



SB-2301  
SEPTEMBER 17, 2013



**FIREYE®**  
**SB SERIES**  
**FLAME SAFEGUARD**  
**CONTROLS**



**WARNING:** Selection of this control for a particular application should be made by a competent professional, licensed by a state or other government. Inappropriate application of this product could result in an unsafe condition hazardous to life and property.

## DESCRIPTION

The Fireeye sbSeries Flame Safeguard Control is a compact, microprocessor based, modular burner management system designed to provide automatic ignition and continuous flame monitoring for commercial sizes of heating and process equipment firing any type of fuel.

The sbSeries are tested to EN298 and CE-certified in compliance with the directives for gas fired appliances and electromagnetic compatibility.

The control unit includes all the necessary digital logic and analog measuring circuitry to control the sequence and monitor the flame of single gas, oil or combination gas/oil burners. Three available control sequences are no-purge, purge, and modulation (air damper control). The part number specifies the various features such as the flame sensor type, no purge, purge, modulation, proof of air opening at start, and timings; thus the designer has control and protection against field tampering of critical sequences.

LED indicators are available on the front of the unit that provide current operating status of the burner system including lockout alarm. A test jack is recessed into the front cover that provides real time reading of the connected flame sensor. This same test jack is also used to connect to an alpha-numeric display, SB510 or SB511. A push button provides reset from lockout condition as well as placing the unit in a check condition usable for pilot turn down test.

The sbSeries flame safeguard control family are of plug-in design and available in models that operate at 120 VAC, 50/60 Hz and 230 VAC, 50/60 Hz making them universally acceptable.

\*The wiring base provides a convenient means for connecting field wiring from the burner and valve system to the control unit. There are three styles of bases: an internal terminal base that provides a guarded wiring compartment; an external terminal base for use within a protective control panel; and an expanded external terminal base for use with the modulation sequence control units.

Sensors that may be used with the sbSeries include flame rod (rectified ionization), ultra-violet (UV) scanners, and self-checking UV scanners for continuous operation. Four types of non self-checking UV scanners meet the demands of various environmental conditions.



## CE CONFORMITY

This product is in conformity with the protection requirements of the following European Council Directives:

73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive, and 90/396/EEC the Gas Appliance Directive based on examination to EN298 “Automatic gas burner control systems for gas burners and gas burning appliances with or without fans”. Conformity of this product with any other “CE Mark” Directive(s) shall not be assumed.

*Product Classification:* Class I: Permanently connected, panel-mounted Industrial Control Equipment with protective earthing (grounding) on metal bases. (EN61010-1).

*Enclosure Rating:* panel-mounted equipment rated IP00, when used with the external terminal wiring bases (the terminals must be enclosed within the panel.) IP30 when used with internal terminal bases. (IEC 529).

*Installation Category (Overvoltage Category):* Category II: Energy-consuming equipment supplied from the fixed installation, local level appliances, and Industrial Control Equipment. (EN61010-1).

*Pollution Degree:* Pollution Degree 2: Normally nonconductive pollution with occasional conductivity caused by condensation. (Ref. IEC 664-1).

*EMC Classification:* Group 1, Class A, ISM Equipment (EN55011, emissions), Industrial Equipment (EN50082-2, immunity).

*Method of EMC Assessment:* Technical File (TF).

*Declaration of Conformity:* EC-87/02/57/M3b.

Deviation from the installation conditions specified in this manual may invalidate this product’s conformity with the Low Voltage, EMC, and Gas Appliance Directives.



**WARNING: This equipment generates and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference**

## SB SERIES SPECIFICATIONS

### Power Supply:

120VAC (min. 102, max 132) 50/60 Hz.

230 VAC (min 196, max 253) 50/60 Hz.

Power Consumption: 12VA (internal consumption, excludes externally connected loads)

Shipping Weight (Approx): 3 lbs (1.4 kg)



### AMBIENT TEMPERATURE LIMITS

	Maximum		Minimum		Weight
sbSeries	140°F	60°C	-40°F	-40°C	3 lbs (1.4kg)
UV Scanner, straight; UV7A4	257°F	125°C	-4° F	-20° C	1 lb (.45kg)
UV Scanner, 90 degree; UV7R4	140°F	60°C	-4° F	-20° C	1 lb (.45kg)
UV Scanner, sealed, NEMA4, UV7A4W	257°F	125°C	-4° F	-20° C	1 lb (.45kg)
UV Scanner, self-check; UV7SC	140°F	60°C	-4° F	-20° C	7 lbs (3.2kg)
Flame Rod (Tip 2460 F); 69ND1-1000K4, -1000K6, -1000K8	1500°F	616°C	-40°F	-40°C	1 lb (.45kg)
Remote Display, 120 VAC; SB510	122°F	50°F	32°F	0°C	1 lb (.45kg)

### LOAD RATINGS

	Function	Terminal	Inductive Load
	The maximum total connected load cannot exceed 15 Amps.	Gas Valves	3, 5
Ignition		4	375 VA
Motor or Contactor		8	470 VA
Control		A, 10, 11, 12, 13	175 VA



**CAUTION:** Published load ratings assume that no control be required to handle inrush current more often than once in 15 seconds. The use of control switches, solenoids, relays, etc. which chatter will lead to premature failure. It is important to run through a test operation (with fuel shut off) following the tripping of a circuit breaker, a blown fuse, or any instance of chattering of any external current consuming devices.



**WARNING:** Selection of programmer and amplifier type for a particular application should be made by a competent professional, such as a Boiler/Burner technician licensed by a state or government agency, engineering personnel of the burner, boiler or furnace manufacturer (OEM) or in the performance of duties based on the information from the OEM.

## sbSeries CE PART NUMBER DESCRIPTION

MAINS	MODEL TYPE	FFRT	AMPLIFIE R	PURGE	PTFI (IGNITION)	MTFI	POST PURGE	RECYCLE	AIR PROVING	RESET
S	P	1	U	0 3 0	4	2	3	N	P	A
1 = 120 VAC 2 = 230 VAC	N = No Purge P = Purge M = Modulation	1 = 1 Sec 3 = 3 Sec	U = UV F = Rect.	000 = No Purge XXX = Purge (Sec) Max value is 900 seconds or 15 minutes in 5 Sec increments	1 = 3 Sec 2 = 5 Sec 4 = 10 Sec *6 = 15 Sec	0 = Intmnt 1 = 3 Sec 2 = 5 Sec 4 = 10 Sec 6 = 15 Sec	0 = No Post 1 = 5 Sec 2 = 10 Sec 3 = 15 Sec 6 = 30 Sec 8 = 60 Sec	N = Non Recycle R = Recycle	F = 10 Sec P = Seq Hold	A = Reset on Power  M = Manual Reset **

**DEFINITIONS:**

**PTFI** = Pilot trial for ignition

**MTFI** = Main trial for ignition

**Intmnt** = Intermittent operation

**FFRT** = Flame failure response time

**UV** = Ultra-violet

**Rect.** = Flame rod rectification

\* 15 Sec PTFI (Ignition) is not FM approved  
 \*\* Double button press required. Will not automatically  
 reset at power-up



## ORDERING INFORMATION

(See timing sequence beginning on page 18)

