

Autioflame

Mk8 MM Installation and Commissioning Guide

AUTOFLAME[®]



Mk8 MM

Installation and Commissioning Guide



Issued by:

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

Important Notes

A knowledge of combustion related procedures and commissioning is essential before embarking 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.

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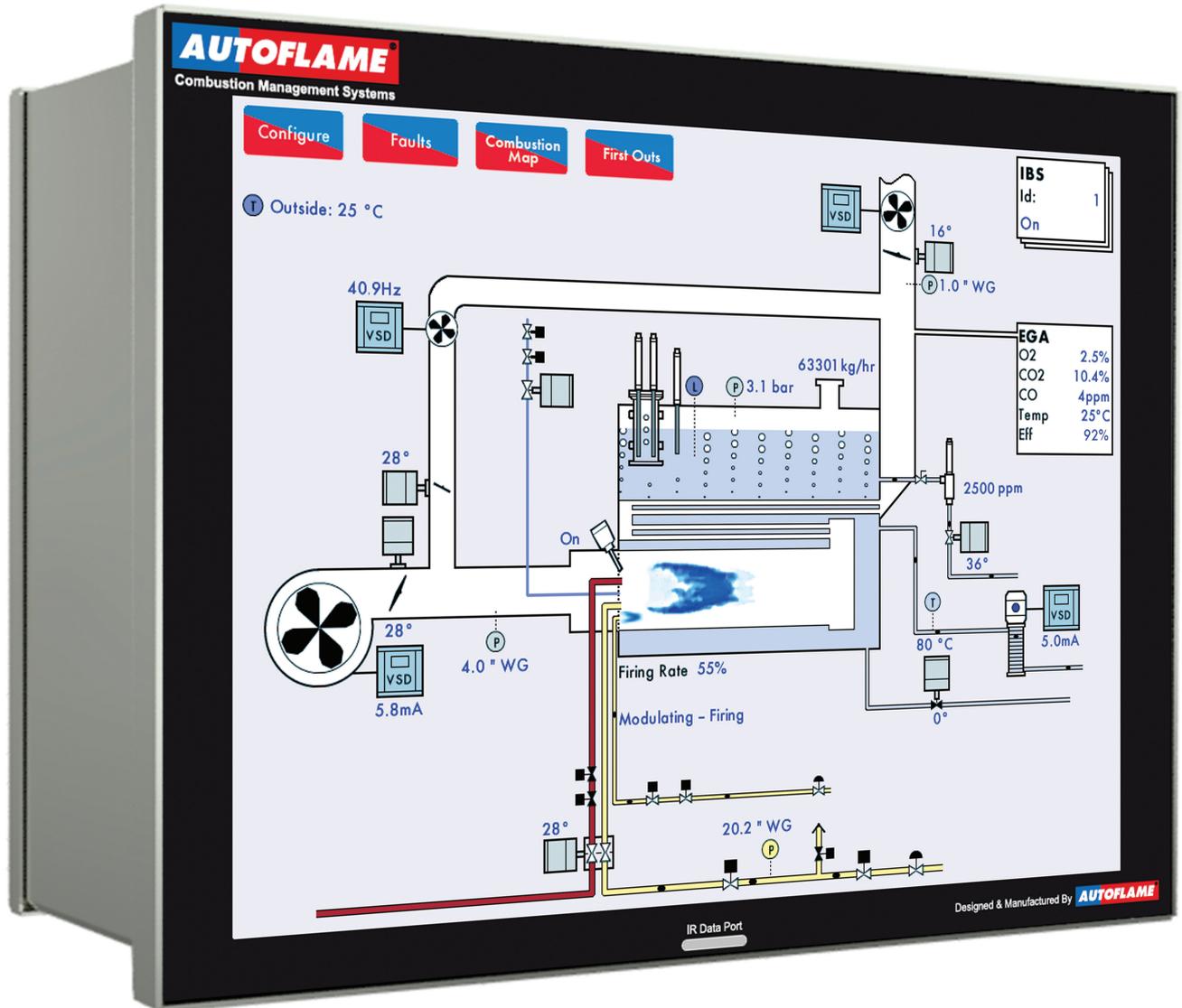
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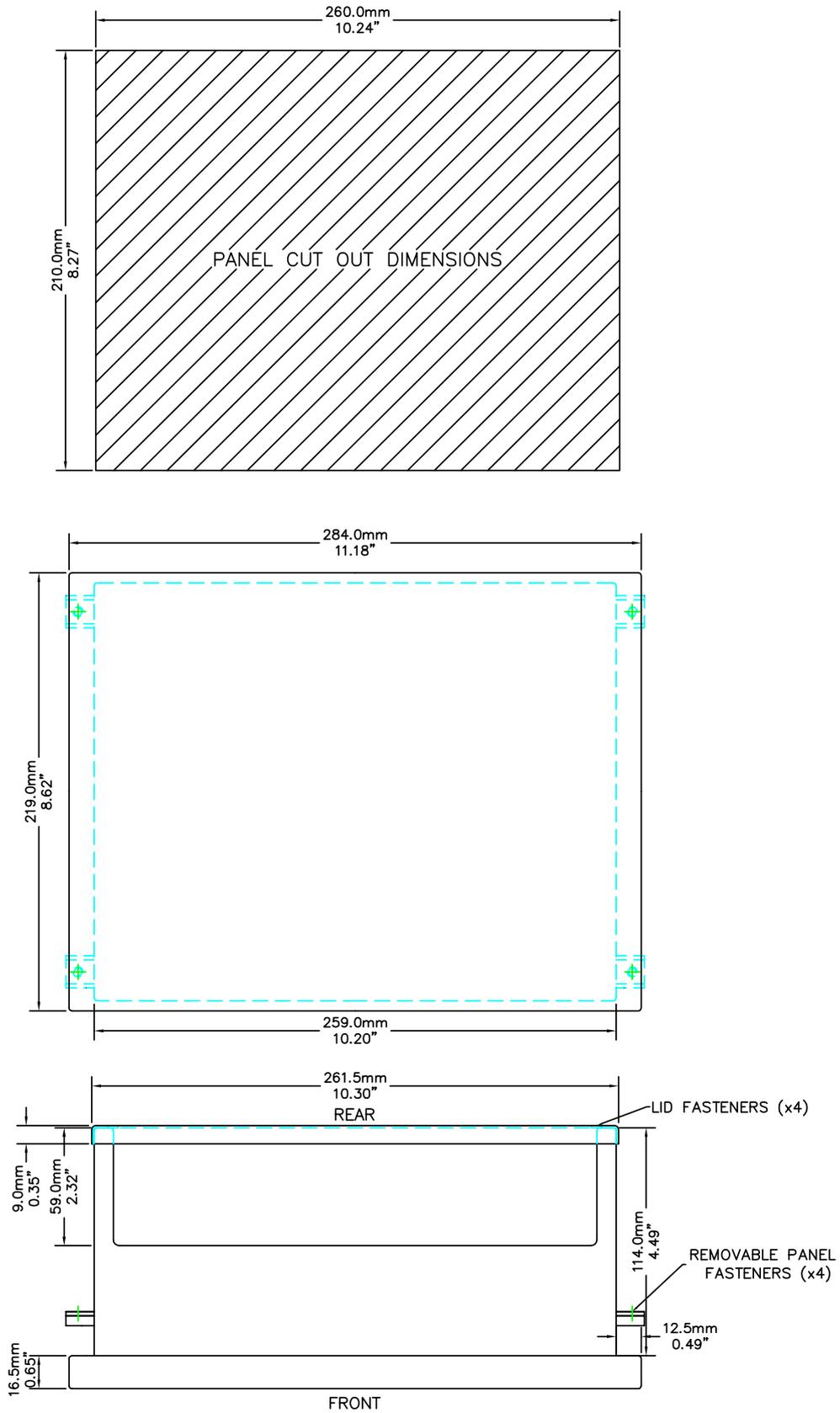
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1.1 Mk8 MM



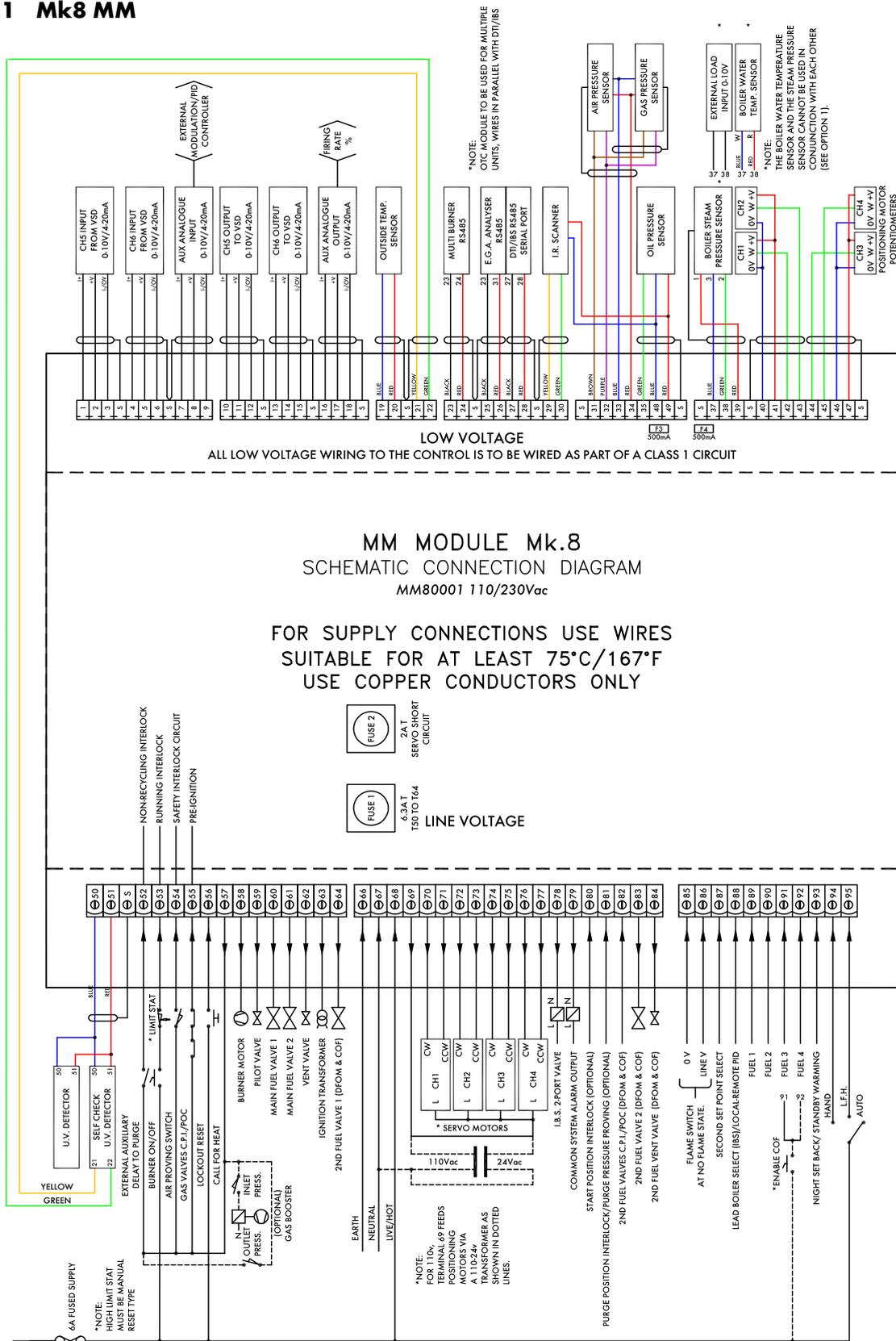
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1.1.1 Fixing Holes and Dimensions



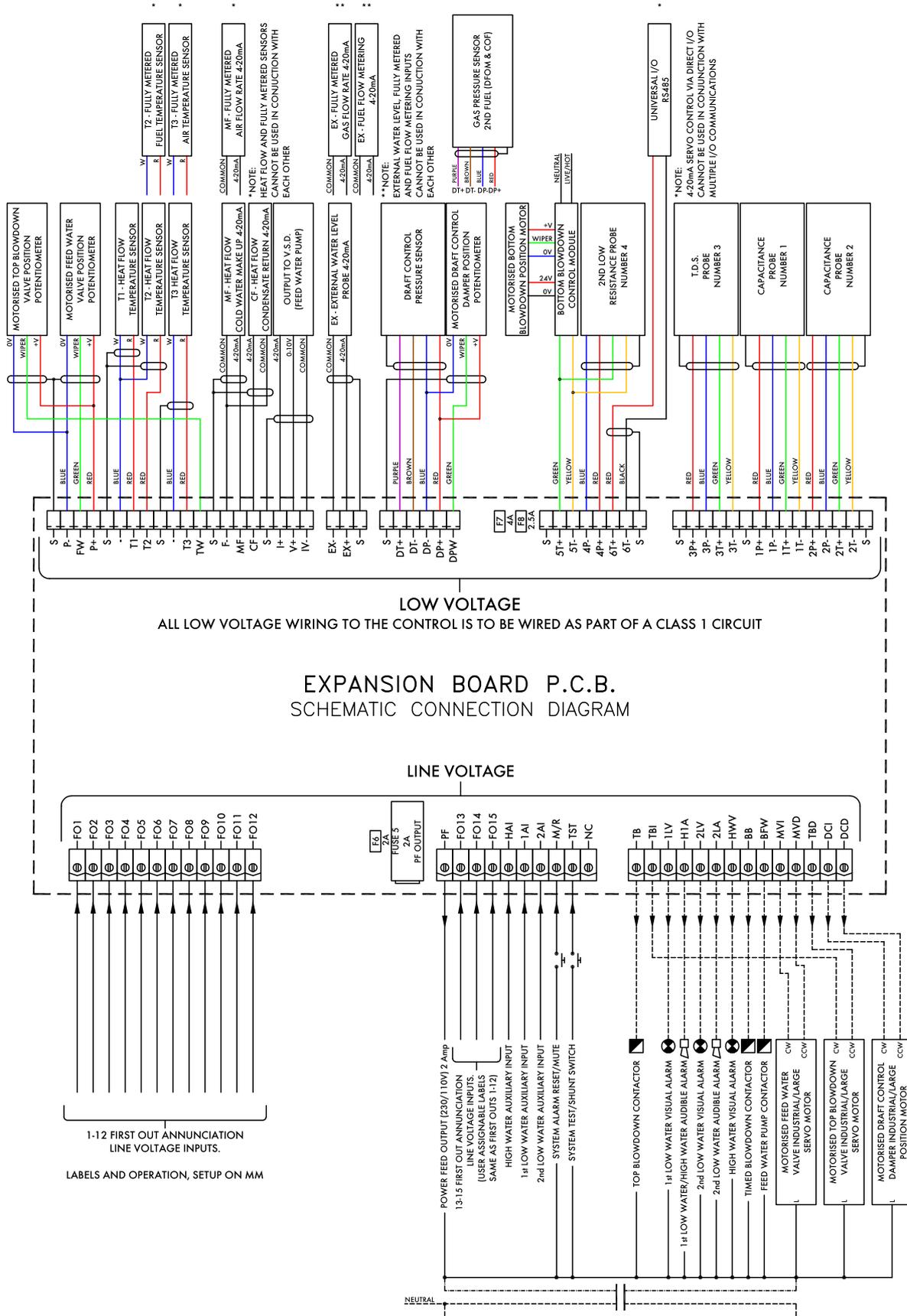
1.2 Wiring Schematic

1.2.1 Mk8 MM



1 DIMENSIONS AND WIRING

1.2.2 Mk8 Expansion Board



1.2.3 Fuse Ratings

Fuse	Rating	Spare Part Number
1	6.3A (T)	FU10026
Fuse 1 protects the mains input to the MM, including the mains output terminals 50 - 64.		
2	2A (T)	FU10034
<ul style="list-style-type: none"> Fuse 2 protects the power supply (terminal 69) for the servomotors, alarm and 2 port valve. If this fuse blows, error 'Triac Power Supply Error (Check F2)' will occur. 		
3	500mA	FU10040
<ul style="list-style-type: none"> Fuse 3 protects the 13.5V power supply to the oil pressure sensor and IR scanner on terminal 49. If this fuse blows, error 'Fused 13.5V Supply Error (Check F3)' will occur. 		
4	500mA	FU10040
<ul style="list-style-type: none"> Fuse 4 protects the 12V power supply to the gas/air pressure sensor and steam pressure detector on terminals 34 and 39. If this fuse blows, error 'Fused 12V Supply Error (Check F4)' will occur. 		
5	2A (T)	FU10034
<ul style="list-style-type: none"> Fuse 5 protects the power supply (terminal PF) for the expansion servos and alarm outputs. If fuse 5 blows, error 'Expansion PF Output (Check F5)' will occur. 		
6	2A	FU10027
<ul style="list-style-type: none"> Fuse 6 protects the DC circuits. If this fuse blows, the display will be off and both LEDs adjacent to fuse 7 and 8 will be off. 		
7	4A	FU10050
<ul style="list-style-type: none"> Fuse 7 protects the internal 5V supply. If this fuse blows the display will be off and the LED adjacent to the fuse will be off. 		
8	2.5A	FU10042
<ul style="list-style-type: none"> Fuse 8 protects the internal 12V supply. If this fuse blows the display will be off and the LED adjacent to the fuse will be off. 		

1.3 Electrical Specifications

Classification according to BS EN298:2012

Mains Supply:	Single phase 230V, +10%/-15% Single phase 120V, +10%/-15%	47-63 Hz, unit max. consumption 140W
Climate:	Min. Temperature Recommended Temperature Max. Temperature Humidity	0°C (32°F) Less than 40°C (104°F) 60°C (140°F) 0 to 90% non-condensing
Storage:	Temperature	-20 to 85°C (-4 to 185°F)
Protection Rating:	The unit is designed to be panel mounted in any orientation and the front fascia is IP65, NEMA4. The back of the unit is IP20, NEMA1.	

1.3.1 MM 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 6A
		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 6A
		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:

1. The high and low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation. **CAUTION – ELECTRIC SHOCK HAZARD.**
2. Control voltage cabling should be maximum 10m, screened (if not screened then less than 1m, however servomotors can be unscreened up to 10m)
3. Any cabling over 10m must have additional surge protection.
4. Low voltage cables should be screened cable as specified in section 1.3.3.
5. The burner 'High Limit Stat' must be a manual reset type.

Note: There is a lid (back plate) fitted onto the back of the Mk8 MM with a Warning label to prevent any unauthorised fuse replacements.

1.3.2 Expansion Board Inputs and Outputs

Outputs: 120/230 V All outputs with the exception of PF are switched neutrals

BFW	250mA	Must be connected through contactor
BB	250mA	Must be connected through contactor
HWV	100mA	(alarm indicator)
2LA	100mA	(alarm indicator)
2LV	100mA	(alarm indicator)
H1A	100mA	(alarm indicator)
1LV	100mA	(alarm indicator)
79	100mA	(alarm indicator on MM board)
TB	250mA	Solenoid only, must be connected through contactor
PF	Maximum 2A	(load currents for above terminals)

Note: Max number of alarm indicators on at any time is 3 (1LV, 2LA, 2LV)

Main Voltage Signal Inputs:

At 120V current loading is approximately maximum 0.7mA per input.

At 230V current loading is approximately maximum 1.5mA per input.

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 Belden 9501 for 2-core shielded cable (1 twisted pair)
- 2 Belden 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 DIMENSIONS AND WIRING

1.3.4 MM Terminals Description

S	All terminals marked S are internally connected. They are provided for connections to the various screened cables.
1	Current Input, 0-20mA/ 4-20mA. For channel 5 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 5 only. Can be connected to the voltage output of a VSD or tachometer system
3	0V common for Terminals 1 or 2
4	Current Input, 0-20mA/ 4-20mA. For channel 6 only. Can be connected to the current output of a VSD or tachometer system or 4-20mA servomotor feedback
5	Voltage Input, 0-10V. For channel 6 only. Can be connected to the voltage output of a VSD or tachometer system
6	0V common for Terminals 4 or 5
7	Current Input, 4-20mA. Used for external modulation or external required setpoint
8	Voltage Input, 2-10V. Used for external modulation or external required setpoint
9	0V common for Terminals 7 or 8
10	Current Output, 0-20mA/ 4-20mA. For channel 5 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 5 only. Can be connected to the voltage input of a VSD or tachometer system
12	0V common for Terminals 10 or 11
13	Current Output, 0-20mA/ 4-20mA. For channel 6 only. Can be connected to the current input of a VSD or tachometer system or 4-20mA servomotor feedback
14	Voltage Output, 0-10V. For channel 6 only. Can be connected to the voltage input of a VSD or tachometer system
15	0V common for Terminals 13 or 14
16	Current Output, 4-20mA/ 0-20mA. Varies in accordance with firing rate
17	Voltage Output, 0-10V/ 2-10V. Varies in accordance with firing rate
18	0V common for Terminals 16 or 17
19, 20	Connections to an Autoflame outside temperature sensor
21, 22	Connections to an Autoflame self-check UV sensor
23, 24	Communications port connections for multi-burner operation

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25, 26	Communications port connections to an Exhaust Gas Analyser (EGA)
27, 28	Communications port connections for DTI and/or IBS
29, 30	Digital communications connections to an Autoflame IR scanner
31, 32	Digital communications connections to an Autoflame air pressure sensor and/or Autoflame gas pressure sensor
33	0V supply to an Autoflame air pressure sensor and/or Autoflame gas pressure sensor
34	+12V supply to an Autoflame air pressure sensor and/or Autoflame gas pressure sensor
35	Signal inputs from Autoflame oil pressure sensor
48	0V supply to an Autoflame oil pressure sensor and/or Autoflame IR scanner
49	+13.5V supply to an Autoflame oil pressure sensor and/or Autoflame IR scanner
37	0V supply to an Autoflame temperature or pressure detector, 0-10V external load detector
38	Signal input from an Autoflame temperature or pressure detector, 0-10V external load detector
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
45	Signal from channel 4 servomotor, indicating position
46	0V Supply to channel 3 and channel 4 servomotors
47	+12V supply to channel 3 and channel 4 servomotors
50, 51	Connections to an Autoflame UV scanner
52	Mains voltage input – external auxiliary delay to purge/ secondary proving set in option/parameter 157
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

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56	Mains voltage input- lockout reset
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
64	Fuel 2 Main Valve 1 (Dual Fuel Output Mode & Change on the Fly)
66	Mains supply – earth
67	Main supply – neutral
68	Mains supply – live/hot
69	Mains voltage output, power to servomotors and/or servomotor 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
76	Switched neutral – drives channel 4 servomotor clockwise
77	Switched neutral – drives channel 4 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 (selectable via option 154)
81	Purge position interlock/ delay purge time (selectable via option 155)
82	Fuel 2 valves C.P.I/POC (Dual Fuel Output Mode & Change on the Fly)
83	Fuel 2 Main Valve 2 (Dual Fuel Output Mode & Change on the Fly)

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- 84 Fuel 2 Vent Valve (Dual Fuel Output Mode & Change on the Fly)
- 85 Mains voltage input. For use when using an external flame switch- 0V when at no flame state
- 86 Mains voltage input. For use when using an external flame switch- line voltage when at no flame state
- 87 Mains voltage input. Select second required setpoint- second set-point facility
- 88 Mains voltage input. Lead boiler select (overrides DTI) / Local - remote PID select for external modulation
- 89 Mains voltage input - selects fuel 1 curve
- 90 Mains voltage input - selects fuel 2 curve
- 91 Mains voltage input - selects fuel 3 curve (enables COF when energised with T92 simultaneously)
- 92 Mains voltage input - selects fuel 4 curve (enables COF when energised with T91 simultaneously)
- 93 Mains voltage input - warming start or night setback input (selectable via option 79)
- 94 Mains voltage input - selects hand operation (overrides mode set on MM screen)
- 95 Mains voltage input - selects low flame hold operation (overrides mode set on MM screen)

1.3.5 Expansion Board Terminals Description

S	All terminals marked S are internally connected. They are provided for connections to the various screened cables.
P-	0V supply to top blowdown and feed water servomotors
FW	Signal from feed water servomotor, indicating position
P+	+12V supply to top blowdown and feed water servomotors
-	Common for terminals T1, T2 and T3
T1	Signal input from T1 temperature sensor
T2	Signal input from T2 temperature sensor
-	Common for terminal T1, T2 and T3
T3	Signal input from T3 temperature sensor
TW	Signal from top blowdown servomotor, indicating position
F-	Common for terminals MF and CF
MF	Current input, 4-20mA for cold water make up flow meter
CF	Current input, 4-20mA for condensate return flow meter
I+	Current output, 4-20mA to feed water VSD
V+	Voltage output, 0-10V to feed water VSD
IV-	Common for terminals I+ and V+
EX-	Common for terminal EX+
EX+	Current input, 4-20mA for external water level probe or fuel flow feedback
DT+, DT-	Digital communications from draught control pressure sensor (Fuel 2 Gas Pressure Sensor in Dual Fuel Output Mode)
DP-	0V supply to draught control pressure sensor and draught control servomotor (Fuel 2 Gas Pressure Sensor in Dual Fuel Output Mode)
DP+	+12V supply to draught control pressure sensor and draught control servomotor (Fuel 2 Gas Pressure Sensor in Dual Fuel Output Mode)
DPW	Signal from draught control servomotor, indicating position
5T+, 5T-	Digital communications from bottom blowdown module and 2 nd low probe
4P-	0V supply to 2 nd low resistance probe
4P+	+12V supply to 2 nd low resistance probe

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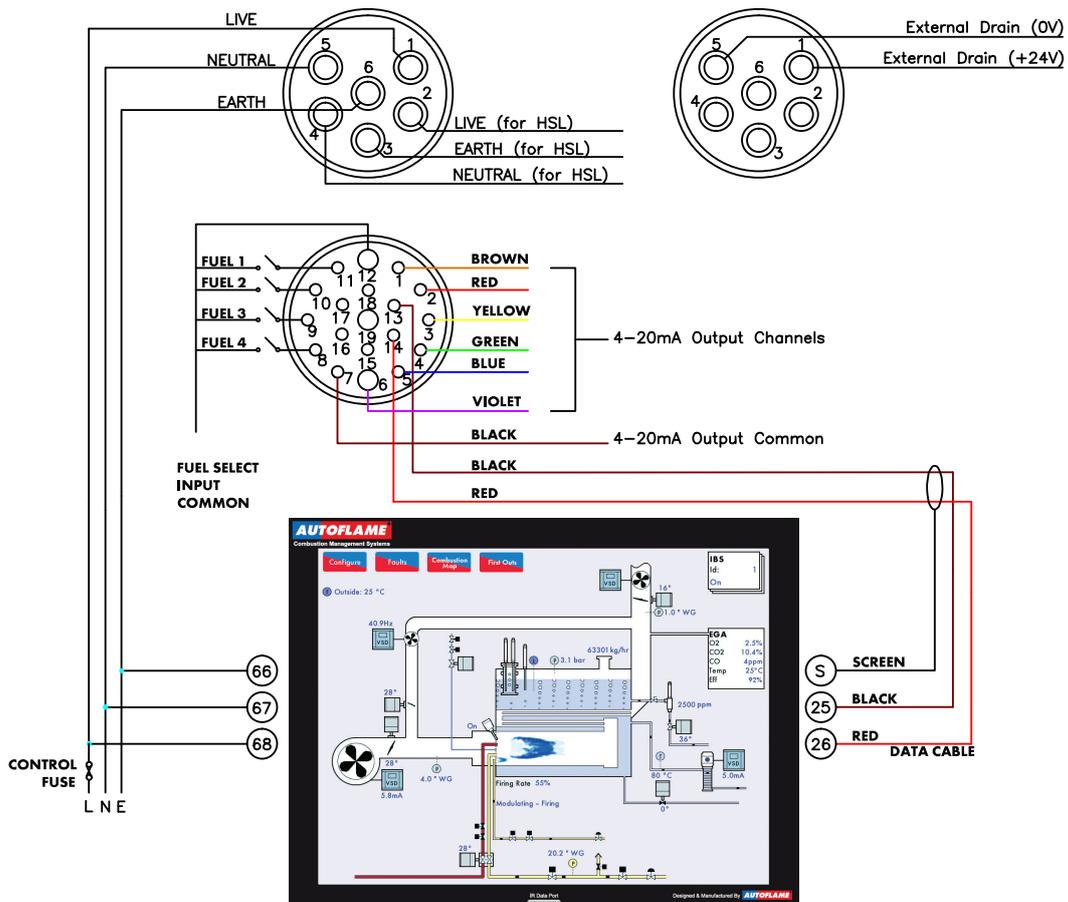
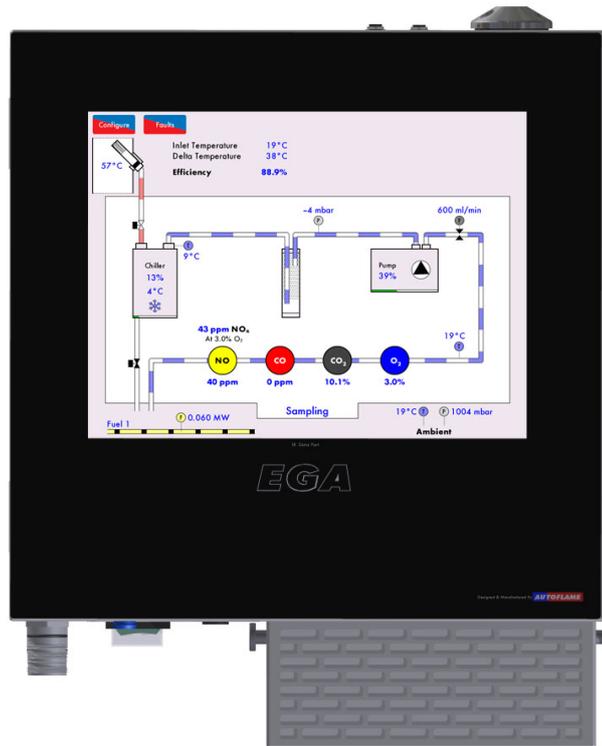
6T+, 6T-	Communications port connections I/O module RS485
3P+	+9V supply to TDS probe
3P-	0V supply to TDS probe
3T+, 3T-	Digital communication connections from TDS probe
1P+	+9V supply to capacitance probe 1
1P-	0V supply to capacitance probe 1
1T+, 1T-	Digital communications connections from capacitance probe 1
2P+	+9V supply to capacitance probe 2
2P-	0V supply to capacitance probe 2
2T+, 2T-	Digital communications connections from capacitance probe 2
FO1	First Out annunciation line voltage input 1
FO2	First Out annunciation line voltage input 2
FO3	First Out annunciation line voltage input 3
FO4	First Out annunciation line voltage input 4
FO5	First Out annunciation line voltage input 5
FO6	First Out annunciation line voltage input 6
FO7	First Out annunciation line voltage input 7
FO8	First Out annunciation line voltage input 8
FO9	First Out annunciation line voltage input 9
FO10	First Out annunciation line voltage input 10
FO11	First Out annunciation line voltage input 11
FO12	First Out annunciation line voltage input 12
PF	Power feed 2A output (230V/110V)
FO13	First Out annunciation line voltage input 13
FO14	First Out annunciation line voltage input 14
FO15	First Out annunciation line voltage input 15
HAI	External high water auxiliary input
1AI	External 1 st low water auxiliary input
2AI	External 2 nd low water auxiliary input

1 DIMENSIONS AND WIRING

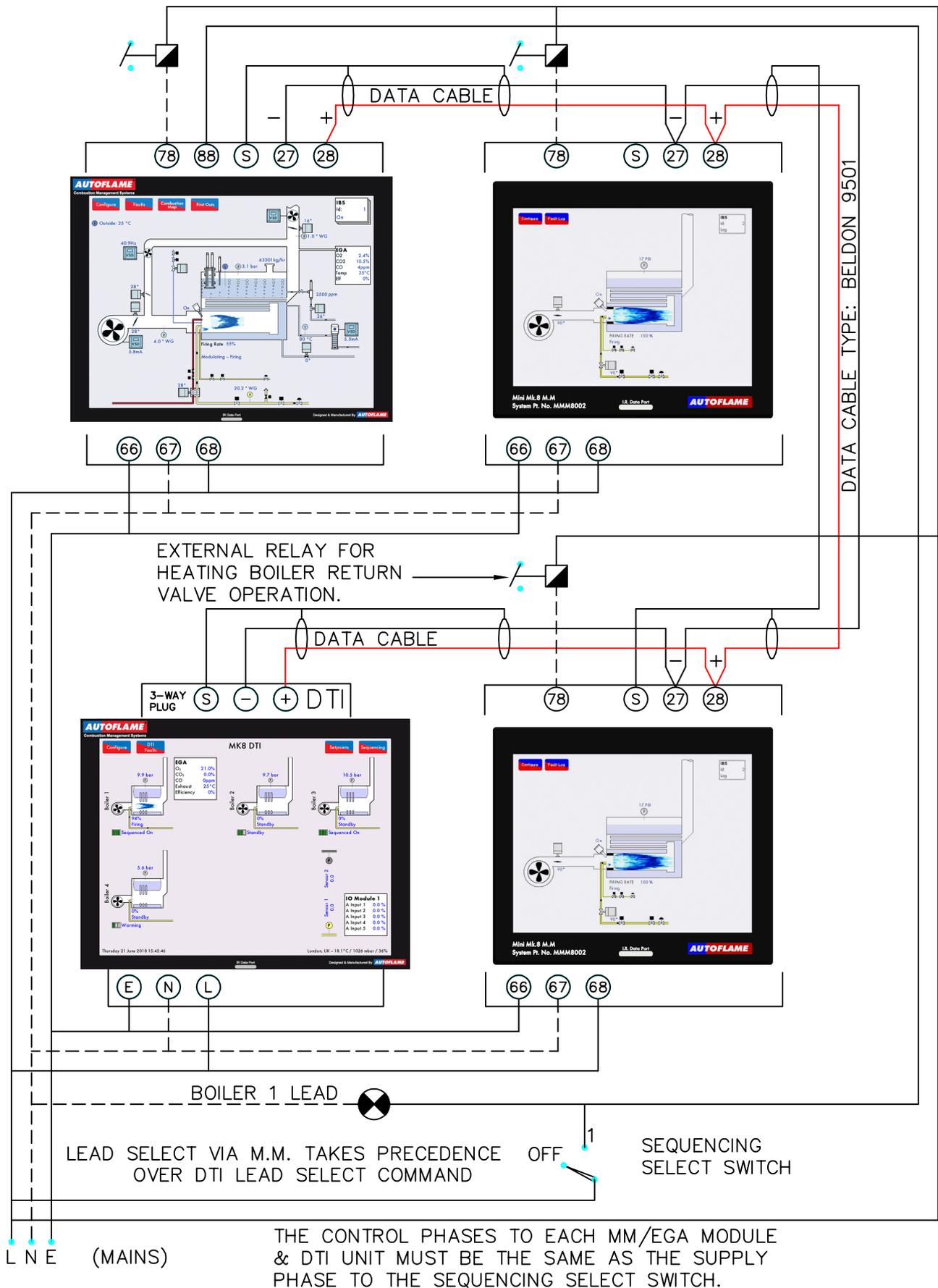
M/R	System alarm mute/reset
TST	System test alarm inputs/ shunt switch (selectable via expansion option 21)
NC	Unused – do not connect
TB	Switched neutral – top blowdown contactor
TBI	Switched neutral – drives top blowdown servomotor clockwise
1LV	Switched neutral – 1 st low water visual alarm
H1A	Switched neutral – 1 st low/ high water audible alarm
2LV	Switched neutral – 2 nd low water visual alarm
2LA	Switched neutral – 2 nd low water audible alarm
HWV	Switched neutral – High water visual alarm
BB	Switched neutral – Bottom blowdown contactor
BFW	Switched neutral – Feed water pump contactor
MVI	Switched neutral – drives feed water servomotor clockwise
MVD	Switched neutral – drives feed water servomotor counter clockwise
TBD	Switched neutral – drives top blowdown servomotor counter clockwise
DCI	Switched neutral – drives draught control servomotor clockwise
DCD	Switched neutral – drives draught control servomotor counter clockwise

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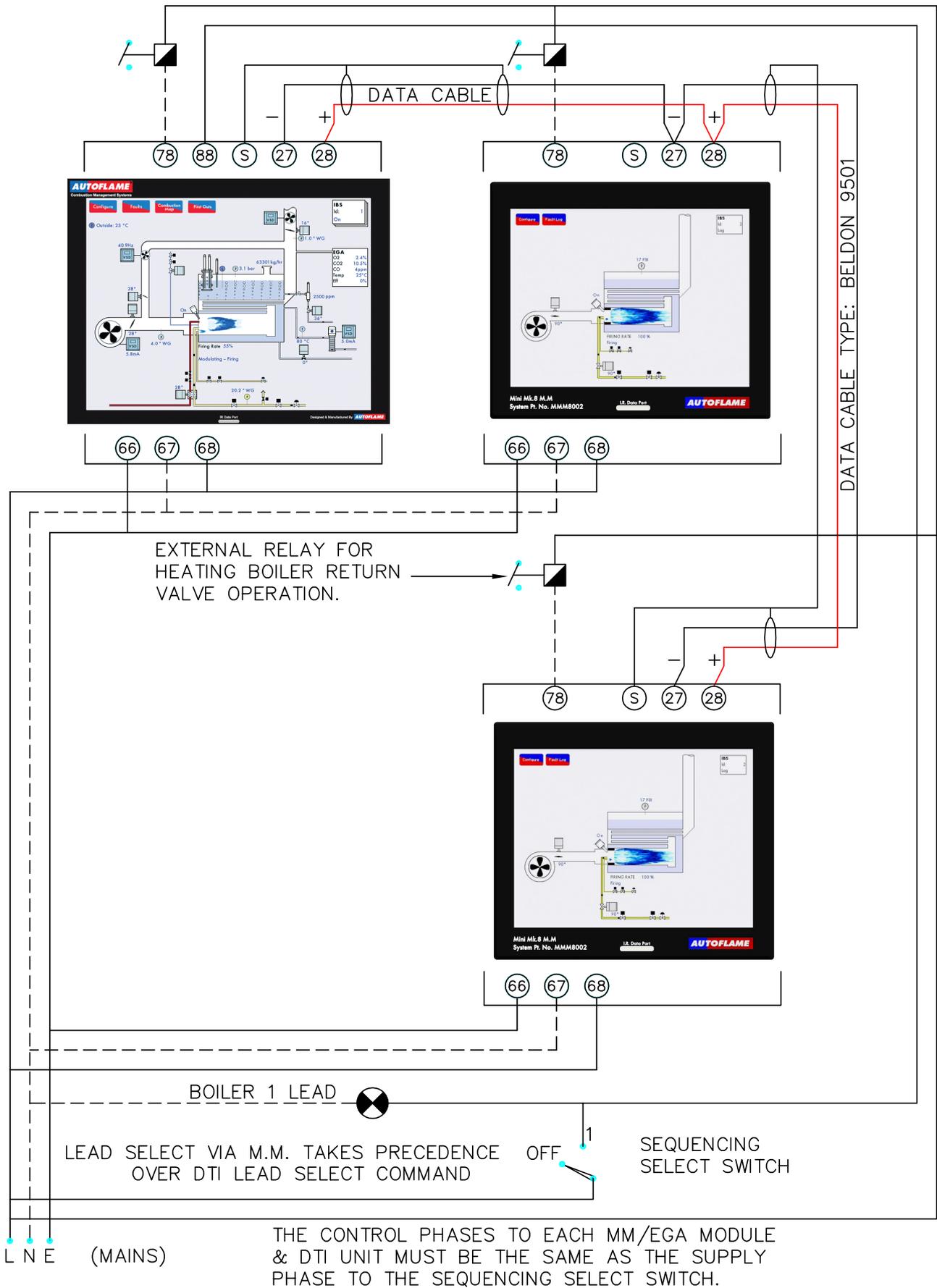
1.4 Connection Between Mk8 MM and Mk8 EGA EVO



1.5 Connection Between Mk8 MM and Mk8 DTI



1.6 Sequencing Connection Diagram



2 OPTIONS AND PARAMETERS

2.1 Options

The Options, Parameters and Expansion Options 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 settings without the correct factory training and understanding of the boiler plant may place themselves and others in a potentially dangerous situation.



