M.M./E.G.A. Technical Manual

Mk6 Evolution	Mini Mk6	Mini Mk5 Evolution
MM60001/E	MMM60016	MMM5002/E

Issued by:

AUTOFLAME ENGINEERING LIMITED
Unit 19, Bellingham Trading Estate
Franthorne Way, Bellingham
London SE6 3BX

Tel. +44 (0)20 8695 2000
Fax. +44 (0)20 8695 2010
Email: sales@autoflame.com
Website: http://www.autoflame.com/

Registered Holder:

Company:

Department:

INDEX

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.

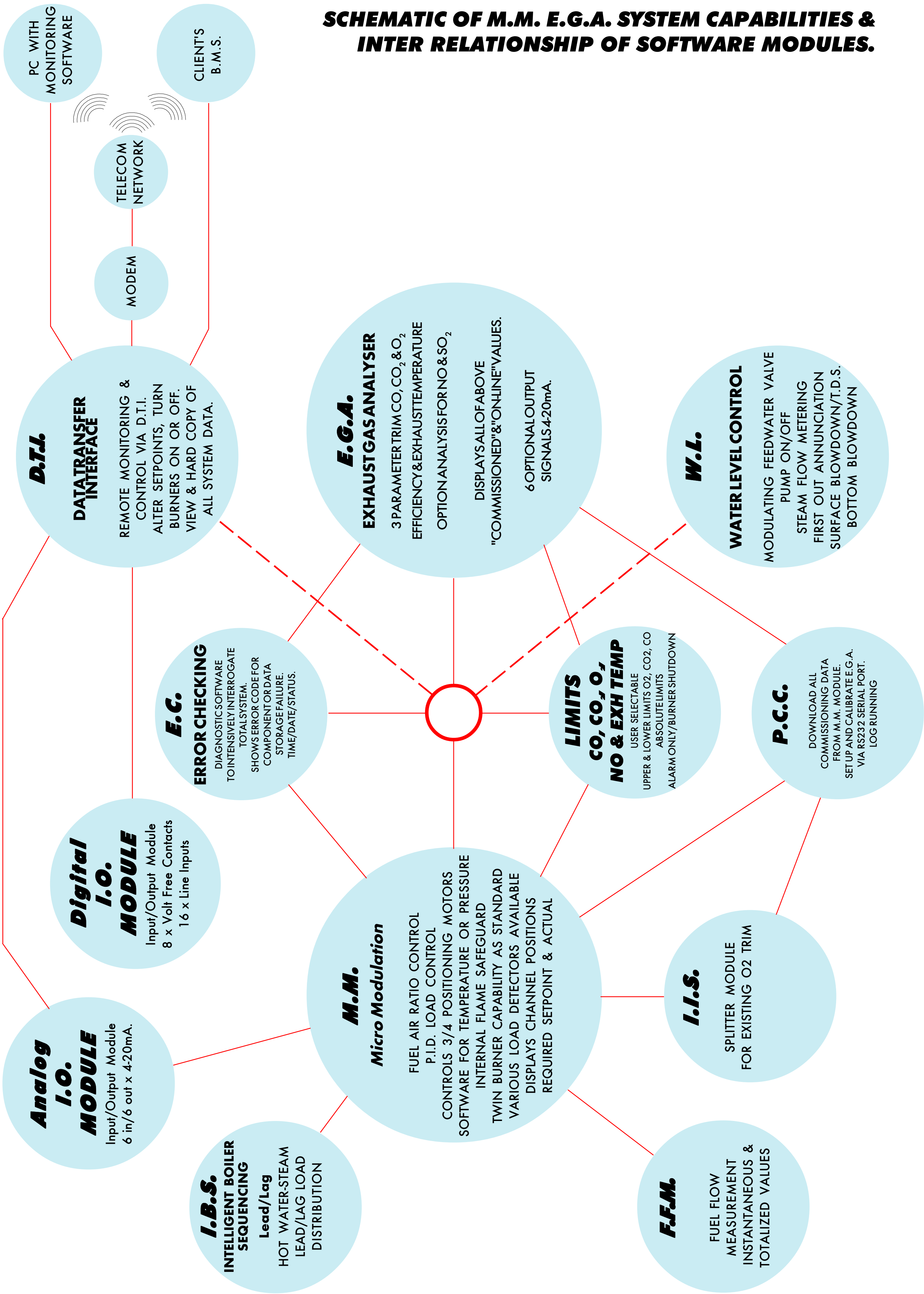
Autoflame's warranty from point of sale is two years on all electronic systems and components.
One year on all mechanical systems, components and sensors.

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.

If in doubt regarding any technical aspect of the system contact your authorised dealer or the Autoflame Technical Sales Department. Either of the above will be pleased to give advice and Technical Information.

Section 1: Overview and Introduction of M.M. E.G.A. System

SCHEMATIC OF M.M. E.G.A. SYSTEM CAPABILITIES & INTER RELATIONSHIP OF SOFTWARE MODULES.



Overview - Features and Benefits of the Autoflame Micro Modulation and Exhaust Gas Analysis Trim Systems

M.M. Micro Modulation/Flame Safeguard

* Fuel/air ratio control
* Control up to 4 positioning motors and 2 variable speed drives (VSD/VFD)- 6 channels
* 4 independent fuel programs
* Fully adjustable P.I.D. load control for temperature and pressure
* External voltage/current load control and setpoint adjustment
* Various boiler load detectors available
* Twin burner capability
* Fully compatible with control frequency drives
* Fuel flow metering software
* Internal flame safeguard- full flame supervision with UV self check
* Gas valve train leak supervision and gas pressure monitoring
* Air windbox pressure proving and monitoring

E.G.A. Exhaust Gas Analysis

* 3 parameter Trim of O_2, CO_2 and CO
* Displays O_2, CO_2, CO Efficiency, Delta T and exhaust gas temperature
* NO, SO_2 (or NO_2) monitoring
* Local display for re-calibration, changing cells, user configuration and stand-alone operation
* Upper/lower/absolute limits for O_2, CO_2, CO, NO and exhaust temperature
* Six 4-20mA output signals to interface with other controls/chart recorders

I.B.S. Intelligent Boiler Sequencing (Lead/Lag control)

* System will Sequence hot water boilers and steam boilers via lead/lag load distribution
* Fully adjustable via user option with the system to enable the control to be tailored to the application
* System control for isolation of valves or pumps
* Phantom setpoint and standby warming for lag boilers via a timing sequence and pressure offset or aquastat

D.T.I. Data Transfer Interface

* System will collect operational data for up to 10 M.M. modules on one site, transmit via RS232 data link to a local PC running winPCDTI or Building Management System (B.M.S.)
* Modem compatibility software to give information and control of boiler house operation remotely
* MODBUS and Johnson's Metasys compatible

W.L. Water Level Control

* Fully modulating water level control including all safeties, 2nd low, 1st low, 1st low pre-alarm, high water pre-alarm, high water
* 15 First Out Annunciation inputs
* Automatic bottom blowdown
* Surface blowdown management (TDS- total dissolved solids)
* Steam flow metering

I.I.F. O_2 Interface Module, Splitter Module

* Interface with existing on-line O_2 analysers via 4-20mA
* Split one E.G.A. signal for two M.M.s for use on common or twin furnace boilers

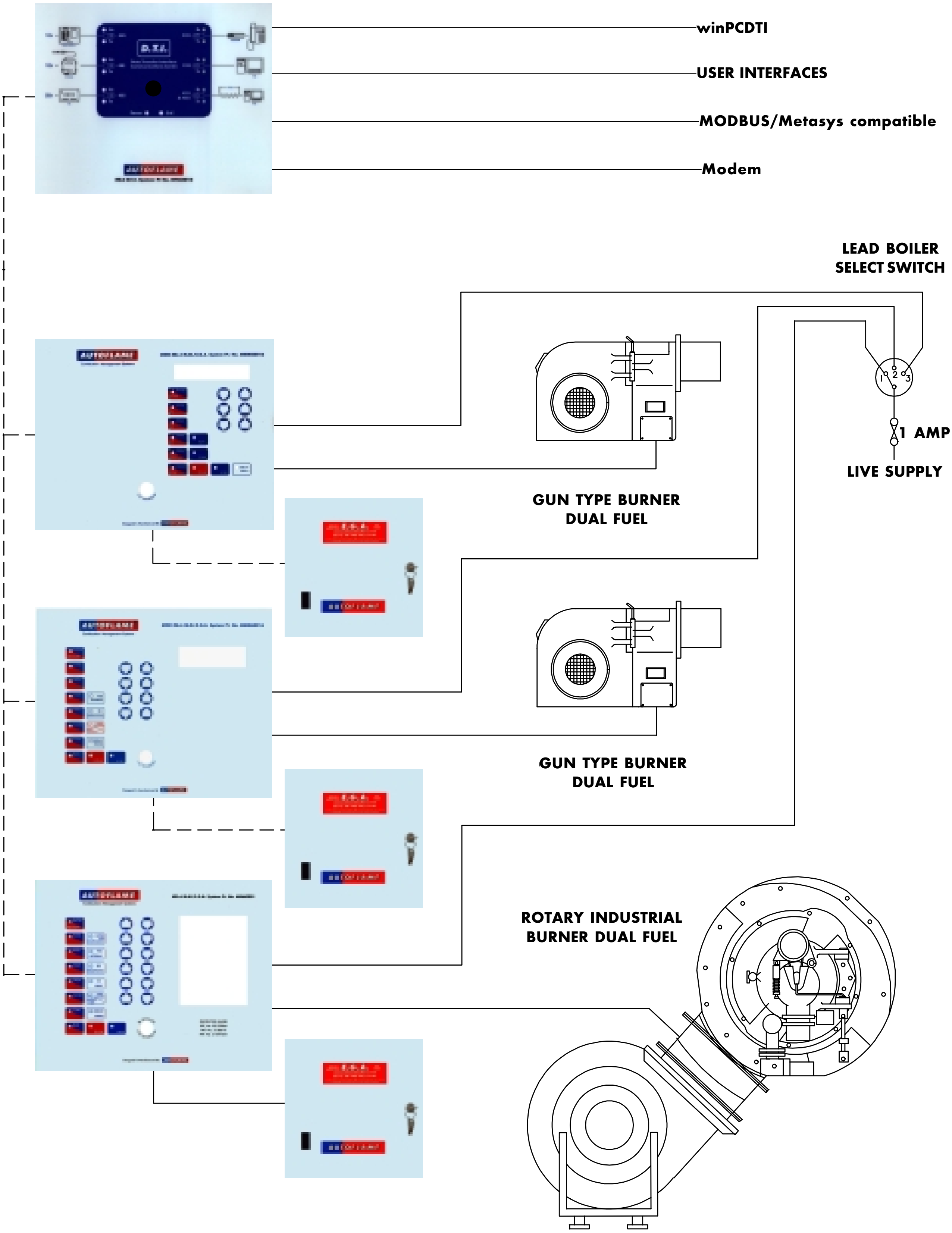
P.C.C. Personal Computer Compatible

* Down load all commissioning data from M.M. module
* Set up and calibrate E.G.A. via RS232 serial por

I/O Digital & Analogue Input/Output Units

* These units can be configured to give inputs and outputs for the DTI system
* Analog modules have six 4-20mA inputs and outputs
* Digital modules have 16 line voltage inputs and 8 volt free contacts
* All inputs/outputs can be labelled for the specific application and set for alarm or monitor only status

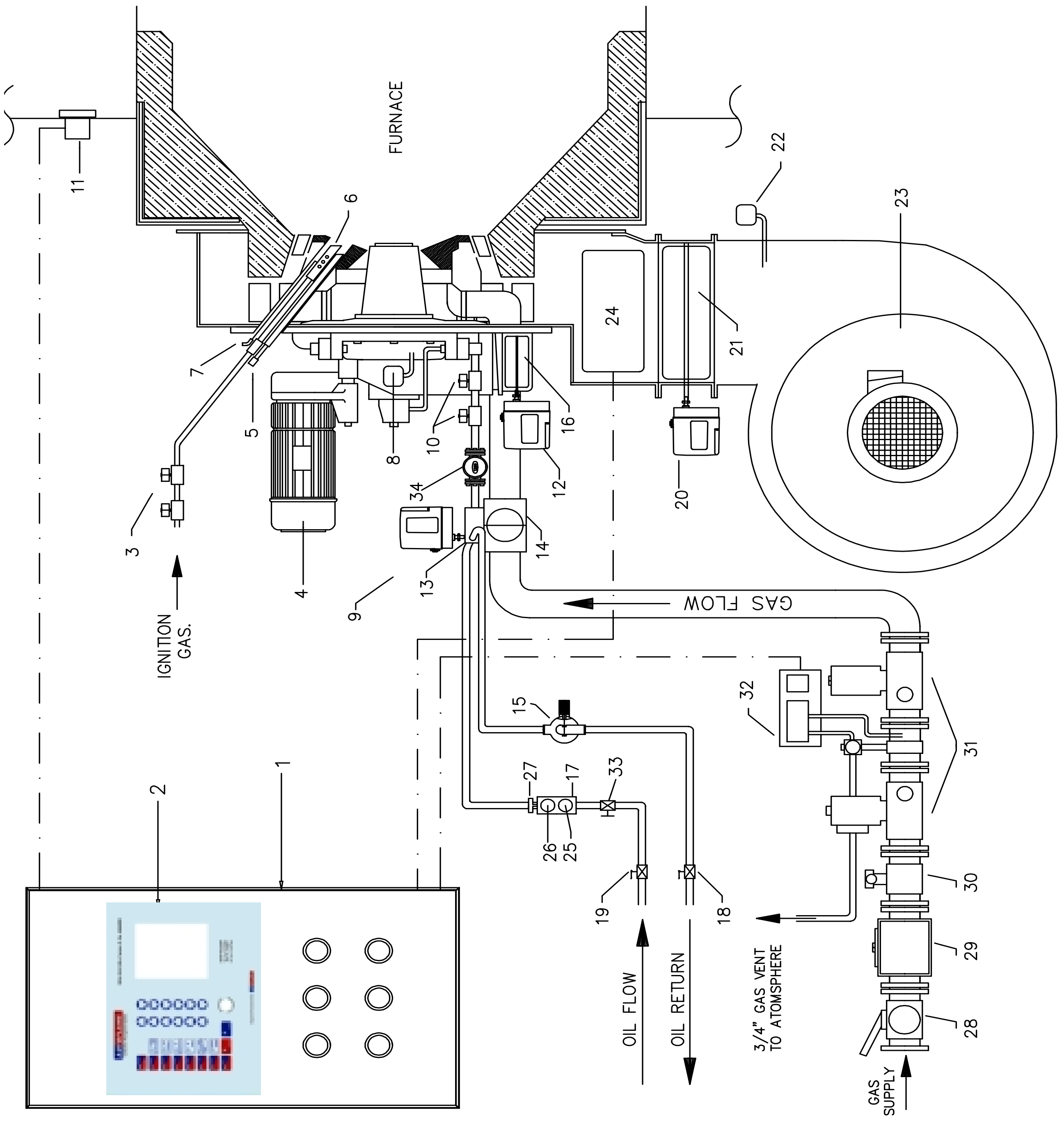
SYSTEMS POSSIBILITIES



LAYOUT OF DUAL FUEL ROTARY CUP BURNER CONTROLS & M.M. SYSTEM

KEY TO CONTROL SYSTEM

1 Control panel
2 Micro Modulation Unit
3 Pilot solenoid valves
4 Rotary cup motor
5 Flame detector
6 Pilot burner
7 Ignition electrodes
8 Atomising air proving switch
9 Fuel servo motor
10 Oil solenoid valves
11 Temperature/pressure sensor
12 Atomising air servo motor
13 Modulating oil valve
14 Modulating gas valve
15 Oil pressure regulator valve
16 Atomising air damper
17 Oil entry block
18 Oil return shut-off valve
19 Oil flow shut-off valve
20 Combustion air servo
21 Modulating combustion air damper
22 Combustion air proving switch
23 Combustion air fan
24 Burner terminal box
25 Oil temperature gauge
26 Oil pressure gauge
27 Oil temperature thermostat
28 Main gas shut-off valve
29 Gas filter
30 Gas flow meter
31 Main gas actuating valves
32 Valve proving system
33 Throttle valve
34 Oil flow meter



	Mk6	Mini Mk6	Mini Mk5 EVO
Micro Modulation Fuel/Air Ratio Control			
Servo channels	4	3 or 4	3
VSD channels	2	0 or 1	0
Fuel profiles	4	4	2
Selectable trim channel (Damper or VSD)	✓	✓	✓
Error diagnostics displayed	✓	✓	✓
Single point change	✓	✓	✓
User defined optimum ignition	✓	✓	✓
FGR management	✓	✓	✓
Exhaust Gas Analyser (requires EGA)			
CO2, O2, CO trim	✓	✓	✓
CO2, O2, CO, NO, SO2 displayed	✓	✓	✓
Exhaust temperature and combustion efficiency displayed	✓	✓	✓
User definable limits to CO2, O2, CO	✓	✓	✓
Burner Control			
User configurable timings	✓	✓	✓
Internal flame safeguard controller for UV	✓	✓	✓
Gas valve proving system	✓	✓	-
Air wind-box pressure proving	✓	✓	-
Gas pressure supervision	✓	✓	-
Air pressure supervision	✓	✓	-
Oil pressure supervision	✓	✓	-
Lockout history	✓	✓	✓
Setpoint Control			
Internal 3 term PID load control to required setpoint	✓	✓	✓
Software adjustable thermostat/pressure-stat	✓	✓	✓
Second setpoint selectable	✓	✓	-
Outside temperature compensation	✓	-	-
Night setback facility	✓	-	-
Further Features			
IBS hot water	✓	✓	✓
IBS steam	✓	✓	✓
IBS low pressure steam	✓	✓	-
Fuel flow metering - instantaneous	✓	✓	✓
Fuel flow metering - totalised	✓	✓	✓
Hand/Auto/Low flame hold	✓	✓	✓
Input for external load control	4-20mA/0-10V	4-20mA/0-10V	0-10V
Output of firing rate	4-20mA/0-10V	-	-
Twin burner capability	✓	✓	-
User Features			
Password protected configurable options and parameters	✓	✓	✓
Infrared communications port	✓	✓	✓
Systems data export via DTI	✓	✓	✓
Internal calendar clock display and logging	✓	✓	✓
Proximity sensor screen saver	✓	-	-
LCD Display	1/4 VGA	20x4 line	20x4 line

Mk6 MM

Mini Mk6 MM

Mini Mk5 EVO MM

MICRO MODULATION (M M)

Overview of System Operation: Features and Benefits

To ensure maximum efficiency in the operation of any boiler, two requirements are of paramount importance, the first being that the air to fuel ratio is kept to the minimum to ensure complete combustion within the limitations of the combustion head design and that these settings once arrived at are infinately repeatable to an incredibly high degree of accuracy. The second requirement should be that the target temperature or pressure of the boiler is monitored by the combustion system and that at all times exactly the right amount of fuel and air is fire to achieve the target value and that at no time irrespective of load change is this target exceeded or fallen short of.

The inherent hysterisis of all mechanical systems that have traditionally involved cams and linkages to characterise the fuel air ratio have made this sort of accuracy impossible. The accuracy of response of fuel input to the monitored target temperature/pressure of the boiler has meant that the target value set by the operator has at most times been exceeded or fallen short of.

The Micro Modulation system provides an easily programmable and flexible means of optimising combustion quality throughout the load requirement range of the boiler/burner unit whilst ensuring the temperature is accurate to within 1 deg C (2 deg. F.) and pressure to within 1.5 p.s.i. The maximum error in degrees angular rotation between the two servo motors at any position in the load range is 0.1 degrees.

At the heart of the system is the control module which contains the micro computer and power supply. The display panel features touch sensitive key pad entry data, readouts and status indicators, all protected beneath a tamper-proof transparent plastic cover. The M.M. system shows angular position of air damper motor and fuel valve. "Required" and "Actual" temperatures are displayed.

Interfaced with the control module by means of high speed solid state switching are up to three dual wound servo motors. One motor is responsible for positioning the air damper and the other operates a fuel valve by which it is possible to meter the input of gas, oil, or dual fuel.

The position of each servo motor is monitored by a voltage dividing system enabling digitalised position information to be encoded into the control modules memory. The relative positions of the air and fuel motors are constantly checked by the system at the rate of 50 times per second.

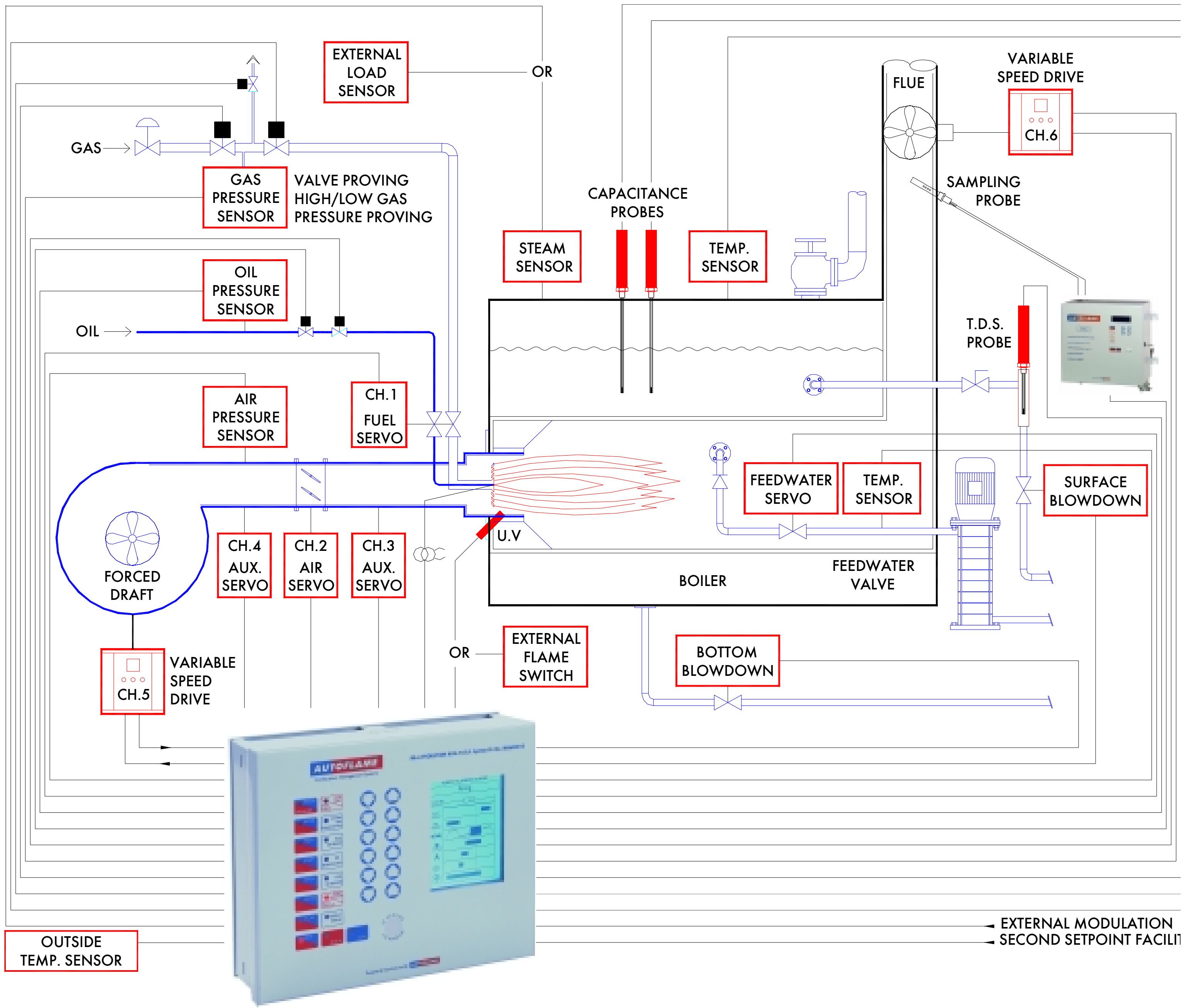
This new system of burner control achieves 'Locked On' near stoichiometric air fuel mixing throughout the fuel input range of the boiler while maintaining exact temperature or pressure target values. The load control incorporates user variable P.I.D. values.

Operating in conjunction with the above control specification is a full three term infinitely adjustable P.I.D. load control package. This ensures that the control of set point temperature is accurate to within 1 deg C (2 deg F.) and pressure to within 0.1 bar (1.5 P.S.I.) Software for temperature or pressure is a user variable option, also various ranges of temperature and pressure are selectable by the user.

The Micro Modulation (M.M.) module is the basic building block of the M.M./E.G.A. system. A complete system based on the Mk6 MM incorporates all of the following control facilities and features:

- 6 channel: 4 positioning motors and 2 Variable Speed Drive interfaces.
- 4 separate fuel profiles
- Full flame supervision control with UV self check- system meets self check criteria on all outputs
- A lockout history of the last 16 incidents held in memory. Time, date, function, re-set
- Single point change capability
- IBS steam sequencing with lead/lag
- IBS heating boiler sequencing- lead/lag- control of return line 2 port valve
- Gas valve train leak proving system
- Gas pressure monitoring and display
- High and Low gas pressure supervision
- Oil pressure high/low limits
- Oil pressure monitoring & display
- User definable optimum ignition position selection- golden start
- User definable flue gas recirculation ignition position selection
- Variable modulation speed (motor travel time user variable)
- Selectable trim channel
- Burner control selectable operation- first/second safety times
- Air wind box pressure proving- display & supervision
- Internal PID 3 term load control- temperature & pressure
- Outside temperature compensation of boiler set point, user adjustable with night seback facility
- Fuel flow metering- instantaneous and totalised readings- user defined units of measurement
- Exhaust temperature and ambient temperature net and absolute readings displayed
- 3 parameter trim- CO_2, O_2 & CO
- Combustion efficiency calculation- net or gross displayed
- NO and SO_2 monitoring & display
- User definable combustion limits on all CO_2, O_2 & CO values
- Second set point user selectable
- Internal calendar clock display and logging functions
- Software adjustable thermostat/pressure stat. facility
- Hand/Auto/Low flame hold facilities
- Password protection of all safety related options and parameters
- Infrared Coms port for upload and download of commissioned data and lockout history
- Twin burner control capability
- 4-20mA/0-10V input for external load control of firing rate
- 4-20mA/0-10V output confirming firing rate position
- Changeover of fuels without shutdown (Special PROM)
- Quarter VGA screen with dynamic display capabilities and IR proximity screen saver
- 110 or 230 volt standard operation
- Panel facing mounting

MK6 EVOLUTION BURNER MANAGEMENT SYSTEM



EXHAUST GAS ANALYSIS (E.G.A.) TRIM SYSTEM

Overview of E.G.A. System Operation

With the E.G.A. trim system it is possible to expand the M.M. so that it will measure and display O_2, CO_2, CO and exhaust temperature, together with boiler efficiency: At the same time inflicting minute corrections on the air damper position to ensure that the originally entered commissioning data is adhered to, irrespective of variations in stack pressure or barometric conditions. As standard, outputs are available which can be connected with appropriate interfacing to an energy management computer to track and record the information that is generated by the E.G.A. system. To expand the M.M. system to the above E.G.A. specification the additional sampling unit and exhaust gas sampling probe must be purchased. The M.M./E.G.A. control form is P + I + D feed forward, and interpolates between all entered data, it also carries error checking self diagnostic software for self identification of system component or data handling failure.

The system trim function is achieved by every paired value for air and fuel having stored values for O_2, CO_2 and CO at the commissioned value. Deviations from these ideal values are held, this data is integrated and expressed as a degree angular value, so that an exact amount of air damper trim may be inflicted at any time to return the system to it's commissioned value at any load condition.

The E.G.A. can also be fitted with NO and SO_2 sensors for monitoring.

All the information available on the E.G.A. can be accessed by one or all three of the following methods:

1. Displayed on the E.G.A. local display.
2. Displayed on the M.M. facia.
3. 6 channel 4-20mA output facility for the above values.

Options #1 and #3 enable the E.G.A. to be used as a Stand Alone on-line continuous monitoring system.

E.G.A. setup and calibration is carried out via the local display or by a PC using an RS232 serial port.

INTELLIGENT BOILER SEQUENCING (I.B.S)

Overview of I.B.S. System Operation

The Intelligent Boiler Sequencing software, which is included in every M.M./E.G.A. module, further extends the application possibilities of the system. The objective of this control form is to ensure that the minimum number of boiler/burner units are in operation at any one time to satisfy the heat requirement imposed upon the boiler plant, particularly in the case of multi boiler installations.

There are two variations of I.B.S. software that can be selected by the user via the Options procedure. The first variation relates to heating boilers and the second variation to steam boilers.

Heating Boilers Sequential Control:

A maximum of ten M.M./E.G.A. modules may be interconnected by a two wire screened data cable: (See interconnection drawing). Any string of modules interconnected as detailed can have one of it's number designated No. 1 or lead boiler. This identifying of "lead" boiler is achieved by either of the following methods:

a) Connecting a mains voltage onto terminal No. 41.
b) Instructing the modules via the D.T.I. module (Data Transfer Interface) by software.

Once a "lead" boiler has been selected the system works in the following way:

Typically every five minutes the sequencing software in the lead boiler identifies it's own firing rate by looking at the position of the fuel valve in the load index and also the maximum heating capacity of the No 1. "lead" boiler. This information would normally be entered when this boiler/burner unit is commissioned. Having established percentage firing rate, and maximum heating capacity, the I.B.S. software calculates the amount of heat being contributed to the system by this boiler. The I.B.S. software in the "lead" M.M./E.G.A. module then contacts in turn each of the modules connected to this loop and gathers similar information from each. The "lead" module's I.B.S. software then calculates the minimum number of boiler/burner units that need to be operational to satisfy the building load, imposed upon the plant at that time, and switches the remainder off.

There is a terminal connection on the M.M./E.G.A. module for controlling a two port valve that would normally be installed in the boiler's return pipe connection to the common return header. This facility ensures that boilers that are switched "off line" do not contribute return temperature water to the flow header thereby diluting the flow temperature to the building: (See relevant data sheets and drawings showing the control sequence detailed above).

Example:
There are four boilers interconnected as above, each with a heating capacity of 586kW(2MBtu.) In the event of each boiler firing 440 kW (1.5MBtu) (3/4 of it's maximum rate), the No. 1 lead boiler would instruct the No. 4 boiler to shut down and boilers No.s 1, 2 and 3 would adjust their firing rate to maximum.

In both cases the boilers are contributing 1758kW (6MBtu) to the system but, after intervention of the I.B.S. sequencing software, three boilers only are carrying the load which is a more fuel efficient method of operation.

If the building load continued to decrease the three boilers would reach a point where they were each firing 381kW (1.3MBtu) each. At this point the I.B.S. software would switch off the No. 3 boiler as two boilers would be capable of generating the 1172kW (4MBtu) required. When the load on the system increases, the reverse procedure applies, i.e. when, for example, two boilers are firing at near 100% load and the setpoint temperature on either of the modules is not being achieved, the I.B.S. software would switch on a third boiler to assist with the generation of the heat requirement. Any boiler can be nominated "lead" boiler by the connection of an input to the appropriate terminal or by a software instruction via the D.T.I.

Steam Boiler Sequential Control:

When the I.B.S. software control package is applied to steam boilers, it's operation is exactly the same as above but with the additional features and enhancements as explained in the following.

In the case of heating boilers only two states in the control form exist, either on or off. When steam boiler variation of I.B.S. is optioned there are three states which are controlled sequentially. The first is "on-line", this is when the boiler is operating purely under the control of the M.M./E.G.A. module's internal P.I.D. load controller.

The second state is "stand-by": In this case the boiler is operated at a reduced pressure setpoint, e.g. if the on-line boiler or boilers are set at a setpoint of 7 bar (100 p.s.i.) the stand-by boiler controls at a setpoint of 5 bar (72 p.s.i.). In this way if the load increases the stand-by boiler can begin to contribute steam quickly. The reduced setpoint is a user variable option in the same way as the normal control pressure setpoint.

The third state is "off-line", this is with the burner shut down and the boiler is cold. If the load on the boiler house increases, this boiler would move into a "Stand By" condition.

Apart from the variations detailed above, the steam sequencing works in precisely the same way as the heating boiler sequencing: The sequencing software package ensures that at all times the minimum number of boilers are operational to satisfy the load imposed on the boiler house.

REMOTE MONITORING AND CONTROL (D.T.I.)

Overview of Data Transfer Interface Operation

By means of our Data Transfer Interface (D.T.I.) module, all the operational data, stored within each of up to ten M.M. modules, can be collected by the D.T.I. for transmission by direct RS232 data link to a local terminal, screen and printer or Building Management System (B.M.S.). This facility can also be achieved remotely via modem/telecom link up. This cost effective system more than meets the requirements of today's E.M.S. and B.M.S. systems in providing all the necessary operational and alarm status and control of boiler plant to achieve its maximum energy efficient operation.

Up to a maximum of ten M.M. modules (one per burner) can be connected to one D.T.I. module by means of a series RS485 data link. The information gathered by the D.T.I. from each M.M. module is then available for transmission to the E.M.S. or B.M.S. via either an RS232 data link or modem/telecom data link.

Remote on/off control of the burners can also be achieved as well as adjustment of the temperature or pressure setpoints and selection of sequence lead boiler. To accommodate the status information from other plant related equipment, the D.T.I. can handle upto 160 direct mains voltage inputs, 80 volt free outputs, 60 4-20mA inputs and 60 4-20mA outputs. Typical remote E.M.S., B.M.S. information and operational facilities that can be achieved are as follows, but are subject to the particular site and management system requirements that are to be accommodated.

The capability exists within the standard D.T.I. software for the end user to label any mains voltage signal input as an "Alarm" condition. When labelled as an "Alarm" condition the system can 'autodial' out onto the general telephone network to a word pager and/or a remote office.

Possible Input/Output Values:

Values available from each MM :

- Required boiler temperature (deg. C/F) or pressure (Bar/PSI).
- Actual boiler temperature (deg. C/F) or pressure (Bar/PSI).
- Burner on/off (internal stat on/off status).
- Burner maximum firing rate.
- Burner firing rate (%).
- M.M. identification number.
- Fuel selected.
- Boiler control detector type (temperature/pressure).
- Error conditions.
- Auto/Hand/Low flame hold operation.
- All MM channels (positioning motors and variable speed drives).
- Number of hours run/start-ups for each fuel.
- Instantaneous and totalised fuel flow metering.
- Lockout/error status.
- Online combustion air pressure.
- Online fuel sensor pressure.
- Data logging- online status, actual value, firing rate- stored in monthly accessible files.

Values available from each MM : cont../...

Maximum set point accepted from DTI.
Minimum set point accepted from DTI.
Lead boiler status.
Burner firing status (off, firing, purge, ignition, pilot proving, main flame proving).
Sequencing optioned.
Sequence status (on, stand-by, warming, off).
Enabled/disabled status.

<u>Additional information available if system has E.G.A.:</u>

E.G.A. operation optioned.
Flue gas oxygen present value.
Flue gas carbon dioxide present value.
Flue gas carbon monoxide (unburnt combustibles) present value.
Flue gas nitrogen oxide present value.
Flue gas sulphur dioxide present value.
Flue gas exhaust temperature present value.
Ambient temperature present value.
Delta T present value (difference between exhaust temperature and ambient temperature).
Combustion efficiency present value.
Flue gas oxygen commission value.
Flue gas carbon dioxide commission value.
Flue gas carbon monoxide (unburnt combustibles) commission value.
Flue gas nitrogen oxide commission value.
Flue gas sulphur dioxide commission value.
Flue gas exhaust temperature commission value.
Ambient temperature commission value.
Delta T commission value (difference between exhaust temperature and ambient temperature).
Combustion efficiency commission value.
E.G.A. error conditions.

<u>DTI control input values:</u>

Change required set point- global and individual.
Select lead boiler.
Shuffle sequencing- change lead/lag order.
Boiler enable/disable.
Change load index/firing rate- global and individual.

<u>Additional information available if system has Water Level controls:</u>

Water level status- control point, high water, 1st low water, 2nd low water, pre-alarms.
Steam temperature, feedwater temperature, pump status and valve position.
Instantaneous and totalised steam flow metering.
Water level alarm status.
15 First Out annunciation input status.
T.D.S. (Total Dissolved Solids) target and measured values- surface blowdown.

ADDITIONAL MODULES

1. **O2 Interface.**

Where an existing O_2 measuring device is fitted the O_2 interface module can receive a 4-20mA signal from the O_2 probe and a 0-10V signal from the thermocouple mounted in the stack for use by the M.M. for one parameter O_2 trim. Values for CO_2, CO, Exhaust Gas Temperature and Efficiency will be displayed as 0.

2. **EGA Splitter.**

On water tube or common furnace boilers it is possible to use one E.G.A. unit to sample the common flue gases and split the signal for use by two M.M. modules. Trim is inflicted on both burners based on the common products of combustion and will therefore not optimise the combustion performance of each burner.

1.10 P.C. COMPATIBILITY

M.M. Infrared Upload/Download

The Mk.6, mini Mk.6 and mini Mk.5 EVO M.M. units each contain an Infra Red Upload/Download port which enables all the commissioning data from a single unit to be downloaded onto a PC using Autoflame IR lead and software. Data can be stored on disk. Stored backup data can be uploaded in to the M.M.

Information includes:

1. Site name, Engineer, Boiler Type, Data, Software revisions, M.M. identification number.
2. All channel positions entered during commissioning for each fuel.
3. E.G.A. values O_2%, CO_2%, COppm, NOppm, SO_2ppm, Ambient Temperature, Exhaust temperature, Delta T, Efficiency % for commissioned, and also autotrim values of O_2, CO_2 and CO at each position.
4. All Option number setting, default- * indicates options changed.
5. All Parameter numbers, setting, default- * indicates Parameters changed.
6. Flow Metering - if entered.
7. Lockout/error history (last 16 events).
8. Water level commissioned data and set-up values.
9. First Out annunciation labels.
10. Bottom blowdown timings and surface blowdown settings.

which can then be used to generate a hard copy Commissioning Report and be stored on disk for future reference.

E.G.A.

The E.G.A. is fitted with a local display. All set-up, configuration and calibration tasks (calibration code and test gas calibration) can be carried out with the use of this display and facia buttons. Each cell is provided with its own unique calibration number which alleviates the need for costly on site calibration with test gas etc. It is also possible to use the RS232 serial port on the E.G.A. for connection to a P.C. to carry out the above procedures.

1.11 ANALOGUE INPUT/OUTPUT UNIT

This unit has 6 individually programmable outputs and 6 individually programmable inputs providing a means of converting items of data within the M.M./E.G.A. system in 4-20mA signals.

The unit can be supplied with outputs readily configured or with the use of the DTI lead and Windows Terminal mode software the outputs are user configurable.

The following functions are available for output data:-

Firing Rate	-	Percentage %
Actual	-	Temperature/Pressure, °C/°F or bar/psi.
Required	-	Temperature/Pressure, °C/°F or bar/psi.
NO	-	p.p.m.
CH1	-	Angular Degrees of travel.
CH2	-	Angular Degrees of travel.
CH3	-	Angular Degrees of travel.
CH4	-	Angular Degrees of travel.
% O_2 Flue	-	Percentage %
% CO_2 Flue	-	Percentage %
CO Flue	-	p.p.m.
Exhaust Temp.	-	Degrees °C
Efficiency	-	Percentage %
Fuel Flow Rate	-	Units/Min.
MM Error	-	4mA no error, 20mA error.
EGA Error	-	4mA no error, 20mA error.

Additionally, the A I/O can be connected directly to a Mini Mk5. In this case, the A I/O uses terminals 48 and 49 of the M.M. therefore neither Sequencing nor the D.T.I. may be used with the A I/O. Channel 1 input can be used as the Remote setpoint change.

Section 2.14: Mk6 M.M. Micro Modulation

Section 2.14: Mk6 M.M. Micro Modulation

2.14.1 MK.6 EVOLUTION M.M. CONTROL UNIT

2.14.2 MK.6 COMMISSIONING AND SETTING UP PROCEDURES

2.14.2.1 Introduction

Important Note: Prior to commissioning, the fuel and air servomotors must be calibrated to ensure that the position of the valves and dampers are corresponding to the potentiometer feed-back signal as displayed on the Mk6 screen/display, i.e. when the valve is fully closed, the Mk6 displays zero degrees.

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

The fundamental idea of the system is to set a fuel valve position and then set a corresponding air damper position. Care must be taken when adjusting the fuel and air positions so as not to create any unstable or hazardous combustion conditions, e.g. moving the fuel valve to the open position without increasing the air damper position. Improper use may result in property damage, serious physical injury or death.

If the system being commissioned is an M.M., without E.G.A., then a combustion monitor is required to check the exhaust gases. If the system does have an E.G.A., then a combustion monitor should not be necessary as the E.G.A. performs all normal exhaust gas measurements. When burning oil a smoke detection device is necessary to check that the smoke generated is within limits.

Ideally to implement commissioning as quickly as possible arrange for a substantial load on the boiler. The commissioning procedure can be interrupted due to excess temperature or pressure, causing the burner to turn off. In these instances the commissioning data accumulated so far is not lost. When the burner is called back on the system starts up automatically and commissioning can proceed from where it left off, providing that power is not removed to the system.

Once a low firing position has been established, the high fire position is entered first, then descending fuel/air positions are entered consecutively until finally a minimum fuel position is entered. The CH1 and CH2 positions must always be less than the ones previously entered. However with CH3 - CH6 it is possible to move the position above or below the previously entered point.

COMMISSIONING PROCEDURE (Systems without Exhaust Gas Analyser).

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

1. Check all interconnecting wiring between the M.M. and external components is correct.
2. Set options and parameters required (refer to sections 2.14.2.4 and 2.14.2.5).
3. Set up positioning motors.
4. Program fuel/air positions.

On a previously commissioned system, it is possible to omit steps #1, 2 or 3.

Notes on Programming Fuel Air Positions

If during commissioning the burner turns off, due to the 'running interlock' opening or a lockout, it is possible to carry on commissioning from the last entered position. This is possible as long as the HIGH position has been entered, and the fuel selected is not changed. When the 'running interlock' is closed again, or the lockout is cleared, the system will purge automatically. Commissioning will then be resumed at Step 7. Automatically the system bypasses the HIGH position entry and resumes the commissioning procedure from the last entered INTER position . Effectively commissioning can now be carried on from Step 12.

If CLOSE remains flashing when pressed, this indicates that the running interlock (terminal #53) is not made, there is an E.G.A. error or the water level is not commissioned (if using the Autoflame water level control). Please refer to the fault finding section 2.14.9.

During commissioning press M.M. to display the channel 1 to 6 values.

Press DISPLAY STATUS to display the fuel selected, actual value and required setpoint. (The required setpoint will be displayed but cannot be adjusted during commissioning. During commissioning the internal stat remains made all the time regardless of the actual value). **Note:** Ensure that the high limit stat is set correctly and wired into the non-recycling interlock.

The OPEN and CLOSE are now stored during commissioning. This means if a lockout occurs upon the first burner light off during commissioning there is now no need to re-enter the open and close positions. The burner will restart once the lockout has been reset and go straight to purge, once purge is complete you are asked to again set the start position. However, if power is completely removed from the system then these positions are not retained in the memory and the open and close positions will need to be reset.

2.14.2.2 Programming Fuel Air Positions (Systems without E.G.A.)

CH1, CH2 etc refers to the rows of buttons with CH1 at the top.

Note: Throughout the commissioning procedure the COM l.e.d. is illuminated.

1. Ensure 'stat' control circuit is closed, i.e. ensure that there is an input on terminal #53.

2. Select fuel. CLOSE flashes. 'ENTER PASSWORD' is displayed.

   Note: If fuel selected is being re-commissioned, press COM before COM l.e.d. stops flashing (five seconds).

3. Enter Access Code. Adjust the numbers using the CH1 and CH2 buttons.

   When numbers are set, press CLOSE (CLOSE l.e.d. steady, ENTER flashes)

4. “SYSTEM ACTIVATE, WATER LEVEL CONFIGURE” is displayed.

   On this password screen, it is necessary to set both CH1 and CH3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 use without the water level system. It is also necessary to set the CH5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable First Out Annunciation, i.e. burner locks out.

   Then press ENTER MEMORY

5. The display indicates angular position of servo motors. After the internal checks are made (CLOSE flashes). Press CLOSE to start entering the close position.

   Note: No error checking of the servomotors is enabled at this stage. Therefore, be careful not to drive the servomotors/dampers beyond any mechanical limitations that may be present on the damper/valve.

6. Use CH1 to CH4 (as optioned) buttons to set positioning motors to 0.0.

   Press ENTER MEMORY (OPEN flashes). The servomotor error checking is now enabled.

7. Press OPEN (OPEN steady, ENTER MEMORY flashes).

8. Use CH1 to CH4 buttons to set positioning motors to their fully open positions.

This is nominally 90.0 for gas butterfly valves and burner air dampers, but may be set to less than 90.0 degrees if there are mechanical stops/limits.

Press ENTER MEMORY (System purges, at end of purge START flashes).

9. Press START (START steady, ENTER MEMORY flashes).

****WARNING** Do not enter START position before reducing fuel input. This could result in a potentially dangerous situation, serious physical damage or death.**

10. Use CH1 to CH6 to set positioning motors to positions where ignition can take place.

Note: Ensure that the main fuel valve is manually isolated until the pilot flame has been successfully established. Once this has been successfully established, gradually introduce the main fuel supply to the burner observing the flame stability. Continue to introduce fuel until the main fuel valve is fully open providing safe and stable combustion is maintained. If the combustion is not safe and stable then adjust the fuel/air ratio accordingly.

11. Press ENTER MEMORY (Burner ignites, HIGH flashes).

12. Press HIGH (HIGH steady, ENTER MEMORY flashes).

13. Use CH1 to CH6 to set maximum firing input (it is not possible to exceed the OPEN position values). Always increase the air first followed by the fuel angular positions.

14. Press ENTER MEMORY (INTER, or INTER and START flash).

Note: Only INTER flashes if the number of INTER positions entered so far is less than or equal to three, thereafter INTER and START flash.

15. Press INTER or START (INTER or START steady, ENTER MEMORY flashes).

16. Use CH1 to CH6 (as optioned) to reduce the positions. Always reduce the fuel first followed by reducing the air angular position.

If present position is an INTER position, go back to 14, otherwise proceed further.

17. Press ENTER MEMORY . At this point all commissioning data is permanently stored. (After a short pause RUN flashes).

18. Press RUN to set the system into normal modulating mode and to store the commissioning program.

Note: If the burner has been previously commissioned then once RUN is pressed then this will overwrite the previous data for the fuel selected. Failure to hit RUN will result in the commissioning data not being stored within the unit. If this is done, a loss of power will result in a loss of data for the fuel selected.

Setting Positioning Motors

Autoflame supply three standard sizes of positioning motors - small, large and industrial. All can be used for positioning fuel and air dampers.
Both types can be configured to drive clockwise or counter clockwise to open a valve or damper.

Layout of small positioning motor, refer to	Section 2.14.2.3.4
Layout of large positioning motor, refer to	Section 2.14.2.3.4
Layout of industrial positioning motor, refer to	Section 8.10

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

The operation of fuel valves and air dampers is often such that they open in a clockwise direction. If the operation needs to be reversed, it is necessary to swop various wiring connections between the M.M. and the positioning motor(s). An example of reversing the operation of a fuel valve is shown in figure B, section 2.14.2.3.4. Figure A shows the connections for normal operation.

Set Up Procedure

Before a burner is fired it is essential to set up each Micro Modulation positioning motor.

A tamper proof screwdriver is required (these can be ordered from Autoflame).

Usually control valves/air dampers that the positioning motors drive, move through up to 90 degrees angular. The M.M. system has the ability to drive valves through up to 96 degrees. Please contact Autoflame technical department for advice on applications for ranges greater than 90 degrees.

All readings displayed on the M.M. are in degrees angular. It is necessary to adjust the potentiometer in the positioning motor assembly so that the M.M. reads 0.0 when the relevant valve/damper is at its fully closed position. The technician must physically check the mechanical position of the dampers and valves. DO NOT ASSUME THEY HAVE BEEN PREVIOUSLY SET CORRECTLY.

To set up a positioning motor, first ensure option 12 is set to 0, (this prevents E.G.A. errors from allowing continuation). Put the M.M. into the commissioning mode so that the CLOSE l.e.d. is steady and the ENTER l.e.d. flashes (see section on commissioning). By doing this it is possible to position the valve/ damper mechanically by using the appropriate up and down buttons.

****WARNING** Electrical Connections are live/hot and mis-application may result in serious physical injury or death.**

Remove the positioning motor cover.

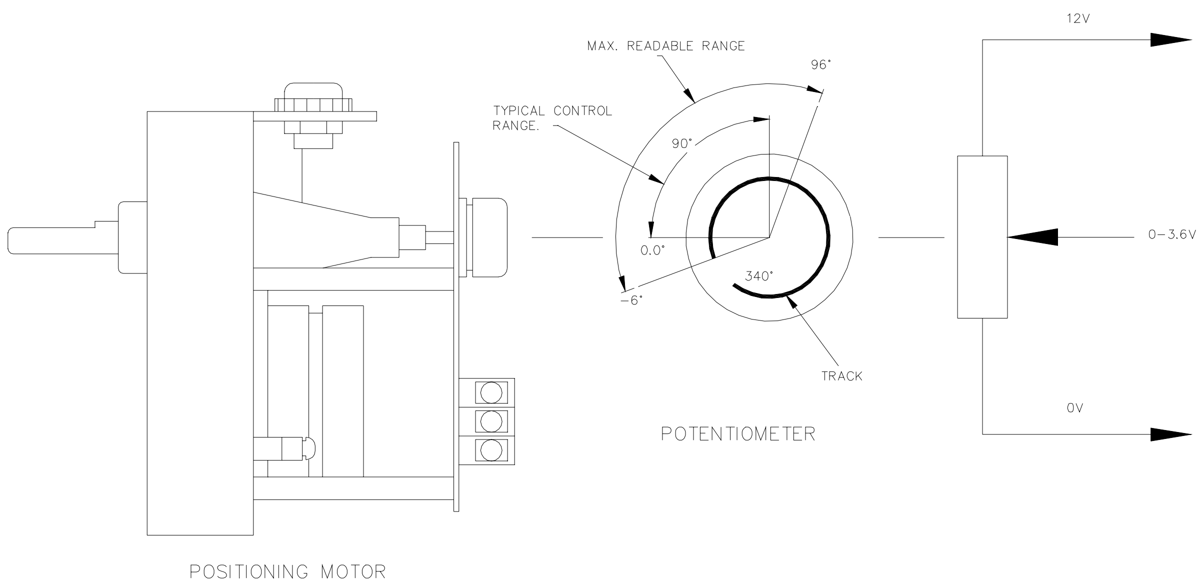
For air positioning motor(s) carry out the following procedure:

Use the up/down buttons for the relevant air damper to position the air damper to its physically closed position. Loosen the two tamper proof screws just sufficiently to enable the potentiometer to rotate. Rotate the potentiometer clockwise or counter clockwise until the relevant display window reads 0.0. Tighten the two tamper proof screws gently until the potentiometer is secure. Do not overtighten the screws. Check that the display still reads 0.0. If not repeat the adjustment process.

For fuel positioning motor(s) carry out the following procedure:

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

In applications where the servomotor is not positioned close to the display then it is possible to measure the feedback voltage from the servomotor in order to ensure that 0.0 degrees is displayed. By testing the DC voltage between the blue and green wires (wiper and 0V) on the servomotor low voltage terminals this will read 0.21V DC when the reading on the display is 0.0 degrees.



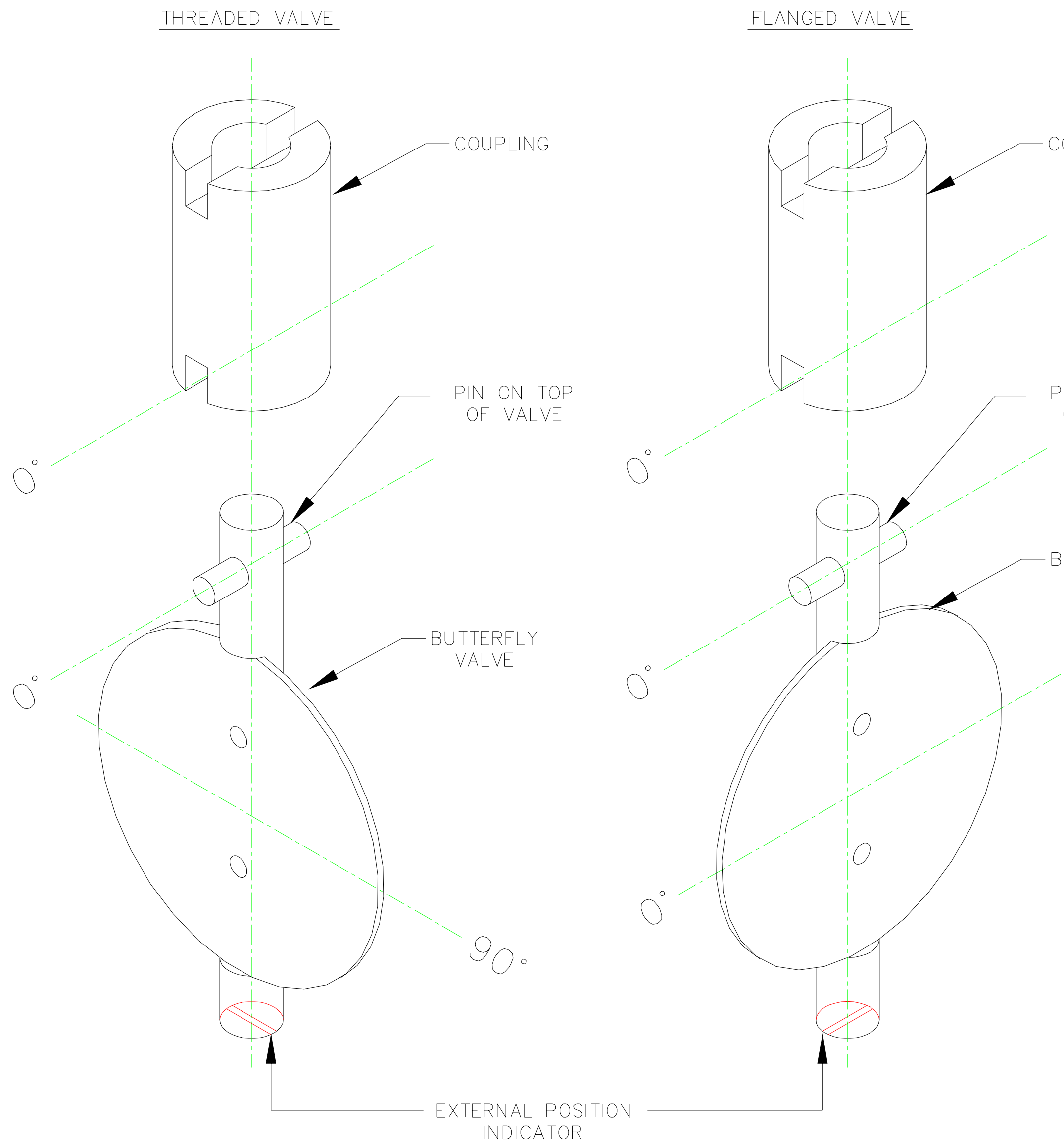
Important Note for Autoflame valves:

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

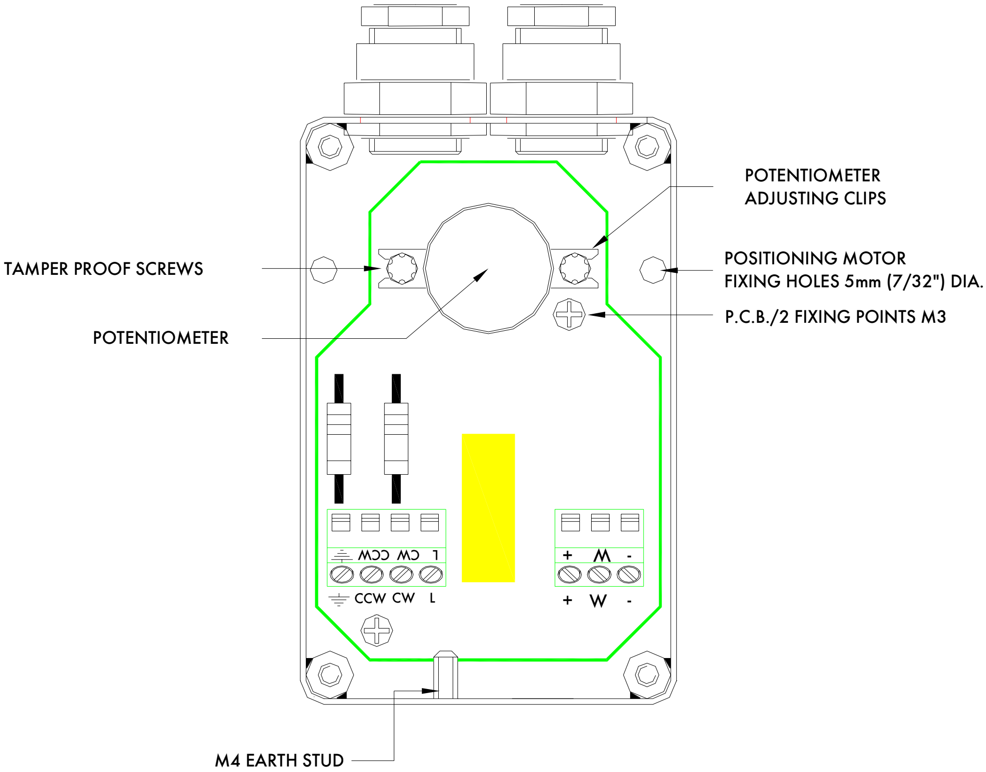
On flanged valves, the pin on the top of the valve is in line with the position of the butterfly valve.

For both valves the external visual position indicator is in line with the position of the butterfly valve.

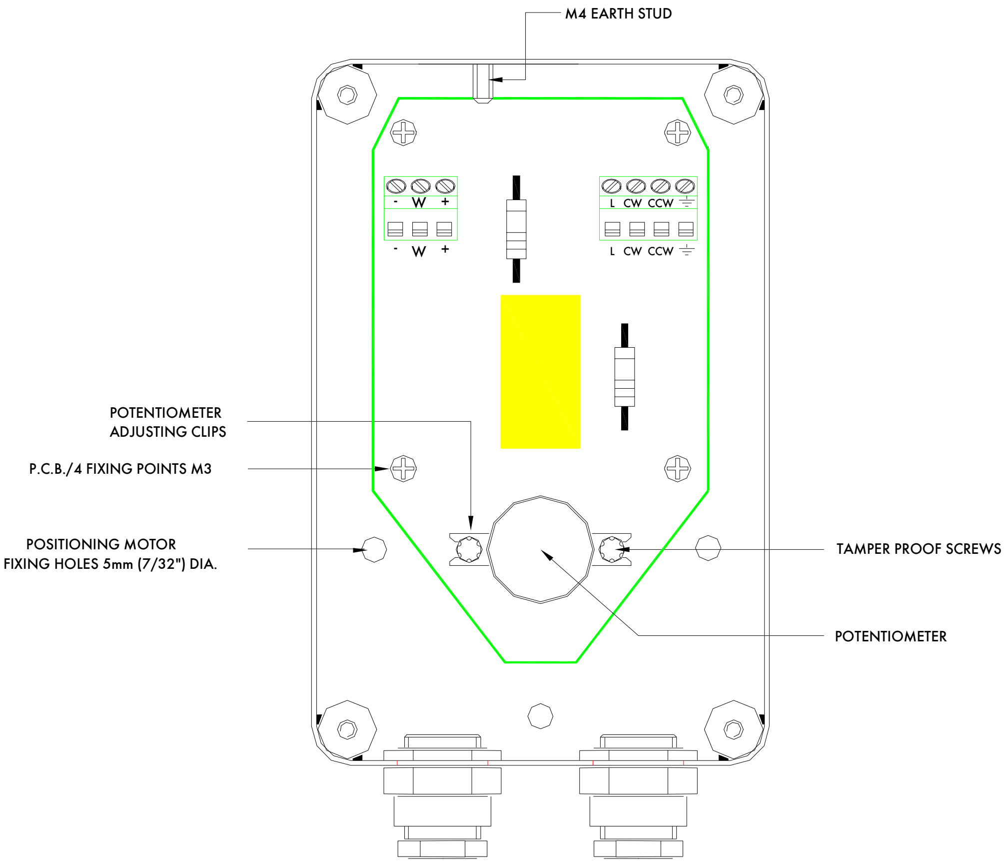
Regardless of the type of valve being used, the servomotor is dispatched from the factory with the potentiometer in the zero position. The same servomotor will be correct for both types of valve, as the servomotor for the threaded valve is mounted at 90 degrees different from the flanged valve.



Small Positioning Motor



Large Positioning Motor



The servomotors shown are 230V in which the low voltage cables and mains voltage cables must enter the servomotor through separate glands. For the 24V servomotors only one gland is required for both the low voltage cables and mains voltage cables.

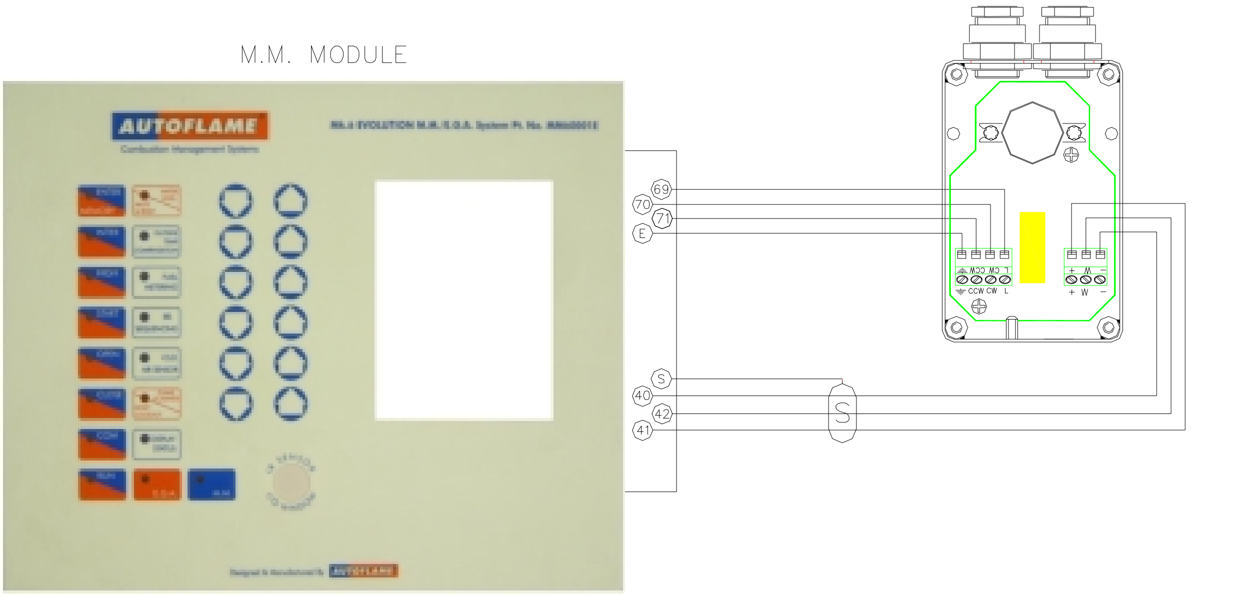
Positioning Motors Direction Change

EXAMPLE TO CHANGE DIRECTION
OF POSITIONING MOTORS.

MOTOR CLOCKWISE ROTATION

FIG. A

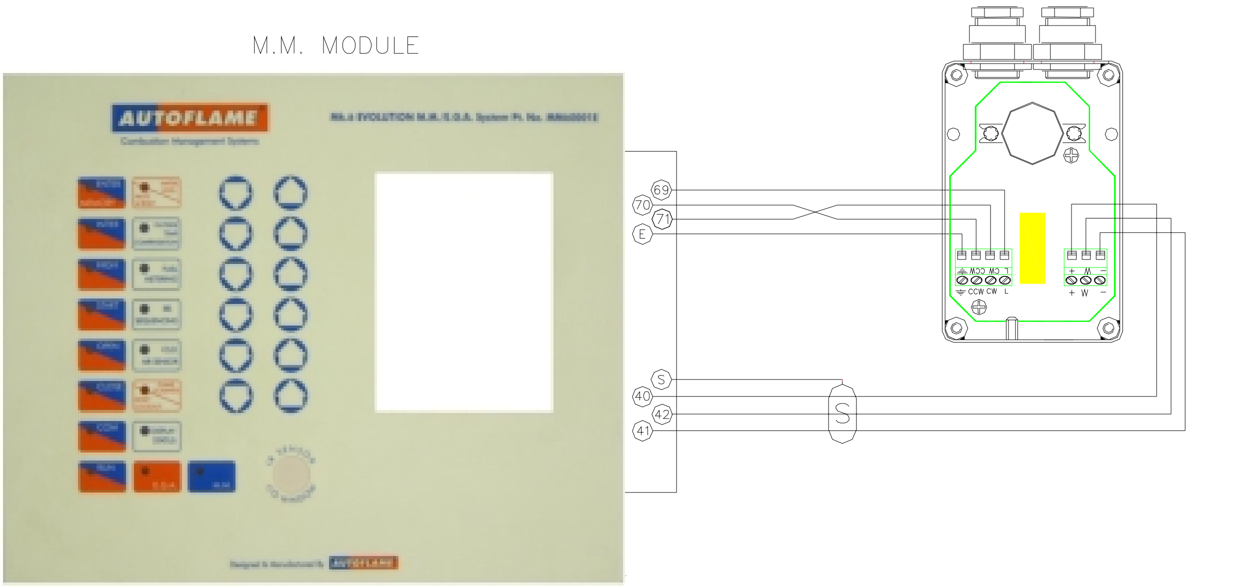
M.M. MODULE



MOTOR ANTICLOCKWISE ROTATION

FIG. B

M.M. MODULE



FOR ILLUSTRATION PURPOSES FUEL MOTOR CONNECTIONS ARE SHOWN.

Replacing the servomotor, servicing the servomotor and the importance of using the servomotors within the specified torque range.

Replacement:

Anytime that a servomotor is changed in the field it is important to verify that the physical position of the fuel valve, air damper, FGR valve or other damper is correct in accordance with the potentiometer feed back as displayed on the Autoflame controller. When the valve is completely closed as indicated on the valve/damper then the potentiometer reads zero angular degrees on the M.M. display. It must not be assumed that the original commissioning engineer has the servomotor set in the correct position.

Note: Once the servomotor has been changed it is imperative to check the combustion performance throughout the firing range in a safe and reliable manner, based on the original data. If the combustion performance is different then either a re-commission is required or single point change of the fuel/air ratio.

Servicing:

It is good practice to periodically (minimum once a year) check the equipment and most notably the following for the servomotors:

1- Overall mechanical soundness, i.e. look for corrosion or mechanical damage.
2- Coupling and associated linkage is tight.
3- Any associated set screws and fixings are secure.
4- Mechanical pins, i.e. roll pins/split pins do not show any signs of corrosion and do not show indication of fatigue.
5- When the burner is off and the power has been securely isolated, remove the servomotor from the damper/valve, and ensure that the damper/valve does not require excessive torque to operate. Make sure that the servomotor is working within its recommended torque rating.
6- Do not stand on the servomotors as this may cause internal damage to the PCB potentiometer leading to a system failure.
7- Do not remove the PCB inside the servomotor as this will affect the integrity of the repeatability and void any warranty that may apply.

Servomotor torque ratings:

It is important that the servomotors are not used outside of their specified operating range.

Servomotor	Part Number	Rating	
Small servomotor	(MM10005)	0.89 ftlbs	(1.2Nm)
Large servomotor	(MM10004)	11 ftlbs	(15Nm)
Industrial servomotor 5	(MM10070)	37 ftlbs	(40Nm)
Industrial servomotor 10	(MM10072)	72 ftlbs	(98Nm)
Industrial servomotor 20	(MM10074)	148 ftlbs	(200Nm)
Industrial servomotor 40	(MM10078)	295 ftlbs	(400Nm)

2.14.2.4 Options

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

If in doubt contact Autoflame technical support directly- sales@autoflame.com.

To Select Options Mode.

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

Option values can be changed by entering the option mode. The password must first be entered.
To enter the password follow the steps listed:

Either deselect and then select fuel or power down and then up.

If system is already commissioned, press COM before the COM l.e.d. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

"ENTER PASSWORD" is displayed.

Use the CH1 and CH2 to set the password codes. Then press CLOSE

"SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

On this password screen, it is necessary to set both CH1 and CH3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to 7 for Mk6 use without the water level system. It is also necessary to set the CH5 value for First Out Annunciation. Set this to 0 to disable the First Out Annunciation, 1 to display the First Out Annunciation (but not to lock out) and to 2 to enable the First Out Annunciation, i.e. burner locks out.

Then press ENTER MEMORY

On the following screen "Select CLOSE to commission combustion fuel air ratio"

To select the 'SET OPTIONS' screen, press the CH1 simultaneously.

To change the option number use the CH2 buttons.

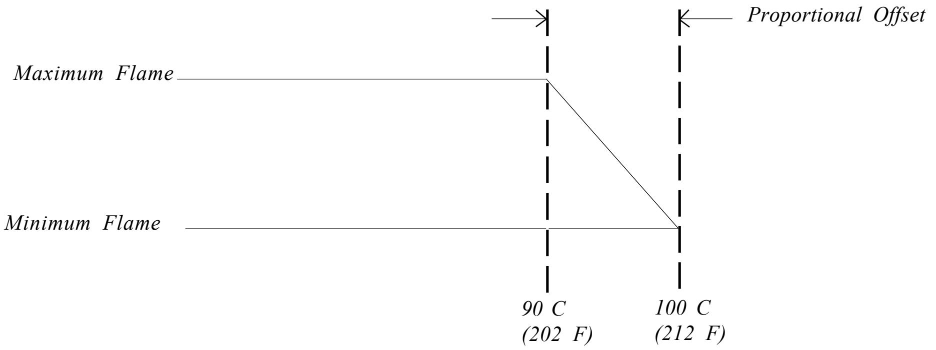
To change the value use the CH3 buttons.

Any number of option values can be changed when in option mode.

When changes have been made press ENTER MEMORY.

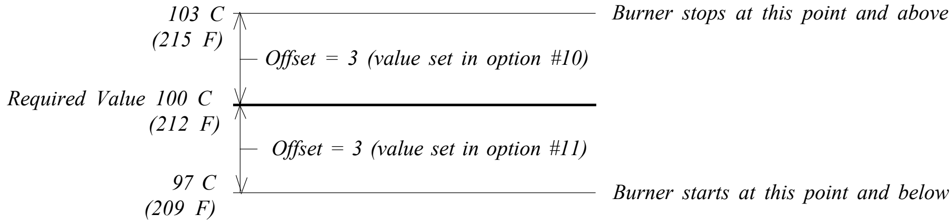
All new option values are then permanently stored.

Option No.	Factory Setting	Option Value	Description
1.	**3**		**Boiler temperature/pressure sensor type:**
		3	Temperature sensor (MM10006 & 7) 20-390 C (50 - 730 F)
		4	Unused
		5	Unused
		6	Medium pressure sensor (MM10008) 2.0 - 23.0 bar (30 - 330 PSI)
		7	High pressure sensor (MM10009) 2.0 - 38.0 bar (30 - 550 PSI)
		8	Low pressure sensor (MM10010) 0.2 - 3.80 bar (1.5 - 55 PSI)
		9	Unused
		10	External temperature sensor (voltage input)- range set by parameters #52-56
		11	External pressure sensor (voltage input)- range set by parameters #52-56
2.	**60**		**Motor travel speed during modulation:** The value is not specific to a time/ distance ratio. If the speed of the motor is too fast then increase this value. If too slow, decrease the value. At times other than modulation the motors move at full speed or at the value set in option #75. Movement is limited by the slowest channel, i.e. slowest moving motor.
		5-240	Adjustment Range 5 = 43 seconds from 0^{0} to 90^{0} 60 = 120 seconds from 0^{0} to 90^{0} 240 = 390 seconds from 0^{0} to 90^{0}
3.	**0**		**Unused:**
4.	**0**		**Unused:**
5.	**1**		**Purge position**: This selects the purge position. (Applicable to channels 1-4 when selected; see options #67-70). VSD channels 5 & 6, if optioned, purge at open position regardless of this option setting. It also applies to post purge if option #118 is set to a value greater than 0.
		0	Selected channels purge at HIGH position (high fire position)
		1	Selected channels purge at OPEN position (full span of servomotor as entered during commissioning)

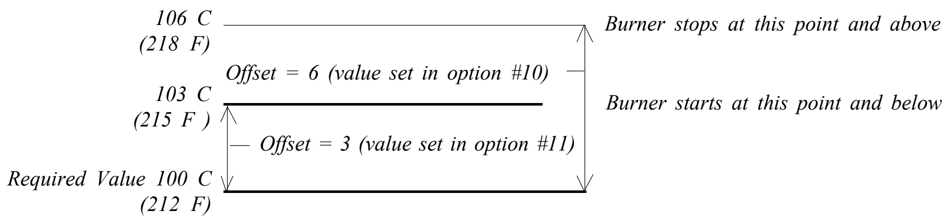
Option No.	Factory Setting	Option Value	Description
6.	**10**		**Proportional control (P)**: This option sets the proportional band. This is the offset point at which the burner will begin to change modulation.
			Example of proportional band offset: Required setpoint = 100 C, Proportional offset = 10 (i.e. option 6 set to value 10).
			
			Proportional band: Value entered- Centigrade, Fahrenheit, Bar or PSI dependent on the type of control sensor used and display units selected- options #1 and #65.
		5-250	If Centigrade, Fahrenheit or PSI units effective.
		0.5-25.0	If Bar units effective.
			Note: Decreasing this value could lead to overshooting of the required setpoint. Increasing this value may cause the burner to modulate too early taking a longer time to reach the required setpoint.
7.	**60**		**Integral control (I) time**: Every n seconds 10% of the present offset from setpoint value is added or subtracted to the present proportional value. The value of n is the number of seconds set in this option. It is possible to set this option to 'off'. If 'off' is selected there will be no integral control. Parameter #106 enables a % variation.
		OFF-250	Seconds.
			Note: Integral is equivalent to 'Reset'.
8.	**1**		**Number of servomotor channels to be enabled**: Channel "1" is always enabled (Fuel Position Motor). Set option #8 to the number of additional channels required (Minimum of 1).
		1	Channels 1 & 2 in use.
		2	Channels 1, 2 & 3 in use.
		3	Channels 1, 2, 3 & 4 in use.
			Note: If option #8 is changed after commissioning then the M.M. unit will need to be recommissioned unless this option is returned to its previous value.

Option No.	Option Value		Description
9.	**1**		**Internal stat operation**: The 'internal stat' serves the purpose of turning the burner on and off according to the actual value relative to the required setpoint. There are three settings for this option. The first keeps the 'internal stat' closed all the time. In this instance, a 'working stat' must be fitted to the boiler. The second setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset below the required setpoint. The third setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset also above the required setpoint. The following diagrams illustrate this operation. The offset values are set in options #10 and #11.
		0	Internal stat always closed.
		1	Burner starts below required setpoint.
		2	Burner starts above required setpoint.

Option #9 = 1, example using 100 C (212 F). Required setpoint.



Option #9 = 2, example using 100 C (212 F). Required setpoint.



Option No.	Option Value		Description
10.	**3**		**Offset above required setpoint at which the burner is stopped:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.
11.	**3**		**Offset below/above required setpoint at which the burner is started:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
12.	**0**		**E.G.A. options:** If this option has a setting 1/2/3/4/5/6/8/9 then the E.G.A. will trim and the burner must be commissioned with the E.G.A. operational. The trim is applied to channel 2 or 5, dependent on the setting of option #76.
		0	E.G.A. not optioned.
		1	If an E.G.A. error occurs then the burner will continue to fire. The servomotors will return to the original commissioned fuel/air ratio and the trim function will not be operational until the E.G.A. error is reset. No combustion/single point changes can be made whilst the E.G.A. is in an error condition. Terminal #79 is not energised in the event of an E.G.A. error.
		2	If an E.G.A. error occurs then the burner will stop firing. The burner will not start until the E.G.A. error has been cleared and the E.G.A. is inside its operating temperature range. Terminal #79 is not energised in the event of an E.G.A. error.
		3	Same as 1, except terminal #79 is energised in the event of an E.G.A. error.
		4	Same as 2, except terminal #79 is energised in the event of an E.G.A. error.
		5	Same as 1, plus the combustion limits are also tested (options #19-27).
		6	Same as 2, plus the combustion limits are also tested (options #19-27).
		7	System commissioned on M.M. only- E.G.A. used only for monitoring and display purposes.
		8	Same as 5, except terminal #79 is energised in the event of an E.G.A. error.
		9	Same as 6, except terminal #79 is energised in the event of an E.G.A. error.
			Note: If the E.G.A. is removed for servicing or this option is set to 0 or 7, then any single point changes made during this time will result in complete re-commissioning when this option is implemented again.
13.	**0**	0-30	**Reset options to original factory settings:** To reset all of the options back to their original factory set values, set option #13 to 26 and press enter.
14.	**0**		**Twin burner application:** Twin burner operation enables two burners to run at the same time and with the same firing rate. The identification numbers must be set for each M.M. unit, e.g. 1 and 2 (see option #33).
		0	Normal single burner operation.
		1	Twin burner operation for twin furnace firetube applications- Both burners always fire simultaneously. If one of the burners develops a fault, then both burners are shut down. Only one load detector is required and this is connected to the odd numbered M.M. unit.
		2	Twin burner operation for common furnace watertube applications- Both burners will fire simultaneously or independently. If both burners are firing then they will synchronise together and fire at the same firing rate. If an error/lockout occurs on one burner then the other burner will continue to fire independently. Two load sensors are required (one for each M.M. unit).
			Note: If communications are lost then a flashing error 100 will appear when viewing the M.M. screen if option #14 is set to 1.

Option No.	Factory Setting	Option Value	Description
15.			**Unused:**
16.	0		**Lead/lag (IBS) and D.T.I:** A lead boiler can be selected by connecting line voltage to terminal #88 on the appropriate M.M. Only 1 M.M. may be selected as lead boiler at a time or the sequencing will not operate. The lead boiler can be selected via the D.T.I. However, for this to be effective all the M.M. units on the system must have terminal #88 volt free. Line voltage on terminal #88 overrides the D.T.I. command.
		0	No sequencing. M.M. units still communicate and can be seen on the D.T.I.
		1	Sequencing enabled- the M.M. unit will respond to sequencing commands.
		2	Setpoint & enable/disable commands accepted from D.T.I.
		3	Both of 1 & 2.
			Note: Accurate fuel flow metering must be entered for sequencing to operate. A RS485 data cable (BELDON9501) must be connected between each M.M. unit (see section 6.11.1 for correct connection)
17.	0		**NO & CO displayed when running on oil:** If fuels 2 or 3 are selected, then the displaying of CO & NO can be on or off. This option is only relevant if an E.G.A. is operational on the system. The pinch valve settings must also be changed in the E.G.A. in order for CO & NO to be displayed.
		0	NO & CO display blanked- not displayed.
		1	NO & CO is displayed normally.
18.	1		**Carry forward of trim:** When the system modulates, the correction that may be existing on the air damper position can be carried forward. This option is only relevant if an E.G.A. is operational on the system.
		0	No carry forward of trim.
		1	Trim carried forward.
19.	0		**Upper offset limit % O_2:** **E.G.A. limits:** Options #19-27 are only relevant if an E.G.A. is operational on the system. Option #12 must be set to 5/6/8 or 9 if any of the following limit checks are to be invoked. This is an offset from the commissioned values.
		0-10.0	% O_2.
20.	0	0-10.0	**Upper offset limit % CO_2:** % CO_2
21.	0	0-200	**Upper offset limit ppm CO:** ppm CO

Option No.	Factory Setting	Option Value	Description
22.	0		**Lower offset limit % O_2:**
		0-10.0	% O_2
23.	0		**Lower offset limit % CO_2:**
		0-10.0	% CO_2
24.			**Unused:**
25.	0		**Absolute value % O_2:** System checks for O_2 values lower than value specified in this otion regardless of the commissioned values.
		0-20.0	% O_2
26.	0		**Absolute value % CO_2:** System checks for CO_2 values higher than value specified in this option regardless of the commissioned values.
		0-20.0	% CO_2
27.	0		**Absolute value ppm CO:** System checks for CO readings higher than value specified in this option regardless of the commissioned values.
		0-200	ppm CO
28.	20		**Trim threshold:** This option is only relevant if an E.G.A. is operational on the system. The value set in this option is subtracted from the required setpoint. If the actual value is below the offset then the E.G.A. will not operate. If the trim is to be effective at all times then set the value to zero. This option must also be set to zero for the E.G.A. to operate when external modulation is optioned.
		0-50	If Centigrade, Fahrenheit or PSI units effective.
		0-5.0	If Bar units effective.
			Note: No single point changes can be made if the actual value is below the offset value.
29.	1		**Golden start:** See section 2.14.12. Parameter #15- sets the time the golden start is maintained from the ignition point.
		0	Golden Start operates.
		1	Golden Start does not operate.
30.	50		**D.T.I.- Required setpoint minimum limit:** If the system is being used with a D.T.I. a maximum and minimum limit for the required setpoint must be set. If a value is received from the D.T.I, that is outside these limits, it will be ignored and the system uses its previous required setpoint. Practical range is limited to range of sensor selected.
		5-9990	If Centigrade, Fahrenheit or PSI units effective.
		0.5-999.5	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
31.	100		**D.T.I.- Required setpoint maximum limit:**
		5-9990	If Centigrade, Fahrenheit or PSI units effective.
		0.5-999.5	If Bar units effective.
32.	20		**Trim delay:** After ignition the E.G.A. does not sample for the period of time set in this option (only relevant if E.G.A. is operational on system). This allows for the combustion to stabilise before sampling commences. The timing starts at the ignition point.
		0-250	Period (seconds) after ignition no sampling takes place.
33.	1		**M.M. Identification:** The identification number must be set on all M.M. units in the boiler house. If not, then problems will occur with sequencing/twin burner and with the D.T.I. communications. Each unit must have a different ID number.
		1-10	Identification number.
34.	5		**Rating of burner:**
		1-999	See option #77 for units.
35.	10		**Sequence scan time:** This is the time period that the M.M. controlling the lead/lag (sequencing) requests information from the other M.M. units to check whether load demand is satisfied.
		1-100	Sequence Scan time (minutes).
36.	0		**E.G.A. sensor selection:** Available when using an E.G.A. system fitted with NO/SO_2 sensors. The following option is for selecting the type of sensors used. The pinch valve configuration must also be checked in the E.G.A. unit.
			SO_2 — NO
		0	Off — Off
		1	Off — On
		2	On — Off
		3	On — On
37.	0		**Derivative control (D) time interval:** The time interval between the controller comparing the actual value and the required setpoint value (derivative is equivalent to 'Rate').
		0	(0=off)
		1-200	Seconds.