ORDER ENTRY PART NUMBER	DESCRIPTION
<b>120 VAC OPERATION</b>	
<b>NO PURGE MODELS</b>	
S1N1U000400RPA	120 VAC, no purge, 10 sec PTFI, INTERMITTENT PILOT, UV amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S1N1F000400RPA	120 VAC, no purge, 10 sec PTFI, INTERMITTENT PILOT, FR amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
<b>PURGE MODELS</b>	
S1P1U005400RPA	120 VAC, 5 sec purge, 10 sec PTFI, INTERMITTENT PILOT, UV amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S1P1F005400RPA	120 VAC, 5 sec purge, 10 sec PTFI, INTERMITTENT PILOT, FR amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S1P3U030103NFA	120 VAC, 30 sec purge, 3 sec PTFI, INTERMITTENT PILOT, UV amp, 3 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S1P3F030103NFA	120 VAC, 30 sec purge, 3 sec PTFI, INTERMITTENT PILOT, FR amp, 3 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S1P1U030423RPA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, 1 sec. FFRT, 15 sec post purge, recycle, sequence hold, reset on power
S1P1F030423RPA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, 1 sec. FFRT, 15 sec post purge, recycle, sequence hold, reset on power
S1P3F090440NFA	120 VAC, 90 sec purge, 10 sec PTFI, 10 sec MTFI, FR amp, 3 sec. FFRT, 0 sec post purge, non-recycle, pre-purge check, reset on power
<b>MODULATION MODELS</b>	
S1M3U030103NFA	120 VAC, 30 sec purge, 3 sec PTFI, INTERMITTENT PILOT, UV amp, 3 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S1M1U030423NPA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S1M1U030423NFA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge air check, reset on power
S1M1F030423NPA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S1M1F030423NFA	120 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge check, reset on power
<b>230 VAC OPERATION</b>	
<b>NO PURGE MODELS</b>	
S2N1U000400RPA	230 VAC, no purge, 10 sec PTFI, INTERMITTENT PILOT, UV amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S2N1F000400RPA	230 VAC, no purge, 10 sec PTFI, INTERMITTENT PILOT, FR amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
<b>PURGE MODELS</b>	
S2P1U005400RPA	230 VAC, 5 sec purge, 10 sec PTFI, INTERMITTENT PILOT, UV amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S2P1F005400RPA	230 VAC, 5 sec purge, 10 sec PTFI, INTERMITTENT PILOT, FR amp, 1 sec. FFRT, no post purge, recycle, sequence hold, reset on power
S2P1U015223RPA	230 VAC, 15 sec purge, 5 sec PTFI, 5 sec MTFI, UV amp, 1 sec. FFRT, 15 sec post purge, recycle, sequence hold, reset on power
S2P1U030223NPA	230 VAC, 30 sec purge, 5 sec PTFI, 5 sec MTFI, UV amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power

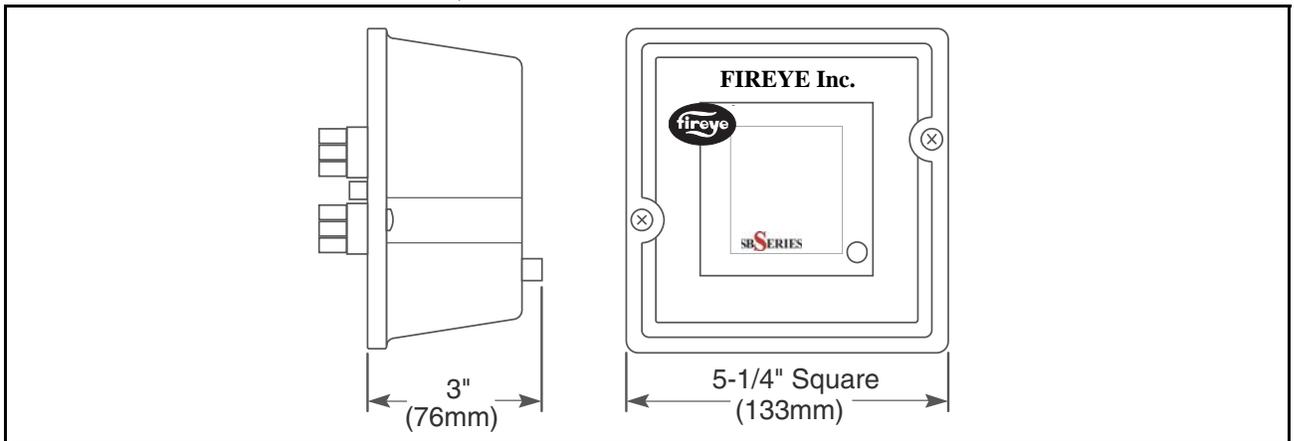


ORDER ENTRY PART NUMBER	DESCRIPTION
S2P1U015423NPA	230 VAC, 15 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2P1U030423NPA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2P1F015223NPA	230 VAC, 15 sec purge, 5 sec PTFI, 5 sec MTFI, FR amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2P1F030223NPA	230 VAC, 30 sec purge, 5 sec PTFI, 5 sec MTFI, FR amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2P1F015423NPA	230 VAC, 15 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2P1F030423NPA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
<b>MODULATION MODELS</b>	
S2M1U030223NPA	230 VAC, 30 sec purge, 5 sec PTFI, 5 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1U030423NPA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1U030443NPA	230 VAC, 30 sec purge, 10 sec PTFI, 10 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1U030423NFA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge check, reset on power
S2M1U030443NFA	230 VAC, 30 sec purge, 10 sec PTFI, 10 sec MTFI, UV amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge check, reset on power
S2M1F030223NPA	230 VAC, 30 sec purge, 5 sec PTFI, 5 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1F030423NPA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1F030443NPA	230 VAC, 30 sec purge, 10 sec PTFI, 10 sec MTFI, FR amp, modulation, 15 sec post purge, non-recycle, sequence hold, reset on power
S2M1F030423NFA	230 VAC, 30 sec purge, 10 sec PTFI, 5 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge check, reset on power
S2M1F030443NFA	230 VAC, 30 sec purge, 10 sec PTFI, 10 sec MTFI, FR amp, modulation, 1 sec. FFRT, 15 sec post purge, non-recycle, pre-purge check, reset on power
<b>SCANNERS</b>	
UV7A4	Straight UV scanner, 4 ft flex conduit
UV7A4W	NEMA 4 UV Scanner, 4 ft flex conduit
UV7R4	90 degree UV Scanner. 6 ft shielded cable
UV7R4C	90 degree UV Scanner. 6 ft flex cable.
UV7SC	Self-check scanner
59-504-010	10 foot cable for self-check scanner
69ND1-1000K4	Flame rod, 12" (15mm), 1/2" mount (Auburn P/N FRS-2-12)
69ND1-1000K6	Flame rod, 18" (30.5mm), 1/2" mount (Auburn P/N FRS-2-18)
<b>WIRING BASES</b>	
61-6990-1	Internal terminal base, metal
61-6990-2	Internal terminal base, plastic
61-6991-1	Exposed terminal base, metal
61-6991-2	Exposed terminal base, plastic

