FieldServer Technologies

PROTOCESSOR

CAMUS Hydronics Ltd.

ProtoNode RER and ProtoNode LER
Startup Guide
For Interfacing Camus Products: Honeywell Sola (DynaFlame, DynaForce, DynaMaxHS, TH Series, Advantus™)
To Building Automation Systems:
BACnet MS/TP, BACnet/IP, Metasys N2 and LonWorks

APPLICABILITY & EFFECTIVITY

Explains ProtoNode RER and LER hardware and how to install it.

The instructions are effective for the above as of January 2015

Document Revision: 4.3

A Quick Start guide

1. Record the information about the unit. (See Section 2.2)
2. Configure each device's Modbus RTU COM setting and Modbus Node-ID for each device connected to the ProtoNode. (See Section 2.2)
3. Set A, B, and S DIP Switch banks on ProtoNode for field protocol baud rate, Node-ID/Device Instance, and proper device configuration. (See Section 2.4)
4. Connect the ProtoNode to the Field protocol port (3 pin Phoenix connector) and the device's RS-485 port to the ProtoNode's RS-485 interface (located on the ProtoNode's 6 pin connector). (See Section 3)
5. Power up the ProtoNode RER and LER. (See Section 3.6)
6. If the Field protocol is BACnet/IP, run the ProtoNode Web GUI to change IP address. See (Section 4)
7. Commission the ProtoNode on the LonWorks Network. This needs to be done by the LonWorks administrator using a LonWorks Commissioning tool. (See Section 5)

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TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

1.1 ProtoNode Gateway

ProtoNode is an external, high performance **Building Automation multi-protocol gateway** that has been preprogrammed for Camus products (hereafter called "device") to various building automation protocols. These protocols include BACnet®[1] MS/TP, BACnet/IP, Metasys®[2] N2 by JCI and LonWorks®[3]. Configurations for the various protocols are stored within the ProtoNode and are selectable via DIP switches for fast and easy installation. It is not necessary to download any configuration files to support the required applications.

1.2 BTL Mark – BACnet Testing Laboratory

The BTL Mark on ProtoNode RER is a symbol that indicates that a product has passed a series of rigorous tests conducted by an independent laboratory which verifies that the product correctly implements the BACnet features claimed in the listing. The mark is a symbol of a high-quality BACnet product. Go to http://www.bacnetinternational.net/btl/ for more information about the BACnet Testing Laboratory.

1.3 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. FieldServer Technologies has more LonMark Certified gateways than any other gateway manufacturer, including the ProtoCessor, ProtoCarrier and ProtoNode for OEM applications and the full featured, configurable gateways.

[1] BACnet is a registered trademark of ASHRAE
[2] Metasys is a registered trademark of Johnson Controls Inc.
[4] LonWorks is a registered trademark of Echelon Corporation

2 BACNET/LONWORKS SETUP FOR PROTOCESSOR PROTONODE RER/LER

2.1 Record Identification Data

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 numbers are as follows:

Model	Part Number
ProtoNode RER	FPC-N34-0565
ProtoNode LER	FPC-N35-0566

Figure 1: ProtoCessor Part Numbers

2.2 Configure Modbus COM Settings on the Device Connected to ProtoNode RER (FPC-N34) and ProtoNode LER (FPC-N35 LonWorks)

2.2.1 Set Modbus COM setting on all of the devices connected to the ProtoNode

- All devices connected to ProtoNode MUST ALL have the same Baud Rate, Data Bits, Stop Bits, and Parity.
- The figure below defines the installed default serial port settings necessary to communicate with the device.

Serial Port Setting	Device
Protocol	Modbus RTU
Baud Rate	38400
Parity	None
Data Bits	8
Stop Bits	1

Figure 2: Modbus RTU COM Settings

2.2.2 Set Modbus RTU Node-ID for each of the devices attached to the ProtoNode

- The first node must start at 1 and go up to 8; if you have a total of 8 devices connected to the ProtoNode.

2.3 Setting the Mac Address, Node_ID, Serial Baud Rate and Selecting the Stored Configurations on the ProtoNode RER (FPC-N34) and ProtoNode LER (FPC-N35 LonWorks)

2.3.1 Setting the MAC Address (DIP Switch A0 – A7) for BACnet MS/TP for ProtoNode RER (FPC-N34 BACnet)

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

- Set DIP switches A0 – A7 to assign MAC Address for BACnet MS/TP for the ProtoNode RER (FPC-N34).
- Please refer to Appendix E.1 for the full range of addresses to set Node-ID/Device Instance.

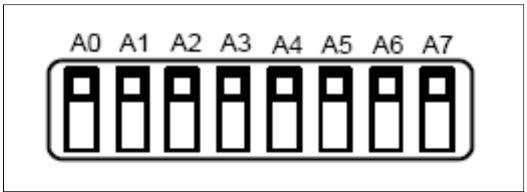


Figure 3: MAC Address DIP Switches

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

2.3.2 Setting the Device Instance (Node-ID) for BACnet MS/TP and BACnet/IP on ProtoNode RER (FPC-N34 BACnet)

- The A Bank of DIP switches are also used to set the BACnet Device Instances.
- The BACnet Device Instance can range from 1 to 4,194,303.
- BACnet/IP/BACnet MS/TP Addressing: The BACnet device instances will be set by taking the Node_Offset (default is 50,000) found in Web Configurator (Section 2.3.2.1) and adding it to the value of the A Bank DIP switches (MAC address). When more than one device is connected to the ProtoNode, the subsequent BACnet Device Instance numbers will be sequential from the first/previous device.

For example:

- Default Node_Offset value = 50,000
- A Bank DIP switch = 11
- Device 1 Instance = 50,011
- Device 2 Instance will then be 50,011(Device Instance 1) **+1** = 50,012
- Device 3 Instance will then be 50,012 (previous Device Instance) **+1** = 50,013
- To change the node_offset see Section 2.3.2.1. The node offset can be changed from 50,000 to 1 to 4,194,302 via the Web Configurator.

2.3.2.1 Set Node_Off to Assign Specific Device Instances for BACnet MS/TP and BACnet/IP

- If the Device Instances need to be set for addresses other than 50,000 to 50,127, change the Node+-Offset (default is 50,000). See Section 4.1 to set the PC's IP address to the same Subnet as the ProtoNode and Section 4.2 to connect to the ProtoNode's Web Configurator which is shown in Figure 4.
- The BACnet Device Instance can range from 1 to 4,194,303.
- BACnet/IP/BACnet MS/TP Addressing: The BACnet device instances will be set by taking the Node_Offset found in Web Configurator (see Figure 4) and adding it to the value of the A Bank DIP

switches. When more than one device is connected to the ProtoNode, the subsequent BACnet device instance numbers will be sequential from the first/previous device.

- Set the PC address to be on the same subnet as the ProtoNode. See section 4.1 on how to change the IP address. (See Figure 4)
- Open the PC browser to default IP address, which will bring you to the FST Web Configurator for the ProtoNode.
- Change the Node-offset to meet the required device instance.

For example:

- Changed Node_Offset value = 1000
- A Bank DIP switch = 11
- Device 1 Instance = 1,011
- Device 2 Instance will then be 1,011(Device Instance 1) +1 = 1,012
- Device 3 Instance will then be 1,012 (previous device instance) +1 = 1,013

NOTE: The A bank dip switch setting + node offset = device instance setting

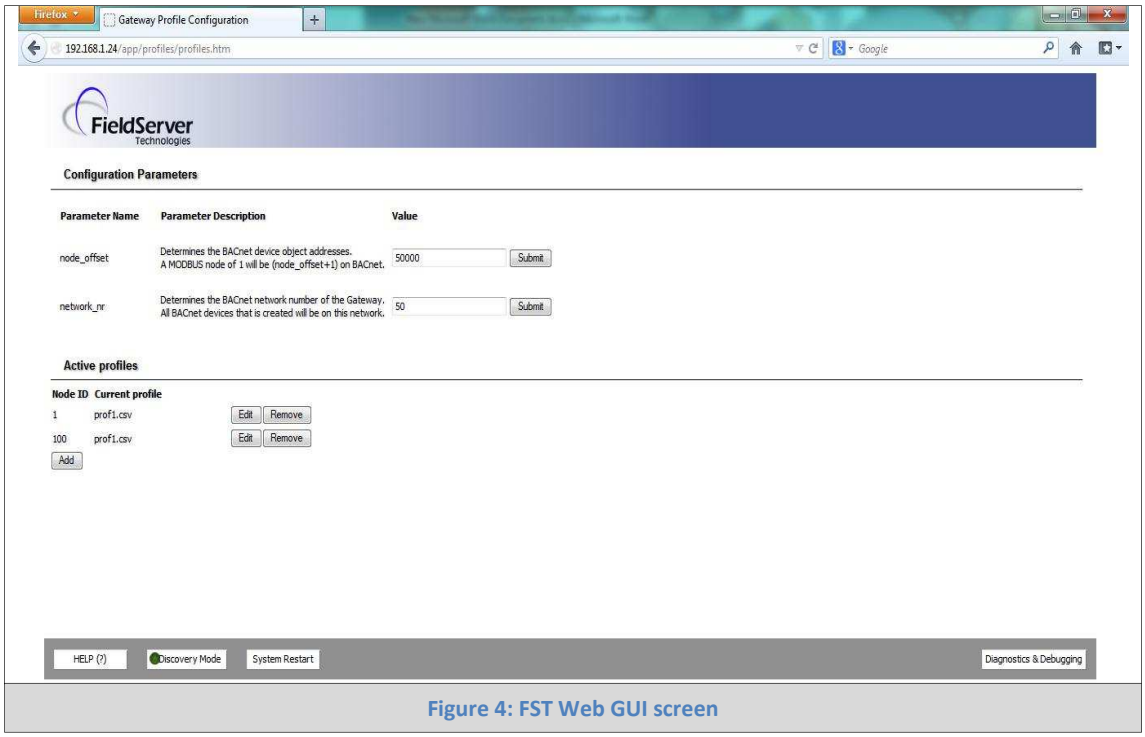


Figure 4: FST Web GUI screen

2.3.3 Setting the Node-ID for Metasys N2 on ProtoNode RER (FPC-N34 Metasys N2)

- Set DIP switches A0 – A7 to assign Node-ID for Metasys N2 for the ProtoNode RER (FPC-N34).
- Metasys N2 Node-ID Addressing: Metasys N2 Node-ID's range from 1-255
- Please refer to Appendix E.1 for the full range of addresses to set Node-ID/Device Instance.

2.3.4 Setting the Serial Baud Rate (DIP Switch B0 – B3) for BACnet MS/TP

- DIP Switches B0 – B3 can be used to set the serial baud rate to match the baud rate provided by the Building Management System for BACnet MS/TP.
- DIP Switches B0 – B3 are disabled on ProtoNode LER (FPC-N35 LonWorks).
- The baud rate on ProtoNode for Metasys N2 is set for 9600. DIP Switches B0 – B3 are disabled for Metasys N2 on ProtoNode RER (FPC-N34).

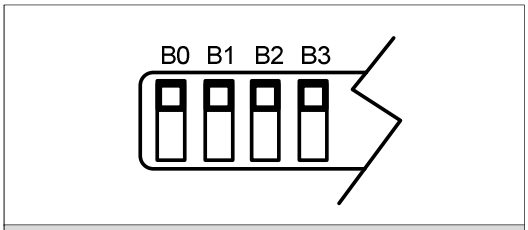


Figure 5: Baud Rate DIP Switches

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

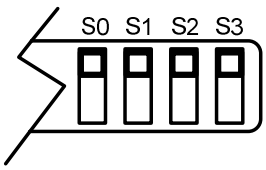
2.3.4.1 Baud Rate DIP Switch Selection

Baud	B0	B1	B2	B3
9600	On	On	On	Off
19200	Off	Off	Off	On
38400	On	On	Off	On
57600	Off	Off	On	On
76800	On	Off	On	On

Figure 6: Baud Rate

2.3.5 Using S0 – S3 bank of DIP Switches to select and load Configuration Files for Devices

- The S bank of DIP switches, S0 - S3 is used to select and load a configuration file from a group of pretested/preloaded configuration files which are stored in the ProtoNode RER FPC-N34 (BACnet MS/TP, BACnet/IP, Metasys N2) and the ProtoNode LER FPC-N35 (LonWorks).



S0 – S3 DIP Switches

S Bank DIP Switch Location

Figure 7: S Bank DIP Switches

2.3.5.1 BACnet MS/TP and BACnet IP DIP Switch Settings

The following chart describes S0 - S3 DIP Switch configuration settings for 1 through 8 device applications to support **BACnet MS/TP and BACnet/IP** on a ProtoNode RER

- To set Sola DIP switch settings, the cover does not need to be removed. The ProtoCessor Small A Bank of DIP switches are all off. This the default position when shipped.

Cover doesn't need to be Removed	ProtoCarrier DIP Switches				ProtoCessor DIP Switches (Remove Cover)							
Profile - FPC-N34-0565	**S0**	**S1**	**S2**	**S3**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
BACnet IP 1 Sola	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 2 Sola	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 3 Sola	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 4 Sola	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 5 Sola	Off	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 6 Sola	On	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 7 Sola	Off	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet IP 8 Sola	On	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 1 Sola	Off	Off	Off	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 2 Sola	On	Off	Off	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 3 Sola	Off	On	Off	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 4 Sola	On	On	Off	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 5 Sola	Off	Off	On	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 6 Sola	On	Off	On	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 7 Sola	Off	On	On	On	Off	Off	Off	Off	Off	Off	Off	Off
BACnet MSTP 8 Sola	On	On	On	On	Off	Off	Off	Off	Off	Off	Off	Off

- To set select these configurations, open the ProtoNode and select the A bank of switches (A1 or A2 or A3) on the small ProtoCessor module that sits on top of the ProtoCarrier (inside the ProtoNode).
- ProtoCessor A1 DIP switch starts on the bottom of the A bank of DIP switches below.
- ProtoCessor A3-A8 DIP switches are disabled.

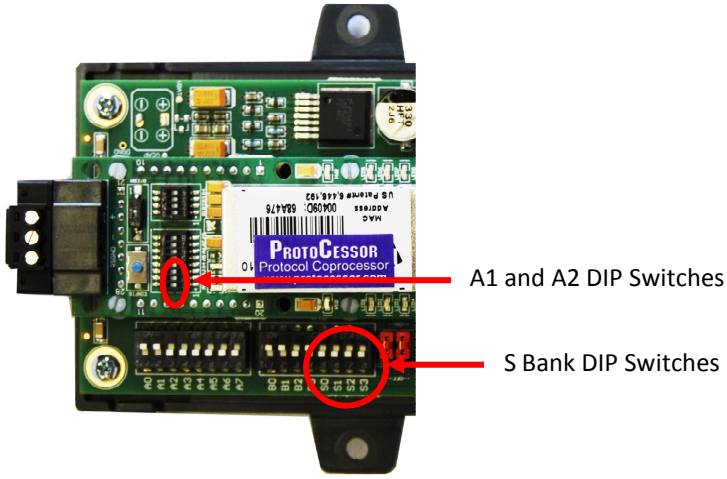


Figure 8: Location for ProtoCessor small A Bank of DIP switches

See Appendix B.1 for the Configuration DIP switch settings for - 1 through 8 Sola to Metasys N2

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

2.3.5.2 LonWorks DIP Switch Settings

The following chart describes the DIP switch settings for the Sola to support **LonWorks**

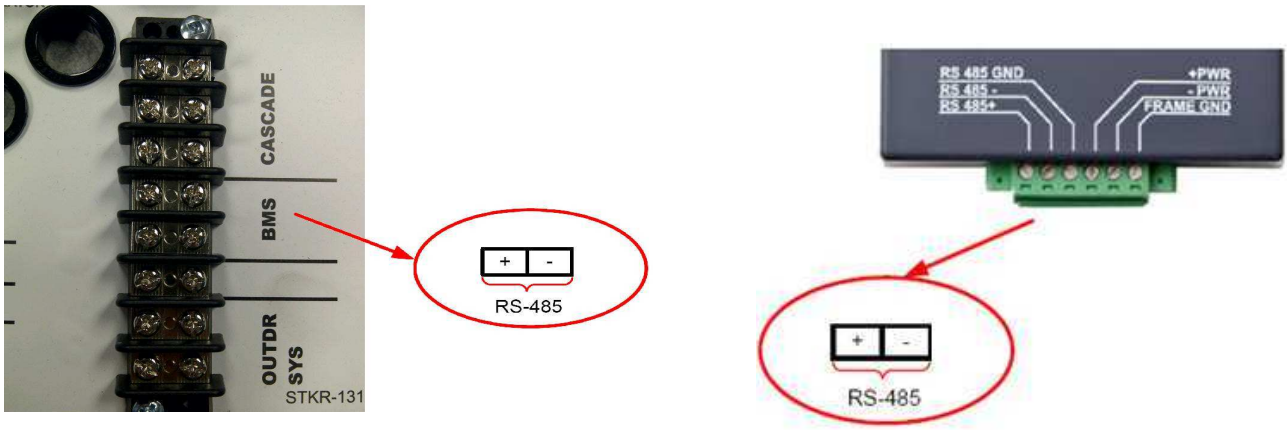
- To set Sola DIP switch settings, the cover does not need to be removed. The ProtoCessor Small A Bank of DIP switches are all off. This the default position when shipped.

