate option.**

- Once this option is selected, the Certificate, Private Key and Private Key Passphrase fields will appear under the mode selection.

Certificate

```
XzyMbQZFiRwZjPe7CTHLcHOrHLowoUFeVtaBMYd4d6VGdNklKazByWkCnOL7mrX
A4lBAQBfM+JPvOx3T/47VEmalXqE3bx3zEuBFJ6pWPtw7LHf2r2ZoHw+9xb+aNMUJ
dVVAelhBMTMsni2ERvQVp0x3psSv2EJvKXS1bOYNRLsq7UzpwuAdT/Wy3o6vUM5
K+Cw9qEoQ0LUXDZTIECt67MkcHMIuEi5pk7TRicHnQF/sIOAYQuiduHOy9exlk9
EmHFVDIz/cjUaF+e74EuSph+gEr0Qo2wymbhc7L22UXse1No0fJ2Zg0Fu1VYJu
JRyaMwWlRFEWuuzMGZiKEWVC+8q2JQsVcgrWMM7naoblL EhoCMH+sKHJMxCDoXGt
vZjpZUoAL51YXxWSVcyZdGiAP5e
-----END CERTIFICATE-----
```

Private Key

```
sHf0zZofHr4YQSDk2BbYVzzbl0L DuKlC8+JI03ooGjoTuHnqkeA/fKfbTAsKeAzw
gKQe+H5UQNk0bdvZiQJrm6daDK2vDmR5k+iUUhEi5N49uplroB97MQaYotzqTT+
THlbpq5t1Sik617k04ObkMhFE5i8fck+ru545sVmpeezh0m5j5SURYAZMlybq5daCu
J4i5NlhbEvxRF4Uk41ZDMCvuj0PcBKUWrb1a/3XXnDnM2K9xyz2wze998D6Wk46
+ZaQFY9E+7i5lJmkoS3GYtwCyH5iP+mPP1K6RnuiD019wwwGPb4dtN/RtInfd0eF
GYeVSk9fxxkxDOFifdWRZbM/rPjn4tmQ1Xf8HqONVN1x/jaMynOXG4cukoId+VQ
u0rZaUeSli2zNkfr7fAASm5NBWq202Cy9lAYnuujs3aALi5uGBEEK62oTMxlzx
-----END RSA PRIVATE KEY-----
```

Private Key Passphrase

Specify if encrypted

Save

Figure 5-6: Certificate Page

- Copy and paste the Certificate and Private Key text into their respective fields. If the Private Key is encrypted type in the associated Passphrase.
- Click Save.
- A “Redirecting” message will appear. After a short time, the FieldServer GUI will open.

5.4 HTTPS with Default Untrusted Self-Signed TLS Certificate or HTTP with Built-in Payload Encryption

- Select one of these options and click the Save button.
- A “Redirecting” message will appear. After a short time, the FieldServer GUI will open.

6 SETUP PROTONODE

6.1 Navigate to the ProtoNode Web Configurator

- From the Web App Device List page, click the Settings tab and then click Configuration.

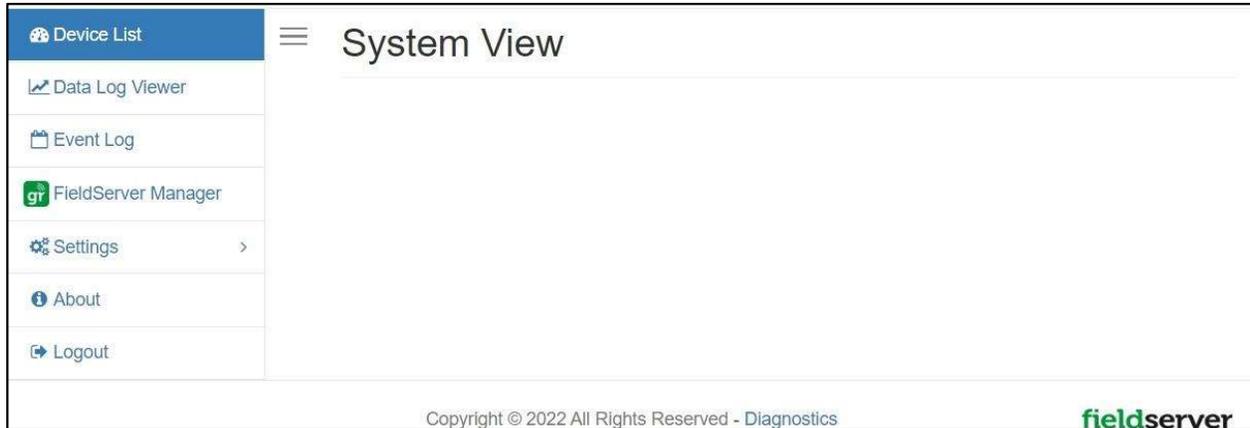


Figure 6-1: ProtoNode Web Configurator home page

- Then click the Profiles Configuration button to go to the Web Configurator page.

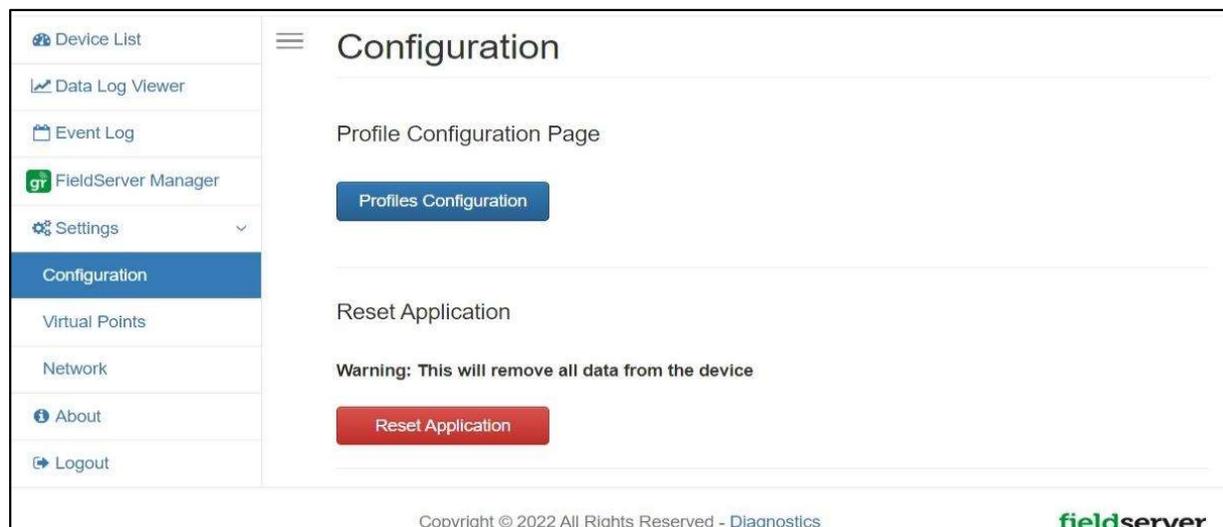


Figure 6-2: ProtoNode Web Configurator configuration page

NOTICE: For Web App instructions to the System View, Data Log Viewer, Event Logger and Virtual Points functions, see the [MSA Grid – FieldServer Manager Start-up Guide](#).

6.2 Set Configuration Parameters

- Ensure that all parameters are entered for successful operation of the gateway. Find the legal value options for each parameter under the Parameter Description in parentheses.
- Set Baud rate to match connected device:

Table 6-1: ProtoNode Configuration Modbus Parameters

Port Setting	Sola, 4109, TSBC, & 4716	Other Devices
Protocol	Modbus RTU	Modbus RTU
Baud Rate	38400	9600
Parity	None	None
Data Bits	8	8
Stop Bits	1	1

6.3 Configure Devices Connected to the Gateway

If Auto-Discovery was performed through the S3 DIP switch on power up, skip this step.

- In the Web Configurator, the Active Profiles are shown below the configuration parameters. The Active Profiles section lists the currently active device profiles. This list is empty for new installations, or after clearing all configurations.

The screenshot displays the MSA web configurator interface. At the top left is the MSA logo. Below it, the 'Configuration Parameters' section is visible, featuring a table with columns for 'Parameter Name', 'Parameter Description', and 'Value'. The 'mod_baud_rate' parameter is highlighted, with a description: 'Modbus RTU Baud Rate. This sets the Modbus RTU baud rate. (9600/19200/38400)'. The value field contains '38400' and a green 'Submit' button is next to it. Below this is the 'Active profiles' section, which has a table with columns for 'Nr', 'Node ID', 'Current profile', and 'Parameters'. A green 'Add' button is positioned below the table. At the bottom of the interface, there are four buttons: 'HELP (?)', 'Clear Profiles and Restart', 'System Restart', and 'Diagnostics & Debugging'.

Figure 6-3: Manual Profile “Add” Button

- To add an active profile to support a device, click the Add button under the Active Profiles heading. This will present a drop-down menu underneath the Current profile column.
- Once the Profile for the device has been selected from the drop-down list, set Node-ID (Modbus address) for any device attached to ProtoNode. The Node-ID needs to be uniquely assigned between 1 and 255. This specification must match the device’s network settings.
- 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 below.

Active profiles			
Nr	Node ID	Current profile	Parameters
1	1	Lon_Sola	Remove
2	22	Lon_RWF40	Remove
3	33	Lon_LMV2_3	Remove
Add			

[HELP \(?\)](#)
[Clear Profiles and Restart](#)
[System Restart](#)
[Diagnostics & Debugging](#)

Figure 6-4: Manually Added Profile List

6.4 Verify Device Communications

- If using a serial connection, check that TX and RX LEDs are rapidly flashing. [See Section 8.4 LED Functions](#) for information and images.
- Confirm the software shows good communications without errors. [See Section 8.2 Viewing Diagnostic Information](#)).

6.5 How to Start the Installation Over: Clearing Profiles

- 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.

6.6 Commissioning LonWorks ProtoNode

Commissioning may only be performed by the LonWorks administrator. To commission the ProtoNode LER LonWorks port, insert a small screwdriver in the commissioning hole on the face of the LER's enclosure to access the Service Pin. See the illustration on the ProtoNode LER as to which way to toggle the screwdriver during commissioning.

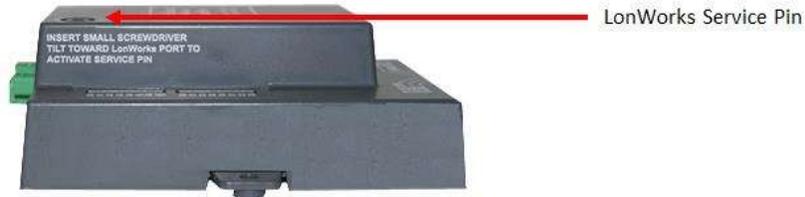
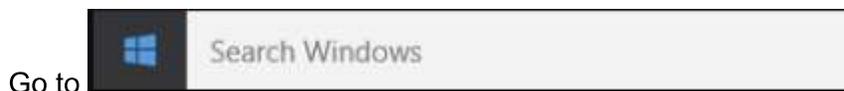


Figure 6-5: LonWorks Service Pin Location

- **If an XIF file is required, see steps Section 4.1.1 to generate XIF**

6.6.1 Instructions to Upload XIF File From the ProtoNode LER Using FS GUI Web Server

- Connect a standard cat5 Ethernet cable between the PC and 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:



Type "control panel"

Then click  Control Panel >  Network and Internet

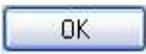
>  Network and Sharing Center > **Change adapter settings**

Right-click on Local Area Connection > Properties

Highlight  **Internet Protocol Version 4 (TCP/IPv4)** > 

- Select: Use the following IP address



- Click  twice

- For Windows 7:

Go to  >  Control Panel >  Network and Internet
 >  Network and Sharing Center >  Change adapter settings

Right-click on Local Area Connection > Properties

Highlight  Internet Protocol Version 4 (TCP/IPv4) > 

- Select: Use the following IP address



- Click  twice
- Open a web browser and go to the following address:
IP address of ProtoCessor/fserver.xif
- Example: **192.168.1.24/fserver.xif**
- Download and save the file onto the PC.



Figure 6-6: Sample of fserver.xif file being generated

7 SETUP ENERGY MANAGEMENT SYSTEM NETWORK

7.1 Navigate to the Network Settings

- From the Web App landing page, click the Settings tab on the left side of the screen.

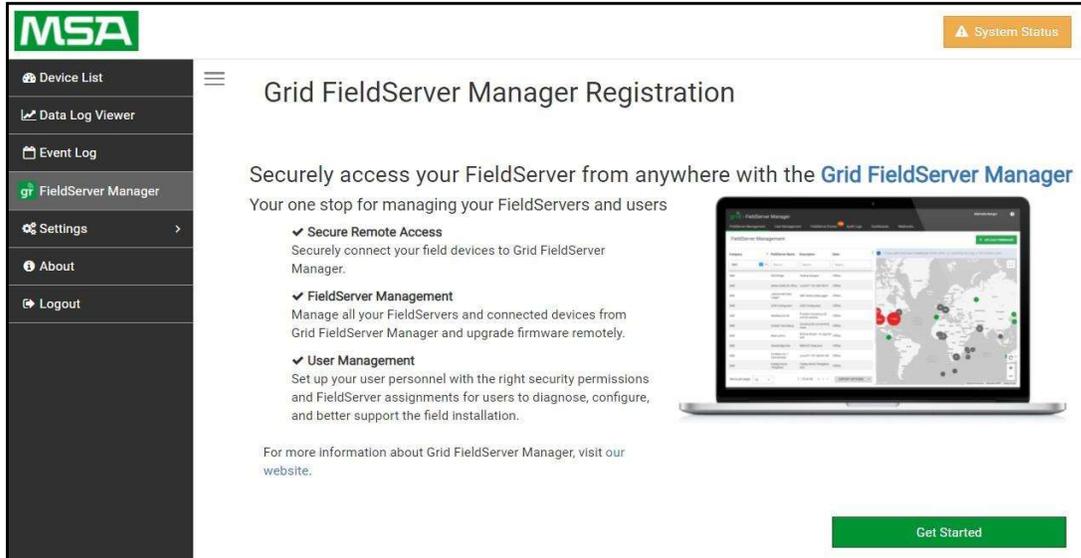


Figure 7-1: ProtoNode Web Configurator Landing Page

- Click the Network tab that appears to open the Network Settings page.

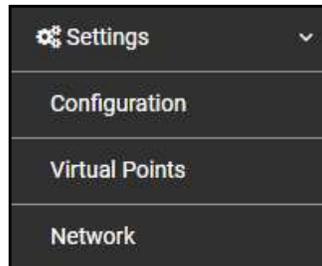


Figure 7-2: Settings Menu

- A warning message will appear when performing the first-time setup, click the Exit Registration button to continue to the Settings page.

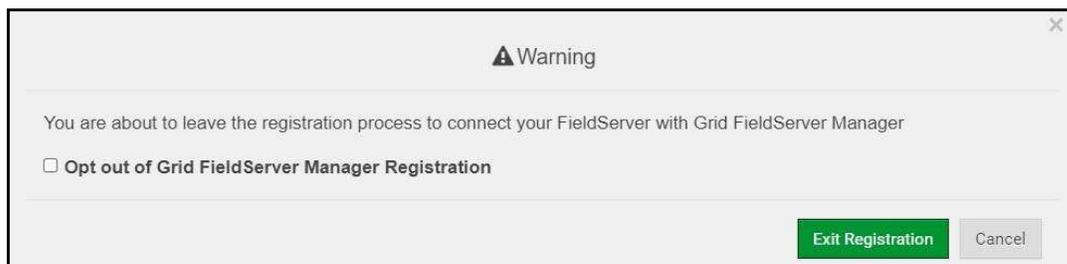


Figure 7-3: Option Out of Grid Page

7.2 Routing Settings

The Routing settings make it possible to set up the IP routing rules for the FieldServer's internet and network connections.

- Click the Add Rule button to add a new row and set a new Destination Network, Netmask and Gateway IP Address as needed.
- Set the Priority for each connection (1-255 with 1 as the highest priority and 255 as the lowest).
- Click the Save button to activate the new settings.

Interface	Destination Network	Netmask	Gateway IP Address	Priority
ETH 1	Default	-	192.168.1.1	255
ETH 1	10.40.50.10	255.255.255.255	192.168.1.1	254

+ Add Rule

Cancel Save

There are unsaved settings

Figure 7-4: Routing Page

7.3 Ethernet 1

The ETH 1 section contains the wired network settings. To change the IP Settings, follow these instructions:

- Enable DHCP to automatically assign IP Settings or modify the IP Settings manually as needed, via these fields: IP Address, Netmask, Default Gateway, and Domain Name Server1/2.

NOTICE: If the FieldServer is connected to a router, the IP Gateway of the FieldServer should be set to the same IP Address of the router.

- Click Save to record and activate the new IP Address.
- Connect the FieldServer to the local network or router.

NOTICE: Write down new IP Settings. Failure to do so will cause lost time.

NOTICE: The browser will need to be pointed to the new IP Address of the FieldServer before the settings are accessible again.

ETH 1 Routing

Enable DHCP

IP Address
192.168.1.24

Netmask
255.255.255.0

Gateway
192.168.1.1

Domain Name Server 1 (Optional)
8.8.8.8

Domain Name Server 2 (Optional)
8.8.4.4

Cancel Save

Network Status

Connection Status	Connected
MAC Address	00:50:4e:13:c3:c0
Ethernet Tx Msgs	60,748
Ethernet Rx Msgs	87,607
Ethernet Tx Msgs Dropped	0
Ethernet Rx Msgs Dropped	0

Figure 7-5: Ethernet Page

8 TROUBLESHOOTING

8.1 Lost or Incorrect IP Address

- Ensure that FieldServer Toolbox is loaded onto the local PC. Otherwise, download the FieldServer-Toolbox.zip via the MSA Safety website.
- Extract the executable file and complete the installation.



Figure 8-1: ProtoNode Ethernet Port

- Connect a standard Cat-5 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.