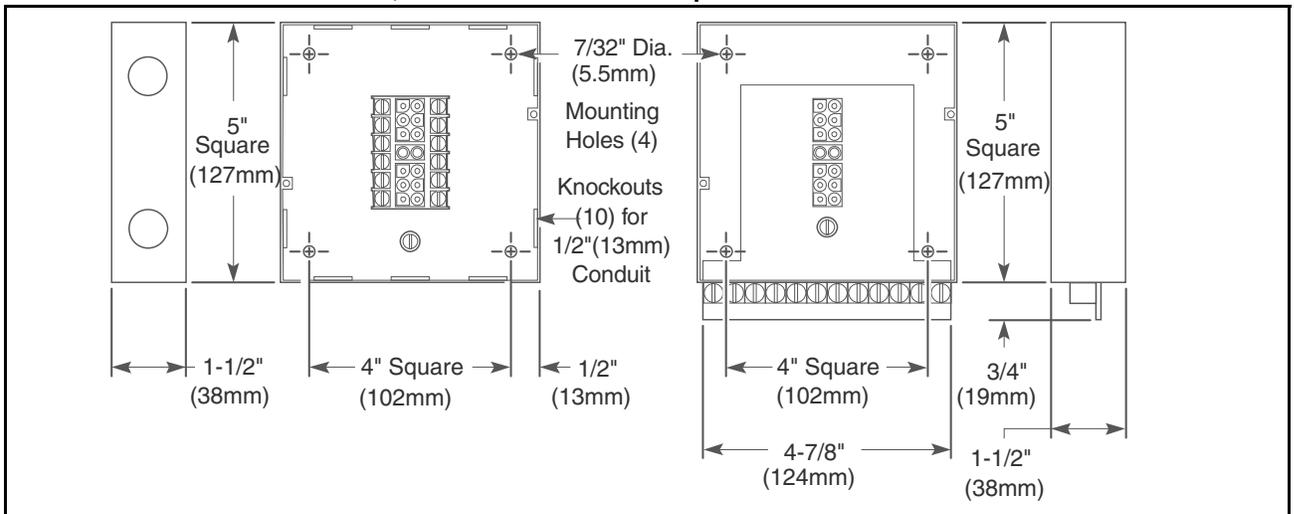
ORDER ENTRY PART NUMBER	DESCRIPTION
61-6994	Modulation base
61-7012-2	Replacement relay module for use in modulation wiring base
<b>TESTERS</b>	
57SB4-1000	Tester for SB Series units, 120 VAC or 230 VAC operation
<b>DISPLAYS</b>	
SB510	Remote display, 120 VAC with keypad
59-511-3	Cable for remote display
36-935	Scanner support (max. temp @ 200°F)
36-936	Scanner support (max. temp @ 475°F)

## DIMENSIONS

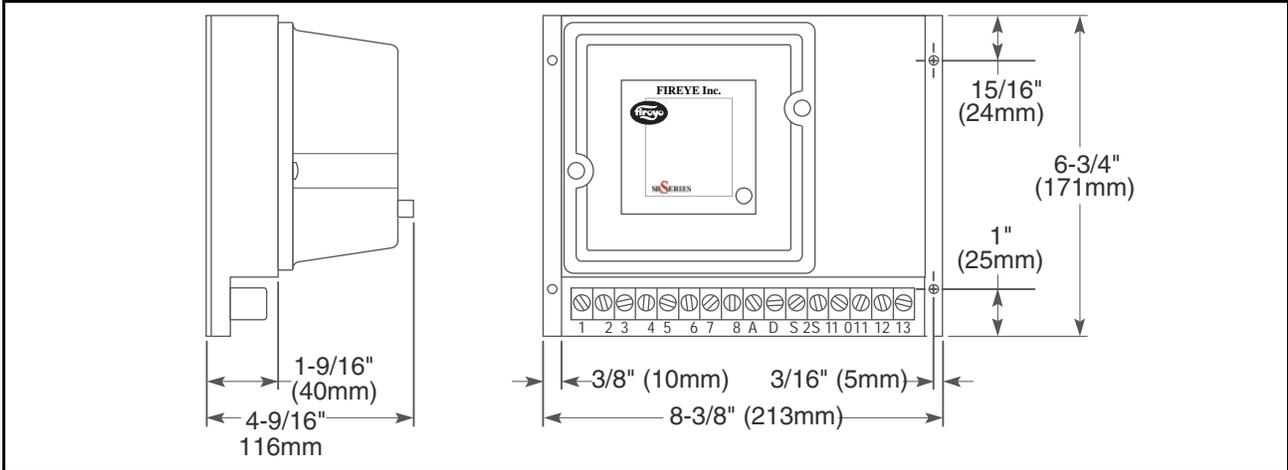
**FIGURE 1. sbSeries Control Unit, all models**



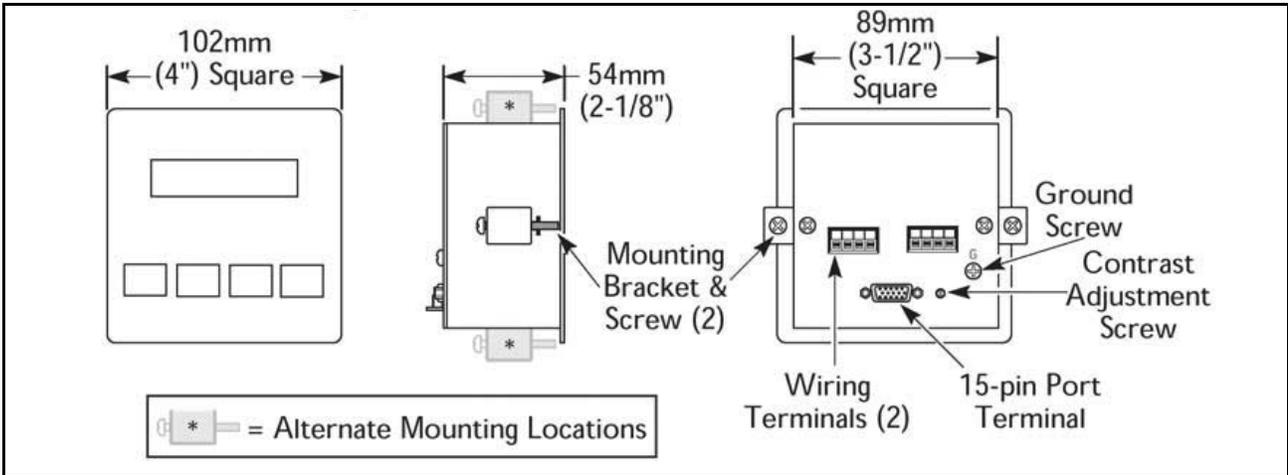
**FIGURE 2. sbSeries Bases, NO-PURGE and PURGE sequence models**



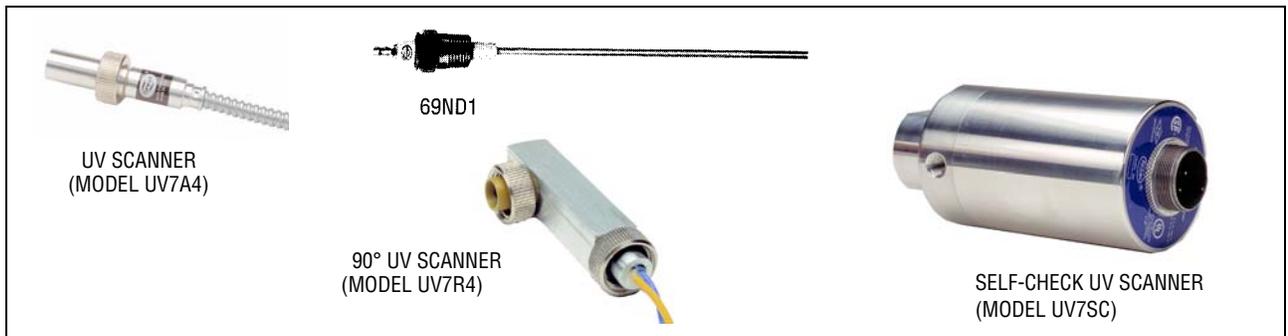
**FIGURE 3. sbSeries MODULATION sequence model, Base Model Number 61-6994**



**FIGURE 4. Remote Display Model Number SB510**



**FLAME SCANNERS**



**CAUTION:** The UV7A4 and UV7R4 ultra-violet flame scanners and associated amplifier modules are non self-checking UV systems and should be applied only to burners that cycle often (e.g. a minimum of once per 12 hours) in order for the safety checking circuit to be exercised.

**WARNING:** Installer must be trained and qualified. Follow the burner manufacturers instructions, if supplied. Otherwise, proceed as follows.

