V-10 TOUCHSCREEN CONTROLLER

Controller for High-Efficiency Boilers and Combi Boilers

Handling the touchscreen

The touchscreen responds to a light finger touch on the screen. Use only a stylus or a clean finger to interact with the touchscreen. Using sharp or metallic objects will cause damage.

If the touchscreen is:

- Left unattended, the screens will step back one screen at a time in 10-minute intervals. The pop-up windows will also step back automatically in 2-minute intervals.
- Not activated for a user-defined period (10 minutes by default), the Home screen dims to save power.

Controller's USB port

Be aware that the USB port is not designed to power user devices that require and draw high amperage. Rather, it is designed for software updates and for downloading log error text files. Powering such devices via the USB port may result in a blank controller screen, and thus require a system reboot.

Power saving

The Backlight setting is a power saving feature. Use the slide bar to set the screen backlight level (brightness). Also, you can program the screen to dim after a specified time of touchless interaction.

Contents

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1.0 Overview of the controller

The controller provides overall management of boiler operations such as self-diagnostics, easy load parameter adjustments, burner operation, safety management systems, call for heat management and load priority.

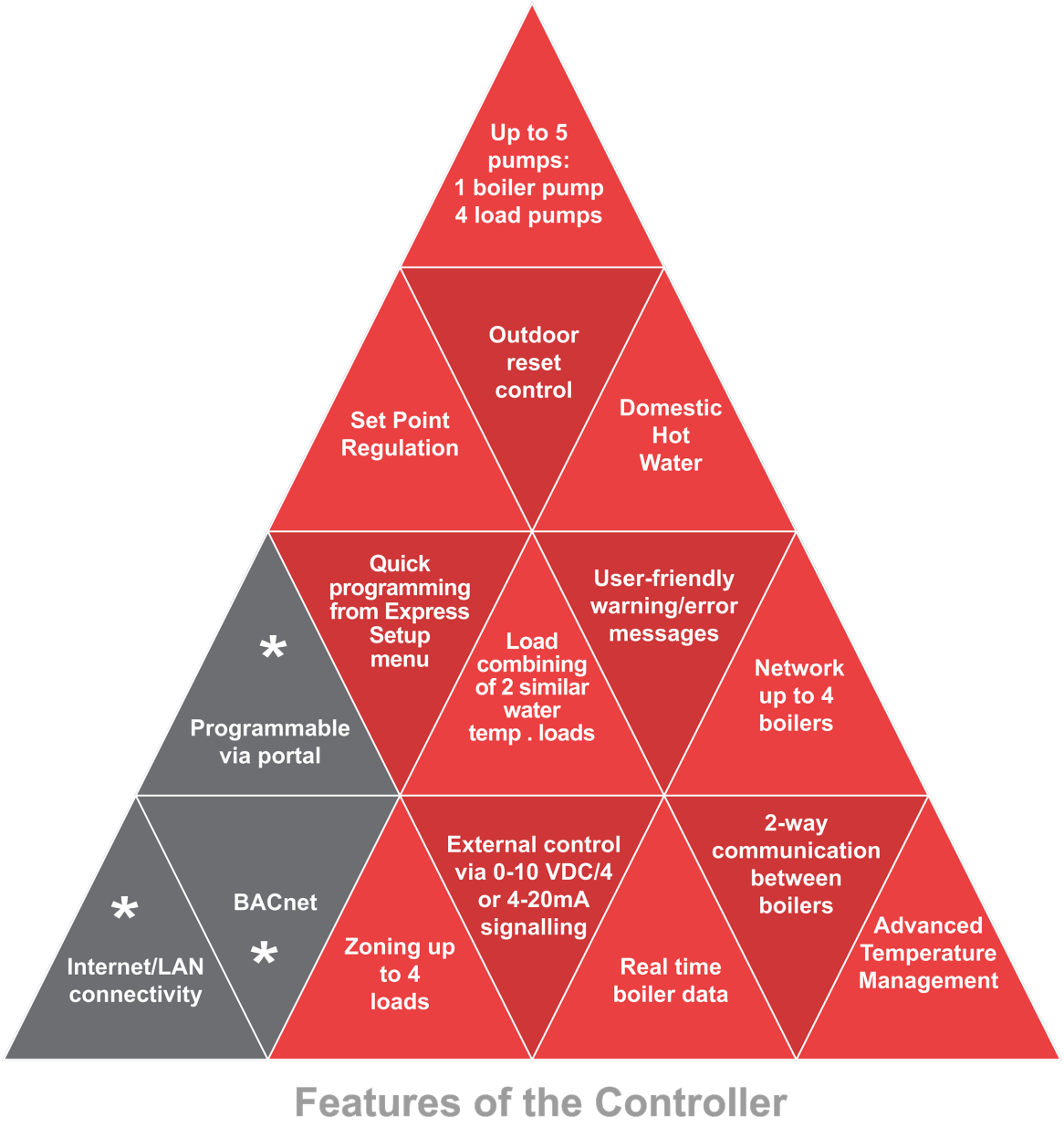


Figure 1 *Touchscreen controller's features*

* Not applicable to theBoiler and Combi Boiler

Controller's menu screens

The diagram below illustrates the navigation structure for menus, submenus, settings and information screens:

Figure 2 *Navigation of the controller*

Who is the manual for?

While this manual is primarily written for heating professionals, some of the content (for example, information about setting overrides) may be useful for building managers and homeowners.

Power-up sequence and operational states/cycles

When a boiler is first energized, the controller runs through a power-up sequence that takes approximately 45 seconds. During this time, the controller completes a self-diagnostic, then loads

all previous settings. When power is restored after a power interruption, the boiler automatically resumes operation with all the previously stored values.

The controller has five states during normal operation as well as an error state for problem detection:

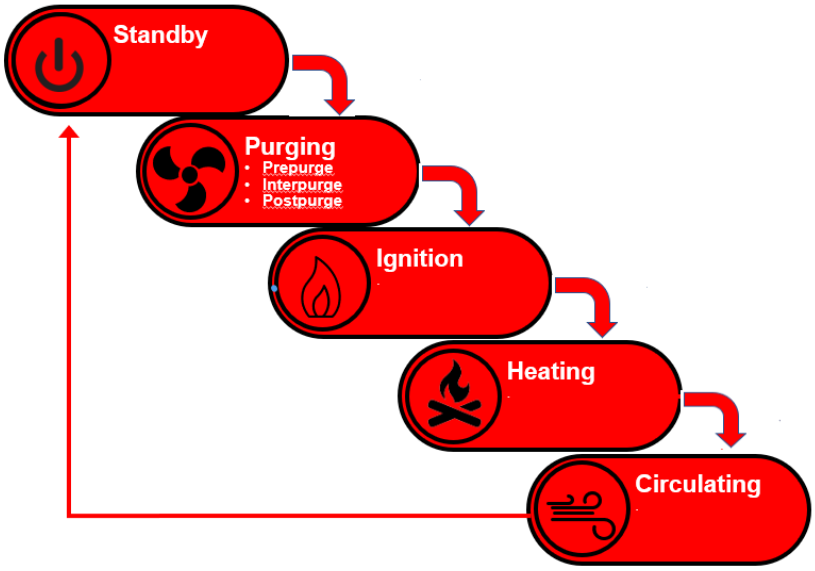


Figure 3 *Stages of controller operation*

For a detailed work flow and sequence of operation , see *Appendix E: Sequence of Operation on page 102*.

Getting to know the controller's interface

The controller's main screen displays four menus: Home, Setup, Status, and More.

1.1 Home

The Home screen displays basic information such as boiler model, ID, thermostat indicators (top bar) and its current operating state. Other information shown includes any loads being serviced and current operating values. The colored background on the bottom bar represents different boiler states (see *Status Bar Color on page 16*).

If one or more errors occur in the boiler, an "Error Logs" button will display on the Home screen. You can select the **Error Logs** button to view the current error log. You can also view other logs to help detect recurring errors. Once you have corrected the error(s), you need to clear the error(s) (> Clear Errors). This enables you to check for any unresolved errors still present in the system.

1.2 Setup

> **Tip**
>
> Setup is a quick way to configure a boiler, and covers 95% of operational requirements.

Setup walks you through a basic setup of the controller. You can configure a boiler's parameters using default values, including all the appropriate values to operate each load type under most operating conditions. If you wish, you can change these default settings later. For instructions on using Setup, see *Configuring loads using Setup (recommended) on page 55*.

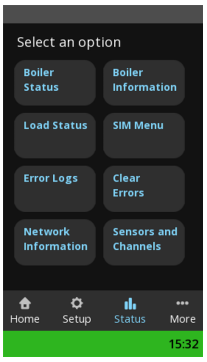
In Setup, you can configure up to four loads with the following control modes:

- DHW (domestic hot water)
- Reset Heating
- Set Point
- Ext. Control
- Zone of

When you select a control mode, the controller automatically loads the appropriate factory default settings. For more information on control modes, see *Operating concepts on page 21*.

1.3 Status

The Status menu displays the following options that enable installers to identify problems:



- Boiler Status
- Boiler Information
- Load Status
- SIM Menu
- Error Logs
- Sensor and Channels
- Clear errors
- Network Information

1.3.1 Boiler Status

The Boiler Status screen lists key operational parameters and their current readings.

1.3.2 Boiler Information

Boiler Information lists basic information such as the controller software version and the boiler model.

1.3.3 Load Status

Load Status displays a menu screen with six possible selections to display the current status details for the four individual loads, operating load statistics, and operational load profiles (graphs) for each load.

You can view:

- Operational information on each load (loads 1-4).
- A status screen that lists the run time statistics for the boiler including specifics for each load.
- A load profile screen that displays each load, showing a bar graph profile of the time the boiler is firing at various throttle levels.

1.3.4 Safety and Ignition Module (SIM) Menu

The SIM reports sensor readings and information on the status bar. In the controller's SIM menu, you can:

- **View Status** - Provides an overview of the burner, gas valve, ignitor and venting.
- Perform a **Hi-Limit Test** - Test the maximum supply cutoff temperature on the boiler. If the SIM detects a high limit temperature, the boiler enters a lockout state. For instructions, see *Testing the Hi-limit temperature function on page 52*.
- Perform a **Module Reset** - Lockouts are typically 5 minutes, depending on the ignition error. Use the Module Reset function to clear a lockout quickly. For instructions, see *Troubleshooting on page 83*.
- Perform a **LWCO Test** - Test the low water cutoff to protect against low water in a boiler. If the SIM detects low water, the boiler enters a lockout state. For instructions, see *Testing the low water cutoff (LWCO) function on page 52*.

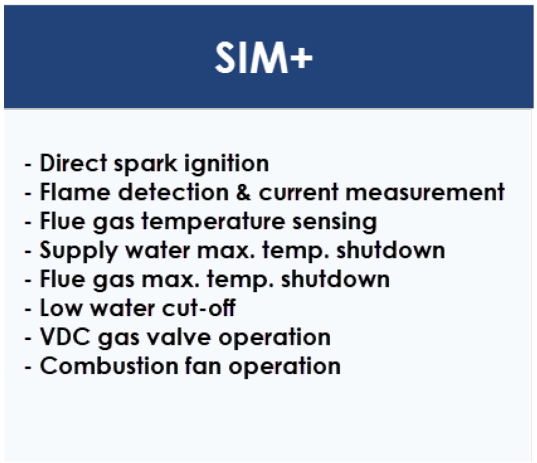


Figure 4 *SIM + module features*

About Status indicators

The SIM's two LEDs indicate the operating status as shown in the table below.

LED 1	LED 2	State	Description, LED status indication
Rapid Flash	Rapid Flash	Power up or Resetting	Startup checks and initialization
Off	Off	Standby	LED 1 Off = No Flame or Sparking LED 2 = Burner-On Call state
Off	On	Pre-Purge or Inter-Purge	LED 1 Off = No Flame or Sparking LED 2 = Burner-On Call state
On	On	Heating	LED 1 On = Flame detected LED 2 = Burner-On Call state
Rapid Flash	On	Igniting	LED 1 flashing = Electrode Sparking LED 2 = Burner-On Call state
Off	Flashing	Lockout	An operating limit was exceeded or a sequence failed or an external sensor fault was detected.
Flash Alternately with LED 2	Flash Alternately with LED 1	Fail-Safe	A critical internal fault was detected. Fail Safe requires a power cycle.

Table 1 LED status indicators

1.3.5 Error logs

The controller records all errors present at the time of an error event in a log. These logs date back to the original power-up, organized by date, time, classification, and type. For every error record, there is a "Details" button that lists:

- **Minor errors**. An abnormal condition exists that does not present an immediate safety hazard.
- **Major errors**. A condition exists that may be a safety hazard. The boiler enters an extended purge then the fan and pump are stopped. The boiler must be checked and restarted. **Exception**: The Ign. Trials Exceeded error will time-out for one hour before the system attempts re-ignition.
- **System faults**. Faults typically related to the touchscreen controller.
- **SIM Status**. Operating SIM status errors. See *About Status indicators on page 15*.

On the Error Logs screen, you can:

- View one or more errors. See *Viewing errors on page 83*.
- Save an error log to a USB stick. See *Backing up (exporting) error logs on page 89*.
- Delete/clear all entries in an error log. See *Deleting or clearing an error log on page 90*.

Important tip for DHW Errors

For On-Demand DHW Errors, in the Error Log always use the dropdown arrow and access *Details* for all the relevant information.

1.3.6 Sensors and Channels

This screen provides information screens on:

- Sensors - The Sensors status screen displays the current active value for each of the temperature and pressure sensors.
  - If a temperature sensor is not connected to the controller the text ‘n/c’ is displayed.
  - If a pressure sensor is not connected to the controller, ‘0’ is displayed.
- ATD Channels - (Analog to-Digital conversion) Lists the raw input values from the analog inputs, up to 4095 (which would indicate a short).

1.3.7 Clear Errors

Errors are triggered when a sensor detects that the boiler is operating outside its limits. If more than one error/alarm is present, the status bar slowly rotates through the alarm states.

Status Bar Color	Description
Green	Normal state - boiler is operating within its limits.
Yellow	Warning error - When the controller detects an error.
Red	Alarm - Unresolved condition or error detected while the boiler is firing or preparing to fire that results in the boiler shutting down and entering a lock-out state. To change these error lockout periods, see *Changing default error lockout time periods on page 79*. » For minor errors, the boiler will lock out for 5 minutes, and then attempt to restart automatically. » For major errors, the boiler will lock out for 60 minutes after 3 unsuccessful ignition attempts, and then attempt to restart.

Table 2 Status bar background colors

Note that "System" errors do not typically result in a boiler lock-out state. If the controller detects a single "system" error, it will typically continue operation, recording the event in the controller's error log. For more serious "system" errors, or if many system errors occur within a short period of time (about 10 seconds), the controller will treat the event as a major error, or will restart to try to clear the problem.

Tip

Once the errors have been rectified, we recommend clearing errors using the "Clear Errors" button on the Home screen because it is faster than a power cycle.

1.3.8 Network Information

The Network Information screen displays setup information related to:

- Internet connectivity such a boiler's IP address and MAC address. For instructions on connecting a boiler to the internet, see *Optional - Setting up for Internet access* on page 1.
- Multiboiler networking (Boiler ID, Master boiler, network ID, available boilers online in a network, and network boilers that are firing).

1.4 More

When you select the More menu, you will be provided with options that enable you to configure the boiler.

- User Settings
- Advanced Setup
- Test Operation
- System Settings
- Network Settings
- Installer Options
- Engineer Options

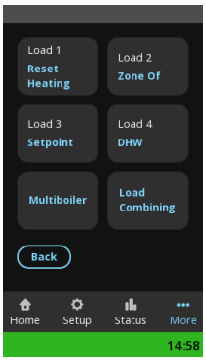
1.4.1 User Settings

This screen enables the user (installer, homeowner, site manager) to set or adjust:

- **Date & Time** - Choose NTP Server or Internal. The controller must be connected to the Internet for the NTP Server selection to work properly. For instructions, see *Changing and updating date and time on page 78*.
- **Overrides** - Typically, temperature overrides for a load are used to reduce temperatures during night-or-away hours to achieve fuel savings. Conversely, you can use overrides to increase temperatures for defined time periods in a day. This may be useful for certain commercial applications where short-term high temperature DHW service is desired.
  - For instructions, see *Setting overrides on page 75*.
- **Backlight** - Set the level of screen brightness to suit the lighting in the space. And to save power, you can set the DIM time that controls how long the screen remains lit after touch screen interaction.
- **Units** - Configure which units of measurement (metric or imperial) are displayed in the controller's screens (see *Changing default units of measurement displayed on the controller's screens on page 80*).
- **Clean the Screen** - Enables the touchscreen to be de-activated (will not respond to touch) for 60 seconds while the screen is being cleaned. Care must be taken not to scratch the screen while cleaning. Spray cleaning solution on a damp soft cloth, not directly onto the screen.

1.4.2 Advanced Setup

Advanced Setup provides access to the full functionality of the system for the advanced installer. Installers can access and configure the following:



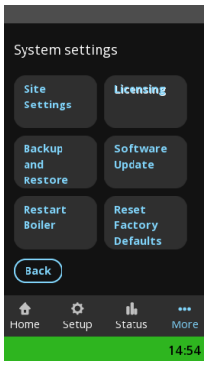
- Loads 1-4: Assign load types to up to four Loads. For instructions on assigning one or more loads, see *Setting loads on page 55*.
- Multiboiler: Set up a boiler to operate as part of a group of boilers (multi-boilers) at a site. For instructions on how to set up multiple boilers, see *Configuring multiple boiler systems on page 67*.
- Load Combining: Set up two loads of compatible temperature to run simultaneously. For information on this feature, see *Combining loads on page 29*. For instructions on setting up two loads, see *Combining two loads to service two loads at the same time on page 60*.

1.4.3 Test Operation

In the "Test Operation" screen, you can test the fan operation and check the venting for any blockage or leakage. The "Fan Test Heat Out" entry box allows the fan to be activated independently and set to speeds corresponding to the entered Heat Out value. You can use the "Fan Test Heat Out" feature when a boiler is not heating. If the boiler is heating, you can check that the heat output values correspond the fan heat output MBtu should be close to the heat output. For instructions, see *Testing the fan operation on page 71*.

1.4.4 System Settings

The System Settings screen provides the following options:



- **Site Settings**. Use to access generic boiler operating parameters that are not specific to a load. Parameters include load control types (pumps or control valves), boiler pump purge time, manual pump purge, and the variable speed (VS) output control settings. For instructions, see *Performing a manual pump purge on page 74*.
- **Licensing**. Use to activate special add-on software packages such as BACnet (not available for this product).
- **Backup and Restore**. Use to back up or restore the boiler's complete controller configuration and settings to/from a USB memory stick inserted into the controller. For instructions, see *Backing up and restoring a boiler's configuration and settings on page 76*
- **Software Update**. Contact Tech Support.
- **Restart Boiler**. Use to initiate a full boiler controller restart that takes approximately two minutes to complete. If you have replaced a fan or performed a software update, you can calibrate the fan via this option. For instructions, see *Calibrating the fan on page 73*.
- **Reset Factory Defaults**. Use to restore all operating parameters to factory default settings. Settings that will not be reset include network, Date and Time, error logs and operating history (see *Resetting configured settings to factory defaults on page 78*).

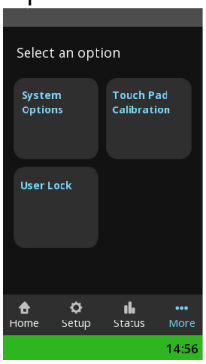
1.4.5 Network Settings

This screen is used for:

- assigning boiler IDs and other network setup to support multiboiler operation. Note that you can also assign boiler IDs for master and subordinate boilers in the Advanced Setup > Multiboiler screen (see *Configuring multiple boiler systems on page 67*).

1.4.6 Installer Options

For the advanced installer, "Installer Options" (password protected) provides options to:



- perform troubleshooting adjustments in the field such as adjusting the firing rate (see *Limiting the minimum and maximum firing rate of the boiler on page 74*).
- calibrate the touchscreen. Over time the touch pad calibration can drift slightly resulting in the touch locations being out of line with the displayed touch points such as buttons or entry boxes. Touchpad calibration resolves these alignment issues.
- enable user lock. Restricts access to areas in the controller with password protection. See *Restricting access to areas in a controller on page 77*.

