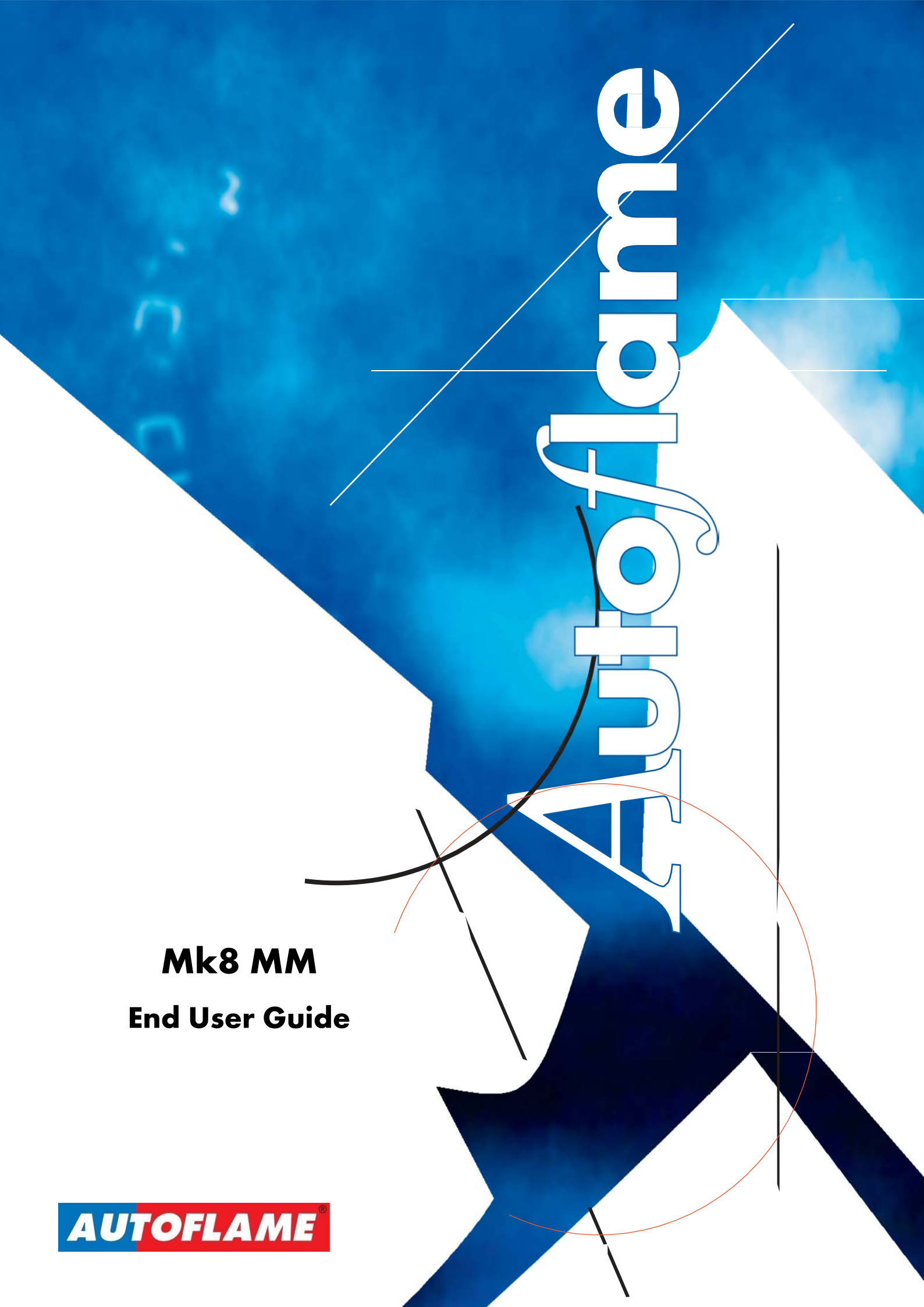

Mk8 MM

End User Guide

AUTOFLAME®

Mk8 MM

End User Guide

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2007

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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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1 OVERVIEW AND BENEFITS

1.1 Features and Benefits

Micro-Modulation (MM) / Flame Safeguard

- Fuel/ air ratio control
- Full colour touch screen
- 120V or 230V standard operation 50/60Hz
- Controls up to 5 servomotors and 2 variable speed drives (VSD/ VFD)
- 4 independent fuel programmes
- Fully adjustable PID load control for temperature or pressure
- Internal flame safeguard – full flame supervision with self-check UV or IR
- Dual flame scanner operation (IR and UV scanners)
- Gas valve train leak supervision and high/low gas pressure monitoring
- Air pressure proving and monitoring
- 128 lockouts, errors, alarms and warnings stored with date, time, phase and reset
- 1000 entry system log stored with date, time and status
- Online diagnostics showing system electronics information
- Single point change for adding, removing and adjusting fuel/air positions on fuel-air curve
- Golden start position for optimum ignition position
- Flue gas recirculation start position
- Variable servomotor travel speed
- Burner control safety times user selectable
- External voltage/current load control and setpoint adjustment
- Outside temperature compensation of boiler setpoint
- Second setpoint and run times scheduling
- Hand/auto/low flame hold firing modes
- Various boiler load detectors available
- Fuel flow metering capability – instantaneous and totalised
- Fuel flow feedback
- Multi-burner capability with synchronised firing rate up to 10 MMs
- 4-20mA (0-20mA) / 0-10V (2-10V) input for external modulation
- 4-20mA (0-20mA) / 0-10V (2-10V) output confirming firing rate
- Fully metered combustion control for commissioning based on equivalence ratio and excess air
- Draft control to maintain stack pressure
- Password protection of all safety related functions
- Infra-red port for upload/download of commission data

- 15 First out annunciation inputs
- 4 fuel commission curves possible
- 24 hour history graphical information on MM when powered on
- Custom boiler display configuration

Water Level Control

- Fully modulating feed water control with servomotor and VSD as well pump on/off
- Capacitance probes for patented wave signature level detection
- Water level alarms 2nd low, 1st low, high water and optional pre 1st low and pre-high water
- Conductivity probe for auxiliary 2nd low alarm
- Automatic bottom blowdown with time reduction for blowdown savings
- Continuous modulating top blowdown control to maintain TDS in water
- Steam/ hot water flow metering to calculate flow rates based on temperature sensor

Exhaust Gas Analyser (EGA)

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

Intelligent Boiler Sequencing

- System will sequence hot water boilers or steam boilers via lead/lag distribution
- Fully adjustable user options within the system to tailor sequencing operation to the application
- System control for isolation of valves or pumps (2 port valve operation)
- Standby setpoint and warming for lag boilers via a standby pressure and timing sequence
- Lead boiler and lag boiler warming modes selection

Remote Control and Data Transfer Interface (DTI)

- Direct Modbus communications from MM including remote setpoint and firing rate adjustment, burner enable/disable (without DTI or intelligent boiler sequencing)
- DTI will collect operational data for up to 10 MM modules, 10 EGA modules and 10 universal I/O modules in one communications loop
- Information transmitted via RS422 or Ethernet link to local PC/network for running Autoflame CEMS Audit software

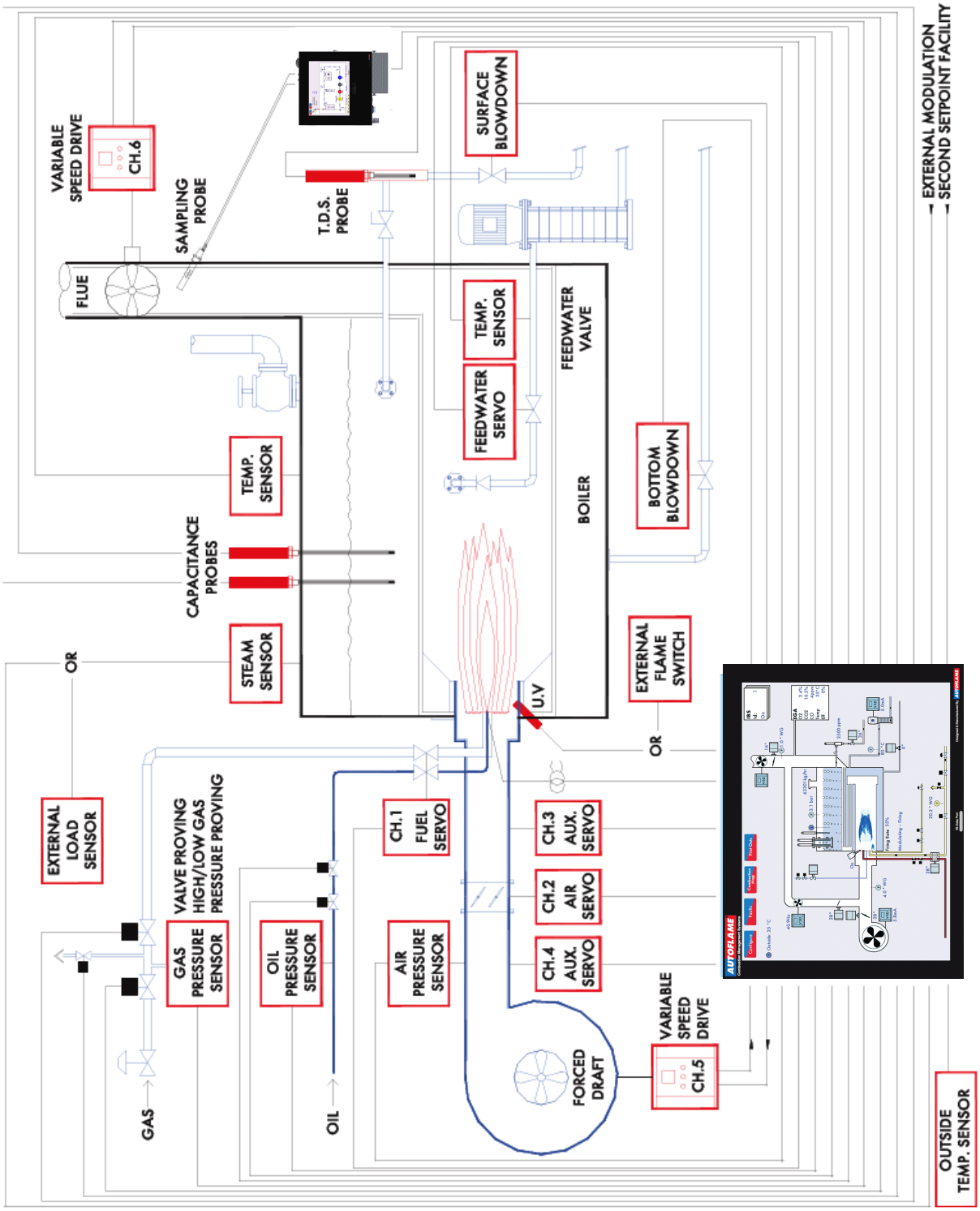
PC Compatible

- Download all commissioning data and controller settings from MM module to a PC
- Upload commission data and controller settings from PC to MM module

Universal Digital and Analogue Input/ Output Module

- Detailed logging inputs and outputs when coupled with Mk7 DTI
- 16 Line voltage inputs (110V/ 230V)
- 6 Analogue inputs and 6 analogue outputs
- 8 Volt free contacts
- Configurable alarms through Mk7 DTTI

1.2 System Example



1.3 Micro-Modulation (MM)

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

- The air to fuel ratio must be kept to the minimum to ensure complete combustion within the limitations of the combustion head design. A very high air to fuel ratio will be an indication of high excess air, which decreases the overall efficiency of the boiler. The fuel valve and air damper positions set for this minimum air to fuel ratio along the whole commission curve must be infinitely repeatable to an incredibly high degree of accuracy.
- The target temperature or pressure of the boiler should be monitored by the combustion system and at all times, with exactly the right amount of fuel and air fired to achieve this target value. Irrespective of load changes, the burner/boiler system should be able to meet the target temperature or pressure.

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

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

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

1.4 Water Level Control

The Autoflame water level control in the Mk8 MM focuses on safety and accuracy in controlling the water level in a steam boiler. The intelligent water level control includes high water alarms, 1st low and 2nd low alarms. Alarm level reporting deals with the ability to determine whether the current water level in the boiler is above or below a predetermined level. These levels vary with each installation, and must therefore be programmed on site by a qualified commissioning engineer.

The feed water flow is managed by 3-element control, in response to the water level measured by the level sensing devices' readings, boiler pressure and the burner's firing rate. The flow is controlled by a fully modulating feed water/VSD or by using an on/off signal from a feed water pump. The feed water going into the boiler can be controlled in the following ways by setting expansion option 2:

- Pump on/off only
- Pump on/off and servomotor control
- Pump on/off and VSD control

The Autoflame 3-element level control has been granted a worldwide patent; being the only system that can combine firing rate, steam pressure and water level within one controller for the purpose of improving feed water control. Safety, accuracy and integrity are guaranteed.

The levels which are commissioned when using capacitance probes and/or external level sensing 4-20mA device include high, control point, 1st low, 2nd low and end of probe.

The level of the water in the boiler should be maintained appropriate to the amount of steam being generated. Should the water level drop below this ideal level by an excessive amount, it is necessary to stop the burner firing. If there is insufficient water in the boiler damage may occur to its structure, and in extreme cases, an explosion. The water level control herein is designed to maintain a satisfactory level of water in the boiler, whilst controlling and reporting low water level conditions.

Total dissolved solids (TDS) are impurities which have not been boiled off with the steam. If the TDS becomes more and more concentrated in the water, bubbles and foaming will occur at the water surface. If these solids then leave with the steam from the boiler, they can contaminate the steam plant equipment, such as heat exchangers, steam traps and control valves. The boiler manufacturer will specify the required TDS level in the water for that boiler. The Mk8 MM has an expansion feature which allows the system to control the TDS level in the boiler via top blowdown control, please see section 4 for top blowdown control.

Suspended solids will exist in the water and if the boiler water is disturbed, they will remain in this state, however when the water is still, these solids will descend to the bottom. Over time, these solids will build up and reduce the heat transfer, and may result in the boiler running less efficient. To reduce this sludge which will build up at the bottom of the boiler, the Mk8 MM has a bottom blowdown control expansion feature. Please see section 5 for bottom blowdown control.

The purpose of steam/hot water flow metering is to measure the amount of steam or hot water which is being produced, and to check the amount of heat this is delivering. The majority of plants will require steam flow metering to check how much steam is being generated and used, and at what cost, so the overall plant efficiency can be determined.

Steam flow meters are very expensive to purchase and install, however with the Autoflame system, the simplest form of steam or hot water flow metering can be set with just using the default values. Autoflame has been granted a worldwide patent on the steam/hot water flow metering function in the software.

1.5 Draught Control

Draught control is used to manage the excess draught from stacks, in both fire-tube and water-tube applications, so heat transfer from the hot gases to the boiler tubes can be optimised. Both heat transfer rate and combustion rate depend on the motion of the flue gases; any changes in boiler pressure can affect the amount of combustion air entering the burner, possibly resulting in unburnt fuel. An excess of unburnt fuel can lead to unsteady combustion with dangerous consequences. A tall stack is susceptible to a changing pressure which is caused be stack temperature and wind velocity. The main benefits of maintain stack pressure through draught control include:

- Improves heat transfer
- Improves combustion efficiency
- Reduces room heat loss
- Improves flame stability while reducing chance of pilot light failure
- Improves flame retention
- Reduce soot accumulation

The Autoflame draught control stores the pressure conditions at the commissioning stage and modulates with the firing curve to maintain this, irrespective of changing firing rate and stack conditions. Normally there is a vertical main stack which has a horizontal cross connection from the boiler flue gas outlet; this is then connected into the main stack.

The boiler only works at optimum efficiency when all of the conditions that effect its operation are held at good commissioned values. Therefore under the new arrangement, a butterfly valve driven by a positioning motor, is placed in the horizontal back flue typically two or three metres from the boiler. A differential pressure sensor is then inserted into the flue that is between the boiler outlet and the butterfly valve. As stack energy alters, the suction or pressure would vary at this point. It can be seen that by measuring the pressure of the draught at the position of the damper could be adjusted to bring the pressure or suction back to its commissioned value, the complete system would then be operating at optimum efficiency again.

1.6 Fully Metered Combustion Control

The fuel-air mixture will determine the combustion performance; poor mixing of the fuel and air will reduce the burner's combustion performance, and in turn, decrease the combustion efficiency. Too fuel rich a fuel-air ratio will result in incomplete combustion, leaving unburnt fuel in the combustion products. Unburnt fuel will cause soot build-up or release harmful CO emissions. In the boiler room, incomplete combustion wastes the fuel, so more fuel is required to meet the load demand, causing a high fuel bill. On the contrast, too much air in the combustion process will waste the heat generated by the fuel burning to heat the excess air; again, the fuel bills will increase. The fully metered system is used in applications where it is not possible to measure the exhaust gases in the stack, or if the firing rate is critical to system and controlled remotely.

The fully metered system will add a layer on top of the standard commission map, with the aim of maintaining the fuel-air ratio for each firing rate. The system can either directly measure mass flow or use corrected volume flows to maintain this ratio.

The Mk8 MM continuously measures the fuel and air flows to compensate for any variations from stored values, in an effort to maintain the commissioned burner efficiency. To compensate for changes the MM will trim the air damper position to try to maintain the commissioned excess air. In addition the MM will move the fuel valve, to try to achieve the firing rate required to maintain the commissioned heat input.

The fully metered combustion control works with the commissioned fuel valve and air damper positions, storing the mass or volume flow of the fuel and air at each point. The flow data is recorded using two 4-20mA inputs, which can be the data from a mass flow meter or calculated from volume flow meter. When using a volume flow meter the fuel density is used to calculate and display a mass flow using either default values or temperature and Autoflame pressure sensors.

If variations occur from the commissioned fuel or air flow, the MM will trim servomotors up to an option limited percentage of their commissioned positions at that time. Unlike other systems, the Autoflame fully metered operation is based on the commissioned fuel-air curve, so combustion deviations are compensated for faster than those systems without a base firing curve. Should any faults occur with the meters, the control can be optioned to revert to the default fuel-air curve to allow the burner to continue to run.

As the fuel valve moves to reach the commissioning firing rate, based on the measured mass flow rate, the air damper will also adjust to achieve the commissioned excess air, due to proportional change required in air flow.

2 ELECTRICAL SPECIFICATIONS

2.1 Classifications

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

2.2 Inputs and Outputs

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	

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.

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 2.3.
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.

2.3 Cable Specifications

Low Voltage
The screened cable used for low voltage wiring from the MM to the servomotors, detectors and variable speed drive must conform to the following specification:

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

16/0.2mm PVC insulated overall braid, screened, PVC sheathed.

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

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

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

(5 Core not readily available)

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

Data Cable
Data cable must be used for communication connections between MMs for sequencing applications as well as between MMs to EGAs, MMs to a DTI and DTI to BMS systems.

Communication cable should not exceed 1km.

Types of data cable that can be used:

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

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

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

2.4 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

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

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
61	Mains voltage output – main fuel valve 2
62	Mains voltage output – vent valve
63	Mains voltage output – ignition transformer
64	Unused – do not connect
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	Unused – do not connect
83	Unused – do not connect
84	Unused – do not connect

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
92	Mains voltage input – selects fuel 4 curve
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)

2.5 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 draft control pressure sensor
DP-	0V supply to draft control pressure sensor and draft control servomotor
DP+	+12V supply to draft control pressure sensor and draft control servomotor
DPW	Signal from draft control servomotor, indicating position
5T+, 5T-	Digital communications from bottom blowdown module and 2nd low probe
4P-	0V supply to 2nd low resistance probe
4P+	+12V supply to 2nd low resistance probe
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 1st low water auxiliary input
2AI	External 2nd low water auxiliary input
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 – 1st low water visual alarm
H1A	Switched neutral – 1st low/ high water audible alarm
2LV	Switched neutral – 2nd low water visual alarm
2LA	Switched neutral – 2nd 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 draft control servomotor clockwise
DCD	Switched neutral – drives draft control servomotor counter clockwise

3 END USER OPERATION

3.1 Home Screen

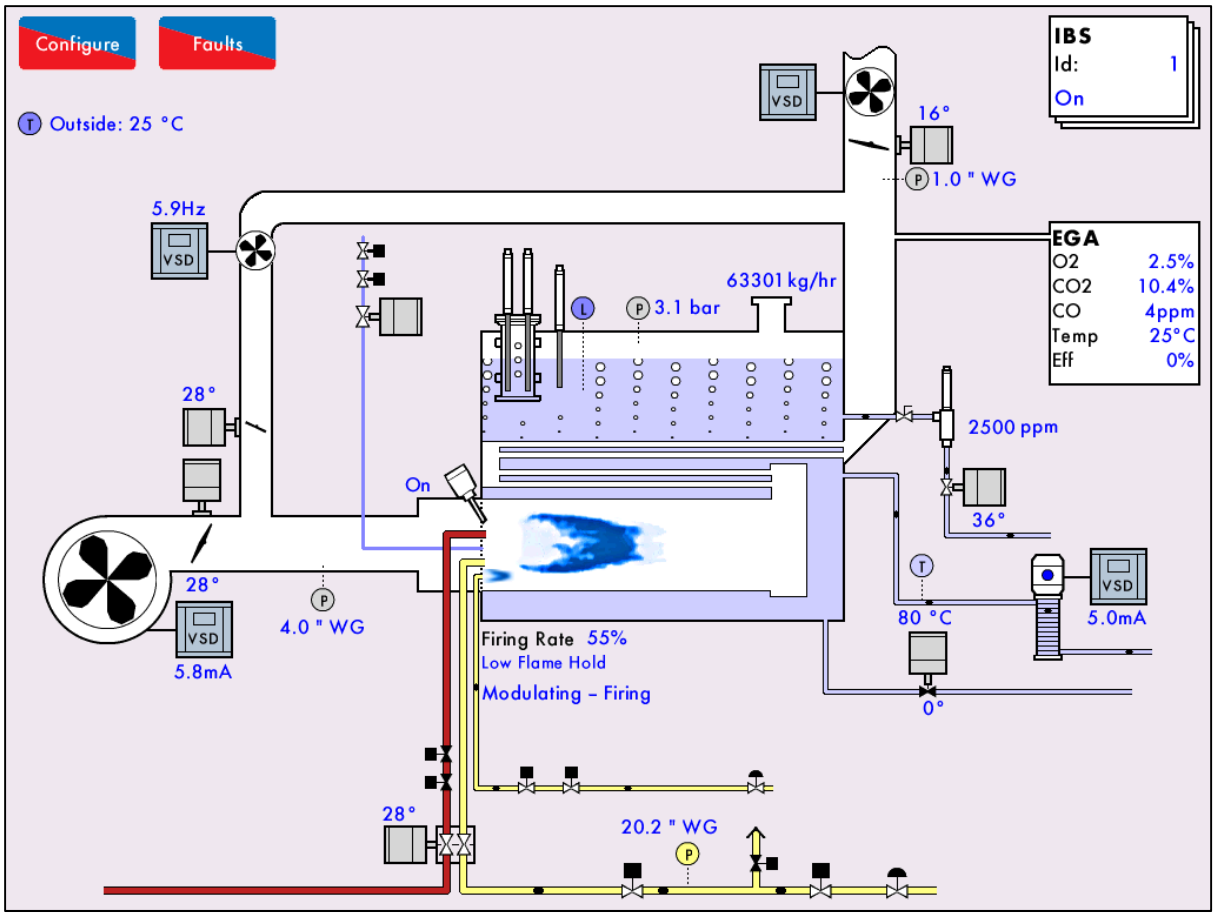
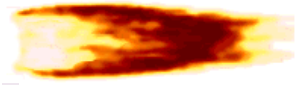
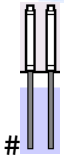
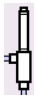
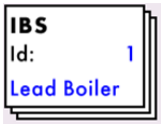


Figure 3.1.i Home Screen

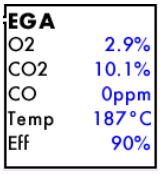
The home screen shown in Figure 3.1.i displays the current boiler setup. It provides operation information for each component of the burner/boiler in real time. Pressing on components will display further information e.g. pressing on the servomotor image will show the servomotor position history. This boiler room setup can be configured to display what is actually on site, please see section 3.19.5 Boiler Room Configuration.

3.1.1 Home Screen Components

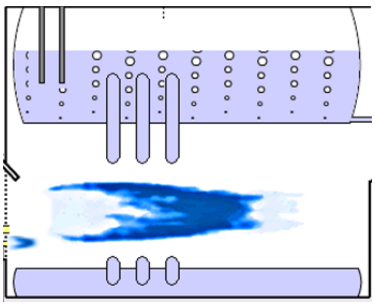
	Servomotor		Variable speed drive
	Flame scanner		Oil pressure sensor
	Air pressure sensor/ boiler steam pressure detector		Gas pressure sensor
	Boiler temperature detector/ outside temperature sensor		Feed water temperature sensor
	Main fuel valve open		Main fuel valve closed
	Pilot gas valve open		Pilot gas valve closed
	Control fuel valve open		Control fuel valve closed
	Main gas regulator		Pilot gas regulator
	Gas flowing		No gas flowing
	Oil flowing		No oil flowing
	Combustion air fan		Induced draught fan
	Gas flame		Oil flame
	Capacitance probes		2nd Low conductivity probe
	External level sensor for water level		Steam header
	TDS probe		Feed water pump



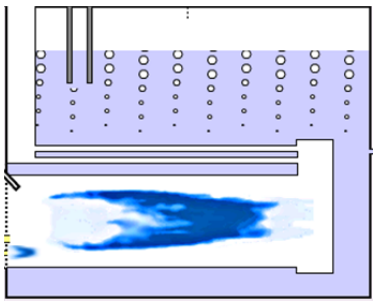
IBS Information



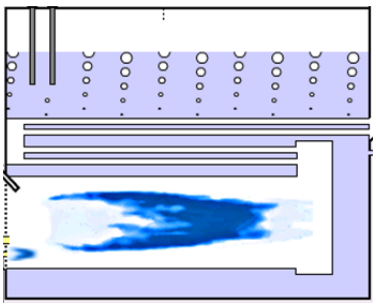
EGA Information



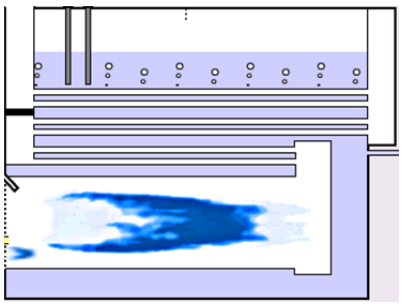
Water tube



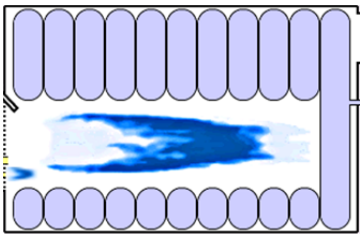
Two Pass Fire Tube



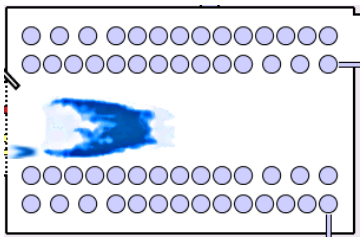
Three Pass Fire Tube



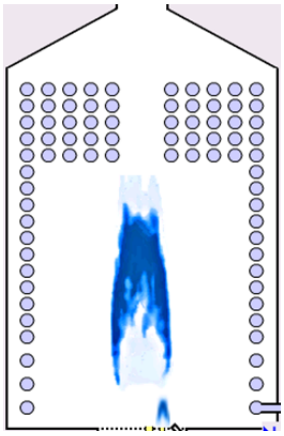
Four Pass Fire Tube



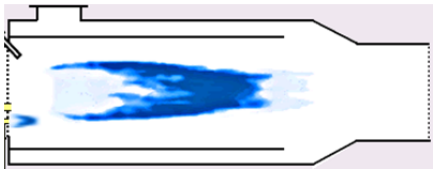
Cast Sectional Tube



Horizontal Coil Tube



Vertical Coil Tube



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3.1.2 Faults

Figure 3.1.2.i Lockouts

Press

in the Home screen to view the faults, which are categorised into lockouts, errors, alarms, warning and first out alarms, and are access by pressing on the corresponding tabs.

Fault	Type	Shuts Down Burner	Reset By
Lockout	Burner control fault	Yes	Reset button or input on T56
Error	Internal or hardware fault	Yes	Power cycle
Alarm	Critical system fault	Yes	Reset button or input
Warning	Non-critical fault	No	Reset button
First out	Configurable fault	Optional	Reset button/ auto

3.2 Status Screen

3.2.1 Status

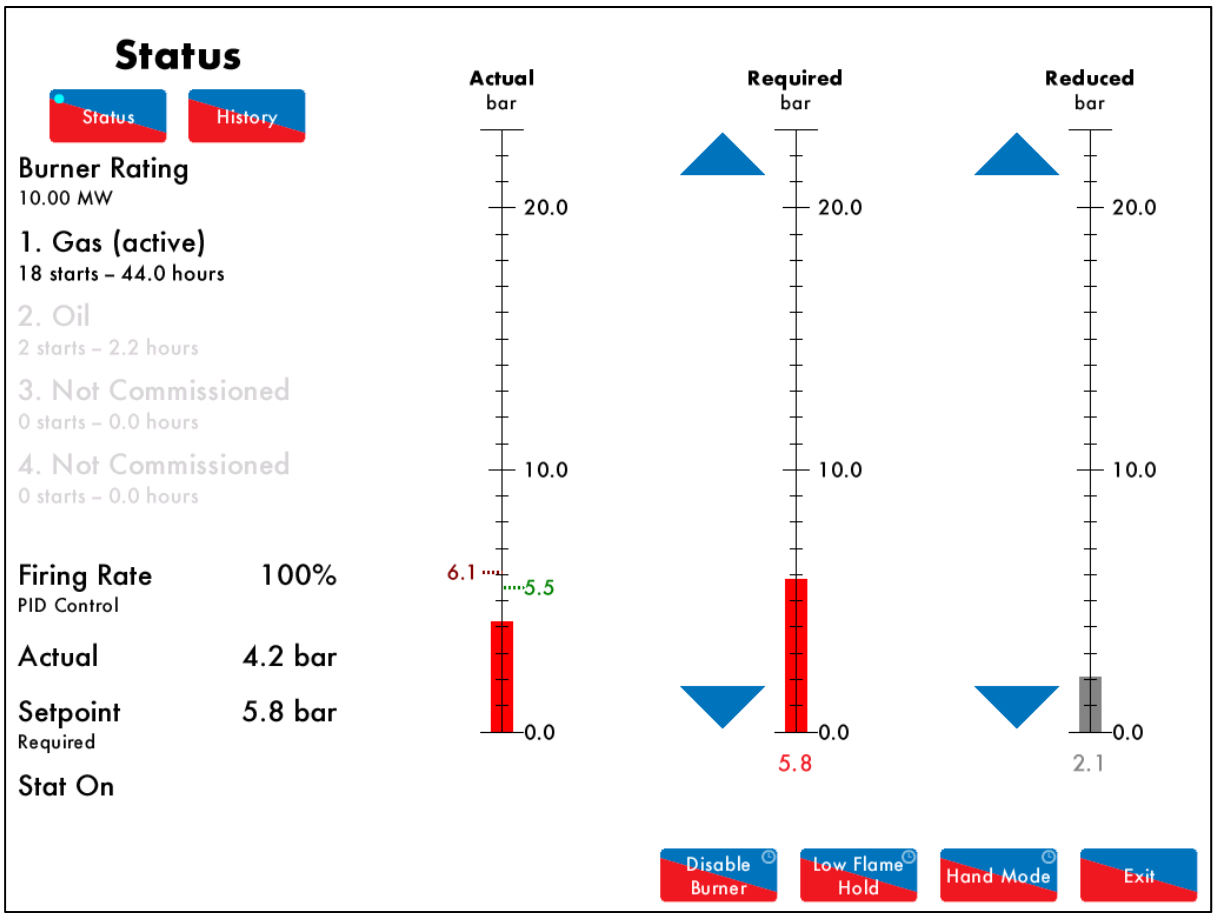


Figure 3.2.1.i Status

Press on the boiler load detector or the boiler image in the Home screen (Figure 3.1.i) to display the Status screen, which gives the following information:

- Burner rating
- Current fuel selected and type
- Burner starts and run hours
- Current firing rate
- Control method – internal PID control, external modulation or DTI/remote firing rate
- Actual temperature/pressure reading from load detector
- Current setpoint – required, reduced, DTI or external
- Stat status – running interlock T53/ internal stat
- Burner switch on/off offset
- Reduced setpoint
- Indication if MM is firing to meet required or reduced setpoint (red = active, grey = inactive)
- Arrows for adjusting setpoint

Press the arrows to change the required or reduced setpoints. If these arrows are not displayed, then either the user setpoint change has been disabled (option 15), the DTI is controlling the setpoint (option 16), external setpoint is enabled (parameter 72), or OTC is enabled (option 80).
Note: Use parameters 29 and 30 to adjust the load detector reading if required.

