

# Installation, Operation & Maintenance Manual

## EOS Interface Guide, Gateway Setup and Points List For EOS BTCII Firmware Version J1239C-345 and Previous

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**Important:** This manual contains information required for installation, operation and maintenance of this equipment. Read and follow the information in this manual and all other provided instructions, labels and markings before installing, operating or servicing this unit.

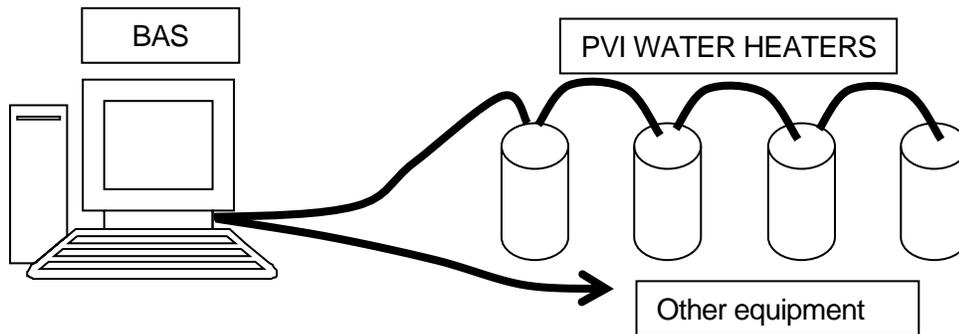
Installation and service must be performed by a qualified service installer, service agency or the gas supplier.

Hot Water Solutions

## OVERVIEW OF INTERFACE METHODS:

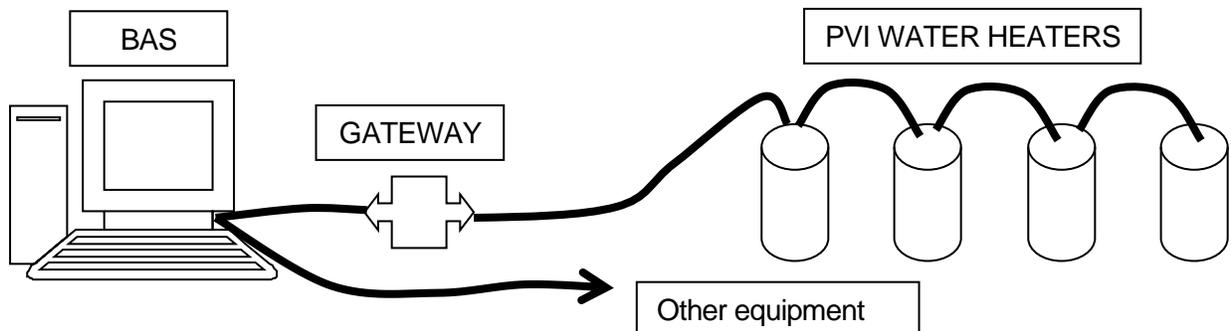
This document is a quick reference for connecting the EOS (BTCII) water heater control to a Building Automation System (BAS). Direct connection via MODBUS RTU or using a gateway to interface to protocols other than MODBUS RTU are the methods covered in this manual.

### BAS to Heaters direct, using MODBUS RTU or MODBUS ASCII:



Building Automation System (BAS) connecting directly to water heaters using MODBUS RTU twisted pair wire. (Wiring is RS-485 physical layer.)

### BAS to heaters using a Protocol Gateway:



Building Automation System (BAS) connecting to a PVI gateway. This can provide interface to BACNET MSTP, BACNET IP, LONWORKS, and MODBUS TCP.

(Wiring from gateway to heaters is RS-485 physical layer. Wiring from BAS to gateway will depend on Protocol.)

### BAS to heaters using discrete connections:

Discrete interface is the control and monitoring of the heater using dry contacts, and or analog signals. ; Typical points: External ENABLE/DISABLE contacts, remote proving contacts, remote equipment contacts, and alarm contacts. Currently the EOS does not support analog input for setpoint for Water Heaters.

## EOS USER INTERFACE:

The display (BTCII) is a touch screen interface that used resistive touch (pressure), unlike your smart phone or tablets, light touches or swipes will not register on this display. You should use your finger with a positive pressure to actuate the indicated section of the screen.



## CHECK FIRMWARE VERSION:

Confirm the firmware version you have before going any further in this interface guide.

- Enter the programming menus by holding the lower left button HOME
- Use the NEXT ITEM button to select the TOOL BOX / MENU
- Press the ENTER button in TOOL BOX / MENU
- Use NEXT ITEM to change to SW version, after the SW will be the Major version, J1239C and J1239B are the Major version this interface guide is for
- Press the ENTER button to display the minor version
- This manual is for Major version J1239C Minor 345 or before: J1239C-345
  - This manual is good for Major version J1239B & J1239C
  - If you have a newer software version, you must obtain the interface guide for that version
  - If you have J1239A version, contact PVI for a newer BTCII display if communication is required
- Hit HOME button to exit TOOLBOX and return to MENU selection
- Hit HOME button again to exit MENU selection section and return to the VIEW screens

### EOS HEATER MODBUS SETTINGS:

The default (as it ships from factory) MODBUS Address is 1. Recommend starting at 1 and counting up. This example shows the settings for using a PVI gateway. If interfacing directly with MODBUS RTU, configure as required.

Home Button.  
Return to the 'Home'  
Screen from any  
menu. Press and hold  
for 3 seconds to  
access the  
programming menu



#### Steps to change or confirm MODBUS settings on heater:

- Enter the programming menus by holding the lower left button HOME
- Use the NEXT ITEM button to select the TOOL BOX menu
- Press the ENTER button in TOOL BOX menu
- Use the UP / DOWN arrows to change user to installer
- Hold the #4 button (On bottom next to ITEM BACK) until it shows ADV USER
- Press HOME button until it shows TOOLBOX / MENU
- Use the NEXT ITEM to get to NETWORK / MENU
- Press ENTER button
- You should only need to change the MODBUS ADDRESS, and only if you need it to be something other than the default of 1. Use the NEXT ITEM and arrows to configure the following parameters:
- ADDRESS: 1 (change to desired MODBUS address)
- DATA TYPE: RTU (Default and setting for PVI gateway)
- BAUD RATE: 19K2 (Default and setting for PVI gateway)
- PARITY: EVEN (Default and setting for PVI gateway)
- Exit by hitting the HOME button

## EOS MODBUS RTU PROTOCOL

The MODBUS RTU protocol is an established industry protocol and technical references are readily available on the Internet.

