SureFire
BURNER MANAGEMENT SYSTEMS

| BMS 350 USER MANUAL

Save lives. Lower costs. Reduce emissions.

We are dedicated to providing quality, American-made safety control systems for industrial burners. The system has been developed through thousands of hours of critical design, engineering, and field testing.

- SureFire BMS

CONTENTS

1.1 | System Introduction

The BMS-350 is designed for fired equipment applications (Heater treater, separator, dehydrator, line heater, tank, etc.) It operates with FT Ignition Units to provide optimal ignition.

The controller's display functions in ambient temperatures from –40°F to 131°F and is coated for corrosion resistance. The unit is housed in a NEMA 4X enclosure with a UV-resistant keypad. Each unit includes function indicator lights and a status-code chart printed on the overlay for troubleshooting support. The system requires 12 VDC power and is solar-ready, featuring a dedicated solar power termination port.

1.2 | Classifications

This Burner Management System is suitable for use in **Class 1, Division 2, Groups C and D locations.**

1.3 | Variations

The BMS-350 monitors a pilot or pilotless burner status using a flame rod or thermocouple as a flame sensor. The SureFire controller manages and monitors both the pilot and main burner valves as needed. The system monitors and controls process temperatures with an RTD or thermocouple circuit. Built-in fail-safe features include:

- Flame failure shutdowns
- Alarm functions
- High-temperature shutdown
- High stack thermocouple input
- Other safety mechanisms
- Loss of power fail safe solenoid valve

The SureFire BMS-350 provides Modbus communications via RS-485 communication protocols if required.

Every SureFire system undergoes a complete factory QA/QC inspection before shipment.

2.1 | WARNINGS ⚠

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace fuses unless power has been switched off or the area is known to be non-hazardous.
- Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Exposure to some chemicals may degrade the sealing properties of materials used in the following devices:
  - Panasonic Relay, Model JW2SN-DC12V
  - Hamlin Relay, Model HE721A0500

AVERTISSEMENTS ⚠

Risque d'explosion:

- La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.
- Couper le courant ou s'assurer que l'emplacement est désigné non dangereux avant de remplacer le fusible.
- Avant de déconnecter l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux.

Exposition aux Produits Chimiques

L'exposition à certains produits chimiques peut dégrader les propriétés d'étanchéité des matériaux utilisés dans les appareils suivants :

- Panasonic Relais, modèle JW2SN-DC12V
- Hamlin Relais, modèle HE721A0500

2.2 | Certifications

Suitable for use in:
Class I, Division 2, Groups C, D, T6 Hazardous (Classified) and Ordinary Location

Certified to:

- CSA STD C22.2 NO. 61010-1
- CSA STD C22.2 NO. 213:2017 Ed.3

Operating Temperature Range:
-40°C (-40°F) ≤ Ambient Temp ≤ 55°C (131°F)

Conforms to:

- UL STD 61010-1
- UL STD 121201:2017 Ed.9

3.1 | SureFire Warranty Statement:

SureFire warrants all equipment of its own manufacture to be free from defects in material and workmanship. SureFire's sole obligation under this warranty is expressly limited to the repair or exchange, F.O.B. Farmington, NM, USA, of such defective equipment. This warranty does not apply to claims resulting from improper installation, misuse, maladjustment, abnormal operating conditions, or lack of routine maintenance, as determined by SureFire. Additionally, it does not cover service for maintenance or issues arising from these causes.

No claims for labor, installation, removal, transportation, or other expenses will be recognized. Notwithstanding any stipulation by the purchaser to the contrary, all other obligations, representations, warranties, and conditions—whether express or implied, statutory or otherwise—including any implied warranties or conditions of merchantability, quality, or fitness, are expressly excluded.

SureFire shall not be liable for any loss, cost, or damages of any kind, whether consequential, indirect, special, or otherwise, arising out of or in connection with the equipment or any defect therein, even if caused by the negligence of SureFire, its employees, or agents.

The provisions of this warranty, including its limitations and exclusions, shall remain enforceable between the parties, even upon termination of this agreement for any reason, including fundamental breach.

For equipment not manufactured by SureFire, the original manufacturer's or vendor's warranty shall apply.

Product Description	Warranty Policy Defective Products	Return Policy Customer Return New Product
SureFire Controllers: BMS-100, BMS-300, and BMS-350 Controllers	3 Years from date of purchase	180 Days from date of purchase 20% Minimum Restocking Fee
SureFire FT Ignition Units: FT-1, FT-2, FT-4, FT-6, FT-8 and FTL-F Ignition Units	2 Years from date of purchase	180 Days from date of purchase 20% Minimum Restocking Fee
Additional Components	Manufacturers carry own individual warranty policy on Components.	Manufacturers carry own individual return policy on Components.

The warranty policy is related to manufacturing defects. The return policy is related to the return of product for any reason other than manufacturing defects. Returns must be approved by SureFire in advance of shipment and returned products must be in their original condition. Restocking fees for returns are at the discretion of SureFire and may vary by product.

3.2 | Shipping Cost:

For warranty claims, the cost of shipping the product to SureFire is the customer's responsibility. If SureFire determines the product is covered under warranty, SureFire will cover the cost of return shipping to the customer. If the product is deemed non-warranty, the customer is responsible for return shipping costs.

For return claims, all shipping costs are the customer's responsibility.

3.3 | Warranty Claims Resolution

SureFire will provide one of the following resolutions for warranty claims, determined at its sole discretion:

- SureFire will repair any defective parts free of charge to the customer.
- SureFire will replace the defective product free of charge to the customer.
- SureFire may provide a credit, minus a restocking fee, for approved return claims.

3.4 | Non-Warranty Products

If a product is returned under a warranty claim and is deemed non-warranty by SureFire, the following options may be offered on a case-by-case basis:

- If the product is repairable, SureFire may provide a repair quotation.
- If the product is not repairable, SureFire may either discard the damaged product or return it to the customer upon consent.
- A replacement product may be purchased.

3.5 | Return Material Authorization (RMA)

To obtain a Return Material Authorization (RMA), it is highly recommended to first contact **SureFire's technical support hotline at 505-333-2876** for potential troubleshooting.

If technical support determines that the product qualifies for a warranty or return claim, please **contact the SureFire Returns Department** at **505-333-2878 Ext. 18** or via email at **returns@surefire-controls.com.**

4-6

PRODUCT DESCRIPTIONS

BMS-350 | FT IGNITION UNITS | AUXILIARY COMPONENTS

4.1 | Enclosure

The SureFire BMS-350 system is housed in a polycarbonate NEMA 4X enclosure that contains the circuit board. The graphic overlay, along with the membrane keypad, is mounted on the exterior of the enclosure.

The NEMA 4X enclosure provides a high level of protection against harsh outdoor elements, including:

- Protection from windblown dust
- Protection against water damage, including rain, sleet, snow, splashing, and direct water contact
- Corrosion protection
- Protection from the external formation of ice

The enclosure is IP66 certified and has been tested to meet the following certifications:

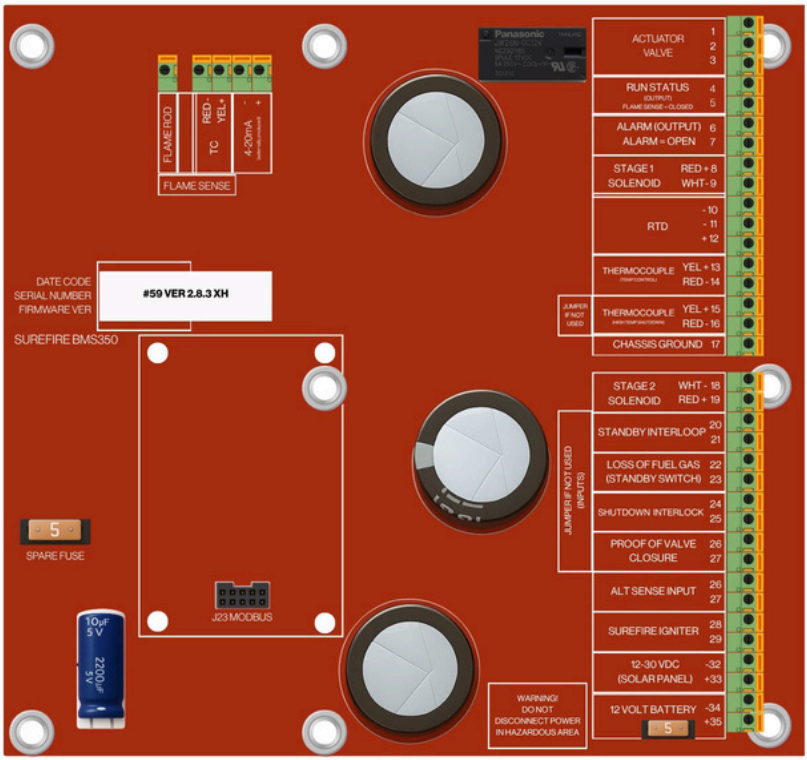
- Dust-tight: No ingress of dust; complete protection against contact.
- Water resistance: Water projected in powerful water jets (12.5mm nozzle) against the enclosure from any direction shall have no harmful effects.

4.2 | Warning ⚠

When drilling holes in the enclosure, ensure that IP66 fittings are used to maintain the IP66 standard. Failure to use fittings that meet the IP66 standard will nullify the certification.

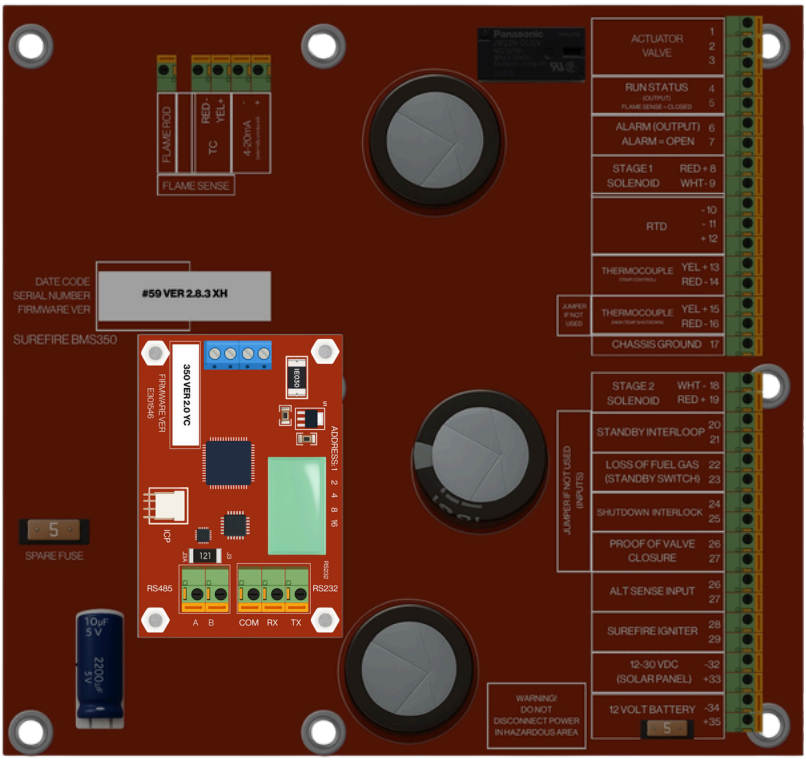
4.3 | BMS-350 Circuit Board

The SureFire BMS-350 system is controlled by state-of-the-art, non-arcing electronics that monitor and control all burner functions. It features four LED indicators and an LED display for easy monitoring. Additionally, the system is equipped with individual terminal blocks and a power connector to simplify wiring and installation.



4.4 | BMS-350 Modbus Card

The SureFire Modbus Card provides Modbus communications via RS-485 communication protocols if required.



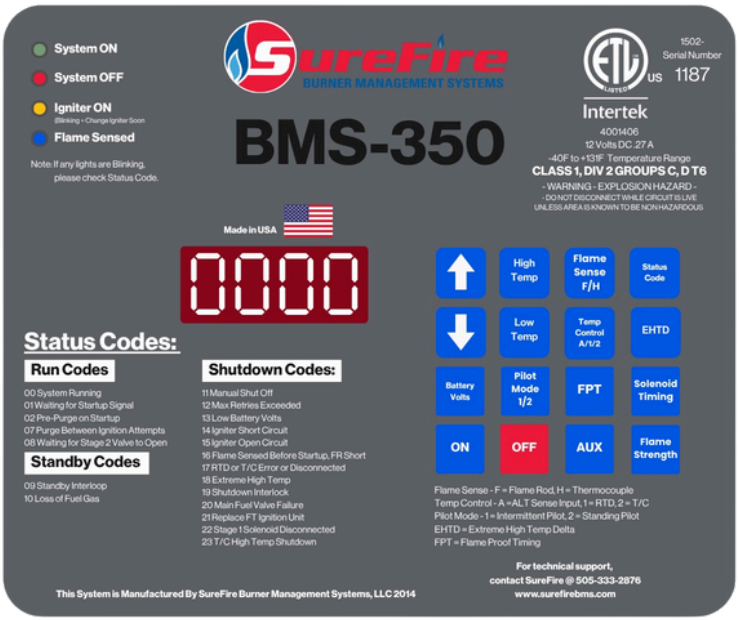
4.5 | LED Indicators

The circuit board's LEDs are designed to illuminate through the lid of the enclosure, providing clear visual status indicators. The LEDs indicate the following:

LED Indicator	Status
GREEN	**LED ON** - Indicates that the system is on and operating properly **Blinking** - Indicates a standby switch has been activated
RED	**LED ON** - Indicates that the system is off **Blinking** - Indicates a shutdown switch has been activated
AMBER	**LED ON** – Indicates the igniter is on **LED Blinking** - Indicates an igniter failure
BLUE	**LED ON** - Indicates a flame has been sensed on the flame sensing device

4.6 | Graphic Overlay

The graphic overlay is used to interface with the system and acquire system data. It also provides a list of status codes and features a display window that shows data, settings, and other relevant information.