3.2.2 Status – History

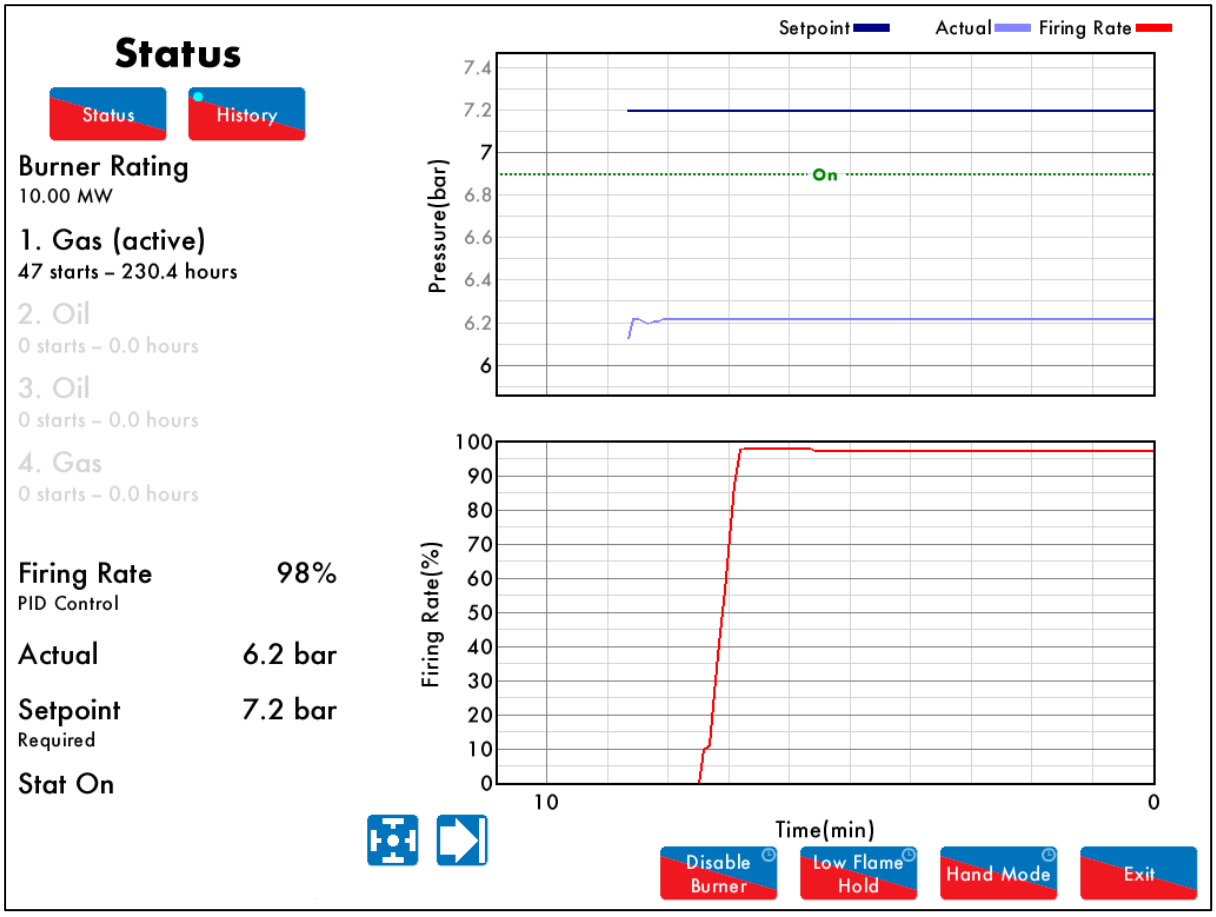


Figure 3.2.2.i Status – History

Press

in the Status screen in Figure 3.2.1.i to show the Status History. The setpoint, actual temperature/pressure and firing rate are displayed graphically.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.2.3 Status – Burner Enable/Disable

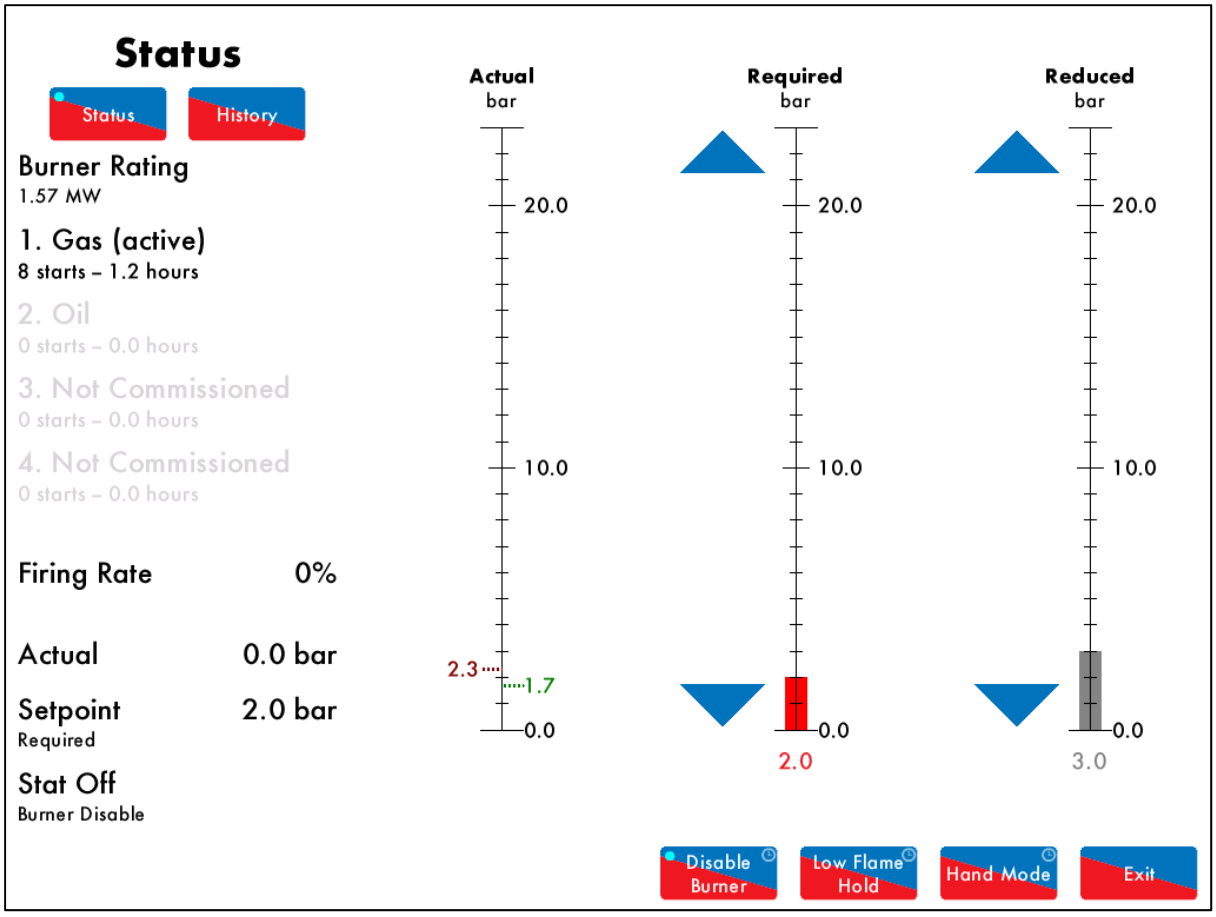


Figure 3.2.3.i Status – Burner Enable/Disable

Press and hold

for 3 seconds in the Status screen in Figure 3.2.1.i to disable the burner. Press and hold this same button to enable the burner.

3.2.4 Status – Low Flame Hold

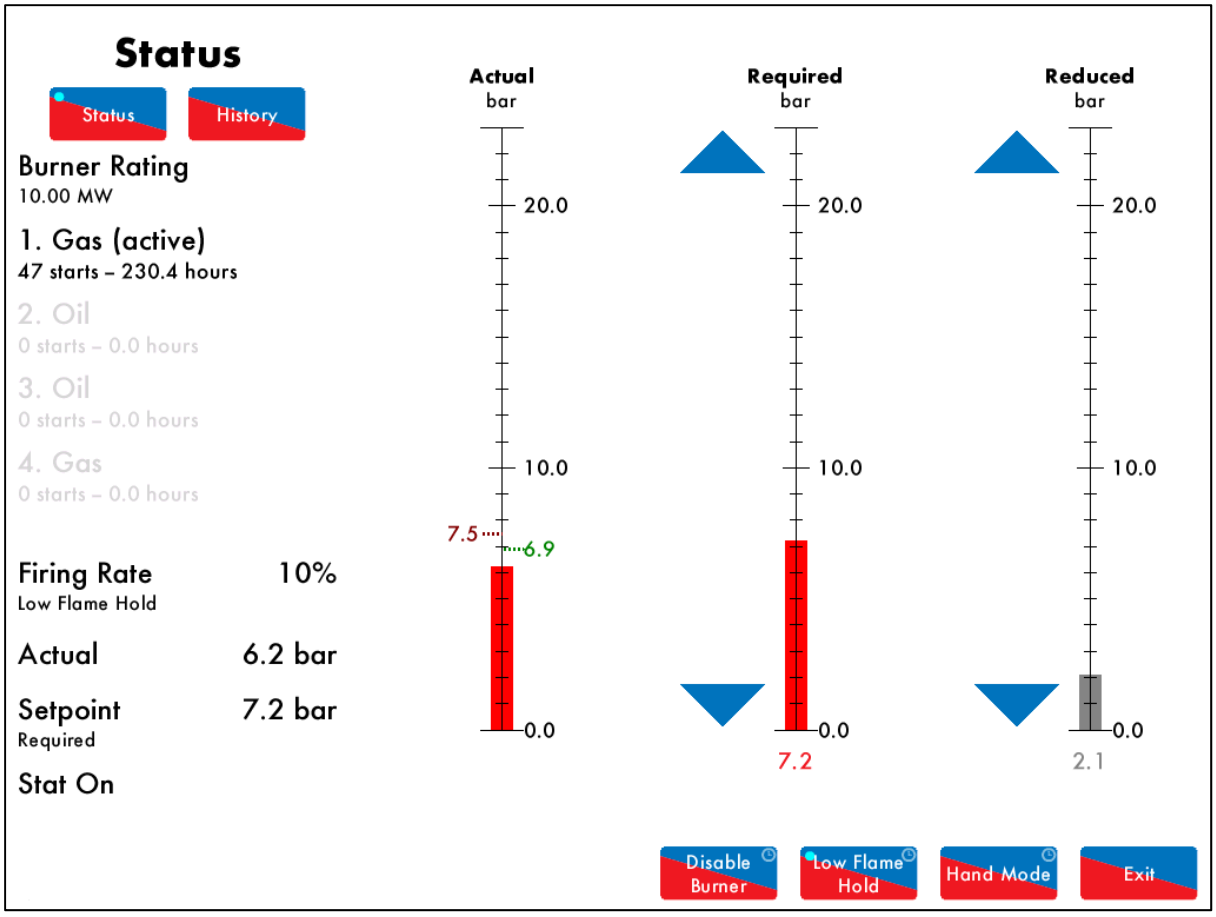


Figure 3.2.4.i Status – Low Flame Hold

Press and hold

for 3 seconds in the Status screen in Figure 3.2.2.i to put the MM in low flame hold. Press and hold this button again to return to normal modulation.

Alternatively, the Mk8 MM can also be put in low flame hold via an input on terminal 95.

If low flame hold or hand mode is selected on the MM screen, this will override an input made on terminal 94 or 95.

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

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

3.2.5 Status – Hand Mode

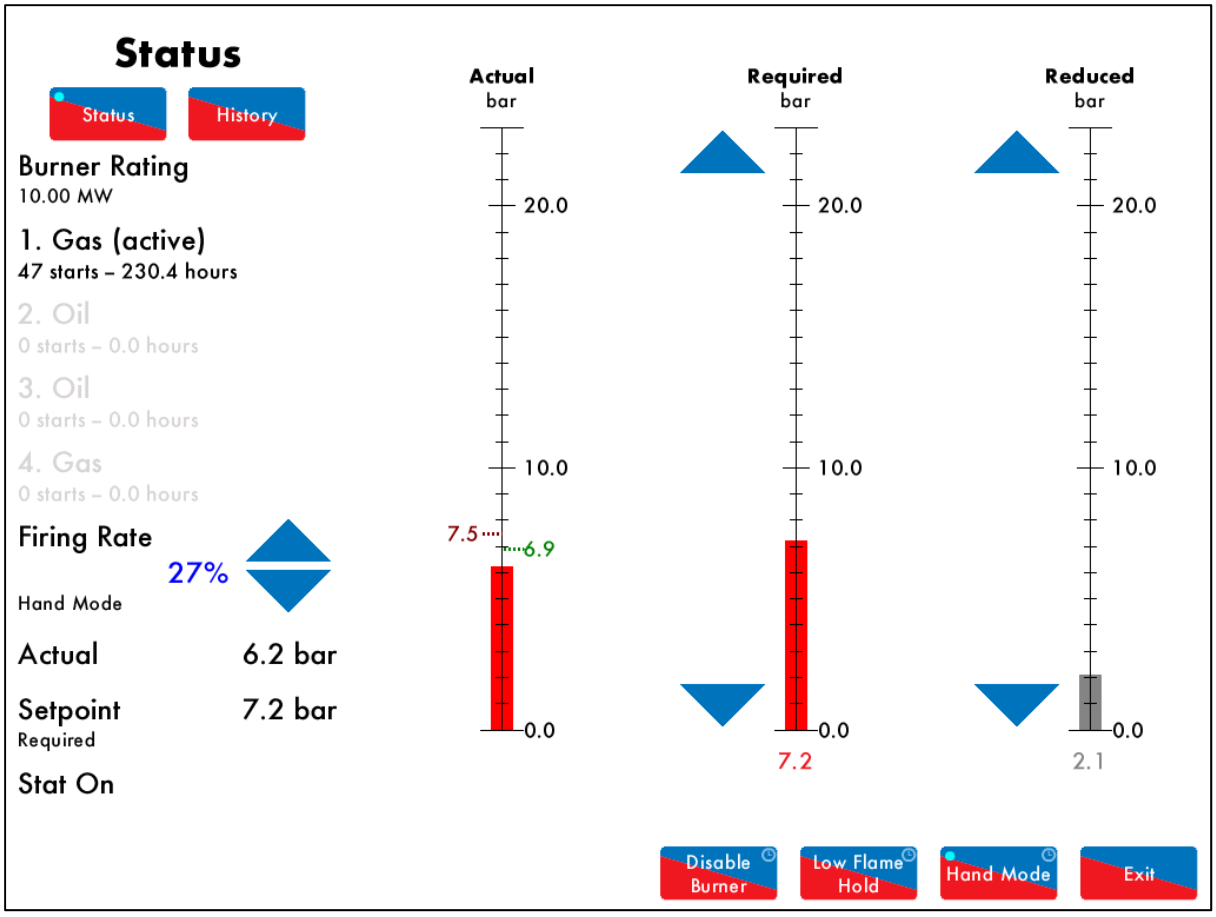


Figure 3.2.5.i Status – Hand Mode

Press and hold Hand Mode for 3 seconds in the Status screen in Figure 3.2.1.i to put the MM into hand mode, where the firing rate can be driving up or down by using the arrows.

Alternatively, the MM can be put into hand mode by an input on terminal 94.

If low flame hold or hand mode is selected on the MM screen, this will override an input made on terminal 94 or 95.

Note: If using intelligent boiler sequencing, then putting the MM into hand mode will remove the MM from the sequence loop. It will resume sequencing once hand mode is deselected and after the next scan time elapses.

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

Note: If a firing rate limit is set (option 66), then the firing cannot be driven past this in hand mode.

3.3 Fuel-Air Screen

3.3.1 Fuel-Air – Curve

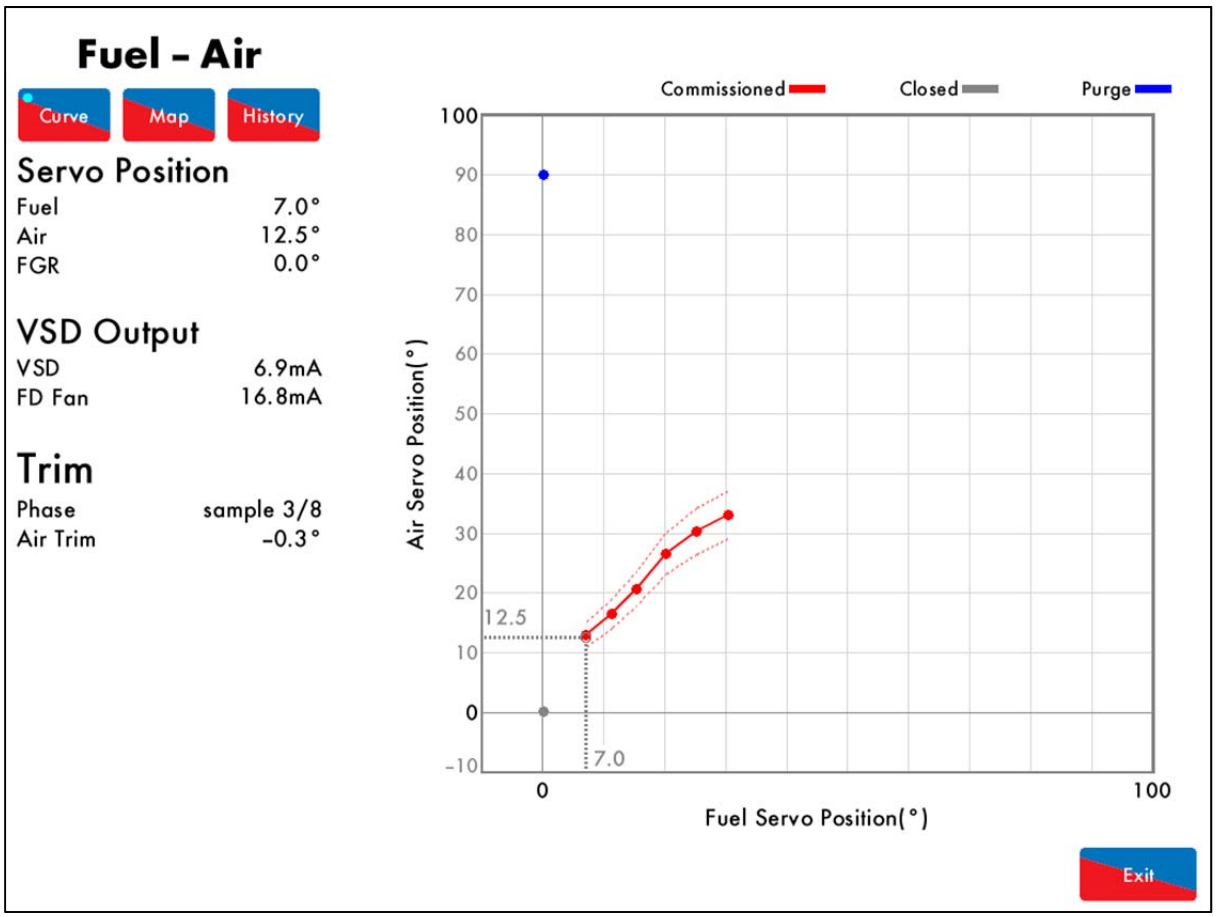


Figure 3.3.1.i Fuel-Air – Curve

Press the flame in the Home screen in Figure 3.1.i to view the Fuel-Air screen, which shows current servomotor and VSD output positions, the trim status and the commission curve graph.

3.3.2 Fuel-Air – Map

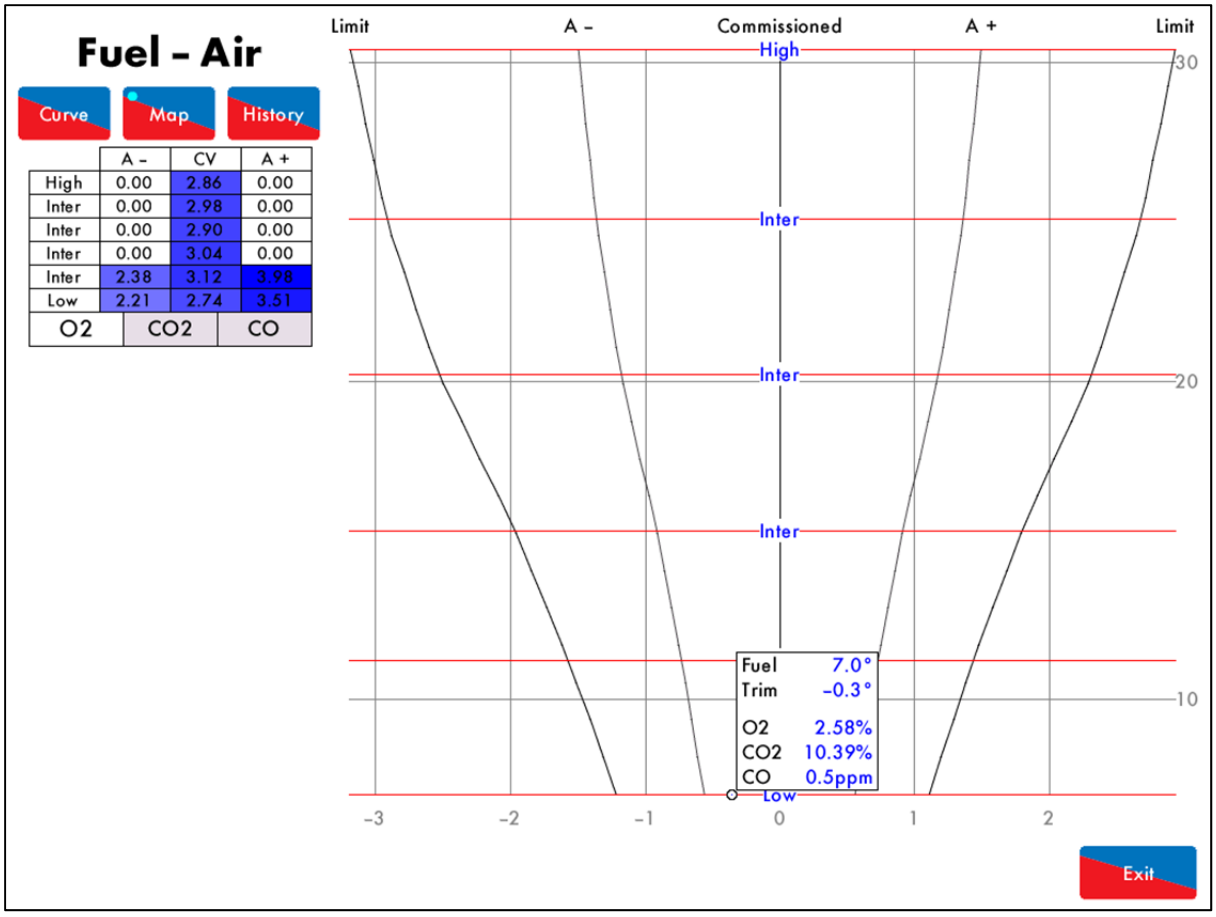


Figure 3.3.2.i Fuel-Air – Map

Press Map in the Fuel-Air screen in Figure 3.3.1.i to view the commissioned trim values if an EGA has been enabled with trim. The air rich (A+) and fuel rich (A-) values are shown for each commissioned point on the fuel-air curve, for the O_2, CO and CO_2. The graph shows the EGA's current readings and if there is any trim correction on the air damper. The circle on the fuel-air map indicates the current position of the trim correction, and how far the current combustion values are from the commissioned values.

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

3.3.3 Fuel-Air – History

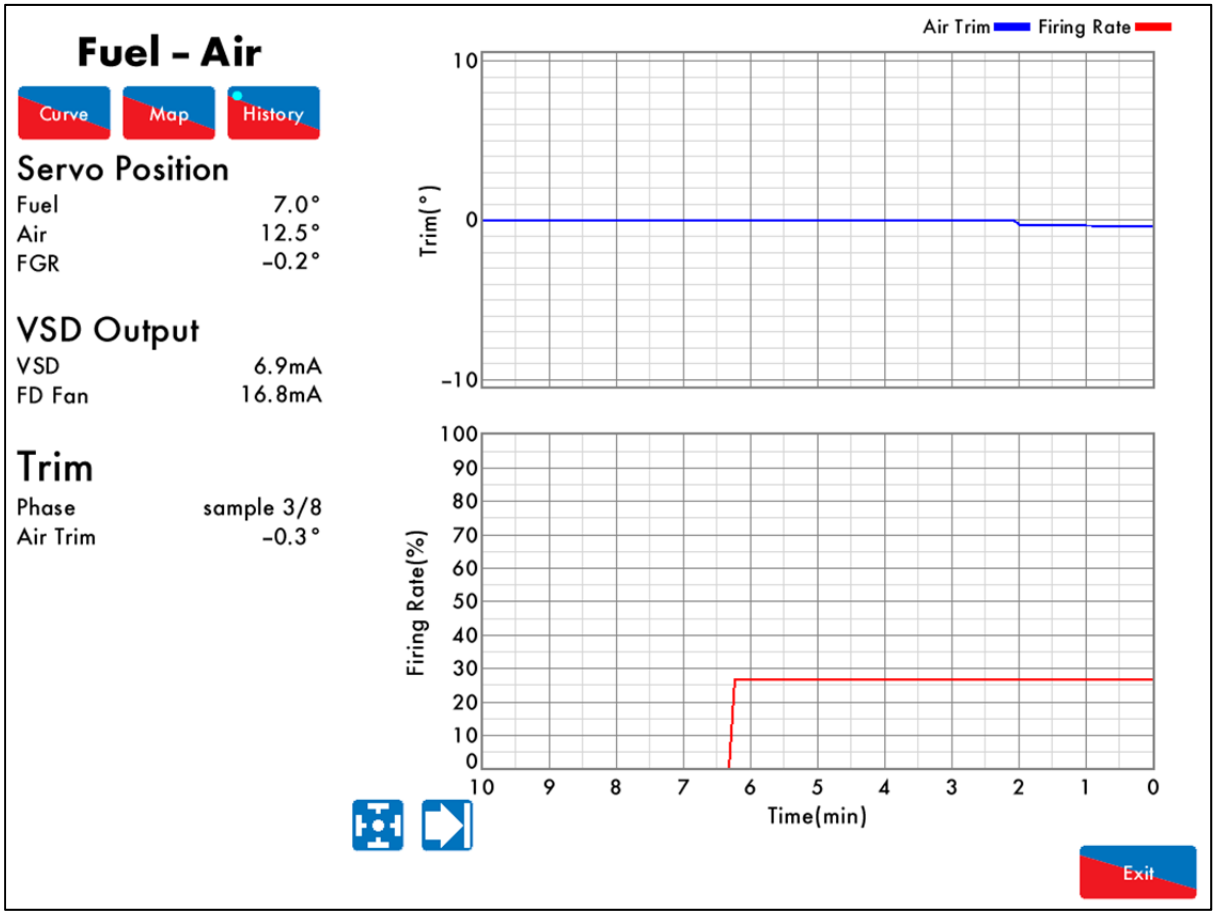


Figure 3.3.3.i Fuel-Air – History

Press History in the Fuel-Air screen in Figure 3.3.1i to view the Fuel-Air History screen, which shows the firing rate and air trim history.

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

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.4 Flame Safeguard Screen

3.4.1 Flame Safeguard

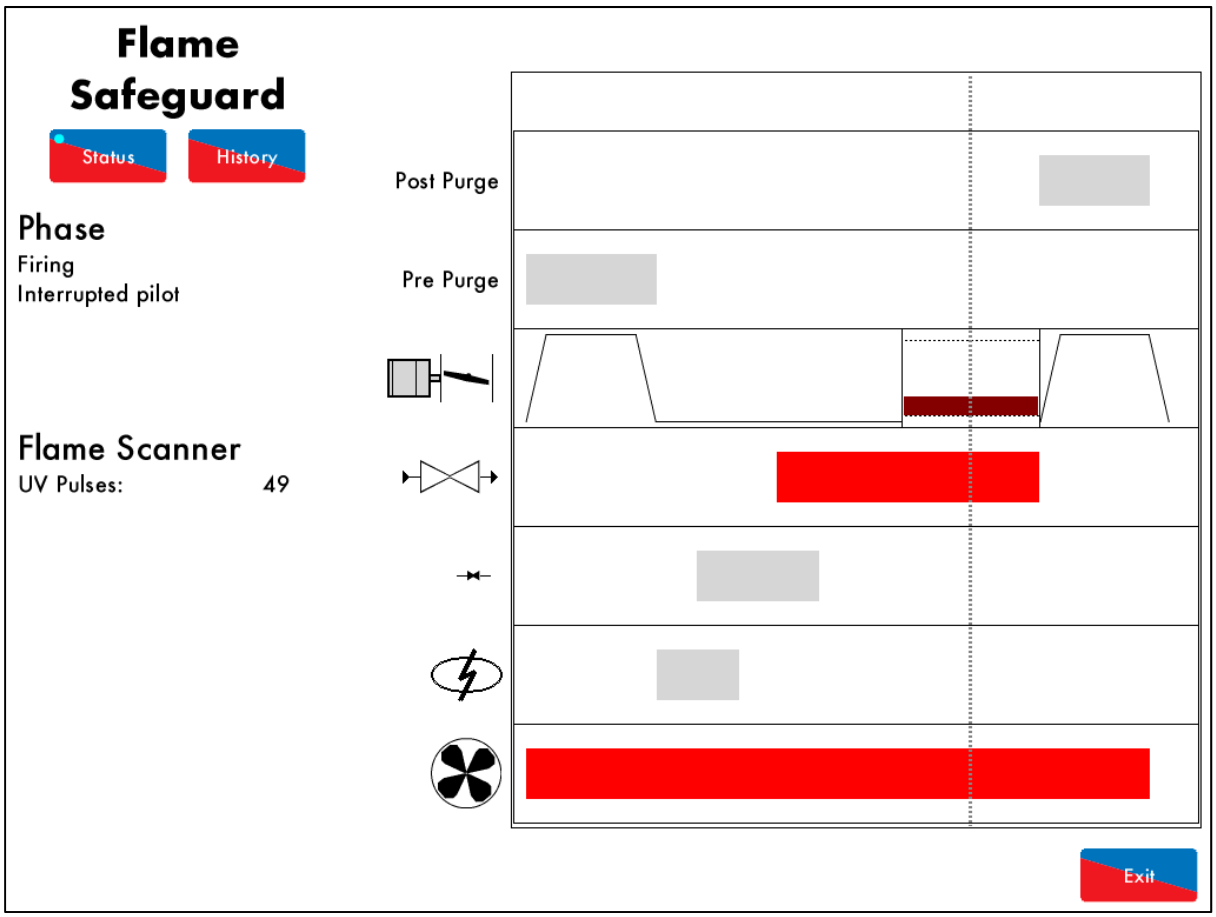


Figure 3.4.1.i Flame Safeguard

Press on the flame scanner in the Home scree in Figure 3.1.i to view the Flame Safeguard screen, which shows the current firing phase of the MM, pilot type and flame scanner signal strength.

Throughout the entire burner start-up and firing sequence, the vertical dotted line will move horizontally showing which phase the burner is at currently. The rows refer to:

- Post purge
- Pre purge
- Air damper position
- Main fuel valve
- Pilot fuel valve
- Ignition
- Blower motor

Note: If a flame switch is used for flame detection, then flame switch show as either on (flame detected) or off (no flame detected).

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

3.4.2 Flame Safeguard – History

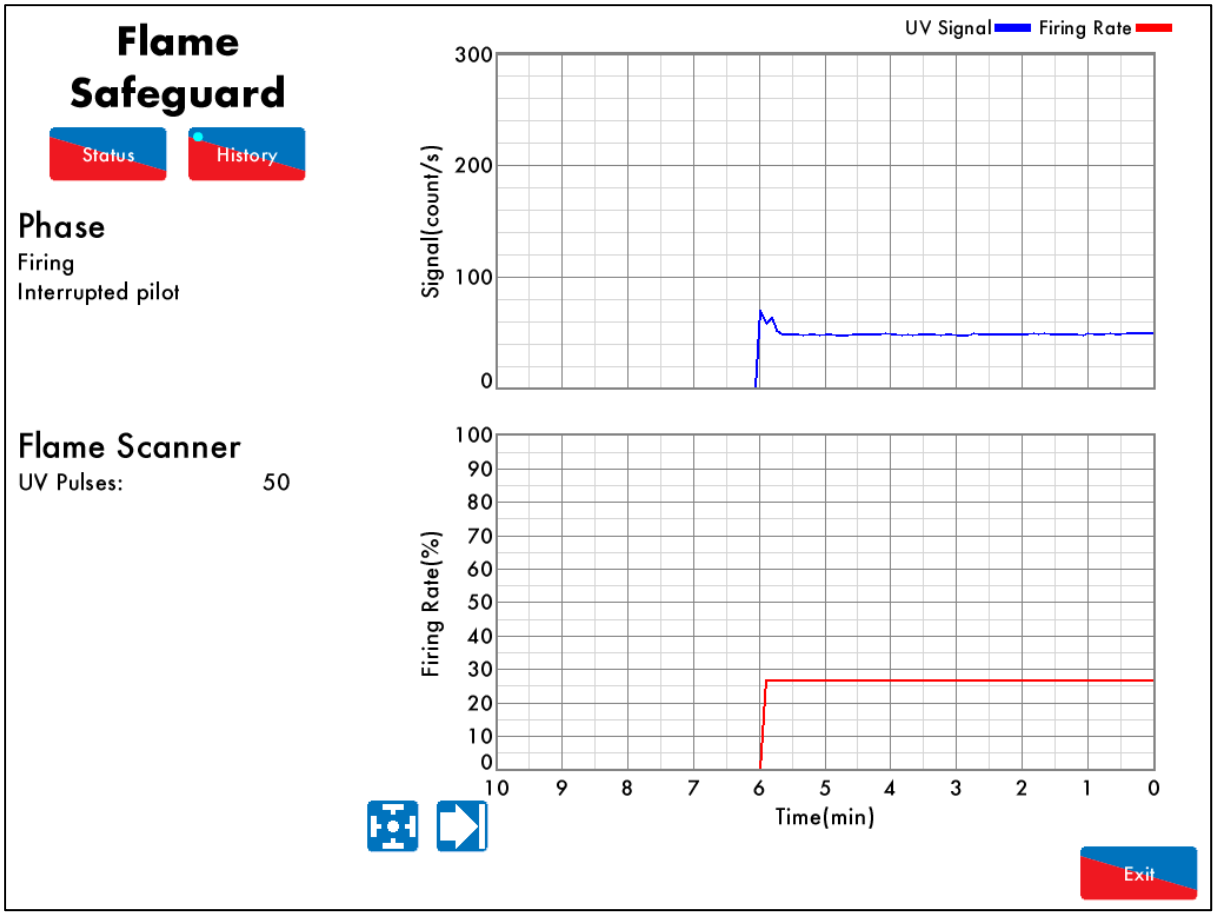


Figure 3.4.2.i Flame Safeguard - History

Press

in the Flame Safeguard screen in Figure 3.4.1.i to view the Flame Safeguard History, showing the flame scanner signal and firing rate.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.5 Channels Screen

3.5.1 Servomotor

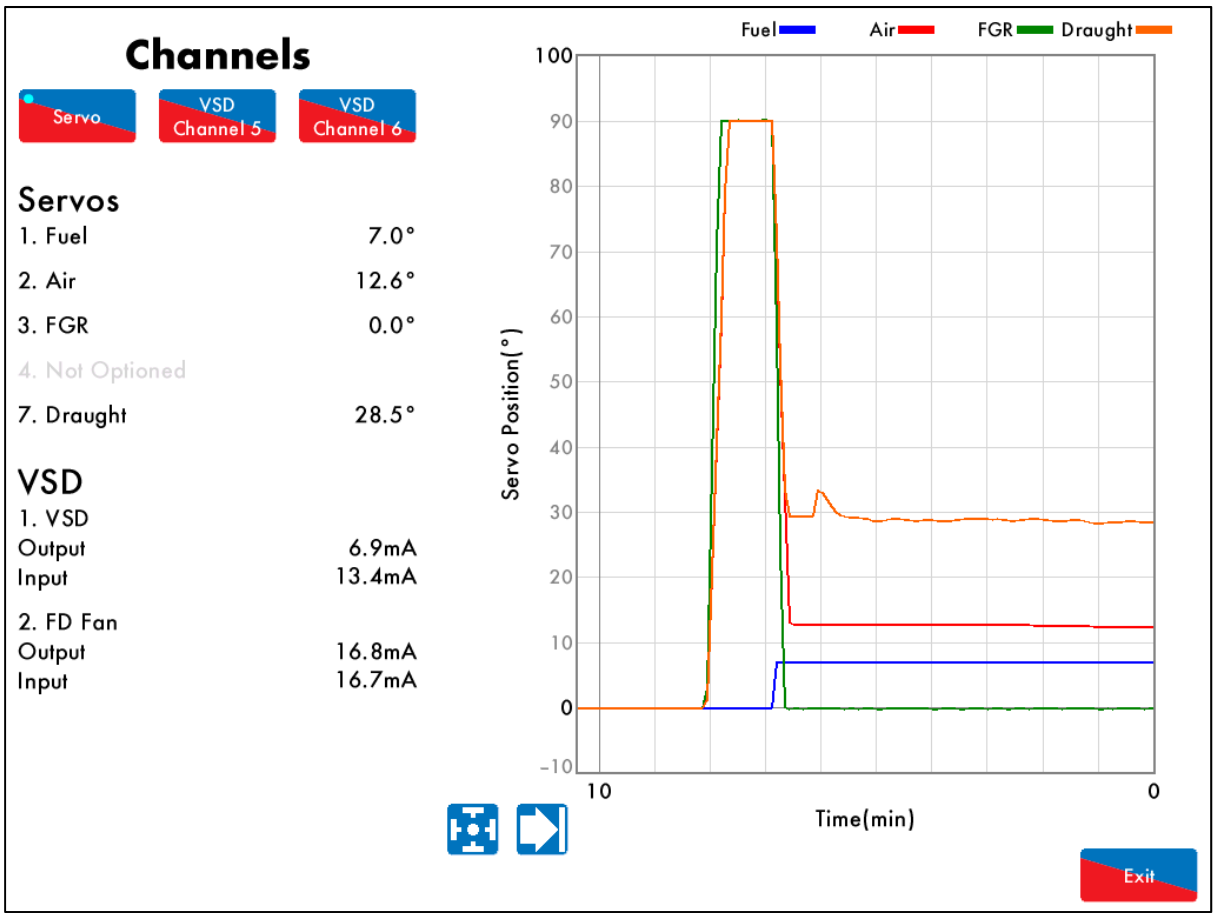


Figure 3.5.1.i Servomotor

Press on a servomotor in the Home screen in Figure 3.1.i to view the Channels screen, which shows the current servomotor positions and VSD outputs and inputs.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.5.2 VSD Channel

