# Burnham Sage2.1 Boiler Control System (SBC2.1) - Overview

***The Burnham Sage2.1 is an "Advanced" Boiler Control System***

- ***It manages ignition and modulation of the boiler's firing rate***
- ***It monitors the limit string***
- ***It monitors temperatures for supply/return/stack/outdoor***
- ***It controls pump operation for boiler, the indirect water heater, and the system***

The Burnham Sage2.1 boiler control system is the next generation of advanced electronic controls designed specifically for condensing boilers by U.S. Boiler Company in partnership with Honeywell. The Sage2.1 is currently installed on Burnham Alpine condensing boilers and will be incorporated into additional condensing boilers in the future.

The Sage2.1 was designed with many features that make the control simple to understand and use, as well as features that optimize boiler performance, flexibility and overall system efficiency and reliability. The Sage2.1 builds on the impressive list of standard features that were provided with the original Sage2 control system. Additional features incorporated into the Sage2.1 system now allow multiple Sage2.1 equipped boilers to be connected with simple RJ45 Ethernet cables and staged from an internal sequencer. All the features on the Sage2.1 control system make boiler installations more competitive and easier to install and set up in the field. The Sage2.1 boiler control system is simply the most powerful, versatile, and installer-friendly boiler control available and it is only available on Burnham brand products. Here are the key features of this exciting new control system:

- **Touch Screen LCD Display:** Every boiler equipped with the Sage2.1 boiler control will include a built-in LCD touch screen control. Boiler status, settings, and diagnostic information are all accessible from the display in simple English text. Control settings can be adjusted from the display, and advanced settings are protected with two levels of password protection to prevent advanced settings from being adjusted by unauthorized users. Built-in diagnostics allow simple trouble-shooting of the boiler. In the event of an error or lockout, the Sage2.1 display turns red. Blinking buttons guide the user through diagnostic screens that explain the issue and how to resolve or repair the issue. Help screens are provided, offering detailed explanations of each setting in simple terms that are easy to understand. The Sage2.1 is intuitive, and guides the user through the settings. This reduces the amount of time spent on the job scanning through control manuals, and gets the installer off the job quicker with fewer issues.

- **Control Data Logging:** The Sage2.1 can display and recall information from numerous control parameters. The previous five (5) lock-out events can be recalled on the display. Real time trending tracks the following four parameters: Supply Temperature, Return Temperature, Flame Signal, and Boiler Firing Rate in a running graphic display. The control also logs runtime hours for the boiler as well as the number of cycles for the boiler, the boiler pump, the DHW pump, and the system pump. This information can assist in diagnosing both boiler and system issues, saving valuable time on service calls.

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- **Outdoor Reset:** The Sage2.1 control features a built-in outdoor reset control which adjusts boiler temperature based on the outdoor temperature. During warmer temperatures the building requires less heat, and the boiler temperature is reduced. This feature helps to keep the boiler in condensing mode longer, resulting in higher efficiency. In addition, outdoor reset improves comfort by reducing overheating of the zones, and quiets expansion noises as piping and radiation expands and contracts less. The outdoor reset curve can be adjusted, using settings that are easy to understand: Outdoor high and low temperatures, and boiler high and low temperatures.
  - With the Sage2.1, the Outdoor Reset function is "enabled" as a factory default setting and does not require the installer to enable the feature on each boiler. This helps ensure the boiler to operate at the highest possible efficiency.
  - The Outside Air Sensor is "enabled" as a factory default setting in Sage2.1 controls. This saves the installer an additional step when setting up the boiler and eliminates the possibility of overlooking the setting.
  - The "Low Boiler Temp" is factory set at 110°F. Adjusting this setting upward provides higher temperatures across the entire outdoor reset curve and helps to improve the comfort of the heating system.
  - Outdoor Reset Boost feature is factory-set for 20 minutes and will raise the boiler temperature 10°F if the heat demand is not satisfied within that time frame. The Boost features allows installer to adjust the boiler with an aggressive outdoor reset curve in order to maximize system efficiency and energy savings while ensuring that the boiler will provide high enough temperatures to maintain comfort.