Cover doesn't need to be removed	**ProtoCarrier DIP Switches**				**ProtoCessor DIP Switches (Remove Cover)**							
Profile - FPC-N35-0566	**S0**	**S1**	**S2**	**S3**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
Lonworks 1 Sola	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 2 Sola	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 3 Sola	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 4 Sola	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 5 Sola	Off	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 6 Sola	On	Off	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 7 Sola	Off	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off
Lonworks 8 Sola	On	On	On	Off	Off	Off	Off	Off	Off	Off	Off	Off

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

2.3.6 Connection from DynaFlame/DynaForce/Advantus™ to Protonode

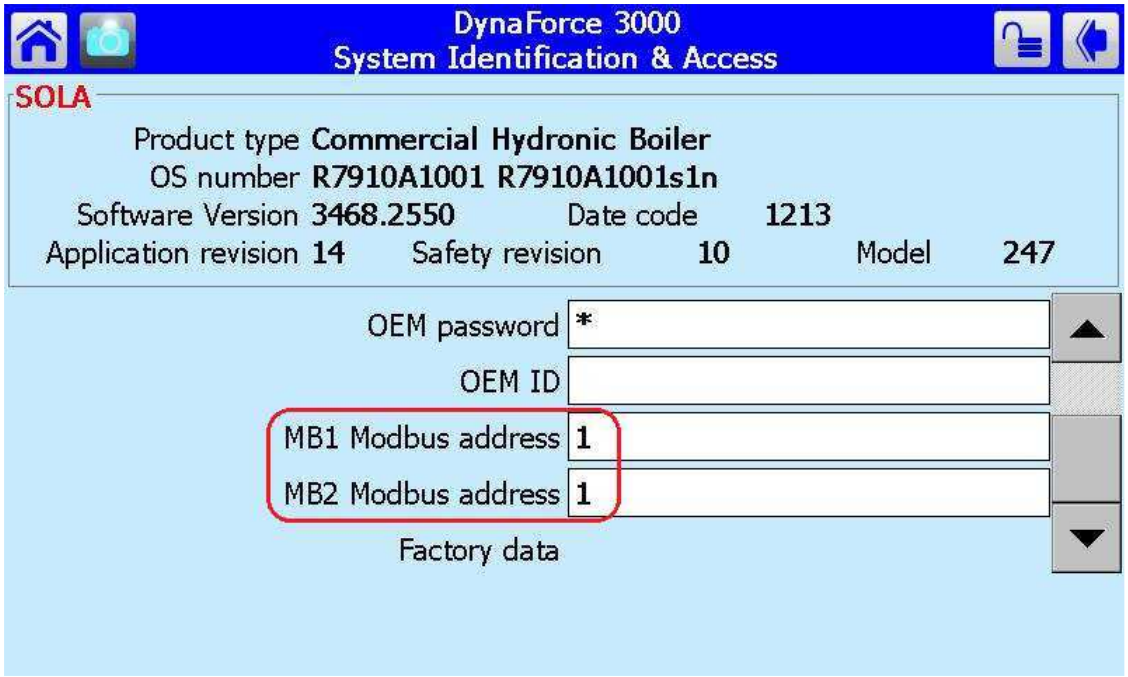
The DynaFlame/DynaForce terminals J3-MB2 (+, -) are connected to the Protonode as shown.



Programming DynaFlame/DynaForce/Advantus™

Configure >  > "sola" (without the quotation marks)

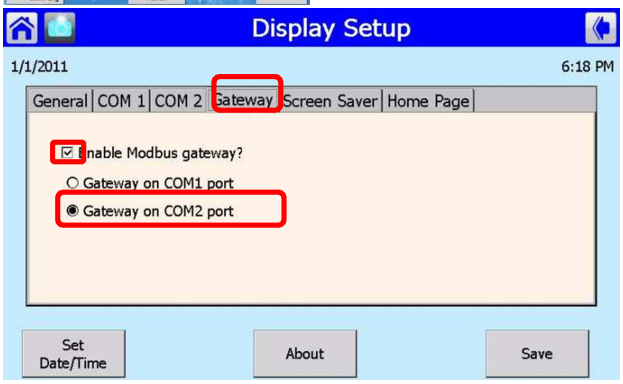
Configure > **System Identification & Access**:



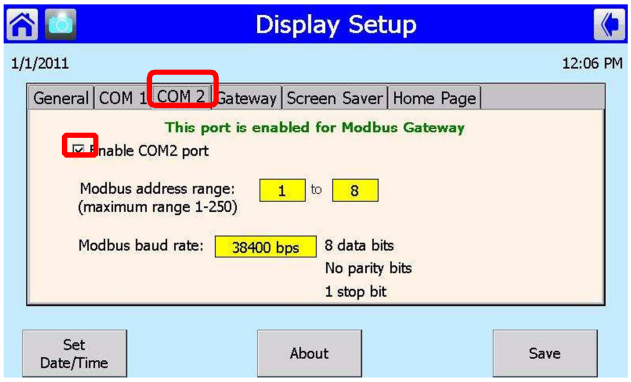
Boiler 1: MB1 Modbus Address = MB2 Modbus Address = 1
Boiler 2: MB2 Modbus Address = MB2 Modbus Address = 2 etc.

Activating Comm. Port 2 on Diana Display

> Setup > Display Setup > Select Gateway tab



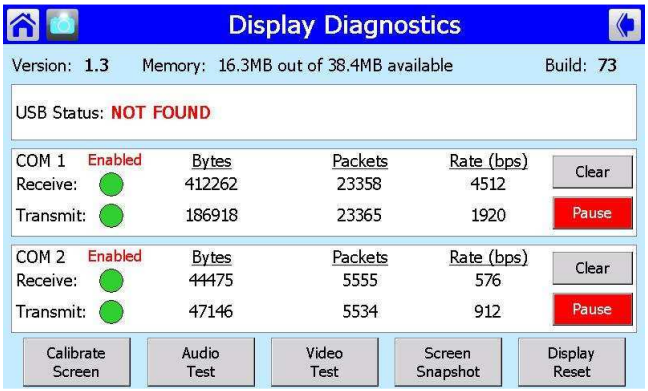
1) Select Gateway tab
2) Check Enable Modbus gateway
3) Select Gateway on COM2 port



1) Select COM2 tab
2) Check Enable COM2 port

Verify activity on COM2 port

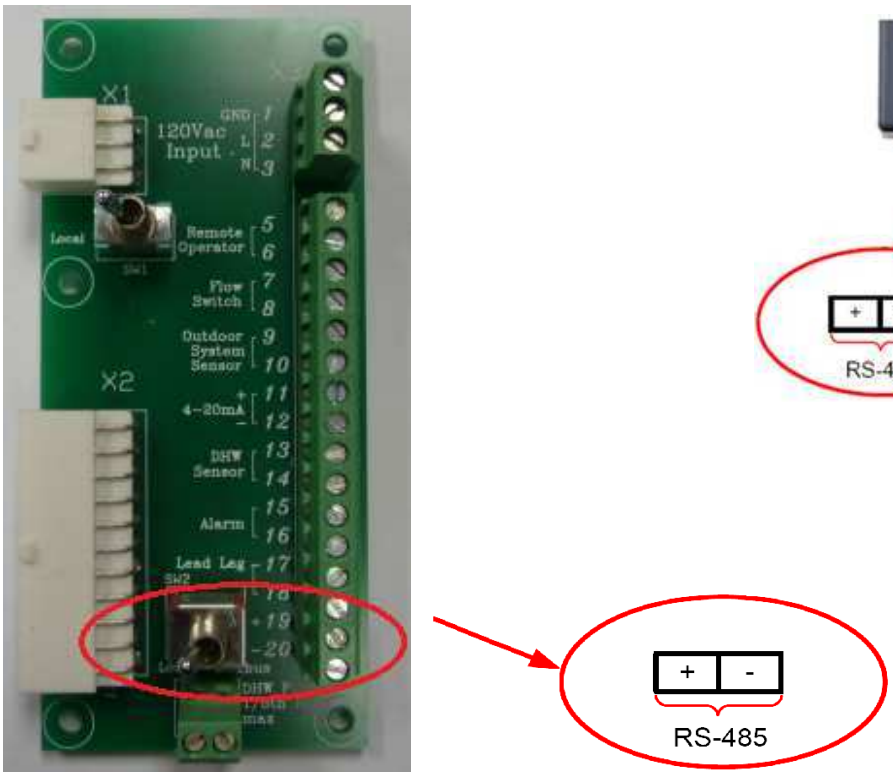
> Setup > Display Diagnostics



COM1: Modbus data between Diana and SOLA

COM2: Modbus data between Diana and front end (Modbus) or Protonode

2.3.7 Connection from DynaMaxHS to Protonode

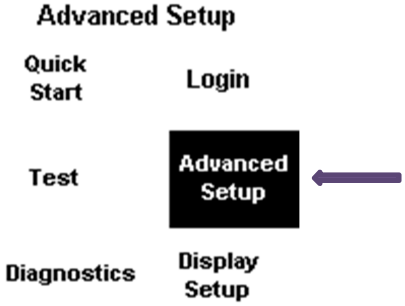


Programming DynaMax[HS]

Place Local/Modbus toggle switch in **LOCAL**

Press ⓘ and select *Login*, enter "sola"

Select *Advanced Setup*



Select *System*

Select *System ID & Access*

Verify *MB1 Modbus address = 1.* To be in sequential order.

Verify *MB2 Modbus address = 1.* To be in sequential order.

Place Local/Modbus toggle switch in **BMS**

3 INTERFACING PROTONODE TO DEVICES

3.1 ProtoNode RER (FPC-N34) and LER (FPC-N35) Showing Connection Ports

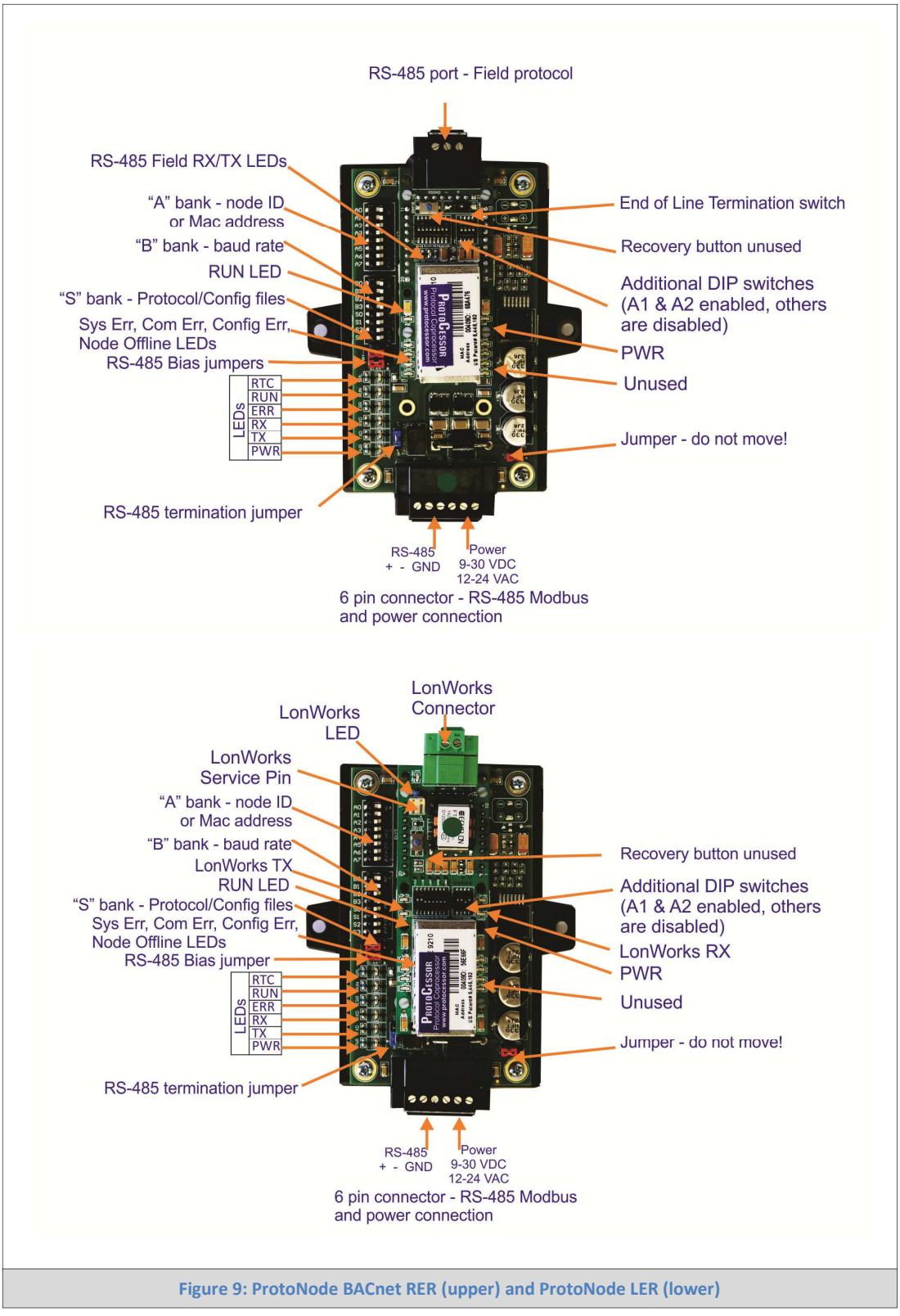


Figure 9: ProtoNode BACnet RER (upper) and ProtoNode LER (lower)

3.2 Wiring Connections to ProtoNode RER (FPC-N34 BACnet) and ProtoNode LER (FPC-N35 LonWorks)

ProtoNode 6 Pin Phoenix connector – Pin outs to Modbus RTU Products

- The 6 pin Phoenix connector is the same for ProtoNode RER (FPC-N34 BACnet) and ProtoNode (FPCN35 LonWorks). Pins 1 through 3 are for Modbus RS-485 to the devices and pins 4 through 6 are for power.

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

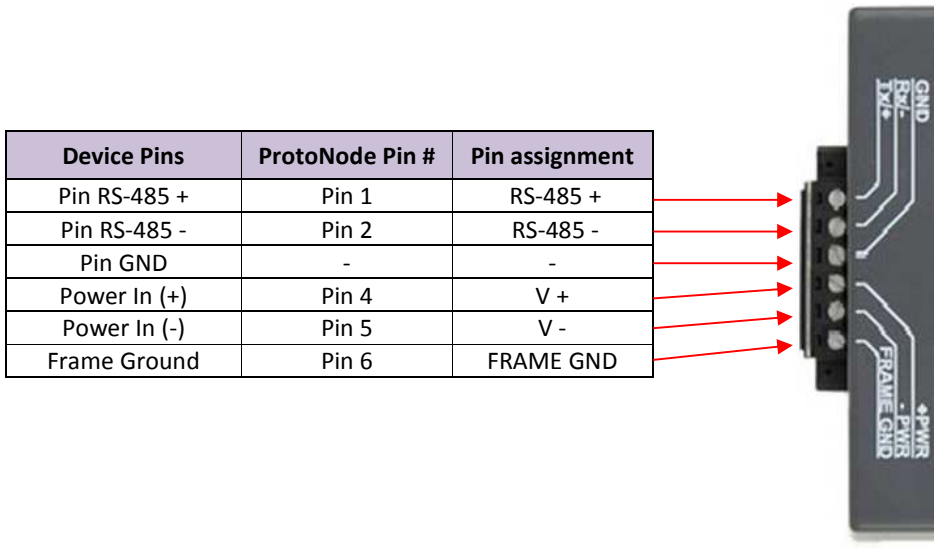


Figure 10: Power and RS-485 Connections

3.2.1 Biasing the Modbus RS-485 Network

- An RS-485 network with more than one device needs to have biasing to ensure proper communication. The biasing needs to be done on one device.
- The ProtoNode has a 510 Ohm resistor switch that is used to set the biasing. The ProtoNode's default position for the Biasing switch is OFF from the factory.
- **Only turn on biasing 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).**
- 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 11.

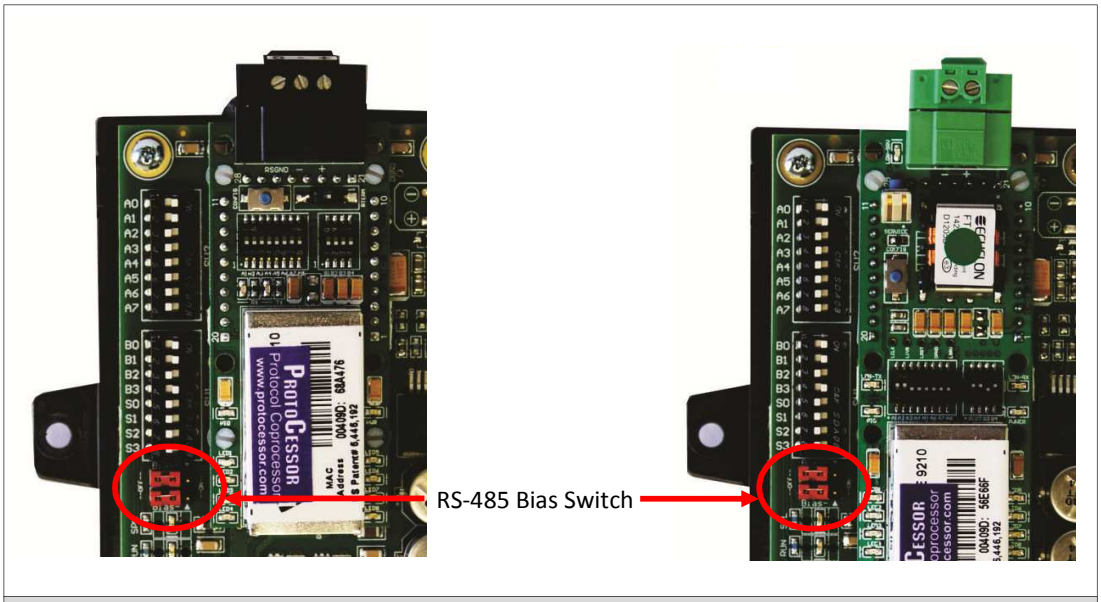


Figure 11: Modbus RS-485 Biasing Switch on the ProtoNode N34 (left) and ProtoNode N35 (right)

3.2.2 End of Line Termination Switch for the Modbus RS-485 port on the ProtoNode

- 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, you turn the Blue RS-485 End-of- Line Terminating switch to ON position.
- On short cabling runs the EOL switch does not to need to be turned ON. The default setting for this Blue EOL switch is OFF.
- **All ways leave the single Red Jumper in the A position. NEVER move the single Red jumper.**

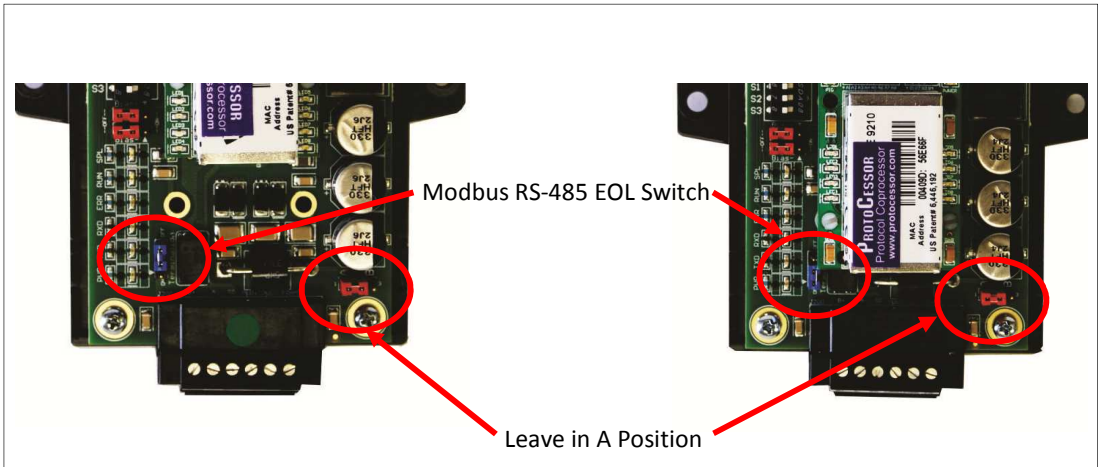
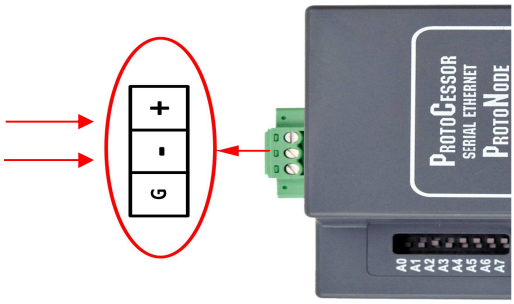


Figure 12: Modbus RS-485 End-Of-Line Termination Switch on the ProtoNode N34 (left) and ProtoNode N35 (right)

3.3 Wiring ProtoNode RER to RS-485 Field Protocol (BACnet MS/TP or Metasys N2)

- Connect BMS BACnet MS/TP or Metasys N2 RS-485 port to the 3-pin RS-485 connector on ProtoNode RER as shown below.