### Data Types Used

The BTCII EOS only uses two data types, Holding Registers (16 bits), and Input Registers (16 bits). They are addressed based on offset of a base address.

- 5 Digit Modbus addressing:
  - Holding Registers (40001 – 49999) or (40001 + offset of 0 - 9998) Read/Write
  - Input Registers (30001 – 39999) or (30001 + offset of 0 - 9998) Read only
- 6 digit Modbus addressing:
  - Holding Registers (400001 – 465536 or 400001 + offset of 0 - 65535) Read/Write
  - Input Registers (300001 – 365536 or 500001 + offset of 0 - 65535) Read only

Other data types such as Coils are not implemented in the BTCII EOS control. Only the data points in the POINTS LIST should be accessed.

### The RS-485 PORT, Physical Layer RS-485

MODBUS RTU uses the physical layer RS-485

RS-485 (EIA-485): A 2 wire (twisted pair) multi drop network. Each device can send data by holding positive and negative voltage on the line and reversing polarity on the 2 wires. When no devices are transmitting, the line will be tri-state. The recommended arrangement of the wires is as a connected series of point-to-point (multi-dropped) nodes, i.e. a line or bus, not a star, ring, or multiply connected network. The number of devices that can be connected to a single line is defined in the RS-485 standard by the input impedance of 32 UNIT LOADs. The wire and circuits interfacing on this 2 wire connection is considered the PHYSICAL LAYER. (RS-485 is the same physical layer as used with BACNET MSTP.)

No provisions for biasing resistors or termination resistors are provided on the EOS BTCII control. If required, this will need to be provided externally.

Note, the PVI gateway does provide biasing (default) and can provide a termination resistor.

## WIRING OF EOS TO BAS (Direct, no Gateway):

On back side of the touch screen is 3 position screw terminals.

Field connection for BAS	BTCII (#1) Back of display	BTCII (#2) Back of display	Testing VDC	Results for proper hookup
RS 485 +, D+	A(-)	A(-)	Positive lead	+ 0.100 To
RS R85 -, D-	B(+)	B(+)	Negative lead	+ 5.500
GND	Gnd	Gnd		

Ensure the proper polarity, check with a Digital Volt Meter set to Volts DC. Take a reading at the back of the BTCII EOS display, from the A(-) Terminal to the B(+) Terminal. The A(-) should be the positive lead when connected.



### The RS-485 PORT: MODBUS RTU

Note that the A(-) connects to D+ and B(+) connects to D-.

This is very easy to get wrong.

## ITEMS REQUIRED FOR GATEWAY INTERFACE:

One or more water heaters with a BTCII EOS control (touch screen LCD).

Protonode Gateway with Power supply adapter (when ordering, please specify what protocol is required; BACNET MSTP, BACNET IP, LONWORKS or MODBUS TCP).

Protonode Gateway Manual (Covers general information for the gateway).

PV7069-EOS-INTERFACE.PDF Interface manual that covers specifics for interfacing with the BTCII EOS system. Also includes the points list for the BTCII EOS control system. (This document.)

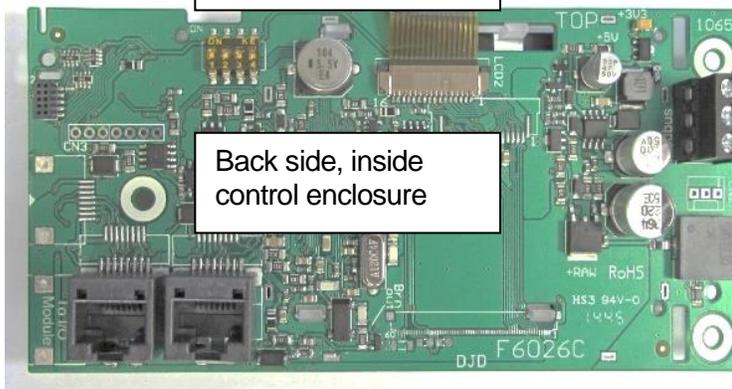
120VAC power outlet for the power supply.

Computer with web browser and Ethernet connection capability to configure gateway.

Identify the equipment and confirm you have a BTCII EOS control. The heaters should have a touch screen control as shown below. The gateway is a grey module that has a wall wart style power supply.



Water Heater BTCII - EOS User Interface



Back side, inside control enclosure

Protocol Gateway



## WIRING BAS TO GATEWAY AND THEN GATEWAY TO EOS:

Each gateway has 3 connection points.

The 6 position terminal block contains connection for power and MODBUS RTU (going to heaters).

The Ethernet port is for configuration, BACNET IP, or MODBUS TCP.

The 3 or 2 pin terminal is for the BAS interface: BACNET MSTP, or LONWORKS.

### Power Connection:

Gateway power supply, 6 position terminal +PWR, -PWR

Use supplied wall wart style power supply. 15VDC. Do not power other devices with same power supply.

If power adapter has not already been connected, cut and discard the connector on the end, strip and terminate the power adapter in the proper terminals. Verify polarity. If another supply is to be used, it must be isolated. Do not use 24VAC power from heater.

### Gateway Connection to Heaters:

Wiring from Gateway to the heaters, use twisted pair wire.

Connector on the back side of the heater's LCD →

The wiring is standard 2 wire RS-485 wiring. You will connect all devices together in a daisy chain. We recommend the gateway to be at the start of this connection.