***Alpine Boilers with Sage2.1 Control System***

- **Domestic Priority with Priority Protection:** The Sage2.1 features built-in Domestic Priority. When selected, all of the Alpine's output is directed to the indirect water heater in order to minimize recovery time. Priority Protection is provided to allow the boiler to continue heating the building in the event of excessive domestic hot water demand. This feature provides back-up in the event of an excessive demand for hot water, or a component failure in the hot water system such as a sensor, aquastat, or circulator, allowing the boiler to continue heating the building and avoid excessive drops in temperature, or possible freezing.
- **Warm Weather Shutdown:** Ideal for commercial installations that maintain heating loop temperatures year round. The Warm Weather Shutdown feature on the Sage2.1 control system can be adjusted to allow the heating loop to cool when the outdoor temperature reaches a specified temperature. This helps to reduce unnecessary boiler/pump cycling and standby losses. Even with the Warm Weather feature active, the boiler will still respond to DHW demands.

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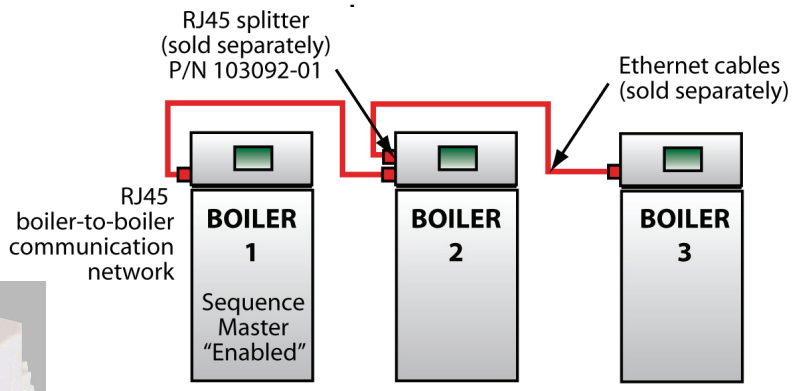
- **Freeze Protection:** If possible freezing water temperatures are detected, the Sage2.1 will operate all pumps connected to the boiler. If water temperatures continue to drop, the boiler will operate and heat the system slightly in order to prevent freezing and damage to the system.
- **Pump Exercise:** If a circulator that is connected to the Sage2.1 control does not operate for seven (7) days, it is activated to run for twenty (20) seconds. This feature reduces the possibility for pumps to seize and fail due to long periods of inactivity, improving the overall reliability of the heating system.
- **Control Flexibility:** The Sage2.1 control can respond to multiple heating demands, and features adjustable pump outputs, allowing for greater installation and piping flexibility. With the touch of a button, pump outputs can be selected for the boiler, the system, and the domestic hot water pumps. For example, touch screen selections allow the user to set the control for either an indirect water heater installed in a boiler loop or in a system loop. This feature allows full pump control for an indirect water heater piped off the system loop, eliminating the costs of additional field-supplied relays, controls, or wiring. And in some cases, additional savings can be achieved by reducing the pump size for the indirect water heater.


***Burnham Sage2.1 Control Module***

- **Adaptable Firing Rate Output:** The Sage2.1 can be set to respond differently to various heat demands. This feature allows the boiler's output to be adjusted for varying heat loads connected to the system. For example, the boiler can be set to fire at full rate for a DHW demand; while for a space heating demand, the Sage2.1 will limit the maximum firing rate in systems where the domestic hot water demand requires more Btu's than space heating. This feature reduces boiler cycling, wear and tear on parts, and enhances heating efficiency and comfort.
- **"Plug & Go" Multiple Boiler Control Sequencer:** When multiple boilers are installed, the Sequencer that is built into the Sage2.1 may be used to coordinate and optimize the operation of up to eight (8) Sage2.1 equipped boilers. Boilers are connected to a boiler-to-boiler communication network by simply "plugging-in" standard RJ45 cables – which can be purchased at most electronics stores, electric supply distributors, & office supply stores, or by hard wiring between the control panels of multiple boilers.

