AUTOFLAME®

Combustion Management Systems



MINI MK8 MM
MANUAL
MMM8002

23.02.2026

Autoflame Engineering Ltd.
Unit 1-2 Concorde Business Centre
Airport Industrial Estate
Wireless Road, Biggin Hill
Kent TN16 3YN
United Kingdom

Tel: +44 (0)1959 578 820
Email: technicalsupport@autoflame.com
Web: www.autoflame.com

MINI MK8 MM MANUAL
MMM8002

23.02.2026

This manual and all the information contained herein is copyright of Autoflame Engineering Ltd. It may not be copied in the whole or part without the consent of the Managing Director.

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 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 herein.

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.

CONTENTS

1. MINI MK8 MM OVERVIEW, SPECIFICATIONS AND WIRING 9

1.1. Mini Mk8 MM Overview 9

1.1.1. Mini Mk8 MM Main Features 10

1.1.2. Fixing Holes and Dimensions 12

1.2. Wiring Schematic 13

1.3. Electrical Specifications 14

1.3.1. Classifications 14

1.3.2. Inputs and Outputs 14

1.3.3. Cable Specifications 15

1.3.4. Terminals Description 16

1.4. Standards 18

1.5. Connection Between Mini Mk8 MM and Mk8 EGA EVO 19

1.6. Connection Between Mini Mk8 MM and Mk8 DTI 20

1.7. Sequencing Connection Diagram 21

2. OPTIONS AND PARAMETERS 22

2.1. Options 22

2.2. Parameters 43

3. COMMISSIONING THE MINI MK8 MM 51

3.1. Overview 51

3.2. Installation Checks 52

3.2.1. Commissioning Checks 52

3.2.2. Operational Checks 52

3.2.3. Installation Precautions 52

3.2.4. Maintenance and Servicing 52

3.3. Servomotors 53

3.3.1. Adjusting the Servomotor Potentiometer 53

3.3.2. Servomotor Feedback Voltage 54

3.3.3. Servomotors – Direction Change 55

3.3.4. Servomotors with Autoflame Valves 56

3.4. Commissioning Fuel and Air Positions 57

3.4.1. Starting Commissioning 58

3.4.2. Enter CLOSE Position 59

3.4.3. Enter OPEN Position 60

3.4.4. Enter START Position 61

3.4.5. Phase Hold 62

3.4.6. Add Trim Data During Commissioning 63

3.4.7. Commissioning VSD 65

3.4.8. Set GOLDEN START Position 66

3.4.9. Set FGR START Position 68

3.4.10. Set HIGH Position 70

3.4.11. Set INTER Position 71
3.4.12. Set INTER or START Position 72
3.4.13. Save Commission 73
3.5. Fuel Flow Commissioning 74
3.5.1. Calorific Fuel Data 77
3.5.2. Conversion Factor for Imperial Gas Flow Meters 78
3.5.3. Correction Factor for Burners Significantly Above Sea Level 78
3.5.4. Gas Volume Conversion Factors 79
3.6. Gas / Air Pressure Commission 81
3.7. Single Point Change 82
3.8. Online Changes 87
4. PID CONTROL 88
4.1. Proportional Band 88
4.2. Integral Control 89
4.3. Derivative Control 90
5. INTELLIGENT BOILER SEQUENCING (IBS) 91
5.1.1. Hot Water Example 92
5.1.2. Boiler Examples 93
5.1.3. IBS Communications 93
5.2. Sequencing Options and Parameters 94
5.3. Hot Water Sequencing 95
5.3.1. Implementing Hot Water Sequencing 95
5.3.2. Two Port Valve Operation 96
5.4. Steam Sequencing 97
5.4.1. Warming Steam Boilers 97
5.4.2. Implementing Steam Sequencing 97
5.4.3. Low Pressure Steam Sequencing 98
5.5. Troubleshooting IBS 99
6. GENERAL FEATURES 100
6.1. Calibrating the Load Sensor's Actual Value 100
6.2. External Modulation 101
6.3. HAND, LOW FLAME HOLD AND AUTO 102
6.3.1. Hand Operation 102
6.3.2. Low Flame Hold 102
6.3.3. Auto Operation 102
6.4. Single Servomotor Operation 103
6.5. PWM Motor Control 105
6.6. No Air Servomotor 106
6.7. No Pre-Purge 107
6.8. Mini Mk8 MM Flame Detection Using Ionisation 108
6.9. Terminals 80, 81 and 82 Functions 109
6.9.1. T80 Functions 109
6.9.2. T81 Functions 109

6.9.3. T82 Functions 110
7. REMOTE CONTROL 111
7.1. Modbus Settings 111
7.2. Configuration 112
7.2.1 Modbus to BACnet/Ethernet IP/Metasys N2 via RS485 with AFPROTOAIR 112
7.3. Modbus Addresses 113
7.3.1 Modbus address for MM status (30102) 116
8. OPERATION 117
8.1. Home Screen 117
8.1.1. Home Screen Components 118
8.1.2. Home Screen Buttons 120
8.1.3. Enable/Disable 121
8.1.4. Faults 121
8.2. Status Screen 122
8.2.1. Status 122
8.2.2. Status – History 123
8.2.3. Status – Low Flame Hold 124
8.2.4. Status – Hand Mode 125
8.3. Fuel-Air Screen 126
8.3.1. Fuel-Air – Curve 126
8.3.2. Fuel-Air – Map 127
8.3.3. Fuel-Air – History 128
8.4. Flame Safeguard Screen 129
8.4.1. Flame Safeguard 129
8.4.2. Flame Safeguard – History 130
8.5. Channels Screen 131
8.5.1. Servomotor 131
8.5.2. VSD Channel 132
8.6. Gas Pressure Sensor Screen 133
8.6.1. Gas Pressure 133
8.6.2. Gas Sensor – History 134
8.7. Air Pressure Sensor Screen 135
8.7.1. Air Pressure 135
8.7.2. Air Sensor – History 136
8.8. Fuel Flow Screen 137
8.8.1. Fuel Flow 137
8.8.2. Fuel Flow – History 138
8.9. Sequencing Screen 139
8.9.1. IBS – Sequencing 139
8.9.2. IBS – Lead Boiler 140
8.9.3. IBS – History 141
8.10. EGA Screen 142
8.10.1. EGA – Gas 142

8.10.2. EGA – Temperature 143
8.10.3. EGA – Efficiency 144
8.11. Outside Temperature Compensation Screen 145
8.12. System Configuration Screen 146
8.12.1. Language 147
8.12.2. Boiler Configuration Screen 148
8.12.3. Options 151
8.12.4. Parameters 152
8.12.5. Online Changes 153
8.12.6. Set Clock 154
8.12.7. Run Times 155
8.12.8. Manual 158
8.12.9. Commission Data 159
8.12.10. System Log 160
9. BURNER START-UP SEQUENCE 161
9.1. Recycle 162
9.2. Standby 163
9.3. Internal Relay Tests 164
9.4. CPI Input 165
9.5. Valve Proving 166
9.6. Zero Air Sensor 170
9.7. Purge 171
9.8. Ignition 174
9.9. Pilot 176
9.10. Proving 179
9.11. Firing 181
9.12. Post Purge 182
9.13. Burner Control Sequence Diagrams 183
9.13.1. Interrupted Pilot – Gas 184
9.13.2. Interrupted Pilot – Oil 185
9.13.3. Intermittent Pilot – Gas with Post VPS 186
10. ERRORS AND LOCKOUTS 187
10.1. Errors 187
10.2. Lockouts 190
10.3. Alarms and Warnings 194
10.4. Setting Conflicts 196
10.5. Forced Commission 199

Important Safety Notes



Please fully read and understand the following notes before commencing with any work related to the Mini Mk8 MM. Failing 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 an 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 fully and safely isolate the mains power before carrying out any work related to the wiring connections, failure to do so can result in serious or even fatal injury.

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.

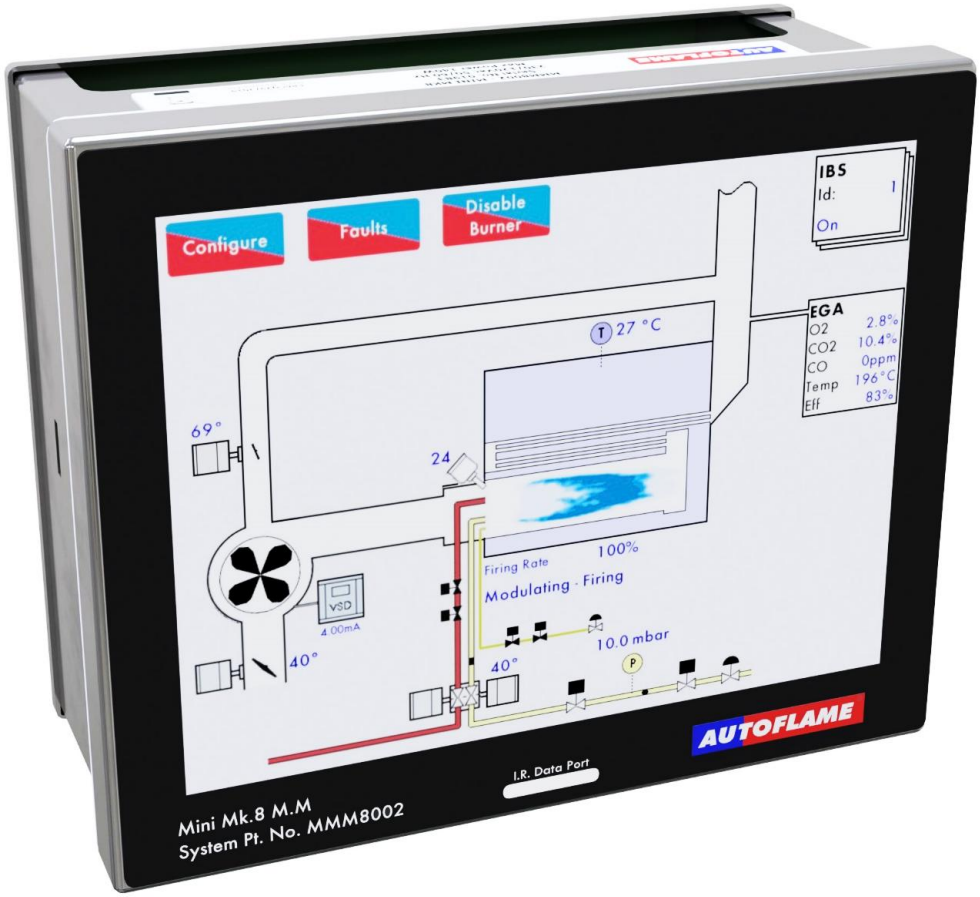
1. MINI MK8 MM OVERVIEW, SPECIFICATIONS AND WIRING

1.1. Mini Mk8 MM Overview

The Mini Mk8 is a Micro-Modulating system that provides an easily programmable and flexible means of optimising combustion throughout the load requirement range of the boiler/burner.

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

This system ensures the burner temperature is accurate to within 1° C/F and pressure to within 1 PSI. The positioning accuracy of the direct drive motors controlling the air damper and fuel valve is 0.1° throughout the load range. This accuracy ensures repeatable fuel-to-air ratio that leads to improved fuel economy and a reduced carbon footprint.



1.1.1. Mini Mk8 MM Main Features

The Mini Mk8 MM features include the following:

- Fuel/Air ratio control
- Full colour touch screen
- 120V or 230V standard operation 50/60Hz
- Controls up to 3 servomotors and 1 variable speed drive (VSD/VFD)
- 2 independent fuel programmes
- Fully adjustable PID load control for temperature or pressure
- Internal flame safeguard – full flame supervision with self-check UV, IR and ionisation
- Gas valve train leak supervision and high/low gas pressure monitoring
- Air pressure proving and monitoring
- 64 lockouts/errors stored with date, time, phase and reset
- System log stored with date, time and status
- Single point change function for adding, removing and adjusting fuel/air positions on the commission curve
- User definable optimum ignition position – golden start
- User definable flue gas recirculation start position
- Variable servomotor travel speed
- Adjustable burner control safety times
- External voltage load control
- Outside temperature compensation of boiler setpoint
- Second setpoint with run times
- Hand/auto/low flame hold
- Various boiler load detectors available
- Fuel flow metering capability – instantaneous and totalised
- Password protection of all safety related functions
- Infra-red port for upload/download of commissioning data
- System will sequence hot water boilers or steam boilers via lead/lag distribution
- Fully adjustable user options within the system to tailor sequencing operation to the application
- System control for isolation of valves or pumps (2 port valve operation)
- Standby setpoint and warming for lag boilers via a standby pressure and timing sequence aqua-stat
- Download all commissioning data from an MM module to a PC via Download Manager
- Upload commissioning data from a PC to an MM module via Download Manager

The following features also available when used with a Mk8 DTI

- Direct Modbus communications from MM include: remote setpoint; firing rate adjustment; enable/disable.
- DTI will collect operational data for up to 10 MM modules, 10 EGAs, and 10 Universal I/O modules on one site.
- Information transmitted via RS422 or Ethernet link to a local PC/network for running Autoflame DTI Manager Software

The following features also available when used with a Mk8 EGA EVO

- 3 Parameter Trim of O_2, CO_2, and CO
- Analysis of O_2, CO_2, CO, NO, exhaust gas temperature, efficiency and delta temperature
- Optional analysis of NO_2 and SO_2
- Local display for re-calibration, changing cells, user configuration and stand-alone operation
- Upper/lower/absolute limits for O_2, CO_2, CO, NO and exhaust temperature
- Six 4-20mA output signals for interface with other controls/chart recorders

Overview of Micro-Modulation (MM)

To ensure maximum efficiency and reliability of the boiler plant operation, two requirements are of paramount importance, the air to fuel ratio and the target temperature or pressure:

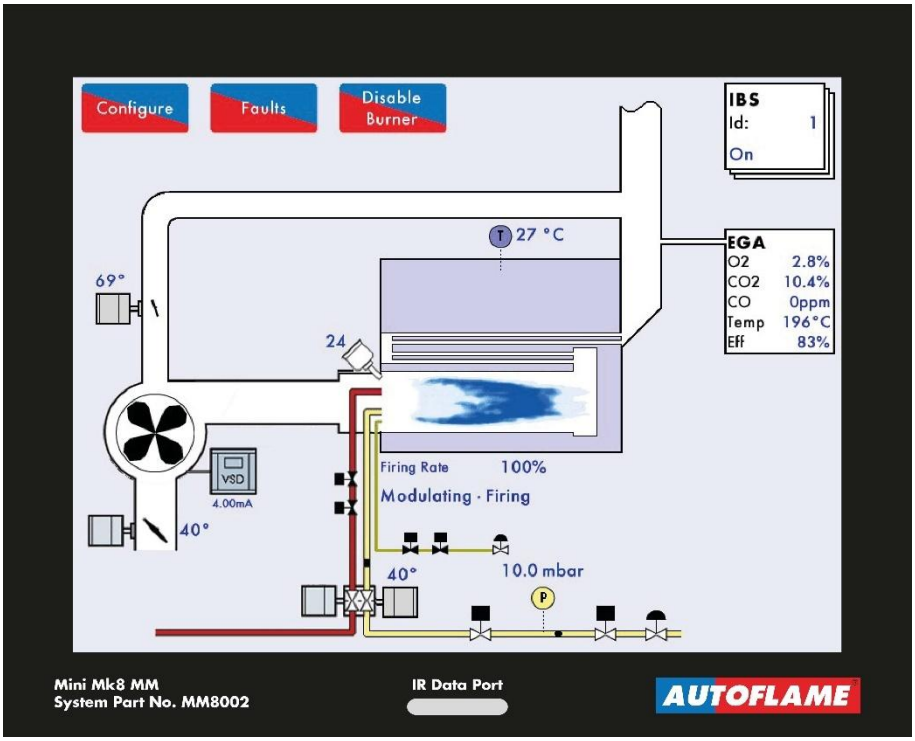
- The air to fuel ratio must be kept to the minimum to ensure complete combustion within the limitations of the combustion head design. A very high air to fuel ratio will be an indication of high excess air, which decreases the overall efficiency of the boiler. The fuel valve and air damper positions set for this minimum air to fuel ratio along the whole commission curve must be infinitely repeatable to an incredibly high degree of accuracy.

- The target temperature or pressure of the boiler should be monitored by the combustion system at all times, with exactly the right amount of fuel and air fired to achieve this target value. Irrespective of load changes, the burner/boiler system should be able to meet the target temperature or pressure.

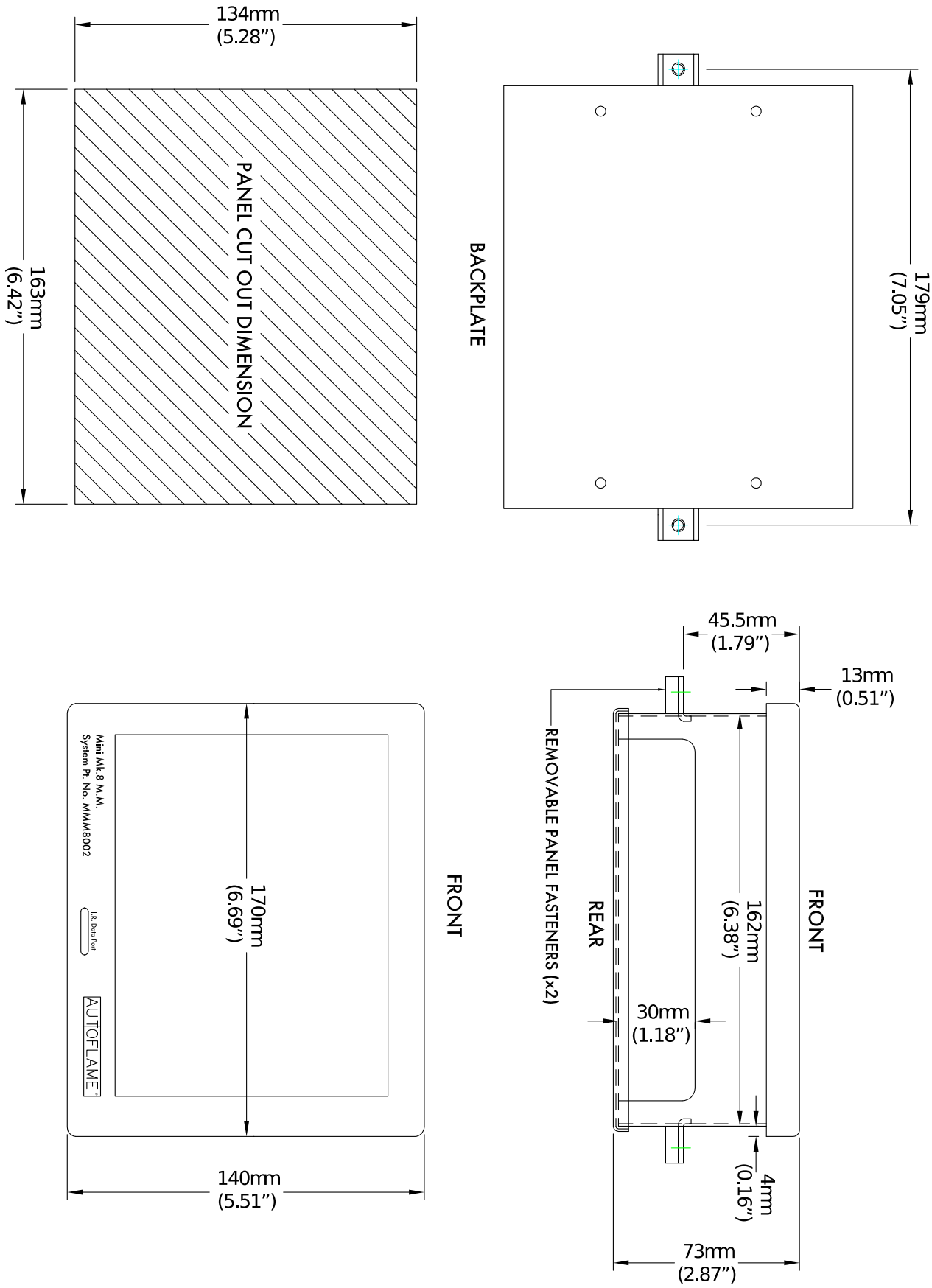
The burner's fuel to air ratio was traditionally governed by mechanical systems which involved multiple cams, shafts and linkages controlled by one motor. An inherent hysteresis in this system design allowed components to become loose, which made it impossible to achieve the required level of accuracy. With this poor accuracy, the response of the fuel input to the monitored temperature/ pressure of the boiler meant that the set target value at most times would overshoot or fall short.

The Micro-Modulation module is the basic building block of the Autoflame System. The Autoflame MM module provides an easily programmable and flexible means of optimising combustion quality throughout the load requirement range of the burner/boiler unit whilst ensuring the temperature is accurate to within 1°C (°F) and pressure to within 1 PSI (0.1Bar). Using direct drive motors to individually control the air damper and fuel valve(s), gives the optimum combustion of the burner at every point along the firing range. The allowed error in angular degrees of rotation between the two servomotors at any position in the load range is 0.1°.

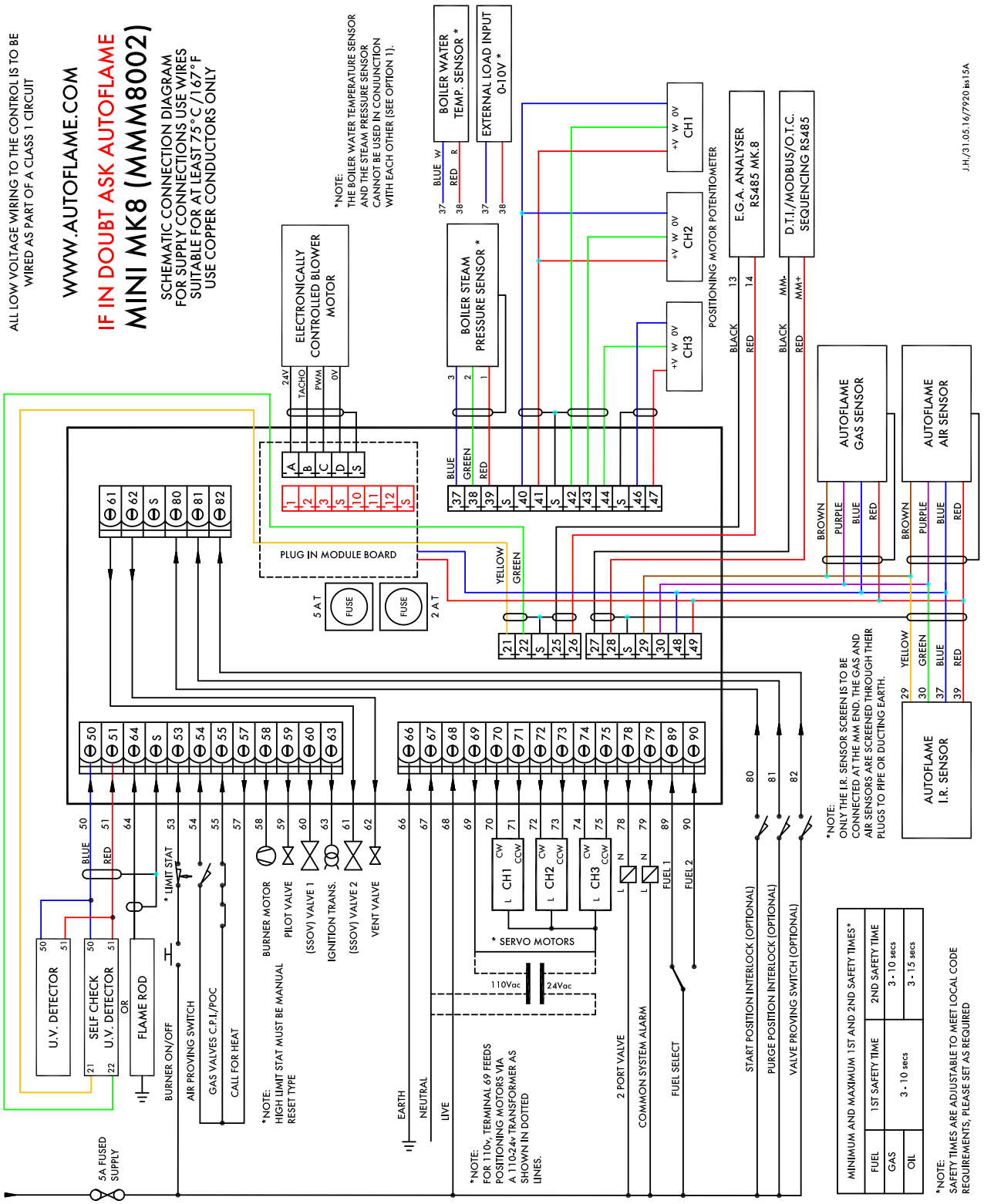
This automated system of burner control can achieve 'locked on' near stoichiometric air to fuel mixing throughout the fuel input range of the boiler while maintaining exact temperature or pressure target values. The load control incorporates user-variable Proportional Integral Derivative control. The PID control is infinitely adjustable to match any boiler room requirements.



1.1.2. Fixing Holes and Dimensions



1.2. Wiring Schematic



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

1.3. Electrical Specifications

1.3.1. Classifications

Classification according to EN298

Mains Supply:	230V, +10%/-15%} 120V, +10%/-15%}	47-63 Hz, unit max. consumption 140W
Climate:	Min. Temperature Recommended Temperature Max. Temperature Humidity	0°C (32°F) Less than 40°C (104°F) 60°C (140°F) 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.	

1.3.2. 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
78	100mA	100mA	To drive relay only – switched neutral
79	100mA	100mA	To drive relay/lamp only – switched neutral
Max. Load	5A	5A	

Note:

- The high and low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation. **CAUTION – ELECTRIC SHOCK HAZARD.**
- 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 1.3.3.
- The burner ‘High Limit Stat’ must be a manual reset type.

The cover (back plate) of the MM must always be re-fitted after the wiring is completed to prevent unauthorised wiring modifications or fuse replacement.

1.3.3. Cable Specifications

Low Voltage

The screened cable used for low voltage wiring from the MM to the servomotors, detectors and variable speed drive 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 MMs for sequencing applications as well as between MMs to EGAs, MMs to a DTI and DTI to BMS systems.

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.

When using a VSD, please review the manufacturer's guidelines on installations to prevent EMC, including the recommendations for reactors and filters.

Note: For the 4-20mA outputs on the Mini Mk8 MM, the maximum voltage drop supported is 12V.

1.3.4. Terminals Description

S	All terminals marked S are internally connected provided for connections to the various screened cables
1	Current Input, 0-20mA/ 4-20mA. For channel 4 only. Can be connected to the current output of a VSD or tachometer system or 4-20mA servomotor feedback
2	Voltage Input, 0-10V. For channel 4 only. Can be connected to the voltage output of a VSD or tachometer system
3	0V common for Terminals 1 or 2
10	Current Output, 0-20mA/ 4-20mA. For channel 4 only. Can be connected to the current input of a VSD or tachometer system or 4-20mA servomotor feedback
11	Voltage Output, 0-10V. For channel 4 only. Can be connected to the voltage input of a VSD or tachometer system
12	0V common for Terminals 10 or 11
21, 22	Connections to an Autoflame self-check UV sensor
25, 26	Communications port connections to an Exhaust Gas Analyser (EGA)
27, 28	Communications port connections for DTI and/or IBS, or Modbus
29, 30	Digital communications connections to an Autoflame IR scanner, Autoflame air pressure sensor and/or Autoflame gas pressure sensor
37	0V supply to an Autoflame temperature / pressure detector, external temperature / pressure detector or 0-10V external modulation input
38	Signal input from an Autoflame temperature / pressure detector, external temperature / pressure detector or 0-10V external modulation input
39	12V supply to an Autoflame pressure detector
40	0V supply to channel 1 and channel 2 servomotors
41	+12V supply to channel 1 and channel 2 servomotors
42	Signal from channel 1 servomotor, indicating position
43	Signal from channel 2 servomotor, indicating position
44	Signal from channel 3 servomotor, indicating position
46	0V Supply to channel 3 servomotor
47	+12V Supply to channel 3 servomotor
48, 49	+15V connections to an Autoflame IR scanner, Autoflame air pressure sensor and/or Autoflame gas pressure sensor
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

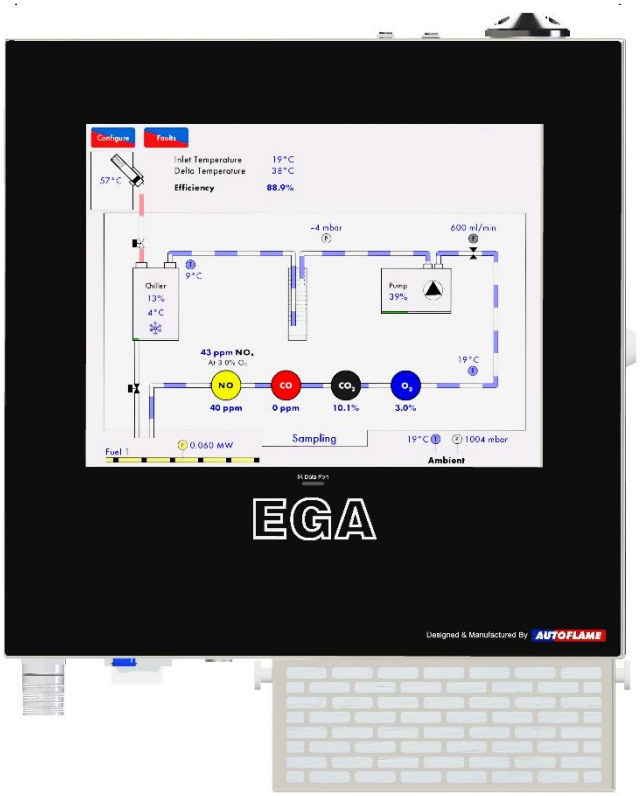
	Note: All external safety devices that require manual reset must be reset external to the Autoflame system and prior to completing the recycling interlock
54	Mains voltage input – air proving switch
55	Mains voltage input - proving circuits, e.g. gas valve proof of closure
57	Mains voltage output – call 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 servomotors and/or stepdown transformer
70	Switched neutral – drives channel 1 servomotor clockwise
71	Switched neutral – drives channel 1 servomotor counter clockwise
72	Switched neutral – drives channel 2 servomotor clockwise
73	Switched neutral – drives channel 2 servomotor counter clockwise
74	Switched neutral – drives channel 3 servomotor clockwise
75	Switched neutral – drives channel 3 servomotor counter clockwise
78	Switched neutral – 2-port valve for IBS operation
79	Switched neutral – alarm output for MM lockout/MM error/EGA error
80	Start position interlock/ night setback input/ reduced setpoint input
81	Purge interlock/ low flame hold input/ purge pressure proving
82	Warming stat/ valve proving mains input
89	Mains voltage input – selects fuel 1 curve
90	Mains voltage input – selects fuel 2 curve

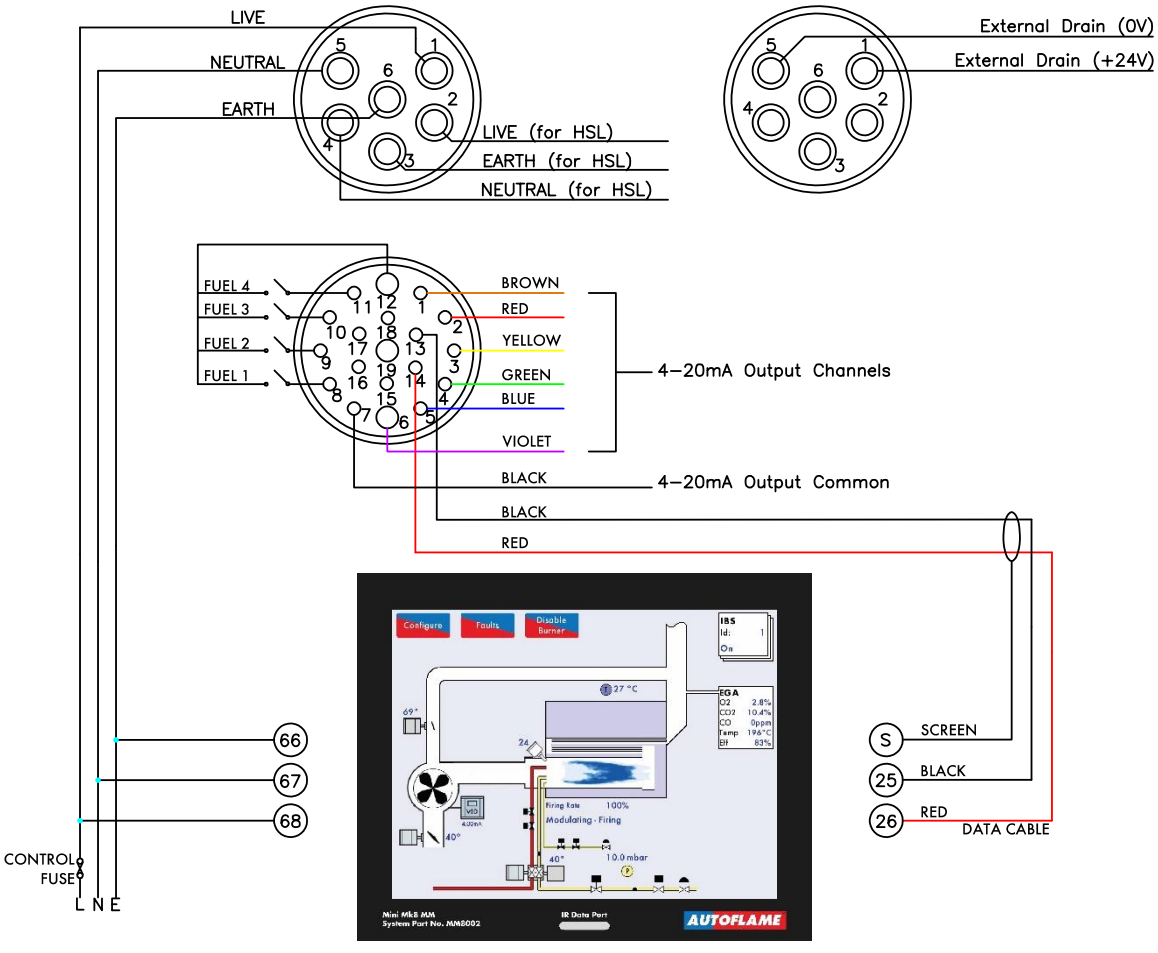
1.4. Standards

The Mini Mk8 MM has been tested and approved to the following standards:

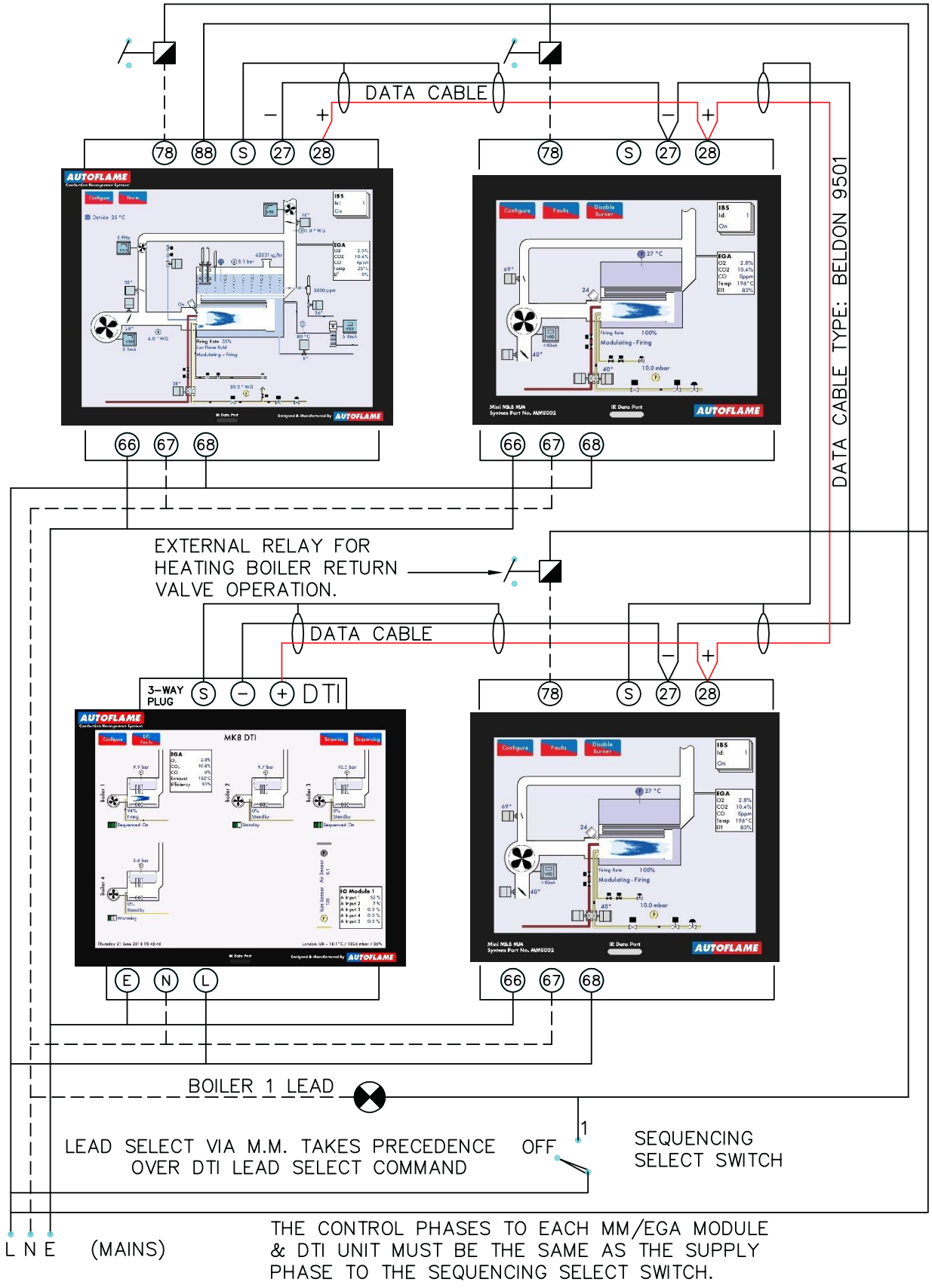
- UL 372, 5th Edition
- C22.2 No. 199-M89
- BS EN 298:2012
- BS EN 12067-2:2004
- BS EN 1643:2014
- BS EN 1854:2010
- ISO 23552-1:2007
- AGA AS 4625-2008
- AGA AS 4630-2005

1.5. Connection Between Mini Mk8 MM and Mk8 EGA EVO

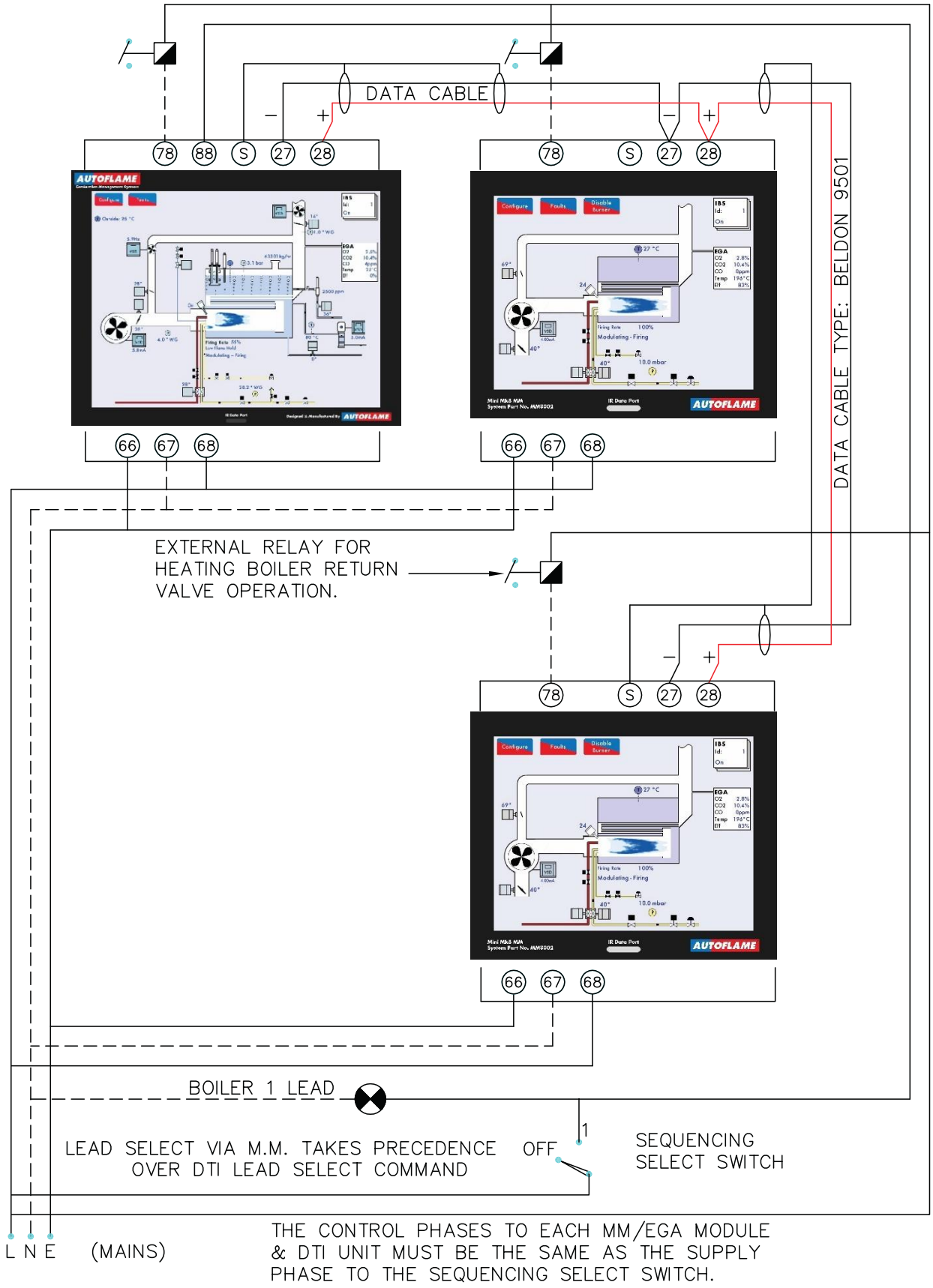




1.6. Connection Between Mini Mk8 MM and Mk8 DTI



1.7. Sequencing Connection Diagram



2. OPTIONS AND PARAMETERS

2.1. Options

The options and parameters are all viewable while the MM is in run mode and the burner is firing; a number of options and parameters can be adjusted through Online Changes. All Burner Control (BC) options/parameters can only be changed when in Commissioning mode.

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

Power up the unit. If the MM has already been commissioned, press 

when the system starts up to enter commissioning mode. If the system is not already commissioned, the MM will go to commissioning mode automatically.

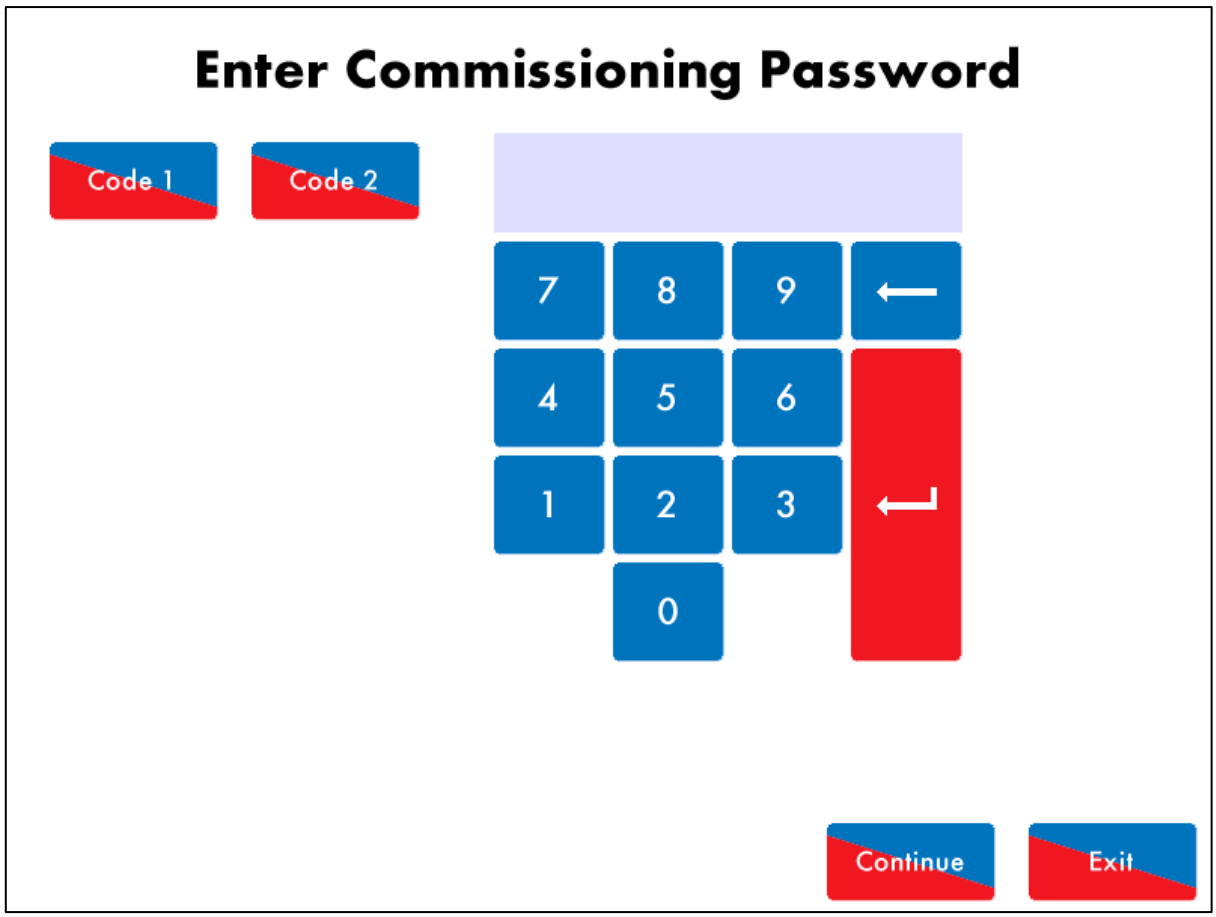


Figure 2.1.i Enter Password

"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.

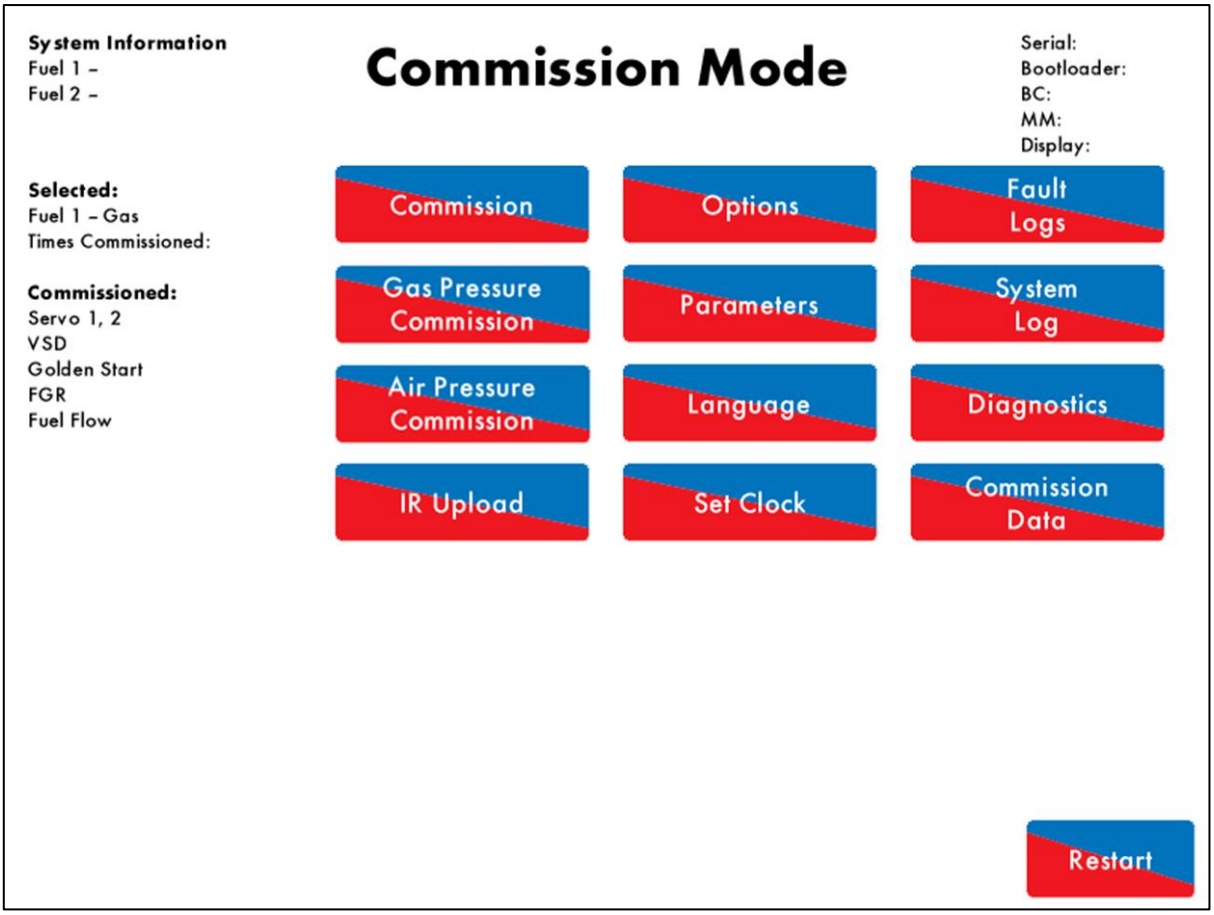


Figure 2.1.ii Commission Mode

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 gas pressure sensor can be commissioned, the commissioned IR data can be uploaded, the fault logs and system diagnostics can be viewed.

Note: The Times Commissioned is for the total system and will increment with every fuel commission, single point change and commission upload.

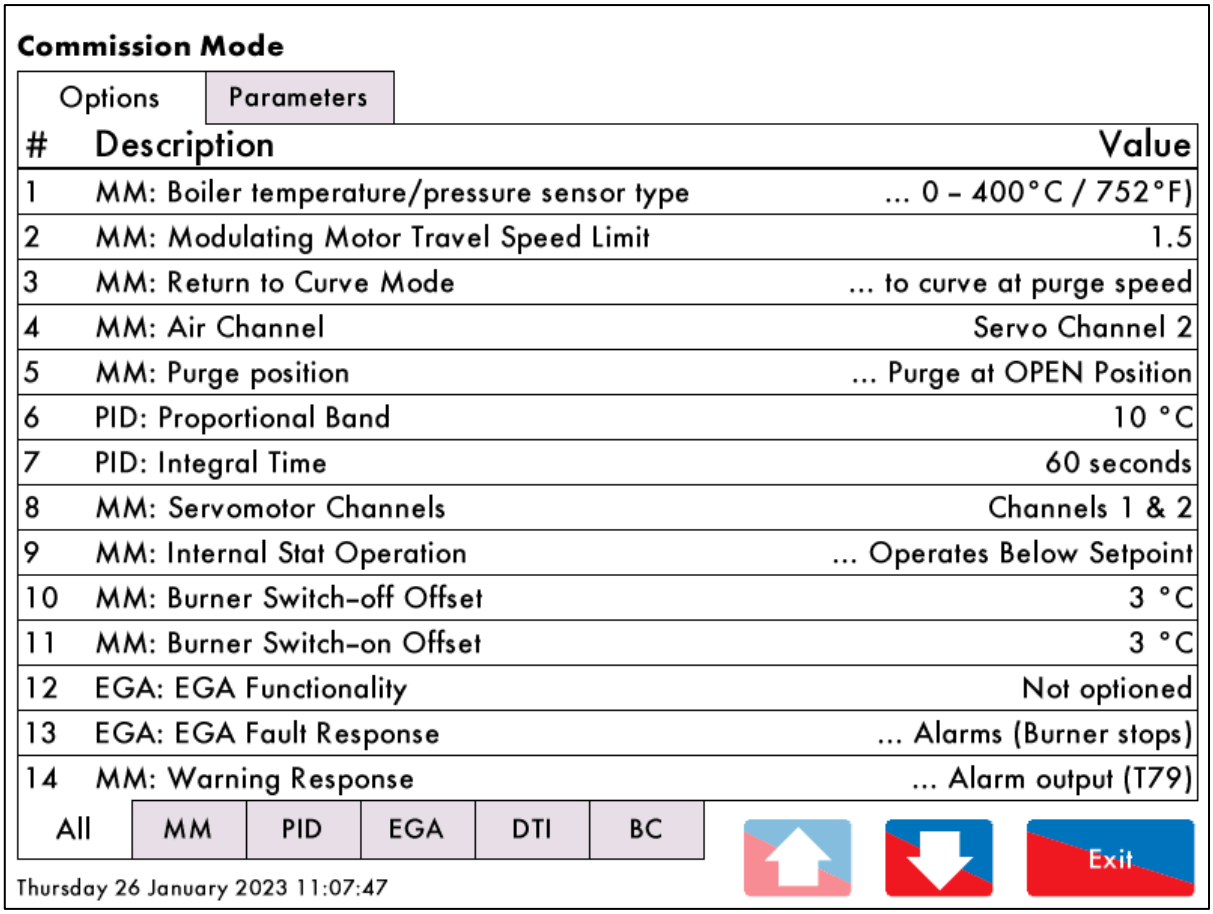


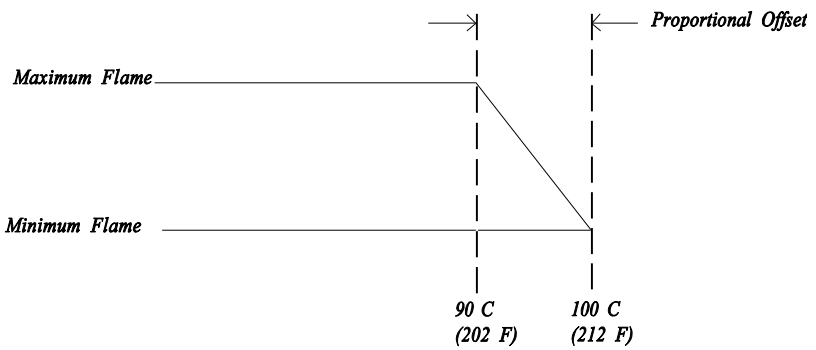
Figure 2.1.iii Options

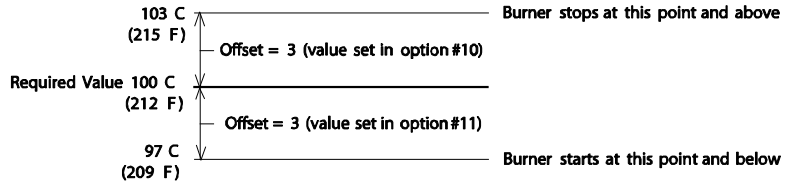
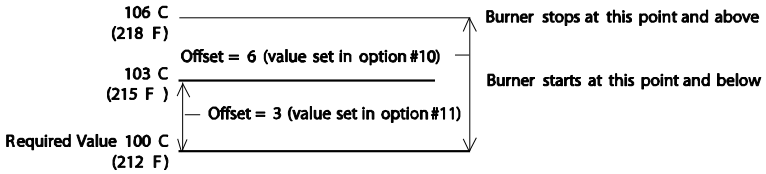
Any number of options and parameters can be changed at one time. By pressing MM, PID, EGA, DTI or BC at the bottom of the screen, the options/ parameters can be grouped together by feature.

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

A full list of options are detailed on the next pages. Options/Parameters 110 – 160 are the burner control settings and are safety critical; these must be entered with the same setting 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.

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 modulating speed of the motor is too fast, then decrease the value, and vice versa. At 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 an 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, then going through single point change to add 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 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), with 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), with 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), with 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), with 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), with 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 option 13) will occur, with 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 option 13) will occur, with 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 option 13) will occur, with 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 boiler is kept in a standby state with the second 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		DTI: 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 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
			If the speed of the motor is too fast, then decrease the value.
		10 – 100	1.0 – 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
			This setpoint is limited by the load detector set in option 1.
		20 – 999	^{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
			This setpoint is limited by the load detector set in option 1.
		20 – 999	^{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 7.3.1.
		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. Please check, the Autoflame Flame Safeguard manual for more information.
		0	Disabled
		1	Enabled

For safety reasons, options 110 – 160 also must 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 giving 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 with 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 that 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	Seconds (for option/parameter 135 set to 0 or 2)
		0 – 100	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	UV
		2	Ionisation
		4	IR
		5	IR and UV
		6	IR and Ionisation
		7	Ionisation to UV switchover
		8	IR or UV
		9	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 options/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	Disabled
		1 – 3600	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 options/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 options/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 options/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 during which 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 the 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 during which a gas valve is opened for the phases '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 options/parameters 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 options/parameters 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/parameters 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, an 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

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. 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
156	0		BC: Terminal T82 Function
			For setting 0, an 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.

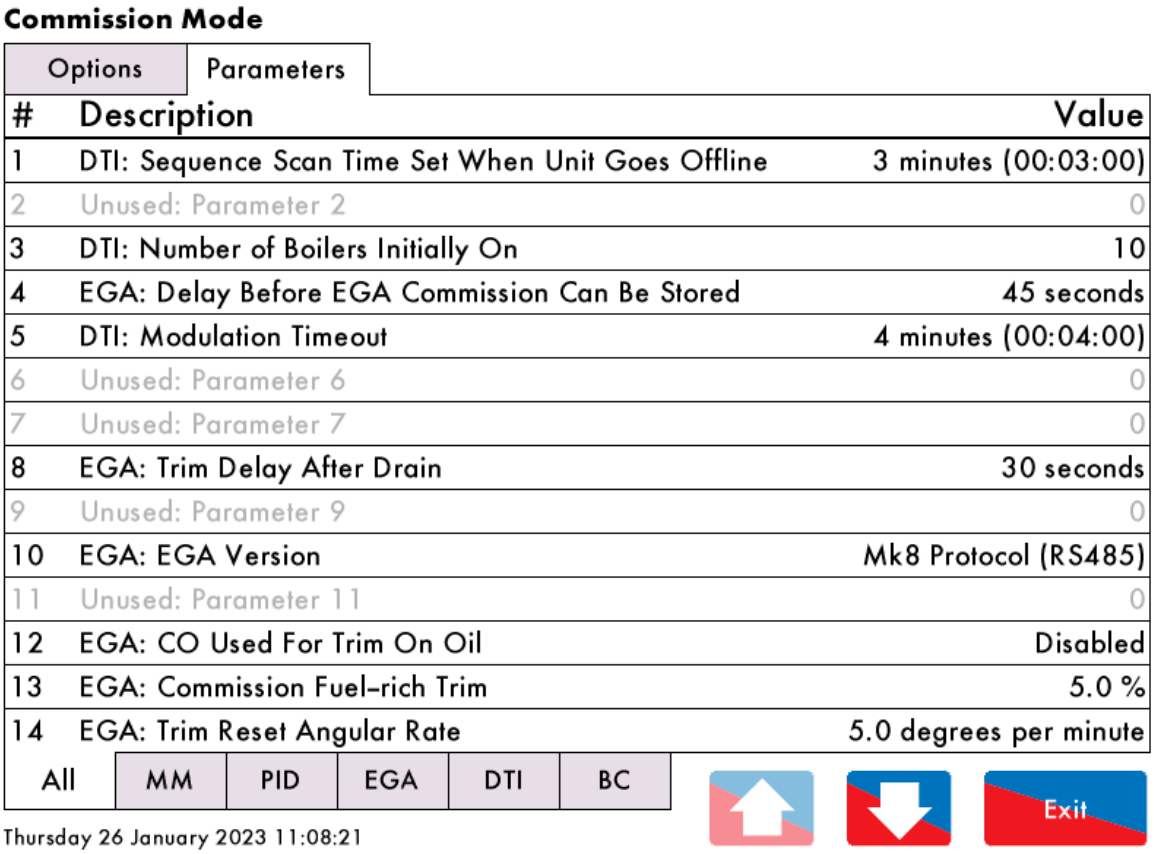


Figure 2.2.i Parameters

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 following pages. Options/parameters 110 – 160 are the burner control settings and are safety critical; these must be entered the same for both the option and parameter 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 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 starts. 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: 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
			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.
		0	Disabled
		1 – 10	Number of trims
18	100		EGA: Maximum Trim During Run
			This is the maximum trim % of air damper movement during firing.
		20 – 100	2.0% - 10.0%
19	50		EGA: Commission Air-Rich Trim
			This is the % air damper movement when commissioning the air-rich trim.
		20 – 75	2.0% - 7.5%
23	1		EGA: Add Air When CO Present
			This sets whether the trim function adds air 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.
		0	Disabled
		1	Enabled
24	120		EGA: (Mk7 Only) Air Calibration Time
			For the Mk8 EGA, this is set as default to 6 minutes.
		20 – 300	Seconds
26	8		EGA: Trim Samples per Cycle
			A cycle is the period between EGA drains to get rid of excess moisture in the exhaust gas sample. This parameter sets the number of trim corrections in between drains.
		1 – 50	
28	0		MM: Internal High Limit Setpoint
			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.
		0 - 9990	Depending on option 1 setting
29	1000		MM: Load Sensor Adjustment
			Adjust the load sensor (voltage) reading, as a percentage of the reading.
		800 – 1200	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
			For the Mk8 EGA, efficiency calculation method is set on the EGA.
		0	English
		1	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 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: Air Calibration on Startup
			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 lag boilers will be off. For setting 1, the lag boilers 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	-		MM: Display Diagnostic Values
		0 1	Disabled 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 1 – 3600	Disabled 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 on for this timer set, repeatedly. This should only be used in test/inspection conditions.
		0 1 – 3600	Disabled Seconds
90	0		MM: VSD Minimum Feedback Variation Check (Fuel 1)
			Enable/disable VSD feedback variation tests for fuel 1.
		0 1	Enabled Disabled
91			MM: VSD Minimum Feedback Variation Check (Fuel 2)
			Enable/disable VSD feedback variation tests for fuel 2.
		0 1	Enabled 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 99.
		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 options/parameters 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 options/parameters 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

3. COMMISSIONING THE MINI MK8 MM

3.1. Overview

Important Note: Prior to commissioning, the fuel and air servomotors must be calibrated to ensure that the position of the valves and damper correspond to the potentiometer feedback signal as displayed on the Mini Mk8 MM. Always physically check that the valve is fully closed when the MM displays zero degrees. If it does not, please drive the valves to the fully closed position and adjust the servomotor potentiometer to set the zero position.

If the MM is commissioned without an EGA, then a combustion analyser is required to check the exhaust gases. If the system does have an EGA, then a combustion analyser is not necessary as the EGA performs all normal exhaust gas measurements. When burning oil a smoke detection device is also necessary to check that the smoke generated is within safe limits.

