INSTALLATION & OPERATING INSTRUCTIONS

VERSA IC ®
Integrated Boiler Control

XTherm
ULTRA HIGH EFFICIENCY

XFyre ®
NINETY PLUS

MVB
Modulating Vertical Boiler

XPak FT
CONDENSING FIRE TUBE

Hi Delta
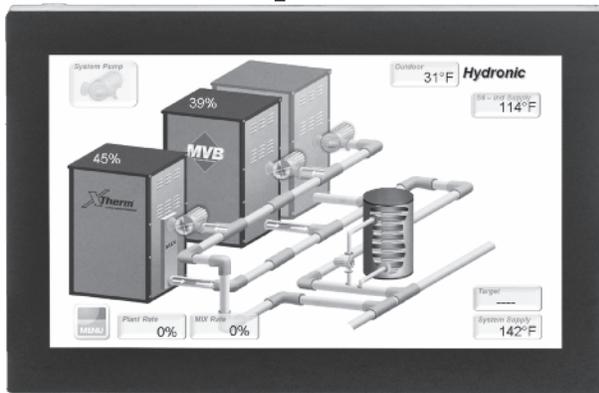
Raypak ®
A Rheem® Company

Revision 6 reflects the following changes:
Changes to: Updated Table of Contents on page 3. Updated cross reference note to "Page 71", at the bottom of Table F on page 37. Updated Fig. 40, Parallel Pump Wiring Diagram on page 55. Added "HI-DELTA" to the headings of Tables N-1 and N-2 on pages 61 and 62. Updated cross reference to "Page 70", "Tables R and S" on Troubleshooting section on page 65. Resequenced page numbers 67 through 78 and Tables R through AF.
Additions: Inserted a page and added new "Tables P and Q" for Primary/Secondary PIM Faults, Hi-Delta only on page 66.
Deletion: None.

Table Of Contents

WARNINGS

WARNING: Improper installation, adjustment, alteration, service, or maintenance can cause property damage, personal injury or loss of life. Refer to the user's information manual provided with the heater. Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

WARNING: Risk of electrical shock. More than one disconnect switch may be required to de-energize the equipment before servicing.

WARNING: When servicing or replacing any components of the control system within this unit, be certain that:
• The gas is off.
• All electrical power is disconnected.

Introduction

The Raypak VERSA IC is an appliance integrated control system consisting of the following components:

- VERSA Control Board
- VERSA Display Board
- VERSA Platform Ignition Module (PIM) in HSI, DSI or Supervised Pilot Ignition
- ID Card
- Water Sensors (up to 5)
- Outdoor Air Sensor

INLET (S2) OUTLET (S1) FIELD INSTALLED (S5, S6, S3)
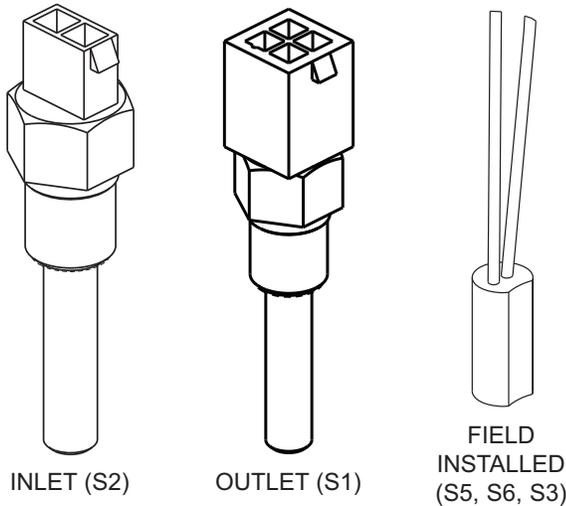
Fig. 1: Water Sensors
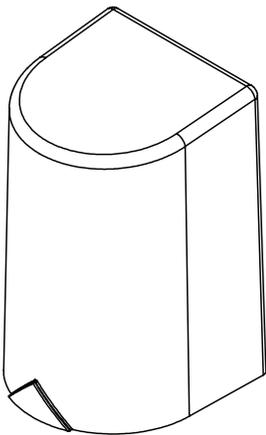
Fig. 2: Outdoor Air Sensor (S4)

The VERSA IC control system provides integrated functions of automatic ignition control, thermostat control, high temperature limit control, diagnostic enumeration, safety interlock, domestic hot water (DHW) override, Cold Water Protection (CWP) and several options for external heater control for Raypak commercial boilers, water heaters and pool heaters. The VERSA IC control system controls the heater pump, system pump and indirect DHW pump simultaneously as needed.

In addition, the VERSA IC control system allows cascading control of multiple units up to 4 units total without the need for an external sequencer. The VERSA IC control system is Modbus ready for easy external communication and control.

VERSA Control Board

The VERSA Control Board provides high-level functionality for the VERSA IC control system. See Fig. 3. It has field interlock connections, cascading heater connections and VERSA Display Board connections. The VERSA IC control system allows "limp-along" operation via the PIM if the VERSA Control Board becomes inactive or if the communications between the VERSA Control Board and the PIM are terminated for any reason. This "limp-along" mode operation is outlined in more detail starting on page 64. The VERSA Control Board is ANSI Z21.23 certified as a boiler/water heater controller and as a pool controller.
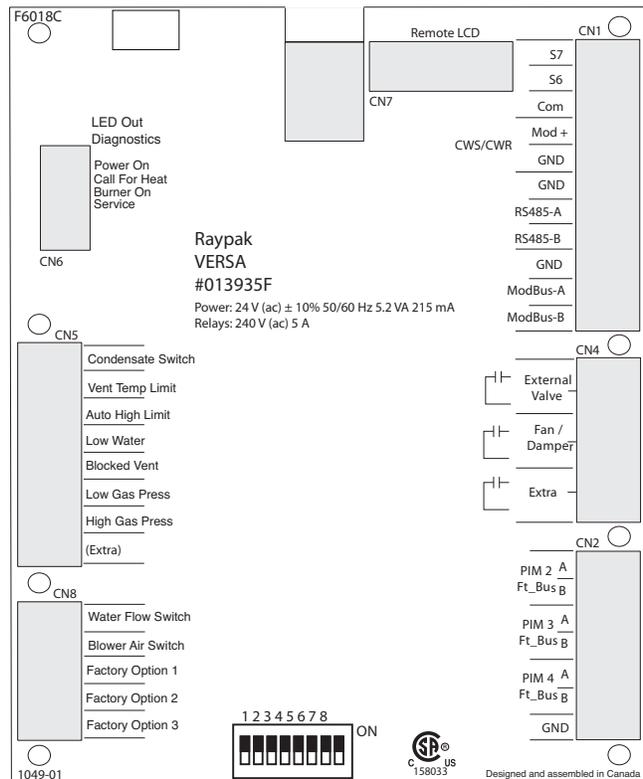
Fig. 3: VERSA Control Board

The VERSA Control Board includes connections for:

LED Indicator Lights (model specific)

CN6
- o   Green – POWER ON
- o   Amber – CALL FOR HEAT
- o   Blue – BURNER ON
- o   Red – SERVICE REQUIRED

Diagnostic Inputs
- **CN5**
  - o Condensate Switch
  - o Vent Temperature Limit
  - o Auto High Limit
  - o Low Water Cutoff
  - o Blocked Vent
  - o Low Gas Pressure
  - o High Gas Pressure
  - o Extra – (future usage)
- **CN8**
  - o Water Flow Switch
  - o Blower Air Switch (model specific)
  - o Factory Option 1 – Factory Defined (10-second delay)
  - o Factory Option 2 – Factory Defined (30-second delay)
  - o Factory Option 3 – Factory Defined (90-second delay)

Cascade Communication Connections
(Ft_bus Communication)
- **CN2**
  - o PIM 2 – A & B
  - o PIM 3 – A & B
  - o PIM 4 – A & B

External Device Triggers (dry contact)
- **CN4**
  - o External Valve
  - o Fan/Damper
  - o Extra - status (burner)

Auxiliary Sensor Inputs
- **CN1**
  - o S6 – IND Supply Sensor/Pool Return Sensor
  - o S7 – N/A

0-10 VDC Output (Cold Water Protection)
  - o Mod+/-

Communication Connections
  - o RS485 (future usage)
  - o Modbus RS485 (RTU/ASCII)

VERSA Display Connection (Ribbon Cable)

VERSA PIM Connection (RJ45 Connection)

DIP Switches (See Fig. 4)
- o #1 – Access Level
  - • **OFF – Installer**
  - • ON - Advanced
- o #2 – Cascading
  - • OFF – Follower/Slave
  - • **ON – Master**
- o #3 – Cold Water Protection
  - • **OFF – None**
  - • ON – CWS/CWR
- o #4 – Proportional Output Selection
  - • **OFF – 0-10 VDC**
  - • ON – 0-20mA (requires 500 ohm resistor)
- o #5 – N/A
- o #6 – Heater Rotation (see page 48)
  - • **OFF – No Rotation**
  - • ON – Enable Rotation
- o #7 – N/A
- o #8 – N/A
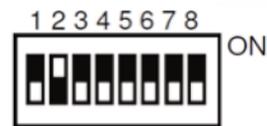
Fig. 4: VERSA Control Board DIP Switches for Master Defaults

VERSA Display Board

The VERSA Display Board is the board with the LCD display viewable from outside of the heater. See Fig. 5. All operation and settings of the VERSA IC control are accomplished through the use of the 5 buttons of the user interface. These buttons are labeled as follows:

- • **MENU – Scroll through available menus**
- • **ITEM – Scroll items within the selected menu**
- • **UP – Increase values in the Adjust menu**
- • **DOWN – Decrease values in the Adjust menu**
- • **RESET – Clear lockout**
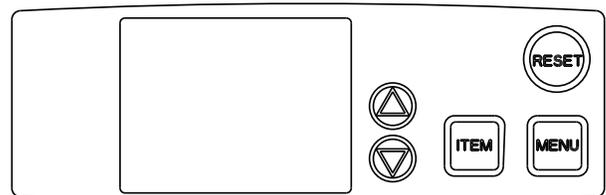
Fig. 5: VERSA Display Board

The display uses a Liquid Crystal Display (LCD) as the method for supplying information. Use the LCD to setup and monitor the operation of your heater. See Fig. 6.

When powering up the unit for the first time or recovering from a power cycle, the LCD will show a LOADING banner for approximately 10 seconds. During this period of time the board performs a self-check routine to ensure the control boards have proper parameters.

If the membrane switch remains inactive for 180 seconds (3 minutes), the screen will revert to the VIEW menu – Boil INLET unless some error/fault exists – then the fault will be displayed. Touching any button resets this timer (the timer can be seen in the bottom right corner of the display) to keep the current view.
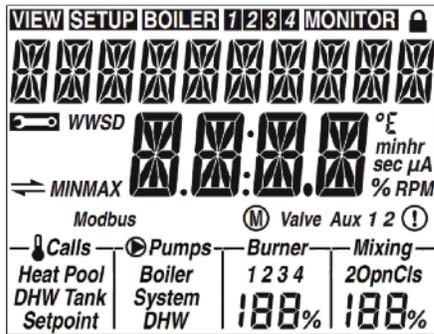
Fig. 6: Display

The VERSA Control Board has 2 access levels: Installer and Advanced. Most settings are hidden in the Installer mode. The Advanced mode can be accessed by changing the VERSA DIP switch #1 from the OFF position (Installer) to the ON position (Advanced).

WARNING: Return the VERSA control DIP switch #1 to the OFF (Installer) position after heaters are fully set up and commissioned, to prevent inadvertent changes to program settings by unauthorized personnel.

The default menu displayed is the **VIEW** menu. If there is an unresolved (active) error, then the default menu is the **TOOLBOX** menu. The default item will be the active error message. After 180 seconds of keypad inactivity, the VERSA Display will return to the default menu and display the default item.

Touch Screen Display

The Touch Screen (TS) user interface uses a high-definition capacitive screen. See Fig. 7. It includes an extensive graphical library used to represent different pipe configurations, error locations, and operation of the unit. The TS has the same basic menu distribution as the original LCD Display. When pressing the menu button the menu bar becomes visible at the bottom of the screen allowing navigation through four additional submenus (VIEW, ADJUST, BOILER, and TOOLS).
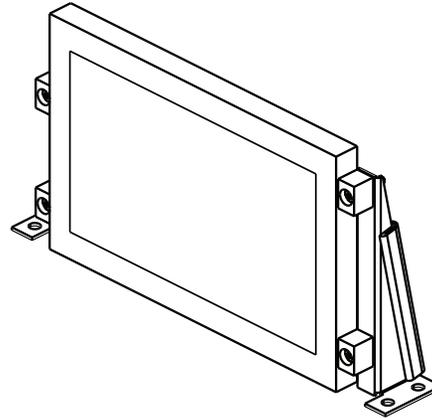
Fig. 7: Touch Screen Display

In addition to the traditional LCD display, the TS offers a few extra features, such as:

* Time stamp
* Diagnostics file
* Editable Contact information
* Touch screen adjustable parameters such as time-out, dim-out, and brightness.

To have a better understanding of the menu items and screen distribution, see Table A and Fig. 8.

TIME STAMP
A real-time clock is built into the TS to provide and hold a time stamp.

In normal operation the battery is only used during the off time periods. This is to prevent the time stamp from being formatted. The expected lifetime of the battery is between 1 to 1.5 years with a constant current draw of 0.03mA. Although time is configured during the factory verification process, it is recomended for the final user to confirm the right time setting.

DIAGNOTICS FILE
Within the TOOL menu under system category, there is a button labeled as FACTORY DIAGNOSTICS. This function will enable a recording process (5-second sampling rate) that will result in a set of files stored in the SD card provided with the TS.

When an evaluation of the overall performance of the unit is required, these files can be sent to the factory for verification.

Fig. 8: Flow Chart

MENU

VIEW
- 3D System View
- Master / Follower Info
- System View

H
- Mode
- Outdoor Enable

H
- Setpoint
- Target Max
- Target Min
- Differential
- System Purge Time

WH
- Tank Setpoint
- Tank Differential
- System Purge Time

P
- Pool Setpoint
- Pool Max
- Pool Differential
- System Purge Time

ADJUST
- Operation Settings
- System Settings
- MIX Settings
- Indirect Settings
- Outdoor Settings
- Modbus Settings

H - WH - P
- MIX Type
- MIX Target
- MIX Lock
- MIX Speed
- MIX Invert
- MIX Trim

H
- IND Sensor Enable
- IND Setpoint
- IND Differential
- Priority Enable
- Priority Ovr Timer

H
- Boiler Start
- Boiler Design
- Outdoor Start
- Outdoor Design
- WWSD

H - WH - P
- Modbus Mode
- Modbus Address
- Modbus Data Type
- Modbus Parity
- Modbus Baud Rate

BOILER
- Master / Follower
- Boiler 2
- Boiler 3
- Boiler 4
- Boiler Error History

TOOLS
- System Tools
- Touch Screen Setup
- Clock Setup
- Screen Reboot

System Tools
- Max Heat Enable
- User Test
- Defaults
- Contact Info
- VERSA / PIM Software Rev
- °C / °F Selection
- Monitor
- Factory Diagnostics Log

Touch Screen Setup
- Brightness
- Dimmer Timeout
- Page Timeout

Icon	When Displayed	Icon	When Displayed
VIEW	Menu = View	Pumps	Menu = View/Test
SETUP	Menu = Setup	Boiler Pump	Menu = View/Test and Boiler Pump is on
BOILER	Menu = Boiler View Menu of Boiler 1, 2, 3 or 4	System Pump	Menu = View/Test and System Pump is on
BOILER 1	Menu = Boiler View Menu of Boiler 1	DHW Pump	Menu = View/Test and DHW Pump is on
BOILER 2	Menu = Boiler View Menu of Boiler 2	Burner	Menu = View/Test
BOILER 3	Menu = Boiler View Menu of Boiler 3	1	Menu = View/Test and PIM 1 is on
BOILER 4	Menu = Boiler View Menu of Boiler 4	2	Menu = View/Test and PIM 2 is on
MONITOR	Menu = Monitor	3	Menu = View/Test and PIM 3 is on
(M)	Single boiler or Master Boiler in Cascade	4	Menu = View/Test and PIM 4 is on
🔒	Menu = View, Solid if Installer Access Level. Flashes at 1Hz if OEM Access Level	(Burner Rate) %	Menu = View/Test and PIM is modulating. Displays current plant firing rate.
🔧	Menu = Toolbox	ModBus	Menu = View and ModBus communication is present
WWSD	Warm Weather Shutdown is active	°C	Whenever the item displayed in the number field is a temperature and UNITS = degC
①	Menu = View, Flashes at 1 Hz if one of the connected PIMs is in Lockout. Menu = View, Solid if there is a known active error on one of the connected PIMs	°F	Whenever the item displayed in the number field is a temperature and UNITS = degF
Calls	Menu = View/Test	min	Whenever the item displayed in the number field is in minutes
Heat	Menu = View/Test and Heat Call present	hr	Whenever the item displayed in the number field is in hours
DHW	Menu = View/Test and DHW Call present	sec	Whenever the item displayed in the number field is in seconds
Pool	Menu = View/Test and Pool Call present	µA	Whenever the item displayed in the number field is in micro-amps
Tank	Menu = View/Test and Tank Call present		
Mixing	Shown whenever Cold Water Protection is enabled (VERSA DIP 3).	%	Whenever the item displayed in the number field is in percent
Setpoint	Menu = View/Test and Setpoint Call present	RPM	Whenever the item displayed in the number field is in RPM

Table A: VERSA LCD Display Symbol Descriptions

The file creation process can be aborted manually by disabling the process, or it can expire automatically after the time period defined by the user (adjustable in the same screen).

CONTACT INFO

When commissioning the equipment, it may be desirable to include contact information for the equipment supplier or Service Company. The contact information can be changed by pressing the CONTACT button in the toolbox menu followed by the EDIT button. The PASSWORD screen will appear, which allows for the contact info to be entered or modified. The default password is RAYPAKREP.

For a complete graphic description of the various screens, pages flow, and basic instructions consult the Touch Screen Quick Start User Guide (Catalog #5000.74).

VERSA PIM Module

The PIM (Platform Ignition Module) is available in DSI (Direct Spark Ignition), or HSI (Proven Hot Surface Ignition) versions depending on Raypak model type. See Fig. 9.

The PIM integrates the functions of Automatic Ignition Control with temperature regulating and control functions. The PIM is designed for a range of boilers, water heaters and pool heaters including ON/OFF, staged and modulating types. The PIM is intended to provide safe lighting and supervision of the burners in a heater.

The PIM is also designed to connect to and receive commands from the VERSA Control Board for higher-level functionality to include indirect DHW, outdoor reset, diagnostic messaging, and other system capabilities. Communication is accomplished using a proprietary protocol on the Ft_bus.

The PIM is CSA certified to the ANSI Z21.20 Standard for Thermostats and Automatic Gas Ignition Systems and Components and CAN/CSA C22.2 No. 199-M99. The VERSA PIM also complies with the UL372 Primary Safety Controls for Gas and Oil Fire Appliances (Harmonized version); UL 1998 Software in Programmable Components, 2nd edition and UL 353 Limit Controls.
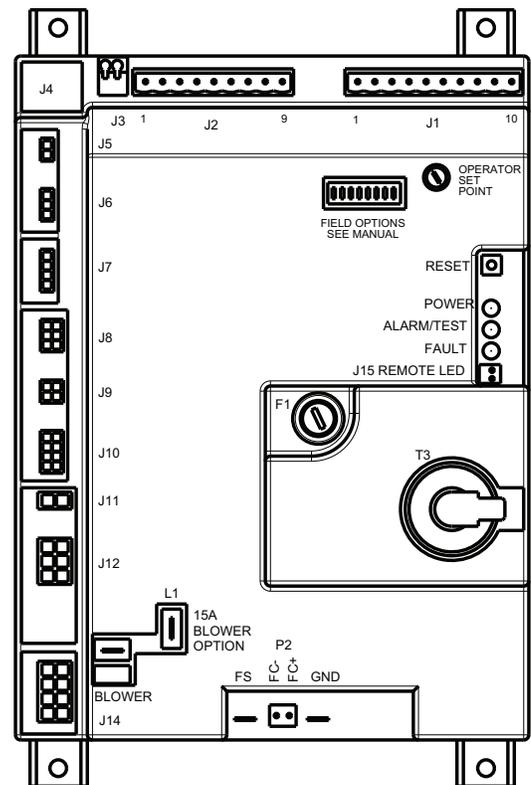
Fig. 9: VERSA DSI PIM Module

The PIM provides standard support for 10k ohm @ 77°F NTC curve J Thermistor probes. The Inlet and Outlet/Hi-Limit sensors are directly processed by the PIM. The System, Outdoor, and DHW tank sensors are also connected to the PIM, but are passed through to the VERSA Control Board which is required to provide those additional functions. Auxiliary sensors, such as the indirect supply / pool return sensor, connect directly to the VERSA Control Board for other enhanced functions depending on the mode selected. For detailed wiring information, refer to the I&O Manual for the product being installed.

PIM DIP Switches

There is an 8-position DIP switch on the PIM that can be field configurable during commissioning. The UP position is "ON" and the DOWN position of each DIP switch is "OFF". The items in **BOLD** below represent factory defaults settings.

DIP Switch #1 – Operator Differential
    ON = Manual Differential
    OFF = **Auto Differential**
DIP Switch #2 – Analog Input Type
    ON = Direct Drive
    OFF = **Target Temperature**
DIP Switch #3 – Pump Post Purge
    ON = **Pump Post Purge Active**
    OFF = Pump Post Purge Inactive
DIP Switch #4 – Pump Exercise Enable
    ON = **Pump Exercise Active**
    OFF = Pump Exercise Inactive
DIP Switch #5 – EMS/Demands
    ON = EMS Analog Input Only
    OFF = **VERSA IC Demands Only**
DIP Switch #6 – EMS Signal Type
    ON = 4-20mA*
    OFF = **0-10 VDC**
DIP Switch #7 – Freeze Protection
    ON = **Freeze Protection Active**
    OFF = Freeze Protection Inactive
DIP Switch #8 – Commission Test
    ON = Commission Test Active
    OFF = **Commission Test Inactive**

*NOTE: 4-20mA operation requires the use of an external 500Ω, 1/2W resistor.

PIM Operator Set-Point Dial

The PIM has a set-point dial that is used to determine the operator set-point applied to the boiler outlet sensor during "limp-along" operation of the VERSA IC Control System. The default position of the operator set-point applied to the boiler outlet sensor dial is the maximum set-point, which is defined by the PIM parameters defined by the ID card. The dial can be adjusted down to a user-defined level between the minimum setting of 70°F (21ºC) or the maximum allowed by the ID card. **This function is only active during "limp-along" operation (see page 64).**

VERSA IC Unit Type ID Card

The VERSA IC Identification Card (ID Card) is a small circuit card that determines the operating parameters for each individual model by unlocking the correct program within the VERSA PIM. It is permanently affixed to the chassis of the heater and MUST be present for the heater to operate. See Fig. 10.
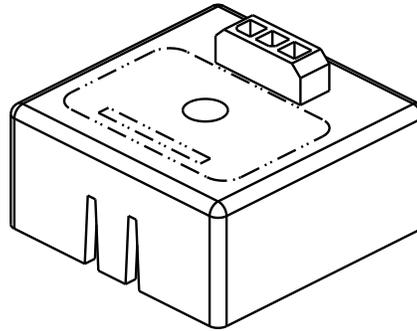
Fig. 10: VERSA PIM ID Card

DANGER: In the event of ID Card failure, field replacement can only be performed by a Raypak Employee or contracted Representative and must be replaced with an ID Card of the same number. Serious risk of severe personal injury, death or substantial property damage if not correctly serviced.

Quick Start Set-up & Programming Tips

1. Determine the piping arrangement for your particular application by referencing the Application drawings and descriptions on pages 12 to 37.

2. Install the System Sensor, Outdoor/Air Sensor, Indirect DHW Sensor as necessary as depicted in the above referenced Application drawing.

3. Wire the sensors to the VERSA IC system as described on the wiring diagram of the respective model (see model I&O wiring diagrams). Sensor wires should be routed to the heater in separate conduit.

CAUTION: Sensor and control wiring must NOT be run in conduit or chases with line voltage.

4. Ensure that the entire system is ready for operation.

    a. Water piping properly filled and purged of air?
    b. Gas pipe properly installed and purged?
    c. Electrical connections properly installed?
    d. For cascading systems:
        i.   Are communication wires properly installed between Follower PIM's and the Master VERSA IC Control? (see page 59)
        ii. Are the DIP switches properly set for Master/Follower operation?
    e. Vent properly installed and terminated?
    f. Sensor wires properly routed in separate conduit?
    g. External interlocks properly installed and wired to VERSA IC Control (louver interlock, extractor, external gas valve, etc.)?
5. For CWP (Cold Water Protection) Systems
        i.   Are the actuators properly installed? (Refer to CWP configuration page 45)
        ii. Is VERSA DIP #3 turned on?

6. Turn on system electricity to allow the VERSA IC Control to be programmed.

7. For H models go to the **ADJUST** menu and set the heater **MODE** as indicated on the Application drawing – 1, 2 or 3. (Mode 1 is for "Stand-Alone" or cascade heaters with no Indirect DHW needs; Mode 2 includes Indirect DHW in the system loop; and Mode 3 includes Indirect DHW in the boiler loop). WH and P models do not require a mode selection as they are configured only for direct DHW or pool heating operation.

8. Use the Application drawings and descriptions as a guide to set up the control.

9. A change to a value will be made as soon as you push the **ITEM** button, change the **MENU** screen, or wait until the 180-second timer expires.

10. Should any error be displayed, check the Troubleshooting Section to identify the source of the error and recommended troubleshooting ideas.

System Sensor Installation

The System Sensor (S3) is required for all selectable modes unless the units firing rate will be controlled by an external source such as our Temp Tracker MOD+ Hybrid sequencer. Proper placement and method of installation are critical for proper operation of the system. The sensor must be installed in a drywell in conjunction with heat-conductive compound as shown in Fig. 11. The drywell must be installed no more than 5 equivalent feet of pipe/tubing downstream of the de-coupler, and installed in such a way that ensures the sensor bulb is in the flow path.

CAUTION: Be careful when installing the drywell not to over-tighten the well as this can damage the well and may prevent the sensor from fitting properly.
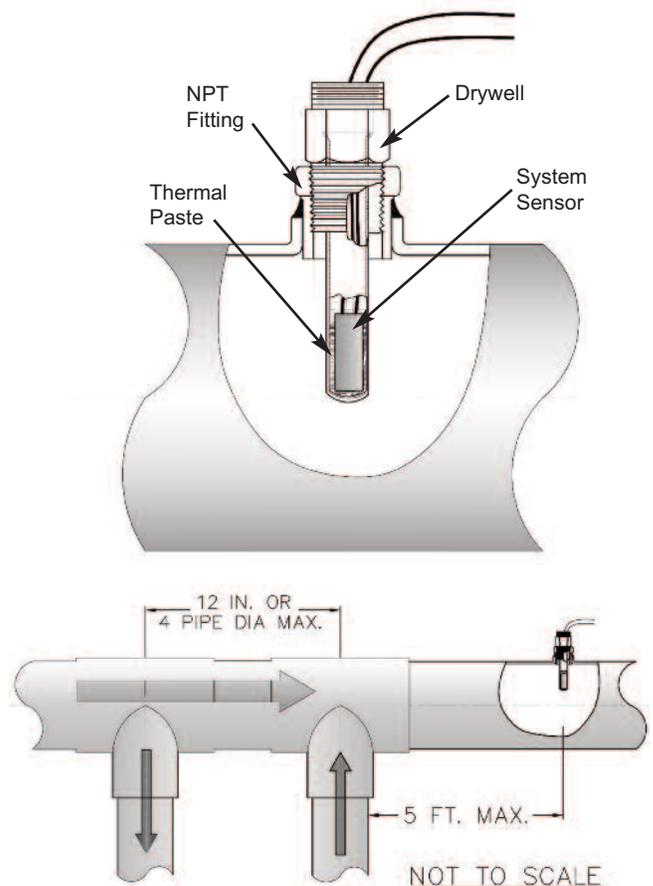
Fig 11: System Sensor Installation

Applications & Modes

The VERSA IC Control system is designed for a wide range of applications. The installer/design engineer should refer to the following drawings for configurations currently supported by the VERSA IC Control system to determine which most closely resembles the intended/installed system configuration. Refer to the section(s) of this manual for instructions outlining the piping layout, sensor locations and settings for best operation of the specific configuration shown.

Boiler Applications

Hot water heating systems all have unique levels of operating diversity that must be accounted for in the system design. The system should always include adequate system flow in excess of the connected boiler flow for proper operation. Where the system flow may drop below the connected boiler flow, a buffer/decoupler may be needed. Failure to design for adequate flow (i.e. bypasses, 3-way control valves, flow-limiting balance devices, buffer tanks, etc.) will result in boiler short-cycling and may reduce boiler life. Always contact your local Raypak representative for system design assistance to avoid these issues.

MODE 1 Hydronic Systems without Indirect DHW

This section covers single- or multiple-boiler installations used for individual hydronic heating systems without indirect DHW. The following diagrams will show single-boiler systems with and without CWP. The CWP diagrams will show an individual 3-way valve at the boiler (MIX Type = VALVE). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor (S4) to adjust the target water temperature as the outdoor air temperature changes. See Table B.

MODE 1 Single

Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency (see figures 12 and 13).

> **CAUTION:** Continous pumping through the unit is not supported and may cause a non-warrantable failure.

The boiler firing rate will be controlled by the System Sensor (S3). See **System Sensor Installation** on page 11. The VERSA IC will provide Max Delta-T (Differential Temperature) control and will cycle the burner if the Max Delta-T is exceeded between Boiler Outlet Sensor (S1) and Boiler Inlet Sensor (S2).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a proportional 3-way valve to bypass water from the boiler outlet to the inlet during operation, when the system return water temperature is below the minimum acceptable level as defined in the Installation and Operating manual for the product being installed.

The Boiler Pump (P1) runs during any call for burner operation and is delayed "off" as user-defined in the BOILER menu after the burner has shut down. The System Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized). The System Pump is delayed "off" as user-defined in the SETUP menu. MODE 1 is used for this configuration. See SETUP menu items in Table B pages 16 and 17. This configuration supports BMS 0-10 VDC input for either temperature or rate control and can be configured for connectivity to BMS via the onboard Modbus port covered later in this manual.

DIP switches #1 and #2 on the VERSA Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off.

> **NOTE:** 0-10VDC firing rate control ignores all sensors except S2 and all functions except Max Delta-T, CWP, Limit and Safety Switches.

MODE 1 Cascade

Diagrams 14-16 show cascade systems (up to 4 boilers maximum) with and without CWP. The CWP diagrams will show either an individual 3-way valve at the boiler (MIX Type = VALVE) or a single 3-way valve providing CWP to all connected boilers within the cascade (MIX Type = PLNT). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor connected to the Master unit (S4a) to adjust the target water temperature as the outdoor air temperature changes.

Reverse/return piping is shown and is recommended to ensure balanced flow through each of the connected boilers. Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency.

> **NOTE:** "a" designation represents connection is at Master boiler "A", etc.

MODE 1 Single

MODBUS — VERSA ← → PIM

ENABLE

0–10 / 4–20mA

S4

S1

S2

P1

P2

S3

1

☐ = FACTORY INSTALLED SENSOR

⬜ = FIELD INSTALLED SENSOR

△1 Maximum distance not to exceed 4 pipe diameters or 12" max.