## INSTALLATION OF CONTROL, SCANNERS AND FLAME DETECTORS

### Wiring Base

Mount the wiring base on the burner or on a panel. The location should be free from excessive vibration and within the specified ambient temperature rating. The base may be mounted in any angular position.

All wiring should comply with applicable electrical codes, regulations and local ordinances. Use moisture resistant wire suitable for at least 90°C. Good electrical wiring practice should be followed to ensure an adequate ground system. Refer to Fireye Service Note SN-100 separately and General Grounding Rules later in this document for grounding methods.

A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preference to alternative paths, where extensive damage may occur to equipment.

Circuit recommendations are found on pages 11 through 13. Consult the factory for assistance with non-standard applications.



**WARNING: Controls require safety limits utilizing isolated mechanical contacts. Electronic limit switches may cause erratic operation and should be avoided.**



**Care must be taken to NOT route the high energy ignition wire in close proximity to the flame sensor wiring.**

## INSTALLATION GUIDELINES

### Terminal 7 - Interlocks and Limit Switch Input

Wire external interlock, control, and limit switches in series to this input. Guard against induced voltage levels to wiring connected to this input. In some extreme wiring runs, reduction of induced voltages may require a load (relay or light) connected to terminal 7 to avoid system error lockouts. This input is the power source for the valve and ignition output terminals. Be sure all switches wired to this input can handle the current required by the total of all loads connected to terminals 3, 4, and 5.

### Terminal 6 - Combustion Air Switch Input

For purge and modulation models: Wire any switches and contacts in series to this terminal for proving airflow function and relating to the air failure light. Power must not be immediately present at terminal 6 when power is first applied to terminals 1 or 7. If the combustion air blower is controlled outside of the sbSeries system, then a three-way solenoid valve must be connected between the air switch port and the blower sensing port. The valve de-energized state should vent the switch to ambient.



#### **Terminal 4 - Ignition Wiring**

The output terminal normally powers a high voltage transformer. Route the high voltage ignition wiring a sufficient distance from all sensors and other low voltage wiring to avoid electrical interference, which may cause erratic operation of the sbSeries system. Keep the high voltage wire as short as possible. The best condition is to mount the ignition transformer close to the burner and keep a low impedance path from the burner ground to the ground of the transformer. Make sure the high voltage lead and ground return paths do not create a loop antenna around the sbSeries and sensor wiring.

#### **Low Fire Start Switch, (Terminal 3 –resistance through valve coil)**

For modulation sequence models: It is possible to wire the system for checking low fire start position prior to pilot ignition. To use this feature, the low fire start switch must be connected between terminal 3 and the pilot valve. On direct spark burners, a by-pass contact must be wired around the low fire switch.

#### **Terminal V or D - Main Valve Closed Switch Input**

The system can be wired to check for the main valve closed switch on the main gas valve prior to start-up and after the end of the burner cycle.

**For purge and no purge models:** The main valve closed switch must be connected to Terminal V and the jumper in the base must be cut.

**For modulation models:** The main valve closed switch must be wired in series between the airflow switch and the high purge damper switch. To use this feature, the jumper in the base must be cut.

#### **Terminal D - High Purge Switch Input**

For modulation models: the system can be wired to check high purge position for the high fire purge portion of the sequence. To use this feature, the red jumper in the base must be cut and the high purge position switch must be connected from terminal D. If this feature is not used, the jumper in the base remains intact a jumper must be installed between terminals 1 and D. (The yellow jumper on the base has no effect whether cut or intact.)

#### **Terminal 1 - Remote Reset**

This feature permits remote mounting of a switch to reset the sbSeries. To use this feature, a normally closed remote reset switch must be wired so that power is interrupted to terminal 1. When it is pressed or actuated, the connection to terminal 1 is momentarily interrupted and resets the sbSeries.

#### **Remote Display**

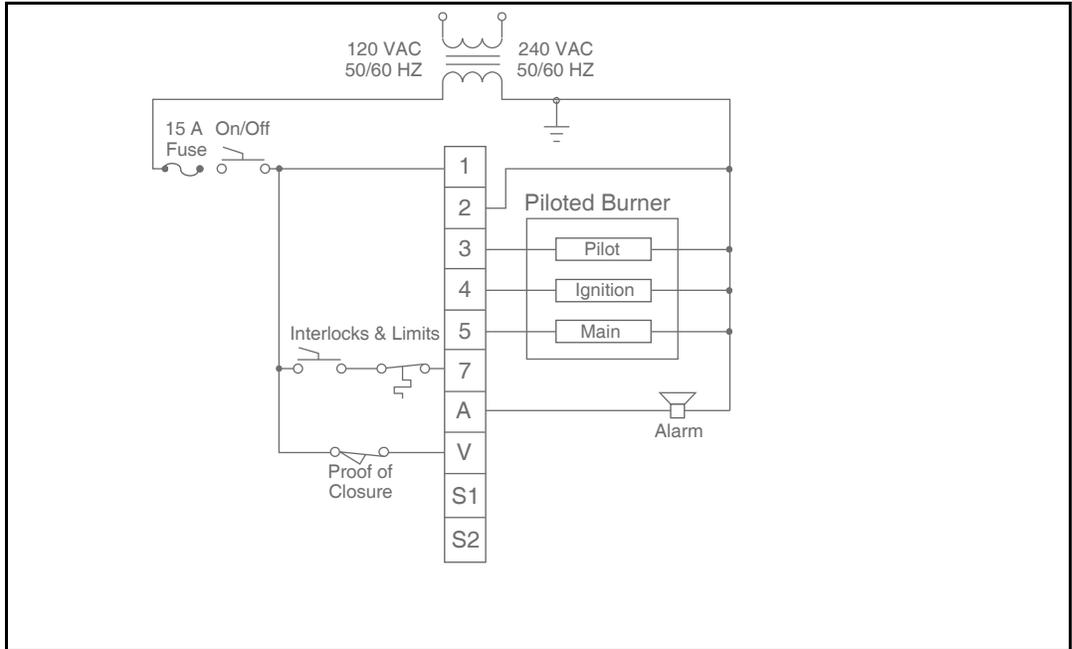
The SB510 remote display is wired according to Figure 10. Mount through a DIN cutout using the two supplied brackets in either the top and bottom or the side slots. Locate the display and wiring to minimize electrical interference. Applying and disconnecting the display power supply should coincide with power to terminal 1 of the sbSeries. Use the appropriate cable (P/N 59-5111-3) to connect to the test jack and to the S2 terminal of the sbSeries wiring base. Do not attempt to parallel the test jack signal to other devices when using a remote display. The LCD display contrast can be adjusted on the back with a small blade screwdriver.

#### **Note:**

1. Control circuit wires must meet 90°C (194°F) specification minimum and must be 1.5mm<sup>2</sup> (No. 16 AWG) or larger and in accordance with all applicable codes.
2. Flame sensor wires must be individually run in their own separate conduit; multiple unshielded flame sensor wires CANNOT be run together in a common conduit or wire way (See Sensor Installation Section).
3. The neutral wire to terminal 2 must be at ground potential (bonded at the supply source).

**WARNING:** Install a modulation sequence model into the modulation style base only; never plug into purge or no-purge bases.