Once a low firing position has been established, the high fire position is entered first, then descending fuel/air positions are entered consecutively until finally a minimum fuel position is entered. The CH1 and CH2 positions must always be less than the ones previously entered.

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

1. Check all interconnecting wiring between the MM and external components is correct.
2. Set options and parameters as required (refer to sections 2.1 and 2.2).
3. Set up servomotors.
4. Program fuel/air positions.

The commissioning procedure as described must be strictly adhered to. Anybody commissioning a Micro-Modulation 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.

The fundamental idea of the system is to set a fuel valve position and then set a corresponding air damper position. Care must be taken when adjusting the fuel and air positions so as not to create any unstable or hazardous combustion conditions, e.g. moving the fuel valve to the open position without increasing the air damper position.

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

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

3.2. Installation Checks

3.2.1. Commissioning Checks

When all the installation and burner adjustments are completed, the entire burner control system 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 servomotors/gas/oil/FGR 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 and Servomotors manual for general checks.

3.3. Servomotors

Autoflame supply three standard sizes of servomotors – small, large and industrial, which can be used for all channels. Autoflame fuel valves require small or large servomotors only. Both small and large servomotors can be configured to drive clockwise or counterclockwise to open a valve or damper. Servomotors can be installed in any orientation. For layout of the small, large and industrial servomotors please refer to the Valves and Servomotors manual.

Viewing the shaft end-on, from the potentiometer end, all servomotors drive in a clockwise direction if power is applied between the LIVE and CW terminals, and counterclockwise if the power is applied between the LIVE and CCW terminal.

The operation of fuel valves and air dampers is often such that they open in a clockwise direction. If the operation needs to be reversed, it is necessary to swap various wiring connections between the MM and the servomotor(s). An example of reversing the operation of a servomotor is shown in Figure 3.3.3.

Servomotors are supplied by the factory set at 0.0 position. Remember that this position may not necessarily automatically position the damper at 0.0 or a closed position. This must be physically checked. Failure to do so can result in damage to equipment, serious injury or death.

3.3.1. Adjusting the Servomotor Potentiometer

Before a burner is fired, it is essential to set up each Micro-Modulation servomotor. A tamper proof screwdriver is required (please contact Autoflame).

Usually control valves/air dampers that the servomotors drive, move through up to 90 angular degrees. The MM system has the ability to drive valves through 360 degrees, but the MM will only display from -6 to 96 degrees.

All Channel 1 to 3 readings displayed on the MM are in angular degrees. It is necessary to adjust the potentiometer in the servomotor assembly so that the MM reads 0.0 when the relevant valve/damper is at its fully closed position. The technician must physically check the mechanical position of the dampers and valves. Whilst all servomotors are set to 0.0 before leaving the factory, this may have changed during shipping. DO NOT ASSUME THEY HAVE BEEN PREVIOUSLY SET CORRECTLY.

To set up a servomotor, first ensure option 12 is set to 0, (this prevents EGA errors from allowing continuation). Put the MM into the commissioning mode and press CLOSE to position the valve/damper mechanically by using the appropriate up and down buttons (see section 3.4.2).

Remove the servomotor cover.

For air servomotors carry out the following procedure:

Use the channel 2 up/down buttons on the MM to position the air damper to its physically closed position. Loosen the two tamper proof screws just enough to enable the potentiometer to rotate. Rotate the potentiometer clockwise or counterclockwise until the relevant channel reads 0.0. Tighten the two tamper proof screws gently until the potentiometer is secure. Do not over tighten the screws. Check that the display still reads 0.0. If incorrect repeat the adjustment process.

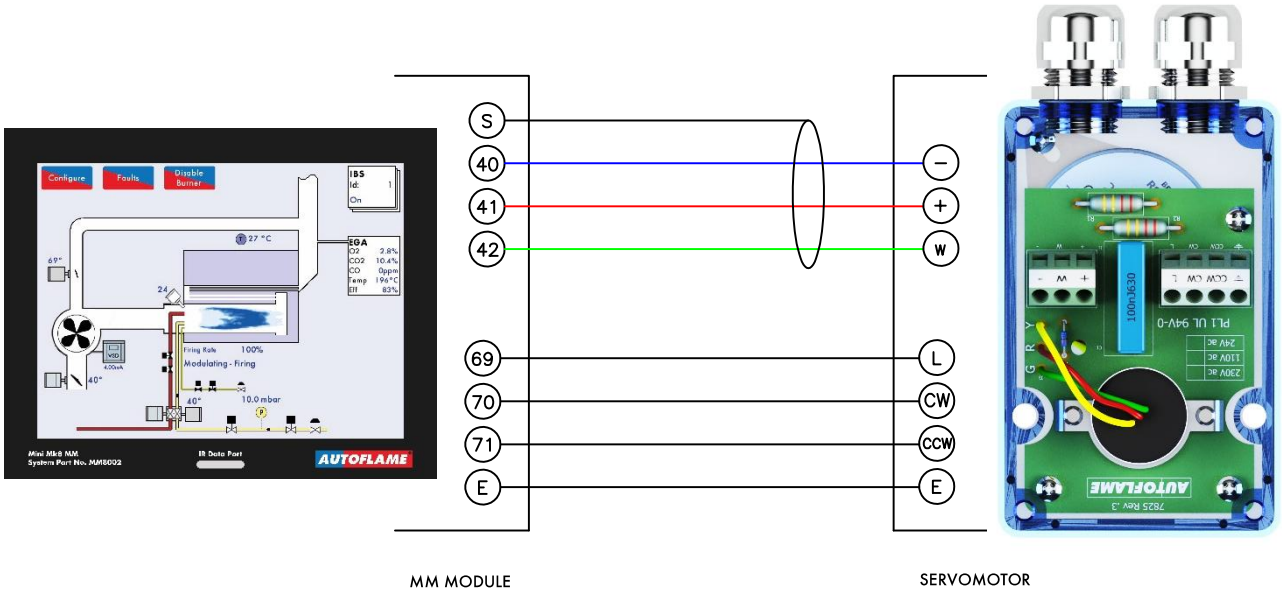
For fuel servomotors carry out the following procedure:

On Autoflame gas, oil and gas/oil piggy-back valves it is necessary to remove the servomotor. Manually position the oil/gas valve slot to its closed position. Observe the position of the drive pin on the servomotor. Use the relevant channel up/down buttons to position the pin so that when the servomotor is reassembled to the valve it is in line with the slot. Reassemble the servomotor to the valve, loosen the two tamper proof screws and proceed to adjust the potentiometer position until 0.0° is displayed. Use the external position indicator to ensure the valve is in the fully closed position.

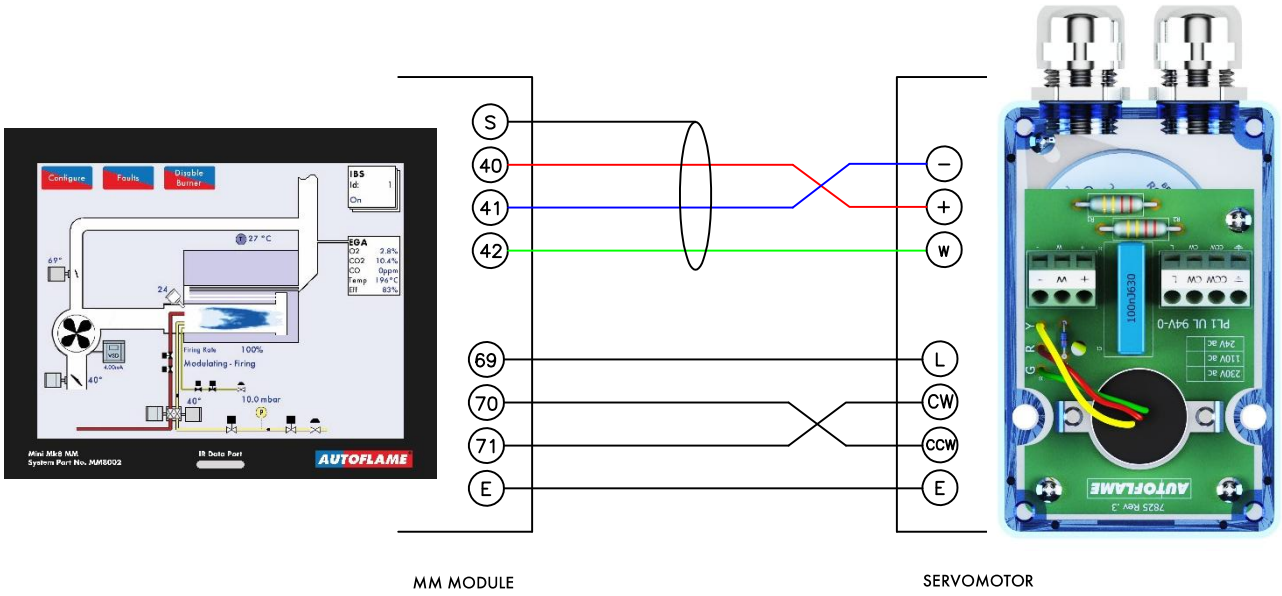
3.3.2. Servomotor Feedback Voltage

In applications where the servomotor is not positioned close to the display, then it is possible to measure the feedback voltage from the servomotor in order to ensure that 0.0° is displayed. By testing the DC voltage between the blue and green wires (wiper and 0V) on the servomotor low voltage terminals this will read 0.21V DC when the reading on the display is 0.0°. The same can be done for when the servomotor is at 96.0˚ where the voltage will be 3.6V.

3.3.3. Servomotors – Direction Change



SERVOMOTOR CLOCKWISE ROTATION



SERVOMOTOR ANTICLOCKWISE ROTATION

3.3.4. Servomotors with Autoflame Valves

On threaded valves, the pin on the top of the valve is 90° opposite from the position of the butterfly valve.

On flanged valves, the pin on the top of the valve is in line with the position of the butterfly valve.

For both valves the external visual position indicator is in line with the position of the butterfly valve. Regardless of the type of valve being used, the servomotor is dispatched from the factory with the potentiometer in the zero position. The same servomotor will be correct for both types of valve, as the servomotor for the threaded valve is mounted at 90° different from the flanged valve.

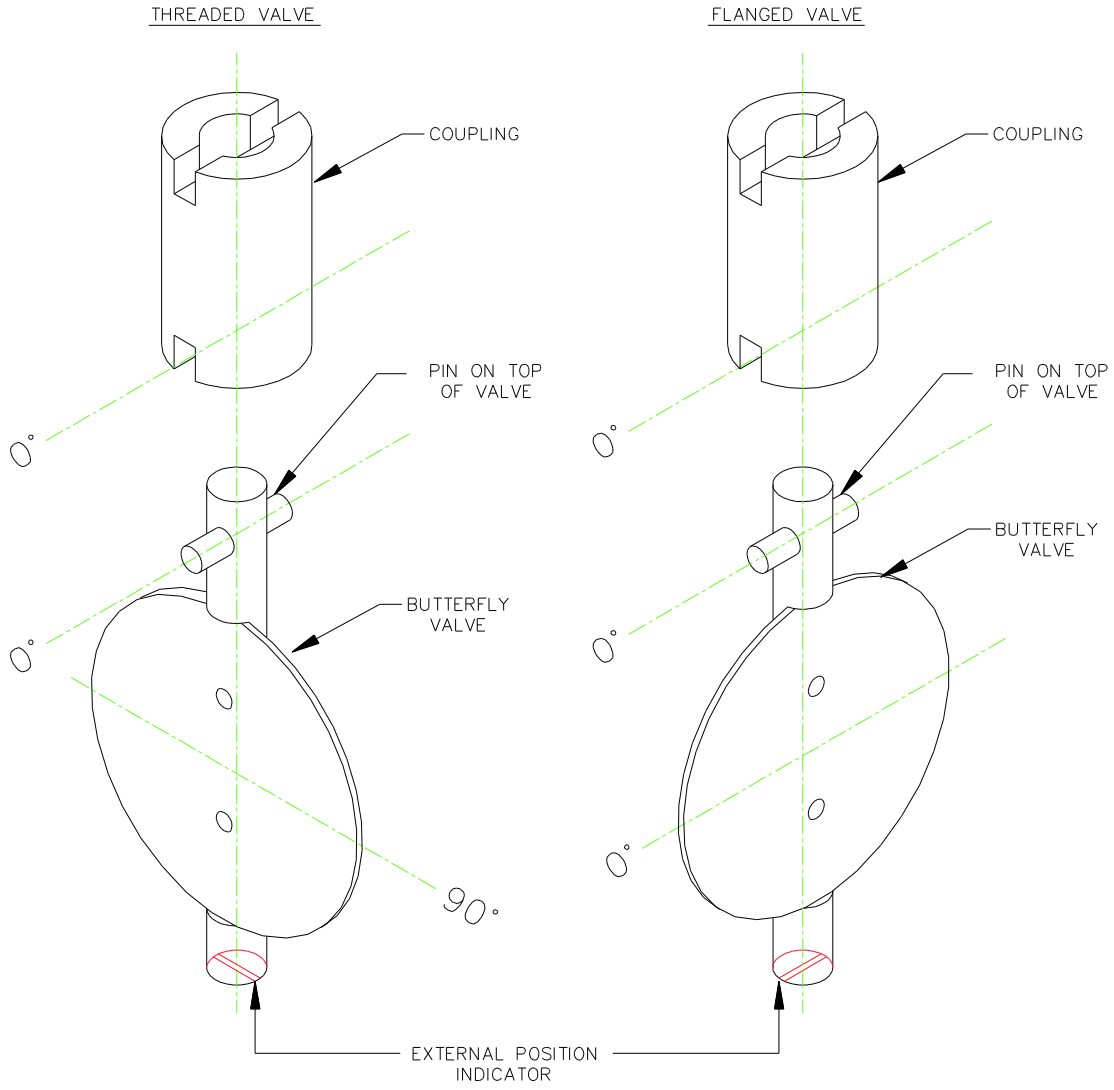


Figure 3.3.4.i Valve Pin Positions

3.4. Commissioning Fuel and Air Positions

The following procedure is shown for commissioning with the EGA option 12 set to 0 (Not Optioned), or 1 (Monitoring only). Trim can be added later by setting option 12 to 2 (Applies trim) or 3 (Applies trim, combustion limits tested). If the EGA is optioned later in Online Changes, the MM will not require a full re-commission; the trim data can be added in Single Point Change. Please see section 3.7 for adding/adjusting the trim data later using Single Point Change.

For option 12 set to 0 or 1 during commissioning, omit section 3.4.6. For option 12 set to 2 or 3 during commissioning, please include section 3.4.6.

The fuel and air positions need to be programmed for the following points: CLOSED, OPEN, GOLDEN START (if optioned), FGR START (if optioned), LOW FIRE (START), INTER POINTS, and HIGH FIRE.

There must be a minimum of 3 INTER points entered on the fuel-air curve, and a maximum of 18. Points can be added/removed in Single Point Change mode (see section 3.7).

During commissioning the required setpoint is not active; the internal stat always remains on regardless of the actual value. Ensure that the high limit stat is set correctly and wired into the recycling interlock (T53), as this will turn the burner off in the event that the safe working maximum temperature or pressure of the boiler is exceeded.

The high limit stat should be set below the rating of the safety valve, please see the manufacturer's guidelines for the safety valve for that boiler.

Note: If a fault occurs, the boiler goes above the high limit stat or power is lost to the MM during commissioning, no data is stored. The points entered are only stored within the MM once the commission has been completed.

3.4.1. Starting Commissioning

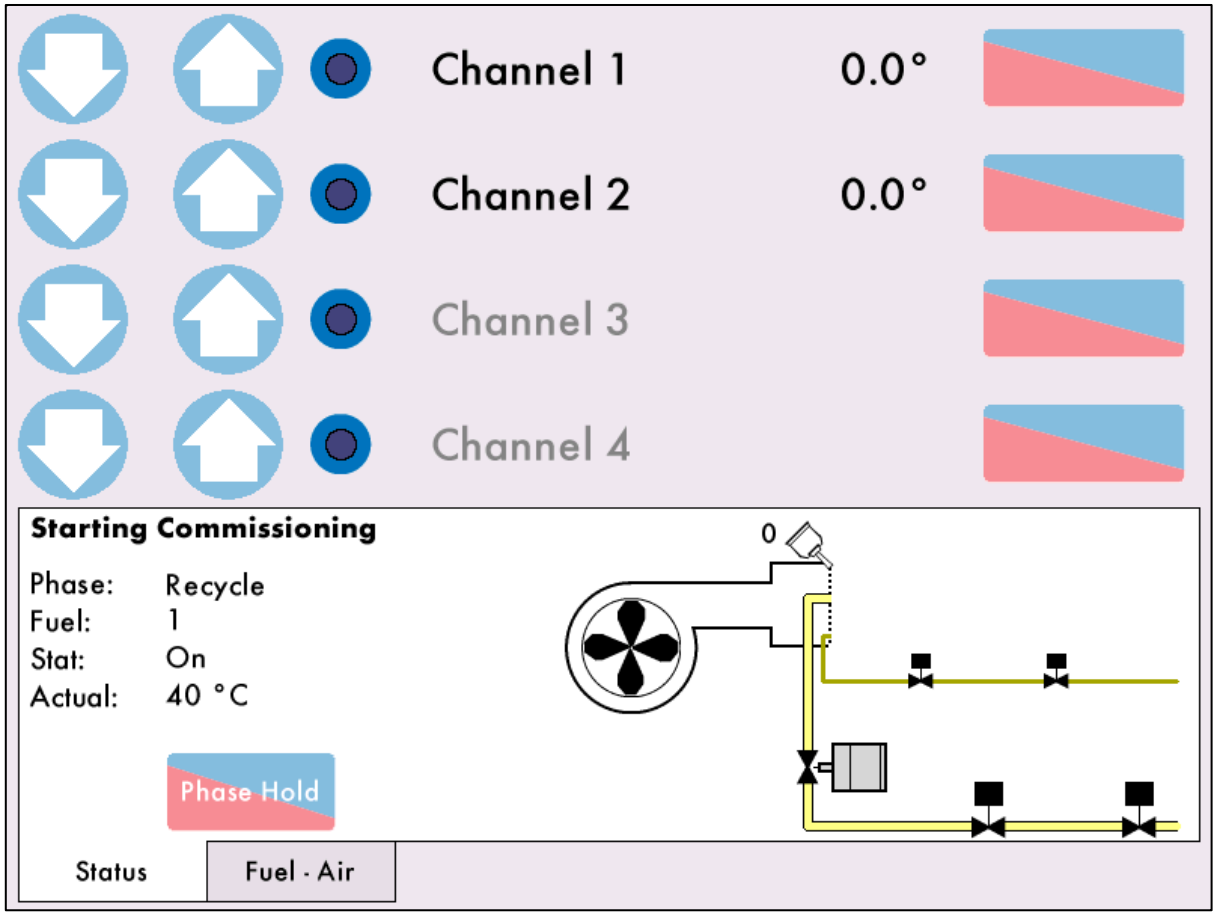


Figure 3.4.1.i Starting Commissioning

Once the options and parameters have been set, press Commission on the Commission Mode screen in Figure 2.1.ii. If the MM has already been commissioned, then press Commission on the Home Display.

Figure 3.4.1.i shows the Commissioning screen. In the Commissioning screen, the 4 channel positions will be shown, with the unused channels greyed out.

Once the MM goes through its internal relay checks and VPS (if optioned), the message 'Select Commissioning' will display.

3.4.2. Enter CLOSE Position

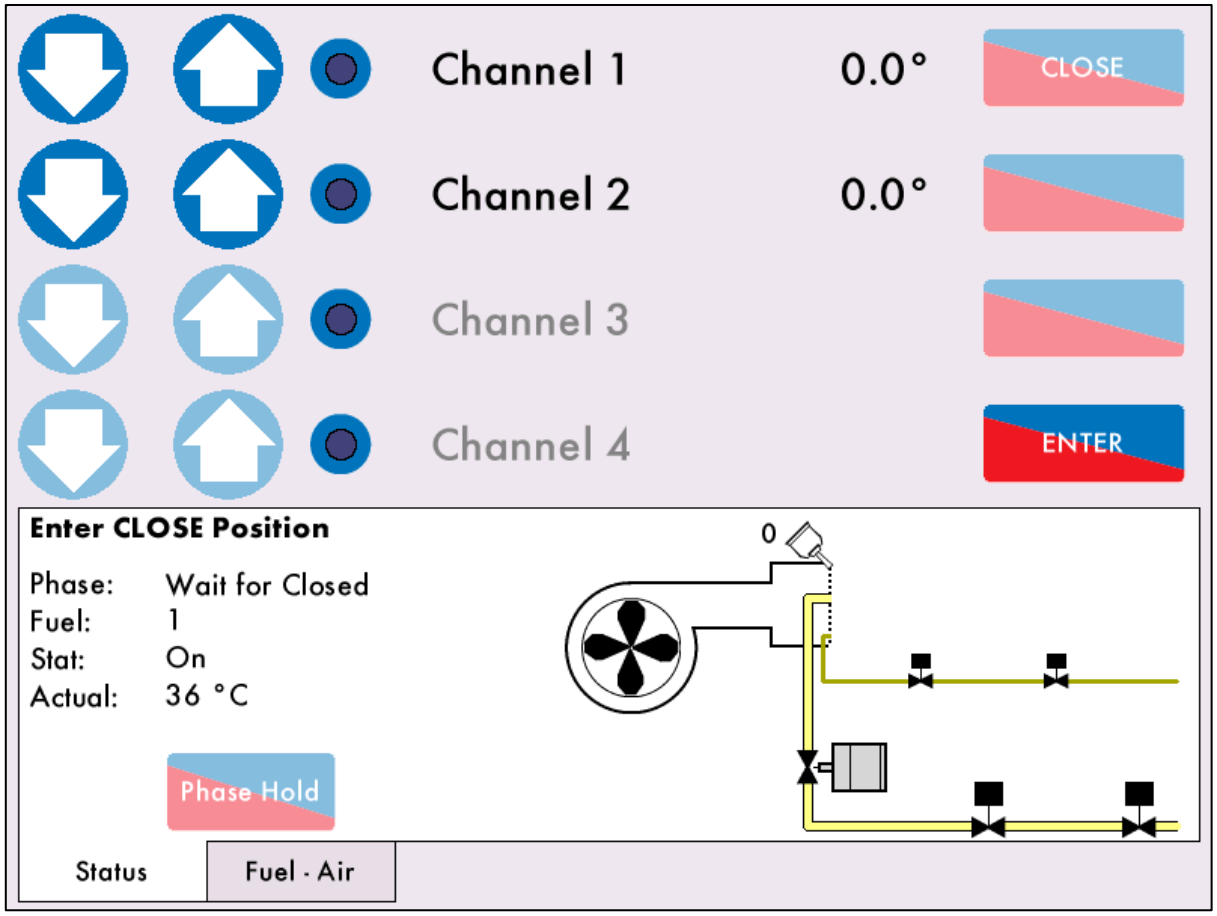


Figure 3.4.2.i Enter CLOSE Position

The MM is now waiting for the CLOSE position to be entered. Press 

to enter this position.

Note: No error checking of the servomotors is enabled at this stage, therefore, do not to drive the servomotors/ dampers beyond any mechanical limitations that may be present on the damper/valve. This may cause damage to the servomotor and/or the damper/valve.

Use the  buttons to set the positions to 0.0°.

Note: Double check the damper/valve is physically at the 0.0° (closed) position. This can be achieved by checking for external indications on the damper assembly or the fuel valve. It is the engineer's responsibility to ensure that the servomotors are correctly calibrated. Incorrect calibration can cause serious injury or death.

Press 

to store the CLOSE position. The burner motor output T58 will energise at this point. A message will then be displayed 'Enter OPEN Position.'

3.4.3. Enter OPEN Position

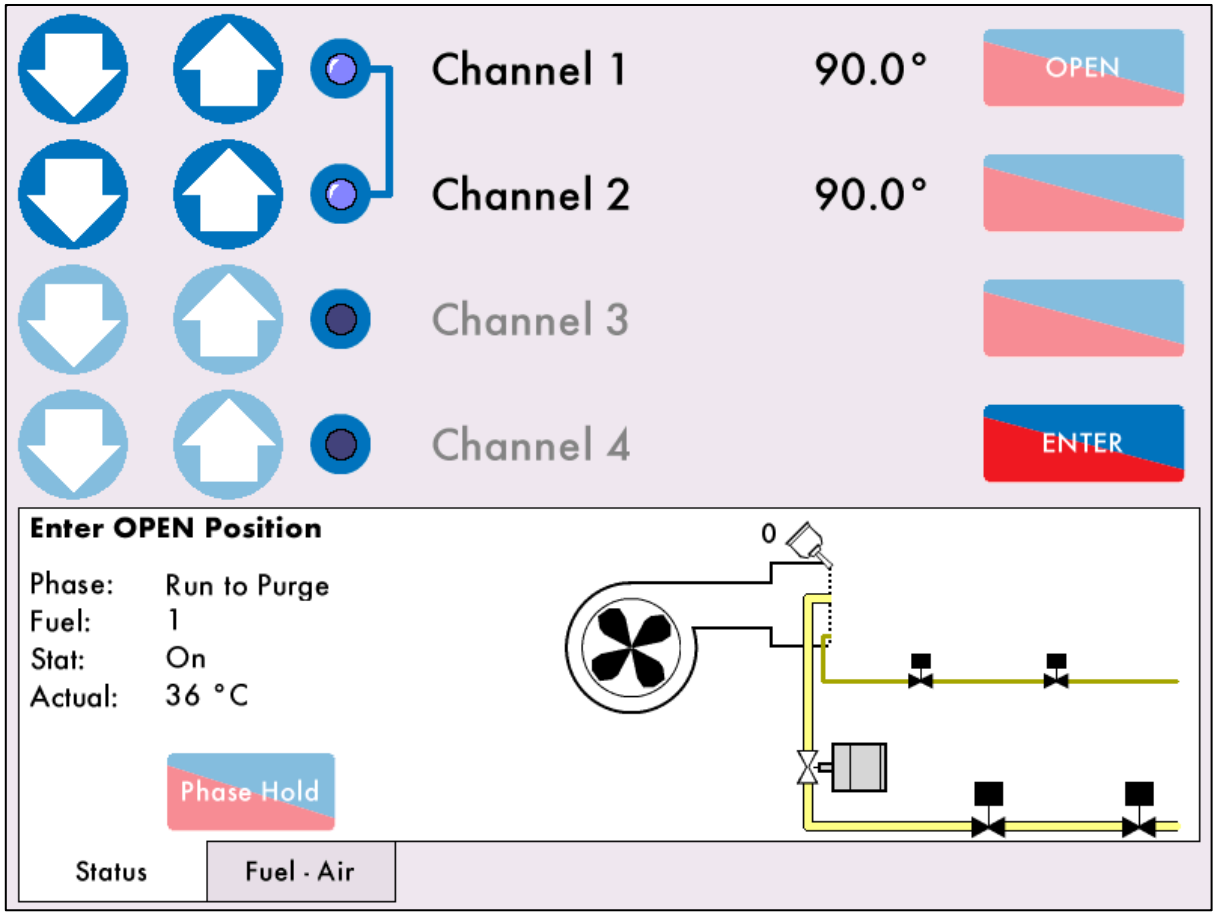


Figure 3.4.3.i Enter OPEN Position

Press 

and then drive the fuel and air servomotors to their OPEN position. The button hold facility allows multiple channels to be driven up or down at the same time. Press on the blue circles  next to the channels; once selected they the blue circles will be filled and a blue line will appear as above in Figure 3.4.3.i to indicate the channels are selected.

Use the  buttons to drive both servomotors to the OPEN position simultaneously. This is normally 90.0 ° for gas butterfly valves and burner air dampers, but may be set to less than 90.0 ° if there are mechanical stops/limits. Channel 4 cannot be adjusted at this stage, since its calibration is dictated by the drive set-up and relevant options.

Press 

to save the OPEN positions.

Pressing on the Fuel-Air tab at any time will give you a graph showing the fuel and air servomotor angles.

3.4.4. Enter START Position

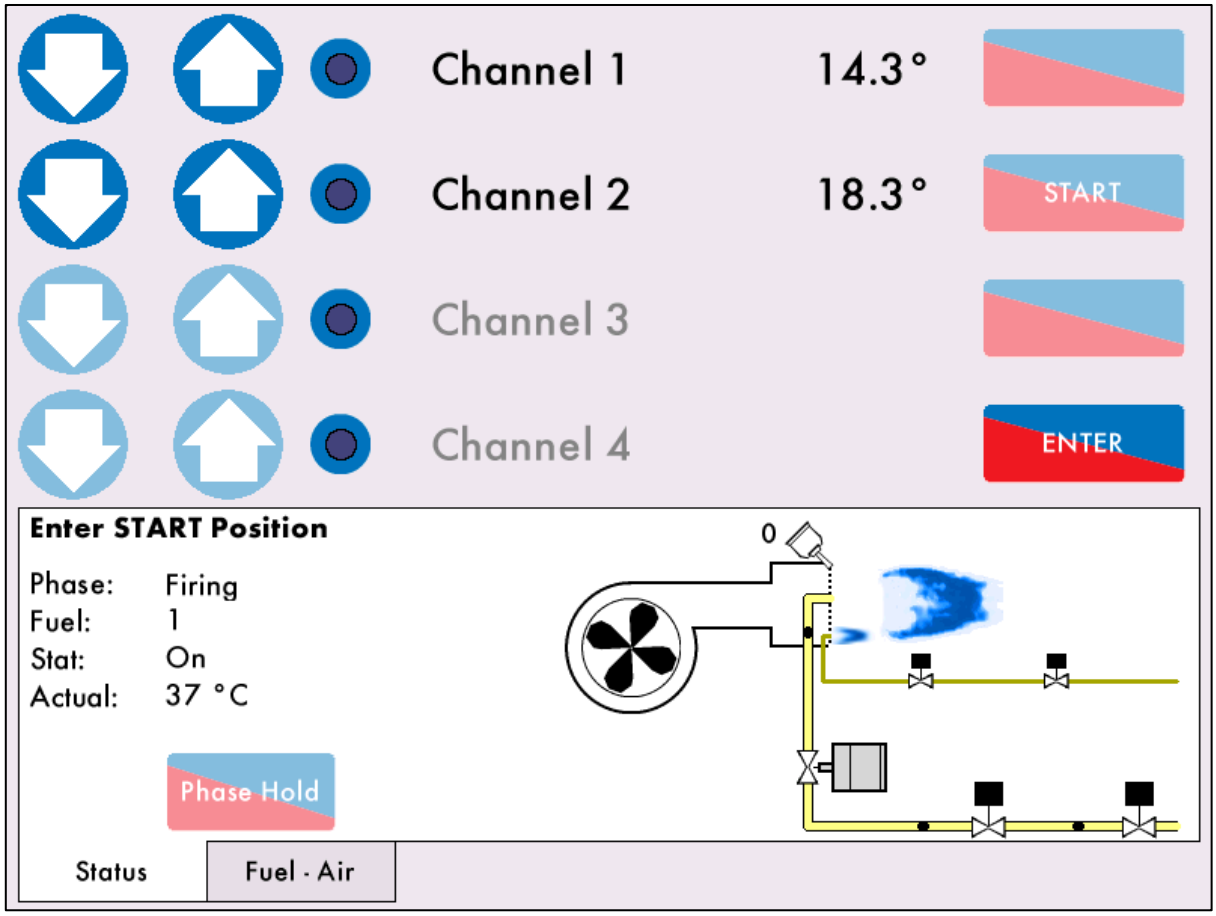


Figure 3.4.4.i Enter START Position

Once the system has purged (see options/parameters 75 and 112), the message 'Set up START Position' will display on the MM.

Press 

and drive the servomotors to their START position. To enter a fuel START position which is less than 10 degrees below the OPEN position, you must drive the servomotor below this band, and then back open. For example, if the CH1 OPEN position is set at 90.0^{O}, to set a CH1 START position of 83.0^{O}, you must drive the CH1 servomotor to below 80.0^{O} and then to 83.0^{O}.

WARNING: ENTERING THE START POSITION BEFORE REDUCING FUEL INPUT APPROPRIATELY COULD RESULT IN AN EXPLOSION.

Press 

to enter the START position, where ignition can take place; these fuel and air positions are not stored permanently as it is just a light-off position to put a flame in the boiler and begin the commissioning process.

3.4.5. Phase Hold

When the system is in commissioning mode only, the Phase Hold feature enables the commissioning engineer to pause the ignition sequence of the burner, in order to make adjustments to the start gas flame if needed.

The phase hold feature can be used in pilot open, pilot proving and main flame proving. If the phase is held in the pilot open stage and the flame goes out, a lockout will occur after 20 seconds. However, if the phase is held in either the pilot proving or main flame proving stages, the MM will lockout immediately if the flame scanner does not detect a flame.

If the flame is present and the 'phase hold' condition is left indefinitely the 'Freeze Timeout' lockout will occur after 10 minutes. When the system is in a run mode the facility is disabled.

To make manual adjustments to the gas, press 

to keep the system at its current phase position, a little blue dot on this 'button' will appear to indicate that the phase is held. Ensure that the main fuel valve is manually isolated until the pilot flame has been successfully established. Once this has been successfully established, gradually introduce the main fuel supply to the burner while observing the flame stability. Continue to introduce fuel until the manual operated main fuel isolation valve is fully open providing safe and stable combustion that can be maintained. If the combustion is not safe and stable, then adjust the fuel/air ratio accordingly. Once the adjustments have been made, press 

to continue with the commissioning process.

3.4.6. Add Trim Data During Commissioning

If option 12 is set to 2 or 3 during commissioning, then when setting the servomotors for the HIGH, INTER, GOLDEN START, FGR START and START positions, the trim data will also need to be saved for the fuel-rich and air-rich trim conditions. The message 'Waiting for EGA readings' will display.

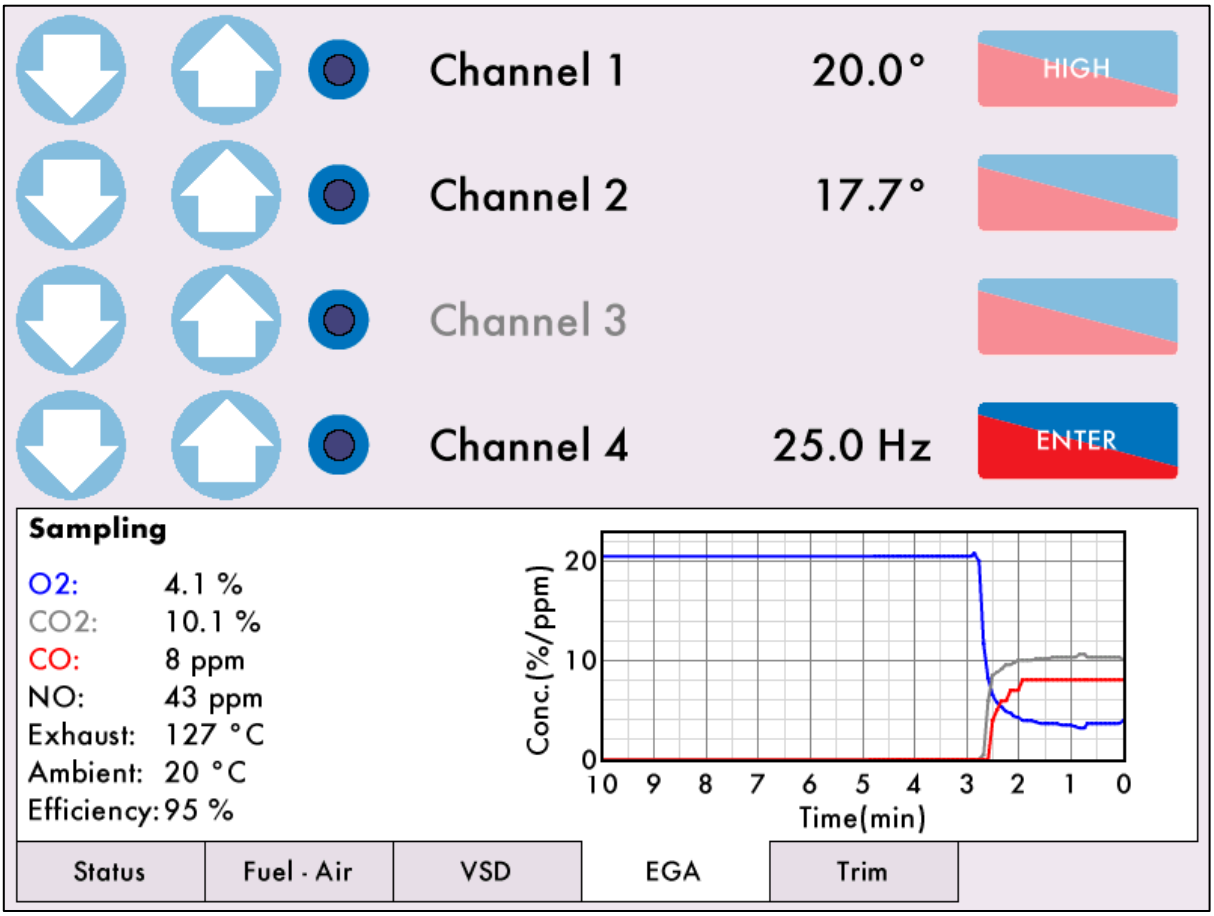


Figure 3.4.6.i Sampling

Press on the EGA tab to display the EGA readings.

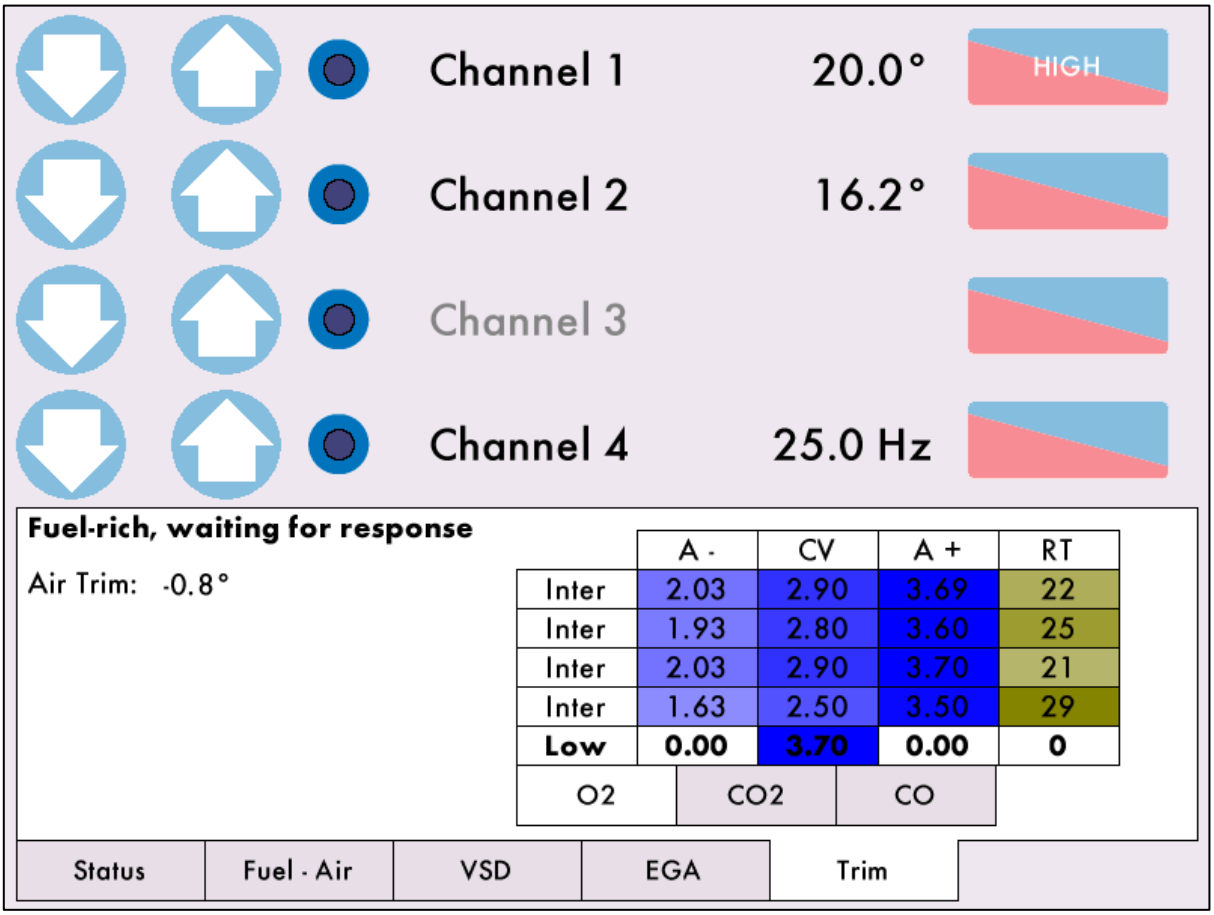


Figure 3.4.6.ii

After you press 

to save those servomotor positions, the EGA will carry out its fuel-rich and air-rich trims.

Once these trim values have been saved, the system will continue with the commissioning process.

Note: If the MM has not been enabled for trim during commissioning, this can be added later by setting option 12 for trim, and going into Single Point Change to add trim to each point, see section 3.7.

3.4.7. Commissioning VSD

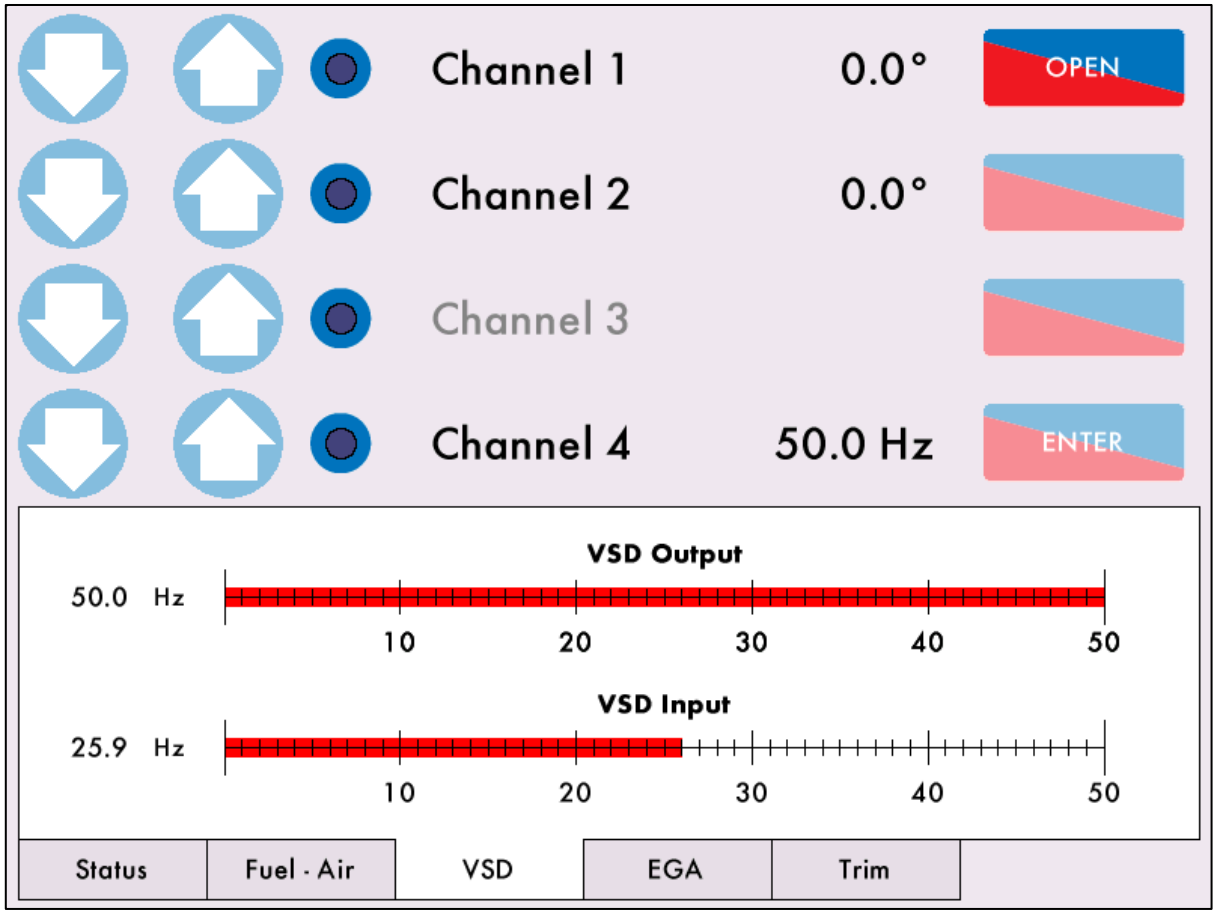


Figure 3.4.7.i Commissioning VSD

Press on the VSD tab to view the VSD output and input signal during commissioning.

If the MM has been enabled with VSD for commissioning and then disabled, or vice versa, a conflict message will appear 'VSD configuration does not match commissioning.'

If there is little movement required with the VSD signal, the feedback fault tolerance should be set accordingly. If the tolerance is not set according to the variation, an error 'VSD feedback change too small' will occur.

Please see option 99 for the VSD fault tolerance, which ensures that a VSD can be verified to be at the correct speed at low fire and different to that of high fire. This also ensures that VSD signal is checked for fixed values and cannot be bypassed, preventing an unsafe condition with reduced air compared to commission. The minimum feedback variation applies to both the upper and lower limits so the total commission must allow for the two combined.

Note: For the 4-20mA outputs on the Mini Mk8 MM, the maximum voltage drop supported is 12V.

3.4.8. Set GOLDEN START Position

If Golden Start has been enabled in option 29 on a new system which has not been commissioned, the message ‘Set Golden Start Position’ will display after the START position has been entered.

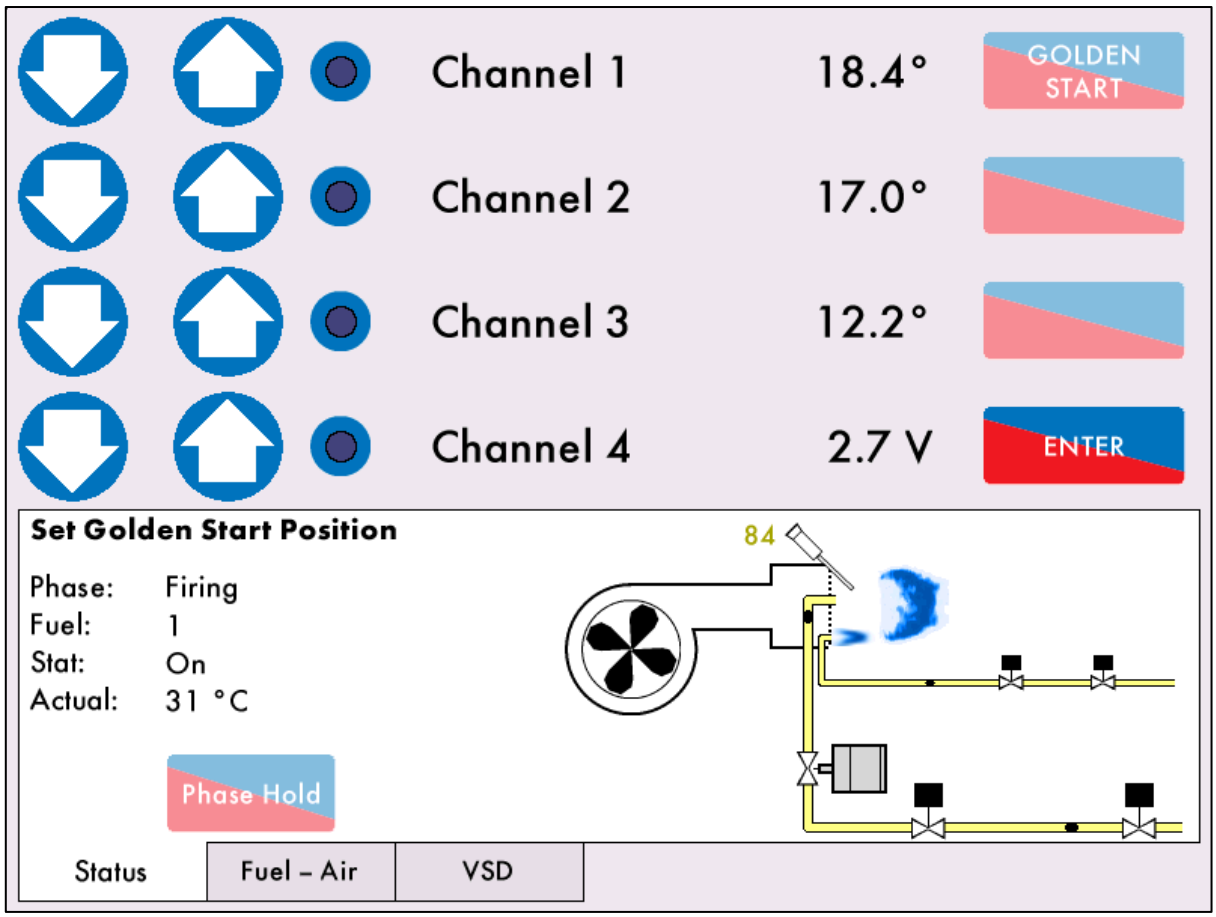


Figure 3.4.8.i Set GOLDEN START Position

Press 

to enter the GOLDEN START position. After entering the GOLDEN START position, proceed to the commissioning steps in section 3.4.9 if FGR START has been enabled, or 3.4.10 if no FGR START is enabled.

Enabling Golden Start on a Commissioned System

If the system has already been commissioned without Golden Start enabled, go into Commission mode and set option 29 to enable Golden Start. The forced commission message will appear as ‘Golden Start optioned but not commissioned.’

Press 

on the home screen and once the system goes through its internal relay tests, the message ‘Select Commissioning’ will appear.

Press 

to go through the commissioning process and enter the CLOSED, OPEN and light-off START positions. After the entering the light-off START position, the message ‘Set Golden Start Position’ will appear; press 

to enter the stored GOLDEN START position and continue with the full commissioning procedure. in section 3.4.9 if FGR START has been enabled, or 3.4.10 if no FGR START is enabled.

Alternatively, to just add the Golden Start position and not go through the whole commissioning procedure, press 

on the home screen, and once the system has gone through its internal relay tests the message ‘Select Commissioning’ will appear. Press 

and the MM will go through purge. The message ‘Set up START position’ will appear to ignite a flame in the burner, see section 3.4.4. Once the burner is firing, the message ‘Set Golden Start Position’ will appear. Press 

to enter the GOLDEN START position. The message ‘Save Commission’ will appear, press 

to save the GOLDEN START position and then press 

to return to run mode.

Note: If FGR START has also been enabled, this position must be entered after the GOLDEN START position.

The Golden Start position of the fuel and air servomotors is completely independent from the modulating load index and commissioned value data.

The facility is particularly useful on combustion systems with large turndowns and when firing heavy oil, as it enables the burner to start/ignite at a fuel rich position and then, after a stable flame is established, return to the commissioned combustion curve.

The Golden Start position needs to be entered for each required fuel.

The MM holds the Golden Start position for a time set in parameter 15; this time starts from the point of main flame. After this time, if the Golden Start fuel position is between Low Fire and High Fire, the air damper will open and the fuel valve will stay in the same position, until fuel/air ratio is on the commissioned combustion curve. If the Golden Start fuel position is outside of the main curve, then both the air damper and fuel will go to the Low Fire position. Once on the commission curve, the MM will modulate as per the load requirement.

3.4.9. Set FGR START Position

Flue Gas Recirculation (FGR) is a method whereby a quantity (approximately 15%) of the boiler flue gases are fed back to the burner and mixed with the combustion air. The virtue of FGR is the reduction of NOx gases. With the FGR facility, servomotor channel 3 can be used to control the amount of flue gas fed back. It is not good practice to feed back the gases when the flue gas is cold, so all the elements (i.e. servomotors and VSD) cannot be set at 'FGR' positions until the gases are hot. During this time the CH3 would normally be set closed. Once the FGR holding conditions are met, modulation takes place in the normal way using the curve entered during commissioning.

Setting FGR on a system which has not been commissioned

If FGR Start has been enabled in options 48, 49 or 50 on a system which has not been commissioned, the message 'Set FGR Position' will display after entering the light-off START position. If Golden Start has been enabled in option 29, this message will appear after entering the GOLDEN START position.

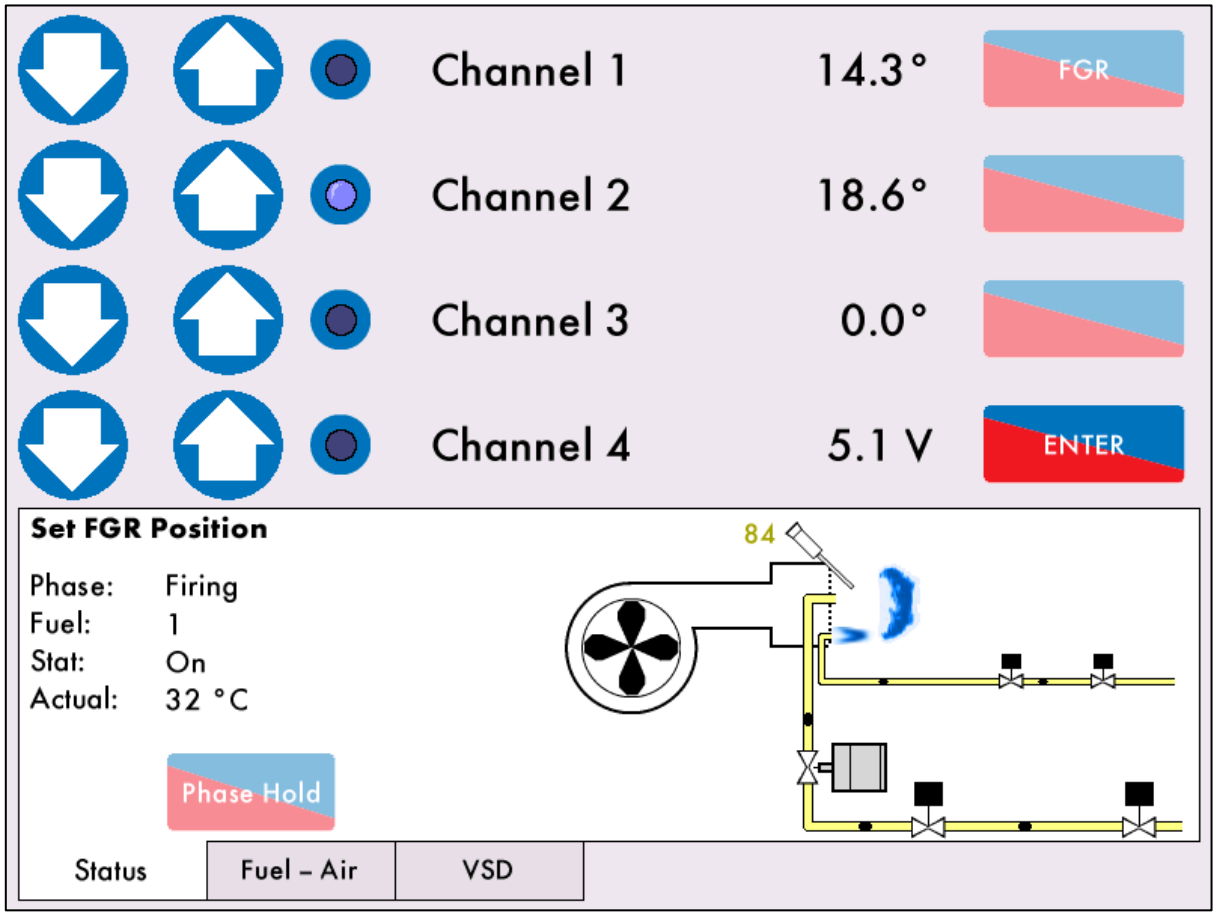


Figure 3.4.9.i Set FGR START Position

Press 

to enter the FGR START position. After entering the FGR START position, proceed to the commissioning steps in section 3.4.10.

Enabling FGR Start on a Commissioned System

If the system has already been commissioned without FGR Start enabled, go into Commission Mode and set option 48, 49 or 50 to enable FGR Start. The forced commission message will appear as 'FGR optioned but not commissioned.'

Press 

on the home screen and once the system goes through its internal relay tests, the message 'Select Commissioning' will appear.

Press 

to go through the commissioning process and enter the CLOSED, OPEN, light-off START and GOLDEN START (if enabled) positions. The message 'Set FGR Position' will then appear; press 

to enter the stored FGR START position and continue with the full commissioning procedure in section 3.4.10.

Alternatively, to just add the FGR Start position and not go through the whole commissioning procedure, press 

on the home screen, and once the system has gone through its internal relay tests the message 'Select Commissioning' will appear. Press 

and the MM will go through purge. The message 'Set up START position' will appear to ignite a flame in the burner, see section 3.4.4. Once the burner is firing, the message 'Set FGR Position' will appear. Press 

to enter the FGR START position. The message 'Save Commission' will appear, press 

to save the FGR START position and then press 

to return to run mode.

Note: If both Golden Start and FGR are optioned then the GOLDEN START position is entered before the FGR START position.

Note: Golden start takes priority over FGR. Once the golden start timer has finished, the servomotors will go straight to the FGR start position.

FGR can be set as a Timer, Offset or Temperature Threshold (see options 48, 49 and 50).

3.4.10. Set HIGH Position

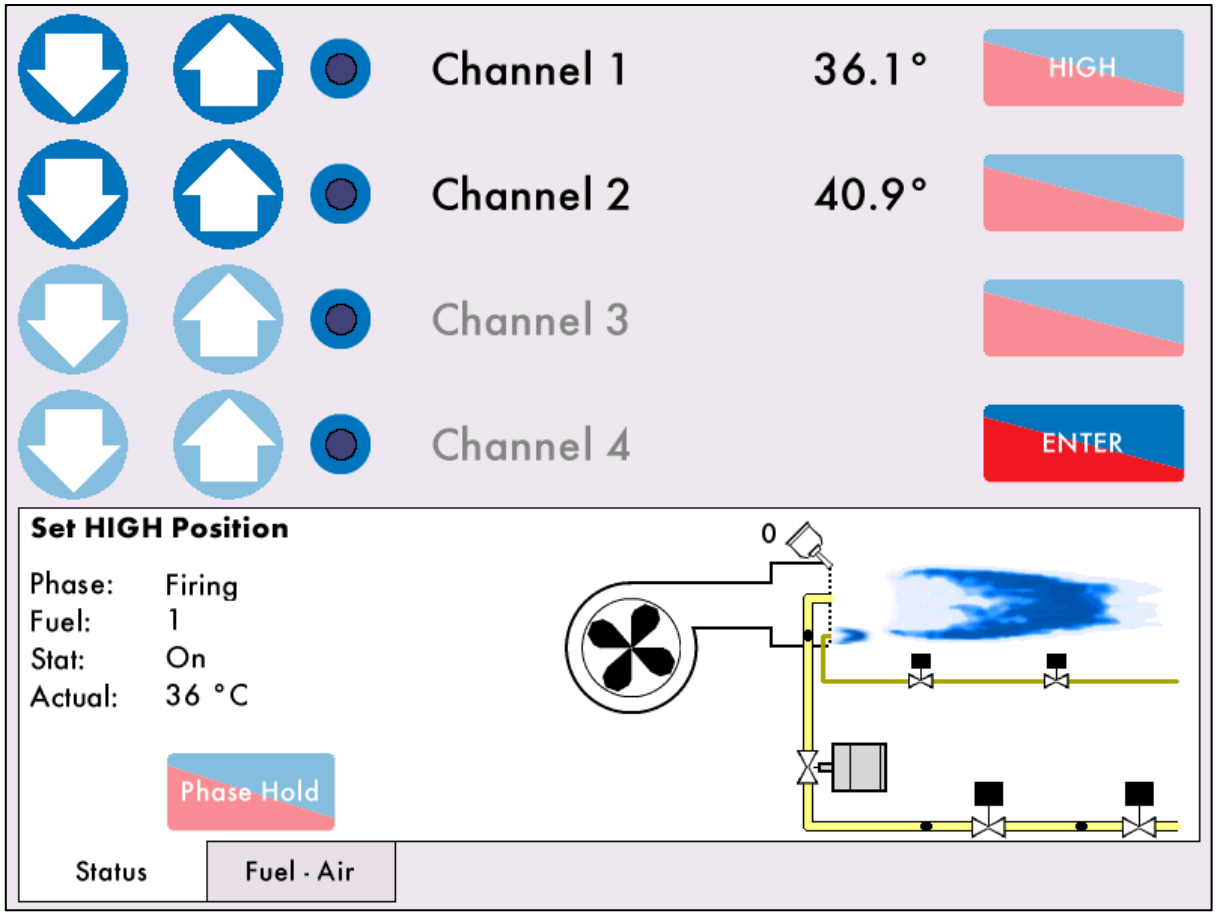


Figure 3.4.10.i Set HIGH Position

Once all the START, GOLDEN START and FGR START positions have been entered, the message 'Set HIGH Position' will appear. Press HIGH and drive the servomotors (and VSD if optioned) to the HIGH position by opening the air damper and fuel valve by a small amount of degrees alternately, so that more fuel is added gradually.

It is not possible to enter the HIGH position higher than the OPEN position. The servomotors must be driven 0.5^{O} up/down from the previous point initially, before entering the next point. Press ENTER to store this HIGH position.

