INSTALLATION & OPERATIONS MANUAL

PROUDLY MADE IN THE USA

Table of Contents

BMS-300 System Introduction

The BMS-350 is designed for heavy duty oilfield applications and is certified to UL and ISA standards for hazardous areas. The BMS-350 is designed to operate with the FT Ignition units to provide optimal ignition.

The controller's display is designed to operate in ambient temperature from –40°F to 131°F, and is coated for corrosion resistance. The unit is mounted in a NEMA 4X enclosure supplied with a UV resistant keypad. Each unit includes function indicator lights and a status code chart printed on the overlay to provide assistance in troubleshooting. The unit requires 12 VDC power and is solar ready with a specific solar power termination port.

This Burner Management System is suitable for use in **Class 1, Division 2, Groups C and D, T6 Hazardous (Classified) and Ordinary Location.**

The system monitors target temperature with an enhanced RTD or Thermocouple circuits and indicates temperatures from 0°F to 490°F (RTD) and 32°F to 2700°F (Thermocouple). The system controls both the pilot and main burner gas valves as necessary and is designed as a fail safe system. High temperature and flame failure shutdowns are available along with an audible startup warning. The system's fail safe run status alarm function allows for remote monitoring for environmental and regulatory compliance. Standard remote features include temperature indication, remote ON and OFF utilizing an RTU or PLC, and Modbus read only communication through RS-485 or RS-232.

The BMS-350 process may also be controlled using the alt sense input. Multiple connections for additional standby and shutdown requirements are also provided.

Every SureFire system must pass complete factory QA/QC inspections before shipment.

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.

Certifications and Warnings

ETL Certified to the Following

Standards:

CERTIFIED TO:

CSA STD C22.2 NO. 61010-1

CSA STD C22.2 NO. 213:2017 Ed.3

7.8 amps @ 12.0 vdc MAX

0.025 amps @ 12.0 vdc AVG

CONFORMS TO:

UL STD 61010-1

UL STD 121201:2017 Ed.9

Intertek

WARNING
EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR
SUITABILITY FOR CLASS I, DIVISION 2;
AVERTISSEMENT
RISQUE D'EXPLOSION – LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL
INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2

WARNING
EXPLOSION HAZARD - DO NOT REPLACE FUSES UNLESS POWER HAS BEEN SWITCHED OFF
OR THE AREA IS KNOWN TO BE NON-HAZARDOUS;
AVERTISSEMENT
RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST
DESIGNE NON DANGEREUX AVANT DE REPLACER LE FUSE.

WARNING
EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN
SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS;
AVERTISSEMENT
RISQUE D'EXPLOSION - AVANT DE DECONNECTER L'EQUIPEMENT, COUPER LE COURANT OU
S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX.

WARNING
EXPOSURE TO SOME CHEMICALS MAY DEGRADE THE SEALING
PROPERTIES OF MATERIALS USED IN THE FOLLOWING DEVICES: PANASONIC RELAY, MOD-
EL JW2SN-DC12V, AND HAMILIN RELAY, MODEL HE721A0500
AVERTISSEMENT
L'exposition à certains produits chimiques peut dégrader les ETANCHEITE
Propriétés des matériaux utilisés dans les dispositifs suivants: RELAIS PANASONIC MODÈLE JW2SN-
DC12V, ET RELAIS HAMILIN, MODÈLE HE721A0500

SureFire Warranty Statement:

SureFire warrants all equipment of its own manufacture to be free of defects in material and workmanship. SureFire's sole obligation hereunder shall be expressly limited to repair or exchange, F.O.B. Farmington, NM, USA of such defective equipment, but does not apply to claims which are a result of improper installation, misuse, maladjustment, abnormal operating conditions, or lack of routine maintenance as determined by SureFire. Nor does the warranty include the furnishing of service for maintenance or problems arising from the foregoing causes. No claims for labor, installation, removal, transportation, or other expenses will be recognized. Notwithstanding any stipulation of the purchaser to the contrary, all other obligations, representations, warranties and conditions, express or implied, statutory or otherwise, including any implied warranties or conditions of merchantability, quality or fitness are hereby excluded and, SureFire shall not be liable for any loss, cost or damages, of any kind whatsoever, 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 hereof relating to the warranty and limitations hereon and limitation of liability shall continue to be enforceable between the parties notwithstanding termination of the within agreement for any reason including fundamental breach. Equipment not of SureFire manufacture shall pass through to the original manufacturer's or vendor's warranty.

Product Description	Warranty Policy Defective Products	Return Policy Customer Return New Product
SureFire Controllers: BMS-300, BMS-100, Flare-100 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 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.

Shipping Cost:

For Warranty Claims, the shipping cost incurred by shipping the product from the customer to SureFire will be at the expense of the customer. If the product is deemed under warranty by SureFire, then the shipping cost incurred by shipping the product from SureFire to the customer will be at the expense of SureFire. If the product is deemed non-warranty by SureFire, then the shipping cost incurred by shipping the product from SureFire to the customer will be at the expense of the customer.

BMS-350 Description

Enclosure:

The SureFire BMS-350 System uses a polycarbonate NEMA 4X enclosure to house the circuit board. The graphic overlay with membrane keypad is mounted on the exterior of the enclosure.

The NEMA 4X enclosure provides a high level of protection from harsh outdoor elements:

♦ Windblown Dust Protection

♦ Water Damage Protection - Rain, Sleet, Snow, Splashing and Direct Water Contact

♦ Corrosion Protection

♦ External Formation of Ice Protection

The Enclosure is IP66 certified and has been tested to the following to meant certification:

♦ Dust tight, no ingress of dust; complete protection against contact

♦ Water projected in powerful water jets (12.5mm nozzle) against the enclosure from any direction shall have no harmful effects.

WARNING:

<u>**When drilling holes in the enclosure, ensure IP66 fittings are used to maintain the IP66 standard. Failure to use IP66 standard fittings nullifies the IP66 certification.**</u>

BMS-350 Description

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 comes with 4 LED indicators and a LED Display. It also comes with individual terminal blocks, ground lug, and power connector to ease wiring and installation.

BMS-350 Description

LED Indicators:

The circuit boards LEDs illuminate through the lid of the enclosure. The LED's 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 igniter is on.
	Blinking - Indicates an igniter failure.
BLUE	LED ON - Indicates a flame has been sensed on the flame sensing device

Graphic Overlay:

The overlay is used for interfacing with the system to acquire system data. The overlay also provides a list of status codes and a display window that shows data, settings, and information.

16 Button Keypad:

The SureFire BMS-350 System has a 16 button keypad to control and monitor the system. The buttons perform the following functions:

Button	Displayed Value / Functional Operation
Up Arrow	♦ Increases the current value ♦ Press and hold for 5 seconds to unlock. A series of zeros will appear on the screen.
Down Arrow	♦ Decrease the current value ♦ Press and hold for 5 seconds to relock the system
High Temp	♦ Displays the High Temperature setpoint ♦ While in locked mode, press and hold for 5 seconds to display the Safety Thermocouple's current temperature
Low Temp	♦ Displays the Low Temperature setpoint
Flame Sense	♦ Displays the current Flame Sensing device: F = Flame Rod H = Thermocouple
Temp Control	♦ Displays the current Temperature Control device: A = Alt Sense 1 = RTD 2 = 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
Battery Volts	♦ Displays the current voltage being supplied from the battery to the BMS-350 system
Pilot Mode	♦ Displays the current Pilot Mode 1 = Intermittent Pilot 2 = Standing Pilot
FPT	♦ Displays the current timing between Stage 1 Solenoid and Stage 2 Solenoid Valves
Flame Strength	♦ Displays the current Flame Strength value ♦ Press and hold for 5 seconds to display the Safety Thermocouple shutdown setpoint

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

SureFire Ignition Units

SureFire FT-Series Ignition Units:

The SureFire BMS-350 is compatible with the listed FT series igniters. Each unit is designed for specific Flare, Combustor and Fire Tube applications. The FT series ignition units have been designed for both piloted and pilotless applications.

Flare / Combustor Pilot System:

The FTL-F series Ignition units are designed for Flare and Combustor applications, utilizing a thermocouple as a flame sensor.

Piloted System:

The FT-1 Ignition units are designed for piloted applications, utilizing the thermocouple or flame rod flame sensing device. The FT-1 Ignition units are used in a piloted application with burners ranging from **125,000 BTU/HR to 10 MM BTU/HR.**

Optional Flame Sensors:

Thermocouple (recommended)

♦ Utilizes temperature reading to verify the presence of a flame

♦ Armored wiring harness rated to 1000°F duty and 1500°F flash

♦ Direct termination to the BMS-350 Controller

Flame Rod:

♦ Kanthal flame rod rated 2600°F

♦ Armored wiring harness to 500°F duty / 800°F flash

♦ Direct termination to BMS-350 controller

For proper pilot placement and flame sensing selection, contact SureFire Tech Support @ 505-333-2876 or the local SureFire representative

SureFire Ignition Units

Pilotless System:

The FT-2, FT-4 and FT-6 Ignition units are designed for pilotless applications with a flame rod flame sensing device. These three ignition units are used in pilotless fire tube applications for horizontal treaters with the following BTU/HR burner ratings.

- FT-2 Systems (1") are rated for **125,000BTU/HR**
- FT-4 Systems (2") are rated for **500,000BTU/HR**
- FT-6 Systems (3") are rated for **1,000,000BTU/HR**

The FT-4-VT and FT-6-VT ignition units are designed for pilotless application for vertical treaters and have the same BTU/HR burner ratings as above.

