PF2200-SB

USER GUIDE

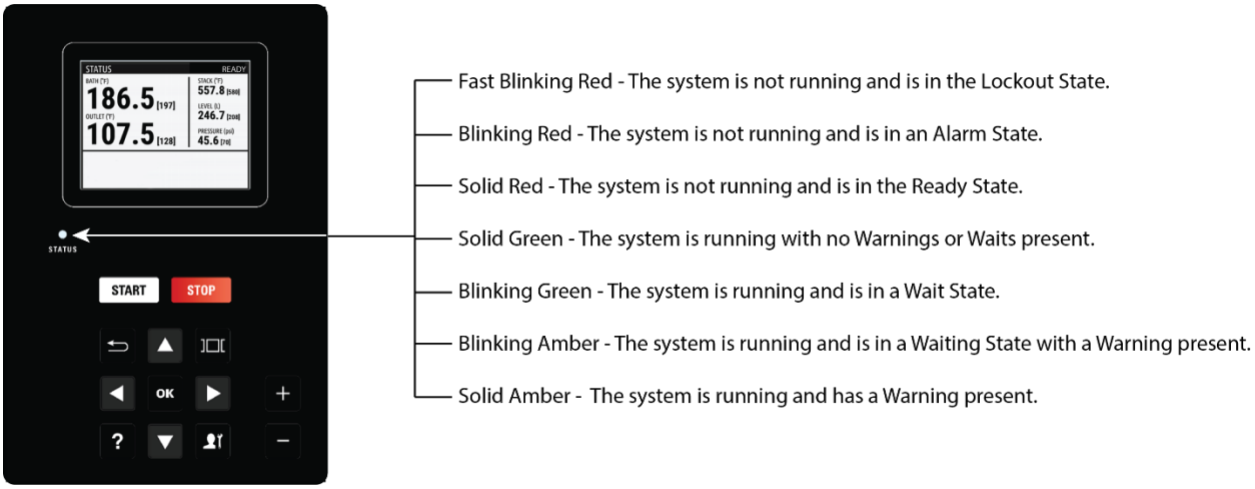
TABLE OF CONTENTS

OVERVIEW

This User Guide is intended to help the Operator use the PF2200-SB Burner Management System.
The keypad located on the front of the unit is the primary method for the operator to interface with the PF2200 system. It allows for screen navigation, starting and stopping the burner, as well as allowing commissioning and adjusting the PF2200 system.

STATUS LED

The Status LED indicator on the front of the PF2200 shows the status of the appliance. The chart below shows the different states indicated by Status LED.



Below is a description of the different alerts found on the PF2200-SB.

- **Alarms -** A persistent abnormal condition in either the equipment, or the process.
- **Waits -** An event causing the BMS to de-energize all safety outputs. when the event clears, the system is free to recycle.
- **Warnings -** An event that indicates a possible issue that may arise, but allows the system to continue running.
- **Main Permissive -** an event that causes the BMS to de-energize the main solenoid outputs (SSV), or an Alarm event shuts the system down.

For more information on the PF2200 systems states, see the "OPERATIONAL STATES" on page 10 section below.

STARTING/STOPPING

Starting, and stopping the burner can be done by selecting the **Start** or **Stop** button on the PF2200.

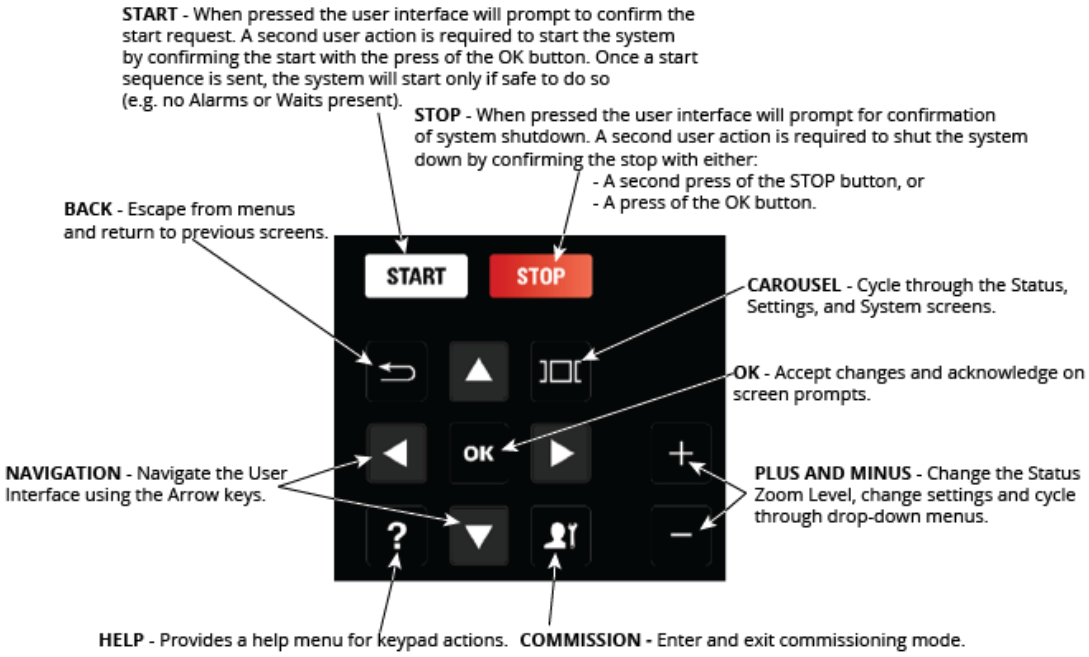
When starting the system, press the **Start** button. The system prompts for an acknowledgment of this action. Press the **OK** or Start button again to continue with the safe start-up of the burner. When shutting down the burner, press the **Stop** button. The system prompts the user to confirm the shutdown, press **OK** or the **Stop** button again. When the shutdown process is complete, the system will prompt for an acknowledgment that the shutdown is complete. Press **OK** to acknowledge the shutdown.

