

## Extended Features Instructions for

# Phantom II

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### Intent

The Extended Features Instruction Manual includes Phantom II Boiler features and functions that are available when using the PAT-Connect Bluetooth Adaptor commissioning, diagnostic and service tool. PAT-Connect consists of a Bluetooth Adaptor and mobile device app (“app”). The app is a local service tool with web portal data collection and live streaming to enable remote support. Refer to PAT-Connect Bluetooth Adaptor Instruction Manual for more information.



### WARNING

This boiler must only be installed, serviced, or repaired by a qualified installer, service agency or gas supplier. Improper installation, adjustment, alteration, service or maintenance can cause severe personal injury, death, or substantial property damage. For assistance or additional information, consult a qualified installer, service agency or the gas supplier. Read these instructions and boiler manual carefully before making adjustments.



The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

 **DANGER**

**Indicates a hazardous situation** that, if not avoided, will result in death or serious injury.

 **CAUTION**

**Indicates a hazardous situation** that, if not avoided, could result in minor or moderate injury.

 **WARNING**

**Indicates a hazardous situation** that, if not avoided, could result in death or serious injury.

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

# 1 Introduction

## Overview

This manual is an extension of the Installation, Operating and Service Instructions for Phantom II Models PHTM2136C, PHTM2136CB, PHTM2200C, PHTM2080H, PHTM2120H, PHTM2120HB, PHTM2150H, and PHTM2180H. The Phantom II's Boiler Control (control) contains features and capabilities which help improve heating system operation and efficiency. Using the app allows the user to gain access to features that help to fine tune the boiler installation. The following is an extended features overview.

## Extended Functions:

### Modulation Menu

#### 1. Low Fire Hold

To help increase boiler run time and decrease unnecessary boiler cycling, control includes low fire hold time. After ignition and flame stabilization periods, firing rate is held (by default) at low fire. This delay allows heat to travel out to and return from system and provide temperature feedback prior to control allowing firing rate modulation. App allows the user to adjust CH1, CH2 and DHW low fire hold time and rate percent.

### System Setup Menu

#### 1. Outdoor Temperature Source

Outdoor temperature sensor may be used for Outdoor Air Reset, CH Frost Protection and Warm Weather Shutdown functions. "Outdoor Temperature Source" parameter sets source for this temperature. Outdoor Sensor thermistor may be connected directly to low voltage connection board or outdoor temperature may be written to control from an Energy Management System (EMS) Modbus connection.

#### 2. Central Heating System Frost Protection

When enabled, frost protection starts boiler and boiler pump and fires boiler when low outside air and low supply water temperatures are sensed. See Table 1-1 'Frost Protection' for conditions that trigger this functionality. App allows user to adjust outdoor air frost protection setpoint, adjust pump overrun time and enable or disable central heat, domestic hot water and sequencer frost protection features.

**Table 1-1: Frost Protection**

Device Started	Start Temperatures	Stop Temperatures
Boiler Pump	Outside Air < 0°F (-18°C)	Outside Air > 4°F (-16°C)
	Supply Water < 45°F (7.2°C)	Supply Water > 50°F (10°C)
Boiler	Supply Water < 38°F (3.3°C)	Supply Water > 50°F (10°C)

### NOTICE: FROST PROTECTION

The control helps provide freeze protection for boiler water. Boiler flue gas condensate drain is not protected from freezing. Frost protection only powers boiler pump. Individual zones are not protected. It is required that boiler be installed in a location that is not exposed to freezing temperatures. Outdoor air interlocks included when outdoor air sensor is used.

#### 3. Warm Weather Shutdown (WWSD)

Some boilers are used primarily for heating buildings, and the boilers can be automatically shutdown when the outdoor air temperature is warm. When outside air temperature is above the WWSD setpoint, this function will shut down the boiler, boiler pump, and system pump.

#### 4. Anti-Short Cycle Time

"Anti-Short Cycle Time" prevents excessive cycling as a result of undersized or micro zoning applications. This feature provides a minimum delay time before the next burner cycle during a continuous heating demand (Heat T'stat or Aux T'stat continuously closed). If a heat demand occurs and a boiler cycles off for any reason the burner will be held off until "Anti-Short Cycle Time" has elapsed. DHW Demand is serviced immediately, without any delay.

### Pump Menu

#### 1. Pump Over Run Time

To dissipate heat into the hydronic system, it is sometimes desirable to include pump over run time. The app allows individual pump over run times to be adjusted.

### Manual Menu

#### 1. Sequencer Manual Mode

When commissioning a multiple boiler system, it is an advantage to have the ability to increase or decrease the common modulation rate. This ability helps demonstrate successful balancing and proper individual boiler temperature response. The app allows the multiple boiler system to be manually or automatically modulated.

# 1 Introduction *(continued)*

## **Central Heat (CH) 1 and 2 Menus**

1. Differences Above and Below
 

The boiler is started based on the demand (Heat T'stat, Aux T'stat inputs or DHW demand), measured supply sensor temperature, setpoint and "difference below". When water temperature is lower than setpoint minus difference below the boiler will start. Similarly, the control uses the "difference above" to stop the boiler. When water temperature is higher than setpoint plus difference above the boiler will stop. These two settings allow the user to adjust the boiler run time and cycling. The app allows these items to be adjusted for CH1, CH2 and heating boiler DHW demands. Combi boilers DHW demands have the difference above and below pre-set and are not adjustable.
2. CH Modulation Sensor
 

Heat demand may respond to the boiler's supply temperature sensor or header temperature sensor. Sometimes it is advantageous to install an optional header temperature sensor in the hydronic system. Installing a sensor in a location that senses blended water temperature allows the boiler to deliver water to heating elements at a desired temperature, independent of the amount of supply water and return water blending that takes place.
3. CH1 vs. CH2 Priority
 

When "CH1 vs. CH2 Priority" is set to "CH1<CH2" Central Heat 2 (Auxiliary Heat) demand has priority over Central Heat 1 demand. If both demands are present the setpoint, difference above, difference below and maximum modulation rates will be Central Heat 2 rather than Central Heat 1. When "CH1 vs. CH2 Priority" is set to "CH1>CH2" Central Heat 1 has priority. Typically, the higher temperature demand is given priority, ensuring high enough temperature to each type of zone.
4. Heat Response Speed
 

"Heat Response Speed" adjusts the temperature controller Proportional, Integral and Derivative (PID) values all at once. Higher values cause a larger firing rate change for each degree of temperature change. If set too high, the temperature "overshoots" required setpoint and may cause the boiler to cycle off unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the temperature response will be sluggish, and temperature will wander away from setpoint.

## **Outdoor Reset CH1 and CH2**

1. Outdoor Reset Enable
 

Outdoor Reset may be set to Sensorless Reset, Outdoor Air Reset or be disabled. Sensorless Reset adjusts the active setpoint based on total boiler heat output per unit of time. Outdoor Air Reset adjusts the active setpoint based on the outdoor temperature. This method requires an outdoor air sensor to be installed. When a heating boiler only serves an indirect water heater the reset feature may be disabled.
2. Boost Time
 

When Central Heat Setpoint is decreased by Sensorless or Outdoor Air Reset features, the Boost function may be enabled to increase the setpoint when central heat demand is not satisfied for longer than the Boost Time setpoint. The Boost feature increases operating temperature setpoint by 10°F (5.6°C) every 20 minutes (field adjustable) the central heat demand is not satisfied. This process will continue until heat demand is satisfied (indoor air is at desired temperature). Once the heat demand is satisfied, the operating setpoint reverts to the value determined by the Sensorless or Outdoor Air Reset settings. If Boost Time is zero, then the boost function is not used.

## **Multiple Boiler Lead Lag Sequencer**

1. Overview
 

The control includes a state-of-the-art Multiple Boiler Lead Lag Sequencer (sequencer), for up to eight (8) follower boilers, capable of auto rotation, outdoor reset, and Boiler-to-Boiler communication network. Boilers are joined to sequencer network by connecting an RJ45 ethernet cable between boilers and setting unique boiler addresses. The control provides precise boiler coordination by sequencing boilers based on both header water temperature and boiler modulation rate. Sequencer features include:
2. Sequencer Master
 

A single control is selected to be the Sequencer Master. The call for heat, outdoor sensor, header sensors, and common pumps are wired to the Sequencer Master "enabled" control.
3. Unison Modulation
 

Boilers are modulated in "unison" (parallel) modulation rate to ensure even heat distribution.

# 1 Introduction *(continued)*

## 4. Condensing Boiler Optimization

The Sequencer Master limits firing rates to a 'Base Load Common Rate' to ensure peak efficiency. Lower firing rates boosts efficiency by helping increase the amount of flue gas water vapor condensation. The control maintains a "Base Load Common Rate" until the last lag boiler is started. At this point, the "Base Load Common Rate" is released to allow boilers to modulated as required to meet heat load.

## 5. Lead Rotation Time

One boiler is a "Lead" boiler and the remaining networked boilers are "Lags". When demand is increasing, the Lead boiler is the first to start and the lag boilers are started in sequential order until demand is satisfied. When demand is decreasing, boilers are stopped in reverse order with the Lead boiler stopped last. To equalize run time, the sequencer automatically rotates Lead boiler after 24 hours of run time.

## 6. Multiple Demands

The Sequencer Master responds to CH1, CH2 (Auxiliary Heat), DHW, and frost protection demands similar to a stand alone boiler.

## 7. Shared or Isolated DHW Demand

When the Indirect Water Heater (IWH) parameter is set to "Primary Piped", the Sequencer Master sequences all required boilers to satisfy the DHW setpoint. When "Boiler Piped" is selected only the individual boiler, with the wired DHW demand and pump, fires to satisfy the DHW setpoint.

## 8. Improved Availability

- A. If the Sequencer Master control is powered down or disabled or if communication is lost between boilers, individual boilers may be setup to automatically resume control as a "stand alone" boiler.
- B. Follower Boiler Rate Adjustment: Each follower boiler continues to monitor supply, return and flue gas temperatures and adjust firing rate to help avoid individual boiler faults, minimize boiler cycling, and provide heat to the building efficiently.
- C. Follower Boiler Status Monitoring: The Sequencer Master monitors follower boiler lockout status and automatically skips over disabled boilers when starting a new follower boiler.

D. All boilers are stopped without delay if the Call for Heat input is removed or if the header temperature is higher than 195°F (90.6°C) (field adjustable).

## 9. Common Vent Specific Features

The Sequencer Master optimizes 120 MBH, 150 MBH or 180 MBH heating boiler operation for common venting installations (see Common Venting Instructions, p/n 112891-01,). When multiple boilers share a common vent, boiler performance may be unreliable when some boilers are at high fire while others are at low fire. To alleviate this risk, Sequencer Master common vent mode will lower boiler firing rates while new boilers start or run at low fire. Additionally, slave boiler "suspend" state is used to manage boilers that fail to start or fault while running.

## **Sequencer Master Menu**

### 1. Stop All Boilers

When Header Temperature exceeds "Stop All Boilers" setpoint all networked boilers are stopped at the same time without any stop boiler time delays. This setpoint allows the sequencer to respond to rapid load decreases.

### 2. Sequencer Response Speed

"Sequencer Response Speed" adjusts the sequencer temperature controller Proportional, Integral and Derivative (PID) values all at once.

### 3. Boiler Start and Stop Delays

When header temperature is below the setpoint minus "Add Stage Error Threshold" and the Sequencer Master firing rate is at maximum for longer than "Boiler Start Delay" seconds the Sequencer Master starts the next boiler. Longer time delay will prevent nuisance starts due to short temperature swings. Boiler Stop Delay is the boiler time delay after header temperature has risen above the setpoint plus "Drop Stage Error Threshold". Longer time delay will prevent nuisance stops due to short temperature swings.

### 4. Base Load Common Rate

To increase efficiency, boilers are kept at or below 'Base Load Common Rate' until all boilers in sequence have started. After the last available boiler has started, modulation rate is no longer limited to 'Base Load Common Rate' setting.

### 5. Add and Drop Stage Error Threshold

The follower boilers are started based on demand (CH1, CH2 or DHW demand), measured header sensor temperature, setpoint, "Add Stage Error Threshold" and boiler start delay. Larger "Add

# 1 Introduction *(continued)*

Stage Error Threshold” will cause boiler to wait for colder water before starting. Similarly, control uses “Drop Stage Error Threshold” to stop boiler. Larger “Drop Stage Error Threshold” will cause boiler to continue firing until a higher water temperature is reached. These two settings allow the user to adjust the follower boiler run time and cycling.

## 6. Lead Rotation Time

“Lead rotation time” is the amount of boiler run time each boiler will spend as “Lead” boiler before switching to the next boiler in the network.

## 7. Demand To Firing Delay

“Demand to Firing Delay” specifies the length of time the Sequencer Master waits for the main fuel valve to be energized after a boiler start command. If “Demand to Firing Delay” time is exceeded before main fuel valve is open the next boiler is started without further delay.

## 8. Indirect Water Heater

“Indirect Water Heater” is set to match the indirect water heater piping location. When “Boiler Piped” is selected, the sequencer responds to an Isolated DHW demand that has an indirect water heater piped to an individual boiler. The individual boiler goes on leave, from the Sequencer Master (acting as a stand-alone boiler) and goes to DHW Service. When “Primary Piped” is selected, the indirect water heater is piped to common piping, Sequencer Master responds to the DHW call for heat and setpoint is greater of DHW or CH regardless of priority. This allows one or more boilers to provide heat to the IWH.

## 9. Common Venting Enable

“Common Vent Enable” sets the Sequencer Master to optimize boiler operation for common venting.

## 10. Common Vent Rate

“Common Vent Rate” sets the maximum modulation rate follower boilers can achieve while a new networked boiler is started. Lower values help newly added boilers avoid faults.

## **Energy Management System (EMS)**

### 1. Overview

The control accepts 4-20mADC, 0-10Vdc, or Modbus interface with EMS systems. Both remote setpoint and firing rate inputs are accepted. The control has multiple, independent RS485 Modbus interface networks. The RS485 Modbus interface

remains available for EMS interface even when also using the boiler-to-boiler communication network.

## **Energy Management Menu**

### 1. MB2 Monitoring Modbus Address

“MB2 Zone Panel/Monitoring Modbus address” sets the Modbus bus port 2 address. This port may be used for the zone panel or remote system monitoring connection.

### 2. EMS Time Out Enable

When “EMS Time Out Enable” is enabled, control switches to local mode if the EMS fails to write value every 30 seconds. When disabled EMS only needs to write a valid number after power up.

### 3. CH Modulation Rate Source

Boiler can modulate firing rate based on local or remote (wired or Modbus) signals. Modulation begins after the start sequence finishes and boiler is released to modulate.

### 4. CH Setpoint Source

Boiler setpoint may be based on local (user entered value or outdoor reset) or remote (wired or Modbus) signals.

## **Limits Menu**

### 1. Preferred outlet/flow high limit

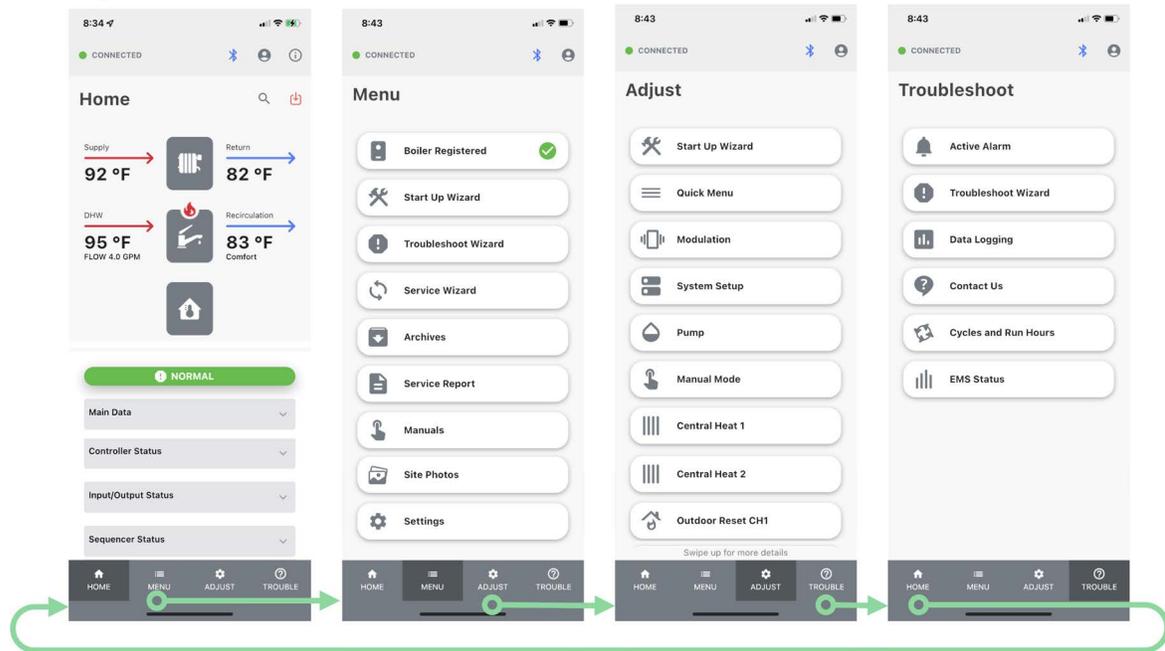
“Preferred outlet/flow high limit” is a field adjustable supply temperature High Limit. This adjustment only allows user to lower the High Limit below the maximum High Limit in the control. This feature may be used to test the supply temperature high limit control feature. By setting Preferred High Limit below the normal operating range the High Limit may be easily tested. When High Limit is reached the boiler manual reset lockout is initiated.