1.4.7 Engineer Options

This option is password protected, reserved for technical support staff troubleshooting .

2.0 Operating concepts

This section contains important information about the control strategies used in the controller to deliver space heating, domestic hot water (DHW), pool heating, garage heating, and snow-melting. Depending on heating requirements, strategies will include the use of these control modes: DHW, Reset Heating, Setpoint, External Control, and Zone Of.

Other topics covered relate to multi-load systems that can have varying temperature loads, low temperature loads, and loads with high thermal mass. Topics include the controller's load priority, load combining, and supply differentials - rules, logic, and settings used to provide added levels of comfort, efficiency and protection. All load settings come with factory defaults. You can change these defaults to suit the application and heating requirements.

2.1 Domestic hot water (DHW)

In a single boiler, the system gives priority to servicing a call for DHW before switching to other loads to service calls for heat (see *Setting load priority on page 27*). (For Combi on-demand DHW operation see *On-Demand DHW options (Combi Boiler only) on page 63*.)

Default settings for the DHW load are suitable for residential applications. It may be necessary to change these settings to satisfy commercial requirements.

For information on wiring DHW, see *Sensors on page 43*.

2.1.1 DHW opt out in a multiple boiler network

When set as a dedicated DHW load, an indirect storage water heater can call up a boiler to "opt out" to service DHW. In a multi-boiler network, one or more dedicated DHW boilers can be programmed to "opt out" of the heating load, enabling the remaining boilers to continue heating uninterrupted. Multiple DHW opt-out boilers can respond to a high demand in DHW in buildings with multiple bathrooms, for example. If opt-out boilers are in the process of making DHW when the master boiler receives a setpoint or heating call, other subordinate boilers on the network will switch to servicing that load.

DHW "opt-out" boilers cannot be configured as the master boiler without DHW operation disrupting the boiler network. Opt-out loads are programmed on the opt-out subordinate boilers only. When an opt-out load is active, the boiler is not available to the network, and will switch on the opt-out pump directly.

Note

If a DDC system or other external control is used to operate individual boilers, the DHW opt-out feature is unavailable.

2.2 Reset heating

In a typical hot water heating system, a thermostat in a building signals a call for heat, causing the boiler to circulate hot water to that space until the thermostat setting is reached. This can be inefficient, requiring several burn on/off cycles, which may overshoot or undershoot the requirement, due to heat loss and outdoor temperature variation. That is, the amount of heat loss from a building varies according to the outdoor temperature. The greater the difference between the temperature inside and the temperature outside, the greater the heat loss.

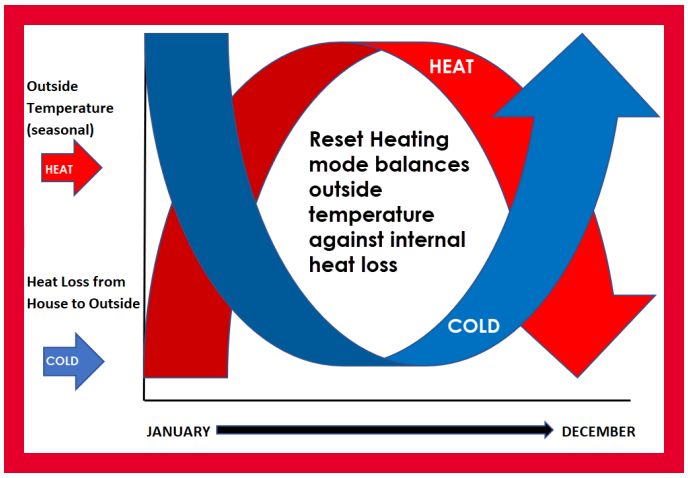


Figure 5 *Heat loss vs outdoor temperature*

The controller's Reset Heating (Outdoor Reset) mode is a way of balancing the heat lost from a building with the heat supplied to the building. The Reset Heating mode uses a temperature management algorithm to automatically adjust or "reset" the supply/outlet water temperature to compensate for the differing rates of heat loss that a building experiences as the outdoor temperature changes.

Note

Reset Heating mode requires the installation of an outdoor temperature sensor (supplied with boiler).

The Set Point mode sets the boiler temperature to accommodate the estimated coldest day of the year. However, the controller's Reset Heating mode will promote energy savings by adjusting the higher setting down based on the outdoor temperature at any particular time of day. When applied to the condensing boilers, the Reset Heating mode enables efficiency benefits by lowering the required circulating water temperature, so that cooler water returns to the boiler

(promoting more condensation). Its temperature control uses lower water heating temperatures for outdoor temperatures above the coldest day expected.

The Reset Heating mode provides a greater degree of heating efficiency and comfort compared with Set Point heating, which relies on the temperature of the return water to fire or shut down.

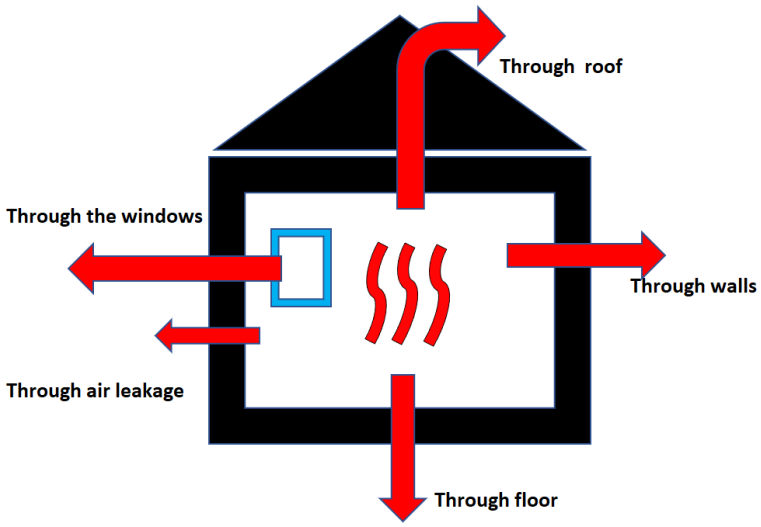


Figure 6 *Potential heat loss from house*

Ensure that the outdoor sensor is appropriately located, typically on the north face of the building away from any heat source. If there is no signal from the outdoor sensor, the controller assigns a default 32°F/0°C value for the outdoor temperature and adopts the appropriate temperature target from the reset curve.

The controller offers two Reset heating methods for controlling the supply/outlet water temperature:

1. "Standard" reset heating (default) that uses a two-point reset heating ratio.
2. Advanced reset heating that uses a characteristic reset curve ratio.

Note

Thermostats and zone valves - Typical room thermostats simply provide a call for heat. They do not control the circulating water temperature from the boiler. Adjustment of a room thermostat from 72°F / 22°C to 86°F / 30°C will make no difference to the delivered temperature if the floor slab has stabilized at the boiler temperature determined by the reset curve.

2.2.1 Standard reset heating (default)

Standard reset uses two points in the reset heating ratio to determine the outlet water temperature. The illustration below shows the relationship of the two points: The supply/outlet water temperature will rise linearly with a decrease in the outdoor temperature until the coldest expected temperature is reached, called the "Design Outdoor" temperature setting. The supply/outlet water temperature changes based on the straight line between the two points.

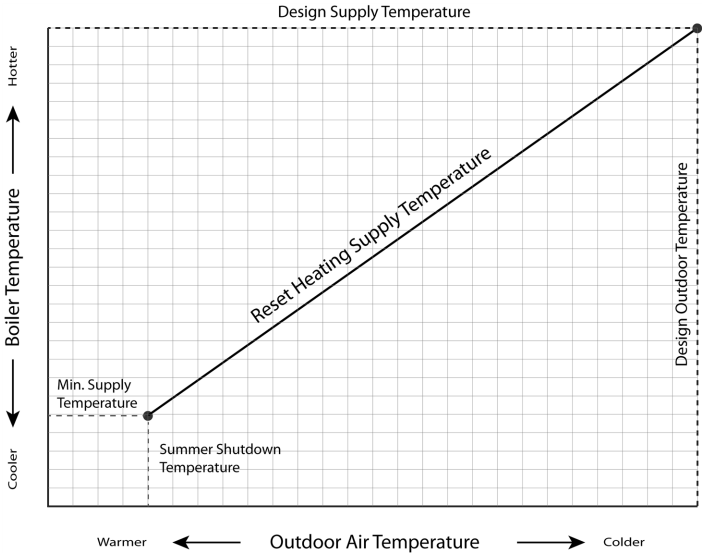


Figure 7 *Standard "straight-line" reset heating*

To determine these two points, and for the system to accurately control the supply/outlet water supply, set the:

- Design Supply° – defines the desired boiler outlet water temperature to occur on the coldest day for the building location. Corresponds to the Design Outdoor air temperature appropriate for the geographic location. Consult the *ACCA manual J* to calculate the Design Outdoor air temperature to perform heat loss calculations and to determine the heating loads of the home or building.
- High Limit° - defines the highest (maximum) water temperature allowed to prevent overheating, or damage to piping or flooring.
- Minimum Supply° - defines the minimum starting supply/outlet water temperature.
- Summer Shutdown°- defines the cut-off level for outdoor temperature that prevents further heating. The boiler ignores a call for heat.

We recommend using "Setup" to program standard reset heating. For a list of standard reset heating settings, see *Operational settings in the Setup menu: temperature ranges and defaults on page 33*.

2.2.2 Advanced reset heating

Advanced Reset heating offers greater control of air temperature in a building, and can be more accurate than standard reset heating. More parameter settings are available that allow the reset heating curve to extend down to much lower target supply water temperatures. This is useful for radiant heat emitters such as floors.

Configure Advanced Reset via **Advanced Setup** >set up a load as **Reset Heating**> Choose an emitter > **OK**>Scroll down to **Advanced Reset** > tap **Off** > then **On** > **Save**. A list of all available settings for Advanced Reset appear. For a list of advanced setup settings, see *Operational settings in the Advanced Setup menu: temperature ranges and defaults on page 35*.

Below is an illustration of how different emitters determine the characterized heating "curve" by delivering heat to an area at a different rate or amount as the outdoor temperature changes.

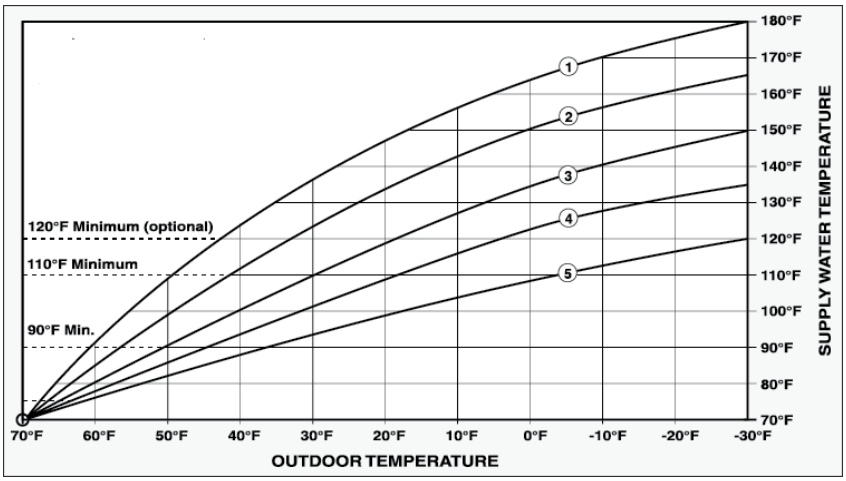


Figure 8 *Characterized heating curve in advanced reset heating*

1	Fin-tube baseboard
2	Air handler
3	Cast iron radiator
4	Low mass radiant floor
5	High mass radiant floor

To establish or "characterize" a heating curve to an application to deliver a more accurate level of heating, specify the following:

- Type of emitter - Once the emittter is selected the controller loads the factory defaults.
- Design Supply° – the desired boiler outlet temperature to occur on the coldest day. Use this temperature when performing heat loss calculations.
- Design Outdoor° – the coldest expected outdoor **air** temperature typically experienced at the installation site. Use this temperature when performing heat loss calculations.
- Design Indoor° - the desired and comfortable temperature to be maintained in the space or building. Use this setting when performing heat loss calculations.
- The Indoor Setpoint°- the lowest supply target temperature corresponding to the Design Indoor temperature. Indoor Setpoint° can be set to the same temperature as the Design Indoor°. Adjust the setting up or down to increase or reduce heating and to "fine tune" for the most comfortable indoor temperature.

  Tip

  To increase heat, use the Indoor Setpoint° setting to adjust the water outlet temperature, not the Design Indoor temperature setting.

- Summer Shutdown - cut-off temperature level for further heating. We strongly recommend using this feature with a value 5°F – 10°F / 3°C – 6°C below the Indoor Setpoint° to avoid short cycling of the boiler during very low heating conditions. The controller must receive a valid signal from the outdoor sensor, supplied with the boiler, for Summer Shutdown to operate correctly.

When defining the above settings, factor in space or building heat loss. See also *Setting the Supply Differential in heating modes on page 32*.

2.3 Set Point

Set point refers to the temperature set in the controller, not to the temperature read from a room thermostat. Since the set point is measured from the water flowing from the boiler and not from the air surrounding a wall thermostat, the boiler may go into circulate mode having satisfied the set point even while the wall thermostat target is not met. Generally, Set Point mode sets the boiler temperature to accommodate the estimated coldest day of the year.

To program the set point target range, set the:

- Boiler Supply° – desired or fixed supply/outlet water temperature.
- Maximum Supply° – the highest water temperature allowed to prevent overheating of the outlet water temperature. Check that this temperature takes into account the construction and safety requirements of each application (e.g., 140°F/ 60°C maximum for in-slab radiant floor to avoid thermal stress).
- Supply Diff'l (differential) - Set the differential to prevent short cycling. The boiler will fire when the boiler supply water temperature falls below the boiler **Current Target°** minus half the Differential. The boiler will shut off when the boiler supply water temperature rises above the boiler **Current Target°** plus half the Differential. See *Setting the Supply Differential in heating modes on page 32*.

» Summer shutdown° - The cut-off temperature level that prevents further heating. Boiler ignores a call for heat.

2.4 External Control

You can place the control of a load under an external electronic controller (such as a building management or automation system). In external control mode, temperature management is controlled by the building management system (BMS), consisting of one or more control panels wired to various sensors and valves in a building. The BMS will determine the desired boiler set point for any given building occupancy parameters.

When setting a load in external control mode, there are some key settings:

» Set the boiler's maximum boiler supply and on/off differential temperatures. The boiler treats these as high limit switches.

» Burner On From - Use a thermostat or external control to control the supply of heat.

For guidance on wiring, see *External control on page 44*. For setup instructions, see *Setting up an external control load on page 59*.

2.5 Zone Of

Boiler zone control enables you to set different spaces in a building with particular temperatures. If you want different rooms or zones in a building to have the same temperature use the "Zone Of" mode. This mode syncs the temperature, so that the temperature load settings in one area match the "zone of" another area. These temperature load settings include matching load priority, target and differential temperatures. If two rooms or zones in a building have different temperatures, use the "load combining" strategy (see *Combining loads on page 29*).

Note

"Zone Of" is not available until one or more active loads have been set up in the system. Zoned loads can operate independently or simultaneously.

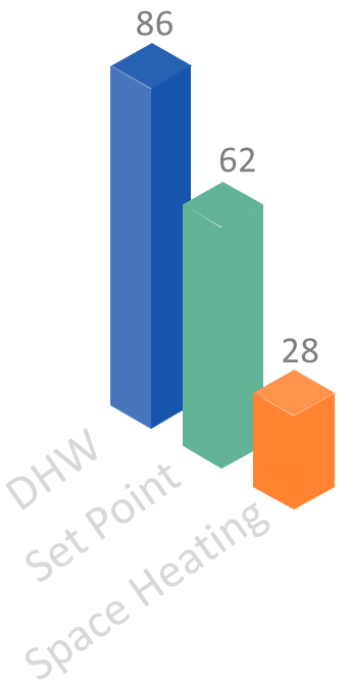
You can use this method of zone control to maximize energy costs. For example, you can zone bedrooms that need lower room temperatures to match another area in the house that is set at a low temperature. For instructions on setting "Zone Of", see *Syncing zones with "Zone Of" on page 57*.

2.6 Setting load priority

Boiler load is the total "work" performed by a boiler. The controller uses a priority algorithm to coordinate or schedule the delivery of heat in multiple load systems. This type of planning strategy

temporarily turns off one or more loads based on given conditions in the system. As an example, an intermittent heating load (e.g., space heating) is suspended until a call for a DHW load has been satisfied. Loads declared as DHW receive significant, but not absolute priority.

Multiple heating loads of varying temperature targets run in sequence with the use of a mixing valve. Each load is serviced at the minimum possible temperature, as opposed to running hot then mixing down (with hardware). Consider *Combining loads on page 29*.



If using Setup, load priority is simplified with options "very low", "low", "high" or "very high". There's more precision in Advanced Setup, where you can enter numeric values between 20 and 90 for a priority load. Note: The priority value has to be different for each load, but the priority scale values do not need to add up to 100 – they are relative only to each other. A higher numerical value means a higher priority.

Consider priority values as minutes. The difference between two load priority values is the number of minutes the higher priority load will operate before switching back to the lower priority load. For example, if DHW has a priority of 86 and the Set Point load has a priority of 62, the DHW load will run for (86-62) 24 minutes before switching to the simultaneously calling Set Point load. Following the initial cycle, the competing loads will switch back and forth after a further 10-minute interval pending satisfaction of one or both loads.

Figure 9 *Default priority values by load type in Installer Settings*

Note

Ensure that competing loads' priorities are set for a difference of 15 (minutes) or more.

Example: If baseboards (set up with Reset Heating as Load 3) are not providing the desired heat, you can bring on baseboard run time sooner by increasing the priority value relative to the other declared loads (e.g., changing the Load 3 preset value from 43 to 50 or reducing another load's value). Temperature targets for the under-served load can also be raised, in this example.

To cause repeated unequal run times; for example, constant 35 vs 5-minute runs, you need to integrate an external load removing relay or timer on one of the heat calls. Do not set each load to the top value, and avoid equal ratings.

2.7 Combining loads

As a control strategy, load combining is used when two rooms or zones in a building have different temperatures. Running two loads at compatible temperature settings at the same time provides added efficiency and heating comfort. This feature allows two compatible loads to run simultaneously; that is, they are "combined" to service their loads at the same time. To set different rooms or zones in a building with the same temperature, see *Syncing zones with "Zone Of" on page 57*.

The main principle for load combining is that the target temperature and the load's minimum and maximum supply temperatures (+/- differential temperature) in the primary and secondary loads must overlap. With the boiler's load priority scheme, load combining functions only while the primary load is the active load. Note that any system or load temperature limits will still be in effect.

In load combining there are two modes: Basic mode and Full mode. Basic mode should cover most of the load combining applications. Use the full mode when the load is not using a mixing valve. Suppressing the higher temperature rather than overshooting the lower temperature may be required.

Note

For Reset Heating or External Control loads, the target temperature is dynamic. Therefore, it is possible that as outdoor and/or indoor temperatures change, reset and external control heating loads could switch in and out of compatible temperatures.

For instructions on using the Load Combining feature, see *Combining two loads to service two loads at the same time on page 60*.

2.7.1 Basic mode load combining (default) - recommended

Basic (simple) mode allows any two of the four loads to be combined together by setting a primary and secondary load.

Parameter	Default	Minimum	Maximum
(1) Primary Load	Disabled	Load 1	Load 4
(2) Secondary Load	Disabled	Load 1	Load 4

The boiler supplies a target water temperature based on the highest water temperature required between both loads.

Let's say a radiant floor is set at 120°F and an air handler is set at 160°F. When both load types call for heat, the boiler will supply 160°F. If only the load for radiant floor is calling, the boiler will supply water temperature at 120°F.