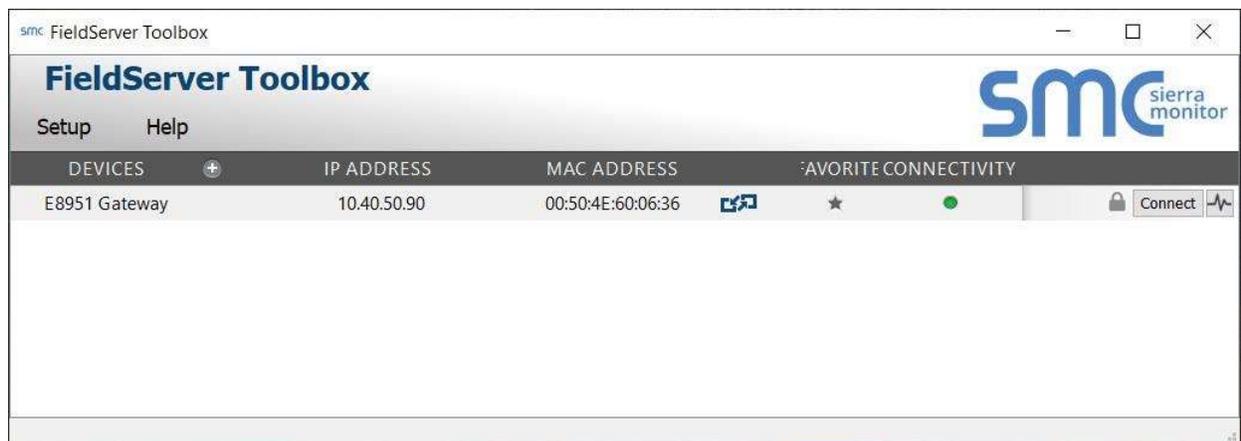
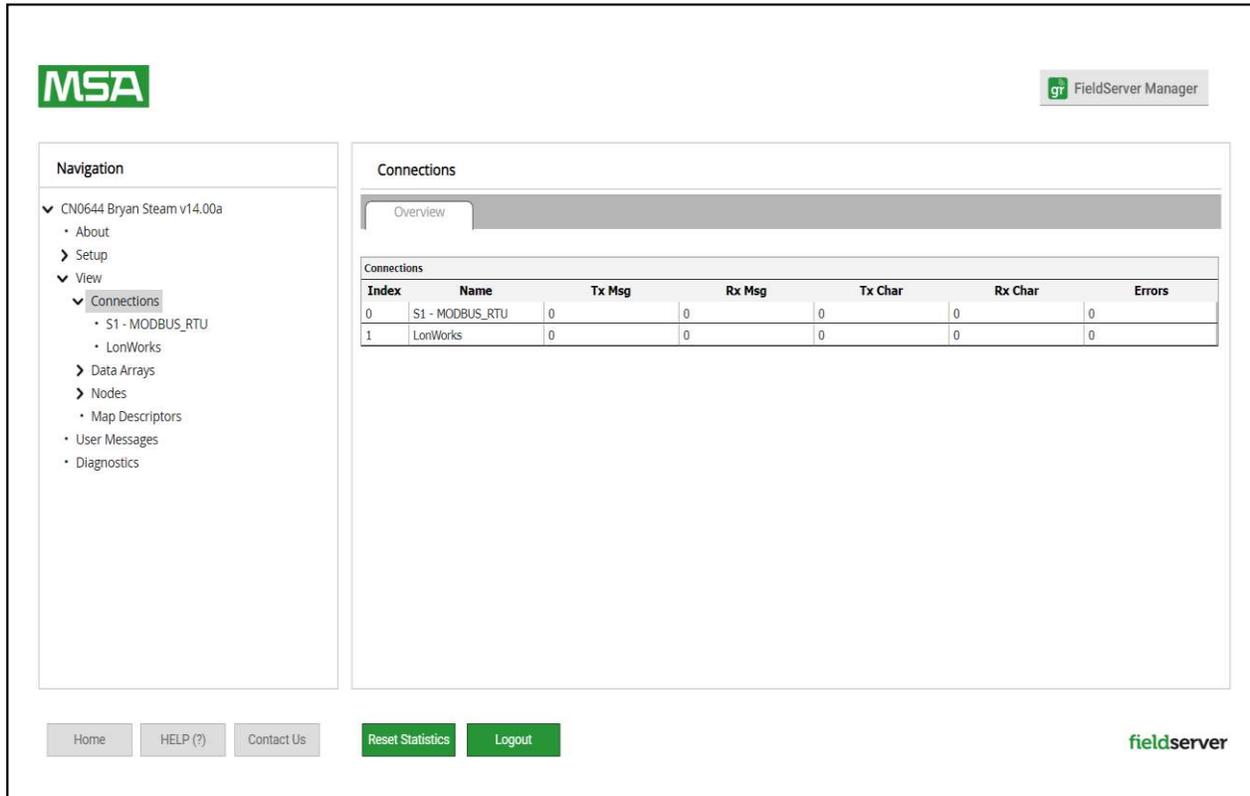


Figure 8-2: Field Server Toolbox

8.2 Viewing Diagnostic Information

- Type the IP Address of the FieldServer into the web browser or use the FieldServer Toolbox to connect to the FieldServer.
- 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 [Section 8.3 Checking Wiring and Settings](#) for the relevant wiring and settings.



The screenshot shows the FieldServer Manager interface. On the left is a navigation menu under 'View' with 'Connections' selected. The main area is titled 'Connections' and contains a table with the following data:

Index	Name	Tx Msg	Rx Msg	Tx Char	Rx Char	Errors
0	S1 - MODBUS_RTU	0	0	0	0	0
1	LonWorks	0	0	0	0	0

Figure 8-3: Connections Page

8.3 Checking Wiring and Settings

No COMS on the Modbus RTU side. If the Tx/Rx LEDs are not flashing rapidly then there is a COM issue. To fix this problem, check the following:

- Visual observations of LEDs on the ProtoNode. Both Tx and Rx LEDs should be flashing rapidly.
- Check baud rate, parity, data bits, stop bits.
- Check device address.
- Verify wiring.
- Verify the device was listed in the Web Configurator ([Section 6.3 Configure Devices Connected to the Gateway](#)).

Field COM problems:

- Visual observations of LEDs on the ProtoNode. ([Section 8.4 LED Functions](#))

- Verify wiring.
- Verify IP Address setting.

NOTICE: If the problem still exists, a Diagnostic Capture needs to be taken and sent to support. ([Section 8.6 Take Diagnostic Capture with FieldServer Utilities](#))

8.4 LED Functions

Please see the diagram below for ProtoNode LER LonWorks LED Locations.

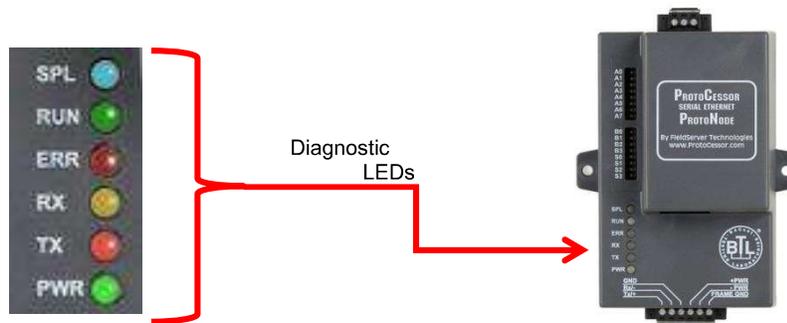


Figure 8-4: ProtoNode LEDS

Tag	Description
SPL	The SPL LED will light if the ProtoNode is offline.
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 ProtoNode. If this occurs, immediately report the related “system error” shown in the error screen of the GUI interface to FieldServer Technologies for evaluation.
RX	The RX LED will flash when a message is received on the host port.
TX	The TX LED will flash when a message is sent on the host port.
PWR	This is the power light and should always show steady green when ProtoNode is powered.

8.5 “No Communication” Troubleshooting Trees

8.5.1 General Troubleshooting

Whenever a setting is changed (i.e. dipswitches or communication) power should be cycled to the ProtoNode to allow for settings to take effect.

1. Is power connected to boilers and ProtoNode?
 - Green PWR LED solid on ProtoNode
 - Green LED solid on control
2. Is the ERR LED red? (see [Section 8.4](#))
3. Is the wiring from the ProtoNode to the Boilers correct? (See [Sections 3.3 – 3.12](#))
4. Does each boiler have a unique address? (see [Section 2.1](#))
5. For TSBC/SBC boilers, are the Parity and Baud rate set correctly? (see [Section 2.1.3](#))
6. Does the ProtoNode Discover boilers but give zero for values?
 - The ProtoNode has remembered older profiles and must be cleared.
 - Connect a PC using an Ethernet cable.
 - Go to 192.168.1.24 ProtoNode profile internet explorer page
 - Select “Clear Profiles And Restart”

For further “No Communication” Troubleshooting, go to the Network Protocol of the EMS Network and follow the Troubleshooting tree under it.

8.5.2 LonWorks troubleshooting

1. Is the wiring to the EMS Network Correct? (See [Section 4.2](#))
2. Has an Auto-Discovery been performed? (See [Section 2.2.2](#))

8.6 Take Diagnostic Capture with FieldServer Utilities

When there is a problem on-site that cannot easily be resolved, perform a Diagnostic Capture before contacting support. Once the Diagnostic Capture is complete, email it to technical support. The Diagnostic Capture will accelerate diagnosis of the problem.

- Access the FieldServer Diagnostics page via one of the following methods:
 - Open the FieldServer FS-GUI page and click on Diagnostics in the Navigation panel
 - Open the FieldServer Toolbox software and click the diagnose icon  of the desired device

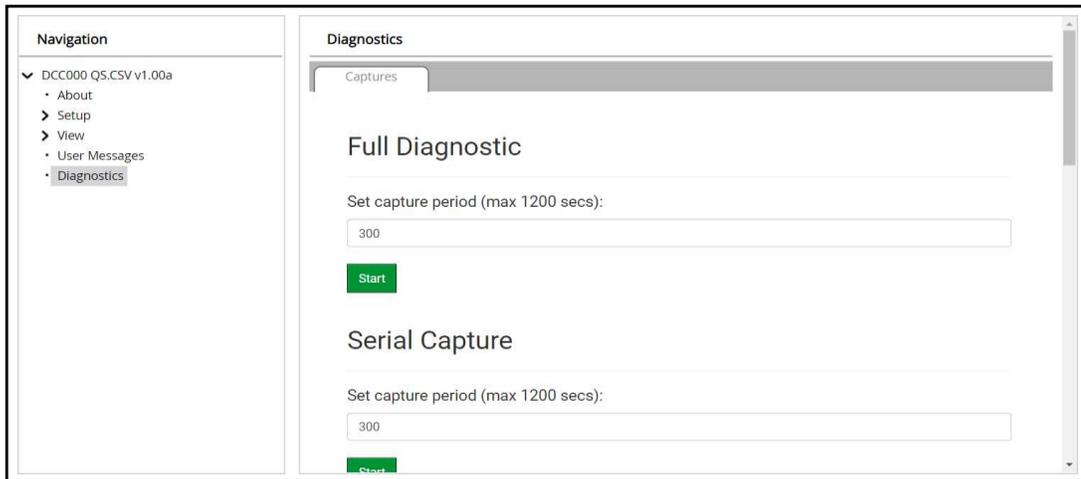


Figure 8-5: Diagnostic Capture Page

- Go to Full Diagnostic and select the capture period.
- Click the Start button under the Full Diagnostic heading to start the capture.
 - When the capture period is finished, a Download button will appear next to the Start button



Figure 8-6: Diagnostic Complete

- Click Download for the capture to be downloaded to the local PC.
- Email the diagnostic zip file to technical support (smc-support.emea@msasafety.com).

9 ADDITIONAL INFORMATION

9.1 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.
 - Default IP Address is 192.168.1.24
 - Use the FS Toolbox utility if the IP Address is unknown ([Section 8.1 Lost or Incorrect IP Address](#))
3. Navigate to Profile Configuration page by clicking “Settings” tab, then click “Configuration”, then click “Profiles Configuration”
4. Click on the “Diagnostics & Debugging” button.
5. 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
6. In the General tab, click on “Choose Files” and select the .SIMG file extracted in step 1.
7. Click on the “Submit” button.
8. When the download is complete, click on the “System Restart” button.

9.2 Change Web Server Security Settings After Initial Setup

NOTICE: Any changes will require a **FieldServer reboot to take effect.**

- Click Diagnostics at bottom of page and then Setup in the Navigation panel.

The screenshot displays the MSA FieldServer Manager web interface. The top left features the MSA logo, and the top right shows the 'FieldServer Manager' title. A navigation pane on the left is expanded to 'DCC000 QS.CSV v1.00a', with sub-items for 'About', 'Setup', 'View', 'User Messages', and 'Diagnostics'. The main content area is titled 'DCC000 QS.CSV v1.00a' and has tabs for 'Status', 'Settings', and 'Info Stats'. The 'Status' tab is active, showing a table with the following data:

Name	Value
Driver_Configuration	DCC000
DCC_Version	V6.05p (A)
Kernel_Version	V6.51c (D)
Release_Status	Normal
Build_Revision	6.1.3
Build_Date	2021-09-08 13:12:43 +0200
BIOS_Version	4.8.0
FieldServer_Model	FPC-N54
Serial_Number	1911100008VZL
Carrier Type	-
Data_Points_Used	220
Data_Points_Max	1500

At the bottom of the interface, there are buttons for 'Home', 'HELP (?)', 'Contact Us', 'System Restart', 'System Reboot', 'System Time Synch', 'Reset Cycle Times', and 'Logout'. The 'fieldserver' logo is visible in the bottom right corner.

Figure 9-1: ProtoNode Diagnostics Home Page

- Click Security in the Navigation panel.

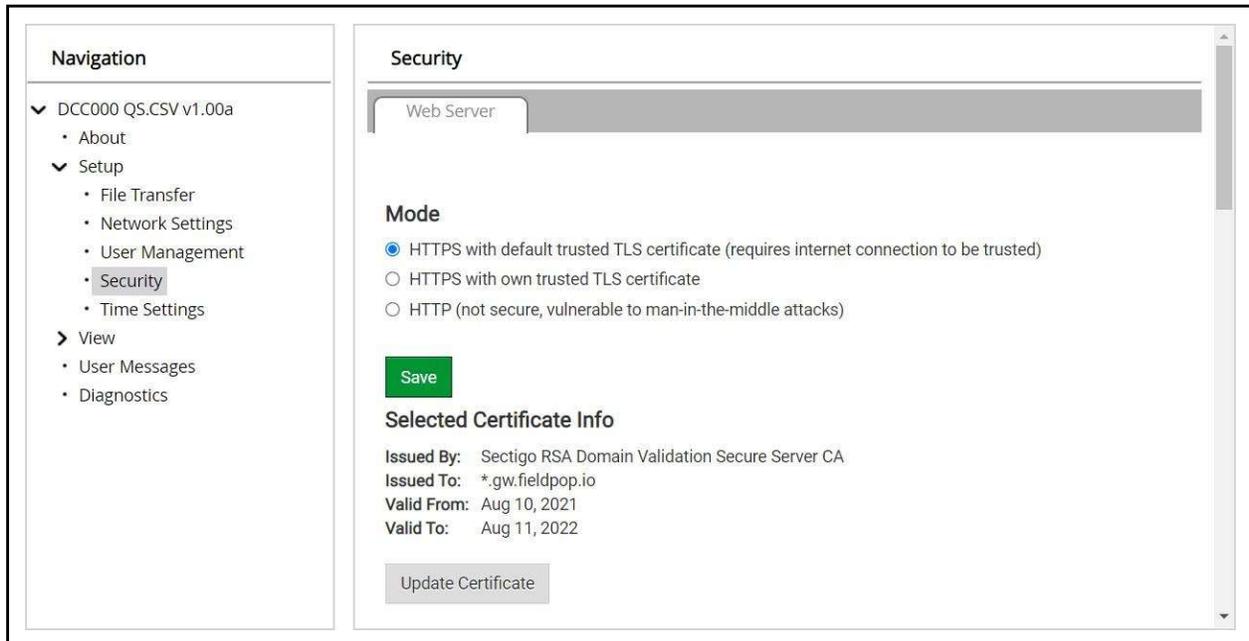


Figure 9-2: Security Selection Page

- Click the Mode desired.
 - If HTTPS with own trusted TLS certificate is selected, follow instructions in [Section 5.3 HTTPS with Own Trusted TLS Certificate](#)
- Click the Save button.

9.3 Edit the Certificate Loaded onto the FieldServer

NOTICE: A loaded certificate will only be available if the security mode was previously setup as HTTPS with own trusted TLS certificate.

- Click Security in the Navigation panel.
- Click the Edit Certificate button to open the certificate and key fields.
- Edit the loaded certificate or key text as needed.
- Click Save.

9.4 Change FieldServer Password

- Click User Management under Setup in the Navigation panel.
- Click the Password tab.

The screenshot shows a web interface for changing the FieldServer password. On the left is a navigation menu with 'User Management' highlighted. The main area is titled 'User Management' and has two tabs: 'Users' and 'Password'. The 'Password' tab is selected. It features a 'Password:' label with a red 'Weak' indicator, a text input field with the placeholder 'Enter password', a 'Show passwords' checkbox, a 'Confirm Password:' label, another text input field with the placeholder 'Confirm password', a 'Generate Password' button, and a 'Confirm' button at the bottom right.

Figure 9-3: Password Page

- Change the general login password for the FieldServer as needed.

NOTICE: The password must meet the minimum complexity requirements. An algorithm automatically checks the password entered and notes the level of strength on the top right of the Password text field.

9.5 FieldServer Manager Connection Warning Message

- If a warning message appears instead of the page as shown below, follow the suggestion that appears on screen.
 - If the FieldServer cannot reach the server, the message in Figure 9-4 will appear
- Follow the directions presented in the warning message.
 - Go to the network settings by clicking the Settings tab and then click the Network tab
 - Ensure that the routing rules are set up correctly
 - Check with the site's IT support that the DNS settings are setup correctly
 - Ensure that the FieldServer is properly connected to the Internet

NOTICE: If changes to the network settings are made, remember to click the Save button. Then power cycle the FieldServer by clicking on the Confirm button in the window and click on the bolded "Restart" text in the yellow pop-up box that appears in the upper right corner of the screen.



Figure 9-4: ProtoNode Lost Connection Page

9.6 System Status Button

The System Status Button can be found on any page of the web apps. This shows the level of alert/functionality for the customer device. This is an aggregate of the Web App page's resource usage upon the local PC or mobile device, connectivity and device alert level.



Figure 9-5: ProtoNode Status Button

The color of the button represents the status of one to all three systems:

Green – Normal status Yellow – Warning status Red – Alarm status

Click on the System Status Button to open the System Status window, showing more details on the status of each system.

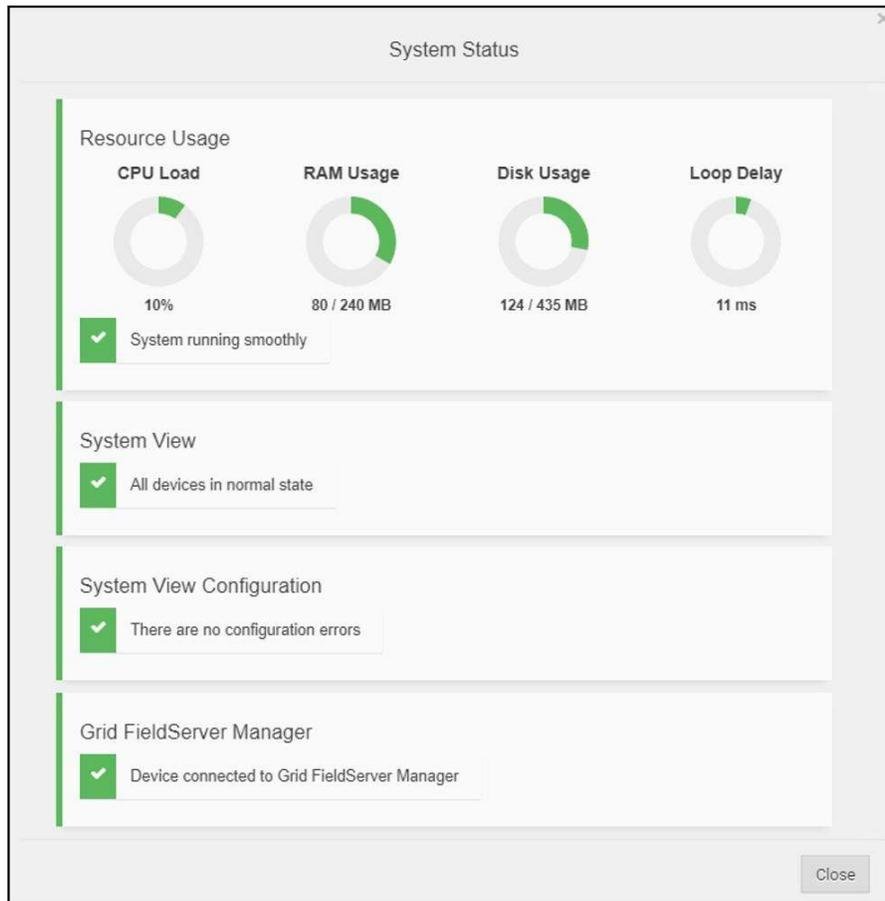


Figure 9-6: ProtoNode Status

NOTICE: If it was selected to opt out of the FieldServer Manager, the Grid FieldServer Manager status will not appear in the System Status window. This means the status will show as green even if the gateway is not connected to the FieldServer Manager.

10 PROTONODE INFORMATION

10.1 Specifications and Ordering Information



Table 10-1: ProtoNode Specifications

	ProtoNode FPC-N35
Part Number	Part Number: 106418-01 FieldServer #: FPC-N35-0817
Electrical Connections	One 6-pin Phoenix connector with: RS-485 port (Tx+ / Rx- / gnd) and Power port (+ / - /Frame-gnd) One Ethernet 10/100 BaseT port One FTT-10 LonWorks port
Power Requirements	Multi-mode power adapter: 9-30VDC or 12 - 24VAC
Approvals	CE Certified; TUV approved to UL 916, EN 60950-1, EN 50491-3 and CSA C22-2 standards; FCC Class A Part 15; DNP3 Conformance Tested; OPC Self-tested for Compliance; RoHS Compliant; CSA 205 Approved; LonMark Certified
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 to 167°F)
Humidity	5 - 95% RH (non-condensing)

NOTICE: Specifications subject to change without notice.