3.4.11. Set INTER Position

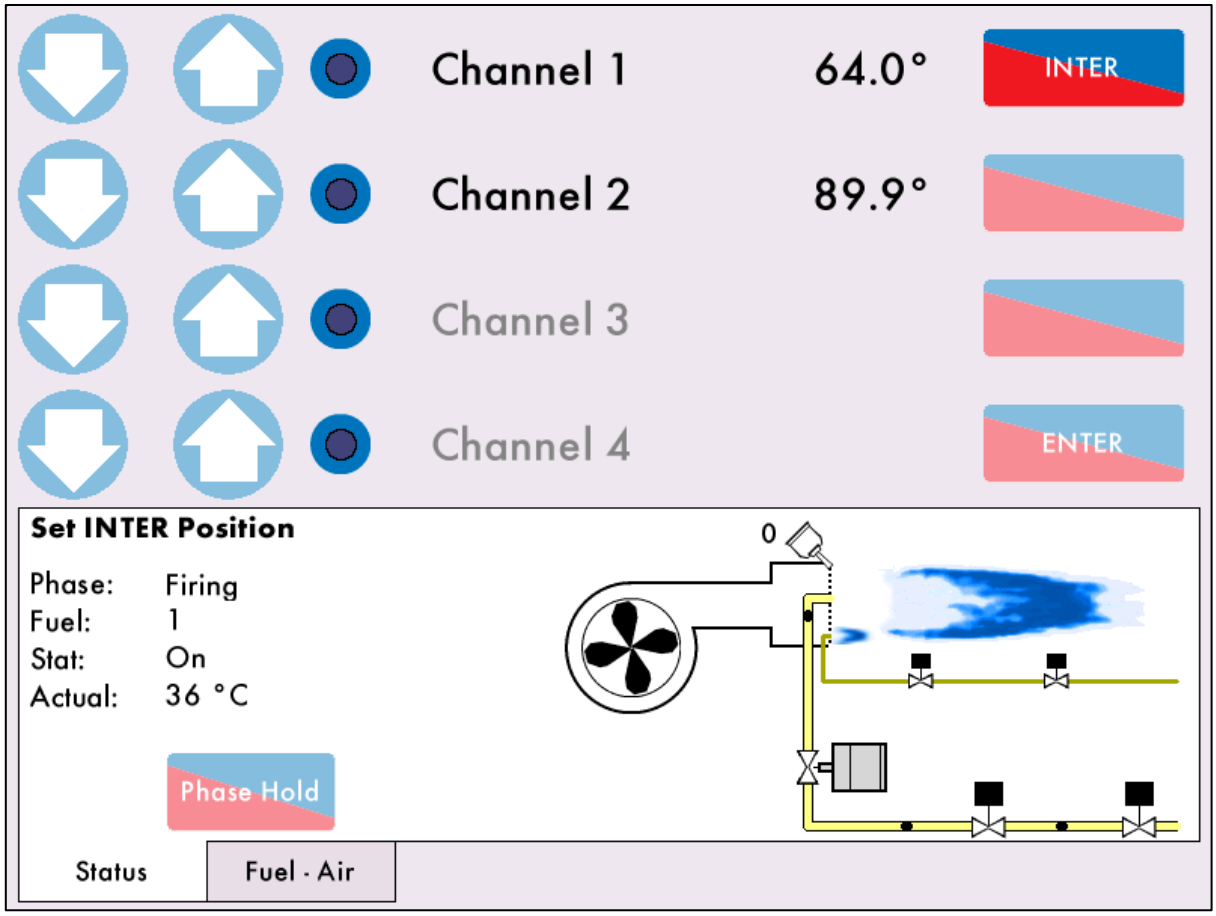


Figure 3.4.11.i Set INTER Position

Once the HIGH position has been entered, the message 'Set INTER Position' will appear. Press INTER to drive the servomotors (and VSD) to the first INTER position. The message 'Move fuel and air positions' will appear at first, as the system must detect a 0.5^{O} movement on CH1 and CH2 before an INTER position can be entered. Press ENTER to store this INTER position.

There must be a minimum of 3 INTER points entered on the fuel-air curve, and a maximum of 18. Points can be added, moved or deleted in Single Point Change mode (see section 3.6).

Continue this process until all the required INTER points have been entered.

3.4.12. Set INTER or START Position

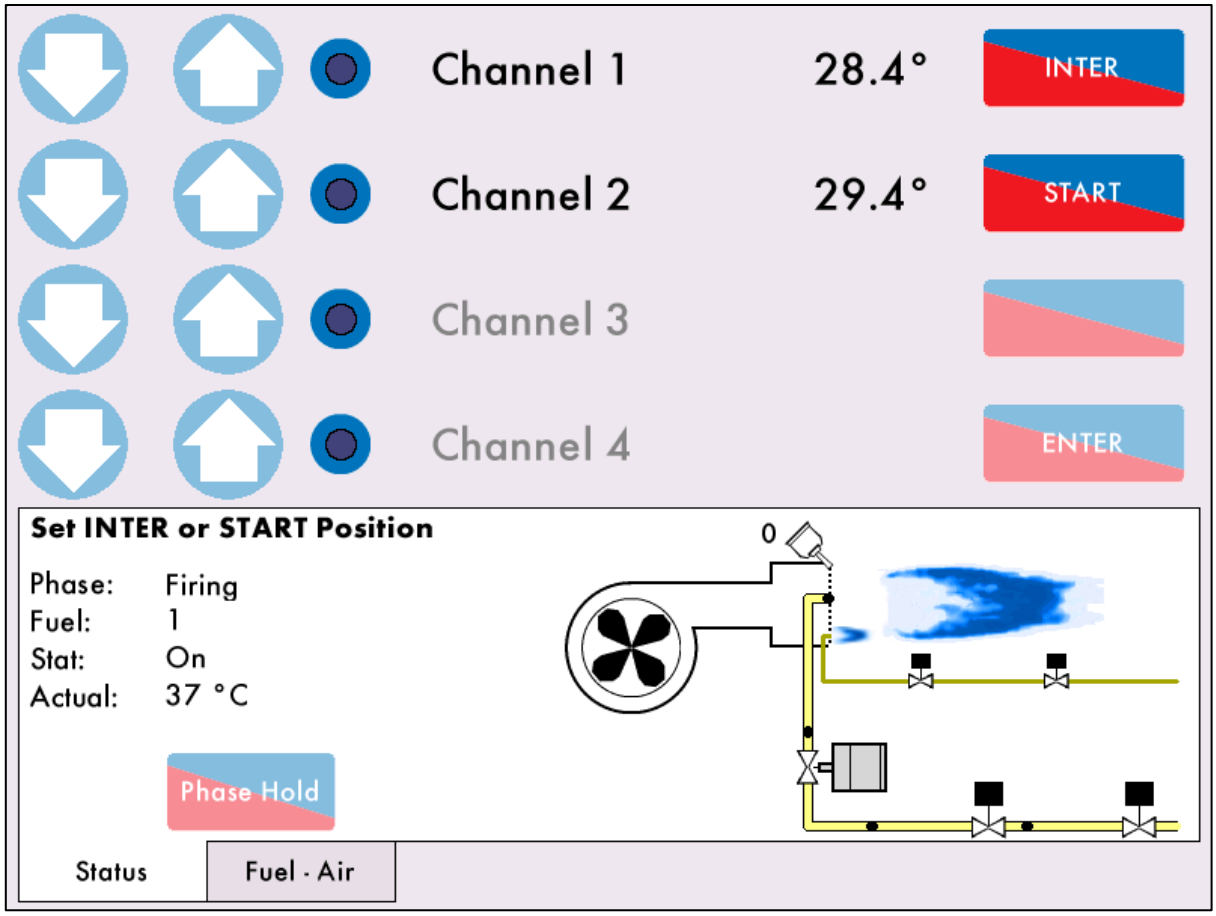


Figure 3.4.12.i Set INTER or START Position

Once the minimum 3 INTER points have been added, you will be prompted to either enter another INTER point or the START/LOW FIRE position.

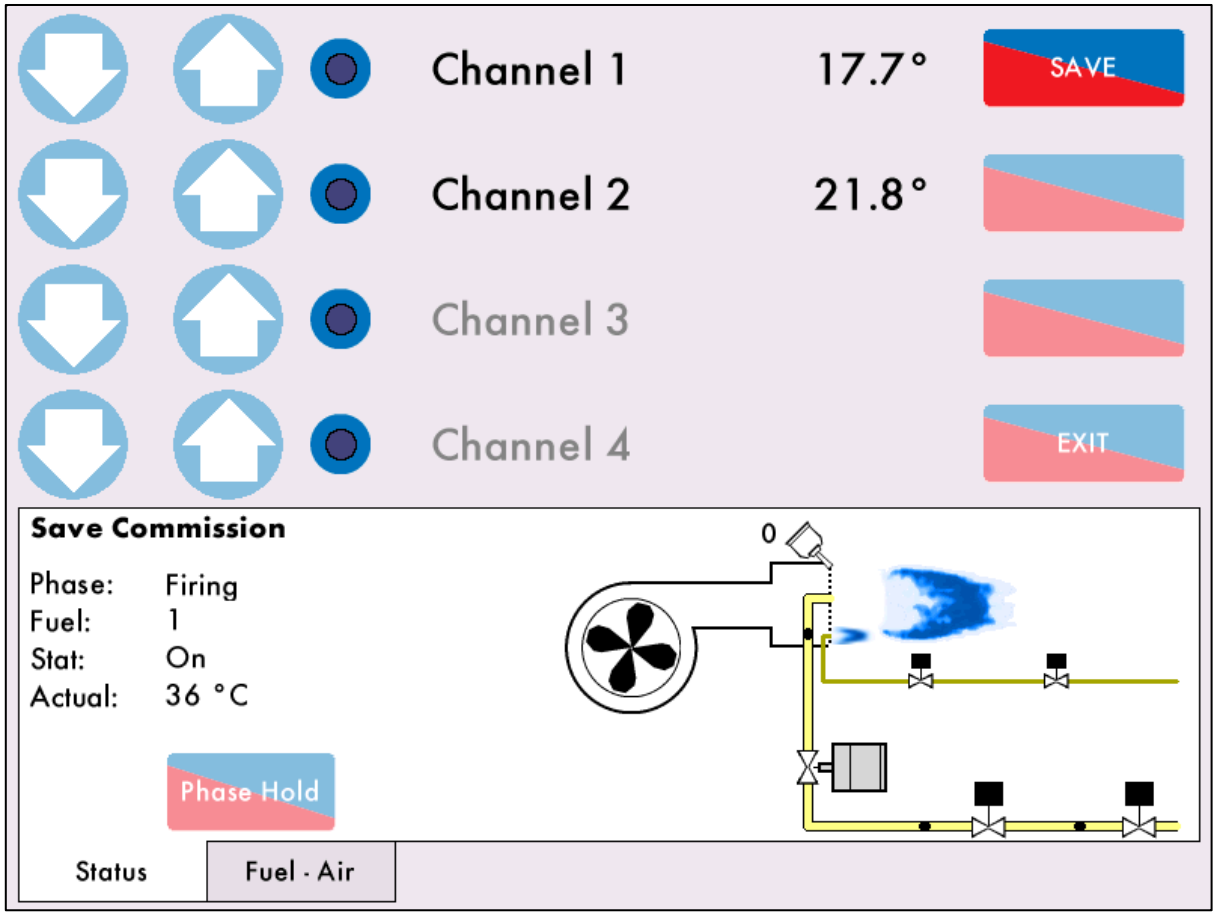
Press 

and drive the servomotors (and VSD) to the START/ LOW FIRE position, and then press 

to store this.

Note: If Golden Start or FGR Start are in use, the Start position is only used for Low Fire.

3.4.13. Save Commission



3.4.13.i Save Commission

Once the START position has been entered, press 

to store this commission curve. The message 'Commission Complete' will appear and press 

to go normal firing mode.

If the burner has been previously commissioned, then the new saved curve will overwrite the previous data for the fuel selected. Failure to save the curve will result in the commissioning data not being stored within the unit and a power loss to the unit will result in a loss of data for the fuel selected.

If during commissioning the burner turns off, due to the 'running interlock' opening or a fault, or if the power has been recycled, no points entered are stored. It is recommended to commission the MM with a quick base curve and then adjust/add/remove points using Single Point Change.

Once the burner has been commissioned, the fuel flow metering will need to be entered, please go to section 3.5 Fuel Flow Commissioning. If there is EGA trim data to be added then continue to section 3.7 Single Point Change before section 3.5 Fuel Flow Commissioning.

Note: If commissioning a fuel for the first time the default required setpoint will be 2.0bar/20PSI/20^{O}C/20^{O}F. The burner will shut down at commission completion due to the low default required setpoint. Go to the Status screen to change the required setpoint.

3.5. Fuel Flow Commissioning

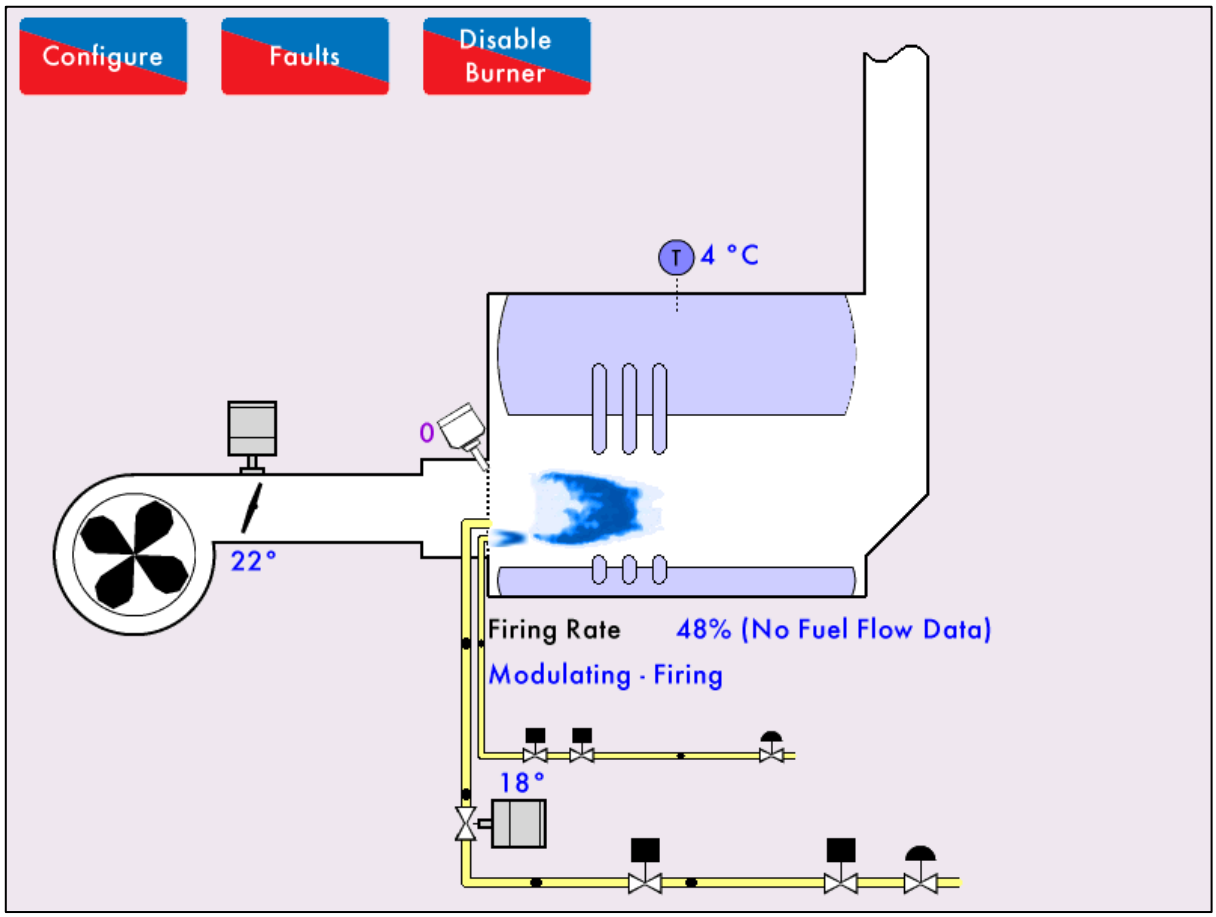


Figure 3.5.i Home Screen – No Fuel Flow Data

Once the burner has been commissioned, fuel flow metering must be commissioned to calculate the firing rate. The fuel flow metering is used to rate the size or burner and calculate the firing rate.

If fuel flow metering is not commissioned and sequencing is optioned, then MM will assume a default burner rating which is based on the fractional fuel valve angle.

The fuel flow is commissioned from the low fire point up to high fire.

If a fuel flow meter is not being used and only arbitrary values are being used then make sure a good range of values are being used (e.g. 1 to 10) with equal spaces between the values. Not doing this could lead to problems when using IBS and the flame graphic.

When using arbitrary values it is good practice to use the following calculation to determine the heat value for each of the 10 points.

$$Value\ Between\ Points = \frac{Burner\ Rating - \left(\frac{Burner\ Rating}{Turndown}\right)}{9}$$

For example: Burner Rating: 5.4MW; Turndown Ratio: 5:1.

$$\frac{5.4 - \left(\frac{5.4}{5}\right)}{9} = 0.48$$

Giving the range (5.40, 4.92, 4.44, 3.96, 3.48, 3.00, 2.52, 2.04, 1.56, 1.08)

Fuel flow metering serves to totalise the amount of fuel being used at each position. If any changes are made to the curve through Single Point Change, then fuel flow will need to be re-commissioned.

Fuel flow commissioning set by option 57, and is carried out in Run mode. The burner must be firing.

On the Home Screen, press 

to access the System Configuration screen.

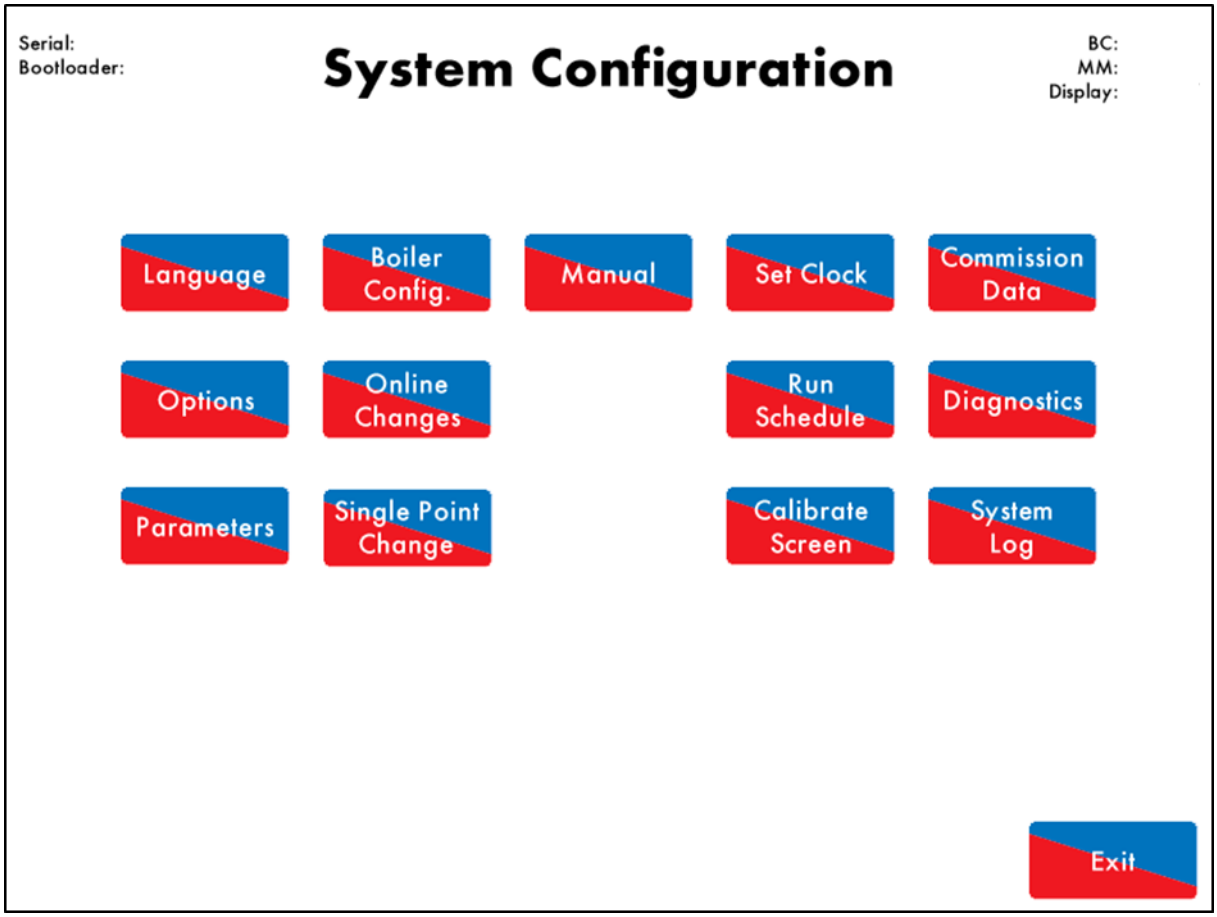


Figure 3.5.ii System Configuration Screen

On the System Configuration screen press 

. You will be prompted to enter the Online Change passwords. Press 

and 

to access the Online Changes screen. Press 

.

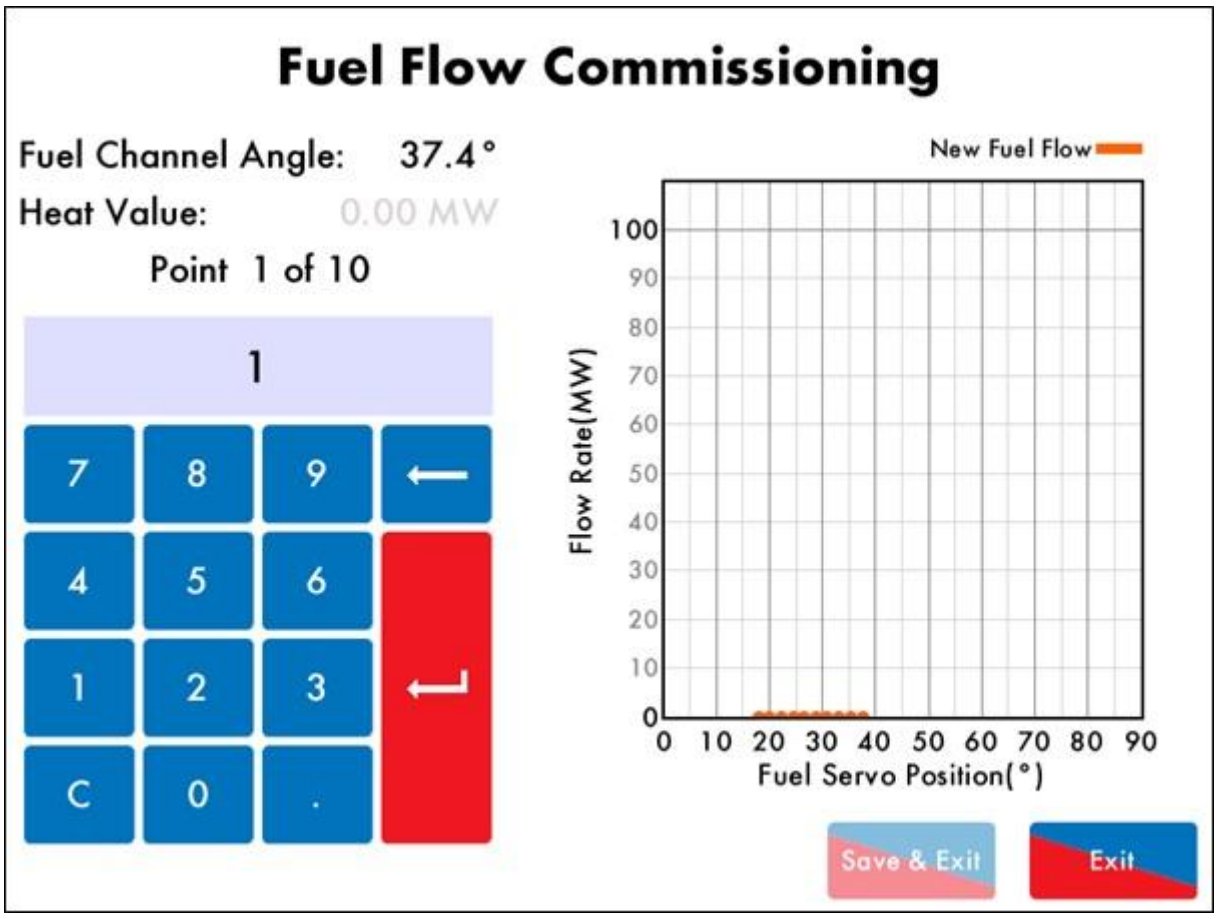


Figure 3.5.iii Fuel Flow Commissioning

There are 10 points which need to be entered across the commission curve from low fire to high fire, with low fire being point 1, and high fire point 10.

Type in the heat value using the keypad and press the return key to save that fuel flow point.

Note: The servomotors will drive to the low fire position, and then drive up as the fuel flow commissioning points are entered. Precautions must be taken to ensure that the boiler is warm enough for all 10 points to be entered.

As you enter the heat values for the 10 points, these will become marked on the graph to the right of the screen.

Once the fuel flow commissioning is complete, press 

to return to modulation in normal firing mode.

If you press 

at any time during fuel flow commission, this will not store the points.

3.5.1. Calorific Fuel Data

Stats	Kerosene SG	Gas Oil CI/SH	Light fuel Oil SG	Medium fuel Oil SG	Heavy Fuel Oil SG
Relative density 15.6°C (60°F) approx. / = litres x = kg	0.79	0.835	0.93	0.94	0.96
Flash point (closed) min °C (°F)	37.8 (100)	65.6 (150)	65.6 (150)	65.6 (150)	65.6 (150)
Viscosity kinematic (cSt) at					
15.6°C (60°F) approx.	2.0	-	-	-	-
37.8°C (100°F) approx.	-	3.0	-	-	-
82.2°C (180°F) approx.	-	-	12.5	30	70
Equivalent Redwood No.1 Viscosity at 37.8°C (100°F)	-	33 approx	250 max	1000 max	3500 max
Freezing point °C / °F	Below -40	Below -40	Below -40	Below -40	Below -40
Cloud point °C max	-	-2.2	-	-	-
Gross calorific values					
KJ/kg approx.	46,520	45,590	43,496	43,030	42,800
Btu/lb approx.	20,000	19,600	18,700	18,500	18,400
KWh/litre approx.	10.18	10.57	11.28	11.22	11.42
Therms/gallon approx.	1.58	1.64	1.75	1.74	1.77
kW/kg	-	12.66	12.08	-	11.89
Sulphur content % wt.	0.2	0.6	2.3	2.4	2.5
Water content % vol.	Negligible	0.05	0.10	0.20	0.30
Sediment content % wt	-	Negligible	0.20	0.03	0.04
Ash content % wt	-	Negligible	0.02	0.03	0.04
Mean specific heat between 0°C - 100°C approx.	0.50	0.49	0.46	0.45	0.45
Volume correction factor per 1°C	0.00083	0.00083	0.0007	0.0007	0.00068
Volume correction factor per 1°F	0.00046	0.00046	0.00039	0.00039	0.00038
Btu/U.S. gallon (US standard)	-	140,000	-	150,000	160,000
Lb/U.S. gallon (US standard)	-	7.01	-	-	7.01
% lighter than water		20%			4%
1 U.S. Gallon of oil / ft of air		1402			

3.5.2. Conversion Factor for Imperial Gas Flow Meters

Required Data:	Pressure of gas at meter in “wg Required gas flow in ft³/min	
Calculations:	Correction factor Reading on gas meter	= (pressure of gas at meter x 0.00228) + 0.948 = required gas flow / correction factor
Example:	Pressure of gas at meter Required gas flow Conversion factor Reading on Meter	= 58” wg = 95 ft³/min = (58 x 0.00228) + 0.948 = 1.08 = 95 / 1.08 = 88 ft³/min

3.5.3. Correction Factor for Burners Significantly Above Sea Level

Note: Above sea level i.e. >200m (1ft = 0.3048m)

Height above sea level in meters, Calculation for correction factor: =

(Pressure of gas at meter x 0.00228) + (0.948 – (height above sea level x 0.0001075))

Example: As above but 250 m above sea level:
Correction factor = (58x0.00228) + (0.948 – (250 x 0.0001075)) = 1.05

3.5.4. Gas Volume Conversion Factors

Assumed gas temperature	10 °C	50 °F
Standard pressure	760 mmHg	101.3612 Kpa
Standard temperature	15.56 °C	
Ambient pressure	101.325 Kpa	

Wg "	PSI	mmH2O	mmHg	Kpa	mBar	Conversion factor
1	0.036	25.4	1.867	0.249	2.49	1.0218
2	0.072	50.8	3.734	0.498	4.98	1.0243
3	0.108	76.2	5.601	0.747	7.47	1.0268
4	0.144	101.6	7.468	0.996	9.96	1.0293
5	0.181	127	9.335	1.245	12.451	1.0318
6	0.217	152.4	11.202	1.494	14.941	1.0343
7	0.253	177.8	13.069	1.743	17.431	1.0368
8	0.289	203.2	14.936	1.993	19.921	1.0393
9	0.325	228.6	16.804	2.242	22.411	1.0418
10	0.361	254	18.671	2.491	24.901	1.0443
15	0.542	381	28.006	3.736	37.352	1.0569
20	0.722	508	37.341	4.981	49.802	1.0694
25	0.903	635	46.677	6.227	62.253	1.0819
30	1.083	762	56.012	7.472	74.703	1.0944
35	1.264	889	65.347	8.717	87.154	1.107
40	1.444	1016	74.682	9.963	99.604	1.1195
45	1.625	1143	84.018	11.208	112.055	1.132
50	1.805	1270	93.353	12.453	124.505	1.1445
55	1.986	1397	102.688	13.699	136.956	1.1571
60	2.166	1524	112.024	14.944	149.406	1.1696
65	2.347	1651	121.359	16.189	161.857	1.1821
70	2.527	1778	130.694	17.435	174.307	1.1947
75	2.708	1905	140.03	18.68	186.758	1.2072
80	2.889	2032	149.365	19.925	199.208	1.2197
85	3.069	2159	158.7	21.171	211.659	1.2322
90	3.25	2286	168.035	22.416	224.109	1.2448
95	3.43	2413	177.371	23.661	236.56	1.2573
100	3.611	2540	186.706	24.907	249.01	1.2698
110	3.972	2794	205.377	27.397	273.911	1.2949
120	4.333	3048	224.047	29.888	298.812	1.3199
130	4.694	3302	242.718	32.379	323.713	1.345
140	5.055	3556	261.388	34.869	348.614	1.37
150	5.416	3810	280.059	37.36	373.515	1.3951
160	5.777	4064	298.73	39.851	398.416	1.4201
170	6.138	4318	317.4	42.341	423.317	1.4452
180	6.499	4572	336.071	44.832	448.218	1.4703
190	6.86	4826	354.741	47.323	473.119	1.4953
200	7.221	5080	373.412	49.813	498.02	1.5204

To use this information:

1) Measure Volumetric flow of gas for 1min in ft^3 (i.e. ft^3/min). Note $1m^3 = 35.31ft^3$

2) Multiply this volume flow by 60 to give volumetric flow per hour (i.e. ft^3/hr).

3) Measure the pressure of the gas supply.

4) Use the table above to obtain a conversion factor.

5) Multiply the volume flow per hour by the conversion factor to obtain a volume at reference conditions.

6) For natural gas, the calorific value is typically 1000 Btu/ft^3. To obtain the firing rate of the boiler at standard reference conditions multiply the volume at reference conditions by 1000.

Represented as an equation:
Firing rate = (Measured Volumetric flow per minute x 60 x Conversion factor x 1000) Btu/hr

3.6. Gas / Air Pressure Commission

To re-commission the gas pressure sensor, go to Commission Mode and press 

. The MM will then run through the points to store the gas pressure values.

If the VPS is optioned on, the unit will run through this process. The MM will go from Low Fire to High Fire and store the gas pressure values along the curve. Once these values are stored, the upper and lower offset limits will be adjusted to the new commissioned gas pressure values.

If the burner turns off during the gas/air pressure commission, the gas/air pressure commission process will need to be restarted. This ensures that the MM does not run with an incomplete set of gas/air pressure readings.

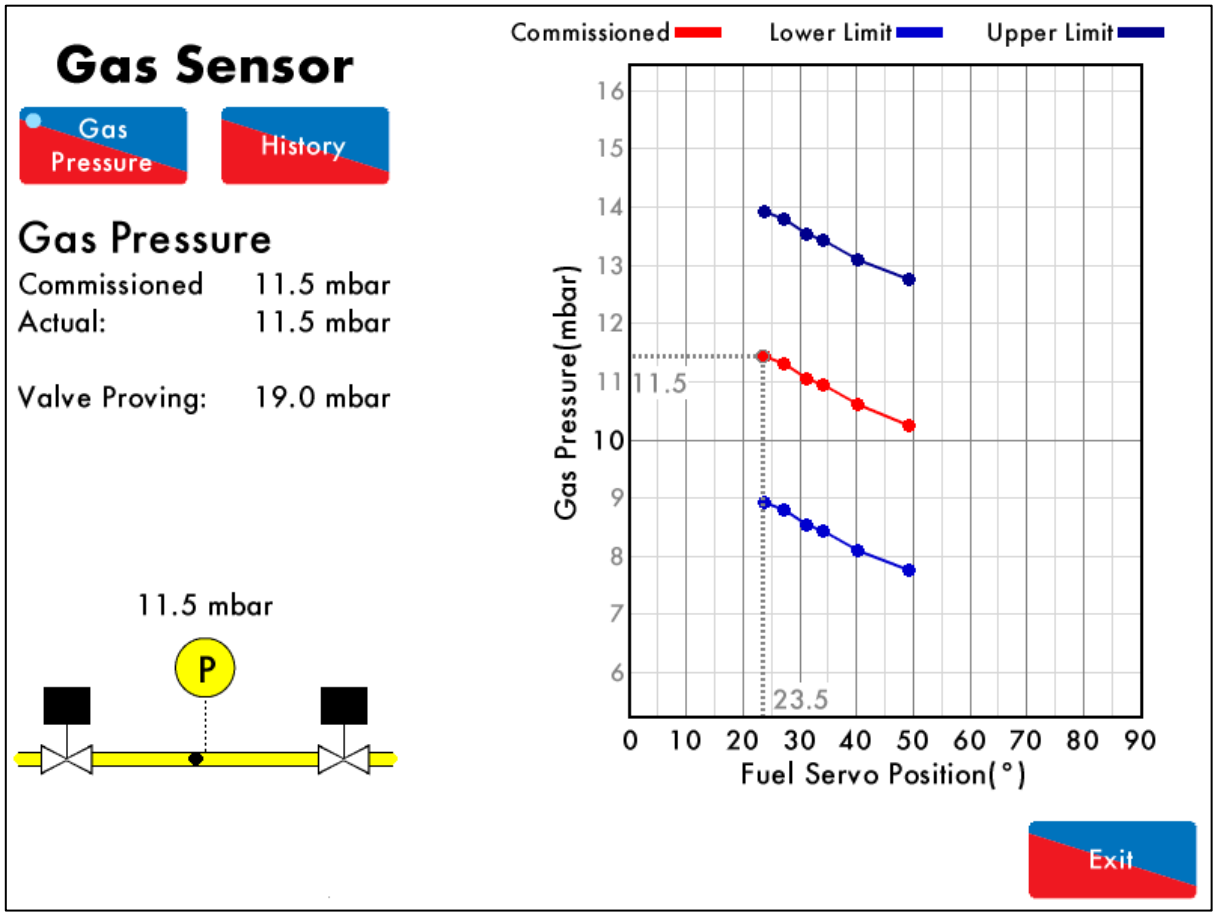


Figure 3.6.i Gas Sensor – Low Fire

To commission the air pressure sensor, in Commission Mode screen press 

to commission the air pressure sensor.

Note: If the gas or air pressure sensor is replaced with the same sensor type (same pressure range) then the sensor will not need to be recommissioned.

Note: For applications where VPS is required after burner shutdown only, the option/parameter 129 should be set to 0 when doing the first gas sensor commission on the system to store the valve proving gas pressure. During normal running, option/parameter 129 can be set to 1.

3.7. Single Point Change

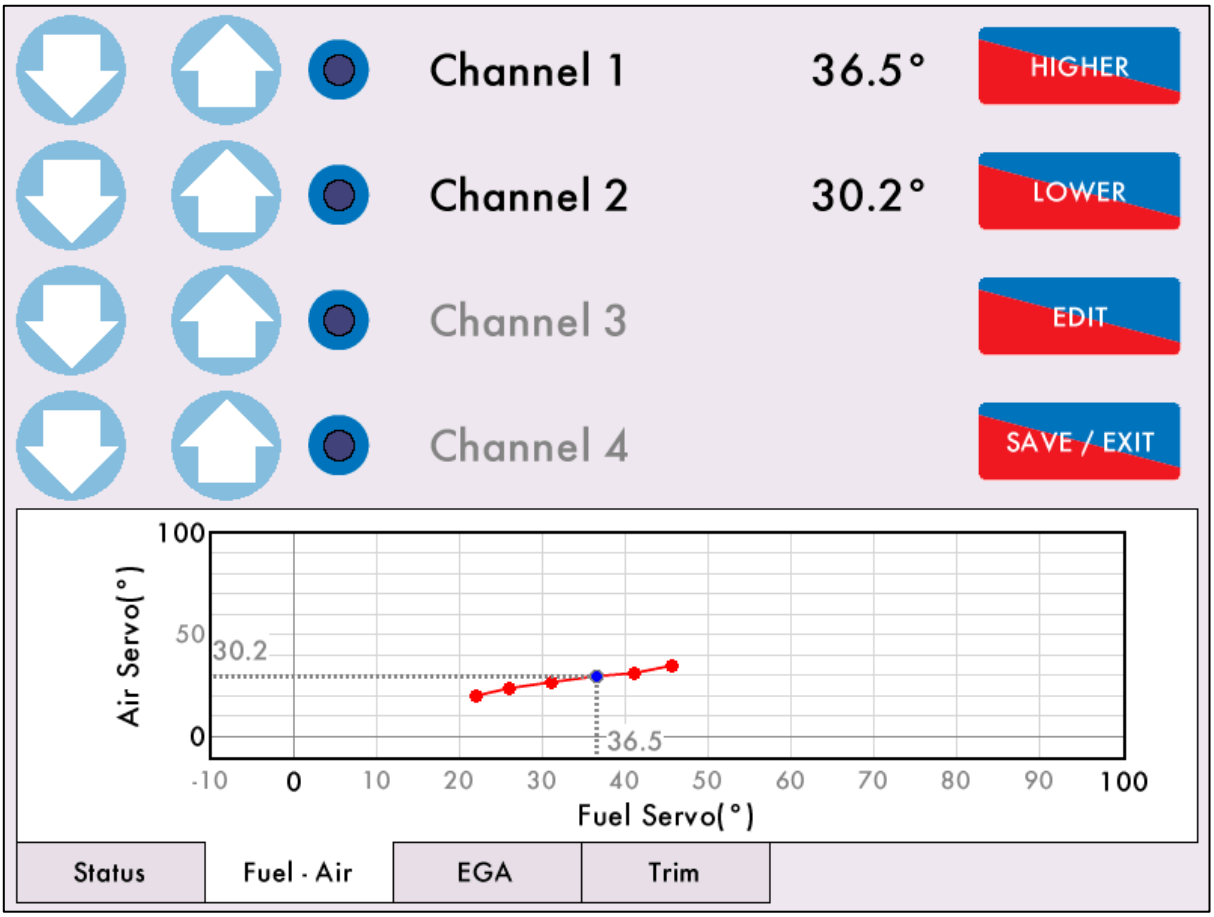


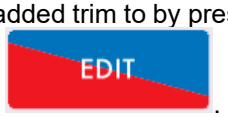
Figure 3.7.i Single Point Change

Press 

in the system configuration screen and enter the password to access Single Point Change mode.

Select the point to be edited or added trim to by pressing 

or 

to go up and down the fuel curve, then press 

.

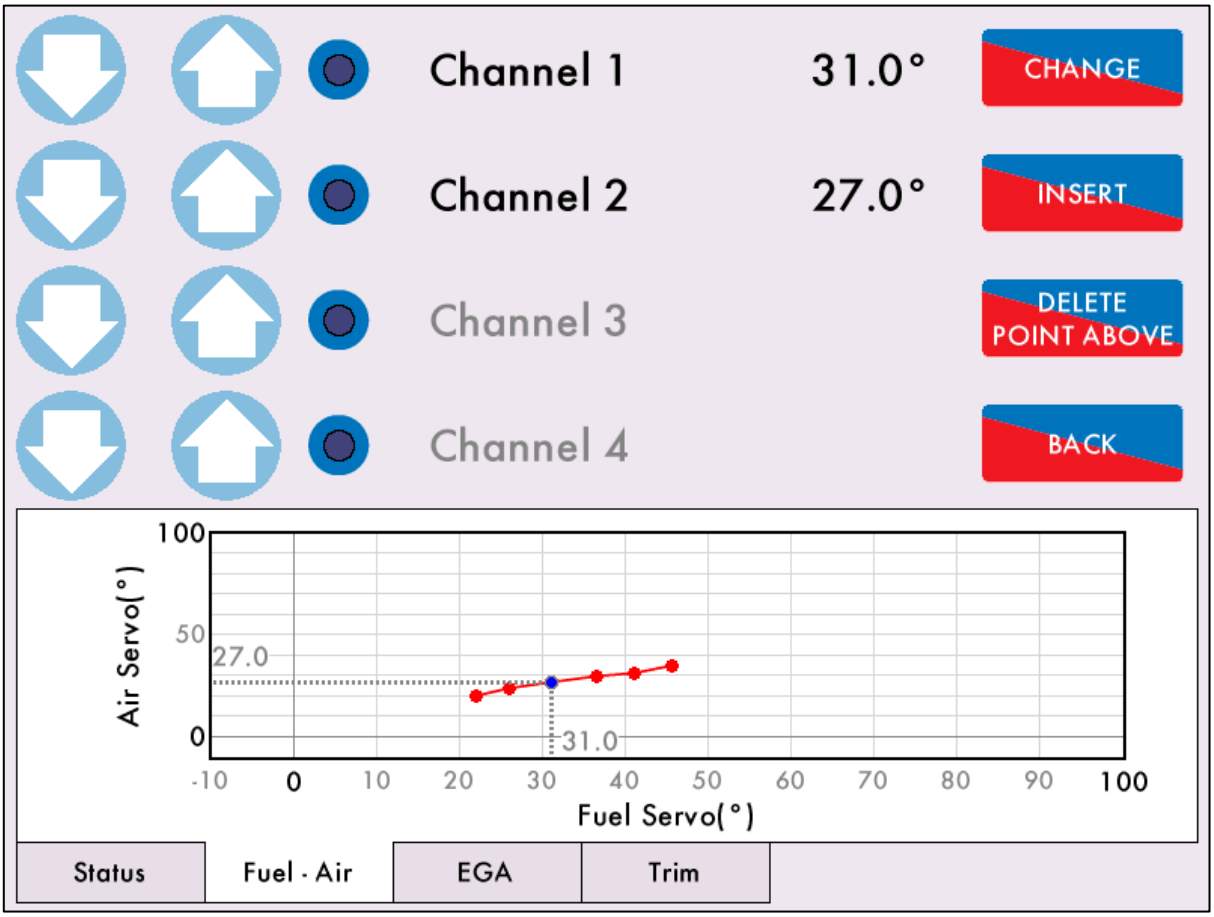


Figure 3.7.ii Changes

To edit a previously entered point press 

and make adjustments to the positions as needed.

To enter a new point press 

.

Press 

to delete the next point on the commission curve.

Or press 

to go back to the previous screen.

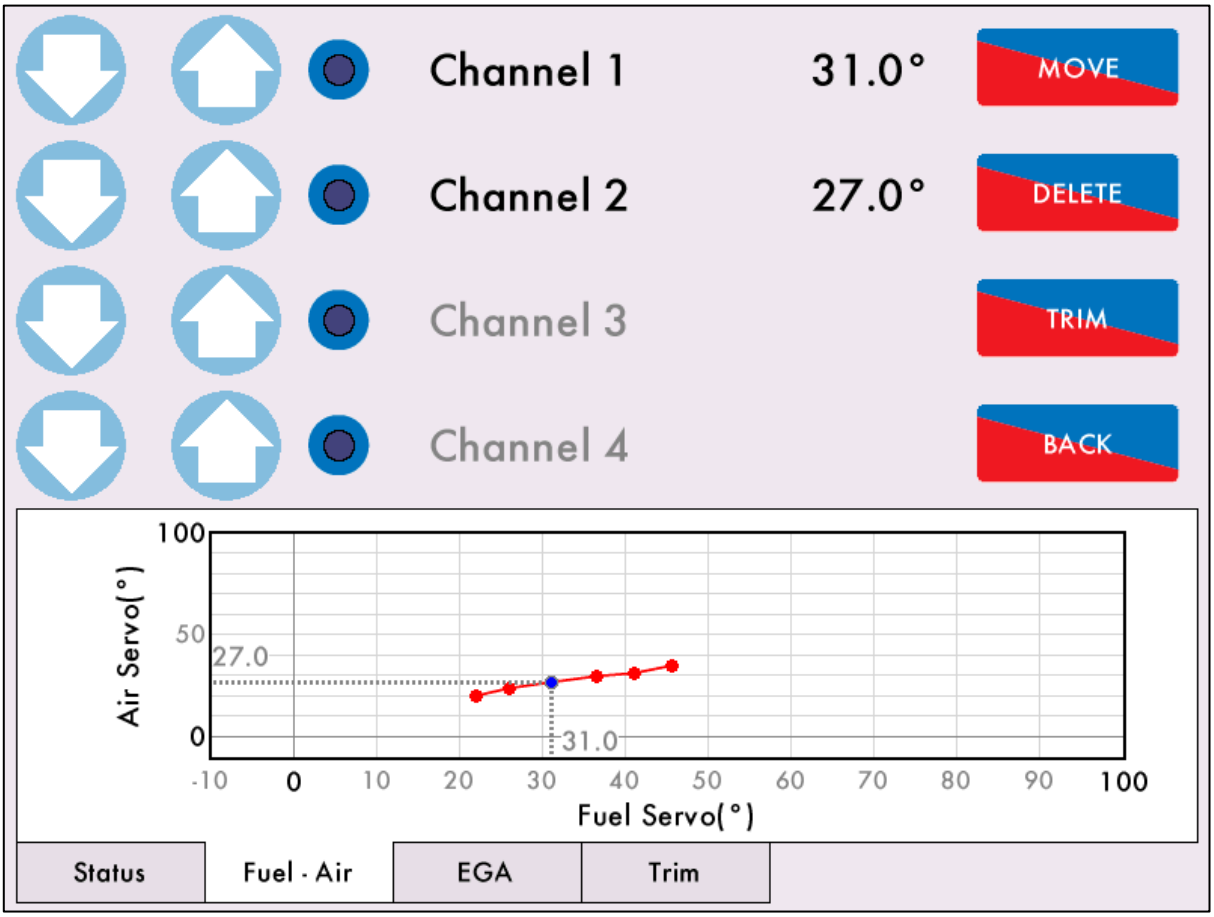


Figure 3.7.iii Changing a Point

Press 

to alter the fuel, air and/or VSD commissioned value of that point. Once the changes have been made, press 

to save this position. If a point is overwritten, the trim data is cleared.

Press 

to remove the point; there must be a minimum of 3 INTER points.

To add trim data to a point press 

, see section 3.4.6 and Figure 3.7.iv.

Note: It is not possible to delete LOW or HIGH FIRE positions or have less than 3 INTER points.

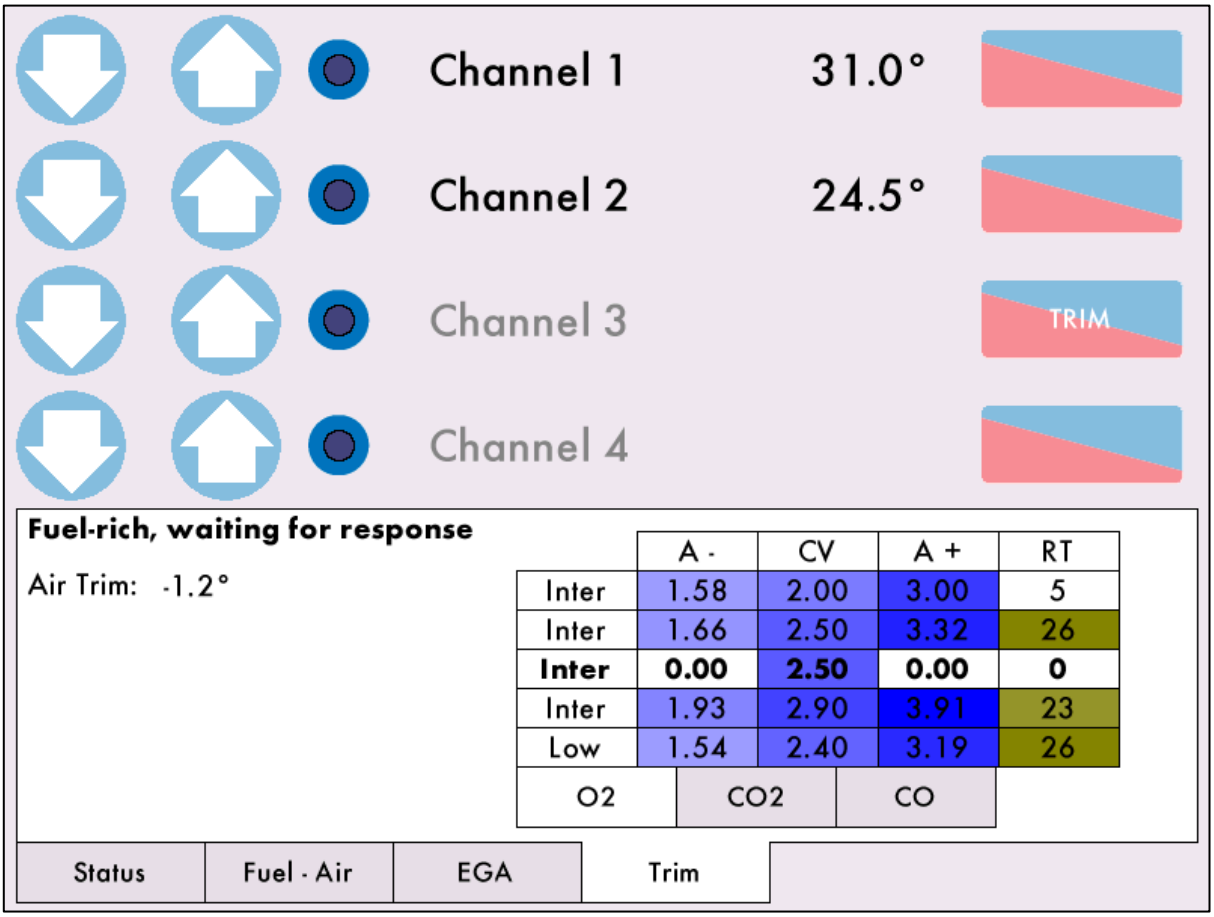


Figure 3.7.iv Single Point Change – Trim

The MM will run through a process of measuring the EGA levels at the commission value, fuel-rich and air-rich trim angles and will store the trim values for this position.

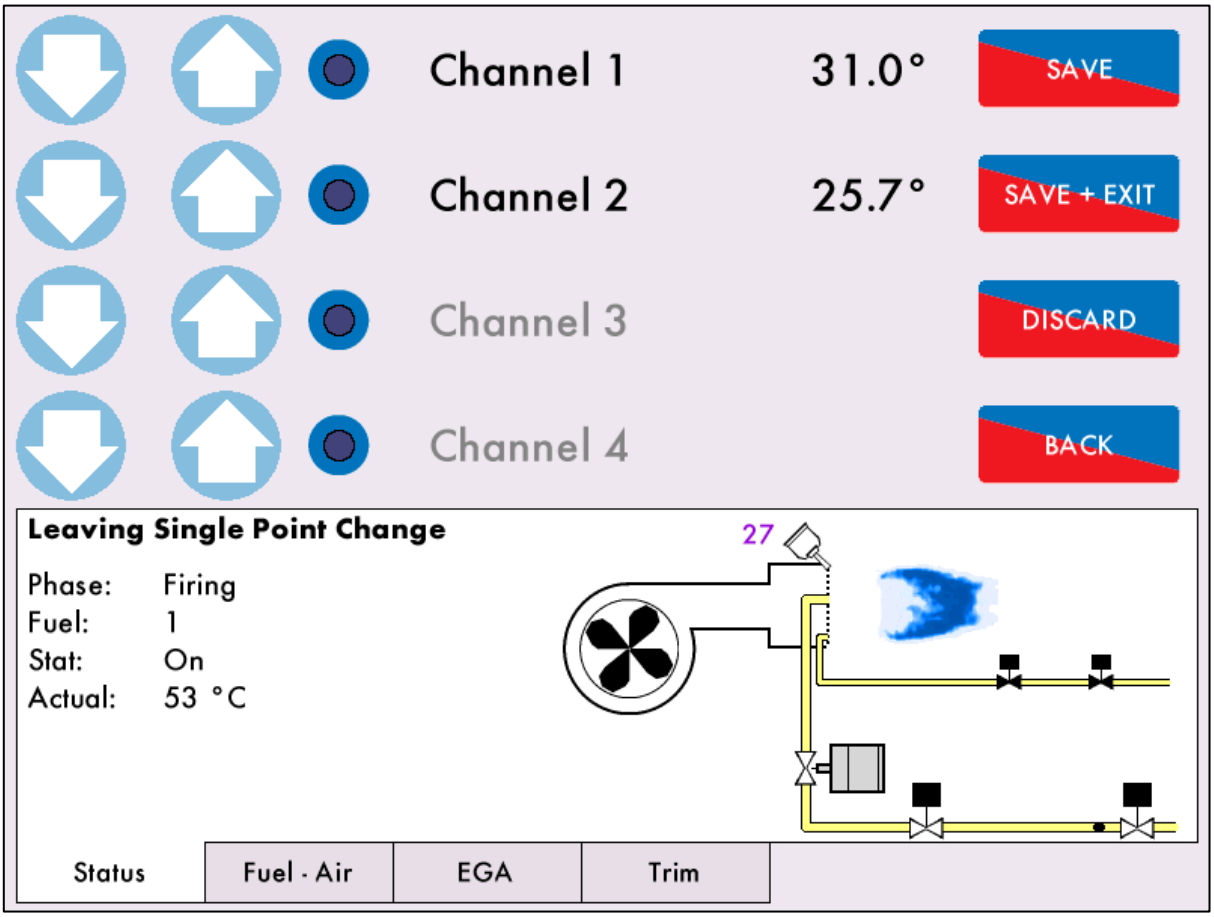


Figure 3.7.v Exit Single Point Change

Once the adjustments have been made, go back to the Single Point Change home screen Figure 3.7.i and press 

.

Press 

to save the changes.

Alternatively press 

to discard the changes and exit Single Point Change.

The fuel flow commissioning must be re-entered if any of the following changes are made in single point change:

- HIGH or START position is changed.
- EGA trim data has been added.
- Points have been added.

Please see section 3.5 Fuel Flow Commissioning.

3.8. Online Changes

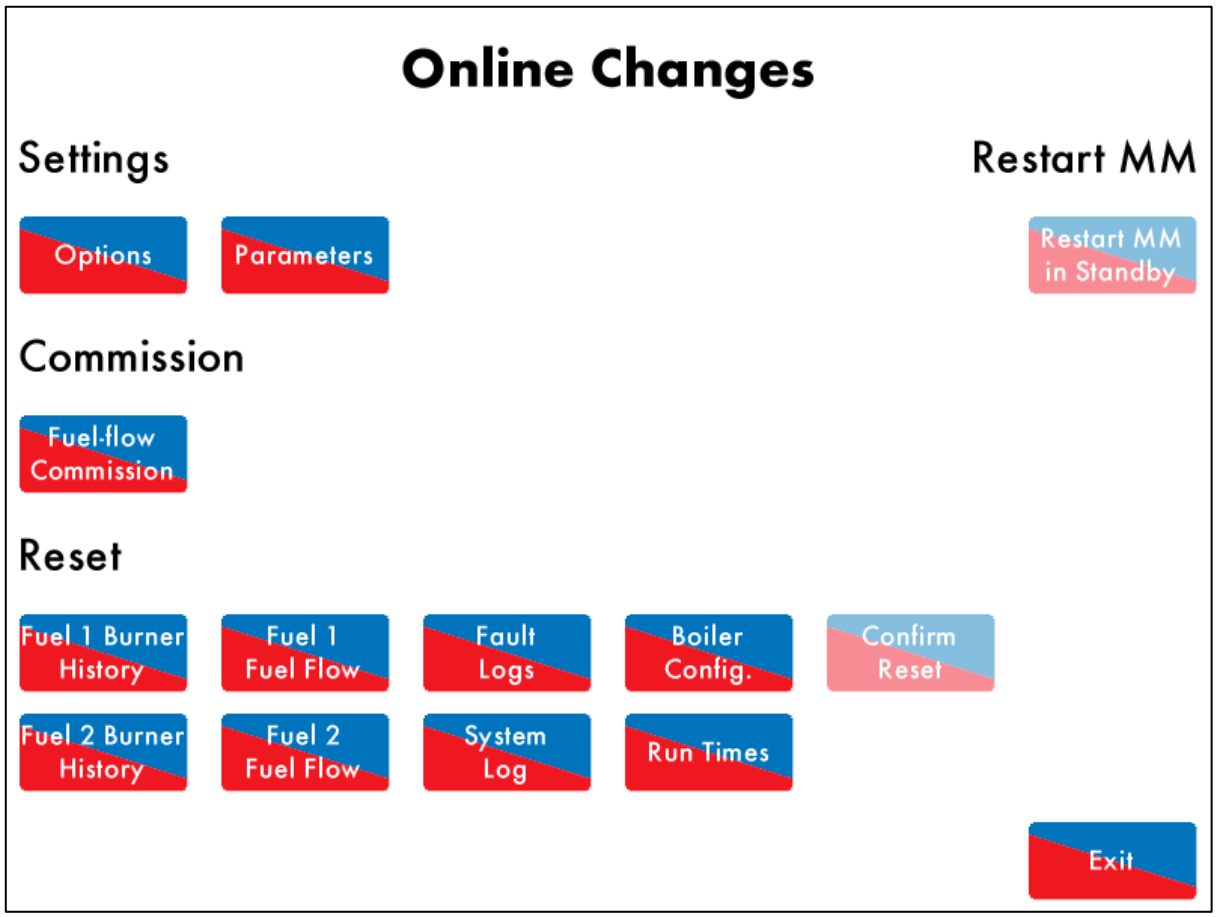


Figure 3.8.i Online Changes Screen

The Online Changes is accessed by pressing Online Changes on the system configuration screen, and then entering the password. The Online Changes feature allows the following:

- Change non-safety critical options and parameters
- Fuel flow commissioning
- Reset burner history
- Reset fuel flow data
- Reset fault logs
- Reset system log
- Reset boiler configuration
- Reset run times
- Restart MM if the burner is in standby

Press on Options or Parameters to change the settings. For the Reset function, press the data to be reset e.g. Fuel 1 Burner History and then press on Confirm Reset.

Press on Restart MM while the burner is in standby to restart the MM.

4. PID CONTROL

The standard algorithm used by Autoflame to control the fuel/air ratio is PID (Proportional-Integral-Derivative) control. The control algorithm compares the actual measured temperature or pressure and compares it to the user specified setpoint temperature or pressure. Depending on the measured and setpoint values, the MM's PID control will then either modulate the burner up or down. The rate of change or speed of the burner modulation in relation to changes in measured temperature or pressure is dependent on the settings of the PID control. The PID control action is the sum of the "Proportional" + "Integral" + "Derivative" actions of the PID control. Each contributes to how the 3 term PID control modulates the burner as outlined below.

Most applications can be controlled adequately using just the Proportional and Integral settings; a PI control setup.

Note: PID control is a fine-tuning process. Settings must be carefully and precisely adjusted by a qualified combustion engineers with thorough understanding of the combustion process. Load requirements, overall system response and all other parameters must be taken into consideration when adjusting the PID settings. Otherwise the changes to the system setup can make the controller operate in an unstable and potentially unsafe manner.

4.1. Proportional Band

The Proportional term is specified in option 6 by defining the "Proportional band" (P-Band). The P-Band is simply an offset from the setpoint pressure or temperature. Outside and below the P-Band, the MM's PID control will modulate the burner at maximum flame, upon reaching the P-Band, it will then modulate the burner linearly down (see option 6).

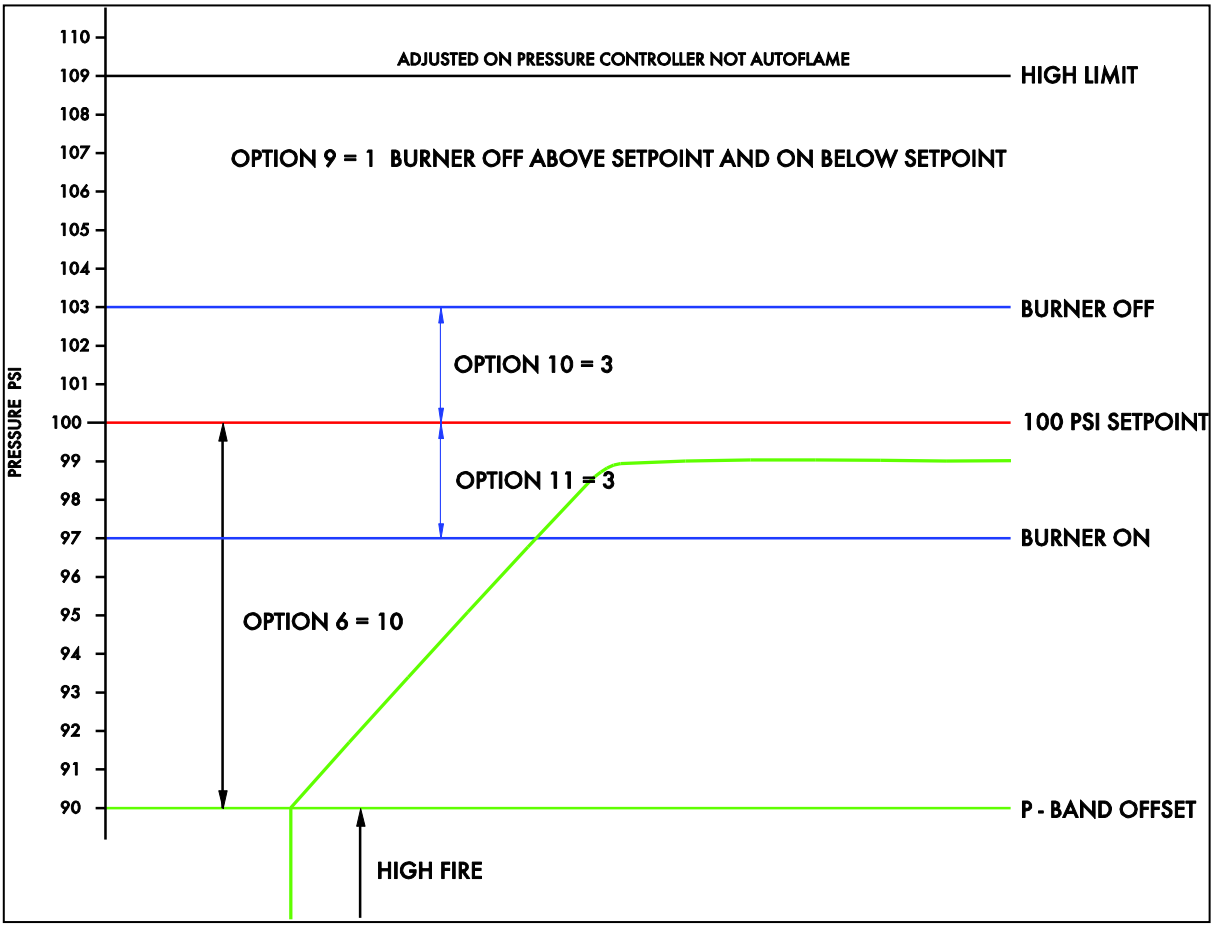


Figure 4.1.i Proportional Band

4.2. Integral Control

The Integral term is specified in option 7, where the “Integral time”, also known as “reset time”, is set. Within a threshold of the P-Band, the integral term has the effect of increasing or decreasing the burner firing rate by a specific amount every “n” seconds. The amount the firing rate is adjusted by is specified in parameter 48, the default is 80% of the difference between the measured and setpoint temperature or pressure values. This amount is added, every “n” seconds, where “n” is specified in option 7, with the default as 60s.