CH1, CH2, CH3, CH4, CH5, CH6 and CH7 refer to the rows of buttons respectively starting with CH1 at the top.

The options, parameters and expansion options and their settings are all viewable while the MM is in run mode. In commissioning mode, all of the options, parameters and expansion options can be adjusted according to the application. Non safety-critical options, parameters and expansion options can be adjusted through Online Changes.



Figure 2.1.i Splash Screen

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 into commissioning mode automatically.

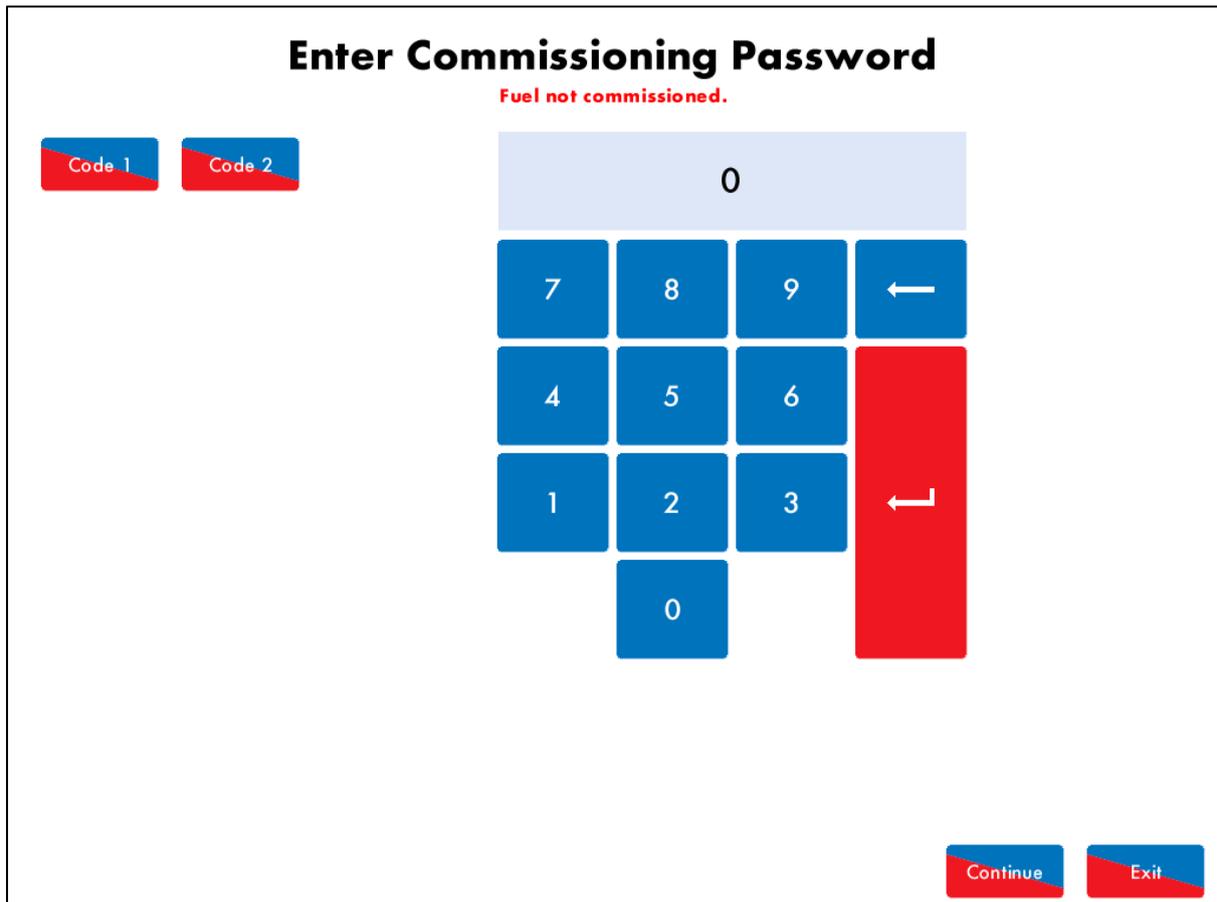


Figure 2.1.ii Enter Commissioning Password

“Enter Commissioning Password” is displayed. Use the keypad to enter the password, then press . Press on  or  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.

2 OPTIONS AND PARAMETERS

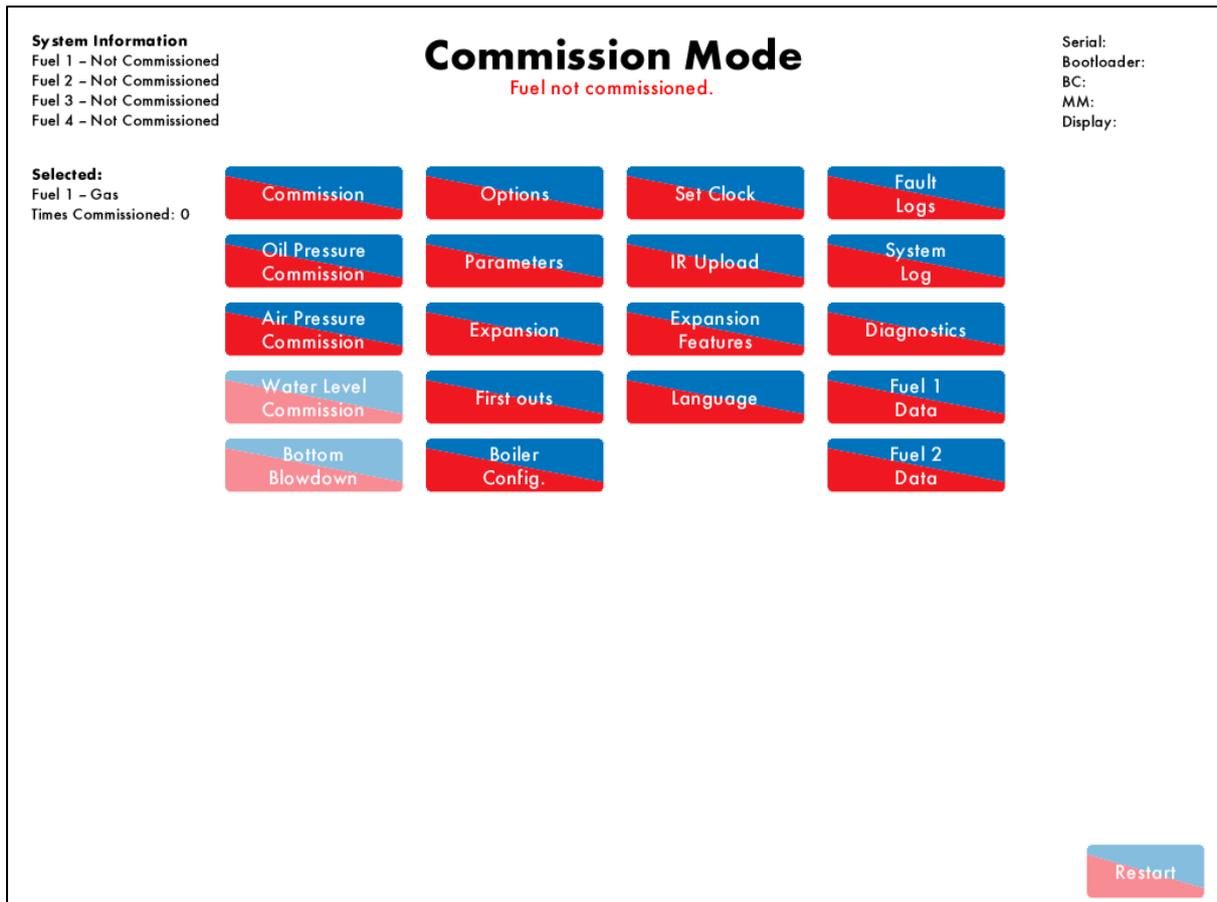


Figure 2.1.iii Commission Mode

The Commission Mode screen gives information on the following:

- Current selected fuel
- Which fuels have been commissioned
- Number of times the unit has been commissioned
- Serial number
- Bootloader version
- BC, MM and Display software

In Commission Mode, the engineer can:

- Commission the burner for selected fuel
- Commission gas and air pressure sensors
- Commission water level probes
- Commission the bottom blowdown module
- Adjust options, parameters and expansion options
- Setup and change Boiler Configuration
- Configure first out settings and labels
- Set the time and date
- Upload/download commissioning data
- Unlock expansion features
- Set the language
- View fault logs, system log and diagnostics
- View fuel commission data

2 OPTIONS AND PARAMETERS

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

Commission Mode		
	Options	
	Parameters	Expansion
#	Description	Value
1	MM: Boiler Temperature/Pressure Sensor Type	Temperature
2	MM: Modulating Motor Travel Speed Limit	1.5
3	Unused: Option 3	0
4	Unused: Option 4	0
5	MM: Purge Position	Channels 1 to 4 purge at OPEN position
6	PID: Proportional Band	10 °C
7	PID: Integral Time	60 seconds
8	MM: Servomotor Channels	Channels 1 & 2
9	MM: Internal Stat Operation	Burner operates below setpoint
10	MM: Burner Switch-Off Offset	3 °C
11	MM: Burner Switch-On Offset	3 °C
12	EGA: EGA Functionality	Not optioned
13	EGA: EGA Fault Response	EGA faults generate Alarms (Burner stops)
14	MM: Warning Response	Warnings drive Common System Alarm output (T79)
15	MM: User Control	Burner on/off and setpoint control enabled
16	DTI: Sequencing and DTI enable	Sequencing disabled
17	Unused: Option 17	0
18	EGA: Carry Forward of Trim	Enabled
19	EGA: O2 Upper Limit Offset	Disabled

All
MM
PID
EGA
DTI
BC

Figure 2.1.iv Options

Press in the Commission Mode screen to access the Options. Any number of options/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.

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.

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

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
1	0		Boiler Temperature/Pressure Sensor Type
		0	Temperature MM10006 0 – 400°C (0 – 752°F)
		1	Low pressure MM10010 0.0 – 3.4 Bar (0.0 – 50 PSI)
		2	Medium pressure MM10008 0 – 20 Bar (30 – 300 PSI)
		3	High pressure MM10009 0 – 34 Bar (30 – 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)
			<i>Note: External load detector wiring low voltage to terminal 37 and high voltage to terminal 38.</i>
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.
		10 – 100	1.0 – 10.0
3	-		Unused
4	-		Unused
5	1		Purge Position
			This purge position applies to channels 1-4 as selected in options 67-70, 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 4 purge at HIGH position.
		1	Channels 1 to 4 purge at OPEN position.
6	10		Proportional Band
			The proportional band is an offset below the required setpoint; when the actual temperature/ pressure reaches this band, the burner will begin to modulate as it approaches the required setpoint.
		5 – 2000	°C, °F, PSI or 0.1 bar or 0.01 bar for low pressure sensor (depends on load detector set in option 1 and metric/imperial units set in parameter 40)
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

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
8	0		<p>Servomotor Channels</p> <p>Channel 1 is always enabled for fuel; this option sets the channels in use.</p> <p>0 Channels 1 & 2 1 Channels 1, 2 & 3 2 Channels 1, 2, 3 & 4</p> <p><i>Note: 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.</i></p>
9	1		<p>Internal Stat Operation</p> <p>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.</p> <p>0 Internal stat always closed 1 Burner operates below setpoint 2 Burner operates above setpoint</p> <p>E.g. Option 9 = 1, required setpoint = 100°C (212°F)</p> <p style="text-align: center;"> 103 C (215 F) — Burner stops at this point and above — Offset = 3 (value set in option #10) Required Value 100 C (212 F) — Offset = 3 (value set in option #11) 97 C (209 F) — Burner starts at this point and below </p> <p>E.g. option 9 = 2, required setpoint = 100°C (212°F)</p> <p style="text-align: center;"> 106 C (218 F) — Burner stops at this point and above — Offset = 6 (value set in option #10) 103 C (215 F) — Burner starts at this point and below — Offset = 3 (value set in option #11) Required Value 100 C (212 F) </p>
10	3	2 - 1000	<p>Burner Switch-Off Offset</p> <p>°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 parameter 40)</p> <p><i>Note: This option is only relevant if option 9 is set to 1 or 2.</i></p>
11	3	0 - 1000	<p>Burner Switch-On Offset</p> <p>°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 parameter 40)</p> <p><i>Note: This option is only relevant if option 9 is set to 1 or 2.</i></p>
12	0		<p>EGA Functionality</p> <p>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.</p> <p>0 Not optioned 1 Monitoring only 2 Applies trim 3 Applies trim, combustion limits tested</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
13	0	0 1	<u>EGA Fault Response</u> EGA faults generate alarms (burner stops) EGA faults generate warnings (burners runs) <i>Note: EGA alarms will drive the common system alarm output (terminal 79), see option 14 for warning response.</i>
14	1	0 1	<u>Warning Response</u> Warnings do not drive common system alarm output (terminal 79) Warnings drive common system alarm output (terminal 79)
15	3	0 1 2 3	<u>User Control</u> This option sets whether the user can turn the burner on and off, or change the required setpoint via the flame screen on the MM 0 Burner on/off and setpoint control disabled 1 Burner on/off disabled and setpoint control enabled 2 Burner on/off enabled and setpoint control disabled 3 Burner on/off and setpoint control enabled
16	0	0 1 2 3	<u>Sequencing and DTI Enable</u> 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 and the Lead Boiler Select on terminal 88 (see option 55) both override the DTI Lead Boiler Select. 0 Sequencing disabled 1 Sequencing enabled 2 DTI enabled 3 Sequencing and DTI
17	-		Unused
18	1	0 1	<u>Carry Forward of Trim</u> 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	0 1 - 100	<u>O₂ Upper Limit Offset</u> If the current O ₂ value is above this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. 0 Disabled 1 0.1% - 10.0% O ₂
20	0	0 1 - 100	<u>CO₂ Upper Limit Offset</u> If the current CO ₂ value is above this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. 0 Disabled 1 0.1% - 10.0% CO ₂
21	0	0 1 - 200	<u>CO Upper Limit Offset</u> If the current CO value is above this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. 0 Disabled 1 - 200 ppm CO

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
22	0	0 1 - 100	<u>O₂ Lower Limit Offset</u> If the current O ₂ value is below this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 0.1% - 10.0% O ₂
23	0	0 0 - 100	<u>CO₂ Lower Limit Offset</u> If the current CO ₂ value is below this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 0.1% - 10.0% CO ₂
24	-		Unused
25	0	0 1 - 200	<u>O₂ Absolute Limit</u> If the current O ₂ value is below this absolute limit, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 0.1% - 20.0% O ₂
26	0	0 1 - 200	<u>CO₂ Absolute Limit</u> If the current CO ₂ value is above this absolute limit, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 0.1% - 20.0% CO ₂
27	0	0 1 - 200	<u>CO Absolute Limit</u> If the current CO value is above this absolute limit, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 1 - 200 ppm CO
28	20	0 - 50	<u>Trim Threshold</u> 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. °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 parameter 40)
29	0	0 1 2	<u>Golden Start</u> 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 and from which point to start counting down. Disabled 1 Enabled. Time counted from point of main flame 2 Enabled. Time counted from ignition
30	50	5 - 9990	<u>Minimum Remote Setpoint (DTI/ Modbus)</u> 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 parameter 40)

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
31	100	5 - 9990	<p>Maximum Remote Setpoint (DTI/ Modbus)</p> <p>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.</p> <p>°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 parameter 40)</p>
32	20	0 - 250	<p>Trim Delay</p> <p>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.</p> <p>Seconds</p>
33	1	1 - 10	<p>MM Identification</p> <p>Each MM within a sequencing/ DTI/ Modbus/ twin burner 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.</p> <p>ID number</p>
34	-		Unused
35	10	1 - 100	<p>Sequence Scan Time</p> <p>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 (Belden 9501), screened at one end.</p> <p>Minutes</p>
36	0	0 1 2 3	<p>Sensor Selection (Mk7 EGA only)</p> <p>This option selects if the Mk7 EGA is fitted with additional cells.</p> <p>0 No optional sensor 1 NO₂ optioned 2 SO₂ optioned 3 NO₂ and SO₂ optioned</p>
37	0	0 1 - 200	<p>Derivative Time</p> <p>The time taken to add/ remove an additional 10% to the firing rate based on the actual value and the required value.</p> <p>0 Disabled Seconds</p>
38	2	0 1 - 15	<p>Derivative Deadband</p> <p>This deadband is the margin above and below the required setpoint in which no derivative control occurs.</p> <p>0 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 parameter 40)</p>
39	-		Unused

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
40	0	0 1	<p><u>Warming Facility for Low Pressure Steam</u></p> <p>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's shell. Set option/parameter 79 to 0 to enable terminal 93 for warming stat. An input on terminal 93 stops/inhibits the burner when the MM is in warming. The boiler will remain in a warming state based on the settings in options 53 and 54.</p> <p>0 1 Steam sequencing with non-return valves Steam sequencing without non-return valves</p>
41	0	0 1	<p><u>Warming Mode</u></p> <p>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.</p> <p>0 1 One MM in warming state All unused MMs in warming state</p>
42	20	5 - 9990	<p><u>Standby Setpoint</u></p> <p>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.</p> <p>°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 parameter 40)</p>
43	0	0 1 2	<p><u>Multi-Burner Function</u></p> <p>The multi-burner function can be used for up to 10 burners, allowing the firing rates to be synchronised for all the burners in the multi-burner loop. For setting 1, if an error or lockout occurs on a burner, all of the other burners will shut down; setting 1 is suitable for firetube boilers. For setting 2, if an error occurs on a burner, all of the other burners will shut down, however if a lockout occurs, the other burners will continue to fire; setting 2 is suitable for watertube boilers. Fuel flow metering must be commissioned accurately for the multi-burner function to operate. Please refer to the MM Application Possibilities manual for commissioning of the multi-burner function.</p> <p>0 1 2 Disabled Fully linked Independent fault</p>
44	1	1 - 10	<p><u>Multi-Burner Id</u></p> <p>When using the multi-burner function, the multi-burner IDs must be set on the MMs This option should be set to 1 for the master, and 2 onwards for the slave MMs.</p> <p>Multi-burner Id</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
45	0	0 1 2	<p><u>External Modulation</u> When enabled, the internal PID control is disabled and the firing rate is set by an external controller applied to the appropriate input terminals 7, 8, 9. This input control signal can be 0-10V (2-10V) or 4-20mA (0-20mA) set through parameter 69, and represent zero/ low to high fire by setting parameter 68. A manual reset high limit stat must be fitted. For setting 1, an external working stat is required and option 9 should be set to 0. For setting 2, option 9 should be set to 1 or 2.</p> <p>0 Disabled 1 Enabled, load sensor not shown 2 Enabled, load sensor shown</p>
46	0	0 1 - 120	<p><u>Cold Start Inhibit Time</u> If the MM progresses from low fire cold start to firing and the burner shuts down within this cold start inhibit time, a cold start will not occur when the burner starts up again. This allows the burner to come straight on in normal firing in situations where the demand has increased drastically and the actual value drops fast.</p> <p>0 Disabled 1 - 120 Minutes</p>
47	0	0 1 - 2000	<p><u>Cold Start Routine</u> 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.</p> <p>0 Disabled 1 - 2000 Minutes</p>
48	0	0 1 - 3600	<p><u>Flue Gas Recirculation - Timer</u> This is the time that the MM channels (servomotors/ VSDs) are held at the FGR start positions, after which modulation takes place. This timer starts at the end main flame proving. 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.</p> <p>0 Disabled 1 - 3600 Seconds</p>
49	0	0 1 - 50	<p><u>Flue Gas Recirculation - Offset</u> 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.</p> <p>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 parameter 40)</p>
50	0	0 1	<p><u>Flue Gas Recirculation - Temperature Threshold</u> 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.</p> <p>0 FGR temperature threshold disabled 1 FGR temperature threshold enabled</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
51	2	2 - 10	<u>Multi-Burner Highest Slave ID</u> This should be set to the highest slave ID set in option 44 for the MMs in the multi-burner loop. Multi-burner slave ID
52	0	0 1 - 20	<u>Multi-Burner Differential Firing Rate Limit</u> If the difference between the firing rates of the Master MM and the slave MMs is equal to or greater than this limit, the Master MM will stop modulating and wait for the slaves to catch up. When the difference reduces to less than or equal to 5%, the Master starts modulating again. Disabled 1% - 20%
53	0	0 1 - 200	<u>Steam Sequencing Burner Off Time</u> 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. Disabled Minutes
54	5	1 - 30	<u>Steam Sequencing Burner On Time</u> 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. Minutes
55	0	0 1	<u>Terminal T88 Function</u> This option selects the function of terminal 88, see options 16 and 45. For setting 0, a line voltage input on terminal 88 is used to select the lead boiler in sequencing, and overrides the DTI lead boiler select. For setting 1, a line voltage input on terminal 88 is used to select the external modulation signal and 0V for internal PID. T88 selects lead boiler T88 selects external modulation
56	0	0 1	<u>Alarm Output Operation (Terminal T79)</u> This is a switched neutral output to select how the alarm function operates. Relay normally off, on during alarm Relay normally on, off during alarm
57	0	0 1 2	<u>Fuel Flow Metering</u> 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. For setting 2, see options 59 and 60. If using setting 2 for fuel flow feedback, then 4-20mA signal is required on terminals EX- and EX+ on the expansion board (this cannot be enabled with external level sensor nor fully metered combustion control, see expansion option 4). For metric units, fuel flow is commissioned in MW for metric units and MMBTU/hr for imperial units. Disabled Enabled Enabled with 4-20mA feedback
58	-		Unused

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
59	100	1 - 10000	Fuel Flow at Maximum Feedback This will set the fuel flow value at 20mA feedback, see option 57. 0.01MW - 100.0 MW
60	0	0 1 - 500	Fuel Flow Feedback Fault Tolerance The fuel flow feedback fault tolerance allows an upper limit to be set on the fuel flow when option 57 is set to 2. If the fuel flow exceeds this limit for 5 seconds, then a warning will appear. Disabled 0.1% - 50.0% of high-fire fuel flow
61	3725	100 - 65000	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 parameter 40. If the units are changed, then this option must be changed accordingly. 100 = 1.00MJ/m ³ or 100 Btu/ft ³
62	2068	100 - 65000	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 parameter 40. If the units are changed, then this option must be changed accordingly. 100 - 1.00 MJ/kg or 100 BTU/lb
63	2068	100 - 65000	Fuel 3 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 parameter 40. If the units are changed, then this option must be changed accordingly. 100 - 1.00 MJ/kg or 100 BTU/lb
64	3725	100 - 65000	Fuel 4 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 parameter 40. If the units are changed, then this option must be changed accordingly. 100 = 1.00MJ/m ³ or 100 Btu/ft ³
65	-		Unused
66	0	0 1 - 100	Firing Rate Limit This is the maximum firing rate that can be obtained by the system, imposed in auto and hand modes. Firing rate limit should not be used with DTI load index control or sequencing. Disabled %
67	1	0 1	Channel 1 Purge Position 0 Channel 1 to purge position 1 Channel 1 to remain closed for purge
68	0	0 1	Channel 2 Purge Position 0 Channel 2 to purge position 1 Channel 2 to remain closed for purge

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Option	Default	Range	Description
69	0	0 1	<u>Channel 3 Purge Position</u> Channel 3 to purge position Channel 3 to remain closed for purge
70	0	0 1	<u>Channel 4 Purge Position</u> Channel 4 to purge position Channel 4 to remain closed for purge
71	0	0 1 - 1440	<u>Continuous Pilot Shut Off Timer</u> If continuous pilot is enabled (see option/ parameter 111), then after this timer has elapsed when in continuous pilot firing, the burner will go off. Disabled Minutes
72	0	0 1 - 1000	<u>Continuous Pilot Shut Off Threshold</u> If continuous pilot is enabled (see option/ parameter 111), then if the actual value is higher than the combined burner switch-off offset (option 10) and this offset above the required setpoint in continuous pilot firing, the burner will go off. 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 parameter 40)
73	-		Unused
74	-		Unused
75	100	10 - 100	<u>Purge Motor Travel Speed</u> If the speed of the motor is too fast, then decrease the value. 0.1 - 10.0
76	0	0 1	<u>Trim Channel</u> If an EGA is optioned, then trim can be applied to either channel 2 servomotor or channel 5 VSD. For setting 1, options 91 to 98 must be set. Trim on Channel 2 Trim on Channel 5
77	-		Unused
78	-		Unused
79	0	0 1	<u>Terminal T93 Function</u> Warming Stat Night setback
80	0	0 1 2	<u>Outside Temperature Compensation</u> Outside temperature compensation disabled Outside temperature compensation enabled Outside temperature compensation enabled using MM sensor
81	90	50 - 999	<u>Setpoint at Minimum Outside Temperature</u> 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 parameter 40)
82	30	0 - 145	<u>Minimum Outside Temperature</u> Value 30 = -10°C or -10°F (see parameter 40)

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
83	80	50 - 999	<u>Setpoint at Maximum Outside Temperature</u> 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 parameter 40)
84	80	0 - 145	<u>Maximum Outside Temperature</u> Value 80 = 40°C or 40°F (see parameter 40)
85	0	0 1 - 100	<u>Night Setback Offset</u> This offset value is subtracted from the required setpoint. An input is required on terminal 93, see option 79. 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 parameter 40)
86	0	0 1 2 3 4 5	<u>Channel 1 Servo Control Method</u> 0 Autoflame servomotor, 0.1 degree control 1 Autoflame servomotor, 0.5 degree control 2 Industrial servomotor, 0.1 degree control 3 Industrial servomotor, 0.5 degree control 4 IO Unit 4-20mA servomotor, 0.5 degree control 5 IO Unit 4-20mA servomotor, 1.0 degree control
87	0	0 1 2 3 4 5	<u>Channel 2 Servo Control Method</u> 0 Autoflame servomotor, 0.1 degree control 1 Autoflame servomotor, 0.5 degree control 2 Industrial servomotor, 0.1 degree control 3 Industrial servomotor, 0.5 degree control 4 IO Unit 4-20mA servomotor, 0.5 degree control 5 IO Unit 4-20mA servomotor, 1.0 degree control
88	0	0 1 2 3 4 5	<u>Channel 3 Servo Control Method</u> 0 Autoflame servomotor, 0.1 degree control 1 Autoflame servomotor, 0.5 degree control 2 Industrial servomotor, 0.1 degree control 3 Industrial servomotor, 0.5 degree control 4 IO Unit 4-20mA servomotor, 0.5 degree control 5 IO Unit 4-20mA servomotor, 1.0 degree control
89	0	0 1 2 3 4 5	<u>Channel 4 Servo Control Method</u> 0 Autoflame servomotor, 0.1 degree control 1 Autoflame servomotor, 0.5 degree control 2 Industrial servomotor, 0.1 degree control 3 Industrial servomotor, 0.5 degree control 4 IO Unit 4-20mA servomotor, 0.5 degree control 5 IO Unit 4-20mA servomotor, 1.0 degree control
90	0	0 1	<u>VSD Operation Channel 5</u> 0 Disabled 1 Enabled
91	0	0 1 2	<u>Output from MM to VSD Channel 5</u> 0 Output range 4 to 20mA 1 Output range 0 to 20mA 2 Output range 0 to 10V

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
92	0	0 1	<u>Output Units Displayed, VSD Channel 5</u> Selected output signal Hertz
93	25	1 - 200	<u>Output Low Speed from MM to VSD Channel 5</u> Hertz
94	50	1 - 200	<u>Output High Speed from MM to VSD Channel 5</u> Hertz
95	0	0 1 2	<u>Input Signal to MM from VSD Channel 5</u> Input range 4 to 20mA Input range 0 to 20mA Input range 0 to 10V
96	0	0 1	<u>Input Units Displayed, VSD Channel 5</u> Selected input signal Hertz
97	0	0 - 200	<u>Input Low Speed to MM from VSD Channel 5</u> Hertz
98	50	0 - 200	<u>Input High Speed to MM from VSD Channel 5</u> Hertz
99	40	5 - 40	<u>VSD Channel 5 Feedback Fault Tolerance</u> This is used to check that the feedback varies while modulating. For example, if this option is set to 4%, the tolerance that is allowed while firing is $\pm 4\%$ of the whole VSD range. For commissioning, the difference between the point with the lowest feedback and the point with the highest feedback must be bigger than twice the tolerance, so for the default of 4% tolerance, the difference between the point with the lowest feedback and the point with the highest feedback has to be greater than 8% of the whole VSD range. 0.5% - 4.0%
100	0	0 1	<u>VSD Operation Channel 6</u> Disabled Enabled
101	0	0 1 2	<u>Output from MM to VSD Channel 6</u> Output range 4 to 20mA Output range 0 to 20mA Output range 0 to 10V
102	0	0 1	<u>Output Units Displayed, VSD Channel 6</u> Selected output signal Hertz
103	25	1 - 200	<u>Output Low Speed from MM to VSD Channel 6</u> Hertz
104	50	1 - 200	<u>Output High Speed from MM to VSD Channel 6</u> Hertz

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
105	0	0 1 2	<u>Input Signal to MM from VSD Channel 6</u> Input range 4 to 20mA Input range 0 to 20mA Input range 0 to 10V
106	0	0 1	<u>Input Units Displayed, VSD Channel 6</u> Selected input signal Hertz
107	0	0 - 200	<u>Input Low Speed to MM from VSD Channel 6</u> Hertz
108	50	0 - 200	<u>Input High Speed to MM from VSD Channel 6</u> Hertz
109	40	5 - 40	<u>VSD Channel 6 Feedback Fault Tolerance</u> This is used to check that the feedback varies while modulating. For example, if this option is set to 4%, the tolerance that is allowed while firing is $\pm 4\%$ of the whole VSD range. For commissioning, the difference between the point with the lowest feedback and the point with the highest feedback must be bigger than twice the tolerance, so for the default of 4% tolerance, the difference between the point with the lowest feedback and the point with the highest feedback has to be greater than 8% of the whole VSD range. 0.5% - 4.0%

2 OPTIONS AND PARAMETERS

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	1 2	<p><u>UV Flame Scanner Type</u></p> <p>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.</p> <p>Standard scanner Self-check scanner</p>
111	0	0 1 2 3 4	<p><u>Pilot Type</u></p> <p>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. For continuous pilot, when the burner goes above its off differential of the required setpoint, the burner will continue to fire with the pilot valves energised for the set time period. See options 71 and 72.</p> <p>Interrupted pilot Intermittent pilot No pilot Continuous interrupted pilot Continuous intermittent pilot</p> <p><i>Note: Setting 2 no pilot cannot be used with single valve pilot (option/ parameter 130).</i></p>
112	40	5 – 240	<p><u>Pre-Purge Time</u></p> <p>Purging the boiler before burner start-up with 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. Time remaining for the pre-purge process to complete is displayed on the main MM screen. Seconds</p>
113	3	3 – 5	<p><u>Pre-Ignition Time</u></p> <p>This is the time period when the ignition transformer is on before the pilot valves opens. Seconds</p>
114	3	3 – 10	<p><u>First Safety Time</u></p> <p>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. Seconds</p>
115	3	3 – 5	<p><u>Pilot Prove Time - Pilot Trial for Ignition (PTFI)</u></p> <p>This is the time period for when the flame is checked after the first safety time, to prove the pilot flame. Seconds</p>
116	3	3 – 10	<p><u>Gas Second Safety Time – Main Trial for Ignition (MTFI)</u></p> <p>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 – 153. This does not apply for intermittent pilot, see option/ parameter 111. For firing on oil, see option/ parameter 123. Seconds</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
117	5	5 - 20	<u>Main Flame Proving Time</u> 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. Seconds
118	0	0 - 100 0 - 100	<u>Post-Purge Time</u> If set, a post-purge will occur after a normal burner shutdown. This time set should allow for the servomotors to travel from low fire to purge position. The flame is not checked during post-purge. See option/ parameter 135 for NFPA post-purge. Time remaining for the post-purge process to complete is displayed on the main MM screen. Seconds (for option/ parameter 135 set to 0 or 2) Minutes (for option/ parameter 135 set to 1 or 3)
119	10	3 - 120	<u>Control Box Recycle Time</u> This is the time delay between the burner shutting down, and going through post-purge if optioned, and the burner starting up again. Seconds
120	10	5 - 50	<u>UV Threshold</u> 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. UV counts
121	5	5 - 10	<u>Delay from Start of Pre-Purge until Air Switch Checked</u> This time delay where the air switch is not checked is included within the total pre-purge time set in option/ parameter 112. Seconds
122	0	0 1 2 3 4	<u>Flame Sensor Selection</u> 0 UV 1 Flame switch 2 IR 3 IR and UV 4 IR or UV
123	3	3 - 15	<u>Oil Second Safety Time - Main Trial For Ignition (MTFI)</u> 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 - 153. This does not apply for intermittent pilot, see option/ parameter 111. For firing on gas, see option/ parameter 116. Seconds
124	0	0 1 - 3600	<u>Timeout on Reaching Purge</u> 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 this timeout set in this option has elapsed. This does not apply to any requirements on purge timing such as any additional proving inputs. Disabled Seconds

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
125	0		<p><u>Fuel Pressure Sensor Mode – Fuel 1</u></p> <p>Gas: For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor. For setting 2, low pressure limit can be checked by external pressure switch. 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.</p> <p>Oil: For setting 2, pressure limits are checked by an Autoflame oil sensor.</p> <p>0 Not checked 1 Pressure limits, valve proving 2 Pressure limits 3 External VPS</p>
126	0		<p><u>Fuel Pressure Sensor Mode – Fuel 2</u></p> <p>Gas: For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor. For setting 2, low pressure limit can be checked by external pressure switch. 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.</p> <p>Oil: For setting 2, pressure limits are checked by an Autoflame oil sensor.</p> <p>0 Not checked 1 Pressure limits, valve proving 2 Pressure limits 3 External VPS</p>
127	0		<p><u>Fuel Pressure Sensor Mode – Fuel 3</u></p> <p>Gas: For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor. For setting 2, low pressure limit can be checked by external pressure switch. 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.</p> <p>Oil: For setting 2, pressure limits are checked by an Autoflame oil sensor.</p> <p>0 Not checked 1 Pressure limits, valve proving 2 Pressure limits 3 External VPS</p>
128	0		<p><u>Fuel Pressure Sensor Mode – Fuel 4</u></p> <p>Gas: For setting 1, valve proving and pressure limits are checked by an Autoflame gas sensor. For setting 2, low pressure limit can be checked by external pressure switch. 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.</p> <p>Oil: For setting 2, pressure limits are checked by an Autoflame oil sensor.</p> <p>0 Not checked 1 Pressure limits, valve proving 2 Pressure limits 3 External VPS</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
129	0		<u>VPS Operation</u> VPS operates before start-up VPS operates after shutdown VPS operates before and after
130	2		<u>Gas Valve Configuration</u> 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
131	1		<u>Fuel valve output configuration</u> This sets the way multi-fuels are configured on the MM, Setting 0, allows the configuration of 4 fuels and switching between them is possible using changeover relays. Setting 1 allows 2 fuels to be configured with each fuel having its own set of outputs and switching between fuels is possible without changeover relays. Setting 2 is similar to setting 1 but with the possibility of fuel Change on the Fly (COF). See section 4 of this guide for the full details. Fuel curves must be commissioned for each fuel valve output mode. This option must be set before commissioning the MM. 0 One set of outputs (Changeover relays, 4 fuels) 1 Two sets of outputs (No changeover relays, 2 fuels) 2 Two sets of outputs, change on the fly (COF)* <i>* requires unlock code</i>
132	20		<u>Gas Valve Proving Time</u> 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 10 - 300
133	25		<u>Maximum Pressure Change Allowed During VPS</u> If MM detects a pressure change greater than this value, a lockout will occur. See parameter 41 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) 0 - 13400
134	3		<u>VPS Valve Opening Time</u> 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 3 - 20
135	0		<u>Purge Time Units/ NFPA Post-Purge</u> 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. 0 Purge time in seconds 1 Purge time in minutes 2 NFPA post-purge in seconds 3 NFPA post-purge in minutes

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
136	25	0 - 13400	<p><u>Gas Pressure Switch – Offset Lower Limit</u></p> <p>This is an offset lower limit from the commissioned gas pressure, see parameter 41 for the gas pressure display units. See option/ parameter 125, 126, 127 and 128 to enable the pressure limits.</p> <p>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)</p>
137	25	0 - 13400	<p><u>Gas Pressure Switch – Offset Upper Limit</u></p> <p>This is an offset upper limit from the commissioned gas pressure, see parameter 41 for the gas pressure display units. See option/ parameter 125, 126, 127 and 128 to enable the pressure limits.</p> <p>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)</p>
138	25	0 1 - 50000	<p><u>Gas Static Line Pressure Lower Limit Offset</u></p> <p>For setting 0, if the measure 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 VPS vid to gas phase is below the absolute value in option 133. For setting other than 0, this measured static line pressure is checked against the value set in this option.</p> <p>Option/ parameter 136 offset lower limit used 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)</p>
139	-	0 1 - 4000	<p><u>Oil Pressure Switch – Offset Lower Limit</u></p> <p>The MM will check the oil pressure is not below this offset lower limit from the commissioned oil pressure, during firing.</p> <p>Disabled 0.001 Bar - 4.000 Bar (0.015 PSI - 58.015 PSI)</p>
140	0	0 1 - 4000	<p><u>Oil Pressure Switch – Offset Upper Limit</u></p> <p>The MM will check the oil pressure is not below this offset lower limit from the commissioned oil pressure, during firing.</p> <p>Disabled 0.001 Bar - 4.000 Bar (0.015 PSI - 58.015 PSI)</p>
141	0	0 - 1200	<p><u>Air Proving Pressure Threshold for Purge</u></p> <p>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 parameter 43 for air pressure display units.</p> <p>0 mbar - 120.0 mbar (0" WG - 48.176" WG)</p>
142	60	4 - 240	<p><u>Shutter Test Interval</u></p> <p>This is the time interval between shutter tests on the self-check UV scanner. See options/ parameter 110 and 122.</p> <p>Seconds</p>

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
143	0	0 1	<u>No Pre-Purge</u> For setting 1, there will only be no pre-purge if the burner has recycled due to meeting operational temperature/ pressure, and the system has gone through VPS checks successfully. If the burner has a lockout, or is restarting after a lockout has been cleared, then the MM will force a pre-purge. No pre-purge is only available when the fuel is set to gas. Enabled Disabled
144	4	1 - 12	<u>Maximum Allowed UV Self-Check Errors</u> 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. Errors
145		0 1	<u>First Out Interlock</u> This expansion feature will need to be unlocked to enable first out interlock. For setting 1, all of the first outs will be tied to burner safety stat circuit. They will be automatically set for active low, and then can be selected for non-recycle or recycle. Please see expansion option 110. Disabled Enabled
146	-		Unused
147	0	0 - 300	<u>Air Pressure Error Window</u> 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	0 1 2	<u>Air Pressure Sensor Type</u> 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. Air switch on T54 Autoflame air pressure sensor Autoflame air pressure sensor and air switch on T54
149	10	7 - 1200	<u>Air Proving Pressure Threshold</u> 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 parameter 43 for air pressure display units. 0.7 mbar - 120.0 mbar (0.281" WG - 48.176 "WG) Value 10 = 0.401 "WG (1.0 mbar)
150	0	0 1	<u>Fuel 1 Type</u> Gas Oil
151	1	0 1	<u>Fuel 2 Type</u> Gas Oil

2 OPTIONS AND PARAMETERS

Option	Default	Range	Description
152	1	0 1	<u>Fuel 3 Type</u> Gas Oil
153	0	0 1	<u>Fuel 4 Type</u> Gas Oil
154	0	0 1	<u>Terminal T80 Function</u> 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. Not used Start Position Interlock
155	0	0 1 2	<u>Terminal T81 Function</u> For setting 1, terminal 81 acts as a line voltage input for a mechanical proving switch. The switch must be made when the air channel servo is at the purge position and it must remain made for the whole duration of the purge phase otherwise a lockout is generated. This input must also not be made while not at purge position. For setting 2, terminal 81 acts as purge pressure proving switch input. The switch must be made continuously for the whole duration of the purge time. If it drops out, the purge timer restarts once the signal is made again. It must also not be 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 time limit for the purge pressure proving to be made. Not used Purge position interlock Purge pressure proving
156	-		Unused
157	0	0 1 - 3600	<u>Delay to Purge (T52) Timeout</u> An input on terminal 52 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. Disabled Seconds
158	0	0 1 - 3600	<u>Purge Pressure Proving (T81) Timeout</u> If option/parameter 155 is set to 2, then the system will lockout if the purge pressure is not proved within the specified time. Setting to 0 will disable this timeout, so the MM will be in the purge phase indefinitely waiting for the pressure proving signal to be received on terminal 81. Disabled Seconds
159	-		Unused
160	0	5 10 15 20 25	<u>Clear Commissioning Data</u> Clear all commissioning data, options and parameters Reset all options to default values Reset all parameters to default values Reset all safety options and parameters to default values Reset all expansion options to default values

2.2 Parameters

Commission Mode			
Options		Parameters	Expansion
#	Description	Value	
1	DTI: Sequence Scan Time Set When Unit Goes Offline	3 minutes (00:03:00)	
2	Unused: Parameter 2	0	
3	DTI: Number of Boilers Initially On	10	
4	EGA: Delay Before EGA Commission Can Be Stored	45 seconds	
5	DTI: Modulation Timeout	4 minutes (00:04:00)	
6	Unused: Parameter 6	0	
7	Unused: Parameter 7	0	
8	EGA: Trim Delay After Drain	30 seconds	
9	Unused: Parameter 9	0	
10	EGA: EGA Version	Mk8	
11	Unused: Parameter 11	0	
12	EGA: CO Used For Trim On Oil	Disabled	
13	EGA: Commission Fuel-Rich Trim	5.0 %	
14	EGA: Trim Reset Angular Rate	5.0 degrees per minute	
15	MM: Golden Start Time	5 seconds	
16	EGA: (Mk7 Only) Time Between Air Calibrations	6.0 hours	
17	EGA: Number Of Trims Before Limits Error Generated	3	
18	EGA: Maximum Trim During Run	10.0 %	
19	EGA: Commission Air-Rich Trim	5.0 %	

All
MM
PID
EGA
DTI
BC

Figure 2.2.i Commission Mode - Parameters

Press in the Commission Mode screen to access the Parameters. Any number of options/ 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.