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



- See Section 4.1 for information on connecting ProtoNode RER to BACnet/IP network.
- If the ProtoNode is the last device on the BACnet MS/TP or Metasys N2 trunk, then the End-Of-Line Terminator needs to be enabled (See Figure 14). It is disabled by default.

Figure 13: Connection from ProtoNode to RS-485 Field Protocol – BACnet MS/TP

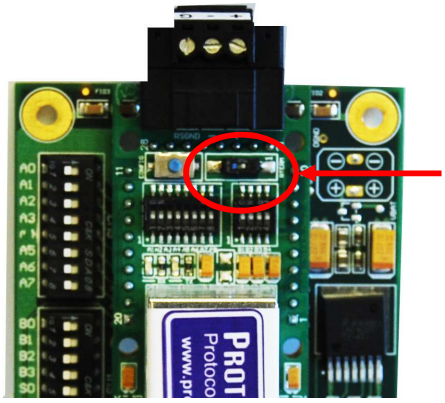


Figure 14: RS-485 EOL Switch

3.4 Wiring ProtoNode LER (FPC-N35) Field Port to a LonWorks Network

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

Figure 15: LonWorks Terminal

3.5 Power-Up ProtoNode RER (FPC-N34 BACnet) or ProtoNode LER (FPC-N35 LonWorks)

Apply power to ProtoNode. Ensure that the power supply used complies with the specifications provided in Appendix F.1. Ensure that the cable is grounded using the "Frame-GND" terminal. ProtoNode accepts either 9-30VDC or 12-24 VAC.

Power Requirement for ProtoNode at 9V through 30 VDC or 12-24 VAC			
	Current Draw Type		
ProtoNode Family	12VDC/VAC	24VDC/VAC	30VDC
FPC – N34 (Typical)	170mA	100mA	80mA
FPC – N34 (Maximum)	240mA	140mA	100mA
FPC – N35 (Typical)	210mA	100mA	90mA
FPC – N35 (Maximum)	250mA	130mA	100mA
Note: These values are 'nominal' and a safety margin should be added to the power supply of the host system. A safety margin of 25% is recommended.			

Figure 16: Required current draw for the ProtoNode

Power to ProtoNode	ProtoNode Pin #	Pin Assignment
Power In (+)	Pin 4	V +
Power In (-)	Pin 5	V -
Frame Ground	Pin 6	FRAME GND

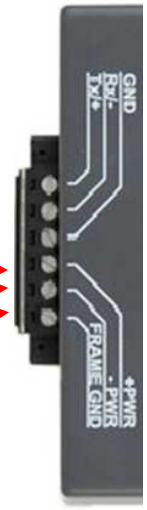


Figure 17: Power Connections

4 CHANGE THE PROTONODE IP ADDRESS USING THE WEB GUI FOR BACNET/IP

4.1 Connect the PC to ProtoNode via the Ethernet Port

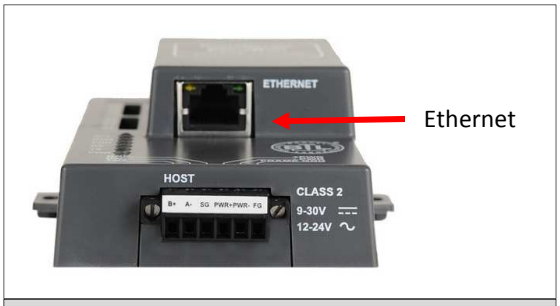
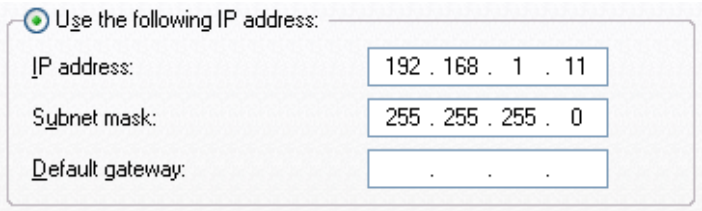


Figure 18: Ethernet Port Location

- Connect a standard CAT5 Ethernet cable (Straight through or Cross-Over) between the PC and ProtoNode
- The Default IP Address of ProtoNode is **192.168.1.24**, Subnet Mask is **255.255.255.0**. If the PC and ProtoNode are on different IP Networks, assign a static IP Address to the PC on the 192.168.1.xxx network
- Go to start > Control Panel > Network Connections
- Right-click on Local Area Connection > Properties
- Highlight Internet Protocol (TCP/IP) > Properties
- Select: Use the following IP address



- Click OK twice

4.2 Use the ProtoNode Web GUI to Connect to the ProtoNode

- Open PC web browser enter the default IP address of the ProtoNode 192.168.1.24 determine if the ProtoNode is up and communicating. Figure 19 is the main landing page for the ProtoNode.

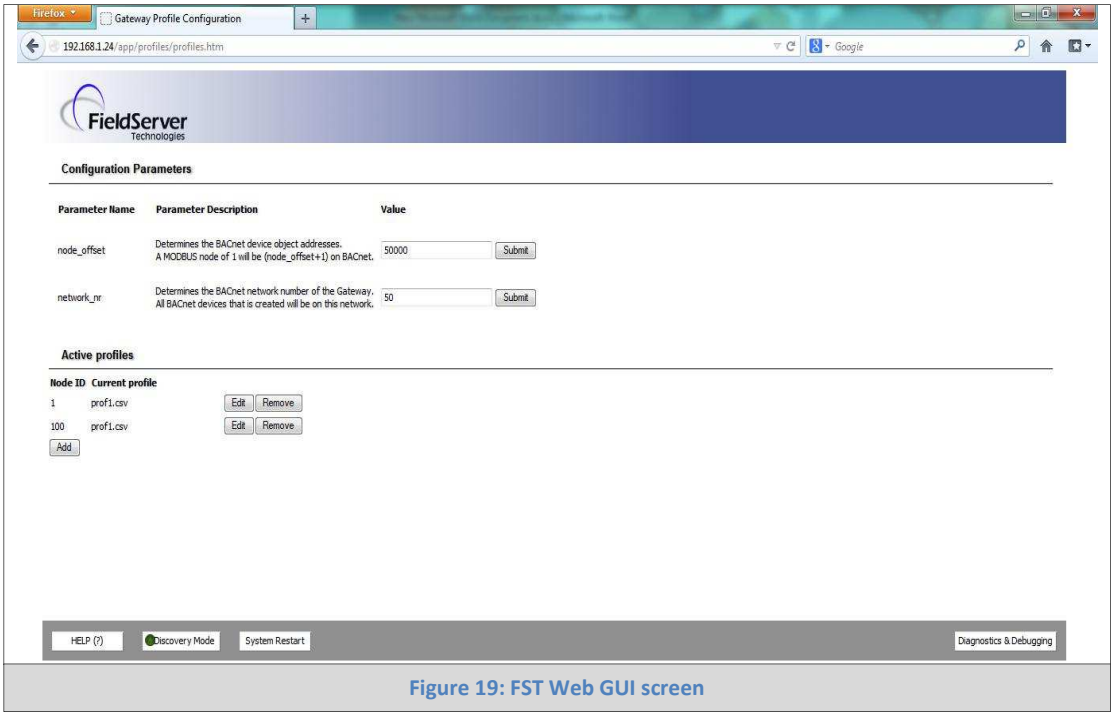


Figure 19: FST Web GUI screen

4.3 Set IP Address for BACnet/IP

- Open a PC web browser, enter the default IP address of the ProtoNode 192.168.1.24 and connect to the ProtoNode.
- From the GUI main landing, click on Diagnostics and Debugging to get to the Utilities section of the GUI (to change IP Address and other capabilities). (See Figure 21)

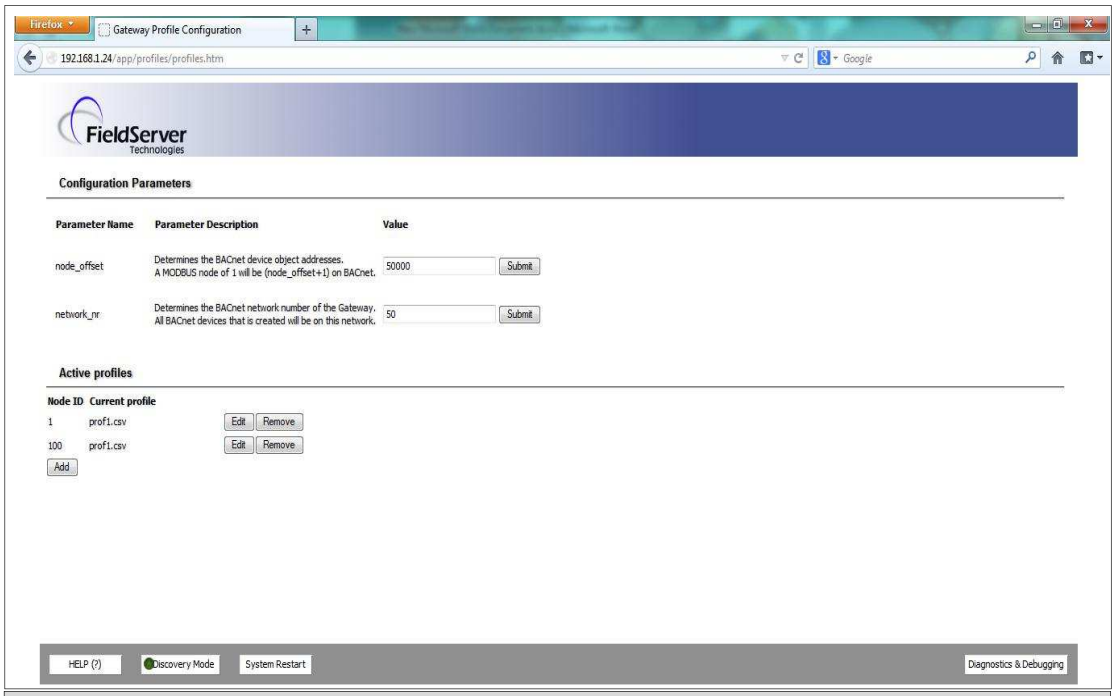


Figure 20: FST Web GUI Utilities page

- From the GUI's Utility page, click on setup and then Network Settings to enter the Edit IP Address Settings menu.
- Modify the IP address (N1 IP address field) of the ProtoNode Ethernet port.
- If necessary, change the Netmask (N1 Netmask field).
- Type in a new Subnet Mask
- If necessary, change the IP Gateway (Default Gateway field)
- Type in a new IP Gateway
- Note: If the ProtoNode is connected to a router, the IP Gateway of the ProtoNode should be set to the IP address of the router that it is connected to
- Reset ProtoNode
- Unplug Ethernet cable from PC and connect it to the network hub or router

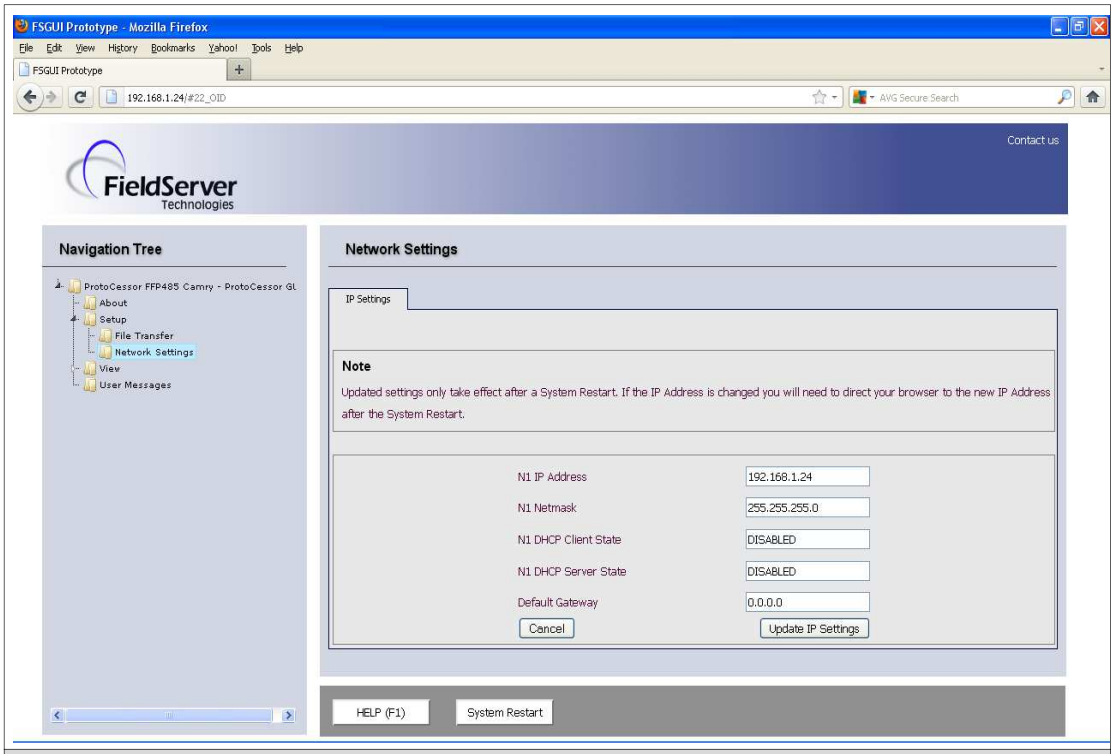


Figure 21: Changing IP Address via FST Web GUI

5 COMMISSIONING PROTONODE LER ON A LONWORKS NETWORK

Commissioning may only be performed by the LonWorks administrator.

5.1 Commissioning ProtoNode LER on a LonWorks Network

The User will be prompted by the LonWorks Administrator to hit the Service Pin on the ProtoNode LER at the correct step of the Commissioning process which is different for each LonWorks Network Management Tool.