Fig. 12: MODE 1, Hydronic Single Boiler

PIM VERSA ← → MODBUS

ENABLE

0 - 10/4 - 20m A

S4

S1

P1

S2

P2

S3

1

CWP Valve Details

GY (+ MOD)   BK (COM)   R (+24VAC)

A

B

AB

☐ = **FACTORY INSTALLED SENSOR**

⬜ = **FIELD INSTALLED SENSOR**

△1 **Maximum distance not to exceed 4 pipe diameters or 12" maximum**
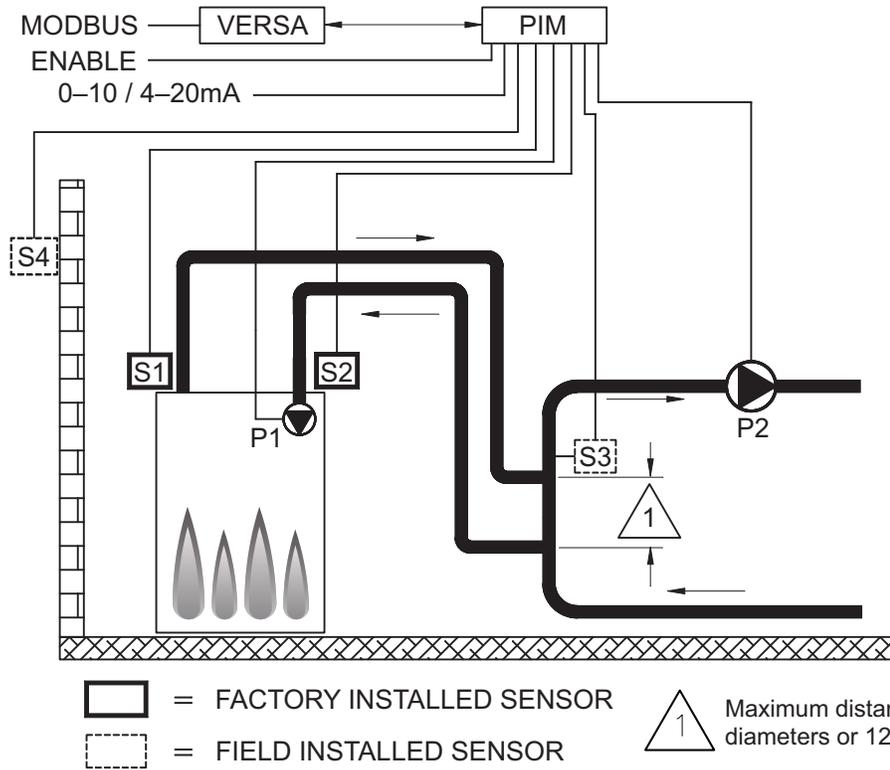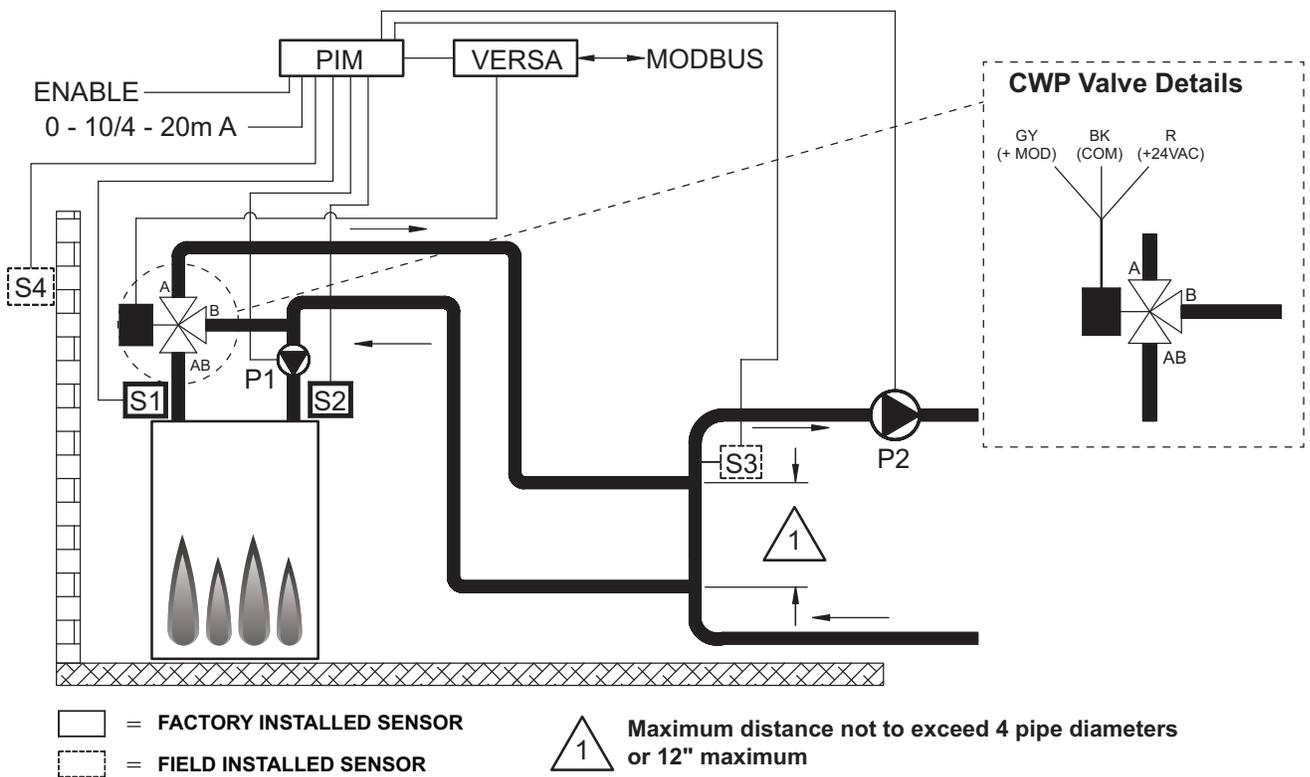
Fig. 13: MODE 1 Hydronic Single Boiler, CWP (MIX TYPE = VALVE, 3-Way)
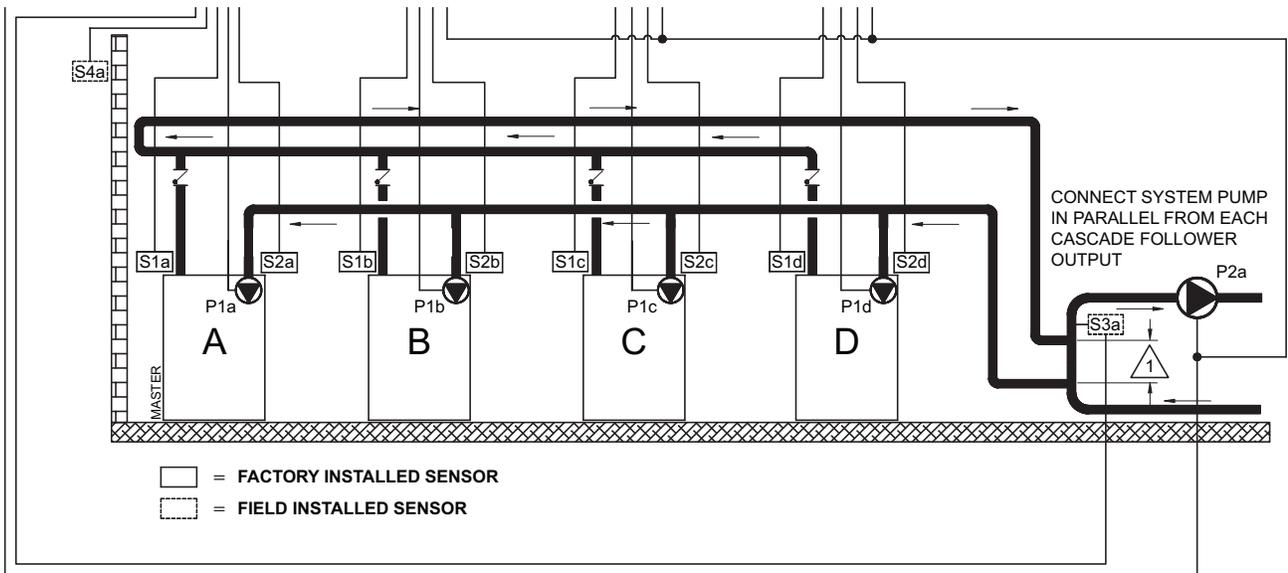
Maximum distance not to exceed 4 pipe diameters or 12" max.

Fig. 14: MODE 1 Hydronic Multi-Boiler

The cascade will be controlled by the System Sensor connected to the Master boiler (S3a). See **System Sensor Installation** on page 11. The VERSA IC of each boiler will provide Max Delta-T control to cycle the burner to ensure that the Delta-T is not exceeded (between Boiler Outlet Sensors (S1a-b-c-d) and Boiler Inlet Sensors (S2a-b-c-d)).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a proportional 3-way valve to bypass water from the boiler outlets to the inlets (S2 a-b-c-d) during operation, when the system return water temperature is below the minimum acceptable level, among all active units, as defined in the Installation and Operating manual for the product being installed.

The Boiler Pumps (P1a-b-c-d) run during any call for the burner on the boiler associated with that pump and are delayed "off" as user-defined in the BOILER menu. The System Pump (P2a) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized). The System Pump is delayed "off" as user-defined in the SETUP menu. It is recommended the system pump be connected in parallel from each cascade follower output, to allow the system pump to be functional during limp-along operation.

Each Follower boiler connects back to the Master boiler via a 2-wire connection for communication within the cascade. All sensors (System (S3a) and Outdoor Air (S4a))

connect to the Master boiler at the field wiring strip on MVB / XTherm, or the PIM J2 terminal block. Each boiler in the cascade connects to and controls its own respective Boiler Pump (P1a-b-c-d). The System Pump (P2a) gets its enable signal from the Master boiler. It is important to remember to enable a boiler to be a follower in the cascade by turning DIP switch #2 on the VERSA Control Board to the OFF position for each of the followers. Once the followers have been configured correctly you must then enable the followers within the SETUP menu of the Master boiler by turning them from OFF to ON. DIP switch #2 on the master boiler must remain ON. MODE 1 is used for this configuration. See SETUP menu items in Table B pages 16 and 17. This configuration supports BMS 0-10 VDC input for temperature control (rate control is not supported) and can be configured for connectivity to BMS via the onboard Modbus port covered later in this manual.

DIP switches #1 and 2 on the VERSA master Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off. Prior to enabling the master boiler, apply power to all units for initial programming of cascade settings. This is accomplished from the master boiler user interface.

The next menu items are not necessarily in the order in which they will appear.
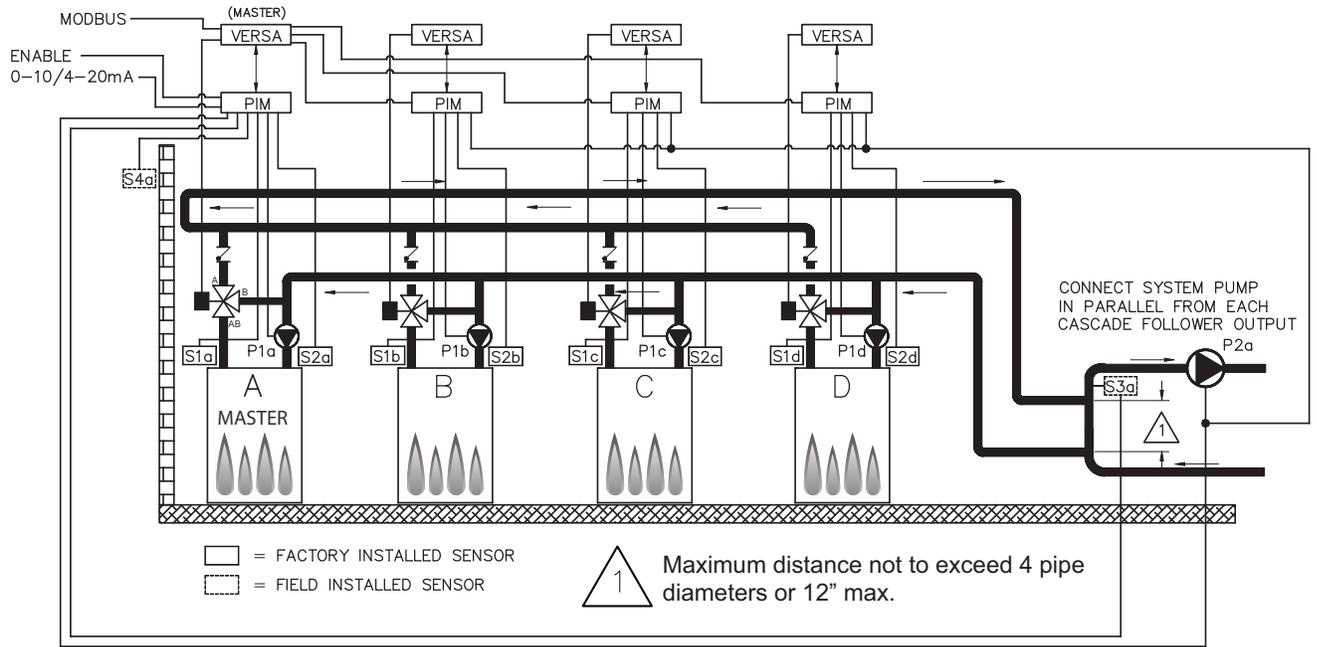
Fig. 15: MODE 1 Hydronic Multi-Boiler (MIX TYPE = VALVE)
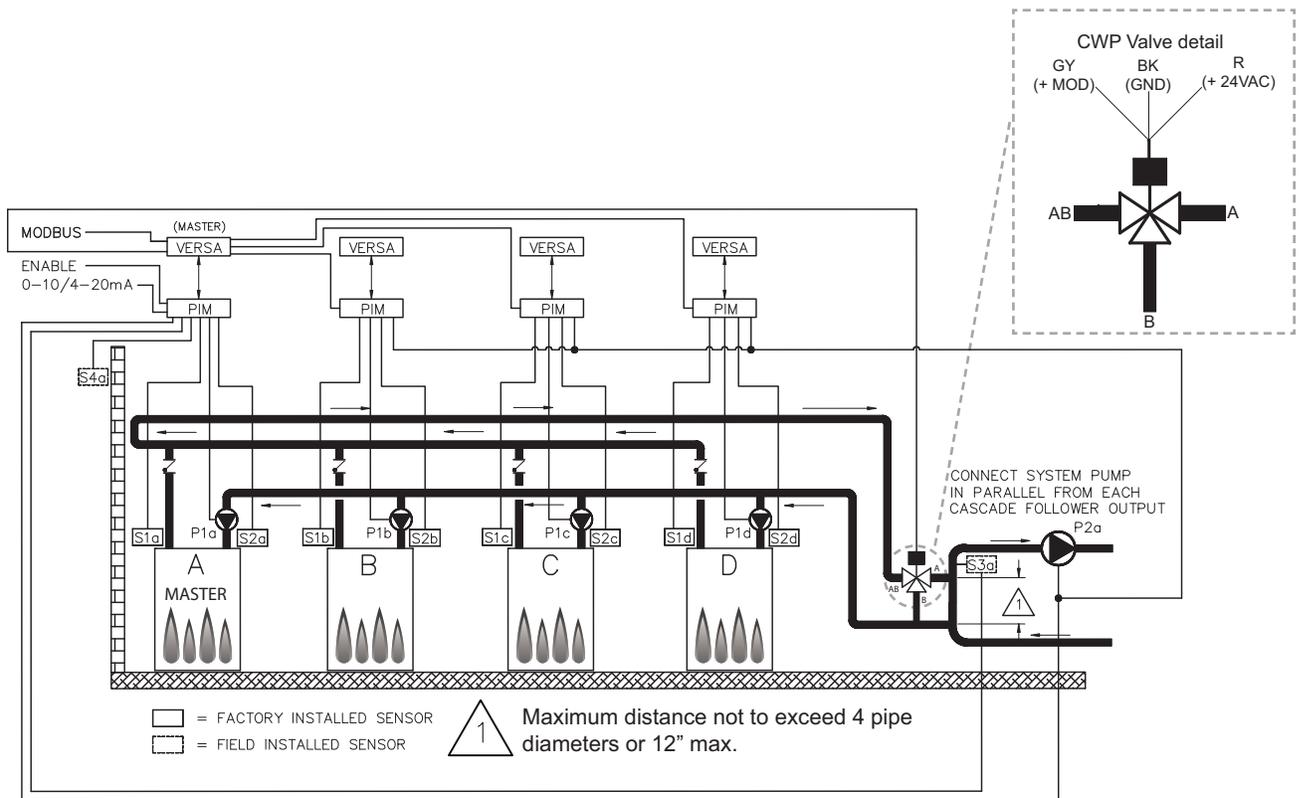
Fig. 16: MODE 1 Hydronic Multi-Boiler (MIX TYPE = PLNT)

Enable followers from appropriate BOILER menu at the master:

Item	Range	Default	User Settings	When is it Displayed	Description
BOILER 1, 2, 3, 4	ON <> OFF	OFF		Cascade Followers present	FT_Bus 1, 2, 3,4 are connected

The following settings are available in the SETUP/ADJUST Menu:

Item	Range	Default	User Settings	When is it Displayed	Description
Target	Reset - Setpoint EMS Modbus	SETP		PIM Identity is H EMS = Temp/Rate Modbus = Temp/Rate	RSET = Outdoor Reset SETP = Setpoint EMS = Energy Management System (Analog Target Temperature) MODB = Modbus
Mode	1, 2, 3	1		PIM Identity is H TARGET = Rset or Setp	Piping and application configuration
SETPOINT	XFYRE 50 TO 192°F (10 to 89ºC) XPAKFT 50 TO 192°F (10 to 89ºC) MVB/XTHERM 50 TO 220°F (10 to 104ºC)	180°F (82ºC)		PIM Identity is H	Piping and application configuration
Target Max.	XFYRE 192°F (89ºC) XPAK FT 192°F (89ºC) MVB/XTHERM 220°F (104.5ºC)	192°F (89ºC) 192°F (89ºC) 210°F (99ºC)		Modbus Rate EMS Rate PIM Identity is H	Maximum Target Boiler Temperature
Target Min.	50 to 180°F (10 to 82ºC)	50°F (10ºC)		Modbus Rate EMS Rate PIM Identity is H	Minimum Target Boiler Temperature
Sys. Purge	0:20 to 20:00 min	0:20 min		Modbus Temp/Rate PIM DIP = Purge On	Sets the length of the System Pump Purge (eg. 0:20 min = 20 seconds)
Units	F or C	F		Always	Show Units Using Icons in Display

When RESET from target screen is selected, the following items will be available for adjustment:

Item	Range	Default	User Settings	When is it Displayed	Description
Out Start	35 to 85°F (1.5 to 29.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Outdoor Reset Starting Temperature
Out Design	-60 to 45°F (-51 to 7ºC)	10°F (-12ºC)		PIM Identity is H Target = Rset	Outdoor Reset Design Temperature
Boil Start	35 to 150°F (11 to 65.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Starting Boiler Target Temperature when Outdoor Temperature is at Outdoor Start
Boil Design	70 to 200°F (21 to 93.5ºC)	180°F (82ºC)		PIM Identity is H Target = Rset	Design Boiler Target Temperature when the Outdoor Temperature is at Outdoor Design (Hottest Water on Coldest Day)
WWSD	40 to 100°F (4.5 to 38ºC)	70°F (21ºC)		Target = Rset PIM Identity is H	The System Warm Weather Shut Down Temperature

When manual differential is selected via PIM DIP switch #1, the following item will appear:

Item	Range	Default	User Settings	When is it Displayed	Description
Target Diff	2 to 42°F (1 to 23.5ºC)	10°F (5.5ºC)		PIM Identity is H PIM DIP = Manual Diff	Differential for Target Boiler Temperature

Item	Range	Default	User Settings	When is it Displayed	Description
The items below correspond to CWP operation. Ensure VERSA DIP #3 is ON to enable CWP.					
MIX TYPE	VALVE, PUMP, PLNT	VALVE		H model & MIX DIP = ON	MIX Type assumes that each individual unit will have the proper wiring and pipe configuration to control its own inlet temperature. For H models using a variable-speed Pump as a CWP method (see page 45).
MIX TARGET	50 TO 140°F (10 to 60ºC)	120°F (49ºC)		MIX DIP = ON	Inlet Target Temperature
MIX LOCK	ON / OFF	OFF		MIX DIP = ON	The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only
MIX TRIM	-5 TO 5	0		MIX DIP = ON	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak
MIX SPEED	SLOW, MED, FAST	MED		MIX DIP = ON	This setting defines speed of response.
MIX INV	ON / OFF	OFF		MIX DIP = ON	This option is related to the use of spring-return actuators with a proportional 2- or 3-way valve
When communication with BMS is required user must enable Modbus port using the settings below by selecting other than "OFF" at Mode-Modbus screen the following settings will become available.					
Mode Modbus	Off, Monitor, Temp, Rate	Monitor		Always	Modbus Operating Mode: Off, Monitor, Temp Control, Rate Control
Address	1 to 247	1		Modbus On	Modbus Slave Address (= Node ID). When using Protonode, do not use values over 127 (see Catalog No. 5000.73).
Data Type	RTU or ASCI	RTU		Modbus On	Modbus Data Type
Baud Rate	2400, 9600, 19K2, 57K6, 115K	19K2		Modbus On	Communication Speed of Network
Parity	None, Even, Odd	Even		Modbus On	Error Detection of System. Integrator needs this information

For detailed information on Modbus operation refer to page 70.

Table B: MODE 1 SETUP menu

MODE 2 Hydronic Systems with Indirect DHW

This section covers single or multiple-boiler installations used for individual hydronic heating systems with indirect DHW demand located on the system loop. Diagrams 17-21 show single-boiler systems with and without CWP. The CWP diagrams will show an individual 3-way valve at the boiler (MIX Type = VALVE). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor (S4) to adjust the target water temperature as the outdoor air temperature changes. See Table C.

MODE 2 Single
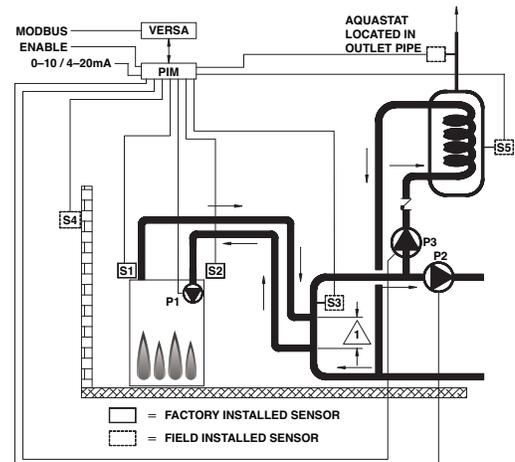
1 Maximum distance not to exceed 4 pipe diameters or 12" max.

Fig. 17: MODE 2 Hydronic Single - Boiler with Indirect DHW
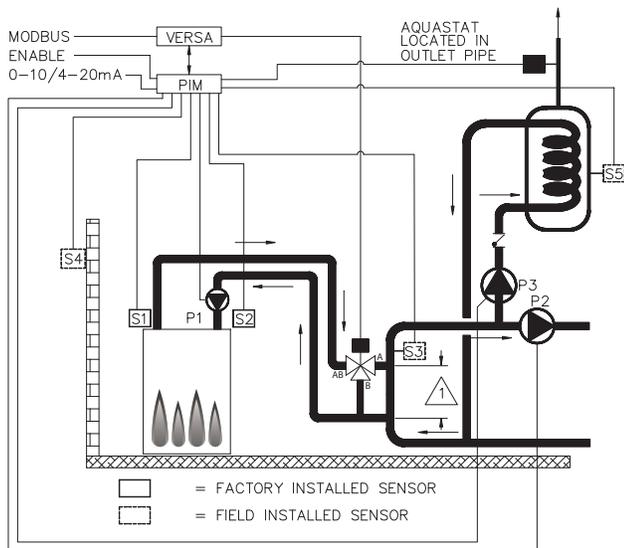
Maximum distance not to exceed 4 pipe diameters or 12" max.

Fig. 18: MODE 2 Hydronic Single - Boiler with Indirect DHW and CWP (MIX TYPE = VALVE)

Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency.

CAUTION: Continous pumping through the unit is not supported and may cause a non-warrantable failure.

The system can also be set to operate the indirect DHW call with or without priority. The boiler firing rate will be controlled by the System Sensor (S3). The Indirect DWH Sensor (S5) determines the indirect call/tank setpoint. The VERSA IC control system also allows for a thermostat controller (tankstat) to be mounted in the indirect tank and provide a call for indirect operation via contact closure in lieu of the tank sensor. The thermostat wiring connection is at the field wiring strip on MVB/XTherm, or the PIM J1 terminal block at terminals 8 and 10. When using an indirect DHW sensor (S5) to control tank temperature, contact closure is required across the indirect override connections for proper operation (see IND Sensor, page 44 for further details). To ensure proper operation during "limp-along" mode, connect an aquastat across the indirect DHW override terminals, or place a jumper across the indirect DHW override terminals and set the PIM operator dial to be equal to DHW Target temperature.

The VERSA IC will provide Max Delta-T (Differential Temperature) control and will cycle the burner if the

Max Delta-T is exceeded between Boiler Outlet Sensor (S1) and Boiler Inlet Sensor (S2).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a proportional 3-way valve to bypass water from the boiler outlet to the inlet during operation, when the system return water temperature is below the minimum acceptable level as defined in the Installation and Operating manual for the product being installed. (See page 45).

The Boiler Pump (P1) runs during any call for burner operation and is delayed "off" as user-defined in the BOILER menu after the burner has shut down. The System Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized). Priority mode toggles the System Pump (P2) off during an indirect call-for-heat. The Indirect Pump (P3) runs during an indirect call-for-heat with no "off" delay. The System Pump is delayed "off" as user-defined in the SETUP menu.

Mode 2 is used for this configuration. DIP switches #1 and 2 on the VERSA Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off.

NOTE: 0-10VDC firing rate control ignores all sensors except S2 and all functions except Max Delta-T, CWP, Limit and Safety Switches.

MODE 2 Cascade
Diagrams 19-21 show cascade systems (up to 4 boilers maximum) with and without CWP in conjunction with an indirect DHW demand located on the system loop. The CWP diagrams show either an individual 3-way valve at the boiler (MIX Type = VALVE) or a single 3-way valve providing CWP to all connected boilers within the cascade (MIX Type = PLNT). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor connected to the Master unit (S4a) to adjust the target water temperature as the outdoor air temperature changes.

Reverse/return piping is shown and is recommended to ensure balanced flow through each of the connected boilers. Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency.
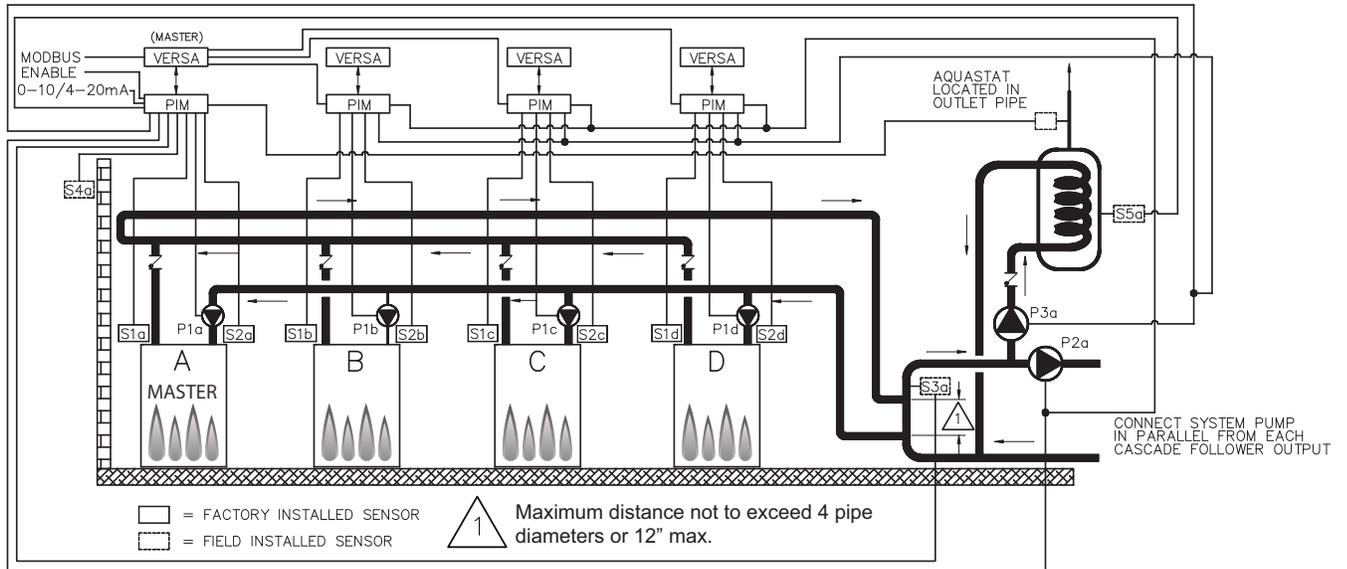
Fig. 19: MODE 2 Hydronic Multi - Boiler with Indirect DHW on system
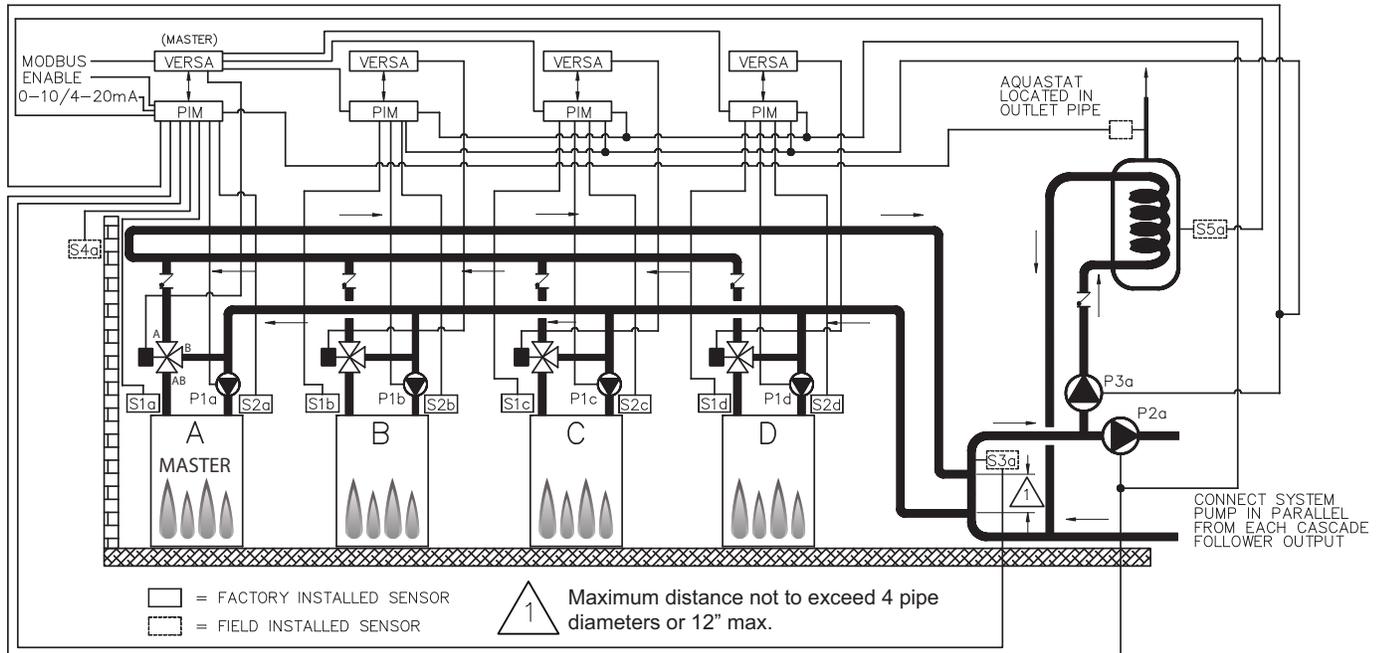
Fig. 20: MODE 2 Hydronic Multi - Boiler with Indirect DHW and CWP (MIX TYPE = VALVE)
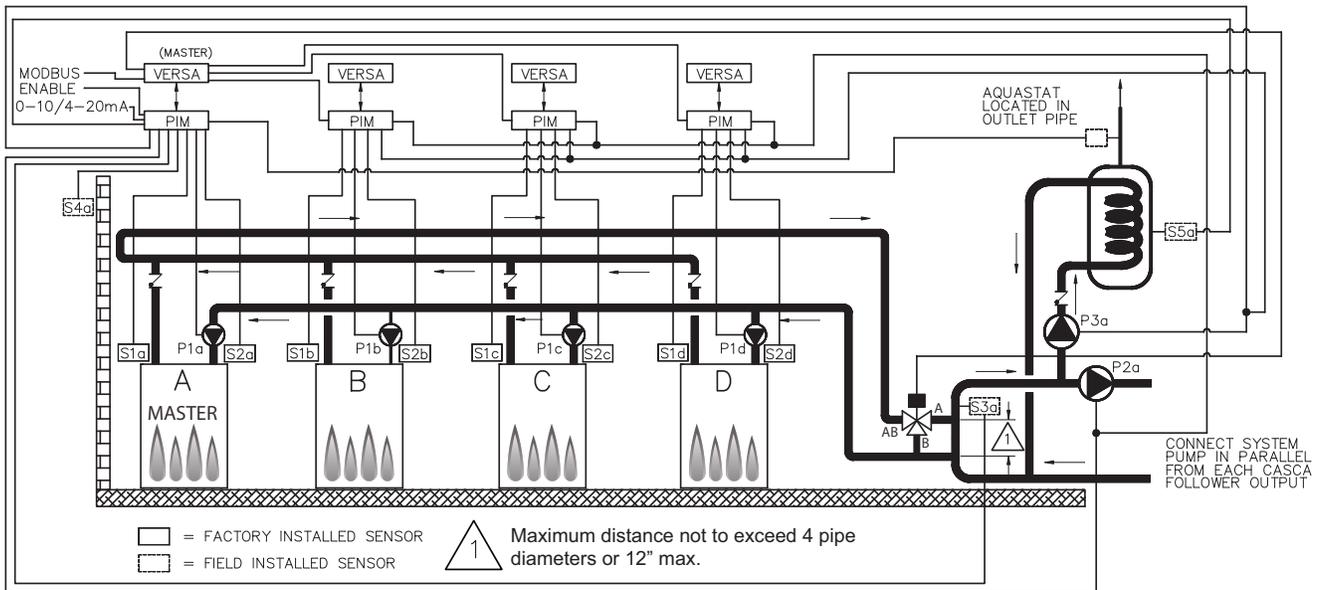
Fig. 21: MODE 2 Hydronic Multi-Boiler with Indirect DHW on system, with CWP (MIX TYPE = PLNT)

The system can also be set to operate the indirect DHW call with or without priority. The system temperature will be controlled by the System Sensor connected to the Master (S3a) during a call for hydronic heat or an indirect call. See **System Sensor Installation** on page 11. The Indirect DHW Sensor (S5a) determines the indirect call based on the user-defined setpoint. The VERSA IC control system also allows for a thermostat controller (tankstat) to be mounted in the indirect tank and provide a call for indirect operation via contact closure in lieu of the tank sensor. The thermostat wiring connection is at the field wiring strip on MVB/XTherm, or the Master PIM J1 terminal block at terminals 8 and 10. When using an indirect DHW sensor to control tank temperature, contact closure is required across the indirect override connections for proper operation (see IND Sensor, page 44 for further details). To ensure proper operation during "limp-along" mode connect an aquastat across the indirect DHW override terminals of the master unit, install a jumper across the indirect DHW terminals of follower units, and set the rest of the follower PIM's operator dial to be equal to DHW Target temperature. In lieu of an aquastat across the indirect DHW override terminals of the master unit, a jumper may be used. This configuration requires all PIM operator dials be set to DHW Target temperature to prevent an over-temp condition from occurring during "limp-along".