Thermocouple

- Utilizes temperature reading to verify the presence of a flame
- Armored wiring harness rated to 1000°F duty and 1500°F flash
- Direct termination to the BMS-350 Controller

Flame Rod:

- Kanthal flame rod rated 2600°F
- Armored wiring harness to 500°F duty / 800°F flash
- Direct termination to BMS-350 controller

For proper pilotless ignition unit and orifice sizing, contact tech support @ 505-333-2876 or the local SureFire representative

1" SureFire Actuator:

♦ Control the main fuel gas to the main burner.
♦ Factory programmed and pre-wired so no adjustment is necessary.
♦ 3 wire termination.
♦ Proof of valve closure switch kit available
♦ Applications include– non-venting pilotless fuel trains, double block fuel trains, fuel trains for combustors and flare systems.

1" & 2" SureFire Solenoid Valve:

♦ Fail-closed device.
♦ No adjustment necessary.
♦ Simple termination and installation.
♦ Kalrez elastomer plunger.
♦ Plunger replacement kits available.
♦ Applications include– non-venting pilotless fuel trains, double block fuel trains, fuel trains for combustors and flares systems.
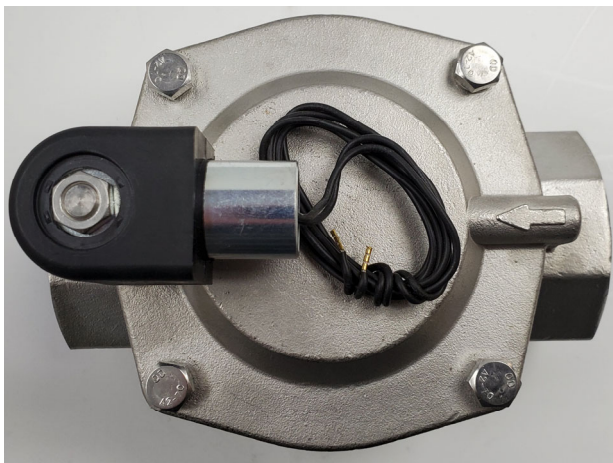
SureFire Additional Components

1/4" ASCO Solenoid Valve:

♦ Fail closed device.
♦ No adjustment necessary.
♦ Simple termination and installation.
♦ Applications include– direct pilot (#72 orifice) and pneumatic valve operation.

1/2" Pressure Switch:

♦ Used on a variety of standbys and shutdowns
♦ Can be set as normally open or normally closed.
♦ Adjustable from 1 psi — 15 psi.
♦ 316 SS construction, wetted parts are NACE

Thermocouple, Type K:

♦ Detects the process temperature.
♦ Simple two wire termination.
♦ Available in: 6", 9" and 12".

1/2" Resistance Temperature Detector:

♦ Detects the process temperature.
♦ Simple three wire termination.
♦ Available in: 5", 6", 9"and 12"

1/4" Slow Flow Valve:

♦ Reduces the inrush of fuel gas into the diaphragm valve for smooth and reliable ignition.
♦ Required on all pilotless installations when not using an actuator valve.
♦ Recommended for piloted installations

SureFire BMS-350 Enclosure:

1. The enclosure is to be mounted on to a pole or a building that is capable of supporting 10 lbs.
2. Position the enclosure so that the LED display is clearly visible for the operator.
3. Install conduit seal-off fittings for all electrical connections to the enclosure.
4. Installation must comply with the national electric code.

WARNING:

♦ Before any welding is attempted, 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 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.

SureFire FT-Series Ignition Unit:

1. Ensure supply gas is turned off and locked out/ tagged out.
2. Install the FT unit in fire tube or proper flare / combustor position.
3. The igniter has two white wires that are not polarity sensitive. Terminate wires to ports 30 & 31. See illustration below.

Flame Rod Flame Sensing:

Piloted and Pilotless ignition units are wired the same as below.

1. Terminate flame rod wire at designated port on upper left hand corner of the circuit board. The port is labeled as "Flame Rod".
2. Isolated grounding is required. Terminate ground wire to circuit board labeled Earth Ground and ground screw on GUA on arrestor housing.
3. Flame sensing switch needs to be on Flame Rod.

NOTES:

♦ Please do not bond the flame sensing ground to facility ground to avoid flame sensing disruption.
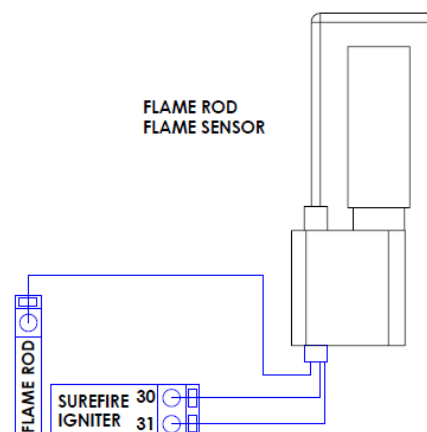
For proper FT unit positioning, contact tech support @ 505-333-2876 or the local SureFire representative

Flame Sensing - Thermocouple:

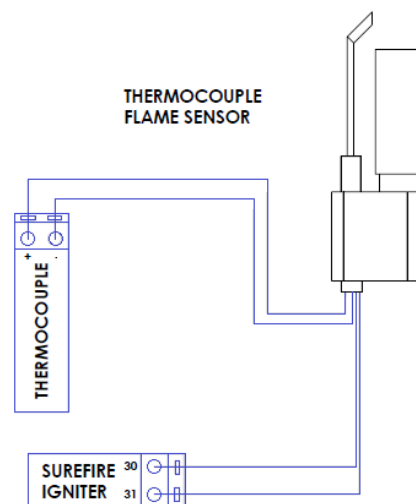1. Thermocouple flame sensing terminate the red (-) wire and yellow (+) wire to the designated ports labeled Thermocouple in the upper left corner of the circuit board.

Piloted System:
1st and 2nd Stage Solenoid Valve

1. Ensure main supply gas is shut off.
2. Locate the pilot gas supply line and instrument gas supply line controlling the main burner control valve.
3. Install 1st stage solenoid down stream of the pilot regulator.
4. Install 2nd stage solenoid in the appropriate location to actuate the main burner control valve.
5. Cut and bend custom 3/8" tubing and connect to tubing fittings on solenoids.
6. Terminate 1st and 2nd stage solenoid wires.
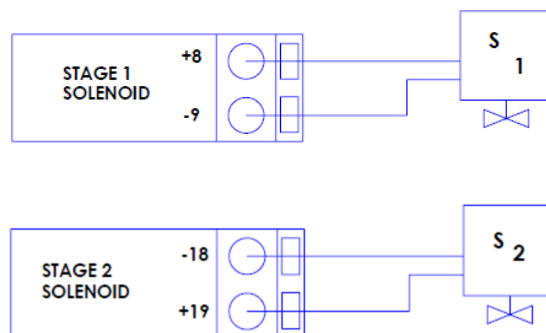
NOTES:
♦ ASCO Solenoid proper flow direction: 2 = Inlet and 1 = Outlet

Pilotless System:
SureFire Actuator Valve & 1st Stage Solenoid Valve

1. Ensure main supply gas is shut off.
2. Locate the pilot gas supply line and eliminate the pilot fuel train completely.
3. Install the SureFire Actuator Valve in the fuel train on the main burner line down steam of the main burner control valve.
4. Locate the instrument gas supply line controlling the main burner control valve and install 1st stage solenoid in the appropriate location to actuate the main burner control valve.
5. Cut and bend custom 3/8" tubing and connect to tubing fittings on the solenoid valve.
6. Terminate 1st stage solenoid wires to ports 8 & 9.
7. Terminate Actuator wires at terminal block labeled Actuator Valve (1, 2 & 3) from the Actuator Valve terminals (1, 2 & 3).

Pilotless System:
SureFire Actuator Valve & 1st Stage Solenoid Valve

NOTES:

♦ Terminal block 1 @ SureFire Actuator port 1
♦ Terminal block 2 @ SureFire Actuator port 2
♦ Terminal block 3 @ SureFire Actuator port 3
♦ Must use a SureFire Actuator valve or an actuator approved by SureFire.
♦ ASCO Solenoid proper flow direction: 2 = Inlet and 1 = Outlet
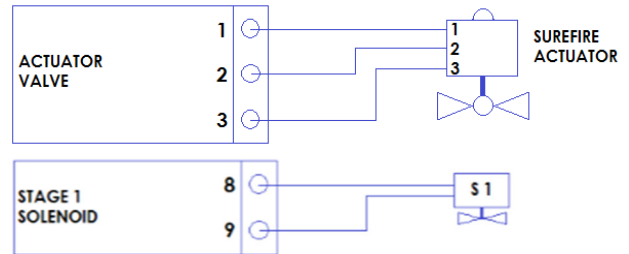
RTD:

1. Install the RTD into the provided thermowell on the vessel for process temperature.
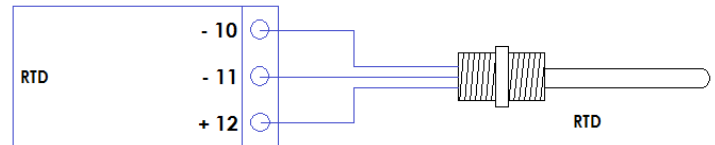2. Connect negative (-) wires to terminals 10 & 11.
3. Connect positive (+) wire to terminal 12.

NOTES:

♦ Software version 2.73 and above. When system recognizes temperature at 4ºF or less, press ON button and a 30 minute timer starts. If system does no recognize a temperature increase above 4ºF, the system will shutdown on code 18. Repeat until temperature gets above 4ºF.

Thermocouple - Process Temperature

1. Install the Thermocouple into the provided thermowell on the vessel for the process temperature.
2. Connection the positive (+) wire (yellow) to the positive terminal, (Port 13).
3. Connect the negative (-) wire (red) to the negative
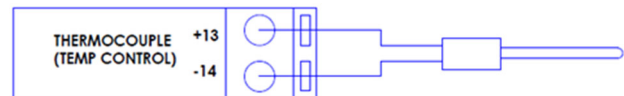
Thermocouple - High Temperature Shutdown

1. Install the thermocouple in the provided thermowell.
2. Connection the positive (+) wire (yellow) to the positive terminal, (Port 15).
3. Connect the negative (-) wire (red) to the negative terminal, (Port 16).