Option 7 is integral time, for which every ‘n’ seconds, 10% of the present offset from the setpoint is added when below the setpoint, or removed when above the setpoint, to the present proportional value.

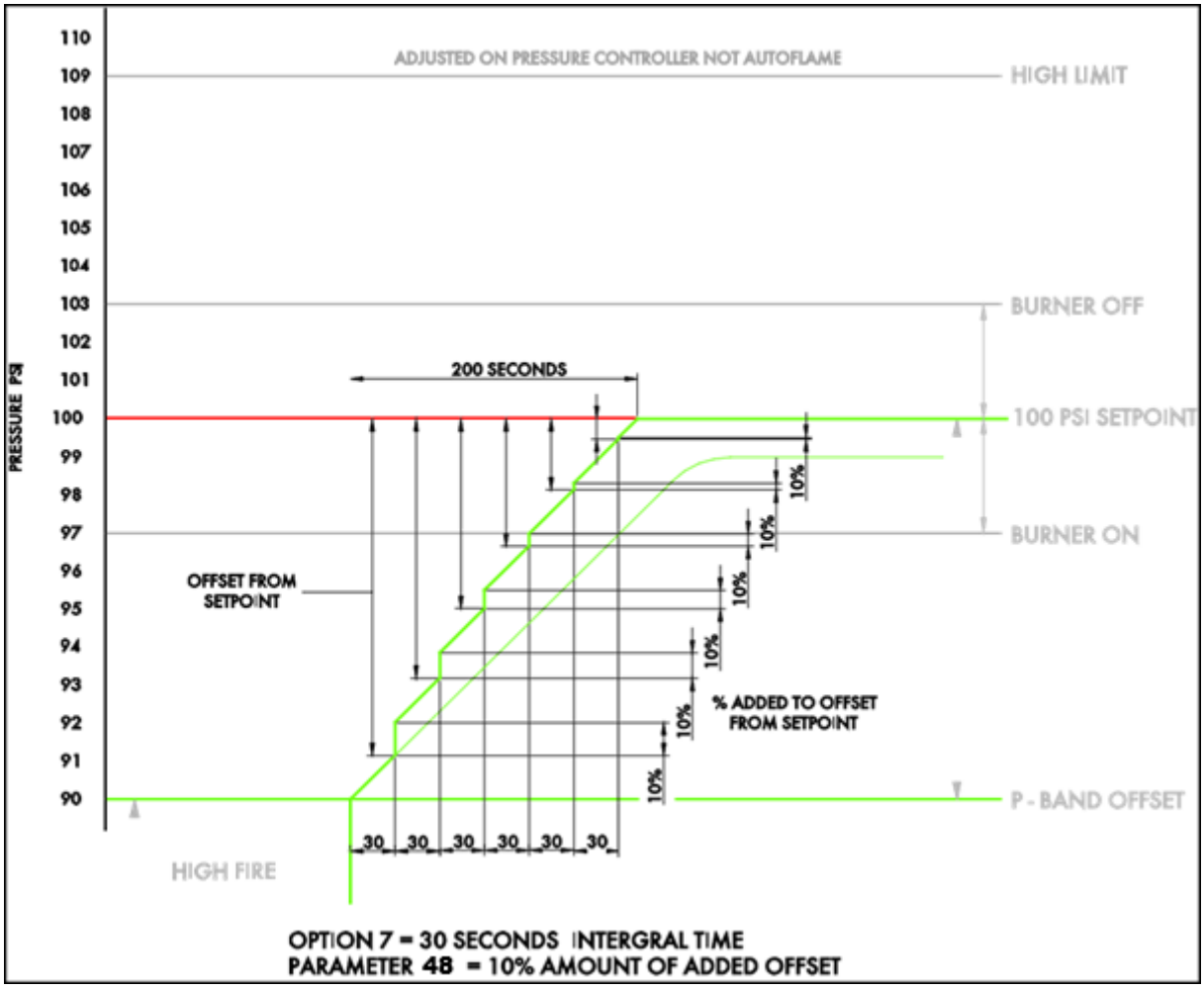


Figure 4.2. Integral Control

(Parameter 48 = 0.8, Integral operation band of P-Band)

4.3. Derivative Control

The Derivative term of the control system analyses the rate of change in the difference between the measured and set point temperature or pressure. Derivative specific options are set in options 37 and 38. The time interval over which the compared and measured temperature or pressure values are taken is set in option 37, the derivative dead-band or margin above and below the required set point in which no derivative action occurs is set in option 38.

The derivative response sensitivity is set as default to 10% firing rate. The derivative time set via option 37 is the time taken to add/remove an additional 10% to the firing rate based on the actual value and the required value.

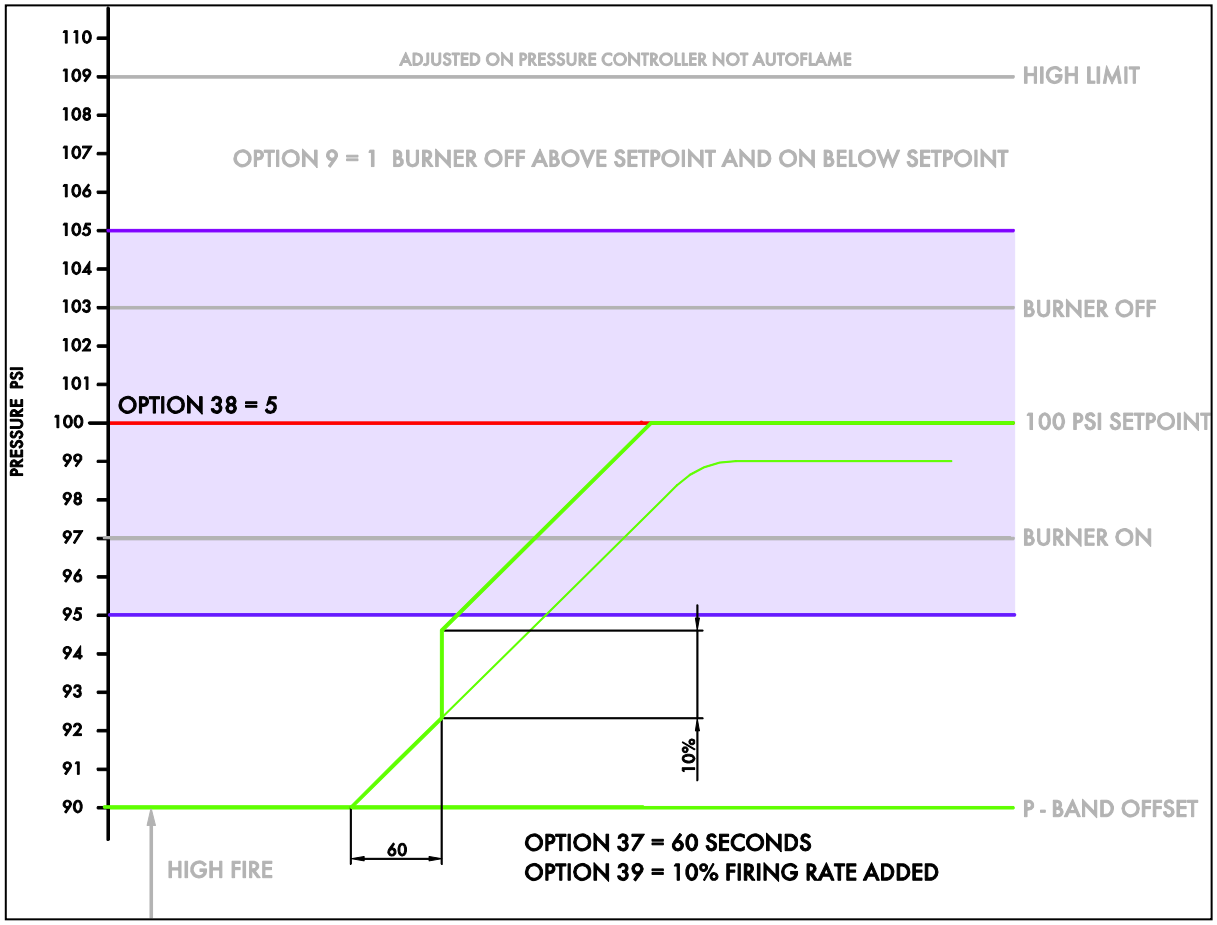


Figure 4.3. Derivative Control

NOTE: The derivative action occurs at all points outside of the deadband. This includes within the proportional band.

5. INTELLIGENT BOILER SEQUENCING (IBS)

The objective of Intelligent Boiler Sequencing (IBS) is to ensure that the minimum number of boiler/burner units are in operation at any one time to satisfy the heat or steam requirement imposed upon the boiler plant, in the case of multi-boiler installations.

The benefits from using IBS include an increased savings in electrical costs, a reduction in thermal stress on the lag boilers, and an increase in overall plant efficiency. It is possible on the MMs to select steam sequencing, low pressure steam sequencing and hot water sequencing.

There are variations of the IBS software that can be selected via the options/parameters procedure: hot water boilers, and steam boilers.

A maximum of ten MMs (Mini Mk8 MMs, Mk8 MMs or combination of both) may be interconnected by a two wire screened data cable. Any MM interconnected may be selected as the lead boiler for the sequencing.

The lead boiler can be selected by:

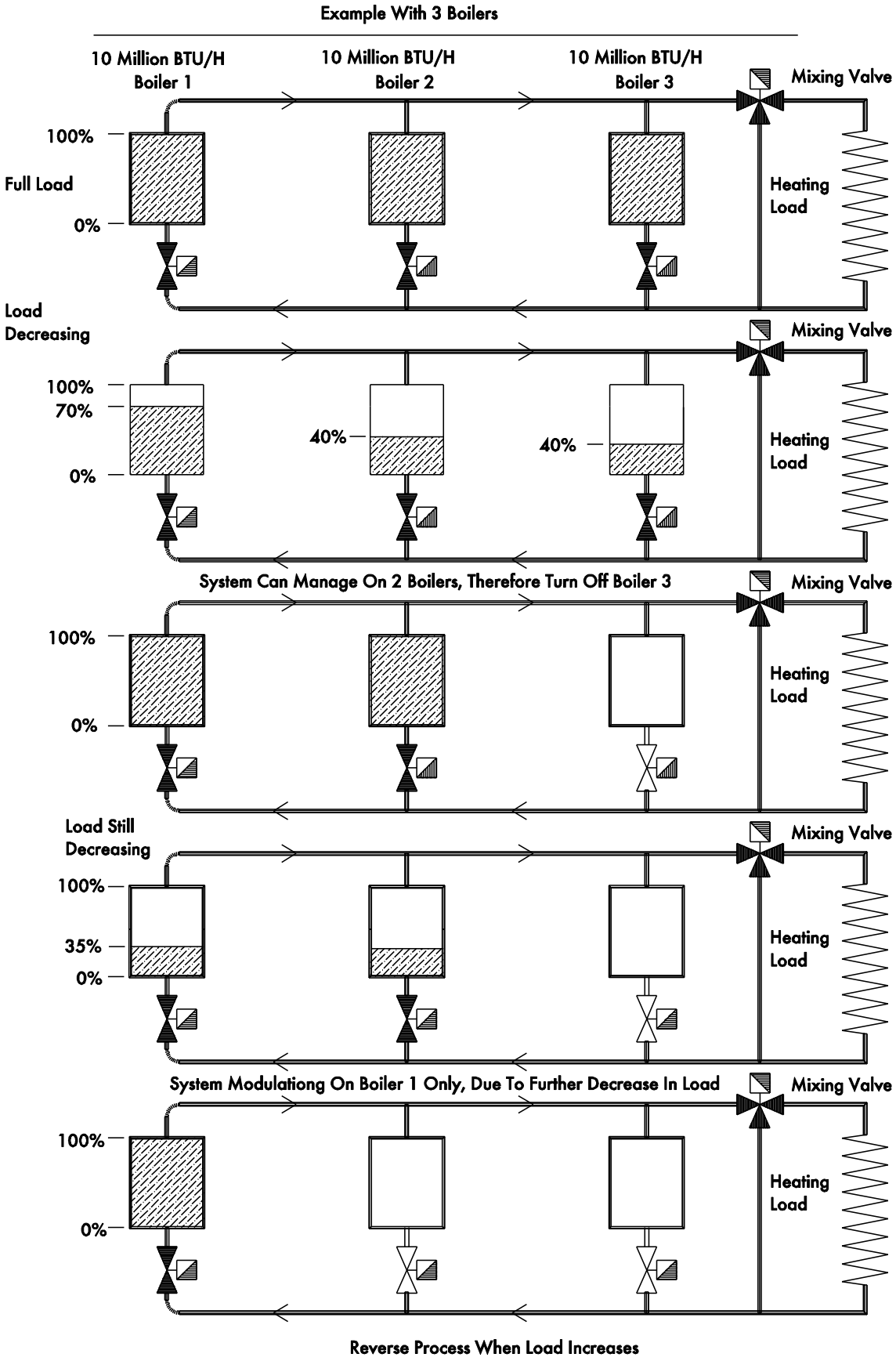
1. Lead Boiler select soft button in the MM's IBS screen.
2. Via Mk8 DTI or using the DTI Manager software.
3. Modbus write.

The sequence order of the MMs in the loop can be changed by changing their ID numbers or by changing the order on the DTI if shuffle sequencing is enabled through parameter 101.

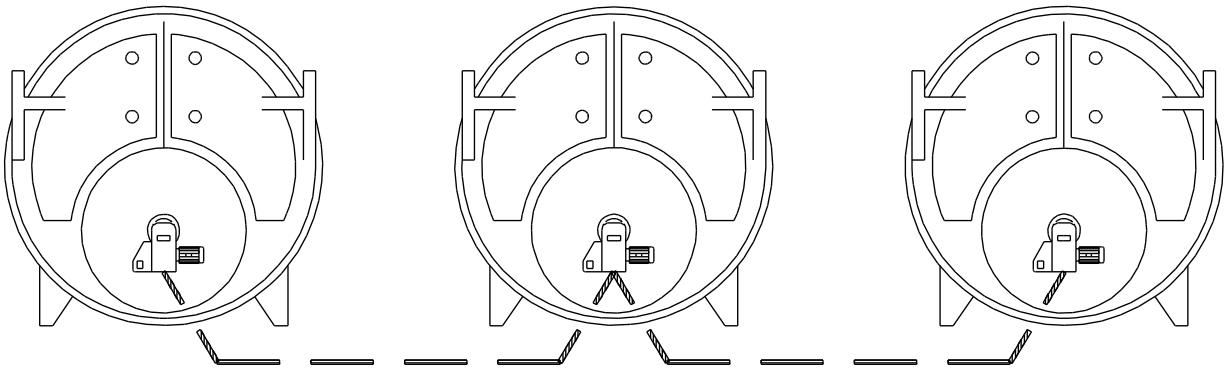
Sequencing can be used with external load detector but it cannot be used with external modulation.

Please refer to section 1 or the Sequencing Connection Diagrams.

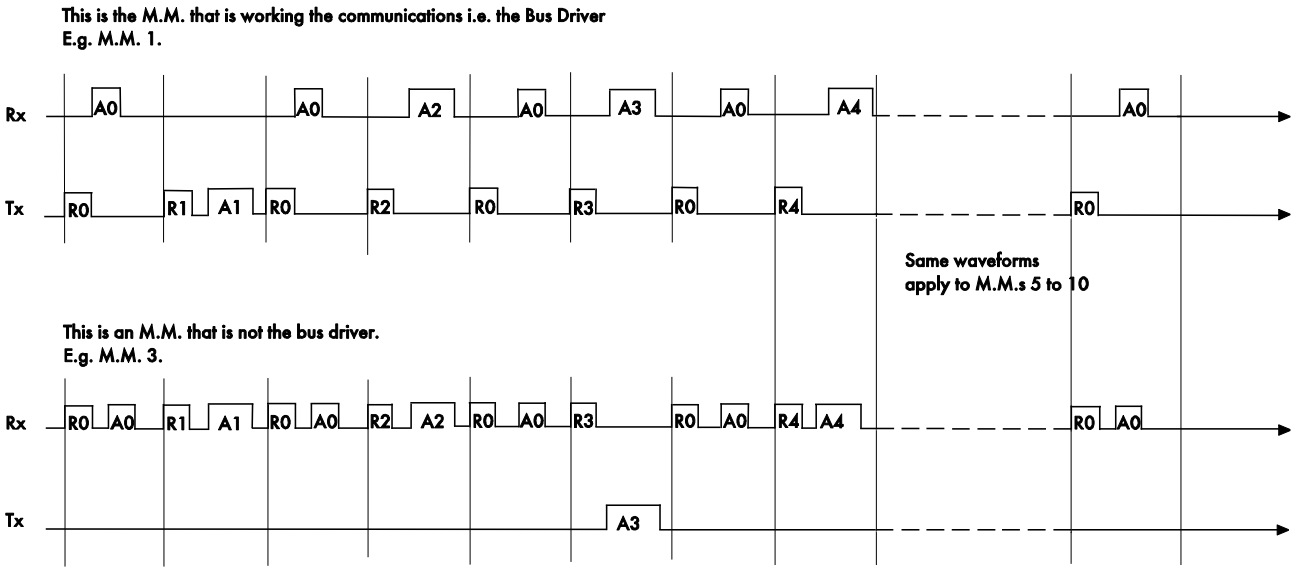
5.1.1. Hot Water Example



5.1.2. Boiler Examples



5.1.3. IBS Communications



Note : Only 1 M.M. is the bus driver.
The Bus driver is always the M.M. with the lowest ID number in the sequencing loop.

R0 - Request to D.T.I.	A0 - Answer from D.T.I.
R1 - Request to M.M. 1	A1 - Answer from M.M. 1
R2 - Request to M.M. 2	A2 - Answer from M.M. 2
R3 - Request to M.M. 3	A3 - Answer from M.M. 3
R4 - Request to M.M. 4	A4 - Answer from M.M. 4
R5 - Request to M.M. 5	A5 - Answer from M.M. 5
R6 - Request to M.M. 6	A6 - Answer from M.M. 6
R7 - Request to M.M. 7	A7 - Answer from M.M. 7
R8 - Request to M.M. 8	A8 - Answer from M.M. 8
R9 - Request to M.M. 9	A9 - Answer from M.M. 9
R10 - Request to M.M.10	A10 - Answer from M.M. 10

5.2. Sequencing Options and Parameters

The following tables show the sequencing options and parameters.

Option	Description
16	Sequencing and DTI enable
33	MM identification
35	Sequence scan time
40	Warming facility for low pressure steam
41	Warming mode
42	Standby setpoint
53	Steam sequencing burner off time
54	Steam sequencing burner on time
57	Fuel flow metering
100	Sequencing/DTI or Modbus operation
Parameter	**Description**
1	Sequence scan time set when unit goes offline
3	Number of boilers initially on
5	Modulation timeout
57	Highest MM ID
62	Hot water sequencing
86	IBS change down threshold
87	IBS change up threshold
101	Shuffle sequencing

5.3. Hot Water Sequencing

5.3.1. Implementing Hot Water Sequencing

For hot water sequencing, a temperature detector must be fitted to all the MMs and option 1 must be set to 0 or 5.

As sequencing is based on firing rate, the MMs must have fuel flow metering entered, see option 57.

The MMs can be configured for sequencing either in Commissioning Mode, or in Online Changes; this allows the commissioning engineer to implement/adjust sequencing later after the burners have been commissioned.

Each MM in the sequencing loop must be set with an individual ID number through option 33; no two MMs can have the same ID number in sequencing, or when connected to a DTI/Modbus interface. The highest MM ID number should be set for that sequencing loop in parameter 57, so the system only looks for communications with these MMs. The maximum number of MMs that can be in a sequence loop is 10. If there is a DTI in the sequence loop, to control the sequence loop via the DTI, parameter 101 must be set to 1.

To enable sequencing, option 16 must be set to 1, or 3 for sequencing with DTI. If option 16 is set to 3, then the DTI/Modbus interface is capable of some remote control. The individual and global required setpoint, lead boiler select, sequence order, enable/disable and firing rate can all be set remotely. If an MM's firing rate is set by the DTI/Modbus interface, then that MM will not follow the sequencing loop.

For hot water sequencing, option 53 must be set to 0 to disable the standby warming which is used in steam sequencing. Options 40 and 41 must be set to 0 on all the MMs in the sequencing loop. If warming is required for lag hot water boilers, then hot water sequencing can function like steam sequencing by setting parameter 62.

In a sequence loop, there is one lead MM, and the rest are lag MMs. The lead MM identifies its own firing rate by looking at its fuel flow metering data, proportional to the system's load requirements. Having established the percentage firing rate and maximum heating capacity, the lead MM calculates the amount of heat being contributed to the system by this burner.

The sequence scan time (see option 35) sets after how long the firing rates of all the MMs in the loop are assessed. The scan time has a critical effect on the responsiveness of the sequencing system. Too long a scan can result in the boilers not coming online quick enough to meet the load demand; too short a scan time (shorter than the burner start-up time) can cause another boiler to be brought online before the previous lag boiler has started firing. The scan time should normally be set at minimum, the start-up time for the burner.

The lead MM looks at its firing rate and sends a command to the lag MMs to either contribute to load because it cannot reach the setpoint, or to stop contributing to the load because the system has met the load demand. Only one lead MM can be selected at one time, if more than 1 is selected as lead MM, then the MMs will ignore the sequencing loop commands and return to independent firing. Parameter 2 sets how often the 'bus driver' MM requests and transmit information to the other MM The 'bus driver' is always the MM with the lowest ID number.

The MMs will start, continue or stop contributing to the load based on the change up and down thresholds, see parameter 86 and 87. The next lag MM will be brought online if the lead MM cannot cope with the load demand, and its firing rate is above the change up threshold. Alternatively, the MM will go into standby, warming or offline if the last two lag MMs have a total combined firing rate less than the change down threshold, because the system can cope with the load demand.

For example, if the change up threshold in parameter 87 is set at 90%, then if the last firing MM in the sequence is above 90% firing rate, then upon the elapse of the next scan time, the next lag MM will be brought online. If at the next scan time, the firing rates of the last two online lag MM are 30% and 40% respectively, and the change down threshold in parameter 86 is set at 80%, then the last lag MM will go into standby, warming or off depending on how the sequencing mode is set.

If a lag MM fails to start when requested, the scan time will be decreased by the offset set in parameter 1, until it is automatically ignored from the sequencing communication loop. If a lag MM fails to modulate after being requested to contribute to the load requirement, then that MM will be ignored from the sequencing communication loop after a time delay set in parameter 5.

After a power recycle, the number of MMs which are initially set on when the MMs start up again, is set in parameter 3.

5.3.2. Two Port Valve Operation

In hot water sequencing, when there is no demand for all of the lag boilers to be on, the system will close the two port valves on the lag boilers that do not need to be on. This will stop the hot water circulating in the system from passing through the boiler and the heat being wasted.

It is possible to use Terminal 78 which is a switched neutral to control the two port valve. This works by switching to neutral once the MM has stopped firing but if the temperature of the boiler ever gets above the required set point then Terminal 78 will switch back even if the boiler is not firing.

- When the two port valve is closed on an OFF lag boiler, if at any time, the residual heat in that boiler is above the required setpoint, the valve is opened immediately and the heat is let through the system. The two port valve then stays open.

- When the lead boiler recognises that it needs a lag boiler to come online after the sequence scan time, the lag boiler will then run its relay tests. This will open the two port valve immediately and it will then stay open.

For the two port valve to close, the lag boiler must be in standby mode, and the actual setpoint must be at or below the required setpoint; it must be in this condition for at least one minute.

Terminal 78 on the MM is a switched neutral connection for controlling a two port valve that would normally be installed in the boilers return pipe connection to the common return header. This facility ensures that boilers that are switched ‘offline’ do not contribute return temperature water to the flow header thereby diluting the flow temperature to the building.

5.4. Steam Sequencing

5.4.1. Warming Steam Boilers

The difference between steam pressure sequencing is the warming periods; the IBS settings explained in section 5.3.1 are the same. By keeping the lag MMs at low fire when they are in standby/warming, when they are requested by the lead MM to come online and contribute to the load, they will not be started from cold.

A steam boiler is at risk of thermal shock if not warmed before running at high fire. If the lag boiler is required to contribute to the steam load, then the boiler must be warm in order to contribute quickly in a safe manner. If the boiler is started from cold and allowed to fire at a high firing rate straight away then this may cause damage to the boiler. The tubes will increase in temperature and if the boiler started from a cold position then this will cause thermal shock to the boiler.

Additionally, not warming a steam boiler can result in a slow response to meet the system's steam demand. For process applications and critical sites such as hospitals, it is imperative that the steam demand is met efficiently and quickly. If one of the boilers fails, or locks out then it is very important that the next boiler in the sequencing loop gets up to pressure as quickly as possible. Therefore, if the boiler starts up from a cold status, then it will take a long time to get up to pressure safely. By warming this lag boiler this means that the boiler will maintain a pressure, offset from the required setpoint in order to ensure that when required this gets up to pressure quickly.

5.4.2. Implementing Steam Sequencing

The operation of IBS for steam boilers is similar to hot water sequencing but with additional features as explained below. In the case of hot water boilers only two states in the control form exist; either on or off. However, with steam boilers sequencing there are three states which are controlled sequentially.

Just like in hot water sequencing, steam sequencing is used to ensure that only the minimum number of boilers required are contributing to meet the required setpoint, reducing fuel consumption and improving the overall plant efficiency.

The steam sequencing operation has 4 sequencing states:

- On – the burner fires and modulates freely to meet the required setpoint. The burner will start and stop according to the above and below offset differentials (see options 9, 10 and 11).
- Standby – the burner remains at the low fire position to meet the standby setpoint (set as an absolute value in option 42). The burner will start and stop according to the above and below offset differentials (see options 9, 10 and 11).
- Warming – the burner remains at the low fire position to meet the standby setpoint (see option 42) and runs according to a timer of X minutes firing (see option 54) and Y minutes not firing (see option 53). If option 54 is set to 0, then the burner will continually fire at the low fire position to meet the standby setpoint in the warming state.
  The burner can also be controlled by a (warming) thermostat fitted in the boiler shell, wired to terminal 82 (see option/parameter 156).
- Off – the burner does not fire.

As well the options/parameters given in section 5.3.1, the following also need to be set for steam sequencing:

- Option 41 – Sets whether all the lag boiler states, either the first lag is kept in standby state with the second lag in warming and the remaining lag MMs off, or all the lag boilers after the first lag boiler are kept in warming state and there are no boilers offline.
- Option 42 – Sets the standby setpoint for sequencing where non-return valves are installed; the first lag boiler will aim to maintain this standby setpoint when in the warming/standby phase. This is set as an absolute value.
- Option 53 – Sets the steam sequencing burner off time. This is the time in minutes for how long the boiler will be off for during Warming mode.
- Option 54 – Sets the steam sequencing burner on time. This is the time in minutes for how long the boiler will be in low flame hold for the boiler to heat up to its standby setpoint, when in Warming mode.

5.4.3. Low Pressure Steam Sequencing

For steam boiler plants where check (non-return) valves are not installed, or the required setpoint is less than 2 Bar (20 PSI), it is not possible to use a standby setpoint. Each pressure sensor would read the same pressure value, regardless of individual boiler temperature/ pressure. A thermostat (Aquastat) can be installed into the boiler shell, and option 40 must be set to low pressure steam sequencing.

With option/parameter 156 set to 0 (T82 warming stat function), a live input on terminal 82 stops/inhibits the burner when the MM is in warming. Removal of this voltage allows the burner to run. The boiler will remain in a warming state based on the settings in options 53 and 54

5.5. Troubleshooting IBS

If IBS is not turning the lag boilers on and off as needed to meet load demand, this indicates that there is an issue with the sequencing communications or with the fuel flow commissioning data.

Fuel Flow Metering must be set correctly on all the MMs as this is used to determine the firing rate and burner rating which IBS looks at to decide whether to bring on or turn off lag boilers.

The MMs must be connected via a Belden 9501 in daisy chain configuration as per the sequencing wiring diagrams in section 1, with the data cable screened at one end only.

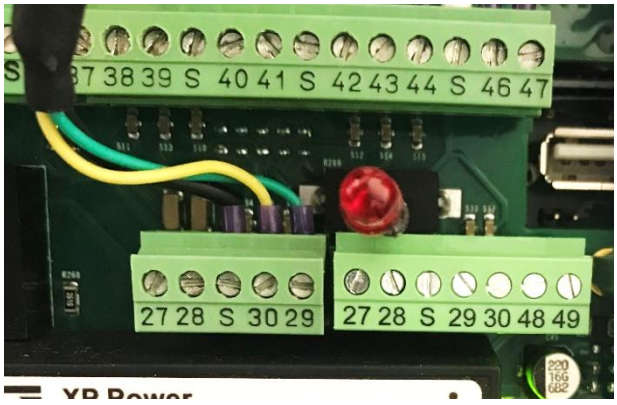
During firing, an MM will be removed from the sequence loop should any of the following occur:

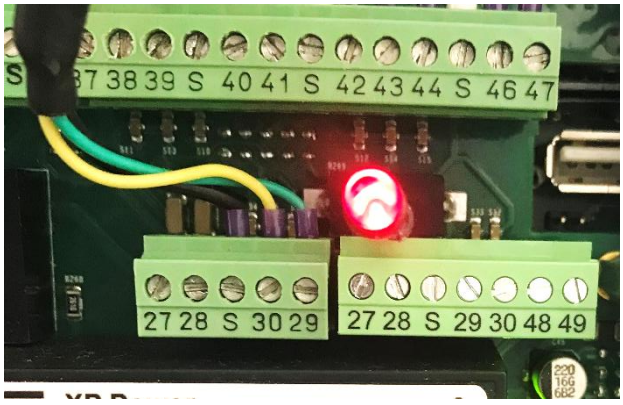
- Communications to the MM has timed out.
- The MM has been disabled remotely via the DTI or a BMS with option 16 set to 3.
- Option 16 on the MM is not set to 1 or 3.
- The MM is in an error, burner lockout or expansion alarm state.
- The MM has not started modulating within the required time.
- The DTI is manually controlling the firing rate.
- Modulation exerciser is being used.
- Option 47 has been set for cold-start routine.
- The MM is in Hand or Low Flame Hold mode.
- The MM has been optioned for Modbus.

Testing Communications with an LED

When having communications problems between Autoflame MMs, a simple test with a standard 5V LED can confirm if they are due to hardware or wiring problems.

Take a standard 5V LED and wire it into terminals 27 and 28 of the MM ensuring correct polarity (black connected to the negative leg of the LED). If the MM is communicating, the LED will flash intermittently. If the LED does not flash, check the polarity is correct on the LED. If the LED still does not flash, please contact Autoflame Sales Department. Do this for all the MMs in the sequence.





6. GENERAL FEATURES

6.1. Calibrating the Load Sensor's Actual Value

The actual load sensor value can be calibrated. Parameter 29 allows the temperature/pressure sensor value to be adjusted, it allows the user to adjust the actual value between a range of 80.0% and 120.0%.

The load sensor reading can be calibrated via Commissioning Mode or through Online Changes.

The percentage change may not be linear to the current temperature/pressure, i.e. 80% of 100°C may not show 80°C.

For example, if the actual temperature was showing as 91°C on the MM, but the true temperature was 79°C, change the value in parameter 29 until the correct temperature adjustment has been made. Figure 6.1 shows the load sensor adjusted by 96.0% to display 79°C.

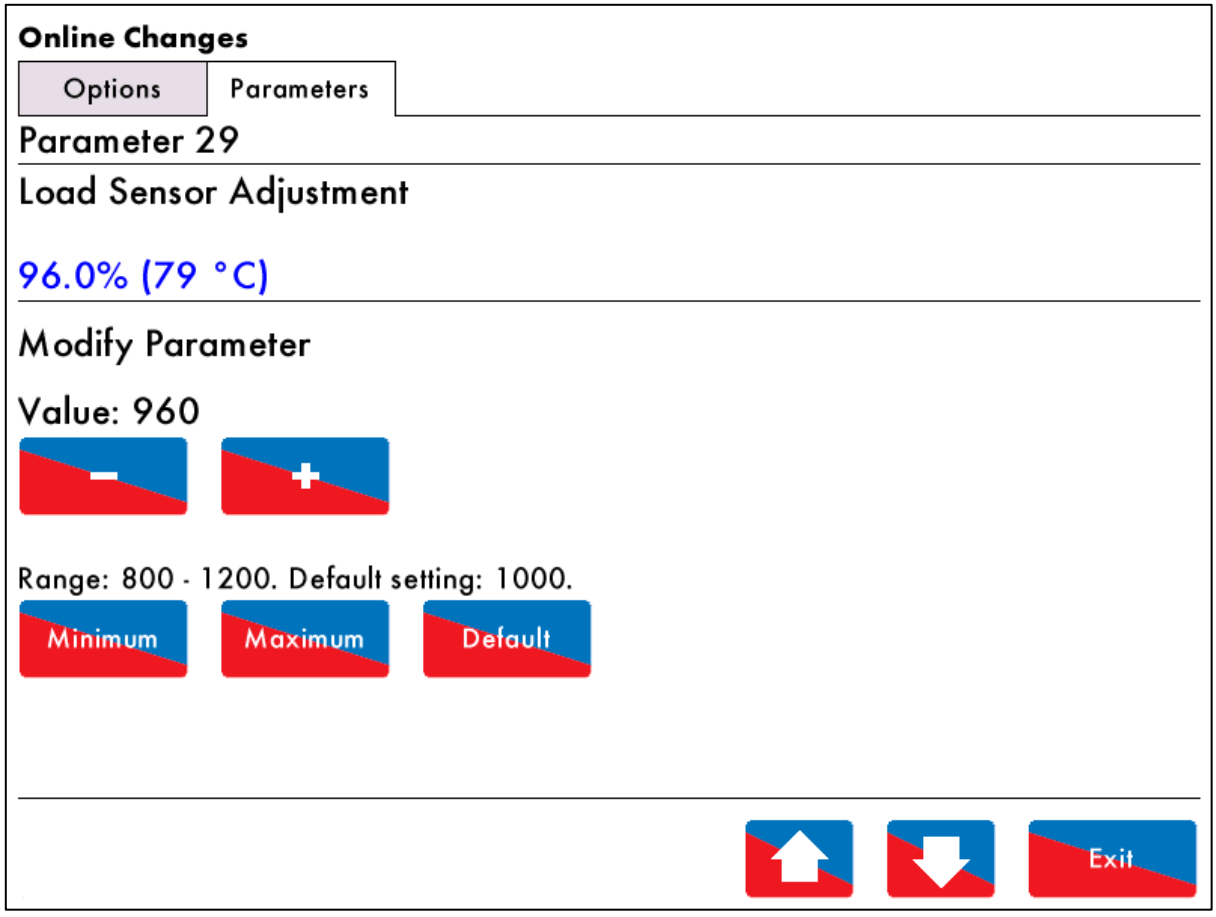


Figure 6.1 Load Sensor Adjusted

6.2. External Modulation

For external modulation, option 45 can be set to 1 (Enabled), and option 9 must be set to 0. The internal PID control is disabled and the firing rate is set by an input control signal on terminal 37, 38 as appropriate for 0 – 10V and 2 – 10V. Set parameters 68 for the external modulation control range, and parameter 69 for the input range. The fuel flow metering must be commissioned.

External modulation using 4-20mA signal requires placing 500Ω resistor across terminals 37 and 38.

6.3. HAND, LOW FLAME HOLD AND AUTO

6.3.1. Hand Operation

Hand operation enables the firing rate positions to be set to a specific position, in the range of low to high fire, when the burner is firing. Fuel flow metering must be entered. Sequencing will not operate correctly if the MM is in hand mode. Hand mode can only be activated when the burner is firing.

The Mini Mk8 MM will go into hand mode when the hand mode soft button is pressed in the Status screen. Arrows will then appear on the screen which can be used to increase and decrease the firing rate. Once the hand mode is deactivated, the MM will go to auto mode and fire according to normal modulation. On the Mini Mk8 MM the transfer between hand and auto mode is always seamless.

If the low flame hold input is activated on terminal 81 (see option/parameter 155), then this will take priority over the hand button pressed in the Status screen.

6.3.2. Low Flame Hold

Low flame hold is the state when the MM's firing rate goes to its low fire position, while the burner is firing. Fuel flow metering must be entered. Sequencing will not operate correctly if the MM is in low flame hold.

To put the Mini Mk8 MM into low flame hold, go to the Status screen and press the low flame hold button, or put an input on terminal 81 (option/parameter 155 must be set to 2). Once out of low flame hold, the MM will return to normal modulation.

6.3.3. Auto Operation

The MM 'Auto' operation enables the burner modulation to maintain the setpoint; the firing rate will modulate according to how far away the actual temperature or pressure is from the required setpoint. The firing rate is determined from the fuel flow metering entered via option 57; the more accurate the fuel flow metering, the more accurate the firing rate.

6.4. Single Servomotor Operation

For applications where only the VSD controls the air going into the burner and no air servomotor is required, the Mini Mk8 MM can be set for single servomotor with VSD. The MM will make changes to the fuel servomotor and VSD in synchronisation as the firing rate modulates up and down.

When using a single servomotor with VSD, the MM checks that the VSD feedback is within the fault tolerance bands set in option 99 as the fuel servomotor drives open to increase the firing rate. If the VSD feedback is not higher than the tolerance band at that servomotor angle, then the servomotor will wait until the VSD ramps up to meet this limit at minimum. This prevents the burner from being too fuel-rich as the firing rate increases. As the fuel servomotor closes, there is a natural lag in the VSD feedback as it slows down; the fuel servomotor still waits for the VSD but does not modify the target VSD speed.

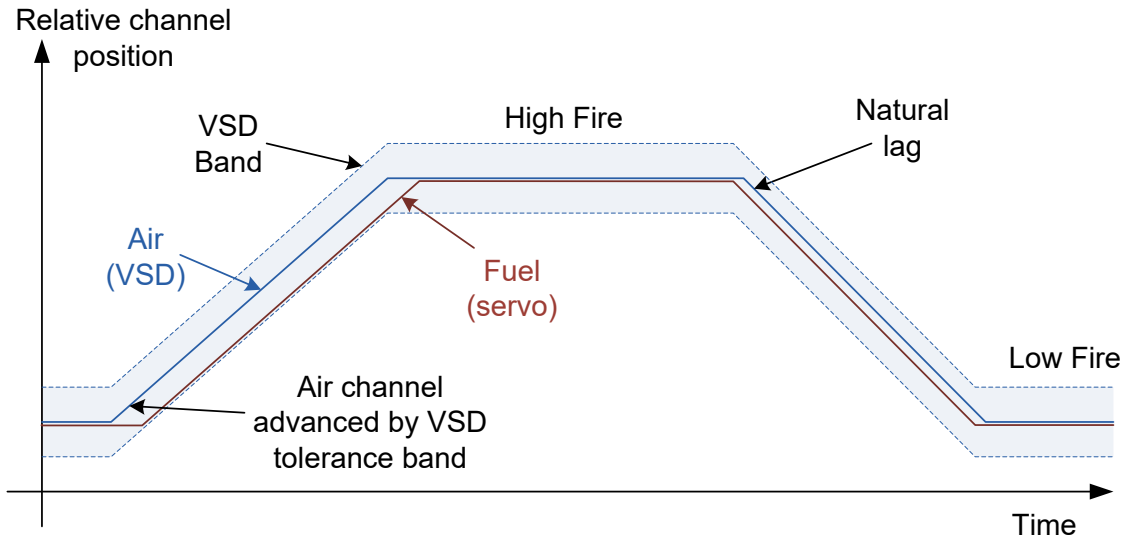


Figure 6.4.i Single Servomotor with VSD Diagram

Option 4 Air Channel must be set to setting 1 for 'VSD Channel 4,' and options 90 to 99 must be set according to the VSD settings. Option 8 must be set to 'Channel 1 only.' Option 89 allows the user to send the high signal to the VSD only when the T58 is required to come on, to prevent the burner being forced with air at start-up.

Note: EGA trim will not work with single servomotor with VSD.

For single servomotor with VSD, both the fuel servomotor on channel 1 and the VSD on channel 4 are wired as normal to the MM.

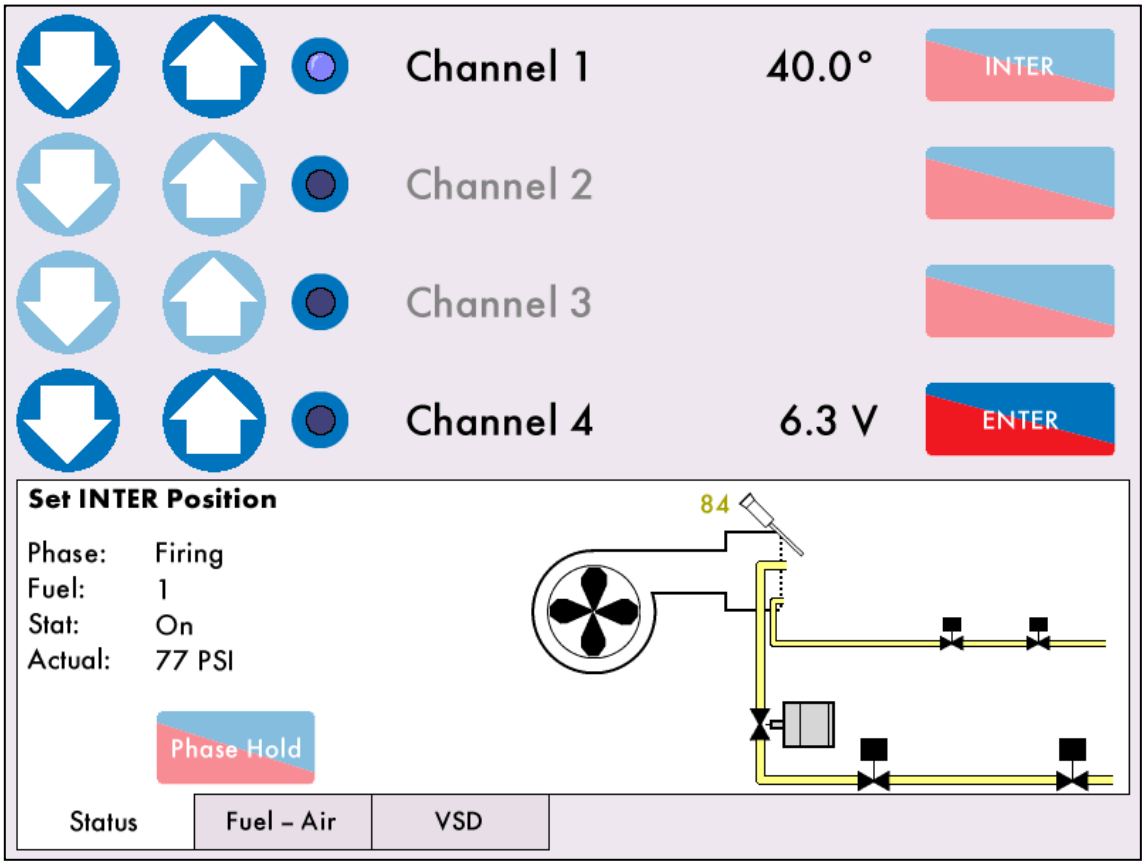


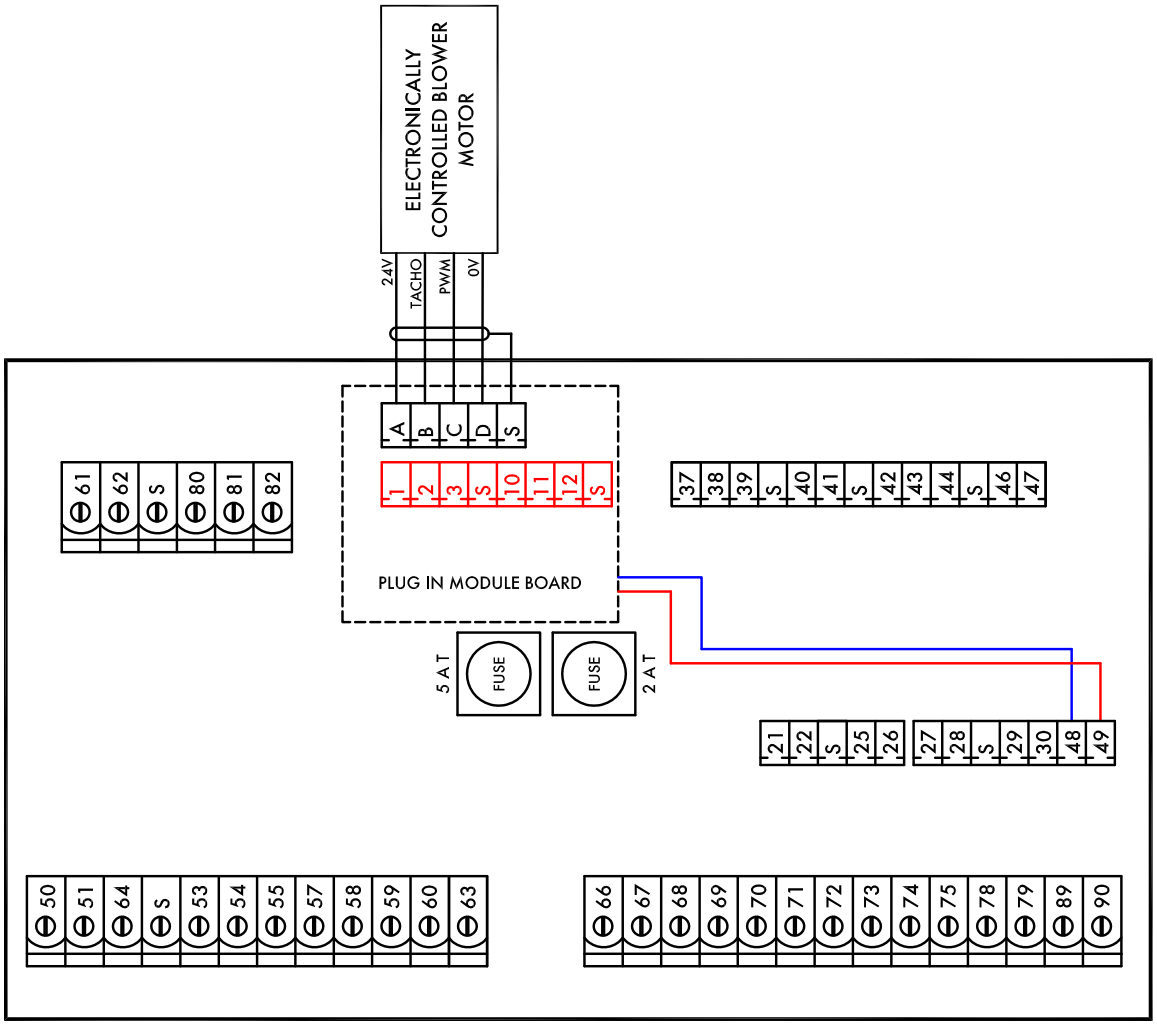
Figure 6.4.ii. Single Servomotor with VSD

The commissioning procedure remains the same, however only the channel 1 gas servomotor position and channel 4 VSD position needs be entered for each point. In Run mode the system will show the servomotor position and VSD input and output signals.

6.5. PWM Motor Control

In applications with fans/blowers that uses Pulse Width Modulation (PWM) control, the Mini Mk8 MM requires an additional module to control these fans, the PWM Adapter Module (Part # SP80050).

This adapter is plugged into the VSD channel 4 terminals (1, 2, 3, 10) on the Mini Mk8 MM and the fan is commissioned like a VSD. The power supplied to the module comes from the IR scanner terminals 48 and 49.



Before purchasing this module, please contact Autoflame Engineering. The digital fan adapter must be purchased according to the specification of the digital fan. The device must be programmed with the correct speed settings for the fan to be used and must be fitted with the correct interface components.

The following options must be set:

Option	Setting	Option	Setting
89	1	94	Default
90	1	95	2 (0-10V)
91	2 (0-10V)	96	Default
92	Default	97	Default
93	Default	98	Default

The supplied pin jumper must be placed for setting the open and closed position in commission mode and must be removed after the pre-purge phase is completed.
The rest of the commissioning procedure is the same as that of Ch4 VSD. In Run mode the system will show the servomotor position and VSD input and output signals.

6.6. No Air Servomotor

Some burner applications use natural draught to supply air for combustion without the need for air blower for forced draught and there is no air damper, so the air supplied to the burner is at atmospheric pressure. In such applications there is no need for control on the air channel and only the fuel channel requires controlling.

The Mini Mk8 MM allows the system to be set so that the burner is commissioned with channel 1 servomotor only to control the fuel flow. This configuration can also be used for pre-mix burners where the fuel to air volume ratio is not varied. In these applications, channel 1 is used to vary the volume of combined air and fuel.

The gas servomotor is wired as normal to the MM and option 4 must be set to 'No Air Channel.' Option 8 must be set to 'Channel 1 only.'

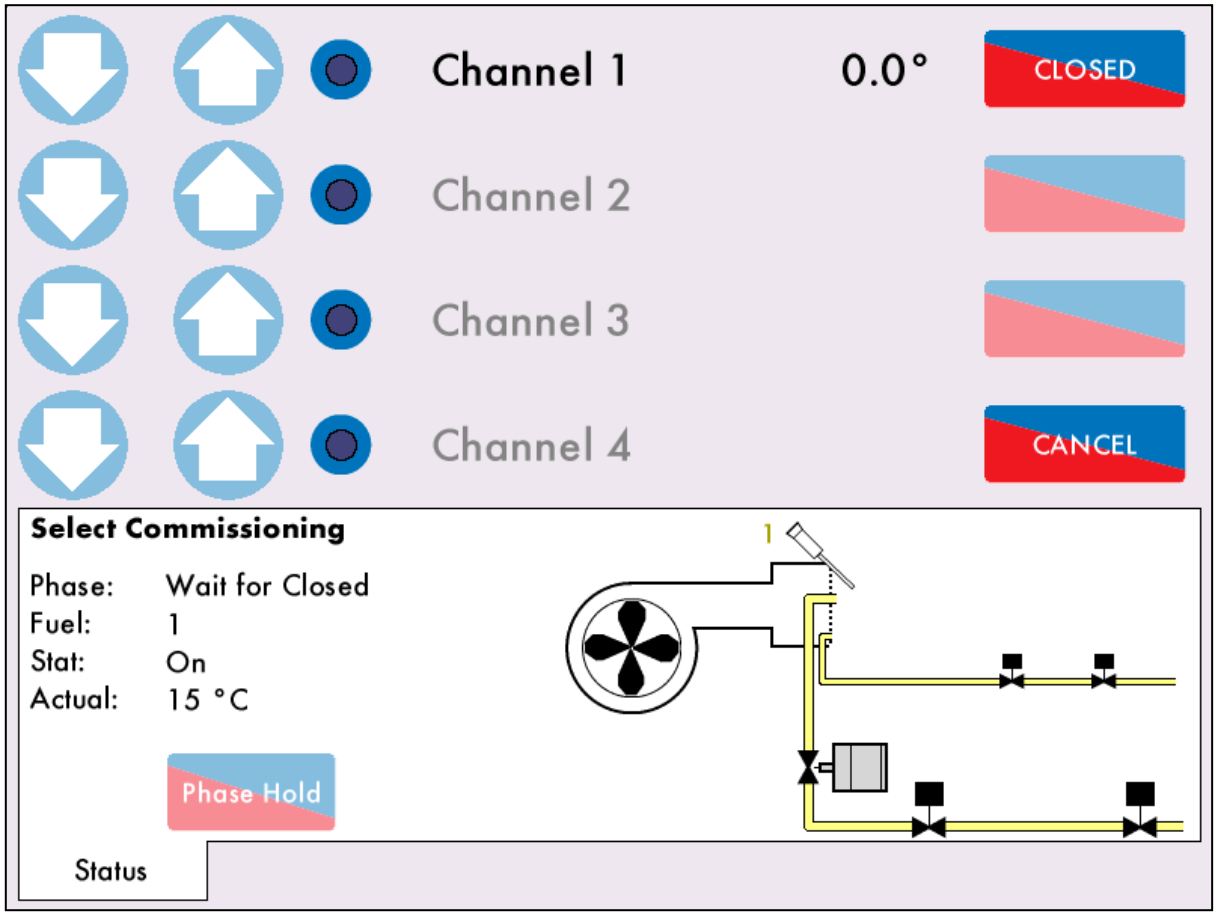


Figure 6.6. Commissioning with No Air Servomotor

The commission procedure follows the normal steps but with channel 1 servomotor only.

For more information on using the Mini Mk8 MM on an atmospheric burner or pre-mix burner and the required limit switches or purge delay, please contact Autoflame Engineering.

6.7. 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 pre-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: No Pre-purge is only available on fuels which are optioned as gaseous.

6.8. Mini Mk8 MM Flame Detection Using Ionisation

As well as using UV or IR, the Mini Mk8 MM 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 (50 counts), lower than this a Lockout will be generated. The maximum sensed rectification voltage is 540Vdc (255 counts).

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

6.9. Terminals 80, 81 and 82 Functions

6.9.1. T80 Functions

Option/parameter 154 controls the function of terminal 80. One of the following functions can be triggered when a live input is detected on this terminal.

Start position interlock	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. For a Flame Safeguard unit, Terminal 80 acts as a live input in response to a mechanical end stop. For more information, please check the Autoflame Flame Safeguard manual.
Night setback input	The setpoint is reduced according to the night setback offset set in option 85.
Reduced setpoint input	The MM will fire to meet the reduced setpoint set via the MM status screen.
Delay to purge input	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. Option/parameter 157 can be used to set a timer for the delay to purge input. 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.

6.9.2. T81 Functions

Option/parameter 155 controls the function of terminal 80. One of the following functions can be triggered when a live input is detected on this terminal.

Purge interlock	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 triggered. This input must not be made while not at purge.
Low flame hold input	An input on terminal 81 will put the MM into low flame hold.
Purge pressure proving	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 not be made before the blower motor starts to confirm the input is working correctly. If this input comes on during the relay tests then lockout is triggered. Option/parameter 158 adds an optional timer to this phase. The system will lockout if this purge interlock timer has elapsed. This timeout can be disabled so the MM will be in the purge phase indefinitely.

Purge pressure proving (option 155 setting 3) works as follows:

- The MM stays indefinitely in purge position (pre-purge or post-purge) until an input is detected on T81.
- Once an input is detected on T81, the MM waits for the purge timer to runout and proceeds to the next phase as normal.

An input on T81 must NOT be detected during the MM start-up stage (before pre-purge), otherwise a lockout will occur.

A purge pressure proving timeout can be set in option 158;

- If option/parameter 158 is set to disabled, the MM stays in purge position indefinitely, or until an input is detected on T81.
- If a time is set in option 158, a lockout is generated if this timer elapses before an input is detected on T81.

Note: Purge Pressure Proving only works with standard post purge (option 135 set to 0 or 1).
It does NOT work with NFPA post purge (option/parameter 135 set to 2 or 3); an input on T81 will have no effect on NFPA post purge.

6.9.3. T82 Functions

Option/parameter 156 governs the function of terminal 82. One of the following functions can be triggered when a live input is detected on this terminal.

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

7. REMOTE CONTROL

7.1. 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.

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 Modbus is ‘offline’ then remote setpoint and firing rate set via Modbus will be disabled. The only exception is the enable/disable burner which changes the enable/disable button on the MM on the home screen, as this change will last until the Modbus state is changed again or the enable/disable button is pressed again.

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

7.2. 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

7.2.1 Modbus to BACnet/Ethernet IP/Metasys N2 via RS485 with AFPROTOAIR

The Mini Mk8 can also communicate from Modbus to BACnet/IP, BACnet MSTP, Ethernet/IP or Metasys N2 with our Protonode convertor (part # AFPROTOAIR) via RS485.

The AFPROTOAIR is pre-loaded with tested Profiles/Configurations for the supported MK8 devices (Mk8 DTI, MK8 MM, Mini Mk8, Mk8 EGA EVO). You would need to select the Mini Mk8 profile, whilst setting up the Protonode convertor via the web configurator.

You can also connect multiple Mini Mk8, Mk8 MM or MK8 EGA EVO by daisy-chain via RS485 onto the Protonode, as long as the Modbus device ID (Option 104 for Mini MK8) (Expansion 104 for MK8 MM) (Setting 57 on Mk8 EGA EVO) are different from each unit & their respective profiles are selected.

For more information, please see Technical Bulletin # 287 & the AFPROTOAIR manual.



7.3. 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 1 position 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

#	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 if actual temperature/pressure is below trim threshold
10219	RD	EGA Cooler Ready	0 = Cooler is not ready, 1 = Cooler is ready Returns value 0 if EGA is an error state
10220	RD	EGA Ambient Temp OK	0 = Temperature not OK, 1 = Temperature 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
12002	RD	Units Imperial or Metric	0 = Imperial, 1 = Metric
30101	RA	Load Index	Firing rate %
30102	RA	Firing Status	0 = Non-modulating, 1 = Modulating Returns value 0 in single point change, fuel flow metering or commissioning For Option 106 setting 1 see section 7.3.1
30104	RA	Burner Rating	MW x 10 Metric units determined from fuel flow metering
30105	RA	Actual Value	Metric: temperature ^{O}C, pressure Bar x 10, low pressure Bar x 100

#	Type	Description	Details
			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 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

#	Type	Description	Details
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 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

7.3.1 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

8. OPERATION

8.1. Home Screen

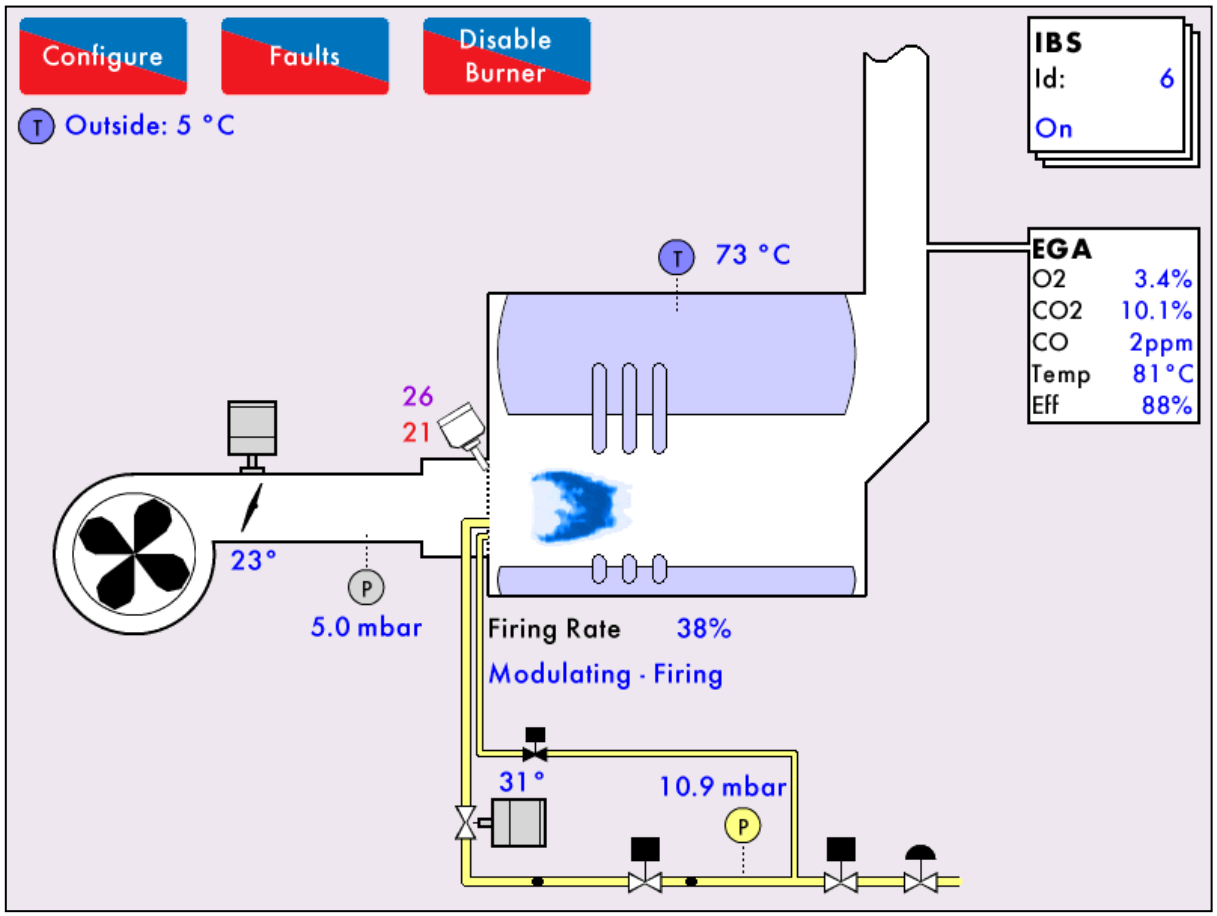
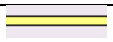
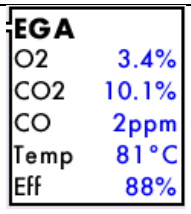
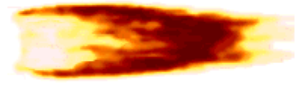
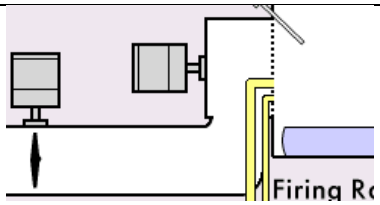
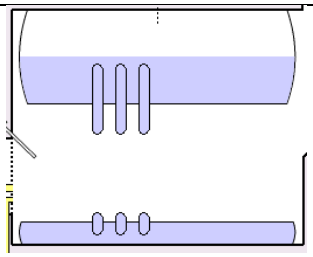
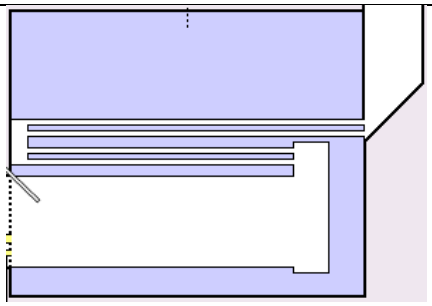
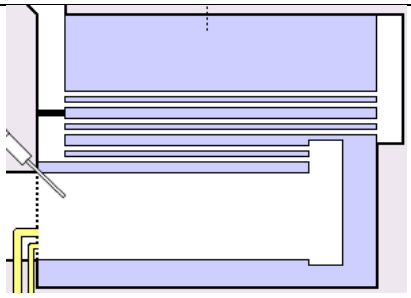
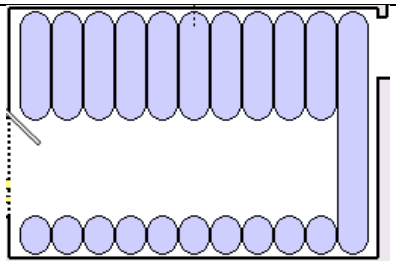
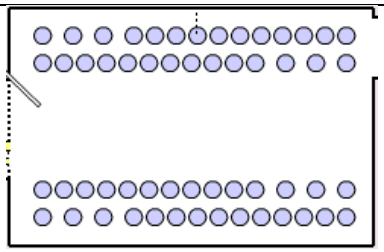
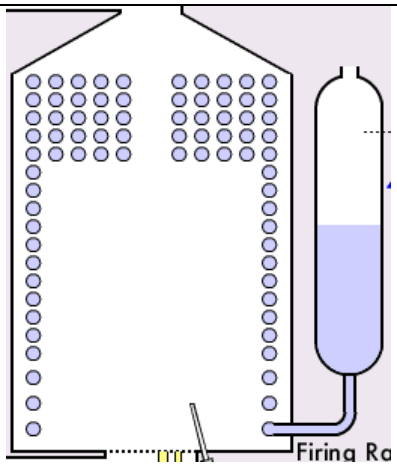
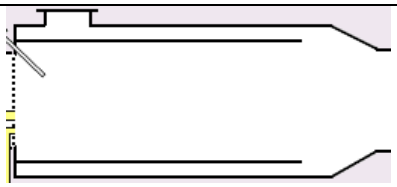
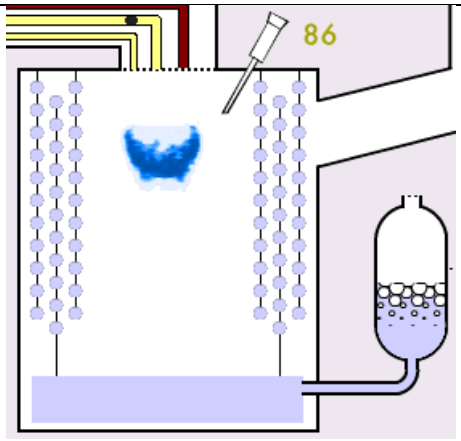
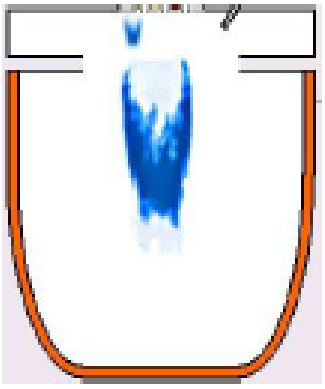


Figure 8.1.i Home

The home screen shown in Figure 8.1.i. displays the current boiler setup. It provides operating information for each component of the burner/boiler in real time. Pressing on components will display further information e.g. pressing on the servomotor image will show the servomotor position history. This boiler room setup can be configured to display what is actually on site, please see section 8.12.2 Boiler Configuration.