Option No.	Factory Setting	Option Value	Description
38.	2		**Derivative control (D) deadband:** The deadband is the margin above and below the required setpoint within which no derivative control occurs.
		0-15	If Centigrade, Fahrenheit or PSI units effective.
		0-1.5	If Bar units effective.
39.	10		**Derivative control (D) response sensitivity:**
			The sensitivity value indicates the amount of percentage firing rate increase or decrease that is inflicted by the derivative action, e.g. if the chosen value was 10% then 10% of the maximum firing rate would be added to the existing rate of fire, i.e. if the burner was firing at 50% load and the derivative action was triggered the firing rate would increase by 10+50 to 60%.
			The following is an example of the above control philosophy in action:
			Note: "Time Between Readings" set to 20 seconds. "Deadband" set to 2°C (2°F.) "Response Sensitivity" set to 10%. Setpoint Information: "Required Setpoint" set to 90°C (190°F.) "Actual Value" reads 86°C (186°F.) Firing Rate Information: Burner firing at 50% of capacity.
			In the example situation there has been 4°C (4°F) drop in temperature below the required setpoint. The deadband is set at 2°C (2°F.), therefore the derivative action will be triggered as the deviation from the required setpoint is in excess of 2°C (2°F.). In this example 10% will be added to the 50% firing rate resulting in an increase in firing rate to 60% of capacity. The "Time Between Readings" is set for 20 seconds and if after this time interval the actual value is not within the 2°C (2°F) deviation from the required deadband another 10% would be added to the 60% firing rate which would result in a 70% firing rate. By careful selection of "Time Between Readings", "Deadband" and "Response Sensitivity" an ideal response to rate of change over time can be configured. The control philosophy detailed operates inversely if the "Actual" temperature exceeds the required setpoint and is outside the "Deadband". To enable or switch on the Derivative action the "Time Between Readings" must be set in excess of 10 seconds.
		1-100	%

Option No.	Factory Setting	Option Value	Description
40.	**0**		**Warming facility for low pressure steam sequencing:** For lead/lag (sequencing) applications where check (non-return) valves are not installed, it is not possible to use a phantom setpoint to keep the boilers in a standby warming condition. Therefore, the facility exists to install a thermostat (aquastat) in the boiler shell. The thermostat will input 230V/120V on terminal #93 and this initiates warming (see option #41). The boiler will remain in a warming state based on the settings for options #53/54.
		0	Disabled.
		1	Enabled.
41.	**0**		**2/3 state steam sequencing:** This option sets 2 states of operation for the lag boilers. Either one boiler is kept in a standby warming state and the other boilers are off, or all lag boilers are kept in a standby warming state and there are no off boilers.
		0	3 state steam sequencing- LEAD, STANDBY, OFF, OFF, OFF, OFF...
		1	2 state steam sequencing- LEAD, STANDBY, STANDBY, STANDBY...
42.	**20**		**Warming facility for medium/high pressure steam sequencing- phantom setpoint:** For lead/lag (sequencing) applications where check (non-return) valves are installed, it is possible to use a phantom setpoint to keep the boilers in a standby warming condition. This value is an offset below the normal required setpoint. When the phantom setpoint is in effect, the burner is held at a low flame position.
		0-100	If Centigrade, Fahrenheit or PSI units effective.
		0-10.0	If Bar units effective.
43.	**5**		**Offset above phantom setpoint when the burner stops:**
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.
44.	**5**		**Offset below phantom setpoint when the burner starts up:**
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
45.	**0**		**External modulation:** When enabled the internal PID control is disabled and the firing rate is set by an external controller applied to the appropriate input terminals #7/8/9. This input control signal can be 0-10V, 2-10V, 4-20mA or 0-20mA representing low to high fire. A high limit stat must be fitted. A working stat may be required depending on the setting of this option.
		0	Disabled.
		1	Enabled- no working stat facility (internal stat always closed- option #9), no local display of pressure/temperature. Required setpoints not displayed. An external working stat is required.
		2	Enabled- no working stat facility (internal stat always closed- option #9), load sensor used for local display of pressure/temperature. Required setpoints not displayed. An external working stat is required.
		3	Enabled- load sensor used for working stat facility and for local display of pressure/temperature. Required setpoints displayed. External working stat not required.
			Note: The fuel flow metering must be entered (option #57). If this is not entered then the M.M. will remain in the low flame hold state. Option #55 must be set to zero if option #45 is set to 1/2/3.
46.	**0**		**Unused:**
47.	**0**		**Cold start routine:** On burner start-up, if the actual value is below 30% of the required setpoint, then the burner will be held at the low flame hold position for no longer than the number of minutes set in this option. If the boiler is at or below 60% of its required setpoint then the burner firing rate would be held at 50% firing for no longer than the number of minutes set in this option. When the actual value exceeds the P band offset on the PID philosophy then the burner reverts to normal PID control. If the burner turns off then the timer is reset.
		0	Off.
		1-2000	Number of minutes cold start operates.
			Note: The cold start routine cannot be used with external modulation (options #45/55 are used).
48.	**0**		**Flue gas recirculation- timer:** This is the time that the M.M. channels (positioning motors/variable speed drives) are held at the FGR start positions, after which modulation then takes place. This timer starts at the end of main flame proving. Also see parameter #90 regarding the commissioning of the FGR positions.
		0-600	Seconds.

Option No.	Factory Setting	Option Value	Description
49.	**0**		**Flue gas recirculation- offset:** This is an offset from the required setpoint. The M.M. channels (positioning motors/variable speed drives are held at the FGR start positions until the actual value reaches the offset value below the required setpoint.
		0-50	If Centigrade, Fahrenheit or PSI units effective.
		0-5.0	If Bar units effective.
50.	**0**		**Flue gas recirculation- flue gas temperature:** The M.M. channels (positioning motors/variable speed drives) are held at the FGR start positions until the flue gas temperature has reached 120°C or 248°F. (An E.G.A. must be present and optioned).
		0	Not optioned.
		1	Optioned.
51.	**0**		**Unused:** Units of Temperature. See option #65.
52.	**0**		**Unused:** Units of Pressure. See option #65.
53.	**1**		**Steam boiler sequencing burner 'off' time:** The steam boiler type sequencing is enabled by setting option #1 to a respective pressure sensor. Options #42/43/44 are relevant to the "Standby" boiler operation.
		1-200	Burner "Off" time (minutes) during warm up cycle. Intelligent boiler sequencing- steam boiler applications.
54.	**5**		**Steam boiler sequencing burner 'on' time:**
		1-30	Burner "On" time (minutes) during warm up cycle. Intelligent boiler sequencing- steam boiler applications.
55.	**0**		**Internal PID/external modulation selectible using terminal #88:** (Cannot be used with lead lag/intelligent boiler sequencing)
		0	Normal operation- internal PID.
		1	Terminal 88 = 0 V- internal PID. Terminal 88 = Line voltage- external modulation. This option also removes the reduced setpoint from the Mk.6 display if it is not a requirement.
			Note: Option #45 must be set to zero if option #55 set to 1. Option #9 will be used as set. If option #9 is set to zero the required setpoint is not displayed.

Option No.	Factory Setting	Option Value	Description
56.	**1**		**Operation of alarm output for all system errors/lockouts and E.G.A. errors on terminal #79:**
		1	Relay normally off, on when alarm.
		2	Relay normally on, off when alarm.
			Note: This is a switched neutral and not a voltage output terminal.
57.	**0**		**Fuel flow metering:** To set this option and initiate the fuel flow metering program, the Enter button must be pressed when viewing this option.
		0	No flow metering.
		1	Flow metering operates and recalibrated.
58.	**15**		**Unused:**
59.	**0**		**Unused:**
60.	**1**		**Hand/auto bumpless transfer operation:**
		0	Fuel valve goes directly to last set hand position.
		1	Hand position (taken on present fuel valve position when changing from auto to hand operation).
		2	As 0, but hand position is not stored in permanent memory.
61.	**1**		**Flow metering units fuel 1- gaseous:**
		0	Cubic feet.
		1	Cubic meters.
		2	DO NOT USE.
		3	DO NOT USE.
		4	DO NOT USE.
62.	**3**		**Flow metering units fuel 2- liquid:**
		0	DO NOT USE.
		1	Lbs.
		2	Kilograms.
		3	Litres.
		4	US gallons.

Option No.	Factory Setting	Option Value	Description
63.	**3**		**Flow metering units fuel 3- liquid:**
		0	DO NOT USE.
		1	Lbs.
		2	Kilograms.
		3	Litres.
		4	US gallons.
64.	**1**		**Flow metering units fuel 4- gaseous:**
		0	Cubic feet.
		1	Cubic meters.
		2	DO NOT USE.
		3	DO NOT USE.
		4	DO NOT USE.
65.	**0**		**Type of fuel flow metering:**
		0	Old fuel flow metering.
		1	Imperial fuel flow metering.
		2	Metric fuel flow metering.
66.	**0**		**Unused:**
67.	**1**		**Channel 1 purge position:** The following options tell the M.M. which channels are to be included in the Purge sequence. See option #5 for purge position.
		0	Channel 1 to purge position.
		1	Channel 1 to remain closed for purge.
68.	**0**		**Channel 2 purge position:**
		0	Channel 2 to purge position.
		1	Channel 2 to remain closed for purge.
69.	**0**		**Channel 3 purge position:**
		0	Channel 3 to purge position.
		1	Channel 3 to remain closed for purge.
70.	**0**		**Channel 4 purge position:**
		0	Channel 4 to purge position.
		1	Channel 4 to remain closed for purge.

Option No.	Factory Setting	Option Value	Description
71.	**0**		**Fuel 1- fuel type:**
		0	Natural gas.
		1	DO NOT ADJUST.
		2	DO NOT ADJUST.
		3	DO NOT ADJUST.
		4	DO NOT ADJUST.
		5	Fuel 1.
72.	**1**		**Fuel 2- fuel type:**
		0	DO NOT ADJUST.
		1	Light distillate oil.
		2	Heavy fuel oil.
		3	DO NOT ADJUST.
		4/5	Fuel 2.
73.	**1**		**Fuel 3- fuel type:**
		0	DO NOT ADJUST.
		1	Light distillate oil.
		2	Heavy fuel oil.
		3	DO NOT ADJUST.
		4/5	Fuel 3.
74.	**0**		**Fuel 4- fuel type:**
		0	Natural gas.
		1	DO NOT ADJUST.
		2	DO NOT ADJUST.
		3	DO NOT ADJUST.
		4	DO NOT ADJUST.
		5	Fuel 4.
75.	**0**		**Purge motor travel speed:** During a purge sequence the motor travel speed can be set independent of option #2. This effects all selected channels.
		0 -100	0 = Quickest time. 100 = Slowest time.
76.	**0**		**Trim channel:** If an E.G.A. is optioned, the trim can be applied to either Channel 2 (positioning motor) or channel 5 (VSD). If trim on channel 5 is used, options #91/97 must be entered correctly.
		0	Trim on channel 2.
		1	Trim on channel 5.

Option No.	Factory Setting	Option Value	Description
77.	**0**		**Burner rating units:** Display purposes only for fuel flow metering.
		0	KW x 100 /hr
		1	Kg x 100 /hr
		2	MW /hr
		3	Btu x 100 /hr
		4	Hp x 100 /hr
		5	lbs x 100 /hr
		6	Btu x 1000 /hr
		7	Hp x 10 /hr
		8	lbs x 1000 /hr
		9	Btu x 1000 000 /hr
78.	**0**		**Unused:**
79.	**0**		**Lowest required setpoint:**
		0-995	Minimum required setpoint allowed when O.T.C. optioned. See option #80 and parameter #88. Point A- see diagram in section 2.14.2.8.1.
80.	**0**		**Outside temperature compensation:**
		0	Disabled.
		1	Enabled.
			Note: A line voltage on terminal #93 invokes a 'Night Setback' offset value, see option #85.
81.	**140**		**Maximum boiler required setpoint at minimum outside temperature:** Point B- see diagram in section 2.14.2.8.1.
		50-999	Value limited in accordance with sensor selected by option #1.
82.	**-30**		**Minimum outside temperature:** Point C- see diagram in section 2.14.2.8.1.
		-40 +40	For Centigrade.
		-40 +105	If Fahrenheit.
83.	**65**		**Minimum boiler required setpoint at maximum outside temperature:**
		50-999	Value limited in accordance with sensor selected by option #1.
84.	**30**		**Maximum outside temperature:** Point D- see diagram in section 2.14.2.8.1.
		-20 +40	For Centigrade.
		-4 +105	If Fahrenheit.

Option No.	Factory Setting	Option Value	Description
85.	**10**		**Night setback 'depression' offset value:** This offset is subtracted from the normal required setpoint and activated by a line voltage on terminal #93.
		0-100	°C/°F/PSI.
86.	**0**		**Channel 1 softened error checking select:** Increases positioning error. fom 0.1° to 0.5° for an industrial servomotor.
		0	CH1 normal positioning motor.
		1	CH1 industrial positioning motor/softened error checking.
87.	**0**		**Channel 2 softened error checking select:**
		0	CH2 normal positioning motor.
		1	CH2 industrial positioning motor/softened error checking.
88.	**0**		**Channel 3 softened error checking select:**
		0	CH3 normal positioning motor.
		1	CH3 industrial positioning motor/softened error checking.
89.	**0**		**Channel 4 softened error checking select:**
		0	CH4 normal positioning motor.
		1	CH4 industrial positioning motor/softened error checking.
90.	**0**		**VSD operation channel 5:**
		0	Not optioned.
		1	Optioned.
91.	**0**		**Output from M.M. to VSD:**
		0	Output units displayed as 4-20 milliamps.
		1	Output units displayed as 0-10 volts.
		2	Output units displayed as hertz.
92.	**25**		**Output low speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.
93.	**50**		**Output high speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.

Option No.	Factory Setting	Option Value	Description
94.	**2**		**Input signal to M.M. from VSD:**
		0	4-20 milliamps.
		1	0-10 volts.
		2	0-20 milliamps.
95.	**0**		**Input units displayed:**
		0	Selected input signal.
		1	Hertz.
96.	**0**		**Input low speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
97.	**50**		**Input high speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
98.	**0**		**Unused:**
99.	**0**		**Unused:**
100.	**0**		**VSD operation channel 6:**
		0	Not optioned.
		1	Optioned.
101.	**0**		**Output from M.M. to VSD:**
		0	Output units displayed as 4-20 milliamps.
		1	Output units displayed as 0-10 volts.
		2	Output units displayed as hertz.
102.	**25**		**Output low speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.
103.	**50**		**Output high speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.

Option No.	Factory Setting	Option Value	Description
104.	**2**		**Input signal to M.M. from VSD:**
		0	4-20 milliamps.
		1	0-10 volts.
		2	0-20 milliamps.
105.	**0**		**Input units displayed:**
		0	Selected input signal.
		1	Hertz.
106.	**0**		**Input low speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
107.	**50**		**Input high speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
108.			**Unused:**
109.			**Unused:**

Option No.	Factory Setting	Option Value	Description
			For safety reasons, options #110-150 also have to be entered in as parameters. It is the responsibility of the commissioning Engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices, e.t.c.
			If the M.M. system is stuck in the 'idle' condition, it is likely that options #110-150 are not identical to parameters #110-150. If the commissioning mode is entered, the relevant options/parameters not set correctly will be displayed at the bottom of the screen. If more than 1 option/parameter is not set correctly, these will be displayed in numerical order, i.e. on entering the commissioning mode again the next sequential option/ parameter not set correctly will be displayed.
110.	**1**		**Burner flame scanner type:**
		1	Internal non-permanent operation- standard scanner.
		2	Internal permanent operation- self-check scanner.
111.	**0**		**Pilot:**
		0	Interrupted pilot.
		1	Intermittant pilot (expanding flame).
112.	**40**		**Pre purge time:**
		05-300	Seconds/minutes- see option #135.
113.	**3**		**Pre ignition time:** Time ignition transformer is on before pilot gas valve opens.
		3-5	Seconds.
114.	**3**		**First safety time:** Time pilot valve is open before UV is checked.
		3-10	Seconds.

Option No.	Factory Setting	Option Value	Description
115.	3		**Pilot prove time- pilot trial for ignition PTFI:**
		3-5	Seconds.
116.	3		**Fuel 1 & fuel 4 (gas programs) second safety time- main trial for ignition MTFI:** Pilot/main valve overlap. (Not Applicable to expanding flame - see option #111).
		3-10	Seconds.
117.	5		**Main flame prove time:** Time period from main valves open to burner modulating- delay to modulation.
		5-20	Seconds.
118.	0		**Post purge time** :
		0-100	Seconds (0- No post purge) U.V. Not checked during post purge. See also option #135.
119.	10		**Control box recycle time:** Time delay from burner shut down to startup.
		3-120	Seconds.
120.	10		**UV threshold:**
		5-50	Minimum Flame Signal Strength during pilot. (At all other times UV threshold is fixed at 5).
121.	5		**Delay from start of pre purge after which air switch checked:**
		5-10	Seconds.
122.	0		**Flame switch operation:** If this option is enabled Terminals 85/86 are used in conjunction with a flame switch to monitor the presence of a flame.
		0	Disabled - normal UV scanner operation.
		1	Enabled - flame switch operation.
123.	3		**Fuel 2 & fuel 3 (oil programs) second safety time- main trial for ignition MTFI:** Pilot/main flame overlap. (Not Applicable to expanding flame - see option #111).
		3-15	Seconds.

Option No.	Factory Setting	Option Value	Description
124.	**1**		**Gas valve proving pressure sensor type:**
		0	Nominal range 0–25" w.g./ 0–65 mbar/ 0–1 psi (Sensor MM60006) **Note.** PSI display not available with this sensor
		1	Nominal range 0–135"w.g./ 0–340 mbar/ 0–5 psi (Sensor MM60008)
		2	Nominal range 0–300"w.g./ 0–750 mbar/ 0–11 psi (Sensor MM60011)
		3	Nominal range 0–550"w.g./ 0–1380 mbar/ 0–20 psi (Sensor MM60012)
		4	Nominal Range 0-1650"w.g/0-4125 mbar/0-60psi (Sensor MM60014)
125.	**0**		**Gas valve proving & high-low pressure limit checked- fuel 1:**
		0	Not checked on fuel 1.
		1	Gas valve proving on + high/low pressure limits (see options #136/137).
		2	Do not select.
		3	Gas high/low pressure Limit. If options #136/137 are set to 0, then the online values are displayed only.
		4	External VPS optioned. It is possible within the unit to use an external VPS controller for this operation. If this is set then the system will wait for a mains voltage input on terminal #55 to confirm that the external VPS operation is completed. The time period for this is 10 minutes before the voltage input must be seen, otherwise a lockout will occur (contact Autoflame before use).
126.	**0**		**Fuel 2/oil high-low pressure limit checked- fuel 2:**
		0	Not checked on fuel 2.
		1	Do not select.
		2	Oil high/low pressure limit. If options #139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See option #125 for information.
127.	**0**		**Fuel 3/oil high-low pressure limit checked- fuel 3:**
		0	Not checked on fuel 3.
		1	Do not select.
		2	Oil high/low pressure limit. If options #139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See option #125 for information.

Option No.	Factory Setting	Option Value	Description
128.	**0**		**Gas valve proving & high-low pressure limit checked- fuel 4:**
		0	Not checked on fuel 4.
		1	Gas valve proving on + high/low pressure limits (see options #136/137).
		2	Do not select.
		3	Gas high/low pressure limit. If options #139/140 are set to 0, then the online values displayed only.
		4	External VPS. See option #125 for information.
129.	**0**		**VPS operation:** This option must be set to 0 during commissioning. Once commissioning is complete it can then be set to 1.
		0	VPS operates before burner start up.
		1	VPS operates after burner run (low gas not checked before burner starts).
130.	**2**		**Gas valve proving:**
		0	Two valve gas valve proving.
		1	Three valve gas valve proving. Vent valve normally closed.
		2	Three valve gas valve proving. Vent valve normally open.
		3	Two valve gas valve proving- single valve pilot.
		4	Three valve gas valve proving- single valve pilot. Vent valve normally closed.
		5	Three valve gas valve proving- single valve pilot. Vent valve normally open.
131.	**0**		**Gas pressure units:** PSI not available for MM60006 - see option #124.
		0	"wg (inches water gauge).
		1	mbar (millibars).
		2	psi (pounds per square inch) - units displayed to 2 decimal places.
132.	**20**		**Gas valve proving time:**
		10-30	Seconds.
133.	**5.0**		**Maximium pressure change allowed during proving time:**
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.4-25.2	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
			Note: Option #124 for pressure sensor range in use, default value will change accordingly. See Section 2.14.2.6.2.

Option No.	Factory Setting	Option Value	Description
134.	3		**VPS valve opening time:**
		3-20	Seconds.
135.	0		**Change purge time:**
		0	Seconds.
		1	Minutes.
		2	NFPA post purge- post purge time in seconds is set in option #118.
			Note: If this option is set to 2 (NFPA post purge) then option #118 must be set to a value of 15 or greater otherwise a lockout warning message will occur. During the NFPA post purge the elements will remain at the position that they were in during normal shutdown or lockout (see also options #67-70). The NFPA post purge will occur under any normal shutdown or lockout at any point in the start up/firing sequence
136.	5.0		**Gas pressure switch- offset lower limit:** This option has two functions: - Static inlet pressure check- lower limit. This is checked prior to burner firing. - Run pressure check- lower limit. This is an offset from the commisioned value. Note options #124/131.
		0	Off- lower limit not checked.
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.1-25.2	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
137.	1.0		**Gas pressure switch- offset upper limit:** This is an offset from the commisioned value. Note settings of options #124/131.
		0	Off- upper limit not checked.
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.5-25	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
138.	0		**Oil pressure units:**
		0	Bar.
		1	PSI.

Option No.	Factory Setting	Option Value	Description
139.	**1.0**		**Lower limit oil pressure switch:** Offset from commissioned value.
		0	Off- lower limit not checked.
		0.8-4	Bar- lower limit from operating pressure.
		0-50	PSI- lower limit from operating pressure.
140.	**1.0**		**Upper limit oil pressure switch:** Offset from commissioned value.
		0	Off- upper limit not checked.
		0.8-4	Bar- upper limit from operating pressure.
		0-50	PSI- upper limit from operating pressure.
141.	**0**		**Purge air pressure proving:** During pre purge this option enables the air proving pressure to be tested at a value independent of option #149. Option #148 must be set.
		0	Off- no purge air pressure proving.
		0-26.9	"wg.
		0.1-67	mbar.
			Note: If option #141 is set without option #148 a lockout will occur when the system starts to purge. The lockout message displayed warns that option #141 is incorrectly set.
142.	**0**		**Unused:**
143.	**0**		**Unused:**
144.	**0**		**Unused:**
145.	**0**		**Autoflame air pressure sensor:**
		0	Autoflame air pressure sensor not optioned.
		1	Autoflame air pressure sensor optioned 0-1 PSI (Sensor MM60005)
		2	Autoflame air pressure sensor optioned 0-2 PSI (Sensor MM60013)
146.	**0**		**Air pressure units:**
		0	"wg.
		1	mBar.

Option No.	Factory Setting	Option Value	Description
147.	**0**		**Air sensor error checking window:** Only active during modulation (error #82). The burner will shut down if outside the window.
		0	No error checking.
		0 - 3	"wg (maximum = +/- 3 "wg).
		0 - 7.5	mbar (maximum = +/- 7.5 mbar).
148.	**0**		**Autoflame air proving selected:**
		0	Not used- requires external air proving switch on terminal #54 (applies to all 4 fuels).
		1	Air proving- requires Autoflame air pressure sensor but no input on terminal #54 (applies to all 4 fuels).
		2	Air proving- requires Autofame air pressure sensor and terminal #54 (applies to all 4 fuels).
149.	**0.3**		**Minimum air pressure proving value:** Air pressure switch function.
		0.3 - 4.9	" wg.
		1 - 12.5	mbar.
150.	**0**		**Clear ALL commissioning data and gas/air sensor re-commission:**
		0 - 10	Range.
		5	Clear commissioning data- restore options/parameters to factory settings.
		7	Air sensor automatic recomission (see section 2.14.18.1 in the technical manual for more information).
		8	Gas sensor automatic recommision (see section 2.14.18.2 in the technical manual for more information).

For safety reasons, options #110 to 150 also have to be entered in as parameters.
It is the responsibility of the commissioning Engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices, e.t.c.

2.14.2.5 Parameters

To Select Parameter Mode

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

Parameter values can be changed by entering the Parameter mode. The password must first be entered. To enter the password follow the steps listed:

Either deselect and then select fuel or power down and then up.

If system is already commissioned, press COM before the COM l.e.d. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

"ENTER PASSWORD" is displayed.

Use the CH1 and CH2 to set the Password codes. Then press CLOSE

"SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

On this password screen, it is necessary to set both CH1 and CH3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 use without the water level system. It is also necessary to set the CH5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable the First Out Annunciation, i.e. burner locks out.

Then press ENTER MEMORY

On the following screen "Select CLOSE to commission combustion fuel air ratio"

To select the 'SET PARAMETERS' screen, press OPEN and CLOSE simultaneously.

To change the parameter number use the CH2 buttons.

To change the value use the CH3 buttons.

Any number of Parameter values can be changed when in Parameter mode.

When changes have been made press ENTER MEMORY

All new Parameter values are then permanently stored.

N.B. The E.G.A. related parameters have the factory default settings from years of testing on many fuels and applications. It is advised to be cautious when changing these parameters, and is recommended not to do so.

Parameter No.	Factory Setting	Parameter Value	Description
1	3	0-20	**Sequencing:** Offset value when unit goes off line, i.e. if the standby boiler fails to start the scan time will be decreased by 3 minutes. If the scan time is set to 10 minutes, this would be reduced to a 7 minute scan time.
2	1	1-10	**Sequencing:** Time between data requests (seconds). Bus driver request information every second, M.M's transmit every second, D.T.I. only listens to transmissions.
3	1	1-10	**Sequencing:** Number of boilers initially set on after powerdown.
4	45	5-100	**E.G.A:** Number of seconds the ENTER is button disabled after E.G.A. is pressed.
5	4	1-50	**Sequencing:** Number of minutes, time out value to reach modulation, i.e. If the boiler is not modulating after being asked to contribute to load, it is kicked out of sequence loop. After being asked to modulate the burner must start to modulate in 4 minutes.
6	60	5-100	**Unused:**
7	16	01-50	**Unused:**
8	30	5-240	**E.G.A:** Delay after draining before trim cycle start, i.e. wash out period. When cells being cleaned with air, this value maintains the last readings until the air sampled during the drain period has gone.
9	60	5-240	**E.G.A:** Auto commission time.
10	0		**Unused:**
11	25	5-60	**E.G.A:** Air flush time. This is the flush out period between going fuel rich and air rich during auto commission (seconds) in order to remove any excess CO produced.
12	0	0-1	**E.G.A:** CO included in trim calculation on F2 & F3 (see option #17), i.e. required when using natural gas on F2 & F3.
		0	No.
		1	Yes.
13	20	5-30	**E.G.A:** ÷4 = % of air damper movement. Amount of auto commission trim. Applies only to air (-) (fuel rich).
14	20	1-200	**E.G.A:** ÷2 number of degrees the fuel valve moves before negative trim is reset.
15	5	2-100	**Golden start timer:** Number of seconds that the positioning motors are held at the "choke" position. Applies to golden start only, see option #29. This time starts from the ignition point.

Parameter No.	Factory Setting	Parameter Value	Description
16	12	1-50	**E.G.A:** Time between calibrations (÷ 2 = Hours). The E.G.A. calibrates every 6 hours if the burner does not turn off.
17	3	0-10	**E.G.A:** Number of trims before an E.G.A. error is flagged when limits exceeded. Each Trim = 30 Seconds.
18	20	5-60	**E.G.A:** Trim amount during run ÷ by 2 = % of trim. This value cannot be set above 20 (10%) or an ERROR 25 will occur.
19	20	5-30	**E.G.A:** ÷4 = % of air damper movement. Amount of auto commission trim. Applies only to air (+) (air rich).
20	0	0-40	**Reset parameters to original factory settings:** To reset all of the parameters back to their original factory set values, set option #20 to 26 and press enter.
21	0		**Unused:**
22	0		**DTI:** Do not adjust.
23	0		**E.G.A:** Trim- add air when CO present. When trim is taking place, if the O2 and CO2 appear on the air rich side but the CO appears on the fuel rich side then the air damper will open further to remove the CO.
		0	Enabled.
		1	Disabled.
24	120	20-240	**E.G.A:** Calibration time (seconds).
25	30	5-100	**E.G.A:** Time between samples.
26	8	1-50	**E.G.A:** Number of samples per trim cycle.
27	25	0-255	**E.G.A:** Minimum operating temperature (÷ 5=deg C).
28	200	0-255	**E.G.A:** Maximum operating temperature (÷ 5=deg C).
29	0	0-10	**Unused:**
30	10	0-40	**Filters load sensor readings:** Temperature and pressure detectors.
		0	No filtering.
		20	Maximum filtering.
31	0	0-1	**Selects efficiency to be displayed:**
		0	English (USA/Canada- incorporates Hydrogen & moisture loss).
		1	European.

Parameter No.	Factory Setting	Parameter Value	Description
32-37			**Unused:**
38	254	0-255	**M.M. password:** Channel 1.
39	1	0-255	**M.M. password:** Channel 2.
40-43			**Unused:**
44	0.4	0-40	**E.G.A:** O_2 window inside which no further trim takes place.
45	0.2	0-20	**E.G.A:** CO_2 window inside which no further trim takes place.
46-47			**Unused:**
48	0.8	0.01-0.99	**Integral control (I) threshold:** This is a percentage below the required setpoint to the proportional band offset at which point the integral control takes effect, i.e. if the required setpoint is 100psi, option #6 = 10psi, parameter #48 = 0.8, the integral control will take effect when the actual value is above 92psi.
49	0	0-1	**Required setpoint:** Set to 1 if required setpoint not to be stored permanently in memory. This is important to set if using parameter #72.
50-51			**Unused:**
52	0	0-2	**External load detector:** Number of decimal points (please see table below).
53	0	0-9990	**External load detector:** Maximum value (please see table below).
54	0	0-100	**External load detector:** Maximum voltage (please see table below).
55	0	0-9990	**External load detector:** Minimum value (please see table below).
56	0	0-100	**External load detector:** Minimum voltage (please see table below).

Example 1: **Pressure** Application	Example 2: **Temperature** Application
Required/Actual Range- 0.0-100.0bar Input Signal- 0-10 Volts Option 1- 11 Option 65- metric units Parameter 52- 1 Parameter 53- 1000 Parameter 54- 10.0 Parameter 55- 00 Parameter 56- 0.0	Required/Actual Range- 1000-2000F Input Signal- 1-6 Volts Option 1- 10 Option 65- imperial units Parameter 52- 0 Parameter 53- 2000 Parameter 54- 6.0 Parameter 55- 1000 Parameter 56- 1.0

Parameter No.	Factory Setting	Parameter Value	Description
57			**Unused:**
58	1		**E.G.A. calibration on start up:**
		1	E.G.A: Calibration on start up.
		0	E.G.A: No calibration on start up.
59			**Unused:**
60	0		**E.G.A. or O2 trim interface module:**
		0	Normal E.G.A. operation.
		1	O_2 trim interface operation.
61	900	0 - 999	**Display backlight on time (seconds):** Set to zero for the backlight to remain on at all times.
62	0	0-1	**Hot Water Sequencing:** If this parameter is set to a value of 1, then the hot water sequencing will operate in the same method as the steam sequencing (contact Autoflame before use).
63	0	0 - 1	**Reset lockout history:** Set to 1 for 2 seconds, then set back to 0 to clear lockout history.
64	0	0 - 1	**Reset totalised fuel flow metering:** Set to 1 for 2 seconds, then set back to 0 to reset totalised fuel metering values for all 4 fuels. To reset the totalised fuel flow metering for individual fuels see option #57.
65	0	0 - 1	**Reset burner history:** Set to 1 for 2 seconds, then set back to 0 to reset burner history, hours run and number of start ups.
66-68			**Unused:**
69	0	0 - 1	**External modulation input range:**
		0	0-20mA, 0-10V.
		1	4-20mA, 2-10V.
70	0	0 - 20	**Filtering of the analogue input:** Terminals #7/8/9. The value set is the number of readings over which an average is taken. The smaller the setting the quicker the response time.
		0	Default value of 5.
		1	Minimum.
		20	Maximum.

Parameter No.	Factory Setting	Parameter Value	Description
71	0	0-20	**Resolution of the analogue input:** Terminals #7/8/9. The effect of resolution is to filter the noise on the input which causes hunting as the M.M. responds to a changing signal.
		0	Default value of 5.
		1	Minimum.
		20	Maximum.
72	0		**External required setpoint:** If this parameter is enabled, the analogue input terminals #7/8/9 are used to set the required setpoint. Input signals can be 0-10/2-10V or 0-20/4-20mA (see parameters #69/70/71). The range of the required setpoint is set by options #30 & 31. Set parameter #49 to 1. Set option #16 to 2.
		0	Disabled.
		1	Enabled.
73-78			**Unused:**
79	0		**EGA splitter for twin burner application:** When using a twin burner it is possible to use the E.G.A. data from the master M.M. module for the slave M.M. module. This means that only one E.G.A. is required for the 2 M.M. units in a twin burner application. This only works with option #14 set to 1 (both burners operate together). Parameter #79 is set to 1 on the slave unit only and parameter #79 is set to 0 on the master M.M. module.
80	40	1 - 50	**Unused:** Do not adjust.
81			**Do not adjust:**
82			**Unused:**
83	0		**Display diagnostic values:**
		0	Disabled.
		1	Enabled.
84	0		**Display diagnostic values for lead/lag (intelligent boiler sequencing):**
		0	Disabled.
		1	Enabled.

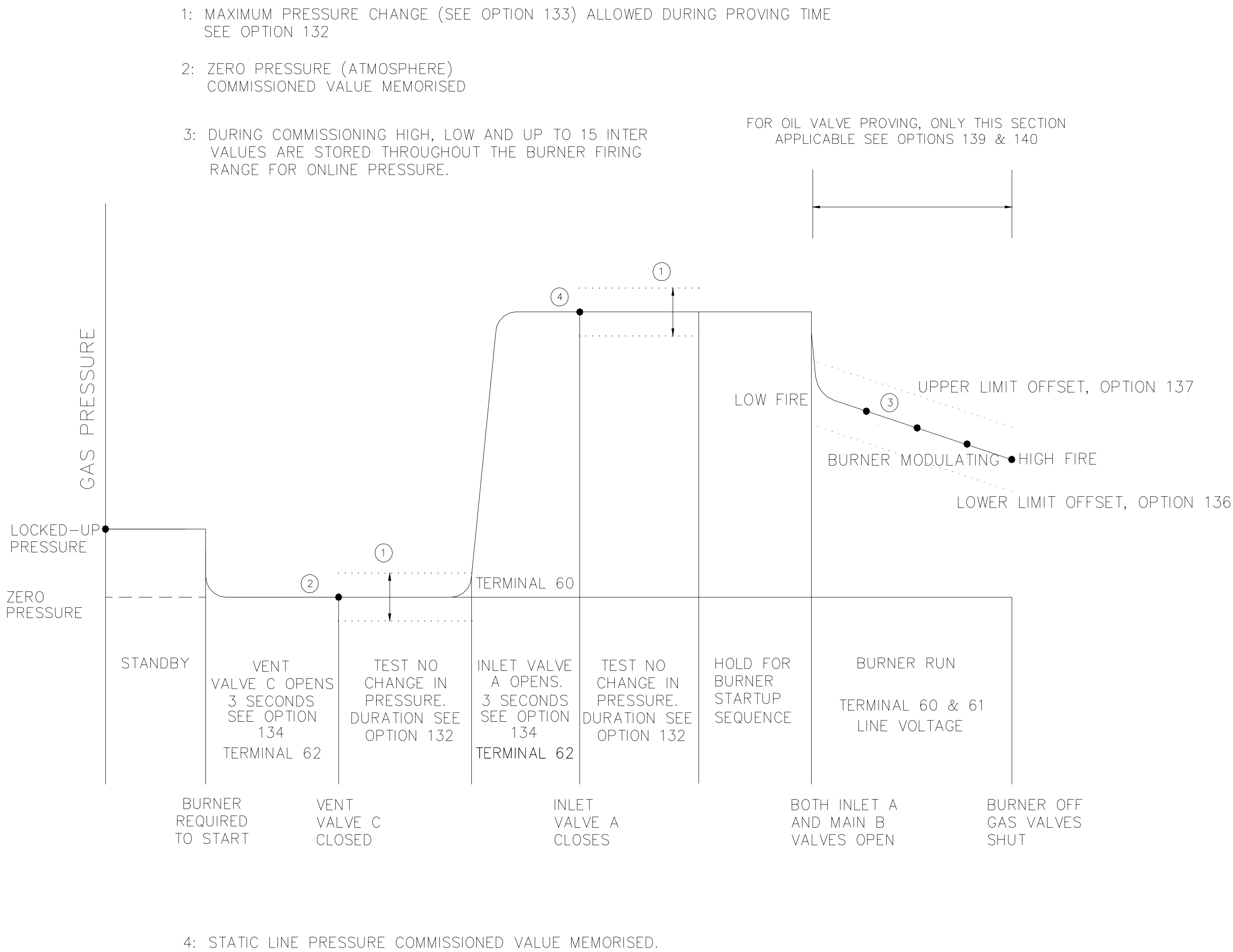
Parameter No.	Factory Setting	Parameter Value	Description
85	0	0-250	**Modulation exerciser:** Repeatedly run between high and low flame. The higher the value, the longer the high/start position is maintained.
86	0	0 - 99	**IBS change down threshold:** If left at 0 change down threshold = 85% firing rate.
87	0	0 - 100	**IBS change up threshold:** If left at 0 change up threshold = 95% firing rate.
			Note: If parameter #86 is set greater than parameter #87 then they will default to 85% and 95% respectively.
88	0	-50 - +50	**Adjust errors in the OTC sensor reading:** If actual reading is too high set a negative value to adjust, if reading is too low set a positive value.
		0	No adjustment made.
		Each unit	1°F or 0.5°C (see option #65 for units of temperature).
89	0		**Unused:**
90	0		**Flue gas recirculation:**
		0	Positions entered after commissioning by performing the single-point change procedure (see section 2.14.13 in the technical manual).
		1	Positions entered during commissioning.
91	0		**Unused:**
92	0		**Boiler differential pressure proving:**
		0	Disabled.
		1	Enabled. The system will be held in a purge condition until a proven input from a differential pressure switch is registered on Terminal #85. Terminal #85 must be reset before start up can take place. If Terminal #85 resets during purge, the system returns to the beginning of the start up sequence.
		2	Enabled. This is the same as 1 but if terminal #85 resets during purge, then a lockout will occur.
93			**Unused:**
94	0		**Upper offset limit ppm NO:**
		0-200	ppm NO.
95	0		**Unused:**

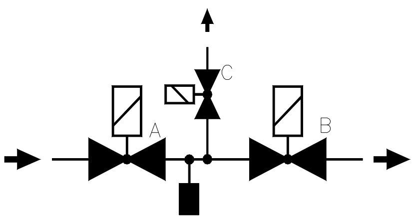
Parameter No.	Factory Setting	Parameter Value	Description
96	0		**Upper offset limit exhaust temperature:**
		0-999	°C/F.
97	0		**Absolute limit value exhaust temperature:** System checks for exhaust temperature readings higher than value specified in this option.
		0-999	°C/F.
			Note: An E.G.A. must be installed and the exhaust temperature reading correct.
98-99	0		**Unused:**
100	0		**Assured low fire shut off:**
		0	Not operational.
		1	Burner modulates to low fire before turning off when above the internal stat.
101	0		**Shuffle sequencing:**
		0	Not operational.
		1	Boiler sequence order changed from the Win PC DTI software.
102	0		**Super "I" control offset:** The default value is zero which turns off the "Super I". The range can be up to 50°C, 50°F, 50 psi or 5 bar.
		0	Not operational.
		1	Sets the point at which the "Super I" control algorithm is put into operation.
103	0		**Super "I" control speed of integration/time:**
		0-30	Seconds (1 second increments).
104	0		**Super "I" control amount of integration:**
		0-5	Degrees (0.1 degree increments).
105	0		**Super "I" control dead band:** The range of 10 would apply to 10°F, 10°C, 10 PSI or 1.0 bar.
		0-10	The range is 0-10 and this can be adjusted in increments of 1.0.

Parameter No.	Factory Setting	Parameter Value	Description
106	0		**Integral control (I) percent:** Percent variation.
		1-25	Every "n" seconds (set in option #7) 10% of the present offset from setpoint value is added or subtracted to the present proportional value. This enables a % variation.
107	14	0-255	**On-line changes password:** Channel 1.
108	14	0-255	**On-line changes password:** Channel 2.
109	0	0-1	**Advanced Water Level Adjusters:** If set to 1 this will give advanced access to the water level controls.

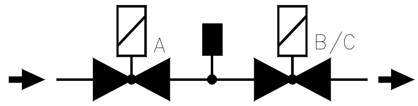
NB. Parameters 110 to 150 are a repeat of their respective options. These values need to be entered as both an option value and a parameter value for safety reasons.

2.14.2.6 Gas Valve Proving





3 VALVE PROVING
A – T60, B – T61, C – T62

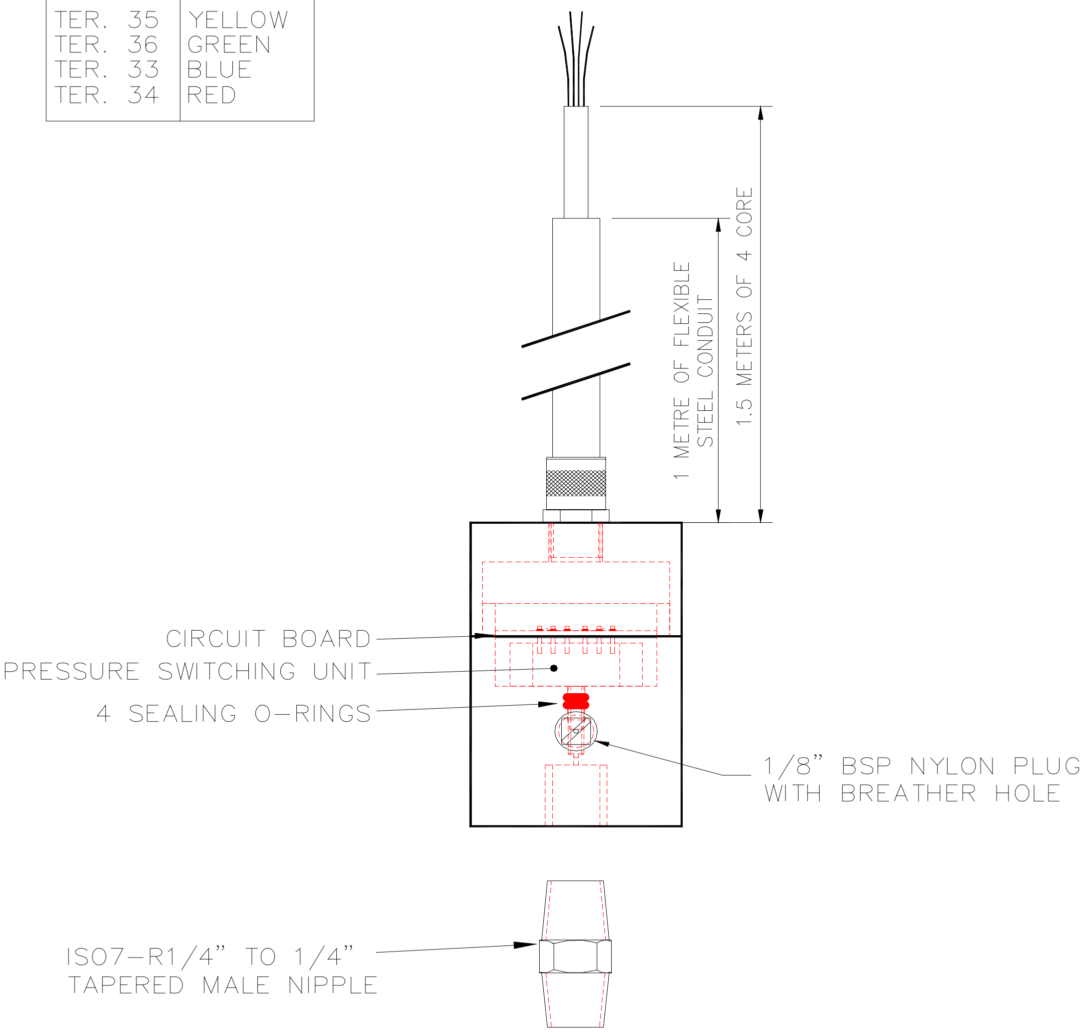


2 VALVE PROVING
A – T60, B/C – T61

2.14.2.6.2 Gas Pressure Sensors

Part Number:	Range
MM60006	12.5-65 mbar / 0.18-1 psi / 5-25 "wg
MM60008	52-340 mbar / 0.75-5 psi / 25-135 "wg
MM60011	115-750 mbar / 1.8-11 psi / 50-300 "wg
MM60012	207-1380 mbar / 3-20 psi / 83-550 "wg
MM60014	0.4-4 bar / 6-60 psi / 162-1620 "wg

CONNECTIONS	
MK.6 MM	SENSOR
TER. 35	YELLOW
TER. 36	GREEN
TER. 33	BLUE
TER. 34	RED



Notes	
IP	52
NEMA	5
HOUSING & LID	ALLUMINIUM
POWER CONSUMPTION	0.1 WATTS
MOUNTING	VERTICAL AS SHOWN. BREATHER HOLES AWAY FROM ANY WATER SOURCE.

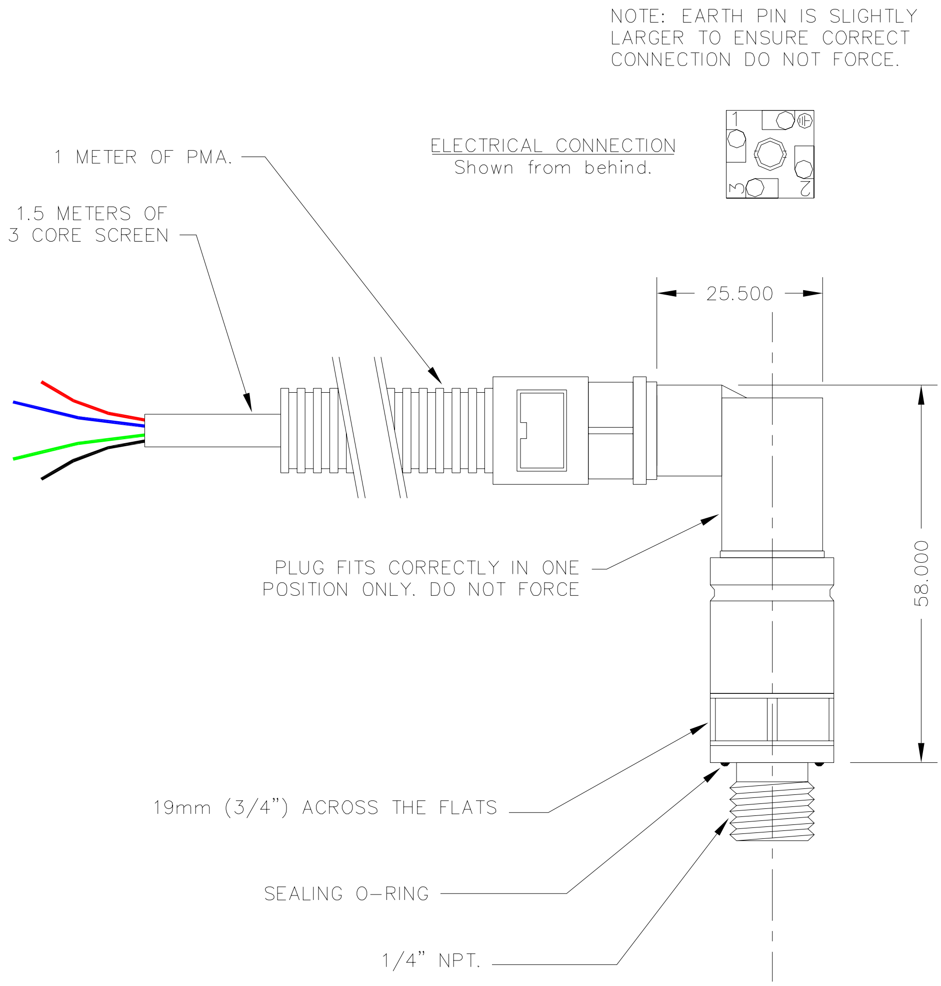
	Actual Operating Range											
	mbar				" w.g.				psi			
	min.	max.	†	zero range	min.	max.	†	zero range	min.	max.	†	zero range
MM60006	-2.5	65	1373.8	-2.5 to 1.25	-1	25	554	-1.0 to 0.5	-0.04	1	20	-0.04 to 0.02
MM60008	-12.5	340	1373.8	-12.5 to 6.25	-5	135	554	-5.0 to 2.5	-0.2	5	20	-0.2 to 0.1
MM60011	-30	750	2060.7	-30 to 15	-12	300	831	-12.0 to 6.0	-0.44	11	30	-0.44 to 0.22
MM60012	-55	1380	4121.4	-55 to 27.5	-22	550	1662	-22.0 to 11.0	-0.8	20	60	-0.8 to 0.4

† maximum pressure above which causes permanent sensor failure

2.14.2.6.2.1 Oil Pressure Sensor

PRESSURE SENSOR ELECTRICAL CONNECTIONS

SENSOR TYPE	MM UNIT
PLUG SENSOR	MK6
GREEN (2)	35
BLUE (3)	33
RED (1)	34
NOT CONNECTED	S



NOTE:

MAXIMUM 2.5mm FLAT BLADE SCREW DRIVER FOR ELECTRICAL CONNECTIONS
I.P. 65
NEMA 4
TORQUE SETTING = MAX. 25Nm
DO NOT USE CASE TO TIGHTEN PRESSURE CONNECTION.
O-RING MATERIAL = VITON
MAX. STORAGE TEMP. -25 TO +85 DEG. C (-13 TO 185 DEG. F)
MAX. OPERATING TEMP. -25 TO +85 DEG. C (-13 TO 185 DEG. F)
MEDIA TEMP -25 TO +125 DEG. C (-13 TO 257 DEG. F)
OPERATING RANGE 0 TO 600 PSI / 0 TO 40 BAR
OVER PRESSURE RATING 1160 PSI / 80 BAR
BURST PRESSURE RATING 4350 PSI / 290 BAR

2.14.2.6.3 Commissioning Valve Proving

If the Valve Proving System (VPS) facility is to be utilised then specific options/parameters must be set (refer to sections - selecting options/parameters. Only options are detailed below, all respective parameters must be set to the same value).

Options #125 through #128 set VPS operation depending on the fuel selected, i.e. Fuels 1,2,3,4.

Option #125 - VPS operational on Fuel 1 (set value = 1).
Option #126 - VPS operational on Fuel 2 (set value = 1).
Option #127 - VPS operational on Fuel 3 (set value = 1).
Option #128 - VPS operational on Fuel 4 (set value = 1).

The following options must be set to configure the VPS operation.

Option #124 - Gas pressure range (low/high).
Option #125 - Valve proving arrangement (two/three valves).
Option #131 - Gas pressure units ("wg/mBar).
Option #132 - Valve proving time.
Option #133 - Pressure change allowed during proving time.

IT IS THE COMMISSIONING ENGINEERS RESPONSIBILITY TO ENSURE THAT RELEVANT VALVE PROVING SYSTEM STANDARDS ARE CONFORMED TO.

The following formulae may be used for calculating the proving time and pressure change allowed. They are based on DVGW requirements of a leakage rate of 0.1% of the maximum volume flow.

Proving time:

Abbreviations:
Vpt - Valve proving time in seconds.
Ip - Inlet pressure in millibars.
Pv - Pipe volume in litres (volume = π r^2 x length).
Mtp - Maximum gas throughput in litres per hour.

Formula:

$$Vpt = 4 \times \left[\left[\frac{Ip \times Pv}{Mtp/1000} \right] + 1 \right]$$

The pipe volume is the total volume of any interconnecting pipe between the valve seals.

Pressure change:

Formula:

0.25 x Nominal inlet pressure (mBar).

Example:

Proving Time -

Inlet pressure = 50 mBar.
Pipe volume = 5 litres.
Mtp = 100,000 litres per hour.

$$Vpt = 4 \times \left[\left[\frac{50 \times 5}{100{,}000 / 1000} \right] + 1 \right]$$

$$= 14 \text{ seconds.}$$

Set option #132 = 15 seconds.
Set parameter #132 = 15 seconds.

Note: option #132 is set in increments of 5 seconds, values must be rounded up.

Pressure change -

Inlet pressure = 100mBar.

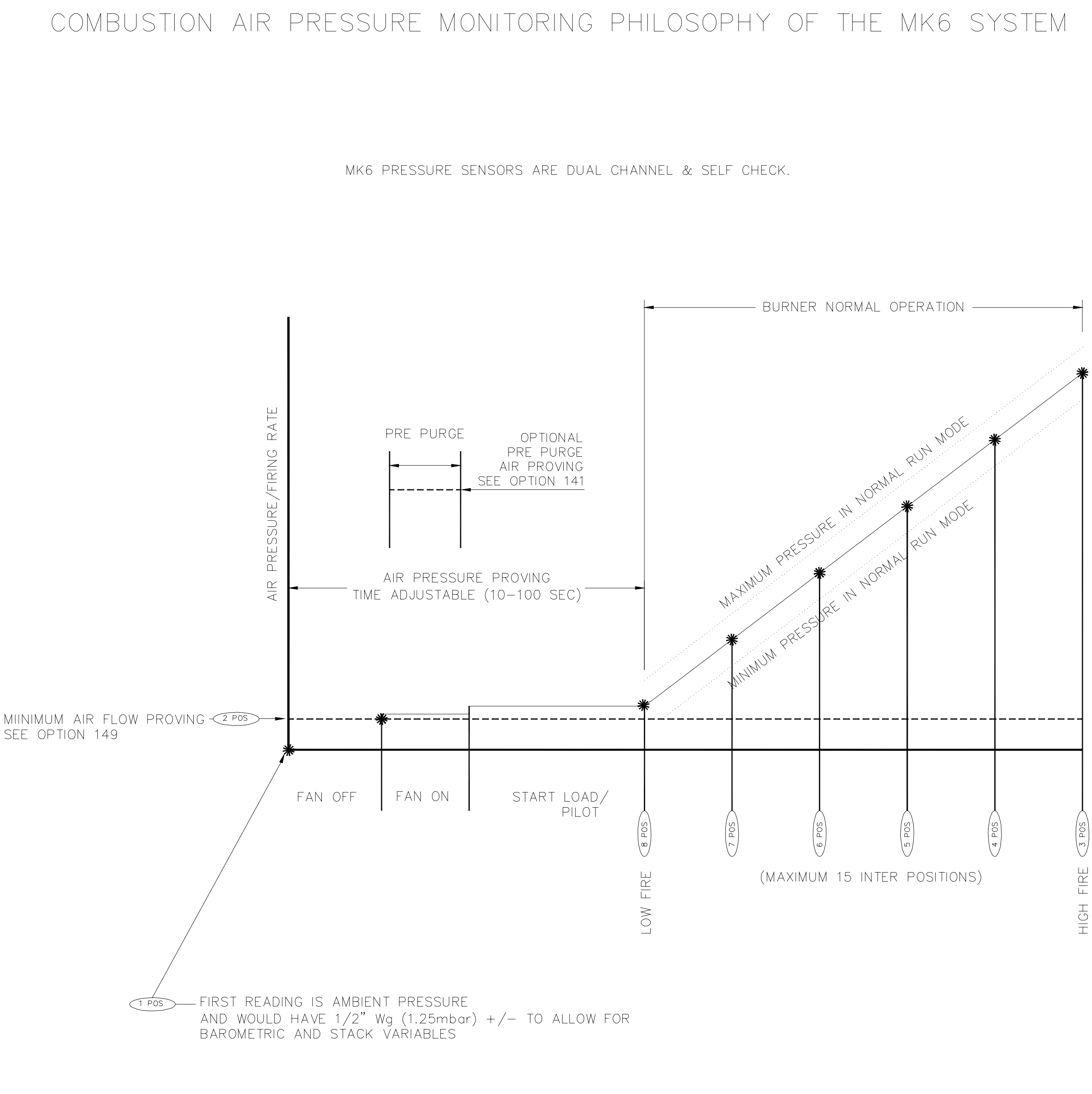
0.25 x 100 = 25.0 mBar.

Set option #133 = 25.0 mBar
Set parameter #133 = 25.0 mBar

General Note

This is a metric formulae, therefore imperial units must converted before applying this calculation.

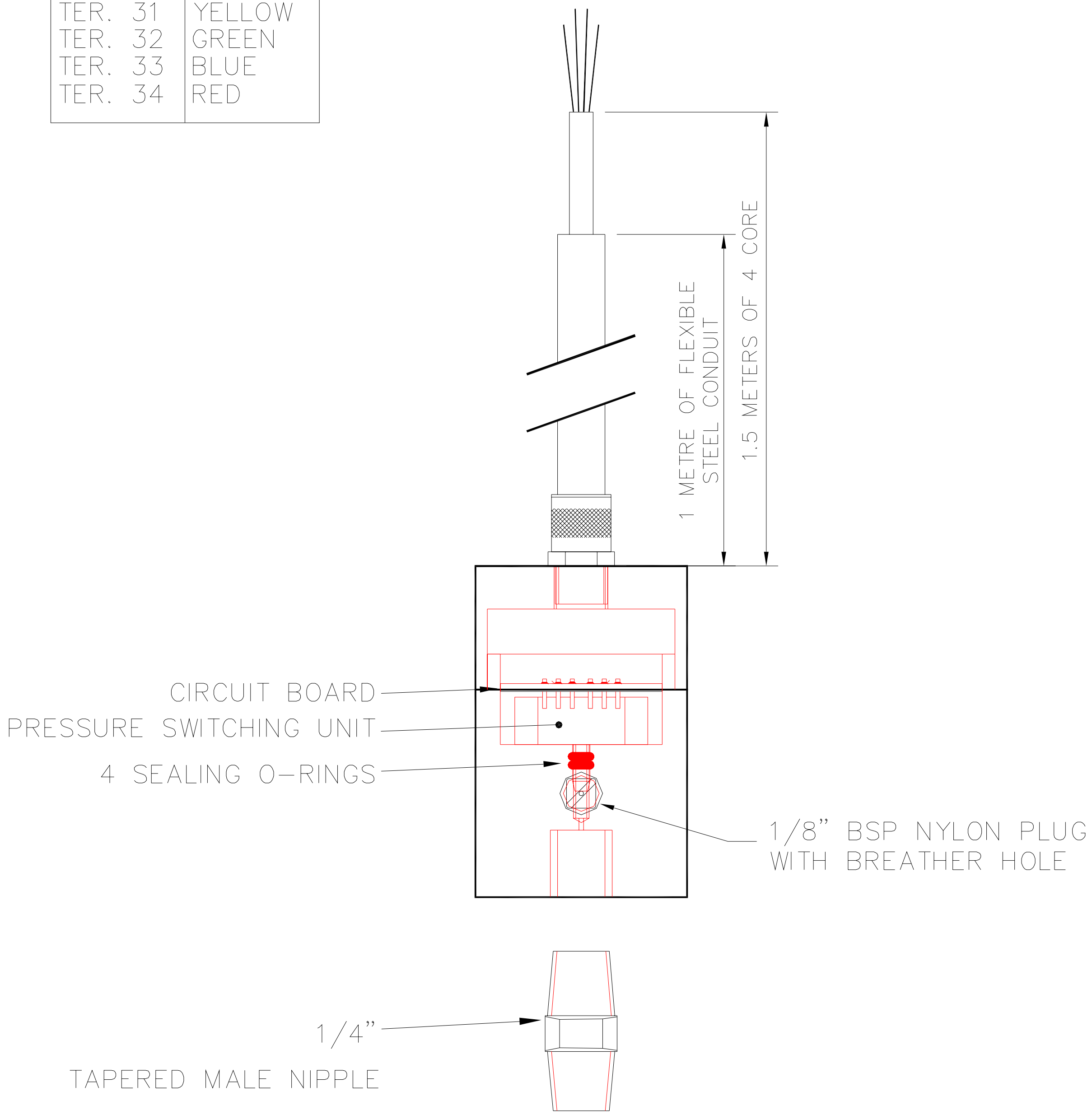
2.14.2.7 Air Pressure Proving



NOTE:
1: 'POS 8' MUST BE SET EQUAL TO 'POS 2' OR HIGHER
2: 'POS 2' MUST BE 0.25" Wg (0.62mbar) HIGHER THAN 'POS 1'
3: MINIMUM PRESSURE IN NORMAL RUN MODE MUST BE HIGHER THAN 'POS 2'
4: DEFAULT SETTINGS FOR MINIMUM & MAXIMUM IS 15% ABOVE AND BELOW ENTERED VALUE

2.14.2.7.2 Air Pressure Sensor

CONNECTIONS	
MK.6 MM	SENSOR
TER. 31	YELLOW
TER. 32	GREEN
TER. 33	BLUE
TER. 34	RED



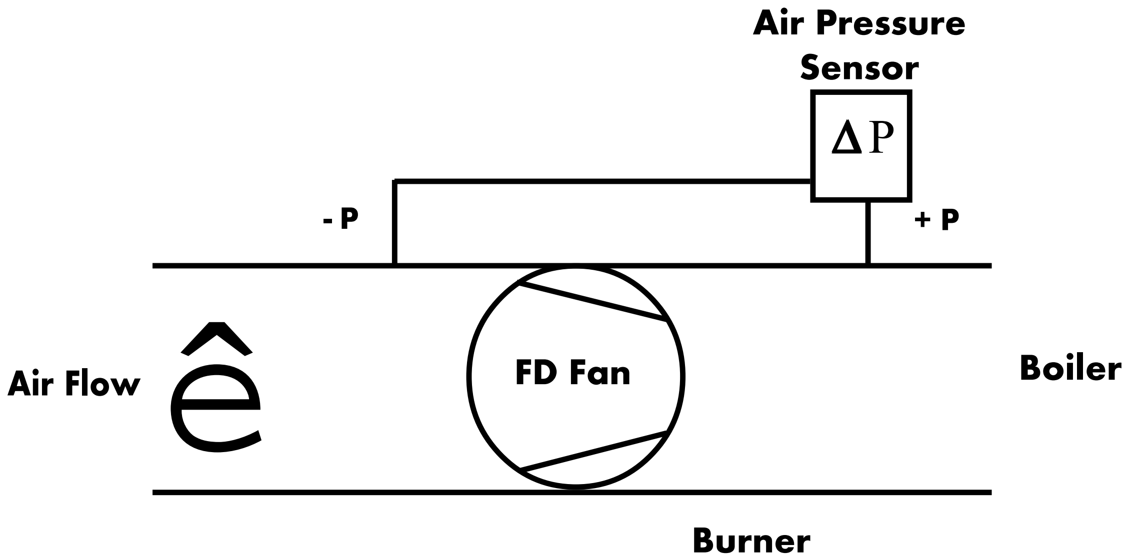
NOTE:

I.P. RATING 52
NEMA 5
MATERIAL SPECIFICATION- ALUMINIUM
POWER CONSUMPTION- 0.1W
MOUNTING- VERTICAL AS SHOWN

WORKING RANGE-	0.3 TO 25 “ WG / -0.75 TO 65 MBAR (MM60005)
	0.6 TO 50 “ WG / -1.5 TO 130 MBAR (MM60013)
ZERO RANGE-	-1 TO 0.5 “ WG / -2.5 TO 1.25 MBAR (MM60005)
	-2 TO 1” WG / -5 TO O2.5 MBAR (MM60013)

Air Pressure Tapped Fitting

The Autoflame Mk6 Air Pressure Sensor is supplied with a tapped fitting to be installed as shown below, to measure a differential pressure. This is only necessary where the air pressure at low fire is below 0.4" w.g. or 1 mbar or when it is a local code requirement.

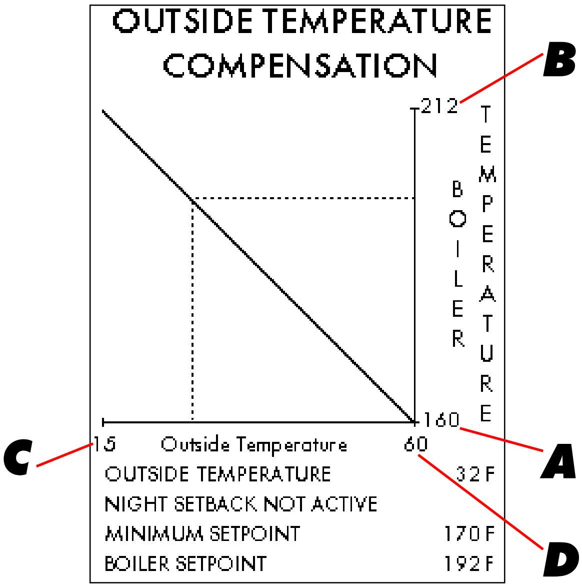


See options #145 to 149

2.14.2.8 Outside Temperature Compensation

This enables the boiler setpoint to be varied according to the outside air temperature, i.e. as the air temperature drops the boiler setpoint can be increased accordingly.

On the MK6 Evolution the outside temperature compensation graph is displayed such that the outside temperature scale is from left to right as the outside temperature increases. In the options the maximum and minimum values of each scale are entered for the outside temperature and boiler setpoint.

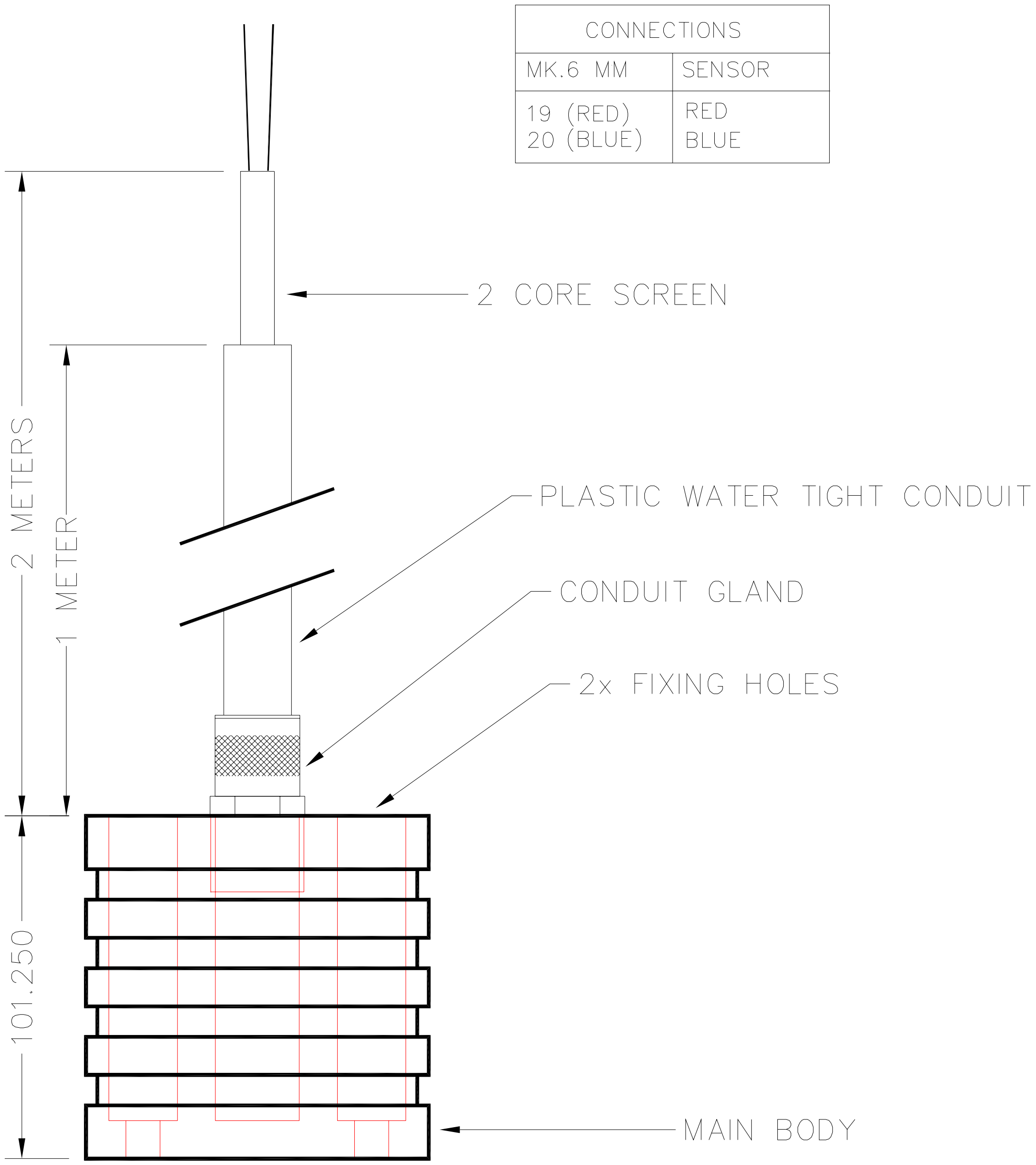


	Option No.	Factory Setting	Option Value	Description
	79.	**0**		**Lowest required value.**
			0-995	Minimum required value allowed when O.T.C. optioned. (see option 80)
	80.	**0**		**Outside temperature compensation.**
			0	Disabled
			1	Enabled
				Note: A line voltage on terminal #93 invokes a 'Night Setback' offset value, see option #85.
B	**81.**	**140**		**Maximum boiler required setpoint at minimum outside temperature.**
			50-999	Value limited in accordance with sensor selected by option #1.
C	**82.**	**-30**		**Minimum outside temperature.**
			-40 +40	If Centigrade units are selected.
			-40 +104	If Fahrenheit units are selected.
A	**83.**	**65**		**Minimum boiler required setpoint at maximum outside temperature.**
			50-999	Value limited in accordance with sensor selected by option #1.
D	**84.**	**30**		**Maximum outside temperature.**
			-20 +40	If Centigrade units are selected.
			-4 +104	If Fahrenheit units are selected.
	85.	**10**		**Night setback 'depression' offset value.**
				This offset is subtracted from the normal required setpoint and activated by a line voltage on terminal #93.
			0-999	degrees/pressure

Ouside Temperature Sensor

AUTOFLAME OUTSIDE AIR TEMPERATURE SENSOR
FOR THE MK6 MM
Pt No : MM60007

CONNECTIONS	
MK.6 MM	SENSOR
19 (RED) 20 (BLUE)	RED BLUE



NOTE:

I.P. RATING 65
NEMA 4
HOUSING- ALUMINIUM
POWER CONSUMPTION- POWERED BY MK6 M.M.
MOUNTING- ANY ORIENTATION

2.14.2.9 Mk6 Electrical Specifications

2.14.2.9.1 Classifications

Classification According to EN298 - F B L L J B

Mains Supply:	230V, +10%/-15% } 120V, +10%/-15% }	47.5 - 63 Hz, Unit max. power consumption 45W
Climate:	Temperature	0 to +60°C (32 to 140°F)
	Humidity	0 to 90% non-condensing.
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.	

Inputs & Outputs:
230V Unit:

Outputs	Terminal	57	250 mA	Must be connected through contactor	Max. load 6 Amp.
		58	250 mA	Must be connected through contactor	
		59	1Amp, 0.6 power factor		
		60	1Amp, 0.6 power factor		
		61	1Amp, 0.6 power factor		
		62	1Amp, 0.6 power factor		
		63	1Amp, 0.6 power factor		
		78	100mA	To drive relay only - switched neutral	
		79	100mA	To drive relay/lamp only - switched neutral	

Analogue I/O.s 240 Ω or less.

120V Unit:

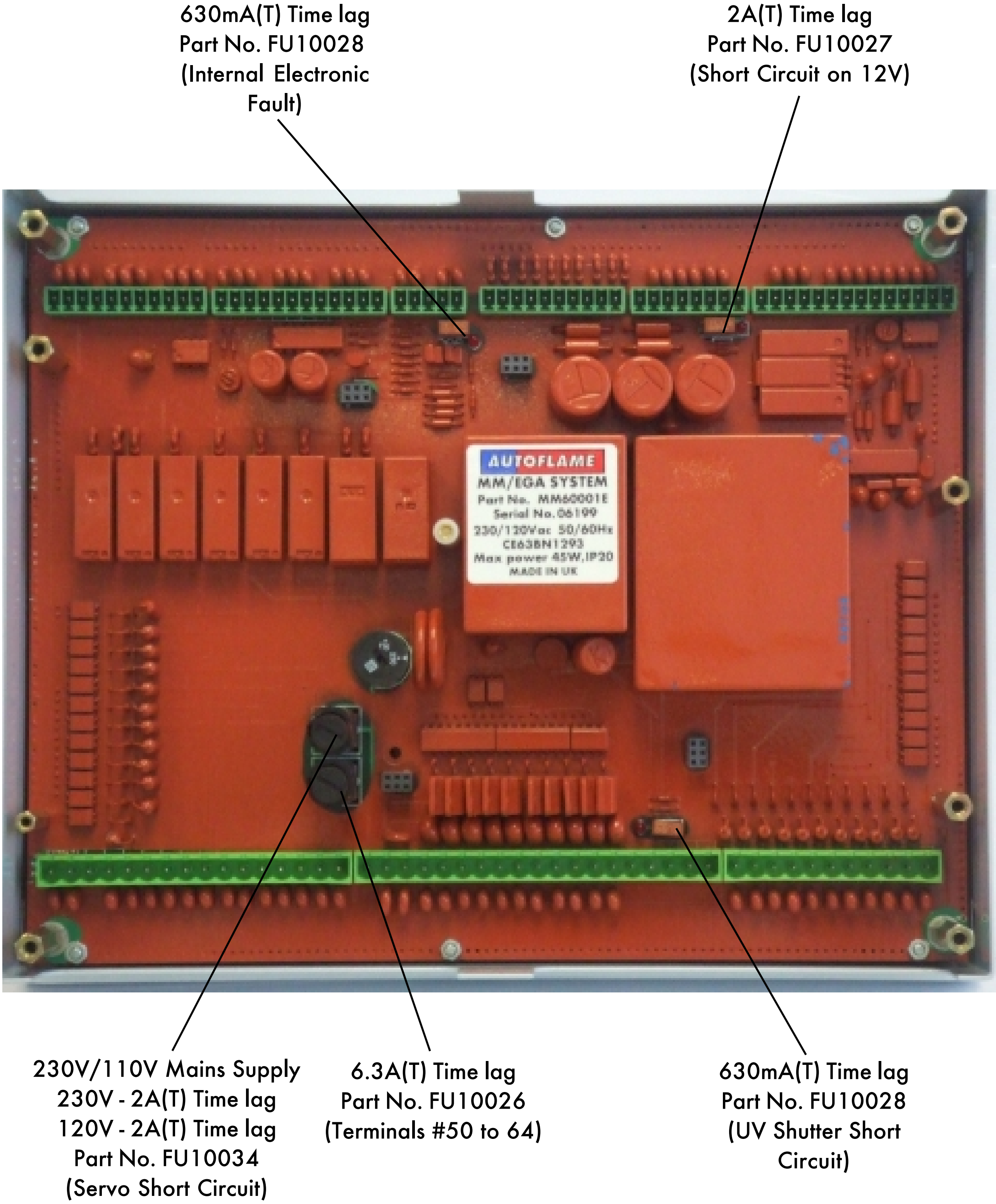
Outputs	Terminal	57	250 mA	Must be connected through contactor	Max. load 6 Amp.
		58	250 mA	Must be connected through contactor	
		59	2Amp, 0.6 power factor		
		60	2Amp, 0.6 power factor		
		61	2Amp, 0.6 power factor		
		62	2Amp, 0.6 power factor		
		63	2Amp, 0.6 power factor		
		78	100mA	To drive relay only - switched neutral	
		79	100mA	To drive relay/lamp only- switched neutral	

Analogue I/O.s 240 Ω or less.

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- Cabling should be a maximum 25m.
3- Use screened cable as specified in Section 2.14.2.9.4.
4- The burner 'High Limit Stat' must be of the manual reset type.

2.14.2.9.2 Fuse Ratings



Text in brackets indicates possible cause of fuse blowing.

All fuses should be time lag type (T).

If an L.E.D. next to a fuse is extinguished, then this indicates that the fuse is blown.

2.14.2.9.3 Terminals Description

1	Current Input, 0-20mA. For channel 5 VSD use only. Can be connected to the current output of a VSD or tachometer system as appropriate.
2	Voltage Input, 0-10V. For channel 5 VSD use only. Can be connected to the voltage output of a VSD or tachometer system as appropriate.
3	Common for terminals #1 and 2.
4	Current Input, 0-20mA. For channel 6 VSD use only. Can be connected to the current output of a VSD or tachometer system as appropriate.
5	Voltage Input, 0-10V. For channel 6 VSD use only. Can be connected to the voltage output of a VSD or tachometer system as appropriate.
6	Common for terminals #4 and 5.
7	Current Input, 0-20mA. Used for external modulation or external required sepoint.
8	Voltage Input, 0-10V. Used for external modulation or external required sepoint.
9	Common for terminals #7 and 8.
10	Current Output, 4-20mA. For channel 5 VSD use only. Can be connected to the current input of a VSD.
11	Voltage Output, 0-10V. For channel 5 VSD use only. Can be connected to the voltage input of a VSD.
12	Common for terminals #10 and 11.
13	Current Output, 4-20mA. For channel 6 VSD use only. Can be connected to the current input of a VSD.
14	Voltage Output, 0-10V. For channel 6 VSD use only. Can be connected to the voltage input of a VSD.
15	Common for terminals #13 and 14.
16	Current Output, 4-20mA. Varies in accordance with firing rate.
17	Voltage Output, 0-10V. Varies in accordance with firing rate.
18	0V common for terminals #16 and 17.

Note that all the common terminals (3, 6, 9, 12, 15, 18) are connected to each other internally. All of the circuitry, associated with the analogue inputs and outputs detailed above, is isolated from earth/ground potential, i.e. floating.

Note: It is advised to put a jumper/link between terminals #3 and #S in order to protect against electrical interference.

19, 20	Connections to the Autoflame outside temperature sensor.
21, 22	Connections to an Autoflame self check UV sensor.
23, 24	Communications port connections for twin burner operation.
25, 26	Communications port connections to an Exhaust Gas Analyser (E.G.A.).
27, 28	Communications port connections for DTI and/or IBS/lead-lag operation.
29, 30	Communications port (currently unassigned).
31, 32	Signal inputs from Autoflame air pressure sensor.
33	0V supply to Autoflame air/gas/oil pressure sensors.
34	+12V supply to Autoflame air/gas/oil pressure sensors.
35	Signal input from Autoflame oil pressure sensor.
35, 36	Signal inputs from Autoflame gas pressure sensor.
37, 38	Connections to an Autoflame boiler temperature detector.
37, 38, 39	Connections to an Autoflame boiler pressure detector.
40	0V supply to channel 1 and channel 2 positioning motors.
41	+12V supply to channel 1 and channel 2 positioning motors.
42	Signal from channel 1 positioning motor, indicating position.
43	Signal from channel 2 positioning motor, indicating position.
44	Signal from channel 3 positioning motor, indicating position.
45	Signal from channel 4 positioning motor, indicating position.
46	0V Supply to channel 3 and channel 4 positioning motors.
47	+12V Supply to channel 3 and channel 4 positioning motors.
48, 49	No terminals allocated.

50,51	Connections to an Autoflame UV sensor.
52	Mains voltage input- external auxiliary delay to purge.
53	Mains voltage input- burner on/off signal. Running interlock circuit.
54	Mains voltage input- safety circuits, e.g. air proving.
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.
60	Mains voltage output- main fuel valve 1.
61	Mains voltage output- main fuel valve 2.
62	Mains voltage output- vent valve.
63	Mains voltage output- ignition transformer.
64	Unused.
65	No terminal allocated.
66	Mains supply- earth.
67	Main supply- neutral.
68	Mains supply- live/hot.
69	Mains voltage output. Power to positioning motors.
70	Switched neutral- drives channel 1 positioning motor clockwise.
71	Switched neutral- drives channel 1 positioning motor counter clockwise.
72	Switched neutral- drives channel 2 positioning motor clockwise.
73	Switched neutral- drives channel 2 positioning motor counter clockwise.
74	Switched neutral- drives channel 3 positioning motor clockwise.
75	Switched neutral- drives channel 3 positioning motor counter clockwise.
76	Switched neutral- drives channel 4 positioning motor clockwise.
77	Switched neutral- drives channel 4 positioning motor counter clockwise.
78	Switched neutral- to drive 2-port valve for IBS/lead-lag operation.
79	Switched neutral- alarm output for M.M. lockout/M.M. error/E.G.A. error./T.D.S. limits

80	Unused- do not connect.
81	Unused- do not connect.
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. Or when using boiler differential proving.
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 sepoint- second set-point facility.
88	Mains voltage input. Can be used to select this M.M. as lead boiler when IBS/lead-lag is implemented. If this terminal is used to select the lead boiler, it will take priority over a lead boiler set via the DTI. Also used as an input to select external modulation using an external PID loop.
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- if low pressure steam operation is optioned, this input is used to detect low boiler temperature (by means of an appropriate temperature switch/ aquastat). If outside temperature compensation is optioned, this input is used to activate the night setback.
94	Mains voltage input- selects hand operation.
95	Mains voltage input- selects low flame hold operation.
S	All terminals marked S are internally connected. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, e.g. section 2.14.6.1.

2.14.2.9.4 Cables

Screened Cable

The screened cable used from the M.M. to the servo motors and detectors must conform to the following specification:

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

Sixteen wires per core;
Diameter of wires in each core 0.2mm;
Rated at 440 volts a.c. rms at 1600 Hz;
DEF 61-12 current rating per core 2.5 Amps;
Maximum operating temperature 70 degrees C (158 degrees F);
Nominal conductor area 0.5 square mm per core;
Nominal insulation radial thickness on core 0.45mm;
Nominal conductor diameter per core 0.93mm;
Nominal core resistance at 20 degrees C. 40.1 Ohm/1000m.;
Nominal overall diameter per core 1.83 mm;
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 Cores
16-2-3C 3 Cores
16-2-4C 4 Cores
16-2-6C 6 Cores

(5 Cores not readily available).

Data Cable

Data cable must be used for connections between MMs for twin burner/sequencing applications and between M.M.'s and E.G.A.'s.

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.
Cable can be ordered directly from Autoflame Engineering.

2.14.2.10 Variable Speed Drives

Installation

The following recommendations are to assist with the installation and fault finding when using variable speed drives (VFD's/inverters).

Inverter Selection

Variable speed drive selection is critical to proper operation. Ensure that the correct size inverter has been selected for the application and is suitable for the motor, and has the necessary input/output signals as shown in section 2.14.6.1.

Mains Cable Connections

Power connections from the variable speed drive to the motor- it is recommended for mains cabling (3 phase) and fuses, that they are to be dimensioned in accordance with the kW rating required.

Motor Cabling

A four core conductor screened cable is recommended. This is due to the rapid voltage changes occurring in variable speed drive systems.

To Avoid Disturbances

It is advised that the motor cables should not be installed with other cable routes- avoid long parallel runs with other cables.

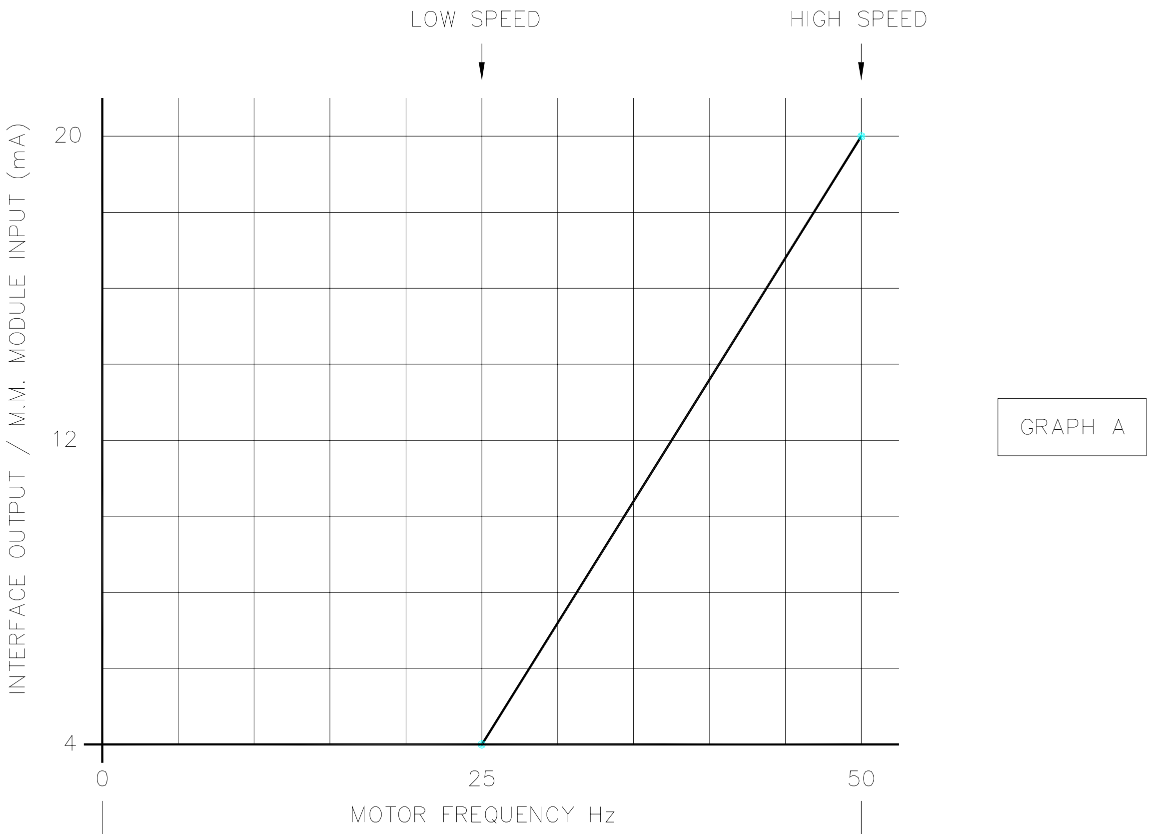
Disturbances caused by radiation from the motor cable can be reduced by installing in-line chokes in the motor cable. However, these chokes may reduce the motor voltage and the maximum available torque. If noise problems exist and unstable output signals cannot be contained within the window and disparity band shown in section 2.14.2.10.3, you should contact the supplier of the variable speed drive for more detailed information and advice.