NOTES:

♦ If this port is unused, insert a jumper into the port.
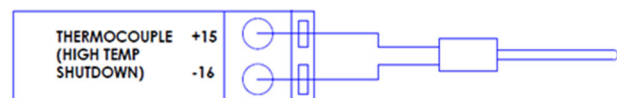
Standby Ports:

- When using a device, install a normally open or closed dry contact device into ports and 20 & 21 and 22 & 23.
- If no device is used, a jumper is required on afore mentioned ports.
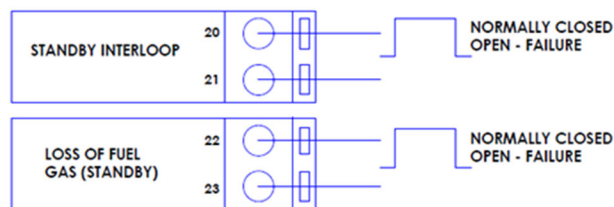
NOTES:
- Closed contact = Normal operation
- Open Contact = Failed operation

Shutdown Ports:

- When using a device, install a normally open or closed dry contact device into ports and 24 & 25 and (proof of valve closure) 26 & 27.
- If no device is used, a jumper is required on afore mentioned ports.
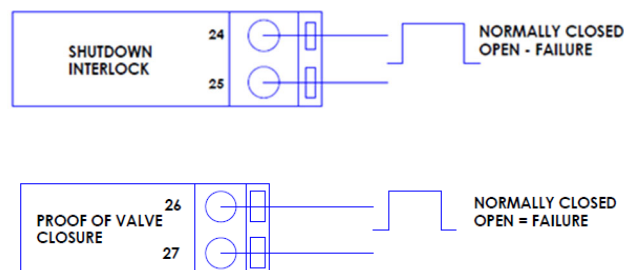
NOTES:
- Closed contact = Normal operation
- Open Contact = Failed operation

4-20mA / 1-5 Volt

- For standard 4-20mA: Connect the positive wire from the remote monitoring equipment to port # 5 and the negative wire to port # 4
- For 1-5 Volt: Connect the positive wire from the remote monitoring equipment to port # 5. Then install a 250Ω resistor in series with the negative wire and terminate to port # 4.
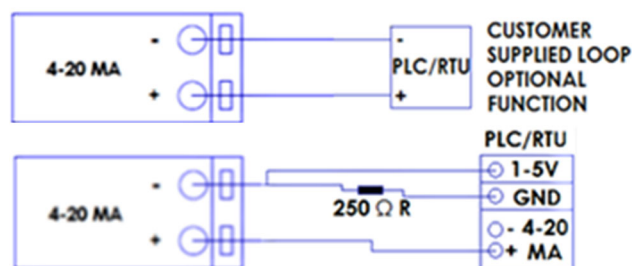
RTD SCALING:
- 4-20mA: 4mA = 0°F   20mA = 670°F
- 1-5 Volt: 1 Volt = 0°F   5 Volt = 670°Φ

THERMOCOUPLE SCALING:
- 4-20mA: 4-20mA = 32°F   20mA = 2400°F
- 1-5 Volt: 1 Volt = 32°F   20mA = 2400°F

Run Status:

1. Terminate the wires from the RTU / PLC to the Run Status terminal ports # 4 & 5
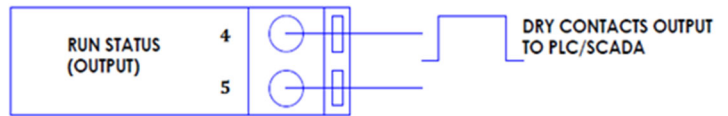
Alarm Output:

1. Terminate the wires from the RTU / PLC to the Alarm Output terminal ports # 6 & 7.
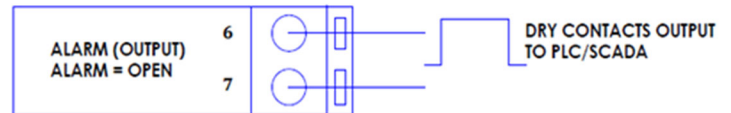
Solar Panel Input:

1. Install 12 VDC Solar Panel on a pole or a building and face it south.
2. Connect negative terminal to port # 32
3. Connect positive terminal to port # 33

NOTES:

♦ Maximum rating for solar panel is 75 watts
♦ The circuit board is internal charge controller to charge 12 VDC battery.
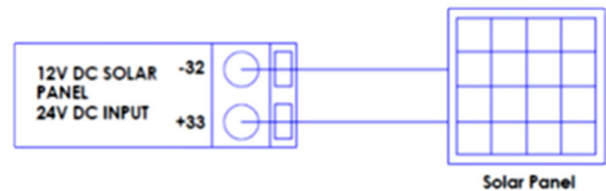
12 VDC Battery Input

1. Install 12 VDC SLA battery.
2. Connect negative terminal to port # 34
3. Connect positive terminal to port # 35

NOTES:

♦ If the battery is more than 10' away from the SureFire controller, use larger AWG wire as needed.
♦ If utilizing a 12 VDC power supply, set voltage @ 13.4 VDC. The power supply should be rated for 75+ Watts.
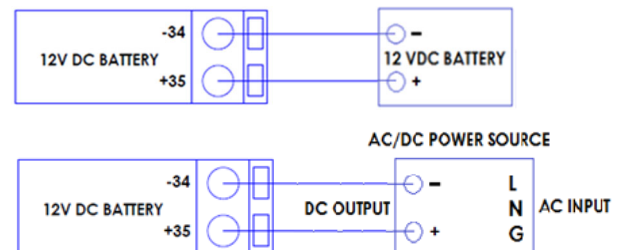
Specifications

Power Supply Specifications	
Battery	12 VDC - 14.5 VDC
12 VDC Power Supply	Set @ 13.4 VDC
Solar Panel	12.0 VDC Only - 75 Watt Max
24 VDC	24.0 VDC
Ignition Unit Specifications	
Igniter Current Draw	7.5 Amps Inrush, 2.0 Amps NOM (During Normal Operation)
Sensor Specifications	
RTD	0°F - 670°F
Thermocouple	32°F - 2,400°F
Alt Sense Switch	Dry Contact Switch (Open / Close Loop)
Standby / Shutdown Switches	Dry Contact Switch (Open / Close Loop)
Output Specifications	
4 - 20mA	12 - 24 VDC for 4 - 20mA Output
Run Status (Output)	12 - 24 VDC @ 1 Amp
	Max Volts: 26 VDC, Max Current: 1 Amp
Alarm (Output)	12 - 24 VDC @ 1 Amp
	Max Volts: 26 VDC, Max Current: 1Amp
Power Supply and Igniter Wiring Requirements	
14 AWG @ 20'	Note: If distance from battery (Power Supply) is further than 20', a large gauge of wire is required.

Run Status and Flame Strength Information

Run Status Operational States:

Operational State	Run	Alarm Out	Red	Green	Blue	Amber
System OFF or Manual Shutdown	Open	Open	ON	OFF	OFF	OFF
System ON, Pre-purge complete, igniter on	Close	Open	OFF	ON	OFF	ON
Flame sensed, Burner running, No Errors	Close	Close	OFF	ON	ON	OFF
Shutdown, Igniter Error	Open	Open	Blinking	OFF	OFF	Blinking
Standby Error	Close	Open	OFF	Blinking	OFF	OFF
Shutdown Error	Open	Close	Blinking	OFF	OFF	OFF

Flame Strength Value Information:

Flame Rod	No Flame Present	Flame Present
Flame Strength Value	Above 500	Below 6

Thermocouple	No Flame Present	Flame Present
Thermocouple flame sensing displays actual temperature, so "flame present" and "no flame present" values may vary.		
Flame strength value	70	If the T/C sees an increase of 20 from the "snap shot" value, a flame is sensed.
If T/C value is greater than 800, must see a 10% decrease to lose a flame.		
If the T/C value is less than 800, must se a 5% decrease to lose a flame.		

Wiring Diagram

T/C ON FT IGNITION UNIT

PLC/RTU

CUSTOMER SUPPLIED LOOP
OPTIONAL FUNCTION

FLAME ROD

TC

4-20 MA

DATE CODE

SERIAL NUMBER

FIRMWARE VER.

