Mini Mk8 MM

Installation and Commissioning Guide

AUTOFLAME®

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THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2007

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Important Notes

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

Short Form - General Terms and Conditions

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

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

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

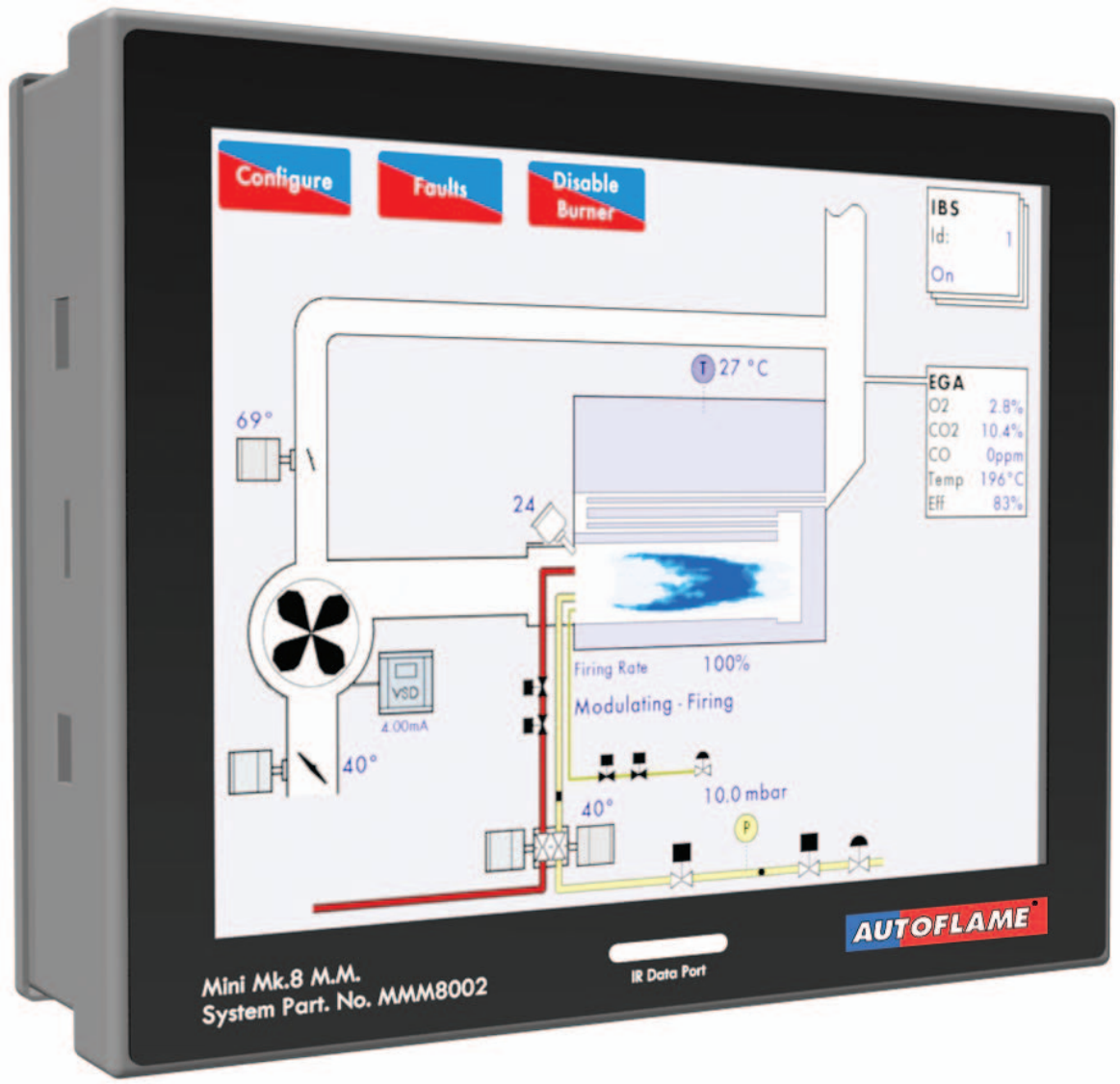
Autoflame's warranty from point of sale is two years on all electronic systems and components.
One year on all mechanical systems, components and sensors.

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.

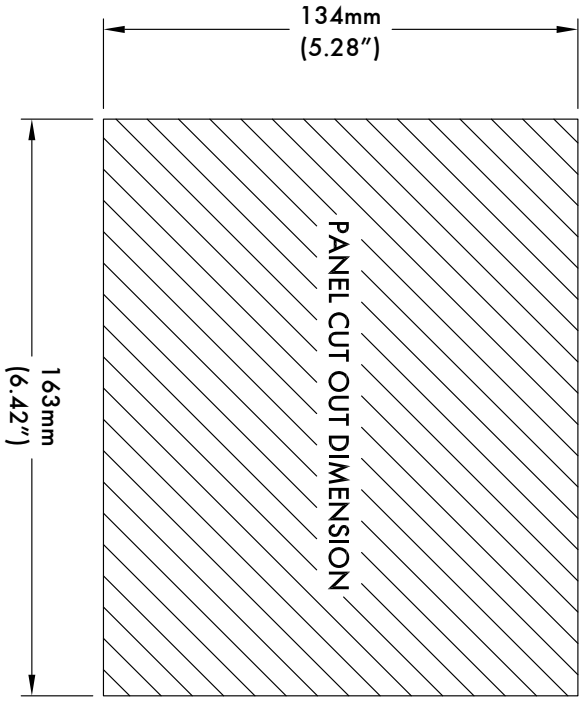
Contents

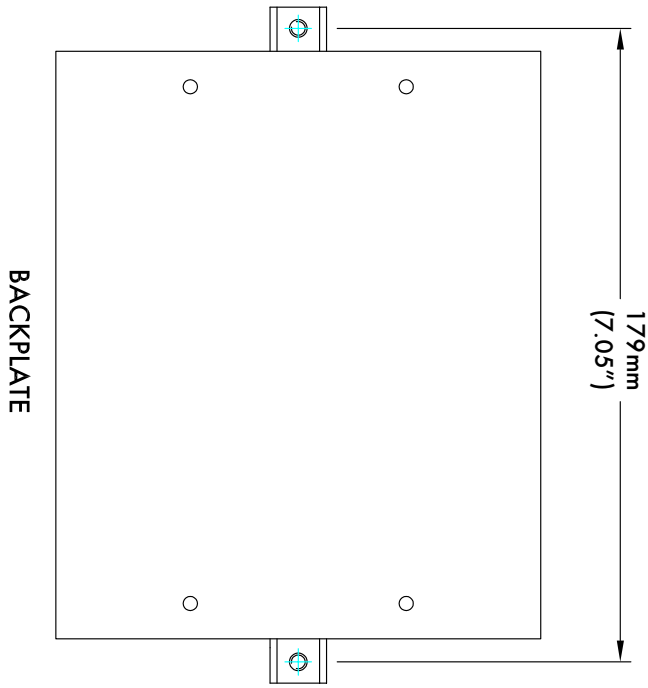
1 DIMENSIONS AND WIRING

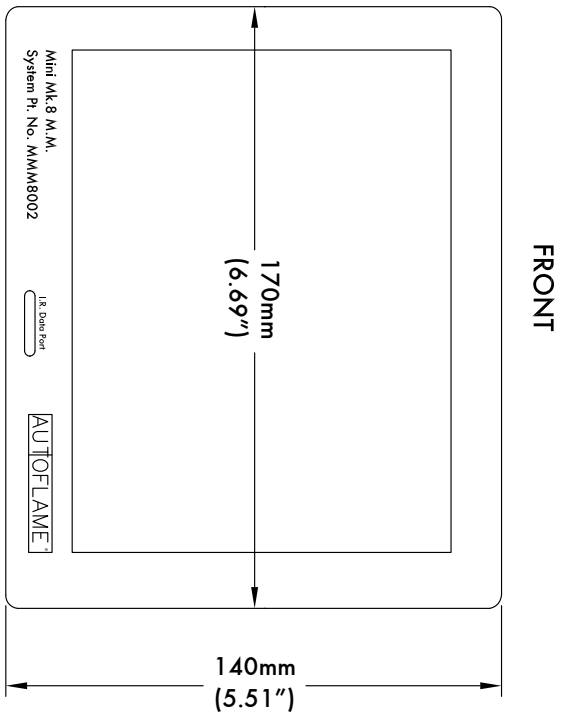
1.1 Mini Mk8 MM

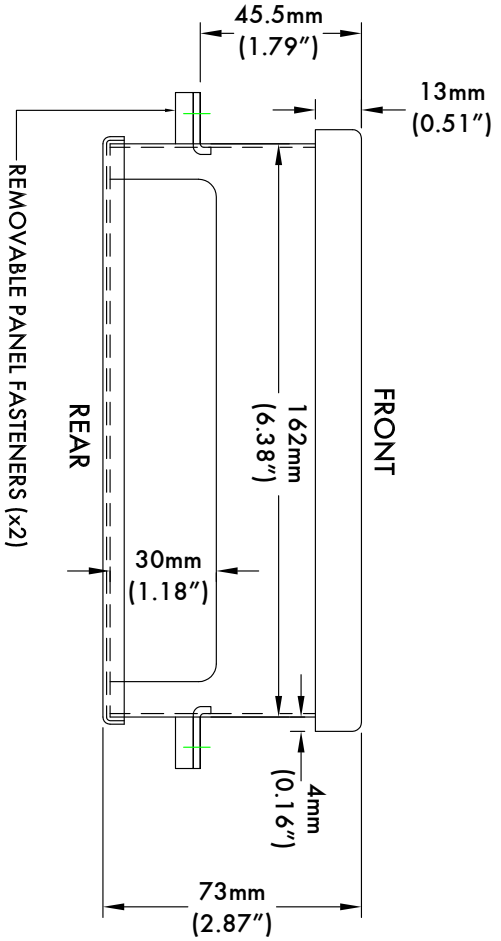


1.1.1 Fixing Holes and Dimensions

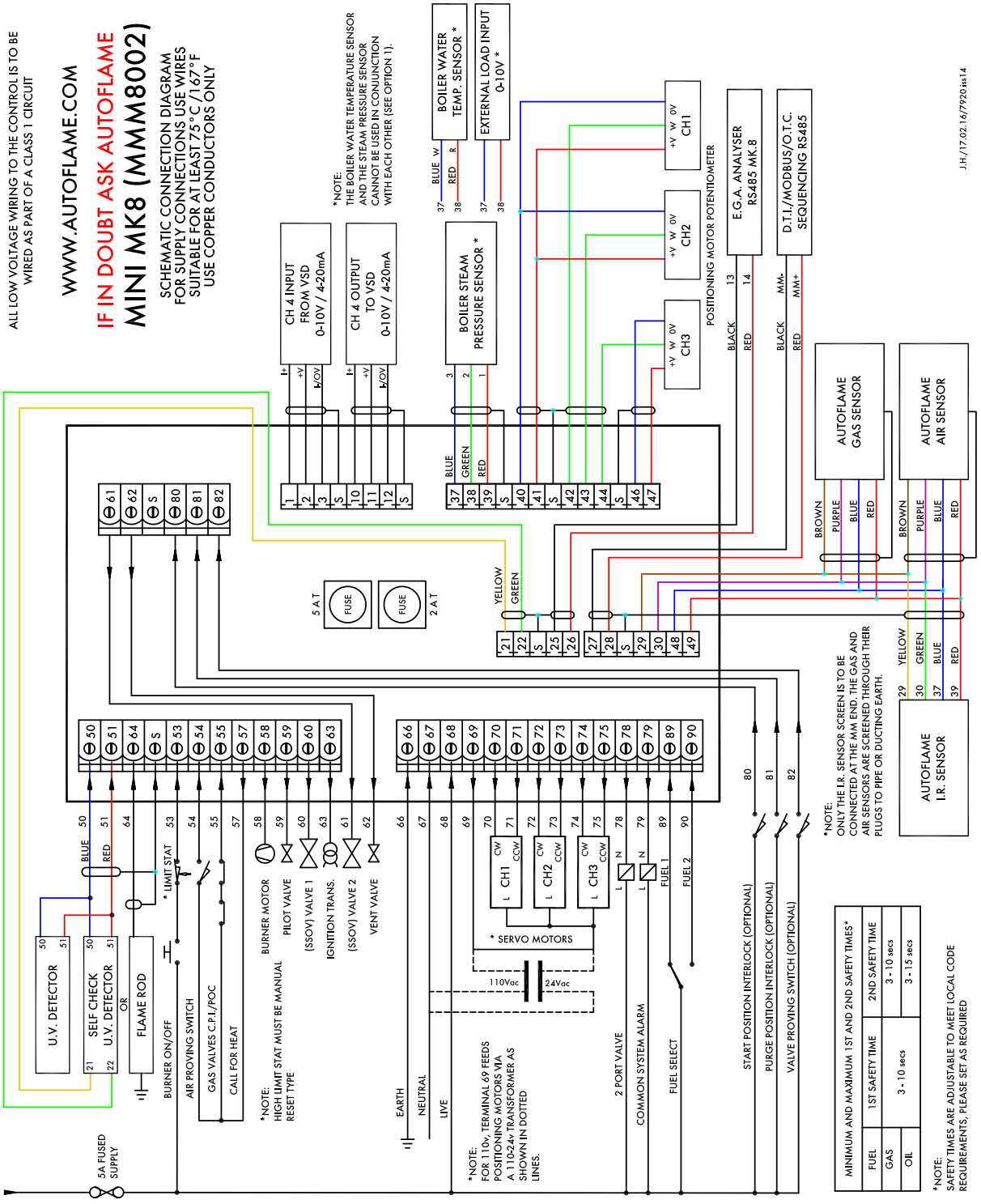








1.2 Wiring Schematic



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	0°C (32°F)
	Recommended Temperature	Less than 40°C (104°F)
	Max. Temperature	60°C (140°F)
	Humidity	0 to 90% non-condensing
Storage:	Temperature	-20 to 85°C (-4 to 185°F)

Protection Rating: The unit is designed to be panel mounted in any orientation and the front facia is IP65, NEMA4. The back of the unit is IP20, NEMA1.

1.3.2 Inputs and Outputs

Inputs and Outputs

230V Unit:

Outputs	Terminal	57	250mA	Must be connected through contactor	
		58	250mA	Must be connected through contactor	
		59	1A	0.6 power factor	
		60	1A	0.6 power factor	
		61	1A	0.6 power factor	Max Load 5A
		62	1A	0.6 power factor	
		63	1A	0.6 power factor	
		78	100mA	To drive relay only – switched neutral	
		79	100mA	To drive relay/lamp only – switched neutral	

120V Unit:

Outputs	Terminal	57	250mA	Must be connected through contactor	
		58	250mA	Must be connected through contactor	
		59	2A	0.6 power factor	
		60	2A	0.6 power factor	
		61	2A	0.6 power factor	Max Load 5A
		62	2A	0.6 power factor	
		63	2A	0.6 power factor	
		78	100mA	To drive relay only – switched neutral	
		79	100mA	To drive relay/lamp only – switched neutral	

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 cable as specified in section 1.3.3.
- The burner 'High Limit Stat' must be a manual reset type.
- There is a lid (back plate) fitted onto the back of the Mini Mk8 MM with a Warning label to prevent any unauthorised fuse replacements.

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:

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

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

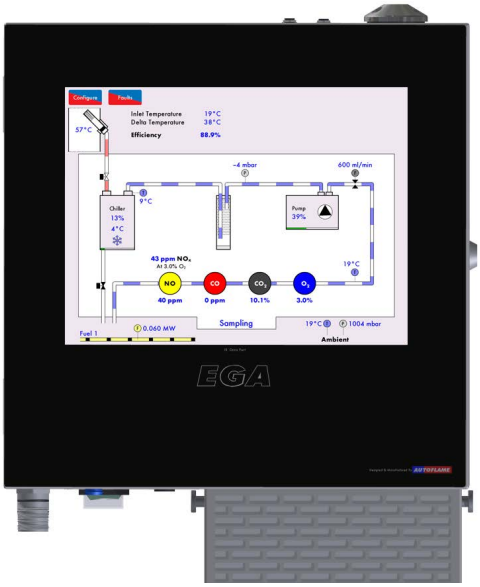
When using a VSD, please review the manufacturer's guidelines on installations to prevent EMC including the recommendations for reactors and filters.

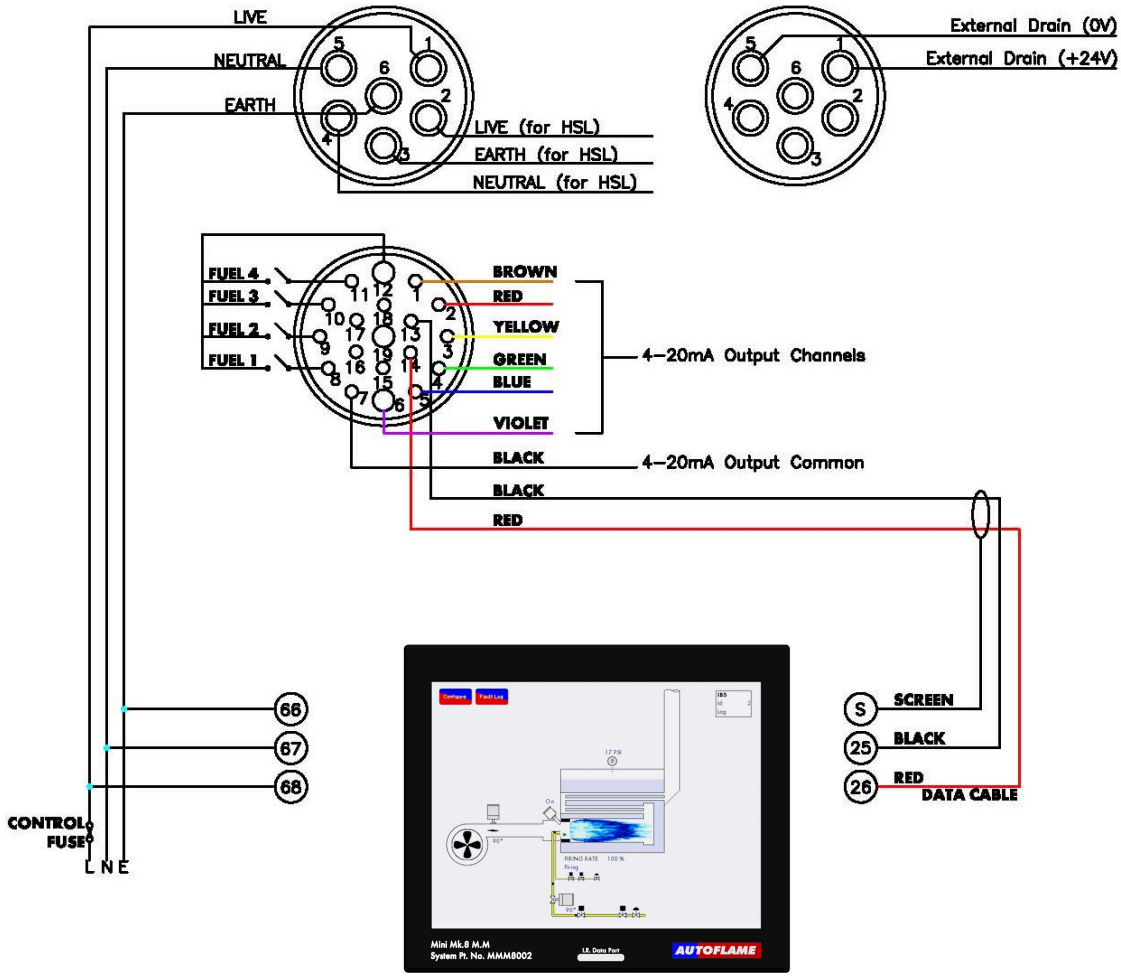
1.3.4 Terminals Description

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 (MM70017), Autoflame air pressure sensor and/or Autoflame gas pressure sensor
37	0V supply to an Autoflame temperature or pressure detector or 0-10V external modulation input
38	Signal input from an Autoflame temperature or 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 (MM70017), Autoflame air pressure sensor and/or Autoflame gas pressure sensor
50, 51	Connections to an Autoflame UV sensor

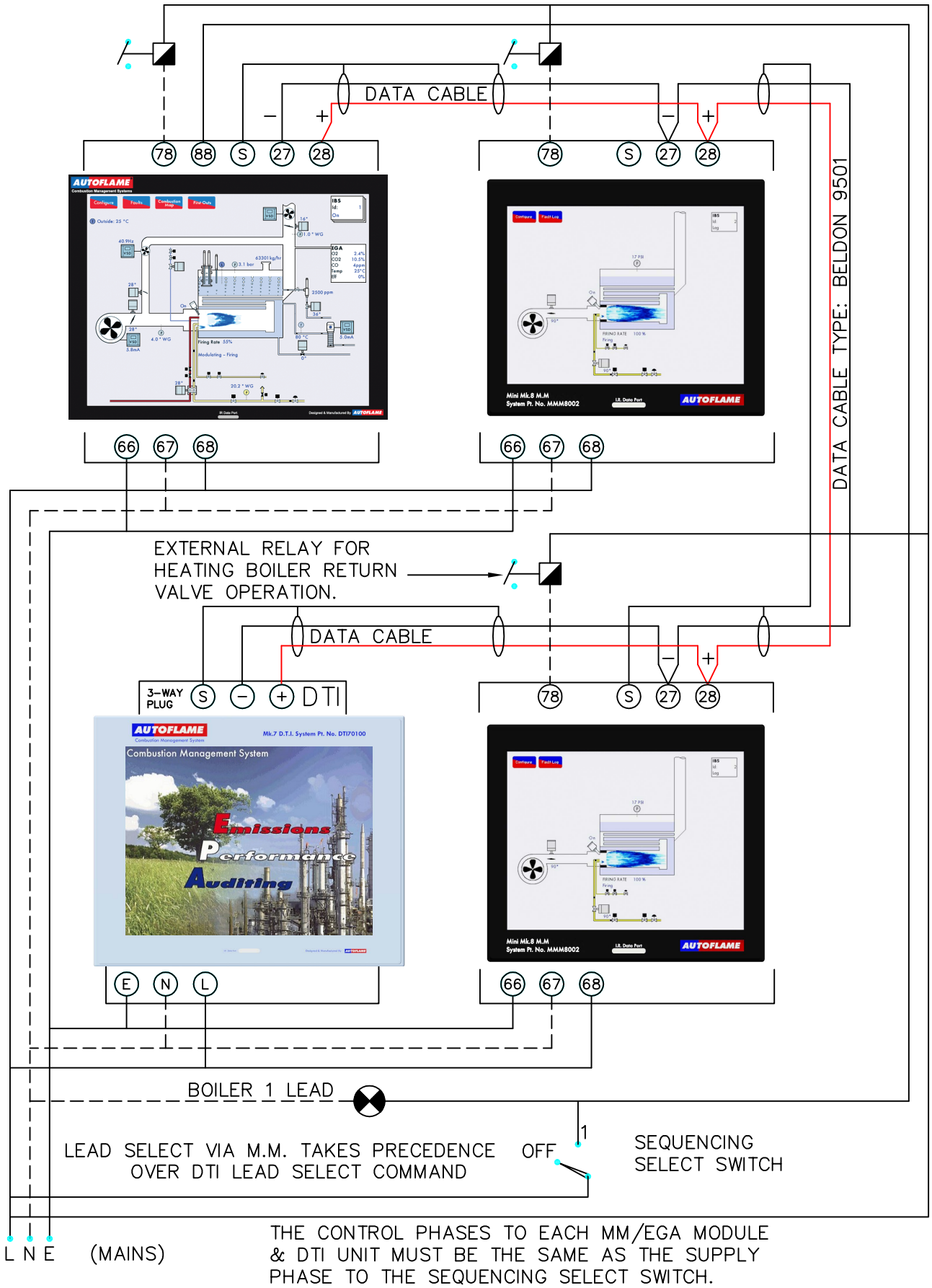
64	Connections to a flame rod
53	Mains voltage input – burner on/off signal, running interlock circuit
54	Mains voltage input – air proving switch
55	Mains voltage input - proving circuits, e.g. gas valve proof of closure
57	Mains voltage output – call for heat
58	Mains voltage output – burner motor
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 Connection Between Mini Mk8 MM and Mk8 EGA EVO