10.2 Compliance with UL Regulations

For UL compliance, the following instructions must be met when operating the 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:
 - Comply with local electrical code
 - Be suited to the expected operating temperature range
 - Meet the current and voltage rating for the FieldServer
- Furthermore, the interconnecting power cable shall:
 - Be of length not exceeding 3.05m (118.3")
 - 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.

10.3 Ordering information

Table 10-2: ProtoNode Ordering Information

	ProtoNode LER LonWorks	ProtoAir RER BACnet
Universal Gateway (Device only)	PN: 106418-01	PN: 29444-3
Universal Gateway I&O	PN: 106417-05	PN: 106417-04
Universal Gateway Enclosure Kit (Includes device mounted inside of a plastic enclosure and I&O)	PN: 112736-02	PN: 112736-01
Universal Gateway Wiring Harness Kit (Includes device installed with AMP/BFIT 1000-4000 CTD 1250-1500 ARC/FF 1000-6000 wiring harness and I&O)	PN: 106433-02	PN: 112316-01
Universal Gateway Kit less Wiring Harness	PN: 106433-01	PN: 112316-02

10.4 ProtoNode Detailed View

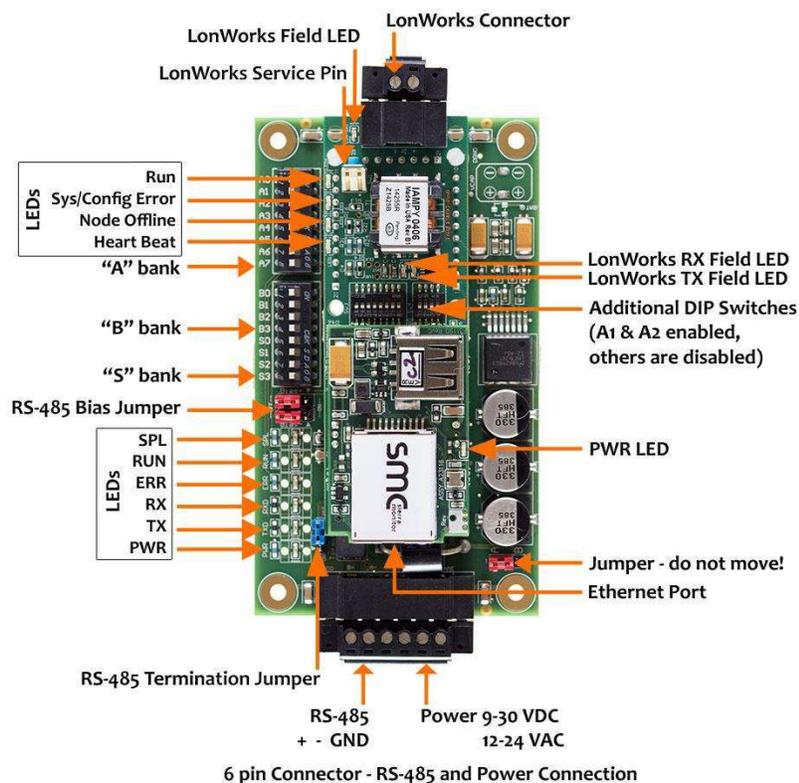


Figure 10-1: LonWorks ProtoNode Detailed View

11 INSTALLATION DETAILS

11.1 Universal Gateway Wiring Harness Kit (PN: 106433-02)

This kit is intended for use with the following boilers: AMP/BFIT 1000-4000, CTD 1250 & 1500, Arctic/FreeFlex 1000-6000.

- Use the provided ½" long self-drilling screws (PN: 80860743) to mount the ProtoNode inside of the boiler next to PCB-06. See Figures 11-1 and 11-2 for boiler specific mounting location. Note – On AMP/BFIT 1000 & 1250 and CTD 1250 the ProtoNode should be mounted on the low voltage control panel located on the left side of the boiler. On Arctic/FreeFlex 1000 the ProtoNode should be mounted in the rear control box.
- For instructions on connecting the ProtoNode to the boiler with the wiring harness, see [Section 3.7 Arctic, AMP, FreeFlex, BFIT & Citadel with Concert Display](#).
- The wiring harness includes Modbus connection from the boiler to the ProtoNode as well as 24V power for the ProtoNode.

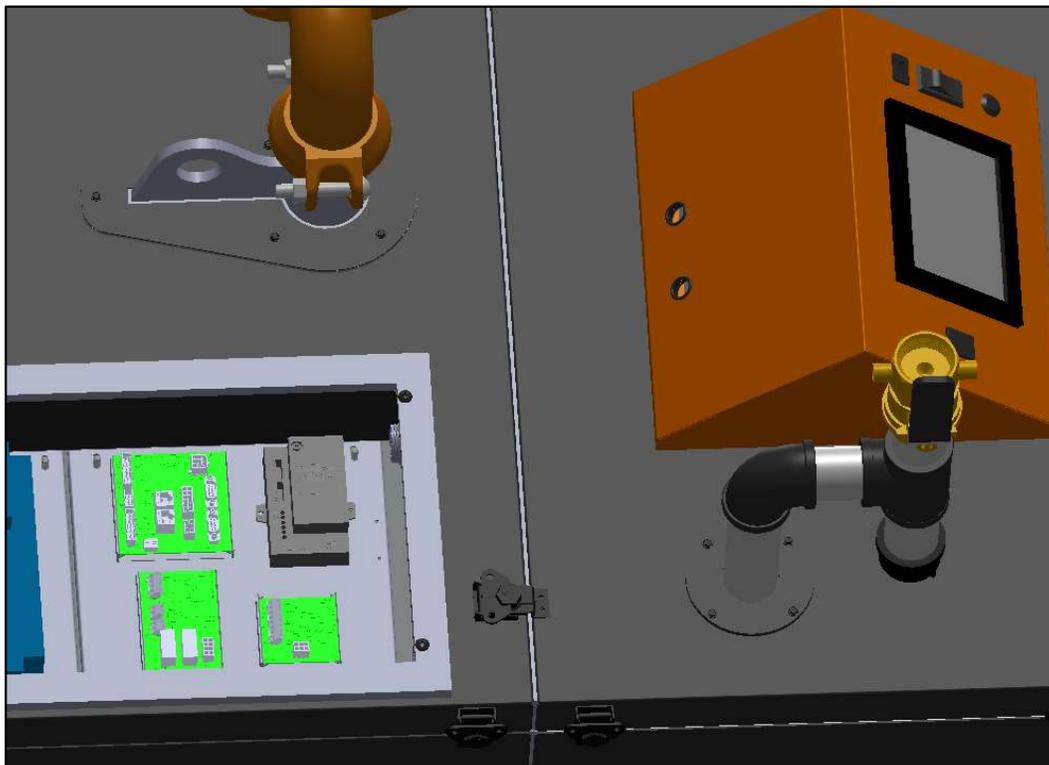


Figure 11-1: ProtoNode Mounting Location for AMP/BFIT 1500-4000, CTD 1500

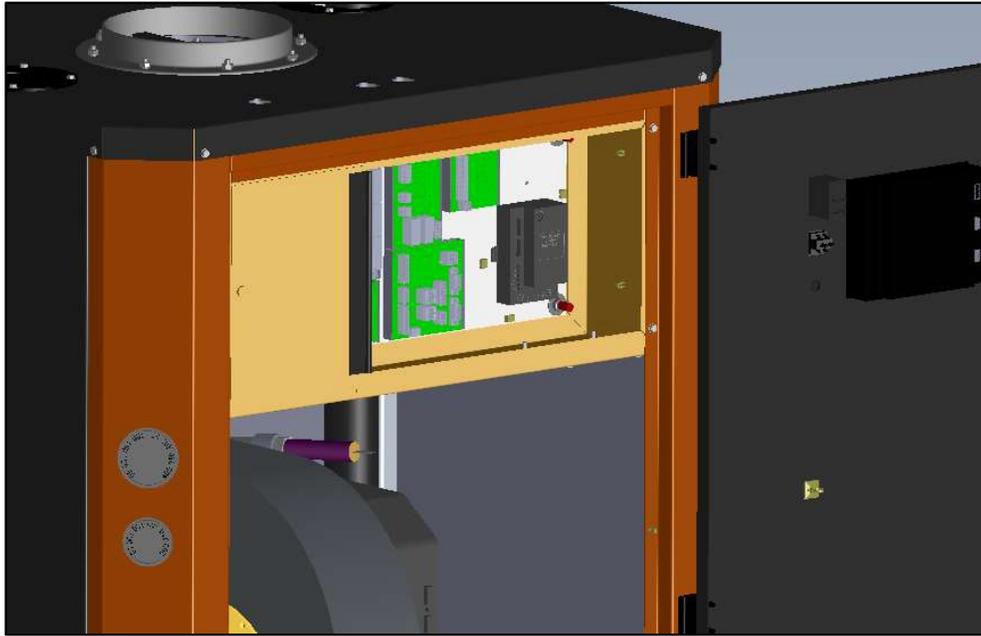


Figure 11-2: ProtoNode Mounting Location for Arctic/FreeFlex 1500-6000

11.2 Universal Gateway Enclosure Kit (PN: 112736-02)

This kit is intended for use with all other boilers and controls not included in the Universal Gateway Kit with Wiring Harness.

- Includes the ProtoNode mounted within a 14"x10"x7" plastic enclosure (see Figure 11-3), as well as mounting brackets to mount the enclosure to a wall.
- Wire power to the ProtoNode following the instructions and requirements in [Section 3.2 Wiring to the ProtoNode 6 Pin Connector](#)

NOTICE: Most ProtoNode compatible boilers have 24V connections that can be wired directly to the ProtoNode as the power supply. If power is not wired directly from the boiler, a 24VDC power supply, 24VAC transformer, or other means of providing the required power must be used. There is space inside of the enclosure for mounting additional electronic devices as needed.

- Wire Modbus communication from the ProtoNode to the boiler by following the relevant instructions based on model in [Section 3 Wiring \(Subsections 3.3 – 3.12\)](#). Table 1-1 lists the appropriate wiring subsection for each compatible model.
- Wire the ProtoNode to the LonWorks network by following the instructions in [Section 3.12 ProtoNode LonWorks Wiring](#).

NOTICE: When running wire from the ProtoNode to other devices, use cable glands or bulkhead connectors with all holes created in the enclosure to ensure that it maintains a waterproof and dustproof seal.

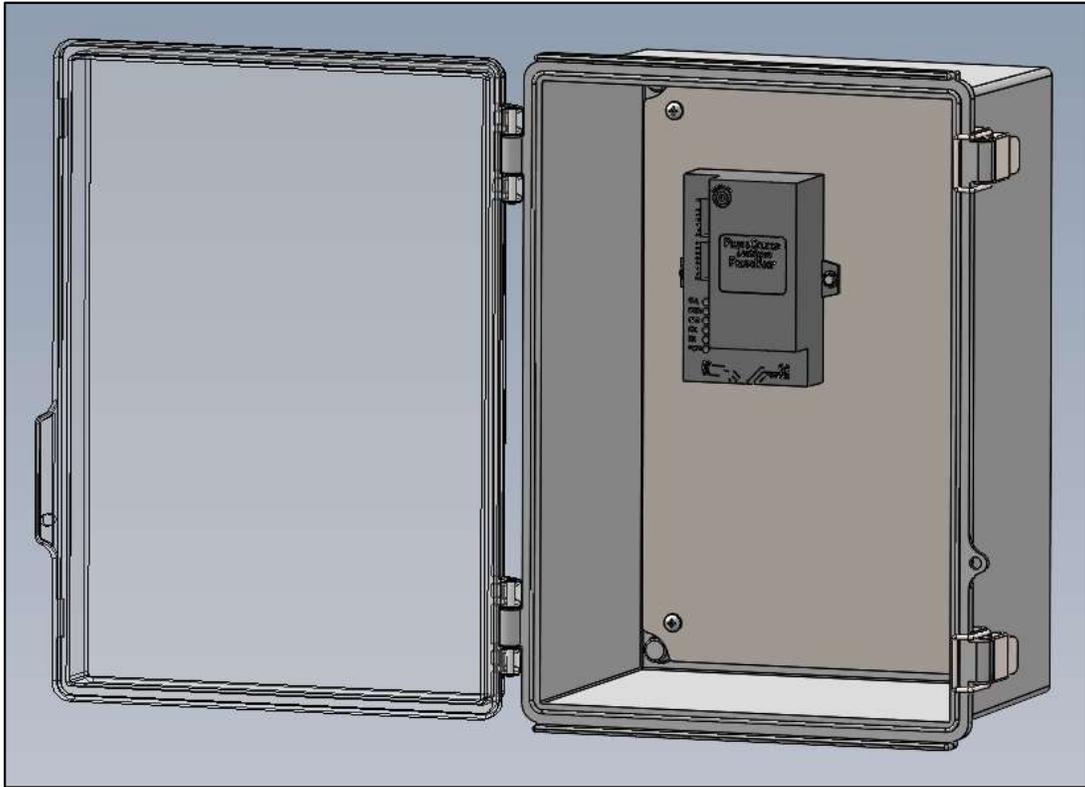


Figure 11-3: ProtoNode Kit with Plastic Enclosure

12 LONWORKS POINTS LIST

12.1 Thermal Solutions Boiler Control (TSBC) & Sage Boiler Control (SBC)

Table 12-1: TSBC/SBC LonWorks Points List

Point Name	Modbus Register	Lon Name	Lon SNVT	Notes
Outdoor Air Reset Enable/Disable	00001	nvoOAResEnDs_XXX	SNVT_switch	
Domestic Hot Water Priority	00002	nvoDmHtWtPri_XXX	SNVT_switch	
Local/Remote	00003	nvoLoc_Rem_XXX	SNVT_switch	
Remote On/Off Modbus Command	00004	nvi/nvoRmOnOfCmd_XXX	SNVT_switch	1
Spare Input (Programmable)	00005	nvoSprInput_XXX	SNVT_switch	
Low Water Cutoff Switch	00006	nvoLoWtCtOff_XXX	SNVT_switch	2
Burner On/Off Switch	00007	nvoBrnOnOfSw_XXX	SNVT_switch	2
Low Water Flow	00008	nvoLoWtrFLo_XXX	SNVT_switch	2
High and Low Gas Pressure Switches	00009	nvoHiLoGsPrs_XXX	SNVT_switch	2
Operating or High Limit	00010	nvoOpOrHiLim_XXX	SNVT_switch	2
Low Combustion Air Flow	00011	nvoLoCmbArFI_XXX	SNVT_switch	2
Fuel Valve Energized	00012	nvoFIVlvEnrg_XXX	SNVT_switch	
Flame Safeguard Alarm	00013	nvoFlmSfgdAl_XXX	SNVT_switch	
Call For Heat (CFH)	00014	nvoCallForHt_XXX	SNVT_switch	
General Alarm	00015	nvoGenAlm_XXX	SNVT_switch	4
Vent Inducer	00016	nvoVntIndcr_XXX	SNVT_switch	
Boiler Pump	00017	nvoBlrPump_XXX	SNVT_switch	
System Pump	00018	nvoSystPmp_XXX	SNVT_switch	
Spare Output (Programmable)	00019	nvoSprOutput_XXX	SNVT_switch	
State Boiler Disabled	00020	nvoStBlrDis_XXX	SNVT_switch	3
State Weather Shutdown	00021	nvoStWthShdn_XXX	SNVT_switch	3
State Lockout	00022	nvoStLockout_XXX	SNVT_switch	3
State Pump Purge	00023	nvoStPmpPurg_XXX	SNVT_switch	3
State Limit Hold	00024	nvoStLimHold_XXX	SNVT_switch	3
State Purge/Pilot Ign	00025	nvoStPrgPIlg_XXX	SNVT_switch	3
State Low Fire/Ignition	00026	nvoStLoFirIlg_XXX	SNVT_switch	3
State Main Ignition	00027	nvoStMainIgn_XXX	SNVT_switch	3
State Low Fire Hold	00028	nvoStLoFrHld_XXX	SNVT_switch	3
State Boiler Running	00029	nvoStBlrRun_XXX	SNVT_switch	3
State Fan Post Purge	00030	nvoStFnPstPg_XXX	SNVT_switch	3
State Pump Cool Down	00031	nvoStPmpCIDn_XXX	SNVT_switch	3
State Standby	00032	nvoStStandby_XXX	SNVT_switch	3
Annunciator Low Water Level	00033	nvoAnLoWtLvl_XXX	SNVT_switch	4
Annunciator Off Switch	00034	nvoAnnOffSw_XXX	SNVT_switch	4
Annunciator Low Water Flow	00035	nvoAnLoWtFlo_XXX	SNVT_switch	4
Annunciator Fuel Limit	00036	nvoAnnFILim_XXX	SNVT_switch	4
Annunciator High Temp Limit	00037	nvoAnHiTmplm_XXX	SNVT_switch	4
Annunciator Low Air Flow	00038	nvoAnLoArFlo_XXX	SNVT_switch	4
Annunciator FSG Lockout	00039	nvoAnFSGLkot_XXX	SNVT_switch	4
Annunciator Outlet Temp Fail	00040	nvoAnOtITpFI_XXX	SNVT_switch	4
Annunciator Inlet Temp Fail	00041	nvoAnInITpFI_XXX	SNVT_switch	4
Annunciator OA Temp Fail	00042	nvoAnOATmpFI_XXX	SNVT_switch	4

Annunciator Remote Temp Fail	00043	nvoAnRemTpFI_XXX	SNVT_switch	4
Annunciator Remote In Fail	00044	nvoAnRemInFI_XXX	SNVT_switch	4
Annunciator Comm Fail	00045	nvoAnComFI_XXX	SNVT_switch	4
Annunciator Low Inlet Temp	00046	nvoAnLoInITp_XXX	SNVT_switch	4
Annunciator Memory Failure	00047	nvoAnnMemFI_XXX	SNVT_switch	4
Boiler Outlet Water Temp	40001	nvoBIOTlWtTp_XXX	SNVT_temp_p	
Boiler Inlet Water Temp	40002	nvoBlInIWtTp_XXX	SNVT_temp_p	
Outside Air Temp	40003	nvoOATmp_XXX	SNVT_temp_p	
Boiler Actual SP	40004	nvoBlrActSP_XXX	SNVT_temp_p	
Remote System Temp	40005	nvoRemSysTmp_XXX	SNVT_temp_p	
Remote Firing Rate or Remote SP	40006	nvi/nvoRmFrRatSP_XXX	SNVT_count_f	1
PCB Temp Sensor	40007	nvoPCBTmpSen_XXX	SNVT_temp_p	
Firing Rate Output to Mod Motor	40008	nvoFrRtOtMod_XXX	SNVT_lev_percent	
Minimum Return Temp SP	40009	nvoMnRetTpSP_XXX	SNVT_temp_p	
Mixing Valve Output	40010	nvoMixVlvOut_XXX	SNVT_lev_percent	
Control Mode	40011	nvoCtrlMode_XXX	SNVT_count_f	

Notes:

1. After a Modbus communication failure, while using the Modbus connection to monitor or control the boilers, the 'Comm Failure' alarm is not cleared until a successful write to both the Remote On / Off Modbus Command (00004) and Remote Firing Rate or Remote Setpoint (40006) points have been completed, power is cycled or the 'Protocol' parameter is changed from Modbus to Peer-to-Peer and back again.
2. The limit string points (00006 - 00011) are only monitored when there is a Call For Heat. Additionally, if one of these items is 'open' items down stream are not monitored.
3. The boiler "state" points (00020 - 00032) are mutually exclusive (i.e. only one is asserted at a time). This will reflect the state of the message on the front of the boiler. Refer to page 6 for an explanation of each state.
4. The "Annunciated" points (00033 – 00046) reflect the state of the signals used to control the displayed Alarm Message. Refer to pages 36 & 37 for an explanation of each annunciator point.
5. "General Alarm" point (00015) turns "On" when the boiler is indicating any alarm condition.