***Typical RJ45 Splitter***




**Sage 2.1- Equipped Boilers**

Three boilers shown, can connect up to eight boilers

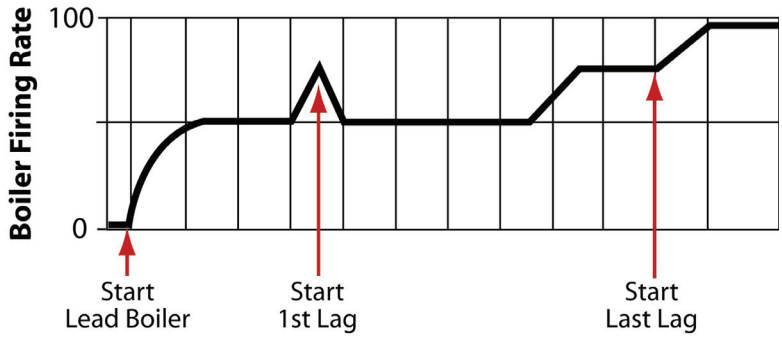
- **The Sage2.1 Sequencer provides the following:**

  - **Sage2.1 Sequencer Master:** A single Sage2.1 Boiler Control is used to control up to eight (8) Sage2.1 equipped boilers by enabling its Sequencer Master. The call for heat, outdoor and header sensors, and pumps are wired to the master enabled Sage2.1 Controller.

  - **Multiple Firing Rate Sensor Options:** The Sage2.1 has multiple firing rate sensor options. Some piping arrangements are better suited to select the firing rate of the boiler based on the header temperature, rather than the boiler supply temperature. Multiple boiler systems using the Sage 2.1's internal sequencer require the use of a header sensor. This feature enhances the versatility of the Alpine boiler by integrating into existing systems without requiring additional controls.

  - **Lead/Slave Boiler Sequencing:** One boiler is a "Lead" boiler and the remaining networked boilers are "Slaves". When demand is increasing, the Lead boiler is the first to start and the Slave boilers are started in sequential order (1,2,3,...) until the demand is satisfied. When demand is decreasing, the boilers are stopped in reverse order which helps equalize run time hours on all boilers.

  - **Advanced Boiler Sequencing:** Both header water temperature and boiler firing rate percentages are used to start and stop the networked boilers. In order to minimize temperature deviations, the Sage2.1 control adjusts the number of boilers running based on the firing rate. This combination allows the boilers to anticipate slow load changes before they disrupt water temperature yet still respond quickly to sudden load changes. These special sequencer features help reduce energy-wasting system temperature swings and the resulting unnecessary boiler cycling. Additionally, the control monitors boiler lockout status and automatically skips over disabled boilers. The Sequencer will operate the boilers as efficiently a possible by lowering the firing rates of the staged boilers in unison as additional stages are brought on.




***Firing Rates of Staged Boilers***

  - **Improved System Reliability:** The Sage 2.1 Control contains several features designed to ensure continued boiler operation in the unlikely event of a sensor or control failure:

    1. *Backup Header Sensor*: In the event of a header sensor failure the lead boiler's supply sensor is used by the Sequence Master to control the firing rate of staged boilers. This feature allows continued Sequencer control in the event of a header sensor failure.

2. *Stand-Alone Back-up*: If the Master Sage 2.1 Control is powered down, disabled, or loses communication with connected boilers, individual boilers can be connected to resume control as stand alone boilers.
3. *Slave Boiler Rate Adjustment*: Each slave boiler continues to monitor supply, return, and flue gas temperatures and modifies the Sequence Master's firing rate demand to help (a.) avoid individual boiler faults, (b.) minimize boiler cycling, and (c.) operate boiler(s) at peak efficiency.
4. *Slave Boiler Status Monitoring*: The Sequence Master constantly monitors slave boiler status and will automatically skip over disabled boilers when staging additional slave boilers.

- **Equalized Run Time/Customized Sequences:** To equalize the run time the sequencer automatically rotates the lead boiler after 24 hours of run time. Normally, boilers are started in boiler numerical order (1,2,3,...) and stopped in reverse order (...3,2,1). However, custom sequences may be established to optimize the response. For example, a large boiler may be selected to run first during winter months and then selected to run last for the remainder of the year.

- **Innovative Condensing Boiler Control:** The Sequence Master reduces firing rates to ensure peak operating efficiency. Lowered firing rates reduce stack temperatures and maximize the Alpine Boiler's ability to condense flue products thus saving fuel. In order to maximize fuel efficiency, the Sage2.1 maintains a lowered modulation rate until the last boiler is started. At this point, the modulation rate is released to allow boilers to modulate as required to meet heat load.

- **Optimized Boiler Modulation:** The Sequence Master develops a firing rate demand based on it's set point and sensed temperature. This demand is used as a firing rate by each boiler. Each boiler continues to monitor boiler supply temperatures along with return and flue gas temperatures and then modifies the modulation rate to minimize boiler cycling and provide heat to the building efficiently.