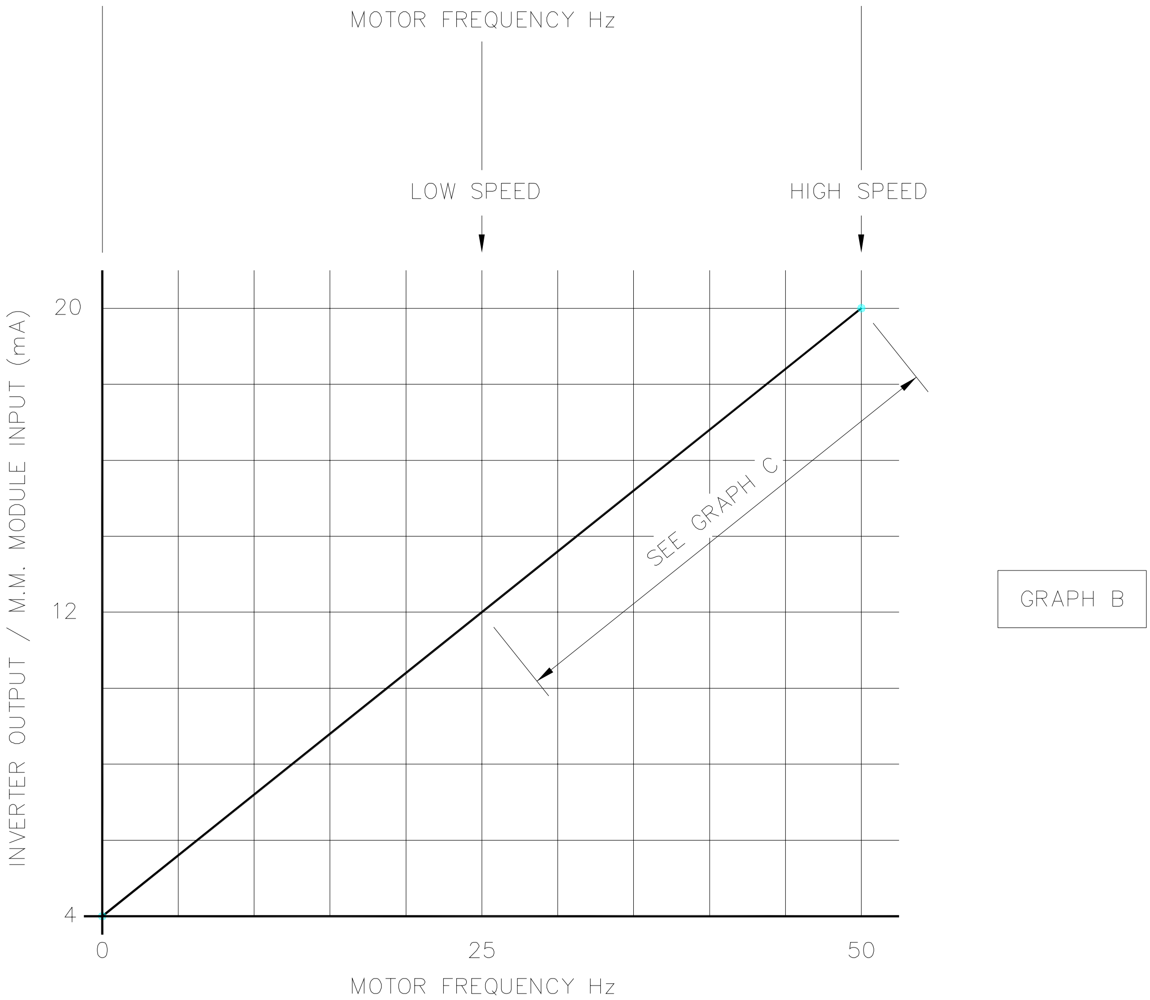
Setting the VSD for Operation

Due to the vast range of variable speed drives it is not possible to give settings/parameters for all types, however some basic rules apply. The minimum and maximum Hz (rpm) should be adjusted before commissioning the Micro Modulation unit. Also the ramp time should be set for the fastest time possible, taking into account limitation of the motor and the application.

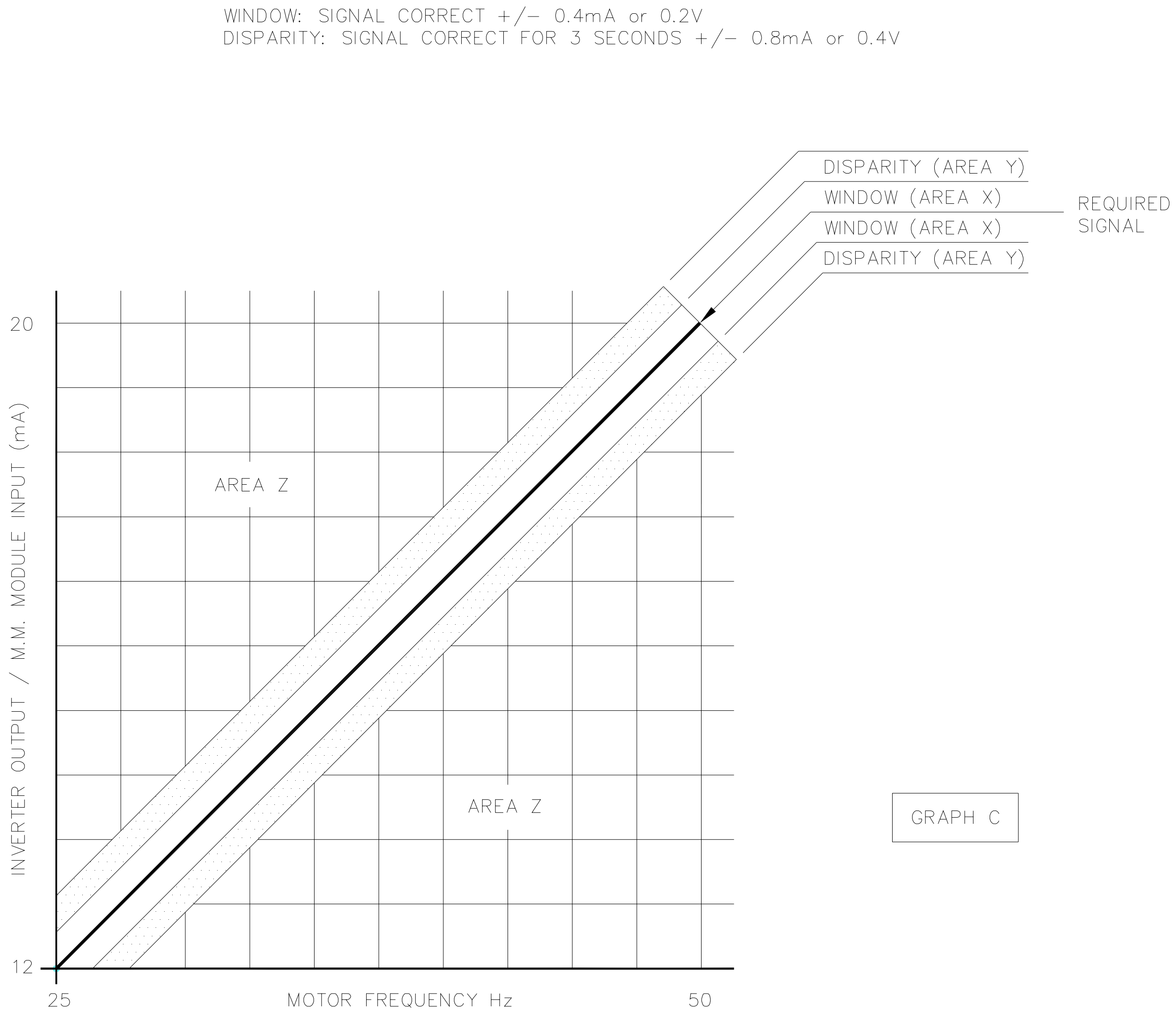
Normal settings would be, low speed 25Hz and high speed 50/60Hz. It is not recommended to set low speed lower than 20Hz. This is because the feed back signal tends to be unstable in this range and over heating of the motor may occur.

Input and Output Signals in Relationship to Frequency



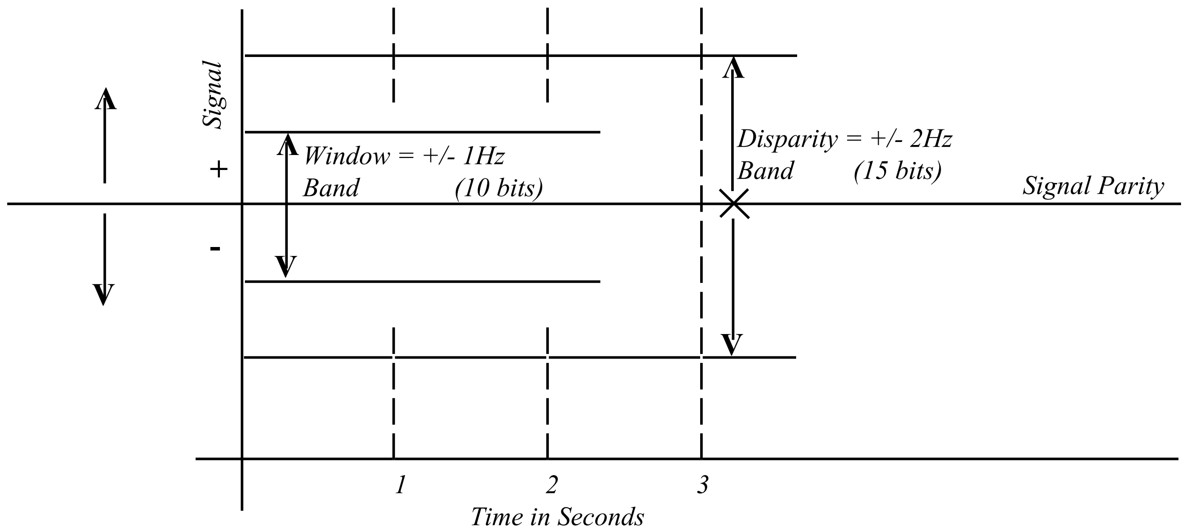


Operational Characteristics of Inverter Output/M.M. Module Input in Relationship to Frequency



Variable Speed Drive Safety Software

In a typical example the motor speed at 50Hz would be 2900rpm and the motor speed at 25Hz would be 1450rpm. This example is typical as there is a linear relationship between linear speed and cycles Hertz. The variable speed drive software allows the following amount of error (disparity) between signal out to the variable speed drive and signal return to the M.M.



The "Window" tolerance has been implemented to accommodate small variations between input and output signal that result from processing through the various A-D and D-A converters involved in the control loop, also motor "Slip", acceleration and deceleration times, all of which produce small variations.

The "Disparity" tolerance which is time limited to a short duration is implemented to deal with the transient disparity/error between input and output signals that results from the PI control mechanism that is typical in variable speed drives (motor speed control mechanism) not operating in phase with the PI (D) control philosophy in the M.M. (Micro Modulation Fuel Air Ratio Controller). This transient disparity occurs and is always self-correcting within the three second time tolerance nominated in the Autoflame control philosophy.

1. Notwithstanding the above, to deal with transients of a very small time scale but of an amplitude greater than the disparity (area Y) as in section 2.14.2.10.3, there is an additional mechanism in the software that allows transient deviations of any amplitude to be tolerated for a duration of less than one second. Under these conditions an error will not be flagged.
   Note: area Z in section 2.14.2.10.3. Any signal deviation longer than one second in area Z will activate safety errors. The tolerance safety time is set for 3 seconds.

2. The "Window" tolerance is +/- 5 bits = 1 Hz = 58rpm (on a motor rotating at 2900rpm at 50Hz).

3. The disparity tolerance is +/- 10 bits = 2Hz = 116rpm (on a motor rotating at 2900rpm at 50Hz). Note that disparity band 2Hz is limited to a maximum of 3 seconds.

4. Fan laws state that:
   a) Speed and volume are a direct linear progression.
   b) Speed increase as a percentage affects pressure produced by the fan as a square root function.

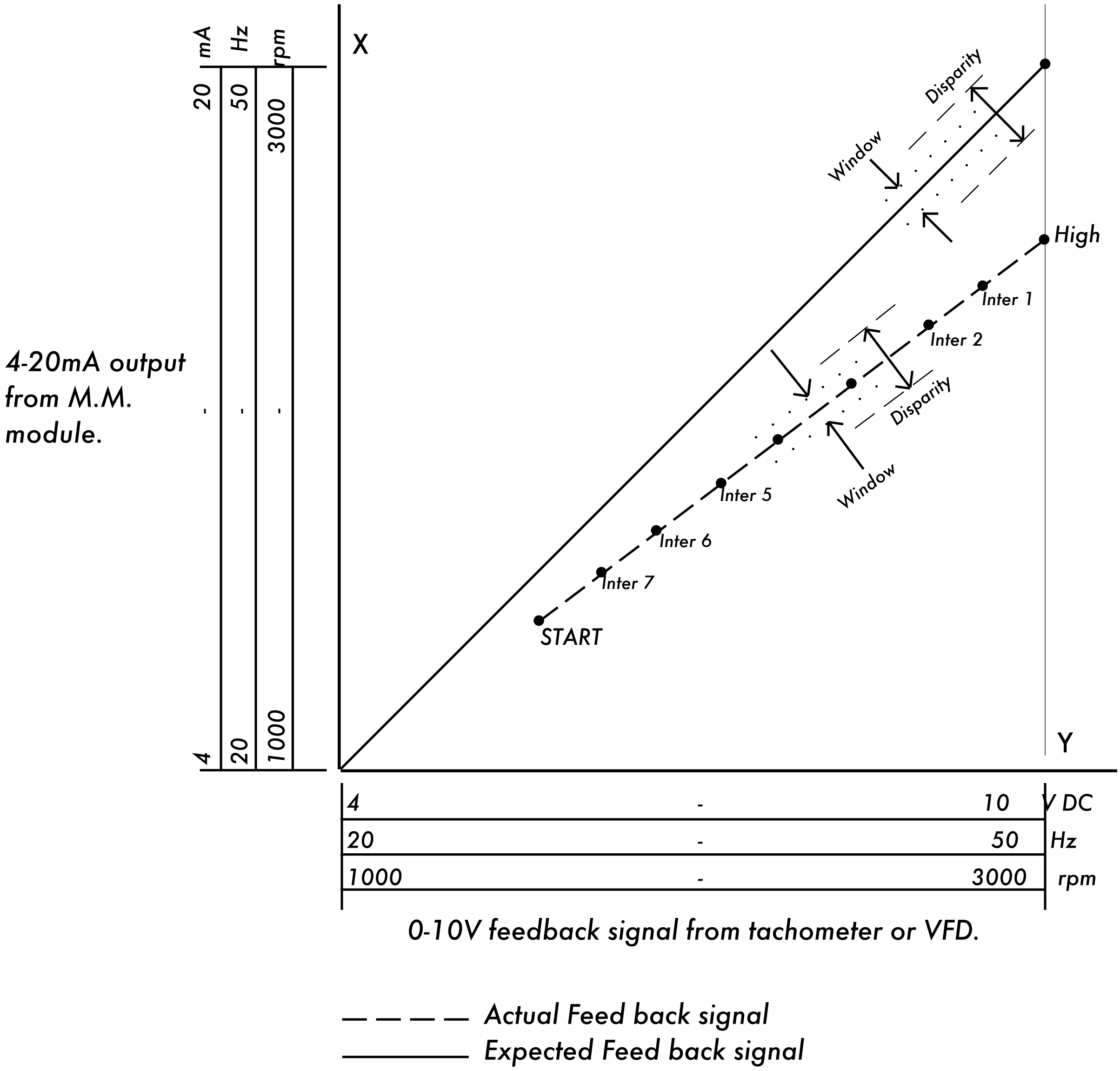
5. The variations in signal allowed in our software would have considerably less effect on the fuel air ratio supplied to the combustion process than variations in ambient temperature/air density e.t.c.

Control Philosophy

When the M.M. is commissioned all the positions for the fuel/air ratio are entered into the memory. These positions are stored together with a motor speed and air damper position. This allows the M.M. to measure the slip by measuring output signal to the variable speed drive, return signal from a tacho and learning the difference for any air position/motor speed setting. This control form gives the facility for a different combination of air/motor speed settings to be accommodated for varying fuels, i.e. F1, F2, F3 & F4. This facility accommodates variances for air requirement for different fuels which is fundamental to the hydrocarbon ratio of the fuel.

Diagram to show Increase in Slip Caused by Damper Sited on Inlet to Combustion Fan

(Caused by pressure/density variations that fan operates in as a function of its position in load index).



During commissioning, each time a position is entered (HIGH/INTER/START) the M.M. also stores the feedback signal value. When the START (low flame) position is entered these values are stored permanently in the memory. A set of values can be stored for each fuel (max. 4). When the M.M. is in the RUN mode the set of values stored for the fuel presently selected is used to generate the window and disparity error checking bands. In commissioning mode error checking is disabled. During run the error checking is disabled during the start up cycle.

2.14.2.11 Installation Checks

Commissioning Checks

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

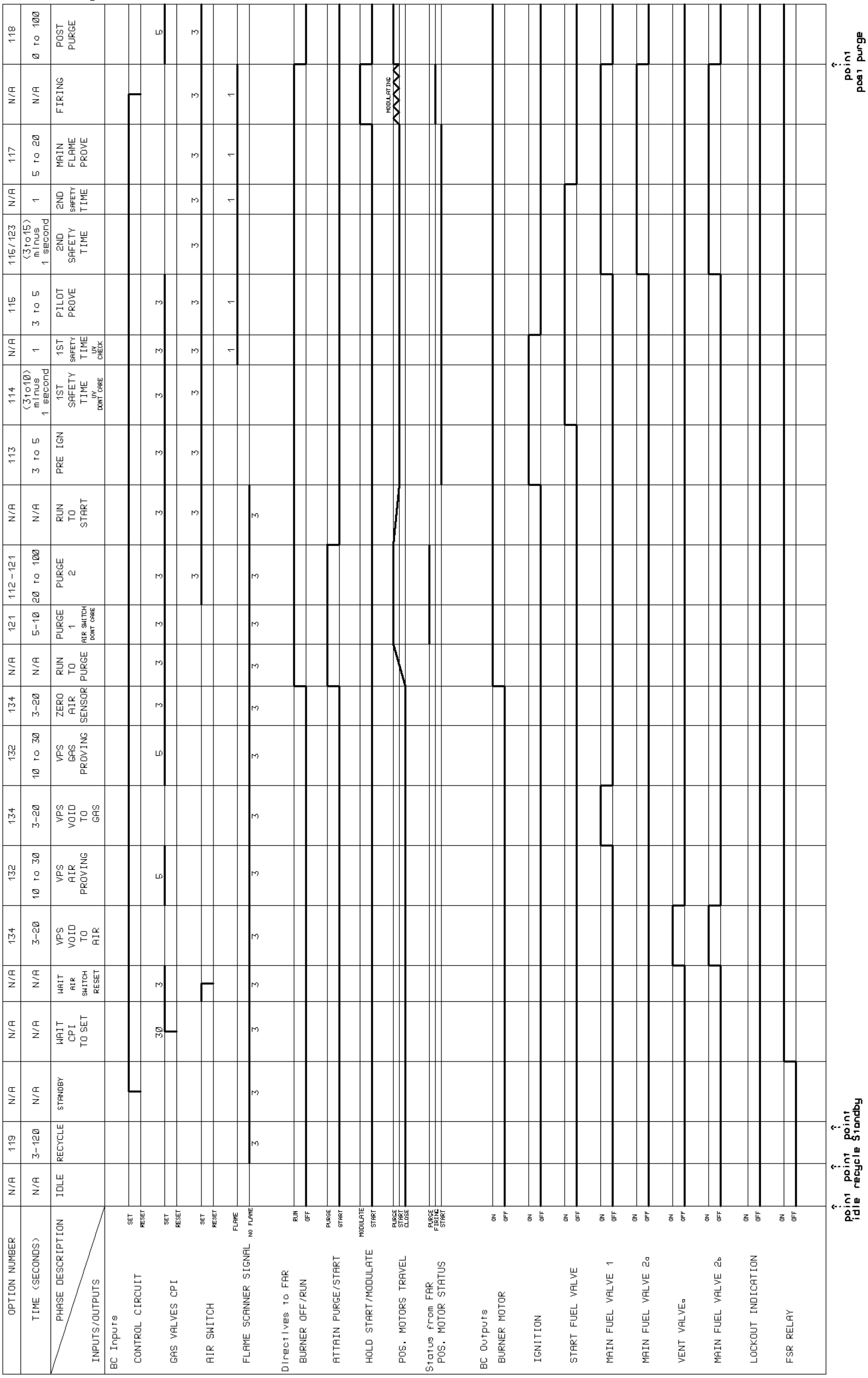
1. Each operating control (temperature, pressure, e.t.c.).
2. Each limit switch (temperature, pressure, low water cutoff, e.t.c.).
3. Each interlock switch (airflow switch, high & low fuel pressure or temperature switches, purge and low fire switches, fuel valve proof of closure interlock, e.t.c.).
4.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

Operational Checks

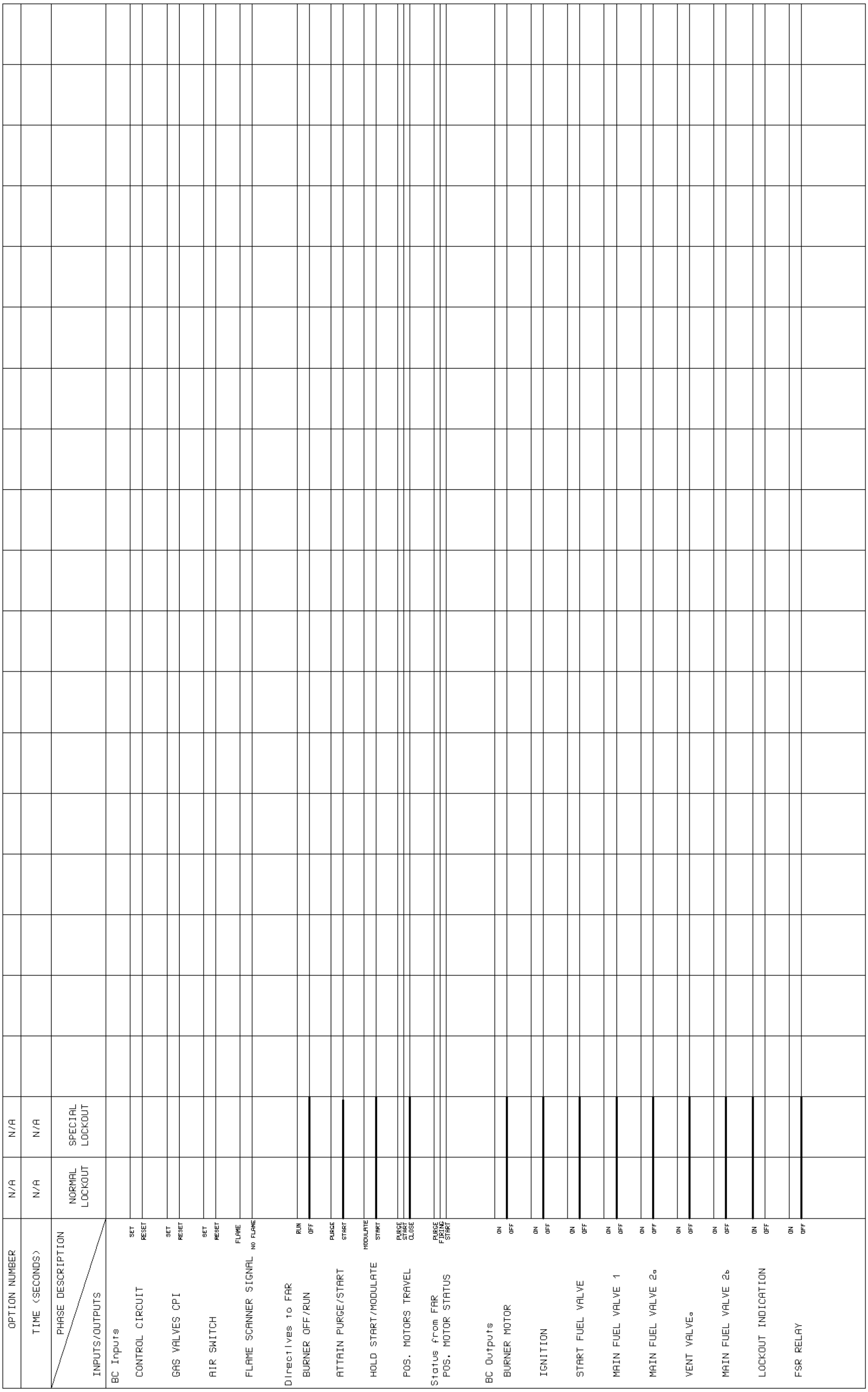
1. Close manual main shut-off valve.
2. Recheck all limit circuit wiring for proper operation and correct connection.
3. Confirm that the automatic main fuel valves are wired correctly.
4. Power the control and electronically check the proper sequence of operation.
5. After assuring yourself that all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

Commissioning or start-up must only be carried out by a factory trained technician.

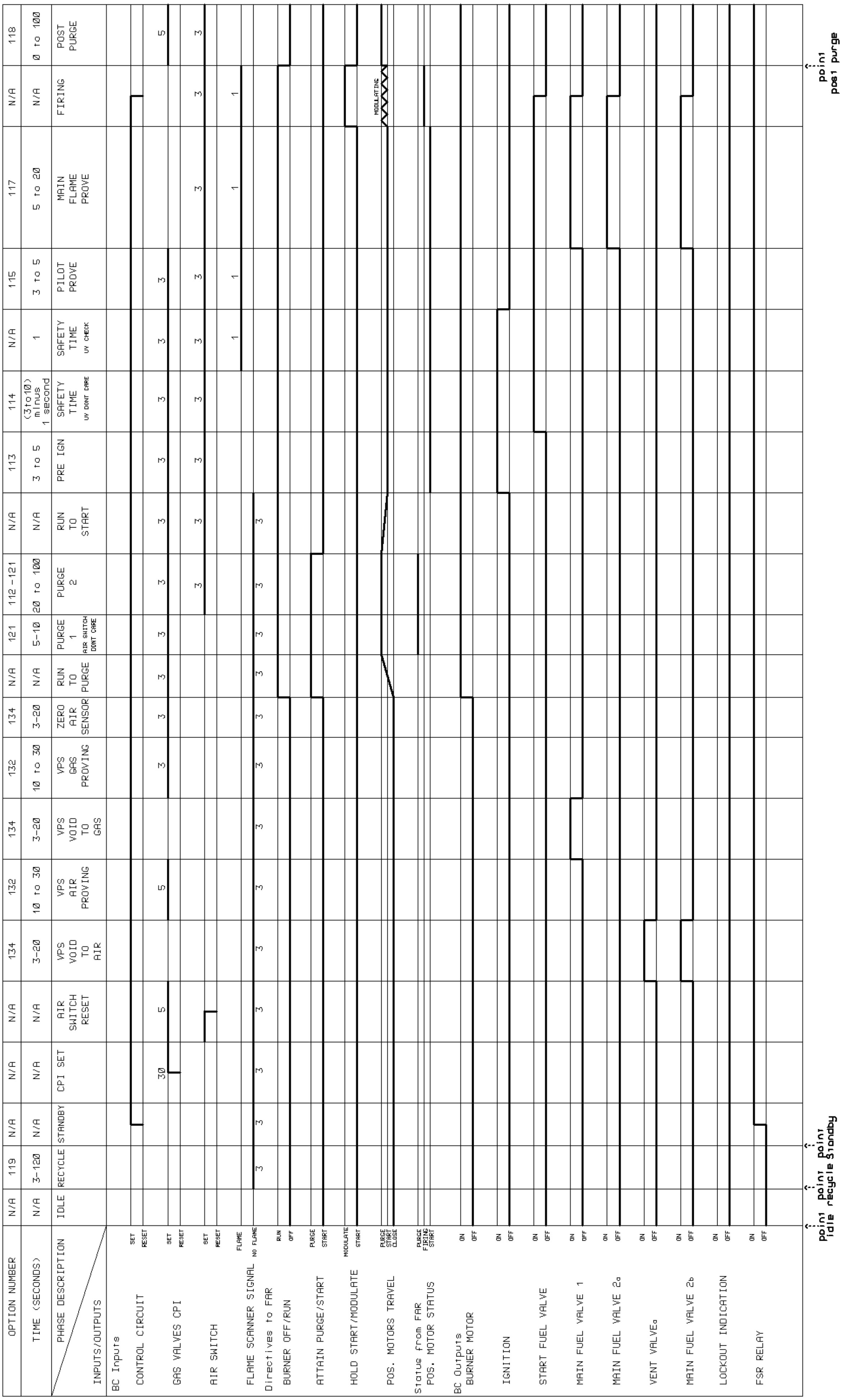
Interrupted Pilot



Lockout


OPTION NUMBER
N/A
N/A
TIME (SECONDS)
N/A
N/A
PHASE DESCRIPTION
NORMAL LOCKOUT
SPECIAL LOCKOUT
INPUTS/OUTPUTS
BC Inputs
CONTROL CIRCUIT
SET
RESET
GAS VALVES CPI
SET
RESET
AIR SWITCH
SET
RESET
FLAME SCANNER SIGNAL
FLAME
NO FLAME
Directives to FAR
BURNER OFF/RUN
RUN
OFF
ATTAIN PURGE/START
PURGE
START
HOLD START/MODULATE
MODULATE
START
POS. MOTORS TRAVEL
PURGE
START
CLOSE
Status from FAR
POS. MOTOR STATUS
PURGE
FIRING
START
BC Outputs
BURNER MOTOR
ON
OFF
IGNITION
ON
OFF
START FUEL VALVE
ON
OFF
MAIN FUEL VALVE 1
ON
OFF
MAIN FUEL VALVE 2a
ON
OFF
VENT VALVEa
ON
OFF
MAIN FUEL VALVE 2b
ON
OFF
LOCKOUT INDICATION
ON
OFF
FSR RELAY
ON
OFF

Intermittent Pilot



Post Burner Operation VPS

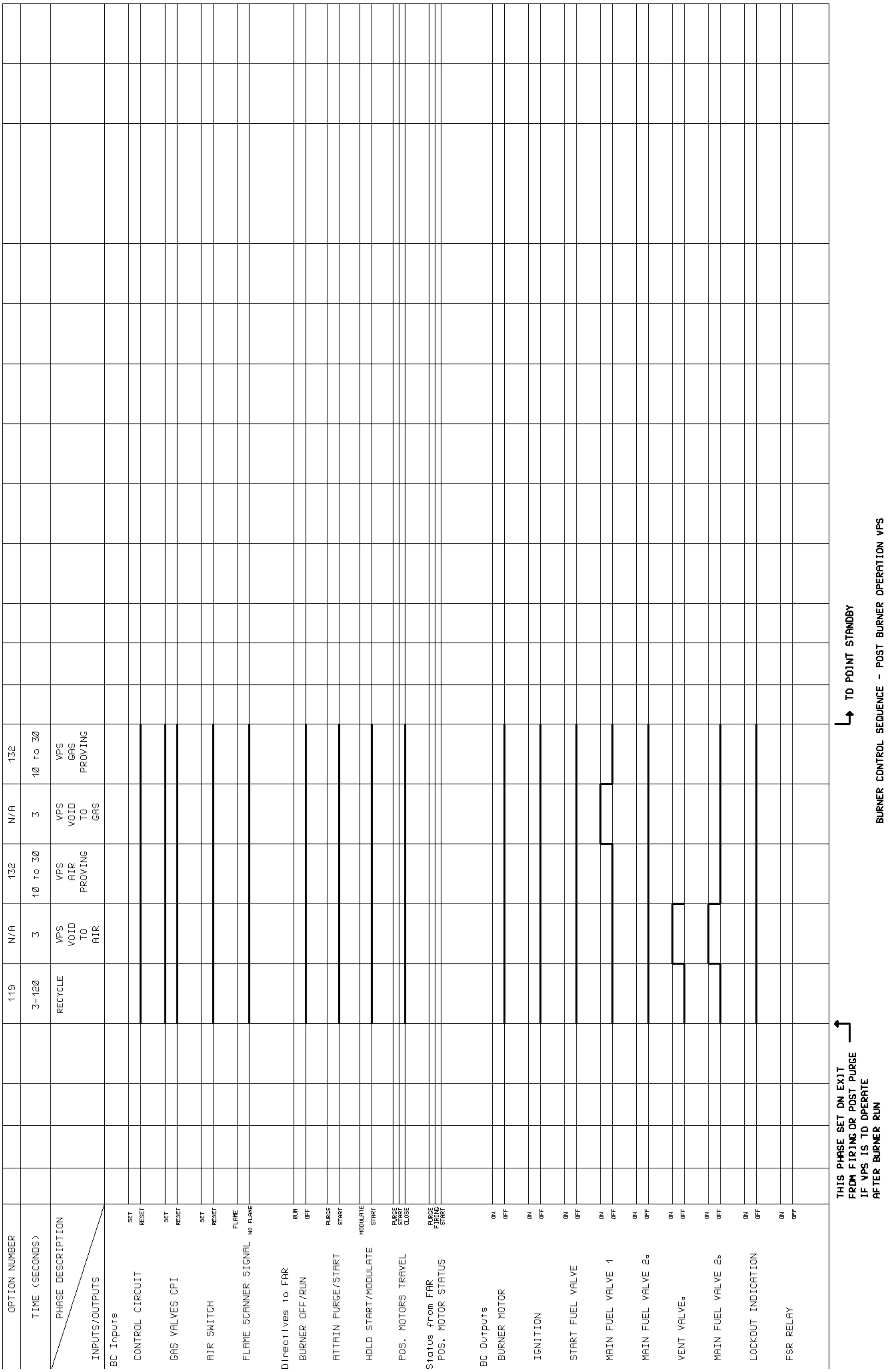


Diagram Notes

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

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

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

point post purge:
this phase is set only if post purge is optioned.

point standby:
this phase is set if VPS has operated after burner run.

Normal lockout is reset when either the mains lockout reset input is set for 2 second or the front facia lockout reset button is pressed for 2 seconds.

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

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

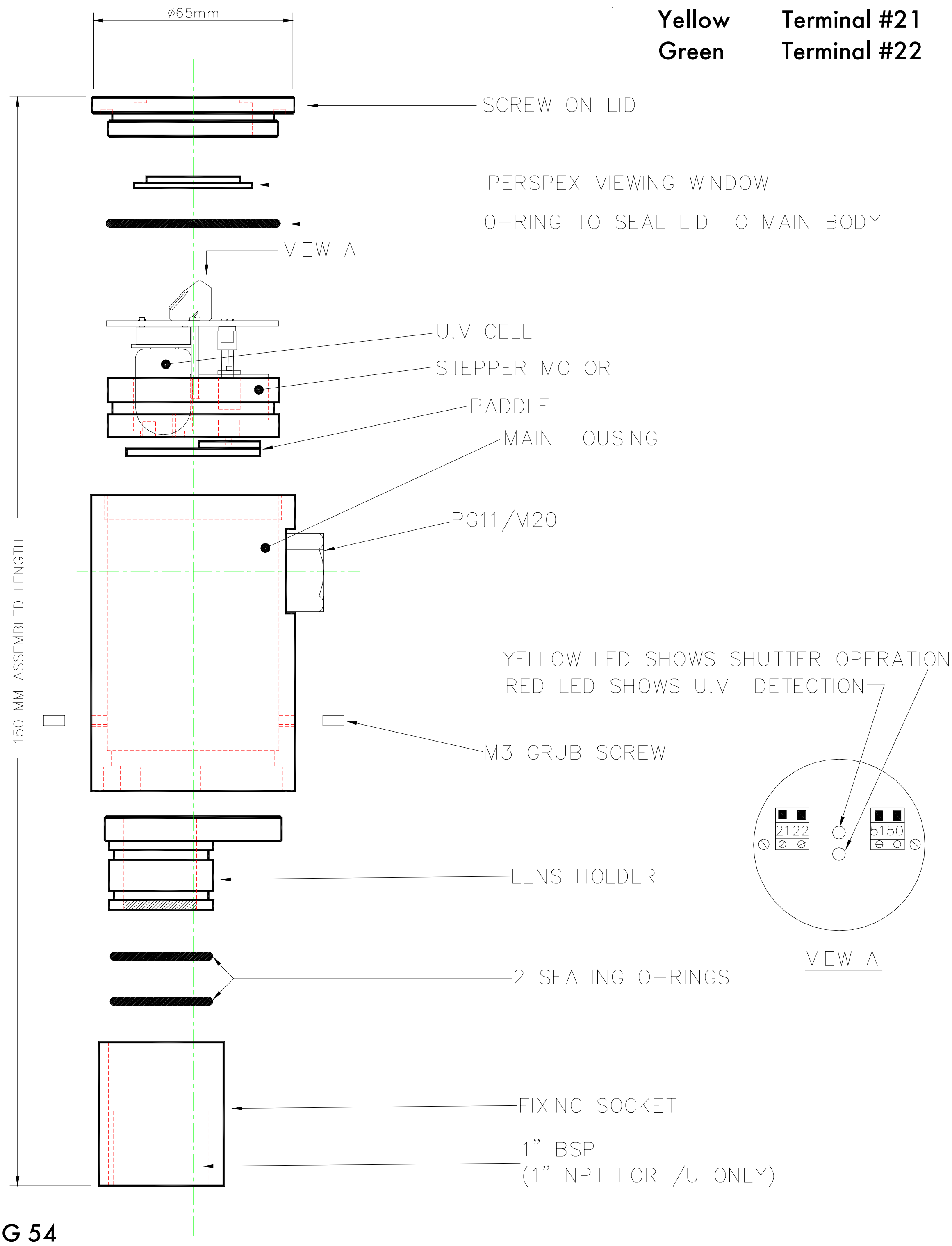
2.14.3.2 Self Check UV Scanner

Part Numbers: MM60003
MM60003/HS

Maximum operating temperature- 50°C / 122°F

Connections

Red	Terminal #51
Blue	Terminal #50
Black	Screen
Yellow	Terminal #21
Green	Terminal #22



NOTE:

I.P. RATING 54
NEMA 5
POWER CONSUMPTION- MAXIMUM 0.5W
HOUSING- ALUMINIUM
MOUNTIN- ANY ORIENTATION

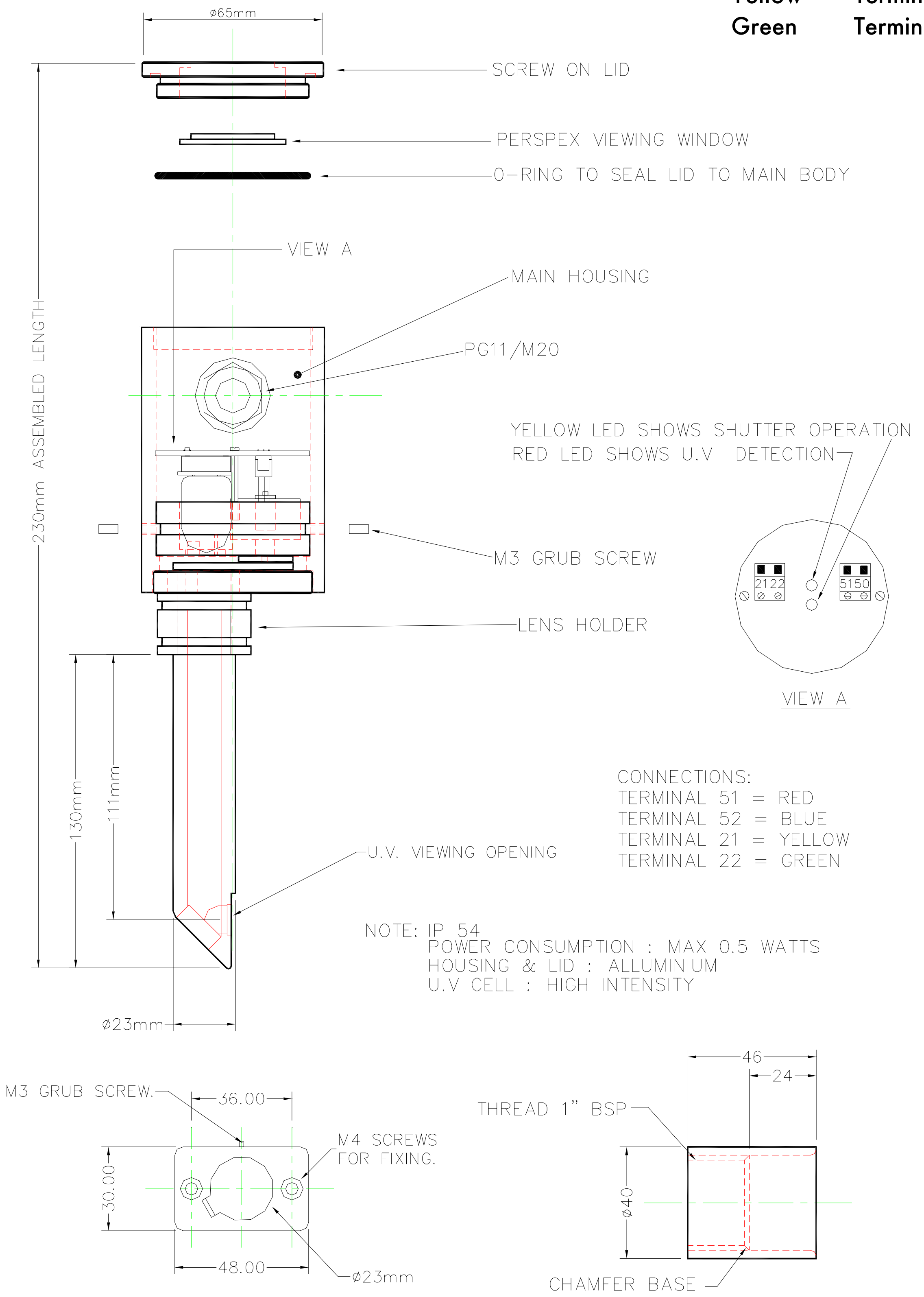
2.14.3.2 Self Check Side View UV Scanner

Part Numbers: MM60003/HS/SV

Maximum operating temperature- 50°C / 122°F

Connections

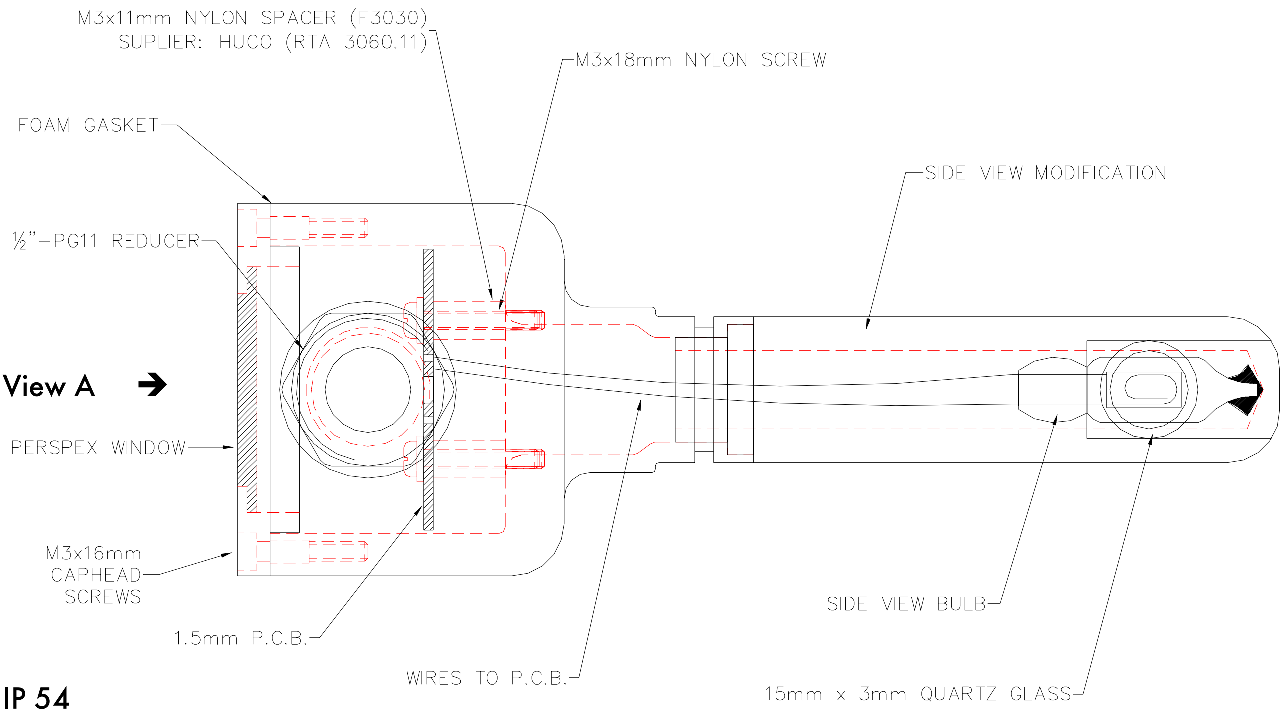
Red	Terminal #51
Blue	Terminal #50
Black	Screen
Yellow	Terminal #21
Green	Terminal #22



2.14.3.3 Standard European UV Scanner - Side-viewing

Part Numbers: MM60004
MM60004/HS

Maximum operating temperature- 60°C / 140°F



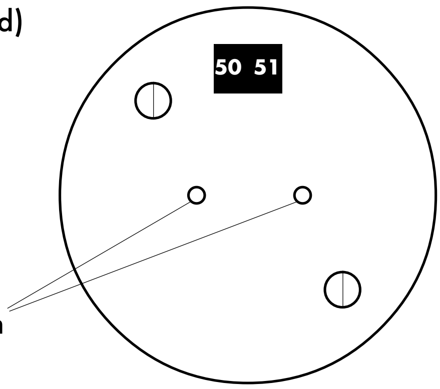
IP 54
NEMA 5
HOUSING: ALUMINIUM
POWER COMSUMPTION: POWERED BY MK.6 MM
MOUNTING: ANY ORIENTATION AS LONG AS PHOTO TUBE FACES THE FLAME

<u>Connections</u>

Red	Terminal 51
Blue	Terminal 50
Black	Screen

<u>View A</u>
(with cover removed)

Note: If wired incorrectly a limited U.V. will be detected but the L.E.D. will not illuminate.

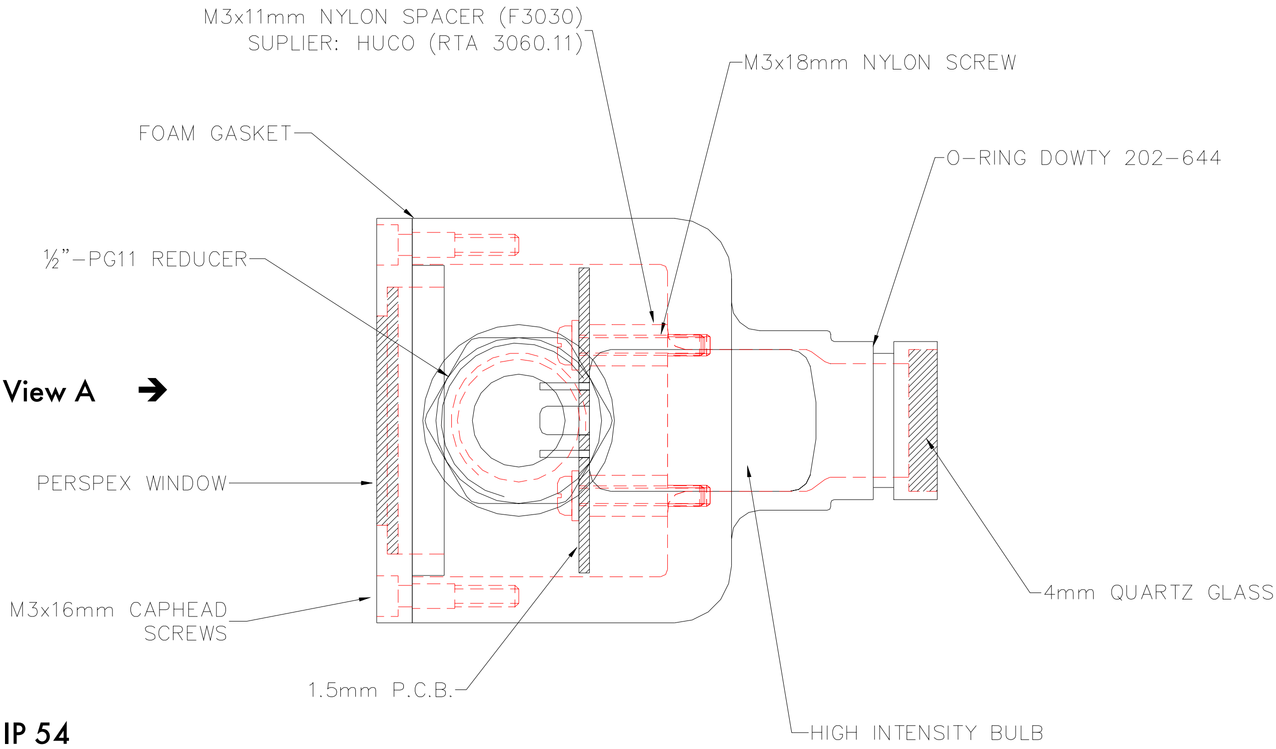


Two red LEDs show UV detection

2.14.3.4 Standard North American UV Scanner - End viewing

Part Numbers: MM60004/U
MM60004/HSU

Maximum operating temperature- 60°C / 140°F



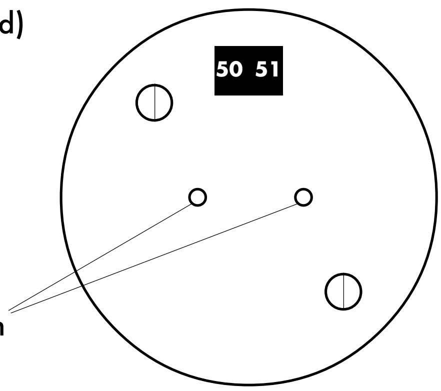
IP 54
HOUSING: ALUMINIUM
POWER COMSUMPTION: POWERED BY MK.6 MM
MOUNTING: ANY ORIENTATION AS LONG AS PHOTO TUBE FACES THE FLAME

<u>Connections</u>

Red	Terminal #51
Blue	Terminal #50
Black	Screen

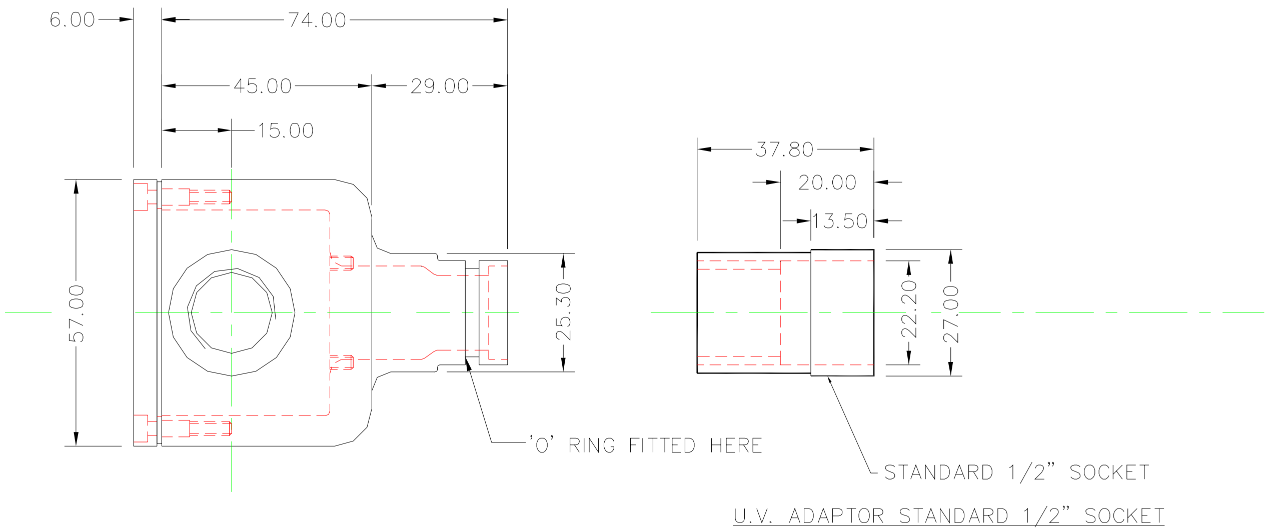
<u>View A</u>
(with cover removed)

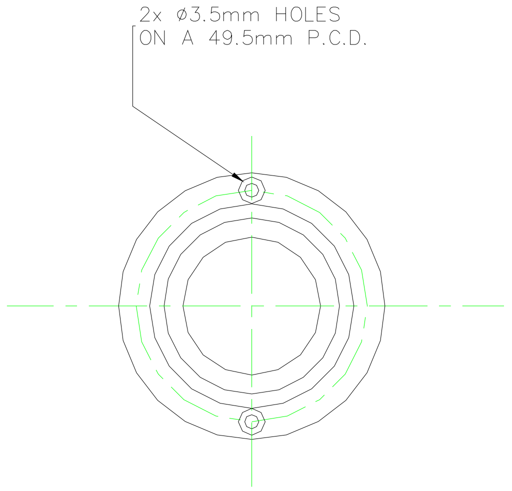
Note: If wired incorrectly a limited U.V. will be detected but the L.E.D. will not illuminate.



2.14.3.4 Standard North American UV Scanner - End Viewing Dimensions

Dimensions





2.14.3.5 Selection of UV Scanner Types

Normal Sensitivity

If the distance from the UV scanner to the flame is up to 20 inches (500mm) the normal sensitivity UV scanner types may be used.

Normal Sensitivity Scanner Types:

MM60003	Self Check
MM60004	Standard (Side View)
MM60004/U	Standard (End View)

Dependant on the application (e.g. flame size/shape/intensity, flame obstruction e.t.c.) where the signal strength is low, a high sensitivity scanner type may be necessary for distances below 20 inches.

High Sensitivity

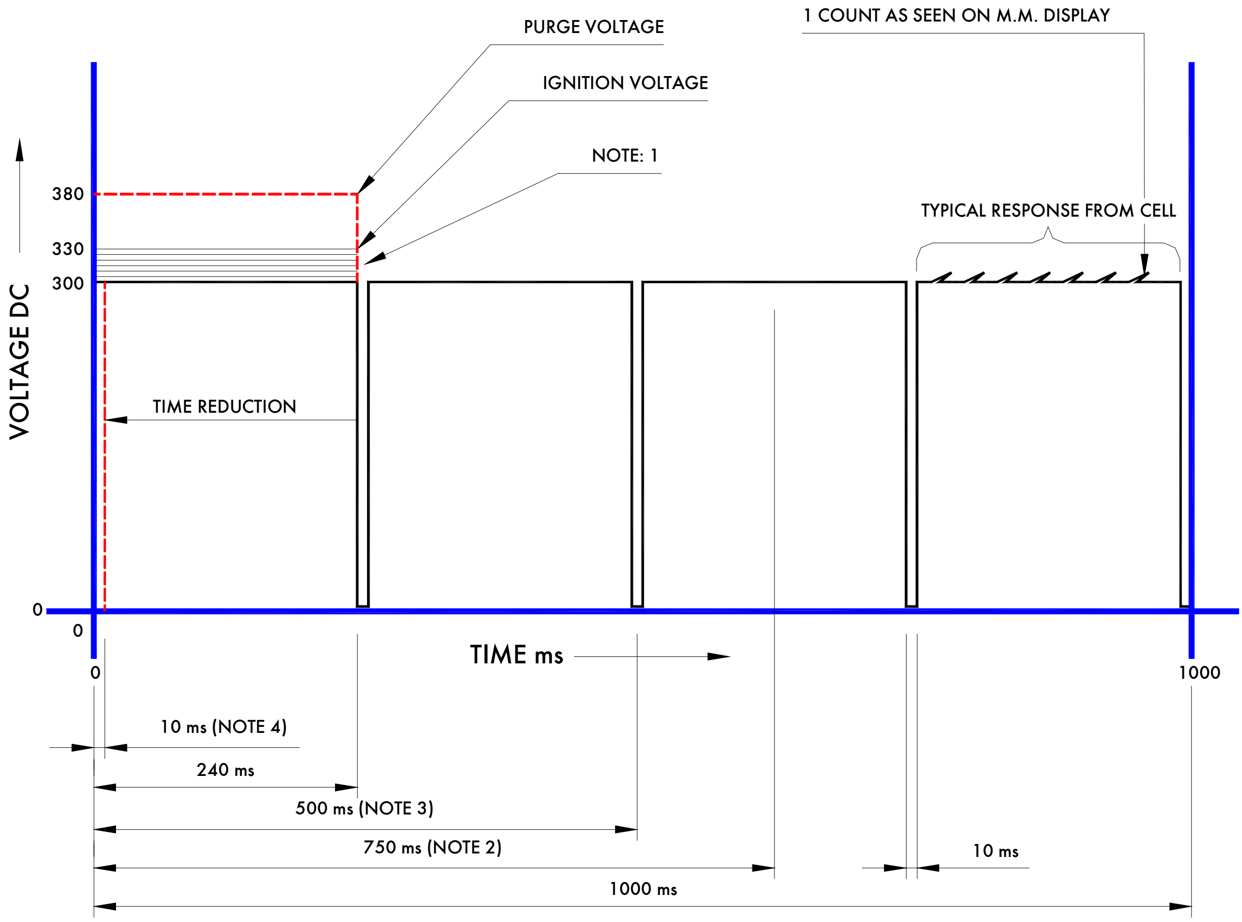
If the distance from the UV scanner to the flame exceeds 20 inches (500mm) the high sensitivity UV scanner types are recommended. The maximum distance from the flame is dependant on the amount of radiated UV. This will vary between applications but the typical maximum distance is 6ft (1500mm).

High Sensitivity Scanner Types:

MM60003/HS	Self Check
MM60004/HS	Standard (Side View)
MM60004/HSU	Standard (End View)

The information above is based on the results of tests using a simulated pilot flame. The flame was simulated by means of a bunsen burner flame with a flame size of 100x20mm.

2.14.3.6 UV Self Adaptive Pulse Width Modulation



NOTE: 1
AFTER FIRST SAFETY TIME VOLTAGE IS REDUCED BY 5 VOLTS EVERY 500 ms, THIS IS PROVIDING THE FLAME SIGNAL IS ABOVE THE U.V. SETPOINT. IF BELOW THE U.V. THRESHOLD VOLTAGE WILL REMAIN AT 330 VOLTS. THE VOLTAGE WILL NOT INCREASE DURING MAIN FLAME OPERATION.

NOTE: 2
IF 5 COUNTS OR LESS HAVE BEEN DETECTED OVER ANY 730 ms PERIOD THE SYSTEM WILL INVOKE A LOCKOUT.
A SHORT CIRCUIT BETWEEN THE 2 WIRES CONNECTED TO THE U.V. WOULD PRODUCE 3 COUNTS OR LESS. THIS IS THE REASON FOR NOMINATING 5 COUNTS AS THE LOCKOUT LEVEL.

NOTE: 3
DURING NORMAL OPERATION 300 VOLTS WOULD BE APPLIED FOR A 240 ms PERIOD AFTER THE SECOND SAFETY TIME. THIS IS PROVIDING THE U.V. SIGNAL IS ABOVE THE U.V. SETPOINT WHICH IS SET AT 25 COUNTS. THE SETPOINT CAN NOT BE ADJUSTED.

NOTE: 4
WHEN THE SIGNAL IS ABOVE THE U.V. SETPOINT, THE TIME VOLTAGE IS APPLIED TO THE CELL IS REDUCED BY 1 ms EVERY 500 ms.
THE TIME WOULD CONTINUE TO REDUCE UNTIL A MINIMUM OF 10 ms HAS BEEN REACHED.
AT THIS STAGE NO FURTHER TIME IS DEDUCTED FROM THE VOLTAGE APPLIED TO THE CELL.

NOTE: 5
EVERY 500 ms THE RECORDED COUNTS ARE AVERAGED AND DISPLAYED ON THE M.M. SCREEN.

4113/19:04:00/SBK

2.14.4 Error Checking, Self Diagnostics Fault Analysis and I.D. Codes

Self Diagnostic Fault Identification Software

The "Error Checking" software, which is included in every M.M. E.G.A. module, continually interrogates the system for component or data handling failure. This intensive self checking programme is inflicted on all peripherals such as positioning motors and load detectors as well as the main M.M./E.G.A. system hardware. The safety related areas, both hardware and software, have been examined and accepted for CE, UL, FM and TUV.

Any error identified by the system is indicated by "ERROR" being displayed and the relevant error number. In the case of E.G.A. related faults, "ERROR EGA" is displayed with the corresponding error identification code.

2.14.4.1 Key to Errors Detected in Mk.6 M.M. System

ERROR- confirms that error has been detected in the M.M. System.

Error Fault Type	Code No	
CH1 Positioning Error	01	- Check wiring & motor
CH2 Positioning Error	02	
CH3 Positioning Error	08	
CH4 Positioning Error	09	
CH1 Gain Error	41	- Check wiring & potentiometers are zeroed correctly
CH2 Gain Error	42	
CH3 Gain Error	43	
CH4 Gain Error	46	
CH5 VSD Error	80	- CH5 variable speed drive error
CH6 VSD Error	81	- CH6 variable speed drive error
CH5 VSD Feedback Error	83	- CH5 variable speed drive feedback signal different to commissioned values
CH6 VSD Feedback Error	84	- CH6 variable speed drive feedback signal different to commissioned values See Section 2.14.2.10
Load Detector	03	- Open circuit on temperature sensor
12V/5V Supply Error	44	- Internal 5V/12V supply outside limits. Check 12V on terminals #40 & 41
Gas Sensor Recommission Error	GASRECOMM	- Reset option/parameter #150 back to 0 and reset options/ parameters #136/137 back to original values

Error Fault Type	Code No
Air Sensor Recommission Error	AIR RECOMM - Reset option/parameter #150 back to 0 and reset option/ parameter #147 back to original value
Watchdog - Error CR2	45 - Unit hardware failure
A/D Converter Error	47 - Check 12V supply on terminals #40, 41
Twin Burner Communications Failed	100 - Flashing error- no communications between the M.M. units
Air Pressure Outside Limits	82 - During run mode actual air pressure outside limits, commissioned +/- 0.3 "wg (see option #147)
Gas Pressure Sensor MM60008 optioned together with psi units	110 - See options #124 & 133 to 137. PSI display cannot be chosen for this sensor range
WL probes detected WL not optioned Check WL configure	251 - Water level probes are detected but the MM is configured for operation without the water level. Check the second password screen

2.14.4.2 Mk.6 Burner Control Lockouts

Lockout Message	Cause
CPI input wrong state	Proof of closure switch opened during ignition sequence Check terminal #55 and proof of closure switches (cpi = close position interlock / proof of closure)
No air proving	No air pressure during start/firing Check terminal #54 and air switch
VPS air proving fail	Leak detected during 'air proving' part of VPS Check 1st main valve
VPS air zeroing fail	When valve C opens, zero value outside limit +0.5 to -1.0" wg Check vent valve
VPS gas proving fail	Leak detected during 'gas proving' part of VPS Check 2nd main valve and vent valve Check pilot valve if using single pilot operation (option #130)
VPS gas pressure low	Gas pressure below minimum application pressure Check option #133 for minimum allowable pressure
No flame signal	No flame signal during ignition/firing

Lockout Message		**Cause**
Simulated flame		The flame is present when it should not be. Call for service immediately. This is potentially a dangerous condition.
Fail safe relay fault	57	These terminals are self checked within the Mk6. If a voltage is detected when the output is off (and vice versa) a lockout occurs.
Vent valve output fault	62	
Main gas output 1 fault	61	
Main gas output 2 fault	60	
Start gas output fault	59	
Motor output fault	58	
Ignition output fault	63	
Shutter fault		UV signal detected during shutter operation on UV self check Check wiring on terminals #21/22
Prolonged lockout reset		Prolonged voltage present on terminal #56/lockout reset button permanently pressed
No CPI reset		Proof of closure switch not made after valves closed after firing Check terminal #55 and proof of closure switches
Gas pressure low limit		Gas pressure low limit exceeded when using a gas sensor Check option #136
Gas pressure high limit		Gas pressure high limit exceeded when using a gas sensor Check option #137
Gas pressure low		Low gas pressure before start up
UV short circuit		Connections to UV tube shorted
Oil pressure low limit		Oil pressure low limit exceeded when using an oil sensor Check option #139
Oil pressure high limit		Oil pressure high limit exceeded when using an oil sensor Check option #140
Purge air pressure low		Insufficient air pressure during purge Check option #141
Option #141 incorrect		Option #141 is set without option #148
Watchdog fault 1a		Internal fault diagnostics - contact Autoflame and report code displayed.
Watchdog fault 1b		
Watchdog fault 1c		
Watchdog fault 1d		
Watchdog fault 2a		
Watchdog fault 2b		
Watchdog fault 2c		
Watchdog fault 2d		

Ram test failed Prom test failed CPU test failed Input fault BC input short Lockout 198, 199, 200, 201, 202	Internal fault diagnostics - contact Autoflame and report code displayed.
Terminal 86 inverse	Terminals #85/86 both have an input or teminals #85/86 both do not have an input when using the flame switch operation- see option #122.
Termminal 85-86 fault	Electronics fault on either terminal #85 or #86.
Prove cct fail	Loss of input on terminal #52. Terminal #52 must see an input at all times from the position to purge to the end of the post purge (cct = closed circuit).
Option 118 incorrect	If using the NFPA post purge (option #135 = 2) then option #118 must have a setting of 15 or above.
Boiler DP proving	If using boiler differential proving (parameter #92 = 2), and the input on terminal #85 is reset then this lockout will occur.

Gas Sensor Related

Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low gas sensor	see section 2.14.2.6.2 for zero limits
Zero high gas sensor	see section 2.14.2.6.2 for zero limits
Excessive VPS Operations	VPS has operated 3 times without burner firing
Signal dev - gas sensor	redundant signals from sensor do not match
Counts low - gas sensor	sensor fault - stuck on signal value
Counts high - gas sensor	sensor fault - stuck on reference value
Signal high - gas sensor	gas pressure exceeds maximum range value
Gas sensor (+ number)	sensor/Mk6 internal fault - report to Autoflame

Air Sensor Related

Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low air sensor	lower limit is -1.0"w.g.
Zero high air sensor	upper limit is +0.5"w.g.
Signal dev - air sensor	redundant signals from sensor do not match
Counts low - air sensor	sensor fault - stuck on signal value
Counts high - air sensor	sensor fault - stuck on reference value
Signal high - air sensor	air pressure exceeds maximum range value
Air sensor (+ number)	sensor/Mk6 internal fault - report to Autoflame

The "Error Checking" software, which is included in every M.M. module, continually interrogates the system for component or data handling failure. This intensive self checking programme is inflicted on all peripherals, e.g. positioning motors/load detectors as well as the main M.M. system hardware. The safety related areas, both hardware and software, have been examined and accepted for CE, UL, FM and TUV.

2.14.4.3 Troubleshooting Guide

Gas/air sensor Diagnostic Codes

Shown at the bottom of the M.M. display if parameter #83=1.

Example:

Gas	43	1001
42	42	1000
Air	50	969
51	51	970

Explanation:

	Average Signal	Pressure Signal	Reference Signal	
Gas {	Gas	43	1001	Sensor Channel 1
	42	42	1000	Sensor Channel 2
Air {	Air	50	969	Sensor Channel 1
	51	51	970	Sensor Channel 2

Typical reference signals are 1000±14. If the reference signal values display 0 or are blank then the sensor is wired incorrectly.

Each sensor has two channels. Each channel gives out two values- a pressure signal and a reference signal. The values displayed are 'digitised' signals (range 0-1023). The two pressure signals should be the same. The two reference signals should be the same.

If the two pressure signals are different by more than 10 the averaged value will show 01 and not the average of the two signals.

With no pressure applied to the sensor the pressure signal value should be between 20 to 60 (typically between 40 to 50). If the reading goes below 5 then an error will occur due to a negative pressure on the sensor.

Note: These values are only displayed once the burner has been commissioned.

AC Drive Diagnostic Codes

Shown at bottom right of the [⊘ V.S.D. AIR SENSOR] display if parameter #83=1.

Example:

0	0	250	253	254
0	0	100	120	121

Explanation:

	1	2	3	4	5
CH5 AC Drive	0	0	250	253	254
CH6 AC Drive	0	0	100	120	121

1 & **2-** should normally be 0.

3 to **5-** digitised values, 0-255.

3- represents linearly (0-255) 4-20mA/0-10V the analog output from the MK6.
4- represents linearly (0-255) 4-20mA/0-10V the analog commissioned value.
5- represents linearly (0-255) 0-20mA/0-10V the analog input into the MK6.

1- window error count value will increment if the difference between **4** & **5** is greater than 10. An M.M. error will occur if the count reaches 150. This takes approximately 3 seconds.

2- disparity error count value - will increment up if the difference between **4** & **5** is greater than 15. An M.M. error will occur if the count reaches 50. This takes approximately 1 second.

Error checking is only carried out when the burner is firing.

The correct feedback signals must be attained for purge & ignition to progress, i.e. **5** must be as **4**±15.

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

UV Problems

If the red LED's fail to illuminate but the burner operates, the flame signal will be reduced. 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 cicumstances 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.

2.14.5 End User Day to Day Operation

2.14.5.1 <u>Normal Run Operation</u>

Upon initial selection of a commissioned fuel, a logo screen flashes up followed by the 'MM STATUS' screen. The COM led flashes for five seconds.

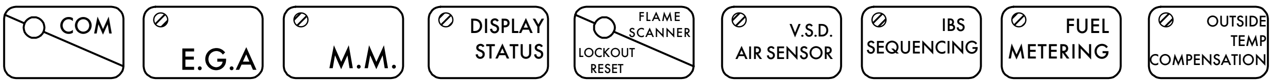
To adjust the required sepoint press DISPLAY STATUS and use the third row accordingly.

To adjust the second/reduced required sepoint press DISPLAY STATUS and use the fourth row buttons accordingly.

The range of the required setpoint is limited according to the type of sensor being used (see option #1). Note that if a DTI is connected and being used to set the required setpoint it will not be possible to adjust the required setpoint from the front facia. In the event of the M.M. losing communication with the DTI (e.g. DTI powered down) the M.M. will run stand alone after approximately 30 seconds. When the M.M. is running stand alone the required setpoint can be set locally on the front facia (any previous DTI disable command will also be ineffective). It is possible to lock the required/reduced setpoints without using a DTI so that this cannot be changed through the front facia (see section 2.14.20).

If the burner control circuit is closed the burner system will sequence through the burner start up procedure. The system purges and ignites, and twenty seconds (nominal) after ignition the system modulates.

Values are displayed according to the selected screen. There are a number of possible screens as shown on the next page. To select one of the display modes just press:



This button also scrolls to the Valve Proving Screen

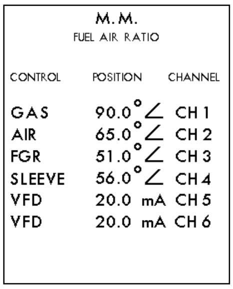
The respective LED will remain illuminated to indicate which mode is selected. The COM and E.G.A. modes are only selectable if an E.G.A. is optioned on the system.

In the event of the system being powered down the commissioning data, options, parameters and required setpoint are all memorised. During normal run operation the RUN led is on all the time. When no fuels are selected only the RUN LED remains illuminated.

If an E.G.A. is operative on the system it will calibrate every time the burner starts and stops. When COM or EGA display modes are selected EGA CALIBRATING is displayed when the E.G.A. is calibrating. If the E.G.A. is cooling, COOLER NOT READY is displayed. If the burner is not firing, SAMPLING SYSTEM READY is displayed. When the burner is firing both modes show E.G.A. if the actual value has not reached the value at which trimming is permitted (see option #28). If an E.G.A. error has occurred the error code number is displayed if either EGA or COM modes are selected.

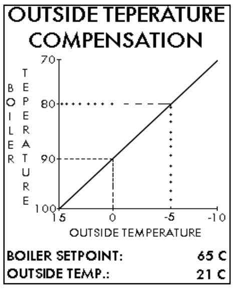
The software version number can be displayed by by pressing the Top CH1 buttons simultaneously, when in the M.M. display mode.

Several different displays are available to provide the operator with unambiguous information through start-up and normal operation.
Selectable screens provide the following information:



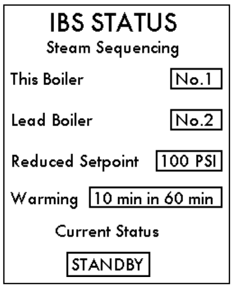
M.M. Status

Shows the actual positions of air and fuel valves as well as fan speed information from inverters, which is expressed as a 4-20mA or 0-10V signal.



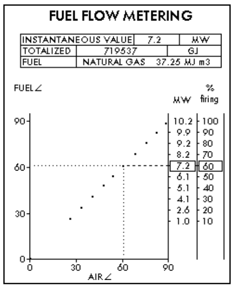
Outside Temperature Compensation

This screen is a graphic display showing the currently pre set relationship between boiler temperature set point and outside ambient temperature. This relationship can be changed by the operator over a wide temperature range.



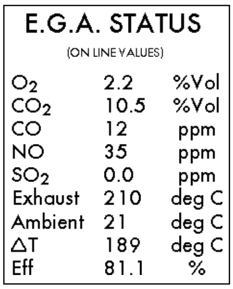
IBS Status

For a multi boiler installation, this screen shows which is the lead boiler plus information on temperature and pressure set points.



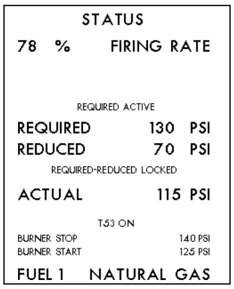
Fuel Metering Status

This screen displays which fuel is currently selected, the consumption at this point in time and the total fuel used to date.



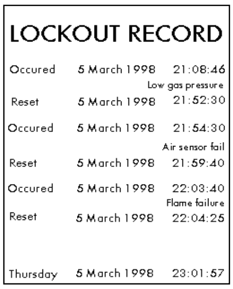
E.G.A. On Line Values

When an Exhaust Gas Analyser (E.G.A.) is included in the system,this screen shows the actual values of the gases being measured in the flue plus the exhaust gas temperature, ambient temperature, dT, and efficiency. A further screen shows the commissioned values.



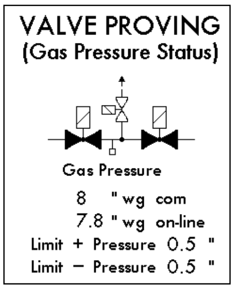
System Status

This screen shows the present firing rate, which fuel is being used, the required setpoint, reduced setpoint and the actual temperature/pressure.



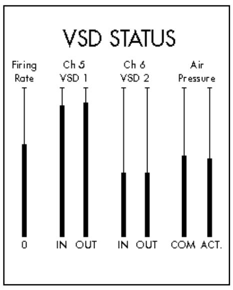
Lockout History.

This screen gives a real time log of the last 16 lockouts. Details include time, date, a brief discription and reset time.



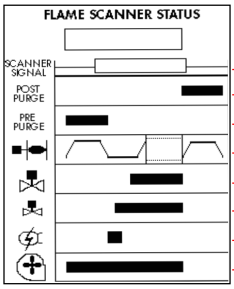
Valve Proving

This screen displays the positions of fuel valves, open or closed during pressure proving prior to burner firing. During run the on-line and commissioned gas pressures are displayed with +/- limits.



Variable Speed Drive

There are two control channels available for driving inverters. These can be 0-10 volts or 4-20 mA as required. This screen shows graphically the input & output signals to the variable speed drives.
The actual wind box pressure is shown against the commissioned data.



Flame Scanner Status, Screen Menu

- Flame Scanner Signal.
- Post Purge.
- Pre Purge.
- Air Damper position.
- Main fuel valve.
- Pilot/start gas valve.
- Ignition.
- Operation of fan.

2.14.5.2 Adjusting Clock Settings, Contrast and Actual Load Reading

Setting Time & Date

To adjust the time and date settings go into COM mode (power down the unit and restart. The COM light will be flashing and you have 5 seconds to press it).

'ENTER PASSWORD' screen is displayed. Set password to: **10 10**. Press CLOSE.

'Set Clock' screen is displayed:

SET CLOCK

DAY	**MONDAY**
DATE	**17**
MONTH	**NOVEMBER**
YEAR	**06**
HOUR	**12**
MINUTES	**30**

24 hour clock

To adjust the values use the corresponding buttons.

When finished press the flashing ENTER MEMORY button to submit to memory.

Adjusting the Screen Contrast

Hold down any of the screen select buttons:

OUTSIDE TEMP COMPENSATION | FUEL METERING | IBS SEQUENCING | V.S.D. AIR SENSOR | FLAME SCANNER LOCKOUT RESET | DISPLAY STATUS | E.G.A | M.M.

and then use the top row to adjust the contrast accordingly.

Calibrating Actual Load Reading

A facility exists to adjust small errors in the actual pressure or temperature displayed on the status screen.

To increase the value press RUN and the CH3 simultaneously.

To decrease press RUN and the CH3 .

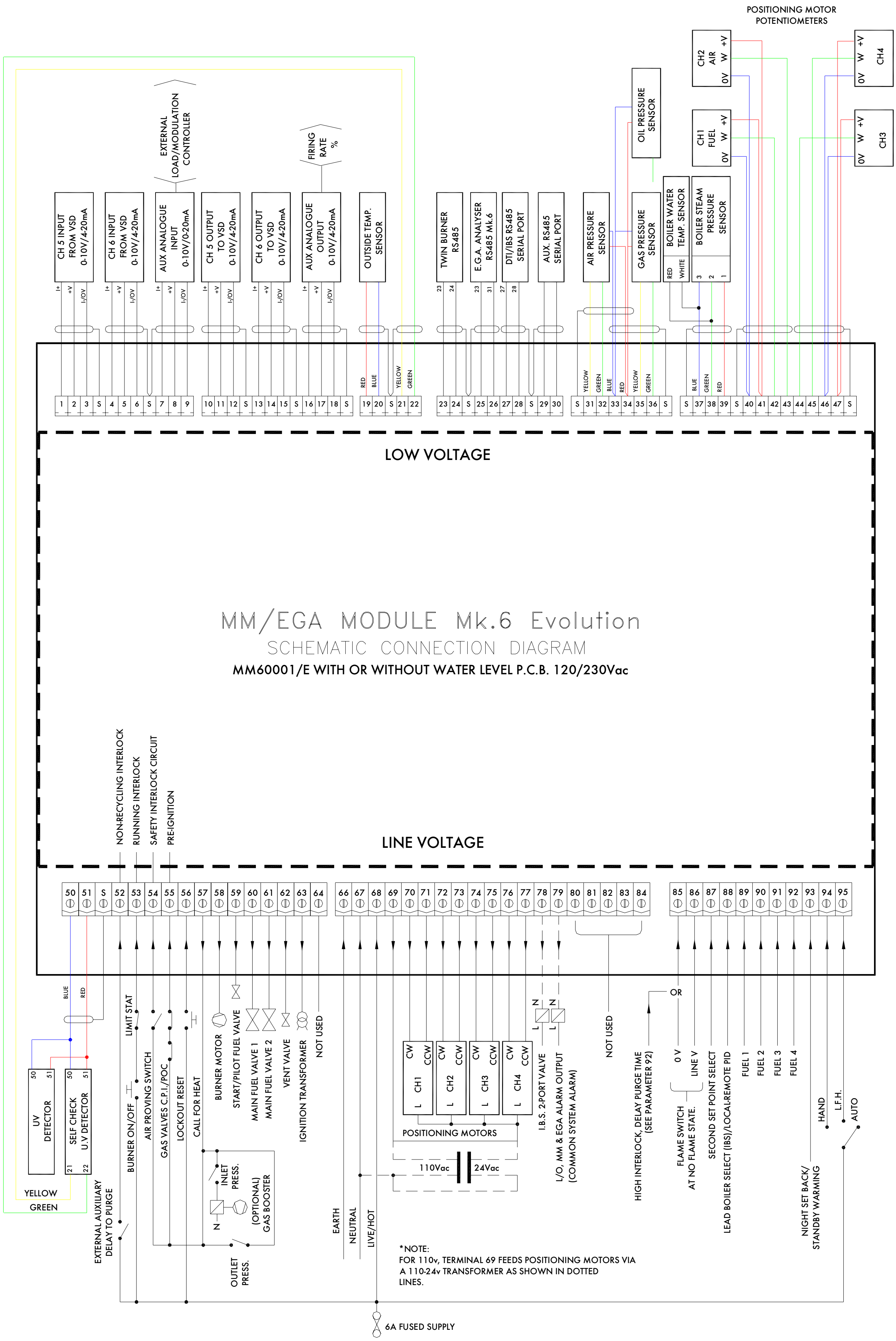
2.14.5.3 EPROM Version Numbers

To display the software version number select the M.M. display screen, then press the channel 1 up and down buttons simultaneously.

EPROM
VERSION NUMBERS

BC	6.26
MM	6.26
DI	6.28

Software version numbers are also displayed on the password screen when in commissioning mode.


MM/EGA MODULE Mk.6 Evolution
SCHEMATIC CONNECTION DIAGRAM
MM60001/E WITH OR WITHOUT WATER LEVEL P.C.B. 120/230Vac
LOW VOLTAGE
LINE VOLTAGE
POSITIONING MOTOR POTENTIOMETERS
CH 5 INPUT FROM VSD 0-10V/4-20mA
CH 6 INPUT FROM VSD 0-10V/4-20mA
EXTERNAL LOAD/MODULATION CONTROLLER
AUX ANALOGUE INPUT 0-10V/0-20mA
CH 5 OUTPUT TO VSD 0-10V/4-20mA
CH 6 OUTPUT TO VSD 0-10V/4-20mA
FIRING RATE %
AUX ANALOGUE OUTPUT 0-10V/4-20mA
OUTSIDE TEMP. SENSOR
TWIN BURNER RS485
E.G.A. ANALYSER RS485 Mk.6
DTI/IBS RS485 SERIAL PORT
AUX. RS485 SERIAL PORT
AIR PRESSURE SENSOR
OIL PRESSURE SENSOR
GAS PRESSURE SENSOR
BOILER WATER TEMP. SENSOR
BOILER STEAM PRESSURE SENSOR
CH2 AIR
CH1 FUEL
CH4
CH3
NON-RECYCLING INTERLOCK
RUNNING INTERLOCK
SAFETY INTERLOCK CIRCUIT
PRE-IGNITION
UV DETECTOR
SELF CHECK U.V DETECTOR
YELLOW
GREEN
BLUE
RED
LIMIT STAT
BURNER ON/OFF
AIR PROVING SWITCH
GAS VALVES C.P.I./POC
LOCKOUT RESET
CALL FOR HEAT
BURNER MOTOR
START/PILOT FUEL VALVE
MAIN FUEL VALVE 1
MAIN FUEL VALVE 2
VENT VALVE
IGNITION TRANSFORMER
NOT USED
INLET PRESS.
(OPTIONAL) GAS BOOSTER
OUTLET PRESS.
EXTERNAL AUXILIARY DELAY TO PURGE
EARTH
NEUTRAL
LIVE/HOT
POSITIONING MOTORS
110Vac
24Vac
I.B.S. 2-PORT VALVE
L/O, MM & EGA ALARM OUTPUT (COMMON SYSTEM ALARM)
NOT USED
HIGH INTERLOCK, DELAY PURGE TIME (SEE PARAMETER 92)
OR
0 V
LINE V
FLAME SWITCH AT NO FLAME STATE.
SECOND SET POINT SELECT
LEAD BOILER SELECT (IBS)/LOCAL-REMOTE PID
FUEL 1
FUEL 2
FUEL 3
FUEL 4
HAND
L.F.H.
AUTO
NIGHT SET BACK/ STANDBY WARMING
*NOTE:
FOR 110v, TERMINAL 69 FEEDS POSITIONING MOTORS VIA A 110-24v TRANSFORMER AS SHOWN IN DOTTED LINES.
6A FUSED SUPPLY

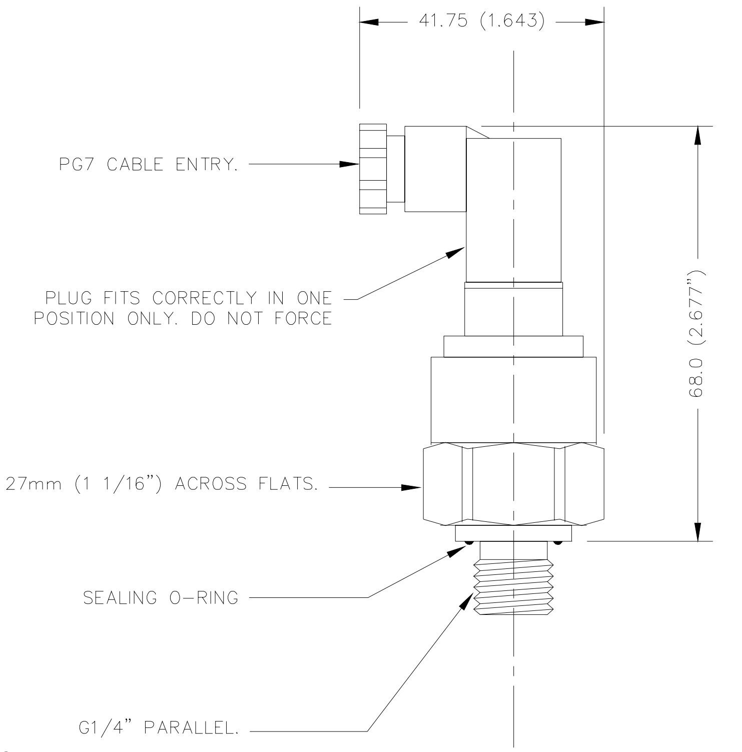
Steam Pressure Sensor

Part Numbers- MM10008/9/10/16

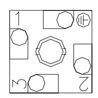
PRESSURE SENSOR ELECTRICAL CONNECTIONS

SENSOR TYPE		MM UNIT	
PLUG SENSOR	LEAD SENSOR	MK6/MINI MK6	MINI MK5
GREEN (2)	GREEN	38	61
BLUE (3)	YELLOW	37	0V
RED (1)	BROWN	39	+V
N/A	WHITE	UNUSED	UNUSED
NOT CONNECTED	SCREEN	S	38

FOR CORRECT OPERATION THE DETECTOR MUST BE INSTALLED WITH A PRESSURE SIPHON LOOP. DO NOT INSTALL AN ISOLATION VALVE BETWEEN DETECTOR AND PRESSURE VESSEL



NOTE: EARTH PIN IS SLIGHTLY LARGER TO ENSURE CORRECT CONNECTION DO NOT FORCE.