To establish a Modbus network set the following parameters:

Communication Menu:

Protocol = Modbus

Modbus Address = Give each boiler a unique address.

Baud Rate = Set identical to remote system.

Parity = Set identical to remote system.

Connect all boilers using a RJ11 ended telephone cable.

12.2 Older Apex, Alpine/Phantom-X and ASPEN/Raptor (4109 profile)

Table 12-2: Older Apex, Alpine/Phantom-X and ASPEN/Raptor LonWorks N2 Points List

Point Name	Description	Modbus Register	Lon Name	Lon SNVT
Burner On Off (See Note 1)	Enable / disable burner. 1 = on 0 = off	400,203	nvi/nvoBrnrOnOff_XXX	SNVT_switch
Demand Source	0 = Unknown 1 = No source demand 2 = Central heat 3 = Domestic hot water 4 = Lead Lag slave 5 = Lead Lag master 6 = Central heat frost protection 7 = Domestic frost protection 8 = No demand due to burner switch turned off 9 = Domestic hot water storage 11 = Warm weather shutdown	400,006	nvoDem_Src_XXX	SNVT_count_f
CH Setpoint (See Note 2)	Use this register to change the boiler setpoint. valid range 79 F (26.1 C) to 191 F (88.3 C)	410,211	nvi/nvoCH_SP_XXX	SNVT_temp_p
DHW Setpoint	Use this register to change the domestic hot water setpoint. valid range 79 F (26.1 C) to 191 F (88.3 C)	410,453	nvi/nvoDHW_SP_XXX	SNVT_temp_p
Lead Lag Setpoint	Use this register to change the lead lag setpoint. valid range 79F (26.1C) to 191F (88.3C)	410,546	nvi/nvoLL_SP_XXX	SNVT_temp_p
CH TOD Setpoint	Use this register to change the central heat 'time of day' setpoint valid range 79 F (26.1 C) to 191 F (88.3 C)	410,212	nvi/nvoCH_TOD_SP_XXX	SNVT_temp_p
CH Setpoint Source	0=Unknown, 1=Normal setpoint, 2=TOD setpoint, 3=Outdoor reset, 4=Remote control (4-20mA), 7=Outdoor reset time of day	410,065	nvoCH_SP_Src_XXX	SNVT_count_f
Active CH Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by CH setpoint source (register 65).	410,016	nvoAct_CH_SP_XXX	SNVT_temp_p
DHW Setpoint Source	0=Unknown, 1=Normal setpoint, 2=TOD setpoint, 5=DHW tap setpoint, 6=DHW preheat setpoint	410,081	nvoDHW_SPSrc_XXX	SNVT_count_f
Active DHW Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by DHW setpoint source (register 81).	410,017	nvoActDHW_SP_XXX	SNVT_temp_p
LL Master Setpoint Source	0=Unknown, 1=CH setpoint, 2=CH TOD setpoint, 3=Outdoor reset, 4=Remote control (4-20mA), 5=DHW setpoint, 6=DHW TOD setpoint, 7=Outdoor reset time of day, 8=Mix setpoint	410,162	nvoLLMstSPSr_XXX	SNVT_count_f

Active LL Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by LL setpoint source (register 162).	410,018	nvoAct_LL_SP_XXX	SNVT_temp_p
Supply Sensor	-40 F (-40°C) to 266 F (130°C)	410,007	nvoSupSensor_XXX	SNVT_temp_p
Return Sensor	-40 F (-40°C) to 266 F (130°C)	410,011	nvoRetSensor_XXX	SNVT_temp_p
Header Sensor	-40 F (-40°C) to 266 F (130°C)	410,013	nvoHdrSensor_XXX	SNVT_temp_p
Stack Sensor	-40 F (-40°C) to 266 F (130°C)	410,014	nvoStkSensor_XXX	SNVT_temp_p
Outdoor Sensor	-40 F (-40°C) to 266 F (130°C)	410,170	nvoOtdrSensr_XXX	SNVT_temp_p
4-20 mA Rem Control Input	mA value for S2 (J8-6) parameter selectable as (remote set point) & (remote modulation)	400,015	nvoRemCtrlIn_XXX	SNVT_count_f
Fan Speed	Speed of the combustion air blower in rpm	400,009	nvoFan_Speed_XXX	SNVT_count_f
Flame Signal	0.01V or 0.01µA precision (0.00-50.00V)	400,010	nvoFlmSig_XXX	SNVT_count_f
Burner Control State	0 Initiate 1 Standby Delay 2 Standby 3 Safe Startup 4 Prepurge - Drive to Purge Rate 5 Prepurge – Measured Purge Time 6 Prepurge – Drive to Lightoff Rate 7 Preignition Test 8 Preignition Time 9 Pilot Flame Establishing Period 10 Main Flame Establishing Period 11 Direct Burner Ignition 12 Run 13 Postpurge 14 Lockout	400,033	nvoBrnCtrlSt_XXX	SNVT_count_f
Lockout Code	Reasons for burner lockout 0 No lockout, 4 Supply high limit 5 DHW high limit 6 Stack High limit 12 Flame detected out of sequence 18 Lightoff rate proving failed 19 Purge rate proving failed 20 Invalid Safety Parameters 21 Invalid Modulation Parameter 22 Safety data verification needed 23 24VAC voltage low/high 24 Fuel Valve Error 25 Hardware Fault 26 Internal Fault 27 Ignition Failure	410,034	nvoLockotCod_XXX	SNVT_count_f
Hold Code	Reason for burner hold 0 None 1 Anti short cycle 2 Boiler Safety Limit Open 3 Boiler Safety Limit Open, (ILK Off) 7 Return sensor fault 8 Supply sensor fault 9 DHW sensor fault 10 Stack sensor fault 11 Ignition failure 13 Flame rod shorted to ground	410,040	nvoHoldCode_XXX	SNVT_count_f

	14 Delta T inlet/outlet high 15 Return temp higher than supply 16 Supply temp has risen too quickly 17 Fan speed not proved 23 24VAC voltage low/high 25 Hardware Fault 27 Ignition Failure			
Burner Cycle Count	0-999,999 (U32)	400,128-400,129	nvi/nvoBrnCycCnt_XXX	SNVT_count_f
Burner Run Time	Hours (U32)	400,130-400,131	nvi/nvoBrnRunTim_XXX	SNVT_time_hour
System Pum Cycle Count	0-999,999 (U32)	400,132-400,133	nvi/nvoSysPmCyCt_XXX	SNVT_count_f
DHW Pump Cycle Count	0-999,999 (U32)	400,134-400,135	nvi/nvoDHWpMcyCt_XX X	SNVT_count_f
Boiler Pump Cycle Count	0-999,999 (U32)	400,138-400,139	nvi/nvoBlrPmCyCt_XXX	SNVT_count_f

NOTICE: All parameters are stored in EEPROM. Only perform writes when it is absolutely necessary to change the value of a register. Care must be taken to avoid excessive writing to parameters stored in EEPROM memory.

Note 1, If only the burner on/off Modbus signal is used instead of the Enable / Disable contact input the boiler will be turned off but the system pump may remain running.

Note 2, when writing CH Setpoint the Energy Management System is responsible for the boiler's setpoint for central heating. Disable the boiler's Outdoor Air Reset function. **WARNING:** All parameters are stored in EEPROM. Only perform writes when it is absolutely necessary to change the value of a register. Care must be taken to avoid excessive writing to parameters stored in EEPROM memory.

12.3 APEX, AMP/BFIT/Citadel/Phantom-XL, Alpine/Phantom-X, Arctic/FreeFlex, Sola (4716 Profile)

Table 12-3: APEX, AMP/BFIT/Citadel/Phantom-XL, Alpine/Phantom-X, Arctic/Freeflex, Sola LonWorks Points List

Point Name	Description	Modbus Register	Lon Name	Lon SNVT
Burner On Off	Enable / disable burner. 1 = on, 0 = off	400,203	nvi/nvoBmrnOnOff_XXX	SNVT_switch
Demand Source	0 = Unknown 1 = No source demand 2 = Central heat 3 = Domestic hot water 4 = Lead Lag slave 5 = Lead Lag master 6 = Central heat frost protection 7 = Domestic hot water frost protection 8 = No demand, burner switch turned off 9 = Domestic hot water storage 11 = Warm weather shutdown	400,006	nvoDem_Src_XXX	SNVT_count_f
CH Setpoint	Status of local setpoint	410,211	nvi/nvoCH_SP_XXX	SNVT_temp_p
DHW Setpoint	Status of local setpoint	410,453	nvi/nvoDHW_SP_XXX	SNVT_temp_p
Lead Lag Setpoint	Status of local setpoint	410,546	nvi/nvoLL_SP_XXX	SNVT_temp_p
CH TOD Setpoint	Status of local setpoint	410,212	nvi/nvoCH_TOD_SP_XXX	SNVT_temp_p
CH Setpoint Source	0=Unknown, 1=Normal setpoint, 2=TOD setpoint, 3=Outdoor reset, 4=Remote control (4-20mA), 7=Outdoor reset time of day	410,065	nvoCH_SP_Src_XXX	SNVT_count_f
Active CH Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by CH setpoint source (register 65).	410,016	nvoAct_CH_SP_XXX	SNVT_temp_p
DHW Setpoint Source	0=Unknown, 1=Normal setpoint, 2=TOD setpoint, 5=DHW tap setpoint, 6=DHW preheat setpoint	410,081	nvoDHW_SPSrc_XXX	SNVT_count_f
Active DHW Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by DHW setpoint source (register 81).	410,017	nvoActDHW_SP_XXX	SNVT_temp_p
LL Master Setpoint Source	0=Unknown, 1=CH setpoint, 2=CH TOD setpoint, 3=Outdoor reset, 4=Remote control (4-20mA), 5=DHW setpoint, 6=DHW TOD setpoint, 7=Outdoor reset time of day, 8=Mix setpoint	410,162	nvoLLMstSPSr_XXX	SNVT_count_f
Active LL Setpoint	-40 F (-40°C) to 266 F (130°C) Setpoint determined by LL setpoint source (register 162).	410,018	nvoAct_LL_SP_XXX	SNVT_temp_p
Supply Sensor	-40 F (-40°C) to 266 F (130°C)	410,007	nvoSupSensor_XXX	SNVT_temp_p
Return Sensor	-40 F (-40°C) to 266 F (130°C)	410,011	nvoRetSensor_XXX	SNVT_temp_p
Header Sensor	-40 F (-40°C) to 266 F (130°C)	410,013	nvoHdrSensor_XXX	SNVT_temp_p
Stack Sensor	-40 F (-40°C) to 266 F (130°C)	410,014	nvoStkSensor_XXX	SNVT_temp_p
Outdoor Sensor	-40 F (-40°C) to 266 F (130°C)	410,170	nvoOtdrSensr_XXX	SNVT_temp_p

4-20 mA Rem Control Input	mA value for S2 (J8-6) parameter selectable as (remote set point) & (remote modulation)	400,015	nvoRemCtrlIn_XXX	SNVT_count_f
Fan Speed	Speed of the combustion air blower in rpm	400,009	nvoFan_Speed_XXX	SNVT_count_f
Flame Signal	0.01V or 0.01µA precision (0.00-50.00V)	400,010	nvoFlmSig_XXX	SNVT_count_f
Burner Control State	<ul style="list-style-type: none"> 0 Initiate 1 Standby Delay 2 Standby 3 Safe Startup 4 Prepurge - Drive to Purge Rate 5 Prepurge – Measured Purge Time 6 Prepurge – Drive to Lightoff Rate 7 Preignition Test 8 Preignition Time 9 Pilot Flame Establishing Period 10 Main Flame Establishing Period 11 Direct Burner Ignition 12 Run 13 Postpurge 14 Lockout 	400,033	nvoBrnCtrlSt_XXX	SNVT_count_f
Lockout Code	<ul style="list-style-type: none"> Reasons for burner lockout 0 No lockout 3 Burner Interlock Open (ILK OFF) low/high 4 Supply high limit 5 DHW high limit 6 Stack High limit 12 Flame detected out of sequence 14 Delta T Inlet/Outlet High 15 Return Temp Higher Than Supply 16 Supply Temp Rose Too Quickly 18 Lightoff rate proving failed 19 Purge rate proving failed 20 Invalid Safety Parameters 21 Invalid Modulation Parameter 22 Safety data verification needed 23 24VAC voltage 24 Fuel Valve Error 25 Hardware Fault 26 Internal Fault 27 Ignition Failure 31 Fan Failed 32 ILK ON 42 AC Phase Fault 46 Pilot Test Flame 47 Flame Lost 284 Memory Reset 	410,034	nvoLockotCod_XXX	SNVT_count_f
Hold Code	<ul style="list-style-type: none"> Reason for burner hold 0 None 1 Anti short cycle 2 Boiler Safety Limit Open 3 Boiler Safety Limit Open, (ILK Off) 7 Return sensor fault 8 Supply sensor fault 9 DHW sensor fault 10 Stack sensor fault 11 Ignition failure 13 Flame rod shorted to ground 14 Delta T inlet/outlet high 15 Return temp higher than supply 16 Supply temp has risen too quickly 17 Fan speed not proved 23 24VAC voltage low/high 25 Hardware Fault 27 Ignition Failure 	410,040	nvoHoldCode_XXX	SNVT_count_f
Burner Cycle Count	0-999,999 (U32)	400,128-400,129	nvi/nvoBrnCycCnt_XXX	SNVT_count_f
Burner Run Time	Hours (U32)	400,130-400,131	nvi/nvoBrnRunTim_XXX	SNVT_time_hour

System Pum Cycle Count	0-999,999 (U32)	400,132-400,133	nvi/nvoSysPmCyCt_XXX	SNVT_count_f
DHW Pump Cycle Count	0-999,999 (U32)	400,134-400,135	nvi/nvoDHWPmCyCt_XXX	SNVT_count_f
Boiler Pump Cycle Count	0-999,999 (U32)	400,138-400,139	nvi/nvoBlrPmCyCt_XXX	SNVT_count_f
CH Modbus Stat	CH Modbus STAT 0 = no demand 1 = demand When this register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), CH Modbus Stat is reverted to 0, no demand.	400,577	nvi/nvoCHModStat_XXX	SNVT_switch
LLCH Modbus Stat	LL CH Modbus STAT 0 = no demand 1 = demand When this register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), CH Modbus Stat is reverted to 0, no demand.	400,563	nvi/nvoLLCHModSt_XXX	SNVT_switch
CH Modbus SP	Use this register to change the boiler setpoint. When this register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), setpoint reverts to local setpoint. valid range 60 F to 190 F	410,579	nvi/nvoCHModSP_XXX	SNVT_temp_p
CH Sequencer Modbus SP	Use this register to change the multiple boiler Sequencer setpoint. When this register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), setpoint reverts to local setpoint. valid range 60 F to 190 F	410,562	nvi/nvoCHSeqMdSP_XXX	SNVT_temp_p
Outdoor Temperature	Building Automation may send the controller the outdoor air temperature. Use this register to change the outdoor temperature. When this register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), temperature is set to bad data quality and outdoor air reset is set back to local setpoint. valid range -40 F to 302 F	410,817	nvi/nvoOutTemp_XXX	SNVT_temp_p
CH Modbus Rate	Use this register to drive individual boiler firing rates. This register is used when firing rate control is performed by an external Energy Management System. Firing rate reverts to local control when register is not written every "Modbus Command Time Out" parameter seconds (default 30 seconds), Range is 0 to 200 % provides 0-100% firing rate.	400,581	nvi/nvoCHModRate_XXX	SNVT_lev_percent
Fan Speed Measured	Speed of the combustion air blower in rpm	400,008	nvoFanSpdMes_XXX	SNVT_count_f
Modbus command timeout	This parameter sets the amount of time the control will wait for input	400,763	nvoModCmdTim_XXX	SNVT_count_f

	from the Energy Management System (EMS). If the EMS does not write to the following register within the "Modbus Command timeout" seconds the following inputs are considered invalid: CH Modbus Stat, CH Modbus Setpoint, CH Sequencer Modbus Setpoint CH Modbus Rate range 30 – 120, Default 30 seconds Other R/W registers should only be written when a value is needed to be changed. Only the above listed registers are stored in non-volatile registers.			
CH pump status	See Pump Status Codes below	400,096	nvoCHPmpStat_XXX	SNVT_count_f
DHW pump status	See Pump Status Codes below	400,100	nvoDHWpmpSt_XXX	SNVT_count_f
Boiler pump status	See Pump Status Codes below	400,108	nvoBlrPmpSt_XXX	SNVT_count_f
Low Temp SP	Setpoint entered on the local user interface. valid range 79 F (26.1 C) to 191 F (88.3 C)	410,643	nvoLoTmpSP_XXX	SNVT_temp_p
Low TempSP source	0=Unknown, 1=Normal setpoint, 2=TOD setpoint, 3=Outdoor reset, 4=Remote control, 7=Outdoor reset time of day, 9=Outdoor boost	410,121	nvoLoTmpSPSr_XXX	SNVT_count_f
Active Low Temp SP	-40 F (-40°C) to 266 F (130°C) Setpoint determined by Low Temp setpoint source (register 121).	410,024	nvoActLoTpSP_XXX	SNVT_temp_p
CH heat demand	0=Off, 1=On	400,066	nvoCH_HtDem_XXX	SNVT_switch
DHW heat demand	0=Off, 1=On	400,083	nvoDHW_HtDem_XXX	SNVT_switch
Low Temp Loop demand	0=Off, 1=On	400,123	nvoLoTpLHtDm_XXX	SNVT_switch

Table 12-4: Pump Status Codes

Status	Description
92	Forced On from manual pump control
93	Forced On due to Outlet high limit is active
94	Forced On from burner demand
95	Forced On due to Lead Lag slave has demand
96	Forced Off from local DHW priority service
97	Forced Off from Lead Lag DHW priority service
98	Forced Off from Central Heat anti-condensation
99	Forced Off from DHW anti-condensation
100	Forced Off due to DHW high limit is active
101	Forced Off from EnviraCOM DHW priority service
102	On due to local CH frost protection is active
103	On due to Lead Lag CH frost protection is active
104	On due to local DHW frost protection is active
105	On due to Lead Lag DHW frost protection is active
106	On from local Central Heat demand
107	On from Lead Lag Central Heat demand
108	On from local DHW demand
109	On from Lead Lag DHW demand

Status	Description
110	On from local Mix demand
111	On from Lead Lag Mix demand
112	On from local Central Heat service
113	On from Lead Lag Central Heat service
114	On from local DHW service
115	On from Lead Lag DHW service
116	On from local Mix service
117	On from Lead Lag Mix service
118	On from Lead Lag auxiliary pump X
119	On from Lead Lag auxiliary pump Y
120	On from Lead Lag auxiliary pump Z
121	On, but inhibited by pump start delay
122	On from pump overrun
123	Off, not needed
124	On from burner demand
125	On from exercise
126	On from local Lead Lag service
127	On from local Lead Lag pump demand

12.4 Siemens RWF40

Table 12-5: Siemens RWF40 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Input 1	nvoInput1_XXX	SNVT_count_inc_f
Input 2	nvoInput2_XXX	SNVT_count_inc_f
Input 3	nvoInput3_XXX	SNVT_count_inc_f
First Setpoint	nvi/nvoFirstSP_XXX	SNVT_count_inc_f
Second Setpoint	nvi/nvoSecondSP_XXX	SNVT_count_inc_f
Operation Mode	nvi/nvoOpMode_XXX	SNVT_count_inc_f
Process Enable	nvi/nvoProcEnbl_XXX	SNVT_switch
Process Setpoint	nvi/nvoProcSP_XXX	SNVT_count_inc_f
Enable K1	nvi/nvoEnableK1_XXX	SNVT_switch
Enable K2	nvi/nvoEnableK2_XXX	SNVT_switch
Enable K3	nvi/nvoEnableK3_XXX	SNVT_switch
Enable K6	nvi/nvoEnableK6_XXX	SNVT_switch
Step Control	nvi/nvoStepCtrl_XXX	SNVT_count_inc_f
Modulation	nvi/nvoModulatn_XXX	SNVT_lev_percent