4.7 | 16 Button Keypad

The SureFire BMS-350 system features a 16-button keypad for controlling and monitoring the system. The buttons perform the following functions:

Button	Displayed Value / Functional Operation
	• **Increases the current value** • **Press and hold for 5 seconds to unlock.**
	• **Decrease the current value** • **Press and hold for 5 seconds to relock the system**
High Temp	• **Displays the High Temperature setpoint** • **Press and hold for 5 seconds to display the Safety Thermocouple Shutdown Setpoint**
Low Temp	• **Displays the Low Temperature Setpoint**
Flame Sensor F/H	• **Displays the current Flame Sensing device:** ◦ F = Flame Rod ◦ H = Thermocouple
Temp Control A/1/2	• **Displays the current Temperature Control device:** ◦ A = Alt Sense ◦ 1 = RTD ◦ 2 = Thermocouple ◦ 3 = RTD and Thermocouple
Status Code	• **Displays the code that corresponds with the current unit's status** • **Press and hold and use the Up or Down Arrows to display the system's past 9 codes**
EHTD	• **Displays the current Extreme High Temp Delta setting**

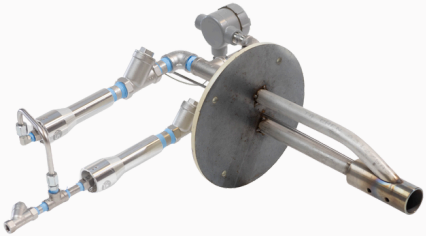
Button	Displayed Value / Functional Operation
Battery Volts	• **Displays the current voltage being supplied from the battery to the BMS-350 system**
Pilot Mode 1/2	• **Displays the current Pilot Mode:** ◦ 1 = Intermittent Pilot ◦ 2 = Standing Pilot
FPT	• **Displays Flame Proof Timing**
Solenoid Timing	• **Displays the solenoid stage the actuator valve opens and closes in conjunction with:** ◦ 1 = Stage 1 ◦ 2 = Stage 2
Flame Strength	• **Displays the current Flame Strength value** • **While in locked mode, press and hold for 5 seconds to display the Safety Thermocouple's current temperature**
AUX	• **Displays current Igniter Ohm value** • **Press and hold to display the following data:** ◦ System Days On ◦ Burner Days On ◦ Ignition Attempts ◦ Successful Ignition
OFF	• **Turns the system OFF**
ON	• **Turns the system ON**

5.1 | SureFire FT-Series Ignition Units

The **SureFire BMS-350** is compatible with the listed **FT series ignition units**. Each unit is specifically designed for **Flare**, **Combustor**, or **Firetube** applications. The FT-series ignition units are suitable for ***piloted*** applications.

5.2 |Combustor Pilot

The FTL-F Series ignition unit for combustor applications utilizes hot surface ignition, flame front generation, and a thermocouple as a flame sensor. The FTL-F Mini series is custom engineered to specifically fit the combustor application.



5.3 | Flare Pilot

The FTL-F series ignition unit for flare applications utilizes hot surface ignition, flame front generation, and a thermocouple as the flame sensor. These pilots are designed in various lengths (5', 7', and 17' in length.) for various flare applications.

5.4 | Firetube Pilot

The FT-1 Ignition unit is designed for piloted applications and utilizes hot surface ignition and a thermocouple as the flame sensor. These units are utilized in piloted applications in conjunction with main burners rated up to 10MM BTU/hr.

For proper pilot placement and flame sensing selection, please contact **SureFire Tech Support at 505-333-2876** or your local SureFire representative.

5.1 | SureFire FT-Series Ignition Units

The **SureFire BMS-350** is compatible with the listed **FT series ignition units**. Each unit is specifically designed for **Firetube** applications. The FT-series ignition units are suitable for both ***piloted*** and ***pilotless*** applications.

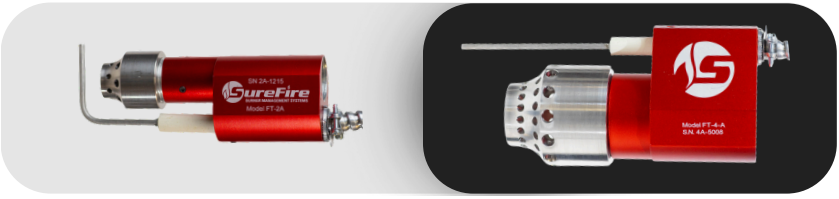
5.2 | Firetube Pilot

The FT-1 Ignition unit is designed for piloted applications and utilizes hot surface ignition and a flame rod as the flame sensor. These units are utilized in piloted applications in conjunction with main burners rated up to 10MM BTU/hr.

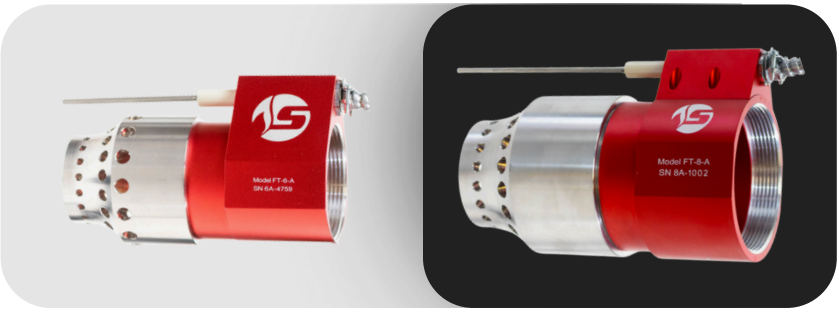
5.3 | Firetube Pilotless

The pilotless FT Ignition Unit is designed for pilotless firetube applications and utilizes hot surface ignition and a flame rod as a flame sensor. These ignition units are rated for burner applications from 125,000 BTU/hr - 1.5MM BTU/hr.

FT-2 **FT-4**



FT-6 **FT-8**



SureFire offers nozzle arrangements for horizontal and vertical firetube applications.

For proper pilot placement and flame sensing selection, please contact **SureFire Tech Support at 505-333-2876** or your local SureFire representative.

12 VOLT ACTUATOR VALVE
Part #51901065

Features:
- Controls the main fuel gas to the main burner
- Factory programmed and pre-wired – no adjustments necessary
- 3-wire termination for easy installation

1" SOLENOID VALVE
Part #51900605 K

Features:
- Fail-closed device
- No adjustment necessary
- Simple termination and installation

2" SOLENOID VALVE
Part #51900608 K

Features:
- Fail-closed device
- No adjustment necessary
- Simple termination and installation

1/4" ASCO SOLENOID VALVE

Features:
- Fail-closed device
- No adjustment necessary
- Simple termination and installation

Additional Accessories

RTDs
Thermocouple
Slow Flow Valve
Pressure Switch
Pressure Transducer
Coalescing Filter
Air/Gas Mixers
Pressure Regulators
Voltage Converters

Service Parts

Flame Rod Replacement Kits
Flame-Sensing Thermocouple Replacement Kits
Overlay Replacement Kits
CCA Replacement Kit

7

MECHANICAL INSTALLATION

CONTROLLER INSTALLATION | IGNITION UNIT INSTALLATION
VALVE INSTALLATION

7.1 | SureFire BMS-350 Enclosure

1. The enclosure must be mounted on a pole, stand, or building that can support at least 10 lbs.
2. The BMS-350 includes a mounting bracket kit ***(screw size is:#10-32)***
3. Using the bracket kit, mount the enclosure on to the apparatus, ensuring the enclosure is level.
4. Position the enclosure so that the LED display is clearly visible to the operator.
5. Install conduit seal-off fittings into the enclosure, ensure the position of the fittings are on the side or bottom of the enclosure, never on the top. Ensure that conduit fittings are water proof.
6. Instillation must comply with the National Electric Code.

WARNING ⚠:

- Before attempting any welding, disconnect all wires going to the circuit board. Any damage caused by welding to the SureFire BMS is NOT covered under warranty.
- Before terminating any wires, ensure that no power is supplied to the controller.
- Any damage caused by standing on or using the enclosure as a step is NOT covered under warranty.

7.2 | SureFire FT-Series Ignition Unit On A Combustor

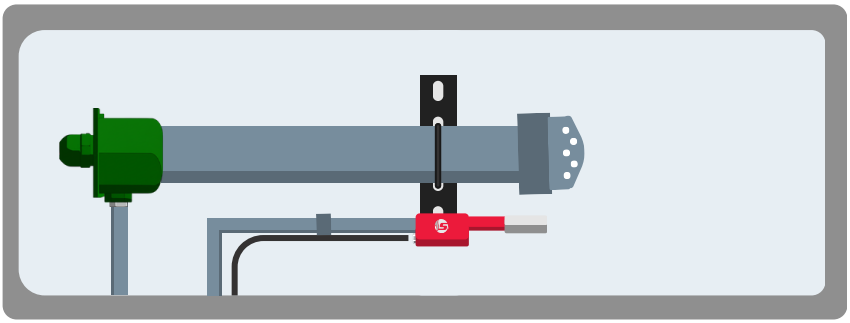
1. Ensure all gas is turned off and locked out/tagged out.
2. Install the FTL-F Mini ignition unit.
3. Ensure the gasket is mounted to the flange and all bolts are securely fastened.

7.3 | SureFire FT-Series Ignition Unit On A Flare

1. Ensure all gas is turned off and locked out/tagged out.
2. Install the FTL-F ignition unit.
    a. The FTL-F ignition unit produces a flame pattern that extends past the nozzle- 9"-12".
3. Secure the supply gas tubing and wiring harness back to the flare body, ensuring their stability in windy conditions.

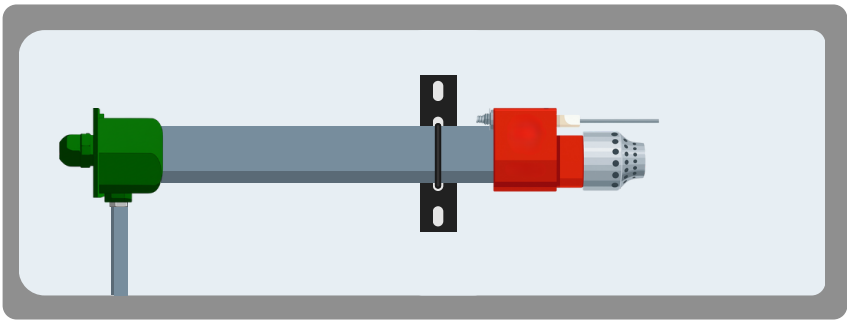
7.2 | SureFire FT-1 Ignition Unit On A Firetube

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Remove the flame arrestor.
3. Remove the existing pilot nozzle.
4. Clean out the existing pilot mixer and pilot orifice.
    a. Ensure that the orifice diameter is a #72.
5. Install the SureFire FT-1 Ignition Unit on the pipe nipple that is screwed in to the mixer.
    a. Ensure the pilot nozzle is 1 inch shorter than the main burner nozzle.
6. Run the wiring harness into an external junction box.
    a. Do not cut the ignitor wires. This will void the warranty and reduce the life of the ignition unit.
7. Re-install the flame arrestor.



7.3 | SureFire FT Pilotless Ignition Unit On A Firetube

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Remove the flame arrestor.
3. Remove the existing pilot burner assembly.
4. Remove the existing main burner nozzle.
5. Clean out the existing air fuel gas mixer and orifice.
6. Install the SureFire FT Pilotless Ignition Unit on the pipe nipple that is screwed into the mixer.
    a. Ensure the pipe nipple length from the end of the mixer to the beginning of the FT Unit is a minimum of 8' of pipe nipple length per 1' of burner diameter.
7. Run the wiring harness into an external junction box.
    a. Do not cut the ignitor wires. This will void the warranty and reduce the life of the ignition unit.
8. Re-install the flame arrestor.



7.4 | Piloted Valve Control (1st and 2nd stage)

1. Ensure all gas is turned off and locked out/tagged out.
2. Locate the pilot gas supply line.
3. Install the ¼“ ASCO in the appropriate location within the pilot fuel train (downstream of the 0-30lb regulator).
4. Locate the main burners diaphragm valve.
5. Install the ¼" ASCO in the instrument gas tubing that feeds the main burners diaphragm valves.
6. Install a ¼” Slow Flow Valve downstream of the ASCO valve referenced in point #5.

NOTES:

1. ASCO Solenoid Proper Flow Direction:
    - 2 = Inlet
    - 1 = Outlet

7.5 | Pilotless Valve Control (1st stage)

Pneumatically Driven:

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Locate the main burners diaphragm valve.
3. Install the ¼" ASCO in the instrument gas tubing that feeds the main burners diaphragm valves.
4. Install a ¼" Slow Flow Valve downstream of the ASCO valve referenced in point #3.

Ventless Fuel Train:

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Locate the main burners diaphragm valve.
3. Remove the existing diaphragm valve.
4. Install the 1" actuator valve and the 1" solenoid valve.
    - The 1" solenoid valve will be upstream of the actuator valve and serves as a fail safe valve.
    - There needs to be a minimum of 3" of pipe nipple in between the actuator valve and the solenoid valve.

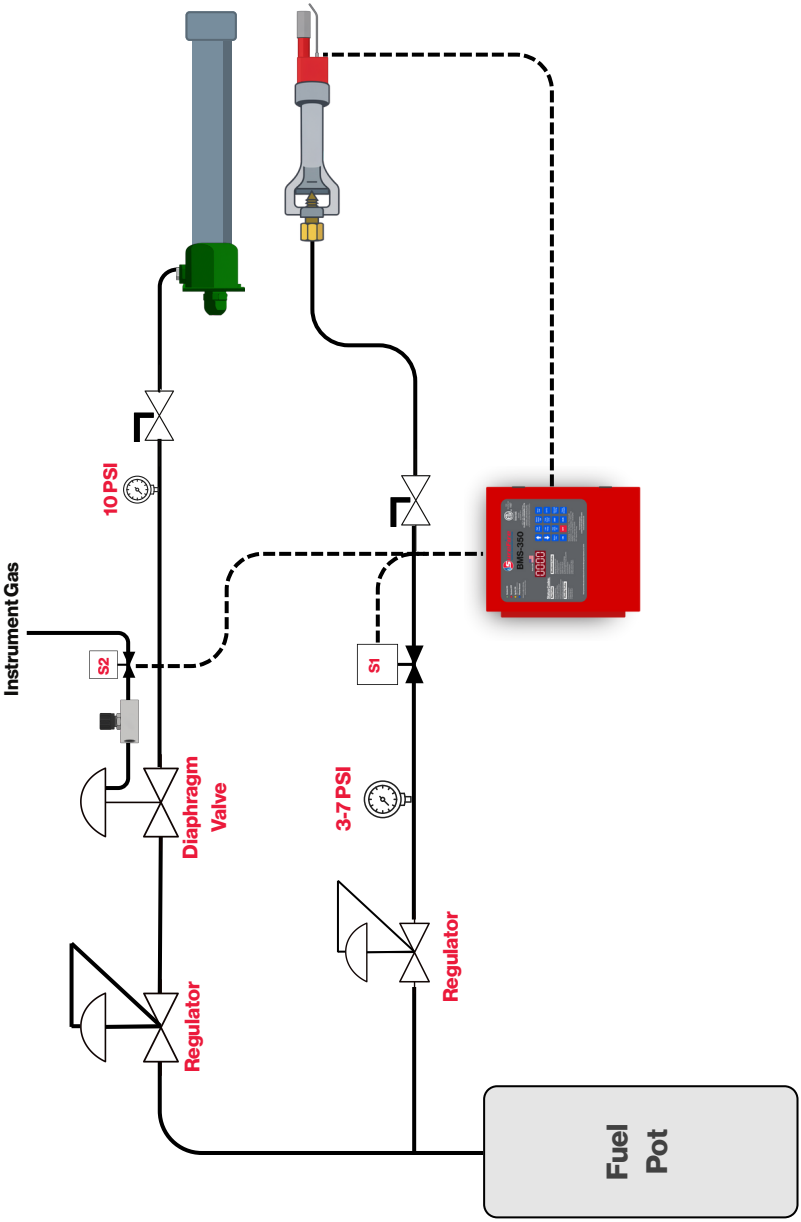
7.6 | Vent Line Control

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Install the SureFire Actuator Valve in the fuel train on the main vent line to the flare (if applicable) or combustor applications.