Starting and **stopping** the burner can also be done with the optional **manual Start/Stop** switch. There are **three** functional positions as shown. When in the stop position, all safety outputs are de-energized. Toggling from the **Run** position to the **Ignite** position for more than **2 seconds** initiates the ignition sequence. Toggling the switch from the **Stop** position to the **Run** and back to the **Stop** position can clear a lockout state.

The optional Manual Switch part number **PFA-004260** mentioned above can be ordered by contacting Profire Energy.

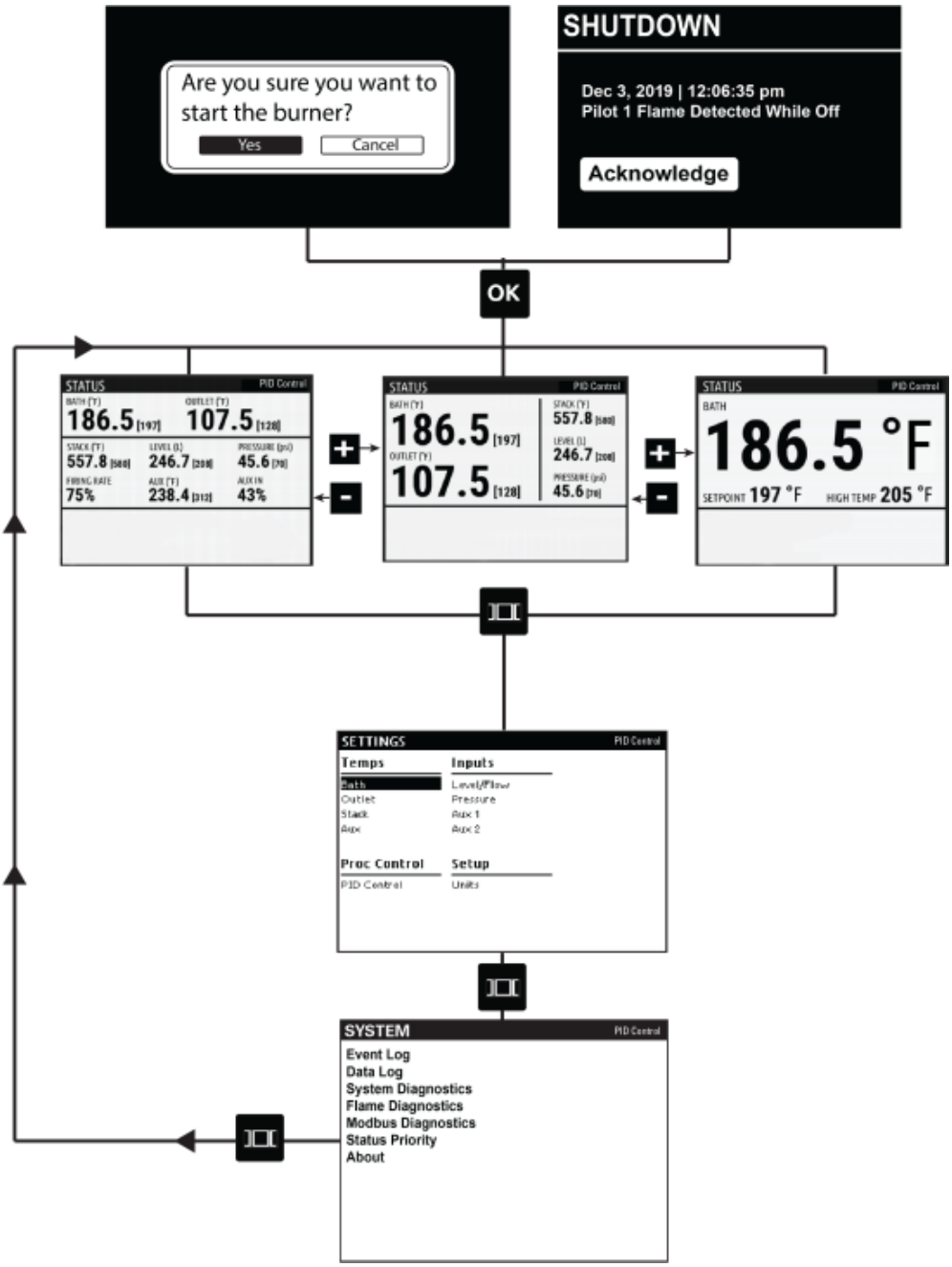
Note: Holding the switch in the Ignite position for more than 4.5 seconds results in a system shutdown on an External Stuck Switch event.

NAVIGATION



See the PF2200-SB Installation Manual for more information on the commissioning of the PF2200-SB.