It is also recommended the system pump and DHW pump be connected in parallel from each cascade follower, to allow these pumps to be functional during limp-along operation.

During an indirect call-for-heat with or without priority selected, the cascade firing rate is determined by the System Supply Sensor (S3a) temperature. The VERSA IC will provide Max Delta-T control to cycle the burner if the Max Delta T is exceeded between Boiler Outlet Sensors (S1a-b-c-d) and Boiler Inlet Sensors (S2a-b-c-d).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water protection system utilizes a proportional 3-way valve to bypass water from the boiler outlets to the inlets (S2 a-b-c-d) during operation, when the system return water temperature is below the minimum acceptable level, among all active units, as defined in the Installation and Operating manual for the product being installed.

Priority mode toggles off the System Pump (P2a) when an indirect call-for-heat is present. Boiler Pumps (P1a-b-c-d) run in conjunction with their associated burner during all heat calls regardless of priority. The Indirect DHW pump (P3a) runs during an indirect call-for-heat with no "off" delay. The Boiler Pumps (P1a-b-c-d) are delay "off" as user-defined in the BOILER menu and System Pump (P2a) is delay "off" in the SETUP menu. The System Pump (P2a) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized) unless an indirect call-for-heat is present with priority.

Mode 2 is used for this configuration. DIP switches #1 and 2 on the VERSA Master Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches the heater must be turned off. It is important to remember to enable a boiler to be a follower in the cascade by turning DIP switch #2 on the VERSA Control Board to the OFF position for each

of the followers. To enable Follower boilers, scroll to the SETUP menu and, using the item button, scroll to the individual boilers and toggle from OFF to ON to allow them to operate when commanded by the Master to run.

Prior to enabling the master boiler, apply power to all units for initial programming of cascade settings. This is accomplished from the master boiler user interface.

The next menu items are not necessarily in the order in which they will appear. Enable followers from appropriate BOILER menu at the master:

Item	Range	Default	User Settings	When is it Displayed	Description
BOILER 1, 2, 3, 4	ON <> OFF	OFF		Cascade Followers present	FT_Bus 1, 2, 3, 4 are connected

The following settings are available in the SETUP/ADJUST Menu. Go to MODE screen within SETUP menu and change MODE = 2 to enable the settings for the configuration described along this section:

Item	Range	Default	User Settings	When is it Displayed	Description
Target	Reset - Setpoint EMS Modbus	SETP		PIM Identity is H EMS = Temp/Rate Modbus = Temp/Rate	RSET = Outdoor RSET = Outdoor Reset SETP = Setpoint EMS = Energy Management System (Analog Target Temperature) MODB = Modbus SETP = Setpoint
Mode	1, 2, 3	1		PIM Identity is H Target = Rset or Setp	Piping and application configuration
SETPOINT	XFYRE 50 TO 192°F (10 to 89ºC) XPAKFT 50 TO 192°F (10 to 89ºC) MVB/XTHERM 50 TO 220°F (10 to 104.5ºC)	180°F (82ºC)		PIM Identity is H	Piping and application configuration
Target Max.	XFYRE 190°F (89ºC) XPAK FT 190°F (89ºC) MVB/XTHERM 220°F (105.5ºC)	192°F (89ºC) 192°F (89ºC) 210°F (99ºC)		Modbus Rate EMS Rate PIM Identity is H	Maximum Target Boiler Temperature
Target Min.	50 to 180°F (10 to 82ºC)	50°F (10ºC)		Modbus Rate EMS Rate PIM Identity is H	Minimum Target Boiler Temperature
Sys. Purge	0:20 to 20:00 min	0:20 min		Modbus Temp/Rate PIM DIP = Purge On	Sets the length of the System Pump Purge (eg. 0:20 min = 20 seconds)
Units	F or C	F		Always	Show Units Using Icons in Display
When RESET from target screen is selected the following items will be available for adjustment:					
Out Start	35 to 85°F (1.5 to 29.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Outdoor Reset Starting Temperature
Out Design	-60 to 45°F (-51 to 7ºC)	10°F (-12ºC)		PIM Identity is H Target = Rset	Outdoor Reset Design Temperature
Boil Start	35 to 150°F 1.5 to 65.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Starting Boiler Target Temperature when Outdoor Temperature is at Outdoor Start
Boil Design	70 to 200°F (21 to 93.5ºC)	180°F (82ºC)		PIM Identity is H Target = Rset	Design Boiler Target Temperature when the Outdoor Temperature is at Outdoor Design (Hottest Water on Coldest Day)
WWSD	40 to 100F (4.5 to 38ºC)	70F (21ºC)		Target = Rset PIM Identity is H	The System Warm Weather Shut Down Temperature
When manual differential is selected via PIM DIP switch #1, the following item will appear:					
Target Diff	2 to 42°F (1 to 23.5ºC)	10°F (5.5ºC)		PIM Identity is H PIM DIP = Manual Diff	Differential for Target Boiler Temperature

The next items are shown and available for adjustment within the SETUP / ADJUST menu while MODE 2 is selected:

Item	Range	Default	User Settings	When is it Displayed	Description
Ind. Sensor	ON - OFF	OFF		PIM Identity is H MODE = 2 or 3	Selects whether a DHW sensor is used
Ind. Setp.	Off, 50 to 180 °F (10 to 82ºC)	140°F (60ºC)		PIM Identity is H MODE = 2 or 3 IND Sensor = ON	Target Indirect DHW Temperature. IND SENSOR is Selected.
Ind. Diff	2 to 10ºF (1ºC to 5.5ºC)	6°F (3.5ºC)		PIM Identity is H MODE = 2 or 3 IND Sensor = ON	Differential for the target indirect DHW tank.
Ind. Supply	OFF, 70 to 200°F (21 to 93.5ºC)	180°F (82ºC)		PIM Identity is H MODE = 2 or 3 IND Sensor = OFF	Target boiler temperature for the DHW heat exchanger during indirect DHW operation
Ind Priori	OFF - ON	OFF		PIM Identity is H MODE = 2	Selects whether or not indirect DHW priority is active during indirect DHW operation
Pri Ovr	Au, 0:10 to 2:00 hr	Au		PIM Identity is H DHW Priority = ON	Sets the length of the priority override time

The items below correspond to CWP operation. Ensure VERSA DIP #3 is ON to enable CWP.

MIX TYPE	VALVE, PUMP, PLNT	VALVE		H model & MIX DIP = ON	MIX Type assumes that each individual unit will have the proper wiring and pipe configuration to control its own inlet temperature. For H models using a variable-speed Pump as a CWP method (see page 45).
MIX TARGET	50 TO 140°F (10 to 60ºC)	120°F (49ºC)		MIX DIP = ON	Inlet Target Temperature
MIX LOCK	ON / OFF	OFF		MIX DIP = ON	The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only
MIX TRIM	-5 TO 5	0		MIX DIP = ON	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak
MIX SPEED	SLOW, MED, FAST	MED		MIX DIP = ON	This setting defines speed of response.
MIX INV	ON / OFF	OFF		MIX DIP = ON	This option is related to the use of spring-return actuators with a proportional 2-way or 3-way valve

When communication with BMS is required, user must enable Modbus port using the settings below by selecting other than "OFF" at Mode-Modbus scree. The following settings will become available.

Mode Modbus	Off, Monitor, Temp, Rate	Monitor		Always	Modbus Operating Mode: Off, Monitor, Temp Control, Rate Control
Address	1 to 247	1		Modbus On	Modbus Slave Address (= Node ID). When using Protonode, do not use values over 127 (see Catalog No. 5000.73).
Data Type	RTU or ASCI	RTU		Modbus On	Modbus Data Type
Baud Rate	2400, 9600, 19K2, 57K6, 115K	19K2		Modbus On	Communication Speed of Network
Parity	None, Even, Odd	Even		Modbus On	Error Detection of System. Integrator needs this information

Table C: Mode 2 SETUP menu

MODE 3 Hydronic Systems with Indirect DHW

This section covers a single-boiler used for hydronic heating in conjunction with an indirect DHW demand located on the boiler loop. Figures 22 and 23 will show single-boiler systems with and without CWP. The CWP diagrams will show an individual 3-way valve at the boiler (MIX Type = VALVE). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor (S4) to adjust the target water temperature as the outdoor air temperature changes. See Table D.

= **FACTORY INSTALLED SENSOR**

= **FIELD INSTALLED SENSOR**

⚠ 1 Maximum distance not to exceed 4 pipe diameters or 12" max.

Fig. 22: MODE 3 Hydronic Single - Boiler with Indirect DHW

MODBUS ENABLE 0-10/4-20mA — VERSA — PIM

AQUASTAT LOCATED IN OUTLET PIPE

S5
S6
P3
S4
A
B
AB
S1   P1   S2
P2
S3
1

☐ = FACTORY INSTALLED SENSOR
⬚ = FIELD INSTALLED SENSOR

⚠ 1 Maximum distance not to exceed 4 pipe diameters or 12" max.
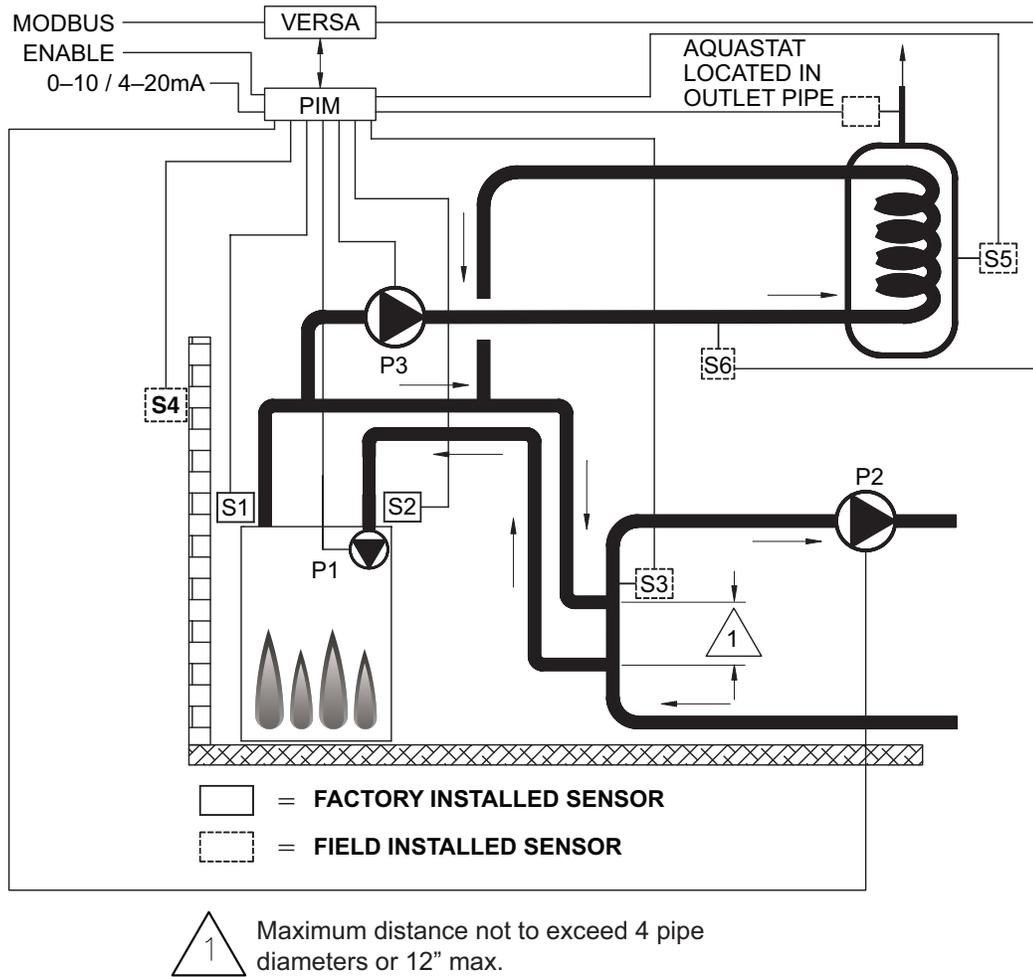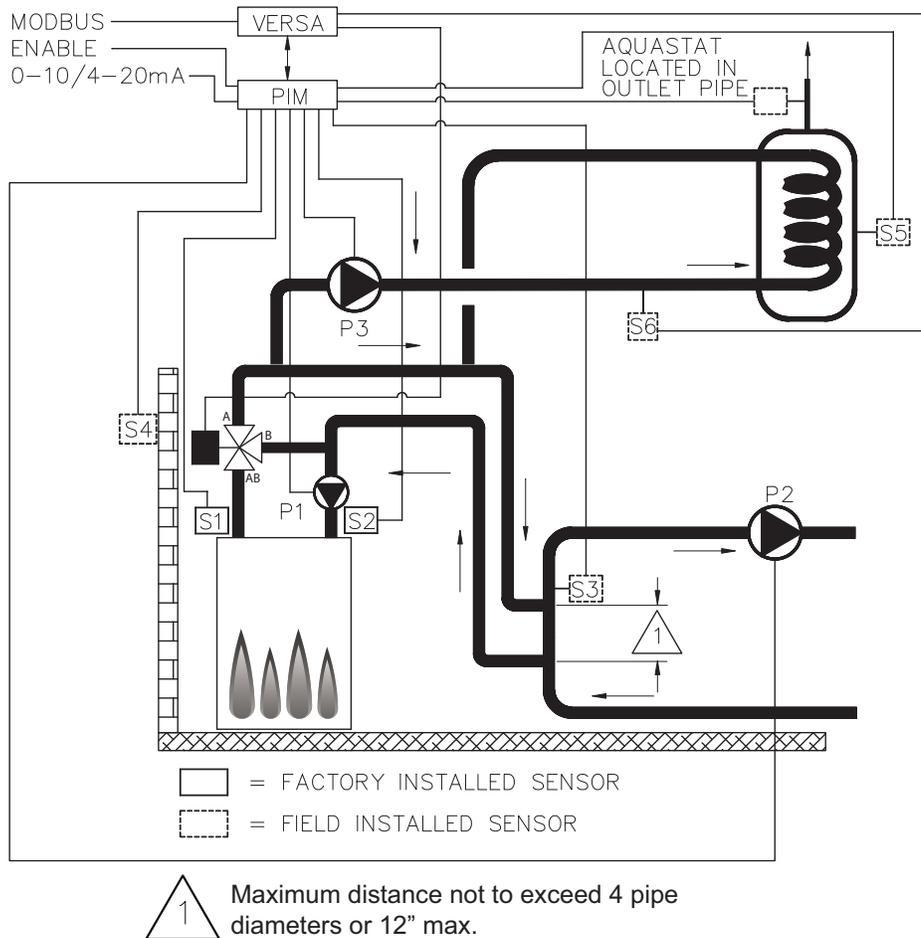
Fig. 23: MODE 3 Hydronic Single - Boiler with Indirect DHW on Boiler Loop and CWP (MIX TYPE = VALVE)

MODE 3 Single

Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency.

> **CAUTION:** Continous pumping through the unit is not supported and may cause a non-warrantable failure.

The system will operate the indirect DHW call with priority function only. The system will be controlled by the System Sensor (S3) whenever the indirect call-for-heat is not active. See **System Sensor Installation** on page 11. The Indirect Sensor (S5) determines the indirect call/tank setpoint. The VERSA IC control system also allows for a thermostat controller (tankstat) to be mounted in the indirect tank and provide a call for indirect operation via contact closure in lieu of the tank sensor. The thermostat controller wiring connection is at the the field wiring strip on MVB/XTherm, or the PIM J1 terminal block at terminals 8 and 10. When using an indirect DHW sensor to control tank temperature, contact closure is required across the indirect override

connections for proper operation (see IND Sensor, page 44 for further details). To ensure proper operation during "limp-along" mode, connect an aquastat across the indirect DHW override terminals, or install a jumper across the Indirect DHW override terminals and set PIM operator dial to be equal to DHW Target temperature to prevent an over-temperature condition from occurring. During an indirect call-for-heat the firing rate is determined by the Indirect Setpoint (or Max Target) at the Indirect Supply Sensor (S6). It is important to install this Sensor in a drywell near the junction between the boiler loop and Indirect loop for best performance. The VERSA IC will provide Max Delta-T (Differential Temperature) control and will cycle the burner if the Max Delta-T is exceeded between Boiler Outlet Sensor (S1) and Boiler Inlet Sensor (S2).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a proportional 3-way valve to bypass water from the boiler outlet to the inlet during operation, when the system return water temperature is below the minimum acceptable level as defined in

24

the Installation and Operating manual for the product being installed. (See page 45).

The Boiler Pump (P1) runs during any call for burner operation and is delayed "off" as user-defined in the BOILER menu after the burner has shut down. The System Pump (P2) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized). An indirect DHW call-for-heat will toggle the System Pump (P2) off until the indirect call-for-heat is satisfied or the priority timer has elapsed allowing the system to return to heating mode. The Indirect DHW Pump (P3) runs during an indirect call-for-heat with no "off" delay. The System Pump is delayed "off" as user-defined in the SETUP menu.

Mode 3 is used for this configuration. DIP switches #1 and 2 on the VERSA Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off.

> **NOTE:** 0-10VDC firing rate control ignores all sensors except S2 and all functions except Max Delta-T, CWP, Limit and Safety Switches.

MODE 3 Cascade

Figures 24-26 show cascade systems (up to 4 boilers maximum) with and without CWP in conjunction with an indirect DHW demand located on the boiler loop. The CWP diagrams will show either an individual 3-way valve at the boiler (MIX Type = VALVE) or a single 3-way valve providing CWP to all connected boilers within the cascade (MIX Type = PLNT). The following piping configurations can be used as fixed setpoint or set up to work in conjunction with an Outdoor Air Reset Sensor connected to the Master boiler (S4a) to adjust the target water temperature as the outdoor air temperature changes.

Reverse/return piping is shown and is recommended to ensure balanced flow through each of the connected boilers. Primary/secondary piping is the only method supported by Raypak to ensure proper boiler and system functionality while achieving maximum system efficiency.
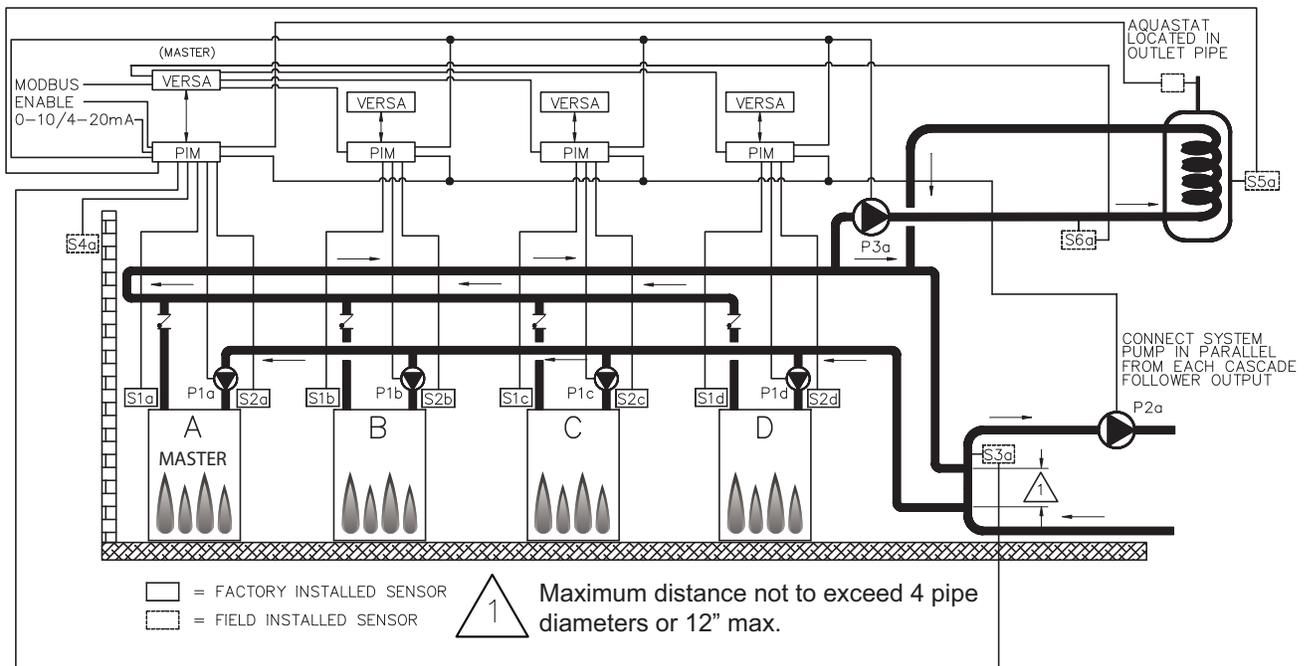
Fig. 24: MODE 3 Hydronic Multi - Boiler with Indirect DHW on Boiler Loop
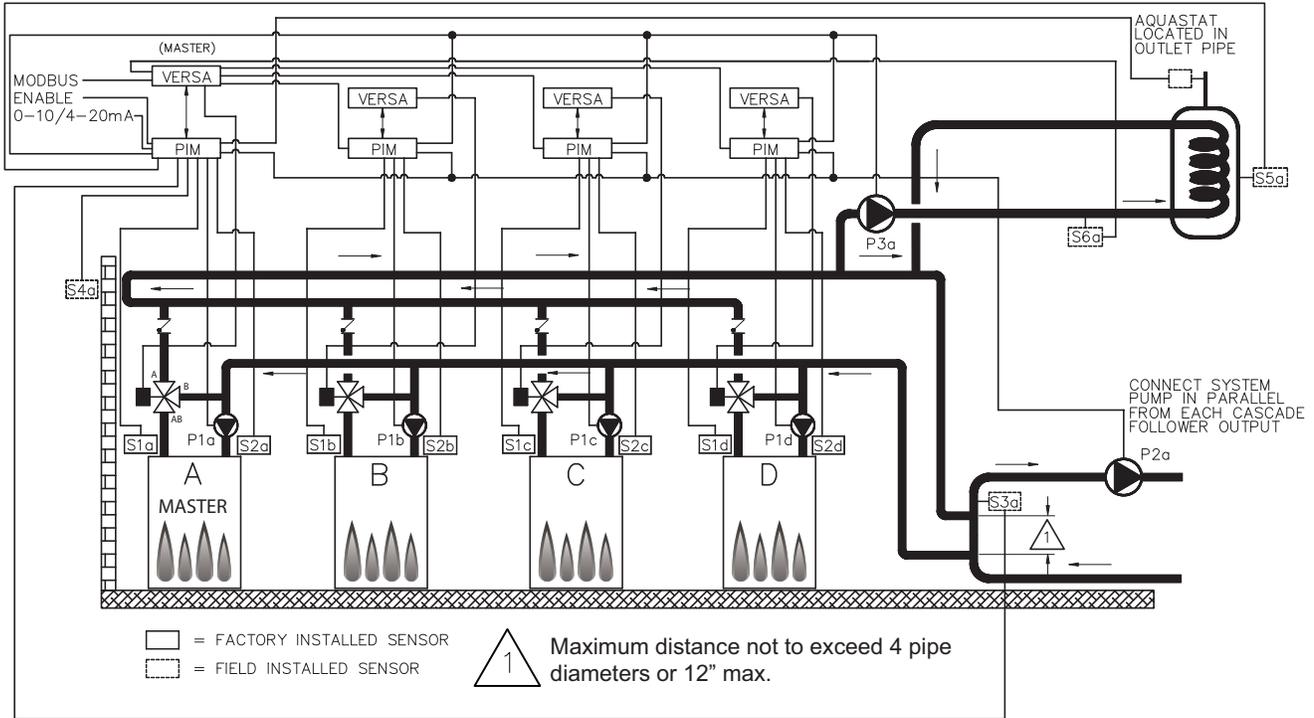
Fig. 25: MODE 3 Boiler with Indirect DHW on Boiler Loop and CWP (MIX TYPE = VALVE)
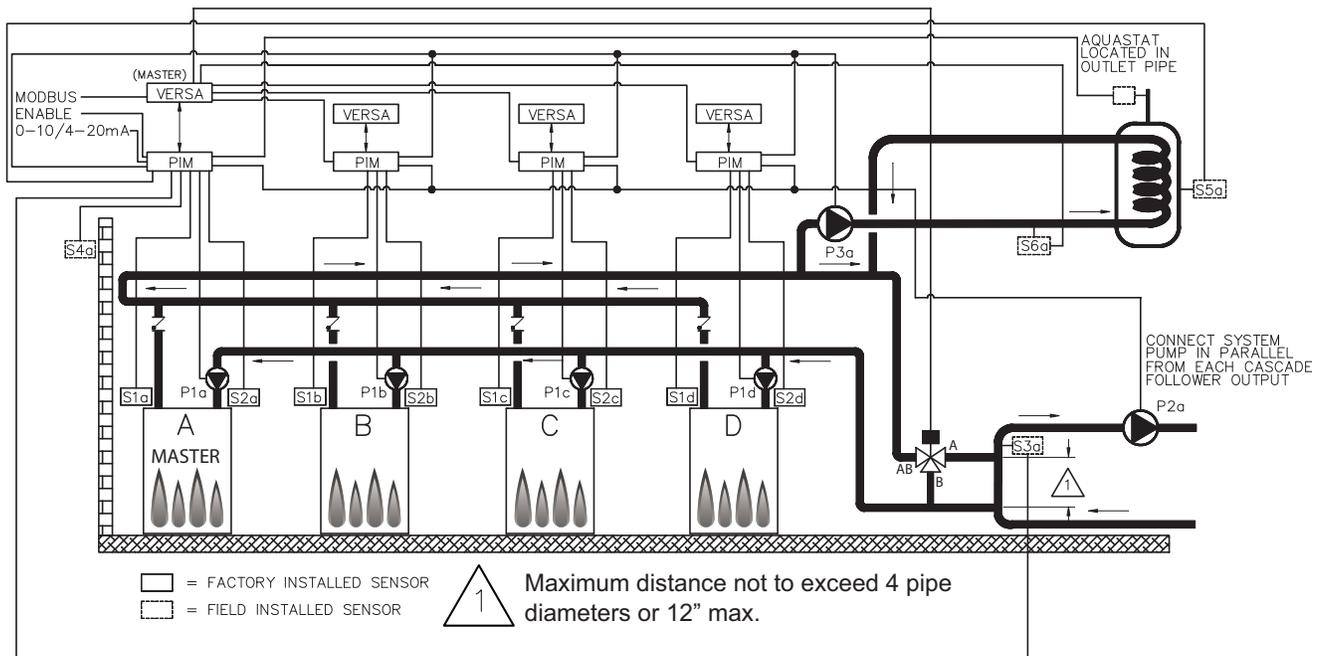
Fig. 26: MODE 3 Hydronic Multi-Boiler with Indirect DHW on Boiler Loop, with CWP (MIX TYPE = PLNT)

The system will operate the indirect DHW call with priority only. The cascade firing rate will be controlled by the System Supply Sensor connected to the Master boiler (S3a) whenever the indirect call-for-heat is not active. See **System Sensor Installation** on page 11. The Indirect DHW Sensor (S5a) determines the indirect call/tank setpoint. When using an indirect DHW sensor to control tank temperature, contact closure is required across the indirect override connections for proper operation. To ensure proper operation during "limp-along" mode, connect an aquastat across the indirect DHW override terminals of master unit, install a jumper across the indirect DHW terminals of follower units and set the rest of the follower PIM's operator dial to be equal to DHW Target temperature. In lieu of an aquastat across the indirect DHW override terminals of the master unit, a jumper may be used. This configuration requires all PIM operator dials be set to DHW Target temperature to prevent an over-temp condition from occurring during "limp-along". It is also recommended the system pump and DHW pump be connected in parallel from each cascade follower, to allow these pumps to be functional during limp-along operation. During an indirect call-for-heat, the firing rate is determined by the Indirect Setpoint (or Max Target) at the Indirect Supply Sensor (S6a). The system will provide Max Delta-T control to cycle the burner if the Max Delta-T is exceeded between Boiler Outlet Sensors (S1a-b-c-d) and Boiler Inlet Sensors (S2a-b-c-d).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water protection system utilizes a proportional 3-way valve to bypass water from the boiler outlets to the inlets (S2 a-b-c-d) during operation, when the system return water temperature is below the minimum acceptable level,

among all active units, as defined in the Installation and Operating manual for the product being installed. Priority mode toggles off the System Pump (P2a) when an indirect call-for-heat is present. Boiler Pumps (P1a-b-c-d) run in conjunction with their associated burner during all heat calls regardless of priority. The Indirect DHW Pump (P3a) runs during an indirect call-for-heat with no "off" delay. The Boiler Pumps (P1a-b-c-d) and System Pump (P2a) delay "off" as user-defined in the ADJUST menu. The System Pump (P2a) runs whenever the system is enabled for heating and the outdoor air temperature is lower than the WWSD temperature setting (if utilized) unless an indirect call for-heat is present with priority.

Mode 3 is used for this configuration. DIP switches #1 and 2 on the VERSA master Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off. It is important to remember to enable a boiler to be a follower in the cascade by turning DIP switch #2 on the VERSA Control Board to the OFF position for each of the followers. To enable Follower boilers, scroll to the SETUP menu at the Master boiler and, using the item button, scroll to the individual boilers and toggle from OFF to ON to allow them to operate when commanded by the Master to run.

Prior to enabling the master boiler, apply power to all units for initial programming of cascade settings. This is accomplished from the master boiler user interface.

The next menu items are not necessarily in the order in which they will appear.

Enable followers from appropriate BOILER menu at the master:

Item	Range	Default	User Settings	When is it Displayed	Description
BOILER 1, 2, 3, 4	ON <> OFF	OFF		Cascade Followers present	FT_Bus 1, 2, 3, 4 are connected

The following settings are available in the SETUP/ADJUST Menu. Go to MODE screen within SETUP menu and change MODE = 3 to enable the settings for the configuration described along this section:

Item	Range	Default	User Settings	When is it Displayed	Description
Target	Reset - Setpoint EMS Modbus	SETP		PIM Identity is H EMS = Temp/Rate Modbus = Temp/Rate	RSET = Outdoor Reset SETP = Setpoint EMS = Energy Management System (Analog Target Temperature) MODB = Modbus
Mode	1, 2, 3	1		PIM Identity is H Target = Rset or Setp	Piping and application configuration
SETPOINT	XFYRE 50 TO 192°F (10 to 89ºC) XPAKFT 50 TO 192°F (10 to 89ºC) MVB/XTHERM 50 TO 210°F (10 to 99ºC)	180°F (82ºC)		PIM Identity is H	Piping and application configuration
Target Max.	100°F (38ºC) to PIM Operating Limit	XFYRE 50 to 192°F (10ºC to 89ºC) XPAK FT 50 to 192°F (10 to 89ºC) XTHERM 50 to 210°F (10 to 99ºC)		Modbus Rate EMS Rate PIM Identity is H	Maximum Target Boiler Temperature
Target Min.	50 to 180°F (10 to 82ºC)	50°F (10ºC)		Modbus Rate EMS Rate PIM Identity is H	Minimum Target Boiler Temperature
Sys. Purge	0:20 to 20:00 min	0:20 min		Modbus Temp/Rate PIM DIP = Purge On	Sets the length of the System Pump Purge (eg. 0:20 min = 20 seconds)
Units	F or C	F		Always	Show Units Using Icons in Display

When RESET from target screen is selected, the following items will be available for adjustment:

Item	Range	Default	User Settings	When is it Displayed	Description
Out Start	35 to 85°F (1.5 to 29.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Outdoor Reset Starting Temperature
Out Design	-60 to 45°F (-51 to 7ºC)	10°F (-12ºC)		PIM Identity is H Target = Rset	Outdoor Reset Design Temperature
Boil Start	35 to 150°F (1.5 to 65.5ºC)	70°F (21ºC)		PIM Identity is H Target = Rset	Starting Boiler Target Temperature when Outdoor Temperature is at Outdoor Start
Boil Design	70 to 200°F (21 to 93.5ºC)	180°F (82ºC)		PIM Identity is H Target = Rset	Design Boiler Target Temperature when the Outdoor Temperature is at Outdoor Design (Hottest Water on Coldest Day)
WWSD	40 to 100F (4.5 to 38ºC)	70F (21ºC)		Target = Rset PIM Identity is H	The System Warm Weather Shut Down Temperature

When manual diferential is selected via PIM DIP switch 1, the following items will appear.