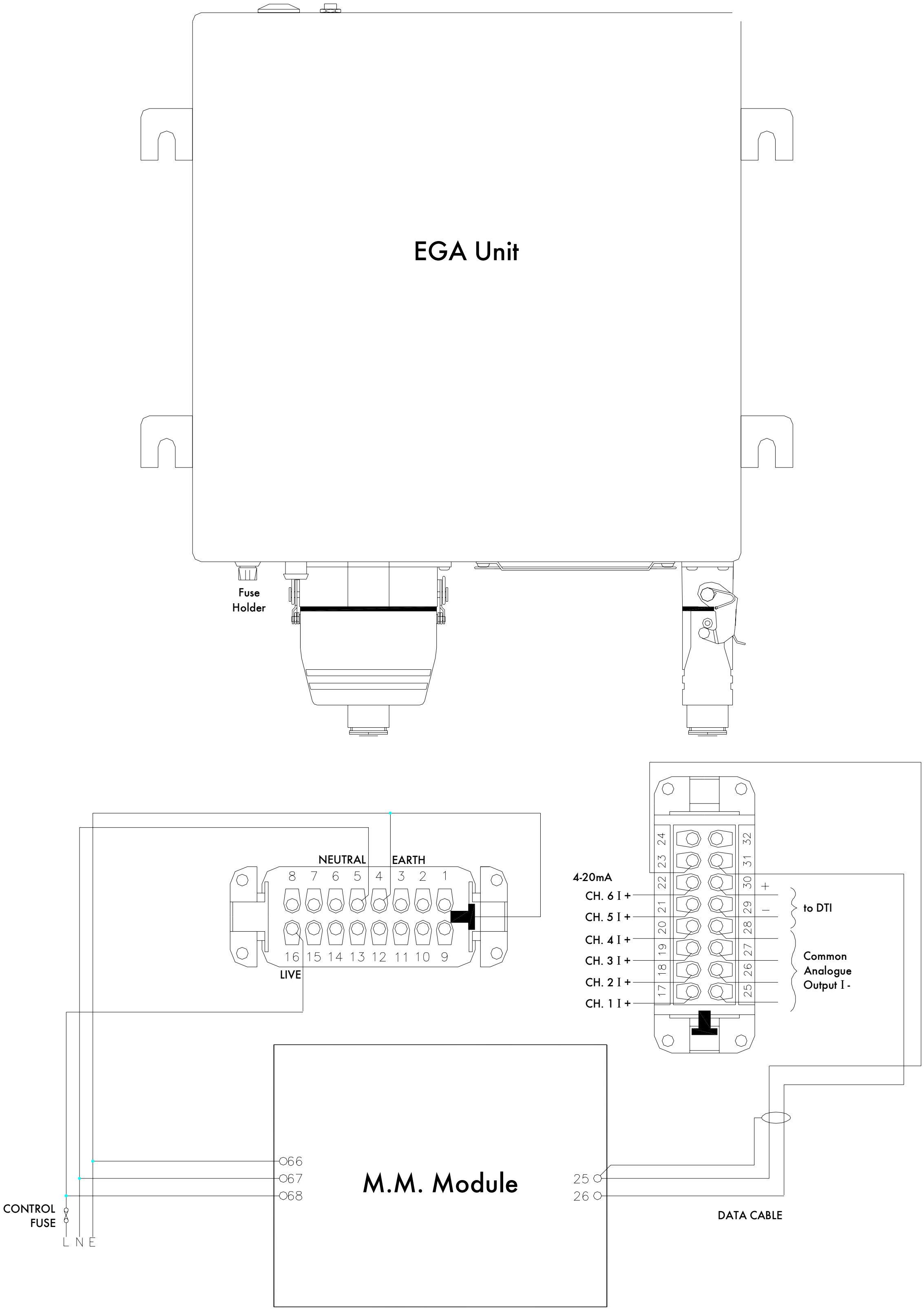
ELECTRICAL CONNECTION
Shown from behind.

NOTES

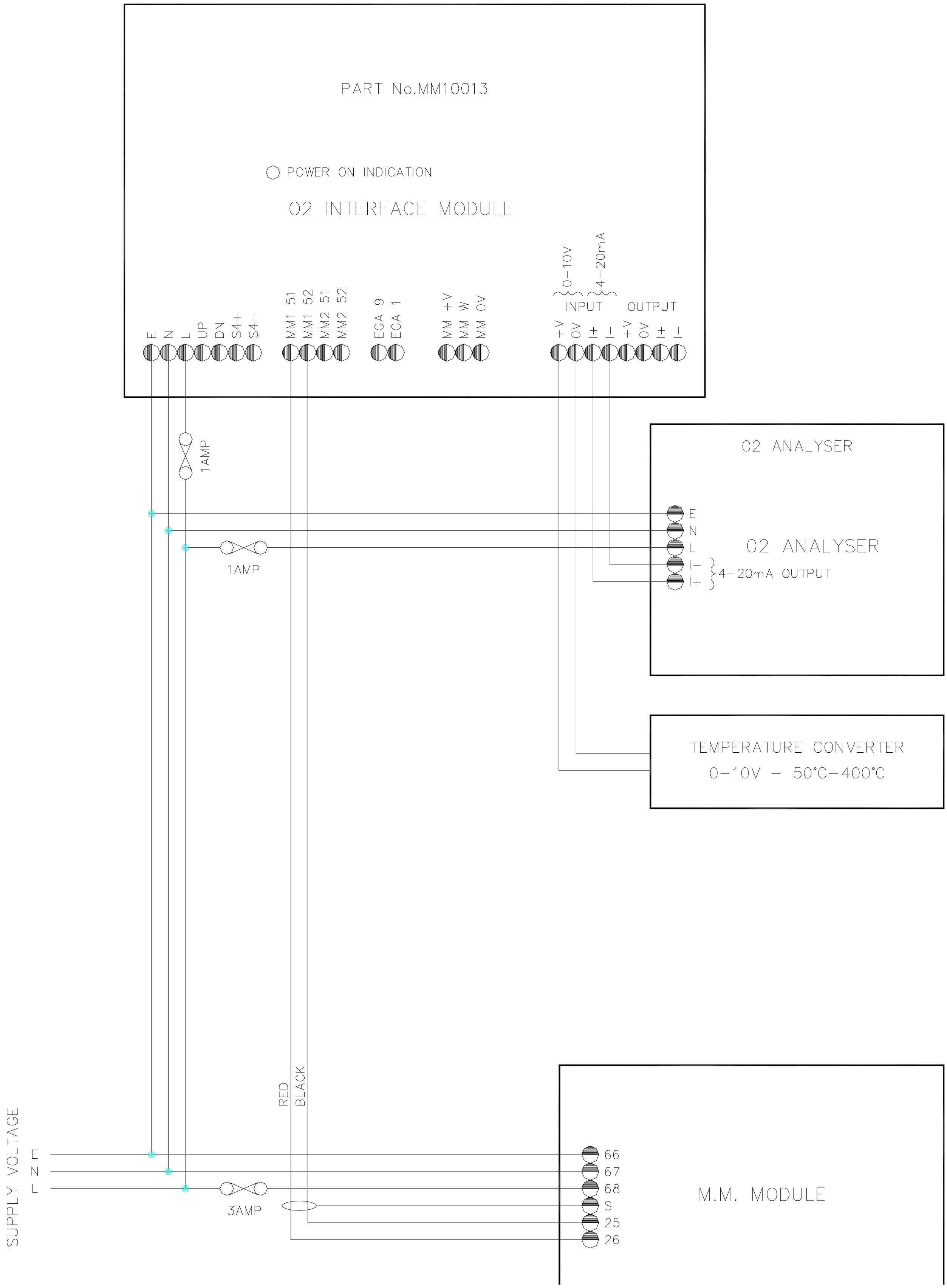
MAXIMUM 2.5mm FLAT BLADE SCREW DRIVER FOR ELECTRICAL CONNECTIONS
I.P. RATING 65
NEMA 4
TORQUE SETTING- 15-20Nm
DO NOT USE CASE TO TIGHTEN PRESSURE CONNECTION.
O-RING MATERIAL- VITON
MAX. STORAGE TEMP. -25 TO +85 DEG. C
MAX. OPERATING TEMP. -25 TO +85 DEG. C
MEDIA TEMP (STEAM) -25 TO 85 DEG. C

Part no.	Actual Range	Over Pressure	Burst Pressure
MM10010	3.0 - 55.0 psi (0 - 3.80 bar)	145 psi (10 bar)	174 psi (12 bar)
MM10008	30 - 330 psi (0 - 23.0 bar)	870 psi (60 bar)	1087 psi (75 bar)
MM10009	30 - 550 psi (0 - 38.0 bar)	1160 psi (80 bar)	1740 psi (120 bar)

Interconnection between M.M. Module and E.G.A. Sampling Unit



Interconnection between M.M. Module AND O2 Interface Module



O2 Interface Module

The O2 interface module allows the use of an existing O2 sensor and in-situ probe to be used in conjunction with the M.M. control.

The O2 analyser is only measuring the O2 reading from the sensor and the exhaust gas temperature via a thermocouple mounted into the stack. It is important to note that the signal from the O2 sensor must be a 4-20mA and the thermocouple reading must be a 0-10V signal. These signals must be ranged as below:

O2 reading:	4 - 20mA = 0 - 20.9% O2
Thermocouple reading:	0 - 10V = 50C - 400C (122F - 752F)

Although the analyser is only measuring the O2 reading from the stack it is possible for the O2 interface module to extrapolate a CO2 value from the O2 sensor reading. These value can then be displayed on the M.M. facia (via the E.G.A. button) or via the D.T.I. on a PC or BMS interface.

Parameter #60 is used to set the operation of the O2 interface module.

If this is set to a value of 0 then the efficiency will be calculated from the exhaust temperature and CO2 value and this will be displayed on the M.M. facia. The CO reading will always be displayed as a zero value.

If this is set to a value of 1 then the CO, NO, exhaust temperature and efficiency will remain blank.

If using the O2 interface module it is possible to use the limits for O2 readings and exhaust gas temperature readings.

2.14.7 Twin Burner Operation

2.14.7.1 Twin Burner Commissioning

Options #14 and #33 have to be set to correctly implement twin burner operation. Refer to the option section. For commissioning purposes it is easiest to set option #14 on each M.M. to value 0, and commission each burner individually. It is the commissioning engineer's responsibility to ensure that no adverse effects are caused as a result of this, particularly, stress to a boiler not designed to have only one burner firing. If this is the case then both burners must be commissioned simultaneously.

AFTER COMMISSIONING SET OPTION #14 TO IT'S TWIN BURNER VALUE ON BOTH M.M.s

Before commencing commissioning set the following options (refer to options section for more details):

Option #33:

Set value of left hand burner to its appropriate identification number, e.g. #1. Set the right hand burner to the Identification of the left hand burner +1, i.e. #2.

Option #33 will have to be interpreted if the boilers are numbered right to left. The details here are for left to right numbering.

Other options may be set as usual.

Normal Operation

Only the odd numbered M.M. needs an input on terminal #88 to make this boiler lead boiler. If a connection is made to the even number M.M. it will be ignored. The same applies for the hand/auto/low flame hold inputs #94/95, i.e. they do not need any connection on the even number M.M. if option #14 = 1. If option #14 = 2 then terminals #94/95 should be wired as normal for hand operation.

The even number burner always takes its load index from the odd number burner including when in 'Hand' mode. If communications between the two burners fail, each M.M. will open its internal stat and approximately every three seconds the displays on each M.M. show a flashing ERROR 100 to indicate a communications failure if option #14 = 1. If option #14 = 2 then the 2 M.M.s run stand-alone.

When entering the flow metering for sequencing purposes it is necessary to put both M.M.s into the "Flow Metering" mode at the same time,

i.e. Start up both burners, wait until both are modulating then press M.M. and COM on one of the M.M. units.

Within 10 seconds press COM and M.M. on the other M.M.

Keep the firing rate of each burner similar when entering profile, i.e. do 'point 1' on each M.M. then 'point 2' on each M.M, e.t.c. This is important as the boiler may be susceptible to stress if one tube is fired at a different rate to the other. The required setpoint and actual value on the even numbered M.M. will mimic the values on the odd number M.M.

The internal stat of the even numbered M.M. follows the odd number M.M.

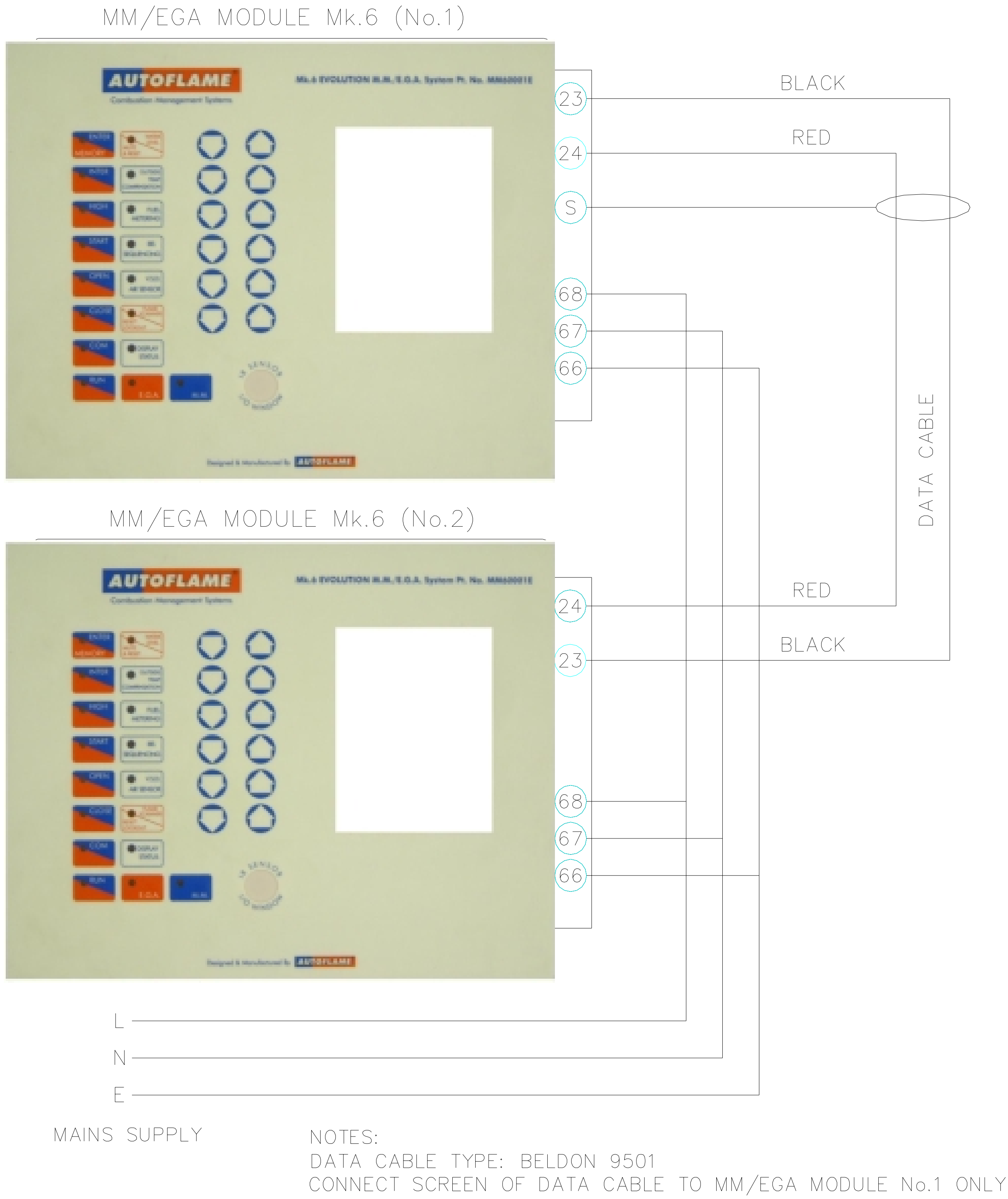
If Option #14 = 1, i.e. both burners fire simultanesouly and together at all times, then the internal stat of both M.M.s will open if there is a period of more than 10 seconds when one M.M. is modulating and the other is not. Therefore, both burners will be off. If one burner locks out then the other burner will shut down immediately.

There are various points that are checked when the system starts up, such as position to purge, purge, position to start, ignition and modulation. This ensures that both burners are operating together and simultaneously.

The load detector input in the even numbered M.M. can be left open circuit, it will not be error checked.

If an error condition arises on one or other of the M.M. units and option #14 = 1 then the other unit will open its internal stat and flash ERROR 100.

Interconnection between the M.M. Modules for Twin Burner Operation



The same arrangement applies to the Mk7 and Mini Mk6.

2.14.8 Hand/Auto and Low Flame Hold Facilities

<u>Low Flame Hold and Hand Operation</u>

'Low Flame Hold' and 'Hand' operation are only effective when the burner is firing. They have no effect when the burner is off or during the burner start up cycle. They are effected by applying a mains voltage signal to terminal #95 for low flame hold, or terminal #94 for hand operation. When these inputs have no mains signals applied, the system is in an automatic mode and modulates according to the PID control.

Low flame hold is brought into operation if terminal #95 has mains voltage applied when the burner is modulating or firing. The minimum flame position will be maintained from now on, until the input from terminal #95 is removed. Low flame hold will be established again by applying an input to terminal #95 again. During low flame hold the PID control is ignored.

'Hand' operation enables the fuel valve and air damper (and other channel) positions to be set to a specific position, in the range of minimum to maximum flame. Once a position has been set it is recorded in the M.M. units memory. As a default setting (option #60) the next time the system is put into a hand operation, the system will take on a fuel/air ratio in the commissioning curve similar to the current firing rate. The M.M. system sets the channel positions to the hand position whenever there is a mains signal on terminal #94. Once the burner is firing the 'hand' position can be adjusted by switching to the M.M.

screen or Display Status screen and using the bottom row of buttons on the Mk6 facia.

See option #60 for details on bumpless transfer.

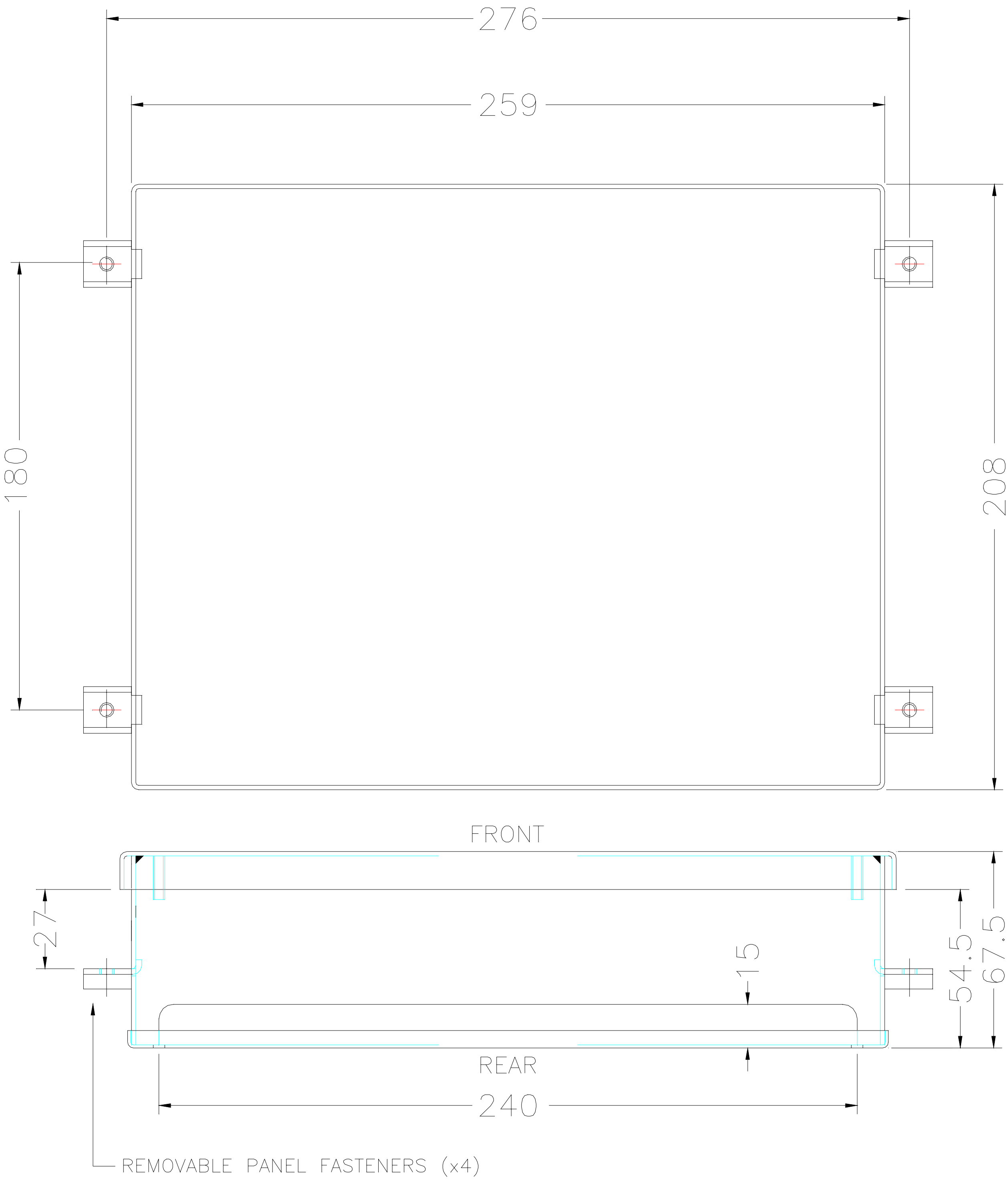
If hand and low flame hold operations are selected at the same time, via inputs both on terminals #94 and on #95, then low flame hold takes priority.

Note: Lead/Lag and sequencing will not operate if either terminal #94 or #95 has mains voltage applied.

2.14.10 Other Information and Illustrations

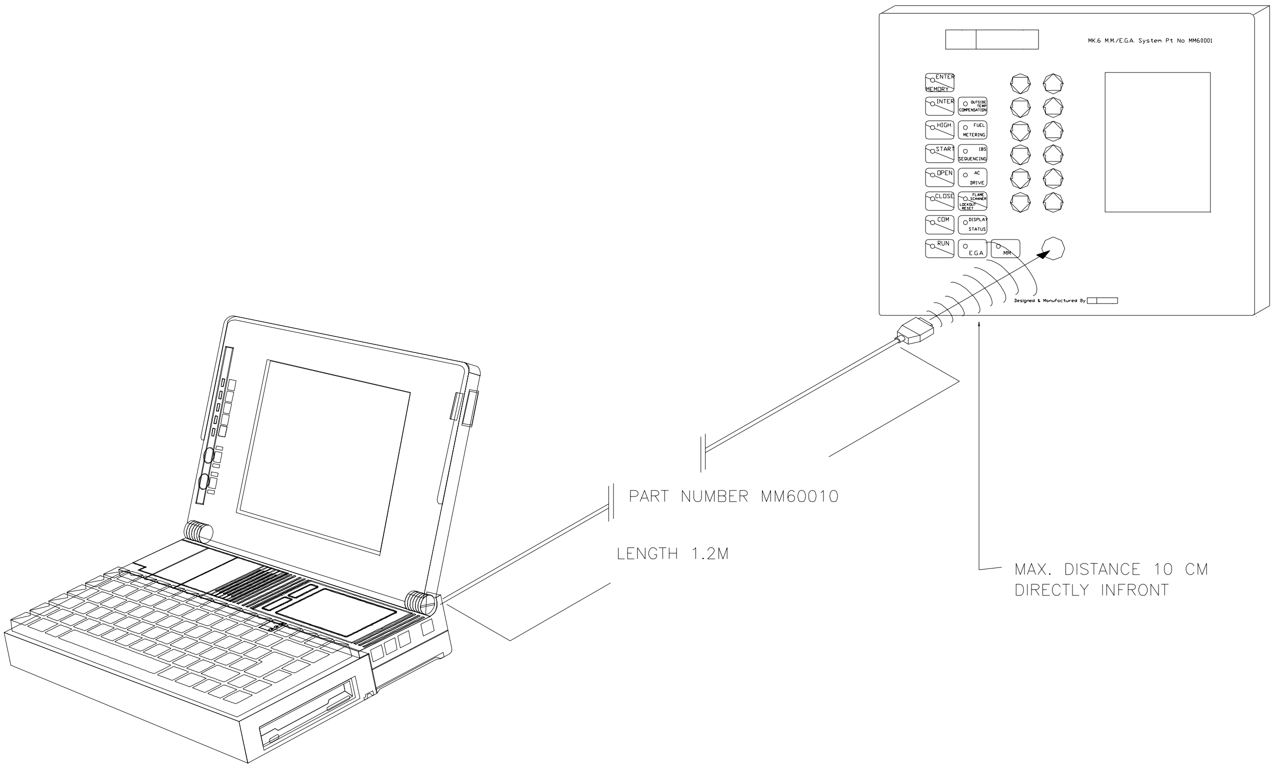
2.14.10.1 Mk6 Evolution M.M. Front Facia Details

2.14.10.2 Mk.6 M.M. Fixing Holes & Dimensional Details



Bottom View shown with lid in position.

2.14.10.3 Schematic View Of IR Upload Download



Software installation:

Insert CD and follow the installation procedure (setup.exe).

When SETUP has completed, insert the key diskette into drive A: click on start and choose run. Type A:\INSTALL.bat and press enter.

The software needs to be configured to the serial (COM) port that the IR lead is connected to. This happens the first time the Mk6 Upload/Download software is run.

WARNING

IT IS THE RESPONSIBILITY OF THE FACTORY TRAINED TECHNICIAN TO ENSURE THAT AFTER AN UPLOAD ALL THE OPTIONS, PARAMETERS AND FUEL/AIR RATIO COMMISSION DATA ARE CHECKED FOR CORRECTNESS. FAILURE TO DO SO WILL RESULT IN SERIOUS EQUIPMENT DAMAGE, CRITICAL INJURY OR DEATH.

2.14.10.4 Maintenance and Servicing

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

The positioning motors/gas/oil/FGR valves do require routine maintenance. Any fault associated with these parts is usually diagnosed by the M.M. Contact Autoflame for preventative maintenance procedures.

2.14.10.5 Installation Precautions

The reliability of the equipment may be impaired if used in environments where strong electromagnetic fields exist. If for example the equipment is installed in a boiler house where radio systems exist then additional EMC (Electro Magnetic Compatability) measures may have
to be considered

2.14.11 Fuel Flow Measurement and Metering Operation

1. Go to options, set option #57 to 1 (default 0).

2. When the above is displayed press ENTER MEMORY, this will initiate the flow metering setup mode.

3. Next time the burner starts the M.M. will go into the ten point setup mode for flow metering automatically.

4. In this mode the display will show the fuel valve position in degrees angular and the flow units which can be adjusted by using the CH1/CH2/CH3/CH4/CH5 buttons as shown at the bottom of the screen.

   Note:

   a) The CH4 window confirms to the commissioning engineer which of the 10 points are currently being measured.

   b) The minimum numerical value for fuel flow that can be entered into memory is 0.01. The maximum numerical value for fuel flow that can be entered into memory is 999.0

   c) The values are entered in descending order, i.e. point #10 is maximum flame and point #1 is at minimum flame. The 10 sequential point on the load index are all located automatically by the M.M. All values are in units/minute or units/hour.

5. When fuel flow has been calculated or read off of a commissioning fuel flow meter the value is entered as detailed in point #4.

   The ENTER MEMORY button is then pressed and the value is logged in the M.M. memory.

6. The above detailed data entry routine is repeated until all 10 points have flow values allocated to them.

7. When the last (10th) point has been entered the burner continues to fire.

8. To display Fuel Flow Metering press FUEL METERING button.

9. To reset the totalising value to 0 (zero) for the individual fuel selected set option #57 to 2, press ENTER MEMORY at that time. To reset all totalised values for each fuel use parameter #64.

Note: Fuel flow metering measurement now automatically starts totalling the amount of fuel used from the moment the main gas valves are energised. If the fuel flow metering is not entered then the firing rate display will read 00% and the system will not totalise the fuel input. Also, any control logic that requires the fuel flow metering, e.g. lead/lag and sequencing and steam flow metering, will not work correctly.

2.14.12 Golden Start

This facility enables an ideal ignition/start position to be set into memory that is not necessarily low flame or indeed part of the standard modulating load index.

To enable this facility to go to option #29, set to 0 (default value = 1) and press ENTER MEMORY

To disable this facility go to option #29, set to 1 and press ENTER MEMORY

To implement the above the system/burner is commissioned in the normal way, i.e. press COM

Enter the password, enter the close position, enter the open position, enter the start (light-off) position (adjust fuel/air positioning motors to give initial arbitrary ignition position). This position is not memorised. The burner will fire and the start position LED will flash again.

Press START , LED will remain stable, adjust the fuel/air positioning motors to give the ideal

ignition/start up position.

Press ENTER MEMORY and proceed with the commissioning routine in the normal way.

Notes:

1. The golden start/ignition position of the fuel and air positioning motors is completely independent from the modulating load index commissioned value data.

2. The facility is particularly useful on combustion systems with large turndowns and when firing heavy fuel oil, as it enables the burners to start/ignite at a fuel rich position and then, after a stable flame is established, to revert to the commissioned values for fuel/air ratio.

3. **WARNING-** this facility is common to all fuels (F1, F2, F3 & F4). A value must be entered on each programmed fuel. **Note:** As of June 2005, the golden start only needs to be entered for the required fuel.

4. The time that the M.M. holds the golden start position for is adjustable, see parameter #15. (default value is 5 seconds, range 0-100 seconds). This timer starts from the ignition point. After this time the air damper will open and the fuel valve will remain at the same position until the fuel/air ratio is on the original commissioning curve. At this point the M.M. will start to modulate based upon the load demand and the PID control.

5. If the commissioning engineer wishes to change the golden start position retrospectively this can be re-entered, without fully recommissioning the burner, in the following manner:

   Go into the commission mode, enter the password, enter the close and the open positions and enter, as previously described, to the point where high flashes then deselect fuel or power down. In this way the new golden start position is entered.

6. It is important to appreciate that the golden start position is completely independent of the fuel/ air paired values that are entered for the normal modulating load index/range.

2.14.13 Single Point Change (One Point Change)

To change a point:-

Start up the burner in the normal way.

Once modulating press START and COM simultaneously. 'ENTER PASSWORD' should be displayed. Set the password and press CLOSE in the same way as if going into normal commissioning, the channel position values should be displayed. The valves track to the nearest commission point (e.g. HIGH/INTER/START).

When all the values have settled at their appropriate positions ENTER flashes. If this point is to be changed press ENTER MEMORY. If not press the CH1 button to move to the next point up or the CH1 button to go to the next point down. The M.M. detects which point has been selected and will steady the appropriate LED on either HIGH, INTER or START as during normal commissioning. Once the correct point to be changed is displayed press ENTER MEMORY. It should now be possible to adjust the fuel/air ratio by using the CH1 - CH6 buttons. Adjust the values as desired and when the correct values are set press ENTER MEMORY. If an E.G.A. is optioned the E.G.A button will flash, press to view. If the E.G.A. is optioned for AUTOTRIM then this will be carried out and E.G.A. values stored.

Once complete the M.M. will revert to just ENTER and RUN flashing. If desired another point can be selected and changed. Otherwise press RUN and the M.M. reverts to normal modulation.

If the CH1 (fuel) HIGH or START position has been adjusted check the flow metering. It is likely that the 10 point flow calibration must be carried out again.

2.14.14 Flue Gas Recirculation

Flue Gas Recirculation (FGR) is a method whereby a quantity (approximately 15%) of the boiler flue gases are fed back to the burner and mixed with the combustion air. The virtue of FGR is the reduction of NOx gases. With the FGR facility, positioning motor channels 3 or 4 can be used to control the amount of flue gas fed back. It is not good practice to feed back the gases when the flue gas is cold, so all the elements (i.e. positioning motors and VFD's) can be set at 'FGR' positions until the gases are hot. During this time the elements (CH3 or CH4) controlling the FGR would normally be set closed. Once the gases are hot, modulation takes place in the normal way using the curve entered during commissioning.

To ascertain if the gases are hot a number of options have been added:

Option #48

A time in seconds that the FGR positions are held for. This timer starts from the point of release to modulation. If a golden start is used in conjunction with the FGR start then the FGR start timer will begin at the end of the golden start timer.

Option #49

An offset amount (e.g. 20) below the required setpoint (e.g. 100). This gives a threshold value of 80 (100 – 20). The FGR positions are held until the actual value has attained the threshold value (80). Once this actual value is reached then normal modulation will occur.

Option #50

This is an enable/disable type option. If enabled an E.G.A. must be present on the system. The FGR positions are held until the exhaust temperature value from the E.G.A. reaches 248F (120C). Once the exhaust gases reach this temperature then normal modulation will occur.

It is possible to use all three of the above options in order to keep the FGR start positions. If this is done then the timer will be held firstly and then the other two options must be satisfied for release to modulation.

It is important to check the setting of parameter #90, which determines at what time the FGR start position will be entered.

If the burner has been commissioned and it is necessary to add an FGR start position, set parameter #90 to 1, and one of the above options to enable FGR start. Then enter the commissioning mode and after the start position is entered the M.M. will prompt for the FGR start position to be entered. After this is entered the M.M. can be reset and this FGR start position will be stored in the memory.

2.14.15 Pilot Turndown/Check Switch Facility

When the system is in commissioning mode only, a facility has been provided that enables a commissioning engineer to pause the ignition sequence of the burner. If the lockout button is pressed during the first safety time the burner control will 'pause' at this position. This enables the commissioning engineer to make adjustments to the start gas flame. If the flame goes out during this time a lockout is set after 15 seconds. If the flame is present and the 'pause' condition is left indefinitely a lockout will be set after 10 minutes. If the lockout button is pressed again the ignition sequence continues. While paused the lockout LED on the front fascia flashes. The 'pause' facility can also be activated during the pilot prove and main flame prove phases. When the system is in a run mode the facility is disabled.

WARNING

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

2.14.16 Time Clock Facility

<u>Time Clock Set Up</u>

To adjust the time clock settings go into commissionning mode (power down/reselect fuel, press COM within 5 seconds). The 'ENTER PASSWORD' screen should now be displayed. It is also possible to change the time clock settings online- see section 2.14.20.

Set the password to **11** **11** and press CLOSE.

The 'Time Clock' screen will be displayed:

TIME CLOCK

	START	STOP	MODE
MONDAY	07:45	16:15	ON off
TUESDAY	07:45	16:15	ON off
WEDNESDAY	07:45	16:15	ON off
THURSDAY	07:45	16:15	ON off
FRIDAY	07:45	16:15	ON rsp
SATURDAY	07:45	16:15	ON rsp
SUNDAY	07:45	16:15	ON off

TIME CLOCK ENABLED

BURNER ON - NORMAL SETPOINT*

Monday 12 October 2000 09:50:23*

Note: items marked * not displayed during setup

Use the channel 6 up/down buttons to select the day and item to be adjusted. The selected item will flash.

For start/stop times:
Set the hour by means of the channel 1 up/down buttons.
Set the minute by means of the channel 2 up/down buttons.

For Mode:
Select the desired operation by means of the channel 1 up/down button.

To enable/disable the time clock operation use the channel 5 up/down buttons.

Press ENTER to memorise the time clock configuration. If enabled, the time clock operates from now on when in run mode. To disable time clock operation, enter the password as described above and set the time clock to disabled using the channel 5 up/down buttons and press ENTER.

<u>Time Clock Operation</u>

Operation during and outside the start/stop times is according to the mode selected:
ON off The burner runs and modulates according to the normal required setpoint during the start/stop times. Outside of the start/stop times the burner is held off.
ON rsp The burner runs and modulates according to the normal required setpoint during the start/stop times. Outside of the start/stop times the burner runs and modulates according to the reduced setpoint.

The normal setpoint and reduced setpoint are adjustable by means of the channel 3 and channel 4 up/down buttons respectively when the DISPLAY STATUS screen is selected. In normal run operation the Time Clock screen is selected on the third press of the display status button.

2.14.18.1 Automatic Commission of Air Pressure Values

A facility has been added to the Mk6 Evolution so that the air pressure values for each fuel/air ratio point entered can be commissioned without having to carry out a full fuel air ratio commission.

To invoke this facility the system must already be commissioned on fuel /air ratio. Option/parameter #150 must be set to value 7 then the enter button pressed. Option/parameter #147 must be noted and set to 0- off so that air pressure limit errors do not occur while the system is running.

Start up the system as normal. Once the burner is firing the system attains the high fire positions and samples and stores the air pressure at that point. The first fuel/air ratio inter positions are then attained and the air pressure again sampled and stored. This process is repeated until all fuel/air ratio inter and start positions are complete. The new air pressure values are then permanently stored and thereafter an MM ERROR is set - AIR RECOMMSSION (this is to bring to the attention of the operator that options/parameters must be adjusted back to operational settings). The error must be cleared and option/parameter #150 set back to 0. If not set back to 0 the air values will be commissioned again and the M.M. ERROR will ensue. Option/parameter #147 must also be adjusted to the appropriate value.

2.14.18.2 Automatic Commission of Gas Pressure Values

A facility has been added to the Mk6 Evolution so that the gas pressure values (during VPS and for each fuel/air ratio point entered) can be commissioned without having to carry out a full fuel air ratio commission.

To invoke this facility the system must already be commissioned on fuel /air ratio. Option/parameter #150 must be set to value 8 then the enter button pressed. Options/parameters 136/137 must be noted and set to 0- off so that gas pressure limit errors do not occur while the system is running.

Start up the system as normal. Once the burner is firing the system attains the high fire positions and samples and stores the gas pressure at that point. The first fuel/air ratio inter positions are then attained and the gas pressure again sampled and stored. This process is repeated until all fuel/air ratio inter and start positions are complete. The new gas pressure values are then permanently stored and thereafter an MM ERROR is set - GAS RECOMMSSION (this is to bring to the attention of the operator that options/parameters must be adjusted back to operational settings). The error must be cleared and option/parameter #150 set back to 0. If not set back to 0 the gas values will be commissioned again and the MM ERROR will ensue. Options/parameters #136/137 must also be adjusted to their appropriate values.

THE FACTORY TRAINED TECHNICIAN MUST NOW CHECK THE SYSTEM FOR CORRECT OPERATION.

Check the gas pressure commission value displayed during VPS operation. Once the burner is firing, check the gas pressure commission values for each fuel/air ratio point entered - this can be achieved by means of the hand operation facility.

2.14.19 Flame Detection using an External Flame Switch

To configure operation with a flame switch option/parameter #122 must be set to 1.

The operation of terminals #85 and #86 must be as follows:

When the flame switch is indicating no flame, the voltage on terminal #85 must be 0Vac, and the voltage on terminal #86 must be mains voltage (110/230Vac).

When the flame switch is indicating the presence of a flame, the voltage on terminal #85 must be mains voltage (110/230Vac), and the voltage on terminal #85 must be 0Vac.

Terminal #85 is the functional input for detecting the flame.

Terminal #86 is solely for the purpose of checking that terminal #85 is operating correctly. Terminal #86 must seen to be the inverse of terminal #85, i.e. if terminal #85 is at 0Vac, terminal #86 must be at mains voltage and if terminal #85 is at mains voltage, terminal #86 must be at 0Vac.

If terminal #86 does not follow the inverse of terminal #85 the following lockout will occur - terminal #86 inverse.

Flame Switch Configuration

Within the M.M. there is a latency of 250 milliseconds on the monitoring of terminal #85. To ensure a 1 second overall flame failure response time, it is essential that the response time of the flame switch is set to no more than 750 milliseconds.

Flame switches often provide a volt free change over contact to indicate the flame status. Alternatively, they may provide a pair of `inverse' outputs. If the flame switch only provides a single output terminal, a relay will have to be installed between the flame switch and the M.M. to provide a set of volt free changeover contacts.

2.14.20 Online Changes

A facility exist in the Mk6 M.M. Evolution that allows certain changes to be made whilst the burner is firing- 'on-line changes'. The various changes that can be made are listed below:

1. Lock the required setpoint and reduced setpoint.
2. Change options.
3. Change parameters.
4. Change the time-clock facility settings.
5. Change the channel labels.

<u>To make on-line changes</u>

1. It is important to firstly be in the M.M. screen.

2. Press DISPLAY STATUS and hold for 5 seconds. If this button is not held for 5 seconds then step 1 and 2 must be repeated. Once this is entered correctly a screen prompting a password will appear.

3. Use the CH1 and CH2 buttons to enter the password and then press CLOSE. If the password is entered incorrectly then the system will not allow the user to proceed.

4. Once the password is entered correctly the 'SELECT FUNCTION' screen will appear. Using the CH1 buttons it is possible to scroll through the various items that can be changed. When the desired selection is displayed press ENTER MEMORY to select it.

Note: RUN can be pressed at any time in order to return to normal operation. The current selected function will only be updated if the ENTER MEMORY button is pressed.

<u>Lock-Unlock Required Setpoint and Reduced Setpoint</u>

If ENTER MEMORY is pressed when 'LOCK REQUIRED VALUE' is displayed it is possible to lock or unlock the required and reduced setpoints. Use the CH1 button to lock the setpoints. Use the CH1 button to unlock the setpoints. Press ENTER MEMORY to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed again. It is now possible to press RUN to return to normal operation, or make further changes on-line.

Options

If ENTER MEMORY is pressed when 'OPTIONS' is displayed then the 'SET OPTIONS' screen will be displayed and options are able to be changed on-line (whilst in run-mode, burner on/off). Refer to section 2.14.2.4 for instructions on changing options. Press ENTER MEMORY to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed again. It is now possible to press RUN to return to normal operation, or make further changes on-line.

Note: Certain options will not be available for changing whilst the burner is running. These include all burner control options (options #110-150), number of servomotors, E.G.A. option #12, VSD options #90/100.

Parameters

If ENTER MEMORY is pressed when 'PARAMETERS' is displayed then the 'SET PARAMETERS' screen will be displayed and parameters are able to be changed on-line (whilst in run-mode, burner on/off). Refer to section 2.14.2.5 for instructions on changing parameters. Press ENTER MEMORY to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed again. It is now possible to press RUN to return to normal operation, or make further changes on-line.

Note: Certain parameters will not be available for changing whilst the burner is running. These include all burner control parameters (parameters #110-150).

Time Clock Facility

If ENTER MEMORY is pressed when 'TIME CLOCK' is displayed then the 'TIME CLOCK' screen will be displayed and it is possible to make changes to the timings for the time clock. Refer to section 2.14.16 for instructions on changing the time clock. Press ENTER MEMORY to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed again. It is now possible to press RUN to return to normal operation, or make further changes on-line.

Changing the Channel Labels

If ENTER MEMORY is pressed when 'CHANNEL LABELS' is displayed then the 'M.M. STATUS' screen is displayed but without the numerical values (channel positions).

To change the channel 1 label use the CH1 buttons.

To change the channel 2 label use the CH2 buttons.

To change the channel 3 label use the CH3 buttons.

To change the channel 4 label use the CH4 buttons.

To change the channel 5 label use the CH5 buttons.

To change the channel 6 label use the CH6 buttons.

The possible label selections for each channel are:

Blank/CH 1/CH 2/ CH 3/ CH 4/ CH 5/ CH 6/FUEL/GAS/OIL/AIR/FGR/P-AIR/S-AIR/T-AIR/ID FAN/FD FAN/STEAM/VFD/BLOWER/SLEEVE/HEAD/INLET/OUTLET

Press ENTER MEMORY to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed again. It is now possible to press RUN to return to normal operation, or make further changes on-line.

Section 2.15: Mini Mk6 M.M. Micro Modulation

2.15.1 Mini Mk6 M.M. Control Unit

The operation of the Mini Mk6 is similar to the Mk6 with fewer options available.

Refer to the appropriate details in Section 2.14.

2.15.2 Mini Mk6 Commissioning

2.15.2.1 Options

To Select Options Mode.
Ch1, Ch2, & Ch3 etc. refer to the rows of buttons respectively starting with CH1 at the top.

Option values can be changed by entering the Option mode. The password must first be entered. To enter the password follow the steps listed:

Either deselect and then select fuel or power down and then up

If system is already commissioned, press COM before the COM l.e.d. stops flashing

If system is not already commissioned, commissioning mode will be set automatically

The password screen is displayed:

```
PASSWORD              0
PASSWORD              0
F1 COMMISSIONED      23
```

Use the CH1 and CH2 buttons to set the Password codes. Then press CLOSE

To select the Options screen, Press the Ch1 buttons simultaneously. The following screen should be displayed:

```
OPTION No    1=   3
BOILER SENSOR TYPE
TEMPERATURE SENSOR
0-400 C,    3-730 F
```

Rows 2, 3 & 4 display textual descriptions of the option number and value

To change the Option number use the CH2 buttons

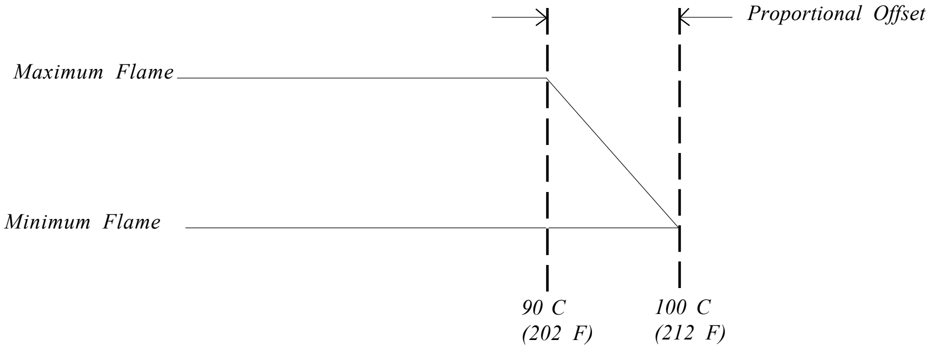
To change the value use CH3 buttons

Any number of Option values can be changed when in Option mode

When changes have been made press ENTER MEMORY

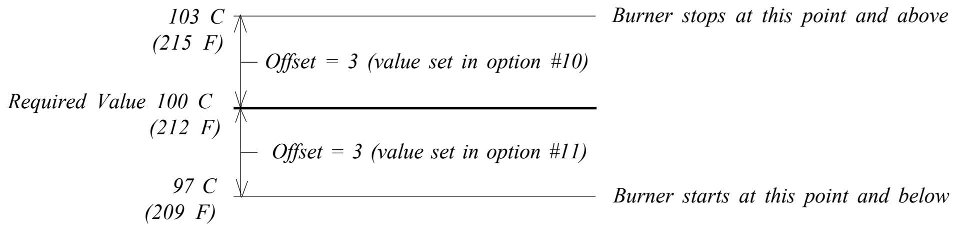
All new Option values are then permanently stored

Option No.	Factory Setting	Option Value	Description
1.	**3**		**Boiler temperature/pressure sensor type:**
		3	Temperature sensor (MM10006 & 7) 20-390 C (50 - 730 F)
		4	Unused
		5	Unused
		6	Medium pressure sensor (MM10008) 2.0 - 23.0 bar (30 - 330 P.S.I.)
		7	High pressure sensor (MM10009) 2.0 - 38.0 bar (30 - 550 P.S.I.)
		8	Low pressure sensor (MM10010) 0.2 - 3.80 bar (1.5 - 55 P.S.I.)
		9	Unused
		10	External temperature sensor (voltage input)- range set by parameters #52-56
		11	External pressure sensor (voltage input)- range set by parameters #52-56
2.	**60**		**Motor travel speed during modulation:** The value is not specific to a time/distance ratio. If the speed of the motor is too fast then increase this value. If too slow, decrease the value. At times other than modulation the motors move at full speed or at the value set in option #75. Movement is limited by the slowest channel, i.e. slowest moving motor.
		5-240	Adjustment range 5 = 43 seconds from 0^0 to 90^0 60 = 120 seconds from 0^0 to 90^0 240 = 390 seconds from 0^0 to 90^0
3.	**0**		**Unused:**
4.	**40**		**Unused:**
5.	**0**		**Purge position**: This selects the purge position. (Applicable to channels 1-4 when selected; see options #67-70). It also applies to post purge if option #118 is set to a value greater than 0.
		0	Selected Channel purges at HIGH position.(High Fire Position)
		1	Selected Channel purges at OPEN position.(Full span of servomotor as entered during commissioning)

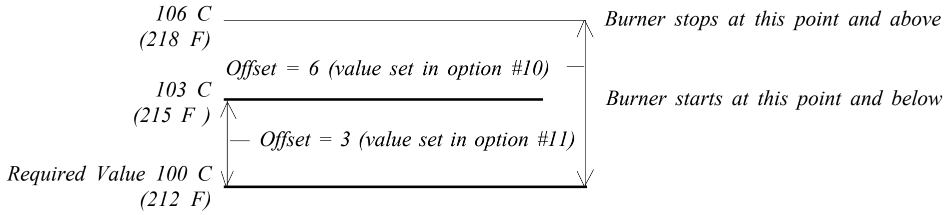
Option No.	Factory Setting	Option Value	Description
6.	**10**		**Proportional control (P)**: This option sets the proportional band. This is the offset point at which the burner will begin to change modulation.
			Example of proportional band offset: Required setpoint = 100 C, Proportional offset = 10 (i.e. option 6 set to value 10).
			
			Proportional band: Value entered- Centigrade, Fahrenheit, Bar or PSI dependent on the type of control sensor used and display units selected- options #1 and #65.
		5-250	If Centigrade, Fahrenheit or PSI units effective.
		0.5-25.0	If Bar units effective.
			Note: Decreasing this value could lead to overshooting of the required setpoint. Increasing this value may cause the burner to modulate too early taking a longer time to reach the required setpoint.
7.	**60**		**Integral control (I) time**: Every n seconds 10% of the present offset from setpoint value is added or subtracted to the present proportional value. The value of n is the number of seconds set in this option. It is possible to set this option to 'off'. If 'off' is selected there will be no integral control. Parameter #106 enables a % variation.
		OFF-250	Seconds.
			Note: Integral is equivalent to 'Reset'.
8.	**1**		**Number of servomotor channels to be enabled**: Channel "1" is always enabled (Fuel Position Motor). Set option #8 to the number of additional channels required (Minimum of 1).
		1	Channels 1 & 2 in use.
		2	Channels 1, 2 & 3 in use.
		3	Channels 1, 2, 3 & 4 in use.
			Note: If option #8 is changed after commissioning then the M.M. unit will need to be recommissioned unless this option is returned to its previous value.

Option No.	Factory Setting	Option Value	Description
9.	1		**Internal stat operation**: The 'internal stat' serves the purpose of turning the burner on and off according to the actual value relative to the required setpoint. There are three settings for this option. The first keeps the 'internal stat' closed all the time. In this instance, a 'working stat' must be fitted to the boiler. The second setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset below the required setpoint. The third setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset also above the required setpoint. The following diagrams illustrate this operation. The offset values are set in options #10 and #11.
		0	Internal stat always closed.
		1	Burner starts below required setpoint.
		2	Burner starts above required setpoint.

Option #9 = 1, example using 100 C (212 F). Required setpoint.



Option #9 = 2, example using 100 C (212 F). Required setpoint.



Option No.	Factory Setting	Option Value	Description
10.	3		**Offset above required setpoint at which the burner is stopped:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.
11.	3		**Offset below/above required setpoint at which the burner is started:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or PSI units effective.
		0.2-5.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
12.	**0**		**E.G.A. options:** If this option has a setting 1/2/5/6 then the E.G.A. will trim and the burner must be commissioned with the E.G.A. operational. The trim is applied to channel 2 or 5, dependent on the setting of option #76.
		0	E.G.A. not optioned.
		1	If an E.G.A. error occurs then the burner will continue to fire. The servomotors will return to the original commissioned fuel/air ratio and the trim function will not be operational until the E.G.A. error is reset. No combustion/single point changes can be made whilst the E.G.A. is in an error condition.
		2	If an E.G.A. error occurs then the burner will stop firing. The burner will not start until the E.G.A. error has been cleared and the E.G.A. is inside its operating temperature range.
		3	Unused.
		4	Unused.
		5	Same as 1, plus the combustion limits are also tested (options #19-27).
		6	Same as 2, plus the combustion limits are also tested (options #19-27).
		7	System commissioned on M.M. only- E.G.A. used only for monitoring and display purposes.
			Note: If the E.G.A. is removed for servicing or this option is set to 0 or 7, then any single point changes made during this time will result in complete re-commissioning when this option is implemented again.
13.	**0**		**Restore Factory Settings:** To set all Options back to their original factory set values, set Option 13 value to 26 and press enter.
		0-30	
14.	**0**		**Twin Burner Systems:** Twin Burner Operation enables two burners to run at the same time and with equal input. 14=1 The burners are identified with identification numbers e.g. 1 and 2 (See Option 33). If one of the burners develops a fault, then both burners are shut down. Only one load detector is required, this is connected to the odd numbered burner. 14=2. One or the other burner can be fired independently. If they are fired at the same time they synchronise together. Load detectors are required on both units. **N.B.** The Burner Control Circuit inputs and low position proving signals (T84 outputs) may have to be cross coupled depending on the application.
		0	Normal single burner operation.
		1	Twin Burner Operation - Both burners always fire together.
		2	Twin Burner Operation - Burners can run individually or together.
15.			**Unused:**

Option No.	Factory Setting	Option Value	Description
16.	**0**		**Lead/lag (IBS) and D.T.I:** A lead boiler can be selected by connecting line voltage to terminal #88 on the appropriate M.M. Only 1 M.M. may be selected as lead boiler at a time or the sequencing will not operate. The lead boiler can be selected via the D.T.I. However, for this to be effective all the M.M. units on the system must have terminal #88 volt free. Line voltage on terminal #88 overrides the D.T.I. command.
		0	No sequencing. M.M. units still communicate and can be seen on the D.T.I.
		1	Sequencing enabled- the M.M. unit will respond to sequencing commands.
		2	Setpoint & enable/disable commands accepted from D.T.I.
		3	Both of 1 & 2.
			Note: Accurate fuel flow metering must be entered for sequencing to operate. A RS485 data cable (BELDON9501) must be connected between each M.M. unit (see section 6.11.1 for correct connection)
17.	**0**		**NO & CO displayed when running on oil:** If fuel 2,3 or 4 are selected, then the displaying of CO & NO can be on or off. This Option is only relevant if an E.G.A. is operational on the system.
		0	NO & CO display always zero.
		1	NO & CO is displayed normally.
18.	**1**		**Carry forward of Trim:** When the system modulates, the correction that may be existing on the air damper position can be carried forward. Only air plus correction is carried forward. This Option is only relevant if an E.G.A. is operational on the system.
		0	No carry forward of trim.
		1	Trim carried forward.
19.	**0**		**Upper offset limit % O_2.** **E.G.A. Limits:** Options 19-27 are only relevant if an E.G.A. is operational on the system. Option 12 value 5 or 6 must be selected if any of the following limit checks are to be invoked. To enable the checking of a particular limit, make the value of the appropriate Option a non-zero value. The amount of 'limit offset' is specified by the value entered. e.g. If the 'upper limit offset O_2' is to be enabled and the value of the offset is 2.0%, then enter the value of 2.0 for Option No. 19.
		0-10.0	% O_2.
20.	**0**		**Upper offset limit % CO_2.**
		0-10.0	% CO_2
21.	**0**		**Upper offset limit CO** (Multiply entered value by 10 to get offset value in ppm).
		0-200	CO

Option No.	Factory Setting	Option Value	Description
22.	0		**Lower offset limit % O_2**
		0-10.0	% O_2
23.	0		**Lower offset limit % CO_2**
		0-10.0	% CO_2
24.			**Unused.**
25.	0		**Absolute value % O_2**.(System checks for O_2 values lower than value specified in this Option).
		0-20.0	% O_2
26.	0		**Absolute value % CO2. (System** checks for CO_2 values higher than value specified in this Option).
		0-20.0	% CO_2
27.	0		**Absolute value ppm CO.** (Multiply value entered by 10 to get actual ppm value). System checks for CO readings higher than values specified in this Option.
		0-200	CO ppm
28.	20		**Trim threshold:** This option is only relevant if an E.G.A. is operational on the system. The value set in this Option is subtracted from the operator set "Required" value. If the Actual value is less than the result then no Trim action will be effected. If the trim is to be effective all the time then set the value to zero. Must also be set to O for the EGA to operate when external modulation is optioned.
		0-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0-5.0	If Bar units effective.
			Note: No single point changes can be made is the actual value is below the offset value
29.	1		**Golden Start:** NB. Must be entered on each fuel individually if more than one fuel is commissioned. Refer to section 2.14.12 for further details.
		0	Golden Start operates.
		1	Golden Start does not operate.
30.	50		**D.T.I. - Required Value Minimum Limit:** If the system is being used with a D.T.I. a maximum and minimum limit for the Required value must be set. The M.M. will only act on values within the limits set. If a value is received from the D.T.I., that is outside these limits, it will be ignored and the system uses its previous Required value. Practical range is limited to range of sensor selected.
		5-995	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.5-99.5	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
31.	**100**		**Maximum Limit.**
		5-995	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.5-99.5	If Bar units effective.
32.	**20**		**Trim Delay:** After ignition the sampling system does not sample for the period of time set in this option. (Only relevant if E.G.A. is operational on system). This allows for the boiler to warm up and combustion to stabilise before sampling commences.
		0-250	Period (seconds) after ignition no sampling takes place.
33.	**1**		**MM Identification No. -** Sequencing Options: If this M.M. is configured as part of a sequencing system and/or required to communicate with a D.T.I. then the following three options must be set: The first is an identification number for this M.M.. The second is the rating of the burner, and the third is the "sequencing scan time". Refer to Sequencing Section for further explanation.
		1-10	Identification Number.
34.		**5**	**Rating of burner**
		1-999	See option 77 for units.
35.	**10**		**Sequence Scan Time. (minutes)**
		1-100	Sequence Scan time (Minutes).
36.	**0**		**E.G.A. Sensor Selection:** Available when using an E.G.A. System fitted with NO/SO_2 sensors. The following option is for selecting the type of Sensor required: Part No. EGA20005 for NO; EGA20006 for SO_2.
			SO_2 NO
		0	Off Off
		1	Off On
		2	On Off
		3	On On
37.	**0**		**Time Between Readings**
			Explanation of D. (Derivative Action): The user adjustable control variables to set up the D action are as detailed below. (Derivative is equivalent to 'Rate')
		0	(0=off)
		1-200	Seconds. The time interval between the controller comparing Actual and Required Setpoint values.

Option No.	Factory Setting	Option Value	Description
38.	2		**Deadband.** The Deadband is the margin above and below the Setpoint within which no derivative control action occurs.
		0-15	If Centigrade, Fahrenheit or PSI units optioned.
		0-1.5	If Bar units optioned.
39.	10		**Response Sensitivity.**
		1-100	%

The Sensitivity Number indicates the amount of percentage firing rate increase or decrease that is inflicted by the Derivative action;

e.g. If the chosen value was 10% then 10% of the maximum firing rate would be added to the existing rate of fire; i.e.: If the burner were firing at 50% load and the derivative action was triggered the firing rate would increase by 10+50 to 60%.

The following is an example of the above control philosophy in action:

<u>Note</u>: "Time Between Readings" set to 20 seconds.
"Deadband" set to 2°C (2°F.)
"Response Sensitivity" set to 10%.

Setpoint Information:
"Required" set to 90°C (190°F.)
"Actual" reads 86°C (186°F.)

Firing Rate Information:
Burner firing at 50% of capacity.

In the example situation there has been 4°C (4°F) drop in temperature below the "Required" value. The Deadband is set at 2°C (2°F.), therefore the Derivative action will be triggered as the deviation from Setpoint is in excess of 2°C (2°F.). In this example 10% will be added to the 50% firing rate resulting in an increase in firing rate to 60% of capacity.

The "Time Between Readings" is set for 20 seconds and if after this time interval the "Actual" reading is not within the 2°C (2°F) deviation from "Required" Deadband another 10% would be added to the 60% firing rate which would result in a 70% firing rate.

By careful selection of "Time Between Readings" "Deadband" and "Response Sensitivity" an ideal response to rate of change over time can be configured.

The control philosophy detailed operates inversely if the "Actual" temperature exceeds the Setpoint and is outside the "Deadband".

To enable or switch on the Derivative action the "Time Between Readings" must be set in excess of 10 seconds.

Option No.	Factory Setting	Option Value	Description
40.	**0**		**Warming Facility for Low Pressure Steam IBS.** For applications without a non return valve, IBS Warming will not operate on reduced setpoint. The facility exists to install a thermostat in the boiler shell, and an input on Terminal 93 initiates Warming.
		0	Disabled
		1	Enabled
41.	**0**		**Steam Boiler Sequencing** Options 41, 42, 43 and 44 are related to the "Standby Warming" Sequencing state. Option 42 enables an offset to be set relative to the Required value to generate a "phantom setpoint". During this "Standby Warming" operation the Boiler Control Circuit relay operates on the phantom setpoint. Options 43 and 44 are offset values above and below the phantom setpoint (i.e. Options 10 and 11 are not used for the phantom setpoint Boiler Control Circuit relay offsets). When a boiler is set to the "Standby Warming" state, by the M.M. Sequencing commands, it runs for a period of time at low flame and then off for a period. This action keeps the boiler warm. Option 53 sets the time interval that the burner is Off: Option 54 sets the time that the burner is On. If Option 41 = 0 only one boiler will be set to the "Standby Warming" state. Boilers further down the sequence will be set to the "OFF" state. In this case Options 53 and 54 set the ON and OFF time. (If Options 41 and 53 are 0 then Hot Water Sequencing is implemented).
		0	3 State Steam Sequencing. ON, Standby/Warming , Off
		1	2 State Steam Sequencing. ON, Standby/Warming
42.	**20**		**Phantom Setpoint.** Offset below normal Required value.
		0-100	If Centigrade, Fahrenheit or p.s.i. units effective.
		0-10.0	If Bar units effective.
43.	**5**		**Offset above phantom setpoint when Boiler Control Circuit opens.**
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.2-5.0	If Bar units effective.
44.	**5**		**Offset below phantom setpoint when Boiler Control Circuit closes.**
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.2-5.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
45.	**0**		**External Modulation:** If this option is enabled, the usual P.I.D. control is disabled and the percentage of firing is set by an external controller applied to the appropriate input (terminals 7,8 & 9). This can be 0-10V, 2-10V, 0-20mA or 4-20mA representing low to high fire. See Parameter 69. The 10 point flow metering calibration must be entered for correct operation. See Option 57. Set Option 9 to 0 and fit both a working stat and high limit stat to turn the burner on and off.
		0	Disabled
		1	Enabled - input from auxilliary analogue input
46.	**0**		**Actual value displayed during External Modulation.** Load sensor input required to display Actual value.
		0	Required and Actual values displayed
		1	Required and Actual values not displayed
47.	**0**		**Cold Start Routine.** If the boiler temperature/pressure is at or below 30% of the target pressure/temperature then the burner would be held at low flame. If the boiler is at or below 60% of its target temperature/pressure then the burner firing rate would be held at 50% firing. When the boiler temperature/pressure exceeds the P Band offset in the PID philosophy then the burner would revert to normal PID load control.
		0	Off
		1	On
48.	**0**	0-120	**Flue Gas Recirculation - Timer.** This is the time that the MM elements (positioning motors/ac drives) are held at the FGR positions, after which modulation then takes place.
49.	**0**	0-50	**Flue Gas Recirculation - Offset.** This is an offset from the required value. The FGR positions are held until such time that the actual value reaches the offset value.
50.	**0**		**Flue Gas Recirculation - Flue Gas Tempertature.**
		0	Not optioned.
		1	Optioned. The FGR positions are held until such time as the flue gas temperature has reached 120°C. (An EGA must be present and optioned).
51.	**0**		**Units of Temperature**. NB. When changing units adjust all other relevant options respectively.
		0	All temperature readings displayed in Celsius.
		1	All temperature readings displayed in Fahrenheit.
52.	**0**		**Units of Pressure.** NB. When changing units adjust all other relevant options respectively.
		0	All pressure readings displayed in Bar.
		1	All pressure readings displayed in p.s.i.

Option No.	Factory Setting	Option Value	Description
53.	**1**		**Steam Boiler Sequencing Burner Off Time:** The steam boiler type sequencing is enabled by setting Option 1 to a respective pressure sensor. Options 42, 43 and 44 are relevant to the "Standby" boiler operation.
		1-200	Burner "Off" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
54.	**5**		**Burner 'On' Time**
		1-30	Burner "On" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
55.	**0**		**Internal PID/External Modulation Selectible using terminal 88.** (Cannot be used with Sequencing/IBS)
		0	Normal operation, Internal PID or External Modulation if Option 45=1.
		1	Terminal 88 = 0 V - internal PID. Terminal 88 = Line Voltage - External Modulation, CR1 always closed.
56.	**1**		**Operation of Alarm Output, Terminal No 79., NB this is a switched neutral and not a voltage output terminal:**
		1	Relay normally Off, On when Alarm.
		2	Relay normally On, Off when alarm.
57.	**0**		**Flow Metering:** If the Air window shows 57 and the Required window shows 1 when ENTER is pressed to store the Options then the 10 point calibration procedure will be invoked the next time the burner starts.
		0	No Flow Metering.
		1	Flow Metering Operates.
		2	Totalised Flow Metering reset to zero for fuel selected
58.	**15**		**Flow Metering Calculation Delay.** Number of seconds from ignition to flow metering calculation starts.
		0-60	Seconds.
59.			**Unused.**
60.	**0**		**Hand/Auto Bumpless Transfer Operation.**
		0	Fuel valve goes directly to last set Hand position.
		1	Hand position (taken on present fuel valve position when changing from Auto to Hand operation).
		2	As 0, but Hand position is not stored in permanent memory.
61.	**1**		**Flow metering units fuel 1 - Gaseous**
		0	Cubic feet
		1	Cubic meters
		2	Kilograms
		3	Litres
		4	US gallons

Option No.	Factory Setting	Option Value	Description
62.	**3**		**Flow metering units fuel 2 - Liquid**
		0	Cubic feet
		1	Cubic meters
		2	Kilograms
		3	Litres
		4	US gallons
63.	**3**		**Flow metering units fuel 3 - Liquid**
		0	Cubic feet
		1	Cubic meters
		2	Kilograms
		3	Litres
		4	US gallons
64.	**1**		**Flow metering units fuel 4 - Gaseous**
		0	Cubic feet
		1	Cubic meters
		2	Kilograms
		3	Litres
		4	US gallons
65-66.			**Unused.**
67.	**1**		**Purge Position:** The following Options tell the M.M. which channels are to be included in the Purge sequence. (See Option 5 for Purge Position).
		0	Channel 1 to Purge position.
		1	Channel 1 to remain closed for Purge.
68.	**0**		**Channel 2 Purge position.**
		0	Channel 2 to Purge position.
		1	Channel 2 to remain closed for Purge.
69.	**0**		**Channel 3 Purge position.**
		0	Channel 3 to Purge position.
		1	Channel 3 to remain closed for Purge.
70.	**0**		**Channel 4 Purge position.**
		0	Channel 4 to Purge position.
		1	Channel 4 to remain closed for Purge.
71.	**0**		**Fuel 1 - Fuel type.**
		0	Natural gas
		3	Fuel 1
			Do not use any other values.
72.	**1**		**Fuel 2 - Fuel type.**
		1	Light Distillate Oil
		2	Heavy Fuel Oil
		3	Fuel 2
			Do not use any other values.

Option No.	Factory Setting	Option Value	Description
73.	**1**		**Fuel 3 - Fuel type.**
		1	Light Distillate Oil
		2	Heavy Fuel Oil
		3	Fuel 3
			Do not use any other values.
74.	**0**		**Fuel 4 - Fuel type.**
		0	Natural gas
		3	Fuel 4
			Do not use any other values.
75.	**0**		**Purge Motor Travel Speed:** During a Purge Sequence the Motor Travel Speed can be set independent of Option 2. This affects all selected channels.
		0 -100	0 = Quickest time, 100 = Slowest time.
76.	**0**		**Unused.**
77.	**0**		**Burner Rating Units.**Display purposes only for Flow Metering.
		0	KW x 100 /hr
		1	Kg x 100 /hr
		2	MW /hr
		3	Btu x100 /hr
		4	Hp x100 /hr
		5	lbs x 100 /hr
78-85.			**Unused.**
86.	**0**		**Channel 1 Softened Error checking Select -** increases positioning error fom 0.1° to 0.5° for Industrial motor
		0	CH1 normal positioning motor.
		1	CH1 industrial positioning motor/softened error checking.
87.	**0**		**Channel 2 Softened Error checking Select .**
		0	CH2 normal positioning motor.
		1	CH2 industrial positioning motor/softened error checking.
88.	**0**		**Channel 3 Softened Error checking Select.**
		0	CH3 normal positioning motor.
		1	CH3 industrial positioning motor/softened error checking.
89.	**0**		**Channel 4 Softened Error checking Select .**
		0	CH4 normal positioning motor.
		1	CH4 industrial positioning motor/softened error checking.

Option No.	Factory Setting	Option Value	Description
90.	**0**		**VSD operation channel 4 (instead of fourth channel servomotor):**
		0	Not optioned.
		1	Optioned.
91.	**0**		**Output from M.M. to VSD:**
		0	Output units displayed as 4-20 milliamps.
		1	Output units displayed as 0-10 volts.
		2	Output units displayed as hertz.
92.	**25**		**Output low speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.
93.	**50**		**Output high speed from M.M. to VSD:** Same value as set on the VSD.
		1-200	Hertz.
94.	**2**		**Input signal to M.M. from VSD:**
		0	4-20 milliamps.
		1	0-10 volts.
		2	0-20 milliamps.
95.	**0**		**Input units displayed:**
		0	Selected input signal.
		1	Hertz.
96.	**0**		**Input low speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
97.	**50**		**Input high speed to M.M. from VSD:** Same value as set on the VSD.
		0-200	Hertz.
98.	**0**		**Unused:**
99.	**0**		**Unused:**
100-109.			**Unused.**

Option No.	Factory Setting	Option Value	Description
110.	1		**Burner control.**
		1	Internal - Standard Scanner
		2	Internal - Self-check Scanner
111.	0		**Pilot**
		0	Interrupted pilot
		1	Intermittant pilot (expanding flame)
112.	40		**Pre purge time**
		20-100	Seconds
113.	3		**Pre ignition time.** Time ignition transformer is on before gas valve opens.
		3-5	Seconds
114.	3		**First safety time.** Time pilot valve is open before UV is checked.
		3-10	Seconds
115.	3		**Pilot prove time. (Pilot trial for ignition PTFI)**
		3-5	Seconds
116.	3		**Fuel 1 & Fuel 4 Second safety time (Main trial for ignition MTFI).** (Not Applicable to expanding flame - see option 111)
		3-10	Seconds
117.	5		**Main flame prove time.**
		5-20	Seconds
118.	0		**Post purge time**
		0-100	Seconds (0 - No post purge)
119.	10		**Control Box Recycle time:** Time delay from burner shut down to startup.
		3-120	Seconds
120.	10		**UV Threshold**
		5-50	Flame Signal Strength below which considered to be flame failure.
121.	5		**Delay from start of pre-purge after which air switch checked**
		5-10	Seconds
122.	0		**Flame switch operation:** If this option is enabled terminals 85/86 are used in conjunction with a flame switch to monitor the presence of a flame.
		0	Disabled - normal UV scanner operation.
		1	Enabled - flame switch operation.
123.	3		**Fuel 2 & Fuel 3 Second safety time (Main trial for ignition MTFI).** (Not Applicable to expanding flame - see option 111) 3-15 Seconds

Option No.	Factory Setting	Option Value	Description
124.	**1**		**Gas valve proving pressure sensor type:**
		0	Nominal range 0–25" w.g./ 0–65 mbar/ 0–1 psi (Sensor MM60006) **Note.** PSI display not available with this sensor
		1	Nominal range 0–135"w.g./ 0–340 mbar/ 0–5 psi (Sensor MM60008)
		2	Nominal range 0–300"w.g./ 0–750 mbar/ 0–11 psi (Sensor MM60011)
		3	Nominal range 0–550"w.g./ 0–1380 mbar/ 0–20 psi (Sensor MM60012)
		4	Nominal Range 0-1650"w.g/0-4125 mbar/0-60psi (Sensor MM60014)
125.	**0**		**Gas valve proving & high-low pressure limit checked- fuel 1:**
		0	Not checked on fuel 1.
		1	Gas valve proving on + high/low pressure limits (see options #136/137).
		2	Do not select.
		3	Gas high/low pressure Limit. If options #136/137 are set to 0, then the online values are displayed only.
		4	External VPS optioned. It is possible within the unit to use an external VPS controller for this operation. If this is set then the system will wait for a mains voltage input on terminal #55 to confirm that the external VPS operation is completed. The time period for this is 10 minutes before the voltage input must be seen, otherwise a lockout will occur (contact Autoflame before use).
126.	**0**		**Fuel 2/oil high-low pressure limit checked- fuel 2:**
		0	Not checked on fuel 2.
		1	Do not select.
		2	Oil high/low pressure limit. If options #139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See option #125 for information.
127.	**0**		**Fuel 3/oil high-low pressure limit checked- fuel 3:**
		0	Not checked on fuel 3.
		1	Do not select.
		2	Oil high/low pressure limit. If options #139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See option #125 for information.

Option No.	Factory Setting	Option Value	Description
128.	**0**		**Gas valve proving & high-low pressure limit checked- fuel 4:**
		0	Not checked on fuel 4.
		1	Gas valve proving on + high/low pressure limits (see options #136/137).
		2	Do not select.
		3	Gas high/low pressure limit. If options #139/140 are set to 0, then the online values displayed only.
		4	External VPS. See option #125 for information.
129.	**0**		**VPS operation:** This option must be set to 0 during commissioning. Once commissioning is complete it can then be set to 1.
		0	VPS operates before burner start up.
		1	VPS operates after burner run (low gas not checked before burner starts).
130.	**2**		**Gas valve proving:**
		0	Two valve gas valve proving.
		1	Three valve gas valve proving. Vent valve normally closed.
		2	Three valve gas valve proving. Vent valve normally open.
131.	**0**		**Gas pressure units:** PSI not available for MM60006 - see option #124.
		0	"wg (inches water gauge).
		1	mbar (millibars).
		2	psi (pounds per square inch) - units displayed to 2 decimal places.
132.	**20**		**Gas valve proving time:**
		10-30	Seconds.
133.	**5.0**		**Maximium pressure change allowed during proving time:**
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.4-25.2	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
			Note: Option #124 for pressure sensor range in use, default value will change accordingly. See Section 2.14.2.6.2.
134.	**3**		**VPS valve opening time:**
		3-20	Seconds.

Option No.	Factory Setting	Option Value	Description
135.	**0**		**Change purge time:**
		0	Seconds.
		1	Minutes.
136.	**5.0**		**Gas pressure switch- offset lower limit:** This option has two functions: - Static inlet pressure check- lower limit. This is checked prior to burner firing. - Run pressure check- lower limit. This is an offset from the commisioned value. Note options #124/131.
		0	Off- lower limit not checked.
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.1-25.2	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
137.	**1.0**		**Gas pressure switch- offset upper limit:** This is an offset from the commisioned value. Note settings of options #124/131.
		0	Off- upper limit not checked.
		0.1-5	"wg/ 0.2-12.4mbar/ psi not available (Sensor MM60006)
		0.5-25	"wg/ 1.1-63 mbar/ 0.02 - 0.91 psi (Sensor MM60008)
		1-56	"wg/ 2.5-140 mbar/ 0.04 - 2.03 psi (Sensor MM60011)
		1.9-103	"wg/ 4.6-356 mbar/ 0.07 - 5.16 psi (Sensor MM60012)
138.	**0**		**Oil pressure units:**
		0	Bar.
		1	PSI.
139.	**1.0**		**Lower limit oil pressure switch:** Offset from commissioned value.
		0	Off- lower limit not checked.
		0.8-4	Bar- lower limit from operating pressure.
		0-50	PSI- lower limit from operating pressure.
140.	**1.0**		**Upper limit oil pressure switch:** Offset from commissioned value.
		0	Off- upper limit not checked.
		0.8-4	Bar- upper limit from operating pressure.
		0-50	PSI- upper limit from operating pressure.

Option No.	Factory Setting	Option Value	Description
141.	**0**		**Purge air pressure proving:** During pre purge this option enables the air proving pressure to be tested at a value independent of option #149. Option #148 must be set.
		0	Off- no purge air pressure proving.
		0-26.9	"wg.
		0.1-67	mbar.
			Note: If option #141 is set without option #148 a lockout will occur when the system starts to purge. The lockout message displayed warns that option #141 is incorrectly set.
142.	**0**		**Unused:**
143.	**0**		**Unused:**
144.	**0**		**Unused:**
145.	**0**		**Autoflame air pressure sensor:**
		0	Autoflame air pressure sensor not optioned.
		1	Autoflame air pressure sensor optioned 0-1 PSI (Sensor MM60005)
		2	Autoflame air pressure sensor optioned 0-2 PSI (Sensor MM60013)
146.	**0**		**Air pressure units:**
		0	"wg.
		1	mBar.
147.	**0**		**Air sensor error checking window:** Only active during modulation (error #82). The burner will shut down if outside the window.
		0	No error checking.
		0 - 3	"wg (maximum = +/- 3 "wg).
		0 - 7.5	mbar (maximum = +/- 7.5 mbar).
148.	**0**		**Autoflame air proving selected:**
		0	Not used- requires external air proving switch on terminal #54.
		1	Air proving- requires Autoflame air pressure sensor.
		2	As 1 but terminal #54 also used if fuel 2 selected (for atomising air).
149.	**0.3**		**Minimum air pressure proving value:** Air pressure switch function.
		0.3 - 4.9	" wg.
		1 - 12.5	mbar.

Option No.	Factory Setting	Option Value	Description
150.	**0**		**Clear ALL commissioning data and gas/air sensor re-commission:**
		0 - 10	Range.
		5	Clear commissioning data- restore options/parameters to factory settings.
		7	Air sensor automatic recomission (see section 2.14.18.1 in the technical manual for more information).
		8	Gas sensor automatic recommision (see section 2.14.18.2 in the technical manual for more information).

For safety reasons, options #110-150 also have to be entered in as parameters.
It is the responsibility of the commissioning Engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices, e.t.c.

If the M.M. system is stuck in the 'idle' condition, it is likely that options #110-150 are not identical to parameters #110-150. If the commissioning mode is entered, the relevant options/parameters not set correctly will be displayed at the bottom of the screen. If more than 1 option/parameter is not set correctly, these will be displayed in numerical order, i.e. on entering the commissioning mode again the next sequential option/ parameter not set correctly will be displayed.

2.15.2.2 Parameters

To Select Parameter Mode.
Ch1, Ch2, Ch3 refer to the rows of buttons respectively starting with CH1 at the top.

Parameter values can be changed by entering the Parameter mode. The password must first be entered. To enter the password follow the steps listed.

Either deselect and then select fuel or power down and then up.

If system is already commissioned, press COM before the COM l.e.d. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

The password screen is displayed.

```
PASSWORD            0
PASSWORD            0
F1  COMMISSIONED   23
```

Use the CH1 and CH2 buttons to set the Password codes. Then OPEN press CLOSE and buttons simultaneously.

The parameters screen will then be displayed as below:

```
PARAMETERS No  1=   3
```

Rows 2, 3 & 4 display textual descriptions of the parameter number and value.

To change Parameter number use the CH2 buttons.

To change value use the CH3 buttons.

Any number of Parameter values can be changed when in Parameter mode.

When changes have been made press ENTER MEMORY

All new Parameter values are then permanently stored.

N.B. The E.G.A. related parameters have the factory default settings from years of testing on many fuels and applications. It is advised to be cautious when changing these parameters, and is recommended not to do so.

Parameter No.	Factory Setting	Parameter Value	Description
1	3	0-20	**Sequencing:** Offset value when unit goes off line, i.e. if the standby boiler fails to start the scan time will be decreased by 3 minutes. If the scan time is set to 10 minutes, this would be reduced to a 7 minute scan time.
2	1	1-10	**Sequencing:** Time between data requests (seconds). Bus driver request information every second, M.M's transmit every second, D.T.I. only listens to transmissions.
3	1	1-10	**Sequencing:** Number of boilers initially set on after powerdown.
4	45	5-100	**E.G.A:** Number of seconds the ENTER is button disabled after E.G.A. is pressed.
5	4	1-50	**Sequencing:** Number of minutes, time out value to reach modulation, i.e. If the boiler is not modulating after being asked to contribute to load, it is kicked out of sequence loop. After being asked to modulate the burner must start to modulate in 4 minutes.
6	60	5-100	**Unused:**
7	16	01-50	**Unused:**
8	30	5-240	**E.G.A:** Delay after draining before trim cycle start, i.e. wash out period. When cells being cleaned with air, this value maintains the last readings until the air sampled during the drain period has gone.
9	60	5-240	**E.G.A:** Auto commission time.
10	0		**Unused:**
11	25	5-60	**E.G.A:** Air flush time. This is the flush out period between going fuel rich and air rich during auto commission (seconds) in order to remove any excess CO produced.
12	0	0-1	**E.G.A:** CO included in trim calculation on F2 & F3 (see option #17), i.e. required when using natural gas on F2 & F3.
		0	No.
		1	Yes.
13	20	5-30	**E.G.A:** ÷4 = % of air damper movement. Amount of auto commission trim. Applies to air (-) only.
14	20	1-200	**E.G.A:** ÷2 number of degrees the fuel valve moves before negative trim is reset.
15	5	2-100	**Golden start timer:** Number of seconds that the positioning motors are held at the "choke" position. Applies to golden start only, see option #29. This time starts from the ignition point.

Parameter No.	Factory Setting	Parameter Value	Description
16	12	1-50	**E.G.A:** Time between calibrations (÷ 2 = Hours). The E.G.A. calibrates every 6 hours if the burner does not turn off.
17	3	0-10	**E.G.A:** Number of trims before an E.G.A. error is flagged when limits exceeded. Each Trim = 30 Seconds.
18	20	5-60	**E.G.A:** Trim amount during run ÷ by 2 = % of trim. This value cannot be set above 20 (10%) or an ERROR 25 will occur.
19	1	0-1	**Unused:**
20	0	0-40	**Reset parameters to original factory settings:** To reset all of the parameters back to their original factory set values, set option #20 to 26 and press enter.
21	0		**Unused:**
22	0		**DTI:** Do not adjust.
23	0		**Unused:**
24	120	20-240	**E.G.A:** Calibration time (seconds).
25	30	5-100	**E.G.A:** Time between samples.
26	8	1-50	**E.G.A:** Number of samples per trim cycle.
27	25	0-255	**E.G.A:** Minimum operating temperature (÷ 5=deg C).
28	200	0-255	**E.G.A:** Maximum operating temperature (÷ 5=deg C).
29	0	0-10	**Unused:**
30	10	0-40	**Filters load sensor readings:** Temperature and pressure detectors.
		0 20	No filtering. Maximum filtering.
31	0	0-1	**Selects efficiency to be displayed:**
		0 1	English (USA/Canada- incorporates Hydrogen & moisture loss). European.
32-37			**Unused:**

Parameter No.	Factory Setting	Parameter Value	Description
38	254	0-255	**M.M. password:** Channel 1.
39	1	0-255	**M.M. password:** Channel 2.
40-43			**Unused:**
44	0.4	0-40	**E.G.A:** O_2 window inside which no further trim takes place.
45	0.2	0-20	**E.G.A:** CO_2 window inside which no further trim takes place.
46-47			**Unused:**
48	0		**Unused:**
49	0	0-1	**Required setpoint:** Set to 1 if required setpoint not to be stored permanently in memory. This is important to set if using parameter #72.
50-51			**Unused:**
52	0	0-2	**External load detector:** Number of decimal points (please see table below).
53	0	0-9990	**External load detector:** Maximum value (please see table below).
54	0	0-100	**External load detector:** Maximum voltage (please see table below).
55	0	0-9990	**External load detector:** Minimum value (please see table below).
56	0	0-100	**External load detector:** Minimum voltage (please see table below).