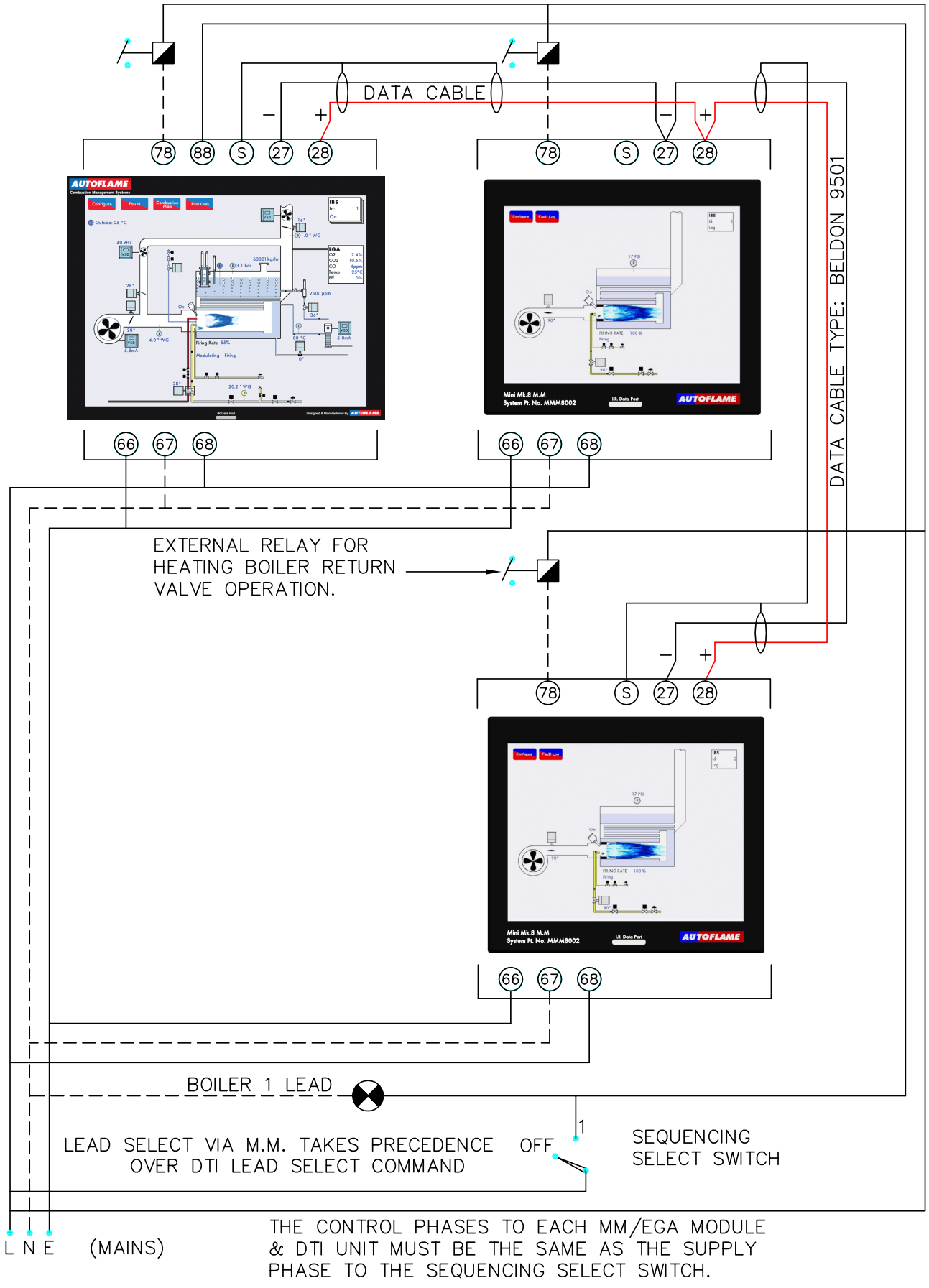




1.5 Connection Between Mini Mk8 MM and Mk7 DTI



1.6 Sequencing Connection Diagram



2 OPTIONS AND PARAMETERS

2.1 Options

Note: The Options and Parameters must only be changed by factory trained and certified technicians who have a thorough appreciation of the Autoflame combustion systems and the combustion process in general. Any person changing these set-ups who does not have the correct factory training and understanding of these settings/adjustments may place themselves and others in a potentially dangerous situation.

CH1, CH2, CH3 and CH4, refer to the rows of  **buttons respectively starting with CH1 at the top.**

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

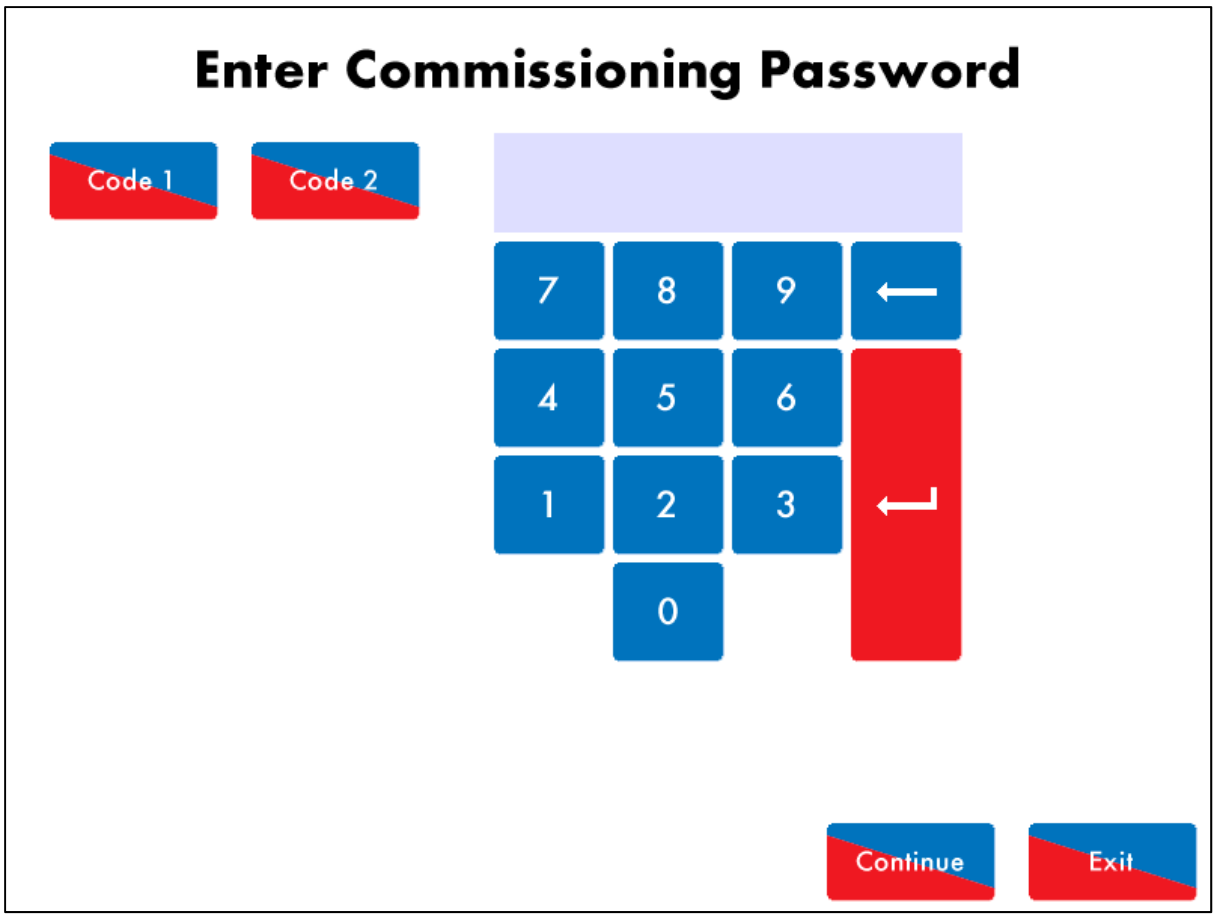


Figure 2.1.i Enter Password

"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.

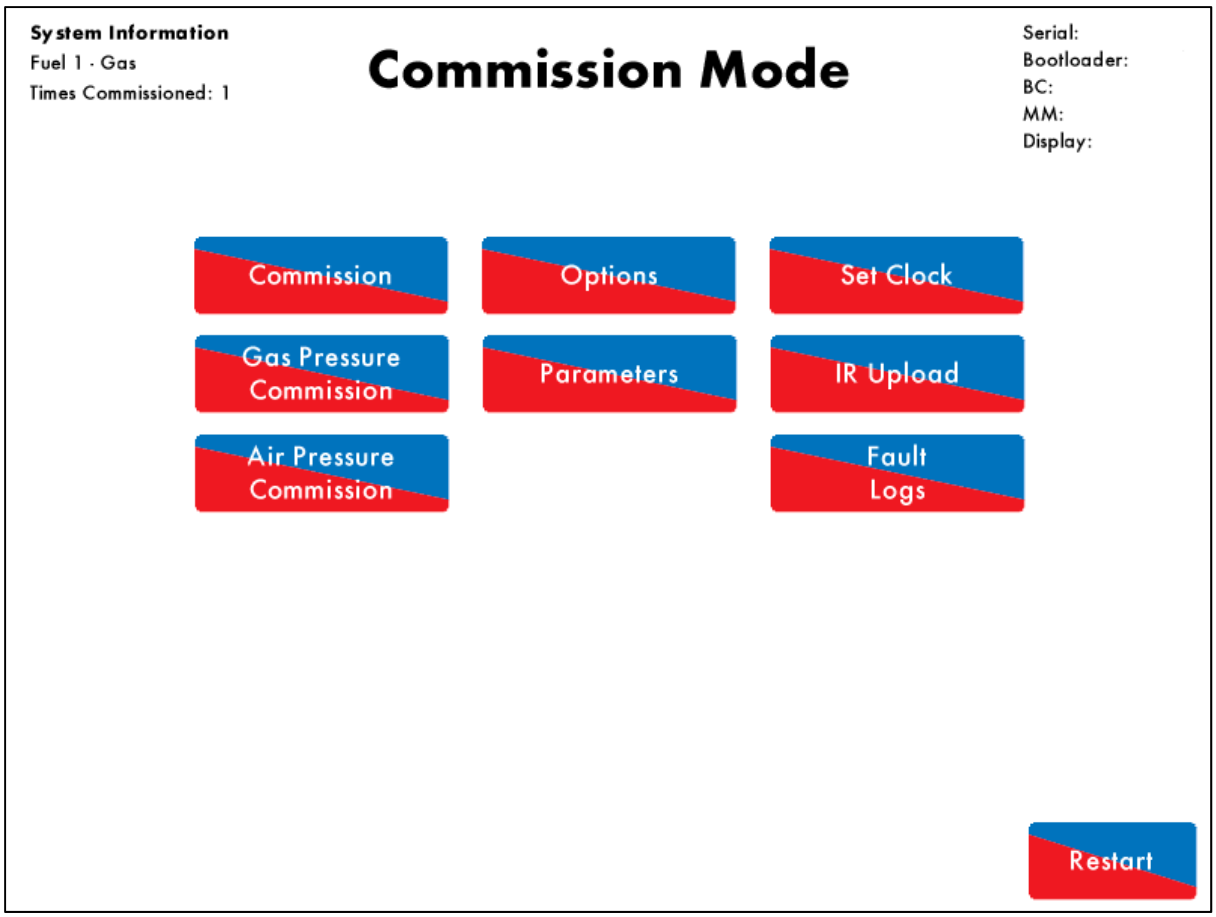


Figure 2.1.ii Commission Mode

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 and the fault logs can also be viewed.

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

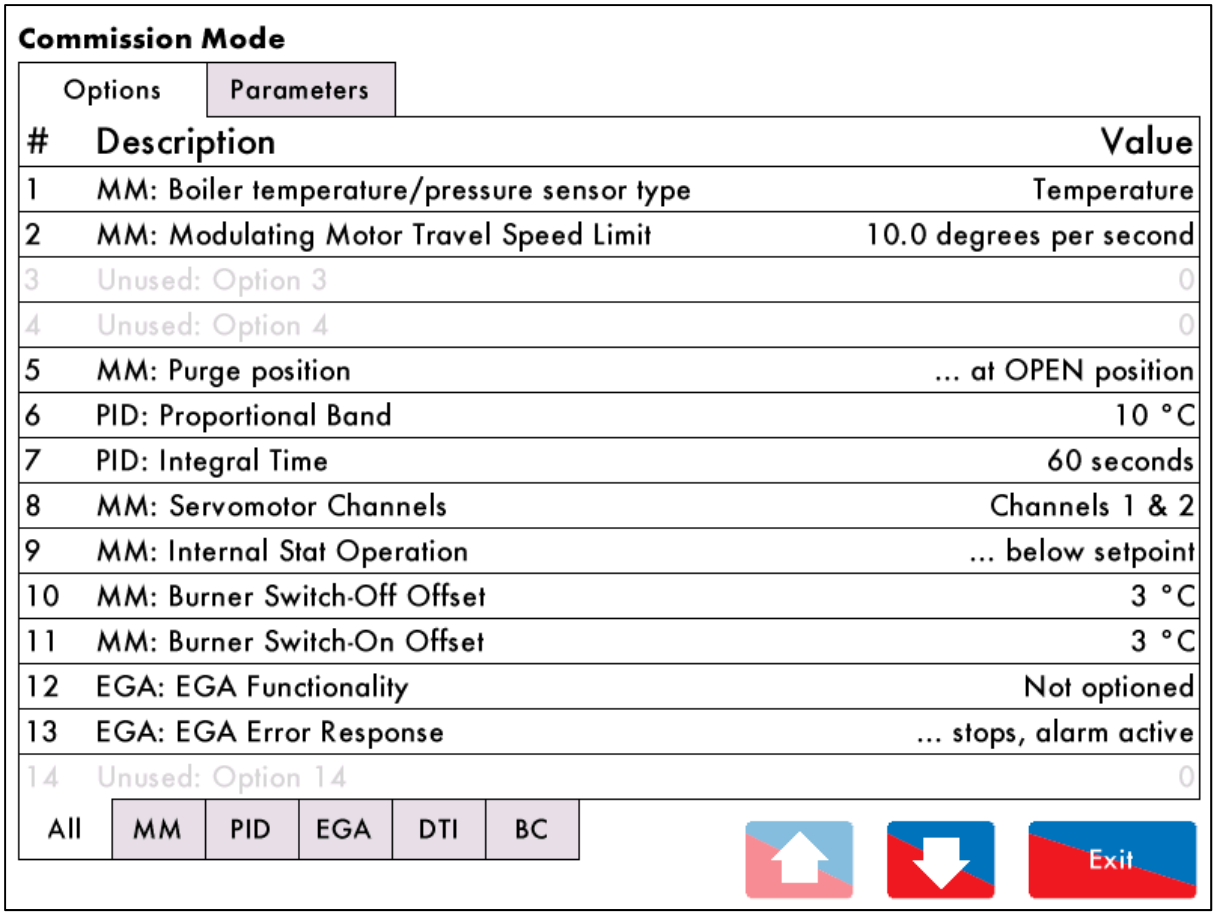


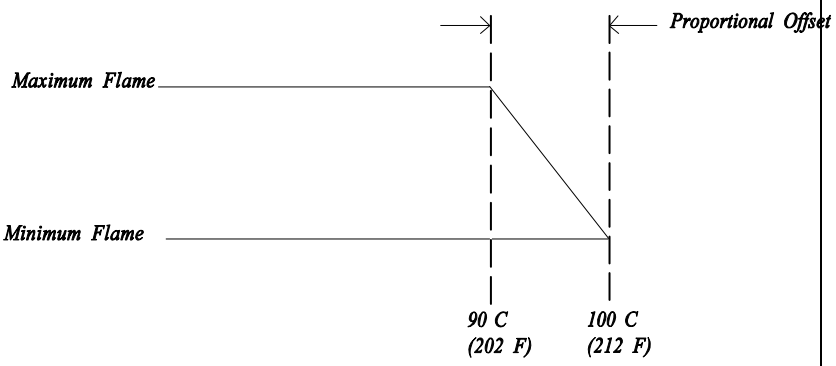
Figure 2.1.iii Options

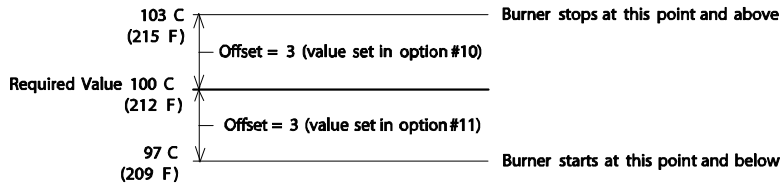
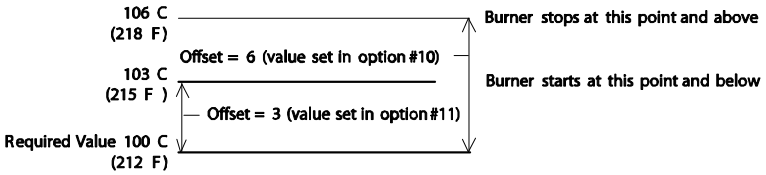
Any number of options and parameters can be changed at one time. By pressing MM, PID, EGA, DTI or BC at the bottom of the screen, the options/ parameters can be grouped together by feature.

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 the same 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.

Option	Default	Range	Description
1	0		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		Modulating Motor Travel Speed Limit
			If the speed of the motor is too fast, then decrease the value, and vice versa. At other times other than modulation, the motors move at full speed or at the value set in option 75. Movement is limited by the slowest channel i.e. the slowest moving motor.
		6 – 100	0.6 – 10.0
3	-		Unused
4	0		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 the channel 1 servomotor and air by the channel 4 VSD. For setting 2, premixed fuel and air is controlled by the channel 1 servomotor. The number of servomotors used is set in Option 8. Please refer to the MM Application Possibilities manual.
		0	Servo channel 2
		1	VSD channel 4
		2	No air channel
5	1		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	Channels 1 to 3 purge at HIGH position.
		1	Channels 1 to 3 purge at OPEN position.
6	10		Proportional Band
			The proportional band is on offset below the required setpoint; when the actual temperature/ pressure reaches this band, the burner will begin to modulate as it approaches the required setpoint.
			
		5 – 2000	°C, °F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in option 65)

Option	Default	Range	Description
7	60		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	Disabled
		1 – 250	Seconds
8	0		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 the MM Application Possibilities for single servomotor operation. See also option 4 to set the air channel mode.
		0	Channels 1 & 2
		1	Channels 1, 2 & 3
		2	Channel 1 only
9	1		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	Internal stat always closed
		1	Burner operates below setpoint
		2	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		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		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.*

Option	Default	Range	Description
12	0		EGA Functionality
			For settings 2 or 3, the E.G.A will trim on the channel 2 air damper, once trim data has been added. If option 12 is set to 0 or 1, then trim can be added at a later date by changing this to 2 or 3 in online changes, going through single point change, and added trim data for each fuel-air position.
		0	Not optioned
		1	Monitoring only
		2	Applies trim
		3	Applies trim, combustion limits tested
13	0		EGA Error Response
			This sets the MM operation on terminal 79 for when an EGA error occurs.
		0	On error burner stops, alarm active
		1	On error burner runs, alarm not active
		2	On error burner runs, alarm active
14	-		Unused
15	3		User Control
			This option sets whether the use 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		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
17	-		Unused
18	1		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		O_2 Upper Limit Offset
			If the current O_2 value is above this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 100	0.1% - 10.0% O_2
20	0		CO_2 Upper Limit Offset
			If the current CO_2 value is above this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 100	0.1% - 10.0% CO_2

Option	Default	Range	Description
21	0		CO Upper Limit Offset
			If the current CO value is above this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 200	1 – 200 ppm CO
22	0		O_2 Lower Limit Offset
			If the current O_2 value is below this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 100	0.1% - 10.0% O_2
23	0		CO_2 Lower Limit Offset
			If the current CO_2 value is below this offset limit from the commissioned value, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		0 – 100	0.1% - 10.0% CO_2
24	-		Unused
25	0		O_2 Absolute Limit
			If the current O_2 value is below this absolute limit, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 200	0.1% - 20.0% O_2
26	0		CO_2 Absolute Limit
			If the current CO_2 value is above this absolute limit, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 200	0.1% - 20.0% CO_2
27	0		CO Absolute Limit
			If the current CO value is above this absolute limit, an EGA error will occur, for option 12 set to 3. See option 13.
		0	Disabled
		1 – 200	1 – 200 ppm CO
28	20		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	°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)
29	0		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 from the point of main flame.
		0	Disabled
		1	Enabled

Option	Default	Range	Description
30	50		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. °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)
31	100		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. °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)
32	20		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		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
34	-		Unused
35	10		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 with data cable (Beldon 9501), screened at one end. Minutes
36	0		Sensor Selection (Mk7 EGA only)
		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		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		Derivative Deadband
		0 1 - 15	This deadband is the margin above and below the required setpoint in which no derivative control occurs. Disabled °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)

Option	Default	Range	Description
39	-		Unused
40	0		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		Warming Mode
			For setting 0, the first lag is kept in a standby state with the second lag in warming, and the remaining lag boilers off. For setting 1, the first lag boiler is in standby, and the remaining lag boilers are in warming.
		0	One MM in warming state
		1	All unused MMs in warming state
42	20		Standby Setpoint
			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	°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)
43	-		Unused
44	-		Unused
45	0		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
46	-		Unused
47	0		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

Option	Default	Range	Description
48	0		Flue Gas Recirculation – Timer
			This is the time that the MM channels (servomotors/ VSDs) are held at 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 – 600	Seconds
49	0		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 – 50	°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)
50	0		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°C (248°F). This option can only be used if an EGA is optioned and operational.
		0	FGR temperature threshold disabled
		1	FGR temperature threshold enabled
51	-		Unused
52	-		Unused
53	0		Steam Sequencing 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		Steam Sequencing 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
55	-		Unused
56	0		Alarm Output Operation (Terminal T79)
			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		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

Option	Default	Range	Description
58	15		Fuel Flow Metering Ignition Delay
			Fuel flow metering begins after the time delay set in this option has elapsed.
		0	Disabled
		1 – 240	Seconds
59	-		Unused
60	-		Unused
61	3725		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		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
63	-		Unused
64	-		Unused
65	0		Display Units
		0	Metric units
		1	Imperial units
66	0		Firing Rate Limit
			This is the maximum firing rate that can be obtained by the system, imposed in auto and hand modes. Firing rate limit is should not be used with DTI load index control or sequencing. The firing rate limit also applies to external modulation.
		0	Disabled
		1 – 100	%
67	1		Channel 1 Purge Position
		0	Channel 1 to purge position
		1	Channel 1 to remain closed for purge
68	0		Channel 2 Purge Position
		0	Channel 2 to purge position
		1	Channel 2 to remain closed for purge
69	0		Channel 3 Purge Position
		0	Channel 3 to purge position
		1	Channel 3 to remain closed for purge
70	-		Unused
71	-		Unused
72	-		Unused

Option	Default	Range	Description
73	-		Unused
74	-		Unused
75	100		Purge Motor Travel Speed
		10 – 100	If the speed of the motor is too fast, then decrease the value. 0.1 – 10.0
76	-		Unused
77	-		Unused
78	-		Unused
79	-		Unused
80	0		Outside Temperature Compensation
		0 1	Outside temperature compensation disabled Outside temperature compensation enabled
81	90		Setpoint at Minimum Outside Temperature
		50 – 999	This setpoint is limited by the load detector set in option 1. °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)
82	30		Minimum Outside Temperature
		0 – 145	Value 30 = -10°C or -10°F (see option 65)
83	80		Setpoint at Maximum Outside Temperature
		50 – 999	This setpoint is limited by the load detector set in option 1. °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)
84	80		Maximum Outside Temperature
		0 – 145	Value 80 = 40°C or 40°F (see option 65)
85	0		Night Setback Offset
		0 1 – 100	This offset value is subtracted from the required setpoint. An input is required on terminal 80, see option/parameter 154. Disabled °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)
86	0		Channel 1 Servo Control Method
		0 1 2 3	Autoflame servomotor, 0.1 degree control Autoflame servomotor, 0.5 degree control Industrial servomotor, 0.1 degree control Industrial servomotor, 0.5 degree control
87	0		Channel 2 Servo Control Method
		0 1 2 3	Autoflame servomotor, 0.1 degree control Autoflame servomotor, 0.5 degree control Industrial servomotor, 0.1 degree control Industrial servomotor, 0.5 degree control

Option	Default	Range	Description
88	0		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
89	0		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	-		VSD Operation Channel 4
		0	Disabled
		1	Enabled
91	0		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		Output Units Displayed, VSD Channel 4
		0	Selected output signal
		1	Hertz
93	25		Output Low Speed from MM to VSD Channel 4
		1 – 200	Hertz
94	50		Output High Speed from MM to VSD Channel 4
		1 – 200	Hertz
95	0		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		Input Units Displayed, VSD Channel 4
		0	Selected input signal
		1	Hertz
97	0		Input Low Speed to MM from VSD Channel 4
		0 – 200	Hertz
98	50		Input High Speed to MM from VSD Channel 4
		0 – 200	Hertz
99	5		VSD Channel 5 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		Sequencing/DTI or Modbus Operation
		0	MM/DTI Sequencing
		1	Modbus

Option	Default	Range	Description
101	0		Modbus Baud Rate
		0	9600 baud
		1	19200 baud
102	0		Modbus Parity Setting
		0	No parity
		1	Odd parity
		2	Even parity
103	1		Modbus Stop Bits Settings
		1	1 stop bit
		2	2 stop bits
104	1		Modbus Device ID
		1 – 247	ID range
105	0		Modbus Data Format
		0	Binary format
		1	ACSII format
106	-		Unused
107	-		Unused
108	-		Unused
109	-		Unused

For safety reasons, options 110 – 160 also have to 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.