- If an XIF file is required, see steps in Section 5.1.1 to generate XIF

Figure 22: LonWorks Service Pin Location

5.1.1 Instructions to Upload XIF File from ProtoNode LER Using FS GUI Web Server

- Connect a standard cat5 Ethernet cable between the PC and ProtoNode
- The Default IP Address of ProtoNode is **192.168.1.24**, Subnet Mask is **255.255.255.0**. If the PC and ProtoNode are on different IP Networks, assign a static IP Address to the PC on the 192.168.1.xxx network
- For Windows XP:

  Go to start > Control Panel > Network Connections

  Right-click on Local Area Connection > Properties

  Highlight Internet Protocol (TCP/IP) > Properties

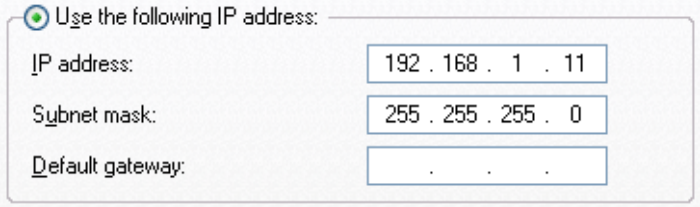
- For Windows 7:

  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) > Properties

- For Windows XP and Windows 7, 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
- If the web browser prompts you to save file, save the file onto the PC. If the web browser displays the xif file as a web page, save the file on your PC as fserver.xif

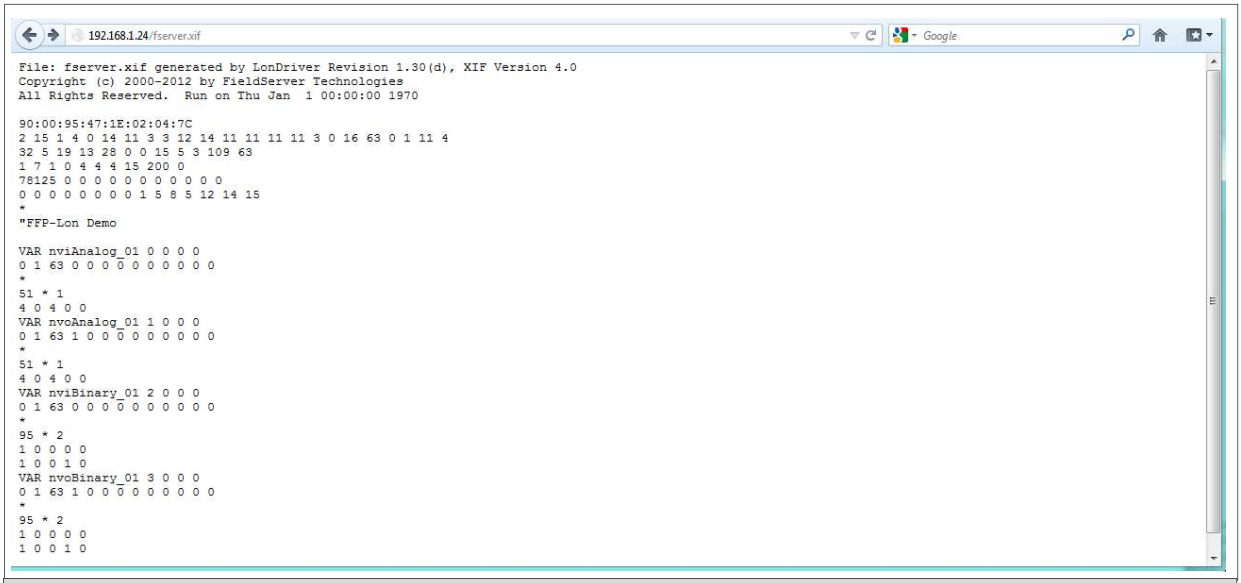


Figure 23: Sample of Fserver.XIF File Being Generated

6 CAS BACNET EXPLORER FOR VALIDATING PROTONODE IN THE FIELD

ProtoCessor has arranged a complementary 2 week fully functional copy of CAS BACnet Explorer (through Chipkin Automation) that can be used to validate BACnet MS/TP and/or BACnet/IP communications of ProtoNode in the field without having to have the BMS Integrator on site. A Serial or USB to RS-485 converter is needed to test BACnet MS/TP.

6.1 Downloading the CAS Explorer and Requesting an Activation Key

- To request the complementary BACnet CAS key, go to http://app.chipkin.com/activation/twoweek/ and fill in all the information. **Enter Vendor Code "camus2013".** Once completed, the key will be sent to the email address that was submitted. From this email, the long key will need to be copied and pasted into the CAS key activation page.

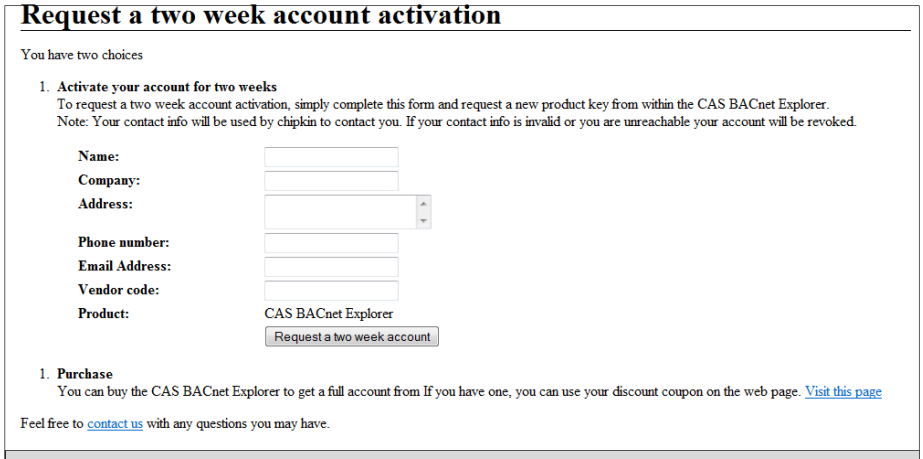


Figure 24: Downloading the CAS Explorer

- Go to the following web site, download and install the CAS BACnet Explorer to your PC: http://www.chipkin.com/technical-resources/cas-bacnet-explorer/
- In the CAS Activation form, enter the email address and paste the CAS key that was sent. Once completed, select Activation.

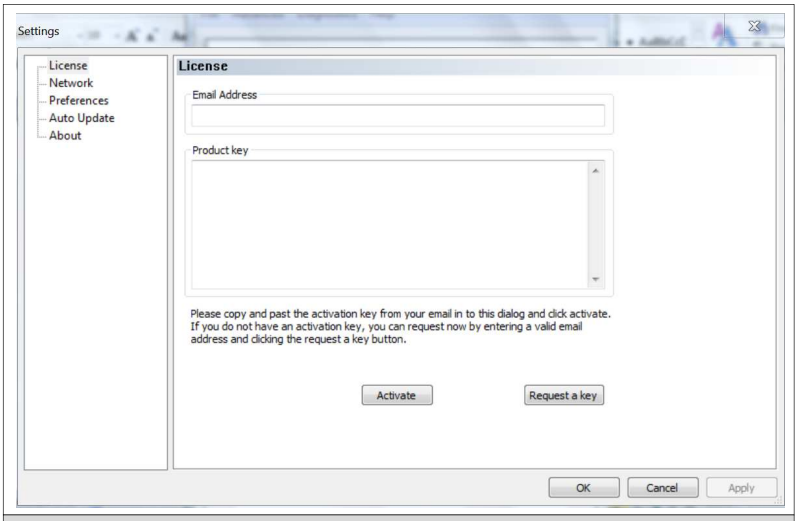


Figure 25: Requesting CAS Activation Key

6.2 CAS BACnet Setup

These are the instructions to set CAS Explorer up for the first time on BACnet MS/ST and BACnet/IP.

6.2.1 CAS BACnet MS/TP Setup

- Using the Serial or USB to RS-485 converter, connect it to your PC and the 3 Pin BACnet MS/TP connector on ProtoNode RER.
- In CAS Explorer, do the following:
    - Click on settings
    - Check the BACnet MSTP box and uncheck the BACnet/IP and BACnet Ethernet boxes
    - Set the BACnet MSTP MAC address to 0
    - Set the BACnet MSTP Baud Rate to 38400
    - Click Ok
    - On the bottom right-hand corner, make sure that the BACnet MSTP box is green
    - Click on discover
    - Check all 4 boxes
    - Click Send

6.2.2 CAS BACnet BACnet/IP Setup

- See Section 5.1 to set the IP address and subnet of the PC that will be running the CAS Explorer.
- Connect a straight through or cross Ethernet cable from the PC to ProtoNode.
- In CAS Explorer, do the following:
    - Click on settings
    - Check the BACnet/IP box and uncheck the BACnet MSTP and BACnet Ethernet boxes
    - In the “Select a Network Device” box, select the network card of the PC by clicking on it
    - Click Ok
    - On the bottom right-hand corner, make sure that the BACnet/IP box is green
    - Click on discover
    - Check all 4 boxes
    - Click Send

Appendix A. Troubleshooting

Appendix A.1. Check Wiring and Settings

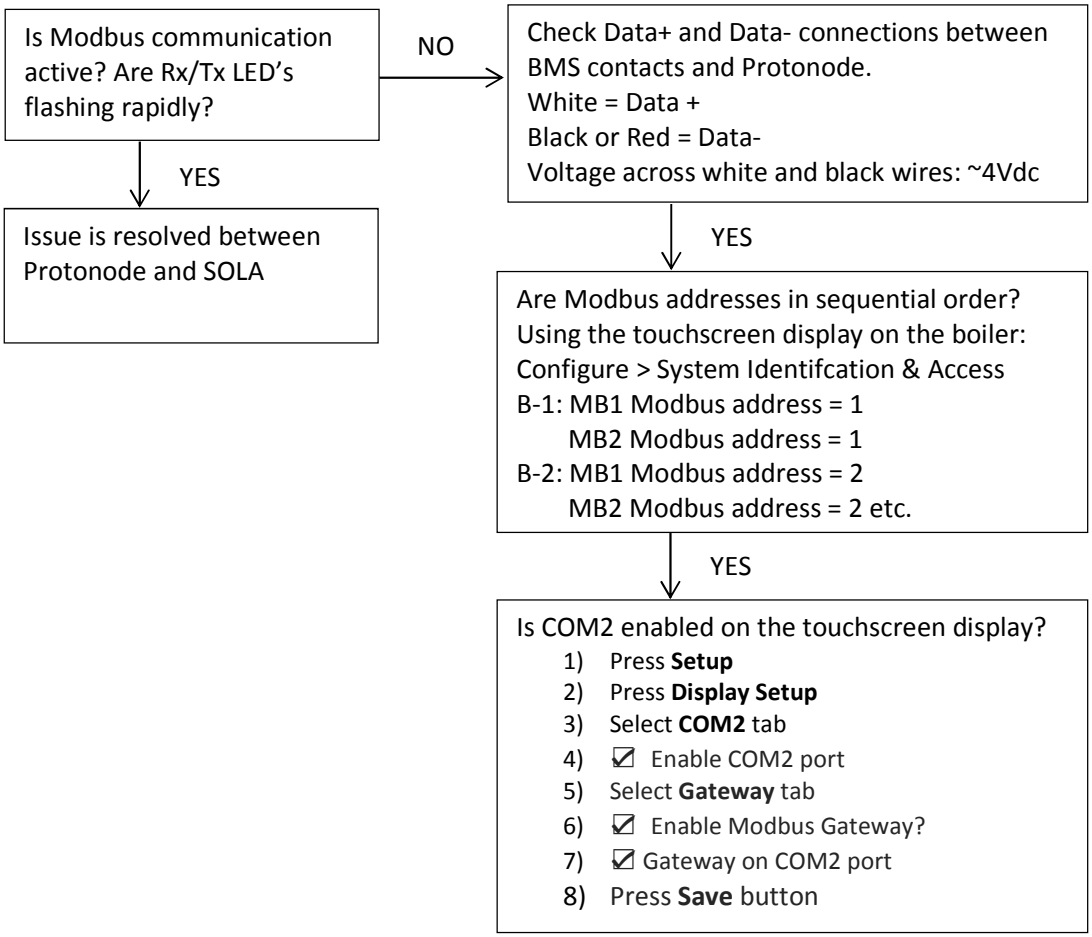
- No COMS on Modbus RTU side. If Tx/Rx are not flashing rapidly then there is a COM issue on the Modbus side and you need to check the following things:
  - Visual observations of LEDs on ProtoNode. (Appendix A.3)
  - Check baud rate, parity, data bits, stop bits
  - Check Modbus device address
  - Verify wiring

Connection to the Protonode

- If Using Windows XP, ensure that the firewall is disabled
- Ensure that all other Ethernet cards active on the PC, especially wireless adapters are disabled

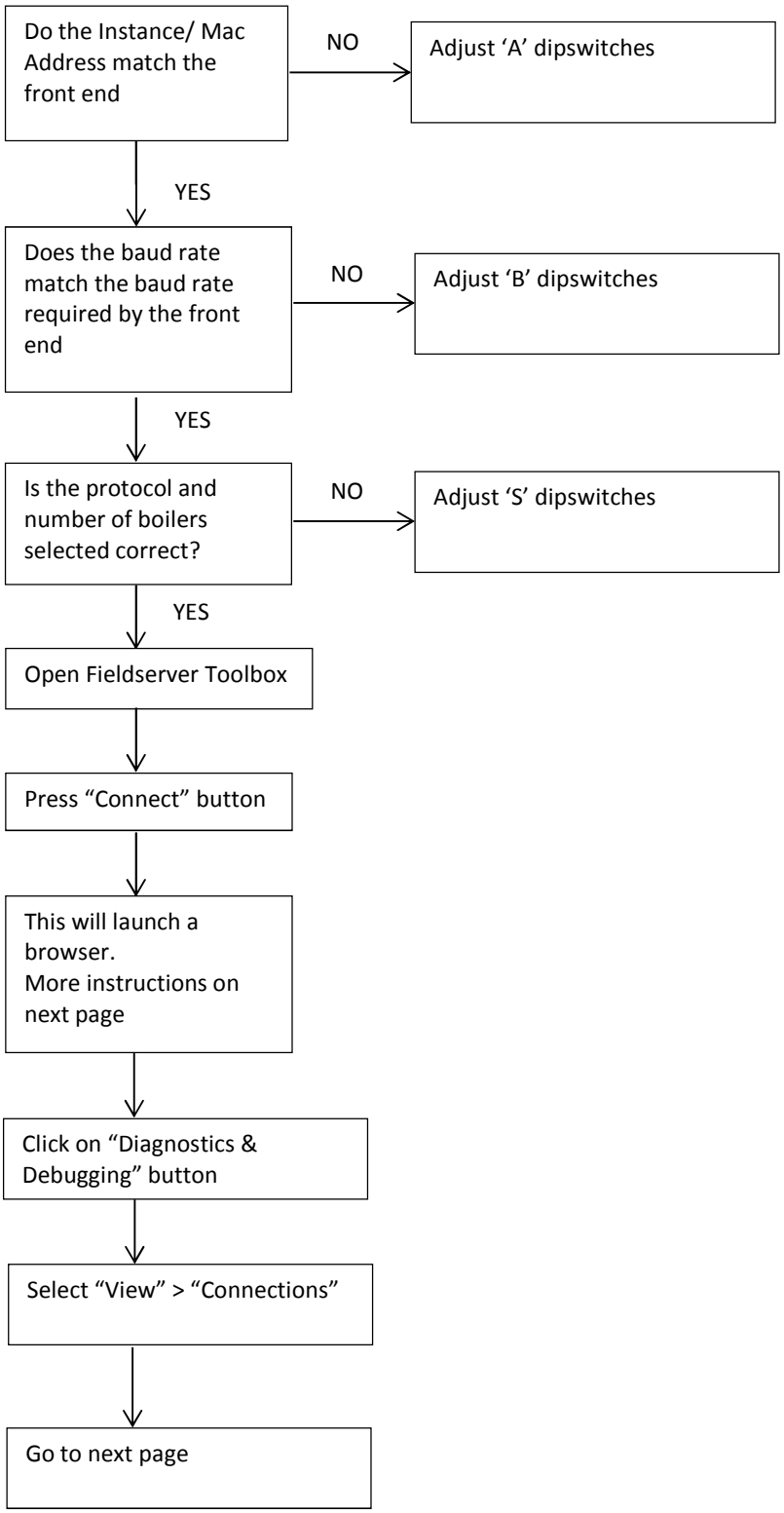
Protonode Troubleshooting Flow Chart

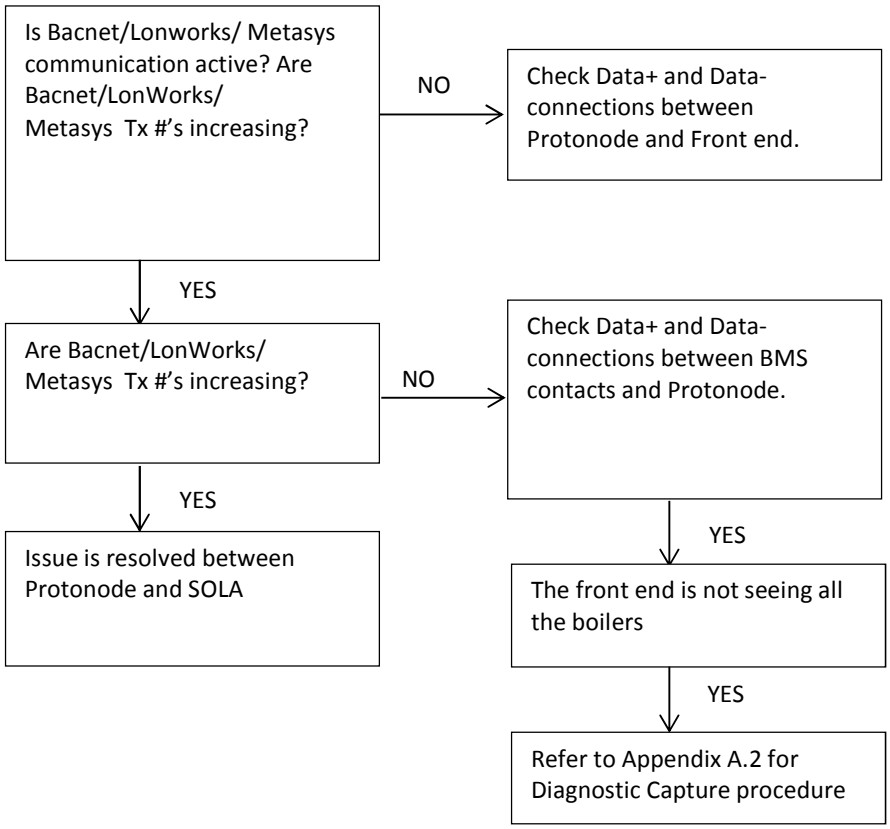
1) Is there communication between the SOLA and Protonode?



No communication on Protonode

2) Is there communication between the Protonode and front end?