Example 1: **Pressure** Application	Example 2: **Temperature** Application
Required/Actual Range- 0.0-100.0bar Input Signal- 0-10 Volts Option 1- 11 Option 65- metric units Parameter 52- 1 Parameter 53- 1000 Parameter 54- 10.0 Parameter 55- 00 Parameter 56- 0.0	Required/Actual Range- 1000-2000F Input Signal- 1-6 Volts Option 1- 10 Option 65- imperial units Parameter 52- 0 Parameter 53- 2000 Parameter 54- 6.0 Parameter 55- 1000 Parameter 56- 1.0

57			**Unused:**

Parameter No.	Factory Setting	Parameter Value	Description
58	1		**E.G.A. calibration on start up:**
		1	E.G.A: Calibration on start up.
		0	E.G.A: No calibration on start up.
59	0		**Unused:**
60	0		**E.G.A. or O2 trim interface module:**
		0	Normal E.G.A. operation.
		1	O_2 trim interface operation.
61	900		**Unused:**
62	0		**Unused:**
63	0	0 - 1	**Reset lockout history:** Set to 1 for 2 seconds, then set back to 0 to clear lockout history.
64	0	0 - 1	**Reset totalised fuel flow metering:** Set to 1 for 2 seconds, then set back to 0 to reset totalised fuel metering values for all 4 fuels. To reset the totalised fuel flow metering for individual fuels see option #57.
65	0	0 - 1	**Reset burner history:** Set to 1 for 2 seconds, then set back to 0 to reset burner history, hours run and number of start ups.
66-68			**Unused:**
69	0	0 - 1	**External modulation input range:**
		0	0-20mA, 0-10V.
		1	4-20mA, 2-10V.
70	0	0 - 20	**Filtering of the analogue input:** Terminals #7/8/9. The value set is the number of readings over which an average is taken. The smaller the setting the quicker the response time.
		0	Default value of 5.
		1	Minimum.
		20	Maximum.

Parameter No.	Factory Setting	Parameter Value	Description
71	0	0-20	**Resolution of the analogue input:** Terminals #7/8/9. The effect of resolution is to filter the noise on the input which causes hunting as the M.M. responds to a changing signal.
		0	Default value of 5.
		1	Minimum.
		20	Maximum.
72	0		**Unused:**
73-79			**Unused:**
80	40	1 - 50	**Unused:** Do not adjust.
81	0		**Do not adjust:**
82	0		**Unused:**
83	0		**Display diagnostic values:**
		0	Disabled.
		1	Enabled.
84	0		**Unused:**
85	0	0-250	**Modulation exerciser:** Repeatedly run between high and low flame. The higher the value, the longer the high/start position is maintained.
86	0	0 - 99	**IBS change down threshold:** If left at 0 change down threshold = 85% firing rate.
87	0	0 - 100	**IBS change up threshold:** If left at 0 change up threshold = 95% firing rate.
			Note: If parameter #86 is set greater than parameter #87 then they will default to 85% and 95% respectively.
88	0		**Unused:**
89	0		**Unused:**

Parameter No.	Factory Setting	Parameter Value	Description
90	0		**Flue gas recirculation:**
		0	Positions entered after commissioning by performing the single-point change procedure (see section 2.14.13 in the technical manual).
		1	Positions entered during commissioning.
91-99	0		**Unused:**
100	0		**Assured low fire shut off:**
		0	Not operational.
		1	Burner modulates to low fire before turning off when above the internal stat.
101-109	0		**Unused:**
			NB. Parameters 110 to 150 are a repeat of their respective options. These values need to be entered as both an option value and a parameter value for safety reasons.

2.15.2.3 Fuel Flow Metering

1. Go to Options, set Option 57 to 1 (default 0).

2. When the above is displayed press ENTER MEMORY, this will initiate the Flow Metering setup mode.

3. The next time the burner starts and reaches modulation, the M.M. will automatically go into the ten point setup mode for Flow Metering. The following screen will be displayed:

```
COMMISSION FLOW
CHANNEL 1          80.0
POINT NUMBER          1
FLOW VALUE        68.16
```

4. In this mode the display will show the channel 1 fuel valve position in degrees angular, and the flow units which can be adjusted by using the third row of buttons.

   Note:

   a) The third row of text confirms to the commissioning engineer which of the 10 points are currently being measured.

   b) The minimum numerical value for fuel flow that can be entered into memory is 0.01.
   The maximum numerical value for fuel flow that can be entered into memory is 999.99.

   c) The values are entered in descending order, i.e. Point No.1 is maximum flame and Point No.10 is at minimum flame. The 10 sequential points on the load index are allocated automatically by the M.M. All values are in units/minute.

5. When fuel flow has been calculated or read off of a commissioning fuel flow meter the value is entered as detailed in Point No.4.

   The ENTER MEMORY button is then pressed and the value is logged in the M.M. memory.

6. The above detailed data entry routine is repeated until all 10 points have flow values allocated to them.

7. When the last (10th) point has been entered the burner continues to fire.

8. To display Fuel Flow Metering press FUEL METERING button.

9. To reset the Totalised value to zero set Option 57 to 2, press ENTER MEMORY while 57 and 2 are being displayed.

10. To ensure maximum accuracy, Option 58 can be altered from its default value (15). This is the delay time from the flame failure control box starting the combustion sequence to the main flame being established. (This option is only of relevance when an external burner control is being used).

2.15.3 End User Day to Day Operation

2.15.3.1 <u>Normal Run Operation</u>

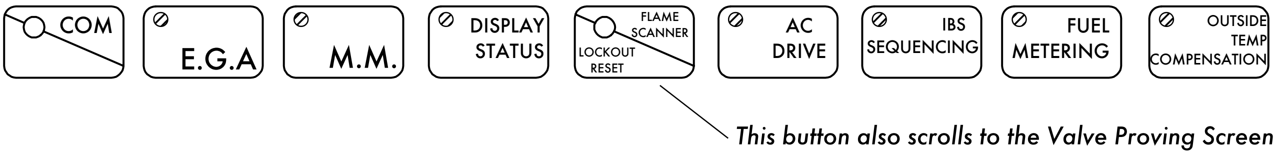
Upon initial selection of a commissioned fuel, a logo screen flashes up followed by the 'MM STATUS' display. The COM l.e.d. flashes for five seconds.

To adjust the Required value press DISPLAY STATUS and use the third row accordingly.

The same method of adjustment is used when the second setpoint is selected (via terminal 87).

The range of the required value is limited according to the type of sensor being used (See Option 1).

If the burner control circuit is closed the burner system will sequence through the burner start up procedure. The system purges and ignites, and twenty seconds (nominal) after ignition the system modulates. Values are displayed according to the selected screen. There are a number of possible screens as shown on the next page. To select one of the display modes just press:



Pressing the bottom row button will display the logo screen.

The respective l.e.d. will remain illuminated to indicate which mode is selected. The COM and E.G.A. modes are only selectable if an E.G.A. is optioned on the system.

In the event of the system being powered down, these selections will be memorised as is all commissioning data, Options and required value. During normal run operation the RUN led is on all the time. When no fuels are selected only the RUN l.e.d. remains illuminated.

If an E.G.A. is operative on the system it will calibrate every time the burner starts and stops. When COM or EGA display modes are selected CAL is displayed when the EGA is calibrating. If the E.G.A. is cooling, COOL is displayed. If the burner is not firing, EGA is displayed. When the burner is firing both modes show E.G.A.. if the Actual value has not reached the value at which trimming is permitted. (See Option 28.) If an E.G.A. error has occurred the error code number is displayed if either of EGA or COM modes are selected.

The software version number can be displayed by by pressing the Top CH1 buttons simultaneously, when in the MM display mode.

Several different displays are available to provide the operator with information through start-up and normal operation.

Selectable screens provide the following information:

Startup/Fuel Select

```
      AUTOFLAME
      MINI  MK6
      COMBUSTION
 MANAGEMENT   SYSTEM
```

Displayed at startup and when no fuel selected.

M.M. Status

```
CHANNEL  1       80.0
CHANNEL  2       42.0
CHANNEL  3       37.6
    LOW  FLAME  HOLD
```

Shows the angular value for each of the positioning motors, channels 1 to 4. The bottom row displays additional status information, including Low Flame Hold, Hand Operation, Golden Start, FGR Start.

IBS Status

```
ID   1      LEAD     2


STATUS   STANDBY
```

For a multi boiler installation, this screen shows which is the lead boiler plus information on temperature and pressure set points.

EGA On Line Values

```
O2    4.3%  CO2    9.4%
CO   12ppn  NO    30ppm
AMB    22C  DELTA  269C
EXH   291C  EFF   77.8%
```

When an Exhaust Gas Analyser (EGA) is included in the system, this screen shows the actual values of the gases being measured in the flue plus the exhaust gas temperature, ambient temperature, dT, and efficiency. A similar screen shows the commissioned values.

Lockout History

```
No  1  10:00  23:JUN:00
RES    10:05  23:JUN:00
NO  FLAME  SIGNAL
FIRING
```

Upto the last 16 lockouts are displayed here. Details include time and date of lockout and reset, the cause of the lockout and at what stage of the sequence the lockout occured. Only one lockout record can be displayed at a time. Press the flame scanner button to scroll through the records.

Fuel Metering Status

```
FUEL  1   NATURAL  GAS
FLOW  UNITS    CU  MTRS
FLOW  RATE/MIN    20.00
TOTAL            4856.7
```

This screen displays which fuel is currently selected, the consumption at this point in time and the total fuel used to date.

System Status

```
FUEL  1  NATURAL  GAS
FIRING  RATE      100%
REQUIRED          82  C
ACTUAL            45  C
```

This screen shows the present firing rate, which fuel is being used, and the required/actual values.

History

```
HISTORY  FUEL  1
HOURS  RUN        1763
STARTUPS           276
```

The hours run and the number of startups for the currently selected fuel are displayed on this screen. The screen is selected by pressing the display status button.

Burner Control Status / Time

```
FIRING
FLAME  SIGNAL       27

TIME  12:25  23:JUN:00
```

Row 1 indicates the burner sequence state, row 2 gives the flame signal strength.

2.15.3.2 Routine Adjustments

Setting Time & Date

To adjust the time and date settings go into COM mode. Power down the unit and restart. The

COM LED will be flashing and you have 5 seconds to press it. Then the password screen is

displayed. Set password to: **10** **10** , Press CLOSE

'Set Clock' screen is displayed:

```
DAY    FRI  DATE    23
MONTH  JUN  YEAR    00
HOURS   12  MINS    28
```

Use the buttons as detailed below to adjust the values appropriately.

Channel 1 Day

Channel 2 Date

Channel 3 Month

Channel 4 Year

HIGH START Hours

OPEN CLOSE Minutes

When finished press the flashing ENTER MEMORY button to submit to memory.

Note: Hours are displayed in 24 hour mode.

Adjusting the Screen Contrast

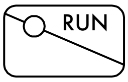
Hold down any of the screen select buttons,

FUEL METERING IBS SEQUENCING FLAME SCANNER LOCKOUT RESET DISPLAY STATUS E.G.A M.M.

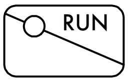
and then use the top row to adjust the contrast accordingly.

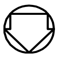
Calibrating Actual Pressure Reading

A facility exists to adjust small errors in the pressure value displayed in the Actual window.

To increase the value press 

and the Ch3  simultaneously.

To decrease press 

and the CH3  . The facility does not work on temperature.

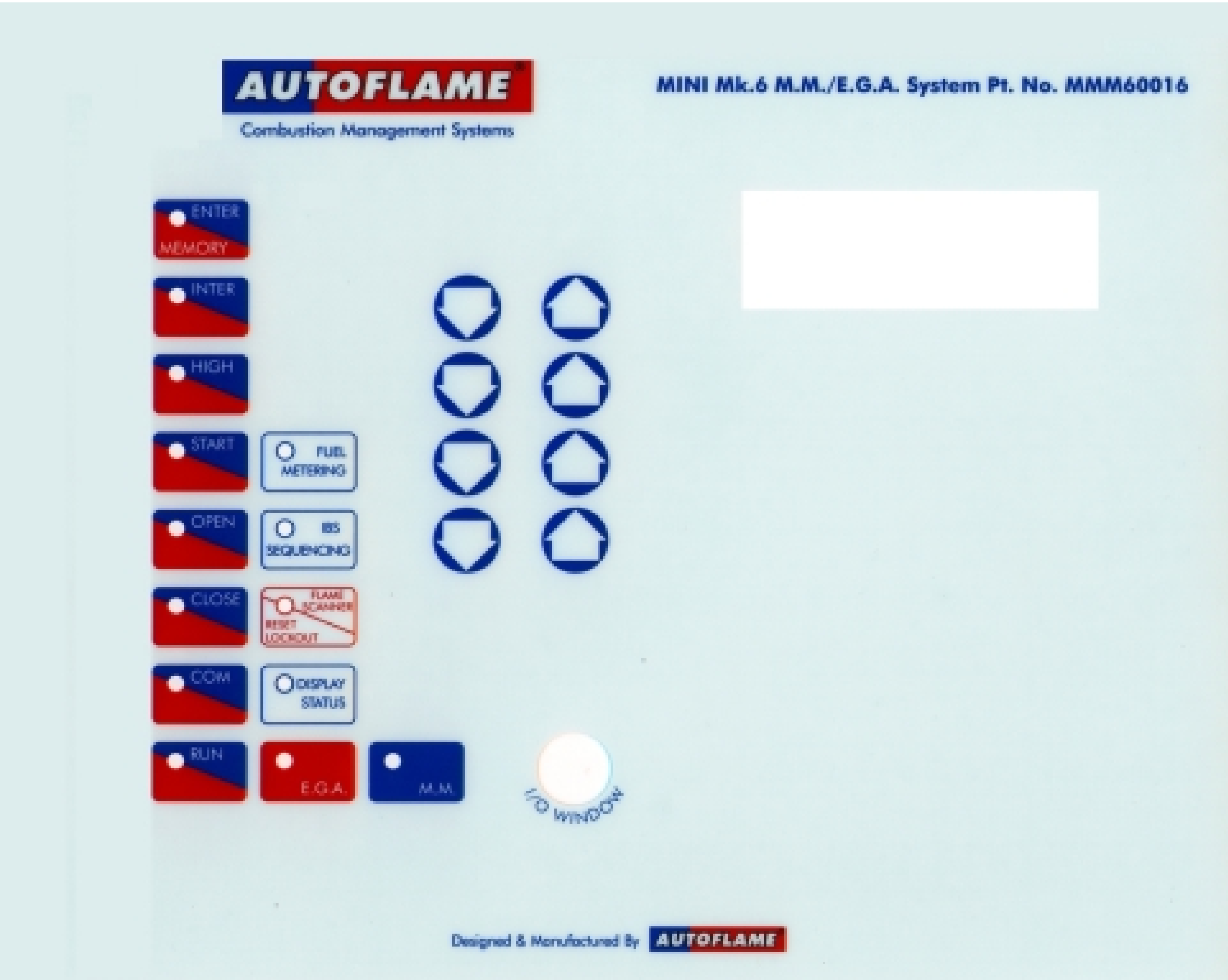
2.15.3.3 EPROM Version Numbers

To display the software version number select the MM Display screen, then press Channel 1 Up and Down simultaneously.

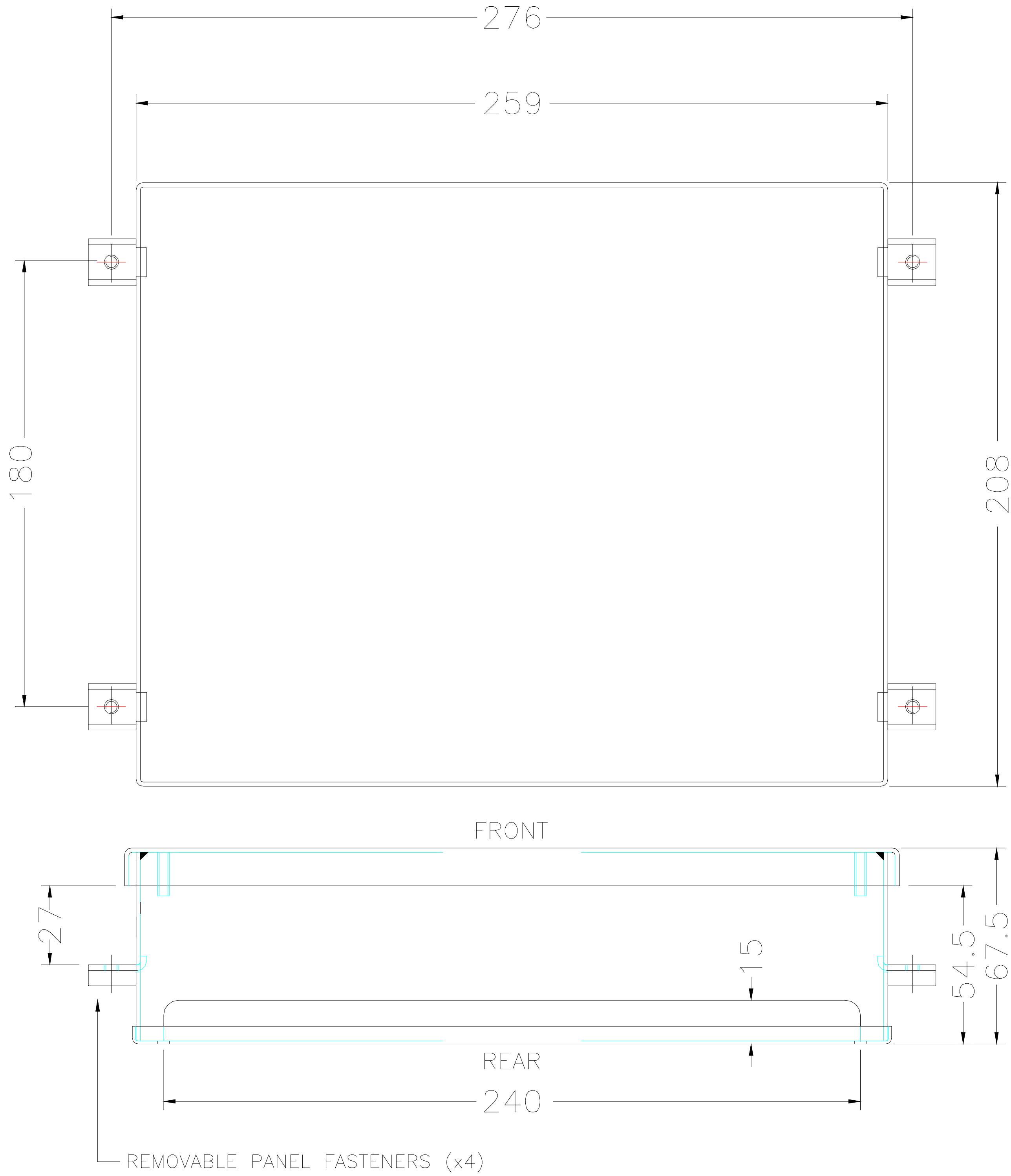
```
SOFTWARE

mini6 BC    41.01
mini5 MM    42.02
```

2.15.4 OTHER INFORMATION AND ILLUSTRATIONS

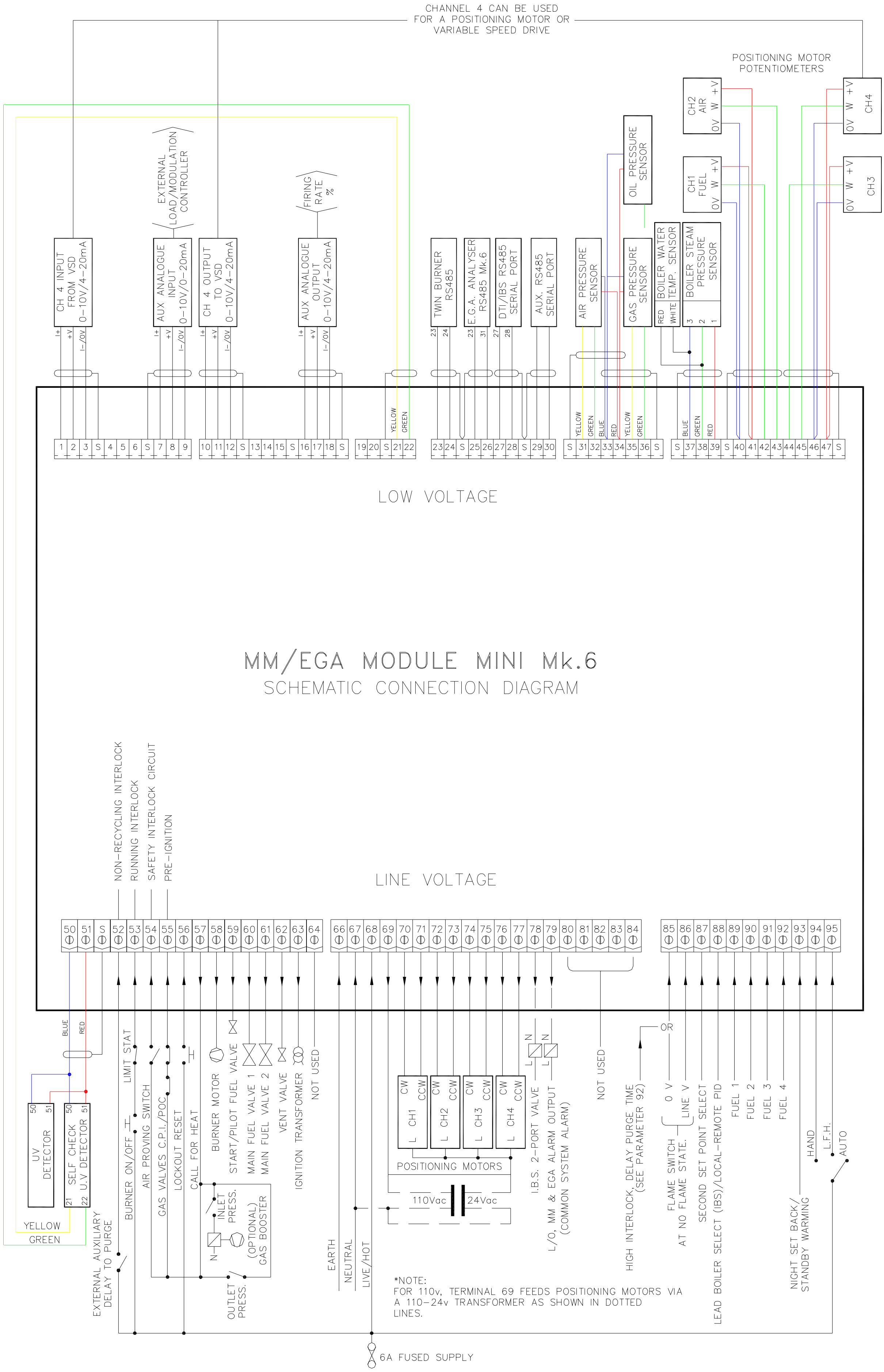
2.15.4.1 Mini Mk.6 MM Facia



2.15.4.2 Mini Mk.6 MM Enclosure Dimensions



2.15.4.3 Schematic Connection Diagram



2.15.4.4 Mini Mk.6 Specifications

2.15.4.4 <u>Classifications</u>

Classification According to EN298 - F B L L J B

Mains Supply:	230V, +10%/-15% } 120V, +10%/-15% }	47.5 - 63 Hz, Unit max. power consumption 45W
Climate:	Temperature	0 to +55°C (32 to 131°F)
	Humidity	0 to 90% non-condensing.
Protection Rating:	The unit is designed to be panel mounted in any orientation and the front facia is IP65. The back of the unit is IP20.	

Inputs & Outputs:
230V Unit:

Outputs	Terminal	57	250 mA	Must be connected through contactor	Max. load 6 Amp.
		58	250 mA	Must be connected through contactor	
		59	1Amp, 0.6 power factor		
		60	1Amp, 0.6 power factor		
		61	1Amp, 0.6 power factor		
		62	1Amp, 0.6 power factor		
		63	1Amp, 0.6 power factor		
		78	100mA	To drive relay only - switched neutral	
		79	100mA	To drive relay/lamp only - switched neutral	
Analogue I/O.s		240 Ω or less.			

120V Unit:

Outputs	Terminal	57	250 mA	Must be connected through contactor	Max. load 6 Amp.
		58	250 mA	Must be connected through contactor	
		59	2Amp, 0.6 power factor		
		60	2Amp, 0.6 power factor		
		61	2Amp, 0.6 power factor		
		62	2Amp, 0.6 power factor		
		63	2Amp, 0.6 power factor		
		78	100mA	To drive relay only - switched neutral	
		79	100mA	To drive relay/lamp only -switchedneutral	
Analogue I/O.s		240 Ω or less.			

Note:

1- The low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation.
2- Cabling should be a maximum 25m.
3- Use screened cable as specified in Section 2.14.2.9.4.
4- The burner 'High Limit Stat' must be of the manual reset type.

2.15.4.5.1 Mini Mk.6 Electrical Specifications

1	Current Input, 4-20mA. For channel 4 VSD use only. Can be connected to the current output of a VSD.
2	Voltage Input, 0-10V. For channel 4 VSD use only. Can be connected to the voltage output of a VSD.
3	Common for terminals #1 and 2.
4	Unused.
5	Unused.
6	Common for terminals #4 and 5.
7	Current Input, 4-20mA. Used for external modulation.
8	Voltage Input, 0-10V. Used for external modulation.
9	Common for terminals #7 and 8.
10	Current Output, 4-20mA. For channel 4 VSD use only. Can be connected to the current input of a VSD.
11	Voltage Output, 0-10V. For channel 4 VSD use only. Can be connected to the voltage input of a VSD.
12	Common for terminals #10 and 11.
13	Unused.
14	Unused.
15	Unused.
16	Current Output, 4-20mA. Varies in accordance with firing rate.
17	Voltage Output, 0-10V. Varies in accordance with firing rate.
18	0V common for terminals #16 and 17.

Note that all the common terminals (3, 6, 9, 12, 15, 18) are connected to each other internally. All of the circuitry, associated with the analogue inputs and outputs detailed above, is isolated from earth/ground potential, i.e. floating.

19, 20	Unused.
21, 22	Connections to an Autoflame self check UV sensor.
23, 24	Communications port connections for twin burner operation.
25, 26	Communications port connections to an Exhaust Gas Analyser (E.G.A.).
27, 28	Communications port connections for DTI and/or IBS/lead-lag operation.
29, 30	Communications port (currently unassigned).
31, 32	Signal inputs from Autoflame air pressure sensor.
33	0V supply to Autoflame air/gas/oil pressure sensors.
34	+12V supply to Autoflame air/gas/oil pressure sensors.
35	Signal input from Autoflame oil pressure sensor.
35, 36	Signal inputs from Autoflame gas pressure sensor.
37, 38	Connections to an Autoflame boiler temperature detector.
37, 38, 39	Connections to an Autoflame boiler pressure detector.
40	0V supply to channel 1 and channel 2 positioning motors.
41	+12V supply to channel 1 and channel 2 positioning motors.
42	Signal from channel 1 positioning motor, indicating position.
43	Signal from channel 2 positioning motor, indicating position.
44	Signal from channel 3 positioning motor, indicating position.
45	Signal from channel 4 positioning motor, indicating position.
46	0V Supply to channel 3 and channel 4 positioning motors.
47	+12V Supply to channel 3 and channel 4 positioning motors.
48, 49	No terminals allocated.

50,51	Connections to an Autoflame UV sensor.
52	Mains voltage input- external auxiliary delay to purge.
53	Mains voltage input- burner on/off signal. Running interlock circuit.
54	Mains voltage input- safety circuits, e.g. air proving.
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.
60	Mains voltage output- main fuel valve 1.
61	Mains voltage output- main fuel valve 2.
62	Mains voltage output- vent valve.
63	Mains voltage output- ignition transformer.
64	Unused.
65	No terminal allocated.
66	Mains supply- earth/ground.
67	Main supply- neutral.
68	Mains supply- live/hot.
69	Mains voltage output. Power to positioning motors.
70	Switched neutral- drives channel 1 positioning motor clockwise.
71	Switched neutral- drives channel 1 positioning motor counter clockwise.
72	Switched neutral- drives channel 2 positioning motor clockwise.
73	Switched neutral- drives channel 2 positioning motor counter clockwise.
74	Switched neutral- drives channel 3 positioning motor clockwise.
75	Switched neutral- drives channel 3 positioning motor counter clockwise.
76	Switched neutral- drives channel 4 positioning motor clockwise.
77	Switched neutral- drives channel 4 positioning motor counter clockwise.
78	Switched neutral- to drive 2-port valve for IBS/lead-lag operation.
79	Switched neutral- alarm output for M.M. lockout/M.M. error/E.G.A. error./T.D.S. limits

80	Unused- do not connect.
81	Unused- do not connect.
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. Or when using boiler differential proving.
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 sepoint- second set-point facility.
88	Mains voltage input. Can be used to select this M.M. as lead boiler when IBS/lead-lag is implemented. If this terminal is used to select the lead boiler, it will take priority over a lead boiler set via the DTI. Also used as an input to select external modulation using an external PID loop.
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- if low pressure steam operation is optioned, this input is used to detect low boiler temperature (by means of an appropriate temperature switch/ aquastat).
94	Mains voltage input- selects hand operation.
95	Mains voltage input- selects low flame hold operation.
S	All terminals marked S are internally connected. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, e.g. section 2.14.6.1.

2.15.5 Error Checking, Self Diagnostics Fault Analysis and I.D. Codes

Self Diagnostic Fault Identification Software

The "Error Checking" software, which is included in every M.M. E.G.A. module, continually interrogates the system for component or data handling failure. This intensive self checking programme is inflicted on all peripherals such as positioning motors and load detectors as well as the main M.M./E.G.A. system hardware. The safety related areas, both hardware and software, have been examined and accepted for CE, UL, FM and TUV.

Any error identified by the system is indicated by "ERROR" being displayed and the relevant error number. In the case of E.G.A. related faults, "ERROR EGA" is displayed with the corresponding error identification code.

2.15.5.1 Key to Errors Detected in Mini Mk.6 M.M. System

ERROR- confirms that error has been detected in the M.M. System.

Error Fault Type	Code No	
CH1 Positioning Error	01	- Check wiring & motor
CH2 Positioning Error	02	
CH3 Positioning Error	08	
CH4 Positioning Error	09	
CH1 Gain Error	41	- Check wiring & potentiometers are zeroed correctly
CH2 Gain Error	42	
CH3 Gain Error	43	
CH4 Gain Error	46	
VSD Error	80	- CH4 variable speed drive error
VSD Feedback Error	83	- CH4 variable speed drive feedback signal different to commissioned values See Section 2.14.2.10
Load Detector	03	- Open circuit on temperature sensor
12V/5V Supply Error	44	- Internal 5V/12V supply outside limits. Check 12V on terminals #40 & 41
Gas Sensor Recommission Error	GASRECOMM	- Reset option/parameter #150 back to 0 and reset options/ parameters #136/137 back to original values
Air Sensor Recommission Error	AIR RECOMM	- Reset option/parameter #150 back to 0 and reset option/ parameter #147 back to original value

Error Fault Type	Code No	
A/D Converter Error	47	- Check 12V supply on terminals #40, 41
Twin Burner Communications Failed	100	- Flashing error- no communications between the M.M. units
Air Pressure Outside Limits	82	- During run mode actual air pressure outside limits, commissioned +/- 0.3 "wg (see option #147)
Gas Pressure Sensor MM60008 optioned together with psi units	110	- See options #124 & 133 to 137. PSI display cannot be chosen for this sensor range

2.15.5.2 Mini Mk.6 Burner Control Lockouts

Lockout Message	Cause
Pre ign fail T55	Proof of closure switch opened during ignition sequence Check terminal #55 and proof of closure switches (cpi = close position interlock / proof of closure)
Safety fail T54	No air pressure during start/firing Check terminal #54 and air switch
VPS air proving fail	Leak detected during 'air proving' part of VPS Check 1st main valve
VPS air zeroing fail	When valve C opens, zero value outside limit +0.5 to -1.0" wg Check vent valve
VPS gas proving fail	Leak detected during 'gas proving' part of VPS Check 2nd main valve and vent valve Check pilot valve if using single pilot operation (option #130)
VPS gas pressure low	Gas pressure below minimum application pressure Check option #133 for minimum allowable pressure
No flame signal	No flame signal during ignition/firing

Lockout Message		Cause
Simulated flame		The flame is present when it should not be. Call for service immediately. This is potentially a dangerous condition.
FSR fault	57	These terminals are self checked within the Mk6. If a voltage is detected when the output is off (and vice versa) a lockout occurs.
Vent valve O/P	62	
Main fuel 1 O/P	61	
Main fuel 2 O/P	60	
Start fuel O/P	59	
Motor O/P	58	
Ignition O/P	63	
Shutter fault		UV signal detected during shutter operation on UV self check Check wiring on terminals #21/22
Prolonged lockout reset		Prolonged voltage present on terminal #56/lockout reset button permanently pressed
Pre ign timeout T55		Proof of closure switch not made after valves closed after firing Check terminal #55 and proof of closure switches
Gas pressure low limit		Gas pressure low limit exceeded when using a gas sensor Check option #136
Gas pressure high limit		Gas pressure high limit exceeded when using a gas sensor Check option #137
Gas pressure low		Low gas pressure before start up
UV short circuit		Connections to UV tube shorted
Oil pressure low limit		Oil pressure low limit exceeded when using an oil sensor Check option #139
Oil pressure high limit		Oil pressure high limit exceeded when using an oil sensor Check option #140
Purge air pressure low		Insufficient air pressure during purge Check option #141
Watchdog fault 1a		Internal fault diagnostics - contact Autoflame and report code displayed.
Watchdog fault 1b		
Watchdog fault 1c		
Watchdog fault 1d		
Watchdog fault 2a		
Watchdog fault 2b		
Watchdog fault 2c		
Watchdog fault 2d		

Ram test failed Prom test failed CPU test failed Input fault BC input short Lockout 198, 199, 200, 201, 202	Internal fault diagnostics - contact Autoflame and report code displayed.
Terminal 86 inverse	Terminals #85/86 both have an input or teminals #85/86 both do not have an input when using the flame switch operation- see option #122.
Termminal 85-86 fault	Electronics fault on either terminal #85 or #86.
Prove cct fail T52	Loss of input on terminal #52. Terminal #52 must see an input at all times from the position to purge to the end of the post purge (cct = closed circuit).

Gas Sensor Related

Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low gas sensor	see section 2.14.2.6.2 for zero limits
Zero high gas sensor	see section 2.14.2.6.2 for zero limits
Excessive VPS Operations	VPS has operated 3 times without burner firing
Signal dev - gas sensor	redundant signals from sensor do not match
Counts low - gas sensor	sensor fault - stuck on signal value
Counts high - gas sensor	sensor fault - stuck on reference value
Signal high - gas sensor	gas pressure exceeds maximum range value
Gas sensor (+ number)	sensor/Mk6 internal fault - report to Autoflame

Air Sensor Related

Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low air sensor	lower limit is -1.0"w.g.
Zero high air sensor	upper limit is +0.5"w.g.
Signal dev - air sensor	redundant signals from sensor do not match
Counts low - air sensor	sensor fault - stuck on signal value
Counts high - air sensor	sensor fault - stuck on reference value
Signal high - air sensor	air pressure exceeds maximum range value
Air sensor (+ number)	sensor/Mk6 internal fault - report to Autoflame

The "Error Checking" software, which is included in every M.M. module, continually interrogates the system for component or data handling failure. This intensive self checking programme is inflicted on all peripherals, e.g. positioning motors/load detectors as well as the main M.M. system hardware. The safety related areas, both hardware and software, have been examined and accepted for CE, UL, FM and TUV.

Section 2.16: MINI Mk5 EVO M.M. Micro Modulation

2.16.1 MINI MK.5 EVO M.M. CONTROL UNIT

2.16.2 MINI MK5 EVO COMMISSIONING

2.16.2.1 Options

To Select Options Mode.
Ch1, Ch2, & Ch3 etc. refer to the rows of buttons respectively starting with CH1 at the top.

Option values can be changed by entering the Option mode. The password must first be entered. To enter the password follow the steps listed:

Either deselect and then select fuel or power down and then up

If system is already commissioned, press COM before the COM l.e.d. stops flashing

If system is not already commissioned, commissioning mode will be set automatically

The password screen is displayed:

```
PASSWORD                0
PASSWORD                0
F1 COMMISSIONED        23
```

Use the CH1 and CH2 buttons to set the Password codes. Then press CLOSE

To select the Options screen, Press the Ch1 buttons simultaneously. The following screen should be displayed:

```
OPTION No    1=   3
BOILER SENSOR TYPE
TEMPERATURE SENSOR
0-400 C,    3-730 F
```

Rows 2, 3 & 4 display textual descriptions of the option number and value

To change the Option number use the CH2 buttons

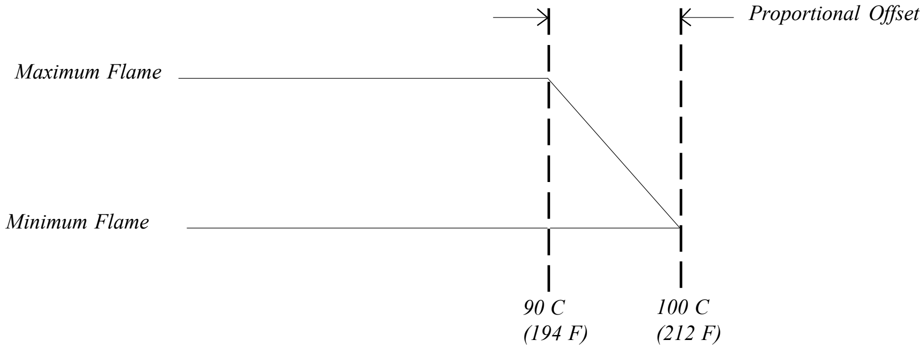
To change the value use CH3 buttons

Any number of Option values can be changed when in Option mode

When changes have been made press ENTER MEMORY

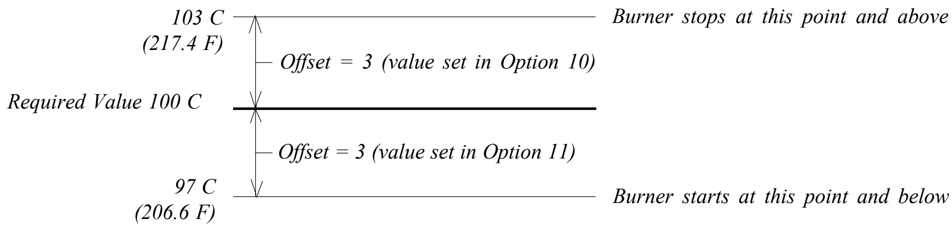
All new Option values are then permanently stored

Option No.	Factory Setting	Option Value	Description
1.	3		**Boiler Temperature/Pressure Sensor Type:**
		3	0-400C Temperature Sensor (MM10006 & 7).20-390 C. (50 - 730 F.)
		4	Unused
		5	Unused
		6	0-18 Bar Pressure Sensor (MM10008) 2.0 - 23.0 bar (30 - 330 P.S.I.)
		7	0-30 Bar Pressure Sensor (MM10009) 2.0 - 38.0 bar (30 - 550 P.S.I.)
		8	0-3.0 Bar Pressure Sensor (MM10010) 0.2 - 3.80 bar (3.0 - 55.0 P.S.I.)
		9	Unused
		10	Non-standard range Temperature Sensor (voltage input)- range set by parameters 52-56
		11	Non-standard range Pressure Sensor (voltage input)- range set by parameters 52-56
2.	60		**Motor Travel Speed:** The value is not specific to a time/distance ratio. If the speed of the motor is too fast then increase this option value. If too slow, decrease the value. This speed adjustment is only relevant during modulation. At other times the motors move at full speed or as set for Purge in Option 75.
		5-240	Adjustment Range
3.	0		**Unused.**
4.	0		**Unused.**
5.	1		**Purge position**: This selects the purge position. (Applicable to Channel 1-3 when selected, See Options 67 - 69).
		0	Selected Channel purges at HIGH position.(High Fire Position)
		1	Selected Channel purges at OPEN position.(Full span of servomotor as entered during commissioning)

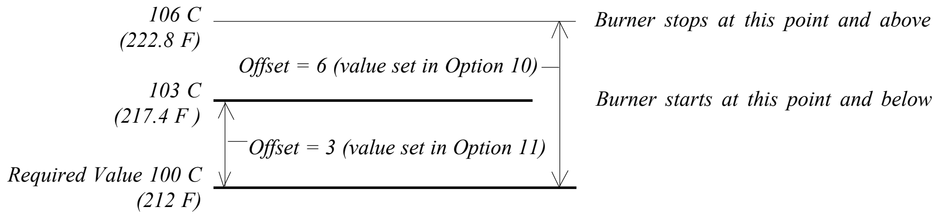
Option No.	Factory Setting	Option Value	Description
6.	10		**P & I control**: Options 6 and 7 are used for adjusting the proportional and integral settings of the M.M.'s built in P + I + D controller. See Option 37 for the derivative adjustments.
			Example of proportional band offset: Required value = 100 C, Proportional offset = 10 (i.e. Option 6 set to value 10).
			
			Proportional band: Value entered - Centigrade, Fahrenheit, Bar or p.s.i. depending on type of control sensor and display units selected (refer Options 1, 51 and 52).
		5-50	For Centigrade, Fahrenheit and p.s.i. selections,
		0.5-5.0	If Bar is selected.
7.	60		**Integral time**: Every n seconds 10% of the present offset from setpoint value is added or subtracted to the present proportional value. The value of n is set in this option. It is possible to set this Option to 'off'. If 'off' is selected there will be no integral action control. (Integral is equivalent to 'Reset')
		OFF-250	Seconds.
8.	1		**Number of Servo Motor Channels to be enabled**: Channel "1" is always enabled (Fuel Position Motor). Set Option 8 to the number of additional channels required (Minimum of 1) .
		1	Channels 1-2 In use.
		2	Channels 1-3 In use.

Option No.	Factory Setting	Option Value	Description
9	1		**Internal Stat Operation**: The 'internal stat' serves the purpose of turning the burner on and off accordingly to the actual value relative to the required setpoint. There are three settings for this Option. The first keeps the 'internal stat' closed all the time. In this instance, a 'working' stat must be fitted to the boiler. The second setting opens the 'internal stat' at an offset above the Required setpoint and closes it at an offset below the Required setpoint. The third setting opens the 'internal stat' at an offset above the Required setpoint and closes it at an offset also above the Required setpoint. The following diagrams illustrate this operation. The offset values are set in Options 10 and 11.
		0	Internal stat always closed (must be set for external modulation- option #45).
		1	Burner stops below Required setpoint.
		2	Burner stops above Required setpoint.

Option 9 = 1, example using 100 C (212 F). Required Value.



Option 9 = 2, example using 100 C (212 F). Required Value.



Option No.	Factory Setting	Option Value	Description
10.	3		**Offset above required setpoint at which the burner is stopped:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.2-5.0	If Bar units effective.
11.	3		**Offset below/above required setpoint at which the burner is started:** (Only relevant if option #9 is set to 1 or 2).
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective,
		0.2-5.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
12.	0		**E.G.A. Options**: There are numerous E.G.A. Options, briefly they are as follows:- The E.G.A. is operational and the system trims. If the E.G.A. develops a fault, the system reverts to M.M. only operation. The system can be further optioned so that in the event of an E.G.A. error the burner will stop. If this type of option is set, the burner will only run when the E.G.A. is ready for operation. Further Options can be set which perform limit checks on the values that the E.G.A. measures. In the event of a limit being exceeded the system can revert to M.M. only operation, or alternatively the burner will stop. A last Option exists to enable an E.G.A. to give readings on the M.M. for just monitoring purposes. i.e. the system is commissioned on M.M. only but E.G.A. values are displayed just for information. All Option values except 0 make the E.G.A. operational. If Options 5 or 6 are selected , refer to Options 19-27 to set limits to be tested for. **Note. If the E.G.A. is removed for servicing and this option is set to #0, then any single point changes made during this time will result in complete re-commissioning when this E.G.A. option is reset.**
		0	E.G.A. not optioned.
		1	System reverts to M.M. only operation if E.G.A. error.
		2	Burner stops if E.G.A. error.
		3	Unused.
		4	Unused.
		5	Limits tested, system reverts to M.M. only operation if E.G.A. error or limit exceeded.
		6	Limits tested, burner stops if E.G.A. error or limit exceeded.
		7	System commissioned on M.M. only, E.G.A. used as monitor.
13.	0		**Restore Factory Settings:** To set all Options back to their original factory set values, set Option 13 value to 26 and press enter.
		0-30	
14.	0		**Unused.**
15.	0		**Unused.**

Option No.	Factory Setting	Option Value	Description
16.	**0**		**Sequencing/DTI:** If Option 16 is set to values 1 or 3, then this M.M. will respond to sequencing commands (see section on Sequencing). A lead boiler can be selected by pressing the LEAD BOILER pushbutton on the front facia of the appropriate M.M. when in the 'IBS' screen. Only 1 M.M. may be selected as lead boiler at a time or the sequencing will not operate. The lead boiler can also be selected via the D.T.I., but the 'LEAD BOILER' pushbutton overrides the DTI lead boiler selection.
		0	No sequencing.
		1	Sequencing enabled.
		2	Setpoint & enable/disable commands accepted from D.T.I.
		3	Both of 1 & 2.
17.	**0**		**NO & CO displayed when running on oil:** If fuel 2 is selected, then the displaying of CO & NO can be on or off. This Option is only relevant if an E.G.A. is operational on the system.
		0	NO & CO not displayed.
		1	NO & CO is displayed normally.
18.	**1**		**Carry forward of Trim:** When the system modulates, the correction that may be existing on the air damper position can be carried forward. Only air plus correction is carried forward. This Option is only relevant if an E.G.A. is operational on the system.
		0	No carry forward of trim.
		1	Trim carried forward.
19.	**0**		**Upper offset limit % O_2.** **E.G.A. Limits:** Options 19-27 are only relevant if an E.G.A. is operational on the system. Option 12 value 5 or 6 must be selected if any of the following limit checks are to be invoked. To enable the checking of a particular limit, make the value of the appropriate Option a non-zero value. The amount of 'limit offset' is specified by the value entered. e.g. If the 'upper limit offset O_2' is to be enabled and the value of the offset is 2.0%, then enter the value of 2.0 for Option No. 19.
		0-10.0	% O_2.
20.	**0**		**Upper offset limit % CO_2.**
		0-10.0	% CO_2
21.	**0**		**Upper offset limit CO.**
		0-2000	CO
22.	**0**		**Lower offset limit % O_2**
		0-10.0	% O_2

Option No.	Factory Setting	Option Value	Description
23.	**0**		**Lower offset limit % CO_2**
		0-10.0	% CO_2
24.			**Unused.**
25.	**0**		**Absolute value % O_2**. (System checks for O_2 values lower than value specified in this Option).
		0-20.0	% O_2
26.	**0**		**Absolute value % CO2.** (System checks for CO_2 values higher than value specified in this Option).
		0-20.0	% CO_2
27.	**0**		**Absolute value ppm CO.** (System checks for CO readings higher than values specified in this Option).
		0-2000	CO ppm
28.	**20**		**Trim threshold:** This option is only relevant if an E.G.A. is operational on the system. The value set in this Option is subtracted from the operator set "Required" value. If the Actual value is less than the result then no Trim action will be effected. If the trim is to be effective all the time then set the value to zero. Must also be set to O for the E.G.A. to operate when external modulation is optioned.
		0-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0-5.0	If Bar units effective.
29.	**1**		**Golden Start:** NB. Must be entered on each fuel individually if more than one fuel is commissioned. Refer to section 2.14.12 for further details.
		0	Golden Start operates.
		1	Golden Start does not operate.
30.	**50**		**D.T.I. - Required Value Minimum Limit:** If the system is being used with a D.T.I. a maximum and minimum limit for the Required value must be set. The M.M. will only act on values within the limits set. If a value is received from the D.T.I., that is outside these limits, it will be ignored and the system uses its previous Required value. Practical range is limited to range of sensor selected.
		5-995	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.5-99.5	If Bar units effective.
31.	**100**		**Maximum Limit.**
		5-995	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.5-99.5	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
32.	20		**Trim Delay:** After ignition the sampling system does not sample for the period of time set in this option. (Only relevant if E.G.A. is operational on system). This allows for the boiler to warm up and combustion to stabilise before sampling commences.
		0-250	Period (seconds) after ignition no sampling takes place.
33.	1		**M.M. Identification No. -** Sequencing Options: If this M.M. is configured as part of a sequencing system and/or required to communicate with a D.T.I. then the following three options must be set: The first is an identification number for this M.M.. The second is the rating of the burner, and the third is the "sequencing scan time". Refer to Sequencing Section for further explanation.
		1-10	Identification Number.
34.		5	**Rating of burner**
		1-999	See option 77 for units.
35.	10		**Sequence Scan Time. (minutes)**
		1-100	Sequence Scan time (Minutes).
36.	0		**E.G.A. Sensor Selection:** Available when using an E.G.A. System fitted with NO/SO_2sensors. The following option is for selecting the type of Sensor required: Part No. EGA20005 for NO; EGA20008 for SO_2.
			SO_2 NO
		0	Off Off
		1	Off On
		2	On Off
		3	On On
37.	0		**Time Between Readings** **Explanation of D. (Derivative Action)**: The user adjustable control variables to set up the D action are as detailed below. (Derivative is equivalent to 'Rate')
		0	(0=off)
		1-200	Seconds. The time interval between the controller comparing Actual and Required Setpoint values.
38.	2		**Deadband.** The Deadband is the margin above and below the Setpoint within which no derivative control action occurs.
		0-15	If Centigrade, Fahrenheit or PSI units optioned.
		0-1.5	If Bar units optioned.

Option No.	Factory Setting	Option Value	Description
39.	**10**	1-100	**Response Sensitivity.**

%

The Sensitivity Number indicates the amount of percentage firing rate increase or decrease that is inflicted by the Derivative action;

e.g. If the chosen value was 10% then 10% of the maximum firing rate would be added to the existing rate of fire; i.e.: If the burner were firing at 50% load and the derivative action was triggered the firing rate would increase by 10+50 to 60%.

The following is an example of the above control philosophy in action:

Note:	"Time Between Readings"	set to 20 seconds.
	"Deadband"	set to 2°C (2°F.)
	"Response Sensitivity"	set to 10%.
Setpoint Information:		
	"Required"	set to 90°C (190°F.)
	"Actual"	reads 86°C (186°F.)
Firing Rate Information:		
	Burner firing	at 50% of capacity.

In the example situation there has been 4°C (4°F) drop in temperature below the "Required" value. The Deadband is set at 2°C (2°F.), therefore the Derivative action will be triggered as the deviation from Setpoint is in excess of 2°C (2°F.). In this example 10% will be added to the 50% firing rate resulting in an increase in firing rate to 60% of capacity.

The "Time Between Readings" is set for 20 seconds and if after this time interval the "Actual" reading is not within the 2°C (2°F) deviation from "Required" Deadband another 10% would be added to the 60% firing rate which would result in a 70% firing rate.

By careful selection of "Time Between Readings" "Deadband" and "Response Sensitivity" an ideal response to rate of change over time can be configured.

The control philosophy detailed operates inversely if the "Actual" temperature exceeds the Setpoint and is outside the "Deadband".

To enable or switch on the Derivative action the "Time Between Readings" must be set in excess of 10 seconds.

Option No.	Factory Setting	Option Value	Description
40.	**0**		**Unused**

Option No.	Factory Setting	Option Value	Description
41.	**0**		**Steam Boiler Sequencing** Options 41, 42, 43 and 44 are related to the "Standby Warming" Sequencing state. Option 42 enables an offset to be set relative to the Required value to generate a "phantom setpoint". During this "Standby Warming" operation the 'internal stat' operates on the phantom setpoint. Options 43 and 44 are offset values above and below the phantom setpoint (i.e. Options 10 and 11 are not used for the phantom setpoint 'internal stat' offsets). When a boiler is set to the "Standby Warming" state, by the M.M. Sequencing commands, it runs for a period of time at low flame and then off for a period. This action keeps the boiler warm. Option 53 sets the time interval that the burner is Off: Option 54 sets the time that the burner is On. If Option 41 = 0 only one boiler will be set to the "Standby Warming" state. Boilers further down the sequence will be set to the "OFF" state. In this case Options 53 and 54 set the ON and OFF time. (If Options 41 and 53 are 0 then Hot Water Sequencing is implemented).
		0	3 State Steam Sequencing. ON, Standby/Warming , Off
		1	2 State Steam Sequencing. ON, Standby/Warming
42.	**20**		**Phantom Setpoint.** Offset below normal Required value.
		0-100	If Centigrade, Fahrenheit or p.s.i. units effective.
		0-10.0	If Bar units effective.
43.	**5**		**Offset above the phantom setpoint when the burner stops.**
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.2-5.0	If Bar units effective.
44.	**5**		**Offset below the phantom setpoint when the burner starts.**
		2-50	If Centigrade, Fahrenheit or p.s.i. units effective.
		0.2-5.0	If Bar units effective.
45.	**0**		**External Modulation:** If this option is enabled, the usual P.I.D. control is disabled and the percentage of firing is set by an external voltage applied to the appropriate input. 0 volts sets the firing rate to minumum, 10.0 volts sets the firing rate to maximum. The 10 point fuel flow metering curve must be entered for correct operation. See option #57. Option #9 must be set to zero for external modulation.
		0	Disabled
		1	Enabled
46.			**Unused.**

Option No.	Factory Setting	Option Value	Description
47.	**0**		**Cold Start Routine.** If the boiler temperature/pressure is at or below 30% of the target pressure/temperature then the burner would be held at low flame. If the boiler is at or below 60% of its target temperature/pressure then the burner firing rate would be held at 50% firing. When the boiler temperature/pressure exceeds the P Band offset in the PID philosophy then the burner would revert to normal PID load control.
		0	Off
		1	On
48.	**0**	0-600	**Flue Gas Recirculation - Timer.** This is the time that the M.M. elements (positioning motors/ac drives) are held at the FGR positions, after which modulation then takes place.
49.	**0**	0-50	**Flue Gas Recirculation - Offset.** This is an offset from the required value. The FGR positions are held until such time that the actual value reaches the offset value.
50.	**0**		**Flue Gas Recirculation - Flue Gas Temperature.**
		0	Not optioned.
		1	Optioned. The FGR positions are held until such time as the flue gas temperature has reached 120°C. (An E.G.A. must be present and optioned).
51.	**0**		**Units of Temperature**. NB. When changing units adjust all other relevant options respectively.
		0	All temperature readings displayed in Celsius.
		1	All temperature readings displayed in Fahrenheit.
52.	**0**		**Units of Pressure.** NB. When changing units adjust all other relevant options respectively.
		0	All pressure readings displayed in Bar.
		1	All pressure readings displayed in p.s.i.
53.	**1**		**Steam Boiler Sequencing Burner Off Time:** The steam boiler type sequencing is enabled by setting Option 1 to a respective pressure sensor. Options 42, 43 and 44 are relevant to the "Standby" boiler operation.
		1-200	Burner "Off" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
54.	**5**		**Burner 'On' Time**
		1-30	Burner "On" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
55.	**0**		**Unused.**

Option No.	Factory Setting	Option Value	Description
56.	**1**		**Operation of Alarm Output, Terminal AL, NB this is a switched neutral and not a voltage output terminal:**
		1	Relay normally Off, On when Alarm.
		2	Relay normally On, Off when alarm.
57.	**0**		**Flow Metering:** If the Air window shows 57 and the Required window shows 1 when ENTER is pressed to store the Options, then the 10 point calibration procedure will be invoked the next time the burner starts.
		0	No Flow Metering.
		1	Flow Metering Operates.
		2	Totalised Flow Metering reset to zero for fuel selected
58.			**Unused.**
59.			**Unused.**
60.	**0**		**Hand/Auto Bumpless Transfer Operation.**
		0	Fuel valve goes directly to last set Hand position.
		1	Hand position (taken on present fuel valve position when changing from Auto to Hand operation).
		2	As 0, but Hand position is not stored in permanent memory.
61.	**1**		**Flow metering units fuel 1 - Gaseous**
		0	Cubic feet
		1	Cubic meters
		2-10	Unused
62.	**3**		**Flow metering units fuel 2 - Liquid**
		0	Unused
		1	Lbs.
		2	Kilograms
		3	Litres
		4	US gallons
		5-10	Unused
63.			**Unused.**
64.			**Unused.**
65.			**Unused.**
66.			**Unused.**

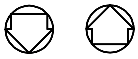
Option No.	Factory Setting	Option Value	Description
67.	1		**Purge Position:** The following Options tell the M.M. which channels are to be included in the Purge sequence. (See Option 5 for Purge Position).
		0	Channel 1 to Purge position.
		1	Channel 1 to remain closed for Purge.
68.	0		**Channel 2 Purge position.**
		0	Channel 2 to Purge position.
		1	Channel 2 to remain closed for Purge.
69.	0		**Channel 3 Purge position.**
		0	Channel 3 to Purge position.
		1	Channel 3 to remain closed for Purge.
70.			**Unused.**
71.	0		**Fuel 1 - Fuel type.**
		0	Natural gas
72.	1		**Fuel 2 - Fuel type.**
		1	Light Distillate Oil
		2	Heavy Fuel Oil
73.			**Unused.**
74.			**Unused.**
75.	0		**Purge Motor Travel Speed:** During a Purge Sequence the Motor Travel Speed can be set independent of Option 2. This affects all selected channels.
		0 -100	0 = Quickest time, 100 = Slowest time.
76.	0		**Unused.**
77.	0		**Burner Rating Units.** Display purposes only for Flow Metering.
		0	KW x100 /hr
		1	Kg x100 /hr
		2	MW /hr
		3	Btu x100 /hr
		4	Hp x100 /hr
		5	lbs x100 /hr
		6	Btu x1000/hr
		7	Hp x10/hr
		8	lbs x1000/hr
		9	Btu x1000000/hr

Option No.	Factory Setting	Option Value	Description
78.	**0**		**Unused:**
79.	**0**		**Lowest required setpoint:**
		0-995	Minimum required setpoint allowed when O.T.C. optioned. See option #80 and parameter #88. Point A- see diagram in section 2.16.4.7.
80.	**0**		**Outside Temperature Compensation:**
		0	Disabled
		1	Enabled
81.	**140**		**Maximum boiler required setpoint at minimum outside temperature:** Point B- see diagram in section 2.16.4.7
		50-999	Value limited in accordance with sensor selected by option #1.
82.	**-30**		**Minimum outside temperature:** Point C- see diagram in section 2.16.4.7.
83.	**65**		**Minimum boiler required setpoint at maximum outside temperature:**
			-40 to +40 for Centigrade -40 to +105 for Fahrenheit
84.	**30**		**Maximum outside temperature:** Point D- see diagram in section 2.16.4.7.
85.			**Unused:**
86.	**0**		**Channel 1 Softened Error checking Select -** increases positioning error fom 0.1° to 0.5° for Industrial motor
		0	CH1 normal positioning motor.
		1	CH1 industrial positioning motor/softened error checking.
87.	**0**		**Channel 2 Softened Error checking Select .**
		0	CH2 normal positioning motor.
		1	CH2 industrial positioning motor/softened error checking.
88.	**0**		**Channel 3 Softened Error checking Select.**
		0	CH3 normal positioning motor.
		1	CH3 industrial positioning motor/softened error checking.
89-109.			**Unused.**

Option No.	Factory Setting	Option Value	Description
110.	**1**		**Burner control.**
		1	Non-permanent operation. Internal - Standard Scanner
111.	**0**		**Pilot**
		0	Interrupted pilot
		1	Intermittant pilot (expanding flame)
112.	**40**		**Pre purge time**
		5-100	Seconds/Minutes (check setting of option #135)
113.	**3**		**Pre ignition time.** Time ignition transformer is on before gas valve opens.
		3-5	Seconds
114.	**3**		**First safety time.** Time pilot valve is open before UV is checked.
		3-10	Seconds
115.	**3**		**Pilot prove time. (Pilot trial for ignition PTFI)**
		3-5	Seconds
116.	**3**		**Fuel 1 Second safety time (Main trial for ignition MTFI).**
			(Not Applicable to expanding flame - see option 111)
		3-10	Seconds
117.	**5**		**Main flame prove time.**
		5-20	Seconds
118.	**0**		**Post purge time**
		0-100	Seconds (0 - No post purge). UV not checked during post purge.
119.	**10**		**Control Box Recycle time.** Time delay from burner shut down to startup.
		3-120	Second
120.	**10**		**UV Threshold**
		5-50	Minimum Flame Signal Strength during pilot. (At all other times the UV threshold is fixed at 5).
121.	**5**		**Delay from start of pre-purge after which air switch checked**
		5-10	Seconds
122.	**0**		**Flame Detection Method**
		0	UV scanner
		1	Do not select
		2	Ionisation

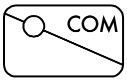
Option No.	Factory Setting	Option Value	Description
123.	**3**		**Fuel 2 Second safety time (Main trial for ignition MTFI).**
			(Not Applicable to expanding flame - see option 111)
		3-15	Seconds
124.			**Unused:**
125.		**0**	**External VPS- fuel 1:**
		0	Not checked on fuel 1.
		4	External VPS optioned. It is possible within the unit to use an external VPS controller for this operation. If this is set then the system will wait for a mains voltage input on terminal #55 to confirm that the external VPS operation is completed. The time period for this is 10 minutes before the voltage input must be seen, otherwise a lockout will occur (contact Autoflame before use).
126.		**0**	**External VPS- fuel 2:**
		0	Not checked on fuel 1.
		4	External VPS. See option #125 for information.
127-134			**Unused:**
135.	**0**		Change pre-purge time from seconds to minutes
		0	Seconds
		1	Minutes
136-149			**Unused:**
150.	**0**		**Clear ALL Commissioning Data and restore Options/Parameters to factory settings.**
		0 - 10	Range
		5	Clear Commissioning Data
			FOR SAFETY REASONS OPTIONS 110 TO 150 ALSO HAVE TO BE ENTERED IN AS PARAMETERS. IT IS THE COMMISSIONING ENGINEER'S RESPONSIBILITY TO ENSURE ALL SETTINGS ARE IN ACCORDANCE WITH THE APPROPRIATE STANDARDS.

2.16.2.2 Parameters

To Select Parameter Mode.
Ch1, Ch2, Ch3 refer to the rows of buttons  respectively starting with CH1 at the top.

Parameter values can be changed by entering the Parameter mode. The password must first be entered. To enter the password follow the steps listed.

Either deselect and then select fuel or power down and then up.

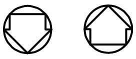
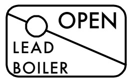
If system is already commissioned, press 

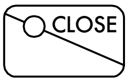
before the COM l.e.d. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

The password screen is displayed.

```
PASSWORD              0
PASSWORD              0
F1  COMMISSIONED     23
```

Use the CH1 and CH2  buttons to set the Password codes. Then press the 

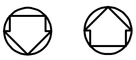
and 

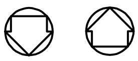
buttons simultaneously.

The parameters screen will then be displayed as below:

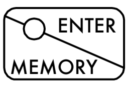
```
PARAMETERS No   1=    3
```

Rows 2, 3 & 4 display textual descriptions of the parameter number and value.

To change Parameter number use the CH2  buttons.

To change value use the CH3  buttons.

Any number of Parameter values can be changed when in Parameter mode.

When changes have been made press 

All new Parameter values are then permanently stored.

Note: Parameters that are noted as unused must not be adjusted from their factory settings.

Parameter No.	Factory Setting	Parameter Value	Description
1	3	0-20	Sequencing - Offset value when unit goes off line i.e. If the Standby Boiler fails to start the scan time will be decreased by 3 minutes. If the scan time is set to 10 minutes, this would be reduced to 7 minutes scan time.
2	1	1-10	Sequencing - Time between data requests (seconds). Bus driver request info every second, M.M's transmit every second, DTI only listens to Transmissions.
3	1	1-10	Sequencing - Number of boilers initially set on after powerdown.
4	45	5-100	E.G.A. -Seconds ENTER button disabled after E.G.A. pressed
5	4	1-50	Sequencing - Number of minutes, time out value to reach modulation, i.e. If the boiler is not modulating after being asked to contribute to load, it is taken out of the sequence loop. After being asked to modulate the burner must start to modulate in 4 minutes.
6	60	5-100	Unused.
7	16	1-50	Unused.
8	30	5-240	E.G.A. - Delay after draining before trim cycle start ie. Wash out period, When cells being cleaned with air, this value maintains the last readings until the air sampled during the drain period has gone.
9	60	5-240	E.G.A. - Auto commission time
10	0		Unused.
11	25	5-60	Air flush time during Auto Commission - (Seconds).
12	0	0-1	E.G.A. - CO included in trim calculation on F2 (See Option 17). 0 - no 1 - yes i.e Required when running gas on F2.
13	20	5-30	E.G.A. - ÷4 = % of Air damper. Amount of Autocommission trim. Applies to Air (-)only.
14	20	1-200	E.G.A. - ÷2 Number of degrees the fuel valve moves before negative trim is reset.
15	5	2-100	Number of seconds positioning motors are held at "choke" position. (Applies to Golden Start only, see option 29). This time starts from the ignition point.
16	12	1-50	Time between calibrations, (÷ 2 = Hours) Calibrates every 6 hours if burner does not turn off.
17	3	1-10	E.G.A. - Number of trims before error flagged when limits exceeded. (each Trim = 30 Seconds)

Parameter No.	Factory Setting	Parameter Value	Description
18	20	5-60	E.G.A. - Trim amount during run ÷ by 2 = % of trim. This value cannot be set above 20 (10%) or an ERROR 25 will occur.
19	1		Unused.
20	0	0-40	Set value to 26 press enter to restore all preset factory settings.
21	0		Unused.
22	0		Unused.
23	0		Unused.
24	120	20-240	E.G.A. - Calibration time - seconds
25	30	5-100	E.G.A. - Time between samples
26	8	1-50	E.G.A. - Number of samples per trim cycle
27	25	0-255	E.G.A. - Minimum Operating Temp. (÷ 5=deg C)
28	200	0-255	E.G.A. - Maximum Operating Temp. (÷ 5=deg C)
29	0		Unused.
30	20	0-40	Filters Load Sensor Readings(Temp. & Pressure) 0 - No Filtering. 20 - Max. Filtering.
31	0	0-1	**Selects Efficiency to be displayed** - 0 - English (USA/Canada)(incorporates Hydrogen & moisture loss) - 1 - European
32	0		Unused.
33	0		Unused.
34	0		Unused.
35	2		Unused.
36	5		Unused.
37	20		Unused.
38	254	0-255	M.M. - password fuel
39	1	0-255	M.M. - password air
40	10		Unused.

Parameter No.	Factory Setting	Parameter Value	Description
41	5		Unused.
42	4		Unused.
43	7		Unused.
44	0.4	0-4.0	E.G.A. - O_2 window inside which no further trim takes place.
45	0.2	0-2.0	E.G.A. - CO_2 window inside which no further trim takes place.
46	0		Unused.
47	0		Unused.
48	0		Unused.
49	0	0-1	Set to 1 if required setpoint not to be stored permanently in memory. This is important to set if changing the required setpoint often, e.g. through the DTI.
50	0		Unused.
51	0		Unused.
52	0	0-2	Number of decimal points (please see table below).
53	0	0-9990	Maximum value (please see table below).
54	0	0-100	0-10.0 volt. Maximum voltage (please see table below).
55	0	0-9990	Minimum value (please see table below).
56	0	0-100	0-10 volt. Minimum voltage (please see table below). The table below shows examples on how to set up the paramters when using an external load sensor.

Example 1: **Pressure** Application	Example 2: **Temperature** Application
Required/Actual Range- 0.0-100.0bar	Required/Actual Range- 1000-2000F
Input Signal- 0-10 Volts	Input Signal- 1-6 Volts
Option 1- 11	Option 1- 10
Option 52- pressure units	Option 51- temperature units
Parameter 52- 1	Parameter 52- 0
Parameter 53- 1000	Parameter 53- 2000
Parameter 54- 10.0	Parameter 54- 6.0
Parameter 55- 00	Parameter 55- 1000
Parameter 56- 0.0	Parameter 56- 1.0

Parameter No.	Factory Setting	Parameter Value	Description
57	0		Unused.
58	0		Unused.
59	0		Unused
60	0	0 - 1	0 - Normal E.G.A. Operation 1 - O_2 Trim Interface Operation.
61	0		Unused.
62	0		Unused.
63	0	0 - 1	Set to 1. Leave for 2 seconds, then set back to 0 to clear lockout history.
64	0	0 - 1	Set to 1. Leave for 2 seconds, then set back to 0 to reset totalised fuel metering values for all 4 fuels.
65	0	0 - 1	Set to 1. Leave for 2 seconds, then set back to 0 to reset burner history, hours run and number of start ups.
66	0		Unused.
67	0		Unused.
68	0		Unused.
69	0	0 - 1	0 - External Modulation input range 0-10V 1 - External Modulation input range 2-10V
70	0	0 - 20	Filtering of Analogue input. 1 - minimum 20 - maximum The value is the number of readings over which an average is taken, the smaller the setting the quicker the response time.
71	0	0 - 1	Resolution of Analogue input. 1 - fine 20 - coarse The effect of resolution is to filter noise on the input which causes hunting as the M.M. responds to a changing signal.
72	0		Unused.
73	0		Unused.

Parameter No.	Factory Setting	Parameter Value	Description
74	0		Unused.
75	0		Unused.
76	0		Unused.
77	0		Unused.
78	0		Unused.
79	0		Unused.
80	0		Unused.
81	0		Unused.
82	0		Unused.
83	0		**Display Diagnostic values**
		0	Disabled
		1	Enabled
84	0		Unused.
85	0	0-250	Modulation Exerciser. Repeatedly run between high and low flame. The higher the value, the longer the high/start position is maintained.
86	0	0 - 99	IBS change down threshold. If left at 0 change down threshold = 85% firing rate.
87	0	0 - 99	IBS change up threshold. If left at 0 change up threshold = 95% firing rate.
			NB: If Parameter 86 is set greater than 87 then they will default to 85% and 95% respectively.
88	0		Unused.
89	0		Unused.
90	0		**Flue Gas Recirculation**
		0	Positions entered after commissioning.
		1	Positions entered during commissioning.
91	0		Unused.

Parameter No.	Factory Setting	Parameter Value	Description
92	0		Unused.
93	0		Unused.
94	0		Unused.
95	0		Unused.
96	0		Unused.
97	0		Unused.
98	0		Unused.
99	0		Unused.
100	0		**Assured Low Fire Shut Off**
		0	Not optional
		1	Burner modulates to low fire before turning off.
101	0		Unused.
102	0		Unused.
103	0		Unused.
104	0		Unused.
105	0		Unused.
106	0		Unused.
107	0		Unused.
108	0		Unused.
109	0		Unused.

NB. Parameters 110 to 150 are a repeat of their respective options. These values need to be entered as both an option value and a parameter value for safety reasons.

2.16.2.3 Fuel Flow Metering

1. Go to Options, set Option 57 to 1 (default 0).
2. When the above is displayed press ENTER MEMORY, this will initiate the Flow Metering setup mode.
3. The next time the burner starts and reaches modulation, the M.M. will automatically go into the ten point setup mode for Flow Metering. The following screen will be displayed:

```
COMMISSION FLOW
CHANNEL 1         80.0
POINT NUMBER         1
FLOW VALUE       68.16
```

4. In this mode the display will show the channel 1 fuel valve position in degrees angular, and the flow units which can be adjusted by using the third row of buttons.

   Note:

   a) The third row of text confirms to the commissioning engineer which of the 10 points are currently being measured.

   b) The minimum numerical value for fuel flow that can be entered into memory is 0.01. The maximum numerical value for fuel flow that can be entered into memory is 999.99.

   c) The values are entered in descending order, i.e. Point No.1 is maximum flame and Point No.10 is at minimum flame. The 10 sequential points on the load index are allocated automatically by the M.M. All values are in units/minute.

5. When fuel flow has been calculated or read off of a commissioning fuel flow meter the value is entered as detailed in Point No.4.

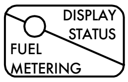
   The ENTER MEMORY button is then pressed and the value is logged in the M.M. memory.

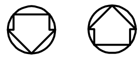
6. The above detailed data entry routine is repeated until all 10 points have flow values allocated to them.
7. When the last (10th) point has been entered the burner continues to fire.
8. To display Fuel Flow Metering press the DISPLAY STATUS FUEL METERING button.
9. To reset the Totalised value to zero set Option 57 to 2, press ENTER MEMORY while 57 and 2 are being displayed.

2.16.3 End User Day to Day Operation

2.16.3.1 Normal Run Operation

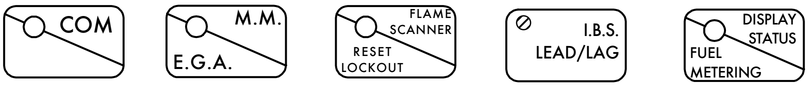
Upon initial selection of a commissioned fuel, a logo screen flashes up followed by the 'M.M. STATUS' display. The COM l.e.d. flashes for five seconds.

To adjust the Required value press 

and use the third row  accordingly.

The range of the required value is limited according to the type of sensor being used (See Option 1).

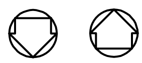
System information is displayed on numerous screens selectable by the following push buttons.



The respective l.e.d. will remain illuminated to indicate which mode is selected. The COM and E.G.A. modes are only selectable if an E.G.A. is optioned on the system.

In the event of the system being powered down the commissioning data, options and parameters, and the required value are stored in the memory. During normal run operation the RUN led is on all the time. When no fuels are selected only the RUN l.e.d. remains illuminated.

If an E.G.A. is operative on the system it will calibrate every time the burner starts and stops. When COM or E.G.A. display modes are selected ‘Calibrating’ is displayed when the E.G.A. is calibrating. If the E.G.A. is cooling, COOL is displayed. If the burner is not firing, ‘E.G.A. Ready’ is displayed. When the burner is firing both modes show ‘Trim Threshold Low’, if the Actual value has not reached the value at which trimming is permitted. (See Option 28.) If an E.G.A. error has occurred the error code number is displayed if either of E.G.A. or COM modes are selected.

The software version number can be displayed by by pressing the Top CH1  buttons simultaneously, when in the M.M. display mode.

Several different displays are available to provide the operator with information through start-up and normal operation.

Selectable screens provide the following information:

Startup/Fuel Select

```
     AUTOFLAME
   MINI MK5 EVO
    COMBUSTION
MANAGEMENT  SYSTEM
```

Displayed at startup and when no fuel selected.

M.M. Status

```
CHANNEL 1       80.0
CHANNEL 2       42.0
CHANNEL 3       37.6
    LOW FLAME HOLD
```

Shows the angular value for each of the positioning motors, channels 1 to 3. The bottom row displays additional status information, including Low Flame Hold, Hand Operation, Golden Start, FGR Start.

IBS Status

```
ID  1     LEAD    2


STATUS  STANDBY
```

For a multi boiler installation, this screen shows which is the lead boiler and the unit's identification number.

E.G.A. On Line Values

```
O2    4.3% CO2   9.4%
CO   12ppn NO   30ppm
AMB    22C DELTA 269C
EXH   291C EFF   77.8%
```

When an Exhaust Gas Analyser (E.G.A.) is included in the system, this screen shows the actual values of the gases being measured in the flue plus the exhaust gas temperature, ambient temperature, dT, and efficiency. A similar screen shows the commissioned values.

Burner Control Status/Time with UV scanner

```
FIRING
FLAME SIGNAL UV   27

TIME  12:25  23:JAN:05
```

Row 1 indicates the burner sequence state, row 2 gives the flame signal strength- UV discharges. If the signal strength drops below 5 then a lockout will occur.

Lockout History

```
No  1  10:00  23:JUN:00
RES    10:05  23:JUN:00
NO FLAME SIGNAL
FIRING
```

Upto the last 16 lockouts are displayed here. Details include time and date of lockout and reset, the cause of the lockout and at what stage of the sequence the lockout occured. Only one lockout record can be displayed at a time. Press the flame scanner button to scroll through the records.

Fuel Metering Status

```
FUEL 1   NATURAL GAS
FLOW UNITS   CU MTRS
FLOW RATE/MIN  20.00
TOTAL         4856.7
```

This screen displays which fuel is currently selected, the consumption at this point in time and the total fuel used to date.

System Status

```
FUEL 1  NATURAL  GAS
FIRING RATE     100%
REQUIRED         82 C
ACTUAL           45 C
```

This screen shows the present firing rate, which fuel is being used, and the required/actual values.

History

```
HISTORY FUEL 1
HOURS RUN       1763
STARTUPS         276

```

The hours run and the number of startups for the currently selected fuel are displayed on this screen. The screen is selected by pressing the display status button.

Burner Control Status/Time with Flame Rod

```
FIRING
FLAME ROD SIGNAL  27

TIME  12:25  23:JAN:05
```

Row 1 indicates the burner sequence state, row 2 gives the flame ionisation signal strength. If the signal strength drops below 5 then a lockout will occur.

2.16.3.2 Routine Adjustments

Setting Time & Date

To adjust the time and date settings go into COM mode. Power down the unit and restart. The COM LED will be flashing and you have 5 seconds to press it. Then the password screen is displayed. Set password to: **10** **10** , then press CLOSE

'Set Clock' screen is displayed:

```
DAY     FRI  DATE     23
MONTH   JAN  YEAR     05
HOURS    12  MINS     28
```

Use the buttons as detailed below to adjust the values appropriately.

Channel 1		Day
Channel 2		Date
Channel 3		Month
OPEN LEAD BOILER	DISPLAY STATUS FUEL METERING	Year
CLOSE	M.M. E.G.A.	Hours
COM	RUN	Minutes

When finished press the flashing ENTER MEMORY button to submit to memory.

Note: Hours are displayed in 24 hour mode.

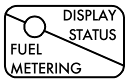
Adjusting the Screen Contrast

Hold down any of the screen select buttons,

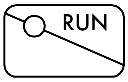
COM M.M. E.G.A. I.B.S. LEAD/LAG DISPLAY STATUS FUEL METERING

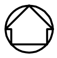
and then use the top row to adjust the contrast accordingly.

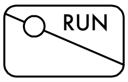
Calibrating Actual Reading

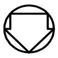
A facility exists to adjust small errors in the actual value. Press 

to select display status screen showing the actual value.

To increase the value press 

and the Ch3  simultaneously.

To decrease press 

and the CH3  .

2.16.3.2.3 Hand/Auto/Low Flame Hold and Lead Boiler Select Facilities

Low Flame Hold and Hand Operation

'Low Flame Hold' and 'Hand' operation are only effective when the burner is firing. They have no effect when the burner is off or during the burner start up cycle. They are effected by pressing the relevant push buttons on the mini Mk5 evolution system when in the M.M. data screen (angular positions).

'Low Flame Hold' is brought into operation if the 'low flame hold' button is pressed. The minimum flame position will be maintained from now on, until either the 'Hand' or 'Auto' buttons are pressed. Low Flame Hold will be established again by pressing the 'low flame hold' button. During 'Low Flame Hold' the PID control is obviously ignored. When the system is held in the 'Low Flame Hold' position the LED on the button will be illuminated.

'Hand' operation enables the fuel valve position to be set to a specific position, in the range of minimum to maximum flame. Once a position has been set it is recorded in the M.M. units memory. Each time the burner starts the fuel valve will be positioned to the 'hand' position set previously, even if the M.M. unit has been powered down. The M.M. system sets the fuel valve to the hand position whenever the 'Hand' button is pressed. Once the burner is firing in the 'hand' position the firing rate can be adjusted by switching to the 'M.M.' screen and using the bottom row of buttons on the M.M. facia.

When the system is held in the 'Hand' position the LED on the button will be illuminated.

To place the M.M. unit in 'Auto' press the 'Auto' button and the M.M. unit will follow the PID control. The 'Auto' LED will be illuminated.

See Option #60 for details on Bumpless Transfer.

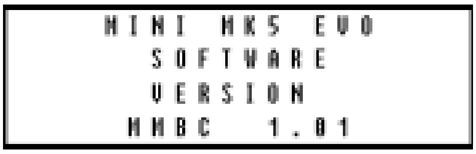
Lead Boiler Select

A lead boiler can be selected by pressing the LEAD BOILER push button on the front facia of the appropriate M.M. when in the 'IBS' screen. Only 1 M.M. may be selected as lead boiler at a time or the sequencing will not operate. The lead boiler can also be selected via the D.T.I., but the LEAD BOILER push button overrides the DTI lead boiler selection.

Note: The selections of Low Flame Hold/Hand Operation/Auto/Lead Boiler Select are non-volatile, i.e. their status is retained in the event of loss of power.

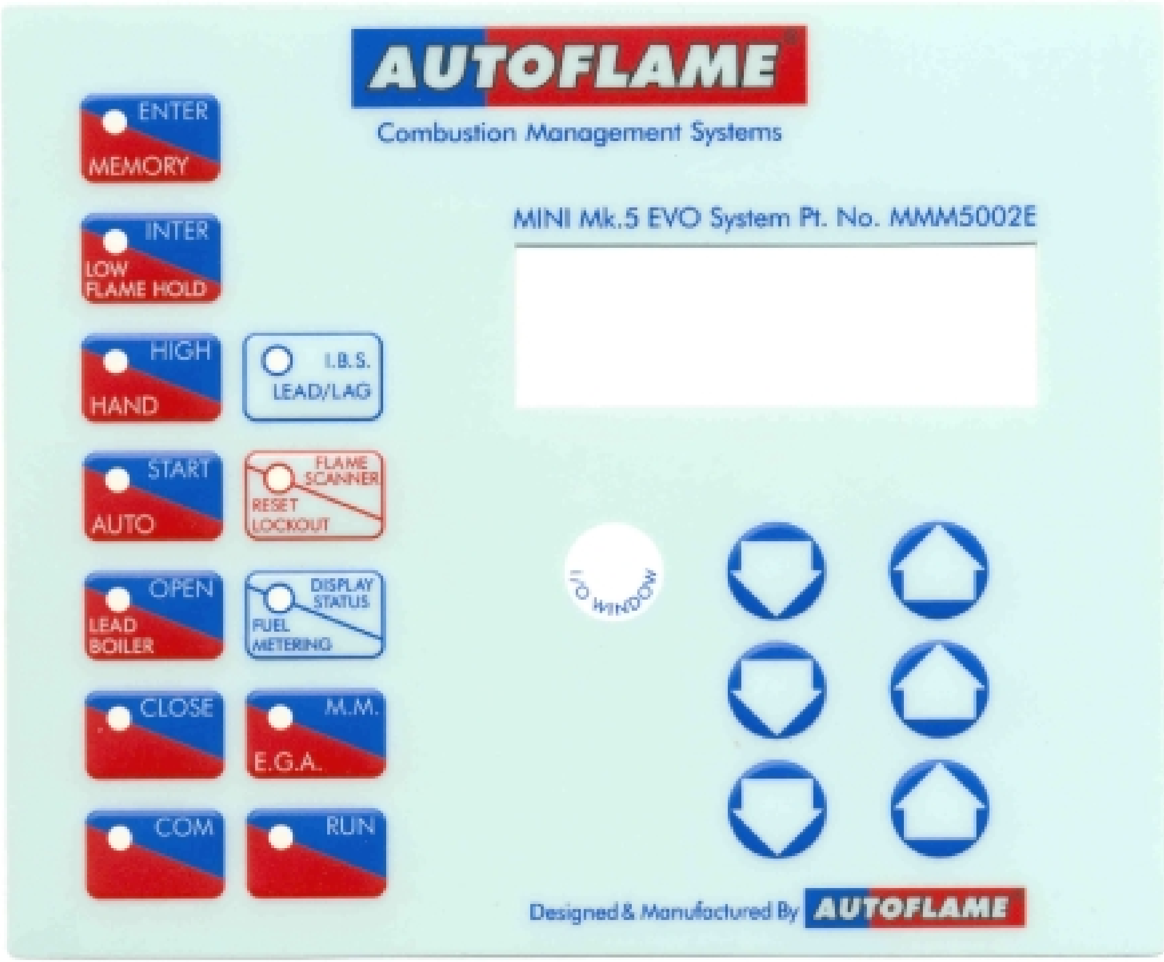
2.16.3.3 EPROM Version Numbers

To display the software version number select the M.M. Display screen, then press Channel 1 Up and Down simultaneously.