Option	Default	Range	Description
110	1		UV Flame Scanner Type
			See option/ parameter 120 for the UV threshold and 122 for the flame sensor operation. For setting 2, the self-check UV scanner opens and closes a shutter to check that the UV scanner is not given a false flame signal.
		1	Standard scanner
		2	Self-check scanner
111	0		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		Pre-Purge Time
			Purging the burner before burner start-up will air will force any combustion remnants out of the stack. Purge time should be set according to boiler manufacturing guide and local codes and regulations.
		5 – 240	Seconds
113	3		Pre-Ignition Time
			This is the time period when the ignition transformer is on before the pilot valves opens.
		3 – 5	Seconds
114	3		First Safety Time
			This is the time period when the pilot valve is open, before the flame is checked. The time range of this option depends on whether its gas or oil.
		3 – 10	Seconds
115	3		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		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 – 10	Seconds
117	5		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

Option	Default	Range	Description
118	0		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		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		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		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		Flame Sensor Selection
		0	UV
		2	Ionisation
		4	IR
		5	IR and UV
		6	IR and ionisation
		7	Ionisation to UV switchover
			Note: Ionisation to UV switchover cannot be used with no pilot (option/ parameter 111) or single valve pilot (option/parameter 130).
123	3		Oil Second Safety Time – Main Trial For Ignition (MTFI)
			This is the time period when the main valves are open and the pilot valve is maintained open, before the flame is checked, for firing on oil. See option/ parameters 150 and 151. This does not apply for intermittent pilot, see option/ parameter 111.
		3 – 15	Seconds
124	0		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

Option	Default	Range	Description
125	0		Fuel Pressure Sensor Mode – Fuel 1
			For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor or valve proving by a low pressure switch. For setting 2, pressure limits are checked by the gas sensor. See option/parameters 136 and 137 for gas pressure limits. For setting 3, the system will wait for a mains voltage input on terminal 55 to confirm that the VPS test is completed. If a voltage is not detected on terminal 55 within 10 minutes, a lockout will occur. Please see MM Application Possibilities manual for option/ parameters and wiring guides on VPS and pressure limits setups.
		0	Not checked
		1	Pressure limits, valve proving
		2	Pressure limits
		3	External VPS
126	0		Fuel Pressure Sensor Mode – Fuel 2
			For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor or valve proving by a low pressure switch. For setting 2, pressure limits are checked by the gas sensor. See option/parameters 136 and 137 for gas pressure limits. For setting 3, the system will wait for a mains voltage input on terminal 55 to confirm that the VPS test is completed. If a voltage is not detected on terminal 55 within 10 minutes, a lockout will occur. Please see MM Application Possibilities manual for option/ parameters and wiring guides on VPS and pressure limits setups.
		0	Not checked
		1	Pressure limits, valve proving
		2	Pressure limits
		3	External VPS
127	-		Unused
128	0		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 MM Application Possibilities manual for setup.
		0	Mains input
		1	Pressure sensor
129	0		VPS Operation
		0	VPS operates before start-up
		1	VPS operates after shutdown
		2	VPS operates before and after
130	2		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		Gas Pressure Units
		0	"wg
		1	mbar
		2	PSI

Option	Default	Range	Description
132	20		Gas Valve Proving Time
		10 – 300	This is the time period for when both gas valves are closed to detect a change in air pressure for the 'VPS air proving' phase, or change in gas pressure for 'VPS gas proving' phase. Seconds
133	25		Maximum Pressure Change Allowed During VPS
		0 – 13400	If MM detects a pressure change greater than this value, a lockout will occur. If both options 136 and 138 are set to 0, then a lockout will occur if the measured static line pressure during the VPS void to gas phase is below this absolute value. See option/parameter 131 for gas pressure display units. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003 "WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)
134	3		VPS Valve Opening Time
		3 – 20	This is the time period for when the phases when a gas valve is opened – 'VPS Venting' for the void to vent to atmosphere and 'VPS Void to Gas' for the void to fill with gas. Seconds
135	0		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		Gas Pressure Switch – Offset Lower Limit
		0 – 13400	This is an offset lower limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. If both options 136 and 138 are set to 0, then a lockout will occur if the measured static line pressure during the VPS void to gas phase is below the absolute value in option 133. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003 "WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)
137	25		Gas Pressure Switch – Offset Upper Limit
		0 – 13400	This is an offset upper limit from the commissioned gas pressure, see option/parameter 131 for the gas pressure display units. These limits are also tested during main flame proving. See option/ parameter 125 and 126 to enable the pressure limits. 0 mbar – 1340 mbar (value 25 = 2.5 mbar) 0" WG – 537.777" WG (value 25 = (1.003 "WG) 0 PSI – 19.435 PSI (value 25 = 0.036 PSI)

Option	Default	Range	Description
138	25		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)
139	-		Unused
140	0		Unused
141	0		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 – 300	0 mbar – 30.0 mbar (0" WG – 12.040" WG)
142	60		Shutter Test Interval
			This is the time interval between shutter tests on the self-check UV scanner. See options/ parameter 110 and 122.
		4 – 240	Seconds
143	0		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		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
145	-		Unused
146	0		Air Pressure Sensor Units
		0	"wg
		1	mbar

Option	Default	Range	Description
147	0		Air Pressure Error Window
		0 – 300	This air pressure error window is only active during modulation; the burner will lockout if the air pressure is outside of this window. 0 mbar – 30.0 mbar (0" WG – 12.040" WG)
148	0		Air Pressure Sensor Type
		0 1 2	For setting 0, and external air pressure switch must be wired to terminal 54.If a reset of voltage is not detected within 2 minutes on terminal 54 during the 'Wait for Air Switch' phase before running to purge, a lockout will occur. For setting 1, the air pressure sensor will look for zero air pressure in the 'Zero Air Sensor' phase before running to purge. Setting 2 includes the checks made for settings 0 and 1, and must both read low before the 'Wait for Air Switch' can be passed. Air switch on T54 Autoflame air pressure sensor Autoflame air pressure sensor and air switch on T54
149	10		Air Proving Pressure Threshold
		7 – 1200	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. 0.7 mbar – 120.0 mbar (0.281" WG – 48.176 "WG) Value 10 = 0.401 "WG (1.0 mbar)
150	0		Fuel 1 Type
		0 1	Gas Oil
151	1		Fuel 2 Type
		0 1	Gas Oil
152	-		Unused
153	-		Unused
154	0		Terminal T80 Function
		0 1 2 3 4	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. Not used Start position interlock Night setback input Reduced setpoint input Delay to purge input

Option	Default	Range	Description
155	0		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 is input must also be not made while not at purge. For setting 2, an input on terminal 81 will put the MM into low flame hold. For setting 3, terminal 81 acts as a purge pressure switch input. It must be made continuously for the full purge time before proceeding from purge. If it drops out during purge the purge timer restarts. It must also be not made before the blower motor starts to confirm the input is working correctly. If this input comes on during the relay tests a lockout is generated. Option 158 adds an optional timer to this phase.
		0	Not used
		1	Purge position interlock
		2	Low flame hold input
		3	Purge pressure proving
156	0		Terminal T82 Function
			For setting 0, input on terminal 82 will stop the MM warming in sequencing where there are no non-return valves, see option 40. When no input is detected, the MM will go into warming. For setting 1, a low pressure switch is wired to terminal 82 for valve proving; see options 125, 126 and 128. Please refer to the MM Application Possibilities manual.
		0	Warming stat
		1	Valve proving mains input
157	0		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		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
159	-		Unused
160	0		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.

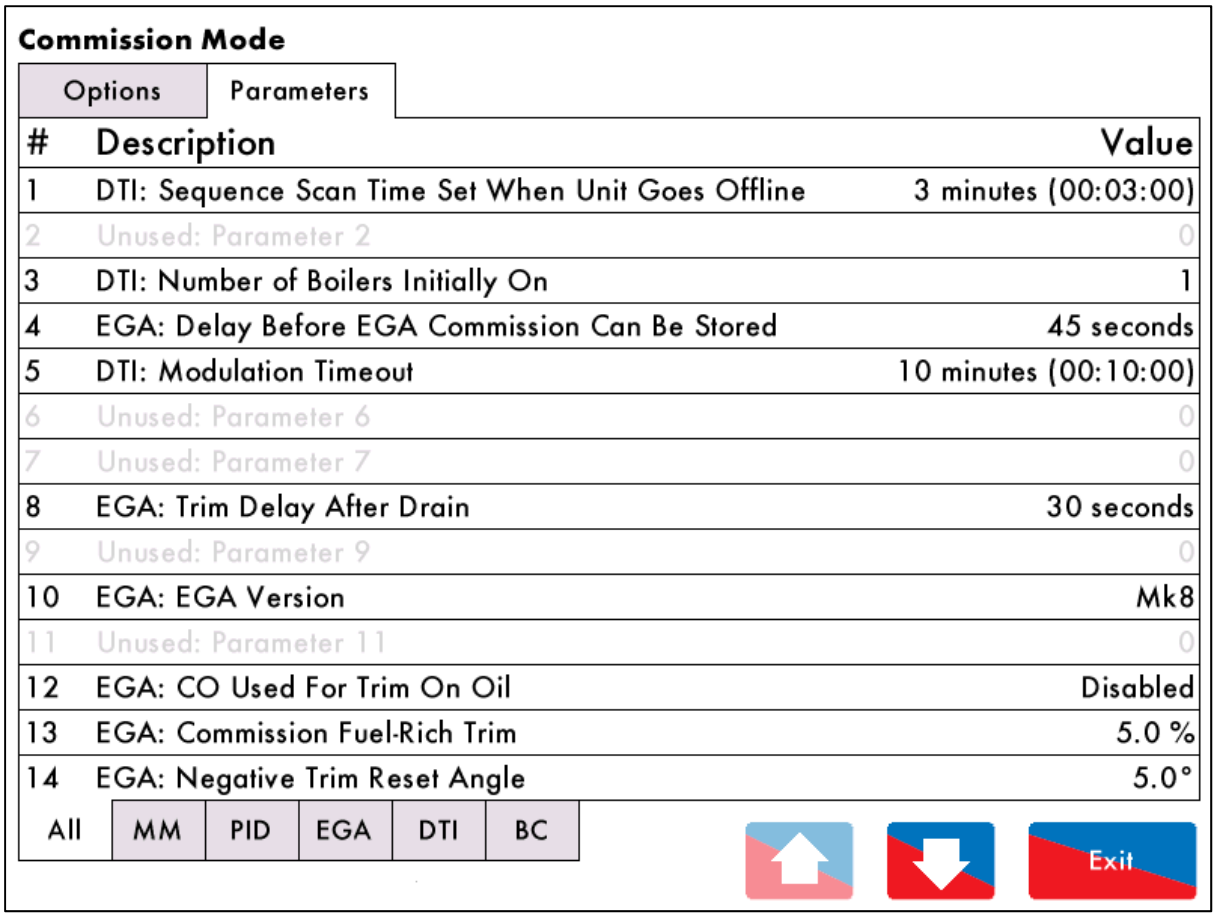


Figure 2.2.i Parameters

Figure 2.2.i shows the Parameters screen. Like 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 are detailed on the next 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.

Para-meter	Default	Range	Description
1	3		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
2	-		Unused
3	10		Number of Boilers Initially On
		1 – 10	This sets the number of boilers which when powered on after a shutdown, are in the On state in the sequence loop. This set should be set to the highest MM ID number (see parameter 57) if the application requires all the MMs to be On in the sequence loop when powered back on.
4	45		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		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
6	-		Unused
7	-		Unused
8	30		Trim Delay After Drain
		5 – 240	This is the delay after draining the sample, before the trim cycle start. Within this delay, the trim correction on the air damper or VSD is maintained while the EGA drains and the cells are purged with air. Seconds
9	-		Unused
10	2		EGA Version
		0 1 2	Mk7 (For use with Mk7 EGA) Mk8 Rev.3 (For use with Mk8 EGA) Mk8 (For use with Mk8 EGA EVO)
11	-		Unused
12	0		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		Commission Fuel-Rich Trim
		20 – 75	The % of air damper movement when commissioning fuel-rich trim. 2.0% - 7.5%

Para-meter	Default	Range	Description
14	50		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		Golden Start Time
		2 – 100	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		(Mk7 E.G.A only) Time Between Air Calibrations
		1 – 50	This is the time period between air calibrations if the burner does not go off. 0.5 hours – 25.0 hours
17	3		Number of Trims Before Limits Errors Generated
		0 1 – 10	When the combustion limits have been exceeded, the MM will make trim corrections on the air damper. If the number of these trims reaches the value set in this parameter an error will be generated. See options 19, 20, 21, 22, 23, 25, 26, 27 and parameters 94, 96 97 for limits. Disabled Number of trims
18	100		Maximum Trim During Run
		20 – 100	This is the maximum trim % of air damper movement during firing. 2.0% - 10.0%
19	50		Commission Air-Rich Trim
		20 – 75	This is the % air damper movement when commissioning the air rich trim. 2.0% - 7.5%
20	-		Unused
21	-		Unused
22	-		Unused
23	1		Add Air When CO Present
		0 1	This sets whether the trim function adds when CO is present. If the O_2 and CO_2 appear air rich but CO appears fuel rich, then the air damper will open further to remove CO. Disabled Enabled
24	120		(Mk7 EGA only) Air Calibration Time
		20 – 300	For the Mk8 EGA, this is set as default 6 minutes. Seconds
25	-		Unused
26	8		Trim Samples per Cycle
		1 – 50	A cycle is the period between when does the EGA carries out a drain to get rid of excess moisture in the exhaust gas sample. This parameter sets the number of trim corrections in between drains.
27	-		Unused

Para-meter	Default	Range	Description
28	-		Unused
29	1000		Load Sensor Adjustment
		800 – 1200	This adjusts the load sensor (voltage) reading, as a percentage of the reading. Value 1000 = 100.0% of actual reading
30	10		Load Sensor Filter Time
		1 – 40	Seconds
31	0		(Mk7 EGA only) Efficiency Calculation Method
			For the Mk8 EGA, efficiency calculation method is set on the EGA.
		0	English
		1	European
32	-		Unused
33	-		Unused
34	-		Unused
35	-		Unused
36	-		Unused
37	-		Unused
38	***		Commissioning Password Code 1
		0 – 255	Code 1
39	***		Commissioning Password Code 2
		0 – 255	Code 2
40	-		Unused
41	-		Unused
42	-		Unused
43	-		Unused
44	-		Unused
45	-		Unused
46	-		Unused
47	-		Unused
48	80		Integral Band
		0 – 100	This is the percentage of the proportional band over which the integral control is active. 0% - 100%
49	-		Unused
50	-		Unused

Para-meter	Default	Range	Description
51	-		Unused
52	0		External Load Detector – Number of Decimal Places
			This affects parameter the external load detector maximum and minimum values set in parameters 53 and 55. See options 1 and 65.
		0	0 decimal place
		1	1 decimal place
		2	2 decimal places
53	20		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 °C (°F)
			20 = 20 Bar (PSI) or °C (°F) if parameter 52 is set to 0
			20 = 2.0 Bar (PSI) or °C (°F) if parameter 52 is set to 1
			20 = 0.2 Bar (PSI) or °C (°F) if parameter 52 is set to 2
54	0		External Load Detector – Maximum Voltage
		0 – 100	0.0V – 10.0V
55	20		External Load Detector – Minimum Voltage
			The scale will depend on how parameter 52 is set. See options 1 and 65.
		0 – 9990	Bar (PSI) or °C (°F)
			20 = 20 Bar (PSI) or °C (°F) if parameter 52 is set to 0
			20 = 2.0 Bar (PSI) or °C (°F) if parameter 52 is set to 1
			20 = 0.2 Bar (PSI) or °C (°F) if parameter 52 is set to 2
56	0		External Load Detector – Minimum Voltage
		0 – 100	0.0V – 10.0V
57	10		Highest MM ID
			This sets the highest MM ID number for that sequence or DTI loop.
		1 –10	Sequence ID
58	1		(Mk7 EGA only) – Air Calibration on Start-up
			For the Mk8 EGA, the air calibration schedule is set on the EGA itself.
		0	Disabled
		1	Enabled
59	-		Unused
60	60		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		Backlight On Time
			If the screen is not pressed and this timer elapses, the backlight will dim.
		0	Disabled
		1 – 1800	Seconds
62	0		Hot Water Sequencing
			For setting 0 the boilers, the lag boilers will be off. For setting 1, the lag boiler will operate as steam sequencing, as set in option 41.
		0	Hot water sequencing operates normally
		1	Hot water sequencing operates as steam sequencing

Para-meter	Default	Range	Description
63	-		Unused
64	-		Unused
65	-		Unused
66	-		Unused
67	-		Unused
68	1		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		Auxiliary Channel 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 – 10V (0 – 20mA) input
		1	2 – 10V (4 – 20mA) input
70	-		Unused
71	-		Unused
72	-		Unused
73	-		Unused
74	-		Unused
75	-		Unused
76	-		Unused
77	-		Unused
78	-		Unused
79	-		Unused
80	-		Unused
81	-		Unused
82	-		Unused
83	-		Display Diagnostic Values
		0	Disabled
		1	Enabled
84	-		Unused

Para-meter	Default	Range	Description
85	0		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 be only be used in test/inspection conditions.
		0 1 – 3600	Disabled Seconds
86	85		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		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		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			Stat Exerciser Period
			If the stat exerciser period is enabled, then T53 will be turned off for this timer set, and then turned off for this timer set, repeatedly. This should be used in test/inspection conditions.
		0 1 – 3600	Disabled Seconds
90	-		Unused
91	-		Unused
92	-		Unused
93	-		Unused
94	0		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 1 – 200	Disabled 1 – 200 ppm NO
95	-		Unused
96	0		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 1 – 999	Disabled 1 – 999 deg°C or deg°F

Para-meter	Default	Range	Description
97	0		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 deg°C or deg°F
98	-		Unused
99	1		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		Assured Low Fire Shut Off
			If enabled, when the burner turns off on internal stat, the MM will modulate to low fire, shut down and recycle the system before turning off. Assured low fire shut off cannot be used with graceful shutdown in parameter 100.
		0	Disabled
		1	Enabled
101	0		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
102	-		Unused
103	-		Unused
104	-		Unused
105	-		Unused
106	-		Unused
107	***		Online Changes Password Code 1
		0 – 255	Code 1
108	***		Online Changes Password Code 2
		0 – 255	Code 2
109	-		Unused

3 COMMISSIONING FUEL-AIR CURVE

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 When the valve is fully closed, the MM should display zero degrees. If it does not, please adjust the servomotor potentiometer.

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.

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.

3.1.1 Commissioning Procedure

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 required (refer to sections 2.1 and 2.2).
3. Set up servomotors.
4. Program fuel/air positions.

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.

WARNING: COMMISSIONING OR BURNER START-UP MUST ONLY BE CARRIED OUT BY A FACTORY TRAINED TECHNICIAN.

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 counter clockwise to open a valve or damper. Servomotors can be installed in any orientation; 2 fixed rotation positions if using Autoflame valves. 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 counter clockwise 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.

Note: 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 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).

****WARNING****

ELECTRICAL CONNECTIONS ARE LIVE/HOT AND INCORRECT APPLICATION MAY RESULT IN SERIOUS PHYSICAL INJURY OR DEATH.

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 counter clockwise 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

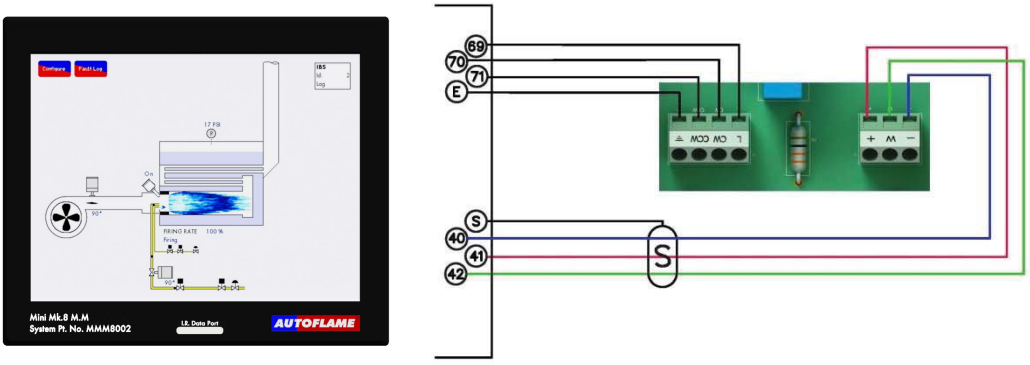
In applications where the servomotor is not positioned close to the display then it is possible to measure the feedback voltage from the servomotor in order to ensure that 0.0 degrees is displayed. By testing the DC voltage between the blue and green wires (wiper and 0V) on the servomotor low voltage 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

MOTOR CLOCKWISE ROTATION

FIG. A

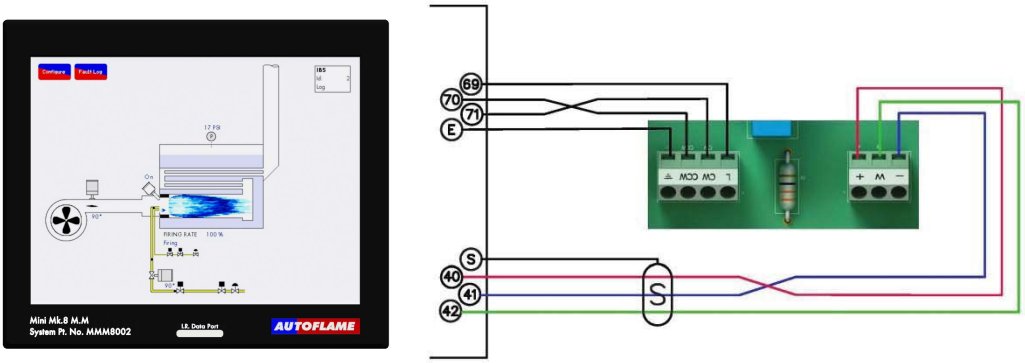
M.M. MODULE



MOTOR ANTICLOCKWISE ROTATION

FIG. B

M.M. MODULE



FOR ILLUSTRATION PURPOSES FUEL MOTOR CONNECTIONS ARE SHOWN.

3.3.4 Servomotors with Autoflame Valves

On threaded valves, the pin on the top of the valve is 90 degrees 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 degrees different from the flanged valve.