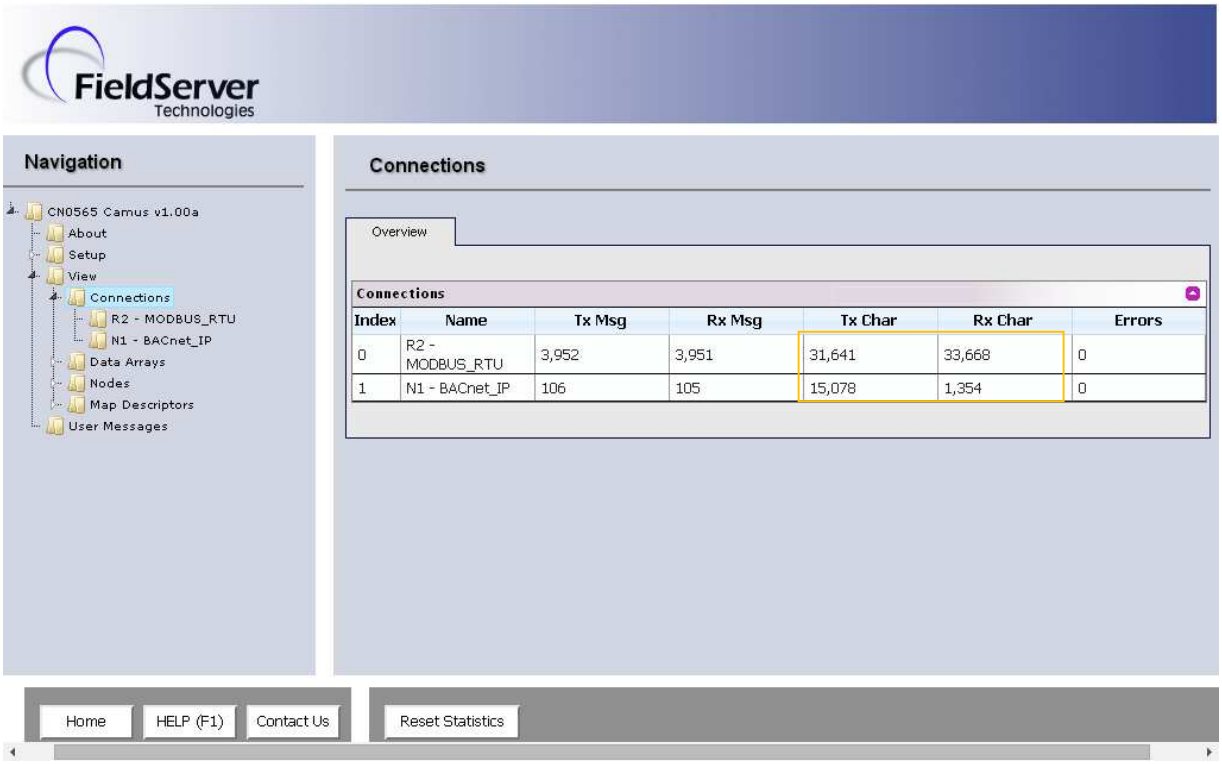

Is Bacnet/Lonworks/ Metasys communication active? Are Bacnet/LonWorks/ Metasys Tx #'s increasing?
NO
Check Data+ and Data- connections between Protonode and Front end.
YES
Are Bacnet/LonWorks/ Metasys Tx #'s increasing?
NO
Check Data+ and Data- connections between BMS contacts and Protonode.
YES
Issue is resolved between Protonode and SOLA
YES
The front end is not seeing all the boilers
YES
Refer to Appendix A.2 for Diagnostic Capture procedure

To verify communication using web browser interface

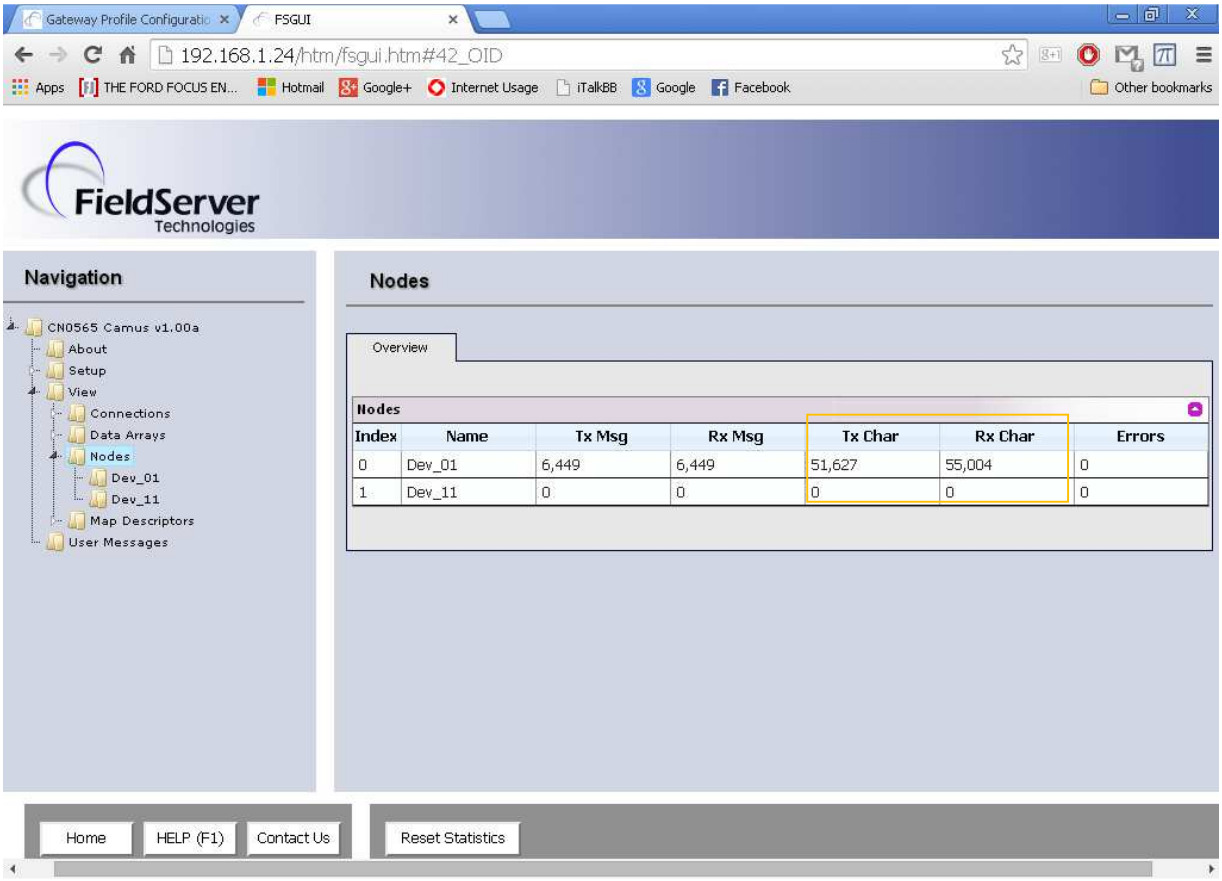
From the Main Menu of click on “Diagnostics & Debugging” button
Select “View” > “Connections”

Modbus RTU	Rx Char	Data from boiler to Protonode
	Tx Char	Data from Protonode to boiler
BacnetIP, BacnetMSTP, LonWorks, MetasysN2	Rx Char	Data from BMS to Protonode
	Tx Char	Data from Protonode to BMS

Successful communication results in all four of the below cells increasing at a rapid pace, this indicates there is communication. In the below example we see that there are no errors which is a sign that data is being passed back and forth from the boilers to the BMS. If any on the cells are not increasing this indicates an issue has occurred and will need to be resolved.



In instances, where there is more than one boiler all connected to a single Protonode it is difficult to decipher which boiler is communicating with the front end and vice versa. The web browser provides a Node Overview feature that identifies the communication that is occurring to/from each boiler.



		Data from
Dev_01	Rx Char	Boiler 1 to Protonode
	Tx Char	Protonode to Boiler 1
Dev_11	Rx Char	BMS to Protonode
	Tx Char	Protonode to BMS

Successful communication results in all both cells increasing at a rapid pace, this indicates there is communication.

- Field COM problems:
  - Visual observations of LEDs on ProtoNode. (Appendix A.3)
  - Visual dipswitch settings (using correct baud rate and device instance)
  - Verify IP address setting
  - Verify wiring

If the problem still exists, a Diagnostic Capture needs to be taken and sent to FieldServer. (Appendix A.2)

Appendix A.2. Take Diagnostic Capture With the FieldServer Utilities

- **Once the log is Diagnostic Capture is complete, email it to support@protocessor.com. The Diagnostic Capture will allow Fieldserver to rapidly diagnose the problem.**
- Make sure the FieldServer Toobox is loaded on the PC
- http://www.sierramonitor.com/assets/blt4587f2670dffcdcc/FieldServer%20ToolBox%20Setup%20for%20all%20FieldServers.zip

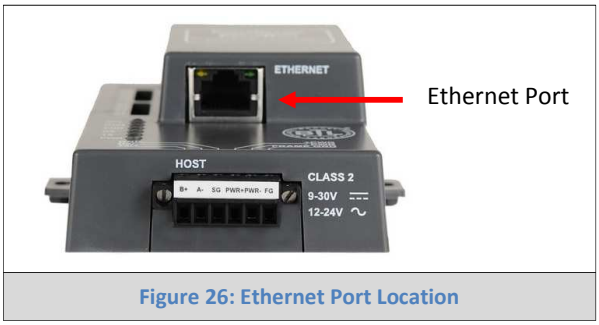


Figure 26: Ethernet Port Location

- Disable any wireless Ethernet adapters on the PC/Laptop
- Disable firewall and virus protection software if possible
- Connect a standard cat5 Ethernet cable between the PC and ProtoNode
- The Default IP Address of ProtoNode is **192.168.1.24**, Subnet Mask is **255.255.255.0**. If the PC and ProtoNode are on different IP Networks, assign a static IP Address to the PC on the 192.168.1.xxx network
- For Windows XP:

Go to start > Control Panel > Network Connections

Right-click on Local Area Connection > Properties

Highlight Internet Protocol (TCP/IP) > Properties

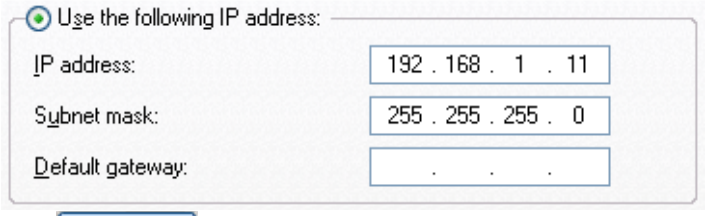
- For Windows 7:

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

Right-click on Local Area Connection > Properties

Highlight  > 

- For Windows XP and Windows 7, select: Use the following IP address



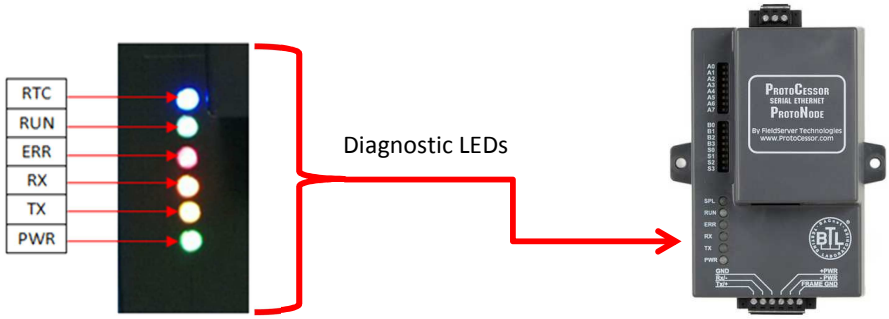
- Click  twice

- Open FieldServer Toolbox from the Desktop.

- Click on the Diagnose  button for the Fieldserver that you want to take a capture of.
- Select Full Diagnostic.
- Set the capture period for 5 minutes.
- Click on the Start Diagnostic button.
- When the capture is complete, click on the Open Containing Folder button.
- Please send the zip file to **support@protocessor.com**. This file will give Fieldserver the information required to evaluate the problem.
- If further assistance is required when performing the Diagnostic Capture please contact Fieldserver at 408-262-2299.

Appendix A.3. LED Diagnostics for Modbus RTU Communications Between ProtoNode and Devices

Please see the diagram below for ProtoNode RER and LER LED Locations.



Tag	Description
RTC	Unused
RUN	The RUN LED will start flashing 20 seconds after power indicating normal operation.
ERR	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 show steady green at all times when ProtoNode is powered.

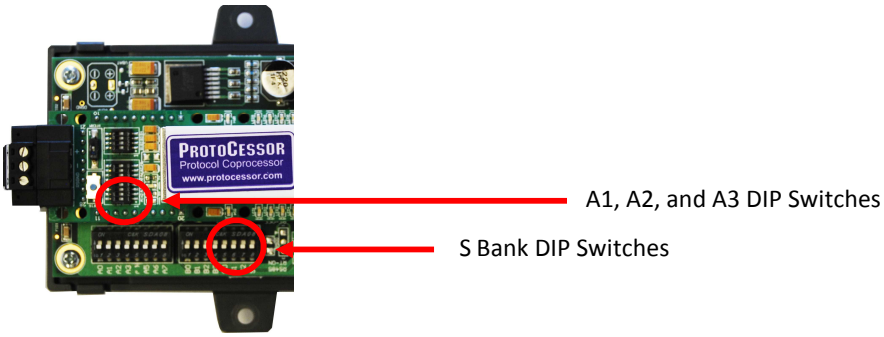
Figure 27: Diagnostic LEDs

Appendix B. Additional Features

Appendix B.1. DIP switch settings to support 1 through 8 Sola to Metasys N2

Note: The lid on top of the ProtoNode has to be removed in order to select the A Bank of DIP switches. Pull on the lid while holding the on to the 6 pin Phoenix connector. Please do not hold the wall mount tabs as these are designed to break off if not required!

- To set select these configurations, open the ProtoNode and select the A bank of switches (A1 or A2 or A3) on the small ProtoCessor module that sits on top of the ProtoCarrier (inside the ProtoNode).
- ProtoCessor A1 DIP switch starts on the bottom of the A bank of DIP switches below.
- ProtoCessor A3-A8 DIP switches are disabled.



Falcon N2	ProtoCarrier DIP Switches				ProtoCessor DIP Switches (Remove Cover)							
Profile - FPC-N34-0565	**S0**	**S1**	**S2**	**S3**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**
Metasys N2 1 Sola	Off	Off	Off	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 2 Sola	On	Off	Off	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 3 Sola	Off	On	Off	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 4 Sola	On	On	Off	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 5 Sola	Off	Off	On	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 6 Sola	On	Off	On	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 7 Sola	Off	On	On	Off	On	Off	Off	Off	Off	Off	Off	Off
Metasys N2 8 Sola	On	On	On	Off	On	Off	Off	Off	Off	Off	Off	Off

Appendix C. Vendor Information - Camus

Appendix C.1. Sola Modbus RTU Mappings to BACnet MS/TP, BACnet/IP, Metasys N2 and LonWorks

Point Name	R/W	Modbus Address (hex)	Modbus Register (dec)	BACnet Object Type	BACnet Object ID / N2 Point Address	N2 Data Type	Lon Name	Lon SNVT	Note
Limits	R	0004	0004	AI	1	AI	nvoXLimits	SNVT_count_f	15-12 Reserved (always 0) 11 = Heat exchanger high limit 10 = Exchanger T-rise limit 9 = Outlet T-rise limit 8 = Inversion inlet/exchanger limit 7 = Inversion exchanger/outlet limit 6 = Inversion inlet/outlet limit 5 = Delta T inlet/exchanger limit 4 = Delta T exchanger/outlet limit 3 = Delta T inlet/outlet limit 2 = Stack limit 1 = DHW high limit 0 = Outlet high limit
Demand source	R	0006	0006	AI	2	AI	nvoXDemandSource	SNVT_count_f	0 = Unknown 1 = No source demand 2 = CH 3 = DHW 4 = Lead Lag slave 5 = Lead lag master 6 = CH frost protection 7 = DHW frost protection 8 = No demand due to burner switch turned off 9 = DHW storage 10 = Reserved 11 = Warm weather shutdown
Outlet sensor	R	0007	0007	AI	3	AI	nvoXOutletSensor	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Firing rate	R	0008	0008	AI	4	AI	nvoXFiringRate	SNVT_count_f	Actual Fire Rate (%[2] or RPM[3])
Fan speed	R	0009	0009	AI	5	AI	nvoXFanSpeed	SNVT_count_f	RPM
Flame signal	R	0010	0010	AI	6	AI	nvoXFlameSignal	SNVT_count_f	0.01V (0.00 – 50.00V)
Inlet sensor	R	000B	0011	AI	7	AI	nvoXInletSensor	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
DHW sensor	R	000C	0012	AI	8	AI	nvoXDHWSensor	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
S5 sensor	R	000D	0013	AI	9	AI	nvoXS5Sensor	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]

Stack sensor	R	000E	0014	AI	10	AI	nvoXStackSensor	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
4 - 20 mA remote ctl input	R	000F	0015	AI	11	AI	nvoX420mARmCtlIn	SNVT_count_f	4-20mA (0.1mA precision)
Active CH setpoint	R	0010	0016	AI	12	AI	nvoXActiveCHSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)
Active DHW setpoint	R	0011	0017	AI	13	AI	nvoXActiveDHWSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)
Active LL setpoint	R	0012	0018	AI	14	AI	nvoXActiveLLSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)
Analog modulation input	R	0015	0021	AI	15	AI	nvoXAnaModInput	SNVT_count_f	0 = No signal, otherwise 4-20mA (0.1mA precision). Duplicate of register (hex) 0015.
Burner control status	R	0020	0032	AI	16	AI	nvoXBrnCtrlStatus	SNVT_count_f	0 = Disabled 1 = Locked Out 2-3 = Reserved 4 = Anti-short cycle 5 = Unconfigured safety data 6-33 = Reserved 34 = Standby hold 35 = Standby delay 36-47 = Reserved 48 = Normal standby 49 = Preparing 50 = Ignition 51 = Firing 52 = Postpurge 53-65535 = Reserved
Lockout code	R	0022	0034	AI	17	AI	nvoXLockoutCode	SNVT_count_f	0 = No lockout 1 – 4096. Refer to Appendix D.1
Alarm reason	R	0023	0035	AI	18	AI	nvoXAlarmReason	SNVT_count_f	0 = None 1 = Lockout, see register (hex) 0015 for lockout code 2 = Alert. Refer to Appendix D.2
Annunciator first out	R	0024	0036	AI	19	AI	nvoXAnnunFirstOut	SNVT_count_f	0 = None 1 = ILK 12 = Flow Switch 13 = High Limit 14 = Gas Pressure Switch 15 = Air Switch
Annuciator Hold	R	0025	0037	AI	20	AI	nvoXAnnunHold	SNVT_count_f	0 = None 1 = ILK 3 = LCI 12 = Flow Switch 13 = High Limit 14 = Gas Pressure Switch
Hold code	R	0028	0040	AI	21	AI	nvoXHoldCode	SNVT_count_f	Reason for burner hold