Gateway 6 Pos. terminal	BTCII (#1) Back of display	BTCII (#2) Back of display
Tx/+	A(-)	A(-)
Rx/-	B(+)	B(+)
GND	Gnd	Gnd

### Building Automation Connection:

BAS protocol	Connection Port on Gateway	Labeled
BACNET MSTP	3 TERMINAL CONNECTOR	FIELD
BACNET IP	ETHERNET PORT	ETHERNET
LONWORKS	2 TERMINAL CONNECTOR	LonWorks
MODBUS TCP	ETHERNET PORT	ETHERNET

## GATEWAY CONFIGURATION CONNECTION:

Both the LONWORKS and BACNET gateway have an Ethernet port. Connect the computer using a patch cable or cross-over cable to establish a direct connection to the gateway. Older units may require a cross-over cable or two patch cables with an Ethernet switch. If using BACNET IP or MODBUS TCP interface, connect the BAS Ethernet cable to the gateway when configuration is complete.

At this point, each heater and the gateway should all be powered, and have all wiring finished. The RUN LED will toggle every second to indicate the gateway is running.

## CONFIGURE GATEWAY DIP SWITCHES:

The ON position is toward the center of the module, and OFF is toward the edge of the module. Only the BACNET gateway requires dip switch settings. The BACNET gateway is used for MODBUS TPC also.

### DIP SWITCHES S0-3 PROTOCOL

Set Protocol (BACNET and MODBUS gateway only):

The gateway protocol is determined on power up by looking at the “S” dip switches.

If the protocol is changed, the configuration/profiles must be cleared and reconfigured. This is done with the HTML interface.

MODBUS RTU does not require a gateway.

LONWORKS: Configured in hardware, no need to adjust dip switches.

Protocol	S0	S1	S2	S3
BACNET IP	OFF	OFF	OFF	OFF
BACNET MSTP	ON	OFF	OFF	OFF
MODBUS TCP	OFF	ON	OFF	OFF
MODBUS RTU	ON	ON	OFF	OFF

### DIP SWITCHES B0-4 BAUD

3PIN CONNECTOR TO BAS, Configure BAUD:

Default is 38400.

Configures the Baud rate for the 3 position terminal block.

This is the connection that will connect to the Building Automation System (BAS).

This is used only when the protocol is BACNET MSTP.

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

### A0-7 (BACNET MSTP) MAC ADDRESS:

Default is MAC address 3.

Configure the MAC address for the BACNET Gateway by summing the “A” dip switches that are ON.

MAC address range: 1 – 127

1	2	4	8	16	32	64		<-sum for address	
A0	A1	A2	A3	A4	A5	A6	A7	Address	
OFF	0	Invalid							
ON	OFF	1							
OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	2	
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	3*	Default
OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	4	
ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	5	
OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	6	
ON	ON	ON	OFF	OFF	OFF	OFF	OFF	7	
OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	8	
ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	9	
OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	10	
ON	OFF	127							

## CONFIGURE THE GATEWAY USING THE HTML INTERFACE:

This section will provide the parameters required for the BTCII EOS control. For more details of the gateway, consult the gateway manual. Connect your computer's Ethernet port to the Ethernet port of the gateway. Using a web browser, browse to the gateway at IP address: **192.168.1.24** default (If you have changed the IP address, go to the appropriate address.)

If the device IP address has been changed and is not known, a utility is available from Feildserver.com. Contact Fieldserver for more information.

Menu options vary depending on if you are configuring a LONWORKS gateway, BACNET Gateway set for BACNET IP, a BACNET gateway set for BACNET MSTP, or a BACNET gateway set for MODBUS TCP.

Using your browser, set the following and SUBMIT after each change

**MODBUS RTU Baud Rate:** 19200 (EOS uses 19200 by default, recommended)

**MODBUS RTU Parity:** EVEN (Recommended setting)

**MODBUS RTU Data Bits:** 8 (Must use 8 data bits for EOS)

**MODBUS RTU Stop Bits:** 1 (Must be 1 with PARITY, if parity = NONE, must be 2 for EOS)

(BACNET options)

**BACNET Network Number:** Must be unique network number on BACNET network

**BACNET Node Offset:** This will be used to create the DEVICE INSTANCE. Sum the device MODBUS Address and this number. Example 50000 Node Offset + MODBUS address 1 = 50001 Device Instance. Each MODBUS device will have its own Device Instance number

(BACNET MSTP option)

**BACNET MSTP Max Master:** 127

(BACNET IP option)

**BACNET IP Port:** 47808 (Default)

**BACNET COV:** COV Disable

(BACNET MSTP option)

**BACNET BBMD:** - (Default "-", enabling this is an advanced feature, not recommended)

**BACNET Router:** NO for 1 water heater, YES for multiple water heaters

## SELECT THE DEVICE TYPE (BACNET & LONWORKS):

Press the **ADD** button, under **Node ID** enter the MODBUS address of the first heater. Typically you will have the nearest heater setup as MODBUS address 1, and the next heater MODBUS address 2. All heaters ship from factory with MODBUS Address set to 1. Each heater must have a unique MODBUS address. (See previous section **Setup heater MODBUS address.**)

Under **Current profile**, select the proper interface for the EOS water heater control.

For BACNET Gateway: Select

**BAC\_IP EOS Water Heater** for BACNET IP

**BAC\_MSTP EOS Water Heater** for BACNET MSTP

For LONWORKS Gateway: Select **LON EOS Water Heater**

Press the **Submit** button.

Add additional devices as required.

After adding all devices, restart the gateway by clicking the **SYSTEM RESTART** button.

## CONFIRM OPERATION:

### Heater Communication:

Communication between gateway and heaters is evident by rapid flashing of the TX and RX LEDs on the gateway. If only the TX is flashing (may be as slow as 30 seconds between flashes), that will indicate no response from the heaters.

### Building Automation System Communication:

Using the HTML interface, you can confirm some operations and under USER MESSAGES, confirm there are no errors messages. At this point, the BAS will need to discover the gateway and implement the points into its integration.