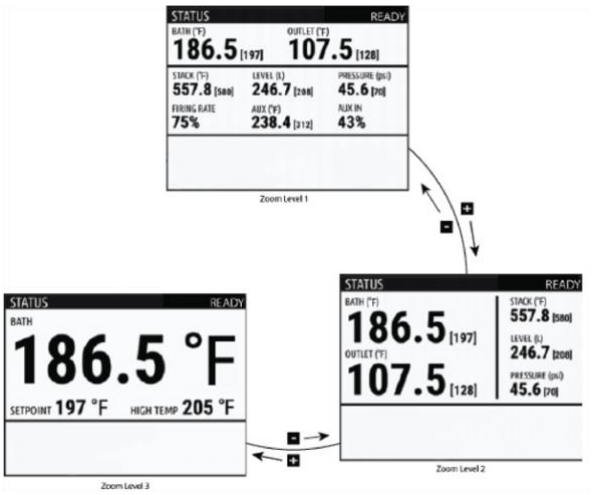
MENU MAP



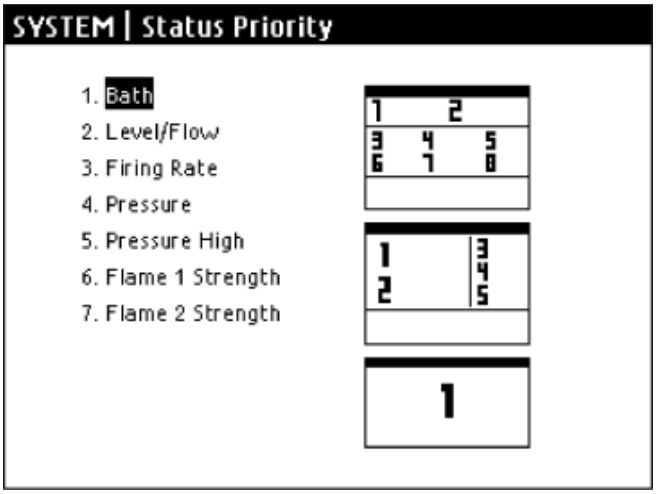
Note: The above diagram shows the menu map of the PF2200 in User Mode. This mode has a limited menu item and options capability.

STATUS SCREEN

- The Status screen can show different layouts based on a set of priorities that can be customized in the System screen under the **Status Priority** menu item.
- To switch through the different status screen layouts, use the **Plus** and **Minus** keys while in operation.



- The information displayed in the status screen is dependent on the activation of the various settings. To change the Priority of what is shown, use the **Carousel** key to navigate to the **System** screen. Use the **Arrow** keys to highlight **Status Priority** and press **OK**. You will then be presented with a list of all active settings that can be shown in prominence on the **status screen**. Using the **Arrow** keys and the **Plus** or **Minus** keys you can change what Status Elements have the higher priority.



OPERATIONAL STATES

This section describes the different states of the PF2200-SB and outlines the behavior of the system in each state.

POWER ON STATE

Power On is the default state of the system when power is applied.

If a previous lockout condition is present, the system transitions into the lockout state.

If the system previously shuts down due to a power loss, and the Low Voltage Re-start setting is enabled, the system purges, and then proceeds to automatically restart the system.

If there are no lockouts, and the system is not automatically re-starting, then the system transitions into the Ready state.

In this system state, the status of each powered output is as follows:

Powered Output	Status
Pilot 1 / 2	De-energized
Coil 1 / 2	De-energized
SSV	De-energized
HFV	De-energized

LOCKOUT STATE

will stay in the Lockout state until the Lockout is acknowledged by the user.

There are four ways to acknowledge a lockout:

- User Interface: Using the keypad to acknowledge the lockout state.
- Toggling of the Start input: From energized to de-energized.
- Toggling of the Start/Stop Switch: Turning the Optional Manual switch to the Stop position, then back to the Run position.
- Modbus Interface: Writing the Acknowledge command to clear the shutdown code modbus register.

In the Lockout state, the status of each powered outputs is as follows:

Powered Output	Status
Pilot 1 / 2	De-energized
Coil 1 / 2	De-energized
SSV	De-energized
HFV	De-energized

For more information on Modbus Register commands, refer to Modbus Registers.

ALARM STATE

indicative of a static problem (e.g., - transmitter not connected, system voltage too low, etc.). The system can only exit this state when all alarms have cleared.

Once all Alarms are cleared, the system will transition to the Ready state.

In the Alarm state, the status of each powered output is as follows:

Powered Output	Status
Pilot 1 / 2	De-energized
Coil 1 / 2	De-energized
SSV	De-energized
HFV	De-energized

READY STATE

Ready is the system state where the system is idle, and no alarms are present. If there are any alarms present while in this state, the system moves to the Alarm state. In the Ready state, the system may proceed to start by one of the following methods:

- Pressing the **Start button** on the Keypad.
- When the remote start setting is enabled, toggling of the **Start** input from Open to Closed.
- Holding the **Start/Stop switch** in the ignite position for **greater** than **2 seconds.**
- **Modbus** interface starts by writing a **start command** to the start stop register modbus register.

In this system state, the status of each powered output is as follows:

Powered Output	Status
Pilot 1	De-energized during Pre-Ignition
Pilot 2	De-energized if disabled Same as Pilot 1 if enabled
Coil 1	De-energized during startup delay
Coil 2	De-energized if disabled Same as Coil 1 if enabled
SSV	De-energized
HFV	De-energized

For more information on Modbus Register commands, refer to Modbus Registers.