SUREFIRE BMS-350

MODBUS

JUMPER IF NOT USED (INPUTS)

Terminal	Label	Right side
1, 2, 3	ACTUATOR VALVE	SUREFIRE ACTUATOR (1, 2, 3)
4, 5	RUN STATUS (OUTPUT)	DRY CONTACTS OUTPUT TO PLC/SCADA
6, 7	ALARM (OUTPUT) ALARM = OPEN	DRY CONTACTS OUTPUT TO PLC/SCADA
+8, −9	STAGE 1 SOLENOID	S1 STAGE 1 SOLENOID VALVE (3-WAY, LOW WATT, N.C.)
−10, −11, +12	RTD	
+13, −14	THERMOCOUPLE (TEMP CONTROL)	
+15, −16	THERMOCOUPLE (HIGH TEMP SHUTDOWN)	
17	CHASSIS GROUND	
−18, +19	STAGE 2 SOLENOID	S2 STAGE 2 SOLENOID VALVE (3-WAY, LOW WATT, N.C.)
20, 21	STANDBY INTERLOOP	NORMALLY OPEN OPEN = FAILURE
22, 23	LOSS OF FUEL GAS (STANDBY)	NORMALLY OPEN OPEN = FAILURE
24, 25	SHUTDOWN INTERLOCK	NORMALLY OPEN OPEN = FAILURE
26, 27	PROOF OF VALVE CLOSURE	NORMALLY OPEN OPEN = FAILURE
28, 29	ALT SENSE INPUT	DRY CONTACT SWITCH CLOSED = RUN OPEN = OFF
30, 31	SUREFIRE IGNITER	
−32, +33	12VDC SOLAR PANEL 24 VDC INPUT	FT IGNITION UNIT
−34, +35	12VDC BATTERY	

BATTERY

SOLAR PANEL

Fuel Train Diagrams

Pilotless Fuel Train:

PS-PRESSURE SWITCH
PRV-PRESSURE REGULATING VALVE
MV-MOTOR VALVE
ACV-ACTUATOR VALVE
HV-HAND VALVE
SV-SOLENOID VALVE
SFV-SLOW FLOW VALVE
PI-PRESSURE INDICATOR

Piloted Fuel Train:

PS-PRESSURE SWITCH
PRV-PRESSURE REGULATING VALVE
MV-MOTOR VALVE
HV-HAND VALVE
SV-SOLENOID VALVE
SFV-SLOW FLOW VALVE
PI-PRESSURE INDICATOR
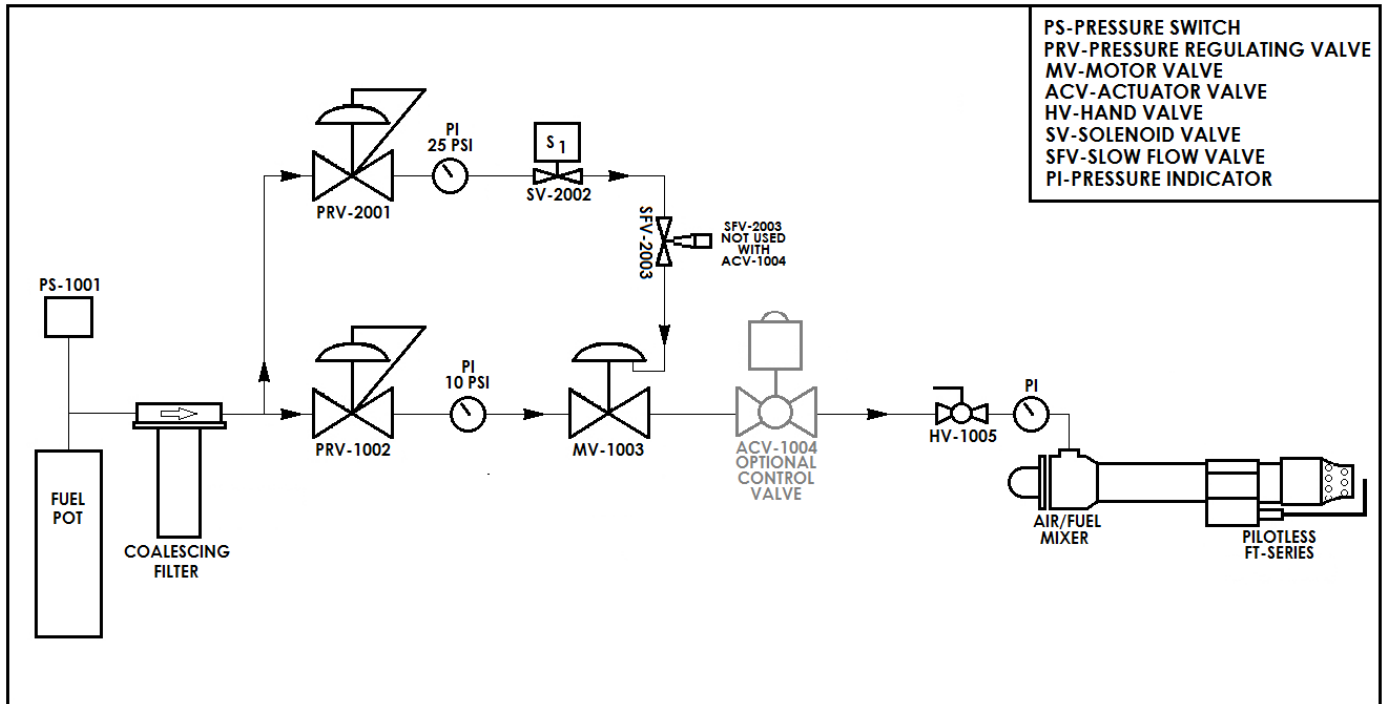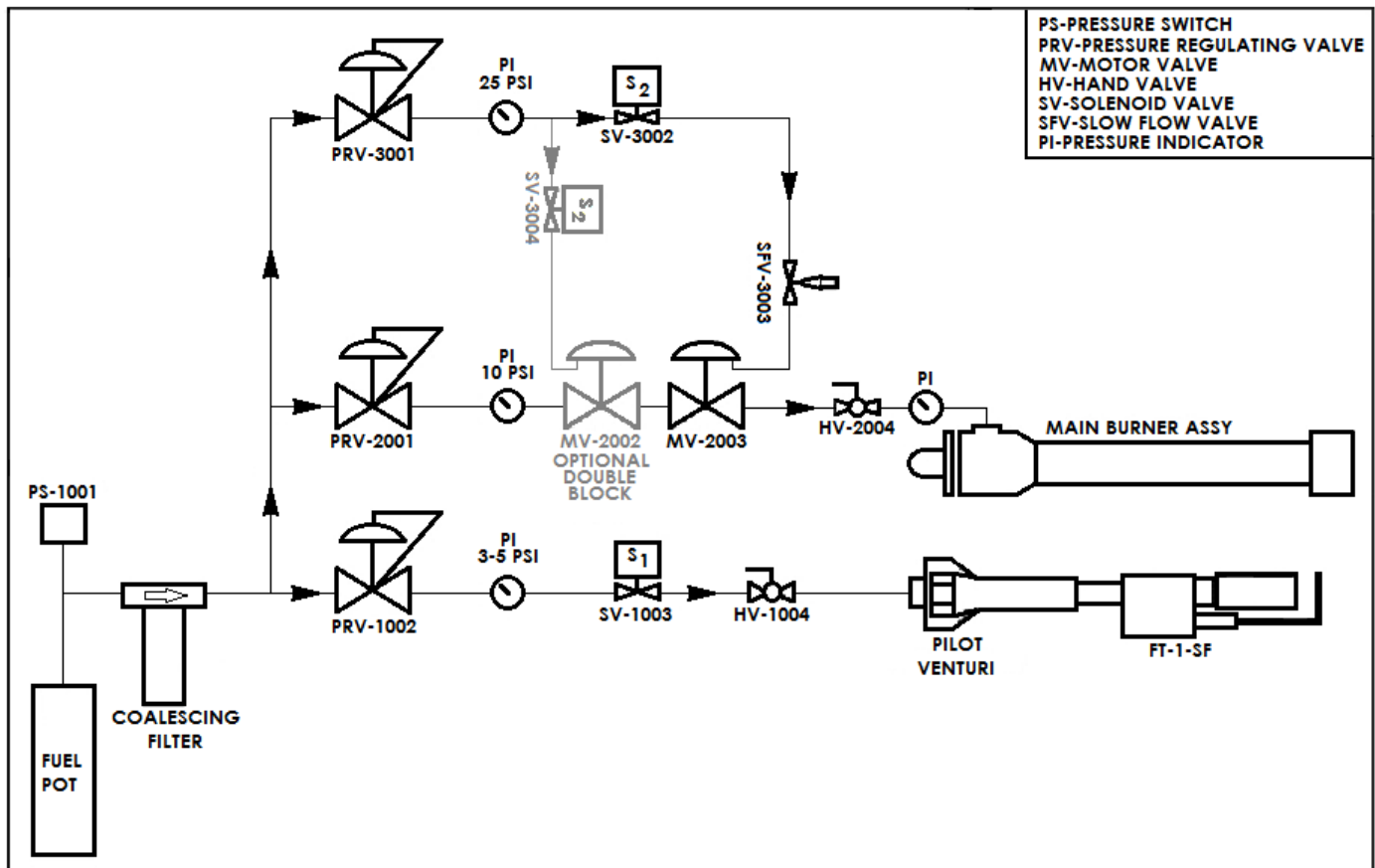
BMS-350 Setup

High Temperature:

- *Primary Function:*
  1. The **High Temp** button displays the current high temperature setpoint.
  2. To adjust the High Temperature setpoint:
     - Unlock the system by pressing and holding the **Up Arrow** button for 5 seconds until a series of zeros appear.
     - Press and hold the **High Temp** button and use the **Up Arrow** or **Down Arrow** buttons to adjust the temperature setpoint. (Press and hold the up or down arrows for 3 seconds to scroll).

NOTES:
- High Temp factory setpoint: RTD = 120°F / Thermocouple = 1,800°F
- High Temp range: RTD = 34°F - 590°F / Thermocouple = 34°F - 2400°F

- *Secondary Function:*
  1. The **High Temp** button displays the Safety Thermocouple's current temperature.
     - Lock the system by pressing and holding the **Up Arrow** for 5 seconds.
     - Press and hold the **High Temp** button for 5 seconds to reveal the temperature.

Low Temperature:

1. The **Low Temp** button displays the current low temperature setpoint.
2. To adjust the Low Temperature setpoint:
   - Unlock the system by pressing and holding the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **Low Temp** button and use the **Up Arrow** or **Down Arrow** buttons to adjust the temperature setpoint.

NOTES:
- Low Temp factory setpoint: RTD = 100°F / Thermocouple = 1,300°F
- Low Temp range: RTD = 32°F - 588°F / Thermocouple = 32°F - 2,398°F

NOTE: The SureFire System comes with a standard 2°F temperature span between the High Temp and the Low Temp to prevent undue wear and tear associated with equipment short cycling.

Flame Sense - Flame Rod (F) or Thermocouple (H):

1. The **Flame Sense** button displays the current flame sensing device.
2. To adjust the flame sensing device:
   - Unlock the system by pressing and holding the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **Flame Strength** button, and use the **Up Arrow** or **Down Arrow** buttons to select the desired flame sensing type.