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.

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

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
1	3		<u>Sequence Scan Time Set When Units Goes Offline</u> If a sequenced MM drops out of the sequence loop, there is a time delay before the next scan time. Minutes
2	-	0 - 20	Unused
3	10		<u>Number of Boilers Initially On</u> 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	1 - 10	<u>Delay Before EGA Commission Can be Stored</u> 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	10 - 120	<u>Modulation Timeout</u> 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	-	1 - 50	Unused
7	-		Unused
8	30		<u>Trim Delay After Drain</u> 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	-	5 - 240	Unused
10	2		<u>EGA Version</u> 0 Mk7 For use with Mk7 EGA 1 Mk8 Protocol (Legacy) - For use with Mk8 EGA 2 Mk8 Protocol (RS485) - For use with Mk8 EGA EVO
11	-		Unused
12	0		<u>CO Used for Trim on Oil</u> 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	0 1	<u>Commission Fuel-Rich Trim</u> The % of air damper movement when commissioning fuel-rich trim. 2.0% - 7.5%
		20 - 75	

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
14	50	0 - 900	<u>Trim Reset Angular Rate</u> 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	2 - 100	<u>Golden Start Time</u> This is the time period for how long the servomotors and VSDs are held at the golden start position, see option 29. Seconds
16	12	1 - 50	<u>(Mk7 E.G.A only) Time Between Air Calibrations</u> This is the time period between air calibrations if the burner does not go off. 0.5 hours - 25.0 hours
17	3	0 - 10	<u>Number of Trims Before Limits Errors Generated</u> 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. Number of trims
18	100	20 - 100	<u>Maximum Trim During Run</u> This is the maximum trim % of air damper movement during firing. 2.0% - 10.0%
19	50	20 - 75	<u>Commission Air-Rich Trim</u> This is the % air damper movement when commissioning the air rich trim. 2.0% - 7.5%
20	-		Unused
21	-		Unused
22	-		Unused
23	1	0 1	<u>Add Air When CO Present</u> 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	20 - 300	<u>(Mk7 EGA only) Air Calibration Time</u> For the Mk8 EGA, this is set as default 6 minutes. Seconds
25	-		Unused
26	8	1 - 50	<u>Trim Samples per Cycle</u> 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
28	-		Unused

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
29	1000	800 - 1200	<u>Load Sensor Adjustment</u> This adjusts the load sensor (voltage) reading, as a percentage of the reading. Value 1000 = 100.0% of actual reading
30	10	1 - 40	<u>Load Sensor Filter Time</u> Seconds
31	0	0 1	<u>(Mk7 EGA only) Efficiency Calculation Method</u> For the Mk8 EGA, efficiency calculation method is set on the EGA. English European
32	-		Unused
33	-		Unused
34	-		Unused
35	-		Unused
36	-		Unused
37	-		Unused
38	***	0 - 255	<u>Commissioning Password Code 1</u> Code 1
39	***	0 - 255	<u>Commissioning Password Code 2</u> Code 2
40	0	0 1	<u>Display Units</u> Metric units Imperial units
41	0	0 1 2	<u>Gas Pressure Units</u> This will set the units displayed for the Autoflame gas pressure sensor optioned. Note, PSI units are not available for sensor MM80006. mbar "WG PSI
42	0	0 1	<u>Oil Pressure Units</u> This will set the units displayed for the Autoflame oil pressure sensor optioned. Bar PSI
43	-	0 1	<u>Air Pressure Sensor Units</u> This will set the units displayed for the Autoflame air pressure sensor. mbar "WG
44	-		Unused
45	-		Unused

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
46	-		Unused
47	-		Unused
48	80		<u>Integral Band</u> This is the percentage of the proportional band over which the integral control is active. 0% - 100%
49	-	0 - 100	Unused
50	-		Unused
51	-		Unused
52	0		<u>External Load Detector - Number of Decimal Places</u> This affects parameter the external load detector maximum and minimum values set in parameters 53 and 55. See option 1 and parameter 40. 0 1 2 0 decimal place 1 decimal place 2 decimal places
53	20		<u>External Load Detector - Maximum Value</u> The scale will depend on how parameter 52 is set. See option 1 and parameter 40. 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	0 - 9990	<u>External Load Detector - Maximum Voltage</u> 0.0V - 10.0V
55	20		<u>External Load Detector - Minimum Value</u> The scale will depend on how parameter 52 is set. See option 1 and parameter 40. 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	0 - 100	<u>External Load Detector - Minimum Voltage</u> 0.0V - 10.0V
57	10		<u>Highest MM ID</u> This sets the highest MM ID number for that sequence or DTI loop. Sequence ID
58	1	1 - 10	<u>(Mk7 EGA only) - Air Calibration on Start-up</u> For the Mk8 EGA, the air calibration schedule is set on the EGA itself. 0 1 Disabled Enabled
59	-		Unused

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
60	60	0 1 - 3600	<u>Logo Display Timer (Standby)</u> 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. Disabled Seconds
61	900	0 1 - 1800	<u>Backlight On Time</u> If the screen is not pressed and this timer elapses, the backlight will dim. Disabled Seconds
62	0	0 1	<u>Hot Water Sequencing</u> 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. Hot water sequencing operates normally Hot water sequencing operates as steam sequencing
63	-		Unused
64	-		Unused
65	-		Unused
66	-		Unused
67	-		Unused
68	1	0 1	<u>External Modulation Control Range</u> The range is set for either low fire to high fire in setting 0, or zero to high fire in setting 1. See options 45 and 55. Low to high Zero to high
69	0	0 1 2	<u>Auxiliary Channel Input Range</u> This sets the range for external modulation input on terminals 7, 8, and 9. 4 to 20mA input 0 to 20mA input 0 to 10V input
70	10	0 1 - 30	<u>Auxiliary Channel Filter Time</u> This sets the time allowed for a reading to be taken on terminals 7, 8 and 9. Disabled Seconds
71	1	0 1 2 3	<u>Firing Rate Output Control Range</u> This sets the range for firing rate output on terminals 16, 17, and 18. 4-20mA, 2-10V, Low to high 4-20mA, 2-10V, Zero to high 0-20mA, 0-10V, Low to high 0-20mA, 0-10V, Zero to high
72	0	0 1	<u>External Setpoint Input</u> If enabled, terminals 7, 8, and 9 are used for external required setpoint. The range and filtering of the input is set in parameters 69 and 70. The required setpoint range is set in options 30 and 31. Disabled Enabled

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
73	-		Unused
74	-		Unused
75	-		Unused
76	-		Unused
77	-		Unused
78	-		Unused
79	-		Unused
80	-		Unused
81	-		Unused
82	-		Unused
83	-		<u>Display Diagnostic Values</u>
		0 1	Disabled Enabled
84	-		Unused
85	0		<u>Modulation Exerciser Period</u>
		0 1 - 3600	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. Disabled Seconds
86	85		<u>IBS Change Down Threshold</u>
		0 - 99	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%
87	95		<u>IBS Change Up Threshold</u>
		0 - 100	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%
88	1000		<u>Outside Temperature Sensor Adjustment</u>
		500 - 2000	If the outside temperature reading is too high, then decrease this value. If the outside temperature reading is too low, then increase this value. 50.0% - 200.0%
89			<u>Stat Exerciser Period</u>
		0 1 - 3600	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. Disabled Seconds

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
90	-		Unused
91	-		Unused
92	-		Unused
93	-		Unused
94	0		<u>NO Upper Limit Offset</u>
		0 1 - 200	If the current NO value is above this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. Disabled 1 - 200 ppm NO
95	-		Unused
96	0		<u>Exhaust Temperature Upper Limit Offset</u>
		0 1 - 999	If the current exhaust temperature value is above this offset limit from the commissioned value, an alarm/ warning (see option 13) will occur, for option 12 set to 3. See parameter 40. Disabled 1 - 999 deg°C or deg°F
97	0		<u>Exhaust Temperature Absolute Limit</u>
		0 1 - 999	If the current exhaust temperature value is above this absolute limit, an alarm/ warning (see option 13) will occur, for option 12 set to 3. See parameter 40. Disabled 1 - 999 deg°C or deg°F
98	-		Unused
99	1		<u>Graceful Shutdown</u>
		0 1	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. Disabled Enabled
100	0		<u>Assured Low Fire Shut Off</u>
		0 1	If enabled, when the burner turns off on internal stat, the MM will modulate to low fire, shut down and recycle the system before turning off. Assured low fire shut off cannot be used with graceful shutdown in parameter 99. Disabled Enabled
101	0		<u>Shuffle Sequencing</u>
		0 1	This allows the sequence order to be changed remotely through the DTI or Modbus. See option 16 and expansion option 100. Disabled Enabled
102	-		Unused
103	-		Unused

2 OPTIONS AND PARAMETERS

Parameter	Default	Range	Description
104	-		Unused
105	-		Unused
106	-		Unused
107	***	0 - 255	<u>Online Changes Password Code 1</u> Code 1
108	***	0 - 255	<u>Online Changes Password Code 2</u> Code 2
109	0	0 1	<u>Software Voltage Conditioner</u> The software voltage conditioner governs the way the MM deals with the mains power stability tests, setting 1 makes the MM more tolerant to mains power instability. Disabled Enabled

Parameters 110 - 160 are a repeat of their corresponding options, and will need to be entered the same.

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.

2.3 Expansion Options

Commission Mode		
Options	Parameters	Expansion
#	Description	Value
1	WLC: Water Level Control Function	Water Level Control Disabled
2	WLC: Feedwater Control Element	Pump On/Off Only
3	WLC: Capacitance Probes	Capacitance Probes Disabled
4	WLC: External Level Sensor	External Level Sensor Disabled
5	WLC: Auxiliary Alarm Inputs	Auxiliary Alarm Inputs Disabled
6	WLC: Second Low Probe	Second Low Probe Disabled
7	WLC: Pre-High Alarm Percentage	Disabled
8	WLC: Pre-First-Low Alarm Percentage	Disabled
9	WLC: Burner Operation at High Water	Burner Runs at High Water
10	WLC: Pump Turn Off Point	Pump Turns Off Above Control Point
11	WLC: Pump Turn Off Percentage	30 %
12	WLC: Pump Turn On Percentage	10 %
13	WLC: Feedwater Control Proportional Band	50 %
14	WLC: Feedwater Control Integral Time	20 seconds
15	WLC: Feedwater Control Derivative Time	Disabled
16	WLC: Feedwater Servo Open Angle	90.0 °
17	WLC: Pump Bypass Operation	Pump Bypass Disabled
18	WLC: Pump Bypass Switch Point	20 %
19	WLC: Pump Bypass Hysteresis	5 %

All WLC TBD BBD DC Modbus FO Flow   

Figure 2.3.i Commission Mode – Expansion Options

Press  in the Commission Mode screen to access the Expansion Options. Any number of expansion options can be changed at one time. By pressing WLC, TBD, BBD, DC, Modbus FO and Flow at the bottom of the screen, the expansion options can be grouped together by feature.

To change the expansion options, the relevant expansion feature must be unlocked. See Mk8 MM Expansion Features Installation and Commissioning Guide for more information.

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

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

Note: The Expansion Feature must be unlocked by sending the code for that MM via Download Manager. Please see PC Software Guide on unlocking Expansion Features.

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
1	0		<p><u>Water Level Control Function</u></p> <p>Expansion feature 1 must be unlocked on the MM. For setting 1, there must be a minimum of two level sensing elements or a conflict will appear. The capacitance probes with/without external level sensor will be commissioned at end of probe, second low, first low, control point and high water.</p> <p>0 1</p> <p>Water level control disabled Water level control enabled</p>
2	0		<p><u>Feedwater Control Element</u></p> <p>The feedwater pump will turn on and off according to the levels set relative to the control point, through expansion options 10, 11 and 12. For setting 0, water going to the boiler is only controlled by the feedwater pump output terminal BFW. For settings 1 and 2, the MM controls the feedwater via a PID loop, see expansion options 13, 14, 15, and 16. For setting 1, the MM uses the servomotor on terminals P-, FW, P+, MVI and MVD. For setting 2 and 3, the MM uses the VSD on terminals I+, V+ and IV-.</p> <p>0 1 2 3 4 5</p> <p>Pump on/off only Pump on/off and Servo Control Pump on/off and VSD Control (0-10V / 0-20mA) Pump on/off and VSD Control (4-20mA / 2-10V) Pump on/off and Servo Control (0-10V / 0-20mA) Pump on/off and Servo Control (4-20mA / 2-10V)</p>
3	0		<p><u>Capacitance Probes</u></p> <p>If water level control is enabled, the MM will require a minimum of two level sensing elements. For the possible water level sensing device combinations, please see section 3.3.</p> <p>0 1 2</p> <p>Capacitance probes disabled One capacitance probe Two capacitance probes</p>
4	0		<p><u>External Level Sensor</u></p> <p>The external level sensor is wired to terminals EX- and EX+ and will give a 4-20mA signal. The readings can be scaled in expansion options 30 and 31. If an external level sensor is used, then a 4-20mA signal for fuel flow feedback cannot be enabled (option 57) and fully metered combustion control cannot be enabled (expansion option 140). For the possible water level sensing device combinations, please see section 3.3.</p> <p>0 1</p> <p>External Level Sensor Disabled External Level Sensor Enabled</p>
5	0		<p><u>Auxiliary Alarm Inputs</u></p> <p>For setting 1, the auxiliary alarm mains inputs terminals HAI, 1AI and 2AI are used in addition to the capacitance probes with/without external level sensor readings. For the possible water level sensing device combinations, please see section 3.3.</p> <p>0 1</p> <p>Auxiliary alarm inputs disabled Auxiliary alarm inputs enabled</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
6	0	0 1	<p><u>Second Low Probe</u> For setting 0, it is recommended that an auxiliary second low mains input is wired to terminals 2AI. For setting 1, the Autoflame conductive second low probe is wired to terminals 4P-, 4P+, 6T- and 6T+. Please see local codes/regulations for second low probe and auxiliary second low alarm setup. For the possible water level sensing device combinations, please see section 3.3.</p> <p>Second low probe disabled Second low probe enabled</p>
7	0	0 1 - 99	<p><u>Pre-High Alarm Percentage</u> The pre-high alarm level is at percentage between the control point and high water, with the control point being referring to 0% and the high water referring to 100%. For setting 0 there is no pre-high alarm and for settings higher than 1, the MM will generate an alarm if the water level reaches this % value between the commissioned control point and high water. For example, if this is set to 45%, then a pre-high alarm will occur if the water level rises to 45% between the control point and high water level.</p> <p>Disabled 1% - 99%</p>
8	0	0 1 - 99	<p><u>Pre-First-Low Alarm Percentage</u> The pre-first-low alarm level is at percentage between the control point and first low, with the control point being referring to 0% and the first low referring to 100%. For setting 0 there is no pre-first-low alarm and for settings higher than 1, the MM will generate an alarm if the water level reaches this % value between the commissioned control point and first low. For example, if this is set to 45%, then a pre-first-low alarm will occur if the water level drops to 45% between the control point and first low level.</p> <p>Disabled 1% - 99%</p>
9	0	0 1	<p><u>Burner Operation at High Water</u> For setting 0, the burner will continue to fire at high water. For setting 1 the burner will stop firing at high water. Expansion option 10 sets whether the pump turns off above the control point or high water.</p> <p>Burner runs at high water Burner stops at high water</p>
10	0	0 1	<p><u>Pump Turn Off Point</u> The water level at which the pump turns off is set as a percentage above the control point for setting 0, or above the high water for setting 1, see expansion option 11.</p> <p>Pump turns off above control point Pump turns off above high water</p>
11	30	0 - 100	<p><u>Pump Turn Off Percentage</u> When the water level reaches this percentage of the control point or high water, depending on how expansion option 10 is set, the pump will turn off. If expansion option 10 is set to 0, then this percentage will be between the control point and high water. If expansion option 10 is set to 1, then this percentage is above high water, and should not be set more than a safe top of the probe level.</p> <p>0% - 100%</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
12	10	0 - 100	<p><u>Pump Turn On Percentage</u></p> <p>When the water level drops the control point, the pump will turn on at this percentage in between the control point and first low. 0% - 100%</p>
13	100	0 1 - 500	<p><u>Feedwater Control Proportional Band</u></p> <p>This proportional band is defined as a fraction of the distance from the control point to first low. The default setting of 100% means that the proportional output reaches maximum (fully open feedwater valve or maximum VSD output) when the water level drops to first low. At halfway between control point and first low the feedwater valve would be 50% open (or the VSD output will be 50%). Reducing the proportional band to 50% would mean that the proportional output reaches maximum (fully open feedwater valve or maximum VSD output) when the water level drops to 50% of the way between control point and first low. Increasing the proportional band to 500% would mean that the water level would have to drop to 5 times the distance from control point to first low. By the time the level drops to first low the feedwater valve will only be 20% open (or the VSD output will be 20% of its maximum output)</p> <p>Disabled 1% - 500%</p>
14	20	0 1 - 1000	<p><u>Feedwater Control Integral Time</u></p> <p>The integral element in the feedwater control will make corrections to the feedwater via the servomotor or VSD, depending on expansion option 2. For a slower response, increase the integral time. For a quicker response in critical steam applications to avoid the water level reaching first low, decrease the integral time. However if overshoot occurs and the water level rises to above the control point and this is not desired, then the derivative element will need to be enabled, see expansion option 15.</p> <p>Disabled Seconds</p>
15	0	0 1 - 1000	<p><u>Feedwater Control Derivative Time</u></p> <p>The derivative element in the feedwater control is suitable for applications requiring a quick response but the water level should not rise too high above the control point. For example, if the burner is set to stop firing at high water in expansion option 9 and high water is commissioned not too far above from control point, then overshoot is undesirable in a critical steam application, as the burner would stop firing.</p> <p>Disabled Seconds</p>
16	900	100 - 900	<p><u>Feedwater Servo Open Angle</u></p> <p>The feedwater servomotor closed position is set by zeroing the potentiometer in commissioning mode. As default the servomotor is set as fully open, however this setting can be decreased to shorten the operational movement range of the servomotor. 10.0° - 90.0°</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
17	0	0 1 2	<p><u>Pump Bypass Operation</u> The pump bypass (terminal TB) will turn on at the switch point set as a % of the open range of the valve, and will turn off at an offset from the switch point, set as the bypass hysteresis, see expansion options 18 and 19. However if the pump is turned off, then the pump bypass will also be turned off. For setting 1, the pump bypass hysteresis is below the switch point, so the pump bypass will turn off at an offset below the switch point. For setting 2, the pump bypass hysteresis is above the switch point, so the pump bypass will turn off at an offset above the switch point.</p> <p>Pump bypass disabled Pump bypass on above switch point Pump bypass on below switch point</p>
18	20	5 - 95	<p><u>Pump Bypass Switch Point</u> The pump bypass switch point is set as a percentage of the valve open range set in expansion option 16. 5% - 95%</p>
19	5	0 1 - 50	<p><u>Pump Bypass Hysteresis</u> The pump bypass hysteresis is set at percentage from the pump bypass switch point set in expansion option 18, and this will below the switch point for expansion option set to 1 (pump bypass on above switch point) and above the switch point for expansion option set to 2 (pump bypass on below switch point).</p> <p>Disabled 1% - 50%</p>
20	0	0 1	<p><u>Burner Operation on Feedwater Control Fault</u> For setting 0, the burner will continue to fire if there is a feedwater fault. If the burner continues to fire and the water level drops below the control point to first low, an alarm will occur and the burner will stop firing. If a feedwater servomotor fault occurs, the feedwater pump will continue to operate. For setting 1 the burner will stop firing if there is a feedwater fault.</p> <p>Burner runs on feedwater control fault Burner stops on feedwater control fault</p>
21	1	0 1	<p><u>Function of Test Input</u> The test input terminal TST can be set for checking the auxiliary alarm outputs or shunt switch. For setting 0, hold the test input continuously to cycle through alarm outputs every two seconds. For setting 1, hold the test input for three seconds to trigger the shunt switch operation, and to cancel the shunt switch operation, hold the test input for a further three seconds. See expansion options 22 and 23 for the shunt switch timings.</p> <p>Test input operates alarm outputs test Test input operates shunt switch</p>
22	300	30 - 600	<p><u>Shunt Switch - Time to 1st Low</u> When the shunt switch test is activated in expansion option 21, there is time delay for the water to reach the first low level, allowing the operator to decrease the water level. This test checks the first low alarm while the burner continues to operate. If water does not drop to the first low level in this time period, then MM will revert back to normal run mode and cancel the shunt switch test.</p> <p>Seconds</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
23	300	30 - 600	<p><u>Shunt Switch – Time to 2nd Low</u></p> <p>After the shunt switch has been tested for first low, there is further time delay for the water to reach the second low level, allowing the operator to further decrease the water level. This test checks the second low alarm while the burner continues to operate. If water does not drop to the second low level in this time period, the burner will turn off.</p> <p>Seconds</p>
24	5	1 - 100	<p><u>Sudden Pressure Drop Trigger Rate</u></p> <p>If the pressure drops by this value set over 3 seconds to a pressure below the reset offset from the required pressure setpoint set in expansion option 26, then a sudden pressure drop condition is detected and the control point will increase by a percentage set in expansion option 25.</p> <p>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 parameter 40)</p>
25	25	0 1 - 75	<p><u>Sudden Pressure Drop Control Point Increase</u></p> <p>If a sudden pressure drop is detected, the water level control point will increase to the percentage of the control point set. Once the steam pressure increases to the reset offset value from the required pressure setpoint, the control point will return to the commissioned value. See expansion options 24 and 26.</p> <p>Disabled 1% - 75%</p>
26	10	0 1 - 100	<p><u>Sudden Pressure Drop Reset Offset</u></p> <p>If the pressure drops by the value set in expansion option 24 over 3 seconds to a pressure below this reset offset from the required pressure setpoint, then a sudden pressure drop condition is detected and the control point will increase by a percentage set in expansion option 25.</p> <p>Disabled 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 parameter 40)</p>
27	30	5 - 100	<p><u>Probe Mismatch Threshold</u></p> <p>The probe mismatch threshold is a percentage of the first low. If the probes and/or external level sensors read a difference in the level greater than this value set for 30 seconds, then a probe mismatch alarm will occur.</p> <p>5% - 100%</p>
28	3	0 1 - 100	<p><u>Capacitance Probe Still Water Threshold</u></p> <p>This threshold set is the distance between the high peak and low peak of the water wave signature. If the capacitance probes detect a reading between the high peak and low peak which is less than this value for 30 seconds while the burner is firing, a capacitance probe still water alarm will occur.</p> <p>Disabled 1 - 100mm or 0.0 - 3.9" (see parameter 40)</p>
29	10	1 - 30	<p><u>Capacitance Probe Filter Time</u></p> <p>The filter time is the rolling time period over which the capacitance probes take the water level reading. When a moving water level is detected this time period reduces in proportion linearly to the movement.</p> <p>Seconds</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
30	0	0 1 - 20000	<u>External Level Sensor Scaling</u> If an external level sensor is set in expansion option 4, then the 4-20mA signal will need be scaled for the length of the sensor. Disabled 0.01 - 200.00mm/mA or 0.01 - 200.00"/mA (see parameter 40)
31	10	1 - 30	<u>External Level Sensor Filter Time</u> The filter time is the rolling time period over which the external level sensor takes the water level reading. When a moving water level is detected this time period reduces in proportion linearly to the movement. Seconds
32	3	0 - 10	<u>Wave Signature Average Level</u> The wave signature average level is set as percentage of the wave signature height of the water level. 0 - 100% (value 3 = 30%)
33	0	0 1 - 50	<u>Feedwater Control Dead Band</u> The Feedwater Control Dead Band is defined as a fraction of the distance from the Control Level to First Low and operates this far above and below the control point. When this option is activated, water level control (servo position or VSD output) will not be updated while the water level is within this dead band, allowing small variation in the water level to be ignored. Disabled Dead Band %
34	-		Unused
35	-		Unused
36	-		Unused
37	-		Unused
38	-		Unused
39	-		Unused
40	0	0 1 2 3	<u>Top Blowdown Function</u> To enable top blowdown, the top blowdown expansion feature must be unlocked. The TDS value in the water, measured by the TDS probe on terminals 3P+, 3P-, 3T+ and 3T-, is maintained by a PID loop, see expansion options 52, 53 and 54. For setting 1, the terminal TB output will open and close an external solenoid valve. For setting 2, the top blowdown valve is open and closed via a top blowdown servomotor on terminals P-, FW, P+, TBI and TBD. For setting 3, continuous top blowdown management is enabled for the top blowdown. 0 Top blowdown disabled 1 Top blowdown using solenoid 2 Top blowdown using servo (2-state) 3 Top blowdown using servo (continuous)
41	0	0 1	<u>TDS Units</u> The TDS units can be displayed in ppm or $\mu\text{S}/\text{cm}$. 0 Concentration in ppm 1 Conductivity in $\mu\text{S}/\text{cm}$

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
42	2500	50 - 9999	<p><u>TDS Target</u> This is the set TDS target value which the TDS control will try to maintain by open and closing the solenoid or top blowdown valve, see expansion option 40. The target TDS value should be set according to the boiler manufacturer's guidelines. ppm or $\mu\text{S/cm}$ (see expansion option 41)</p>
43	180	20 - 1000	<p><u>TDS Temperature Compensation</u> The steam temperature is calculated from the steam pressure sensor reading. The TDS value read will be corrected by the % per $^{\circ}\text{C}$ set, for the difference between the steam temperature and 25 degrees $^{\circ}\text{C}$, so the TDS measured value displayed is shown corrected to 25 degrees $^{\circ}\text{C}$. This temperature compensation coefficient will depend on the contaminants in the water and should be set accurately for the contaminants that make up the TDS in the water. 0.20 - 10.00% per $^{\circ}\text{C}$</p>
44	65	20 - 100	<p><u>TDS PPM Conversion</u> The ppm to $\mu\text{S/cm}$ conversion coefficient will depend on the contaminants in the water and should be set accurately for the contaminants that make up the TDS in the water. 0.20 - 1.00ppm / ($\mu\text{S/cm}$)</p>
45	1000	10 - 999	<p><u>TDS Adjustment</u> This value will automatically display the adjustment factor when the TDS probe is recalibrated during running. 0.010 - 9.999</p>
46	0	0 1 - 5000	<p><u>TDS Warning Level</u> The TDS warning level is an absolute limit; if the average TDS reading taken from the measurement time is higher than this TDS limit, a warning will be generated. This limit should not be set lower than the target TDS value set in expansion option 42. Disabled ppm or $\mu\text{S/cm}$ (see expansion option 41)</p>
47	10	0 1 - 100	<p><u>Pressure Threshold</u> This pressure threshold is an offset below the required pressure setpoint. If the actual pressure is below this offset pressure, then TDS control will not operate. Disabled 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 parameter 40)</p>
48	25	2 - 60	<p><u>Sample Time</u> The first stage of the TDS control cycle is the sample time, where the solenoid valve or top blowdown servomotor is fully opened to take a sample. Seconds</p>
49	25	2 - 60	<p><u>Settle Time</u> The second stage of the TDS control cycle is the settle time. Following taking a sample time in expansion option 48, the solenoid valve or top blowdown servomotor goes fully closed to allow the sample to stabilise for this settle time. Seconds</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
50	10	2 - 30	<p><u>Measurement Time</u></p> <p>The third stage of the TDS control cycle is the measurement time. Following the settle time in expansion option 49, TDS probe will measure the TDS in the sample every second set in the measurement time. The average across these measurements is taken as the TDS reading for that cycle. A longer measurement time will allow an average to be taken over more TDS probe measurements, and so the TDS readings will be smooth.</p> <p>Seconds</p>
51	600	10 - 1200	<p><u>Blowdown Time</u></p> <p>The final stage of the TDS control cycle is the blowdown time. Following the measurement time in expansion option 50, if the measured reading is less than 100ppm below the target value, the solenoid valve or top blowdown servomotor will remain closed for the duration of the blowdown time. If the measured reading is higher than the target TDS value, the PID control will operate.</p> <p>Seconds</p>
52	1800	10 - 10000	<p><u>Proportional Band</u></p> <p>The proportional band is set as an offset of above the set TDS target value, within the proportional band, the PID control will make corrections during the blowdown time to maintain the TDS target value. If using a solenoid valve or servomotor (2-state) TDS control, then the P element will determine how long the valve is fully open for before it goes to fully closed, during the blowdown time. If using servomotor continuous TDS control, then the P element will determine what angle the valve is opened to during the blowdown time. If the measured is above this proportional band, then the solenoid valve or top blowdown servomotor will remain fully open.</p> <p>ppm or $\mu\text{S}/\text{cm}$ (see expansion option 41)</p>
53	600	0 1 - 1000	<p><u>Integral Time</u></p> <p>For a slower response, increase the integral time. For a quicker response with fast changing TDS values, decrease the integral time.</p> <p>Disabled Seconds</p>
54	5	0 1 - 1000	<p><u>Derivative Time</u></p> <p>For water level with a quickly changing TDS value in the water, a derivative time can be added to prevent overshoot.</p> <p>Disabled Seconds</p>
55	900	100 - 900	<p><u>Servo Open Angle</u></p> <p>The TDS servomotor closed position is set by zeroing the potentiometer in commissioning mode. As default the servomotor is set as fully open, however this setting can be decreased to shorten the operational movement range of the servomotor.</p> <p>$10.0^\circ - 90.0^\circ$</p>
56	-		Unused
57	-		Unused
58	-		Unused
59	-		Unused

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
60	0	0 1 2	<p><u>Bottom Blowdown Function</u> To enable bottom blowdown, the bottom blowdown expansion feature must be unlocked. The bottom blowdown function can be set for up to 4 timed blowdowns over 24 hours. For setting 1, the timed blowdown output terminal BB is used with an external solenoid valve. For setting 2, the bottom blowdown control module is used on terminals 5T+ and 5T-, which is connected to the bottom blowdown servomotor.</p> <p>0 Bottom blowdown disabled 1 Bottom blowdown using solenoid 2 Bottom blowdown using Autoflame controller</p>
61	0	0 1	<p><u>Bottom Blowdown Triggering</u> For setting 0, when the MM does not need a manual trigger for a blowdown to start when the configured blowdown timing is reached. For setting 1, a manual trigger is required to start the blowdown when the configured blowdown timing is reached.</p> <p>0 Automatic triggering 1 Manual triggering</p>
62	0	0 1	<p><u>Bottom Blowdown Reduction</u> If bottom blowdown reduction is enabled, then the timing of the blowdown will reduce in proportion to the steam production. If there is no steam production and the configured blowdown timing is reached, then the minimum time for that blowdown can be set in expansion option 63.</p> <p>0 Bottom blowdown reduction disabled 1 Bottom blowdown reduction enabled</p>
63	0	0 1 - 60	<p><u>Minimum Blowdown Duration</u> This is the minimum duration for which blowdown will occur, if bottom blowdown reduction is enabled in expansion option 62. For setting 0, if there is no steam production, no blowdown will occur, however if a time is set, then the minimum blowdown duration will be used when there is no steam production.</p> <p>0 Disabled 1 - 60 Seconds</p>
64	0	0 - 5000	<p><u>Boiler Steam Production Rating</u> If bottom blowdown reduction is enabled in expansion option 62, then the maximum steam production rating for that boiler should be set. The bottom blowdown time is reduced according to the current steam production and maximum steam production ratio. This will mean that the blowdown occurs for a shorter time when there is low steam production.</p> <p>0 - 500000 kg/hour or 0 - 1102310l lb/hr (see parameter 40)</p>
65	-		Unused
66	-		Unused
67	-		Unused
68	-		Unused
69	-		Unused
70	-		Unused
71	-		Unused

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
72	-		Unused
73	-		Unused
74	-		Unused
75	-		Unused
76	-		Unused
77	-		Unused
78	-		Unused
79	-		Unused
80	0		<u>Draught Control Servo Channel</u>
			To use a draught servomotor on channel 7 with or without the draught control function, the draught control expansion feature must be unlocked. The servomotor is wired to terminals DP-, DP+, DPW, DCI and DCD. For setting 0 there draught servomotor is optioned off. For setting 1, the draught servomotor can be set for draught control or just servomotor operation in expansion option 82.
		0	Draught servo disabled
		1	Draught servo enabled
81	0		<u>Draught Servo Control Method</u>
		0	Autoflame servomotor, 0.1 degree control
		1	Autoflame servomotor, 0.5 degree control
		2	Industrial servomotor, 0.1 degree control
		3	Industrial servomotor, 0.5 degree control
		4	IO Unit 4-20mA servomotor, 0.5 degree control
		5	IO Unit 4-20mA servomotor, 1.0 degree control
82	0		<u>Draught Control Function</u>
			For setting, if the draught servomotor channel is enabled in expansion option 80, but the draught control is disabled, the servomotor will open and close according to its commissioned curve, without any corrections to maintain stack pressure. For setting 2, the MM will make corrections to the stack damper as the measured stack pressures varies from the commissioned stack pressure. The draught air pressure sensor is wired to terminals DT+, DT-, DP- and DP+.
		0	Draught control disabled
		1	Draught control enabled
83	15		<u>Draught Servo Minimum Angle</u>
			A minimum angle for the draught servomotor when the draught control is enabled in expansion option 82, at all other times other than the closed position. During commissioning, the servomotor position cannot be set low than this minimum angle value, except for the closed position.
		0 - 90	0° - 90°

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
84	1	0 1 2	<u>Maximum Compensation</u> The maximum compensation angle is the percentage of the commissioned draught servomotor angle. This is the maximum correction on the stack damper either forwards or backwards, during draught control. 10% 15% 20%
85	5	1 - 30	<u>Delay Before Compensation</u> This time delay is used for two stages in the burner cycle; once main flame has been established, the draught control operation will only begin after this time delay. During firing, correction on the stack damper will only be made the servomotor is outside of the angle variation tolerance for that commissioned point, for this time period, see expansion option 86. Seconds
86	10	0 - 60	<u>Commissioned Angle Variation Tolerance</u> During firing, if the draught servomotor angle is outside of the commissioned variation tolerance for the time period set in expansion option 85, corrections will be made on the stack damper. 0° - 60°
87	0	0 1 - 500	<u>Pressure Tolerance Before Fault</u> This is the maximum variation from the commissioned draught air pressure. If the pressure is at this maximum variation or higher for 2 minutes, then an alarm/warning is generated, see expansion option 88. Disabled 0.1 - 50.0 mbar or 0.1 - 50.0 "WG (see parameter 43)
88	0	0 1	<u>Action on Pressure Sensor Fault</u> For setting 0, an alarm will occur and the burner will stop firing. For setting 1, a warning will occur and the burner will continue firing, with the draught servomotor will move to the commissioned angle throughout the firing curve, without any draught control compensation. Draught pressure sensor fault generates alarm Draught pressure sensor fault generates warning
89	15	1 - 60	<u>Pressure Sensor Filter Time</u> This is the time period over which the draught air pressure sensor readings are filtered over time. If there is excess fluctuation in the pressure readings, increase the filter time. To improve the system's response to changes in pressure, decrease the filter time. Seconds
90	200	1 - 10000	<u>Proportional Band</u> The proportional band is an offset from the commissioned draught air pressure, where the PI control will make corrections to maintain the commissioned air pressure. 2.00 - 100.00 mbar or 2.00 - 100.00 "WG (see parameter 43)
91	5	1 - 1000	<u>Integral Time</u> For a slower response to the changes in draught air pressure, increase the integral time. For a quicker response, decrease the integral time. Seconds
92	-		Unused

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
93	-		Unused
94	-		Unused
95	-		Unused
96	-		Unused
97	-		Unused
98	-		Unused
99	-		Unused
100	0		<u>Sequencing/DTI or Modbus Function</u>
			To enable direct Modbus, the Modbus expansion feature must be unlocked. If direct Modbus is enabled, then option 16 must be set to 0, as Intelligent Boiler Sequencing cannot be used with direct Modbus. Please see section 7.3 in the 'Mk8 MM Expansion Features Installations and Set-up Guide' for the available Modbus addresses.
		0 1	MM/DTI Sequencing Modbus
101	0		<u>Modbus Baud Rate</u>
			The baud rate on the MM should be set the same as the baud rate used on the external Modbus communication program.
		0 1	9600 Baud 19200 Baud
102	0		<u>Modbus Parity Setting</u>
			The parity on the MM should be set the same as the baud rate used on the external Modbus communication program.
		0 1 2	No parity Odd parity Even parity
103	1		<u>Modbus Stop Bits Setting</u>
			The stop bits on the MM should be set the same as the baud rate used on the external Modbus communication program.
		1 2	1 stop bit 2 stop bits
104	1		<u>Modbus Device ID</u>
			This ID is used to recognise the device on the external Modbus communication program.
		1 - 247	
105	0		<u>Binary Format</u>
			The binary format on the MM should be set the same as the baud rate used on the external Modbus communication program.
		0 1	Binary format ASCII format
106	-		Unused
107	-		Unused

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
108	-		Unused
109	-		Unused
110	0		First Outs Function
		0 1	If first outs are enabled, they will can be configured and labelled in Commission mode and Online Changes. To tie the first outs interlock to the MM's safety stat, set option/ parameter 145. Disabled Enabled
111	-		Unused
112	-		Unused
113	-		Unused
114	-		Unused
115	-		Unused
116	-		Unused
117	-		Unused
118	-		Unused
119	-		Unused
120	0		Heat Flow Function
		0 1 2 3 4 6 7 8 9	To determine the steam or hot water flow, the heat flow expansion feature must be unlocked. Up to 3 temperature sensors (T1, T2 and T3) are used for steam or hot water flow metering depending on what heat flow function is set. T1 is wired to terminals T1 and -, T2 to terminals T2 and -, T3 to terminals T3 and -. See Expansion Features Installation and Commissioning Guide. Disabled Steam flow with default values Steam flow Steam flow with economiser Steam flow with deaerator Steam flow with deaerator and feed sensor Hot water flow with default values Hot water flow Hot water flow with economiser
121	100		Boiler Standing Losses
		0 – 200	The boiler standing losses are known as the heat lost from the boiler surfaces and pipework through radiation, and is set as a percentage of the maximum continuous rating of the boiler. 0.00 – 2.00%
122	100		Blow Down Losses
		0 – 100	This is the typical losses resulting from top blowdown and bottom blowdown. 0.00 – 10.0%