WAITING STATE

Waiting is considered a "running" state of the system, with all powered outputs de-energized. The system holds this state until all wait conditions have been cleared. Once all waits have been cleared the system automatically begins the start-up sequence.

Note: purging after a flame loss is considered a wait.

Powered Output	Status
Pilot 1	De-energized during Pre-Ignition
Pilot 2	De-energized if disabled Same as Coil 1 if enabled
Coil 1	De-energized during startup delay
Coil 2	De-energized if disabled Same as Coil 1 if enabled
SSV	De-energized
HFV	De-energized

IGNITION STATE

Ignition is the state where a pilot flame is established, and the system achieves this by energizing the coil and pilot outputs while monitoring flame presence on the ionization inputs.

If a flame is not detected within the pilot-flame establishing period of 4 seconds, the system purges and restarts the ignition sequence. If the system fails to establish flame 3 consecutive times, the system proceeds to a lockout state.

If the flame is detected within the Pilot-Flame Establishing period, the system holds the pilot flame for the user configurable pilot start up delay time to help warm up the appliance, and establish a draft. once the pilot start up delay time has elapsed, the system transitions to the Pilot State.

Actuating and monitoring of Pilot 2 can be enabled or disabled via the user interface and should only be enabled if multiple pilots are in use.

If Pilot 2 is enabled, the system requires both flames to be satisfied within the Pilot-Flame Establishing Period in order to proceed.

If Pilot 2 is disabled, the system only requires Pilot 1 flame to be satisfied within the Pilot-Flame Establishing Period in order to proceed.

Any Alarms or Waits that occur during this state will cause the system to transition to a Lockout state, or a Waiting state respectively.

In this system state, the status of each powered outputs is as follows:

Powered Output	Status
Pilot 1	Energized *
Pilot 2	De-energized if disabled Same as Pilot 1 if enabled
Coil 1	Energized during Ignition De-energized during startup delay
Coil 2	De-energized if disabled Same as Coil 1 if enabled
SSV	De-energized
HFV	De-energized

*: The Pilot Outputs are energized 500ms after the Coil Outputs.

PILOT STATE

The Pilot state is the system state which represents a minimum amount of heating required to light off the main burner. It is typically tied to the Pilot valve in the fuel gas train – meaning that the pilot valve(s) are on in this state but, the main valves are off.
Once in Pilot state, the system must verify all configured process temperatures are below their respective process setpoints and, main permissive(s) (if configured) have been cleared in order to enter the Main Light Off state.

Any Alarms or Waits that occur during this state will cause the system to transition to a Lockout state, or a Waiting state respectively.

The system exits Pilot state and transition to Pre-purge state in the event of Pilot Flame loss for more than 4 seconds. This is regardless of whether pilot two is enabled and does not suffer a flame loss.

In the Pilot state, the status of each powered outputs is as follows:

Powered Output	Status
Pilot 1	Energized
Pilot 2	De-energized if disabled Energized if enabled
Coil 1 & 2 SSV HFV	De-Energized

MAIN LIGHT-OFF STATE

The system enters the Main Light Off state from the Pilot state when the controller is calling for more heat. If the system enters the Main Light Off state as part of a fresh startup, the Main Light Off state holds for the user configurable main startup delay time. To help establish a draft and heat up the appliance before the mains.

If the system enters the Main Light Off state from a Process Control state the Main Startup Delay Time is fixed at 5 seconds since a draft has already been established and the appliance is already warm.

In addition, the Main Light Off state facilitates the option of proving Main Light Off position. When the proof of light off input (POL) is enabled, the Main Light Off state holds until the position has been proven. If position cannot be proven within 60 seconds the system transitions to lockout state.
Any Alarms or Waits that occur during Main Light Off state will cause the system to transition to Lockout state or a Waiting state, respectively.

When the Main Light Off Position is enabled, and the system fails to establish Main Light Off in the Main Light Off Timeout, the system exits to a Lockout state and triggers a Post purge.

In the Main Light Off state, the status of each powered outputs is as follows:

Powered Output	Status
Pilot 1	Energized
Pilot 2	De-energized if disabled Energized if enabled
Coil 1 & 2 SSV HFV	De-Energized

PROCESS CONTROL STATE

Once the system has determined the mains can be turned on, it enters the Process Control state. In this state, the system actively tries to maintain the process temperature setpoint via the actuation of valves in various configurations.

There are three main process control modes offered, and they are:

1. On/Off Control
2. Staged Heating
3. PID Control

Refer to the PF2200 Product Manual for more information on these three modes listed.

Any alarms or waits that occur during this state forces the system to transition to the Alarm state or a Waiting state, respectively.

If Pilot Mode is set to Interrupted Pilot, the system transitions to Pre-purge if there is a Flame Loss for more than 1 second. If relights remaining is zero, the system transitions to the Lockout state.

In the Process Control state, the status of each powered outputs is as follows:

Powered Output	Status
Pilot 1	Energized
Pilot 2	De-energized if disabled Energized if enabled
Coil 1 / 2	De-Energized
SSV HFV	Energized or De-energized, depending on the process control state. See process control modes below for specific valve behavior.