Item	Range	Default	User Settings	When is it Displayed	Description
Target Diff	2 to 42°F (1 to 23.5ºC)	10°F (5.5ºC)		PIM Identity is H DIP = Manual Diff	Differential for Target Boiler Temperature

The next items are shown and available for adjustment within the SETUP / ADJUST menu while MODE 2 is selected:

Item	Range	Default	User Settings	When is it Displayed	Description
Ind. Sensor	ON - OFF	OFF		PIM Identity is H MODE = 2 or 3	Selects whether a DHW sensor is used
Ind. Setp.	Off, 50 to 180 F (10 to 82ºC)	140F (60ºC)		PIM Identity is H MODE = 2 or 3 Ind. Sensor = ON	Target Indirect DHW Temperature. Ind. Sensor is Selected.
Ind. Diff	2 to 10F (1 to 5.5ºC)	6F (3.5ºC)		PIM Identity is H MODE = 2 or 3 Ind. Sensor = ON	Differential for the target indirect DHW tank Ind. Sensor is Selected
Ind. Supply	OFF, 70 to 200F (21 to 93.5ºC)	180F (82ºC)		PIM Identity is H MODE = 2 or 3 Ind. Sensor = OFF	Target boiler temperature for the DHW heat exchanger during indirect DHW operation
Ind. Priori	OFF - ON	OFF		PIM Identity is H MODE = 2	Selects whether or not indirect DHW priority is active during indirect DHW operation
Pri Ovr	Au, 0:10 to 2:00 hr	Au		PIM Identity is H tN4 Bus Detected OR DHW Priority = ON	Sets the length of the priority override time

Item	Range	Default	User Settings	When is it Displayed	Description
The items below correspond to CWP operation. Turn VERSA DIP #3 on to enable CWP.					
MIX TYPE	VALVE, PUMP, PLNT	VALVE		H model & MIX DIP = ON	MIX Type assumes that each individual unit will have the proper wiring and pipe configuration to control its own inlet temperature. For H models using a variable speed Pump as a CWP method (see page 45).
MIX TARGET	50 TO 140°F (10 to 60°C)	120°F (49°C)		MIX DIP = ON	Inlet Target Temperature
MIX LOCK	ON / OFF	OFF		MIX DIP = ON	The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only
MIX TRIM	-5 TO 5	0		MIX DIP = ON	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak
MIX SPEED	SLOW, MED, FAST	MED		MIX DIP = ON	This setting defines speed of response.
MIX INV	ON / OFF	OFF		MIX DIP = ON	This option is related to the use of spring-return actuators with a proportional 2- or 3-way valve
When communication with BMS is required user must enable Modbus port using the settings below by selecting other than "OFF" at Mode-Modbus screen the following settings will become available.					
Mode Modbus	Off, Monitor, Temp, Rate	Monitor		Always	Modbus Operating Mode: Off, Monitor, Temp Control, Rate Control
Address	1 to 247	1		Modbus On	Modbus Slave Address (= Node ID). When using Protonode, do not use values over 127 (see Catalog No. 5000.73).
Data Type	RTU or ASCI	RTU		Modbus On	Modbus Data Type
Baud Rate	2400, 9600, 19K2, 57K6, 115K	19K2		Modbus On	Communication Speed of Network
Parity	None, Even, Odd	Even		Modbus On	Error Detection of System. Integrator needs this information

Table D: MODE 3 SETUP menu

WH Direct DHW Applications

This section covers single- or multiple-heater installations using WH model for use on direct Domestic Hot Water heating systems with or without CWP, used in conjunction with a storage tank. The CWP diagrams will show both a heater pump as well as a variable-speed pump (MIX Type = 2). The piping configurations below are representative of condensing and non-condensing heaters. See Table E.

CAUTION: Continous pumping through the unit is not supported and may cause a non-warranty failure.

WH - Single

The tank temperature will be controlled by the System Sensor (S3). The tank sensor must be installed in the lower third of the tank using a drywell for proper operation. The VERSA IC will provide Max Delta-T (Differential Temperature) control and will cycle the burner if the Max Delta-T is exceeded between Heater Outlet Sensor (S1) and Heater Inlet Sensor (S2). See Fig. 27.

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a variable-flow pumping system to inject just the right amount of water from the main system loop into the heater loop to maintain the optimum inlet temperature as defined in the Installation and Operating manual. See Fig. 28.
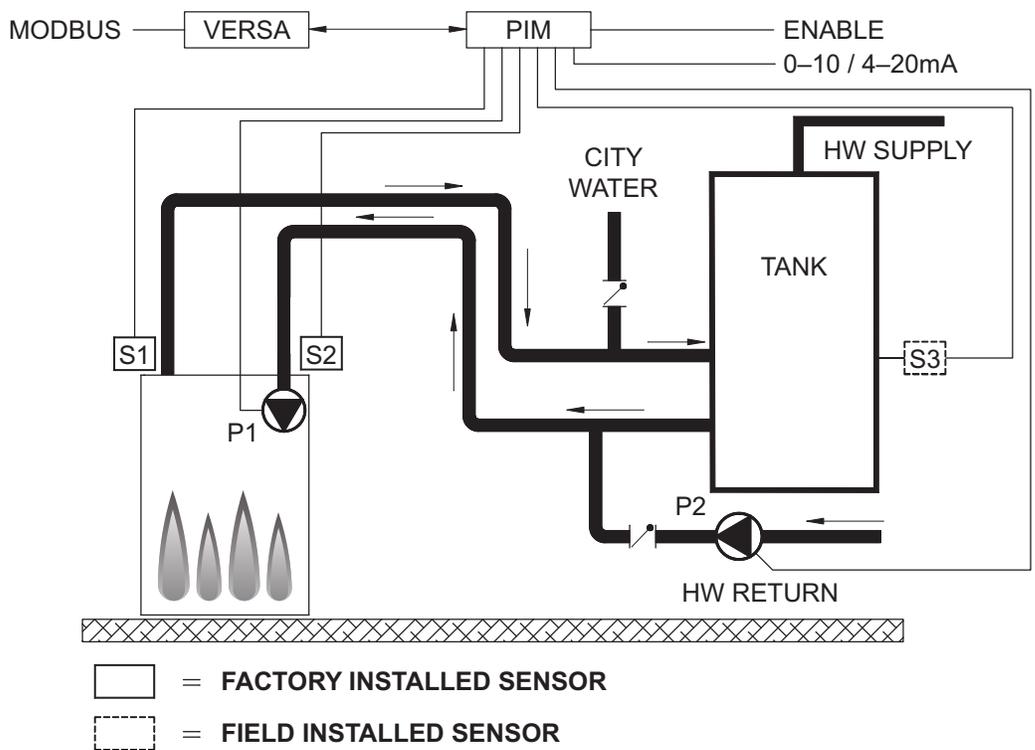
Fig. 27: WH - Direct DHW - Single Heater
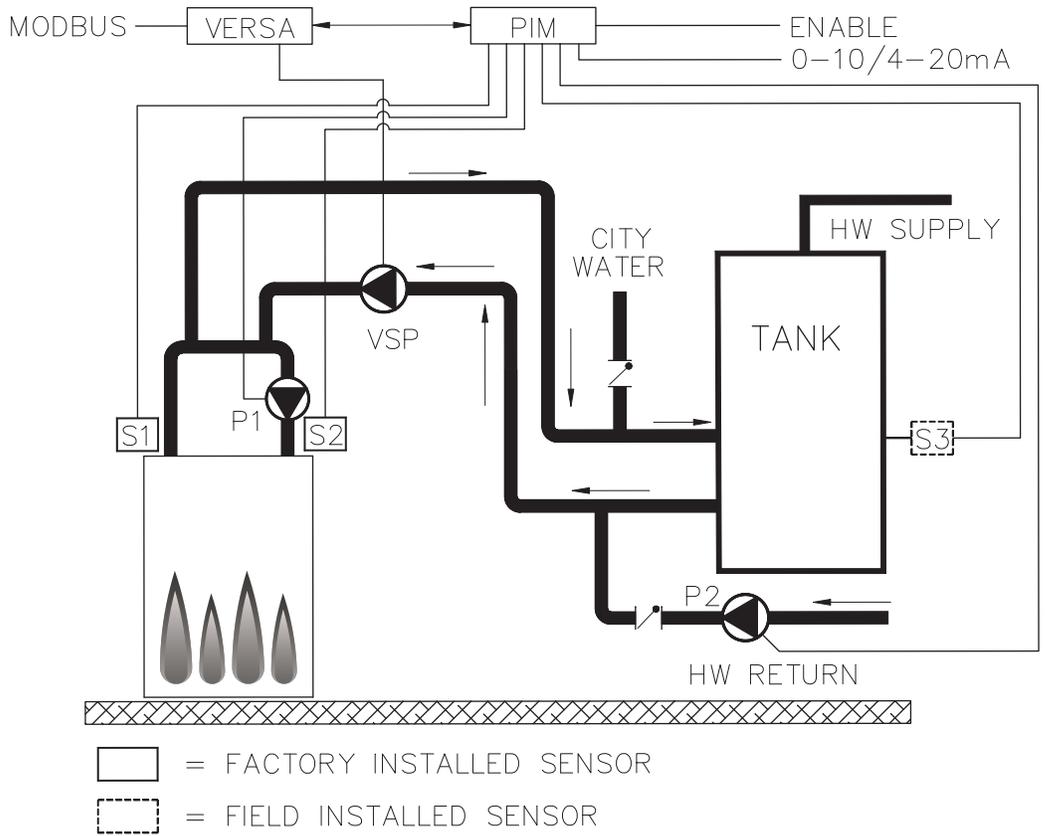
Fig. 28: WH Direct DHW - single Heater with CWP (VS Pump – MIX TYPE = 2)

The Heater Pump (P1) runs during any call for burner operation and is delayed "off" as user-defined in the SETUP menu after the burner has shut down. The System Pump output (P2) can be used for the recirculation pump and is enabled to run whenever the heater is enabled for operation. The Heater Pump (P1) runs during any call-for-heat. The Heater Pump (P1) is delayed "off" as user-defined in the BOILER menu. The System Pump output (P2) is delayed "off" only when the heater is disabled by opening the connection across the enable/disable at the PIM. There is no mode to configure for WH operation, as this is the only mode available when built as a WH model unit. The Supply Sensor (S3) MUST BE installed in the storage tank and functional for heater operation. DIP switches #1 and #2 on the VERSA Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches the heater must be turned off.

> **NOTE:** 0-10VDC firing rate control ignores all sensors except S2 and all functions except Max Delta-T, CWP, Limit and Safety Switches.

WH - Cascade

This section covers a cascade of up to 4 WH models for use on direct Domestic Hot Water heating systems with and without CWP using a variable-speed pump (MIX Type = 2), in conjunction with a storage tank. Figures 29 and 30 represent a cascade of condensing or non-condensing heaters.
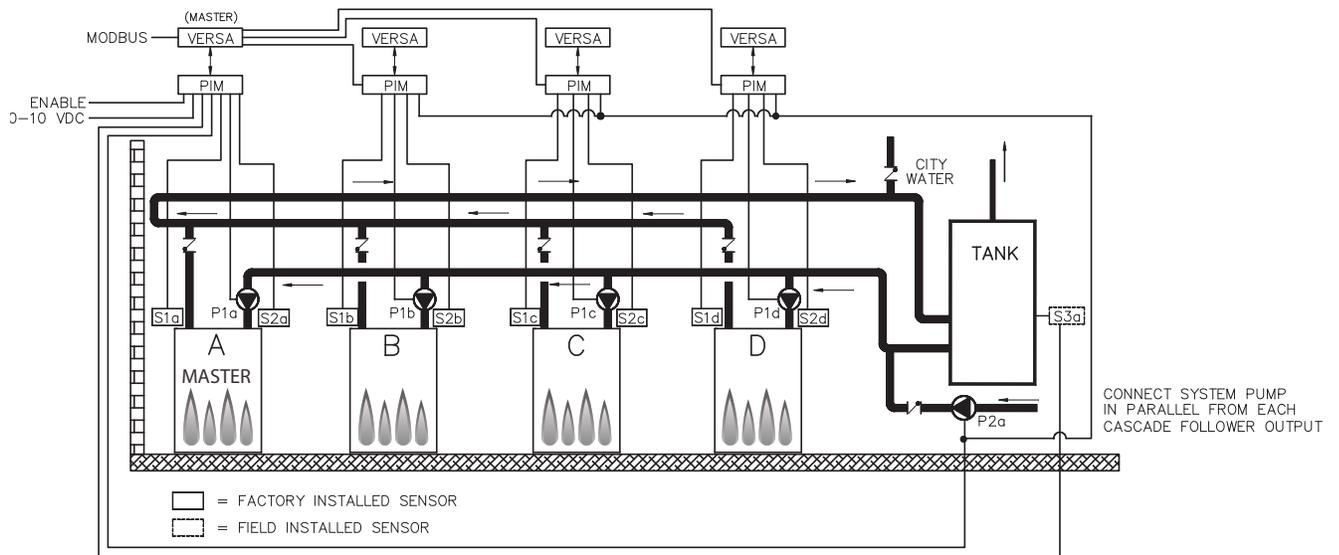
Fig. 29: WH Direct DHW Application - Multiple Heaters
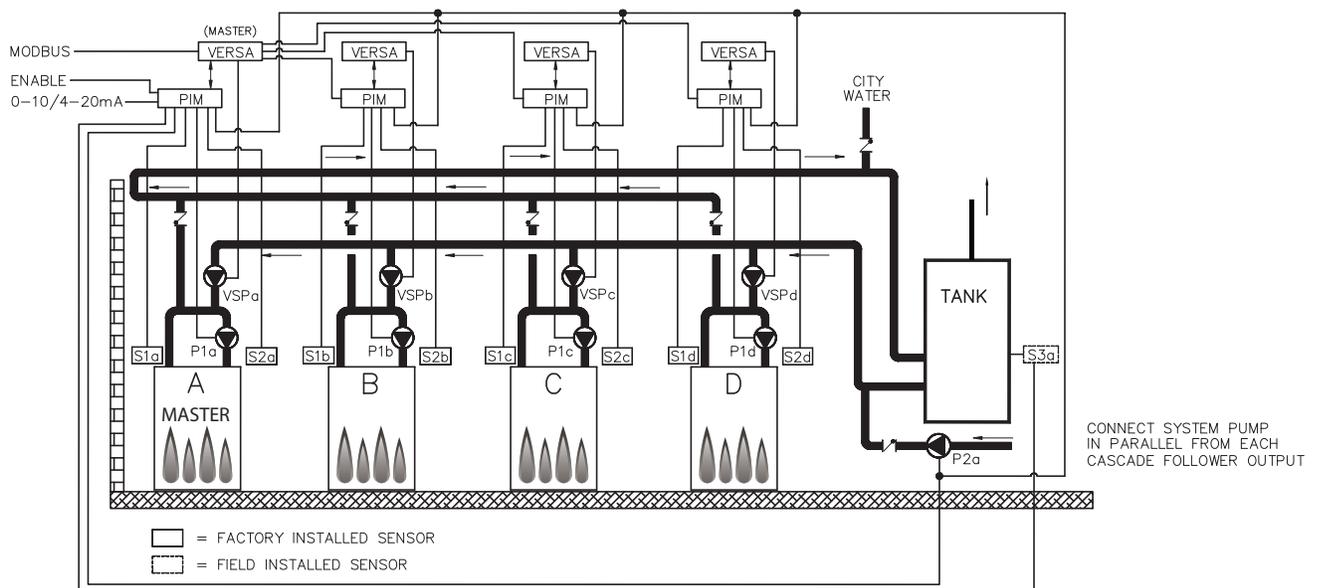
Fig. 30: WH Direct DHW Application - Multiple Heaters with CWP (VS Pump)

The tank temperature will be controlled by the System Sensor (S3a). The tank sensor must be installed in the lower third of the tank using a drywell for proper operation. The VERSA IC control system will provide Max Delta-T control to cycle the burner if the Max Delta-T is exceeded between Heater Outlet Sensors (S1a-b-c-d) and Heater Inlet Sensors (S2a-b-c-d).

In WH mode, the differential setting is below-setpoint only. It is not divided between above- and below-setpoint.

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a variable-flow pumping system to inject just the right amount of water from the main system loop into the heater loop to maintain the optimum inlet temperature (S2) as defined in the Installation and Operating manual for the product being installed. The variable-flow pumping system pump will operate in parallel with the pump mounted on the heater.

The Heater Pumps (P1a-b-c-d) run during any call for the associated heaters burner operation and is delayed "off" as user-defined in the BOILER menu after the associated heater burner has shut down. The System Pump output (P2a) can be used for the recirculation pump; it is enabled to run whenever the heater is enabled for operation. The System Pump

output (P2a) is delayed "off" only when the heater is disabled by opening the connection across the enable/disable at the PIM. It is recommended the system pump be connected in parallel from each cascade follower, to allow the system pump to be functional during limp-along operation, if used.

If multiple storage tanks are used, plumb to ensure equal flow through each tank and install one system sensor (S3) on one tank only.

There is no mode to configure for WH operation as this is the only mode available when built as a WH model unit. DIP switches #1 and #2 on the VERSA master Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches the heater must be turned off. It is important to remember to enable a heater to be a follower in the cascade by turning DIP switch #2 on the VERSA Control Board to the OFF position for each of the followers. For followers equipped with CWP, DIP #3 must be ON.

To enable Follower heaters, scroll to the SETUP menu and, using the item button, scroll to the individual heaters and toggle from OFF to ON to allow them to operate when commanded by the Master to run.

The next menu items are not necessarily in the order in which they will appear.

Enable followers from appropriate BOILER menu at the master:

Item	Range	Default	User Settings	When is it Displayed	Description
BOILER 1, 2, 3, 4	ON <> OFF	OFF		Cascade Followers present	FT_Bus 1, 2, 3, 4 are connected
The following settings are available in the SETUP/ADJUST Menu:					
Target	EMS Modbus	Not Visible		EMS = Temp/Rate* Modbus = Temp/Rate	EMS = Energy Management System (Analog Target Temperature) MODB = Modbus
TANK SETP	50 TO 150°F (10 to 65.5ºC)	125°F (51.5ºC)		PIM Identity is WH	WH Setpoint Temperature
TANK DIFF	2 to 10°F (1 to 5.5ºC)	5°F (3ºC)		PIM Identity is WH	WH Differential Temperature
Sys. Purge	OFF, 0:20 to 20:00 min	0:20 min		Modbus Temp/Rate PIM DIP = Purge On	Sets the length of the System Pump Purge (eg. 20 min = 20 seconds)
Units	°F or °C	°F		Always	Show Units Using Icons in Display

*Direct drive from the EMS (PIM DIP switch 2 = ON) applies only to a single unit. Target temp (PIM DIP 2 = OFF) can be used for either a single unit or cascade.

The items below correspond to CWP operation. Ensure VERSA DIP #3 is ON to enable CWP:

Item	Range	Default	User Settings	When is it Displayed	Description
MIX TYPE	2	2		PIM Identity is WH MIX DIP = ON	MIX Type assumes that each individual unit will have the proper wiring and pipe configuration to control its own inlet temperature
MIX TARGET	50 TO 140°F (10 to 60ºC)	120°F (49ºC)		MIX DIP = ON	Inlet Target Temperature
MIX LOCK	ON / OFF	OFF		MIX DIP = ON	The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only
MIX TRIM	-5 TO 5	0		MIX DIP = ON	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak
MIX SPEED	SLOW, MED,FAST	MED		MIX DIP = ON	This setting defines speed of response.
MIX INV	ON / OFF	OFF		MIX DIP = ON	This option is related to the use of spring-return actuators with a proportional 2 or 3-way valve

When communication with BMS is required user must enable Modbus port using the settings below by selecting other than "OFF" at Mode-Modbus screen the following settings will become available.

Mode Modbus	Off, Monitor, Temp, Rate	Monitor		Always	Modbus Operating Mode: Off, Monitor, Temp Control, Rate Control
Address	1 to 247	1		Modbus On	Modbus Slave Address (= Node ID). When using Protonode, do not use values over 127 (see Catalog No. 5000.73).
Data Type	RTU or ASCI	RTU		Modbus On	Modbus Data Type
Baud Rate	2400, 9600, 19K2, 57K6, 115K	19K2		Modbus On	Communication Speed of Network
Parity	None, Even, Odd	Even		Modbus On	Error Detection of System. Integrator needs this information

For detailed information on MODBUS operation refer to page 70.

Table E: WH applications SETUP menu

33

Pool – Heater Applications

Single Unit

This section covers single- or multiple-heater installations using P models for use on direct Pool Water heating systems with or without CWP. Primary/secondary piping is the only method supported by Raypak to ensure proper heater and system functionality while achieving maximum system efficiency. Figures 31-34 represent condensing and non-condensing heaters. The CWP diagrams show both a heater pump and a variable-flow pumping system. See Table F.

CAUTION: Continous pumping through the unit is not supported and may cause a non-warrantable failure.

△1 Maximum distance not to exceed 4 pipe diameters or 12" max.
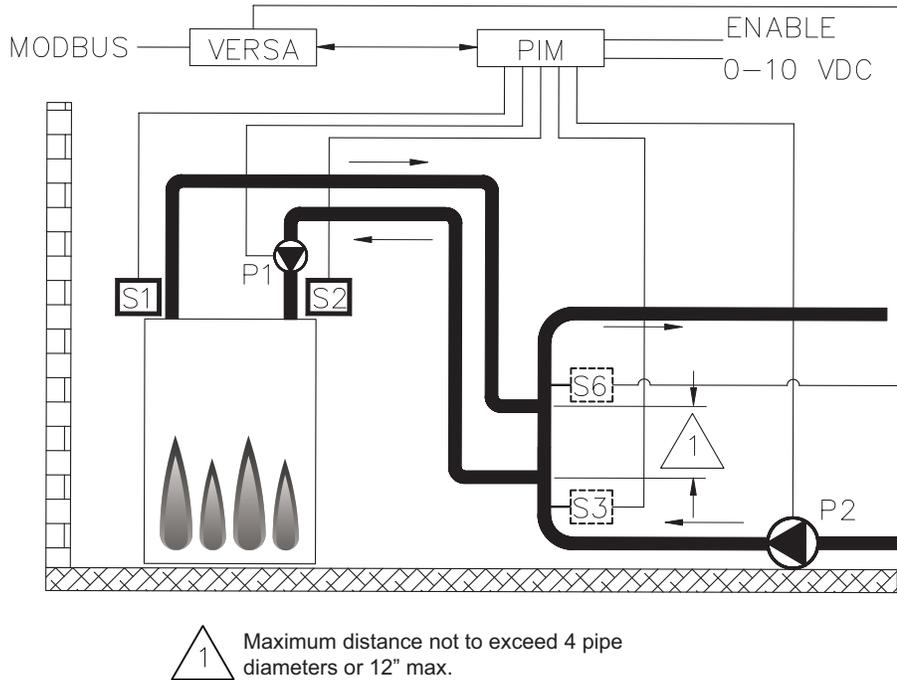
Fig. 31: Pool Single condensing Heater application

△1 Maximum distance not to exceed 4 pipe diameters or 12" max.
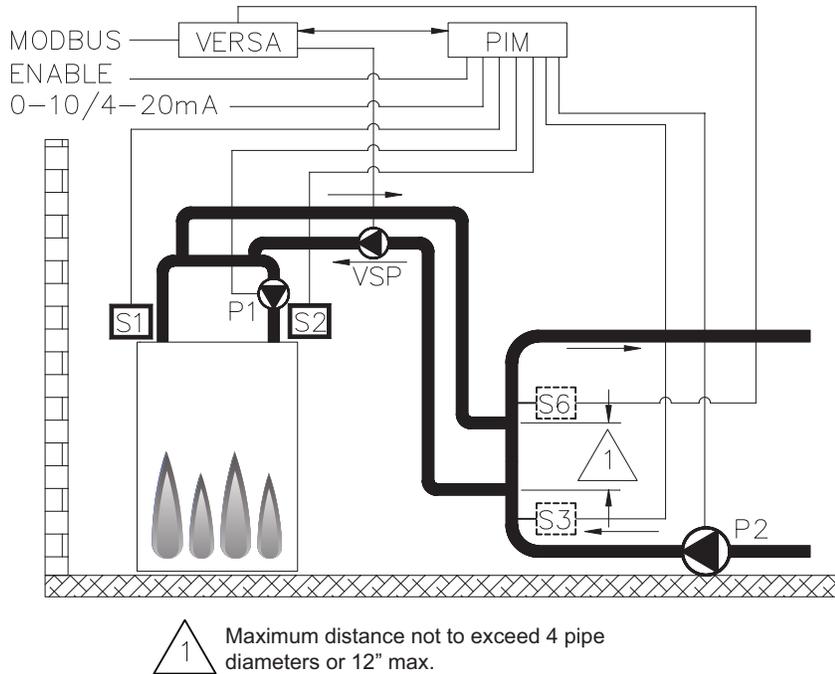
Fig. 32: Pool Single Heater with CWP (VS Pump)

The pool temperature will be controlled by the System Sensor (S3). The VERSA IC will provide Max Return protection control using the Pool Return sensor (S6) and will cycle the burner if the return to the pool exceeds the Max Return setting. Both the system (S3) and Pool Return (S6) sensors must be installed using drywells and fully immersed into the flow path for proper operation. Max Delta-T (Differential Temperature) control is also provided and will cycle the burner if the Max Delta-T is exceeded between Heater Outlet Sensor (S1) and Heater Inlet Sensor (S2).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a variable-flow pumping system to inject just the right amount of water from the main system loop into the boiler loop to maintain the optimum inlet temperature (S2) as defined in the Installation and Operating manual for the product being installed. The variable-flow pumping system will operate in parallel with the unit mounted heater pump.

The Heater Pump (P1) runs during any call for burner operation and is delayed "off" as user-defined in the SETUP menu after the burner has shut down. The System Pump output (P2) is available to drive the filter pump and enabled to run whenever the heater is enabled for operation. The Heater Pump (P1) runs during any call-for-heat. The Heater Pump (P1) is delayed "off" as user-defined in the BOILER menu. The System Pump output (P2) is delayed "off" only when the heater is disabled by opening the connection across the enable/disable at the PIM.

There is no mode to configure for Pool operation as this is the only mode available when built as a P model unit. The System Sensor (S3) and Pool Return sensor (S6) MUST BE installed in the circulation loop and be functional for heater operation.

DIP switches #1 and #2 on the VERSA Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off.

The Differential setting applies below-setpoint only.

> **NOTE:** 0-10VDC firing rate control ignores all sensors except S2 and all functions except Max Delta-T, CWP, Limit and Safety Switches.

POOL – Cascade

This section covers a cascade of up to 4 P model heaters for use on direct Pool Water heating systems with and without CWP using a variable-flow pumping system. Reverse/return piping is shown and is recommended to ensure balanced flow through each of the connected units. Primary/secondary piping is the only method supported by Raypak to ensure proper heater and system functionality while achieving maximum system efficiency. The piping configurations below are representative of a cascade of condensing heaters without CWP or non-condensing heaters with CWP provided by a variable-flow pumping system.
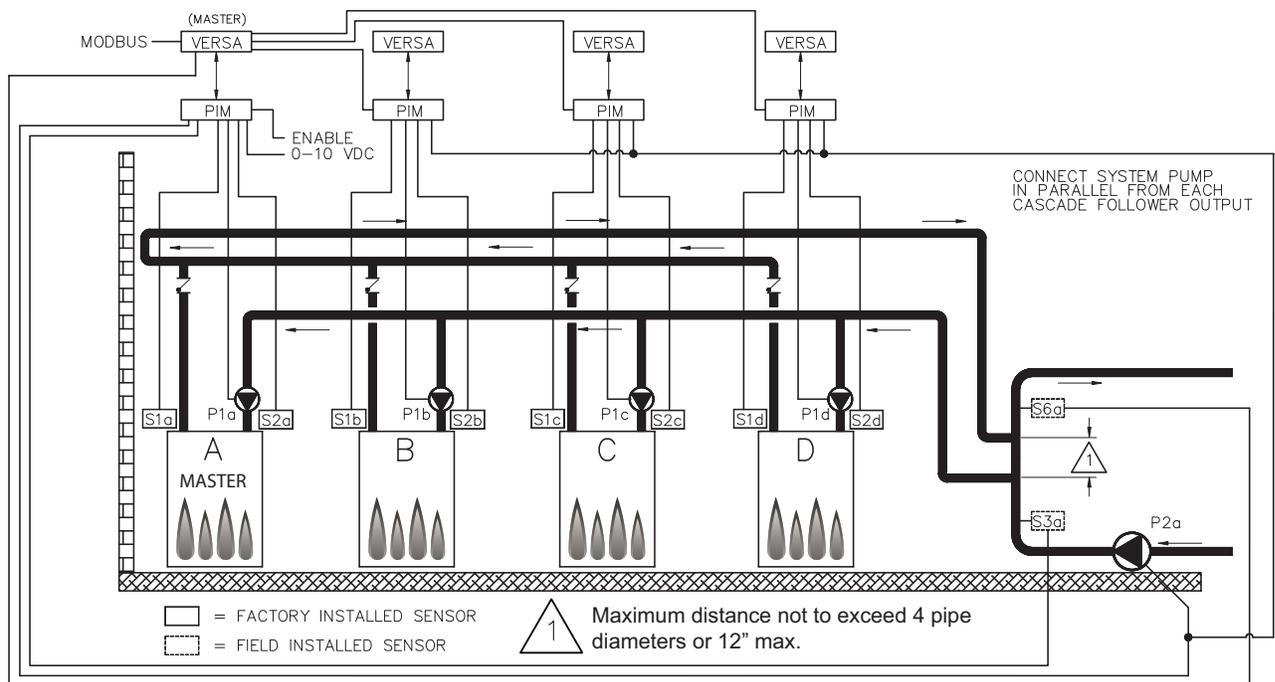
Fig. 33: Pool Multi Heaters Cascade
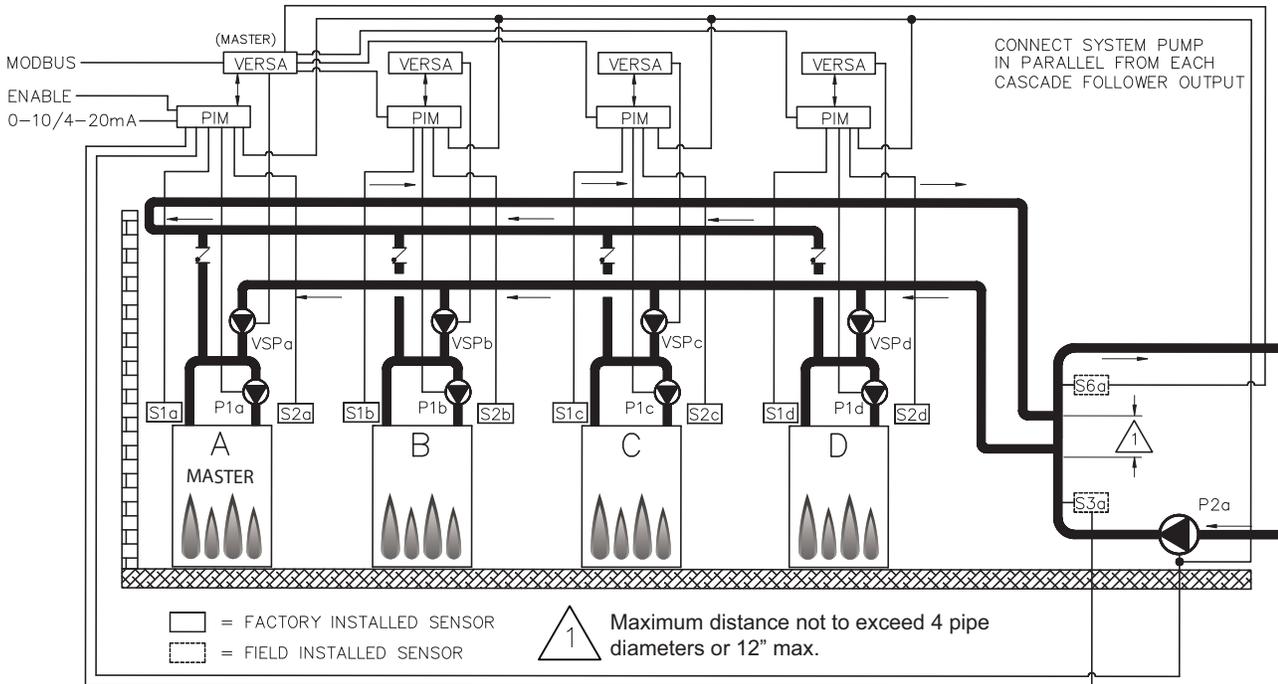
Fig. 34: Pool Multi Heaters Cascade with CWP (VS Pump)

The pool temperature will be controlled by the System Sensor (S3a). The VERSA IC will provide Max Return protection control using the Pool Return sensor (S6a) and will cycle the burner(s) if the return to the pool exceeds the Max Return setting. Both the system (S3) and Pool Return (S6) sensors must be installed using a drywell and fully immersed into the flow path for proper operation. The system will provide Max Delta-T control to cycle the burner to ensure that the Delta-T is not exceeded (between Heater Outlet Sensors (S1a-b-c-d) and Heater Inlet Sensors (S2a-b-c-d).