## TROUBLESHOOTING GATEWAY:

- ERR Red LED on
  - Gateway is reporting an error
  - Connect to gateway with HTML interface to view error messages
- PWR LED not on
  - Confirm power on +PWR and –PWR
- TX & RX not flashing
  - Confirm connections to heaters and MODBUS addressing
  - Confirm gateway has been configured
- TX flashing, RX not flashing
  - Gateway is talking to EOS, but not getting response from EOS. Confirm wiring, confirm EOS is configured to proper address, Baud, Parity, Stop bits

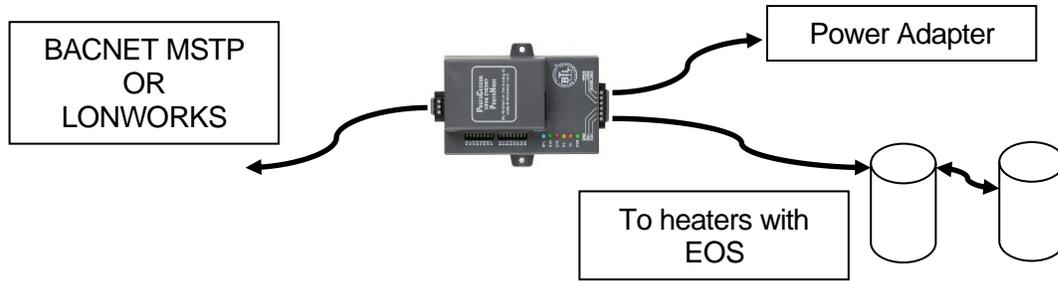
### Verify polarity of all connections:

Set a Digital Volt Meter to read DC Volts. (Capable of reading less than 1.0VDC)

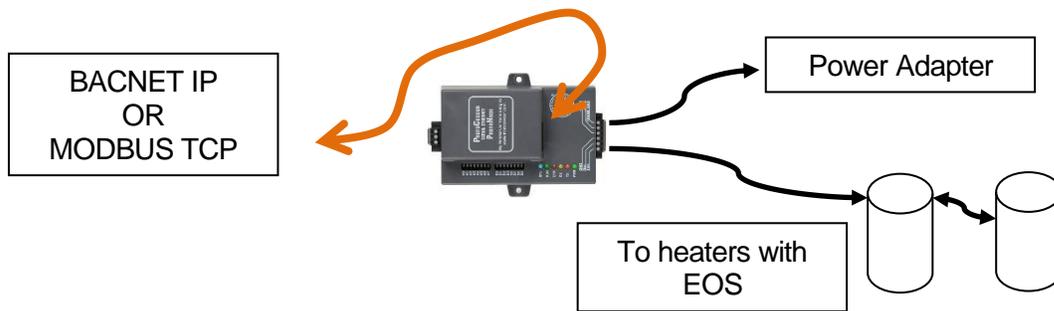
Pos. (red) Probe	Neg. (black) Probe	Min	Max	Actual Reading
Gateway 6 pin terminal block				
+PWR	-PWR	+9.0VDC	+30VDC	
Tx/+	Rx/-	+0.1VDC	+5.5VDC	
Gateway 3 pin terminal block (BACNET MSTP only)				
RS 485 +	RS 485 -	+0.1VDC	+5.5VDC	
BTCII 3 pin terminal block (Each heater)				
A(-)	B(+)	+0.1VDC	+5.5VDC	
A(-)	B(+)	+0.1VDC	+5.5VDC	
A(-)	B(+)	+0.1VDC	+5.5VDC	
A(-)	B(+)	+0.1VDC	+5.5VDC	
A(-)	B(+)	+0.1VDC	+5.5VDC	

## HOOKUP OVERVIEW:

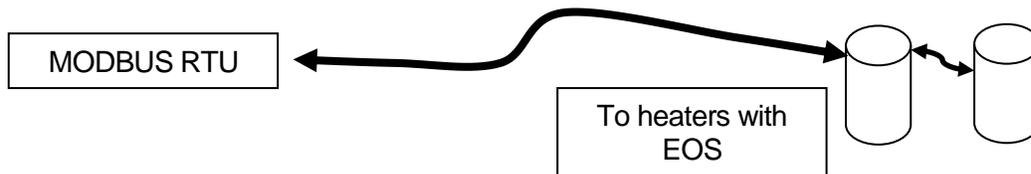
### BACNET MSTP or LONWORKS



### BACNET IP or MODBUS TCP



### MODBUS RTU Direct Connect



## APPLICATION SPECIFICS:

Each product that uses the BTCII EOS control may have subtle differences. The following products address the important information regarding each device.

### Conquest 100 Gallon (199 – 299) & 130 gallon 399:

Model Numbers: 20 L 100A-GCL, 25 L 100A-GCL, 30 L 100A-GCL, 40 L 130A-GCL

**Ext Enable:** Terminals R1 – R2, Jumper to enable. Heater ships with jumper on this. An external enable/disable can be attached to this. You can monitor the state of this input. 1 = enabled.

**Upper Tank Temp:** is a temperature probe in the top of the tank.

**High Limit Temp:** is a 2<sup>nd</sup> sensor in the same mechanical probe as the **Upper Tank Temp** probe. This is used as a safety.

**Lower Tank Temp:** Temperature of the mid-section of the tank, this sensor controls the agitator pump.

**Vent Temp:** Temperature of the Flue gasses exiting the heater.

**Modulation:** Not used on this equipment.

**Pump Status:** This is the agitator pump ON/OFF.

**Pump Runtime:** Hours on for agitator pump.

#### Discrete connections:

Enable/Disable: R1 – R2 (Input to heater) Closed = ENABLE.

Alarm: A1 & A2 (Output from Heater) Closed = ALARM.

Remote Equipment / Burner ON: P1 – P2 (Output from Heater) Closed – Heater is heating.

Remote Proving: C1 – C2 (Input to heater).

- Closed = Remote device is ready, it is OK to operate the burner.
- Open = Remote device is not ready. If the heater has a call for heat, this will cause an error if not resolved within a few minutes.

### Conquest 130 Gallon (500 – 800):

Model Numbers: 50 L 130A-GCML, 60 L 130A-GCML, 70 L 130A-GCML, 80 L 130A-GCML

**Ext Enable:** Terminals R1 – R2, Jumper to enable. Heater ships with jumper on this. An external enable/disable can be attached to this. You can monitor the state of this input. 1 = enabled.