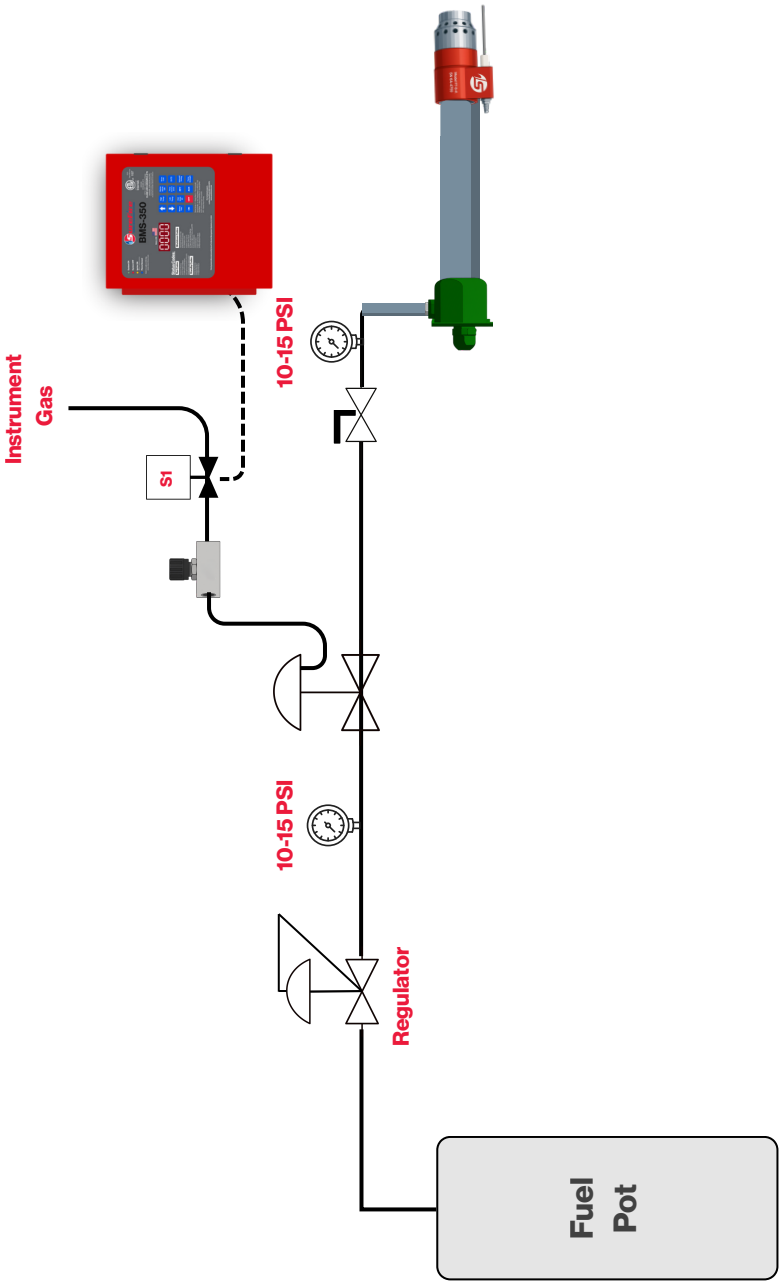
7.7 | 2nd Stage Valve Control

1. Ensure the supply gas is turned off and locked out/tagged out.
2. Install a 1/4" ASCO Valve, SureFire Actuator Valve, SureFire 1" Solenoid Valve, or SureFire 2" Solenoid Valve in the appropriate position based on the application's demands.

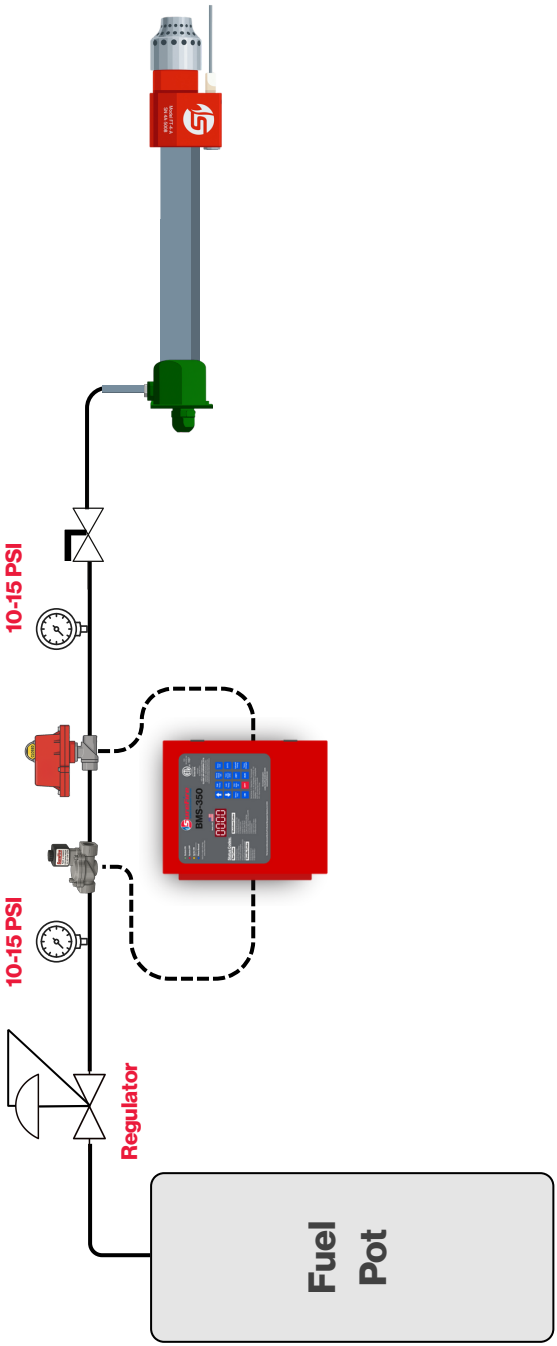
8.3Standing Pilot Diagram



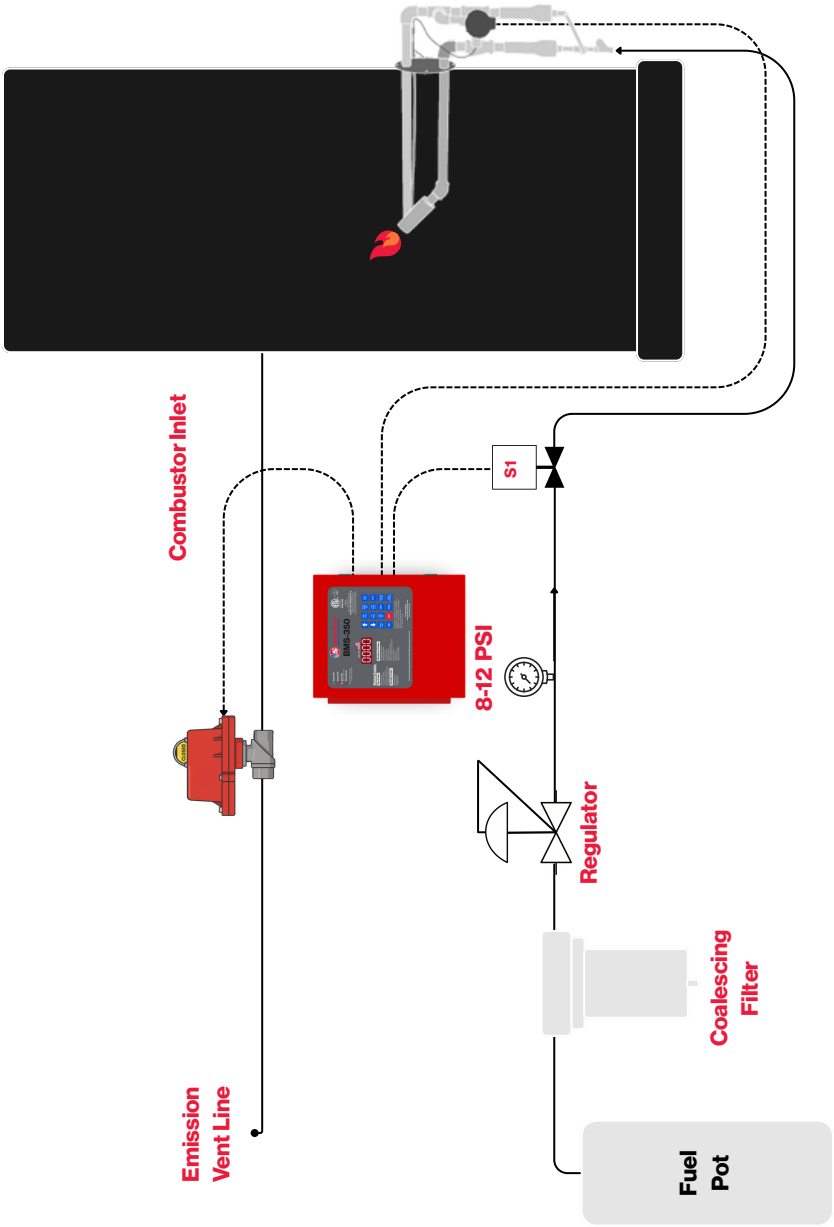
8.3 Pilotless (Pneumatic) Diagram

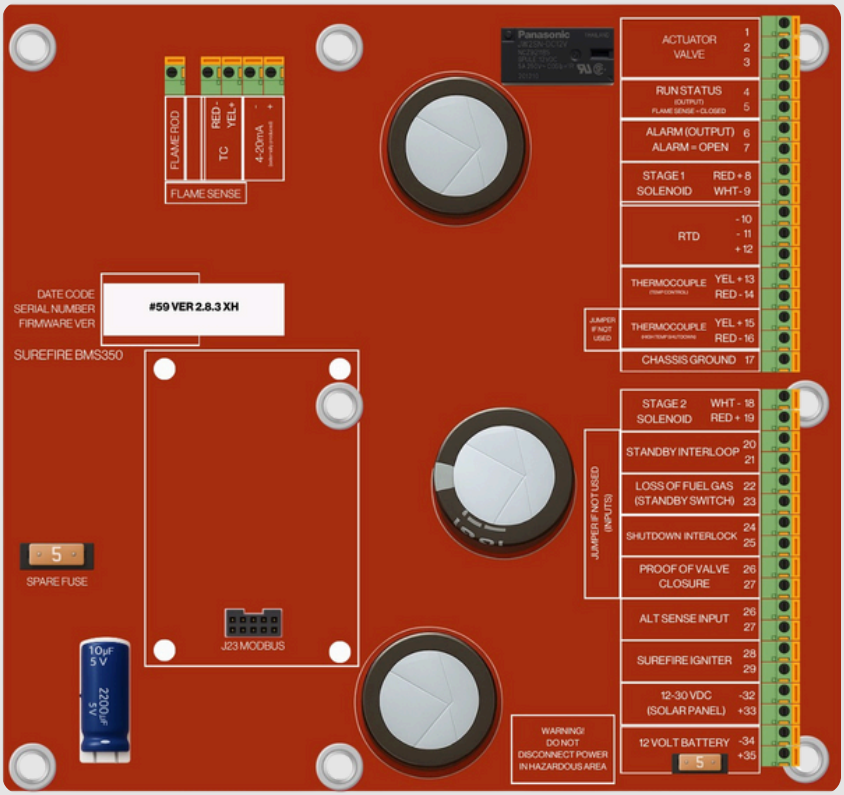


8.3 Pilotless (Pneumatic) Diagram



8.1 Combustor Pilot Diagram





9-11

ELECTRICAL INSTALLATION

WIRING TERMINATION | ELECTRICAL DIAGRAMS SPECIFICATIONS

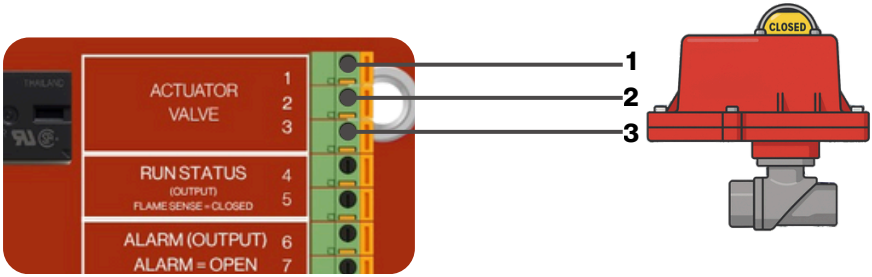
9.1 | Actuator Valve Port

Functions:

Controls the electrical actuation of the SureFire Actuator Valve or a 2nd stage Solenoid Valve.

Actuator *Installation:*

1. The Actuator Valve will require 3 wires (customer supplied).
2. Install a conduit box into the ½" threads on the Actuator Valve.
3. Use 18 gauge standard copper wire for this device.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color code all wiring for easy identification.
6. Terminate the 3 wires as shown in the diagram below.



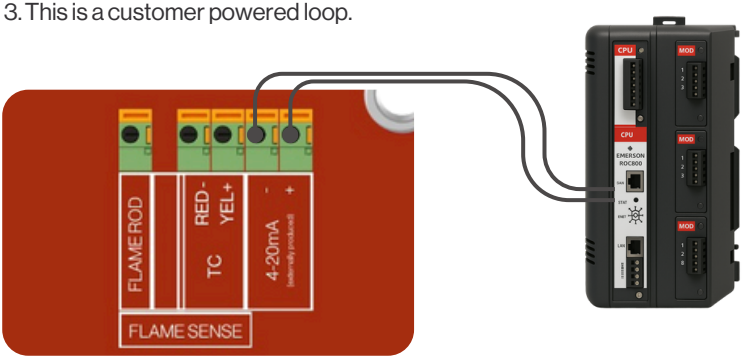
9.2 | 4-20-mA Input

Functions:

Provides remote monitoring of the process temperature input via 4-20mA or 1-5 vdc

Installation:

1. Ensure there is no power to the BMS-350 or PLC before terminating any wires.
2. Connect the positive wire from the remote monitoring equipment to port 5 and the negative wire to port 4.
3. This is a customer powered loop.



9.3 | Run Status

Functions:

Provides remote monitoring of the run state of the BMS.