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
123	0	0 1	<u>Blow Down Loss Calculation Method</u> For setting 0, a fixed blow down loss is used in the steam or hot water flow metering, set in expansion option 122. For setting 1, the blow down loss will change according to the current firing rate in the metering calculation. Fixed loss Loss proportional to firing rate
124	100	0 - 9999	<u>Make Up Flowmeter Range</u> The make-up flowmeter range is only relevant if the steam flow metering function has been set with deaerator in expansion option 120. 0.0 - 999.9 litres/s or gallon/s (see parameter 40)
125	100	0 - 9999	<u>Condensate Flowmeter Range</u> The condensate flowmeter range is only relevant if the steam flow metering function has been set with deaerator in expansion option 120. 0.0 - 999.9 litres/s or gallon/s (see parameter 40)
126	80	0 - 300	<u>Default Feedwater Temperature</u> If the heat flow function is set for steam or hot water flow metering using default values, then this default feedwater temperature is used for the steam or hot water flow metering calculations. °C or °F (see parameter 40)
127	10	0 1 - 100	<u>Steam Flow Start Pressure Offset</u> The steam flow start pressure is an offset of the required pressure. Steam flow metering will begin when the actual pressure is within this offset from the required pressure, as the system would be generating useful steam. Disabled 0.1 - 10.0 bar or 1 - 100 PSI (see parameter 40)
128	10	0 1 - 100	<u>Steam Flow Stop Pressure Offset</u> The steam flow stop pressure is an offset below the required pressure. if the actual steam pressure below this value, then steam flow metering will stop. Disabled 0.1 - 10.0 bar or 1 - 100 PSI (see parameter 40)
129	0	0 1 - 10	<u>Heat Flow Data Source</u> For setting 0, the T1, T2 and T3 temperature sensor are wired to the MM, and the heat flow function is set via expansion option 120. For setting 1, the same temperature information is fed back up to the MM via connections to the IO module connected to the DTI. The ID number of the IO module must be set in expansion option 129. Sensors connected to MM Sensors connected to IO Unit 1 - 10
130	-		Unused
131	-		Unused
132	-		Unused
133	-		Unused
134	-		Unused
135	-		Unused

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
136	-		Unused
137	-		Unused
138	-		Unused
139	-		Unused
140	0		Fully Metered Function
		0 1	The fully metered function maintains the commissioned heat input and fuel-air ratio based on 4-20mA signals from the fuel and air mass or volume flow meters. External water level sensor and 4-20mA fuel flow feedback must be disabled. Disabled Enabled
141	0		Fuel Flow Meter Type
		0 1 2	The fuel-air ratio is derived from the mass flow rates of the fuel and air going into the burner. The fuel flow meter is wired to terminals EX+ and EX-, and the 4-20mA signal is scaled by setting expansion option 142. For setting 0, a volume flow meter is used and a displayed mass flow rate is calculated using either internal constants or via measured temperature/pressures. For setting 1, a mass flow meter is used to the display the mass flow rate, when using a fuel mass flow meter, expansion options 145 and 147 must be set to 0. Setting 2 is the same as setting 0 but for a volume meter with square root extraction included. Volume flow meter Mass flow meter Volume flow meter (with square root extraction)
142	0		Fuel Flow Meter Scaling
		0 - 65535	The fuel flow meter is scaled by setting the flow rate at 20mA feedback from the flow meter. 0 - 65535 m ³ /hr (0ft ³ /hr)
143	-		Air Flow Meter Type
		0 1 2	The air flow meter is wired to terminals MF and F-, and the 4-20mA signal is scaled in expansion option 144. For setting 0, a volume flow meter is used and a displayed mass flow rate is calculated using either internal constants or via measured temperature/pressures. For setting 1, a mass flow meter is used to the display the mass flow rate, when using a fuel mass flow meter, expansion options 146 and 148 must be set to 0. Setting 2 is the same as setting 0 but for a volume meter with square root extraction included. Volume flow meter Mass flow meter Volume flow meter (with square root extraction)
144	0		Air Flow Meter Scaling
		0 - 65535	The air flow meter is scaled by setting the flow rate at 20mA feedback from the flow meter. 0 - 65535 m ³ /hr (0ft ³ /hr)

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
145	0	0 1	<p><u>Fuel Temperature Sensor Enable</u></p> <p>The fuel temperature sensor is wired to terminal T3. This cannot be used with the mass flow meters for fully metered, or at the same time as steam/hot water flow metering, see expansion options 141 and 120.</p> <p>0 Disabled 1 Enabled</p>
146	0	0 1	<p><u>Air Temperature Sensor Enable</u></p> <p>The air temperature sensor is wired to terminal T2. This cannot be used with the mass flow meters for fully metered, or at the same time as steam/hot water flow metering, see expansion options 141 and 120.</p> <p>0 Disabled 1 Enabled</p>
147	0	0 1	<p><u>Fuel Pressure Sensor Enable</u></p> <p>The fuel pressure sensor is wired to terminals 31, 32, 33 and 34. This cannot be used with the mass flow meters for fully metered. The pressure sensor can still be used for flame safeguard checking such as high/low pressure limits and VPS.</p> <p>0 Disabled 1 Enabled</p>
148	0	0 1	<p><u>Air Pressure Sensor Enable</u></p> <p>The air pressure sensor is wired to terminals 31, 32, 33 and 34. This cannot be used with the mass flow meters for fully metered. The pressure sensor can still be used for flame safeguard checking such as high/low pressure limits and VPS.</p> <p>0 Disabled 1 Enabled</p>
149	100	0 - 100	<p><u>Maximum Fuel Channel Compensation</u></p> <p>This is the maximum percentage of the fuel servomotor angle which the MM will move towards the closed and open position to maintain the commissioned firing rate (heat input). The fuel servomotor angle will never exceed commissioned high fire position or go below the commissioned low fire position.</p> <p>0.0% - 10.0%</p>
150	100	0 - 100	<p><u>Maximum Air Channel Compensation</u></p> <p>This is the maximum percentage of the air servomotor angle which the MM will move towards the closed and open position to maintain the commissioned fuel-air ratio. The air servomotor's movement ranges from the commissioned closed position to the commissioned open to close positions.</p> <p>0.0% - 10.0%</p>
151	0	0 1 2	<p><u>Action on Air Adjustment Failure</u></p> <p>If after the air servomotor has made adjustments to compensate for the changes in the flow rate, and the fuel-air ratio cannot still be met, an alarm or warning will occur. For setting 0, the MM generates an alarm and will lockout the burner upon on an air adjustment failure. For setting 1, the MM generates a warning. For setting 2, the MM generates a warning and disables the air adjustment and the air servomotor returns to the original commissioned curve.</p> <p>0 Generate alarm 1 Generate warning 2 Generate warning, disable air adjustment</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
152	0	0 1	<p><u>Action on Flow Meter Failure</u></p> <p>If one of the flow meters loses communications with the MM or has a fault, the MM can either generate alarm and lockout the burner, or generate the warning and revert to the commissioned curve with no fuel and air servomotor trim adjustments.</p> <p>Generate alarm Generate warning</p>
153	1013	1013 850 - 1100	<p><u>Default absolute ambient air pressure</u></p> <p>The default ambient air pressure must be set when using volume flow meters, to derive the mass flow rate used to calculate the fuel-air ratio.</p> <p>1013 mbar (406.5" WG) mbar (341.1 - 441.5 " WG)</p>
154	656	656 1 - 10000	<p><u>Fuel 1 Density</u></p> <p>The fuel density must be set when using volume flow meters, to derive the mass flow rate used to calculate fuel-air ratio. This is at 1013mbar, 15°C (14.69 PSI, 59°F)</p> <p>0.656 kg/m³ at 1013mbar, 15°C (0.041 lb/ft³) 0.001 - 10.0 kg/m³ (0.00006 lb/ft³ - 0.625 lb/ft³)</p>
155	656	656 1 - 10000	<p><u>Fuel 2 Density</u></p> <p>The fuel density must be set when using volume flow meters, to derive the mass flow rate used to calculate fuel-air ratio. This is at 1013mbar, 15°C (14.69 PSI, 59°F)</p> <p>0.656 kg/m³ at 1013mbar, 15°C (0.041 lb/ft³) 0.001 - 10.0 kg/m³ (0.00006 lb/ft³ - 0.625 lb/ft³)</p>
156	656	656 1 - 10000	<p><u>Fuel 3 Density</u></p> <p>The fuel density must be set when using volume flow meters, to derive the mass flow rate used to calculate fuel-air ratio. This is at 1013mbar, 15°C (14.69 PSI, 59°F)</p> <p>0.656 kg/m³ at 1013mbar, 15°C (0.041 lb/ft³) 0.001 - 10.0 kg/m³ (0.00006 lb/ft³ - 0.625 lb/ft³)</p>
157	656	656 1 - 10000	<p><u>Fuel 4 Density</u></p> <p>The fuel density must be set when using volume flow meters, to derive the mass flow rate used to calculate fuel-air ratio. This is at 1013mbar, 15°C (14.69 PSI, 59°F)</p> <p>0.656 kg/m³ at 1013mbar, 15°C (0.041 lb/ft³) 0.001 - 10.0 kg/m³ (0.00006 lb/ft³ - 0.625 lb/ft³)</p>
158	0	0 1 2	<p><u>Action on Fuel Adjustment Failure</u></p> <p>If after the fuel servomotor has made adjustments to compensate for the changes in the flow rate, and the fuel-air ratio cannot still be met, an alarm or warning will occur. For setting 0, the MM generates an alarm and will lockout the burner upon on a fuel adjustment failure. For setting 1, the MM generates a warning. For setting 2, the MM generates a warning and disables the fuel adjustment and the fuel servomotor returns to the original commissioned curve.</p> <p>Generate Alarm Generate Warning Generate Warning, Disable Fuel Adjustment</p>

2 OPTIONS AND PARAMETERS

Exp Option	Default	Range	Description
159	0	0 1 - 60	<p><u>Flow Meter Filter Length</u></p> <p>This is the time period over which the Flow Meter readings are filtered over time. If there is excess fluctuation in the flow readings, increase the filter time. To improve the system's response to changes in flow, decrease the filter time.</p> <p>1s 1s to 60s</p>
160	-		Unused

3 COMMISSIONING PROCEDURE

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 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 an MM must be trained in operating combustion equipment safely. 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 start position has been entered, the high fire position is entered next, then descending fuel/air positions are entered consecutively until finally the low fire position is entered. CH1 and CH2 positions must always be less than the ones previously entered; however CH3 to CH7 can be set lower or higher than the previous position. CH7 is used for the draught servomotor (unlockable expansion feature).

CH1	Fuel valve
CH2	Air damper
CH3	Auxiliary Servomotor
CH4	Auxiliary Servomotor
CH5	VSD 1
CH6	VSD 2
CH7	Draught servomotor (unlockable expansion feature)

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 up Fuel Valves Output Configuration Mode (refer to section 4)
3. Set options, parameters and expansion options required (refer to section 2).
4. Commission bottom blowdown module if optioned.
5. Commission water level probes and external level sensor if optioned (refer to Expansion Features Installation and Commissioning Guide).
6. Set up servomotors.
7. Program fuel/air positions.

On a previously commissioned system it is possible to omit steps 1 to 5.

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 90.0° angular degrees. The MM system has the ability to drive valves through 360.0° degrees, but the MM will only display from -6.0° to 96.0° degrees.

All Channel 1 to 4 and 7 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.**

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.

3 COMMISSIONING PROCEDURE

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°. The same can be done for when the servomotor is at 96.0° where the voltage will be 3.6V.

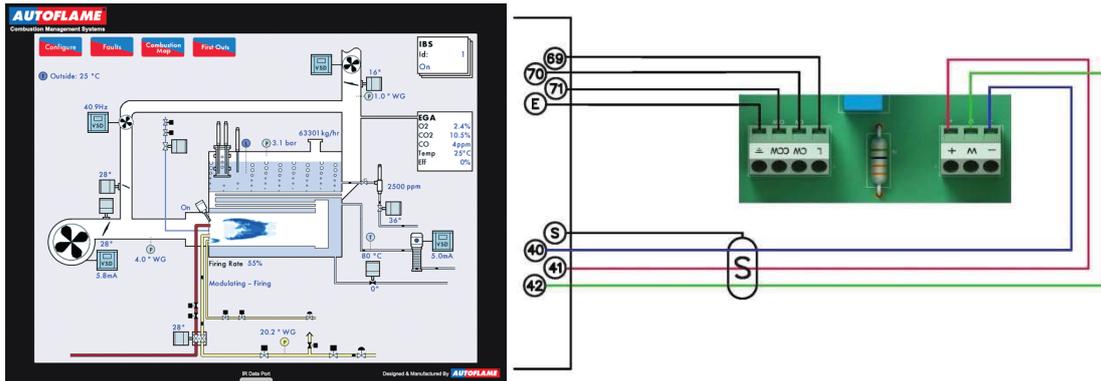
3 COMMISSIONING PROCEDURE

3.3.3 Servomotors – Direction Change

MOTOR CLOCKWISE ROTATION

FIG. A

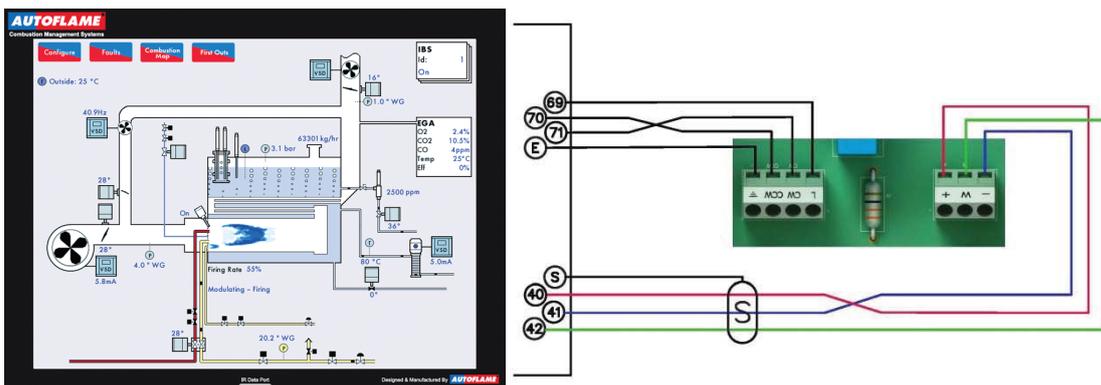
M.M. MODULE



MOTOR ANTICLOCKWISE ROTATION

FIG. B

M.M. MODULE



FOR ILLUSTRATION PURPOSES FUEL MOTOR CONNECTIONS ARE SHOWN.

3 COMMISSIONING PROCEDURE

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.

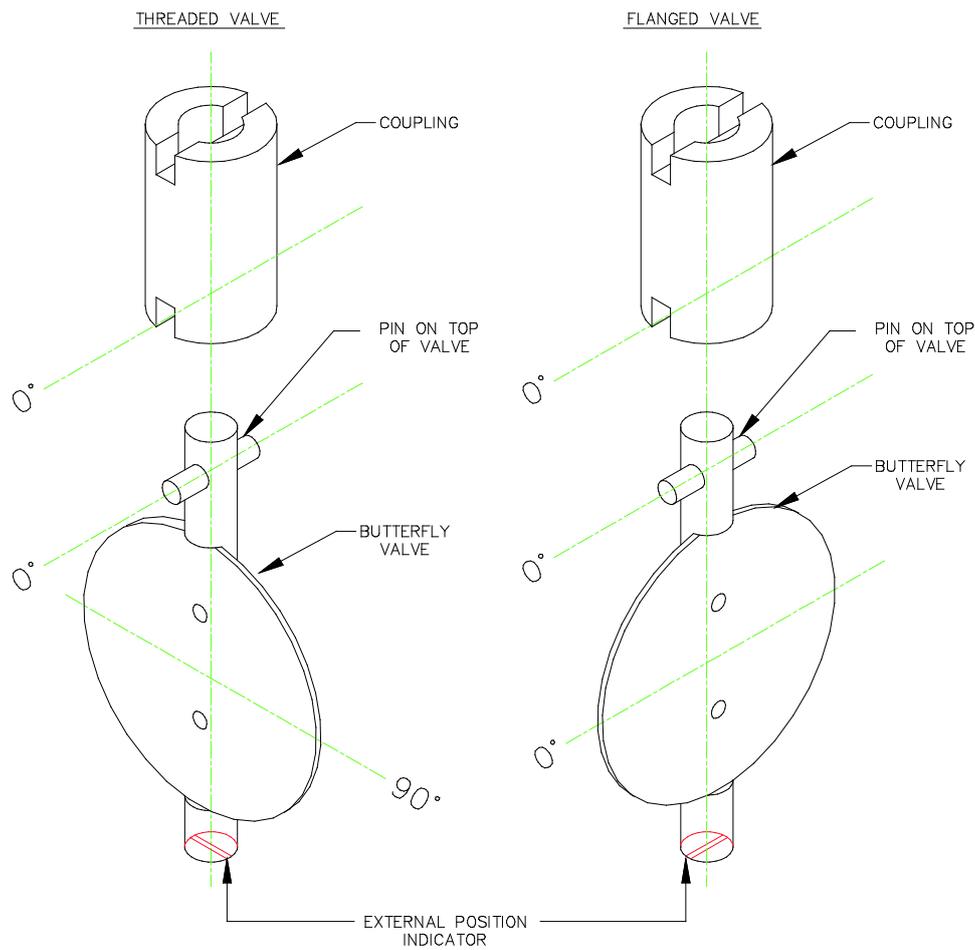


Figure 3.3.4.i Valve Pin Positions

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

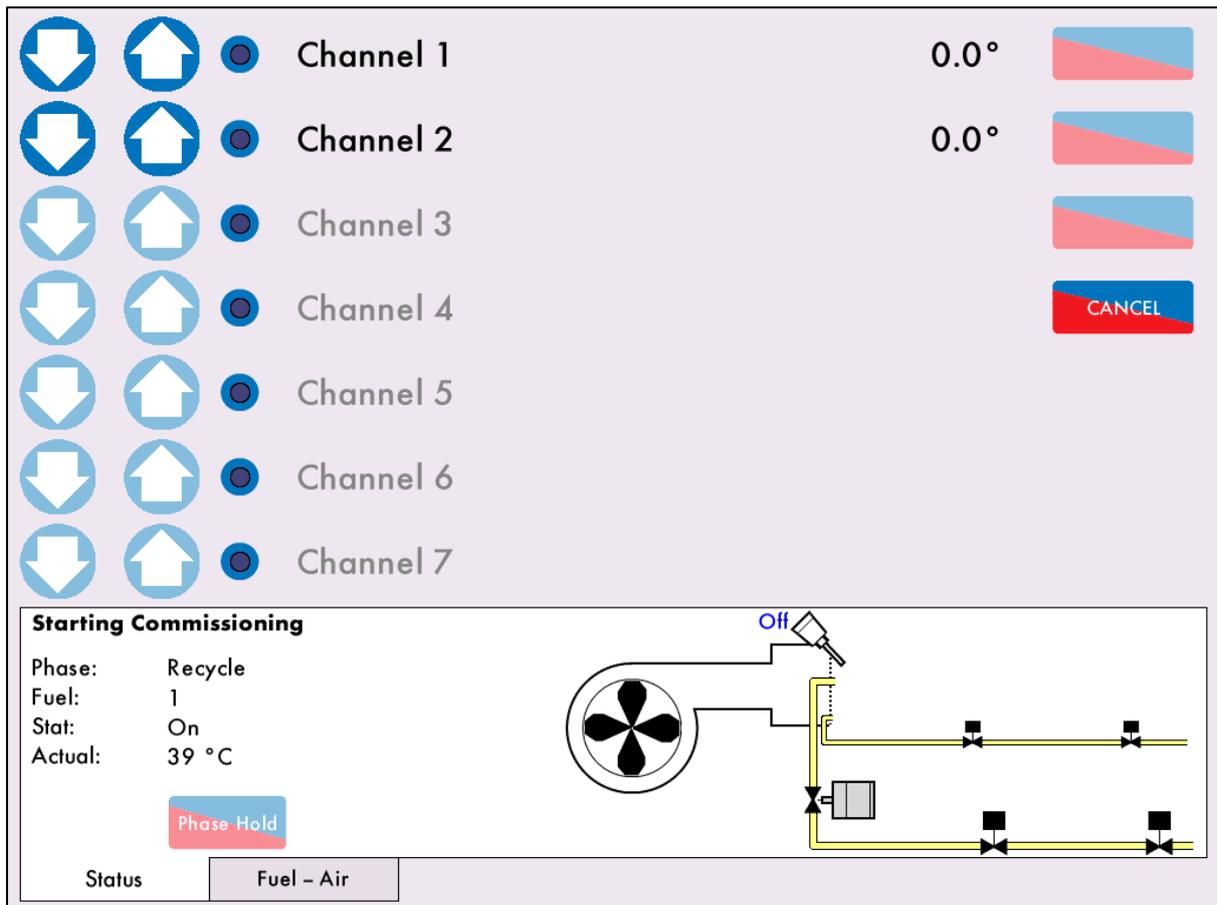


Figure 3.4.1.i Starting Commissioning

Once the options, parameters and expansion options 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 7 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 CLOSED Position

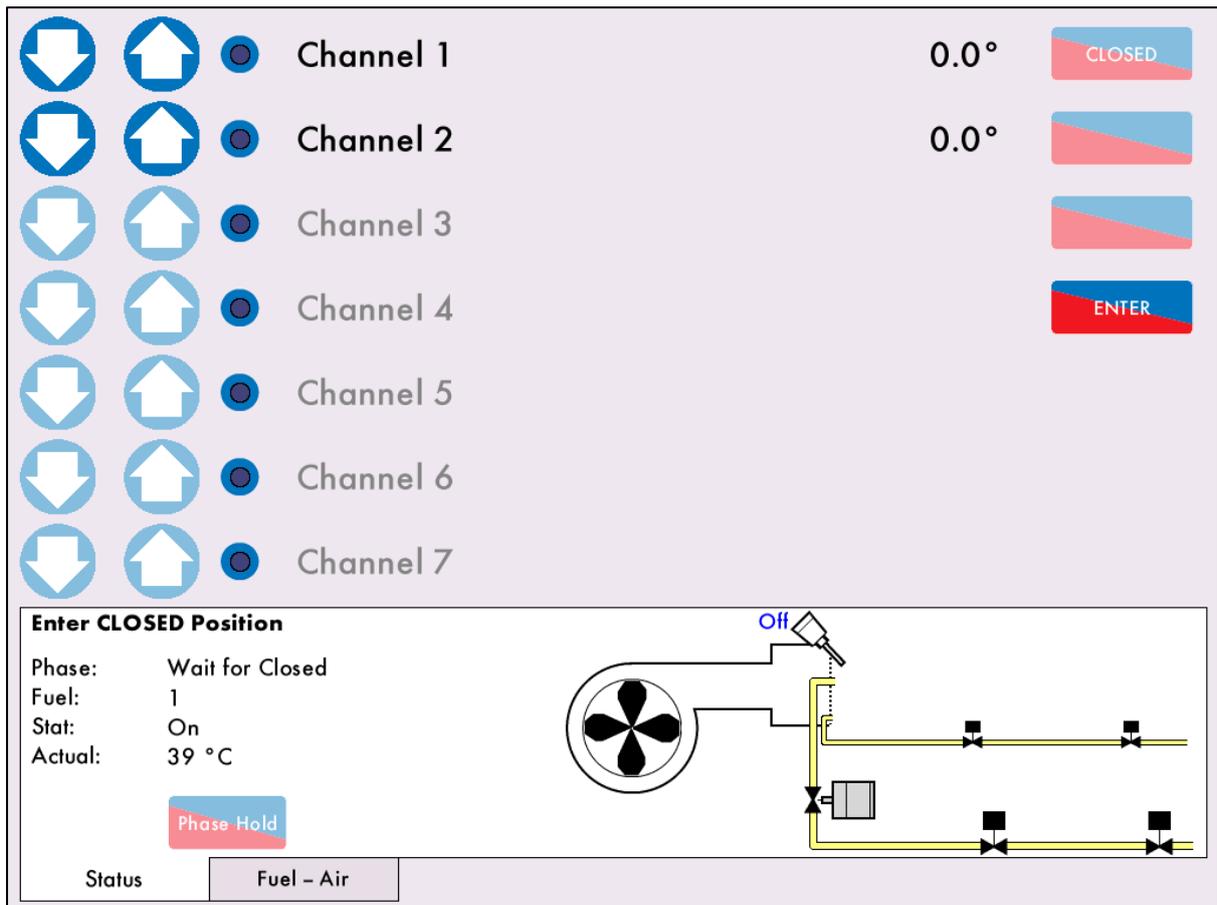


Figure 3.4.2.i Enter CLOSED Position

The MM is now waiting for the CLOSED 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 CLOSED 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

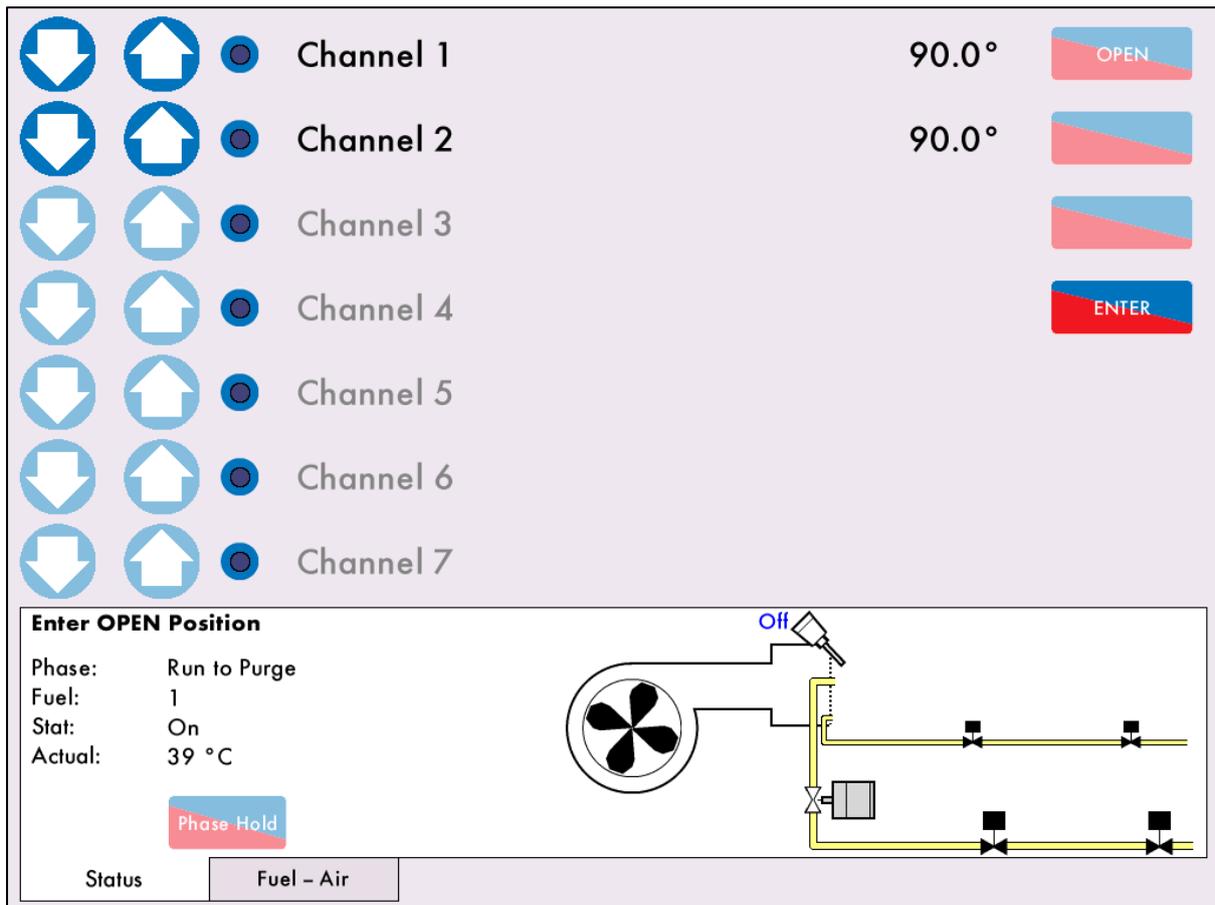


Figure 3.4.3.i Enter OPEN Position

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 will appear as  to indicate the channels are selected.

Use the   buttons to drive both servomotors to the OPEN position simultaneously. This is normally 90.0° for Autoflame gas butterfly valves and burner air dampers, but may be set to less than 90.0° if there are mechanical stops/limits on third party valves. Channels 5 and 6 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 Set up START Position

The screenshot displays the 'Set up START Position' interface. It features a list of seven channels, each with up and down arrow icons, a selected channel indicator (a blue circle), and a numerical angle value. Channel 1 is selected and shows 21.5°. Channel 2 shows 24.6°. A 'START' button is visible next to Channel 1, and an 'ENTER' button is at the bottom right. Below the channel list, a sub-section titled 'Set up START Position' shows system parameters: Phase: Run to Ignition, Fuel: 1, Stat: On, Actual: 39 °C. A 'Phase Hold' button is present. To the right is a schematic diagram of a boiler system with a fan, fuel line, and air line, with an 'Off' label. At the bottom, there are 'Status' and 'Fuel - Air' buttons.

Figure 3.4.4.i Set up START Position

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

Press  and drive the servomotors to their START position. To enter a fuel START position which is less than 10 degrees below the OPEN position, you must drive the servomotor below this band, and then back open. For example, if the CH1 OPEN position is set at 90.0°, 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  to enter the START position, where a light off 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 gas regulator 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 HAZARDOUS SITUATION. FAILURE TO DO SO WILL RESULT IN SERIOUS EQUIPMENT DAMAGE, CRITICAL INJURY OR DEATH.

3.4.6 Add Trim Data During Commissioning

If option 12 is set to 2 or 3 during commissioning, 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.

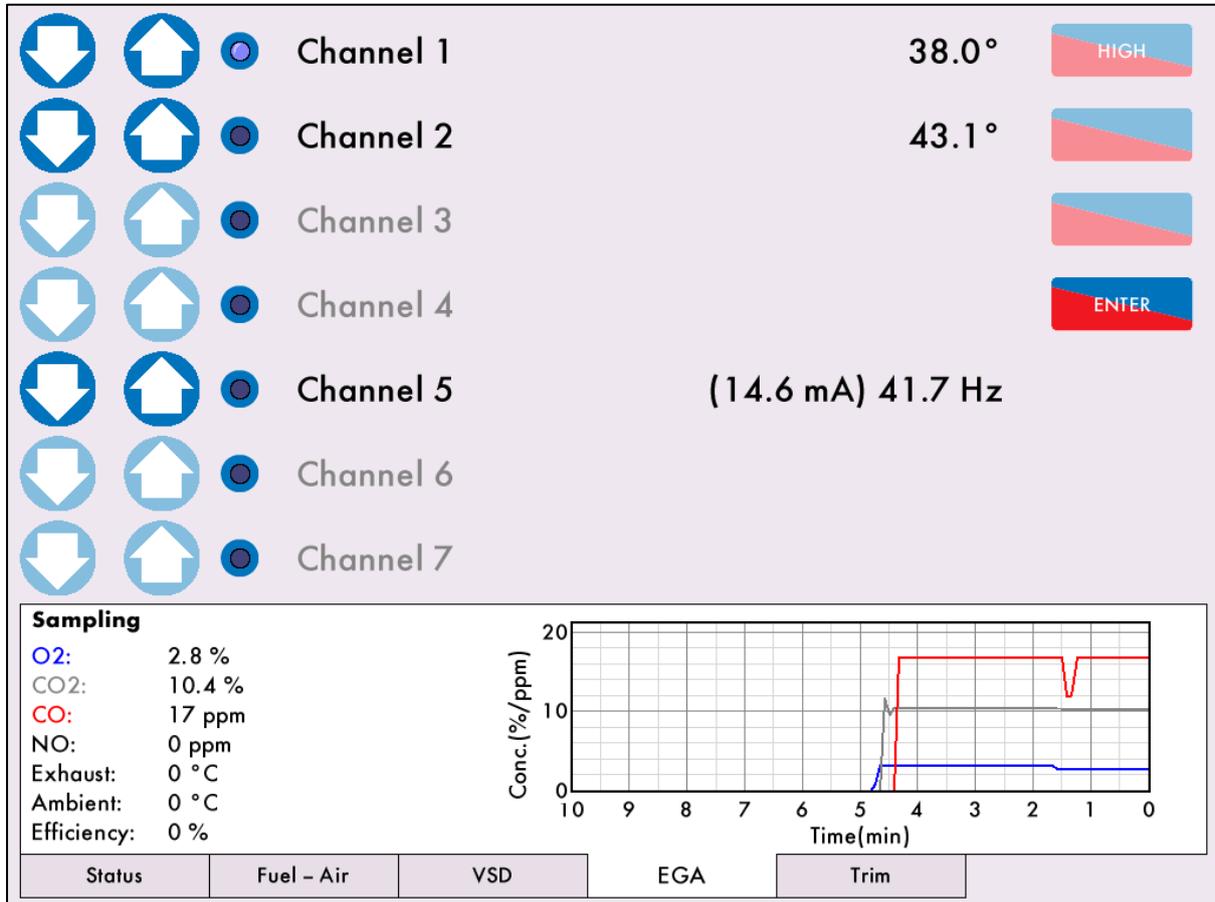


Figure 3.4.6.i Sampling

Press on the EGA tab to display the EGA readings.

3 COMMISSIONING PROCEDURE

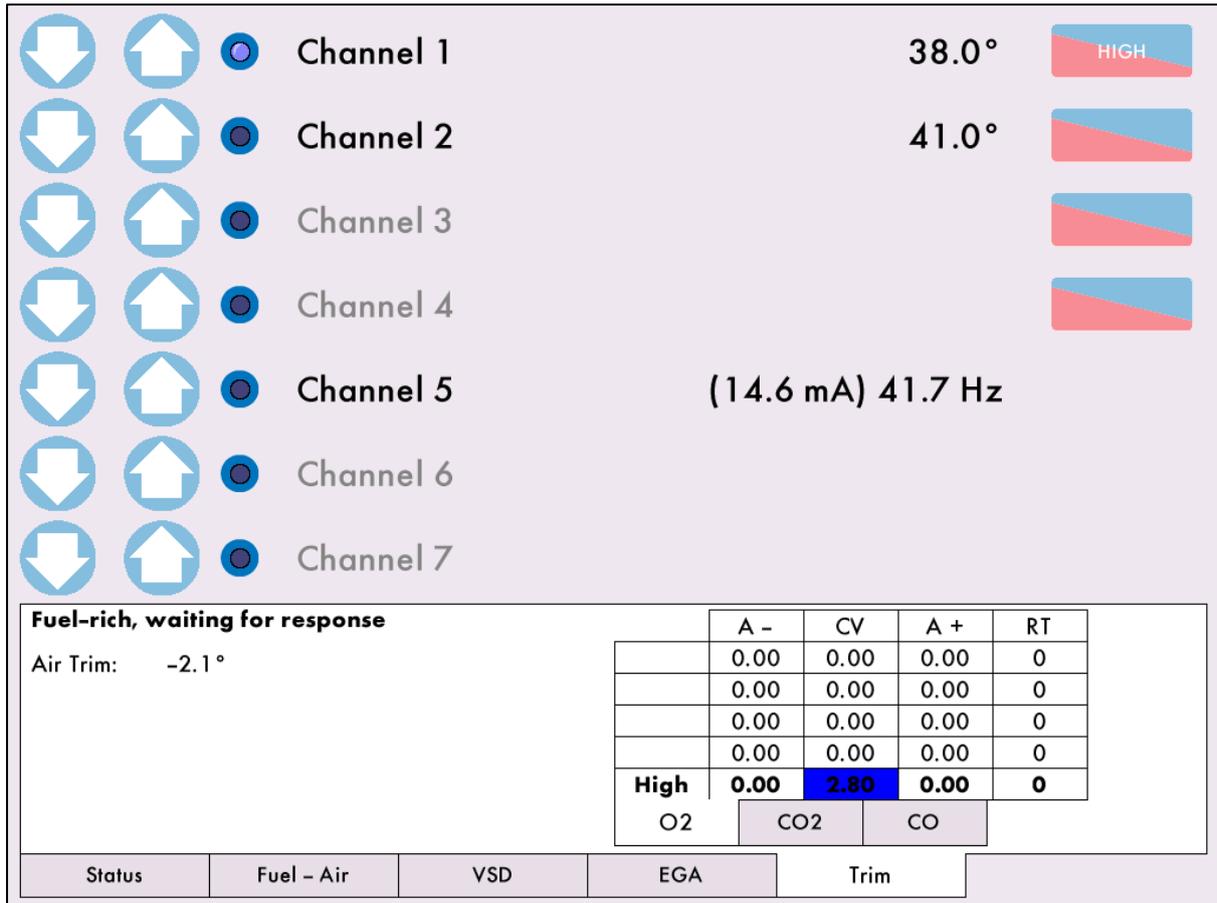


Figure 3.4.6.ii Commissioning with Trim

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 option12 for trim, and going into Single Point Change to add trim to each point, see section 3.7.

3.4.7 Commissioning VSD

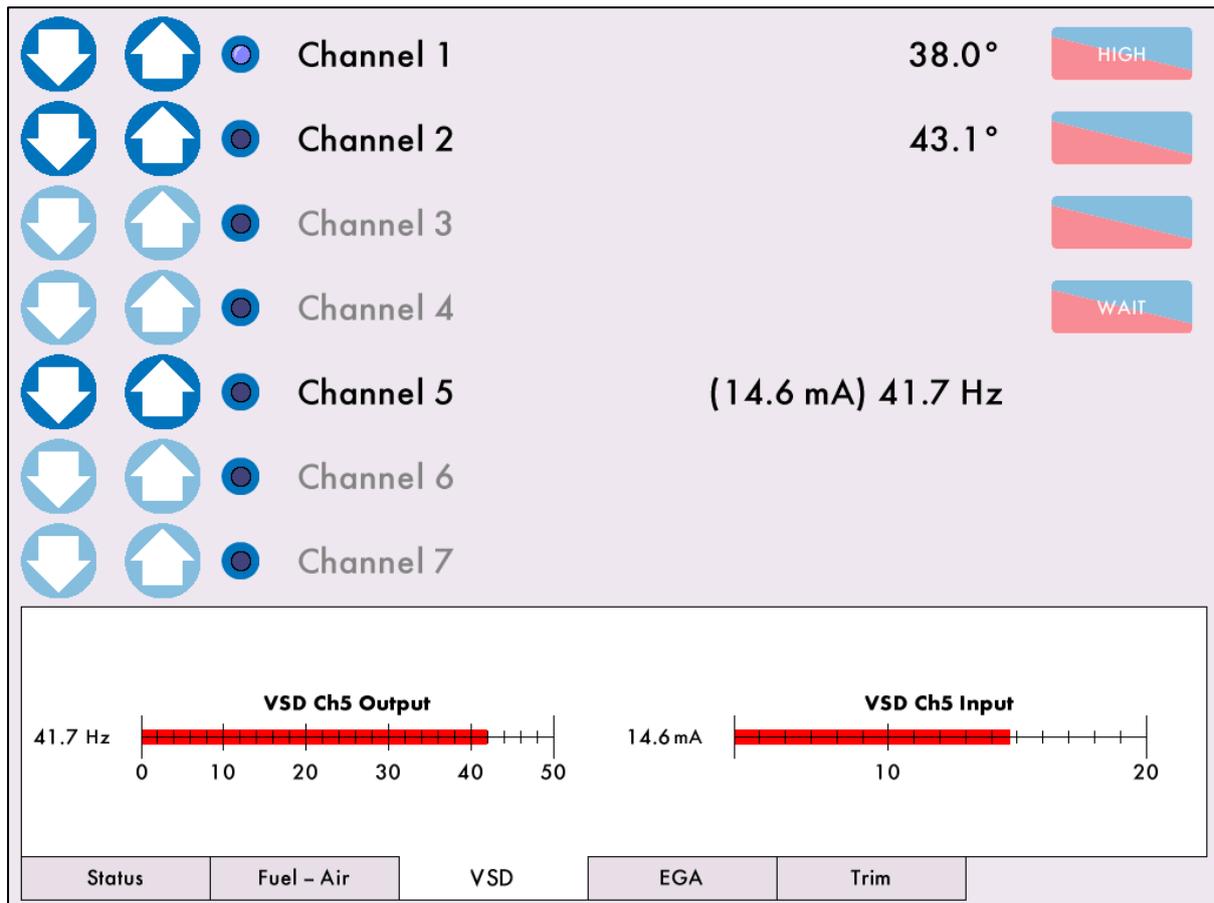


Figure 3.4.7.i Commissioning VSD

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 options 99 and 109 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.