**FIGURE 5. WIRING FOR NO PURGE MODELS**



**FIGURE 6. WIRING FOR PURGE MODELS**

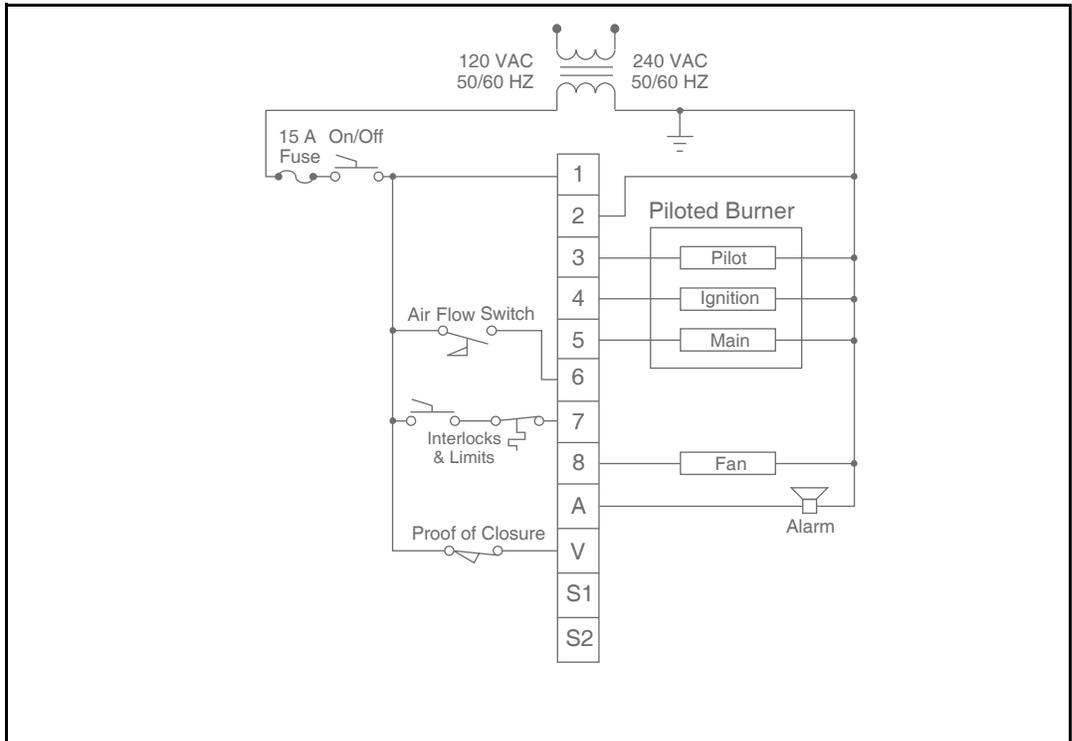


FIGURE 7.

**WIRING FOR DIRECT SPARK OF MAIN FLAME, NO PURGE MODELS & PURGE MODELS**

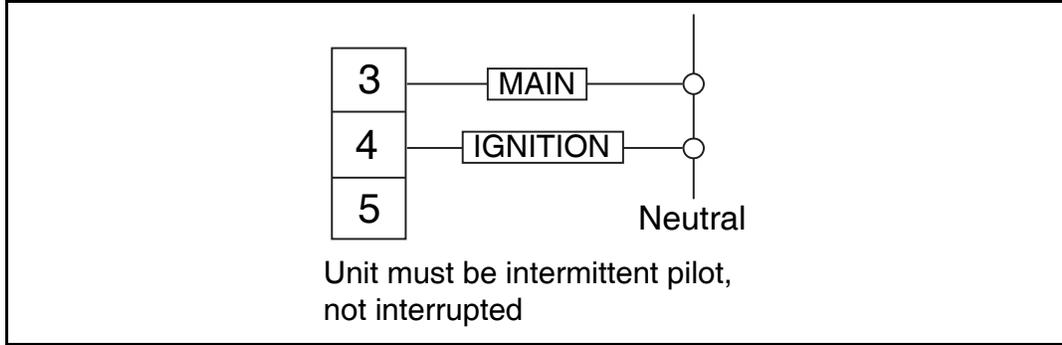


FIGURE 8.

**WIRING FOR MODULATION MODULES**

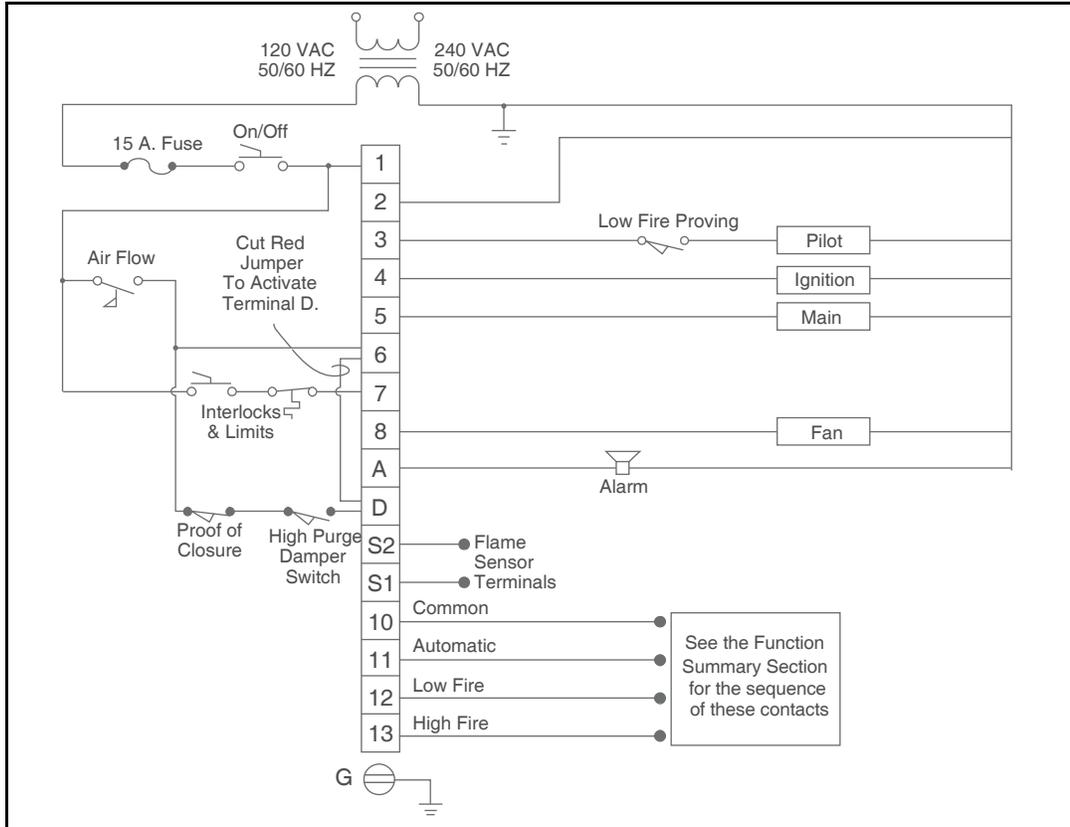
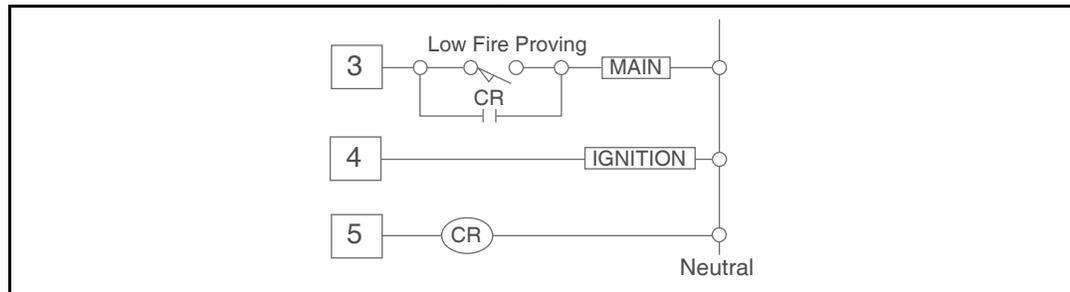
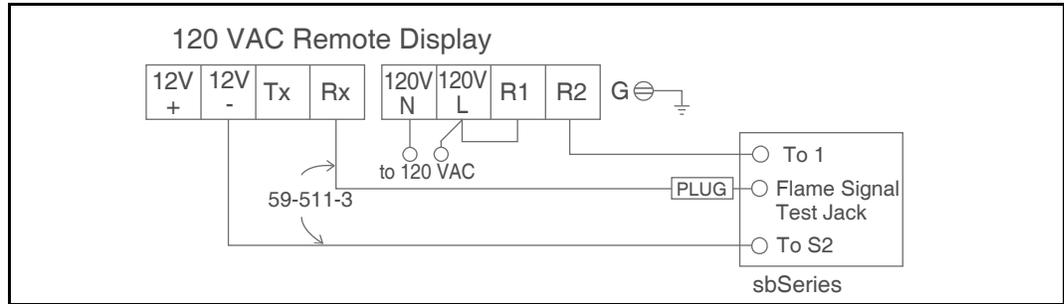


FIGURE 9.