NOTES:
- Flame Rod = F / Thermocouple = H
- Flame Sense factory default = Flame Rod

Flame Strength:

Primary Function:
1. The **Flame Strength** button displays the current flame strength value for the selected Flame Sensing device.
2. To view the current flame strength value, press the **Flame Strength** button.

Secondary Function:

1. The **Flame Strength** button also displays the Safety Thermocouple temperature setpoint.
2. To adjust the Safety Thermocouple setpoint:
   - Unlock the system by pressing and holding the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press the hold the **Flame Strength** button to reveal the setpoint. Use the **Up Arrow** or **Down Arrow** buttons to adjust the desired temperature setpoint.

NOTES:
- The Safety Thermocouple factory setpoint: 300°F
- The Safety Thermocouple range: 40°F - 2,400°F

- The **Blue LED** corresponds with the flame strength. If the system detects a flame, the **Blue LED** will illuminate.

Extreme High Temperature Delta (EHTD):

1. The **EHTD** button displays the current Extreme High Temperature Delta setpoint.
2. To adjust the Extreme High Temperature Delta:
   - Press the **EHTD** button to view the current setpoint.
   - Unlock the system by pressing and holding the **Up Arrow** button down for 5 seconds until a series of zeros appear.
   - Press and hold the **EHTD** button and use the **Up Arrow** or **Down Arrow** to adjust the current setpoint.

NOTES:
- EHTD factory setpoint: 50°F
- EHTD range while in RTD temperature control mode: 10°F - 520°F
- EHTD range while in Thermocouple temperature control mode: 10°F - 1,000°F

Temp Control - Alt Sense (A), RTD (1) and Thermocouple (2):

1. The **Temp Control** button displays the current input / temperature control device.
2. The system can be controlled by three different input devices; RTD, Thermocouple, and Alt Sense Input.
3. To adjust the input control device:
   - Press the **Temp Control** button to view the current setting.
   - Unlock the system by pressing the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **Temp Control** button and use the **Up Arrow** or **Down Arrow** to adjust the current setting.

NOTES:
- A value of **"A"** means the **Alt Sense Input** mode is activated.
- A value of **"1"** means the **RTD** mode is activated.
- A value of **"2"** means the **Thermocouple** mode is activated.

- If the **Alt Sense Input** mode is activated, the input device will need to be terminated to ports # 28 and 29.
- If a "**closed**" circuit is detected on this port, that will signal to start the sequence.
- If a "**open**" circuit is detected on this port, that will signal the to keep the system in a standby mode; status code "**01**".

- A typical **Alt Sense Input** device would be a pressure switch (Part # 51901001) defined on page # 13. Another device would be a dry contact switch from a PLC / RTU type device.

BMS-350 Setup

Pilot Mode - Intermittent (1) or Standing (2):

1. The **Pilot Mode** button displays the current pilot mode.
2. To adjust this Pilot Mode:
   - Press the **Pilot Mode** button to view the current setting.
   - Unlock the system by pressing the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **Pilot Mode** button and use the **Up Arrow** or **Down Arrow** to select the desired setting.

NOTES:
- A value of **"1"** means **"Intermittent Pilot"** mode is activated.
- A value of **"2"** means **"Standing Pilot"** mode is activated.
- Pilot Mode factory setting: 1 - Intermittent Pilot.

Intermittent Pilot Operation:
- While in Intermittent Pilot mode, the pilot will turn off once the High Temperature setpoint is reached. It will then reignite once the Low Temperature setpoint is reached.

Standing Pilot Operation:
- While in Standing Pilot mode, the pilot will remain on once the High Temperature setpoint is reached. It will turn off if the process temperature reaches 10°F above the High Temperature setpoint.

Flame Proof Timing (FPT):

1. The **FPT** button displays the current timing for the system to prove a flame once the first stage Solenoid has opened.
2. To adjust this setting:
   - Press the **FPT** button to view the current setting.
   - Unlock the system by pressing the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **FPT** button and use the **Up Arrow** or **Down Arrow** to adjust the setting.

NOTES:
- Flame Proof Timing factory setting: 15 seconds
- Flame Proof Timing range: 15 seconds - 60 seconds

BMS-350 Setup

Solenoid Timing:

1. The **Solenoid Timing** button displays the current amount of time that elapses between the first stage Solenoid valve opening and the second stage Solenoid valve opening.
2. To adjust the Solenoid Timing setpoint:
   - Press the **Solenoid Timing** button to view the current timing setpoint.
   - Unlock the system by pressing and holding the **Up Arrow** button for 5 seconds until a series of zeros appear.
   - Press and hold the **Solenoid Timing** button and use the **Up Arrow** or **Down Arrow** to select the desired timing.

NOTES:
- Solenoid Timing factory setpoint: 30 seconds
- Solenoid Timing range: 5 seconds - 60 seconds

Auxiliary Functions (AUX):

Primary Function:
- The **AUX** button displays the current ohm value of the FT Ignition Units Igniter. Press the **AUX** button to display that value.

Secondary Function:
- The **AUX** button 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:
- The **AUX** button 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:
- The **AUX** button 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.

Status Code:

Primary Function:
1. The **Status Code** button displays the code that corresponds with the current unit status.
2. To observe the current status of the system, press the **Status Code** button to view the current status code.

NOTE:
♦ Status codes and descriptions are printed on the keypad overlay on the front of the controller for easy troubleshooting support.

Secondary Function:
1. The **Status Code** button can display the past 9 shutdown or standby codes.
2. To view the previous 9 shutdown codes:
    ♦ Press and hold the **Status Code** button and use the **Up Arrow** or **Down Arrow** button to view those status codes.

Battery Volts:

1. The **Battery Volts** button displays the current voltage that is being supplied to system by the power supply (battery or actual power supply).
2. To view the current supply voltage, press the **Battery Volts** button.

NOTE:
♦ The SureFire BMS-350 system accepts voltages defined in the specification section of this manual on page No. 19.
♦ This system is able to measure the battery / power supply voltage at all times; however, it does not replace a battery load tester in the troubleshooting process.

WARNING:

♦ **This system only accepts 12 VDC. If a power supply delivers 24 VDC or AC voltage, a power converter will need to be acquired.**

♦ **If the supply voltage drops below 11 VDC, the system will shutdown on status code 13.**

Intermittent Pilot Sequence of Operation

Ignition Process:
1. Press the ON button.
2. Pre-purge - 120 second countdown displayed - **Red** **LED ON**.
5. Audible Alarm - 5 second countdown- **Green** **LED ON**.
6. Igniter on - 5 second countdown - **Green** and **Amber** **LED ON.**
7. Stage 1 Solenoid valve opens - igniter unit remains on - **Green**, **Blue** and **Amber** **LED ON.**
8. Ignition is achieved, flame is sensed - **Green** and **Blue** **LED ON.**
9. Stage 2 solenoid valve opens - once the timing between solenoids expires -**Green** and **Blue** **LED ON.**
10. System is running - Status code 00 - **Green** and **Blue** **LED ON**
11. Process Temperature exceeds High Temp Set point - Stage 1 and Stage 2 solenoids close - **Green** **LED ON.**
12. Process Temperature reduced to Low Temp Set point - Restart at step 5.

Re-Ignition Process - No Flame Sensed:
1. Once the system recognizes that no flame is sensed, the system will automatically begin the re-ignition process. **Green** **LED ON.**
2. Purge between ignition attempts - 120 second countdown - **Green** **LED ON.**
3. Reference step 5 - 10 in the "Ignition Process Section".

NOTE: If system fails to prove flame on the third attempt, the system shuts down on code 12. **Blinking Red LED.**

Re-Ignition Process - Standby:
1. System in Standby - **Blinking Green LED.**
2. Once the Standby issue is resolved, the system will automatically begin the re-ignition process.
3. Pre-purge - 120 second countdown - **Blinking Green LED.**
4. Reference step 5 - 10 in the "Ignition Process Section".

Re-Ignition Process - Shutdown:
1. The system requires manual reset in the event of a shutdown.
2. System in Shutdown - **Blinking Red LED.**
3. Once the Shutdown issue is resolved, press the OFF than ON button to reset.
4. Pre-purge - 120 second countdown - **Blinking Red LED.**
5. Reference step 5 - 10 in the "Ignition Process Section".

Flow Chart:

Ignition Process:

1. Press the ON button
2. Pre-Purge - 120 second countdown displayed– **Red** LED ON
5. Audible Alarm - 5 second countdown - **Green** LED ON
6. Igniter on - 5 second countdown- **Green** and **Amber** LED ON
7. Stage 1 Solenoid valve opens - igniter remains on - **Green, Blue** and **Amber** LED ON
8. Ignition is achieved, flame is sensed - **Green** and **Blue** LED ON
9. Stage 2 solenoid valve opens - once the timing between solenoids expires - **Green** and **Blue** LED ON
10. System is running - Status code 00 - **Green** and **Blue** LED ON
11. Process Temperature exceeds High Temp Set point - Stage 2 solenoid valve closes and Stage 1 solenoid remains open - **Green** and **Blue** LED ON
    - If the process temperature exceeds the high temp set point by 10 $^\circ$F, stage 1 solenoid valve will close - **Green** LED ON
    - If the above occurs, the system will restart at step 5 once process temperature is reduced to low temp set point
12. Process Temperature reduced to Low Temp Set point - Restart at step 9

Re-Ignition Process - No Flame Sensed:

1. Once the system recognizes that no flame is sensed, the system will automatically begin the re-ignition process.
2. Purge between ignition attempts - 120 second countdown - **Green** LED ON.
3. Reference step 5 - 10 in the "Ignition Process Section".