12.5 Siemens RWF55

Table 12-6: Siemens RWF55 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Analog Input InP1	nvoInP1_XXX	SNVT_count_inc_f
Analog Input InP2	nvoInP2_XXX	SNVT_count_inc_f
Analog Input InP3	nvoInP3_XXX	SNVT_count_inc_f
Actual Setpoint	nvoActSP_XXX	SNVT_count_inc_f
Setpoint 1	nvi/nvoSP_1_XXX	SNVT_count_inc_f
Setpoint 2	nvi/nvoSP_2_XXX	SNVT_count_inc_f
Analog Input InP3	nvoInP3Unfil_XXX	SNVT_count_inc_f

Actual Angular Positioning	nvoActAngPos_XXX	SNVT_count_inc_f
Burner Alarm	nvoBrnrAlm_XXX	SNVT_count_inc_f
Activation Remote Operation	nvi/nvoREM_XXX	SNVT_count_inc_f
Controller Off In Remote Setpoint	nvi/nvorOFF_XXX	SNVT_count_inc_f
Switch-On Threshold Remote	nvi/nvorHYS1_XXX	SNVT_count_inc_f
Switch-Off Threshold Down Remote	nvi/nvorHYS2_XXX	SNVT_count_inc_f
Switch-Off Threshold Up Remote	nvi/nvorHYS3_XXX	SNVT_count_inc_f
Setpoint Remote	nvi/nvoSPr_XXX	SNVT_count_inc_f
Burner Release Remote Operation	nvi/nvoRK1_XXX	SNVT_count_inc_f
Relay K2 Remote Operation	nvi/nvoRK2_XXX	SNVT_count_inc_f
Relay K3 Remote Operation	nvi/nvoRK3_XXX	SNVT_count_inc_f
Relay K6 Remote Operation	nvi/nvoRK6_XXX	SNVT_count_inc_f
Step-By-Step Control Rem Operation	nvi/nvorStEP_XXX	SNVT_count_inc_f
Angular Pos Output Remote Operation	nvi/nvorY_XXX	SNVT_count_inc_f

12.6 Honeywell RM7800

Table 12-7: Honeywell RM7800 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Flame Signal	nvoFlameSig_XXX	SNVT_count_f
Burner Cycles	nvoBrnCyc_XXX	SNVT_count_f
Burner Hours	nvoBrnHrs_XXX	SNVT_time_hour
Burner Fault Code	nvoBrnFltCod_XXX	SNVT_count_f
Initiate	nvoInitiate_XXX	SNVT_switch
Standby	nvoStandby_XXX	SNVT_switch
Purge	nvoPurge_XXX	SNVT_switch
Pilot Ignition	nvoPilotIgn_XXX	SNVT_switch
Main Ignition	nvoMainIgn_XXX	SNVT_switch
Run	nvoRun_XXX	SNVT_switch
Postpurge	nvoPostpurge_XXX	SNVT_switch
Pre-Ignition	nvoPreIgntn_XXX	SNVT_switch
Valve Proving	nvoVlvProv_XXX	SNVT_switch
Alarm	nvoAlarm_XXX	SNVT_switch
Hold	nvoHold_XXX	SNVT_switch
Lockout	nvoLockout_XXX	SNVT_switch
First Out Code *	nvo1stOutCod_XXX	SNVT_count_f
Main Valve Proof of Closure *	nvoMnVlvCls_XXX	SNVT_switch
Burner Switch *	nvoBrnrSw_XXX	SNVT_switch
Operating Control *	nvoOpCtrl_XXX	SNVT_switch
Auxiliary Limit 1 *	nvoAuxLim1_XXX	SNVT_switch
Auxiliary Limit 2 *	nvoAuxLim2_XXX	SNVT_switch
Low Water Cutoff *	nvoLoWtrCut_XXX	SNVT_switch
High Limit *	nvoHiLim_XXX	SNVT_switch
Auxiliary Limit 3 *	nvoAuxLim3_XXX	SNVT_switch
Oil Select Switch *	nvoOilSelSw_XXX	SNVT_switch
High Oil Pressure *	nvoHiOilPrs_XXX	SNVT_switch
Low Oil Pressure *	nvoLoOilPrs_XXX	SNVT_switch
High Oil Temperature *	nvoHiOilTmp_XXX	SNVT_switch

Low Oil Temperature *	nvoLoOilTmp_XXX	SNVT_switch
Gas Select Switch *	nvoGasSelSw_XXX	SNVT_switch
High Gas Pressure *	nvoHiGasPrs_XXX	SNVT_switch
Low Gas Pressure *	nvoLoGasPrs_XXX	SNVT_switch
Air Flow Switch *	nvoAirFLoSw_XXX	SNVT_switch
Auxiliary Interlock 4 *	nvoAuxIntlk4_XXX	SNVT_switch
Auxiliary Interlock 5 *	nvoAuxIntlk5_XXX	SNVT_switch

12.7 Siemens LMV52

Table 12-8: Siemens LMV52 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Process Value	nvoProcVal_XXX	SNVT_count_f
Flame Signal	nvoFlameSig_XXX	SNVT_lev_percent
Fuel Rate Volume	nvoFuelRtVol_XXX	SNVT_count_f
O2 Level	nvoO2Level_XXX	SNVT_lev_percent
Supply Air	nvoSupplyAir_XXX	SNVT_count_f
Flue Gas	nvoFlueGas_XXX	SNVT_count_f
Combustion Efficiency	nvoCombstEff_XXX	SNVT_lev_percent
Control Mode	nvi/nvoCtrlMode_XXX	SNVT_switch
Operating Mode	nvi/nvoOpMode_XXX	SNVT_count_f
External Setpoint	nvi/nvoExtSP_XXX	SNVT_count_f
Fuel Rate	nvi/nvoFuelRate_XXX	SNVT_count_f
Process Setpoint	nvi/nvoProcSP_XXX	SNVT_count_f
Hours	nvoHours_XXX	SNVT_time_hour
Current Lockout Error code	nvoCrntErCd_XXX	SNVT_count_f
Current Lockout Error diagnosis	nvoCrntErDg_XXX	SNVT_count_f
Current Lockout Error class	nvoCrntErCls_XXX	SNVT_count_f
Current Lockout Error phase	nvoCrntErPh_XXX	SNVT_count_f
Current Lockout Fuel	nvoCrntFuel_XXX	SNVT_count_f
Current Lockout Output	nvoCrntOutpt_XXX	SNVT_count_f
Current Lockout Date: Year	nvoCrntTPDYr_XXX	SNVT_count_f
Current Lockout Date: Month	nvoCrntTPDMn_XXX	SNVT_count_f
Current Lockout Date: Day	nvoCrntTPDDy_XXX	SNVT_count_f
Current Lockout Time of day: hours	nvoCrntTODHr_XXX	SNVT_count_f
Current Lockout Time of day: minutes	nvoCrntTODMn_XXX	SNVT_count_f
Current Lockout Time of day: Seconds	nvoCrntTODSc_XXX	SNVT_count_f
Current Lockout Startup counter total	nvoCrntStCtT_XXX	SNVT_count_f
Current Lockout Hours run total	nvoCrntHrRnT_XXX	SNVT_time_hour
Lockout Error Code	nvoLckotErCd_XXX	SNVT_count_f
Lockout Diagnostic Code	nvoLckotDgCd_XXX	SNVT_count_f
Fuel Selected	nvoFuelSel_XXX	SNVT_count_f
Firing Rate	nvoFirRate_XXX	SNVT_count_f

12.8 Siemens LMV36

Table 12-9: Siemens LMV36 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Flame Signal	nvoFlameSig_XXX	SNVT_lev_percent
Lockout Error Code	nvoLckotErCd_XXX	SNVT_count_f
Lockout Diagnostic Code	nvoLckotDgCd_XXX	SNVT_count_f
Control Mode	nvi/nvoCtrlMode_XXX	SNVT_switch
Operating Mode	nvi/nvoOp_Mode_XXX	SNVT_count_f
Fuel Rate	nvi/nvoFuelRate_XXX	SNVT_count_f
Fuel Selected	nvoFuelSel_XXX	SNVT_count_f
Firing Rate	nvoFirRate_XXX	SNVT_count_f

12.9 Precision Digital Trident PD765

Table 12-10: Precision Digital Trident PD765 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Display Value	nvoDispVal_XXX	SNVT_count_f
Relay 1 Status	nvi/nvoRel1Stat_XXX	SNVT_switch
Relay 2 Status	nvi/nvoRel2Stat_XXX	SNVT_switch
Alarm 1 Status	nvoAlm1Stat_XXX	SNVT_switch
Alarm 2 Status	nvoAlm2Stat_XXX	SNVT_switch
Alarm 1 Acknowledge	nvi/nvoAlm1Ack_XXX	SNVT_switch
Alarm 2 Acknowledge	nvi/nvoAlm2Ack_XXX	SNVT_switch
Relay 1 Set Point	nvi/nvoRl1SP_XXX	SNVT_count_f
Relay 1 Reset Point	nvi/nvoRl1ResPt_XXX	SNVT_count_f
Relay 1 Turn-on Delay	nvi/nvoRl1TnOnDL_XXX	SNVT_count_f
Relay 1 Turn-off Delay	nvi/nvoRl1TnOfDL_XXX	SNVT_count_f
Relay 1 Normal/Fail-Safe	nvi/nvoRl1NrFISf_XXX	SNVT_switch
Relay 1 Operation	nvi/nvoRl1Oper_XXX	SNVT_count_f
Relay 2 Set Point	nvi/nvoRl2SP_XXX	SNVT_count_f
Relay 2 Reset Point	nvi/nvoRl2ResPt_XXX	SNVT_count_f
Relay 2 Turn-on Delay	nvi/nvoRl2TnOnDL_XXX	SNVT_count_f
Relay 2 Turn-off Delay	nvi/nvoRl2TnOfDL_XXX	SNVT_count_f
Relay 2 Normal/Fail-Safe	nvi/nvoRl2NrFISf_XXX	SNVT_switch
Relay 2 Operation	nvi/nvoRl2Oper_XXX	SNVT_count_f
4-20mA Out-Mode Output Option	nvi/nvo420MdOtOp_XXX	SNVT_switch
4-20mA Out-Mode Data Source	nvi/nvo420MdDtSr_XXX	SNVT_count_f
4-20mA Out-Sensor Break Value	nvi/nvo420SnBkVl_XXX	SNVT_count_f
4-20mA Out-Overrange value	nvi/nvo420OvrVal_XXX	SNVT_count_f
4-20mA Out-Underrange value	nvi/nvo420UndVal_XXX	SNVT_count_f
4-20mA Out-Max value Allowed	nvi/nvo420MxvIAL_XXX	SNVT_count_f
4-20mA Out-Min value Allowed	nvi/nvo420MnVIAL_XXX	SNVT_count_f
4-20mA Out-Display Value 1	nvi/nvo420DspVl1_XXX	SNVT_count_f
4-20mA Out-Display Value 2	nvi/nvo420DspVl2_XXX	SNVT_count_f
4-20mA Out-Output 1	nvi/nvo420Outpt1_XXX	SNVT_count_f

4-20mA Out–Output 2	nvi/nvo420Outpt2_XXX	SNVT_count_f
4-20mA Out–Data in mA or Data in bit	nvi/nvo420DtmABt_XXX	SNVT_count_f

12.10 Siemens LMV2_3

Table 12-11: Siemens LMV2_3 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Burner control phase	nvoBrnCtrlPh_XXX	SNVT_count_inc_f
Pos of current fuel actuator	nvoPosCrFlAc_XXX	SNVT_count_inc_f
Pos of air actuator	nvoPosAirAct_XXX	SNVT_count_inc_f
Manipulated variable VSD	nvoManVarVSD_XXX	SNVT_count_inc_f
Current type of fuel	nvoCrntTypFl_XXX	SNVT_count_inc_f
Current output	nvoCrntOutpt_XXX	SNVT_count_inc_f
Flame signal	nvoFlmSig_XXX	SNVT_count_inc_f
Current fuel throughput	nvoCrntFlThr_XXX	SNVT_count_inc_f
Startup counter total	nvoStrtCntTo_XXX	SNVT_count_inc_f
Current error: Error code	nvoErrCode_XXX	SNVT_count_inc_f
Current error: Diagnostic code	nvoDiagCode_XXX	SNVT_count_inc_f
Current error: Error class	nvoErrClass_XXX	SNVT_count_inc_f
Current error: Error phase	nvoErrPh_XXX	SNVT_count_inc_f
Program stop	nvi/nvoProgStop_XXX	SNVT_count_inc_f
Modbus mode	nvi/nvoModbsMode_XXX	SNVT_count_inc_f
Modbus breakdown time	nvi/nvoModBrdnTm_XXX	SNVT_count_inc_f
Operating mode in remote op	nvi/nvoOpMdRemOp_XXX	SNVT_count_inc_f
Preselect target output mod/multistg	nvi/nvoPrTrgOtMd_XXX	SNVT_count_inc_f
Hours run fuel 0 resettable	nvi/nvoHrRnFl0Rs_XXX	SNVT_count_inc_f
Hours run fuel 1 resettable	nvi/nvoHrRnFl1Rs_XXX	SNVT_count_inc_f
Hours run unit live	nvoHrRnUntLv_XXX	SNVT_count_inc_f
Start counter fuel 0 resettable	nvi/nvoStCtFl0Rs_XXX	SNVT_count_inc_f
Start counter fuel 1 resettable	nvi/nvoStCtFl1Rs_XXX	SNVT_count_inc_f
Start counter total	nvoStCntTot_XXX	SNVT_count_inc_f
Fuel volume fuel 0 resettable	nvi/nvoFlVol0Res_XXX	SNVT_count_inc_f
Fuel volume fuel 1 resettable	nvi/nvoFlVol1Res_XXX	SNVT_count_inc_f
Number of faults	nvoNumFlts_XXX	SNVT_count_inc_f
Preselected output Fuel 0	nvi/nvoPreOutFl0_XXX	SNVT_count_inc_f
Preselected output Fuel 1	nvi/nvoPreOutFl1_XXX	SNVT_count_inc_f
Burner control parameter set code	nvoBrCtPmCod_XXX	SNVT_count_inc_f
Burner control parameter set version	nvoBrCtPmVer_XXX	SNVT_count_inc_f
Burner control identification number	nvoBrCtldNum_XXX	SNVT_count_inc_f
SW version burner control	nvoSWVerBrCt_XXX	SNVT_count_inc_f
Min output fuel 0	nvoMinOutFl0_XXX	SNVT_count_inc_f
Max output fuel 0	nvoMaxOutFl0_XXX	SNVT_count_inc_f
Min output fuel 1	nvoMinOutFl1_XXX	SNVT_count_inc_f
Max output fuel 1	nvoMaxOutFl1_XXX	SNVT_count_inc_f
Operation mode of burner fuel 0	nvoOpMdBnFl0_XXX	SNVT_count_inc_f

Operation mode of burner fuel 1	nvoOpMdBnFl1_XXX	SNVT_count_inc_f
Error History Current Error	nvoHstErrCd_XXX	SNVT_count_inc_f
Error History Diagnostic Code	nvoHstDiagCd_XXX	SNVT_count_inc_f
Error History Error Class	nvoHstErrCls_XXX	SNVT_count_inc_f
Error History Error Phase	nvoHstErrPh_XXX	SNVT_count_inc_f
Error History Type of Fuel	nvoHstTypFl_XXX	SNVT_count_inc_f
Error History Output	nvoHstOut_XXX	SNVT_count_inc_f
Error History Start counter total	nvoHstStCnTo_XXX	SNVT_count_inc_f
Inputs Word	nvoInputWord_XXX	SNVT_count_inc_f
Controller On/Off	nvoCtrOnOff_XXX	SNVT_switch
Inputs Word 1	nvoInWrd1_XXX	SNVT_switch
Inputs Word 2	nvoInWrd2_XXX	SNVT_switch
Inputs Word 3	nvoInWrd3_XXX	SNVT_switch
Inputs Word 4	nvoInWrd4_XXX	SNVT_switch
Inputs Word 5	nvoInWrd5_XXX	SNVT_switch
Inputs Word 6	nvoInWrd6_XXX	SNVT_switch
Pressure Switch Valve Proving	nvoPrsSwVlPr_XXX	SNVT_switch
Safety Loop	nvoSftyLp_XXX	SNVT_switch
Inputs Word 9	nvoInWrd9_XXX	SNVT_switch
Pressure Switch Min	nvoPrsSwMin_XXX	SNVT_switch
Pressure Switch Max	nvoPrsSwMax_XXX	SNVT_switch
Inputs Word 12	nvoInWrd12_XXX	SNVT_switch
Air Pressure Switch	nvoArPrsSw_XXX	SNVT_switch
Inputs Word 14	nvoInWrd14_XXX	SNVT_switch
Inputs Word 15	nvoInWrd15_XXX	SNVT_switch
Outputs Word	nvoOutputWord_XXX	SNVT_count_inc_f
Alarm	nvoAlarm_XXX	SNVT_switch
Outputs Word 1	nvoOutWrd1_XXX	SNVT_switch
Outputs Word 2	nvoOutWrd2_XXX	SNVT_switch
Outputs Word 3	nvoOutWrd3_XXX	SNVT_switch
Ignition	nvoIgnition_XXX	SNVT_switch
Outputs Word 5	nvoOutWrd5_XXX	SNVT_switch
Fan	nvoFan_XXX	SNVT_switch
Outputs Word 7	nvoOutWrd7_XXX	SNVT_switch
Outputs Word 8	nvoOutWrd8_XXX	SNVT_switch
Outputs Word 9	nvoOutWrd9_XXX	SNVT_switch
Outputs Word 10	nvoOutWrd10_XXX	SNVT_switch
Outputs Word 11	nvoOutWrd11_XXX	SNVT_switch
Outputs Word 12	nvoOutWrd12_XXX	SNVT_switch
Fuel Valve 1	nvoFIVlv1_XXX	SNVT_switch
Fuel Valve 2	nvoFIVlv2_XXX	SNVT_switch
Fuel Valve 3/PV	nvoFIVlv3_XXX	SNVT_switch

Table 12-12: Fireye YB110 LonWorks Points List

Point Name	Lon Name	Lon SNVT
Com Status	nvoComStatus_XXX	SNVT_switch
Safety_Relay	nvoSafetyRel_XXX	SNVT_switch
Main_Valve_In	nvoMainVlvIn_XXX	SNVT_switch
Delayed_Valve_In	nvoDelVlvIn_XXX	SNVT_switch
Pilot_Valve_In	nvoPltVlvIn_XXX	SNVT_switch
Ignition_In	nvoIgnIn_XXX	SNVT_switch
Blower_In	nvoBlwrIn_XXX	SNVT_switch
Op_Cntrl	nvoOpCntrl_XXX	SNVT_switch
Run_Intlck	nvoRunIntlck_XXX	SNVT_switch
Purge_Damper	nvoPrgDmpr_XXX	SNVT_switch
Term_23	nvoTerm23_XXX	SNVT_switch
Remote_Reset	nvoRemReset_XXX	SNVT_switch
Start_Input	nvoStInput_XXX	SNVT_switch
FVES_POC	nvoFVES_POC_XXX	SNVT_switch
Pilot_Hold	nvoPiltHld_XXX	SNVT_switch
Low_Fire_Start	nvoLoFirStrt_XXX	SNVT_switch
Ref_AC_Line	nvoRefACLine_XXX	SNVT_switch
Ignition_Out	nvoIgnOut_XXX	SNVT_switch
Pilot_Valve_Out	nvoPltVlvOut_XXX	SNVT_switch
Blower_Out	nvoBlwrOut_XXX	SNVT_switch
Main_Valve_Out	nvoMainVlvOt_XXX	SNVT_switch
Delayed_Valve_Out	nvoDelVlvOut_XXX	SNVT_switch
Internal_Safety_Out	nvoIntSftyOt_XXX	SNVT_switch
Low_Fire_Out	nvoLoFireOut_XXX	SNVT_switch
High_Fire_Out	nvoHiFireOut_XXX	SNVT_switch
Auto_Out	nvoRelModOut_XXX	SNVT_switch
Alarm_Out	nvoAlmOut_XXX	SNVT_switch
Status	nvoStatus_XXX	SNVT_count_f
Msgn	nvoMsgn_XXX	SNVT_count_f
Gstat	nvoGstat_XXX	SNVT_count_f
Timer	nvoTimer_XXX	SNVT_count_f
Flame	nvoFlame_XXX	SNVT_count_f
Logstat	nvoLogstat_XXX	SNVT_count_f
Sysmins	nvoSysmins_XXX	SNVT_time_min
Bnrmins	nvoBnrmins_XXX	SNVT_time_min
Cycles	nvoCycles_XXX	SNVT_count_f
Lockout_Count	nvoLockotCnt_XXX	SNVT_count_f
Lockout1_Msg	nvoLkot1Msg_XXX	SNVT_count_f
Lockout1_Module	nvoLkot1Mod_XXX	SNVT_count_f
Lockout1_BnrHrs	nvoLkot1BrHr_XXX	SNVT_time_hour
Lockout1_BnrCyCs	nvoLkot1BrCy_XXX	SNVT_count_f
Lockout2_Msg	nvoLkot2Msg_XXX	SNVT_count_f
Lockout2_Module	nvoLkot2Mod_XXX	SNVT_count_f
Lockout2_BnrHrs	nvoLkot2BrHr_XXX	SNVT_time_hour