Installation:

1. Terminate wires from the RTU/PLC to the Run Status terminals (Ports 6 & 7).

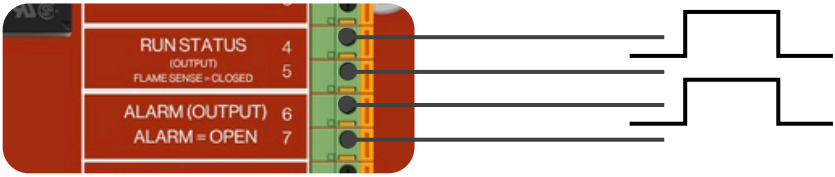
9.4 | Alarm Out

Functions:

Provides remote monitoring of the alarm state of the BMS.

Installation:

1. Terminate wires from the RTU/PLC to the Run Status terminals (Ports 6 & 7).



Unit Status	Run Status	Alarm Out	Red LED	Green LED	Blue LED	Amber LED
System OFF or Manual Shutdown	Open	Open	ON	OFF	OFF	OFF
System On Igniter On	Closed	Open	OFF	ON	OFF	ON
Flame Sensed	Closed	Closed	OFF	ON	ON	OFF
Shutdown Igniter Error	Open	Open	Blinking	OFF	OFF	Blinking
Standby	Closed	Open	OFF	Blinking	OFF	OFF
Shutdown	Open	Closed	Blinking	OFF	OFF	OFF

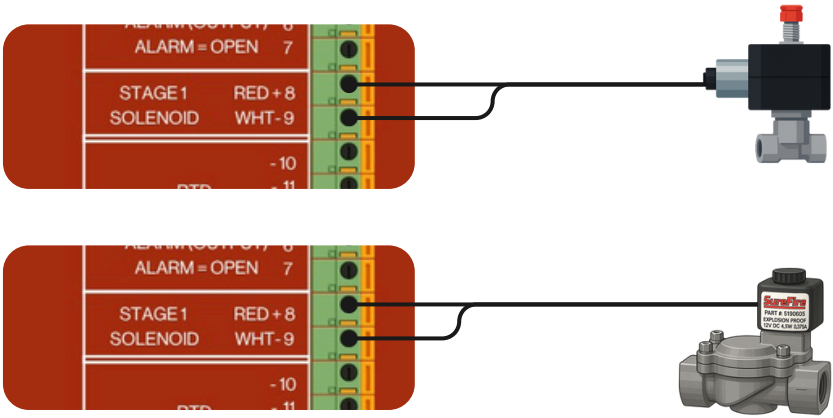
9.5 | Stage 1 Solenoid Valve

Functions:

Controls the electrical actuation of the solenoid valve for the pilot burner in a piloted arrangement or the main burner in a pilotless arrangement.

Installation:

1. The ASCO valve has three wires: two red and one green. For this application, the two red wires will be used (not polarity-sensitive), while the green wire will not be used.
2. Install a conduit box onto the electrical fitting on the ASCO valve.
3. Use 18-gauge, stranded copper wire for this device.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color-code all wiring for easy identification.
6. Terminate the 2 wires as shown in the diagram below.



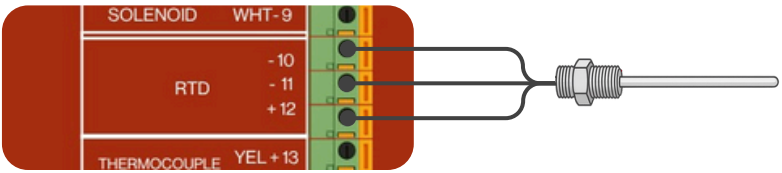
9.7 | RTD Installation

Functions:

Monitors the process temperature.

Installation:

1. Install a junction box on the electrical connection for the RTD.
2. Connect negative (-) wires to terminals 10 & 11.
3. Connect the positive (+) wire to terminal 12.
    - The two identically colored wires are the negative wires, and the unique colored wire is the positive.
    - The BMS-350 requires a 3 wire RTD.
4. When the system recognizes a temperature of 4ºF or less, press the ON button to start a 30-minute timer.
5. If the temperature does not increase above 4ºF, the system will shut down with code 18.
6. Repeat the process until the temperature rises above 4ºF.



9.6 | Thermocouple Temperature Control

Functions:

Monitors the process temperature

Installation:

1. Install a junction box on the electrical connection for the RTD.
2. The thermocouple has 2 wires, a yellow and a red.
    - Yellow = Positive
    - Red = Negative
3. Run a single pair of wire from the junction box to the BMS-350 enclosure.
    - This wire can be either a type K thermocouple wire, or an 18-gauge stranded copper wire.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color-code all wiring for easy identification.
6. Terminate the 2 wires as shown in the diagram below.

Note:

- Type K thermocouple wire will be more accurate than stranded copper.
- Ensure there is only one junction in the thermocouple wiring, as multiple cold junctions will cause temperature errors.

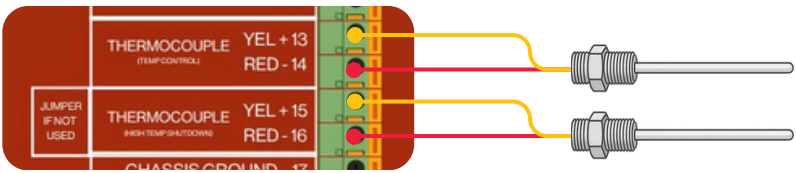
9.7 | Thermocouple High Temperature Shutdown

Functions:

Monitors a high stack or additional thermocouple temperature

Installation:

1. **Reference 9.6.1 thru 9.6.6**
2. Install a junction box on the electrical connection for the high stack or safety thermocouple.



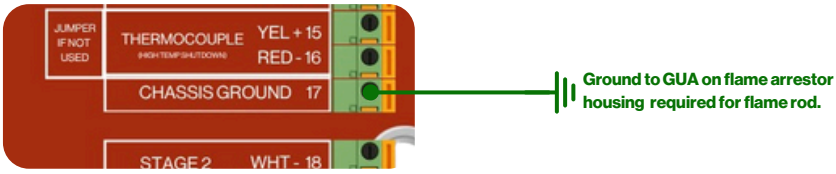
9.8 | Chassis Ground

Functions:

For flame rod flame sensing, this provides an isolated grounding plane.

Installation:

1. Run a single wire from the GUA on a flame arrestor housing (where the FT ignition unit wires are terminated) to the chassis ground on the BMS-350 circuit board.
2. For flame sensing, an isolated ground is required.
3. For future troubleshooting, label or color-code all wiring for easy identification.
4. Terminate the wire as shown in the diagram below.



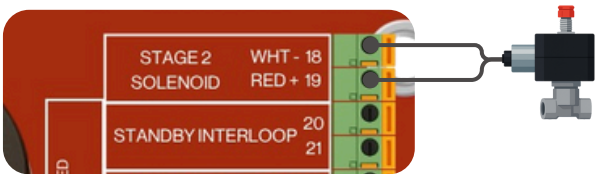
9.9 | Stage 2 Solenoid Valve

Functions:

Controls the electrical actuation of the solenoid valve for the main burner in a piloted arrangement.

Installation:

1. The ASCO valve has three wires: two red and one green. For this application, the two red wires will be used (not polarity-sensitive), while the green wire will not be used.
2. Install a conduit box onto the electrical fitting on the ASCO valve.
3. Use 18-gauge, stranded copper wire for this device.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color-code all wiring for easy identification.
6. Terminate the 2 wires as shown in the diagram below.



9.10 | Standby Switches

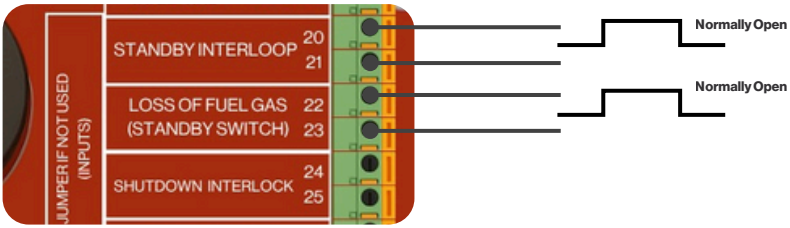
Functions:

To allow the BMS-350 to be placed into a standby state via an external signal.

Installation:

1. Run a single pair of wire from the external device back to the BMS-350.
   - The external device needs to be a normally closed dry contact device, such as a pressure switch or a low level switch.
   - This wire can be 18 gauge stranded copper wire.
2. Terminate the 2 wires as shown in the diagram below.
3. If the terminal port observes continuity, then the BMS-350 continues to operate normally.
4. If the terminal port observes no continuity then the BMS-350 will be placed into a standby state.
5. While in a standby state if that terminal port observes continuity the BMS-350 returns to an operational state.
6. If this port is unused, a jumper must be installed in the terminal.

NOTE: This applies to the standby interloop and loss of fuel gas.



9.11 | Shutdown Switches

Functions:

To allow the BMS-350 to be placed into a shutdown state via an external signal.

Installation:

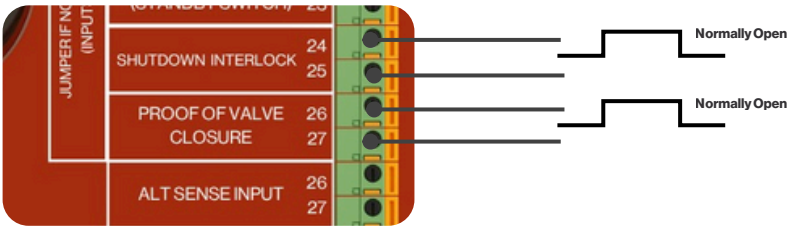
1. Run a single pair of wire from the external device back to the BMS-350.
    - The external device needs to be a normally closed dry contact device, such as a pressure switch or a low level switch.
    - This wire can be 18 gauge stranded copper wire.
2. Terminate the 2 wires as shown in the diagram below.
3. If the terminal port observes continuity, then the BMS-350 continues to operate normally.
4. If the terminal port observes no continuity then the BMS-350 will be placed into a shutdown state.
5. While in a shutdown state if that terminal port observes continuity the BMS-350 returns to an operational state.
6. If this port is unused, a jumper must be installed in the terminal.

NOTE:

- This applies to the ESD and Shutdown Interlock.

Proof of Valve Closure:

- The Proof of Valve Closure does not operate as a standard shutdown.
- This port looks for a close signal related to the actuator valve prior to start up ensuring that all valves are closed prior to the ignition sequence.

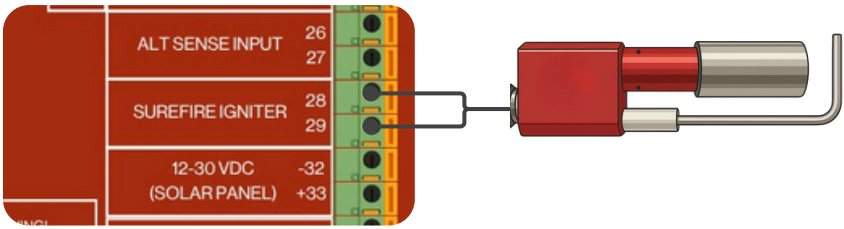


9.12 | SureFire Igniter

Functions:
Provides ignition for the FT Ignition Unit.

Installation:

1. The SureFire FT Ignition Unit has three total wires, two white wires (which are not polarity-sensitive) for the igniter and one black wire for the flame rod.
2. Install a conduit box on the flame arrestor (for firetube applications) for wire termination.
3. Referencing the table below, run the appropriate wire gauge from the junction box to the **BMS-350** enclosure.
    - It is recommended to run two pair of wire for the ignition unit: One pair for the igniter and one pair for the flame rod/ground.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color-code all wiring for easy identification.
6. Terminate the 2 wires as shown in the diagram below.



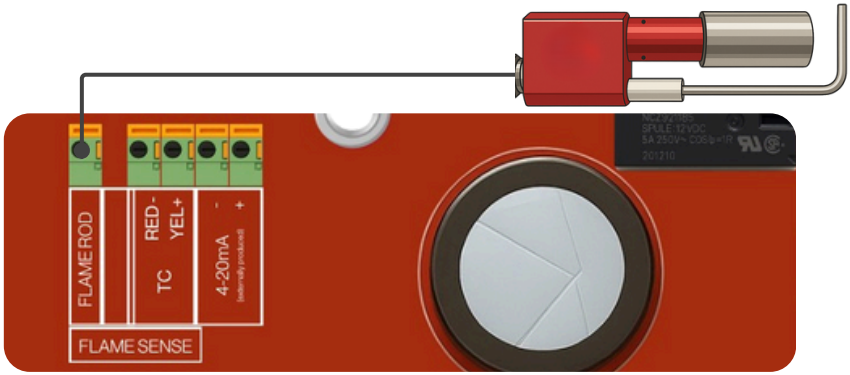
Ignition Unit Specifications	
Ignition Unit @ Inrush	6.5 Amps Inrush
Ignition Unit @ Steady State	2.0 Amps Nominal (during ignition only)
Igniter Wiring Requirements	
16 AWG	10 foot length - Copper Stranded
14 AWG	20 foot length - Copper Stranded
12 AWG	30 foot length - Copper Stranded

9.13 | Flame Rod

Functions:
Provides flame sensing for the FT Ignition Unit.

Installation:

1. The SureFire FT Ignition Unit has three total wires, two white wires (which are not polarity-sensitive) for the igniter and one black wire for the flame rod.
2. Install a conduit box on the flame arrestor (for firetube applications) for wire termination.
3. ***Reference 9.11.3 for the recommended wiring arrangement.***
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For flame sensing, an isolated ground is required. Terminate a ground wire to the circuit board labeled earth ground, and to the ground screw on the junction box mounted to the arrestor housing.
6. For future troubleshooting, label or color-code all wiring for easy identification.
7. Terminate the wire as shown in the diagram below.



Flame Rod	*No Flame Present*	*Flame Present*
Flame Strength Value	> 500	<6

Flame Sensing Software	*No Flame Present*	*Flame Present*
Delta Based	< 300°F	> 350°F
Percentage Based	20% Decrease (If value < 800°F) or 40% Decrease (If Value > 800°F)	Increase of 20°F

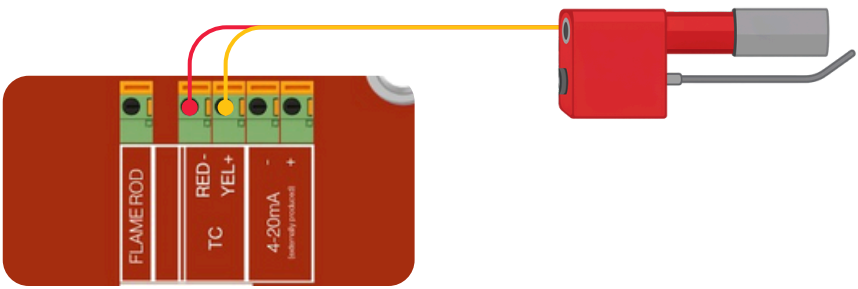
9.14 | Thermocouple Flame Sensing

Functions:
Provides flame sensing for the FT Ignition Unit.