### 2. Preferred stack/flue high limit

“Preferred stack/flue high limit” is a field adjustable flue temperature High Limit. This adjustment only allows user to lower the High Limit below the maximum High Limit in the control. This feature may be used to test the Flue Temperature High Limit control feature. By setting Preferred Flue Temperature High Limit below the normal operating range the High Limit may be easily tested.

## 2 User Interface

### General Navigation



**Figure 2-1: Navigation**

The Menu buttons, located at the bottom of the screen, provides access to all display functions. The following user interface areas are accessed from Menu buttons:

#### HOME

The HOME screen provides an overview of the boiler, control, and any networked boiler operation.

#### MENU

The MENU screen provides boiler registration, Start-Up Wizard, Troubleshooting Wizard, Service Wizard and remote support features:

- Boiler Registration: Initiate a boiler registration with convenience of boiler model, location and contractor information already filled in.
- Wizards: Save time by organized guided start-up, troubleshooting and service actions and help prevent call back by ensuring nothing is missed.
- Service Report, Archives and Site photos: Document your installation on the smart phone, store data on a web portal or allow information to be emailed. These features allow the user to provide information to contractors, representatives, or manufacturer for efficient remote support.
- Manuals: Boiler Instruction Manual, user's manual, quick start guide, and specification are always available.
- Settings: Bluetooth Adaptor, boiler firmware or default parameters may be updated.

#### ADJUST

Each adjustable parameter is presented for adjustment with parameter explanation and adjustable range.

#### TROUBLE

The TROUBLE screen collects both live data and the history of how the boiler has operated and provides tools to review and improve system operation.

- Active Alarms are presented with possible causes and corrective actions. If necessary, pdfs are included to help resolve problems.
- Lockout History – provides data on up to eight (8) hold or Lockout errors.
- Data logging – Up to eleven (11) data points may be selected, viewed on screen, saved to smart phone or emailed.
- Cycle & Run Time History – collects boiler and pump cycles and hours of operation. All cycles and run hours, other than the controller quantities, may be reset to aid in identifying improvements made.

## 2 User Interface *(continued)*

### Home Screen

Home screen is the primary boiler monitoring screen. The user may gain boiler system operational condition by simply pressing “Main Data”, “Controller Status”, “Input/Output Status” or “Sequencer Status”.

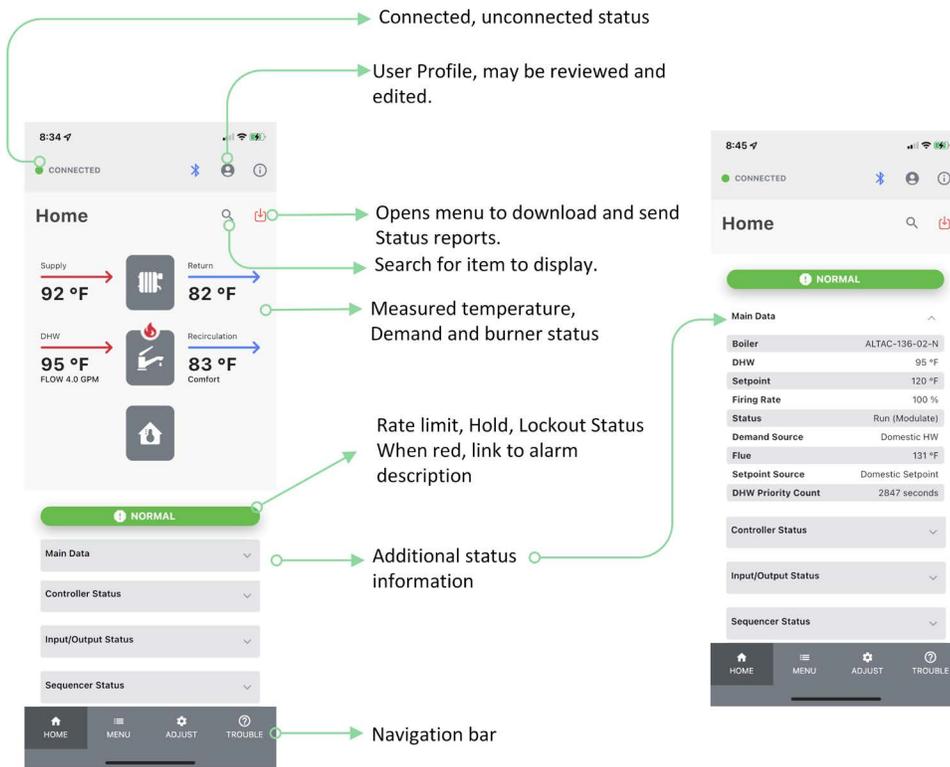


Figure 2-2: Home Screen

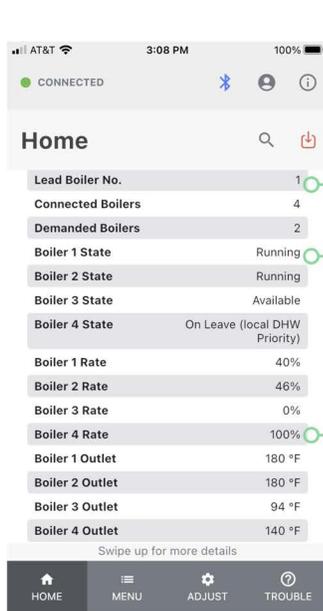
Table 2-3: Display Descriptions

	Background dark when Central Heat demand is present.
	Background dark when DHW demand is present.
	Visible when burner is firing. Icon adjacent to active priority.
<p>Comfort</p>	Combi Boilers Only. Visible when Recirculation (Comfort) Mode is active. (Visible after successful calibration.)
	Visible when CH setpoint reset is enabled.

## 2 User Interface *(continued)*

### Sequencer Status

The Home Screen provides connected boiler status useful for initial connection status, load balancing and general monitoring.



#### Lead Boiler:

Upon power up the lowest numbered boiler becomes the lead boiler. The lead boiler is the first to start and last to stop. The lead boiler is automatically rotated after 24 hours of run time.

Additionally, the lead is rotated if there is a lead boiler fault.

#### Follower Boiler Status:

**Available:** Boiler is ready and waiting to be started by the Sequencer Master.

**Add Stage:** Boiler has begun the start sequence but has not yet reached the boiler running status.

**Running:** Boiler is running.

**On Leave:** Boiler has left the network to service a DHW demand.

**Suspend:** Boiler is held for suspend time after a failed start or boiler fault during running status. Each boiler fault increases the suspend time; 30 seconds; 5 minutes; 10 minutes; and then 15 minutes for additional faults. Once the Sequencer Master demand is removed the suspend time is reset to 30 seconds.

#### Boiler Number:

Up to eight (8) boiler's state, rate and outlet temperature and address shown.

**Figure 2-4: Home Screen Boiler Status Screen**

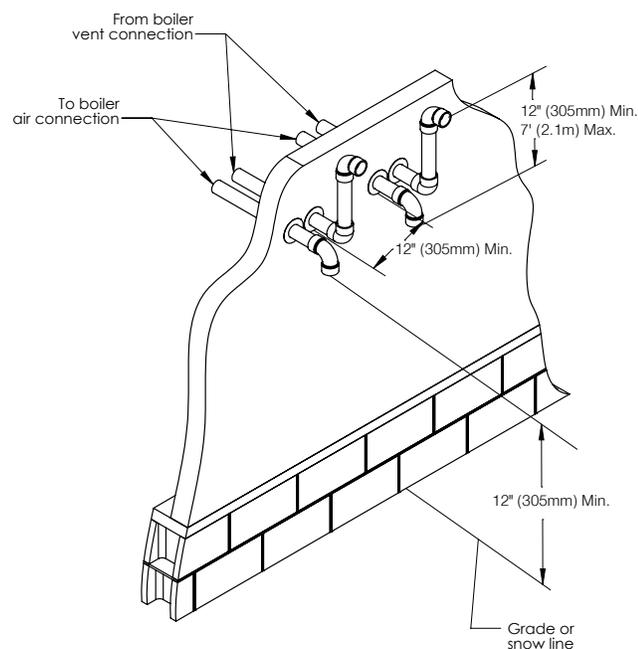
## 3 Multiple Boiler Installations

### Venting

#### ⚠ WARNING

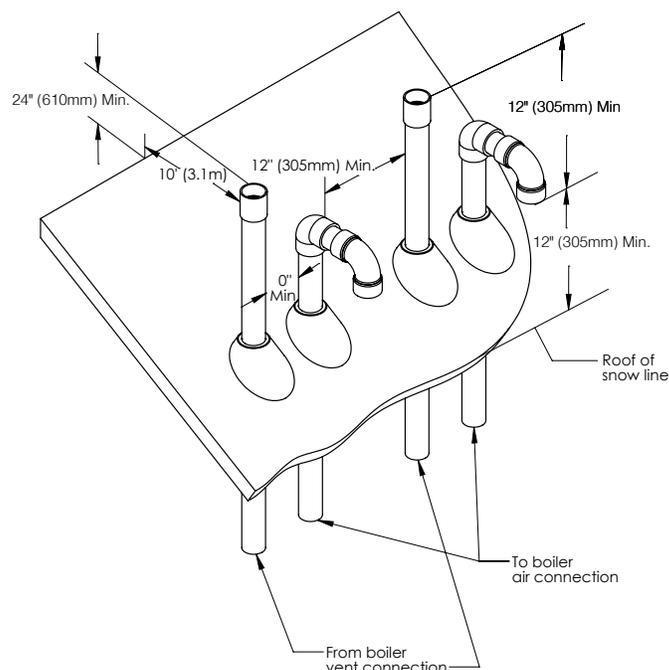
##### Asphyxiation Hazard.

- Vent and air pipe installations shall be in accordance with instructions outlined in Boiler Instruction Manual.
  - For common venting, refer to Common Vent instruction.
  - Failure to comply with any of the above requirements could result in severe personal injury, death or substantial property damage.
1. Multiple boiler vent and air piping terminations are shown in Figure 3-1.
  2. In addition to instructions outlined in boiler Instruction Manual, consider the following guidelines when selecting terminal location.
    - A. For horizontal sidewall terminations, follow instructions outlined in boiler Instruction Manual for individual boilers. When selecting termination location for next boiler, maintain minimum 12 in. (305 mm) horizontal distance between adjacent boiler termination. See Figure 3-1 for details.



**NOTICE:** Installing multiple individual boiler vent terminations too close together may result in flue gas condensation on building surfaces and potential frost damage. To avoid/minimize frost damage, extend distance from building surfaces to vent termination end and increase horizontal distance between adjacent vent terminations.

- B. For vertical roof terminations, follow instructions outlined in boiler Instruction Manual for individual boilers. When selecting termination location for next boiler, maintain minimum 12 in. (305 mm) horizontal distance between adjacent boiler termination. See Figure 3-1 for details.
- C. Multiple individual boiler vent and air pipes may be piped through common conduit or chase so one (wall or roof) penetration may be made.



**Figure 3-1: Multiple Boiler Terminations**

### 3 Multiple Boiler Installations *(continued)*

#### Water Piping

 **WARNING**

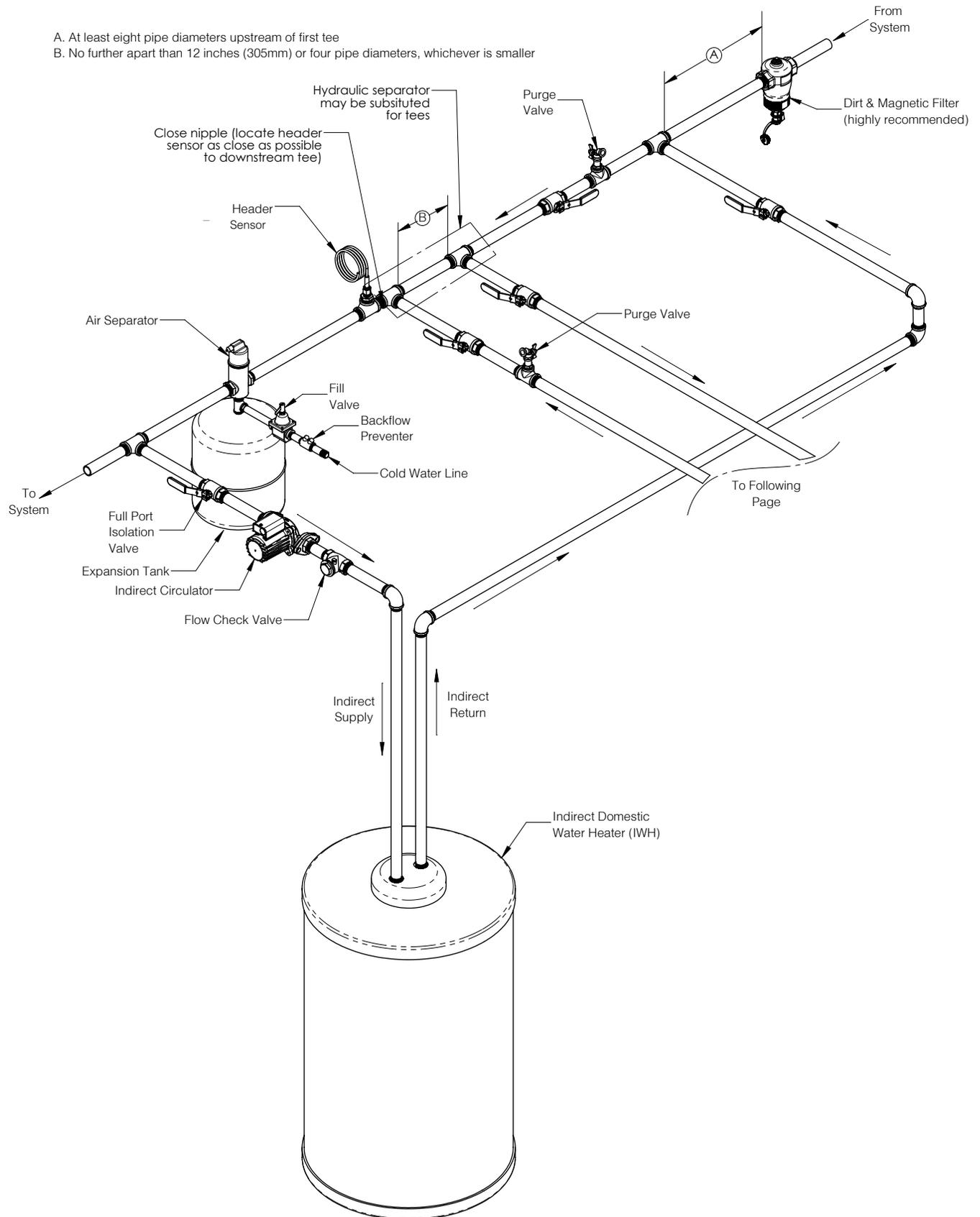
**Burn Hazard. Property Damage.**

- Heating system piping installation shall be in accordance with instructions outlined in Boiler Instruction Manual.
- See boiler Instruction Manual for standard piping components (including required components) for each individual boiler.
- Failure to comply with any of the above requirements could result in severe personal injury, death or substantial property damage.

1. Multiple boiler heating systems piping is shown in Figure 3-2.
2. Follow instructions outlined in boiler Instruction Manual for installation of near boiler piping supplied with boiler.