In order to enable MIX settings, VERSA DIP #3 must be set to the ON position. Raypak's Cold Water Protection system utilizes a variable-flow pumping system pump to inject just the right amount of water from the main system loop into the boiler loop to maintain the optimum inlet temperature (S2 a-b-c-d), among all active units, as defined in the Installation and Operating manual for the product being installed. The variable-flow pumping system pump will operate in parallel with the unit mounted heater pump. The Boiler Pumps (P1a-b-c-d) run during any call for that pumps associated heaters burner and is delayed "off" as user-defined in the BOILER menu after the associated boilers burner has shut down. The System Pump (P2a) runs whenever the system is enabled for heating. The System Pump is delayed "off" as user-defined in the SETUP menu. It is recommended the system pump be connected in parallel from each cascade follower, to allow the system pump to be functional during limp-along operation if this output is used to operate the filtration pump.

Each Follower boiler connects back to the Master boiler via a 2-wire connection for communication within the cascade. All sensors (Supply (S3a) and Pool Return sensor (S6a)) connect to the Master. Each heater in the cascade connects to and controls its own respective Boiler Pump (P1a-b-c-d). The System Pump (P2a) gets its enable signal from the Master. It is important to remember to enable a heater to be a follower in the cascade by turning DIP switch #2 on the VERSA Control Board to the OFF position for each of the followers. Once the followers have been configured correctly you must then enable the followers within the appropriate BOILER menu at the Master by turning them from OFF to ON, master DIP #2 must remain on. See BOILER menu items in Table C. This configuration supports BMS 0-10 VDC input for temperature control (in rate mode, any firing rate drives the heater to 100%) and can be configured for connectivity to BMS via the onboard Modbus port covered later in this manual.

There is no mode to configure for Pool operation as this is the only mode available when built as a P model unit. The Supply Sensor (S3a) and Pool Return sensor (S6a) MUST BE installed in the circulation loop and functional for heater operation. DIP switches #1 and 2 on the VERSA master Control Board must be in the ON position to make programming changes. Prior to setting any DIP switches, the heater must be turned off.

The differential setting applies below-setpoint only.

The next menu items are not necessarily in the order in which they will appear.

Enable followers from appropriate BOILER menu at the master:

Item	Range	Default	User Settings	When is it Displayed	Description
BOILER 1, 2, 3, 4	ON <> OFF	OFF		Cascade Followers present	FT_Bus 1, 2, 3, 4 are connected
The following settings are available in the SETUP/ADJUST Menu:					
Target	EMS Modbus	Not Visible		*EMS = Temp/Rate Modbus = Temp/Rate	EMS = Energy Management System (Analog Target Temperature) MODB = Modbus
POOL SETP	50 TO 104°F, 106°F (10 to 41ºC)	80°F (26.5ºC)		PIM Identity is P	Pool Setpoint Temperature
POOL DIFF	1 to 5°F (0.5 to 3ºC)	2°F (1ºC)		PIM Identity is P	Pool Differential Temperature
POOL MAX	110 TO 120°F (43.5 to 49ºC)	110°F (43.5ºC)		PIM Identity is P	MAX Supply Temperature to Pool
Sys. Purge	OFF, 0:20 to 20:00 min	0:20 min		*Modbus Temp/Rate PIM DIP = Purge On	Sets the length of the System Pump Purge
Units	°F or °C	°F		Always	Show Units Using Icons in Display
The items below correspond to CWP operation. Ensure VERSA DIP #3 is ON to enable CWP:					
MIX TARGET	50 TO 140°F (10 to 60ºC)	120°F (49ºC)		MIX DIP = ON	Inlet Target Temperature
MIX LOCK	ON / OFF	OFF		MIX DIP = ON	The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX LOCK = ON Alarm and lockout, MIX LOCK = OFF Alarm only
MIX TRIM	-5 TO 5	0		MIX DIP = ON	This adjustment is for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak
MIX SPEED	SLOW, MED,FAST	MED		MIX DIP = ON	This setting defines speed of response.
MIX INV	ON / OFF	OFF		MIX DIP = ON	This option is related to the use of spring-return actuators with a proportional 2- or 3-way valve
When communication with BMS is required user must enable Modbus port using the settings below by selecting other than "OFF" at Mode-Modbus screen the following settings will become available.					
Mode Modbus	Off, Monitor, Temp, Rate	Monitor		Always	Modbus Operating Mode: Off, Monitor, Temp Control, Rate Control
Address	1 to 247	1		Modbus On	Modbus Slave Address (= Node ID). When using Protonode, do not use values over 127 (see Catalog No. 5000.73).
Data Type	RTU or ASCI	RTU		Modbus On	Modbus Data Type
Baud Rate	2400, 9600, 19K2, 57K6, 115K	19K2		Modbus On	Communication Speed of Network
Parity	None, Even, Odd	Even		Modbus On	Error Detection of System. Integrator needs this information

For detailed information on MODBUS operation refer to page 71.

*Direct drive from the EMS (PIM DIP 2 = ON) applies to a single unit only. Target temp (PIM DIP 2 = OFF) can be used for either a single unit or cascade.

Table F: Pool applications SETUP menu

VERSA IC Control Menus

The user interface consists of several Menu options.

Press the **MENU** button to scroll through the different menus in the interface. Press the **ITEM** button to select a specific menu to scroll through available items within a selected menu. The **UP** and **DOWN** buttons allow for setting changes to items in the **SETUP** menu. The available menus are **VIEW**, **SETUP**, **BOILER**, **MONITOR** and **TOOLBOX**. The **RESET** button is used to reset the control when a hard lockout condition has occurred. See specific heater I&O for instructions regarding resetting the control.

User Interface Menus

The **VIEW**, **BOILER**, **MONITOR** and **TOOLBOX** menus (Tables G-J) are available in the control by hitting the **MENU** button on the membrane switch and then pushing the **ITEM** button to scroll through the menus. Some menu items are model-specific and not available on all equipment types.

VIEW Menu

The "**VIEW**" icon is turned on. BOILER and 1 segment are turned on if BOILER 2, 3 or 4 are set to ON.

Item	When is it Displayed	Description
OUTDOOR	MASTER PIM Identity is H TARGET = RSET	Outdoor air temperature, the number field displays "----" if the OUTDOOR sensor has a fault.
TARGET	MASTER MODBUS RATE EMS RATE	Current target water temperature, the number field displays "----" when there is no current target.
POOL	PIM identity is P	Current pool temperature, the number field displays "----" if the pool sensor fails.
TANK	PIM identity is WH	Current system supply temperature, the number field displays "----" if the Tank sensor fails.
SUPPLY	MASTER	Current system supply temperature, the number field displays "----" if the SUPPLY sensor has a fault.
IND SUPPLY	PIM Identity is H, MODE = 3	Current temperature being supplied to the indirect, the number field displays "----" if the indirect DHW sensor fails.
Boil OUTLET	Always	Current boiler outlet temperature as communicated from the PIM, the number field displays "----" if the outlet sensor fails.
Boil INLET	Always	Current boiler inlet temperature as communicated from the PIM, the number field displays "----" if the inlet sensor fails.
Boil ΔT	Always	Current temperature difference between the boiler outlet and boiler inlet, the number field displays "----" if the inlet and/or outlet sensor fails.
DHW Supply	MASTER PIM Identity is H, MODE = 2 OR 3 DHW SENSOR = ON	Current Indirect DHW Supply temperature, the number field displays "----" if the DHW sensor has a fault.
Boiler 1	MASTER	Shows the operation status of master boiler. IDLE, POST, PREP, MOD%, STG 1, SOFT, HARD
Boiler 2, 3, 4	MASTER	Shows the operation status of all boilers in cascade. IDLE, POST, PREP, MOD%, STG 1, SOFT, HARD

Table G: View menu

BOILER View Menu

The "**BOILER 1**" icon is turned on. Boiler 1, 2, 3 or 4 are displayed for their respective boilers.

Item	Display	User Settings	When is it Displayed	Description
BOILER 1	ON < > OFF		FT_Bus 1 is connected	Enables Boiler for operation
BOILER 2	ON < > OFF		FT_Bus 2 is connected	Enables Boiler for cascade operation
BOILER 3	ON < > OFF		FT_Bus 3 is connected	Enables Boiler for cascade operation
BOILER 4	ON < > OFF		FT_Bus 4 is connected	Enables Boiler for cascade operation
IGNITION 1, IGNITION 2	IDLE, PREP, IGN, BURN, POST, HARD, SOFT STG 1, 2, 3, 4	N/A	Always	IDLE=no CFH PREP=pre-purge or inter-purge between trials for ignition IGN=trial for ignition BURN=burner operating POST=post purge HARD=a hard lockout fault has occurred requiring manual reset (Ignition Lockout or manual high limit) SOFT=a soft lockout fault has occurred which interrupts the heating cycle (any safety other than ignition or manual high limit). The CFH will resume after the soft lockout fault has been corrected and a 15 min. waiting period has expired.
LIMIT TEMP	H 240°F max WH 210°F max P 190°F max	N/A	Always	Current Outlet -Limit temperature, set by PIM. Max set by ID Card.
EMS VDC	VDC	N/A	Always	Current EMS signal in Volts DC
FIRE RATE	%	N/A	Always	PIM firing rate
SPEEDX 1000	RPM	N/A	PIM Identity Modulating	Blower speed in revolutions per minute (rpm) x 1000, set by PIM
OUTLET MAX	°F or °C		PIM identity H	Defines max outlet temperature offset above target setpoint (press and hold up and down arrows for 3 seconds to enable adjustment).
OPERATOR	°F or °C		Always	Operator Potentiometer setting on PIM
DIFF	°F or °C	N/A	PIM Differential DIP set to Auto	Current auto differential – Fixed by PIM
Pump post	min		PIM DIP = purge	Sets the length of the boiler pump purge.
FLAME CUR	Amp	N/A	Always	Flame current in micro-amps (µA)
MASS	1 < > 2		Always	Thermal mass recovery
IDENTITY	H, WH, P	N/A	Always	Identifies the unit as boiler, water heater or pool heater
IGN TYPE	STG, MOD	N/A	Always	PIM Board type
ID CARD		N/A	Always	Identifies Raypak Identity Card

Table H: Boiler menu

MONITOR Menu

The "**MONITOR**" icon is turned on.

Item	Display	When is it Displayed	Description
RUN TIME Burner	hrs	Always	Burner runtime (hours). Press UP & DOWN buttons for 3 sec to clear this entry
CYCLES Burner	0 to 9999	Always	Number of boiler cycles. Press UP & DOWN buttons for 3 sec to clear this entry
RUN TIME Pumps – Boiler	hrs	Always	Boiler pump runtime (hours). Press UP & DOWN buttons for 3 sec to clear this entry
RUN TIME PUMPS – System	hrs	Always	System pump runtime (hours). Press UP & DOWN buttons for 3 sec to clear this entry
RUN TIME PUMPS – DHW	hrs	MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is H, MODE = 2 or 3	DHW pump runtime (hours). Press UP & DOWN buttons for 3 sec to clear this entry
OUTLET HI	°F or °C	Always	Captures the highest Boiler Outlet Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
OUTLET LO	°F or °C	Always	Captures the lowest Boiler Outlet Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
INLET HI	°F or °C	Always	Captures the highest Boiler Inlet Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
INLET LO	°F or °C	Always	Captures the lowest Boiler Inlet Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
DELTA HI	°F or °C	Always	Captures the highest Delta T Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
OUTDOOR HI	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is H TARGET = RSET	Captures the highest Outdoor Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
OUTDOOR LO	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is H TARGET = RSET	Captures the lowest Outdoor Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
SYS HI	°F or °C	MASTER MODBUS RATE EMS RATE PIM Identity is H or P	Captures the highest System Supply Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
SYS LO	°F or °C	MASTER MODBUS RATE EMS RATE PIM Identity is H or P	Captures the lowest System Supply Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
DHW HI	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is H, MODE = 2 or 3 DHW SENS = ON	Captures the highest indirect DHW Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
DHW LO	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is H, MODE = 2 or 3 DHW SENS = ON	Captures the lowest indirect DHW Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
TANK HI	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is WH	Captures the highest Tank Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
TANK LO	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is WH	Captures the lowest Tank Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
POOL HI	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is P	Captures the highest Pool Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry
POOL LO	°F or °C	MASTER MODBUS TEMP/RATE EMS TEMP/RATE PIM Identity is P	Captures the lowest Pool Temperature recorded. Press UP & DOWN buttons for 3 sec to clear this entry

Table I: Monitor menu

TOOLBOX Menu

The "**TOOLBOX**" icon is turned on.

Item	Display	Default	When is it Displayed	Description
Lookup Active Error			Active Error Present	Lookup and display the active error information
USER TEST	OFF <> ON	OFF	Advanced	Select ON to start the function, setting returns to OFF after running the test.
MAX HEAT	OFF <> ON	OFF	Advanced	Select ON to start the function, the setting will time out to OFF after 24 hrs or can be set to OFF again by the user
P/N 104901	(JXX <> XXA)		Always	Software number of VERSA IC® Control. The number field alternate Jxx <> xxA when the item is entered
DEFAULTS	----		Always	Press UP & DOWN for 3 seconds to show CLR and load factory defaults to all settings. Does not clear the fault history.
HISTORY-1 <->			Logged error present	Alternate "HISTORY 1" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-2 <->			Logged error present	Alternate "HISTORY 2" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-3 <->			Logged error present	Alternate "HISTORY 3" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-4 <->			Logged error present	Alternate "HISTORY 4" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-5 <->			Logged error present	Alternate "HISTORY 5" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-6 <->			Logged error present	Alternate "HISTORY 6" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-7 <->			Logged error present	Alternate "HISTORY 7" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-8 <->			Logged error present	Alternate "HISTORY 8" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-9 <->			Logged error present	Alternate "HISTORY 9" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-10 <->			Logged error present	Alternate "HISTORY 10" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-11<->			Logged error present	Alternate "HISTORY 11" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-12<->			Logged error present	Alternate "HISTORY 12" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-13<->			Logged error present	Alternate "HISTORY 13" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-14<->			Logged error present	Alternate "HISTORY 14" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry
HISTORY-15<->			Logged error present	Alternate "HISTORY 15" with lookup and display the most recent error information if less than 30 days old. Press UP & DOWN buttons for 3 sec to clear this entry

Table J: TOOLBOX Menu

Control Settings

Boiler System (BOILER 1, 2, 3, 4)

These settings inform the control how many units are part of a cascaded system. Each heater in the cascade must have this setting adjusted to ON to be recognized. In addition, DIP switch #2 on the MASTER heater VERSA Control Board must be set to "ON" (Master) while the same DIP switch for the remaining heaters must be set to OFF (Follower). Connections between the additional heaters must be made between the respective heater PIM and the Master heater VERSA Control Board (see Wiring Connections on page 57 for details).

> **NOTE:** During service or if it is determined that a heater should NOT be operational, this value can be set to OFF to disable a heater so the system will not use it or calculate it in the system operation. If the MASTER unit needs to be powered off, the system will allow functionality through the followers by using limp-along mode. To allow proper functionality, the system pump and DHW pump (if applicable) must be connected as depicted on Fig. 40 & 41 on pages 55 & 56.

Outlet Max

The VERSA IC control board uses this function in an attempt to prevent an over-temperature condition from occurring in hydronic systems. The Outlet Max value will anticipate a rapid temperature increase and force the system to modulate down before such an event occurs. This setting has an adjustable range of 20 to 40ºF (11 to 22ºC) above the Target value. The minimum value for the resulting High Outlet Limit will always be 170ºF (76.5ºC), regardless of the Target value. The resulting value defines the High Outlet limit and the unit will start modulating 20ºF (11ºC) below the high limit value.

Target Configuration (TARGET)

This setting is used to define if the control will operate based on Outdoor Air Reset (RSET), setpoint control (SETP), or an Energy Management System through the ModBus communication protocol (MODB). The default setting is SETP.

Mode Selection (MODE)

This MODE selection determines the operational characteristics of the system. MODE = 1 relates to hydronic heating or process heating applications. Mode = 2 relates to conventional heating with an indirect heating need located in the system loop piping.

Mode = 3 relates to conventional heating with an indirect heating needs located within the boiler loop piping. Refer to the Application diagrams and descriptions on pages 12-29 for more details of how your specific system should be configured.

Setpoint Temperature (SETPOINT)

This is the target setpoint heater temperature when a call-for-heat is present while operating in setpoint operation. This value is only available to set/change when the PIM identity is "H" and the TARGET = SETP. The range of adjustments is from 50ºF (10ºC) to the maximum value programmed into the PIM for instance XFyre 50 to 192ºF (10 to 89ºC), XPak-FT 50 to 192ºF (10 to 89ºC), MVB / XTherm 50 to 220ºF (10 to 104.5ºC). The default value is 180ºF (82ºC).

Tank Setpoint (TANK SETP)

This is the setpoint temperature for the storage tank. It is only available to set/change when the PIM identity is "WH". A range of 50 to 150ºF (10 to 65.5ºC) is available with a default of 125ºF (51.5ºC). For temperatures in excess of this range, use an H model boiler configured in Mode 1 for process application.

Pool Setpoint (POOL SETP)

This is the setpoint temperature for the pool at the S3 sensor. This value is only available to set/change when the PIM identity is "P". As shipped, a range of 50 to 104ºF (10 to 40ºC) is available with a default of 80ºF (26.5ºC).

The max setting can be extended to 106ºF by accessing this setting, pressing both the UP and DOWN arrows for 3 seconds, then pressing the UP arrow. This procedure must be repeated each time this screen is accessed.

Pool Maximum Supply (SUPPLY MAX)

This is the maximum supply temperature to the pool at the S6 sensor. This value is only available to set/change when the PIM identity is "P". The heater will shut down if the temperature exceeds this maximum value. The range of adjustment is 110 to 120ºF (43.5 to 49ºC).

Differential Settings

A heat source must be operated with a differential in order to prevent short cycling. The heater differential is divided around the heater target temperature.

1. **Target Differential (TARGET DIFF)**
   This value is only available to set/change when the PIM identity is "H" and the PIM DIP switch #1

(Operator Differential) is set to ON (Manual Differential). Target Differential is split equally above and below the target set-point (SETPOINT). For example, in the case of a 180ºF (82ºC) set-point with a 10ºF (5.5ºC) differential, the control will energize the boiler when the controlled temperature drops to 175°F and then will shut the boiler off at 185°F (85ºC). The Target Differential defaults to 10ºF (5.5ºC) with a range of 2 to 42ºF (1 to 23.5ºC).

2. Tank Differential (TANK DIFF)

Tank Differential applies below the setpoint. For example, in the case of a TANK SETP setpoint of 130ºF with a 6ºF differential, the control will energize the heater when the tank temperature drops to 124ºF and then will shut the heater off at 130ºF. The Tank Differential defaults to 5ºF with a range of 2 to 10ºF. This value is only available to set/change when the PIM identity is "WH".

3. Pool Differential (POOL DIFF)

Pool Differential applies below the setpoint. For example, in the case of a POOL SETP setpoint of 80ºF with a 2ºF differential, the control will energize the heater when the pool temperature drops to 78ºF and then will shut the heater off at 80ºF. The Pool Differential defaults to 2ºF with a range of 1 to 5ºF. This value is only available to set/change when the PIM identity is "P".

4. Indirect Differential (IND DIFF)

Indirect Differential is the differential for the indirect DHW tank temperature. It applies below the setpoint. For example, in the case of an IND SETP setpoint of 130ºF with a 6ºF differential, the control will energize the heater when the tank temperature drops to 124ºF and then will shut the heater off at 130ºF. The Indirect Differential defaults to 6ºF with a range of 2 to 10ºF. This value is only available to set/change when the PIM identity is "H" and MODE = 2 or 3 and DHW SENS = ON.

System Pump Purge (SYS PURGE)

The VERSA IC Control continues to operate the system pump after the system is shut down, either by removing the enable closure or by warm weather shut down (when used). When SYS PURGE is set to OFF, there is no system pump post purge. The default timing is 20 sec (0:20 min), but can be adjusted from 20 sec to 20 minutes.

Maximum Target Boiler Temperature (TARGET MAX)

This is the maximum target temperature that the boiler

can be set to. This value is only available to set/change when the PIM identity is "H". The range of adjustments is for XFyre 50 to 192ºF, XPak-FT 50 to 192ºF, MVB / XTherm 50 to 220ºF. Refer to the specific product I&O Manual for this information.

Minimum Target Boiler Temperature (TARGET MIN)

This is the minimum target temperature that the boiler can be set to. This value is only available to set/change when the PIM identity is "H". The range of adjustments is from 50 to 180ºF.

Indirect Sensor Selection (IND SENSOR)

This setting determines whether a DHW sensor or an aquastat will control the indirect DHW tank temperature. This value is only available for set/change when the PIM identity is "H", the MODE = 2 or 3. The setting can be "ON" or "OFF". The default value is "OFF." Contact closure is required for operation across the IND DHW Override terminals when using the IND Sensor option.

CAUTION: When using the IND Sensor, it is recommended that the operator setpoint dial on the PIM be set for DHW Target temperature to prevent an over-temperature condition from occurring. An aquastat may be installed on the discharge pipe of the indirect DHW tank to act as a secondary limit.

Target Indirect DHW Temperature (IND SETP)

This is the target indirect DHW water temperature setting when a DHW sensor is selected. This value is only available for set/change when the PIM identity is "H", the MODE = 2 or 3 and the DHW SENSOR = ON. The range of settings is 50 to 180ºF. The default value is 140ºF.

Target Boiler Temperature for DHW Heat Exchanger (IND SUPPLY)

This is the target boiler temperature for the DHW heat exchanger during indirect DHW operation. This value is only available to set/change when the PIM identity is "H", the MODE = 2 or 3 and the DHW SENSOR = OFF. The range of settings is 70 to 200ºF not to exceed "Target Max". The default value is 180ºF. This setting is only available when using an aquastat in the indirect tank in lieu of a 10k Ohm sensor. When using a sensor this setting is defaulted to the IND SETP plus 40ºF, not to exceed Target Max.

Selection of Indirect Priority (IND PRIORITY)

This selects whether or not indirect DHW priority is active during indirect DHW operation. This value is only available to set/change when the PIM identity is "H", the MODE = 2. The setting can be "ON" or "OFF". The default value is "OFF". Mode 3 requires priority functionality due to the piping configuration.

Priority Override Time (PRI OVR)

This selects the length of time for the priority override. This value is only available for set/change when the PIM identity is "H" or DHW PRIORITY = ON. The settings can be "Au" or from 10 min to 2.0 hours. The default value is "1:00 hr". This will maintain the priority override until the call-for-heat in this system is satisfied.

Cold Water Protection (CWP)

Some applications require reliable protection against harmful condensation caused by frequent, extended, cold water exposure. The CWP system utilizes several piping configurations with proportional 3-way valve, 2-way valve or injection VS pump system to maintain the inlet water temperature to the unit during operation in order to prevent harmful condensation.

The applicable settings for this operation are enabled and shown within the SETUP menu when the VERSA board DIP switch # 3 is enabled.

The following are the settings for the CWP:
- MIX Type (H and WH)
- MIX Target
- MIX Lock
- MIX Speed
- MIX Inv
- MIX Trim

MIX Type

For Hydronic systems MIX Type has three options, "VALVE, PUMP" and "PLNT".

"VALVE and PUMP" assumes that each individual unit will have the proper wiring and pipe configuration to control its own inlet temperature. (see Fig. 13 on page 12). Pump selection is available for High temp process applications using H models.

"PLNT" assumes that a 3-way valve will control the inlet temperature among the entire system (cascade). (see Fig. 16 on page 15)

For Domestic Hot Water systems (WH), Mix Type = 2 only. This is used in conjunction with a variable-speed injection pump (See Fig. 28 on page 30).

MIX Target

This is the control setpoint for inlet temperature, the default setting is 120ºF (49ºC). Consult the product-specific manual for required minimum inlet temperature for proper operation.

> **WARNING:** A MIX Target setting below the minimum required for the product being used will cause damage from harmful condensation.

MIX Lock

The equipment will trigger a warning when "MIX Target" is not reached within 7 minutes. MIX Lock defines whether the system will alarm and continue running or will alarm and lockout the unit. MIX Lock "ON" will shut the unit down and provide an alarm if the inlet temperature is not achieved within 7 minutes, requiring manual reset. MIX Lock "OFF" will only provide an alarm contact closure while allowing the unit to remain operational if the inlet temperature is not achieved within 7 minutes.

MIX Speed

This setting defines speed of response. The default setting of MED has been found to provide stable operation in most piping configurations. Depending on product selection and mix of sizes (cascade) the setting can be adjusted to fine-tune the CWP operation.

MIX Inv

This option is related to the use of spring-return actuators with a proportional 2- or 3-way valve for CWP. Valve actuators can be field-configured to provide spring-to-system or spring-to-bypass operation, depending on user preference. This output can be configured for MIX INV "OFF" 0 to 10 VDC (0% to 100%), or MIX INV "ON" 10 to 0 VDC (0 % to 100%).

MIX Trim

This item allows adjustment for various types and sizes of units as well as various actuator motor speeds and types supplied by Raypak. For systems with very cold start-up temperatures such as snow melt / deicing, the trim may require adjustment to lower values for stable operation. For the majority of the systems with CWP the default value of zero will provide stable operation.

H Models & MIX Type = PUMP

H models include a cold water protection MIX Type selection for individual injection pump ("PUMP"). MIX Type = PUMP is for those systems that require low lead and/or non-ferrous plumbing systems such as high-temperature potable water (kitchen) or process systems (laundry). For more detailed information about this configuration refer to the product-specific I&O manual.

> **WARNING:** Operating below the minimum inlet required for the product being used will cause damage from harmful condensation.

Temperature Units of Measure (°F or °C)

This selects the units of measure to show on the display. The choices are degrees Fahrenheit (°F) and degrees Celsius (°C). The default is degrees Fahrenheit (°F).

Modbus Operating Mode Selection (MODBUS)

This allows the system integrator to select the Modbus operating mode. The choices are "OFF", monitor (MNTR), temperature control (TEMP) and rate control (RATE). The default setting is "MNTR".

Modbus Component Address (ADDRESS)

This assigns a slave address to components on the Modbus communication network. The range of adjustments is 1 to 247. The default value is 1.

Modbus Data Type (DATA TYPE)

This assigns the Modbus data type. The options include "RTU" and "ASCI". The default is "RTU".

Modbus Communication Baud Rate (BAUD RATE)

This assigns the communication speed for the Modbus communication network. The choices include: 2400, 9600, 19K2, 57K6 and 115K. The default value is 19K2.

Modbus Parity (PARITY)

The choices are "NONE", "EVEN" and "ODD". The default is "EVEN". 1 stop bit is used for "EVEN" or "ODD". 2 stop bits are used for "NONE".

Heater Mass (BOIL MASS)

The heater mass setting (1 or 2) allows the installer to adjust the VERSA IC Control to the thermal mass of the system. See Table K. The heater mass setting automatically determines the preliminary PID modulation parameters.

Heater Mass Definitions	
Mass = 1	Fast response
Mass = 2	Standard response

Table K: Mass parameters

> **NOTE:** Always start with a heater mass setting of 2 (Default).

Boiler Pump Purge (BOIL PURGE)

The VERSA IC Control continues to operate the boiler pump after the burner shuts down for the time selected. When BOIL PURGE is set to OFF, there is no boiler pump post purge. The default timing is 3:00 min, but can be adjusted from 20 sec to 10 minutes.

> **CAUTION:** Continuous pumping through the unit is not supported and may cause a non-warrantable failure.

Additional Operational Features

Outdoor Reset Operation
When a building is being heated, heat escapes through the walls, doors, and windows to the colder outside air. The colder the outside temperature, the more heat escapes. If you can input heat into the building at the same rate that it is lost out of the building, then the building temperatures will remain constant. The Reset Ratio is an adjustment that lets you achieve this equilibrium between heat input and heat loss.

The VERSA control can change the System Setpoint based on outdoor temperature (Outdoor Reset). The VERSA control varies the temperature of the circulating heating water in response to changes in the outdoor temperature. The heating water temperature is controlled through the modulation and/or sequencing of the cascade.

The VERSA control can also control the system circulating pump with an adjustable Warm Weather Shutdown temp (WWSD) See page 48. When the outdoor temperature is above the WWSD Cutoff, the pump is turned off and no heating water is circulated through the system. When the outdoor temperature drops below the WWSD Cutoff, the system pump relay is activated and the heating water circulates through the system. The temperature of the heating water is controlled by the Reset Ratio, Water Offset, and changes with the outdoor temperature.

Reset Ratio/Outdoor Reset
The starting point for most reset systems is a 1:1 ratio of outdoor temp changes to heating water temperature changes. This means that for every degree the outdoor temperature drops, the temperature of the heating water will increase one degree. With the VERSA, both ends of the slope are adjustable. It is factory set at 70°F (21ºC) water temperature (Boil START) at 70°F (21ºC) outdoor air (OUT START), and 180°F (82ºC) water temperature (Boil DESIGN) at 10°F (-12ºC) outdoor air (OUT DESIGN). Each building has different heat-loss characteristics. A very well-insulated building will not lose much heat to the outside air, and may need a Reset Ratio of 2.00 (OD):1.00 (SYS) (Outdoor: Water). This means the outdoor temperature would have to drop 2 degrees to increase the water temperature 1 degree. On the other hand, a poorly-insulated building may need a Reset Ratio of 1.00 (OD):2.00 (SYS). This means that for each degree the outdoor temperature drops the water temperature will increase 2 degrees. The VERSA control Reset Ratio allows for full customization to match any building's heat loss characteristics.

A heating curve that relies not only on Outdoor temperature but also on the type of radiation will improve heat comfort. The user can fine-tune these adjustments based on the needs of the specific building.

Reset Ratio
The control uses the following four settings to determine the reset ratio:

Outdoor Starting Temperature (OUT START)
This is the outdoor temperature at which the control starts to calculate a reset when Outdoor Reset is active. This value is only available for set/change when the PIM identity is "H" and the TARGET = RSET. The range of adjustment is 35 to 85°F (1.5 to 29.5ºC). The default value is 70°F (21ºC). See Fig. 35 for Outdoor Reset curve information.

Outdoor Design Temperature (OUT DESIGN)
This is the outdoor temperature that is typically the coldest temperature of the year where the building is located. This temperature is used when doing heat loss calculations for the building. This value is only available for set/change when the PIM identity is "H" and the TARGET = RSET. The range of adjustment is -60 to 45°F. The default value is 10°F (5.5ºC). See Fig. 35 for Outdoor Reset curve information.

Boiler Design temperature (Boil DESIGN)
This is the water temperature required to heat the system when the outdoor air temperature is as cold as the OUT DESIGN temperature. This value is only available for set/change when the PIM identity is "H" and the TARGET = RSET. The range of adjustment is 70 to 200ºF (21 to 93ºC) (200 = Boiler Design max value, user-selectable). The default value is 180°F (82ºC). See Fig. 35 for Outdoor Reset curve information. The Highest TARGET calculable value is determined by Boil Design setting.

Boiler Start Temperature (Boil START)
This is the starting boiler target temperature that the system requires when the outdoor air temperature equals the OUT START temperature setting. The Boil START is typically set to the desired building temperature. This value is only available for set/change when the PIM identity is "H" and the TARGET = RSET. The range of adjustment is TARGET MIN to 150°F (65.5ºC). The default value is 70°F (21ºC). See Fig. 35 for Outdoor Reset curve information. The lowest target calculation will be truncated based on the target minimum setting.
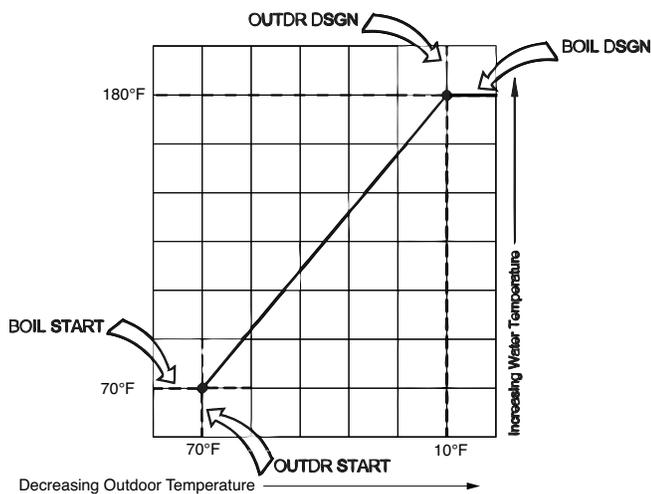
Fig. 35: Outdoor Air Reset Curve

Warm Weather Shut Down (WWSD)

When the outdoor air temperature rises above the WWSD setting, the VERSA IC Control turns on the WWSD segment in the display. When the Control is in Warm Weather Shut Down, the Control does not operate the heating system to satisfy any heating demand – however, any water heating or indirect heating load will override the WWSD function until such call-for-heat is satisfied. This value is only available to set/change when the PIM identity is "H" and the TARGET = RSET. The range of adjustments is from 40 to 100°F (4.5 to 38°C) or OFF. The default value is 70°F (21°C). The lowest target calculation will be truncated based on the Target Min Setting.

> **NOTE:** WWSD has a differential of 2°F (1°C). Ensure the proper installation of the outdoor air sensor to prevent short-cycling.