Remote stat	R/W	002A	0042	AV	22	AO	nvi/nvoXRemoteStat	SNVT_count_f	Reserved for future use
CH status	R	0040	0064	AI	23	AI	nvoXCHStatus	SNVT_count_f	0 = Unknown 1 = Disabled 2 = Normal 3 = Suspended
CH setpoint source	R	0041	0065	AI	24	AI	nvoXCHSPSource	SNVT_count_f	0 = Unknown 1 = Normal Setpoint 2 = Time of Day Setpoint 3 = Outdoor reset 4 = Remote control 7 = Outdoor reset time of day
CH heat demand	R	0042	0066	AI	25	AI	nvoXCHHeatDemand	SNVT_count_f	0 = Off 1 = On
CH burner demand	R	0043	0067	AI	26	AI	nvoXCHBrnDemand	SNVT_count_f	0 =Off 1 = On
CH requested rate	R	0044	0068	AI	27	AI	nvoXCHReqRate	SNVT_count_f	RPM or %[3]
DHW status	R	0050	0080	AI	28	AI	nvoXDHWStatus	SNVT_count_f	0 = Unknown 1 = Disabled 2 = Normal 3 = Suspended
DHW heat demand	R	0053	0083	AI	29	AI	nvoXDHWHeatDemand	SNVT_count_f	0 = Off 1 = On
DHW burner demand	R	0054	0084	AI	30	AI	nvoXDHWBrnDemand	SNVT_count_f	0 = Off 1 = On
DHW requested rate	R	0055	0085	AI	31	AI	nvoXDHWReqRate	SNVT_count_f	RPM or %[3]
Pump A status	R	005D	0093	AI/AI	32	AI	nvoXPmpAStatus	SNVT_count_f	**Bitmap** 15 – 14 = Reserved 13 = Auxiliary 2 pump demand 12 = Auxiliary 1 pump demand 11 = System pump demand 10 = Boiler pump demand 9 = DHW pump demand 8 = CH pump demand **Reason** 7 = Reserved 6 = Pump assigned to logical pump 5 = Pump exercise requested 4 = Pump on due to exercise 3 = Pump on due to Post pump 2 = Forced off 1 = Forced on
Pump B status	R	005E	0094	AI/AI	33	AI	nvoXPmpBStatus	SNVT_count_f	

									0 = On due to normal demand
CH pump status	R	0060	0096	AI/AI	34	AI	nvoXCHPmpStatus	SNVT_count_f	Refer to Appendix D.3
DHW pump status	R	0064	0100	AI/AI	35	AI	nvoXDHWPmpStatus	SNVT_count_f	
System pump status	R	0069	0105	AI/AI	36	AI	nvoXSysPmpStatus	SNVT_count_f	
Boiler pump status	R	006C	0108	AI/AI	37	AI	nvoXBlrPmpStatus	SNVT_count_f	
Lead lag master status	R	00A0	0160	AI	38	AI	nvoXLdLgMstrStat	SNVT_count_f	0 = Unknown 1 = Disabled 2 = Normal 3 = Suspended
Lead lag slave status	R	00A1	0161	AI	39	AI	nvoXLdLgSlvStatus	SNVT_count_f	**Bitmap** 15 = Slave command received 14 = Slave mode has priority over CH & DHW 13 = Slave is modulating 12 = CH frost protection request 11 = DHW frost protection request 10 = Frost protection burner request 9 = Local frost protection request 8 = Reserved (always 0) 7-0 = Burner control status see register (hex) 32
Pump C status	R	00A8	0168	AI	40	AI	nvoXPmpCStatus	SNVT_count_f	**Bitmap** 15 – 14 = Reserved 13 = Auxiliary 2 pump demand 12 = Auxiliary 1 pump demand 11 = System pump demand 10 = Boiler pump demand 9 = DHW pump demand 8 = CH pump demand **Reason** 7 = Reserved 6 = Pump assigned to logical pump 5 = Pump exercise requested 4 = Pump on due to exercise 3 = Pump on due to Post pump 2 = Forced off 1 = Forced on 0 = On due to normal demand
Outdoor temperature	R	00AA	0170	AI	41	AI	nvoXOutdoorTmp	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Date Code	R	00BB	0187	AI	43	AI	N/A	N/A	Variable length string (up to 10 characters)

Safety processor build	R	00BC	0188	AI	44	AI	N/A	N/A	
Application processor build	R	00BD	0189	AI	45	AI	N/A	N/A	
Installer Password	R	00BE	0190	AV	46	AO	nvi/nvoXInstllrPswd	SNVT_count_f	Password: sola
Burner switch	R/W	00CB	0203	AV	47	AO	nvi/nvoXBrnSwitch	SNVT_count_f	Used to enable/disable burner control 0 = Off 1 = On
CH enable	R/W	00D0	0208	AV	48	AO	nvi/nvoXEnable	N/A	0 = Disable Central Heating 1 = Enable Central Heating
CH setpoint	R/W	00D3	0211	AV	49	AO	nvi/nvoXCHSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
CH TOD setpoint	R/W	00D4	0212	AV	50	AO	nvi/nvoXCHTODSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]. Reserved for future use
CH outdoor reset enable	R/W	00D7	0215	AV	51	AO	nvi/nvoXCHOtdrResEn	SNVT_count_f	0 = Disable outdoor reset 1 = Enable outdoor reset
Prepurge Time	R/W	00E7	0231	AV	52	AO	N/A	N/A	SAFETY PARAMETER 0-64800 seconds (18 hours)
Post Purge Time	R/W	00EC	0236	AV	53	AO	N/A	N/A	SAFETY PARAMETER 0-64800 seconds (18 hours)
DHW Demand Switch	R/W	01C1	0449	AV	54	AO	nvi/nvoXDHWDemSwitch	SNVT_count_f	0 = DHW Disabled 1 = DHW Enabled
DHW Setpoint	R/W	01C5	0453	AV	55	AO	nvi/nvoXDHWSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Outlet high limit setpoint	R/W	01D0	0464	AV	56	AO	N/A	N/A	SAFETY PARAMETER -40 – 130°C (0.1°C precision)[1]
Delta T inlet/outlet degrees	R/W	01D7	0471	AV	57	AO	N/A	N/A	-40 – 130°C (0.1°C precision)[1]
CH ODR max outdoor temp	R/W	0200	0512	AV	58	AO	nvi/nvoXCHODRMxOtdrTp	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
CH ODR min water temp	R/W	0201	0513	AV	59	AO	nvi/nvoXCHODRMnWtrTmp	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
CH frost protection enable	R/W	0210	0528	AV	60	AO	N/A	N/A	0 = Disable 1 = Enable
DHW frost protection enable	R/W	0211	0529	AV	61	AO	N/A	N/A	0 = Disable 1 = Enable
Outdoor frost protection setpnt	R/W	0212	0530	AV	62	AO	N/A	N/A	-40 – 130°C (0.1°C precision)[1]
Lead Lag slave enable	R/W	0220	0544	AV	63	AO	N/A	N/A	0 = Lead/Lag slave disabled 1 = Lead/lag simple slave enabled for EnviraCom Master 2 = Lead/lag simple slave enabled for Global Modbus master

									3= Lead/lead full slave enabled for Global Modbus master
Lead Lag master enable	R/W	0221	0545	AV	64	AO	N/A	N/A	0 = Not a lead/Lag master 1 = Lead/Lag master
Lead Lag setpoint	R/W	0222	0546	AV	65	AO	nvi/nvoXLdLgSetpoint	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Leadlag modulation sensor	R/W	022E	0558	AV	66	AO	nvi/nvoXLdLgModSensor	SNVT_count_f	Sensor used for Lead Lag modulation: 0 = S5 sensor 1 = S10 sensor
Leadlag CH Modbus setpoint	R/W	0232	0562	AV	67	AO	N/A	N/A	-40 – 130°C (0.1°C precision)[1]
CH ModBus setpoint	R/W	0243	0579	AV	68	AO	N/A	N/A	-40 – 130°C (0.1°C precision)[1]
CH modulation rate source	R/W	0244	0580	AV	69	AO	nvoXCHModRatSrc	SNVT_count_f	0 = Local modulation (sensor)
Warm weather shutdown setpoint	R/W	0274	0628	AV	71	AO	nvi/nvoXWrmWthShtdnSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Lead lag DHW setpoint	R/W	02C1	0705	AV	72	AO	nvi/nvoXLdLgDHWSP	SNVT_temp_p	-40 – 130°C (0.1°C precision)[1]
Slave 1 State	R	0302	0770	AI	73	AI	nvoXSlave1State	SNVT_count_f	Slave State: 0 = Slave is unknown 1 = Available 2 = Add Stage 3 = Suspended Stage 4 = Firing 5 = On leave 6 = Disabled 7 = Recovering
Slave 2 State	R	0306	0774	AI	75	AI	nvoXSlave2State	SNVT_count_f	
Slave 3 State	R	030A	0778	AI	77	AI	nvoXSlave3State	SNVT_count_f	
Slave 4 State	R	030E	0782	AI	79	AI	nvoXSlave4State	SNVT_count_f	
Slave 5 State	R	0312	0786	AI	81	AI	nvoXSlave5State	SNVT_count_f	
Slave 6 State	R	0316	0790	AI	83	AI	nvoXSlave6State	SNVT_count_f	
Slave 7 State	R	031A	0794	AI	85	AI	nvoXSlave7State	SNVT_count_f	
Slave 8 State	R	031E	0798	AI	87	AI	nvoXSlave8State	SNVT_count_f	
Slave 1 firing rate	R	0304	0772	AI	74	AI	N/A	N/A	Current firing rate (0-100%)
Slave 2 firing rate	R	0308	0776	AI	76	AI	N/A	N/A	
Slave 3 firing rate	R	030C	0780	AI	78	AI	N/A	N/A	
Slave 4 firing rate	R	0310	0784	AI	80	AI	N/A	N/A	
Slave 5 firing rate	R	0314	0788	AI	82	AI	N/A	N/A	
Slave 6 firing rate	R	0318	0792	AI	84	AI	N/A	N/A	
Slave 7 firing rate	R	031C	0796	AI	86	AI	N/A	N/A	
Slave 8 firing rate	R	0320	0800	AI	88	AI	N/A	N/A	
Burner cycle count	R	0080-0081	0128-0129	AV	89	AO	N/A	N/A	0-999,999
Burner run time	R	0082-0083	0130-0131	AV	90	AO	N/A	N/A	0-999,999 hours

CH pump cycle count	R	0084-0085	0132-0133	AV	91	AO	nvi/nvoXCHPmpCycCnt	SNVT_count_f	0-999,999
DHW pump cycle count	R	0086-0087	0134-0135	AV	92	AO	nvi/nvoXDHWPmpCycCnt	SNVT_count_f	0-999,999
System pump cycle count	R	0088-0089	0136-0137	AV	93	AO	nvoXSysPmpCycCnt	SNVT_count_f	0-999,999
Boiler pump cycle count	R	008A-008B	0138-0139	AV	94	AO	nviXBlrPmpCycCnt	SNVT_count_f	0-999,999
Controller run time	R	0090-0091	0144-0145	AI	95	AI	nvoXContRunTime	SNVT_count_f	0-999,999 hours
CH Modbus Rate	R	0245	0581	AI	96	AI	nvoXCHModRate	SNVT_count_f	Commanded CH modulation rate[4] when source is Modbus
Lead Boiler Address	R	0321	0801	AI	97	AI	nvoXLdBlrAddr	SNVT_count_f	Modbus address of the first boiler that will be or was added to service Lead Lag demand (slave must be available for firing)
Boiler Firing Rate Per Output	R/W	0235	0565	AV	98	AO	nvi/nvoXBlrFrRtPrOtpt	SNVT_lev_percent	**Bitmap** 15 = Slave demand request 14 = Slave suspend startup 13 = Slave run fan request 12 = Turn on auxiliary pump X 11 = Turn on auxiliary pump Y 10 = Turn on auxiliary pump Z 9 = Slave pump demand 8 = Commanded rate is binary fraction %[5] 7-0 = Commanded rate[4]
Boiler Firing Rate	R/W	0235	0565	BV	99	DO	nvi/nvoXBlrFirRate	SNVT_switch	
Boiler Enable	R/W	0235	0565	BV	100	DO	nvi/nvoXBlrEnable	SNVT_switch	
Burner control status Normal	R	N/A	N/A	BI	101	DI	nvoXBrnrCtrlStNor	SNVT_switch	0 = Off 1 = On
Burner control status Firing	R	N/A	N/A	BI	102	DI	nvoXBrnrCtrlStFir	SNVT_switch	0 = Off 1 = On
General Fault Alarm	R	N/A	N/A	BI	103	DI	N/A	N/A	0 = Off 1 = On
Lead Lag Operation Switch	R/W	022B	0555	BV	104	DO	nvi/nvoXLdLgOpSwitch	SNVT_switch	To enable/disable the Lead Lag boiler plant

[1] All temperature registers are expressed in °C regardless of what temperature units are set to on the boiler, ex. 32.0°C = 320. A temperature that is NOT applicable has a value of 0x8FFF.

[2] All percentage values are given in 0.1% granularity, ie. 0-1000 is the range from 0.0 – 100.0%

[3] Most significant bit in value determines which units type the parameter has: 0 = RPM, 1 = %. If modulation output parameter doesn't match with the setting of this bit, then the parameter setting is invalid

[4] For binary fraction % format commanded rate is a binary fraction between .00000000 (0% = no heat at all) and .11111111 (99.98% = maximum fire). For a 0.5% step format commanded rate is a value between 0 (minimum fire) and 200 (maximum fire) that is a multiple of 0.5% (200 x 0.5% = 100%)

[5] Commanded rate in least significant byte of this register can be expressed in two formats: binary fraction % or multiple of 035% steps. Bit 8 of this register indicates which format the commanded rate is expressed in; when bit 8 is set, the commanded rate is in binary fraction % format when bit 8 is cleared, the commanded rate is in 0.5% steps.

Appendix D. Lockout & Alert Codes

Appendix D.1. Lockout Codes

Code	Description	Note
0	None	No lockout/hold
1	Unconfigured safety data	Lockout
2	Waiting for safety data verification	Lockout
3	Internal fault: Hardware fault	Hold
4	Internal fault: Safety relay feedback error	Hold
5	Internal fault: Unstable power (DCDC) output	Hold
6	Internal fault: Invalid processor clock	Hold
7	Internal fault: Safety relay drive error	Hold
8	Internal fault: Zero crossing not detected	Hold
9	Internal fault: Flame bias out of range	Hold
10	Internal fault: Invalid burner control state	Lockout
11	Internal fault: Invalid burner control state flag	Lockout
12	Internal fault: Safety relay drive cap short	Hold
13	Internal fault: PII shorted to ILK	Hold/Lockout
14	Internal fault: HFS shorted to LCI	Hold/Lockout
15	Internal fault: Safety relay test failed due to feedback ON	Lockout
16	Internal fault: Safety relay test failed due to safety relay OFF	Lockout
17	Internal fault: Safety relay test failed due to safety relay not OFF	Lockout
18	Internal fault: Safety relay test failed due to feedback not ON	Lockout
19	Internal fault: Safety RAM write	Lockout
20	Internal fault: Flame ripple and overflow	Hold
21	Internal fault: Flame number of sample mismatch	Hold
22	Internal fault: Flame bias out of range	Hold
23	Internal fault: Bias changed since heating cycle starts	Hold
24	Internal fault: Spark voltage stuck low or high	Hold
25	Internal fault: Spark voltage changed too much during flame sensing time	Hold
26	Internal fault: Static flame ripple	Hold
27	Internal fault: Flame rod shorted to ground detected	Hold
28	Internal fault: A/D linearity test failed	Hold
29	Internal fault: Flame bias cannot be set in range	Hold
30	Internal fault: Flame bias shorted to adjacent pin	Hold
31	Internal fault: SLO electronics unknown error	Hold
32	Internal fault: Safety key 0	Lockout
33	Internal fault: Safety key 1	Lockout
34	Internal fault: Safety key 2	Lockout
35	Internal fault: Safety key 3	Lockout
36	Internal fault: Safety key 4	Lockout
37	Internal fault: Safety key 5	Lockout
38	Internal fault: Safety key 6	Lockout
39	Internal fault: Safety key 7	Lockout
40	Internal fault: Safety key 8	Lockout

41	Internal fault: Safety key 9	Lockout
42	Internal fault: Safety key 10	Lockout
43	Internal fault: Safety key 11	Lockout
44	Internal fault: Safety key 12	Lockout
45	Internal fault: Safety key 13	Lockout
46	Internal fault: Safety key 14	Lockout
47	Flame rod to ground leakage	Hold
48	Static flame (not flickering)	Hold
49	24Vac voltage low/high	Hold
50	Modulation fault	Hold
51	Pump fault	Hold
52	Motor tachometer fault	Hold
53	AC inputs phase reversed	Lockout
54	Safety GVT model ID doesn't match application's model ID	Lockout
55	Application configuration data block CRC errors	Lockout
56-57	RESERVED	
58	Internal fault: HFS shorted to IAS	Lockout
59	Internal fault: Mux pin shorted	Lockout
60	Internal fault: HFS shorted to LFS	Lockout
61	Anti-short cycle	Hold
62	Fan speed not proved	Hold
63	LCI off	Hold
67	ILK off	Hold
68	ILK on	Hold
69	Pilot test hold	Hold
70	Wait for leakage test completion	Hold
71-77	RESERVED	
78	Demand lost in run	Hold
79	Outlet high limit	Hold
81	Delta T inlet/outlet limit	Hold
82	Stack limit	Lockout
91	Inlet sensor fault	Hold
92	Outlet sensor fault	Hold
93	DHW sensor fault	Hold
94	S2 (J8-6) sensor fault	Hold
95	Stack sensor fault	Hold
96	S5 (J8-11) sensor fault	Hold
97	Internal fault: A2D mismatch	Lockout
98	Internal fault: Exceeded VSNSR voltage tolerance	Lockout
99	Internal fault: Exceeded 28V voltage tolerance	Lockout
101-104	RESERVED	
105	Flame detected out of sequence	Lockout
106	Flame lost in MFEP	Lockout
107	Flame lost early in run	Lockout
108	Flame lost in run	Lockout
109	Ignition failed	Lockout
110	Ignition failure occurred	Hold
111	Flame current lower than WEAK threshold	Hold