### 3 Multiple Boiler Installations *(continued)*

- A. At least eight pipe diameters upstream of first tee  
 B. No further apart than 12 inches (305mm) or four pipe diameters, whichever is smaller



**Figure 3-2: Multiple Boiler Water Piping w/Primary Piped Indirect Water Heater  
 (Page 1 of 2)**

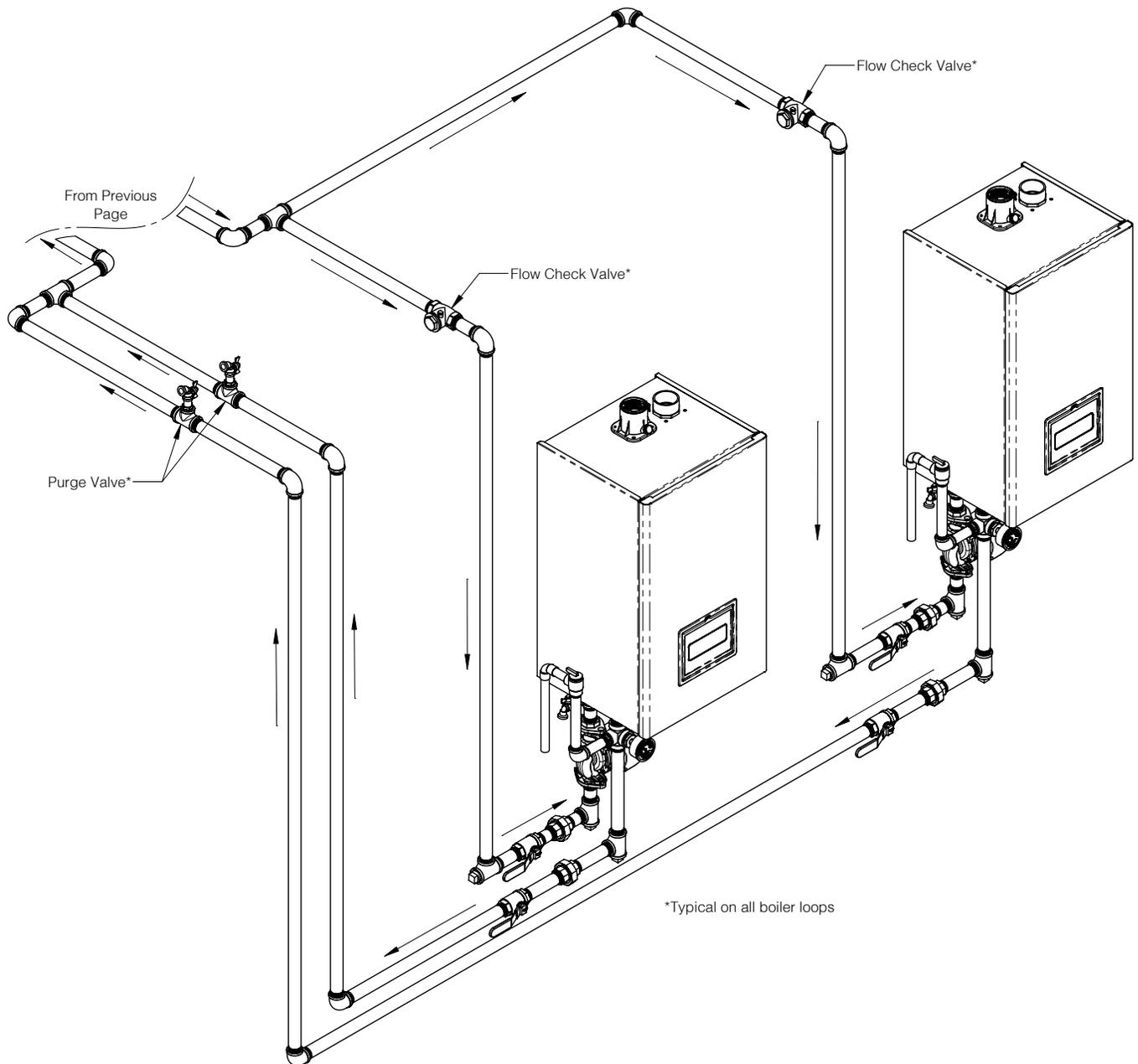
### 3 Multiple Boiler Installations *(continued)*

**NOTICE:** Installer is responsible for piping configurations to provide proper flow rates and meet local codes.

**NOTICE:** Primary-secondary piping is required.

#### **CAUTION**

**Burn Hazard. Property Damage.** Under some conditions this boiler can deliver water to heating system that is significantly higher than boiler setpoint. Where such overheat could cause personal injury or property damage (e.g. low temperature radiant floor zones), protect system from excessive temperatures using tempering valves or other means.



**Figure 3-3: Multiple Boiler Water Piping w/Primary Piped Indirect Water Heater (Page 2 of 2)**

### 3 Multiple Boiler Installations *(continued)*

#### Gas Piping

 **WARNING**

**Explosion Hazard.**

- Gas piping installation shall be in accordance with instructions outlined in boiler manual.
- Failure to comply with any of the above requirements could result in severe personal injury, death or substantial property damage.
- Check for gas leaks as outlined in the boiler manual.

1. See boiler manual for standard piping components (including components supplied with boiler) for each individual boiler.
2. Additional gas pressure regulator(s) may be required to properly regulate inlet gas pressure at smallest individual boiler.

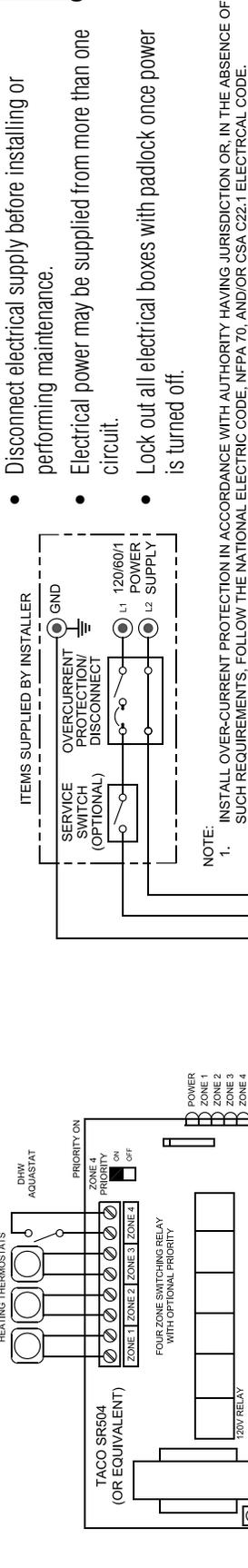
### 3 Multiple Boiler Installations *(continued)*

#### Field Wiring

#### DANGER

##### Electrical Shock Hazard.

- Disconnect electrical supply before installing or performing maintenance.
- Electrical power may be supplied from more than one circuit.
- Lock out all electrical boxes with padlock once power is turned off.



**Figure 3-4: Multiple Boiler Wiring Diagram**

**NOTICE:** Heating Availability

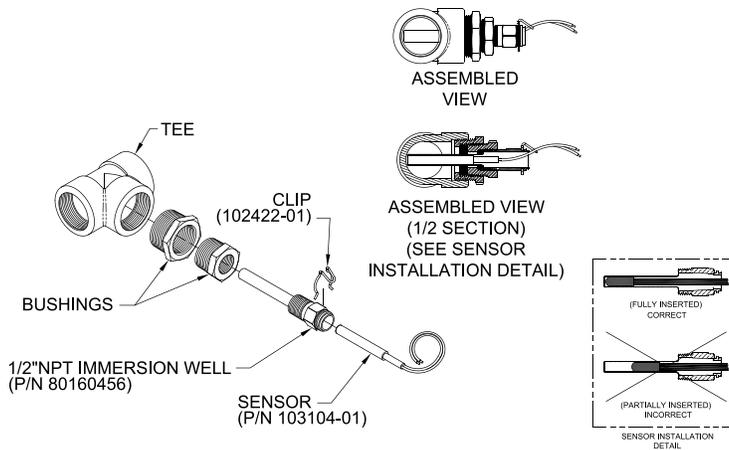
1. Networked Boilers Heat T'stats:
  - Sequencer Master is lost or unavailable when powered down or ethernet cable is disconnected. When a Sequencer Master is lost the follower boilers revert to local, stand-alone operation, and monitors their own Heat T'stat and supply sensor. Follower boilers need a closed Heat T'stat to have a "call for heat". To ensure follower boiler continued operation, jumper the Heat T'stats on each follower boiler. While Sequencer Master boiler is powered and connected to the boiler-to-boiler network, follower boiler Heat T'stat jumpers are ignored and follower boiler operation is directed by the Sequencer Master. Sequencer Master boiler with lockout condition will not interrupt Sequencer Master directing follower boiler normal operation.
2. System Pump Operation (when using system pump and zone valves)
  - When the follower boiler Heat T'stats are jumpered and the system pump is wired to a zone panel or external relay the boilers will supply heat even after loss of the Sequencer Master. To continue supplying heat to the building in the event the Sequencer Master is lost, it is important to consider system pump wiring. When the system pump is wired to the Sequencer Master and the Sequencer Master is powered down the system pump will shut off. System pump operation can be ensured by wiring to zone panel, or external relay (for example SR501). Wire relay with input from thermostat and contacts to system pump and master boiler.

### 3 Multiple Boiler Installations *(continued)*

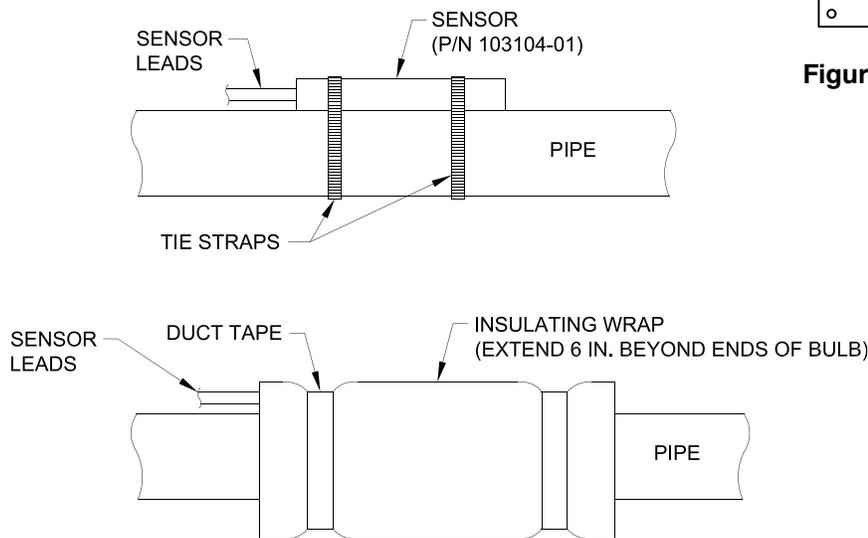
#### Field Wiring *(continued)*

##### Header Sensor (P/N 101935-01 or 103104-01)

A header sensor must be installed and wired to the Sequencer Master “enabled” control. The header sensor is installed on the common system piping and provides blended temperature information to the Sequencer Master. Refer to piping diagram Figure 3-2 for installation location and Figure 3-5 or 3-6 for installation detail.



**Figure 3-5: Recommended "Immersion" Type Header Sensor installation Detail**

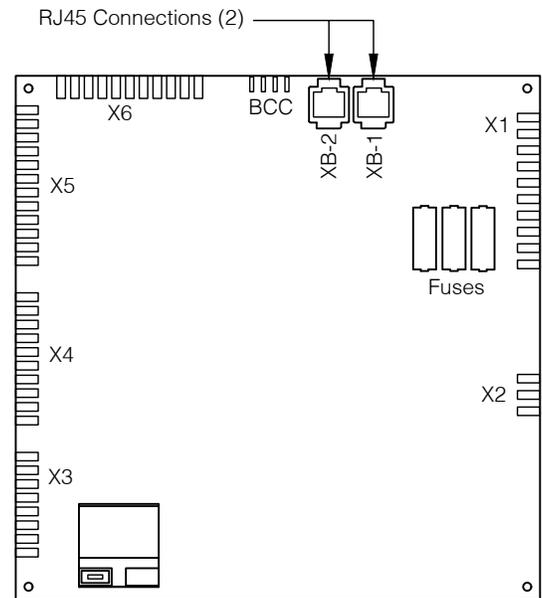


**NOTICE:** The “Strap-On” type sensor must be mounted to the top side of a horizontal section of pipe as indicated in Figure 3-2.

**Figure 3-6: Alternate “Strap-On” Type Header Sensor Installation Detail**

##### Ethernet Cables

Ethernet cables are used to connect the boiler network together. These are standard “straight through” cables that can be purchased at electrical distributors. Connect ethernet cables to rear of control at X8-1 or X8-2 ports. Up to 8 controls can be connected in sequence through these ports.



**Figure 3-7: Boiler-to-Boiler Communication Network Connections**

### 3 Multiple Boiler Installations *(continued)*

#### Communication

Boiler-to-Boiler communication network allows the control's Internal sequencer to communicate boiler information, including modulation rate and on/off commands, using standard Ethernet cables.

**NOTICE:** The Phantom II boiler must be the enabled Sequencer Master. If Phantom II and Phantom\* boilers are connected in a boiler-to-boiler communication network there is a risk the Phantom\* boiler will remain at low fire and prevent other boilers from being started. To avoid this condition, set all Phantom\* boiler's "Central Heat 1 Low Fire Hold Time" to 0 seconds.

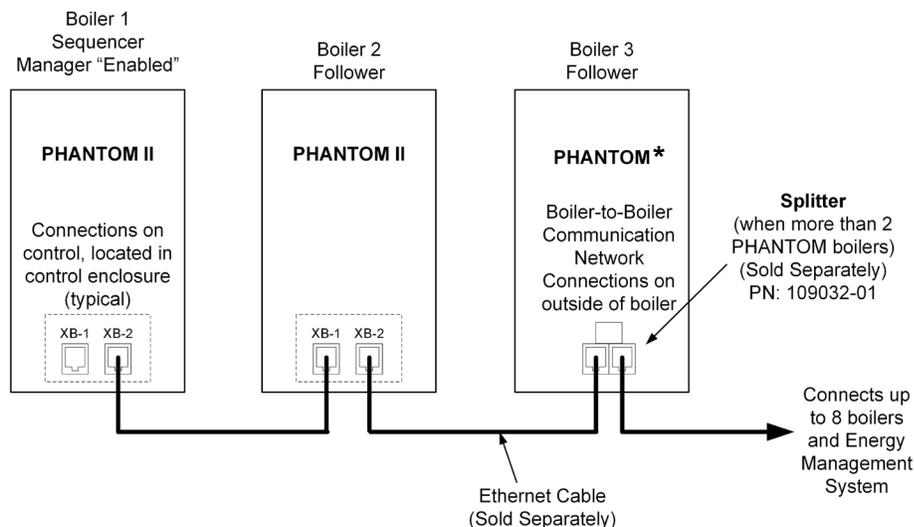


Figure 3-8: Boiler-to-Boiler Communication Network

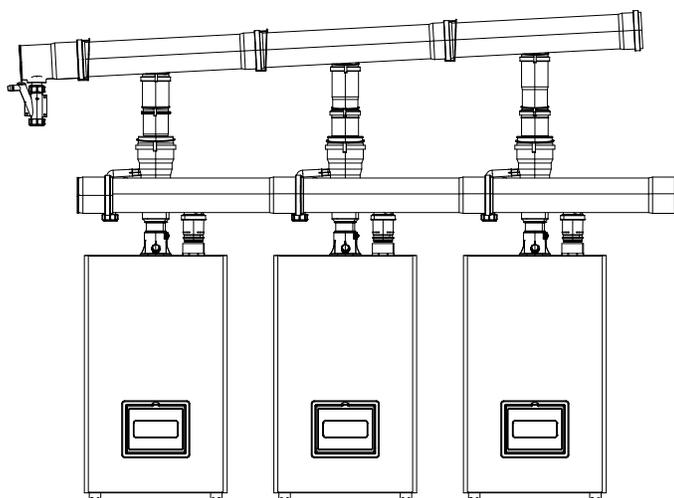
#### Setup Procedure

Table 3-9: Sequence Setup Procedure

Step	Description	Comments
1	Install and wire the Header Sensor	Wire the Header Sensor to low voltage terminal strip terminals "Header Sensor". <b>NOTICE:</b> This step cannot be skipped. The Sequencer Master cannot be "Enabled" unless a Header Sensor is installed.
2	Install Ethernet Cables between Boilers	Use standard "straight through" Ethernet type cables to make connections between boilers. Ethernet cables are "plugged in" to connection X8-1 or X8-2 on rear of control. When multiple Alpine* boilers are also connected, an RJ45 splitter may be used to connect the boilers. Refer to Figure 3-8.
3	Apply Power to All Boilers Set Unique Boiler Addresses	Assign all boilers a unique Boiler Address using any number from 1 through 8. (Found in App: Adjust Menu/Sequencer Master/Boiler address) Boiler address must be set at each boiler's local display or with app connected directly to boiler. <b>WARNING</b> <b>Burn Hazard. Property Damage.</b> When two or more boiler's addresses are the same, undesirable simultaneous operation occurs. If Multiple boilers start simultaneously these boilers could deliver water to heating system that is higher than boiler setpoint. Where such overheat could cause personal injury or property damage (e.g. low temperature radiant floor zones), protect system from excessive temperatures using tempering valves or other means.
4	Enable 1 Boiler Master	Enable only one control's Sequencer Master. (Found in App: Adjust Menu/Sequencer Master/Sequencer Master Enable)
5	Confirm Communication	Use app to connect to the Sequencer Master Enabled boiler. From app Home Screen, select "Sequencer Status" menu. All boilers should be listed. If a boiler is not shown, check Ethernet cable connections and confirm all boilers have unique addresses.

\* Phantom II boiler-to-boiler communication network is compatible with Phantom, Phantom Combi, Phantom-X, Raptor, Raptor Combi Shadow.

### 3 Multiple Boiler Installations *(continued)*



**Figure 3-10: PHTM II Heating Boiler Common Venting (Three shown, typical for 2 to 4)**

**NOTICE:**

- Control internal sequencer master must be used to sequence and coordinate boilers using common venting. Phantom II Control internal sequencer with Common Vent Enable, Enabled is specifically designed to improve boiler performance and help avoid boiler faults. Application software version 48 or newer is also required.
- When using common venting, Control Internal Sequencer Master must be "Enabled" and Common Vent Enable must be set to "Enable".
- Connect 2 to 4, same size, Heating Boilers. For example, 2 to 4 120 MBH or, 2 to 4 150 MBH or, 2 to 4 180 MBH.
- It is recommended to start boilers individually prior to connecting them to the boiler-to-boiler network.