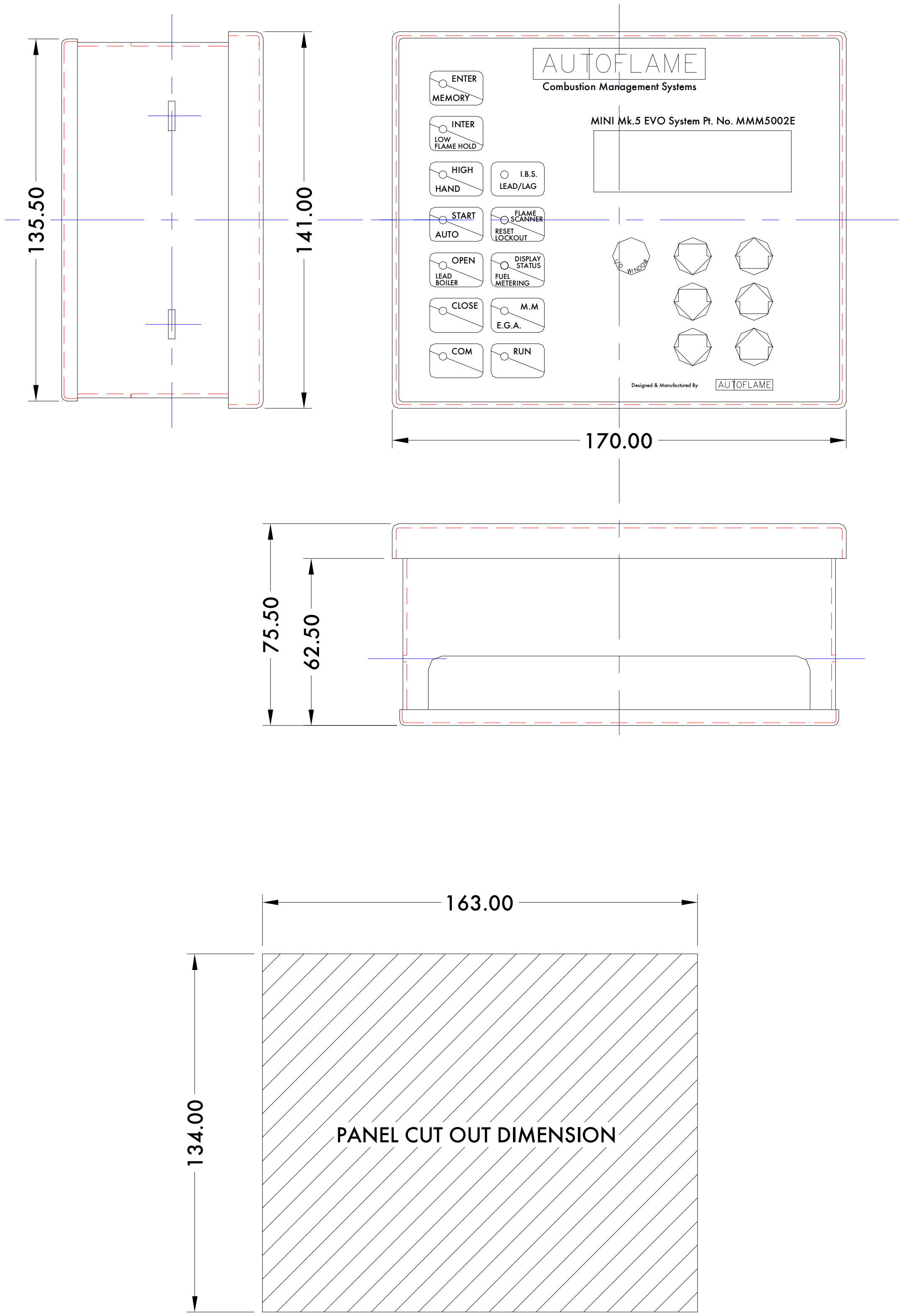
2.16.4 OTHER INFORMATION AND ILLUSTRATIONS

2.16.4.1 <u>Mini Mk.5 EVO M.M. Facia</u>

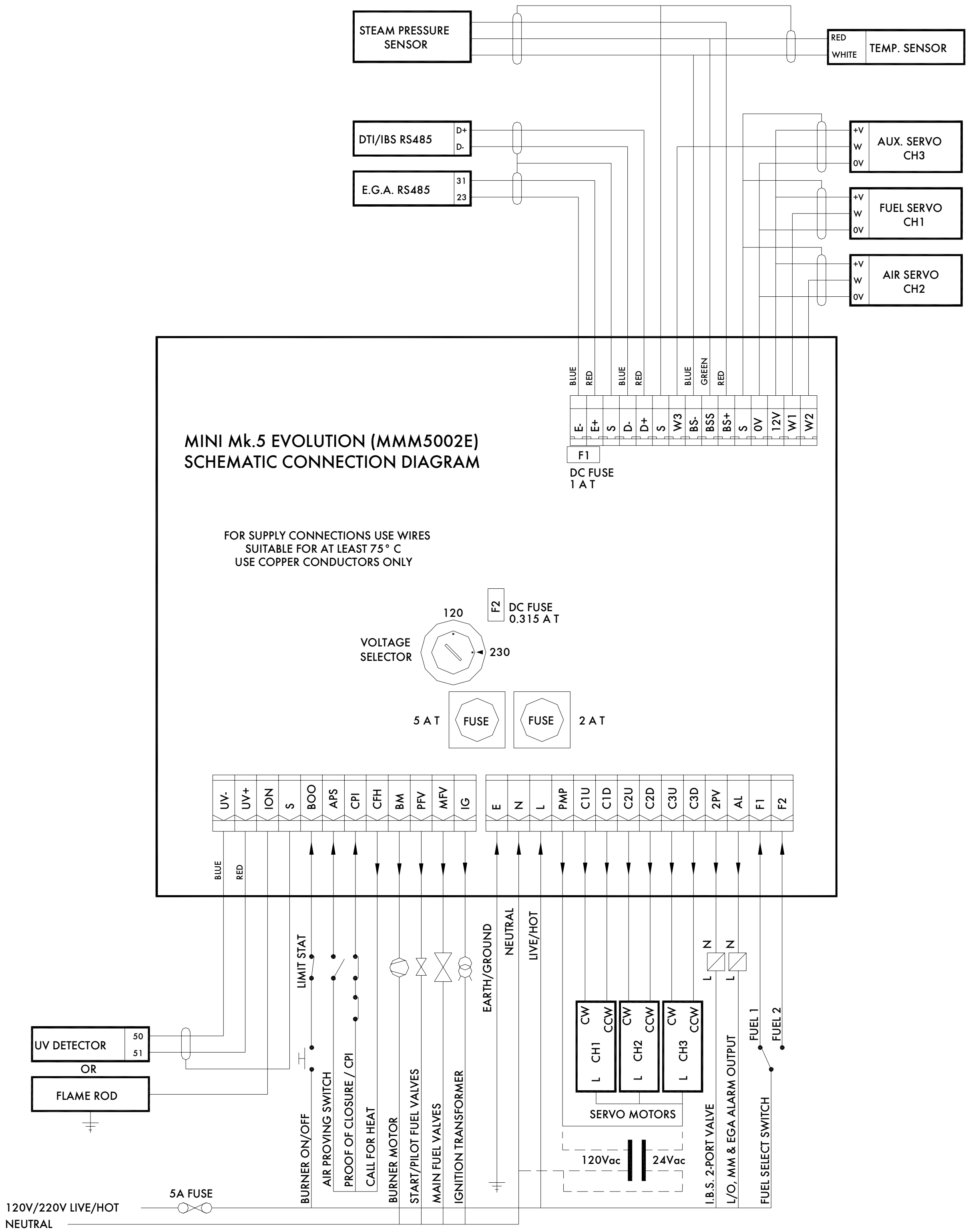


2.16.4.2 Mini Mk.5 EVO M.M. Enclosure Dimensions

MINI MK5 EVOLUTION OUTSIDE
DIMENSIONS / CUT OUT DETAILS



2.16.4.3 Schematic Connection Diagram



*NOTE:
FOR 120v, TERMINAL PMP FEEDS POSITIONING MOTORS VIA A 120-24v TRANSFORMER AS SHOWN IN DOTTED LINES.

2.16.4.4 Mini Mk.5 Evolution Specifications

2.16.4.4.1 Classifications

Classification According to EN298 - F B L L J B

Mains Supply:	230V, +10%/-15% } 120V, +10%/-15% } 47.5 - 63 Hz, Unit max. power consumption 10W	
Environment:	Temperature	0 to +60°C (32 to 140°F)
	Humidity	0 to 90% non-condensing.
Protection Rating:	The unit is designed to be panel mounted in any orientation and the front facia is IP65. The back of the unit is IP20.	

Output Ratings:

230V Unit:

			Max		
Outputs	Terminal	CFH	250 mA	Must be connected through contactor	Total Max. Load 3.5 Amp.
		BM	250 mA	Must be connected through contactor	
		PFV	1Amp, 0.6 power factor		
		MFV	1Amp, 0.6 power factor		
		IG	1Amp, 0.6 power factor		
		2PV	100mA	To drive relay only - switched neutral	
		AL	100mA	To drive relay/lamp only - switched neutral	

120V Unit:

Outputs	Terminal	CFH	250 mA	Must be connected through contactor	Total Max. Load 5 Amp.
		BM	250 mA	Must be connected through contactor	
		PFV	2Amp, 0.6 power factor		
		MFV	2Amp, 0.6 power factor		
		IG	2Amp, 0.6 power factor		
		2PV	100mA	To drive relay only - switched neutral	
		AL	100mA	To drive relay/lamp only - switched neutral	

Note.

1. The Low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation.
2. Cabling should be a maximum 10m.
3. Use screened cable as specified in Section 2.14.2.9.4.
4. The burner 'High Limit Stat' must be of the manual reset type.
5. When the system is running at 230V, the supply voltage at which the valve outputs are de-energised is nominally 143V.

2.16.4.5 Mini Mk.5 Evolution Electrical Specifications

2.16.4.5.1 Low voltage terminals

E-, E+	Communications port connections to an Exhaust Gas Analyser.
D-, D+	Communications port connections for DTI and/or IBS/lead-lag operation.
BS-, BSS	Connections to an Autoflame Boiler temperature detector.
BS-, BSS, BS+	Connections to an Autoflame Boiler pressure detector.
0V	0V Supply to Channel 1 and Channel 2 positioning motors.
12V	+12V Supply to Channel 1 and Channel 2 positioning motors.
W1	Signal from Channel 1 positioning motor, indicating position.
W2	Signal from Channel 2 positioning motor, indicating position.
W3	Signal from Channel 3 positioning motor, indicating position.
BS-	0V Supply to Channel 3 positioning motor.
BS+	+12V Supply to Channel 3 positioning motor.

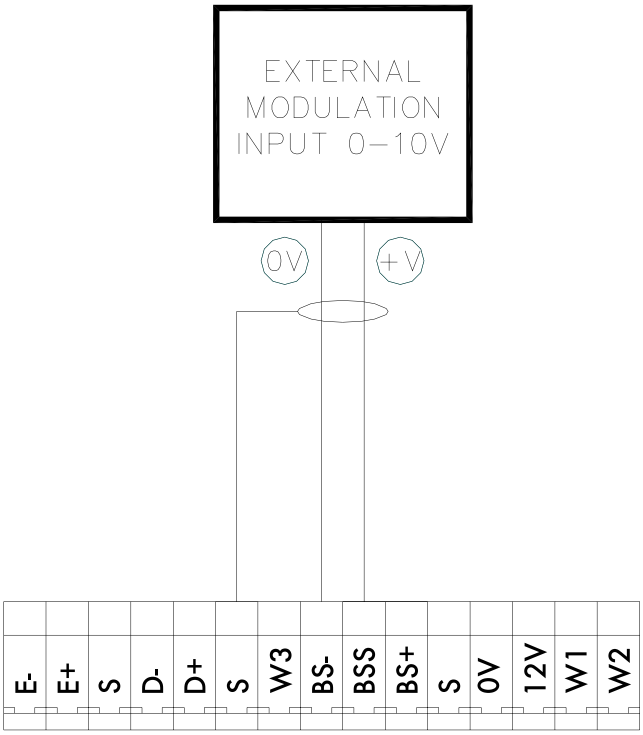
2.16.4.5.2 UV and ionisation terminals

UV-, UV+	Connections to an Autoflame UV sensor.
ION	Connection to flame rod/ionisation probe.

2.16.4.5.3 Mains voltage terminals

BOO	Mains voltage input. Burner on/off signal. Running interlock circuit.
APS	Mains voltage input. Safety circuits (eg Air proving).
CPI	Mains voltage input. Proving circuits (eg Gas valve proof of closure)
CFH	Mains voltage output. Call for heat.
BM	Mains voltage output. Burner motor.
PFV	Mains voltage output. Start/Pilot valve.
MFV	Mains voltage output. Main fuel valves.
IG	Mains voltage output. Ignition transformer.
E	Mains supply earth.
N	Main supply neutral.
L	Mains supply live/hot.
PMP	Mains voltage output. Positioning motor power.
C1U	Switched neutral – drives Channel 1 positioning motor clockwise.
C1D	Switched neutral – drives Channel 1 positioning motor counter clockwise.
C2U	Switched neutral – drives Channel 2 positioning motor clockwise.
C2D	Switched neutral – drives Channel 2 positioning motor counter clockwise.
C3U	Switched neutral – drives Channel 3 positioning motor clockwise.
C3D	Switched neutral – drives Channel 3 positioning motor counter clockwise.
2PV	Switched neutral – to drive 2-port valve for IBS operation.
AL	Switched neutral - Alarm output for lockout/error/E.G.A. error.
F1	Mains voltage input. Selects fuel 1 curve.
F2	Mains voltage input. Selects fuel 2 curve.
S	All terminals marked S are internally connected. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, eg section 2.16.4.3.

2.16.4.6 External Modulation



To use external modulation it is required to use a 0-10V input on the terminals as detailed above. It is not possible to use a steam pressure detector or temperature sensor when using external modulation. A 'working stat' must be fitted on the boiler. See option #45. Option #9 must be set to zero for external modulation.

Important note:
It is necessary to use a signal isolator to prevent any excessive voltages being applied to these terminals. The signal isolator used must have the following charcteristics:

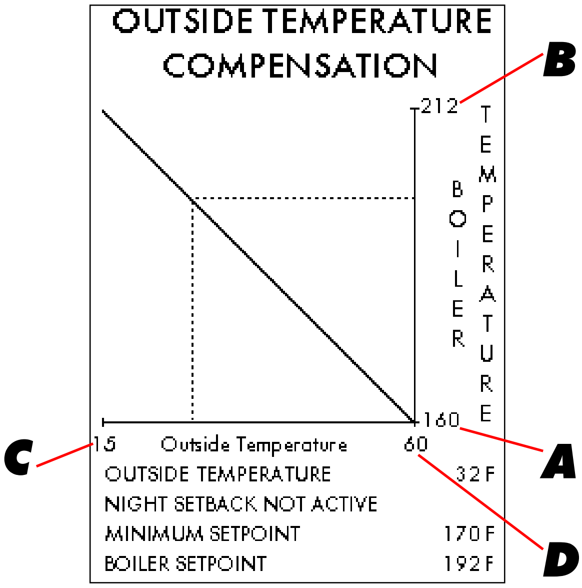
Signal isolation voltage- 3.75kV
Creepage- 5mm
Clearance- 4mm
The equipment and cables must be housed in a clean environment- IP55

2.16.4.7 Outside Temperature Compensation

This enables the boiler setpoint to be varied according to the outside air temperature, i.e. as the air temperature drops the boiler setpoint can be increased accordingly.

An additional module is required (part number MM60015) in order to use the outside temperature probe (part number MM60007).

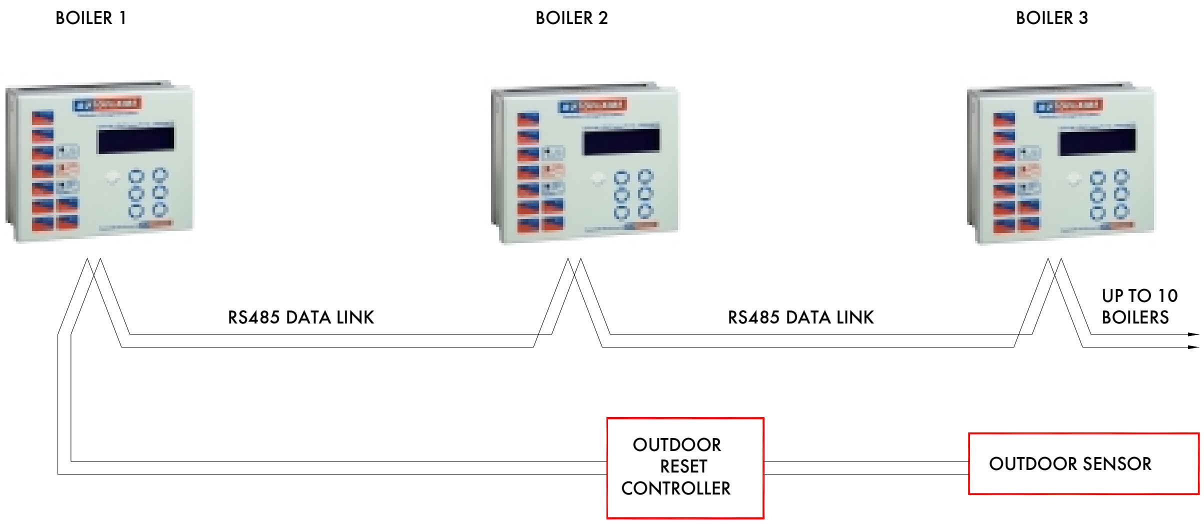
The chart on the right hand side shows how the setpoint varies without the outdoor temperature. The table below shows the relevant options in the mini Mk5 evo that need to be set.



	Option No.	Factory Setting	Option Value	Description
	79.	0		**Lowest required value.**
			0-995	Minimum required value allowed when O.T.C. optioned. (see option 80)
	80.	0		**Outside temperature compensation.**
			0	Disabled
			1	Enabled
B	81.	140		**Maximum boiler required setpoint at minimum outside temperature.**
			50-999	Value limited in accordance with sensor selected by option #1.
C	82.	-30		**Minimum outside temperature.**
			-40 +40	If Centigrade units are selected.
			-40 +104	If Fahrenheit units are selected.
A	83.	65		**Minimum boiler required setpoint at maximum outside temperature.**
			50-999	Value limited in accordance with sensor selected by option #1.
D	84.	30		**Maximum outside temperature.**
			-20 +40	If Centigrade units are selected.
			-4 +104	If Fahrenheit units are selected.

2.16.4.7.1 <u>Outside Temperature Compensation</u>

Up to 10 mini Mk5 Evolution modules can be used with one outdoor reset controller. The diagram below illustrates the connections between each of the mini Mk5 evo modules, the outdoor reset controller and also the outdoor sensor. The data cable is wired into terminals D-, D+, S on the mini Mk5 evo which is the same terminals as used for the DTI module. A DTI is not required for this control but it can still be used and this would be wired onto the end of the daisy chain.



2.16.5 Error Checking, Self Diagnostics Fault Analysis and I.D. Codes

Self Diagnostic Fault Identification Software

The "Error Checking" software, which is included in every M.M. E.G.A. module, continually interrogates the system for component or data handling failure. This intensive self checking programme is inflicted on all peripherals such as positioning motors and load detectors as well as the main M.M./E.G.A. system hardware. The safety related areas, both hardware and software, have been examined and accepted for UL.

Any error identified by the system is indicated by "ERROR" being displayed and the relevant error number. In the case of E.G.A. related faults, "ERROR EGA" is displayed with the corresponding error identification code.

2.16.5.1 Key to Errors Detected in Mini Mk.5 Evolution M.M. System

ERROR- confirms that error has been detected in the M.M. System.

Error Fault Type	Code No	
CH1 Positioning Error	01	
CH2 Positioning Error	02	- Check wiring & motor
CH3 Positioning Error	08	
CH1 Gain Error	41	
CH2 Gain Error	42	- Check wiring & potentiometers are
CH3 Gain Error	43	zeroed correctly
Load Detector	03	- Open circuit on temperature sensor
12V/5V Supply Error	44	- Internal 5V/12V supply outside limits. Check 12V on terminals #0V and 12V

2.16.5.2 Mini Mk.5 Evolution Burner Control Lockouts

Lockout Message		Cause
Pre ign fail cpi		Proof of closure switch opened during ignition sequence Check terminal #CPI and proof of closure switches (cpi = close position interlock / proof of closure)
Safety fail aps		No air pressure during start/firing Check terminal #APS and air switch
No flame signal		No flame signal during ignition/firing
Simulated flame		The flame is present when it should not be. Call for service immediately. This is potentially a dangerous condition.
FSR fault Main fuel O/P Start gas O/P Motor O/P Ignition O/P	CFH MFV PFV BM IG	These terminals are self checked within the mini Mk5 evolution. If a voltage is detected when the output is off (and vice versa) a lockout occurs.
Prolonged L/O reset		Lockout reset button permanently pressed
Pre ign timeout cpi		Proof of closure switch not made after valves closed after firing Check terminal #CPI and proof of closure switches
UV short circuit		Connections to UV tube shorted
Watchdog '.....' RAM test failed PROM test failed CPU test failed Input fault Lockout 199 Lockout 201 Lockout 202		Internal fault diagnostics - contact Autoflame and report code displayed.

Section 3: E.G.A. Exhaust Gas Analysis

Section 3: E.G.A. Exhaust Gas Analysis

3.1 Introduction

3.1.1 Features and Benefits

The E.G.A. Mk.6 is the accomplishment of twenty years on-going research and development for the exhaust gas sampling system. The E.G.A. can be used for three separate applications:

Application No.1: E.G.A. stand alone

Stand alone sampling system. The emissions levels can be accessed via:

The local display on the front of the E.G.A. facia (serial numbers 5000+)
The remote display pod, local to the installation (max. distance 15m)- older E.G.A. units
The 6 channel 4-20mA signals, user configurable (max. load 250 Ohms each)
The Data Transfer Interface module (D.T.I.); this enables connection to a PC, BMS, PLC, e.t.c.

Application No.2: E.G.A. combustion trim

Interfaced with the Micro Modulation (M.M.) system enabling combustion trim. The combustion/emissions levels can be accessed via:

The M.M. unit. This displays both the commissioned values and the actual values
The 6 channel 4-20mA signals, user configurable
From the M.M. unit via the Data Transfer Interface module (D.T.I.); this enable connection to a PC, BMS, PLC, e.t.c.

Application No.3: EPA compliant C.E.M.S. (Continuous Emission Monitoring Software)

Ability to monitor the exhaust gases and determine the exact amounts (volumetric and weight) of each of the exhaust gas parameters. These values are dependent on the fuel input, the calorific value of the fuel and the exhaust gas values (%, ppm).

Monitoring Capabilities.

O_2	Oxygen	% by volume
CO	Carbon Monoxide	ppm
CO_2	Carbon Dioxide	% by volume
NO	Nitrogen Oxide	ppm
SO_2	Sulphur Dioxide	ppm
NO_2	Nitrogen Dioxide	ppm
Combustion Efficiency		% (a calculation of CO_2 and delta temperature)
Exhaust gas temperature		Degrees Celsius or Fahrenheit
Ambient temperature		Degrees Celsius or Fahrenheit
Delta temperature		Degrees Celsius or Fahrenheit

NO and SO_2 or NO_2 are monitored only, not used for combustion trim, although limits can be set for NO.

3.1.2 Overview of system operation

The analyser samples the combustion gas via the stack mounted sampling probe (part #MM10003) purchased separately from the analyser. The exhaust gas is drawn from the stack by a pump mounted internally within the analyser. Ensure that the supplied sample tubing is used between the sampling probe and the analyser. The internal diameter of the sample tubing is 3mm; if a larger diameter tubing is used the sample gas remains resident in the tubing for a longer period. This will seriously effect the correct operation of the combustion trim. Contact Autoflame sales team for advice on applications.

Once the exhaust gas has entered the analyser the gas is reduced in temperature by the chiller block. The chiller block serves two functions; firstly reducing the gas temperature and secondly removing the condensation from the gas prior to the gas entering the sensors. The condensate accumulated in the chiller unit is drained every 4 minutes automatically through the drain solenoid.

The exhaust gas is then filtered through the dry filter. This is a fine filter which removes any dust particles carried over from the cooling process. On leaving the filter the exhaust gas is checked to ensure a vacuum is maintained prior to entering the pump. On exiting the pump the exhaust gas is again checked to ensure the pump is producing a pressure. Both pressure switches indicate there operation by the status indication L.E.D.s. (located next to each pressure switch).

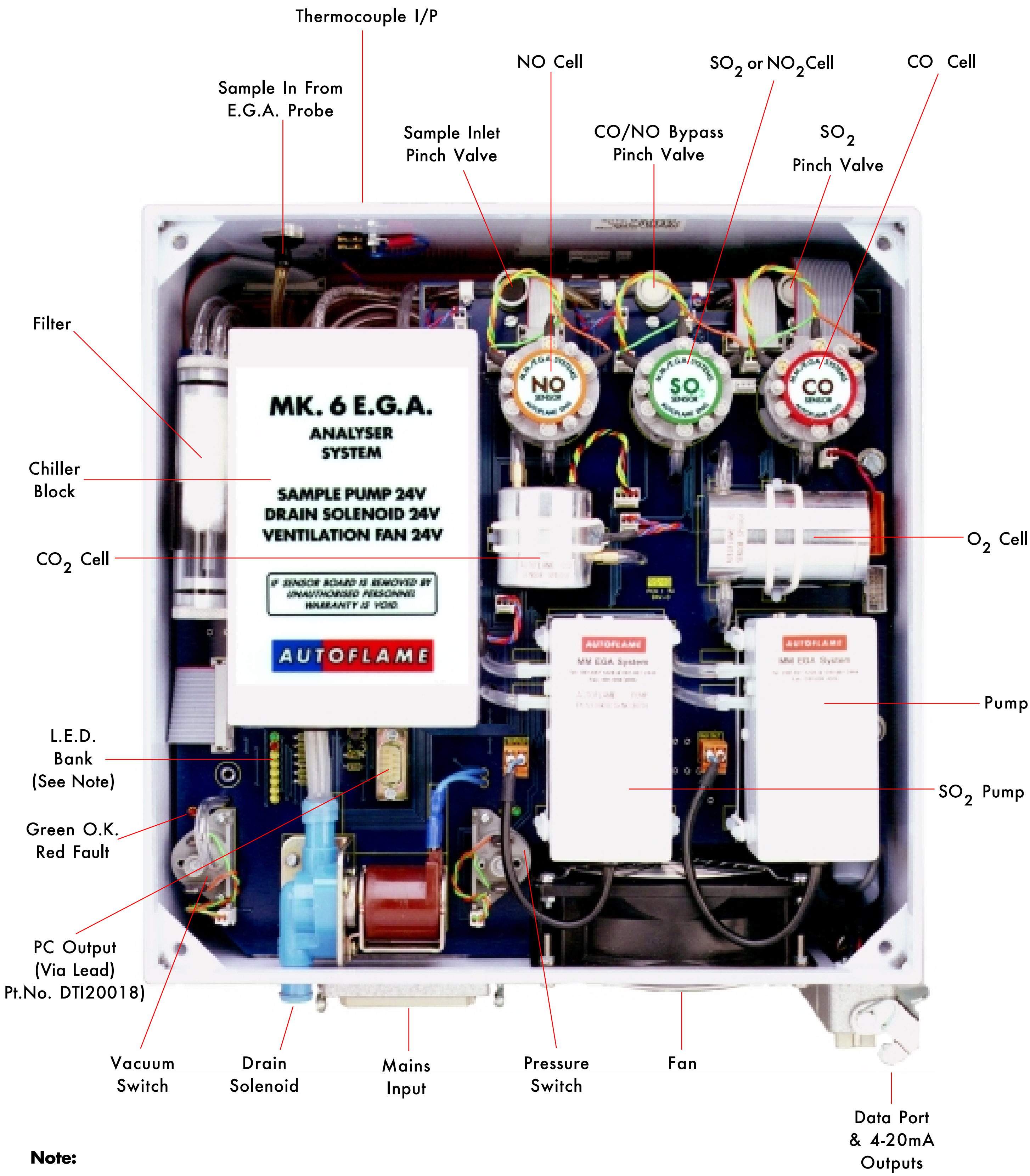
The conditioning process of the exhaust gas is now complete. The gases are now measured by the sensors. The exhaust gas now exits the sampling system from the clear tubing located at the rear of the chiller unit.

Important note:

The exhaust gas is vented into the air stream leaving the E.G.A. unit. This is located on the outside of the E.G.A. enclosure next to the drain solenoid outlet. It is extremely important that the exhaust gas is vented to atmosphere, i.e. do not install the E.G.A unit within a sealed enclosure. This would cause the E.G.A. unit to self calibrate on contaminated gas. The E.G.A. unit will self calibrate every 6 hours or when the burner starts and stops.

If the E.G.A. unit is to be installed in an area of harsh environmental conditions outside those as quoted for the E.G.A. module then an environmental enclosure is required. Please contact Autoflame sales for further information on this unit.

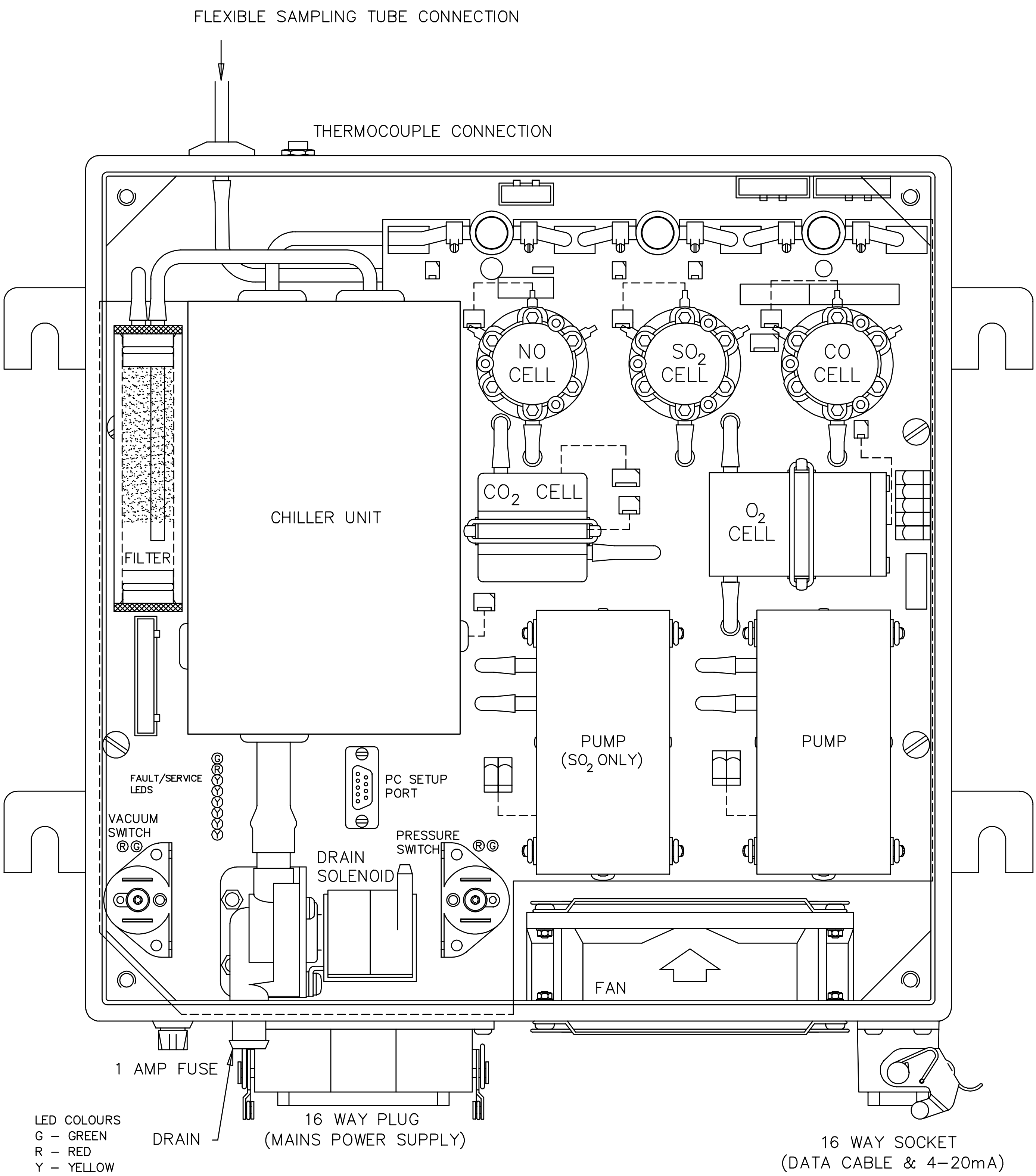
3.1.3 E.G.A. Mk.6 an Inside View (cover removed)



Note:

Green #1	=	O.K.
Red #2	=	Fault or Service
Yellow #3 to 8	=	Service Period Indicators (1 LED extinguishes every 2 Months)
Mains Supply	=	230V/110V Standard

3.1.3.1 E.G.A. Mk.6 an Inside View (cover removed)

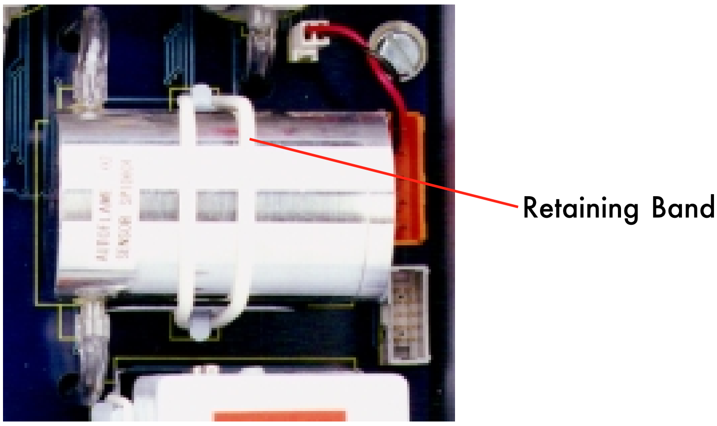


3.2 Sensor Characteristics

3.2.1 O_2 Sensor

This electrochemical cell is used for the detection of oxygen covering a concentration range of 0 to 100%. Due to the construction of the sensor they offer a long life and a high resistance when used with high sulphur content fuels. It is therefore suited to analysis when firing heavy or light fuel oil. The cell employs the principles detailed below:-

The oxygen sensor incorporates a lead oxygen cell with a lead anode and a gold cathode, using a specific acid electrolyte. Oxygen molecules which diffuse through a non porous Teflon membrane into the electrochemical cell are reduced at the gold electrode. The current flow between the electrodes is proportional to the oxygen concentration in the flue gases measured.



Features:

Virtually no influence from CO, H_2 S, NO**x**, SO**x** and H_2, i.e. no cross sensitivity.
No warm up time required.

Operation ranges:

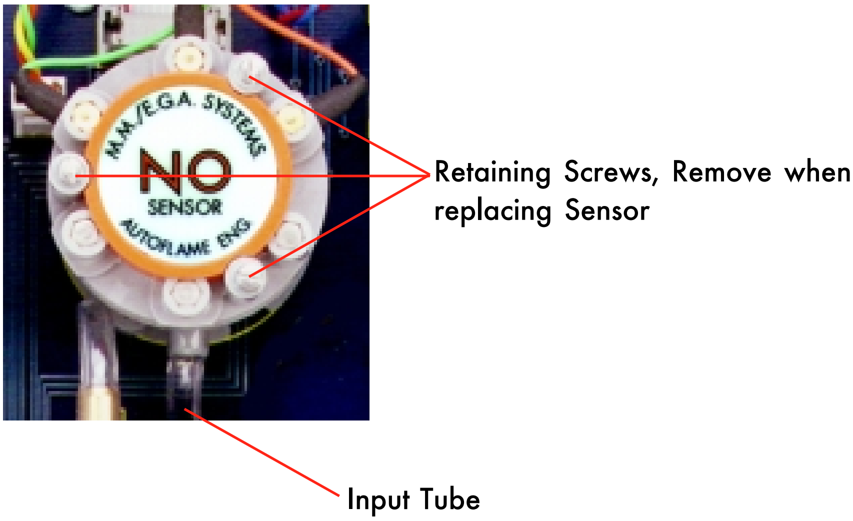
Detection range	0-20.9% O_2
Accuracy	± 0.3%
Operating temperature	5°C to 40°C (41°F to 104°F)
Shelf life	6 months from date of dispatch

(In normal operation the sensor has a life expectancy of 2 years & is guaranteed for 1 year)

Long Term Output Drift	< 1% signal/month typically.
	< 10% over operating life.

3.2.2 CO ,NO and SO_2 Sensors

These sensors are electrochemical cells which are specifically managed by the calibration philosophy within the E.G.A. unit. The accuracy of these sensors are within ±5% at 100ppm. From our experience over the last five years we would expect to see a drift of ± 10ppm per annum without calibration. In our view this drift would not be detrimental to the operation or application of the E.G.A. The EPA compliant E.G.A. unit ensures that this problem does not occur by performing an automatic self calibration every 24 hours with known constituents of test gas. The life of the sensors is a function of the concentration of gases measured over time. In order to optimize the life of the CO cell, the electronics will detect when the signal level from the cell reaches or exceeds 600ppm and will isolate the CO & NO cells. The gas flow to these cells is restored once the O_2 & CO_2 readings are restored to a level within the pre-programmed limits.



CO Measurement:

On Gas Fuel	Measuring Range 0-1000ppm
On Fuel Oil	Optional, CO is not normally measured as standard
Resolution at 20 deg C	1ppm
Repeatability	1% of signal
Shelf life	6 months from date of dispatch

NO Measurement:

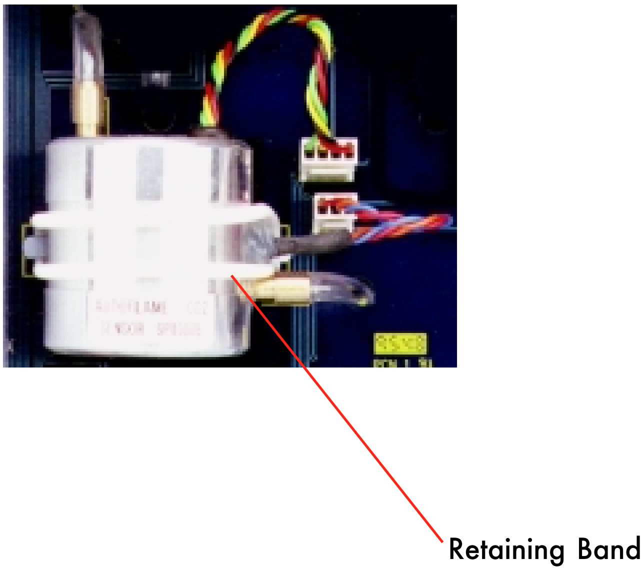
On Gas Fuel	Measuring Range 0-1000ppm
On Fuel Oil	Optional, NO is not normally measured as standard
Resolution at 20 deg C	1ppm
Repeatability	2% of signal
Shelf life	6 months from date of dispatch

SO_2 Measurement:

On Gas Fuel	Optional, SO_2 is not normally measured as standard
On Fuel Oil	Measuring Range 0-1000ppm
Resolution at 20 deg C	1ppm
Repeatability	1% of signal
Shelf life	6 months from date of dispatch

3.2.3 CO_2 Sensor

This is manufactured to an Autoflame specification and the technology employed is thermal conductivity. This sensor has no moving parts and is not an electrochemical cell. The exact description of how this works is commercially sensitive. The accuracy is ±0.3% of reading. The cross sensitivity is virtually zero to other gases due to the method of calibration used within the E.G.A. unit. The lifetime is not less than two years on gas firing, and on oil firing is dependent on the sulphur content of the fuel.



Measuring Range	0-20%
Shelf life	12 months from date of dispatch

3.3 Commissioning and Setting up Procedures

3.3.1 Introduction

Commissioning with the E.G.A. is an extension to commissioning with the M.M. The factory trained technician must be completely familiar with the commissioning of the M.M. unit before commissioning with the E.G.A. module. Section #2 of the Technical manual clearly explains commissioning with the M.M. unit.

The commissioning procedure as described must be strictly adhered to. Anybody commissioning an M.M./ E.G.A. system must have an adequate understanding of combustion plant and be officially certified by Autoflame Engineering or their registered Distributors. In the wrong hands, hazardous conditions could be made to exist that could lead to product damage, critical injury or death.

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

If the system being commissioned is an M.M. without an E.G.A. then a combustion monitor is required to check the exhaust gases. If the system does have an E.G.A. then a combustion monitor should not be necessary as the E.G.A. performs all normal exhaust gas measurements. When burning oil a smoke detection device is necessary to check smoke generated is within government guide lines.

Ideally, to implement commissioning as quickly as possible arrange for a substantial load on the boiler. The commissioning procedure can be interrupted due to excess temperature or pressure, causing the burner to turn off. In these instances the commissioning data accumulated so far is not lost. When the burner is called back on, the system starts up automatically and commissioning can proceed from where it left off.

Once the burner has been fired the maximum fuel position is entered first then descending fuel positions are entered consecutively until finally a minimum fuel position is entered. The CH1 and CH2 positions must always be less than the ones previously entered. However with CH3 - CH6 it is possible to move the position above or below the previously entered points. This is important if these channels are used to control FGR (flue gas recirculation) or atomisation of oil.

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

1. Check all interconnecting wiring between the M.M. and external components are correct.
2. Set the options required (refer to option section #2.14.2.4).
3. Set up positioning motors.
4. Programme fuel/air positions.

3.3.2 Programming Fuel Air Positions (Systems with the Exhaust Gas Analyser)

CH1, CH2 etc refers to the rows of buttons with CH1 at the top.

Note: Throughout the commissioning procedure the COM l.e.d. is illuminated.

1. Ensure 'stat' control circuit is closed, i.e. ensure that there is an input on terminal #53.

2. Select fuel. CLOSE flashes. 'ENTER PASSWORD' is displayed.

   Note: If fuel selected is being re-commissioned, press COM before COM l.e.d. stops flashing (five seconds).

3. Enter Access Code. Adjust the numbers using the CH1 and CH2 buttons.

   When numbers are set, press CLOSE (CLOSE l.e.d. steady, ENTER flashes)

4. "SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

   On this password screen, it is necessary to set both CH1 and CH3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 use without the water level system. It is also necessary to set the CH5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable First Out Annunciation, i.e. burner locks out.

   Then press ENTER MEMORY

5. The display indicates angular position of servo motors. After the internal checks are made (CLOSE flashes). Press CLOSE to start entering the close position.

6. Use CH1 to CH4 (as optioned) buttons to set positioning motors to 0.0.

   Press ENTER MEMORY (OPEN flashes).

7. Press OPEN (OPEN steady, ENTER MEMORY flashes).

8. Use CH1 to CH4 buttons to set positioning motors to their fully open positions.

   This is nominally 90.0 for gas butterfly valves and burner air dampers, but may be set to less than 90.0 degrees if there are mechanical stops/limits.
   The E.G.A. unit will now carry out a calibration for 2 minutes.

   Press ENTER MEMORY (System purges, at end of purge START flashes).

9. Press START (START steady, ENTER MEMORY flashes).

****WARNING**** **Do not enter START position before reducing fuel input. This could result in a potentially dangerous situation.**

10. Use CH1 to CH6 to set positioning motors to positions where ignition can take place.

11. Press [ENTER MEMORY] (Burner ignites, HIGH flashes).

12. Press [HIGH] (HIGH steady, EGA flashes).

13. Use CH1 and CH6 to set maximum firing input (it is not possible to exceed the OPEN position values). Always increase the air first followed by the fuel angular positions.

14. Press [E.G.A] (HIGH steady, EGA steady, ENTER flashes) to view the online combustion readings. If the readings are satisfactory go to step #16, otherwise go to step #15.

15. Press [M.M.] (HIGH steady, EGA flashes).

    Make adjustments to fuel and/or air valve positions. Go to step #14.

16. Press [ENTER MEMORY] (Combination of MM, EGA and RUN flashes).

    The system will now carry out 'Auto Commission' routines. No operator intervention will be permitted during this time. This takes approximately two minutes. While the autocommission is taking place the EGA. and MM. l.e.d.s flash initially (fuel rich autocommission), then RUN and MM flash (air rich autocommission). When finished INTER flashes or INTER and START flash.

    Note: Only INTER flashes if the number of INTER positions entered so far is less than or equal to three, thereafter INTER and START flash.

17. Press [INTER] or [START] (INTER or START steady, EGA flashes).

18. Use CH1 to CH6 to reduce the Fuel and Air positions. Always reduce the fuel first followed by the air angular position.

19. Press [E.G.A] (START or INTER steady, EGA steady, ENTER flashes).

    Observe combustion readings and wait for these values to stabilise. If readings are satisfactory go to step #22, other wise go to step #20.

20. Press [M.M.] (START or INTER steady, MM steady, EGA flashes).

21. Use CH1 to CH6 to adjust valve settings. Go to step #19.

22. Press [ENTER MEMORY] (Combination of MM, EGA and RUN flashes).

    The system will now carry out 'Auto Commission' routines. No operator intervention will be permitted during this time. This takes approximately two minutes. While the autocommission is taking place the EGA. and MM. l.e.d.s flash initially (fuel rich autocommission), then RUN and MM flash (air rich autocommission). When finished INTER flashes or INTER and START flash. (If START position has just been entered then RUN flashes).

If the position just entered was the START position, go to step #24, otherwise go to step #23.

23. Press INTER or START (START or INTER steady, MM steady, EGA flashes).

    Go to step #18.

24. Press RUN to set system into normal modulating mode.

25. If an EGA error occurs in commissioning mode, it cannot be reset using the "press close/open button". If the fault in the EGA can be cleared the error will reset automatically.

3.3.3 E.G.A. combustion trim operation

With the E.G.A. trim facility it is possible to expand the M.M. so it will measure and display O_2, CO, CO_2 and exhaust gas temperature, together with boiler temperature or pressure. It is also possible to use these values for 3 parameter trim in order to optimise the burner combustion capabilities throughout the firing range of the burner in a safe manner. This means that the safety is never compromised by efficiency, but the best burner/boiler efficiency is maintained.

During commissioning, for every paired value of fuel and air, the corresponding values of O_2, CO, CO_2 are stored. These values are known as the commissioned values. The system will then automatically induce an 'autotrim' cycle in which the air damper will close 5% of the entered air damper position and then hold this position for 60 seconds. This is known as the fuel rich part of the autotrim cycle. After the 60 seconds the values of O_2, CO, CO_2 are stored. The 60 seconds allows the combustion gases to move through the passes (2/3/4) in order to obtain the new combustion values. After these values have been stored then the E.G.A. will stop sampling from the stack for 25 seconds and sample from atmosphere (through the solenoid valve) in order to clear any CO residue that may have been produced during this fuel rich autotrim. During this time the air damper will now 5% of the entered air damper position and then following the 25 seconds air flush period the air damper position will be held for 60 seconds. This is known as the air rich part of the autotrim cycle. After the 60 seconds the values of O_2, CO, CO_2 are stored. It is now possible to move to the next position in the fuel and air curve to be entered. Again, this same process will occur and every fuel and air position entered. This builds up a complete map of the burner's combustion performance (see the graphs on the following pages).

During the normal run mode, the on-line sample at any position within the burner's firing rate is compared to the commissioned values. There are 3 individually sampled parameters (O_2, CO, CO_2) in order to verify the combustion performance either side of the commissioned value. The software within the M.M. unit will inflict minute corrections to the channel 2 air damper positions or the channel 5 variable speed drive in order to maintain the commissioned values. These minute changes ensure that the originally entered commissioning data is adhered to, irrespective of variations in stack pressure, ambient temperature (pressure) fluctuations, barometric conditions or fuel pressure changes.

The system trim function is achieved by every paired value for air and fuel having stored values for O_2, CO_2 and CO at the commissioned value. Deviations from these ideal values are held and accessible via the "COM" button on the MM facia when in E.G.A mode. This data is integrated and expressed as a degree angular value; this ensures the exact amount of channel 2 or channel 5 trim may be inflicted at any time to return the system to it’s commissioned value at any load condition.

The importance of measuring 3 parameters

The E.G.A. is continually measuring the formation of CO. The on-line CO value is compared to the commissioned value. A higher CO reading can be contributed to both lean and rich combustion. A lack of air will produce imcomplete combustion and the formation of CO up the stack. Also, excess air around the flame envelope has the effect of chilling the flame edge causing incomplete combustion and higher CO levels.

An ingress of tramp air through an ill fitting boiler door or flue section will distort the O_2 reading and show an increase in this value. This is now not measuring the combustion gases but in fact the influence of the tramp air.

Single parameter O_2 trim systems would see both of these conditions as rich (excess air) combustion and start to trim back the air damper position by closing the air damper. In reality this trim process is not trimming the combustion gases at this point, but is in fact trimming the exhaust gases which have a higher influence of O_2. This can potentially lead to the formation of excessive amounts of CO but more importantly this can lead to the formation of dangerous combustion conditions, i.e. incomplete combustion.

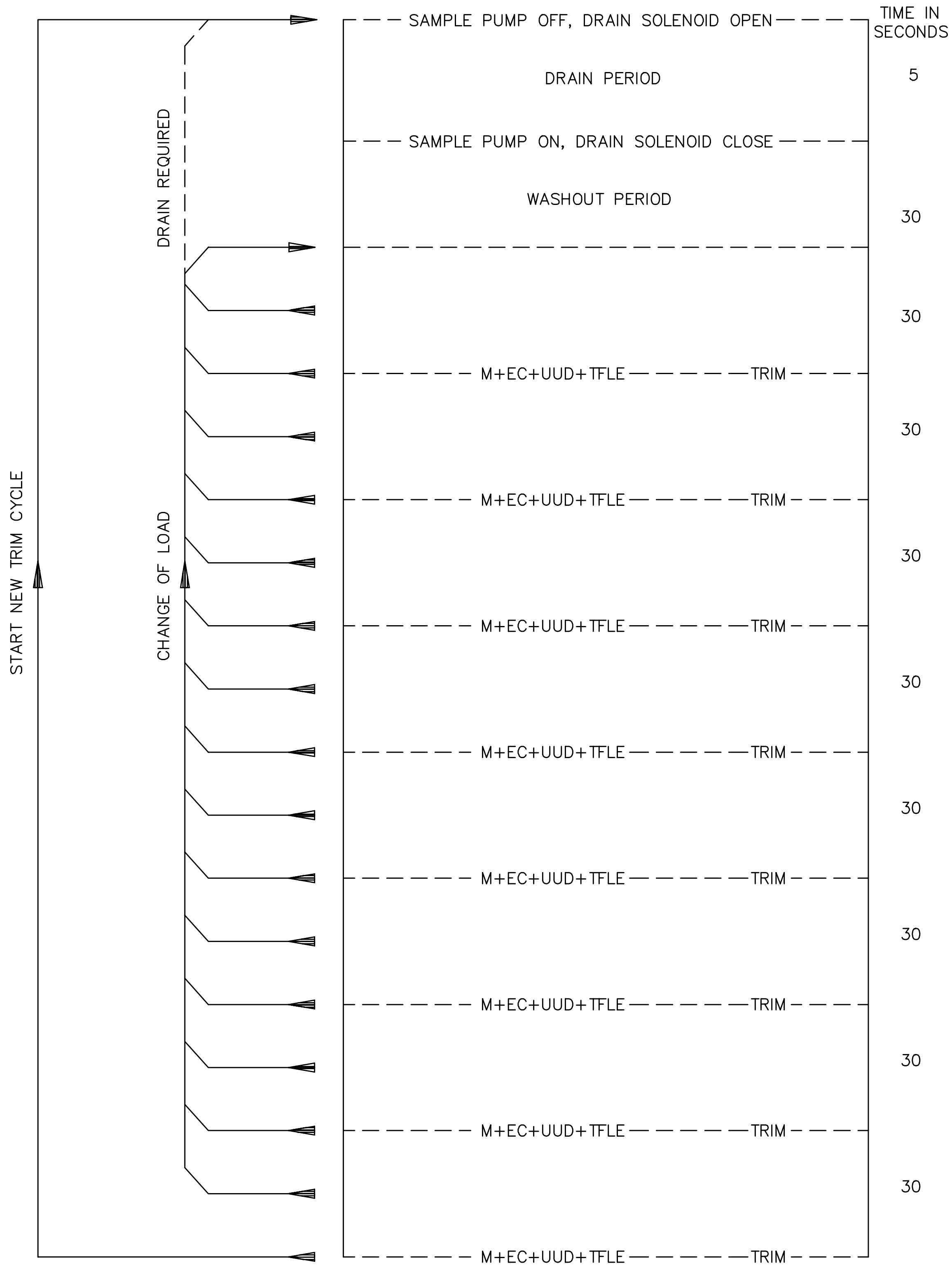
Similiarly single parameter CO_2 trim systems would see an ingress of air as lower CO_2 levels in the flue, inflicting similar dangerous conditions in the boiler.

By referencing all 3 parameters against mapped combustion performance the burner can be trimmed back to the original commissioned values whilst maintaining the highest degree of safety.

An added benefit of mapped combustion is 'feed forward trim'. In a fuel rich situation where air is being added, as the burner modulates to a new position the deviation in the air damper is added to each air position and so maintaining optimum combustion during modulation.

As a safety feature during lean (lack of air) combustion, where air is being subtracted, when modulating, the fuel and air ratio will return back to the commissioned fuel and air mix for every 10 degrees of fuel valve movement. Once this position is held the system will determine whether closing the air damper is still required at this new position. This ensures safe combustion at all times and the safety is never compromised by efficiency.

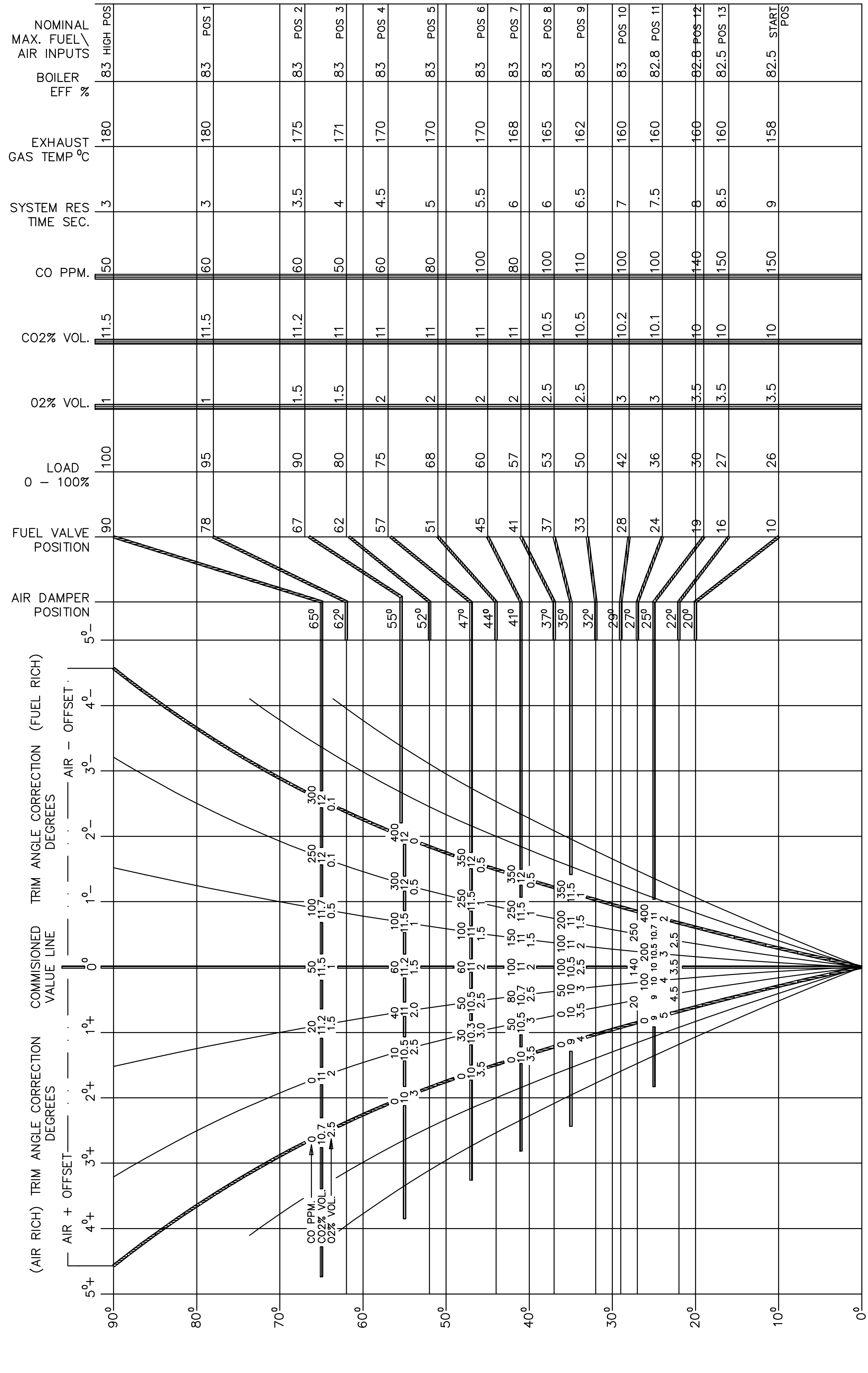
3.3.4 Trim Timing Operation



KEY:

EC = ERROR CHECKING
UDD = UPDATE DISPLAY
M = MEASURE
T = TRIM
TFLE = TEST FOR LIMITS EXCEEDED.

3.3.5 Graphical Trim Operation



GRAPHICAL REPRESENTATION OF E.G.A. TRIM SYSTEM OPERATION

3.3.6 Combustion Efficiency Calculations

Based on dry gas.

English Calculation:

% Combustion Efficiency = 100 - (sensible heat loss + Hydrogen and moisture loss).

$$= 100 - \left(\left(\frac{K1\ (TG\text{-}TA)}{\%C02} + (K2\ (1121.4 + (TG\text{-}TA)) \right) \right)$$

K1=0.38	Natural Gas(F1)
K1=0.56	Fuel Oil (F2/F3)
K2=0.0083	Natural Gas (F1)
K2=0.0051	Fuel Oil (F2/F3)

European Calculation:

% Combustion Efficiency = 100 - sensible heat loss

$$= 100 - ((TG\text{-}TA) \times ((A/(20.9\text{-}02)) + B))$$

A=0.66	Natural Gas (F1)
A=0.68	Fuel Oil (F2/F3)
B=0.009	Natural Gas (F1)
B=0.007	Fuel Oil (F2/F3)

TG: Flue Gas Temperature
TA: Ambient Air Temperature in Boiler House

3.4 Error Checking, Self Diagnostics

3.4.1 Key To Errors Detected

Errors detected in the E.G.A. part of the system are indicated when COM or E.G.A. display modes are selected on the M.M. In the event of an E.G.A. failure, the E.G.A. screen on the M.M. will display a flashing error to enable the operator to identify the issue. This will automatically default to this flashing display in the event of an E.G.A. error. At this time all other screens will be viewable. The switched neutral alarm output terminal (#79) can be set to become active or remain inactive in the event of an E.G.A. error (see option #12 in section 2.14.2.4). Depending on the setting of this option will determine how the burner will operate, i.e. continue to run based on the original commissioned values (trim and limits testing disabled) or become disabled until the E.G.A. error is reset and becomes fully operational once again.

<u>**Error Number**</u>	<u>**Fault Description**</u>
01	No communications to E.G.A. Check communications between terminals #23/31 on the E.G.A. and terminals #25/26 (E+/E-) on the M.M. module. Ensure that the E.G.A. is earthed (grounded).
08	O_2 Upper limit exceeded Check option #19 and section 3.10
09	CO_2 Upper limit exceeded Check option #20 and section 3.10
10	CO Upper limit exceeded Check option #21 and section 3.10
11	O_2 Lower limit exceeded Check option #22 and section 3.10
12	CO_2 Lower limit exceeded Check option #23 and section 3.10
14	O_2 Absolute limit exceeded (O_2 less than specified value) Check option #25 and section 3.10
15	CO_2 Absolute limit exceeded (CO_2 greater than specified value) Check option #26 and section 3.10
16	CO Absolute limit exceeded (CO greater than specified value) Check option #27 and section 3.10
20	Pump fault – pump failed/sample system blocked Check that the sampling probe is not blocked (filter in probe) Remove sample inlet tubing and press open/close on the facia via the E.G.A. screen in order to force the unit into a re-calibration. If the error is cleared then the blockage is in the probe/sampling tube.

20 Pump fault – pump failed/sample system blocked (continued)

If error persists check the flow through the E.G.A. module. Isolate each section and test the flow (this should be 550-650cc/min)

If error persits then remove the inlet to the pump (lower pipe connection). If the error is resolved then check the filter and sampling line within the E.G.A.

If error persists replace the pump.

21 O_2 Cell failure

Check terminal connections on the wires from the cell

Check voltage across the O2 cell

22 CO_2 Cell failure

Check terminal connections on the wires from the cell

Ensure the temperature sensor is plugged in (right side of cell)

23 CO Cell failure

Check terminal connections on the wires from the cell

30 NO Upper limit exceeded

Check parameter #94 and section 3.10

33 Exhaust temperature upper limit exceeded

Check parameter #96 and section 3.10

35 Exhaust temperature absolute limit exceeded (exhaust temperature greater than specified value)

Check parameter #97 and section 3.10

Sampling system should be carefully packed in the carton in which was supplied or similar and marked "Fragile - Scientific Instruments" and "Do Not Drop".

When plugs are removed to disconnect the sampling system, the M.M./E.G.A. control module will recognise that the sampling system has been removed and will run on M.M. values only depending on the setting of option #12. The fault Error Code, displayed on the M.M./E.G.A. module will remain displayed but only when the control unit is in the E.G.A. or commissioning display modes. When it is in the M.M. mode, all normal values and functions would be displayed. When the fault has been rectified on the sampling system and it is returned from your dealer, the E.G.A. sampling system can be plugged in and the M.M./E.G.A control module can be put into E.G.A. mode.

Note: If the E.G.A. is removed then no single point changes can be made to the commissioning curve since the E.G.A. data will not be present. If the E.G.A. is optioned out in order to make any single point changes, then once the E.G.A. is optioned back in (option #12), then the system will need to be re-commissioned or the old data uploaded into the M.M. module.

The Error Code that is displayed can be cleared by pressing " OPEN" and "CLOSE" simultaneously. The system will now operate normally in the E.G.A. mode and the displays will return to their normal function.

When first going into commissioning mode, the MM invokes an EGA calibration. If an error occurs at this stage it will be necessery to fix the EGA and set commissioning mode again (reselect fuel).

Other Possible Problems

On the M.M. display there are 4 lines of text that may appear when the E.G.A. is awaiting various parameters to be met.

1- Ambient Temperature- this will read OK, high or low. This must be between 5-40C (40-104F) or the settings of parameters #27/28. The temperature is measured by a sensor on the electronics PCB and is cross reference with the sensor on the side of the CO_2 cell.

2- E.G.A. Trim Threshold- this will be OK or low and is looking at the setting of option #28. This value is an offset from setpoint, before which the E.G.A. will not operate. This ensures that the E.G.A. does not pull in high amounts of condensate.

3- Cooler- this will be Ready or Not Ready. There is a temperature sensor on the chiller unit and this chiller must get down to a set temperature before the pump will start to draw a sample from the stack.

Check the operation of the fan. When the E.G.A. is powered the fan is the first component to start-up and the purpose of this is to cool the chiller unit. Ensure that the door of the E.G.A. is closed and that the 24V dc is present on the fan. If the ambient air in the boiler house is high, it may be necessary to draw cooler air into the E.G.A. Check that the cable to the right of the chiller is connected and all pins follow through. Check the voltage selector switch is set to the correct voltage, i.e. if set for 230V and the mains voltage input is 120V, the fan will run slowly and not cool the unit.

4- Comms- this can read OK or Not Ok and this is checking for continuity between the E.G.A. and M.M. Check the wiring between the M.M. and E.G.A. modules.

Fuse keeps blowing

If the EGA is mounted in an excessively dusty environment a build up of particles on the terminals can cause arcing. If the particles are corrosive then any attack to the conformal coating on the printed circuit boards can cause tracks to arc & component failure. Any sign of this activity & the unit should be returned to the supplier.

Continuous O_2 reading at 20.9%

Check all piping is airtight
Check sample tube is not blocked.
Check that there are no leaks on the flue.
Check the CO/NO pinch valve (V1) tubing for leaks.

3.4.2 L.E.D. Status Indication

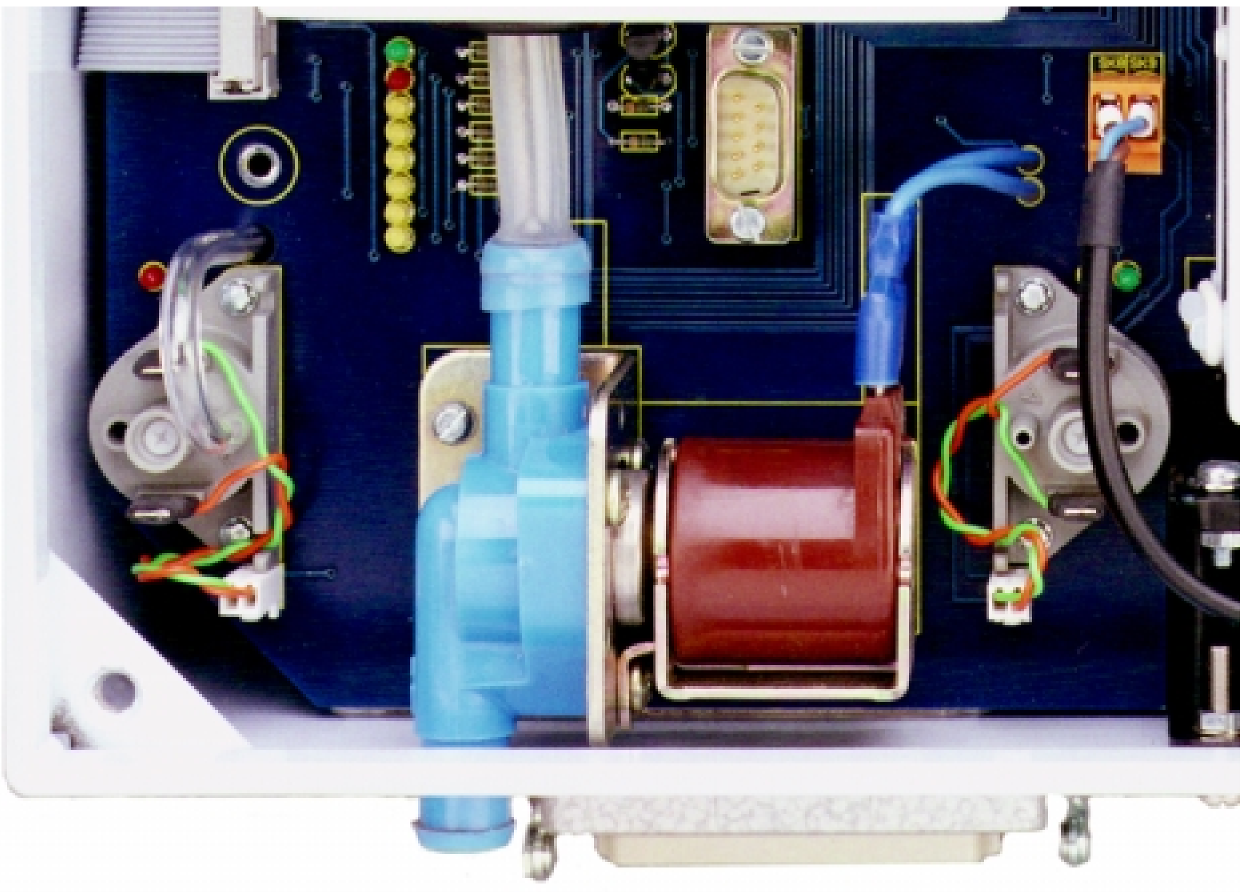
To assist the end user to determine the basic status and fault diagnosis, the P.C.B. is fitted with status indication in the form of L.E.D.s. The following indications are available:

Green	=	O.K. System operates correctly.
Red	=	Fault.
Yellow	=	6 L.E.D.'s each L.E.D. indicates a 2 month operation period.
		(1 L.E.D. is extinguished every 2 months- this time is also active during storage).
Red	=	Pressure switch fail (located: right of drain solenoid).
Green	=	Pressure switch proved (located: right of drain solenoid).
Red	=	Vacuum switch fail (located: left of drain solenoid).
Green	=	Vacuum switch proved (located: left of drain solenoid).

See L.E.D. positions below.

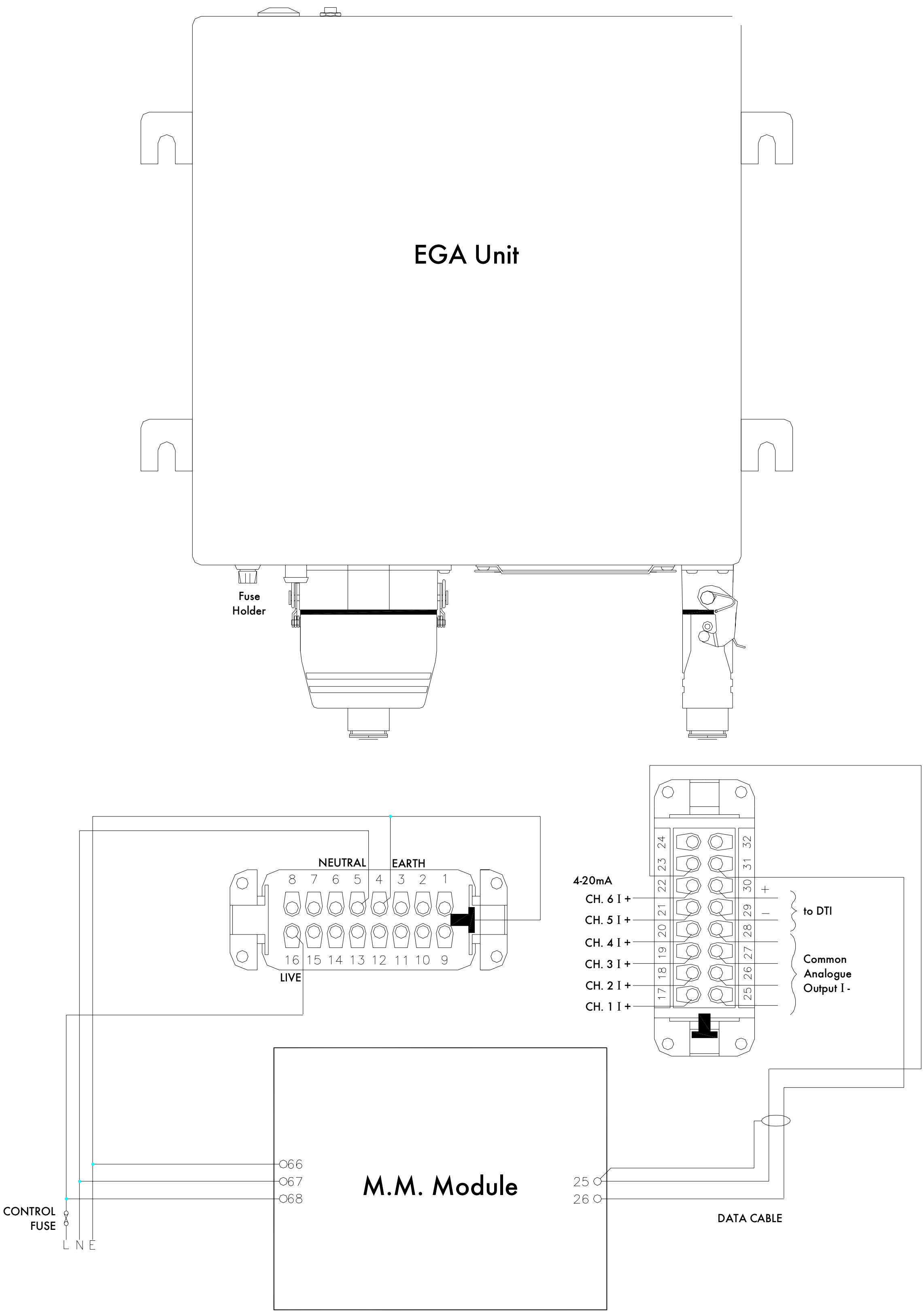
Once all the yellow L.E.D.s have been extinguished the red L.E.D. will be illuminated, this is an indication that the analyser now requires servicing. The service must be carried out by an Autoflame certified technician or alternatively returned to our factory in the UK or US. The system will still continue to operate during this time. When both the green & red LED's are illuminated, this indicates that a service is required, the unit will continue to operate in this condition.

* **important:** when shipping the E.G.A. unit back to our factory, the unit must be returned in the original packaging, therefore avoiding additional charges due to transit damage.

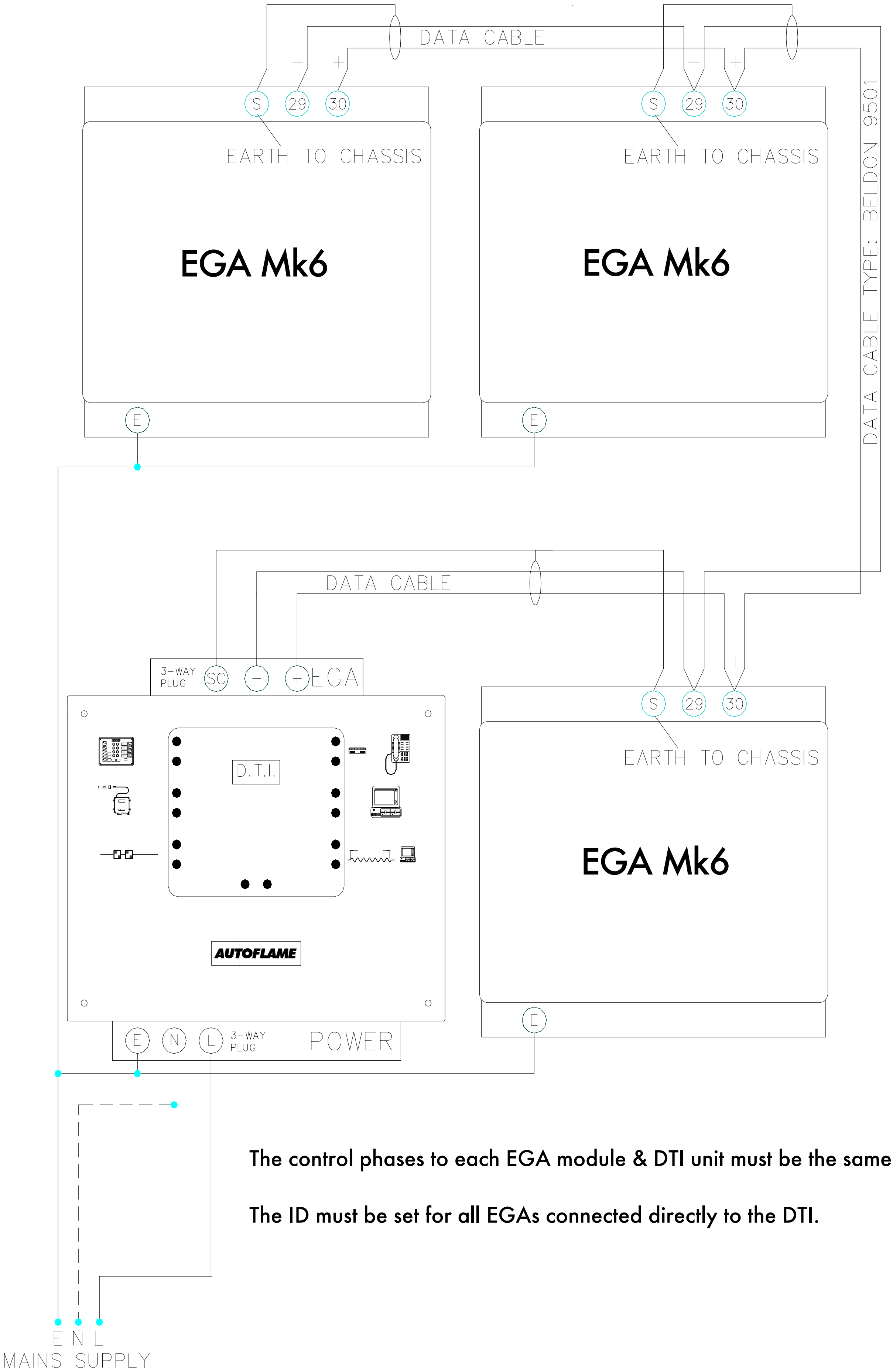


3.6 Electrical Schematics

3.6.1 Interconnection between E.G.A. and M.M. Module



3.6.2 Interconnection between stand alone E.G.A. modules and DTI unit



The control phases to each EGA module & DTI unit must be the same.

The ID must be set for all EGAs connected directly to the DTI.

3.7 Testing & Calibration

!!! WARNING !!!

As always observe health and safety procedures. An operator working on the E.G.A. must be of proficient technical standard. Take care when removing the front cover of the analyser. If the Analyser is powered, the cooling fan will be in operation.

3.7.1 Approach to Testing & Calibrating an E.G.A.

Please see section 3.8 for E.G.A. modules with a serial number greater than 5000 (all calibration, cell replacement and testing is made through a local display).

Please see section 3.9 for E.G.A. modules with a serial number less than 5000 (all calibration, cell replacement and testing is made through a PC).

The information contained in this manual provides a comprehensive understanding and operation of the Exhaust Gas Analyser (E.G.A.) units. If using this manual for the first time please read all of it thoroughly before working on an E.G.A. unit.

The method test and calibration is based on the E.G.A. being connected to PC running the 'EGA PC Calibration Software'. (This is a standard product available from Autoflame pt No. DTI20018, comprising software supplied on a diskette and a lead that connects from a PC serial port to the EGA setup port. The lead is identified by red shrouds at each end).

For brevity, the various screens, information and actions that may be carried out on the PC are not covered in detail in this manual, only a brief overview is given. Operators can quickly familiarise themselves by working hands on through the various menus on a real system. Throughout the manual any examples of text that are displayed on the PC screen are shown in bold.

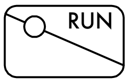
To install the software on the PC make a subdirectory on the hard drive, using the DOS copy command, simply copy all files from the diskette to the PC hard drive. To start the program type EGATOPC <return>. (The program runs in DOS only. A mouse is NOT supported). The first time the software is run select **SYSTEM** from the main menu. This is the setup of the PC configuration to work as monochrome/colour screen, printer port.... can be set. Once all items have been worked through the settings are stored immediately. The next time the program is run these settings will be restored automatically. If the system settings need modifying subsequently then select the **SYSTEM** menu and change the settings as desired.

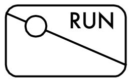
At all times when the EGA is sampling, during day to day operation or testing, it must be kept upright otherwise condensate may find its way out of the chiller block, into the filter and beyond.

3.8 EGA local display features and capabilities

The following information is provided in order to enable the Autoflame E.G.A. system to be set-up, calibrated and serviced by the end-user. With the local display it is possible to perform all the operations previously accessed through the EGA to PC software.

To ensure that the combustion readings are correct, it is recommended that the E.G.A. should be either checked or calibrated once a year. Error codes and fault history displayed on the E.G.A. screen or through the Micro Modulation unit must be observed. The E.G.A. will log up to 10 faults, with the oldest being discarded after 10 faults, and will record the error type and date and time when the error occurred.

At any point during the E.G.A. set-up procedure, press 

to revert back to the online combustion values. If using an SO_2 or NO_2 sensor it is necessary to press 

again to view these online values.

The online display shows:

- O_2- %
- CO_2- %
- CO- ppm
- NO- ppm (if optioned)
- Ambient temperature- ^{0}C or ^{0}F
- Exhaust gas temperature- ^{0}C or ^{0}F
- Delta temperature- ^{0}C or ^{0}F
- Combustion efficiency- %
- SO_2- ppm (if optioned) OR NO_2- ppm (if optioned)

3.8.1 Fault history

Press FAULT HISTORY to view the fault history log. Up to 10 errors are logged in the E.G.A. and each error is displayed with the date and time when it occurred. To view the previous 10 errors in time sequential order press FAULT HISTORY to move through each one.

3.8.2 E.G.A. Status

Press STATUS to view the various E.G.A. status screens.

The first status screen shows:

E.G.A. operating mode- with MM or stand alone
Software version
Fuel selected
Date, month, year and time

Press the STATUS button to move to the next status screen. This shows the number of hours run in each fuel.

Press the STATUS button to move to the last of the status screens. This shows when the E.G.A. is next due for a service. This date will be exactly one year since the unit was sent out, and corresponds to the 6 amber L.E.D's on the E.G.A. These lights can only be seen when the door is open (in the bottom left hand corner). One light is extinguished every 2 months, and once these have all gone out then the E.G.A. is due a service. It is recommended that each E.G.A. is sent back for an annual service.

3.8.2 E.G.A. local display set-up guide and calibration options

3.8.2.1 E.G.A. set-up guide

To enter the set-up mode, firstly press the RUN button to display the online combustion values. Press COM to enter the set-up mode. Once this button is pressed the password screen will activate. Enter the password using the CH1 and CH2 buttons. The CH1 buttons change the units and the CH2 buttons change the tens value.

Once the correct password has been entered, press COM to enter the "SELECT FUNCTION" mode.

3.8.2.1 Select Function

The "SELECT FUNCTION" screen is displayed.

Use the CH1 buttons to select the function to be changed. Once the desired function is selected, press ENTER MEMORY to change the settings for that function.

The various settings you can change include:

- Setting the date and time
- Configuration of the E.G.A.
- Configuration of the six 4-20mA outputs

3.8.2.2 Setting the date/time

Once "SET DATE/TIME" is displayed press ENTER MEMORY

The CH1 buttons scroll through the various options to change,

i.e. date, month, year, hour and minute.

The CH2 buttons change the actual value for each option.

Once the date/time has been set, press ENTER MEMORY to return to the "SELECT FUNCTION" menu.

3.8.2.3 Configuration of the E.G.A.

Once "E.G.A. CONFIGURE" is displayed press

The CH1 buttons scroll through the various settings that can be changed. When the desired setting is displayed, press to start making any changes.

The settings that are adjustable through the "E.G.A. CONFIGURE" menu include:

(For each setting the function of CH1 and CH2 buttons are shown)

	CH1	CH2
Operating mode	with MM or stand alone	no function
Temperature unts	imperial or metric	no function
Efficiency calculation	english or european	no function
ID number	1-10	no function
NO sensor	fitted or not fitted	no function
SO2 sensor	fitted or not fitted	no function
CO/NO pinch valve	selects fuel	selects open or close
Change the password	units	tens

Once the required changes are made for a particular selection, press to move to the next selection, i.e. after changing the ID number press to move to the NO sensor selection.

Once all required changes have been made, use the CH1 buttons to scroll to the "RETURN TO SELECT FUNCTION" screen and press

3.8.2.4 Configuration of the six 4-20mA outputs

Once the "4-20mA OUTPUTS" screen is displayed, press ENTER MEMORY to set the correct outputs and signal range.

The CH1 selects which output (1-6) is to be changed. When the correct ouput is displayed press ENTER MEMORY to make the changes.

Use the CH1 to select which output signal is required.

The possible output signals are listed below:

O_2- %
CO_2- %
CO- ppm
NO- ppm
Exhaust temperature- ^{0}C or ^{0}F
Efficiency- %
SO_2- ppm
Smoke density
Air temperature- ^{0}C or ^{0}F
Ambient temperature- ^{0}C or ^{0}F
Ready Status

Once the desired output signal is selected press ENTER MEMORY. For each output (1-6) and chosen output signal it is necessary to set a range (4-20mA).

Firslty the lower range is set (4mA). The CH1 changes the units (i.e. 0.1%, 1ppm,e.t.c) and the CH2 changes the tens (i.e. 1.0%, 10ppm, e.t.c). When the correct lower range is set press ENTER MEMORY.

Next the upper range is set (20mA). The CH1 changes the units (i.e. 0.1%, 1ppm,e.t.c) and the CH2 changes the tens (i.e. 1.0%, 10ppm, e.t.c). When the correct upper range is set press ENTER MEMORY.

The next 4-20mA signal will now need to be set. Once these are all set (or the desired ouputs are set), use the CH1 buttons to scroll to the "RETURN TO SELECT FUNCTION" screen and press ENTER MEMORY, or press RUN to return to the online cambustion values.

3.8.3 Changing the cells and test gas calibration

This section describes the procedure for changing out the cells of the E.G.A. in the field and also applying a test gas to calibrate the cells.

When in the normal operating mode, i.e. the RUN button is illuminated. Hold down the CAL button for 2 seconds in order to enter the calibration menu. Once this is done the "CALIBRATION METHOD" menu will appear.

Use the CH1 buttons to select which calibration method is to be used. The 2 choices are "CALIBRATION CODE" and "GAS CALIBRATION". Once the correct screen is displayed press ENTER MEMORY to proceed.

3.8.3.1 Calibration code

Once ENTER MEMORY has been pressed "SELECT CELL TYPE" will appear. Use the CH1 to select the cell that is to be replaced and then press ENTER MEMORY

It is now necessary to enter the 15 digit code. This code contains information regarding the manufacture date and range it was set for.

To do this use the CH1 buttons to move left and right to select the digit to change. Then use the CH2 buttons to change the value for each digit.

Once the correct code has been entered press ENTER MEMORY

If the wrong code has been inputted, then "INCORRECT CODE" is displayed. Press ENTER MEMORY to return to the "SELECT CELL TYPE" screen and start again.

Press RUN when finished to go back to the online combustion values.

3.8.3.2 Gas calibration

Once [ENTER / MEMORY] has been pressed "SELECT CAL GASES" is displayed. Use the CH1 ▽ △ to select the gas and use CH2 ▽ △ to select "YES/NO" for each gas.

Once the correct test gas constituents are selected press to [ENTER / MEMORY] continue.

"SET GAS SPANS" will be displayed. Now it is necessary to set the percentage of each gas is the test gas.

Use CH1 ▽ △ buttons to select the gas and the CH2 ▽ △ buttons to select the percentage for each gas.

Once this is set press [ENTER / MEMORY] to continue. The E.G.A. will perfrom a zero calibration and then the "CONNECT CAL GAS" screen will be displayed. Once the test gas is connected, and the flow is set with the flow gauge (550-600cc), press [ENTER / MEMORY] to perfom the test gas calibration.

Press [RUN] once this is finished to return to the online combustion values.

3.9 EGA Set-up Software Introduction

The following information is provided to enable the Autoflame E.G.A. system to be calibrated and serviced by a factory trained technician.

The software is operating a context sensitive help system. This means that by pressing the F1 function key you will get a help message specific to the function selected in the program. If you are unable to find the HELP you require in the software notes go to the desired function in the program and press F1.