112	Pilot test flame timeout	Lockout
113	Flame circuit timeout	Lockout
114-121	RESERVED	
122	Lightoff rate proving failed	Lockout
123	Purge rate proving failed	Lockout
124	High fire switch OFF	Hold
125	High fire switch stuck ON	Hold
126	Low fire switch OFF	Hold
127	Low fire switch stuck ON	Hold
128	Fan speed failed during prepurge	Hold
129	Fan speed failed during preignition	Hold
130	Fan speed failed during ignition	Hold
131	Fan movement detected during standby	Hold
132	Fan speed failed during run	Hold
133-135	RESERVED	
136	Interrupted Airflow Switch failed to close	Hold
137	ILK failed to close	Hold
138-142	RESERVED	
143	Internal fault: Flame bias out of range 1	Lockout
144	Internal fault: Flame bias out of range 2	Lockout
145	Internal fault: Flame bias out of range 3	Lockout
146	Internal fault: Flame bias out of range 4	Lockout
147	Internal fault: Flame bias out of range 5	Lockout
148	Internal fault: Flame bias out of range 6	Lockout
149	Flame detected	Lockout
150	Flame not detected	Hold
151	High fire switch ON	Hold
158	Main valve ON	Lockout
159	Main valve OFF	Lockout
160	Ignition ON	Lockout
161	Ignition OFF	Lockout
162	Pilot valve ON	Lockout
163	Pilot valve OFF	Lockout
166-171	RESERVED	
172	Main relay feedback incorrect	Lockout
173	Pilot relay feedback incorrect	Lockout
174	Safety relay feedback incorrect	Lockout
175	Safety relay open	Lockout
176	Main relay ON and safe start check	Lockout
177	Pilot relay ON at safe start check	Lockout
178	Safety relay ON at safe start check	Lockout
179-183	RESERVED	
184	Invalid Blower/HIS output setting	Lockout
185	Invalid Delta T limit enable setting	Lockout
186	Invalid Delta T limit response setting	Lockout
187	Invalid DHW high limit enable setting	Lockout
188	Invalid DHW high limit response setting	Lockout
189	Invalid Flame sensor type setting	Lockout

192	Invalid igniter on during setting	Lockout
193	Invalid ignite failure delay setting	Lockout
194	Invalid ignite failure response setting	Lockout
195	Invalid ignite failure retries setting	Lockout
196	Invalid ignition source setting	Lockout
197	Invalid interlock open response setting	Lockout
198	Invalid Interlock start check setting	Lockout
199	Invalid LCI enable setting	Lockout
200	Invalid lightoff rate setting	Lockout
201	Invalid lightoff rate proving setting	Lockout
202	Invalid Main Flame Establishing Period setting	Lockout
203	Invalid MFEP flame failure response setting	Lockout
204	Invalid NTC sensor type setting	Lockout
205	Invalid Outlet high limit response setting	Lockout
206	Invalid Pilot Flame Establishing Period setting	Lockout
207	Invalid PII enable setting	Lockout
208	Invalid pilot test hold setting	Lockout
209	Invalid pilot type setting	Lockout
210	Invalid postpurge time setting	Lockout
211	Invalid power up with lockout setting	Lockout
212	Invalid preignition time setting	Lockout
213	Invalid prepurge rate setting	Lockout
214	Invalid prepurge time setting	Lockout
215	Invalid purge rate proving setting	Lockout
216	Invalid run flame failure response setting	Lockout
217	Invalid run stabilization time setting	Lockout
218	Invalid stack limit enable setting	Lockout
219	Invalid stack limit enable setting	Lockout
224	Invalid DHW demand source setting	Lockout
225	Invalid flame threshold setting	Lockout
226	Invalid outlet high limit setpoint setting	Lockout
228	Invalid Stack limit setpoint setting	Lockout
229	Invalid modulation output setting	Lockout
230	Invalid CH demand source setting	Lockout
231	Invalid Delta T limit delay setting	Lockout
234	Invalid outlet high limit enable setting	Lockout
235	Invalid outlet connector type setting	Lockout
236	Invalid inlet connector type setting	Lockout
237	Invalid DHW connector type setting	Lockout
238	Invalid Stack connector type setting	Lockout
239	Invalid S2 (J8-6) connector type setting	Lockout
240	Invalid S5 (J8-11) connector type setting	Lockout
244	Internal fault: Safety relay test invalid state	Lockout
246	4-20mA cannot be used for both modulation and setpoint control	Lockout
250	Invalid fan speed error message	Lockout
252-255	RESERVED	

Appendix D.2. Alert Codes

Code	Description
0	None (No alert)
1	Alert PCB was restored from factory defaults
2	Safety configuration parameters were restored from factory defaults
3	Configuration parameters were restored from factory defaults
4	Invalid Factory Invisibility PCB was detected
5	Invalid Factory Range PCB was detected
6	Invalid range PCB record has been dropped
7	EEPROM lockout history was initialized
8	Switched application annunciation data blocks
9	Switched application configuration data blocks
10	Configuration was restored from factory defaults
11	Backup configuration settings was restored from active configuration
12	Annunciation configuration was restored from factory defaults
13	Annunciation configuration was restored from backup
14	Safety group verification table was restored from factory defaults
15	Safety group verification table was updated
16	Invalid Parameter PCB was detected
17	Invalid Range PCB was detected
18	Alarm silence time exceeded maximum
19	Invalid safety group verification table was detected
20	Backdoor password could not be determined
21	Invalid safety group verification table was not accepted
22	CRC errors were found in application configuration data blocks
23	Backup Alert PCB was restored from active one
24	RESERVED
25	Lead Lag operation switch was turned OFF
26	Lead Lag operation switch was turned ON
27	Safety processor was reset
28	Application processor was reset
29	Burner switch was turned OFF
30	Burner switch was turned ON
31	Program Module (PM) was inserted into socket
32	Program Module (PM) was removed from socket
33	Alert PCB was configured
34	Parameter PCB was configured
35	Range PCB was configured
36	Program Module (PM) incompatible with product was inserted into socket
37	Program Module application parameter revision differs from application processor
38	Program Module safety parameter revision differs from safety processor
39	PCB incompatible with product contained in Program Module
40	Parameter PCB in Program Module is too large for product
41	Range PCB in Program Module was too large for product
42	Alert PCB in Program Module was too large for product
43	IAS start check was forced on due to IAS enabled
44	Low voltage was detected in safety processor
45	High line frequency occurred
46	Low line frequency occurred
47	Invalid subsystem reset request occurred
48	Write large enumerated Modbus register value was not allowed
49	Maximum cycle count was reached
50	Maximum hours count was reached

51	Illegal Modbus write was attempted
52	Modbus write attempt was rejected (NOT ALLOWED)
53	Illegal Modbus read was attempted
54	Safety processor brown-out reset occurred
55	Application processor watchdog reset occurred
56	Application processor brown-out reset occurred
57	Safety processor watchdog reset occurred
58	Alarm was reset by the user at the control
59	Burner control firing rate was > absolute max rate
60	Burner control firing rate was < absolute min rate
61	Burner control firing rate was invalid, % vs. RPM
62	Burner control was firing with no fan request
63	Burner control rate (nonfiring) was > absolute max rate
64	Burner control rate (nonfiring) was < absolute min rate
65	Burner control rate (nonfiring) was absent
66	Burner control rate (nonfiring) was invalid, % vs. RPM
67	Fan off cycle rate was invalid, % vs. RPM
68	Setpoint was overridden due to sensor fault
69	Modulation was overridden due to sensor fault
70	No demand source was set due to demand priority conflicts
71	CH 4-20mA signal was invalid
72-	RESERVED
74	Periodic Forced Recycle
75	Absolute max fan speed was out of range
76	Absolute min fan speed was out of range
77	Fan gain down was invalid
78	Fan gain up was invalid
79	Fan minimum duty cycle was invalid
80	Fan pulses per revolution was invalid
81	Fan PWM frequency was invalid
82-	RESERVED
84	Lead Lag CH 4-20mA water temperature setting was invalid
85	No Lead Lag add stage error threshold was configured
86	No Lead Lag add stage detection time was configured
87	No Lead Lag drop stage error threshold was configured
88	No Lead Lag drop stage detection time was configured
89	Lead Lag all boiler off threshold was invalid
90	Modulation output type was invalid
91	Firing rate control parameter was invalid
92	Forced rate was out of range vs. min/max modulation
93	Forced rate was invalid, % vs. RPM
94	Slow start ramp value was invalid
95	Slow start degrees value was invalid
96	Slow start was ended due to outlet sensor fault
97	Slow start was end due to reference setpoint fault
98	CH max modulation rate was invalid, % vs. RPM
99	CH max modulation rate was > absolute max rate
100	CH modulation range (max minus min) was too small (< 4% or 40 RPM)
101	DHW max modulation rate was invalid, % vs. RPM
102	DHW max modulation rate was > absolute max rate
103	DHW modulation range (max minus min) was too small (< 4% or 40 RPM)
104	Min modulation rate was < absolute min rate
105	Min modulation rate was invalid, % vs. RPM
106	Manual rate was invalid, % vs. RPM

107	Slow start enabled, but forced rate was invalid
108	Analog output hysteresis was invalid
109	Analog modulation output type was invalid
110	IAS open rate differential was invalid
111	IAS open step rate was invalid
112	Mix max modulation rate was invalid, % vs. RPM
113	Mix max modulation rate was > absolute max or < absolute min rates
114	Mix modulation range (max minus min) was too small (< 4% or 40 RPM)
115	Fan was limited to its minimum duty cycle
116	Manual rate was > CH max modulation rate
117	Manual rate was > DHW max modulation rate
118	Manual rate was < min modulation rate
119	Manual rate in Standby was > absolute max rate
120	Modulation commanded rate was > CH max modulation rate
121	Modulation commanded rate was > DHW max modulation rate
122	Modulation commanded rate was < min modulation rate
123	Modulation rate was limited due to Outlet limit
124	Modulation rate was limited due to Delta-T limit
125	Modulation rate was limited due to Stack limit
126	Modulation rate was limited due to anticondensation
127	Fan speed out of range in RUN
128	Modulation rate was limited due to IAS was open
129	Slow start ramp setting of zero will result in no modulation rate change
130	No forced rate was configured for slow start ramp
131	CH demand source was invalid
132	CH P-gain was invalid
133	CH I-gain was invalid
134	CH D-gain was invalid
135	CH OFF hysteresis was invalid
136	CH ON hysteresis was invalid
137	CH sensor type was invalid
138	CH hysteresis step time was invalid
139	CH remote control parameter was invalid
140	CH ODR not allowed with remote control
141	Steam P-gain was invalid
142	Steam I-gain was invalid
143	Steam D-gain was invalid
144	Steam OFF hysteresis was invalid
145	Steam ON hysteresis was invalid
146	CH control was suspended due to fault
147	CH header temperature was invalid
148	CH Outlet temperature was invalid
149	CH steam pressure was invalid
150	Steam setpoint source parameter was invalid
151	Minimum water temperature parameter was greater than setpoint
152	Minimum water temperature parameter was greater than time of day setpoint
153	Minimum pressure parameter was greater than setpoint
154	Minimum pressure parameter was greater than time of day setpoint
155	CH modulation rate source parameter was invalid
156	Steam modulation rate source parameter was invalid
157	DHW demand source was invalid
158	DHW P-gain was invalid
159	DHW I-gain was invalid
160	DHW D-gain was invalid

161	DHW OFF hysteresis was invalid
162	DHW ON hysteresis was invalid
163	DHW hysteresis step time was invalid
164	DHW sensor type was invalid
165	Inlet sensor type was invalid for DHW
166	Outlet sensor type was invalid for DHW
167	DHW storage OFF hysteresis was invalid
168	DHW storage ON hysteresis was invalid
169	DHW modulation sensor type was invalid
170	DHW modulation sensor was not compatible for Auto mode
171	DHW control was suspended due to fault
172	DHW temperature was invalid
173	DHW inlet temperature was invalid
174	DHW outlet temperature was invalid
175	DHW high limit must be disabled for Auto mode
176	DHW sensor type was not compatible for Auto mode
177	DHW priority source setting was invalid
178	DHW priority method setting was invalid
179	CH S5 (J8-11) sensor was invalid
180	CH Inlet temperature was invalid
181	CH S10 (J10-7) sensor was invalid
182	Lead Lag CH setpoint source was invalid
183	Lead Lag P-gain was invalid
184	Lead Lag I-gain was invalid
185	Lead Lag D-gain was invalid
186	Lead Lag OFF hysteresis was invalid
187	Lead Lag ON hysteresis was invalid
188	Lead Lag slave enable was invalid
189	Lead Lag hysteresis step time was invalid
190	No Lead Lag Modbus port was assigned
191	Lead Lag base load common setting was invalid
192	Lead Lag DHW demand switch setting was invalid
193	Lead Lag Mix demand switch setting was invalid
194	Lead Lag modulation sensor setting was invalid
195	Lead Lag backup modulation sensor setting was invalid
196	Lead Lag slave mode setting was invalid
197	Lead Lag rate allocation setting was invalid
198	Lead selection setting was invalid
199	Lag selection setting was invalid
200	Lead Lag slave return setting was invalid
201	Lead Lag add stage method setting was invalid
202	STAT may not be a Lead Lag CH demand source when Remote Stat is enabled
203	Lead Lag base load rate setting was invalid
204	Lead Lag master was suspended due to fault
205	Lead Lag slave was suspended due to fault
206	Lead Lag header temperature was invalid
207	Lead Lag was suspended due to no enabled Program Module installed
208	Lead Lag slave session has timed out
209	Too many Lead Lag slaves were detected
210	Lead Lag slave was discovered
211	Incompatible Lead Lag slave was discovered
212	No base load rate was set for Lead Lag slave
213	Lead Lag slave unable to fire before demand to fire delay expired
214	Adding Lead Lag slave aborted due to add requirement change
215	No Lead Lag slaves available to service demand

216	No Lead Lag active service was set due to demand priority conflicts
217	No Lead Lag add stage method was specified
218	No Lead Lag drop stage method was specified
219	Using backup Lead Lag header sensor due to sensor failure
220	Lead Lag frost protection rate was invalid
221	Lead Lag drop stage method setting was invalid
222	CH frost protection temperature was invalid
223	CH frost protection inlet temperature was invalid
224	DHW frost protection temperature was invalid
225-226	RESERVED
227	DHW priority override time was not derated due to invalid outdoor temperature
228	Warm weather shutdown was not checked due to invalid outdoor temperature
229	Lead Lag slave communication timeout
230	RESERVED
231	Lead Lag CH setpoint was invalid
232	Lead Lag CH time of day setpoint was invalid
233	Lead Lag outdoor temperature was invalid
234	Lead Lag ODR time of day setpoint was invalid
235	Lead Lag ODR time of day setpoint exceeded normal setpoint
236	Lead Lag ODR max outdoor temperature was invalid
237	Lead Lag ODR min outdoor temperature was invalid
238	Lead Lag ODR low water temperature was invalid
239	Lead Lag ODR outdoor temperature range was too small (minimum 12 C / 22
240	Lead Lag ODR water temperature range was too small (minimum 12 C / 22 F)
241	Lead Lag DHW setpoint was invalid
242	Lead Lag Mix setpoint was invalid
243	Lead Lag CH demand switch was invalid
244	Lead Lag ODR min water temperature was invalid
245	RESERVED
246	CH setpoint was invalid
247	CH time of day setpoint was invalid
248	CH outdoor temperature was invalid
249	CH ODR time of day setpoint was invalid
250	CH ODR time of day setpoint exceeds normal setpoint
251	CH max outdoor setpoint was invalid
252	CH min outdoor setpoint was invalid
253	CH ODR low water temperature was invalid
254	CH ODR outdoor temperature range was too small
255	CH ODR water temperature range was too small
256	Steam setpoint was invalid
257	Steam time of day setpoint was invalid
258	Steam minimum pressure was invalid
259	CH ODR min water temperature was invalid
260	RESERVED
261	DHW setpoint was invalid
262	DHW time of day setpoint was invalid
263	DHW storage setpoint was invalid
264	STAT may not be a DHW demand source when Remote Stat is enabled
265-266	RESERVED
267	STAT may not be a CH demand source when Remote Stat is enabled
268	CH 4mA water temperature setting was invalid
269	CH 20mA water temperature setting was invalid
270	Steam 4mA water temperature setting was invalid
271	Steam 20mA water temperature setting was invalid
272	Abnormal Recycle: Pressure sensor fault