When multiple boilers share a common vent, there is a risk of loss of flame during running and startup modes. Common vent logic is provided to alleviate this risk. Networked boilers will be brought to lower firing rate when a boiler is starting. Already running boiler firing rate reduction due to high supply, high flue or high differential temperatures shall be limited to an acceptable minimum modulation rate.

**Table 3-11: Common Vent Sequencer Setup Procedure**

Step	Description	Comments
1		Complete sequence setup procedure, Table 3-9.
2	Install Common Vent Materials	Refer to 112891-01 Common Venting Instructions.
3	Set Common Vent Enable Parameter to "Enable" on All Boilers	When Common Vent Enable is enabled on all networked boilers, boiler operation is optimized to suit common venting. <b>NOTICE:</b> Common Vent Enable must be set to "Enable" on every networked boiler.
4	Set Boiler Minimum Firing Rates on All Boilers	Set boiler Minimum Modulation based on boiler size and fuel (refer to Table 3-13). Minimum Modulation must be set at each boiler's local display or with app connected directly to boiler. <b>NOTICE:</b> Minimum Modulation must be set on every networked boiler.
5	Set Indirect Water Heater to Primary Piped	When common vent is enabled, individual boilers must NOT go on leave. <b>NOTICE:</b> Indirect Water Heater parameter must be set to Primary on all networked boilers.

\* Sage Controller equipped boilers such as Phantom, Phantom Combi, Phantom-X, Raptor, Raptor Combi Shadow.

### 3 Multiple Boiler Installations *(continued)*

#### Sequence Master

Select the "Sequence Master" menu button to access the following parameters:

**Table 3-12: Sequence Master Menu**

Default	Range/Choices	Parameter and Description														
No Sequencer Master	Sequencer Master, No Sequencer Master	<p><b>Sequencer Master Enable</b> Used to "turn on" Boiler-to-Boiler communication network. Sequencer Master: Sequencer Master is Enabled. No Sequencer Master Sequencer Master is Disabled</p> <p><b>NOTICE:</b> Enable Only one Sequencer Master in the boiler-to-boiler network. Header sensor must be installed and valid to enable the Sequencer Master.</p>														
0	1 to 8	<p><b>Boiler Address</b> Each boiler must be given a unique address, address determines boiler start order.</p>														
Disabled	Disabled, Enable	<p><b>Common Vent Enable</b> When enabled, boiler operation is optimized to suit common venting. Disable: Common vent control function is not used. Enable: Common vent control function used, multiple boilers installed with common vent.</p> <p><b>NOTICE:</b> Common Vent Enable must be set to "Enable" in every networked boiler.</p>														
0%	0-30%	<p><b>Minimum Modulation</b> "Minimum Modulation" is used to raise the lowest modulation rate the Control will go to during any demand priority. This parameter corrects the value up to 30%. When using common vent, set value based on boiler size and Fuel Gas Selection:</p> <p><b>Table 3-13: Common Vent Minimum Modulation Settings</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Boiler Size</th> <th colspan="2">Minimum Modulation%</th> </tr> <tr> <th>Natural Gas</th> <th>LP</th> </tr> </thead> <tbody> <tr> <td>PHTM-120B MBH</td> <td>6%</td> <td>8%</td> </tr> <tr> <td>PHTM-150 MBH</td> <td>6%</td> <td>8%</td> </tr> <tr> <td>PHTM-180 MBH</td> <td>6%</td> <td>8%</td> </tr> </tbody> </table> <p><b>NOTICE:</b> When venting four natural gas 120 MBH boilers through a 4 inch common vent, set Minimum Modulation to 9%.</p>	Boiler Size	Minimum Modulation%		Natural Gas	LP	PHTM-120B MBH	6%	8%	PHTM-150 MBH	6%	8%	PHTM-180 MBH	6%	8%
Boiler Size	Minimum Modulation%															
	Natural Gas	LP														
PHTM-120B MBH	6%	8%														
PHTM-150 MBH	6%	8%														
PHTM-180 MBH	6%	8%														
45%	0-100%	<p><b>Common Vent Rate</b> Maximum modulation rate slave boilers can achieve while a new networked boiler is started. Lower values help new boiler starts avoid loss of flame.</p>														
Disabled	Disabled, Outdoor Air	<p><b>Sequencer Reset Enable</b> If an outdoor sensor is installed and sequencer Outdoor Reset is Enabled, boiler will automatically adjust heating zone setpoint temperature based on outdoor reset curve. Disabled: Disable, do not calculate setpoint based on outdoor temperature. Outdoor Air: Calculate temperature setpoint based on outdoor temperature using a reset curve defined by Low Outdoor Temp, High Outdoor Temp, Low Boiler Temp and CH Setpoint and Boost Time parameters</p> <p><b>NOTICE:</b> Sensorless reset is not available for use with Sequencer Master.</p>														
195°F	CH1 Setpoint through 195°F	<p><b>Stop All Boilers</b> When header temperature is higher than Stop All Boilers setpoint all networked boilers are stopped at once without any stop boiler time delays. This setpoint allows the Sequencer to respond to rapid load decreases.</p>														

### 3 Multiple Boiler Installations *(continued)*

#### Sequence Master *(continued)*

**Table 3-12: Sequence Master Menu *(continued)***

Default	Range/Choices	Parameter and Description
195°F	CH1 Setpoint through 195°F	<b>Stop All Boilers</b> When header temperature is higher than Stop All Boilers setpoint all networked boilers are stopped at once without any stop boiler time delays. This setpoint allows the Sequencer to respond to rapid load decreases.
2	1 to 3	<b>Sequencer Response Speed</b> "Sequencer Response Speed" adjusts the temperature controller Proportional, Integral and Derivative ("Sequencer P Gain", "Sequencer I Gain" and "Sequencer D Gain") values all at once. Higher values cause a larger firing rate change for each degree of temperature change. If set too high, the temperature "overshoots" required setpoint and may cause the boiler to cycle off unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the temperature response will be sluggish and temperature will wander away from setpoint.
120 seconds	2 to 1,200 seconds	<b>Boiler Start Delay</b> When header temperature is below the setpoint minus "Add Stage Error Threshold" and the Sequencer Master firing rate is at maximum for longer than "Boiler Start Delay" seconds the Sequencer Master starts the next boiler. Longer time delay will prevent nuisance starts due to short temperature swings.
40%	20 to 100%	<b>Base Load Common Rate</b> To maximize condensing boiler efficiency, the firing rate is limited to an adjustable value. Boilers are kept at or below this firing rate until last available boiler has started, then the modulation rate limit is released up to 100%.
60 seconds	0 to 900 seconds	<b>Boiler Stop Delay</b> When header temperature is above the setpoint plus "Drop Stage Error Threshold" and the Sequencer Master firing rate is at minimum for longer than "Boiler Stop Delay" seconds the Sequencer Master stops a boiler. Longer time delay will prevent nuisance stops due to short temperature swings.
5°F	2 to 30°F	<b>Add Stage Error Threshold</b> The "Add Stage Error Threshold" parameter is subtracted from the setpoint temperature to determine the temperature at which a follower boiler should be turned on.
7°F	2 to 30°F	<b>Drop Stage Error Threshold</b> The "Drop Stage Error Threshold" parameter is added to the setpoint temperature to determine the temperature at which a follower boiler should be turned off.
24 hours	0 – 720 hours	<b>Lead Rotation Time</b> "Lead rotation time" is the amount of "Boiler Run Time" each boiler will spend as "Lead" boiler before switching to the next boiler in the network. This ensures each boiler in network has similar Cycles and Run Hours.
240 seconds	20 to 400 seconds	<b>Demand to Firing Delay</b> The "Demand to Firing Delay" specifies the length of time the Sequencer Master waits for the main fuel valve to be energized after a boiler start command. If the "Demand to Firing Delay" time is exceeded before the main fuel valve is open the next boiler is started without further delay.

### 3 Multiple Boiler Installations *(continued)*

#### Sequence Master *(continued)*

**Table 3-12: Sequence Master Menu *(continued)***

Default	Range/Choices	Parameter and Description
Boiler Piped	Boiler Piped, Primary Piped	<p><b>Indirect Water Heater</b> "Indirect Water Heater" (IWH) is set to match the indirect water heater piping location.</p> <p>Boiler Piped: Sequencer to respond to an Isolated DHW demand that has an indirect water heater piped to an individual boiler. The individual boiler goes on "Leave" from the Sequencer Master and goes to single boiler DHW Service.</p> <p>Primary Piped: The indirect water heater is piped to common piping. The Sequencer Master responds to the DHW Call for Heat. This allows one or more boilers to provide heat to the IWH.</p>
5°F	2 to 30°F	<p><b>Add Stage Error Threshold</b> The "Add Stage Error Threshold" parameter is subtracted from the setpoint temperature to determine the temperature at which a follower boiler should be turned on.</p>
7°F	2 to 30°F	<p><b>Drop Stage Error Threshold</b> The "Drop Stage Error Threshold" parameter is added to the setpoint temperature to determine the temperature at which a follower boiler should be turned off.</p>
24 hours	0 – 720 hours	<p><b>Lead Rotation Time</b> "Lead rotation time" is the amount of "Boiler Run Time" each boiler will spend as "Lead" boiler before switching to the next boiler in the network. This ensures each boiler in network has similar Cycles and Run Hours.</p>
240 seconds	20 to 400 seconds	<p><b>Demand to Firing Delay</b> The "Demand to Firing Delay" specifies the length of time the Sequencer Master waits for the main fuel valve to be energized after a boiler start command. If the "Demand to Firing Delay" time is exceeded before the main fuel valve is open the next boiler is started without further delay.</p>
Boiler Piped	Boiler Piped, Primary Piped	<p><b>Indirect Water Heater</b> "Indirect Water Heater" (IWH) is set to match the indirect water heater piping location.</p> <p>Boiler Piped: Sequencer to respond to an Isolated DHW demand that has an indirect water heater piped to an individual boiler. The individual boiler goes on "Leave" from the Sequencer Master and goes to single boiler DHW Service.</p> <p>Primary Piped: The indirect water heater is piped to common piping. The Sequencer Master responds to the DHW Call for Heat. This allows one or more boilers to provide heat to the IWH.</p>

### 3 Multiple Boiler Installations *(continued)*

#### **Sequencer Follower Menu**

Select the “Sequence Follower” menu button to access the following parameters:

**Table 3-14: Sequence Follower Menu**

Default	Range/Choices	Parameter and Description
0	1 to 8	<b>Boiler Address</b> Each boiler must be given a unique address, address determines boiler start order.

## 4 Energy Management Interface

### Communication

The control system has a full featured ability to interface with an Energy Management System (EMS). The control system allows remote control and monitoring via RS485 Modbus or through direct wiring. The EMS connection is separate from the Boiler-to-Boiler communication network and may be used simultaneously.

Modbus communication connects to the same RJ45 port that is used by the Boiler-to-Boiler communication network. Connect one end of the ethernet cable to the control and cut off the other end of the cable to access the individual conductors. The control is a 3 wire Modbus communication, labeled as Modbus 2 (MB2) in Table 4-1 below:

**Table 4-1: RJ45 Port Pin Identification**

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

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

**Table 4-2: Energy Management Interface Specifications**

Feature	Description
Com Port	Modbus 2
Type	RS485
Registers	Holding Registers (HR), U16, 40,000 numbers, U32 when noted
Bit Transfer Rate	38400 bps
Parity	None
Modbus Network	RTU Mode
Function Codes	03, 06, 16, and 17
Modbus Command Time Out	30 seconds, selectable, see "EMS Time Out Enable" parameter.
Modbus Address	Field adjustment from 1 to 255 (parameter adjustable)
Data	16 bit holding registers, 32 bit uses two consecutive 16 bit holding registers

## 4 Energy Management Interface *(continued)*

### Setup Procedure

**Table 4-3: Energy Management Menu**

Default	Range/Choices	Parameter and Description
1	1 to 255	<p><b>MB2 Monitoring Modbus Address</b>            "MB2 Zone Panel/Monitoring Modbus address" sets the Modbus port 2 address. This port may be used for the remote system monitoring connection.</p>
Disabled	Enabled, Disabled	<p><b>EMS Time Out Enable</b>            When "EMS Time Out Enable" is enabled, control switches to local mode if the EMS fails to write value every 30 seconds. When disabled EMS only needs to write a valid number after power up.</p>
Local	Local, Wired Modbus	<p><b>CH Modulation Rate Source</b>            The boiler can modulate (vary boiler heat input) based on local or remote (wired or Modbus) signals. Modulation begins after the start sequence finishes and the boiler is released to modulate. The "CH Modulation Rate Source" has the following selections:</p> <p>Local: Local setpoint and control is used to determine firing rate.</p> <p>Wired: Input wired to 4-20mA terminal is used as the firing rate % (not a valid selection when Sequencer Master is enabled).</p> <p>Modbus: Modbus signal wired to the Modbus terminals is used to determine firing rate % (not a valid selection when Sequencer Master is enabled).</p>
Local	Local, Wired Modbus	<p><b>CH Setpoint Source</b>            The setpoint may be based on local (user entered value or outdoor reset) or remote (wired or Modbus) signals. "CH Setpoint Source" has the following selections:</p> <p>Local: Uses CH Setpoint or Reset Curve provides the setpoint.</p> <p>Wired: Signal wired to the 4-20mA terminal provides the setpoint.</p> <p>Modbus: Modbus signal wired to the Modbus terminal provides the setpoint.</p>
130	50 to 180°F	<p><b>CH 4mA/0Vdc water temperature</b>            "CH 4mA/0Vdc water temperature" is the temperature used when wired (4-20mA) input is at minimum (4mA).</p>
180	120 to 190°F	<p><b>CH 20mA/10Vdc water temperature</b>            "CH 20mA/10Vdc water temperature" is the temperature used when wired (4-20mA) input is at maximum (20mA).</p>
1	0=Unconfigured 1= 4 - 20 mA 2=0-10Vdc	<p><b>4-20mAdc/0-10Vdc Input Type Selection</b>            "4-20mA/0-10Vdc Input Type Selection" allows the user to select either 4-20mA or 0-10Vdc input type. This input is used for remote Setpoint or Firing Rate control.</p>

## 4 Energy Management Interface *(continued)*

### Modbus List

**Table 4-4: Modbus Signal List**

The following is the list of available Modbus signals.

Modbus Register	Protocol Name	Description	Read/Write
<b>Enable/Disable</b>			
HR 1001	Central Heat Enable/Disable	Central Heat Enable/Disable 0 = Disable 1 = Enable This register enables single boiler Central Heat 1 demand and Sequencer Master Central Heat 1 demand. This signal does not revert to 0 if not written.	W
HR 100	Demand Source	0 Unknown 1 Standby 2 Central Heat 1 3 Central Heat 2 4 Domestic Hot Water 5 Sequencer Control 6 CH Frost Protection 7 DHW Frost Protection 8 OFF Switch 9 Warm Weather Shutdown	R
HR 9	CH1 Heat Demand	0=Off, 1=On	R
HR 10	CH2 Heat Demand	0=Off, 1=On	R
HR 3	DHW Heat Demand	0=Off, 1=On	R
<b>Temperature Sensors</b>			
HR 16	Supply Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 17	Return Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 18	DHW Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 20	Stack Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 22	Header Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 1728	Outdoor Temperature	-40°F (-40°C) to 320°F (160°C)	R
HR 1000	Modbus Remote Outdoor Temperature	*Energy Management System may send control the outdoor air temperature. Use this register to change the outdoor temperature.	W

\* Feature available with PAT-Connect Bluetooth Adaptor and App Adjust/Energy Management Menu.

## 4 Energy Management Interface *(continued)*

### Modbus List *(continued)*

**Table 4-4: Modbus Signal List (continued)**

Modbus Register	Protocol Name	Description	Read/Write
<b>Setpoints</b>			
HR 1002	CH Modbus Setpoint	<p>CH Modbus Setpoint*</p> <p>This setpoint is used for local Central Heat 1 setpoint or Sequencer Master setpoint.</p> <p>Valid range 60°F (16°C) to 190°F (88°C)</p> <p>Note: When "EMS Time Out Enable*" is enabled, setpoint switches to local mode if the EMS fails to write value every 30 seconds. When disabled EMS only needs to write a valid number after power up. The default setting is disabled.</p>	W
HR 14	Active Setpoint	-40°F (-40°C) to 320°F (160°C)	R
HR 15	Active Sequencer Master Setpoint	-40°F (-40°C) to 320°F (160°C)	R
HR 34	CH1 Setpoint Source	<p>0 = Unknown,            1 = Normal setpoint,            2 = Rate Based Reset setpoint,            3 = Outdoor reset Setpoint,            4 = Remote control (4-20/0-10 or Modbus),            5 = Outdoor boost</p>	R
HR 35	CH2 Setpoint Source	<p>0 = Unknown,            1 = Normal setpoint,            2 = Rate Based Reset Setpoint,            3 = Outdoor Air Reset Setpoint,            4 = Remote control (4-20/0-10 or Modbus),            5 = Outdoor Boost</p>	R
HR 36	Sequencer Master Setpoint Source	<p>0=Unknown,            1=Remote Modbus,            2=Remote 4-20/0-10,            3=DHW,            4=CH1,            5=CH1 Outdoor Air Reset            6=CH2,            7=CH2 Outdoor Air Reset</p>	R
HR 109	0-10VDC/4-20mADC input	<p>Diagnostic tool to troubleshoot / confirm input signal. Resolution 1mV or 10uA            0-20.000 Vdc (0 - 30.00mAdc)</p> <p>Signal shows remote set point or remote rate, depending on selection.</p>	R
<b>Troubleshooting</b>			
HR 29	Lockout Code	See Table 4-5	R
HR 28	Hold Code	See Table 4-5	R

\* Feature available with PAT-Connect Bluetooth Adaptor and App Adjust/Energy Management Menu.