Installation:

1. The SureFire FT Ignition Unit has four total wires, two white wires (which are not polarity-sensitive) for the igniter, one yellow wire (positive) and one black wire (negative) for the thermocouple.
2. Install a conduit box on the flame arrestor (for firetube applications) for wire termination. For flare applications the FTL-F Ignition Unit includes a conduit box.
3. Run a single pair of wire from the junction box to the BMS-350 enclosure.
   a. This wire can be either a type K thermocouple wire, or an 18-gauge stranded copper wire.
4. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
5. For future troubleshooting, label or color-code all wiring for easy identification.
6. Terminate the 2 wires as shown in the diagram below.

Note: Type K thermocouple wire will be more accurate than stranded copper.
Note: Ensure there is only one junction in the thermocouple wiring, as multiple cold junctions will cause temperature errors



Flame Sensing Software	*No Flame Present*	*Flame Present*
Delta Based	< 300°F	> 350°F
Percentage Based	20% Decrease (If value < 800°F) or 40% Decrease (If Value > 800°F)	Increase of 20°F

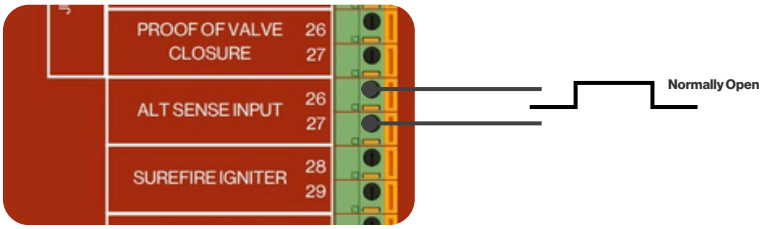
9.15 | Alt Sense Input

Functions:

To allow remote activation of the BMS-350.

Installation:

1. Run a single pair of wires from the RTU/PLC back to the BMS-350.
2. This wire can be 18 gauge stranded copper wire.
3. Terminate the 2 wires as shown in the diagram below.
4. The remote on receives a signal/continuity from the RTU/PLC to activate the BMS-350.
5. This port will be left vacant if not used.



9.16 | Solar Panel

Functions:

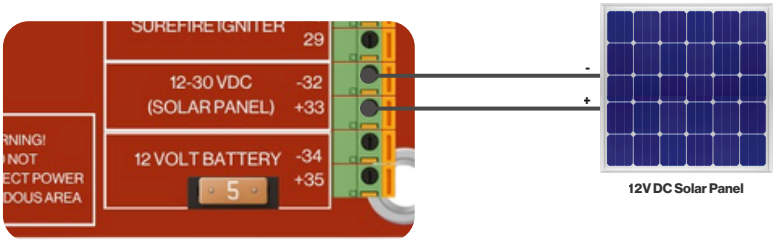
The **BMS-350** has a built-in solar charge regulator that allows a solar panel to charge a battery without the need for an external charge controller.

Installation:

1. Run a pair of 18-gauge, stranded copper wires from the solar panel to the **BMS-350**.
2. Ensure the wiring arrangement is suitable for outdoor use.
3. Terminate the 2 wires as shown in the diagram below.

Notes:

- The maximum rating for the solar panel is 75 watts.



9.17 | 12 VDC ONLY

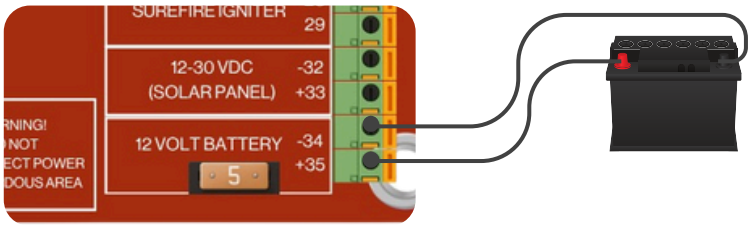
Functions:

This port allows 2 methods of voltage supply to power the **BMS-350**:

- 12 VDC power supply
- 12 VDC battery

Installation:

1. Referencing the table below, run the appropriate wire gauge from the power supply device to the **BMS-350** enclosure.
2. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
3. For future troubleshooting, label or color-code all wiring for easy identification.
4. Terminate the 2 wires as shown in the diagram below.



Power Supply Specifications	
Battery Volts	12 - 13.4 VDC
12 VDC Power Supply	Set @ 13.4 VDC Rated at min 10 Amps
Max System Amperage	7.8 Amp / 0.4 Amp Avg.
Battery/Power Supply Wiring Requirements	
16 AWG	10 foot length - Copper Stranded
14 AWG	20 foot length - Copper Stranded
12 AWG	30 foot length - Copper Stranded

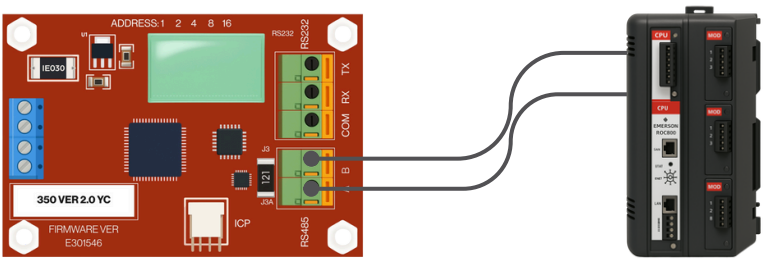
9.18 | Modbus Card (Optional)

Functions:

To provide RS-485 modbus read only communications.

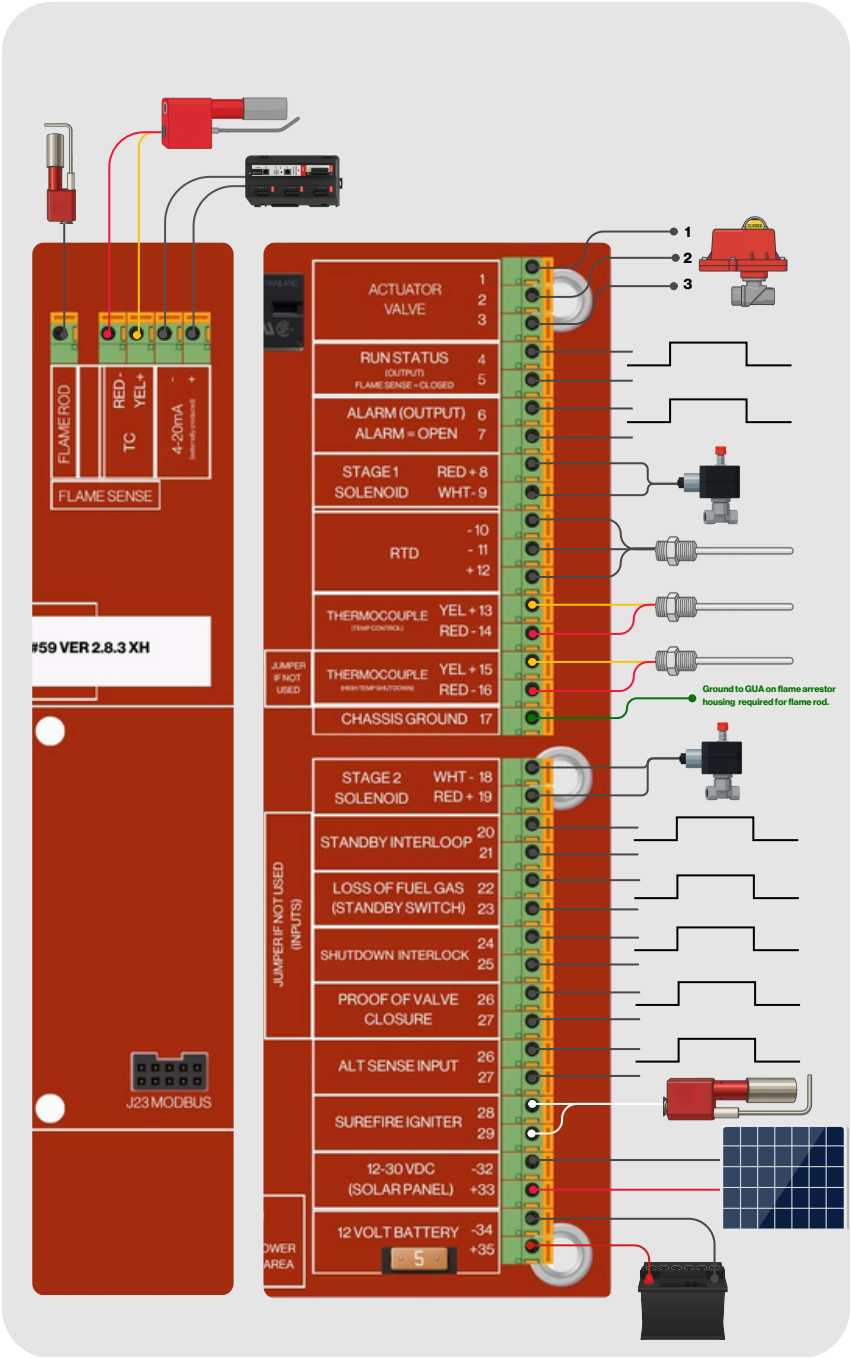
Installation:

1. Run a single pair of wire from the PLC/RTU to the BMS-350 "**MODBUS RS-485**" port.
2. When terminating wires, ensure proper electrical fittings are used to maintain proper operation and moisture resistance.
3. For future troubleshooting, label or color-code all wiring for easy identification.
4. Terminate the 2 wires as shown in the diagram below.



9.16 | BMS-350 Specifications

Power Supply Specifications	
Battery Volts	11-15 VDC
12 VDC Power Supply	SET @ 13.4 VDC, 10 Amps
Solar Panel	12 VDC / 75 Watt Solar Panel
Max System Amperage	7.8 Amps / 0.6 Amps Avg.
Ignition Unit Specifications	
Igniter Current Draw	7.5 Amps Inrush, 2.0 Amps NOM (during normal operation)
Sensor Specifications	
RTD Range	0°F — 529°F
ALT Sense Input	Dry Contact Switch (Open / Close loop)
Standby or Shutdown Inputs	Dry Contact Switch (Open / Close loop)
Remote ON/OFF Inputs	Dry Contact Switch (Open / Close loop)
Note: No voltage or current should be applied to the dry contact ports above.	
Output Specifications	
4-20mA	12-24 VDC for 4-20mA Output
Status	12-24 VDC @ 0.5 Amps
Relay Specifications	
Stage 1 Solenoid Valve Load	12 VDC, 60 Watt MAX
Stage 2 and ALT Solenoid Load	12 VDC, 60 Watt MAX
Actuator Valve Load	12 VDC, 60 Watt MAX
Other	
Fuses: F1, F2, and F3	5 Amps
Fuses: F4 and F5	10 Amps


FLAME ROD
RED-
YEL+
TC
4-20mA
FLAME SENSE
#59 VER 2.8.3 XH
J23 MODBUS
ACTUATOR VALVE 1 2 3
RUN STATUS 4
(OUTPUT) 5
FLAME SENSE = CLOSED
ALARM (OUTPUT) 6
ALARM = OPEN 7
STAGE 1 SOLENOID RED + 8 WHT - 9
RTD - 10 - 11 + 12
THERMOCOUPLE YEL + 13
(TEMP CONTROL) RED - 14
JUMPER IF NOT USED
THERMOCOUPLE YEL + 15
(HIGH TEMP SHUTDOWN) RED - 16
CHASSIS GROUND 17
Ground to GUA on flame arrestor housing required for flame rod.
STAGE 2 SOLENOID WHT - 18 RED + 19
JUMPER IF NOT USED (INPUTS)
STANDBY INTERLOOP 20 21
LOSS OF FUEL GAS (STANDBY SWITCH) 22 23
SHUTDOWN INTERLOCK 24 25
PROOF OF VALVE CLOSURE 26 27
ALT SENSE INPUT 26 27
SUREFIRE IGNITER 28 29
12-30 VDC (SOLAR PANEL) -32 +33
12 VOLT BATTERY -34 +35
1
2
3

12-14

SYSTEM SETUP

SYSTEM SETUP | MENU | MODBUS

11.1 | Unlocking the System

1. Press and hold the UP ARROW button for 5 seconds.
2. The display will flash 0000 to indicate the system is unlocked.
3. The system will automatically relock after 5-minutes of no button activity.

11.2 | Up Arrow

1. To increase the value of the displayed setting.

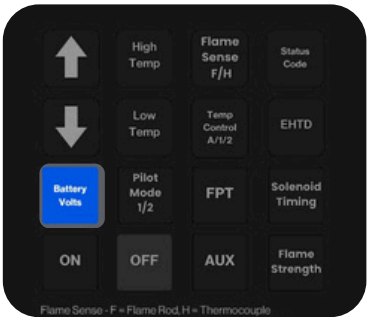
11.3 | Down Arrow

1. To decrease the value of the displayed sett

11.11 | Battery Volts

1. Displays the VDC being supplied to the igniter.
2. Press and hold in conjunction with the up or down arrow to adjust the setting.

Note: This setting should only be modified after consulting SureFire technical support as energizing an new or lightly used igniter with 14 vdc may cause premature failure.

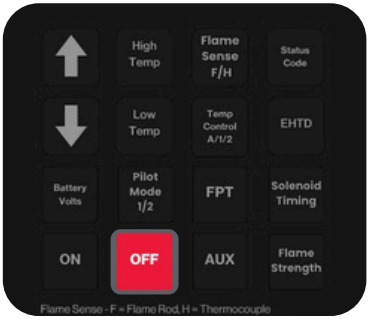


11.4 | On Button

1. Starts the ignition sequence

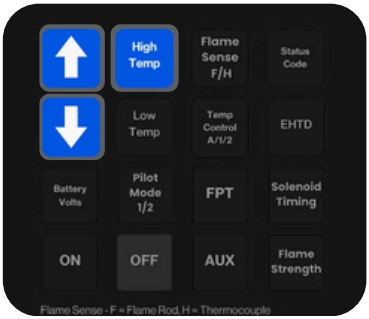
11.5 | Off Button

1. Turns off the system



11.6 | High Temp

1. Press to display the current high temperature setpoint.
2. While unlocked, press in conjunction with the up or down arrow to adjust the high temperature setpoint.



Device	Default Setting	Minimum	Maximum
RTD	120°F	34°F	590°F
T/C	1800°F	34°F	2400°F

11.7 | Low Temp

1. Press to display the current low temperature setpoint.
2. While unlocked, press in conjunction with the up or down arrow to adjust the low temperature setpoint.