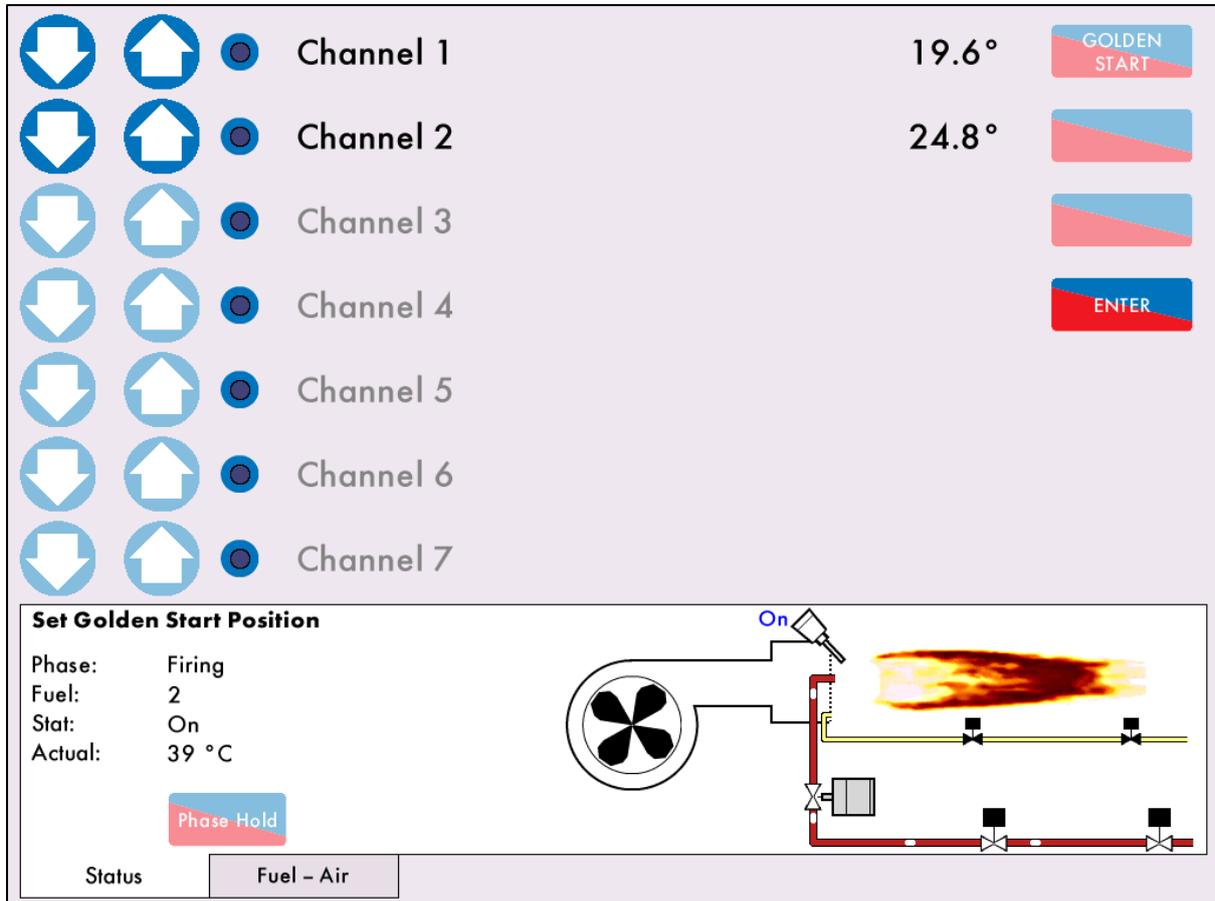


Figure 3.4.8.i Set GOLDEN START Position

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 **CLOSED** 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 **GOLDEN START** 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.

3 COMMISSIONING PROCEDURE

Alternatively, to just add the Golden Start position and not go through the whole commissioning procedure, press  on the home screen, and once the system has gone through its internal relay tests the message 'Select Commissioning' will appear. Press  and the MM will go through purge. The message 'Set up START position' will appear to ignite a flame in the burner, see section 3.4.4. Once the burner is firing, the message 'Set Golden Start Position' will appear. Press  to enter the GOLDEN START position. The message 'Save Commission' will appear, press  to save the GOLDEN START position and then press  to return to run mode.

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

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

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

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

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

Golden Start can be set in Option 29 to start from first ignition instead of after the main flame stabilisation phase has passed, this is particularly useful for briefly providing additional fuel when starting an oil flame with direct spark (no pilot mode – see option 111)

3.4.9 Set FGR Position

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

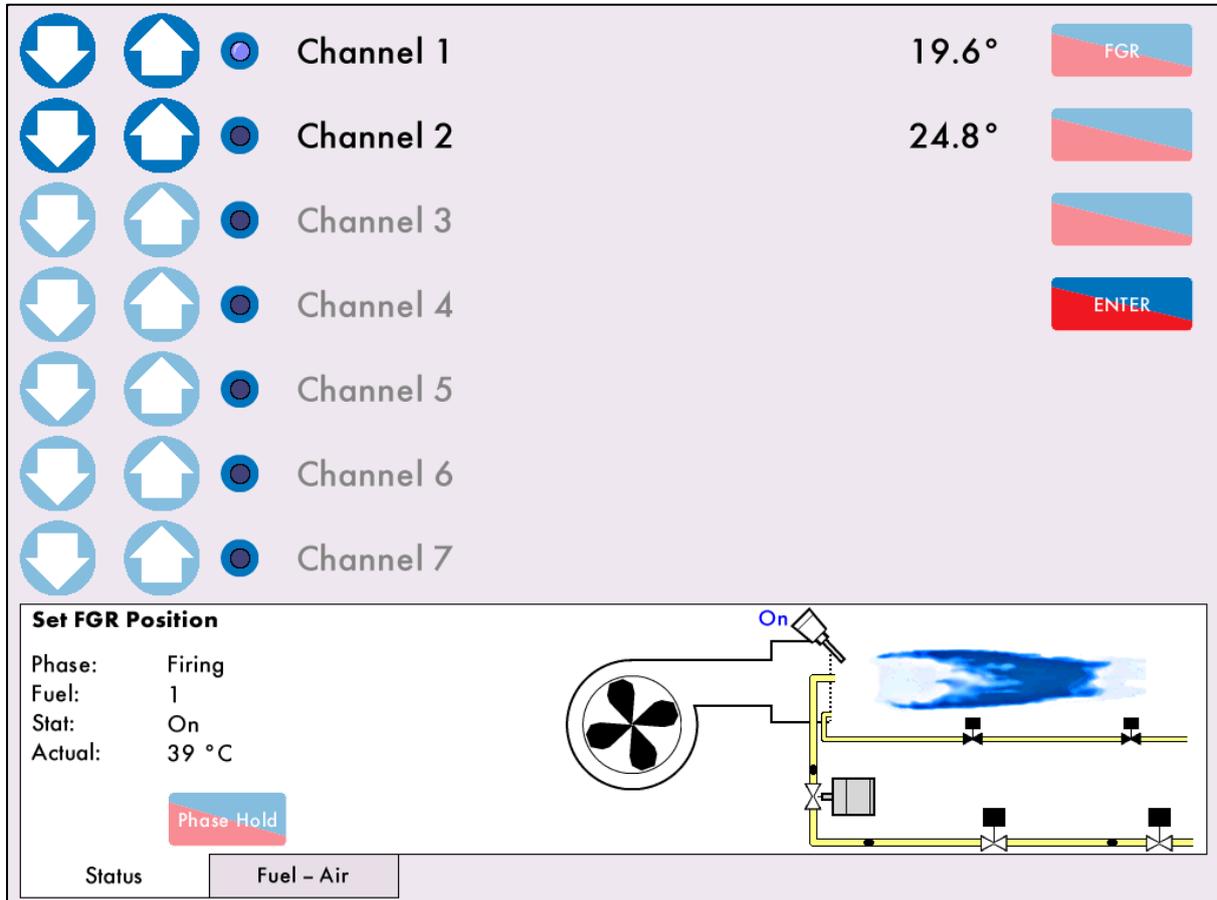


Figure 3.4.9.i Set FGR Position

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

Enabling FGR Start on a Commissioned System

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

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

Press  to go through the commissioning process and enter the CLOSED, OPEN, light-off START and GOLDEN START (if enabled) positions. 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.

3 COMMISSIONING PROCEDURE

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 NO_x 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

The screenshot displays a control interface for setting HIGH positions. It features seven channels, each with up and down arrow buttons and a status indicator. Channel 1 is set to 38.0° and Channel 2 to 43.1°. A 'HIGH' button is visible next to Channel 1, and an 'ENTER' button is at the bottom right. Below the channels is a 'Set HIGH Position' panel showing 'Phase: Firing', 'Fuel: 1', 'Stat: On', and 'Actual: 39 °C'. A 'Phase Hold' button is also present. At the bottom, there are 'Status' and 'Fuel - Air' buttons. To the right, a diagram shows a fan connected to a combustion chamber with fuel and air lines.

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

The screenshot displays the control interface for setting INTER positions. It features seven channels, each with up/down arrow buttons, a status indicator, a channel label, a temperature reading, and an INTER button. Channel 1 is at 32.9° and Channel 2 is at 36.1°. The bottom section shows a 'Set INTER Position' dialog with status 'Firing', fuel '1', and actual temperature '39 °C'. It includes a 'Phase Hold' button and a 'Fuel - Air' status indicator. To the right is a schematic diagram of the fuel-air system with a turbine and various valves.

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 detect 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/removed 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

The screenshot displays a control interface for setting INTER or START positions. The top section lists seven channels, each with up/down arrows, a selected channel indicator, the channel name, a temperature reading, and a button. Channel 1 is at 17.8° and Channel 2 is at 25.7°. The bottom section, titled "Enter START Position", shows system parameters: Phase: Firing, Fuel: 1, Stat: On, Actual: 39 °C, and a Phase Hold button. A schematic diagram of a boiler system is also visible.

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 Metering

If fuel flow metering has been enabled in option 57, the message 'No Fuel Flow Data' will display on the Home screen once the burner has been commissioned. Fuel flow metering is used to rate the size of 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. The high fire point will set the burner rating in MW if metric or MMBTu/hr if imperial.

On the Mk8 MM, fuel flow metering can be taken as the values entered in the fuel flow commissioning screen from the fuel flow meter or through a 4-20mA signal on terminals EX- and EX+.

3.5.1 Commissioning Fuel Flow Through MM

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.

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

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

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

Giving the range (5.40, 4.92, 4.44, 3.96, 3.48, 3.00, 2.52, 2.04, 1.56, 1.08), with 5.4MW as the high fire burner rating point and 1.08MW as the low fire point derived using an estimated burner turndown value.

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.

Enable Fuel flow commissioning by setting option 57. Fuel flow commissioning is done in Run mode while the burner is firing.

On the Home Screen, press  to access the System Configuration screen.

3 COMMISSIONING PROCEDURE

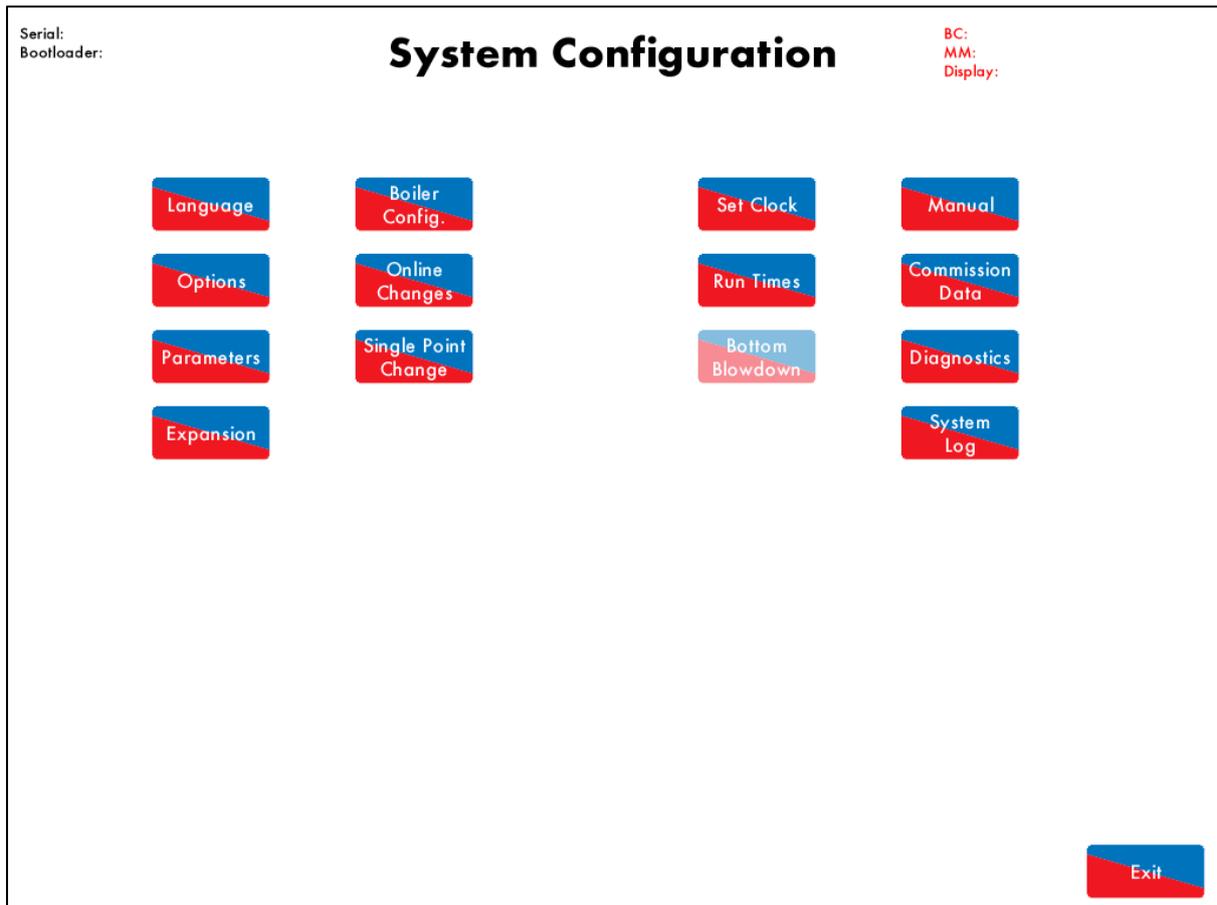


Figure 3.5.1.i System Configuration Screen

On the System Configuration screen press . You will be prompted to enter the Online Change password. Press  to access the Online Changes screen.

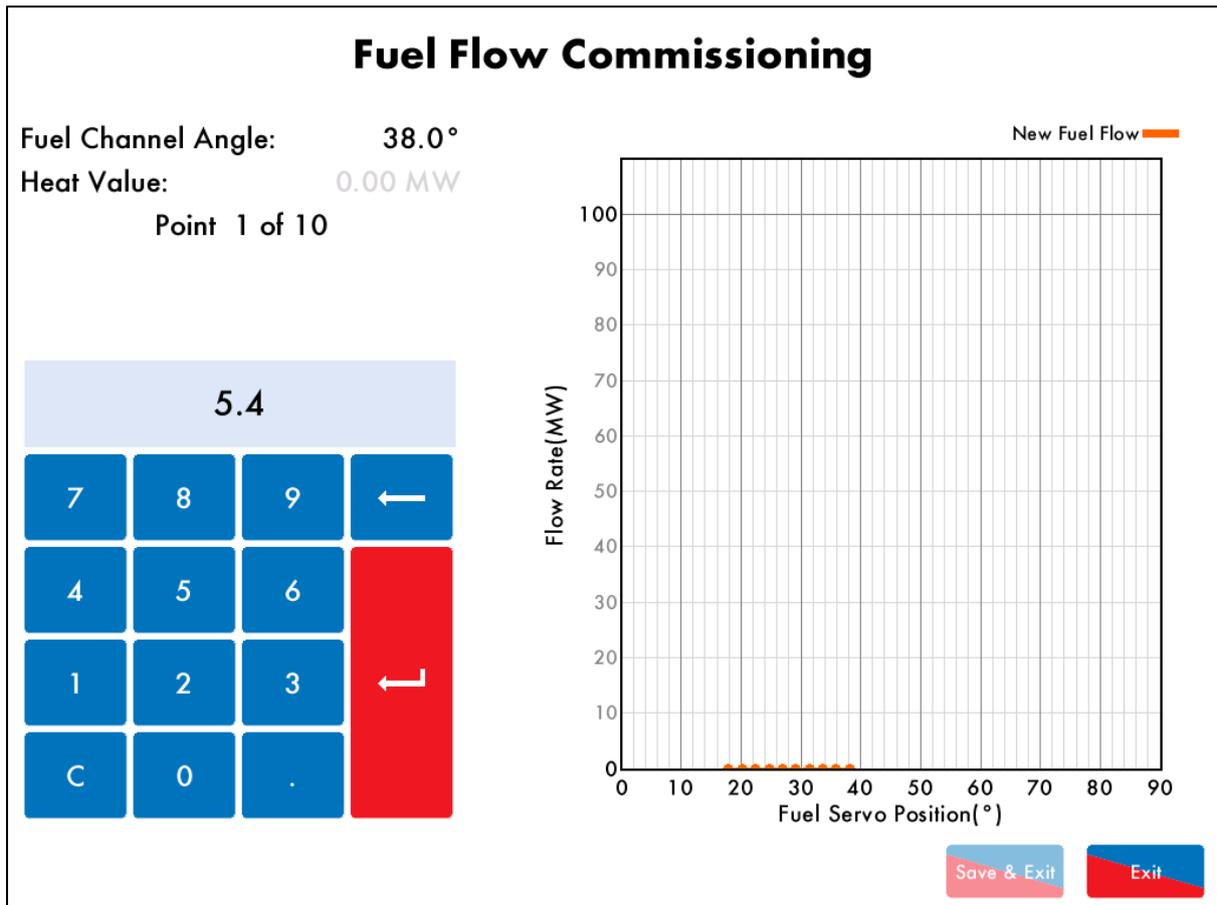


Figure 3.5.iii Fuel Flow Commissioning

Press  to access the fuel flow commissioning screen. There are 10 points which need to be entered across the commission curve from high fire to low fire, with high fire being point 1, and low fire point 10. Type in the heat value or 'dummy value' using the keypad and press the return key to save that 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.

3.5.2 Commissioning Fuel Flow Through 4-20mA Feedback

If fuel flow metering is enabled through using 4-20mA feedback on terminals EX- and EX+, the heat value will automatically get populated according to the analogue signal at that fuel valve position. After each heat value is displayed, press enter to go to the next fuel flow point.

3 COMMISSIONING PROCEDURE

3.5.3 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. 37.8 °C (100 °F) approx. 82.2 °C (180 °F) approx.	2.0 - -	- 3.0 -	- - 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. Btu/lb approx. KWh/litre approx. Therms/gallon approx. kW/kg	46,520 20,000 10.18 1.58 -	45,590 19,600 10.57 1.64 12.66	43,496 18,700 11.28 1.75 12.08	43,030 18,500 11.22 1.74 -	42,800 18,400 11.42 1.77 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			

3.5.4 Conversion Factor for Imperial Gas Flow Meters

Required Data: Pressure of gas at meter in "wg
 Required gas flow in ft³/min

Calculations: Correction factor = (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 ft³/min
 Conversion factor = (58 x 0.00228) + 0.948 = 1.08
 Reading on Meter = 95 / 1.08 = 88 ft³/min

3.5.5 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 COMMISSIONING PROCEDURE

3.5.6 Gas Volume Conversion Factors

Assumed gas temperature	10 °C	50 °F
Standard pressure	101.325 Kpa	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

3 COMMISSIONING PROCEDURE

How to use this information:-

1. Measure Volumetric flow of gas for 1 min in ft³ (i.e. ft³/min). Note 1 m³ = 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 commission the gas pressure sensor, go to Commission Mode and press . The MM will then run through the points to store the gas pressure values.

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

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

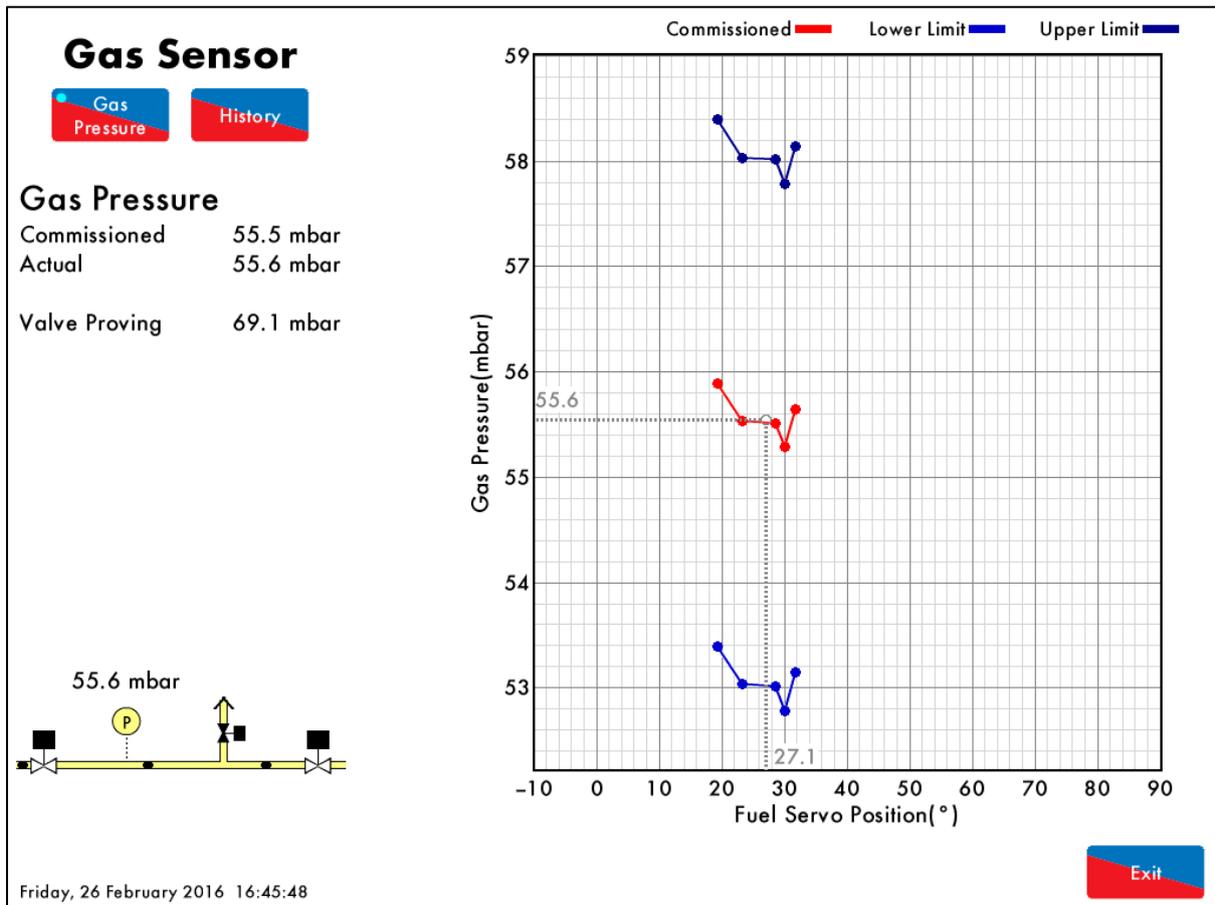


Figure 3.6.i Gas Sensor

To commission the air pressure sensor, in Commission Mode screen press . The air pressure sensor commission procedure is the same as the gas pressure sensor commission procedure. The same procedure also applies for commissioning the oil 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

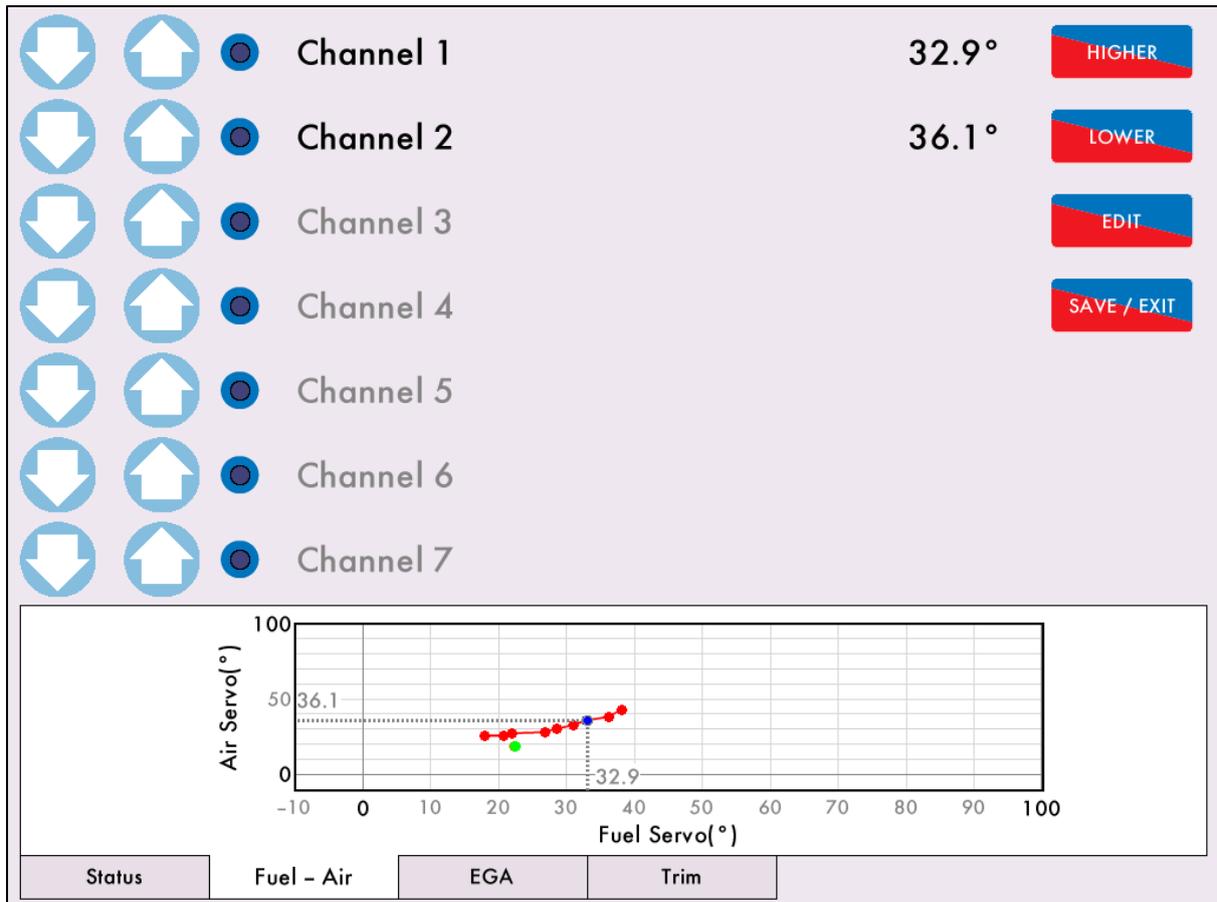


Figure 3.7.i Single Point Change

Single Point Change can only be accessed when the burner is firing and in Run mode. 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 .

The Status screen will display the message 'Select change to make.'

3 COMMISSIONING PROCEDURE

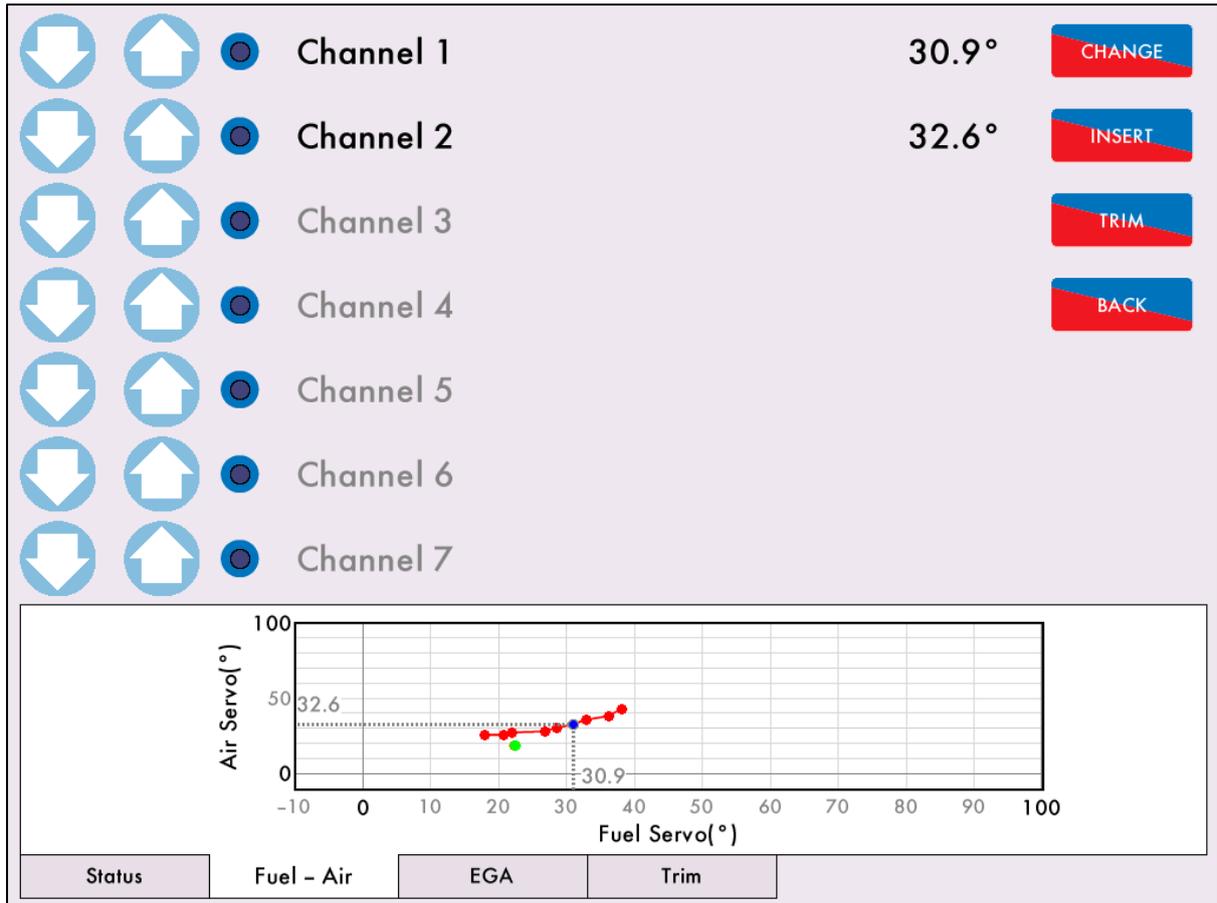


Figure 3.7.ii Changes

To edit a previously entered point press  and make adjustments to the positions as needed (see Figure 3.7.iii).

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.

3 COMMISSIONING PROCEDURE

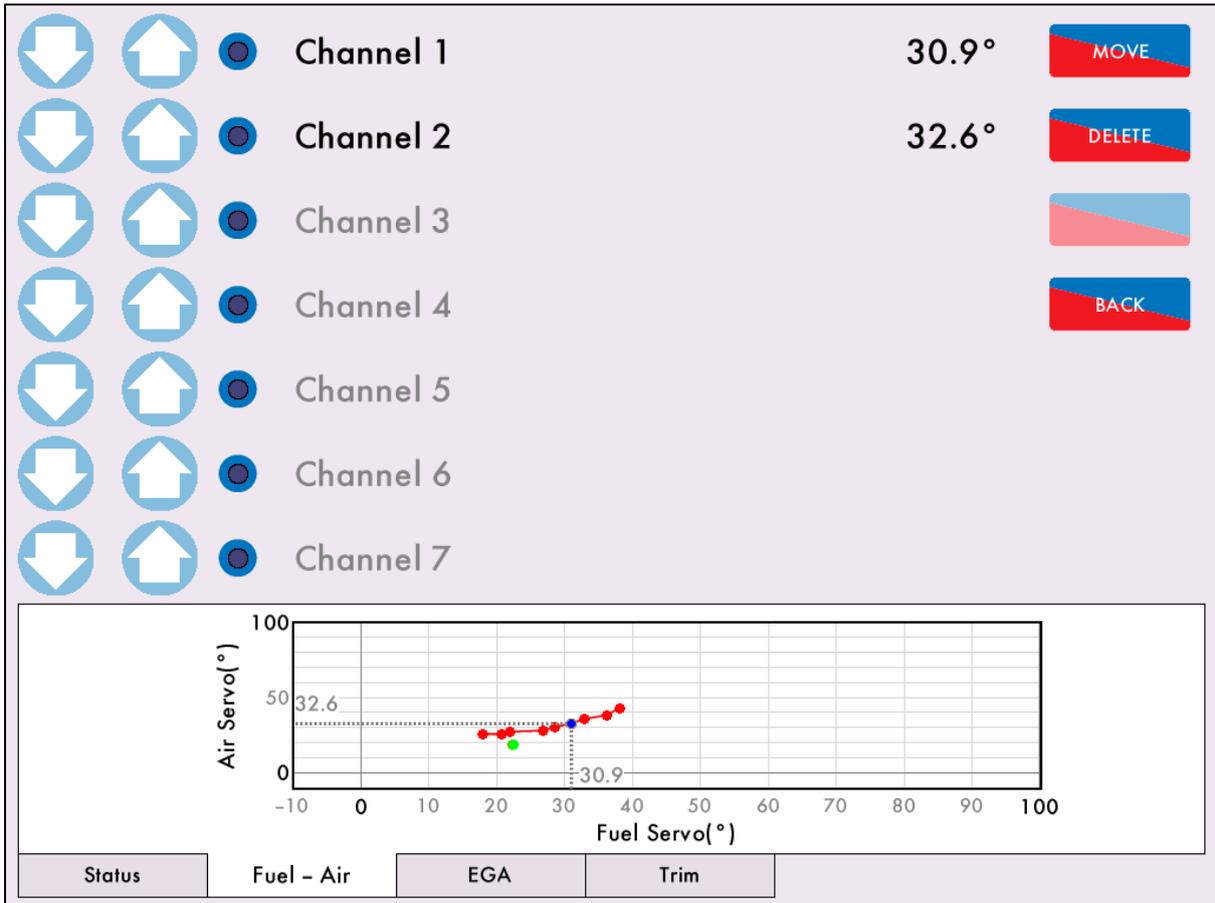


Figure 3.7.iii Changing a Point

Press **MOVE** to edit 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 and the trim data will need to be added.

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

3 COMMISSIONING PROCEDURE

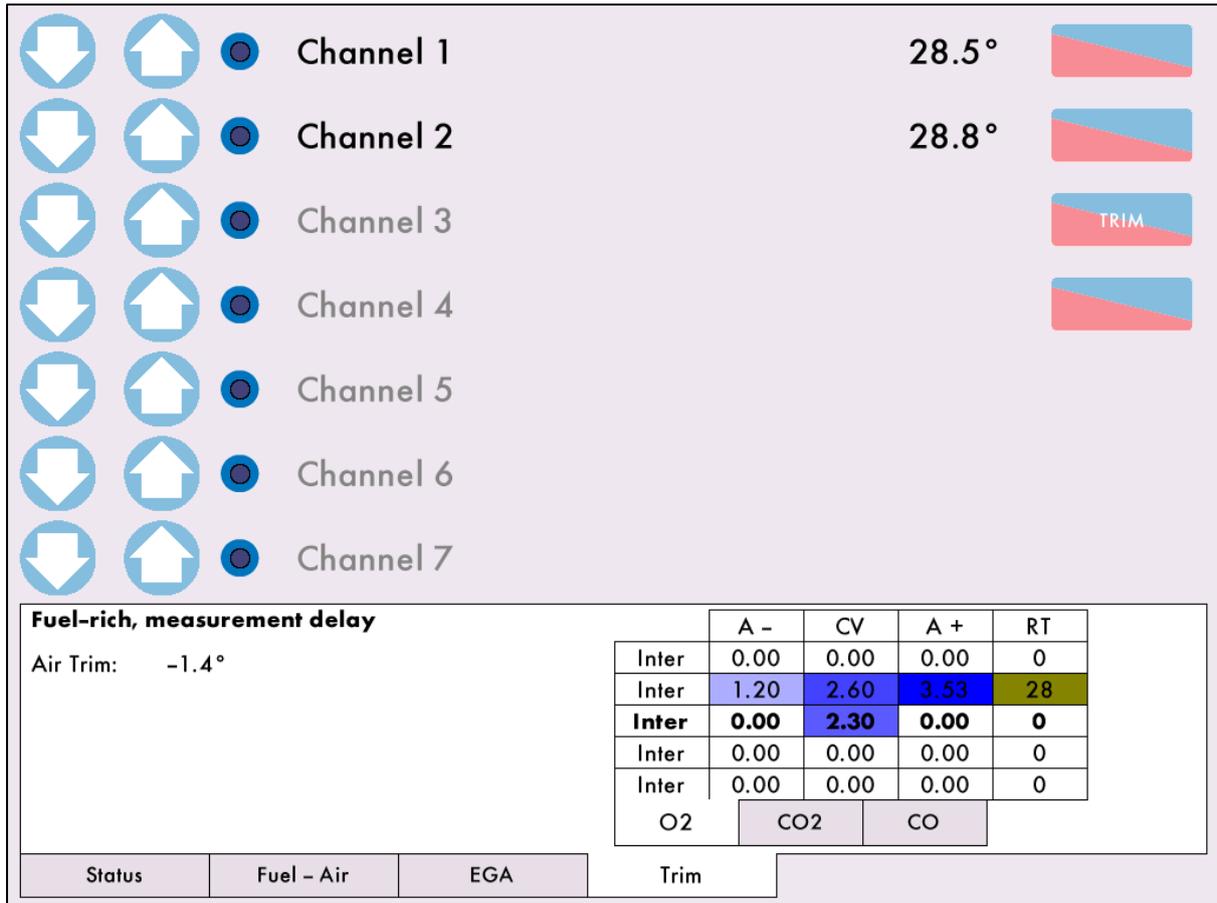


Figure 3.7.iv Single Point Change - Trim

The MM will store the trim values for this position.

3 COMMISSIONING PROCEDURE

The screenshot displays a control interface for 'Leaving Single Point Change'. It features seven channels, each with a set of up/down arrow buttons, a radio button, and a temperature reading. Channel 1 is set to 28.5° and has a 'SAVE' button. Channel 2 is set to 30.2° and has a 'SAVE + EXIT' button. Channels 3, 4, 5, 6, and 7 have 'DISCARD' and 'BACK' buttons respectively. Below the channels is a status section with the following data:

Phase:	Firing
Fuel:	1
Stat:	On
Actual:	37 °C

To the right of the status section is a schematic diagram of a fuel system. It shows a fan connected to a fuel line with a valve labeled 'On'. The fuel line leads to a burner assembly with a blue flame. Below the burner are two sets of valves. At the bottom of the diagram is a table with four columns: Status, Fuel - Air, EGA, and Trim.