Lockout2_BnrCycs	nvoLkot2BrCy_XXX	SNVT_count_f
Lockout3_Msg	nvoLkot3Msg_XXX	SNVT_count_f
Lockout3_Module	nvoLkot3Mod_XXX	SNVT_count_f
Lockout3_BnrHrs	nvoLkot3BrHr_XXX	SNVT_time_hour
Lockout3_BnrCycs	nvoLkot3BrCy_XXX	SNVT_count_f
Lockout4_Msg	nvoLkot4Msg_XXX	SNVT_count_f
Lockout4_Module	nvoLkot4Mod_XXX	SNVT_count_f
Lockout4_BnrHrs	nvoLkot4BrHr_XXX	SNVT_time_hour
Lockout4_BnrCycs	nvoLkot4BrCy_XXX	SNVT_count_f
Lockout5_Msg	nvoLkot5Msg_XXX	SNVT_count_f
Lockout5_Module	nvoLkot5Mod_XXX	SNVT_count_f
Lockout5_BnrHrs	nvoLkot5BrHr_XXX	SNVT_time_hour
Lockout5_BnrCycs	nvoLkot5BrCy_XXX	SNVT_count_f
Lockout6_Msg	nvoLkot6Msg_XXX	SNVT_count_f
Lockout6_Module	nvoLkot6Mod_XXX	SNVT_count_f
Lockout6_BnrHrs	nvoLkot6BrHr_XXX	SNVT_time_hour
Lockout6_BnrCycs	nvoLkot6BrCy_XXX	SNVT_count_f
Lockout7_Msg	nvoLkot7Msg_XXX	SNVT_count_f
Lockout7_Module	nvoLkot7Mod_XXX	SNVT_count_f
Lockout7_BnrHrs	nvoLkot7BrHr_XXX	SNVT_time_hour
Lockout7_BnrCycs	nvoLkot7BrCy_XXX	SNVT_count_f
Lockout8_Msg	nvoLkot8Msg_XXX	SNVT_count_f
Lockout8_Module	nvoLkot8Mod_XXX	SNVT_count_f
Lockout8_BnrHrs	nvoLkot8BrHr_XXX	SNVT_time_hour
Lockout8_BnrCycs	nvoLkot8BrCy_XXX	SNVT_count_f
Lockout9_Msg	nvoLkot9Msg_XXX	SNVT_count_f
Lockout9_Module	nvoLkot9Mod_XXX	SNVT_count_f
Lockout9_BnrHrs	nvoLkot9BrHr_XXX	SNVT_time_hour
Lockout9_BnrCycs	nvoLkot9BrCy_XXX	SNVT_count_f
Lockout10_Msg	nvoLkot10Msg_XXX	SNVT_count_f
Lockout10_Module	nvoLkot10Mod_XXX	SNVT_count_f
Lockout10_BnrHrs	nvoLko10BrHr_XXX	SNVT_time_hour
Lockout10_BnrCycs	nvoLko10BrCy_XXX	SNVT_count_f
Op_Control	nvoOpControl_XXX	SNVT_switch
Aux_1	nvoAux1_XXX	SNVT_switch
Aux_2	nvoAux2_XXX	SNVT_switch
Aux_3	nvoAux3_XXX	SNVT_switch
High_water	nvoHiwater_XXX	SNVT_switch
Low_Water	nvoLoWater_XXX	SNVT_switch
High_Oil_Temp	nvoHiOilTmp_XXX	SNVT_switch
Low_Oil_Temp	nvoLoOilTmp_XXX	SNVT_switch
Low_Oil_Press	nvoLoOilPrs_XXX	SNVT_switch
Low_Atom_Media	nvoLoAtomMed_XXX	SNVT_switch
Low_Gas_Press	nvoLoGasPrs_XXX	SNVT_switch
High_Gas_Press	nvoHiGasPrs_XXX	SNVT_switch
Aux_Gas	nvoAuxGas_XXX	SNVT_switch
High_Press	nvoHiPress_XXX	SNVT_switch
High_Temp	nvoHiTemp_XXX	SNVT_switch
Aux_4	nvoAux4_XXX	SNVT_switch

Aux_5	nvoAux5_XXX	SNVT_switch
Aux_6	nvoAux6_XXX	SNVT_switch
Aux_7	nvoAux7_XXX	SNVT_switch
Air_Flow	nvoAirFLo_XXX	SNVT_switch

12.12 Alta/Phantom II Control

Table 12-13: Alta/Phantom II Control LonWorks Points List

Point Name	Description	Modbus Register	Lon Name	Lon SNVT
Central Heat Enable/Disable	Central Heat Enable/Disable 0 = Disable 1 = Enable This register enables single boiler Central Heat 1 demand and Sequencer Master Central Heat 1 demand. This signal does not revert to 0 if not written.	401001	nvi/nvoCntHtEnbl_XXX	SNVT_switch
Demand Source	1 Unknown 2 Standby 3 Central Heat 1 4 Central Heat 2 5 Domestic Hot Water 6 Sequencer Control 7 CH Frost Protection 10 Warm Weather Shutdown	400100	nvoDemSrc_XXX	SNVT_count_f
CH1 Heat Demand	0=Off, 1= On	400009	nvoCH1HtDem_XXX	SNVT_switch
CH2 Heat Demand	0=Off, 1= On	400010	nvoCH2HtDem_XXX	SNVT_switch
DHW Heat Demand	0=Off, 1= On	400003	nvoDHWHtDem_XXX	SNVT_switch
Supply Temperature	-40°F (-40°C) to 320°F (160°C)	400016	nvoSupTmp_XXX	SNVT_count_f
Return Temperature	-40°F (-40°C) to 320°F (160°C)	400017	nvoRetTmp_XXX	SNVT_count_f
DHW Temperature	-40°F (-40°C) to 320°F (160°C)	400018	nvoDHWTmp_XXX	SNVT_count_f
Stack Temperature	-40°F (-40°C) to 320°F (160°C)	400020	nvoStackTmp_XXX	SNVT_count_f
Header Temperature	-40°F (-40°C) to 320°F (160°C)	400022	nvoHdrTmp_XXX	SNVT_count_f
Outdoor Temperature	-40°F (-40°C) to 320°F (160°C)	401728	nvoOtdrTmp_XXX	SNVT_count_f
Modbus Remote Outdoor Temperature	*Energy Management System may send control the outdoor air temperature. Use this register to change the outdoor temperature.	401000	nvi/nvoModRmOtTp_XXX	SNVT_count_f
CH Modbus Setpoint	CH Modbus Setpoint* This setpoint is used for local Central Heat 1 setpoint or Sequencer Master setpoint. Valid range 60°F (16°C) to 190°F (88°C) Note: When "EMS Time Out Enable*" is enabled, setpoint	401002	nvi/nvoCHModSP_XXX	SNVT_count_f

	switches to local mode if the EMS fails to write value every 30 seconds. When disabled EMS only needs to write a valid number after power up. The default setting is disabled.			
Active Setpoint	-40°F (-40°C) to 320°F (160°C)	400014	nvoActSP_XXX	SNVT_count_f
Active Sequencer Master Setpoint	-40°F (-40°C) to 320°F (160°C)	400015	nvoActSqMsSP_XXX	SNVT_count_f
CH1 Setpoint Source	1 = Unknown, 2 = Normal setpoint, 3 = Rate Based Reset setpoint, 4 = Outdoor reset Setpoint, 5 = Remote control (4-20/0-10 or Modbus), 6 = Outdoor boost	400034	nvoCH1SPSrc_XXX	SNVT_count_f
CH2 Setpoint Source	1 = Unknown, 2 = Normal setpoint, 3 = Rate Based Reset Setpoint, 4 = Outdoor Air Reset Setpoint, 5 = Remote control (4-20/0-10 or Modbus), 6 = Outdoor Boost	400035	nvoCH2SPSrc_XXX	SNVT_count_f
Sequencer Master Setpoint Source	1=Unknown, 2=Remote Modbus, 3=Remote 4-20/0-10, 4=DHW, 5=CH1, 6=CH1 Outdoor Air Reset 7=CH2, 8=CH2 Outdoor Air Reset	400036	nvoSqMstDmSr_XXX	SNVT_count_f
0-10VDC 4-20mADC input	Diagnostic tool to troubleshoot / confirm input signal. Resolution 1mV or 10uA 0-20.000 Vdc (0 - 30.00mAdc) Signal shows remote set point or remote rate, depending on selection.	400109	nvoADCInput_XXX	SNVT_count_f
Lockout Code	See Table 12-14	400029	nvoLckotCde_XXX	SNVT_count_f
Hold Code	See Table 12-14	400028	nvoHoldCde_XXX	SNVT_count_f
CH Modbus Rate	*Use this register to drive individual boiler firing rates. This register is used when firing rate control is performed by an external building automation system. Range 0-100 % Note: When "EMS Time Out Enable*" is enabled, control switches to local mode if the EMS fails to write value every 30 seconds. When disabled, EMS only needs to write a valid	401003	nvi/nvoCHModRte_XXX	SNVT_lev_percent

	number after power up. The default is disabled.			
Fan Speed Demanded	Speed of the combustion air blower in rpm	400103	nvoFnSpdDem_XXX	SNVT_count_f
Fan Speed Feedback	Speed of the combustion air blower in rpm	400104	nvoFnSpdFdbk_XXX	SNVT_count_f
Flame Signal	0-100%	400101	nvoFlmSig_XXX	SNVT_lev_percent
Burner Control State	1 Self Check 2 Standby 3 Waiting for Limit to close 4 Prepurge 5 Direct Burner Ignition 6 Low Fire Hold 7 Calibration 8 Rate Limit 9 Run (Modulate) 10 Postpurge 11 Pump Purge 12 Standby Delay 13 Lockout 14 Boiler Switch Off 15 Warm Wheather Shutdown	400013	nvoBrnCtrlSt_XXX	SNVT_count_f
Burner Run Time Hours	Hours (U32)	400024-25	nvoBrnRnTmHr_XXX	SNVT_time_hour
Burner Cycle Count	0-999,999 (U32)	400026-27	nvoBrnCycCnt_XXX	SNVT_count_f
Pump A (System Pump) Cycles	0-999,999 (U32)	400686-687	nvoPmpACyc_XXX	SNVT_count_f
Pump B (Boiler Pump) Cycles	0-999,999 (U32)	400688-689	nvoPmpBCyc_XXX	SNVT_count_f
Pump C (DHW Pump) Cycles	0-999,999 (U32)	400690-691	nvoPmpCCyc_XXX	SNVT_count_f
Pump A (System Pump) Status	0 = Off, 1 = On	400106	nvoPmpAStat_XXX	SNVT_switch
Pump B (Boiler Pump) Status	0 = Off, 1 = On	400107	nvoPmpBStat_XXX	SNVT_switch
Pump C (DHW Pump) Status	0 = Off, 1 = On	400108	nvoPmpCStat_XXX	SNVT_switch
Recirculation Temperature	-40°F (-40°C) to 320°F (160°C)	400038	nvoRecrcTmp_XXX	SNVT_count_f

Table 12-14: Alta/Phantom II Lockout / Hold List

Code	Description
1	Anti short cycle
2	Boiler Safety Limit Open
4	Supply High Limit
5	Low Boiler Water Flow
6	Stack High Limit
7	Return temp higher than supply
8	Return Sensor Fault
9	Supply Sensor Fault
10	DHW Sensor Fault
11	Flue Sensor Fault
12	Outdoor Air Sensor Fault
13	Header Sensor Fault
14	0-10/4-20 Input Warning
15	APS Defective (failed to open)
16	Low Combustion Air Flow
17	Invalid Safety Parameters
18	Invalid Application Parameters
19	Flame Signal Fault during Run
20	Flame Signal Fault during Calibration
21	Fuel Gas Fault
22	No Flame at Ignition
23	Flame Detected Out Of Sequence
24	Flame loss during Run
25	Hardware Fault
26	Calibration Fault
27	120 Vac Supply Fault
28	24 Vac Supply Fault
29	Excessive Reset Selection
30	Sequencer Fault
31	Variable Speed Pump Fault
32	Zone Panel Fault

12.13 Conductor Sequencing Panel

Table 12-15: Conductor Sequencing Panel LonWorks Points List

Point Name	Lon Name	Lon SNVT Type
Plant load	nvoPlant Ld XXX	SNVT_count_f
EMS Enable	nvi/nvoEMS_Enbl XXX	SNVT_switch
EMS Setpoint	nvi/nvoEMS_SP XXX	SNVT_temp_p
Firing Rate	nvoFir_Rate XXX	SNVT_lev_percent
Active Setpoint	nvoAct_SP XXX	SNVT_temp_p
Master SP Source	nvoMstrSPSrc XXX	SNVT_count_f
Status	nvoStatus XXX	SNVT_count_f
Priority	nvoPriority XXX	SNVT_count_f
Lead	nvoLead XXX	SNVT_count_f
SYSTEM SUPPLY	nvoSys_Sup XXX	SNVT_temp_p
SYSTEM RETURN	nvoSys_Ret XXX	SNVT_temp_p
OUTDOOR AIR	nvoOtdr_Air XXX	SNVT_temp_p
UAI5 EMS SETPOINT	nvoAI5EMS_SP XXX	SNVT_temp_p
UAI7 PUMP FEEDBACK	nvoPmp_Fdbk XXX	SNVT_lev_percent
STEAM PRESSURE	nvoStm_Prs XXX	SNVT_count_f
BLR_A SHELL	nvoBlrAShl XXX	SNVT_temp_p
BLR_B SHELL	nvoBlrBShl XXX	SNVT_temp_p
BLR_C SHELL	nvoBlrCShl XXX	SNVT_temp_p
BLR_D SHELL	nvoBlrDShl XXX	SNVT_temp_p
UDO1 CONFIGURABLE	nvoUDO1_Cnfg XXX	SNVT_count_f
UDO2 ALARM	nvoUDO2_Alm XXX	SNVT_count_f
UDO7 BLR D ISOLATION VALVE	voBIDIsoVlv XXX	SNVT_switch
UDO8 PUMP A	nvoPmp_A XXX	SNVT_switch
UDO9 BLR A ISOLATION VALVE	nvoBIAIsoVlv XXX	SNVT_switch
UDO10 BLR B ISOLATION VALVE	nvoBIBIsoVlv XXX	SNVT_switch
UDO11 BLR C ISOLATION VALVE	nvoBICIsoVlv XXX	SNVT_switch
UDO12 PUMP B	nvoPmp_B XXX	SNVT_switch
ALR Press High	nvoALR_PrsHi XXX	SNVT_switch
ALR Press Low	nvoALR_PrsLo XXX	SNVT_switch
ALR Temp High	nvoALR_TmpHi XXX	SNVT_switch
ALR Temp Low	nvoALR_TmpLo XXX	SNVT_switch
ALR Return Temp Low	nvoALRRtTpLo XXX	SNVT_switch
ALR Pump A Fault	nvoALRPmAFIt XXX	SNVT_switch
ALR Pump B Fault	nvoALRPmBFIt XXX	SNVT_switch
ALR Shell 1 High	nvoALR_Sh1Hi XXX	SNVT_switch
ALR Shell 2 High	nvoALR_Sh2Hi XXX	SNVT_switch
ALR Shell 3 High	nvoALR_Sh3Hi XXX	SNVT_switch
ALR Shell 4 High	nvoALR_Sh4Hi XXX	SNVT_switch
BLR1 Supply	nvoB1_Sup XXX	SNVT_temp_p
BLR1 Return	nvoB1_Ret XXX	SNVT_temp_p
BLR1 Stack	nvoB1_Stk XXX	SNVT_temp_p
BLR1 CH Mod Rate	nvoB1_CHMdRt XXX	SNVT_lev_percent
BLR1 Rate Commanded	nvoB1_RteCmd XXX	SNVT_lev_percent
BLR1 CH Mod Stat	nvoB1_CHMdSt XXX	SNVT_switch
BLR1 General Alarm	nvoB1_GenAlm XXX	SNVT_switch
BLR1 Boiler Pump	nvoB1_BlRPmp XXX	SNVT_switch
BLR1 System Pump	nvoB1_SysPmp XXX	SNVT_switch
BLR1 Pump Status	nvoB1_PmpSta XXX	SNVT_switch
BLR1 Flame	nvoB1_Flame XXX	SNVT_count_f
BLR1 State	nvoB1_State XXX	SNVT_count_f
BLR1 Ann Lockout	nvoB1_AnnLck XXX	SNVT_count_f
BLR1 Ann Hold	nvoB1_AnnHld XXX	SNVT_count_f
ALR BLR1SupplyHigh	nvoALRB1SpHi XXX	SNVT_switch