Reset Ratio

The VERSA control uses the following four settings as shown to calculate the Reset Ratio (RR):
For example, when using the default values, the RR is:

$$\text{RESET RATIO (RR)} = \frac{\text{OUTDOOR START} - \text{OUTDOOR DESIGN}}{\text{BOILER DESIGN} - \text{BOILER START}}$$

RR = (70 - 10) / (180 - 70) = 0.55

Pump and CWP Exercise

This feature (when enabled via DIP switch #4 on the PIM is set to ON) will cycle the pumps and CWP, if enabled, for 10 seconds every 72 hours, even with no heat demand, to help extend the life of the pumps. During this operation, the word "EXERCISE" will display on the VERSA IC Display.

Freeze Protection

This feature (when enabled via DIP switch #7 on the PIM being set to ON) will cycle the boiler pump on if either the inlet or outlet heater sensors drops below 45°F (7°C). The pump will continue to operate until the temperature rises above 50°F (10°C) at both sensors. If the temperature continues to drop below 38°F (3.5°C) at either sensor, the heater will enable a heating cycle to operate at minimum firing rate to raise the water temperature in the boiler to avoid freezing. The heating cycle will terminate when both the Inlet and Outlet temperatures rise above 42°F (5.5°C).

Should the heater be in a soft-lockout condition, the Freeze Protection operation will override all soft-lockout timers to operate; however, it will NOT override a hard lockout.

Freeze protection is functional with the VERSA IC Control operator, but will also function in "limp-along" mode should the VERSA IC Control not be functioning, as long as the PIM DIP switch #7 is ON.

Heater Rotation

When configured for cascade operation the VERSA Master can be user-defined to provide lead rotation. Lead rotation, when selected via VERSA DIP #6, is fixed at 48 hours of burner run time as measured between the lead unit and any other cascade member run time. Once there is 48 hours difference in burner run time between the lead unit and another cascade member, the lead will rotate to the unit with the least amount of burner run time once the current call for heat is satisfied. The remaining units will be operated sequentially based on their order within the cascade.

Another feature of the rotation function is to force a rotation event to occur after 60 hours of the lead stage operating continuously due to a continuous call for heat from the system. In the event that the lead unit is not allowed to cycle off due to a continuous demand, the VERSA will force the cascade to achieve "target + differential" by increasing the firing rate of the active unit until the system temperature is satisfied. Once the system temperature is satisfied, the active unit will cycle off. This will in turn allow the rotation event to occur to ensure equalized runtime of the cascade members.

Target Differential – Auto/Manual

The VERSA IC control system is configured as standard with an "Auto Differential" feature (H models only). This function serves as part of how the controller attempts to achieve a minimum ON time to ensure maximum system and boiler operating efficiency. The

VERSA IC will automatically adjust the target differential during each cycle as needed to prevent short cycling of the burner, while also trying to maintain the system supply temperature as close to target as is possible. The user can select via DIP switch #1 on the PIM to disable the auto differential function and set a fixed differential. Typically a manual differential is suggested when operating at elevated temperatures near the limit of the appliance. This is done to prevent overshooting the temperature so as not to trip the manual reset high limit. The manual differential is adjustable from 2 to 42ºF (1 to 23ºC) and is split equally above and below the target temperature.

Minimum Run Time

The VERSA IC Control system attempts to maintain a minimum run time of 210 seconds for each heater. This is accomplished several ways automatically by the control system. One method is by automatically adjusting the differential (Auto DIFF) used around the target temperature, and another is by extending the OFF time of the burner to achieve longer ON times. However, should the temperature exceed one-half the calculated differential above the target temperature, the heater will shut down. Conversely, if the system temperature exceeds the full differential below the target temperature, the heater will fire to achieve the setpoint.

Outdoor Sensor Fault Operation

If the Outdoor Sensor is open (OPN) or shorted (SHT), the alarm will signify the fault, but the boiler will continue operation and set the TARGET temperature based on an outdoor temperature of 32ºF (0ºC).

System Sensor Fault Operation

If the System Sensor is not functioning, the heater will alarm to signify the fault but will still operate to achieve target based on the Outlet Sensor. The boiler pump will be enabled to run continuously during this fault to ensure water flow is moving past the active outlet sensor.

Field Test

Whenever the heater is IDLE or in lockout, pressing and holding the test/reset button on the PIM (or the reset button on the heater membrane switch – if present) for a period of 5 seconds shall initiate a field test mode. The PIM will light the amber Alarm/Test LED indicator and sequentially turn on the pump outputs for a minimum of 10 seconds each. Pressing and holding the test button (or reset button) for at least one second will cancel the field test and the PIM Alarm/Test LED shall be turned off.

User Test

This test is accessible from the **TOOLBOX** menu on the VERSA IC Display. "USER TEST" is displayed on the first line of the display and "OFF" is shown on the second line. "USER TEST" remains on the first line of the display throughout this testing mode.   Only the second line of the display changes to show the state of operation. When this functionality is enabled (push the UP button on the membrane switch), the system begins a system-wide test of the heater. See Table L. "STRT" appears on the display, then the system pump is enabled (and the display shows "SYS").

After approx. 10 seconds, the DHW pump is enabled (and the system pump disabled) and the display shows "DHW". Approx. 10 seconds later, the boiler pump is enabled along with the system pump (the display shows "PMP1"). After approx. 10 more seconds, the display will show "Boil 1" which initiates a CFH for this User Test.

If the heater is enabled to run, the heater will go through a normal trial for ignition and light. If ignition is successful, the display will show "MIN1" and the heater will operate at minimum firing rate.   Pushing the UP button on the membrane switch will hold the firing rate at this level as long as desired and the display will flash "HOLD" at 1-second intervals during this period of time.

NOTE: If the heater outlet temperature approaches the PIM Hi-Limit value, the heater will ramp down the firing rate to keep the temperature in a safe operating range.

Pressing the UP button again will step the program to ramp up the firing rate to maximum input and "MAX1" will display. Pressing the UP button again will hold this

Number Field	Output Action
SYS	System Pump relay turns on.
DHW	DHW Pump relay turns on.
PMP 1	System and Boiler Pump relays turn on.
CWP 1	CWP Proportional Output.
Boil 1	Ignite Boiler Burner.
Min 1	Hold Boiler at Min Fire.
Max 1	Ramp Boiler to Max Fire and hold.

Table L: User Test Operation

firing rate for as long as desired and the display will flash "HOLD" at 1-second intervals during this period of time. Any CFH received from the system during this User Test will be ignored until the test is completed.

For Cascade configurations, the USER TEST item is only available though the master unit. To perform a user test at each individual follower, go to each Boiler menu from the Master user interface, and enable only the boiler to be tested.

When CWP is enabled (VERSA DIP#3) VALV becomes available for USER TEST.

Commission Test Mode

When the PIM DIP switch #8 is turned to the ON position, a Commission Test Mode is activated. The PIM lights the amber Alarm/Test LED. This mode activates certain functions to assist initial commission testing of the system. The configured high limit temperature is overridden to match the setpoint potentiometer position. The high limit can then be adjusted by the potentiometer to assist commission testing and verification. The operating setpoint is automatically set to 20°F (11ºC) above the high limit (stand-alone mode), or it can be controlled by the VERSA IC Control.

Max Heat Function

This function sets the target temperature equal to Boiler Maximum value whenever any demand is present. In addition, the DHW priority is disabled and WWSD is disabled. The Max Heat function will be aborted if 24 hours has elapsed since it was initiated or if the user sets MAX HEAT = OFF in the **TOOLBOX** menu.

Max Delta T Protection

The VERSA IC system is capable of controlling the operation of the heaters so that a maximum value of Delta-T is not exceeded in an attempt to protect the heaters from flashing to steam or damaging the heat exchanger due to scale which can form at high temperatures.

If the Maximum Delta-T value is exceeded, the heater will shutdown (pumps will continue to operate), the alarm light will turn on and the display will show "DELTA T ERR". Once the Delta-T drops below half the maximum value, as defined by the unit type, the alarm light will turn off and the heater will return to IDLE state until a CFH is present.

This value is set by the PIM and is not adjustable.
- H units   40 Delta-T (ºF)
- WH, P 2003-2004 ONLY   35 Delta-T (ºF)
- all other WH and P units   30 Delta-T (ºF)

Sequence of Operation

1. Upon initial application of 24VAC power, the PIM resets with all outputs in the "OFF" state.

2. The PIM and VERSA IC Control perform a processor and memory self-test to ensure proper operation.

3. The PIM confirms the presence of a valid ID Card which matches the configuration stored in memory at the factory. If a valid ID Card is NOT present, the PIM generates a diagnostic fault and will shut down waiting for this fault to be addressed.

4. The PIM reads the DIP switch settings and configures itself for the desired operation.

5. The PIM scans the Ft_bus communications for the VERSA IC Control and if found, system operation is controlled by the VERSA IC Control.

6. Non-volatile memory is checked for any active lockout conditions. If any exist, they must be addressed before the PIM will allow a new trial for ignition to start.

7. The PIM continually monitors the flame status to ensure that no flame is present during Standby. If an erroneous flame is detected, the PIM generates a False Flame error fault.

8. The PIM verifies that the vent sensor (some models) is below the vent limit temperature before burner operation. If the vent temperature is exceeded, the PIM performs a Post-purge and proceeds to a hard lockout.

9. A Call-for-heat is initiated by the presence of any one or more of the 4 sources below:
   a. A heat demand (contact closure) on the TH field wiring terminals.
   b. A voltage greater than 0.5 VDC on the analog 0-10 VDC EMS signal input.
   c. A heat demand present on the DHW field wiring terminals.
   d. A heat demand from the VERSA IC control based on the DHW sensor temperature.

10. The PIM initiates a trial for ignition counter to the programmed number of trials for ignition (1 or multiple) and proceeds to Pump Purge mode.

11. The VERSA IC Control will turn on the system, boiler and/or DHW pump as necessary to address the call-for-heat. This is dependent on the Mode of operation selected. The pumps will proceed through their purge period before the control will move into a Trial for Ignition (TFI). For systems with CWP enabled, the MIX output is sent to the MIX MIN % value.

12. The VERSA Control Board and PIM check the safety circuit and will stop from going into a trial for ignition if any of the safety devices is in an error/fault condition.

13. If no fault condition is found, the air pressure switch (if present) is verified to be in the open position before the blower is energized.

14. The blower(s) are energized and set to pre-purge speed (if modulating).

15. The air pressure switch is verified to close within 60 seconds to prove air flow.

16. Once the air pressure switch closes (or the blower speed is acknowledged as operating at the pre-purge speed by the tachometer output), the blower proceeds to pre-purge for the specified duration.

17. The voltage level of the 24VAC supply input is confirmed to be above 18.0VAC – if not, a Low Voltage fault will be recorded and the heater will go into a soft lockout condition until the voltage rises above 18.0VAC consistently.

18. If all checks have passed, the system proceeds to ignition.

19. The PIM re-initializes the ignition counter to the configured number of trials (typically 1 or 3).

20. The Hi Limit sensor is confirmed to read below the Hi Limit setpoint.

21. The blower light-off RPM speed (modulating blowers only) is verified.

22. The gas valve relay contacts are verified open – if closed, a fault code will be issued and the heater will post-purge and go into a hard lockout condition.

23. On heaters equipped with a Hot Surface Igniter:
    a. The control turns on the HSI and the HSI proving current is verified to be above the configured value.

b. The configured heat-up delay takes place to allow the HSI element to reach ignition temperature.
c. The gas valve output is energized for the trial-for-ignition time to light the burner.
d. The HSI is de-energized during the last second of the trial-for-ignition period to sense for the burner flame.
e. The flame sense is checked for successful lighting of the burner. If a valid flame is detected, the main gas valve, operating pumps and blower relay remain energized and the PIM proceeds to the Heating mode. For systems with CWP enabled, the MIX output is released to its control point based on distance from Inlet temperature target

24. On heaters equipped with a Direct Spark Igniter:
    a. The DSI igniter (high voltage spark output) is energized.
    b. The gas valve output is energized for the trial-for-ignition time to light the burner.
    c. The flame sense is checked for successful lighting of the burner. If a valid flame is detected, the sparking is terminated, the main gas valve, operating pumps and blower relay remain energized and the PIM proceeds to the Heating mode. For systems with CWP enabled, the MIX output is released to its control point based on distance from Inlet temperature target

25. If flame is not detected during the trial-for-ignition period, the gas valve output is disabled immediately and the blower goes to a post-purge.

26. On single trial-for-ignition models, the PIM enters ignition lockout and the LED on the PIM indicates the fault code for ignition lockout. The VERSA IC Display should also state Ignition Lockout.

27. On multi-trial-for-ignition models, the control goes through an interpurge delay before additional ignition attempts are started. If no flame is detected after the final trial-for-ignition, the PIM enters ignition lockout and the LED on the PIM indicates the fault code for ignition lockout. The VERSA IC Display should also state Ignition Lockout.

28. During a heating cycle the flame status, air pressure switch, LWCO, water pressure switch and other safety switches are continually monitored for proper state.

29. The System temperature is monitored against the target temperature to determine the proper firing rate or staging level. Cascade configuration utilize sequential staging for follower units as required to achieve and maintain target temperature.

30. The PIM remains in heating mode until the staging reaches 0% or the firing rate drops below the configured minimum value for the heater.

31. When the call-for-heat is satisfied, the gas valves(s) are immediately disabled, a blower post-purge is completed and the controls proceed to IDLE mode.

32. The pumps complete a purge period as set in the **ADJUST** menu.

33. Should a loss of flame occur on Direct Spark Ignition models during a heating cycle, the control will energize the high voltage spark igniter within 0.8 seconds for the configured trial-for-ignition period in an effort to relight the burner (multi-try models allow 3 tries for ignition with inter-purges). If the burner relights, normal operation is resumed. If the burner does not relight, the gas valve is de-energized immediately and the control will go into ignition lockout.

34. Should a loss of flame occur on Hot Surface Ignition models during a heating cycle, the gas valve is de-energized within 0.8 seconds and the blower goes through a post-purge. After the flame recycle delay, the control attempts to relight the burner (multi-try models allow 3 tries for ignition with inter-purges). If the burner relights, normal

operation is resumed. If the burner does not relight, the gas valve is de-energized immediately and the control will go into ignition lockout.

Wiring Connections - PIM

The following information relates to the wiring connections on the PIM, VERSA IC Control and VERSA IC Display boards. Refer to each product-specific I&O manual for specific connections for specific models. See Fig. 36-39.
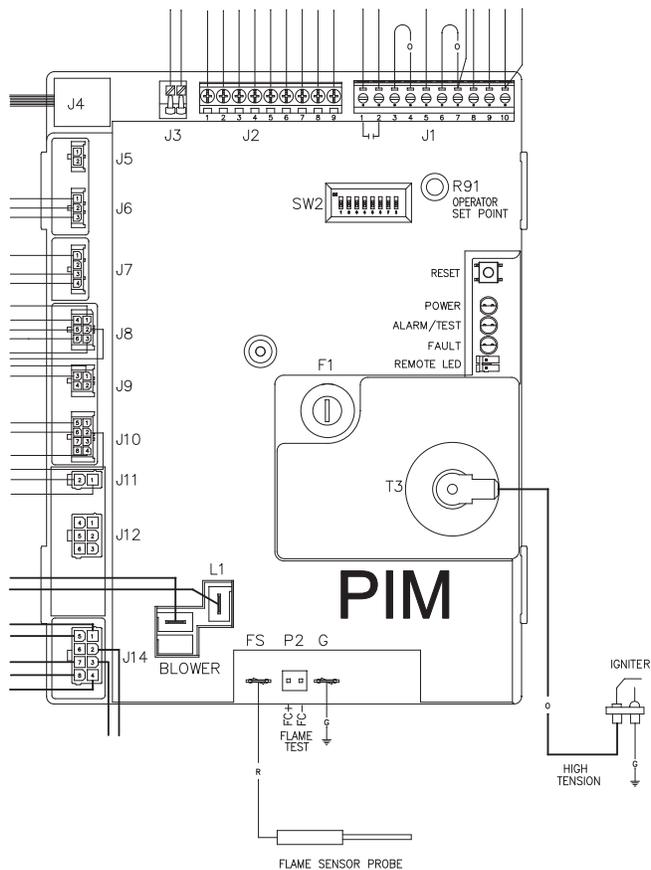
Fig. 36: PIM Connections – DSI Control

PIM Low-Voltage Connections (30VAC Max)

Connector	Pin #	Function	Type & Rating
J1	1	Alarm Contacts	0-30VAC, 2.0A Max – Dry contact
J1	2	Alarm Contacts	0-30VAC, 2.0A Max – Dry contact
J1	3	N/A	
J1	4	24VAC Out (R)	18-30VAC, 2.0A Max
J1	5	Remote Reset	0-30VAC, 2.0A Max
J1	6	N/A	
J1	7	24VAC Out (R)	18-30VAC, 2.0A Max
J1	8	DHW Call (DHW)	0-30VAC, 2.0A Max
J1	9	Heat Call (TH)	0-30VAC, 2.0A Max
J1	10	24VAC Out (R)	18-30VAC, 2.0A Max
J2	1	DHW Sensor	10K Thermistor – J Curve

Connector	Pin #	Function	Type & Rating
J2	2	DHW Sensor Common	10K Thermistor – J Curve
J2	3	System Supply Sensor	10K Thermistor – J Curve
J2	4	System Sensor Common	10K Thermistor – J Curve
J2	5	Outdoor Sensor	10K Thermistor – J Curve
J2	6	Outdoor Sensor Common	10K Thermistor – J Curve
J2	7	tN4 Communications	Communications Network Signal
J2	8	0-10VDC Analog EMS Input	0-10VDC or 4-20mA
J2	9	Common	Ground
J3	1	Ft_bus B	22AWG Twisted Pair
J3	2	Ft_bus A	22AWG Twisted Pair
J4	1	PIM to VERSA IC Control	RJ45
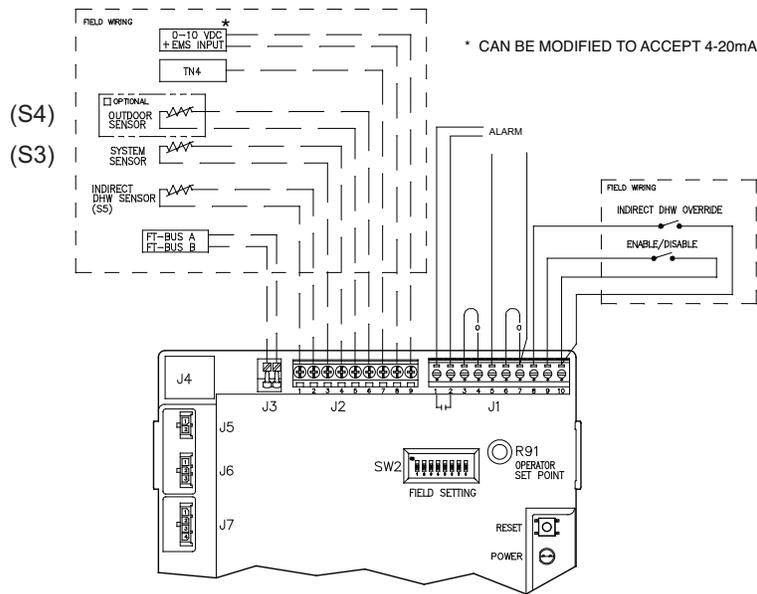
Fig. 37: VERSA PIM Control Connections (XFyre and XPak FT)
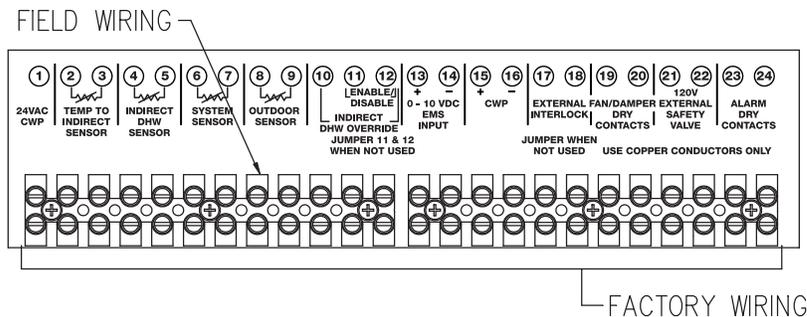
Fig. 38: Field Wiring for MVB / XTherm / Hi Delta

PIM Factory Low-Voltage Wiring Connections

Connector	Pin #	Function	Type & Rating	Connector	Pin #	Function	Type & Rating
J5	1	Ft_bus B (PIM to PIM)	20-30AWG, 2.0A	J11	2	24VAC Common	30VAC, 8A
J5	2	Ft_bus A (PIM to PIM)	20-30AWG, 2.0A	J12	1	Gas Valve Common (Isolated Relay)	120/240VAC, 8A
J6	1	ID Card	20-30AWG, 2.0A	J12	2	2nd Stage Gas Valve	120/240VAC, 5A
J6	2	ID Card	20-30AWG, 2.0A	J12	3	Gas Valve Return	120/240VAC, 5A
J6	3	ID Card	20-30AWG, 2.0A	J12	4	2nd Stage Gas Valve Return	120/240VAC, 5A
J7	1	Hi-Limit Sensor	10K Thermistor – J Curve	J12	5	Gas Valve (MV/PV)	120/240VAC, 8A
J7	2	Hi-Limit Sensor Common	10K Thermistor – J Curve	J12	6	Valve Power (Isolated Contact)	120/240VAC, 8A
J7	3	Outlet Sensor Common	10K Thermistor – J Curve	J13	1	Blower Output (L1)	120/240VAC, 5A
J7	4	Outlet Sensor	10K Thermistor – J Curve	J13	2	Blower Output (L2)	120/240VAC, 5A
J8	1	NOT USED		J13	3	Blower Ground	120/240VAC, 8A
J8	2	Air Pressure Switch (model specific)	20-30AWG, 2.0A	J13	4	L1 Supply Input	120/240VAC, 8A
J8	3	NOT USED		K5 Relay		F1 & F2 Terminals	120/240VAC,15A
J8	4	Air Pressure Switch (model Specific) Retun	20-30AWG, 2.0A	J14	1	DHW Pump	120/240VAC, 5A
J8	5	Safety loop	20-30AWG, 2.0A	J14	2	Boiler Pump	120/240VAC, 5A
J8	6	Safety loop	20-30AWG, 2.0A	J14	3	L1s – System Pump Supply	120/240VAC, 8A
J9	1	Inlet Sensor	10K Thermistor – J Curve	J14	4	System Pump	120/240VAC, 5A
J9	2	NOT IN USE	10K Thermistor – J Curve	J14	5	L1 Supply Power	120/240VAC, 8A
J9	3	Inlet Sensor Common	10K Thermistor – J Curve	J14	6	NOT USED	
J9	4	NOT IN USE	10K Thermistor – J Curve	J14	7	L2 (Neutral)	120/240VAC, 8A
J10	1	FUTURE		J14	8	Pumps Ground	120/240VAC, 8A
J10	2	PWM Out (Modulation %)	20-30AWG, 2.0A	HV		Spark Output (T3 Coil)	25kV
J10	3	FUTURE		GND		Burner Ground	
J10	4	Tachometer Input	20-30AWG, 2.0A	S1		Hot Surface Igniter	5.0A Max
J10	5	Fan Power (18VDC)	20-30AWG, 2.0A	S1/FS		Hot Surface Igniter	5.0A Max
J10	6	Fan Ground	20-30AWG, 2.0A	FS		Flame Sense Rod	
J10	7	FUTURE		P2	FC+	Flame Current Measurement	
J10	8	FUTURE		P2	FC-	Flame Current Measurement	
J11	1	24VAC Power	30VAC, 8A				

Fig. 39: VERSA PIM Control Connections

Parallel Pump Wiring Description

In the event of losing the Master unit, Follower units are made capable of operating the System and IND DHW pumps (as required) in "limp-along" mode (see page 64). The System pump outputs from each cascade member must be connected in parallel to activate the system pump during "limp-along" operation. This configuration will allow the system to continue to operate during Master unit failure or lose of the Master unit VERSA board. The IND DHW pump (if applicable) must be also connected in parallel from each individual cascade member output to ensure functionality during "limp-along".

Figures 40-41 illustrate the proper parallel connections method to be used for the System Pump. The same concept must be applied to the IND DHW pump, when applicable.

> **WARNING:** Failure to properly install and/or wire the System pump and IND DHW pump may result in a system failure during limp-along mode as well as damage to the equipment.
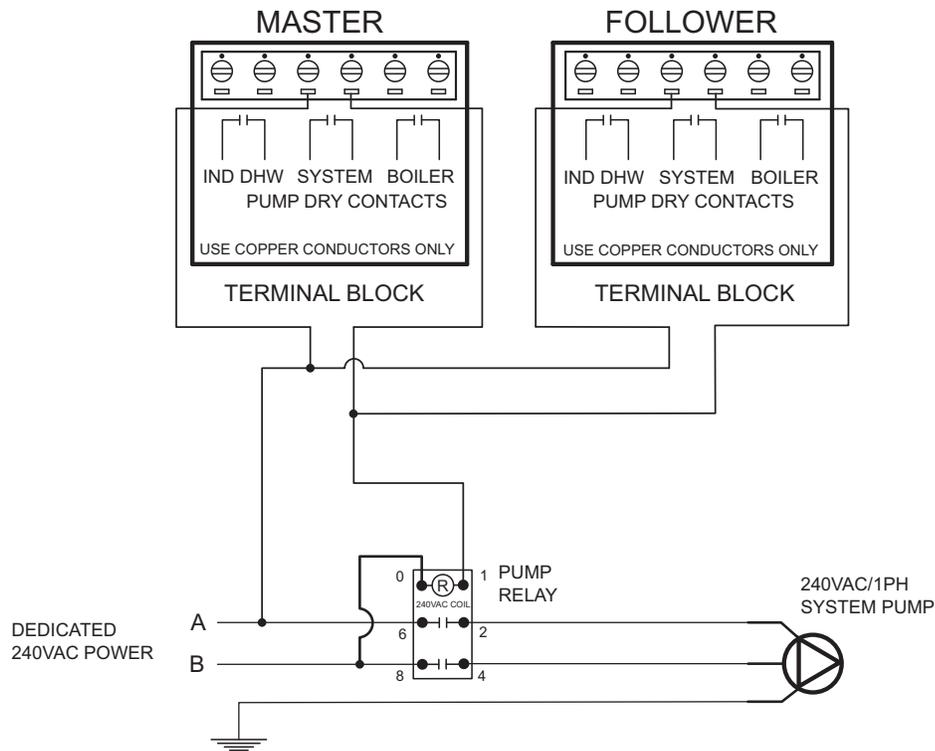
Fig 40: Parallel Pump Wiring Diagram for MVB / XTherm 2503 - 4505

MASTER   FOLLOWER

Fig 41: Parallel Pump Wiring Diagram for XPAK FT® / XFYRE® / MVB & XTherm Models 503A - 2005A
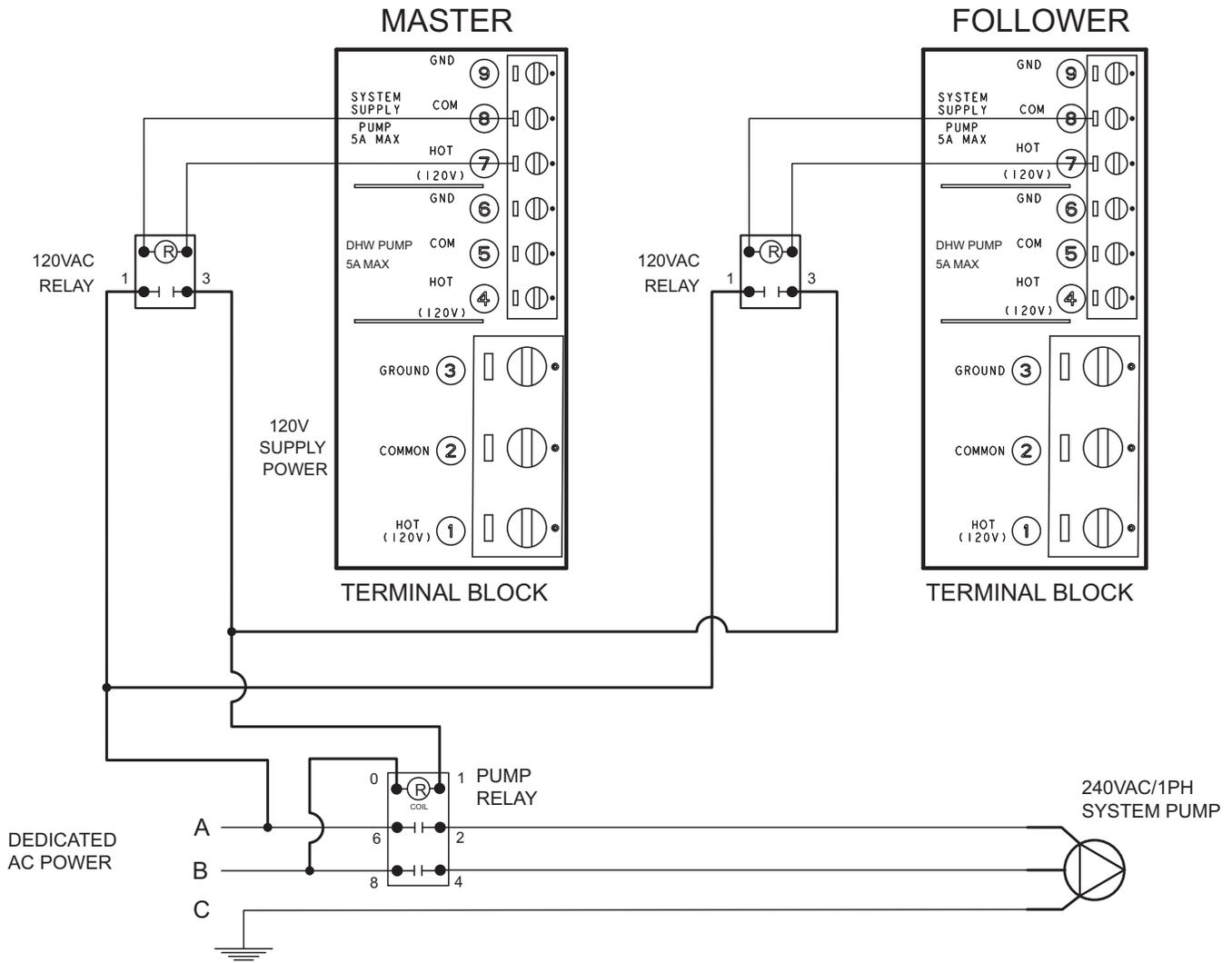
	120VAC/1PH	240VAC/1PH
A	HOT	HOT(L1)
B	COMMON	HOT(L2)
C	GROUND	GROUND

Wiring Connections – VERSA IC Control

Connector	Pin #	Function	Type & Rating
CN1	1	N/A	(S7)
CN1	2	Aux 1	S6 –IND Sensor
CN1	3	Common	Aux 1 & 2 Common
CN1	4	Mod +	CWS/CWR
CN1	5	Mod -	
CN1	6	RS485 Ground	FUTURE
CN1	7	RS485-A	
CN1	8	RS485-B	
CN1	9	ModBus Ground	ModBus Communication link
CN1	10	ModBus-A	
CN1	11	ModBus-B	

Connector	Pin #	Function	Type & Rating
CN4	1	External Valve	Dry contact closure with call for burner
CN4	2	External Valve	
CN4	3	Fan/Damper	Dry contact closure with call for burner
CN4	4	Fan/Damper	
CN4	5	Extra – STATUS (burner)	Dry contact closure with burner
CN4	6	Extra	

Connector	Pin #	Function	Type & Rating
CN2	1	PIM 2 Ft_bus A	
CN2	2	PIM 2 Ft_bus B	
CN2	3	PIM 3 Ft_bus A	
CN2	4	PIM 3 Ft_bus B	Cascade Connections from Master VERSA IC Control to Follower PIMs
CN2	5	PIM 4 Ft_bus A	
CN2	6	PIM 4 Ft_bus B	
CN2	7	Shield Ground	

Left diagram labels:

CN7 Remote LCD

Raypak VERSA

CN1:
S7
S6 — Y
Com — BL/Y
Mod + — R/Y (CWS/CWR)
GND — BK/Y
GND — G
RS485 A(+) — BR
RS485 B(–) — BR/O
GND
Modbus A(+)
Modbus B(–)

CN4:
EXTERNAL VALVE — GY / BK/W
FAN/DAMPER — V/W / V/W
Extra

CN2:
PIM 2 Ft_bus A / B
PIM 3 Ft_bus A / B
PIM 4 Ft_bus A / B
GND

4 5 6 7 8 ON

Table M: VERSA IC control connections

Wiring the Thermostat

Connect the Enable/Disable terminals to the PIM (shown in Fig. 37) or to the low-voltage field wiring terminals (model dependent). Alternately, any dry contact closure (including a remote thermostat) across these terminals will enable the unit to run. Caution should be used to ensure neither of the terminals becomes connected to ground.

Wiring the Outdoor Sensor

1. There is no connection required if an outdoor sensor is not used in this installation.

2. If using an Outdoor Sensor, connect the sensor wires to the terminals marked OUTDOOR SENSOR (PIM J2 connector terminals 5 and 6); refer to Fig. 37 on page 53. Caution should be used to ensure neither of these terminals becomes connected to ground.

3. Use minimum 18 AWG wire for runs of up to 150 feet.

4. Mount the outdoor sensor on an exterior surface of the building, preferably on the north side of the building in an area that will not be affected by direct sunlight and that will be exposed to varying weather conditions.