2.7.2 Full mode load combining

In Full mode load combining, there are six default parameter settings:

Parameter	Default	Minimum	Maximum
(1) Primary Load	Disabled	Load 1	Load 4
(2) Secondary Load	Disabled	Load 1	Load 4
(3) Initial Delay	5 mins	2 mins	15 mins
(4) Off Delay	5 mins	2 mins	15 mins
(5) Retry Delay	10 mins	5 mins	60 mins
(6) Maximum Throttle %	75 %	50 %	90 %

(1)	**Primary Load - Highest temperature**	Set as the load that will control the boiler operation while Load Combining is active. This load must have a higher initial priority than the Secondary Load, and should have a higher water temperature requirement.
(2)	**Secondary Load - Lowest temperature**	Set to the load that will be serviced simultaneously, in combination with the Primary Load, if the conditions for Load Combining are met; that is, if the: - Supply temperature requirements for the Primary Load are being met; - Supply temperature is within the temperature range requirements of the Secondary Load **and** the boiler has the capacity to service the Secondary Load as determined by the Maximum Throttle % setting.
(3)	**Initial Delay**	The number of minutes after the Primary Load must initially be serviced before the boiler can add the Secondary load. Allow sufficient time for the Primary Load to stabilize before the boiler adds the Secondary load.
(4)	**Off Delay**	When the secondary load is added into combination service the supply temperature should fall briefly below the allowed temperature

		range for the Primary load. The Off Delay is the number of minutes after the loads have been initially combined that the loads will continue to be combined regardless of an under-temperature condition. Allow a long enough delay to allow the boiler to drive the supply temperature up within the Primary load's target supply temperature range. The loads will be uncombined if the under temperature condition persists after the Off Delay time. If the supply temperature exceeds the requirements for either the Primary or Secondary loads, the loads will no longer be combined.
5	**Retry Delay**	If the boiler removes the Secondary load from combined service because load combining conditions are not followed, the Retry Delay is the number of minutes the boiler waits before attempting to add the Secondary load back into combination service.
6	**Maximum Throttle %**	Maximum (percentage) of the boiler's heat output below which load combining is allowed to begin. If set at Maximum Throttle 75% for example, the throttle needs to be operating at below 75% of the boiler's heat output before the Secondary load is added into combined service. The Maximum Throttle % has no effect once the loads have been combined.

Table 3 *Default parameter settings in full mode load combining*

Example of compatible load combining

Primary Load 140°F to 180°F
Secondary Load 150°F to 170°F
Initial Delay: 5 mins
Off Delay: 5 mins
Retry Delay: 10 mins
Maximum Throttle %: 75 %

- The boiler will wait a minimum of 5 minutes (initial delay) after it begins servicing the Primary load before adding the Secondary load.
- The supply temperature must be between 150°F and 170°F (the compatible temperature range for both loads), and the throttle is below 75%, before the secondary load is added.
- If the supply temperature rises above 170°F, the load is dropped.
- If the supply temperature is/or drops below 150°F after the 5-minute "Off Delay", the secondary load is also dropped.
- If the secondary load is dropped, the boiler waits a minimum of 10 minutes (Retry Delay) before attempting to add the Secondary load again. At this time, the supply temperature must be between 150°F and 170°F.

Example of incompatible load combining

Primary Load 140°F to 180°F
Secondary Load 120°F to 140°F

The secondary load temperature range of 120°F to 140°F is outside the range (does not overlap) with the Primary load's supply temperature range of 140°F to 180°F. Load combining will be ignored, and the loads sequentially serviced according to the system's priority rotation. "Not compatible" is displayed on the Load Combining screen.

2.8 Setting the Supply Differential in heating modes

An on/off appliance, such as a boiler, must be operated with a differential to prevent short-cycling. When the supply water temperature drops below the low limit of the differential, the appliance is turned on. The appliance continues to run until the temperature reaches the upper limit of the differential. If the differential is set too wide, there can be large temperature swings, and if the differential is too narrow, the appliance short-cycles and operates inefficiently. To prevent short cycles, component wear-and-tear, and impaired efficiency, you should set a moderate differential.

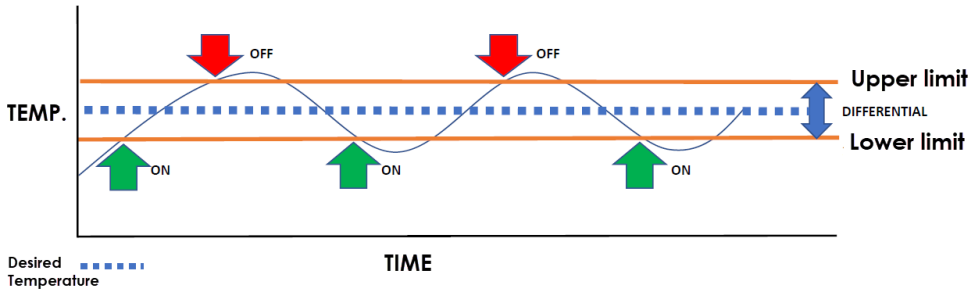


Figure 10 *Boiler turns on/off according to differential high and low limits*

A differential is based on a boiler's target temperature. For example, a boiler that has a target temperature of 150°F and a differential of 20°F will operate between 160°F and 140°F. The boiler will fire when the boiler supply water temperature falls below the boiler **Current Target°** minus half the Differential. The boiler will shut off when the boiler supply water temperature rises above the boiler **Current Target°** plus half the Differential.

When you set the differential, check that the Maximum Supply° is higher then the boiler supply plus half its supply temperature differential to ensure the maximum supply takes account of the construction and safety requirements of each application (e.g., 140°F / 60°C maximum for typical in-slab radiant floor to avoid thermal stress).

Ensure the range between the boiler supply and maximum supply temperatures is greater than one half of the Supply Diff'l°. Suggested Supply Diff'l° settings: High mass radiant 18°F / 10°C.

> Example: For radiant floor - Design Supply° is 125°F, Maximum Supply° is 140°F, and Supply Diff'l° is 18°F (half of which is 9°F) works well.

For DHW the Supply Differential works the same, although wider. However, for the *Tank Differential* the setting applies only below the target. For example, if the DHW tank target temperature is 135°F, a differential of 10°F means that DHW calls when the tank falls to 125°F.

2.9 Operational settings in the Setup menu: temperature ranges and defaults

Operational settings in the Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
DHW	Tank Setpoint°	Target temperature of DHW	95°F – 160°F	140°F
	Boiler Supply°	Target outlet water temperature	95°F – 185°F	170°F
	Maximum Supply°	Temperature limit to prevent overheating of outlet water temperature	41°F – 190°F	190°F
	Priority	Priority of the DHW load against other loads	Very Low – Very High	Very High
	Pump Post Purge	Time (seconds) the pump will operate after satisfying call for DHW	0 – 900 seconds	180 secs
	Boiler Pump	See *Boiler Pump on page 91*.	On – Off	On

Operational settings in the Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
Reset Heating	Emitter	Enter the device type used to emit heat: high mass radiant system, low mass radiant system, air handler, cast radiator, or baseboard.		high mass radiant system
	Design Supply°	Desired boiler outlet temperature on the coldest day	95°F – 185°F	125°F
	Maximum supply°	Maximum water temperature limit to prevent overheating	41°F – 190°F	140°F
	Minimum Supply°	Anchors reset calculation	41°F – 190°F	80°F
	Design outdoor		-76°F – 86°F	14°F
	Priority	Priority of the Reset Heating load against other loads	Very Low – Very High	Very Low
	Pump post Purge	Time (seconds) the pump will operate after satisfying call for heat	0 – 900 seconds	0
	Summer Shutdown°	Cut-off level for outdoor temperature that prevents further heating	32°F – 122°F	65°F
Setpoint	Boiler Supply°	Desired or target outlet water temperature	59°F – 185°F	130°F
	Maximum Supply°	Temperature limit to prevent overheating of outlet water	41°F – 190°F	145°F
	Summer Shutdown°	Cut-off temperature level that prevents further heating.	32°F – 122°F	65°F
	Priority	Priority of the Set Point load against other loads	Very Low-Very High	Med
	Pump Post Purge	Time (seconds) the pump will operate after satisfying call for heat	0 – 900 seconds	0

Operational settings in the Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
Ext. Control	Burner On From	Type of control used to control boiler supply of heat.	Thermostat or Ext. Control	Thermostat
	Max. Control° (9.5VDC)	Temperature limit per maximum voltage sent to the controller	32°F-185°F	160°F
	Min. Control° (2.1VDC)	Lowest temperature per minimum voltage sent to the controller	32°F-185°F	100°F
	Maximum supply	Maximum limit to prevent overheating	41°F-190°F	190°F
	Failsafe enable	(if no signal boiler comes on - prevent no heat occurring and ext. controller failure	Enabled or Disabled	Disabled
	Failsafe setpoint		86°F-185°F	122°F
	Priority	Priority of the call for heat by external control against other loads	Very Low - Very High	High
	Pump Post Purge	Time (seconds) the pump will operate after satisfying call for heat from external control	0-900 seconds	300 secs

Table 4 *Temperature ranges and defaults in declared loads - Setup*

2.10 Operational settings in the Advanced Setup menu: temperature ranges and defaults

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
Reset Heating	Current Target°	Display-only. A variable, dependent upon the current outdoor temperature and the settings for Design Supply, Design Outdoor, Minimum Supply, and Maximum Supply.	95°F – 185°F	n/a
	Emitter	Type of heating device used to transfer heat in a building (radiant, air handler, cast radiator, baseboard)		
	Boiler Pump	See *Boiler Pump on page 91*.	On – Off	On

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
	Design Supply°	Desired boiler outlet temperature on the coldest day	50°F – 190°F	125°F
	Design Outdoor°	Coldest expected outdoor temperature typically experienced at the installation site. Set the Design Outdoor Air temperature correctly for the geographic location; consult the heat loss calculation documentation used in the design of the heating system.	-76°F – 86°F	14°F
	Summer Shutdown°	Cut-off level for outdoor temperature that stops further heating	32°F – 122°F	65°F
	Maximum Supply°	Highest supply water temperature	41°F – 190°F	70°F
	Minimum Supply°	Lowest supply water temperature	41°F – 147°F	70°F
	Supply Diff'l	The boiler fires when the supply falls below the **Current Target°** minus half the Differential and shuts off when the supply rises above the **Current Target°** plus half the Differential.	3°F – 62°F	20°F
	Ramp Speed	See *Ramp Speed on page 95*.	1 – 10	3
	Priority	See *Priority on page 95*.	20 – 90	28
	Pump Purge	See *Pump Post Purge (sec) on page 95*.	0 – 900 seconds	0
	Indoor From°	See *Indoor°From on page 93*.	Indoor / Sec. Loop	Indoor
	Outdoor From°	See *Outdoor°From on page 94*.	Outdoor, Sec. Loop, DHW	Outdoor
	Water From°	See *Definition of terms on page 91*.	Outlet, Sec. Loop, DHW	
	Burner On From	Type of control used to control boiler supply of heat.	Thermostat, Ext. Control, Sec. Loop, DHW	Thermostat

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
Advanced Reset (When Advanced Reset check box is checked)	Current Target°	Display-only. A variable, dependent upon the current outdoor temperature and the settings for Design Supply, Design Outdoor, Minimum Supply, and Maximum Supply.	95°F – 185°F	n/a
	Emitter	Type of heating device used to transfer heat in a building (radiant, air handler, cast radiator, baseboard)		
	Boiler Pump	See *Boiler Pump on page 91*.	On – Off	On
	Design Supply°	Desired boiler outlet temperature on the coldest day	50°F – 190°F	125°F
	Design Outdoor°	Coldest expected outdoor temperature typically experienced at the installation site. Set the Design Outdoor Air temperature correctly for the geographic location; consult the heat loss calculation documentation used in the design of the heating system.	-76°F – 86°F	14°F
	Design Indoor°	This setting only becomes available when the Advanced Reset check box is checked. The indoor air temperature used that factors in the heat loss calculations for the heating space.	41°F-95°F	72°F
	Indoor Setpoint°	This setting only becomes available when the Advanced Reset check box is checked.	41°F – 95°F	75°F
	Summer Shutdown°	Cut-off level for outdoor temperature that stops further heating	32°F – 122°F	65°F
	Maximum Supply°	Highest supply water temperature	41°F – 190°F	70°F
	Minimum Supply°	Lowest supply water temperature	41°F-147°F	70°F
	Supply Diff'l	The boiler fires when the supply falls below the **Current Target°** minus half the Differential and shuts off when the supply rises above the **Current Target°** plus half the Differential.	3°F – 62°F	20°F
	Ramp Speed	See *Ramp Speed on page 95*.	1 – 10	3

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
	Priority	See *Priority on page 95*.	Very Low – Very High	Low
	Pump Purge	See *Pump Post Purge (sec) on page 95*.	0 – 900 seconds	0
	Indoor From°	See *Indoor°From on page 93*.	Indoor / Sec. Loop	Indoor
	Outdoor From°	See *Outdoor°From on page 94*.	Outdoor, Sec. Loop, DHW	
	Water From°	See *Definition of terms on page 91*.	Outlet, Sec. Loop, DHW	
	Burner On From	Type of control used to control boiler supply of heat.	Thermostat, Ext. Control, Sec. Loop, DHW	Thermostat
Setpoint	Boiler Pump	See *Boiler Pump on page 91*.	On-Off	On
	Boiler Supply°	Target outlet water temperature	59°F – 185°F	130°F
	Maximum Supply°	Temperature limit to prevent overheating of outlet water	41°F – 190°F	145°F
	Supply Diff'l	The boiler fires when the supply falls below the **Current Target°** minus half the Differential and shuts off when the supply rises above the **Current Target°** plus half the Differential.	3°F – 62°F	20°F
	Summer Shutdown°	Cut-off level for further heating.	32°F – 122°F	65°F
	Ramp Speed	See *Ramp Speed on page 95*.	1 – 10	7
	Priority	See *Priority on page 95*.	20 – 90	62
	Pump Post Purge (sec)	See *Pump Post Purge (sec) on page 95*.	0 – 900 seconds	0
	Water°From	See *Definition of terms on page 91*.	Outlet, Sec. Loop, DHW	
	Burner On From	Type of control used to control boiler supply of heat.	Thermostat, Ext. Control, Sec. Loop,	Thermostat

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
			DHW	
DHW	Boiler Pump	See *Boiler Pump on page 91*.	On – Off	On
	Boiler Supply°	Target temperature for the outlet	95°F – 185°F	170°F
	Maximum Supply°	Limit to prevent overheating of supply water	41°F – 190°F	190°F
	Supply diff.	The boiler fires when the supply falls below the **Current Target°** minus half the Differential and shuts off when the supply rises above the **Current Target°** plus half the Differential.	3°F – 62°F	20°F
	Tank Setpoint°	Target temperature of DHW	95°F – 160°F	140°F
	Tank diff.		3°F – 62°F	10°F
	Ramp Speed	See *Ramp Speed on page 95*.	1 – 10	7
	Priority	Priority of the DHW load against other loads	20 – 90	87
	Pump Post Purge	See *Pump Post Purge (sec) on page 95*.	0 – 900 seconds	180 secs
	Water°From	See *Definition of terms on page 91*.	Outlet, Sec. Loop, DHW	Outlet
	Tank°From		Sec. Loop, DHW	DHW
Ext. Control	Boiler Pump	See *Boiler Pump on page 91*.	On – Off	On
	Burner On From	Type of control used to control boiler supply of heat.	Thermostat or Ext. Control	Thermostat
	Max. Control° (9.5VDC)	Temperature limit per maximum voltage sent to controller.	32°F – 185°F	160°F
	Min. Control° (2.1VDC)	Lowest temperature per minimum voltage sent to controller.	32°F – 185°F	100°F
	Maximum Supply°	Limit to prevent overheating of supply/outlet water	41°F – 190°F	190°F

Operational settings in the Advanced Setup Menu				
Mode	**Setting**	**Description**	**Temp. Range**	**Default**
	Supply Diff'l	The boiler fires when the supply falls below the **Current Target°** minus half the Differential and shuts off when the supply rises above the **Current Target°** plus half the Differential.	3°F – 62°F	20°F
	Ramp Speed	See *Ramp Speed on page 95*.	1 – 10	7
	Priority	Priority of the call for heat by external control against other loads	20 – 90	65
	Pump Post Purge	See *Pump Post Purge (sec) on page 95*.	0 – 900 seconds	300 secs
	Fail Safe Enable	See *Failsafe Enable on page 92*.	Enabled / Disabled	Disabled
	Water°From	See *Definition of terms on page 91*.	Outlet, Sec. Loop, DHW	Outlet

Table 5 *Temperature ranges and defaults in declared loads - Advanced Setup*

3.0 Wiring

Warning

Wiring and testing must be performed by experienced and trained professionals.

For reference, you can find wiring diagrams for the respective boiler in the *Appendices on page 97*.

This section includes the following topics:

- Boiler pump
- Thermostats
- Load pumps or valves
- Sensors
- Alarm contacts
- External control
- Multiple boilers: wiring and networking
- Wiring checklist

Note

For a boiler to fire, it needs an "enabler" across the load such as a zone valve end switch, thermostat switch, or jumper.

3.1 Boiler pump

For Boiler boilers, wire the boiler pump to its boiler pump harness lead. The image below shows the boiler pump leads (yellow and white wires) located in the wiring box behind the controller.

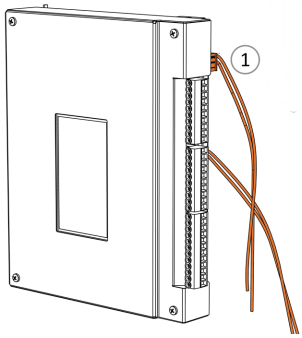


Figure 11 : *Field wiring for (primary) pump – (1) yellow and white wires*

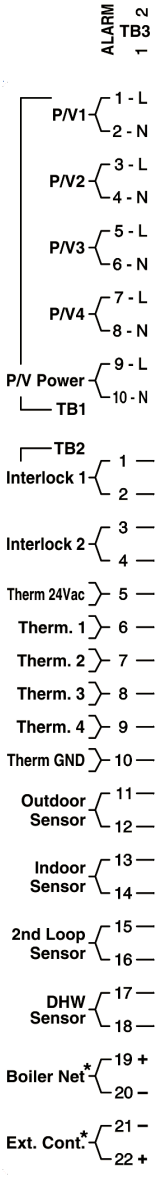


Figure 12 *Controller's wiring strip*

3.2 Thermostats

The controller is compatible with most common thermostats including simple single contact types (for example, a mercury switch) as well as most power-stealing-type thermostats. The standard connection for common thermostats provides a simple contact closure for the boiler (see the electrical diagrams in the *Appendices on page 97*). For example, Therm 1 will activate Pump 1, Therm 2 will activate Pump 2, etc (see *Figure 12*) .

- The Therm. 24Vac (TB2 terminal 5) provides 24 volts AC to all thermostats (up to four). This connects to the "R" terminal on the thermostat.
- Each individual thermostat's "W" terminal connects separately to one of the controller input terminals: Therm. 1 (TB2: 5-6); to activate load one, close 5-6, Therm. 2 (TB2: 5-7); to activate load 2, close 5-7, Therm. 3 (TB2: 5-8); to activate load 3, close 5-8, or Therm. 4 (TB2: 5-9); to activate load 4, close 5-9.
- The appliance is compatible with conventional thermostats.

Caution: power-stealing thermostats

The V10 controller does not support power-stealing thermostats. Power stealing thermostats take their operating power from the thermostat line. If a t-stat has electronic display but does not use a C-wire or a battery, it is power-stealing.

Note

Some thermostats, for example those with WiFi circuits, may require their own 24V power source.

3.3 Load pumps or valves

Note

TB1: 9-10 P/V power is prewired with 120VAC.

You can wire up to four load pumps to the load pump terminal labeled P/V1 (Pump/Valve1), P/V2, P/V3, and P/V4 (see *Figure 12*). The top pair PV/V1 - 1 L(live) and 2 N(neutral) is reserved for Load 1, the second pair PV/V2 - 3 L and 4 N is reserved for Load 2 etc.

The factory has pre-wired the terminal to use a 120VAC power supply, but it can be configured for other voltage uses in the field.

> **Note**
>
> The total loads running should not exceed 10 amps.

> **Note**
>
> Any pump being directly switched by an V10 control board must draw less than 4 amps.