## 4 Energy Management Interface *(continued)*

### Modbus List *(continued)*

**Table 4-4: Modbus Signal List (continued)**

Modbus Register	Protocol Name	Description	Read/Write
<b>Burner</b>			
HR 1003	CH Modbus Rate	<p>*Use this register to drive individual boiler firing rates. This register is used when firing rate control is performed by an external building automation system.</p> <p>Range 0-100 %</p> <p>Note: When "EMS Time Out Enable*" is enabled, control switches to local mode if the EMS fails to write value every 30 seconds. When disabled, EMS only needs to write a valid number after power up. The default is disabled.</p>	W
HR 103	Fan Speed Demanded	Speed of the combustion air blower in rpm	R
HR 104	Fan Speed Feedback	Speed of the combustion air blower in rpm	R
HR 101	Flame Signal	0-100%	R
HR 13	Burner Control State	0 Self Check 1 Standby 2 Waiting for Limit to close 3 Prepurge 4 Direct Burner Ignition 5 Low Fire Hold 6 Calibration 7 Rate Limit 8 Run (Modulate) 9 Postpurge 10 Pump Purge 11 Standby Delay 12 Lockout 13 Boiler Switch Off 14 Warm Weather Shutdown	R
<b>Statistics</b>			
HR 24-25	Burner Run Time Hours	Hours (U32)	R
HR 26-27	Burner Cycle Count	0-999,999 (U32)	R
HR 686-687	Pump A (System Pump) Cycles	0-999,999 (U32)	R
HR 688-689	Pump B (Boiler Pump) Cycles	0-999,999 (U32)	R
HR 690-691	Pump C (DHW Pump) Cycles	0-999,999 (U32)	R
HR 106	Pump A (System Pump) Status	0 = Off, 1 = On	R
HR 107	Pump B (Boiler Pump) Status	0 = Off, 1 = On	R
HR 108	Pump C (DHW Pump) Status	0 = Off, 1 = On	R

\* Feature available with PAT-Connect Bluetooth Adaptor and App Adjust/Energy Management Menu.

## 4 Energy Management Interface *(continued)*

### Modbus List *(continued)*

**Table 4-5: Reason for Burner Hold or Lockout**

Code	Description
01	Anti short cycle
02	Boiler Safety Limit Open
04	Supply High Limit
05	Low Boiler Water Flow
06	Stack High Limit
07	Return Temperature Higher than Supply
08	Return Sensor Fault
09	Supply Sensor Fault
10	DHW Sensor Fault
11	Flue Sensor Fault
12	Outdoor Air Sensor Fault
13	Header Sensor Fault
14	0-10/4-20 Input Warning
15	APS Defective (failed to open)
16	Low Combustion Air Flow
17	Invalid Safety Parameters
18	Invalid Application Parameters
19	Flame Signal Fault during Run
20	Flame Signal Fault during Calibration
21	Fuel Gas Fault
22	No Flame at Ignition
23	Flame Detected Out of Sequence
24	Flame Loss during Run
25	Hardware Fault
26	Calibration Fault
27	120 VAC Supply Fault
28	24 VAC Supply Fault
29	Excessive Reset Selection
30	Sequencer Fault
31	Variable Speed Pump Fault
32	Zone Panel Fault

## 5 Setup & Tuning

### Parameter Adjustment

Control operation may be tailored to suit the application by adjusting parameters. To access the app and adjust parameters no password is required:

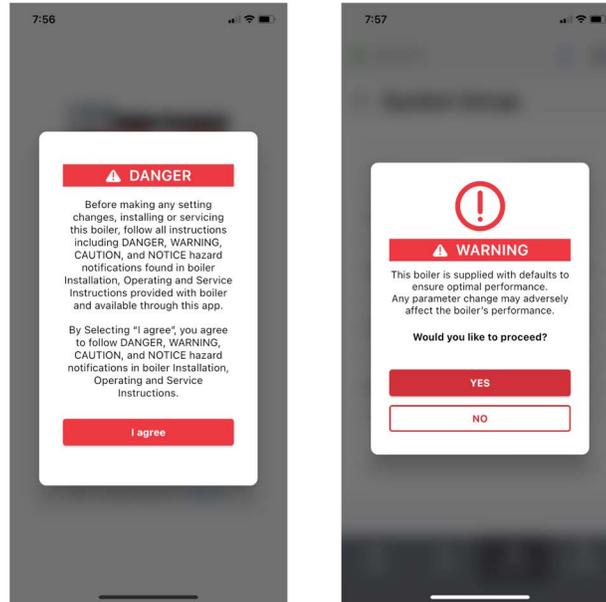


Figure 5-1: App User Messages

Editing parameters is accomplished by selecting the parameter to edit and either selecting the “plus” and “minus” buttons to the left of the value or selecting the value and using a keypad. Select “Save” button to write edited value. Select “Cancel” button to reject edited value. Leaving the parameter edit screen with the ‘Back’ button does not save the edited value. Refer to Figure 5-2 below.

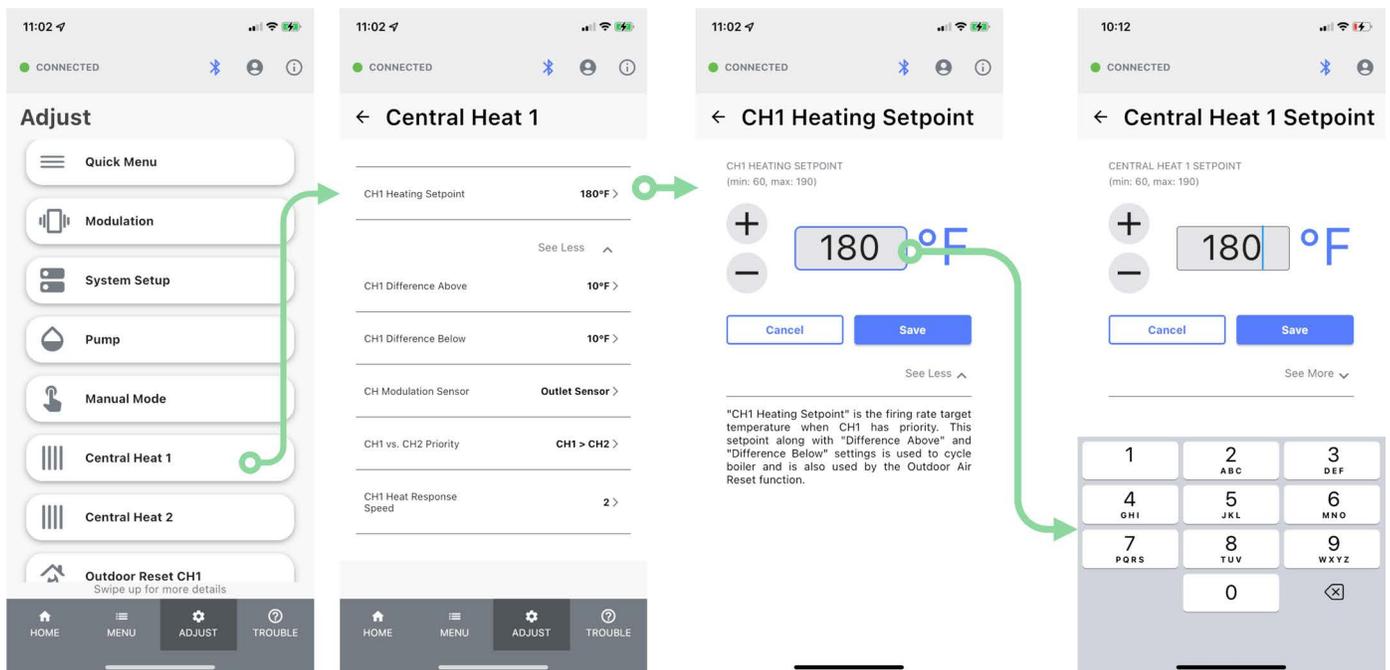
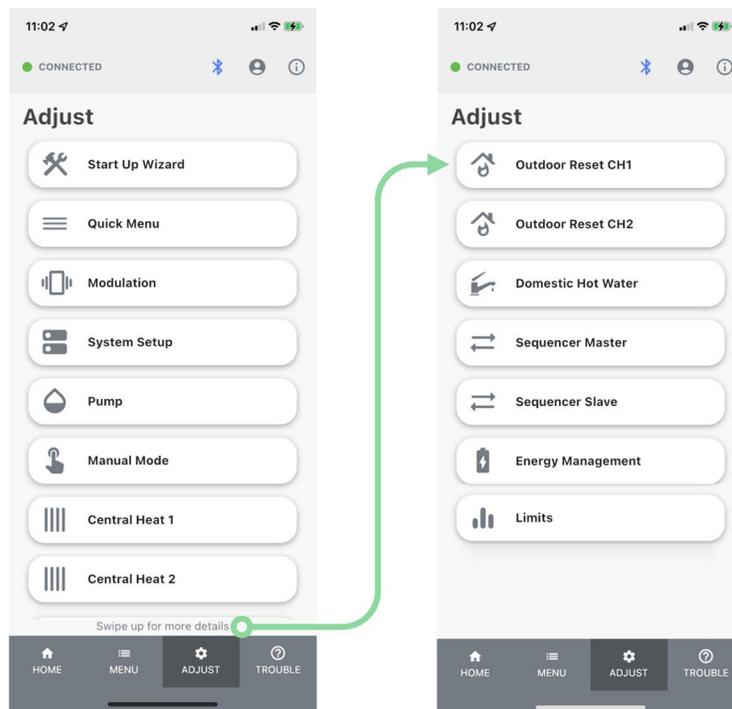


Figure 5-2: Adjust Menu

## 5 Setup & Tuning *(continued)*

### Quick Menu

The following pages describe the control's adjustable parameters. Parameters are presented in the order they appear on the app's "Adjust" screen. See Figure 5-3 for location of individual adjust menus.



**Figure 5-3: Adjust Menu**

Select the "Quick Menu" button to access the following parameters:

**Table 5-4: Quick Menu**

Default	Range/ Choices	Parameter and Description
On	On, Off	<p><b>Boiler Switch</b>            "Boiler Switch" may be used to prevent boiler starts while boiler powered. However, the boiler may still respond to frost protection.            Off: Boiler is disabled (only runs for frost protection)            On: Boiler may respond to any demand.</p>
Disabled	Enabled, Disabled	<p><b>Recirculation (Comfort) Mode</b>            Recirculation (Comfort) Mode may be used to keep DHW water warm that is immediately available at fixtures. A recirculation piping system that supplies water to fixtures and then back to boiler is required to use this feature.            Disabled: DHW heat demand is generated by DHW flow detected by the DHW Flow sensor.            Enabled: DHW heat demand is generated by DHW flow detected by the DHW Flow sensor and recirculation temperature low.</p> <p><b>NOTICE:</b> This feature requires a recirculation sensor wired to the "Header Sensor" terminals, a recirculation pump wired to the "Aux Pump" terminals and an Enable Recirculation input wired to the "Aux T' Stat" terminals. Refer to Phantom II Instruction Manual Figure 11-3 for more information about piping requirements and additional parameter adjustments.</p> <p><b>NOTICE:</b> Enable Recirculation (Comfort) Mode by adding a jumper, time of day clock or momentary pushbutton to "Aux T' Stat" terminals. Be aware, enabling recirculation with a jumper may lead to excessive boiler cycles.</p>

## 5 Setup & Tuning *(continued)*

### Quick Menu *(continued)*

**Table 5-4: Quick Menu *(continued)***

Default	Range/Choices	Parameter and Description
Combi Boiler 120°F (49°C)  Heating Boiler 170°F (76.7°C)	Combi Boiler 60°F to 150°F (16°C to 60°F)  Heating Boiler 60°F to 190°F (16°C to 88°C)	<b>DHW Setpoint</b> "DHW Setpoint" is the target temperature used by the Combi, Indirect Water Heater, and sequencer DHW system. DHW Setpoint along with "Difference Above" and "Difference Below" settings is used to cycle boiler.  <b>NOTICE:</b> DHW outlet temperature may be "Difference Above" degrees hotter than "DHW Setpoint".
180°F (83°C)	60°F to 190°F (16°C to 88°C)	<b>Central Heat 1 Setpoint</b> "Central Heat 1 Setpoint" is the target temperature and is used by the outdoor air reset function for central heat 1 priority. CH1 Heating Setpoint along with "Difference Above" and "Difference Below" settings is used to cycle boiler.
180°F (83°C)	60°F to 190°F (16°C to 88°C)	<b>Central Heat 2 Setpoint</b> "Central Heat 2 Setpoint" is the target temperature and is used by the outdoor air reset function for central heat 2 priority. CH2 Heating Setpoint along with "Difference Above" and "Difference Below" settings is used to cycle boiler.
Natural Gas	Natural Gas, LP	<b>Fuel Gas Selection</b> "Fuel Gas Selection" is used to switch the boiler fuel source between Natural Gas and LP. <b>NOTICE:</b> Gas Valve mechanical switching must be set to proper position. See Boiler Instruction Manual for further information.
0 to 2,000 feet	Refer to boiler Instruction Manual	<b>Altitude Selection</b> "Altitude Selection" is used to set boiler altitude. This setting must match actual installed boiler altitude. Settings are as follows: 0 to 2,000 feet (0 to 610 m) 2,001 to 6,000 feet (611 m to 1,828 m) 6,001 to 7,800 feet (1,829 m to 2,438 m) 7,801 to 10,100 feet (2,439 m to 3,079 m)
Off	On/Off	<b>Calibrate</b> Setting to "On" enables a manual calibration to be attempted at next boiler start. For immediate calibration cycle CH demand or cycle Boiler On/Off Switch. On Manual calibration is requested Off Manual calibration is not requested
Varies	14 to 46	<b>Gas Valve Offset</b> Gas valve offset is set automatically during calibration. When replacing an old gas valve with a new gas valve, it is possible boiler will not start unless this value is changed. For this situation, set Gas Valve Offset to 30 to allow the boiler to start.
Off	On/Off	<b>Factory Default</b> Returns all parameters back to the original factory default. <b>Must be set after a repair control is installed.</b> On Set all parameter values to Factory Default value. Off No action.

## 5 Setup & Tuning *(continued)*

### Modulation Menu

Select the “Modulation” menu button to access the following parameters:

**Table 5-5: Modulation Menu**

Default	Range/Choices	Parameter and Description
Disable	Enable, Disable	<p><b>Manual Modulation Enable</b> When “Manual Modulation Enable” is set to “Enable”, modulation is stopped and firing rate is set to the “Manual Modulation”.</p> <p><b>Note:</b> Boiler will remain in Manual modulation for 15 minutes after last Manual Modulation adjustment. After 15 minutes boiler automatically returns to Auto modulation. Enable Manual Modulation sets firing rate. Disable Modulation rate is automatic.</p>
Maximum Modulation* %	0 to Maximum Modulation*	<p><b>Manual Modulation</b> “Manual Modulation” is the boiler firing rate when “Manual Modulation Enable” is set to “Enable” and the boiler is in the run state.</p>
Maximum Modulation* %	0 to Maximum Modulation*	<p><b>Central Heat 1 Max Modulation</b> “CH1 Maximum Modulation” defines the highest modulation rate the control will go during a central heat 1 demand priority. It is also the maximum rate used for the sequencer. If the rated input of the installed radiation is less than the maximum output of the boiler, change the Central Heat Maximum Modulation (fan speed) setting to limit the boiler output accordingly."</p>
Maximum Modulation* %	0 to Maximum Modulation*	<p><b>Central Heat 2 Max Modulation</b> “CH2 Maximum Modulation” defines the highest modulation rate the control will go to during a central heat 2 demand priority. If the rated input of the installed radiation supplied by Central Heat 2 pumps is less than the maximum output of the boiler, change the Central Heat 2 Maximum Modulation (fan speed) setting to limit the boiler output accordingly.</p>
Maximum Modulation* %	0 to Maximum Modulation*	<p><b>DHW Max Modulation</b> “DHW Maximum Modulation” defines the highest modulation rate the control will go to during a Domestic Hot Water demand priority. If the rated input of the indirect water heater is less than the maximum output of the boiler, change the DHW Maximum Modulation (fan speed) setting to limit the boiler output accordingly.</p>
0%	0-30%	<p><b>Minimum Modulation Capacity</b> "Minimum Modulation" is used to raise the lowest modulation rate the control will go to during any demand priority. This parameter corrects that value up to 30%.</p>
0%	Refer to boiler Instruction Manual	<p><b>Gas Valve Ignition Capacity</b> “Gas Valve Ignition Capacity” is used to adjust the gas valve initial opening during Direct Ignition State. Value increases or decreases gas valve ignition capacity.</p>

\*Refer to boiler Instruction Manual.