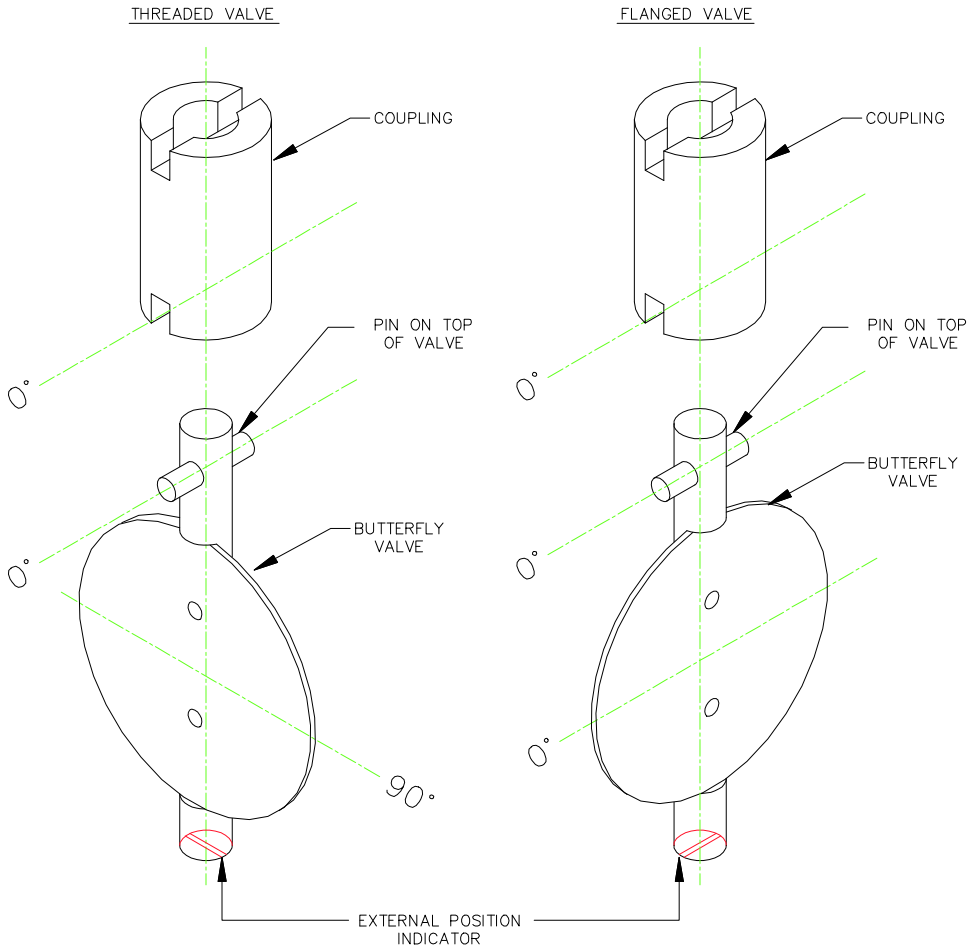


Figure 3.3.4.i Valve Pin Positions

3.4 Commissioning Fuel and Air Positions

The following procedure is shown for commissioning the EGA with 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). Please see section 3.7 for adding/adjusting the trim data later during Single Point Change. 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.

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 remains on at all times 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

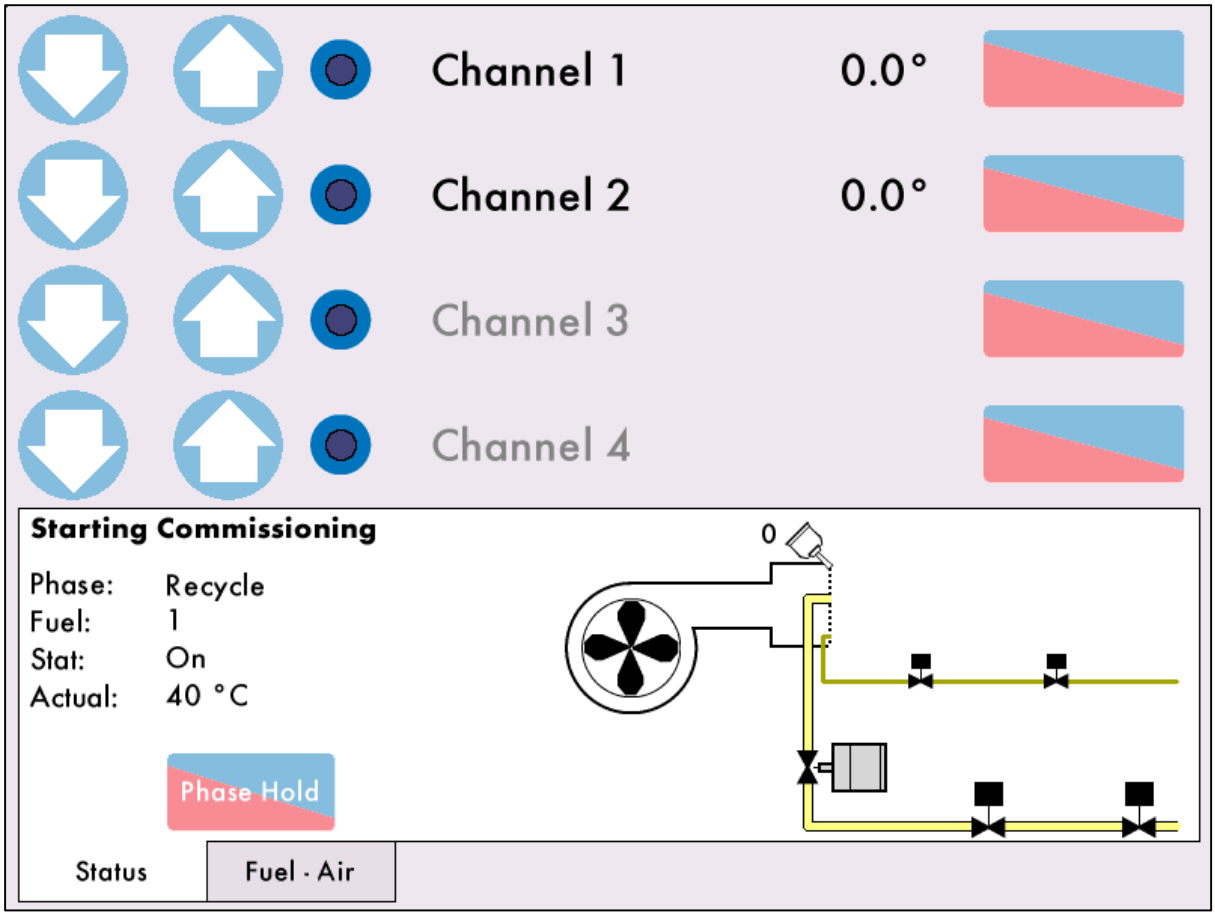


Figure 3.4.1.i Starting Commissioning

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

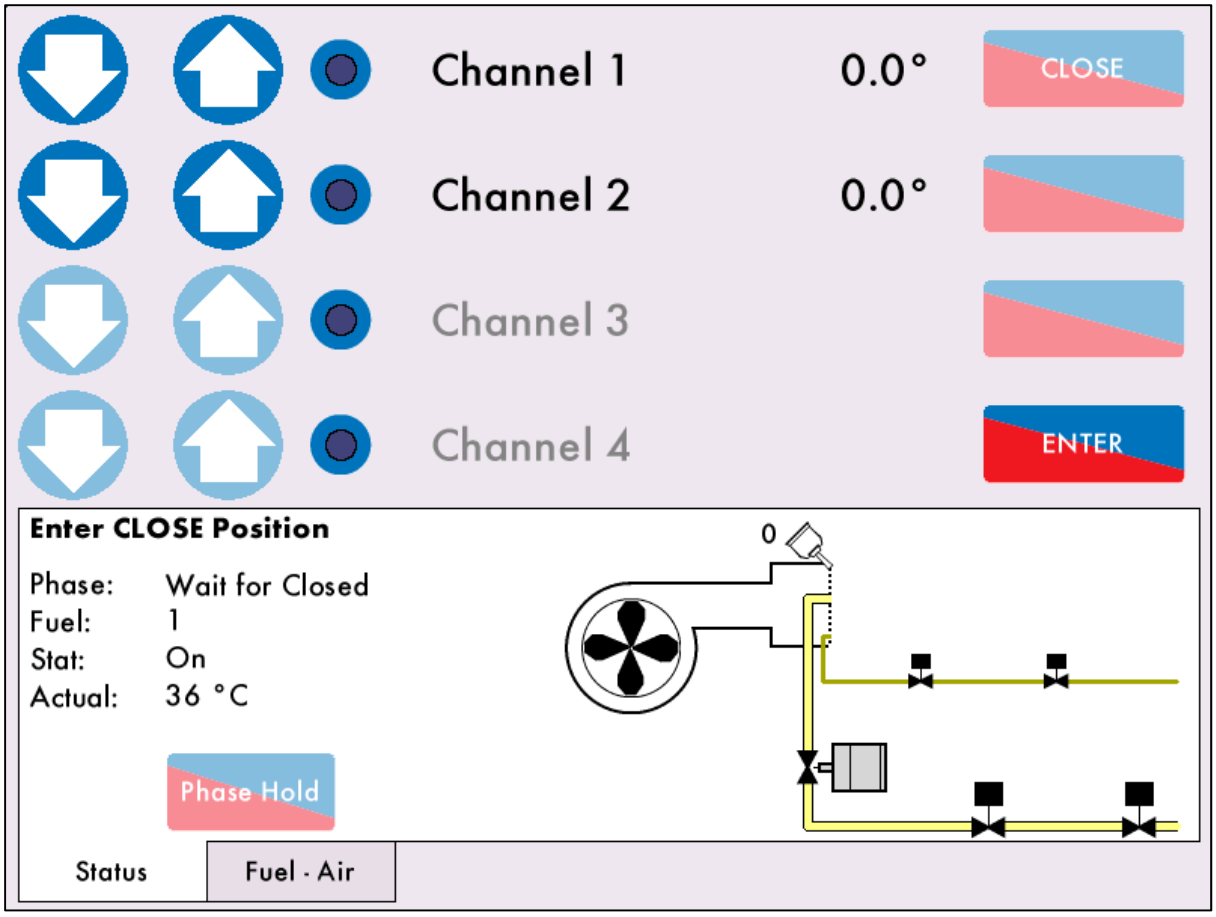


Figure 3.4.2.i Enter CLOSE Position

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

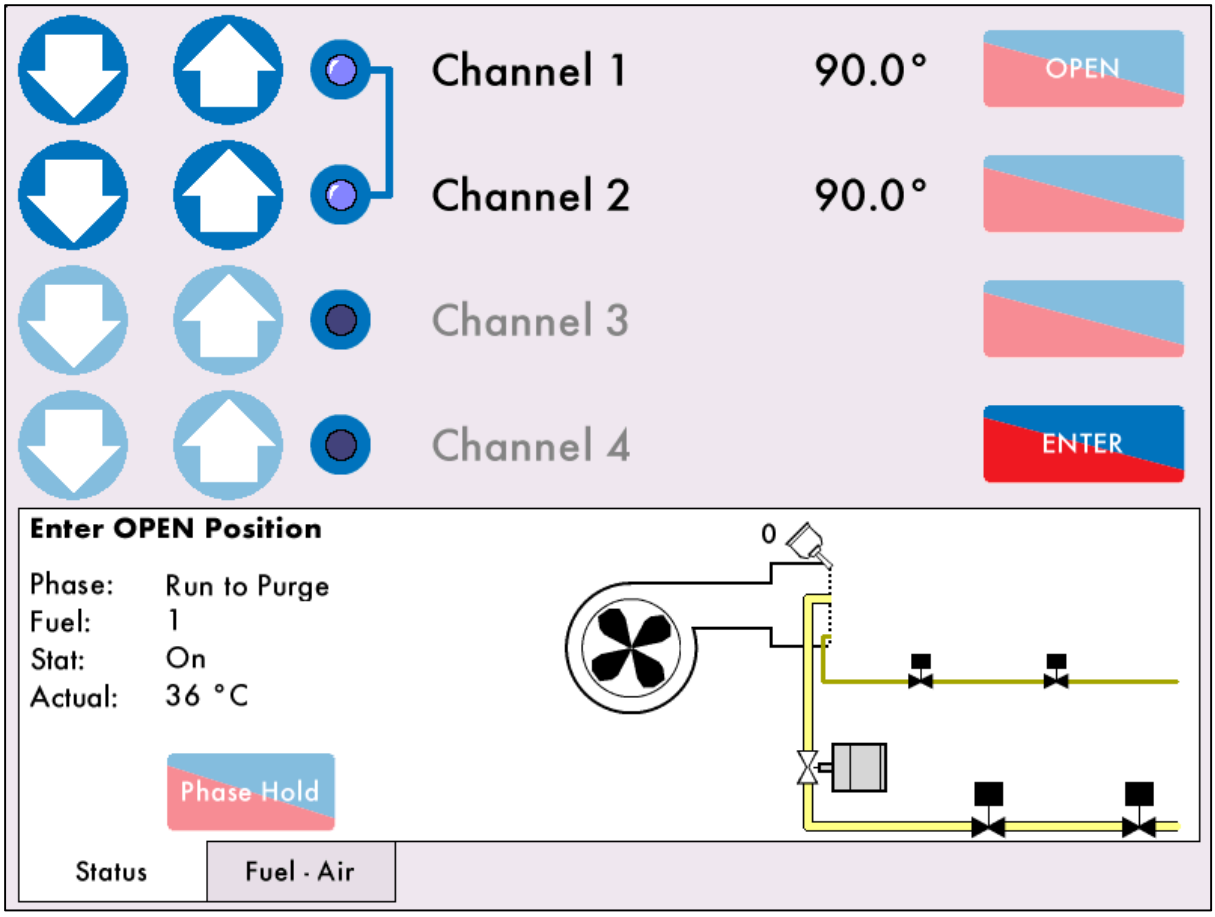


Figure 3.4.3.i Enter OPEN Position

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, 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

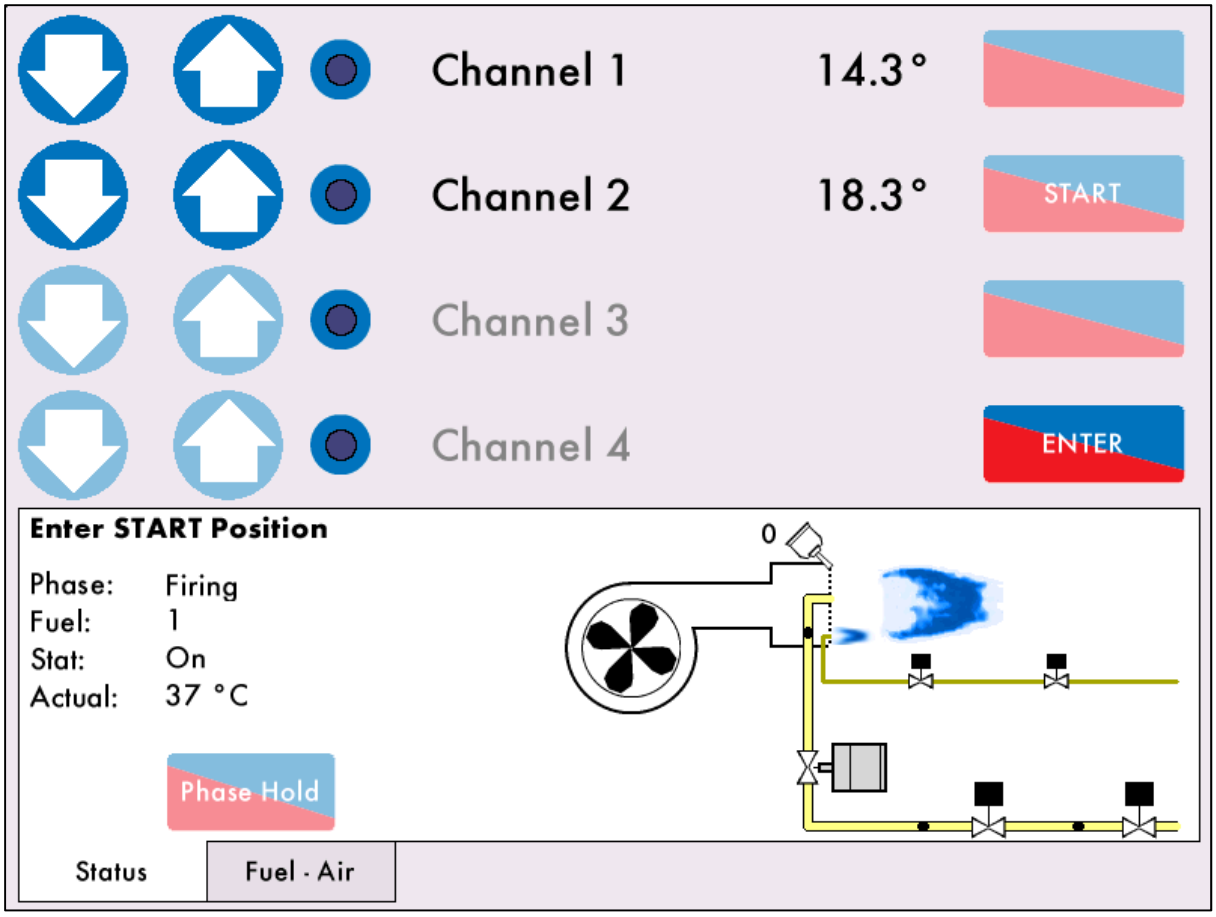


Figure 3.4.4.i Enter START Position

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

Press START 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°, to set a CH1 START position of 83.0°, you must drive the CH1 servomotor to below 80.0° and then to 83.0°.

****WARNING** ENTERING THE START POSITION BEFORE REDUCING FUEL INPUT APPROPRIATELY COULD RESULT IN SERIOUS PHYSICAL DAMAGE OR DEATH.**

Press ENTER 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 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 adjustments with the gas manually, press 

to keep the system at its current phase positions, 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.

****WARNING****

IT IS THE RESPONSIBILITY OF THE FACTORY TRAINED TECHNICIAN TO ENSURE THAT USE OF THE PHASE HOLD FACILITY DOES NOT LEAD TO A HAZADOUS SITUATION. FAILURE TO DO SO WILL RESULT IN SERIOUS EQUIPMENT DAMAGE, CRITICAL INJURY OR DEATH.

3.4.6 Add Trim Data During Commissioning

If the 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.

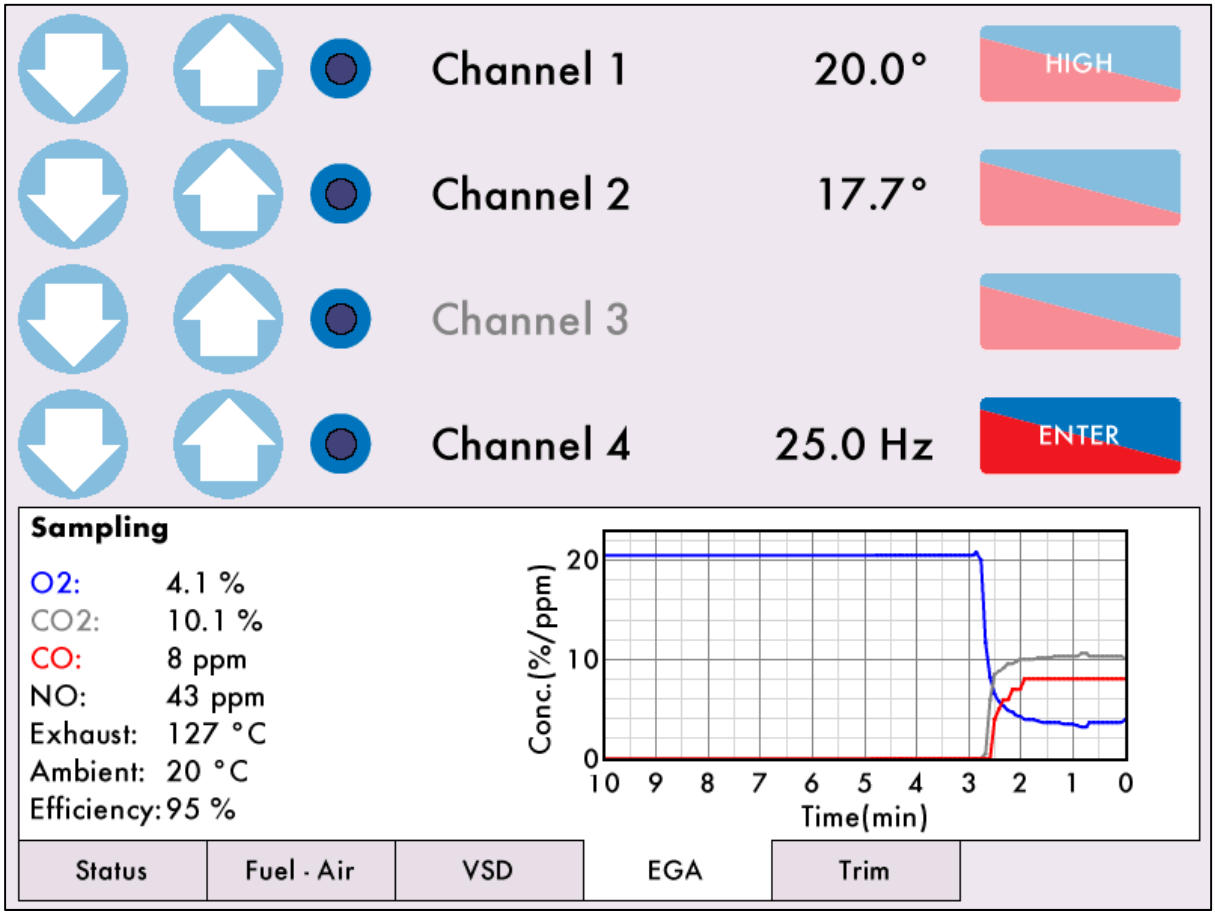


Figure 3.4.6.i Sampling

Press on the EGA tab to display the EGA readings.