ALR_LeadBLR1Fault	nvoALRLdB1FI_XXX	SNVT_switch
ALR_BLR1StartFault	nvoALRB1StFI_XXX	SNVT_switch
ALR_BLR1Lockout	nvoALRB1Lkot_XXX	SNVT_switch
ALR_BLR1lost	nvoALRB1lost_XXX	SNVT_switch
ALR_BLR1Mod_Source	nvoALRB1MdSr_XXX	SNVT_switch
ALR_BLR1DMD_Source	nvoALRB1DmSr_XXX	SNVT_switch
ALR_S78001Lost	nvoALR1Lost_XXX	SNVT_switch
BLR2_Supply	nvoB2_Sup_XXX	SNVT_temp_p
BLR2_Return	nvoB2_Ret_XXX	SNVT_temp_p
BLR2_Stack	nvoB2_Stk_XXX	SNVT_temp_p
BLR2_CH_Mod_Rate	nvoB2_CHMdRt_XXX	SNVT_lev_percent
BLR2_Rate_Commanded	nvoB2_RteCmd_XXX	SNVT_lev_percent
BLR2_CH_Mod_Stat	nvoB2_CHMdSt_XXX	SNVT_switch
BLR2_General_Alarm	nvoB2_GenAlm_XXX	SNVT_switch
BLR2_Boiler_Pump	nvoB2_BlRPmp_XXX	SNVT_switch
BLR2_System_Pump	nvoB2_SysPmp_XXX	SNVT_switch
BLR2_Pump_Status	nvoB2_PmpSta_XXX	SNVT_switch
BLR2_Flame	nvoB2_Flame_XXX	SNVT_switch
BLR2_State	nvoB2_State_XXX	SNVT_count_f
BLR2_Ann_Lockout	nvoB2_AnnLck_XXX	SNVT_count_f
BLR2_Ann_Hold	nvoB2_AnnHld_XXX	SNVT_count_f
ALR_BLR2SupplyHigh	nvoALRB2SpHi_XXX	SNVT_switch
ALR_LeadBLR2Fault	nvoALRLdB2FI_XXX	SNVT_switch
ALR_BLR2StartFault	nvoALRB2StFI_XXX	SNVT_switch
ALR_BLR2Lockout	nvoALRB2Lkot_XXX	SNVT_switch
ALR_BLR2lost	nvoALRB2lost_XXX	SNVT_switch
ALR_BLR2Mod_Source	nvoALRB2MdSr_XXX	SNVT_switch
ALR_BLR2DMD_Source	nvoALRB2DmSr_XXX	SNVT_switch
ALR_S78002Lost	nvoALR2Lost_XXX	SNVT_switch
BLR3_Supply	nvoB3_Sup_XXX	SNVT_temp_p
BLR3_Return	nvoB3_Ret_XXX	SNVT_temp_p
BLR3_Stack	nvoB3_Stk_XXX	SNVT_temp_p
BLR3_CH_Mod_Rate	nvoB3_CHMdRt_XXX	SNVT_lev_percent
BLR3_Rate_Commanded	nvoB3_RteCmd_XXX	SNVT_lev_percent
BLR3_CH_Mod_Stat	nvoB3_CHMdSt_XXX	SNVT_switch
BLR3_General_Alarm	nvoB3_GenAlm_XXX	SNVT_switch
BLR3_Boiler_Pump	nvoB3_BlRPmp_XXX	SNVT_switch
BLR3_System_Pump	nvoB3_SysPmp_XXX	SNVT_switch
BLR3_Pump_Status	nvoB3_PmpSta_XXX	SNVT_switch
BLR3_Flame	nvoB3_Flame_XXX	SNVT_switch
BLR3_State	nvoB3_State_XXX	SNVT_count_f
BLR3_Ann_Lockout	nvoB3_AnnLck_XXX	SNVT_count_f
BLR3_Ann_Hold	nvoB3_AnnHld_XXX	SNVT_count_f
ALR_BLR3SupplyHigh	nvoALRB3SpHi_XXX	SNVT_switch
ALR_LeadBLR3Fault	nvoALRLdB3FI_XXX	SNVT_switch
ALR_BLR3StartFault	nvoALRB3StFI_XXX	SNVT_switch
ALR_BLR3Lockout	nvoALRB3Lkot_XXX	SNVT_switch
ALR_BLR3lost	nvoALRB3lost_XXX	SNVT_switch
ALR_BLR3Mod_Source	nvoALRB3MdSr_XXX	SNVT_switch
ALR_BLR3DMD_Source	nvoALRB3DmSr_XXX	SNVT_switch
ALR_S78003Lost	nvoALR3Lost_XXX	SNVT_switch
BLR4_Supply	nvoB4_Sup_XXX	SNVT_temp_p
BLR4_Return	nvoB4_Ret_XXX	SNVT_temp_p
BLR4_Stack	nvoB4_Stk_XXX	SNVT_temp_p
BLR4_CH_Mod_Rate	nvoB4_CHMdRt_XXX	SNVT_lev_percent
BLR4_Rate_Commanded	nvoB4_RteCmd_XXX	SNVT_lev_percent
BLR4_CH_Mod_Stat	nvoB4_CHMdSt_XXX	SNVT_switch
BLR4_General_Alarm	nvoB4_GenAlm_XXX	SNVT_switch
BLR4_Boiler_Pump	nvoB4_BlRPmp_XXX	SNVT_switch

BLR4_System_Pump	nvoB4_SysPmp_XXX	SNVT_switch
BLR4_Pump_Status	nvoB4_PmpSta_XXX	SNVT_switch
BLR4_Flame	nvoB4_Flame_XXX	SNVT_switch
BLR4_State	nvoB4_State_XXX	SNVT_count_f
BLR4_Ann_Lockout	nvoB4_AnnLck_XXX	SNVT_count_f
BLR4_Ann_Hold	nvoB4_AnnHld_XXX	SNVT_count_f
ALR_BLR4SupplyHigh	nvoALRB4SpHi_XXX	SNVT_switch
ALR_LeadBLR4Fault	nvoALRLdB4FI_XXX	SNVT_switch
ALR_BLR4StartFault	nvoALRB4StFI_XXX	SNVT_switch
ALR_BLR4Lockout	nvoALRB4Lkot_XXX	SNVT_switch
ALR_BLR4lost	nvoALRB4lost_XXX	SNVT_switch
ALR_BLR4Mod_Source	nvoALRB4MdSr_XXX	SNVT_switch
ALR_BLR4DMD_Source	nvoALRB4DmSr_XXX	SNVT_switch
ALR_S78004Lost	nvoALR4Lost_XXX	SNVT_switch
BLR5_Supply	nvoB5_Sup_XXX	SNVT_temp_p
BLR5_Return	nvoB5_Ret_XXX	SNVT_temp_p
BLR5_Stack	nvoB5_Stk_XXX	SNVT_temp_p
BLR5_CH_Mod_Rate	nvoB5_CHMdRt_XXX	SNVT_lev_percent
BLR5_Rate_Commanded	nvoB5_RteCmd_XXX	SNVT_lev_percent
BLR5_CH_Mod_Stat	nvoB5_CHMdSt_XXX	SNVT_switch
BLR5_General_Alarm	nvoB5_GenAlm_XXX	SNVT_switch
BLR5_Boiler_Pump	nvoB5_BlzPmp_XXX	SNVT_switch
BLR5_System_Pump	nvoB5_SysPmp_XXX	SNVT_switch
BLR5_Pump_Status	nvoB5_PmpSta_XXX	SNVT_switch
BLR5_Flame	nvoB5_Flame_XXX	SNVT_switch
BLR5_State	nvoB5_State_XXX	SNVT_count_f
BLR5_Ann_Lockout	nvoB5_AnnLck_XXX	SNVT_count_f
BLR5_Ann_Hold	nvoB5_AnnHld_XXX	SNVT_count_f
ALR_BLR5SupplyHigh	nvoALRB5SpHi_XXX	SNVT_switch
ALR_LeadBLR5Fault	nvoALRLdB5FI_XXX	SNVT_switch
ALR_BLR5StartFault	nvoALRB5StFI_XXX	SNVT_switch
ALR_BLR5Lockout	nvoALRB5Lkot_XXX	SNVT_switch
ALR_BLR5lost	nvoALRB5lost_XXX	SNVT_switch
ALR_BLR5Mod_Source	nvoALRB5MdSr_XXX	SNVT_switch
ALR_BLR5DMD_Source	nvoALRB5DmSr_XXX	SNVT_switch
ALR_S78005Lost	nvoALR5Lost_XXX	SNVT_switch
BLR6_Supply	nvoB6_Sup_XXX	SNVT_temp_p
BLR6_Return	nvoB6_Ret_XXX	SNVT_temp_p
BLR6_Stack	nvoB6_Stk_XXX	SNVT_temp_p
BLR6_CH_Mod_Rate	nvoB6_CHMdRt_XXX	SNVT_lev_percent
BLR6_Rate_Commanded	nvoB6_RteCmd_XXX	SNVT_lev_percent
BLR6_CH_Mod_Stat	nvoB6_CHMdSt_XXX	SNVT_switch
BLR6_General_Alarm	nvoB6_GenAlm_XXX	SNVT_switch
BLR6_Boiler_Pump	nvoB6_BlzPmp_XXX	SNVT_switch
BLR6_System_Pump	nvoB6_SysPmp_XXX	SNVT_switch
BLR6_Pump_Status	nvoB6_PmpSta_XXX	SNVT_switch
BLR6_Flame	nvoB6_Flame_XXX	SNVT_switch
BLR6_State	nvoB6_State_XXX	SNVT_count_f
BLR6_Ann_Lockout	nvoB6_AnnLck_XXX	SNVT_count_f
BLR6_Ann_Hold	nvoB6_AnnHld_XXX	SNVT_count_f
ALR_BLR6SupplyHigh	nvoALRB6SpHi_XXX	SNVT_switch
ALR_LeadBLR6Fault	nvoALRLdB6FI_XXX	SNVT_switch
ALR_BLR6StartFault	nvoALRB6StFI_XXX	SNVT_switch
ALR_BLR6Lockout	nvoALRB6Lkot_XXX	SNVT_switch
ALR_BLR6lost	nvoALRB6lost_XXX	SNVT_switch
ALR_BLR6Mod_Source	nvoALRB6MdSr_XXX	SNVT_switch
ALR_BLR6DMD_Source	nvoALRB6DmSr_XXX	SNVT_switch
ALR_S78006Lost	nvoALR6Lost_XXX	SNVT_switch
BLR7_Supply	nvoB7_Sup_XXX	SNVT_temp_p
BLR7_Return	nvoB7_Ret_XXX	SNVT_temp_p

BLR7_Stack	nvoB7_Stk_XXX	SNVT_temp_p
BLR7_CH_Mod_Rate	nvoB7_CHMdRt_XXX	SNVT_lev_percent
BLR7_Rate_Commanded	nvoB7_RteCmd_XXX	SNVT_lev_percent
BLR7_CH_Mod_Stat	nvoB7_CHMdSt_XXX	SNVT_switch
BLR7_General_Alarm	nvoB7_GenAlm_XXX	SNVT_switch
BLR7_Boiler_Pump	nvoB7_BlPmp_XXX	SNVT_switch
BLR7_System_Pump	nvoB7_SysPmp_XXX	SNVT_switch
BLR7_Pump_Status	nvoB7_PmpSta_XXX	SNVT_switch
BLR7_Flame	nvoB7_Flame_XXX	SNVT_switch
BLR7_State	nvoB7_State_XXX	SNVT_count_f
BLR7_Ann_Lockout	nvoB7_AnnLck_XXX	SNVT_count_f
BLR7_Ann_Hold	nvoB7_AnnHld_XXX	SNVT_count_f
ALR_BLR7SupplyHigh	nvoALRB7SpHi_XXX	SNVT_switch
ALR_LeadBLR7Fault	nvoALRLdB7FI_XXX	SNVT_switch
ALR_BLR7StartFault	nvoALRB7StFI_XXX	SNVT_switch
ALR_BLR7Lockout	nvoALRB7Lkot_XXX	SNVT_switch
ALR_BLR7lost	nvoALRB7lost_XXX	SNVT_switch
ALR_BLR7Mod_Source	nvoALRB7MdSr_XXX	SNVT_switch
ALR_BLR7DMD_Source	nvoALRB7DmSr_XXX	SNVT_switch
ALR_S78007Lost	nvoALR7Lost_XXX	SNVT_switch
BLR8_Supply	nvoB8_Sup_XXX	SNVT_temp_p
BLR8_Return	nvoB8_Ret_XXX	SNVT_temp_p
BLR8_Stack	nvoB8_Stk_XXX	SNVT_temp_p
BLR8_CH_Mod_Rate	nvoB8_CHMdRt_XXX	SNVT_lev_percent
BLR8_Rate_Commanded	nvoB8_RteCmd_XXX	SNVT_lev_percent
BLR8_CH_Mod_Stat	nvoB8_CHMdSt_XXX	SNVT_switch
BLR8_General_Alarm	nvoB8_GenAlm_XXX	SNVT_switch
BLR8_Boiler_Pump	nvoB8_BlPmp_XXX	SNVT_switch
BLR8_System_Pump	nvoB8_SysPmp_XXX	SNVT_switch
BLR8_Pump_Status	nvoB8_PmpSta_XXX	SNVT_switch
BLR8_Flame	nvoB8_Flame_XXX	SNVT_switch
BLR8_State	nvoB8_State_XXX	SNVT_count_f
BLR8_Ann_Lockout	nvoB8_AnnLck_XXX	SNVT_count_f
BLR8_Ann_Hold	nvoB8_AnnHld_XXX	SNVT_count_f
ALR_BLR8SupplyHigh	nvoALRB8SpHi_XXX	SNVT_switch
ALR_LeadBLR8Fault	nvoALRLdB8FI_XXX	SNVT_switch
ALR_BLR8StartFault	nvoALRB8StFI_XXX	SNVT_switch
ALR_BLR8Lockout	nvoALRB8Lkot_XXX	SNVT_switch
ALR_BLR8lost	nvoALRB8lost_XXX	SNVT_switch
ALR_BLR8Mod_Source	nvoALRB8MdSr_XXX	SNVT_switch
ALR_BLR8DMD_Source	nvoALRB8DmSr_XXX	SNVT_switch
ALR_S78008Lost	nvoALR8Lost_XXX	SNVT_switch

Appendix A. "A" Bank DIP Switch Settings

Address	A0	A1	A2	A3	A4	A5	A6	A7
1	On	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
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47	On	On	On	On	Off	On	Off	Off
48	Off	Off	Off	Off	On	On	Off	Off

Address	A0	A1	A2	A3	A4	A5	A6	A7
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
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95	On	On	On	On	On	Off	On	Off
96	Off	Off	Off	Off	Off	On	On	Off

Address	A0	A1	A2	A3	A4	A5	A6	A7
97	On	Off	Off	Off	Off	On	On	Off
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101	On	Off	On	Off	Off	On	On	Off
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144	Off	Off	Off	Off	On	Off	Off	On
145	On	Off	Off	Off	On	Off	Off	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
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192	Off	Off	Off	Off	Off	Off	On	On
193	On	Off	Off	Off	Off	Off	On	On
194	Off	On	Off	Off	Off	Off	On	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
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240	Off	Off	Off	Off	On	On	On	On
241	On	Off	Off	Off	On	On	On	On
242	Off	On	Off	Off	On	On	On	On
243	On	On	Off	Off	On	On	On	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
244	Off	Off	On	Off	On	On	On	On
245	On	Off	On	Off	On	On	On	On
246	Off	On	On	Off	On	On	On	On
247	On	On	On	Off	On	On	On	On
248	Off	Off	Off	On	On	On	On	On
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251	On	On	Off	On	On	On	On	On
252	Off	Off	On	On	On	On	On	On
253	On	Off	On	On	On	On	On	On
254	Off	On	On	On	On	On	On	On
255	On	On	On	On	On	On	On	On

Appendix B.1. Choose Whether to Integrate the FieldServer Manager

When first logging onto the ProtoNode, the Web App will open on the FieldServer Manager page.

NOTICE: If a warning message appears instead, go to [Section 9.5 FieldServer Manager Connection Warning Message](#) to resolve the connection issue.

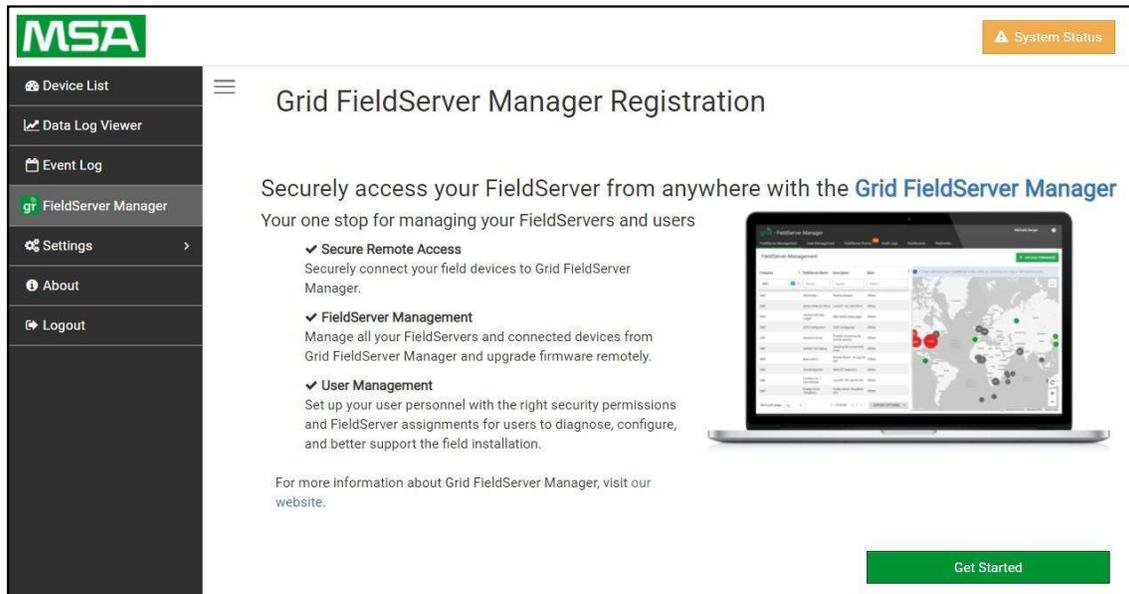


Figure Appendix B-1: ProtoNode Web Configurator Landing Page

- Either go through the FieldServer Manager setup to integrate cloud functionality to the FieldServer or opt out.

The screenshot shows the MSA FieldServer Manager web configurator. The left navigation pane is expanded to 'Connections'. The main content area shows a table of connections:

Index	Name	Tx Msg	Rx Msg	Tx Char	Rx Char	Errors
0	R1 - MODBUS_RTU	144	0	1,152	0	144
1	ETH1 - Modbus/TCP	0	0	0	0	0

At the bottom of the page, there are buttons for 'Home', 'HELP (?)', 'Contact Us', 'Reset Statistics', and 'Logout'. The 'fieldserver' logo is visible in the bottom right corner.

• **Figure Appendix B-2: Web Configurator Connections Page**

- For FieldServer Manager setup, continue with instructions in the following sections
- To opt out of the FieldServer Manager, click on a tab other than the Grid FieldServer Manager tab, click the checkbox next to “Opt out of Grid FieldServer Manager Registration” in the Warning window that appears and click the Exit Registration button
- To ignore FieldServer Manager setup until the next time the Web App is opened, click a tab other than Grid FieldServer Manager and then click the Exit Registration button with the “Opt out” checkbox unchecked

NOTICE: If user setup is already complete go to [Section Appendix B.3 Registration Process](#).

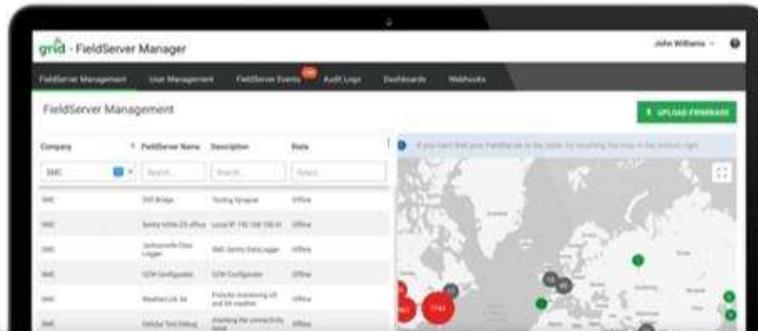
Appendix B.2. User Setup

Before the gateway can be connected to the FieldServer Manager, a user account must be created. Request an invitation to the FieldServer Manager from the manufacturer’s support team. Once an invitation has been requested , follow the instructions below to set up login details:

- The “Welcome to the MSA Grid - FieldServer Manager” email will appear as shown below.

grid - Fieldserver Manager

Welcome to FieldServer Manager



Your one stop for managing your FieldServers and users

- ✓ Secure Remote Access
- ✓ FieldServer Management
- ✓ User Management

COMPLETE REGISTRATION

Contact Us

+1 408 262-6611

smc-support@msasafety.com

www.msasafety.com

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MSA | fieldserver

Figure Appendix B-3: Grid Welcome Page

NOTICE: If no email was received, check the spam/junk folder for an email from notification@fieldpop.io. Contact the manufacturer's support team if no email is found.

- Click the "Complete Registration" button and fill in user details accordingly.

Complete Your Registration

Email Address

First Name
 *

Last Name
 *

Mobile Phone Number
 *

New Password *Invalid Mobile Number
 *

Confirm Password * Please enter new password
 *

By registering my account with MSA, I understand that I am agreeing to the FieldServer Manager [Terms of Service and Privacy Policy](#) *

* Mandatory Fields

Figure Appendix B-4: Grid Registration Page

- Fill in the name, phone number, password fields and click the checkbox to agree to the privacy policy and terms of service.

NOTICE: If access to data logs using RESTful API is needed, do not include “#” in the password.

- Click “Save” to save the user details.
- Click “OK” when the Success message appears.
- Record the email account used and password for future use.

Appendix B.3. Registration Process

Once the FieldServer Manager user credentials have been generated, the ProtoNode can be registered onto the server.

- Click the FieldServer Manager tab.

NOTICE: If a warning message appears instead, go to [Section 9.5 FieldServer Manager Connection Warning Message](#) to resolve the connection issue.