**Upper Tank Temp:** is a temperature probe in the top of the tank.

**High Limit Temp:** is a 2<sup>nd</sup> sensor in the same mechanical probe as the **Upper Tank Temp** probe. This is used as a safety.

**Lower Tank Temp:** Temperature of the mid-section of the tank, this sensor controls the agitator pump.

**Vent Temp:** Temperature of the Flue gasses exiting the heater.

**Modulation:** Represents signal sent to fan motor.

**Pump Status:** This is the agitator pump ON/OFF.

**Pump Runtime:** Hours on for agitator pump.

#### Discrete connections:

Enable/Disable: R1 – R2 (Input to heater) Closed = ENABLE.

Alarm: A1 & A2 (Output from Heater) Closed = ALARM.

Remote Equipment / Burner ON: P1 – P2 (Output from Heater) Closed – Heater is heating.

Remote Proving: C1 – C2 (Input to heater).

- Closed = Remote device is ready, it is OK to operate the burner.
- Open = Remote device is not ready. If the heater has a call for heat, this will cause an error if not resolved within a few minutes.

**Power VTX:**

Model Numbers: 50 L 225A-PVX, 75 L 225A-PVX, 100 L 225A-PVX

**Ext Enable:** Terminals R1 – R2, Jumper to enable. Heater ships with jumper on this. An external enable/disable can be attached to this. You can monitor the state of this input. 1 = enabled.

**Upper Tank Temp:** is a temperature probe in the top of the tank.

**High Limit Temp:** is a 2<sup>nd</sup> sensor in the same mechanical probe as the **Upper Tank Temp** probe. This is used as a safety.

**Lower Tank Temp:** Temperature of the mid-section of the tank, this sensor controls the integral tank circulator pump.

**Vent Temp:** Temperature of the Flue gasses exiting the heater.

**Modulation:** Represent signal sent to fan motor.

**Pump Status:** This is the agitator pump ON/OFF.

**Pump Runtime:** Hours on for agitator pump.

**Discrete connections:**

Enable/Disable: R1 – R2 (Input to heater) Closed = ENABLE.

Alarm: A1 & A2 (Output from Heater) Closed = ALARM.

Remote Equipment / Burner ON: P1 – P2 (Output from Heater) Closed – Heater is heating.

Remote Proving: C1 – C2 (Input to heater).

- Closed = Remote device is ready, it is OK to operate the burner.
- Open = Remote device is not ready. If the heater has a call for heat, this will cause an error if not resolved within a few minutes.

## POINTS LIST:

The gateway will provide a full points list, including typical points and advanced points. Normal interface will only require the TYPICAL POINTS. For future expansion and custom applications, many points are provided designated as ADVANCED POINTS and not advised to be used in normal integration. The Advanced Points are present for the purpose of future development and custom applications. Please consult factory if any points in the ADVANCED POINTS LIST are required.

### Key:

LONWORKS shows multiple devices connected with a device number suffix, (#) represent the device. MODBUS address with “:” to designate single bit usage of register. Number following colon represents bit location, 0 is the least significant bit.

Point Name	Read/Write	Short Description	
<i>MODBUS</i>	Register Type	Address Offset	MODBUS Address
<i>BACNET</i>	BACNET Name	Object Instance	BACNET Units
<i>LONWORKS</i>	Lon Read name_#	Lon Write name_#	Lon Units
Notes			

## TYPICAL POINTS:

The points that are typically used to interface with the heater.

### TYPICAL POINTS:

Enable	Read/Write	Enable Heater 1=on 0 = off	
<i>MODBUS</i>	Holding Register	100	40101
<i>BACNET</i>	Enable	40101	
<i>LONWORKS</i>	nviEnable_#	nvoEnable_#	
<b>Note:</b> This can be used to prevent the heater from heating via communication. 0 = off, 1 = on			

Heater Setpoint Occ	Read/Write	Water Heater Setpoint Occ	
<i>MODBUS</i>	Holding Register	101	40102
<i>BACNET</i>	Enable	40102	Deg-F
<i>LONWORKS</i>	nvoHtSPOcc_#	nviHtSPOcc_#	Deg_F
<b>Note:</b> This is the setpoint for the heater. Signed 16 bit integer.			

Heater Setpt UnOcc	Read/Write	Heater Setpt UnOcc	
<i>MODBUS</i>	Holding Register	102	40103
<i>BACNET</i>	Heater Setpt UnOcc	40103	Deg-F
<i>LONWORKS</i>	nvoHtSPUnOcc_#	nviHtSPUnOcc_#	Deg_F
<b>Note:</b> Setpoint when scheduled setback is active, typically not used with water heaters.			

Ext Enable	Read Only	External Enable	
<i>MODBUS</i>	Input Register	15	30016
<i>BACNET</i>	Ext Enable	30016	
<i>LONWORKS</i>	nvoExtEnable_#		
<b>Note:</b> Input on J1-9. With signal on terminal J1-9, the heater is enabled to operate. To discretely disable the heater, open the connection between J1-10 and J1-9.			

**TYPICAL POINTS:**

<b>Ignition Status</b>	Read Only	Ignition 0=Idle 3=Burn 5=Fail	
<i>MODBUS</i>	Input Register	101	30102
<i>BACNET</i>	Ignition Status	30102	
<i>LONWORKS</i>	nvoIgnStatus_#		
<b>Note:</b> This goes through the cycle of the burner. 0=IDLE, 1=PREPurge, 2=IGNition, 3=BURNer ON, 4=postPURG, 5=FAIL.			

<b>Upper Tank Temp</b>	Read Only	Top of Tank Temperature	
<i>MODBUS</i>	Input Register	102	30103
<i>BACNET</i>	Upper Tank Temp Cur	30103	Deg-F
<i>LONWORKS</i>	nvoUpTkTmpCr_#.		Deg_F
<b>Note:</b> Typically this will be the probe at the top of the tank. Terminal J7-4 & J7-3 common. Signed 16 bit integer. This probe has a 2 <sup>nd</sup> sensor, see High Limit Temp.			