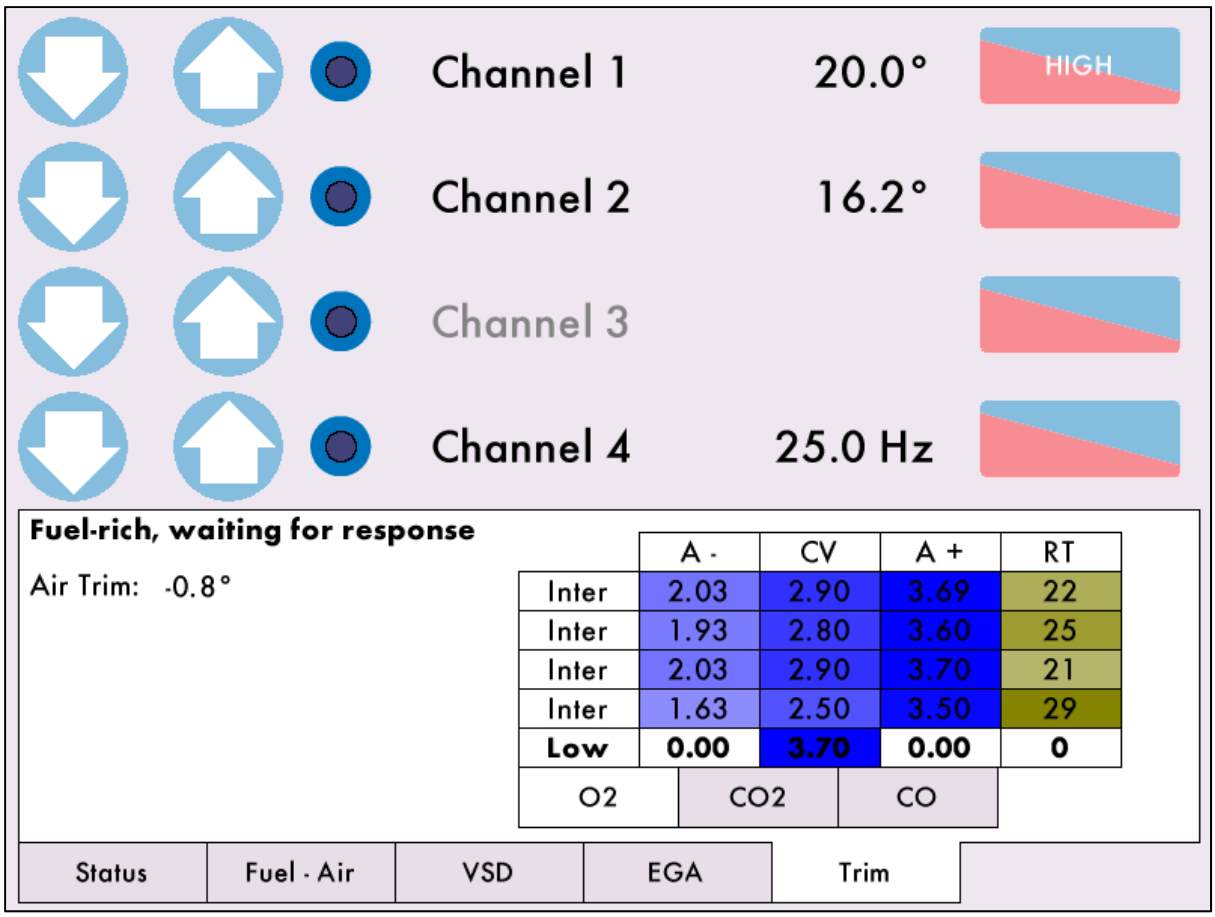


Figure 3.4.6.ii

After you press 

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

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

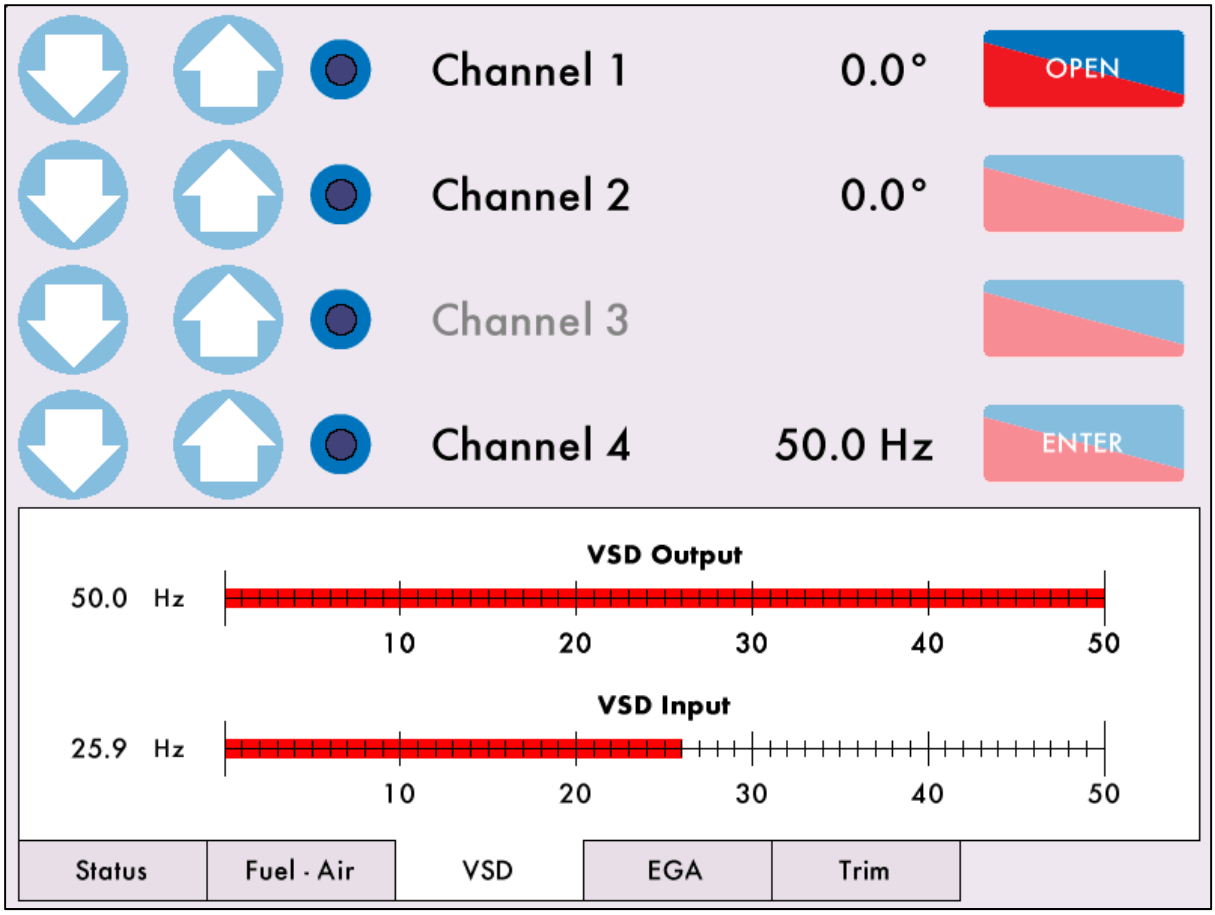


Figure 3.4.7.i Commissioning VSD

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 than commissioned. The minimum feedback variation applies to both the upper and lower limits so the total commission must allow for the two combined.

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.

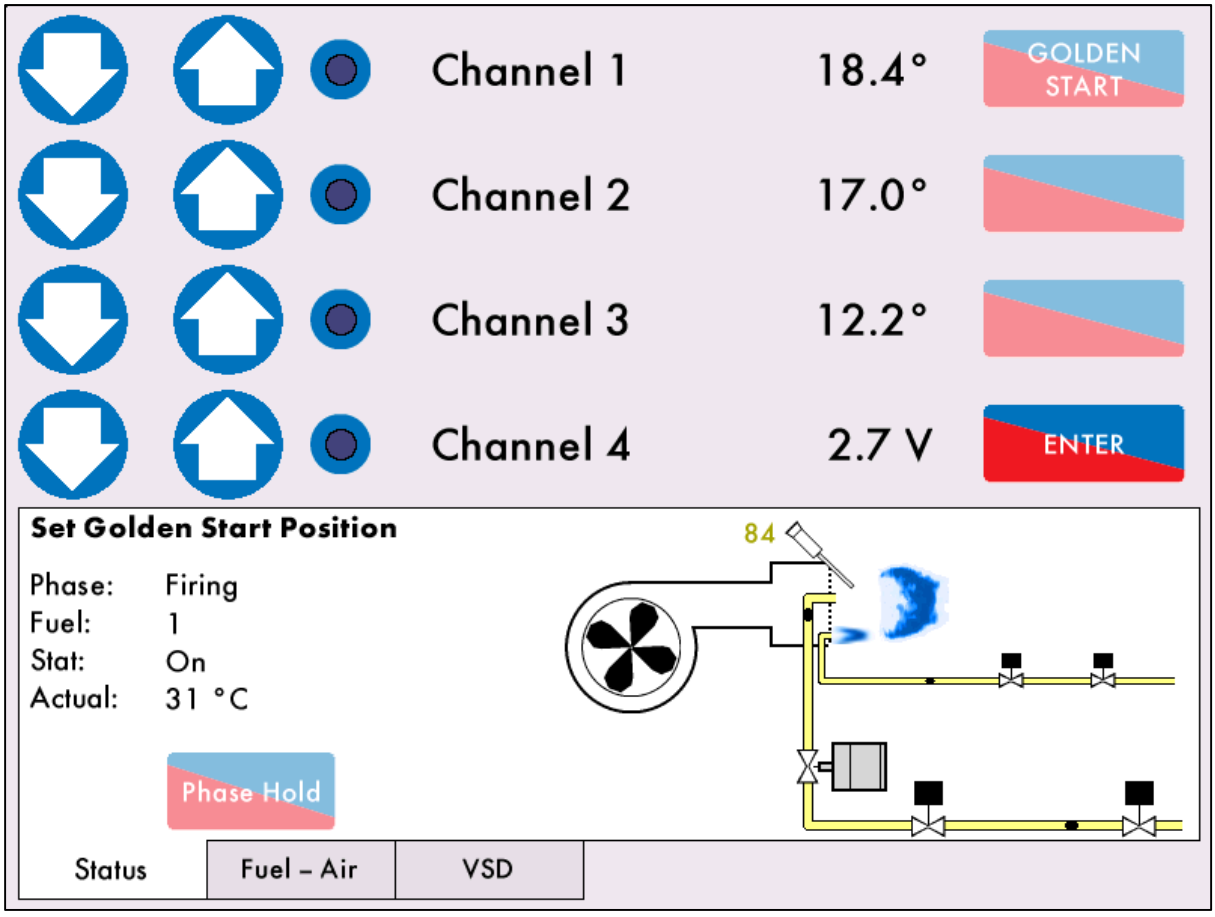


Figure 3.4.8.i Set GOLDEN START Position

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

Press CLOSE 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 positon 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 load requirement.

3.4.9 Set FGR START Position

If FGR Start has been enabled in options 48, 49 or 50 on a system which 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.

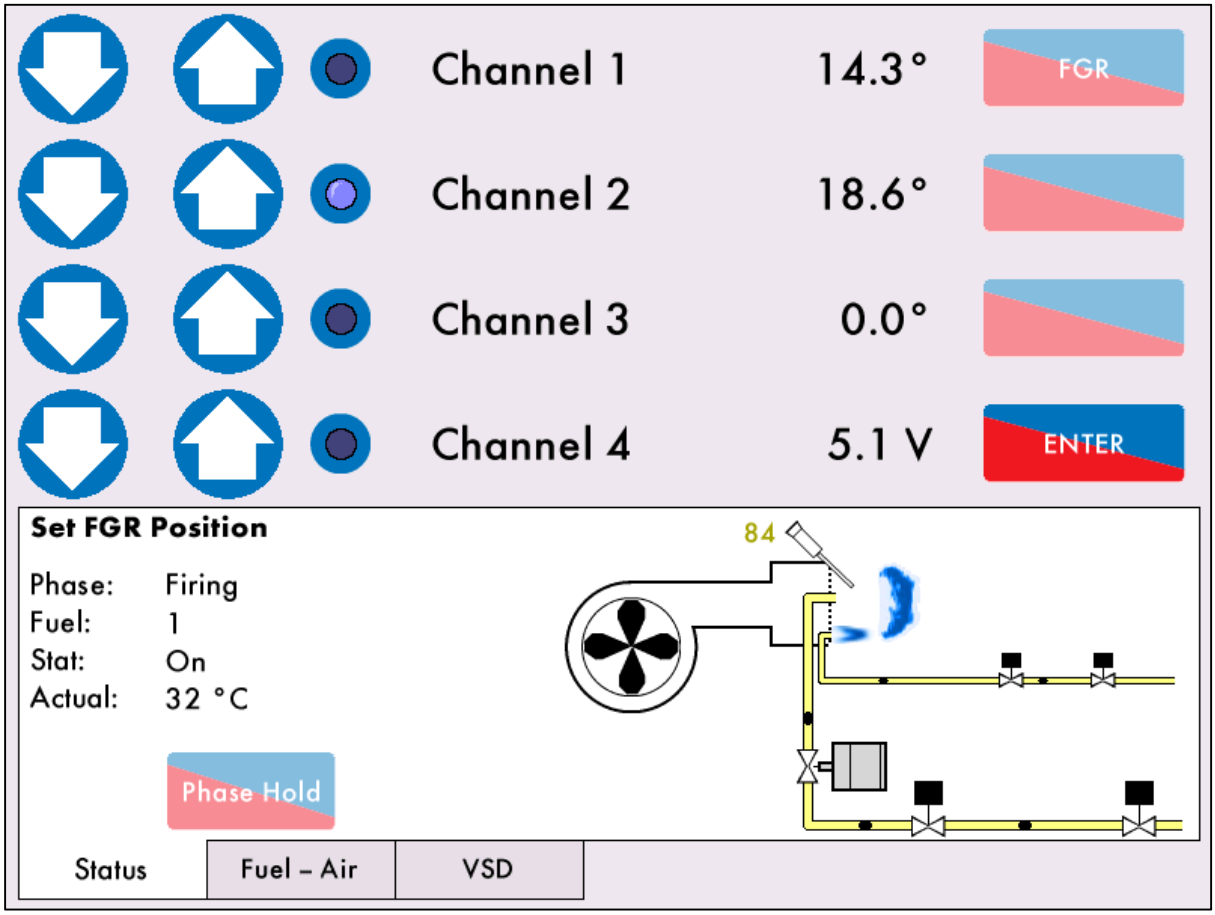


Figure 3.4.9.i Set FGR START Position

Press 

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

<u>Enabling FGR Start on a Commissioned System</u>
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. After the entering the light-off START or GOLDEN START (if enabled) position, the message 'Set FGR Position' will 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.

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) can 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.

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

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

3.4.10 Set HIGH Position

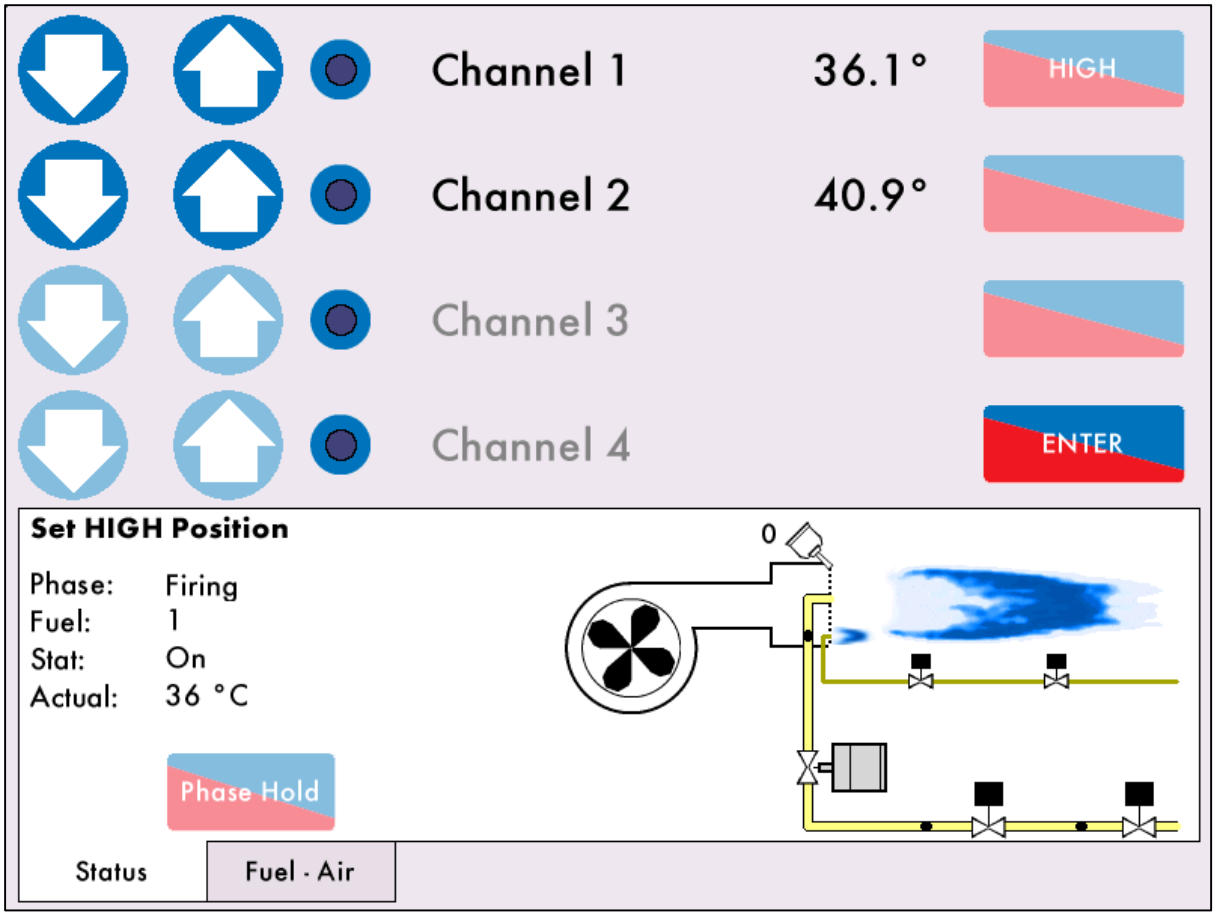


Figure 3.4.10.i Set HIGH Position

Once all the START, GOLDEN START and FGR START positions have been entered, the message 'Set HIGH Position' will appear. Press 

and drive the servomotors (and VSD if optioned) to the HIGH position by opening the air damper and fuel valve some degrees alternatively, so that more fuel is added gradually.

**** WARNING** IT IS THE RESPONSIBILITY OF THE COMMISSIONING ENGINEER TO ENSURE THAT THE FLAME IS SAFE AND THERE IS A GOOD COMBUSTION AT ALL TIMES DURING COMMISSIONING.**

It is not possible to enter the HIGH position higher than the OPEN position. The servomotors must be driven 0.5° up/down from the previous point initially, before entering the next point, the fuel. Press 

to store this HIGH position.

3.4.11 Set INTER Position

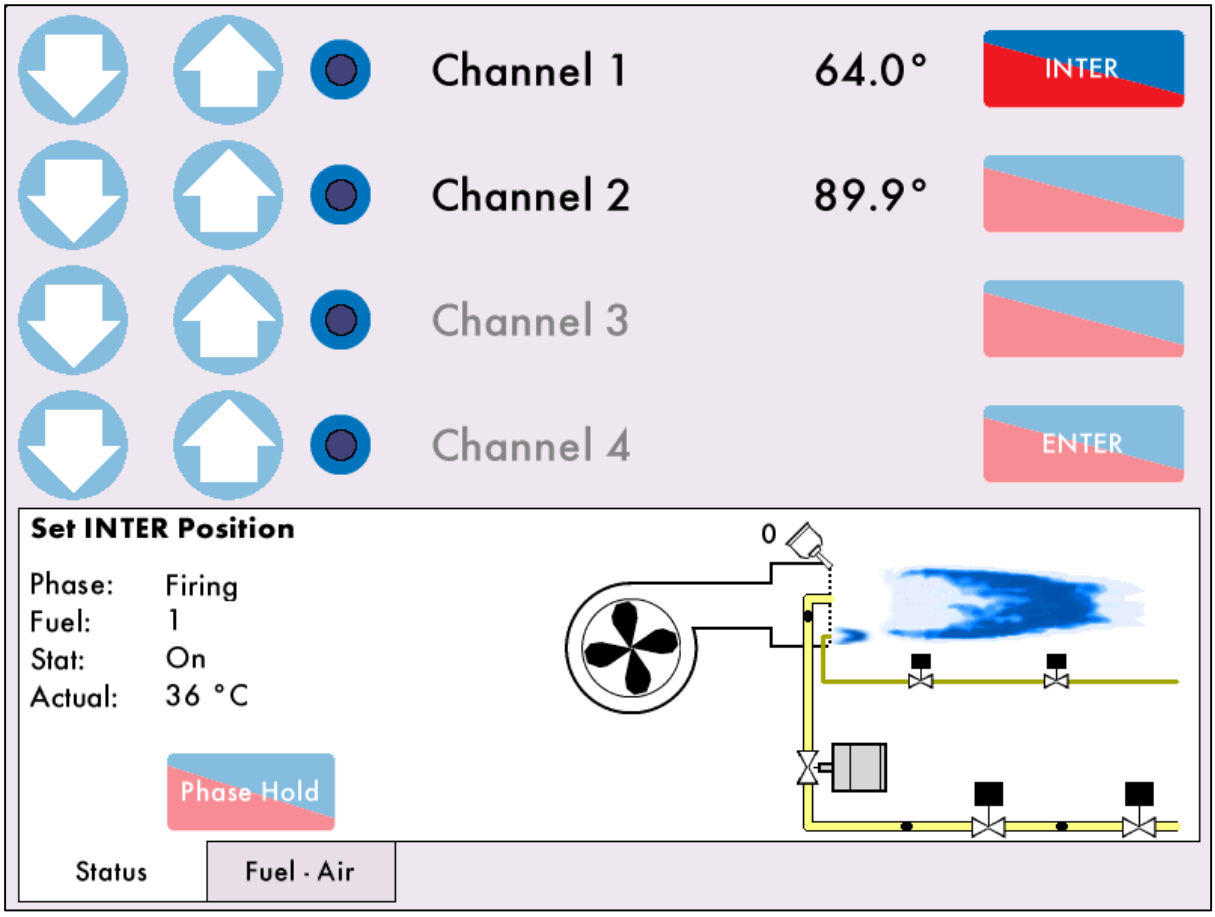


Figure 3.4.11.i Set INTER Position

Once the HIGH position has been entered, the message 'Set INTER Position' will appear. Press 

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 detected a 0.5° movement on CH1 and CH2 before an INTER position can be entered. Press 

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 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

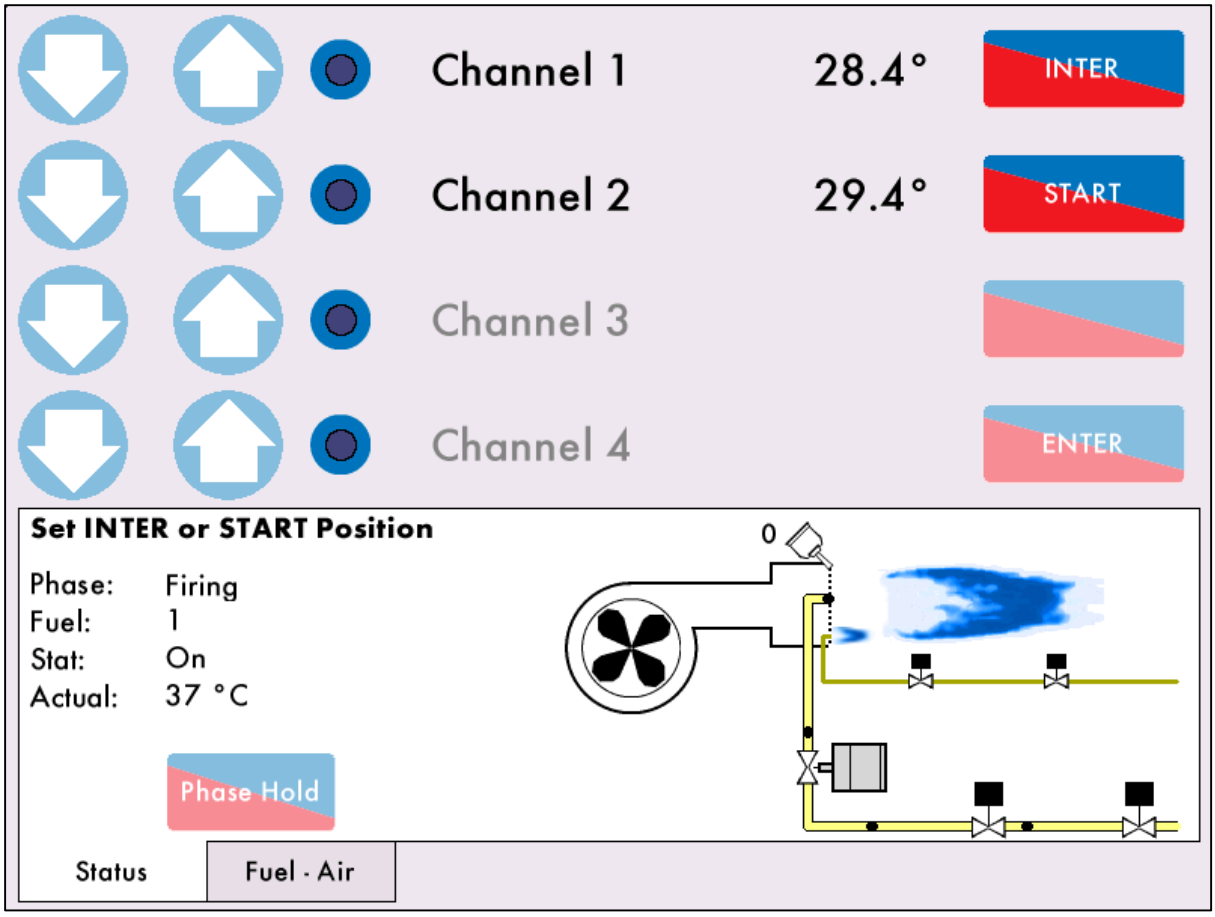


Figure 3.4.12.i Set INTER or START Position

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.