Wiring the Indirect Sensor

1. There is no indirect sensor connection required if an indirect water heater is not used in the installation. Use 18 AWG wire for runs of up to 150 feet.

2. When the Indirect DHW call-for-heat is active, the PIM communicates this to the VERSA Control. The VERSA Control calculates the optimal operation and sends the firing rate and pump output requests to the PIM so it can activate the Indirect DHW pump and Boiler pump if needed. If an optional Indirect DHW sensor is connected, the PIM will pass this signal to the VERSA Control. This allows the VERSA Control to optimize the Indirect DHW demand to maintain the Indirect DHW setpoint. The Indirect DHW thermostat must be closed for proper operation when using the Indirect DHW sensor. It is recommended that a tankstat be used as a limiting device in conjunction with a tank sensor and wired to the Indirect DHW connections at the PIM, or install a jumper across the Indirect DHW override terminals and set PIM operator dial to be equal to DHW Target temperature to prevent an over-temperature condition from occurring. If a VERSA Control is not present, the PIM shall activate the Indirect DHW pump whenever the Indirect DHW call is active. The Boiler pump may also be activated based on the Indirect DHW piping configuration setting.

3. Connect the indirect tank sensor to the terminals marked INDIRECT DHW SENSOR (see wiring diagram). Caution should be used to ensure neither of these terminals is connected to ground.

Energy Management System Setup

Temperature or Rate Control using an external 0–10VDC or 4-20mA control signal

1. A signal from an energy management system can be used to control either the setpoint temperature or the firing rate of the heater.

2. To enable this remote control function, set DIP switch #5 on the PIM to the UP position. DIP switch #5 toggles between an EMS ON (UP) signal or a demand signal from the VERSA Control OFF (DOWN). Using DIP switch #2 on the PIM, select between Direct Drive (UP) or Target Temperature (DOWN) setpoint /Firing rate.

3. For use of a 4-20mA signal, DIP switch #6 must be in the ON (UP) position and a 500 OHM 1/2 watt resistor wired in parallel across the input wires.

4. Connect an Energy Management system or other auxiliary control signal to the terminals marked 0-10V (+/-) on the PIM (see Fig. 37). Caution should be used to ensure that the +0-10V connection does not create a short to ground. See Fig. 42 and Tables N-1 and N-2.

- **Temperature Control:** Remote target temperature can be used in both single-boiler applications as well as multi-boiler cascade to provide target temperature. When configured to allow an energy management system to provide a target temperature input to the VERSA IC Control, the control requires both a contact closure across the enable/disable connection as well as a DC voltage input to allow the boiler to fire. The minimum voltage required to operate the burner is 1.0 VDC (5.6mA) and equates to a target temperature equal to 50ºF or Target Min setting in the adjust menu. 10 VDC (20mA) equates to the max allowable setpoint for the unit based on the PIM value (XFyre 192ºF, XPak-FT 192ºF, MVB / XTherm 220ºF). The TARGET MIN setting in the ADJUST menu of

the VERSA IC Control will serve to truncate the lower temperature range of the EMS signal while the TARGET MAX setting will serve to truncate the upper range of the EMS signal (see page 61).

Example: An MVB H7-2003A has a setpoint range based on the ID card of 50°F to 220°F (1 VDC = 50°F & 10 VDC = 220°F). If the Target MIN setting is increased to 140°F and the TARGET MAX is reduced to 180°F the boiler will respond to a EMS signal as follows. With a contact closure at the ENABLE terminals and a 1 VDC input signal to the boiler, a call for heat will be generated to maintain the system at 140°F system temperature (for 10 VDC a CFH will maintain 180°F).
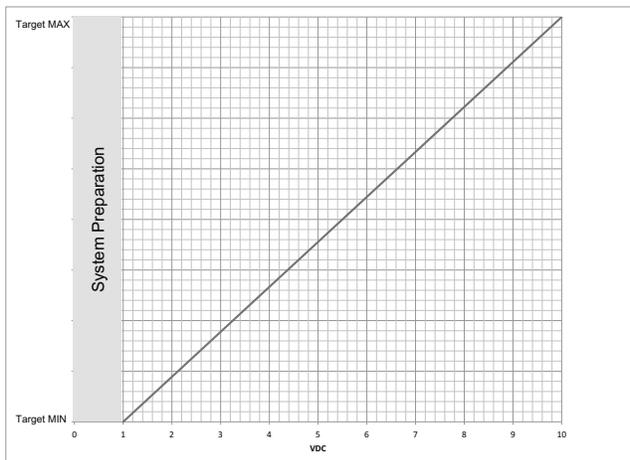
Fig. 42: VERSA 0-10 VDC Chart

The VERSA IC Control will determine the firing rate required to achieve the designated target temperature provided from the EMS.

- **Rate Control: Firing-rate control will not work with a multi-boiler cascade arrangement.** Multi-boiler systems require each boiler to be driven individually when wanting to provide firing rate control from an EMS or multi-boiler sequencer such as our Raypak TempTracker MOD+ Hybrid. When configured to allow an energy management system to provide a burner firing rate input to the VERSA IC Control, the control requires both a contact closure at the enable/disable connection as well as a DC voltage input to allow the boiler to fire. The minimum voltage required to fire the burner is 1.0 VDC (5.6mA) which also equates to low fire. A voltage of 10 VDC (20mA) equates to a call for full fire. To turn off the burner the EMS will need to open the contact across the enable/disable. Reducing

the voltage input signal below. 0.8 VDC (5.3mA) will also shut off the active burner call. When operating in response to a firing rate input from an EMS the VERSA IC Control does not provide temperature control of the system, however will still provide Max Delta-T functionality as well as Manual High Limit operation. The EMS system is now fully responsible for supply water temperature control as well as managing minimum cycle times to prevent short cycling of the equipment.

Cascade Set-up and Operation

The VERSA IC system has the capability of controlling the operation of up to 4 heaters without the addition of an external sequencing controller. In order to establish a cascade system, one heater needs to have the VERSA IC Control DIP switch #2 set to the ON position to be recognized as the Master heater in the system. On all other heaters, turn OFF VERSA DIP switch #2 so the system recognizes them as followers. In addition, communication wire needs to run from the J3 connections on each follower PIM (minimum 22AWG twisted pair wire) to the CN2 terminals on the VERSA board on the Master heater. Once the field wiring is installed as per the instructions, remember to enable each of the Follower units within the SETUP menu on the Master. Once enabled within the VERSA IC control system, it is now possible to view the individual boiler data at the Master boiler as well as for the Master boiler to begin using the Followers to answer any heat requests from the system.

Sequence of Operation

Multiple units are handled using a first-on, last-off protocol. The first unit will modulate to support the load. If it fires at 100% without satisfying the demand, the next unit will be activated and will modulate to support the load; the first unit remains operating at 100%. If the second unit reaches 100% without satisfying the demand, both units 1 and 2 will remain at 100% while the third unit fires and modulates, etc. As the system temperature approaches setpoint and the load is reduced to the point where a unit can be shut down, the last unit to fire becomes the first to be shut off.

Wiring the Cascade System Communication Bus

Designate the primary boiler as the master boiler/boiler 1 by leaving DIP switch #2 on the VERSA IC board in the ON position. All other connected units must have their VERSA DIP switch #2 OFF to designate them as followers. Follower VERSA boards are ignored by their corresponding PIM Modules. Use minimum of 22 AWG wire to connect the master VERSA board to the PIM

on the followers. Up to 3 followers can be connected to the VERSA Master. For systems requiring more than 4 connected boilers, an external sequencer such as the Raypak TempTracker MOD+ Hybrid can be used.

NOTE: Do not use shielded cable.

Use the shortest length cable possible to reach between the boilers. Do not run unprotected cables across the floor or where they will become wet or damaged. Do not run communication cables in parallel with, or close to or against, high voltage (120 VAC or greater) wiring. Raypak recommends that the total maximum length of each set of communication bus cables not exceed 200 feet.

Connect the Cascade Ft_bus wires to the PIM by pressing down on the slots with a small screwdriver and then inserting the wires into the holes. See Fig. 43.
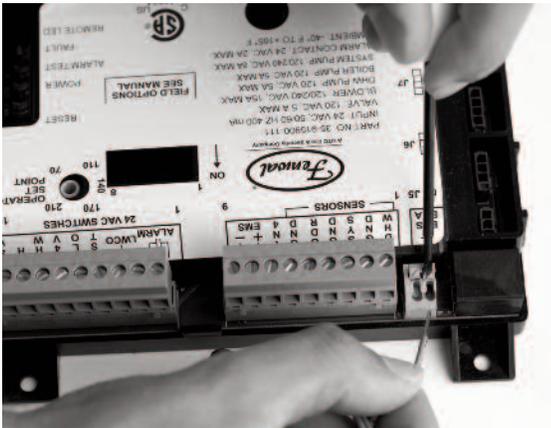
Fig. 43: Ft_bus Wire Connection

| INPUT SIGNAL VDC | XFYRE 300A-850A | | MVB / XTHERM / HI-DELTA | | | INPUT SIGNAL mA | Example | |
	H7 BOILER °F	WH7 WATER HEATER °F	H7 BOILER °F	WH7 WATER HEATER °F	P* POOL HEATER °F		Target Min 140°F	Target Max 180°F
10.0	192°F/ 89°C	150°F/ 66°C	220°F/ 105°C	150°F/ 66°C	104/106°F/ 40°C	20.0		180°F/ 82°C
9.9	190°F/ 88°C	149°F/ 65°C	218°F/ 103°C	149°F/ 65°C	104/106°F/ 40°C	19.8		180°F/ 82°C
9.8	189°F/ 87°C	148°F/ 64°C	216°F/ 102°C	148°F/ 64°C	104/106°F/ 40°C	19.7		180°F/ 82°C
9.7	187°F/ 86°C	147°F/ 64°C	214°F/ 101°C	147°F/ 64°C	104/106°F/ 40°C	19.5		179°F/ 81°C
9.6	186°F/ 85°C	146°F/ 63°C	213°F/ 100°C	146°F/ 63°C	104/106°F/ 40°C	19.4		179°F/ 81°C
9.5	184°F/ 85°C	144°F/ 62°C	211°F/ 99°C	144°F/ 62°C	104/106°F/ 40°C	19.2		178°F/ 81°C
9.4	183°F/ 84°C	143°F/ 62°C	209°F/ 98°C	143°F/ 62°C	104/106°F/ 40°C	19.0		178°F/ 81°C
9.3	181°F/ 83°C	142°F/ 61°C	207°F/ 97°C	142°F/ 61°C	104/106°F/ 40°C	18.9		177°F/ 80°C
9.2	179°F/ 82°C	141°F/ 61°C	205°F/ 96°C	141°F/ 61°C	104/106°F/ 40°C	18.7		177°F/ 80°C
9.1	178°F/ 81°C	140°F/ 60°C	203°F/ 95°C	140°F/ 60°C	104/106°F/ 40°C	18.6		176°F/ 80°C
9.0	176°F/ 80°C	139°F/ 59°C	201°F/ 94°C	139°F/ 59°C	104/106°F/ 40°C	18.4		176°F/ 80°C
8.9	175°F/ 79°C	138°F/ 59°C	199°F/ 93°C	138°F/ 59°C	104/106°F/ 40°C	18.2		176°F/ 79°C
8.8	173°F/ 78°C	137°F/ 58°C	197°F/ 92°C	137°F/ 58°C	104/106°F/ 40°C	18.1		175°F/ 79°C
8.7	171°F/ 77°C	136°F/ 58°C	196°F/ 91°C	136°F/ 58°C	104/106°F/ 40°C	17.9		175°F/ 79°C
8.6	170°F/ 77°C	134°F/ 57°C	194°F/ 90°C	134°F/ 57°C	104/106°F/ 40°C	17.8		174°F/ 79°C
8.5	168°F/ 76°C	133°F/ 56°C	192°F/ 89°C	133°F/ 56°C	104/106°F/ 40°C	17.6		174°F/ 78°C
8.4	167°F/ 75°C	132°F/ 56°C	190°F/ 88°C	132°F/ 56°C	104/106°F/ 40°C	17.4		173°F/ 78°C
8.3	165°F/ 74°C	131°F/ 55°C	188°F/ 87°C	131°F/ 55°C	104/106°F/ 40°C	17.3		173°F/ 78°C
8.2	164°F/ 73°C	130°F/ 54°C	186°F/ 86°C	130°F/ 54°C	104/106°F/ 40°C	17.1		172°F/ 78°C
8.1	162°F/ 72°C	129°F/ 54°C	184°F/ 85°C	129°F/ 54°C	104/106°F/ 40°C	17.0		172°F/ 78°C
8.0	160°F/ 71°C	128°F/ 53°C	182°F/ 84°C	128°F/ 53°C	104/106°F/ 40°C	16.8		172°F/ 77°C
7.9	159°F/ 70°C	127°F/ 53°C	180°F/ 82°C	127°F/ 53°C	104/106°F/ 40°C	16.6		171°F/ 77°C
7.8	157°F/ 70°C	126°F/ 52°C	179°F/ 81°C	126°F/ 52°C	104/106°F/ 40°C	16.5		171°F/ 77°C
7.7	156°F/ 69°C	124°F/ 51°C	177°F/ 80°C	124°F/ 51°C	104/106°F/ 40°C	16.3		170°F/ 77°C
7.6	154°F/ 68°C	123°F/ 51°C	175°F/ 79°C	123°F/ 51°C	104/106°F/ 40°C	16.2		170°F/ 76°C
7.5	153°F/ 67°C	122°F/ 50°C	173°F/ 78°C	122°F/ 50°C	104/106°F/ 40°C	16.0		169°F/ 76°C
7.4	151°F/ 66°C	121°F/ 50°C	171°F/ 77°C	121°F/ 50°C	104/106°F/ 40°C	15.8		169°F/ 76°C
7.3	149°F/ 65°C	120°F/ 49°C	169°F/ 76°C	120°F/ 49°C	104/106°F/ 40°C	15.7		168°F/ 76°C
7.2	148°F/ 64°C	119°F/ 48°C	167°F/ 75°C	119°F/ 48°C	104/106°F/ 40°C	15.5		168°F/ 75°C
7.1	146°F/ 63°C	118°F/ 48°C	165°F/ 74°C	118°F/ 48°C	104/106°F/ 40°C	15.4		168°F/ 75°C
7.0	145°F/ 63°C	117°F/ 47°C	163°F/ 73°C	117°F/ 47°C	104/106°F/ 40°C	15.2		167°F/ 75°C
6.9	143°F/ 62°C	116°F/ 46°C	162°F/ 72°C	116°F/ 46°C	104/106°F/ 40°C	15.0		167°F/ 75°C
6.8	142°F/ 61°C	114°F/ 46°C	160°F/ 71°C	114°F/ 46°C	104/106°F/ 40°C	14.9		166°F/ 74°C
6.7	140°F/ 60°C	113°F/ 45°C	158°F/ 70°C	113°F/ 45°C	104/106°F/ 40°C	14.7		166°F/ 74°C
6.6	138°F/ 59°C	112°F/ 45°C	156°F/ 69°C	112°F/ 45°C	104/106°F/ 40°C	14.6		165°F/ 74°C
6.5	137°F/ 58°C	111°F/ 44°C	154°F/ 68°C	111°F/ 44°C	104/106°F/ 40°C	14.4		165°F/ 74°C
6.4	135°F/ 57°C	110°F/ 43°C	152°F/ 67°C	110°F/ 43°C	104/106°F/ 40°C	14.2		164°F/ 73°C
6.3	134°F/ 56°C	109°F/ 43°C	150°F/ 66°C	109°F/ 43°C	104/106°F/ 40°C	14.1		164°F/ 73°C
6.2	132°F/ 56°C	108°F/ 42°C	148°F/ 65°C	108°F/ 42°C	104/106°F/ 40°C	13.9		164°F/ 73°C
6.1	130°F/ 55°C	107°F/ 42°C	146°F/ 64°C	107°F/ 42°C	104/106°F/ 40°C	13.8		163°F/ 73°C
6.0	129°F/ 54°C	106°F/ 41°C	145°F/ 63°C	106°F/ 41°C	104/106°F/ 40°C	13.6		163°F/ 72°C
5.9	127°F/ 53°C	104°F/ 40°C	143°F/ 61°C	104°F/ 40°C	104/106°F/ 40°C	13.4		162°F/ 72°C
5.8	126°F/ 52°C	103°F/ 40°C	141°F/ 60°C	103°F/ 40°C	104/106°F/ 40°C	13.3		162°F/ 72°C
5.7	124°F/ 51°C	102°F/ 39°C	139°F/ 59°C	102°F/ 39°C	104/106°F/ 40°C	13.1		161°F/ 72°C
5.6	123°F/ 50°C	101°F/ 38°C	137°F/ 58°C	101°F/ 38°C	104/106°F/ 40°C	13.0		161°F/ 71°C
5.5	121°F/ 49°C	100°F/ 38°C	135°F/ 57°C	100°F/ 38°C	104/106°F/ 40°C	12.8		160°F/ 71°C
5.4	119°F/ 49°C	99°F/ 37°C	133°F/ 56°C	99°F/ 37°C	104/106°F/ 40°C	12.6		160°F/ 71°C
5.3	118°F/ 48°C	98°F/ 37°C	131°F/ 55°C	98°F/ 37°C	104/106°F/ 40°C	12.5		160°F/ 71°C
5.2	116°F/ 47°C	97°F/ 36°C	129°F/ 54°C	97°F/ 36°C	104/106°F/ 40°C	12.3		159°F/ 70°C
5.1	115°F/ 46°C	96°F/ 35°C	127°F/ 53°C	96°F/ 35°C	104/106°F/ 40°C	12.2		159°F/ 70°C

* Setpoints above 104ºF/40°C are only available if the setpoint range has been extended in the field. See 'Pool Setpoint' on page 41.

Table N-1: VERSA Setpoint 0-10 VDC / 4 - 20 mA operation

INPUT SIGNAL VDC	XFYRE 300A-850A		MVB / XTHERM / HI-DELTA			INPUT SIGNAL mA	Example	
	H7 BOILER °F	WH7 WATER HEATER °F	H7 BOILER °F	WH7 WATER HEATER °F	P* POOL HEATER °F		Target Min 140°F	Target Max 180°F
5.0	113°F/ 45°C	94°F/ 35°C	126°F/ 52°C	94°F/ 35°C	104/106°F/ 40°C	12.0	158°F/ 70°C	
4.9	112°F/ 44°C	93°F/ 34°C	124°F/ 51°C	93°F/ 34°C	104/106°F/ 40°C	11.8	158°F/ 70°C	
4.8	110°F/ 43°C	92°F/ 33°C	122°F/ 50°C	92°F/ 33°C	104/106°F/ 40°C	11.7	157°F/ 69°C	
4.7	108°F/ 42°C	91°F/ 33°C	120°F/ 49°C	91°F/ 33°C	104/106°F/ 40°C	11.5	157°F/ 69°C	
4.6	107°F/ 42°C	90°F/ 32°C	118°F/ 48°C	90°F/ 32°C	104/106°F/ 40°C	11.4	156°F/ 69°C	
4.5	105°F/ 41°C	89°F/ 32°C	116°F/ 47°C	89°F/ 32°C	104/106°F/ 40°C	11.2	156°F/ 69°C	
4.4	104°F/ 40°C	88°F/ 31°C	114°F/ 46°C	88°F/ 31°C	104/106°F/ 40°C	11.0	156°F/ 68°C	
4.3	102°F/ 39°C	87°F/ 30°C	112°F/ 45°C	87°F/ 30°C	104/106°F/ 40°C	10.9	155°F/ 68°C	
4.2	101°F/ 38°C	86°F/ 30°C	110°F/ 44°C	86°F/ 30°C	104/106°F/ 40°C	10.7	155°F/ 68°C	
4.1	99°F/ 37°C	85°F/ 29°C	109°F/ 43°C	85°F/ 29°C	104/106°F/ 40°C	10.6	154°F/ 68°C	
4.0	97°F/ 36°C	83°F/ 29°C	107°F/ 42°C	83°F/ 29°C	104/106°F/ 40°C	10.4	154°F/ 67°C	
3.9	96°F/ 35°C	82°F/ 28°C	105°F/ 40°C	82°F/ 28°C	104/106°F/ 40°C	10.2	153°F/ 67°C	
3.8	94°F/ 35°C	81°F/ 27°C	103°F/ 39°C	81°F/ 27°C	104/106°F/ 40°C	10.1	153°F/ 67°C	
3.7	93°F/ 34°C	80°F/ 27°C	101°F/ 38°C	80°F/ 27°C	104/106°F/ 40°C	9.9	152°F/ 67°C	
3.6	91°F/ 33°C	79°F/ 26°C	99°F/ 37°C	79°F/ 26°C	104/106°F/ 40°C	9.8	152°F/ 66°C	
3.5	89°F/ 32°C	78°F/ 25°C	97°F/ 36°C	78°F/ 25°C	104/106°F/ 40°C	9.6	152°F/ 66°C	
3.4	88°F/ 31°C	77°F/ 25°C	95°F/ 35°C	77°F/ 25°C	104/106°F/ 40°C	9.4	151°F/ 66°C	
3.3	86°F/ 30°C	76°F/ 24°C	93°F/ 34°C	76°F/ 24°C	104/106°F/ 40°C	9.3	151°F/ 66°C	
3.2	85°F/ 29°C	75°F/ 24°C	92°F/ 33°C	75°F/ 24°C	104/106°F/ 40°C	9.1	150°F/ 65°C	
3.1	83°F/ 28°C	73°F/ 23°C	90°F/ 32°C	73°F/ 23°C	104/106°F/ 40°C	9.0	150°F/ 65°C	
3.0	82°F/ 28°C	72°F/ 22°C	88°F/ 31°C	72°F/ 22°C	104/106°F/ 40°C	8.8	149°F/ 65°C	
2.9	80°F/ 27°C	71°F/ 22°C	86°F/ 30°C	71°F/ 22°C	104/106°F/ 40°C	8.6	149°F/ 65°C	
2.8	78°F/ 26°C	70°F/ 21°C	84°F/ 29°C	70°F/ 21°C	104/106°F/ 40°C	8.5	148°F/ 64°C	
2.7	77°F/ 25°C	69°F/ 21°C	82°F/ 28°C	69°F/ 21°C	104/106°F/ 40°C	8.3	148°F/ 64°C	
2.6	75°F/ 24°C	68°F/ 20°C	80°F/ 27°C	68°F/ 20°C	104/106°F/ 40°C	8.2	148°F/ 64°C	
2.5	74°F/ 23°C	67°F/ 19°C	78°F/ 26°C	67°F/ 19°C	104/106°F/ 40°C	8.0	147°F/ 64°C	
2.4	72°F/ 22°C	66°F/ 19°C	76°F/ 25°C	66°F/ 19°C	104/106°F/ 40°C	7.8	147°F/ 63°C	
2.3	71°F/ 21°C	65°F/ 18°C	75°F/ 24°C	65°F/ 18°C	104/106°F/ 40°C	7.7	146°F/ 63°C	
2.2	69°F/ 21°C	63°F/ 17°C	73°F/ 23°C	63°F/ 17°C	104/106°F/ 40°C	7.5	146°F/ 63°C	
2.1	67°F/ 20°C	62°F/ 17°C	71°F/ 22°C	62°F/ 17°C	104/106°F/ 40°C	7.4	145°F/ 63°C	
2.0	66°F/ 19°C	61°F/ 16°C	69°F/ 21°C	61°F/ 16°C	104/106°F/ 40°C	7.2	145°F/ 62°C	
1.9	64°F/ 18°C	60°F/ 16°C	67°F/ 19°C	60°F/ 16°C	104/106°F/ 40°C	7.0	144°F/ 62°C	
1.8	63°F/ 17°C	59°F/ 15°C	65°F/ 18°C	59°F/ 15°C	104/106°F/ 40°C	6.9	144°F/ 62°C	
1.7	61°F/ 16°C	58°F/ 14°C	63°F/ 17°C	58°F/ 14°C	104/106°F/ 40°C	6.7	144°F/ 62°C	
1.6	60°F/ 15°C	57°F/ 14°C	61°F/ 16°C	57°F/ 14°C	104/106°F/ 40°C	6.6	143°F/ 61°C	
1.5	58°F/ 14°C	56°F/ 13°C	59°F/ 15°C	56°F/ 13°C	104/106°F/ 40°C	6.4	143°F/ 61°C	
1.4	56°F/ 14°C	55°F/ 13°C	58°F/ 14°C	55°F/ 13°C	104/106°F/ 40°C	6.2	142°F/ 61°C	
1.3	55°F/ 13°C	53°F/ 12°C	56°F/ 13°C	53°F/ 12°C	104/106°F/ 40°C	6.1	142°F/ 61°C	
1.2	53°F/ 12°C	52°F/ 11°C	54°F/ 12°C	52°F/ 11°C	104/106°F/ 40°C	5.9	141°F/ 60°C	
1.1	52°F/ 11°C	51°F/ 11°C	52°F/ 11°C	51°F/ 11°C	104/106°F/ 40°C	5.8	141°F/ 60°C	
1.0	50°F/ 10°C	50°F/ 10°C	50°F/ 10°C	50°F/ 10°C	104/106°F/ 40°C	5.6	140°F/ 60°C	
0.9						5.4		
0.8			Boiler Idle			5.3		
0.7			System Pump Enable			5.1		
0.6						5.0		
0.5			System Pump Disable			4.8		
0.4						4.6		
0.3						4.5		
0.2						4.3		
0.1						4.2		
0.0			System Offline			4.0		

* Setpoints above 104ºF are only available if the setpoint range has been extended in the field. See 'Pool Setpoint' on page 41.

Table N-2: VERSA Setpoint 0-10 VDC / 4 - 20 mA operation
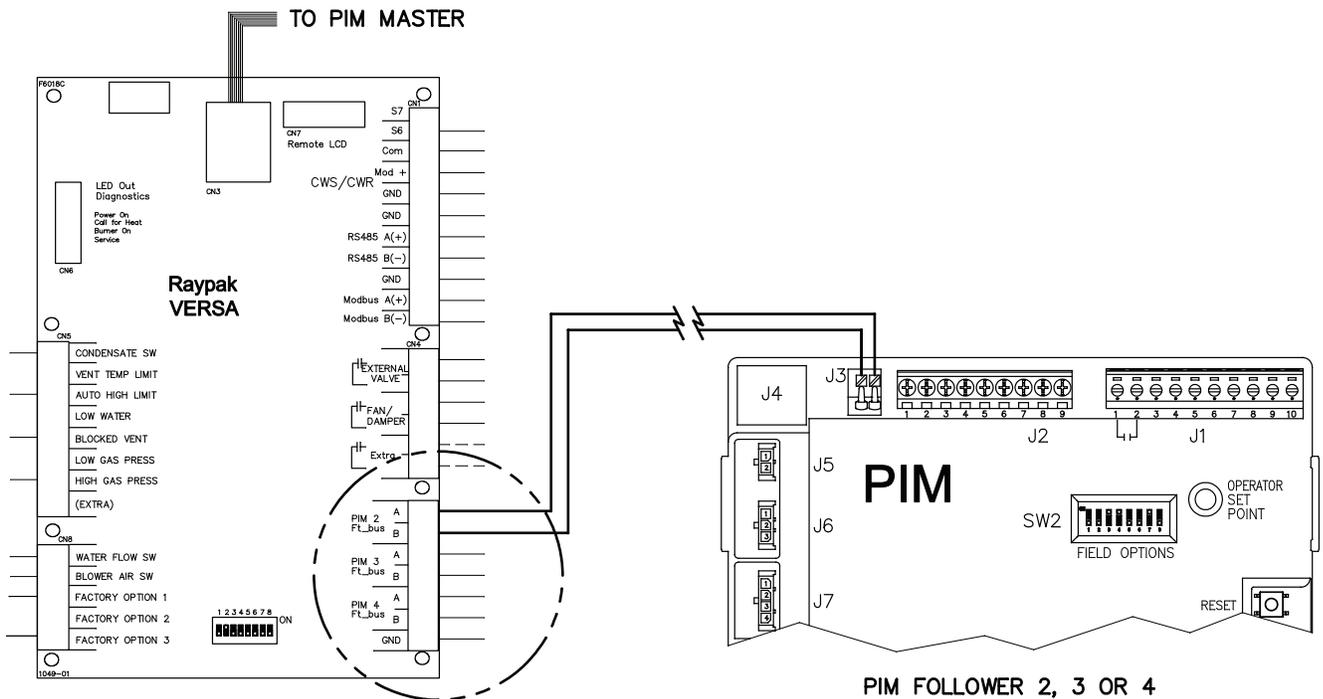
Fig. 44: Cascade System Wiring

Cascade System Pump and Sensor Wiring

1. On the boiler designated as the Master, connect the system pump wiring to the System pump output terminals. The output is rated for pilot duty only (2A maximum). For System pump operation during limp-along mode, it is recommended to connect the system pump outputs from each unit in parallel. (See pages 55 and 56 and Table 44).

2. Connect the boiler pump wires to the boiler pump terminals or associated relay, based on model type and size.

3. Connect the system supply sensor to the MASTER, per the instructions provided with the unit.

4. Connect the Outdoor Sensor (if used) to the MASTER, per the instructions provided with the unit. the Master PIM.

5. Connect the Enable/Disable wiring to the Master. This connection must be provided through dry contacts closure. For each follower to be operational during limp-along mode the enable must be jumpered at each unit.

NOTE: This dry contacts closure can come from a room thermostat or a remote relay. No power of any kind should be applied to either of these terminals.

Cascade Follower Pump and Sensor Wiring

1. Once the Master has been identified, additional boilers will be designated as Followers. DIP switch #2 on each follower VERSA board must be set to the OFF/Down position.

2. For each follower boiler, connect the boiler pump wires to the terminal block at the rear of each unit. Connect to terminals 4, 5, and 6.

3. The System pump and DHW pump outputs may be configured for use during limp-along mode. See pages 55 and 56.

Alarm Connection

An alarm bell or light may be connected to the alarm contacts on the boiler PIM. The Alarm Contacts are 3A rated dry contacts on a normally-open relay that closes during fault or lockout conditions, and the maximum voltage across the contacts is 30 VAC or 30 VDC.

Connections are made at J1 pins 1 and 2 on the boiler PIM. In a cascade system, the alarm output of all connected units will be active if either the master boiler or follower(s) have a lockout condition.

"Limp-Along" Operation of PIM

The VERSA IC PIM is fully capable of "limp-along" operation of the heater should anything happen to the VERSA Control board or the communications between the PIM and VERSA Control board.

> **NOTE:** The PIM reverts to "limp-along" operation whenever communication with the VERSA Control Board is lost for more than 30 seconds or if the VERSA Control is not found on the communications bus during power up.

The Operator Setpoint potentiometer on the PIM (see Fig. 45) is used to control the Operating Setpoint at the outlet sensor during limp-along operation. This is the target outlet temperature used in the firing rate calculations. The maximum target setpoint will be limited to H models of XFyre 192ºF (89ºC), XPak-FT 192ºF (89ºC), MVB / XTherm 220ºF (104.5ºC). WH models of XFyre 160ºF (71ºC), MVB/XTherm 180ºF (82ºC) regardless of the potentiometer position. P models have a maximum setpoint of 104ºF, or 106ºF if the range has been extended. See 'Pool Setpoint' on page 43.

The PIM calculates the required firing rate or stage demand using the heater inlet and outlet sensor inputs and the target setpoint from the operator potentiometer setting. The algorithm uses the boiler mass and other parameter settings to refine the firing rate for optimal setpoint control. Full auto-differential capability is retained when enabled using DIP switch #1 on the PIM.

The PIM will respond to a DHW call signal on the field wiring terminals. The DHW pump is activated and the temperature is controlled to the operating setpoint of the potentiometer. The boiler pump will be activated whenever there is a Call For Heat to satisfy target temperature.

> **NOTE:** Direct DHW (Mode 1) and Indirect DHW (Mode 2 or Mode 3) configuration require that all PIM operator dials be set to DHW Target temperature to prevent an over-temp condition from occurring during "Limp-Along".

Limitations During PIM "Limp-Along" Operation

1. Diagnostic information is limited to the alarm relay and red LED flash codes on the PIM, and will only be displayed if the VERSA board on the unit has failed.

2. System Sensor operation is NOT supported.

3. DHW Sensor operation is NOT supported.

4. Outdoor Sensor and Outdoor Reset functions are NOT supported.
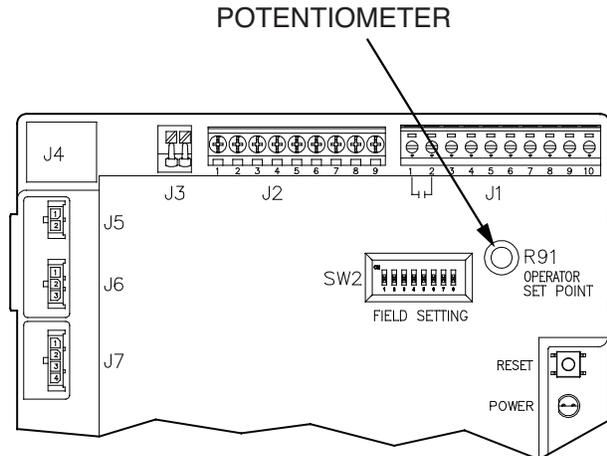
Fig. 45: PIM Potentiometer Location

Troubleshooting

Before troubleshooting the system, ensure that:

- Ensure units are properly installed per the instructions provided in the installation and operation manual for the unit being serviced.
- All mechanical and electrical connections are secure and tight
- All system wiring is correct
- A system ground is properly connected to the heater (The igniter, flame sensor and ignition module must share a common ground with the burner. Nuisance shutdowns are often caused by a poor or erratic ground.)
- Isolate the system from any other hardware application, reset the PIM and restore defaults on the VERSA board. To perform this function refer to page 70.