## 5 Setup & Tuning *(continued)*

### Modulation Menu *(continued)*

**Table 5-5: Modulation Menu *(continued)***

Default	Range/Choices	Parameter and Description
0%	Refer to Boiler Instruction Manual.	<b>Blower Ignition Capacity</b> "Blower Ignition Capacity" is used to adjust the blower speed during Direct Ignition State. Value increases or decreases blower ignition capacity.
Off	On/Off	<b>Calibration Recovery</b> "Calibration Recovery" is used following E20.3, "Calibration too different from previous result and combustion condition changed too much since last calibration." Perform "Calibration Recovery" to prevent E20.3. Steps to complete Calibration Recovery: 1. Select Calibration Recovery "On", 2. Provide Central Heat Demand, (If boiler is already running, turn Boiler Switch "Off" then "On") 3. Allow boiler to start and run, 4. Observe Calibration Status progress from "Wait" to "Complete", 5. Remove Central Heat Demand.
0 seconds (combi)	0 to 3,600 seconds	<b>DHW Low Fire Hold Time</b> "DHW Low Fire Hold Time" is the amount of time the control will wait at low fire modulation rate before being released to modulate. After ignition and flame stabilization periods the firing rate is held at low fire for "DHW Low Fire Hold Time". This delay allows heat to travel out to the system and provide system feedback prior to the control modulating firing rate.
20%	10 to 100%	<b>DHW Low Fire Hold Rate</b> "DHW Low Fire Hold Rate" is the modulation rate the boiler will fire at for the duration of the "DHW Low Fire Hold Time" before being released to modulate.
30 seconds	0 to 3,600 seconds	<b>Central Heat 1 Low Fire Hold Time</b> "CH1 Low Fire Hold Time" (CH1 = Central Heat demand sensed at T*Stat terminals) is the amount of time the control will wait at low fire modulation rate before being released to modulate. After ignition and flame stabilization periods the firing rate is held at low fire for "CH1 Low Fire Hold Time". This delay allows heat to travel out to the system and provide system feedback prior to the control modulating firing rate and helps prevent short cycling.
20%	10 to 100%	<b>Central Heat 1 Low Fire Hold Rate</b> "CH1 Low Fire Hold Rate" is the modulation rate the boiler will fire at for the duration of the "CH1 Low Fire Hold Time" before being released to modulate.
30 seconds	0 to 3,600 seconds	<b>Central Heat 2 Low Fire Hold Time</b> "CH2 Low Fire Hold Time" (CH2 = Central Heat demand sensed at Aux T*Stat terminals) is the amount of time the control will wait at low fire modulation rate before being released to modulate. After ignition and flame stabilization periods the firing rate is held at low fire for "CH2 Low Fire Hold Time". This delay allows heat to travel out to the system and provide system feedback prior to the control modulating firing rate and helps prevent short cycling.
20%	10 to 100%	<b>Central Heat 2 Low Fire Hold Rate</b> "CH2 Low Fire Hold Rate" is the modulation rate the boiler will fire at for the duration of the "CH2 Low Fire Hold Time" before being released to modulate.

\*Refer to boiler Instruction Manual.

## 5 Setup & Tuning *(continued)*

### System Setup Menu

Select the "System Setup" menu button to access the following parameters:

**Table 5-6: System Menu**

Default	Range/Choices	Parameter and Description
F (Fahrenheit)	F (Fahrenheit) C (Celsius)	<b>Temperature Units</b> "Temperature Units" parameter determines whether temperature is represented in units of Fahrenheit or Celsius degrees.
60 minutes	0-120 minutes	<b>DHW Priority Time</b> When "DHW Priority Time" is greater than zero and Domestic Hot Water (DHW) heat demand is present the DHW demand will take "Priority" over central heating demands for the length of "Priority Time". After priority time the system & boiler pumps are free to respond to pump demands. This provides priority protection over excessively long DHW demands.
130°F	50 to 180°F	<b>Central Heat 1 Low Boiler Water Temp</b> Outdoor Air Reset: "CH1 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when outdoor air temperature is greater than the "CH1 High Outdoor Temperature". If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.  Sensorless Reset: CH1 Setpoint parameter sets high limit for Reset setpoint and is the active setpoint when boiler load is high. Water temperature setpoint between low and high load is proportional to boiler load. "CH1 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when boiler heat loss is low. If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.
130°F	50 to 180°F	<b>Central Heat 2 Low Boiler Water Temp</b> Outdoor Air Reset: "CH2 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when outdoor air temperature is greater than the "CH2 High Outdoor Temperature". If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.  Sensorless Reset: CH2 Setpoint parameter sets high limit for Reset setpoint and is the active setpoint when boiler load is high. Water temperature setpoint between low and high load is proportional to boiler load. "CH2 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when boiler heat loss is low. If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.

## 5 Setup & Tuning *(continued)*

### System Menu *(continued)*

Table 5-6: System Menu *(continued)*

Default	Range/Choices	Parameter and Description	
Combi: Central Heat 2 Heating: DHW IWH Demand	Recirculation, DHW IWH Demand, Central Heat 2	<b>Auxiliary Thermostat Input Select</b> The "Auxiliary Thermostat Input Select" parameter allows Aux T'Stat terminal function selections; Recirculation; DHW IWH demand; or Central Heat 2:	
		Recirculation:	Recirculation enable input. When Recirc (Comfort) Mode is enabled, "Aux Pump" output is energized to run a recirculation pump when this input is "On". This input may be (a) jumpered allowing recirculation pump to run at all times, (b) wired to a time of day clock, or (c) wired to a momentary push button. Note: recirculation pump continues to run for 15 minutes after this input is removed.
		DHW IWH Demand:	Indirect Water Heater (IHW) DHW heat demand may be wired to Aux T'Stat terminal (not for combi boilers).
		Central Heat 2:	Central Heat 2 (Auxiliary Heat) demand contact may be wired to Aux T'Stat terminal.
Wired	Wired, Modbus	<b>Outdoor temperature source</b> The Outdoor Temperature sensor is used for Outdoor Air Reset, CH Frost Protection and Warm Weather Shutdown functions. The "Outdoor Temperature Source" parameter sets the source for this temperature:	
		Wired	Outdoor Sensor thermistor is installed directly to the terminals.
		Modbus	Outdoor temperature is retrieved through the Modbus connection from another boiler or Energy Management System.
Enable	Disable, Enable	<b>CH Frost Protection Enable</b> "CH Frost Protection Enable" helps provide a level of protection from boiler water freezing by starting pumps and/or boiler based on outside air and boiler water temperatures.	
		Disable:	Frost Protection is not used.
		Enable:	Boiler and system circulators start and boiler fires based on frost protection setpoint, outside air (if sensor is installed), supply and return temperatures.
		Overview: - Pump Start Temp: Outside Air < Frost Protection Setpoint or Supply Water < 45°F - Pump Stop Temp: Outside Air > Frost Protection Setpoint + 4°F or Supply Water > 50°F - Boiler Start Temp: Supply Water < 38°F - Boiler Stop Temp: Supply Water > 50°F and Return > 41°F <b>NOTICE:</b> Condensing boiler condensate or condensate drain is not protected by this feature.	
Enable	Disable, Enable	<b>DHW Frost Protection Enable</b> "DHW Frost Protection Enable" helps provide a level of protection from Domestic Water freezing by starting boiler based on DHW water temperatures. DHW frost protection function is available only in COMBI boilers.	
		Disable:	Frost Protection not used.
		Enable:	Boiler starts based on DHW temperature.
		Overview:	<ul style="list-style-type: none"> <li>Boiler Start Temp: DHW Water &lt; 38°F</li> <li>Boiler Stop Temp: DHW Water &gt; 50°F</li> </ul>

## 5 Setup & Tuning *(continued)*

### System Menu *(continued)*

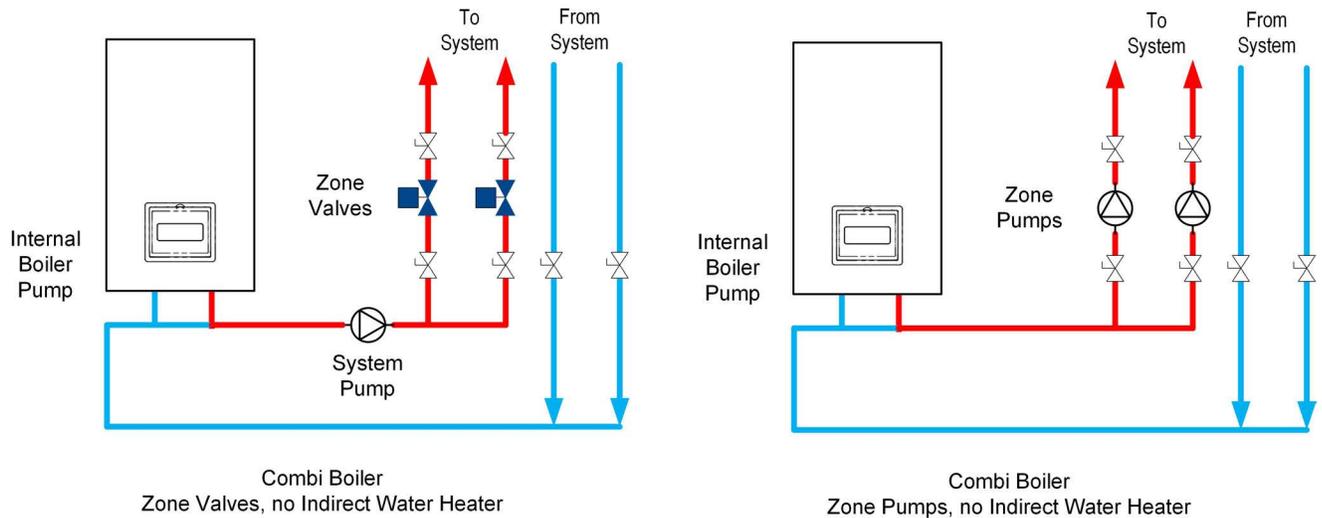
**NOTICE:** FROST PROTECTION The control helps provide freeze protection for boiler water. Boiler flue gas condensate drain is not protected from freezing. Frost protection only controls system and boiler pumps. Individual zones are not protected. It is required that boiler be installed in a location that is not exposed to freezing temperatures. Outdoor air interlocks included when outdoor air sensor is wired to low voltage terminal block.

**Table 5-6: System Menu *(continued)***

Default	Range/Choices	Parameter and Description
Enable	Disable, Enable	<p><b>Sequencer CH Frost Protection</b> When “Sequencer CH Frost Protection” is enabled and any boiler has an active CH frost protection demand, and no higher priority demand is present, the sequencer active service is set to frost protection and pump demand is established according to the selected pump configurations.</p>
1 minute	0 to 10 minutes	<p><b>CH Frost Protection Overrun Time</b> “CH Frost Protection Overrun Time” is the time boiler pump will continue to run after CH frost protection pump demand ends.</p>
1 minute	0 to 10 minutes	<p><b>DHW Frost Protection Overrun Time</b> “DHW Frost Protection Overrun Time” is the time the boiler pump will continue to run and diverting valve stays in position after DHW frost protection demand ends</p>
32°F	-50 to 120°F	<p><b>Outdoor Frost Protection Setpoint</b> “Outdoor Frost Protection Setpoint” is the Outdoor Temperature at which pumps are started for Frost Protection</p>
Disable	Disable, Enable	<p><b>Warm Weather Shutdown Enable</b> “Warm Weather Shutdown Enable” allows heating demands to be disabled during warm weather.</p>
		<p>Disable: Warm Weather Shutdown (WWSD) is not used.</p>
		<p>Enable: Central heat demands are prevented if the outside temperature is greater than the WWSD setpoint. WWSD is initiated as soon as outside air temperature is above WWSD Setpoint. The control does not require thermostat to be satisfied before entering WWSD.</p>
<p><b>NOTICE:</b> Even if boiler is in WWSD, boiler will still start in response to a Domestic Hot Water call for heat.</p>		
70°F	50 to 120°F	<p><b>Warm Weather Shutdown Setpoint</b> When "Warm Weather Shutdown" (WWSD) is “Enabled” and the outside air temp is higher than the WWSD Setpoint, boiler is shutdown except for Domestic Hot Water calls for heat.</p>
3 minutes	0 to 10 minutes	<p><b>Anti-Short Cycle Time</b> "Anti-Short Cycle Time" provides a minimum delay time before the next burner cycle during a continuous heating demand (Heat T'Stat or Aux T'Stat continuously closed). If a heat demand occurs and a boiler cycles due to temperature over setpoint plus difference above, the burner will be held off until “Anti-Short Cycle Time” has elapsed.</p> <p>DHW Demand is serviced immediately, without any delay.</p>

## 5 Setup & Tuning *(continued)*

### Pump Menu

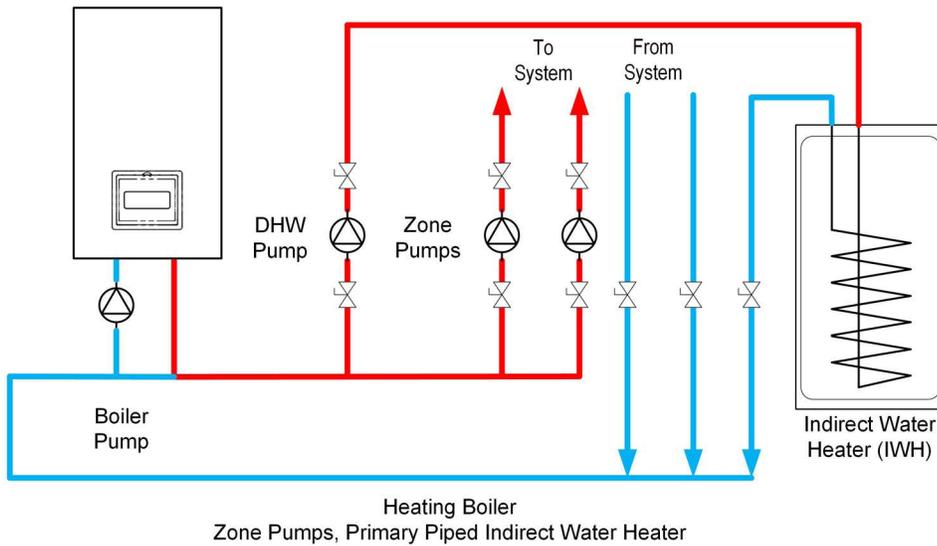


**Figure 5-7: Example Pump Arrangements, Combi Boiler, no Indirect Water Heater**

Explanation	This piping arrangement only services central heat. When there is any demand both boiler and system pumps turn on. Only boiler pump is started for frost protection.	
Zone Pump Parameter Selections:	System Pump Options (Pump A): Boiler Pump Options (Pump B): Aux Pump Options (Pump C):	"Zone 1 Pump, CH1 Only, Optional Priority" "Boiler Pump, Any Demand" "Zone 2 Pump, Auxiliary Heat Only, Optional Priority"
Zone Valve Parameter Selections:	System Pump Options (Pump A): Boiler Pump Options (Pump B): Aux Pump Options (Pump C):	"System Pump Any Demand" "Boiler Pump, Any Demand" "Pump Not Used"

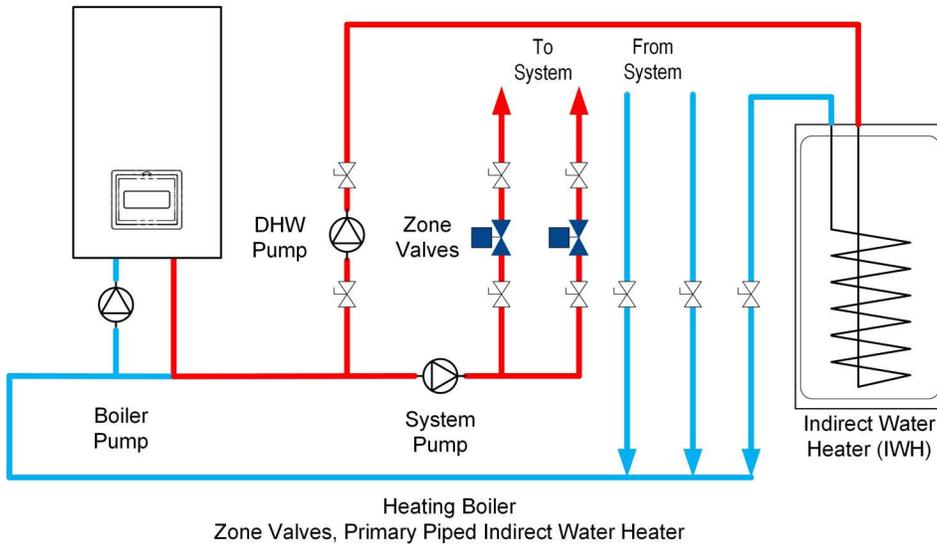
## 5 Setup & Tuning *(continued)*

### Pump Menu *(continued)*



#### **WARNING**

Read all Indirect Water Heater (IWH) instructions contained in component manufacturer's manuals before installing, starting up, operating, maintaining or servicing.