Figure 3.7.v Exit Single Point Change

Press **SAVE** to store the changes made. Press **SAVE / EXIT** to store these changes and 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

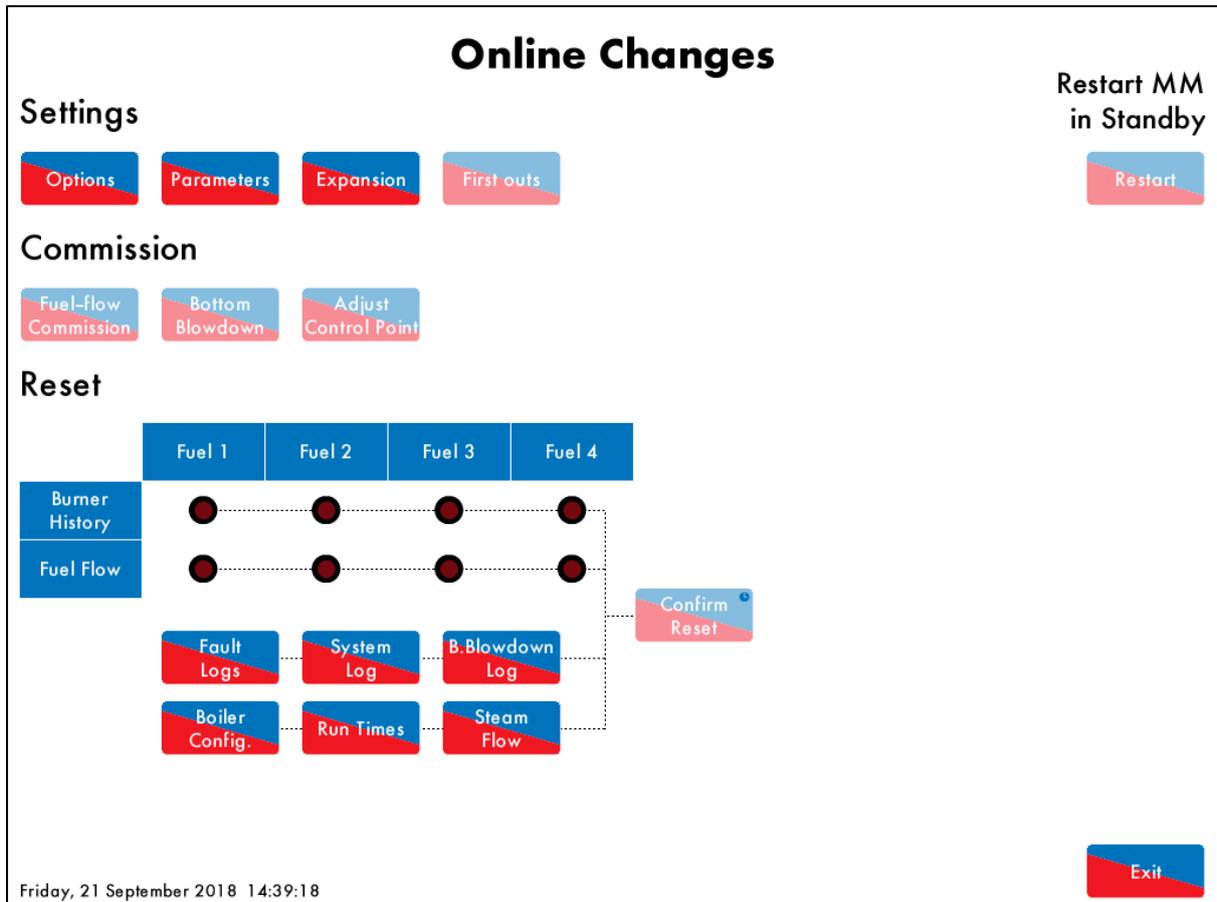


Figure 3.8.i Online Changes Screen

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

- Change non-safety critical options, parameters and expansion options
- Configure settings and labels for first outs
- Fuel flow commissioning
- Set bottom blowdown servomotor positions
- Adjust water level control point
- Reset burner history
- Reset fuel flow data
- Reset fault logs
- Reset system log
- Reset bottom blowdown log
- Reset boiler configuration
- Reset run times
- Reset steam flow metering
- Restart MM if the burner is in standby

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

4.1 Overview

The Mk8 MM is capable of controlling multi-fuel applications in various ways; it offers the possibility of commissioning up to 4 different fuels as well as offering 3 different ways of switching between fuels.

The MM's default Single Fuel Output Mode allows the commissioning of up to 4 different fuel curves using the same set of fuel outputs and changing between fuels is possible using changeover relays. The Dual Fuel Output Mode allows the configuration and commissioning of 2 different fuels using separate set of outputs for each fuel on the MM and therefore no changeover relays required when switching between fuels.

The fuel Change on the Fly feature (COF) offers the possibility of switching between any two fuels configured in Dual Fuel Output Mode without the need to turn off the burner, thus eliminating downtimes when switching between fuels, reducing heat loss from the pre and post-purge processes as well as reducing thermal stress on the boiler. COF also opens the possibility of setting up automatic fuel switchover (for example when the main fuel is running low).

The system and burner suitability must be considered before setting up the fuel output mode or configuring it for COF.

4.2 Fuel Output Modes on the Mk8 MM

Option / Parameter 131 (Fuel Valve Output Configuration) allows multi-fuels to be configured in 2 different ways on the Mk8 MM:

1) Single Fuel Output Mode (SFOM) – One Set of Fuel Outputs

This is the standard (default) mode, it allows the configuration and commissioning of up to 4 different fuels using single set of outputs on the MM, switching between fuels is possible through the use of changeover relays.

2.a) Dual Fuel Output Mode (DFOM) – Two Sets of Fuel Outputs

Available as standard, it allows 2 fuels to be configured and commissioned using 2 separate sets of fuel outputs on the MM (2 main valves and one vent valve) and inputs (Proof of closure/ CPI). No changeover relays are required to change between fuels in DFOM.

2.b) Dual Fuel Output Mode with Change on the Fly (DFOM-COF)

This mode operates in the same way as Dual Fuel Output Mode but also allows switching between fuels while the burner is firing.

When COF is enabled and fuel select is triggered while the burner is firing, the burner simply modulates to low fire. The air damper angle is increased to allow extra air for both fuels to fire at the same time, and the second fuel is introduced so both fuels fire simultaneously for a short period of time. The first fuel is then turned off and the burner modulates up to the required firing rate without turning off the burner. The MM still runs through all of the standard safety checks.

The Changeover on the Fly is an unlockable feature that requires the purchase of unlock code (COF) before it can be optioned, this can be uploaded to the MM via IR Lead using Autoflame Download Manager software (version 8.13 and above). COF is available only on Revision 4 of the Mk8 MM, for more information please contact Autoflame.

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

Commission Mode		
Options	Parameters	Expansion
Option 131		
BC: Fuel valve output configuration		
2. Two sets of outputs, change on the fly (COF)		
0. One set of outputs (changeover relays, 4 fuels)		
1. Two sets of outputs (no changeover relays, 2 fuels)		
2. Two sets of outputs, change on the fly (COF)		
Default		
  		

Figure 4.1: Fuel valve output configuration

The fuel curves must be commissioned according to the optioned fuel output mode, so if Single Fuel Output Mode is optioned the fuels has to be commissioned in Single Fuel Output Mode, changing the fuel valve output mode requires recommissioning of any fuel used in that mode.

4.3 Single Fuel Output Mode (SFOM)

Single Fuel Output Mode (SFOM) is the standard (default) mode of operation for the Mk8 MM, it can be selected by setting Option/ Parameter 131 to 0. On this mode it is possible to configure and commission 4 fuels utilising the main set of fuel outputs on the MM using changeover relays.

4.3.1 Fuel Configuration and Wiring in SFOM

In Single Fuel Output Mode, up to 4 fuels are wired to the MM's main fuel output terminals using changeover relays;

- All configured fuels are controlled by the same fuel channel
- Combustion air is controlled by a defined air damper channel and/or VSD channel
- All fuels use the same Proof of Closure / CPI input

Terminal	Description	Function
T60	Main Fuel Valve 1	Mains voltage output for valve 1 - fuel 1
T61	Main Fuel Valve 2	Mains voltage output for valve 2 - fuel 1
T55	Main Fuel Valves CPI/POC	Proving Circuit - Fuel 1 Proof of Closure
T62	Main Fuel Vent Valve	Mains voltage output - vent valve
T31,32,33 & 34	Main Fuel Gas Pressure Sensor	In case of gaseous fuel
T35, 48 & 49	Main Fuel Oil Pressure Sensor	In case of liquid fuel

4.3.2 Pressure Sensors in SFOM

The same fuel pressure sensor is used for all fuels configured in SFOM for valve proving and/or limits testing, and it can be switched over from one fuel to another using a changeover relay. Only the fuel that is firing is checked, the inactive fuels are not checked.

4.3.3 Commissioning in SFOM

When using SFOM any fuels used have to be commissioned in Single Fuel Output Mode, therefore fuels commissioned in DFOM will require recommissioning.

The fuels can use the same servo channels, also it is possible to use the same servo motor to control multi-fuels using the 'piggyback' valve arrangement.

4.3.4 Fuel Changeover Process in SFOM

Fuel changeover is possible in SFOM using changeover relays, when the fuel select input is changed on the MM, this will trigger an MM shutdown and restart on the newly selected fuel. The MM will go through the standard optioned safety checks during the process.

In SFOM, it is possible to switch between fuels at any MM phase (firing, standby, etc.).

4.4 Dual Fuel Output Mode (DFOM)

Dual Fuel Output Mode (DFOM) can be selected by setting Option / Parameter 131 to 1. The main MM screen displays the fuel trains for fuel 1 and 2 based on the optioned fuel types (Option 150/151), with fuel 1 displayed on the right side of the screen and fuel 2 on the left, it is also possible to display 2 gas fuels or 2 oil fuels at the same time. In this mode the boiler configuration setting for fuel trains displayed (Option 15) has no effect.

4.4.1 Fuel Configuration and Wiring in DFOM

In Dual Fuel Output Mode both fuels are wired directly to the MM using 2 independent sets of outputs without the use of relays;

- Fuel 1 is controlled by Channel 1
- Fuel 2 is controlled by Channel 3
- Air is controlled by Channel 2 (and a VSD channel if using a VSD)

“Proof of Closure” (CPI) inputs are required for both fuels, and must remain active for the non-firing fuel while firing on the other fuel.

Terminal	Description	Function
T60	Main Fuel Valve 1	Mains voltage output for valve 1 - fuel 1
T61	Main Fuel Valve 2	Mains voltage output for valve 2 - fuel 1
T55	Main Fuel Valves CPI/POC	Proving Circuit - Fuel 1 Proof of Closure
T62	Main Fuel Vent Valve	Mains voltage output - vent valve
T31,32,33 & 34	Main Fuel Gas Pressure Sensor	In case of gaseous fuel
T35, 48 & 49	Main Fuel Oil Pressure Sensor	In case of liquid fuel
T64	2 nd fuel Valve 1	Mains voltage output for valve 1- fuel 2
T83	2 nd Fuel Valve 2	Mains voltage output for valve 2 - fuel 2
T82	2 nd Fuel Valves CPI/POC	Proving Circuit - Fuel 2 Proof of Closure
T84	2 nd Fuel Vent Valve	Mains voltage output - vent valve
DT+, DT-, DP- & DP+	2 nd Fuel Gas Pressure Sensor	In case of gaseous fuel

4.4.2 Pressure Sensors in DFOM

If 2 gas fuels are going to be configured in DFOM, 2 separate gas pressure sensors may be used for both fuels simultaneously for the purpose of limits testing as well as valve proving, depending on Options 125 & 126 setting.

The main gas pressure sensor which can be wired to terminals 31-34 on the main MM board is used for Fuel 1, an additional gas pressure sensor can be used for fuel 2 if required; this can be wired to terminals (DT+, DT-, DP-, DP+) on the MM Expansion Board.

Valve proving may be used with or without a vent valve (Option 130 setting 2 or 3).

If 2 liquid fuels are configured in DFOM, it is not possible to use pressure sensors for both fuels at the same time.

4.4.3 Commissioning in DFOM

When using Dual Fuel Output Mode, any fuels used have to be commissioned in Dual Fuel Output Mode, therefore fuels commissioned in SFOM will require recommissioning.

Fuel 1 uses channel 1 for fuel and channel 2 for air. Channel 3 is not available when running fuel 1 since it is permanently assigned to fuel 2. When commissioning fuel 1 the closed position for servo channel 3 should be set, but it will not be possible to move servo channel 3 after this.

Fuel 2 uses channel 3 for fuel and channel 2 for air. Channel 1 is not available when running fuel 2 since it is permanently assigned to fuel 1. When commissioning fuel 2 the closed position for servo channel 1 should be set, it will not be possible to move servo channel 1 after this.

IMPORTANT: If a VSD is used to control the air fan in addition to the air damper servo, it is very important to have similar VSD signal output on both fuels when commissioning the fuels in Dual Fuel Output Mode.

4.4.4 Fuel Changeover Process in Dual Fuel Output Mode

On a system configured in Dual Fuel Output Mode, when fuel select is triggered on the MM, fuel changeover will only take place if the MM is in one of the following modes:

- In normal "Run" mode the fuel can be changed while the burner is in the Recycle or Standby states.
- In "Commission Mode" the fuel can be changed while in the commission menu screen (but not in the commissioning screen).
- In "Run" mode if the fuel input is changed while firing, it will cause a burner shutdown, allowing the fuel to be changed when Recycle/Standby state is reached.

The selected fuel must be commissioned in Dual Fuel Output Mode, if the newly selected fuel is not commissioned then a warning will appear indicating that the selected fuel cannot be run and the MM will continue in its current mode running on the same fuel (if the burner is firing then it will continue to fire on the current original fuel). This warning will clear automatically when the fuel selection is returned to the current fuel.

If the burner is firing and the newly selected fuel has a gas pressure sensor optioned then a fuel pressure test will take place. The supply-side fuel valve for the newly selected fuel is briefly opened and the fuel pressure is measured. If the fuel pressure is within the optioned limits of the commissioned pressure for the new fuel then the fuel changeover process may continue, otherwise the MM will continue to fire on the current fuel. This does not happen if an oil fuel is selected.

Failure of a gas pressure limits test at this point will trigger a warning indicating that low gas pressure prevented a fuel changeover. This warning will clear automatically when the fuel selection is returned to the current fuel. Selecting the new fuel again will perform another gas pressure test.

If the burner is firing and a burner shutdown is triggered, the shutdown will follow any optioned procedures such as low-fire shutdown, post-purge, valve proving, etc. If the current fuel is reselected while the burner is still firing the fuel change shutdown can be cancelled.

Once the MM reaches the Recycle/Standby state, the fuel changeover takes place and the burner will restart on the newly selected fuel.

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

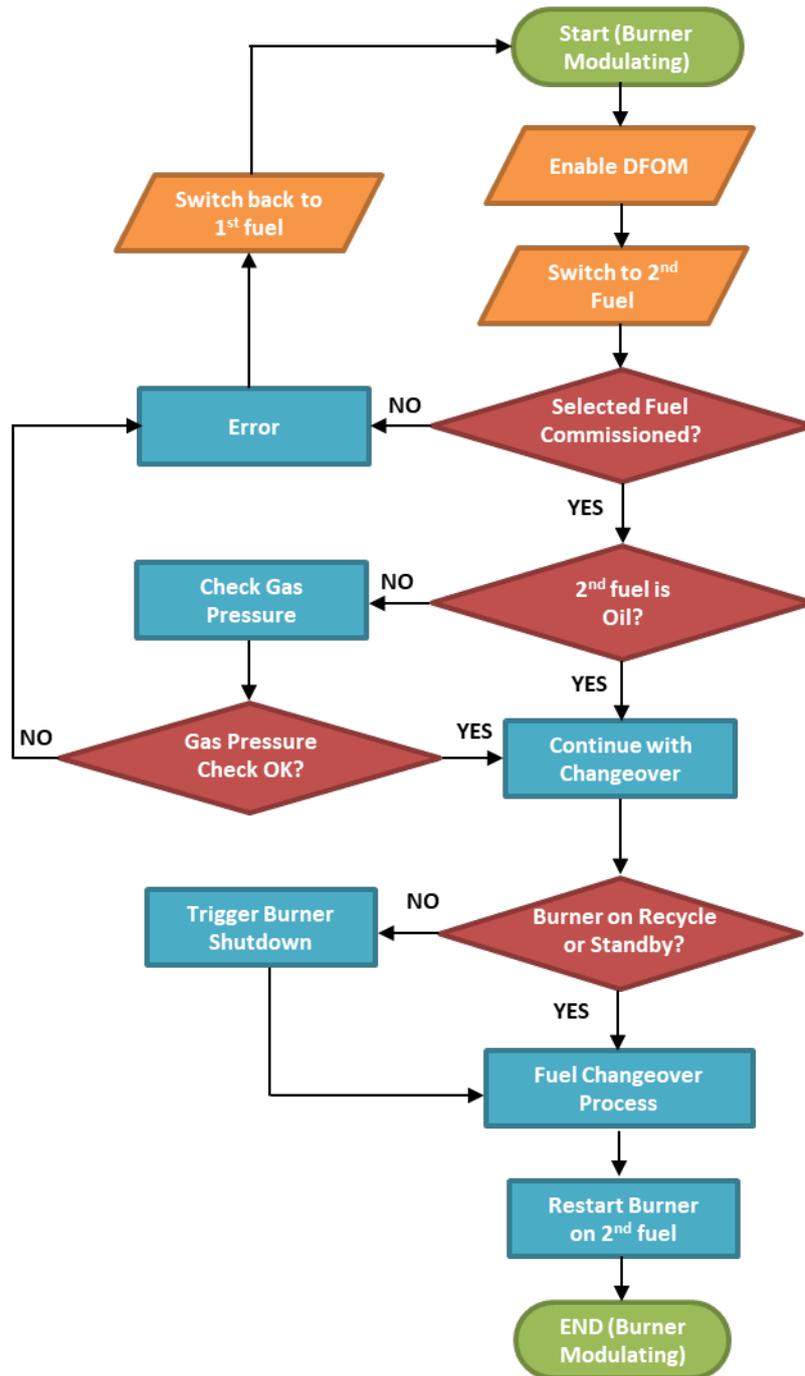


Figure 4.4: Fuel Changeover Process in Dual Fuel Output Mode

4.5 Fuel Change on the Fly (COF)

4.5.1 Overview

Fuel Change on the Fly (COF) can be optioned by setting option/parameter 131 to 2. In this mode, the fuel setup is the same as in Dual Fuel Output Mode, the fuel changeover process however, is completely different.

Fuel Change on the Fly is activated by applying live voltage input to terminals 91 and 92 simultaneously. When these inputs are active, a message "COF Enabled" is displayed on the MM's main boiler screen.

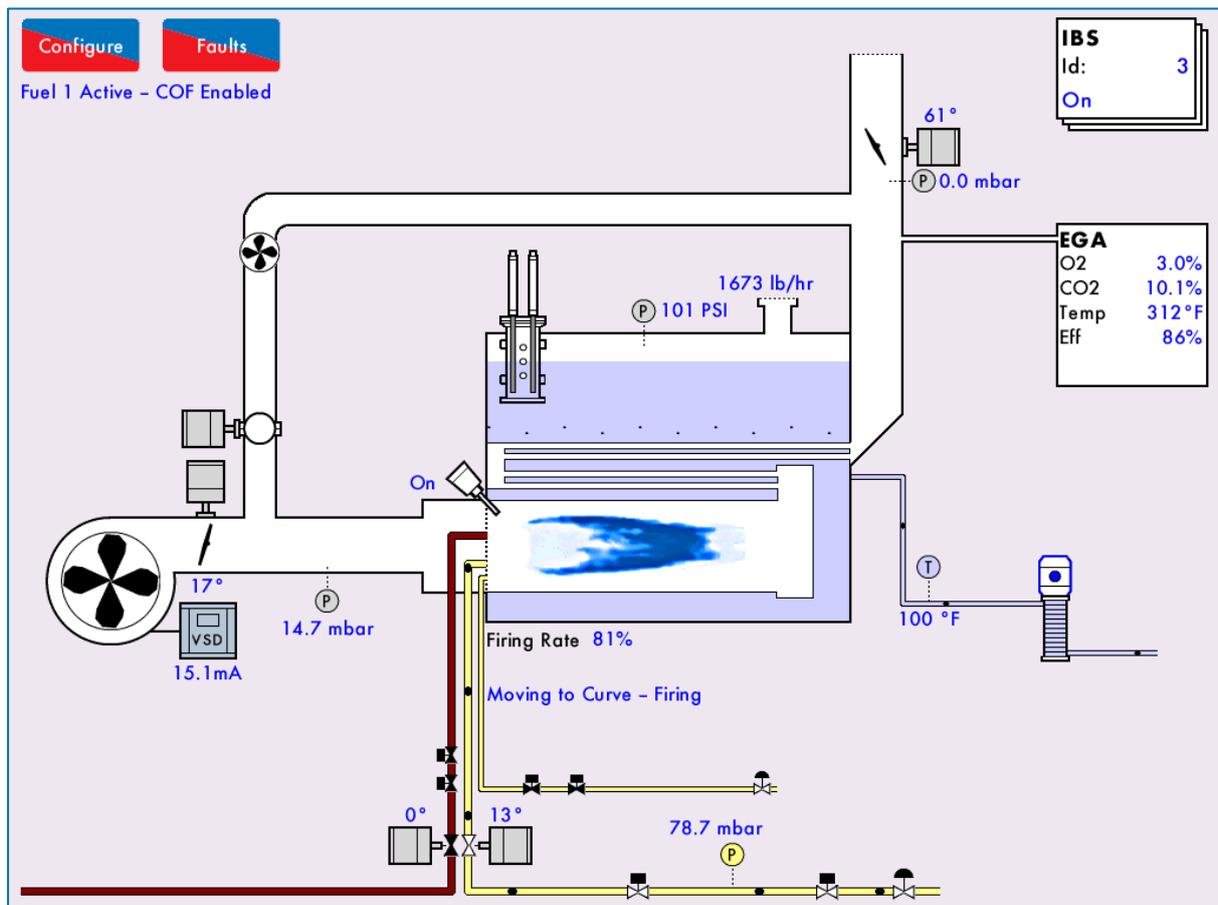


Figure 4.5.1: The main MM screen with "COF Enabled" before fuel changeover

If the COF input is not active (no live voltage on terminals 91 & 92) when the selected fuel is changed then the MM will operate as already described for Dual Fuel Output Mode, shutting down the burner for a fuel change.

If COF is not enabled, the MM will change fuel in the same way as in Dual Fuel Output Mode, shutting down the burner and restarting on the newly selected fuel.

4.5.2 Checks before COF can take place

Fuel Change on the Fly can be triggered by introducing live voltage to T91 & T92 simultaneously, the changeover can only happen if the burner is in firing mode. The MM will undergo the following checks before going ahead with a COF fuel change:

MM Phase: Modulating – Firing

For a Fuel Change on the Fly to take place, the MM will first check whether the newly selected fuel is commissioned, if the selected fuel is not commissioned then a warning will be displayed indicating that the selected fuel cannot be run. This warning will clear automatically when the fuel selection is returned to the current fuel. If the burner is firing then it will continue to fire on the current fuel.

MM Phase: Modulating - Gas Pressure Test

If the burner is firing and the newly selected fuel has pressure sensor optioned (depending on option 125-126 setting), a fuel pressure test will take place, during which the supply-side fuel valve (Valve 1) for the new fuel is briefly opened and the fuel pressure is measured. If the fuel pressure is within the optioned limits (in options 136 & 137) of the commissioned pressure then the fuel changeover process may continue, however if the pressure for the selected fuel is not within these limits the MM will continue to fire on the current fuel. Failure of a gas pressure test at this point causes a warning to be generated, indicating that gas pressure prevented a fuel changeover. This warning will clear automatically when the fuel selection is returned to the current fuel. Selecting the new fuel again will perform another gas pressure test. This test does not take place if an oil fuel is selected.

4.5.3 COF Changeover Position

This is a position at which both fuels fire simultaneously as part of the fuel Change on the Fly process.

MM Phase: Modulating to COF

The current fuel modulates down its commissioned curve to its low fire point (or its FGR point otherwise if optioned)

MM Phase: Fuel Changeover – Firing

From this point the MM moves to the **COF Changeover Position** which is generated by a combination of the two commissioned fuel curves as follows:

- Servo 1 (Fuel 1) COF changeover position is the commissioned angle for the low fire point (or the FGR point for fuel 1 if optioned).
- Servo 3 (Fuel 2) COF changeover position is the commissioned angle for the low fire point (or the FGR point for fuel 2 if optioned).
- Servo 2 (Air Angle) COF changeover position is an increased air angle calculated to provide enough air for safe combustion of the both fuels to fire simultaneously and to make sure that the combustion is Air-Rich during the changeover process.
- Other channels, if optioned (i.e. servo 4, draught servo, and VSDs) take the larger value or more open angle of the two fuels at the changeover point (FGR or low fire).

IMPORTANT: If a VSD is used to control the air fan in addition to the air damper servo, it is very important to have similar VSD signal output on both fuels when commissioning the fuels in Dual Fuel Output Mode, this is to ensure that sufficient amount of air is present for both fuels to fire at the COF Changeover Position.

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

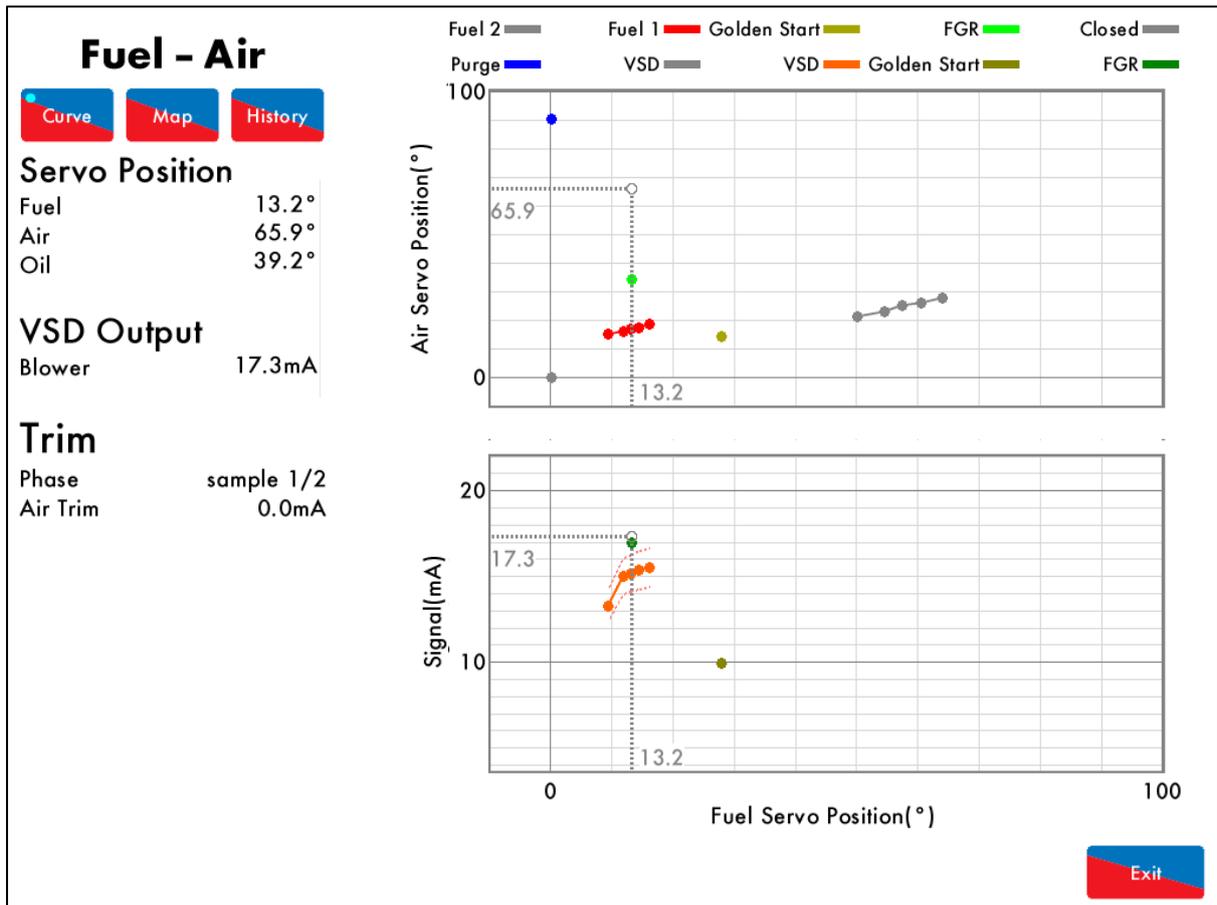


Figure 4.5.3 COF Changeover Position

4.5.4 COF Fuel Changeover

Once the COF Changeover Position has been reached, the fuel changeover process takes place, the process takes the following steps:

- MM Phase: Fuel Changeover – COF Pre-Ignition**
 A pre-ignition phase turns on the ignition and pilot outputs (if interrupted pilot is selected in option 111); these outputs remain on during the changeover process while both fuels are firing simultaneously.
- MM Phase: Fuel Changeover – COF 1st Safety**
 The new fuel main valves are opened starting its main flame. The two fuels fire together for the main flame proving time (Option 117).

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

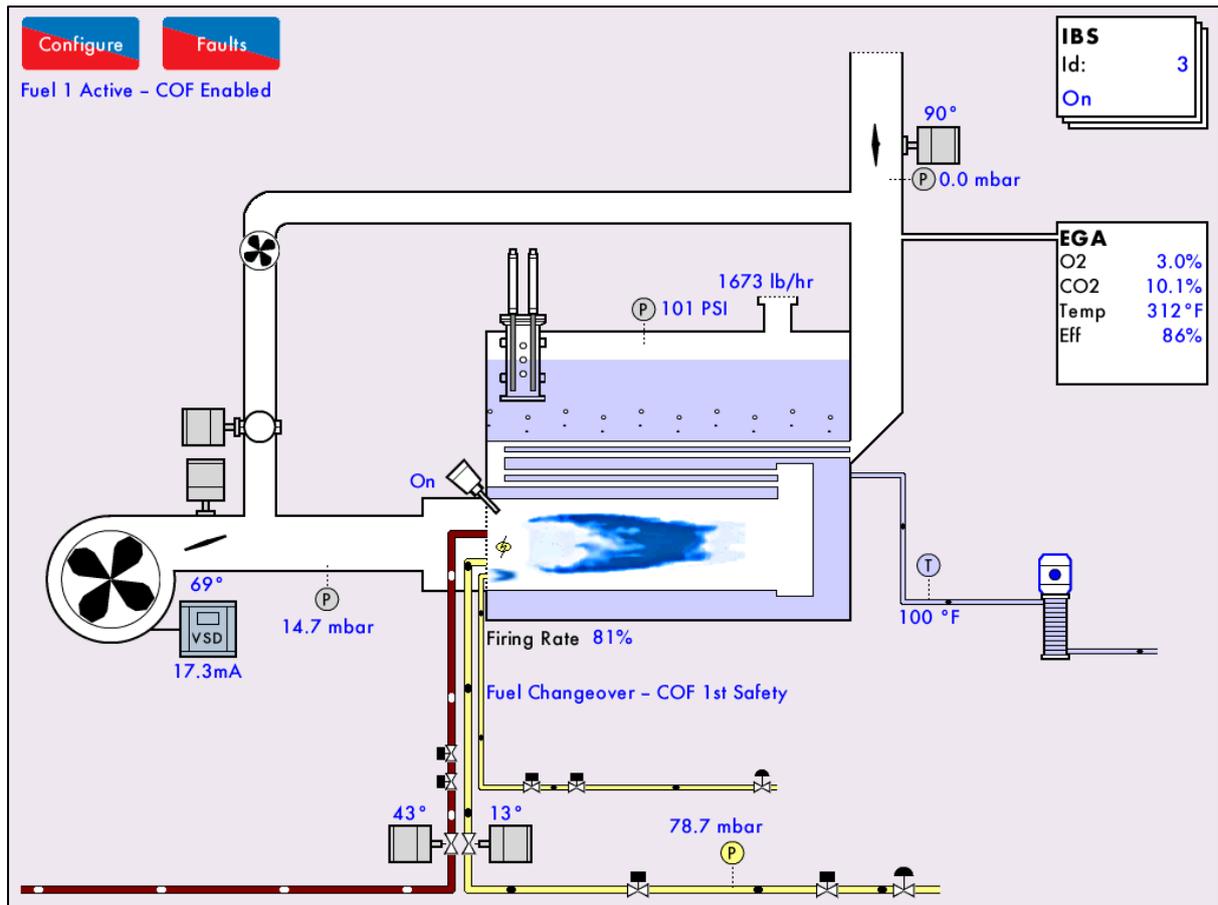


Figure 4.5.4: COF 1st safety phase where both fuels fire simultaneously

- MM Phase: Fuel Changeover - COF 2nd safety**
 The original fuel main valves are turned off and the new fuel servo/VSD channels move onto the commissioned curve of the new fuel while maintaining the same fuel channel angle. The main flame on the new fuel is monitored for five seconds in the COF 2nd safety phase.
- MM Phase: Moving to Curve – COF Main Proving**
 The pilot (if interrupted pilot is selected in option 111) and ignition outputs are turned off.
- MM Phase: Moving to curve – firing**
 The new fuel starts to modulate up its commissioned curve.

4.5.5 Checks after COF Fuel Changeover

After a fuel changeover, if valve proving is optioned on the previous fuel which is now no longer firing, valve proving takes place for that fuel while the current fuel continues to fire. This verifies that no leaks are present on the non-running fuel valves. Failure of valve proving will cause a lockout that stops the burner.

4 FUEL OUTPUT MODES AND CHANGEOVER OPTIONS

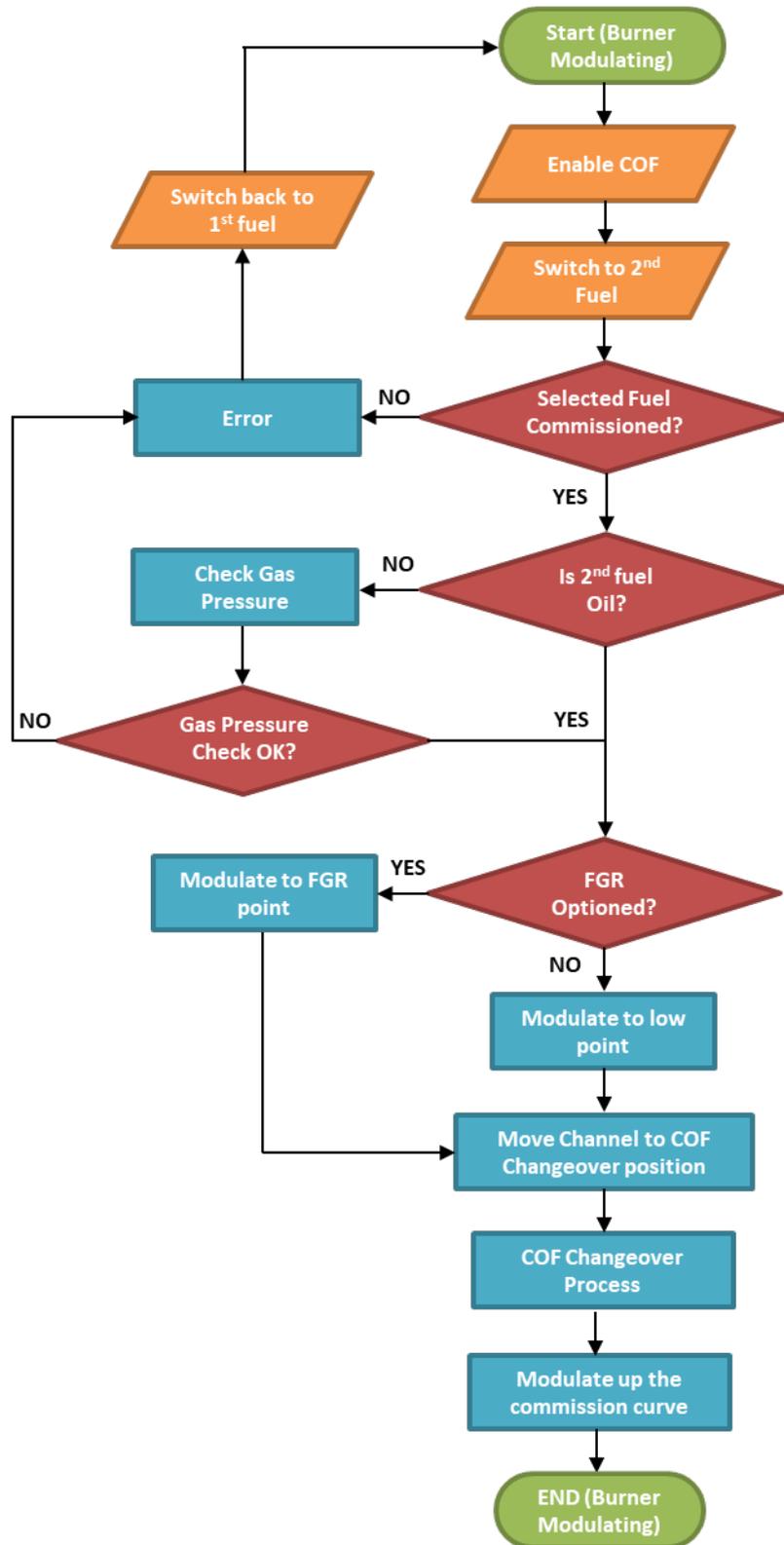


Figure 4.5: Fuel Changeover on the Fly Process

4.6 Gas Pressure Sensors and Valve Proving in DFOM with COF

There are some key differences in the operation of gas pressure sensors and valve proving between Single Fuel Output Mode and Dual Fuel Output Mode.

Before and/or after firing the burner (according to Option 129) valve proving takes place simultaneously for any fuel for which it is optioned. Failure of the valve proving process on either fuel will cause a lockout that stops the burner. This does not happen in Single Fuel Output Mode.

The tests performed during valve proving are different in Dual Fuel Output Mode:

- If a fuel is about to be fired (at burner start-up or before a COF changeover to that fuel) the static line pressure is tested against the optioned pressure limits defined in options 136, 137 and 138. This is the same as in single fuel output (standard) mode.
- If the fuel is not about to be fired, the static line pressure is tested (at burner start-up for the 2nd fuel or after a COF changeover for example) against a lower threshold, defined by Option 133 (Maximum pressure change allowed during valve proving). This tests that the pressure is high enough for valve proving to be valid (a drop in pressure can be detected that would cause the test to fail) but it does not require that the fuel has enough pressure to fire. This is to accommodate fuels that may not always be available such as waste biogas collected and burned periodically. It means that low pressure on a fuel that isn't about to fire will not prevent the burner from firing on the current fuel, provided that the pressure on the 2nd fuel is high enough to prove that the valve are not leaking.

If the fuel selection is changed while the burner is firing and the newly selected fuel has a gas pressure sensor optioned then a fuel pressure test will take place. The supply-side fuel valve for the new fuel is briefly opened and the fuel pressure is measured. If the fuel pressure is within the optioned limits of the commissioned pressure (Set in options 136 & 137) the fuel changeover may continue – otherwise the MM will continue to fire on the current fuel. It should be noted that low pressure at this point will not generate a lockout as valve proving is not being performed.

After a Fuel Change on the Fly, if valve proving is optioned for the fuel that has just been turned off then valve proving will take place on that fuel while the burner continues to fire. The pressure must be high enough for valve proving to be valid or a lockout will be generated, but the pressure does not need to be as high as the commissioned limits.

When valve proving is performed on the inactive fuel while the active fuel is firing the gas pressure sensor will be re-zeroed for 3 gas valve configurations. The gas sensor will not be re-zeroed with 2 valve configuration (Option 13 setting 0 or 3).

Fuel pressure limits continue to be tested for the currently firing fuel as normal, including when other operations such as valve proving are taking place on the other fuel.

4.7 Limitations of DFOM and COF

The following functions cannot be used if the MM is configured for Dual Fuel Output Mode or COF:

- Fully Metered Combustion.
- Single Valve Pilot (Option 130 settings 3, 4 &5).
- No Pilot Mode (Direct Spark, option 111 setting 2) on Gas fuels only.
- Multi-burner mode will operate with Dual Fuel Output Mode but is not possible with COF.
- Although it is possible to configure 2 liquid fuels, it is not possible to have pressure sensors for both fuels at the same time.
- Piggyback valve arrangement, separate servo-motor is required for each fuel.
- Dual Fuel Output Mode and COF features will not be displayed on the Mk7 DTI, only Mk8 DTI is able to display these features.

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

5 M.M. FEATURES

5.1 Calibration of the Actual Value

To calibrate the actual value, a parameter has been added to allow the temperature/ pressure sensor reading 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.