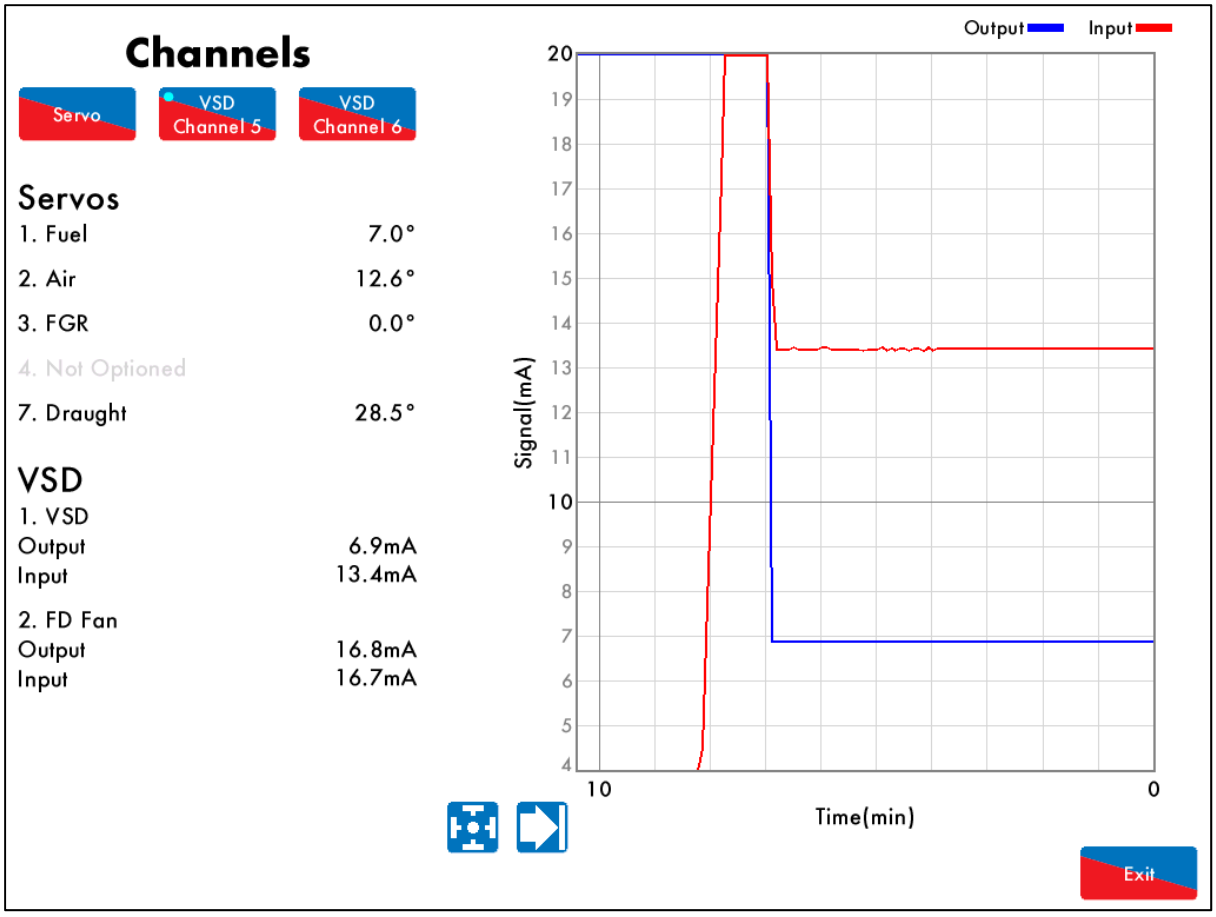


Figure 3.5.2.i VSD Channel

Press VSD Channel 5 or VSD Channel 6 in the Channels screen in Figure 3.5.1.i to view the VSD Channel 5 or VSD Channel 6 output and input history, respectively. Alternatively, pressing on the VSD in the Home screen in Figure 3.1.i will also display the VSD Channel screen.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.6 Gas Pressure Sensor Screen

3.6.1 Gas Pressure

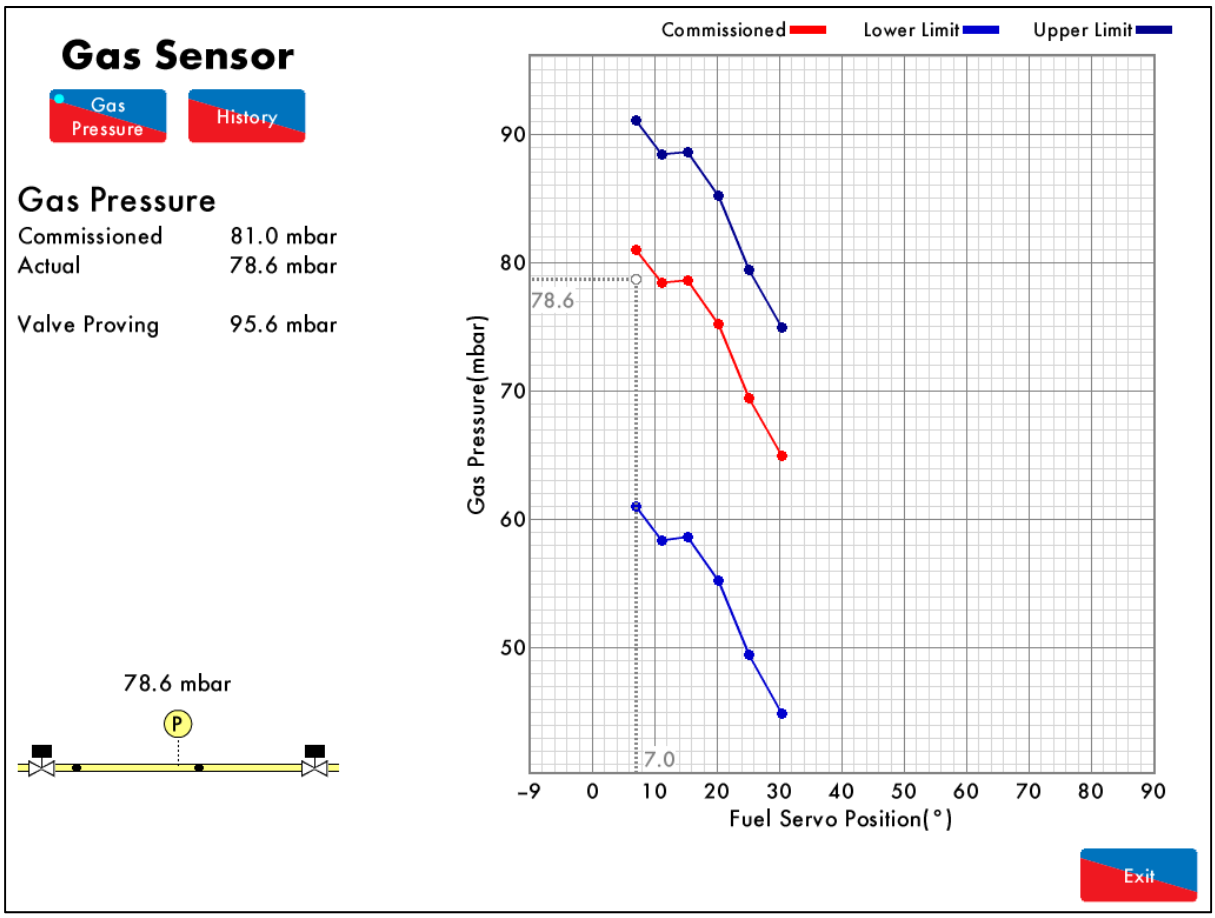


Figure 3.6.1.i Gas Pressure

Press on the gas pressure sensor (if enabled) in the Home screen in Figure 3.1.i to view the gas pressure screen, which shows the following information:

- Commissioned gas pressure for the corresponding point on fuel-air curve
- Actual (current) gas pressure
- Valve proving gas pressure
- Status of main gas and vent valves
- Upper/lower offset gas pressure limits for fuel-air curve

3.6.2 Gas Sensor – History

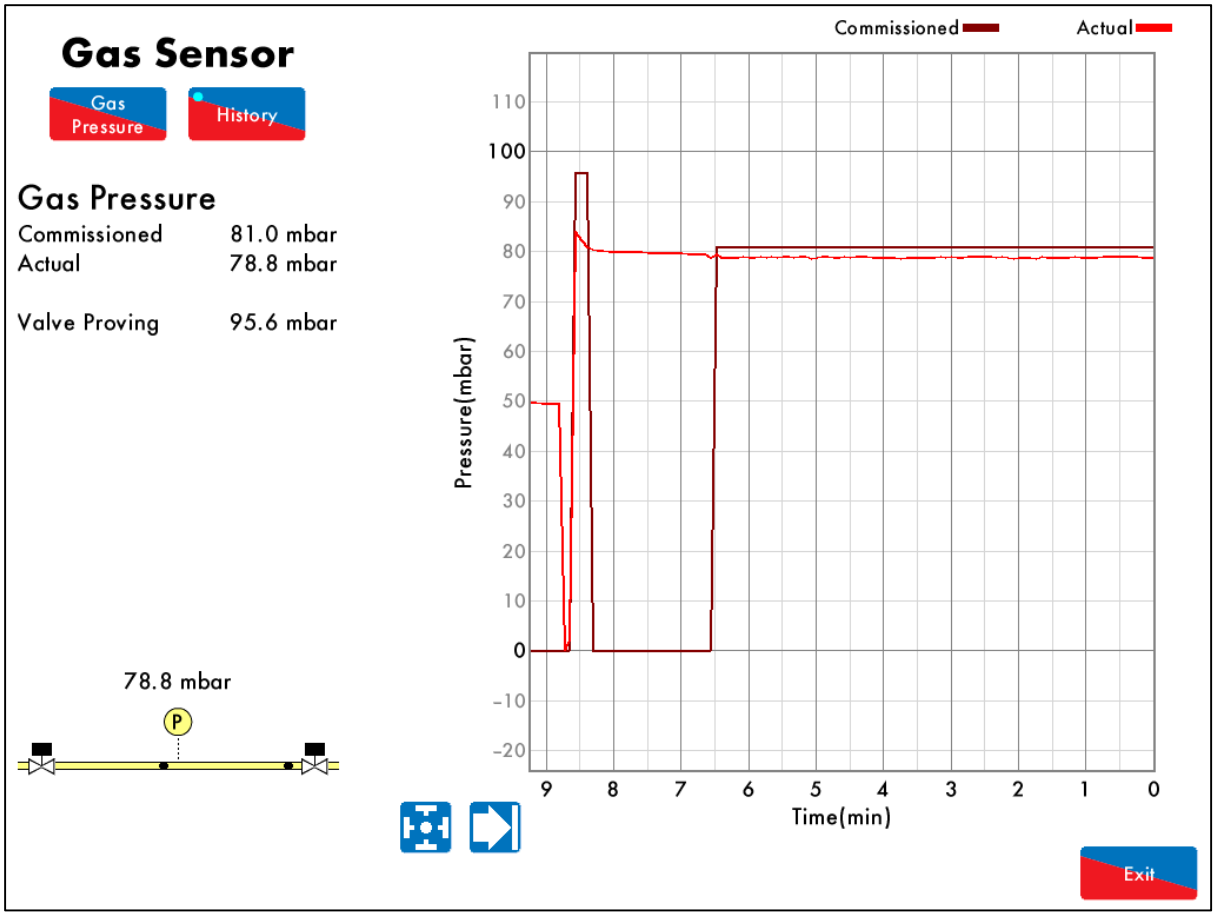


Figure 3.6.2.i Gas Sensor – History

Press History in the Gas Pressure screen in Figure 3.6.1.i to view the Gas Pressure History screen, showing the commissioned and actual gas pressure histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.7 Air Pressure Sensor Screen

3.7.1 Air Pressure

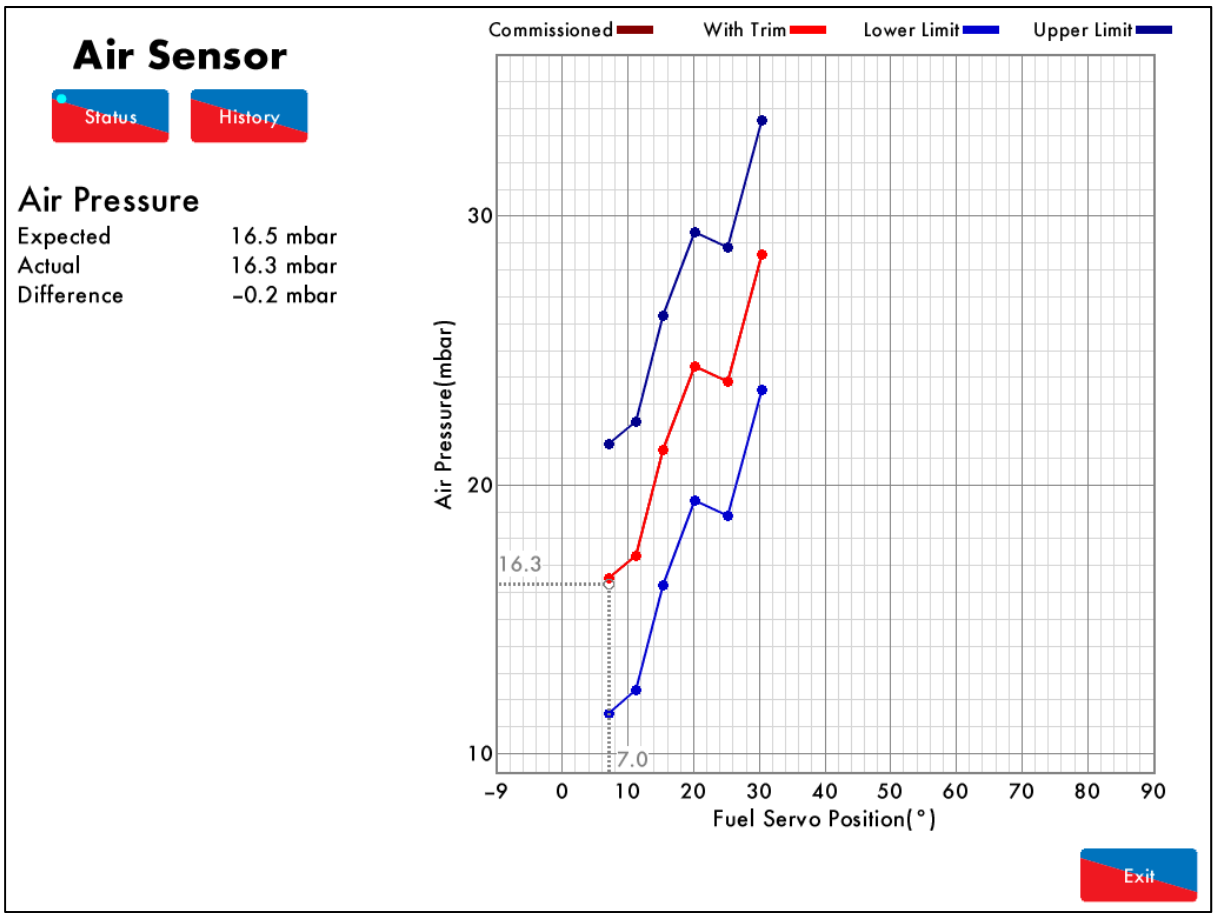


Figure 3.7.1.i Air Pressure

Press on the air pressure sensor in the Home screen in Figure 3.1.i to view the Air Pressure screen, which shows the expected air pressure, actual (current) air pressure and the difference between these values, for the corresponding point on the fuel-air curve.

The graph shows the commissioned air pressure for the fuel-air curve and the upper/lower offset limits, as well as the air pressure values with trim function enabled on the air damper.

If commissioned with an EGA, the air pressure is stored during the commissioning the trim function, and shown as the red line on the graph.

3.7.2 Air Sensor – History

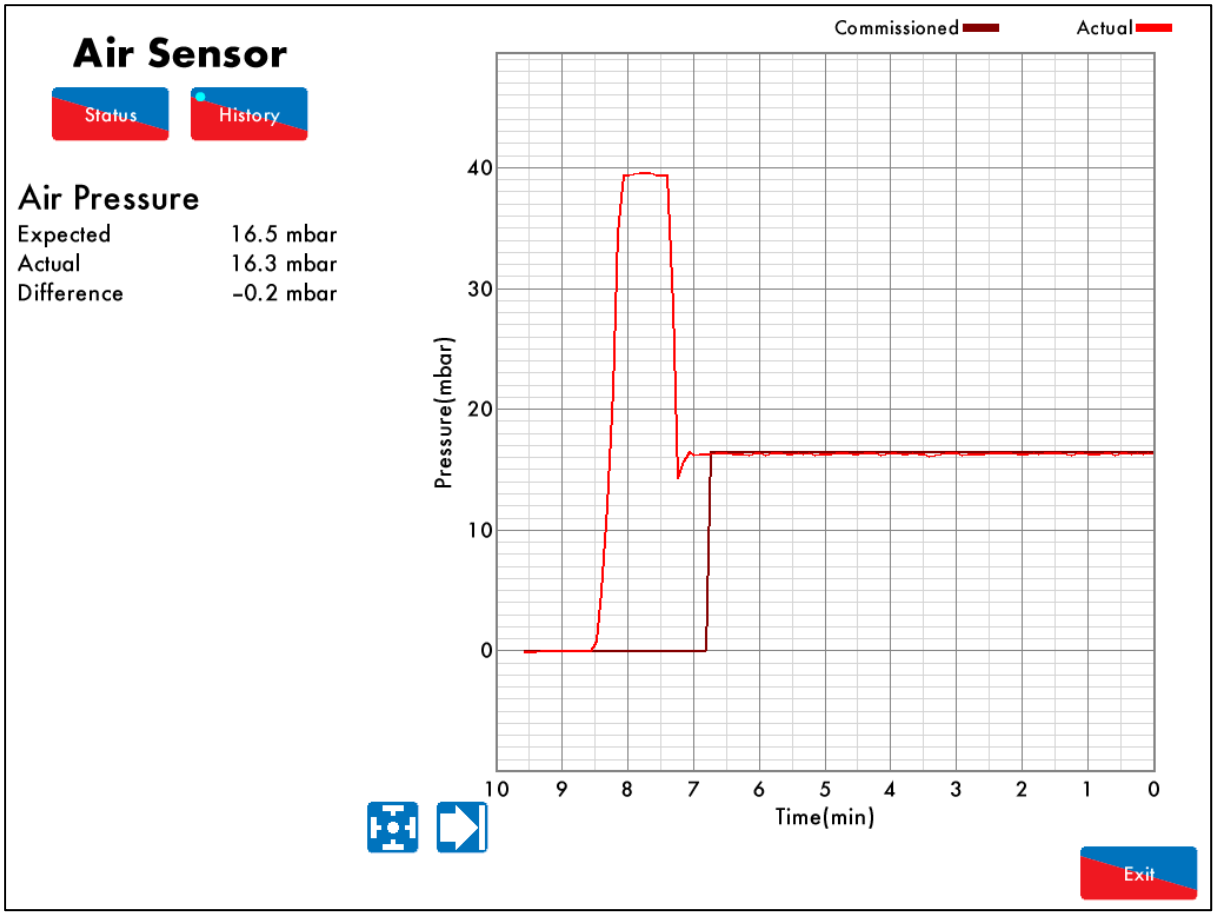


Figure 3.7.2.i Air Sensor – History

Press History in the Air Pressure screen in Figure 3.7.1.i to view the Air Pressure History screen, showing the commissioned and actual air pressure histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.8 Fuel Flow Screen

3.8.1 Fuel Flow

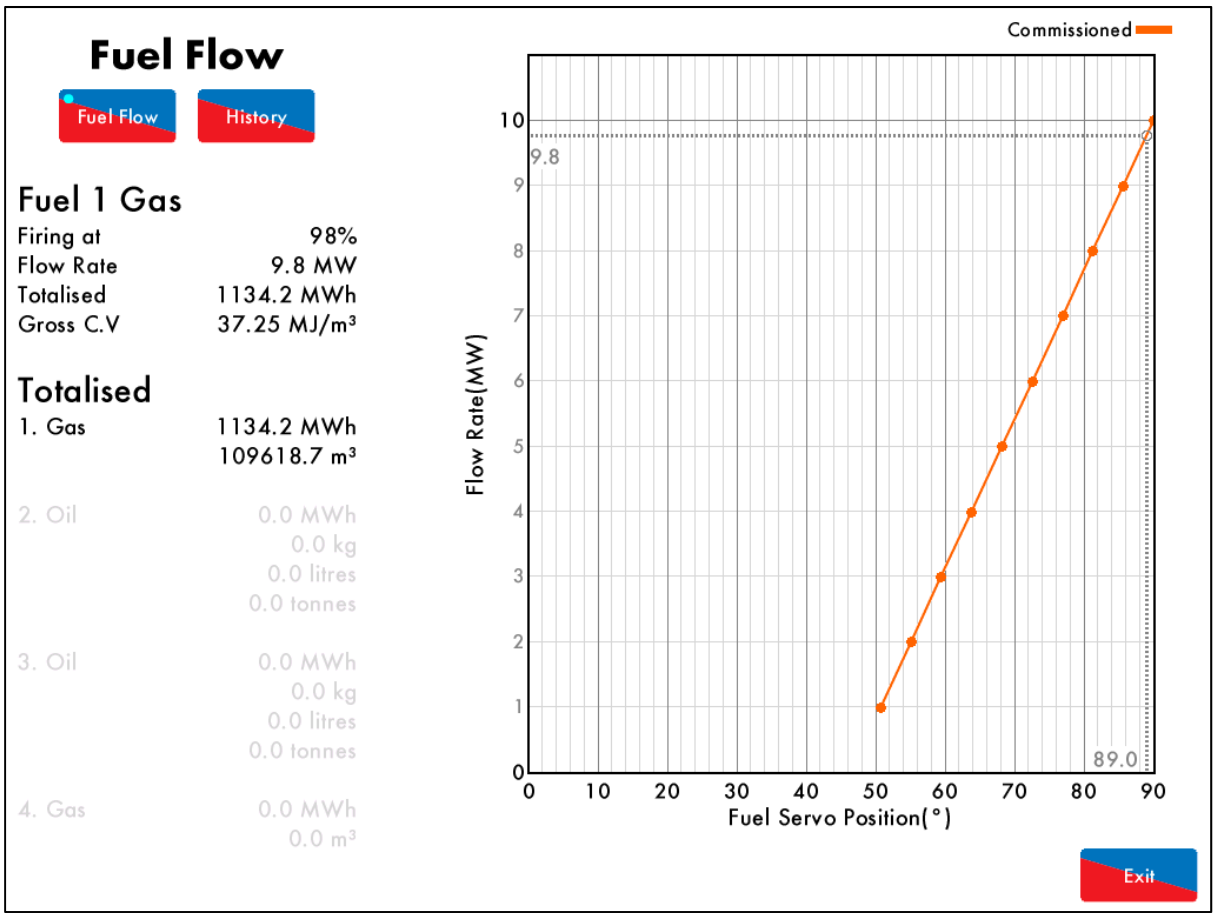


Figure 3.8.1.i Fuel Flow

Press on the main gas/oil pipe in the Home screen in Figure 3.1.i to view the Fuel Flow screen, which shows the following information:

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

Note: If option *57* is disabled, then no fuel flow information will be displayed.

3.8.2 Fuel Flow – History

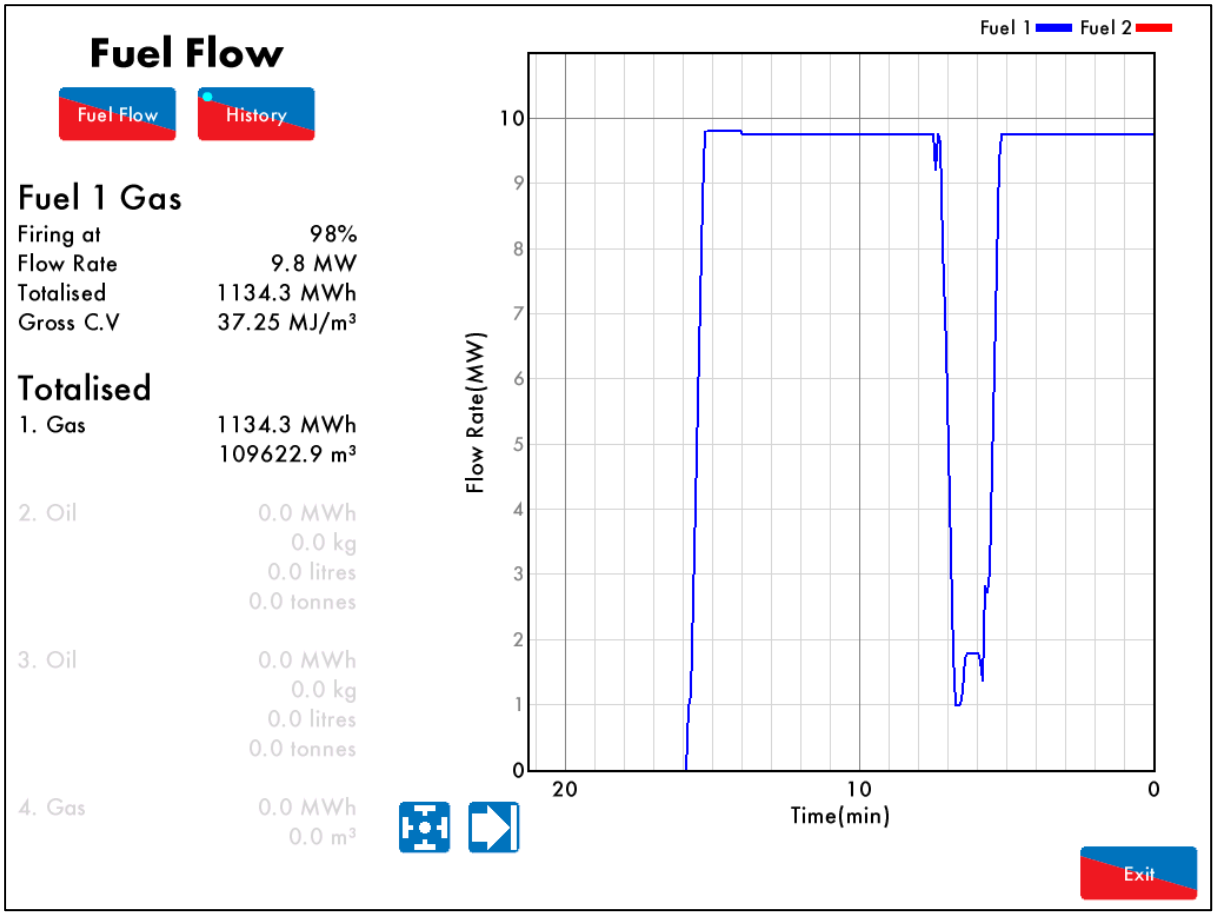


Figure 3.8.2.i Fuel Flow – History

Press History in the Fuel Flow screen in Figure 3.8.1.i to view the Fuel Flow History.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.9 Sequencing Screen

3.9.1 IBS – Status

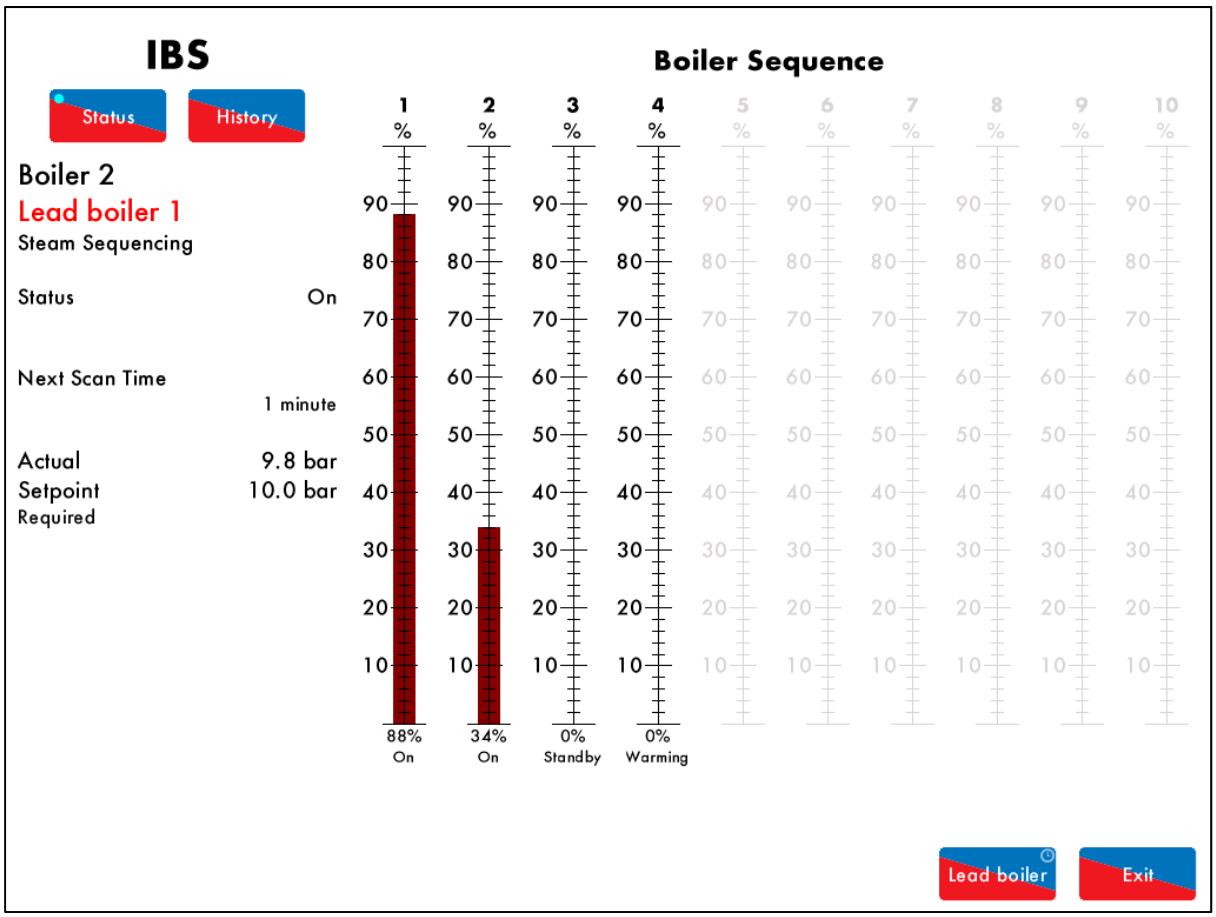


Figure 3.9.1.i IBS – Status

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

- MM boiler ID number
- Lead boiler ID number
- Type of sequencing (steam/ hot water)
- Current sequencing state
- Next scan time due
- Actual temperature/ pressure
- Setpoint value and setpoint type (required/ standby)
- Number of boilers in sequencing loop
- Current firing rates of all boilers in sequencing loop
- Current sequencing states of all boiler in sequencing loop
- Warming off and on times shown on screen for boilers which are in Warming sequencing state

Note: Sequencing must be enabled in option 16 for IBS information to display.

Note: Any bars showing in pink indicate that the MM has dropped out of the sequencing loop,

Note: Up to 10 boilers can be sequencing together. If multi-burner is used on a boiler, then it is the master MM which will communicate in the sequencing loop.

3.9.2 IBS – Lead Boiler

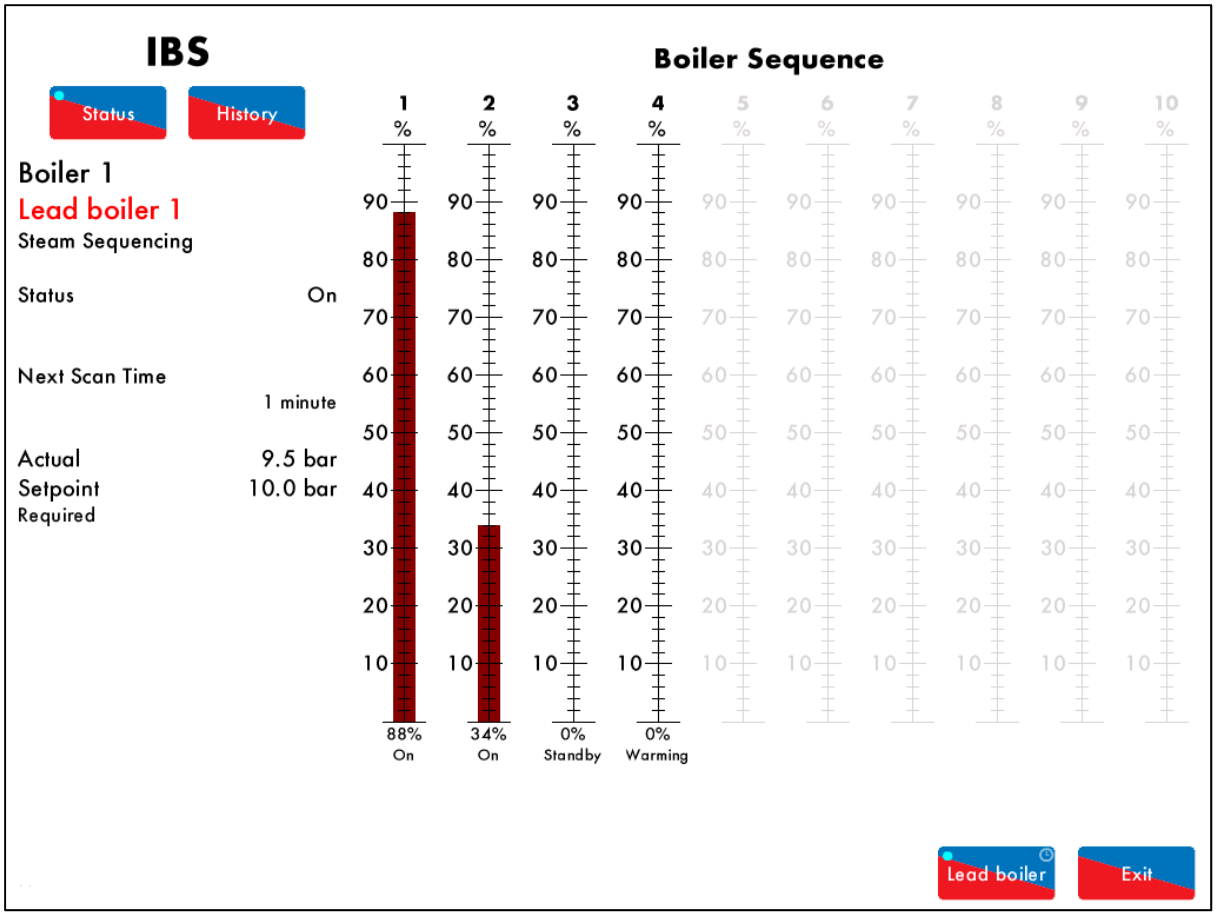


Figure 3.9.2.i IBS – Lead Boiler

A boiler can be selected as a lead boiler by the following ways:

1. Press and hold Lead boiler for 3 seconds in the IBS Status screen in Figure 3.9.1.i.
2. An input on terminal 88.
3. If a DTI is enabled, then the lead boiler can be selected remotely either through Autoflame PC CEMS Audit Software, or via a Modbus address via the DTI.