<b>Lower Tank Temp</b>	Read Only	Lower Tank Temperature	
<i>MODBUS</i>	Input Register	105	30106
<i>BACNET</i>	Lower Tank Temp Cur	30106	Deg-F
<i>LONWORKS</i>	nvoLoTkTmpCr_#.		Deg_F
<b>Note:</b> Typically this will be the temperature probe at the lower section of the Tank. J9-3 & J9-1. Signed 16 bit integer.			

<b>Vent Temp</b>	Read Only		
<i>MODBUS</i>	Input Register	108	30109
<i>BACNET</i>	Vent Temp Cur	30109	Deg-F
<i>LONWORKS</i>	nvoVentTmpCr_#		Deg_F
<b>Note:</b> Typically this is the temperature probe at the flue vent. Used on some products to monitor the flue gas temperature exiting the heater. J9-4 & J9-2. Signed 16 bit integer.			

<b>High Limit Temp</b>	Read Only	Top of Tank 2nd Temperature	
<i>MODBUS</i>	Input Register	111	30112
<i>BACNET</i>	High Limit Temp	30112	Deg-F
<i>LONWORKS</i>	nvoHiLimTmp_#		Deg_F
<b>Note:</b> This is the High Temperature Limit, this is a 2 <sup>nd</sup> sensor in the same probe as the Upper Tank Temp. Sensor connections J7-1 and J7-3 common. Signed 16 bit integer.			

<b>Modulation</b>	Read Only	Rate between 0-100 to represent modulation	
<i>MODBUS</i>	Input Register	112	30113
<i>BACNET</i>	Modulation	30113	
<i>LONWORKS</i>	nvoModul_#		
<b>Note:</b> Provide a number to represent modulation. 0-100.			

<b>Flame Current</b>	Read Only	Flame Current for proof of flame	
<i>MODBUS</i>	Input Register	113	30114
<i>BACNET</i>	Flame Current	30114	
<i>LONWORKS</i>	nvoFlmCurr_#		
<b>Note:</b> Returns a number that represents approximate flame current. Flame current is used to verify a flame is present, or loss of flame. 10 = 1µA, or 0.000001 Amps 40 = 4µA, or 0.000004 Amps.			

<b>Burner Runtime</b>	Read Only	Burner Runtime Hours 0-65535	
<i>MODBUS</i>	Input Register	114	30115
<i>BACNET</i>	Burner Runtime	30115	
<i>LONWORKS</i>	nvoBrnRunTm_#		
<b>Note:</b> Number of hours the burner has been enabled. Once it reaches 65536 it rolls to zero. (65535 hours is about 7 ½ years of burner enabled time) Unsigned 16 bit integer.			

**TYPICAL POINTS:**

<b>Burner Cycles</b>	Read Only	Number of burner cycles 0-65535	
<i>MODBUS</i>	Input Register	115	
<i>BACNET</i>	Burner Cycles	30116	
<i>LONWORKS</i>	nvoBrnCyc_#		
<b>Note:</b> Each time the control attempts to start the burner, this counter is incremented. Once the counter reaches 65535, it will roll over to zero on next attempt.			

<b>Pump Status</b>	Read Only	Pump Status ON/OFF	
<i>MODBUS</i>	Input Register	116	30117
<i>BACNET</i>	Pump Status	30117	
<i>LONWORKS</i>	nvoPmpStat_#		
<b>Note:</b> Relay 3 status. J14-2.(J14-5 Common) Typically used for pump 1 = ON, 0 =OFF			

<b>Pump Runtime</b>	Read Only	Hours for Relay 3, Pump Runtime Hours	
<i>MODBUS</i>	Input Register	117	30118
<i>BACNET</i>	Pump Runtime	30118	
<i>LONWORKS</i>	nvoPmpRunTm_#		
<b>Note:</b> Total hours pump has been enabled. 0-65535 hours, rolls over to zero. (Hours for Relay 3), Unsigned 16 bit integer.			

<b>Com Status</b>	Read Only	Communication Status bit	
<i>MODBUS</i>	Input Register	NA	NA
<i>BACNET</i>	Gateway_EOS_ComStatus	200	
<i>LONWORKS</i>	nvoGWEOS_Com_#		
<b>Note:</b> This point is not generated by the heater; it is generated internally by the gateway. It is a status of the communication connection between the gateway and the heater. If active (GOOD), the gateway is talking to the heater. If inactive (NOT_PRESENT) then the gateway does not have good communication with the heater. This point may take up to 3 minutes to register properly after communication is established or interrupted. If this value if reading NOT_PRESENT, then no all over values are suspect, as the device is not communicating. Generally the Gateway will hold the last value received. The only way to ensure you have the current values from the heater is to verify this point is ACTIVE as well.			

<b>Current Error</b>	Read Only	Current Error Code	
<i>MODBUS</i>	Input Register	200	30201
<i>BACNET</i>	Current Error	30201	
<i>LONWORKS</i>	nvoCurrError_#		
<b>Note:</b> Error code for the latest error. See error code list.			

<b>Error History1 - 15</b>	Read Only	Error History Error Code	
<i>MODBUS</i>	Input Register	201-215	30202 - 30216
<i>BACNET</i>	Error History1 to 15	30202 - 30216	
<i>LONWORKS</i>	nvoErrHist1 to 15_#		
<b>Note:</b> Error code for the latest error. See error code list.			