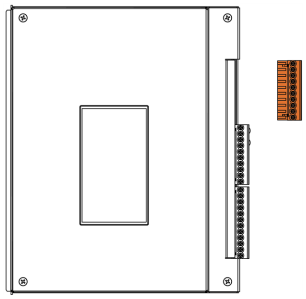


Figure 13 *Load pump terminal*

3.4 Sensors

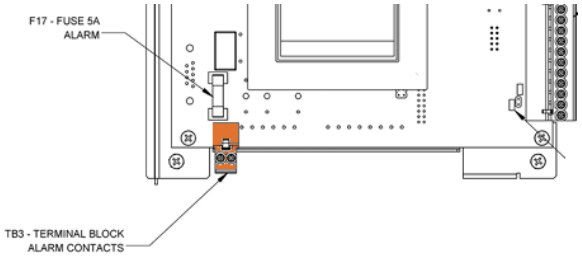
Use a thermister (10K ohm type 2 sensor) wired to any of the following sensors at TB2:

- Outdoor Sensor - 11 and 12 terminals
- Indoor Sensor - 13 and 14 terminals
- 2nd Loop Sensor - 15 and 16 terminals
- DHW sensor - You can use two methods for wiring DHW on a boiler controller:
  - **Aquastat**: Set up a call for heat for DHW by using an aquastat that is wired to a Therm 1, 2, 3, or 4 connection (see *Figure 12*).
  - **DHW sensor**: Use a DHW thermister (10K ohm type-2 sensor) to connect to the "DHW Sensor" 17 and 18 terminal connections (see *Figure 12*). With this method, the Therm connection corresponding to the DHW pump is not used.

3.5 Alarm contacts

> **Note**
>
> **Always disconnect electrical power to the boiler before removing the circuit board cover.**

The controller provides a relay dry contact connection to indicate the boiler's alarm state externally. This can be used, for example, to connect to an external alarm panel or an indicator light. The terminals on TB3 (see *Figure 12*) supply the wiring connection. To access the TB3 connection, disconnect electrical power to the boiler, and remove the controller front cover.

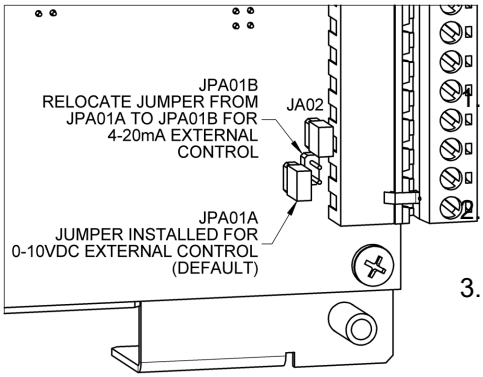


The alarm contacts will normally be open indicating that there is no alarm present. The contacts are closed when an alarm state is present and boiler operation has been disabled. This corresponds to when the boiler status bar on the display is red. The error that was detected creating the alarm state is recorded in the Error Log and displayed on the boiler status bar.

Figure 14 *Location of alarm contacts on front of controller*

3.6 External control

Connections are provided at TB2 (see *Figure 12*) *Ext. Cont. -/+*to receive a 0-10VDC or 4-20 mA signal for external control. The default configuration is **0-10VDC** (JPA01A installed).



To switch over to **4-20 mA** (JPA01B):

1. Remove the electrical box cover and the circuit board cover to access the jumper on the lower-right corner of the control circuit board.
2. Use needle-nose pliers to move the plastic jumper tab from position A (shown) onto the pins in position B.
3. Reinstall the cover, and then restore power to the boiler.

Figure 15 *External control jumper positions A and B*

3.7 Multiple boilers: wiring and networking

Caution

- **Controllers must be powered off during boiler network wiring.**
- **Network wiring should not run parallel to any nearby line voltage wiring.**

Networking multiple V10 controlled modulating condensing boilers at a plant site offers tangible energy savings. Networked boilers produce exceptional "turn down" capability to match any building load demands. Boiler networks are designed for single load applications and certain two-load systems. Three- or four-load sequences (typically for residential scenarios) are generally not suitable for larger multi-boiler applications.

You can connect up to 4 boilers in the Boiler and Combi Boiler to operate as a single heating plant.

Other benefits of networking multiple boilers include:

- System redundancy.
- Removing a single boiler off-line for servicing without affecting the operation of the other boilers on the network.
- “Opting out” a single boiler from the heating load when called upon for DHW by an individual indirect storage water heater.

3.7.1 Methods for networking a group of boilers

The methods that can be used for networking a group of boilers include:

1. (Recommended method) An Ethernet switch device.
2. BoilerNet two-wire CAN-bus daisy chain cabling.
3. Standard crossover cable for a simple 2-boiler network.

Warning

Disconnect the electrical power to the boiler before removing the circuit board cover.

3.7.2 Internet connectivity

If you build a network that is not connected to the internet, you can still assign manual IP addresses to each boiler, that is, assign fixed IP addresses. For example, if using the simple 2-boiler networking method, you will need to assign manual IP addresses to both boilers. For instructions, see *Assigning fixed IP addresses to boilers on a network using a switch not connected to the internet on page 69*.

3.7.3 Ethernet switch device (recommended)

Networking switch devices, purchased from any office supply or computer store, contain multiple ports that enable you to connect multiple boilers via a network (Ethernet) cable.

Use a parallel Cat 5 cable with the switch device. The cable plugs into each boiler’s Ethernet jack located at the back of the controller (see *Appendix A: Controller Board Layout on page 97*).

3.7.4 BoilerNet two-wire CAN bus daisy chain cabling

Warning

Always power the boilers down prior to working on or installing the two-wire CAN bus. Failure to do so will destroy the network chips on all the boiler control boards on the network.

Note

The CAN bus method is suitable for small networks consisting of 2-3 boilers.

The boilers are configured in a daisy chain network for communication and control via a proprietary network called BoilerNet.

Use polarity-sensitive twisted 2-wire leads (CAN bus standard) to join one boiler to the next (to a maximum of 4 Boiler or Combi Boiler boilers). Connection is made between the “Boiler Net” terminals near the base of the TB2 terminal strip. Wiring between boilers needs to be a sequential “daisy chain” approach, where all +s connect only with +s and all the -s connect only with -s.

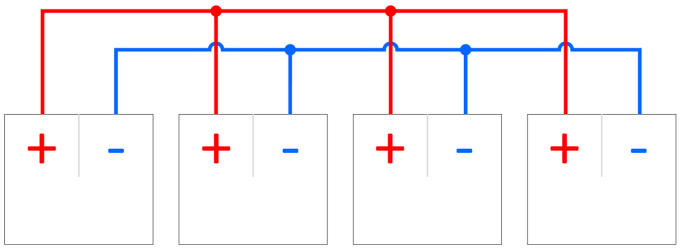


Figure 16 *Daisy-chain wiring*

BoilerNet Component	Requirements
CAN bus interface that communicates between boilers.	The wire type and installation must comply with CAN bus standards such as ISO 11898 and/or SAE J2284.
Cable	Polarity-sensitive twisted 2-wire leads (CAN bus standard) to join one boiler to the next (to a maximum of 24 boilers). Connection made between the "Boiler Net" terminals #19 and #20 (see *Figure 12*). Specifications for the cable: » 24 AWG shielded twisted pair » 9 twists / ft » Capacitance 12.5pF/ft (cond./cond.) » Resistance 25.5 ohms/1000 ft
Network Wiring	» Power down all boilers prior to connecting or disconnecting. » The "Boiler Net +" and "Boiler Net –" are polarity sensitive and must not be crossed. » Network wiring must only be installed in a "Daisy Chain" arrangement where network wiring goes from the first boiler to the second to the third to the fourth, and so on. » If using shielded pair wire, ensure the shielding is only grounded at one end of the "Daisy Chain". If the shielding is grounded in multiple locations (i.e. at each boiler or at the first and last boiler,) the shielding becomes ineffective and in some cases increases the electromagnetic interference affecting the communication signal. The termination jumper (JA02) needs to be removed from the boiler controller boards that are NOT the first or last boiler in the BoilerNet chain. For example, in a two-boiler network, JA02 must be left installed in both controls, and in a three-boiler network, the JA02 must be removed on the middle boiler only.
Terminators	Terminators must be removed from the middle boilers, and the wire polarity must be correct at all the boilers.

Table 6 *CAN bus setup requirements*

Removing jumpers when networking three or more boilers

When three or more boilers are networked, removal of a circuit board jumper is necessary (as illustrated below). Note on the illustration that you must not remove the jumpers from the boilers on both ends of the networked boiler system.

Caution

Failure to remove the required jumpers may cause network instability.

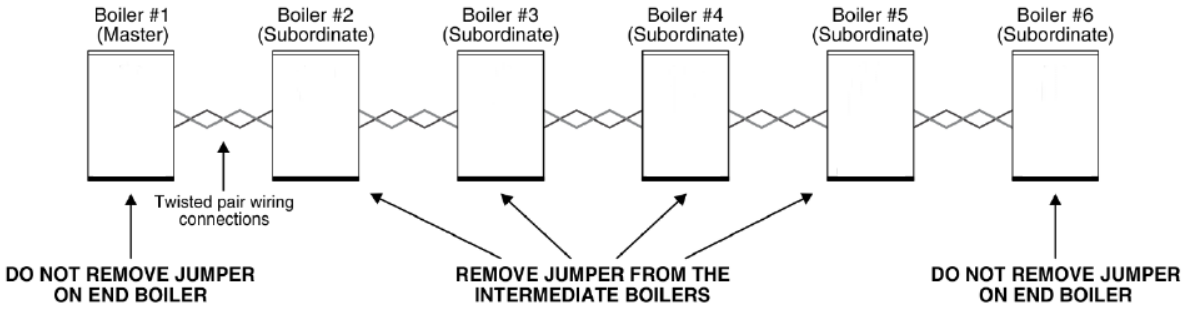


Figure 17 *Circuit board jumper removal*

To remove jumpers:

1. Turn off power to the boilers.
2. Remove the control board covers from each intermediate (non-terminating) boiler in the array.
3. Locate the jumper clips at the bottom right of the circuit board. There are two of them. The jumper for configuring multi-boiler operation is the JA02 shown in the drawing below.
4. Pull this jumper clip straight away from the two pins on the circuit board, and store it somewhere safe in case it might be needed in the future. Common practice is to place it so that it hangs onto the bottom pin only.
5. Replace the control board covers, and restore power to the boilers.

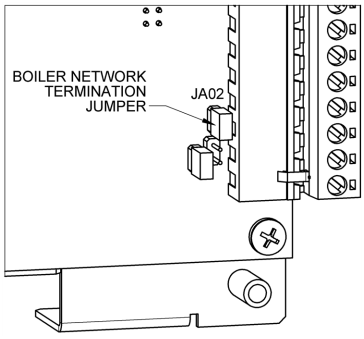


Figure 18 *Jumper A02*

3.8 Wiring checklist

The following provides useful checks to confirm that wiring is successful.

Checklist for Wiring	Check
Ensure the appropriate loads are set to "Off" or to an appropriate load type.	☐
Ensure the pumps cycle on or off as expected.	☐
Check all wiring for poor connections. Look for flickering screen or intermittent calls for heat.	☐
Ensure the DHW sensor is fully immersed in the well to prevent tank overheating.	☐
If three or more boilers are networked using CAN bus, ensure that you have removed appropriate jumpers from the center boilers. For instructions, see *Removing jumpers when networking three or more boilers on page 48*.	☐

Intentionally left empty

4.0 Start-up

Note

For a boiler to fire, it needs an "enabler" across the load such as a zone valve end switch, thermostat switch, or jumper.

When a boiler is first energized, the controller runs through a power-up sequence that takes approximately one minute. During this time, the controller completes a self-diagnostic, and loads all previous settings. When power is restored after a power interruption, the boiler automatically resumes operation with all the previously stored values.

If commissioning a boiler with a new (replacement controller), see *Programming a replacement touchscreen controller on page 80*.

4.1 Start-up checklist

Start-up Checklist	Check
Measured the inlet gas pressure. Refer to the boiler's *Installation and Operating Instructions* manual.	☐
Tested the flue gas (combustion test). Refer to the boiler's *Installation and Operating Instructions* manual.	☐
Tested the ignition system safety shutoff device. For instructions, see *Testing the ignition safety shutoff on page 52*.	☐
Tested the Hi Limit cutoff temperature functionality to ensure the sensor is working. For instructions, see *Testing the Hi-limit temperature function on page 52*.	☐
Tested the low water cutoff functionality to ensure that the sensor is working. For instructions, see *Testing the low water cutoff (LWCO) function on page 52*.	☐
Tested the pressure relief valve. For instructions, refer to the *Installation and Operating Instructions* manual "Service and maintenance: Relief valve" section.	☐
Checked that the exhaust pipe clamp is tight and secure (no leaking flue into the room). Refer to the *Installation and Operating Instructions* manual "Installation: Exhaust vent material" section.	☐
Tested the flow by observing the supply and return delta temperature.	☐
Verified that the correct pump is activated by the corresponding call for heat.	☐

4.2 Testing the ignition safety shutoff

To test the ignition system safety shutoff device:

1. With the boiler in operation, shut off the gas control valve directly outside the boiler case.
2. Ensure that the boiler has shut off and the appropriate error information is displayed on the controller.
3. To restart the boiler, reset the power or on the touchscreen controller, tap >**Clear Errors** > **Yes**.

4.3 Testing the Hi-limit temperature function

The hi-limit temperature function monitors the maximum supply temperature set in the safety ignition module (SIM). If the water temperature exceeds the hi-limit temperature, the boiler goes into a lockout condition, requiring a manual reset.

To test the Hi-limit function:

1. Go to > **SIM Menu** > **Hi-Limit Test** > Read the instructions.

   You will need to enter a cutoff temperature below the actual supply temperature value currently displayed. For example, if the Supply Temp. value is 180°F, enter 170°F in the Cut Off Temp. box.

2. Tap inside the **Cut-Off Temp.** box, and then tap a number value > **OK**.

   The message: "Hi-Limit Detected" is displayed.

3. To reset the boiler, select the **Reset** button. The cutoff value reverts to normal upon reset.

   The message: "The SIM module has been reset" is displayed.

4. Tap **Close**.

4.4 Testing the low water cutoff (LWCO) function

The LWCO function provides continuous protection against a low water incident. If the SIM detects low water in the boiler it enters a lockout condition. Here, you will need to reset the boiler. To test the LWCO on the boiler, you can also manually place the boiler in a lockout condition.

To test the LWCO function:

1. Go to > **SIM Menu** > **LWCO Test** > Read the instructions.
2. On the touchscreen controller, select the **Reset** button.

   The message: "The SIM Module has been reset" is displayed.

3. Tap the **Close** button.

Intentionally left empty

5.0 Setting loads

Boiler networks are designed for single-load applications and certain two-load systems. A three- or four-load sequential management strategy, popular on single boiler residential systems, does not typically scale up to larger multi-boiler applications. Large systems imply significant thermal masses that generally cannot change temperature quickly.

The controller can control up to four load pumps that are zoned for the same temperature. However, for multiple-temperature applications, you should use external mixing valves or injection control for cooler demands, or "Opt-out" strategy (for a description of the "opt out" feature, see *Domestic hot water (DHW) on page 21*).

Note

For multi-boiler systems, you must configure the boiler network configuration before setting loads. For instructions, see *Configuring multiple boiler systems on page 67*.

1. Leave loads in subordinate boilers set to **Off** (see Opt-out section for exceptions).
2. Set up and configure heat loads on the master boiler only. Use the Advanced Setup menu to specify:
   - A set temperature (Setpoint) or
   - The reset heating curve.
     The boiler will supply the "Design Supply Temperature" on the coldest days of the year (as defined by the "Design Outdoor Temperature" appropriate to your area; contact your heating wholesaler if unsure of this value). The target temperature will change according to the outdoor sensor inputs.

The controller is programmed with default settings and parameters typical of standard installation conditions. You can use one of two methods for setting up loads:

- **Setup** (recommended method) is a quick method for setting all the necessary parameters for most single-boiler installations.
- **Advanced Setup** is recommended for the advanced installer. For instructions, see *Setting loads using Advanced Setup on page 58*.

5.1 Configuring loads using Setup (recommended)

As the boiler controller is equipped to automatically detect altitude this value will be set for you (see ●●● > **System Settings** > **Site Settings** > **Altitude**).

Note

Zone Of is not available as an option until you have programmed a load with one of the other control modes.

5.1.1 Configuring a load on a boiler

The "Select a load" menu screen appears displaying four possible loads. All loads are set to "Off" to allow the system to be programmed to correspond to the installation's specific wiring connections.

To configure a load:

1. Tap ⚙.

   If the boiler has never been programmed, all loads will be set to "Off".

   For example, if Load 1 is piped and wired (Load 1 = P/V1 & Therm.1) to heat a load type, select "Load 1 - Off" button.

2. On the **Select a load** screen select a load (Load 1-4) > Select a control mode (e.g., Setpoint) > **OK**. To change the control mode, select the **Change...** button.

   > **Note**
   >
   > Zone Of is available as an option only after you have programmed a load with one of the other control modes.

   If selecting:

   - Setpoint, DHW or Ext. Control, a settings screen is populated with pre-programmed values appropriate for typical residential applications.

     To change a value: Choose a setting > Using the number pad, enter a new value > select **OK**. The temperature setting range is shown on the number pad popup. For information on recommended settings, see *Operating concepts on page 21*.

   - Reset Heating > Choose an emitter type (e.g., H-Mass Radiant) > **OK**. The Reset Heating screen is populated with default settings. Ensure that these settings will work for the intended application, and change them if necessary. For information on recommended settings, see *Reset heating on page 22*. Note that an outdoor sensor must be installed for Reset Heating.

3. Once all values are set as desired, tap **Save**.
4. Repeat steps for other loads connected to the boiler.

   Date and time in the boiler are factory set. If the boiler is connected to the internet, date and time will be updated automatically. If the boiler is not connected to the internet, you can manually change the date and time (see *Changing and updating date and time on page 78*).

5. (optional) To change units (Imperial or Metric) on the boiler, go to ●●● > **User Settings** > **Units** > Choose preferred units > **Save**.

> **Note**
>
> After defining the loads, perform a manual pump purge to ensure air is purged. Go to ●●● > **System Settings** > **Site Settings** > Set **Manual Pump Purge** to "On" > **Save**.

5.1.2 Syncing zones with "Zone Of"

To use the Zone Of control mode, you must have an active load set up. If you want to duplicate or link the configuration (load type and settings) of another active load, you can use "Zone Of". Let's say that Load 1 is already configured as a Setpoint load, and you want Load 3 to have the same properties and settings as Load 1.

To link the zone of Load 3 to match the zone of Load 1 (in our example, Setpoint):

1. Tap ⚙ to display the **Select a load** screen.
2. Tap **Load 3** > choose **Zone Of**.
3. Tap Load 1 **Setpoint**> **Save**.

Load 3 is now linked to the configuration of Load 1.

5.1.3 Changing an assigned control mode on a load type

If you are modifying a control mode on a load type and its settings, we recommend that you change the control mode before you change any setting values to prevent changes from being lost.

1. To change a control mode, tap ⚙ > choose the load you wish to change.
2. If selecting:
   a. **DHW**, **Setpoint**, or **Ext. Control**, tap **Change...** > **Save.**
   b. **Reset Heating** > choose an emitter > **OK** > Save.
   c. **Zone Of** > tap **OK** > select the control load that you wish to link the current load with> **Save**.

5.1.4 Removing an assigned control mode from a load

1. To change a control mode, go to ⚙ > choose the load you wish to change:
2. Choose a control mode (e.g., Reset Heating) > Tap **Change...** > **Off** > **OK**.

5.1.5 Changing settings in a load

After programming a controller, you can change the settings of one or more loads.

> **Note**
>
> You can adjust the Outdoor design temperature in the Advanced Setup menu.

1. To change one or more settings in a load, tap ⚙ to display the **Select a load** screen.
2. Select a setting highlighted in blue > enter a new value/option > **Save**.

5.2 Setting loads using Advanced Setup

The Advanced Setup menu provides more options for the experienced installer. For a list of operational settings in this menu, see *Operational settings in the Advanced Setup menu: temperature ranges and defaults on page 35*.

1. Go to ●●● > **Advanced Setup**.

   If the boiler has never been programmed, all loads will be set to "Off".

2. On the **Select a load** screen, choose a load (Load 1-4) > Choose a control mode (e.g., Reset Heating) > **OK**. To change the control mode, select the **Change...** button.