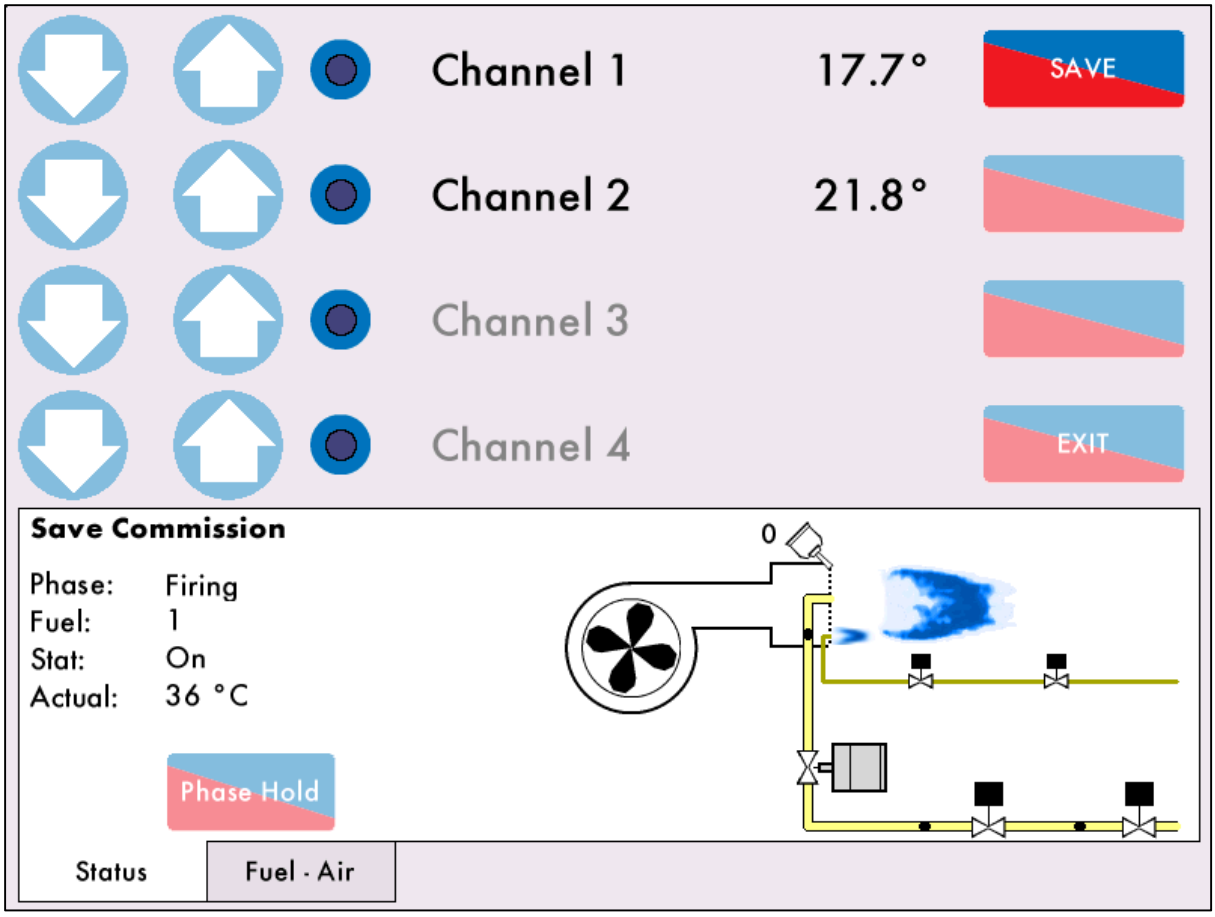
Press 

to 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 the points in the 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°C/20°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

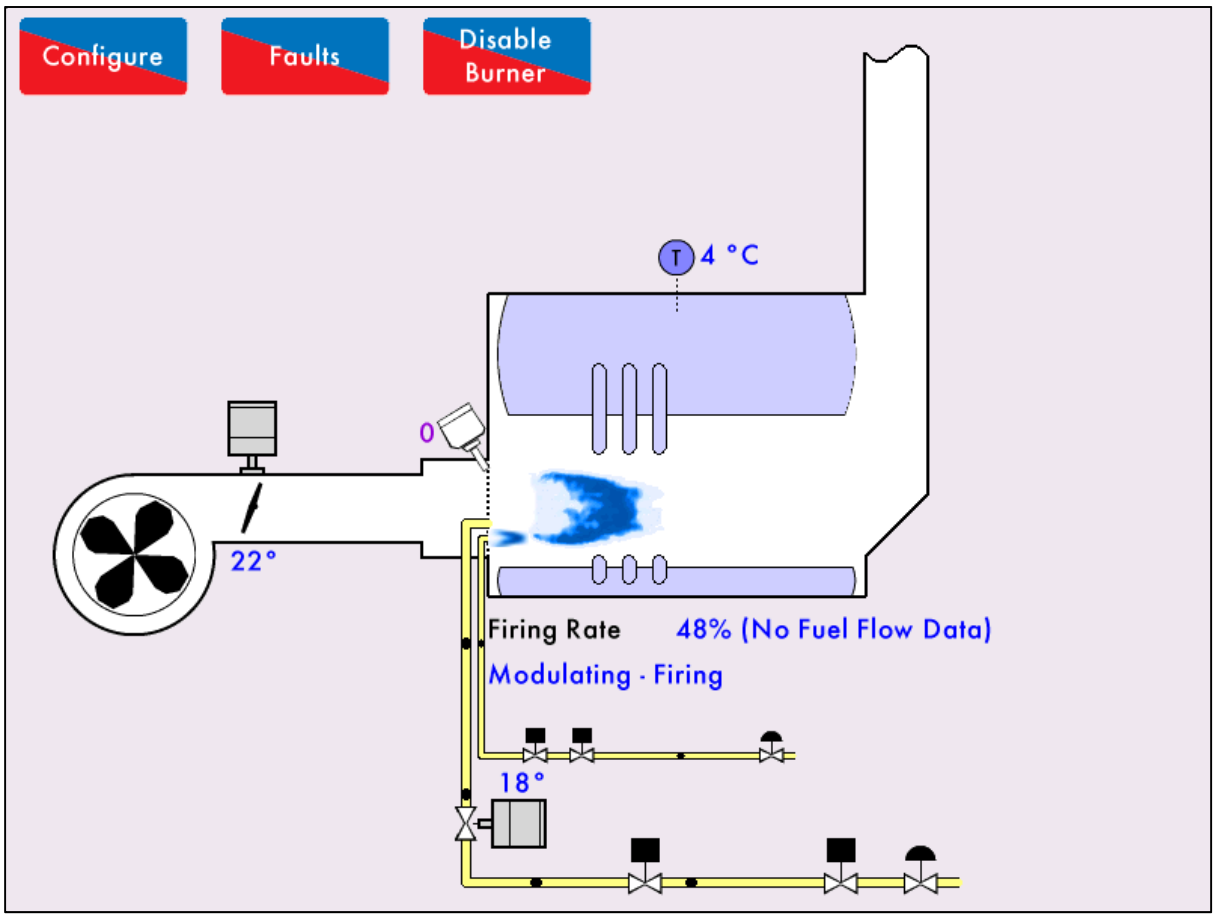


Figure 3.5.i Home Screen – No Fuel Flow Data

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 high fire point down to low 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. 100 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.

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

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.

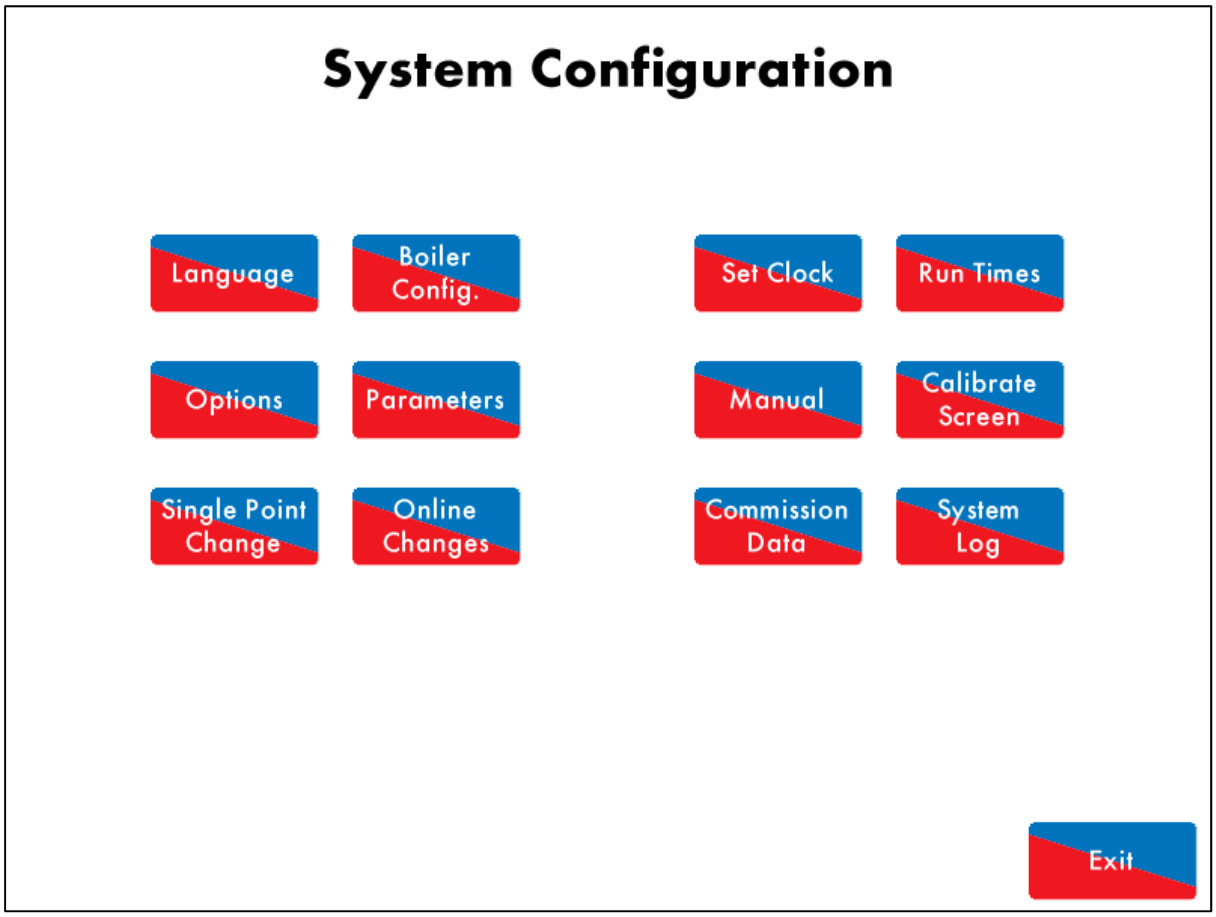


Figure 3.5.ii System Configuration Screen

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 

.

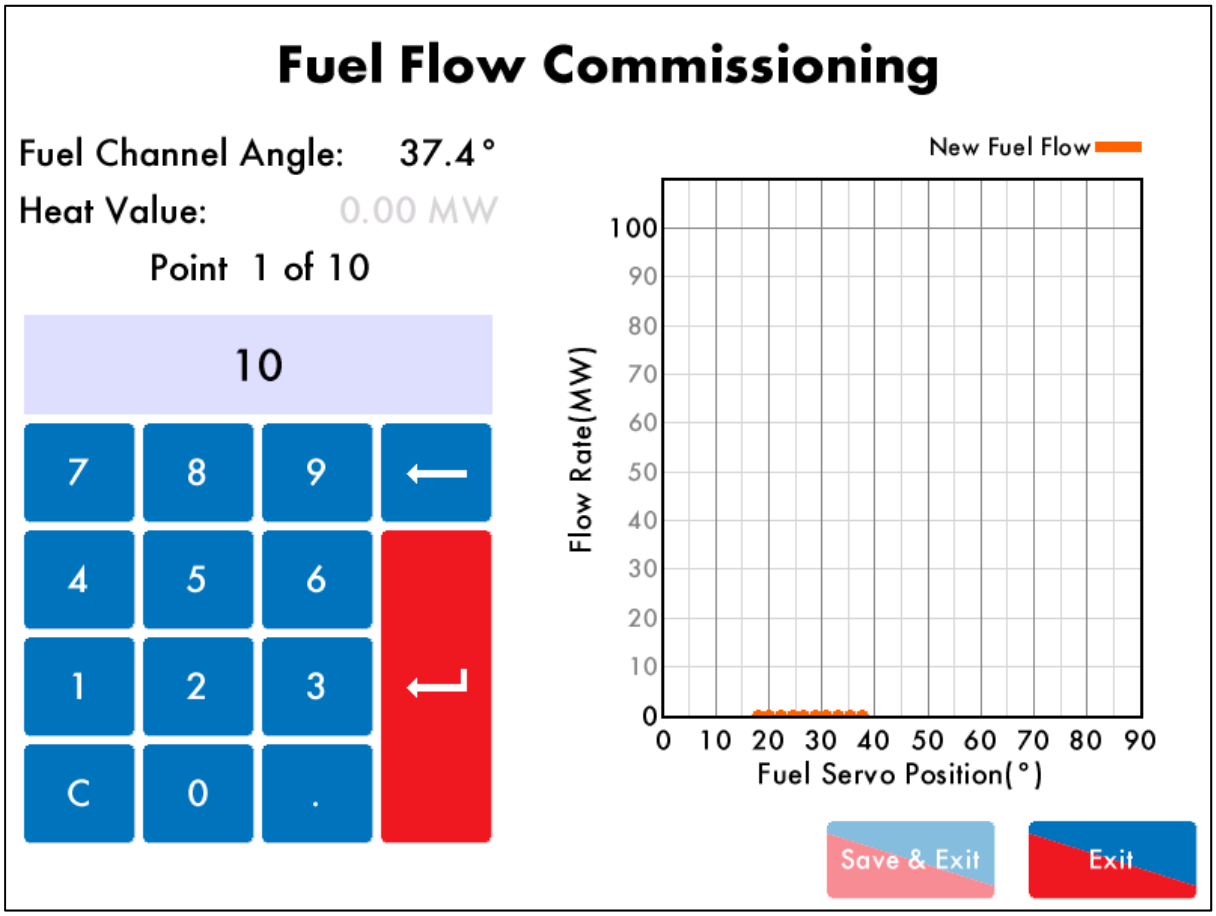


Figure 3.5.iii Fuel Flow Commissioning

There are 10 points which need to be entered across the commission curve from low fire to high fire, with high fire being point 1, and low 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 up to the high fire position, and then drive down 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 ft^3/min

Calculations: Correction factor = (pressure of gas at meter x 0.00228) + 0.948
Reading on gas meter = required gas flow / correction factor

Example: Pressure of gas at meter = 58" wg
Required gas flow = 95 ft^3/min
Conversion factor = (58 x 0.00228) + 0.948 = 1.08
Reading on Meter = 95 / 1.08 = 88 ft^3/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	e 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

How to use this information:-

1. Measure Volumetric flow of gas for 1min in ft3 (i.e. ft3/min). Note 1m3 = 35.31ft3

2. Multiply this volume flow by 60 to give volumetric flow per hour (i.e. ft3/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/ft3. 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 Gas Pressure Commission. 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 with be restarted. This ensures that the MM does not run with an incomplete set of gas/air pressure readings.

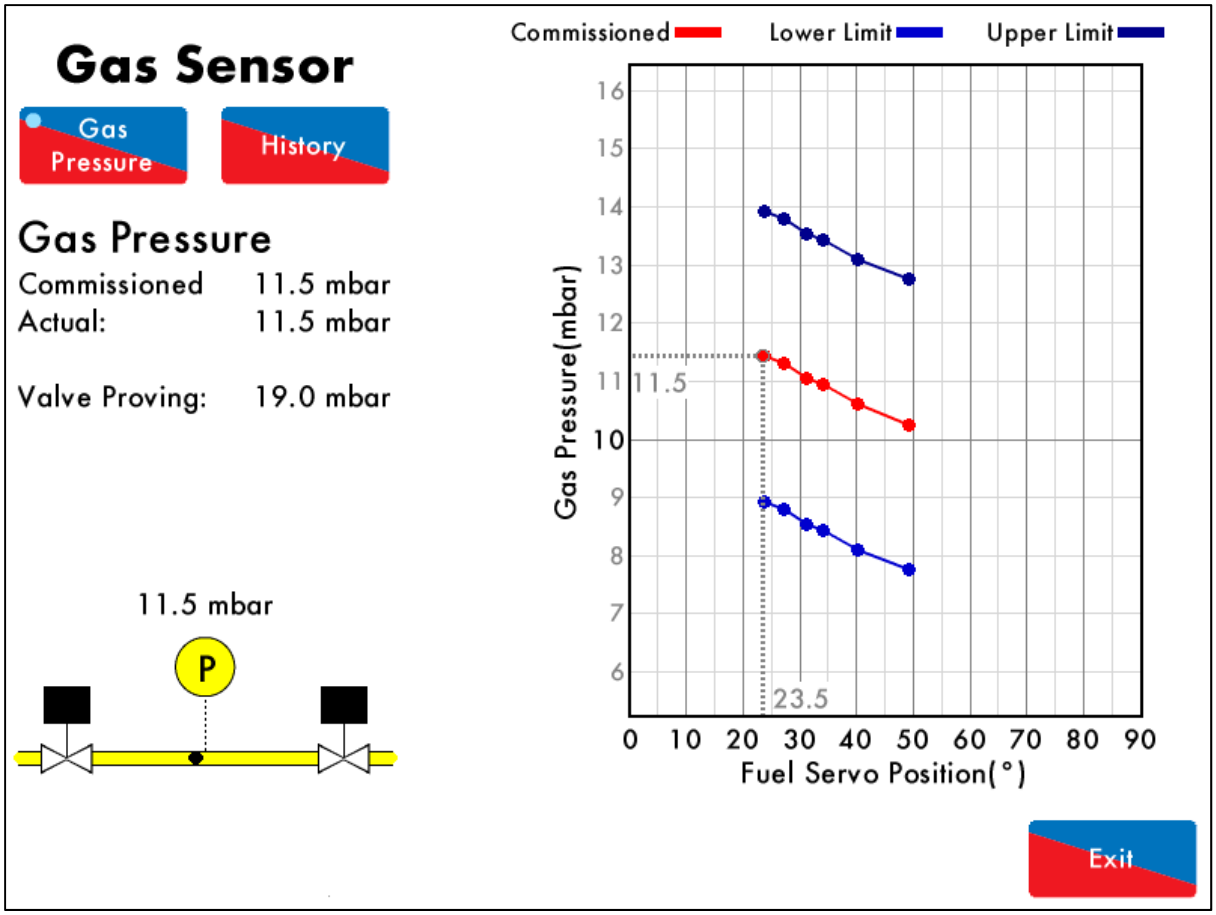


Figure 3.6.i Gas Sensor – Low Fire

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

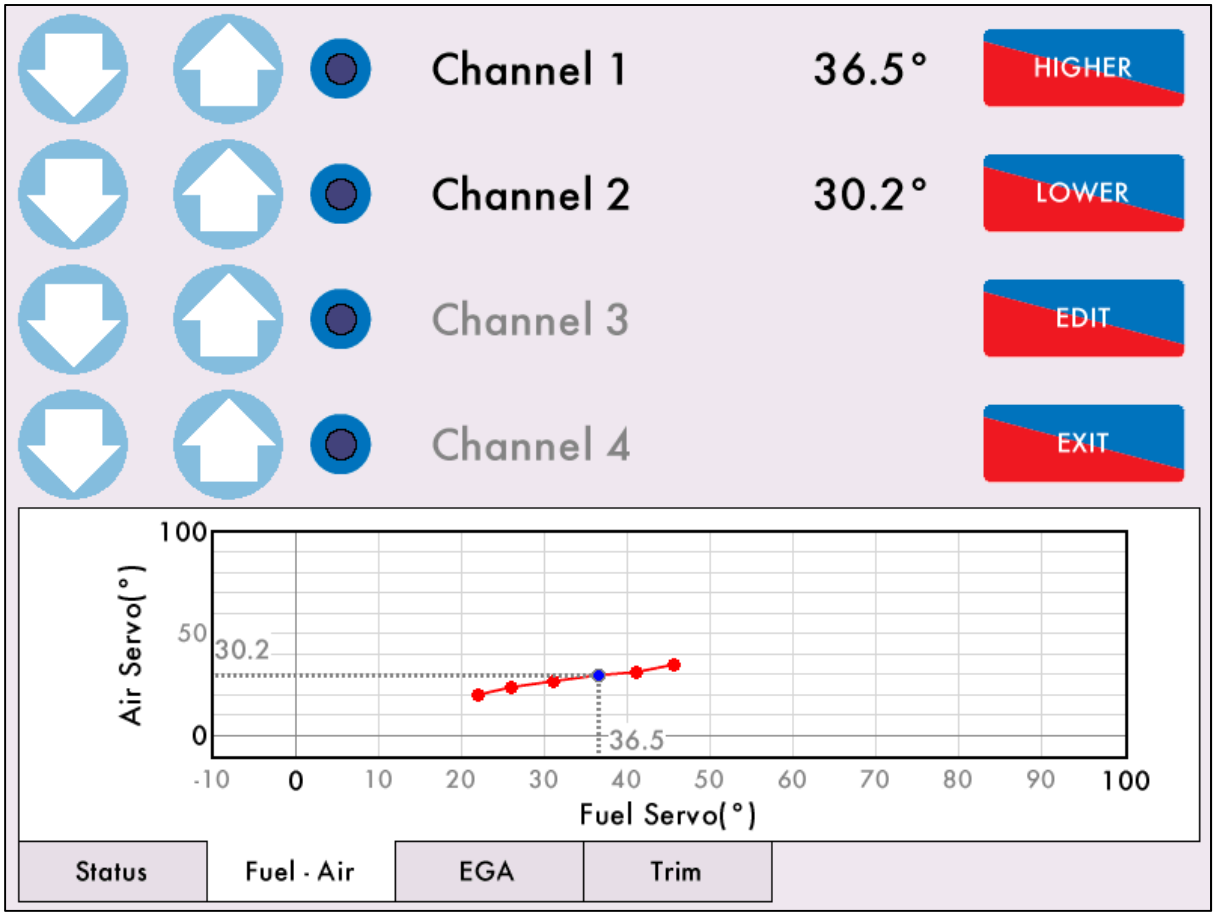


Figure 3.7.i Single Point Change

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 

.

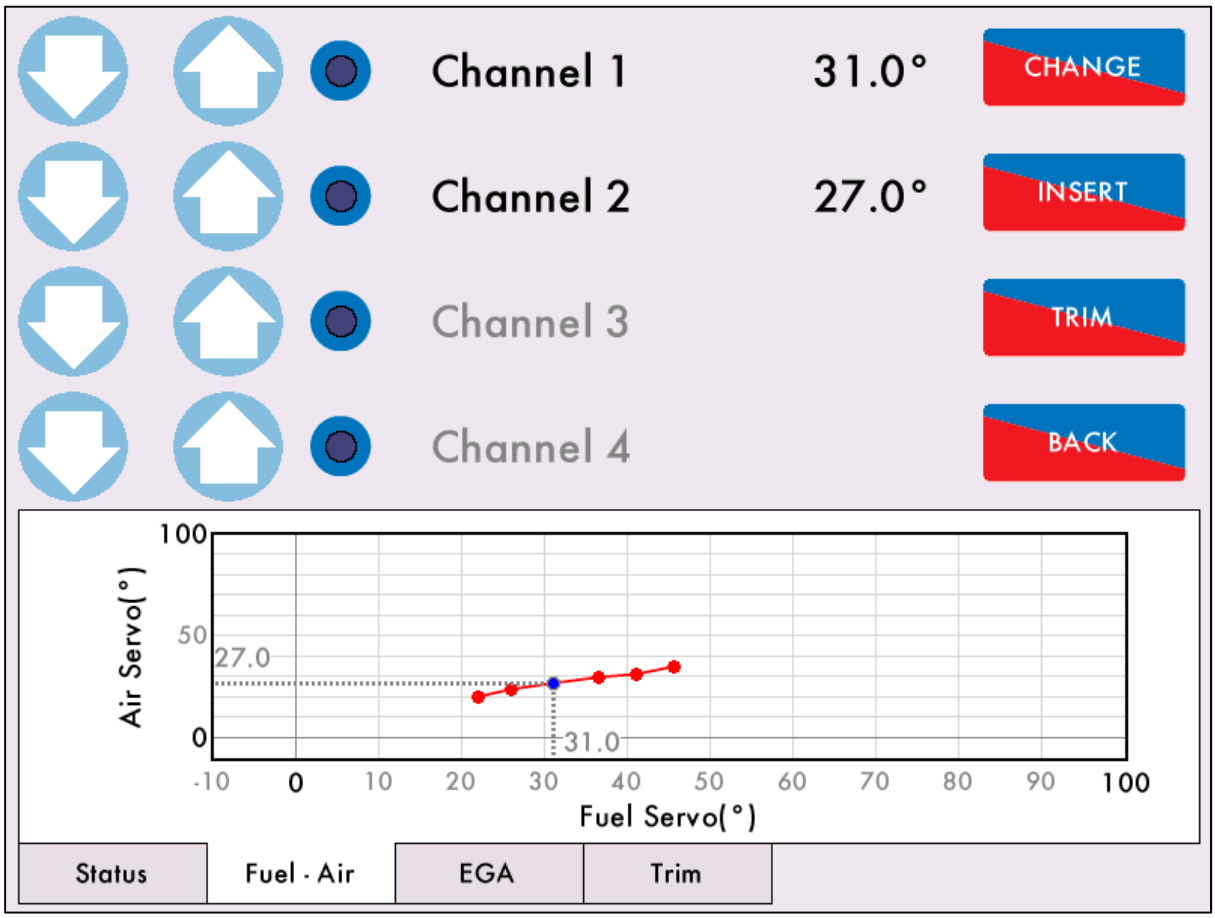


Figure 3.7.ii Changes

To edit a previously entered point press 

and make adjustments to the positions as needed (see Figure 3.7.iiii).