- **Multiple Demands:** The Sequence Master responds to Central Heat, DHW and frost protection demands similar to the stand-alone boiler. When the Indirect Water Heater (IWH) parameter is set to "Primary Piped" the Sequence Master drives the "networked" boilers to the DHW setpoint. When "Boiler Piped" is selected, the individual Slave boiler responds to the DHW demand. The "Primary Piped" option allows all boilers to be staged for a DHW demand, maximizing recovery, and providing back-up for DHW with multiple boilers available to respond to a demand.

- **DHW Two-Boiler Start:** When the Indirect Water Heater (IWH) parameter is set to "Primary Piped" and the DHW Two Boiler Start parameter is enabled two boilers are started without delay in response to a DHW call for heat. This feature allows rapid recovery of large DHW demands and multiple Indirect Water Heaters.

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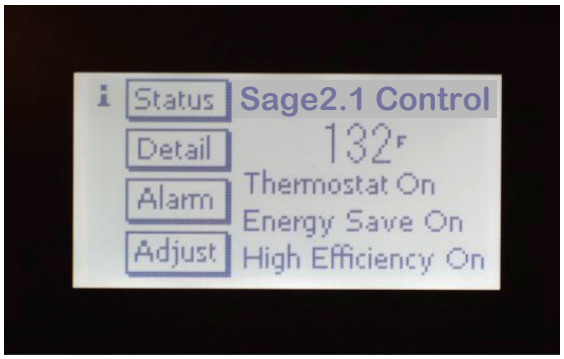
- **External Multiple Boiler Control Compatible:** The Sage2.1 control can be connected to external staging controls and accepts 4-20mA and contact inputs from a multiple boiler controller. When selected, the Sage2.1 control system accepts 4-20mA remote setpoint or firing rate demand signals from an external BAS/BMS. External controls can modulate the Alpine's firing rate in order to satisfy overall system demand. No additional relays or wiring is required.
- **Energy Management System (EMS) Compatible:** The Sage2.1 control can be connected to a building's energy management system (EMS) using simple menu selections and wiring a 4-20m Adc input. The Sage2.1 allows EMS controls to adjust either the central heating setpoint or the firing rate of the boiler. This allows the Sage2.1 to be compatible with EMS controls that develop energy efficient setpoints based on outside air temperature, solar loading, and actual room air temperatures. The Sage2.1 uses this setpoint input to cycle the boiler and modulate the boiler's firing rate.
- **"Night Setback" and "Unoccupied" Control Modes:** The Sage2.1 is EnviraCom™ enabled, allowing the boiler to communicate directly with Honeywell EnviraCom™ thermostats. This feature allows the boiler to further enhance system efficiency by reducing the water temperature during home "sleep" and "away" modes.
- **Reliability:** The Sage2.1 has been designed to have the best boiler control reliability and durability available in the industry today. Many of the industry's most common boiler control issues have been factored in to the design of the Sage2.1. For example, the Sage2.1 features built-in brown-out protection. If the power supply temporarily dips in voltage - a symptom known as a "brown-out", the Sage2.1 will re-cycle when voltage recovers, continuing to heat the building without requiring a service call to manually reset the control. In addition, no additional devices such as "brown out relays" are required for the boiler. The Sage2.1 features duty rated pump relays and wiring, meaning the control also may not require internal fuse protection for pump outputs if the total amp draw does not exceed the circuit breaker rating. The control is capable of handling up to 15 amps, and will not require additional relays to switch power to the circulators in most installations.