NOTE: If system fails to prove flame on the third attempt, the system shuts down on code 12. **Blinking Red LED.**
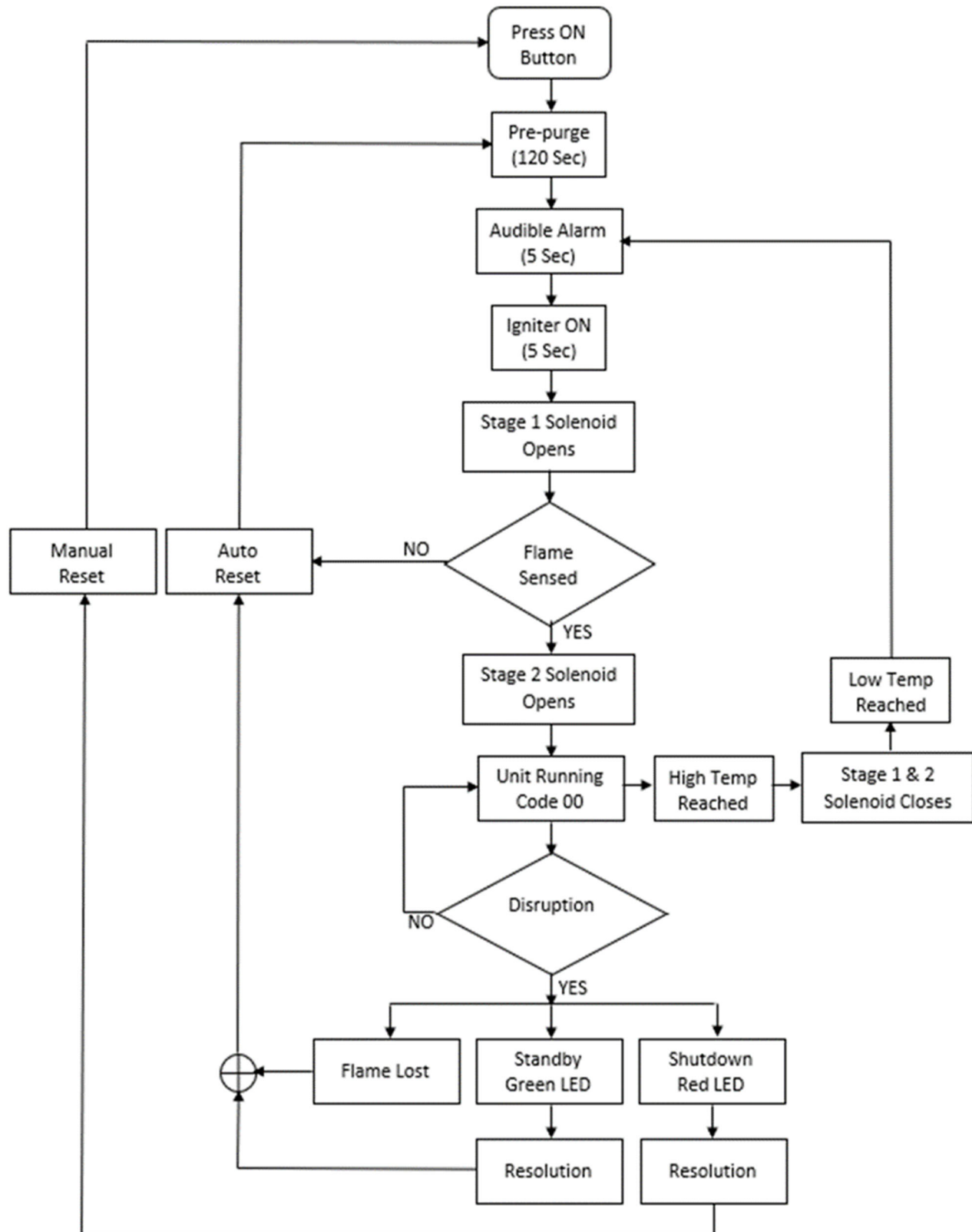
Re-Ignition Process - Standby:

1. System in Standby - **Blinking Green LED.**
2. Once the Standby issue is resolved, the system will automatically begin the re-ignition process.
3. Pre-purge - 120 second countdown - **Blinking Green LED.**
4. Reference step 5 - 10 in the "Ignition Process Section".

Re-Ignition Process - Shutdown:

1. The system requires manual reset in the event of a shutdown.
2. System in Shutdown - **Blinking Red LED.**
3. Once the Shutdown issue is resolved, press the OFF than ON button to reset.
4. Pre-purge - 120 second countdown - **Blinking Red LED.**
5. Reference step 5 - 10 in the "Ignition Process Section".

Flow Chart:

Pilotless Sequence of Operation

Ignition Process:

1. Press the ON button
2. Pre-Purge - 120 second countdown displayed– **Red** LED ON
3. Audible Alarm - 5 second countdown - **Green** LED ON
4. Igniter on - 5 second countdown- **Green** and Amber LED ON
5. Stage 1 Solenoid/Actuator valve opens - igniter remains on - **Green** and Amber LED ON
6. Ignition is achieved, flame is sensed - **Green** and Blue LED ON
7. System is running - Status code 00 - **Green** and Blue LED ON
8. Process Temperature exceeds High Temp Set point - Stage 1 solenoid valve close - **Green** LED ON
9. Process Temperature reduced to Low Temp Set point - Restart at step 5

NOTE: On a pilotless system, the Stage 2 Solenoid is not used.

Re-Ignition Process - No Flame Sensed

1. Once the system recognizes that no flame is sensed, the system will automatically begin the re-ignition process.
2. Purge between ignition attempts - 120 second countdown - **Green** LED ON.
3. Reference step 5 - 10 in the "Ignition Process Section".

NOTE: If system fails to prove flame on the third attempt, the system shuts down on code 12. **Blinking Red LED.**
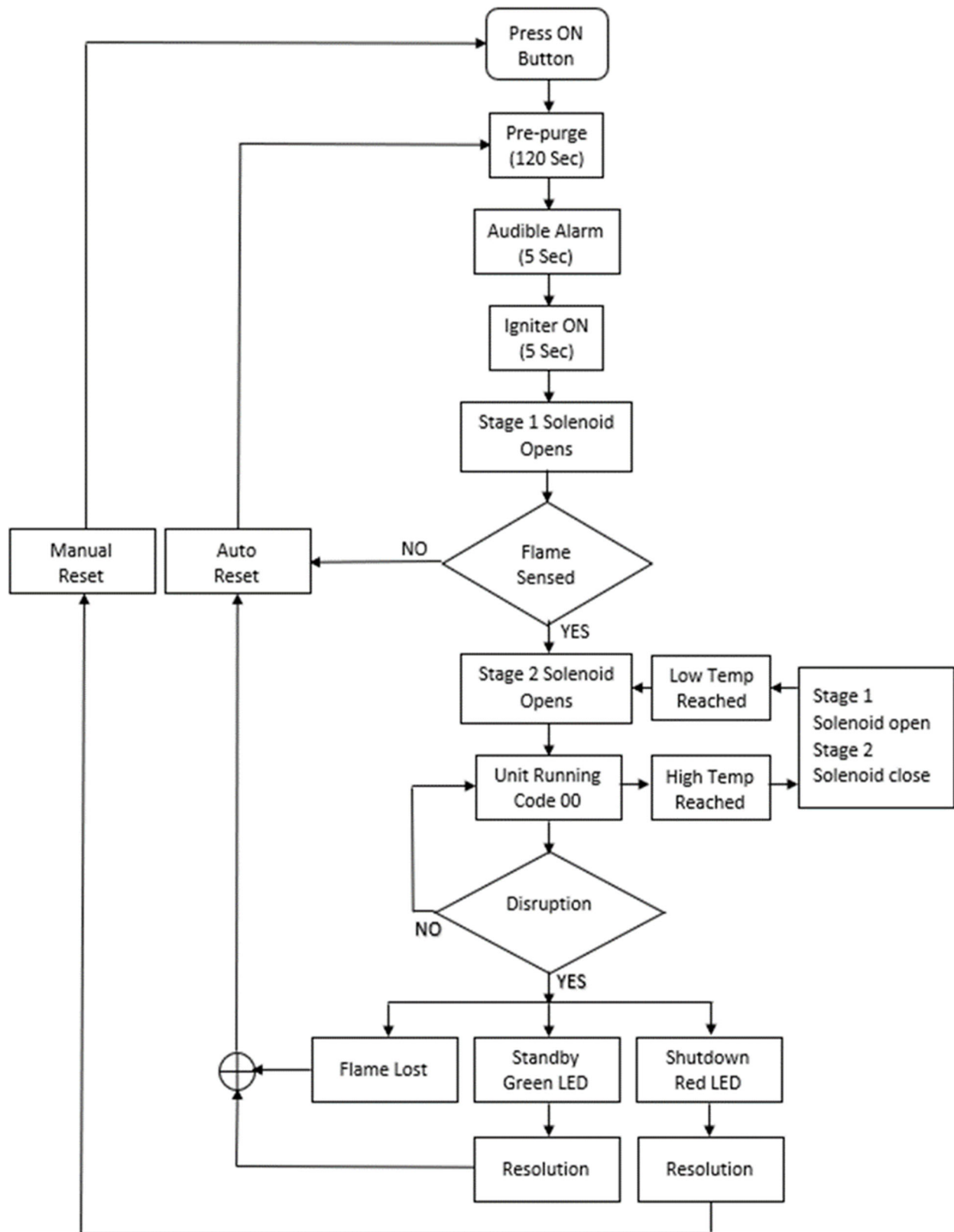
Re-Ignition Process - Standby

1. System in Standby - **Blinking Green LED.**
2. Once the Standby issue is resolved, the system will automatically begin the re-ignition process.
3. Pre-purge - 120 second countdown - **Flashing Green LED.**
4. Reference step 5 - 10 in the "Ignition Process Section".