To enter a new point press 

.

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.

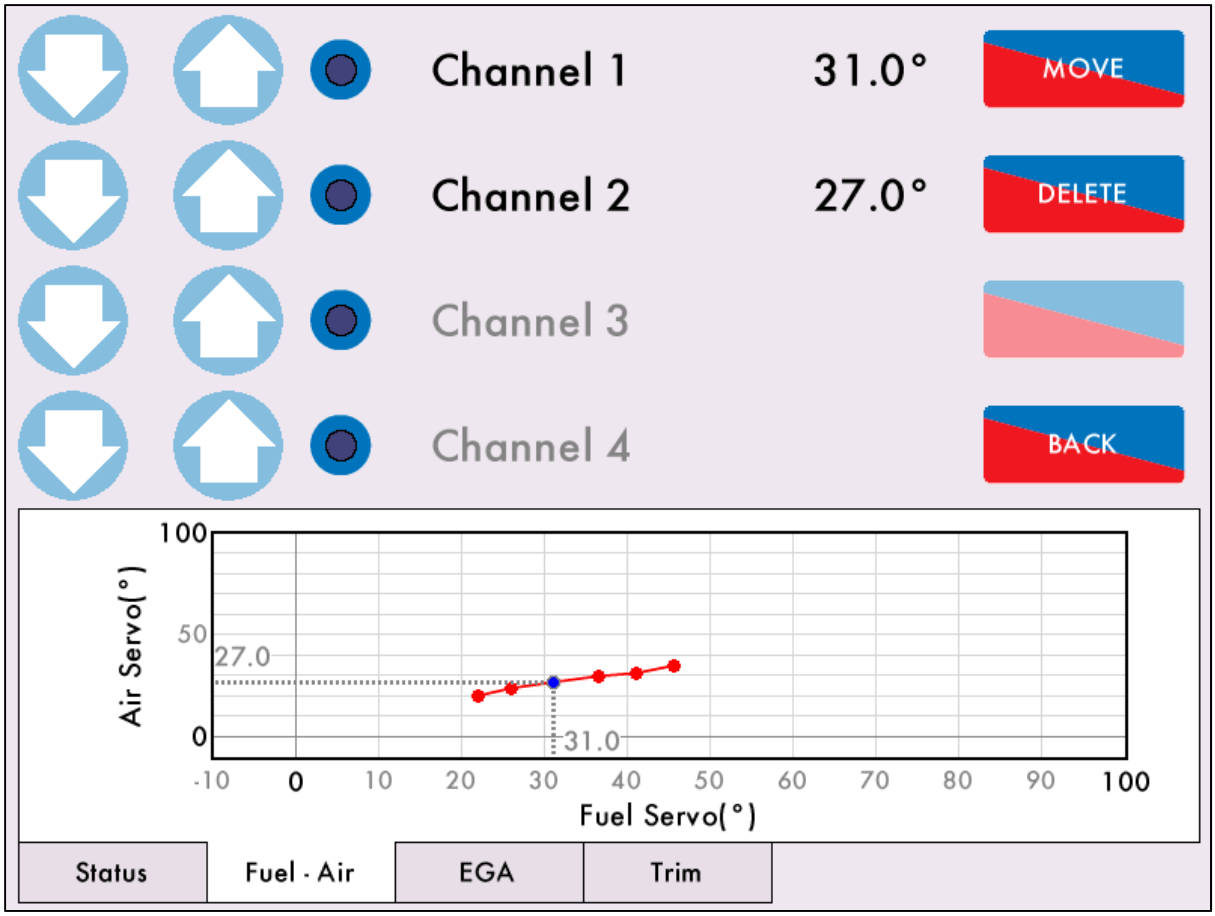


Figure 3.7.iii Changing a Point

Press MOVE to the fuel, air and/or VSD commissioned value of that point. Once the changes have been made, press ENTER to save this position. If a point is overwritten, the trim data is cleared.

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

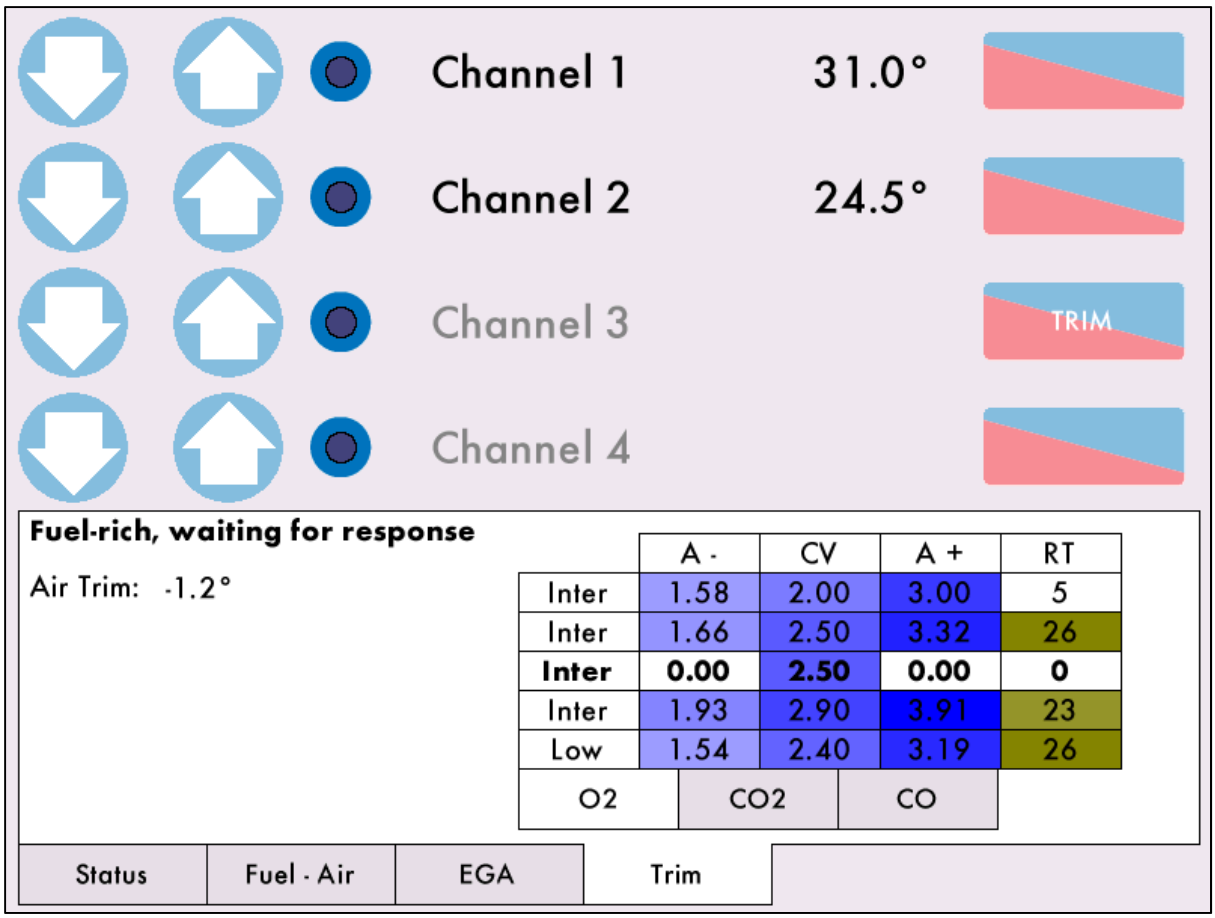


Figure 3.7.iv Single Point Change – Trim

The MM will store the trim values for this position.

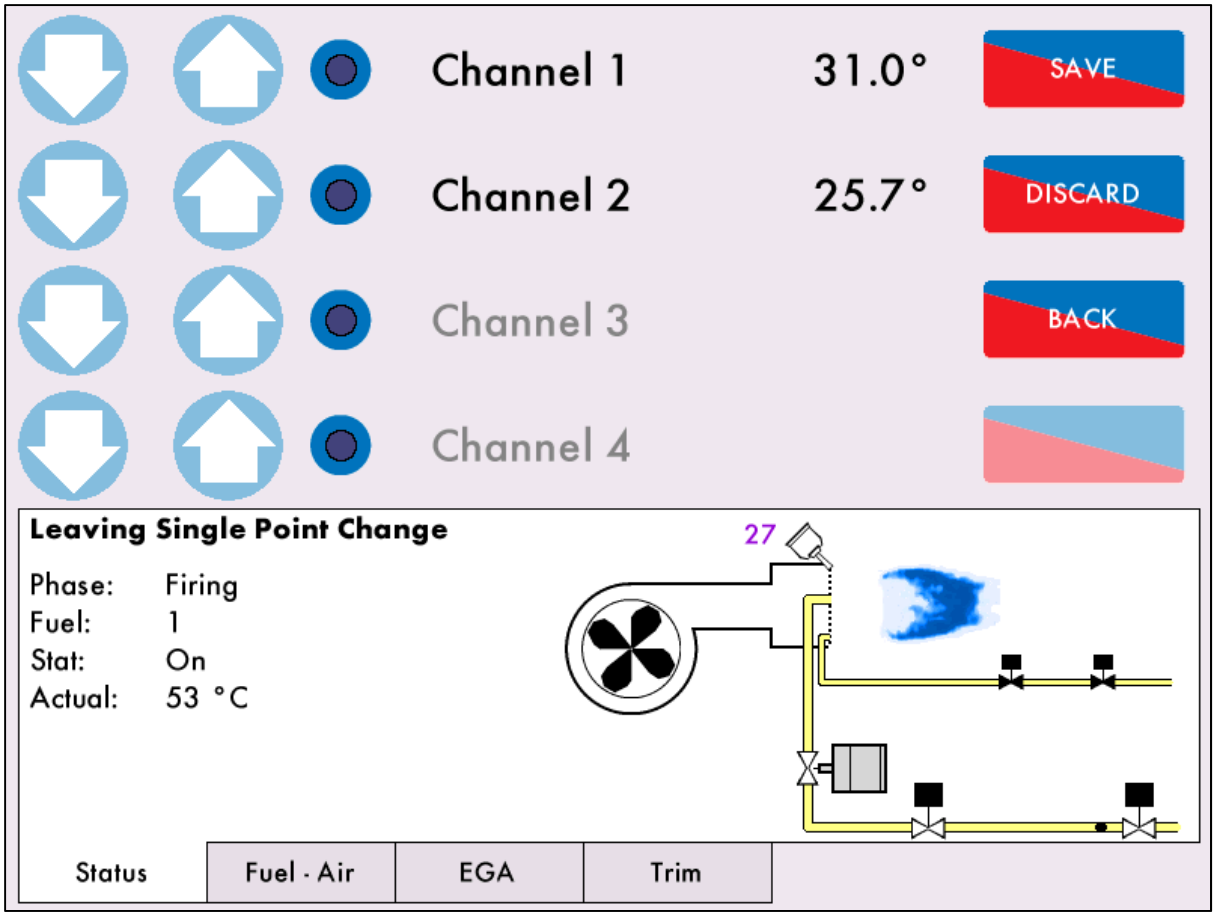


Figure 3.7.v Exit Single Point Change

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

.

Press 

to leave Single Point Change mode.

The fuel flow commissioning must be entered (again) if 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 go to section 3.5 Fuel Flow Commissioning.

3.8 Online Changes

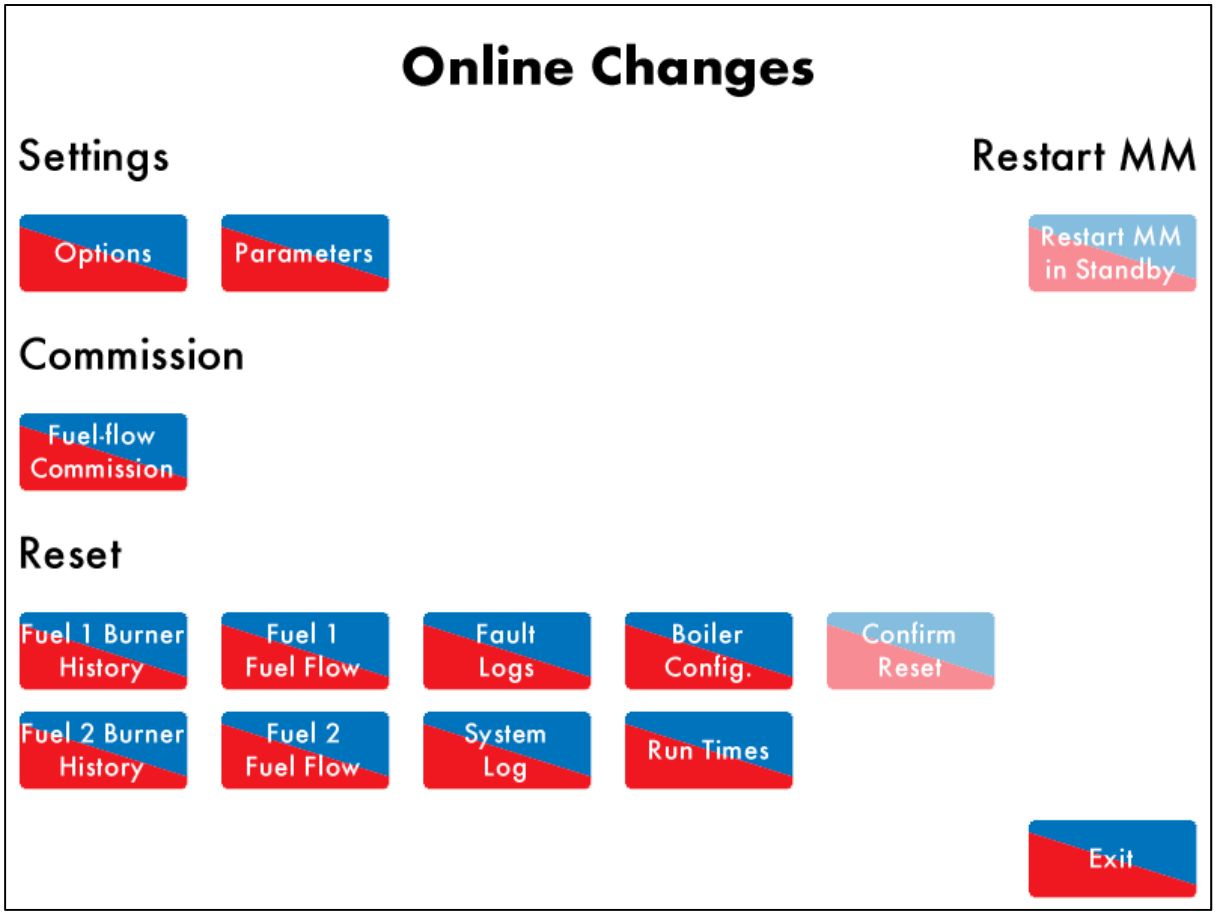


Figure 3.8.i Online Changes Screen

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:
Fuel flow commissioning (section 3.5)

- Change non-safety critical options and parameters
- 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.

3.9 General Operation

3.9.1 Calibrating the Actual Value

To calibrate the actual value, a new parameter has been added to allow the temperature/ pressure sensor to be adjusted. Parameter 29 allows you to adjust the actual value between a range of 80.0% and 120.0%.

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

Note: 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 91degC on the MM, but the true temperature was 79degC, change the value in parameter 29 until the correct temperature adjustment has been made. Figure 3.9.1.i shows the load sensor adjusted by 96.0% to display 79degC.

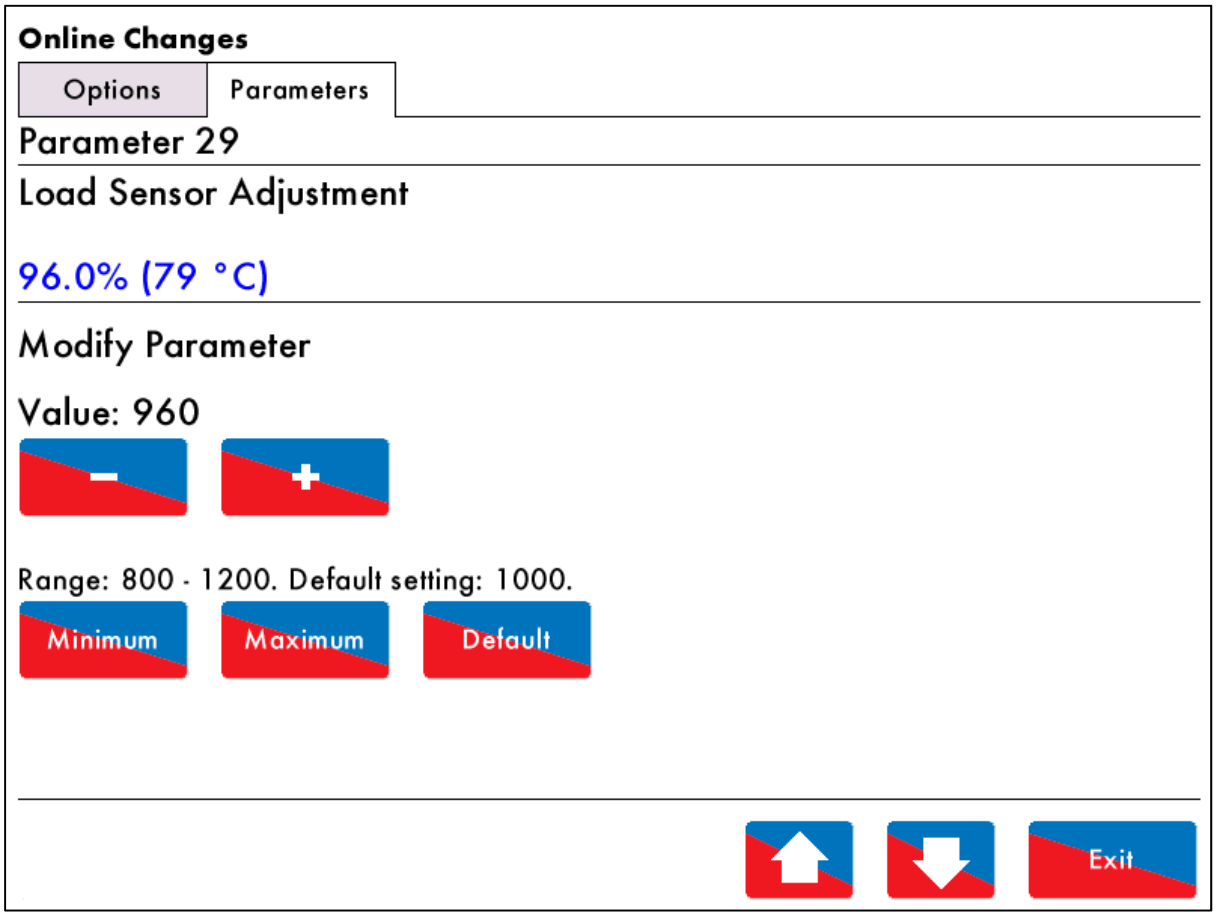


Figure 3.9.1.i Load Sensor Adjusted

3.9.2 External Modulation

For external modulation, option 45 must 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 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 through option.

Note: 4-20mA external modulation can be used via a 500 ohm resistor across terminals 37 and 38.

3.9.3 Additional Functions

Options/ parameters 154, 155 and 156 have been added to set the function of terminals 80, 81 and 82, respectively. Terminal 80 is used for start position interlock, night setback input, and reduced setpoint input. Terminal 81 is used for purge interlock and low flame hold input. Terminal 82 is used for warming stat and valve proving mains input. Proving valves (end switch) provide a secondary confirmation that a valve has reached a predefined position.

To install the End Limit Switches,

1. Mount the servomotor onto the valve and ensure the potentiometer reads the correct position on the MM for the "CLOSED" and "OPEN" valve positions.
2. Mount the End Switch Proving Unit (E.S.P.U.). The servomotor may have to be moved to a suitable position in order to allow the E.S.P.U. to be attached to the valve.
3. Undo the End Limit Switch holding screws.
4. Adjust the position of CAM corresponding to switches 1 (S1) and 2 (S2) by loosening the CAM screws and move to the required position.
5. Wire the ESPU according to the Valve Proving the End Limit Switch will be required to provide. See the End Limit Switch wiring diagram in Figure 3.9.3.i

Note: The use of these switches is determined by the application approval necessary. These are not required to meet UL, FM or CE.

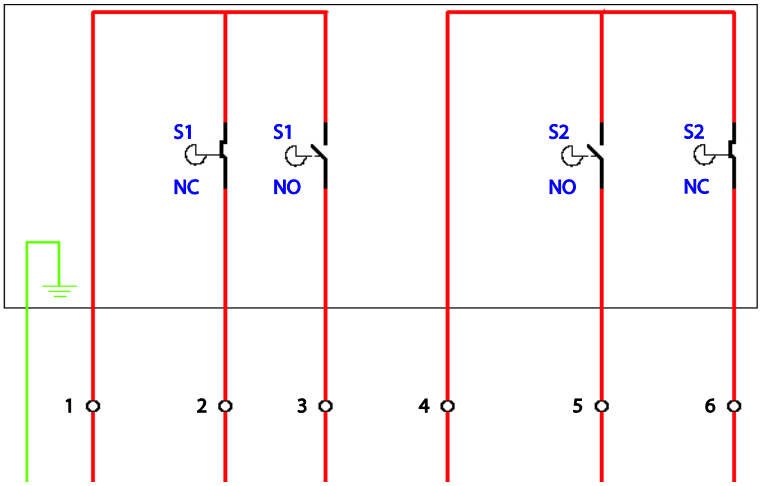


Figure 3.9.3.i End Switch Wiring Schematic

End Limit Switches are mounted on the end of bespoke valves (please contact Autoflame regarding bespoke valve manufacture) which are attached to the air and fuel valve and commissioned depending on the use of the End Limit Switches. An End Limit Switch comprises of two switches, as shown in Figure 3.9.3.i. Each comprises of an Earth and 6 connections to be wired as appropriate. The switches S1 and S2 are setup as per on site specification. These are then wired into either or both of the terminals 80, the start position interlock, and terminal 81 purge interlock.

If option/ parameter 154 is set to 1, then the MM waits at RUN TO IGNITION until this interlock is made on terminal 80. If option/ parameter 155 is set to 1 then MM waits at RUN TO PURGE until this interlock is made on terminal 81.

If option/ parameter 154 is set to 2, terminal 80 is the night setback input (night setback offset must be set in option 85). If it is set to 3, terminal 80 is used for reduced setpoint input. If option/ parameter 155 is set to 2, terminal 81 is used for the low flame hold input. If option/ parameter 156 is set to 0, than terminal 82 is used for the warming stat for sequencing. If it is set to 1, terminal 82 is used for the valve proving mains input (see option/ parameter 128).

4 REMOTE CONTROL

4.1 Modbus Settings

To access data remotely from the Mini Mk8 MM, this can be done either by connecting a Mk7 DTI, or by using direct Modbus. Direct Modbus cannot be used with sequencing or Mk7 DTI.

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

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

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

Up to 10 MMs can be linked to 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 by setting 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.

Please see next page for Modbus addresses.