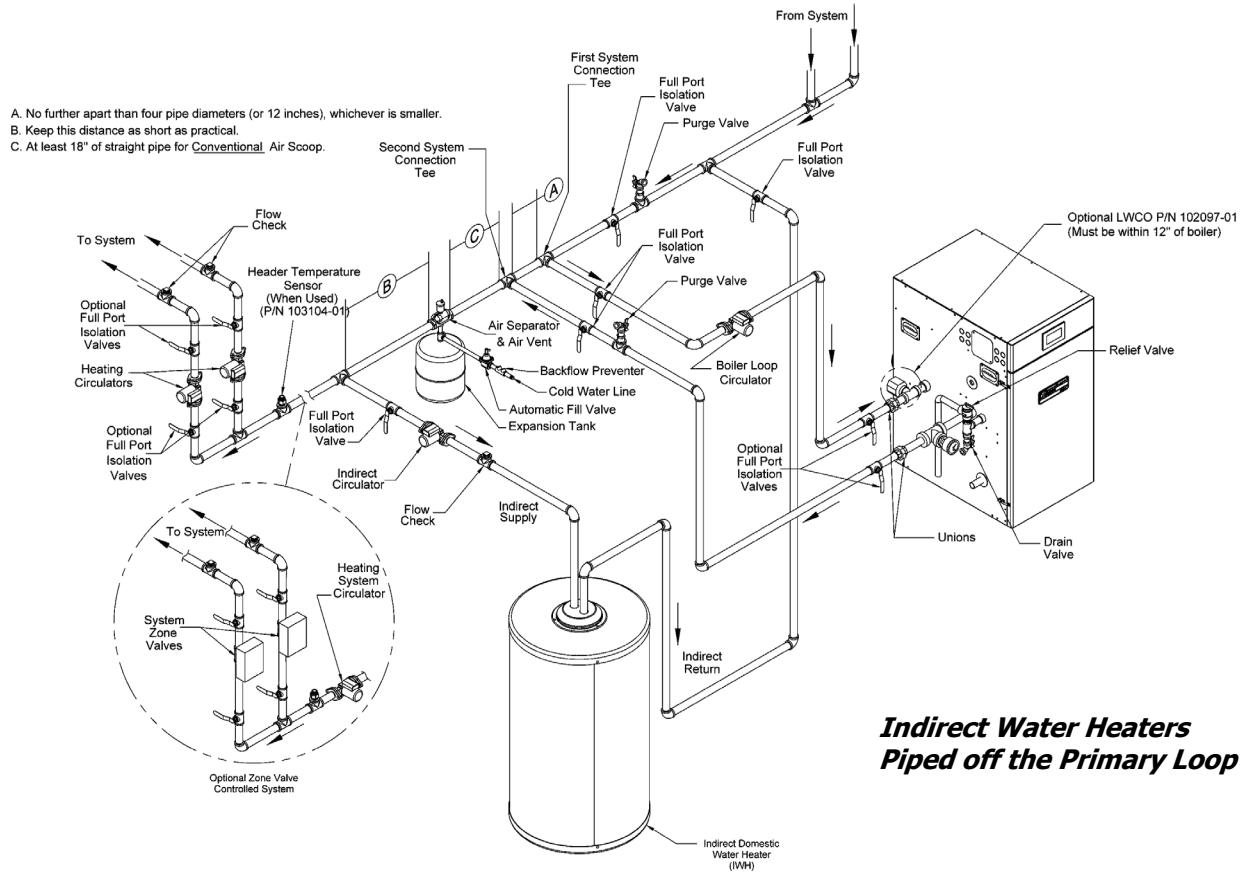



***Sage2.1 LCD Touch Screen Display***

- **Simple and Easy Operation:** The Sage2.1 boiler control is simple, intuitive, and easy to operate. The straightforward full text display shows the settings and status of the boiler is user-friendly, saving the installer time. The Sage2.1 LCD option provides expanded factory diagnostic screens providing additional information and troubleshooting assistance. The Sage2.1 control does not require special tools such as handheld electronics, or PC's with expensive software and adapters to interface with the boiler in order to make adjustments or access operating information.

# Burnham Sage2.1 Boiler Control System (SBC2.1) – Overview (con't)

- **Expanded Factory Settings Included with Sage2.1 Control Systems:**
  - The Manual Rate Firing Mode includes a timeout feature that will return the boiler to normal modulation of the firing rate after ten (10) minutes. This ensures the boiler will modulate properly in the event that the manual firing rate mode is not disabled to the "off" status after testing.
  - Sage2.1 Boiler Control Systems include twenty-nine (29) additional factory diagnostic screens in LCD Display - gives additional troubleshooting codes and enhanced information over the original Sage2 control systems.
  - Both EnviraCom and conventional thermostats are automatically detected by Sage2.1 control systems.
  - With Sage2.1 control systems, lockout history is cleared during initial software loading. Boilers are not sent to the field with "Lockout 22 Safety Data Verification Required" messages in the "Lockout History" memory.
  - High Altitude Capabilities: Alpine High Altitude Models 150, 210, & 285 are certified for natural gas use up to 10,000 ft.
- **Installation & Operation (I&O) Manuals for Sage2.1 Equipped Boilers**
  Alpine boiler Installation & Operation (I&O) manuals for Sage2.1 equipped boilers include extensive information and clarifications on Sage2.1 boiler control system capabilities.
  In particular, the I&O manual incorporates a simplified piping and pump selection section. A standardized piping diagram recommends that all indirect water heaters be piped off the primary loop (shown below and in I&O manual) which is a more reliable method of piping the indirect water heaters rather than being piped off the boiler loop.