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

3.9.3 IBS – History

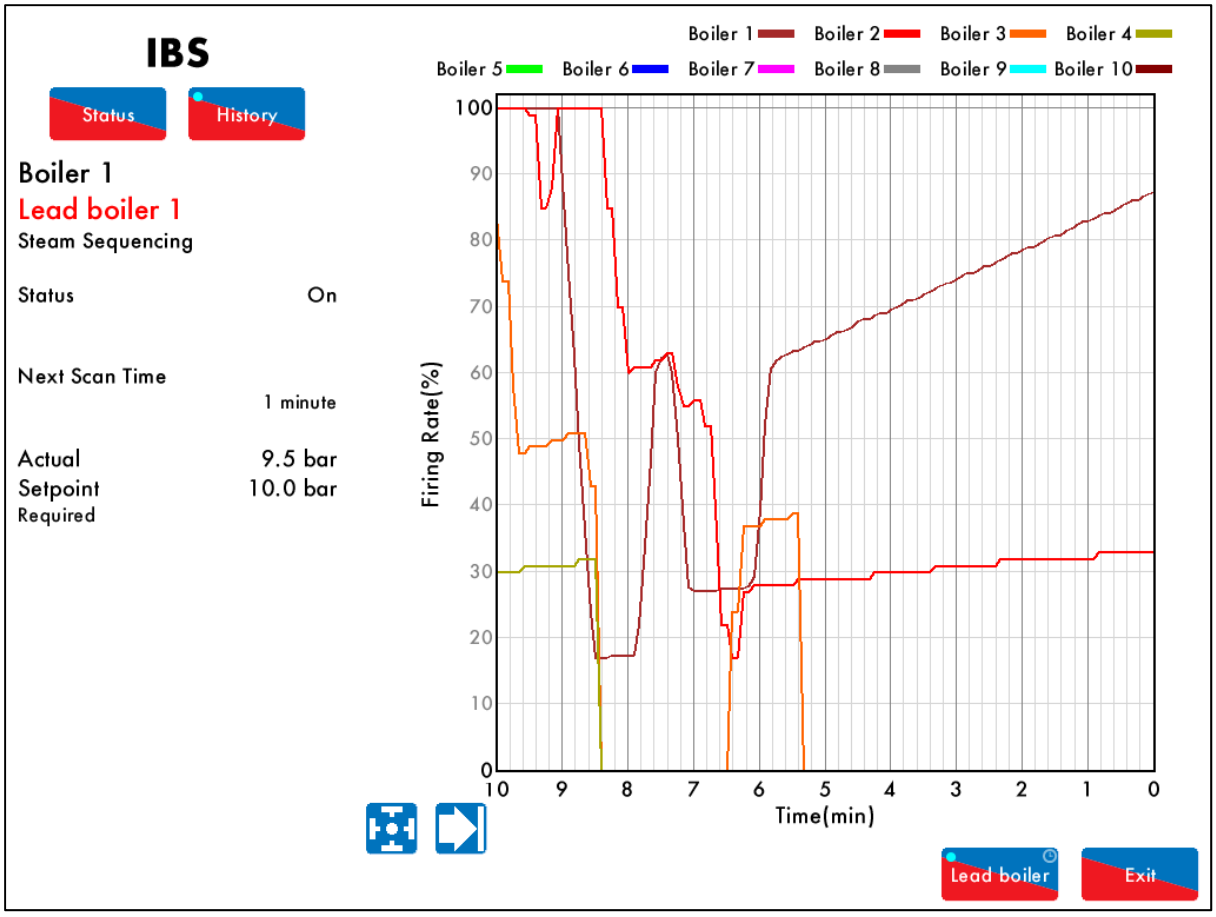


Figure 3.9.3.i IBS – History

Press History in the IBS Status screen in Figure 3.9.1.i to view the IBS History screen, which shows the firing rates histories for all the boilers in the sequencing loop.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.10 EGA Screen

3.10.1 EGA – Gas

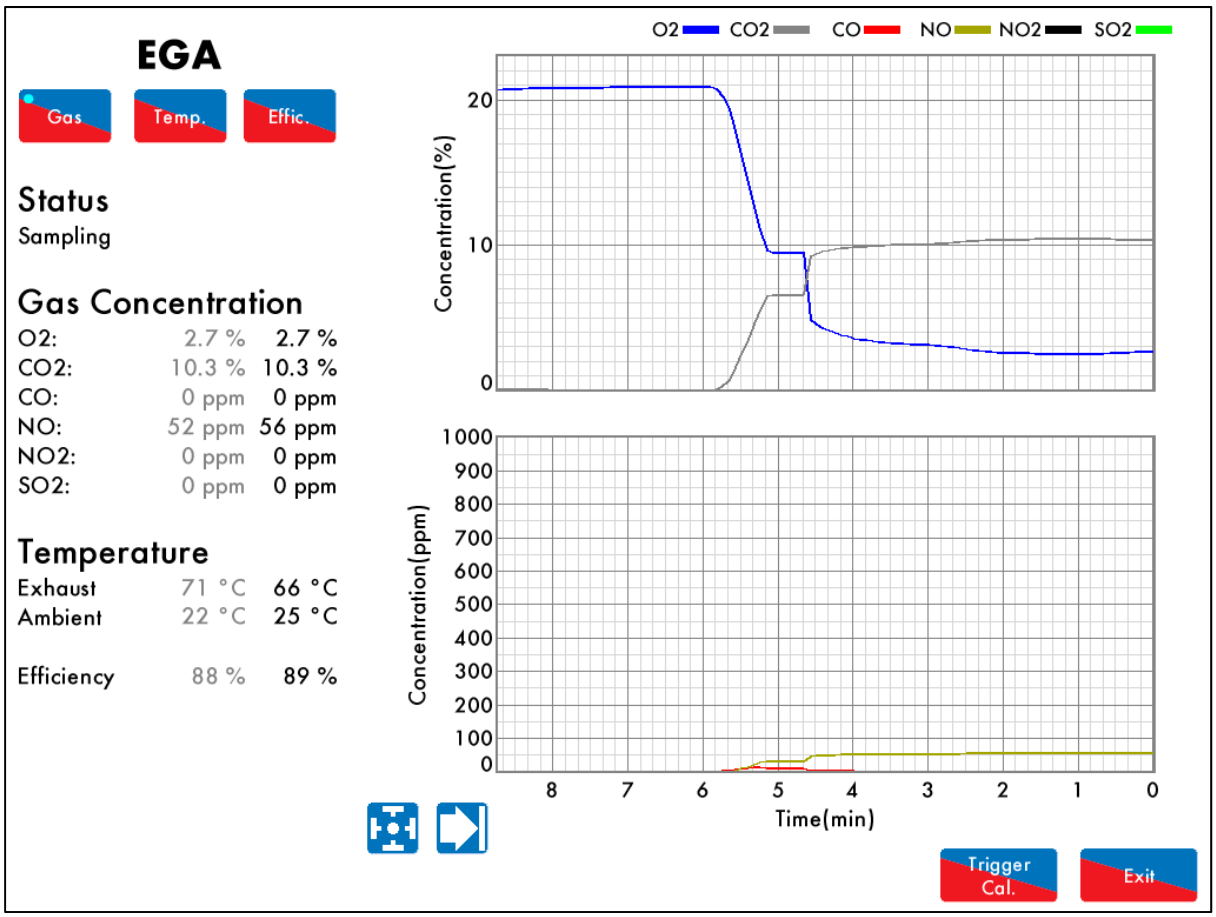


Figure 3.10.1.i EGA – Gas

Press the EGA box (if enabled) in the Home screen in Figure 3.1.i to view the EGA Gas screen, which shows the following information:

- EGA current status
- Current exhaust gases, temperature and efficiency values (in black)
- Commissioned exhaust gases, temperature and efficiency values if trim is enabled (in grey)

The graphs show the exhaust gas concentrations histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

Press to force the EGA into an air calibration when it is next in a safe condition (not trimming and span gas calibration).

3.10.2 EGA – Temperature

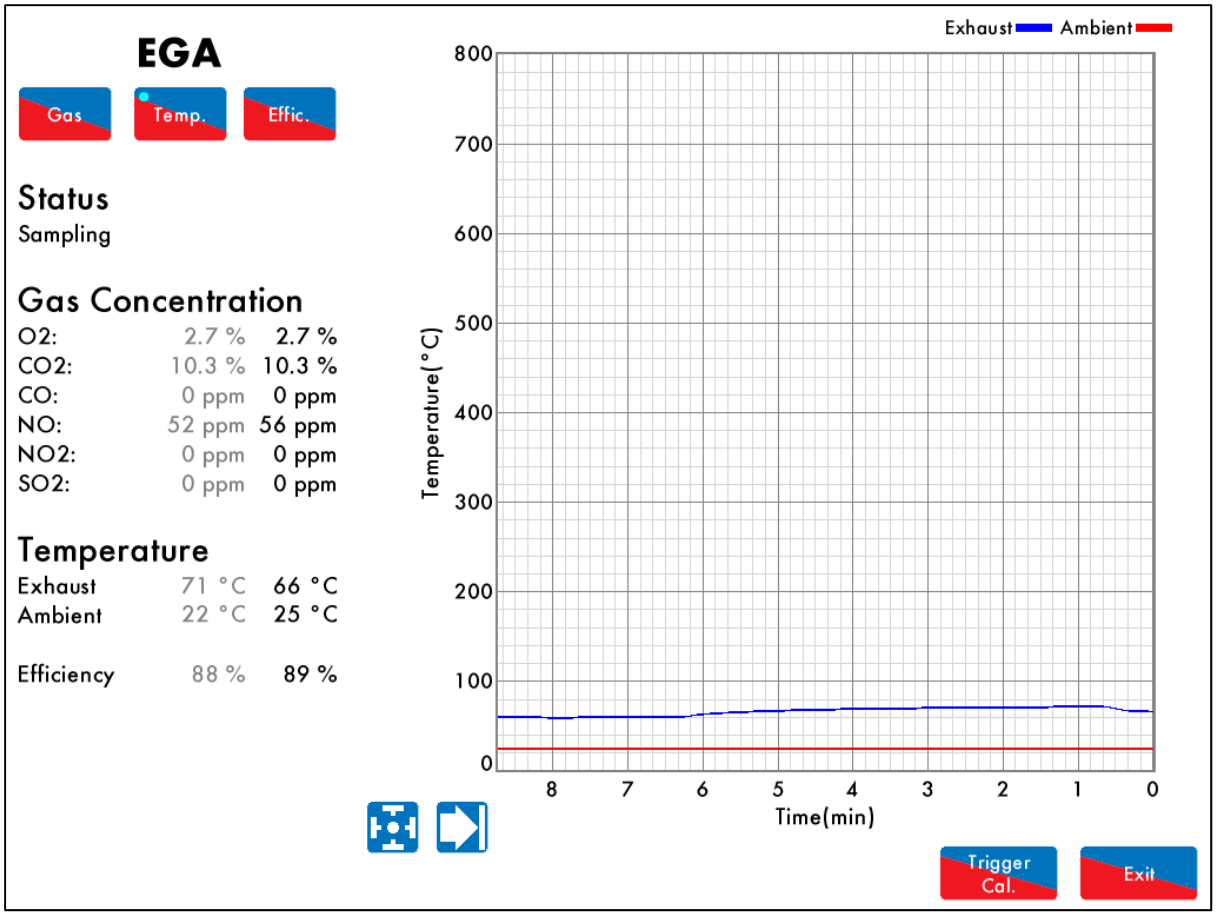


Figure 3.10.2.i EGA – Temperature

Press Temp. in the EGA Gas screen in Figure 3.10.1.i to vie the EGA Temperature screen, which shows the exhaust and ambient temperature histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

Press Trigger Cal. to force the EGA into an air calibration when it is next in a safe condition (not trimming and span gas calibration).

3.10.3 EGA – Efficiency

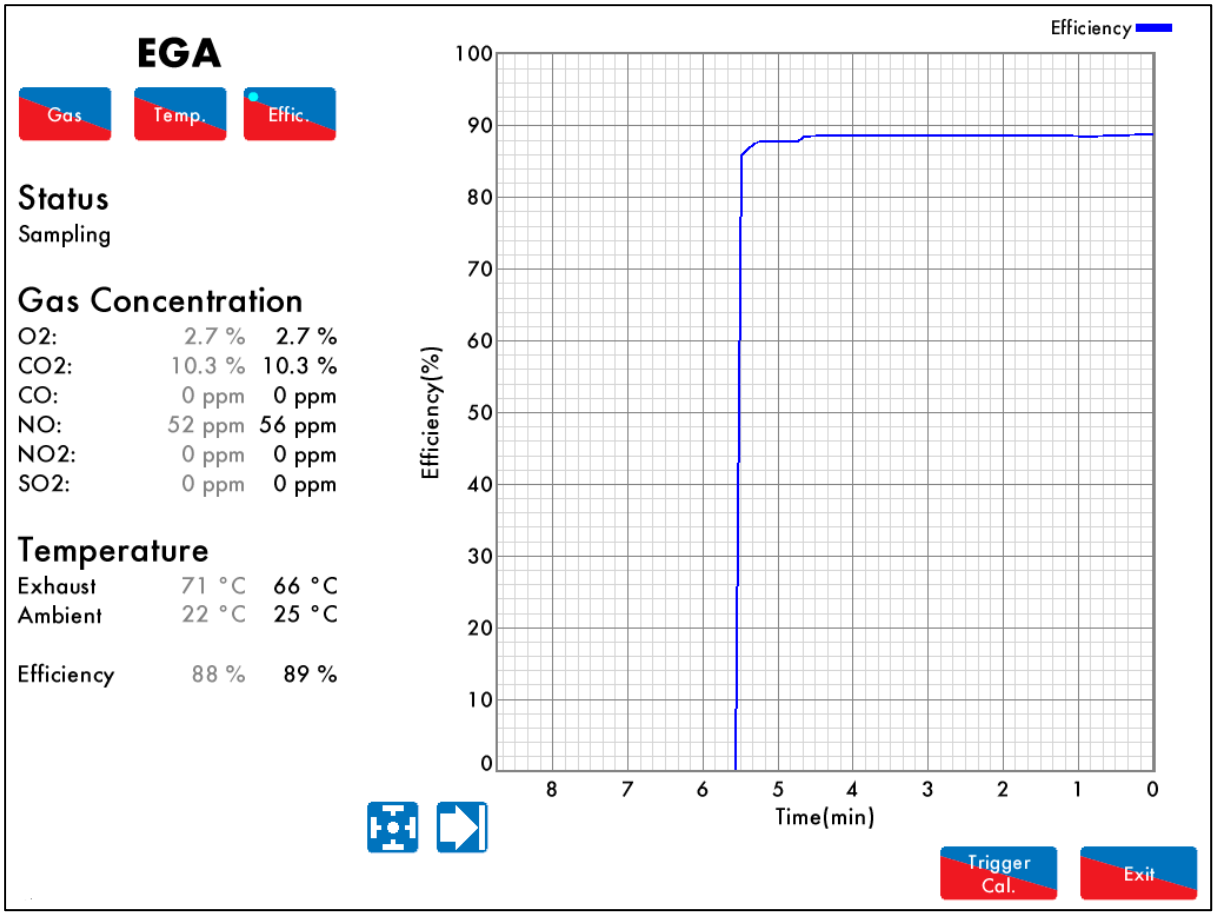


Figure 3.10.3.i EGA – Efficiency

Press Effic. in the EGA Gas screen in Figure 3.10.1.i to view the EGA Efficiency screen, which shows the combustion efficiency history calculated by the EGA.

The combustion efficiency is not displayed when the O_2 value is above 15.0% O_2.

Note: The combustion efficiency calculated by the EGA can be displayed as a net or gross value, depending on the setting on the EGA.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

Press Trigger Cal. to force the EGA into an air calibration when it is next in a safe condition (not trimming and span gas calibration).

3.11 Outside Temperature Compensation Screen

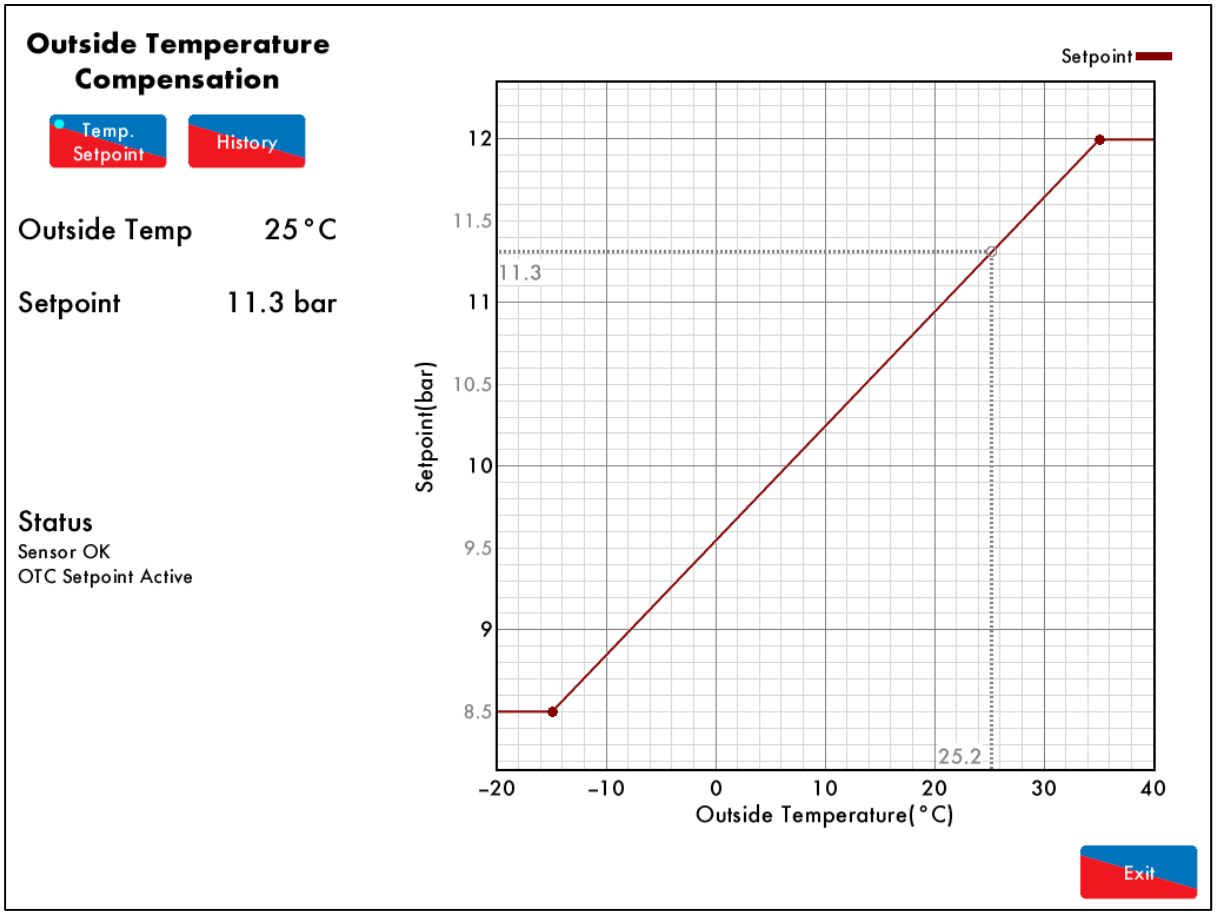


Figure 3.11.i Outside Temperature Compensation

Press on the outside temperature sensor (if enabled) in the Home screen to view the Outside Temperature Compensation screen. The following information is displayed:

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

The required setpoint will adjust according to the outside temperature, based on the minimum and maximum outside temperature and setpoints set.

Press History to view the outside temperature and setpoint histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.12 Water Level Screen

3.12.1 Water Level – Status

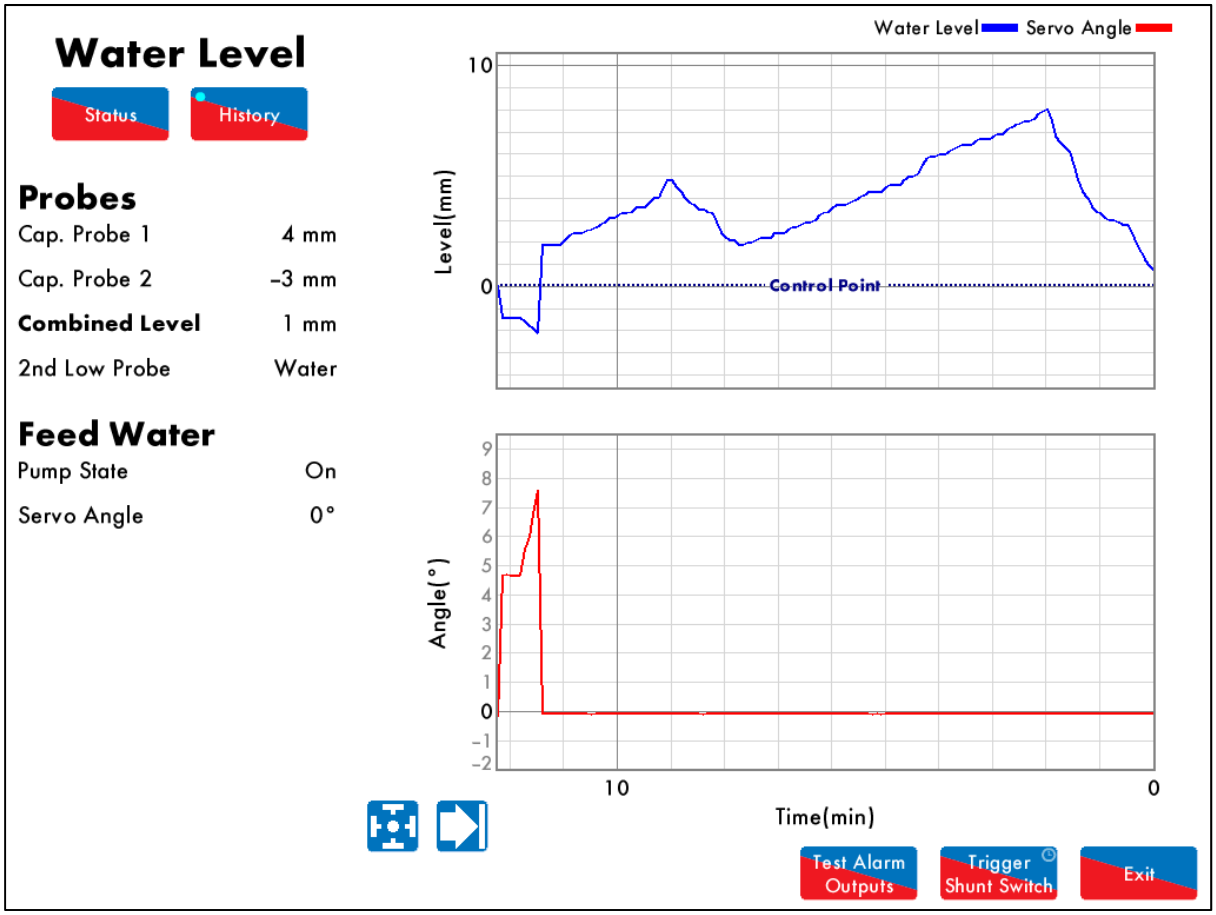


Figure 3.12.1.i Water Level

Press on the water level probes or the feed water pump (if enabled) in the Home screen in Figure 3.1.i to view the Water Level Status screen, which shows the following information:

- Capacitance probe, external level sensor readings
- Auxiliary alarm inputs and 2nd low probe water detection
- Combined water level reading
- Feed water pump state on/off, VSD output, servomotor position
- Feed water pump bypass on/off, pump on/off levels
- Feed water temperature
- Commissioned 2nd low, 1st low, pre 1st low, control point, pre high and high water levels

Press Test Alarm Outputs to continuously cycle the alarm outputs every 2 seconds without shutting the burner down. Press Trigger Shunt Switch to check the water level alarms. There is time delay for the burner to reach 1st low (expansion option 22), allowing the operator to decrease the water level to check the 1st low alarm. If the water does not drop to 1st low within this time, the shunt switch test is cancelled and the MM reverts to normal operation. There is additional delay (expansion option 23) to allow the operator to decrease the water to 2nd low to check the 2nd low alarm. If the water level does not drop in this time, the MM leaves shunt switch test and the burner will turn off. The timer will display when doing these tests. After reaching 2nd low, if the water level does not rise to control point within 10 minutes, alarms will occur.

3.12.2 Water Level – History

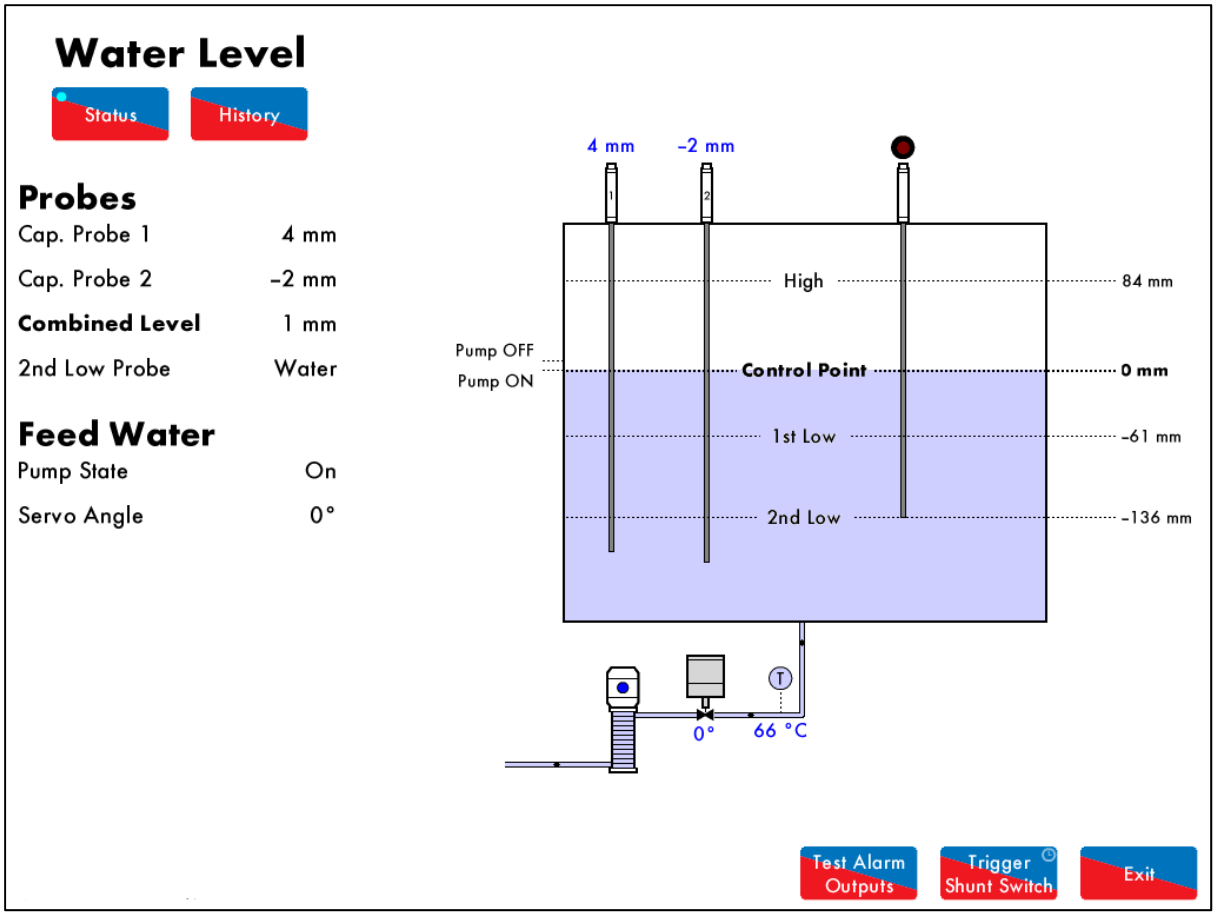


Figure 3.12.2.i Water Level – History

Press

in the Water Level Status screen in Figure 3.12.1.i to view the Water History screen which shows the combined water level and feed water servomotor/ VSD histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.13 Top Blowdown Screen

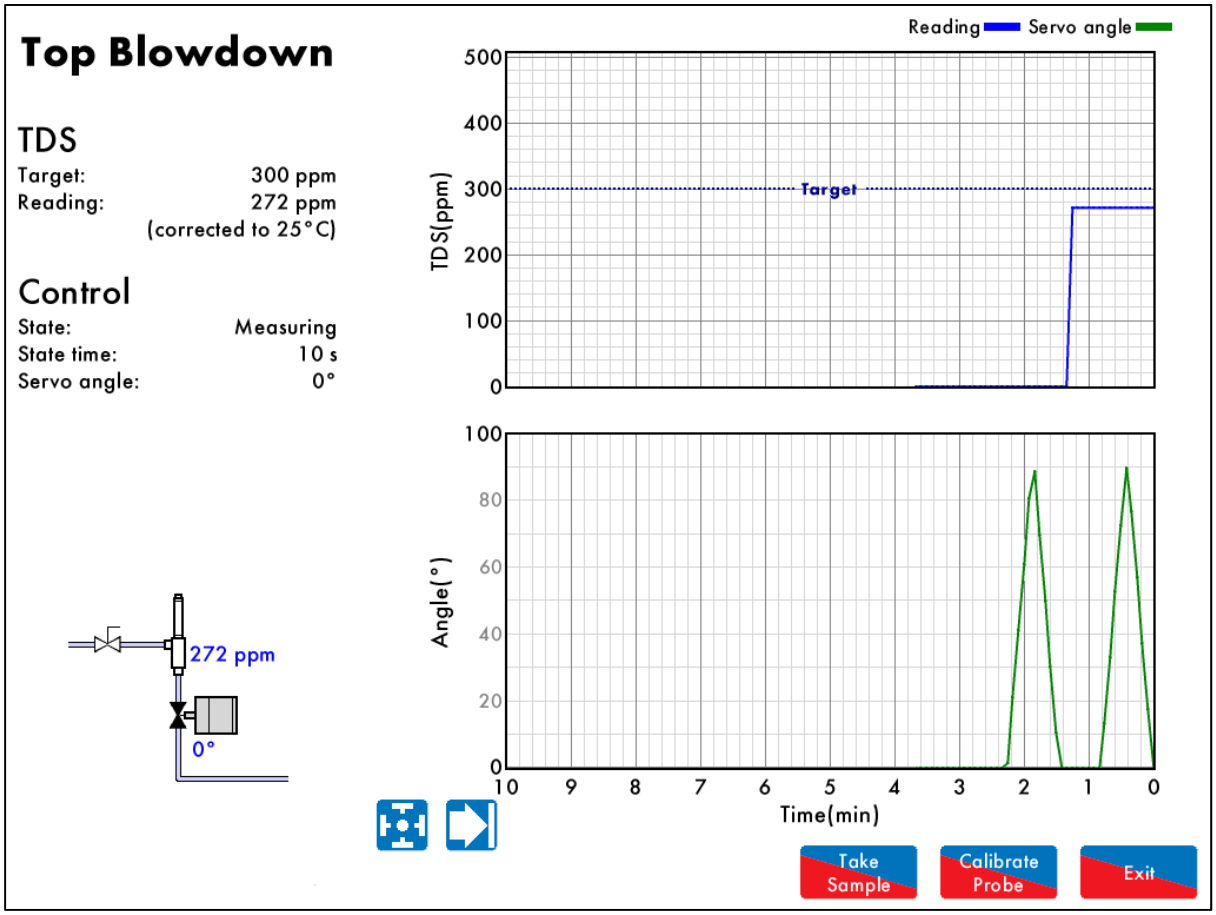


Figure 3.13.i Top Blowdown

Press on the TDS probe (if enabled) in the Home screen in Figure 3.1.i to view the Top Blowdown screen, which shows the following information:

- Target TDS value
- Current TDS reading
- Top blowdown control state and timing
- Top blowdown servomotor angle

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

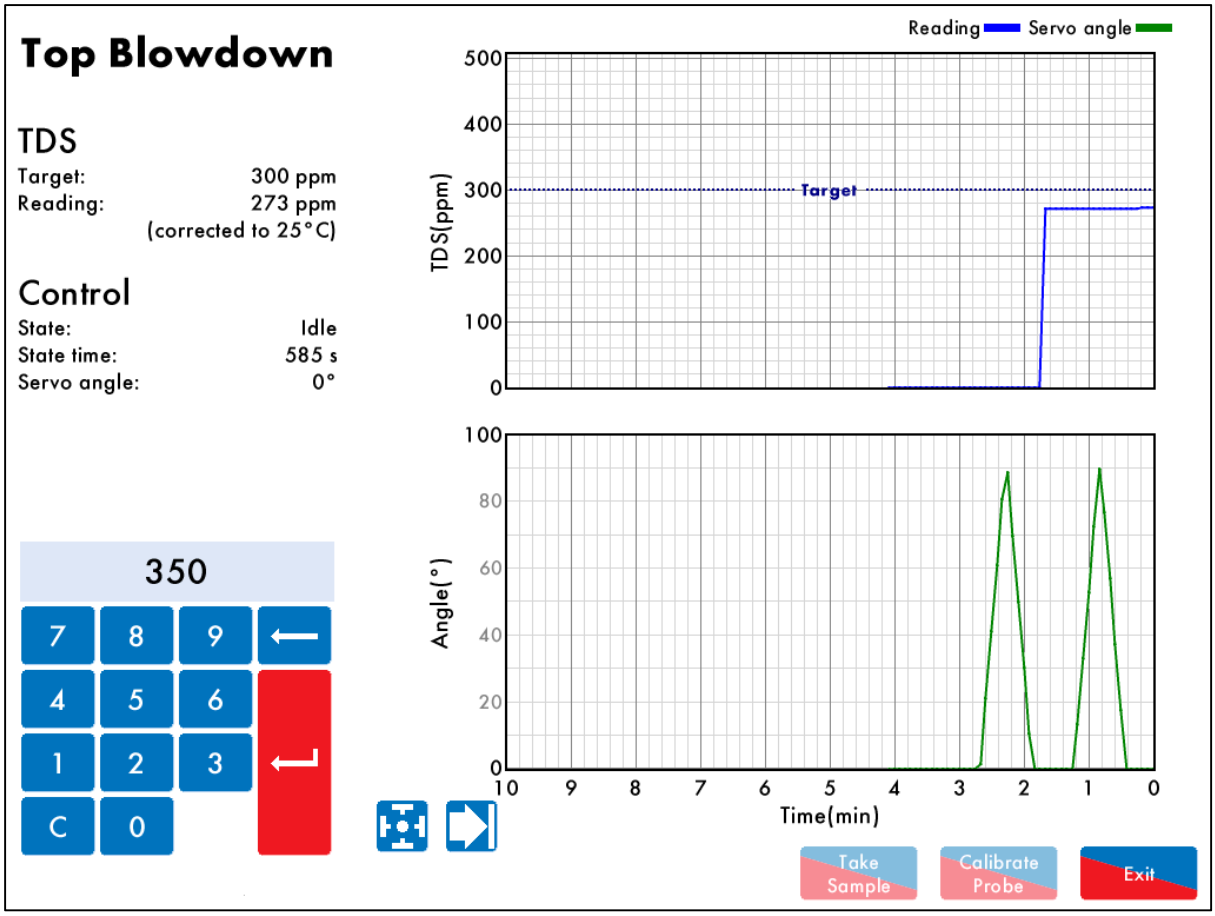


Figure 3.13.ii Calibrate TDS Probe

To calibrate the probe, press Calibrate Probe to calibrate the TDS probe. After taking a manual sample of the TDS, enter the value into the keypad and press ↵ to enter this value. This value must be within 10% - 990% of the probe reading to avoid incorrect calibration. If there is an air lock, the TDS probe will not be calibrated as the reading will be 0ppm. To check the manual sample value against the now calibrated probe value, press Take Sample to sample the TDS using the probe.

Note: Top blowdown control does not operate when the TDS probe is being calibrated, when a fresh sample is taken or when the burner is not firing.