   Once a control mode is assigned, all the load's parameters can be edited individually.

   > **Note**
   >
   > "Zone Of" is not available as an option until you have programmed a load with one of the other control modes.

   If selecting:

   - Setpoint, DHW or Ext. Control, the settings screen is populated with pre-programmed values appropriately selected for typical residential applications. To change a default value: Choose a setting > Using the number pad, enter a new value > select **OK**. For information on recommended settings, see *Operating concepts on page 21*.
   - Reset Heating, choose an emitter type, and then **OK**. The Reset Heating screen is populated with default settings. Check the pre-programmed values carefully to ensure that they will work for the intended application. Change the settings, if necessary. For information on recommended settings, see *Reset heating on page 22*.

3. Once all values are set as desired, tap **Save**.
4. Repeat steps for other loads connected to the boiler.

Note

To reset the controller's configuration to factory settings, see *Resetting configured settings to factory defaults on page 78*.

To set up an air handler to communicate the indoor and outdoor temperatures to enable the boiler to control its reset heating curve, see *Configuring multiple boiler systems on page 67*.

Note

After defining the loads, perform a manual pump purge to ensure air is purged. Go to ●●● > **System Settings** > **Site Settings** > Set **Manual Pump Purge** to "On" > **Save**.

5.3 Setting up an external control load

To set up external control (BMS) to manage a desired boiler set point:

1. Go to ●●● > **Advanced Setup**.

   If the boiler has never been programmed, all loads will be set to "Off".

2. On the **Select a load** screen, choose **Ext. Control** > **OK**. The settings screen is populated with pre-programmed values appropriately selected for typical residential applications.
3. In the **Burner on from** field, choose either **Thermostat** or **Ext. Control**.
   - » If set as "Thermostat" (dry-contact enabled), the boiler will wait for a call for heat from the thermostat terminal associated with the load, and then look at the Ext. Cont. terminals for the target water temperature signal.
   - » If set to "Ext.Cont.", the controller only uses the Ext. Cont. terminals to determine a call for heat. If the voltage at the Ext. Cont. terminals is below 2.1VDC there is no call for heat. If the voltage is at or above 2.1VDC, then there is a call for heat.
4. In the **Minimum control** field, set the minimum supply set point temperature from the BMS for Voltage 2.1VDC (e.g., 81°F)
5. In the **Maximum control** field, set the maximum supply temperature for the BMS for Voltage 9.5VDC (e.g., 170°F)
6. In the **Maximum** (boiler) **supply** field, enter the system high limit (e.g., maximum 190°F).
7. In the **Water from** field, for a:
   - » Single boiler, choose **Outlet** > **OK**.
   - » Multiboiler network, choose **Sec. Loop** > **OK**.
   - » Buffer tank, choose **Sec. Loop** or **DHW** > **OK**.
8. **Save**.

5.3.1 Setting up external control for heat output (firing rate) – single boiler

The following procedure documents setup required when the external control is modulating the boiler output (firing rate). It applies only for a single boiler operation, or in a multiboiler system where system input from the BMS is wired to each boiler.

To set up external control for Heat Output:

1. Go to ●●● > **Advanced Setup**.

   If the boiler has never been programmed, all loads will be set to "Off".

2. On the **Select a load** screen, choose **Ext. Control** > **OK**. The settings screen is populated with default values.
3. For external control of firing rate, tap ●●● >**Installer Options** > enter the default password **1445** > **OK** >**System Options** > Change **Ext. Control Heat Out** from **Disabled** to **Enabled**> **OK** > **Save**.
4. Return to ●●● > **Advanced Setup** and re-open the **External Control** load. You will now be see an option **External Control for**. Change **Setpoint** to **Heat Output** >**OK**.
5. In the **Minimum control** field, set the minimum firing rate for the BMS Voltage 2.1VDC.
6. In the **Maximum control** field, set the maximum firing rate for the BMS Voltage 9.5VDC.
7. In the **Maximum supply** field, enter the system high limit temperature (e.g., maximum 190°F).
8. In the **Water from** field leave it at default **Outlet** > **OK**.
   - » Buffer tank, choose **Sec. Loop** or **DHW** > **OK**.

5.4 Combining two loads to service two loads at the same time

To enable the boiler to service two loads at the same time, you can combine loads using the controller's basic mode or full mode. We recommend using the basic mode, which is the system default. For information on "Full Mode", see *Full mode load combining on page 30*. Load combining operates by this criteria:

- » The "primary" load is set at the highest temperature.
- » That both loads are set to operate within the same target temperature range (overlap of temperature).
- » That the "secondary" load is configured with a lower initial priority than the "primary" load (we recommend a priority difference of at least 15). If the secondary load's running priority becomes higher than the primary load, then it is serviced in the normal priority rotation, just

as if the load were not combined. The primary load will be dropped, and the secondary load will be serviced in the normal priority rotation.

The steps described below illustrate a typical-load combination setup of DHW with reset heating, using basic mode. In Setup, Load 1 is programmed as domestic hot water (DHW) and load 2 is programmed as reset heating. Because DHW will have the highest temperature load, it will be set up as the primary load. For examples of compatible and incompatible load settings, see *Example of compatible load combining on page 31*.

5.4.1 Combining loads using "basic mode"

To combine two loads using " basic mode" :

1. Go to ●●● > **Advanced Setup** > **Load Combining**.

   The "Basic Mode" box is checked by default.

2. In the **Primary Load** field, tap **Disabled** > select the load type that will control boiler operation (while load combining is active), in our example Load 1- DHW> **OK**.
3. In the **Secondary Load** field, tap **Disabled** > select the load type for the secondary load, in our example, Load 2 - Reset Heating > **OK**.

   A message appears reminding users that a mixing valve must be used in basic mode.

4. Tap **Yes** to confirm that a mixing valve has been installed >**Save**.
5. Check the Status field. If the field indicates that it is out of temperature range, you may need to adjust the temperature of one of the loads.

5.4.2 Combining loads using "full mode"

To combine two loads using " full mode" :

1. Go to ●●● > **Advanced Setup** > **Load Combining**.

   The "Basic Mode" box is checked by default. .

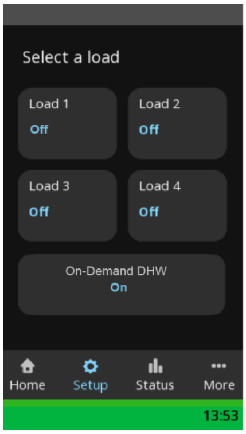
2. Uncheck the "**Basic Mode**" box to activate parameters Initial Delay, Off Delay, Retry Delay, and Maximum Throttle.

Initial Delay	Amount of time (minutes) between when the primary load is being serviced and the secondary load is brought on to be serviced. For example, 5 equals 5 minutes.
Off Delay	The minimum continuation of combination after loads initially combine, regardless of an under-temperature condition. Default is 5 minutes.
Retry	The system was unable to bring on a load because of a conflict with set rules.

Delay	Indicates the amount of time (default is 10 minutes) before the system will attempt to service the secondary load.
Maximum Throttle %	If say the throttle is set at 75% (default) and the boiler is already running over 75% of it full fire the secondary load will not be allowed to be serviced at the same time. Once the boiler is running below 75% of its capacity, the secondary load will be serviced.

3. In the **Primary Load** field, tap **Disabled** > select the load type that will control boiler operation (while load combining is active), in our example Load 1- DHW> **OK**.
4. In the **Secondary Load** field, tap **Disabled** > select the load type for the secondary load, in our example, Load 2 - Reset Heating > **OK**.
5. To change the Initial Delay default, tap **5** > from the number pad, pick a number > **OK**.
6. To change the Off Delay default, tap **5** > from the number pad, pick a number > **OK**.
7. To change the Retry Delay default, tap **10** > from the number pad, pick a number > **OK**.
8. To change the Maximum Throttle %, tap **75%** > from the number pad, pick a number > **OK**
9. Tap **Save** to save the changes.
10. Check the Load Combining screen. If the field indicates that it is out of temperature range, you may need to adjust the temperature of one of the loads.

6.0 On-Demand DHW options (Combi Boiler only)



This section outlines the different options added to the controller for use with combi boilers. Additions include the DHW Setpoint displayed on the Home screen, On-Demand DHW Load Configuration options, and fields relating to the On-Demand DHW function shown on the Status screen.

Similar to the other load settings, the On-Demand DHW load settings come with factory defaults. You can change these defaults to suit your application and heating requirements.

6.1 On-Demand DHW Load Configuration

The controller is programmed with default settings and parameters typical of standard residential installation conditions. For more information, see *Setting loads on page 55* in the main Controller manual. You can use one of two methods for setting up the On-Demand DHW load:

- **Setup** (recommended method) is a quick method for setting all the necessary parameters for most single-boiler installations.
- **Advanced Setup** is recommended for the advanced installer. For instructions, see *Setting loads using Advanced Setup on page 58* in the main Controller manual.

6.1.1 Configuring the On-Demand DHW load

The "Select a load" menu screen displays four possible loads and a On-Demand DHW load option.

To configure the On-Demand DHW load:

1. Tap **Setup**.

   If the boiler has never been programmed, the On-Demand DHW load will be active, and all other loads set to "Off".

2. On the **Select a load** screen select **On-Demand DHW**. For details on the different options, see *Table 7* .
   - To activate or deactivate the On-Demand DHW load: Select **Load Active** > select **On** or **Off**.
   - To change the DHW target temperature: Select **Target (DHW Temp)** > Using the number pad, enter a new value > select **OK**. The temperature setting range is shown on the number pad popup.
     - If Output over 140°F (60°C) is selected, a warning pop-up requests confirmation that this is a special high-temperature application.

» To set the On-Demand DHW mode: Select **Fast-Heat Mode** > select your desired mode > select **OK**. See *On-Demand DHW modes: Standard and Fast-Heat modes on page 64* for more information on each mode.

» In **Fast-Heat Mode** you can select the **Min. Supply Temp**. The boiler will try to heat up the heat exchanger to that value.

3. Once all values are set as desired, tap **Save**.

Note

After defining the loads, perform a manual pump purge to ensure air is purged. Go to ●●● > **System Settings** > **Site Settings** > Set **Manual Pump Purge** to "On" > **Save**.

6.1.2 On-Demand DHW modes: Standard and Fast-Heat modes

In the On-Demand DHW Settings screen, you can select between three On-Demand DHW modes:

Standard Mode (Off): The DHW heat exchanger will not maintain the DHW target temperature between demands for hot water.

Fast-Heat Mode (Always On): The DHW heat exchanger is maintained at the DHW target temperature.

Intelligent Fast-Heat Mode (Intelligent): This mode operates like the Fast-Heat mode but has the added advantage of learning when the domestic hot water is used. During the low use periods, the heat exchanger is allowed to cool.

6.1.3 Operational settings in the On-Demand DHW Settings screen

Operational settings in the On-Demand DHW Settings screen			
Setting	**Description**	**Range**	**Default**
Load Active	Activates or deactivates the On-Demand DHW Load	On, Off	On
Target (DHW Temp)	The target temperature for the On-Demand DHW load	95°F -149°F	120°F
Fast-Heat Mode	Sets the On-Demand DHW heating mode. See *On-Demand DHW modes: Standard and Fast-Heat modes on page 64*	Off, Always On, Intelligent	Off

Table 7 *Operational settings in the On-Demand DHW Settings screen*

6.2 On-Demand DHW Status Readings

You can check the status of the On-Demand DHW operation by going to **Status** > **Boiler Status** and scrolling to the end of the list. Below are the available readings used for the On-Demand DHW heat exchanger.

On-Demand DHW Status Readings	
Status	**Description**
DHW Flow	The flow rate going through the On-Demand DHW heat exchanger.
DHW Input Temp.	The inlet DHW temperature going through the On-Demand DHW heat exchanger.
DHW Output Temp.	The outlet DHW temperature going through the On-Demand DHW heat exchanger.
DHW Divert Pos.	The position of the diverting valve, indicating a range between 0 and 400. At 0, 100% of the water is going through the domestic loop. At 400, 100% of the water is going through the outside loop.

Table 8 *On-Demand DHW Status Readings*

On-Demand DHW Error Messages	
Error	**Description**
Combi Block Error	Combi Block is not connected or not responding
Combi Diverter Error	Diverter motor is not connected or not responding
No Combi Inlet Temp. Sensor	Invalid inlet temperature sensor reading
No Combi Outlet Temp. Sensor	Invalid outlet temperature sensor reading
Inverted Combi Temp. Sensors	Possibly, temperature sensor are swapped

Table 9 *On-Demand DHW Errors*

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7.0 Configuring multiple boiler systems

When configuring a network of boilers, you can assign a boiler as the "master" boiler, so that it can control the other "subordinate" boilers on the network. This enables all heating loads to be set up via the master boiler.

7.1 Checklist for configuring multiple boilers

Checklist for Multi-boiler Setup	Check
Master boiler is configured (see "Configuring a master boiler" below).	☐
Subordinate boilers are configured (see *Configuring a subordinate boiler on page 68*).	☐
All subordinate boilers have a unique ID.	☐
Master boiler designated and all boilers shown on the network (see *Confirming network programming was successful on page 68*).	☐
A secondary loop sensor is wired to the master boiler controller (see TB2: 15-16 at *Figure 12*) and the heat load is mapped to the secondary loop sensor (Water From° set to Sec. Loop).	☐

7.2 Configuring a master boiler

You can assign a boiler among a group of boilers as the "master" boiler. When you configure a boiler as the master boiler, it receives all sensor and dry contact call-for-heat signals, manages the secondary pumps, and coordinates the firing of all boilers in the group.

To assign a boiler in a network as the master (lead) boiler:

1. Go to ●●● > **Advanced Setup** > **Multiboiler**.

   Note

2. In the **Boiler ID** field, tap **0** > On the number pad select **1** > **OK** to set the default value from 0 to 1. Note that the master can be assigned any ID in its range.
3. In the **Master** field, tap **No** > **Yes** (for Master boiler only – leave all other boilers set to "No"). After assigning a master, the screen populates with these fields: Staging delay, Rotation, Fixed Lead, Firing Order, Add Level (%), Drop Level (%), Opt Out box Types, boilers Online, Boilers Available, Boilers Firing.

   The Master Redundancy field is used to assign a secondary master should the master boiler fail.

4. (If desired) In the **Staging Delay** field, tap **8** (default staging delay in minutes), and on the number pad, set the minimum delay time before the next boiler comes on line (must be at minimum equal to time for closed-loop water to complete one full circuit of system. For large mass systems, allow for two or more loop times).

Rotation is turned to "On" to balance the run time on each of the boilers. When Fixed Lead is turned to "On", the master boiler will always be the first to answer a call for heat. If left to "Off", the boiler on the network with the least run time will be the first respond to a call for heat. Note that when Rotation is set to "On", Fixed Lead is treated as "Off".

5. (If desired) In the **Rotation** field, tap **Off** > **On**. This gives each boiler similar run times. There is a 48-hour maximum allowable run time difference between boilers.

   If prompted to restart, tap **Cancel**, and go back to the ●●● > **Advanced Setup** > **Multiboiler**.

6. (Applicable if Fixed Lead is set to "On" and Rotation is set to "Off) To promote more balanced run times, in the **Firing Order** field > tap > **First On / first Off** > **First on / last off** > **OK**. "First On / Last Off" allows for wider turndown ratios when a smaller model boiler is chosen as a master of larger model boilers.

   > **Tip**: For a quick check that the system is calls boiler as configured, temporarily change the "Staging Delay" to one minute.

7. Tap **Save**. The text "Master" should display in the Status bar.

7.3 Configuring a subordinate boiler

Each subordinate boiler requires a unique ID and the “Master Boiler” option must be set to “No”. Subordinate boilers that will be controlled by the master boiler require some basic configuration.

To configure a subordinate boiler:

1. Go to ●●● > **Advanced Setup** > **Multiboiler**.
2. In the **Boiler ID** field, tap **0** > On the number pad select a unique ID number (e.g. 2, 3 etc. - "1" is typically reserved for the master boiler, but it can be assigned any number 1-24).
3. Ensure that **Master**is set to **No** > **Save**.

7.4 Confirming network programming was successful

After assigning boiler IDs, the controller prompts you to restart. You can check that the master boiler is now the designated master.

To check that the master boiler is the designated master:

1. Go to ●●● > **Advanced Setup** > **Multiboiler**. Alternatively, go to > **Network Information**.
2. Scroll down to **Boilers Online**. The "Boilers Online" field should show the number of boilers networked.

"Boilers available" means the number of boilers available for the master to call upon. For example, there may be three boilers online ready to answer a call for heat, but when there is a call for DHW only 2 boilers will be available.

7.5 Confirming number of boilers available and firing on the network

To check available boilers that are online/ firing on a network, go to > **Network Information** > To view all available/unavailable boilers and their network IDs, see **Net. Boilers**.

7.6 Assigning fixed IP addresses to boilers on a network using a switch not connected to the internet

If you are connecting boilers on a network via a switch that is not connected to the internet, you will need to manually assign IP addresses to each boiler; for example, in a 2-boiler network.

1. Go to ●●● > **Network Settings**.
2. In the **TCP/IP** field, select **Manual**.
3. In the **IP Address** field, tap the IP address value, and on the number pad, enter an IP address > **OK**. Most home routers will accept 192.168.0.1-254 or 192.168.1.1-254. If there is a possibility that the network of boilers could have internet connectivity in the future, we recommend using 192.268.20.1-254 to avoid IP address conflicts.
4. In the **Net Mask** field, enter **255.255.255.0**. Leave "DNS Server" and "Gateway" as 0.0.0.0. > **Save**.

7.6.1 Backup Masters and other advanced features

Contact Technical Support for more information about Advanced Multiboiler Features.

Intentionally left empty

8.0 Other operating procedures

This section describes other settings that heating professionals can use when operating, servicing, or troubleshooting a boiler.

- Testing the fan operation
- Testing the firing rate
- Testing for a vent leak
- Calibrating the fan
- Performing a manual pump purge
- Limiting the minimum and maximum firing rate of the boiler
- Adjusting the space heating temperature
- Adjusting the domestic hot water temperature
- Checking the water flow in the boiler
- Setting Overrides
- Backing up and restoring a boilers' configuration and settings
- Restricting access to areas in a controller
- Switching a boiler to unoccupied "away" mode
- Resetting configured settings in a boiler to factory defaults
- Changing and updating date and time
- Changing default error lockout time periods
- Changing default units of measurement displayed on the controller's screens
- Setting the venting material
- Programming a replacement touchscreen controller

8.1 Testing the fan operation

When a boiler is not heating, you can test its fan heat output. For all models the fan heat output MBtu value should match closely the heat output MBtu value.

The test also includes the vent factor. A lower vent factor value indicates a shorter vent while a higher vent factor value indicates a longer vent. These values are useful for troubleshooting issues such as a blocked vent. To view the fan model, go to > **Boiler Information** > **Fan Type**.

To test the fan's heat output:

1. Go to ●●● > **Test Operation**.
2. In the **Fan Test: Heat Out** field, tap **0 MBtu**, then enter a heat value between 0 and the maximum firing rate> **OK**.
3. To check if the heat output value and the fan heat output value correspond, go to > **Boiler**

Status.

4. Exiting the screen will stop the fan test.

8.2 Testing the firing rate

Fuel	CO_2 at High fire		CO_2 at Low fire		CO max PPM
	Range	Target	Range	Target	
Natural Gas	8.9% - 10.0%	9.5%	8.2% - 9.2%	8.7%	<150
Propane	10.3% - 11.3%	10.8%	9.3% -10.3%	9.8%	< 250

Table 10 Combustion test target ranges - CO_2 / Maximum CO

8.2.1 Testing the high fire

1. To run the boiler at high fire you need an active call for heat. This must be a large load to maintain high fire.
2. You can set the heat-out value in manual mode to the maximum MBH for the boiler. To do this: Go to ●●● > **Test Operation** > Tap inside the **Fan Test: Heat Output** box, and using the number pad, enter the maximum MBH > **OK** .
3. When the boiler reaches high fire, insert the combustion analyzer test probe into the flue gas test port. Then verify that the CO2 reading is within the combustion test targets defined in the table below. Make necessary adjustments to the high fire on the gas valve, as necessary.
4. To exit the **Test Operation** screen, select **Back**.