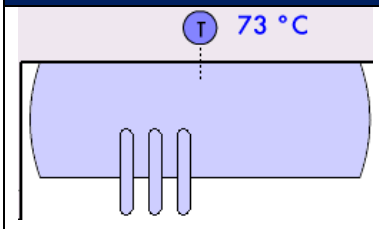
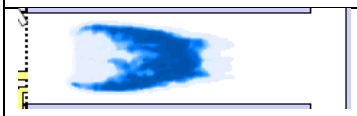
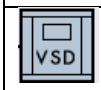
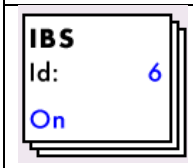
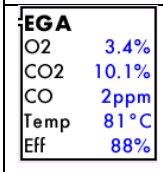
8.1.1. Home Screen Components

Servomotor		VSD	
Flame Detector		Gas Pressure Sensor	
Air Pressure/ Boiler Steam Pressure Sensor		OTC/ Boiler Temperature Sensor	
Gas Pipe – gas flowing		Gas Pipe – no flow	
Oil Pipe – oil flowing		Oil Pipe – no flow	
Fuel Valve – solenoid open		Fuel Valve – solenoid closed	
Fuel Control Valve – open		Fuel Control Valve – closed	
Regulator		Feed Water Pump	
Feed Water Valve		Steam/ Air Atomisation	
FGR/ Induced Draft Valve		Air Damper	
Combustion Air Fan		EGA Information	
IBS Information		Induced draft	
Gas Flame		Oil Flame	

Rotary Cup Burner		Water Tube	
Three-Pass Fire Tube		Four-Pass Fire Tube	
Cast-Sectional Tube		Horizontal Coil Tube	
Vertical Coil Tube		Kiln	
Vertical Condenser		Crucible	

8.1.2. Home Screen Buttons

The Home screen comprises of various components that can be selected to navigate through the information screens of the MM. The components display in the Home screen according to the boiler room configuration, see section 8.12.2.

Button	Component	Description
	Status	The current boiler temperature/pressure is displayed next to the temperature/pressure detector. Pressing on the boiler or the load detector gives access to the Status screen, see section 3.2.
	Fuel-Air	The current firing rate will display below the flame, pressing the flame gives access to the Fuel-Air Screen, see section 3.3.
	Flame Safeguard	The number of counts will be displayed for the flame scanner used. This button gives access to the Flame Safeguard screen, see section 3.4.
	Servomotor	This button is animated to display the current angular position of the servomotor, and gives access to the Channels screen, shown in section 3.5.
	VSD	This button shows the VSD input signal, and gives access to the Channels screen, see section 3.5.
	Gas Pressure Sensor	This button is animated with the current measured gas pressure, and gives access to the Gas Sensor screen, see section 3.6.
	Air Pressure Sensor	This button is animated with the current measured air pressure, and gives access to the Air Sensor screen, see section 3.7.
	Fuel Flow	Pressing on the gas/oil pipe gives access to the Fuel Flow screen, see section 3.8.
	IBS	The IBS box will show the ID number of the M.M., and its status, and if it is the lead boiler. This button gives access to the IBS screen, see section 3.9.
	EGA	The EGA box will show the current exhaust gas and temperature, and efficiency values. This button gives access to the EGA screen, see section 3.10.
	Outside Temperature Compensation	This temperature sensor is animated with the current outside temperature. This button gives access to the OTC screen, see section 3.11.

8.1.3. Enable/Disable

If option 15 is set to 2 or 3 then the burner can be enabled/disabled by pressing 

in the Home screen (Figure 8.1.i). If option 15 is set to 0 or 1, then the burner cannot be enabled/disabled via the home screen.

8.1.4. Faults

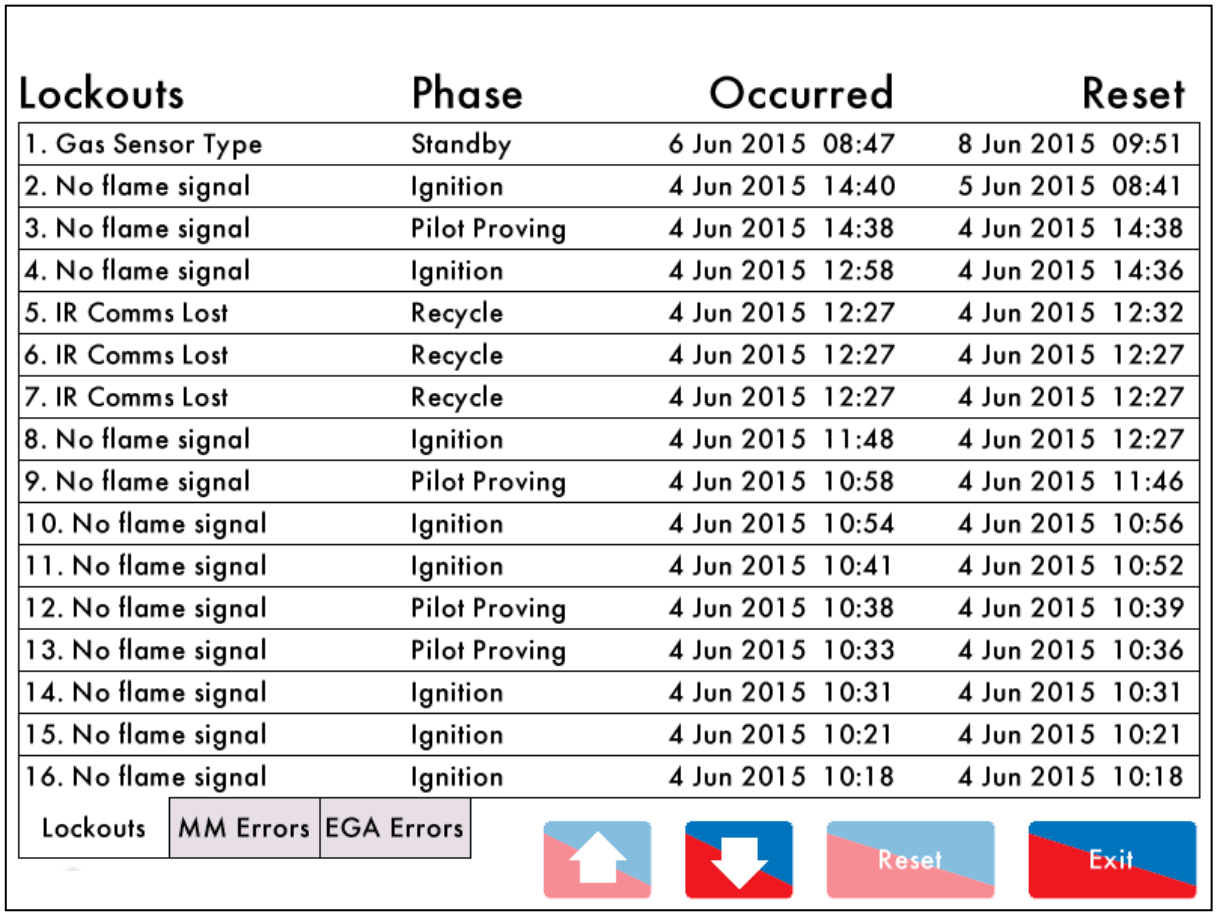


Figure 8.1.4.i Faults

Press 

in the Home screen (Figure 8.1.i) to view the burner lockouts, MM errors, and EGA errors. The MM will store up to 64 burner lockouts, MM errors and EGA errors. These can be reset via Online Changes, see section 8.12.5.

8.2. Status Screen

8.2.1. Status

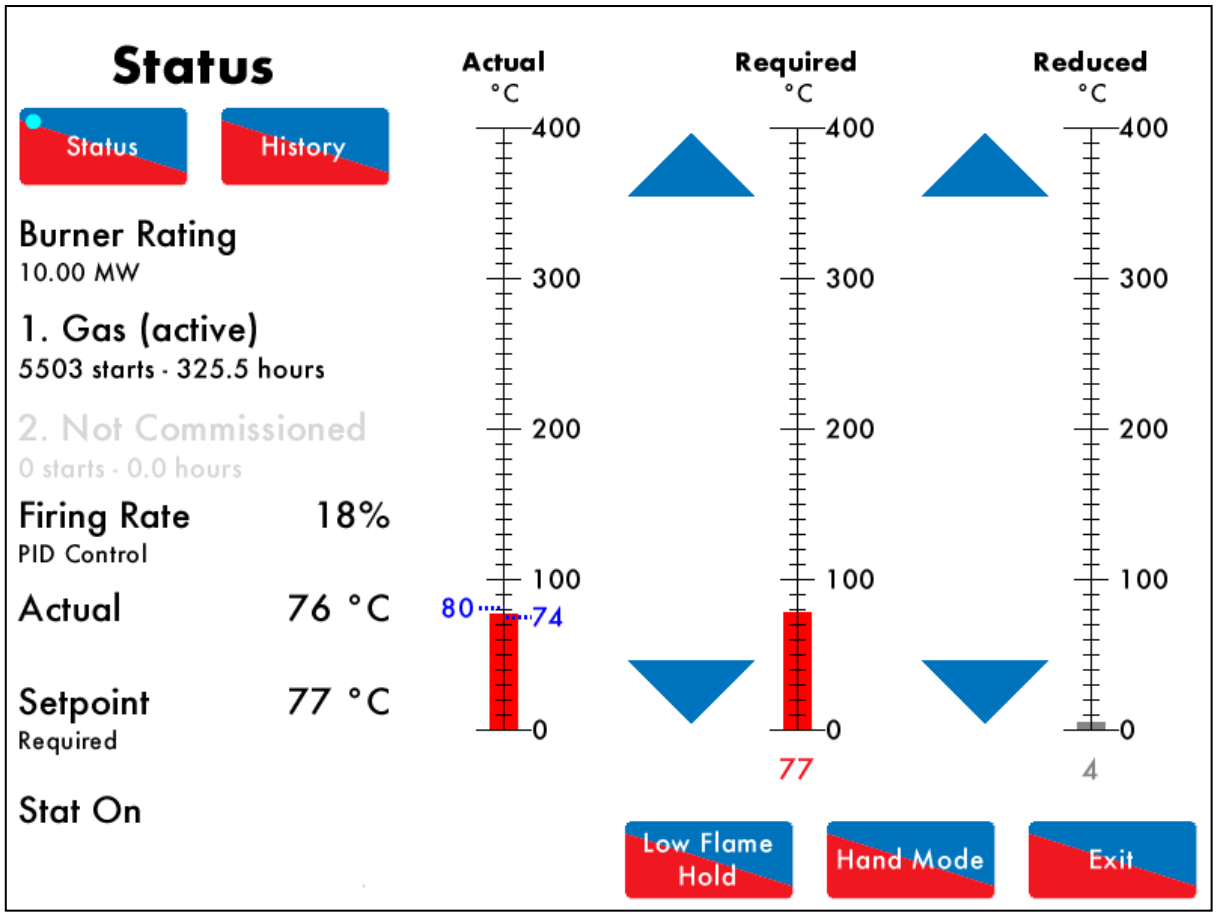


Figure 8.2.1.i Status

Press the boiler load detector button or the boiler image in the Home screen (Figure 8.1.i) to display the Status screen in Figure 8.2.1.i. The status screen gives the following information:

- Burner rating
- Current fuel selected and type
- Burner starts and run hours
- Current firing rate
- Control method – internal PID control or external modulation (see option 45)
- Actual temperature/ pressure
- Setpoint – required/ reduced temperature/pressure
- Stat status – T53 call for heat on or off
- Burner switch on/off offset (see options 9, 10, and 11)
- Reduced setpoint (see section 8.12.7 Run Times, and option/parameter 154)
- Indication if MM is firing to meet required or reduced setpoint (red = active, grey = inactive)
- Arrows for adjusting setpoint (they do not appear if using a DTI or OTC)

Press the  arrows to change the required or reduced setpoints. If these arrows are not displayed, then either the user setpoint change has been disabled (see option 15), or the DTI is controlling the setpoint (see options 16 and 100) or OTC is enabled (see option 80).
Note: Use parameters 29 and 30 to adjust the load detector reading if required.

8.2.2. Status – History

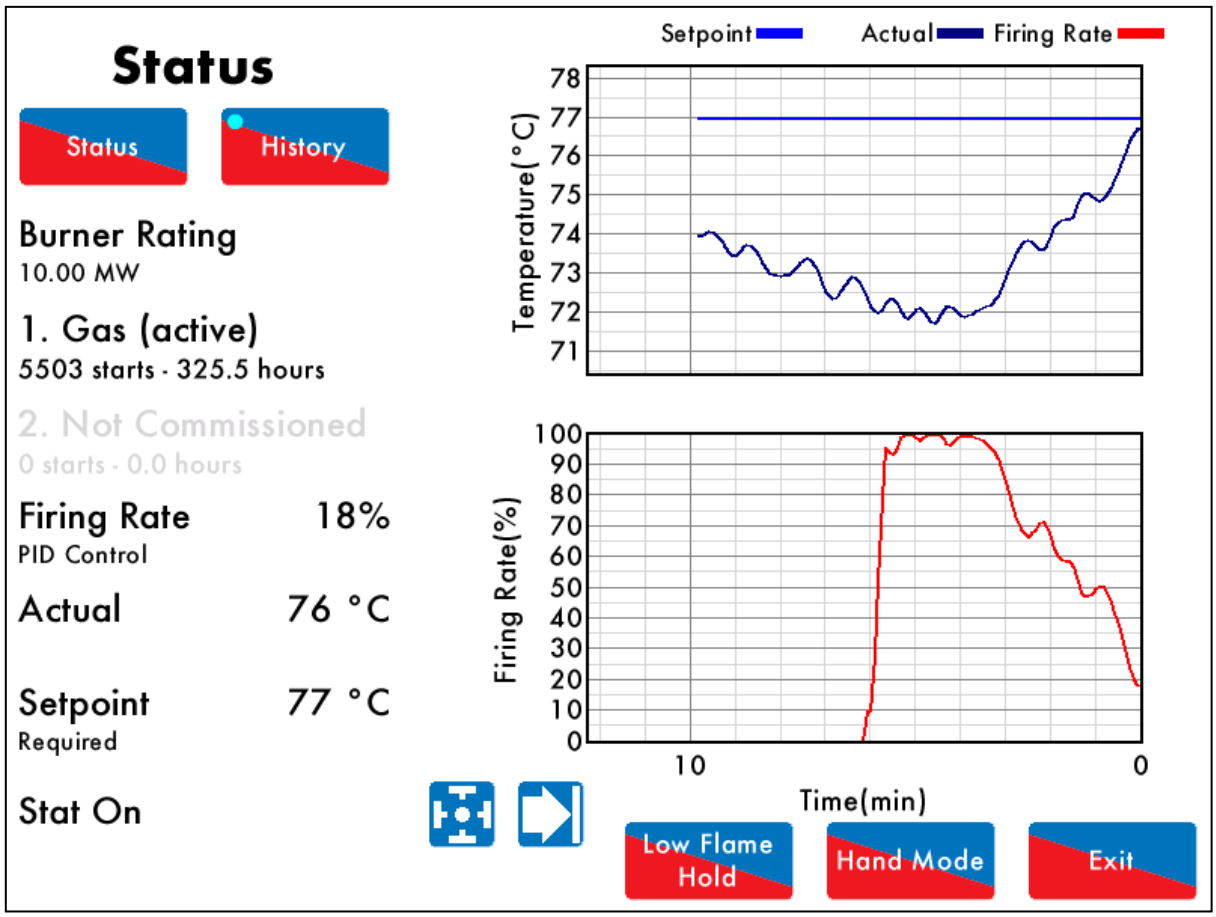


Figure 8.2.2.ii Status – History

Press 

in the Status screen (Figure 8.2.1.i) to show the Status History in Figure 8.2.2.ii. The setpoint, actual temperature/pressure and firing rate are displayed graphically. This data is logged for 24 hours on the MM.

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.

This information is logged for 3 years on the DTI when connected with the MM.
0
Note: Power cycling the MM or changing fuel will reset this data log.

8.2.3. Status – Low Flame Hold

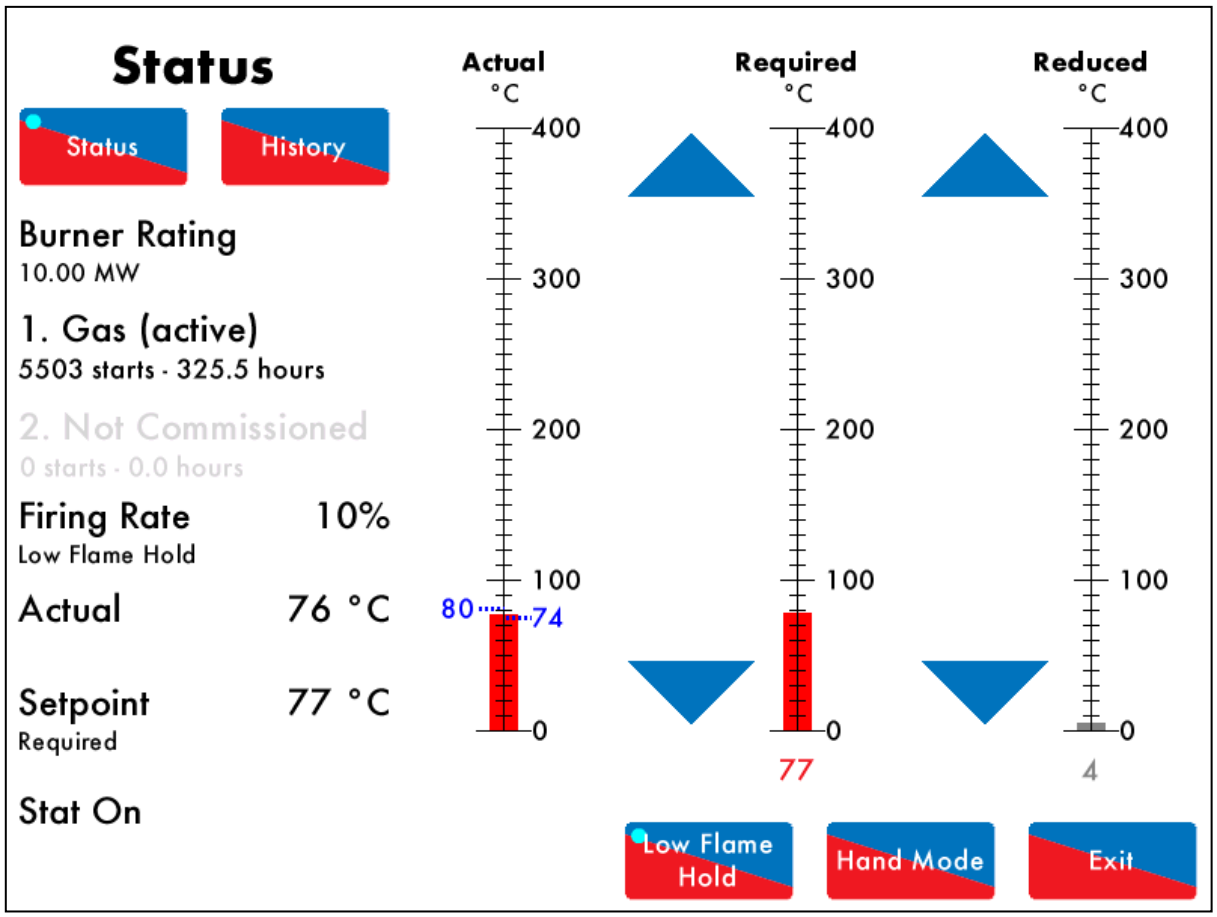


Figure 8.2.3.i Status – Low Flame Hold

Press 

on the Status screen (Figure 8.2.1.i) to put the MM in low flame hold, and press this button again to return to modulation, see Figure 8.2.3.i.

Alternatively, the Mini Mk8 MM can also be put in low flame hold via an input on terminal 81, see option/ parameter 155.

Note: If using Intelligent Boiler Sequencing, then putting the MM into low flame hold will remove the unit from the sequence loop. It will resume once low flame hold is deselected and after the next scan time elapses.

Note: If low flame hold and hand mode are both selected, then hand mode takes priority.

8.2.4. Status – Hand Mode

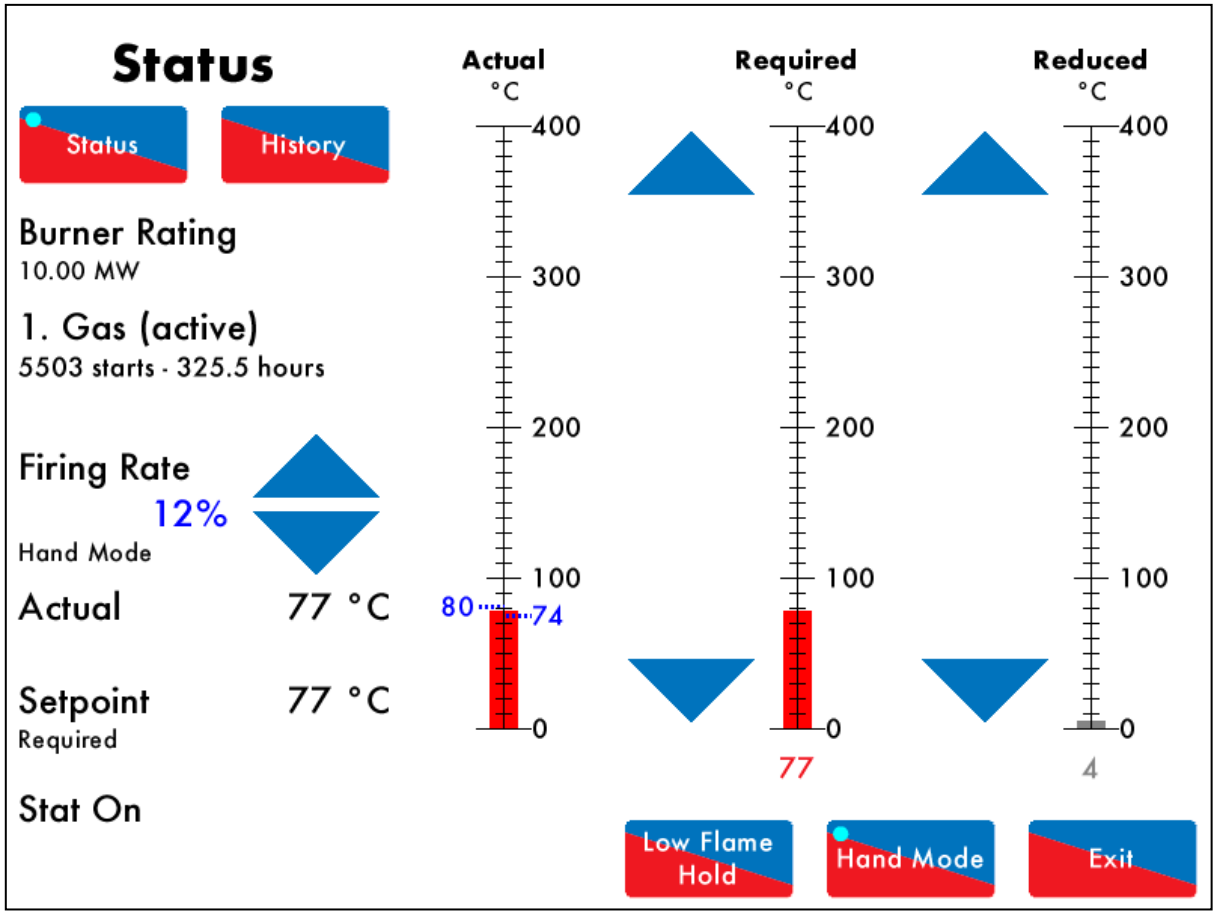


Figure 8.2.4.i Status – Hand Mode

Press 

on the Status screen (Figure 8.2.1.i) to put the MM in hand mode, where the firing rate can be driven up or down by using the  buttons (see Figure 8.2.4.i).

Alternatively, the firing rate can be set remotely via Modbus addresses 40121 and 40131, see section 7.

Note: If using Intelligent Boiler Sequencing, then changing the firing rate via hand mode removes the unit from the sequence loop. It will resume once hand mode is deselected and after the next scan time elapses.

Note: If low flame hold and hand mode are both selected, then hand mode takes priority.

8.3. Fuel-Air Screen

8.3.1. Fuel-Air – Curve

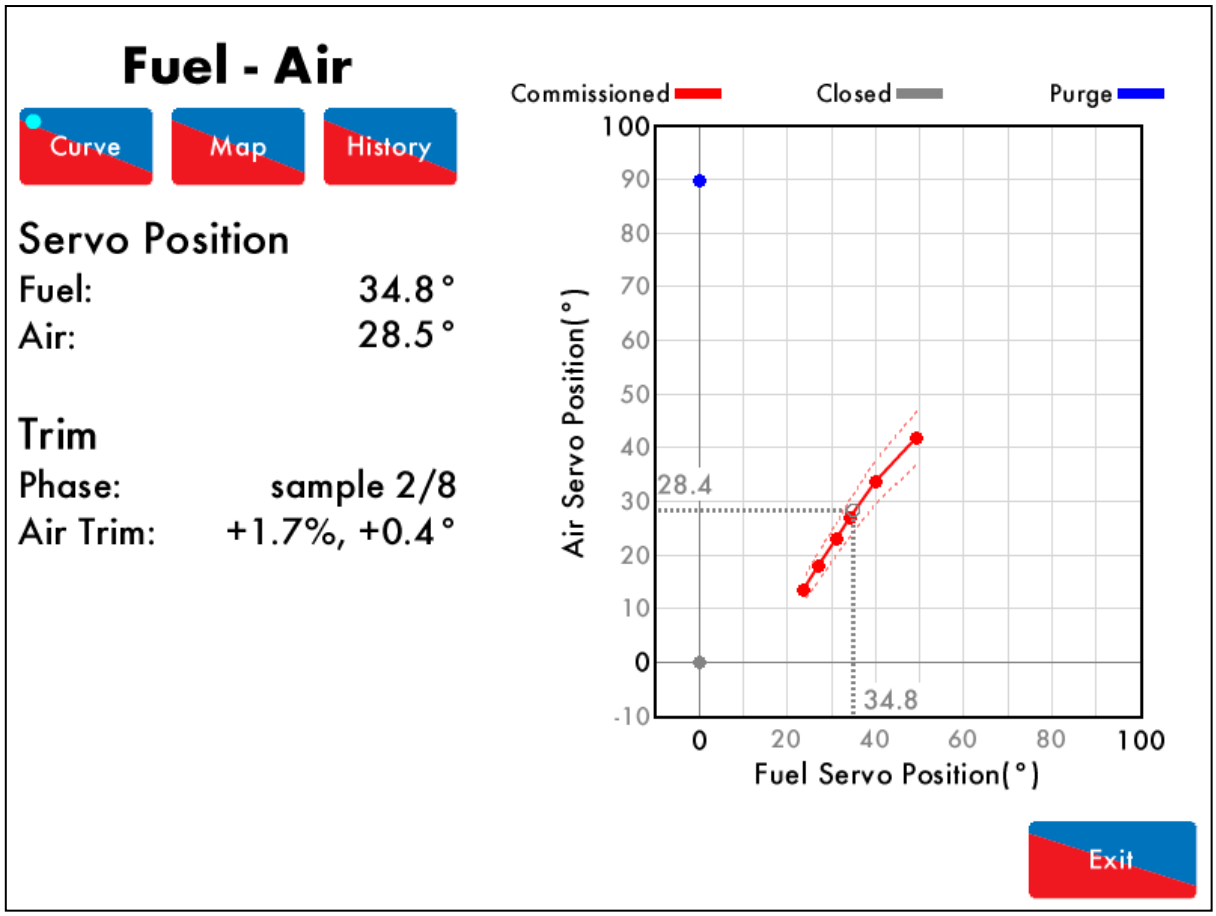


Figure 8.3.1.i Fuel-Air – Curve

Press the flame in the Home screen (Figure 8.1.i) to view the Fuel-Air screen in Figure 8.3.1.i. This shows the fuel valve and air damper angular position, the trim status and the commission curve graph.

8.3.2. Fuel-Air – Map

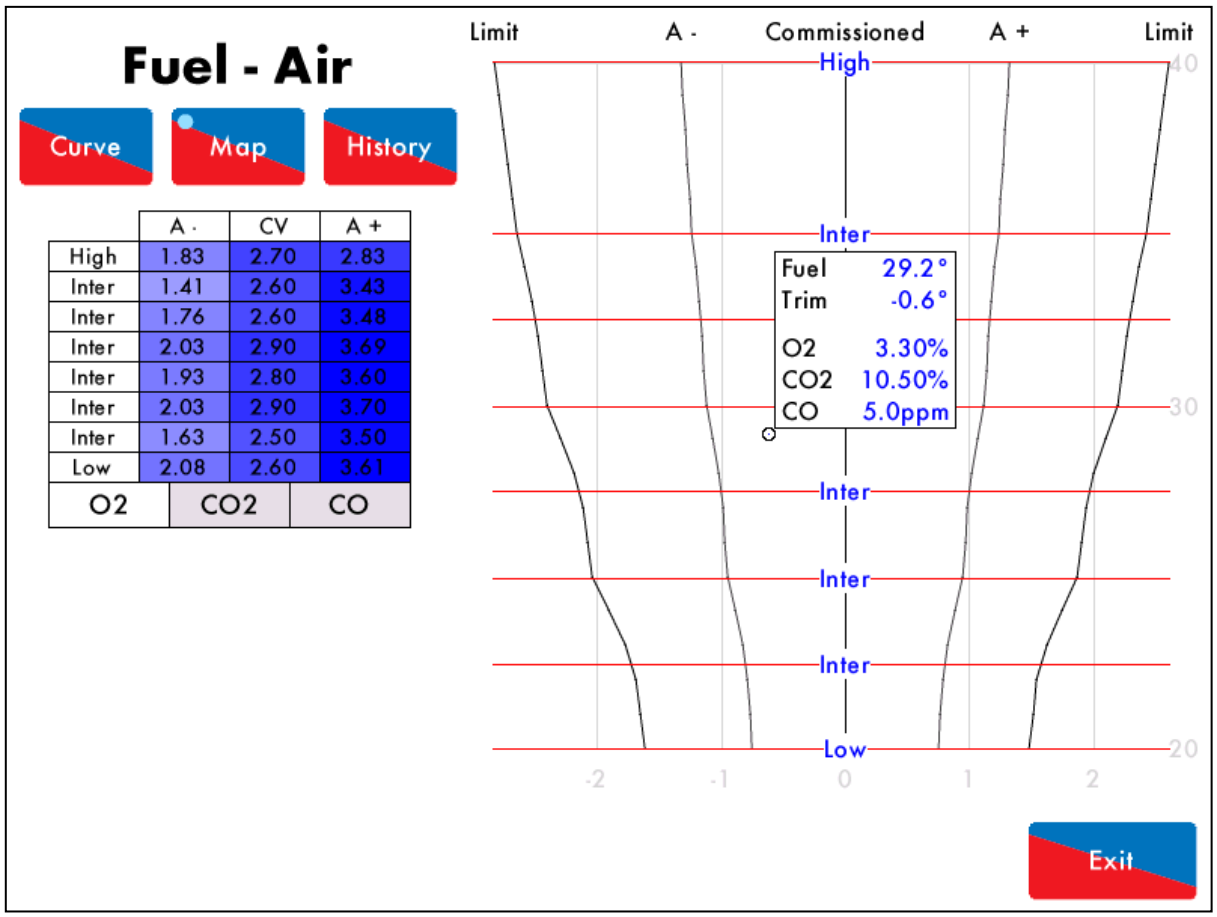


Figure 8.3.2.i Fuel-Air Map

Press 

in the Fuel-Air screen (Figure 8.3.1.i) to view the Fuel-Air Map screen shown in Figure 8.3.2.i. The air-rich and fuel-rich trim values are shown for each commissioned point. The graph shows the EGA's current reading and if there is any trim correction on the air damper. The circle on the fuel-air map indicates the current position of the trim correction, and how far the current combustion values are from the commissioned values.

Option 12 must be set to 2 or 3 for the 3-parameter trim function to be activated.

8.3.3. Fuel-Air – History

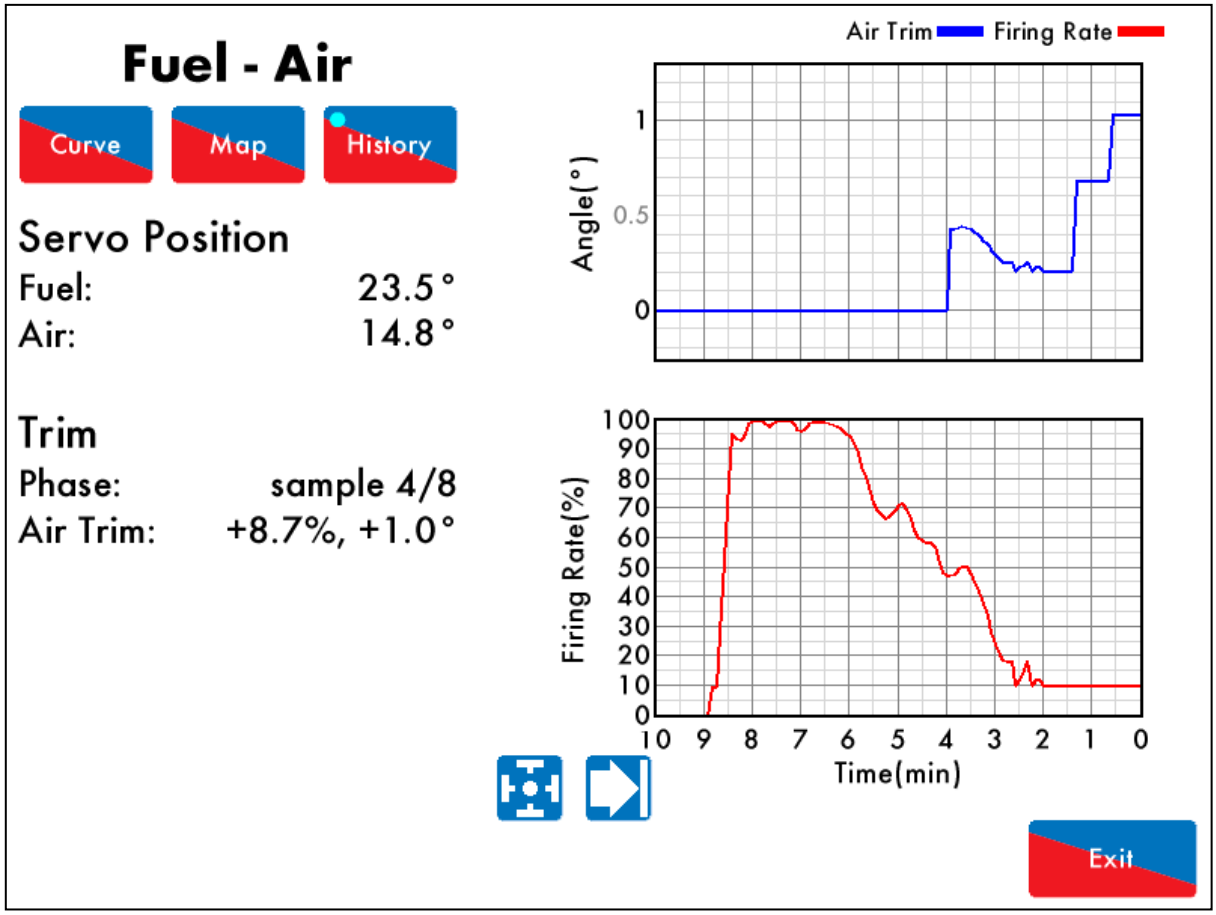


Figure 8.3.3.i Fuel-Air – History

Press 

in the Fuel-Air screen (Figure 8.3.1.i) to view the Fuel-Air History screen in Figure 8.3.3.i. The firing rate and air trim history (if an EGA is optioned for trim) is displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.4. Flame Safeguard Screen

8.4.1. Flame Safeguard

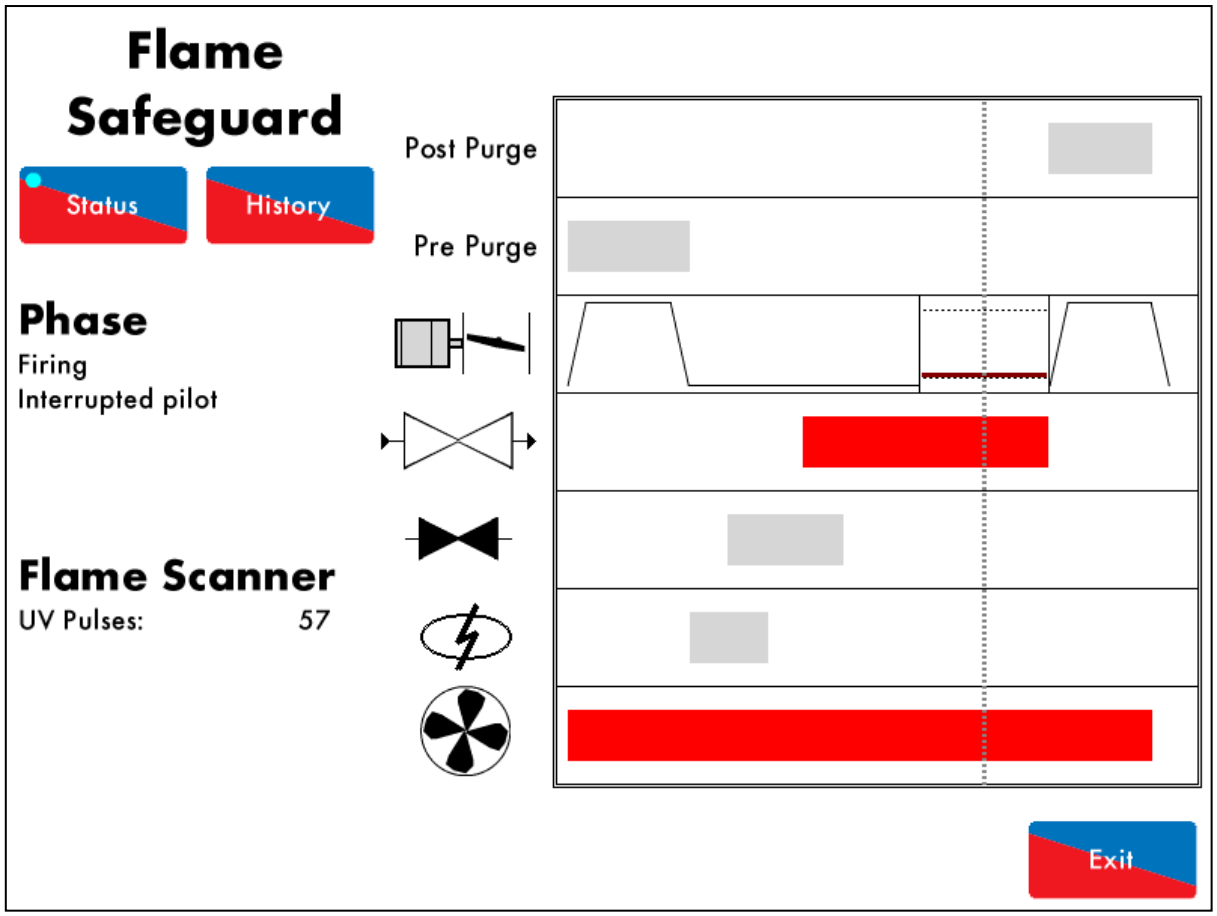


Figure 8.4.1.i Flame Safeguard – Status

Press on the flame detector in the Home screen (Figure 8.1.i) to view the Flame Safeguard screen in Figure 8.4.1.i. 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
- Air damper position
- Main fuel valve
- Pilot valve
- Ignition
- Blower motor

Please refer to section 4 for the start-up sequence of the burner.

8.4.2. Flame Safeguard – History

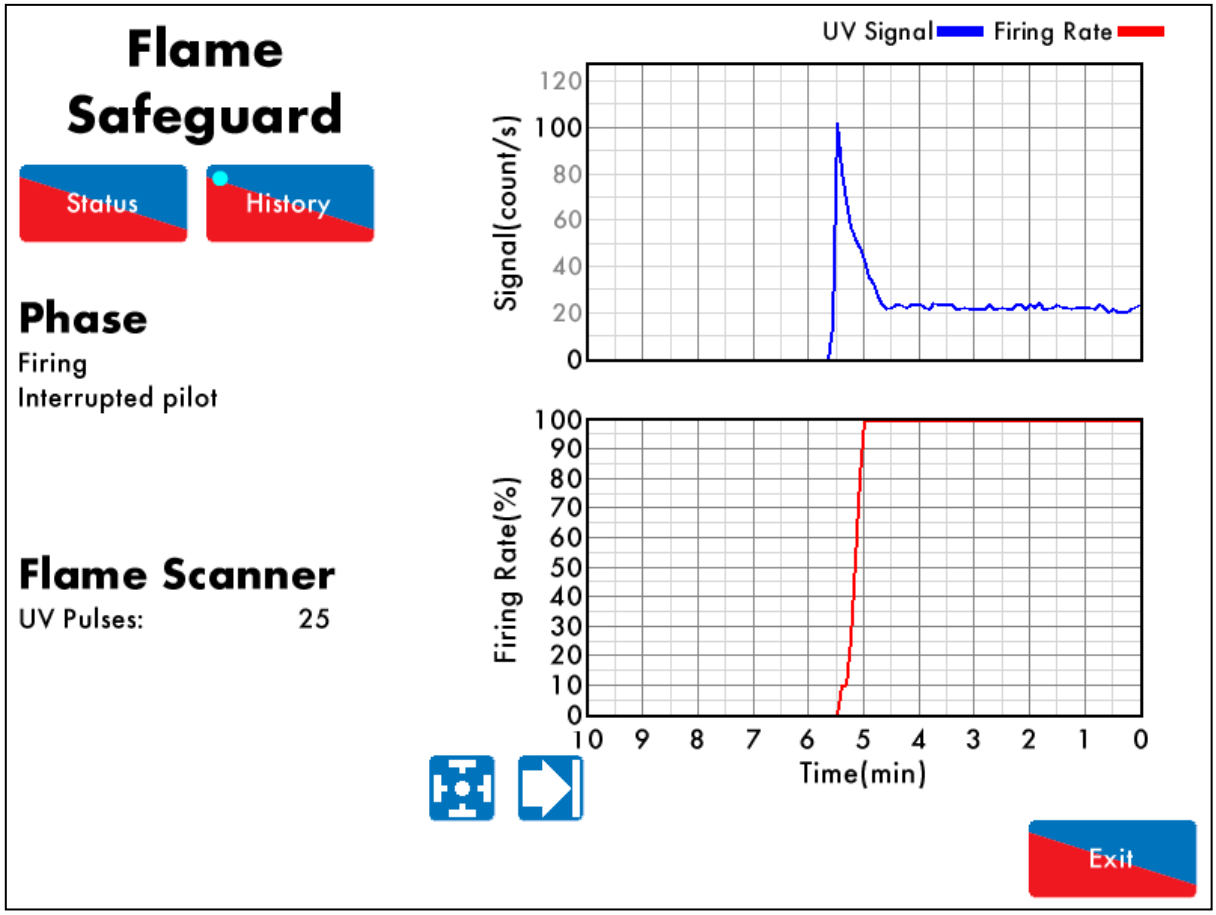


Figure 8.4.2.i Flame Safeguard – History

Press 

in the Flame Safeguard screen (Figure 8.4.1.i) to view Flame Safeguard History screen in Figure 8.4.2.i. The flame scanner signal and firing rate histories are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the Mk8 DTI when connected to the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.5. Channels Screen

8.5.1. Servomotor

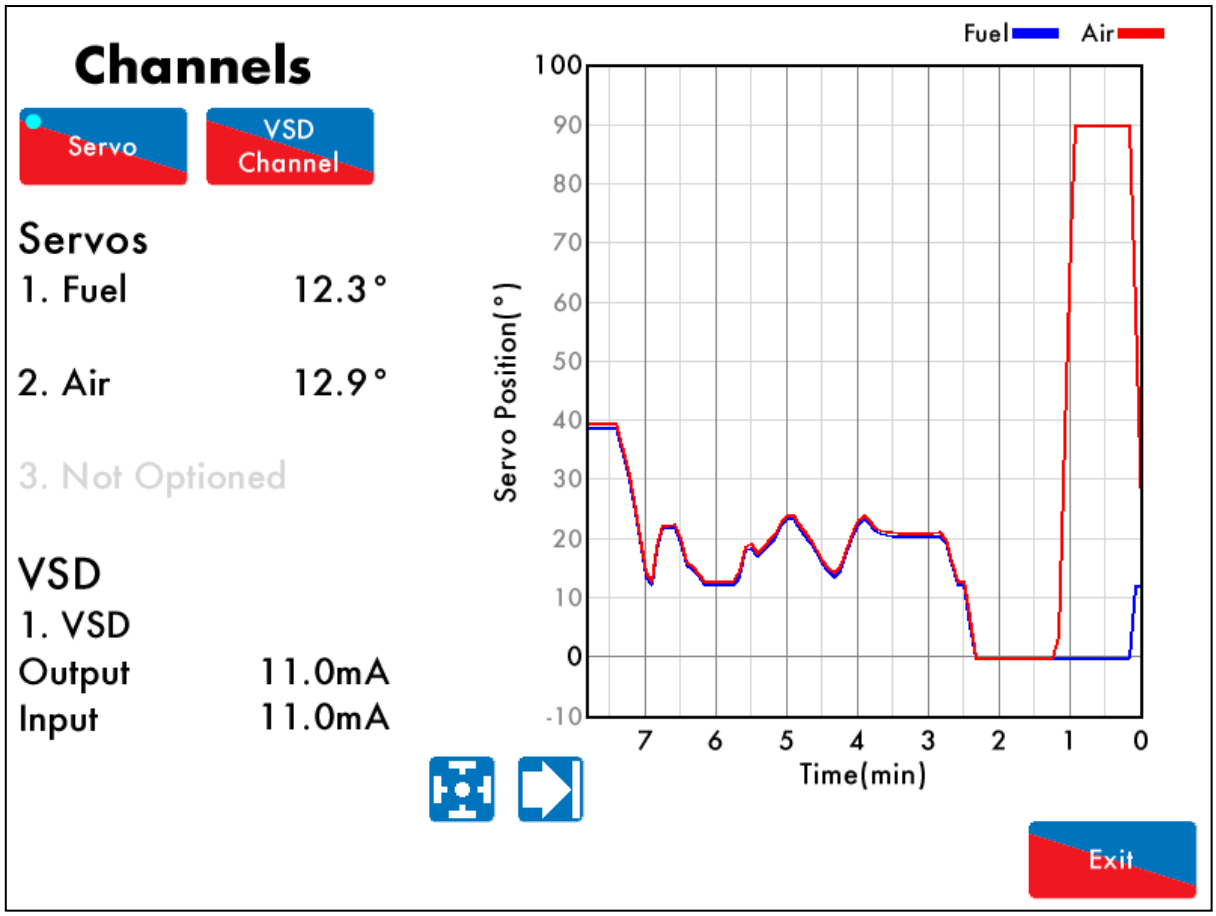


Figure 8.5.1.i Servomotor

Press on the servomotor or VSD in the Home screen (Figure 8.1.i) to view Channel screen in Figure 8.5.1.i. The following information is shown:

- Current fuel and air servomotor positions
- VSD output and input

This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the Mk8 DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.5.2. VSD Channel

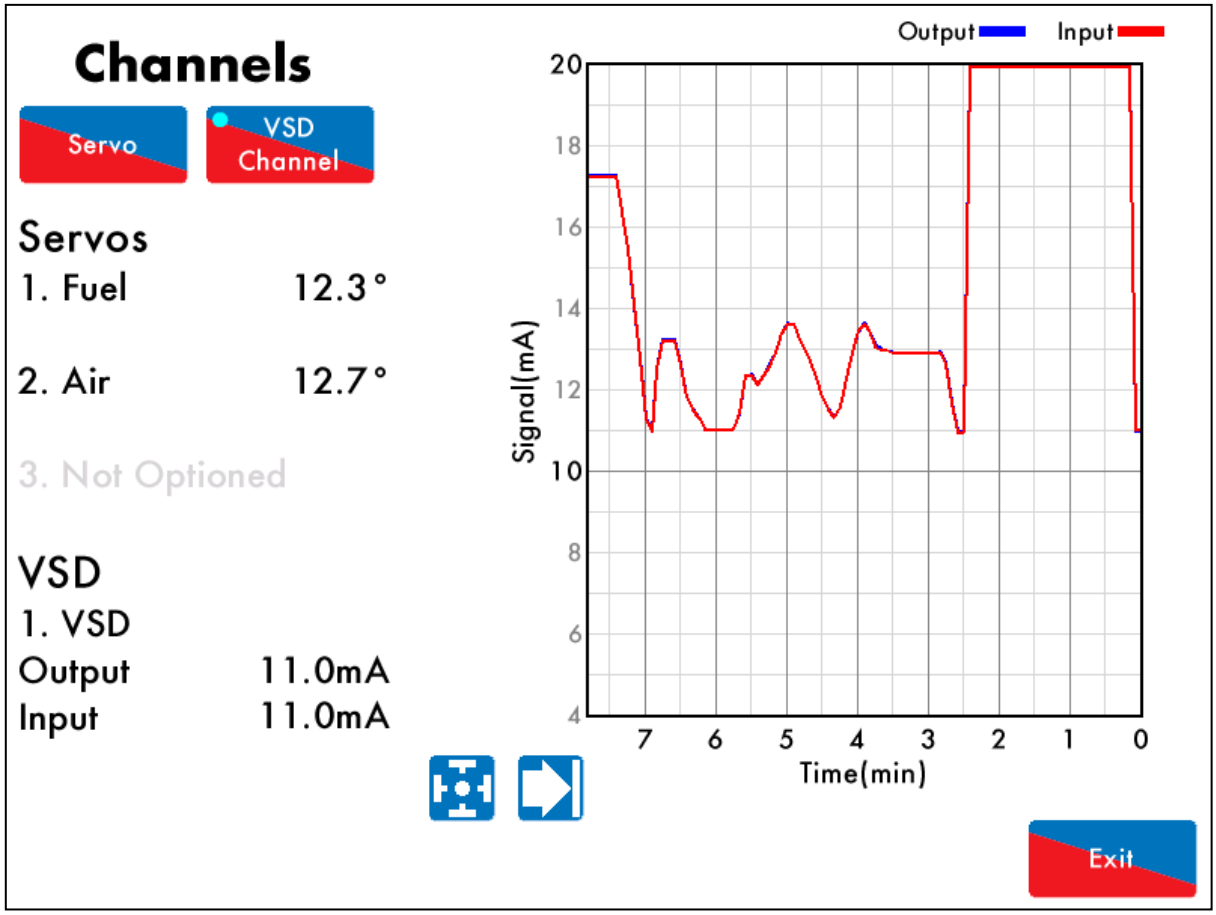


Figure 8.5.2.i VSD Channel

Press 

on the Channels screen (Figure 8.5.1.i) to view the VSD Channel screen in Figure 8.5.2.i. The VSD output and input signal histories are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the Mk8 DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.6. Gas Pressure Sensor Screen

8.6.1. Gas Pressure

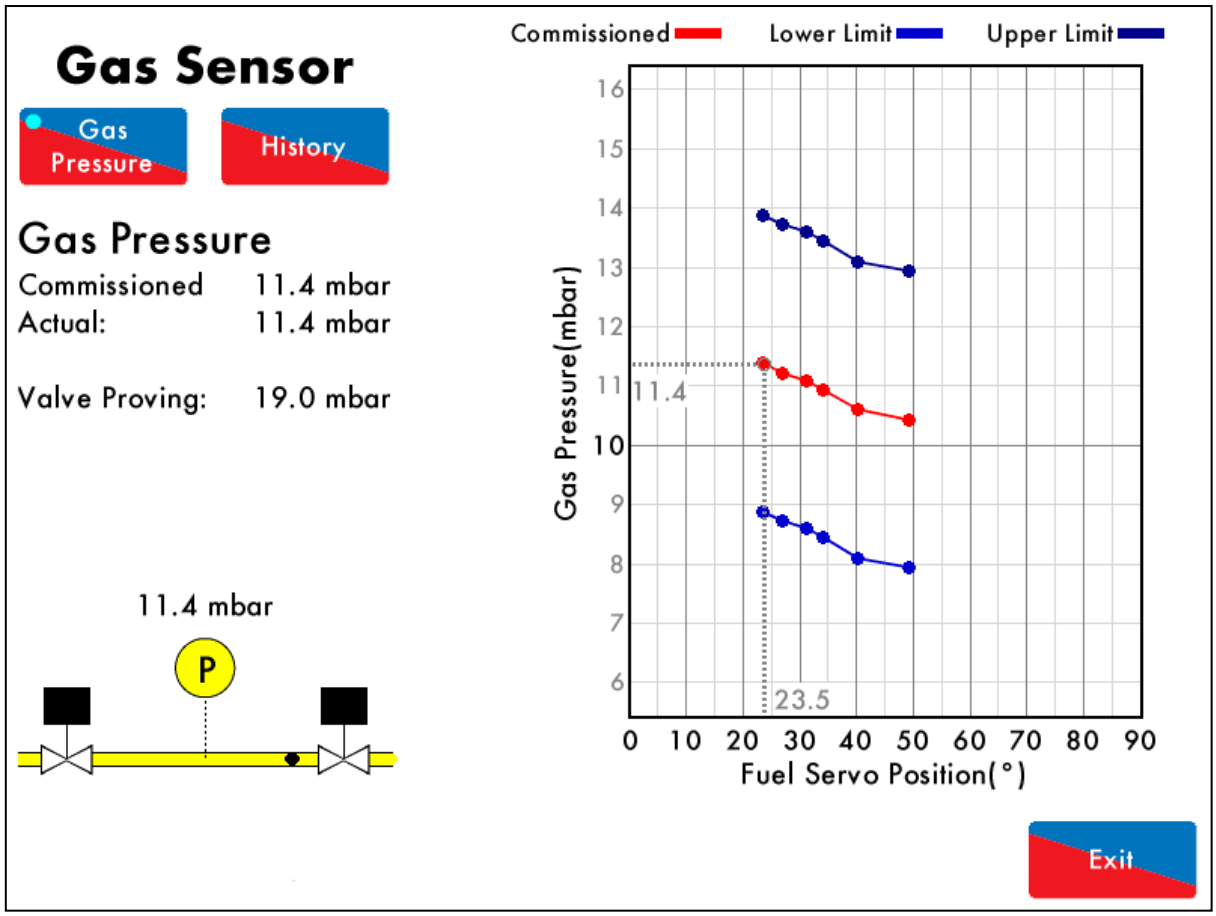


Figure 8.6.1.i Gas Pressure

Press on the gas pressure sensor in the Home screen (Figure 8.1.i) to view the Gas Pressure screen in Figure 8.6.1.i. The following information is displayed:

- Commissioned gas pressure
- Actual (current) gas pressure detected
- Valve proving gas pressure
- Status of main gas and vent valves
- Upper/lower gas pressure limits for the fuel servomotor positions

8.6.2. Gas Sensor – History

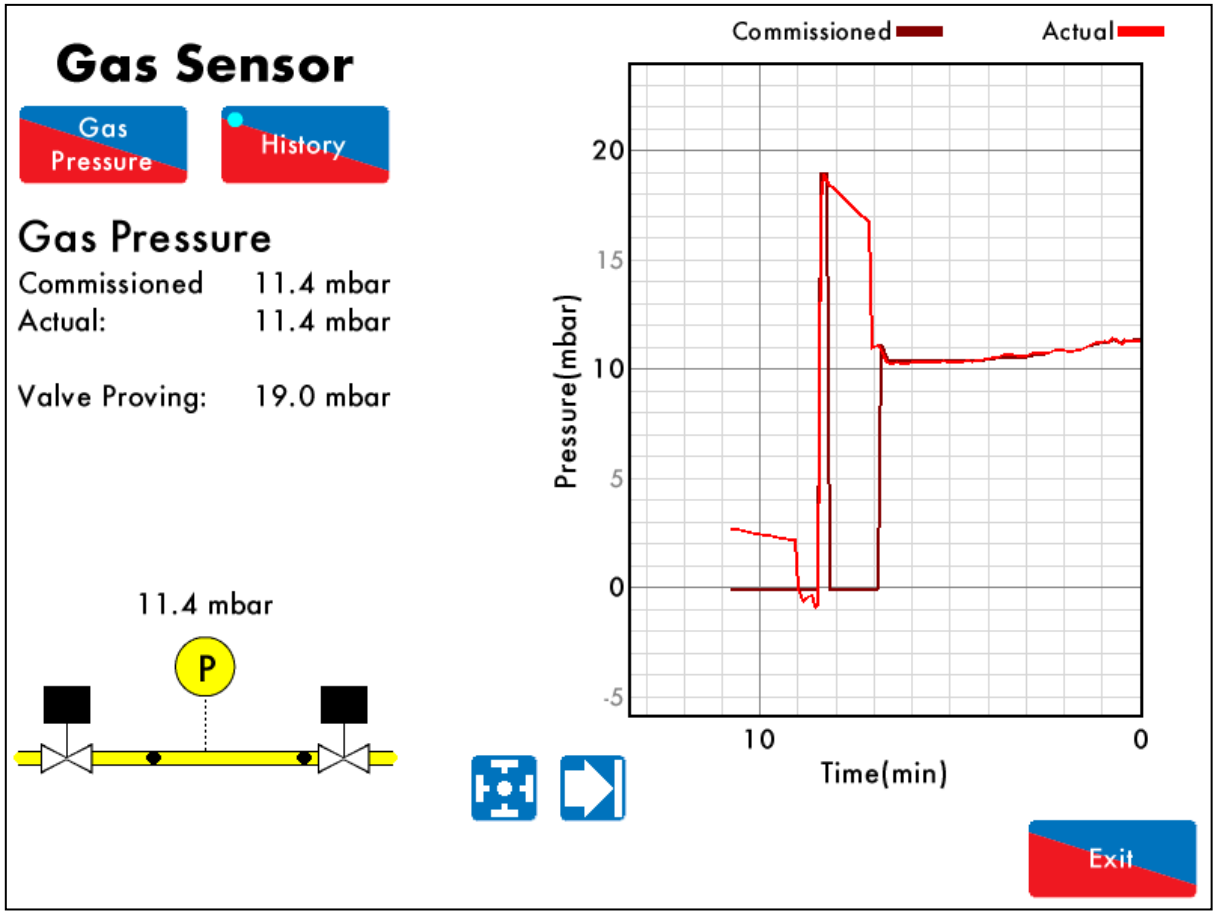


Figure 8.6.2.i Gas Sensor – History

Press History in the Gas Pressure screen (Figure 8.6.1.i) to view the Gas Pressure History screen in Figure 8.6.2.i. The commissioned and actual gas pressure histories are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.7. Air Pressure Sensor Screen

8.7.1. Air Pressure

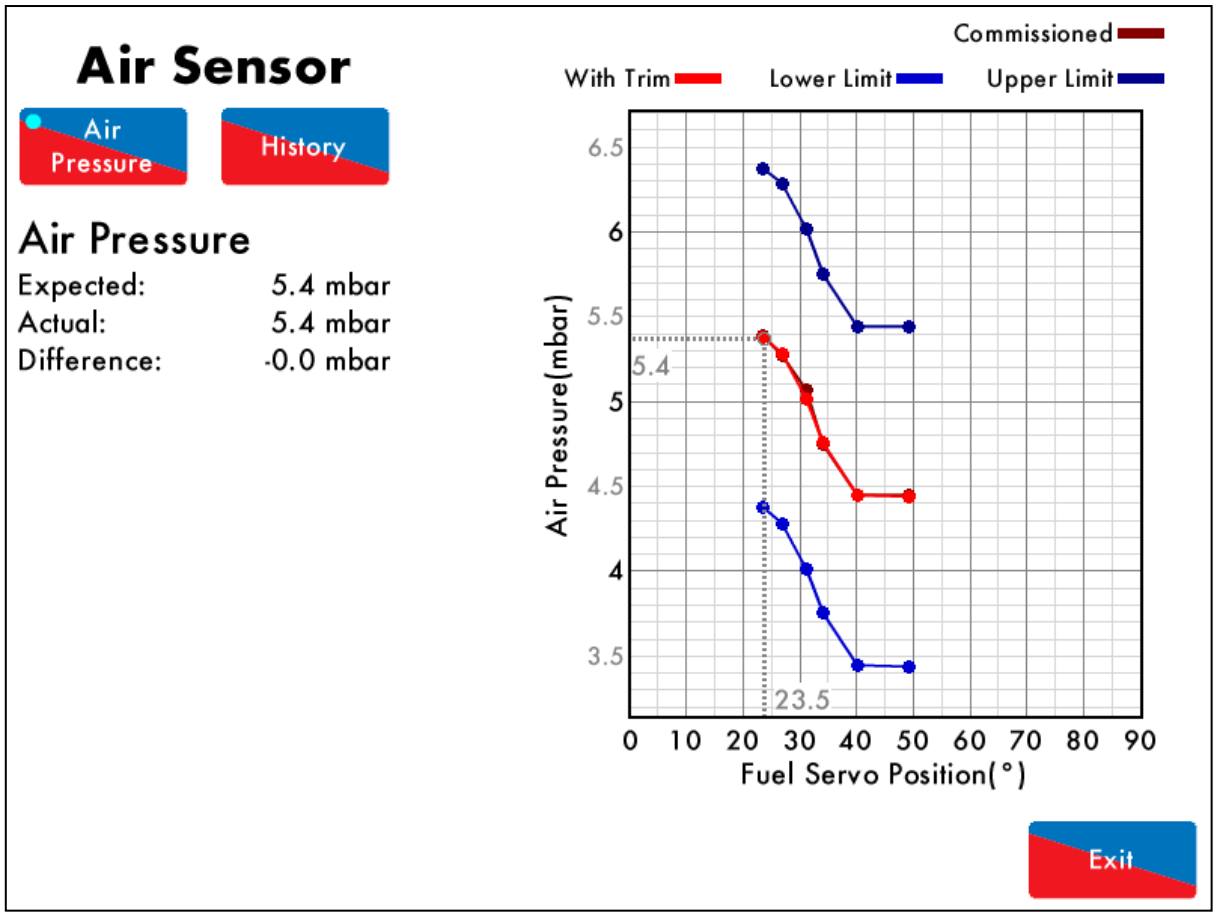


Figure 8.7.1.i Air Pressure

Press on the air pressure sensor in the Home screen (Figure 8.1.i) to view the Air Pressure screen in Figure 8.7.1.i. The expected air pressure, actual air pressure, and the difference between the expected and the actual air pressure values are displayed.