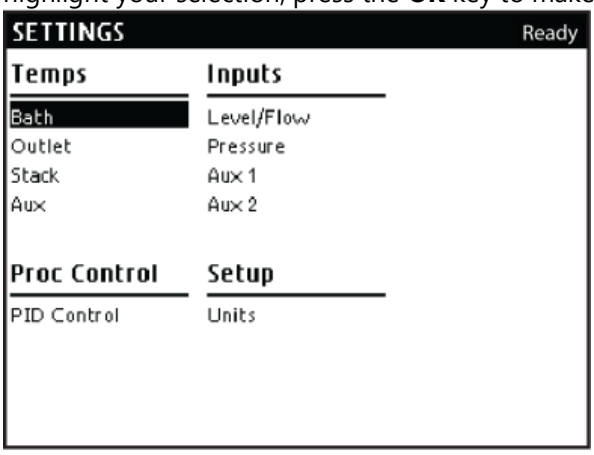
For more information on the different operational sates of the PF2200-SB see the Operational States section found in the Product Manual here. For more information on setting up a PID see the PF2200 PID TUNING GUIDE.

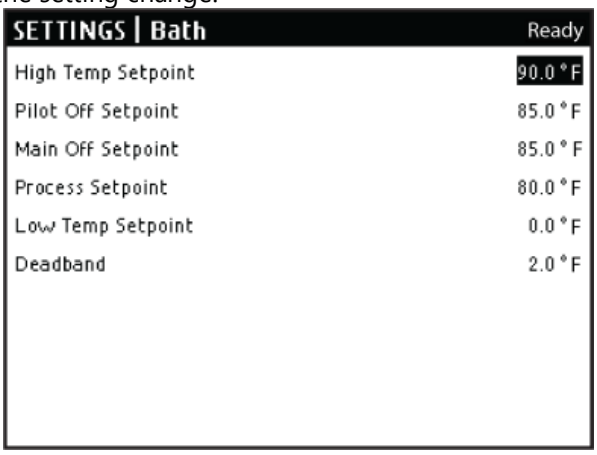
SETTINGS

The Settings screen is accessed from any screen by using the **Carousel** key. Use the **Arrow** keys to navigate between setting and the **Plus** or **Minus** keys to adjust setting.

A **Password** is required for some setting changes. For more information on **Passwords**, see the section on Passwords found in the **Installation Guide**.

Once the Password is entered, you are returned to the settings screen where you can proceed to make the necessary changes. This authentication mode is valid for **15 minutes** regardless of activity.
In the case of a drop-down menu, press the **OK** key to open the drop-down, use the **Arrow** keys to highlight your selection, press the **OK** key to make the setting change.





Commissioning mode is a view that allows access to the full settings menu. Please refer to the COMMISSIONING section of the Installation Guide for more information on the Commissioner mode. To exit Commissioning mode, and return to User mode, press the Commissioning button. The user is then presented with an acknowledgment prompt.

TEMPERATURE INPUTS

The PF2200-SB has three distinct temperature inputs: Bath, Outlet, and Stack; each of which is configurable to be either a Type-K thermocouple or PT-100 RTD input.

The following is a description of each of the setpoints and available setpoints for each Input:

- High-Temperature ESD Setpoint: the temperature at which the system shuts down. If the temperature input exceeds this trip point, the system generates an alarm and if running proceed to lockout
- Pilot Off Setpoint: the temperature at which the system de-energizes all valves, including the pilot, and enters a waiting state. When the temperature falls back down below this value minus the deadband, the system reignites the pilot.
- Main Off Setpoint: the temperature at which the system de-energizes the main valves and enters the Pilot state. The main valves are turned back on when the temperature drops below the Process Control Setpoint minus the deadband.

- Process Control Setpoint: The setpoint about which the process temperature is controlled. In PID mode, the TCV is actuated in relation to this setpoint. In Staged Heating mode, the HFV is actuated by this setpoint.
- Low-Temperature Warning Setpoint: If the temperature drops below this trip point, the system displays a warning on the user interface and continues to run.

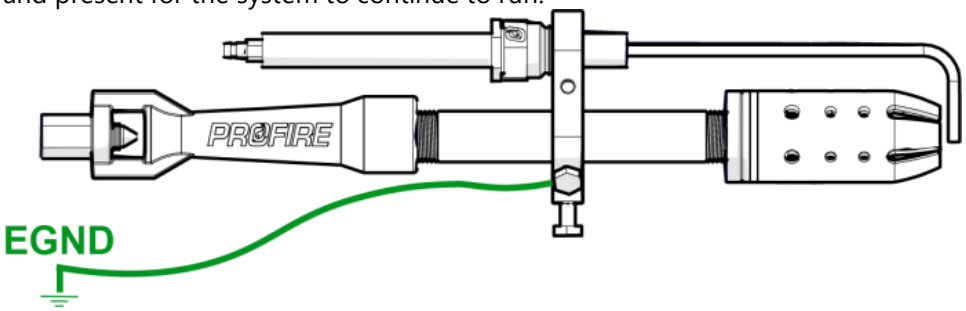
Setpoint	Description
High-Temperature ESD Setpoint	The temperature at which the system shuts down. If the temperature input exceeds this trip point, the system will generate an alarm and if running proceeds to lockout.
Pilot Off Setpoint	The temperature at which the system de-energizes all valves, including the pilot, and enters a waiting state. The system will reignite the pilot when the temperature falls below the Process Setpoint minus the deadband.
Main Off Setpoint	The temperature at which the system de-energizes the main valves and enters the Pilot state. The main valves will reignite when the temperature drops below the Process Control Setpoint minus the deadband.
Process Control Setpoint	The setpoint at which the process temperature will be controlled. In PID mode, the TCV will be actuated in relation to this setpoint. In Staged Heating mode, the HFV will be actuated by this setpoint.
Low-Temperature Warning Setpoint	If the temperature drops below this trip point the system will display a warning on the user interface and will continue to run.