Re-Ignition Process - Shutdown

1. The system requires manual reset in the event of a shutdown.
2. System in a Shutdown - **Blinking Red LED.**
3. Once the Shutdown issue is resolved, press the OFF than ON button to reset.
4. Pre-purge - 120 second countdown - **Flashing Red LED.**
5. Reference step 5 - 10 in the "Ignition Process Section".

Flow Chart:

Troubleshooting Guide

Run Codes:

Code	Symptom	Action	LED
00 System Running	♦ Pilot/main burner is on.	♦ Normal operation. ♦ Successful ignition recorded ♦ Process temperature increasing.	Blue and Green LEDs ON
01 Waiting for startup signal	♦ Pilot/main burner is not on.	♦ Normal operation. ♦ Process temperature reached high temp setting. ♦ Waiting for process temperature to decrease below low temp setting.	Green LED ON
02 Pre-Purge on Startup	♦ Pilot/main burner is not on.	♦ Normal operation. ♦ 120 second countdown.	Red LED ON
08 Purge between Ignition Attempts	♦ Pilot/main burner is not on.	♦ Normal operation. ♦ No ignition on previous attempts. ♦ 120 second countdown.	Green LED ON
09 Waiting for main valve to open	♦ Main burner is on. (Single stage) ♦ Pilot is on but main burner is not. (Dual stage)	♦ Normal operation. ♦ System is on and flame is proven. ♦ Waiting for 2nd stage solenoid to open.	Green and Blue LEDs ON

Standby Codes:

Code	Symptom	Action	LED
09 Standby Interloop	♦ Pilot/main burner is not on. ♦ No activity when system is attempting startup. ♦ Ports 20 & 21 are activated.	♦ System detecting an open circuit. ♦ No jumper at ports 20 & 21. ♦ Customer supplied switch is activated. ♦ Check wire connections.	Blinking Green LED.
10 Loss of Fuel Gas	♦ Pilot/main burner is not on. ♦ Igniter is not lighting gas. ♦ No activity when system is attempting startup. ♦ Ports 22 & 23 are activated.	♦ System detecting an open circuit. ♦ No jumper at ports 22 & 23. ♦ Customer supplied switch is activated. ♦ Check wire connections.	Blinking Green LED

Troubleshooting Guide

Shutdown Codes:

Code	Symptom	Action	LED
11 Manual / Remote Shut Off	◆ Pilot/main burner is not on.	◆ System was manually or remotely turned OFF. ◆ To startup system press the ON button.	Red LED ON
12 Max Retries Exceeded	◆ Pilot/main burner is not on. ◆ Ignition failed three consecutive attempts.	◆ Check fuel supply. ◆ Check power supply. ◆ Check air/fuel mixer. ◆ Ensure burner pressures are within appropriate range. (3-5lbs for pilot, 8-18 lbs. for main). ◆ Check pilot ignition unit positioning for piloted system. ◆ Check for plugged or frozen orifice. ◆ Check igniter wires and fuses. ◆ Check wiring for flame sensing ground. ◆ Check temperature settings on pneumatic temperature controller (T12) ◆ Ensure that all valves and external components are functioning properly. ◆ Check igniter voltage and Ohms.	Blinking Red LED
13 Low Battery Volts	◆ Pilot/main burner is not on. ◆ Igniter is not lighting gas. ◆ No activity when system is attempting startup.	◆ Check battery voltage. ◆ Check re-charging device. ◆ Check wiring for power package. ◆ A power outage occurred. ◆ Replace battery.	Blinking Red LED
14 Igniter Short Circuit	◆ Pilot/main burner is not on. ◆ System will proceed through startup but will shutdown when igniter receives voltage.	◆ Ensure igniter wires are not touching each other, or grounding to conduit. ◆ Ensure there is no moisture in the conduit. ◆ Check power supply. When power supply is inefficient, system detects a short circuit.	Blinking Amber and Red LEDs
15 Igniter Open Circuit	◆ Pilot/main burner is not on. ◆ System will proceed through startup but will shutdown when igniter receives voltage.	◆ Ensure igniter wires are terminated properly. ◆ Check for disconnected wires ◆ Igniter element could have wore out or is broken. ◆ Check power supply. When power supply is inefficient, system detects an open circuit.	Blinking Amber and Red LEDs

Troubleshooting Guide

Shutdown Codes:

Code	Symptom	Action	LED
16 Flame Sensed Before Startup	• Pilot/main burner is not on. • No activity when system is attempting startup.	• Ensure proper flame sensing mode is selected. • Flame rod wire shorting against ground. • Flame Rod shorting against ground. • Ensure ignition unit did not received heat damage.	Blinking Red LED
17 RTD or TC Error or Disconnected	• Pilot/main burner is no on. • No activity when system is attempting startup.	• Verify RTD/TC are properly terminated. • Verify RTD/TC wires are not shorted. • Physical RTD/TC failure. • Process Temperature below 1°F	Blinking Red LED
18 Extreme High Temp	• Pilot/main burner is not on. • No activity when system is attempting startup.	• Process may have exceed the EHTD setting. • Process below 4°F. • Check wire connections on RTD/TC. • Check the functionality of the RTD/TC.	Blinking Red LED
19 Shutdown Interlock	• Pilot/main burner is not on. • No activity when system is attempting startup. • Ports 24 & 25 are activated.	• System detecting an open circuit. • No jumper at ports 24 & 25.. • Customer supplied device is activated. • Check wire connections.	Blinking red LED
20 Main Fuel Valve Failure	• Pilot/main burner is not on. • No activity when system is attempting startup. • Ports 26 & 27 are activated.	• System detecting an open circuit. • No jumper at 26 & 27 • 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.**	Blinking Red LED
21 Replace FT Ignition Unit	• Pilot/main burner is not on. • No activity when system is attempt startup.	• Igniter ohms have exceeded 4 ohms. • Igniter has deteriorated causing high ohms.	Blinking Red LED

Troubleshooting Guide

Shutdown Codes:

Code	Symptom	Action	LED
22 Stage 1 Solenoid Valve Disconnected	♦ Pilot/main burner is not on. ♦ No activity when attempting startup	♦ Inspect device for faulty operation. ♦ Verify wiring from device. ♦ System detecting battery volts 11 VDC - verify battery voltage.	Blinking Red LED
23 T/C High Temp Shutdown	♦ Pilot/main burner is not on. ♦ No activity when attempting startup ♦ Ports 15 & 16 are activated	♦ Inspect device for faulty operation. ♦ Verify wiring from device. ♦ Jumper is required if function is utilized - so verify the jumper's installation.	Blinking Red LED

Programming Information for
Surefire BMS-350 with Modbus Interface
(Firmware Name: BMS-350 Modbus 2.0)

This document describes the programming interface for the BMS-350 burner controller using the Modbus interface board. The Modbus registers, their contents, command sequencing and examples of command execution over Modbus are described.

This document applies to firmware revisions 2.0. In order to use Modbus 2.0, the BMS-350 firmware package needs to be 2.74.

1.0 Introduction:

The Modbus interface to the BMS-350 is accomplished via an intermediary processor board, the BMS Modbus board. **The function of this board is to serve as a Modbus RTU slave**, handling requests from the Modbus master to read information and relay command data to the BMS-350 board.

The Modbus board behaves as a specialized "mailbox"; a set of Modbus holding registers is available in the Modbus board, any of which can be read or written by either the BMS board or the Modbus master. This arrangement relieves the BMS board of the job of hosting the Modbus and relaxes many of the timing constraints that would overtax the limited hardware resources on the BMS board Micro Controller Unit (MCU).

A number of the registers are constantly updated by the BMS board with information such as temperatures, modes, output states, ignition attempts, and other important data. These should be treated as read-only by the Modbus master. Other registers are defined as command and parameter registers to be written by the Modbus master to cause the BMS board to perform an action or set an operational variable (such as high temperature limit).

Both RS-485 and RS-232 interfaces are available for use by the Modbus master. Only one of these interfaces can be selected for use at any given time via the configuration DIP switch. The configuration DIP switch also sets the Modbus slave address or slave ID and the baud rate.

LEDs are present on the Modbus board to indicate processing of Modbus packets (from the Modbus side) and BMS-350 packets (from the BMS-350 side). The **LEDs illuminate when intact packets are received and are being processed**. Under normal operation the LED on the BMS side should show regular activity as it updates the holding registers on the Modbus board and queries for command data. The LED on the Modbus side will only show activity if the Modbus master is reading from or writing to the Modbus board.

2.0 Amber LED Indication:

There are two LEDs in the Modbus circuit board that indicates different operations

COM LED:

This LED indicates that the Modbus circuit board is communicating and sending data packages to the BMS-350 circuit board. This LED is labeled COM.

BMS COM LED:

This LED indicates that the BMS-350 is communicating and sending data packages to the Modbus circuit board. This LED is labeled BMS COM.

Modbus Information

3.0 Basic Read/Write Operation:

Basic operation of the BMS-350 with Modbus is as follows:

For reading a register (or registers) the Modbus master sends a holding register read request to the BMS Modbus board using **Modbus Function 03** (see "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b", **www.modbus.org** for more detailed information about the Modbus protocol and functions). The Modbus board will respond with the contents of the requested registers. There are currently 256 registers defined (Modbus addresses 40001 thru 40256), but not all are used. Attempts to read registers outside that address space will return an error according to the Modbus protocol.

While the Modbus board is servicing a read request from the master, it is unable to service simultaneous read requests from the BMS board for command data. This may result in the BMS board waiting for access and may result in a blinking LED display on the BMS board. For this reason, it is best for the master to refrain from reading a large number of registers in a single request, and also to avoid issuing rapid read requests. It is suggested that read requests be limited to about 10 registers or less at a time.

For writing a register, the Modbus master sends a holding register write request to the BMS Modbus board using **Modbus Function 6** (write single register) or **Modbus Function 16** (write multiple registers). The supplied data will be written to the specified register.