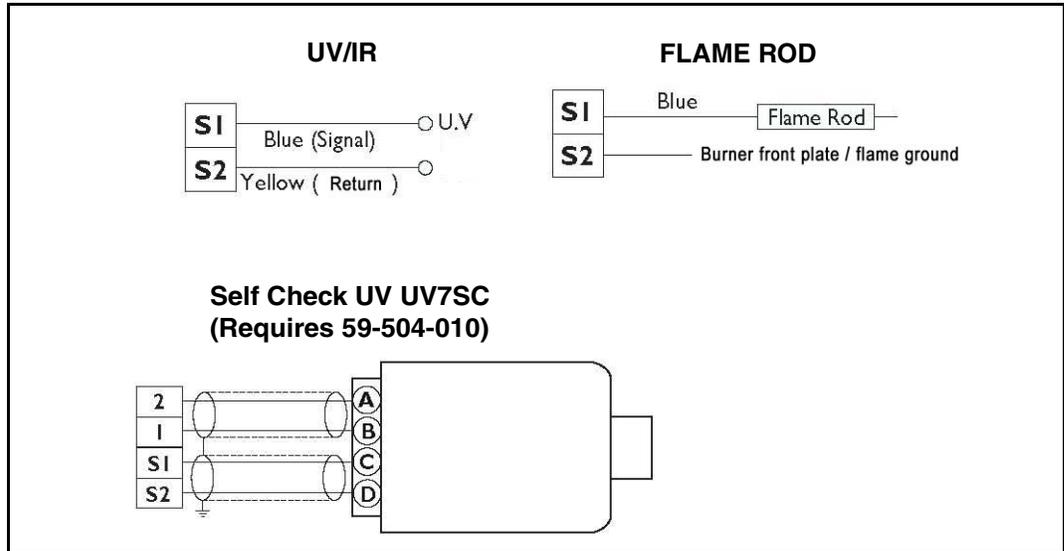
**WIRING FOR DIRECT SPARK OF MAIN FLAME, MODULATION MODULES**



**FIGURE 10. WIRING FOR 120 VAC REMOTE DISPLAY MODULE**



**FIGURE 11. TYPICAL CONNECTIONS FOR ALL MODELS**



**Notes for Figures 9 and 10**

1. For UV ground, shielding & conduit must not be connected to terminal S2. For FR, S2 must connect to flame ground (burner front plate). Do not connect shielding or conduit to terminal S2.
2. Control circuit wires must meet 90°C (194°F) specification minimum and must be No.16 AWG or larger and in accordance with all applicable codes.
3. Flame sensor wires must be individually run in their own separate conduit; flame sensor wires CANNOT be run together in a common conduit or wireway.
4. Flame signal should read between 4 and 10 VDC with a digital volt meter. Drop off is approximately 4.0 VDC. Positive test jack point is on the cover marked "Flame Signal" with S2.
5. Neutral must be grounded.



## OPERATION

### Introduction

This section describes the features of the sbSeries CE. It is presented in three categories: Standard Features, Optional Features, System Errors and Lockout Conditions, and the LED Indicator Lights.

### Standard Features

The following functions are standard features on the SbSeries models as noted.

#### Interlocks and Limit Switch Input (Terminal 7)

This input is considered the normal operation control or run input to the sbSeries system. Interlocks are generally pressure or temperature switches that when activated will start the burner. Limit switches are generally pressure, temperature, and other switches that when activated will stop the burner. The interlocks and limit switches are wired in series. A break in this circuit will shut the burner down, but will not produce an alarm or lockout condition.

#### Combustion Air Switch Input (Terminal 6)

**For PURGE and MODULATION sequence models:** This input is for monitoring the combustion air switch separately from other interlocks and limits. The sbSeries checks the air flow switch input is open before start-up, closed during operation, and open again at burner shutdown, thus preventing operation with an air switch that is defective, maladjusted or bypassed. This input has about a 1 second delay to filter out and ignore a momentary interruption.

If the input is improperly powered before the fan output is energized, the system error light will blink. The input must de-energize within 30 seconds or the sbSeries will alarm and lockout.

After the fan output has energized, the air switch input must be made within 10 seconds. If not proven, then the system will lockout and the alarm output and the air failure light will come on. However, if the unit has the air switch input hold

feature, the sequence is held indefinitely without causing a lockout. Then when the air switch input is made, the sequence continues.

If the air switch opens during the main firing cycle, the system will lockout and the alarm output and the air failure light will come on. However, if the unit has the recycle option and the main output has been operating for at least 35 seconds, the sbSeries will shut-down and restart.

#### Pre-Purge

**For PURGE sequence models:** The sbSeries delays the sequence after the air switch is proven by the specified purge time. Once completed, the sequence continues to the trial for ignition.

**For MODULATION sequence models:** The purge time is doubled into two sequences. The first is a high fire purge for the specified time. The second is a low fire purge allowing the air butterfly valve time to achieve starting position.

SEQUENCE STEP	INTERNAL CONTACTS	FUNCTION
Power Off	10 to 11	AUTO
Power On, Limits Off	10 to 12	LOW
Purge to High Fire	10 to 13	HIGH
Purge to Low Fire	10 to 12	LOW
Automatic Modulation	10 to 11	AUTO
Alarm and Lockout	10 to 12	LOW

### Main Fuel Valve Closed Switch (Terminal V)

**For NO-PURGE and PURGE sequence models:** The sbSeries can be interlocked with the main valve closed position switch. This feature checks the switch position before start-up and after shut-down to insure proper valve operation when the jumper on the base is cut.

### Main Fuel Valve Closed / High Fire Purge Check (Terminal D)

**For MODULATION sequence models:** This feature is enabled when the jumper on the base is cut. The system checks that the high fire purge position switch and the main valve closed switch are both made at the end of the high fire purge.

### Low Fire Start (Terminal 3 – impedance)

**For MODULATION sequence models:** When wired, the system checks for the low fire start position prior to light-off.

### Pilot Test Mode



In the pilot test mode, the sbSeries will hold the sequence once the pilot flame is established and prevents energizing the main valve (terminal 5).

Depressing the TEST/RESET button on the front cover enters this mode. When in the pilot test mode, the green “INTERLOCKS CLOSED” light blinks. To exit the pilot test mode, simply push the TEST/RESET button again.

### Interrupted or Intermittent Pilot

An interrupted pilot shuts off at the time specified by the part number after the main valve is energized. An intermittent pilot (specified as 00 time) continues during the entire main flame firing cycle.

### Spark, Pilot Flame & Main Flame Separation

During the trial for ignition period (TFI), the pilot and ignition outputs remain energized. At the end of the TFI, the pilot output remains on and the ignition output is de-energized. After a five second delay to prove the pilot or start flame, the main gas valve is energized.