The graph shows the commissioned air pressure and its upper/ lower limits for the fuel servomotor positions, as well as the air pressure values with trim added on the air damper.

If commissioned with an EGA, the air pressure is stored during trim. The red line of air pressure is then displayed to take into account the deviation in the air from the brown commissioned line on the graph.

8.7.2. Air Sensor – History

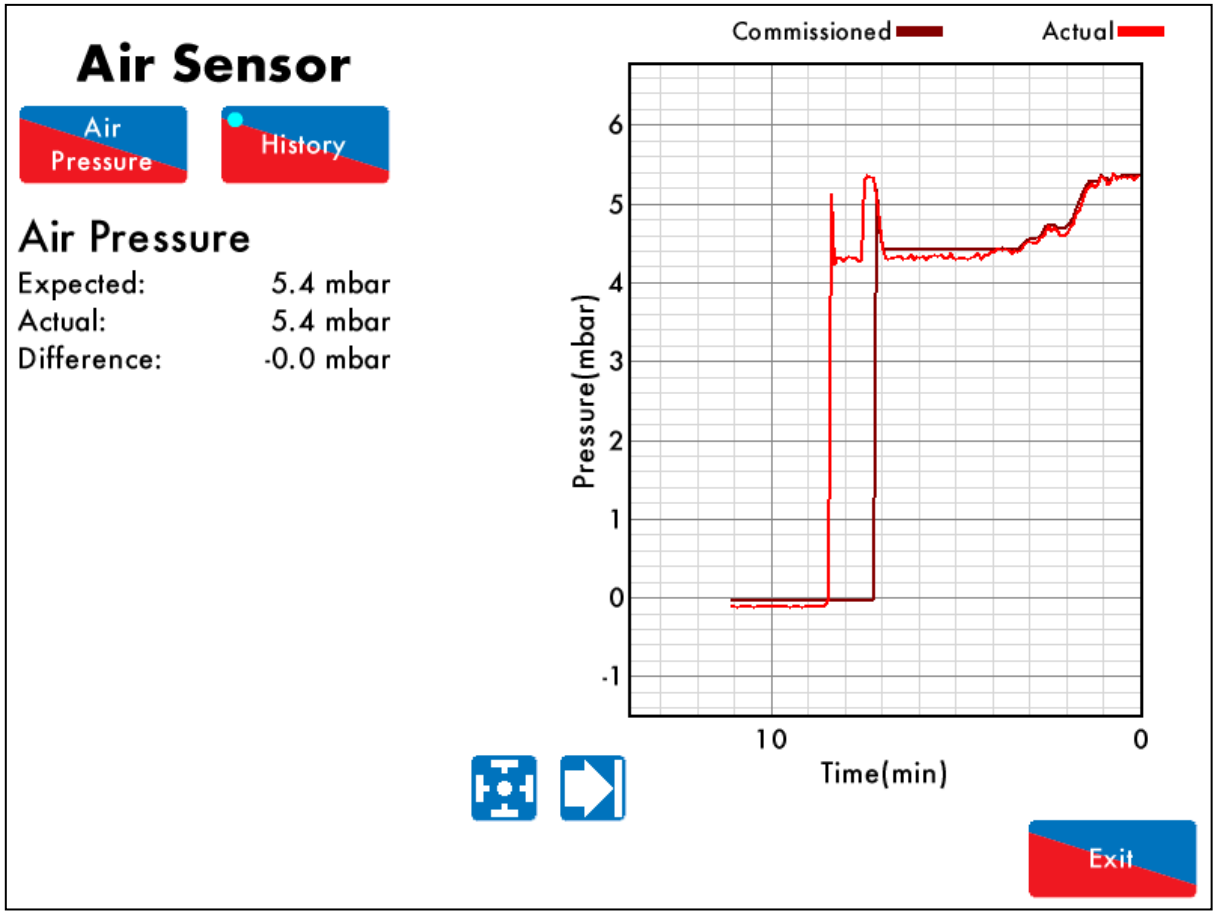


Figure 8.7.2.i Air Sensor – History

Press 

on the Air Pressure screen (Figure 8.7.1.i) to view the Air Pressure History in Figure 8.7.2.i. The commissioned and actual air pressure histories are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.8. Fuel Flow Screen

8.8.1. Fuel Flow

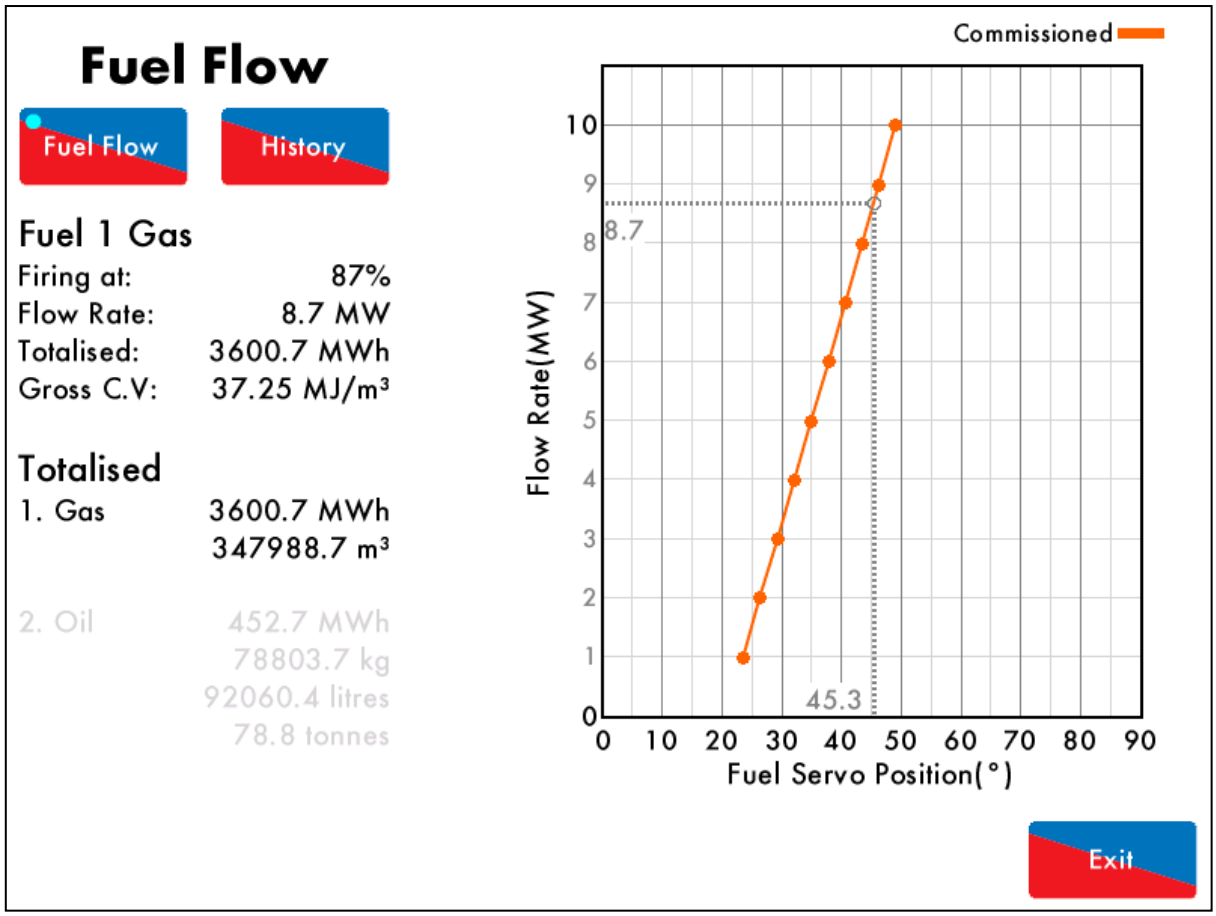


Figure 8.8.1.i Fuel Flow

Press the gas/oil pipe in the Home screen (Figure 8.1.i) to view the Fuel Flow screen in Figure 8.8.1.i. The following information is shown:

- Current firing rate
- Current fuel flow
- Gross calorific value of the fuel
- Totalised fuel flow
- Totalised fuel used

8.8.2. Fuel Flow – History

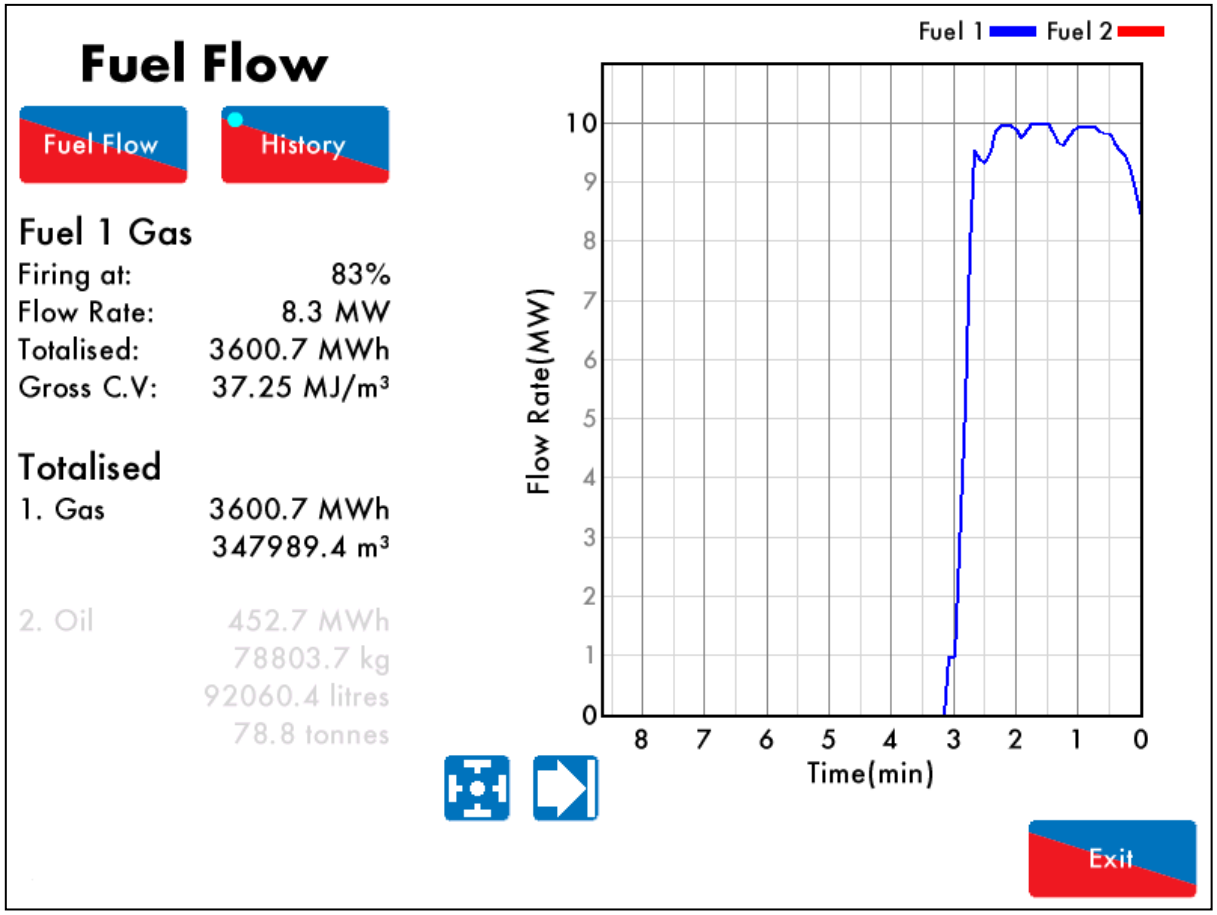


Figure 8.8.2.i Fuel Flow – History

Press 

in the Fuel Flow screen in Figure 8.8.1.i to view the Fuel Flow History in Figure 8.8.2.i. The fuel flow rate history is displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.9. Sequencing Screen

8.9.1. IBS – Sequencing

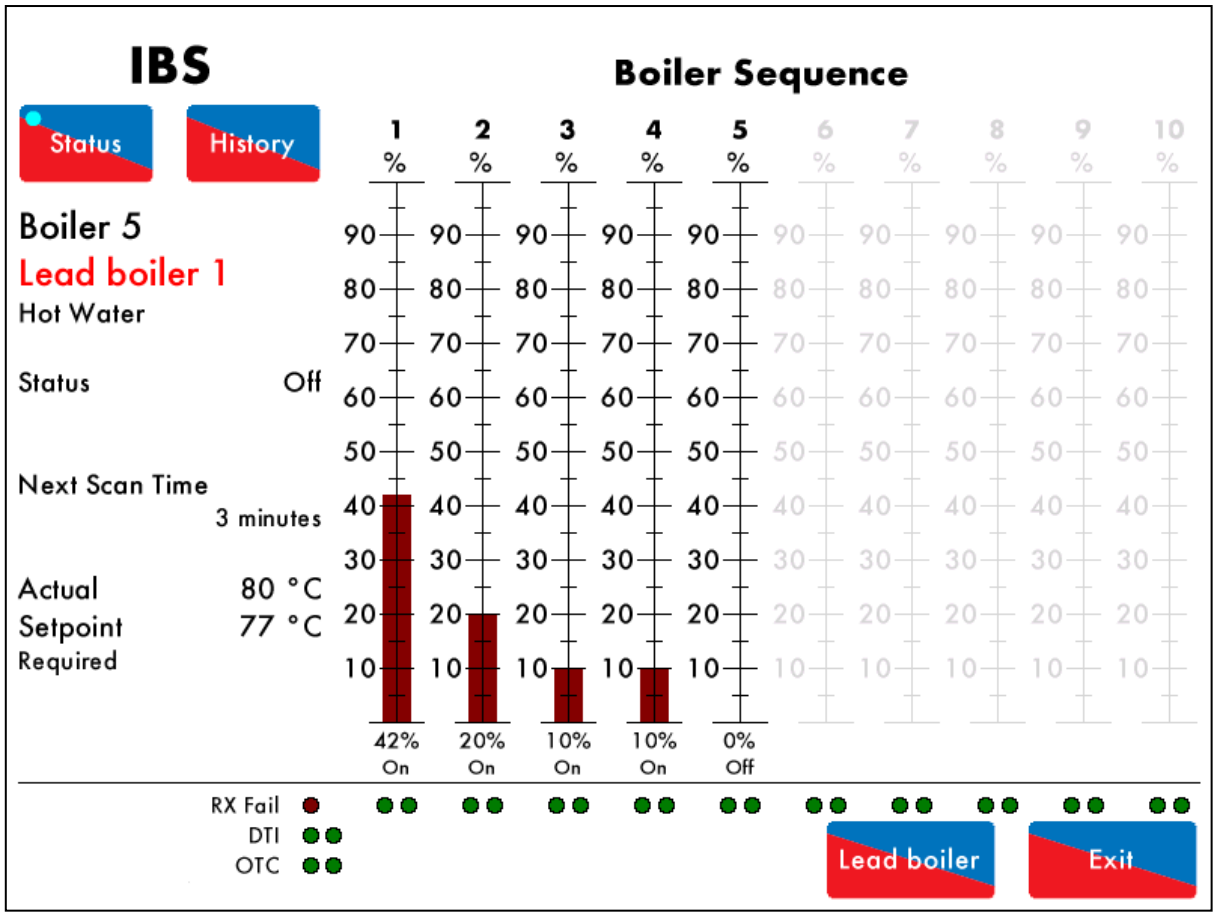


Figure 8.9.1.i IBS – Status

Press on the IBS box in the Home screen (Figure 3.1.i) to view the IBS Status screen in Figure 8.9.1.i. The following information is displayed:

- ID number of the MM
- Lead boiler
- Type of sequencing (steam/hot water)
- Current status
- Next scan time
- Actual temperature/pressure
- Required setpoint
- Number of MMs in the sequencing loop
- Current firing rates of all the MMs in the loop
- Current status of all the MMs in the loop
- Sequencing communications check

Note: To display the sequencing communications diagnostics as shown above, parameter 83 must be set to 1.

Pressing on the bars of MMs which are offline will give more information on why it has been removed from the sequencing loop.

8.9.2. IBS – Lead Boiler

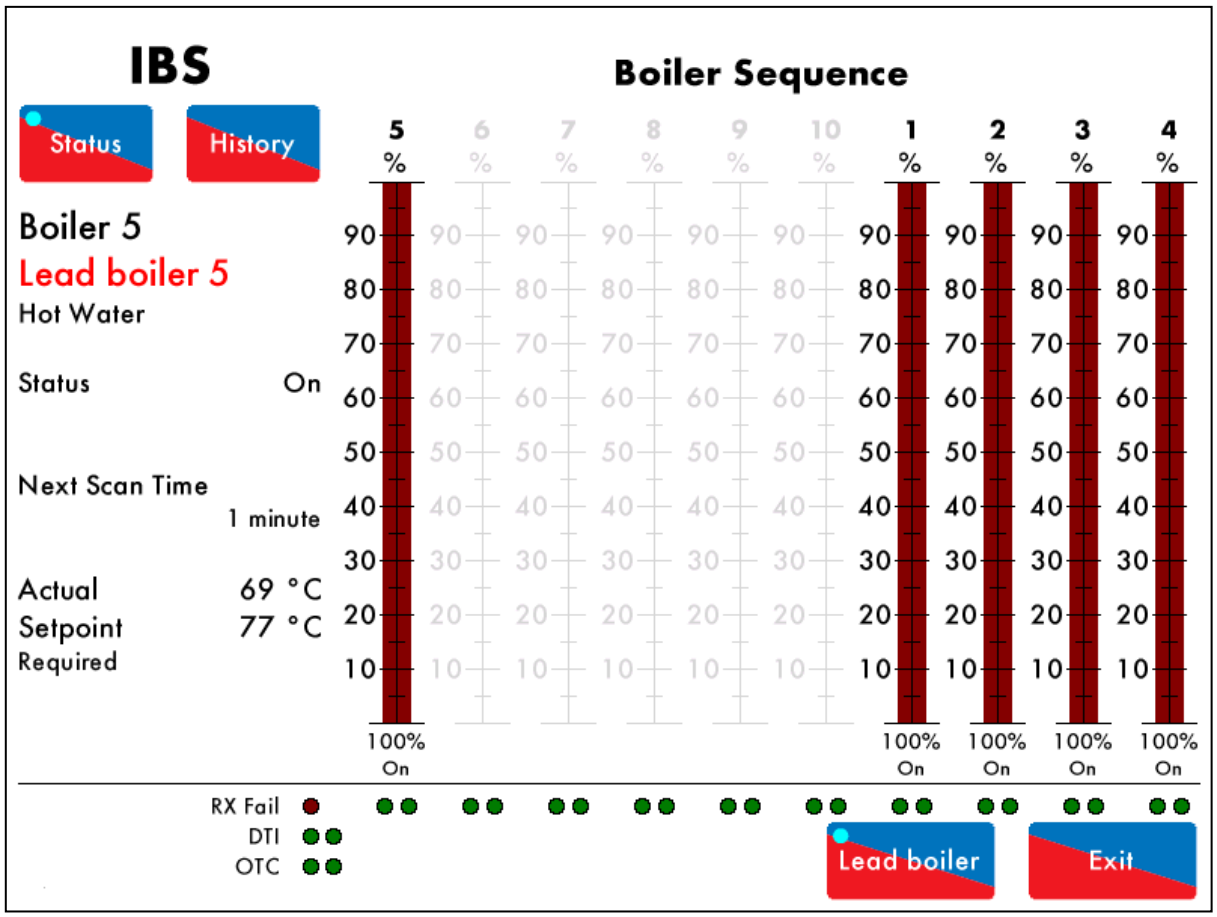


Figure 8.9.2.i IBS – Lead Boiler

Press 

in the IBS Status screen (Figure 8.9.1.i) to select that MM as the lead boiler.

Note: If another MM has already been selected as lead boiler, or no boilers have been selected as lead boiler, then the MMs will fire independently until one lead boiler has been selected.

8.9.3. IBS – History

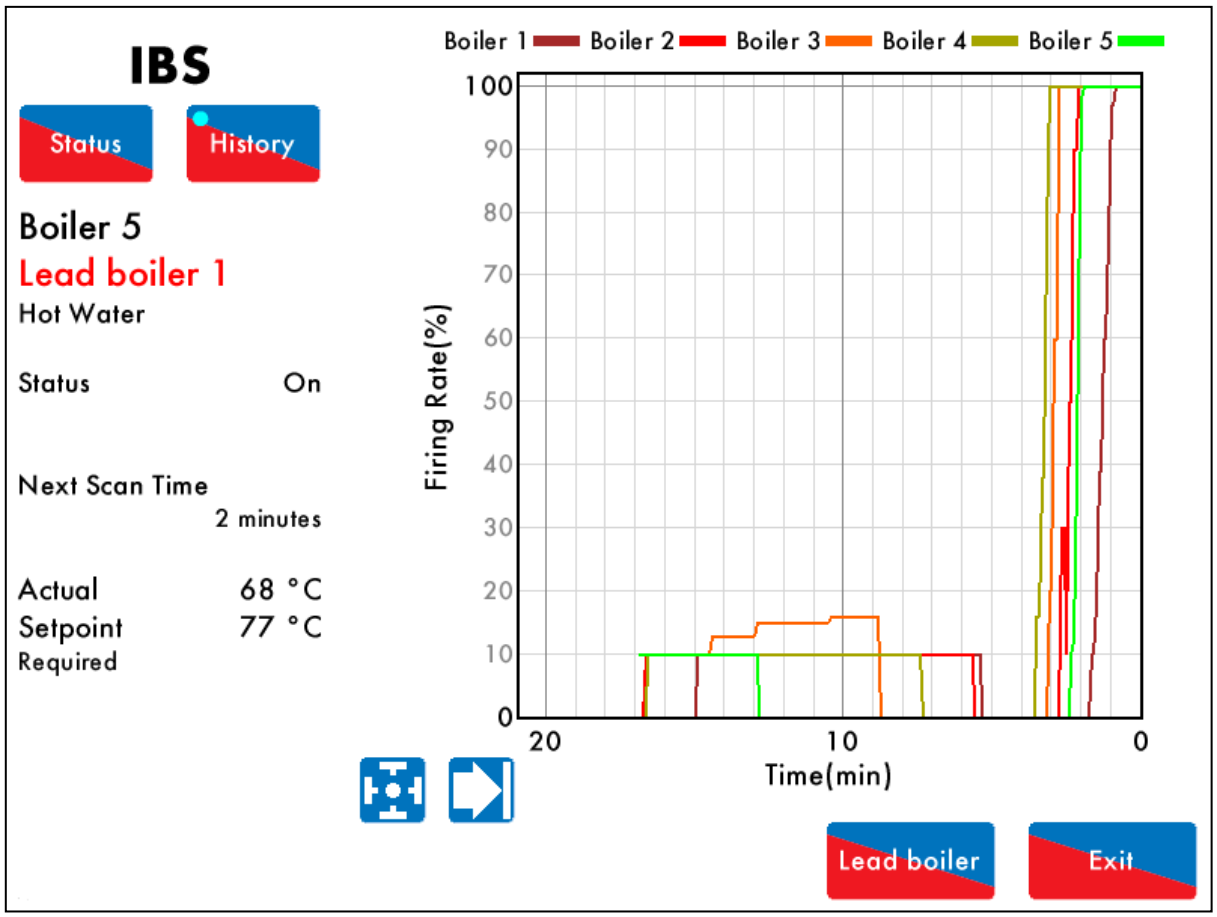


Figure 8.9.3.i IBS – History

Press 

in the IBS – Status screen (Figure 8.9.1.i) to view IBS History screen in Figure 8.9.3.i. The firing rate histories for the MMs in the sequencing loop are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.10. EGA Screen

8.10.1. EGA – Gas

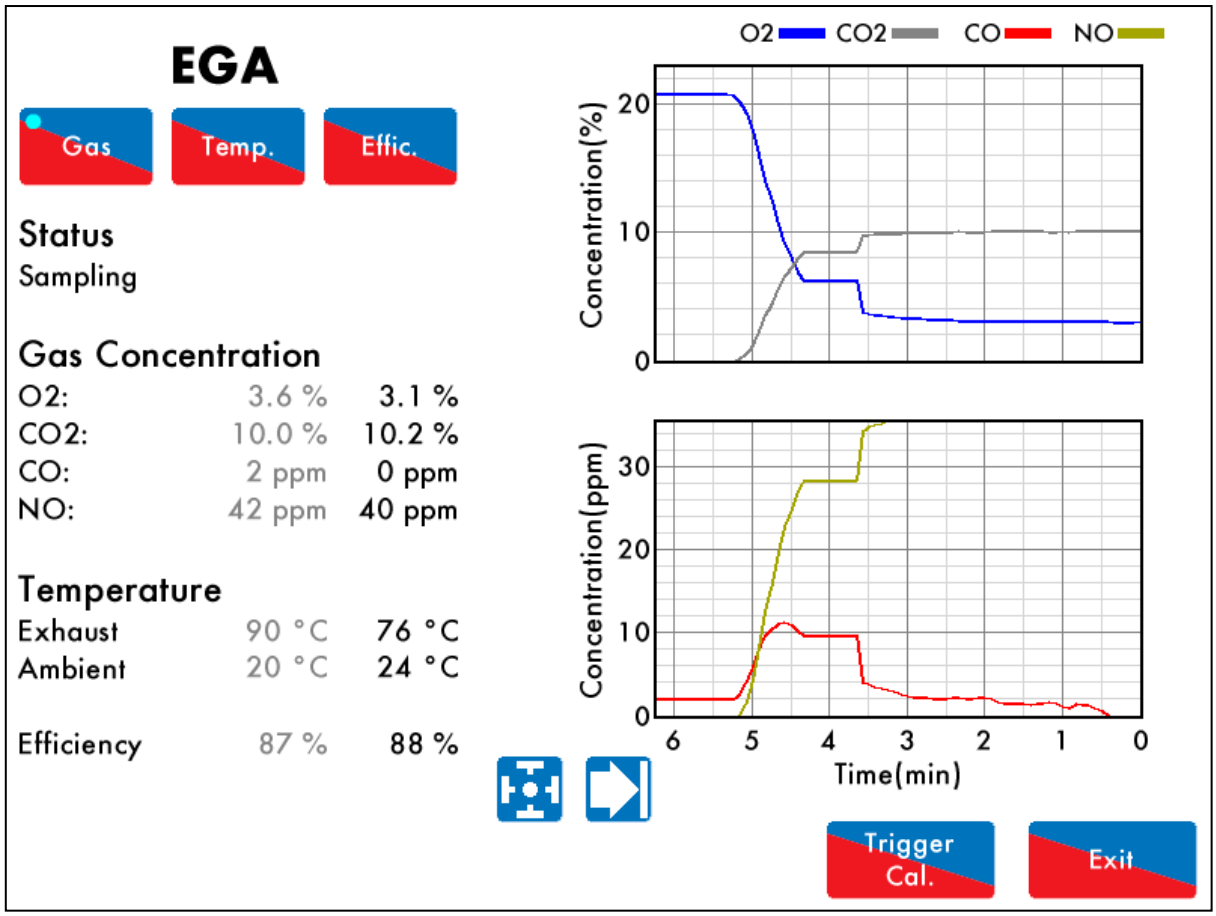


Figure 8.10.1.i EGA – Gas

Press the EGA box in the Home screen (Figure 8.1.i) to view the EGA Gas screen in Figure 8.10.1.i. The following information is displayed:

- EGA status
- Commissioned exhaust gases, temperature and efficiency values (in grey)
- Current exhaust gases, temperature and efficiency values (in black)

This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

Press 

to force the EGA into a calibration when it is next in a safe condition, such as not trimming and not calibrating.

8.10.2. EGA – Temperature

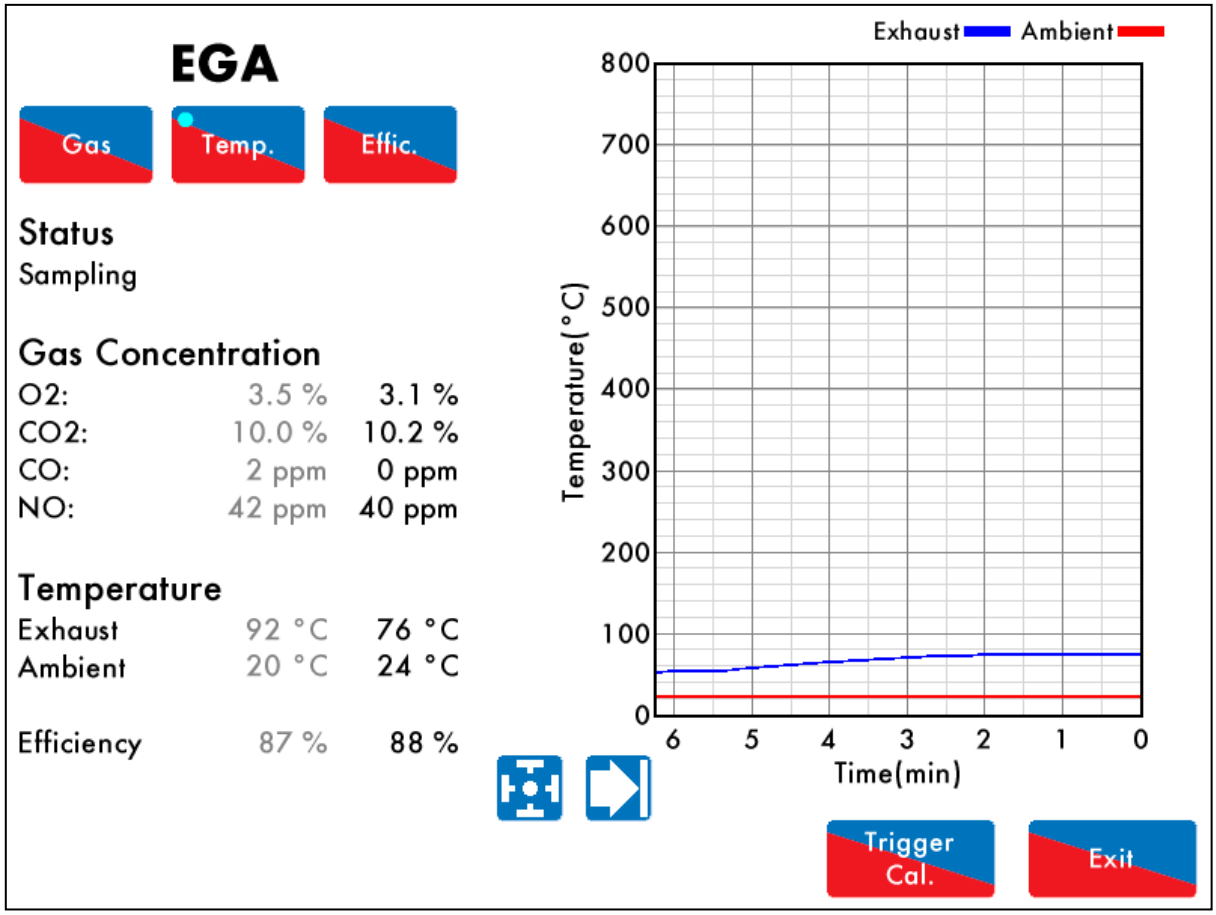


Figure 8.10.2.i EGA – Temperature

Press 

in the E.G.A Gas screen (Figure 8.10.1.i) to view EGA Temperature screen in Figure 8.10.2.i.The exhaust and ambient temperature histories are displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.10.3. EGA – Efficiency

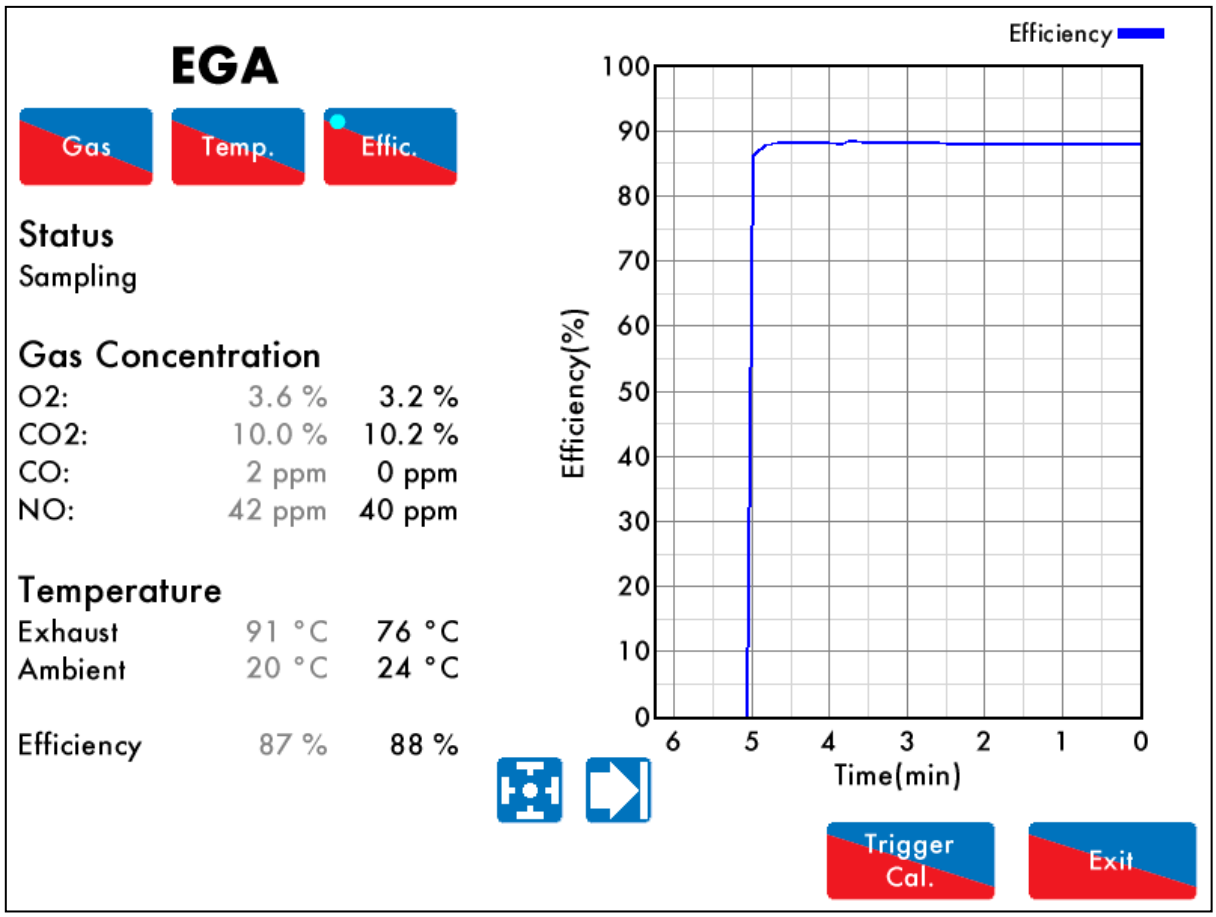


Figure 8.10.3.i EGA – Efficiency

Press 

in the EGA Gas Screen (Figure 8.10.1.i) to view the EGA Efficiency screen in Figure 8.10.3.i. The combustion efficiency history is displayed. This data is logged for 24 hours on the MM.

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

This information is logged for 3 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset this data log.

8.11. Outside Temperature Compensation Screen

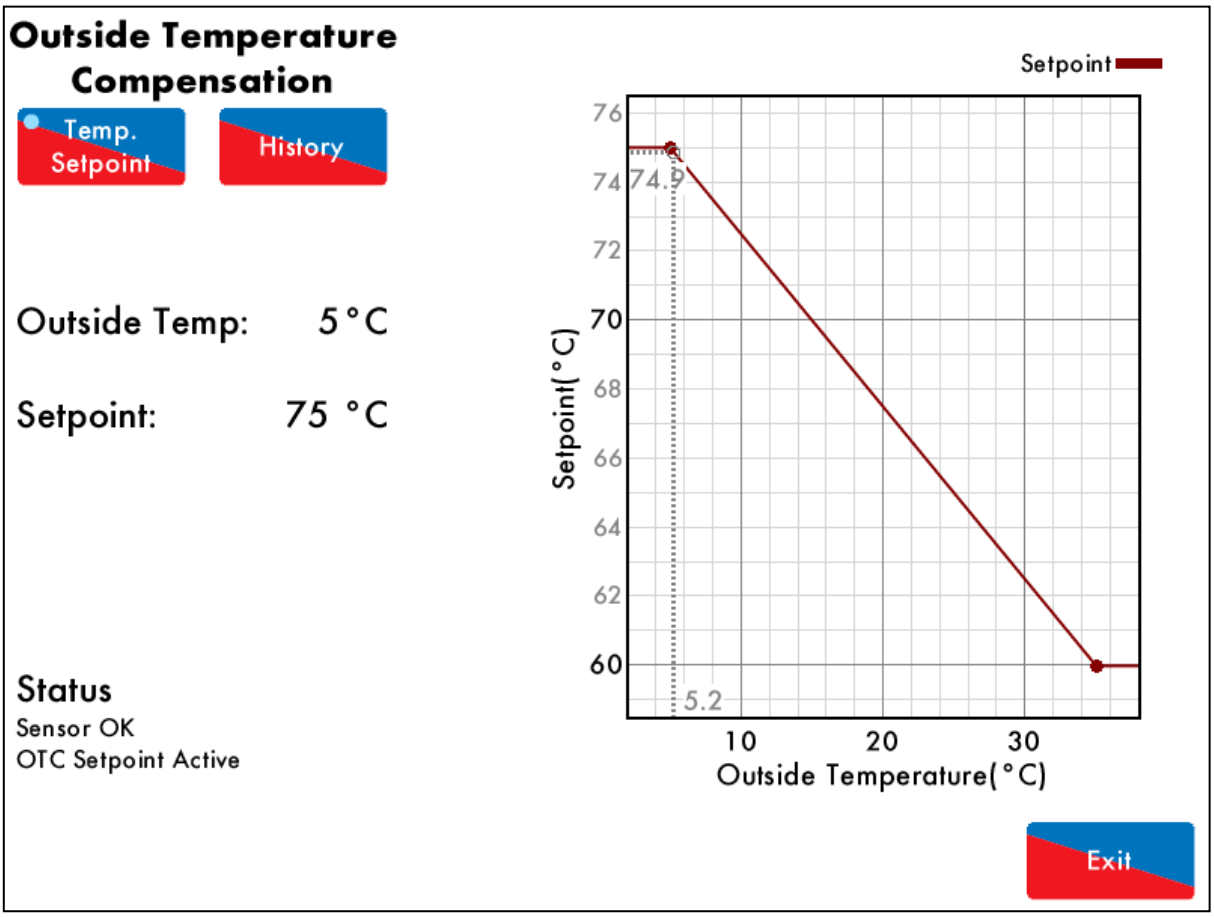


Figure 8.11.i OTC – Temperature, Setpoint

Press on the outside temperature sensor in the Home screen (Figure 8.1.i) to view the Outside Temperature Compensation screen in Figure 8.11.i The following information is displayed:

- Current outside temperature
- Current required setpoint
- Status of the OTC sensor
- Status of the OTC required setpoint

Press 

in the Outside Temperature Compensation screen (Figure 8.11.i) to view the Outside Temperature Compensation History. The outside temperature and setpoint history are stored on the MM for 24 hours.

Note: Power cycling the MM or changing fuel will reset this data log.

8.12. System Configuration Screen

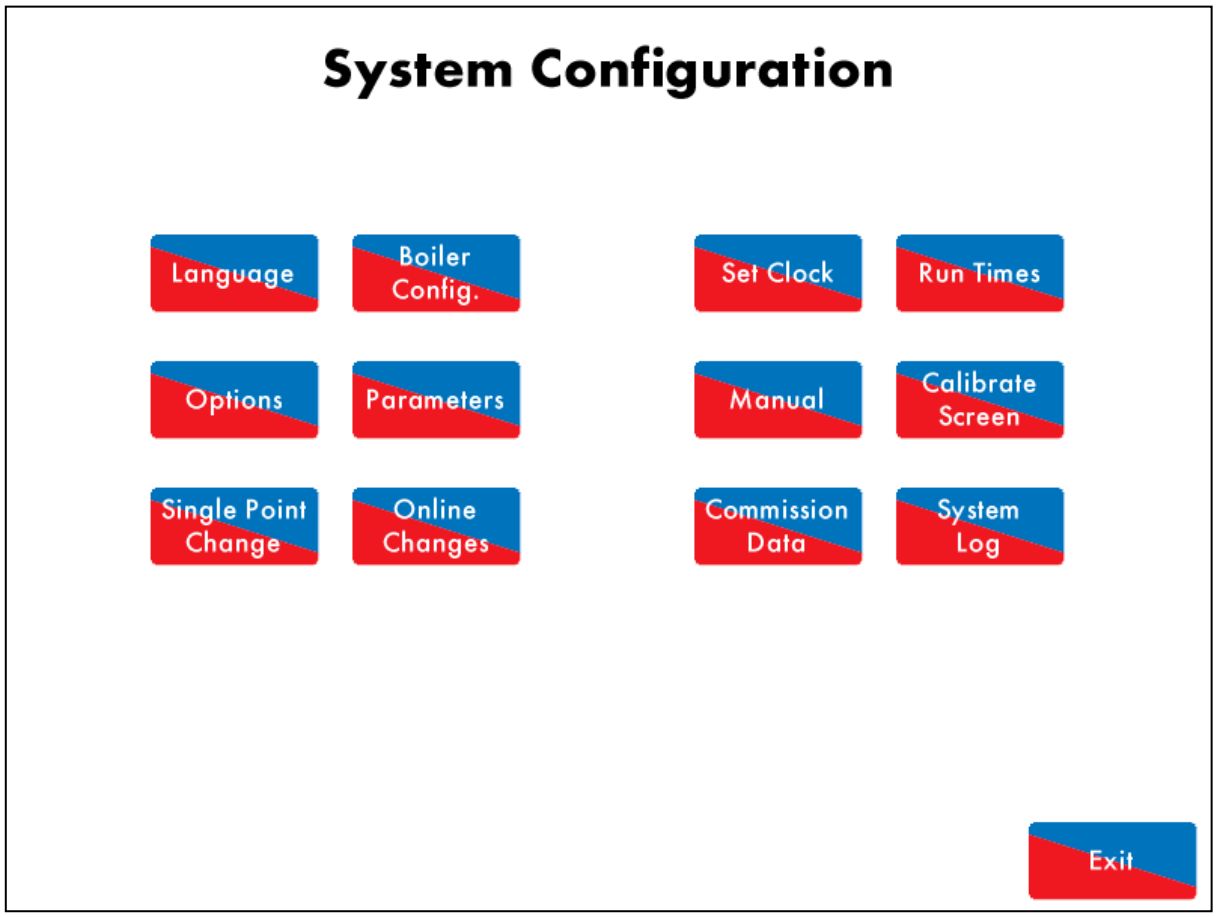


Figure 8.12.i System Configuration

Press 

in the Home screen (Figure 8.1.i) to view the System Configuration screen in Figure 8.12.i. In System Configuration, it is possible to view or make changes to the following:

- Language (password protected)
- Boiler Configuration displayed (password protected)
- View all Options/Parameters
- Online Changes (password protected)
- Single Point Change (password protected)
- Clock (password protected)
- Run Times (password protected)
- Manual
- Commission Data
- System Log
- Calibrate Screen

8.12.1. Language



Figure 8.12.1.i Language

Press 

in the System Configuration screen (Figure 8.12.i) to view the Language screen in Figure 8.12.1.i. You will be prompted to enter a password. Select the language to be displayed and press 

.

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

Note: The Online Changes password is used to access the Language selection screen. Please contact your local Autoflame approved tech centre for this password.

8.12.2. Boiler Configuration Screen

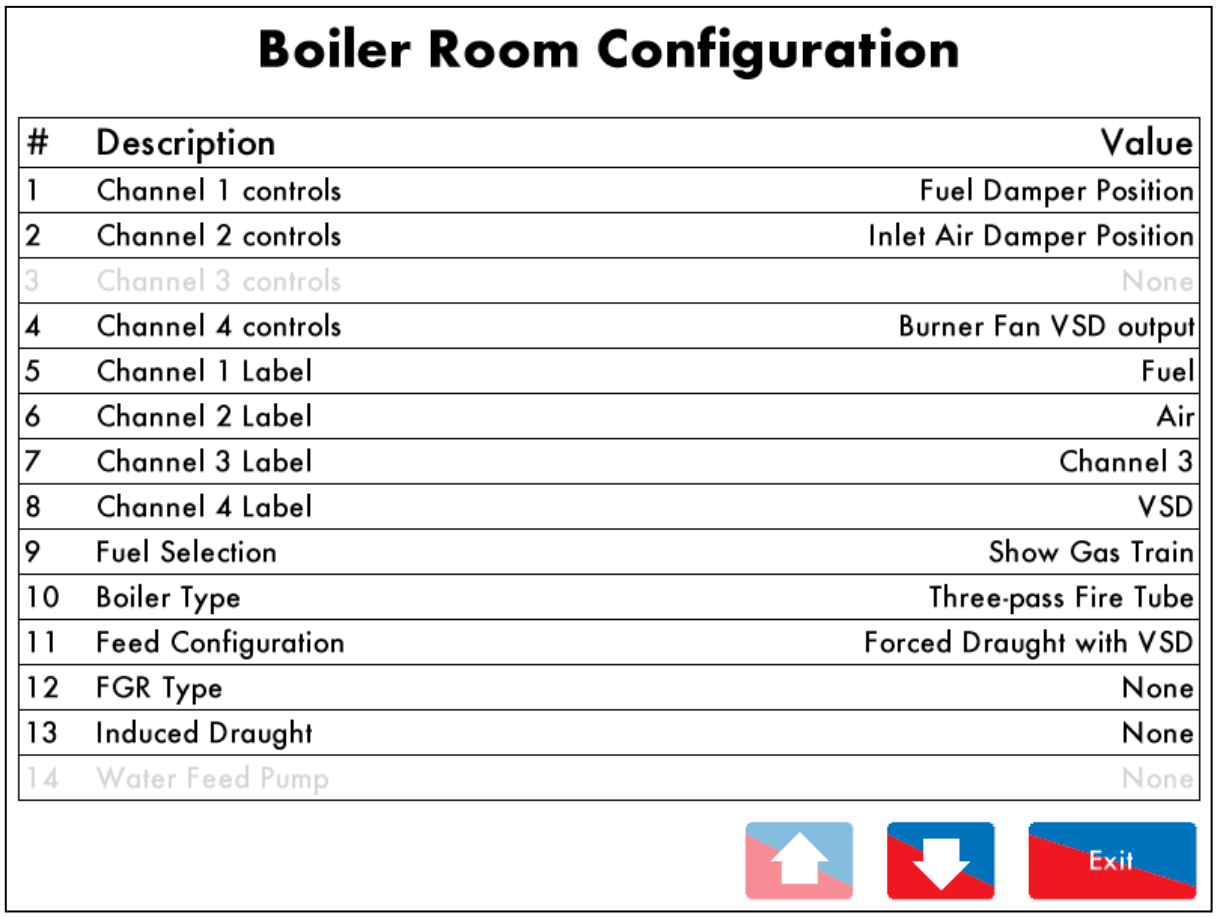


Figure 8.12.2.i Boiler Room Configuration

Press 

in the System Configuration screen (Figure 8.12.i) to view the Boiler Configuration screen in Figure 8.12.2.i. You will be prompted to enter the password. It is possible to set up the boiler display shown in the Home screen. Once the settings have been configured to show how the boiler is setup, press 

.

Note: The Online Changes password is used to access the Boiler Configuration selection screen. Please contact your local Autoflame approved tech centre for this password.

The table below shows the available Boiler Configuration settings.

Setting	Description	
1	Channel 1 Controls	
Fuel damper position		
2	Channel 2 Controls	
None		Draught air damper position
Inlet air damper position		Steam/air atomisation damper position
FGR air damper position		Water inlet damper position
3	Channel 3 Controls	
None		Draught air damper position
Inlet air damper position		Steam/air atomisation damper position
Outlet air damper position		Water inlet damper position
FGR air damper position		
4	Channel 4 controls	
None		Draught fan VSD output
Burner fan VSD output		Water feed VSD output
FGR fan VSD output		
5	Channel 1 Label	
Channel 1		Steam
Fuel		VSD
Gas		Blower
Oil		Sleeve
Air		Head
FGR		Inlet
P-Air (primary air)		Outlet
S-Air (secondary air)		Water
ID fan (induced draught)		Gas 1
FD fan (forced draught)		Gas 2
6	Channel 2 Label	
Channel 2		Steam
Fuel		VSD
Gas		Blower
Oil		Sleeve
Air		Head
FGR		Inlet
P-Air (primary air)		Outlet
S-Air (secondary air)		Water
ID fan (induced draught)		Gas 1
FD fan (forced draught)		Gas 2
7	Channel 3 Label	
Channel 1		Steam
Fuel		VSD
Gas		Blower
Oil		Sleeve
Air		Head
FGR		Inlet
P-Air (primary air)		Outlet
S-Air (secondary air)		Water
ID fan (induced draught)		Gas 1
FD fan (forced draught)		Gas 2

Setting	Description	
8	Channel 4 Label	
Channel 1		Steam
Fuel		VSD
Gas		Blower
Oil		Sleeve
Air		Head
FGR		Inlet
P-Air (primary air)		Outlet
S-Air (secondary air)		Water
ID fan (induced draught)		Gas 1
FD fan (forced draught)		Gas 2
9	Fuel Selection	
Show gas train		Show gas and oil
Show oil train		Show gas and oil close-coupled
10	Boiler Type	
Water tube		Vertical coil tube
Three-pass fire tube		Kiln
Four-pass fire tube		Vertical Condenser
Cast-sectional tube		Crucible
Horizontal coil tube		
11	Feed Configuration	
Forced draught		Rotary cup
Forced draught VSD		
12	FGR Type	
None		Forced FGR with VSD
Induced FGR with a motorised damper		Forced FGR with a motorised damper and VSD
13	Induced draught	
None		Induced draught with a VSD
Induced draught		Induce draught with motorised damper
14	Water Feed Pump	
None		
Show Water Pump		
Show Water Pump, VSD controlled		
15	Steam/Air Atomisation	
None		Show steam/air train with a servo
Show steam/air train		
16	Two-Port Valve	
None		Show two-port valve
17	Combustion Head Type	
Diffuser		Mesh
18	Water Feed Valve	
None		
Show Water Valve		
Show Water Valve, Servo Controlled		

8.12.3. Options

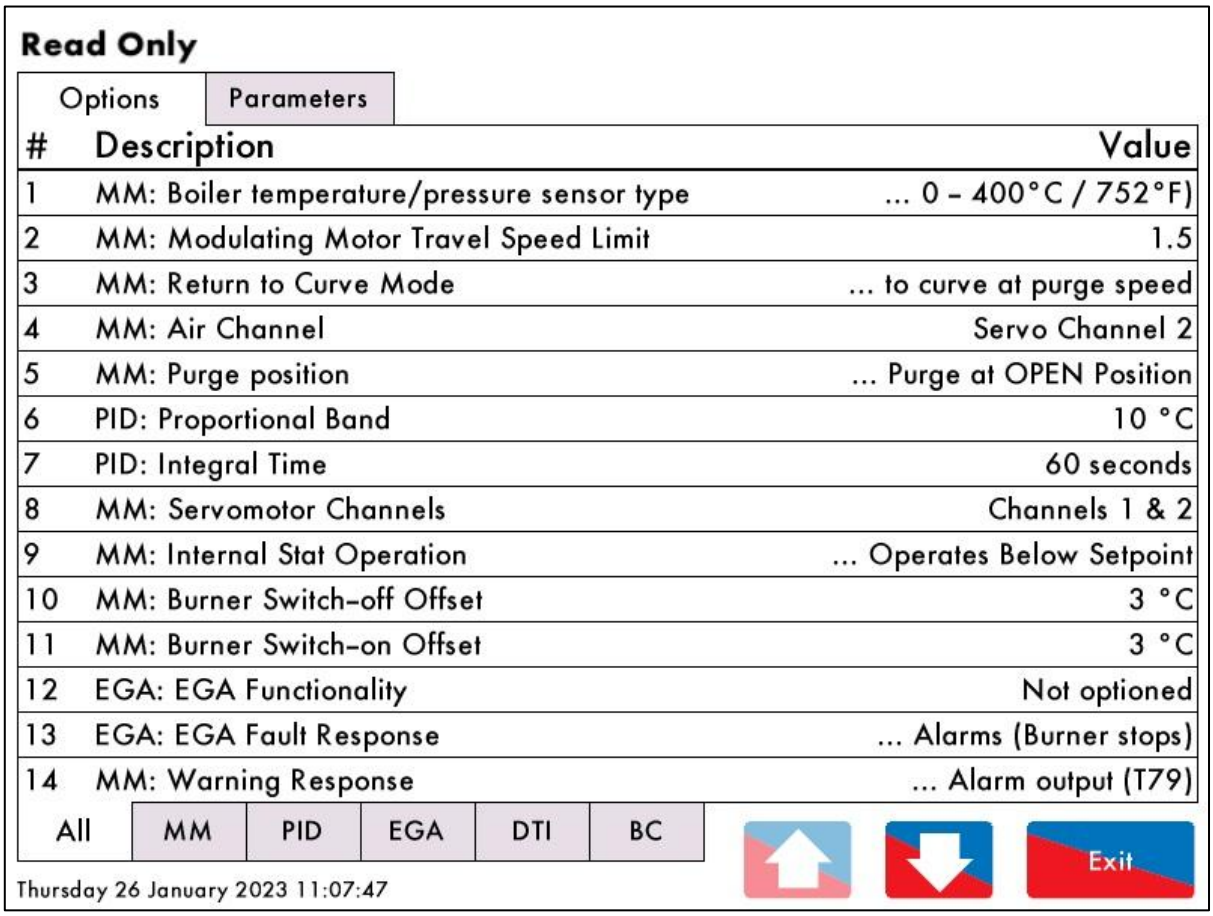


Figure 8.12.3.i Options

Presss 

in the System Configuration screen (8.12.i) to view Options screen in Figure 8.12.3.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 8.12.5.

8.12.4. Parameters

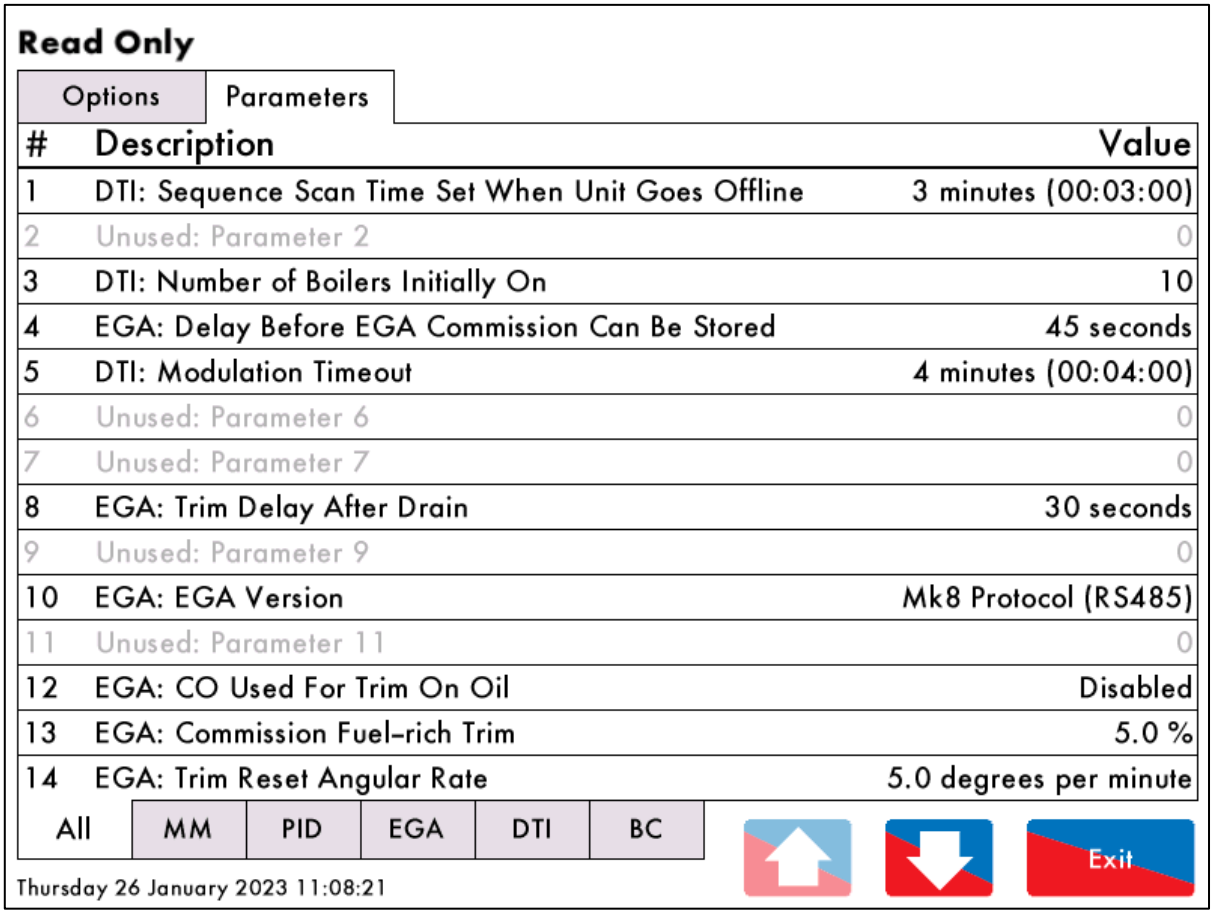


Figure 8.12.4.i Parameters

Press 

in the System Configuration screen (Figure 8.12.i) to view the Parameters screen in Figure 8.12.4.i. The Parameters screens display all the parameters and their settings. To make changes to these parameters, refer to section 8.12.5.

8.12.5. Online Changes

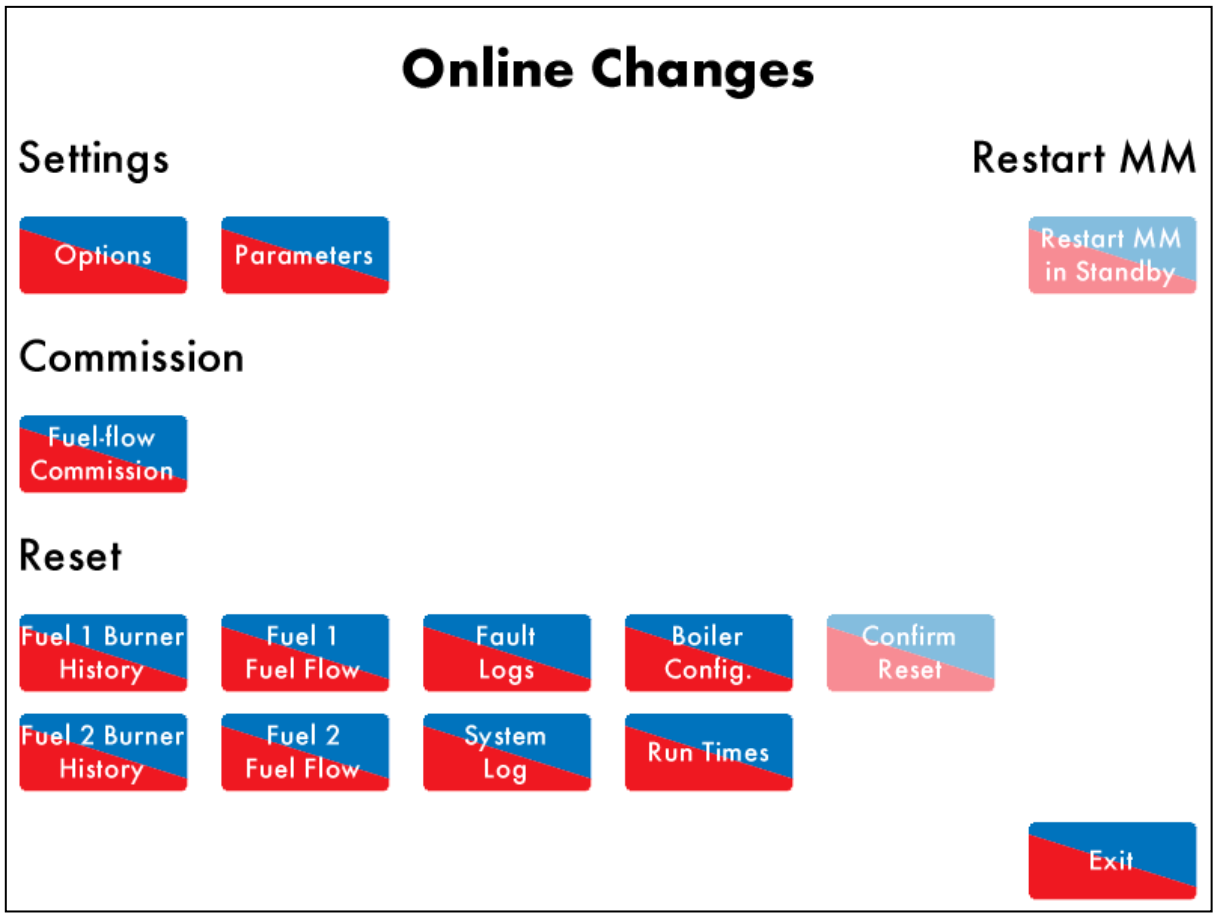


Figure 8.12.5.i Online Changes

Press 

in the System Configuration screen (Figure 3.12.i) to view the Online Changes screen in Figure 8.12.5.i. You will be prompted to enter the password. It is possible to change the non-safety critical options/parameters by pressing 

or 

.