Device	Default Setting	Minimum	Maximum
RTD	100°F	32°F	588F
T/C	1300°F	32°F	2398°F

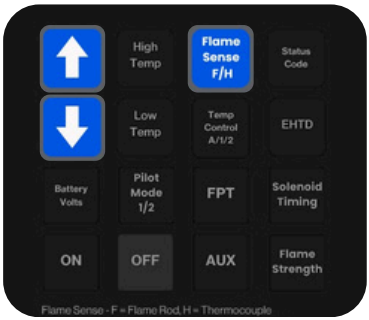
11.8 | Pilot Mode

1. Press to display the current status code.
2. While unlocked, press and hold to display the current pilot mode.
3. Utilize the up or down arrow to adjust the setting.

Default Setting	*Intermittent Pilot*	*Standing Pilot*
1	1	2

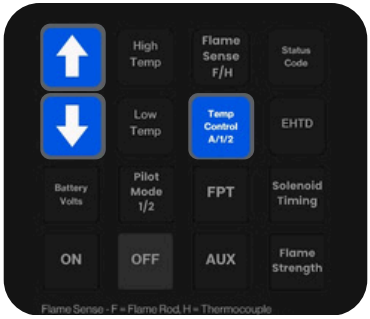
11.14 | Flame Sensor F/H

1. Displays the selected flame sensing device.
2. The available selection is as follows:
   - Flame Rod = F / Thermocouple = H
   - Flame Sense factory default = Flame Rod
3. FL = Flame Rod



11.14 | Temp Control A/1/2

1. Displays the current input/temperature control device.
2. The available device inputs are as follows: **Alt Sense (A), RTD (1), Thermocouple (2) and Dual (3)**
3. While unlocked, press and hold to display the current device input.
4. Utilize the up or down arrow to adjust the setting.



11.9 | Flame Proof Timing

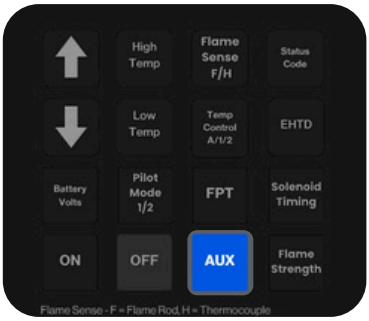
1. Displays the flame proof timing setpoint (number of seconds allowed to sense the presence of a flame)
2. While unlocked, press and hold in conjunction with the up or down arrow to adjust the setpoint.

Default Setting	*Minimum*	*Maximum*
15	10	60
Seconds	Seconds	Seconds

11.14 |AUX

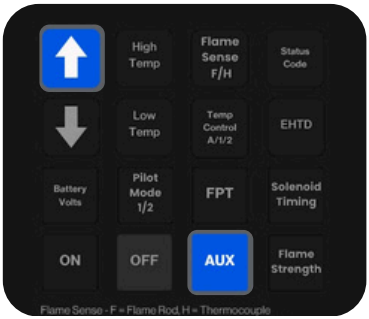
Primary Function:

- Displays the current ohm value of the FT Ignition Units Igniter. **Press the AUX button**



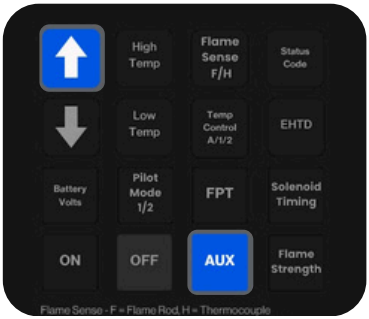
Secondary Function:

- Displays the number of days the System has been powered on. Press and hold the AUX button, then press the **Up Arrow one time** to display that value.



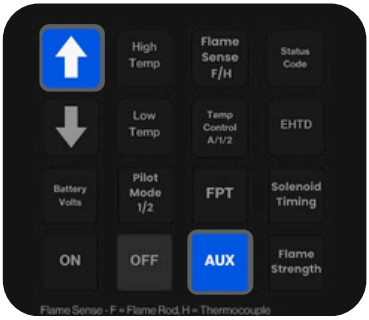
Tertiary Function:

- Displays the number of hours the main burner has been open. Press and hold the AUX button, then press the **Up Arrow two times** to display that value.



Quaternary Function:

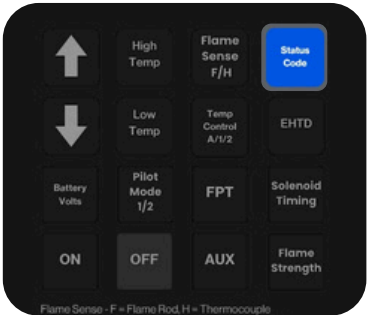
- Displays the number of ignition attempts and successful ignition attempts. Press and hold the AUX button, then press the **Up Arrow three times** to display the attempts value or press the **Up Arrow four times** to display the successes value.



11.8 | Status Code

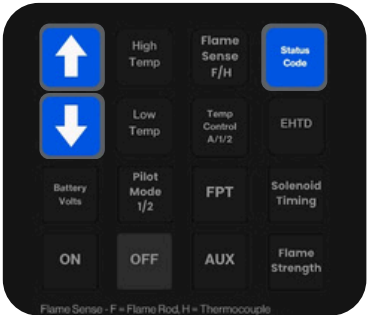
1. Primary Function:

- Displays the code that corresponds with the current unit status.



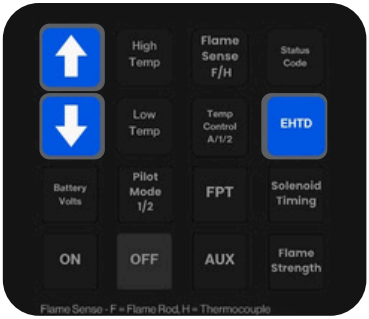
2. Secondary Function:

- Displays the past 9 shutdown or standby codes.
- While unlocked, Press and hold the Status Code button and use the Up Arrow or Down Arrow button to view those status codes.



11.16 | EHTD

1. Displays the EHTD (extreme high temperature delta) setting.
2. While unlocked, press and hold in conjunction with the up or down arrow to adjust the setting.

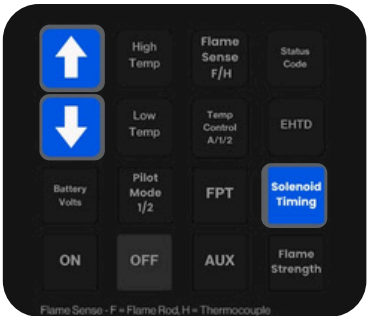


NOTE: The EHTD setting is a delta in addition to the high temperature setpoint. For example, if the high temperature setpoint is set on 150F, and EHTD is set on 50, the system will shutdown on code 18 at 200F.

Device	Default Setting	Minimum	Maximum
RTD	50°F	10°F	520F
T/C	50°F	10°F	1000°F

11.17 | Solenoid Timing

1. Displays the current setting of the actuator valve, whether it is energized with stage 1 or stage 2.
2. While unlocked, press and hold in conjunction with the up or down arrow to adjust the setting.

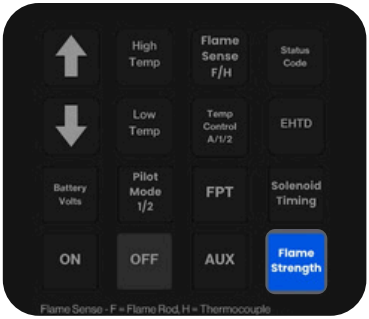


Stage 1 (Default)	Stage 2
1	2

11.8 | Flame Strength

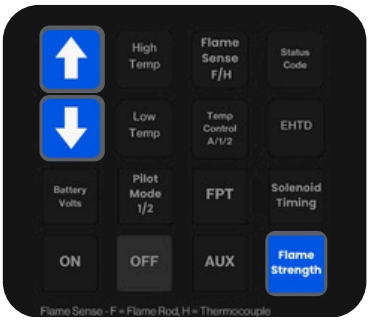
1. Primary Function:

- Displays the current flame strength value for the selected Flame Sensing device.



2. Secondary Function:

- Displays the Safety Thermocouple temperature setpoint.
- While unlocked, Press and hold the Flame Strength button to reveal the setpoint. Use the Up Arrow or Down Arrow buttons to adjust the desired temperature setpoint.



Default Setting	*Minimum*	*Maximum*
300°F	40°F	2400F

12.1 | Introduction

Introduction

The Modbus communication for the BMS-350 is facilitated through an intermediary circuit board, the BMS-350 Combination Card.

This Combination Card includes the following key functions:

- Acts as the Modbus PLC / RTU slave
- Relays command data to the BMS-350 board

The Combination Card functions as a specialized mailbox, maintaining a setup of holding registers accessible by both the BMS-350 Controller and PLC / RTU Master.

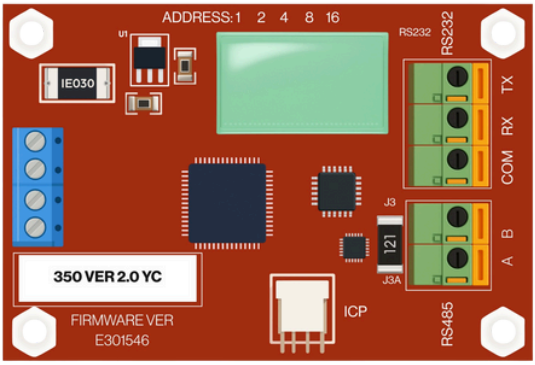
12.3 | Modbus Register Overview

The Modbus communications include a variety of holding registers that can be poled by the Modbus master:

- Status codes
- Temperature values
- Pressure values
- Setpoints
- Safety data
- Other critical data

12.4 | Modbus Visual Indication

- The Combination Card includes LED indication of the communication between the Modbus master (PLC/RTU) and the Modbus slave (Combination Card)



An amber LED labeled “MODBUS ONLINE” will flash when the communication network between the master and slave has not only been established, but commands are being received and responded to.

12.4 Setup Information

Data Bit
8
Stop Bit
1
Parity Bit
None
Baud Rate
9600
Max Register - Singular Poling
10 Registers
Data Type
Unsigned Integers - 16 Bit
Register Range
40001 thru 40255
Poling Frequency
2 Seconds **or** Greater

12.5 Register Map

Modbus Register	Register Name	*Notes*
40001	Status Code (R)	See Status Codes on pages 26 or reference BMS-350 overlay
40002	Process Temperature	Bit 9..0 is 0-590 degrees (RTD) Bit 9..0 is 0-2400 degrees (Thermocouple)
40003	High Temperature Setpoint	Bit 9..0 is 34-590 degrees (RTD) Bit 9..0 is 34-2400 degrees (Thermocouple)
4004	Low Temperature Setpoint	Bit 9..0 is 32-588 degrees (RTD) Bit 9..0 is 32-2398 degrees (Thermocouple)

Modbus Register	Register Name	*Notes*
40005	Configuration and Status	*Bit 0 – System LED status* *0 : RED LED solid - System OFF* *1: GREEN LED solid - System running* *Bit 1 – Pilot mode* *0 : Intermittent pilot* *1: Standing pilot* *Bit 2 – Flame sense / Run Status* *0 : No flame sensed* *1: Flame sensed* *Bit 3 – System unlock status* *0 : System lock* *1: System unlock* *Bit 4 – Loss of fuel gas* *0 : Clear* *1: Activated (GREEN LED blinking)* *Bit 5 – Proof of valve closure* *0 : Clear* *1: Activated (RED LED blinking)* *Bit 6 – Shutdown interlock* *0 : Clear* *1: Activated (RED LED blinking)* *Bit 7 – Standby interloop* *0 : Clear* *1: Activated (GREEN LED blinking)* *Bit 8 – Alarm (Output)* *0 : Open* *1: Close* *Bit 9 – Red LED* *0 : Not Blinking* *1: Blinking* *Bit 10 – Unallocated* *Bit 11 – Unallocated* *Bit 12 – Unallocated* *Bit 13 – Unallocated* *Bit 14 – Unallocated* *Bit 15 – Unallocated*
40006	Battery Volts	Bit 9...0 = 0 - 145 (14.5)

Modbus Register	Register Name	*Notes*
40007	Burner Days On	Days burner on, rolls over to 0 after 9999
40008	Ignition Attempts	Number of ignition attempts, rolls over to 0 after 9999
40009	Successful Ignition Attempts	Number of successful ignitions, rolls over to 0 after 9999
40010	Command Status	0x55 IDLE - Ready for new command 0x01 Command executed OK 0x02 Bad command, nothing done 0x03 BMS read of exec reg from Modbus board timed out 0x04 BMS read of exec packet from Modbus board had bad checksum 0x05 BMS read of cmd reg from Modbus board timed out 0x06 BMS read of cmd packet had bad checksum 0x07 Command number not recognized (Ready for new command) 0x08 BMS read of param reg from Modbus board timed out 0x09 BMS read of param packet had bad checksum 0x0A Parameter out of limits for command 0x0B BMS 350 Controller is locked 0x0C Unknown status code returned from Modbus board read attempt

Modbus Register	Register Name	*Notes*
40011	Command Number	0x01 – Unlock – same as pressing unlock sequence on keypad. Display function and timeout exactly the same as if done from keypad. No parameter required. 0x02 – Set low temperature limit. Behaves as if done from the keypad. Requires parameter in the format of register 40004. 0x03 – Set high temperature limit. Behaves as if done from the keypad. Requires parameter in the format of register 40003. 0x04 – Turn ON. Behaves as if keypad ON button were pressed. No parameter required. 0x05 – Turn OFF. Behaves as if keypad OFF button were pressed. No parameter required. 0x06 – Set safety thermocouple threshold. Behaves as if done from the keypad.
40012	Command Parameter	Parameter for command (if required, ignored if not required). May also be interpreted as "command value".
40013	Command Execute	Factory use only
40014	Igniter Ohms	Igniter resistance range 18 - 65 (1.8 - 6.5 Ω) Modbus does not show decimal.

Modbus Register	Register Name	*Notes*
40015	System, Days On	Days system on, rolls over to 0 after 9999
40016 - 40019	Unallocated	Read as zero, can be written to but will be ignored.
40020	Bit 0 – System LED status 0: RED LED solid – System OFF 1: GREEN LED solid – System running	Bit #0 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40021	Bit 1 – Pilot mode 0: Intermittent pilot 1: Standing pilot	Bit #1 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40022	Bit 2 – Flame sense / Run status 0: No flame sensed 1: Flame sensed	Bit #2 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40023	Bit 3 – System unlock status 0: System lock 1: System unlock	Bit #3 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40024	Bit 4 – Loss of fuel gas 0: Clear 1: Activated (GREEN LED blinking)	Bit #4 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.

Modbus Register	Register Name	*Notes*
40025	Bit 5 – Proof of valve closure 0: Clear 1: Activated (RED LED blinking)	Bit #5 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40026	Bit 6 – Shutdown Interlock 0: Clear 1: Activated (RED LED blinking)	Bit #6 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40027	Bit 7 – Standby Interloop 0: Clear 1: Activated (GREEN LED blinking)	Bit #7 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40028	Bit 8 – Alarm (Output) 0: Open 1: Close	Bit #8 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40029	Bit 9 – RED LED 0: Not blinking 1: Blinking	Bit #9 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40030-40035	Unallocated	Read as zero, can be written to but will be ignored.

Modbus Register	Register Name	*Notes*
40036	Flame sense T/C Temperature (R)	Bit 9..0 is 70–2400 degrees (Thermocouple)
40037	Safety T/C Temperature (R)	Bit 9..0 is 40–2400 degrees (Thermocouple)
40038	Safety T/C Temperature Threshold (RW)	Bit 9..0 is 40–2400 degrees (Thermocouple)
40039-40249	Unallocated	Read as zero, can be written to but will be ignored.
40250	BMS diagnostics register #1 (R)	Factory use only
40251	BMS diagnostics register #1 (R)	Factory use only
40252	BMS read count (R)	Factory use only
40253	Modbus board firmware revision (R)	Factory use only
40254	Modbus read count (R)	Number of function 03 requests from the Modbus master
40255	BMS write count (R)	Factory use only

Switch	Selects	*Description*
Switch # 1	Modbus address bit 0	On = 1 | Off = 0
Switch # 2	Modbus address bit 1	On = 1 | Off = 0
Switch # 3	Modbus address bit 2	On = 1 | Off = 0
Switch # 4	Modbus address bit 3	On = 1 | Off = 0
Switch # 5	Modbus address bit 4	On = 1 | Off = 0
Switch # 6	Baud rate for communications	Off = 9600 9600 is the only selection
Switch # 7	N/A	N/A
Switch # 8	Interface for Modbus master	Off = RS485 485 is the only selection

Desired Modbus address	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5
1	ON	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF
5	ON	OFF	ON	OFF	OFF
6	OFF	ON	ON	OFF	OFF
7	ON	ON	ON	OFF	OFF
8	OFF	OFF	OFF	ON	OFF
9	ON	OFF	OFF	ON	OFF
10	OFF	ON	OFF	ON	OFF
11	ON	ON	OFF	ON	OFF
12	OFF	OFF	ON	ON	OFF
13	ON	OFF	ON	ON	OFF
14	OFF	ON	ON	ON	OFF
15	ON	ON	ON	ON	OFF
16	OFF	OFF	OFF	OFF	ON
17	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON
19	ON	ON	OFF	OFF	ON
20	OFF	OFF	ON	OFF	ON
21	ON	OFF	ON	OFF	ON
22	OFF	ON	ON	OFF	ON
23	ON	ON	ON	OFF	ON
24	OFF	OFF	OFF	ON	ON
25	ON	OFF	OFF	ON	ON
26	OFF	ON	OFF	ON	ON
27	ON	ON	OFF	ON	ON
28	OFF	OFF	ON	ON	ON
29	ON	OFF	ON	ON	ON
30	OFF	ON	ON	ON	ON
31	ON	ON	ON	ON	ON

13

SYSTEM OPERATION

SEQUENCE OF OPERATION | FLOW CHARTS
TROUBLESHOOTING GUIDE

13.1 | Sequence of Operation | Intermittent Pilot or Pilotless

1. Press the **ON** button.
2. The 120 second pre-purge countdown begins.

NOTE: The flame value will be reflective of a flame rod setup; however, if a thermocouple is used for flame sensing, the flame value will reflect an actual temperature reading.

Display Value	Status Code	*Flame Value*	*LED Indicator*
120 Second Countdown	24 Purge Before Startup	504 - 506	

NOTE: Utilize the keypad overlay to display the status code and flame value.

3. Once the pre-purge countdown ends, if the input signal is presence (temperature or Alt Sense) the 5 second audible alarm will begin.

Display Value	Status Code	*Flame Value*	*LED Indicator*
5 Second Countdown	4 5 Second Alarm	504 - 506	

4. The igniter is energized for 5 total seconds

Display Value	Status Code	*Flame Value*	*LED Indicator*
5 Second Countdown	5 Igniter ON	504 - 506	

5. The stage 1 solenoid valve and actuator valve are energized and the flame proof timing countdown begins.

Display Value	Status Code	*Flame Value*	*LED Indicator*
15 Second Countdown	08 Waiting for Main Valve	3 - 5	

6. Ignition is achieved and either the pilot flame or pilotless burner flame is sensed.

NOTE: If ignition is not achieved or flame sensing fails, the process will restart at step # 2 following the expiration of the flame proof timing countdown with a status code of 07

Display Value	Status Code	*Flame Value*	*LED Indicator*
30 Second Countdown	08 Waiting for Main Valve	3 - 5	

7. The stage 2 solenoid valve is energized following the expiration of the timing between solenoid countdown.

NOTE: In pilotless mode, the countdown between stage 1 and stage 2 is arbitrary.

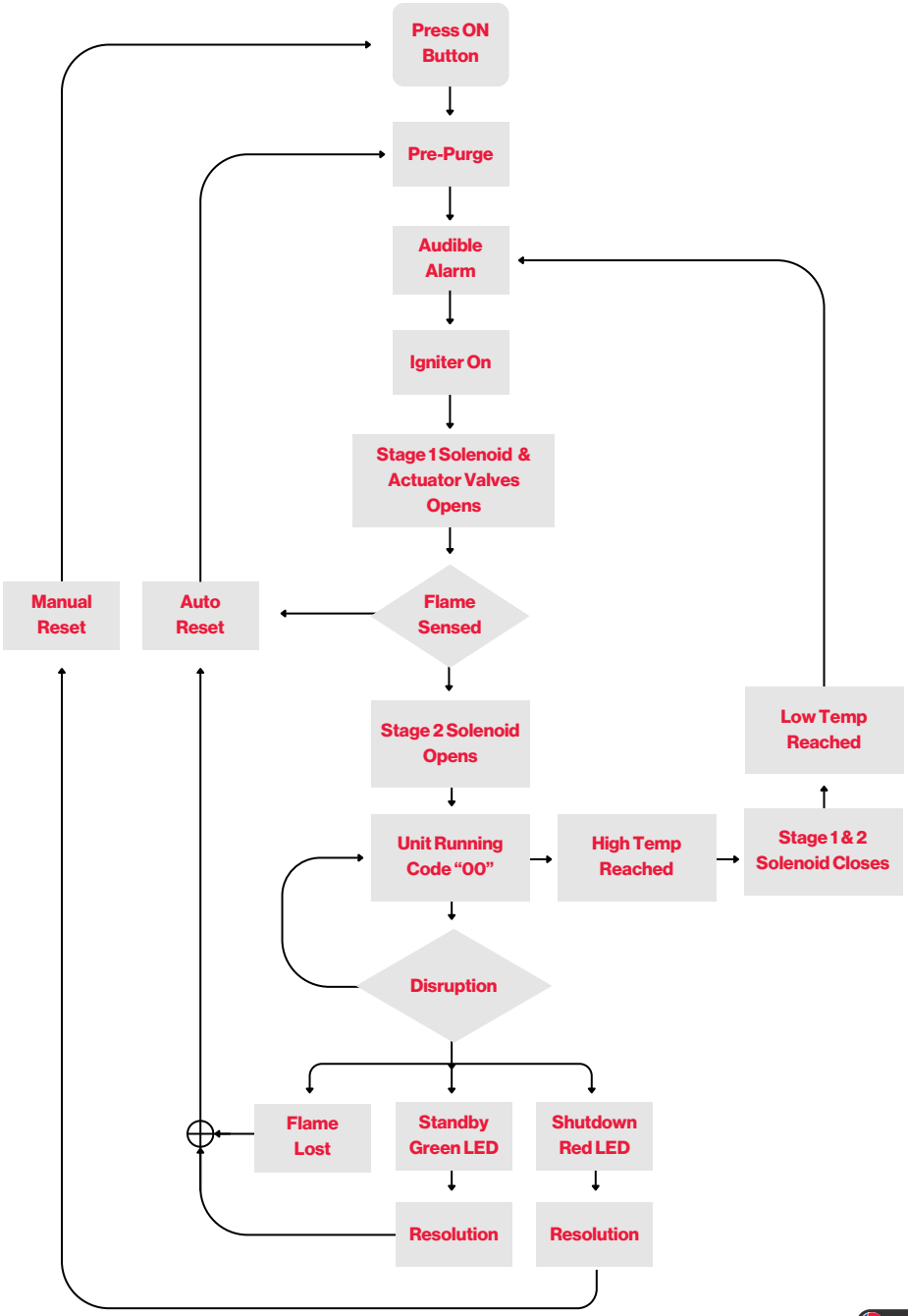
Display Value	Status Code	*Flame Value*	*LED Indicator*
F 85 Process Temp	00 System Running	3 - 5	

8. The process temperature rises above the high temperature setpoint and all valves are de-energized

Display Value	Status Code	*Flame Value*	*LED Indicator*
F 130 Process Temp	01 Waiting for Startup Signal	504 - 506	

9. The process temperature drops below the low temperature setpoint, and the process resumes at step # 3.

13.2 | Diagram of Operation /Intermittent Pilot or Pilotless



13.3 | Sequence of Operation / Standing Pilot

1. Press the **ON** button.
2. The 120 second pre-purge countdown begins.

Display Value	Status Code	Flame Value	LED Indicator
120 Second Countdown	24 Purge Before Startup	504 - 506	

NOTE: Utilize the keypad overlay to display the status code and flame value.

3. Once the pre-purge countdown ends, if the input signal is present (temperature or Alt Sense) the 5 second audible alarm will begin.

Display Value	Status Code	Flame Value	LED Indicator
120 Second Countdown	24 Purge Before Startup	504 - 506	

4. The igniter is energized for 5 total seconds

Display Value	Status Code	Flame Value	LED Indicator
5 Second Countdown	5 Igniter ON	504 - 506	

5. The stage 1 solenoid valve and actuator valve are energized and the flame proof timing countdown begins.

Display Value	Status Code	Flame Value	LED Indicator
15 Second Countdown	08 Waiting for Main Valve	3 - 5	

6. Ignition is achieved and the pilot flame is sensed.

Note: If ignition is not achieved, the process will restart at step # 2 following the expiration of the flame proof timing countdown with a status code of 09.

Display Value	Status Code	Flame Value	LED Indicator
30 Second Countdown	08 Waiting for Main Valve	3 - 5	

7. The stage 2 solenoid valve is energized following the expiration of the timing between solenoid countdown.

Display Value	Status Code	*Flame Value*	*LED Indicator*
F 85 RTD Temp	00 System Running	3 - 5	

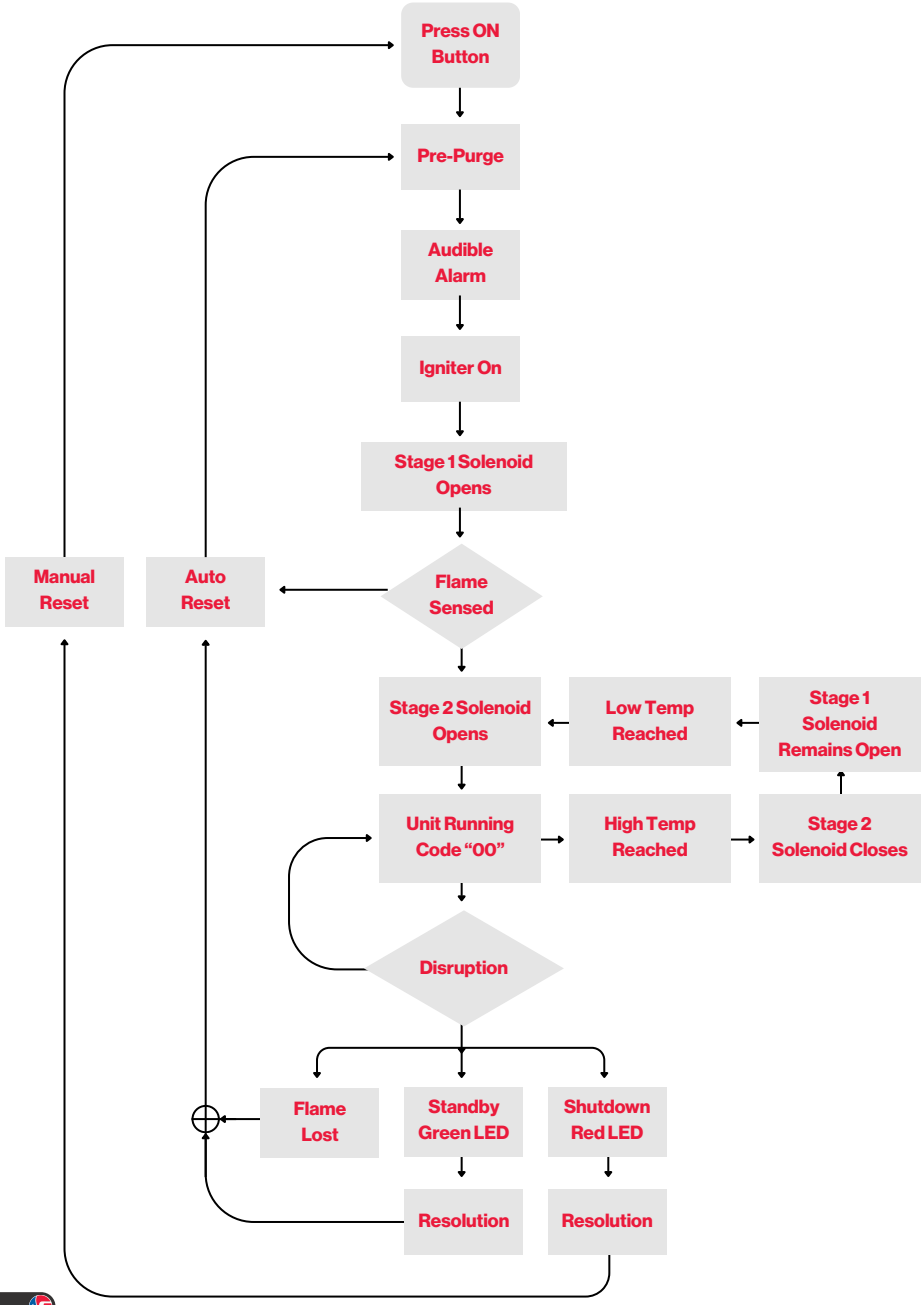
8. The process temperature rises above the high temperature setpoint, and the stage 2 solenoid valve is de-energized, while stage 1 remains energized (keeping the pilot lit).