Note that you cannot test the firing rate if there is a Low Air Flow error, Low RPM error, or if the fan is not operating.

8.2.2 Testing the low fire

1. To run he boiler at low fire, set the heat-out value in manual mode to the minimum MBH for the boiler. To do this: Go to ●●● > **Test Operation** > Tap the **Fan Test: Heat Out** box, and using the number pad, enter the minimum MBH > **OK**.
2. Adjust the low fire according to the table below using a Torx 15 screwdriver. Turn the screwdriver clockwise to raise the CO_2% (to richen). Turn counter-clockwise to lower CO_2%. Start with ⅛ of a turn until you see the analyzer measure a change then only make 1/16 adjustments. If changing direction on this adjustment you may notice a significant backlash.
3. To exit the **Test Operation** screen, select **Back**.

8.3 Adjusting the space heating temperature

Ensure that a reset heating or set point load is set up in the controller. See *Setting loads on page 55*.

To adjust the space heating temperature in:

- A Reset Heating load, go to ●●● > **Advanced Setup** > Select the **Reset Heating** load > tap **Design supply** temperature number value (default 125°F) > On the number pad choose a value between 50°F and 190°F > **OK** > **Save**.
- A Set Point load, go to ●●● > **Advanced Setup** > Select the **Set Point** load > tap **Boiler Supply** temperature value > On the number pad, choose a value between 59°F and 185°F > **OK** > **Save**.

8.4 Adjusting the domestic hot water temperature

To adjust the domestic hot water temperature, go to ●●● > **Advanced Setup** > Select the **DHW** load > tap **DHW Tank setpoint** temperature value > On the number pad, choose a number > **OK** > **Save**.

8.5 Testing for a vent leak

You need to drive the fan into manual high speed operation for vent leak testing.

To perform a vent leak test:

1. Go to ●●● > **Test Operation.**
2. Set **Vent Test** to "On".

Paint all joints with an approved leak test solution just as you would joints in a gas line, and make sure there are no leaks.

8.6 Calibrating the fan

After replacing a fan or performing a software update, fan calibration is required.

1. Remove all calls for heat by pulling out the entire TB2 terminal block (see *Figure 12*).
2. Go to ●●● > **System Settings** > **Restart Boiler**.
3. Tap **Yes** to "Restart the boiler".
4. Check your consent to "Run the Fan Pressure Calibration on restart?"

A red bar appears across the bottom of the display and the boiler turns off, then restarts. During calibration the status will display Offline. When the status returns to Standby, calibration is complete.

5. Restore the calls for heat by re-inserting the TB2 terminal block.
6. Confirm normal operation and install the cover to the boiler.

8.7 Performing a manual pump purge

After installing a boiler, you will need to perform a manual pump purge to ensure that air is fully removed from the piping circuit.

1. After defining loads, go to ●●● > **System Settings** > **Site Settings** > In the **Manual Pump Purge** field, set to "**On**". The manual pump purge runs until it is turned off, or when there is a call for heat. Take care not to dead-head against closed zone valves.
2. To shut off the manual pump purge, tap "**On**" to toggle to "Off".

8.8 Limiting the minimum and maximum firing rate of the boiler

If a boiler is oversized for the specific installation you can lower the maximum firing output, or if operation is unstable at low output due to a high wind environment you can raise the minimum firing rate output.

To adjust the minimum or maximum firing range on a boiler:

1. Go to ●●● > **Installer Options** > On the number pad, enter the default password **1445** > **OK**. Either:
   a. Tap **System Options** > Tap the number value in the **Minimum Output** field and enter the desired minimum output > **OK** > **Save**.
   b. Tap **System Options** >Tap the number value in the **Maximum Output** field and enter the desired maximum output > **OK** > **Save**.

8.9 Checking the water flow in the boiler

To see a calculated water flow (based on firing rate and temperatures), go to  > **Boiler Status** > **Flow Rate**. Refer to the Specifications table in the *Installation and Operation instructions* manual for the required flow rate.

8.10 Setting overrides

Note

Date and time must be set in the boiler for overrides to work. For instructions, see *Changing and updating date and time on page 78*.

Applying an override changes a load's temperature targets according to a schedule. Typically, temperature overrides for a load are used to reduce temperatures during night-or-away hours to achieve fuel savings.

Conversely, you can use overrides to increase temperatures for defined time periods in a day. For example, a domestic hot water load may be set up for a nighttime override of heating up 140°F to ensure the tank is free of bacteria, or appartment managers may want to set up a DHW override so that the water is extra hot for the morning. If using temperature overrides:

- For Reset Heating loads, the Indoor Setpoint temperature setting is overridden for the programmed time periods.
- In setpoint loads, the Boiler Supply temperature setting is overridden.
- In DHW loads, the DHW Tank Setpoint is overridden. The DHW Boiler Supply temperature is also overridden to keep the difference between the Boiler Supply and the DHW Tank Setpoint temperature the same when the override is in effect.

To set up a temperature override (example for a DHW load):

1. Go to ●●● > **User Settings** > **Overrides**.

   Each load can have two automated (override) programs for each day of the week: Prog 1 and Prog 2. Each program includes one override temperature that can be applied during two separate programmable time periods, for example, in the morning and in the evening.

2. Tap the **Edit** button for the DHW load (the system is programmed to heat the DHW to 125°F).
3. Tap either **Prog 1** or **Prog 2** next to a day of the week, for example Monday.

   Each period is defined by a start and an end time in 24-hour clock format. If the programmed times overlap, Prog 1 will supersede Prog 2.

4. Tap the **DHW Tank Setpoint** value > On the number pad, enter a temperature value, for example, 140°F > **OK**.
5. In the **Start Time 1** field, tap **0:00** > Enter the hour and minutes, using the 24- hour format (e.g., 01:00) > **OK** > **OK** to confirm.
6. In the **End Time**field, tap **0:00** > Enter the hour and minutes, using the 24- hour format (e.g., 04:00) > **OK** > **OK** to confirm.
7. Tap the **Save** button to save the settings in the selected program.
8. (Optional) Repeat steps 3-7 to configure program settings for the other days of the week.

9. When you have finished entering the necessary settings for the required program(s), tap the **Back** button.
   Temperature Override programming can be enabled or disabled for each load independently, without affecting the temperature and time settings for each day of the week.
10. Tap the **Enable** box next to a load with a temperature override, so that it has a check mark in the box.
11. Tap the **Save** button, and then tap the **Back** button to return to the Overrides screen.
12. Now, when you want to set the override, check the **Enable** box next to the DHW load that has the override set up > **Save**.

Based on the programmed settings above, the system begin heating the DHW at 01:00 am to 140°F, and will end at 04:00 am, and revert to heating the DHW at 125°F. This will continue every Monday during the night until you uncheck the "Enable" box.

Note

The automated override feature for DHW needs a tank sensor, not an aquastat (for which DHW *Tank Setpoint*has no effect).

8.11 Limiting the minimum and maximum firing rate of the boiler

If a boiler is oversized for the specific installation you can lower the maximum firing output, or if operation is unstable at low output due to a high wind environment you can raise the minimum firing rate output.

To adjust the minimum or maximum firing range on a boiler:

1. Go to ●●● > **Installer Options** > On the number pad, enter the default password **1445** > **OK**. Either:
   a. Tap **System Options** > Tap the number value in the **Minimum Output** field and enter the desired minimum output > **OK** > **Save**.
   b. Tap **System Options** >Tap the number value in the **Maximum Output** field and enter the desired maximum output > **OK** > **Save**.

8.12 Backing up and restoring a boiler's configuration and settings

You can back up/restore a boiler’s complete controller configuration and settings to or from a USB memory stick that you can then load onto other boilers. This saves time when setting up multiple boilers that will have the same configuration and settings.

8.12.1 Backing up a boiler's configuration and settings

1. Go to ●●● > **System Settings** > **Backup and Restore**.
2. Choose **This Boiler** or **Boiler Model**:
   - » "This Boiler" creates or loads a copy of the configuration for the specific single boiler.
   - » "Boiler Model" creates or loads a copy/clone of the configuration. Creating a standard boiler configuration allows for quick loading of settings into another boiler of the same model.
3. Insert a USB Flash into one of the ports on the left-hand side of the controller.
4. Select **Backup** to save the boiler's configuration and settings to the chosen device.

8.12.2 Loading boiler configuration and settings from a device onto another boiler

To load the configuration and settings backed up on a device to another boiler:

1. Go to ●●● > **System Settings** > **Backup and Restore**.
2. Choose **This Boiler** or **Boiler Model**:
   - » "This Boiler" creates or loads a copy of the configuration for the specific single boiler.
   - » "Boiler Model" creates or loads a copy/clone of the configuration. Creating a standard boiler configuration allows for quick loading of settings into another boiler of the same model.
3. Insert the device containing the boiler configuration and settings into one of the ports on the left-hand side of the controller.
4. Select **Restore** to save the configuration and settings from the USB stick to the chosen boiler.

8.13 Restricting access to areas in a controller

In the controller, you can restrict access to the boiler controls by enabling password access. When you enable password protection, you are provided with an installer default password and a user default password. These passwords cannot be changed. The installer password enables the heating professional to access all options in the boiler. You can give the homeowner the user default password, so that they can access User Settings.

To turn on password protection:

1. Go to ●●● > **Installer Options** > enter the Installer password 1445.
2. Select **User Lock** >**On**.The screen confirms the default passwords: User Password: 4321 and Installer Password: 1445.
3. Tap **Save** to enable password access.

When password protection is activated, the Installer password will be required to access the four loads on the "Setup" menu, the "Advanced Setup", "System Settings", "Network Settings", and "Test Operation" screens. The User password will be required on "User Settings" (under ●●●).

The 'Security' password is permanent until it is turned "Off".

8.14 Switching a boiler to unoccupied "away" mode

You can reduce energy consumption by switching the boiler to "unoccupied" mode during holidays or other away periods.

In unoccupied mode, the:

- DHW load is turned off.
- The circulating water temperature of a Reset Heating load is lowered by reducing the Indoor Setpoint° to 50°F / 10°C.
- Setpoint controlled loads are not adjusted through this process to avoid the potential for boiler cycling as there is no linkage with the relevant thermostat.

To turn on unoccupied mode, go to ●●● > **User Settings** > Remove the check mark from the **Occupied** check box > **Save**.

To remove unoccupied mode, go to ●●● > **User Settings** > Check the **Occupied** check box > **Save**.

8.15 Resetting configured settings to factory defaults

You can use the factory default reset function when the boiler gets into an error for unknown reason or the error cannot be cleared. Or you simply want to reset all boiler settings to default.

To reset default factory settings in a boiler:

1. Go to ●●● > **System Settings** > **Reset Factory Defaults**.
2. If you are certain that you want to reset all settings, and lose all configured (customized) settings in the controller, select **Yes**. The controller will take approximately two minutes to reset to factory defaults.

8.16 Changing and updating date and time

The boiler is delivered factory-preset with date and time. Once the boiler is connected to the internet, you can set up data and time to update automatically (e.g., for daylight savings). Setting the date and time in a boiler is necessary for programming overrides. You can also manually change the time zone.

8.16.1 Setting up date and time to update automatically in a boiler connected to the Internet

If the boiler is connected to the Internet or to a computer (e.g., a server set up on an internal network that acts as the NTP time source), you can set up date and time to update its internal clock automatically from an Internet time service.

1. Go to ●●● > **User Settings** > **Date & Time**.
2. Select the **NTP Server** option. When NTP server is selected, the time in the controller synchronizes daily with the NTP server.
3. In the **Time** field, tap the time (blue link) > On the **Enter Time** popup, and set the time in hours and minutes (using the 24-hour format) > **OK**.
4. In the **Date** field, tap the date > On the **Enter Date** popup, enter the year/month/date > **Save**.
5. In the **Time Zone** field, tap the zone > On the **Time Zone** popup, select your time zone > **OK**.
6. Tap **Save**.

8.16.2 Changing the default date and time in a boiler not connected to the Internet

If the boiler is not connected to the internet, there will be times when you need to manually set/reset a boiler's date and time. For example, if the boiler has been shutoff, or if there has been a daylight saving time change.

To set the date and time manually:

1. Go to ●●● > **User Settings** > **Date & Time**.
2. Ensure that the **Internal** option (default) is selected. "Internal" refers to an internal clock used for time keeping.
3. Set the **Date & Time** boxes, using the number pad.
4. (If required), tap the **Time Zone** field, and select an option.
5. Tap **Save**.

8.17 Changing default error lockout time periods

You can change the default lockout periods in mutes for major errors, interlock errors, minor errors and warnings.

1. Go to ●●● > **Installer Options** > On the number pad, enter the default password **1445**.
2. Tap **System Options** > In one of the Error Lockout fields, tap the number value, and on the number pad choose a value in the range indicated > **OK** > **Save**.

8.18 Changing default units of measurement displayed on the controller's screens

You can set the controller to display imperial or metric units of measurement.

Go to ●●● > **User Settings** > Units > Tap the desired unit(s) > **Save**.

8.19 Setting the venting material

The default setting for venting material in the controller is PVC. Other options include CPVC and PP (polypropylene).

Caution

If you change the venting setting, you are solely liable and responsible for selecting the correct venting type.

To select a different venting type:

1. Go to the ●●● > **System Settings** > **Site Settings**.
2. Scroll down to the **Venting Material** field, and select **PVC**.A popup is displayed indicating Installer responsibility for selecting the correct venting type.
3. Carefully choose an option, then tap **OK** > **Save**.

8.20 Programming a replacement touchscreen controller

After powering up a replacement touchscreen controller, you need to enter the correct boiler number details. Verify the correct model number on the boiler’s rating plate.

1. On the touchscreen controller, tap the **Boiler Model** box, and from the dropdown list, carefully select the correct boiler model number.

   Caution for replacement board startup

   Important:You have only one chance to enter the correct model number. If you save an incorrect model the board will be unusable and you will have to buy another controller.

2. Tap the **Save** button.

3. Select "**Setup**" to set up the loads configured in the old boiler.
4. Check that the boiler has registered the thermostat connections correctly along with the correct load types and settings.
5. Check that all pumps operate according to the previous controller.
6. Check the temperature sensor and pressure sensor readings.

Intentionally left empty

9.0 Troubleshooting

This section provides a list of controller error messages and possible way to resolve the errors. For information on the types of errors, see *Clear Errors on page 16*. Note that disconnected wires or defective sensors may be the cause of the error. Always check connections and wiring first.

Warning

Do not attempt to repair the control module (circuit board). If the control module is defective, replace it immediately.

9.1 Viewing errors

If one ore more errors are displaying on the status bar, you can view more details by going to the Error Logs screen.

1. Go to > **Error Logs** button. Alternatively, go to > **Error Logs**.
2. Tap an error log, and then tap the **Details...** button. The Error log displays all the errors present at the time of the error event such as minor errors, major errors, and system faults.

   Each error type is displayed as a dropdown that you can select to view the types of errors; for example, selecting the "View minor errors dropdown may display "SIM: See SIM Status" as a message.

Tip

Once the errors have been resolved, it is not necessary to wait for the lockout period to end. See "Clearing Errors" below.

9.2 Clearing errors

When you clear an error, the system clears any error states and forces the controller to reassess the boiler's error status and to determine if any error state is still present.

To clear the error(s), go to > **Clear Errors** > **Yes**.

Failed Touchscreen calibration

Note on TouchScreen Calibration

Care, and stylus or pencil, must be used for recalibration. A careless recalibration can render the touchscreen unresponsive. If this happens, put an empty text file named **recal_touch_screen** on a high-quality USB's root directory, insert USB, power cycle the V10, and you will be given the chance to properly recalibrate.

9.3 Troubleshooting error messages

The bottom line of the touchscreen displays the boiler's error status. The following colors represent the boiler's operating status:

- Green – Normal
- Yellow – Warning
- Red – Alarm

Errors shown on the touchscreen controller are described below as well as diagnoses and fixes. The text inside the bar will indicate the specific warning or alarm. If there is more than one alarm present the text will scroll slowly through all current alarm conditions. Besides the errors listed below, see also *Miscellaneous touchscreen controller errors on page 86*.

9.3.1 Ignition trials exceeded error

Ignition Trials Exceeded Error		
Issue	**Diagnosis**	**Fix**
Error – *Ignition trials exceeded*. Ignition Failure after 3 tries boiler has failed to ignite on 3 successive attempts. Boiler is in lockout for 1 hour, then repeats 3-try sequence. Consult service technician if error recurs.	No spark	• Check that ignition lead is secure at the control module and at the probe. • Adjust ignition probe rod gap between ⅛ and 3⁄16 th inch (3.2-4.7 mm).
	Gas line not fully purged, or manual shutoff closed.	Purge gas lines. Check for gas flow. Open manual gas shutoff and reset boiler.
	Boiler ignites, but shuts off at the end of the ignition trial. Improperly grounded pressure vessel/burner or unserviceable ignition lead or spark module.	Ensure the pressure vessel is grounded. Check the ignition probe/flame sensor is electrically isolated from the vessel, and its ceramic insulator is intact. Replace ignition lead. Replace spark module.

9.3.2 Water High Limit error

Water High Limit Error		
Issue	**Diagnosis**	**Fix**
Error – Water High-Limit	Water temperature exceeds 208°F, or 201°F for 15 sec. Boiler is in hard lockout mode.	See *Resetting a boiler after a LWCO lockout on page 90*.

9.3.3 Low Water Cut-off error

Low Water Cutoff Error		
Issue	**Diagnosis**	**Fix**
Error - Low Water Cutoff	The Safety and Ignition module has detected a low water condition.	See *Resetting a boiler after a hi-limit temperature lockout on page 90*.

9.3.4 Interlock 1 or 2 error

Interlock 1 or 2 error		
Issue	**Diagnosis**	**Fix**
Error: *Interlock [1 or 2] Open*	Jumper lead on Interlock terminals of TB2 is loose or compromised.	Replace the jumper lead.
	External safety is in an alarm state.	Inspect the external safety devices.

9.3.5 Vent High Limit

Vent High Limit		
Issue	**Diagnosis**	**Fix**
Error: *Vent High Limit*	• Venting material set to CPVC or Polypropylene (PP): exhaust gas temperature exceeds 248°F for 6 seconds, or 232°F for 60 sec. Boiler is in hard lockout mode. • Venting material set to PVC: exhaust gas temperature exceeds 205°F for 6 seconds, or 189°F for 60 sec. Boiler is in hard lockout mode.	• Check return water temperature.

9.4 Miscellaneous touchscreen controller errors

Miscellaneous errors		
Issue	**Diagnosis**	**Fix**
Error - *Max. delta T Exceeded*	• Outlet is more than 45°F (25°C) above the inlet temperature. • Outlet is rising faster than 9°F (5°C) per minute	• Check water flow. • Check temperature sensor. • Check wiring to temp sensor and control module.
Error - *Low RPM / Air Flow*	Fan is below 1150 RPM at the end of fan pre-purge, or below 100 RPM during heating.	• Check for blocked vent • Check fan wiring connections
Error - *Fan Pressure*	Exceeded SIM+ fan power threshold	• Check for blocked vent
Error - *Module High Current*	Exceeded 24 VAC to SIM+ and gas valve	• Check transformer output
Error - *Low Module Current*	Inadequate current to gas valve (starts below 25mA or stays below 20mA)	• Inspect harness and ignition cable • Inspect Interlock 1 & 2 external safety circuits for excessive resistance • Verify good supply voltage and ground • On SIM+ check for constant 24V between J2 harness terminals 1 (Red) & 7 (Blue) • On SIM+ check for 24V during a trial for ignition between J2 harness terminals 2(Orange) & 7 (Blue)
Error - *Low Water Pressure*	Inlet water pressure below 4 psi	• Check system for leaks • Check water pressure, expansion tank • Check pressure sensor connection
Error - *Inlet Pres. Sensor*	Inlet water pressure sensor appears to be shorted or disconnected.	• Check wiring to sensor • Replace sensor.
Error - *See: Status > SIM menu > Status*	SIM/SIM+ has detected an error that has subsequently cleared	• Note error in log • Restart to observe operation
Error - *Roll Out Switch*	Rollout switch, by combustion chamber, has detected 230°F temperature.	• Inspect lid, fan and ignitor gaskets • Manually reset when safe

<table>
<tr><th colspan="3">Miscellaneous errors</th></tr>
<tr><th>Issue</th><th>Diagnosis</th><th>Fix</th></tr>
<tr><td>Error - Controller Board</td><td>Error internal to control board</td><td>• Typically result of poor incoming power
• May require a reboot</td></tr>
<tr><td>Error - No Boilernet Comm</td><td>Controller set as Master detects a CANbus wiring issue</td><td>• Check Subordinate boiler is on
• Check network wiring</td></tr>
<tr><td>Error - No MAC address</td><td>Boiler cannot verify a valid MAC address</td><td>• See Network Settings</td></tr>
<tr><td>Error - Flame Signal / Vent Block</td><td>SIM+ flame current drops below minimum values shown below:</td><td>• Check for vent blockage
• Check for poor gas pressure
• Check for unstable flame or improper combustion CO_2%
• Check condition and grounding of flame rod</td></tr>
<tr><td></td><td colspan="2">Flame Current Minimums
<table><tr><th>Model</th><th>≤ 3500 RPM</th><th>>3500 RPM</th></tr><tr><td>Boiler Model 110</td><td>2.8 µA</td><td>2.3 µA</td></tr><tr><td>Combi Model 150, Boiler Model 150</td><td>3.4 µA</td><td>2.9 µA</td></tr><tr><td>Boiler Model 199</td><td>4.8 µA</td><td>4.0 µA</td></tr><tr><td>Combi Model 199</td><td>3.2 µA</td><td>4.0 µA</td></tr></table></td></tr>
<tr><td>Error - Reversed Flow</td><td>Return temperature reads higher than supply temperature for 10 minutes</td><td>• Check boiler pump flow direction
• Check wiring connections for supply and return sensors</td></tr>
<tr><td>Error - Temp. probe error</td><td>An internal temperature sensor appears to be shorted or open circuit.</td><td>• Check supply, return and vent temperature sensors
• Error will trigger if above dual sensors deliver divergent values</td></tr>
<tr><td>Error - Unhandled error code</td><td>Reserved for unforeseen conditions</td><td>Contact Tech Support</td></tr>
<tr><td>Blank – screen dark</td><td></td><td>• Check transformer; replace if damaged.
• Check circuit board for visible damage.</td></tr>
<tr><td>Controller is stuck in "service" mode after software update.</td><td>If update fails or no updates applied.</td><td>• Restarting returns the boiler to normal operation.</td></tr>
</table>

Warning

Never attempt to repair the control module (circuit board). If the control module is defective, replace it immediately.

On-Demand DHW Error Messages - 150,000 BTU/hr, 199,000 BTU/hr only		
Error Text	**Diagnosis**	**Fix**
Error - *Combi Block*	Communication error with CBI board	• Check CBI board connection • Replace CBI board
Error - *Combi Diverter*	Diverter valve current out of range	• Check for stuck diverter valve • Check diverter valve connection
Error - *No Combi Inlet Temp. Sensor*	Temperature sensor appears to be shorted or open circuit.	• Check DHW inlet temperature sensor
Error - *No Combi Outlet Temp. Sensor*	Temperature sensor appears to be shorted or open circuit.	• Check DHW outlet temperature sensor
Error - *Inverted Combi Temp. Sensor*	DHW Inlet exceeds DHW Outlet 45 seconds during DHW call.	• Check DHW temperature sensor wiring • Check DHW sensor accuracy

Important tip for DHW Errors

For On-Demand DHW Errors, in the Error Log always use the dropdown arrow and access *Details* for all the relevant information.

9.5 Warning messages

A warning message alerts the user to a condition they should be aware of, even if it has not yet prevented boiler operation. Some warnings, such as for a temperature sensor failure, turn to errors when a call for heat is detected, while others may appear during heating (e.g. *Output Limited*) or prevent a call for heat from beginning (*Unoccupied*).

Warning Messages		
Warning Text	**Diagnosis**	**Fix**
Outlet Limited	Detected greater than 40°F (22°C) difference between inlet and outlet temperature sensors.	• Check for failed pump • Check flow restriction • Check for failed temperature sensor

Warning Messages		
Warning Text	**Diagnosis**	**Fix**
Remote offline	A boiler defined as a Master cannot detect any subordinate boilers.	• Confirm boiler is properly wired to subordinate boilers • Check Subordinate boiler is on • Check IP Network numbers • Check that boilers have the same Network ID
Unoccupied	The Occupied box has been unchecked, indicating that the boiler should not fire.	• Go to User Menu, check the box Occupied
Summer	A thermostat call is detected, but the boiler will not fire because the Outdoor temperature is above the *Summer Shutdown* temperature for that load. Applies to space heating loads but not DHW.	• If required, adjust the Summer Shutdown temperature • Check that outdoor sensor is mounted on the North face of the building and not exposed to direct sunlight • Check accuracy of Outdoor temperature sensor
Failsafe Setpoint	Indication that a Subordinate boiler has lost contact with its Master, or a boiler set up for External Control has lost contact with an external controller.	• For boiler networks, confirm Master boiler is operational and properly wired to subordinate boilers • For External Control, check voltage input and wiring
• *Inlet/Outlet Sensor* • *Remote Loop Sensor* • *Pressure Switch*	Sensor issue detected between calls for heat.	Treat as corresponding sensor error message

9.6 Backing up (exporting) error logs

You may need to back up an error log onto a USB stick to send to the Technical Support team for troubleshooting.

1. To back up an error log, go to > **Error Logs** > Select an error log (link) > **Export** > Insert the USB stick into the side of the controller > **Yes**.

2. After the data is copied, remove the device from the controller > **Close**.

9.7 Deleting or clearing an error log

Deleting will delete all entries in an error log.

Go to > **Error Logs** > Choose an error log (link) > **Delete all** > **Yes** to clear all entries in the error log.

9.8 Resetting a boiler after a LWCO lockout

A boiler that has been placed in a lockout condition due to a LWCO error will need to be reset in the controller's SIM module.

1. Check that there is enough water in the system.
2. To reset the SIM Module, go to > **SIM Menu**> **LWCO Test** > **Reset** > **Yes**.
3. Go to > **Clear Errors** > **Yes**.
4. Run the boiler to ensure that the error has been cleared.
5. If the error persists, test the LWCO. Go to > **SIM Menu**> **LWCO Test** > Run the test to check if the low water cutoff sensor is opening.

9.9 Resetting a boiler after a hi-limit temperature lockout

A boiler that has been placed in a lockout condition due to a hi-limit temperature error will need to be reset in the controller's SIM module.

1. Go to > **Clear Errors** > **Yes**.
2. Check that there is no air trapped in the system.
3. To reset the SIM Module, go to > **SIM Menu**> **Hi-Limit Test** > **Reset** > **Yes**.
4. Run the boiler to ensure that the error has been cleared.
5. If the error persists, perform a hi-limit test. Go to > **SIM Menu**> **Hi-Limit Test** > Run the test to see if the hi-limit switch is opening. You can also perform this test for gasket blowouts.

10.0 Definition of terms

Term	Definition
Add Level (%)	Sets the relative ouput level at which an idle boiler fires up. This is a percent of the maximum firing rate of the lead boiler – on a Boiler Model 199, for instance, a value of 60 would correspond to an output of 199 x 60/100 = 119. Note that this value must be at least 10 higher than the Drop Level (%), which will be adjusted to satisfy this if Add Level (%) is changed.
Aquastat Control	Device used in hydronic heating systems for controlling water temperature. Typically used to manage domestic hot water temperature in an indirect water heater.
BACnet	A Data Communication Protocol for Building Automation and Control Networks - A protocol that provides information about a boiler's heating, ventilating, and air conditioning control (HVAC), lighting control, access control, and fire detection.
Boiler Pump	Enables you to shut off the Boiler Pump (primary loop pump) while a load is running. The load pump must be piped (series piping) to ensure adequate flow through the boiler without needing the Boiler Pump to provide flow through the heat exchanger. When you set the Boiler Pump to "Off" a warning message appears as a reminder. If the load is a radiant floor, we strongly recommend using primary or secondary piping and leaving the Boiler Pump set to "On".
Boiler Pump Purge Time (Site Settings)	Adjustable independently of the four load pumps. Many installations use a primary (boiler) loop. We recommend that the boiler pump operate for 3 – 5 minutes after all calls for heat have been satisfied.
Boiler Turndown	A ratio that compares the full maximum boiler heat output (high fire) to the minimum level of heat output (low fire).
Call for Heat	A call for heat could be: The thermostat is indicating that room temperature is below the thermostat setting. An Aquastat calling for DHW. The tank sensor calling for DHW.
Classic-DDC control	Involves separate dry-contact calls and throttle control signals to each boiler from external DDC. (Not generally recommended.)
Cycles	Running tally of the number of calls for heat that a load has received in the last 24 hours. Fewer cycles per day = better efficiency.
Delta T	Difference between the supply water temperature and the return water temperature.
Drop Level (%)	Sets the relative output level at which a firing boiler will be shut down as a percent of the maximum firing rate of the master boiler. Note that this value must be at least 10 lower than Add Level (%), which will be adjusted to satisfy this when Drop Level (%) is changed.

Term	Definition
DSP	Daylight Standard Pacific - time zone update.
Failsafe Enable	Fail Safe Enable is available only in External Control and only if the "Burner On From" is set to External Control. If this feature is active and the External Control voltage drops below 0.25Vdc, the boiler automatically turns on the Boiler Pump (if set to "ON"), the load pump, and operates the boiler to the Fail Safe Set Point temperature. This temperature set point is adjustable.
Failsafe SP Differential	The supply differential used by the subordinate boiler while in Failsafe SP mode. If the supply temperature exceeds Failsafe SP + (Failsafe SP Differential) / 2, then the boiler will enter Circulating until the supply temperature decreases to Failsafe SP – (Failsafe SP Differential) / 2, at which point it will reignite and enter heating again.
Failsafe SP Delay (min)	The delay in minutes of lost communication with the master, and the subordinate boiler entering Failsafe SP mode.
Enable Failsafe SP	When set to On, provides the ability to maintain a setpoint temperature in subordinate boilers if communication with the master is lost. Only available on subordinate boilers, it enables default setpoint operation. If a boiler receives no communication from a master boiler for the period "Failsafe SP Delay," it will fire at the preset setpoint/differential until communication resumes.
Firing Order	Firing Order determines which boiler is shut down first. If FirstOn/FirstOff is selected, the first boiler fired up will be shutdown first. If FirstOn/LastOff is selected, then the most recently fired boiler will be shutdown first.
Fixed Lead	A boiler that is always the first to fire up. Appears as a field if Master, Primary Master, or Secondary Master are set to "On". If Fixed Lead is set to "On", then the active master will always attempt to fire first, before any other boilers. Otherwise, the boiler with the lowest burner on time will attempt to fire first.
Fully autonomous mode	Designation of a master boiler that will receive all sensor and dry contact call-for-heat signals, manage the secondary pump(s) and, via BoilerNet connection, coordinate firing of all subordinate boilers. This fully autonomous approach uses the internal heat regulation and boiler management software.
Group Add Level (%)	Similar to Add Level (%) for master boilers, this is the relative output level at which the Group Opt Out Lead will bring another boiler on to service the Group Opt Out load. Note that this value must be at least 10 higher than Group Drop Level (%), which adjusts to satisfy this if Group Add Level (%) is changed.
Group Drop Level (%)	Similar to Drop Level (%) for master boilers, this is the relative output level at which the Group Opt Out Lead will shut down a boiler that is currently servicing the Group Opt Out load. Note that this value must be at least 10 lower than Group Add Level (%), which adjusts to satisfy this if Group Drop Level (%) is changed.
Group Opt Out Lead	This boiler is the Group Opt Out lead, and is the first to fire when a call for heat is received on the Group Opt Out load. Makes the remaining Group Opt Out fields visible.
Group Staging	Similar to Staging Delay (min) for master boilers, this value determines the

Term	Definition
Delay (min)	number of minutes between boilers being fired up or shut down by the Group Opt Out Lead.
Heating curve	Summarized as the ratio at which the water temperature increases as the outdoor temperature decreases.
Heating Enabled	The boiler is powered and there is a Call for Heat, Heat is Required. The boiler will start and enter the Heating Cycle unless it is in an error mode.
Heat pump	Uses electricity to draw heat out of a building in the summer (to cool the space) and heat from the outside air to indoors in the winter time (to warm the space).
Heat Required	Temperature sensors on the boiler indicate that water temperature is below the water temperature target or setpoint.
Indoor°From	If an indoor temperature sensor is being used, the sensor will normally be connected to the TB2 Indoor Sensor terminals on the controller board. Alternatively the TB2 2nd Loop Sensor input terminals can be wired to the indoor temperature sensor. If using TB2 2nd Loop Sensor, you must configure the Indoor°From setting as Sec. Loop. Use for shop or warehouse, but not for residential properties.
HVAC	Heating, ventilation and air conditioning system.
Master Rotation	Rotates the role of active master between any boilers configured as Primary or Secondary Masters on the network. This feature confirms that master redundancy is functioning properly. The time between master rotations is 24 hours. The active master will not attempt to pass the role of active master to a master currently in an Error or Circulating state, or to a Secondary Master currently servicing an opt out load.
n/c	Not connected
NTP Server	Network Time Protocol
Opt out	A term used to describe a boiler that "opts out"or becomes unavailable to a network to satisfy a request. Typically, opt out boilers are used and dedicated to service DHW.

Term	Definition
Opt out types Load 1-4	The Opt Out Type for each load dictates how the load is handled by the multi-boiler algorithm. » **None**: Only for boilers configured as a master. This load is serviced by the entire multi-boiler network (the master will not opt out to service the load, but will use all boilers to service it). » **Single**: » A subordinate boiler will opt out of the main multi-boiler network to service a load. » Master boilers with a load configured as Single will opt out to service that load, but will continue to control the subordinates and run the highest priority multi-boiler load. » **Group**: The boiler will opt out of the main multi-boiler network to service this load if commanded by the Group Opt Out Lead. Mainly for DHW purposes, it allows a subset of the main multi-boiler network to be configured to opt out from the main network load as needed to service the DHW load. Note: The same load (1-4) must be configured as Group Opt Out on each boiler in the group. For example, if Load 2 is configured as Group Opt Out on Boiler #1, and you want #2 and #3 to also be part of the opt out group, then Load 2 must be configured as Group Opt Out on boilers #2 and #3 as well. One boiler must be chosen as the Group Opt Out Lead – this is the only boiler that needs a physical call for heat (such as a thermostat) wired into the controller on the Group load. Only one opt out group is permitted per network. Once one load is configured as Group, it must be set back to Single or None before a different load can be configured as Group.
Outdoor°From	The Default setting is Outdoor. If an outdoor temperature sensor is being used the sensor will normally be connected to the TB2 Outdoor Sensor terminals on the controller board. Alternatively the TB2 2nd Loop Sensor or the DHW Sensor input terminals can be wired to the outdoor temperature sensor. To support these alternate wiring options the "Outdoor°From" setting must be set to Sec. Loop or DHW to correspond with the wiring.

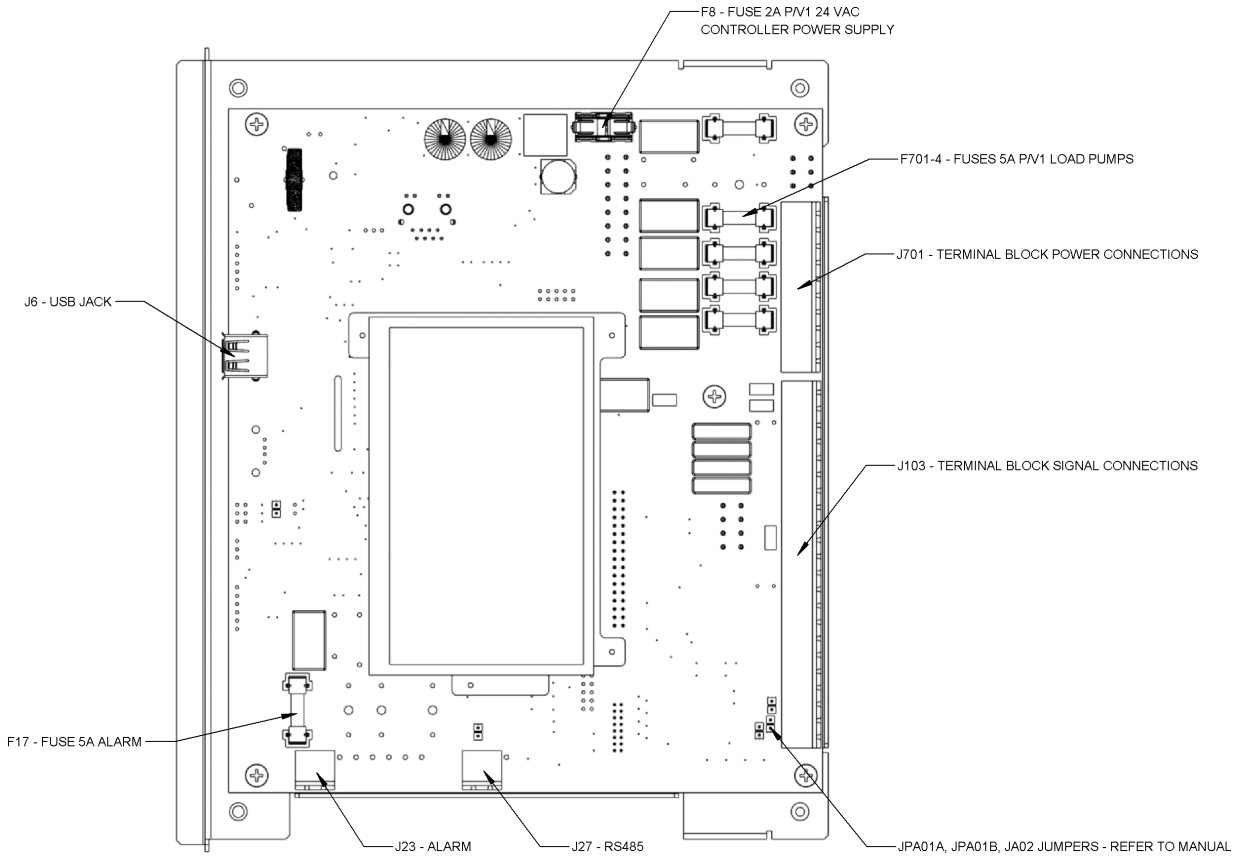
Term	Definition
Priority	A load has a priority value between 20 and 90. Note: The Priority Value has to be different for each load. A higher numerical value means a higher priority. Consider these values as minutes. The difference between two load priority values is the number of minutes the higher priority load will be allowed to operate before switching back to the lower priority load. For example, if DHW has a priority of 80 and the Set Point load has a priority of 50, the DHW load will operate for (80-50) 30 minutes while the Set Point load is temporarily turned off.
Pump Post Purge (sec)	How long a load pump operates after the call for heat has ended. Each load pump can be operated for a period of time after the call for heat has ended. This feature takes the heat left-over in the heat exchanger and nearby boiler piping after the burner has turned off and pumps it into the load. A good example of this is the indirect water heater DHW load. After the tank has reached its target temperature, the boiler shuts down, but allows the load pump to operate for a period of time to transfer heat that is stored in the boiler's heat exchanger into the hot water tank. You can adjust this feature in seconds from 0 to 900 (15 min). If the load has zone valves that close off the flow to the load as the boiler shuts down, this can be set to 0 sec. You can set each load independently to provide maximum flexibility.
Ramp Speed	How fast the boiler tries to raise the water temperature flowing through the heat emitters. With a fin tube baseboard radiator, you may want the water temperature to rise quickly to provide heat as quickly as possible. This type of heat emitter has very little mass, so it can heat up quickly. When the call for heat is removed, it cools down quickly. Generally this requires a higher (faster) ramp speed. A radiant floor, on the other hand, has significant mass, and therefore takes a long time to heat up. When the call for heat is removed, the floor is still warm and continues to add heat to the space for a significant period of time. If the indoor temperature overshoots the desired indoor temperature, we recommend reducing the Ramp Speed value. Generally this requires a lower (slower) ramp speed. You can manually set the Ramp Speed by choosing a value from 1 to 10. A setting of 1 will raise the water temperature very slowly and 10 will raise the water temperature very quickly.
Rotation	Rotation monitors the boilers on the network for a difference of more than 48 hours in burner on time. If a boiler is currently firing, which has 48 hours or more of burner on time than a currently idle boiler, the active master will tell the idle boiler to fire up. Once the master detects that the rotated in boiler is in Heating mode, and has finished its post ignition hold, it will tell the rotated out boiler to shut down. If the rotated in boiler is in Error, Circulating, or does not complete its post ignition hold within 2 minutes, the rotation will be declared a failure and the rotated out boiler will continue firing as before. Rotation balances the amount of time each boiler spends firing. If a run time difference of more than 48 hours is detected between the currently firing boiler with the most run time and the idle boiler with the least run time, the running boiler will be shut down and the idle boiler will be fired up.