### Post Purge

**For PURGE and MODULATION sequence models:** Post purge maintains the combustion air fan output for the time specified after the interlocks and limit switch input have opened.

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## OPTIONAL FEATURES

The following functions are optional features that must be specified when ordering.

### Recycle Mode

With “R” specified, the sbSeries will restart the sequence after flame or air failure. The recycle mode allows the system to re-initiate the start-up sequence automatically only if the main burner has been operating for at least 35 seconds. If the pilot or start flame fails to light during recycling, the system will alarm and lockout. If the recycle is successful and the main burner is once again operational for at least 35 seconds, the system is enabled for another recycle. At no time will the system recycle in the event of a pilot or starting flame failure.

### Air Switch Input Hold

**For PURGE and MODULATION sequence models:** With “H” specified, the SbSeries holds the sequence indefinitely until the air switch input is made. Once made, normal functional sequence continues.



### Manual Reset on Power Outage

With “B” specified, the TEST/RESET button must be pressed twice (in and out) to start the sequence. The system error light blinks rapidly (about 4 times per second) and a remote display will show “PUSH RESET TO START”.

### Remote Display

Two models of remote display are available. The model SB511 operates on 24VDC and has no keypad. The model SB510 operates on 120VAC and has a keypad for reset function. The display is mounted through the panel-door and features a liquid crystal display in a DIN housing. The unit connects to the sbSeries by a cable to the flame signal test jack, and receives a serial communication on each sequence state change.

The display incorporates the following functions:

1. Provides status messages for the sbSeries sequence, see “Remote Display Messages”.
2. Indicates lockout conditions when they occur, as well as the amount of time into the sequence when the lockout occurred.
3. Provides continuous monitoring of the burner’s flame signal strength and run time during main burner operation.

### System Errors and Lockout Conditions

FAULT CONDITION	LOCKOUT CONDITION
(Illuminated by the red “Fault Condition” LED on the front cover) prevents gas ignition. The unit will continue its sequence after the error is cleared	Energizes the alarm output and deenergizes the gas valve and ignition outputs. The unit must be reset to clear the alarm and start the sequence. To reset, the button must be pressed twice so that the button is in the out position

The following fault conditions result in immediate lockout conditions:

1. Wiring error that puts external voltage on the output terminals.
2. Welded internal contacts or other malfunctions in the sbSeries.
3. Main fuel valve closed position switch is open after cycle shutdown or before start-up. The system error light blinks twice and then remains on. The fan output terminal 8 will energize.
4. Low fire fail (for modulation model) – the low fire switch is open prior to trial for ignition.
5. High fire fail (for modulating model) – the high fire switch is not closed at the end of high fire purge.  
The following situations will result in a lockout condition:
6. Air failure (for purge and modulation models) – loss of combustion air anytime during the operational cycle. The Air Failure LED will be on for this condition. (See “Recycle Mode”).
7. Pilot flame fail – loss of flame during the trial for pilot ignition period. The Flame Failure LED will be on for this condition.
8. Main flame fail – loss of flame during the main burner trial for ignition or run period (recycling not selected). The Flame Failure LED will be on for this condition. The following result in lockout conditions after 30 seconds, the system error light blinks about 14 times and then remains on:
9. If a flame is detected out of sequence, which may be caused by:
  - a. a faulty scanner;
  - b. electrical interference on the sensor wiring;
  - c. a flame exists in the burner or in the line of sight of a scanner, due to a gas leak, product fire or other condition.
10. Air flow switch closed before start-up (for purge and modulation models).



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## Status Lights and Push-Button

All of the status lights and the TEST/RESET push-button are located on the front cover of the sbSeries. This section describes their respective functions.

### Interlocks Closed

This green LED illuminates when the operation limits are made.

The limits are wired in series to terminal 7. This input becomes energized to begin the burner sequence. When in the test mode, this LED blinks (see “Pilot Test Mode”).

### Air Failure

**For purge and modulation models:** this red LED illuminates whenever combustion air is lost during the operational cycle of the sbSeries.

### Fault Condition

This red LED illuminates when a system error is detected (see “System Errors & Lockout Conditions”).

### Flame Failure

This red LED illuminates when a pilot or main flame fails.

### Low Fire

For modulation models: this yellow LED illuminates during the low fire period of the purge cycle.

### High Fire

For modulation models: this red LED illuminates during the high fire period of the purge cycle.

### Auto

For modulation models: this green LED illuminates during the automatic period which occurs 20 seconds after the main valve is energized.

### Test/Reset

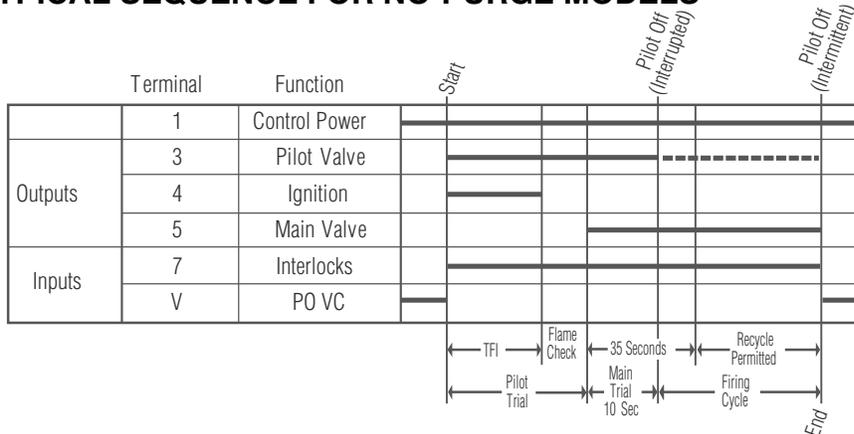
This push-button is used to activate the pilot test mode or to reset the sbSeries unit.

### Flame Signal

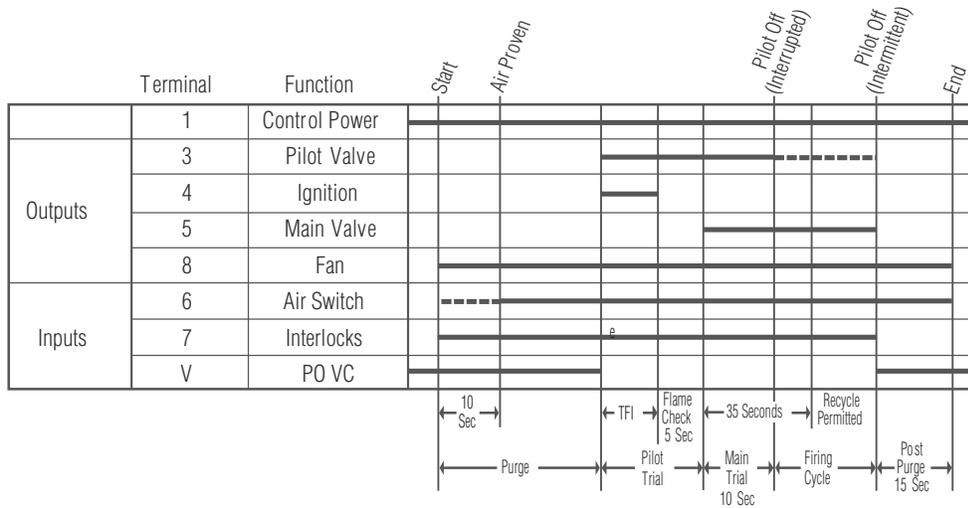
This red LED is located behind the signal test port and illuminates when a flame signal is present.