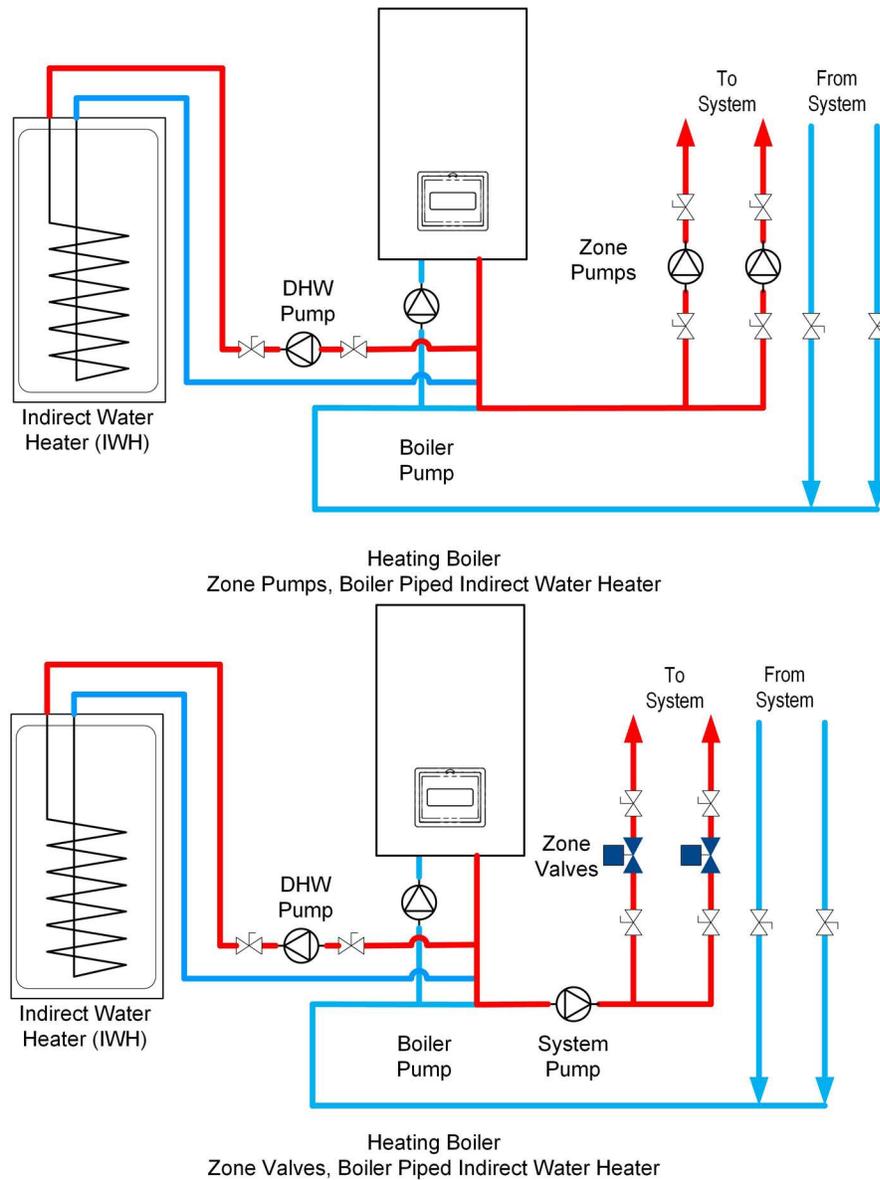


**Figure 5-8: Example Pump Arrangements, Heating boiler, Primary Piped Indirect Water Heater (IWH)**

Explanation	This piping arrangement permits the system pump to run or not run when there is a domestic hot water call for heat. Domestic hot water priority is optional. It is permissible for the domestic and system pumps to run at the same time. The boiler pump must run for every call for heat.	
Zone Pump Parameter Selections:	System Pump Options (Pump A): Boiler Pump Options (Pump B): Aux Pump Options (Pump C):	"System Pump, Central Heat, Optional Priority" "Boiler Pump, Any Demand" "DHW Primary Loop Piped IWH"
Zone Valve Parameter Selections:	System Pump Options (Pump A): Boiler Pump Options (Pump B): Aux Pump Options (Pump C):	"System Pump, Central Heat, Optional Priority" "Boiler Pump, Any Demand" "DHW Primary Loop Piped IWH"

## 5 Setup & Tuning *(continued)*

### Pump Menu *(continued)*

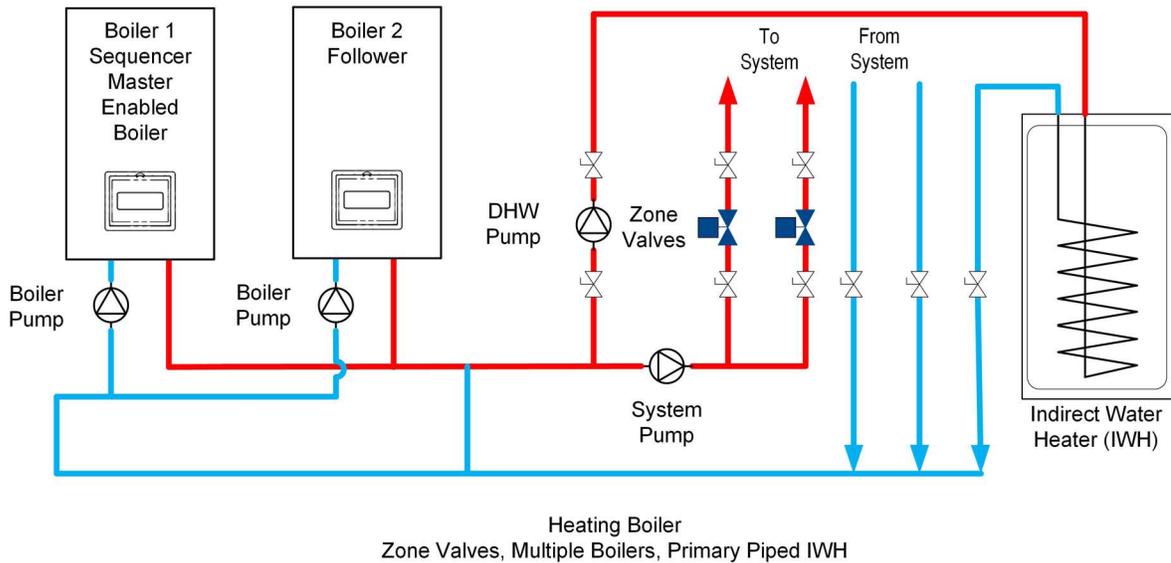


**Figure 5-9: Example Pump Arrangements, Heating Boiler, Boiler Piped IWH**

Explanation	Make sure indirect water heater and DHW pump are sized to maintain flow though boiler within limits. This piping arrangement does not allow both boiler and domestic hot water pumps to run at the same time. When call for Domestic Hot Water is received the DHW pump is turned on and the boiler pump is turned off. This piping arrangement permits the system pump to run or not run when there is a domestic hot water call for heat. Domestic hot water priority is required.
Zone Pump Parameter Selections:	System Pump Options (Pump A): "System Pump, Central Heat, Optional Priority" Boiler Pump Options (Pump B): "Boiler Pump Any Demand" Aux Pump Options (Pump C): "DHW Primary Loop Piped IWH"
Zone Valve Parameter Selections:	System Pump Options (Pump A): "System Pump, Central Heat, Optional Priority" Boiler Pump Options (Pump B): "Boiler Pump Any Demand" Aux Pump Options (Pump C): "DHW Primary Loop Piped IWH"

## 5 Setup & Tuning *(continued)*

### Pump Menu (continued)



**Figure 5-10: Example Pump Arrangements, Multiple Boilers Primary Piped IWH**

Explanation	This piping arrangement permits the system pump to run or not run when there is a domestic hot water call for heat. Domestic hot water priority is optional. It is permissible for the domestic and system pumps to run at the same time. The boiler pump must run for every call for heat.	
Boiler 1 Sequencer Master Parameter Selections:	Sequence Master Enable:	"Sequence Master"
	Indirect Water Heater:	"Primary Piped"
Boiler 1 Pump Parameter Selections:	System Pump Options (Pump A):	"System Pump, Central Heat, Optional Priority"
	Boiler Pump Options (Pump B):	"Boiler Pump, Any Demand"
	Aux Pump Options (Pump C):	"DHW Primary Loop Piped IWH"
Boiler 2 Pump Parameter Selections:	System Pump Options (Pump A):	"Pump Not Used"
	Boiler Pump Options (Pump B):	"Boiler Pump, Any Demand"
	Aux Pump Options (Pump C):	"Pump Not Used"

## 5 Setup & Tuning *(continued)*

### Pump Menu *(continued)*

Table 5-11: Pump Menu

Default	Range/Choices	Parameter and Description
System Pump Central Heat Optional Priority	Pump Not Used,	<b>System Pump Output Select</b> The System Pump (Pump A) is wired to 120 VAC terminals labeled 'System Pump'. "System Pump Options (Pump A)" may be set to energize the output as follows:
	System Pump Any Demand,	Pump Not Used: Pump output is not used.
	System Pump Central Heat, Optional Priority,	System Pump Any Demand: Pump Runs during any call-for-heat.
	Zone 1 Pump, CH1 Only, Optional Priority	System Pump Central Heat, Optional Priority: Pump Runs during central heat call for heat. Pump does not start for a DHW call-for-heat and will be forced off if there is a DHW call-for-heat and Domestic Hot Water Priority is active.
Boiler Pump Any Demand	Zone 1 Pump, CH1 Only, Optional Priority	Zone 1 Pump, CH1 Only, Optional Priority: Pump runs during central heat 1 (Heat T'stat) demand call-for-heat. Pump does not run for Auxiliary Heat or DHW call-for-heat. The pump will be forced off when DHW priority is active. This option allows the system pump output to be used as a zone pump.
	Pump Not Used,	<b>Boiler Pump Output Select</b> The Boiler Pump (Pump B) is wired to 120 VAC terminals labeled 'Boiler Pump'. "Boiler Pump Options (Pump B)" may be set to energize the output as follows:
	Boiler Pump Any Demand,	Pump Not Used: Pump output is not used.
	Boiler Pump Header Sensor Demand,	Boiler Pump Any Demand: Pump Runs during any call for heat.
Combi: Zone 2 Pump, Auxiliary Heat Only, Optional Priority  Heating: DHW Primary Loop Piped IWH	Boiler Pump Central Heat, Off for Domestic	Boiler Pump Header Sensor Demand: Pump runs when boiler is firing and when there is DHW demand. Selected when Header Sensor is selected as modulation sensor and boiler is a stand-alone boiler.
	Pump Not Used,	Boiler Pump Central Heat, Off for Domestic: Pump runs during central heat, auxiliary heat and frost protection call for heat and will be forced off if there is a DHW call for heat and DHW priority is active.
	Recirculation Pump,	<b>Auxiliary Pump Output Select</b> The Auxiliary Pump (Pump C) is wired to 120 VAC terminals labeled 'Aux Pump'. "Aux Pump Options (Pump C)" may be set to energize the output as follows:
	DHW Primary Loop Piped IWH,	Pump Not Used: Pump output is not used.
	DHW Boiler Piped IWH,	Recirculation Pump: Pump runs when Recirc (Comfort) Mode selected, recirculation sensor installed and Aux T'stat enabled (jumper installed, optional Recirculation Timer On or after optional Point of use button pressed.) Note: Recirculation pump remains running 15 minutes after Aux T'stat input removed.
	Zone 2 Pump, Auxiliary Heat Only, Optional Priority	DHW Primary Loop Piped IWH: Pump runs during domestic hot water call for heat. Domestic hot water priority enabled or disabled does not affect pump operation. (Not for Combi boilers.)
	DHW Boiler Piped IWH: Pump runs during DHW demand. Pump is forced off during central heat demands when 1) DHW priority is disabled or 2) DHW priority is enabled and DHW demand has remained on for longer than priority time. (Not for Combi boilers.)	
	Zone 2 Pump, Auxiliary Heat Only, Optional Priority: Pump runs during Auxiliary Heat call for heat. Pump does not start for Central Heat 1 or DHW call for heat. The pump will be forced off when DHW priority is active. This allows the DHW pump output to be used as a zone pump.	

## 5 Setup & Tuning *(continued)*

### Pump Menu (continued)

**Table 5-11: Pump Menu (continued)**

Default	Range/Choices	Parameter and Description
0 seconds	0 to 255 Seconds	<b>System Pump (Pump A) Over run time</b> “Pump A Over run time” is duration Pump A output is energized after demand is satisfied. Used to dissipate heat within the system.
2 seconds	0 to 255 Seconds	<b>Boiler Pump (Pump B) Over run time</b> “Pump B Over run time” is duration Pump B is energized after demand is satisfied. Used to dissipate heat within the system.
Combi: 0 seconds  Heating: 2 seconds	0 to 255 Seconds	<b>Auxiliary Pump (Pump C) Over run time</b> “Pump C Over run time” is duration Pump C is energized after demand is satisfied. Used to dissipate heat within the system.

### Manual Mode Menu

Select the “Manual Mode” menu button to access the following parameters:

**Table 5-12: Manual Mode Menu**

Default	Range/Choices	Parameter and Description
Disable	Disable, Enable	<b>Manual Modulation Enable</b> When “Manual Modulation Enable” is set to “Enable” modulation is stopped and firing rate is set to the “Manual Modulation”.
Maximum Modulation*	0 to Maximum Modulation*	<b>Manual Modulation</b> “Manual Modulation” is the boiler firing rate when “Manual Modulation Enable” is set to “Enabled” and the boiler is in the Run State.
Auto	Manual, Auto	<b>Sequencer Manual Auto</b> (visible when Sequencer Master Enabled) When “Sequencer Manual Auto” is set to “Manual” sequencer modulation is stopped and boiler demand firing rate is set to the “Sequencer Manual Rate”.
100%	0 to 100%	<b>Sequencer Manual Rate</b> (visible when Sequencer Master Enabled) “Sequencer Manual Rate” sets the boiler demand to the networked boilers when “Sequencer Manual Auto” is set to “Manual” and there is at least one boiler released to modulate.

\* Refer to boiler Instruction Manual.

## 5 Setup & Tuning *(continued)*

### Central Heat 1 Menu

Select the "Central Heat 1" menu button to access the following parameters:

**Table 5-13: Central Heat 1 Menu**

Default	Range/Choices	Parameter and Description
180°F	60 to 190°F	<b>CH1 Heating Setpoint</b> "CH1 Heating Setpoint" is the target temperature of the Modulation Sensor when CH1 has priority. This setpoint along with "Difference Above" and "Difference Below" settings is used to cycle boiler and also used by the Outdoor Air Reset function.
10°F	2 to 30°F	<b>CH1 Difference Above</b> "CH1 Difference Above" is the number of degrees the temperature can increase above the setpoint before the boiler is shutdown.
10°F	2 to 30°F	<b>CH1 Difference Below</b> "CH1 Difference Below" is the number of degrees the temperature must decrease below the setpoint before the boiler is started.
Outlet Sensor	Outlet Sensor, Header Sensor	<b>CH Modulation Sensor</b> Heat Demand may respond to the boiler's Outlet Temperature or Header Temperature sensors. When Header Sensor is selected the boiler is fired in response to the sensor wired to Header Sensor terminals.
CH1 > CH2	CH1 > CH2, CH1 < CH2	<b>CH1 vs. CH2 Priority</b> "CH1 vs. CH2 Priority" determines whether Central Heat 1 or Central Heat 2 has priority while both demands are present. When it is CH1 > CH2, Central Heat 1 has priority over Central Heat 2 and responds to CH1 setpoint and difference above/below settings. When it is CH1 < CH2, Central Heat 2 has priority over Central Heat 1 and responds to CH2 setpoint.
2	1, 2, 3	<b>CH1 Heat Response Speed</b> "CH1 Heat Response Speed" adjusts the CH1 temperature controller Proportional, Integral and Derivative ("CH1 P Gain", "CH1 I Gain" and "CH1 D Gain") values all at once. Higher values cause a larger firing rate change for each degree of temperature change. If set too high, the temperature "overshoots" required setpoint and may cause the boiler to cycle off unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the temperature response will be sluggish and temperature will wander away from setpoint.