***Indirect Water Heaters Piped off the Primary Loop***

# Burnham Sage2.1 Boiler Control System (SBC2.1) – Overview (con't)

- **Sage2.1 Part Numbers:**
  Boilers equipped with the Sage2.1 control systems have unique product coding for easy identification in computerized inventories. Also, Sage2.1 equipped boilers are clearly marked on the outside of the packaging. Shown here are Sage2.1 related part numbers and pricing.

| Part Number | Description | Trade Price |
|---|---|---|
| 103192-01 | RJ45 Splitter for Ethernet Cables | $10 |
| 103104-01 | 10KΩ Header Sensor (well or surface mount) | $35 |
| 102726-02 | LCD Display (Programmed for Sage2.1) | $250 |
| 103141-01 | Sage2.1 Control for ALP80-210 & 500 | $375 |
| 103141-02 | Sage2.1 Control for ALP285 | $375 |
| 103141-03 | Sage2.1 Control for ALP399 | $375 |

- **Feature Summary of the Sage 2.1 Control Boiler Control System:**
  Unmatched boiler control capabilities available exclusively from U.S. Boiler Company, Inc. – manufacturer of Burnham® brand boilers.

**Burnham Sage2.1 Boiler Control System Features**

- Microprocessor Boiler Control
- Auto Reset High Limit
- Manual Reset Flue Temperature Limit
- Active Firing Rate Limit for Supply & Return Temp.
- Blocked Vent Monitoring
- Condensate Trap Float Monitoring
- Boiler and System Frost Protection
- Night Setback (When Connected to EnviraCom T-Stat)
- Adjustable Outdoor Reset Boost
- DHW Priority Protection
- 3-Pump Outputs (Boiler, System, DHW)
- Pump Exercise
- 4-20mA BMS Staging Input
- Remote Control of Temperature Set Point
- EnviraCom Enabled
- Built-In Sequencer for up to 8 Boilers
- Adjustable Lead Lag Rotation
- Optimized Efficiency Staging
- Multi-Boiler DHW Staging
- Data Logging for Boiler Lock-Outs
- Pump Cycle History
- Multi-Color LCD Touch Screen Display
- Active Buttons for Clear Navigation
- Graphic Display of Limit Status
- Real-Time Trend Display of:
  - Supply Temperature
  - Return Temperature
  - Flame Signal
  - Firing Rate
- Self-Guided Diagnostics
- Energy Save Display
- Separate Low & Line Voltage Terminal Strips
- Ignition, Temperature, & Limit Monitoring
- Built-In Manual Reset High Limit at 210°F
- Active Rate Limit for Flue Temperature
- Adjustable Set Point & DHW Limit Differentials
- Flame Current Monitoring
- Adjustable Outdoor Reset
- Warm Weather Shutdown
- Unoccupied Mode (When Connected to EnviraCom T-Stat)
- Adjustable DHW Priority
- Adjustable Maximum Firing Rates for DHW and Space Heating Demands
- Adjustable Pump Operation
- Boiler Anti-Cycling
- Remote Control of Firing Rate
- ModBus Operation (single boiler)
- Alarm Contacts for Boiler Lock-Out
- RJ45 Jacks for Boiler to Boiler Connection
- Adjustable PID for Staging
- Slave Boiler Monitoring
- Two Boiler DHW Start
- Boiler Run Time & Cycle History
- 2 - Level Password Protection
- Full Text Display of Settings
- Graphic Display of Sensor Values
- Graphic Display of Outdoor Reset Curve
- Over 120 Help Screens with Full Text Explanations of Terms, Settings, Status, and Troubleshooting Information
- Programmable Service Contact Information
- Maximum Efficiency Display
- Multiple Firing Rate Sensor Options

Burnham by U.S. Boiler Company

Burnham Sage2.1™ boiler control system