273	Abnormal Recycle: Safety relay drive test failed
274	Abnormal Recycle: Demand off during Pilot Flame Establishing Period
275	Abnormal Recycle: LCI off during Drive to Purge Rate
276	Abnormal Recycle: LCI off during Measured Purge Time
277	Abnormal Recycle: LCI off during Drive to Lightoff Rate
278	Abnormal Recycle: LCI off during Pre-Ignition test
279	Abnormal Recycle: LCI off during Pre-Ignition time
280	Abnormal Recycle: LCI off during Main Flame Establishing Period
281	Abnormal Recycle: LCI off during Ignition period
282	Abnormal Recycle: Demand off during Drive to Purge Rate
283	Abnormal Recycle: Demand off during Measured Purge Time
284	Abnormal Recycle: Demand off during Drive to Lightoff Rate
285	Abnormal Recycle: Demand off during Pre-Ignition test
286	Abnormal Recycle: Demand off during Pre-Ignition time
287	Abnormal Recycle: Flame was on during Safe Start check
288	Abnormal Recycle: Flame was on during Drive to Purge Rate
289	Abnormal Recycle: Flame was on during Measured Purge Time
290	Abnormal Recycle: Flame was on during Drive to Lightoff Rate
291	Abnormal Recycle: Flame was not on at end of Ignition period
292	Abnormal Recycle: Flame was lost during Main Flame Establishing Period
293	Abnormal Recycle: Flame was lost early in Run
294	Abnormal Recycle: Flame was lost during Run
295	Abnormal Recycle: Leakage test failed
296	Abnormal Recycle: Interrupted air flow switch was off during Drive to Purge
297	Abnormal Recycle: Interrupted air flow switch was off during Measured Purge
298	Abnormal Recycle: Interrupted air flow switch was off during Drive to Lightoff
299	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition test
300	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition time
301	Abnormal Recycle: Interrupted air flow switch was off during Main Flame
302	Abnormal Recycle: Ignition failed due to interrupted air flow switch was off
303	Abnormal Recycle: ILK off during Drive to Purge Rate
304	Abnormal Recycle: ILK off during Measured Purge Time
305	Abnormal Recycle: ILK off during Drive to Lightoff Rate
306	Abnormal Recycle: ILK off during Pre-Ignition test
307	Abnormal Recycle: ILK off during Pre-Ignition time
308	Abnormal Recycle: ILK off during Main Flame Establishing Period
309	Abnormal Recycle: ILK off during Ignition period
310	Run was terminated due to ILK was off
311	Run was terminated due to interrupted air flow switch was off
312	Stuck reset switch
313	Run was terminated due to fan failure
314	Abnormal Recycle: Fan failed during Drive to Purge Rate
315	Abnormal Recycle: Fan failed during Measured Purge Time
316	Abnormal Recycle: Fan failed during Drive to Lightoff Rate
317	Abnormal Recycle: Fan failed during Pre-Ignition test
318	Abnormal Recycle: Fan failed during Pre-Ignition time
319	Abnormal Recycle: Fan failed during Ignition period
320	Abnormal Recycle: Fan failed during Main Flame Establishing Period
321	Abnormal Recycle: Main Valve off after 10 seconds of RUN
322	Abnormal Recycle: Pilot Valve off after 10 seconds of RUN
323	Abnormal Recycle: Safety Relay off after 10 seconds of RUN
324	Abnormal Recycle: Hardware flame bias
325	Abnormal Recycle: Hardware static flame
326	Abnormal Recycle: Hardware flame current invalid

327	Abnormal Recycle: Hardware flame rod short
328	Abnormal Recycle: Hardware invalid power
329	Abnormal Recycle: Hardware invalid AC line
330	Abnormal Recycle: Hardware SLO flame ripple
331	Abnormal Recycle: Hardware SLO flame sample
332	Abnormal Recycle: Hardware SLO flame bias range
333	Abnormal Recycle: Hardware SLO flame bias heat
334	Abnormal Recycle: Hardware SLO spark stuck
335	Abnormal Recycle: Hardware SLO spark changed
336	Abnormal Recycle: Hardware SLO static flame
337	Abnormal Recycle: Hardware SLO rod shorted
338	Abnormal Recycle: Hardware SLO AD linearity
339	Abnormal Recycle: Hardware SLO bias not set
340	Abnormal Recycle: Hardware SLO bias shorted
341	Abnormal Recycle: Hardware SLO electronics
342	Abnormal Recycle: Hardware processor clock
343	Abnormal Recycle: Hardware AC phase
344	Abnormal Recycle: Hardware A2D mismatch
345	Abnormal Recycle: Hardware VSNSR A2D
346	Abnormal Recycle: Hardware 28V A2D
347	Abnormal Recycle: Hardware HFS IAS shorted
348	Abnormal Recycle: Hardware PII INTLK shorted
349	Abnormal Recycle: Hardware HFS LCI shorted
350	Abnormal Recycle: Hardware HFS LFS shorted
351	Abnormal Recycle: Invalid zero crossing
352	Abnormal Recycle: fault stack sensor
353	Abnormal Recycle: stack limit
354	Abnormal Recycle: delta T limit
355	Abnormal Recycle: fault outlet sensor
356	Abnormal Recycle: outlet high limit
357	Abnormal Recycle: fault DHW sensor
358	Abnormal Recycle: DHW high limit
359	Abnormal Recycle: fault inlet sensor
360	Abnormal Recycle: Check Parameters Failed
361	Internal error: No factory parameters were detected in control
362	Internal error: PID iteration frequency was invalid
363	Internal error: Demand-Rate interval time was invalid
364	Internal error: Factory calibration parameter for modulation was invalid
365	Internal error: CH PID P-scaler was invalid
366	Internal error: CH PID I-scaler was invalid
367	Internal error: CH PID D-scaler was invalid
368	Internal error: DHW PID P-scaler was invalid
369	Internal error: DHW PID I-scaler was invalid
370	Internal error: DHW PID D-scaler was invalid
371	Internal error: Lead Lag master PID P-scaler was invalid
372	Internal error: Lead Lag master PID I-scaler was invalid
373	Internal error: Lead Lag master PID D-scaler was invalid
374	Abnormal Recycle: Hardware flame bias high
375	Abnormal Recycle: Hardware flame bias low
376	Abnormal Recycle: Hardware flame bias delta high
377	Abnormal Recycle: Hardware flame bias delta low
378	Abnormal Recycle: Hardware flame bias dynamic high
379	Abnormal Recycle: Hardware flame bias dynamic low
380	Abnormal Recycle: Fan Speed Not Proven
381	Abnormal Recycle: Fan Speed Range Low

382	Abnormal Recycle: Fan Speed Range High
383-450	RESERVED
451	Circulator control was invalid
452	Circulator P-gain was invalid
453	Circulator I-gain was invalid
454	Circulator temperature was invalid
455	Circulator outlet temperature was invalid
456	Circulator inlet temperature was invalid
457	Circulator outdoor temperature was invalid
458	Circulator sensor choice was invalid
459	Circulator PID setpoint was invalid
460	LCI lost in run
461	Abnormal Recycle: Demand lost in run from application
462	Abnormal Recycle: Demand lost in run due to high limit
463	Abnormal Recycle: Demand lost in run due to no flame
464	LCI lost in Combustion Pressure Establishing Period
465	LCI lost in Combustion Pressure Stabilization Period
466	RESERVED
467	Internal error: EEPROM write was attempted before EEPROM was initialized
468	Internal error: EEPROM cycle count address was invalid
469	Internal error: EEPROM days count address was invalid
470	Internal error: EEPROM hours count address was invalid
471	Internal error: Lockout record EEPROM index was invalid
472	Internal error: Request to write PM status was invalid
473	Internal error: PM parameter address was invalid
474	Internal error: PM safety parameter address was invalid
475	Internal error: Invalid record in lockout history was removed
476	Internal error: EEPROM write buffer was full
477	Internal error: Data too large was not written to EEPROM
478	Internal error: Safety key bit 0 was incorrect
479	Internal error: Safety key bit 1 was incorrect
480	Internal error: Safety key bit 2 was incorrect
481	Internal error: Safety key bit 3 was incorrect
482	Internal error: Safety key bit 4 was incorrect
483	Internal error: Safety key bit 5 was incorrect
484	Internal error: Safety key bit 6 was incorrect
485	Internal error: Safety key bit 7 was incorrect
486	Internal error: Safety key bit 8 was incorrect
487	Internal error: Safety key bit 9 was incorrect
488	Internal error: Safety key bit 10 was incorrect
489	Internal error: Safety key bit 11 was incorrect
490	Internal error: Safety key bit 12 was incorrect
491	Internal error: Safety key bit 13 was incorrect
492	Internal error: Safety key bit 14 was incorrect
493	Internal error: Safety key bit 15 was incorrect
494	Internal error: Safety relay timeout
495	Internal error: Safety relay commanded off
496	Internal error: Unknown safety error occurred
497	Internal error: Safety timer was corrupt
498	Internal error: Safety timer was expired
499	Internal error: Safety timings
500	Internal error: Safety shutdown
501	RESERVED
502	Mix setpoint was invalid
503	Mix time of day setpoint was invalid

504	Mix outdoor temperature was invalid
505	Mix ODR time of day setpoint was invalid
506	Mix ODR time of day setpoint exceeds normal setpoint
507	Mix ODR max outdoor temperature was invalid
508	Mix ODR min outdoor temperature was invalid
509	Mix ODR low water temperature was invalid
510	Mix ODR outdoor temperature range was invalid
511	Mix ODR water temperature range was invalid
512	Mix demand switch was invalid
513	Mix ON hysteresis was invalid
514	Mix OFF hysteresis was invalid
515	Mix ODR min water temperature was invalid
516	Mix hysteresis step time was invalid
517	Mix P-gain was invalid
518	Mix I-gain was invalid
519	Mix D-gain was invalid
520	Mix control was suspended due to fault
521	Mix S10 (J10-7) temperature was invalid
522	Mix outlet temperature was invalid
523	Mix inlet temperature was invalid
524	Mix S5 (J8-11) temperature was invalid
525	Mix modulation sensor type was invalid
526	Mix ODR min water temperature setpoint was invalid
527	Mix circulator sensor was invalid
528	Mix flow control was invalid
529	Mix temperature was invalid
530	Mix sensor was invalid
531	Mix PID setpoint was invalid
532	STAT may not be a Mix demand source when Remote Stat is enabled
533-539	RESERVED
540	Delta T inlet/outlet enable was invalid
541	Delta T exchanger/outlet enable was invalid
542	Delta T inlet/exchanger enable was invalid
543	Delta T inlet/outlet degrees was out of range
545	Delta T inlet/exchanger degrees was out of range
546	Delta T response was invalid
547	Delta T inversion limit response was invalid
548	Delta T rate limit enable was invalid
549	Delta T exchanger/outlet wasn't allowed due to stack limit setting
550	Delta T inlet/outlet limit was exceeded
551	Delta T exchanger/outlet limit was exceeded
552	Delta T inlet/exchanger limit was exceeded
553	Inlet/outlet inversion occurred
554	Exchanger/outlet inversion occurred
555	Inlet/exchanger inversion occurred
556	Delta T exchanger/outlet wasn't allowed due to stack connector setting
557	Delta T inlet/exchanger wasn't allowed due to stack limit setting
558	Delta T inlet/exchanger wasn't allowed due to stack connector setting
559	Delta T delay was not configured for recycle response
560	Outlet T-rise enable was invalid
561	Heat exchanger T-rise enable was invalid
562	T-rise degrees was out of range
563	T-rise response was invalid
564	Outlet T-rise limit was exceeded
565	Heat exchanger T-rise limit was exceeded

566	Heat exchanger T-rise wasn't allowed due to stack limit setting
567	Heat exchanger T-rise wasn't allowed due to stack connector setting
568	Outlet T-rise wasn't allowed due to outlet connector setting
569	T-rise delay was not configured for recycle response
570	Heat exchanger high limit setpoint was out of range
571	Heat exchanger high limit response was invalid
572	Heat exchanger high limit was exceeded
573	Heat exchanger high limit wasn't allowed due to stack limit setting
574	Heat exchanger high limit wasn't allowed due to stack connector setting
575	Heat exchanger high limit delay was not configured for recycle response
576	CH pump output was invalid
577	DHW pump output was invalid
578	Boiler pump output was invalid
579	Auxiliary pump output was invalid
580	System pump output was invalid
581	Mix pump output was invalid
582-589	RESERVED
590	DHW plate preheat setpoint was invalid
591	DHW plate preheat ON hysteresis was invalid
592	DHW plate preheat OFF hysteresis was invalid
593	Tap detect degrees was out of range
594	Tap detect ON hysteresis was invalid
595	Inlet - DHW tap stop degrees was out of range
596	Outlet - Inlet tap stop degrees was out of range
597	DHW tap detect on threshold was invalid
598	DHW plate preheat detect on threshold was invalid
599	DHW plate preheat detect off threshold was invalid
600	Delta T inlet temperature was invalid
601	Delta T outlet temperature was invalid
602	Delta T exchanger temperature was invalid
603	Parameter PCB was switched to backup
604	Range PCB was switched to backup

Appendix D.3. Pump Status Codes

Status	Description Note
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
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 override
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

Appendix E. MAC Address DIP Switch Settings

Appendix E.1. MAC Address DIP Switch Settings

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

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

Address	A0	A1	A2	A3	A4	A5	A6	A7
90	Off	On	Off	On	On	Off	On	Off
91	On	On	Off	On	On	Off	On	Off
92	Off	Off	On	On	On	Off	On	Off
93	On	Off	On	On	On	Off	On	Off
94	Off	On	On	On	On	Off	On	Off
95	On	On	On	On	On	Off	On	Off
96	Off	Off	Off	Off	Off	On	On	Off
97	On	Off	Off	Off	Off	On	On	Off
98	Off	On	Off	Off	Off	On	On	Off
99	On	On	Off	Off	Off	On	On	Off
100	Off	Off	On	Off	Off	On	On	Off
101	On	Off	On	Off	Off	On	On	Off
102	Off	On	On	Off	Off	On	On	Off
103	On	On	On	Off	Off	On	On	Off
104	Off	Off	Off	On	Off	On	On	Off
105	On	Off	Off	On	Off	On	On	Off
106	Off	On	Off	On	Off	On	On	Off
107	On	On	Off	On	Off	On	On	Off
108	Off	Off	On	On	Off	On	On	Off
109	On	Off	On	On	Off	On	On	Off
110	Off	On	On	On	Off	On	On	Off
111	On	On	On	On	Off	On	On	Off
112	Off	Off	Off	Off	On	On	On	Off
113	On	Off	Off	Off	On	On	On	Off
114	Off	On	Off	Off	On	On	On	Off
115	On	On	Off	Off	On	On	On	Off
116	Off	Off	On	Off	On	On	On	Off
117	On	Off	On	Off	On	On	On	Off
118	Off	On	On	Off	On	On	On	Off
119	On	On	On	Off	On	On	On	Off
120	Off	Off	Off	On	On	On	On	Off
121	On	Off	Off	On	On	On	On	Off
122	Off	On	Off	On	On	On	On	Off
123	On	On	Off	On	On	On	On	Off
124	Off	Off	On	On	On	On	On	Off
125	On	Off	On	On	On	On	On	Off
126	Off	On	On	On	On	On	On	Off
127	On	On	On	On	On	On	On	Off
128	Off	Off	Off	Off	Off	Off	Off	On
129	On	Off	Off	Off	Off	Off	Off	On
130	Off	On	Off	Off	Off	Off	Off	On
131	On	On	Off	Off	Off	Off	Off	On
132	Off	Off	On	Off	Off	Off	Off	On
133	On	Off	On	Off	Off	Off	Off	On
134	Off	On	On	Off	Off	Off	Off	On
135	On	On	On	Off	Off	Off	Off	On
136	Off	Off	Off	On	Off	Off	Off	On
137	On	Off	Off	On	Off	Off	Off	On
138	Off	On	Off	On	Off	Off	Off	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
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186	Off	On	Off	On	On	On	Off	On
187	On	On	Off	On	On	On	Off	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
188	Off	Off	On	On	On	On	Off	On
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212	Off	Off	On	Off	On	Off	On	On
213	On	Off	On	Off	On	Off	On	On
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234	Off	On	Off	On	Off	On	On	On
235	On	On	Off	On	Off	On	On	On
236	Off	Off	On	On	Off	On	On	On

Address	A0	A1	A2	A3	A4	A5	A6	A7
237	On	Off	On	On	Off	On	On	On
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239	On	On	On	On	Off	On	On	On
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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 F. Reference

Appendix F.1. Specifications

	ProtoNode RER	ProtoNode LER
Electrical Connections	One 6-pin Phoenix connector, one RS-485 +/- ground port, power +/- frame ground port One 3-pin RS-485 Phoenix connector, one RS-485 +/- ground port One Ethernet-10/100 Ethernet port	One 6-pin Phoenix connector, one RS-485 +/- ground port, power +/- frame ground port One Ethernet 10/100 BaseT port One FTT-10 LonWorks port
Approvals:	Pending CE (EN55022;EN55024; EN60950), UL916, Pending FCC Class A Part 15, DNP3 Conformance Tested, OPC Self-tested for Compliance, RoHS Compliant, CSA 205 Approved	
	BTL Marked	LonMark Certified
Power Requirements	Multi-mode power adapter: 9-30VDC or 12 - 24VAC	
Physical Dimensions	11.5 cm L x 8.3 cm W x 4.1 cm H (4.5 x 3.2 x 1.6 in.)	
Weight:	0.2 kg (0.4 lbs)	
Operating Temperature:	-40°C to 75°C (-40°F to167°F)	
Surge Suppression	EN61000-4-2 ESD EN61000-4-3 EMC EN61000-4-4 EFT	
Humidity:	5 - 90% RH (non-condensing)	
(Specifications subject to change without notice)		

Figure 28: Specifications

Appendix F.1.1. Compliance with UL Regulations

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

- The units shall be powered by listed LPS or Class 2 power supply suited to the expected operating temperature range.
- The interconnecting power connector and power cable shall:
  - Comply with local electrical code.
  - Be suited to the expected operating temperature range.
  - Meet the current and voltage rating for ProtoNode/Net
- Furthermore, the interconnecting power cable shall:
  - Be of length not exceeding 3.05m (118.3”)
  - Be constructed of materials rated VW-1 or FT-1 or better
- If the unit is to be installed in an operating environment with a temperature above 65 °C, it should be installed in a Restricted Access Area requiring a key or a special tool to gain access
- This device must not be connected to a LAN segment with outdoor wiring.

Appendix G. Limited 2 Year Warranty

FieldServer Technologies warrants its products to be free from defects in workmanship or material under normal use and service for two years after date of shipment. FieldServer Technologies 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 FieldServer Technologies personnel.

All warranties hereunder are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without FieldServer Technologies 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 FieldServer Technology'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, FieldServer Technologies 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 FieldServer Technologies for damages including, but not limited to, consequential damages arising out of/or in connection with the use or performance of the product.