*Note: Communication signals from the remote display are superimposed on the flame signal test jack. During a valid flame On condition these communication signals will appear to be negligible in comparison to the flame signal (if measuring the flame signal with a DVM for example). When flame is off, the display communication signals or display “discover” signals will appear prevalent on the flame signal test jack. Use of an analog DVM will mask this phenomenon to an extent.*

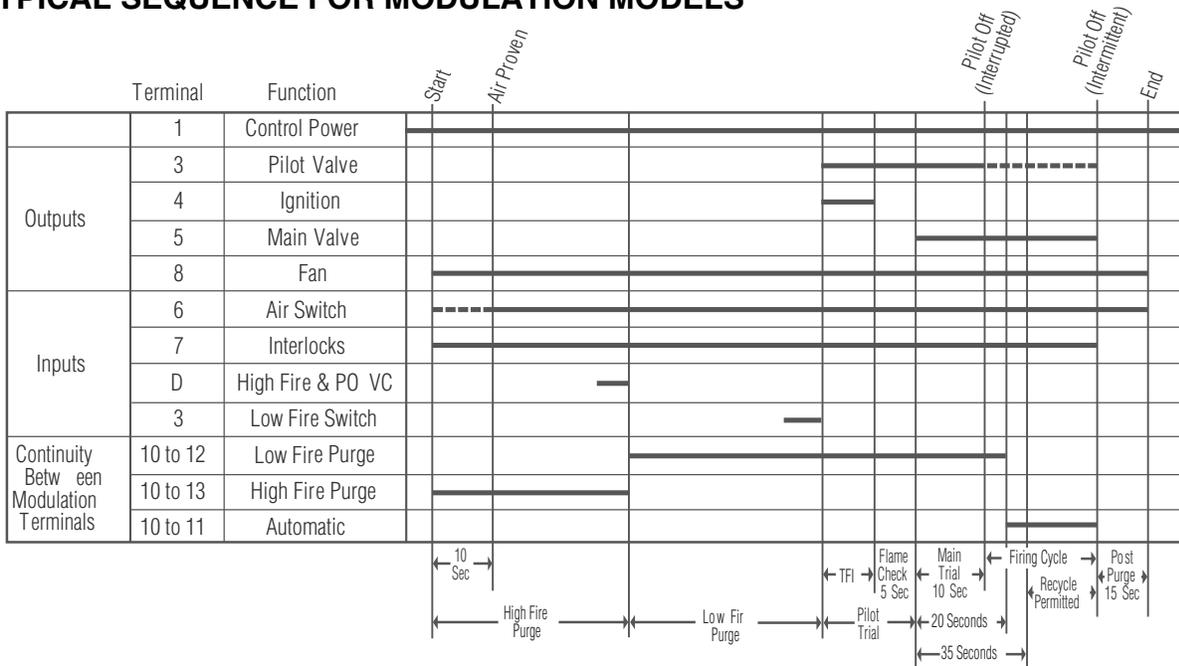
### TYPICAL SEQUENCE FOR NO-PURGE MODELS



### TYPICAL SEQUENCE FOR PURGE MODELS



### TYPICAL SEQUENCE FOR MODULATION MODELS



## SENSOR INSTALLATION



**WARNING:** Incorrect sensor installation may cause the sensor to generate a false flame signal, causing unburned fuel to collect in the combustion chamber. The result can be explosions, injuries and property damage. Be certain that the flame sensor detects only pilot and main flames, not glowing refractory, burner or ignition parts.

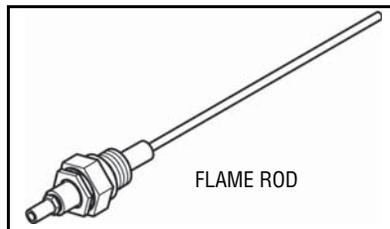
### SENSOR WIRING

Route sensor wiring a sufficient distance from ignition and other high voltage wiring to avoid electrical interference. Wherever possible, try to terminate the flexible metal shield surrounding the leads within inches of the Multi-Burner Control terminals. If the shield must be grounded to reduce interference, ground the shield at the control end to the shield terminal. For self-checking UV scanners, ground both braided shields. To achieve the maximum wiring distance, the shield should not be grounded (keep in mind that an ungrounded shield provides less protection against electrical interference).

#### **Do not ground the shield to terminal GND.**

*Note:* Unshielded sensor wiring must not be run in common with other wires; it must be run in separate conduit. Multiple flame sensor wiring must not be run together in a common conduit or wireway. Use #14 to #18 AWG wire suitable for 90°C (194°F) and 600 volt insulation, and run each pair of leads in its own shielded cable. Multiple shielded cables can be run in a common conduit.

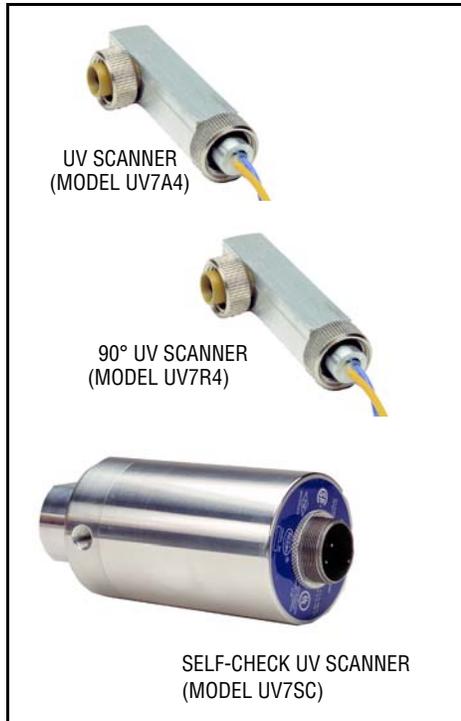
\* The burner at which a flame fails will be identified by a flashing red “FLAME FAIL” LED on the corresponding flame sensing module.



### FLAME RODS

Flame rods should be used only on gas burners. They accumulate soot on oil burners, causing nuisance shutdowns and unsafe operating conditions. See the burner manufacturer’s literature for flame rod mounting location. When installing flame rods, please consider the following:

1. Keep the flame rod as short as possible and at least 1/2" (13mm) away from any refractory.
2. Position the rod into the side of both the pilot and main flames, preferably at a descending angle to minimize drooping of the flame rod against burner parts, as shown at left. Flame rod position must adequately detect the pilot flame at all burner draft conditions. Extend the rod 1/2" (13mm) into nonluminous flames, such as blue flames from burning an air/gas mixture. For partially luminous flames, such as atmospheric air/gas mixtures, place the rod at the edge of the flame.
3. Provide a burner/flame grounding area that is at least four times greater than the flame rod area contacting the flame. The flame rod/burner ground ratio and position of the rod in the flame may need adjustment to yield maximum flame signal strength.
4. Ignition interference from the spark plug may increase or decrease the flame signal strength. Reversing the ignition transformer primary leads may reverse this effect. Reducing the spark gap or adding grounding area between the flame rod and spark plug may eliminate the interference.



## SCANNERS

Use only Fireeye scanner models UV7A4, UV7R4 & UV7SC. Consult the burner manufacturer's instructions for mounting location. When installing scanners, please consider the following:

1. Position the scanner within 18" (457mm) of the flame.
2. Bushing threads are 1/2" F.N.P.T. for scanner models UV7A4 and UV7R4; model UV7SC has 1" F.N.P.T. bushing threads.
3. The ambient temperature limits of each scanner varies; check the literature supplied with the scanner. For higher temperatures, use Fireeye heat insulator P/N 35-319. If necessary, also use a purge tee.
4. An optional magnifying lens (Fireeye P/N 46-185) may also be used to increase the flame signal strength in difficult sighting situations.

## NOTICE

When Fireeye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireeye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireeye products and not to any other equipment or to the combined system or its overall performance.

## WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireeye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye be liable for consequential or special damages of any nature that may arise in connection with such product or part.



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