FLAME DETECTION I/O (ION +/-)

Two Ionization flame detection I/O's are supported by the PF2200-SB. These terminals are intended to be connected to a flame rod which makes physical contact with the flame.

Through the use of the rectification property of the flame, the PF2200-SB measures the presence of a flame by applying an AC signal to the rod. If an open circuit event exists, the result is Loss of Flame.

Pilot 1 flame detection is always enabled, whereas Pilot 2 flame detection can be enabled or disabled via the user interface. If Pilot 2 flame detection is enabled, both Pilot 1 and Pilot 2 flames must be established and present for the system to continue to run.



For troubleshooting a Flame detection issue, see the Troubleshooting section at the end of this document.

EMERGENCY SHUTDOWN INPUT

The Emergency Shutdown Input (ESD) is an energized-to-run digital input that is always enabled. If the contact is de-energized, the system presents an alarm and proceeds to lockout (if running). If the contact is energized, the alarm clears.

Note: This digital input is self energized by the PWR terminal and does not need to be energized by the user.

LEVEL/FLOW INPUT

The Level/Flow input is meant to monitor an external level (e.g., tank level), and provide the necessary feedback in the event of a high or low-level event. The Level Input is configurable as either Disabled, Digital Input, or 4-20mA signal through the user interface. The level input can be connected to either a switch or transmitter.

PRESSURE INPUT

The Pressure Input is meant to monitor an external pressure (e.g., fuel pressure), and provide the necessary feedback in the event of a high and/or low- pressure event. The Pressure Input is configurable as either Disabled, Digital Input, or 4-20mA signal through the user interface; the pressure input can be connected to either a switch or transmitter.

AUXILIARY INPUTS

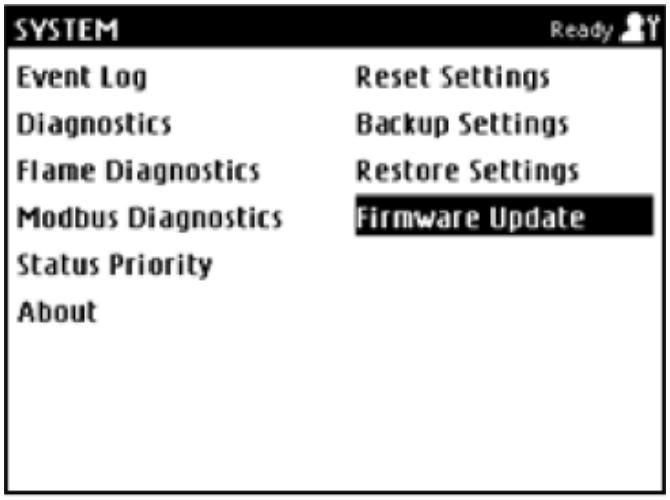
The Auxiliary Inputs 1 and 2 are intended to be connected to a generic I/O device that may not fit into any of the above-mentioned categories. Configurable as either a digital or 4-20mA input, this input is intended to be connected to either a switch / PLC output (digital) or transmitter (4-20mA). The Auxiliary Inputs have trip modes of Alarm, Wait, Warning, and Main Permissive.

For information on all the various Inputs and outputs of the PF2200-SB visit the Inputs and Outputs sections of the Product Manual.

SYSTEM SCREEN

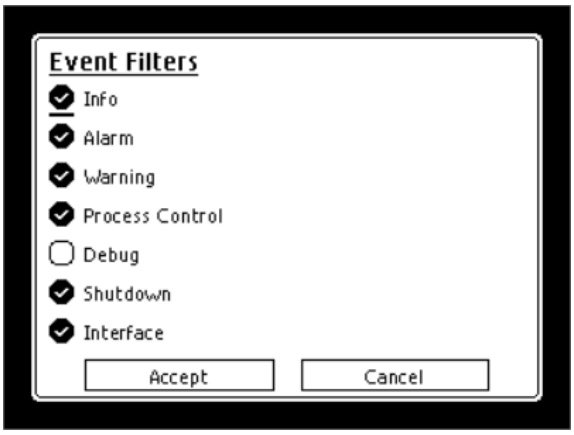
The System Screen gives access to system tools and troubleshooting information, including Event and Data Logging, Diagnostics, Firmware updates, as well as the Status Priority customization settings. Also contained in the System Screen is the Reset, Backup, and Restore options.

A supplied USB Storage device records system events as well as data logs which are used for information and troubleshooting.



EVENT LOG SCREEN

The PF2200-SB event log continuously records Alarms, Warnings, Shutdowns, and Process control decisions as well as general system information and stores it on the USB storage device (if installed). While in the Event Log screen, press the **OK** key to open the filters screen. Use the **Arrow Up** and **Down** keys to underline the desired filter. Press the **OK** key to make the selection. When complete, use the **Down Arrow** key to go to navigate to highlight the "**Accept**" button. Press the **OK** key to accept the selections and return to the filtered event log.