The E.G.A. calibration software is accessed using an IBM PC or compatible, running MS DOS together with the software and data cable provided. The PC operates via the RS 232 serial port, either COM1 or COM2 and the corresponding serial port in the E.G.A. (see diagram 3.1.3) The serial port in the E.G.A. is a 9 pin 'D' type connector on the cell board. The dust cover on the D connector must be replaced after use.

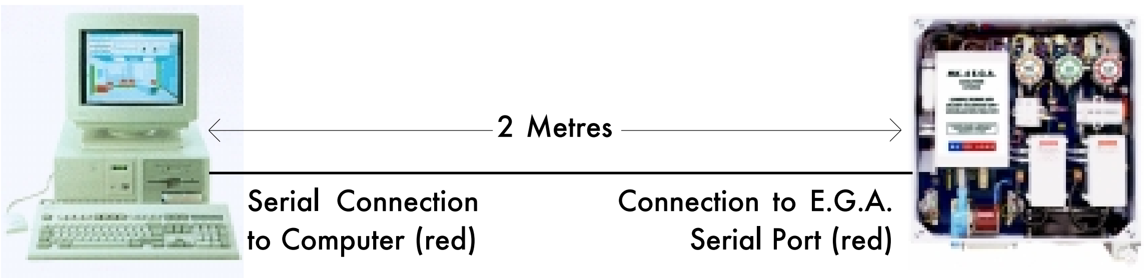
To ensure the combustion readings are correct the E.G.A. should be either checked or calibrated once a year. Error codes and information displayed on the local display, the remote display pod (used for stand alone analysers) or the M.M. unit (used for combustion trim) must be observed.

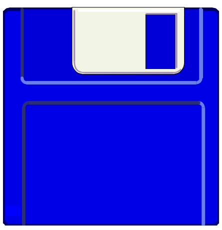
The E.G.A. will log faults and retain the types of fault stating the date the fault occurred. Up to 10 values will be logged with the oldest fault being discarded. The logged values may be displayed on the PC.

Once connected it is important to establish communication is correct. This is displayed on the PC screen, top left, with the message "EGA Communicating OK".

Should there be a communications problem please check the following points:

1) The data cable that is being used is the correct type as supplied with the software.
2) All interconnections are correct and secure.
3) The E.G.A. is powered and operational.
4) The correct serial port is selected from the software, (COM1 or COM2)





Cable & Disk Part No. DTI20018

3.5" Floppy Disk (EGADISK)

3.9.0.1 Software Possiblities

The E.G.A. 6 channel analogue output facility is PC configurable to enable the user to set the range and items of data required and also user selectable. Via the same software and connection lead (part no. DTI 20018) the E.G.A. can be configured and operated as required. This can also be used to service, fault find and calibrate the unit in two ways:-

Replacement sensors are supplied pre-coded which is entered into the EPROM of the unit to calibrate the cell.

Test gas calibration by placing known concentrations of gas through the E.G.A. module.

Selecting the output signals of the 4-20mA
There are eleven possibilities:-

1. O_2 range adjustable
2. CO_2 range adjustable
3. CO range adjustable
4. NO range adjustable
5. SO_2 range adjustable.
6. Exhaust gas temperature
7. Efficiency/nett/gross
8. Input for ambient air temperature i.e. combustion air inlet on burner
9. Air temperature input 4-20mA
10. E.G.A. unit air temperature ambient
11. Smoke density auxiliary input/output 0-10v from smoke obscuration 4 to 20 mA output.

3.9.1 Using The Software

Calibrate Sensor (Replacing a Sensor)

The use of this facility will enable the user to calibrate the sensors within the E.G.A.. Each sensor is supplied by Autoflame complete with it's own unique calibration code number.

step 1. Removing the sensor to be replaced. Power the unit down before removing the sensor.

a) For O_2 and CO_2 sensors disconnect the corresponding plugs associated with the sensor and the two plastic tubes, now remove the sensor retaining strap and install the new sensor following the steps in reverse order.

b) For CO, SO_2 and NO sensors, disconnect the corresponding plugs associated with the sensor, now remove the three screws located on the top of the sensor, only replace the sensor head. Do not remove the plastic tubing from the sensor housing. When tightening the new sensor in place ensure a tight fit so that the cell does not leak, but ensure that the screws are not over-tightened as this can lead to cracks in the cell that would cause leaks.

step 2. Select Calibrate Sensor from the tool bar displayed at the bottom of the screen page. This command will allow you to change a sensor without the need for test calibration gas.

step 3. After selection of the desired type of sensor from the menu listing, press the Enter key.

step 4. Type in the calibration code at the prompt and type Enter.

step 5. The E.G.A. communications will update the P.C. with information regarding the types of sensor fitted, i.e. CO, NO, SO_2, CO_2 and O_2.

step 6. Changing of the sensor is now complete, remove serial connection and replace cover on the E.G.A. unit. If the cover is left off the E.G.A. the internal components may over heat due to lack of cooling air from the fan located on the base of the unit. If the internal temperature is above +40 deg C (104F) or below +5 deg C (40F) the pod or M.M. unit will display "Ambient Temperature High" or "Ambient Temperature Cool" respectively.

Note: Only sensors purchased as spares have a code number issued.

3.9.2 Status

When the status toolbar option is selected the PC will display all the information from the E.G.A. unit. The information will only be received provided the E.G.A. is communicating with the PC. Ensure the E.G.A. is powered.

The Status screen will display the following information typically:

EGA Identification Number:	1	
Operating Mode:	EGA with MM	
Operating Status:	Ready for operation	
Monitoring:	Oxygen	O_2
	Carbon Dioxide	CO_2
	Carbon Monoxide 1	CO
	Nitrous Oxide	NO
	Sulphur Dioxide	SO_2
Run Time (Fuel 1)	433 Hours	
Run Time (Fuel 2)	120 Hours	
Run Time (Fuel 3)	10 Hours	

Note: The above information is an example of Status information available

3.9.3 Faults

The Faults screen page shows the listing of all fault conditions that have occurred on either the M.M. unit or the Stand alone display Pod. Up to 10 faults can be stored and displayed after this, subsequent faults will erase the oldest fault listed. The date the error was detected and the Error number will also be listed.

Example:

1	:	12/09/96	O_2 cell failed	(21) Error number
2	:	04/10/96	Pump failed	(20) Error number

3.9.3 Options

This facility allows the user to select those options for the desired operation of the software. The user can configure the various options by pressing the Enter key when set to the required menu. Once Options has been selected the Configuration Menu will be displayed, showing the following menu options.

3.9.3.1 4 - 20mA Outputs

As standard the E.G.A. unit is supplied with 6 4-20mA output channels. The user can programme the required output from the function menu and configuring to the desired range. The minimum output is 4mA the maximum output is 20mA, each can be set to the range required.

Standard Factory Setup			
CH No.	Selection	Min	Max
CH1	O_2	0	20.9
CH2	CO_2	0	15
CH3	CO	0	999
CH4	NO	0	999
CH5	Deg C	0	400
CH6	Eff %	0	100

An external PSU is not required for the analogue outputs. The maximum permissable load on each analogue output is 250Ω. All the negative terminals are common to each other. The analogue outputs as a whole are isolated.

3.9.3.2 EGA Operating Mode

The E.G.A. Mode Setup allows the user to select the type of sensors and the desired operation on the analyser. The menus for each option show the selection available at each point. Use the Enter key to move to the next value, use 'Y' to denote selection of the NO and SO_2 sensors, or 'N' if not in use. When selections are complete press Enter.
If you select this option but decide not to change any values press the Escape key.

Setup configurations available:

Identification Number
CO Sensor type
Stand Alone or MM operation
Efficiency Calculation
NO_2 Sensor fitted
SO Sensor fitted

3.9.3.3 Pinch Valve Control

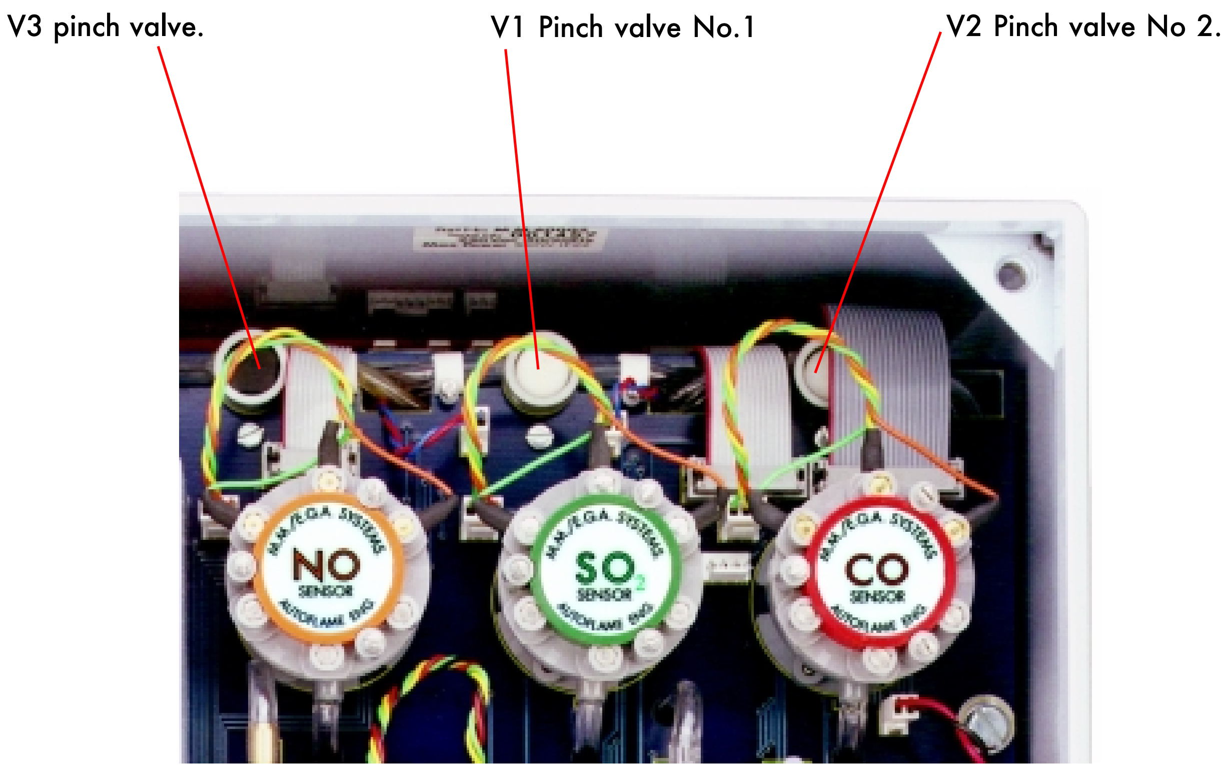
This facility allows the user to measure CO and NO when operating on F2 or F3 fuel programmes. As standard, CO and NO will only be measured when operating on fuel programme F1. This F1 programme should always be used for the operation of gas firing. This facility may be required if gas is operating on F2 programme or the user would like to measure CO and NO when burning fuel oil.

V1 = Pinch valve No.1 (brown)- CO/NO pinch valve. This pinch valve is located at the top of the cell PCB. Second from the left, with a brown top to the valve.
V2 = Pinch valve No.2- SO_2 pinch valve.

To check the pinch valves operate correctly:

The Pinch valves are checked in the M.M. Run mode. Select fuel 1 (F1), press E.G.A. to display the E.G.A. information. Check that pinch valve 1 is open. The black topped pinch valve (V3) should close when an E.G.A. calibration takes place, at this stage the sample line is closed and the drain solenoid is opened. At all other times, i.e. when no calibration is taking place the black topped valve should be open.

Select fuel 2 (F2). Check pinch valve 1 is closed all the time fuel 2 is selected, unless this has been changed by the user as described earlier in this section.



3.9.3.4 System Configuration.

This function allows the user to select the following:

Language:	English, German or French.
Serial Port:	1 or 2
Monitor:	Colour: Yes or No
Printer Port:	PRN as standard
Baud Rate:	9600 as standard

3.9.3.5 Test and Calibration Menu.

Options available:

a. Enter report details
b. Set time and date
c. Clear fault records
d. Print report
e. Modify Distributor details
f. Load fault record to disk
g. Sensor calibration dates
h. Return to main menu

3.9.3.6 Return to Main Menu (press ESC key)

3.9.3.7 Quit.

This will return the user to the DOS prompt.

3.10 Limits on Five Measured Combustion Parameters

3.10.1 Overview of System Operation: Features and Benefits

The limits control software, which is included in every M.M. E.G.A. module, further extends the application and control possibilities of the system when the E.G.A. sampling system is fitted. The function of the limits control software enables the end user or commissioning engineer to insert upper, lower and absolute limits on either or all of the five combustion parameters that the E.G.A. system measures; O_2, CO_2, CO, NO and exhaust gas temperature. To invoke this additional control facility, follow the commissioning data and technical information sheet within this section.

The limits control software is configured in two distinct forms: "Standard" limits or "Absolute" limits. Either configuration is a user variable selection via the options in section 2.14.2.4

"Standard" Limits:

"Standard" limits are a set percentage volume, ppm or temperature above or below the commissioned value for O_2CO_2, NO and exhaust gas temperature. In the case of CO, it is a specific amount of ppm (parts per million) above the commissioned value. These values are entered when commissioning of the E.G.A. system has been completed throughout the load index of the burner.

"Absolute" Limits:

"Absolute" limits are a specific percentage volume (numerical value). In this form only an ultimate low value may be put on O_2 in percentage volume and an ultimate high value for CO_2 in percentage volume, ppm or temperature. In the case of CO an ultimate high value in ppm may be entered. In the case of exhaust gas temperature an ultimate high temperature maybe entered. These values are entered when commissioning of the E.G.A. system has been completed throughout the load index of the burner.

The values for either "Absolute" or "Standard" limits are implemented via the Micro Modulation Controller options as in section 2.14.2.4. When an entered limit is exceeded, either in "Absolute" or "Standard" configuration, the following alternative control functions are available to the user (selected via options).

Control Function 1.

The trim function is turned off automatically and the system runs on M.M. fuel and air positions only, i.e. the original commissioning data. Also an error value is displayed (see error listings). The error value displayed can be cleared and the trim function reinstated by pressing the "Open" and "Close" buttons simultaneously when viewing the E.G.A. error or data.

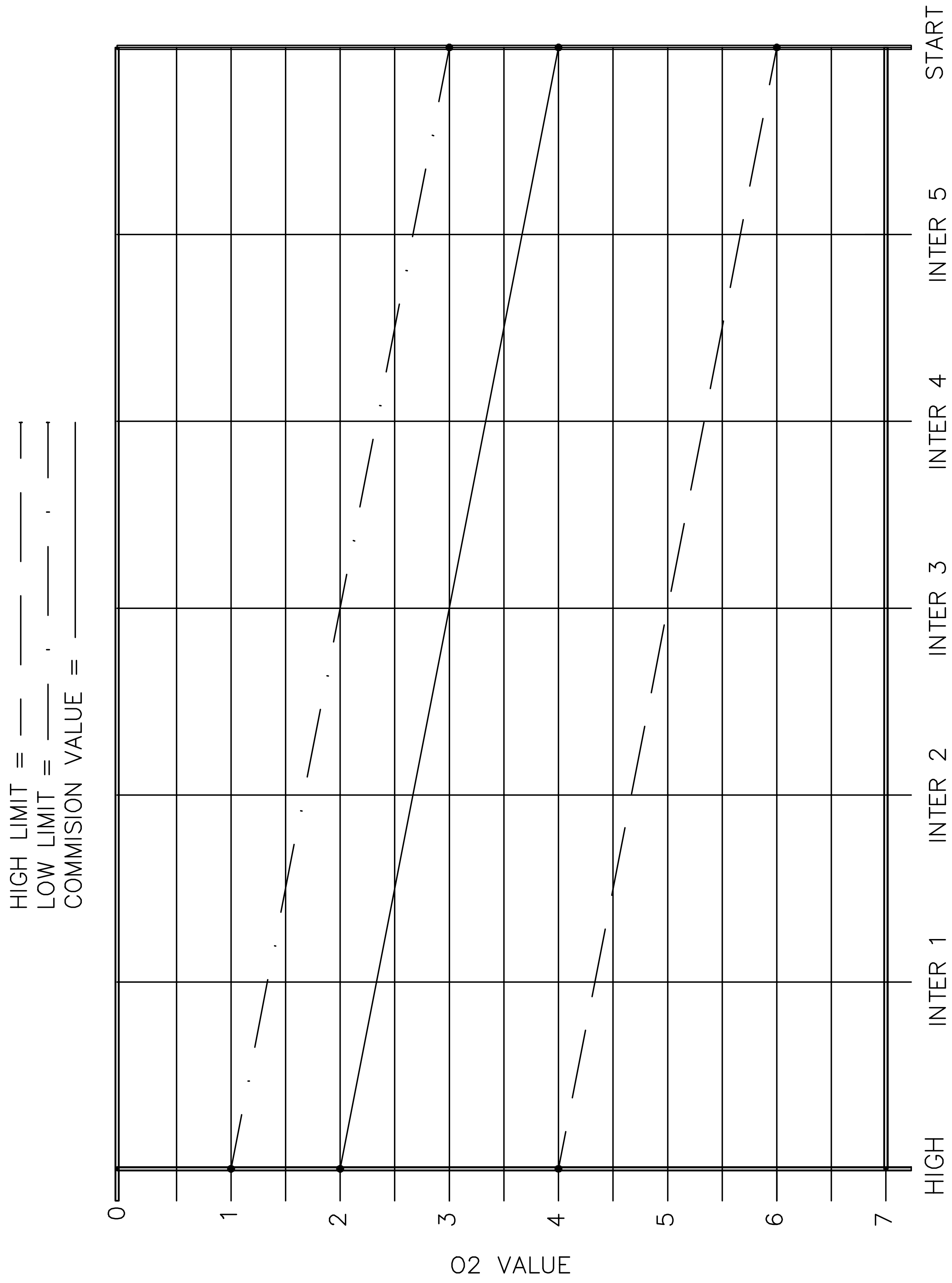
Control Function 2.

The combustion system is shut down, i.e. the burner stops running. Also an error value is displayed (see error listings). The error value displayed can be cleared and the combustion system restarted by pressing the "Open" and "Close" buttons simultaneously when viewing the E.G.A. error or data.

(See relevant data sheets and drawings showing the control forms and facilities detailed above).

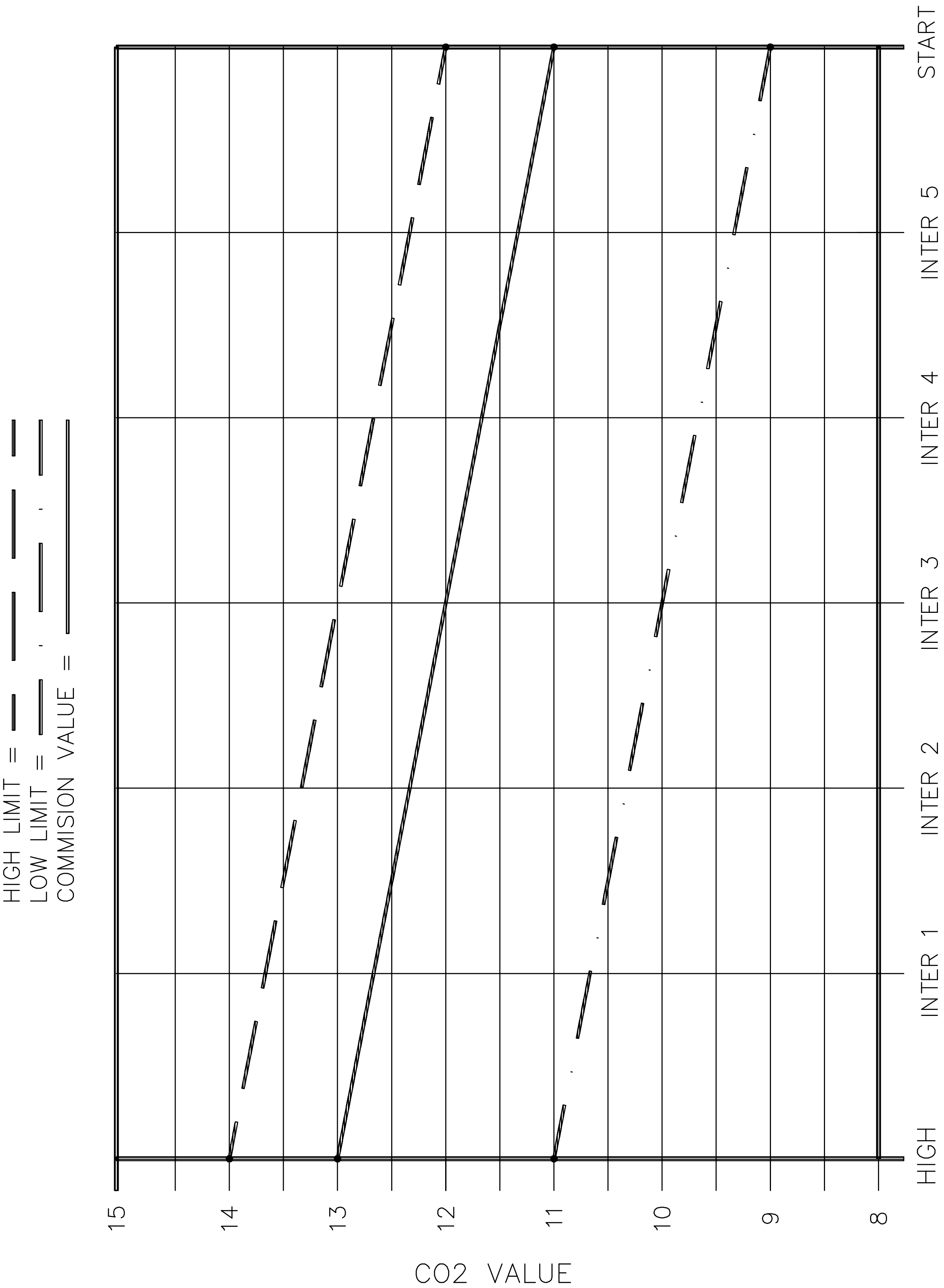
3.10.2

EXAMPLE OF LIMITS ON
O2 MEASUREMENT



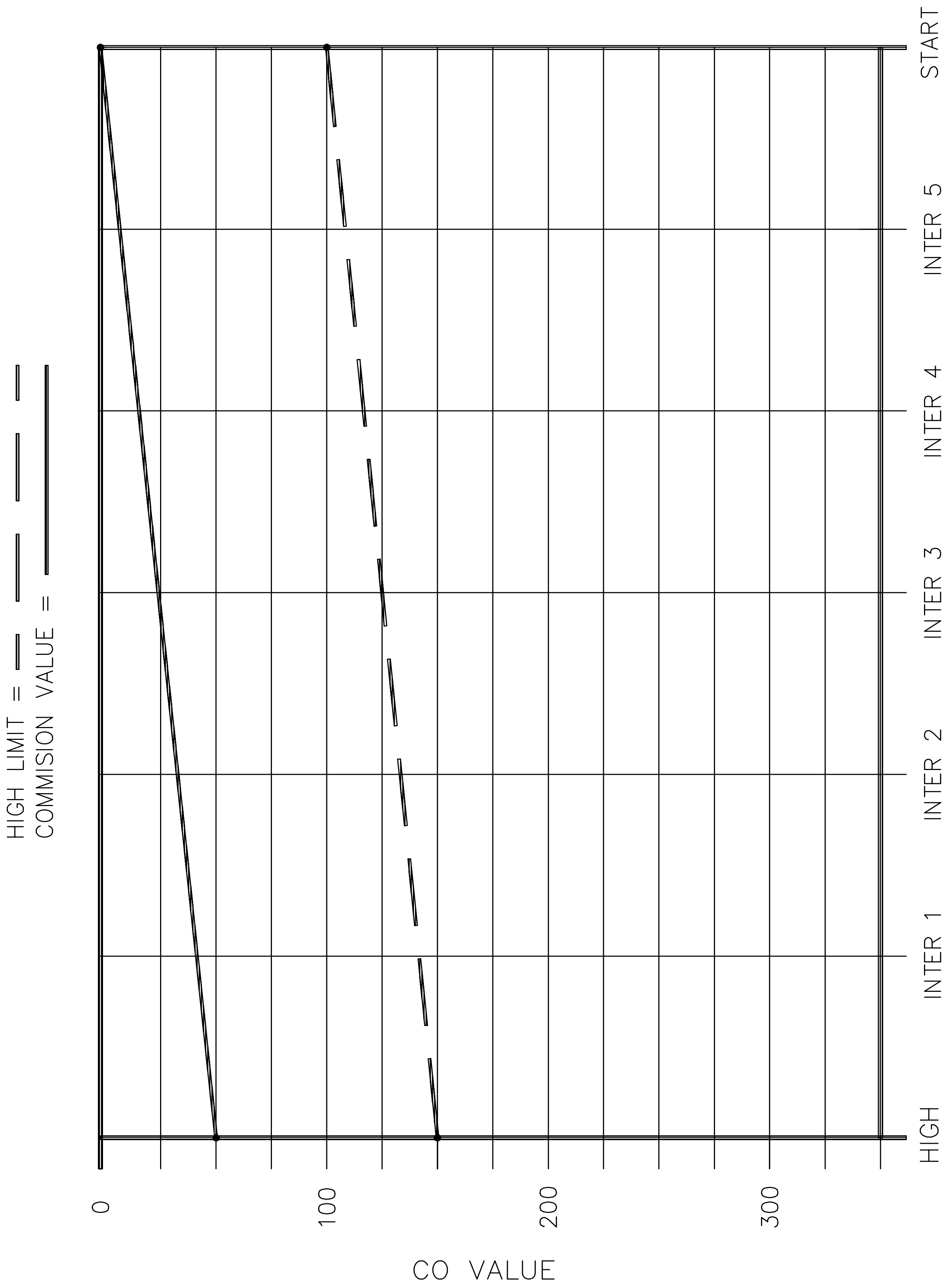
3.10.3

EXAMPLE OF LIMITS ON
CO2 MEASUREMENT

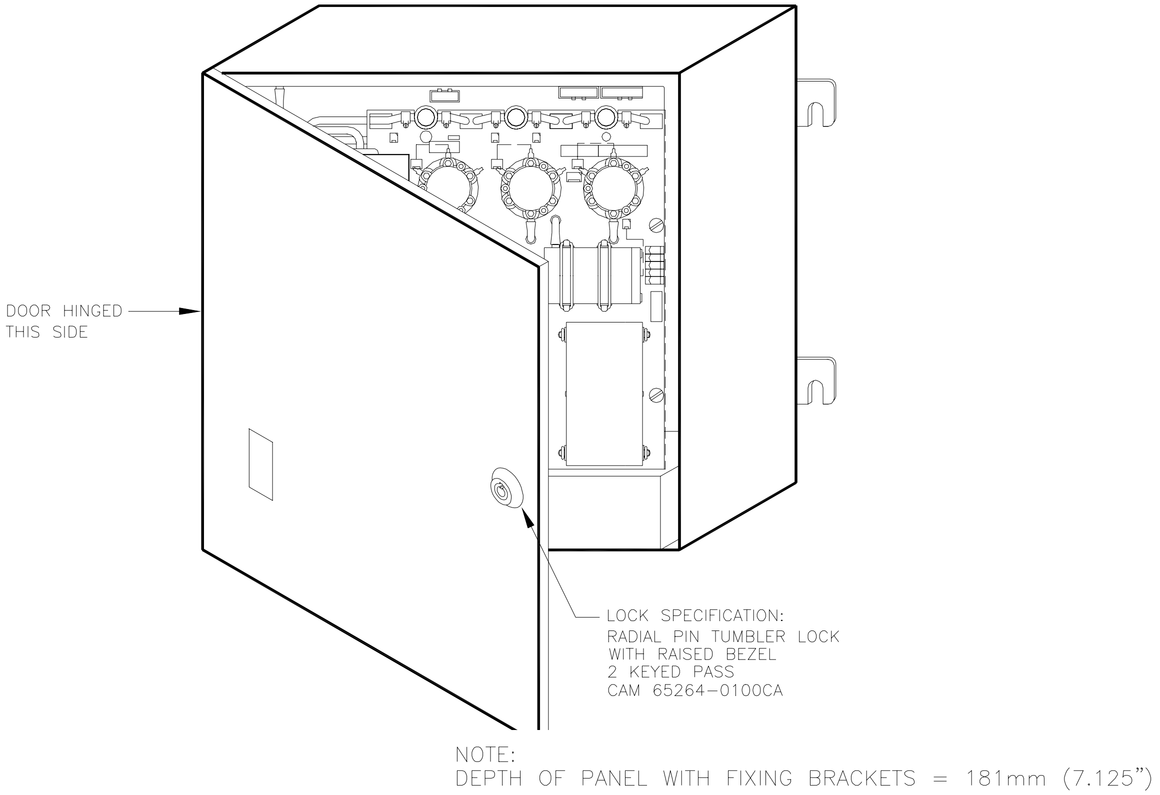


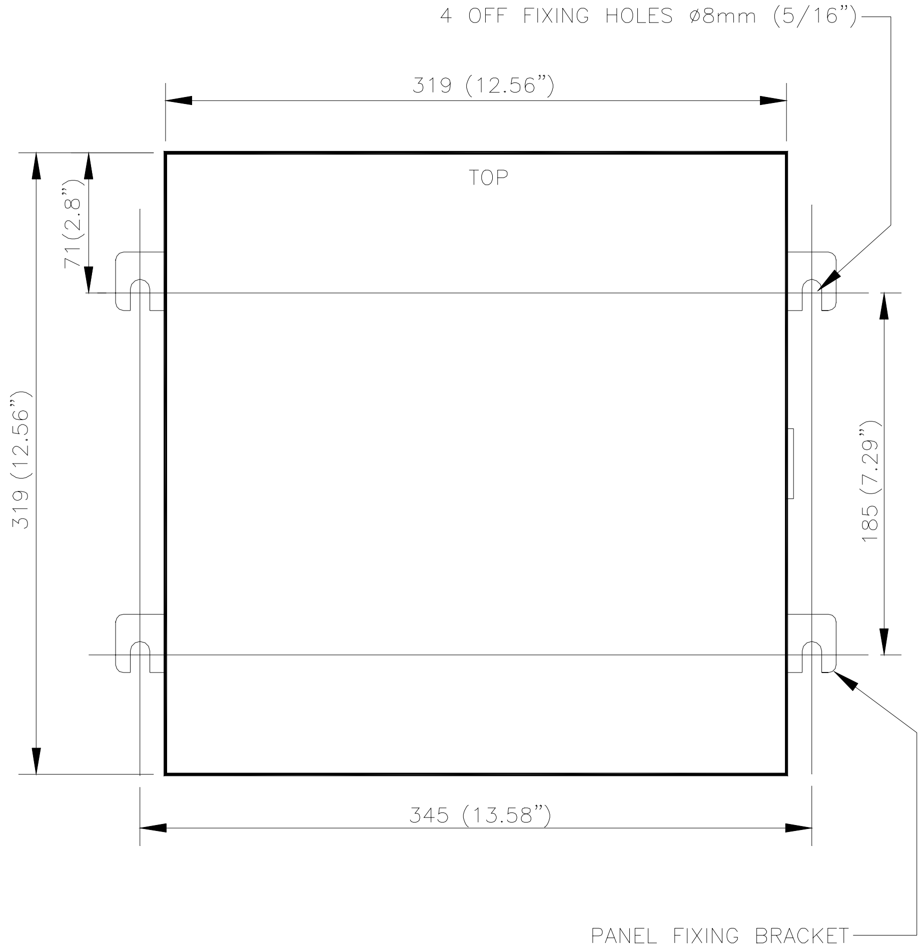
3.10.4

EXAMPLE OF LIMITS ON
CO MEASUREMENT



3.11 EGA Dimensions





If EGA is in a hot area, cool air should be directed from a lower level or from outside with a filter.

3.12 Standard E.G.A. Sampling Probe

3.12.1 Installation and Maintenance

E.G.A. Sampling Probe Installation.

Mount the sampling probe at an angle of approximately 45 degrees.

Install a 1.5" B.S.P. socket on the flue or other point that the sampling probe is to be positioned.

Mount the main body of the probe as far in as possible; adjustment is made by loosening the grub screws in the flats of the 1.5" B.S.P. bush supplied on the probe.

Keep the thermocouple cable and sample tube away from hot surfaces.

Note: For correct E.G.A. operation, the probe must be positioned without air leaks as this will give incorrect readings on all sensors.

E.G.A. Sampling System Unit Installation

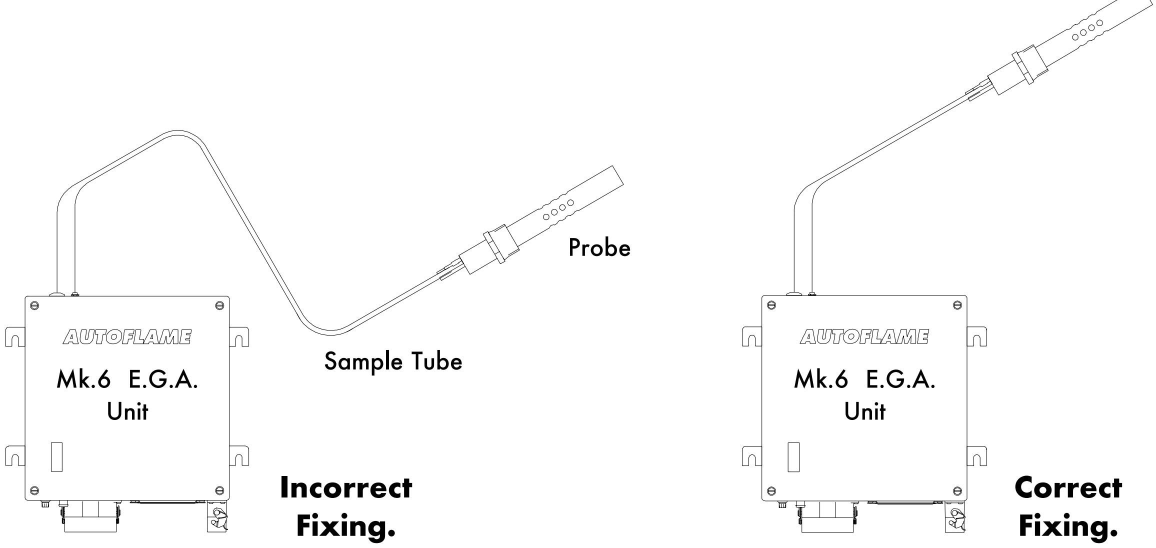
Push the sample tube onto the inlet tube. Plug the thermocouple connector into the socket and tighten the screw.

To obtain optimum performance and reliability do not mount the unit in ambient temperatures above 40 degrees C (104F) or areas of direct heat radiation. Ensure that the air flow to the intake in the bottom of the E.G.A. unit is not impeded and the air temperature is less than 40 degrees C (104F).

Do not mount the units where excessive vibration occurs (floor standing racks are available from Autoflame Engineering Ltd).

Position the sample tube so that the sample slopes down to the E.G.A. unit at all times.
The E.G.A. unit must always be mounted lower than the E.G.A. probe.

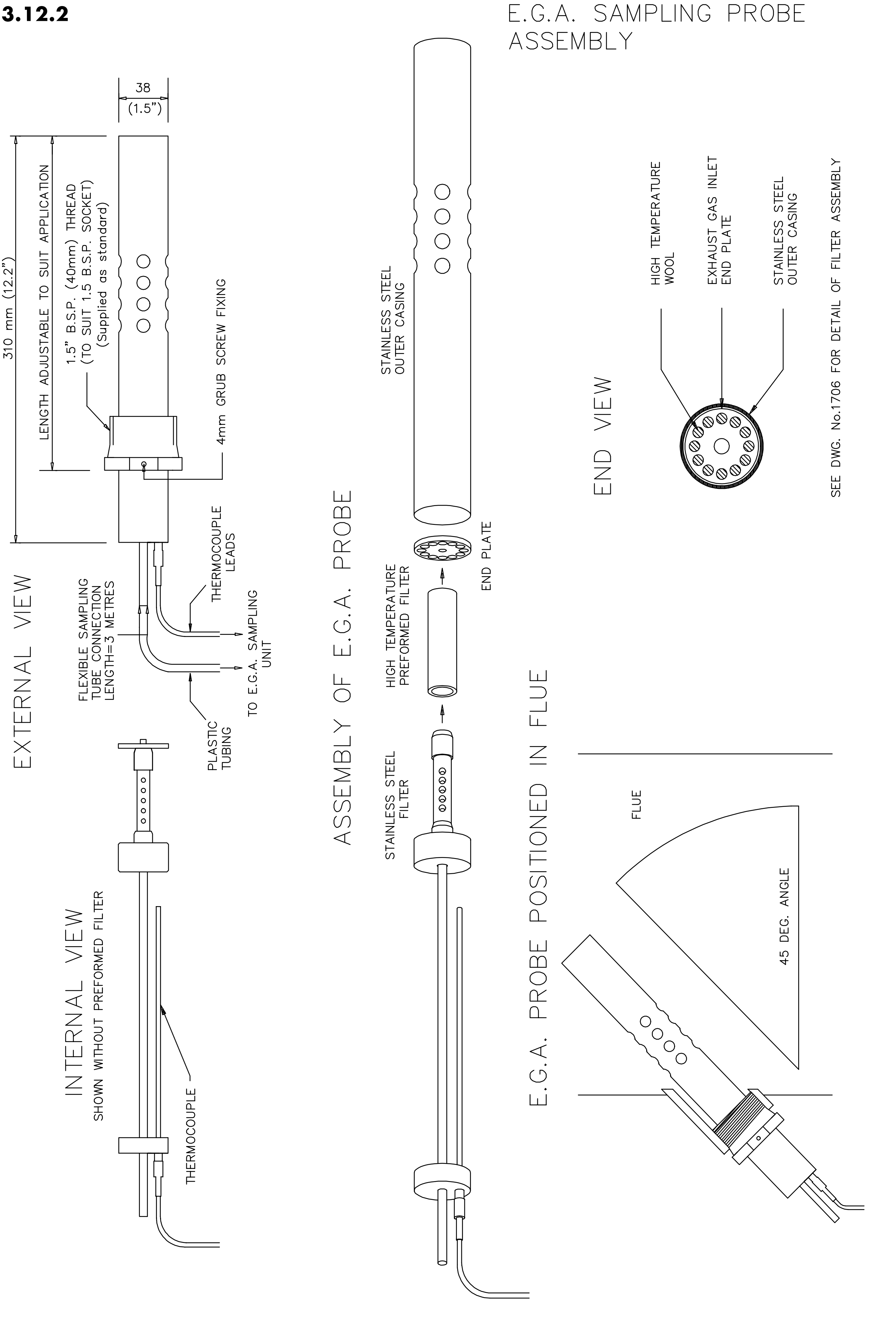
Diagram to show correct mounting/fixing position.



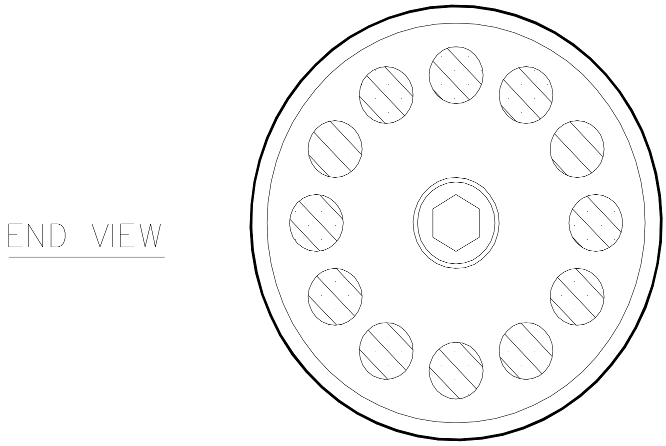
Incorrect Fixing.

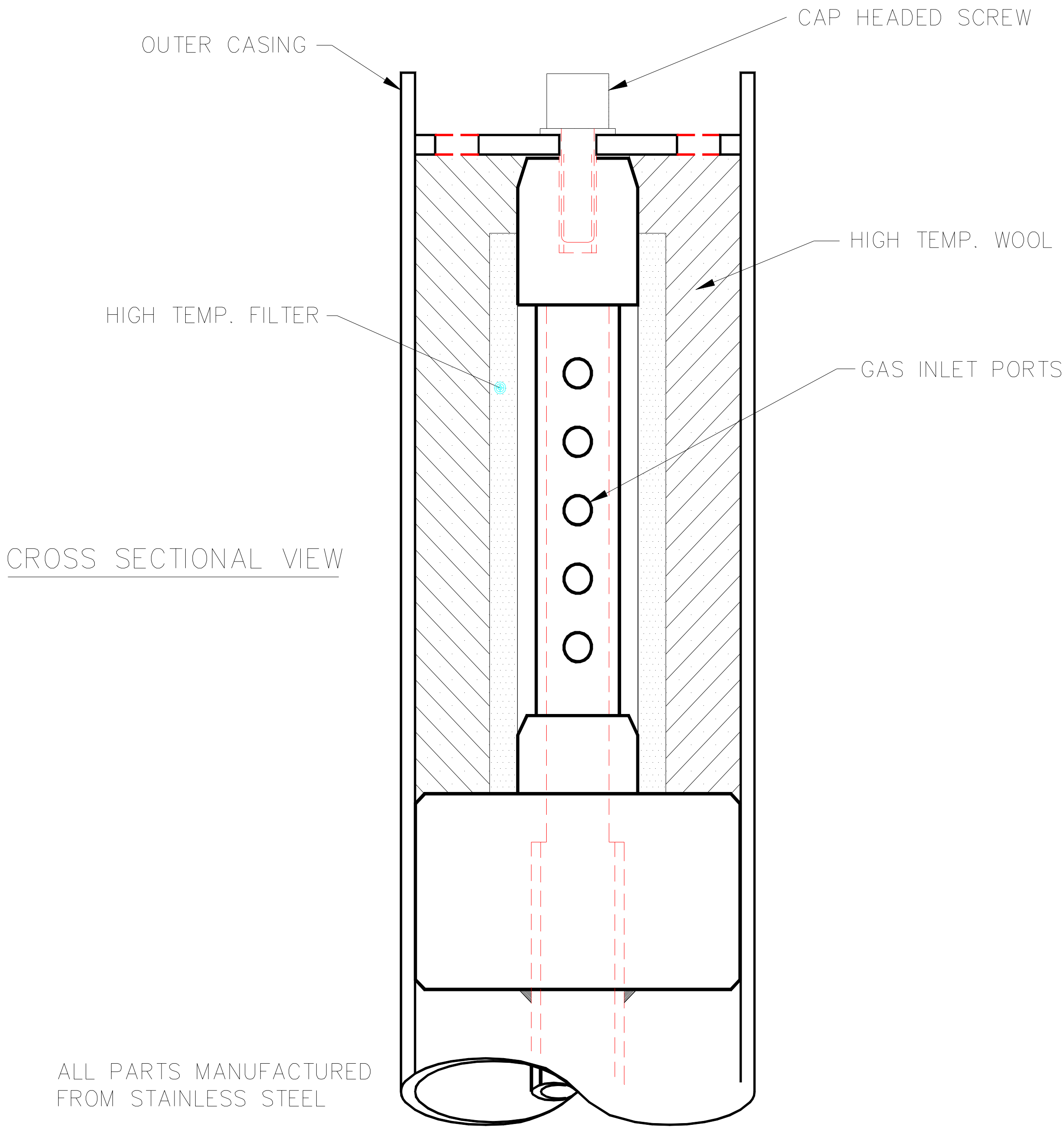
Correct Fixing.

3.12.2


E.G.A. SAMPLING PROBE ASSEMBLY
38
(1.5")
310 mm (12.2")
LENGTH ADJUSTABLE TO SUIT APPLICATION
1.5" B.S.P. (40mm) THREAD
(TO SUIT 1.5 B.S.P. SOCKET)
(Supplied as standard)
4mm GRUB SCREW FIXING
THERMOCOUPLE LEADS
FLEXIBLE SAMPLING TUBE CONNECTION LENGTH=3 METRES
TO E.G.A. SAMPLING UNIT
PLASTIC TUBING
EXTERNAL VIEW
INTERNAL VIEW
SHOWN WITHOUT PREFORMED FILTER
THERMOCOUPLE
ASSEMBLY OF E.G.A. PROBE
STAINLESS STEEL OUTER CASING
END PLATE
HIGH TEMPERATURE PREFORMED FILTER
STAINLESS STEEL FILTER
END VIEW
HIGH TEMPERATURE WOOL
EXHAUST GAS INLET END PLATE
STAINLESS STEEL OUTER CASING
SEE DWG. No.1706 FOR DETAIL OF FILTER ASSEMBLY
E.G.A. PROBE POSITIONED IN FLUE
FLUE
45 DEG. ANGLE

3.12.3


END VIEW

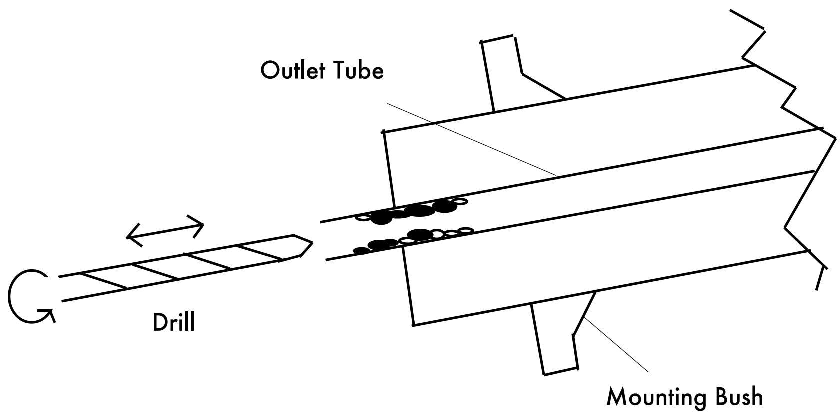

OUTER CASING
CAP HEADED SCREW
HIGH TEMP. WOOL
HIGH TEMP. FILTER
GAS INLET PORTS
CROSS SECTIONAL VIEW
ALL PARTS MANUFACTURED
FROM STAINLESS STEEL

3.12.4 Maintainance of the Sampling Probe

On gas only applications it is unlikely that there should be continual maintenance required on the stack mounted probe. It is advised that the probe is checked annualy on gas firing applications in order to ensure that the probe is free of any blockages. On heavy or solid fuel applications, deposits may build up in the outlet part of the tube. If the tube blocks a 'pump failure' will be displayed on the M.M. unit (See Section 3.3.1).

The deposits can be cleared by running a long drill (7mm)(.275") up into the outlet tube by hand. Twist and withdraw the drill often so as to pull out the deposits, otherwise the deposits will be pushed further into the probe assembly.

<u>Sectional Diagram to Show Method of Clearing a Blocked Outlet Tube.</u>



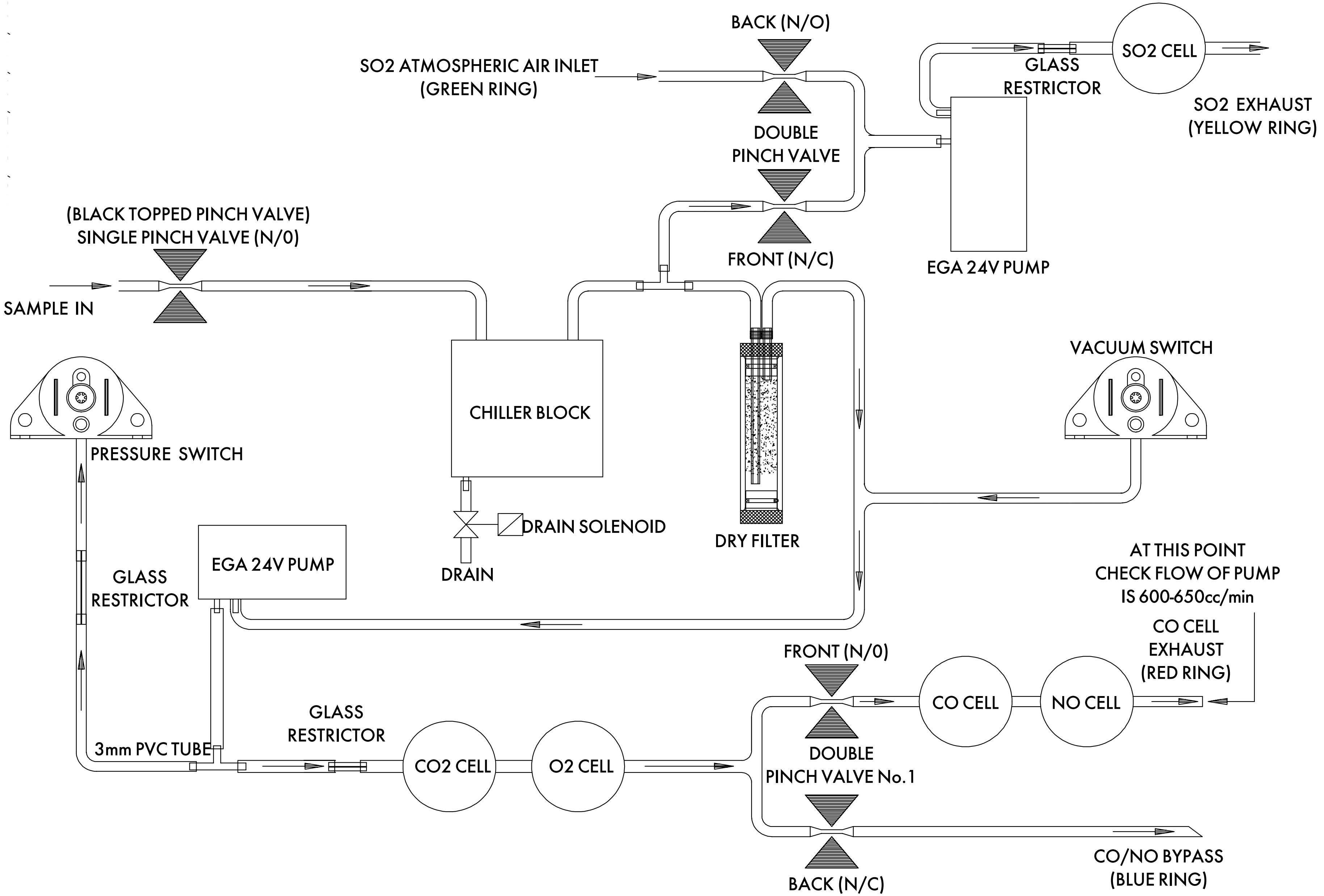
3.12.6 Servicing E.G.A. Sampling Probe.

If the filter assembly in the E.G.A. sampling probe is blocked then it is necessary to disassemble the probe and fit a new pre-formed fine filter and coarse filter material. To check if the E.G.A. probe is blocked connect it to the E.G.A. If the flow drops by more than 100 cc/min then the filtering materials must be replaced.

To disassemble the probe, remove the two cap headed screws visible on the outside of the assembly (one each end). The whole of the internal assembly can now be withdrawn from the sample connection end. Remove all traces of the filtering materials from the stainless steel filter. Check that the ways in the stainless steel filter are clear and also the inner sample tube. Very carefully (the pre-formed fine filter is delicate) push the pre-formed filter onto the stainless steel filter.
Slide the inner assembly back into the stainless steel outer casing. Pack the void between the fine filter and the outer casing with coarse filtering material as shown on the filter assembly diagram. Use a small rod to pack the material down a little at a time. Reassemble the exhaust gas inlet end plate and the two screws.

After reassembly connect the probe to the E.G.A. and check that the drop in flow is no more than 50 cc/min.

3.13 Mk.6 E.G.A. Internal Tubing Pipework



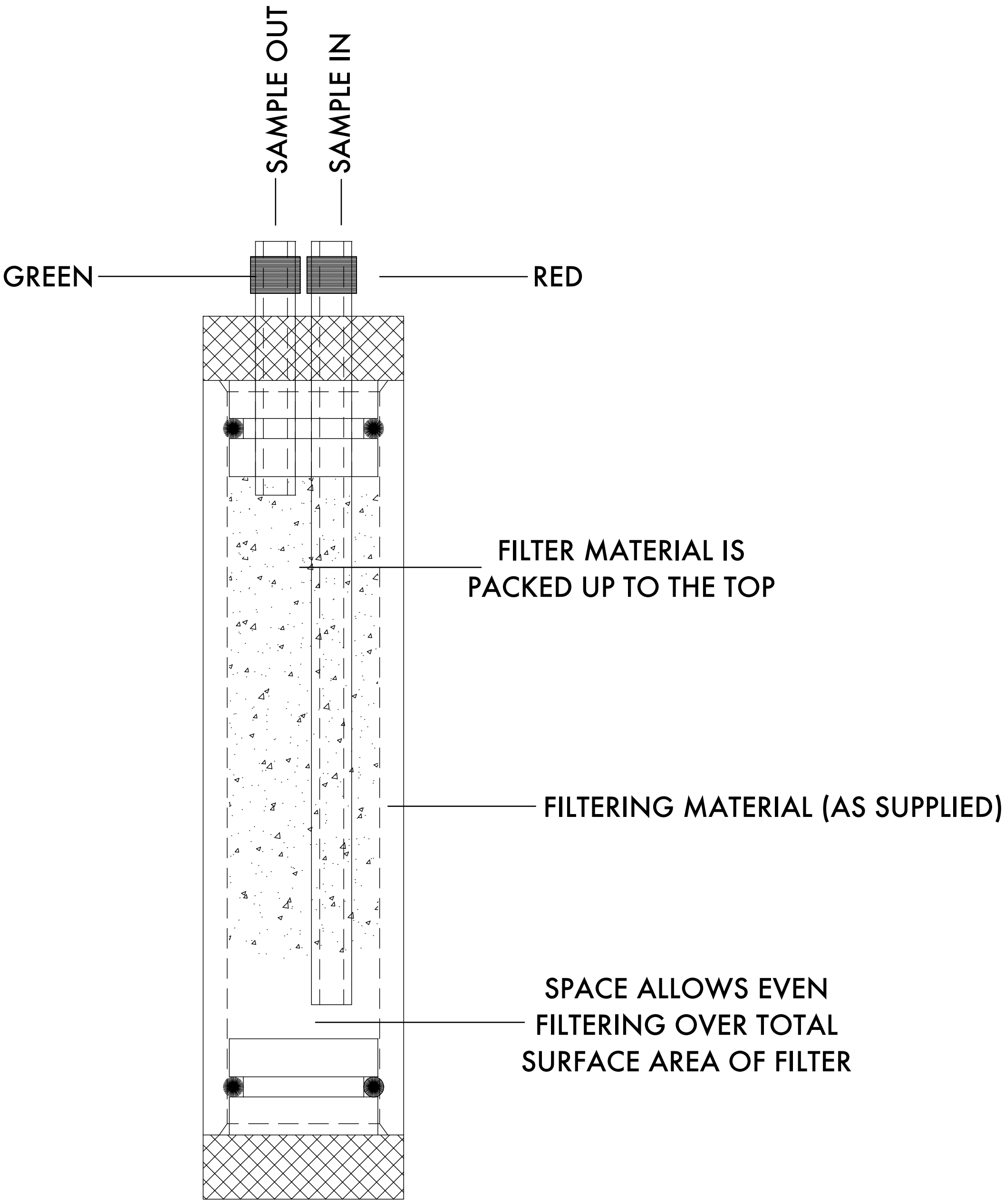
3.15 Technical Specifications

Electrical Supply:	230V/50Hz or 110V/60Hz (selectable)
Pump Flow:	550-650 cc/min (0.55-0.65 l/min)
Environmental Rating:	IP20 NEMA1
Air Conditioned Unit:	IP54 NEMA13

Temperature Range:-

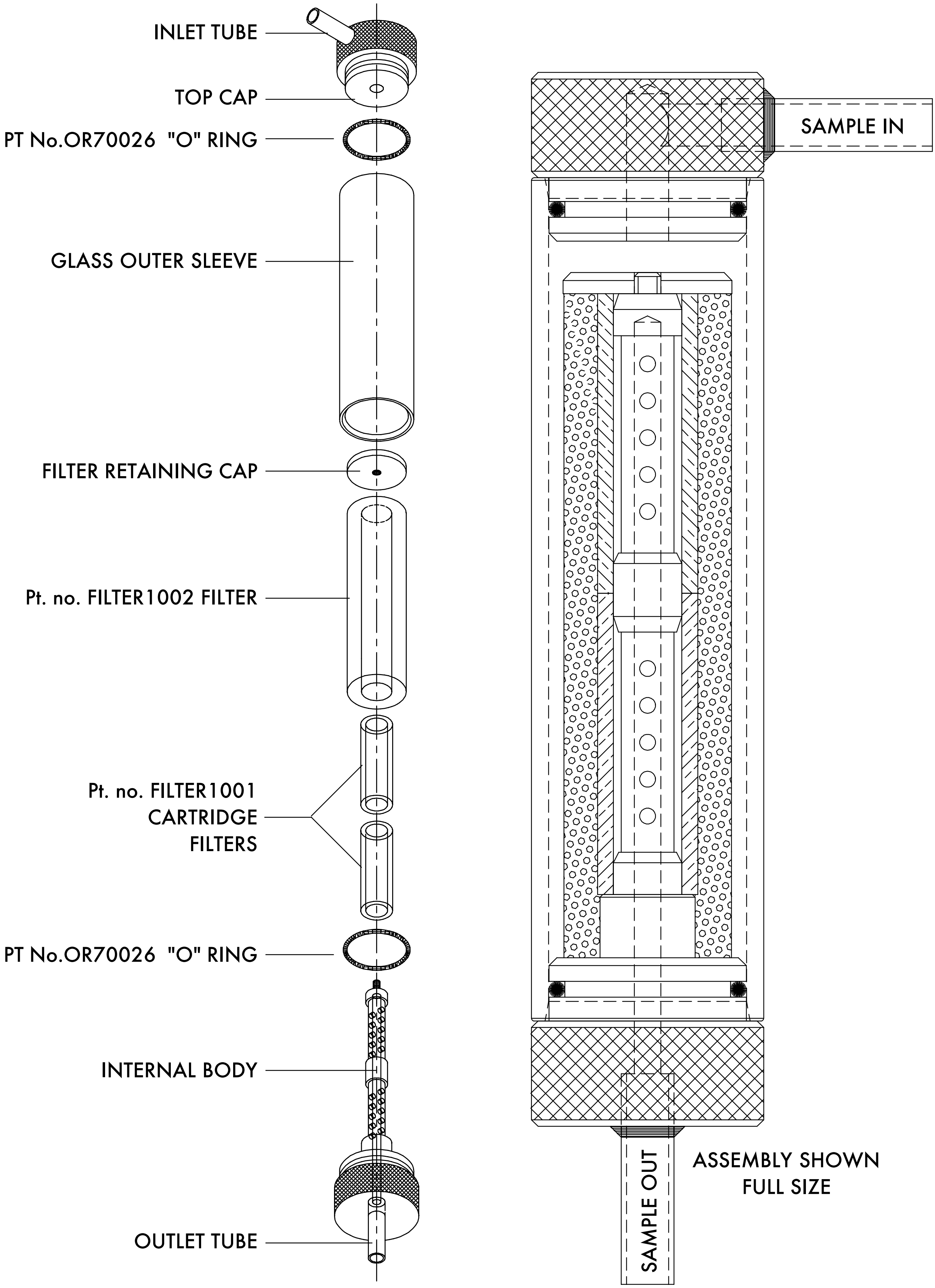
E.G.A.	Min. +5 deg C (40F) Max. +40 deg C (104F)
Ceramic sampling Probe	0-1600 deg C (32-2912F)
Type "S" Thermocouple	0-1600 deg C (32-2912F)
Type "K" Thermocouple	0-400 deg C (32-752F)

3.15.2 General Assembly of Dry Filter

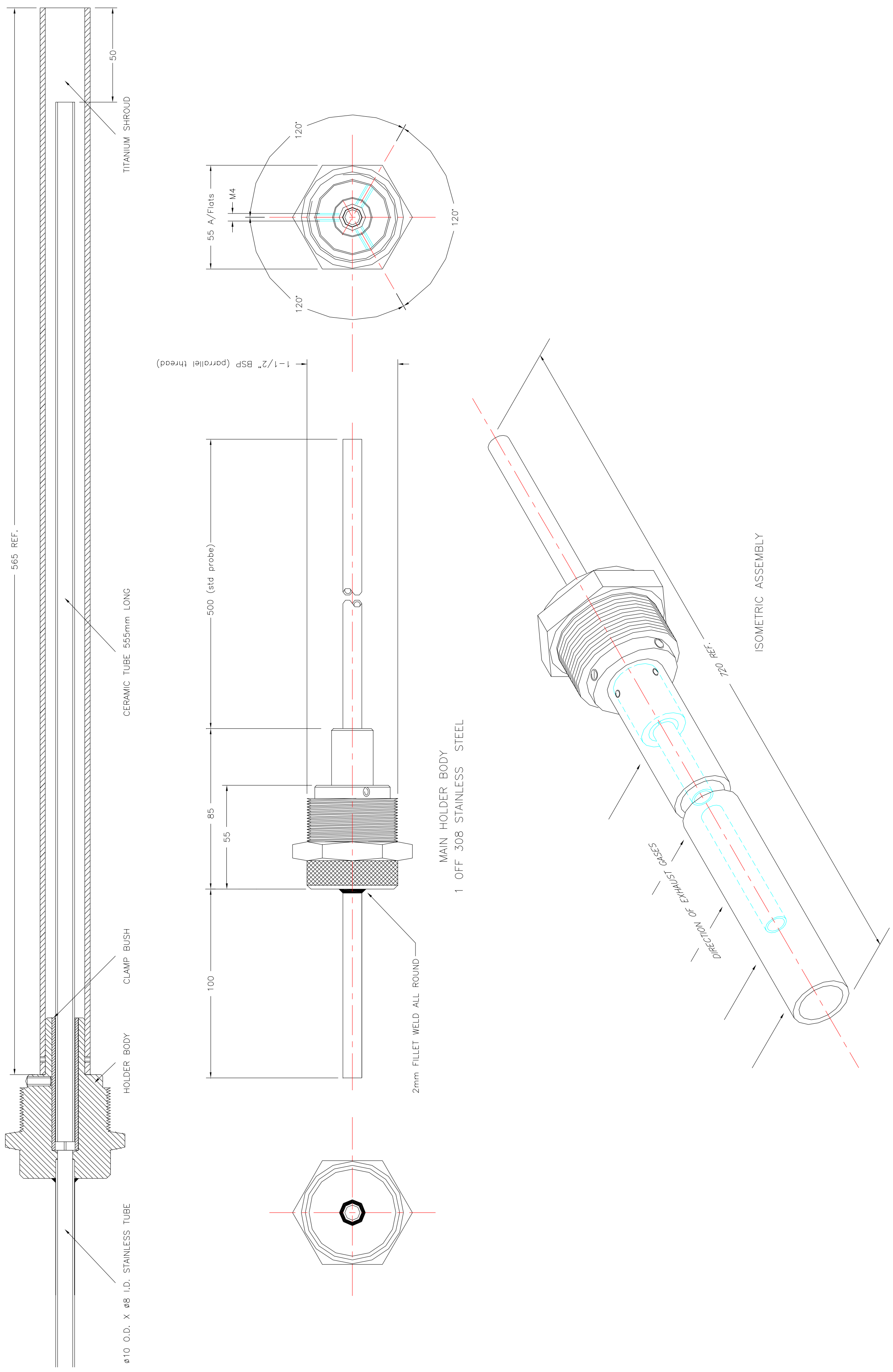


N.B. FREE SPACE MUST BE LEFT AT BOTTOM TO STOP ANY PREMATURE BLOCKAGE
THE SAMPLE IN & OUT PIPES MUST BE CONNECTED CORRECTLY OR BLOCKAGE
WILL OCCUR WITHIN A FEW HOURS.

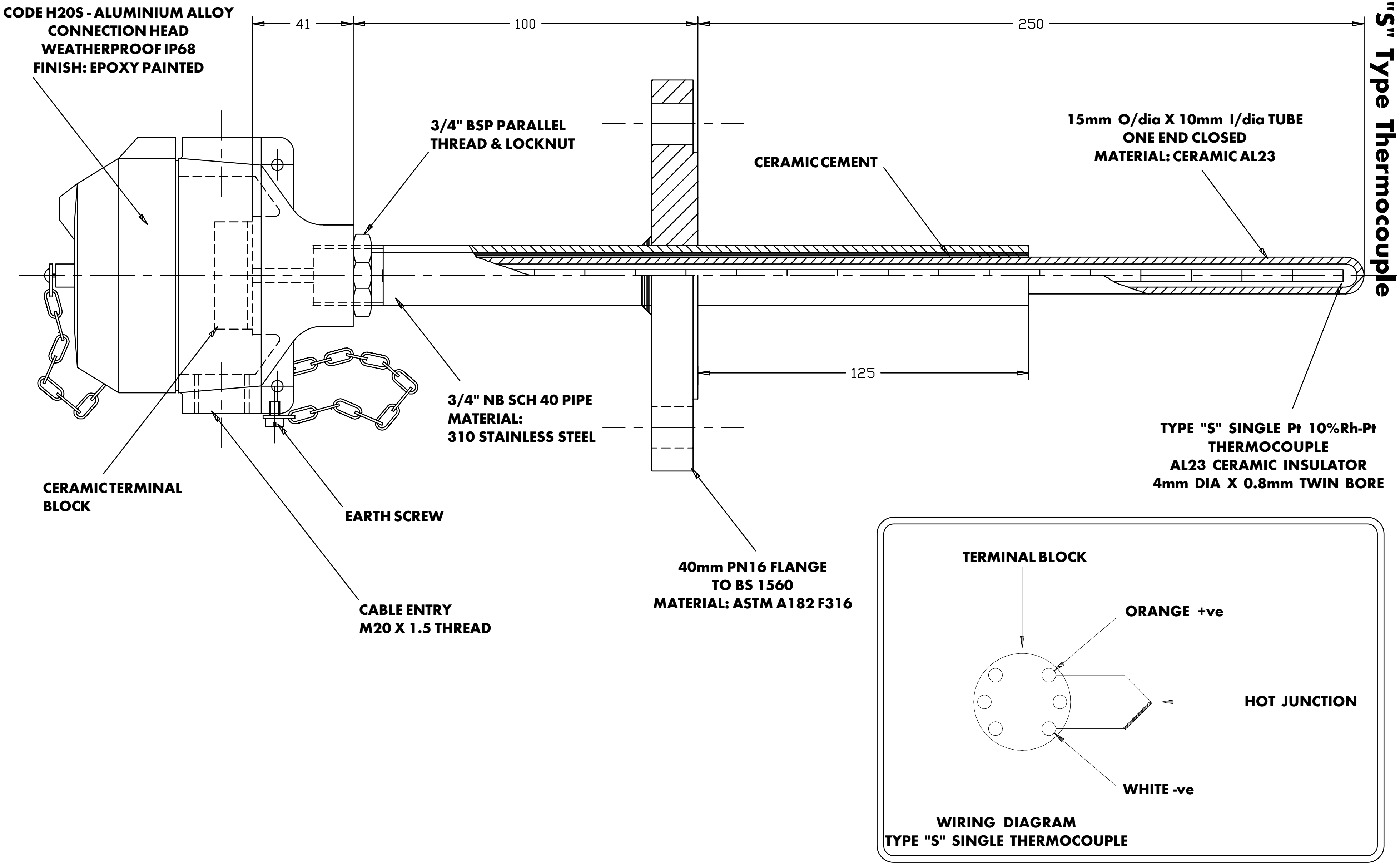
3.15.3 General Assembly & exploded view of the Particulate Filter



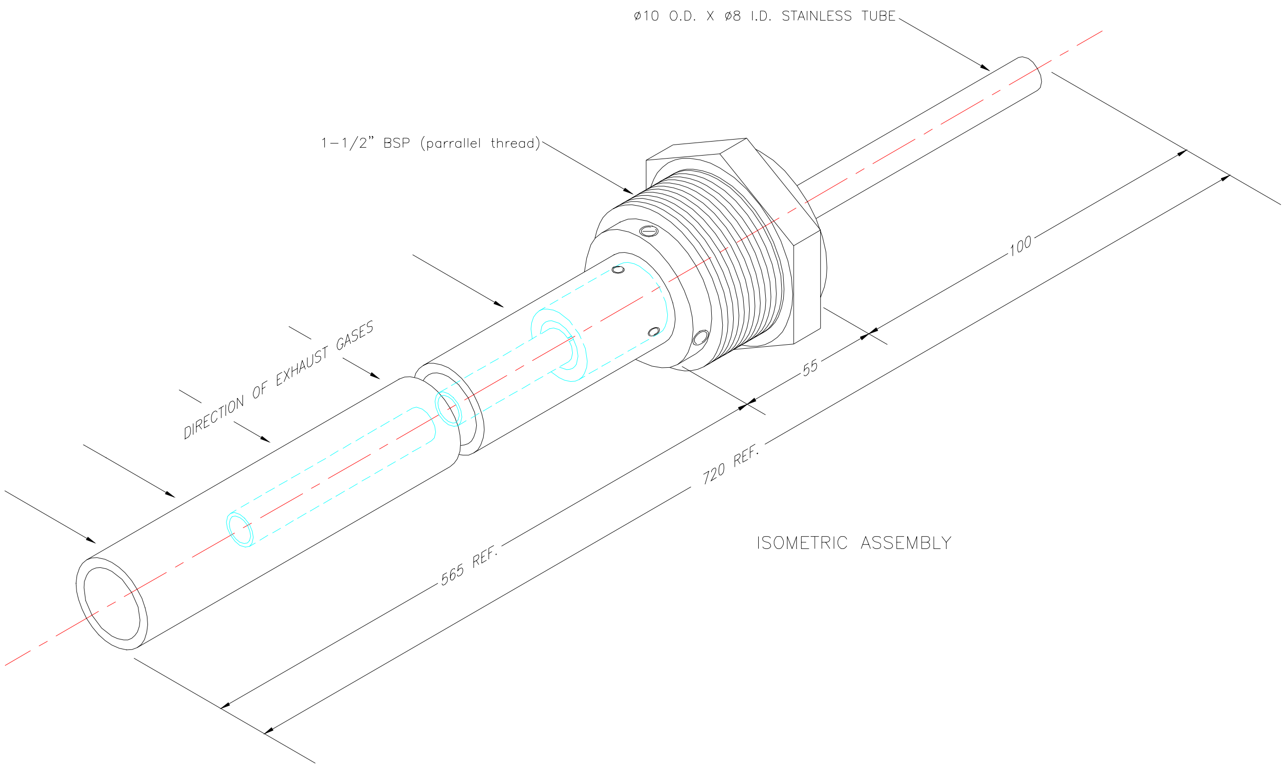
3.15.4 High Temperature Probes



"S" TYPE HIGH TEMPERATURE THERMOCOUPLE ASSEMBLY



3.15.6 Ceramic Sampling Probe Assembly



3.15.7 O2 Interface Module

The O2 interface module allows the use of an existing O2 sensor and in-situ probe to be used in conjunction with the M.M. control.

The O2 analyser is only measuring the O2 reading from the sensor and the exhaust gas temperature via a thermocouple mounted into the stack. It is important to note that the signal from the O2 sensor must be a 4-20mA and the thermocouple reading must be a 0-10V signal. These signals must be ranged as below:

O2 reading:	4 - 20mA = 0 - 20.9% O2
Thermocouple reading:	0 - 10V = 50C - 400C (122F - 752F)

Although the analyser is only measuring the O2 reading from the stack it is possible for the O2 interface module to extrapolate a CO2 value from the O2 sensor reading. These value can then be displayed on the M.M. facia (via the E.G.A. button) or via the D.T.I. on a PC or BMS interface.

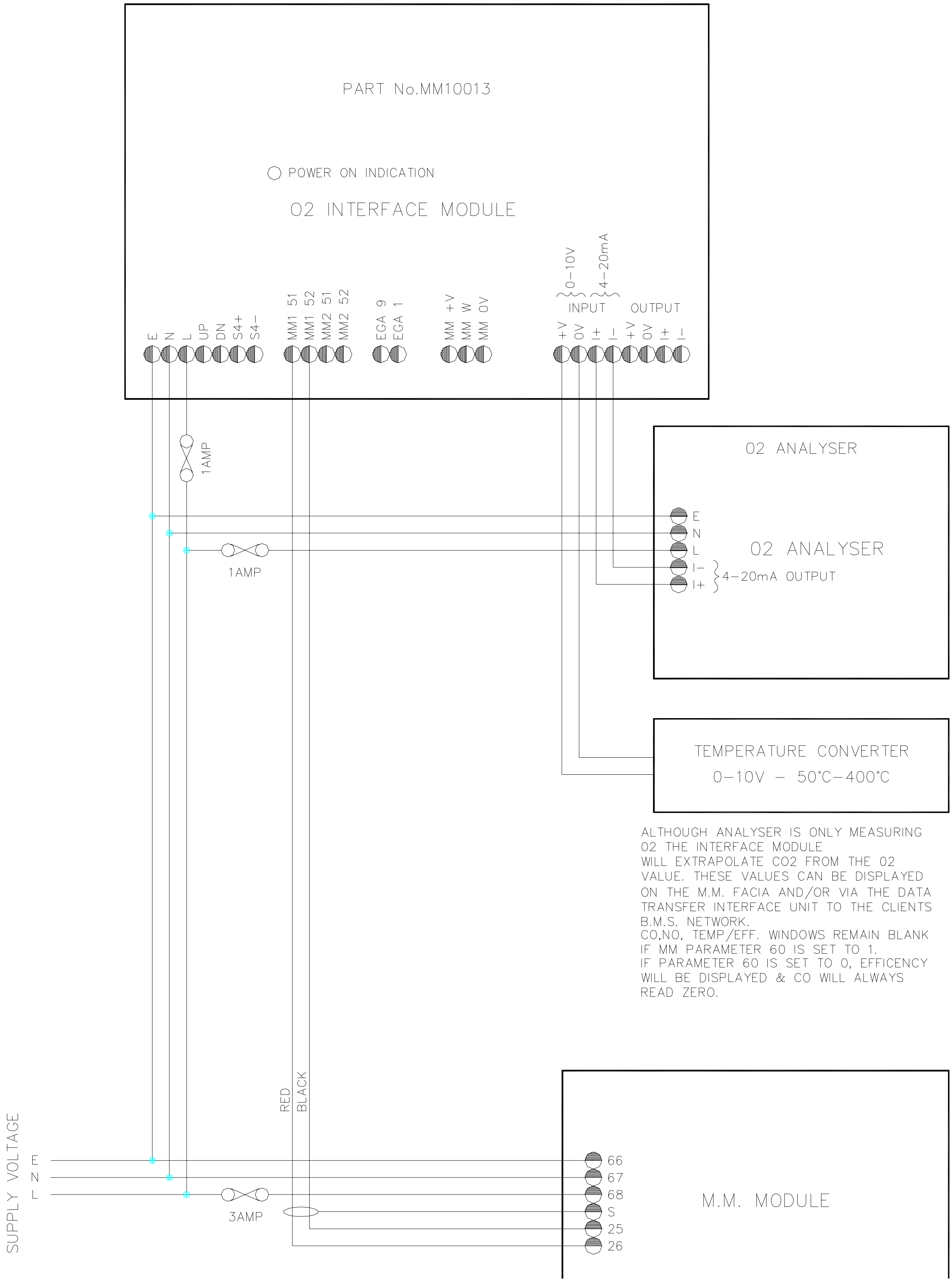
Parameter #60 is used to set the operation of the O2 interface module.

If this is set to a value of 0 then the efficiency will be calculated from the exhaust temperature and CO2 value and this will be displayed on the M.M. facia. The CO reading will always be displayed as a zero value.

If this is set to a value of 1 then the CO, NO, exhaust temperature and efficiency will remain blank.

If using the O2 interface module it is possible to use the limits for O2 readings and exhaust gas temperature readings.

Interconnection between M.M. Module and O2 Interface Module

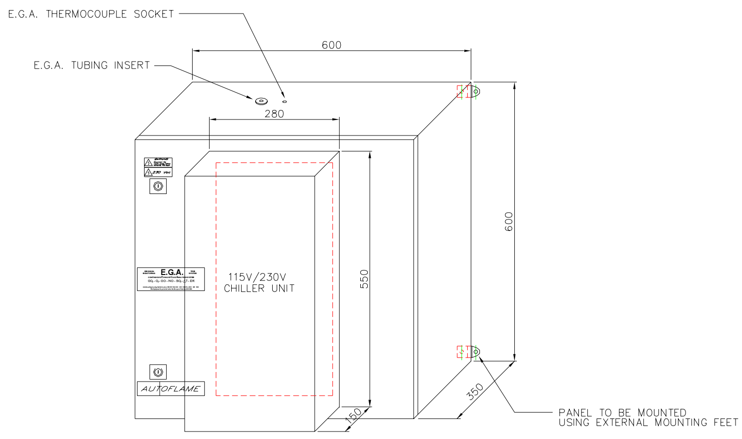


3.15.8 Chilled Environmental Enclosure

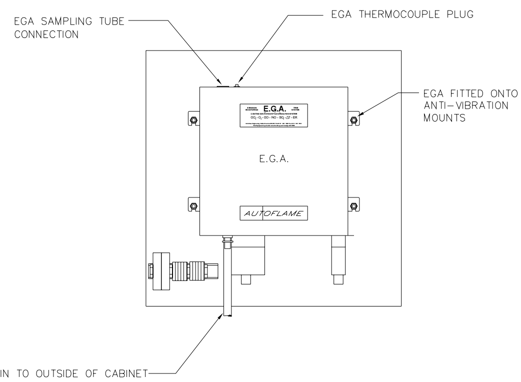
In areas of harsh ambient conditions, or excessive heat, it is necessary to utilise an environmental enclosure with the E.G.A. module. This allows protection to the E.G.A. from excessive heat and dust and ensures that the E.G.A. is well protected. By utilising this enclosure, this allows the E.G.A. to operate under the correct conditions in order to sample the exhaust gases.

Autoflame manufacture a chilled environmental enclosure that uses a chiller modules and control panel in order to maintain the E.G.A. that is installed within the enclosure at a set temperature. The temperature is user-adjustable by means of a thermostat counted on the unit but is nominally set for 35C (95F), which ensures ideal operating conditions for the E.G.A.

Please see the diagram below showing information on the chilled environmental enclosure. Please contact Autoflame sales for further information.



PANEL



BACKPLATE

3.16 Shipping the E.G.A.

The EGA is a scientific instrument with delicate components. Whenever the EGA is shipped, it is essential that the EGA is packed carefully in an Autoflame EGA shipping carton as originally supplied.

Ensure that delivery carriers treat the package appropriately. Label the package as containing delicate scienctific instrument.

If the EGA is damaged, repair costs will be incurred.

Please contact Autoflame Engineering or your local dealer to obtain a new Autoflame carton.

Section 4: I.B.S. Intelligent Boiler Sequencing

4.1 INTELLIGENT BOILER SEQUENCING (I.B.S.)

Overview of System Operation: Features and Benefits

The Intelligent Boiler Sequencing software, which is included in every M.M. E.G.A. module, further extends the application possibilities of the system. The objective of this control form is to ensure that the minimum number of boiler/burner units are in operation at any one time to satisfy the heat requirement imposed upon the boiler plant, particularly in the case of multi boiler installations.

There are two variations of I.B.S. software that can be selected by the user via the Options procedure. The first variation relates to heating boilers and the second variation to steam boilers.

Heating Boilers Sequential Control:

A maximum of ten M.M. E.G.A. modules may be interconnected by a two wire screened data cable: (See interconnection drawing). Any string of modules interconnected as detailed can have one of it's number designated No. 1 or lead boiler. This identifying of "lead" boiler is achieved by either of the following methods:

a) Connecting a mains voltage onto terminal No. 41.
b) Instructing the modules via the D.T.I. module (Data Transfer Interface) by software.

Once a "lead" boiler has been selected the system works in the following way:

Typically every five minutes the sequencing software in the lead boiler identifies it's own firing rate by looking at the position of the fuel valve in the load index and also the maximum heating capacity of the No 1. "lead" boiler. This information would normally be entered when this boiler/burner unit is commissioned. Having established percentage firing rate, and maximum heating capacity, the I.B.S. software calculates the amount of heat being contributed to the system by this boiler. The I.B.S. software in the "lead" M.M. E.G.A. module then contacts in turn each of the modules connected to this loop and gathers similar information from each. The "lead" module's I.B.S. software then calculates the minimum number of boiler/burner units that need to be operational to satisfy the building load, imposed upon the plant at that time, and switches the remainder off. There is a terminal connection on the M.M. E.G.A. module for controlling a two port valve that would normally be installed in the boiler's return pipe connection to the common return header. This facility ensures that boilers that are switched "off line" do not contribute return temperature water to the flow header thereby diluting the flow temperature to the building: (See relevant data sheets and drawings showing the control sequence detailed above).

Example:

There are four boilers interconnected as above, each with a heating capacity of 586kw (2 Mbtu.) In the event of each boiler firing 440kW (1.5 Mbtu) (3/4 of it's maximum rate), the No. 1 lead boiler would instruct the No. 4 boiler to shut down and boilers No.s 1, 2 and 3 would adjust their firing rate to maximum. In both cases the boilers are contributing 1758kW (6 Mbtu) to the system but, after intervention of the I.B.S. sequencing software, three boilers only are carrying the load which is a more fuel efficient method of operation.

If the building load continued to decrease the three boilers would reach a point where they were each firing 390kW (1.33 Mbtu) each.

At this point the I.B.S. software would switch off the No. 3 boiler as two boilers would be capable of generating the 1172kW (4 Mbtu) required. When the load on the system increases, the reverse procedure applies, i.e. when, for example, two boilers are firing at near 100% load and the setpoint temperature on either of the modules is not being achieved, the I.B.S. software would switch on a third boiler to assist with the generation of the heat requirement. Any boiler can be nominated "lead" boiler by the connection of an input to the appropriate terminal or by a software instruction via the D.T.I.

Steam Boiler Sequential Control:

When the I.B.S. software control package is applied to steam boilers, it's operation is exactly the same as above but with the additional features and enhancements as explained in the following.

In the case of heating boilers only two states in the control form exist, either on or off. When steam boiler variation of I.B.S. is optioned there are three states which are controlled sequentially.

The first is "on-line", this is when the boiler is operating purely under the control of the M.M. E.G.A. module's internal P.I.D. load controller.

The second state is "Standby Warming": In this case the boiler is operated at a reduced pressure setpoint, and runs for a number of minutes each hour: e.g. if the on-line boiler or boilers are set at a setpoint of 7 bar (100 p.s.i.) the standby warming boiler controls at a setpoint of 5 bar (72 p.s.i.). In this way if the load increases the standby warming boiler can begin to contribute steam quickly. The reduced setpoint is a user variable option in the same way as the normal control pressure setpoint. The number of minutes run time is also adjustable.

The third state is "off-line", this is with the burner shut down and the boiler cold. If the load on the boiler house increases, this boiler would move into a "warming" condition.

Apart from the variations detailed above, the steam sequencing works in precisely the same way as the heating boiler sequencing: The sequencing software package ensures that at all times the minimum number of boilers are operational to satisfy the load imposed on the boiler house.

Note:

It should be appreciated that all data and control variables can be shown on a screen via the addition of the D.T.I. module to the data loop. The screen and keyboard can be sited locally in the boiler house or the whole system can be addressed remotely via the normal telecommunications network.
In the software in the D.T.I. there is a histogram facility which shows the firing rate and state of each boiler in the boiler house.

4.2.1 GUIDE TO COMMISSIONING SEQUENCING

Before any attempt is made to implement Sequencing operation, it is necessary that the fuel/air positions and load index are already entered. Refer to Sections 2 or 3 for Commissioning fuel/air positions.

The load index is implemented using the same ten point load index entry method used for the Flow Metering as detailed in Sections 2 and 3 of the manual. If the Flow Metering has already been optioned and the ten point load index entered then it is not necessary to enter this again. However if it is not entered, proceed as detailed below.

1. Set Option 57 to Value 1 (Refer to Section 2.2.4 - Setting Options).

2. Press ENTER MEMORY whilst 57 and 1 are being displayed in the Air and Required windows respectively.

3. Next time the burner starts the M.M. will automatically go into the ten point load index entry mode. The firing range is automatically divided into ten equal parts. Each of the ten divisions from high to low has a fuel flow value in whatever unit of flow measurement the user requires allocated to it. (All extrapolated fuel flow values between the ten points are calculated from a "best fit" mathematical formula).

4. In this mode the Fuel Position window will show fuel value in degrees angular.

   The Air Position window will be blank.

   The Required window and its associated ▽ △ buttons will be used to enter the fuel flow in the chosen fuel flow unit per minute value.

   Note:

   a) The Actual window confirms to the commissioning engineer which of the 10 points are currently being measured.

      When the positioning motors are moving from one calibrated point to another the Actual display flashes. When it reaches the next point to be calibrated, with a flow value, the display remains steady.

   b) The minimum numerical value for fuel flow that can be entered into memory is 0.01. The maximum numerical value for fuel flow that can be entered into memory is 999.

   c) The values are entered in descending order, i.e. Point No.1 is maximum flame and Point No.10 is at minimum flame.

The 10 sequential points on the load index are allocated automatically by the M.M.

5. When fuel flow has been calculated or read off of a commissioning fuel flow meter the value is entered as detailed in Point No.4.