4.2 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

4.3 Modbus Addresses

There are 4 types of Modbus addresses:

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

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

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

3x Read analogue inputs – variable data in

4x Read/Write analogue outputs – variable adjustments

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

Address	Description	Type
00001	Enable/Disable MM	Read/write digital
• 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	EGA Trim Optioned	Read digital
• 0 = Trim not optioned, 1 = Trim optioned • Returns value 0 when option 12 is set for monitoring only.		
10218	EGA is Trimming	Read digital
• 0 = EGA not trimming, 1 = EGA is trimming • Returns value 0 is actual temperature/pressure is below trim threshold		
10219	EGA Cooler Ready	Read digital
• 0 = Cooler is ready, 1 = Cooler is not ready • Returns value 0 if EGA is an error state		
10220	EGA Ambient Temp OK	Read digital
• 0 = Temperature OK, 1 = Temperature not OK		
10221	EGA NO_2 On	Read digital
• 0 = NO_2 cell not optioned, 1 = NO_2 cell optioned • See option 36, valid for Mk7 EGA only		
10222	EGA SO_2 On	Read digital
• 0 = SO_2 cell not optioned, 1 = SO_2 cell optioned • See option 36, valid for Mk7 EGA only		
10224	EGA OK to Sample	Read digital
• 0 = EGA is not sampling, 1 = EGA is sampling		
10233	Hand Mode	Read digital
• 0 = MM not in hand mode, 1 = MM in hand mode		
10234	Low Flame Hold	Read digital
• 0 = MM not in low flame hold, 1 = MM in low flame hold		
10242	Disabled Status	Read digital
• 0 = Burner enabled, 1 = Burner disabled • Returns state of enable/disable button on MM home screen and same value as address 00001		
30101	Load Index	Read analogue
• Firing rate %		

Address	Description	Type
30102	Firing Status	Read analogue
	• 0 = Non-modulating, 1 = Modulating • Returns value 0 single point change, fuel flow metering and commissioning	
30104	Burner Rating	Read analogue
	• MW x 10 • Metric units determined from fuel flow metering	
30105	Actual Value	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30106	Required Value	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30107	Selected Fuel	Read analogue
	• 0 = Fuel 1, 1 = Fuel 2	
30109	Channel 1 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30110	Channel 2 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30111	Channel 3 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30113	MM Error Number	Read analogue
	• 0 = System is does not have an error, N = error number, check error codes	
30115	EGA Current O_2 Value	Read analogue
	• % x 10	
30116	EGA Current CO_2 Value	Read analogue
	• % x 10	
30117	EGA Current CO Value	Read analogue
	• ppm x 10	
30118	EGA Current Exhaust Gas Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30119	EGA Current Efficiency Value	Read analogue
	• % x 10	
30120	EGA Current NO Value	Read analogue
	• ppm x 10	
30121	EGA Current SO_2 Value	Read analogue
	• ppm x 10	
30122	EGA Commissioned O_2 Value	Read analogue
	• % x 10	
30123	EGA Commissioned CO_2 Value	Read analogue
	• % x 10	
30124	EGA Commissioned CO Value	Read analogue
	• ppm x 10	

Address	Description	Type
30125	EGA Commissioned Exhaust Gas Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30126	EGA Commissioned Efficiency Value	Read analogue
	• % x 10	
30127	EGA Commissioned NO Value	Read analogue
	• ppm x 10	
30128	EGA Commissioned SO_2 Value	Read analogue
	• ppm x 10	
30129	EGA Error Code	Read analogue
	• 0 = EGA does not have a fault, N = EGA error	
30130	Minimum Remote Setpoint	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30131	Maximum Remote Setpoint	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30132	Current Flow Thousands	Read analogue
	• 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	Current Flow Millions	Read analogue
	• 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	Fuel 1 Flow Total Thousands	Read analogue
	• 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	
30135	Fuel 1 Flow Total Millions	Read analogue
	• 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	Fuel 1 Flow Total Billions	Read analogue
	• 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	Fuel 2 Flow Total Thousands	Read analogue
	• 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	Fuel 2 Flow Total Millions	Read analogue
	• 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	

Address	Description	Type
30139	Fuel 2 Flow Total Billions	Read analogue
• 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		
30140	Fuel 3 Flow Total Thousands	Read analogue
• 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		
30141	Fuel 3 Flow Total Millions	Read analogue
• 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		
30142	Fuel 3 Flow Total Billions	Read analogue
• 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	EGA Current Ambient Temperature	Read analogue
• Metric: temperature x 10 °C • Imperial: temperature x 10 °F		
30144	EGA Current Delta Temperature	Read analogue
• Metric: temperature x 10 °C • Imperial: temperature x 10 °F		
30145	EGA Commissioned Ambient Temperature	Read analogue
• Metric: temperature x 10 °C • Imperial: temperature x 10 °F		
30146	EGA Commissioned Delta Temperature	Read analogue
• Metric: temperature x 10 °C • Imperial: temperature x 10 °F		
30147	UV Counts	Read analogue
• Returns value displayed on MM		
30148	IR Counts	Read analogue
• Returns value displayed on MM		
30149	Ionisation Counts	Read analogue
• Returns value display on MM		
30150	EGA Current NO_2 Value	Read analogue
• ppm x 10		
30151	EGA Commissioned NO_2 Value	Read analogue
• ppm x 10		
30804	Channel 4 VSD Output	Read analogue
• mA x 10 or V x 10		
30805	Channel 4 VSD Input	Read analogue
• mA x 10 or V x 10		
30830	Lockout Number	Read analogue
• 0 = System is not in lockout, N = lockout number		
30831	Fuel 1 Type	Read analogue
• 0 = Gas, 1 = Oil • Option/ parameter 150 value		

Address	Description	Type
30832	Fuel 2 Type	Read analogue
	• 0 = Gas, 1 = Oil • Option/parameter 151 value	
30839	Fuel 1 Hours Run	Read analogue
	• Completed hours	
30840	Fuel 2 Hours Run	Read analogue
	• Completed hours	
30843	Fuel 1 Start-ups	Read analogue
	• Start-ups	
30844	Fuel 2 Start-ups	Read analogue
	• Start-ups	
30849	Current Gas Pressure	Read analogue
	• mbar x 10, "wg x 10, PSI x 100 • parameter 41 value	
40001	Remote Required Setpoint	Read/write analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °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	Remote Firing Rate	Read/write analogue
	• % • 40131 must be set to 1 to change the firing rate remotely	
40131	Remote Firing Rate Enable	Read/write analogue
	• 0 = Remote firing rate disabled, 1 = remote firing rate enabled	

5 ERRORS AND LOCKOUTS

5.1 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 – 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°		
2	Channel 2 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 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°		
3	Channel 3 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 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 – 47 and 70 – 75		
6	Channel 2 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40 – 47 and 70 – 75		
7	Channel 3 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40 – 47 and 70 – 75		
9	Channel 1 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals 70 – 75 • 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 70 – 75 • 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 70 – 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		

Error	Message	Description
16	ADC Error	Internal fault
• Contact Autoflame approved local Tech Centre		
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		
25	Zero-Crossing Detection Error	Internal fault
• Check mains supply going to unit is within acceptable voltage range		
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		

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

5.2 Burner 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 not should be
• Isolate gas/ oil immediately • 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	Power supply fault
• Check mains voltage to the MM		
32	Gas Pressure Low Limit	Gas pressure lower than commissioned VPS value
• Check gas pressure • Check option/parameters 136 and 138		
33	VPS Pressure Zeroing	Gas pressure sensor cannot be zeroed at VPS venting
• Check gas pressure is within zero range (see MM Application Possibilities) • 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 time from position to purge to post purge. • Check wiring on terminal 80.		
45	No Proving Circuit Set T80	Delay to purge timeout has elapsed
• Check option/parameter 157, and wiring on terminal 80.		
46	Purge Pressure Proving Timeout	Purge pressure proving timeout has elapsed
• Check option/parameters 155 and 158, and wiring on terminal 81.		
47	Ion. Internal Failsafe Fault	Internal check failed for flame rod
• Check wiring on terminal 64		

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

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

5.3 EGA Errors

The table below shows the EGA errors on the Mini Mk8 MM. Option 13 sets the way the MM responds to an EGA error.

EGA Error	Description
1	EGA Internal Error
• Check EGA for fault.	
2	No Communications
• 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
• Current O_2 value is above upper offset limit of commissioned value.* • Check exhaust gas readings and option 19.	
4	O_2 Absolute Limit
• Current O_2 value is below absolute limit.* • Check exhaust gas readings and option 25.	
5	O_2 Lower Limit
• Current O_2 value is below lower offset limit of commissioned value.* • Check exhaust gas readings and option 22.	
6	CO_2 Upper Limit
• Current CO_2 value is above upper offset limit of commissioned value.* • Check exhaust gas readings and option 20.	
7	CO_2 Absolute Limit
• Current CO_2 value is above absolute limit.* • Check exhaust gas readings and option 26.	
8	CO_2 Lower Limit
• Current CO_2 value is below lower offset limit of commissioned value.* • Check exhaust gas readings and option 23.	
9	CO Upper Limit
• Current CO value is above upper offset limit of commissioned value.* • Check exhaust gas readings and option 21.	
10	CO Absolute Limit
• Current CO value is above absolute limit.* • Check exhaust gas readings and option 27.	
11	NO Upper Limit
• Current NO value is above upper offset limit of commissioned value.* • Check exhaust gas readings and parameter 94.	
12	Exhaust Temperature Upper Limit
• Current exhaust temperature is above upper offset limit of commissioned value.* • Check exhaust gas readings and parameter 96.	
13	Exhaust Temperature Absolute Limit
• Current exhaust temperature is above absolute limit.* • Check exhaust gas readings and parameter 97.	

*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).

5.4 Troubleshooting and Further Information

5.4.1 UV Shutter Faults

UV shutter fault– there are two LED's on the back of the self-check UV. The red LED indicates the presence of a flame; the yellow LED indicates shutter operation. The red LED will flicker in the presence of UV light. Every 60 seconds the yellow LED will come on, indicating that the shutter is closing. The red LED should then extinguish briefly. If this is not happening check the wiring to self-check UV sensor:

Green wire = Terminal 22
Yellow wire = Terminal 21
Blue wire = Terminal 50
Red wire = Terminal 51

5.4.2 UV Problems

If the red LED's fail to illuminate but the burner operates, it is likely that the 2 wires are crossed. This must be corrected. Once corrected a full flame signal strength will be displayed/registered.

The Autoflame UV software utilises early spark termination within the internal flame safeguard control. Therefore, detection of the ignition spark is allowed. During start-up the ignition is de-energised and the pilot flame must be proven without the spark before the main fuel valves are open (safety shut off). Due to the above statement it is not necessary to have a sight tube on the UV for pick-up. This, in fact, will drastically reduce the flame pick-up.

If insufficient UV is detected, it is advised to use a swivel mount assembly (UVM60003/UVM60004) in order to obtain maximum pick-up. This will allow the commissioning engineer to reliably sight the UV for optimum performance and trouble free operation.

Note: Under no circumstances is a non-Autoflame UV scanner permitted to be used. This is in breach of all codes and approvals associated with the Autoflame combustion management system. This may lead to serious equipment damage, critical injury or death.

If a non-Autoflame scanner is required then please contact Autoflame directly for technical support. For more information on UV scanners, please refer to MM Flame Safeguard and Operation.

5.4.3 Snubbers

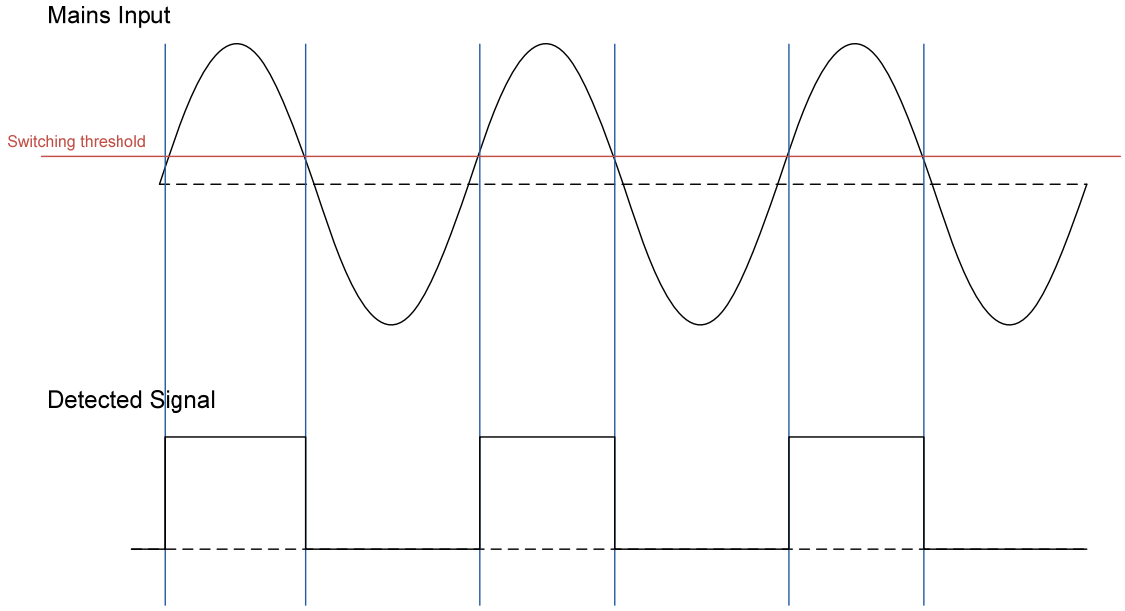
The Autoflame system has internal components which protects itself against voltage/current spikes and electrical interference. In some installations this internal protection is not enough, especially when the main fuel valve Terminals 60 and 61 have been connected to older gas valves and voltage/current spikes have occurred when the valves have been switched on or off. This can cause internal damage to the MM Snubbers can be used on these old gas valves to protect the MM from these spikes; they should be fitted across the power terminals of the gas valves. Please contact Autoflame Sales for more information.

5.4.4 Channel Positioning Error

The 'Channel Positioning' MM Error is caused by incorrect wiring and incorrect servomotor position. In addition to checking the wiring, and zeroing the potentiometer, please also check that the correct voltage is supplied to the servomotors, which should be ±10% of the required voltage, and the unit is earthed properly. This can cause hunting issues if not at the required voltage or incorrect earthing.

5.4.5 Input Fault

The 'Input Fault' MM Error relates to a fault with the power supply going to the MM The MM verifies the power supply going to the unit; the mains inputs are sampled to check the DC voltage. The diagram below illustrates the AC voltage that comes in through the power supply with the detected signal (digital input).



The MM checks the ON state of the digital signal in the mains input; the ON state of the digital input should be 50%. This means that the digital input should be in the ON state for a half-wave of the AC signal. The OFF state is safe. If the MM sees the digital input being ON for more than 75% across a sample period, then it will get stuck in an unsafe state. This will cause an Input Fault lockout to occur.

If this lockout persists, the mains input should be checked. To troubleshoot this issue, please check for any DC voltage in the mains voltage and contact your local power supplier.

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

Setting Conflict Message
(118) (141) (149) Purge air pres. threshold cannot be higher when post purge is optioned
• If post purge is enabled, then the purge air pressure threshold cannot be set higher than the running air pressure threshold. • Check option/parameters 118, 141 and 149.
(123) Fuel 2 2nd Safety time too high for Gas
• If fuel 2 is gas, the maximum allowed 2nd safety time is 10 seconds. • Check option/parameters 123 and 151.
(125, 126) (128) Pressure limits do not operate using digital input.
• Gas pressure upper/lower limits can only be used with a gas pressure sensor. • Check option/parameters 125, 126 and 128.
(125, 126) (129) (135) Post VPS cannot be optioned with NFPA Post Purge
• If NFPA post purge is enabled for gas, VPS can only be set for operating before burner start-up. • Check option/parameters 125, 126, 129 and 135.
(125) (150) Gas pressure sensor cannot be optioned when fuel type is oil (fuel 1)
• Valve proving and gas pressure limits can only be used for gas • Check option/parameters 125 and 150
(126) (151) Valve proving cannot be optioned when fuel type is oil (fuel 2)
• Valve proving and gas pressure limits can only be used for gas • Check option/parameters 126 and 151
(128) (156) T82 is no set as VPS input
• If valve proving is optioned and configured as a digital VPS input from, T82 must be configured as the input for a VPS input gas pressure switch. • Check option/parameters 128 and 156.
(P85) (16) Modulation exerciser cannot be used with sequencing
• Modulation exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 85.
(P89) (16) Stat exerciser cannot be used with sequencing
• Stat exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 89.
(P99) (P100) Graceful shutdown and assured low fire shut off not allowed
• If graceful shutdown is set, then assured low fire shut off cannot be used. • Check parameters 99 and 100.

5.4.8 Forced Commission

The MM will be forced into Commission mode if there is a setting conflict as in 5.4.6, and/or 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 option/parameters 110 – 160. • Check options 110 – 160 match to their corresponding parameter.
Invalid option value.
• An option value is outside the allowed range for the current software. • Check all options.
Invalid parameter value.
• A parameter value is outside the allowed range for the current software. • Check all parameters.
Options have been reset.
• Option settings have been reset due to data lost in an EEPROM error.
Parameters have been reset.
• Parameter settings have been reset due to data lost in an EEPROM error.
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 option/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.

6 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

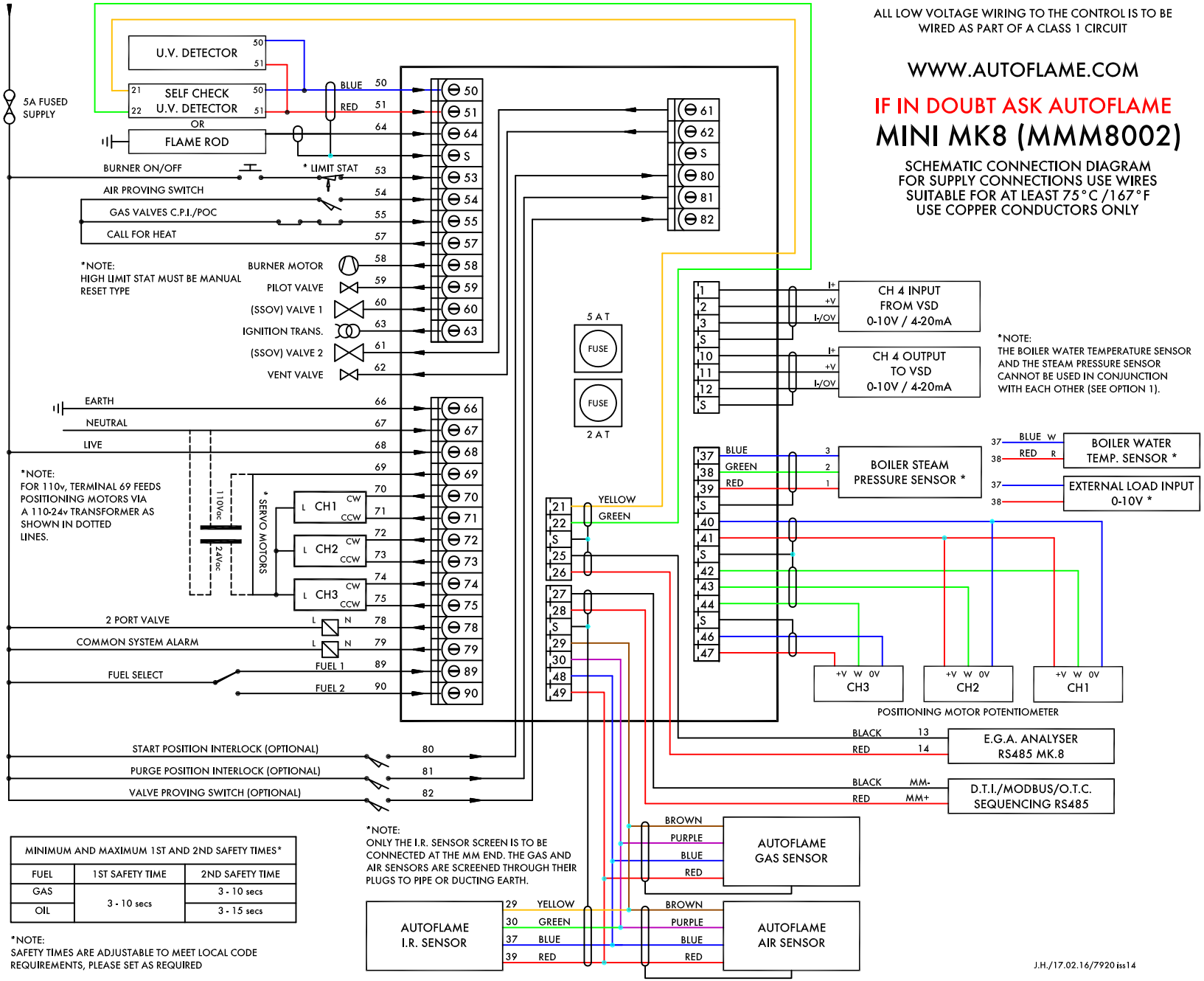
BS EN 1854:2010

ISO 23552-1:2007

AGA AS 4625-2008

AGA AS 4630-2005

Notes


ALL LOW VOLTAGE WIRING TO THE CONTROL IS TO BE WIRED AS PART OF A CLASS 1 CIRCUIT
WWW.AUTOFLAME.COM
IF IN DOUBT ASK AUTOFLAME
MINI MK8 (MMM8002)
SCHEMATIC CONNECTION DIAGRAM
FOR SUPPLY CONNECTIONS USE WIRES SUITABLE FOR AT LEAST 75°C /167°F
USE COPPER CONDUCTORS ONLY
5A FUSED SUPPLY
U.V. DETECTOR
SELF CHECK U.V. DETECTOR
OR
FLAME ROD
BURNER ON/OFF
* LIMIT STAT
AIR PROVING SWITCH
GAS VALVES C.P.I./POC
CALL FOR HEAT
*NOTE: HIGH LIMIT STAT MUST BE MANUAL RESET TYPE
BURNER MOTOR
PILOT VALVE
(SSOV) VALVE 1
IGNITION TRANS.
(SSOV) VALVE 2
VENT VALVE
EARTH
NEUTRAL
LIVE
*NOTE: FOR 110v, TERMINAL 69 FEEDS POSITIONING MOTORS VIA A 110-24v TRANSFORMER AS SHOWN IN DOTTED LINES.
110Vac
24Vac
* SERVO MOTORS
CH1
CH2
CH3
CW
CCW
2 PORT VALVE
COMMON SYSTEM ALARM
FUEL SELECT
FUEL 1
FUEL 2
5 A T
FUSE
2 A T
YELLOW
GREEN
CH 4 INPUT FROM VSD 0-10V / 4-20mA
CH 4 OUTPUT TO VSD 0-10V / 4-20mA
*NOTE: THE BOILER WATER TEMPERATURE SENSOR AND THE STEAM PRESSURE SENSOR CANNOT BE USED IN CONJUNCTION WITH EACH OTHER (SEE OPTION 1).
BOILER STEAM PRESSURE SENSOR *
BOILER WATER TEMP. SENSOR *
EXTERNAL LOAD INPUT 0-10V *
+V W 0V
CH3
CH2
CH1
POSITIONING MOTOR POTENTIOMETER
START POSITION INTERLOCK (OPTIONAL)
PURGE POSITION INTERLOCK (OPTIONAL)
VALVE PROVING SWITCH (OPTIONAL)
E.G.A. ANALYSER RS485 MK.8
D.T.I./MODBUS/O.T.C. SEQUENCING RS485
MM-
MM+
MINIMUM AND MAXIMUM 1ST AND 2ND SAFETY TIMES*
FUEL | 1ST SAFETY TIME | 2ND SAFETY TIME
GAS | 3 - 10 secs | 3 - 10 secs
OIL | | 3 - 15 secs
*NOTE: SAFETY TIMES ARE ADJUSTABLE TO MEET LOCAL CODE REQUIREMENTS, PLEASE SET AS REQUIRED
*NOTE: ONLY THE I.R. SENSOR SCREEN IS TO BE CONNECTED AT THE MM END. THE GAS AND AIR SENSORS ARE SCREENED THROUGH THEIR PLUGS TO PIPE OR DUCTING EARTH.
AUTOFLAME I.R. SENSOR
AUTOFLAME GAS SENSOR
AUTOFLAME AIR SENSOR
BROWN
PURPLE
BLUE
RED
J.H./17.02.16/7920 iss14

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