When the supplied USB storage device is installed in the USB port on the back of the enclosure door, the system will automatically log events to the storage device. The data saved is stored on a provided USB storage device, and when the USB device becomes full the oldest data will be overwritten by the newest data.

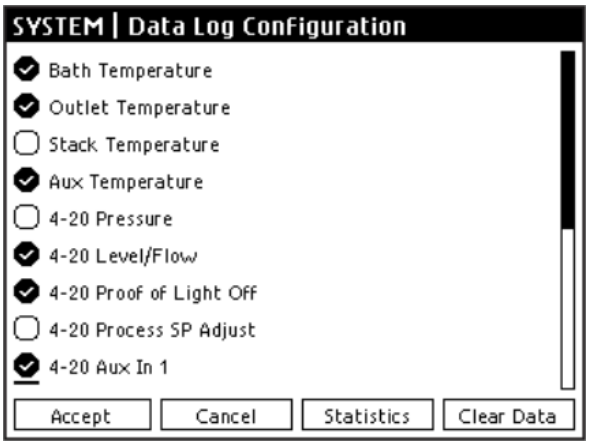
DATA LOGGING SCREEN

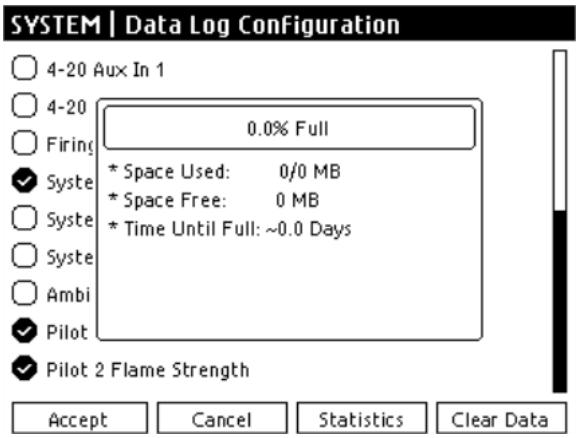
The PF2200-SB data logging tool will monitor various input and output data and will automatically log the data to the supplied USB storage device.

Use the keypad to choose up to 8 items to log to the USB. The sample interval rate for data collection is 15 seconds. The Data logger creates folder for each individual data logging set, and creates a .CSV file

that can be opened and inspected. when the USB storage device becomes full the logging will begin to delete the oldest logs to make room for the newest logs recorded.

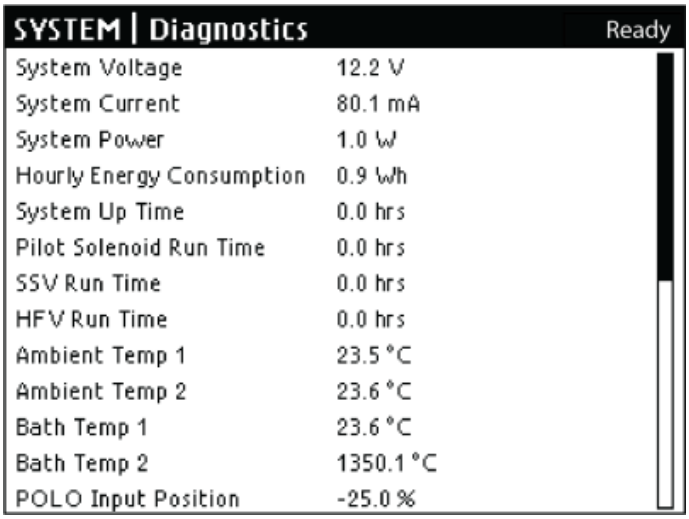
The statistics dialog will show an approximation of logging time remaining on the USB before old logs start getting deleted.





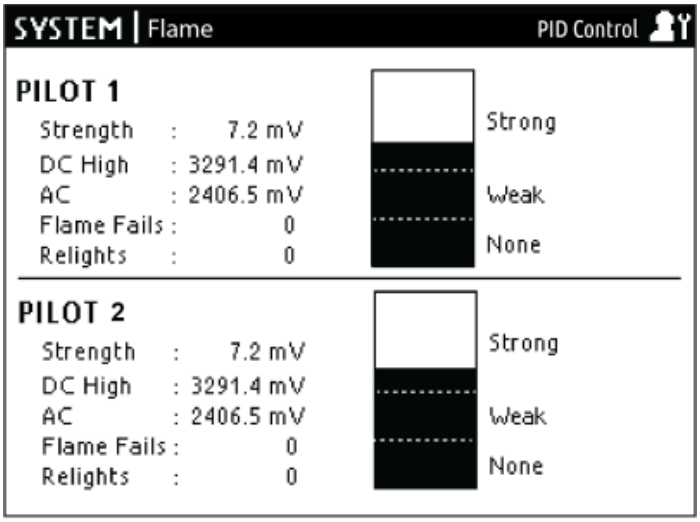
SYSTEM DIAGNOSTICS SCREEN

Diagnostics allows the user to get an organized view of all the diagnostic values on the system. Use the Up and Down Arrows to scroll through the information presented.