Press 

to reset the Fuel 1 burner history and then press 

. The fuel 1 and 2 burner and fuel flow history, fault logs, system log, boiler configuration and run times can all be reset.

If the MM is in standby mode, press 

to restart the MM. This button will be greyed out as in Figure 8.12.5.i if the burner is on.

8.12.6. Set Clock

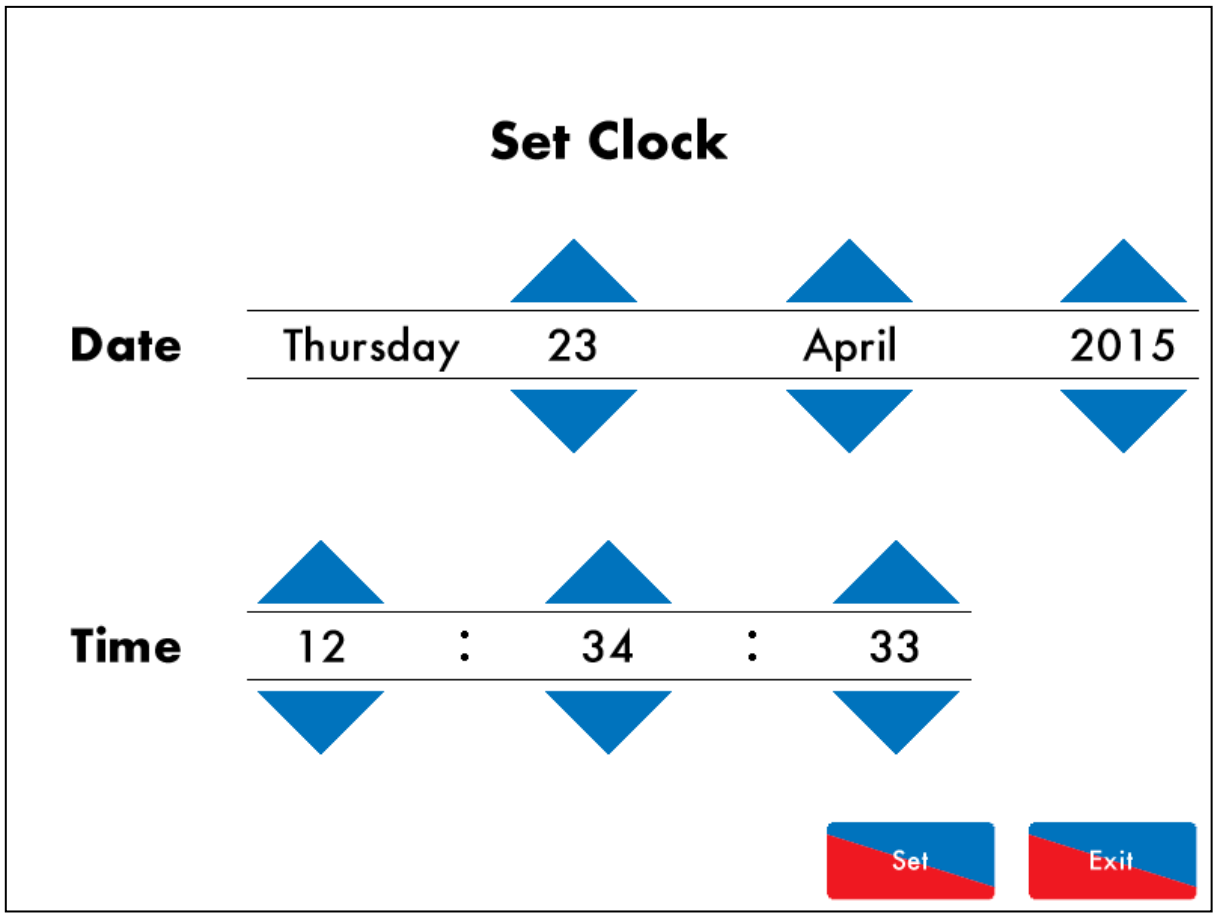


Figure 8.12.6.i Set Clock

Press 

in the System Configuration screen (Figure 8.12.i) to view the Set Clock screen in Figure 8.12.6.i. You will be prompted to enter the password. Change the time and date using the   buttons. Press 

and then 

.

Note: If connected to a Mk8 DTI the time and date will be set by this and not be user adjustable. Please refer to the Mk8 DTI Manual to change this time.

8.12.7. Run Times

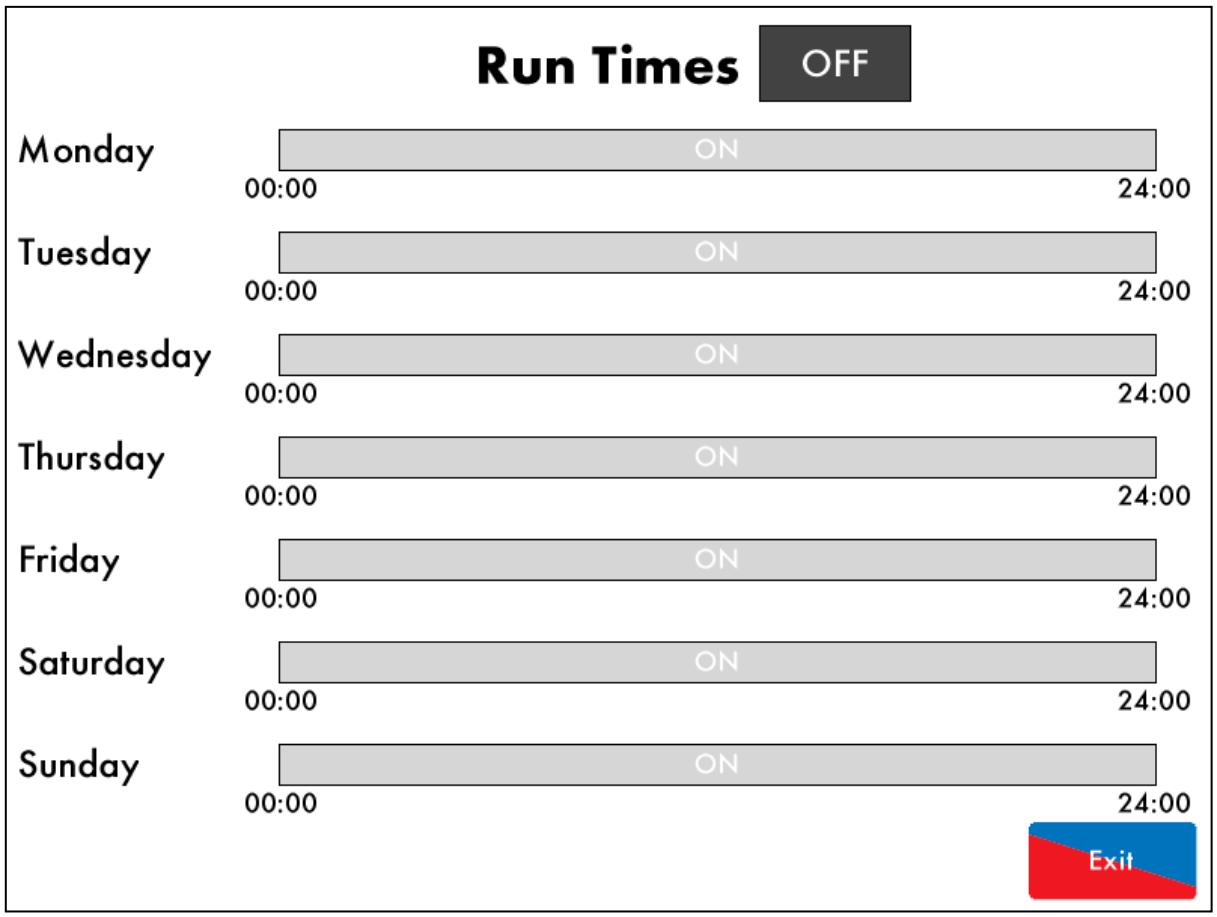


Figure 8.12.7.i Run Times – OFF

Press 

in the System Configuration screen (Figure 8.12.i) to view the Run Times screen in Figure 8.12.7.i. You will be prompted to enter a password. Run Times sets when the MM is scheduled to be on and firing to the required setpoint, on and firing to the reduced setpoint or off.

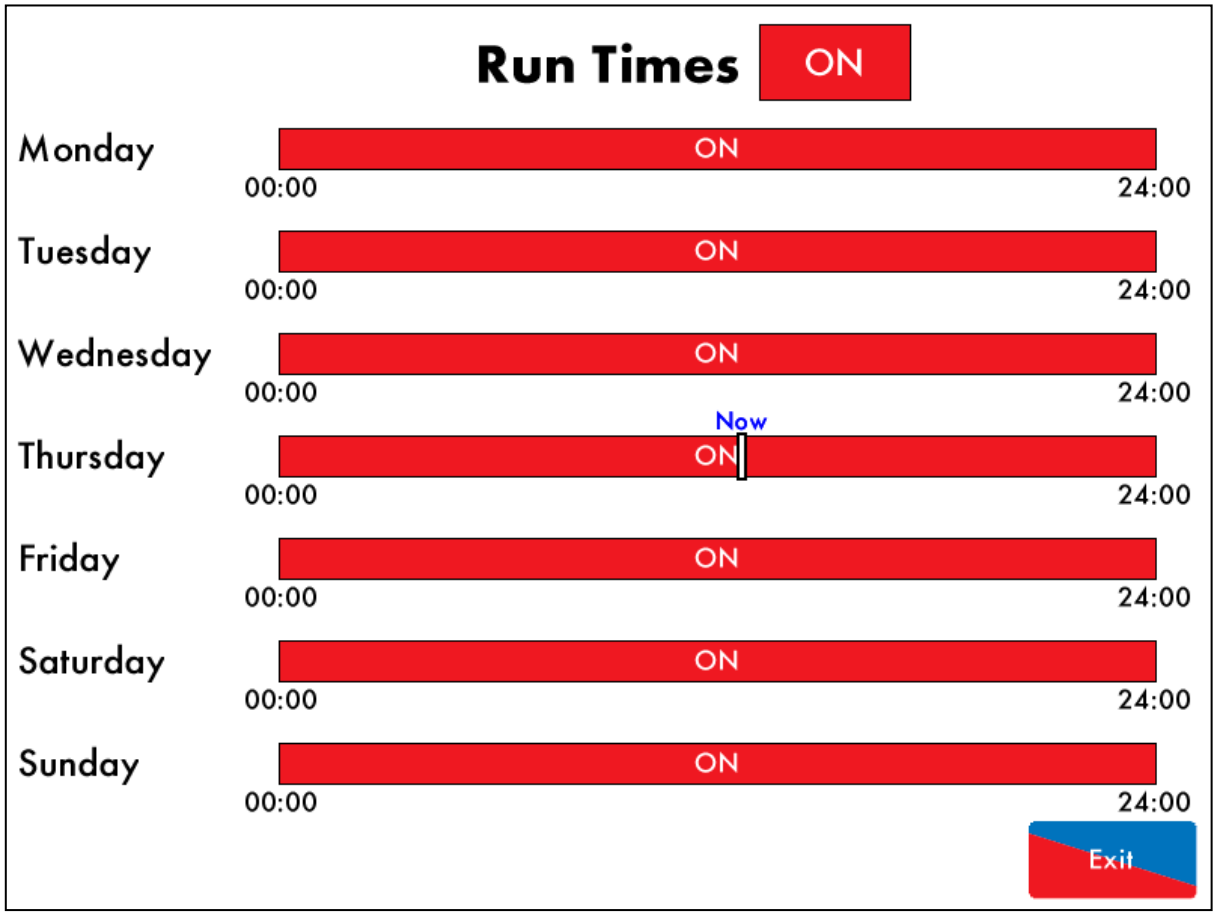


Figure 8.12.7.ii Run Times – ON

Press OFF in the Run Times screen (Figure 8.12.7.i) to view the Run Times On/Off screen in Figure 8.12.7.ii. Press ON in the Run Times – ON screen to disable the run times.

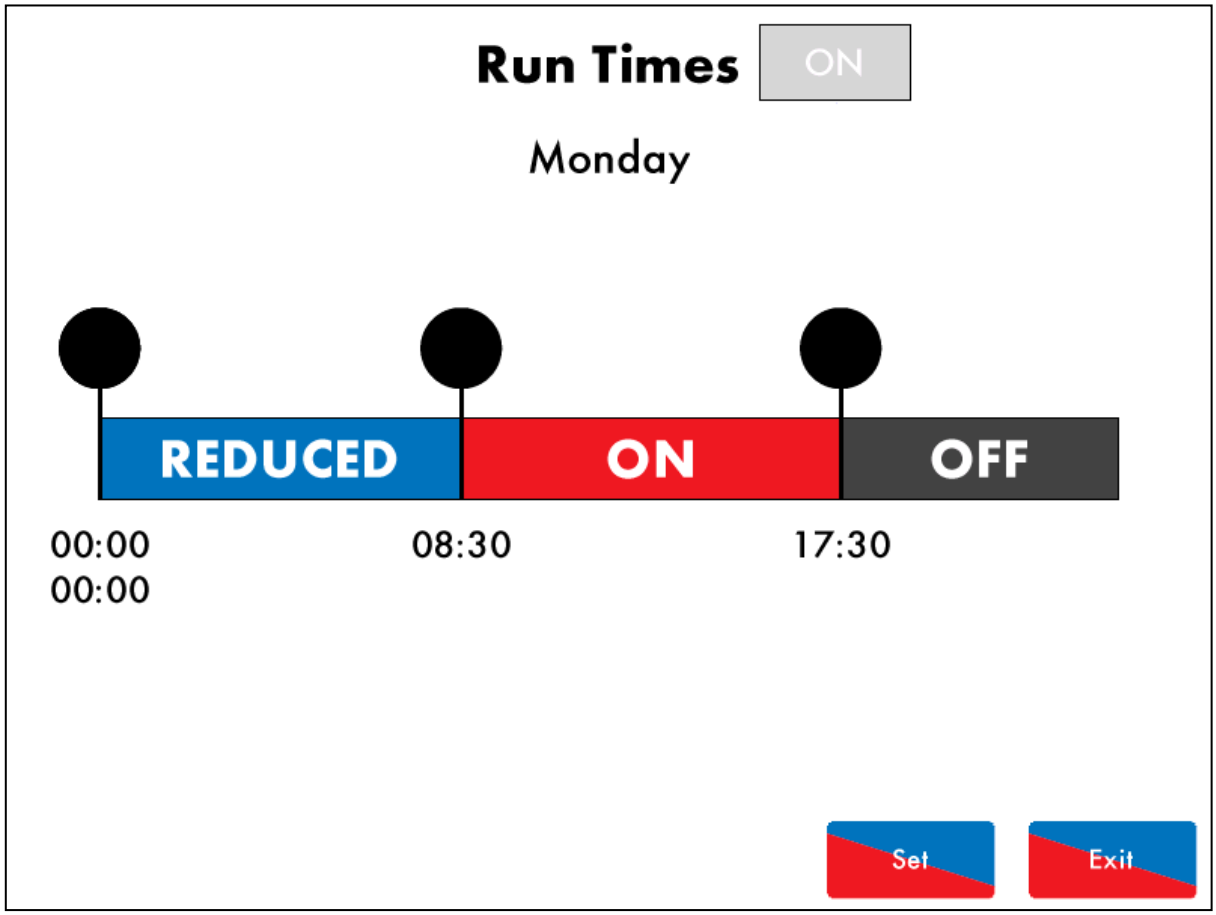


Figure 8.12.7.iii Run Times – Monday

To set the schedule, press on the bar for that day in the Run Times On/Off screen (Figure 8.12.7.ii) and drag the to set the intervals, and then press the bar to change the intervals to ON, OFF or REDUCED. Up to 4 time periods can be set.

Note: The MM will fire to the reduced setpoint set in the Status screen (Figure 8.2.1.i) when scheduled in the Run Times or if option/parameter 154 is set to 3 and an input is detected on Terminal 80.

8.12.8. Manual

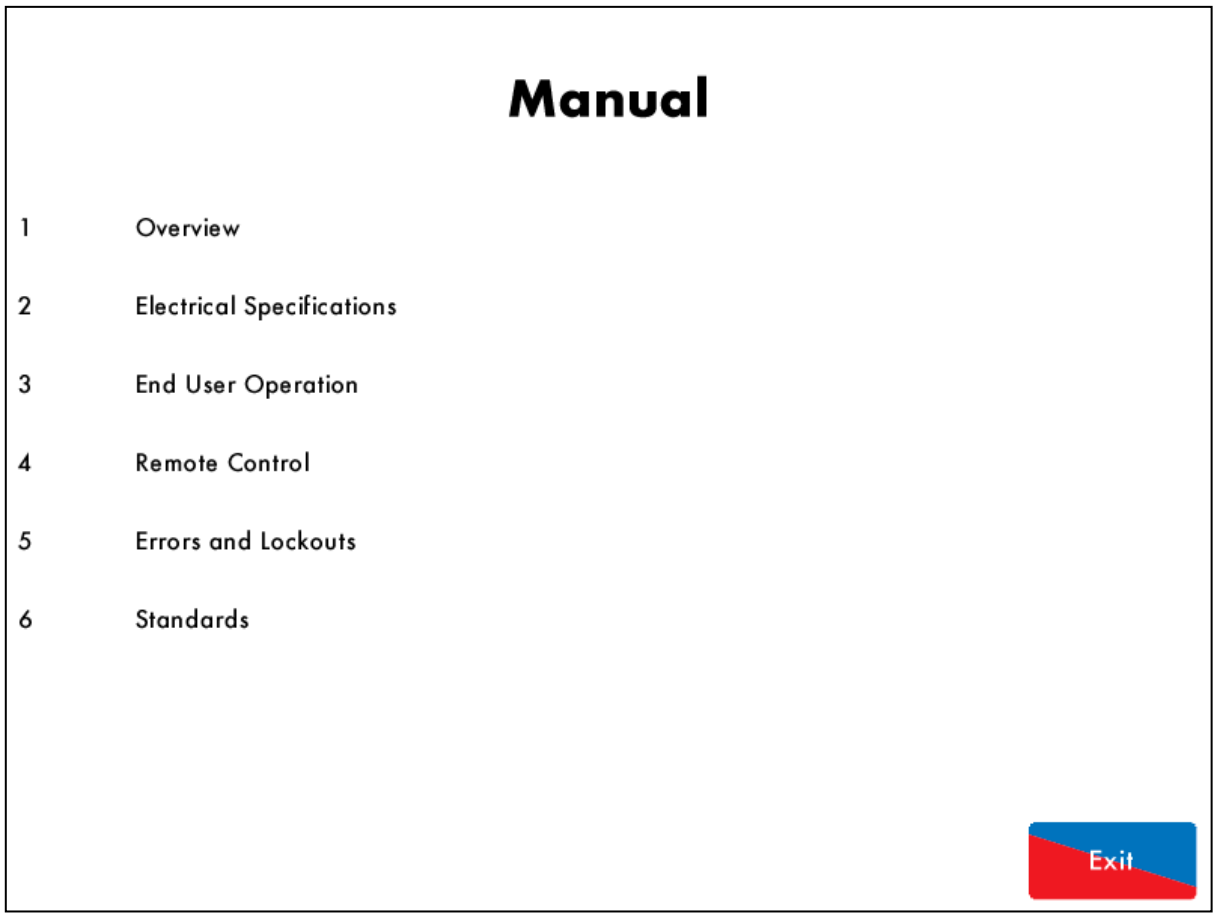


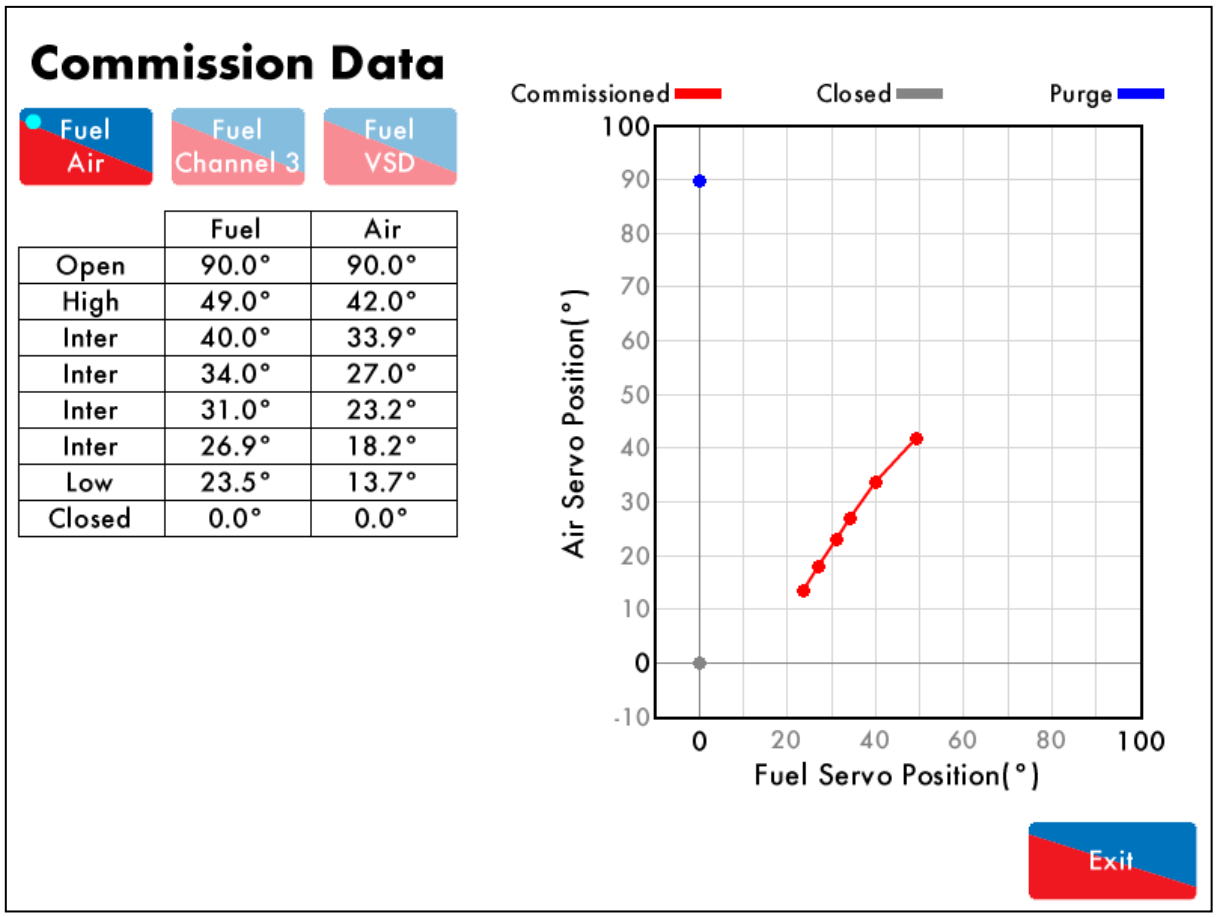
Figure 8.12.8.i Manual

Press 

in the System Configuration (8.12.i) to view the Manual screen in Figure 8.12.8.i. Press on the section headings to navigate to the sections.

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

8.12.9. Commission Data



	Fuel	Air
Open	90.0°	90.0°
High	49.0°	42.0°
Inter	40.0°	33.9°
Inter	34.0°	27.0°
Inter	31.0°	23.2°
Inter	26.9°	18.2°
Low	23.5°	13.7°
Closed	0.0°	0.0°

Figure 8.12.9.i Commission Data

Press Commission Data in the System Configuration screen (Figure 8.12.i) to view the Commission Data screen in Figure 8.12.9.i.

8.12.10. System Log

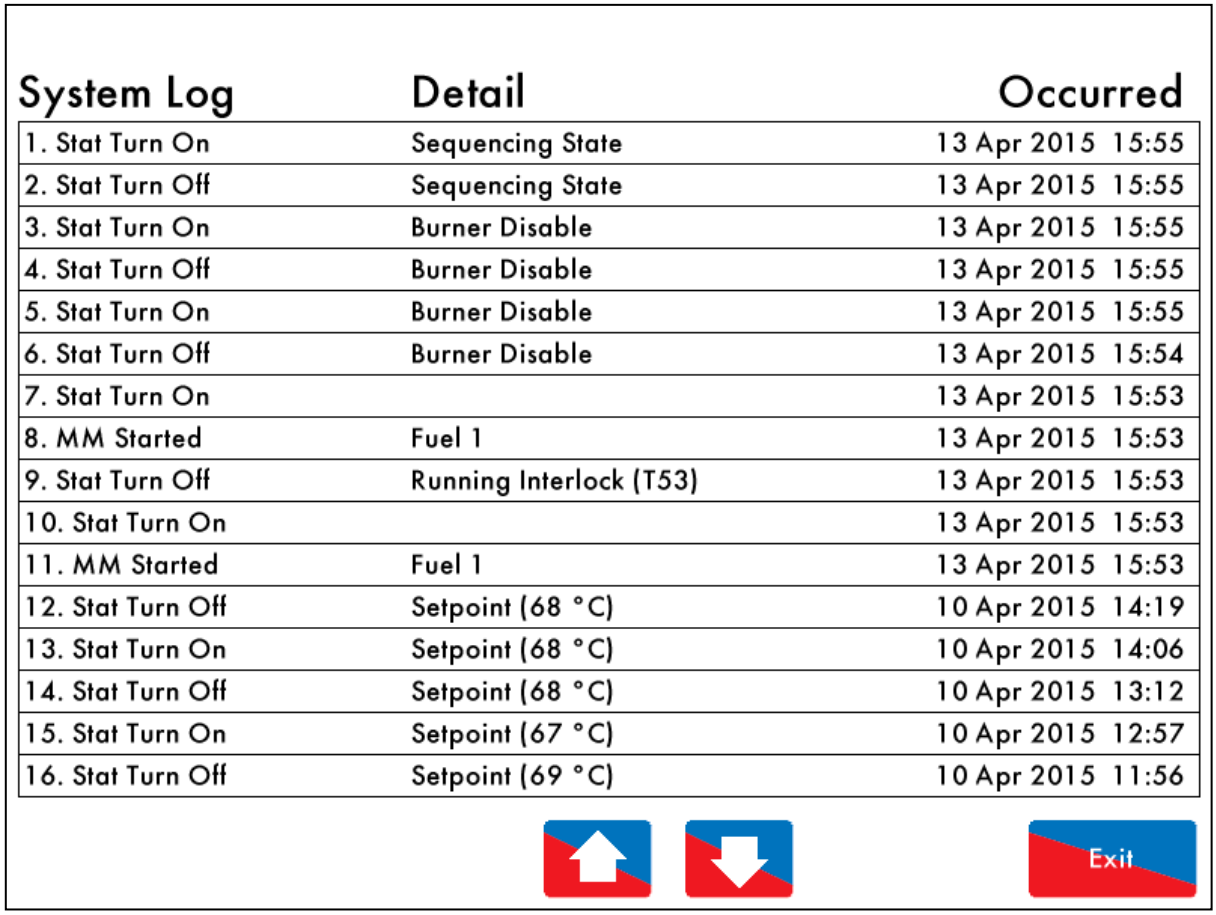


Figure 8.12.10.i System Log

Press 

in the System Configuration screen (Figure 8.12.i) to view the System Log screen in Figure 8.12.10.i. This data is stored on the MM and the SD card for 1000 entries.

9. 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
- 2 Valve proving system – no vent valve, single valve pilot
- Interrupted pilot
- UV scanner
- Air pressure sensor
- Gas pressure sensor – VPS and pressure limits checked
- VPS operates before start-up
- Pre-purge and post-purge
- No golden start
- No FGR start

9.1. Recycle

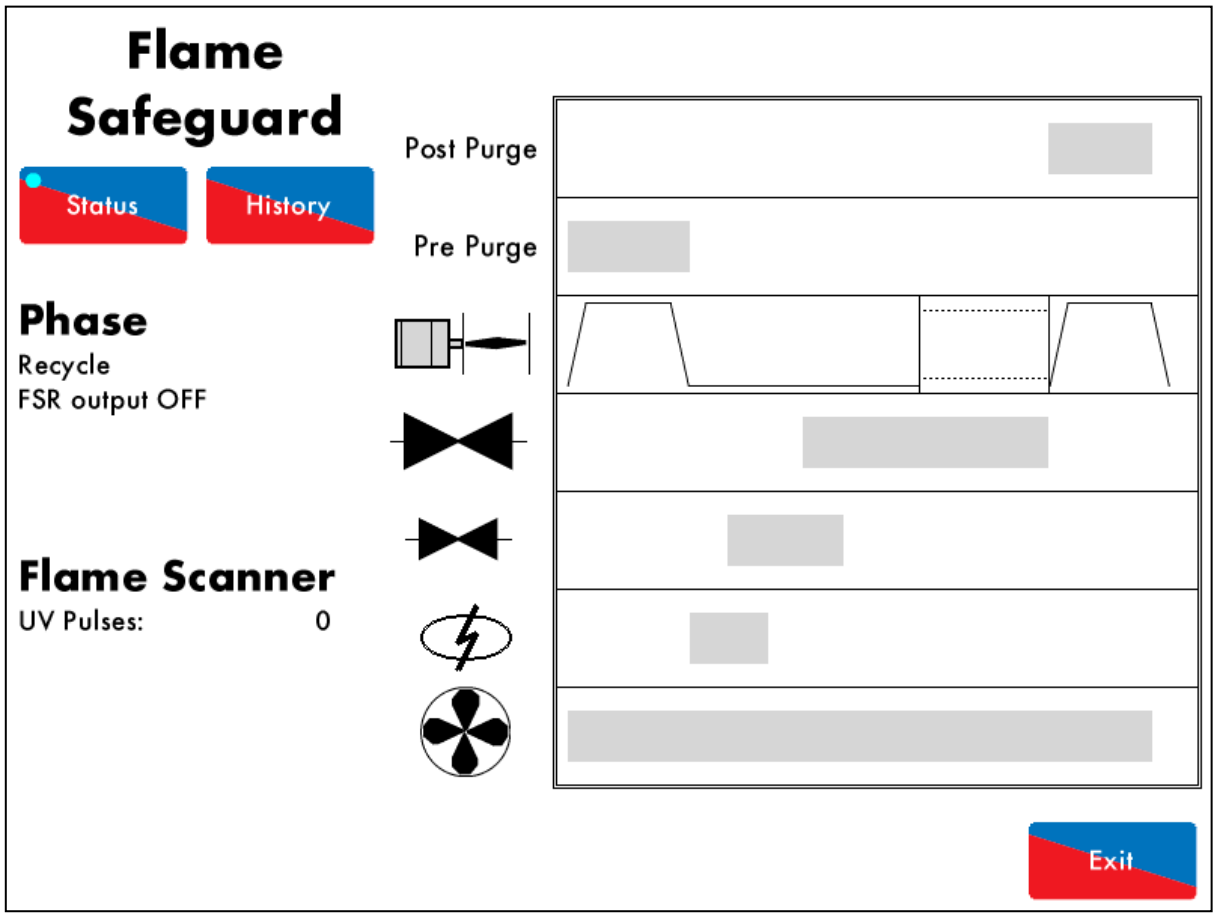


Figure 9.1.i Recycle

When the burner enters the Recycle phase shown in Figure 9.1.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 options/parameters 118 and 135.

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

9.2. Standby

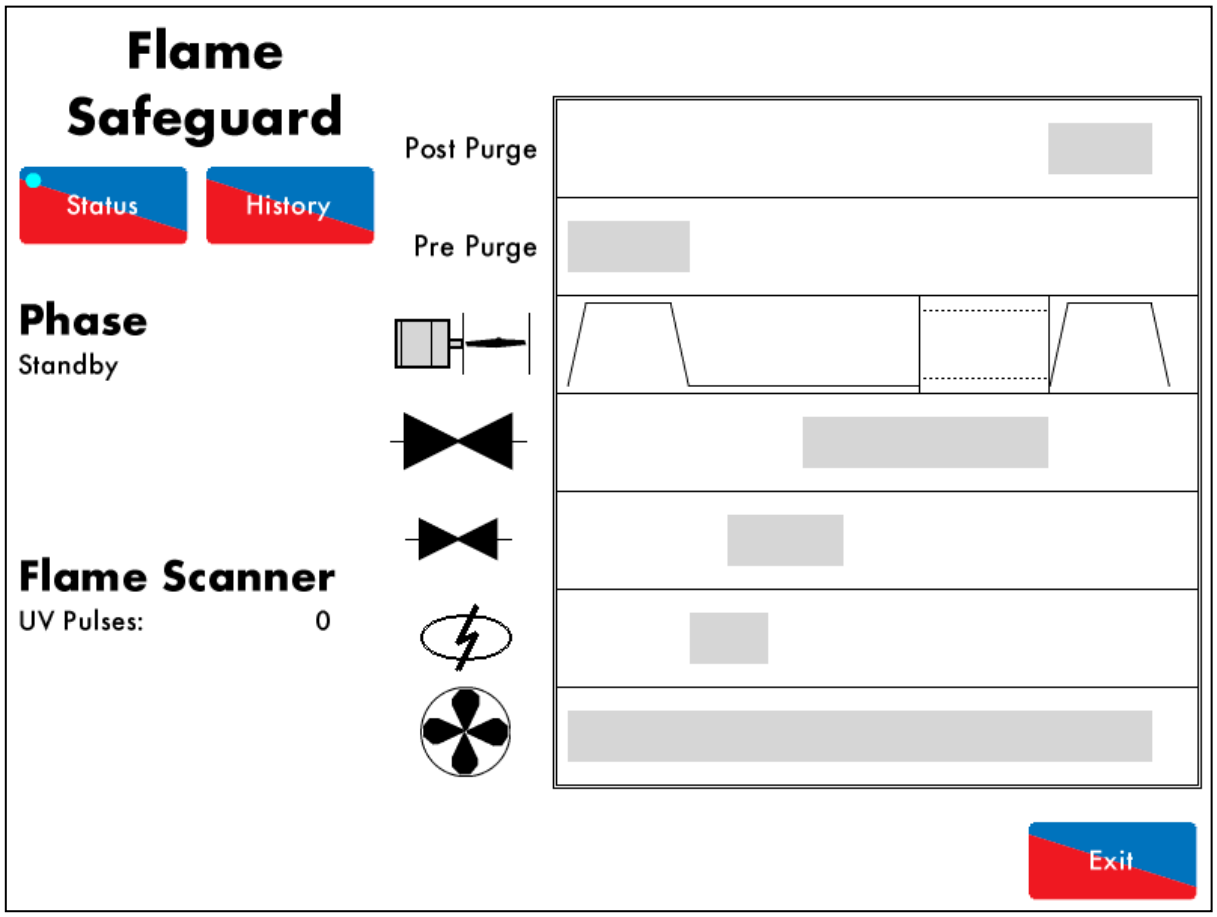


Figure 9.2.i Standby

The burner will go into Standby shown in Figure 9.2.i., before the safety checks begin to initiate the burner start-up sequence.

The MM will remain in this phase if it is waiting for a call to start via the internal stat, subject to the required setpoint and load demand. 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 only move to the next phase when the actual temperature/pressure of the system has reached the burner's on range, set as an offset value of the required temperature/pressure. See options 9, 10 and 11.

The Standby phase is also part of the Intelligent Boiler Sequencing. The MM could be in Standby because it is a lag boiler and not required to contribute to the system. See options 16, 41, 42, 53 and 54.

The MM will remain in Standby if the burner has been disabled, see section 8.1.3. The MM can also be disabled remotely, see section 7 Remote Control.

9.3. Internal Relay Tests

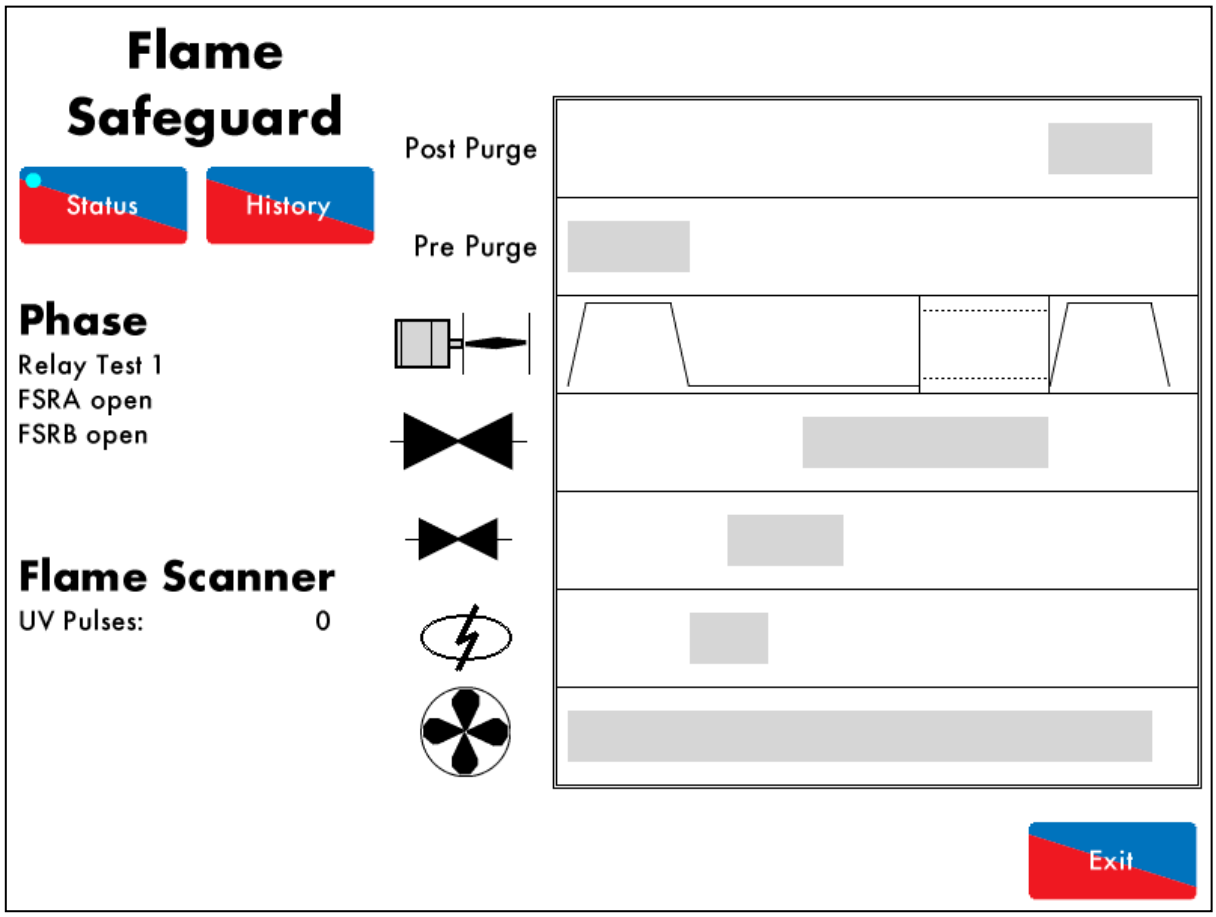


Figure 9.3.i Relay Test 1

During the Internal Relay Tests phase shown in Figure 9.3.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.

9.4. CPI Input

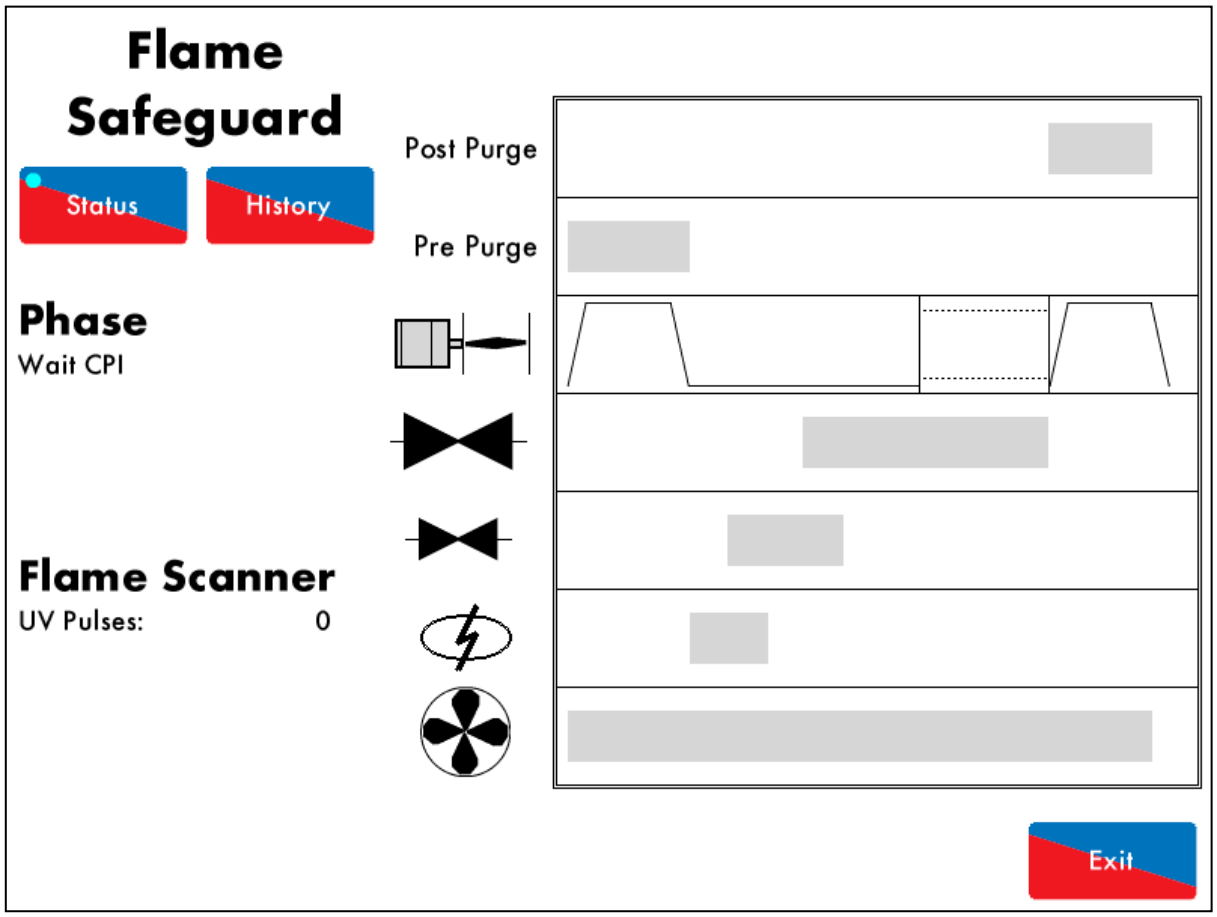


Figure 9.4.i CPI Input

In the Wait CPI phase shown in Figure 9.4.i, a check is made on terminal 55 for the proof of closure switch. If terminal 55 does not see an input within 20 seconds, the lockout 'No CPI Reset' will occur.

9.5. Valve Proving

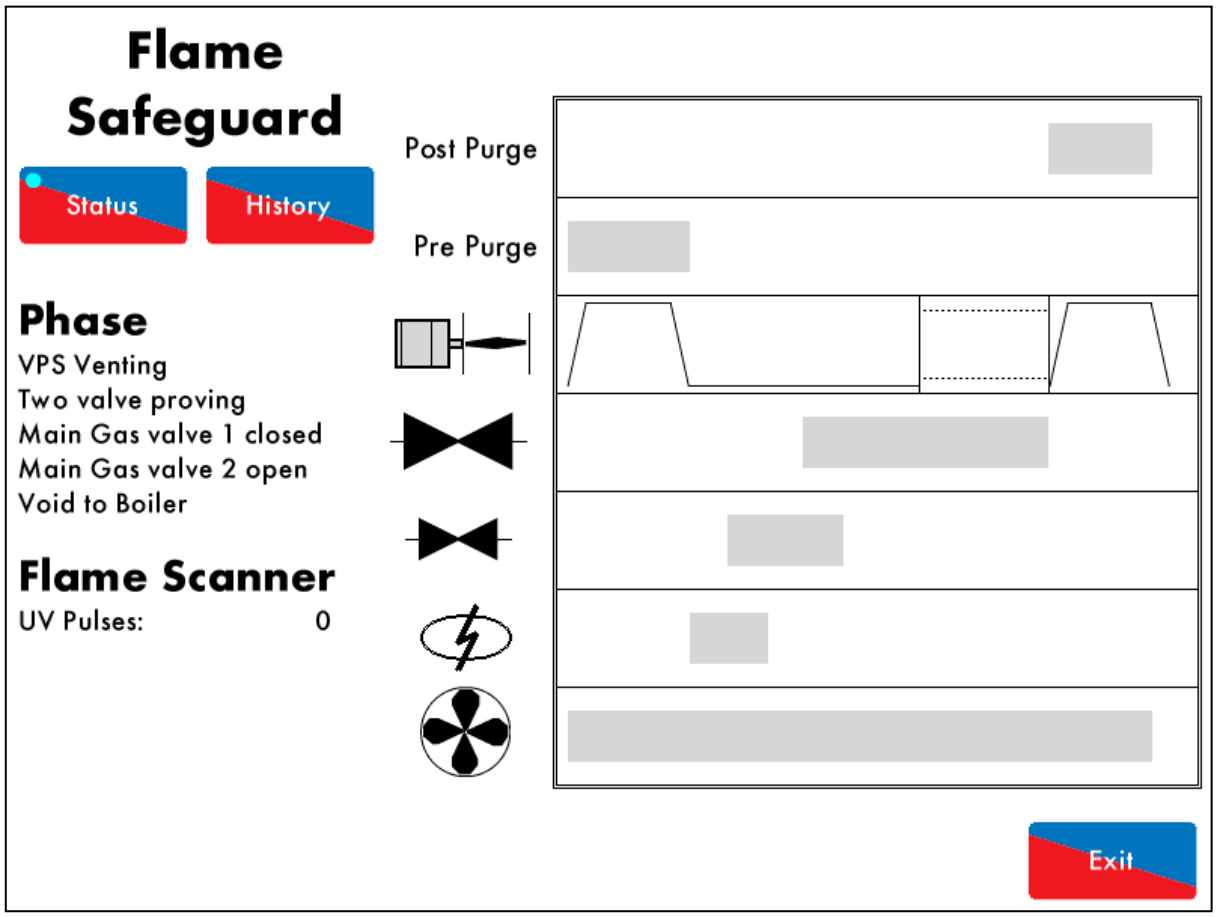


Figure 9.5.i VPS Venting

In this example, the MM 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 9.5.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. The gas pressure sensor is now zeroed. If the gas pressure sensor cannot be zeroed, the lockout 'VPS air zeroing fail' will occur, since the gas pressure has been detected when venting to atmosphere. This could indicate that there is a fault with the main gas valve 1 or 2.

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.

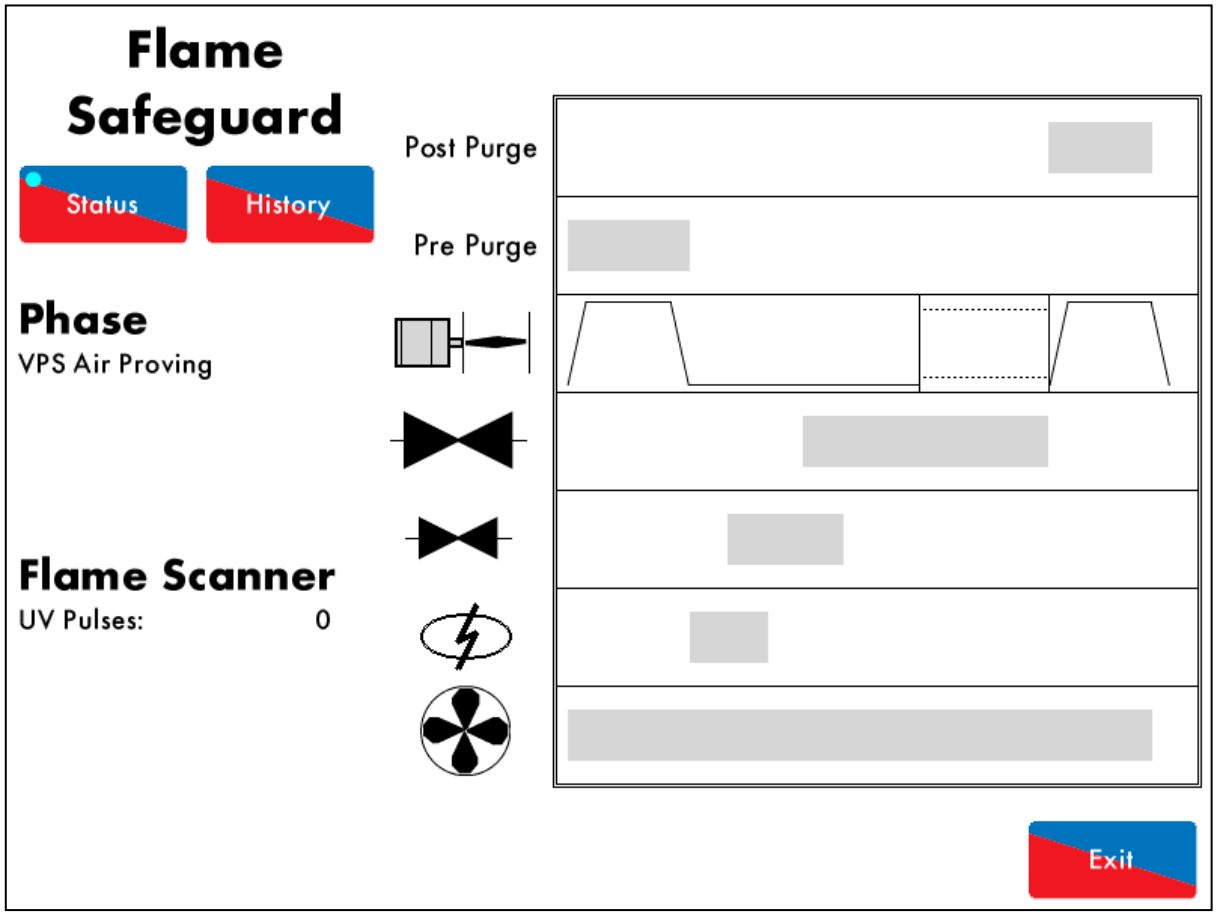


Figure 8.5.ii VPS Air Proving

In the VPS Air Proving phase shown in Figure 8.5.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 before pressure reading is taken. If a pressure increase is detected 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.

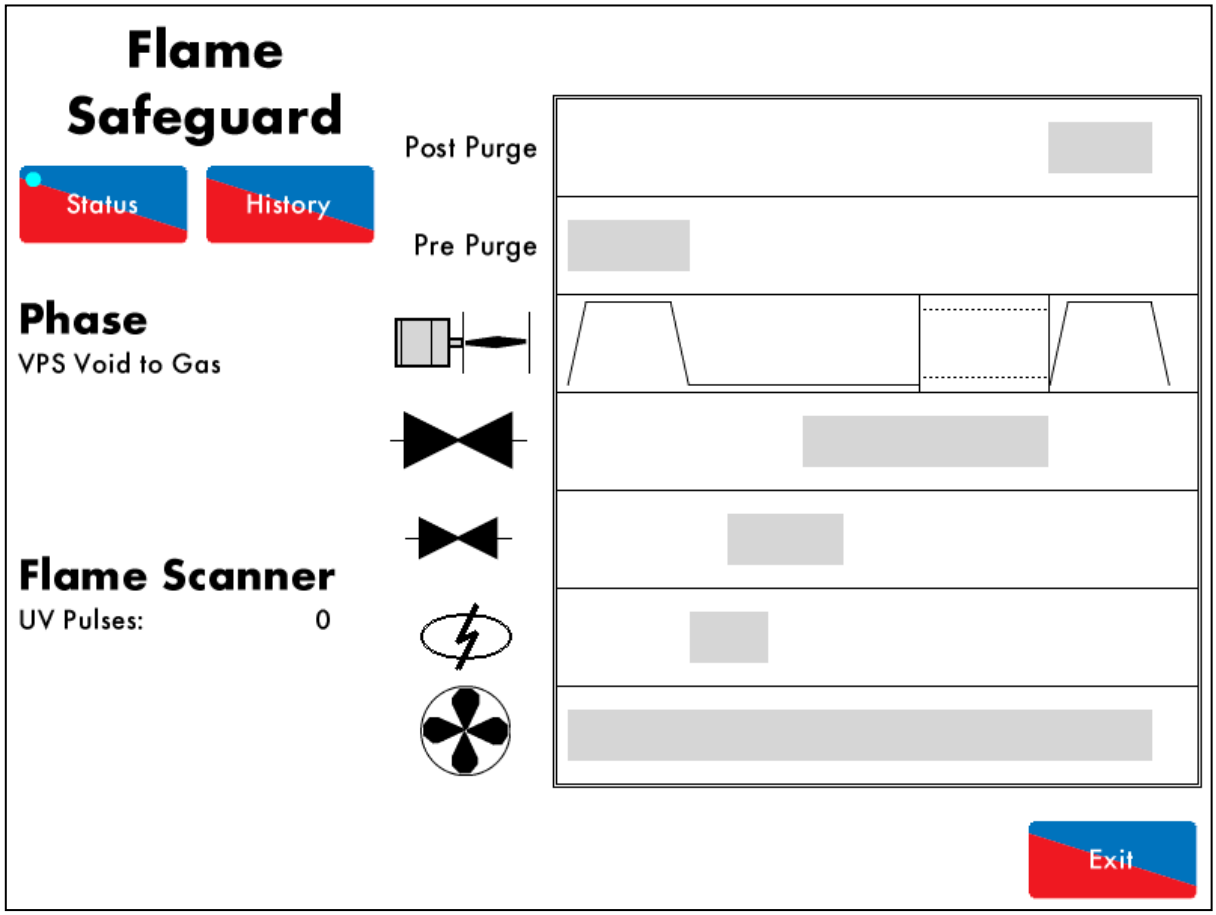


Figure 9.5.iii VPS Void to Gas

In the VPS Void to Gas phase shown in Figure 9.5.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 the measured static line pressure is below the offset lower limit set in option/parameter 138, then a 'gas pressure low limit' lockout 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.

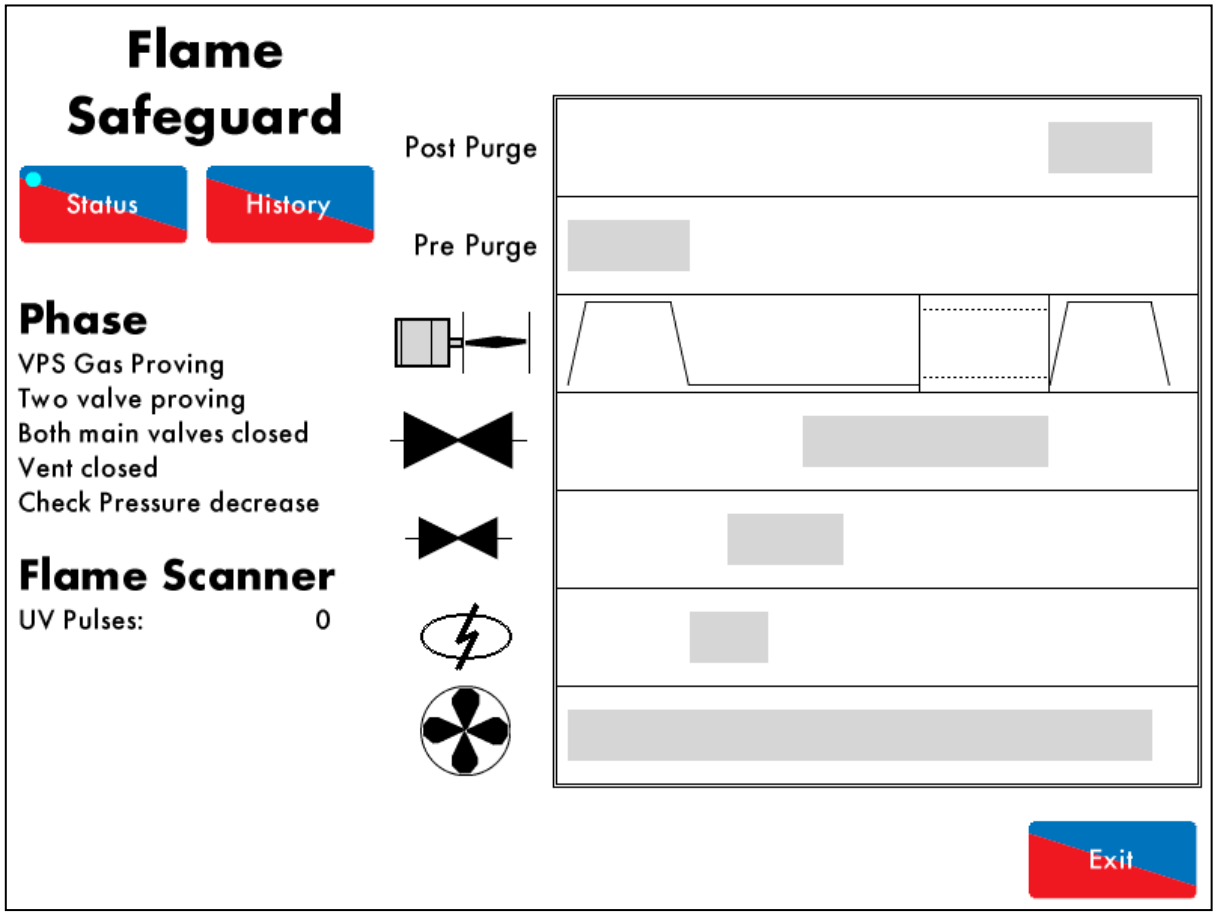


Figure 9.5.iv VPS Gas Proving

In the VPS Gas Proving phase shown in Figure 9.5.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 before the initial gas pressure reading is taken. The reading taken after this delay must be at least 80% of this measured static line pressure. If there is a decrease in the gas pressure, 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.

If the measured static line pressure is below the offset limit the lockout 'VPS Gas Input Too low' will occur, see option/parameter 138.

9.6. Zero Air Sensor

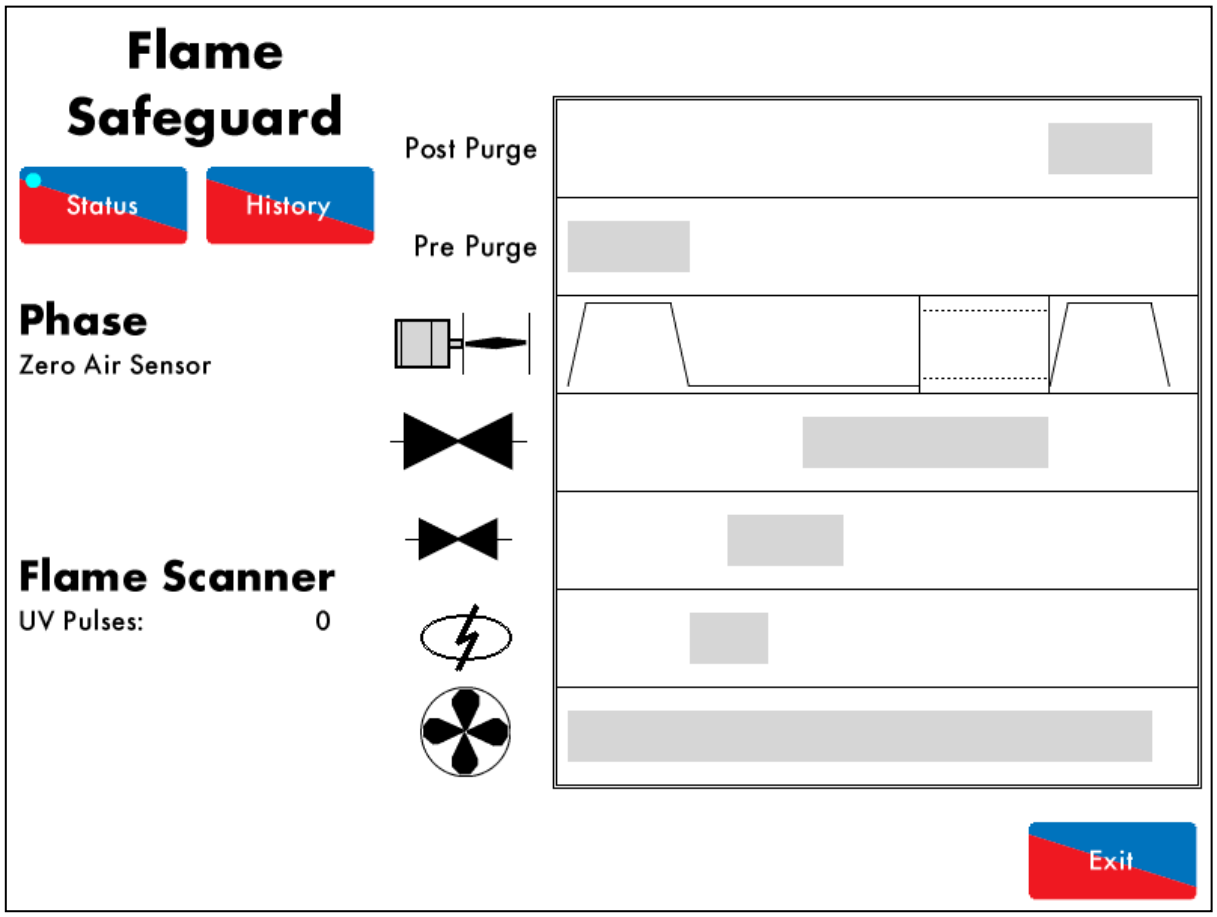


Figure 9.6.i Zero Air Sensor

Once the VPS checks are competed, the air pressure is checked before the burner motor starts up in the Zero Air Sensor screen shown in Figure 9.6.i. The air pressure sensor will look for zero air pressure. If the air pressure sensor cannot be zeroed because there is 5mbar difference from the air pressure sensor's zero value, then the lockout 'Air Sensor Zero' will occur.

If an air switch is used on T54, the MM 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 2minutes, the lockout 'Wait Air Switch Timeout' will occur.

If both an air pressure sensor and air switch are optioned, then both must read low before the 'Wait for Air Switch' phase can be passed, see option/parameter 148.