- The system is powered and the unit is enabled (TH).

The PIM is equipped with an onboard buss-type fuse (T8AL250VP) to protect the 24VAC circuits and the 24VAC relay outputs to the gas valves. ONLY use a type GMA fuse (8 Amp max) as a replacement for proper operation.

Fault codes are displayed on the VERSA IC Display. Many of these fault codes are also displayed by a flashing red LED on the PIM module. The number of flashes indicates the fault – see Table O below for explanation of the flash codes and troubleshooting recommendations. Any failure in the standard safety chain is reported as a general fault.

If the VERSA IC Display is showing an error/fault code, troubleshoot as noted in Tables R and S.

Error Mode	LED Flash Code on PIM	Recommended Troubleshooting
Normal Operation	Red LED OFF	
ID Card Fault	Red LED Steady ON, Green Power LED OFF	Check that the proper ID Card is securely connected. Perform a power and system reset.
Internal Control Fault	Red LED Steady ON	Perform a power and system reset. If the fault remains, replace the PIM.
Airflow Fault	Red LED – 1 Flash	Check blower operation and air flow switch.
False Flame Error	Red LED – 2 Flashes	Check for proper gas valve closure. Clean burner and electrodes.
Ignition Lockout Fault	Red LED – 3 Flashes	Check the gas supply. Check transformer. Check igniters. Check wiring. Press reset button on PIM/membrane switch. Recycle power.
Ignition Proving Current Fault	Red LED – 4 Flashes	Check HSI element (for those models equipped with a hot surface igniter). Replace as necessary.
Low Voltage Fault	Red LED – 5 Flashes	Check the 24VAC input voltage – the voltage must be above 18.0VAC for proper operation. Replace transformer as necessary.
Vent Temperature Fault	Red LED – 6 Flashes	(If equipped with Vent sensor)Check for a blocked flue. Check the vent sensor and wiring. Check vent connections and vent system. If damage is observed, contact a qualified installer to have the vent system properly inspected and repaired as necessary.
Hi-Limit Fault	Red LED – 7 Flashes	Check for proper water flow. Check hi-limit setting and outlet sensor.
Sensor Fault	Red LED – 8 Flashes	Check the VERSA IC Control for fault identification. Check sensor and wiring.
N/A	Red LED – 9 Flashes	Check wiring at J8, pins 1 & 3 for loose or missing jumper.
Water Pressure Fault	Red LED – 10 Flashes	Check system piping for leaks. Check water pressure switch (if equipped) and connections. Check wiring on PIM at J1, pins 6 & 7 for loose or missing jumper.
Blower Speed Fault	Red LED – 11 Flashes	Verify the tachometer signal and the connections at terminals J5 on the PIM. Confirm power to boiler is at or above minimum required.
N/A	Red LED – 12 Flashes	Check wiring on PIM at J1, pins 3 and 4 for loose or missing jumper.
Hi-Temperature Delta Fault	Red LED – 13 Flashes	Check pump operation. Confirm proper water flow across heat exchanger (Delta-T).
Ft_bus Communications Fault	Red LED – 14 Flashes	Verify that the VERSA IC Control is connected and operating properly. Check the cable between the PIM and the VERSA IC Control.
General limit circuit fault	Red LED – 15 Flashes	Check the VERSA IC for fault indication and troubleshooting information.

Table O: LED Flash Codes on PIM

DUAL PIM ERROR CODE DESCRIPTION

Fault ID	Item/Description	Fault Condition	LED Code (Flashes)
1	Airflow Fault	Open or close fault	1
2	Flame Error	False flame signal	2
3	Hard Lockout	Ignition Lockout	3
4	Ignition Proving Current fault	HSI Element current not in range	4
5	Low Voltage Fault	Voltage below 18.0Vac	5
6	Vent Temperature Fault	High Vent temperature reached	6
7	Hi-Limit Fault	Hi-Limit Reached	7
9	Safety #1 Fault	Safety input fault detected	9
10	Water flow Fault	Open or close fault	10
11	Blower Speed Fault	RPM out of expected range	11
12	LWCO Fault	LWCO Open	12
13	Hi-Delta Temp Fault	Delta T exceeds threshold	13
14	Ft-Bus Comm Fault	Loss of Communications	14
15	ID Card Fault	Invalid or Missing card	Red On, Green Off
16	Outlet Sensor Fault	open/short	8
17	Inlet Sensor Fault	open/short	8
18	Hi-Limit Sensor Fault	open/short or mismatch to outlet	8
19	Vent Sensor Fault	open/short	8
20	Safety #2 Fault	Safety input fault detected	15

NOTE: The Secondary PIM monitors the Primary PIM Fault status and energizes the Alarm Relay when any Fault ID is indicated.

Table P: Primary PIM Faults, Hi-Delta only

Fault ID	Item/Description	Fault Condition	LED Code (Flashes)
1	Airflow Fault	Open or close fault	
2	Flame Error	False flame signal	2
3	Hard Lockout	Ignition Lockout	3
4	Ignition Proving Current fault	HSI Element current not in range	4
5	Low Voltage Fault	Voltage below 18.0Vac	5
6	Vent Temperature Fault	High Vent temperature reached	
7	Hi-Limit Fault	Hi-Limit Reached	
9	Safety #1 Fault	Safety input fault detected	
10	Water flow Fault	Open or close fault	
11	Blower Speed Fault	RPM out of expected range	11
12	Interlock Fault	Interlock Open	12
13	Hi-Delta Temp Fault	Delta T exceeds threshold	
14	Ft-Bus Comm Fault	Loss of Communications	14
15	ID Card Fault	Invalid or Missing card	Red On, Green Off
16	Outlet Sensor Fault	open/short	
17	Inlet Sensor Fault	open/short	
18	Hi-Limit Sensor Fault	open/short or mismatch to outlet	
19	Vent Sensor Fault	open/short	
20	Safety #2 Fault	Safety input fault detected	

NOTE: The Secondary PIM energizes the Alarm Relay when any Fault ID is indicated.

Table Q: Secondary PIM Faults, Hi-Delta only

Error Message	Description	Recommended Troubleshooting
OUTLET SEN	Heater outlet sensor fault, 3-sec delay	Check outlet sensor Check outlet sensor wiring
LIMIT SEN	High limit sensor fault, 3-sec delay	Check limit sensor Check limit sensor wiring
INLET SEN	Heater inlet sensor fault, 3-sec delay	Check inlet sensor Check inlet sensor wiring
INTERLOCK	Factory installed jumper in place when shipped, 90-sec delay	Check louver end switch & wiring Check combustion air damper end switch & wiring Check extractor & wiring
WATER PRESS	Water pressure switch fault (if equipped) – Raypak factory installed jumper in place if not shipped with water pressure switch, 90-sec delay	Verify wiring at J1 terminals 6 & 7 Check heater pump Check isolation valves
AIR PRESS	Air pressure switch fault (if equipped) – Raypak factory installed jumper in place if not shipped with air pressure switch, 90-sec delay	Verify wiring at J8 terminals 2 & 4 Check blower(s) Check air pressure switch tubing
GAS PRESS	Gas pressure switch fault (if equipped) – Raypak factory installed jumper in place if not shipped with high pressure switch and/or low gas pressure switch, 90-sec delay	Verify wiring at J8 terminals 1 & 3 Check gas pressure switches Check gas pressure Check gas pressure switch tubing
IGNITION	Ignition fault	Reset ignition control – Push either RESET button on membrane switch or reset button on PIM or recycle power
LIMIT TRIP	Boiler outlet temperature tripped the high limit	Push reset button on high limit control if Manual Reset High Limit tripped Wait for water temperature to drop and auto reset high limit will reset Check pump operation Check bypass (if equipped) for too much water flow
FLAME	Flame detected without call for heat, 3-sec delay	Shut off gas supply Recycle power Check gas valve leakage
ID CARD	Invalid/missing ID Card, 3-sec delay	Connect ID Card mounted in heater Contact the factory if "Invalid ID Card" is noted
IGN CTRL	Internal PIM control fault, 3-sec delay	Recycle power – if error continues to occur, replace PIM
DELTA T	Threshold Delta T temperature exceeded, 3-sec delay	Check pump operation Check Delta T setting Check bypass (if equipped) for too much water flow
LO HSI CUR	Low HSI current at PIM control, 3-sec delay	Check HSI current Replace HSI Replace PIM control
LOW 24VAC	Low 24VAC power at PIM control, 3-sec delay	Check power supply Check transformer
BLOW SPEED	Blower speed (rpm) out of range, 3-sec delay	Check power supply Check blower wiring to PIM Check blower type
SAFETY INPUT	Additional factory installed safety fault – see Product I&O manual for specific information relating to this, 3-sec delay	Verify wiring at J8 – terminals 5 & 6

Table R: Error messages generated from the PIM but displayed on the VERSA IC Display

Error Message	Timeout	Description	Troubleshooting
CTRL SETUP	3 sec	EEPROM setup block read error at power up. Factory defaults are reloaded. Operation stops until all adjustments are checked.	Check all SETUP items (Restoring factory defaults at VERSA® may clear these faults)
SUPPLY ERR	3 sec	System supply sensor is shorted or has an open circuit. The control will cease operation.	Check supply sensor Check supply sensor wiring
DHWSUP ERR	3 sec	Plant sensor is shorted or has an open circuit. The control will cease operation.	Check Aux1 sensor Check Aux 1 sensor wiring
OUTDOOR ERR	3 sec	Outdoor air sensor is shorted or has an open circuit. The control will continue to operate assuming an outdoor temperature of 32°F	Check outdoor air sensor Check outdoor air sensor wiring
DHW ERR	3 sec	Indirect DHW sensor is shorted or has an open circuit. The control will cease operation for indirect DHW, but will continue to operate as required for system heating.	Check DHW sensor Check DHW sensor wiring
TANK ERR	3 sec	Tank sensor is shorted or has an open circuit. The control will cease operation.	Check tank sensor Check tank sensor wiring
POOL ERR	3 sec	Pool sensor is shorted or has an open circuit. The control will cease operation.	Check pool sensor Check pool sensor wiring
DEV LOST	3 sec	Device xx on heater bus is lost, if device is on the tN4 bus, the zone is displayed as well.	Check wiring between VERSA IC control board and all PIM's on the network Check communication wiring for BMS system
DEV ERR	3 sec	More than 1 master detected on tN4 bus.	Check DIP switches on cascaded heaters to make sure only 1 unit is set to Master while the others are set to Followers/Slave. Check communication wiring at heater with noted address
PIM 1 ERR	3 sec	Communications with PIM 1 were established but then lost.	Check cabling and DIP switch settings for Master/Follower configuration.
PIM 2 ERR	3 sec	Communications with PIM 2 were established but then lost.	Confirm cabling and DIP switch settings.
PIM 3 ERR	3 sec	Communications with PIM 3 were established but then lost.	Confirm cabling and DIP switch settings.
PIM 4 ERR	3 sec	Communications with PIM 4 were established but then lost.	Confirm cabling and DIP switch settings.
CONDENSATE	3 sec	Condensate switch has tripped	Check for blockage of condensate drain Check condensate switch Check condensate switch wiring Check for heat exchanger leak which might overwhelm the capacity of the condensate drain causing this error
VENT TEMP	1 sec	Vent temperature switch has tripped	Check vent temperature switch Check vent temperature switch wiring Check PVC/CPVC/Polypropylene vent for any damage due to excessive temperatures Check vent for leaks near vent temperature switch
AUTO LIMIT	3 sec	Automatic high limit has tripped	Check the automatic high limit switch Check the automatic high limit switch wiring Check for proper pump operation Check bypass (if equipped) for too much water flow
LOW WATER	1 sec	Low water cut-off has tripped	Push reset button on LWCO control Check LWCO probe & wiring
VENT BLOCK	3 sec	Blocked vent switch has tripped	Check venting Check vent pressure switch & wiring Check vent pressure switch tubing
LOW GAS	1 sec	Low gas pressure switch has tripped	Push reset button on low gas pressure switch Verify proper gas pressure Open manual gas valves fully Clean out drip leg
HIGH GAS	1 sec	High gas pressure switch has tripped	Push reset button on high gas pressure switch Verify proper gas pressures
EXTRA	1 sec	Extra limit switch has tripped – see product I&O manual for more detail if this limit is used and how to troubleshoot it.	See product specific I&O manual troubleshooting section
WATER FLOW	3 sec	Water flow switch has tripped 10 sec to make, then 1 sec to 'FAULT'	Check heater pump operation Purge air from system Replace flow switch as necessary
BLOWER	10 sec	Blower air pressure switch has tripped	Check air filter Check blower Check air pressure switch hose Check wiring
OPTION 1	10 sec	Factory option #1 switch has tripped. This switch uses a 10 sec delay on initial CFH before reporting the fault	Check wiring diagram to determine what is connected here
OPTION 2	30 sec	Factory option #2 switch has tripped. This switch uses a 30 sec delay on initial CFH before reporting the fault	Check wiring diagram to determine what is connected here
OPTION 3	90 sec	Factory option #3 switch has tripped. This switch uses a 90 sec delay on initial CFH before reporting the fault	Check wiring diagram to determine what is connected here Check field interlocks such as combustion air damper proving switch

Table S: Error messages generated from the VERSA IC Control Board

Technical Data

VERSA IC Control Board Ratings

Enclosure	Bare board with stand-offs
Power Supply	24 VAC +/- 10%, 60Hz
Control Load	TBD
Safety/Fan/Extra Relays	240VAC, 5A
Modulating Output	0-10 VDC, 3K min. load impedance / 0-20mA
Demands	Connect to 24VAC return to initiate demand
Ambient Conditions	Inside enclosure use ONLY; 32°F to 122°F (0 to 50°C), <90% relative humidity non-condensing

Table T: VERSA IC Control Board Ratings

PIM Ratings

Input Power	18-30 VAC 50/60Hz (Class 2 transformer)
Input Current Drain	400mA @ 24VAC with gas and blower relays energized
Gas Valve Relays	5.0A max (continuous)
Combustion Blower	5.0A max for standard (J2) connection 15.0A max for heavy duty (K5 relay) terminals
Hot Surface Igniter	5.0A max, 120/240VAC
Pump Relays	5.0A max (continuous)
Alarm Relay	2.0A, 30VDC or 30VAC max
Operating Temperature	-40 to +176°F (-40 to +80°C)
Storage Temperature	-40 to +185°F (-40 to +85°C)
Flame Sensitivity	0.7 μA minimum
Flame Failure Response or Reignition Time	0.8 seconds minimum
Flame Detector Self-Check Rate	Once per second minimum
Flame Failure Lockout Time	Varies by model
Spark Rate	Remote sense – 50/60Hz; Local sense – 25/30Hz
Moisture Resistance	Conformal coated to operate non-condensing to 95% relative humidity

Table U: PIM Ratings

10K Sensor Resistance Values

Temperature (°F/°C)	Resistance (Ω)
32/0	32550
41/5	25340
50/10	19870
59/15	15700
68/20	12490
77/25	10000
86/30	8059
95/35	6535
104/40	5330
113/45	4372
122/50	3605
131/55	2989
140/60	2490
149/65	2084
158/70	1753
167/75	1481
176/80	1256
185/85	1070
194/90	915
203/95	786
212/100	667

Table V: 10K Sensor resistance values

Restoring VERSA to factory defaults

To restore the VERSA control to factory default settings do the following.

1. Using the MENU button scroll to the TOOLBOX menu.

2. Use the ITEM button and scroll until you reach the DEFAULTS screen.

3. Press and hold the UP and DOWN arrow buttons simultaneously until CLR appears on the screen.

The VERSA has been returned to factory default setting. Press the MENU button to return to the ADJUST menu and set the controller for the desired functionality.

Resetting PIM

Should it be necessary to move a PIM control to another heater, the PIM has to be reset to allow the ID Card to unlock the appropriate program parameters and to load them into the PIM memory.

> **CAUTION: DO NOT** swap a PIM from 1 heater to another heater without resetting the PIM as outlined below.

Follow these steps for a hard reset of the PIM to clear program parameters:

1. Remove power from the PIM control.

2. Set all DIP switches on the PIM to their OFF position.

3. Unplug connector J6 on the PIM control.

4. Unplug VERSA CAT 5 cable from PIM control.

5. Press and hold the reset/test button (located next to the LEDs on the right side of the PIM board) while powering the controller for 5-7 seconds.

6. The red diagnostic LED will flash indicating a successful reset. The PIM board's memory is now clear of any ID Card parameters.

7. Release the reset/test button.

8. Remove power from the PIM control.

9. Connect connector J6 to the PIM control.

10. Power up the PIM control.

11. If the reset was successful, the green LED shows steady ON.

12. If the red and yellow LEDs are ON and the green LED is OFF, the reset was NOT successful.

13. If the reset was not successful, repeat steps 1-10.

14. If reset was successful, remove power and reset DIP switches for desired operation and return the unit to operation.

15. Restore VERSA to default values, be aware that all configuration will be reset. Verify user settings as necessary.

Modbus Communication Values

The VERSA IC Control has a setting called **Modbus** that determines how it operates. See Tables U-AD. When an external controller using the Modbus protocol is connected, the available settings are:

1. MODBUS = OFF

   a. Modbus messages are ignored.

2. MODBUS = MNTR (Monitor Mode)

   a. The VERSA IC Control operates as usual, however the Modbus connection allows for remote viewing and adjustment of selected VERSA IC Control parameters (See table AB).

3. MODBUS = TEMP (Temperature Control Mode)

   a. The VERSA IC Control operates as a slave to a Modbus master control. The Modbus handles all monitor functions and operates the boilers, writing the Target Temp, Sys Pump and DHW Pump data.

   i. DHW and System Pumps are exclusively turned on and off according to the pump operation sent by the Modbus master control (See table AB). The VERSA control board does not control these pump outputs in this mode.

   ii. Boiler pumps are operated as per usual by the VERSA IC Control.

   iii. The boiler system is operated at the target temperature sent by the Modbus master control.

      1. A non-zero positive value below target min will be interpreted as target min value.

      2. A zero value will disable the unit
      3. Values within target min and max range will call for heat whenever the supply sensor reading is below target.

> **CAUTION:** Do not use negative values.

4. MODBUS = RATE (Rate Control Mode)

   a. The VERSA IC Control operates as a slave to a Modbus master control (See Table AB).

   i. Operates as a single-boiler only (no cascade) and writes the target rate data and all pump commands.

   ii. Pumps are turned on and off according to the pump operation sent by the Modbus master control

   iii. No system sensor is required. The boiler is operated at the target rate sent by the Modbus master control

      1.- A 1 to 100 integer value correspond to a target firing rate from min+1 to 100%.

> **CAUTION:** Do not use negative integer values.

To enable Modbus with the VERSA IC Control, you must first turn DIP switch #1 on the VERSA Control Board to the "ON" position to access the Advanced menus. The lock icon on the upper right-hand corner of the **VIEW** menu will disappear when configured correctly. From the **VIEW** menu press the **MENU** button once to reach the **SETUP** menu. Using the **ITEM** button scroll to the **Modbus MODE** screen and select either **MNTR**, **TEMP** or **RATE** for the functionality desired. From there press the **ITEM** button to move to the **ADDRESS** screen, **DATA TYPE** screen, **BAUD RATE** screen and then **PARITY** screen to complete setup for Modbus.

> **NOTE:** Available ModBus Data Types:
> RTU = Remote Terminal Unit
> ASCI = ASCII data, not commonly used

> **NOTE:** ModBus monitor and control temperature values are only available in Fahrenheit.

ITEM	RANGE	DEFAULT	ACCESS LEVEL	WHEN DISPLAYED	DESCRIPTION
MODBUS	OFF – MNTR – TEMP – RATE	MNTR	Advanced	Always	ModBus Operating Mode: Off, Monitor, Temp Control, Rate Control
ADDRESS	1 to 247	1	Advanced	MODBUS ON	ModBus slave address
DATA TYPE	RTU <> ASCI	RTU	Advanced	MODBUS ON	ModBus data type
BAUD RATE	2400 <> 9600 <> 19K2 <> 57K6 <> 115K	19K2	Advanced	MODBUS ON	
PARITY	NONE - EVEN - ODD	EVEN	Advanced	MODBUS ON	Even/Odd=1 stop bit, None=2 stop bits

Table W: Modbus Screens

Register	Parameter	Read/Write	Format	Note	Register Address
System Status Registers					
	MODBUS	R	S16	0 = Off, 1 = Monitor, 2 = Temp, 3 = Rate	0
	System Supply Temperature	R	S16		1
	Outdoor Temperature	R	S16		2
	DHW Temperature	R	S16		3
	Aux 1 Temperature	R	S16		4
	Aux 2 Temperature	R	S16		5
	System Pump	R	S16		6
	System Pump Runtime	R	S16		7
	DHW Pump	R	S16		8
	DHW Pump Runtime	R	S16		9
	Setback	R	S16	Only relevant if MODBUS = MNTR	10
	reserved				

Table X: Modbus System Status Registers

Register	Parameter	Read/Write	Format	Note	Register Address
Boiler 1 Status Registers					
	Boiler1 detected	R	S16	0 = boiler not detected, 1 = boiler detected	16
	Boiler1 On/Off	R/W	S16	0 = offline, 1 = online	1028
	Boiler1 Outlet temperature	R	S16		17
	Boiler1 Inlet temperature	R	S16		18
	Boiler1 Vent temperature	R	S16		19
	Boiler1 High Limit temperature	R	S16		20
	Boiler1 Operator temperature	R	S16		21
	Boiler1 Mod Rate	R	S16	0-100%	22
	Boiler1 Mix Rate	R	S16	not available in initial release	23
	Boiler1 Ignition Status	R	S16		24
	Boiler1 Runtime	R	S16		25
	Boiler1 Cycles	R	S16		26
	Boiler1 Pump	R	S16		27
	Boiler1 Pump Runtime	R	S16		28
	Boiler1 Error Code	R	S16		29
	Boiler1 Error History 1	R	S16		30
	Boiler1 Error History 2	R	S16		31
	Boiler1 Error History 3	R	S16		32
	Boiler1 Error History 4	R	S16		33
	Boiler1 Error History 5	R	S16		34
	Boiler1 Error History 6	R	S16		35
	Boiler1 Error History 7	R	S16		36
	Boiler1 Error History 8	R	S16		37
	Boiler1 Error History 9	R	S16		38
	Boiler1 Error History 10	R	S16		39
	Boiler1 Error History 11	R	S16		40
	Boiler1 Error History 12	R	S16		41
	Boiler1 Error History 13	R	S16		42
	Boiler1 Error History 14	R	S16		43
	Boiler1 Error History 15	R	S16		44
	reserved				

Table Y: Boiler 1 Status Registers

Register	Parameter	Read/Write	Format	Note	Register Address
Boiler 2 Status Registers		.		MODBUS = MNTR or TEMP	
	Boiler2 detected	R	S16	0 = boiler not detected, 1 = boiler detected	45
	Boiler2 On/Off	R/W	S16	0 = offline, 1 = online	1029
	Boiler2 Outlet temperature	R	S16		46
	Boiler2 Inlet temperature	R	S16		47
	Boiler2 Vent temperature	R	S16		48
	Boiler2 High Limit temperature	R	S16		49
	Boiler2 Operator temperature	R	S16		50
	Boiler2 Mod Rate	R	S16	0-100%	51
	Boiler2 Mix Rate	R	S16	not available in initial release	52
	Boiler2 Ignition Status	R	S16		53
	Boiler2 Runtime	R	S16		54
	Boiler2 Cycles	R	S16		55
	Boiler2 Pump	R	S16		56
	Boiler2 Pump Runtime	R	S16		57
	Boiler2 Error Code	R	S16		58
	Boiler2 Error History 1	R	S16		59
	Boiler2 Error History 2	R	S16		60
	Boiler2 Error History 3	R	S16		61
	Boiler2 Error History 4	R	S16		62
	Boiler2 Error History 5	R	S16		63
	Boiler2 Error History 6	R	S16		64
	Boiler2 Error History 7	R	S16		65
	Boiler2 Error History 8	R	S16		66
	Boiler2 Error History 9	R	S16		67
	Boiler2 Error History 10	R	S16		68
	Boiler2 Error History 11	R	S16		69
	Boiler2 Error History 12	R	S16		70
	Boiler2 Error History 13	R	S16		71
	Boiler2 Error History 14	R	S16		72
	Boiler2 Error History 15	R	S16		73
	reserved				

Table Z: Boiler 2 Status Registers

Register	Parameter	Read/Write	Format	Note	Register Address
Boiler 3 Status Registers		.		MODBUS = MNTR or TEMP	
	Boiler3 detected	R	S16	0 = boiler not detected, 1 = boiler detected	74
	Boiler3 On/Off	R/W	S16	0 = offline, 1 = online	1030
	Boiler3 Outlet temperature	R	S16		75
	Boiler3 Inlet temperature	R	S16		76
	Boiler3 Vent temperature	R	S16		77
	Boiler3 High Limit temperature	R	S16		78
	Boiler3 Operator temperature	R	S16		79
	Boiler3 Mod Rate	R	S16	0-100%	80
	Boiler3 Mix Rate	R	S16	not available in initial release	81
	Boiler3 Ignition Status	R	S16		82
	Boiler3 Runtime	R	S16		83
	Boiler3 Cycles	R	S16		84
	Boiler3 Pump	R	S16		85
	Boiler3 Pump Runtime	R	S16		86
	Boiler3 Error Code	R	S16		87
	Boiler3 Error History 1	R	S16		88
	Boiler3 Error History 2	R	S16		89
	Boiler3 Error History 3	R	S16		90
	Boiler3 Error History 4	R	S16		91
	Boiler3 Error History 5	R	S16		92
	Boiler3 Error History 6	R	S16		93
	Boiler3 Error History 7	R	S16		94
	Boiler3 Error History 8	R	S16		95
	Boiler3 Error History 9	R	S16		96
	Boiler3 Error History 10	R	S16		97
	Boiler3 Error History 11	R	S16		98
	Boiler3 Error History 12	R	S16		99
	Boiler3 Error History 13	R	S16		100
	Boiler3 Error History 14	R	S16		101
	Boiler3 Error History 15	R	S16		102
	reserved				

Table AA: Boiler 3 Status Registers

Register	Parameter	Read/Write	Format	Note	Register Address
Boiler 4 Status Registers				MODBUS = MNTR or TEMP	
	Boiler4 detected	R	S16	0 = boiler not detected, 1 = boiler detected	103
	Boiler4 On/Off	R/W	S16	0 = offline, 1 = online	1031
	Boiler4 Outlet temperature	R	S16		104
	Boiler4 Inlet temperature	R	S16		105
	Boiler4 Vent temperature	R	S16		106
	Boiler4 High Limit temperature	R	S16		107
	Boiler4 Operator temperature	R	S16		108
	Boiler4 Mod Rate	R	S16	0-100%	109
	Boiler4 Mix Rate	R	S16	not available in initial release	110
	Boiler4 Ignition Status	R	S16		111
	Boiler4 Runtime	R	S16		112
	Boiler4 Cycles	R	S16		113
	Boiler4 Pump	R	S16		114
	Boiler4 Pump Runtime	R	S16		115
	Boiler4 Error Code	R	S16		116
	Boiler4 Error History 1	R	S16		117
	Boiler4 Error History 2	R	S16		118
	Boiler4 Error History 3	R	S16		119
	Boiler4 Error History 4	R	S16		120
	Boiler4 Error History 5	R	S16		121
	Boiler4 Error History 6	R	S16		122
	Boiler4 Error History 7	R	S16		123
	Boiler4 Error History 8	R	S16		124
	Boiler4 Error History 9	R	S16		125
	Boiler4 Error History 10	R	S16		126
	Boiler4 Error History 11	R	S16		127
	Boiler4 Error History 12	R	S16		128
	Boiler4 Error History 13	R	S16		129
	Boiler4 Error History 14	R	S16		130
	Boiler4 Error History 15	R	S16		131
	reserved				

Table AB: Boiler 4 Status Registers

Register	Parameter	Read/Write	Format	Note	Register Address
Monitor Mode Parameter Registers				MODBUS = MNTR	
	CH Call	R	S16		11
	DHW Call	R	S16		12
	Target temperature	R	S16	degF	13
	Target rate	R	S16	Plant target output	14
	Auto Diff	R	S16	(%) 0 = off, 1 = on	15
	Manual Differential	R/W	S16	(only relevant when auto diff is off)	1006
Monitor Mode				MODBUS = MNTR and Space Heating Mode	
	Target Mode	R/W	S16	0 = Reset, 1 = Setpoint	1000
	Setpoint Target	R/W	S16	XFYRE / XPAKFT 50 to 192°F MVB / XTHERM 50 to 220°F	1001
	Outdoor Start	R/W	S16	35 to 85°F	1002
	Outdoor Design	R/W	S16	-60 to 45°F	1003
	Boil Start	R/W	S16	35 to 150°F	1004
	Boil Design	R/W	S16	70 to 200°F	1005
	DHW Exchange	R/W	S16	OFF, 70 to 200°F	1007
	DHW Tank	R/W	S16	OFF, 50 to 180°F	1008
	DHW Differential	R/W	S16	2 to 10°F	1009
	DHW Priority	R/W	S16	0 = no DHW priority, 1 = DHW priority	1010
	DHW During UnOcc	R/W	S16	0 = No DHW during UnOcc, 1 = DHW during UnOcc	1011
	WWSD During Occ	R/W	S16	40 to 100°F	1012
	WWSD During UnOcc	R/W	S16	40 to 100°F	1013
Monitor Mode Tank				MODBUS = MNTR and Tank Mode	
	Tank Setpoint	R/W	S16	50 to 150°F	1014
	Tank Differential	R/W	S16	2 to 10°F	1015
	Tank During UnOcc	R/W	S16	0 = No heating during UnOcc, 1 = heating during UnOcc	1016
Monitor Mode Pool				MODBUS = MNTR and Pool Mode	
	Pool Setpoint	R/W	S16	50 to 104/106°F	1017
	Pool Differential	R/W	S16	2 to 10°F	1018
	Pool Supply Max	R/W	S16	110 to 120°F	1019
	Pool During UnOcc	R/W	S16	0 = No heating during UnOcc, 1 = heating during UnOcc	1020
	Reserved				

Table AC: Modbus Monitor Modes

Register	Parameter	Read/Write	Format	Note	Register Address
Pump Control Mode Parameters				MODBUS = TEMP or RATE	
	System Pump	R/W	S16		1021
	DHW Pump	R/W	S16		1022
	Boiler Pump	R/W	S16	Only relevant when MODBUS = RATE	1023
	reserved				
Temperature Control Mode Parameters				MODBUS = TEMP	
	Target temperature	R/W	S16	50 to PIM value	1024
	Auto Diff	R	S16	0 = off, 1 = on	132
	Manual Differential	R/W	S16	2 to 42°F (only relevant when auto diff is off)	1025
	reserved				
Rate Control Mode Parameters				MODBUS = RATE	
	Target Mod Rate	R/W	S16	0 - 100%	1026
		R/W	S16	50 to 140F (not available in initial release)	1027
	reserved				

Table AD: Modbus Control Mode Parameters

ModBus Error Codes			
Code	**Description**	**Code**	**Description**
0	No Error	PIM	Jumpers
VERSA	Errors	27	LWCO (Jumper)
1	EEPROM	28	Water Pressure (Jumper)
2	Outdoor Sensor (S4)	29	Air Pressure (Jumper)
3	Supply Sensor (S3)	30	Gas Pressure (Jumper)
4	Plant Sensor IND Supply (S6)	PIM	Sensors
5	Mix Sensor	31	Boiler Outlet Sensor
6	DHW Sensor (S5)	32	Boiler Inlet Sensor
7	Tank Sensor	33	Vent Sensor
8	Pool Sensor	34	High Limit Sensor
10	No PIM1	PIM	Ignition
11	Dev Lost / No VRS 2 or No PIM 2	35	Ignition Failure
12	Dev Lost / No VRS 3 or No PIM 3	PIM	Errors
13	Dev Lost / No VRS 4 or No PIM 4	36	Vent Hi-Limit
14	Condensate	37	Boiler Hi-Limit
15	Vent Temperature	38	False Flame
16	Auto Hi-Limit	39	OEM ID Card
17	Low Water	40	Internal fault
18	Vent Blocked	41	Delta T Max
19	Low Gas Pressure	42	HSI Proof
20	High Gas Pressure	43	Low Voltage
21	Extra	44	Blower Speed
22	Flow Switch	45	Safety Input
23	Air Pressure	tN4	Errors
24	Option 1	46	Duplicate Master
25	Option 2	47	Device Error
26	Option 3	48	Device Lost

Table AE: Modbus Error Table

Status Table	
0:	Error Lock
1:	Idle
2:	Pre-Purge
4:	Ignition
8:	Burn
16:	Post-Purge
32:	Ignition Failure
64:	Ignition Try 1
128:	Ignition Try 2
256:	Soft Lock
512:	Hard Lock

Table AF: Modbus Boiler Status

ISO 9001
Registered Quality Management System

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