Online Changes

Options Parameters

Parameter 29

Load Sensor Adjustment

96.0% (79 °C)

Modify Parameter

Value: 960

-
+

Range: 800 - 1200. Default setting: 1000.

Minimum
Maximum
Default

↑
↓
Exit

Figure 4.1.i Load Sensor Adjusted

5.2 External Modulation

When using External Modulation the internal PID control is disabled and the firing rate is set by an input control signal on terminals 7, 8 and 9 as appropriate for 0 – 10V or 0/4 – 20mA. Set parameters 68 for the external modulation control range, and parameter 69 for the input range.

There are two options to enable the use of External Modulation:

- Option 45: Setting this option to either 1 or 2 enables the constant use of the external input signal for the modulation control.
- Option 55: Setting this option to 1 enables the possibility for the user to choose between internal PID control and External Modulation according to the signal provided on terminal 88. Providing a line voltage input on terminal 88 selects External Modulation and 0V selects Internal PID.

Note: External Modulation cannot be used if External Setpoint is enabled as the Auxiliary Analogue Input can only be used for a single functionality.

5.3 External Setpoint

The Auxiliary Analogue Input channel can be used to receive an external setpoint input. This feature can be enabled in Parameter 72 and an input control signal needs to be provided on terminals 7, 8 and 9 as appropriate for 0-10V or 0/4-20mA. The input signal range and filtering time are set in parameter 69 and 70 respectively. The minimum and maximum external setpoint input values are set in options 30 and 31 respectively.

When External Setpoint is enabled the MM uses the signal provided into the auxiliary analogue input to determine the required setpoint value.

When External Setpoint is enabled, Second Setpoint input may be used to select the reduced setpoint.

Note: External Setpoint cannot be used if External Modulation is enabled as the Auxiliary Analogue Input can only be used for a single functionality.

5.4 Second Setpoint Select

Terminal 87 allows selecting between the main setpoint and a secondary setpoint. When terminal 87 is at 0V the MM uses the internal 'Required' setpoint value. When a line voltage input is provided on terminal 87, the MM uses the internal 'Reduced' setpoint value. A second setpoint input (T87) may be used to select the reduced setpoint.

5.5 Start Position Interlock and Purge Position Interlock

Options/ parameters 154, 155 and have been added to set the function of terminals 80 and 81, respectively. Terminal 80 can be used for start position interlock and Terminal 81 can be used for either purge position interlock or purge pressure proving. Proving valves (end switch) provides 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 4.5.i

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

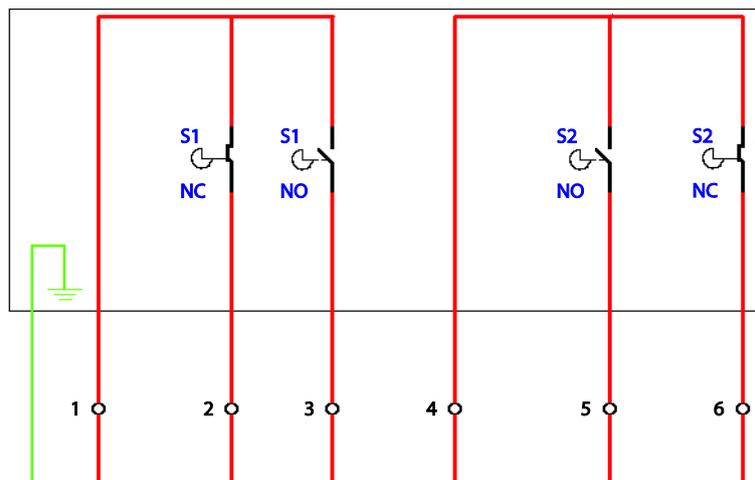


Figure 4.5.i End Switch Wiring Schematic

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 4.5.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 position 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.

5.6 Purge Pressure Proving/ Purge Hold

Setting option/ parameter 155 to 2 makes terminal 81 a purge pressure proving input. In this case a pressure switch to provide the purge pressure proving signal needs to be installed and the feedback connected to terminal 81. The switch must be made continuously for the whole duration of the purge time. If the signal is lost the purge time stops and it restart when the switch is made again. If the switch is made before the blower motor starts a lockout is generated.

Option/ parameter 158 allows to set a timeout for the purge pressure proving. If the system does not see a signal on terminals 81 within the time set in option parameter 158 a lockout is generated. Setting option/ parameter to 0 disables the timeout functionality and the MM will stay in the purge phase indefinitely.

To allow for a quick cool down of the boiler a manual switch can be added to the panel. This switch can then be used to break the feedback from the pressure switch to the MM causing the MM to stay purging for the desired period of time.

Caution: When it is desired to end the continuous purge, it is necessary to disable the burner prior to turning the manual switch back to the normal position. Otherwise the burner will start up.

6 ERRORS AND LOCKOUTS

6.1 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
		<ul style="list-style-type: none"> • Check wiring on terminals 40 - 42 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°
2	Channel 2 Positioning Error	Servomotor is outside of the commissioned range
		<ul style="list-style-type: none"> • Check wiring on terminals 40, 41, 43 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°
3	Channel 3 Positioning Error	Servomotor is outside of the commissioned range
		<ul style="list-style-type: none"> • Check wiring on terminals 44, 46, 47 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°
4	Channel 4 Positioning Error	Servomotor is outside of the commissioned range
		<ul style="list-style-type: none"> • Check wiring on terminals 45 - 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 7 Positioning Error	Servomotor is outside of the commissioned range
		<ul style="list-style-type: none"> • Check wiring on terminals DP-, DP+, DPW • 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°
6	Channel 1 Gain Error	Servomotor position measurement hardware error
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 40 - 42 and 70 - 71
7	Channel 2 Gain Error	Servomotor position measurement hardware error
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 40, 41, 43 and 72 - 73
8	Channel 3 Gain Error	Servomotor position measurement hardware error
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 44, 46, 47 and 74 - 75
9	Channel 4 Gain Error	Servomotor position measurement hardware error
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 45 - 47 and 76 - 77
10	Channel 7 Gain Error	Servomotor position measurement hardware error
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals DP-, DP+, DPW and DCI, DCD
11	Channel 1 Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 70 & 71 • Check servomotors drive in correct direction and valve is not stuck

6 ERRORS AND LOCKOUTS

Error	Message	Description
12	Channel 2 Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals and 72 and 73 • Check servomotors drive in correct direction and damper is not stuck
13	Channel 3 Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals and 74 and 75 • Check servomotors drive in correct direction and valve is not stuck
14	Channel 4 Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals and 76 and 77 • Check servomotors drive in correct direction and valve is not stuck
15	Channel 7 Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals DCI and DCD • Check servomotor drives in correct direction and damper is not stuck
16	Analogue Power Supply Error	ADC measured 12V supply out of range
		<ul style="list-style-type: none"> • Check wiring for shorts on terminals 41, 47 and 39
17	Digital Power Supply Error	ADC measured 3.3V supply out of range
		<ul style="list-style-type: none"> • Check for noise on the mains input, wiring and voltages on all terminals
18	EEPROM Error	Fault communicating with the on board EEPROM
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
19	ADC Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
20	Watchdog Timeout	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
21	Processor Clock Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
22	System Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
23	Flash Data Error	Internal fault
		<ul style="list-style-type: none"> • Re-install software SD card
24	Processor Temperature Error	Internal fault
		<ul style="list-style-type: none"> • Check ambient temperature of unit does not exceed maximum recommended temperature
25	Burner Control Comms Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
26	Burner Control Reset	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
27	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
29	Mains Input Detection Error	Mains input stuck on
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 89 - 92
30	Channel 5 VSD Error	Feedback incorrect
		<ul style="list-style-type: none"> • Check VSD feedback against commissioned VSD and ensure the feedback is stable
31	Channel 6 VSD Error	Feedback incorrect
		<ul style="list-style-type: none"> • Check VSD feedback against commissioned VSD and ensure the feedback is stable

6 ERRORS AND LOCKOUTS

Error	Message	Description
32	VSD Feedback Change Too Small	Feedback change detected during commissioning is too small
		<ul style="list-style-type: none"> • Check VSD feedback during commissioning • Check option 99 for VSD on channel 5 and option 109 for VSD on channel 6 • Check wiring on terminals 1 - 3, 4 - 6, 10 - 12 and 13 - 15
33	Missing Commissioning Data	Internal fault
		<ul style="list-style-type: none"> • Check there is commissioning data for all options servomotors/VSD
34	FAR Execution Speed	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
35	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
36	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
37	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
38	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local Tech Centre
39	VSD Sampling Error	VSD feedback current/ voltage too high on channel 5/6
		<ul style="list-style-type: none"> • Check wiring on terminals 1 - 3, 4 - 6, 10 - 12 and 13 - 15
40	VSD Feedback Too Low	VSD feedback value is too low during commissioning on channel 5/6
		<ul style="list-style-type: none"> • Check VSD feedback while commissioning
41	APS Commission Data Fault	No air pressure trim data for a point with EGA trim
		<ul style="list-style-type: none"> • Check EGA trim and air pressure trim in fuel-air curve
42	Comm VPS Gas Pressure Low	Commissioned gas pressure during VPS below option/ parameter 133 threshold
		<ul style="list-style-type: none"> • Check option/ parameter 133 and check gas pressure • Re-commission gas pressure sensor
43	Comm Running Gas Pressure Low	Commissioned gas pressure during running below option/ parameter 136
		<ul style="list-style-type: none"> • Check option/ parameter 136 and check gas pressure • Re-commission gas pressure sensor
44	Comm Air Pressure Low	Commissioned air pressure during running below option/ parameter s 147 and 149
		<ul style="list-style-type: none"> • Check option/parameters 147 and 149 • Re-commission air pressure sensor
45	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
46	Software Error	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
47	Expansion PF Output (Check F5)	Internal fault
		<ul style="list-style-type: none"> • Check wiring on terminal PF • Check fuse 5 (2A) on expansion board
48	WL Alarm Output Internal Fault	Internal fault
		<ul style="list-style-type: none"> • Check expansion option 5 • Check wiring and voltages on terminals HAI, 1AI, 2AI

6 ERRORS AND LOCKOUTS

Error	Message	Description
49	Expansion Servo Hardware Fault	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local tech centre 	
50	Triac Power Supply Error (Check F2)	Internal fault
	<ul style="list-style-type: none"> Check wiring on terminal 69 Check fuse 2 (2A T) 	
51	Fused 12V Supply Error (Check F4)	Internal fault
	<ul style="list-style-type: none"> Check gas/air pressure sensor wiring on terminals 31 - 34, and load detector on 37 - 39 Check fuse 4 (500mA) 	
52	Fused 13.5V Supply Error (Check F3)	Internal fault
	<ul style="list-style-type: none"> Check IR scanner wiring on terminals 29, 30, 48, 49 and oil pressure sensor on 48, 49 Check fuse 3 (500mA) 	
53	Air Pressure Zeroing Fault	Commissioned air zero pressure is more than 5mbar from sensor's zero value
	<ul style="list-style-type: none"> Check air pressure sensor value during VPS 	
54	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
55	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
56	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
57	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
58	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
59	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
60	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
61	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
62	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
63	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
64	ADC Reference Voltage Error	Hardware fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
65	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
66	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	
67	Software error	Internal fault
	<ul style="list-style-type: none"> Contact Autoflame approved local Tech Centre 	

6.2 Lockouts

Lockouts occur when the MM detects a fault with the burner operation such as VPS, gas/air pressure sensor and flame scanners. The lockout must be cleared and investigated on the MM.

Lockout	Message	Description
1	CPI Input Wrong State	Proof of closure switch opened during ignition sequence
	<ul style="list-style-type: none"> • Check wiring on terminal 55 • Check proof of closure switches 	
2	No Air Proving	No air pressure during start/ firing
	<ul style="list-style-type: none"> • 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)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 63 	
4	Motor Output Fault	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 58 	
5	Start Gas Output Fault	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 59 	
6	Main Gas 1 Output Fault	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 60 	
7	Main Gas 2 Output Fault	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 61 	
8	Vent Valve Output Fault	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 62 	
9	Failsafe Relay (Check F1)	Voltage detected when output is off (and vice versa)
	<ul style="list-style-type: none"> • Check wiring and voltage on terminal 57 • Check fuse 1 (6.3A T) and wiring on terminals 50 - 64 	
10	Simulated Flame	Flame is present when it not should be
	<ul style="list-style-type: none"> • 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 Air Proving Fail	Leak detected during 'air proving' part of VPS
	<ul style="list-style-type: none"> • Check main fuel valve • Call a certified Commissioning Engineer to investigate 	
12	VPS Gas Proving Fail	Leak detected during 'gas proving' part of VPS
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Check wiring on terminals 21 and 22 • Check UV scanner type and check option/ parameter 110 is set accordingly 	

6 ERRORS AND LOCKOUTS

Lockout	Message	Description
15	NO CPI Reset	Proof of closure switch not made after valves closed
		<ul style="list-style-type: none"> • Check wiring on terminal 55 and check proof of closure switches
16	Prolonged Lockout Reset	Prolonged voltage detected on terminal 56/ lockout reset button permanently pressed
		<ul style="list-style-type: none"> • Check lockout reset button is not pressed • Check wiring on terminal 56
17	Gas Pressure Low	Gas pressure low limit exceeded while firing(gas sensor)
		<ul style="list-style-type: none"> • Check gas pressure • Check option/ parameter 136
18	Gas Pressure High	Gas pressure high limit exceeded while firing (gas sensor)
		<ul style="list-style-type: none"> • Check gas pressure • Check option/ parameter 137
19	RAM Test Failed	Hardware fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
20	PROM Test Failed	Hardware fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
21	FSR Test 1A	Internal relay test failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
22	FSR Test 2A	Internal relay test failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
23	FSR Test 1B	Internal relay test failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
24	FSR Test 2B	Internal relay test failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
25	Watchdog Fail 2A	Internal check failed
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
26	Watchdog Fail 2B	Internal check failed
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
27	Watchdog Fail 2C	Internal check failed
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
28	Watchdog Fail 2D	Internal check failed
		<ul style="list-style-type: none"> • Contact Autoflame
29	Input Fault	Power supply fault
		<ul style="list-style-type: none"> • Check mains voltage to the MM
32	Gas Pressure Low Limit	Gas pressure lower than commissioned VPS value
		<ul style="list-style-type: none"> • Check gas pressure sensor value • Check option/parameter 136
33	VPS Air Zeroing	Gas pressure sensor cannot be zeroed at VPS venting
		<ul style="list-style-type: none"> • Check gas pressure is within zero range (see MM Application Possibilities) • Check vent valve
36	Oil Pressure Too Low	Oil pressure below offset lower limit during running
		<ul style="list-style-type: none"> • Check option/parameter 139 • Check oil pressure sensor
37	Oil Pressure Too High	Oil pressure above offset upper limit during running
		<ul style="list-style-type: none"> • Check option/parameter 140 • Check oil pressure sensor

6 ERRORS AND LOCKOUTS

Lockout	Message	Description
39	Freeze Timeout	MM kept in Phase Hold for more than 10minutes
		<ul style="list-style-type: none"> MM kept in Phase Hold during commissioning for more than 10 minutes
40	Purge Air Pressure Low	Insufficient air pressure during purge
		<ul style="list-style-type: none"> Check option/parameter 141 Check air pressure sensor/ air pressure switch
42	Terminal 86 Inverse	Input detected on both terminals 85,86 where there should not be, and vice versa
		<ul style="list-style-type: none"> Check option/parameter 122 Check wiring and voltages on terminals 85, 86
43	Terminal 85/86 Fault	Hardware fault on terminals 85/86
		<ul style="list-style-type: none"> Check wiring and voltages on terminals 85, 86 and contact Autoflame
44	Proving Circuit Fail T52	Loss of input on terminal 52; MM must see input at all times from position to purge to post-purge
		<ul style="list-style-type: none"> Check wiring on terminal 52
45	No Proving Circuit Set	Secondary proving timeout elapsed
		<ul style="list-style-type: none"> Check option/parameter 157 Check wiring on terminal 52
46	Proving Interlock Timeout	Purge interlock timeout elapsed
		<ul style="list-style-type: none"> Check option/ parameters 155 and 158 Check wiring on terminal 81
52	High IR Ambient	Flame detected when there should not be
		<ul style="list-style-type: none"> Visually check flame and check IR scanner Call a certified Commissioning Engineer to investigate
53	IR Comms Lost	Loss of comms with IR scanner
		<ul style="list-style-type: none"> Check wiring and screen on terminals 29, 30, 48 and 49 Check that the IR scanner is not removed from the magnetic ring socket
54	Watchdog Long X A	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
55	Watchdog Long Y A	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
56	Watchdog Off A	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
57	Watchdog Short X B	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
58	Watchdog Short Y B	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
59	Watchdog Long X B	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
60	Watchdog Long Y B	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
61	Watchdog Off B	Internal check failed
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
62	UV Signal Too High	Internal check failed for UV
		<ul style="list-style-type: none"> Check wiring on terminals 21, 22, 50 and 51

6 ERRORS AND LOCKOUTS

Lockout	Message	Description
63	Purge Limit Switch	Interlock not made on terminal 81
		<ul style="list-style-type: none"> • Check option/ parameter 155 • Check wiring on terminal 81
64	Start Limit Switch	Interlock not made on terminal 80
		<ul style="list-style-type: none"> • Check option/ parameter 154 • Check wiring on terminal 80
65	FSR A	Internal check failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
66	FSR B	Internal check failed
		<ul style="list-style-type: none"> • Check wiring and voltages on terminals 50 - 63
67	Gas Sensor Comms	Signal lost from gas pressure sensor
		<ul style="list-style-type: none"> • Check wiring and screen on terminals 31 - 34
68	Gas Sensor Type	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
69	Gas Sensor Fault	Internal pressure sensor fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
70	UV Pot Fault	Internal UV scanner fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
71	Air Sensor Comms	Signal lost from air pressure sensor
		<ul style="list-style-type: none"> • Check wiring and screen on terminals 31 - 34
72	Air Sensor Type	Internal fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
73	Air Sensor Fault	Internal pressure sensor fault
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
74	Air Sensor Zero	Air pressure is more than 5mbar from sensor's zero value
		<ul style="list-style-type: none"> • Check air pressure sensor value during VPS
75	Air Sensor Signal High	Air pressure is above 400mbar
		<ul style="list-style-type: none"> • Check Autoflame approved local tech centre
76	Air Sensor Error Window	Air pressure outside of these limits for 3 seconds
		<ul style="list-style-type: none"> • Check air pressure • Check option/parameter 147
77	Wait Air Switch Timeout	Voltage has not been reset for 2minutes
		<ul style="list-style-type: none"> • 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
		<ul style="list-style-type: none"> • 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
		<ul style="list-style-type: none"> • Contact Autoflame approved local tech centre
80	Timeout on Reaching Purge	Time set in option/parameter 124 has elapsed
		<ul style="list-style-type: none"> • Check option/parameter 124
81	Oil Pressure Sensor Fault	No comms received from oil pressure sensor
		<ul style="list-style-type: none"> • Check wiring and screen on terminals 48, 49

6 ERRORS AND LOCKOUTS

Lockout	Message	Description
82	Purge Pressure Proving Input	Input on T81 read high during relay test phases
		<ul style="list-style-type: none"> Input has been made before the blower starts; it should only be made continuously during purge. Check wiring on terminal 81.
83	Main Gas 3 Output Fault	Voltage detected when output is off (and vice versa)
		<ul style="list-style-type: none"> Check wiring and voltage on terminal 64
84	Main Gas 4 Output Fault	Voltage detected when output is off (and vice versa)
		<ul style="list-style-type: none"> Check wiring and voltage on terminal 83
85	Vent Valve 2 Output Fault	Voltage detected when output is off (and vice versa)
		<ul style="list-style-type: none"> Check wiring and voltage on terminal 84
86	Gas Sensor 2 Comms	Signal lost from gas pressure sensor
		<ul style="list-style-type: none"> Check wiring and screen on terminals DT+, DT-, DP- and DP+ on the MM expansion board
87	Gas Sensor 2 Fault	Internal pressure sensor fault
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre
88	VPS Air Proving Fail (Fuel 2)	Leak detected during 'air proving' part of VPS
		<ul style="list-style-type: none"> Check fuel 2 valve 1 Call a certified Commissioning Engineer to investigate
89	Gas Pressure Low Limit (Fuel 2)	Gas pressure lower than commissioned VPS value
		<ul style="list-style-type: none"> Check gas pressure sensor value Check option/parameter 136
90	VPS Gas Proving Fail (Fuel 2)	Leak detected during 'gas proving' part of VPS
		<ul style="list-style-type: none"> Check option/parameter 133 Check fuel 2 gas valve 1 and vent valve Check pilot valve if using single valve pilot Isolate gas and call a certified Commissioning Engineer to investigate
91	Gas Proving Fail High (Fuel 2)	Gas pressure too high during VPS
		<ul style="list-style-type: none"> Isolate gas Check fuel 2 valve 1 and vent valve Check option/ parameters 133 and 134 Call a certified Commissioning Engineer to investigate
92	Oil Pressure Too Low (Fuel 2)	Internal fault
		<ul style="list-style-type: none"> Check option/parameter 139 Check oil pressure sensor
93	Gas Pressure Low (Fuel 2)	Gas pressure low limit exceeded while firing (gas sensor)
		<ul style="list-style-type: none"> Check gas pressure Check option/ parameter 136
94	Oil Pressure Too High (Fuel 2)	Oil pressure above offset upper limit during running
		<ul style="list-style-type: none"> Check option/parameter 140 Check oil pressure sensor
95	Gas Pressure High (Fuel 2)	Gas pressure high limit exceeded while firing (gas sensor)
		<ul style="list-style-type: none"> Check gas pressure Check option/ parameter 137
96	NO CPI Reset	Proof of closure switch not made after valves closed
		<ul style="list-style-type: none"> Check wiring on terminal 55 and check proof of closure switches
199	Lockout 199	Internal fault
		<ul style="list-style-type: none"> Contact Autoflame approved local tech centre

6 ERRORS AND LOCKOUTS

Lockout	Message	Description
200	Lockout Cleared	Lockout has been cleared
		<ul style="list-style-type: none">• MM status after lockout has been reset (Modbus)
201	Power up CPU Test Fail	Internal check failed
		<ul style="list-style-type: none">• Contact Autoflame approved local tech centre
202	Power up EEPROM Test Fail	Internal check failed
		<ul style="list-style-type: none">• Contact Autoflame approved local tech centre

6.3 Alarms and Warnings

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

Option 13	EGA Fault Response
Option 14	Warning Response
Expansion Option 9	Burner Operation at High Water
Expansion Option 20	Burner Operation on Feedwater Control Fault
Expansion Option 88	Action on Pressure Sensor Fault

Fault	Message	Description
1	EGA Internal Error	Fault on EGA
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check EGA for fault description
2	No EGA Communications	MM has lost communications with EGA
		<ul style="list-style-type: none"> Alarm or warning based on option 13 (warning if option 12 is set to monitoring only) Check parameter 10 is set to correct EGA version Check EGA operating mode is selected as 'EGA with MM' Check wiring between EGA and MM (terminals 25 and 26 on MM)
3	O ₂ Upper Limit	O ₂ value is above upper limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 19
4	O ₂ Absolute Limit	O ₂ value is below absolute limit*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 25
5	O ₂ Lower Limit	O ₂ value is below lower limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 22
6	CO ₂ Upper Limit	CO ₂ value is above upper limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 20
7	CO ₂ Absolute Limit	CO ₂ value is above absolute limit*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 26
8	CO ₂ Lower Limit	CO ₂ value is below lower limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 23
9	CO Upper Limit	CO value is above upper limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 21
10	CO Absolute Limit	CO value is above absolute limit*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and option 27
11	NO Upper Limit	NO value is above upper limit offset of commissioned value*
		<ul style="list-style-type: none"> Alarm or warning depending on option 13 Check exhaust gas readings and parameter 94

6 ERRORS AND LOCKOUTS

Fault	Message	Description
12	Exhaust Temperature Upper Limit	Exhaust temperature is above upper limit offset of commissioned value*
		<ul style="list-style-type: none"> • Alarm or warning depending on option 13 • Check exhaust gas readings and parameter 96
13	Exhaust Temperature Absolute Limit	Exhaust temperature is above absolute limit*
		<ul style="list-style-type: none"> • Alarm or warning depending on option 13 • Check exhaust gas readings and parameter 97
50	Load Sensor Fault	Incorrect/no load sensor detected
		<ul style="list-style-type: none"> • Alarm • Check option 1 • Check wiring on terminals 37 - 39
51	Auxiliary Input Low	3mA or lower received from 4-20mA external modulation/ external setpoint
		<ul style="list-style-type: none"> • Alarm • Check parameter 69 • Check feedback from external modulation/ external setpoint controller • Check wiring on terminals 7 - 9
52	Zero Crossing Detection	Irregular mains power
		<ul style="list-style-type: none"> • Warning • Check mains supply to the MM is within acceptable voltage range
63	Zero Crossing Detection	Internal fault in the MM's main board
		<ul style="list-style-type: none"> • Alarm • Check all fuses on the MM's main board • Check the mains supply to the MM is within acceptable voltage range
64	Zero Crossing Detection	Internal fault in the MM's expansion board
		<ul style="list-style-type: none"> • Alarm • Check all fuses on the MM's expansion board • Check the mains supply to the MM is within acceptable voltage range
80	Oil Pressure Sensor Fault	No comms received from oil pressure sensor
		<ul style="list-style-type: none"> • Warning (lockout 81 if oil pressure limits set in option/parameters 139 and 140) • Check wiring and screen on terminals 48, 49
100	Cap Probe 1 Communications Fault	No comms with capacitance probe 1
		<ul style="list-style-type: none"> • Alarm • Check wiring and screen on terminals 1P+, 1P-, 1T+ and 1T-
101	Cap Probe 2 Communications Fault	No comms with capacitance probe 2
		<ul style="list-style-type: none"> • Alarm • Check wiring and screen on terminals 2P+, 2P-, 2T+ and 2T-
102	Cap Probe 1 Short Circuit	Hz reading is below 10kHz
		<ul style="list-style-type: none"> • Alarm • Check water level Hz reading • Check wiring on terminals 1P+, 1P-, 1T+ and 1T-
103	Cap Probe 2 Short Circuit	Hz reading is below 10kHz
		<ul style="list-style-type: none"> • Alarm • Check water level Hz reading • Check wiring on terminals 2P+, 2P-, 2T+ and 2T-

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Fault	Message	Description
104	Cap Probe 1 Temp Compensation Error	Temperature corrected probe reference is not as expected
	<ul style="list-style-type: none"> • Alarm • Re-commission capacitance probes at temperature 	
105	Cap Probe 2 Temp Compensation Error	Temperature corrected probe reference is not as expected
	<ul style="list-style-type: none"> • Alarm • Re-commission capacitance probes at temperature 	
106	Cap Probe 1 Still Water Detected	Wave signature high to low peak distance is less than still water threshold
	<ul style="list-style-type: none"> • Alarm • Check still water threshold in expansion option 28 • Check capacitance probe 1 reading history 	
107	Cap Probe 2 Still Water Detected	Wave signature high to low peak distance is less than still water threshold
	<ul style="list-style-type: none"> • Alarm • Check still water threshold in expansion option 28 • Check capacitance probe 2 reading history 	
108	Cap Probe 1 Serial Number Mismatch	Probe serial number detected is not the commissioned probe serial number
	<ul style="list-style-type: none"> • Alarm • If changing capacitance probe 1, re-commission is required 	
109	Cap Probe 2 Serial Number Mismatch	Probe serial number detected is not the commissioned probe serial number
	<ul style="list-style-type: none"> • Alarm • If changing capacitance probe 2, re-commission is required 	
110	Cap Probe 1 Detected But Not Optioned	Probe connected but not optioned
	<ul style="list-style-type: none"> • Alarm • Check expansion options 1 and 3 • Check wiring on terminals 1P+, 1P-, 1T+ and 1T- 	
111	Cap Probe 2 Detected But Not Optioned	Probe connected but not optioned
	<ul style="list-style-type: none"> • Alarm • Check expansion options 1 and 3 • Check wiring on terminals 2P+, 2P-, 2T+ and 2T- 	
112	External Level Sensor Input Low	3mA or lower received from 4-20mA external level sensor
	<ul style="list-style-type: none"> • Alarm • Check feedback from external level sensor • Check wiring on terminals EX- and EX+ 	
113	Probe Reading Mismatch	Reading of one of the probes/sensor is less than or equal to its end-of-probe value or the difference between probes/sensor readings is greater than the mismatch threshold
	<ul style="list-style-type: none"> • Alarm • Check expansion option 27 • Check capacitance probes and sensor readings 	

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Fault	Message	Description
114	Probe Serial Numbers are the Same	One capacitance probe detected on both capacitance probe terminals
	<ul style="list-style-type: none"> • Alarm • If using two capacitance probes, then two individual probes must be connected • Check wiring on terminals 1P+, 1P-, 1T+, 1T-, 2P+, 2P-, 2T+ and 2T- 	
120	Aux WL Inputs Mismatch	High water and 1 st or 2 nd low auxiliary level inputs detected simultaneously
	<ul style="list-style-type: none"> • Alarm • Check wiring on terminals HAI, 1AI and 2AI 	
121	Water Levels Diverse	Probes/ sensor detects 1 st or 2 nd low and high water simultaneously
	<ul style="list-style-type: none"> • Alarm • Check water level readings for probes and sensor if optioned • Re-commission probes/sensor 	
122	Permanent Alarm Reset Input	Input held on alarm reset terminal for more than 10 seconds
	<ul style="list-style-type: none"> • Alarm • Check input on terminal M/R 	
123	Second Low Probe Communications Fault	No comms with second low probe
	<ul style="list-style-type: none"> • Alarm • Check wiring and screen on terminals 5T+, 5T-, 4P- and 4P+ 	
124	Second Low Probe Hardware Fault	Internal check failed
	<ul style="list-style-type: none"> • Alarm • Contact Autoflame approved local tech centre 	
125	Permanent Test Input	Input held on test terminal for more than 60 seconds
	<ul style="list-style-type: none"> • Alarm • Check input on terminal TST 	
126	Second Low Probe Detected But Not Optioned	Second low probe connected but not optioned
	<ul style="list-style-type: none"> • Alarm • Check expansion option 6 • Check wiring on terminals 5T+, 5T-, 4P- and 4P+ 	
127	Aux WL Inputs Detect But Not Optioned	Mains detected on auxiliary WL inputs but not optioned
	<ul style="list-style-type: none"> • Alarm • Check expansion option 5 • Check wiring on terminals HAI, 1AI and 2AI 	
130	Feed Water Servo Position Error	Servomotor is outside of the commissioned range
	<ul style="list-style-type: none"> • Alarm or warning or depending on expansion option 20 (if set to warning, feed water pump will continue to operate as normal) • Check wiring on terminals P-, FW and P+ • Check signal cable from the MM to the servomotor is screened at one end • Check that the servomotor is zeroed correctly 	

6 ERRORS AND LOCKOUTS

Fault	Message	Description
131	Feed Water Servo Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Alarm or warning depending on expansion option 20 • Check wiring and voltages on terminals MVI and MVD • Check servomotor drives in correct direction • Check feed water valve is not stuck
150	High Water	Probes/sensor detect water level above commissioned high water
		<ul style="list-style-type: none"> • Alarm or warning depending on expansion option 9 • Check water level reading
151	Pre-High Water	Probes/sensor detect water level above set pre-high water
		<ul style="list-style-type: none"> • Warning • Check water level reading • Check expansion option 7
152	Pre-1 st Low	Probes/sensor detect water level below set pre-1 st low
		<ul style="list-style-type: none"> • Warning • Check water level reading • Check expansion option 8
153	1 st Low	Probes/sensor detect water level below commissioned 1 st low
		<ul style="list-style-type: none"> • Alarm • Check water level reading • 1st low alarm will automatically clear if water level increases above 1st low
154	2 nd Low	Probes/sensor detect water level below 2 nd low
		<ul style="list-style-type: none"> • Alarm • Check water level reading • 2nd low alarm requires manual reset
155	Shunt Switch Time Expired	Once shunt switch time expires, system goes to normally running
		<ul style="list-style-type: none"> • Warning • If water drops after shunt switch time expires, system will generate 1st or 2nd low as relevant
200	Top Blowdown Sensor Communications Fault	No comms with the top blowdown sensor
		<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals 3P+, 3P-, 3T+ and 3T-
201	Top Blowdown Servo Position Error	Servomotor is outside of the commissioned range
		<ul style="list-style-type: none"> • Warning • Check wiring on terminals P-, TW, P+ and TBI, TBD • Check signal cable from the MM to the servomotor is screened at one end • Check that the servomotor is zeroed correctly
202	Top Blowdown Servo Movement Error	Servomotor moves when not expected and vice versa
		<ul style="list-style-type: none"> • Warning • Check wiring on terminals TBI and TBD • Check servomotor drives in correct direction • Check top blowdown valve is not stuck
250	Top Blowdown Reading High	TDS value detected too high
		<ul style="list-style-type: none"> • Warning • Check expansion option 46 and TDS value

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Fault	Message	Description
300	Bottom Blowdown Controller Comms	No comms with bottom blowdown controller
		<ul style="list-style-type: none"> • Warning • Check bottom blowdown controller is powered on and enabled • Check wiring and screen on terminals 5T+ and 5T-
301	Bottom Blowdown Controller Software Fault	Internal check failed
		<ul style="list-style-type: none"> • Warning • Contact Autoflame approved local tech centre
302	Bottom Blowdown Servo Closing Fault	No movement detected when bottom blowdown valve goes to close
		<ul style="list-style-type: none"> • Warning • Check wiring on terminals 5T+ and 5T- • Check bottom blowdown valve is not stuck
303	Bottom Blowdown Servo Opening Fault	No movement detected when bottom blowdown valve goes to open
		<ul style="list-style-type: none"> • Warning • Check wiring on terminals 5T+ and 5T- • Check bottom blowdown valve is not stuck
304	Bottom Blowdown Servo Battery Drive Fault	Battery has failed on bottom blowdown controller
		<ul style="list-style-type: none"> • Warning • Contact Autoflame approved local tech centre
305	Bottom Blowdown Controller Main Power Fault	Main power has failed on bottom blowdown controller
		<ul style="list-style-type: none"> • Warning • Contact Autoflame approved local tech centre
350	Bottom Blowdown Servo Not Commissioned	Bottom blowdown controller has not been requested to drive servomotor to closed since it was powered on
		<ul style="list-style-type: none"> • Warning • Commission bottom blowdown servomotor
400	Draught Pressure Sensor Timeout	No comms within 2 seconds from draught pressure sensor
		<ul style="list-style-type: none"> • Alarm or warning depending on option 88 • Check wiring and screen on terminals DT+, DT-, DP- and DP+
410	Draught Pressure Outside Tolerance	Pressure is outside of set tolerance
		<ul style="list-style-type: none"> • Alarm or warning depending on option 88 • Check expansion option 87
420	Fuel flow Feedback Input Low	3mA or lower received from 4-20mA external fuel flow input
		<ul style="list-style-type: none"> • Warning • Check feedback from external fuel flow input • Check wiring on terminals EX- and EX+
430	Fuel flow Feedback Below Tolerance	Fuel flow signal below fuel flow feedback fault tolerance
		<ul style="list-style-type: none"> • Warning • Check feedback from external fuel flow input • Check option 60

6 ERRORS AND LOCKOUTS

Fault	Message	Description
431	Fuel flow Feedback Above Tolerance	Fuel flow signal above fuel flow feedback fault tolerance
	<ul style="list-style-type: none"> • Warning • Check feedback from external fuel flow input • Check option 60 	
440	Temperature Sensor T1 Fault	Fault or no comms with T1 sensor
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals - and T1 	
441	Temperature Sensor T2 Fault	Fault or no comms with T2 sensor
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals - and T2 	
442	Temperature Sensor T3 Fault	Fault or no comms with T3 sensor
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals - and T3 	
443	Make Up Flow Meter Fault	Fault or no comms with make up flow meter
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals F- and MF 	
444	Condensate Flow Meter Fault	Fault or no comms with condensate flow meter
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals F- and CF 	
445	Deaerator IO Comms Fault	Fault or no comms with deaerator IO
	<ul style="list-style-type: none"> • Warning • Check wiring and screen on terminals 6T+ and 6T- 	
500	Multi-Burner Communications Fault	Loss of comms between MMs in multi-burner loop
	<ul style="list-style-type: none"> • Alarm • Check wiring on terminals 23 and 24 on all MMs in multi-burner loop 	
501	Multi-Burner Version Mismatch	Software versions of MMs in multi-burner loop do not match
	<ul style="list-style-type: none"> • Alarm • Check that software versions of MMs in multi-burner loop match 	
502	Multi-Burner Not Polled	MM in multi-burner loop has been detected but not polled
	<ul style="list-style-type: none"> • Alarm • Check option 51 on master MM • Check wiring on terminals 23 and 24 	
503	Multi-Burner Config (Multi-Burner Mode)	Multi-burner mode is not the same for all MMs in loop
	<ul style="list-style-type: none"> • Alarm • Check option 43 on all MMs in multi-burner loop 	
504	Multi-Burner Config (Fuel Index)	Same fuel number must be selected on all MMs in multi-burner loop
	<ul style="list-style-type: none"> • Alarm • Check which fuel is selected on all MMs in multi-burner loop • Check wiring on terminals 89, 90, 91 and 92 	
505	Multi-Burner Config (Fuel Type)	Fuel type is not the same for all MMs in multi-burner loop
	<ul style="list-style-type: none"> • Alarm • Check option/parameters 150 - 153 on all MMs in multi-burner loop 	

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Fault	Message	Description
506	Multi-Burner Config (Pilot Type)	Pilot type not the same for all MMs multi-burner loop
		<ul style="list-style-type: none"> • Alarm • Check option/parameter 111 on all MMs in multi-burner loop
507	Multi-Burner Config (Load Sensor)	Load sensor not set the same for all MMs in multi-burner loop
		<ul style="list-style-type: none"> • Alarm • Check option 1 on all MMs in multi-burner loop
510	Multi-Burner Differential Firing Rate	Slave MM firing rate differs from the Master MM firing rate by 1.5x the Differential Firing Rate Limit (Option 52) value
		<ul style="list-style-type: none"> • Alarm • Check modulation speed of the slave MMs
550	Fuel Flow Meter Fault	Less than 3mA signal received from fuel flow meter
		<ul style="list-style-type: none"> • Alarm or warning depending on expansion option 152 (if set to warning, the MM will use the commissioned value without any fuel or air servomotor adjustment) • Check wiring and screen on terminal MF and F-
551	Air Flow Meter Fault	Less than 3mA signal received from air flow meter
		<ul style="list-style-type: none"> • Alarm or warning depending on expansion option 152 (if set to warning, the MM will use the commissioned value without any fuel or air servomotor adjustment) • Check wiring and screen on terminal EX+ and EX-
552	Fuel Temperature Sensor Fault (T2)	Fault or no comms with T2 sensor
		<ul style="list-style-type: none"> • Warning (MM will use commissioned temperature) • Check wiring and screen on terminals - and T2
553	Air Temp Sensor Fault (T3)	Fault or no comms with T3 sensor
		<ul style="list-style-type: none"> • Warning (MM will use commissioned temperature) • Check wiring and screen on terminals - and T3
554	Fuel Pressure Sensor Fault	Fault or no comms with fuel pressure sensor
		<ul style="list-style-type: none"> • Warning or lockout if VPS and/or pressure limits enabled in option/parameters 125 - 128 (if warning, MM uses commissioned pressure) • Check wiring and screen on terminals 31 - 34
555	Air Pressure Sensor Fault	Fault or no comms with air pressure sensor
		<ul style="list-style-type: none"> • Warning/Lockout -option 148 • Check wiring and screen on terminals 31 - 34 • Lockout if option 148 is set for air pressure sensor in flame safeguard
560	Fully Metered Air Adjustment Failure	Air adjustment has reached limit and fuel-air ratio still not met
		<ul style="list-style-type: none"> • Alarm/Warning - exp option 151 • Check for changes affecting combustion including fuel/air pressure, temperature etc. • Warning if expansion option 151 is set to 1 • Warning and air adjustment is disabled if expansion option 151 is set to 2
580	Servo Control I/O Unit Communications Fault	Fault or no comms with the servo control IO module
		<ul style="list-style-type: none"> • Alarm • Check for wiring on terminals 6T+ and 6T-
581	Servo Control I/O Unit Channel 1 Output Fault	4-20mA output detects open circuit
		<ul style="list-style-type: none"> • Alarm • Check wiring on output 1 on I/O module

6 ERRORS AND LOCKOUTS

Fault	Message	Description
582	Servo Control I/O Unit Channel 2 Output Fault	4-20mA output detects open circuit
	<ul style="list-style-type: none"> • Alarm • Check wiring on output 2 on I/O module 	
583	Servo Control I/O Unit Channel 3 Output Fault	4-20mA output detects open circuit
	<ul style="list-style-type: none"> • Alarm • Check wiring on output 3 on I/O module 	
584	Servo Control I/O Unit Channel 4 Output Fault	4-20mA output detects open circuit
	<ul style="list-style-type: none"> • Alarm • Check wiring on output 4 on I/O module 	
585	Servo Control I/O Unit Channel 7 Output Fault	4-20mA output detects open circuit
	<ul style="list-style-type: none"> • Alarm • Check wiring on output 5 on I/O module 	
586	Servo Control I/O Unit Channel 1 Input Fault	4-20mA input less than 3mA
	<ul style="list-style-type: none"> • Alarm • Check wiring on input 1 on I/O module 	
587	Servo Control I/O Unit Channel 2 Input Fault	4-20mA input less than 3mA
	<ul style="list-style-type: none"> • Alarm • Check wiring on input 2 on I/O module 	
588	Servo Control I/O Unit Channel 3 Input Fault	4-20mA input less than 3mA
	<ul style="list-style-type: none"> • Alarm • Check wiring on input 3 on I/O module 	
589	Servo Control I/O Unit Channel 4 Input Fault	4-20mA input less than 3mA
	<ul style="list-style-type: none"> • Alarm • Check wiring on input 4 on I/O module 	
590	Servo Control I/O Unit Channel 7 Input Fault	4-20mA input less than 3mA
	<ul style="list-style-type: none"> • Alarm • Check wiring on input 5 on I/O module 	
600	Low gas pressure before fuel changeover	Selected fuel gas pressure is too low and therefore not ready to run
	<ul style="list-style-type: none"> • Warning • Check selected Fuel Gas Pressure • Check gas pressure sensor wiring 	
601	Selected fuel cannot be run	Selected fuel is not fully commissioned
	<ul style="list-style-type: none"> • Warning • Check that selected fuel is properly commissioned for Dual Fuel Output Mode • Check if FGR and/or Golden Start points are optioned but not commissioned 	

*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).