9.7. Purge

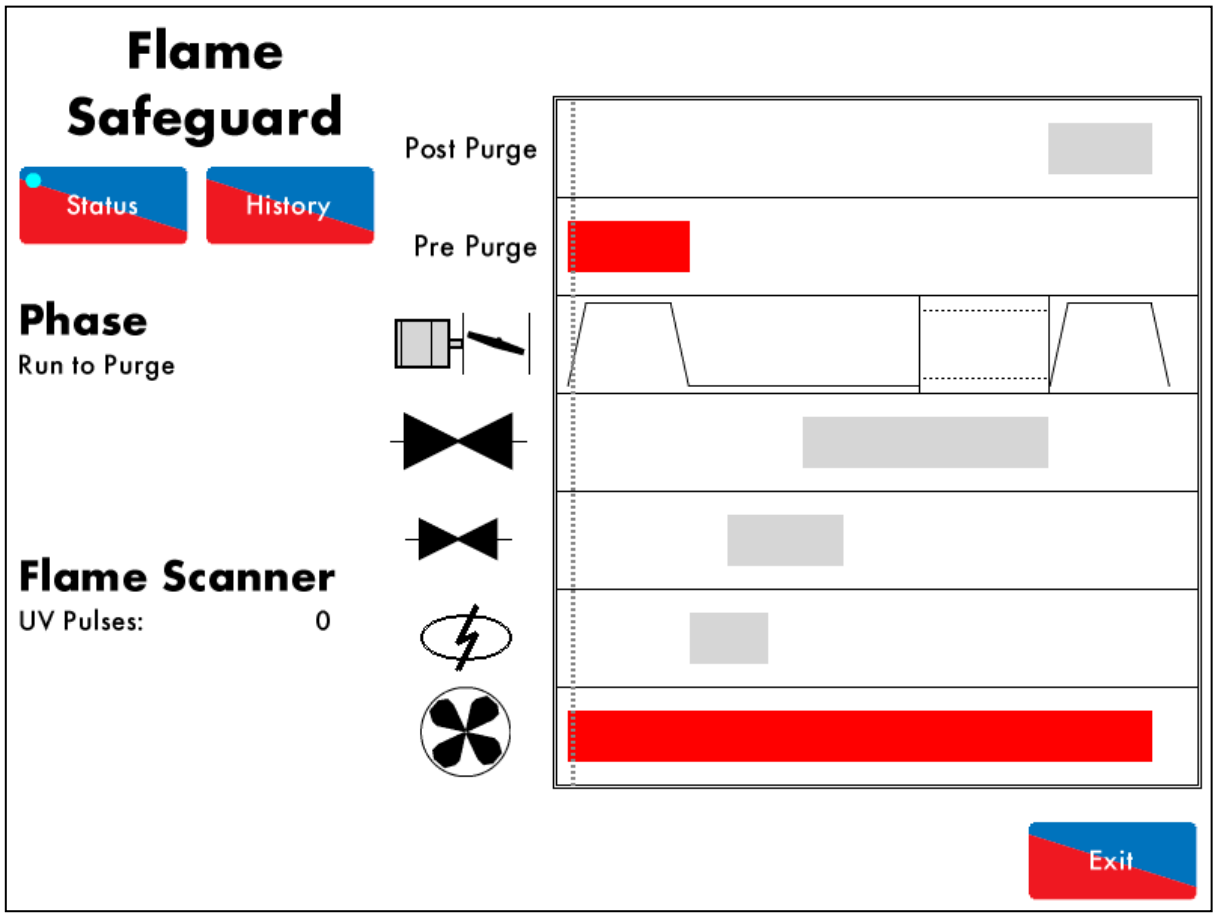


Figure 9.7.i Run to Purge

Once all the internal relay and VPS checks have been made, the channels move to their commissioned purge positions in the Run to Purge phase shown in Figure 9.7.i. The burner motor output is switched on. If a VSD is fitted and the feedback does not match the commissioned signal, the MM will sit at Run to Purge indefinitely without a lockout.

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

Note: A delay to purge input can be used on terminal 80; a timeout can also be optioned for this input. See options/parameters 154 and 57.

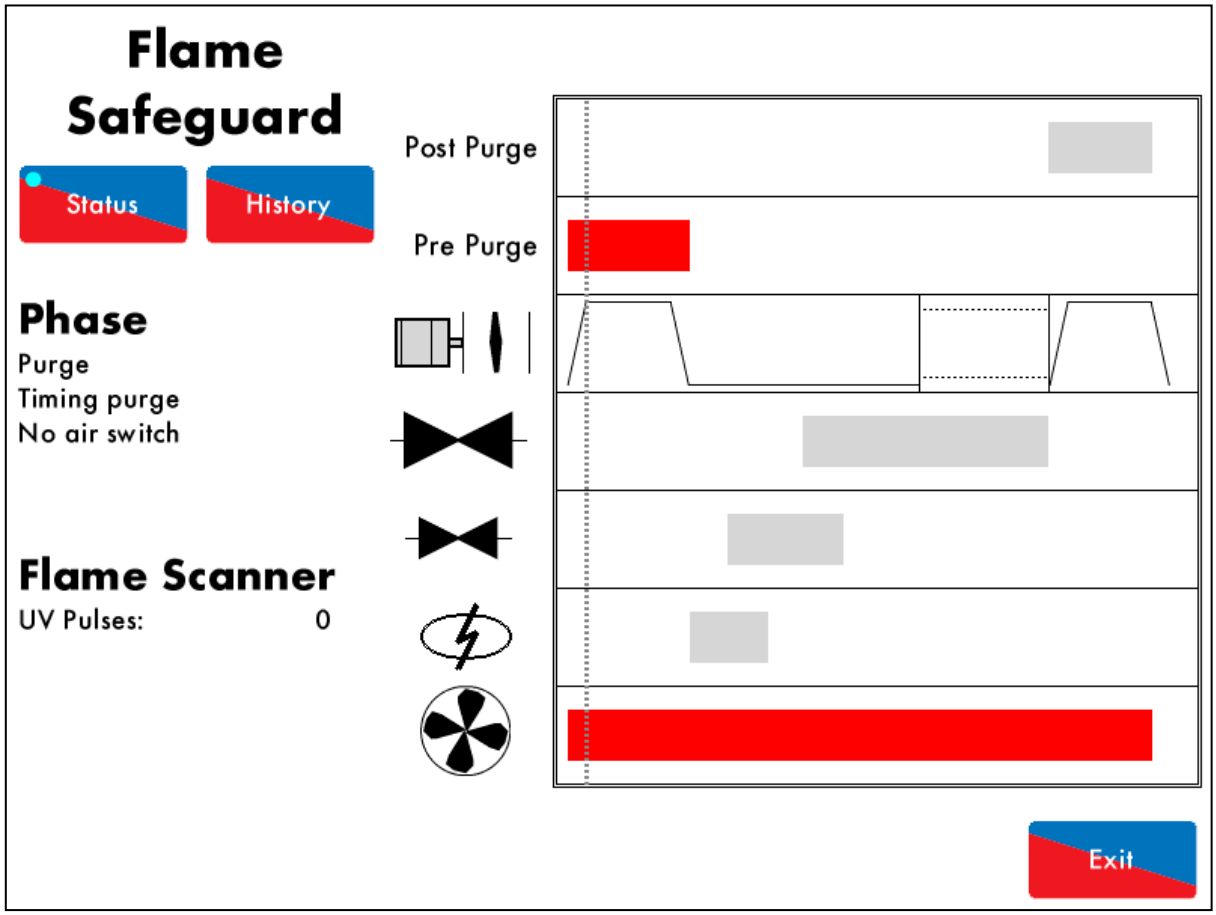


Figure 9.7.ii Purge No Air Switch

The Purge No Air Switch phase shown in Figure 9.7.ii allows a delay before the air switch/air pressure sensor is checked. See option/parameter 121.

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

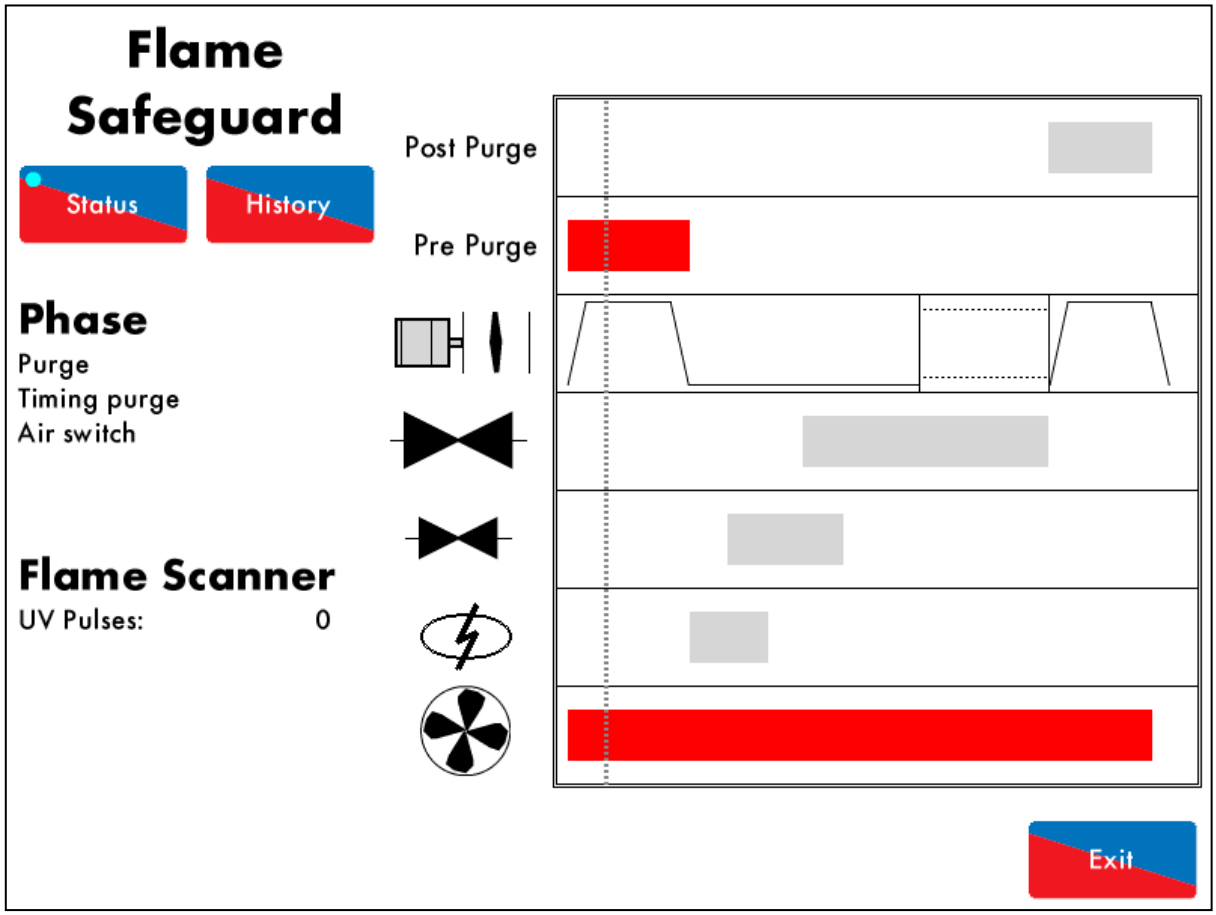


Figure 9.7.iii Purge Air Switch

Once the 'delay from start of the purge before the air switch is checked' has elapsed, the air pressure sensor checks for a minimum air pressure in the Purge Air Switch phase shown in Figure 9.7.iii. If the air pressure sensor does not detect sufficient air, then the lockout 'No Air Proving' will occur. See options/parameters 141 and 149.

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.

Note: A purge pressure proving input can be used on terminal 81 with an optional timeout; this input is checked after the no air switch delay, see options/parameters 155 and 158.

9.8. Ignition

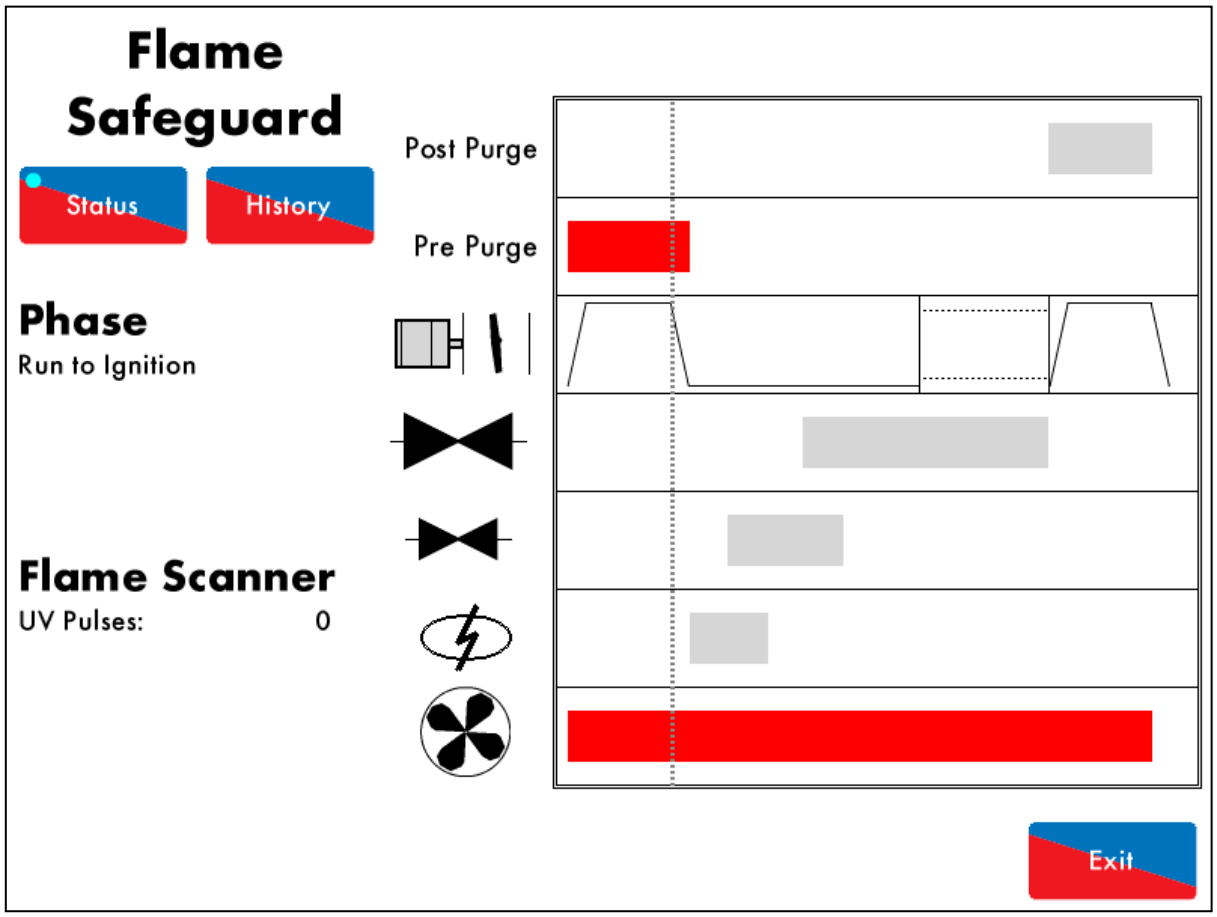


Figure 9.8.i Run to Ignition

In the Run to Ignition phase shown in Figure 9.8.i, the channels will move to their commissioned start positions. If a VSD is fitted and the feedback does not match the commissioned signal, the MM will sit at Run to Ignition indefinitely without a lockout.

Note: If the system has been commissioned with FGR start, then the MM will run to the FGR start position, unless Golden Start is commissioned and the MM will run to the Golden Start position.

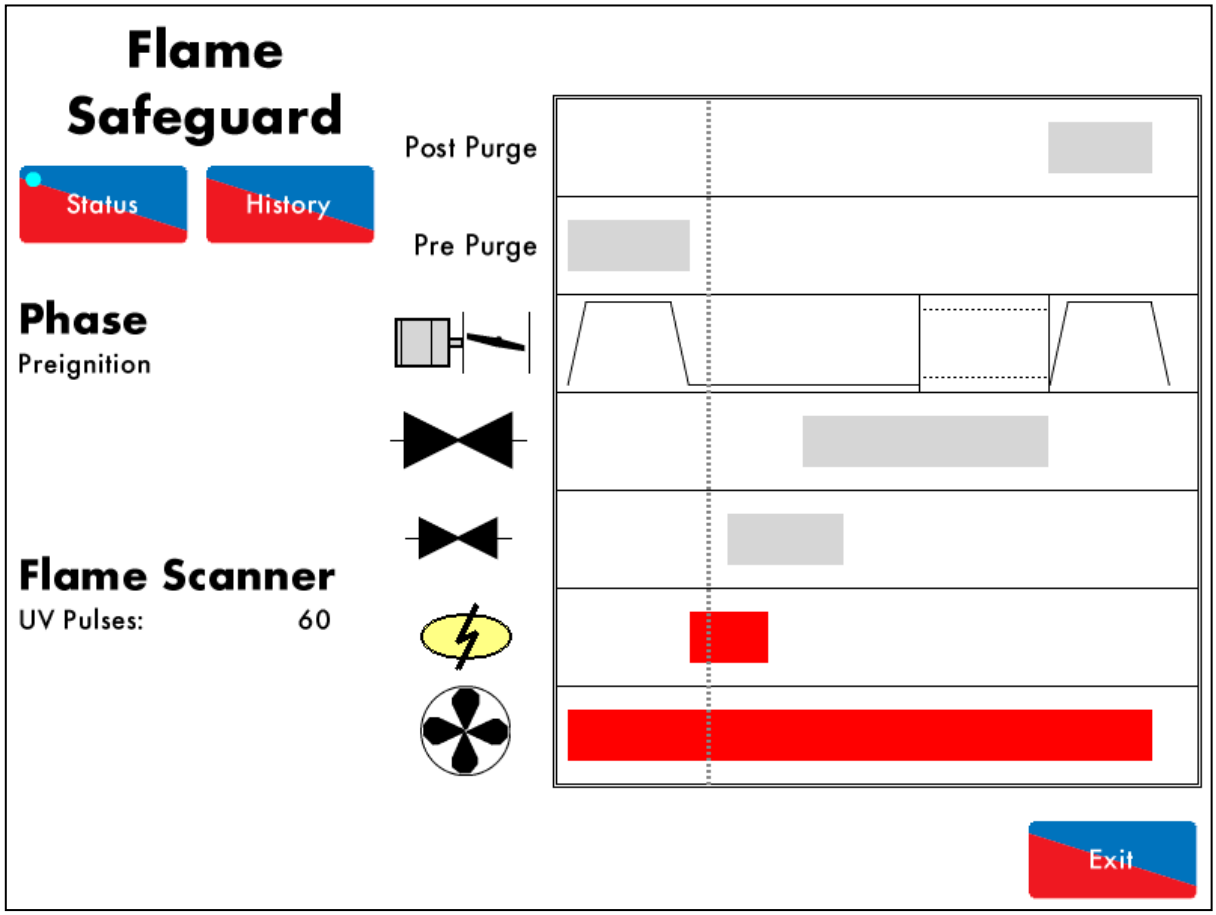


Figure 9.8.ii Pre-ignition

The ignition transformer output is switched on in the Pre-ignition phase shown in Figure 9.8.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.

9.9. Pilot

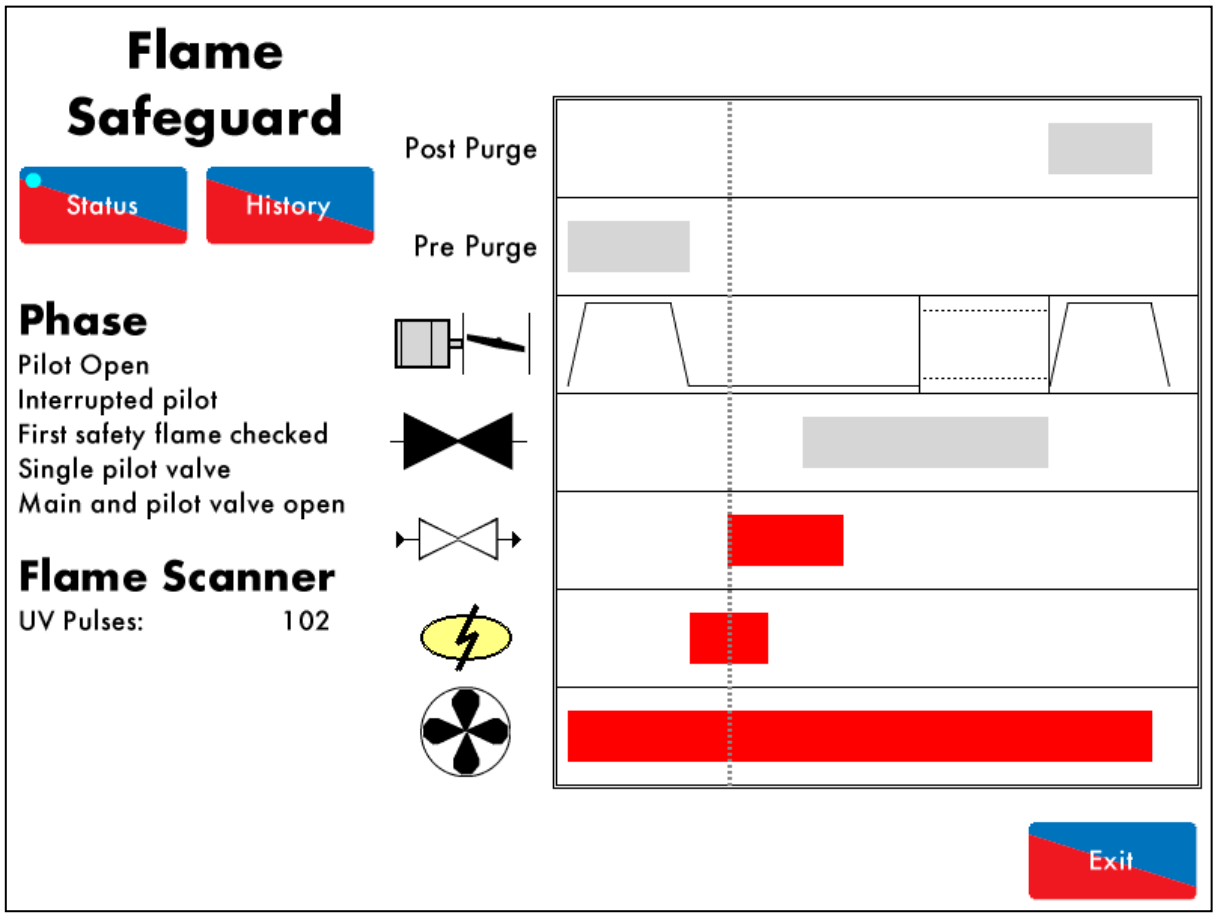


Figure 9.9.i Pilot Open

The pilot gas valve is switched on (open) in the Pilot Open phase shown in Figure 9.9.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.

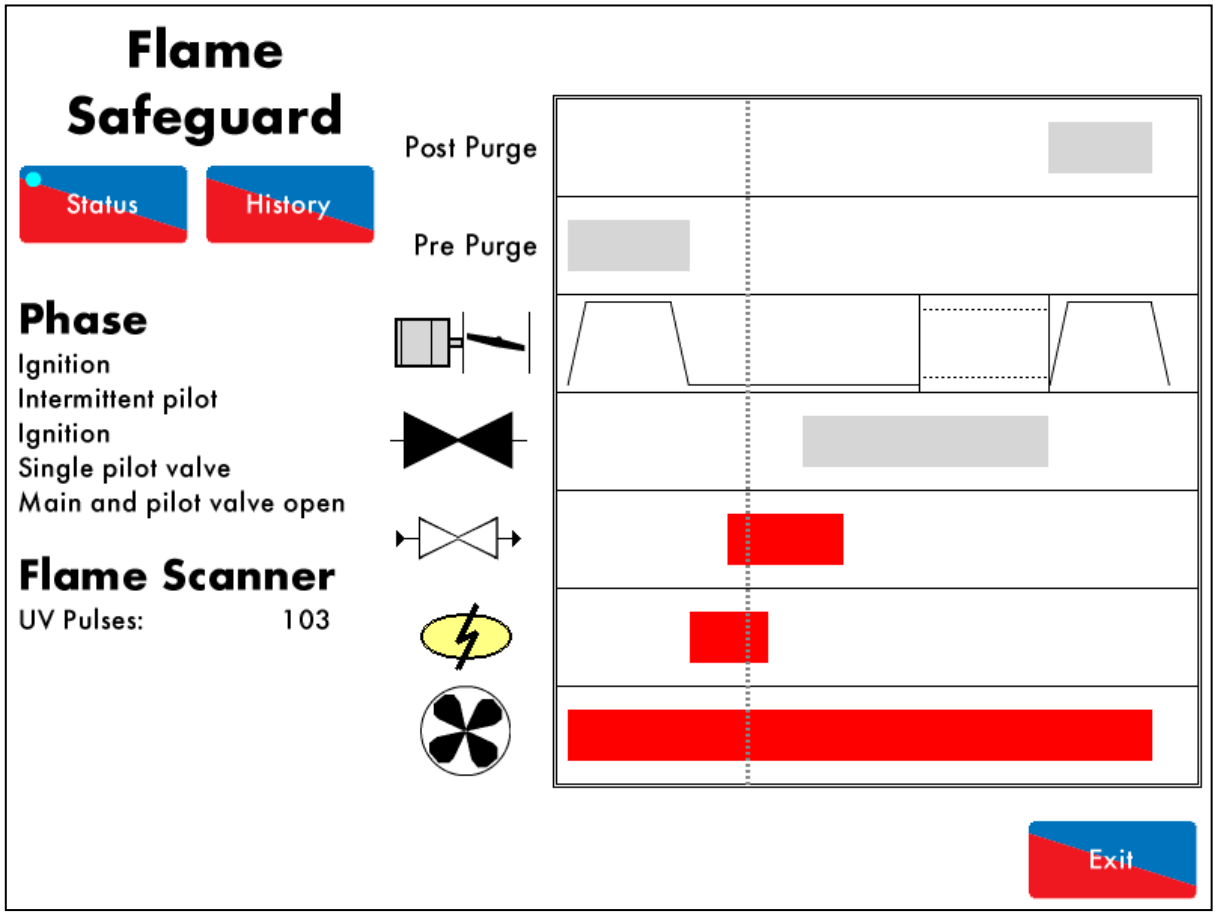


Figure 9.9.ii Ignition

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 9.9.ii. If the pilot goes out, the lockout 'No Flame Signal' will occur.

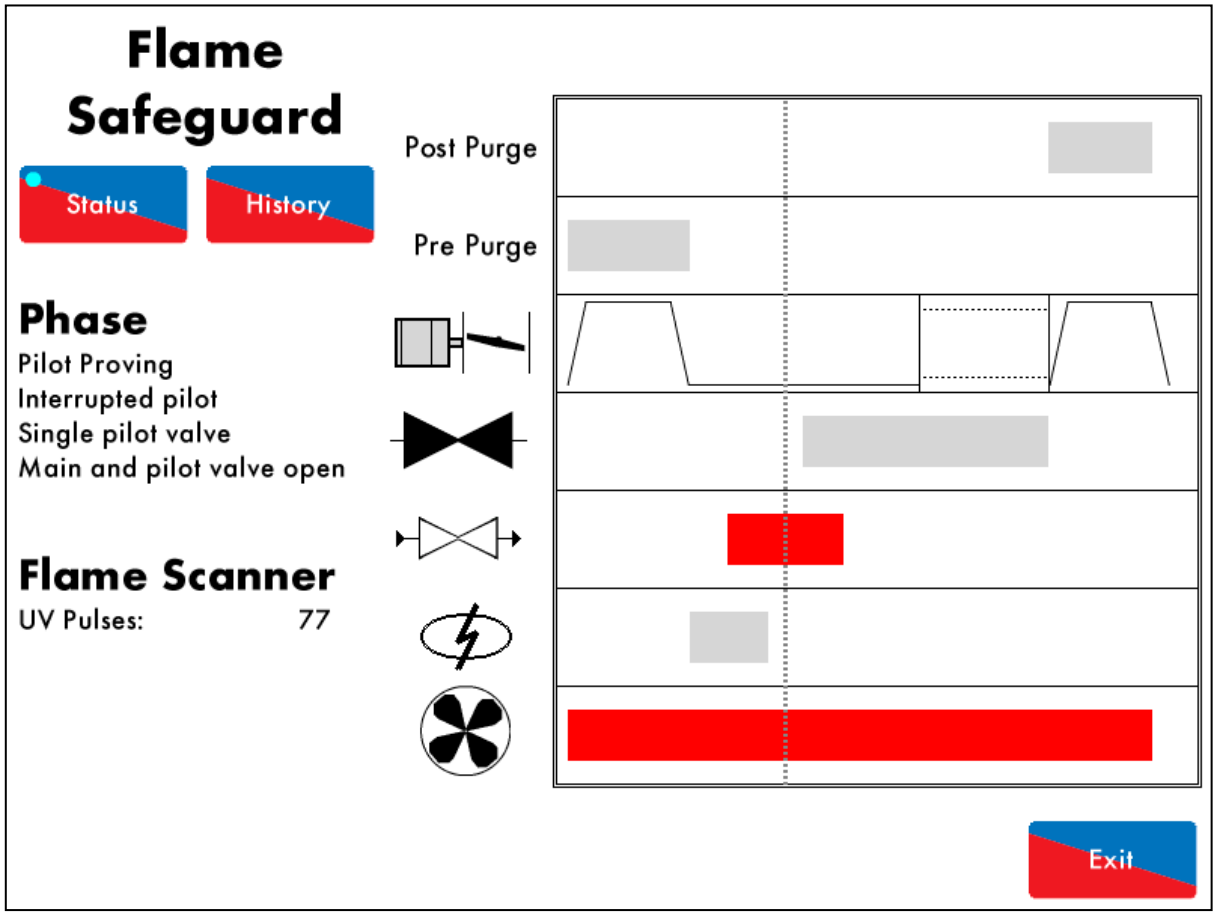


Figure 9.9.iii Pilot Proving

The ignition transformer output is switched off after the pilot ignition, in the Pilot Proving phase shown in Figure 9.9.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 options/parameters 115 and 120.

9.10. Proving

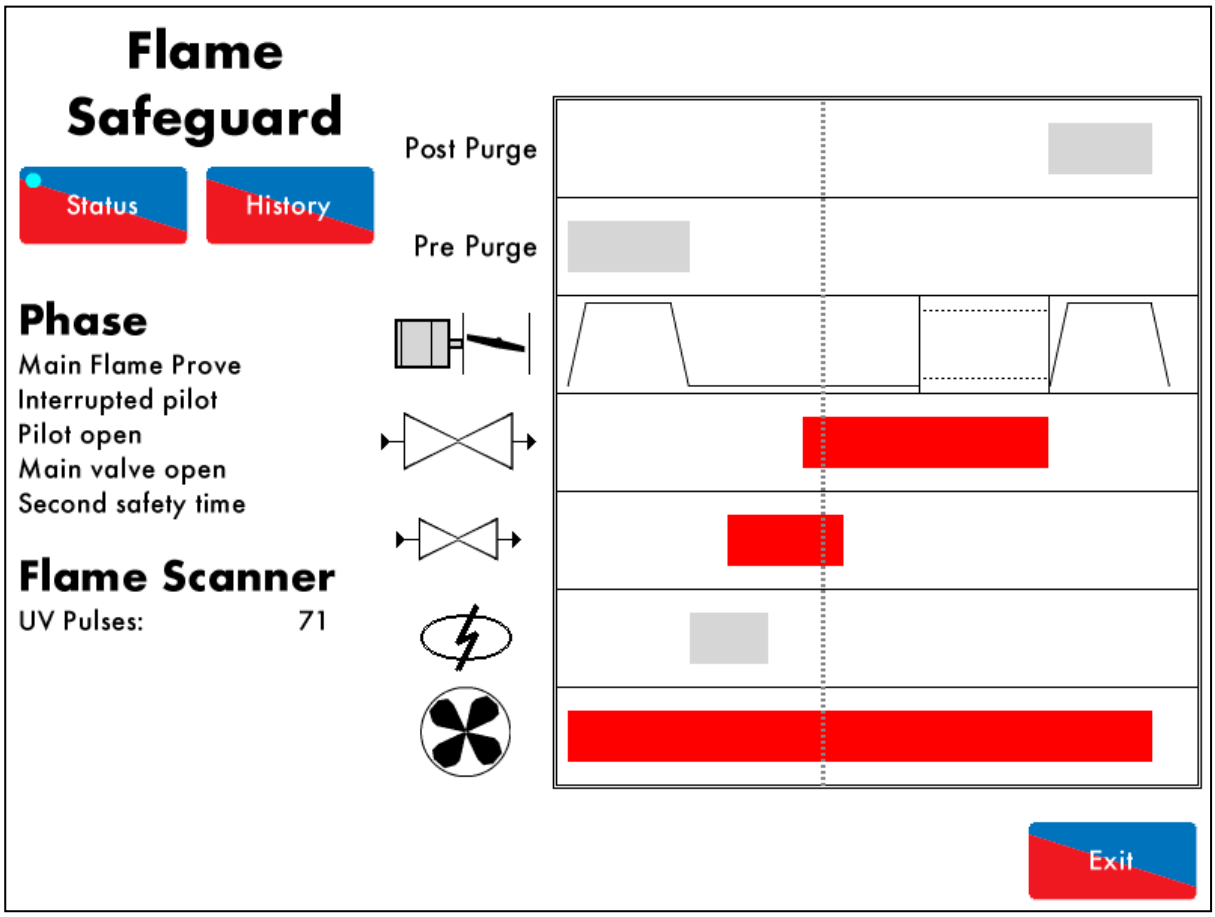


Figure 9.10.i Main Flame Prove Second Safety Time

The 2nd safety time begins, where the flame is not checked in the Interrupted Pilot 2nd Safety phase shown in Figure 9.10.i.

The 2nd safety time is the period where the pilot/main valves opening, 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.

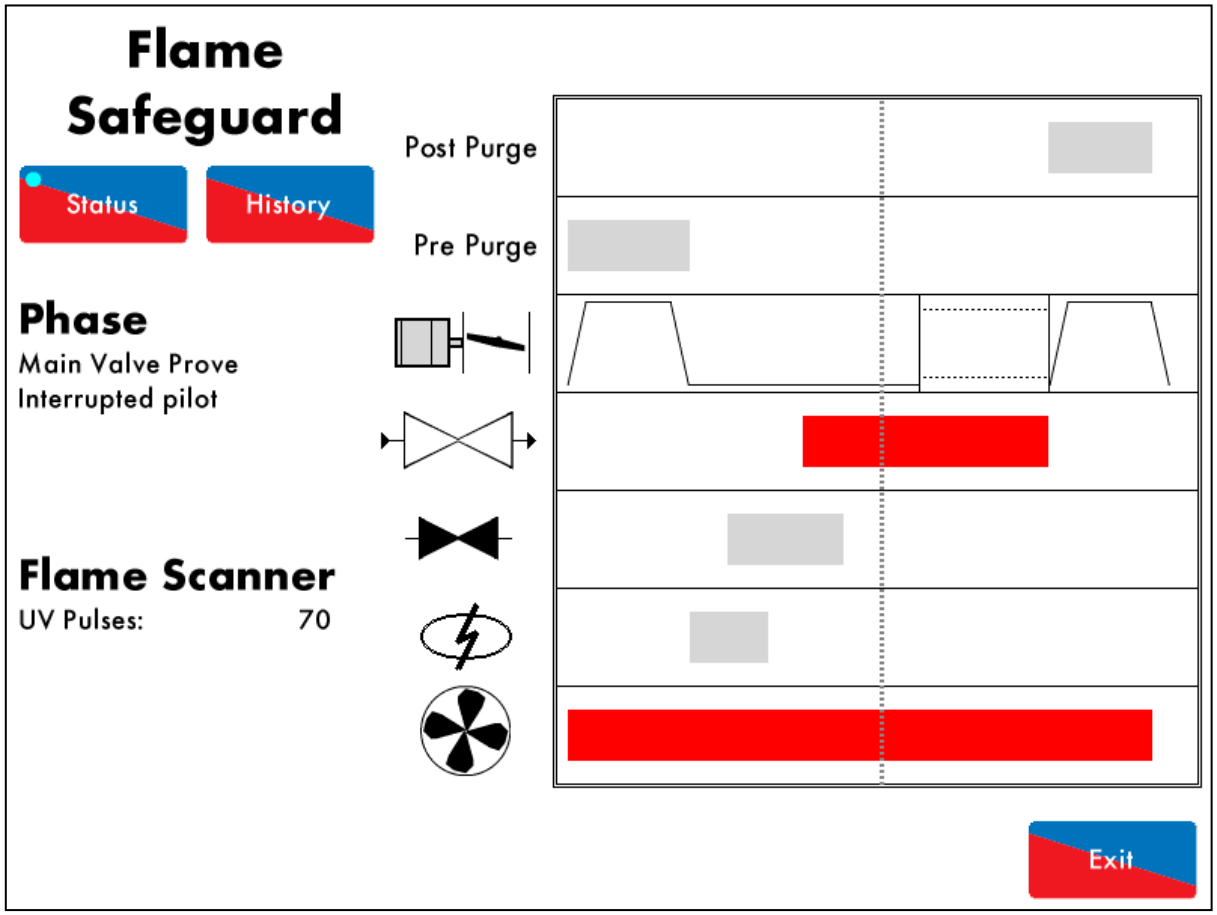


Figure 9.10.ii Main Flame Prove

In the Interrupted Pilot Main Prove phase shown in Figure 9.10.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. If the main flame fails now, the lockout 'No Flame Signal' will occur. See option/parameter 117.

After the second safety time, the gas pressure limits are checked in the main flame proving phase, see options/parameters 136 and 137.

9.11. Firing

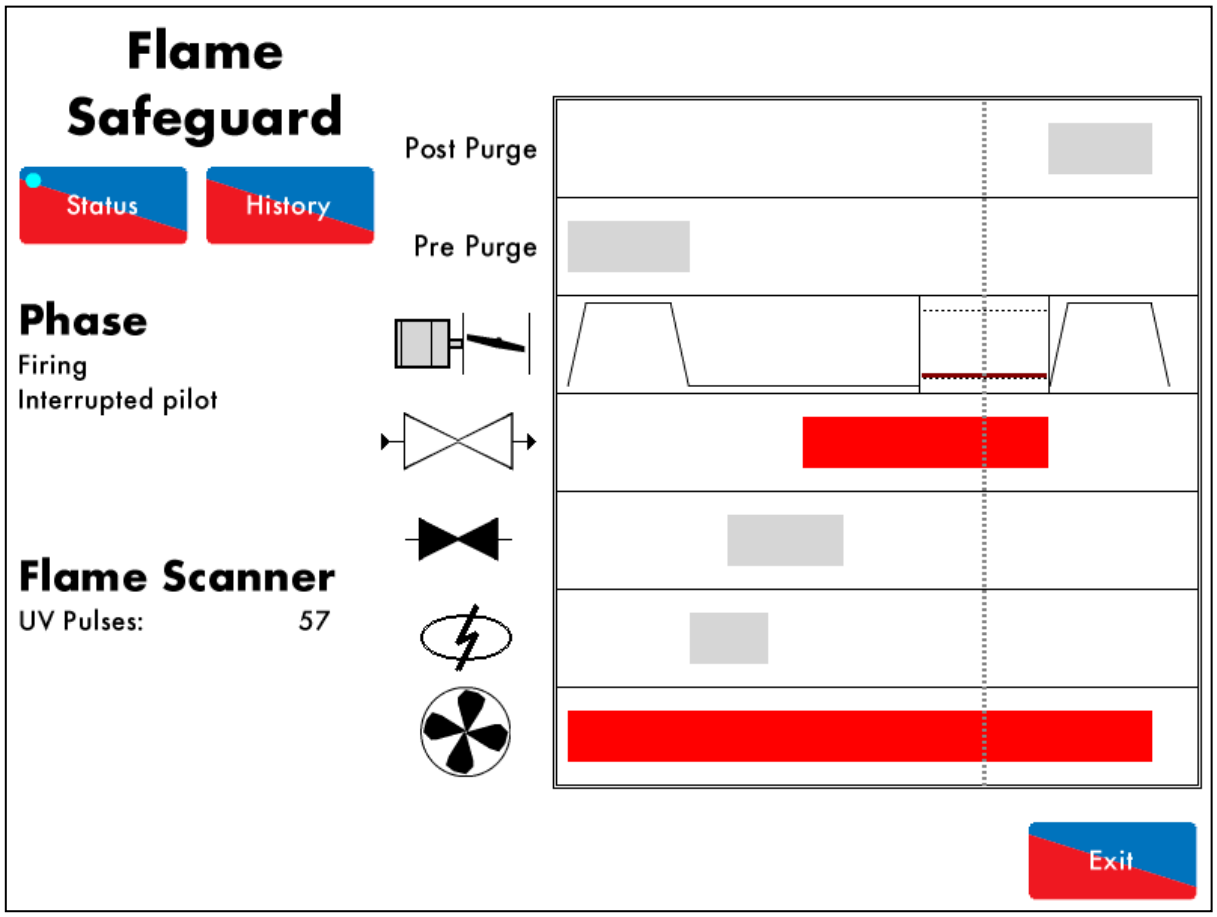


Figure 9.11.i Firing

The burner has now completed the start-up sequence and fires normally according to its set operation in the Firing phase shown in Figure 9.11.i. If using internal PID, the burner will modulate its firing rate up and down based on how far away its actual temperature/pressure is from meeting the required temperature/pressure.

The gas and air pressure limits are continually monitored in this example. If the gas pressure exceeds the upper limit or is below the lower limit, the lockouts ‘Gas Pressure High’ or ‘Gas Pressure Low’ will occur, respectively. If the air pressure is outside of the limits, the lockout ‘Air Pressure Out of Window’ will occur. See options/parameters 136, 137 and 147.

9.12. Post Purge

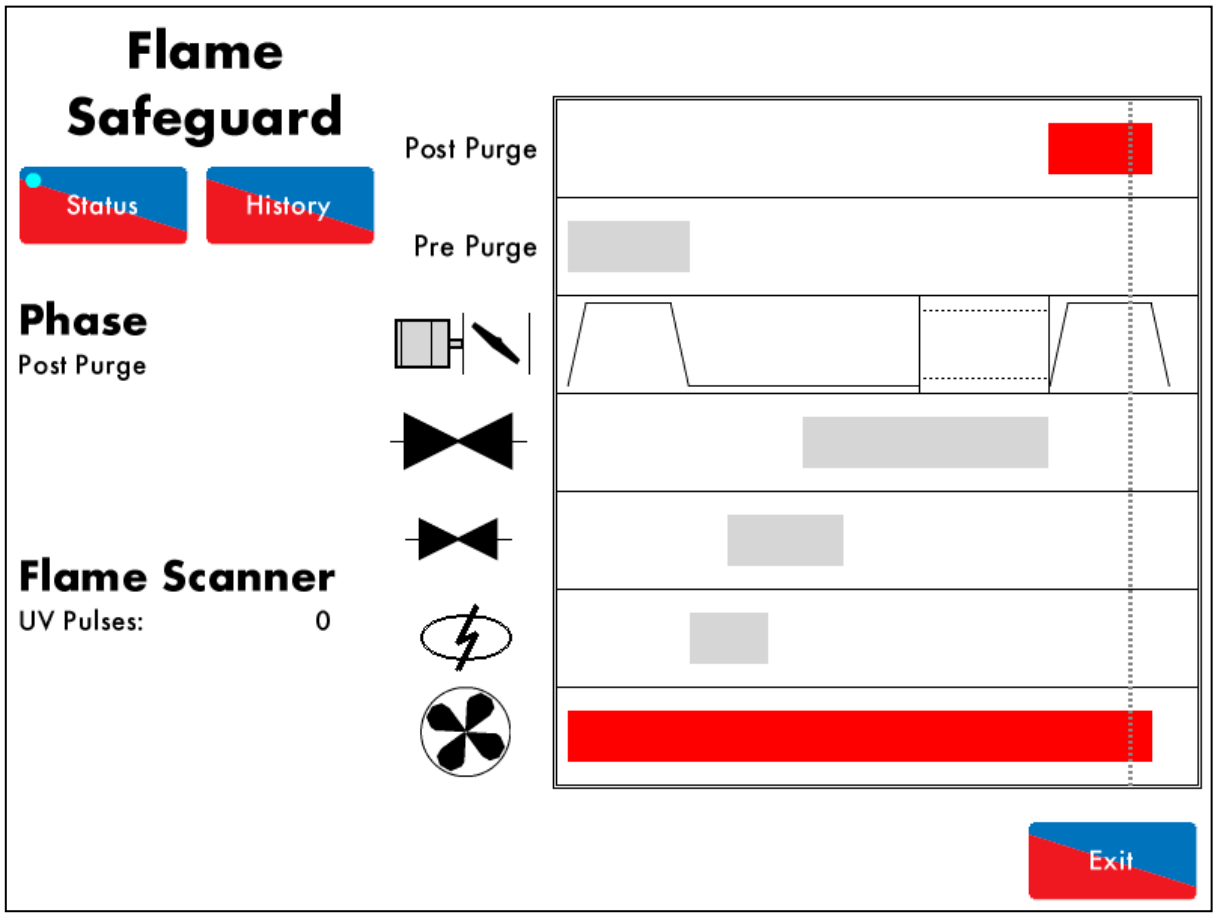


Figure 9.12.i Post Purge

The Post-Purge phase shown in Figure 9.12.i is optioned in this example. When T53 is switched off and the burner is off, the MM will purge fresh air through the burner/boiler, when the burner shuts down in normal conditions (internal/external stat). The outputs of the main gas valves 1 and 2, and the pilot valve are switched off (closed). See options/parameters 118 and 135.

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

After Post-Purge, the MM will go back to the Recycle phase, the burner start-up sequence will continue 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, if optioned.

9.13. Burner Control Sequence Diagrams

The time to achieve safety shutdown where a fault is detected is within 4 seconds. The resulting safety shutdown state is defined by the shut-off valve terminals being de-energised.

The maximum flame failure response time is 1second.

Diagram Notes

If VPS is not optioned on the fuel selected, the VPS phases are bypassed.

Point idle – this phase is set at power up when no fuel selected on exit from lockout.

Point recycle – this phase is set on exit from firing and post purge if VPS has not operated after burner run.

Point post purge – this phase is set only if post purge is optioned.

Point standby – this phase is set if VPS has operated after burner run.

Normal lockout is reset when either the mains lockout reset input is set for 2 seconds or the display screen lockout reset button is pressed for 2 seconds.

Prolonged lockout reset is set if either the mains lockout reset input or display screen lockout reset input is set for 10 or more seconds. Normal lockout is set on exit from permanent lockout reset after 20 seconds and is reset in the normal way.

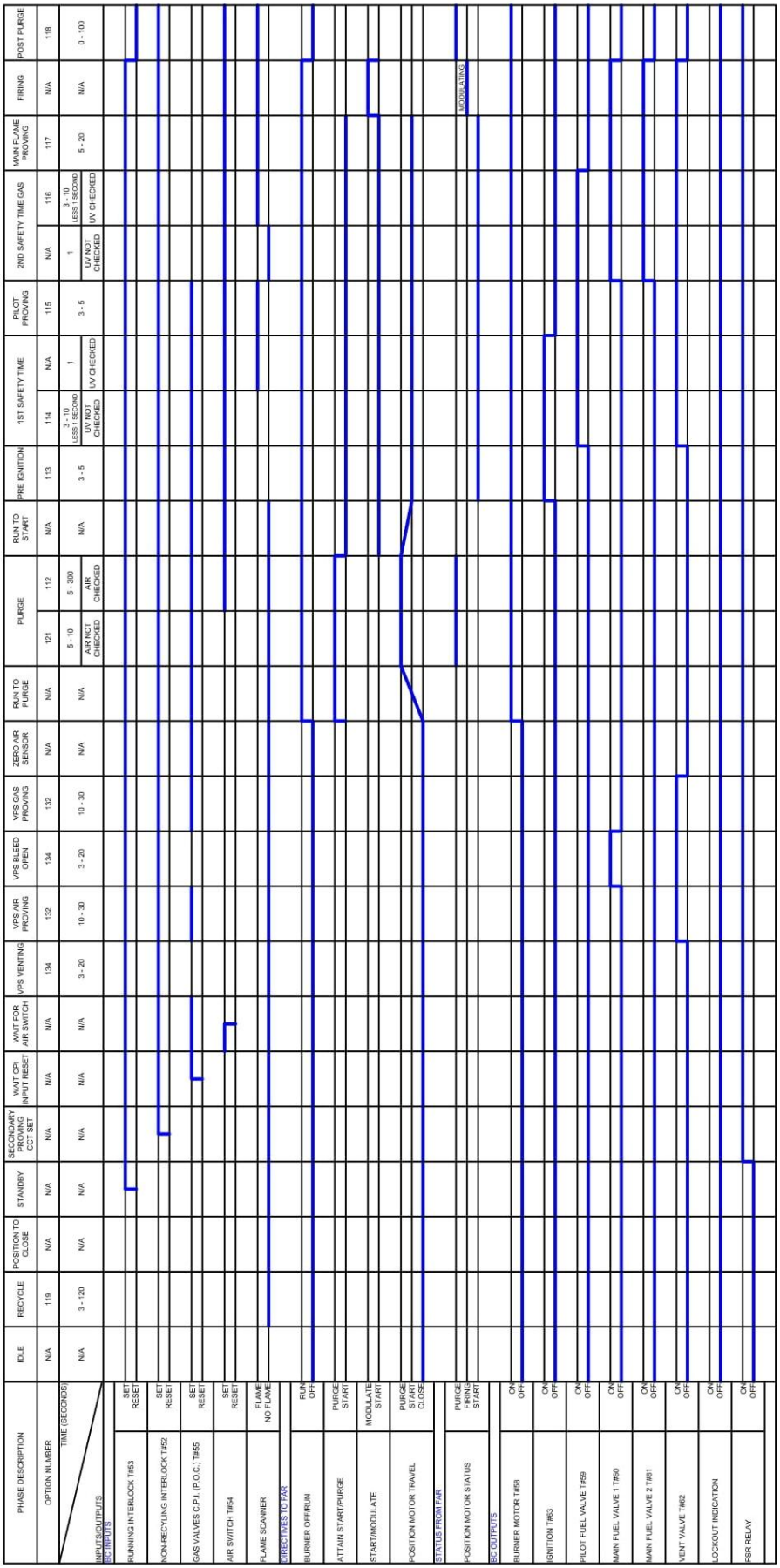
Blue waveforms indicate required condition. Values above/below waveform are time in seconds that the state must be continuously incorrect after which a lockout is set. If the waveform is not bold then the status is not important.

The following burner control sequence diagrams are shown with example timings:
- 3 second window (±1 second) for UV detection for simulated flame
- 1 second window for UV loss for flame failure
- 3 second window (±1 second) for CPI loss for CPI input wrong state/ no CPI reset
- 3 second window (±1 second) for air switch loss for no air proving

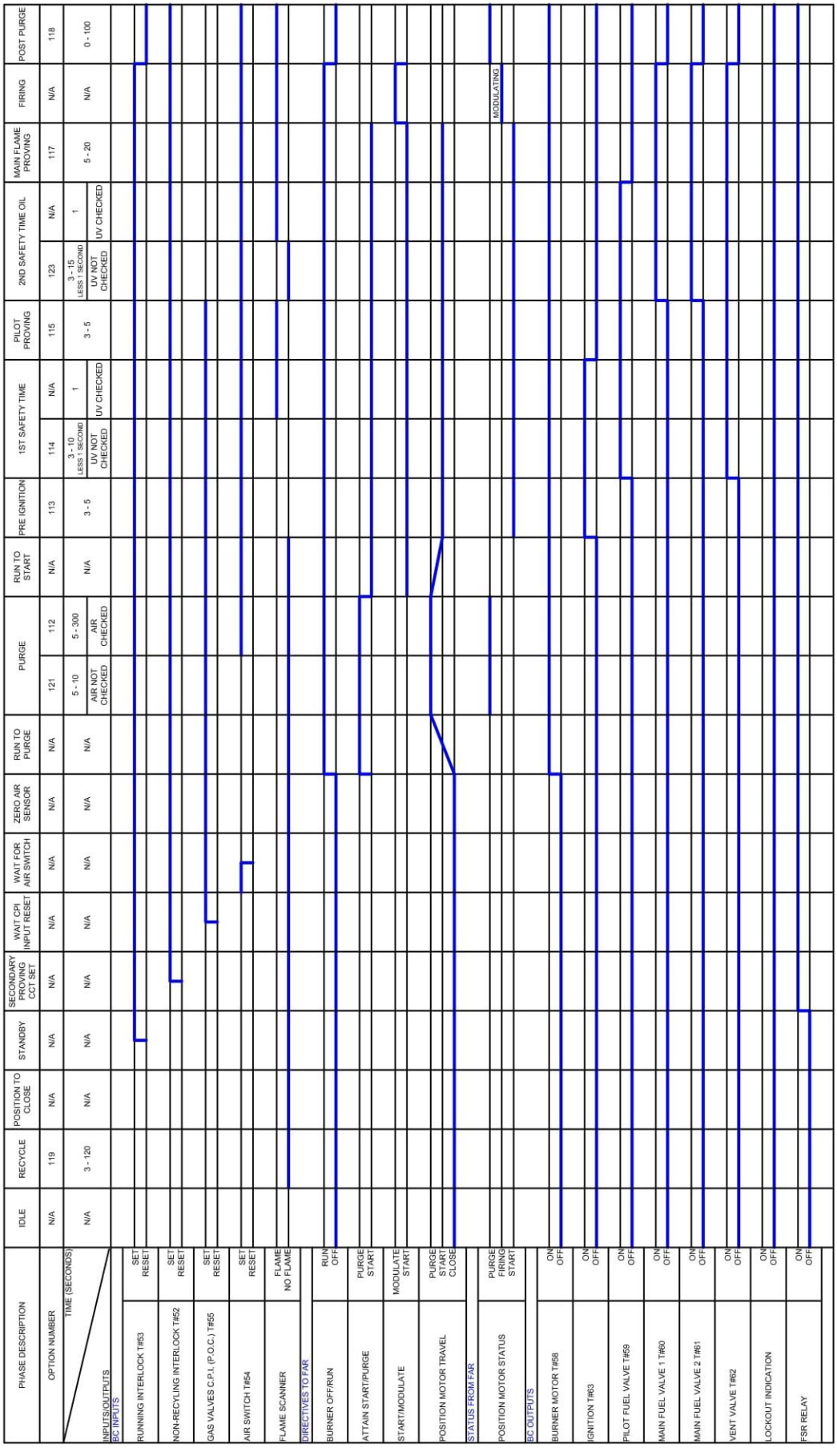
The Mini Mk8 MM has the following default timings:

Burner control default timings	Seconds
Flame failure response time	< 1
Time to achieve safety shutdown	< 4
Time to achieve lockout	< 1

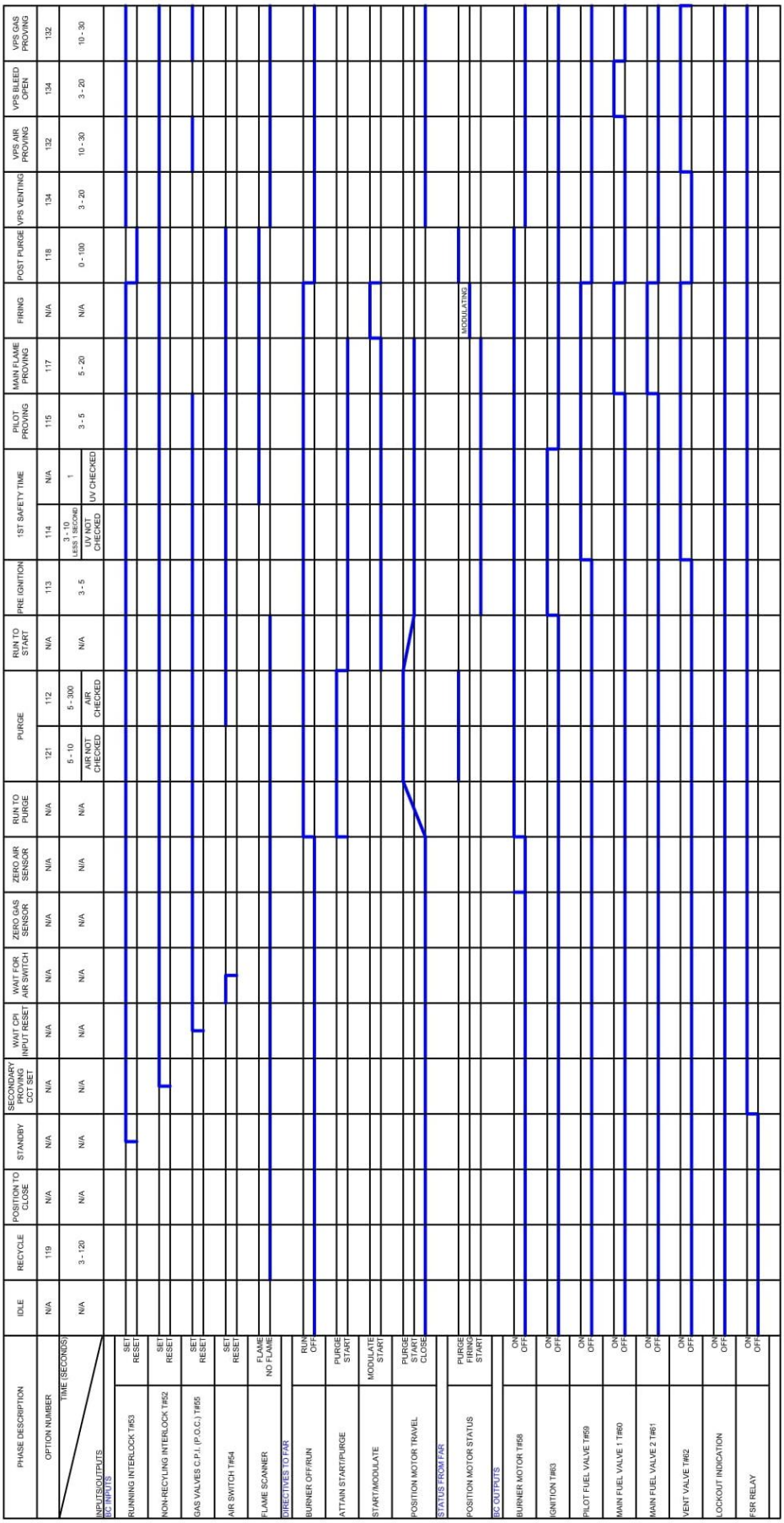
9.13.1. Interrupted Pilot – Gas



9.13.2. Interrupted Pilot – Oil



9.13.3. Intermittent Pilot – Gas with Post VPS



10. ERRORS AND LOCKOUTS

10.1. Errors

Errors occur when the MM detects an internal fault, component out of range, internal check failure or power supply issue. To clear an error, the MM must be restarted.

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 options/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		

10.2. Lockouts

Lockouts occur when the MM 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 MM.

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 options/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 be 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 options/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 options/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 options/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		

10.3. 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

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		
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		

Fault	Message	Description
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		
57	High Limit Setpoint Breached	Actual Setpoint is above the Internal High limit Setpoint
• Alarm • Check internal setpoint and parameter 28		

*When option 12 is set to 3 for trim and combustion limits, the combustion limits are evaluated once per trim cycle. A combustion limit error will occur if the current exhaust value has crossed the combustion limit for the number of trim cycles set in parameter 17 (the default value is 3 cycles).

10.4. Setting Conflicts

Some of the option/parameter values may require another option/parameter to be set, as described in the table below. The MM will be forced into Commission Mode.

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 options 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 options/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 options/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 options/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 options/parameters 118 and 135
(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 options/parameters 118, 141 and 149.

Setting Conflict Message
(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 options/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 options/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 options/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 options/parameters 126 and 151
(128) (156) T82 is not 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 options/parameters 128 and 156.
(P28) (9) High Limit Setpoint requires Stat-On Offset below setpoint.
• If High limit setpoint is enabled, option 9 must be configured to operate below setpoint (setting 1) • Check parameter 28 & option 9
(P28) (9) High Limit Setpoint cannot be used when internal stat is disabled.
• If High limit setpoint is enabled, option 9 must be configured to operate below setpoint (setting 1) • Check parameter 28 & option 9
(P32) (P33) Invalid user setpoint configuration.
• The user setpoint maximum value (P33), must be higher than the minimum value (P32). • Check parameters 32 & 33
(P80) (1) Return Delta Temperature Limit Requires Temperature Load Sensor
• If return delta temperature is enabled, Option 1 must be set for a temperature load sensor. • Check parameter 80 & option 1
(P80) (80) Return Delta Temperature Limit cannot be used with Outside Temperature
• If return delta temperature is enabled, Option 80 must be disabled. • Check parameter 80 & option 80
(P80) (P81) Return Delta Temperature Restart Limit must be less than Shutdown Limit
• The return delta temperature restart limit (P81) must be lower, than the return shutdown limit (P80). • Check parameters 80 & 81
(P80) (P82) Return Delta Temperature Turndown Threshold must be less than Shutdown Limit
• The return delta temperature turndown (P82) must be lower, than the return shutdown limit (P80). • Check parameters 80 & 82
(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

Setting Conflict Message
(109) (155) Flame Safeguard Mode requires Purge Position Interlock
• If Flame Safeguard mode is enabled, Purge position interlock must be enabled. • Check option/parameter 155
(109) (154) Flame Safeguard Mode requires Start Position Interlock
• If Flame Safeguard mode is enabled. Start position interlock must be enabled. • Check option/parameter 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/parameter 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

10.5. Forced Commission

The MM will be forced into Commission mode if there is a setting conflict and/or one or more of the following conditions occurs:

Forced Commission Message
Fuel not commissioned. • Selected fuel must be commissioned.
Servo configuration does not match commissioning. • The number of servomotors selected does not match the last commission settings. • Check option 8.
VSD configuration does not match commissioning. • The settings for VSD channel 4 do not match the last commission settings. • Check options 90, 91 and 95.
Golden Start optioned but not commissioned. • Golden Start has been optioned but not set in the last commission settings, see section 3.4.8. • Check option 29.
FGR optioned but not commissioned. • FGR start has been optioned but not set in the last commission settings, see section 3.4.9. • Check options 48, 49 and 50.
EGA fuel/air-rich trim ranges changed. • EGA trim range does not match last commission settings. • Check parameters 13 and 19.
BC option/parameter mismatch. • There is a mismatch in the BC options/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.
VPS sensor not commissioned. • Gas pressure sensor has been enabled but not commissioned. Perform a gas pressure commission or a full re-commission.
Commissioned gas pressure during valve proving too low. • Gas pressure stored during valve proving is less than option/parameter 133.
Commissioned running gas pressure too low. • Gas pressure at one or more commissioned points is less than option/parameter 136.
APS sensor not commissioned. • Air pressure has been enabled but not commissioned. Perform an air pressure commission or a full re-commission.
Commissioned air pressure too low. • Air pressure at one or more commissioned points is less than options/parameters 147 and/or 149.

Forced Commission Message
VSD feedback variation too small
• VSD feedback variation is within optioned tolerance band meaning that a constant value can pass for any point on the curve. • Check option 99.
Air channel configuration does not match commissioning
• Air channel selected does not match the last commission settings. • Check option 4.
IR Upload was completed successfully, check configuration then restart.
• Check data has uploaded successfully before restarting in run mode.

MINI MK8 MM MANUAL
MMM8002
23.02.2026

Autoflame Engineering LTD
Unit 1-2, Concorde Business Centre
Airport Industrial Estate, Wireless Road
Biggin Hill, Kent TN16 3YN
United Kingdom

Tel: +44 (0)1959 578 820
Email: technicalsupport@autoflame.com
Website: www.autoflame.com

AUTOFLAME®
Combustion Management Systems