3.14 Bottom Blowdown Screen

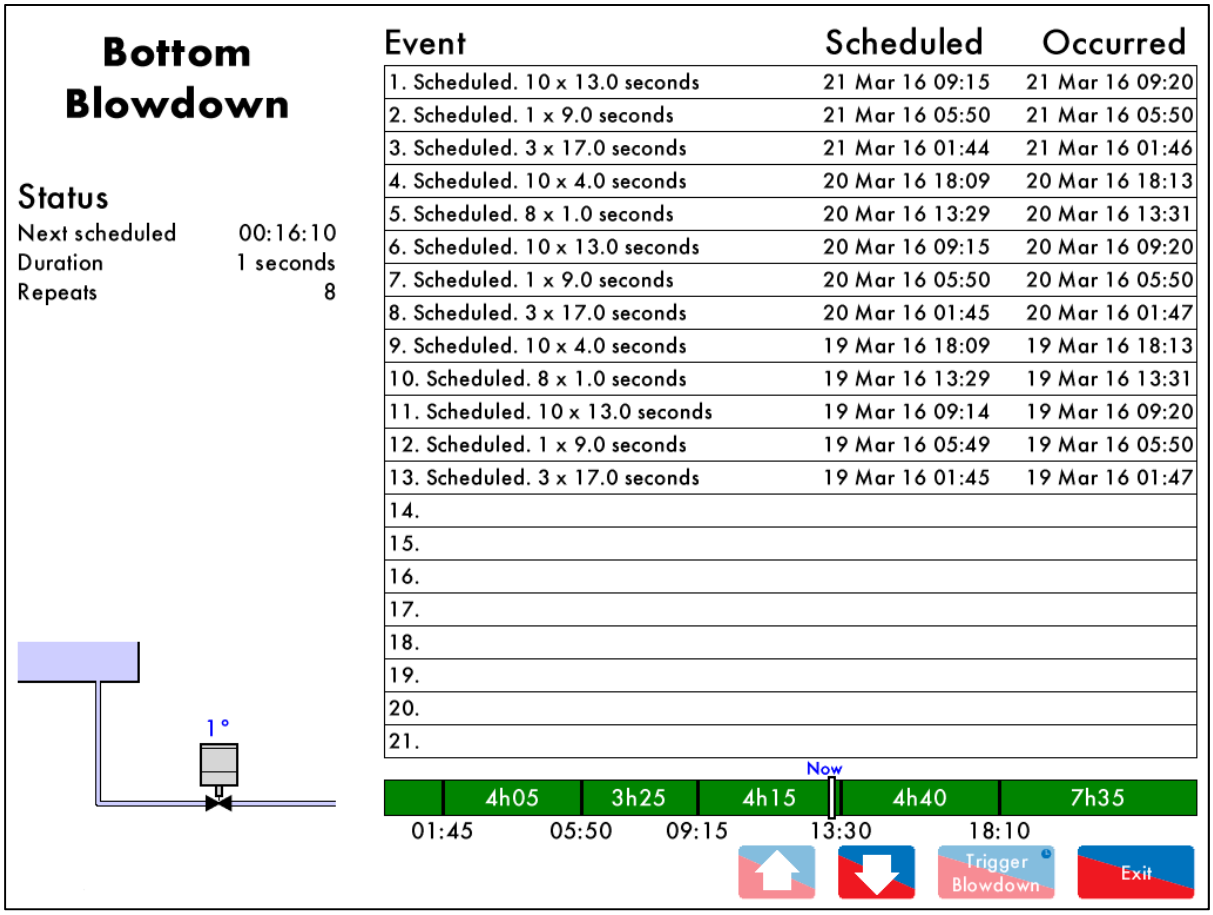


Figure 3.14.i Bottom Blowdown

Press on the bottom blowdown servomotor in the Home screen Figure 3.1.i to view the Bottom Blowdown screen, showing the bottom blowdown servomotor position, and when the next bottom blowdown is due. The bottom blowdown log stores the last 128 blowdowns, with the following information:

- Type of blowdown – scheduled, manual
- Date and time blowdown scheduled
- Date and time blowdown occurred
- Number of repeats the and duration of blowdown

If a manual trigger has been set for the bottom blowdown (expansion option 61), then when the next blowdown is due, the Trigger Blowdown button must be pressed for the valve to blowdown. The status will then showing 'waiting trigger' until this is pressed or a line voltage input is detected on terminal MB on the bottom blowdown module. If the blowdown is not triggered, the log will show the scheduled blowdown as being 'missed.'

To set the bottom schedule, please refer to section 3.18.9.

3.15 Steam Flow Screen

3.15.1 Steam Flow – Status

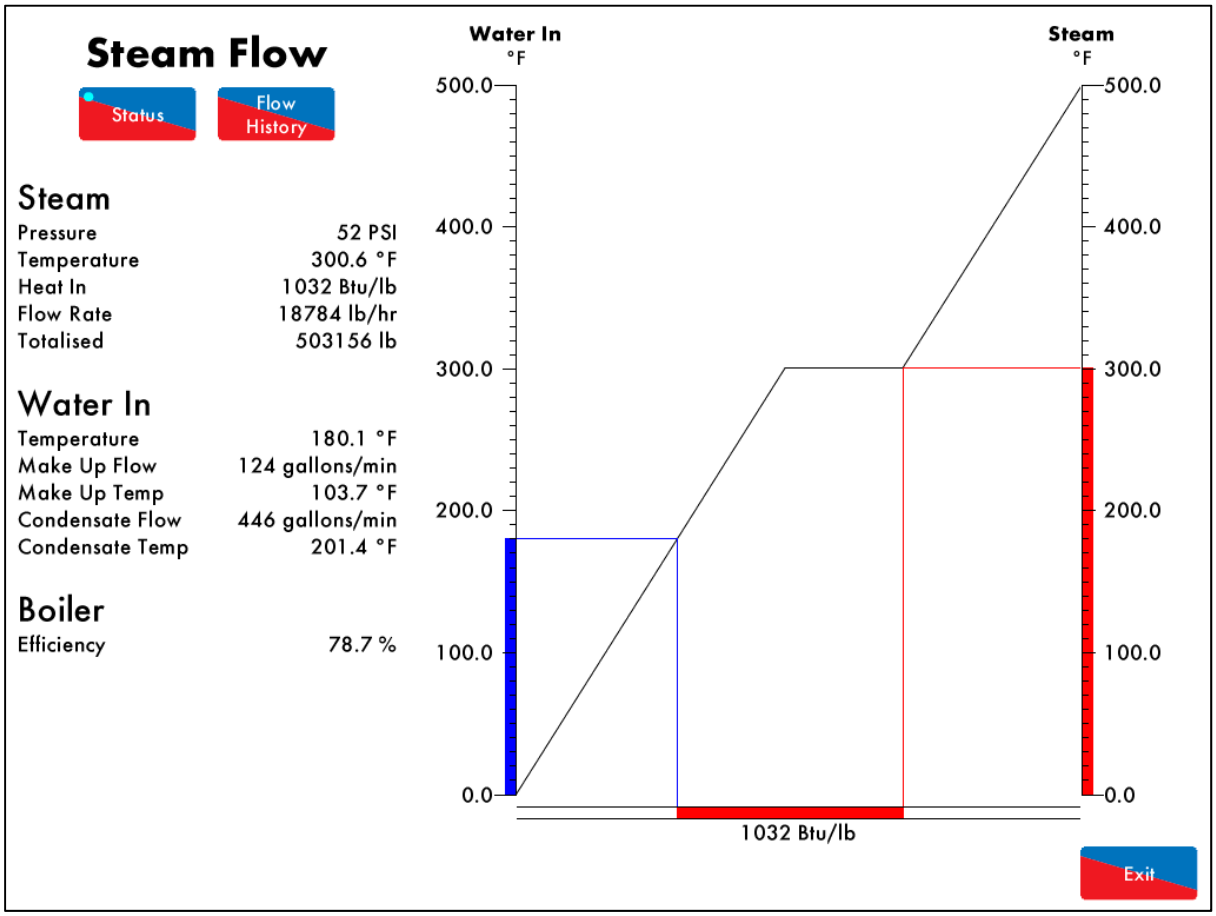


Figure 3.15.1.i Steam Flow

Press on the steam header (if enabled) in the Home screen in Figure 3.1.i to view the Steam Flow Status screen, which shows the following information:

- Current steam pressure
- Current steam temperature
- Heat in
- Steam flow rate
- Totalised steam flow
- Feed water temperature
- Make up water flow rate
- Make up water temperature
- Condensate water flow rate
- Condensate water temperature
- Boiler efficiency

Note: The information displayed will depend on the steam/ hot water flow metering configuration (expansion option 120).

3.15.2 Steam Flow – History

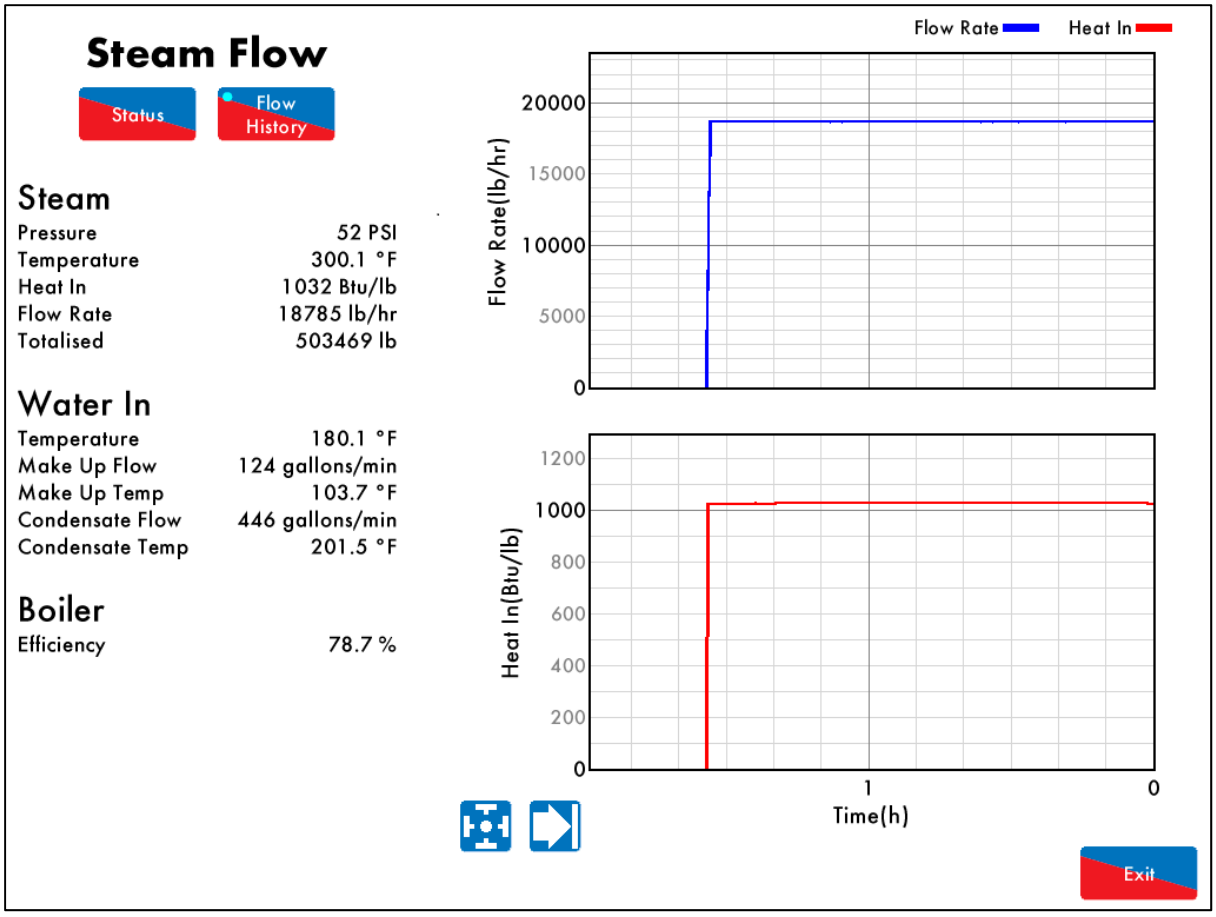


Figure 3.15.ii Steam Flow

Press Flow History in the Steam Flow Status screen in Figure 3.15.1.i to view the Steam Flow History screen, which shows the flow rate and heat in histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.16 Draught Screen

3.16.1 Draught Control – Status

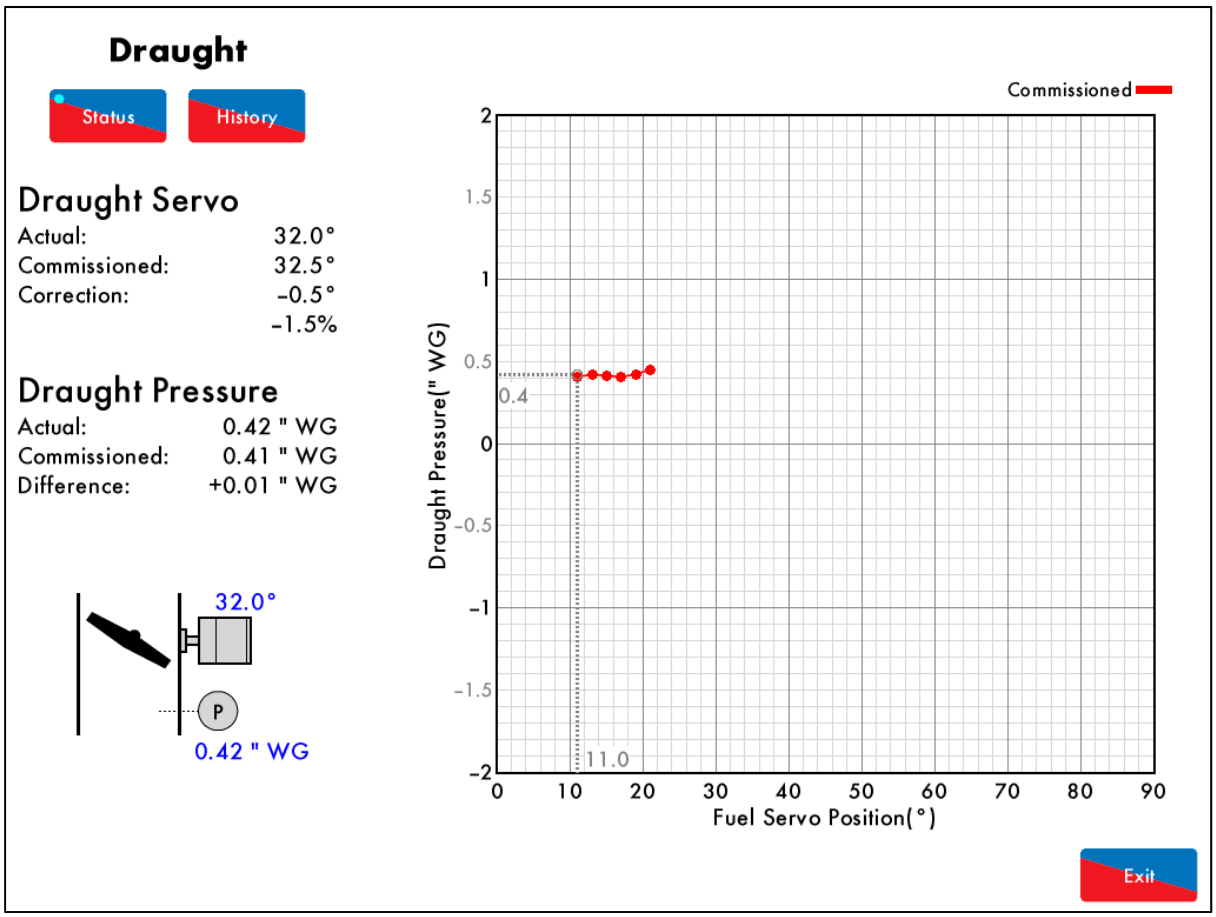


Figure 3.16.1.i Draught Control – Status

Press on the draught servomotor in the Home screen in Figure 3.1.i to view the Draught Control Status screen, which shows the following information:

- Actual draught servomotor angle
- Commissioned draught servomotor angle
- Draught servomotor correction
- Actual draught pressure
- Commissioned draught pressure
- Difference between actual and commissioned draught servomotor

3.16.2 Draught Control – History

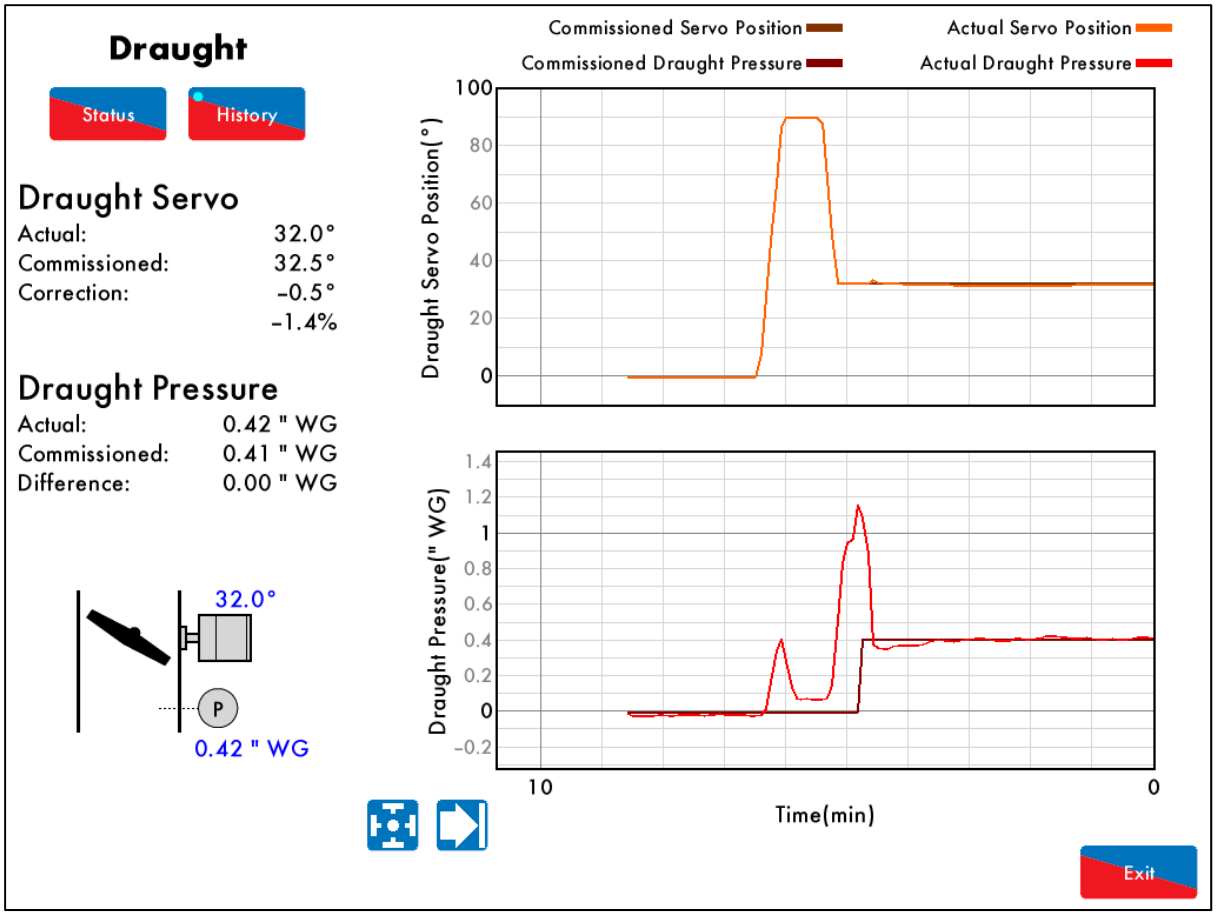


Figure 3.16.2.i Draught Control – History

Press

in the Draught Control Status screen in Figure 3.16.1.i to view the Draught Control History screen, showing the draught servomotor and draught pressure histories.

This data is logged for 24 hours on the MM. Use the buttons to change the timescale of the data displayed, and press and drag on the axis to zoom in/out of the graph.

This information is logged for 2 years on the DTI when connected with the MM.

Note: Power cycling the MM or changing fuel will reset the 24 hour history data log on the MM.

3.17 First Outs

First Out Label	Function	Active State
1. First Out 1	Monitor	Active High
2. First out 2	Monitor	Active High
3. First out 3	Non-recycle	Active High
4. First out 4	Non-recycle	Active High
5. First out 5	Recycle	Active High
6. First out 6	Recycle	Active High
7. First out 7	Monitor	Active High
8. First out 8	Non-recycle	Active High
9. First out 9	Recycle	Active High
10.First out 10	Monitor	Active High
11. First out 11	Non-recycle	Active High
12. First out 12	Recycle	Active High
13. First out 13	Disabled	Active High
14. First out 14	Monitor	Active High
15. First out 15	Non-recycle	Active High

Exit

Figure 3.17.i First Outs

Press

(if enabled) in the Home Screen in Figure 3.1.i to view the First Outs screen. The functions of a first out when active is summarised below:

Function When Active	Description
Disabled	Does not function.
Monitor	Burner continues firing, but the events will be logged.
Non-recycle	Burner stops firing and the first out must be reset for the burner to restart.
Recycle	Burner stops firing and restarts automatically when the input state changes.
Stop EGA Sampling	Burner continues firing, but the EGA stops sampling.
Stops EGA Trimming	Burner continues firing, but the EGA trim stops operating.

3.18 Fully Metered Combustion Control

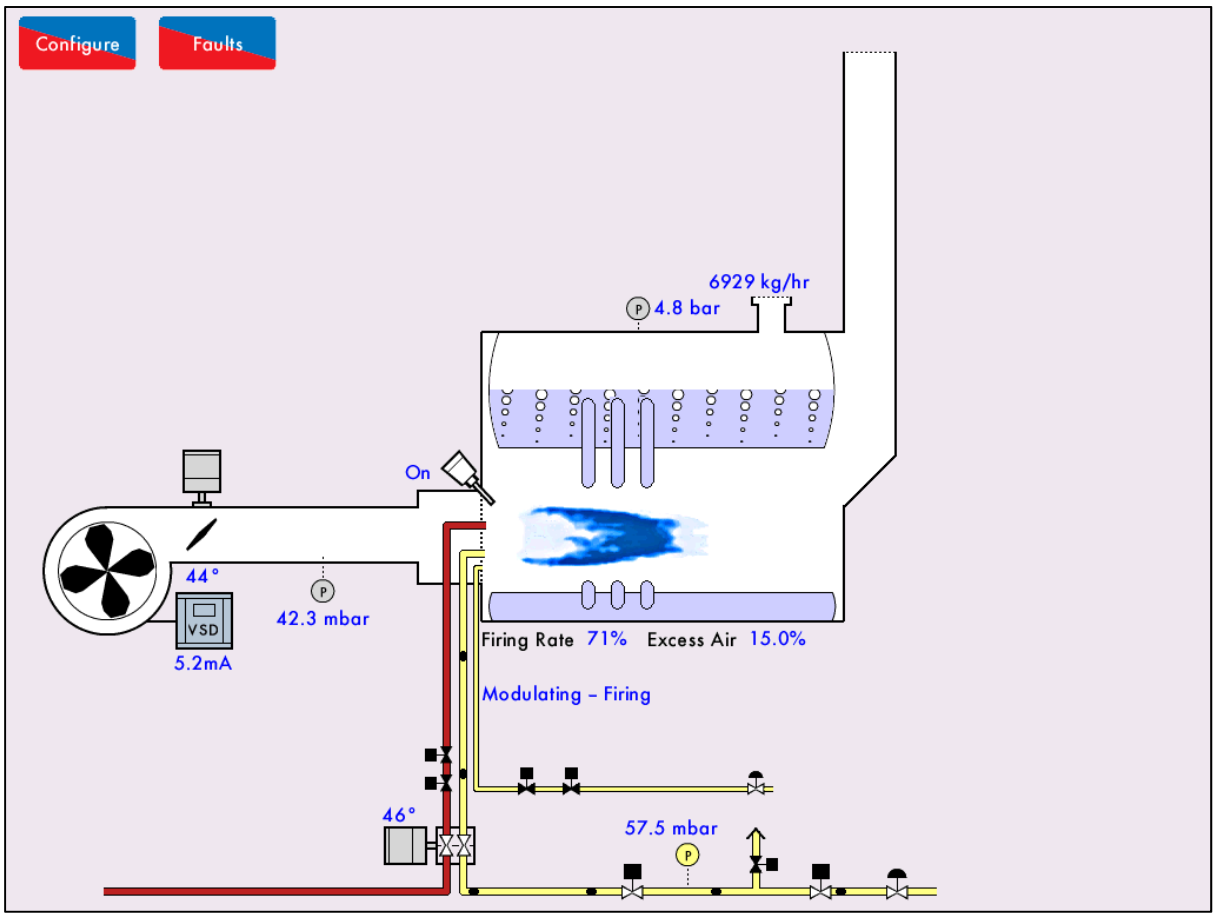


Figure 3.18.i Fully Metered Combustion Control

If fully metered combustion control is enabled, the Home screen will display the excess air going into the combustion process.

Pressing on the servomotors will show the fuel-air screens with the following information available:

- Current fuel and air mass flow rates
- Current fuel and air volume flow rates
- Current fuel and air temperatures
- Current fuel and air pressures
- Current fuel and air correction % to maintain the fuel-air ratio at that firing rate
- Current equivalence ratio
- Current excess air
- Commissioned excess air

3.19 System Configuration Screen

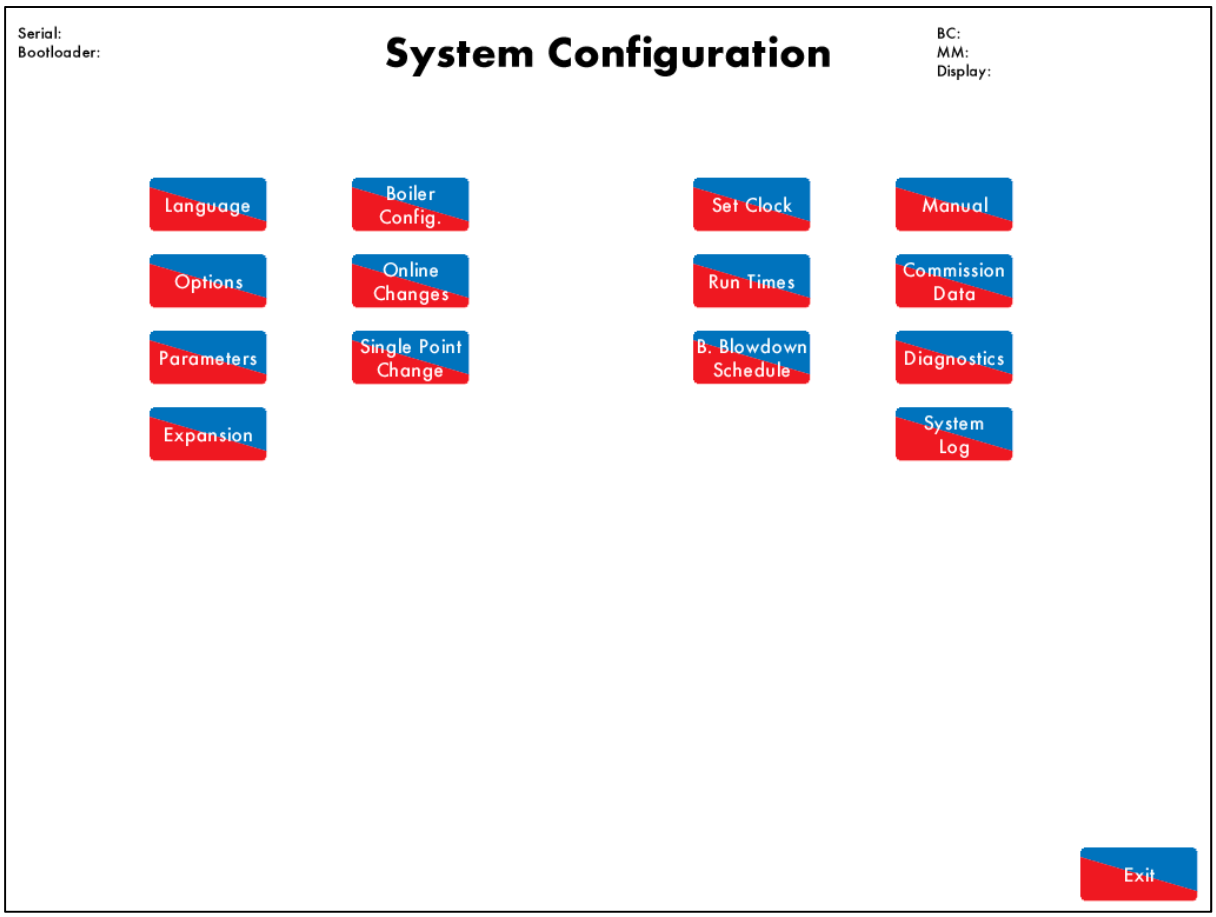


Figure 3.19.i

Press

in the Home screen in Figure 3.1.i to access the System Configuration screen. From this screen is is possible to:

- Change language (password protected)
- View all options
- View all parameters
- View all expansion options
- Change boiler configuration display in Home screen (password protected)
- Access online changes (password protected)
- Acess single point change (password protected)
- Set clock (password protected)
- Set run times (password protected)
- Set bottom blowdown scheduel if enabled (password protected)
- View operating manual
- View commission data
- View real-time diagnostics
- View system log

In the top left corner, the serial number and bootloader of the MM are shown, and in the top righ, the BC, MM and Display software versions are shown.

3.19.1 Language Selection

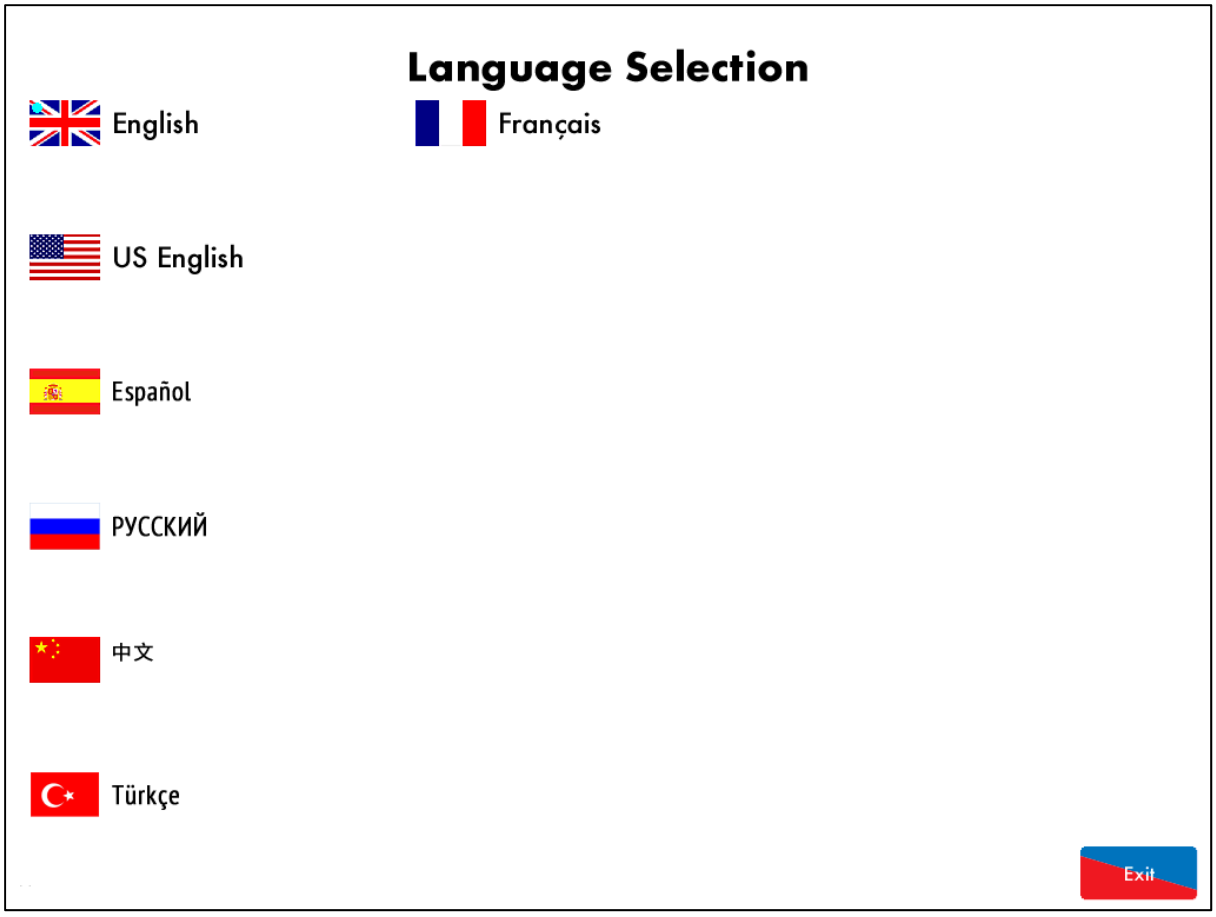


Figure 3.19.1.i Language Selection

Press

in the System Configuration screen in Figure 3.19.i to access Language Selection screen; you be will be prompted to enter the Online Changes password. Please contact your local approved Autoflame tech centre for this password.

Note: The SD card must contain the language file to be able to select the language. If a language required is not available, please contact the Autoflame office.

3.19.2 Options

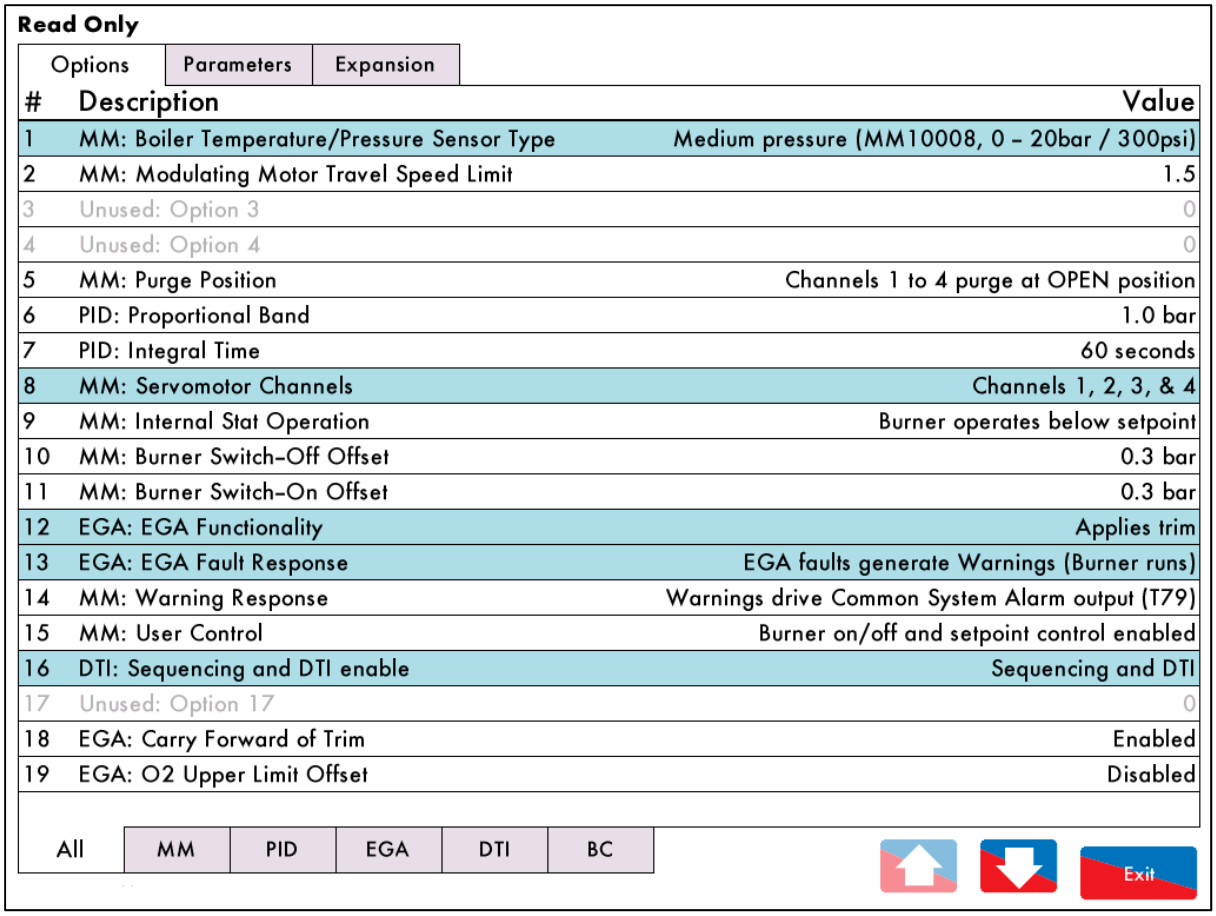


Figure 3.19.2.i Options

Press

in the System Configuration screen in Figure 3.19.i to view the Options screen, which displays all of the options and their ranges and settings. This is a read only mode, so no changes can be made to the options in this screen. Options highlighted in blue are ones which have been changed from the default values.