Term	Definition
Semi-autonomous mode	Involves a remote analogue signal to the master boiler's External Control terminals. This signal corresponds to a target set-point temperature, with the range scaled according to the programmed min-max temperatures. The V-10 controller's multi-boiler heat regulation algorithm still determines which boiler fires, throttle levels etc., but to an externally determined operating temperature. Call-for-heat to the Master can be conveyed via a 2.1+ VDC signal on the External Control terminal, or via a dry contact boiler enable with the 0-10VDC input for target temperature.
Short Cycling	A boiler's burner turns on and off frequently. This leads to shorter component life, reduced efficiency, and higher emissions. A cycle on/off time typically should be 10 minutes or longer.
Staging Delay	The number of minutes between boilers being fired up or shut down by the master, that is, the length of time before the next boiler is brought online once the current firing boiler has passed its add boiler firing rate level. It must be at minimum equal to time for closed-loop water to complete one full circuit of system. For large mass systems, allow for two or more loop times.
Water° From	The Default setting is Outlet. When set to Outlet, the controller determines the supply water temperature from the outlet temperature sensor on the boiler. Alternatively the 2nd Loop Sensor or the DHW Sensor input terminals can be wired to a water temperature sensor. To support these alternate wiring options the Water°From setting must be set to Sec. Loop on DHW to correspond with the wiring. Multi-boiler: Most have an external sensor mounted on the building supply water.

Appendices

This section includes the controller board diagram, internal wiring diagram, Opt out DHW wiring diagram, and sequence of operation.

Appendix A: Controller Board Layout



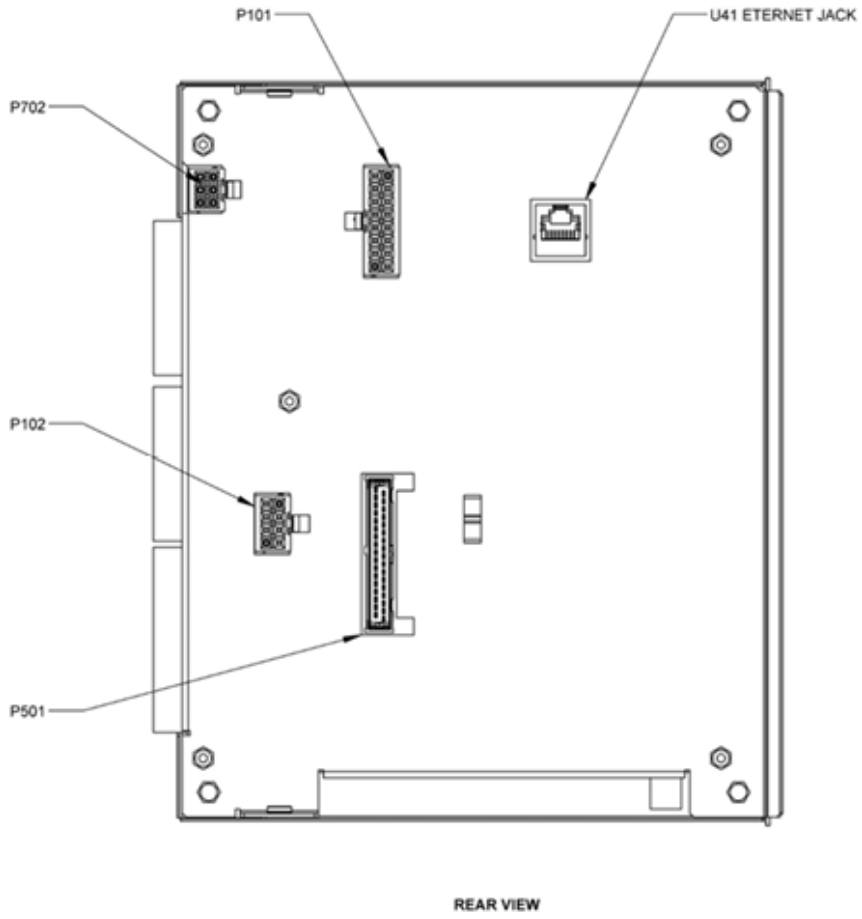


Figure 19 *Front and back of controller*

Appendix B: Controller electrical diagram - Boiler

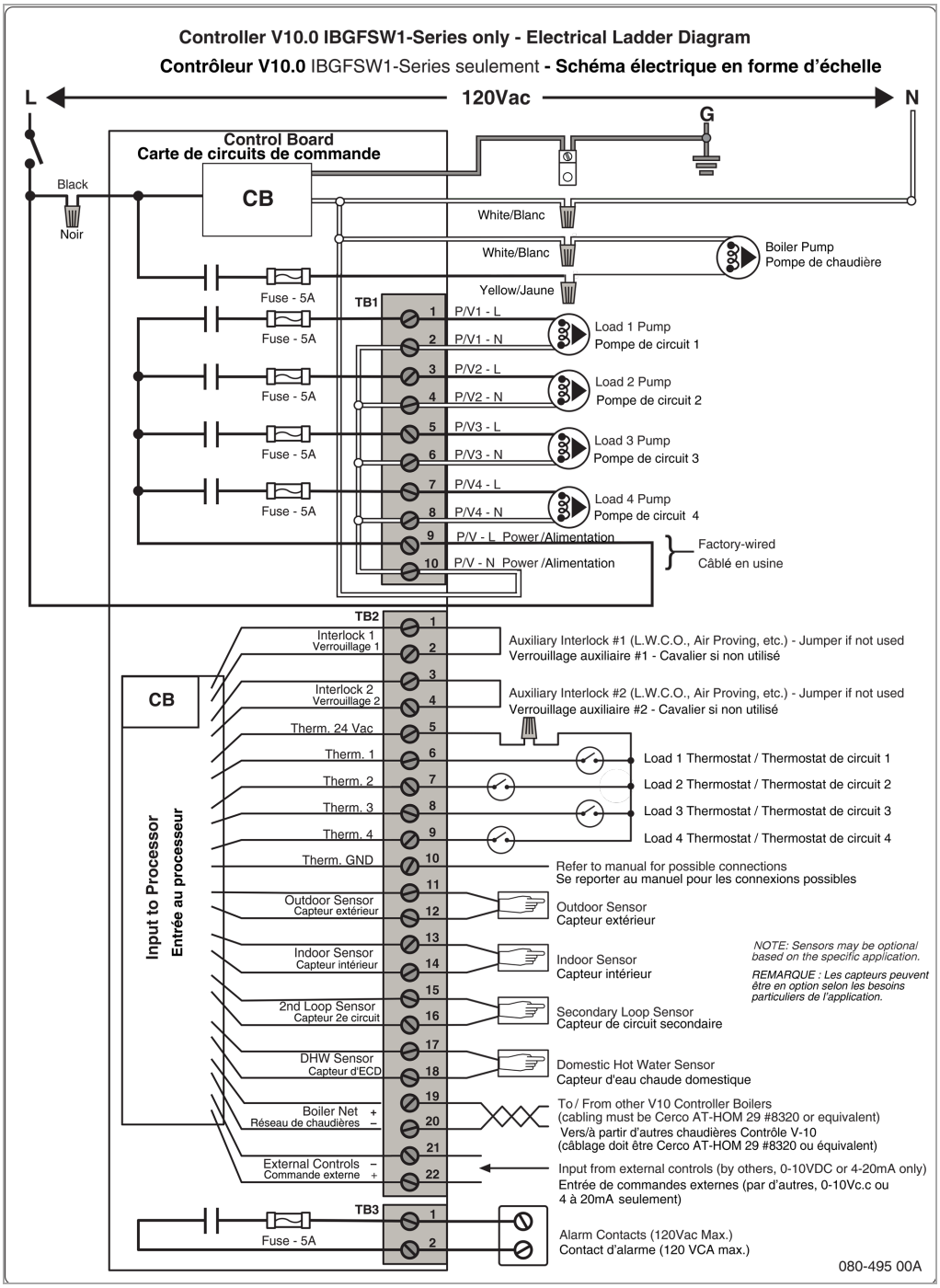


Figure 20 *Boiler - Controller diagram*

Appendix C: Controller electrical diagram - Combi Boiler

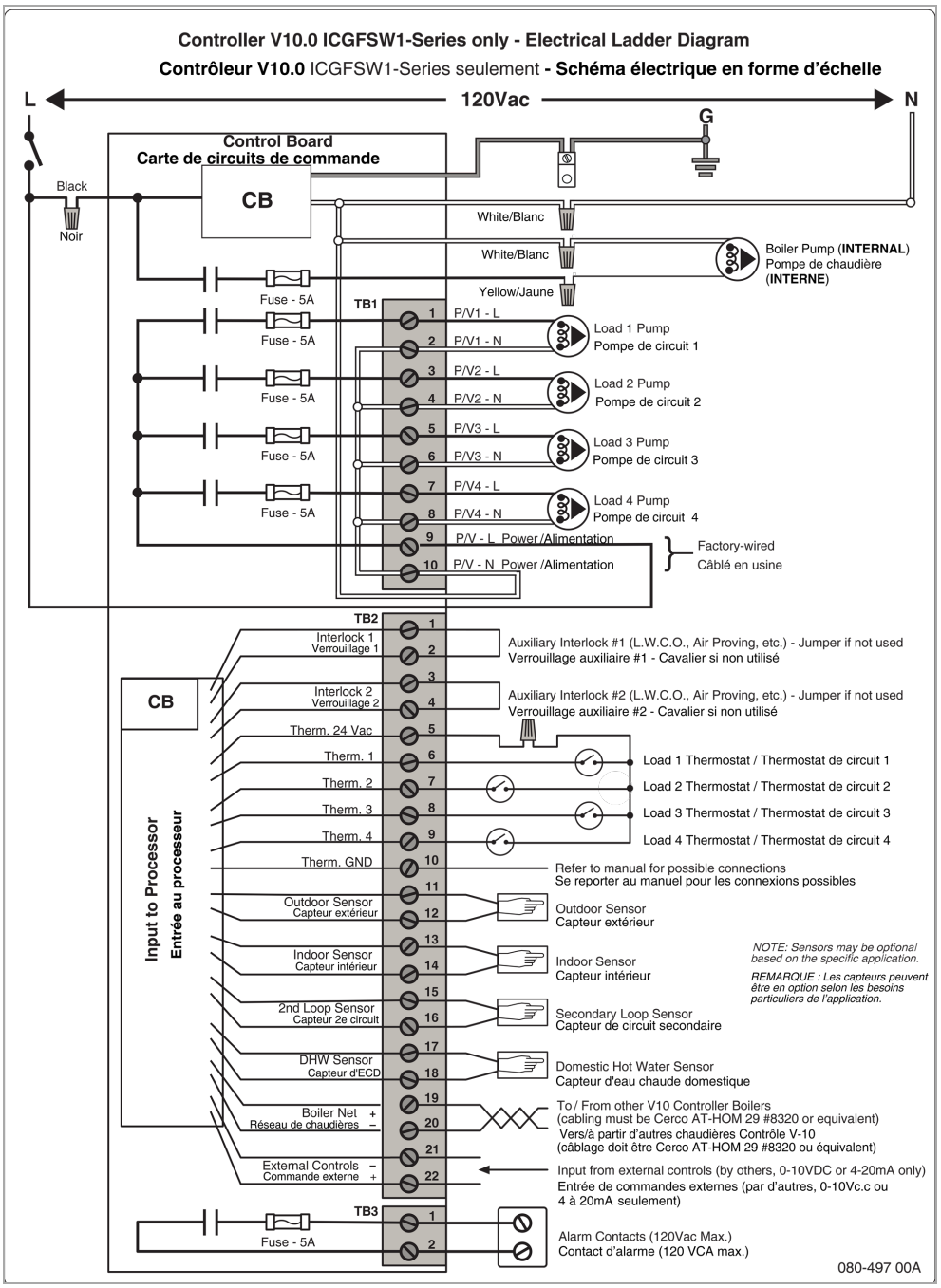


Figure 21 *Combi Boiler* - *Controller diagram*

Appendix D: Wiring diagram - Opt Out DHW

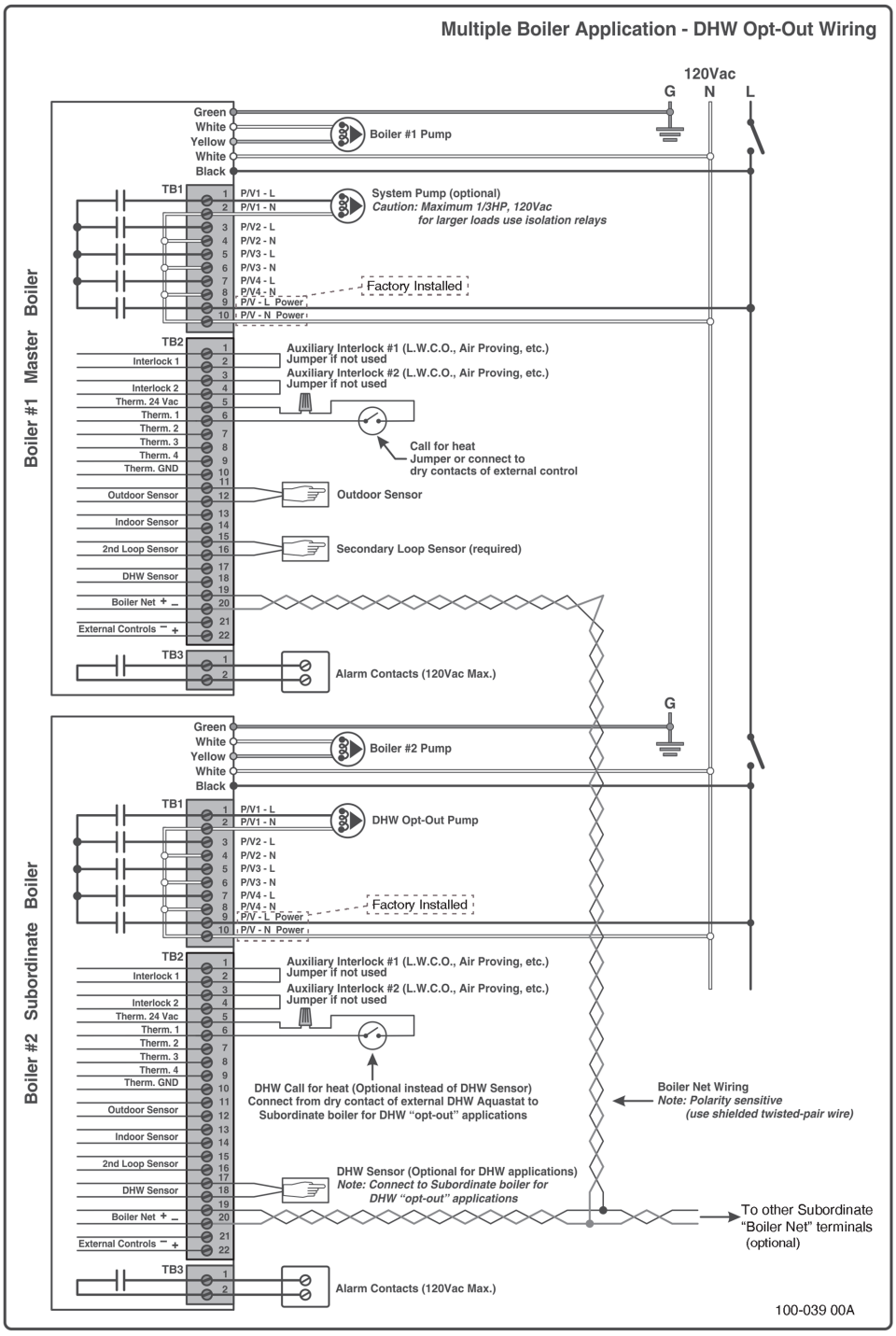


Figure 22 *Opt Out DHW wiring diagram*

Appendix E: Sequence of Operation

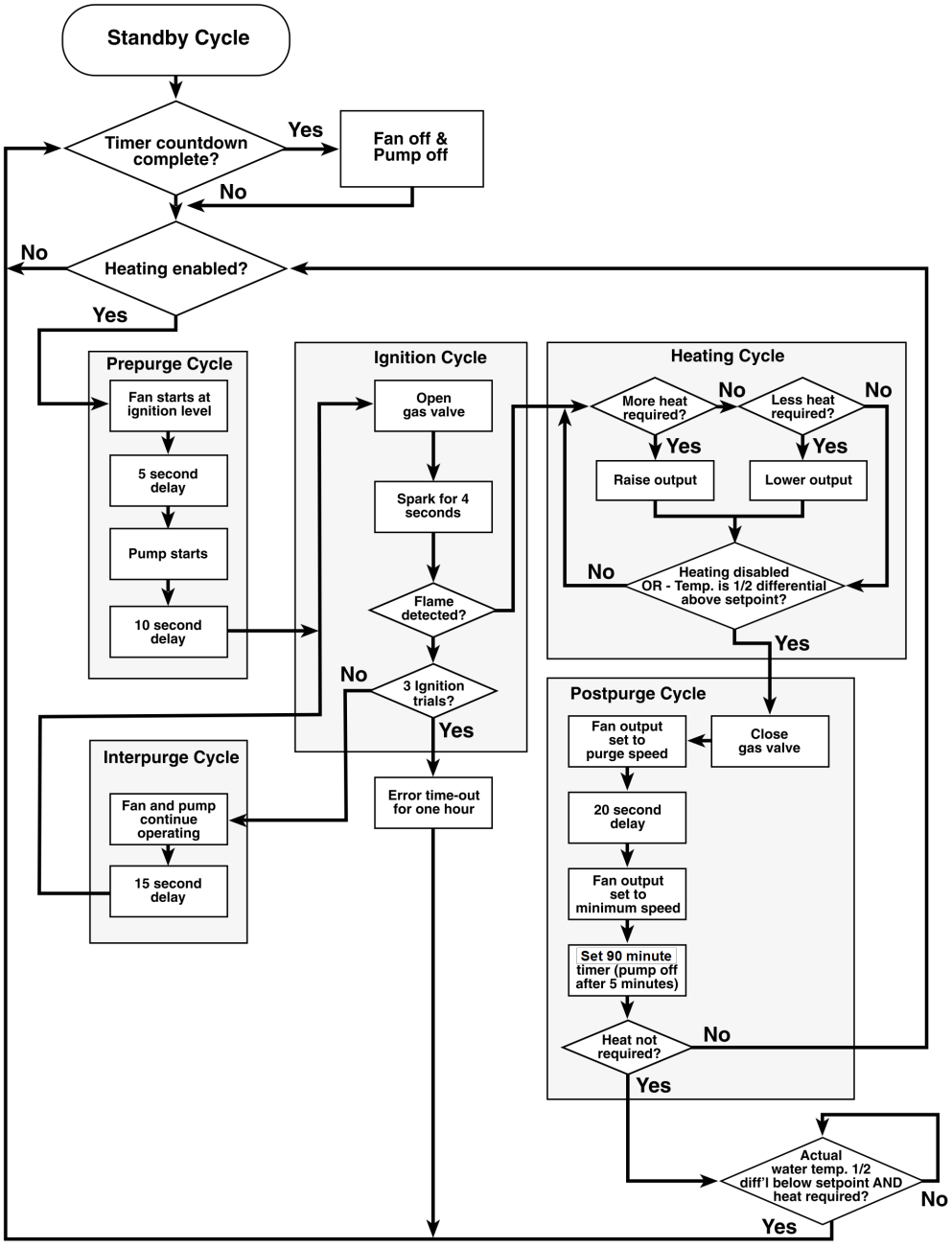


Figure 23 *Sequence of Operation*

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