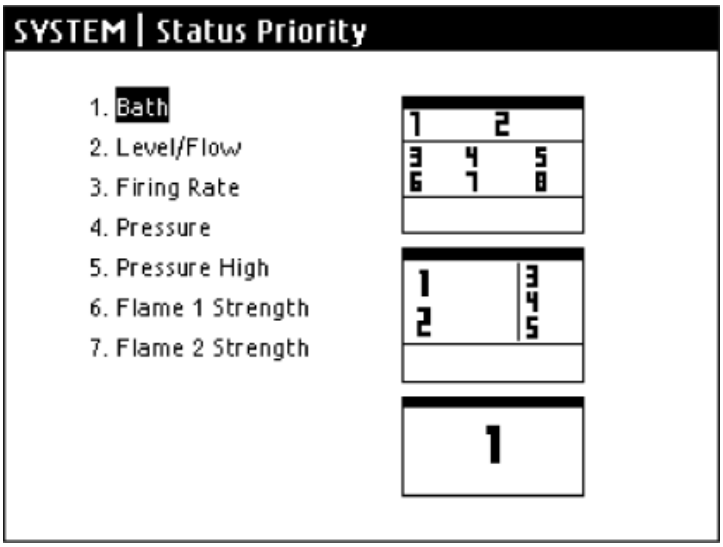
FLAME DIAGNOSTICS SCREEN

Under the Flame Diagnostics screen, the Flame Strength and Diagnostic Voltage are displayed. This screen also records the number of Flame Fails and Relights. On the right portion of the screen, you are shown a graphical representation of the flame quality.



STATUS PRIORITY SCREEN

The Status Priority screen allows the user to adjust the status screens in accordance to the desired information for the application of the system.



ABOUT SCREEN

The About screen displays important system information about the unit including, serial numbers as well as firmware versions.

RESET/BACKUP/RESTORE SETTINGS

Reset, Backup, and Restore functions allow the user to save, reset, and restore settings quickly and easily. Once you have the settings as desired, you can backup the settings to a USB stick, allowing you to copy settings quickly to other units. The Reset function returns the settings to the factory defaults. To restore or copy the settings to a unit, insert the USB stick with the settings backup on it. Use the Restore function to update the settings from the backup.

Refer to the PF2200-SB Manual for more information on the Systems screen.
FIRMWARE UPDATE
The Firmware update function can be used to update the system with approved Profire Firmware Bundles.

Refer to the Firmware Update Guide for more information on the Firmware Update process.

Note: To confirm the update was successful, navigate to the About screen after the reboot to verify the Burner Management System, and the User Interface versions are correct.

CERTIFICATIONS

The PF2200-SB (Single Burner BMS) is certified to the following standards:

- IEC 61508:2010, SIL 2

The PF2200-SB is pending certification to the following standards:

- UL 60730-2-5/ANSI Z21.20-2014 & UL 121201
- CSA C22.2 No. 60730-2-5 & C22.2 No. 213
- CSA C22.2 No. 213-17

TROUBLESHOOTING

For a complete list of **Alerts and there meaning**, refer to the PF2200 ALERT CODES.

Problem	Diagnosis
The System has visible flame but cannot detect	1. Ensure pilot assembly, flame rod, and the gap between are fully engulfed in flame. If not, adjust rod position. 2. Ensure flame detection wiring does not exceed the recommended maximum length. 3. Ensure burner assembly has a low impedance path to Ion- terminal of BMS. 4. For longer run lengths, ensure ignition cable is used to avoid ground-loading.
The System is unresponsive or BMS card will not communicate with User Interface card	1. Ensure the Status LEDs for both cards are functioning. If status LED is not functioning, cycle power (if safe to do so) and check again. 2. If status LED is still not functioning, attempt a firmware update of both cards.

Problem	Diagnosis
	3. If firmware update fails, card is likely faulty.
The Ignition transformer “clicks” but no visible spark	1. Ensure all wires in the ignition path are properly terminated and that there is a low impedance path from the primary-windings to the BMS card as well as the secondary-windings to the ignition rod. 2. Ensure the gap between the ignition rod and the burner housing is within the tolerances specified in this manual under PF2200 Declarations section under ”High Voltage Spark Gap Range”. Often times there is either excess buildup or the rod has drooped to compromise the gap distance.
Solenoids are not turning on, or turning on then over time turn off	1. Ensure the solenoid is wired correctly and to the appropriate terminals. – To ensure proper solenoid wiring, a multi-meter in OHM mode can be used to measure the resistance between the + and – terminal of the associated output. Note: this measurement should be done with the BMS card powered off. – If properly wired, the multi-meter should read a resistance of the solenoid coil plus the run length (i.e. if the multimeter reads open, there is likely a problem with wiring). 2. Ensure the PWM setting is correct for the appropriate solenoid. – If using a peak-and-hold solenoid, the appropriate PWM setting can be found in the solenoid data sheet. Typically add a margin of 5-10% to allow for temperature variance – If using a non-peak-and-hold solenoid, ensure the PWM setting is set to 100%
Digital input will not energize	1. Ensure the input is properly wired. See section 4 for Interfacing / Wiring configurations. 2. In the case of a dry contact, ensure the PWR terminal is connected and is sourcing the correct voltage. 3. Ensure adequate amount of wetting current is being applied through contact. – Run a current meter in series with the digital input switch and verify the energized state meets the requirements outlined in the “Electrical and Mechanical Ratings” section of this document – If there is not adequate wetting current, the digital input either has too high of an impedance or the wiring has been compromised

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