Note:
♦ Address 40001 maps to Register 1
♦ Address 40002 maps to Register 2
    ↓   ↓   ↓
♦ Address 40255 maps to Register 255

The following table is the register map for the BMS-350. Bits are in Most Significant Bit (MSB) first order.

Modbus address	Register name Modbus master does R (Read) or RW (Read or Write)	Data type	Notes
40001	Status Code (R)	unsigned int 16	See Status Codes on pages 26 or reference BMS-350 overlay
40002	Process temperature (R)	unsigned int 16	Bit 9..0 is 0-590 degrees (RTD) Bit 9..0 is 0-2400 degrees (Thermocouple)
40003	High temperature limit (R)	unsigned int 16	Bit 9..0 is 34-590 degrees (RTD) Bit 9..0 is 34-2400 degrees (Thermocouple)
40004	Low temperature limit (R)	unsigned int 16	Bit 9..0 is 32-588 degrees (RTD) Bit 9..0 is 32-2398 degrees (Thermocouple)

Modbus Information

Modbus address	Register name Modbus master does R (Read) or RW (Read or Write)	Data type	Notes

40005	Configuration and status (R)	unsigned int 16	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	Average battery voltage (R)	unsigned int 16	0 to 145 volts (14.5) Modbus does not show decimal.
40007	Burner days on (R)	unsigned int 16	Days burner on, rolls over to 0 after 9999
40008	Number of ignition attempts (R)	unsigned int 16	Number of ignition attempts, rolls over to 0 after 9999
40009	Number of successful ignition (R)	unsigned int 16	Number of successful ignitions, rolls over to 0 after 9999

Modbus Information

Modbus address	Register name Modbus master does R (Read) or RW (Read or Write)	Data type	Notes
40010	Command status (R)	unsigned int 16	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
40011	Command number (RW)	unsigned int 16	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 (RW)	unsigned int 16	Parameter for command (if required, ignored if not re-quired). May also be interpreted as "command value".
40013	Command execute (RW)	unsigned int 16	Factory use only
40014	Igniter Ohms (R)	unsigned int 16	Igniter resistance range 18 - 65 (1.8 - 6.5 Ω) Modbus does not show decimal.
40015	System days on (R)	unsigned int 16	Days system on, rolls over to 0 after 9999

Modbus address	Register name Modbus master does R (Read) or RW (Read or Write)	Data type	Notes
40016 thru 40019	Unallocated	unsigned int 16	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	unsigned int 16	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	unsigned int 16	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	unsigned int 16	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	unsigned int 16	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)	unsigned int 16	Bit #4 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40025	Bit 5 – Proof of valve closure 0 : Clear 1 : Activated (RED LED blinking)	unsigned int 16	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)	unsigned int 16	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)	unsigned int 16	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	unsigned int 16	Bit #8 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.

Modbus Information

Modbus address	Register name Modbus master does R (Read) or RW (Read or Write)	Data type	Notes
40029	Bit 9 – RED LED 0 : Not blinking 1 : Blinking	unsigned int 16	Bit #9 of register 40005 unpacked into a single register for use by controllers with primitive bit manipulation capabilities.
40030	Bit 10 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40031	Bit 11 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40032	Bit 12 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40033	Bit 13 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40034	Bit 14 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40035	Bit 15 – Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40036	Flame sense T/C Temperature (R)	unsigned int 16	Bit 9..0 is 70-2400 degrees (Thermocouple)
40037	Safety T/C Temperature (R)	unsigned int 16	Bit 9..0 is 40-2400 degrees (Thermocouple)
40038	Safety T/C Temperature Threshold (RW)	unsigned int 16	Bit 9..0 is 40-2400 degrees (Thermocouple)
40039 thru 40249	Unallocated	unsigned int 16	Read as zero, can be written but will be ignored
40250	BMS diagnostics register #1 (R)	unsigned int 16	Factory use only
40251	BMS diagnostics register #1(R)	unsigned int 16	Factory use only
40252	BMS read count (R)	unsigned int 16	Factory use only
40253	Modbus board firmware revision (R)	unsigned int 16	Factory use only
40254	Modbus read count (R)	unsigned int 16	Number of function 03 requests from the Modbus master
40255	BMS write count (R)	unsigned int 16	Factory use only

4.0 Command Operation:

Command operation on the BMS-350 utilizes the "mailbox" concept. The general sequence is as follows:

1. MASTER reads Command Status register (Modbus 40010). If it reads as 0x55 (IDLE) then proceed. Otherwise wait a short time (a few hundred ms would be reasonable) and poll that register again. Continue to do so until the register reads as 0x55 (IDLE) or 0x07.
2. MASTER writes the Command Number register (Modbus 40011) with the desired command number. Note that the first command to be issued is likely 0x01 (UNLOCK).
3. If the desired command requires a parameter, MASTER writes the parameter data to the Command Parameter register (Modbus 40012).
4. MASTER polls the Command Status register (Modbus 40010). If the command executed without error, status code 0x01 (OK) will be returned. If an error occurred during reading or executing the command, the relevant status code will be returned. If the status code is 0x55 (IDLE) or 0x07, then wait a short time (a few hundred ms would be reasonable) and poll that register again. Continue to do so until the register returns a status code other than 0x55.
5. MASTER polls the Command Status register (Modbus 40010). If it reads 0x55 (IDLE) or 0x07 then proceed. Otherwise wait a short time (a few hundred ms would be reasonable) and poll that register again. Continue to do so until the register reads as 0x55 (IDLE) or 0x07.

5.0 DIP Switch Configuration and Settings:

Switch SW1 on the Modbus board configures the Modbus address, baud rate, and selects the serial interface to be used. The notation "ON" and "OFF" follows from the direction of the arrow and the word "ON" located on the left side of the switch body near SW1-1.

The switches are as follows:

Switch	Selects	Description
SW1-1	Modbus address bit 0	"ON" position is "1", "OFF" is 0
SW1-2	Modbus address bit 1	"ON" position is "1", "OFF" is 0
SW1-3	Modbus address bit 2	"ON" position is "1", "OFF" is 0
SW1-4	Modbus address bit 3	"ON" position is "1", "OFF" is 0
SW1-5	Modbus address bit 4	"ON" position is "1", "OFF" is 0
SW1-6	Baud rate for communication with Modbus master	"ON" is 19200, "OFF" is 9600
SW1-7	Unused	Unused
SW1-8	Interface for communication with Modbus master	"ON" is RS232, "OFF" is RS485

Make sure at the receiving end, the following bits are set as:

♦ Data Bit = 8
♦ Parity Bit = None
♦ Stop Bit = 1

Modbus Information

The following table shows the switch settings for SW1-1 through SW1-5 required to obtain the desired Modbus address:

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

Modbus Information

6.0 Troubleshooting Information:

SYMPTOM: The LEDs on the BMS Modbus board do not flash.

DISCUSSION: The LEDs only flash when intact (complete and correct) packets are received from their respective interfaces. If the data arrives garbled, or if no data is sent, then the corresponding LED will not flash. The COM LED is between the MCU and the large terminal blocks, and is associated with activity on the Modbus. The BMS COM LED is between the MCU and the small terminal blocks, and is associated with activity on the BMS board.

POSSIBLE SOLUTIONS:
1. Verify that the cables or wires to the BMS Modbus board are connected.
2. Verify that the wires are connected to the correct pins.
3. Verify that the baud rate for data transmission is in agreement on both sides (for example, if the BMS Modbus board is set for 9600 baud, then the Modbus master must also be set for 9600 baud).
4. Verify that power is present at the BMS Modbus board.
5. If the Modbus COM LED doesn't flash, verify that the Modbus master is sending read or write requests.
6. If the BMS COM LED doesn't flash, verify that the BMS board has power. Under normal operation this LED should always be flashing if both boards are powered.

SYMPTOM: BMS-350 display flickers during Modbus operation

DISCUSSION: Due to the hardware constraints on the BMS-350, the LED display will flicker slightly during normal operation when the Modbus is in use. If the Modbus master polls the BMS-350 for data at a rapid rate, or transfers many registers during each poll, the flickering becomes worse. If the Modbus is being queried on a continuous basis, the display and keypad may become difficult to operate.

POSSIBLE SOLUTIONS:
1. Limit the number of registers being read from the BMS-350 during each transfer to about 10 or less.
2. Limit the polling interval to about twice per second.

SYMPTOM: Command status always reads 0x0B when attempting to execute a command

DISCUSSION: The BMS-350 board must be "unlocked" before any commands that modify the operational variables will succeed. This is similar to the front panel operation which requires a special sequence to unlock access to operational variables. A special command is used to allow the Modbus master to remotely unlock the BMS-350, command 0x01. The unlock will eventually timeout in the same manner as if done from the keypad.

POSSIBLE SOLUTIONS:

1. Execute an UNLOCK command (0x01) before attempting to execute any command that changes an operational variable (e.g. sets a low temperature limit). See the example in Section 4.

Note: When changes are made, re-set/re-start system by powering OFF and powering back ON.

Software Versions

BMS-350

Software Version	Release Date	Description
V2.5	05/08/2019	Standard base software

MODBUS

Software Version	Release Date	Description
V2.0	05/06/2019	Standard base software

Serial Number: _____

Software Version: _____

Installation Notes

Installation Notes

Installation Notes

BMS-350 Installation and Operations Manual:

Last Update: **02/02/2021**

Version: **6.0**

SureFire Farmington, NM Office:

Mailing Address: **1910 Rustic Place, Farmington, NM 87401**
Phone: **(505) 333 - 2878**
Fax: **(505) 333 - 2879**

SureFire Houston, TX Office:

Mailing Address: **12510 Cutten Road, Houston, TX 77066**

Phone: **(281) 377 - 9756**

Fax: **(281) 379 - 1081**

SureFire 24-Hour Technical Support:

Phone: **(505) 333 - 2876**

For SureFire Product Updates Please Visit: www.surefire-controls.com
Follow Us: