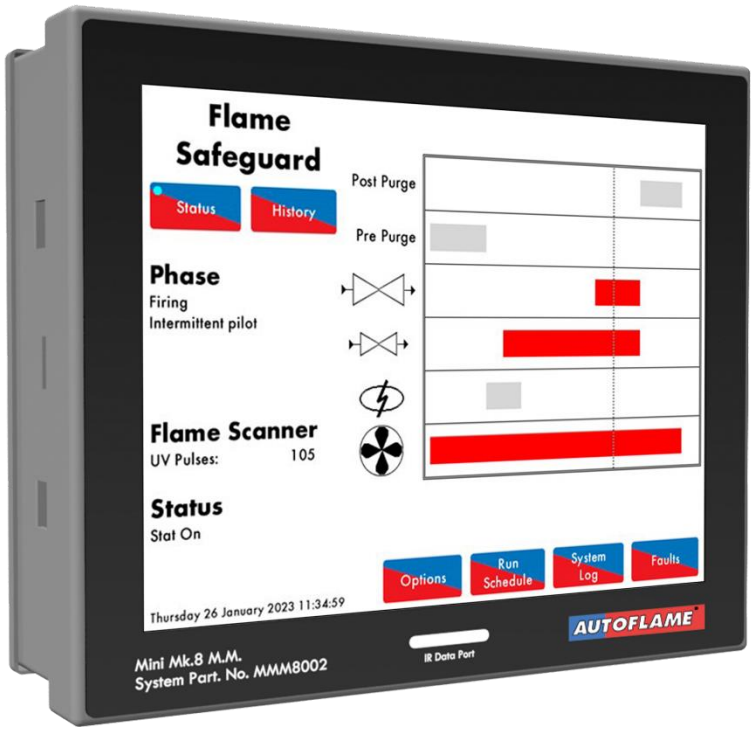
AUTOFLAME®
Combustion Management Systems



AUTOFLAME MINI MK8 FLAME SAFEGUARD CONTROLLER MANUAL MMM8002/FSG

08 APR 2024

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AUTOFLAME MINI MK8 FLAME SAFEGUARD MANUAL MMM8002/FSG

08 APR 2024

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Autoflame Engineering Ltd.'s policy is one of continuous improvement in both design and manufacture. We therefore reserve the right to amend specifications and/or data without prior notice. All details contained in this manual are correct at the time of going to print.

Important Notes

A knowledge of combustion related procedures and commissioning is essential before embarking in work on any of the MM / EGA systems. This is for safety reasons and effective use of the MM / EGA system. Hands on training is required. For details on schedules and fees relating to group training courses and individual instruction, please contact the Autoflame Engineering Ltd. offices at the address listed on the front.

Short Form - General Terms and Conditions

A full statement of our business terms and conditions are printed on the reverse of all invoices. A copy of these can be issued upon application, if requested in writing.

The system equipment and control concepts referred to in this manual MUST be installed, commissioned and applied by personnel skilled in the various technical disciplines that are inherent to the Autoflame product range, i.e. combustion, electrical and control.

The sale of Autoflame's systems and equipment referred to in this manual assume that the dealer, purchaser and installer has the necessary skills at his disposal. i.e. A high degree of combustion engineering experience, and a thorough understanding of the local electrical codes of practice concerning boilers, burners and their ancillary systems and equipment.

Autoflame's warranty from point of sale

- Two years on all electronic and electro-mechanical equipment, assemblies and components.
- One year on all EGA systems and UV & IR scanners, including parts, components, cells and sensors.

The warranty assumes that all equipment supplied will be used for the purpose that it was intended and in strict compliance with our technical recommendations.

Autoflame's warranty and guarantee is limited strictly to product build quality, and design. Excluded absolutely are any claims arising from misapplication, incorrect installation and/or incorrect commissioning.

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Important Safety Notes



WARNING

Fire, Explosion or Electrical Shock Hazard. Can cause severe injury, death or property damage.

Please fully read and understand the following notes before commencing with any work related to the Mini Mk8 MM Flame Safeguard Controller. Failure to do so can result in serious or even fatal injury, and can cause permanent equipment failure and substantial property damage.

Installation, commissioning, burner start-up and changing Options/Parameters must only be carried out by an Autoflame-trained and certified technician with thorough understanding of the Autoflame combustion control systems and boiler/combustion control in general. Any person carrying out this work without undergoing the necessary training and gaining understanding of the boiler plant may place themselves and others in a potentially dangerous situation or cause permanent equipment failure.

Any person working on a boiler plant must be adequately trained and have a thorough understanding and appreciation of the boiler plant.

It is the responsibility of the commissioning technician to ensure that the system operation meets all local codes and regulations.

Electrical connections are live; make sure to isolate the mains power, fully and safely, before carrying out any work related to the wiring connections; failure to do so can result in serious or even fatal injury.

Use extreme care while testing the system. Live voltages are present on most terminal connections when the power is on and are a serious electrical shock hazard.

Replace all limits and interlocks not operating properly. Do not bypass limits and interlocks.

Modification to the Autoflame system settings should only ever be carried out by a qualified combustion engineer. Changes to the Autoflame control system setup has the potential to make the controller operate in an unstable and potentially unsafe manner.

If you are unclear about anything related to the Autoflame system, please contact Autoflame for advice.

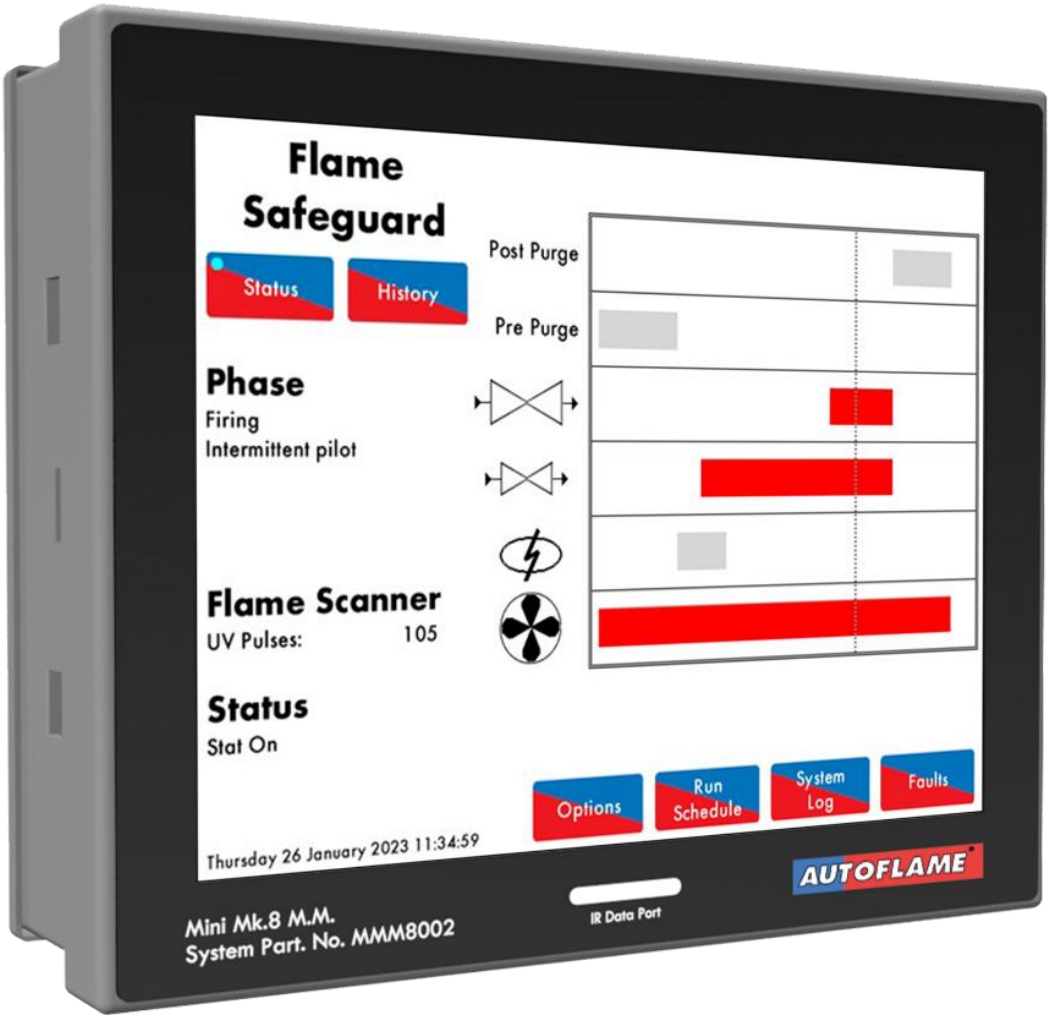
1. AUTOFLAME FLAME SAFEGUARD OVERVIEW, SPECIFICATIONS AND WIRING

1.1. Autoflame Flame Safeguard Overview

The Autoflame Flame Safeguard unit or MMM8002/FSG is a version of the Micro-Modulating system that provides an easily programmable and flexible means of providing the flame safeguard aspects of controlling a boiler/burner.

This control module encompasses all the functions required for reliable flame safeguard management. Built into this system is a fully automated flame safeguard and valve proving system, MODBUS connectivity, and a touchscreen interface.

This system monitors the flame safeguard, as it checks on the flame of the burner from the use of a UV, Ionisation, or IR Scanner.

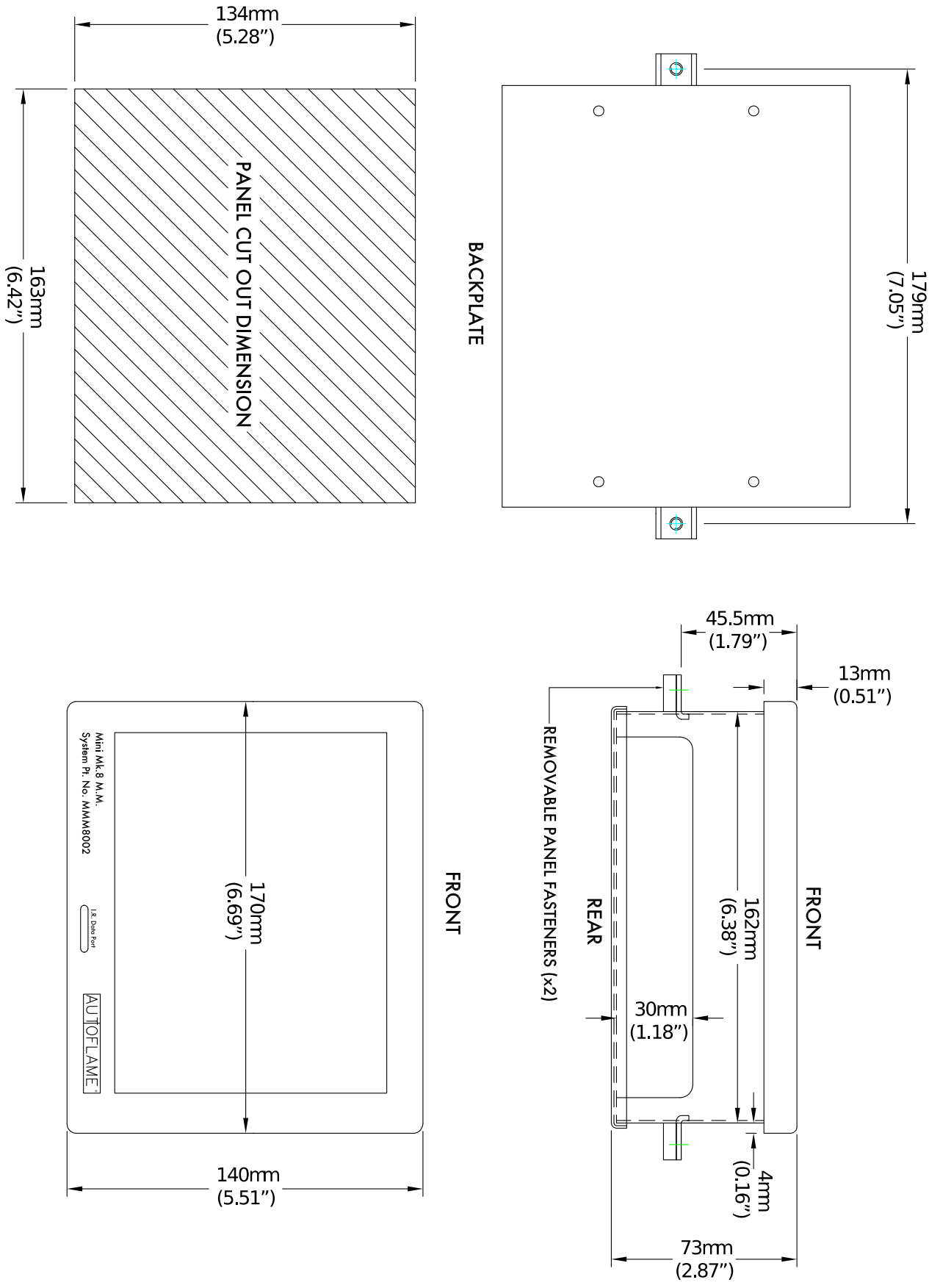


1.1.1. Autoflame Flame Safeguard Main Features

The Autoflame Flame Safeguard features include the following:

- Full colour touch screen.
- 120V or 230V Standard operation 50/60Hz.
- 2 independent fuel programmes.
- Internal flame safeguard – full flame supervision with self-check UV, IR and ionisation.
- Gas valve train leak supervision via digital input (T82).
- Air pressure proving and monitoring via Air switch.
- 64 Lockouts/errors stored with date, time, phase and reset.
- System log stored with date, time and status.
- Adjustable burner control safety times.
- Password protection of all safety related functions.
- Infra-red port for upload/download of configuration data.
- Fully adjustable user options within the system to tailor operation to the application.
- Download all commissioning data from an Autoflame Flame Safeguard unit to a PC via Download Manager.
- Upload commissioning data from a PC to an Autoflame Flame Safeguard unit via Download Manager.
- Direct Modbus for communication to BMS or remote monitoring and control
- On-board diagnostics
- System fault alarm output

1.1.2. Fixing Holes and Dimensions



1.2. Installation

When Installing this Flame Safeguard Controller

Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.

Check the ratings given in the instructions and marked on the product to ensure the product is suitable for your application.

The installer must be an Autoflame trained, experienced, flame safeguard service technician.
After installation is complete, check out the product operation as detailed in these instructions.

Never update the software on the Flame Safeguard Controller without consulting Autoflame first. Using wrong software can damage equipment.



Warning

Fire or Explosion Hazard. Can cause severe injury, death or property damage.
To prevent possible hazardous burner operation, perform verification of safety requirements each time a Flame Safeguard controller is installed on a burner.

IMPORTANT

For on-off gas-fired systems, some authorities, who have jurisdiction, prohibit the wiring of any limit or operating contacts in series between the flame safeguard control and the main fuel valve(s).

Two flame detectors can be connected if necessary (see the latest Autoflame Flame Scanners Guide)

This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class B computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case the users, at their own expense, may be required to take whatever measures are required to correct this interference.
This digital apparatus does not exceed the Class B limits for radio noise of digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

1.2.1. Humidity

The Autoflame Flame Safeguard controller is designed to operate in a maximum 90 percent relative humidity, continuous, noncondensing moisture environment.

Condensing moisture can cause a shutdown.

1.2.2. Vibration

Do not install the Flame Safeguard controller where it could be subjected to vibration in excess of 0.5G continuous maximum vibration.

1.2.3. Weather

The Flame Safeguard controller is not designed to be watertight. If installed outdoors it must be protected by an approved watertight enclosure. See protection rating in section 1.2.4.

1.2.4. Environmental Classification

The Flame Safeguard Controller meets the following climate specification:

Climate:	Min. Temperature	0°C (32°F)
	Recommended Temperature	Less than 40°C (104°F)
	Max. Temperature	60°C (140°F)
	Humidity	0 to 90% non-condensing
Storage:	Temperature	-20 to 85°C (-4 to 185°F)
Protection Rating:	The unit is designed to be panel mounted in any orientation and the front facia is IP65, NEMA4. The back of the unit is IP20, NEMA1.	

1.3. Wiring

1. **For the internal block diagram of the Autoflame Flame Safeguard controller, see section 1.3.1 & 1.3.2.**
2. **Disconnect the power supply before beginning installation to prevent electrical shock and equipment damage. More than one power disconnect may be involved.**
3. **All wiring must comply with all applicable electrical codes, ordinances and regulations. Wiring, where required, must comply with NEC Class 1 wiring.**
4. **Recommended wire size and type is defined in section 1.4.5 Cable Specifications. For high temperature installations, use wire selected for a temperature rating above the maximum operating temperature. All wiring must be moisture resistant.**
5. **Do not connect more than two wires per terminal. If more than two wires need to be connected to a terminal, wire into a suitable terminal block in the panel first and from there to the unit terminal with a single wire.**
6. **Recommended wire routing for Autoflame Flame Scanners:**
    a. **Do not run high voltage ignition transformer wires in the same conduit with the flame scanner wiring.**
    b. **Do not route flame scanner wires in a conduit with line voltage circuits.**
    c. **Enclose flame scanner wires in metal conduit.**
    d. **Follow directions given in the Autoflame Flame Scanners Guide.**
7. **Do not exceed the terminal ratings. Refer to the wiring diagram in section 1.3.1 & 1.3.2 or to the ratings in the section 1.4 Electrical Specifications.**
8. **The voltage tolerance of the power supply must match those of the Flame Safeguard controller. A separate power supply circuit may be required for the Flame Safeguard controller with the required disconnect and overload protection added.**
9. **Check all wiring circuits and complete all the checks before installing the plug-in connectors to the flame safeguard controller; see section 1.3.1 & 1.3.2.**
10. **Install all electrical connectors.**
11. **Restore power to the panel.**

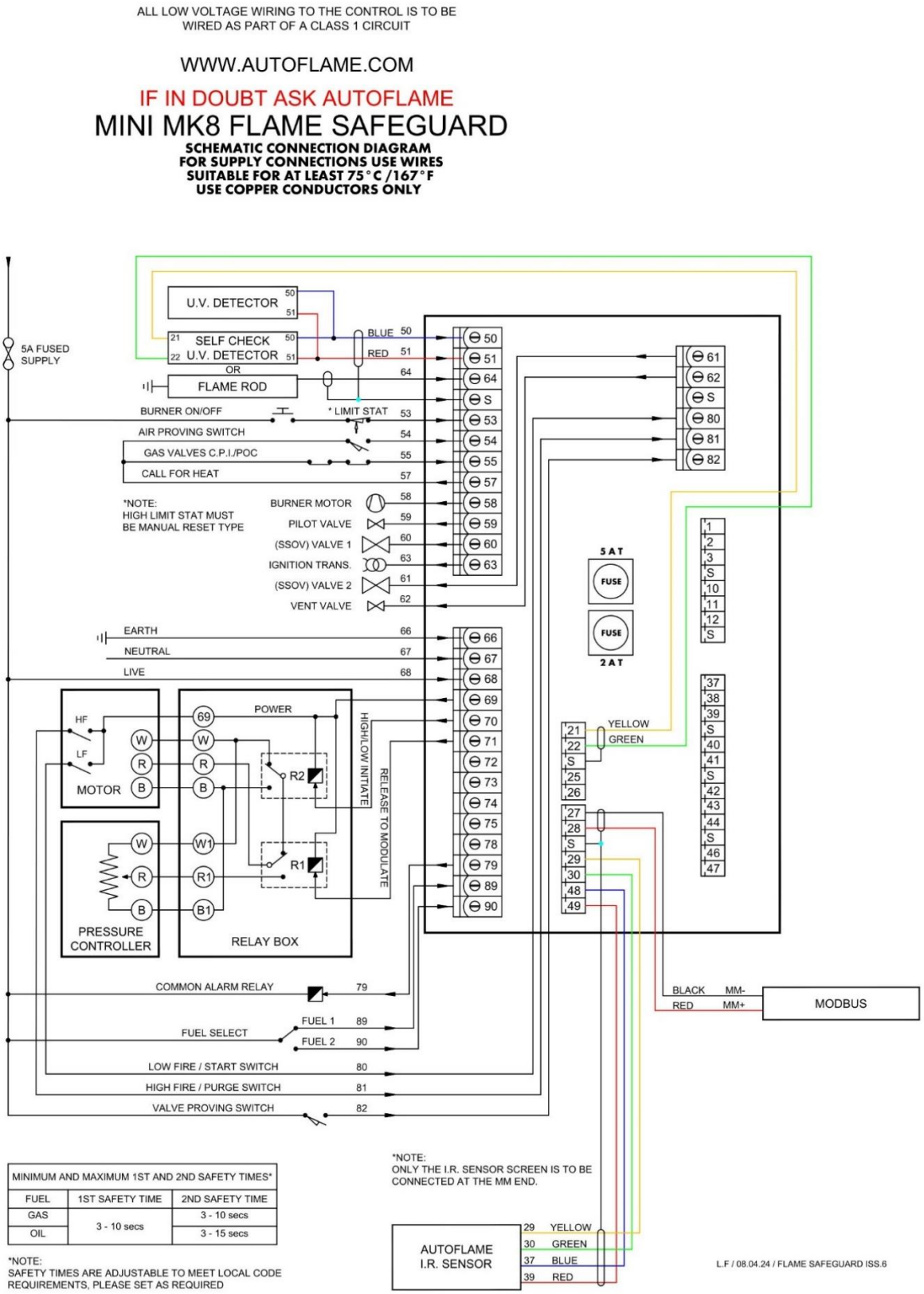


Electrical Shock Hazard

Can cause severe injury, death or property damage.

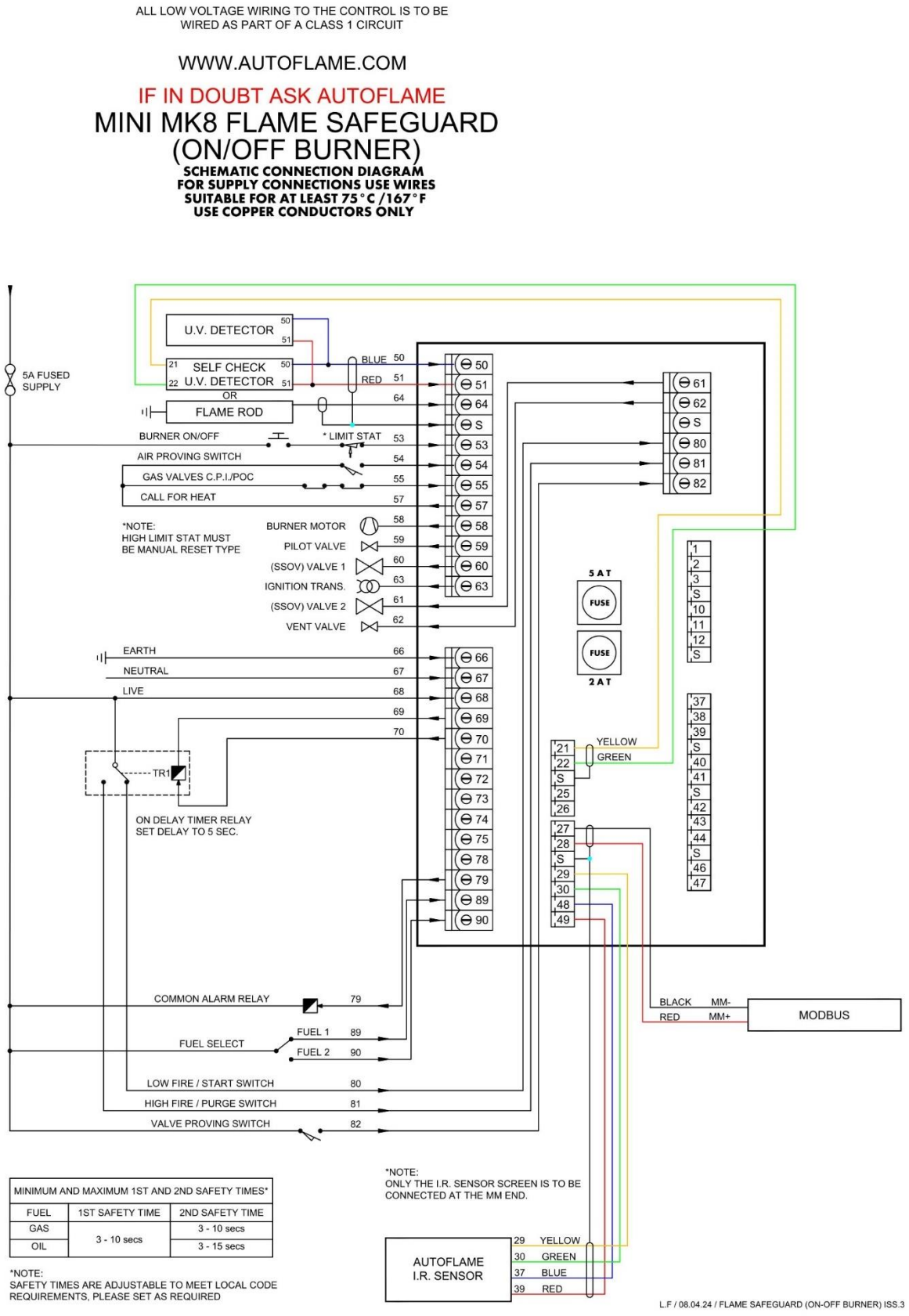
1. **To prevent electrical shock and equipment damage, disconnect the power supply before beginning installation. More than one power supply disconnect may be involved.**
2. **Wiring connections for the Autoflame Flame Safeguard controller are unique; therefore, refer to sections 1.3 and 1.4 for the correct specifications and connections.**
3. **Wiring must comply with all applicable codes, ordinances and regulations.**
4. **Wiring, where required, must comply with NEC Class 1 wiring.**
5. **Loads connected to the Flame Safeguard controller must not exceed those listed on the wiring label or the specifications (see section 1.4.2 of this manual).**
6. **Limits and interlocks must be rated to carry and break current simultaneously to the ignition transformer, pilot valve, and main fuel valve(s).**
7. **All external timers must be listed or component recognized by authorities who have jurisdiction for the specific purpose for which they are used.**

1.3.1. Servo Motor Control Schematic



Fuse	Terminals Protected
5A	Mains voltage output terminals 57 – 63
2A	Low voltage terminals and switched neutral outputs

1.3.2. On/Off Burner Control Schematic



Fuse	Terminals Protected
5A	Mains voltage output terminals 57 – 63
2A	Low voltage terminals and switched neutral outputs

1.4. Electrical Specifications

1.4.1. Classifications

Classification according to EN298

Mains Supply:	230V, +10%/-15%} 120V, +10%/-15%}	47-63 Hz, unit max. consumption 140W

1.4.2. Inputs and Outputs

Outputs Terminal	Rating (230V)	Rating (120V)	Notes
57	250mA	250mA	Must be connected through contactor
58	250mA	250mA	Must be connected through contactor
59	1A	2A	0.6 power factor
60	1A	2A	0.6 power factor
61	1A	2A	0.6 power factor
62	1A	2A	0.6 power factor
63	1A	2A	0.6 power factor
79	100mA	100mA	To drive relay/lamp only – switched neutral
Max. Load	5A	5A	



Electrical Shock Hazard

Can cause severe injury, death or property damage.

- The high and low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation.
- Control voltage cabling should be maximum 10m, screened (if not screened then less than 1m, however servomotors can be unscreened up to 10m).
- Any cabling over 10m must have additional surge protection.
- Low voltage cables should be screened (shielded) cable as specified in section 1.4.5.
- The burner 'High Limit Stat' must be a manual reset type.

The cover (back plate) of the Flame Safeguard controller must always be re-fitted after the wiring is completed to prevent access to the electric shock hazard areas, unauthorised wiring modifications or fuse replacement.

1.4.3. Internal Hardware Status Monitoring

The Flame Safeguard controller analyses the integrity of the internal hardware and diagnostics values for key parameters are available.
The relay safety checks are carried out during every startup sequence and their progress will be displayed on the screen.

1.4.4. Inputs Checks

All system input circuits are examined to assure that the Flame Safeguard controller is capable of recognising the true status of external controls, limits and interlocks. If any input fails this test, a safety shutdown occurs and the fault will be logged.

1.4.5. Cable Specifications

Low Voltage

The screened cable used for low voltage wiring from the Flame Safeguard unit to the detectors must conform to the following specification:

U.V. cable length should not exceed 25m; all other screened cable should not exceed 50m.

- 16/0.2mm PVC insulated overall braid, screened, PVC sheathed.
- Sixteen wires per core.
- Diameter of wires in each core 0.2mm.
- Rated at 440V AC rms at 1600Hz.
- DEF 61-12 current rating per core 2.5A.
- Maximum operating temperature 70°C (158°F).
- Nominal conductor area 0.5sq mm per core.
- Nominal insulation radial thickness on core 0.45mm.
- Nominal conductor diameter per core 0.93mm.
- Nominal core resistance at 20°C. 40.1Ω/1000m.
- Nominal overall diameter per core 1.83mm.
- Fill factor of braid screen 0.7.
- Equivalent imperial conductor sizes 14/0.0076.

Use the number of cores suitable for the application. A universal part numbering system appears to have been adopted for this type of cable as follows:

- 16-2-2C 2 Core.
- 16-2-3C 3 Core.
- 16-2-4C 4 Core.
- 16-2-6C 6 Core.
- 16-2-8C 8 Core.

(5 Core not readily available)

Note: If using 4 Core cable and interference is detected, use 2 sets of 2 Core.

Data Cable

Data cable must be used for communication connections between MM to BMS systems for Modbus RS485.

Communication cable should not exceed 1km.

Types of data cable that can be used:

- Belden 9501 for 2-core shielded cable (1 twisted pair).
- Belden 9502 for 4-core shielded cable (2 twisted pairs).
- STC OS1P24.

Samples are available upon request. Low voltage and data cable can be ordered directly from Autoflame Engineering, please contact Autoflame.

1.4.6. Terminals Description

S	All terminals marked S are internally connected and provide for connections to the various screened cables.
21, 22	Connections to an Autoflame self-check UV sensor.
27, 28	Communications port connections for Modbus.
29, 30	Digital communications connections to an Autoflame IR scanner (MM80017).
48, 49	+15V connections to an Autoflame IR scanner (MM80017).
50, 51	Connections to an Autoflame UV sensor.
64	Connections to a flame rod.
53	Mains voltage input – burner on/off signal, running interlock circuit. **Note: All external safety devices that require manual reset must be reset external to the Autoflame system and prior to completing the recycling interlock.**
54	Mains voltage input – air proving switch.
55	Mains voltage input - proving circuits, e.g. gas valve proof of closure.
57	Mains voltage output – call for heat.
58	Mains voltage output – burner motor.
59	Mains voltage output – start/pilot valve.
60	Mains voltage output – main fuel valve 1.
61	Mains voltage output – main fuel valve 2.
62	Mains voltage output – vent valve.
63	Mains voltage output – ignition transformer.
66	Mains supply – earth.
67	Main supply – neutral.
68	Mains supply – live/hot.
69	Mains voltage output, power to Relay Box (SP80070, SP80070/110).
70	Switched neutral – High/Low Initiate output.
71	Switched neutral – Release to Modulate output.
79	Switched neutral – alarm output for MM lockout/MM error.
80	Low Fire / Start position interlock.
81	High Fire / Purge interlock.
82	Valve proving mains input.
89	Mains voltage input – selects fuel 1 curve
90	Mains voltage input – selects fuel 2 curve

Note that outputs T70 and T71 are switched neutrals and must be connected to the motor through relays. Autoflame provide the relay box (SP80070, SP80070/110) to facilitate this. Alternatively, relays may be wired in as per the wiring schematic in section 1.3.1.

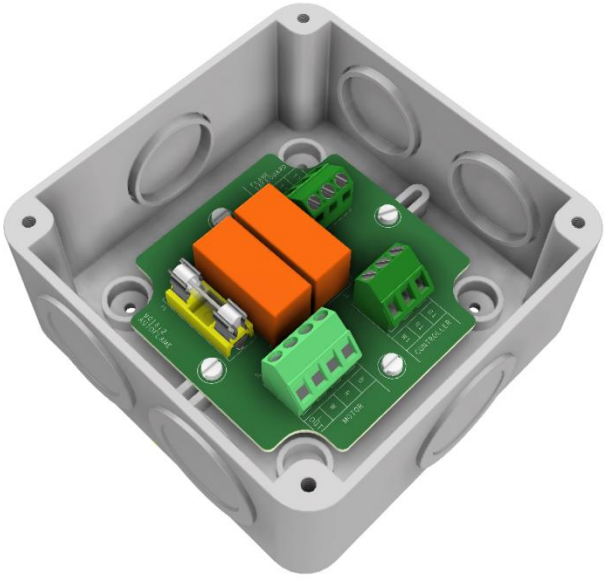
1.5. Relay Box

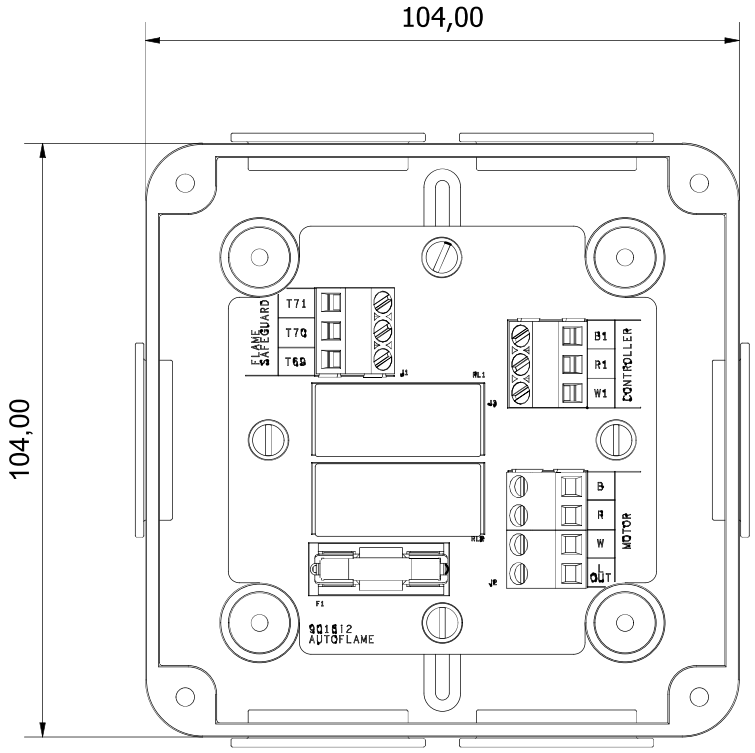
The relay box (SP80070, SP80070/110) provides all the connections shown in section 1.3.1 for wiring between a servo motor with high and low limit switches and the Flame Safeguard controller. It also provides for the switchover of control to a load sensor allowing the burner to modulate once the flame has been established. The Flame Safeguard unit will continue to monitor the status of the flame and initiate a safety shutdown in the event of any issues.

PLEASE NOTE – THAT THERE ARE TWO DIFFERENT VERSIONS OF THE FLAME SAFEGUARD RELAY ADAPTOR (230V & 110V). THE FOLLOWING PART NUMBER USED, FOR THESE VOLTAGES ARE SP80070 FOR 230V & SP80070/110 FOR 110V.

1.5.1. Relay Box Terminal Description

T69	Mains voltage output, power to Relay Box (SP80070, SP80070/110).
T70	Switched neutral – High/Low Initiate output.
T71	Switched neutral – Release to Modulate output.
B1	Connection to a controller (Common Voltage Input)
R1	Connection to a controller (Common Voltage Input)
W1	Connection to a controller (Common Voltage Input)
B	Connection to a motor (Common Voltage Input)
R	Connection to a motor (Common Voltage Input)
W	Connection to a motor (Common Voltage Input)
LOUT	Fused mains voltage output (F1 in Relay box) – for end switches to the motor (the common for T80 & T81)





For an On/Off burner, connections are defined in section 1.3.2 for an On-delay timer relay to allow the start-up sequence to be carried out.



CAUTION - Equipment Damage Hazard.

Improper connection or replacement of relays or the relay box will cause equipment failure.

1.6. Converting a Flame Safeguard unit to an Autoflame Flame Safeguard

The tables below list the connections on other flame safeguard devices and the corresponding Autoflame terminal to be used in an upgrade.

1.6.1. Converting Honeywell Flame Safeguard Units

1.6.1.1. EC7810A:

Honeywell Terminal # (EC7810A)	Abbreviation	Autoflame Terminal #	Type	Description
G	-	-[1]	Input	FLAME SENSOR GROUND
Earth G	-	66	Input	EARTH GROUND
N	-	67	Input	LINE VOLTAGE COMMON (NEUTRAL)
3	L1	68	Input	LINE VOLTAGE SUPPLY (L1)
4	AL	79[2]	Output	ALARM (NORMALLY OPEN)
6	RT	53	Input	LIMITS AND BURNER CONTROL
8	PV1	59	Output	PILOT VALVE 1 (INTERRUPTED)
9	MV	60,61[3]	Output	MAIN FUEL VALVE
10	IGN	63	Output	IGNITION
F (11)	-	-[1]	Input	FLAME SIGNAL
-	HI	B/B1[4]	Output	FIRING RATE HIGH FIRE
13	COM	R[4]	Output	FIRING RATE COMMON
14	MOD	R1[4]	Output	FIRING RATE MODULATE
-	LO	W/W1[4]	Output	FIRING RATE LOW FIRE
16	-	57	Output	CONTROL VOLTAGE
17	ES2	55	Input	PREIGNITION INTERLOCK INPUT
18	ES1	80	Input	LOW FIRE SWITCH INPUT
-	ES3	81	Input	HIGH FIRE SWITCH INPUT
20	LOS	53	Input	LOCKOUT INPUT
21	PV2	59	Output	PILOT VALVE 2 (INTERMITTENT)
22	SHTR	-[1]	Output	SHUTTER

1.6.1.2. EC7820A:

Honeywell Terminal # (EC7820A)	Abbreviation	Autoflame Terminal #	Type	Description
G	-	-[1]	Input	FLAME SENSOR GROUND
Earth G	-	66	Input	EARTH GROUND
N	-	67	Input	LINE VOLTAGE COMMON (NEUTRAL)
3	AL	79[2]	Output	ALARM (NORMALLY OPEN)
4	FAN	58	Output	BURNER/BLOWER MOTOR
6	RT	53	Input	LIMITS AND BURNER CONTROL
7	LD2	54	Input	AIRFLOW SWITCH INPUT
8	PV1	59	Output	PILOT VALVE 1 (INTERRUPTED)
9	MV	60, 61[3]	Output	MAIN FUEL VALVE
10	IGN	63	Output	IGNITION
F (11)	-	-[1]	Input	FLAME SIGNAL
-	HI	B/B1[4]	Output	FIRING RATE HIGH FIRE
13	COM	R[4]	Output	FIRING RATE COMMON
14	MOD	R1[4]	Output	FIRING RATE MODULATE
-	LO	W/W1[4]	Output	FIRING RATE LOW FIRE
16	-	57	Output	CONTROL VOLTAGE
17	ES2	55	Input	PREIGNITION INTERLOCK INPUT
18	ES1	80	Input	LOW FIRE SWITCH INPUT
-	ES3	81	Input	HIGH FIRE SWITH INPUT
20	LOS	53	Input	LOCKOUT INPUT
21	PV2	59	Output	PILOT VALVE 2 (INTERMITTENT)
22	SHTR	-[1]	Output	SHUTTER

1.6.1.3. EC7850A:

Honeywell Terminal # (EC7850A)	Abbreviation	Autoflame Terminal #	Type	Description
G	-	-[1]	Input	FLAME SENSOR GROUND
Earth G	-	66	Input	EARTH GROUND
N	-	67	Input	LINE VOLTAGE COMMON (NEUTRAL)
3	AL	79[2]	Output	ALARM (NORMALLY OPEN)
4	L1	68	Input	LINE VOLTAGE SUPPLY (L1)
5	FAN	58	Output	BURNER/BLOWER MOTOR
6	RT	53	Input	LIMITS AND BURNER CONTROL
7	LD2	54	Input	AIRFLOW SWITCH INPUT
8	PV1	59	Output	PILOT VALVE 1 (INTERRUPTED)
9	MV	60, 61[3]	Output	MAIN FUEL VALVE
10	IGN	63	Output	IGNITION
F (11)	-	-[1]	Input	FLAME SIGNAL
12	HI	B/B1[4]	Output	FIRING RATE HIGH FIRE
13	COM	R[4]	Output	FIRING RATE COMMON
14	MOD	R1[4]	Output	FIRING RATE MODULATE
15	LO	W/W1[4]	Output	FIRING RATE LOW FIRE
16	-	57	Output	CONTROL VOLTAGE
17	ES2	55	Input	PREIGNITION INTERLOCK INPUT
18	ES1	80	Input	LOW FIRE SWITCH INPUT
19	ES3	81	Input	HIGH FIRE SWITCH INPUT
20	LOS	53	Input	LOCKOUT INPUT
21	PV2	59	Output	PILOT VALVE 2 (INTERMITTENT)
22	SHTR	-[1]	Output	SHUTTER

Notes

1: Any flame sensing device will need to be replaced with an Autoflame sensor. For more details, please see the Autoflame Flame scanner guide.

2: Switched neutral output should be connected to neutral side of relay coil.

3: Terminal 60 = Main Fuel Valve 1, Terminal 61 = Main Fuel Valve 2. On Autoflame FSG.

4: The connections shown assume the use of an Autoflame relay box. Please consult the wiring diagram, if alternative relays are used.

1.6.2. Converting Fireye Flame Safeguard Units

1.6.2.1. Fireye E110:

Fireye Terminal # (E110)	Autoflame FSG Terminal #	Type	Description
L1	68	Input	HOT – 120 VAC
L2	67	Input	GROUND – NEUTRAL
-	66	Input	EARTH GROUND
S1	-[1]	Input	SCANNER (+)
S2	-[1]	Input	SCANNER (-)
3	55	Output	PRE-IGNITION INTERLOCKS (FUEL VALVE END SWITCH)
M	58	Output	BLOWER MOTOR
D	80	Input	LOW FIRE START INTERLOCK
P	54	Input	RUNNING INTERLOCKS (AIR FLOW SWITCH)
5[2]	63	Output	5 SEC EARLY SPARK TERMINATION
6[2]	59	Output	10 SEC INTERUPTED PILOT
7	60, 61[3]	Output	MAIN FUEL VALVE
8	81	Input	OPEN DAMPER PURGE INTERLOCK
A	79[4]	Output	ALARM
X	B/B1[5]	Output	MODULATION HIGH FIRE
10	R[5]	Output	MODULATION COMMON
11	R1[5]	Output	AUTO MODULATION
12	W/W1[5]	Output	MODULATION LOW FIRE
13	53	Input	OPERATING CONTROL INTERLOCK

1.6.2.2. Fireye Burnerlogix:

Fireye Terminal # (BURNERLOGIX)	Autoflame FSG Terminal #	Type	Description
L1	68	Input	HOT – 120 VAC
L2	67	Input	GROUND – NEUTRAL
E	66	Input	EARTH GROUND
S1	-[1]	Input	SCANNER (+)
S2	-[1]	Input	SCANNER (-)
3	53	Input	OPERATING CONTROL INTERLOCK
M	58	Output	BLOWER MOTOR
D	80	Input	LOW FIRE START INTERLOCK
P	54	Input	RUNNING INTERLOCKS (AIR FLOW SWITCH)
W[2]	63	Output	IGNITION TRANSFORMER
5[2]	63	Output	5 SEC EARLY SPARK TERMINATION
6[2]	59	Output	10 SEC INTERUPTED PILOT
7	60, 61[3]	Output	MAIN FUEL VALVE
8	81	Input	OPEN DAMPER PURGE INTERLOCK
A	79[4]	Output	ALARM
X	B/B1[5]	Output	MODULATION HIGH FIRE
10	R[5]	Output	MODULATION COMMON
11	R1[5]	Output	AUTO MODULATION
12	W/W1[5]	Output	MODULATION LOW FIRE
13	55	Output	PRE-IGNITION INTERLOCKS (FUEL VALVE END SWITCH)

Notes

1: Any flame sensing device will need to be replaced with an Autoflame sensor. For more details, please see the Autoflame Flame scanner guide.

2: The pilot configuration may vary for Terminals W, 5 & 6. Check which connects to the ignition transformer.

3: Terminal 60 = Main Fuel Valve 1, Terminal 61 = Main Fuel Valve 2. On Autoflame FSG.

4: Switched neutral output should be connected to neutral side of relay coil.

5: The connections shown assume the use of an Autoflame relay box. Please consult the wiring diagram, if alternative relays are used.

1.7. Standards

The Autoflame Flame Safeguard unit has been tested and approved to the following standards:

- UL 372, 5th Edition
- C22.2 No. 199-M89
- BS EN 298:2012
- BS EN 12067-2:2004
- BS EN 1643:2014
- BS EN 1854:2010
- ISO 23552-1:2007
- AGA AS 4625-2008
- AGA AS 4630-2005

2. OPTIONS AND PARAMETERS

2.1. Options

The options and parameters are all viewable while the Flame Safeguard controller is in run mode and the burner is firing. All Burner Control (BC) options/parameters can only be changed in Commissioning mode.

Through Commissioning Mode, all the options and parameters can be adjusted according to the application.

Power up the unit. Press Commission during the system start up.

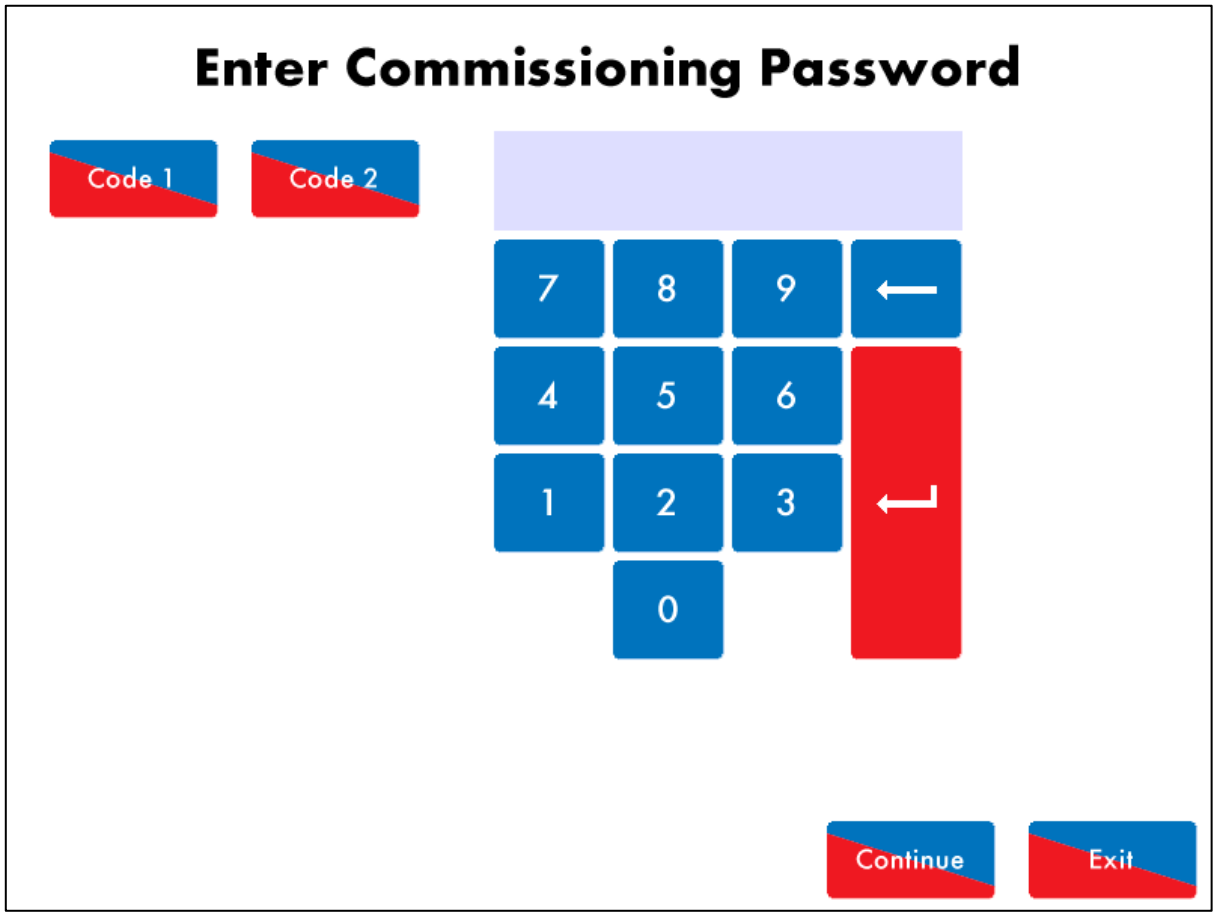


Figure 2.1.i Enter Password

"Enter Commissioning Password" is displayed. Use the keypad to enter the password, then press Continue. Press on Code 1 or Code 2 to change the value of an incorrect entry.

Note: The commissioning password should not be distributed to anyone who is not a factory trained and a certified engineer.

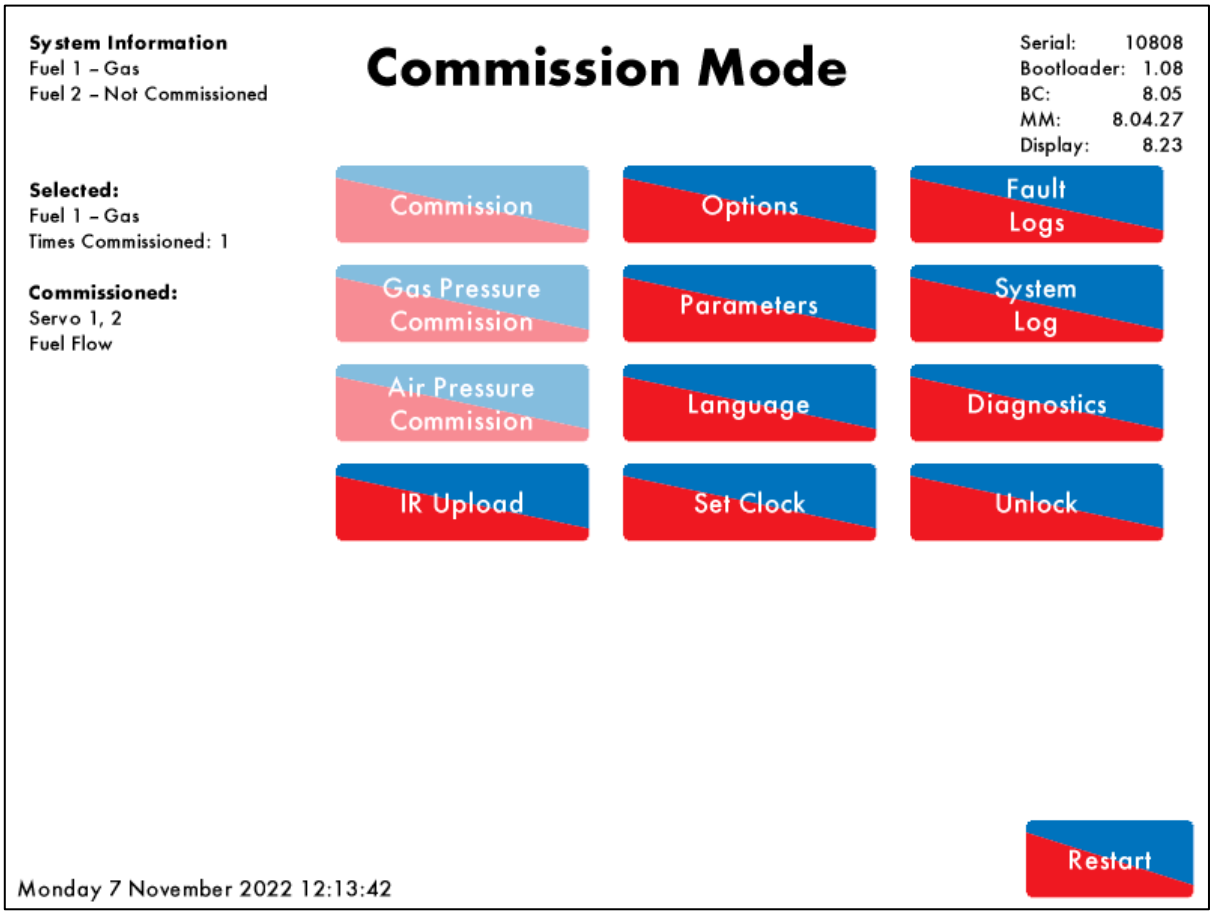


Figure 2.1.ii Commission Mode

The “Commission Mode” screen gives information on which fuel is selected, how many times the unit has been commissioned, serial number, bootloader, and BC, MM and Display software.

In the Commission Mode screen, all the options/ parameters can be adjusted, the commissioned IR data can be uploaded, the fault logs and system diagnostics can be viewed.

Note: Commissions may only be carried out with a fully unlocked Mini Mk8 MM. The number of commissions will remain at zero unless the unit has been fully unlocked at any time and will not increment while in flame safeguard mode.

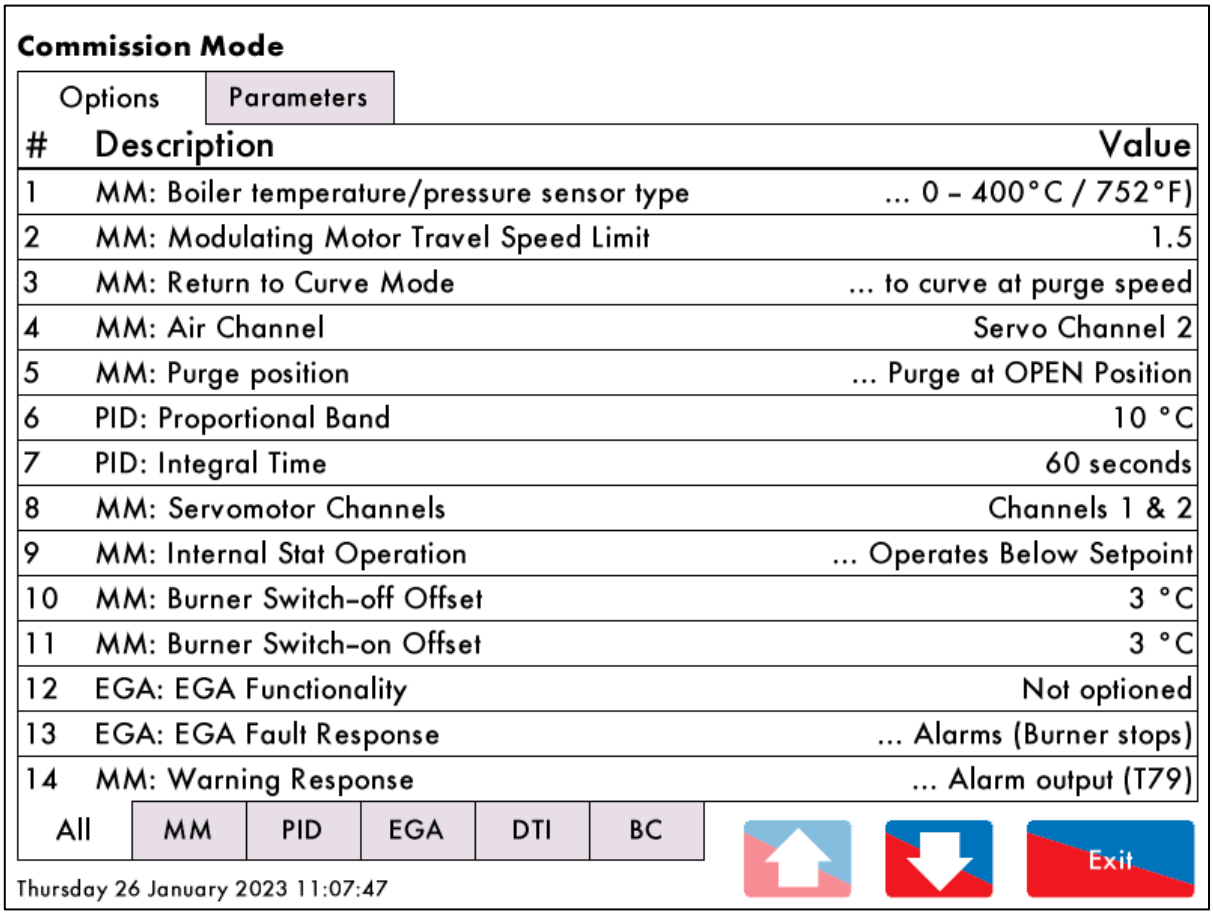


Figure 2.1.iii Options

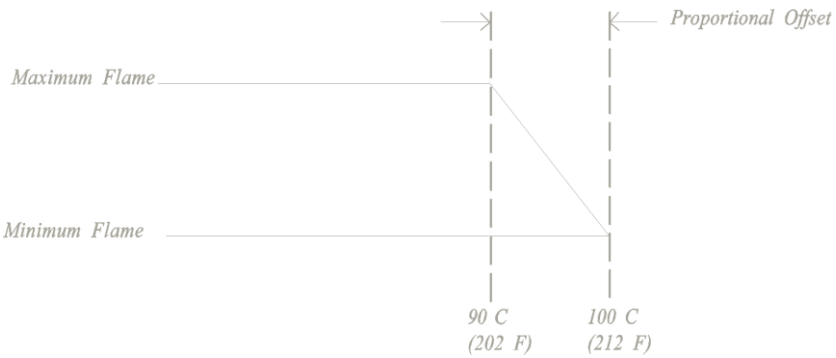
Any number of options and parameters can be changed at one time. By pressing MM, PID, EGA, DTI or BC at the bottom of the screen, the options/ parameters can be grouped together by feature.

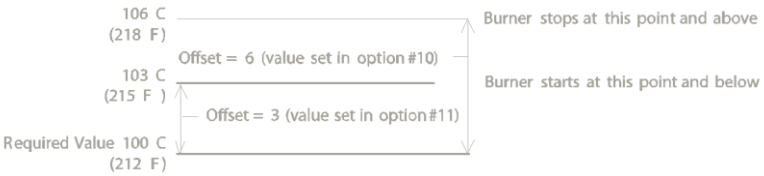
When the changes have been made to suit the application's needs, press Exit to go back to the Commission Mode screen.

A list of all the options is provided on the following pages. Options/Parameters 110 – 160 are the burner control settings and are safety critical; the same value must be entered for both the option and parameter value. If these BC options and parameters do not match, there will be an option/parameter conflict lockout.

To set all the options and parameters to the default values and erase the commissioning data, set option/ parameter 160 to 5. The MM will then automatically restart.

PLEASE NOTE: Although all Options/Parameters are settable, the majority only apply to a fully unlocked Mini MK8 (MMM8002) - details of how to unlock the Flame Safeguard controller to a Mini Mk8 is provided in section 8. Options and parameters which have no impact when set as a Flame Safeguard unit have been greyed out in the tables below.

Opt. #	Default	Range	Description
1	0		MM: Boiler Temperature/Pressure Sensor Type
			Terminals 37, 38, and 39 are used for the load detector.
		0	Temperature MM10006 0 – 400°C (0 – 752°F)
		1	Low pressure MM10010 0.0 – 3.4 Bar (0.0 – 50.0 PSI)
		2	Medium pressure MM10008 0 – 20 Bar (0 – 300 PSI)
		3	High pressure MM10009 0 – 34 Bar (0 – 500 PSI)
		4	Extra high pressure MM10017 0 – 100 Bar (0 – 1450 PSI)
		5	External temperature (voltage input, range set by parameters 52 to 56)
		6	External pressure (voltage input, range set by parameters 52 to 56)
2	15		MM: Modulating Motor Travel Speed Limit
			If the speed of the motor is too fast, then decrease the value, and vice versa. At other times other than modulation, the motors move at full speed or at the value set in option 75. Movement is limited by the slowest channel i.e. the slowest moving motor.
		6 – 100	0.6 – 10.0
3	0		MM: Return to Curve mode
			Controls how quickly the MM moves from off-curve positions (Golden Start, FGR) to the firing curve.
		0	Return to curve at purge speed.
		1	Return to curve at modulating speed.
4	0		MM: Air Channel
			For setting 0, the servomotors on channels 1 and 2 control the fuel and air, respectively. For setting 1, the fuel is controlled by Channel 1 servomotor and air by Channel 4 VSD. For setting 2, premixed fuel and air is controlled by Channel 1 servomotor. The number of servomotors used is set in Option 8.
		0	Servo Channel 2
		1	VSD Channel 4
		2	No Air Channel
5	1		MM: Purge Position
			This purge position applies to channels 1-3 as selected in options 67-69, however VSD channels will always purge at open position as default. This setting applies for post-purge if set; see option/ parameter 118 and 135.
		0	Selected Channels Purge at HIGH Position.
		1	Selected Channels Purge at OPEN Position.
6	10		PID: Proportional Band
			The proportional band is on offset below the required setpoint; when the actual temperature/ pressure reaches this band, the burner will begin to modulate as it approaches the required setpoint.
			
		5 – 2000	°C, °F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)

Opt. #	Default	Range	Description
7	60		PID: Integral Time
			Every 'n' seconds, 10% of the present offset from the required setpoint is added or subtracted when below or above the setpoint, respectively, to the present proportional value. The value of 'n' is the number of seconds set in this option; if set to 0, there will be no integral control.
		0 1 – 250	Disabled Seconds
8	0		MM: Servomotor Channels
			Channel 1 is always enabled for fuel; this option sets the channels in use. If option 8 is changed after commissioning, then the MM will need to be re-commissioned, unless this option is returned to its previous setting. For setting 2, please refer to section 6.4. Also see option 4 to set the air channel mode.
		0 1 2	Channels 1 & 2 Channels 1, 2 & 3 Channel 1 only
9	1		MM: Internal Stat Operation
			The internal stat turns the burner on and off according to the actual value relative to the required setpoint. For setting 0, the internal stat is kept closed all the time, and a working stat must be fitted to the boiler. For setting 1, the internal stat is opened at an offset above the required setpoint, and closed at an offset below the required setpoint. For setting 2, the internal stat is opened at an offset above the required setpoint, and closed at an offset above the required setpoint. The offset values are set in options 10 and 11.
		0 1 2	Internal Stat Always Closed Burner Operates Below Setpoint Burner Operates Above Setpoint
			E.g. Option 9 = 1, required setpoint = 100°C (212°F) 
			E.g. option 9 = 2, required setpoint = 100°C (212°F) 
10	3		MM: Burner Switch-Off Offset
		2 – 1000	°C, °F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65) *Note: This option is only relevant if option 9 is set to 1 or 2.*
11	3		MM: Burner Switch-On Offset
		0 – 1000	°C, °F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65) *Note: This option is only relevant if option 9 is set to 1 or 2.*

Opt. #	Default	Range	Description
12	0		EGA: EGA Functionality
			For settings 2 or 3, the E.G.A will trim on the channel 2 air damper, once trim data has been added. If option 12 is set to 0 or 1, then trim can be added at a later date by changing this to 2 or 3 in online changes, going through single point change, and added trim data for each fuel-air position.
		0	Not Optioned
		1	Monitoring Only
		2	Applies Trim
		3	Applies Trim, Combustion Limits Tested
13	0		EGA: EGA Error Response
			This sets the MM operation when an EGA fault occurs. EGA alarms will drive the common system alarm output (terminal 79), see option 14 for warning response.
		0	EGA faults generate Alarms (Burner stops)
		1	EGA faults generate Warnings (Burner runs)
14	0		MM: Warning Response
			This sets the MM operation on terminal 79 for when an EGA fault occurs.
		0	Warnings do not drive Common System Alarm output (T79)
		1	Warnings drive Common System Alarm output (T79)
15	3		MM: User Control
			This option sets whether the user can turn the burner on and off, or change the required setpoint via the flame screen on the MM.
		0	Burner on/off and setpoint control disabled
		1	Burner on/off disabled and setpoint control enabled
		2	Burner on/off enabled and setpoint control disabled
		3	Burner on/off and setpoint control enabled
16	0		DTI: Sequencing and DTI Enable
			A lead boiler can be selected by pressing Lead Boiler in the IBS screen or via the DTI if optioned. Only 1 MM may be selected as lead boiler at a time, or the sequencing will not operate. The Lead Boiler button on the MM overrides the DTI Lead Boiler Select.
		0	Sequencing Disabled
		1	Sequencing Enabled
		2	DTI Enabled
		3	Sequencing and DTI
18	1		EGA: Carry Forward of Trim
			When the system modulates, the correction that may already exist on the air damper position can be carried forward (only relevant if an EGA is operational on the system). Trim will be reset if the rate of change of the fuel valve angle is greater than that set in parameter 14.
		0	Disabled
		1	Enabled
19	0		EGA: O_2 Upper Limit Offset
			If the current O_2 value is above this offset limit from the commissioned value, an alarm/ warning will occur (see option 13), for option 12 set to 3.
		0	Disabled
		1 – 100	0.1% - 10.0% O_2
20	0		EGA: CO_2 Upper Limit Offset
			If the current CO_2 value is above this offset limit from the commissioned value, an alarm/ warning will occur (see option 13), for option 12 set to 3.
		0	Disabled
		1 – 100	0.1% - 10.0% CO_2

Opt. #	Default	Range	Description
21	0		EGA: CO Upper Limit Offset
			If the current CO value is above this offset limit from the commissioned value, an alarm/ warning will occur (see option 13), for option 12 set to 3.
		0	Disabled
		1 – 200	1 – 200 ppm CO
22	0		EGA: O_2 Lower Limit Offset
			If the current O_2 value is below this offset limit from the commissioned value, an alarm/ warning will occur (see option 13), for option 12 set to 3.
		0	Disabled
		1 – 100	0.1% - 10.0% O_2
23	0		EGA: CO_2 Lower Limit Offset
			If the current CO_2 value is below this offset limit from the commissioned value, an alarm/ warning will occur (see option 13), for option 12 set to 3.
		0	Disabled
		0 – 100	0.1% - 10.0% CO_2
25	0		EGA: O_2 Absolute Limit
			If the current O_2 value is below this absolute limit, an alarm/ warning (see option13) will occur, for option 12 set to 3.
		0	Disabled
		1 – 200	0.1% - 20.0% O_2
26	0		EGA: CO_2 Absolute Limit
			If the current CO_2 value is above this absolute limit, an alarm/ warning (see option13) will occur, for option 12 set to 3.
		0	Disabled
		1 – 200	0.1% - 20.0% CO_2
27	0		EGA: CO Absolute Limit
			If the current CO value is above this absolute limit, an alarm/ warning (see option13) will occur, for option 12 set to 3.
		0	Disabled
		1 – 200	1 – 200 ppm CO
28	20		EGA: Trim Threshold
			The trim threshold is an offset from the required setpoint; if the actual value is below this offset, then the EGA will not trim. This option should be set to 0 if trim is to be effective at all times during firing, and/or if external modulation is optioned. No single point changes can be made if the actual value is below this trim threshold.
		0 – 50	^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
29	0		MM: Golden Start
			Golden start allows an optimum ignition position to be set in the fuel-air curve, which is not necessarily low flame or part of the standard modulating index. Parameter 15 sets how long golden start position is maintained for. This option also sets from which point to start the Golden Start timer.
		0	Disabled
		1	Enabled (time counted from point of main flame)
		2	Enabled (time counted from ignition)

Opt. #	Default	Range	Description
30	50		DTI: Minimum Remote Setpoint (DTI/ Modbus)
		5 – 9990	If a required value command is received from the DTI or Modbus that is below this minimum remote setpoint value, then it will be ignored by the MM. The MM will continue to fire to meet the previous required setpoint. ^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
31	100		DTI: Maximum Remote Setpoint (DTI/ Modbus)
		5 – 9990	If a required value command is received from the DTI or Modbus that is above this maximum remote setpoint value, then it will be ignored by the MM. The MM will continue to fire to meet the previous required setpoint. ^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
32	20		EGA: Trim Delay
		0 – 250	After ignition, the EGA does not sample for the time delay set in this option (if EGA is set to 2 or 3). This allows for the combustion to stabilise before sampling commences. The delay timer starts at the ignition point. Seconds
33	1		DTI: MM Identification
		1 – 10	Each MM within a sequencing/ DTI/ Modbus loop must be set with an individual ID number. For communications between the MMs, there cannot be more than 1 MM with the same ID number. ID number
35	10		DTI: Sequence Scan Time
		1 – 100	This is the time period between sequencing requests from the lead and the lag MMs. On the sequence scan time, the lead MM will demand lag-burners to be brought online or offline, depending on load requirements. See parameters 86 and 87 for change down and up thresholds. Accurate fuel flow metering must be entered for sequencing to operate. The MMs must be connected using data cable (Belden 9501), screened at one end. Minutes
36	0		EGA: (Mk7 Only) Sensor Selection
		0 1 2 3	This option selects if the Mk7 EGA is fitted with additional cells. No Optional Sensor NO_2 Optioned SO_2 Optioned NO_2 and SO_2 Optioned
37	0		PID: Derivative Time
		0 1 – 200	The time taken to add/ remove an additional 10% to the firing rate based on the actual value and the required value. Disabled Seconds
38	2		PID: Derivative Deadband
		0 1 - 15	This deadband is the margin above and below the required setpoint in which no derivative control occurs. Disabled ^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)

Opt. #	Default	Range	Description
40	0		DTI: Warming Facility for Low Pressure Steam
			For sequencing applications where non-return valves are not installed, it is not possible to use a setpoint to keep the boilers in a standby condition. A thermostat (aquastat) can be installed into the boiler shell. Set option/ parameter 156 to 0 to enable terminal 82) for warming stat. When terminal 82 sees a 230/120V input, warming is stopped. The boiler will remain in a warming state based on the settings in options 53 and 54.
		0	Steam Sequencing With Non-Return Valves
		1	Steam Sequencing Without Non-Return Valves
41	0		DTI: Warming Mode
			For setting 0, the first lag is kept in a standby state with the second lag in warming, and the remaining lag boilers off. For setting 1, the first lag boiler is in standby, and the remaining lag boilers are in warming.
		0	One MM in Warming State
		1	All unused MMs in Warming State
42	20		DTI: Standby Setpoint or Phantom Setpoint Offset
			For sequencing applications where non-return valves are installed, the first lag boiler uses a standby setpoint to keep the boiler in a standby condition. The standby setpoint is set as an absolute value in this option. When the standby setpoint is in effect, the burner is held at low flame hold.
		5 – 9990	^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
45	0		MM: External Modulation
			When enabled, the internal PID control is disabled and the firing rate is set by an external controller applied to terminals 37 and 38. This input control signal can be 0-10V or 2-10V set through parameter 69, and represents zero/ low to high fire by setting parameter 68. A manual reset high limit stat must be fitted.
		0	Disabled
		1	Enabled
47	0		MM: Cold Start Routine
			On burner start-up, if the actual value is at 30% or below of the required setpoint, then the burner will be held at low fire for the number of minutes set in this option. It will then go to mid-fire. If the actual value is below 60% of the required setpoint, then the burner will be held at mid-fire for the set minutes. Once this cold start time has elapsed, or the value goes above 60% of the required setpoint, the burner will go to high fire as per the internal PID. It is not recommended to use cold start routine with external modulation or sequencing.
		0	Disabled
		1 – 2000	Minutes
48	0		MM: Flue Gas Recirculation – Timer
			This is the time that the MM channels (servomotors/ VSDs) are held at during the FGR start positions, after which modulation takes place. The burner will start at the FGR start position (unless golden start is optioned and burner starts up at the golden start position. FGR allows approximately 15% of the boiler flue gases via an auxiliary channel (e.g. 3) to be fed back to the burner and mixed with combustion air, to reduce NOx.
		0	Disabled
		1 – 3600	Seconds

Opt. #	Default	Range	Description
49	0		MM: Flue Gas Recirculation – Offset
			This is an offset from the required setpoint. The MM channels (servomotors/ VSDs) are held at the FGR start positions until the actual value reaches this offset value below the required setpoint.
		0	Disabled
		1 – 1000	^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
50	0		MM: Flue Gas Recirculation – Temperature Threshold
			The MM channels (servomotors/ VSDs) are held at the FGR start positions until the flue gas temperature has reached 120^{O}C (248^{O}F). This option can only be used if an EGA is optioned and operational.
		0	FGR Temperature Threshold Disabled
		1	FGR Temperature Threshold Enabled
53	0		DTI: Sequencing Warming Burner Off Time
			When the MM is in warming mode, it will warm to the standby setpoint according to the on and off times set in options 53 and 54.
		0	Disabled
		1 – 200	Minutes
54	5		DTI: Sequencing Warming Burner On Time
			When the MM is in warming mode, it will warm to the standby setpoint according to the on and off times set in options 53 and 54.
		1 – 30	Minutes
56	0		MM: Alarm Output Operation (Terminal #79)
			This is a switched neutral output to select how the alarm function operates.
		0	Relay Normally Off, On During Alarm
		1	Relay Normally On, Off during alarm
57	0		MM: Fuel Flow Metering
			Fuel flow metering determines the firing rate. If no fuel flow meter is available, a 'dummy curve' should be entered using the burner turndown ratio from the burner rating to determine the low fire point, and the burner rating for the high fire point. If enabled, fuel flow metering is initiated once the burner has been commissioned and is firing. The MM will drive up to the high fire point first, and then go down the curve.
		0	Disabled
		1	Enabled
58	15		MM: Fuel Flow Metering Ignition Delay
			Fuel flow metering begins after the time delay set in this option has elapsed.
		0	Disabled
		1 – 240	Seconds
61	3725		MM: Fuel 1 Calorific Value
			This is the gross calorific value / higher heating value (HHV) including the latent heat of vaporisation of water. To set either metric or imperial units, see option 65. If the units are changed, then this option must be changed accordingly.
		100 – 65000	100 = 1.00MJ/m^3 or 100 Btu/ft^3
62	2068		MM: Fuel 2 Calorific Value
			This is the gross calorific value / higher heating value (HHV) including the latent heat of vaporisation of water. To set either metric or imperial units, see option 65. If the units are changed, then this option must be changed accordingly.
		100 – 65000	100 – 1.00 MJ/kg or 100 BTU/lb

Opt. #	Default	Range	Description
65	0		MM: Display Units
		0	Metric Units
		1	Imperial Units
66	0		MM: Firing Rate Limit
			This is the maximum firing rate that can be obtained by the system, imposed in auto and hand modes. Firing rate limit is should not be used with DTI load index control or sequencing. The firing rate limit also applies to external modulation.
		0	Disabled
		1 – 100	%
67	1		MM: Channel 1 Purge Position
		0	Channel 1 to purge position
		1	Channel 1 to remain closed for purge
68	0		MM: Channel 2 Purge Position
		0	Channel 2 to purge position
		1	Channel 2 to remain closed for purge
69	0		MM: Channel 3 Purge Position
		0	Channel 3 to purge position
		1	Channel 3 to remain closed for purge
75	100		MM: Purge Motor Travel Speed
		10 – 100	If the speed of the motor is too fast, then decrease the value. 0.1 – 10.0
80	0		MM: Outside Temperature Compensation
		0	Outside temperature compensation disabled
		1	Outside temperature compensation enabled
81	90		MM: Setpoint at Minimum Outside Temperature
		20 – 999	This setpoint is limited by the load detector set in option 1. ^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
82	30		MM: Minimum Outside Temperature
		0 – 145	Value 30 = -10^{O}C or -10^{O}F (see option 65)
83	80		MM: Setpoint at Maximum Outside Temperature
		20 – 999	This setpoint is limited by the load detector set in option 1. ^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)
84	80		MM: Maximum Outside Temperature
		0 – 145	Value 80 = 40^{O}C or 40^{O}F (see option 65)
85	0		MM: Night Setback Offset
			This offset value is subtracted from the required setpoint. An input is required on terminal 80, see option/parameter 154.
		0	Disabled
		1 – 100	^{O}C, ^{O}F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)

Opt. #	Default	Range	Description
86	0		MM: Channel 1 Servo Control Method
		0	Autoflame servomotor, 0.1 degree control
		1	Autoflame servomotor, 0.5 degree control
		2	Industrial servomotor, 0.1 degree control
		3	Industrial servomotor, 0.5 degree control
		4	Autoflame servomotor, 0.5 degree control, relaxed tolerance
		5	Industrial servomotor, 0.5 degree control, relaxed tolerance
87	0		MM: Channel 2 Servo Control Method
		0	Autoflame servomotor, 0.1 degree control
		1	Autoflame servomotor, 0.5 degree control
		2	Industrial servomotor, 0.1 degree control
		3	Industrial servomotor, 0.5 degree control
		4	Autoflame servomotor, 0.5 degree control, relaxed tolerance
		5	Industrial servomotor, 0.5 degree control, relaxed tolerance
88	0		MM: Channel 3 Servo Control Method
		0	Autoflame servomotor, 0.1 degree control
		1	Autoflame servomotor, 0.5 degree control
		2	Industrial servomotor, 0.1 degree control
		3	Industrial servomotor, 0.5 degree control
		4	Autoflame servomotor, 0.5 degree control, relaxed tolerance
		5	Industrial servomotor, 0.5 degree control, relaxed tolerance
89	0		MM: VSD Output When Commissioning Closed Position
			For setting 0, the VSD output is 0mA, 4mA or 0V. For setting 1, the VSD output is 20mA or 10V.
		0	When commissioning closed, VSD output is high
		1	When commissioning closed, VSD output is low
90	-		MM: VSD Operation Channel 4
		0	Disabled
		1	Enabled
91	0		MM: Output from MM to VSD Channel 4
		0	Output range 4 to 20mA
		1	Output range 0 to 20mA
		2	Output range 0 to 10V
92	0		MM: Output Units Displayed, VSD Channel 4
		0	Selected output signal
		1	Hertz
93	25		MM: Output Low Speed from MM to VSD Channel 4
		1 – 200	Hertz
94	50		MM: Output High Speed from MM to VSD Channel 4
		1 – 200	Hertz
95	0		MM: Input Signal to MM from VSD Channel 4
		0	Input range 4 to 20mA
		1	Input range 0 to 20mA
		2	Input range 0 to 10V
96	0		MM: Input Units Displayed, VSD Channel 4
		0	Selected input signal
		1	Hertz

Opt. #	Default	Range	Description
97	0		MM: Input Low Speed to MM from VSD Channel 4
		0 – 200	Hertz
98	50		MM: Input High Speed to MM from VSD Channel 4
		0 – 200	Hertz
99	5		MM: VSD Channel 4 Feedback Fault Tolerance
			This is used to check that the feedback varies from high to low fire. For example, if high fire feedback is 20mA and this option is set to 4%, the tolerance that is allowed while firing is ±0.8mA. For commissioning, the low fire feedback must be less than this upper and lower tolerance (1.6mA), so the feedback at low fire must be commissioned at 18.4mA or lower.
		5 – 40	0.5% – 4.0%
100	0		MM: Sequencing/DTI or Modbus Operation
		0	MM/DTI Sequencing
		1	Modbus
101	0		MM: Modbus Baud Rate
		0	9600 baud
		1	19200 baud
102	0		MM: Modbus Parity Setting
		0	No parity
		1	Odd parity
		2	Even parity
103	1		MM: Modbus Stop Bits Settings
		1	1 stop bit
		2	2 stop bits
104	1		MM: Modbus Device ID
		1 – 247	ID range
105	0		MM: Modbus Data Format
		0	Binary format
		1	ACSII format
106	0		MM: MM Status Modbus Address 30102 Function
			Setting 0 means Modbus shows 1 for Firing or 0 for not Firing. Setting 1 means Modbus shows a value describing the current MM state. For more details for setting 1, see section 5.3.1.
		0	Modbus address 30102 shows Firing Status
		1	Modbus address 30102 shows MM State
109	0		MM: Flame Safeguard Mode
			When enabled by setting 1, the controller becomes a Flame Safeguard unit. This operates without any control of servo or VSD channels and with a reduced set of screens. The existing functions for Start Position Interlock (T80) (Option/Parameter 154) and Purge Position Interlock (T81) (Option/Parameter 155) must be used, when utilising the Flame Safeguard Mode.
		0	Disabled
		1	Enabled

For safety reasons, options 110 – 160 must also be entered in as Parameters. It is the responsibility of the commissioning engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices. If options 110 – 160 are not identical with the parameters 110 – 160, then the MM will go straight to Commissioning Mode and an option/ parameter conflict message will appear.

Opt. #	Default	Range	Description
110	1		BC: UV Flame Scanner Type
			See option/ parameter 120 for the UV threshold and 122 for the flame sensor operation. For setting 2, the self-check UV scanner opens and closes a shutter to check that the UV scanner is not given a false flame signal.
		1	Standard scanner
		2	Self-check scanner
111	0		BC: Pilot Type
			For interrupted pilot, when lighting off, the pilot valve will close at the point the main flame proving phase begins. For intermittent pilot, when lighting off, the pilot valve will remain open during firing.
		0	Interrupted pilot
		1	Intermittent pilot
		2	No pilot
			Note: Setting 2 (no pilot) cannot be used with single valve pilot (option/ parameter 130) or flame scanner switchover (option/parameter 122).
112	40		BC: Pre-Purge Time
			Purging the burner before burner start-up will air will force any combustion remnants out of the stack. Purge time should be set according to the boiler manufacturer's requirements and local codes and regulations.
		5 – 240	Seconds
113	3		BC: Pre-Ignition Time
			This is the time period when the ignition transformer is on before the pilot valves opens.
		3 – 5	Seconds
114	3		BC: First Safety Time
			This is the time period when the pilot valve is open, before the flame is checked. The time range of this option depends on whether its gas or oil.
		3 – 10	Seconds
115	3		BC: Pilot Prove Time - Pilot Trial for Ignition (PTFI)
			This is the time period for when the flame is checked after the first safety time, to prove the pilot flame.
		3 – 5	Seconds
116	3		BC: Gas Second Safety Time – Main Trial for Ignition (MTFI)
			This is the time period when the main valves are open and the pilot valve is maintained open, before the flame is checked, for firing on gas. See option/ parameters 150 and 151. This does not apply for intermittent pilot, see option/ parameter 111.
		3 – 15	Seconds
117	5		BC: Main Flame Proving Time
			This is the time period after the second safety phase for interrupted pilot or after the pilot proving phase for intermittent pilot, where the flame is checked, before going to normal firing/modulation.
		5 – 20	Seconds

Opt. #	Default	Range	Description
118	0		BC: Post-Purge Time
			If set, a post-purge will occur after a normal burner shutdown. The timer begins once all channels have gone to their post-purge positions. The flame is not checked during post-purge. See option/ parameter 135 for NFPA post-purge.
		0 – 100 0 – 100	Seconds (for option/ parameter 135 set to 0 or 2) Minutes (for option/ parameter 135 set to 1 or 3)
119	10		BC: Control Box Recycle Time
			This is the time delay between the burner shutting down, and going through post-purge if optioned, and the burner starting up again.
		3 – 120	Seconds
120	10		BC: UV Threshold
			This is the minimum flame signal strength, if the flame strength is lower than this threshold, a lockout will occur. The UV counts will stabilise at 5 times this value when increasing, and 3 times this value when decreasing.
		5 – 50	UV counts
121	5		BC: Delay from Start of Pre-Purge Until Air Switch Checked
			This time delay where the air switch is not checked is included within the total pre-purge time set in option/ parameter 112.
		5 – 10	Seconds
122	0		BC: Flame Sensor Selection
		0 2 4 5 6 7 8 9	UV Ionisation IR IR and UV IR and Ionisation Ionisation to UV switchover IR or UV IR or Ionisation
			Note: Ionisation to UV switchover cannot be used with no pilot (option/ parameter 111) or single valve pilot (option/parameter 130).
123	3		BC: Oil Second Safety Time – Main Trial for Ignition (MTFI)
			This is the time period when the main valves are open and the pilot valve is maintained open, before the flame is checked, for firing on oil. See option/ parameters 150 and 151. This does not apply for intermittent pilot, see option/ parameter 111.
		3 – 15	Seconds
124	0		BC: Timeout on Reaching Purge
			If the MM is stuck in Run to Purge or Run to Post Purge because the servomotors and VSDs are moving to the purge position, then a lockout will occur after the timeout set in this option has elapsed. This does not apply to any requirements on purge timing such as any additional proving inputs.
		0 1 – 3600	Disabled Seconds

Opt. #	Default	Range	Description
125	0		BC: Fuel Pressure Sensor Mode – Fuel 1
			For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor or valve proving by a low pressure switch. For setting 2, pressure limits are checked by the gas sensor. See option/parameters 136 and 137 for gas pressure limits. For setting 3, the system will wait for a mains voltage input on terminal 55 to confirm that the VPS test is completed. If a voltage is not detected on terminal 55 within 10 minutes, a lockout will occur. Please see MM Application Possibilities manual for option/ parameters and wiring guides on VPS and pressure limits setups.
		0	Not Checked
		1	Valve Proving, Pressure Limits
		2	Pressure Limits Only
		3	External VPS
126	0		BC: Fuel Pressure Sensor Mode – Fuel 2
			For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor or valve proving by a low pressure switch. For setting 2, pressure limits are checked by the gas sensor. See option/parameters 136 and 137 for gas pressure limits. For setting 3, the system will wait for a mains voltage input on terminal 55 to confirm that the VPS test is completed. If a voltage is not detected on terminal 55 within 10 minutes, a lockout will occur. Please see Autoflame Sensors Guide for option/ parameters and wiring guidance on VPS and pressure limits setups.
		0	Not Checked
		1	Valve Proving, Pressure Limits
		2	Pressure Limits Only
		3	External VPS
128	0		BC: VPS Sensor Type
			For setting 0, a low pressure switch is used for VPS and is wired to terminal 82 (set option/ parameter 156). For setting 1, the Autoflame gas pressure sensor is used for VPS. Please refer to the Autoflame Sensor Guide for setup information.
		0	Mains input
		1	Pressure sensor
129	0		BC: VPS Operation
		0	VPS operates before start-up
		1	VPS operates after shutdown
		2	VPS operates before and after
130	2		BC: Gas Valve Configuration
		0	No vent valve
		1	Vent normally closed
		2	Vent normally open
		3	No vent valve. Single valve pilot
		4	Vent normally closed. Single valve pilot
		5	Vent normally open. Single valve pilot
			Note: Single valve pilot cannot be used with no pilot (option/parameter 111) or flame scanner switchover (option/parameter 122).
131	0		BC: Gas Pressure Units
		0	"WG
		1	mbar
		2	PSI

Opt. #	Default	Range	Description
132	20		BC: Gas Valve Proving Time
		10 – 300	This is the time period for when both gas valves are closed to detect a change in air pressure for the 'VPS air proving' phase, or change in gas pressure for 'VPS gas proving' phase. Seconds
133	25		BC: Maximum Pressure Change Allowed During VPS
		0 – 13400	If MM detects a pressure change greater than this value, a lockout will occur. If both options 136 and 138 are set to 0, then a lockout will occur if the measured static line pressure during the VPS void to gas phase is below this absolute value. See option/parameter 131 for gas pressure display units. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003" WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)
134	3		BC: VPS Valve Opening Time
		3 – 20	This is the time period for when the phases when a gas valve is opened – 'VPS Venting' for the void to vent to atmosphere and 'VPS Void to Gas' for the void to fill with gas. Seconds
135	0		BC: Purge Time Units / NFPA Post-Purge
		0 1 2 3	See option/ parameter 118 for the purge timing. For setting 2, option/parameter 118 must be set to 15 seconds or higher. During the NFPA post-purge, all the servomotors will remain in the position they were in before normal shutdown or lockout. The NFPA post-purge will occur under any normal shutdown or lockout at any point in firing. Purge time in seconds Purge time in minutes NFPA post purge in seconds NFPA post purge in minutes
136	25		BC: Gas Running Pressure Lower Limit Offset
		0 – 13400	This is an offset lower limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. If both options 136 and 138 are set to 0, then a lockout will occur if the measured static line pressure during the VPS void to gas phase is below the absolute value in option 133. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003" WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)
137	25		BC: Gas Running Pressure Upper Limit Offset
		0 – 13400	This is an offset upper limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003" WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)

Opt. #	Default	Range	Description
138	25		BC: Gas Static Line Pressure Lower Limit Offset
			For setting 0, if the measured static line pressure during the VPS void to gas phase is below the gas pressure offset lower limit set in option/parameter 136, a lockout will occur. If both options 136 and 138 are set to 0, then a lockout will occur if the measured static line pressure during the VPS void to gas phase is below the absolute value in option 133. For settings other than 0, this measured static line pressure is checked against the value set in this option.
		0	Option/parameter 136 offset lower limit used
		1 – 50000	0.1 mbar – 5000 mbar (value 25 = 2.5 mbar) 0.040” WG – 2006.630” WG (value 25 = 1.003” WG) 0.001 PSI – 72.519 PSI (value 25 = 0.036 PSI)
141	0		BC: Air Proving Pressure Threshold for Purge
			This is the minimum air pressure that must be detected by the MM during purge, when using an Autoflame air pressure sensor. If this is set to 0, then MM will look for the minimum air pressure set in option/ parameter 149. See option/ parameter 146 for air pressure display units. If post-purge is enabled in option/parameter 118 then the purge air threshold cannot be set higher than the running threshold in option 149. If both the proving pressure thresholds for purge and normal running are both enabled, during the ‘driving to ignition’ and ‘driving to post purge’ phases the lower of these two thresholds are used.
		0 – 1200	0 mbar – 30.0 mbar (0” WG – 12.040” WG)
142	60		BC: UV Shutter Test Interval
			This is the time interval between shutter tests on the self-check UV scanner. See options/ parameter 110 and 122.
		4 – 240	Seconds
143	0		BC: No Pre-Purge
			For setting 1, there will only be no pre-purge if the burner has recycled after crossing the internal stat, and has gone through VPS checks successfully. If the burner has a lockout, or is restarting after a lockout has been cleared, the MM will force a pre-purge. Fuel must be set to gas.
		0	Pre-purge operates
		1	No pre-purge
144	4		BC: Maximum Allowed UV Self-Check Errors
			The MM will test the flame detection of self-check UV scanner at a time interval, set in option/ parameter 142, and will generate a lockout if it has more errors than set in this option. See options/ parameters 110 and 122.
		1 – 12	Errors
146	0		BC: Air Pressure Sensor Units
		0	“WG
		1	mbar
147	0		BC: Air Pressure Error Window
			This air pressure error window is only active during modulation; the burner will lockout if the air pressure is outside of this window.
		0 – 300	0 mbar – 30.0 mbar (0” WG – 12.040” WG)

Opt. #	Default	Range	Description
148	0		BC: Air Pressure Sensor Type
			For setting 0, and external air pressure switch must be wired to terminal 54. If a reset of voltage is not detected within 2 minutes on terminal 54 during the 'Wait for Air Switch' phase before running to purge, a lockout will occur. For setting 1, the air pressure sensor will look for zero air pressure in the 'Zero Air Sensor' phase before running to purge. Setting 2 includes the checks made for settings 0 and 1, and must both read low before the 'Wait for Air Switch' can be passed.
		0	Air switch on T54
		1	Autoflame air pressure sensor
		2	Autoflame air pressure sensor and air switch on T54
149	10		BC: Air Proving Pressure Threshold
			This is the minimum air pressure that must be detected by the MM during normal firing and during purge when option/ parameter 141 is set to 0, when using an Autoflame air pressure sensor. See option/ parameter 146 for air pressure display units. If post-purge is enabled in option/parameter 118 then the purge air threshold cannot be set higher than the running threshold in option 149. If both the proving pressure thresholds for purge and normal running are both enabled, during the 'driving to ignition' and 'driving to post purge' phases the lower of these two thresholds are used.
		7 – 1200	0.7 mbar – 120.0 mbar (0.281" WG – 48.176 "WG) Value 10 = 0.401 "WG (1.0 mbar)
150	0		BC: Fuel 1 Type
		0	Gas
		1	Oil
151	1		BC: Fuel 2 Type
		0	Gas
		1	Oil
154	0		BC: Terminal T80 Function
			Setting 1 allows an additional safety check on the valves and damper to ensure that they are in the correct position for start/low fire. See Valves and Servomotors manual for information on setup and wiring. For setting 2, when an input is detected on terminal 80 the setpoint is reduced according to the night setback offset set in option 85. For setting 3, when an input is detected on terminal 80 the MM will fire to meet the reduced setpoint set via the MM status screen. For setting 4, terminal 80 is used as a delay to purge input to indicate that the system is ready to move to the purge phase, otherwise the system will be stuck in 'delay to purge' indefinitely, unless a timer is enabled in option/parameter 157.
		0	Not used
		1	Start position interlock
		2	Night setback input
		3	Reduced setpoint input
		4	Delay to purge input
			Option/Parameter 154 must be set to 1: Start Position Interlock when used in flame safeguard mode.

Opt. #	Default	Range	Description
155	0		BC: Terminal T81 Function
			For setting 1, terminal 81 acts as an input for a mechanical end stop. It must be made for the whole of the timed purge and post purge phases otherwise a lockout is generated. This input must also not be made while not at purge. For setting 2, an input on terminal 81 will put the MM into low flame hold. For setting 3, terminal 81 acts as a purge pressure switch input. It must be made continuously for the full purge time before proceeding from purge. If it drops out during purge the purge timer restarts. It must also be not made before the blower motor starts to confirm the input is working correctly. If this input comes on during the relay tests a lockout is generated. Option 158 adds an optional timer to this phase.
		0	Not used
		1	Purge interlock
		2	Low flame hold input
		3	Purge pressure proving
			Option/Parameter 155 must be set to 1: Purge Interlock when used in flame safeguard mode.
156	0		BC: Terminal T82 Function
			For setting 0, input on terminal 82 will stop the MM warming in sequencing where there are no non-return valves, see option 40. When no input is detected, the MM will go into warming. For setting 1, a low pressure switch is wired to terminal 82 for valve proving; see options 125, 126 and 128. Please refer to section 6.9.
		0	Warming stat
		1	Valve proving mains input
157	0		BC: Delay to Purge (T80) Timeout
			If option/parameter 154 is set to 4, an input on terminal 80 is required to indicate the system is ready to move toward the purge phase. If the MM does not see this input for 1 second within this time set, then a lockout will occur. Setting 0 will disable this timeout, so the MM would sit indefinitely in delay to purge.
		0	Disabled
		1 – 3600	Seconds
158	0		BC: Purge Pressure Proving (T81) Timeout
			If option/parameter 155 is set to 3, then the system will lockout if this purge interlock timer has elapsed. Setting 0 will disable this timeout, so the MM will be in the purge phase indefinitely.
		0	Disabled
		1 – 15000	Seconds
160	0		BC: Clear Commissioning Data
		5	Clear all commissioning data, options and parameters
		10	Reset all options to default values
		15	Reset all parameters to default values
		20	Reset all safety options and parameters to default values

2.2. Parameters

Please refer to section 2.1 Options for instructions on accessing and changing parameters.

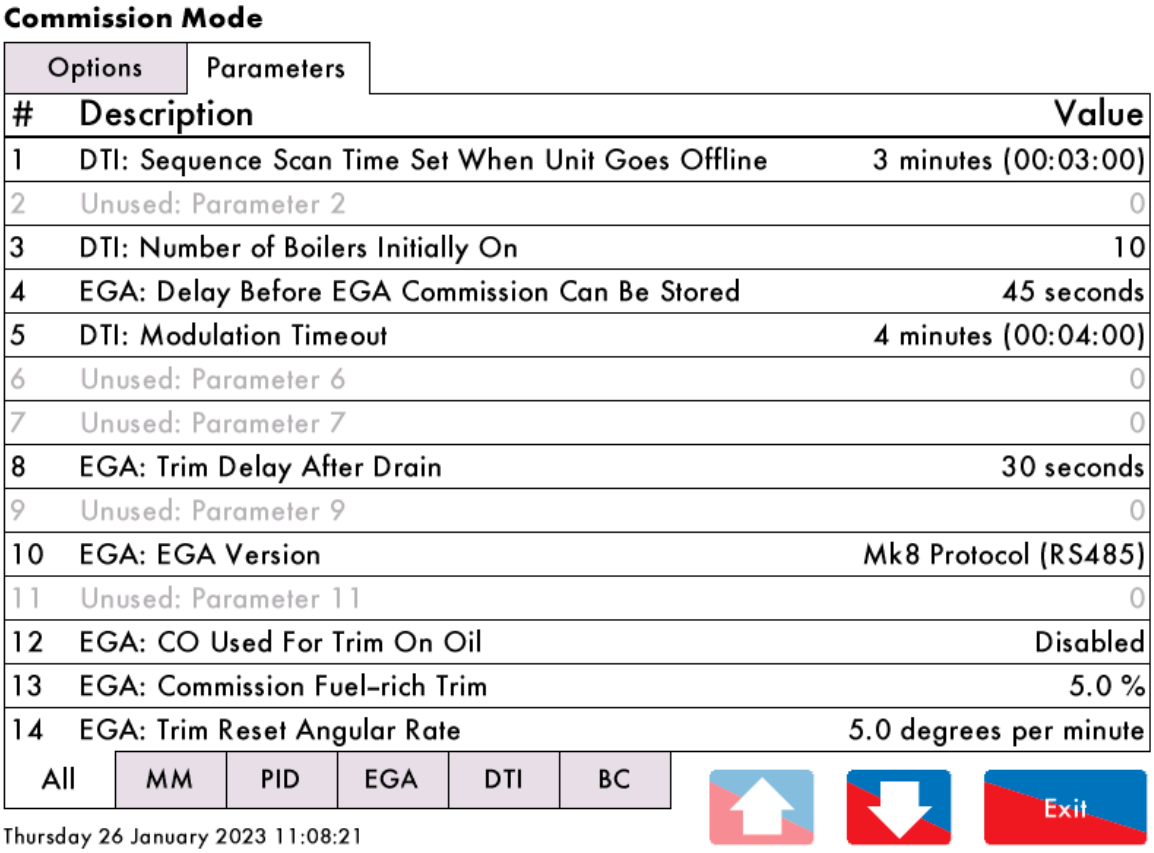


Figure 2.2.i Parameters

Figure 2.2.i shows the Parameters screen. As with the Options, the Parameters can be easily viewed by feature by pressing the tabs MM, PID, EGA, DTI and BC.

A full list of parameters is detailed on the next pages. Options/ parameters 110 – 160 are the burner control settings and are safety critical; the parameter value must correspond to its equivalent option value.

Par. #	Default	Range	Description
1	3		DTI: Sequence Scan Time Set When Units Goes Offline
		0 – 20	If a sequenced MM drops out of the sequence loop, there is a time delay before the next scan time. Minutes
3	10		DTI: Number of Boilers Initially On
		1 – 10	This sets the number of boilers which when powered on after a shutdown, are in the On state in the sequence loop. This set should be set to the highest MM ID number (see parameter 57) if the application requires all the MMs to be On in the sequence loop when powered back on. Boilers/MMs
4	45		EGA: Delay Before EGA Commission Can be Stored
		10 – 120	During commission and single point change, there is a delay before the EGA values are stored. This value should be set in proportion to how long it takes for the gases to reach the EGA Seconds
5	4		DTI: Modulation Timeout
		1 – 50	If a sequenced MM does not start modulating after being asked to by the lead MM, it is ignored in the sequencing loop. Upon the next scan time, if the MM modulates as required, it will be included in the sequencing loop. Minutes
8	30		EGA: Trim Delay After Drain
		5 – 240	This is the delay after draining the sample, before the trim cycle start. Within this delay, the trim correction on the air damper or VSD is maintained while the EGA drains and the cells are purged with air. Seconds
10	2		EGA: EGA Version
		0 1 2	Mk7 Protocol Mk8 Protocol (Legacy) Mk8 Protocol (RS485)
12	0		EGA: CO Used for Trim on Oil
		0 1	If the fuel has been set as oil (see options/ parameters 150 to 153), then the trim function can include CO to calculate the required trim correction. Disabled Enabled
13	50		EGA: Commission Fuel-Rich Trim
		20 – 75	The % of air damper movement when commissioning fuel-rich trim. 2.0% - 7.5%
14	50		EGA: Trim Reset Angular Rate
		0 – 900	This is the change time in the fuel valve angle per minute that will reset the trim correction. 0.0 – 90.0 degrees per minute
15	5		MM: Golden Start Time
		2 – 3600	This is the time period for how long the servomotors and VSDs are held at the golden start position from the point of main flame, see option 29. Seconds
16	12		EGA: (Mk7 Only) Time Between Air Calibrations
		1 – 50	This is the time period between air calibrations if the burner does not go off. 0.5 hours – 25.0 hours

Par. #	Default	Range	Description
17	3		EGA: Number of Trims Before Limits Errors Generated
		0 1 – 10	When the combustion limits have been exceeded, the MM will make trim corrections on the air damper. If the number of these trims reaches the value set in this parameter an error will be generated. See options 19, 20, 21, 22, 23, 25, 26, 27 and parameters 94, 96 97 for limits. Disabled Number of trims
18	100		EGA: Maximum Trim During Run
		20 – 100	This is the maximum trim % of air damper movement during firing. 2.0% - 10.0%
19	50		EGA: Commission Air-Rich Trim
		20 – 75	This is the % air damper movement when commissioning the air rich trim. 2.0% - 7.5%
23	1		EGA: Add Air When CO Present
		0 1	This sets whether the trim function adds when CO is present. If the O_2 and CO_2 appear air rich but CO appears fuel rich, then the air damper will open further to remove CO. Disabled Enabled
24	120		EGA: (Mk7 Only) Air Calibration Time
		20 – 300	For the Mk8 EGA, this is set as default 6 minutes. Seconds
26	8		EGA: Trim Samples per Cycle
		1 – 50	A cycle is the period between when does the EGA carries out a drain to get rid of excess moisture in the exhaust gas sample. This parameter sets the number of trim corrections in between drains.
28	0		MM: Internal High Limit Setpoint
		0 - 9990	The MM will shut down the burner or inhibit it from starting if the load (pressure or temperature) reaches this value regardless of any other setpoint in use. This setpoint will also operate in Commission Mode. If this setpoint is reached during Single Point Change, the MM will exist Single Point Change and offer to save any current changes. Depending on Option 1 setting
29	1000		MM: Load Sensor Adjustment
		800 – 1200	Adjust the load sensor (voltage) reading, as a percentage of the reading. Value 1000 = 100.0% of actual reading
30	10		MM: Load Sensor Filter Time
		1 – 40	Seconds
31	0		EGA: (Mk7 Only) Efficiency Calculation Method
		0 1	For the Mk8 EGA, efficiency calculation method is set on the EGA. English European
32	0		MM: User Setpoint Minimum Value
		0 – 9990	This limits the change for the minimum setpoint value in the status screen.
33	0		MM: User Setpoint Maximum Value
		0 – 9990	This limits the change for the maximum setpoint value in the status screen.

Par. #	Default	Range	Description
34			MM: Vendor Details Line 1
			Enter Vendor Name
35			MM: Vendor Details Line 2
			Enter Address Details (Street)
36			MM: Vendor Details Line 3
			Enter Address Details (Town / City / Zip)
37			MM: Vendor Details Line 4
			Enter Contact Details (Phone / Email Address)
38	***		MM: Commissioning Password Code 1
		0 – 255	Code 1
39	***		MM: Commissioning Password Code 2
		0 – 255	Code 2
47	0		DTI: Standby or Phantom Setpoint Type
			Instead of a fixed setpoint when the MM is in standby mode, it would have its current setpoint offset down by a value instead. When configured for Phantom Setpoint, the Standby Setpoint Option 42 becomes a Phantom Setpoint Offset.
		0	Use Fixed Standby Setpoint
		1	Use Phantom Setpoint Offset
48	80		PID: Integral Band
			This is the percentage of the proportional band over which the integral control is active.
		0 – 100	0% - 100%
52	0		MM: External Load Detector – Number of Decimal Places
			This affects parameter the external load detector maximum and minimum values set in parameters 53 and 55. See options 1 and 65.
		0	0 decimal place
		1	1 decimal place
		2	2 decimal places
53	20		MM: External Load Detector – Maximum Value
			The scale will depend on how parameter 52 is set. See options 1 and 65.
		0 – 9990	Bar (PSI) or ^{O}C (^{O}F)
			20 = 20 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 0
			20 = 2.0 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 1
			20 = 0.2 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 2
54	0		MM: External Load Detector – Maximum Voltage
		0 – 100	0.0V – 10.0V
55	20		MM: External Load Detector – Minimum Value
			The scale will depend on how parameter 52 is set. See options 1 and 65.
		0 – 9990	Bar (PSI) or ^{O}C (^{O}F)
			20 = 20 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 0
			20 = 2.0 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 1
			20 = 0.2 Bar (PSI) or ^{O}C (^{O}F) if parameter 52 is set to 2
56	0		MM: External Load Detector – Minimum Voltage
		0 – 100	0.0V – 10.0V

Par. #	Default	Range	Description
57	10		DTI: Highest MM ID
			This sets the highest MM ID number for that sequence or DTI loop.
		1 –10	Sequence ID
58	1		EGA: (Mk7 Only) – Air Calibration on Start-up
			For the Mk8 EGA, the air calibration schedule is set on the EGA itself.
		0	Disabled
		1	Enabled
60	60		MM: Logo Display Timer (Standby)
			If a custom logo is stored on the data micro-SD card in the MM, then after this timer in standby mode, the custom logo will appear on the screen.
		0	Disabled
		1 – 3600	Seconds
61	900		MM: Backlight On Time
			If the screen is not pressed and this timer elapses, the backlight will dim.
		0	Disabled
		1 – 1800	Seconds
62	0		DTI: Hot Water Sequencing
			For setting 0 the boilers, the lag boilers will be off. For setting 1, the lag boiler will operate as steam sequencing, as set in option 41.
		0	Two State Hot Water Sequencing (On/Off)
		1	Three State Hot Water Sequencing (On/Warming/Off)
63	0		DTI: Two Port Valve Output Polarity
			Sets terminal #78 operation
		0	Valve normally open (closes when energised)
		1	Valve normally closed (opens when energised)
64	0		MM: Logo Display Preferences
			If enabled from Parameter 60, the custom logo will display for setting 0 & 1, for setting 2 & 3 a black screen will be used as a logo.
		0	Default Behaviour
		1	Logo Displays While Firing
		2	Use Black Screen as Logo
		3	Black Screen as Logo Displays While Firing
68	1		MM: External Modulation Control Range
			The range is set for either low fire to high fire in setting 0, or zero to high fire in setting 1. See option 45.
		0	Low to high
		1	Zero to high
69	0		MM: External Modulation Input Range
			This sets the range for external modulation input on terminals 37 and 38. To use mA, a 500ohm resistor needs to be placed across the terminals.
		0	0 to 10V Input
		1	2 to 10V Input
80	0		MM: Distributed Return Temperature Shutdown Delta - T
		0 - 500	A user-defined differential temperature threshold may be configured that causes the burner to stop when breached (i.e. when the difference between inlet & outlet temperatures become too large).

Par. #	Default	Range	Description
81	0		MM: Distributed Return Temperature Restart Delta - T
		0 - 500	A user-defined differential temperature threshold may be configured that determines when the burner may restart following a shutdown caused by the differential temperature shutdown threshold.
82	0		MM: Distributed Return Temperature Turndown Delta - T
		0 - 500	A differential temperature threshold may be defined by the user to determine the differential temperature at which the maximum firing rate starts to be reduced.
83	0		MM: Display Diagnostic Values
			Enabling this parameter allows the display of more detailed information in the system log.
		0	Disabled
		1	Enabled
85	0		MM: Modulation Exerciser Period
			If the modulation exerciser period is enabled, then the MM will repeatedly run between high fire and low fire. This value sets how long the MM will remain at the high fire and low fire positions. This should only be used in test/inspection conditions.
		0	Disabled
		1 – 3600	Seconds
86	85		DTI: IBS Change Down Threshold
			IF the combined firing rate of the last 2 MMs in the sequence loop is below this value, then the last lag MM will go from ‘on’ to the next phase (‘standby’, ‘warming’ or ‘off’) depending on how option 41 is set.
		0 – 99	0% - 99%
87	95		DTI: IBS Change Up Threshold
			If the firing rate of the last MM in the sequence loop in the ‘On’ phase is above this value, then the next MM will go to the ‘On’ phase upon the next sequence scan time, to meet the load demand.
		0 – 100	0% - 100%
88	1000		MM: Outside Temperature Sensor Adjustment
			If the outside temperature reading is too high, then decrease this value. If the outside temperature reading is too low, then increase this value.
		500 – 2000	50.0% - 200.0%
89			MM: Stat Exerciser Period
			If the stat exerciser period is enabled, then T53 will be turned off for this timer set, and then turned off for this timer set, repeatedly. This should be used in test/inspection conditions.
		0	Disabled
		1 – 3600	Seconds
90	0		MM: VSD Minimum Feedback Variation Check (Fuel 1)
			Enable/Disable VSD feedback variation tests for fuel 1.
		0	Enabled
		1	Disabled
91			MM: VSD Minimum Feedback Variation Check (Fuel 2)
			Enable/Disable VSD feedback variation tests for fuel 2.
		0	Enabled
		1	Disabled

Par. #	Default	Range	Description
94	0		EGA: NO Upper Limit Offset
			If the current NO value is above this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3.
		0	Disabled
		1 – 200	1 – 200 ppm NO
96	0		EGA: Exhaust Temperature Upper Limit Offset
			If the current exhaust temperature value is above this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See options 13 and 65.
		0	Disabled
		1 – 999	1 – 999 ^{O}C or ^{O}F
97	0		EGA: Exhaust Temperature Absolute Limit
			If the current exhaust temperature value is above this absolute limit, an EGA error will occur, for option 12 set to 3. See options 13 and 65.
		0	Disabled
		1 – 999	1 – 999 ^{O}C or ^{O}F
99	1		MM: Graceful Shutdown
			If enabled, when the fuel is deselected, the fuel valve outputs are de-energised, and then a post-purge occurs before the MM restarts. This must not be used if changeover relays are used on the system. Graceful shutdown cannot be used with assured low fire shut off in parameter 100.
		0	Disabled
		1	Enabled
100	0		MM: Assured Low Fire Shut Off
			If enabled, when the burner turns off on internal stat, the MM will modulate to low fire, shut down and recycle the system before turning off. Assured low fire shut off cannot be used with graceful shutdown in parameter 100.
		0	Disabled
		1	Enabled
101	0		DTI: Shuffle Sequencing
			This allows the sequence order to be changed remotely through the DTI or Modbus. See options 16 and 100.
		0	Disabled
		1	Enabled
103	0		MM: Air Pressure Warning Lower Offset
			This is an offset lower limit from the commissioned air pressure.
		0 - 1000	0 mbar (disabled) – 100 mbar
104	0		MM: Air Pressure Warning Upper Offset
			This is an offset upper limit from the commissioned air pressure.
		0 - 1000	0 mbar (disabled) – 100 mbar
105	0		MM: Gas Pressure Warning Lower Offset
			This is an offset lower limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. A warning will be generated if the measured static line pressure during the VPS void to gas phase is below the absolute value in option 133.
		0 - 13400	0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0” WG – 537.777” WG (value 25 = (1.003” WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)

Par. #	Default	Range	Description
106	0		MM: Gas Pressure Warning Upper Offset
		0 - 13400	This is an offset upper limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003" WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)
107	***		MM: Online Changes Password Code 1
		0 – 255	Code 1
108	***		MM: Online Changes Password Code 2
		0 – 255	Code 2
109	0		MM: Mains Voltage Tolerance
			The MM performs internal tests to ensure that the mains power is safe for the unit to operate. When these tests fail the MM generates an error. This parameter governs the way the MM handle these tests results; setting 1 makes the MM more tolerant to the mains power instability while setting 2 disables the errors altogether. ***Note:*** *Setting 2 should only be used temporarily while investigating and correcting the cause of mains power instability. Running the MM continually on unstable power can degrade the MM and cause permanent damage to the unit.*
		0	Standard
		1	Increased
		2	Errors Disabled

2.3. Language

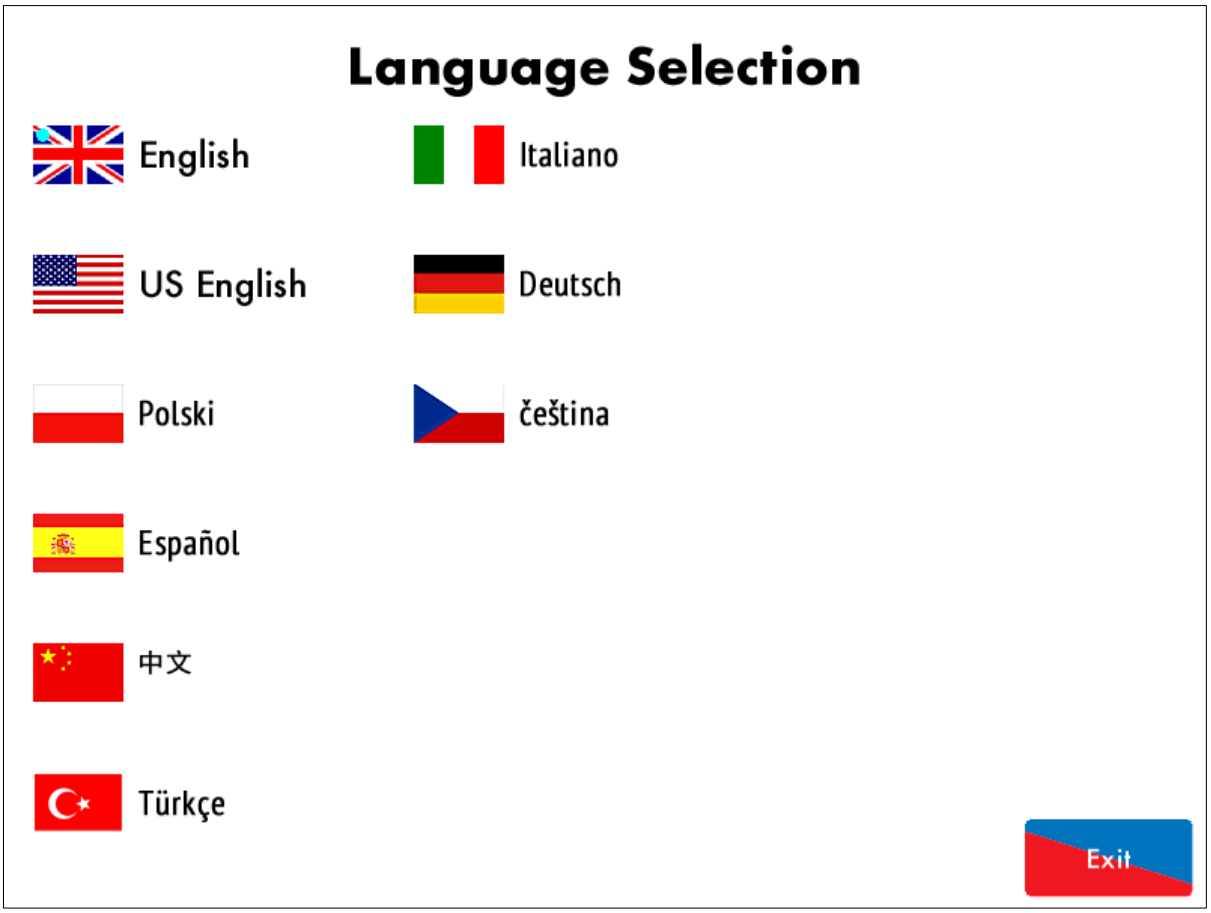
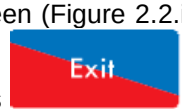


Figure 2.3.i Language

Press 

in the commission mode screen (Figure 2.2.ii) to view the Language screen in Figure 2.3.i. Select the language to be displayed and press 

.

Note: The SD card must contain the language file to view this.

2.4. Set Clock

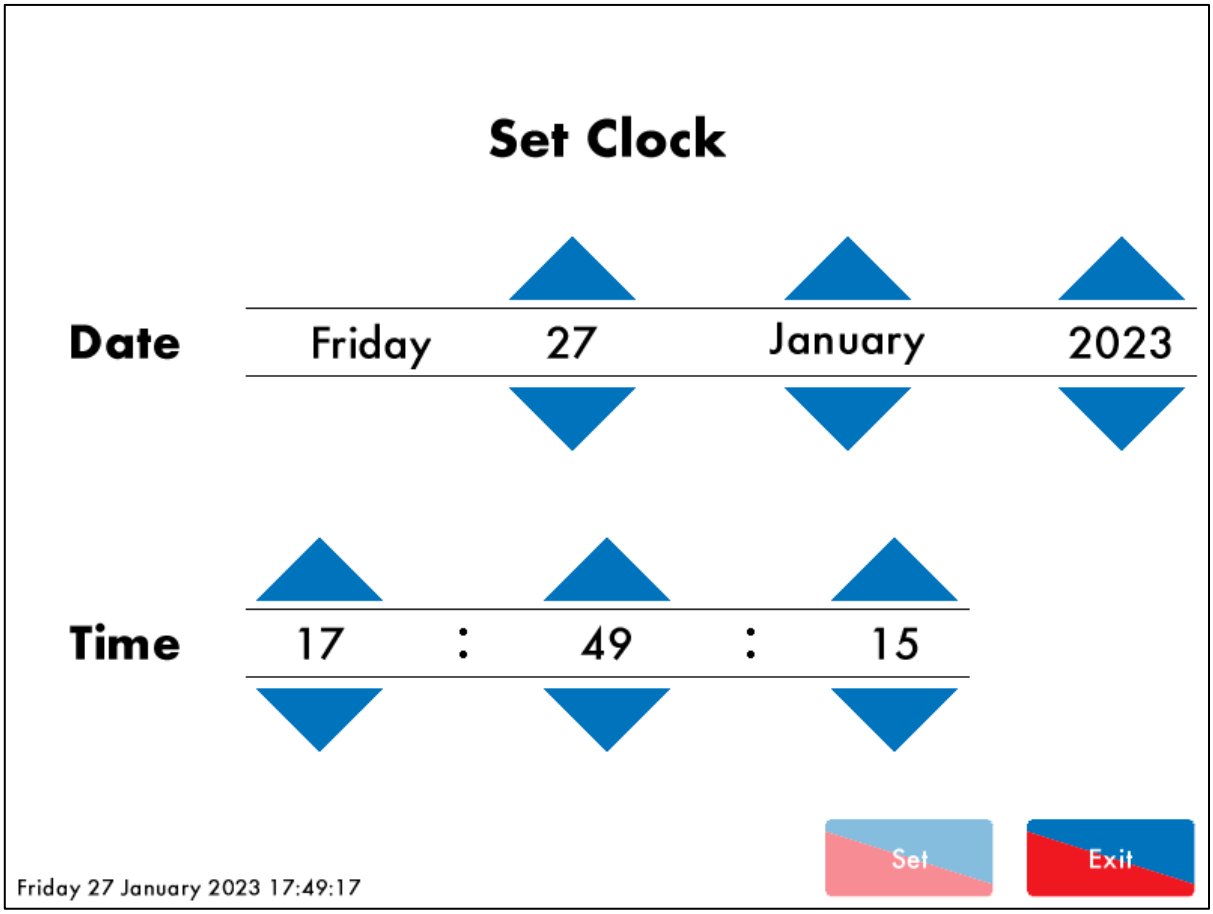


Figure 2.4.i Set Clock

Press 

in the commissioning mode screen (Figure 2.1.ii) to view the Set Clock screen in Figure 2.4.i. Change the time and date using the  buttons. Press 

and then 

.

3. CONFIGURING THE AUTOFLAME FLAME SAFEGUARD UNIT

3.1. Overview



WARNING

Fire, Explosion or Electrical Shock Hazard. Can cause severe injury, death or property damage.

1. **Use extreme care while installing and testing the system. Live voltage is present on most terminal connections when the power is on.**
2. **Switch off the unit power before installing or removing the backplate cover and/or any of the plug-in wiring connectors.**
3. **Replace all limits and interlocks not operating properly.**
4. **Do not bypass limits and interlocks.**
5. **Close all manual fuel shutoff valve(s) before starting any tests.**



FIRE OR EXPLOSION HAZARD

Can cause severe injury, death or property damage. To prevent possible hazardous burner operation, perform verification of safety requirements each time a control is installed on a burner.

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber for longer than a few seconds without igniting, an explosive mixture could result. It is recommended that you limit the trial for pilot to ten seconds, and limit the attempt to light the main burner to two seconds from the time the fuel has reached the burner nozzle. In any case, do not exceed the nominal lightoff time specified by the equipment manufacturer. Close the manual shutoff valve(s) if the flame is not burning at the end of the specified time.

PRELIMINARY INSPECTION

Perform the following inspections to avoid common problems.
Make certain that:

1. **The wiring connections are correct and all terminal screws are tight.**
2. **The flame detector(s) is clean, installed and correctly positioned. Consult the Autoflame Flame Scanner guide for instructions.**
3. **The burner is completely installed and ready to fire; consult equipment manufacturer instructions.**
4. **The fuel lines are purged of air.**
5. **The combustion chamber and flues are clear of fuel and fuel vapour.**
6. **Power is connected through a safety shut-off switch.**
7. **Lockouts on the Flame Safeguard controller are reset.**
8. **All limits and interlocks are reset.**

3.1.1. Single Servo Burner Set Up

In order to drive the servo motor to the purge and start positions and to allow a load sensor to take over control once firing, the outputs and inputs used in Flame Safeguard Mode are as follows:

Outputs:

- T70 (Switched Neutral) is the High/Low Initiate output.
- T71 (Switched Neutral) is the Release to Modulate output.
    - When T71 is low, and T70 is High, the motor moves to Purge.
    - When T71 is Low and T70 is Low, the motor moves to Light Off.
    - When T71 is High, the Motor releases to Modulate via the external Pressure sensor.

Inputs:

- Input T80 is the Low/Fire Start Switch, which is made when the motor start position mechanical switch has been made.
- Input T81 is the High Fire/Purge Switch, which is made when the motor purge position mechanical switch has been made.

The wiring is to be completed as shown in the schematic in section 1.2.1. The Relay Box (SP80070, SP80070/110) is available from Autoflame to provide all the correct connections for ease of installation. If using other relays, ensure that you conform to the wiring schematic provided.

3.1.2. On/Off Burner Set Up

With a simple On/Off burner, The wiring is simplified to provide the following outputs and inputs:

Outputs:

- T70 (Switched Neutral) is the High/Low Initiate output. This starts a timer relay when high to initiate the purge sequence after a short delay and confirms the start position when it goes low.

Inputs:

- T80 is the Low/Fire Start Switch, which is made when the timer relay is driven low.
- T81 is the High Fire/Purge Switch, which is made after a delay of 5 seconds when the timer relay is driven high.

The wiring is to be completed as shown in the schematic in section 1.2.2. A simple ON-delay timer relay such as Allen-Bradley 700-FEA6TU23 or 700-FEM6TU23 set in mode (A) with a 5 second delay is required.

3.1.3. Wiring Checks

Important Note: Do not wire these outputs to a servo, since driving a servo in both directions at the same time would result in damage and must be avoided.

On a newly installed system the following procedures should be carried out as listed:

1. Check all interconnecting wiring between the Flame Safeguard unit and external components is correct.
2. Set the options and parameters required (refer to sections 2.1 and 2.2).



Improper use may result in property damage, serious physical injury or death.

The configuring procedure as described must be strictly adhered to. Anybody configuring a flame safeguard system must have an adequate understanding of combustion plant. In the wrong hands hazardous conditions could be made to exist. The Autoflame products must only be installed, set up, commissioned and adjusted by an Autoflame certified technical engineer.

Please make sure that you fully read and understand the safety notes section before starting the configuration process.

3.2. Installation Checks



WARNING

Electrical Shock Hazard, Fire or Explosion Hazard. Can cause severe injury, death or property damage.

1. **Use extreme care while testing the system. Voltage is present on most terminal connections when power is on.**
2. **Isolate the power before removing or installing the Autoflame Flame Safeguard Controller.**
3. **Make sure all manual fuel shutoff valve(s) are closed before starting the initial lightoff check and the Pilot Turndown tests.**
4. **Do not put the system in service until you have satisfactorily completed all applicable tests as required by regulations and the equipment manufacturer.**

3.2.1. Configuration Checks

When all the installation and burner adjustments are completed, the entire burner control system including the Flame Safeguard should be tested in accordance with the manufacturer's instructions. The procedure should verify the correct operation of:

1. Each operating control (temperature, pressure etc.)
2. Each limit switch (temperature, pressure, low water cut-off, etc.)
3. Each interlock switch (airflow switch, high and low fuel pressure or temperature switches, purge and low fire switches, fuel valve proof of closure interlock etc.)
4. Pilot flame failure response and lockout.
5. Main flame failure response and lockout.
6. Tight shut-off for all valves.

3.2.2. Operational Checks

1. Close manual main shut-off valve.
2. Check all limit circuit wiring for proper operation and correct connection.
3. Confirm that the automatic main fuel valves are wired correctly.
4. Power the control and electronically check the proper sequence of operation.
5. After assuring yourself that all the interlocks and valves are properly wired and that the sequence of operation is correct, open the manual main shut-off fuel valve and proceed cautiously through the boiler light off process. Check all safety interlocks for proper shutdown of the boiler.

3.2.3. Installation Precautions

The reliability of the equipment may be impaired if used in environments where strong electromagnetic fields exist e.g. if the equipment is installed in a boiler house where radio systems exist then additional EMC (Electro Magnetic Compatibility) measures may have to be considered. Please contact Autoflame for more information.

3.2.4. Maintenance and Servicing

The Micro-Modulation unit uses solid state technology. It requires no routine maintenance.

The gas/oil valves do require routine maintenance. Any fault associated with these parts is usually diagnosed by the MM. Contact Autoflame for preventative maintenance procedures; please refer to the Valves manual for general checks.

4. GENERAL FEATURES

4.1. No Pre-Purge

It is possible to minimise the burner start-up time by bypassing the pre-purge. The major advantage of this control means that the overall boiler efficiency is increased by minimising the heat loss to the stack during a purge cycle. This means the burner starts-up quicker therefore reaching setpoint in a reduced time. According to the EN676 European regulation, the burner is allowed to restart without a pre-purge if the burner has recycled due to operational temperature/pressure. When the burner is stopped by a lockout then this procedure is not allowed and the burner will have to start-up as normal with a pre-purge. In order for no pre-purge to be active, valve proving must take place and finish successfully. If this valve proving operation is successful then the burner may start-up without a pre-purge.

In order to initiate the no pre-purge feature, option/ parameter 143 must be set to a value of 1. During the first start-up the burner will start with a pre-purge initiated. Once the complete commissioning curve has been entered and the burner has started successfully, the burner will then start-up every time with no pre-purge. If the burner goes above its setpoint and turns off on high temperature/ pressure, then the next time the burner starts-up, it will go through the VPS operation and then light off without a pre-purge, i.e. the burner has shut down in a controlled manner and the gas valves have been checked for integrity.

According to the EN676 regulation, the burner is only allowed to work in this manner if VPS operation has been set to operate before the burner starts up; option/parameter 129 must be set to 0.

The start sequence without pre-purge is as follows:

1. Firstly the system goes through its internal tests and relay checks.
2. Call for heat on Terminal 57 activates and the system will go through the VPS operation.
3. If this operation is successful then the MM will drive the channels to the light off or start position.
4. Once all channels reach the start position then the burner will light off.

If the burner shuts down in an abrupt manner, e.g. loss of power to the unit, then the next time the burner starts-up a complete purge will be initiated.

If no pre-purge is enabled in option/parameter 143, and one or more of the following conditions occur, the next time the burner starts up, a complete pre-purge will be initiated:

- Burner lockout.
- Loss of power to the MM.
- VPS checks have failed.
- MM has been in standby for 24 hours or more.

Note: Pre-purge is only available on fuels which are optioned as gaseous.

4.2. Autoflame Flame Safeguard Flame Detection Using Ionisation

As well as using UV or IR, the MMM8002/FSG can detect a flame using an ionisation signal/flame rod. This is wired into terminal 64 and the cable must be shielded.

For ionisation, the flame will be signalled when the rectification voltage is above 30Vdc, the maximum sensed rectification voltage is 540Vdc, above which a Lockout will be generated.

Please check Autoflame Flame Scanners Guide for further details about flame detection options.

4.3. Terminals 80, 81 and 82 Functions

4.3.1. T80 Functions

Option/parameter 154 controls the function of terminal 80 and must be set to 1: Start Position Interlock when used in flame safeguard mode.
Setting it to other values will result in an Options/Parameters mismatch lockout.

Start position interlock	Terminal 80 acts as a live input in response to a mechanical end stop. Allows an additional safety check on the valves and damper to ensure that they are in the correct position for start/low fire using end limit switch. Please check Autoflame Valves Guide for further details. When set up as an On/Off burner this is a live input after the completion of the purge sequence to initiate the start-up process.

4.3.2. T81 Functions

Option/parameter 155 controls the function of terminal 81 and must be set to 1: Purge Interlock when used in flame safeguard mode.
Setting it to other values will result in an Options/Parameters mismatch lockout.

Purge interlock	Terminal 81 acts as a live input in response to a mechanical end stop. It must be made for the whole of the timed purge and post purge phases, otherwise a lockout is triggered. This input must not be made while not at purge. When set up as an On/Off burner this is a live input after a 5 second delay to run the burner start up purge sequence.

4.3.3. T82 Functions

Option/parameter 156 governs the function of terminal 82. The only function can be triggered in flame safeguard mode when a live input is detected on this terminal.

Valve proving mains input	A low-pressure switch can be wired to terminal 82 for valve proving; see Option/parameter 125, 126 and 128. Please refer to the Sensors Guide for further details.

5. REMOTE CONTROL

5.1. Modbus Settings

The data on a Mini Mk8 MM can be accessed remotely either by connecting the MM to a Mk8 DTI, or by using Direct Modbus. Note that only a small subset of this data will be valid when in flame safeguard mode.

There are a limited number of Modbus addresses available on the Mini Mk8 MM which can be accessed directly without the need for a DTI.

When using Direct Modbus, e.g. connecting to Building Management System from the MM without a DTI, then neither Autoflame Intelligent Boiler Sequencing (IBS) nor the DTI can be used.

The MM communicates using an RS485 data link from terminals 27 (-ve) and 28 (+ve). Belden 9501 data cable is recommended.

Up to 10 MMs can be linked together and connected to a Building Management System via terminals 27 and 28. Each Mini Mk8 MM will need to be set with an individual Modbus device ID in option 104.

The maximum block of addresses the Mini Mk8 MM can read and write to is 127, as per Modbus having a built-in limit of 255 byte packets.

If the MM does not receive any Modbus commands for 60 seconds, the Modbus goes 'offline.' You can keep the Modbus 'online' with a simple instruction, such as polling or setting a single value to that individual MM.

If the MM is powered off or the communications is lost, the Modbus address values from the unit will not be true.

5.2. Configuration

Option	Description	Setting
100	Sequencing/DTI or Modbus function	1
101	Modbus baud rate	As required
102	Modbus parity setting	As required
103	Modbus stop bits setting	As required
104	Modbus device ID	As required
105	Binary format	As required

The following terminals are used for Direct Modbus.

Terminal	Description
27	RS485 -
28	RS485 +
S	Screen

5.3. Modbus Addresses

There are 4 types of Modbus addresses:

0x Read/Write digital outputs – off/on commands

1x Read digital inputs – off/on signals/indications

These are binary values and have a 0/1 value indicating an off/on or no/yes value.

3x Read analogue inputs – variable data in

4x Read/Write analogue outputs – variable adjustments

These are multiple integer values and can have a value of 0 to 65534 and do not contain decimal points i.e. channel 1position Modbus value is 900 which is equivalent to 90.0^{O}

Address Type:
RWD = Read / Write Digital
RD = Read Digital
RWA = Read / Write Analogue
RA = Read Analogue

Modbus addresses which are meaningless for use in flame safeguard mode are greyed out.

#	Type	Description	Details
00001	RWD	Enable/Disable MM	0 = Burner is enabled 1 = Burner is disabled Value changes state of enable/disable button on MM home screen; changes are kept if MM loses comms with Modbus device sending commands
10217	RD	EGA Trim Optioned	0 = Trim not optioned 1 = Trim optioned Returns value 0 when option 12 is set for monitoring only.
10218	RD	EGA is Trimming	0 = EGA not trimming 1 = EGA is trimming Returns value 0 is actual temperature/pressure is below trim threshold
10219	RD	EGA Cooler Ready	0 = Cooler is ready, 1 = Cooler is not ready Returns value 0 if EGA is an error state
10220	RD	EGA Ambient Temp OK	0 = Temperature OK, 1 = Temperature not OK
10221	RD	EGA NO_2 On	0 = NO_2 cell not optioned, 1 = NO_2 cell optioned See option 36, valid for Mk7 EGA only
10222	RD	EGA SO_2 On	0 = SO_2 cell not optioned, 1 = SO_2 cell optioned See option 36, valid for Mk7 EGA only
10224	RD	EGA OK to Sample	0 = EGA is not sampling, 1 = EGA is sampling
10233	RD	Hand Mode	0 = MM not in hand mode, 1 = MM in hand mode
10234	RD	Low Flame Hold	0 = MM not in low flame hold, 1 = MM in low flame hold
10242	RD	Disabled Status	0 = Burner enabled, 1 = Burner disabled Returns state of enable/disable button on MM home screen and same value as address 00001
30101	RA	Load Index	Firing rate %
30102	RA	Firing Status	0 = Non-modulating, 1 = Modulating Returns value 0 single point change, fuel flow metering and commissioning. For Option 106 setting 1 see section 5.3.1
30104	RA	Burner Rating	MW x 10 Metric units determined from fuel flow metering

#	Type	Description	Details
30105	RA	Actual Value	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100 Imperial: temperature ^{O}F, pressure PSI, low pressure PSI x 10
30106	RA	Required Value	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100 Imperial: temperature ^{O}F, pressure PSI, low pressure PSI x 10
30107	RA	Selected Fuel	0 = Fuel 1, 1 = Fuel 2
30109	RA	Channel 1 Position	Degrees x 10 Range is -6.0^{O} to 96.0^{O}
30110	RA	Channel 2 Position	Degrees x 10 Range is -6.0^{O} to 96.0^{O}
30111	RA	Channel 3 Position	Degrees x 10 Range is -6.0^{O} to 96.0^{O}
30113	RA	MM Error Number	0 = System is does not have an error, N = error number, check error codes
30115	RA	EGA Current O_2 Value	% x 10
30116	RA	EGA Current CO_2 Value	% x 10
30117	RA	EGA Current CO Value	ppm x 10
30118	RA	EGA Current Exhaust Gas Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30119	RA	EGA Current Efficiency Value	% x 10
30120	RA	EGA Current NO Value	ppm x 10
30121	RA	EGA Current SO_2 Value	ppm x 10
30122	RA	EGA Commissioned O_2 Value	% x 10
30123	RA	EGA Commissioned CO_2 Value	% x 10
30124	RA	EGA Commissioned CO Value	ppm x 10
30125	RA	EGA Commissioned Exhaust Gas Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30126	RA	EGA Commissioned Efficiency Value	% x 10
30127	RA	EGA Commissioned NO Value	ppm x 10
30128	RA	EGA Commissioned SO_2 Value	ppm x 10
30129	RA	EGA Error Code	0 = EGA does not have a fault, N = EGA error
30130	RA	Minimum Remote Setpoint	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100 Imperial: temperature ^{O}F, pressure PSI, low pressure PSI x 10
30131	RA	Maximum Remote Setpoint	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100 Imperial: temperature ^{O}F, pressure PSI, low pressure PSI x 10
30132	RA	Current Flow Thousands	Metric kW, imperial MMBTU/hr x 1000 Remainder after whole number of MW or MMBTU/hr x 1000 taken away. E.g. 1.5MW gives 500 value and 15.1MMBTU/hr gives 100 value
30133	RA	Current Flow Millions	Metric MW, imperial MMBTU/hr Whole number of MW or MMBTU/hr. E.g. 1.5MW gives 1 value and 15.1MMBTU/hr gives 15 value
30134	RA	Fuel 1 Flow Total Thousands	Metric kW/hr, imperial MMBTU/hr Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value

#	Type	Description	Details
30135	RA	Fuel 1 Flow Total Millions	Metric MW/h, imperial MMBTU Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value
30136	RA	Fuel 1 Flow Total Billions	Metric GW/hr, imperial MMBTU / 1000 Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value
30137	RA	Fuel 2 Flow Total Thousands	Metric kW/hr, imperial MMBTU/hr Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value
30138	RA	Fuel 2 Flow Total Millions	Metric MW/h, imperial MMBTU Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value
30139	RA	Fuel 2 Flow Total Billions	Metric GW/hr, imperial MMBTU / 1000 Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value
30143	RA	EGA Current Ambient Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30144	RA	EGA Current Delta Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30145	RA	EGA Commissioned Ambient Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30146	RA	EGA Commissioned Delta Temperature	Metric: temperature x 10 ^{O}C Imperial: temperature x 10 ^{O}F
30147	RA	UV Counts	Returns value displayed on MM
30148	RA	IR Counts	Returns value displayed on MM
30149	RA	Ionisation Counts	Returns value display on MM
30150	RA	EGA Current NO_2 Value	ppm x 10
30151	RA	EGA Commissioned NO_2 Value	ppm x 10
30804	RA	Channel 4 VSD Output	mA x 10 or V x 10
30805	RA	Channel 4 VSD Input	mA x 10 or V x 10
30830	RA	Lockout Number	0 = System is not in lockout, N = lockout number
30831	RA	Fuel 1 Type	0 = Gas, 1 = Oil Option/ parameter 150 value
30832	RA	Fuel 2 Type	0 = Gas, 1 = Oil Option/parameter 151 value
30839	RA	Fuel 1 Hours Run	Completed hours
30840	RA	Fuel 2 Hours Run	Completed hours
30843	RA	Fuel 1 Start-ups	Start-ups
30844	RA	Fuel 2 Start-ups	Start-ups
30847	RA	Current Air Pressure	mbar x 10, “wg x 10 option/parameter 146 value
30849	RA	Current Gas Pressure	mbar x 10, “wg x 10, PSI x 100 option/parameter 131 value
32009	RA	Alarm Status	0 = No Alarm, 1 = Alarm
32010	RA	Warning Status	0 = No Warning, 1 = Warning
32012	RA	Alarm Code	0 = System is not in Alarm, N = Alarm number
32013	RA	Warning Code	0 = System is not in Warning, N = Warning number
32027	RA	Cold Start Status	0 = System not in cold start mode, 1 = System in Cold Start mode
40001	RWA	Remote Required Setpoint	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100 Imperial: temperature ^{O}F, pressure PSI, low pressure PSI x 10

#	Type	Description	Details
			After 1 minute of no Modbus communications to the unit, the M.M. will ignore this required value and use the required setpoint set on the M.M.'s status screen.
40121	RWA	Remote Firing Rate	% 40131 must be set to 1 to change the firing rate remotely
40131	RWA	Remote Firing Rate Enable	0 = Remote firing rate disabled 1 = Remote firing rate enabled

5.3.1. Modbus address for MM status (30102)

MM option 106 sets how Modbus address for MM status (30102) operates. When Option 106 is set to 1. "Modbus address 30102 shows MM State". The following values are shown on the table below.

Code	Explanation
1	Recycle
2	Standby
3	Starting
4	Wait Secondary Proving
5	Wait CPI
6	Wait Air Switch
7	Zero Air Sensor
8	Valve Proving
9	Run to Pre-Purge
10	Pre-Purge
11	Run to Start
12	Pre-Ignition
13	Pilot Proving
14	Main Flame Proving
15	Golden Start
16	FGR
17	Firing
18	Moving to low fire to shut down
22	Run to Post-Purge
23	Post-Purge
24	Post-Firing Valve Proving
255	Fault

6. OPERATION

6.1. Home Screen

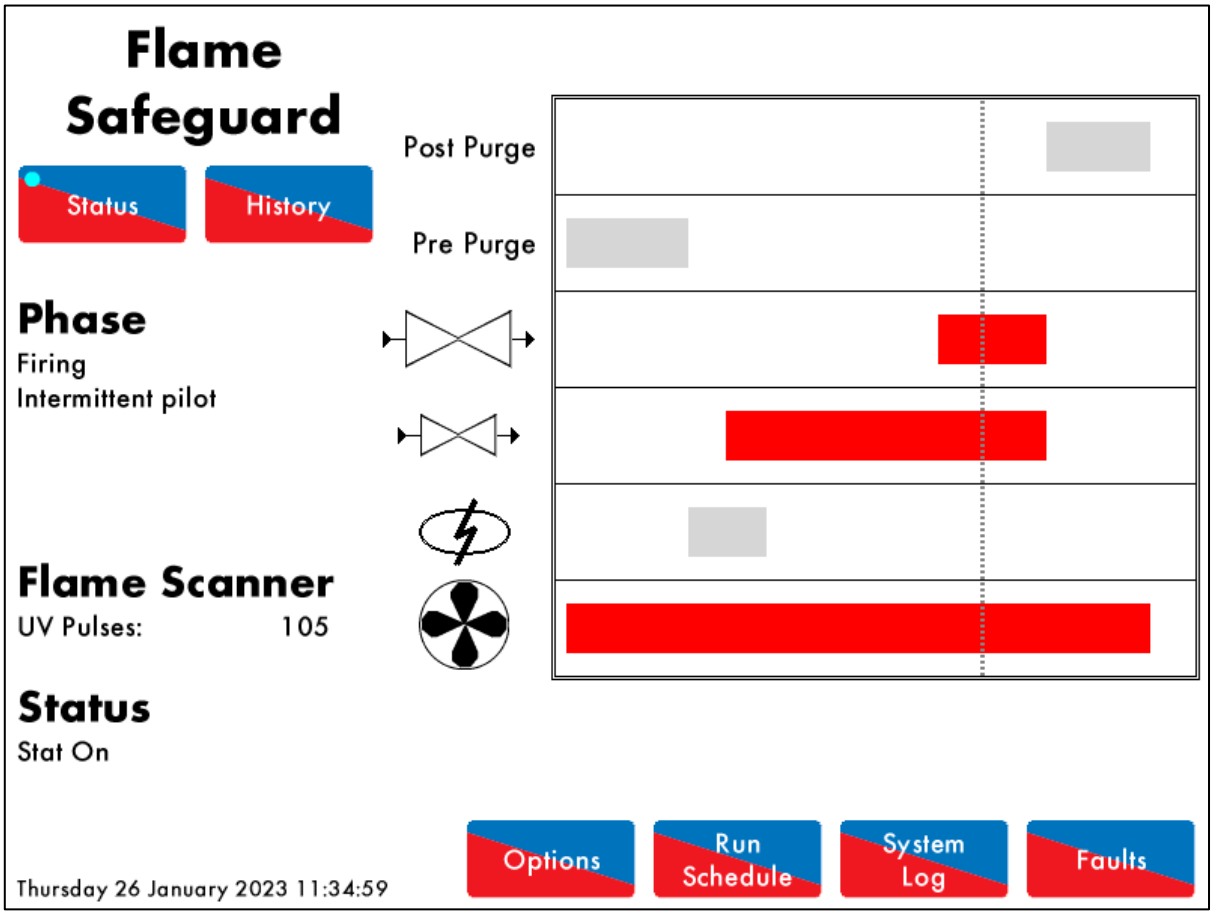


Figure 6.1.i Home

The home screen shown in Figure 6.1.i. displays the Flame Safeguard screen. The Flame Safeguard screen displays the following information:

- Current phase of the MM
- Flame scanner signal strength

Throughout the entire firing sequence, the vertical dotted line will move horizontally showing the currently active components. The inactive components are shown in grey, and active in red. The rows refer to:

- Post purge
- Pre-purge
- Main fuel valve
- Pilot valve
- Ignition
- Blower motor

6.1.1. Flame Safeguard – History

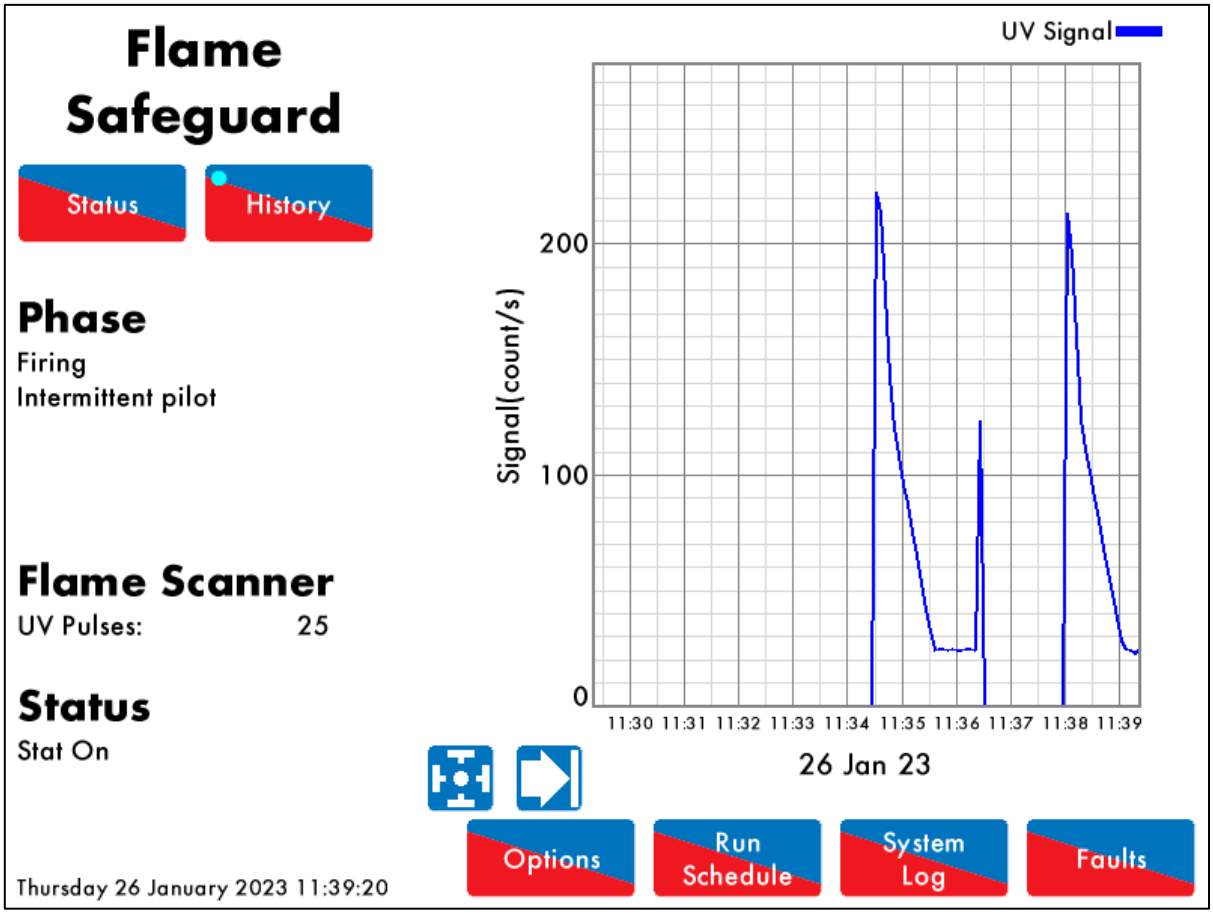


Figure 6.1.1.i Flame Safeguard – History

Press 

in the Flame Safeguard screen (Figure 6.1.i) to view Flame Safeguard History screen in Figure 6.1.1.i. The flame scanner signal history is displayed. This data is logged for 24 hours on the unit.

Use the  buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/ out of the graph.

Note: Power cycling the Flame Safeguard controller or changing fuel will reset this data log.

6.1.2. Options

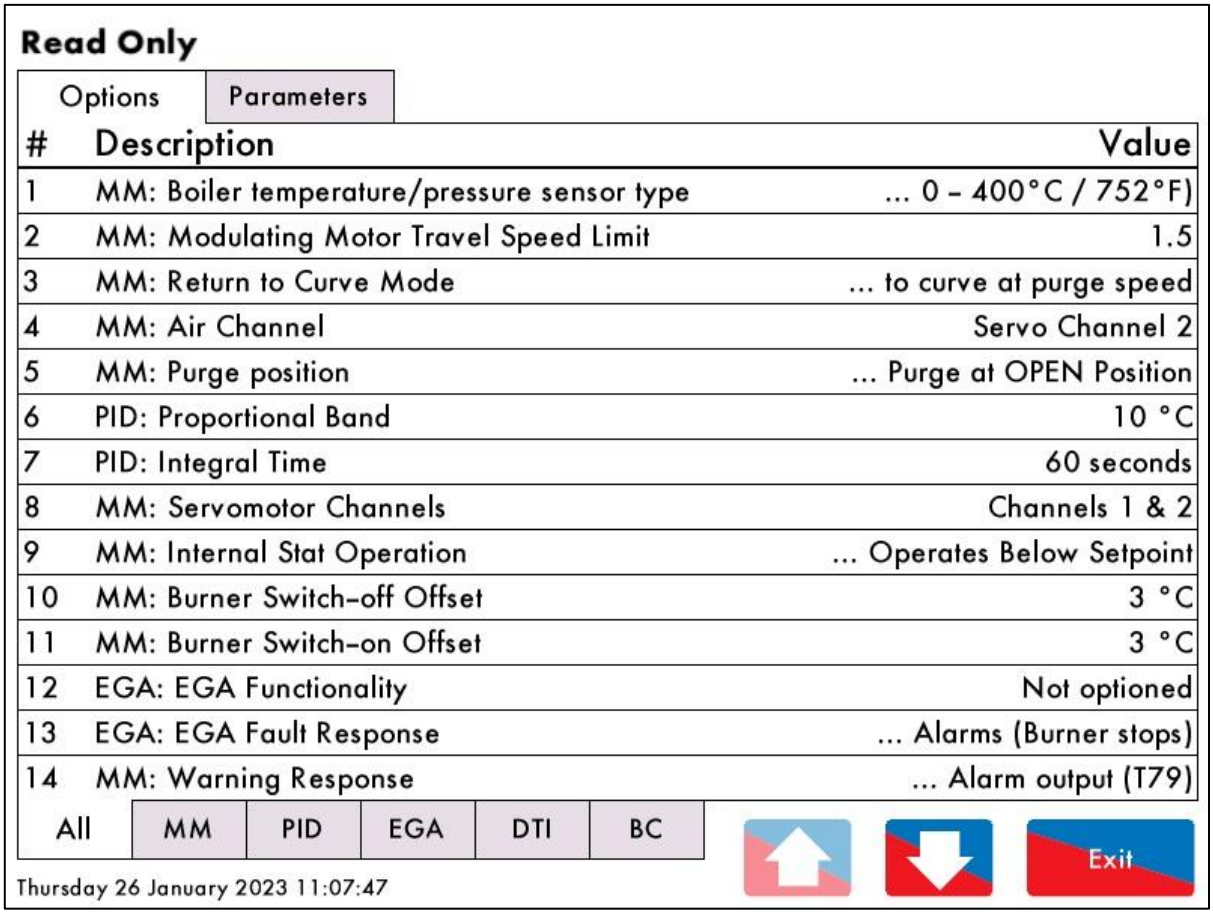


Figure 6.1.2.i Options

Press 

in the main screen (6.1.i) to view Options screen in Figure 6.1.2.i. The Options screens display all the options and their settings, however no changes can be made to these settings. To make changes to the Options, please refer to section 2.

6.1.3. Parameters

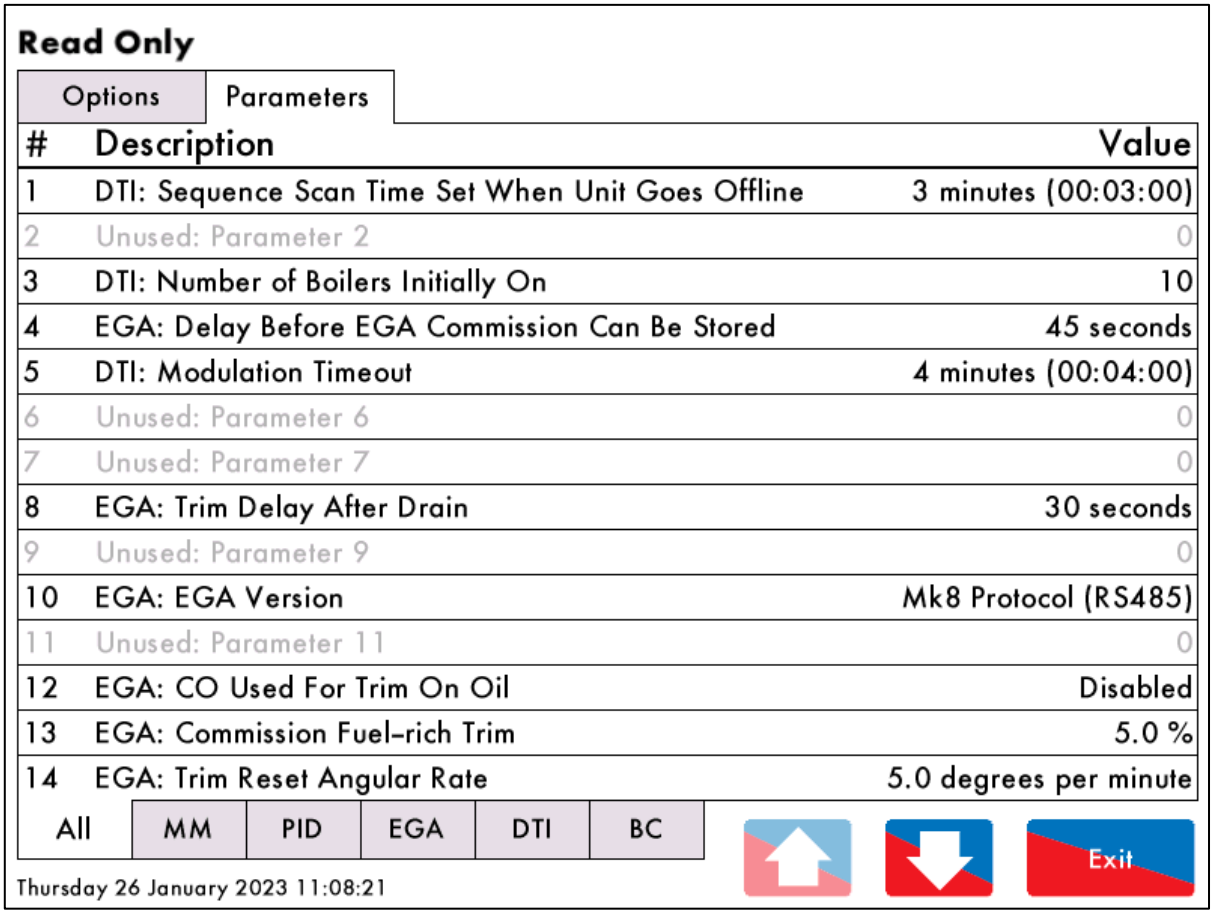


Figure 6.1.3.i Parameters

Press Parameters tab in the Option screen (Figure 6.1.2.i) to view the Parameters screen in Figure 6.1.3.i. The Parameters screens display all the parameters and their settings. To make changes to these Parameters, refer to section 2.

6.1.4. Run Times

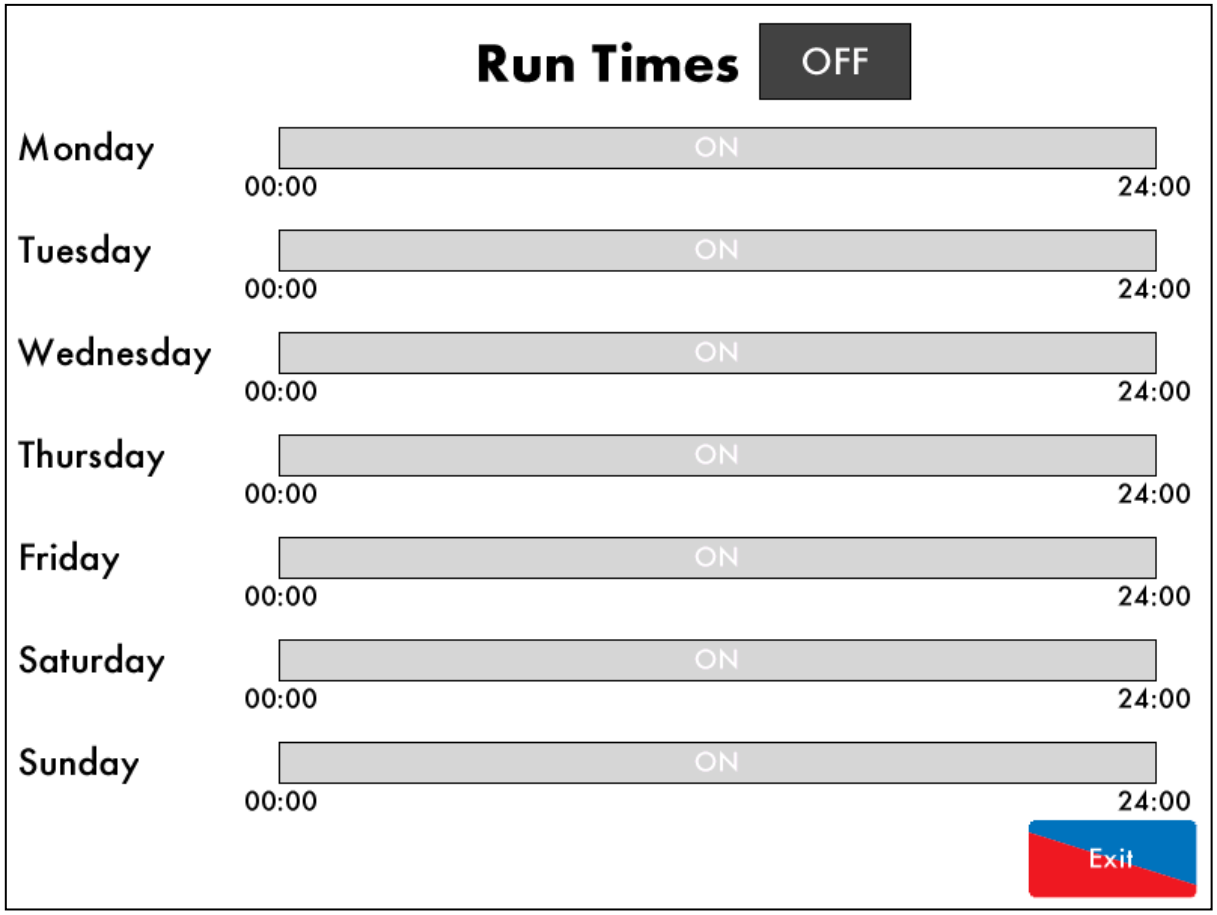


Figure 6.1.4.i Run Times – OFF

Press 

in the main screen (Figure 6.1.i) to view the Run Times screen in Figure 6.1.4.i. You will be prompted to enter a password. Run Times sets when the Autoflame Flame Safeguard unit is scheduled to be on and firing or off.

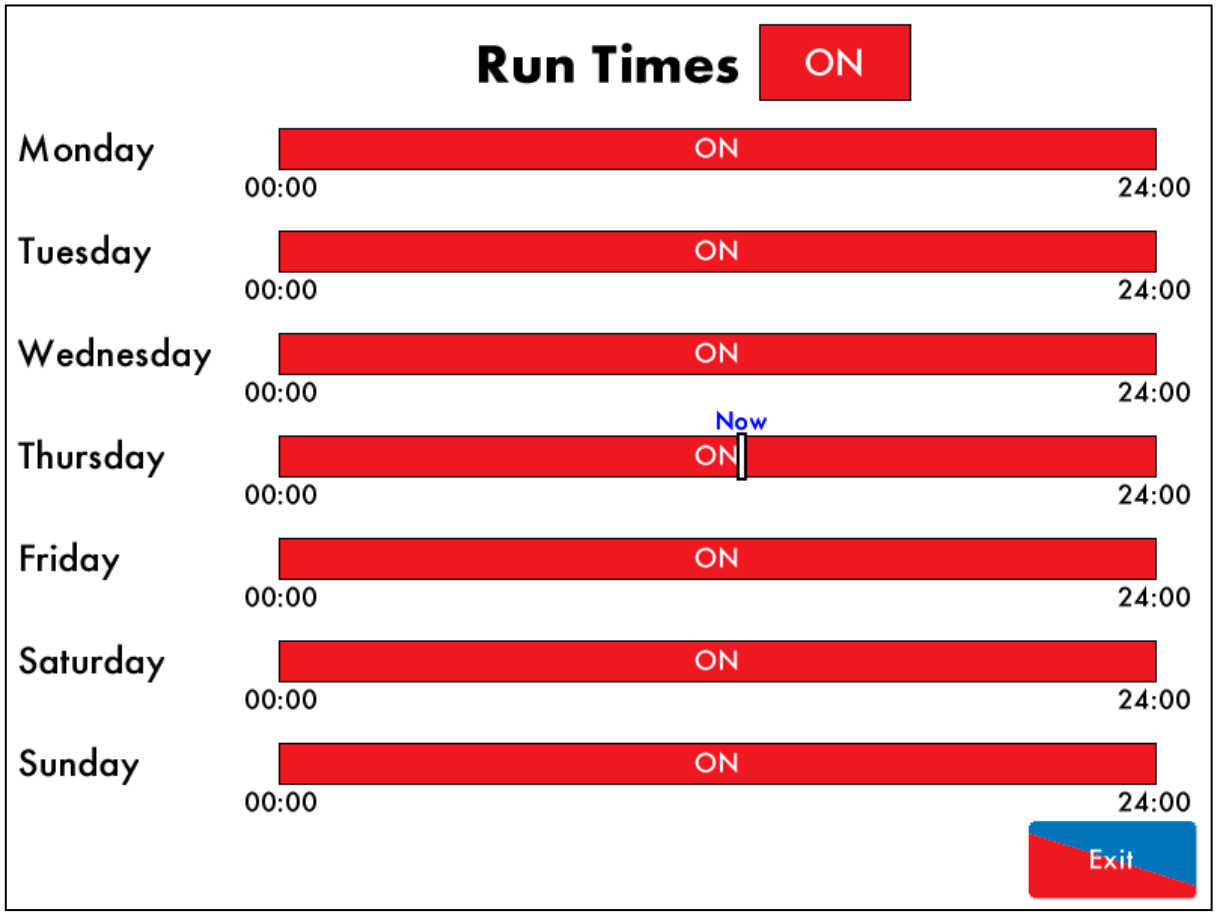


Figure 6.1.4.ii Run Times – ON

Press OFF in the Run Times screen (Figure 6.1.4.ii) to enable the Run Times (set to ON) and have the Flame Safeguard controller determine when the burner may fire.

Press ON in the Run Times screen (Figure 6.1.4.ii) to disable (set to OFF) the run times allowing the burner to fire whenever the external control demands.

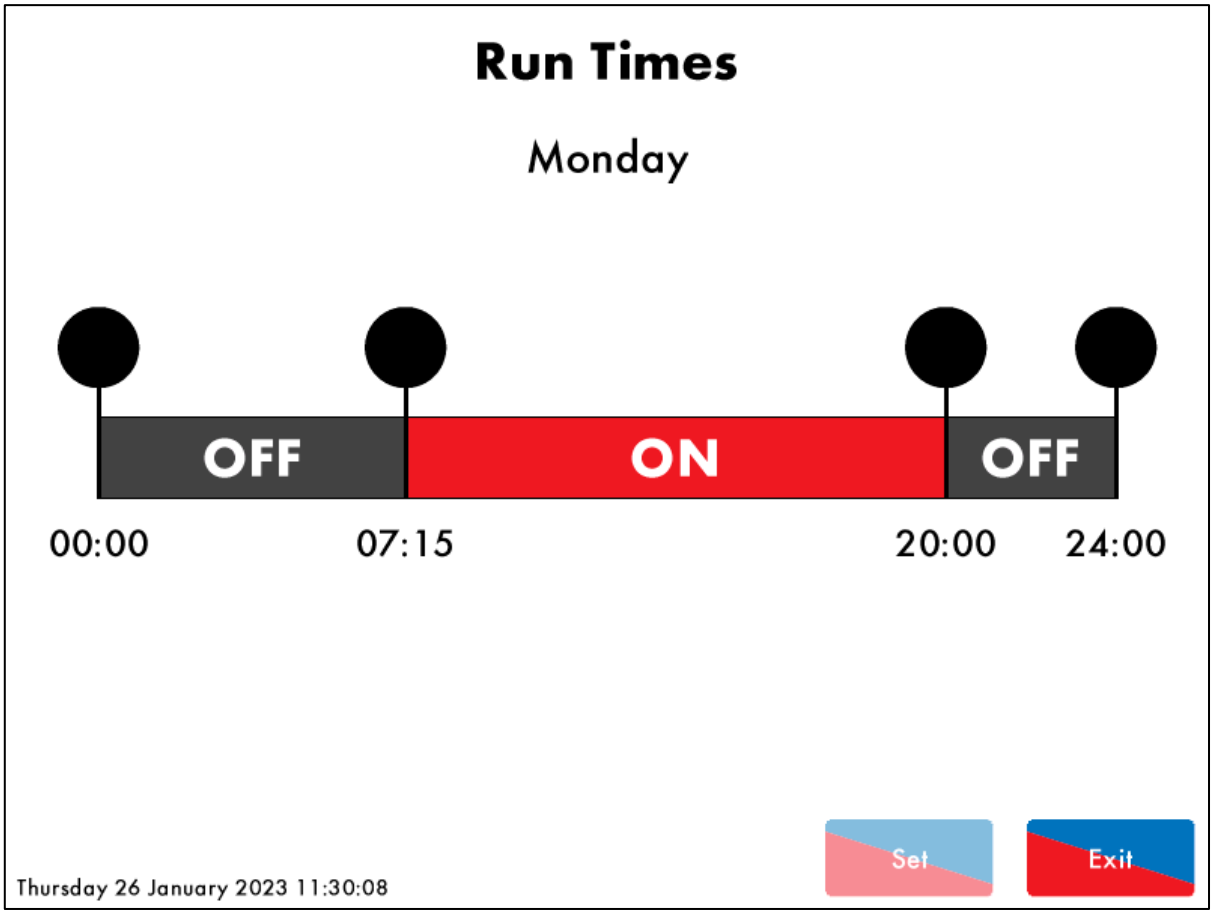


Figure 6.1.4.iii Run Times – Monday

To set the schedule, press on the bar for that day in the Run Times On/Off screen (Figure 6.1.4.ii) to bring up the individual day editing screen (Figure 6.1.4.iii).

Drag the  at the 00:00 time to add new intervals, and drag them to the required time position. Up to 4 time periods can be set. Then press the bar between the markers to toggle the intervals between ON and OFF.

6.1.5. System Log

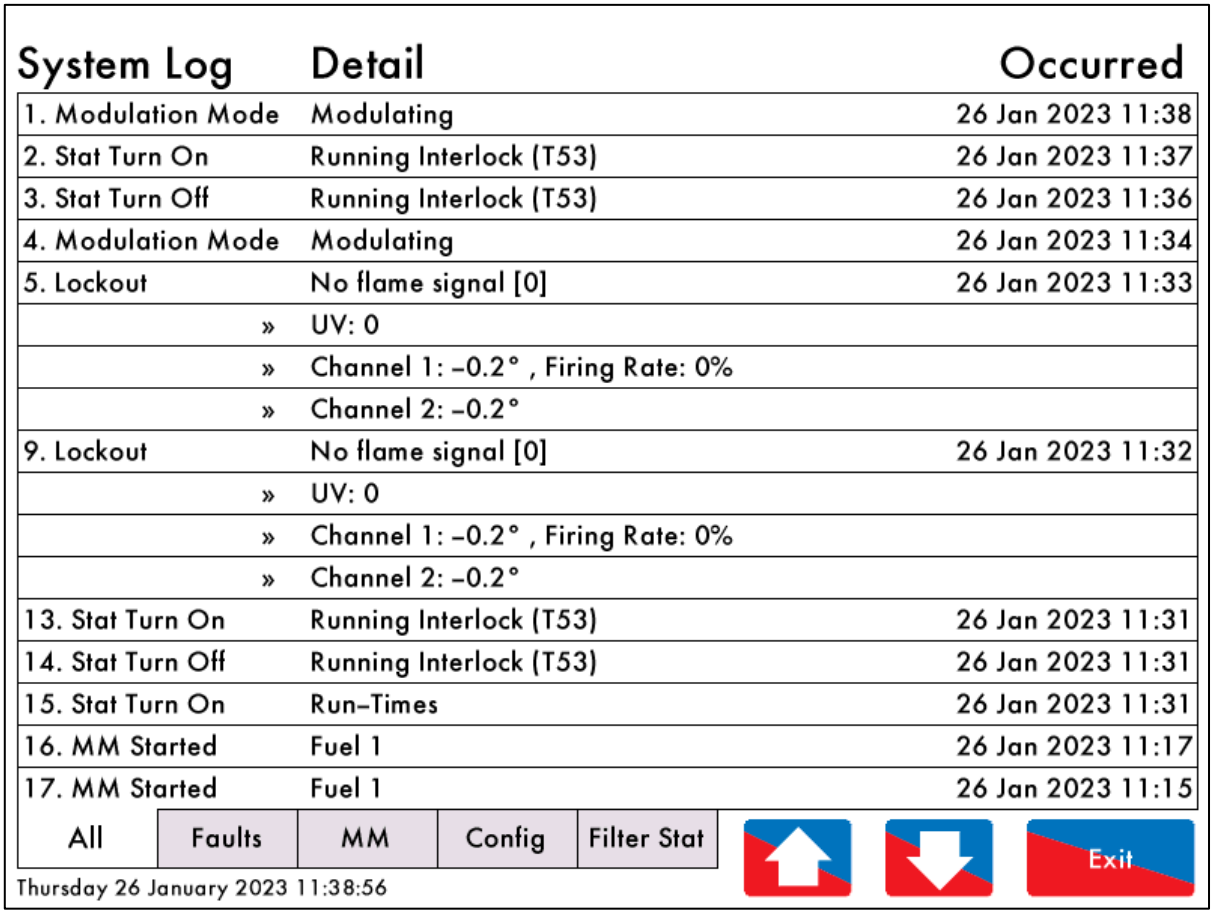


Figure 6.1.5.i System Log

Press 

in the Commission Mode screen or Flame Safeguard Home screen (Figure 2.1.ii or 6.1.i) to view the System Log screen as shown in Figure 6.1.5.i. This data is stored on the MM and the SD card for 1000 entries.

6.1.6. Faults

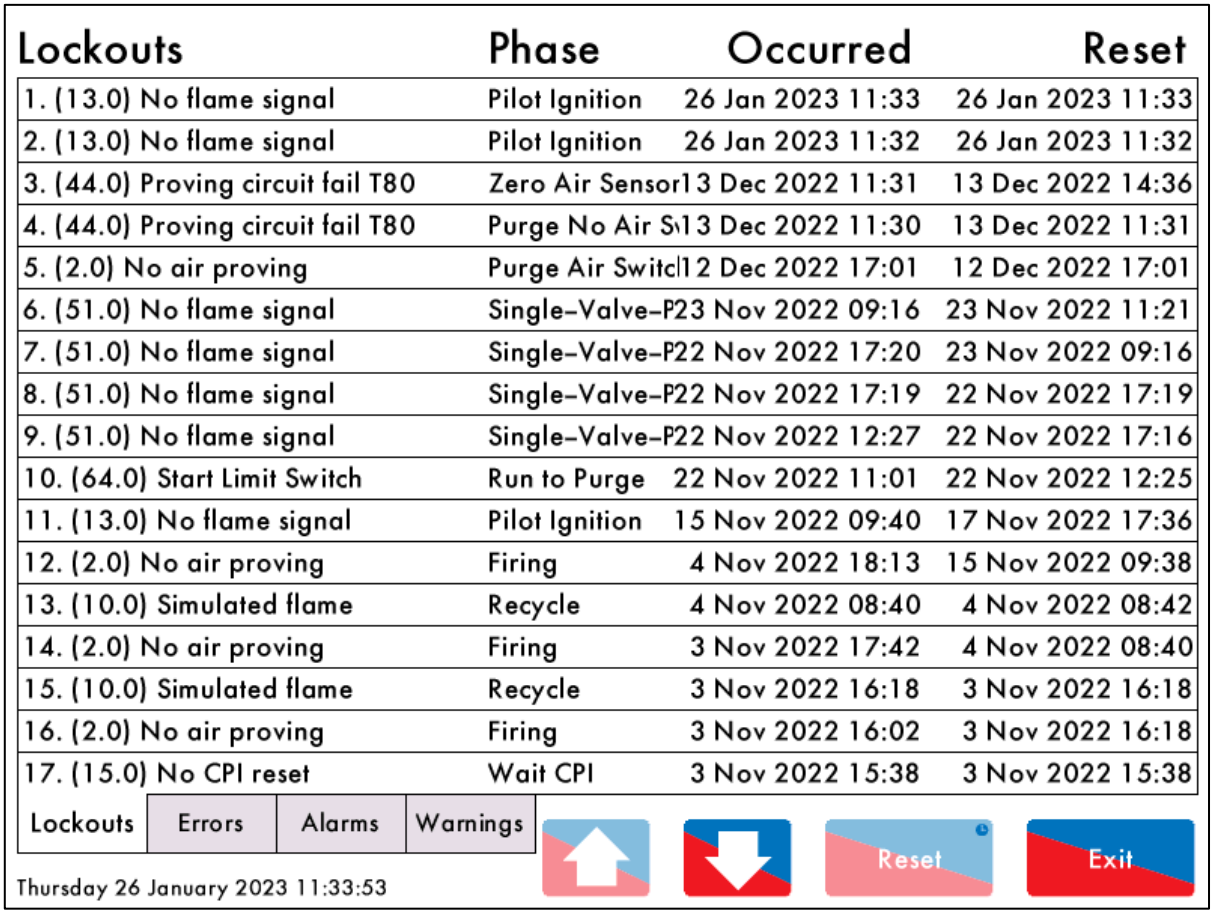


Figure 6.1.6.i Faults

Press 

in the Home screen (Figure 6.1.i) to view the burner Lockouts, Errors, Alarms and Warnings (Figure 6.1.6.i). The MM will store up to 64 burner Lockouts and MM errors.

7. BURNER START-UP SEQUENCE

The MM goes through a series of internal checks and flame safeguard checks before starting up the burner; these are relevant to the burner application. Any errors or lockouts which might occur in the start-up sequence will provide information on the time and date they have occurred, and the phase in which it occurred. If any errors or lockouts occur, please contact Autoflame Engineering Ltd or your local Autoflame Technology Centre.

The following start-up sequence is shown for an example burner application. The system has been set up with these burner control features:

- Firing on gas.
- 1 Valve proving system – No vent valve.
- Intermittent pilot.
- UV scanner.
- Air switch on T54.
- Mains Input (T82) – VPS and pressure limits checked.
- VPS operates before start-up.
- Pre-purge and post-purge.

7.1. Recycle

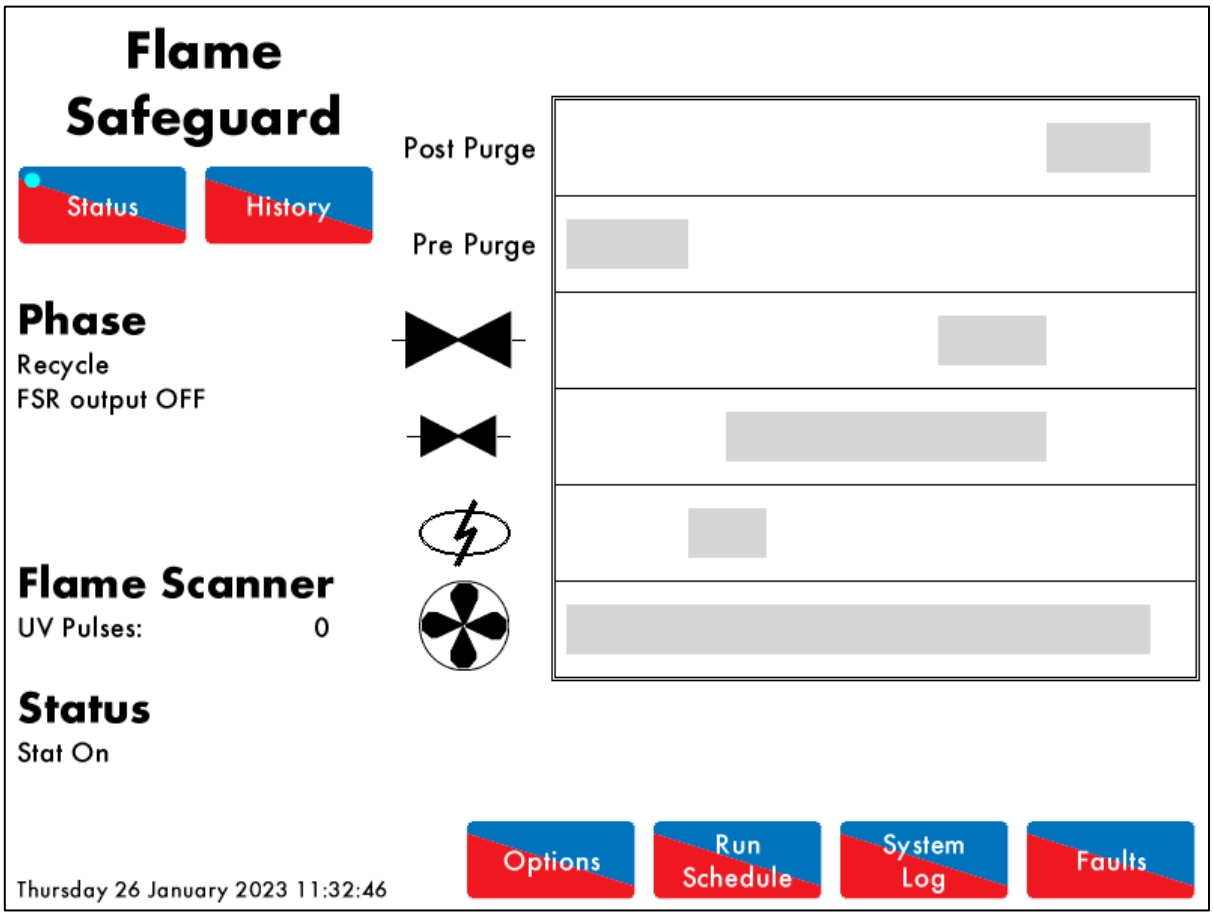


Figure 7.1.i Recycle

When the burner enters the Recycle phase shown in Figure 7.1.i, both the fuel valves and air damper go to their respective commissioned ‘closed’ positions, and the burner is not firing.

As the burner is off in Recycle, there should not be any flame detected. The UV scanner checks that there is no flame, and if a flame is detected, the lockout ‘Simulated Flame’ will occur. This could be a result of after burn and must be investigated. A post-purge could be necessary. See option/parameters 118 and 135.

While the MM is in the Recycle phase, if T53 is switched ON, there will be a time delay before the burner starts up. See option/parameter 119.

7.2. Standby

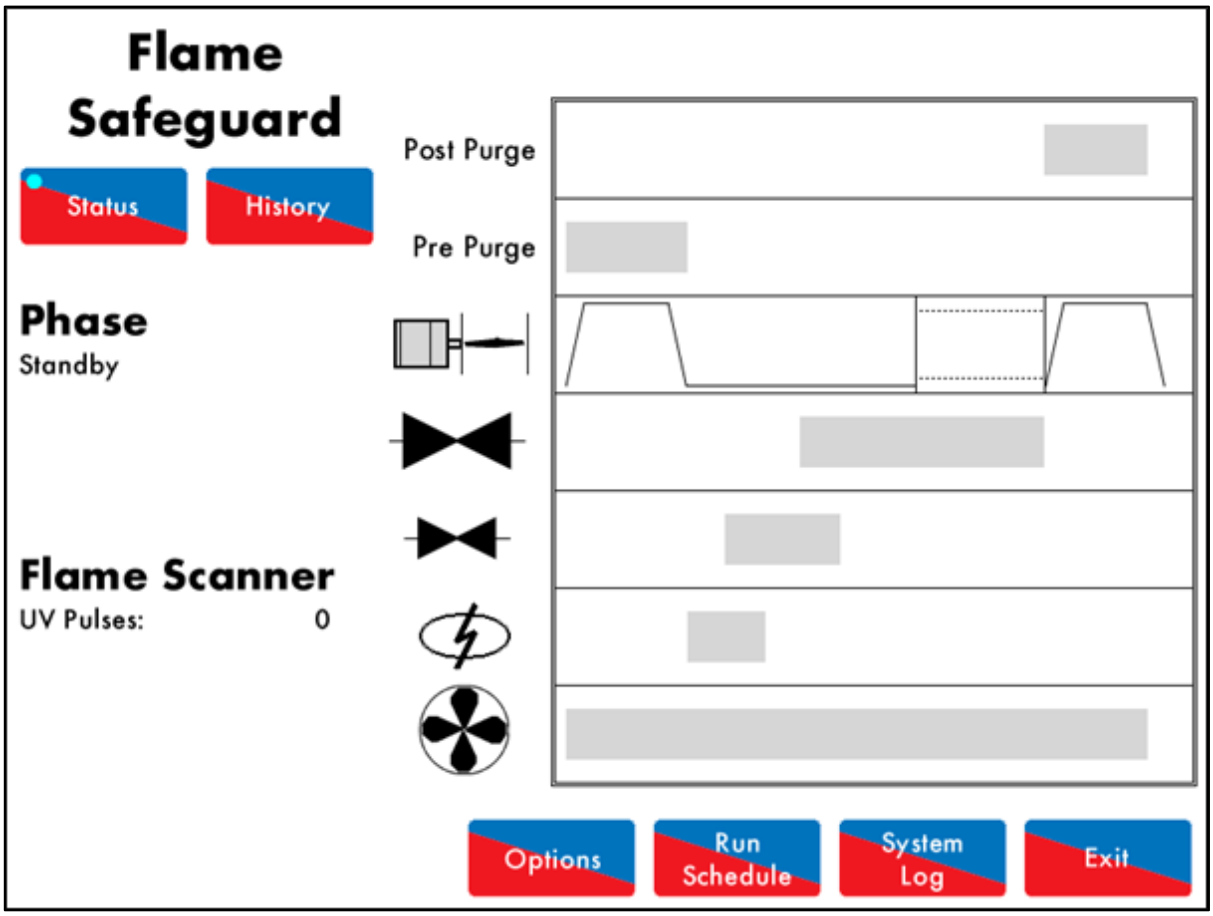


Figure 7.2.i Standby

The burner will go into Standby shown in Figure 7.2.i., before the safety checks begin to initiate the burner start-up sequence.

The Flame Safeguard controller will remain in this phase if it is waiting due to the Run Schedule being active, but the current phase being OFF. The external safety interlock circuit is tied into T53, this also must be ready for the burner to be switched on, to move to the next phase.

The MM will remain in Standby if the burner has been disabled, via T53.

7.3. Internal Relay Tests

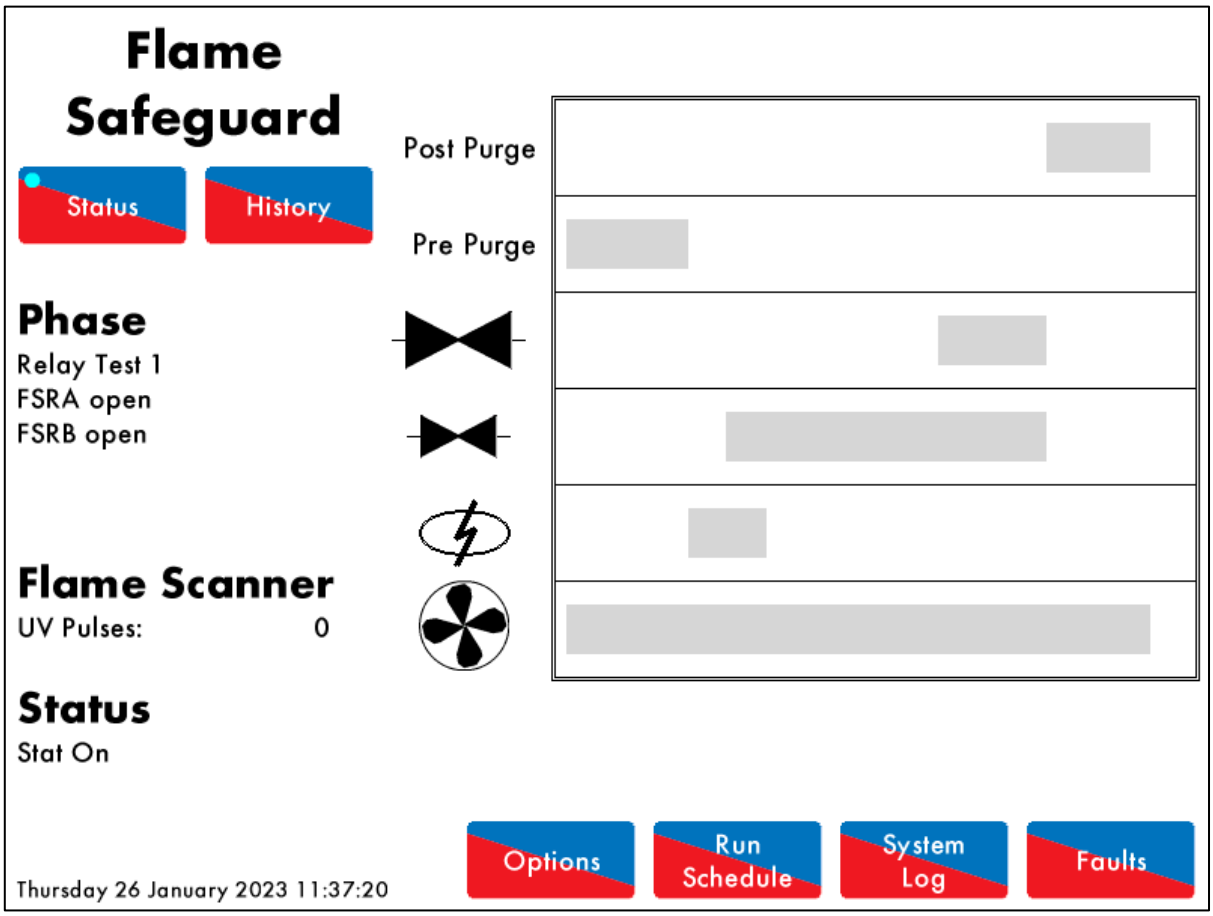


Figure 7.3.i Relay Test 1

During the Internal Relay Tests phase shown in Figure 7.3.i., the MM will check its internal flame safe relays 1 to 5. Should any Lockouts occur now for the relay tests such as 'FSR Test 1A' this is an indication of an internal fault within the MM.

The MM will go through a series of 5 relay tests.

If voltage is detected on terminal 57 call for heat during these checks when there should not be, the lockout 'Fail Safe Relay Fault' will occur. Please check the 5A fuse.

7.4. CPI Input

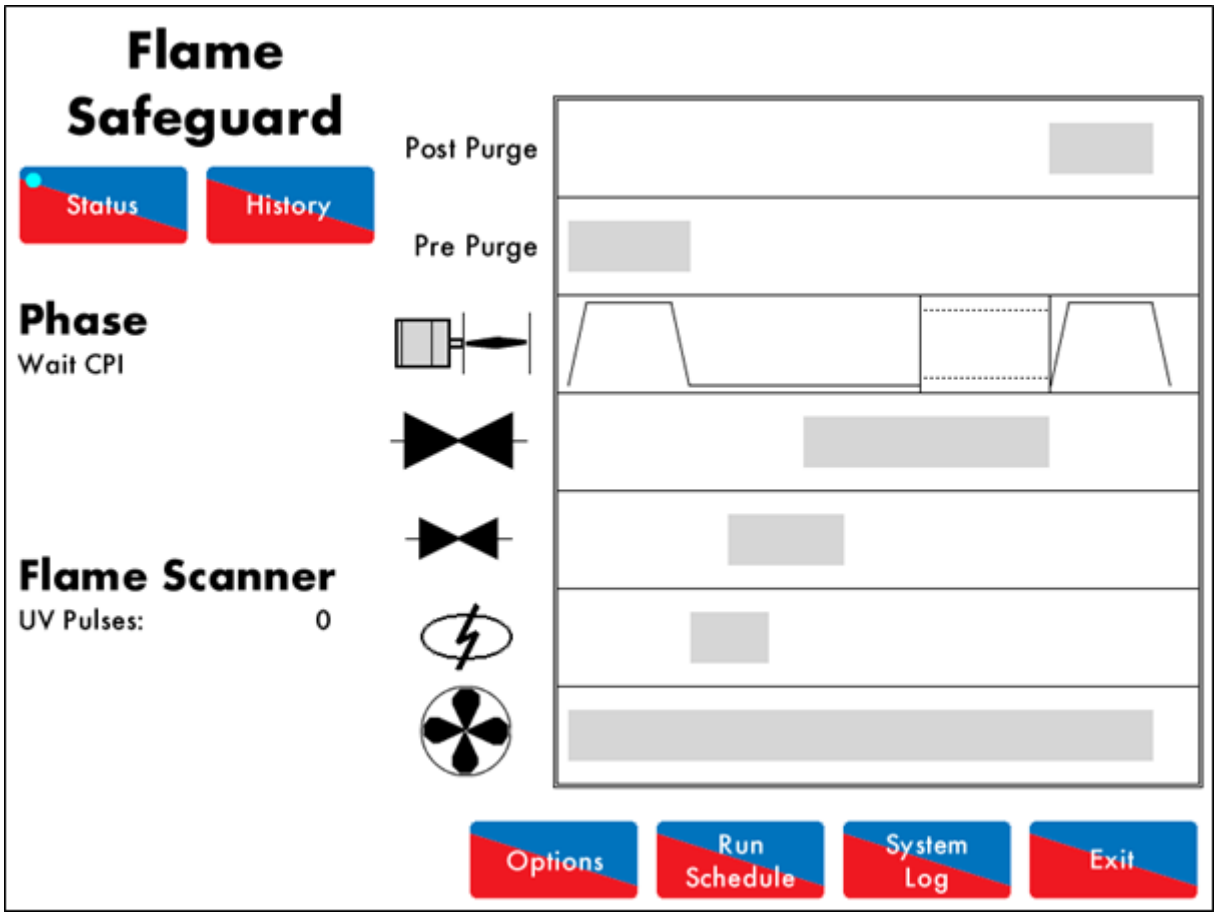


Figure 7.4.i CPI Input

In the Wait CPI phase shown in Figure 7.4.i, a check is made on terminal 55 for the proof of closure switch. If terminal 55 does not see an input within 5 seconds, the lockout 'No CPI Reset' will occur.

7.5. Valve Proving

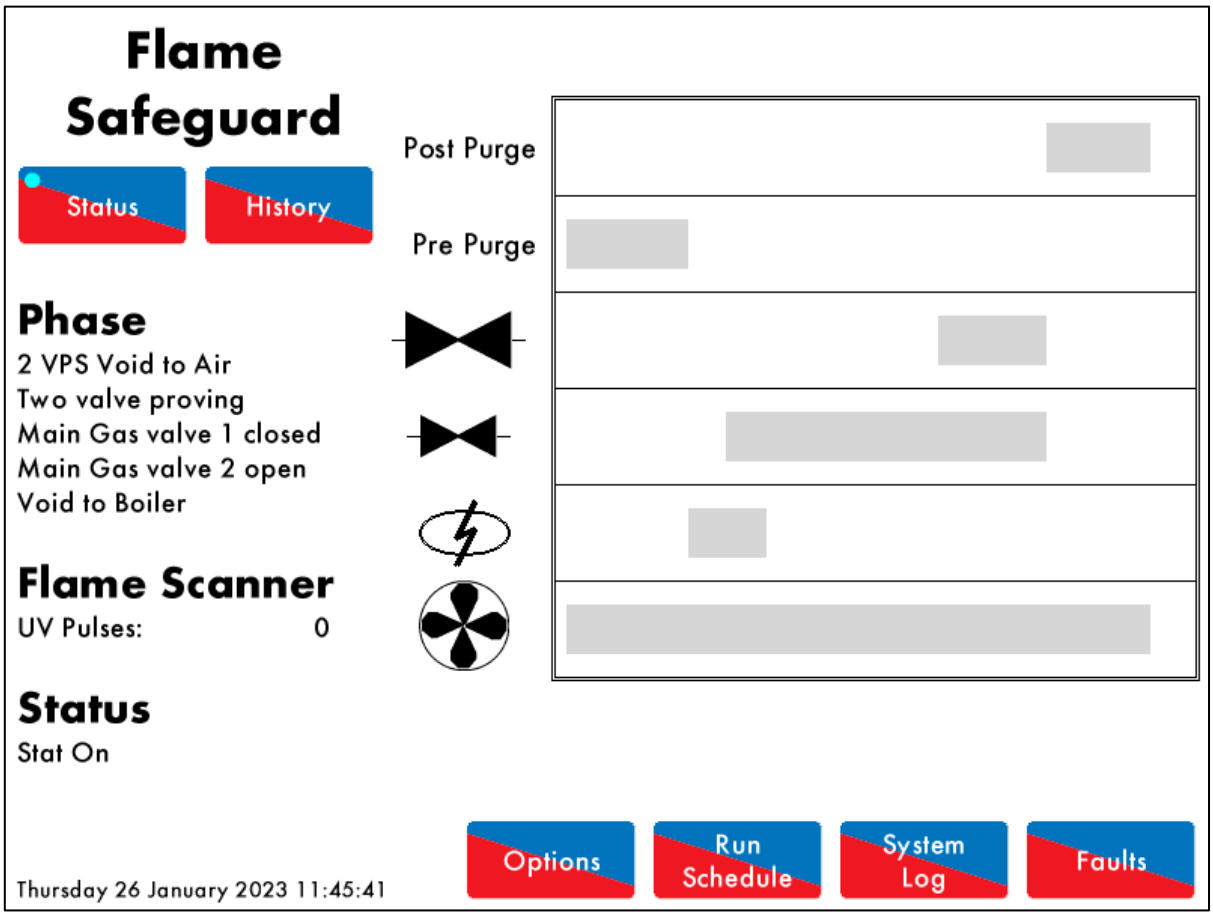


Figure 7.5.i VPS Venting

In this example, the Flame Safeguard controller has no vent valve and has single valve pilot optioned. 2 Valve proving is used to check the integrity of the gas for any leaks. See option/parameter 130.

During the VPS Venting phase shown in Figure 7.5.i., the main gas valve 1 is checked. The main gas valve 1 output is off (closed), and the main gas valve 2 output is on (opened), so that the void between the main gas valves can vent to atmosphere.

If no voltage is detected when the burner main gas valve 2 output T61 should be on (and vice versa), the lockout 'Main Gas 2 Output Fault' will occur.

Note: If valve proving has been optioned with no vent valve and with single valve pilot, then the pilot valve is used for this VPS venting phase.

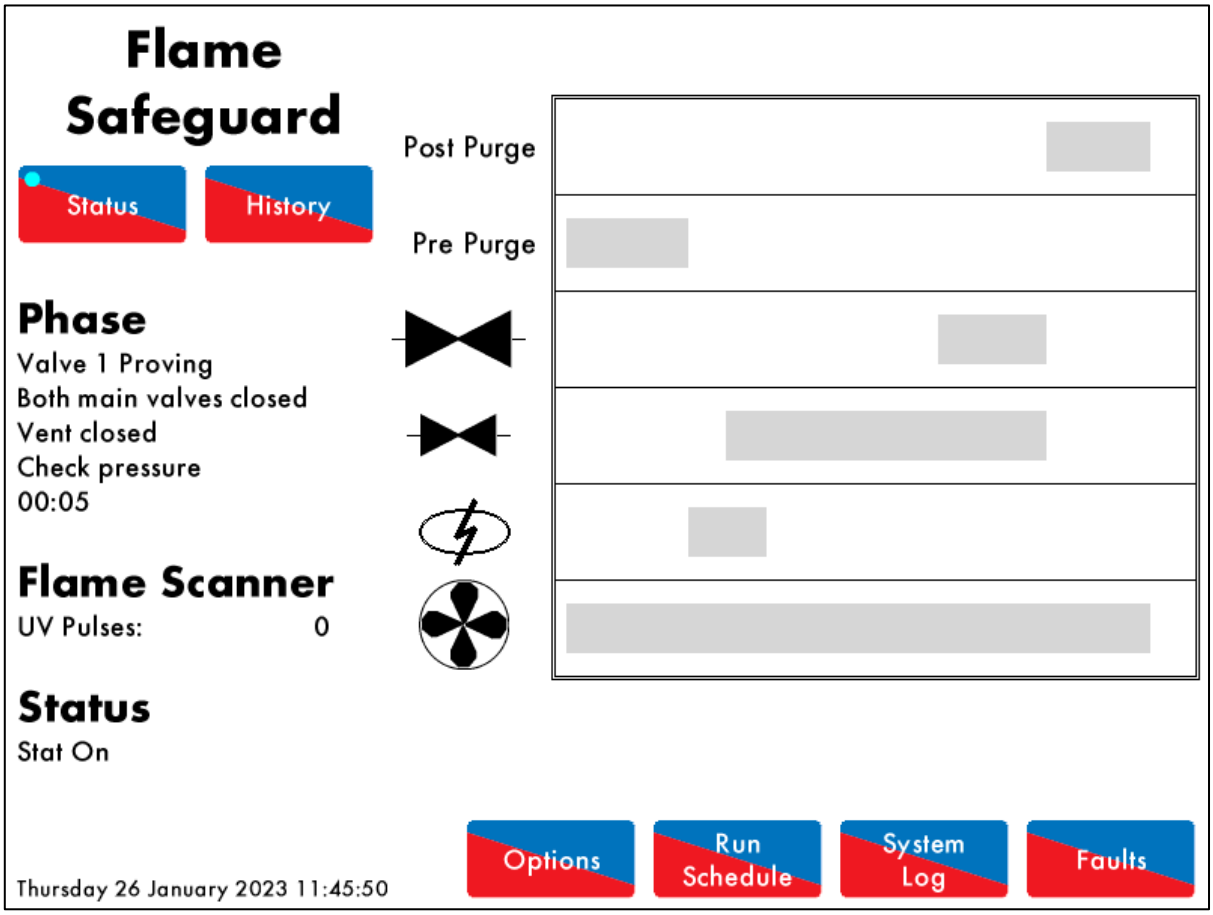


Figure 7.5.ii VPS Air Proving

In the VPS Air Proving phase shown in Figure 7.5.ii, the main gas valve 2 output is off (closed) and the main gas valve 1 output is off (closed), to check for a pressure increase.

After the valves close, there is a 1.5 second delay after which the air pressure switch must remain off. If a signal is detected here, then the lockout 'VPS Air Proving Fail' occurs as air has been let in between the main gas valve 1 and 2, indicated that main gas valve 1 has failed.

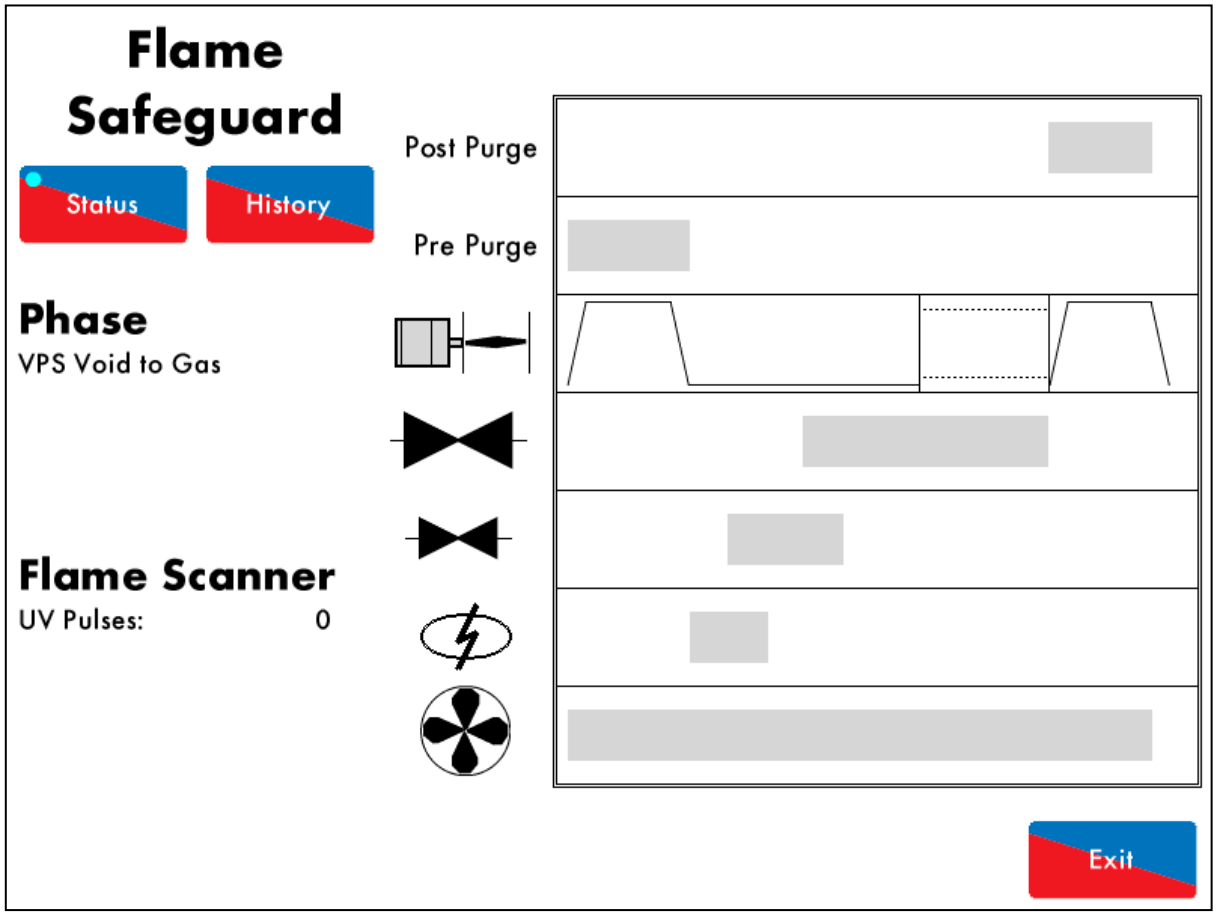


Figure 7.5.iii VPS Void to Gas

In the VPS Void to Gas phase shown in Figure 7.5.iii, the main gas valve 1 output is on (open), and the main gas valve 2 is output off (closed) – gas is let through to fill the void.

If no voltage is detected when the burner main gas valve 1 output T60 should be on (and vice versa), the lockout 'Main Gas 1 Output Fault' will occur.

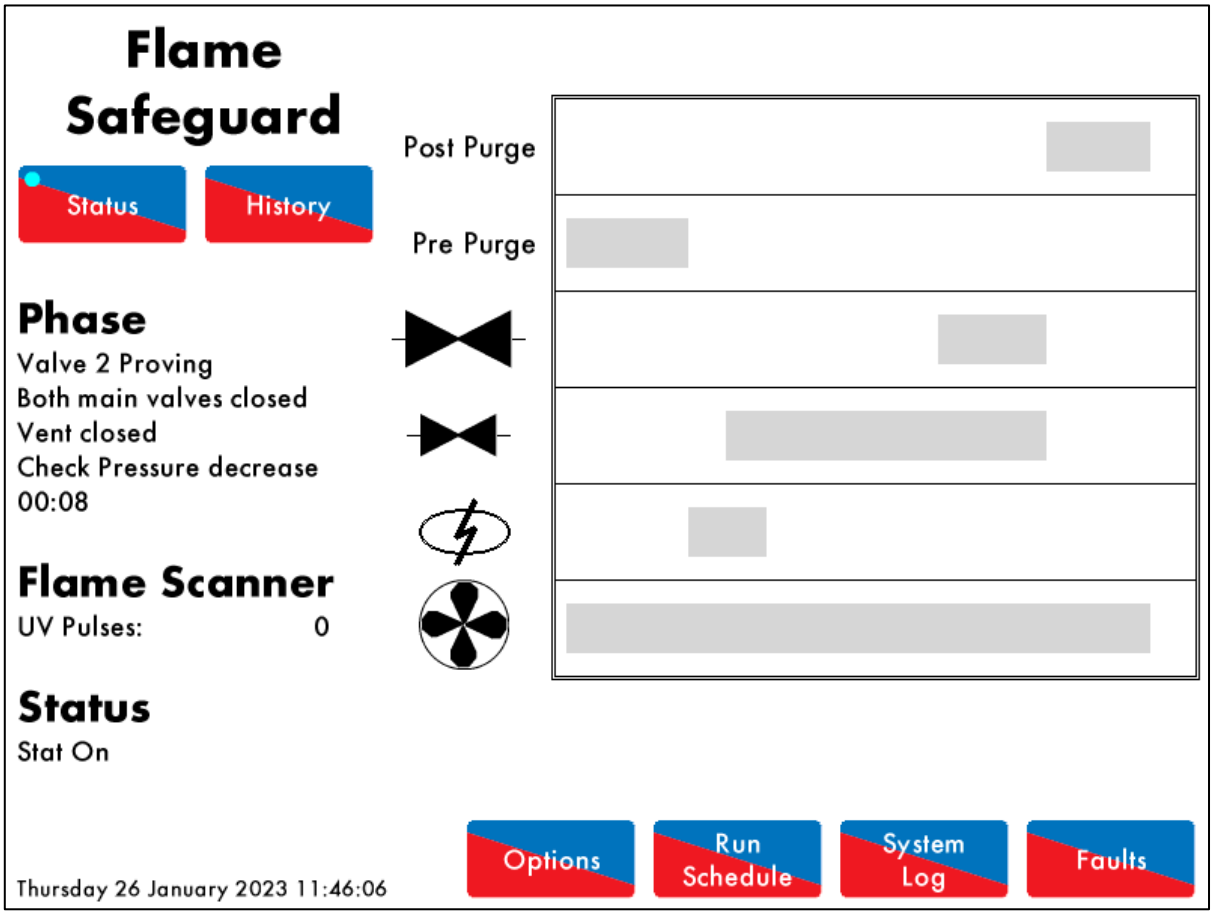


Figure 7.5.iv VPS Gas Proving

In the VPS Gas Proving phase shown in Figure 7.5.iv, the outputs of main gas valves 1 and 2 are both off (closed), to check for any gas leaks in the void between the main valves.

After the valves close, there is 1.5 second delay after which the gas pressure switch must be on, indicating the pressure is above the set value. If the pressure switch is off, there could be a leak of pressure out and the lockout 'VPS Gas Proving Fail Low' will occur. This indicates that there could be a fault with main gas valve 2. See option/parameter 133.

If the lockout 'VPS Gas Input Too High' occurs, this indicates that there an increase in pressure has been detected. Check the main gas valve 1, and ensure the valve opening times are set correctly, see option/ parameter 134.

7.6. Wait for Air Switch

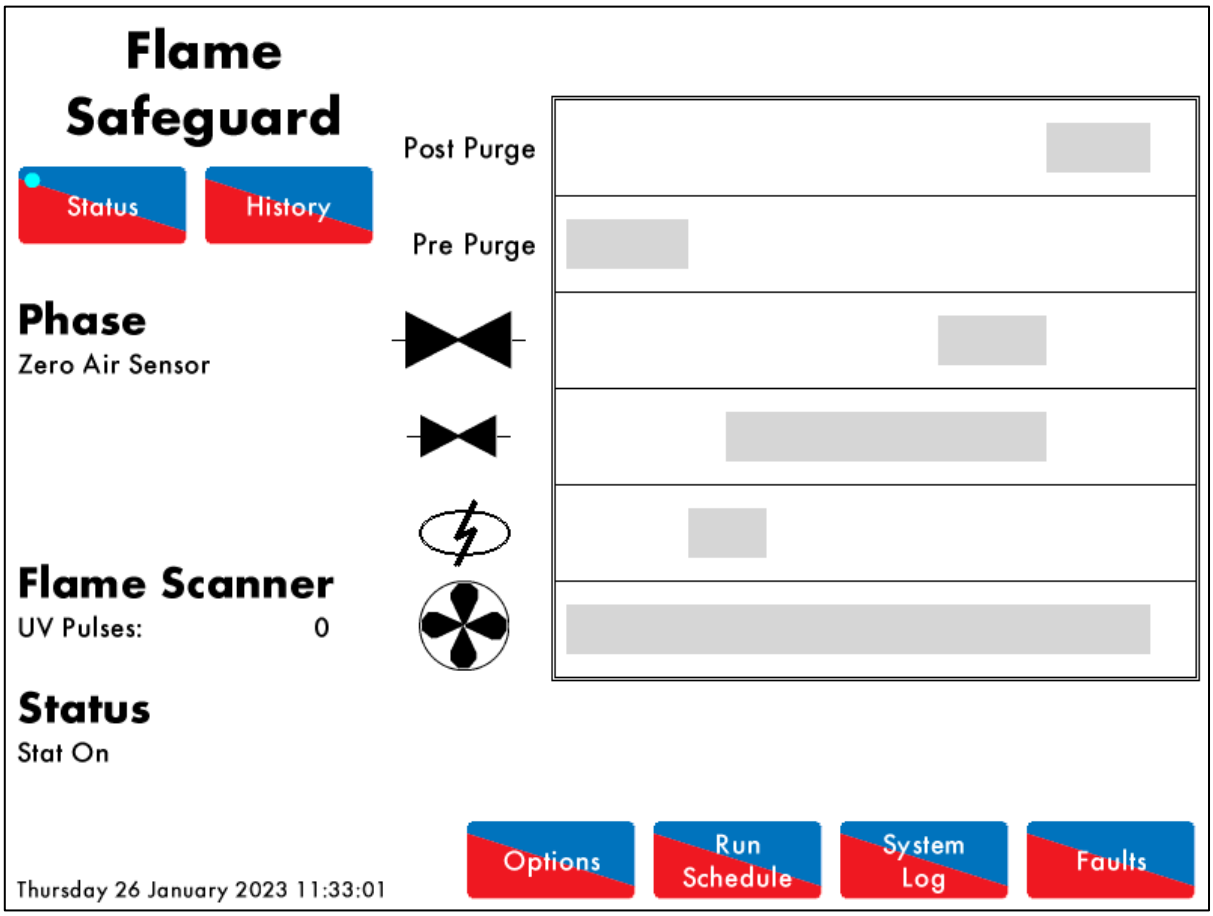


Figure 7.6.i Zero Air Sensor

Once the VPS checks are competed, if an air switch is used on T54, the Flame Safeguard controller will go to the Wait for Air Switch phase. If a reset of voltage is not seen and the MM is in this phase more than 2 minutes, the lockout 'Wait Air Switch Timeout' will occur.

7.7. Purge

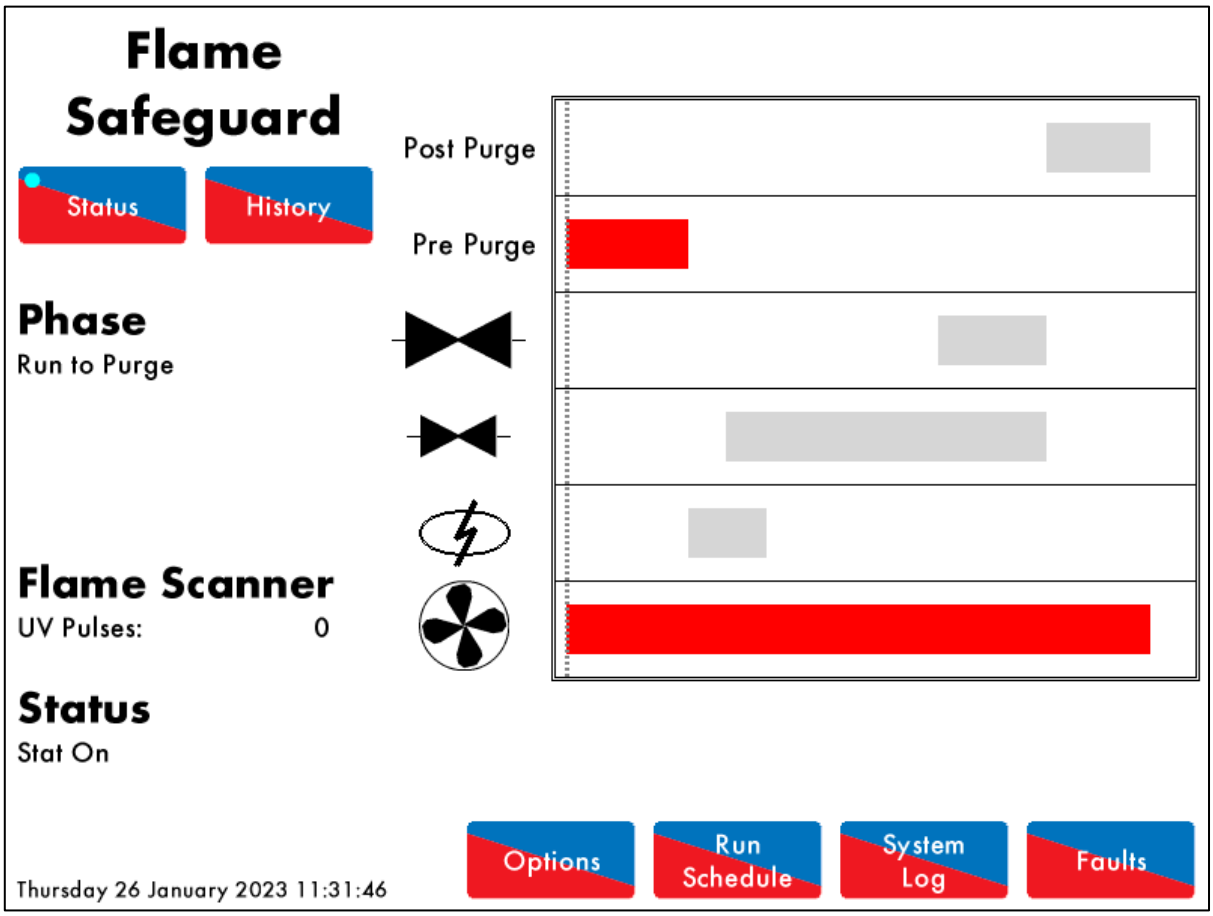


Figure 7.7.i Run to Purge

Once all the internal relay and VPS checks have been made, the motor moves to their purge positions in the Run to Purge phase shown in Figure 7.7.i. The burner motor output is switched on.

If no voltage is detected when the burner motor output T58 should be on (and vice versa), the lockout 'Motor Output Fault' will occur.

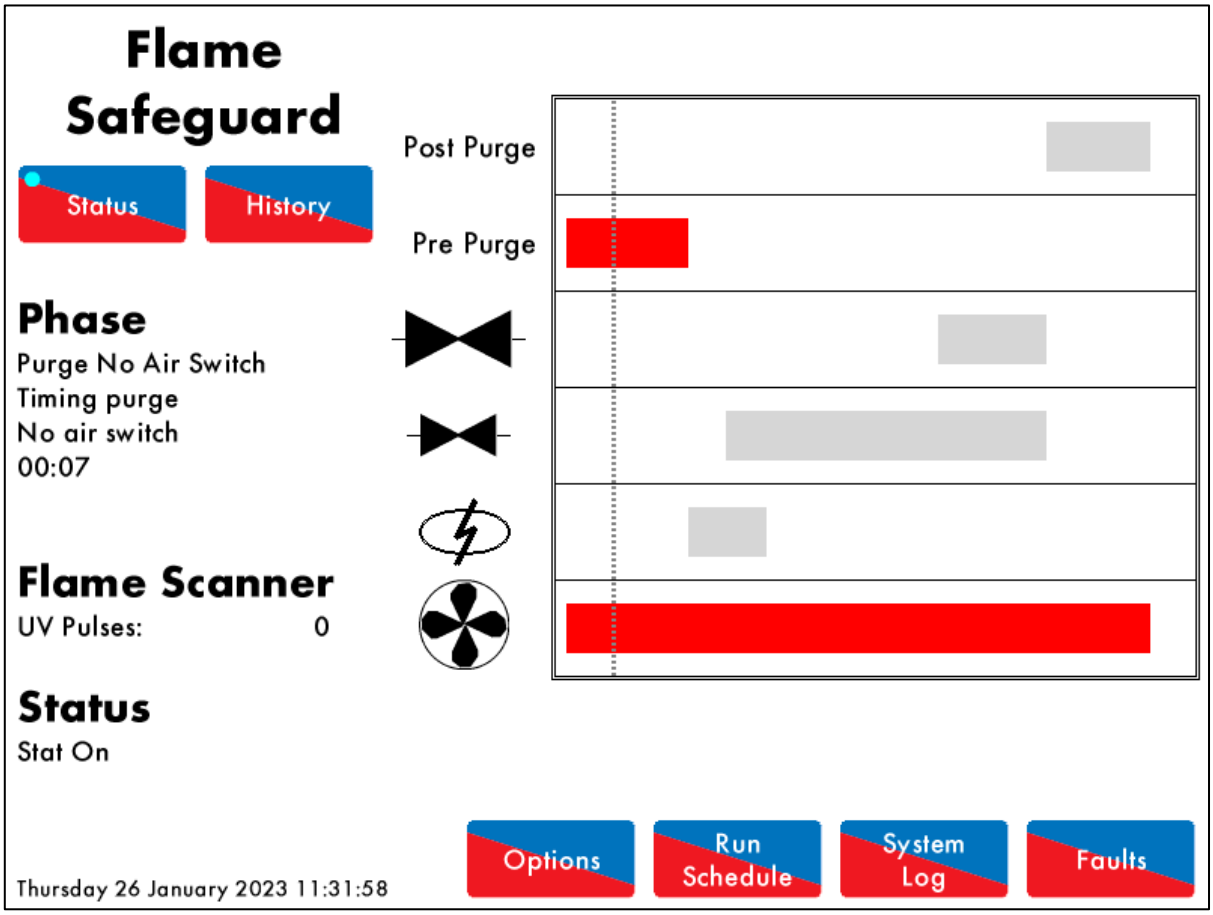


Figure 7.7.ii Purge No Air Switch

The Purge No Air Switch phase shown in Figure 7.7.ii allows a delay before the air switch is checked. See option/parameter 121.

Note: A purge position interlock must be connected to terminal 81; this input must be made in order for the system to begin the purge phase, see option/parameter 155.

In the On/Off burner setup, The T70 (switched neutral) can be used to drive T81 (Purge Switch) through a 5 second ON-delay timer relay to initiate the purge phase.

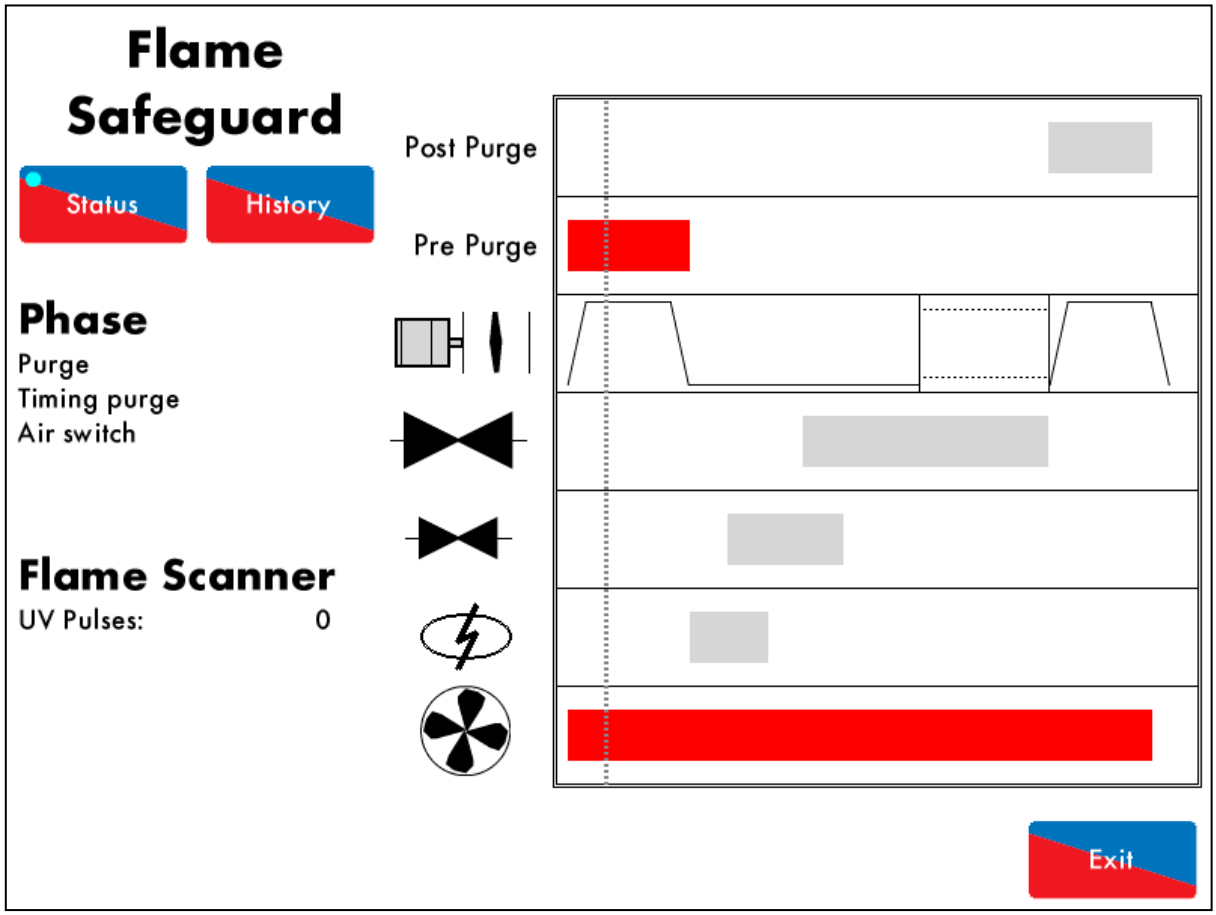


Figure 7.7.iii Purge Air Switch

Once the 'delay from start of the purge before the air switch is checked' has elapsed, if using an air switch, line voltage must be present on T54 throughout the purge cycle and maintained until the burner enters the Recycle phase on Shut Down. See option/ parameter 145.

Purging the burner/boiler forces fresh air to flow through the combustion chamber; this clears out any fuel remnants or residual combustion gases. See option/parameter 112.

7.8. Ignition

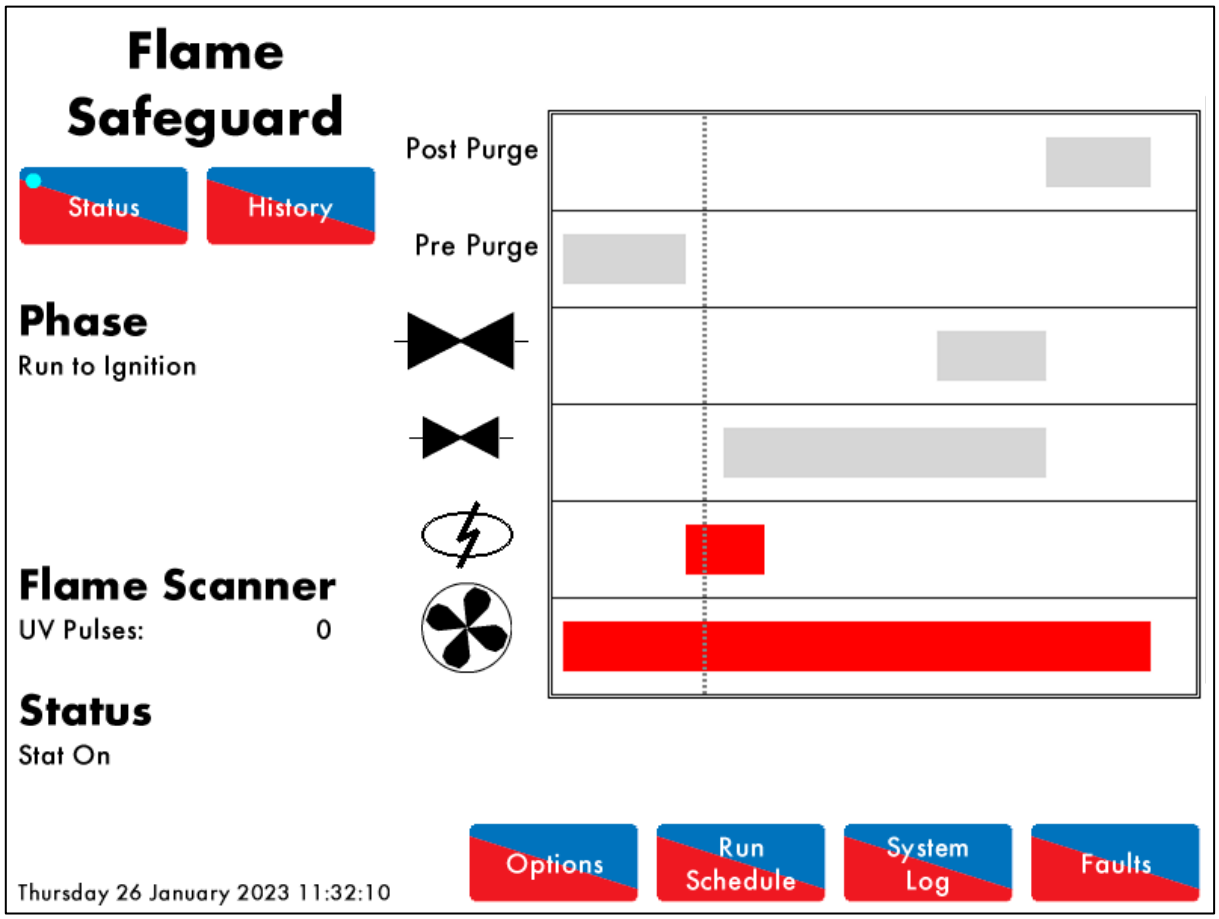


Figure 7.8.i Run to Ignition

In the Run to Ignition phase shown in Figure 7.8.i, the motor will move to the start position. A start position interlock is connected to terminal 80; This input must be made to initiate the ignition phase.

In the On/Off burner setup, The T70 (switched neutral) turning off can be used to swap the drive from T81 to T80 (Start Switch) through the relay to initiate the ignition phase.

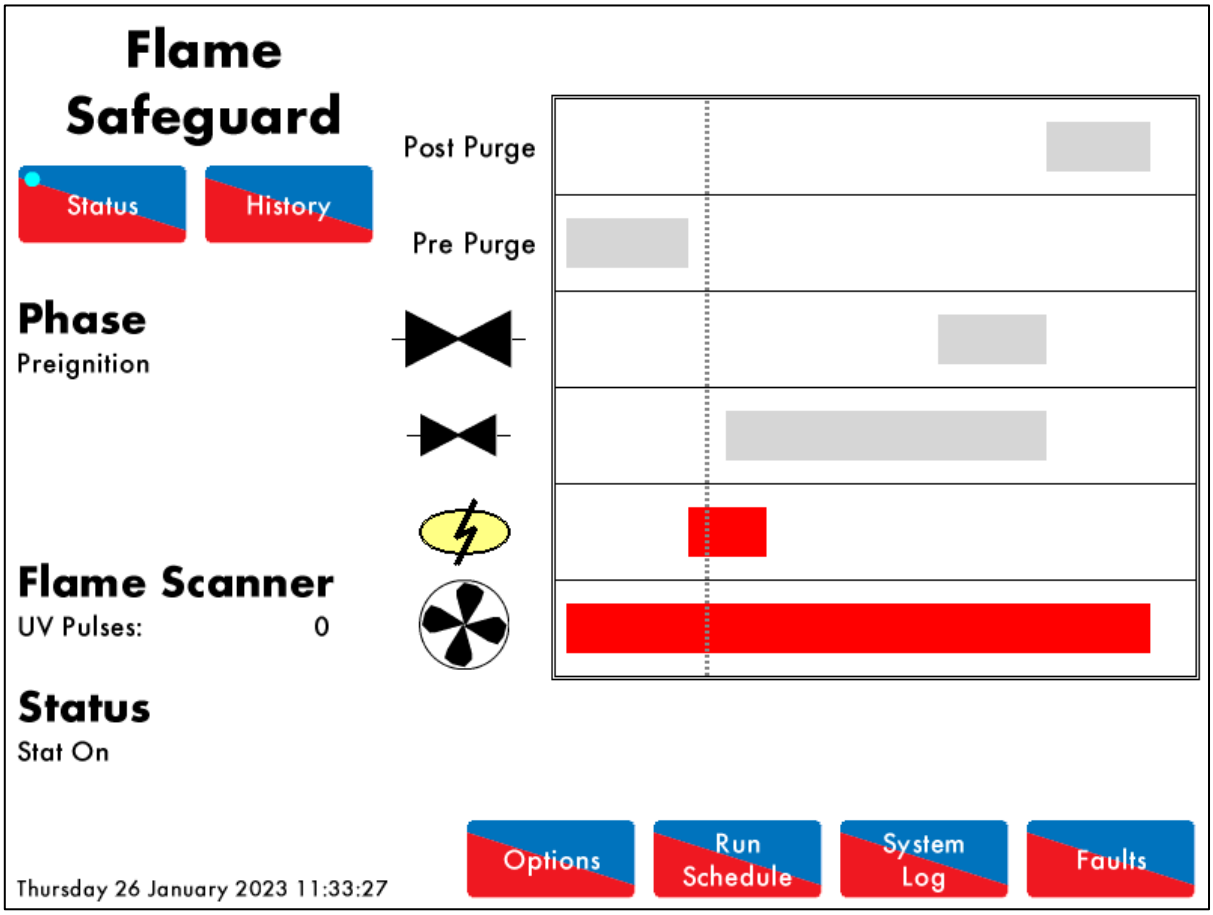


Figure 7.8.ii Pre-ignition

The ignition transformer output is switched on in the Pre-ignition phase shown in Figure 7.8.ii, before the pilot gas valve is switched on (open). See option/parameter 113.

If no voltage is detected when the ignition output T63 should be on (and vice versa), the lockout 'Ignition Output Fault' will occur.

If the gas valves proof of closure switch output T55 is opened during ignition, the lockout 'CPI Input Wrong State' will occur.

7.9. Pilot

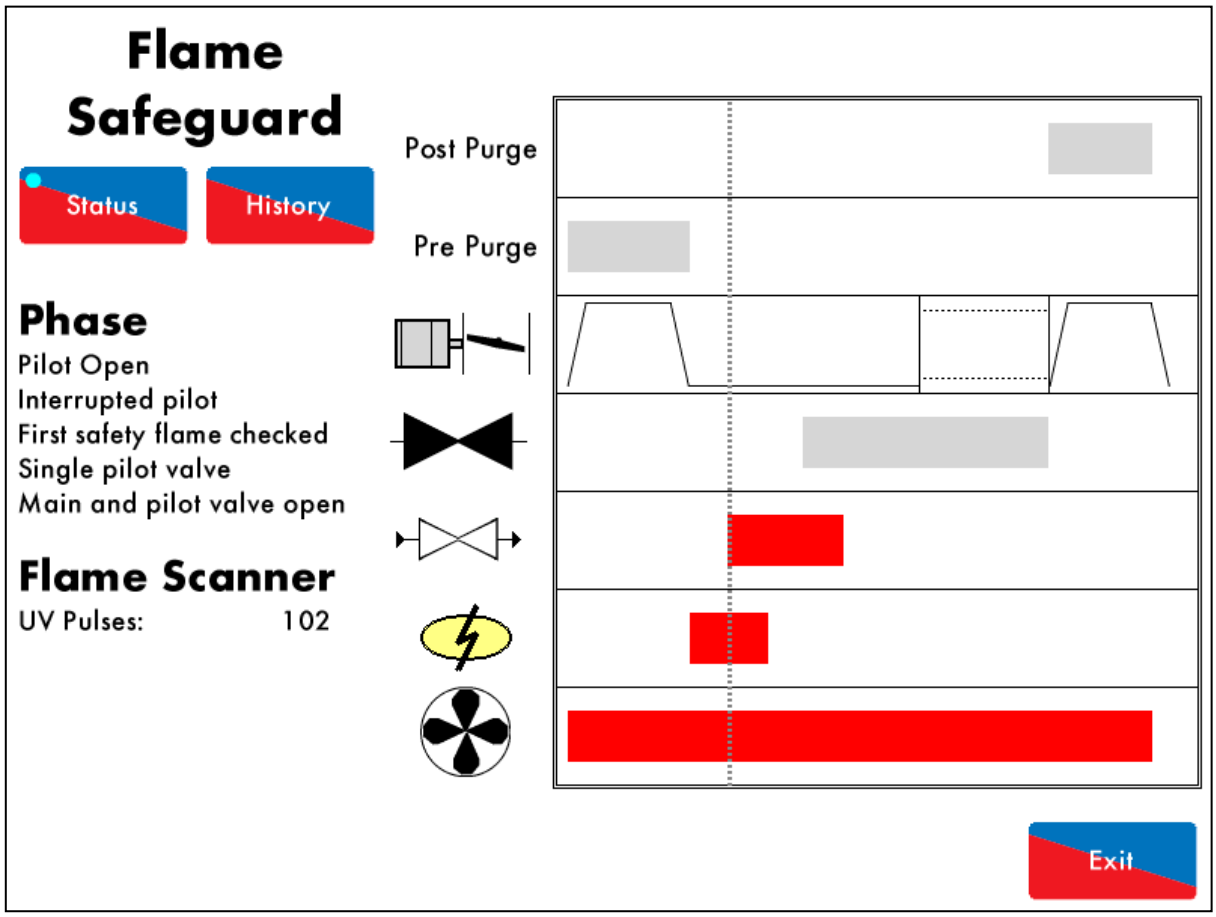


Figure 7.9.i Pilot Open

The pilot gas valve is switched on (open) in the Pilot Open phase shown in Figure 7.9.i. The 1st safety time is the period when the pilot valve is open before the flame is checked. See option/parameter 114.

If no voltage is detected when the pilot valve output T59 should be on (and vice versa), the fault 'Start Gas Output Fault' will occur.

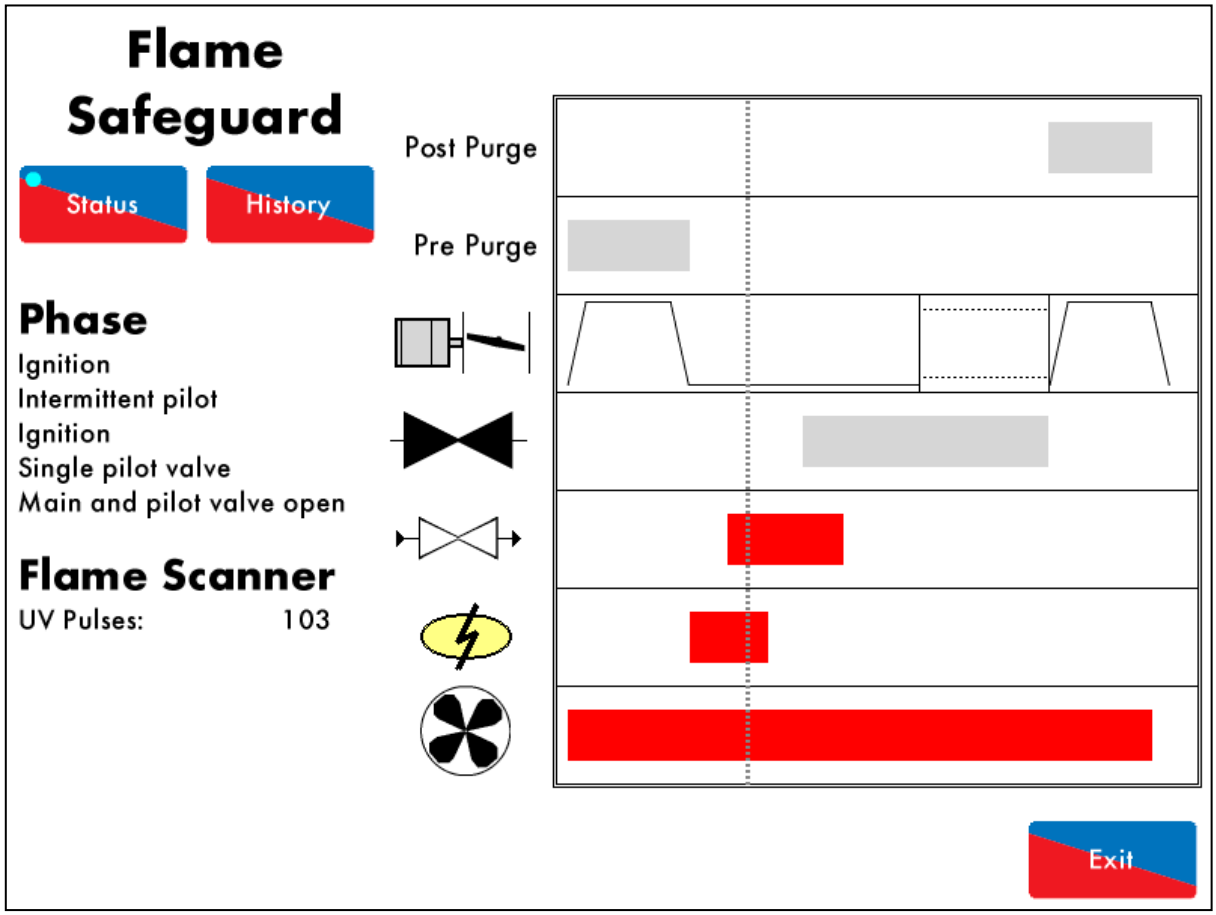


Figure 7.9.ii Ignition

At the end of the 1st safety time period, the pilot flame is checked by the UV scanner in the Single Valve Pilot Ignition shown in Figure 7.9.ii. If the pilot goes out, the lockout 'No Flame Signal' will occur.

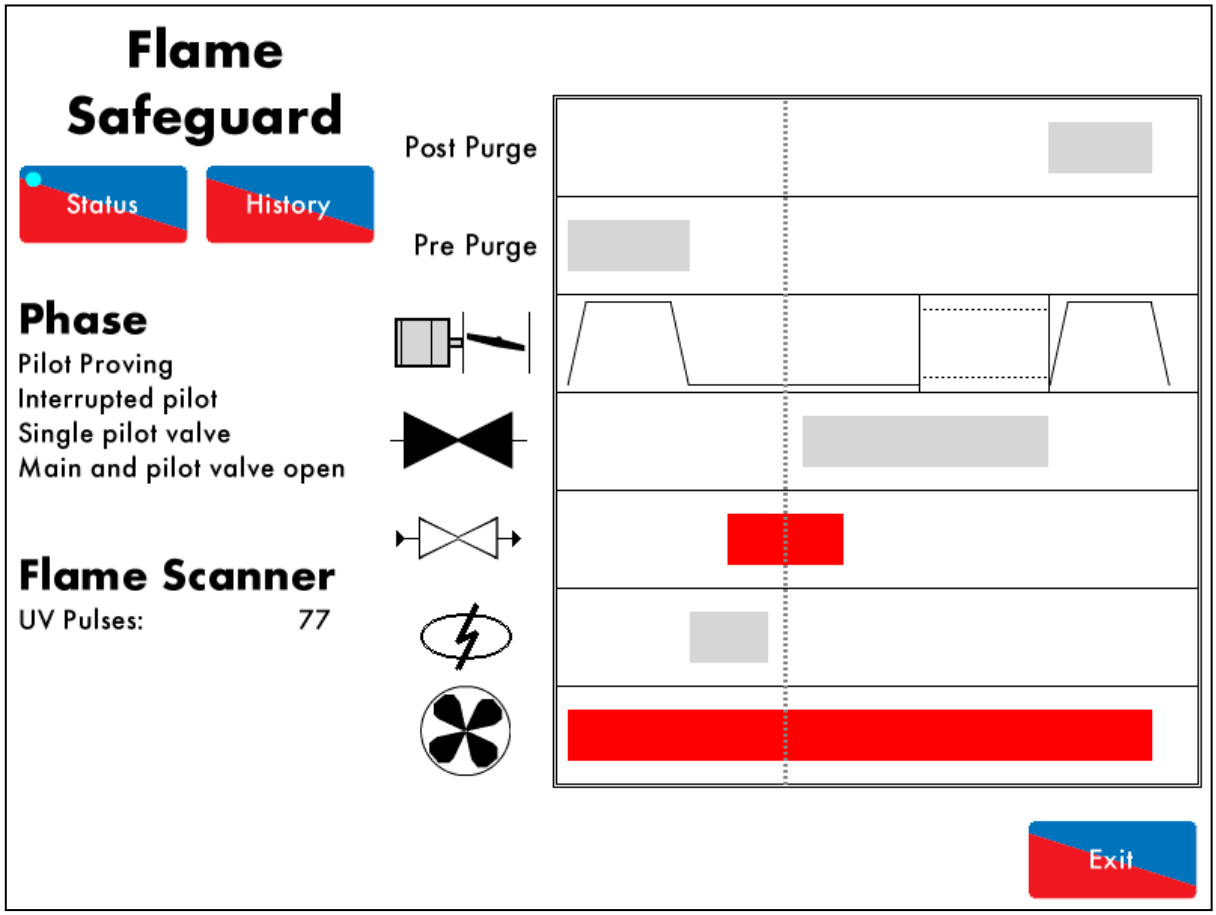


Figure 7.9.iii Pilot Proving

The ignition transformer output is switched off after the pilot ignition, in the Pilot Proving phase shown in Figure 7.9.iii. This proving period gives the pilot flame a chance to stabilise. The flame is checked to ensure the pilot is strong. If the pilot goes out, the lockout 'No Flame Signal' will occur. See option/parameters 115 and 120.

7.10. Proving

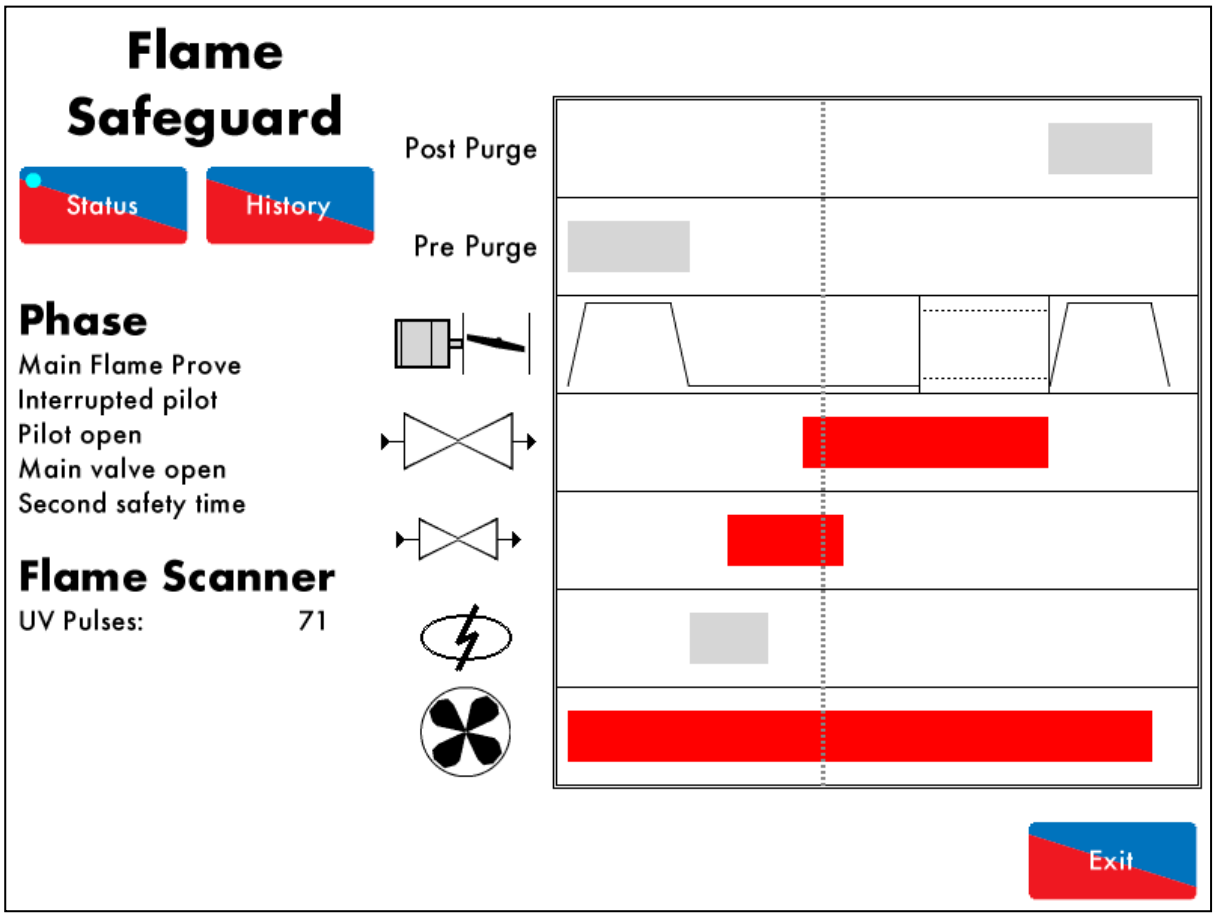


Figure 7.10.i Main Flame Prove Second Safety Time

The 2nd safety time begins, where the flame is checked in the Interrupted Pilot 2nd Safety phase shown in Figure 7.10.i.

The 2nd safety time is the period where the pilot/main valves overlap. The outputs of the main gas valves 1 and 2 are switched on (opened), while the pilot valve output is maintained on (opened). This 2nd safety time allows the main flame to light prior to the pilot valve output being switched off (closed). See option/parameter 116. If the flame is not strong enough, the lockout 'No Flame Signal' will occur.

If no voltage is detected when the burner main gas valve 1 output T60 should be on (and vice versa), the lockout 'Main Gas 1 Output Fault' will occur.

If no voltage is detected when the burner main gas valve 2 output T61 should be on (and vice versa), the lockout 'Main Gas 2 Output Fault' will occur.

The CPI/POC input T55 is now no longer checked through the firing cycle.

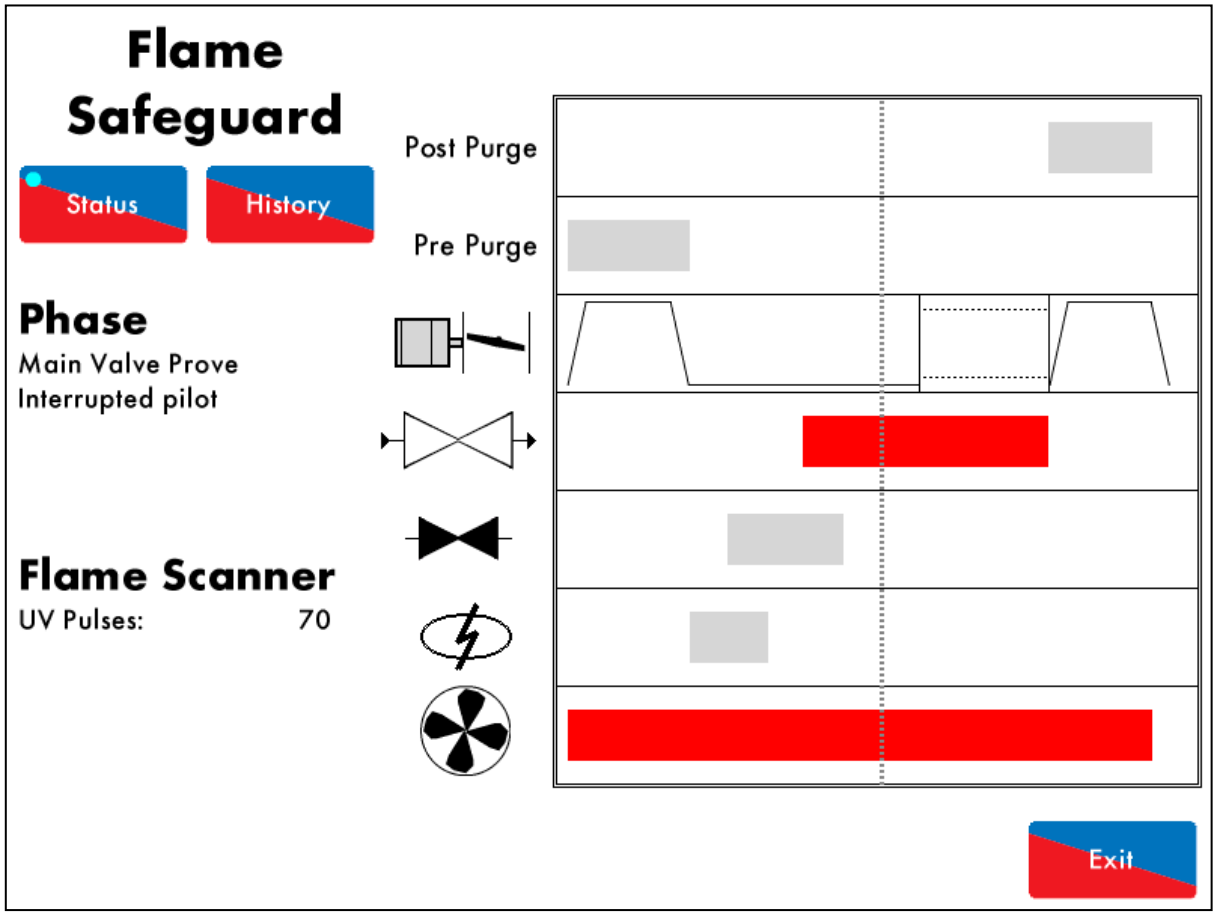


Figure 7.10.ii Main Flame Prove

In the Interrupted Pilot Main Valve Prove phase shown in Figure 7.10.ii, the pilot gas valve output is switched off (closed). There is a time delay to allow the main flame to stabilise before the burner proceeds to normal modulation as set. If the main flame fails now, the lockout 'No Flame Signal' will occur. See option/ parameter 117.

7.11. Firing

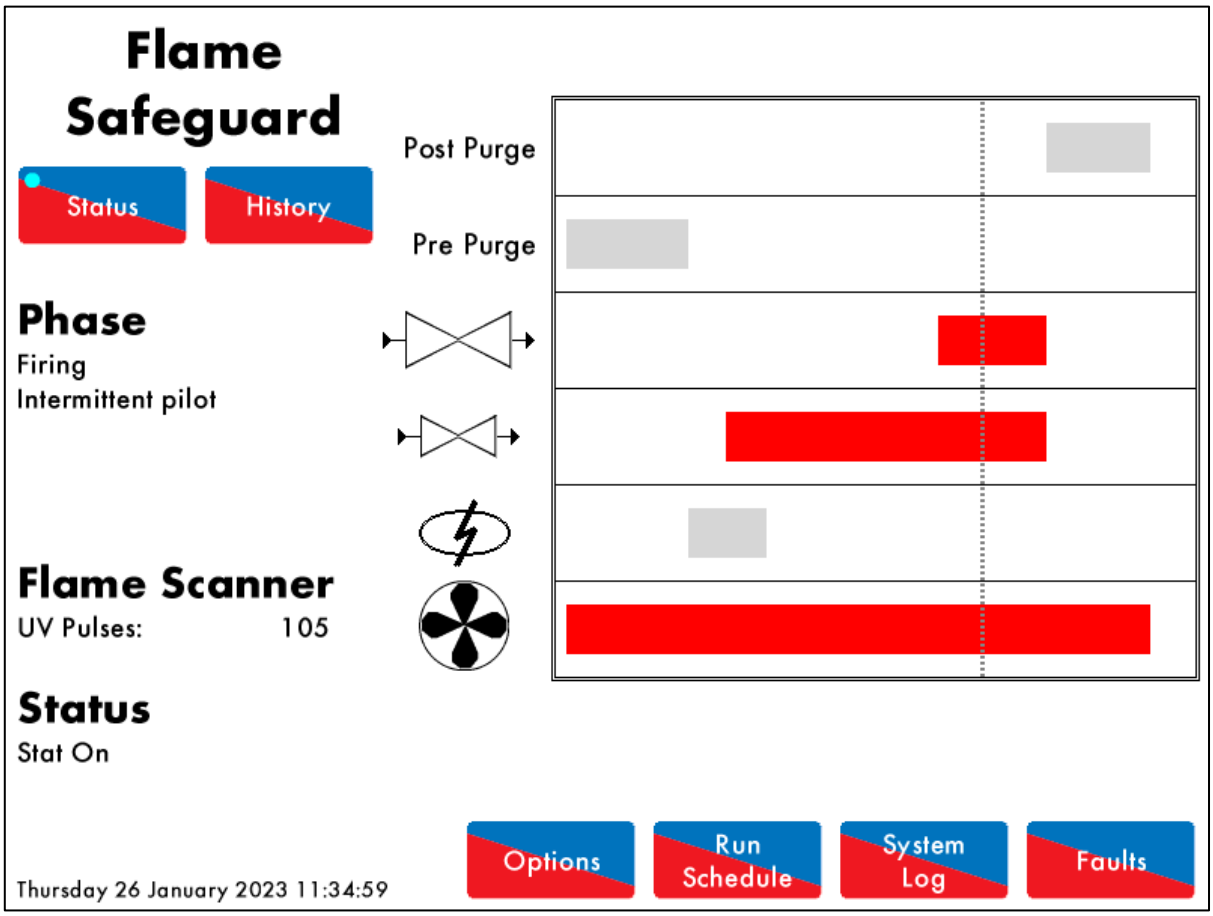


Figure 7.11.i Firing

The burner has now completed the start-up sequence.

T71 Release to modulate is activated to switch control of the servo motor to the load sensor and the burner fires normally and modulates according to this load sensor.

The Flame Safeguard controller remains in the Firing phase shown in Figure 7.11.i until the signal on T53 is removed, indicating a shutdown of the burner, or a flame detection error is seen.

With an On/Off burner, T71 is not connected and the burner just continues to fire so long as a flame is detected.

7.12. Post Purge

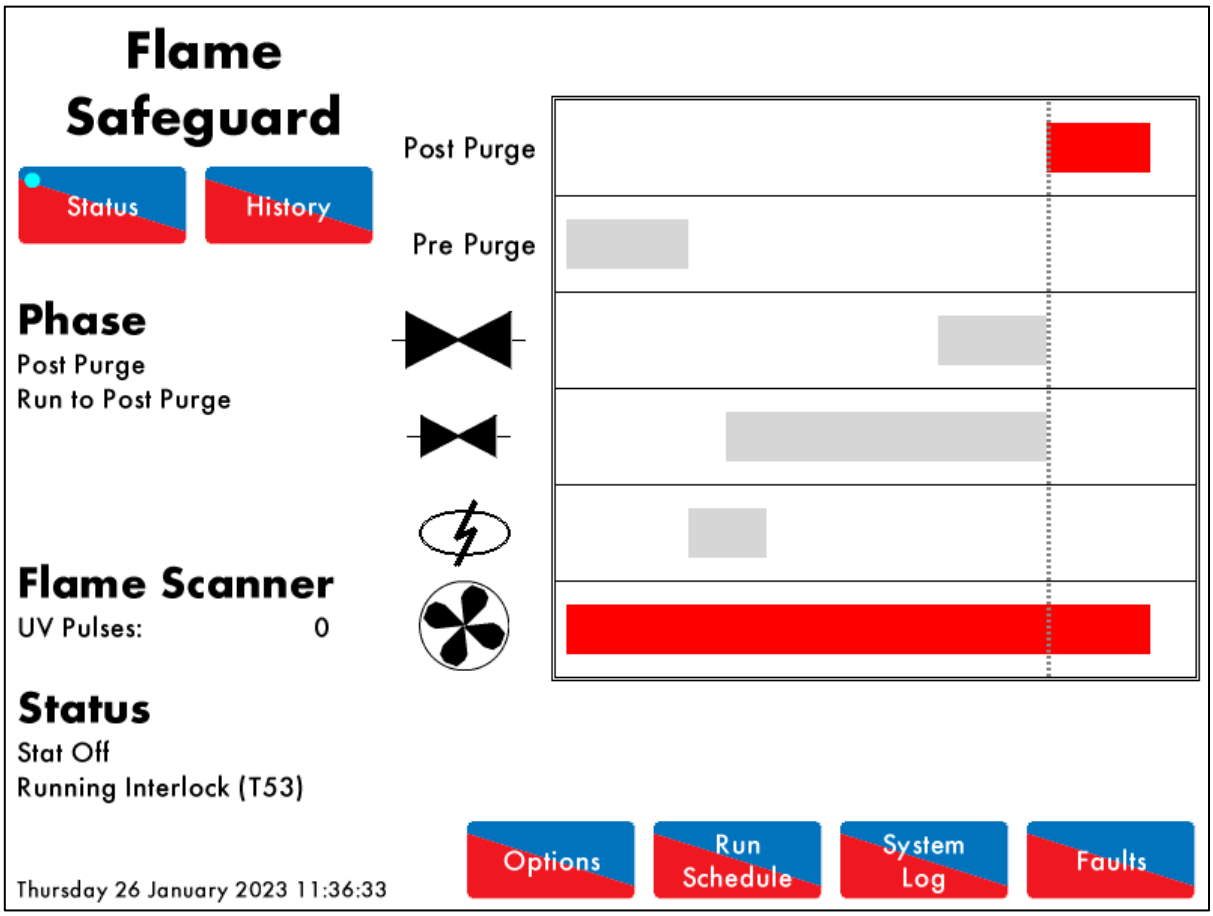


Figure 7.12.i Post Purge

The Post-Purge phase is shown in Figure 7.12.i. When T53 is switched off to turn the burner off, the Flame Safeguard controller will close the fuel valves and take back control of the servo. If a post purge is set, it will drive the servo to open, purging fresh air through the burner/boiler, when the burner shuts down in normal conditions. The outputs of the main gas valves 1 and 2, and the pilot valve are switched off (closed). See option/parameters 118 and 135.

The post purge timer begins once the motor has moved to their post purge positions and the purge interlock has been made on terminal 81. This does not apply to NFPA post purge.

After Post-Purge, the MM will go back to the Recycle phase and the burner start-up sequence will commence as required.

Note: If NFPA Post-Purge is selected, then the burner will also perform a Post-Purge in the event of a lockout/error at any time after the Ignition phase, and the purge interlock on terminal 81 is not checked.

8. UNLOCKING THE AUTOFLAME FLAME SAFEGUARD UNIT TO A MINI MK8

8.1. Fully unlocking the Autoflame Flame Safeguard Controller

A Mini Mk8, set to operate in Flame Safeguard Mode only, can be purchased under Order Code MMM8002/FSG and comes pre-locked. If you want to unlock a Flame Safeguard unit, to work as a fully functional Mini Mk8, you will need to go into commission mode, and then press the Unlock button.

An unlock code needs to be purchased, to be able to activate this functionality.

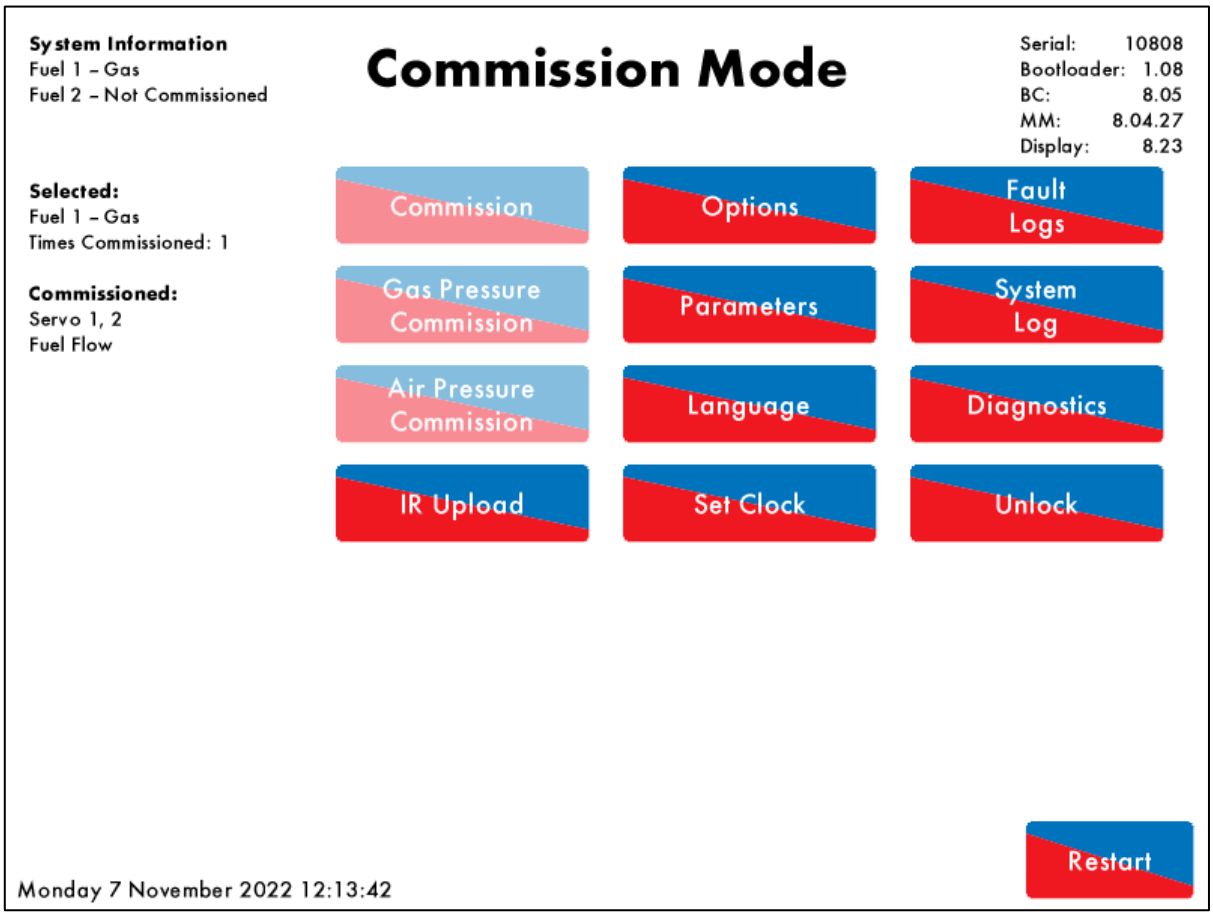


Figure 8.1.i Autoflame Flame Safeguard unit, showing the unlock button.



Figure 8.1.ii After pressing the Unlock button, you can upload the unlock code via Download Manager or Enter code.

Once the unlock button has been pressed, you have the option of using Download Manager and an IR Lead to upload the unlock code.

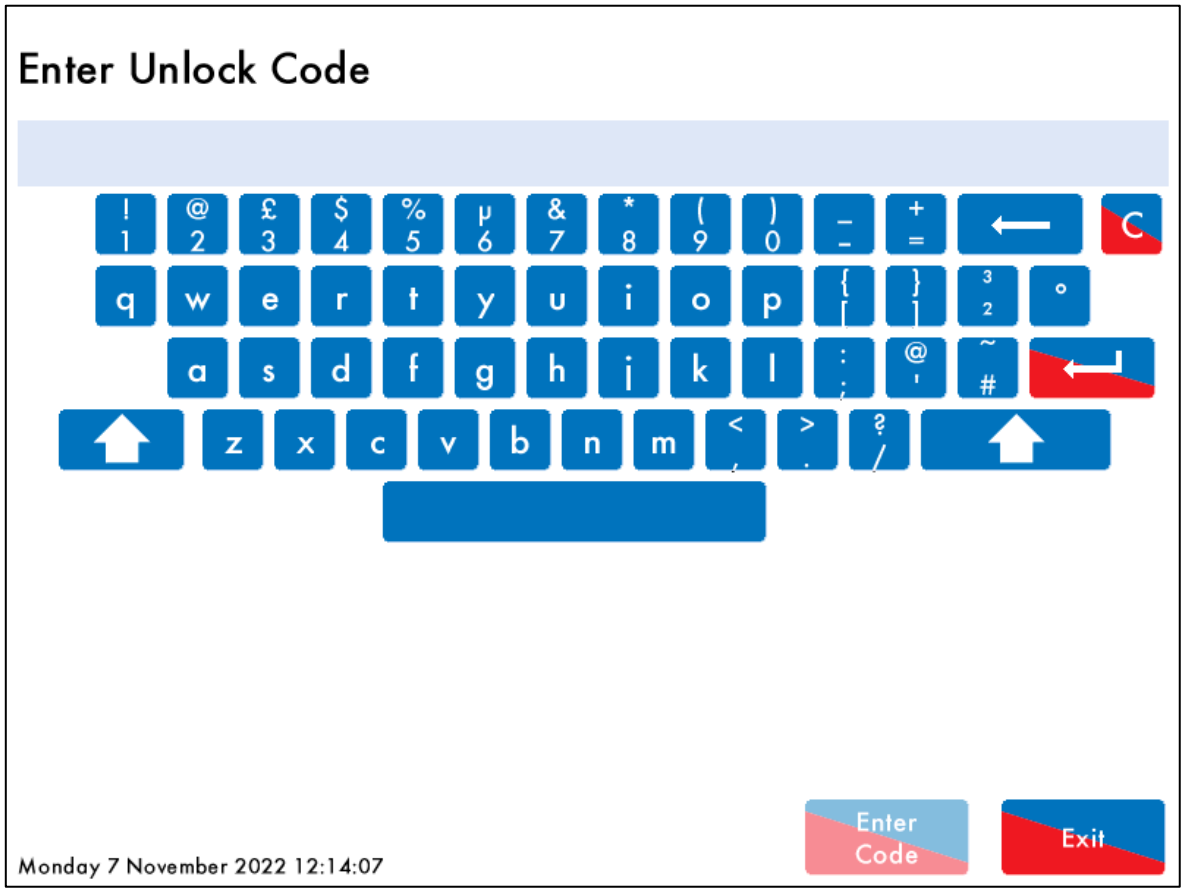


Figure 8.1.iii If you don't have an IR Lead, then you can enter the code via the Mini Mk8

Alternatively, by pressing the “Enter Code” button, you can type in the Unlock code on the keypad, if you don’t have access to the Download Manager Software.

Once unlocked, the Flame Safeguard Mode can be turned on/off by accessing Option 109.

9. ERRORS AND LOCKOUTS

9.1. Errors

Errors occur when the Flame Safeguard controller detects an internal fault, component out of range, internal check failure or power supply issue. To clear an error, the Flame Safeguard controller must be restarted. Only a subset of errors will be relevant when in flame safeguard mode. Other errors are greyed out in the table below.

Error	Message	Description
1	Channel 1 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40, 41, 42. • Check signal cable from the MM to the servomotor is screened at one end. • Check potentiometer is zeroed correctly. • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
2	Channel 2 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40, 41, 43. • Check signal cable from the MM to the servomotor is screened at one end. • Check potentiometer is zeroed correctly. • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
3	Channel 3 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 44, 46, 47. • Check signal cable from the MM to the servomotor is screened at one end. • Check potentiometer is zeroed correctly. • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
5	Channel 1 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40, 41, 42 and 70 – 71		
6	Channel 2 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40, 41, 43 and 72 – 73		
7	Channel 3 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 44, 46, 47 and 74 – 75		
9	Channel 1 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals 70 & 71. • Check servomotors drive in correct direction. • Check valve is not stuck		
10	Channel 2 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals 72 & 73. • Check servomotors drive in correct direction. • Check damper is not stuck		
11	Channel 3 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals 74 & 75. • Check servomotors drive in correct direction. • Check valve is not stuck		
13	Analogue Power Supply Error	ADC measured 12V supply out of range
• Check wiring for shorts on terminals 41, 47 and 39		
14	Digital Power Supply Error	ADC measured 3.3V supply out of range
• Check for noise on the mains input, wiring and voltages on all terminals		
15	EEPROM Error	Fault communicating with the on board EEPROM
• Contact Autoflame approved local Tech Centre		
16	ADC Error	Internal fault
• Contact Autoflame approved local Tech Centre		

Error	Message	Description
17	Watchdog Timeout	Internal fault
• Contact Autoflame approved local Tech Centre		
18	Processor Clock Error	Internal fault
• Contact Autoflame approved local Tech Centre		
19	System Error	Internal fault
• Contact Autoflame approved local Tech Centre		
20	Flash Data Error	Internal fault
• Re-install software SD card		
21	Processor Temperature Error	Internal fault
• Check ambient temperature of unit does not exceed maximum recommended temperature		
22	Burner Control Comms Error	Internal fault
• Contact Autoflame approved local Tech Centre		
23	Burner Control Reset	Internal fault
• Contact Autoflame approved local Tech Centre		
24	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
26	Mains Input Detection Error	Fuel mains input stuck reading low
• Check wiring and voltages on mains voltage terminals 53 – 90		
27	Load Sensor Error	Voltage from load sensor is outside of expected range
• Check load sensor wiring and ensure that the return voltage/resistance is less than 1V/ 1kΩ		
28	VSD Error	Feedback incorrect
• Check VSD feedback against commissioned VSD and ensure the feedback is stable		
29	VSD No Commission Feedback	No VSD feedback detected during commissioning
• Re-commission with VSD feedback connected. • Check wiring on terminals 1 – 3 and 10 – 12		
30	Missing Commissioning Data	Internal fault
• Check there is commissioning data for all options servomotors/VSD		
31	FAR Execution Speed	Internal fault
• Contact Autoflame approved local Tech Centre		
32	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
33	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
34	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
35	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
36	VSD Sampling Error	VSD feedback current/ voltage too high
• Check wiring on terminals 1 – 3 and 10 – 12		
38	Air Pressure Commission Fault	No air pressure trim data for a point with EGA trim
• Check EGA trim and air pressure trim in fuel-air curve		
39	Gas Pressure VPS Commission Fault	Commissioned gas pressure during VPS is below option/ parameter 133 threshold
• Check option/ parameter 133 and check gas pressure. • Re-commission gas pressure sensor		

Error	Message	Description
40	Gas Pressure Run Commission Fault	Commissioned gas pressure during Golden/ FGR start or main curve is below option/ parameter 136 threshold
• Check option/ parameter 136 and check gas pressure. • Re-commission gas pressure sensor		
41	Air Pressure Commission Fault	Commissioned air pressure during Golden/ FGR start or main curve is too low
• Check option/parameters 147 and 149. • Re-commission air pressure sensor		
42	Air Pressure Zeroing Fault	Commissioned air zero pressure is more than 5mbar from sensor's zero value
• Check air pressure sensor value during VPS		

9.2. Lockouts

Lockouts occur when the Flame Safeguard controller detects a fault with the burner operation such as VPS, gas/air pressure sensor and flame scanners. The lockout must be cleared and investigated on the Flame Safeguard controller. Only a subset of Lockouts will be relevant when in flame safeguard mode. Other Lockouts are greyed out in the table below.

Lockout	Message	Description
1	CPI Input Wrong State	Proof of closure switch opened during ignition sequence
• Check wiring on terminal 55. • Check proof of closure switches		
2	No Air Proving	No air pressure during start/ firing
• Check wiring on terminal 54. • Check air pressure switch. • Check air pressure sensor. • Check air pressures during running		
3	Ignition Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 63		
4	Motor Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 58		
5	Start Gas Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 59		
6	Main Gas 1 Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 60		
7	Main Gas 2 Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 61		
8	Vent Valve Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 62		
9	Failsafe Relay (Check 5AT)	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 57. • Check 5A fuse		
10	Simulated Flame	Flame is present when it should not be
• Isolate all fuels immediately. • Check the wiring and screening on the flame scanner. • Call a certified Commissioning Engineer to investigate. • If this lockout occurs during shutdown a post-purge may be required for after burn		
11	VPS Valve 1 Proving Fail	Leak detected during ‘air proving’ part of VPS
• Check 1st main gas valve. • Call a certified Commissioning Engineer to investigate		
12	VPS Valve 2 Proving Fail	Leak detected during ‘gas proving’ part of VPS
• Check option/parameter 133. • Check 2nd main gas valve and vent valve. • Check pilot valve if using single valve pilot. • Isolate gas and call a certified Commissioning Engineer to investigate		
13	No Flame Signal	No flame detected during ignition/ firing
• Visually check flame. • Check the flame scanner. • Call a certified Commissioning Engineer to investigate		
14	Shutter Fault	UV signal detected during shutter operation on self-check
• Check wiring on terminals 21 and 22. • Check UV scanner type and check option/ parameter 110 is set accordingly.		

Lockout	Message	Description
15	NO CPI Reset	Proof of closure switch not made after valves closed
• Check wiring on terminal 55. • Check proof of closure switches		
17	Gas Pressure Low	Gas pressure low limit exceeded while firing (gas sensor)
• Check gas pressure. • Check option/ parameter 136		
18	Gas Pressure High	Gas pressure high limit exceeded while firing (gas sensor)
• Check gas pressure. • Check option/ parameter 137		
19	RAM Test Failed	Hardware fault
• Contact Autoflame approved local Tech Centre		
20	PROM Test Failed	Hardware fault
• Contact Autoflame approved local Tech Centre		
21	FSR Test 1A	Internal relay test failed
• Check wiring and voltages on terminals 50 – 64		
22	FSR Test 2A	Internal relay test failed
• Check wiring and voltages on terminals 50 – 64		
23	FSR Test 1B	Internal relay test failed
• Check wiring and voltages on terminals 50 – 64		
24	FSR Test 2B	Internal relay test failed
• Check wiring and voltages on terminals 50 – 64		
26	Watchdog Fail 2B	Internal check failed
• Contact Autoflame approved local tech centre		
28	Watchdog Fail 2D	Internal check failed
• Contact Autoflame approved local tech centre		
29	Input Fault	Mains input stuck-on detection
• Check mains voltage to the MM		
32	Gas Pressure Low Limit	Gas pressure lower than commissioned VPS value
• Check gas pressure. • Check option/parameters 136 and 138		
33	VPS Pressure Zeroing	Gas pressure sensor cannot be zeroed at VPS venting
• Check gas pressure is within zero range (see Autoflame Sensors Guide) • Check vent valve		
39	Freeze Timeout	MM kept in Phase Hold for more than 10minutes
• MM kept in Phase Hold during commissioning for more than 10 minutes		
44	Proving Circuit Fail T80	Loss of input on terminal 80 when delay to purge is enabled
• MM must see an input at all times from position to purge to post purge. • Check wiring on terminal 80.		
45	No Proving Circuit Set T80	Delay to purge timeout has elapsed
• Check option/parameter 157, and wiring on terminal 80.		
46	Purge Pressure Proving Timeout	Purge pressure proving timeout has elapsed
• Check option/parameters 155 and 158, and wiring on terminal 81.		
47	Ion. Internal Failsafe Fault	Internal check failed for flame rod
• Check wiring on terminal 64		
48	Ion. Positive Peak Failsafe Fault	Signal check failed for flame rod
• Check wiring on terminal 64		

Lockout	Message	Description
49	Ion. Negative Peak Failsafe Fault	Signal check failed for flame rod
• Check wiring on terminal 64		
50	Simulated Flame	Flame detected when there should not be (secondary test for ionisation)
• Visually check flame and check flame rod • Call a certified Commissioning Engineer to investigate		
51	No Flame Signal	No flame detected when there should be (secondary test for ionisation)
• Visually check flame and check flame rod • Call a certified Commissioning Engineer to investigate		
52	High IR Ambient	Flame detected when there should not be
• Visually check flame and check IR scanner • Call a certified Commissioning Engineer to investigate		
53	IR Comms Lost	Loss of comms with IR scanner
• Check wiring and screen on terminals 29, 30, 48 and 49. • Check that the IR scanner is not removed from the magnetic ring socket		
62	UV Signal Too High	Internal check failed for UV
• Check wiring on terminals 21, 22, 50 and 51		
63	Purge Limit Switch	Interlock not made on terminal 81
• Check option/ parameter 155. • Check wiring on terminal 81		
64	Start Limit Switch	Interlock not made on terminal 80
• Check option/ parameter 154. • Check wiring on terminal 80		
65	FSR A	Internal check failed
• Check wiring and voltages on terminals 50 – 64		
66	FSR B	Internal check failed
• Check wiring and voltages on terminals 50 – 64		
67	Gas Sensors Comms	Signal lost from gas pressure sensor
• Check wiring and screen on terminals 29, 30, 48 and 49		
68	Gas Sensor Type	Wrong gas pressure sensor detected
• Check option/parameters 128 and 156		
69	Gas Sensor Fault	Internal pressure sensor fault
• Contact Autoflame approved local tech centre		
70	UV Pot Fault	Hardware fault
• Contact Autoflame approved local tech centre		
71	Air Sensor Comms	Signal lost from air pressure sensor
• Check wiring and screen on terminals 29, 30, 48 and 49		
72	Air Sensor Type	Wrong air pressure sensor detected
• Check option/parameter 148		
73	Air Sensor Fault	Internal pressure sensor fault
• Contact Autoflame approved local tech centre		
74	Air Sensor Zero	Air pressure is more than 5mbar from sensor's zero value
• Check air pressure sensor value during VPS		
75	Air Sensor Signal High	Air pressure reading is above 400mbar
• Contact Autoflame approved local tech centre.		

Lockout	Message	Description
76	Air Sensor Error Window	Air pressure outside of these limits for 3 seconds
• Check air pressure. • Check option/parameter 147		
77	Wait Air Switch Timeout	Voltage has not been reset for 2minutes
• Check air pressure sensor value during VPS. • Check voltage has been reset on terminal 54 within 2minutes before run to purge. • Check wiring and voltage on terminal 54		
78	Gas Proving Fail High	Gas pressure too high during VPS
• Isolate gas • Check 1st main valve and vent valve. • Check option/ parameters 133 and 134. • Call a certified Commissioning Engineer to investigate		
79	FSR Test 1C	Hardware fault
• Contact Autoflame approved local tech centre		
80	Timeout on Reaching Purge	Time set in option/parameter 124 has elapsed
• Check option/parameter 124		
82	Purge Pressure Proving Input	Input on T81 read high during relay test phases
• Input has been made before the blower starts; it should only be made continuously during purge. • Check wiring on terminal 81.		
198	BC Input Short	Internal fault
• Contact Autoflame approved local tech centre		
199	Lockout 199	Internal fault
• Contact Autoflame approved local tech centre		
200	Lockout Cleared	Lockout has been cleared
• MM status after lockout has been reset (Modbus)		
201	Power up CPU Test Fail	Internal check failed
• Contact Autoflame approved local tech centre		
202	Power up EEPROM Test Fail	Internal check failed
• Contact Autoflame approved local tech centre		

9.3. Alarms and Warnings

Alarms and warnings are faults detected with the system operation. If an alarm occurs, the burner will stop running, and if a warning occurs, the burner will continue to run. The following options/parameters set whether system operation faults are set as alarms or warnings:

Option 13 EGA Fault Response
Option 14 Warning Response

Only a subset of alarms and warnings will be relevant when in flame safeguard mode. Other alarms and warnings are greyed out in the table below.

Fault	Message	Description
1	EGA Internal Error	Fault on EGA
• Alarm or warning depending on option 13. • Check EGA for fault description		
2	No EGA Communications	MM has lost communications with EGA
• Alarm or warning based on option 13 (warning if option 12 is set to monitoring only) • Check parameter 10 is set to correct EGA version. • Check EGA operating mode is selected as 'EGA with MM'. • Check wiring between EGA and MM (terminals 25 and 26 on MM)		
3	O_2 Upper Limit	O_2 value is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 19		
4	O_2 Absolute Limit	O_2 value is below absolute limit*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 25		
5	O_2 Lower Limit	O_2 value is below lower limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 22		
6	CO_2 Upper Limit	CO_2 value is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 20		
7	CO_2 Absolute Limit	CO_2 value is above absolute limit*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 26		
8	CO_2 Lower Limit	CO_2 value is below lower limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 23		
9	CO Upper Limit	CO value is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 21		
10	CO Absolute Limit	CO value is above absolute limit*
• Alarm or warning depending on option 13. • Check exhaust gas readings and option 27		
11	NO Upper Limit	NO value is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and parameter 94.		

Fault	Message	Description
12	Exhaust Temperature Upper Limit	Exhaust temperature is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13. • Check exhaust gas readings and parameter 96.		
13	Exhaust Temperature Absolute Limit	Exhaust temperature is above absolute limit*
• Alarm or warning depending on option 13. • Check exhaust gas readings and parameter 97		
50	Load Sensor Fault	Incorrect/no load sensor detected
• Alarm • Check option 1. • Check wiring on terminals 37 – 39		
52	Zero-Crossing Fault	Mains voltage test failed
• Alarm • Check mains supply going to unit is within acceptable voltage range. • Check Parameter 109 setting		
53	Gas Pressure Warning Level	Gas pressure not within commissioned range
• Alarm • Check main gas pressure		
54	Mains Input Stuck On (Fuel 1 Select)	Voltage detected during the zero-crossing period of the mains cycle
• Alarm • Check that all screening is applied as per the wiring diagram. • Check earthing at T66. • Check Parameter 109 setting		
55	Mains Input Stuck On (Fuel 2 Select)	Voltage detected during the zero-crossing period of the mains cycle
• Alarm • Check that all screening is applied as per the wiring diagram. • Check earthing at T66. • Check Parameter 109 setting		

9.4. Setting Conflicts

Some of the option/parameter values may require another option/parameter to be set, as described in the table below. The Flame Safeguard controller will be forced into Commission Mode. Only a subset of these will be relevant when in flame safeguard mode, however no options may be set in conflict without causing an Options/Parameters lockout and must be cleared.

Setting Conflict Message
(1) (45) External modulation cannot be used with external load sensor. • External modulation and external load sensor are connected to the same terminals, so they cannot be used together. • Check options 1 and 45.
(1) (P53, P54, P55, P56) External load sensor incorrectly configured • The external load sensor must be set with the minimum and maximum values and voltages. • Check option 1 and parameters 53 – 56.
(1) (81, 83) OTC setpoints too high for optioned load sensor • If minimum and maximum setpoints OTC setpoints must be set within the possible range of the optioned load detector. • Check option 1, 81 and 83.
(4) (8) Servo channel 2 configured as air but not enabled • If the air servomotor is enabled, then channel 2 must also be enabled. • Check options 4 and 8.
(4) (12) Trim requires the use of a servo as the air channel • If the air channel is controlled by a VSD and no air servomotor, then trim function cannot be used. • Check options 4 and 12.
(4) (90) VSD Channel 4 configured as air but not enabled. • If the air is controlled by the VSD on channel 4, then this VSD must be enabled. • Check options 4 and 90.
(30) (31) Invalid remote setpoint configuration • The Minimum Remote Setpoint (DTI/Modbus/External) cannot be set higher than the Maximum Remote Setpoint (DTI/Modbus/External) and vice versa. • Check options 30 and 31.
(45) (16) External modulation cannot be used with sequencing • External modulation cannot be used on any MMs in sequencing. • Check options 16 and 45
(81, 82, 83, 84) OTC Configuration invalid • Setpoints at minimum and maximum outside temperatures cannot be set the same. • Minimum and maximum outside temperatures cannot be set the same. • Check options 81, 82, 83 and 84
(111) (122) Flame scanner changeover cannot be optioned with no pilot • If no pilot is set, then flame scanner changeover cannot be used. • Check option/parameters 111 and 122.
(111) (130) Single valve pilot cannot be optioned with no pilot • If no pilot is set, then gas valve configuration cannot be set for single valve pilot. • Check option/parameters 111 and 130.
(116) Fuel 1 2nd Safety time too high for Gas • If fuel 1 is gas, the maximum allowed 2nd safety time is 10 seconds. • Check option/parameters 116 and 150.
(118) (135) NFPA Post Purge must be at least 15 seconds • If NFPA Post Purge is enabled, then this time must be set to a minimum of 15 seconds. • Check option/parameters 118 and 135

Setting Conflict Message
(118) (141) (149) Purge air pres. threshold cannot be higher when post purge is optioned • If post purge is enabled, then the purge air pressure threshold cannot be set higher than the running air pressure threshold. • Check option/parameters 118, 141 and 149.
(123) Fuel 2 2nd Safety time too high for Gas • If fuel 2 is gas, the maximum allowed 2nd safety time is 10 seconds. • Check option/parameters 123 and 151.
(125, 126) (128) Pressure limits do not operate using digital input. • Gas pressure upper/lower limits can only be used with a gas pressure sensor. • Check option/parameters 125, 126 and 128.
(125) (150) Gas pressure sensor cannot be optioned when fuel type is oil (fuel 1) • Valve proving and gas pressure limits can only be used for gas. • Check option/parameters 125 and 150
(126) (151) Valve proving cannot be optioned when fuel type is oil (fuel 2) • Valve proving and gas pressure limits can only be used for gas. • Check option/parameters 126 and 151
(128) (156) T82 is no set as VPS input • If valve proving is optioned and configured as a digital VPS input from, T82 must be configured as the input for a VPS input gas pressure switch. • Check option/parameters 128 and 156.
(P85) (16) Modulation exerciser cannot be used with sequencing • Modulation exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 85.
(P89) (16) Stat exerciser cannot be used with sequencing • Stat exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 89.
(P99) (P100) Graceful shutdown and assured low fire shut off not allowed • If graceful shutdown is set, then assured low fire shut off cannot be used. • Check parameters 99 and 100.
(158) (112) Purge Pressure Proving Timeout must be longer than Pre-Purge Time • Check options/parameters 112 and 158
(158) (118) Purge Pressure Proving Timeout must be longer than Post-Purge Time • Check options/parameters 118 and 158
(109) (155) Flame Safeguard Mode requires Purge Position Interlock • If Flame Safeguard mode is enabled, Purge position interlock must be enabled. • Check Options/Parameters 155
(109) (154) Flame Safeguard Mode requires Start Position Interlock • If Flame Safeguard mode is enabled. Start position interlock must be enabled. • Check Options/Parameters 154
(109) (148) Air Pressure Sensor cannot be used with Flame Safeguard Mode • If Flame Safeguard mode is enabled. An air pressure sensor must be disabled, only an air switch is used, • Check Option/Parameters 148
(109) (125,126,128) Gas Pressure Sensor cannot be used with Flame Safeguard Mode • If Flame Safeguard mode is enabled. A gas pressure sensor must be disabled, only a digital input (T82) can be used. • Check Options/Parameters 125,126, 128

9.5. Forced Commission

The Flame Safeguard controller will be forced into Commission mode if there is a setting conflict and/or one or more of the following conditions occurs (This list is a subset of the forced commission for an unlocked Mini Mk8 MM):

Forced Commission Message
BC Option/parameter mismatch. • There is a mismatch in the BC option/parameters 110 – 160. • Check options 110 – 160 match to their corresponding parameter.
Invalid option value. • An option value is outside the allowed range for the current software. • Check all options.
Invalid parameter value. • A parameter value is outside the allowed range for the current software. • Check all parameters.
Options have been reset. • Option settings have been reset due to data lost in an EEPROM error.
Parameters have been reset. • Parameter settings have been reset due to data lost in an EEPROM error.
IR Upload was completed successfully, check configuration then restart. • Check data has uploaded successfully before restarting in run mode.

AUTOFLAME MINI MK8
FLAME SAFEGUARD
CONTROLLER MANUAL
MMM8002/FSG
08 APR 2024

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