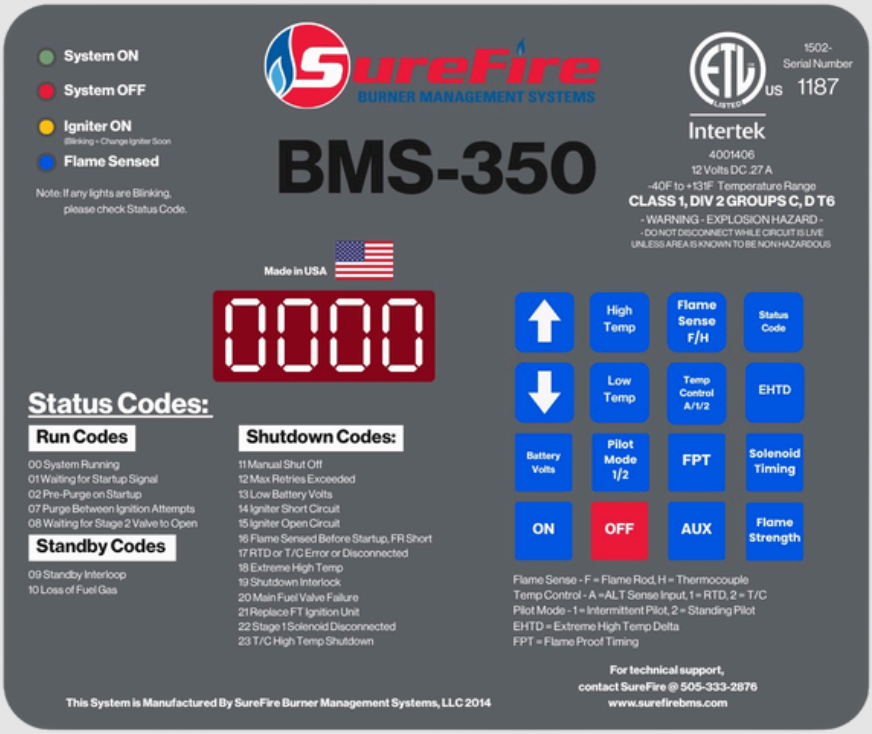
Note: If the process temperature continues to rise 10 F over the high temperature setpoint, the stage 1 solenoid with then be de-energized.

Display Value	Status Code	*Flame Value*	*LED Indicator*
F 140 RTD Temp	01 Waiting for Startup Signal	3 - 5	

13.4 | Standing Pilot Sequence of Operation

Flow Chart:





14

TROUBLESHOOTING GUIDE

STATUS CODES | EVENT DESCRIPTIONS | SOLUTIONS
LED INDICATORS

14.1 | Run Codes:

Status Code	Event Description	Corrective Action	LED Indicator
00 System Running	• Flame is present • Solenoid valves are open • No errors	• Normal operation - no interaction required	
01 Waiting for startup signal	• Flame is not present • Solenoid valves are closed • No errors	• Normal operation - no interaction required • Waiting for RTD temperature to decrease below low temperature setpoint or waiting for signal from Alt Sense Input	
02 Purge On Start-up	• Flame is not present • Solenoid valves are closed • No errors	• Normal operation - no interaction required • The display shows the pre-purge countdown	
07 Purge between Ignition Attempts	• Pilot/main burner is not on	• Normal operation - no interaction required • No ignition on previous attempts • 120 second countdown	
08 Waiting for Stage 2 valve to open	• Main burner is on (single stage) • Pilot is on but main burner is not (dual stage)	• Normal operation - no interaction required • 60 second countdown (unless adjusted on keypad)	

14.2 | Standby Codes:

Status Code	Event Description	Corrective Action	LED Indicator
09 Standby Interloop	• Pilot/main burner is not on. • No activity when system is attempting startup. • Ports 17 & 18 are activated.	• System detecting an open circuit. • No jumper at ports 17 & 18. • Customer supplied switch is activated. • Check wire connections.	Flashing

10
Loss of Fuel Gas Standby
	• Pilot flame is not present
	• Solenoid valves are closed
	• No activity when attempting to start up the system
		• Ports #19 and #20 are experiencing an open circuit
		• If this port observes no continuity, the system will enter a standby state
		• Verify if an external device is connected to these ports
		  ◦ If not, ensure a jumper is fastened securely in ports #19 and #20
		• Determine if the device is activated or faulty
		  ◦ If faulty, replace the device
		• If activated (open circuit), resolve the issue and the system will automatically restart the ignition process
			Flashing

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator
11 Manual/Remote	• Flame is not present • Solenoid valves are closed • The system is in a manual shutdown state • The system will restart if the ON button is pressed	• Normal operation • The OFF button was pressed, or the Remote OFF port was activated • To restart the system, press the ON button	

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator

12
Max Retries Exceeded
	• Flame or pilot flame is not present.
	• Solenoid valves are closed.
	• The system has attempted ignition and failed in sequential attempts.
	• The system will restart if the OFF and ON buttons are pressed, but the issue may persist.
	• (Reference 11.5 where applicable.)
		• Use a DMM to verify igniter resistance (normal 1.3–2.0 ohms).
		• Ensure input power is adequate.
		• Verify battery voltage.
		• Ensure the power supply is rated 8A or greater with adequate wire gauge from the power supply to the BMS.
		• Place a DMM in series and observe VDC when the igniter energizes.
		  ◦ If the supply drops below 10.6 VDC, the igniter may not fire correctly
		• If a Fired Equipment Piloted Application
		  ◦ Ensure the pilot mixer is free of debris.
		  ◦ Confirm pilot fuel supply of 3–7#.
		  ◦ Verify pilot orifice size #72.
		  ◦ If ignition does not occur:
		  ▪ Check the igniter, fuel supply, and power conditions.
		  ◦ If the flame is established but flame strength is not increasing:
		  ◦ Possible flame rod/flame sense thermocouple failure.
		  ◦ Possible grounding issue.
		  ◦ Flame may be lifting off the nozzle.
		• If a Piloted Flare/ECD Application
		  ◦ (This section was only in one description, so it's added here as unique content.)
		  ◦ Ensure all orifices, Y strainers, and FTL-F (¾") pipe are free of debris or blockage.
		  ◦ Confirm pilot fuel is being supplied (8–12#).
		  ◦ If ignition "popping" occurs but the pilot won't establish:
		  ▪ Review the pilot side of the system.
		  ◦ If no ignition "popping" occurs:
		  ▪ Review the flame-front/ignition side.
		  ◦ If the pilot establishes but flame strength does not increase:
		  ◦ Likely positioning issue or damage to the flame sense thermocouple.
		• If a Pilotless Burner Application
		  ◦ Ensure the air/fuel mixer is free of debris.
		  ◦ Verify correct air and gas settings.
		  ◦ Confirm fuel supply (8–12#).
		  ◦ If ignition does not occur:
		  ▪ Check igniter, fuel supply, or power conditions.
		  ◦ If flame establishes but no flame strength value is sensed:
		  ◦ Possible flame rod failure, grounding issue, or flame lifting off the nozzle.
			Flashing

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator
13 Low Battery Volts	• Flame is not present • Solenoid valves are closed • The system may restart if the OFF and ON buttons are pressed, depending on the input voltage	• The input voltage decreased to below 10.6 VDC during the ignition process • Check battery voltage and verify it under load • If the battery is below 10.6 VDC, check the charging mechanism (solar panel, battery charger, site power, etc.) to ensure the battery is being charged • Ensure the power supply is rated at 8A or greater with adequate wire gauge from the power supply to the BMS. Place a DMM in series and observe the VDC when the igniter is energized to see if the supply drops below 10.6 VDC • Ensure the wire gauge is adequate for the igniter, as insufficient input power even with sufficient input power	Flashing

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator
14 Igniter Short Circuit	• Flame is not present • Solenoid valves are closed • The system will not restart if OFF and ON button is pressed	• Use a DMM a verify the ohm value of the igniter (normal 1.3 – 2.0). If the igniter is damaged or shorted, the ohms' resistance will read an elevated value, requiring a replacement igniter / FT ignition unit • If the igniter is in good shape, verify the wire connections, ensuring there are no breaks or shorted wires. • If the igniter and wiring are in good shape, verify the gauge size between the FT ignition unit and the BMS, ensuring adequate wire gauge size is being utilized • If everything associated with the igniter is verified, review the input power: ◦ Check battery voltage – ensure the voltage is verified with a load applied. ◦ Ensure power supply is rated at 8A or greater with adequate wire gauge size from power supply to the BMS. Place a DMM in series and observe the VDC when the igniter is energized to observe if the supply decreases below 10.6 VDC	 Flashing
15 Igniter Open Circuit	• Flame is not present • Solenoid valves are closed • The system will not restart if the OFF and ON buttons are pressed	• Use a DMM to verify the ohm value of the igniter (normal 1.3–2.0). If the igniter is broken or damaged, the resistance will read 0 or open, requiring a replacement igniter or FT ignition unit • If the igniter is in good condition, verify the wire connections to ensure there are no breaks or disconnected wires • If the igniter and wiring are in good condition, verify the gauge size between the FT ignition unit and the BMS to ensure proper wire sizing • If all components related to the igniter are verified, review the input power: ◦ Check battery voltage and verify it under load ◦ Ensure the power supply is rated at 8A or greater with adequate wire gauge from the power supply to the BMS. Place a DMM in series and observe the VDC when the igniter is energized to see if the supply drops below 10.6 VDC	 Flashing

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator
16 Flame Sensed Before Startup, FR Short	• Flame is not present • Solenoid valves are closed • The system will not restart if the OFF and ON buttons are pressed	• The flame sensing thermocouple is either disconnected or faulty • Verify the wiring connections to ensure there are no breaks or disconnected wires • If the thermocouple is wired correctly, press the flame value button. If 2450 is shown, this indicates the thermocouple is faulty and needs replacement	Flashing
17 RTD or TC Error or Disconnected	• Pilot/mainburner is not on. • No activity when system is attempting startup.	• verify RTD/TC are properly terminated. • Verify RTD/TC are not shorted. • Physical RTD/TC failure. • Process Temperature below 1°F	Flashing
18 Extreme High Temp	• Flame is not present • Solenoid valves are closed • The system will not restart if the OFF and ON buttons are pressed	• The safety thermocouple's high temperature setpoint has been exceeded **(reference 11.4)** • Determine the cause of the elevated temperature condition, resolve it, and restart the system	Flashing

19
Shutdown Interlock
	• Flame is not present
	• Solenoid valves are closed
	• No activity when attempting to start up the system
		• Ports #25 and #26 are experiencing an open circuit
		• If this port observes no continuity, this will cause the system to enter a shutdown state
		• Verify if an external device is connected to these ports
		  ◦ **If Not,** ensure a jumper is fastened securely in ports #25 and #26
		• Determine if the device is activated or faulty
		  ◦ **If faulty,** replace the device
		• If activated (open circuit), resolve the issue; the system will require a local reset to restart the ignition process
			Flashing

14.3 | Shutdown Codes:

Status Code	Event Description	Corrective Action	LED Indicator
20 Main Fuel Valve Failure	• Flame is not present • Solenoid valves are closed • No activity when attempting to start up the system	• System detecting an open circuit. • No jumper at 21 & 22. • Switch on main fuel valve is activated. • Check wire connections. • Check main fuel valve. **Note: Not a shutdown, works as a:** ◦ permissive. Ignores open circuit ◦ after audible alarm.	Flashing
21 Replace FT-Ignition Unit	• Pilot flame is not present • Solenoid valves are closed • The system will not restart if the OFF and ON buttons are pressed	• Use a DMM a verify the ohm value of the igniter (normal 1.3 – 2.0). If the igniter is worn, the ohm value will be greater than 10 ohms, requiring a replacement igniter / FT ignition unit	Flashing
22 Stage 1 Solenoid Disconnected	N/A	• Shutdown code is inactive. If the shutdown code is needed, please contact SureFire Tech Support.	N/A
23 T/C High Temp. Shutdown	• Pilot flame is not present • Solenoid valves are closed • The system will not restart if the OFF and ON buttons are pressed	• The safety thermocouple's high temperature setpoint has been exceeded (reference 11.4) • Determine the cause of the elevated temperature condition, resolve it, and restart the system	Flashing

14.4 | Modbus Troubleshooting Guide

Sequence	Troubleshooting

Step 1	**Verify Communication Parameters (Reference Section 12.4 of Operations Manual)**
	• Confirm that both the master and slave devices are configured with identical communication parameters:
	  ◦ Baud Rate (e.g., 9600)
	  ◦ Data Bits (8)
	  ◦ Parity (None)
	  ◦ Stop Bits (1)
	  ◦ Device ID / Slave Address (unique for each slave on the network – reference 11.14)
	• Check that termination resistors and biasing resistors (if required) are applied consistently.
	• Ensure all devices use the same protocol type: Modbus RS-485

Step 2	**Verify Register Mapping and Addressing**
	• Confirm the correct method of register addressing for the specific PLC or SCADA platform in use:
	  ◦ Some systems require 40001 as the first holding register.
	  ◦ Others may require 1 or 0 as the first register reference.
	• Validate that the function codes (e.g., 03: Read Holding Registers, 04: Input Registers, 06: Write Single Register) match the intended operation.
	• Confirm endianness (byte and word order) if numerical values appear scrambled or incorrect.

Step 3	**Utilize a PLC Communication Simulator**
	• Connect a Modbus simulator application directly to the BMS-100 to bypass external PLC hardware and field wiring.
	• If the simulator shows no connectivity:
	  ◦ Suspect internal hardware on SureFire's BMS-100.
	  ◦ Escalate for hardware diagnostics or replacement.
	• If the simulator shows connectivity:
	  ◦ The issue is likely related to external wiring, third-party PLC hardware, or configuration outside of the BMS-100.

Step 4	***Physical Layer and Wiring Checks***
	• *Verify correct RS-485 wiring topology:*
	  ◦ *Use twisted pair shielded cable rated for RS-485.*
	  ◦ *Ensure daisy-chain topology (no stubs or stars).*
	  ◦ *Maximum cable length typically 1200 meters (4000 feet) for standard baud rates.*
	• *Confirm polarity: A(+) and B(–) terminals must be consistent across all devices.*
	• *Inspect for broken wires, loose terminations, or reversed polarity.*
	• *Check shield grounding practices—generally grounded at one point only.*
	• *Ensure termination resistors (120 Ω) are installed at both ends of the line (if applicable)*
	• *Check for excessive noise, voltage drops, or reflections on the line.*
	• *Verify that only one device is configured as the master*

14.4 | Modbus Troubleshooting Guide

Sequence	Troubleshooting
Step 5	**Firmware / Software Considerations** • Confirm that all devices have up-to-date firmware revisions that support Modbus. • Verify the correct Modbus table or register map is being referenced. • Review system logs (if available) for error codes or communication timeout messages.

Step 6	**Escalation and Documentation**
	• If all above steps fail:
	  ◦ Replace cables or swap ports to isolate hardware vs. software issues.
	  ◦ Test with a known-good master or slave device.
	• Document all troubleshooting steps, findings, and corrective actions in the system log for future reference
	• Contact SureFire Technical Support at 505-333-2876.

24/7 CARE FOR OUR CLIENTS.

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