6.4 Settings Conflicts

Some of the options, parameters and expansion options may require another option, parameter or expansion option to be set. Please see the below table for these settings conflicts. A setting conflict will result in the MM being forced in to Commission mode.

Setting Conflict Message
<p>(1) (P53, P54, P55, P56) External load sensor incorrectly configured</p> <ul style="list-style-type: none"> The external load sensor must be set with the minimum and maximum values and voltages. Check option 1 and parameters 53 – 56.
<p>(1) (81, 83) OTC setpoints too high for optioned load sensor</p> <ul style="list-style-type: none"> 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.
<p>(9) (45) Internal stat must be disabled if load sensor not present</p> <ul style="list-style-type: none"> If external modulation is enabled without a load sensor, the internal stat must always be closed. Check options 9 and 45.
<p>(30) (31) Invalid remote setpoint configuration</p> <ul style="list-style-type: none"> 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.
<p>(43) (44) (E1) Water level control only be on the multi-burner master</p> <ul style="list-style-type: none"> Water level control should only be enabled on the master (multi-burner ID 1 set in option 44), when using the multi-burner function. Check options 43, 44 and expansion option 1.
<p>(43) (44) (16) Sequencing only be only the multi-burner master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can be set for sequencing. Check options 16, 43 and 44.
<p>(43) (44) (12) EGA and trim can only be on the multi-burner master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can be optioned with an EGA. Check options 12, 43 and 44.
<p>(43) (44) (E110) First Outs can only be on the multi-burner master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can have first outs enabled. Check options 43, 44 and expansion option 110.
<p>(43) (44) (E120) Heat-flow can only be on the multi-burner master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can have heat flow function enabled. Check options 43, 44 and expansion option 120.
<p>(43) (44) (45) External modulation can only be on the multi-burner master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 4) can be set for external modulation. Check options 43 – 45.
<p>(43) (44) (E82) Draught control can only be on the multi-burner master.</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can be set for draught control. Check options 43, 44 and expansion option 82.
<p>(43) (44) (47) Cold Start should only be optioned on the Multi-Burner Master</p> <ul style="list-style-type: none"> Only the master (multi-burner ID 1 set in option 44) can be se for cold start. Check options 43, 44 and 47
<p>(43) (52) Differential Firing Rate Limit requires Fully-Linked Multi-Burner</p> <ul style="list-style-type: none"> Differential Firing Rate Limit requires Fully- Linked Multi-Burner operation Check options 43 and 52

Setting Conflict Message	
(43) (57) Fuel flow metering must be enabled for multi-burner	<ul style="list-style-type: none"> The multi-burner function requires fuel flow metering. Check options 43 and 57.
(43) (111) Continuous Pilot is not supported for Fully-Linked Multi-Burner	<ul style="list-style-type: none"> Continuous pilot cannot be used in Fully-Linked Multi-Burner operation Check options 43 and 111
(43) (135) NFPA Post Purge cannot be optioned with multi-burner	<ul style="list-style-type: none"> The multi-burner function can only use standard, not NFA post-purge. Check option 43 and option/parameter 135.
(43) (P100) Assured Low-Fire Shut Off not supported for Fully-Linked Multi-Burner	<ul style="list-style-type: none"> Assure Low-Fire Shut Off cannot be used with Fully-Linked Multi-Burner operation Check option 43 and parameter 100
(44) (52) Differential Firing Rate Limit should only be set on the Multi-Burner master	<ul style="list-style-type: none"> Only the Multi-Burner master (multi-burner ID 1 set on option 44) can have Differential Firing Rate Limit enabled Check options 44 and 52
(45) (55) External modulation conflict	<ul style="list-style-type: none"> Switched T88 external modulation is not set with permanent external modulation. Check options 45 and 55.
(45/55) (16) External modulation conflict	<ul style="list-style-type: none"> External modulation cannot be used on any MMs in sequencing. Check options 16, 45 and 55
(45) (P72) External modulation and external setpoint both optioned	<ul style="list-style-type: none"> External modulation and external setpoint cannot be used simultaneously. Check option 45 and parameter 72.
(81, 82, 83, 84) OTC Configuration invalid	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> If no pilot is set, then gas valve configuration cannot be set for single valve pilot. Check option/parameters 111 and 130.
(112, 135) (158) Purge pressure proving timeout shorter than pre-purge time.	<ul style="list-style-type: none"> Purge pressure proving timeout must be longer than the pre-purge time Check option/parameters 112, 135 and 158.
(118, 135) (158) Purge pressure proving timeout shorter than post-purge time.	<ul style="list-style-type: none"> Purge pressure proving timeout must be longer than the post-purge time Check option/parameters 118, 135 and 158.
(118) (135) NFPA Post Purge must be at least 15 seconds.	<ul style="list-style-type: none"> If NFPA Post-Purge is enabled, then this time must be set to a minimum of 15 seconds. Check option/parameters 118 and 135
(125) (150) Valve proving cannot be optioned when fuel type is oil (fuel 1)	<ul style="list-style-type: none"> Valve proving can only be used for gas Check option/parameters 125 and 150

6 ERRORS AND LOCKOUTS

Setting Conflict Message
<p>(126) (151) Valve proving cannot be optioned when fuel type is oil (fuel 2)</p> <ul style="list-style-type: none"> Valve proving can only be used for gas Check option/parameters 126 and 151
<p>(127) (152) Valve proving cannot be optioned when fuel type is oil (fuel 3)</p> <ul style="list-style-type: none"> Valve proving can only be used for gas Check option/parameters 127 and 152
<p>(128) (153) Valve proving cannot be optioned when fuel type is oil (fuel 4)</p> <ul style="list-style-type: none"> Valve proving can only be used for gas Check option/parameters 128 and 153
<p>(125, 126, 127, 128) (129) (135) Post VPS cannot be optioned with NFPA Post Purge.</p> <ul style="list-style-type: none"> If NFPA post-purge is enabled for gas, VPS can only be set for operating before burner start-up. Check option/parameters 125, 126, 127, 128, 129 and 135.
<p>(145) (E110) First Out Interlock requires First Outs to be enabled</p> <ul style="list-style-type: none"> To use First Out Interlock, First Outs functionality has to be enables in expansion option 110 Check option 145 and expansion option 110
<p>(P85) (16) Modulation exerciser cannot be used with sequencing.</p> <ul style="list-style-type: none"> Modulation exerciser should be used for test purposes and cannot be used with sequencing. Check option 16 and parameter 85. Stat exerciser should be used for test purposes and cannot be used with sequencing. Check option 16 and parameter 89.
<p>(P99) (P100) Graceful shutdown and assured low fire shut off not allowed.</p> <ul style="list-style-type: none"> If graceful shutdown is set, then assured low fire shut off cannot be used. Check parameters 99 and 100.
<p>(E1) (1) Water level control requires a boiler pressure sensor.</p> <ul style="list-style-type: none"> Water level control cannot be used with a hot water boiler (load/external temperature detector). Check expansion option 1 and option 1.
<p>(E1) (E3, E4) At least one analogue level sensor required.</p> <ul style="list-style-type: none"> If water level is enabled with one capacitance probe, then an external level sensor is required. Check expansion options 1, 3 and 4.
<p>(E1) (E3, E4, E5, E6) Sensor enabled but water level control disabled.</p> <ul style="list-style-type: none"> Water level control enabled must be enabled if capacitance probes, external level sensor, 2nd low probe or auxiliary water level alarm inputs are set. Check expansion options 1, 3, 4, 5 and 6.
<p>(E3, E4, E5, E6) At least two level sensing elements are required.</p> <ul style="list-style-type: none"> A minimum of two of the following level sensing elements is required: capacitance probe, external level sensor, auxiliary water level alarm input or second low probe. Check expansion options 3, 4, 5 and 6.
<p>(E4) (57) External level sensor cannot be optioned with fuel flow feedback</p> <ul style="list-style-type: none"> External level sensor cannot be used with fuel flow feedback, as they use same terminals. Check expansion option 4 and option 57.
<p>(E11) (E12) Pump turn off point must be above pump turn on point.</p> <ul style="list-style-type: none"> Pump turn off point cannot be set lower than pump turn on point. Check expansion options 11 and 12.
<p>(E17) (E40) Bypass valve cannot be optioned with solenoid top blowdown.</p> <ul style="list-style-type: none"> Bypass and solenoid top blowdown cannot be used together, as they use same terminals. Check expansion options 17 and 40.

6 ERRORS AND LOCKOUTS

Setting Conflict Message
<p>(E28) (E3) External level sensor without scaling requires a capacitance probe.</p> <ul style="list-style-type: none"> • If external level sensor does not have a scale to indicate what level the 4-20mA signal represents, a capacitance probe is required. • Check expansion options 3 and 38.
<p>(E40) (1) Top blowdown requires a boiler pressure sensor.</p> <ul style="list-style-type: none"> • Top blowdown cannot be used with a hot water boiler (load/external temperature detector). • Check expansion option 40 and option 1.
<p>(E42) (E46) TDS warning level less than TDS target.</p> <ul style="list-style-type: none"> • TDS warning level cannot be set lower than the TDS target value. • Check expansion options 42 and 46.
<p>(E60) (1) Bottom blowdown requires a boiler pressure sensor.</p> <ul style="list-style-type: none"> • Bottom blowdown cannot be used with a hot water boiler (load/external temperature detector).
<p>(E62) (E64) Bottom blowdown reduction boiler steam production rating not set.</p> <ul style="list-style-type: none"> • If bottom blowdown reduction is enabled, than steam production rating must be set. • Check expansion options 62 and 64.
<p>(E62) (E120) Bottom blowdown reduction requires steam flow to be enabled.</p> <ul style="list-style-type: none"> • If bottom blowdown reduction is enabled, then steam flow metering must be enabled. • Check expansion options 62 and 120.
<p>(E80) (E82) Draught control enabled but draught servo disabled.</p> <ul style="list-style-type: none"> • Draught servomotor must be enabled for draught control. • Check expansion options 80 and 82.
<p>(E120) (57) Heat flow requires fuel flow to be optioned and commissioned.</p> <ul style="list-style-type: none"> • If heat flow function is set, fuel flow metering must be optioned and commissioned. • Check expansion 120 and option 57.
<p>(E120) (1) Steam flow requires a boiler pressure sensor.</p> <ul style="list-style-type: none"> • A boiler load/external pressure detector must be set for steam flow metering. • Check expansion option 120 and option 1.
<p>(E120) (1) Water flow requires a boiler temperature sensor.</p> <ul style="list-style-type: none"> • A boiler load/external temperature detector must be set for hot water flow metering. • Check expansion option 120 and 1.
<p>(E127) (E128) Steam flow start pressure offset must be less than stop offset.</p> <ul style="list-style-type: none"> • The steam flow start pressure offset cannot be set higher than the steam flow stop pressure offset. • Check expansion options 127 and 128.
<p>(E140) (12) Fully metered cannot be optioned with EGA trim.</p> <ul style="list-style-type: none"> • Fully metered control can be used with the EGA set as monitoring only, but not 3-parameter trim. • Check expansion option 140 and option 12.
<p>(E140) (E4) Fully metered cannot be optioned with external water level probe.</p> <ul style="list-style-type: none"> • Fully metered control cannot be used with external water level probe (terminals EX- and EX+ are required for both features). • Check expansion options 140 and 4.
<p>(E140) (E120, E129) Fully metered cannot be optioned with local heat flow.</p> <ul style="list-style-type: none"> • Fully metered control cannot be used with steam or hot water flow metering. • Check expansion options 140, 120 and 129.
<p>(E140) (E141, E143) Fuel temperature cannot be optioned with mass flow meter.</p> <ul style="list-style-type: none"> • Fuel temperature sensor cannot be used with a fuel mass flow meter in fully metered control. • Check expansion options 140, 141 and 143.

Setting Conflict Message
(E140) (E141, E145) Fuel pressure cannot be optioned with mass flow meter. <ul style="list-style-type: none"> Fuel pressure sensor cannot be used with a fuel mass flow meter in fully metered control. Check expansion options 140, 141 and 145.
(E140) (E142, E144) Air temperature cannot be optioned with mass flow meter. <ul style="list-style-type: none"> Air temperature sensor cannot be used with an air mass flow meter in fully metered control. Check expansion options 140, 142 and 144.
(E140) (E142, E146) Air pressure cannot be optioned with mass flow meter. <ul style="list-style-type: none"> Air pressure sensor cannot be used with an air mass flow meter in fully metered control. Check expansion options 140, 142 and 146.
(E140) (150, E154) Fully metered requires gas fuel 1 to have non-zero density. <ul style="list-style-type: none"> Density must be set for gas in fully metered control. Check option 150 and expansion options 140 and 154.
(E140) (151, E155) Fully metered requires gas fuel 2 to have non-zero density. <ul style="list-style-type: none"> Density must be set for gas in fully metered control. Check option 151 and expansion options 140 and 155.
(E140) (152, E156) Fully metered requires gas fuel 3 to have non-zero density. <ul style="list-style-type: none"> Density must be set for gas in fully metered control. Check option 152 and expansion options 150 and 156.
(E140) (153, E157) Fully metered requires gas fuel 4 to have non-zero density. <ul style="list-style-type: none"> Density must be set for gas in fully metered control. Check option 153 and expansion options 140 and 157.
(E140) (E142) Fully metered requires non-zero fuel flow meter scaling. <ul style="list-style-type: none"> Fuel flow meter must be scaled in fully metered control. Check expansion options 140 and 142.
(E140) (E144) Fully metered requires non-zero air flow meter scaling. <ul style="list-style-type: none"> Air flow meter must be scaled in fully metered control. Check expansion options 140 and 144.
(E140) (60) Fully metered does not function with fuel flow feedback tolerance. <ul style="list-style-type: none"> Fully metered control cannot be used with fuel flow feedback tolerance (terminals EX- and EX+ are required for both features). Check option 60 and expansion 140.
(E140) (57) Fully metered requires fuel flow metering to be enabled (1). <ul style="list-style-type: none"> Fuel flow metering must be enabled when using fully metered control. Check option 57 and expansion option 140.
(E140) (76) Fully metered cannot use air trim on channel 5 (VSD). <ul style="list-style-type: none"> Air trim cannot be used on channel 5 VSD in fully metered control. Check option 76 and expansion option 140.
(86) (E129) Servo channel 1 via I/O unit cannot be optioned with heatflow sensors via I/O unit. <ul style="list-style-type: none"> Heat flow sensors from the I/O unit cannot be optioned with servo channel via I/O unit. Check option 86 and expansion 129.
(87) (E129) Servo channel 2 via I/O unit cannot be optioned with heatflow sensors via I/O unit. <ul style="list-style-type: none"> Heat flow sensors from the I/O unit cannot be optioned with servo channel via I/O unit. Check option 87 and expansion 129.
(88) (E129) Servo channel 3 via I/O unit cannot be optioned with heatflow sensors via I/O unit. <ul style="list-style-type: none"> Heat flow sensors from the I/O unit cannot be optioned with servo channel via I/O unit. Check option 88 and expansion 129.

Setting Conflict Message

(89) (E129) Servo channel 4 via I/O unit cannot be optioned with heatflow sensors via I/O unit.

- Heat flow sensors from the I/O unit cannot be optioned with servo channel via I/O unit.
- Check option 89 and expansion 129.

(E81) (E129) Servo channel 7 via I/O unit cannot be optioned with heatflow sensors via I/O unit.

- Heat flow sensors from the I/O unit cannot be optioned with servo channel via I/O unit.
- Check expansion options 81 and 129.

6.5 Forced Commission Reasons

In addition to when there is a setting conflict, the MM will be forced into commission mode if any of the forced commission reason occurs.

Forced Commission Message
Fuel not commissioned.
<ul style="list-style-type: none"> Selected fuel must be commissioned.
Servo configuration does not match commissioning.
<ul style="list-style-type: none"> Option 8 and/or expansion option 80 do not match the last commission settings.
VSD configuration does not match commissioning.
<ul style="list-style-type: none"> VSD settings for channels 5 and 6 must be the same as the last commission settings.
Golden start optioned but not commissioned.
<ul style="list-style-type: none"> Commission golden start position (see section 3.4.8).
FGR optioned but not commissioned.
<ul style="list-style-type: none"> Commission FGR start position (see section 3.4.9).
Trim channel does not match commissioning.
<ul style="list-style-type: none"> Option 76 trim channel must be the same as the last commission settings.
Fuel/air-rich trim ranges changed.
<ul style="list-style-type: none"> Parameter 13 and/or parameter 19 do not match last commission settings.
BC Option/parameter mismatch.
<ul style="list-style-type: none"> BC options 110 – 160 must be set the same as their corresponding parameters.
Invalid option value.
<ul style="list-style-type: none"> An option value is outside the allowed range.
Invalid parameter value.
<ul style="list-style-type: none"> A parameter value is outside the allowed range.
Invalid expansion option value.
<ul style="list-style-type: none"> An expansion option value is outside the allowed range.
Options have been reset.
<ul style="list-style-type: none"> Option settings have been reset due to data lost in an EEPROM error.
Parameters have been reset.
<ul style="list-style-type: none"> Parameter settings have been reset due to data lost in an EEPROM error.
Expansion options have been reset.
<ul style="list-style-type: none"> Expansion option settings have been reset due to data lost in an EEPROM error.
VPS sensor not commissioned.
<ul style="list-style-type: none"> Gas pressure sensor has been enabled but not commissioned.
Commissioned gas pressure during valve proving too low.
<ul style="list-style-type: none"> Gas pressure stored during valve proving is less than option/parameters 133 and/or 136.
Commissioned running gas pressure too low.
<ul style="list-style-type: none"> Gas pressure at one or more commissioned points is less than option/parameter 136.
APS sensor not commissioned.
<ul style="list-style-type: none"> Air pressure has been enabled but not commissioned.
Commissioned air pressure too low.
<ul style="list-style-type: none"> Air pressure at one or more commissioned points is less than option/parameters 147 and/or 149.
IR Upload was completed successfully, check configuration then restart.
<ul style="list-style-type: none"> Check data has uploaded successfully before restarting in run mode.

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Forced Commission Message
Options and/or parameters reset to default values. Check configuration then restart.
<ul style="list-style-type: none"> • Reset of setting using option/parameter 160. Set/check settings and restart.
First outs are optioned but not configured. Check configuration then restart.
<ul style="list-style-type: none"> • Configure first outs and restart.
Too many sensors require commissioning.
<ul style="list-style-type: none"> • Gas and air pressure sensors can be optioned on after fuel has been commissioned, but only one a time before completing commissioning process for each.
Draught servo minimum angle greater than a commissioned draught servo angle.
<ul style="list-style-type: none"> • One or more commissioned points for draught servomotor is lower than expansion option 83.c
Capacitance probe not commissioned.
<ul style="list-style-type: none"> • Capacitance probe has been enabled but not commissioned.
Capacitance probe serial number does not match commissioning.
<ul style="list-style-type: none"> • Capacitance probes have changed, recommission water level.
External level sensor not commissioned.
<ul style="list-style-type: none"> • External level sensor has been enabled but not commissioned.
VSD1 Feedback variation too small. Maximum VSD fault tolerance is –
<ul style="list-style-type: none"> • Difference between smallest and largest channel 5 VSD feedback is less than option 99 (this message will display required value for option 99 to run).
VSD 2 Feedback variation too small. Maximum VSD fault tolerance is –
<ul style="list-style-type: none"> • Difference between smallest and largest channel 6 VSD feedback is less than option 109 (this message will display a required value for option 109 to run).
Draught control optioned but not commissioned.
<ul style="list-style-type: none"> • Draught control has been enabled but not commissioned.
Fully metered optioned but not commissioned.
<ul style="list-style-type: none"> • Fully metered control has been enabled but not commissioned.
Fully metered configuration does not match commissioning.
<ul style="list-style-type: none"> • One or more sensors used for fully metered control that were not present during commissioning are now enabled.

6.6 Troubleshooting and Further Information

6.6.1 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

6.6.2 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.

6.6.3 Snubbers

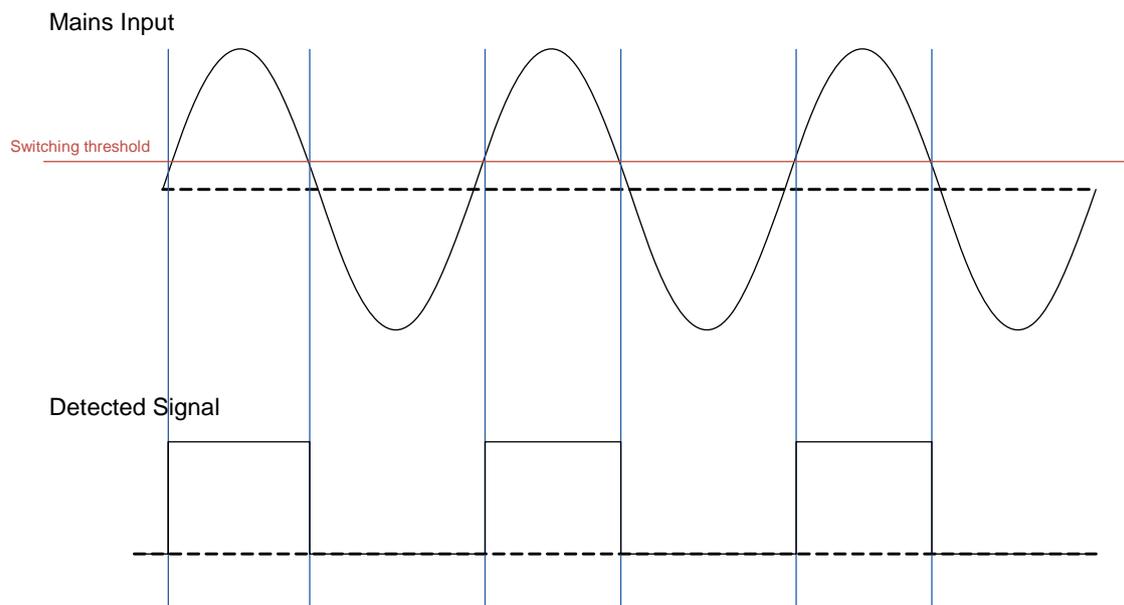
The Autoflame system has internal components which protects itself against voltage/current spikes and electrical interference. In some installations this internal protection is not enough, especially when the main fuel valve Terminals 60 and 61 have been connected to older gas valves and voltage/current 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.

6.6.4 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 $\pm 10\%$ of the required voltage, and the unit is earthed properly. This can cause hunting issues if not at the required voltage or incorrect earthing.

6.6.5 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.

7 STANDARDS

The 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

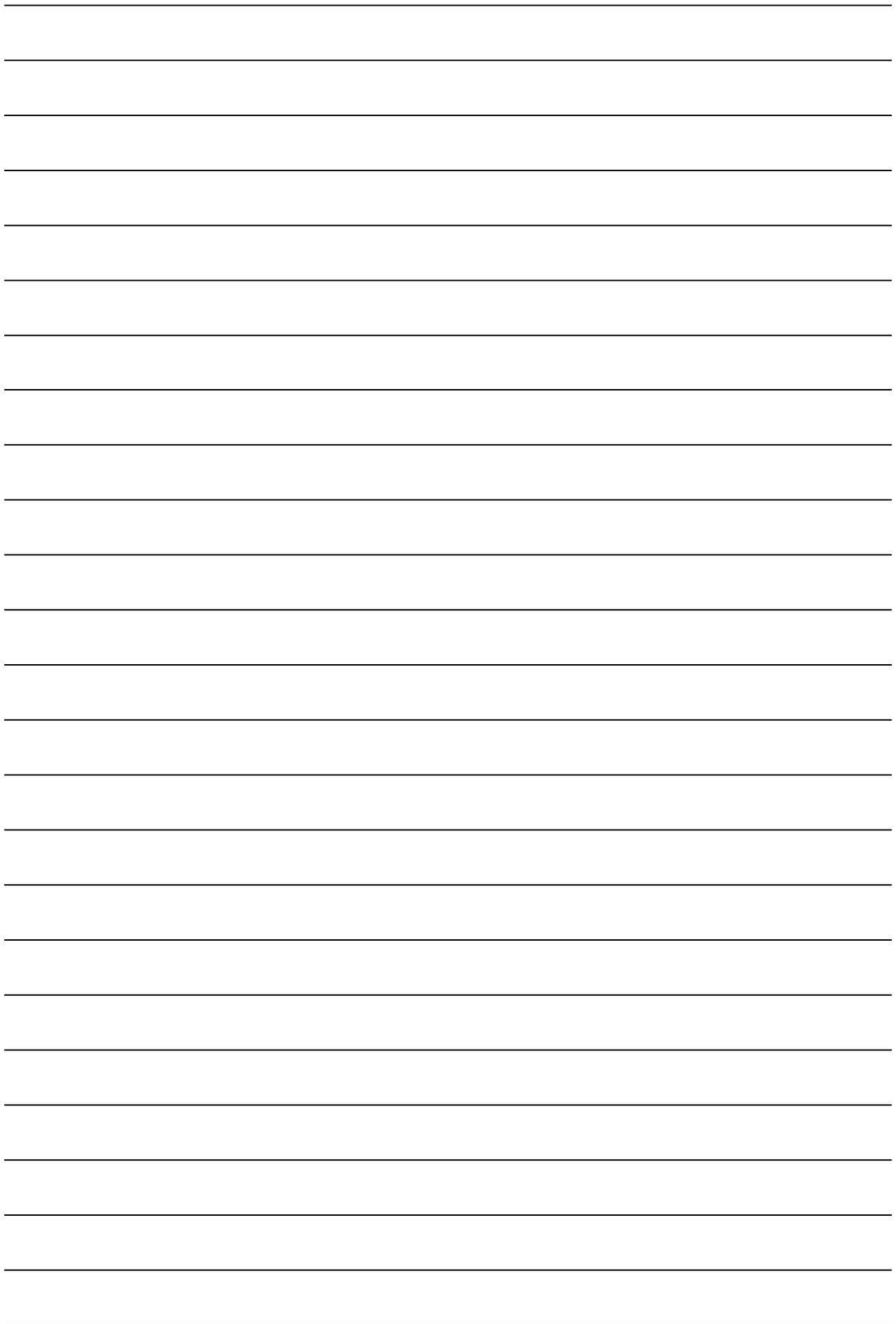
BS EN 1643:2014

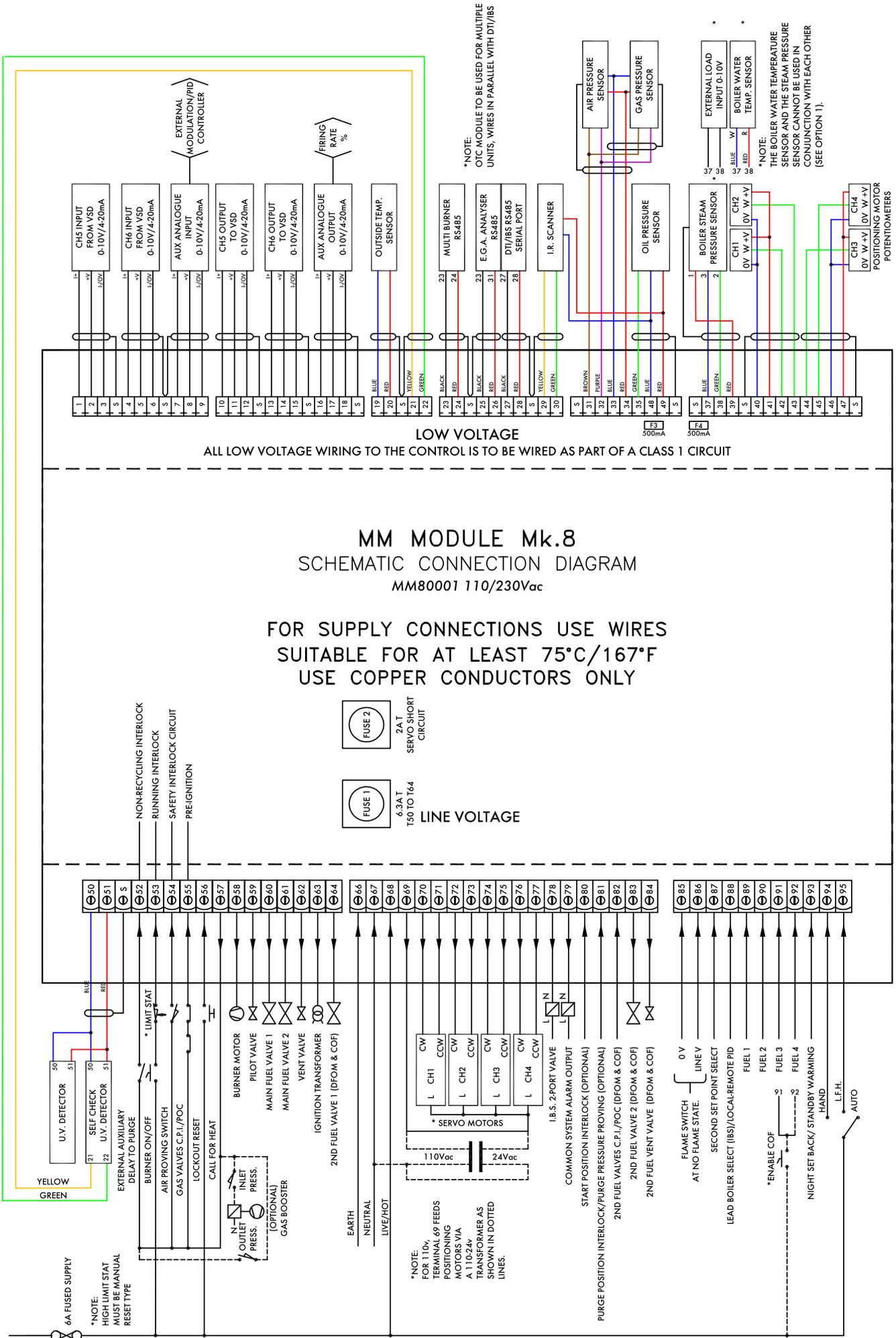
BS EN 1854

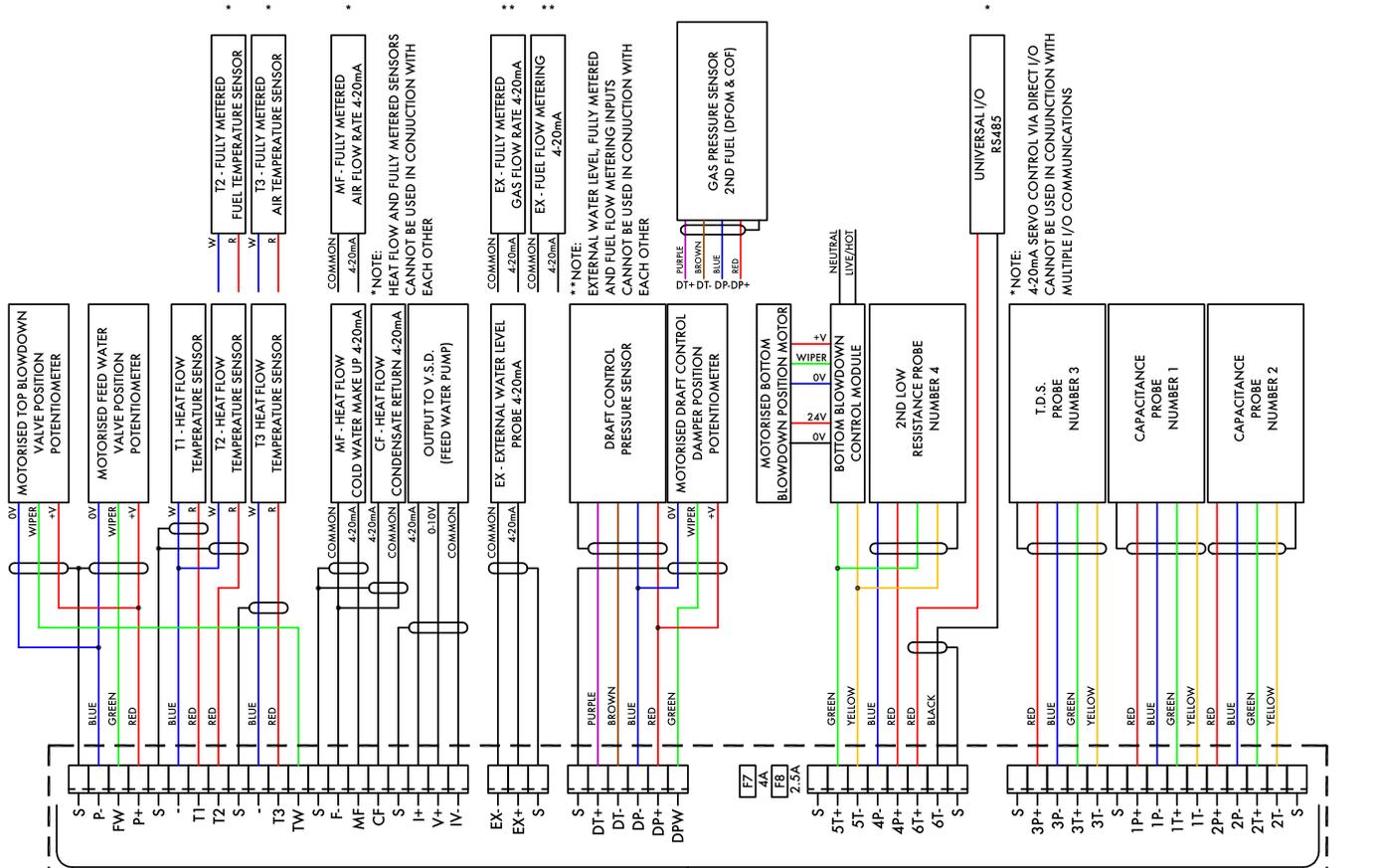
ISO 23552-1:2007

AS 4625 - 2008

AS 4630 - 2005

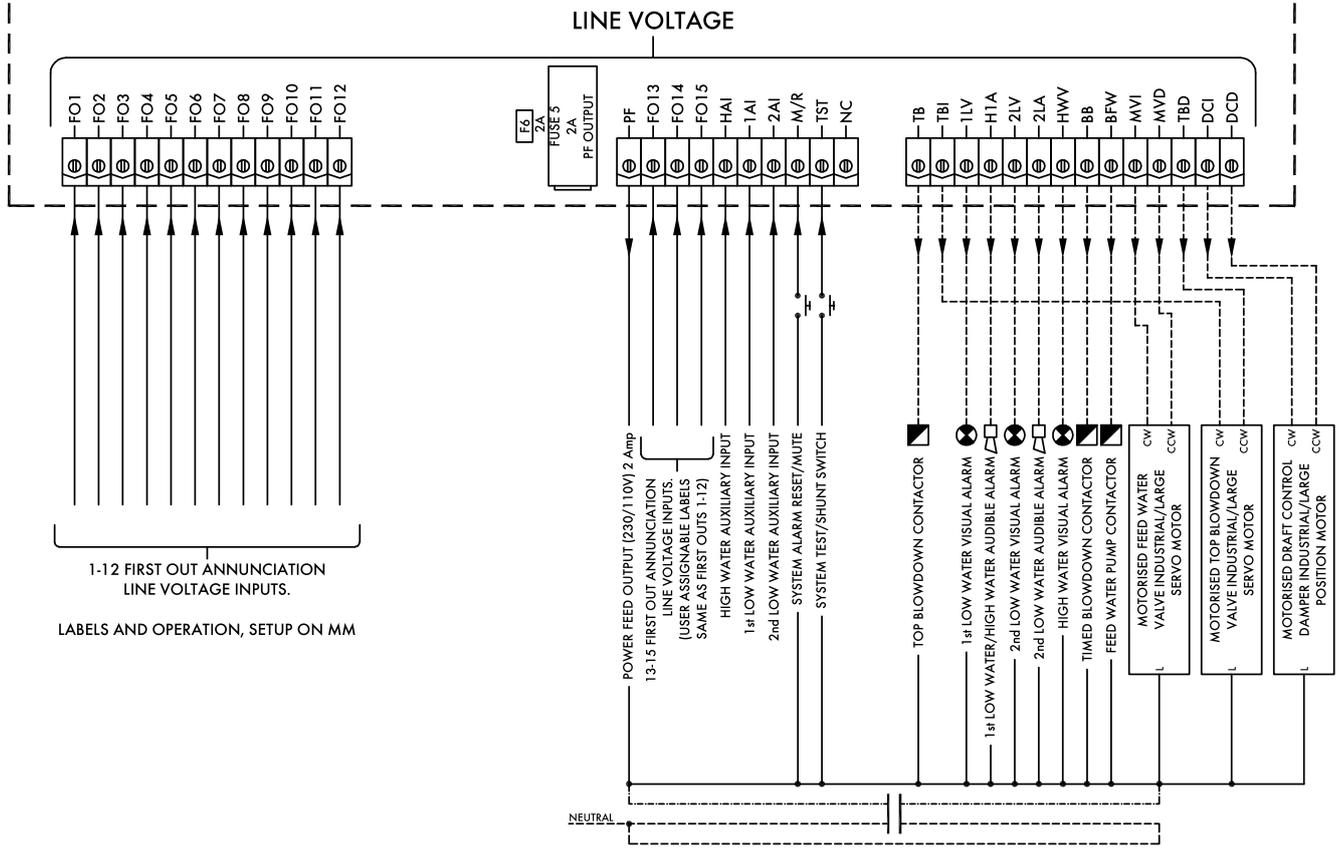






LOW VOLTAGE
 ALL LOW VOLTAGE WIRING TO THE CONTROL IS TO BE WIRED AS PART OF A CLASS 1 CIRCUIT

EXPANSION BOARD P.C.B. SCHEMATIC CONNECTION DIAGRAM



1-12 FIRST OUT ANNUNCIATION LINE VOLTAGE INPUTS.
 LABELS AND OPERATION, SETUP ON MM

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