## LIST OF ERRORS

<b>Error Codes</b>			
<i>ERROR CODES:</i>			
Code	Description		
0	No Error		
Control Display Errors (Errors generated from the control touch screen interface module.)			
1	EEPROM	4	DHW Sensor
2	Outdoor Sensor	5	Vent Limiting
3	Supply Sensor	6	FTBus Communication
<i>PIM Errors (Errors generated by the PIM module)</i>			
7	LWCO	17	Vent Hi-Limit
8	Remote Proof	18	Boiler/Tank Hi-Limit
9	Air Pressure	19	False Flame
10	Low Gas Pressure	20	OEM Card
11	Boiler Outlet/Tank Top Sensor	21	Internal Failure
12	Boiler Inlet/Tank Bottom Sensor	22	Hi-Delta
13	Vent Sensor	23	Low HSI
14	Hi-Limit Sensor	24	Low Voltage
15	Ignition Failure	25	Blower Speed
16	Flame Loss	26	High Gas Pressure
<i>tN4 Errors (Related to the communication links between multiple heaters in a linked system)</i>			
27	Master Lost	29	Device Duplicate
28	Device Lost	30	Device Error

## ADVANCED POINTS LIST:

The following points are for future expansion and custom applications. Before implementation, consult factory to confirm proper use and operation.

### Advanced Points List:

<b>A_B_Setpoint</b>	Read/Write	Boiler Setpoint	
<i>MODBUS</i>	Holding Register	0	40001
<i>BACNET</i>	A_B_Setpoint	40001	Deg-F
<i>LONWORKS</i>	nvoA_B_SP_#	nviA_B_SP_#	Deg_F
<b>Note:</b> Boiler Setpoint. Signed 16 bit integer.			

<b>A_Sanitation Enable</b>	Read/Write	Enable Sani 1=on 0 = Off	
<i>MODBUS</i>	Holding Register	103	40104:0
<i>BACNET</i>	A_Sanitation Enable	40104	
<i>LONWORKS</i>	nvoA_SanEnbl_#	nviA_SanEnbl_#	
<b>Note:</b> Enable Sanitation mode 1=on 0 = Off			

<b>A_DWH Setpoint</b>	Read/Write	Boiler DHW Setpoint	
<i>MODBUS</i>	Holding Register	1	40002
<i>BACNET</i>	A_DWH Setpoint	40002	Deg-F
<i>LONWORKS</i>	nvoA_DWHSP_#	nviA_DWHSP_#	Deg_F
<b>Note:</b> Boiler DHW Setpoint, signed 16 bit integer.			

<b>A_Pump</b>	Read/Write	Pump 1=on 0=Auto	
<i>MODBUS</i>	Holding Register	2	40003:0
<i>BACNET</i>	A_Pump	40003	
<i>LONWORKS</i>	nvoA_Pump_#	nviA_Pump_#	
<b>Note:</b> Pump 1=on 0=Auto, Relay 3 (J14-2)			

<b>A_AuxPump</b>	Read/Write	DHW Sani Pump 1=on 0=Auto	
<i>MODBUS</i>	Holding Register	3	40004:0
<i>BACNET</i>	A_AuxPump	40004	
<i>LONWORKS</i>	nvoA_AuxPump_#	nviA_AuxPump_#	
<b>Note:</b> DHW Sani Pump 1=on 0=Auto, Relay 1 (J14-1)			

<b>A_Setback SP Occ</b>	Read/Write	Setback Setpoint Occ	
<i>MODBUS</i>	Holding Register	104	40105
<i>BACNET</i>	A_Setback SP Occ	40105	Deg-F
<i>LONWORKS</i>	nvoA_StbSPOc_#.	nviA_StbSPOc_#	Deg_F
<b>Note:</b> Setback Setpoint Occ			

<b>A_Setback SP UnOcc</b>	Read/Write	Setback Setpoint UnOcc	
<i>MODBUS</i>	Holding Register	105	40106
<i>BACNET</i>	A_Setback SP UnOcc	40106	Deg-F
<i>LONWORKS</i>	nvoA_StbSPUn_#.	nviA_StbSPUn_#	Deg_F
<b>Note:</b> Setback Setpoint UnOcc			

<b>A_WWSD Occ</b>	Read/Write	Setback WWSD Occ	
<i>MODBUS</i>	Holding Register	106	40107
<i>BACNET</i>	A_WWSD Occ	40107	Deg-F
<i>LONWORKS</i>	nvoA_WWSDOcc_#.	nviA_WWSDOcc_#	Deg_F
<b>Note:</b> Setback WWSD Occ			

**Advanced Points List:**

<b>A_WWSD UnOcc</b>	Read/Write	Setback WWSD UnOcc	
<i>MODBUS</i>	Holding Register	107	40108
<i>BACNET</i>	A_WWSD UnOcc	40108	
<i>LONWORKS</i>	nvoA_IDHWE nb_#.	nviA_IDHWE nb_#	
<b>Note:</b> Setback WWSD UnOcc			

<b>A_IDHW Enable</b>	Read/Write	IDHW Enable 1=on 0 = Off	
<i>MODBUS</i>	Holding Register	108	40109
<i>BACNET</i>	A_IDHW Enable	40109	
<i>LONWORKS</i>	nvoA_IDHWSPO_#.	nviA_IDHWSPO_#	
<b>Note:</b> IDHW Enable 1=on 0 = Off			

<b>A_IDHW SP Occ</b>	Read/Write	Boiler IDHW Setpoint Occ	
<i>MODBUS</i>	Holding Register	109	40110
<i>BACNET</i>	A_IDHW SP Occ	40110	
<i>LONWORKS</i>	nvoA_IDHWSPU_#.	nviA_IDHWSPU_#	
<b>Note:</b> Boiler IDHW Setpoint Occ			

<b>A_IDHW SP UnOcc</b>	Read/Write	Boiler IDHW Setpoint UnOcc	
<i>MODBUS</i>	Holding Register	110	40111
<i>BACNET</i>	A_IDHW SP UnOcc	40111	
<i>LONWORKS</i>	nvoA_DDHWSP_#.	nviA_DDHWSP_#	
<b>Note:</b> Boiler IDHW Setpoint UnOcc			

<b>A_DDHW SP Occ</b>	Read/Write	DDHW Setpoint Occ	
<i>MODBUS</i>	Holding Register	111	40112
<i>BACNET</i>	A_DDHW SP Occ	40112	
<i>LONWORKS</i>	nvoA_DDHWSP_#.	nviA_DDHWSP_#	
<b>Note:</b>			