Press on the MM, PID, EGA, DTI and BC tabs to group together options in those categories.

3.19.3 Parameters

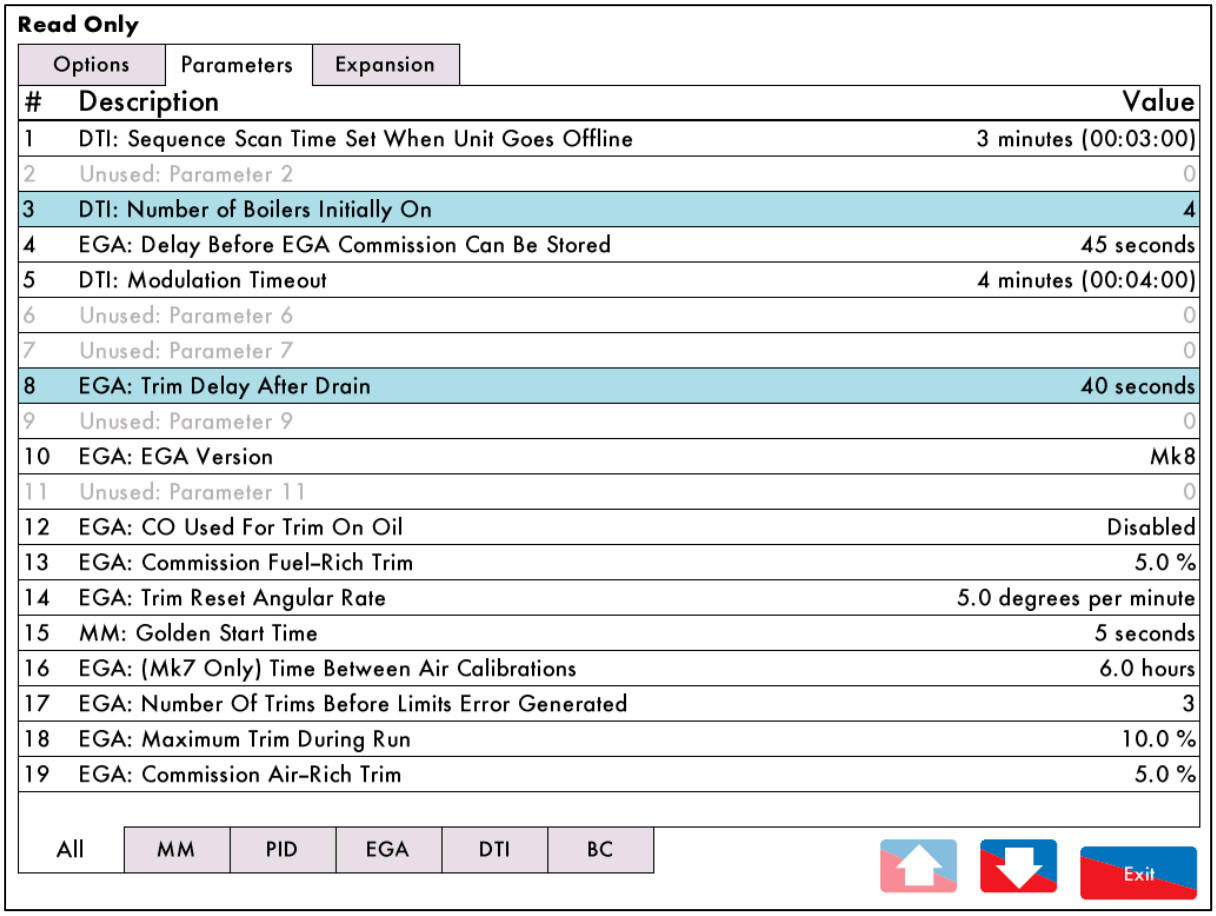


Figure 3.19.3.i Parameters

Press

in the System Configuration screen in Figure 3.19.i to view the Parameters screen, which displays all of the parameters and their ranges and settings. This is a read only mode, so no changes can be made to the parameters in this screen. Parameters highlighted in blue are ones which have been changed from the default values.

Press on the MM, PID, EGA, DTI and BC tabs to group together parameters in those categories.

3.19.4 Expansion Options

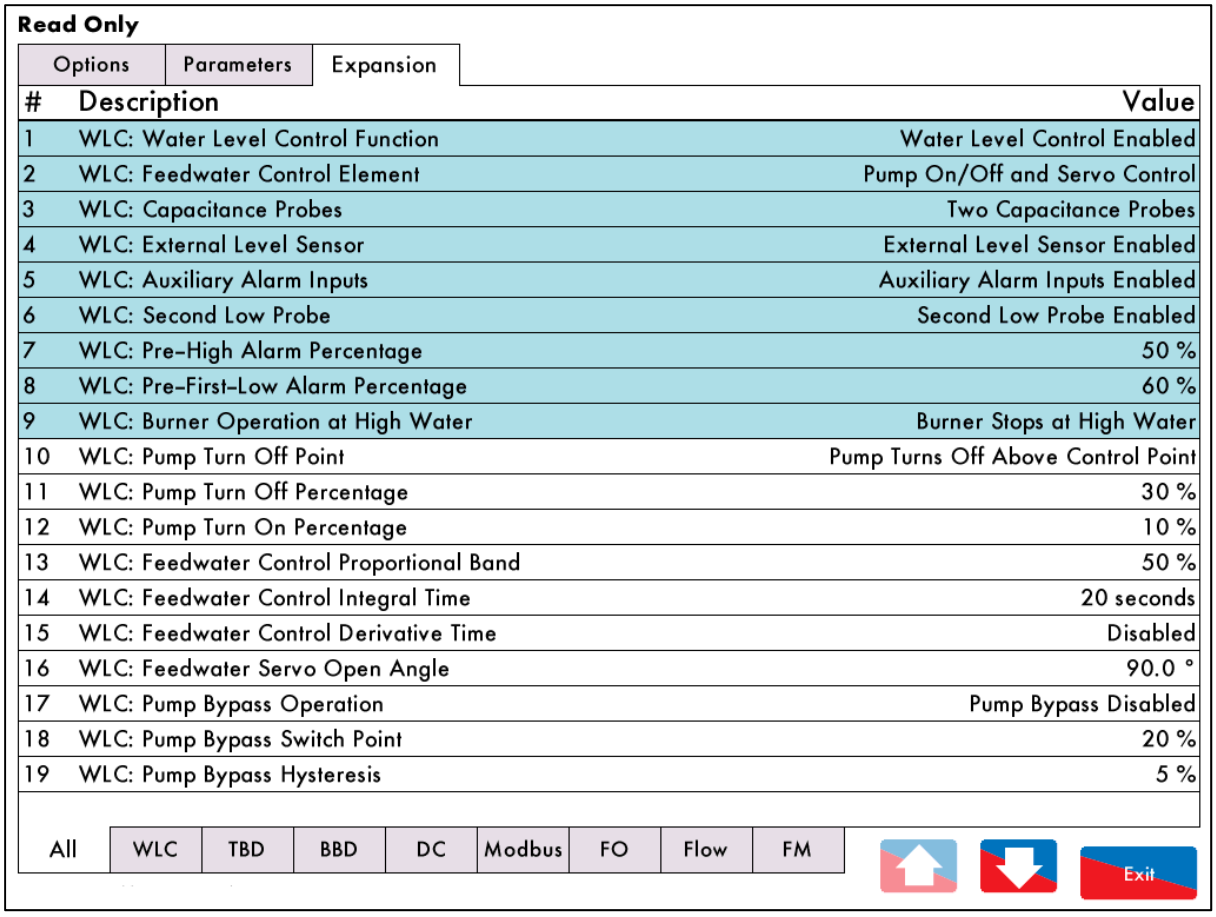
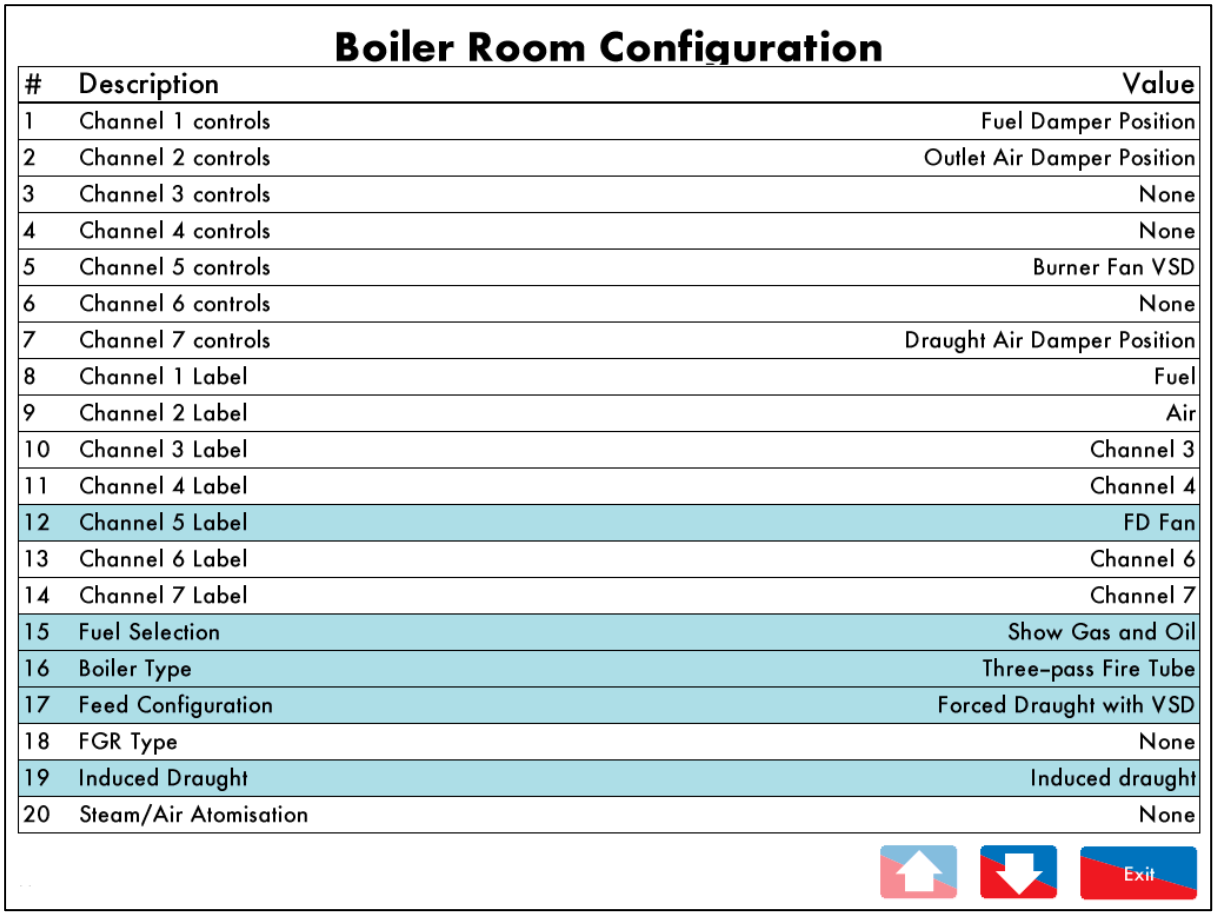


Figure 3.19.4.i Expansion Options

Press Expansion in the System Configuration screen in Figure 3.19.i to view the Expansion Options screen, which displays all of the expansion options and their ranges and settings. This is a read only mode, so no changes can be made to the expansion options in this screen. Expansion options highlighted in blue are ones which have been changed from the default values.

Press on the MM, PID, EGA, DTI and BC tabs to group together expansion options in those categories.

3.19.5 Boiler Room Configuration



Boiler Room Configuration

#	Description	Value
1	Channel 1 controls	Fuel Damper Position
2	Channel 2 controls	Outlet Air Damper Position
3	Channel 3 controls	None
4	Channel 4 controls	None
5	Channel 5 controls	Burner Fan VSD
6	Channel 6 controls	None
7	Channel 7 controls	Draught Air Damper Position
8	Channel 1 Label	Fuel
9	Channel 2 Label	Air
10	Channel 3 Label	Channel 3
11	Channel 4 Label	Channel 4
12	Channel 5 Label	FD Fan
13	Channel 6 Label	Channel 6
14	Channel 7 Label	Channel 7
15	Fuel Selection	Show Gas and Oil
16	Boiler Type	Three-pass Fire Tube
17	Feed Configuration	Forced Draught with VSD
18	FGR Type	None
19	Induced Draught	Induced draught
20	Steam/Air Atomisation	None

Exit

Figure 3.19.5.i Boiler Room Configuration

Press

in the System Configuration screen in Figure 3.19.i to access the Boiler Room Configuration screen; you be will be prompted to enter the Online Changes password. Please contact your local approved Autoflame tech centre for this password.

The boiler room configuration settings are used to customise the Home screen in Figure 3.1.i. Any settings which are highlighted in blue are ones which have been changed from the default value.

The table below shows the available Boiler Room Configuration settings:

Setting	Default	Range	Description
1	1		Channel 1 Controls
		1	Fuel damper position
2	3		Channel 2 Controls
		2	Inlet air damper position
		3	Outlet air damper position
		7	Rotary cup primary air damper position
3	0		Channel 3 Controls
		0	None
		2	Inlet air damper position
		3	Outlet air damper position
		4	FGR air damper position
		5	Draught air damper position
		6	Steam/air atomisation damper position
		7	Rotary cup primary air damper position
4	0		Channel 4 Controls
		0	None
		2	Inlet air damper position
		3	Outlet air damper position
		4	FGR air damper position
		5	Draught air damper position
		6	Steam/air atomisation damper position
		7	Rotary cup primary air damper position
5	1		Channel 5 Controls
		0	None
		1	Burner fan VSD
		2	FGR fan VSD
		3	Draught fan VSD
		4	Rotary cup primary air VSD
6	0		Channel 6 Controls
		0	None
		1	Burner fan VSD
		2	FGR fan VSD
		3	Draught fan VSD
		4	Rotary cup primary air VSD
7	5		Channel 7 Controls
		5	Draught air damper position

Setting	Default	Range	Description
8	1		Channel 1 Label
		0	Channel 1
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught
9	4		Channel 2 Label
		0	Channel 2
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught

Setting	Default	Range	Description
10	0		Channel 3 Label
		0	Channel 3
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught
11	0		Channel 4 Label
		0	Channel 4
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught

Setting	Default	Range	Description
12	12		Channel 5 Label
		0	Channel 5
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught
13	0		Channel 6 Label
		0	Channel 6
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught

Setting	Default	Range	Description
14	0		Channel 7 Label
		0	Channel 7
		1	Fuel
		2	Gas
		3	Oil
		4	Air
		5	FGR
		6	P-Air
		7	S-Air
		8	T-Air
		9	ID fan
		10	FD fan
		11	Steam
		12	VSD
		13	Blower
		14	Sleeve
		15	Head
		16	Inlet
		17	Outlet
		18	Water
		19	Draught
15	0		Fuel Selection
		0	Show gas train
		1	Show oil train
		2	Show gas and oil
		3	Show gas and oil close-coupled
16	0		Boiler Type
		0	Water tube
		1	Two-pass fire tube
		2	Three-pass fire tube
		3	Four-pass fire tube
		4	Cast-sectional tube
		5	Horizontal coil tube
		6	Vertical coil tube
		7	Kiln
17	0		Feed Configuration
		0	Forced draught
		1	Forced draught with VSD
		2	Rotary cup
18	0		FGR Type
		0	None
		1	Induced FGR with a motorised damper
		2	Forced FGR with a motorised damper
		3	Forced FGR with VSD
		4	Forced FGR with motorised damper and VSD

Setting	Default	Range	Description
19	0		Induced Draught
		0	None
		1	Induced draught
		2	Induced draught with damper
		3	Induced draught with VSD
		4	Induced draught with motorised damper and VSD
20	0		Steam/ Air Atomisation
		0	None
		1	Show steam/ air train
		2	Show steam/ air train with a servo
21	0		Two-Port Valve
		0	None
		1	Show two-port valve
22	0		Combustion Head Type
		0	Diffuser
		1	Mesh
23	0		Water Level Probes Display
		0	Display in boiler
		1	Display in pot
24	0		Boiler Pressure Metric Display Units
		0	bar
		1	kPa
25	0		Fuel 1 Configuration Override
		0	None
		1	Disable FGR fan animation
26	0		Fuel 2 Configuration Override
		0	None
		1	Disable FGR fan animation
27	0		Fuel 3 Configuration Override
		0	None
		1	Disable FGR fan animation
28	0		Fuel 4 Configuration Override
		0	None
		1	Disable FGR fan animation

3.19.6 Online Changes

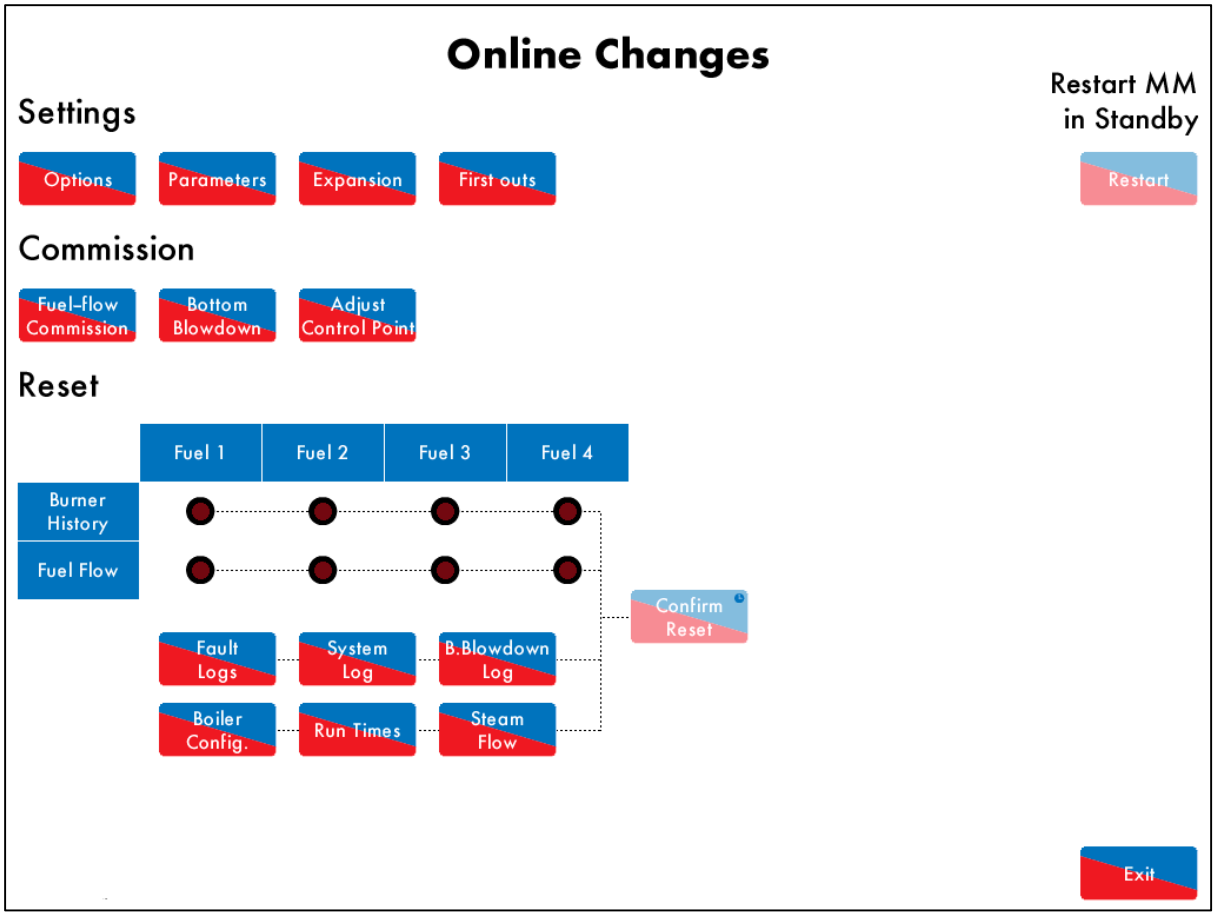


Figure 3.19.6.i Online Changes Screen

Press Online Changes in the System Configuration screen in Figure 3.19.i to access the Online Changes screen; you be will be prompted to enter the Online Changes password. Please contact your local approved Autoflame tech centre for this 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

3.19.7 Set Clock

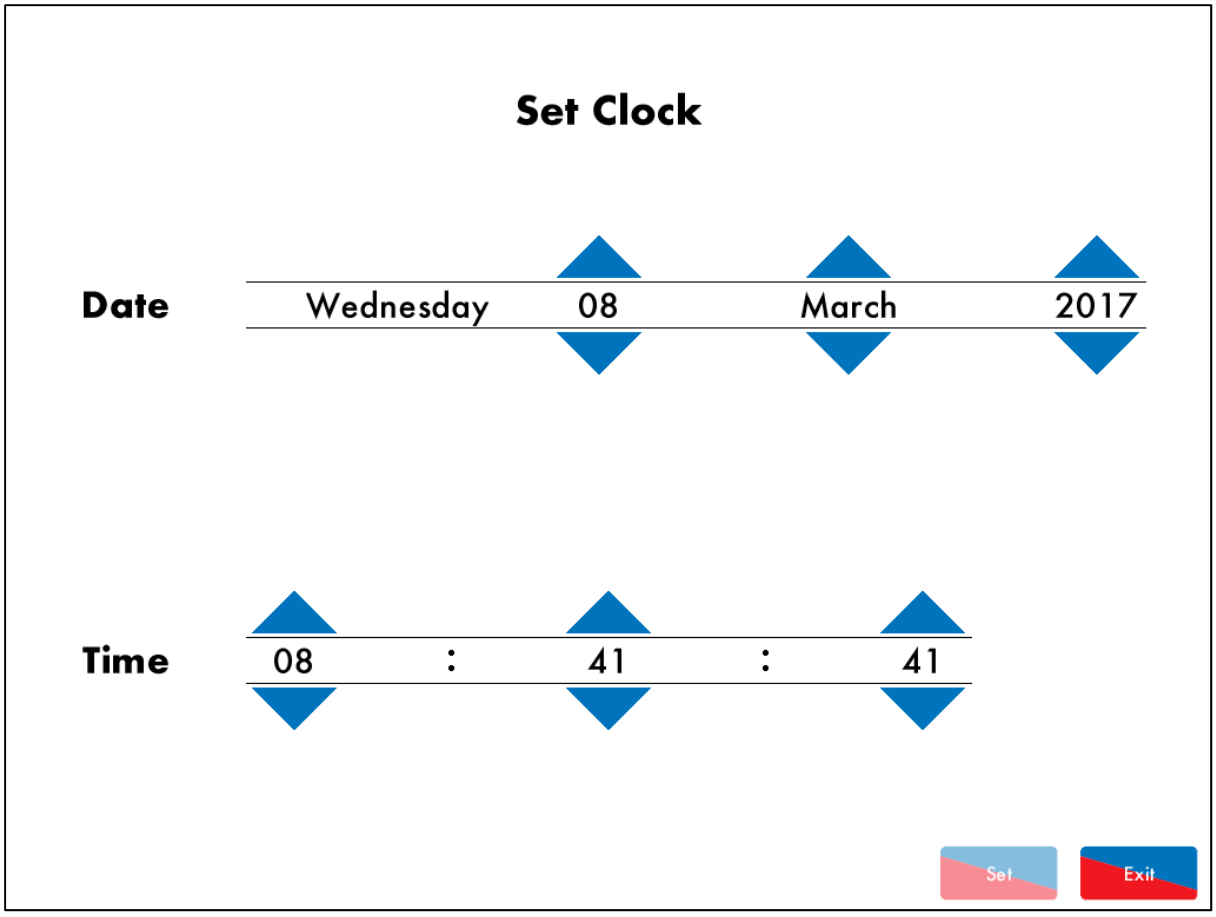


Figure 3.19.7.i Set Clock

Press Set Clock in the System Configuration screen in Figure 3.19.i to access the Set Clock screen; you will be prompted to enter the password (10, 10). Change the time and data using the arrows and then press Set and then press Exit.

Note: If the MM is connected to a DTI, then then time and data will be set by the DTI and cannot be adjusted on the MM.

3.19.8 Run Times

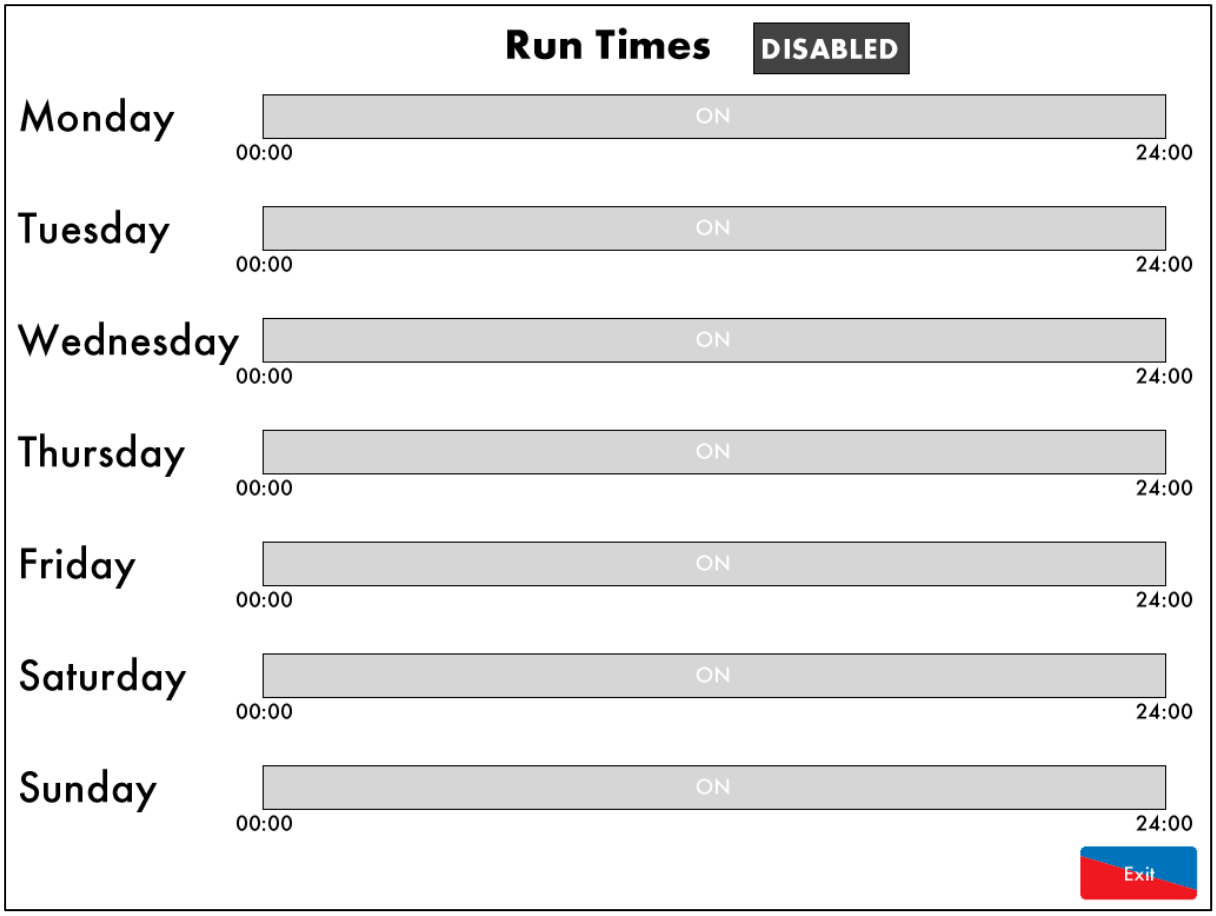


Figure 3.19.8.i Run Times – Disabled

Press

in the System Configuration screen in Figure 3.19.i to access the Run Times screen, where a burner schedule can be set; you will be prompted to enter a password (11, 11). Run times sets when the MM is scheduled to be on and firing to meet the required setpoint, on and firing to meet the reduced setpoint or off.

The reduced setpoint is set in the Status screen in Figure 3.2.1.i.

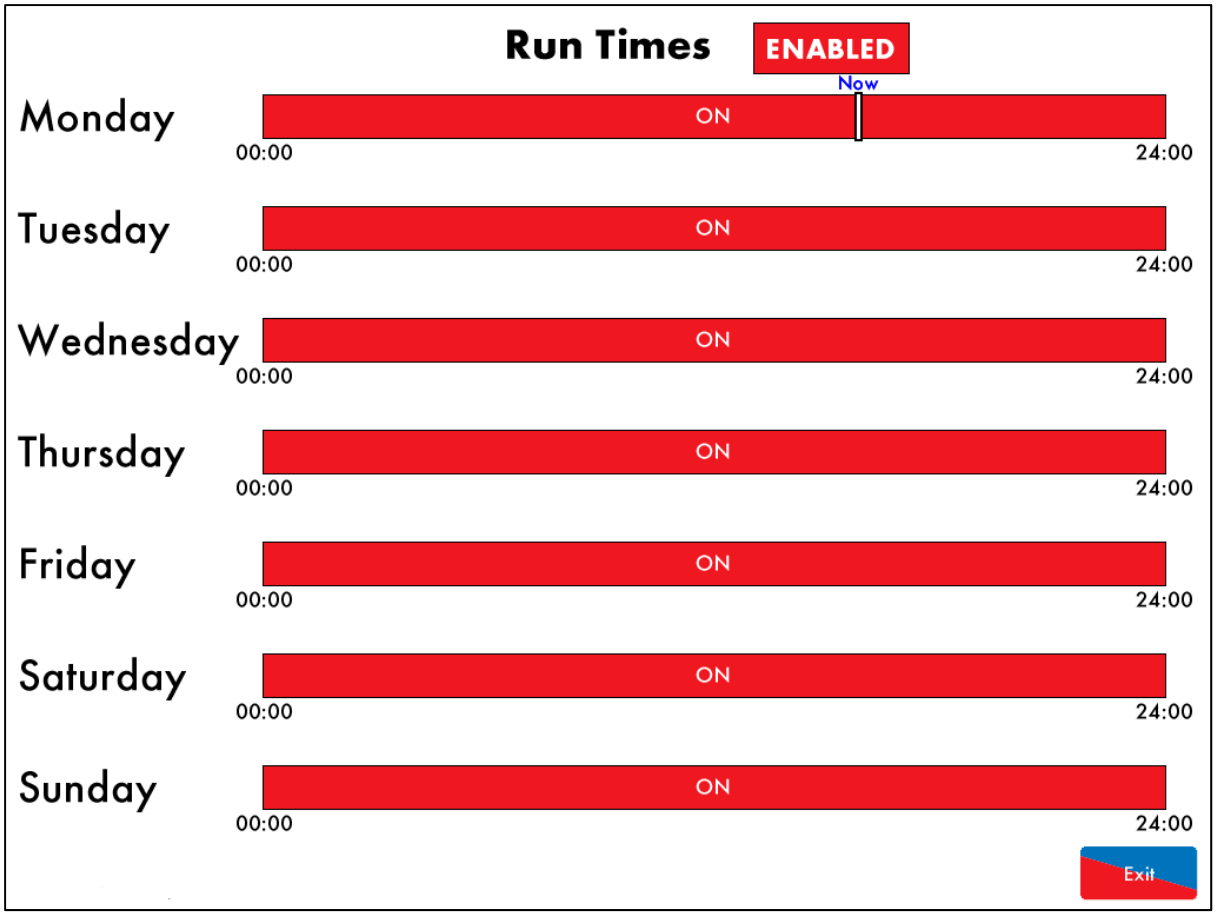


Figure 3.19.8.ii Run Times – Enabled

Press **DISABLED** in the Run Time screen in Figure 3.19.8.i to enable Run Times. Press on the bar next to the day to set the run times for that day of the week.

To disable the run times press **ENABLED**.

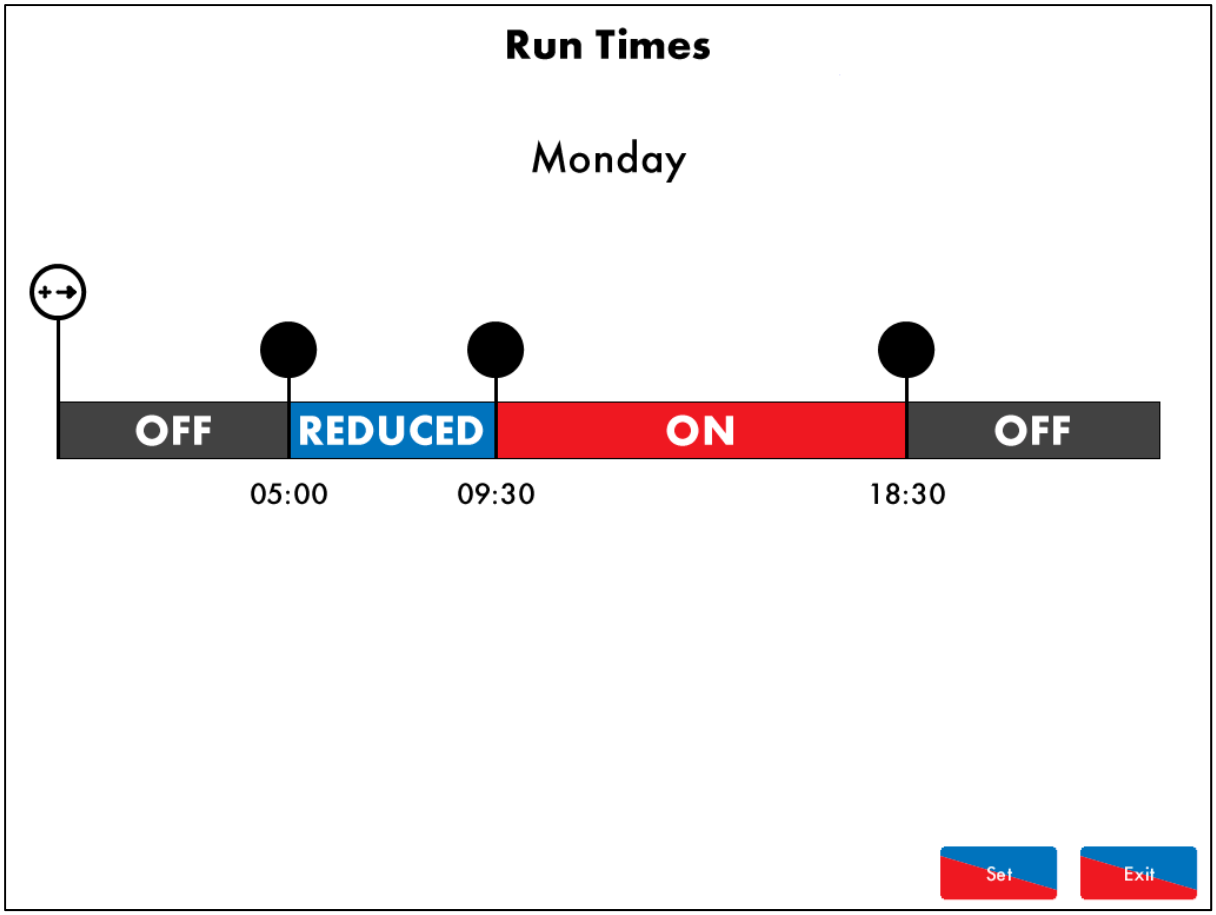


Figure 3.19.8.iii Run Times – Monday

To see the schedule press on the bar for that day in the Run Times screen in Figure 3.19.8.ii and press to add intervals, displayed as , then press on the bar to change the intervals to ON, OFF or REDUCED. Up to 10 time intervals can be set per day.

To remove an interval press on and drag upwards.

Press Set and then press Exit.

3.19.9 Bottom Blowdown Schedule

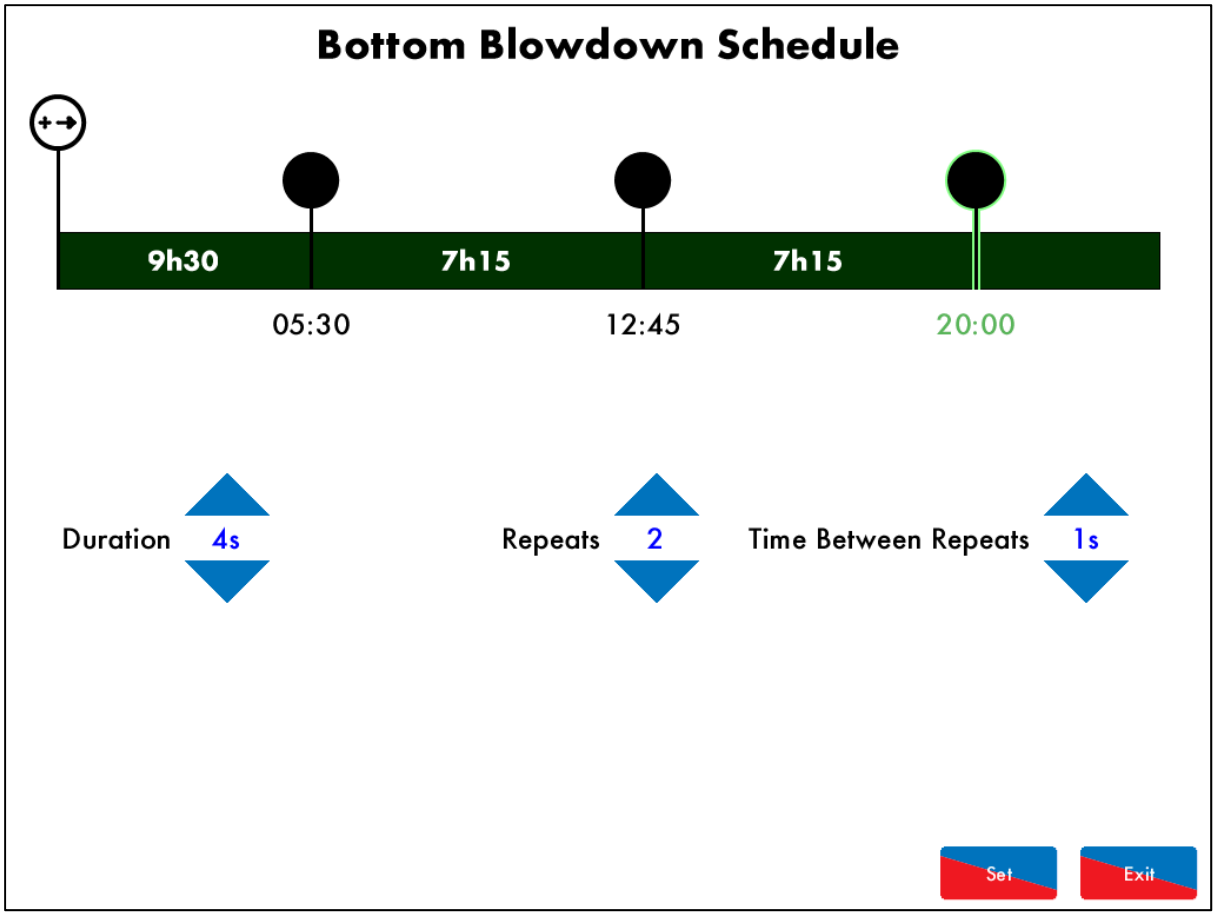


Figure 3.19.9.i Bottom Blowdown Schedule

Press B. Blowdown Schedule in the System Configuration screen in Figure 3.19.i to access the Bottom Blowdown Scheduel screen; you will be prompted to enter a password (13, 13).

Press on to add a blowdown time. Press and drag to the left or right to adjust this time. Use the buttons to increase and decrease the time/number of repeats. The bottom blowdowns can be schedule at 5 minute intervals within the following ranges:

Configuration	Range
Duration of blowdown	1 – 60s
Number of repeats for the blowdown	1 – 10
Time between repeats	1 – 60s
Number of schedule blowdowns	1 – 10 over 24hour period

To remove a blowdown time press on and drag this up, and then press to remove this blowdown time from the schedule.

Once the blowdown times have been set, press Set to save the blowdown times, and then press Exit to leave the bottom blowdown configuration screen.

3.19.10 Manual

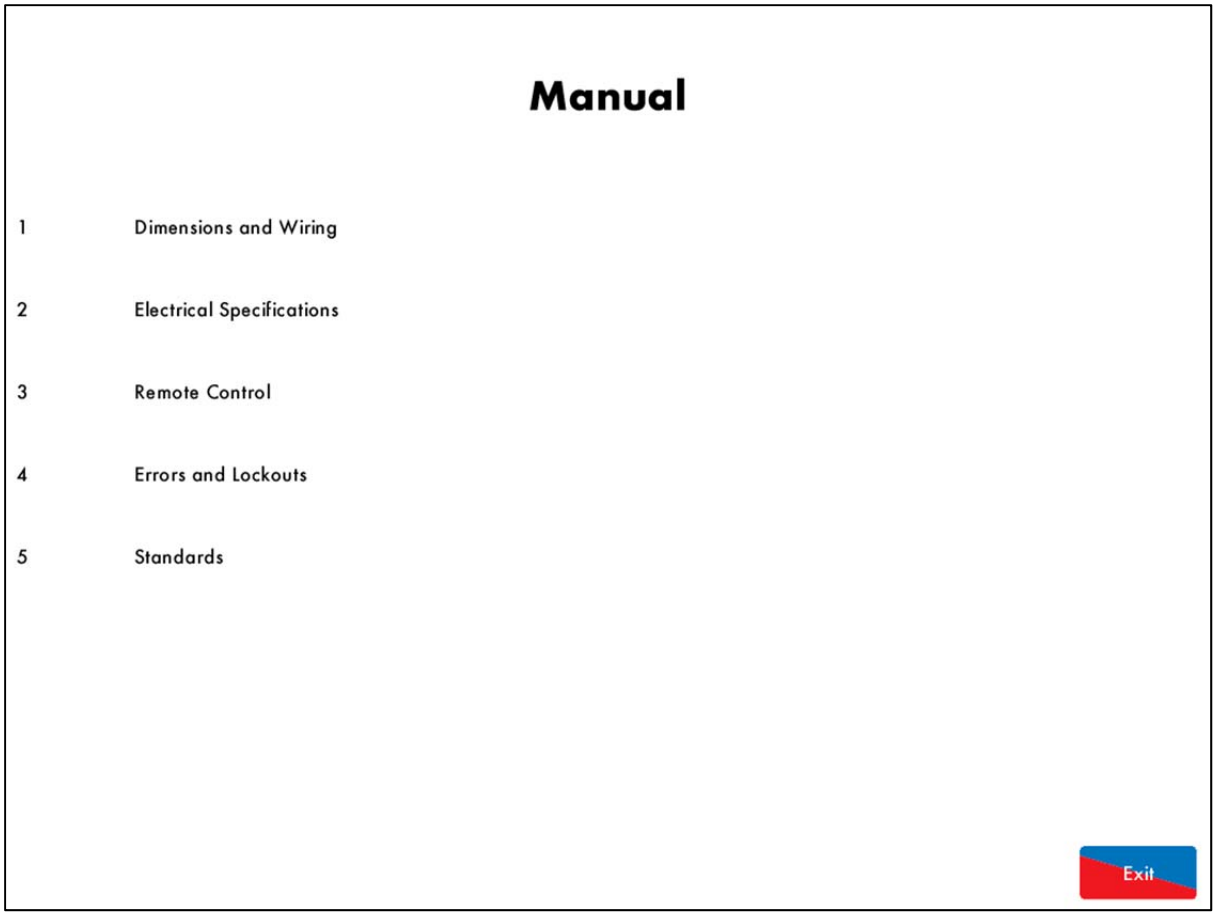


Figure 3.19.10.i Manual

Press

in the System Configuration screen in Figure 3.19.i to view the Manual screen. Press on the section headings to navigate through the operating manual.

Note: The SD card must contact the manual file to be able to view the operating manual on the MM screen.

3.19.11 Commission Data

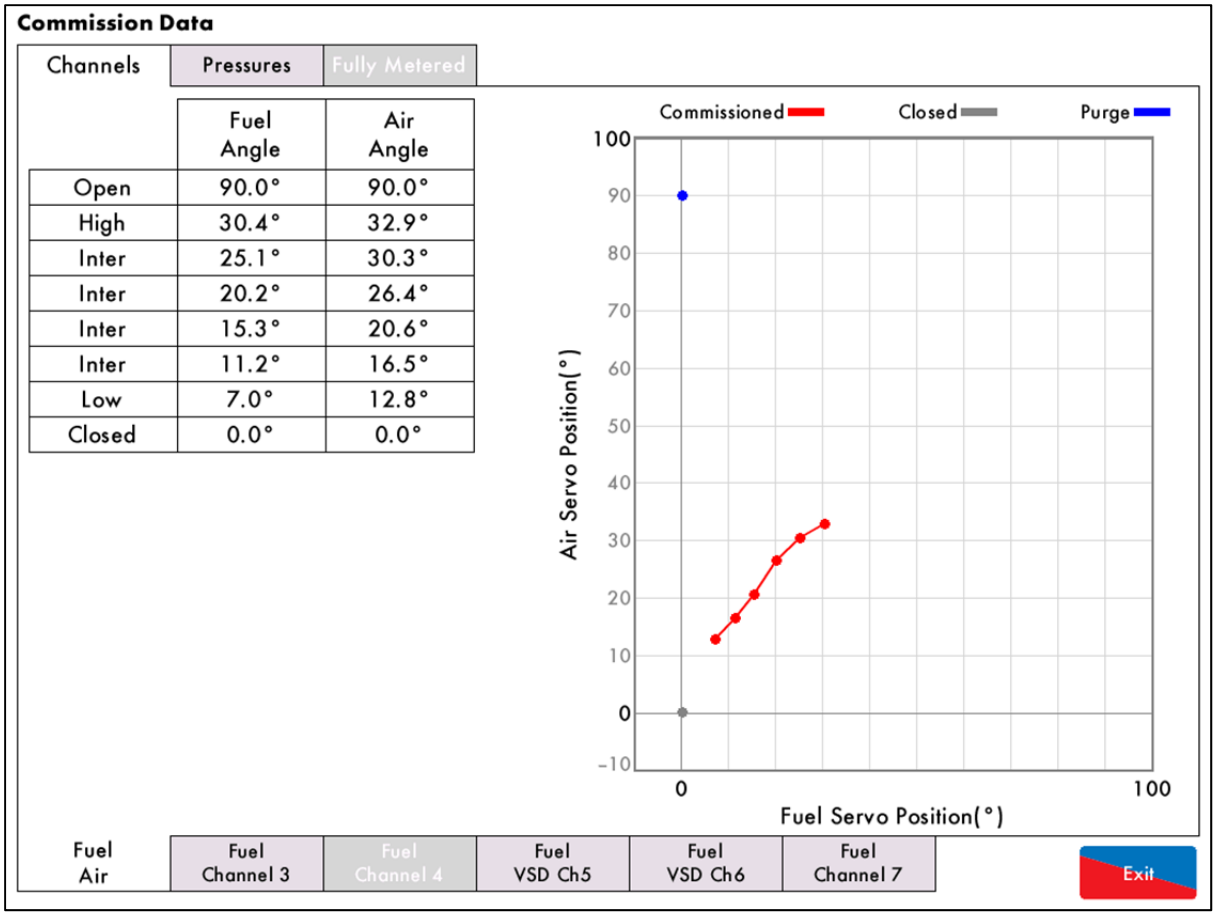
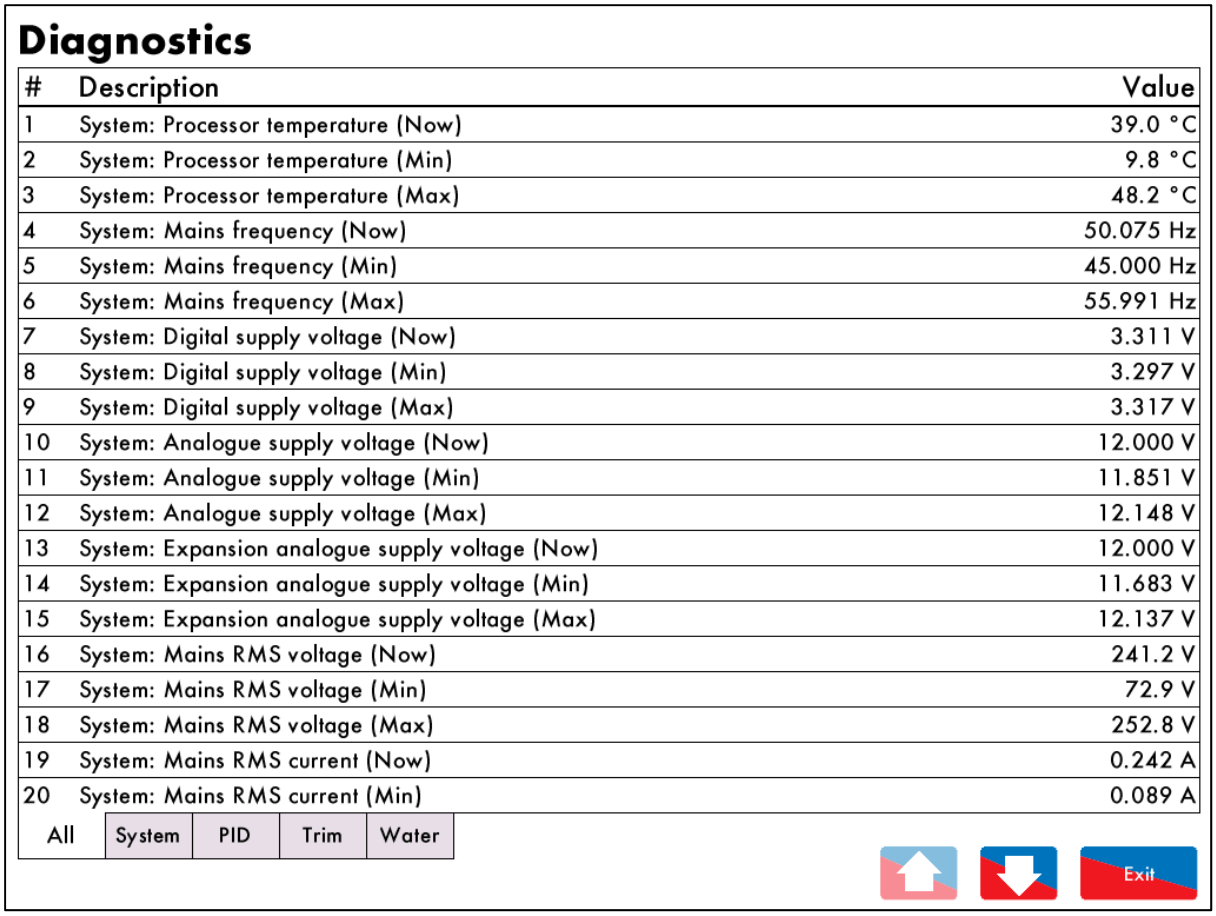


Figure 3.19.11.i Commission Data

Press Commission Data in the System Configuration screen in Figure 3.19.i to view the Commission Data screen.

3.19.12 Diagnostics



Diagnostics

#	Description	Value
1	System: Processor temperature (Now)	39.0 °C
2	System: Processor temperature (Min)	9.8 °C
3	System: Processor temperature (Max)	48.2 °C
4	System: Mains frequency (Now)	50.075 Hz
5	System: Mains frequency (Min)	45.000 Hz
6	System: Mains frequency (Max)	55.991 Hz
7	System: Digital supply voltage (Now)	3.311 V
8	System: Digital supply voltage (Min)	3.297 V
9	System: Digital supply voltage (Max)	3.317 V
10	System: Analogue supply voltage (Now)	12.000 V
11	System: Analogue supply voltage (Min)	11.851 V
12	System: Analogue supply voltage (Max)	12.148 V
13	System: Expansion analogue supply voltage (Now)	12.000 V
14	System: Expansion analogue supply voltage (Min)	11.683 V
15	System: Expansion analogue supply voltage (Max)	12.137 V
16	System: Mains RMS voltage (Now)	241.2 V
17	System: Mains RMS voltage (Min)	72.9 V
18	System: Mains RMS voltage (Max)	252.8 V
19	System: Mains RMS current (Now)	0.242 A
20	System: Mains RMS current (Min)	0.089 A

Figure 3.19.12.i Diagnostics

Press

in the System Configuration screen in Figure 3.19.i to view the real-time diagnostics. This data is logged hourly on the SD card for up to 3 months. The minimum and maximum values are the lowest and highest values the MM as detected for this measurement.

3.19.13 System Log

Figure 3.19.13.i System Log

Press

in the System Configuration screen in Figure 3.19.i to view the System Log screen, which stores 1000 entries of the following information:

- Stat on/ off
- Setting changes
- Commission/single point change
- Fuel flow commission
- MM restart
- Setpoint changes

4 REMOTE CONTROL

4.1 Overview

To access data remotely from the Mk8 MM, this can be done by either connecting to a MK7 DTI, or by using direct Modbus. Direct Modbus cannot be used with sequencing or Mk7 DTI. The MM Direct Modbus expansion feature must be unlocked.

To activate direct Modbus on the Mk8 MM, the Direct Modbus expansion software feature must be unlocked. The activation code for the serial number of the MM will need to be purchased using part number MK8006, and uploaded to the unit via Download Manager software.

Please see Autoflame PC Software Guide for more information on unlocking expansion features on the Mk8 MM using Download Manager software.

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

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

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

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

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

If the MM does not receive any Modbus commands for 60 seconds, the Modbus goes 'offline.' You can keep the Modbus 'online' with a simple instruction, such as polling or setting a single value to that individual MM. If the Modbus is 'offline' then remote setpoint and firing rate set via Modbus will be disabled. The only exception is the enable/disable burner which changes the enable/disable button on the MM on the home screen, as this change will last until the Modbus state is changed again or the enable/disable button is pressed again.

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

4.2 Configuration

The following expansion options will need to be set on the Mk8 MM for direct Modbus.

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

The following terminals are used for direct Modbus.

Terminal	Description
27	RS485 -
28	RS485 +
S	Screen

4.3 Modbus Addresses

There are 4 types of Modbus addresses:

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

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

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

3x Read analogue inputs – variable data in

4x Read/Write analogue outputs – variable adjustments

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

Address	Description	Type
00001	Enable/Disable MM	Read/write digital
	• 0 = Burner is enabled, 1 = Burner is disabled • Value changes state of enable/disable button on MM home screen; changes are kept if MM loses comms with Modbus device sending commands	
10194	Running Interlock Status	Read digital
	• 0 = Running interlock (T53) is off • 1 = Running interlock (T53) is on	
10217	EGA Trim Optioned	Read digital
	• 0 = Trim not optioned, 1 = Trim optioned • Returns value 0 when option 12 is set for monitoring only.	
10218	EGA is Trimming	Read digital
	• 0 = EGA not trimming, 1 = EGA is trimming • Returns value 0 is actual temperature/pressure is below trim threshold	
10219	EGA Cooler Ready	Read digital
	• 0 = Cooler is ready, 1 = Cooler is not ready • Returns value 0 if EGA is an error state	
10220	EGA Ambient Temp OK	Read digital
	• 0 = Temperature OK, 1 = Temperature not OK	
10221	EGA NO_2 On	Read digital
	• 0 = NO_2 cell not optioned, 1 = NO_2 cell optioned • See option 36, valid for Mk7 EGA only	
10222	EGA SO_2 On	Read digital
	• 0 = SO_2 cell not optioned, 1 = SO_2 cell optioned • See option 36, valid for Mk7 EGA only	
10224	EGA OK to Sample	Read digital
	• 0 = EGA is not sampling, 1 = EGA is sampling	
10233	Hand Mode	Read digital
	• 0 = MM not in hand mode, 1 = MM in hand mode	
10234	Low Flame Hold	Read digital
	• 0 = MM not in low flame hold, 1 = MM in low flame hold	
10242	Disabled Status	Read digital
	• 0 = Burner enabled, 1 = Burner disabled • Returns state of enable/disable button on MM home screen and same value as address 00001	

Address	Description	Type
12001	Water Level Optioned	Read digital
	• 0 = Water level not optioned, 1 = water level optioned	
12002	Units Imperial or Metric	Read digital
	• 0 = Imperial,1 = Metric	
12003	Feed water Pump State	Read digital
	• 0 = Pump off, 1 = Pump on	
12004	TDS Units	Read digital
	• 0 = ppm, 1 = µS/cm	
12005	Water Level Ready	Read digital
	• 0 = No, either water level is not optioned or a water level fault is active • 1 = Yes, requires water level to be optioned and no water level faults	
12006	TDS Optioned	Read digital
	• 0 = TDS not optioned, 1 = TDS optioned	
12007	First Out 1 State	Read digital
	• 0 = First Out 1 not active, 1 = First Out 1 active (does not mean first out has been cleared)	
12008	First Out 2 State	Read digital
	• 0 = First Out 2 not active, 1 = First Out 2 active (does not mean first out has been cleared)	
12009	First Out 3 State	Read digital
	• 0 = First Out 3 not active, 1 = First Out 3 active (does not mean first out has been cleared)	
12010	First Out 4 State	Read digital
	• 0 = First Out 4 not active, 1 = First Out 4 active (does not mean first out has been cleared)	
12011	First Out 5 State	Read digital
	• 0 = First Out 5 not active, 1 = First Out 5 active (does not mean first out has been cleared)	
12012	First Out 6 State	Read digital
	• 0 = First Out 6 not active, 1 = First Out 6 active (does not mean first out has been cleared)	
12013	First Out 7 State	Read digital
	• 0 = First Out 7 not active, 1 = First Out 7 active (does not mean first out has been cleared)	
12014	First Out 8 State	Read digital
	• 0 = First Out 8 not active, 1 = First Out 8 active (does not mean first out has been cleared)	
12015	First Out 9 State	Read digital
	• 0 = First Out 9 not active, 1 = First Out 9 active (does not mean first out has been cleared)	
12016	First Out 10 State	Read digital
	• 0 = First Out 10 not active, 1 = First Out 10 active (does not mean first out has been cleared)	
12017	First Out 11 State	Read digital
	• 0 = First Out 11 not active, 1 = First Out 11 active (does not mean first out has been cleared)	
12018	First Out 12 State	Read digital
	• 0 = First Out 12 not active, 1 = First Out 12 active (does not mean first out has been cleared)	
12019	First Out 13 State	Read digital
	• 0 = First Out 13 not active, 1 = First Out 13 active (does not mean first out has been cleared)	
12020	First Out 14 State	Read digital
	• 0 = First Out 14 not active, 1 = First Out 14 active (does not mean first out has been cleared)	
12021	First Out 15 State	Read digital
	• 0 = First Out 15 not active, 1 = First Out 15 active (does not mean first out has been cleared)	

Address	Description	Type
30101	Load Index	Read analogue
	• Firing rate %	
30102	Firing Status	Read analogue
	• 0 = Non-modulating, 1 = Modulating • Returns value 0 single point change, fuel flow metering and commissioning	
30104	Burner Rating	Read analogue
	• MW x 10 • Metric units determined from fuel flow metering	
30105	Actual Value	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30106	Required Value	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30107	Selected Fuel	Read analogue
	• 0 = Fuel 1, 1 = Fuel 2, 2 = Fuel 3, 3 = Fuel 4	
30109	Channel 1 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30110	Channel 2 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30111	Channel 3 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30112	Channel 4 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30113	MM Error Number	Read analogue
	• 0 = System is does not have an error, N = error number, check error codes	
30114	Multi-Burner Id	Read analogue
	• MM Id number set in option 44	
30115	EGA Current O_2 Value	Read analogue
	• % x 10	
30116	EGA Current CO_2 Value	Read analogue
	• % x 10	
30117	EGA Current CO Value	Read analogue
	• ppm x 10	
30118	EGA Current Exhaust Gas Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30119	EGA Current Efficiency Value	Read analogue
	• % x 10	
30120	EGA Current NO Value	Read analogue
	• ppm x 10	

Address	Description	Type
30121	EGA Current SO_2 Value	Read analogue
	• ppm x 10	
30122	EGA Commissioned O_2 Value	Read analogue
	• % x 10	
30123	EGA Commissioned CO_2 Value	Read analogue
	• % x 10	
30124	EGA Commissioned CO Value	Read analogue
	• ppm x 10	
30125	EGA Commissioned Exhaust Gas Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30126	EGA Commissioned Efficiency Value	Read analogue
	• % x 10	
30127	EGA Commissioned NO Value	Read analogue
	• ppm x 10	
30128	EGA Commissioned SO_2 Value	Read analogue
	• ppm x 10	
30129	EGA Error Code	Read analogue
	• 0 = EGA does not have a fault, N = EGA error	
30130	Minimum Remote Setpoint	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30131	Maximum Remote Setpoint	Read analogue
	• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10	
30132	Current Flow Thousands	Read analogue
	• Metric kW, imperial MMBTU/hr x 1000 • Remainder after whole number of MW or MMBTU/hr x 1000 taken away. E.g. 1.5MW gives 500 value and 15.1MMBTU/hr gives 100 value	
30133	Current Flow Millions	Read analogue
• Metric MW, imperial MMBTU/hr • Whole number of MW or MMBTU/hr. E.g. 1.5MW gives 1 value and 15.1MMBTU/hr gives 15 value		
30134	Fuel 1 Flow Total Thousands	Read analogue
	• Metric kW/hr, imperial MMBTU/hr • Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value	
30135	Fuel 1 Flow Total Millions	Read analogue
• Metric MW/h, imperial MMBTU • Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value		
30136	Fuel 1 Flow Total Billions	Read analogue
• Metric GW/hr, imperial MMBTU / 1000 • Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value		

Address	Description	Type
30137	Fuel 2 Flow Total Thousands	Read analogue
	• Metric kW/hr, imperial MMBTU/hr • Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value	
30138	Fuel 2 Flow Total Millions	Read analogue
	• Metric MW/h, imperial MMBTU • Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value	
30139	Fuel 2 Flow Total Billions	Read analogue
	• Metric GW/hr, imperial MMBTU / 1000 • Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value	
30140	Fuel 3 Flow Total Thousands	Read analogue
	• Metric kW/hr, imperial MMBTU/hr • Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value	
30141	Fuel 3 Flow Total Millions	Read analogue
	• Metric MW/h, imperial MMBTU • Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value	
30142	Fuel 3 Flow Total Billions	Read analogue
	• Metric GW/hr, imperial MMBTU / 1000 • Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value	
30143	EGA Current Ambient Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30144	EGA Current Delta Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30145	EGA Commissioned Ambient Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30146	EGA Commissioned Delta Temperature	Read analogue
	• Metric: temperature x 10 °C • Imperial: temperature x 10 °F	
30147	UV Counts	Read analogue
	• Returns value displayed on MM	
30148	IR Counts	Read analogue
	• Returns value displayed on MM	
30149	Flame Switch Status	Read analogue
	• 0 = Off, 1 = On	
30150	EGA Current NO_2 Value	Read analogue
	• ppm x 10	
30151	EGA Commissioned NO_2 Value	Read analogue
	• ppm x 10	

Address	Description	Type
30801	Fuel 4 Flow Total Thousands	Read analogue
	• Metric kW/hr, imperial MMBTU/hr • Remainder after whole number of MW/hr or MMBTU x 1000 taken away, x 1000. E.g. 1.5MW/hr gives 500 value and 15.1MMBTU gives 100 value	
30802	Fuel 4 Flow Total Millions	Read analogue
	• Metric MW/h, imperial MMBTU • Whole number of MW/hr or MMBTU. E.g. 1.5MW/hr gives 1 value and 15.1MMBTU gives 15 value	
30803	Fuel 4 Flow Total Billions	Read analogue
	• Metric GW/hr, imperial MMBTU / 1000 • Whole number of GW/hr or MMMBTU E.g. 1.5MW/hr gives 0 value and 15.1MMBTU gives 0 value	
30804	VSD 1 Output	Read analogue
	• mA x 10 or V x 10	
30805	VSD 1 Input	Read analogue
	• mA x 10 or V x 10	
30806	VSD 2 Output	Read analogue
	• mA x 10 or V x 10	
30807	VSD 2 Input	Read analogue
	• mA x 10 or V x 10	
30808	Channel 7 Position	Read analogue
	• Degrees x 10 • Range is -6.0° to 96.0°	
30830	Lockout Number	Read analogue
	• 0 = System is not in lockout, N = lockout number	
30831	Fuel 1 Type	Read analogue
	• 0 = Gas, 1 = Oil • Option/ parameter 150 value	
30832	Fuel 2 Type	Read analogue
	• 0 = Gas, 1 = Oil • Option/parameter 151 value	
30833	Fuel 3 Type	Read analogue
	• 0 = Gas, 1 = Oil • Option/parameter 152 value	
30834	Fuel 4 Type	Read analogue
	• 0 = Gas, 1 = Oil • Option/parameter 153 value	
30839	Fuel 1 Hours Run	Read analogue
	• Completed hours	
30840	Fuel 2 Hours Run	Read analogue
	• Completed hours	
30841	Fuel 3 Hours Run	Read analogue
	• Completed hours	
30842	Fuel 4 Hours Run	Read analogue
	• Completed hours	

Address	Description	Type
30843	Fuel 1 Start-ups	Read analogue
• Start-ups		
30844	Fuel 2 Start-ups	Read analogue
• Start-ups		
30845	Fuel 3 Start-ups	Read analogue
• Start-ups		
30846	Fuel 4 Start-ups	Read analogue
• Start-ups		
30847	Current Air Pressure	Read analogue
• mbar x 10, "wg x 10 • Parameter 43 value		
30849	Current Gas Pressure	Read analogue
• mbar x 10, "wg x 10, PSI x 100 • parameter 41 value		
32001	Capacitance Probe 1 Signal	Read analogue
• Hz reading		
32002	Capacitance Probe 1 Reading on MM	Read analogue
• Metric: mm • Imperial: inches x 10		
32005	Capacitance Probe 2 Signal	Read analogue
• Hz reading		
32006	Capacitance Probe 2 Reading on MM	Read analogue
• Metric: mm • Imperial: inches x 10		
32009	Alarm Status	Read analogue
• 0 = No alarm, 1 = Alarm		
32010	Warning Status	Read analogue
• 0 = No warning, 1 = Warning		
32012	Alarm Code	Read analogue
• 0 = System is not in alarm, N = alarm number		
32013	Warning Status	Read analogue
• 0 = System is not in warning, N = warning number		
32014	Steam Temperature (°C)	Read analogue
• °C		
32015	Feed Water Temperature (°C)	Read analogue
• °C		
32016	Steam Flow Rate (lb/hr)	Read analogue
• lb per hour		
32017	Heat to Steam Output (BTU per lb)	Read analogue
• BTU per lb		
32018	Feed Water Control Element Percent	Read analogue
• %		
32020	Sudden Pressure Drop	Read analogue
• 0 = Sudden pressure drop not detected, 1 = sudden pressure drop detected		

Address	Description	Type
32021	Boiler Efficiency	Read analogue
	• %	
	• Returns value 0 if no heat flow function is enabled	
32022	Economiser Efficiency	Read analogue
	• %	
	• Returns value 0 if no heat flow function is enabled	
32023	Totalised Steam low word (lbs)	Read analogue
	• Total steam output = steam low word + (65536 x steam high word)	
32024	Totalised Steam high word (lbs)	Read analogue
	• Total steam output = steam low word + (65536 x steam high word)	
32025	Steam Temperature (°F)	Read analogue
	• °F	
32026	Feed Water Temperature (°F)	Read analogue
	• °F	
32027	Steam Flow Rate (kg/hr)	Read analogue
	• Kg per hour	
32028	Heat to Steam Output (KJ/kg)	Read analogue
	• KJ per kg	
32029	Totalised Steam low word (kg)	Read analogue
	• Total steam output = steam low word + (65536 x steam high word)	
32030	Totalised steam kg high word (kg)	Read analogue
	• Total steam output = steam low word + (65536 x steam high word)	
32037	Cold Start Status	Read analogue
	• 0 = System not in cold start mode, 1 = system in cold start mode	
32040	TDS Target Value	Read analogue
	• Target value in ppm or µS/cm	
32041	TDS Measured Value	Read analogue
	• Measured value in ppm or µS/cm	
32045	Current Draught Servo Angle	Read analogue
	• mbar x 10, "wg x 10	
	• Parameter 43 value	
32046	Current Draught Pressure	Read analogue
	• mbar x 10, "wg x 10	
	• Parameter 43 value	
32047	Commissioned Draught Pressure	Read analogue
	• mbar x 10, "wg x 10	
	• Parameter 43 value	
32048	Time to Next Bottom Blowdown	Read analogue
	• Returns value = (hours x 100) + minutes e.g. 215 is 2 hours 15minutes	
32049	Current Heat Flow	Read analogue
	• Metric: MW x 10	
	• Imperial: MMBTU/hour x 10	
32050	Current Water Flow	Read analogue
	• Metric: Litres per second x 1000	
	• Imperial: US gallons per minute x 1000	

Address	Description	Type
32051	External Level Sensor Reading Depth	Read analogue
	• Metric: mm • Imperial: inches x 10	
32052	Second Low Probe Input	Read analogue
	• 0 = No water is detected, 1 = water is detected	
32053	Auxiliary High Water Input	Read analogue
	• 0 = Input not active, 1 = input active	
32054	Auxiliary 1st Low Input	Read analogue
	• 0 = Input not active, 1 = input active	
32055	Auxiliary 2nd Low Input	Read analogue
	• 0 = Input not active, 1 = input active	
32056	Combined Water level Reading Depth	Read analogue
	• Metric: mm • Imperial: inches x 10	
33001	Fully Metered Excess Air Reading Valid	Read analogue
	0 = Invalid reading, 1 = Valid reading	
33002	Fully Metered Current Excess Air %	Read analogue
	• Excess air % x 1000	
33003	Fully Metered Commissioned Excess Air %	Read analogue
	• Excess air % x 1000	
33010	Fully Metered Current Fuel Mass Flow Thousands	Read analogue
	• 1000s of kg for metric, or lbs for imperial	
33011	Fully Metered Current Fuel Mass Flow Singles	Read analogue
	• 0 to 999 kgs for metric or lbs for imperial	
33012	Fully Metered Commissioned Fuel Mass Flow Thousands	Read analogue
	• 1000s of kg for metric, or lbs for imperial	
33013	Fully Metered Commissioned Fuel Mass Flow Singles	Read analogue
	• 0 to 999 kgs for metric or lbs for imperial	
33014	Fully Metered Current Fuel Volume Flow Thousands	Read analogue
	• m^3 per hour	
33015	Fully Metered Current Fuel Volume Flow Singles	Read analogue
	• m^3 per hour	
33016	Fully Metered Fuel Flow Meter Current (4-20mA) Signal	Read analogue
	• mA x 10	
33017	Fully Metered Fuel Temperature	Read analogue
	• °C x10 for metric, or °F x 10 for imperial	
33018	Fully Metered Fuel Pressure	Read analogue
	• mbar x 10, "WG x 10 or PSI x 100	
33019	Fully Metered Fuel Channel Correction Fraction	Read analogue
	• Applied correction x 1000	
33020	Fully Metered Current Air Mass Flow Thousands	Read analogue
	• 1000s of kg for metric, or lbs for imperial	
33021	Fully Metered Current Air Mass Flow Singles	Read analogue
	• 0 to 999 kgs for metric or lbs for imperial	

Address	Description	Type
33022	Fully Metered Commissioned Air Mass Flow Thousands	Read analogue
• 1000s of kg for metric, or lbs for imperial		
33023	Fully Metered Commissioned Air Mass Flow Singles	Read analogue
• 0 to 999 kgs for metric or lbs for imperial		
33024	Fully Metered Current Air Volume Flow Thousands	Read analogue
• m^3 per hour		
33025	Fully Metered Current Air Volume Flow Singles	Read analogue
• m^3 per hour		
33026	Fully Metered Air Flow Meter Current (4-20mA) Signal	Read analogue
• mA x 10		
33027	Fully Metered Air Temperature	Read analogue
• °C x10 for metric, or °F x 10 for imperial		
33028	Fully Metered Air Pressure	Read analogue
• mbar x 10 or "WG x 10		
33029	Fully Metered Air Channel Correction Fraction	Read analogue
• Applied correction x 1000		
33030	Fully Metered Atmospheric Air Pressure	Read analogue
• mbar or "WG x 10		
40001	Remote Required Setpoint	Read/write analogue
• Metric: temperature °C, pressure Bar x 10, low pressure Bar x 100 • Imperial: temperature °F, pressure PSI, low pressure PSI x 10 • After 1 minute of no Modbus communications to the unit, the M.M. will ignore this required value and use the required setpoint set on the M.M.'s status screen.		
40121	Remote Firing Rate	Read/write analogue
• % • 40131 must be set to 1 to change the firing rate remotely		
40131	Remote Firing Rate Enable	Read/write analogue
• 0 = Remote firing rate disabled, 1 = remote firing rate enabled		

5 ERRORS AND LOCKOUTS

5.1 Errors

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

Error	Message	Description
1	Channel 1 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 47 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
2	Channel 2 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 47 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
3	Channel 3 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 47 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
4	Channel 4 Positioning Error	Servomotor is outside of the commissioned range
• Check wiring on terminals 40 – 47 • Check signal cable from the MM to the servomotor is screened at one end • Check potentiometer is zeroed correctly • Go into Commissioning mode, check the servomotor position and ensure that closed is at 0.0°		
5	Channel 7 Positioning Error	Servomotor is outside of the commissioned range
• 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
• Check wiring and voltages on terminals 40 – 47 and 70 – 77		
7	Channel 2 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40 – 47 and 70 – 77		
8	Channel 3 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40 – 47 and 70 – 77		
9	Channel 4 Gain Error	Servomotor position measurement hardware error
• Check wiring and voltages on terminals 40 – 47 and 70 – 77		
10	Channel 7 Gain Error	Servomotor position measurement hardware error
• 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
• Check wiring and voltages on terminals 70 – 77 • Check servomotors drive in correct direction and valve is not stuck		

Error	Message	Description
12	Channel 2 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals and 70 – 77 • Check servomotors drive in correct direction and damper is not stuck		
13	Channel 3 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals and 70 – 77 • Check servomotors drive in correct direction and valve is not stack		
14	Channel 4 Movement Error	Servomotor moves when not expected and vice versa
• Check wiring and voltages on terminals and 70 – 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
• 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
• Check wiring for shorts on terminals 41, 47 and 39		
17	Digital Power Supply Error	ADC measured 3.3V supply out of range
• Check for noise on the mains input, wiring and voltages on all terminals		
18	EEPROM Error	Fault communicating with the on board EEPROM
• Contact Autoflame approved local tech centre		
19	ADC Error	Internal fault
• Contact Autoflame approved local tech centre		
20	Watchdog Timeout	Internal fault
• Contact Autoflame approved local tech centre		
21	Processor Clock Error	Internal fault
• Contact Autoflame approved local tech centre		
22	System Error	Internal fault
• Contact Autoflame approved local tech centre		
23	Flash Data Error	Internal fault
• Re-install software SD card		
24	Processor Temperature Error	Internal fault
• Check ambient temperature of unit does not exceed maximum recommended temperature		
25	Burner Control Comms Error	Internal fault
• Contact Autoflame approved local Tech Centre		
26	Burner Control Reset	Internal fault
• Contact Autoflame approved local Tech Centre		
27	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
28	Zero-Crossing Detection Error	Internal fault
• Check mains supply going to unit is within acceptable voltage range		
29	Mains Input Detection Error	Mains input stuck on
• Check wiring and voltages on terminals 89 – 92		
30	Channel 5 VSD Error	Feedback incorrect
• Check VSD feedback against commissioned VSD and ensure the feedback is stable		
31	Channel 6 VSD Error	Feedback incorrect
• Check VSD feedback against commissioned VSD and ensure the feedback is stable		

Error	Message	Description
32	VSD Feedback Change Too Small	Feedback change detected during commissioning is too small
• 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
• Check there is commissioning data for all options servomotors/VSD		
34	FAR Execution Speed	Internal fault
• Contact Autoflame approved local Tech Centre		
35	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
36	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
37	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
38	Software Error	Internal fault
• Contact Autoflame approved local Tech Centre		
39	VSD Sampling Error	VSD feedback current/ voltage too high on channel 5/6
• 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
• Check VSD feedback while commissioning		
41	APS Commission Data Fault	No air pressure trim data for a point with EGA trim
• 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
• 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
• 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
• Check option/parameters 147 and 149 • Re-commission air pressure sensor		
45	Software Error	Internal fault
• Contact Autoflame approved local tech centre		
46	Software Error	Internal fault
• Contact Autoflame approved local tech centre		
47	Expansion PF Output (Check F5)	Internal fault
• Check wiring on terminal PF • Check fuse 5 (2A) on expansion board		
48	WL Alarm Output Internal Fault	Internal fault
• Check expansion option 5 • Check wiring and voltages on terminals HAI, 1AI, 2AI		

Error	Message	Description
49	Expansion Servo Hardware Fault	Internal fault
• Contact Autoflame approved local tech centre		
50	Triac Power Supply Error (Check F2)	Internal fault
• Check wiring on terminal 69 • Check fuse 2 (2A T)		
51	Fused 12V Supply Error (Check F4)	Internal fault
• 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
• 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
• Check air pressure sensor value during VPS		
54	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
55	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
56	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
57	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
58	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
59	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
60	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
61	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
62	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
63	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
64	ADC Reference Voltage Error	Hardware fault
• Contac Contact Autoflame approved local Tech Centre • Contact Autoflame approved local Tech Centre		
65	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
66	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		
67	Software error	Internal fault
• Contact Autoflame approved local Tech Centre		

5.2 Lockouts

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

Lockout	Message	Description
1	CPI Input Wrong State	Proof of closure switch opened during ignition sequence
• Check wiring on terminal 55 • Check proof of closure switches		
2	No Air Proving	No air pressure during start/ firing
• Check wiring on terminal 54 • Check air pressure switch • Check air pressure sensor • Check air pressures during running		
3	Ignition Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 63		
4	Motor Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 58		
5	Start Gas Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 59		
6	Main Gas 1 Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 60		
7	Main Gas 2 Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 61		
8	Vent Valve Output Fault	Voltage detected when output is off (and vice versa)
• Check wiring and voltage on terminal 62		
9	Failsafe Relay (Check F1)	Voltage detected when output is off (and vice versa)
• 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
• 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
• Check 1st main valve • Call a certified Commissioning Engineer to investigate		
12	VPS Gas Proving Fail	Leak detected during 'gas proving' part of VPS
• Check option/parameter 133 • Check 2nd main gas valve and vent valve • Check pilot valve if using single valve pilot • Isolate gas and call a certified Commissioning Engineer to investigate		
13	No Flame Signal	No flame detected during ignition/ firing
• Visually check flame • Check the flame scanner • Call a certified Commissioning Engineer to investigate		
14	Shutter Fault	UV signal detected during shutter operation on self-check
• Check wiring on terminals 21 and 22 • Check UV scanner type and check option/ parameter 110 is set accordingly		

Lockout	Message	Description
15	NO CPI Reset	Proof of closure switch not made after valves closed
• Check wiring on terminal 55 and check proof of closure switches		
16	Prolonged Lockout Reset	Prolonged voltage detected on terminal 56/ lockout reset button permanently pressed
• 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)
• Check gas pressure • Check option/ parameter 136		
18	Gas Pressure High	Gas pressure high limit exceeded while firing (gas sensor)
• Check gas pressure • Check option/ parameter 137		
19	RAM Test Failed	Hardware fault
• Contact Autoflame approved local tech centre		
20	PROM Test Failed	Hardware fault
• Contact Autoflame approved local tech centre		
21	FSR Test 1A	Internal relay test failed
• Check wiring and voltages on terminals 50 – 63		
22	FSR Test 2A	Internal relay test failed
• Check wiring and voltages on terminals 50 – 63		
23	FSR Test 1B	Internal relay test failed
• Check wiring and voltages on terminals 50 – 63		
24	FSR Test 2B	Internal relay test failed
• Check wiring and voltages on terminals 50 – 63		
25	Watchdog Fail 2A	Internal check failed
• Contact Autoflame approved local tech centre		
26	Watchdog Fail 2B	Internal check failed
• Contact Autoflame approved local tech centre		
27	Watchdog Fail 2C	Internal check failed
• Contact Autoflame approved local tech centre		
28	Watchdog Fail 2D	Internal check failed
• Contact Autoflame		
29	Input Fault	Power supply fault
• Check mains voltage to the MM		
32	Gas Pressure Low Limit	Gas pressure lower than commissioned VPS value
• Check gas pressure sensor value • Check option/parameter 136		
33	VPS Air Zeroing	Gas pressure sensor cannot be zeroed at VPS venting
• 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
• Check option/parameter 139 • Check oil pressure sensor		
37	Oil Pressure Too High	Oil pressure above offset upper limit during running
• Check option/parameter 140 • Check oil pressure sensor		

Lockout	Message	Description
39	Freeze Timeout	MM kept in Phase Hold for more than 10minutes
• MM kept in Phase Hold during commissioning for more than 10 minutes		
40	Purge Air Pressure Low	Insufficient air pressure during purge
• 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
• Check option/parameter 122 • Check wiring and voltages on terminals 85, 86		
43	Terminal 85/86 Fault	Hardware fault on terminals 85/86
• 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
• Check wiring on terminal 52		
45	No Proving Circuit Set	Secondary proving timeout elapsed
• Check option/parameter 157 • Check wiring on terminal 52		
46	Proving Interlock Timeout	Purge interlock timeout elapsed
• Check option/ parameters 155 and 158 • Check wiring on terminal 81		
52	High IR Ambient	Flame detected when there should not be
• Visually check flame and check IR scanner • Call a certified Commissioning Engineer to investigate		
53	IR Comms Lost	Loss of comms with IR scanner
• Check wiring and screen on terminals 29, 30, 48 and 49 • Check that the IR scanner is not removed from the magnetic ring socket		
54	Watchdog Long X A	Internal check failed
• Contact Autoflame approved local tech centre		
55	Watchdog Long Y A	Internal check failed
• Contact Autoflame approved local tech centre		
56	Watchdog Off A	Internal check failed
• Contact Autoflame approved local tech centre		
57	Watchdog Short X B	Internal check failed
• Contact Autoflame approved local tech centre		
58	Watchdog Short Y B	Internal check failed
• Contact Autoflame approved local tech centre		
59	Watchdog Long X B	Internal check failed
• Contact Autoflame approved local tech centre		
60	Watchdog Long Y B	Internal check failed
• Contact Autoflame approved local tech centre		
61	Watchdog Off B	Internal check failed
• Contact Autoflame approved local tech centre		
62	UV Signal Too High	Internal check failed for UV
• Check wiring on terminals 21, 22, 50 and 51		

Lockout	Message	Description
63	Purge Limit Switch	Interlock not made on terminal 81
• Check option/ parameter 155 • Check wiring on terminal 81		
64	Start Limit Switch	Interlock not made on terminal 80
• Check option/ parameter 154 • Check wiring on terminal 80		
65	FSR A	Internal check failed
• Check wiring and voltages on terminals 50 – 63		
66	FSR B	Internal check failed
• Check wiring and voltages on terminals 50 – 63		
67	Gas Sensor Comms	Signal lost from gas pressure sensor
• Check wiring and screen on terminals 31 – 34		
68	Gas Sensor Type	Internal fault
• Contact Autoflame approved local tech centre		
69	Gas Sensor Fault	Internal pressure sensor fault
• Contact Autoflame approved local tech centre		
70	UV Pot Fault	Internal UV scanner fault
• Contact Autoflame approved local tech centre		
71	Air Sensor Comms	Signal lost from air pressure sensor
• Check wiring and screen on terminals 31 – 34		
72	Air Sensor Type	Internal fault
• Contact Autoflame approved local tech centre		
73	Air Sensor Fault	Internal pressure sensor fault
• Contact Autoflame approved local tech centre		
74	Air Sensor Zero	Air pressure is more than 5mbar from sensor's zero value
• Check air pressure sensor value during VPS		
75	Air Sensor Signal High	Air pressure is above 400mbar
• Check Autoflame approved local tech centre		
76	Air Sensor Error Window	Air pressure outside of these limits for 3 seconds
• Check air pressure • Check option/parameter 147		
77	Wait Air Switch Timeout	Voltage has not been reset for 2minutes
• Check air pressure sensor value during VPS • Check voltage has been reset on terminal 54 within 2minutes before run to purge • Check wiring and voltage on terminal 54		
78	Gas Proving Fail High	Gas pressure too high during VPS
• Isolate gas • Check 1st main valve and vent valve • Check option/ parameters 133 and 134 • Call a certified Commissioning Engineer to investigate		
79	FSR Test 1C	Hardware fault
• Contact Autoflame approved local tech centre		
80	Timeout on Reaching Purge	Time set in option/parameter 124 has elapsed
• Check option/parameter 124		
81	Oil Pressure Sensor Fault	No comms received from oil pressure sensor
• Check wiring and screen on terminals 48, 49		

Lockout	Message	Description
82	Purge Pressure Proving Input	Input on T81 read high during relay test phases
• Input has been made before the blower starts; it should only be made continuously during purge. • Check wiring on terminal 81.		
198	BC Input Short	Internal fault
• Contact Autoflame approved local tech centre		
199	Lockout 199	Internal fault
• Contact Autoflame approved local tech centre		
200	Lockout Cleared	Lockout has been cleared
• MM status after lockout has been reset (Modbus)		
201	Power up CPU Test Fail	Internal check failed
• Contact Autoflame approved local tech centre		
202	Power up EEPROM Test Fail	Internal check failed
• Contact Autoflame approved local tech centre		

5.3 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 Feed water Control Fault
Expansion Option 88	Action on Pressure Sensor Fault

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

Fault	Message	Description
12	Exhaust Temperature Upper Limit	Exhaust temperature is above upper limit offset of commissioned value*
• Alarm or warning depending on option 13 • Check exhaust gas readings and parameter 96		
13	Exhaust Temperature Absolute Limit	Exhaust temperature is above absolute limit*
• Alarm or warning depending on option 13 • Check exhaust gas readings and parameter 97		
50	Load Sensor Fault	Incorrect/no load sensor detected
• Alarm • Check option 1 • Check wiring on terminals 37 – 39		
51	Auxiliary Input Low	3mA or lower received from 4-20mA external modulation/ external setpoint
• Alarm • Check parameter 69 • Check feedback from external modulation/ external setpoint controller • Check wiring on terminals 7 – 9		
80	Oil Pressure Sensor Fault	No comms received from oil pressure sensor
• 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
• Alarm • Check wiring and screen on terminals 1P+, 1P-, 1T+ and 1T-		
101	Cap Probe 2 Communications Fault	No comms with capacitance probe 2
• Alarm • Check wiring and screen on terminals 2P+, 2P-, 2T+ and 2T-		
102	Cap Probe 1 Short Circuit	Hz reading is below 10kHz
• 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
• Alarm • Check water level Hz reading • Check wiring on terminals 2P+, 2P-, 2T+ and 2T-		
104	Cap Probe 1 Temp Compensation Error	Temperature corrected probe reference is not as expected
• Alarm • Re-commission capacitance probes at temperature		
105	Cap Probe 2 Temp Compensation Error	Temperature corrected probe reference is not as expected
• 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
• Alarm • Check still water threshold in expansion option 28 • Check capacitance probe 1 reading history		

Fault	Message	Description
107	Cap Probe 2 Still Water Detected	Wave signature high to low peak distance is less than still water threshold
• 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
• 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
• Alarm • If changing capacitance probe 2, re-commission is required		
110	Cap Probe 1 Detected But Not Optioned	Probe connected but not optioned
• 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
• 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
• Alarm • Check feedback from external level sensor • Check wiring on terminals EX- and EX+		
113	Probe Reading Mismatch	Difference between probes/sensor readings is below mismatch threshold
• Alarm • Check expansion option 27 • Check capacitance probes and sensor readings		
114	Probe Serial Numbers are the Same	One capacitance probe detected on both capacitance probe terminals
• 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 1st or 2nd low auxiliary level inputs detected simultaneously
• Alarm • Check wiring on terminals HAI, 1AI and 2AI		
121	Water Levels Diverse	Probes/ sensor detects 1st or 2nd low and high water simultaneously
• 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
• Alarm • Check input on terminal M/R		

Fault	Message	Description	Type
123	Second Low Probe Communications Fault	No comms with second low probe	
• Alarm • Check wiring and screen on terminals 5T+, 5T-, 4P- and 4P+			
124	Second Low Probe Hardware Fault	Internal check failed	
• Alarm • Contact Autoflame approved local tech centre			
125	Permanent Test Input	Input held on test terminal for more than 60 seconds	
• Alarm • Check input on terminal TST			
126	Second Low Probe Detected But Not Optioned	Second low probe connected but not optioned	
• 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	
• 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	
• Alarm or warning or depending on expansion option 20 • Check wiring on terminals P-, FW and P+ • Check signal cable form the MM to the servomotor is screened at one end • Check that the servomotor is zeroed correctly			
131	Feed Water Servo Movement Error	Servomotor moves when not expected and vice versa	
• 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	
• 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	
• Warning • Check water level reading • Check expansion option 7			
152	Pre-1st Low	Probes/sensor detect water level below set pre-1st low	
• Warning • Check water level reading • Check expansion option 8			
153	1st Low	Probes/sensor detect water level below commissioned 1st low	
• Alarm • Check water level reading • 1st low alarm will automatically clear if water level increases above 1st low			

Fault	Message	Description
154	2nd Low	Probes/sensor detect water level below 2nd low
• 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
• 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
• 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
• Warning • Check wiring on terminals P-, TW, P+ and TBI, TBD • Check signal cable form 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
• 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
• Warning • Check expansion option 46 and TDS value		
300	Bottom Blowdown Controller Comms	No comms with bottom blowdown controller
• 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
• Warning • Contact Autoflame approved local tech centre		
302	Bottom Blowdown Servo Closing Fault	No movement detected when bottom blowdown valve goes to close
• 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
• 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 Warning
• Warning • Contact Autoflame approved local tech centre		

Fault	Message	Description
305	Bottom Blowdown Controller Main Power Fault	Main power has failed on bottom blowdown controller
• 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
• Warning • Commission bottom blowdown servomotor		
400	Draught Pressure Sensor Timeout	No comms within 2 seconds from draught pressure sensor
• 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
• 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
• 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
• Warning • Check feedback from external fuel flow input • Check option 60		
431	Fuel flow Feedback Above Tolerance	Fuel flow signal above fuel flow feedback fault tolerance
• Warning • Check feedback from external fuel flow input • Check option 60		
440	Temperature Sensor T1Fault	Fault or no comms with T1 sensor
• Warning • Check wiring and screen on terminals –and T1		
441	Temperature Sensor T2 Fault	Fault or no comms with T2 sensor
• Warning • Check wiring and screen on terminals – and T2		
442	Temperature Sensor T3 Fault	Fault or no comms with T3 sensor
• Warning • Check wiring and screen on terminals – and T3		
443	Make Up Flow Meter Fault	Fault or no comms with make up flow meter
• Warning • Check wiring and screen on terminals F- and MF		
444	Condensate Flow Meter Fault	Fault or no comms with condensate flow meter
• Warning • Check wiring and screen on terminals F- and CF		
445	Deaerator IO Comms Fault	Fault or no comms with deaerator IO
• Warning • Check wiring and screen on terminals 6T+ and 6T-		

Fault	Message	Description
500	Multi-Burner Communications Fault	Loss of comms between MMs in multi-burner loop
• 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
• 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
• 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
• 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
• 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
• Alarm • Check option/parameters 150 – 153 on all MMs in multi-burner loop		
506	Multi-Burner Config (Pilot Type)	Pilot type not the same for all MMs multi-burner loop
• 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
• Alarm • Check option 1 on all MMs in multi-burner loop		
550	Fuel Flow Meter Fault	Less than 3mA signal received from fuel flow meter
• 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
• 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
• 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
• Warning (MM will use commissioned temperature) • Check wiring and screen on terminals – and T3		

Fault	Message	Description	
554	Fuel Pressure Sensor Fault	Fault or no comms with fuel pressure sensor	
• 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	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	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	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	Alarm
• Check wiring on output 1 on I/O module			
582	Servo Control I/O Unit Channel 2 Output Fault	4-20mA output detects open circuit	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	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	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	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	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	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	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	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	Alarm
• Check wiring on input 5 on I/O module			

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

5.4 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
(1) (P53, P54, P55, P56) External load sensor incorrectly configured
• The external load sensor must be set with the minimum and maximum values and voltages. • Check option 1 and parameters 53 – 56.
(1) (81, 83) OTC setpoints too high for optioned load sensor
• If minimum and maximum setpoints OTC setpoints must be set within the possible range of the optioned load detector. • Check option 1, 81 and 83.
(9) (45) Internal stat must be disabled if load sensor not present
• If external modulation is enabled without a load sensor, the internal stat must always be closed. • Check options 9 and 45.
(30) (31) Invalid remote sepoint configuration
• The Minimum Remote Setpoint (DTI/Modbus/External) cannot be set higher than the Maximum Remote Setpoint (DTI/Modbus/External) and vice versa. • Check options 30 and 31.
(43) (44) (E1) Water level control only be on the multi-burner master
• 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.
(43) (44) (16) Sequencing only be only the multi-burner master
• Only the master (multi-burner ID 1 set in option 44) can be set for sequencing. • Check options 16, 43 and 44.
(43) (44) (12) EGA and trim can only be on the multi-burner master
• Only the master (multi-burner ID 1 set in option 44) can be optioned with an EGA. • Check options 12, 43 and 44.
(43) (44) (E110) Firstouts can only be on the multi-burner master
• Only the master (multi-burner ID 1 set in option 44) can have first outs enabled. • Check options 43, 44 and expansion option 110.
(43) (44) (E120) Heat-flow can only be on the multi-burner master
• 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.
(43) (44) (45) External modulation can only be on the multi-burner master
• Only the master (multi-burner ID 1 set in option 4) can be set for external modulation. • Check options 43 – 45.
(43) (44) (E82) Draught control can only be on the multi-burner master.
• Only the master (multi-burner ID 1 set in option 4) can be set for draught control. • Check options 43 and 44, and expansion option 82.
(43) (57) Fuel flow metering must be enabled for multi-burner
• The multi-burner function requires fuel flow metering. • Check options 43 and 57.
(43) (135) NFPA Post Purge cannot be optioned with multi-burner
• The multi-burner function can only use standard, not NFA post purge. • Check option 43 and option/parameter 135.

Setting Conflict Message
(45) (55) External modulation conflict • Switched T88 external modulation is not set with permanent external modulation. • Check options 45 and 55.
(45/55) (16) External modulation conflict • 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 • External modulation and external setpoint cannot be used simultaneously. • Check option 45 and parameter 72.
(81, 82, 83, 84) OTC Configuration invalid • Setpoints at minimum and maximum outside temperatures cannot be set the same. • Minimum and maximum outside temperatures cannot be set the same. • Check options 81, 82, 83 and 84
(111) (122) Flame scanner changeover cannot be optioned with no pilot. • If no pilot is set, then flame scanner changeover cannot be used. • Check option/parameters 111 and 122.
(111) (130) Single valve pilot cannot be optioned with no pilot. • If no pilot is set, then gas valve configuration cannot be set for single valve pilot. • Check option/parameters 111 and 130.
(112, 135) (158) Purge pressure proving timeout shorter than pre-purge time. • 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. • 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. • 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) • Valve proving can only be used for gas • Check option/parameters 125 and 150
(126) (151) Valve proving cannot be optioned when fuel type is oil (fuel 2) • Valve proving can only be used for gas • Check option/parameters 126 and 151
(127) (152) Valve proving cannot be optioned when fuel type is oil (fuel 3) • Valve proving can only be used for gas • Check option/parameters 127 and 152
(128) (153) Valve proving cannot be optioned when fuel type is oil (fuel 4) • Valve proving can only be used for gas • Check option/parameters 128 and 153
(125, 126, 127, 128) (129) (135) Post VPS cannot be optioned with NFPA Post Purge. • If NFPA post purge is enabled for gas, VPS can only be set for operating before burner start-up. • Check option/parameters 125, 126, 127, 128, 129 and 135.
(P85) (16) Modulation exerciser cannot be used with sequencing. • Modulation exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 85.

Setting Conflict Message
(P89) (16) Stat exerciser cannot be used with sequencing.
• Stat exerciser should be used for test purposes and cannot be used with sequencing. • Check option 16 and parameter 89.
(P99) (P100) Graceful shutdown and assured low fire shut off not allowed.
• If graceful shutdown is set, then assured low fire shut off cannot be used. • Check parameters 99 and 100.
(E1) (1) Water level control requires a boiler pressure sensor.
• Water level control cannot be used with a hot water boiler (load/external temperature detector). • Check expansion option 1 and option 1.
(E1) (E3, E4) At least one analogue level sensor required.
• If water level is enabled with one capacitance probe, then an external level sensor is required. • Check expansion options 1, 3 and 4.
(E1) (E3, E4, E5, E6) Sensor enabled but water level control disabled.
• 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.
(E3, E4, E5, E6) At least two level sensing elements are required.
• 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.
(E4) (57) External level sensor cannot be optioned with fuel flow feedback
• External level sensor cannot be used with fuel flow feedback, as they use same terminals. • Check expansion option 4 and option 57.
(E11) (E12) Pump turn off point must be above pump turn on point.
• Pump turn off point cannot be set lower than pump turn on point. • Check expansion options 11 and 12.
(E17) (E40) Bypass valve cannot be optioned with solenoid top blowdown.
• Bypass and solenoid top blowdown cannot be used together, as they use same terminals. • Check expansion options 17 and 40.
(E28) (E3) External level sensor without scaling requires a capacitance probe.
• 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.
(E40) (1) Top blowdown requires a boiler pressure sensor.
• Top blowdown cannot be used with a hot water boiler (load/external temperature detector). • Check expansion option 40 and option 1.
(E42) (E46) TDS warning level less than TDS target.
• TDS warning level cannot be set lower than the TDS target value. • Check expansion options 42 and 46.
(E60) (1) Bottom blowdown requires a boiler pressure sensor.
• Bottom blowdown cannot be used with a hot water boiler (load/external temperature detector).
(E62) (E64) Bottom blowdown reduction boiler steam production rating not set.
• If bottom blowdown reduction is enabled, than steam production rating must be set. • Check expansion options 62 and 64.
(E62) (E120) Bottom blowdown reduction requires steam flow to be enabled.
• If bottom blowdown reduction is enabled, then steam flow metering must be enabled. • Check expansion options 62 and 120.

Setting Conflict Message
(E80) (E82) Draught control enabled but draught servo disabled.
• Draught servomotor must be enabled for draught control. • Check expansion options 80 and 82.
(E120) (57) Heat flow requires fuel flow to be optioned and commissioned.
• If heat flow function is set, fuel flow metering must be optioned and commissioned. • Check expansion 120 and option 57.
(E120) (1) Steam flow requires a boiler pressure sensor.
• A boiler load/external pressure detector must be set for steam flow metering. • Check expansion option 120 and option 1.
(E120) (1) Water flow requires a boiler temperature sensor.
• A boiler load/external temperature detector must be set for hot water flow metering. • Check expansion option 120 and 1.
(E127) (E128) Steam flow start pressure offset must be less than stop offset.
• The steam flow start pressure offset cannot be set higher than the steam flow stop pressure offset. • Check expansion options 127 and 128.
(E140) (12) Fully metered cannot be optioned with EGA trim.
• 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.
(E140) (E4) Fully metered cannot be optioned with external water level probe.
• 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.
(E140) (E120, E129) Fully metered cannot be optioned with local heat flow.
• Fully metered control cannot be used with steam or hot water flow metering. • Check expansion options 140, 120 and 129.
(E140) (E141, E143) Fuel temperature cannot be optioned with mass flow meter.
• Fuel temperature sensor cannot be used with a fuel mass flow meter in fully metered control. • Check expansion options 140, 141 and 143.
(E140) (E141, E145) Fuel pressure cannot be optioned with mass flow meter.
• 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.
• 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.
• 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.
• 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.
• 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.
• Density must be set for gas in fully metered control. • Check option 152 and expansion options 150 and 156.

Setting Conflict Message
(E140) (153, E157) Fully metered requires gas fuel 4 to have non-zero density.
• 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.
• 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.
• 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.
• 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).
• 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).
• 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 heat flow 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 86 and expansion 129.
(87) (E129) Servo channel 2 via I/O unit cannot be optioned with heat flow 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 87 and expansion 129.
(88) (E129) Servo channel 3 via I/O unit cannot be optioned with heat flow 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 88 and expansion 129.
(89) (E129) Servo channel 4 via I/O unit cannot be optioned with heat flow 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 heat flow 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.

5.5 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.
• Selected fuel must be commissioned.
Servo configuration does not match commissioning.
• Option 8 and/or expansion option 80 do not match the last commission settings.
VSD configuration does not match commissioning.
• VSD settings for channels 5 and 6 must be the same as the last commission settings.
Golden start optioned but not commissioned.
• Commission golden start position (see section 3.4.8).
FGR optioned but not commissioned.
• Commission FGR start position (see section 3.4.9).
Trim channel does not match commissioning.
• Option 76 trim channel must be the same as the last commission settings.
Fuel/air-rich trim ranges changed.
• Parameter 13 and/or parameter 19 do not match last commission settings.
BC Option/parameter mismatch.
• BC options 110 – 160 must be set the same as their corresponding parameters.
Invalid option value.
• An option value is outside the allowed range.
Invalid parameter value.
• A parameter value is outside the allowed range.
Invalid expansion option value.
• An expansion option value is outside the allowed range.
Options have been reset.
• Option settings have been reset due to data lost in an EEPROM error.
Parameters have been reset.
• Parameter settings have been reset due to data lost in an EEPROM error.
Expansion options have been reset.
• Expansion option settings have been reset due to data lost in an EEPROM error.
VPS sensor not commissioned.
• Gas pressure sensor has been enabled but not commissioned.
Commissioned gas pressure during valve proving too low.
• Gas pressure stored during valve proving is less than option/parameters 133 and/or 136.
Commissioned running gas pressure too low.
• Gas pressure at one or more commissioned points is less than option/parameter 136.
APS sensor not commissioned.
• Air pressure has been enabled but not commissioned.
Commissioned air pressure too low.
• 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.
• Check data has uploaded successfully before restarting in run mode.

Forced Commission Message
Options and/or parameters reset to default values. Check configuration then restart.
• Reset of setting using option/parameter 160. Set/check settings and restart.
First outs are optioned but not configured. Check configuration then restart.
• Configure first outs and restart.
Too many sensors require commissioning.
• 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.
• One or more commissioned points for draught servomotor is lower than expansion option 83.c
Capacitance probe not commissioned.
• Capacitance probe has been enabled but not commissioned.
Capacitance probe serial number does not match commissioning.
• Capacitance probes have changed, recommission water level.
External level sensor not commissioned.
• External level sensor has been enabled but not commissioned.
VSD1 Feedback variation too small. Maximum VSD fault tolerance is —
• 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 —
• 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.
• Draught control has been enabled but not commissioned.
Fully metered optioned but not commissioned.
• Fully metered control has been enabled but not commissioned.
Fully metered configuration does not match commissioning.
• One or more sensors used for fully metered control that were not present during commissioning are now enabled.

5.6 Troubleshooting and Further Information

5.6.1 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

5.6.2 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.

5.6.3 Snubbers

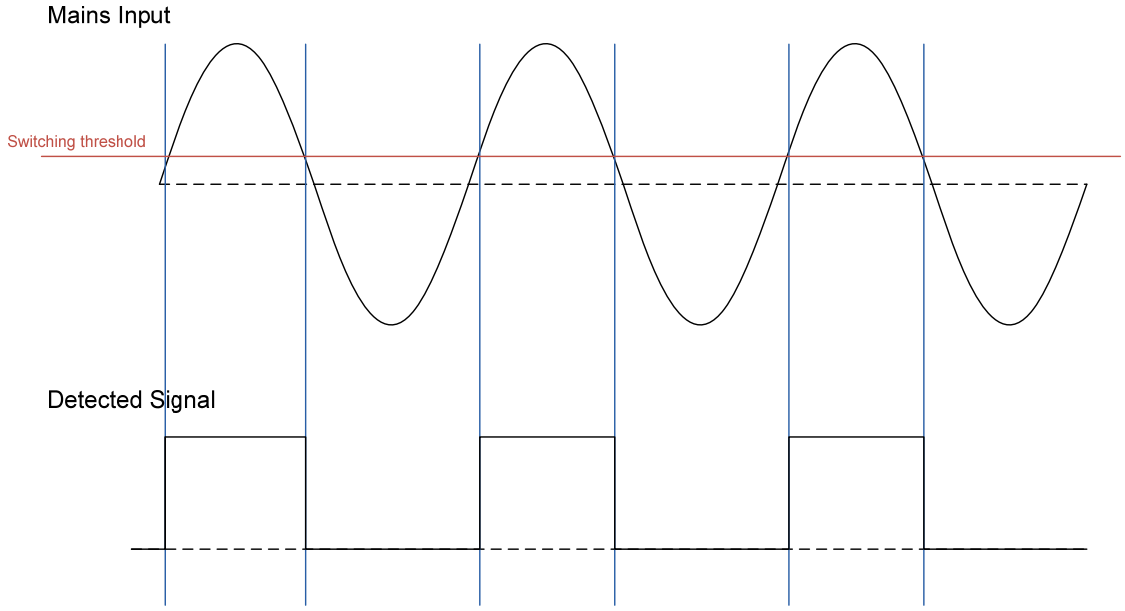
The Autoflame system has internal components which protects itself against voltage/current spikes and electrical interference. In some installations this internal protection is not enough, especially when the main fuel valve Terminals 60 and 61 have been connected to older gas valves and voltage/current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

5.6.4 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 ±10% of the required voltage, and the unit is earthed properly. This can cause hunting issues if not at the required voltage or incorrect earthing.

5.6.5 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.

6 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 23522:2007

AS 4625 – 2008

AS 4630 – 2005

Notes

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