## 5 Setup & Tuning *(continued)*

### Central Heat 2 Menu

Select the "Central Heat 2" menu button to access the following parameters:

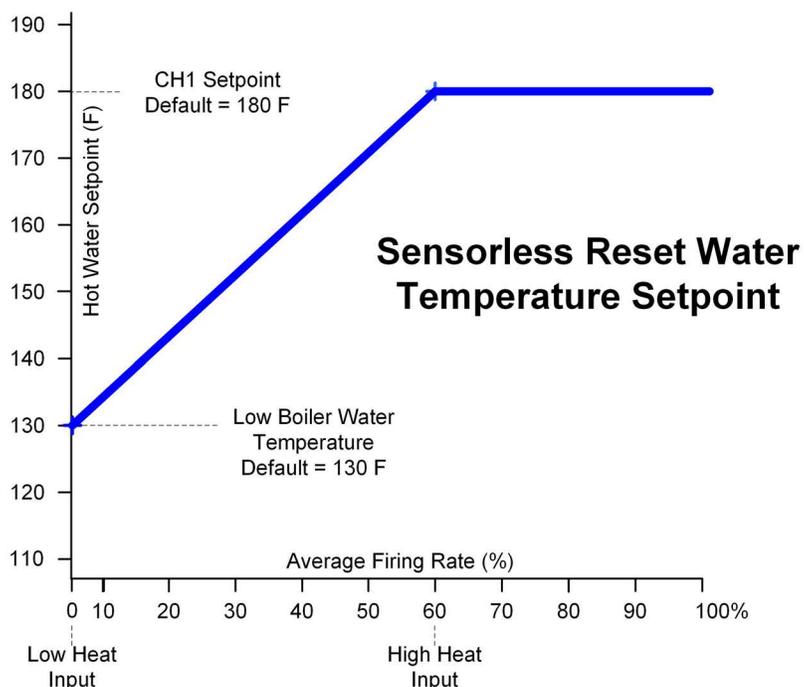
**Table 5-14: Central Heat 2 Menu**

Default	Range/Choices	Parameter and Description
180°F	60 to 190°F	<b>CH2 Heating Setpoint</b> "CH2 Heating Setpoint" is the target temperature of the Modulation Sensor when CH2 has priority. This setpoint along with "Difference Above" and "Difference Below" settings is used to cycle boiler and also used by the Outdoor Air Reset function.
10°F	2 to 30°F	<b>CH2 Difference Above</b> "CH2 Difference Above" is the number of degrees the temperature can increase above the setpoint before the boiler is shutdown.
10°F	2 to 30°F	<b>CH2 Difference Below</b> "CH2 Difference Below" is the number of degrees the temperature must decrease below the setpoint before the boiler is started.
Outlet Sensor	Outlet Sensor, Header Sensor	<b>CH2 Modulation Sensor</b> "Heat Demand may respond to the boiler's Outlet Temperature or Header Temperature sensors. When Header Sensor is selected the boiler is fired in response to the sensor wired to Header Sensor terminals.
CH1 > CH2	CH1 > CH2, CH1 < CH2	<b>CH1 vs. CH2 Priority</b> "CH1 vs. CH2 Priority" determines whether Central Heat 1 or Central Heat 2 has priority while both demands are present. When it is CH1 > CH2, Central Heat 1 has priority over Central Heat 2 and responds to CH1 setpoint and difference above/below settings. When it is CH1 < CH2, Central Heat 2 has priority over Central Heat 1 and responds to CH2 setpoint.
2	1, 2, 3	<b>CH2 Heat Response Speed</b> "CH2 Heat Response Speed" adjusts the CH2 temperature controller Proportional, Integral and Derivative ("CH2 P Gain", "CH2 I Gain" and "CH2 D Gain") values all at once. Higher values cause a larger firing rate change for each degree of temperature change. If set too high, the temperature "overshoots" required setpoint and may cause the boiler to cycle off unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the temperature response will be sluggish and temperature will wander away from setpoint.

## 5 Setup & Tuning *(continued)*

### Outdoor Reset Central Heat 1

Heating Element Type	CH Setpoint	Low Boiler Water Temp
 Radiators	140°F – 160°F (60°C – 71°C)	140°F (60°C)
 Convection Baseboard Fin tube Convective	160°F – 190°F (71°C – 88°C)	140°F (60°C)
 Radiant Baseboard	130°F – 160°F (54°C – 71°C)	130°F (54°C)
 Fan Coil	180°F – 190°F (82°C – 87°C)	140°F (60°C)
 In Slab Radiant High Mass Radiant	100°F – 140°F (38°C – 60°C)	90°F (32°C)
 Staple-up Radiant Low Mass	130°F – 160°F (54°C – 71°C)	90°F (32°C)



**Figure 5-15: Sensorless Reset Water Temperature CH1 Setpoint (Typical for CH2)**

Select the “Central Heat 1” menu button to access the following parameters:

**Table 5-16: Outdoor Reset Central Heat 1 Menu**

Default	Range/Choices	Parameter and Description
Sensorless Reset	Disabled, Sensorless Reset, Outdoor Air Reset	<b>CH1 Outdoor Reset Enable</b> When “CH1 Outdoor Reset Enable” is either ‘Sensorless Reset’ or ‘Outdoor Air Reset’, CH1 setpoint is automatically adjusted as the outdoor temperature or heating load changes.
		Disabled: Do Not automatically adjust CH1 Heating Setpoint
		Sensorless Reset: Sensorless Reset Adjust the active setpoint based on total boiler heat output per unit of time. As boiler average heat output increases the home heat demand is increased and it can be inferred that outside air is colder and water temperature needs to increase. Similarly, as boiler average heat output decreases it can be inferred that outside air temperature has increased allowing water temperature to be decreased.
Outdoor Air Reset: Adjust the active setpoint based on the outdoor temperature, Low Outdoor Temp, High Outdoor Temp, Low Boiler Water Temp, and Central Heat Setpoint parameters. This method requires an outdoor air sensor installed.		
0°F	-50 to 120°F	<b>CH1 Low Outdoor Temp</b> (visible when Outdoor Air Reset selected) When outdoor air temperature is equal to the “CH1 Low Outdoor Temp” parameter the active setpoint equals the “CH1 Heating Setpoint”. Low Outdoor Temp is the outdoor temperature used in the heat loss calculation. It is typically set to the coldest outdoor temperature.

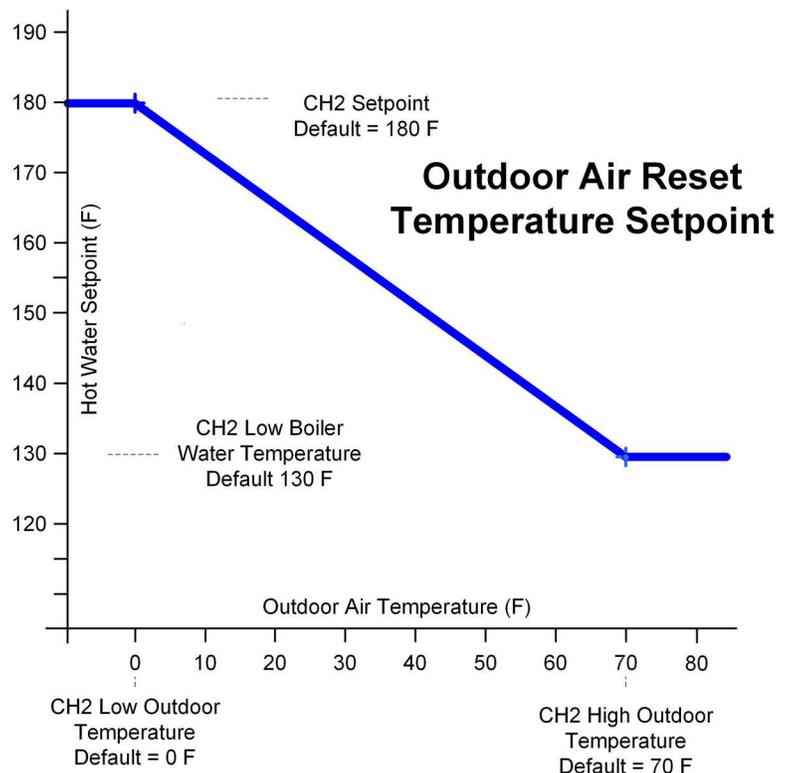
## 5 Setup & Tuning *(continued)*

**Table 5-16: Outdoor Reset Central Heat 1 Menu (continued)**

Default	Range/Choices	Parameter and Description
70°F	-50 to 120°F	<b>CH1 High Outdoor Temp</b> (visible when Outdoor Air Reset selected) When outdoor air temperature is equal to the "CH1 High Outdoor Temp" parameter the active setpoint equals the "CH1 Low Boiler Water Temp". High Outdoor Temp parameter is typically set to the desired building temperature.
130°F	50 to 180°F	<b>Central Heat 1 Low Boiler Water Temp</b> Outdoor Air Reset: "CH1 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when outdoor air temperature is greater than the "CH1 High Outdoor Temperature". If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.  Sensorless Reset: CH1 Setpoint parameter sets high limit for Reset setpoint and is the active setpoint when boiler load is high. Water temperature setpoint between low and high load is proportional to boiler load. "CH1 Low Boiler Water Temp" parameter sets low limit for Reset setpoint and is the active setpoint when boiler heat loss is low. If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.
20 minutes	0 to 120 minutes	<b>Boost Time</b> When "Boost Time" is set greater than zero and the active setpoint has been decreased by outdoor reset settings, the active setpoint is increased when the space heat demand is not satisfied for longer than the "Boost Time" setting. This parameter is used for both CH1 and CH2 demand priorities and stand alone and sequencer setpoints.

### Outdoor Reset Central Heat 2

Heating Element Type	CH Setpoint	Low Boiler Water Temp
 Radiators	140°F – 160°F (60°C – 71°C)	140°F (60°C)
 Convection Baseboard Fin tube Convective	160°F – 190°F (71°C – 88°C)	140°F (60°C)
 Radiant Baseboard	130°F – 160°F (54°C – 71°C)	130°F (54°C)
 Fan Coil	180°F – 190°F (82°C – 87°C)	140°F (60°C)
 In Slab Radiant High Mass Radiant	100°F – 140°F (38°C – 60°C)	90°F (32°C)
 Staple-up Radiant Low Mass	130°F – 160°F (54°C – 71°C)	90°F (32°C)



**Figure 5-17: Outdoor Air Reset Water Temperature CH2 Setpoint (Typical for CH1)**

## 5 Setup & Tuning *(continued)*

### Outdoor Reset Central Heat 2 (continued)

Select the “Outdoor Reset Central Heat 2” menu button to access the following parameters:

**Table 5-18: Outdoor Reset Central Heat 2 Menu**

Default	Range/Choices	Parameter and Description	
Sensorless Reset	Disabled, Sensorless Reset, Outdoor Air Reset	<b>CH2 Outdoor Reset Enable</b> When “CH2 Outdoor Reset Enable” is either ‘Sensorless Reset’ or ‘Outdoor Air Reset’, CH2 setpoint is automatically adjusted as the outdoor temperature or heating load changes.	
		Disable:	Do Not automatically adjust CH2 Heating Setpoint.
		Sensorless Reset:	Adjust the active setpoint based on total boiler heat output per unit of time. As boiler average heat output increases the home heat demand is increased and it can be inferred that outside air is colder and water temperature needs to increase. Similarly, as boiler average heat output decreases it can be inferred that outside air temperature has increased allowing water temperature to be decreased.
		Outdoor Air Reset:	Adjust the active setpoint based on the outdoor temperature, Low Outdoor Temp, High Outdoor Temp, Low Boiler Water Temp, and Central Heat Setpoint parameters. This method requires an outdoor air sensor installed.
0°F	-50 to 120°F	<b>CH2 Low Outdoor Temp</b> (only visible when “Outdoor Air Reset” selected) When outdoor air temperature is equal to the “CH2 Low Outdoor Temp” parameter the active setpoint equals the “CH2 Heating Setpoint”. Low Outdoor Temp is the outdoor temperature used in the heat loss calculation. It is typically set to the coldest outdoor temperature.	
70°F	-50 to 120°F	<b>CH2 High Outdoor Temp</b> (only visible when “Outdoor Air Reset” selected) When outdoor air temperature is equal to the “CH2 High Outdoor Temp” parameter the active setpoint equals the “CH2 Low Boiler Water Temp”. High Outdoor Temp parameter is typically set to the desired building temperature.	
130°F	50 to 180°F	<p><b>Central Heat 2 Low Boiler Water Temp</b></p> <p>Outdoor Air Reset: “CH2 Low Boiler Water Temp” parameter sets low limit for Reset setpoint and is the active setpoint when outdoor air temperature is greater than the “CH2 High Outdoor Temperature”. If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.</p> <p>Sensorless Reset: CH2 Setpoint parameter sets high limit for Reset setpoint and is the active setpoint when boiler load is high. Water temperature setpoint between low and high load is proportional to boiler load. “CH2 Low Boiler Water Temp” parameter sets low limit for Reset setpoint and is the active setpoint when boiler heat loss is low. If the occupied space feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.</p>	

## 5 Setup & Tuning *(continued)*

### Domestic Hot Water

Select the “Domestic Hot Water” menu button to access the following parameters:

**Table 5-19: Domestic Hot Water Menu**

Default	Range/Choices	Parameter and Description
Combi: 120°F  Heating Boiler: 170°F	Combi: 60 to 150°F  Heating Boiler: 60 to 190°F	<b>DHW Setpoint</b> “DHW Setpoint” is the target temperature when DHW has priority. This setpoint along with “Difference Above” and “Difference Below” settings is used to cycle boiler.
Combi: 28°F  Heating: 7°F	2 to 30°F	<b>DHW Difference Above</b> (visible when heating boiler) “DHW Difference Above” is the number of degrees the temperature can increase above the setpoint before the boiler is shutdown.
Combi: 2°F  Heating: 5°F	2 to 30°F	<b>DHW Difference Below</b> (visible when heating boiler) “DHW Difference Below” is the number of degrees the temperature must decrease below the setpoint before the boiler is started.
60 minutes	0 to 120 minutes	<b>DHW Priority Time</b> When “DHW Priority Time” is greater than zero and Domestic Hot Water (DHW) heat demand is “on” the DHW demand will take “Priority” over central heating demands for the length of “Priority Time”. After priority time the system & boiler pumps are free to respond to pump demands. This provides priority protection over excessively long DHW demands.
2	1, 2, 3	<b>DHW Response Speed</b> (visible when heating boiler) “DHW Response Speed” adjusts the DHW temperature controller Proportional, Integral and Derivative (“DHW P Gain”, “DHW I Gain” and “DHW D Gain”) values all at once. Higher values cause a larger firing rate change for each degree of temperature change. If set too high, the temperature “overshoots” required setpoint and may cause the boiler to cycle off unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the temperature response will be sluggish and temperature will wander away from setpoint.
50	40 to 90°F	<b>Inlet Sensor Default</b> (visible when combi boiler) “Inlet Sensor Default” is used as Combi Inlet water temperature when the Recirculation sensor is not installed. Set number to expected domestic hot water inlet temperature.

## 5 Setup & Tuning *(continued)*

### Domestic Hot Water *(continued)*

**Table 5-19: Domestic Hot Water Menu *(continued)***

Default	Range/Choices	Parameter and Description	
Combi: Central Heat 2  Heating: DHW IWH Demand	Recirculation, DHW IWH Demand, Central Heat 2	<b>Auxiliary Thermostat Input Select</b> The Auxiliary Thermostat Input Select parameter allows the Aux T'stat terminal function selections; Recirculation demand; DHW IWH demand; or Central Heat 2 demand:	
		Central Heat 2:	Central Heat 2 (Auxiliary Heat) demand contact may be wired to terminal Aux T'stat.
		DHW IWH Demand:	DHW Heat demand contact may be wired to terminal Aux T'stat.
		Recirculation:	DHW Recirculation enable "point of use" push button, recirculation period timer or jumper may be connected to terminal Aux T'stat.
Combi: Recirculation  Heating: Header	Recirculation, Header	<b>Recirculation vs. Header Selection</b> "Recirculation vs. Header Selection" sets the Header Sensor terminals for use as a recirculation sensor or header sensor. CH Modulation Sensor "Header sensor" selection produces a modulation parameter fault if selected when "Recirculation vs. Header Selection" is not set to Header Sensor. Further, Comfort Mode selection produces a modulation parameter fault if selected when "Recirculation vs. Header Selection" is not set to recirculation Sensor.	

### Limits

**Table 5-20: Limits Menu**

Default	Range/Choices	Parameter and Description	
210°F	176 to 210°F	<b>Preferred Outlet/Flow High Limit</b> "Preferred Outlet/Flow High Limit" is a field adjustable supply temperature High Limit. This adjustment only allows the user to lower the High Limit below the maximum High Limit in the control.  This feature may be used to test the Supply Temperature High Limit control feature. By setting the Preferred High Limit below the normal operating range the High Limit may be easily tested. When the High Limit is reached, the boiler manual reset lockout is initiated.	
204°F	176 to 204°F	<b>Preferred Stack/Flue Limit Setpoint</b> "Preferred Stack/Flue High Limit" is a field adjustable flue temperature High Limit. This adjustment only allows the user to lower the High Limit below the maximum High Limit in the control.  This feature may be used to test the Flue Temperature High Limit control feature. By setting the Preferred Flue Temperature High Limit below the normal operating range the High Limit may be easily tested.	

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