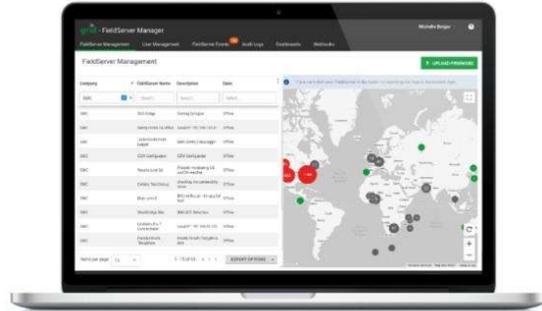
Grid FieldServer Manager Registration

Securely access your FieldServer from anywhere with the **Grid FieldServer Manager**

Your one stop for managing your FieldServers and users

- ✓ **Secure Remote Access**
Securely connect your field devices to Grid FieldServer Manager.
- ✓ **FieldServer Management**
Manage all your FieldServers and connected devices from Grid FieldServer Manager and upgrade firmware remotely.
- ✓ **User Management**
Set up your user personnel with the right security permissions and FieldServer assignments for users to diagnose, configure, and better support the field installation.

For more information about Grid FieldServer Manager, visit our [website](#).



Get Started

Figure Appendix B-5: Grid Get Started Button

- Click Get Started to view the FieldServer Manager registration page.
- To register, fill in the user details, site details, gateway details and FieldServer Manager account credentials.
 - Enter user details and click Next

A screenshot of the Grid Account Setup registration page. At the top, a progress bar shows four steps: 1. Installer Details (highlighted with a green circle), 2. Installation Site, 3. FieldServer Details, and 4. Account Details. Below the progress bar, the 'Installer Details' section contains several input fields: 'Installer Name', 'Company', 'Telephone', and 'Email'. The 'Installation Date' field is pre-filled with '20-September-2021' and includes a calendar icon. At the bottom right, there are two buttons: a grey 'Cancel' button and a green 'Next' button.

Figure Appendix B-6: Grid Account Setup Page

- Enter the site details by entering the physical address fields or the latitude and longitude then click Next

Grid FieldServer Manager Registration

1 Installer Details
2 Installation Site

3 FieldServer Details
4 Account Details

Installation Site Details

Search

Site Name

Building

Street Address

Suburb

City

State

Country

Postal Code

Latitude

Longitude

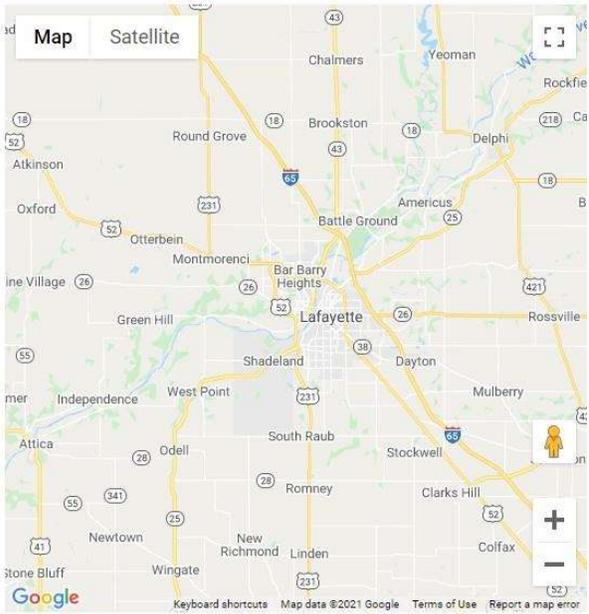


Figure Appendix B-7: Grid Site Setup

- Enter Name and Description (required) then click Next

The screenshot shows the 'Grid FieldServer Manager Registration' page at step 3, 'FieldServer Details'. A progress bar at the top indicates four steps: 1. Installer Details, 2. Installation Site, 3. FieldServer Details (highlighted in green), and 4. Account Details. The main content area is titled 'FieldServer Details' and contains the following fields:

- Name:** A red input field.
- Description:** A red input field.
- FieldServer Info:** A text area with the placeholder text: 'Optionally specify any other information relating to the FieldServer i.e., calibration, commissioning or other notes'.
- Timezone:** A dropdown menu currently set to '(GMT -08:00) America/Los_Angeles'.

At the bottom right, there are three buttons: 'Cancel' (disabled), 'Previous' (disabled), and 'Next' (active).

Figure Appendix B-8: Grid FieldServer Details Page

- Click the “Create an Grid FieldServer Manager account” button and enter a valid email to send a “Welcome to MSA Grid – FieldServer Manager” invite to the email address entered

The screenshot shows the 'Grid FieldServer Manager Registration' page at step 4, 'Account Details'. The progress bar at the top shows steps 1 through 4, with step 4 highlighted in green. The main content area is titled 'New Users' and contains the following elements:

- A text block: 'If you do not have Grid FieldServer Manager credentials, you can create a new Grid FieldServer Manager account now'.
- A green button: 'Create an Grid FieldServer Manager account'.
- A section titled 'Existing Users - Enter FieldServer registration details'.
- A sub-section titled 'User Credentials' with two red input fields: 'Username' and 'Password'.

At the bottom right, there are three buttons: 'Cancel' (disabled), 'Previous' (disabled), and 'Register FieldServer' (active).

Figure Appendix B-9: Grid Account Page

Once the device has successfully been registered, a confirmation window will appear. Click the Close button and the following screen will appear listing the device details and additional information auto-populated by the ProtoNode.

FieldServer Details	Installer Details	Installation Site Details
Name: Test1	Installer Name: Test	Site Name: Site#1
Description: FS Test	Company: MSA Safety	Building:
FieldServer Info:	Telephone: (408) 444-4444	Street Address: 1020 Canal Road
Timezone: America/Los_Angeles	Email: contactus@msasafety.com	Suburb:
MAC Address: 00:50:4E:60:13:FE	Installation Date: Sep 20, 2021	City: Lafayette
Tunnel Server URL: tunnel.fieldpop.io		State: Indiana
FieldServer ID: treedancer_KrgPKmLRY		Country: United States
Product Name: Core Application - Default		Postal Code: 47904
Product Version: 5.2.0		

[Update FieldServer Details](#)

Figure Appendix B-10: Grid Registration Summary

NOTICE: Update these details at any time by going to the FieldServer Manager tab and clicking the Update FieldServer Details button.

Appendix B.4. Login to the FieldServer Manager

After the gateway is registered, go to www.smccloud.net and type in the appropriate login information as per registration credentials.

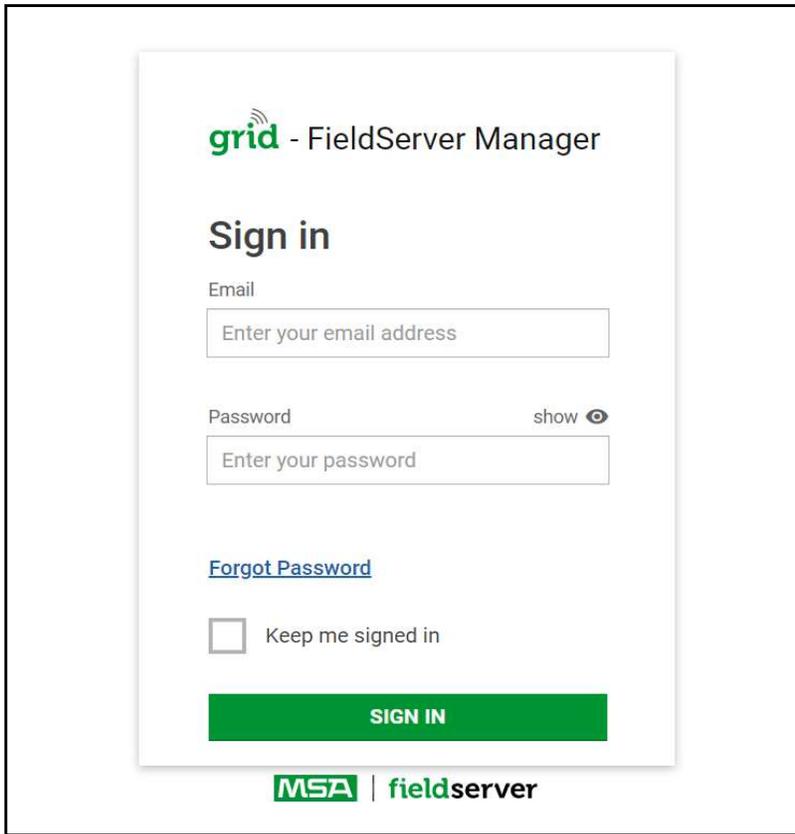


Figure Appendix B-11: Grid Sign In Page

NOTICE: If the login password is lost, see the [MSA Grid - FieldServer Manager Start-up Guide](#) for recovery instructions.

NOTICE: For additional FieldServer Manager instructions see the [MSA Grid - FieldServer Manager Start-up Guide](#).

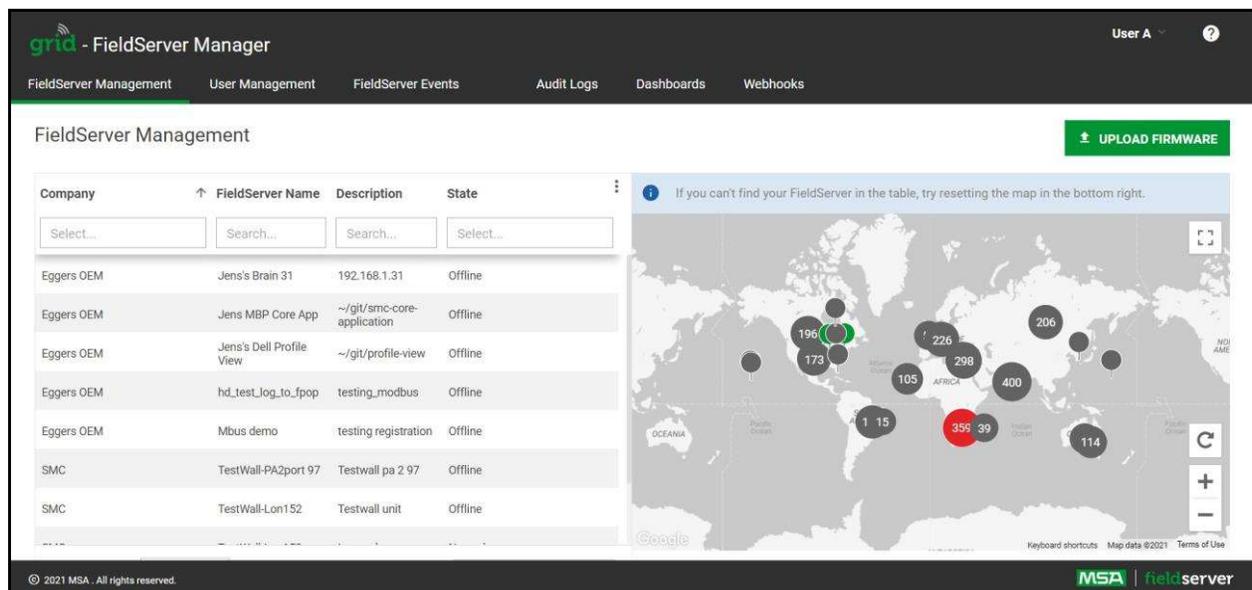


Figure Appendix B-12: Grid Map Page

Appendix B.5. Change User Management Settings

- From the FS-GUI page, click Setup in the Navigation panel.
- Click User Management in the navigation panel.

NOTICE: If the passwords are lost, the unit can be reset to factory settings to reinstate the default unique password on the label. For recovery instructions, see the [FieldServer Next Gen Recovery document](#). If the default unique password is lost, then the unit must be mailed back to the factory.

NOTICE: Any changes will require a FieldServer reboot to take effect.

- Check that the Users tab is selected.

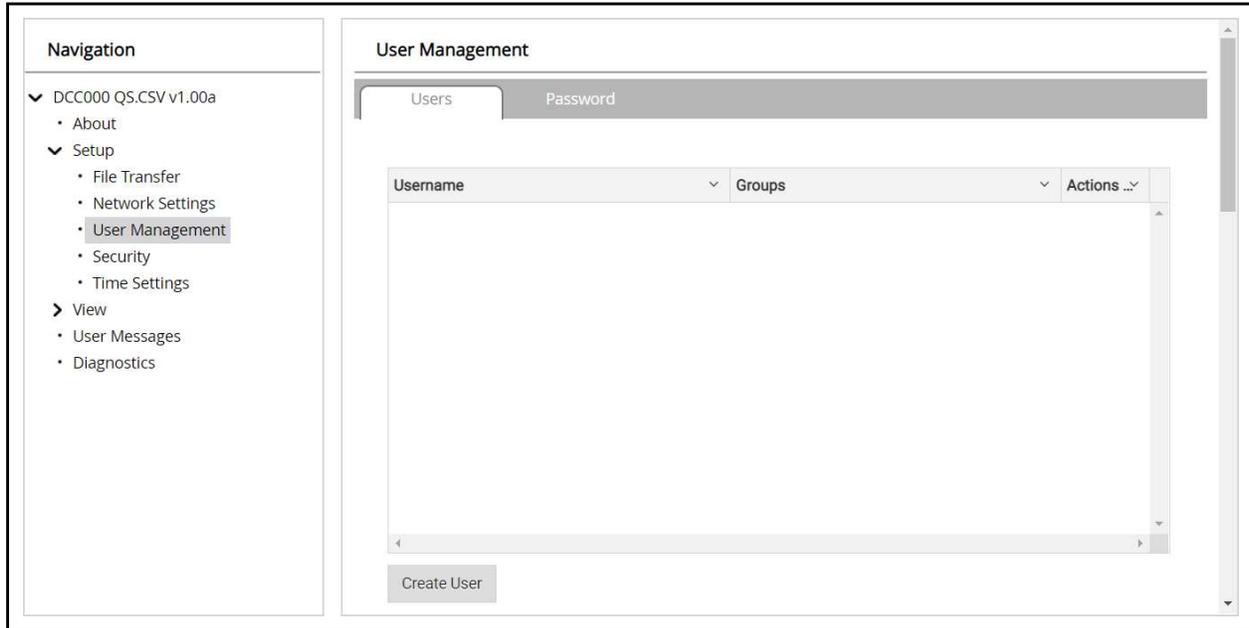


Figure Appendix B-13: Grid User Management Page

User Types:

Admin – Can modify and view any settings on the FieldServer. **Operator** – Can modify and view any data in the FieldServer array(s). **Viewer** – Can only view settings/readings on the FieldServer.

Appendix B.6. Create Users

- Click the Create User button.

Create User

Username:
Enter a unique username

Security Groups:
 Admin
 Operator
 Viewer

Password: Weak
Enter password

Show Passwords

Confirm Password:
Confirm password

Generate Password

Create Cancel

Figure Appendix B-14: Grid User Setup Page

- Enter the new User fields: Name, Security Group and Password.
 - **User details are hashed and salted**

NOTICE: The password must meet the minimum complexity requirements. An algorithm automatically checks the password entered and notes the level of strength on the top right of the Password text field.

- Click the Create button.
- Once the Success message appears, click OK.

Appendix B.7. Edit Users

- Click the pencil icon next to the desired user to open the User Edit window.

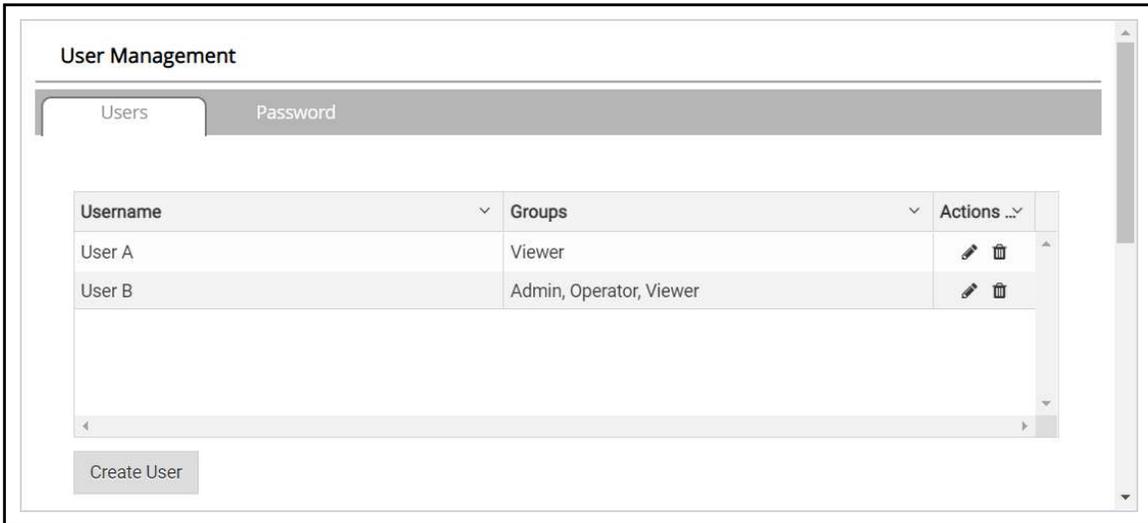


Figure Appendix B-15: Grid User Summary Page

- Once the User Edit window opens, change the User Security Group and Password as needed.

The 'Edit User' dialog box contains the following fields and options:

- Username:** Text field containing 'User A'.
- Security Groups:**
 - Admin
 - Operator
 - Viewer
- Password:** Text field containing 'Optional'.
- Show passwords
- Confirm Password:** Text field containing 'Optional'.
- Generate Password:** Button.
- Confirm:** Green button.
- Cancel:** Gray button.

Figure Appendix B-16: Grid User Setup Page

- Click Confirm.
- Once the Success message appears, click OK.

Appendix B.8. Delete Users

- Click the trash can icon next to the desired user to delete the entry.

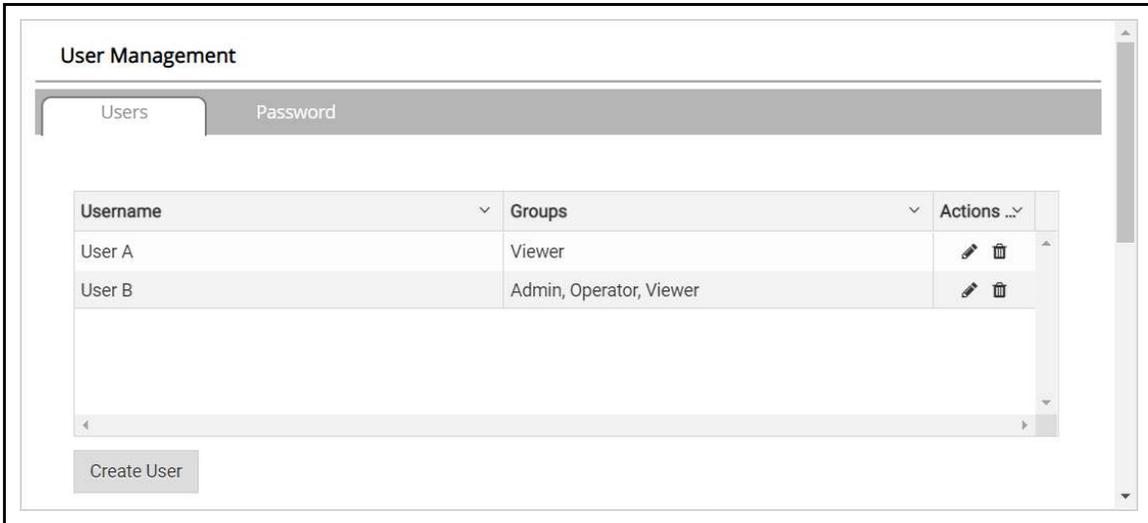


Figure Appendix B-17: Grid User Deletion Page

- When the warning message appears, click Confirm.



Figure Appendix B-18: Grid User Deletion Warning Page

Seller Limited Warranty

Seller warrants its products to be free from defects in workmanship or material under normal use and service workmanship for a period of 12 months after the date of start-up or 18 months after the date of shipment, whichever shall be less. Seller 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 the Seller.

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 Seller' 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, the Seller'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, Seller 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 the Seller for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.