<b>A_DDHW SP UnOcc</b>	Read/Write	Boiler DDHW Setpoint UnOcc	
<i>MODBUS</i>	Holding Register	112	40113
<i>BACNET</i>	A_DDHW SP UnOcc	40113	
<i>LONWORKS</i>	nvoA_DDHWSPU_#.	nviA_DDHWSPU_#	
<b>Note:</b>			

<b>A_Pool SP Occ</b>	Read/Write	Boiler Pool Setpoint Occ	
<i>MODBUS</i>	Holding Register	113	40114
<i>BACNET</i>	A_Pool SP Occ	40114	
<i>LONWORKS</i>	nvoA_PoolSPO_#.	nviA_PoolSPO_#	
<b>Note:</b>			

<b>A_Pool SP UnOcc</b>	Read/Write	Boiler Pool Setpoint UnOcc	
<i>MODBUS</i>	Holding Register	114	40115
<i>BACNET</i>	A_Pool SP UnOcc	40115	
<i>LONWORKS</i>	nvoA_PoolSPU_#.	nviA_PoolSPU_#	
<b>Note:</b>			

<b>A_Outdoor Temp Cur</b>	Read Only	Outdoor Temperature	
<i>MODBUS</i>	Input Register	1	30002
<i>BACNET</i>	A_Outdoor Temp Cur	30002	
<i>LONWORKS</i>	nvoA_OutTpCr_#.		
<b>Note:</b> J2-5,6 ODR Sensor			

**Advanced Points List:**

<b>A_Supply Temp Cur</b>	Read Only	HWS Header Temperature EXT	
<i>MODBUS</i>	Input Register	4	30005
<i>BACNET</i>	A_Supply Temp Cur	30005	
<i>LONWORKS</i>	nvoA_SupTpCr_		
<b>Note:</b> J2-3,4 SYS Sensor			

<b>A_Alert Status</b>	Read Only	Alert Relay ALARM ON ANY 1=ON	
<i>MODBUS</i>	Input Register	12	30013
<i>BACNET</i>	A_Alert Status	30013	
<i>LONWORKS</i>	nvoA_AltStat_		
<b>Note:</b> Status of Alarm contact J1-1,2			

<b>A_Target Temp</b>	Read Only	Target Temperature after adj	
<i>MODBUS</i>	Input Register	0	30001
<i>BACNET</i>	A_Target Temp	30001	Deg-F
<i>LONWORKS</i>	nvoA_TrgtTmp_#.		Deg_F
<b>Note:</b>			

<b>A_DHW Temp Cur</b>	Read Only	DHW Temperature EXT	
<i>MODBUS</i>	Input Register	7	30008
<i>BACNET</i>	A_DHW Temp Cur	30008	Deg-F
<i>LONWORKS</i>	nvoA_DHWTpCr_#.		Deg_F
<b>Note:</b> J2-1,2 DHW Sensor			

<b>A_AUX Pump Stat</b>	Read Only	Auxiliary Pump Status 1=ON	
<i>MODBUS</i>	Input Register	10	30011
<i>BACNET</i>	A_AUX Pump Stat	30011	
<i>LONWORKS</i>	nvoA_AUXPpSt_#.		
<b>Note:</b> Status of Relay 1 (J14-1)			

<b>A_AUX Pump RTime</b>	Read Only	Auxiliary Pump Runtime Hours	
<i>MODBUS</i>	Input Register	11	30012
<i>BACNET</i>	A_AUX Pump RTime	30012	Hours
<i>LONWORKS</i>	nvoA_AUXPpRT_#.		Hours
<b>Note:</b> Hours on pump Relay 1			

<b>A_Setback Status</b>	Read Only	Setback 0=Occ 1 = UnOcc	
<i>MODBUS</i>	Input Register	13	30014
<i>BACNET</i>	A_Setback Status	30014	
<i>LONWORKS</i>	nvoA_SetbkSt_#.		
<b>Note:</b>			

<b>A_Auto-Diff</b>	Read Only	Auto Diff 0=Manual-FIXED 1=AUTO-PID	
<i>MODBUS</i>	Input Register	14	30015
<i>BACNET</i>	A_Auto-Diff	30015	
<i>LONWORKS</i>	nvoA_AutoDif_#.		
<b>Note:</b>			

<b>A_DHW Call</b>	Read Only	DHW Call present=0 No call=1	
<i>MODBUS</i>	Input Register	16	30017
<i>BACNET</i>	A_DHW Call	30017	
<i>LONWORKS</i>	nvoA_DHWCall_#.		
<b>Note:</b>			

**Advanced Points List:**

<b>A_EMS Signal</b>	Read Only	PIM EMS Signal 0 - 100 = 0-10VFD	
<i>MODBUS</i>	Input Register	17	30018
<i>BACNET</i>	A_EMS Signal	30018	
<i>LONWORKS</i>	nvoA_EMSSig_#.		
<b>Note:</b>			

<b>A_Boiler Cas ADR</b>	Read Only	ADR 0=None 1=Master2-X=Member	
<i>MODBUS</i>	Input Register	100	30101
<i>BACNET</i>	A_Boiler Cas ADR	30101	
<i>LONWORKS</i>	nvoA_BICsAdr_#.		
<b>Note:</b>			

<b>A_Model Number</b>	Read Only	Model Number	
<i>MODBUS</i>	Input Register	300	30301
<i>BACNET</i>	A_Model Number	30301	
<i>LONWORKS</i>	nvoA_ModNum_#.		
<b>Note:</b>			

<b>A_Firmware Revision</b>	Read Only	SVN Revision	
<i>MODBUS</i>	Input Register	301	30302
<i>BACNET</i>	A_Firmware Revision	30302	
<i>LONWORKS</i>	nvoA_FWRev_#.		
<b>Note:</b>			

<b>A_Application Ver</b>	Read Only	Application Version	
<i>MODBUS</i>	Input Register	302	30303
<i>BACNET</i>	A_Application Ver	30303	
<i>LONWORKS</i>	nvoA_AppVer_#.		
<b>Note:</b>			