   The [ENTER MEMORY] button is then pressed and the flow value is passed into the M.M. memory.

6. The above detailed data entry routine is repeated until all 10 points have flow values allocated to them.

7. When the last (10th) point has been entered the M.M. stops the burner and implements the calculations necessary to enable the Load Index to be actioned. Whilst the calculations are being carried out a rolling decimal point is displayed.

8. If it is not required to subsequently display the Flow Metering values, set Option 57 back to value 0.

9. If implementing "hot water" Sequencing set Options as follows ON EACH M.M.:

   Set Option 16 to Value 1 or 3.
   Set Option 33 to identification number accordingly.
   Set Option 34 to the rating of burner.
   Set Option 35 to time between Sequence scans.
   ENSURE OPTION 53 IS SET TO 0.

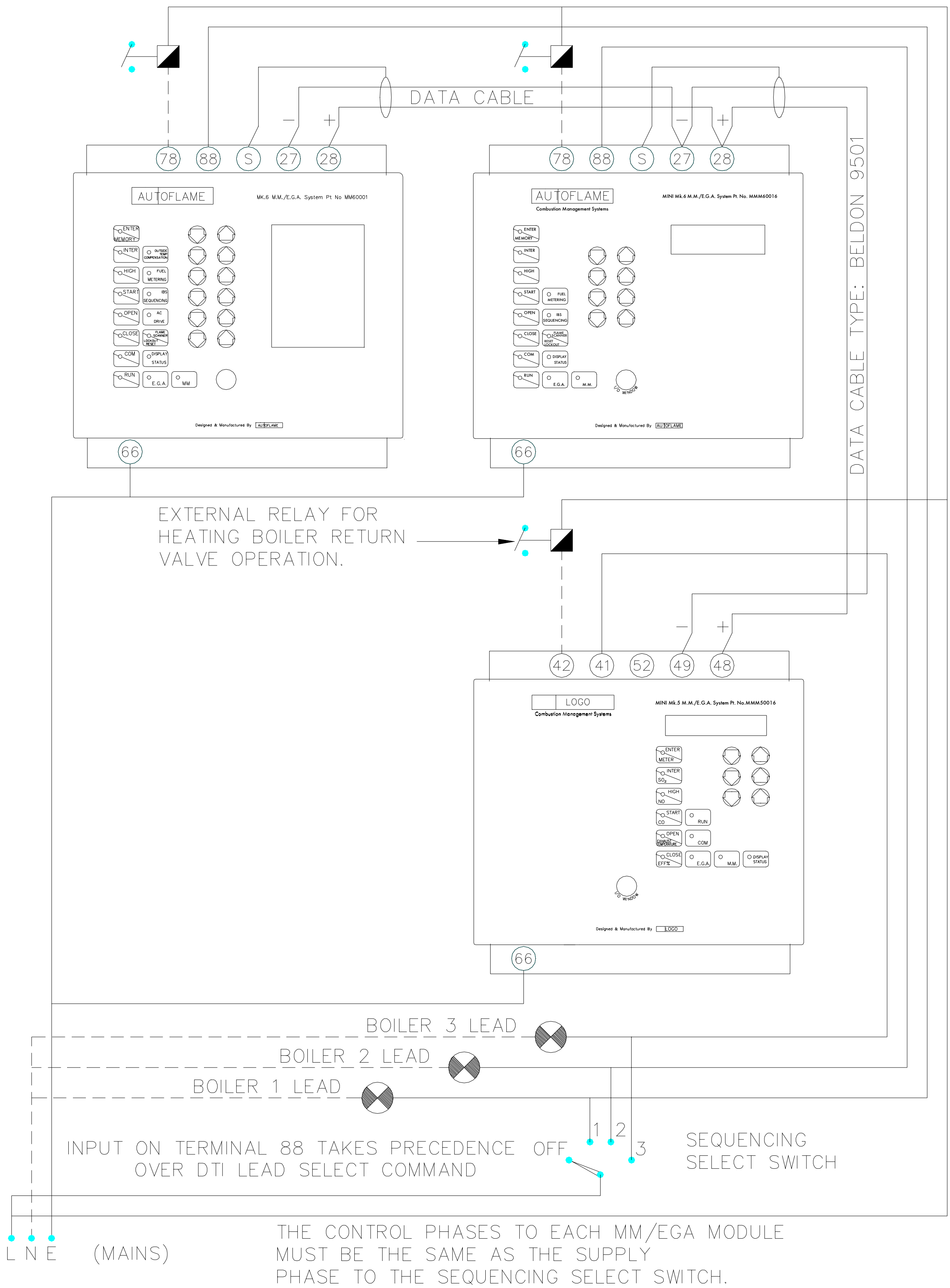
10. If implementing "steam" Sequencing set Options as follows ON EACH M.M.:

   Set Option 16 to Value 1 or 3.
   Set Option 33 to identification number accordingly.
   Set Option 34 to the rating of burner.
   Set Option 35 to time between Sequence scans.
   Set Option 53 to the time required for the boiler to be off.
   Set Option 54 to the time required for the boiler to be on.

Note: Options 53 and 54 are relevant to the "Stand-by Warming" state.
Option 53 is the indication to this M.M. that the Sequencing being done is either hot water or steam (i.e. 0 - Hot water, non zero value - Steam).

4.4 ELECTRICAL SCHEMATICS

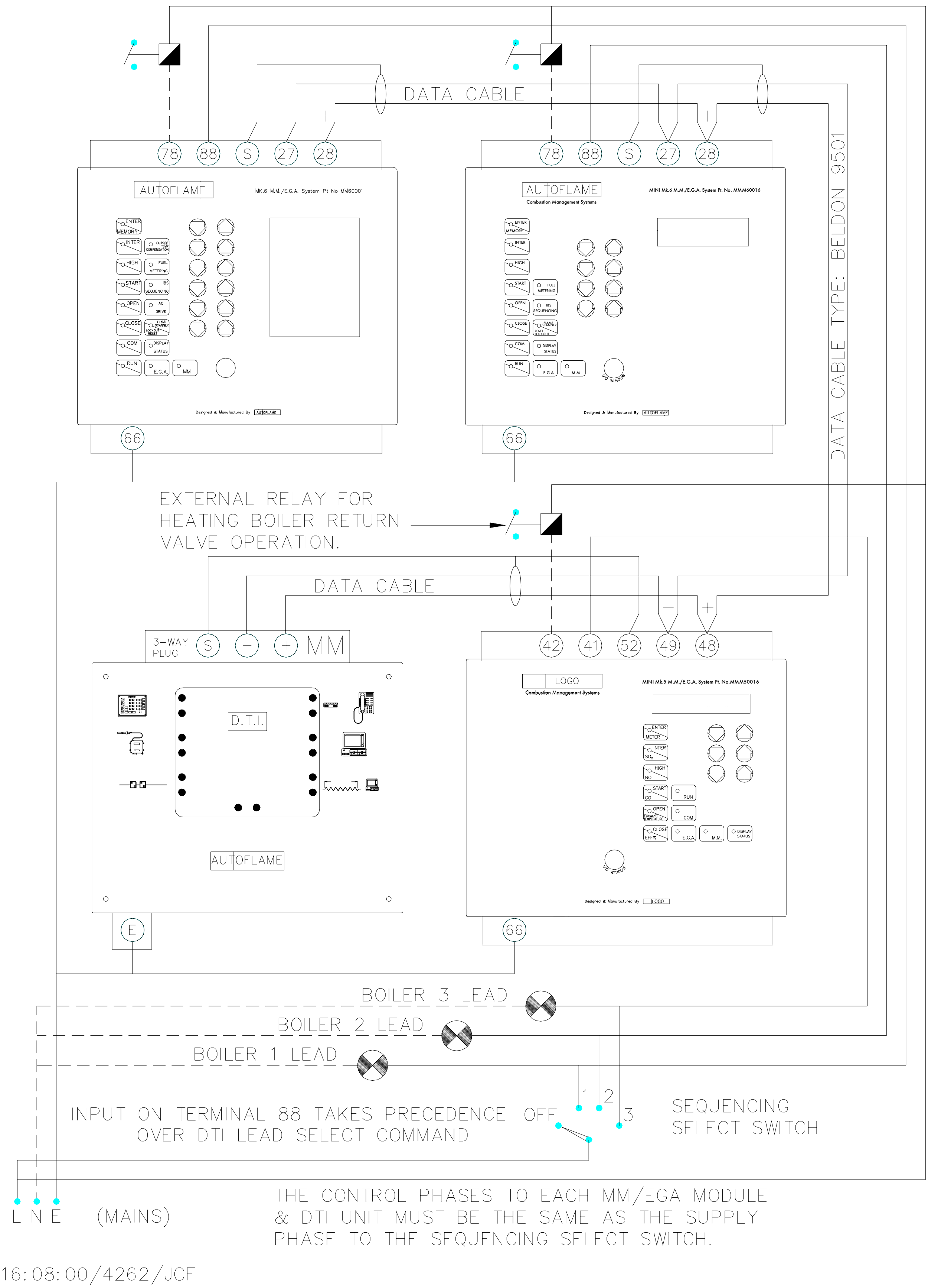
Sequencing Connection Diagram

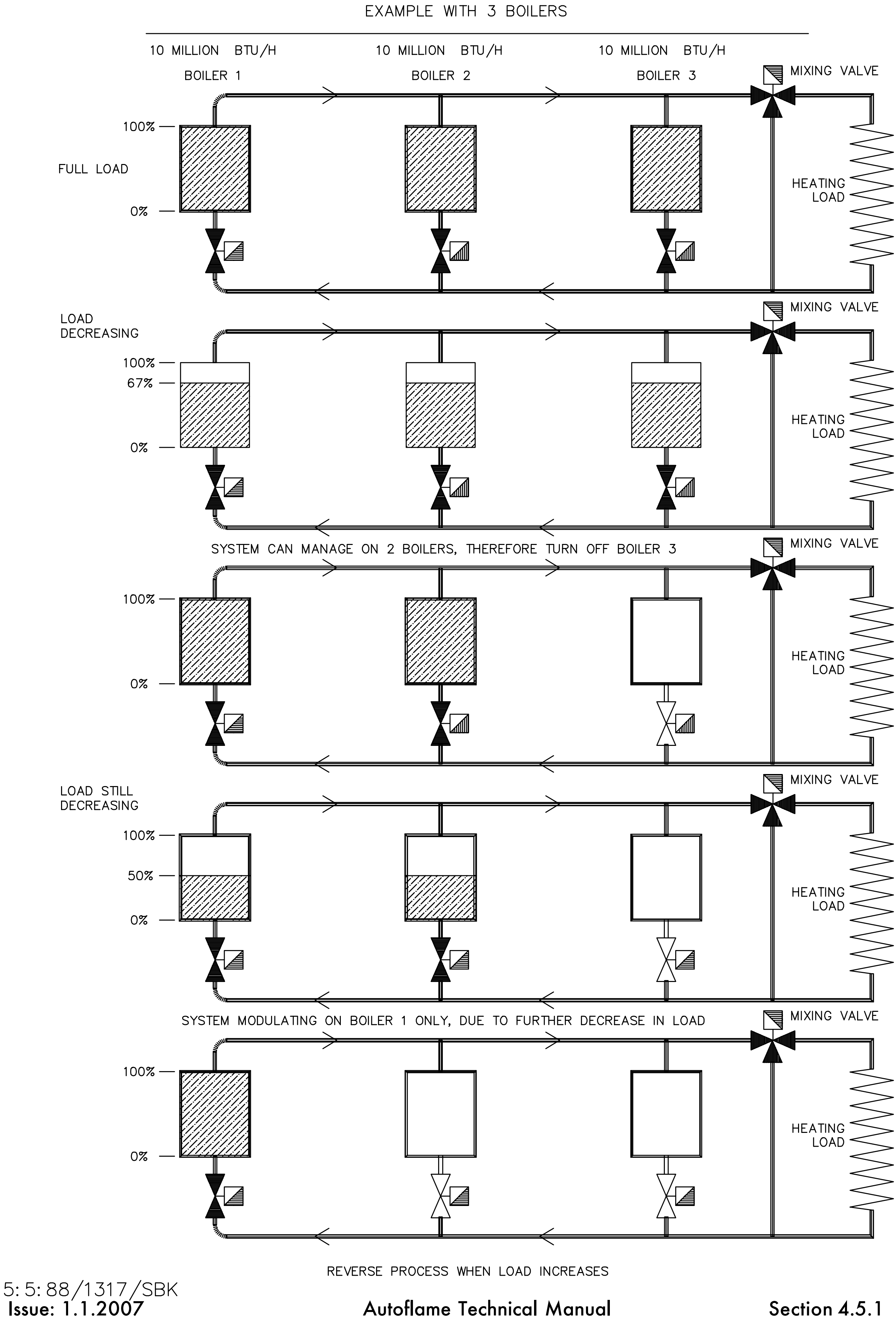


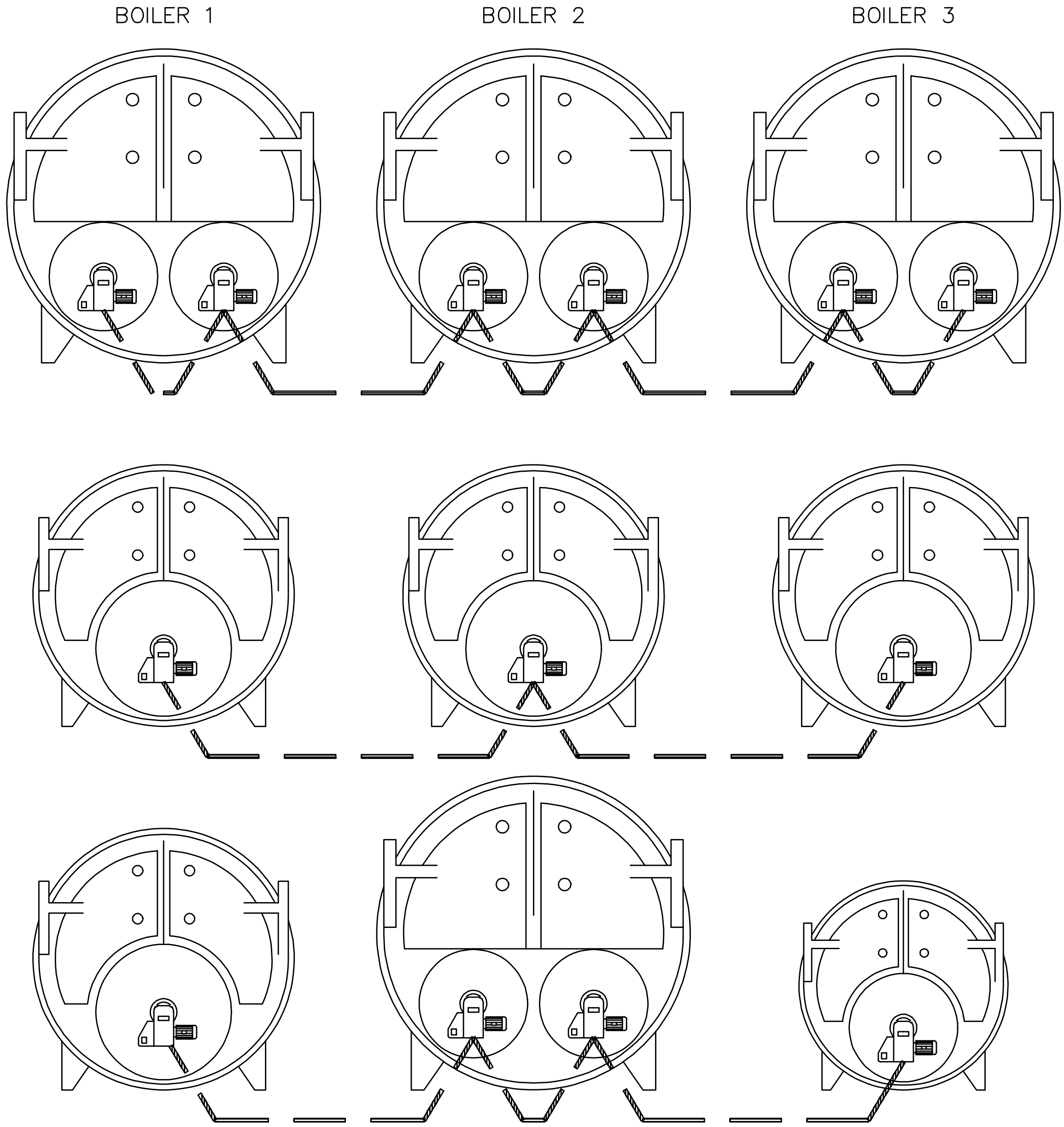
16:08:00/4263/JCF

DTI/Sequencing Connection Diagram

If a voltage on terminal 88 is used to select lead boiler, it will take priority over a lead boiler set via the DTI.




EXAMPLE WITH 3 BOILERS
10 MILLION BTU/H
BOILER 1
10 MILLION BTU/H
BOILER 2
10 MILLION BTU/H
BOILER 3
MIXING VALVE
100%
FULL LOAD
0%
HEATING LOAD
LOAD DECREASING
100%
67%
0%
MIXING VALVE
HEATING LOAD
SYSTEM CAN MANAGE ON 2 BOILERS, THEREFORE TURN OFF BOILER 3
MIXING VALVE
100%
0%
HEATING LOAD
LOAD STILL DECREASING
MIXING VALVE
100%
50%
0%
HEATING LOAD
SYSTEM MODULATING ON BOILER 1 ONLY, DUE TO FURTHER DECREASE IN LOAD
MIXING VALVE
100%
0%
HEATING LOAD
REVERSE PROCESS WHEN LOAD INCREASES
5: 5: 88/1317/SBK

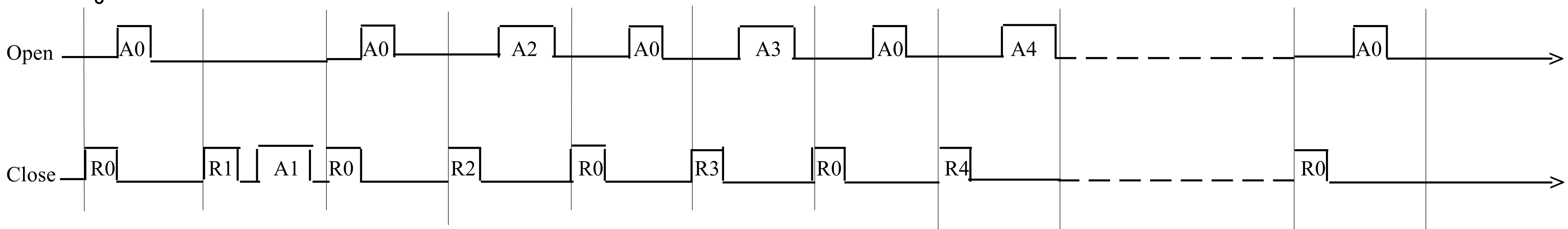


NOTE: TO OPERATE AUTOFLAME SEQUENCING A D.T.I. UNIT IS NOT REQUIRED

5: 5: 88/1319/SBK

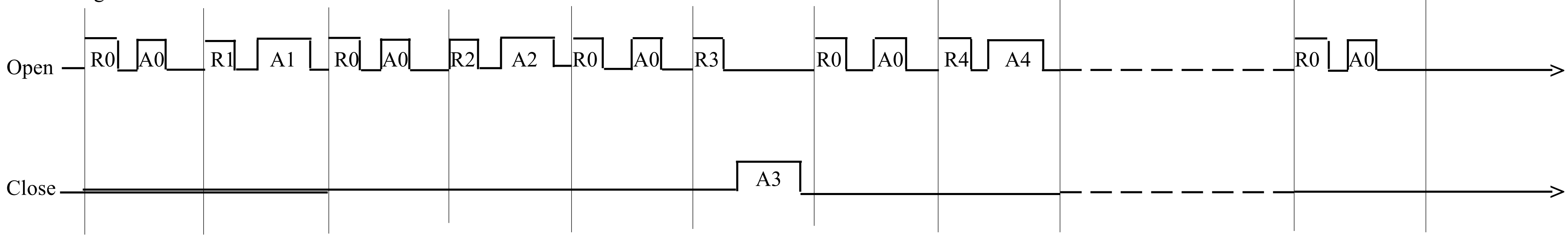
Diagram showing Example of Data Communications with Reference to Flickering L.E.D.s

This is the M.M. that is working communications:
Eg.: - M.M. No. 1.



Same waveforms apply to M.M. No.s 5 to 10.

This is an M.M. that is not working communications.
Eg.: M.M. No. 3.

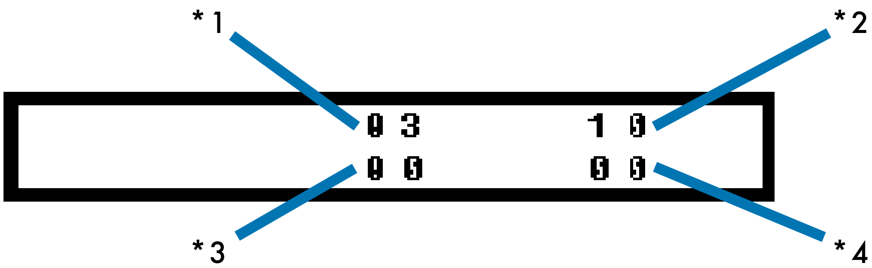


Note:- Only 1 M.M. works the communications.

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

4.5.4 Mini Mk5 Sequencing Status Information

If parameter 32 = 1 then the information below is displayed instead of the Flow Metering Grand Total. (Totalising still continues to work in the background).



Sequencing Status Information

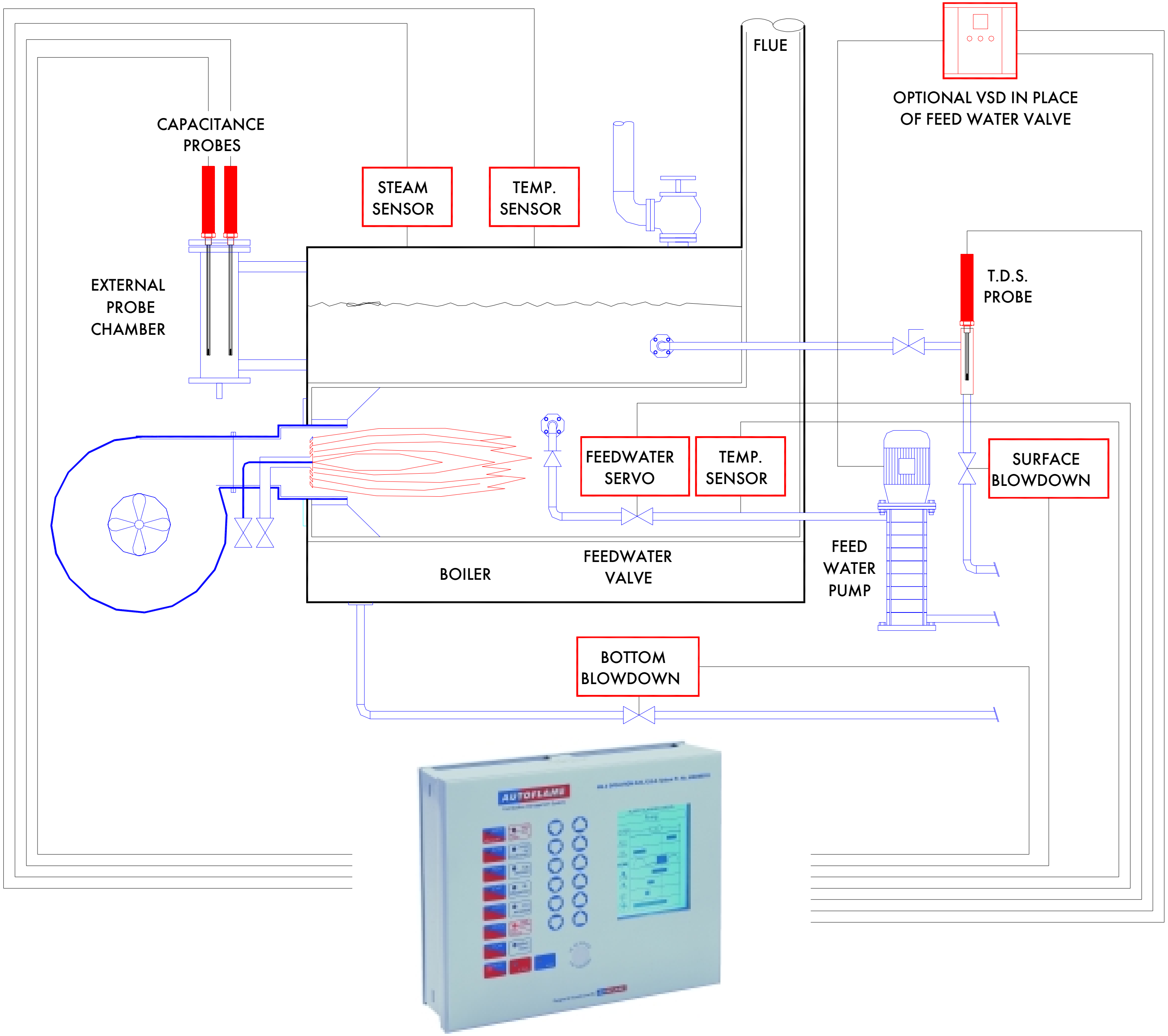
<table>
<tr><td colspan="3">Sequence Code: Steam
0 On
1 Standby/Warming
2 Off
3 Off

Sequence Code: Hot Water
On
Off
Off
Off</td><td>*1</td></tr>
<tr><td>Receiving Sequencing Information
0 = No
1 = Yes</td><td>CR1 Relay Status
0 = Off
1 = On</td><td>Working Communications/ Sequencing
0 = No
1 = Yes</td><td>*2</td></tr>
<tr><td>Unused</td><td>Status of Input 41
0 = 0V AC
1 = 230V AC (110V AC)</td><td>Disabled Status
0 = Enabled
1 = Disabled</td><td>*3</td></tr>
<tr><td colspan="3">Lead Boiler
0 = No Lead Boiler Selected
1 to 10 = Number of Lead Boiler</td><td>*4</td></tr>
</table>

Section 5: Water Level Control and T.D.S. Management

Section 5: Water Level Control And T.D.S. Management

5.1.1 Water Level System Schematic



5.1.2 Method Of Operation & Control Philosophy

The Autoflame level control is probably the safest and most accurate method of controlling water level in a steam boiler.

The system has a typical level control accuracy of + or – 2mm in still water. This accuracy is maintained during normal operation by Autoflame's patented "wave signature and turbulence management" software.

The system safety is guaranteed as the level measurement is managed by two identical capacitance probes both of which measure and control to the level switching points entered at the time of commissioning.

Both probes control typically "high level", "required level", "first low" and "second low". The level reading from both probes are constantly compared and checked against each other and the commissioned data. When controlling required level this data stream is combined with a PI algorithm which controls either the two port feedwater control valve or the variable speed drive to the feed pump. Each probe is self checked for electrical and mechanical integrity by hardware references and self checking software routines. Each probe and its control electronics are compensated for ambient temperature variations and component drift. It can be seen that this methodology guarantees absolute safety of operation.

By our method the probes control the required level by sampling and learning wave signature and of the turbulence within the boiler shell. This "wave signature management" takes into account the changes in burner firing rate and any variance in pressure in the boiler shell. Incorporated within the system hardware are all necessary electronic switching functions to control audible alarms, mute/reset and indication lights required to meet standard North American and European codes. Safety, accuracy and integrity are guaranteed.

5.1.3 Movement Detection Of Water

When the burner is running it is expected that a wave turbulence signature of in excess of 20Hz / 1mm will always be present (due to vibration of thermal energy). Both probes are checked for this value. The default setting is 20Hz, a range of 0-100Hz is possible, if set to '0' this feature is turned off. This feature ensures that either probe cannot read a still water condition when the burner is running. This safety check ensures no static or stuck value can be accepted (i.e probes are being checked that they are in water).

5.1.4 Swell Management

When there is a sudden drop in boiler pressure an increase in water level will be observed. This is due to the steam bubbles in the water expanding and so increasing the water level. It follows that the water feed would then turn off or to a low flow condition. The Autoflame system identifies this ambiguous condition and increases the "required water level" by up to 50% of the distance between normal "required level" and "high water level". When normal conditions are reinstated "required level" returns to the normal setting. This stops spurious shut downs due to 1st low being switched during these transient conditions. The Autoflame system knows what the firing rate and boiler pressure is at any one time and uses this information to identify the above condition. This system is the only water level control in the world that can do this, this feature is one of the main elements in the patent claim.

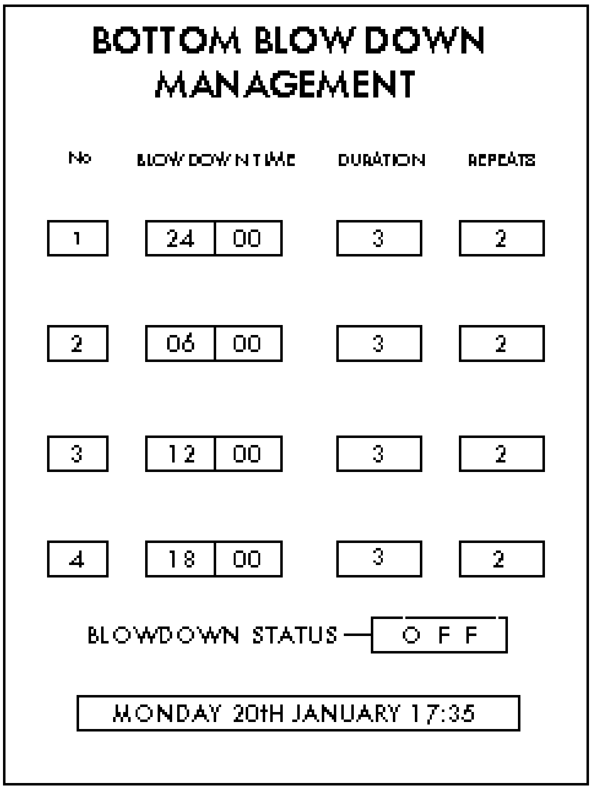
5.2 "2nd Low" Switching Philosophy

"High" "normal level" and "1st low" operate as described in drawing no: 4957 with special software filtering to measure wave turbulence signature.
"2nd low" switches when either probe reads low for 10 seconds. This is an ultimate safety condition and so no filtering software is utilized.

5.3 Bottom Blowdown/External Probe Chamber Blowdown Management

Blowdown Management can either be used for automatic bottom blowdown for the boiler or for automatic blowdown for the external probe chamber.

Up to 4 blowdowns can be accommodated in a 24 hour period. The duration of each blowdown can be programmed into the system, time 0-60 seconds. Each blowdown can be repeated by nominating the number in the last box on the display. In this way a pulsed effect can be implemented for maximum sludge evacuation effect.



Each blowdown time is checked by on board software to ensure that not more than one boiler can blowdown at any one time (when units are data linked). An example of this would be where there are 4 boiler/burner units on a common header with one blowdown receiver.

5.3.1 Shunt Switch Philosophy

The ability to implement a controlled by-pass of the low water cut off's during a manual water column blow down, boiler blowdown or evaporation test has been added to the control features of the Mk6 with water level control. This modification has been incorporated into the confines of the Mk6 keypad so as to avoid the requirement for any additional push buttons/key switches on the control panel. See section 5.10.11 for further details.

5.4 Historical Record Of Events On Autoflame Water Level Control

Within the system there are four dedicated screens for the recording of events relating to water level control & management of the boiler.
Each event is tagged for time, date and the type of incident, i.e high water, 1st low 2nd low and lockout.

WATER LEVEL
ALARM RECORD

Occurred	26 November 2002	12:02:53
		2nd Low
Reset	26 November 2002	13:15:43
Occuued	12 December 2002	09:45:12
		1st Low
Reset	12 December 2002	10:31:17

Tuesday 13 December 2002 14:57:41

Each screen will give details of four events, therefore the last 16 events will be kept in memory. This information can be accessed , monitored and logged via the D.T.I data transfer package.

5.5 First Out Annunciation

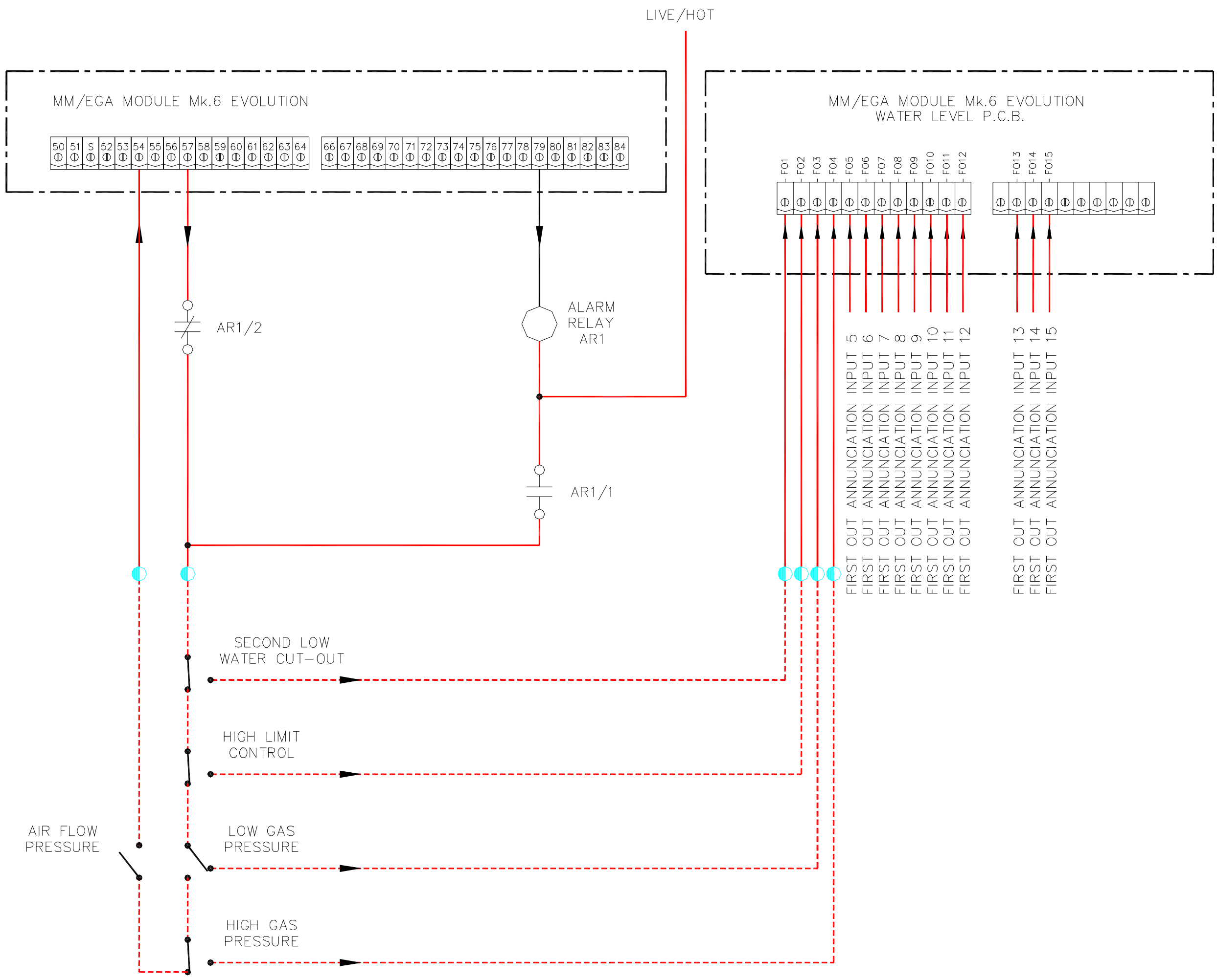
When the control circuit has a long series chain of various thermostat and switching elements, it is sometimes difficult to identify which element has opened the control circuit (see schematic detail under).

The First Out Annunciation can be set in any of the following ways:

Disabled- First Out does not appear on the MM screen (not in use).

Displayed- First Out status is viewed on the MM screen. The burner will continue to operate if a First Out fails.

Enabled- First Out status is viewed on the MM screen. In the event of a First Out the burner will shutdown until the error is corrected.



To assist with resolving the above potential dilemma it is possible to connect the normally open side of each thermostat or switch element to one of the inputs on the first out annunciation water level P.C.B. as shown above.

FIRST OUT STATUS

INPUT	TITLE	STATUS
1	SYSTEM PRESSURE LOW	NORMAL
2	BOILER HIGH LIMIT STAT	FAIL
3	HIGH GAS PRESSURE	NORMAL
4	BOILER FLOW SWITCH	NORMAL
5	FIRE CIRCUIT	NORMAL
6	LOW GAS PRESSURE	NORMAL
7		
8		
9		
10		
11		
12		
13		
14		
15		

It is possible to monitor a maximum of 15 different inputs in a series control circuit. Each input responds to a signal voltage of between 100V to 250Vac. The first element in the loop that changes state will alter from “normal” to “fail” as detailed above. This first out fail status will remain until reset. The title on the above display can contain up to 30 user definable characters. Autoflame supply utility software that can be run on a laptop and upload the user defined titles through the infra red window on the MK6. The above screen is activated/shown on the MK6 Evo when any first out monitored element changes status from “normal” to “fail”. This screen can also be selected at any time by toggling through “water level” screens.

Note:
The lockout failed can be optioned in two alternative modes
A: Manual reset of a alarm/fail condition
B: Automatic reset of a alarm/fail condition

5.5.2 Procedure for wiring First Out Annunciator.

The below diagram shows the correct procedure for wiring a field device to the Autoflame First Out Annunciator. The switch required is a double throw contact, this is one with a Common (c), Normally Closed (nc) and Normally Open (no) contacts. Figure 1 shows the devise being a gas pressure switch, announced on MA1.

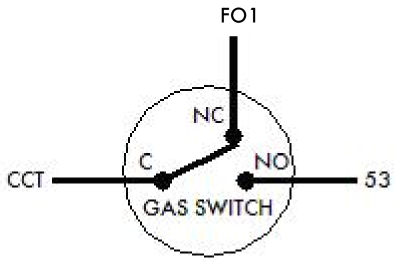


Fig 1. Switch shown in a failed condition.

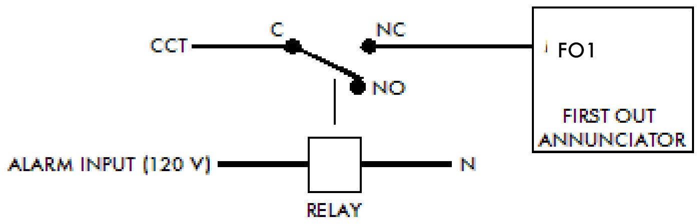
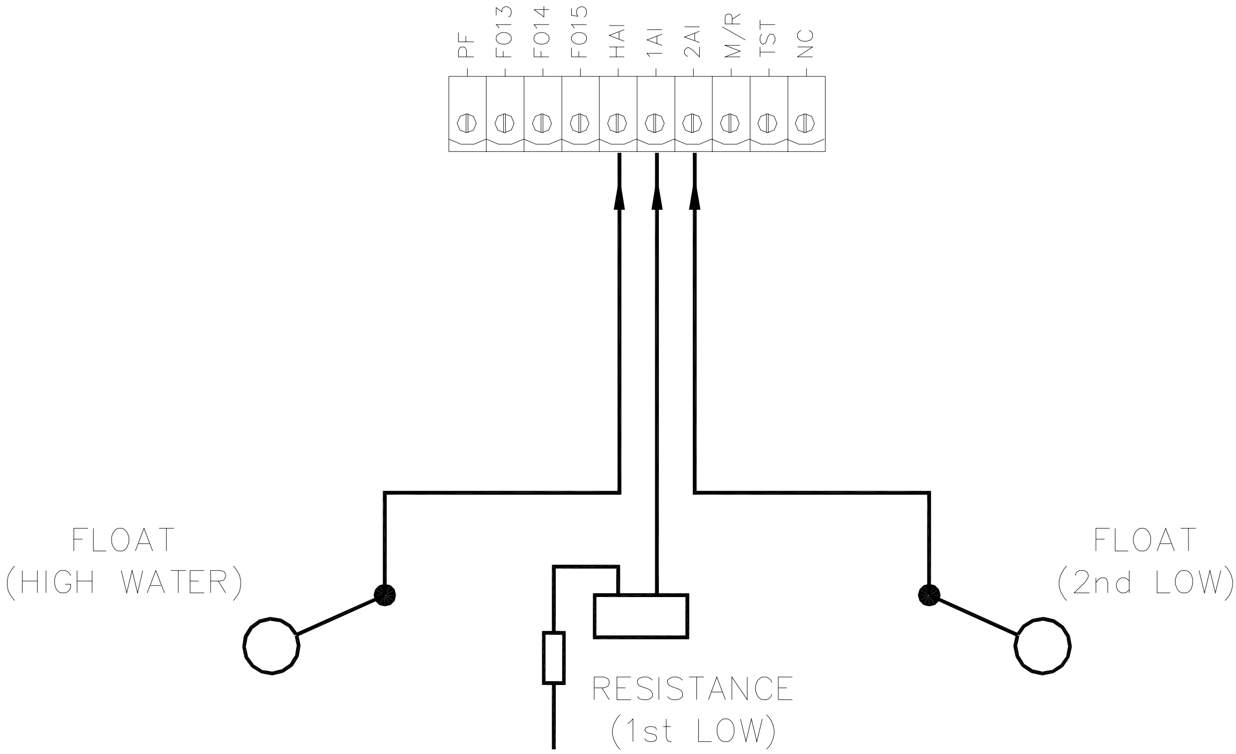


Fig 2. Alarm input shown inverse condition i.e. voltage input signal removed.

5.6 Ability To Integrate Other Water Level Controls Into The Autoflame System

As a confidence building exercise it is sometimes requested by a client that he would also like to retain his old float type level controls as a "belt & braces" solution. Autoflame have allocated 3 terminals to accommodate "high", "1st low" and "2nd low". This is a user selectable facility which can be accessed by the water level "SETUPS" in the MK6 Evo. Shown below is the connection schematic which shows how this can be implemented if required.



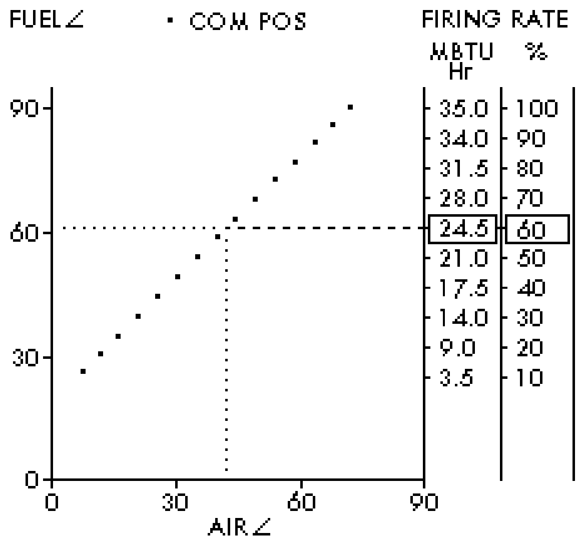
Example of non Autoflame level control elements being incorporated into the Autoflame Water Level Control System.

5.7 Steam Flow Metering

Steam flow metering is a very commercially attractive capability that exists within the Autoflame level control package. This unique idea for steam flow measurement and metering has been granted an international patent for the engineering concepts involved. By the addition of two temperature detectors it is possible to extrapolate accurately steam flow from a boiler both as an instantaneous value and a totalized amount over time. This means that by the addition in price of two temperature sensors the end client can be offered the benefit of a full steam flow metering package. This avoids the cost of an expensive steam flow meter and orifice plate that is typically accurate at the higher firing rates only. An explanation of how this is achieved is detailed below.

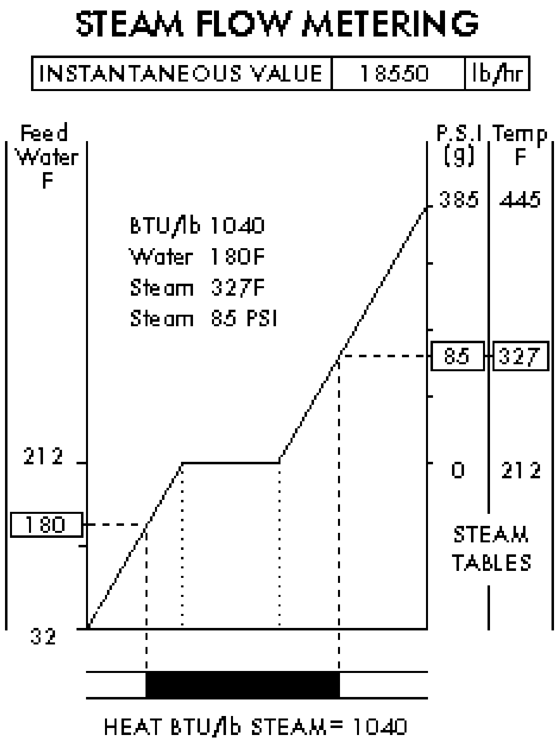
FUEL FLOW METERING

INSTANTANEOUS VALUE	24.5	MBTU/Hr
TOTALIZED	25425	MBTU
FUEL	NATURAL GAS (1000 btu/Cuft)	



From Fuel Flow Metering it can be seen that the fuel gross calorific heat input is 24.5 million BTU/hr (example).

Therefore 24,500,00 BTU/hr (gross fuel calorific value)
less 245,000 BTU/hr (1% loss standing losses)
less 4,365,900 BTU/hr (18% stack loss E.G.A)
equals 19,889,100 BTU/hr (net calorific value of the fuel into the wet side of the boiler).



From Steam Flow Metering it is possible to calculate the amount of heat necessary to raise 1lb of water from 180 degrees F (feed water temp) to 85 p.s.i G steam at 327 degrees F. From standard steam tables held in memory the amount of heat required is calculated to be 1040 BTU. This figure is the latent heat of liquid into steam (gas) plus the sensible heat components.
Note feed water temperature and steam temperature are measured by the systems temperature sensors.

$$\frac{19{,}889{,}100 \text{ BTU}}{1040 \text{ BTU/hr of steam}} = 19{,}124 \text{ lb/hr}$$

If blow down losses are calculated to be 3% (example) the system allows this correction to be entered.

19,124 x 0.97 = 18,550 lbs/hr Steam Flow.

Instantaneous values are calculated using the above. Totalized values for steam flow use the same mechanism but sample values are taken every 5 seconds and integrated over the run time of the boiler burner system.

5.7.1.1 Steam Flow Metering Incorporating a Deaerator

A common practice in steam generation is the use of a "deaerator" to remove the oxygen from the feed water and hence reduce the incidence of oxygen corrosion in the boiler, steam & condensate pipe work.

The principle of a deaerator is to mix the make-up water with the condensate return and live steam direct from the boiler in a tank. Flash steam may also be directed back to the tank. The effect is to mechanically "scrub" the oxygen from the feed water and also to preheat it before it is pumped to the boiler.

In the system as set out above it is no longer valid to measure the temperature of the feed water just before it enters the boiler as the inlet temperature for the "steam meter" calculation. This water has already been preheated by steam from the boiler and therefore this additional energy should not be taken into the software calculation.

The solution is to treat the boiler and deaerator as one system. The energy into the system is supplied by the burner and the inlet temperature is the "weighted average" of the condensate return temperature and makeup water temperature. The outlet steam temperature is measured by a temperature sensor in exactly the same way as in a system without a deaerator.

5.7.1.2 Steam Flow Measurement For Multi Boilers With Steam Deaerators

1) A flow meter is fitted into the condensate return and into the cold water makeup pipelines. A PT1000 temperature detector is fitted into both condensate and cold water make up pipelines (T1 & T1A).

2) Each flow meter has a 4-20mA output. In each case 4mA equals '0' gallons per minute or litres per second, 20mA equals the maximum range of the meter. The maximum range must be entered into the MK6 Evo via setup options (GPM or L/sec)

3) From the information /data collected as in '2' the "weighted" temperature of the feed water to the boilers can be calculated. The "weighted" temperature of the feed water is distributed to each of the MK6 Evo's (as in our example dwg no: 5211). The weighted temperature is sent digitally via the RS485 data transmission line to each MM MK6 Evo (terminals 27 & 28).

4) Each Water Level P.C.B. has its own steam temperature sensor mounted at the steam outlet on each boiler (T2) see dwg no: 5211.

5) It is important that the No:1 MK6 Evo with Water Level P.C.B. is not powered down as the data transmission would 'stop'. If the No:1 is switched off out of necessity then the default "weighted" value temperature entered at the time of commissioning would be used until the No:1 and its data transmission were reinstated. In this way maximum accuracy in the steam flow rate calculation can be guaranteed.

When "Imperial" units are selected (US spec) the following units of measurement are used:

Steam Flow = lb/hr
Liquid Flow = U.S. Gallons/min
Temperature = Degrees F
Heat Flow = BTU/hr
Heat = BTU

When "Metric" units are selected (Euro spec) the following units of measurement are used:

Steam Flow = Kg/hr
Liquid Flow = Litres/sec
Temperature = Degrees C
Heat Flow = MW
Heat = KJ

5.7.2 Steam Flow Metering Incorporating a Deaerator, Calculations

1: First the percentage "Make up" in the "Feed water" must be calculated.

Where %Mu = % Cold make up water
V1 = Volume of condensate return water
V2 = Volume of cold make up water

$$\%Mu = \frac{100 \times V2}{(V2 + V1)}$$

Example: 1
Steam boiler with a volume of condensate return at 40 GPM and make up water at 8 GPM

$$\text{Make up \%} = \frac{100 \times 8}{(8 + 40)} = 16.7\%$$

2: To calculate the second part to establish the "Weighted Average Temperature" the following equation is used.

Where T ave = Weighted Average temperature
T1A = Temperature of condensate
T1 = Temperature of make up water
%Mu = Percentage of make up water

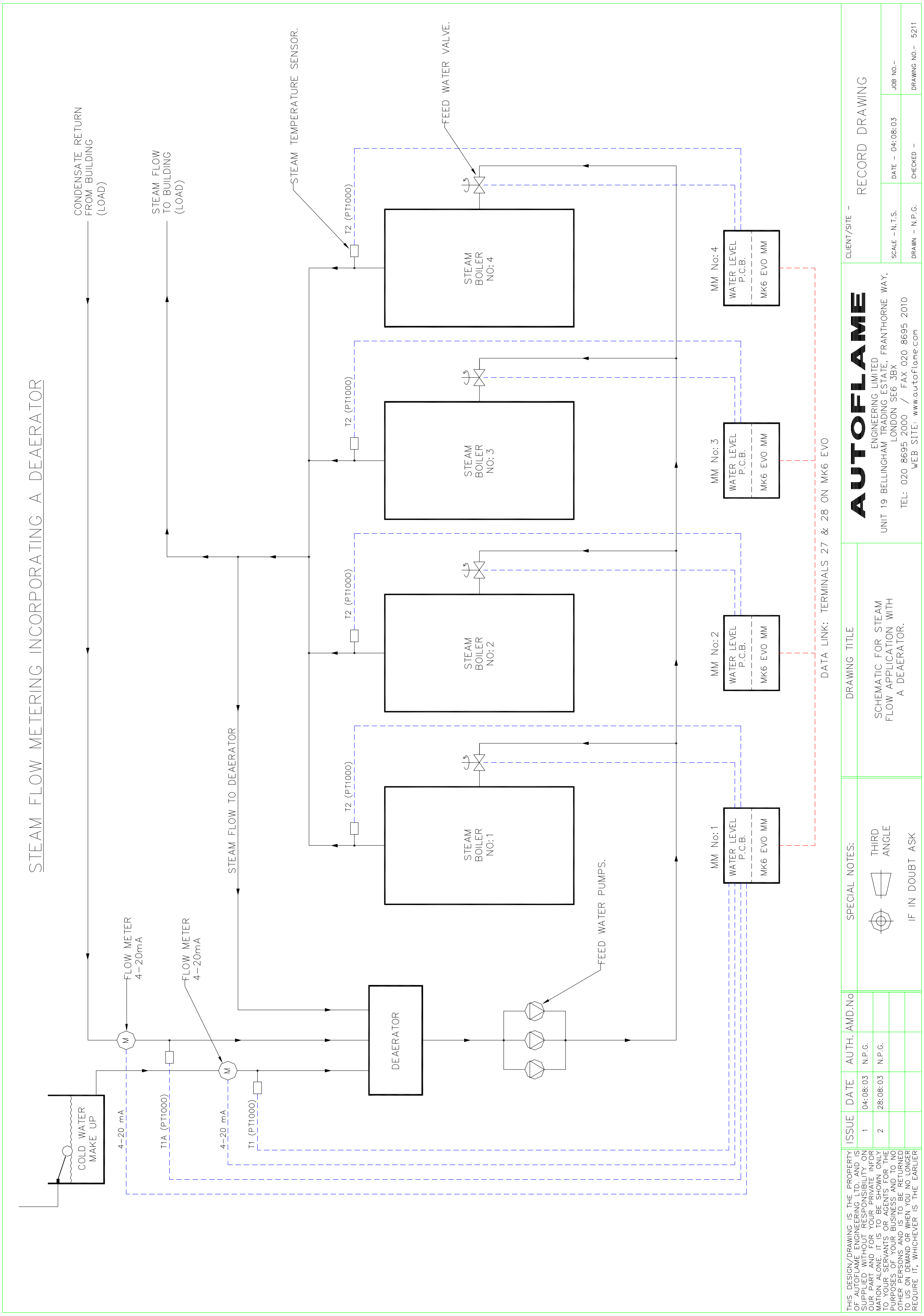
$$T\ ave = T1A - \frac{(\%Mu \times (T1A - T1))}{100}$$

Example: 2
Steam boiler with condensate return temperature of 176°F and a make up water temperature of 41°F . From the above example (1) the make up percentage is 16.7%

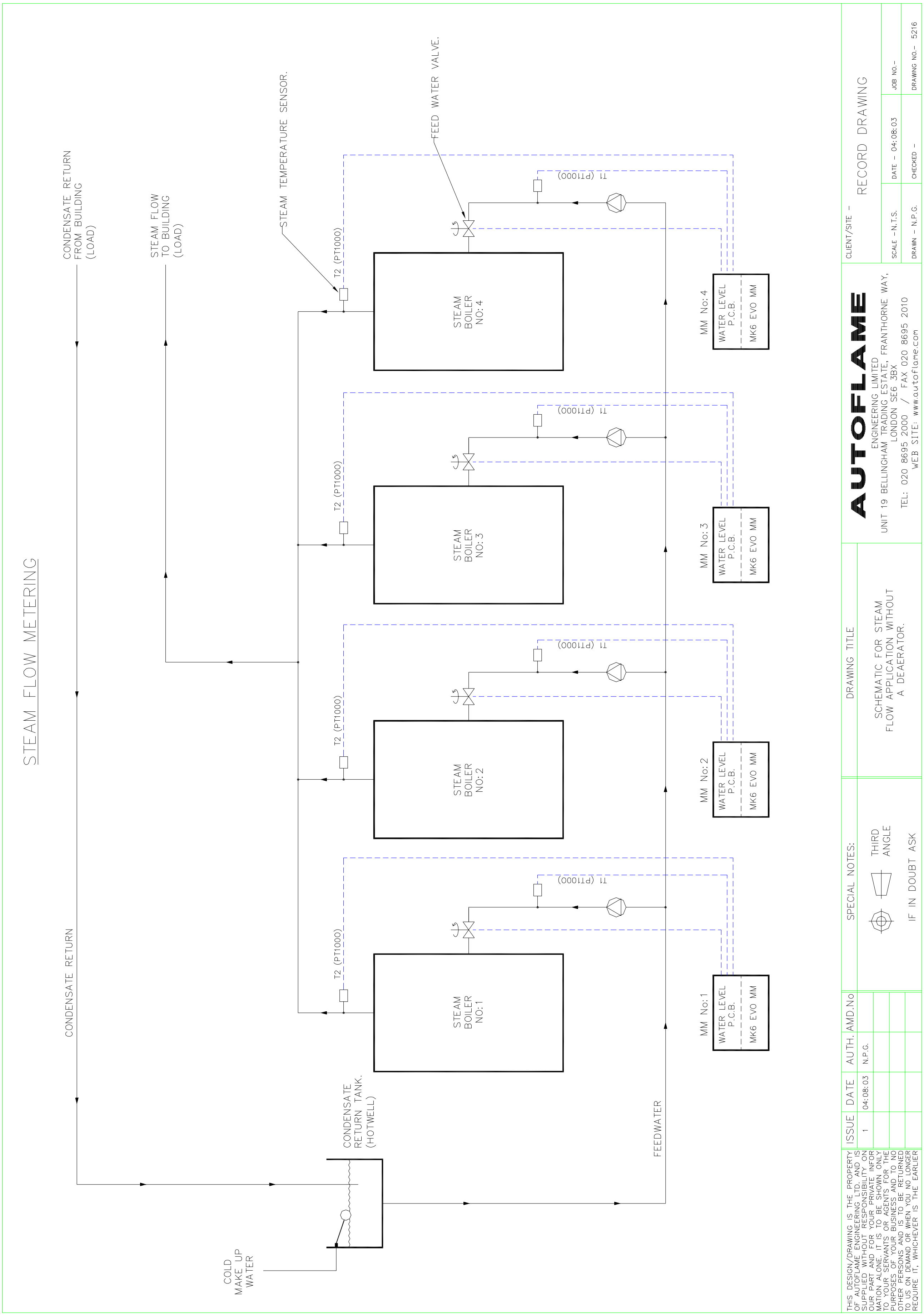
$$\text{Weighted average} = 176 - \frac{(16.7 \times (176 - 41))}{100} = 153.4°F$$

To implement the above control form the following calculations have been imbedded in the revised software to obtain the "Weighted Average Temperature" (T ave).

5.7.3 Schematic For Steam Flow Application With A Deaerator



5.7.4 Schematic For Steam Flow Application Without A Deaerator



5.8 Heat Flow & Hot Water Flow Metering

Heat Flow Metering is simply measuring the amount of heat being transferred to the water by a hot water boiler. If we know the stack losses and the standing losses of the boiler at any moment then whatever energy is left over must be going into the water.

From the EGA stack losses = 100 – combustion efficiency.

Radiation losses are specific to the boiler, 1% radiation losses are typical for a packaged boiler operating at maximum continuous rating. The loss is constant regardless of boiler output so at 50% firing rate it would be 2% of the energy input.
The total heat in at any time is given by the heat flow metering so we can calculate the instantaneous heat going into water. By integrating these values we can get a totalised value.
Set out below is an example together with relevant calculation, these calculations are embedded in to the software in the MK6 MM Evo version of the water level PCB

5.8.1 Calculation for Heat Output & Volume Flow

Example
A boiler firing at 75% has an input of 20,472,840 BTU/Hr (6MW). The temperature of the flow (MM Temperature detector) out is 185°F and the temperature of the return T1 is 167°F. The combustion efficiency is 82% (MK6 EGA), Radiation losses are 1% at maximum continuous rating

Description	Imperial units	Metric Units
Firing rate	75%	75%
Input	20.47 MMBTU/HR	6MW
Return Temperature	167°F	75°C
Flow Temperature	185°F	85°C
Sp Ht water	1.0 BTU/lb/°F	4.18KJ/KG/°C
Density Water	60.68lb/cuft @176°F	972 kg M^3 @80°C
Combustion Efficiency	82%	82%

$$\text{Efficiency } \% = 100 - \left(\text{stack loss} + \left(\frac{\text{radiation losses} \times 100}{75\%}\right)\right)$$

$$\text{Therefore Efficiency} = 100 - \left(18\% + \left(\frac{1\% \times 100}{75\%}\right)\right) = 80.67\%$$

$$\text{Useful heat into water} = \text{Total Heat} \times \frac{\text{Efficiency}}{100}$$

5.8.1 Heat Flow & Hot Water Flow Metering

Therefore U.H.W = $20{,}472{,}840 \times \frac{80.67}{100} = 16{,}515{,}440$ BTU Hr

Volume Flow in lbs hr = $\dfrac{\text{Useful heat M BTU Hr}}{\text{SP Ht BTU /lb/°F x (Flow Temp – Return Temp)}}$

Therefore lbs hr = $\dfrac{16{,}515{,}440}{1 \times (185 - 167)} = 917{,}397$ lb Hr

Note: - Density of water at 176°F = 60.68lbs cu ft

Therefore Cu ft Hr = $\dfrac{917{,}397}{60.68} = 15{,}118$ cu ft Hr

Note: - 1 cu ft Hr = 0.124676 US G.P.M

Therefore 15118 x 0.124676 = 1884.85 US G.P.M

Volume flow in US G.P.M = 1884.85

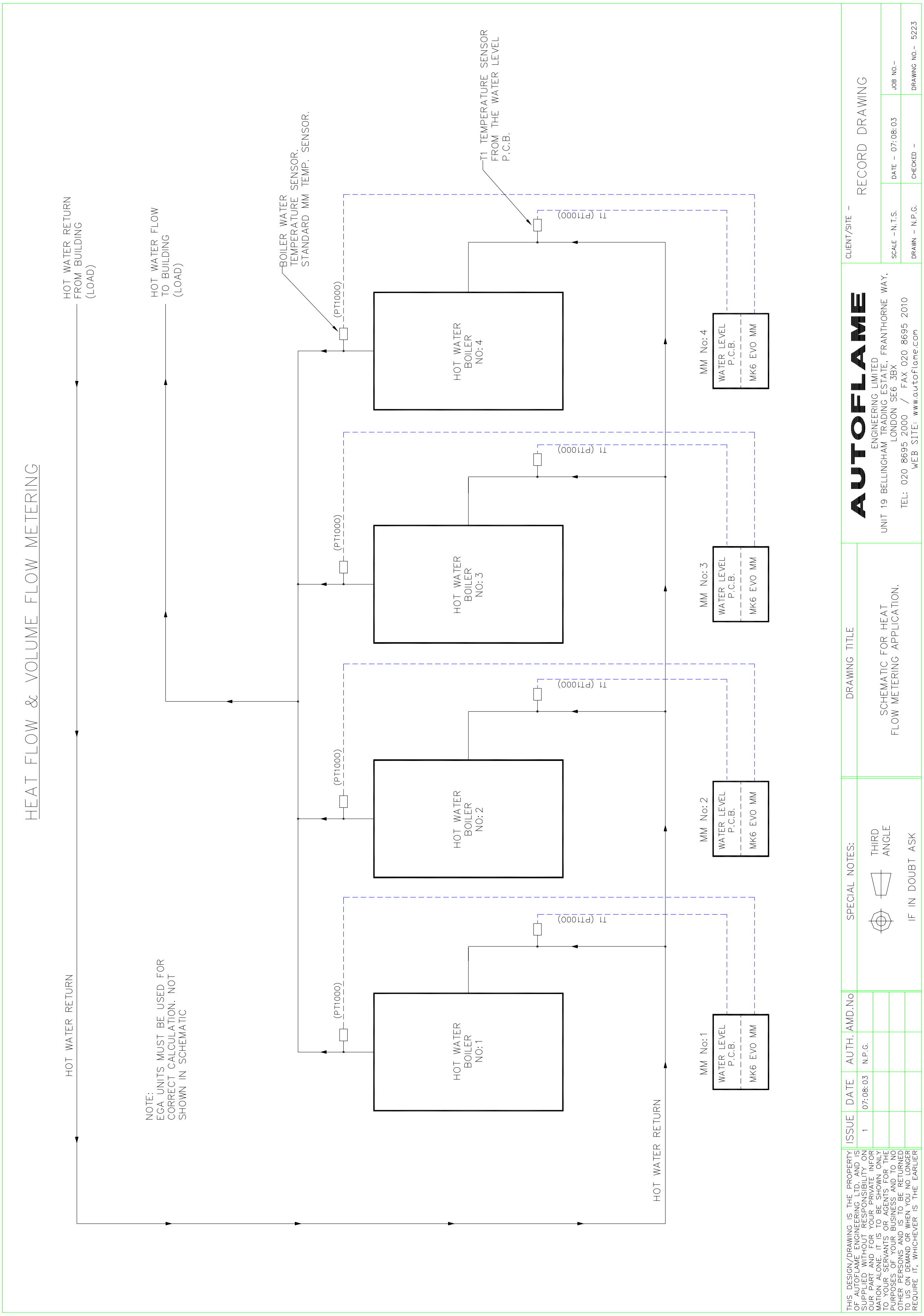
It can be seen from the above that by adding the water level P.C.B and a return temperature detector to the MK6 system that you get the following additional useful information.

"Useful heat into water" (BTU/hr) &
"Volume flow" (US G.P.M)

This is displayed on the screen of the MK6 EVO.

The direct benefit is that you have a "Heat meter" and "Flow meter" for any hot water boiler.

5.8.2 Schematic For Heat Flow Metering Application

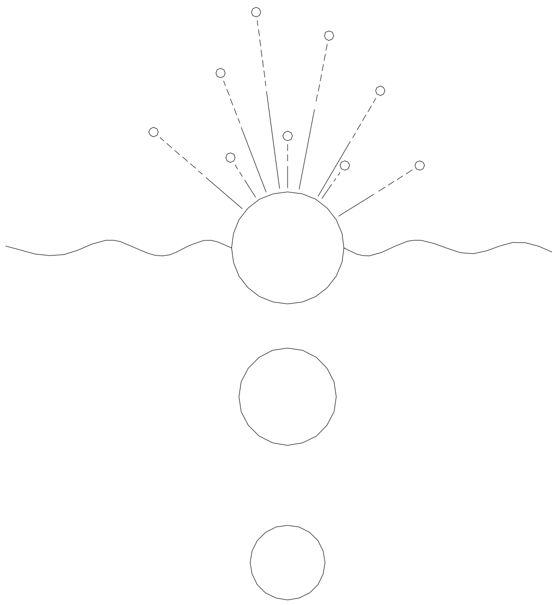


5.9.1 Wave Signature Explanation

Wave signature in a boiler is a combination of the following main components.

5.9.1.1 Breaking Bubble/Spray

Bubbles of steam breaking at the boiler water level surface. These precipitate little droplets as spray several inches above the water surface in an upwards direction.

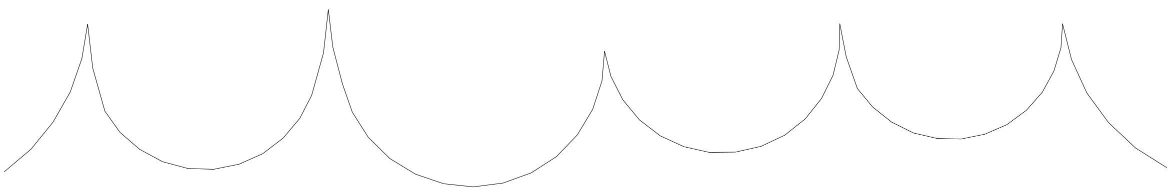


Surface tension of bubble bursts releasing droplets.

The droplets tend to coat the surface of the level probe which in turn will read as an increase in the water level. This situation is largely avoided by fitting anti surge pots inside the boiler shell (see section 5.9.7).
When the probes are fitted externally to the boiler shell this situation can not arise (see section 5.9.9).

5.9.1.2 Thermal Currents (heat energy in water)

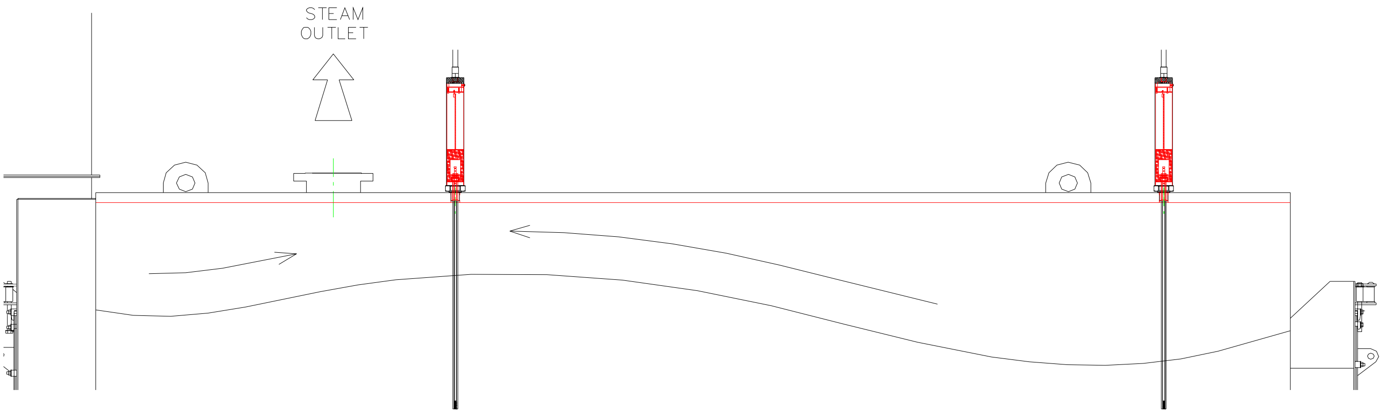
Many bubbles breaking simultaneously and thermal currents from the furnace tube and 2nd, 3rd, 4th pass smoke tube create their own turbulence/wave signature on the surface of the water. The typical result is short choppy/peaky wave patterns as below.



A second set of turbulence is the wave reflections off the sides of the boiler. The whole of the above is largely attenuated away by mounting the probes externally to the main boiler shell in a separate pot or pots (see section 5.9.9)

5.9.1.3 Steam Flow Induced Surge

When the boiler is producing high quantities of steam, this steam is travelling over the surface and can produce swells and surging motions (longwave).



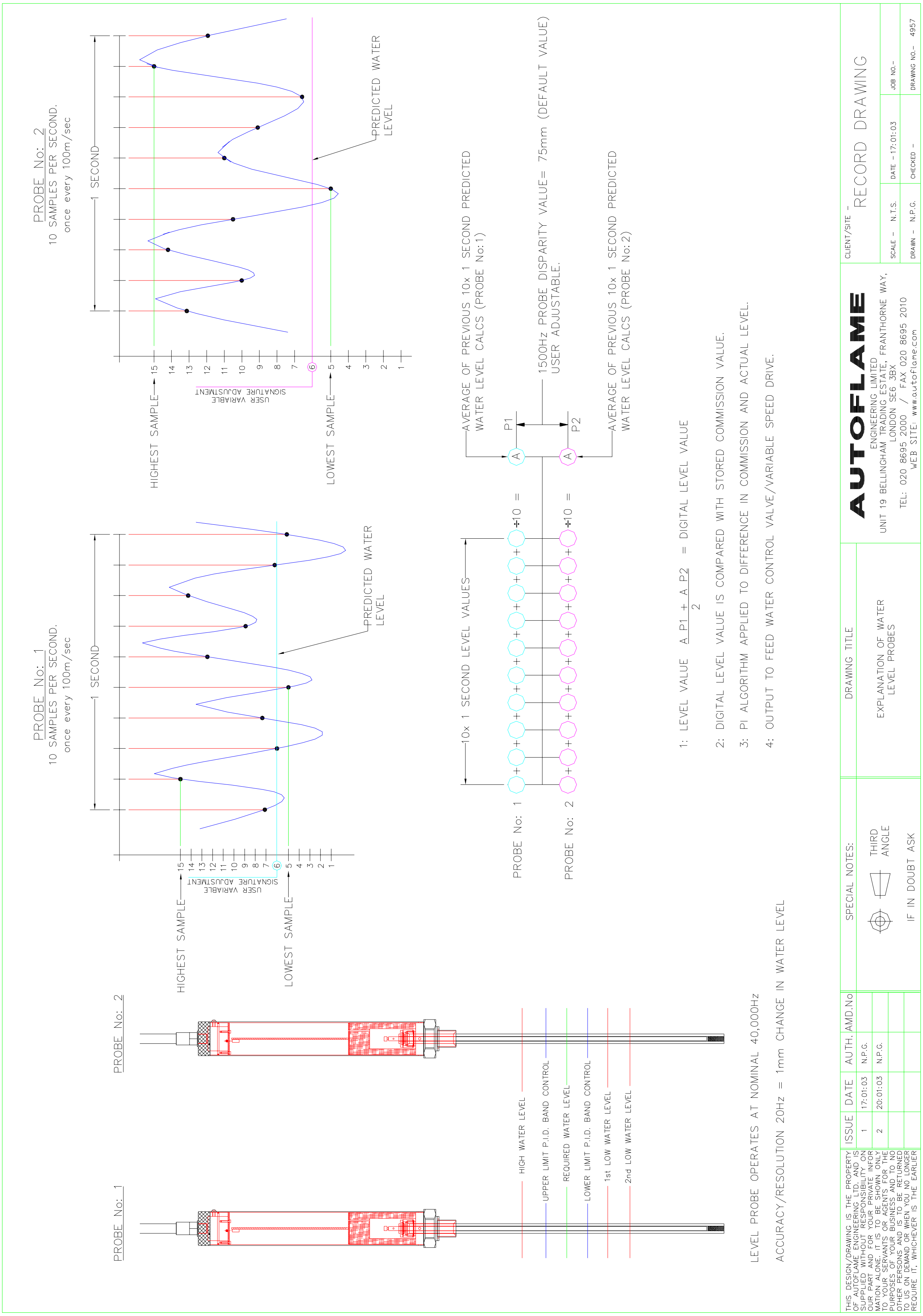
The above situation will be shown in high relief when the steam outlet is at one end of the boiler and one level probe is sited adjacent to the steam outlet and the second probe is sited at the opposite end of the boiler. The user adjustable probe disparity value may have to be increased to take this situation into account.

5.9.1.4 Foaming

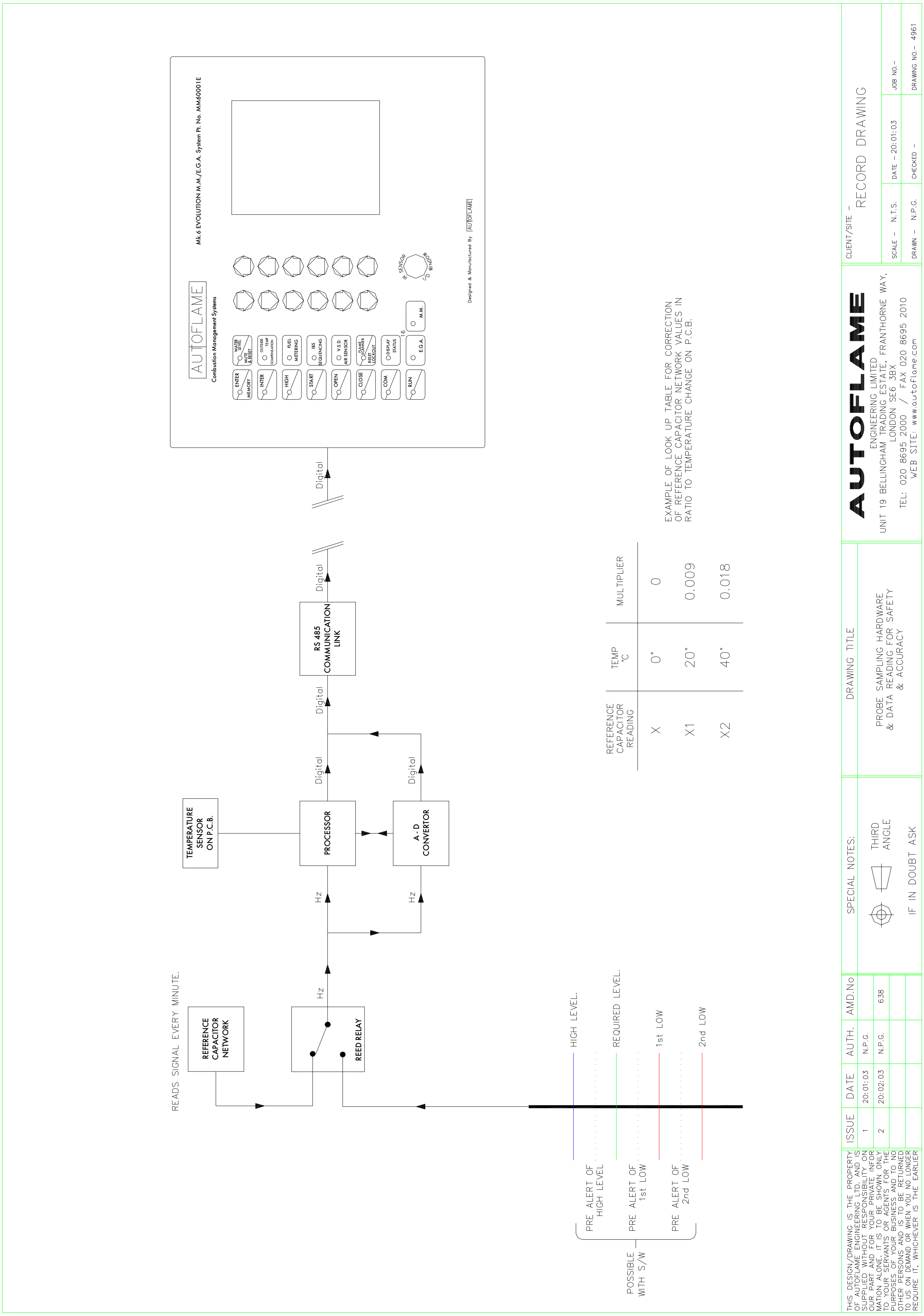
Foaming on the surface of the boiler is brought about by a less than adequate blow down regime and/or not controlling and managing T.D.S in the appropriate manner. Incorrect or insuffcient water treatment will exacerbate all of the above. Foaming will read as a step increase in water level. This situation should only ever occur in a badly managed boiler plant.

It can be seen from the above examples that wave signature will tend to be very installation specific. It is driven by boiler size, water treatment regime, position of heat transfer surface relative to water level and the load pattern imposed on boiler.
The Autoflame system takes into account all of these variables and uses them to create a control algorithm that produces perfect level control with absolute safety.

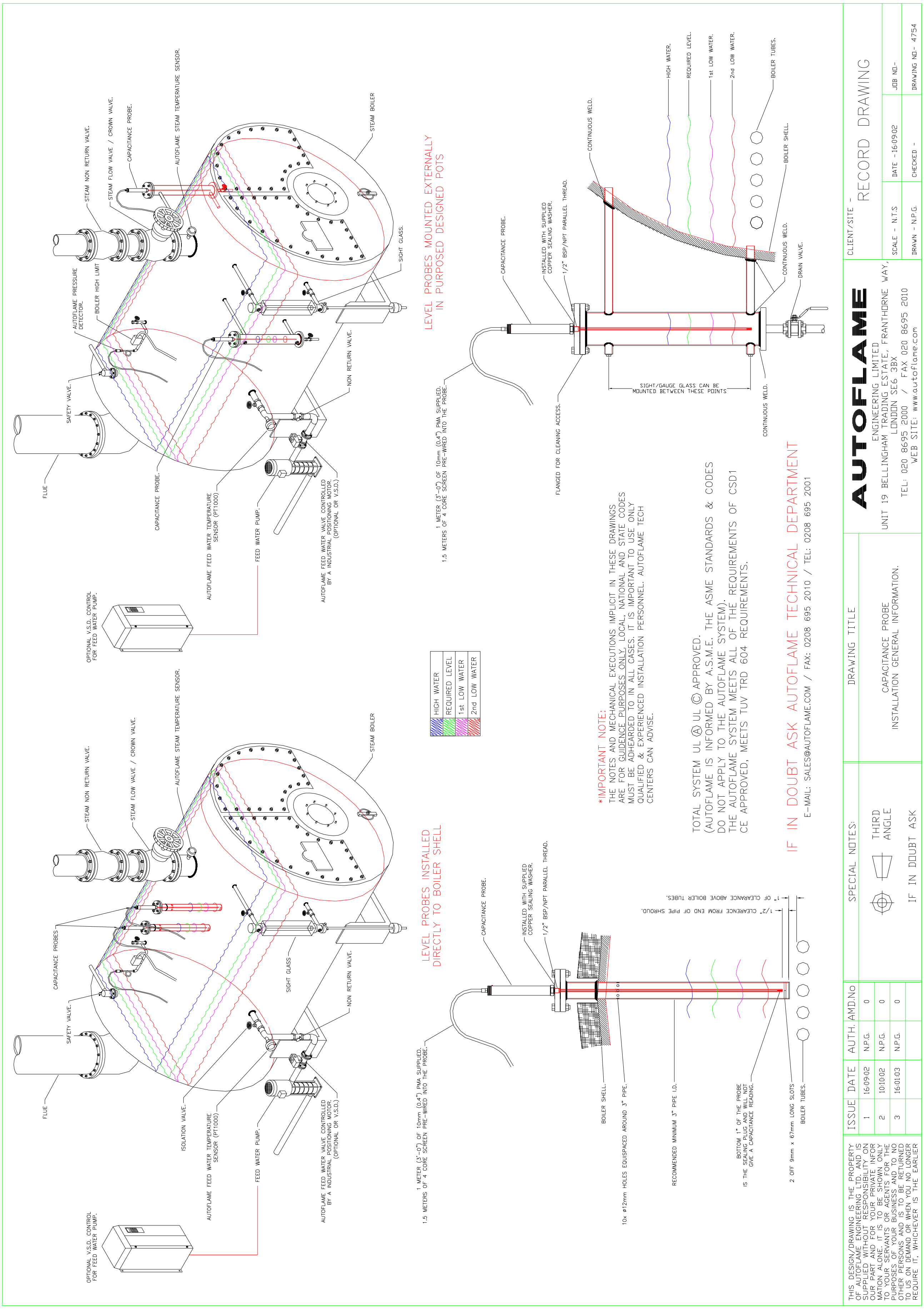
5.9.2 Schematic Explanation Of The Water Level Probe Operation



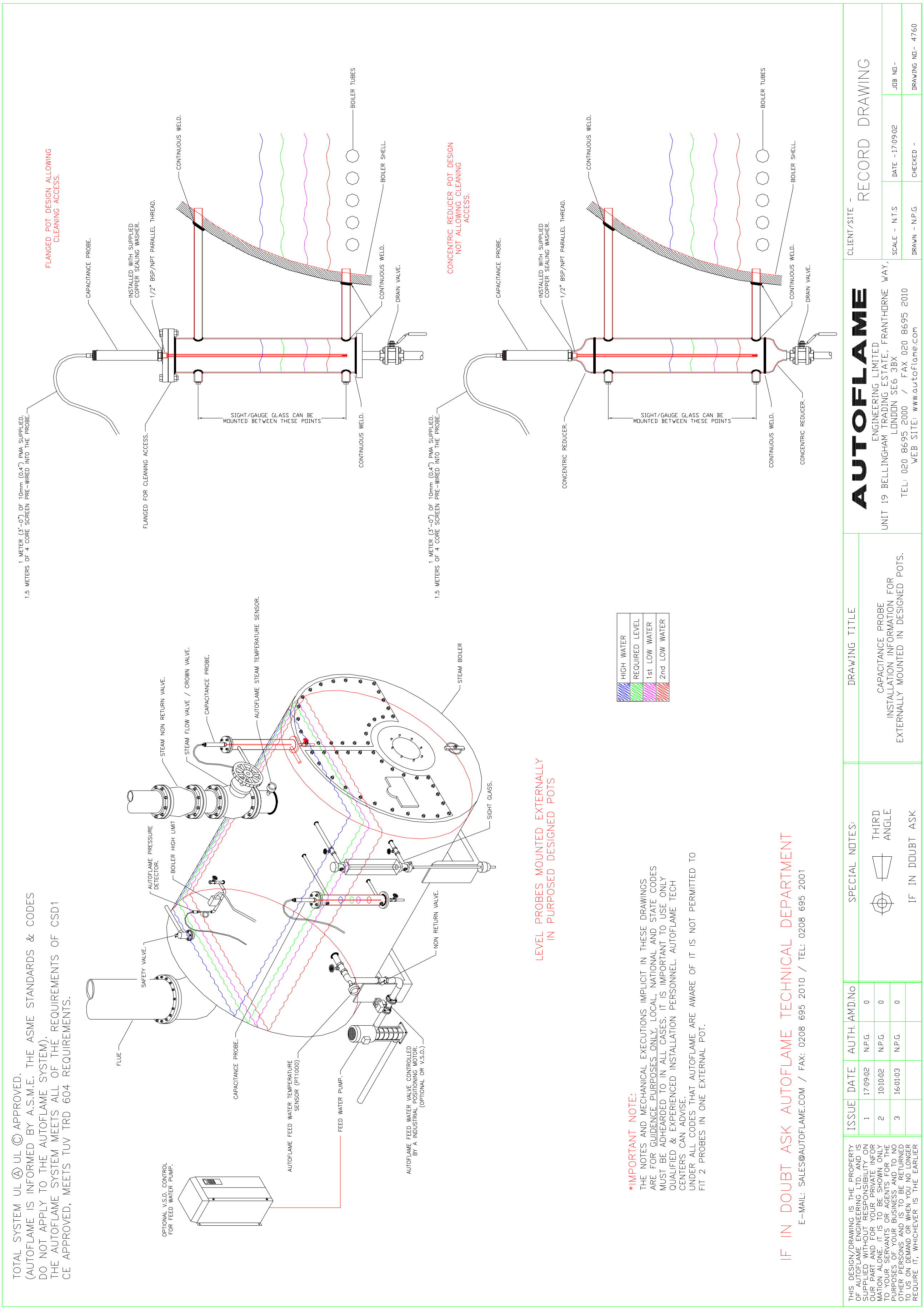
5.9.3 Schematic Of The Probe Sampling Hardware



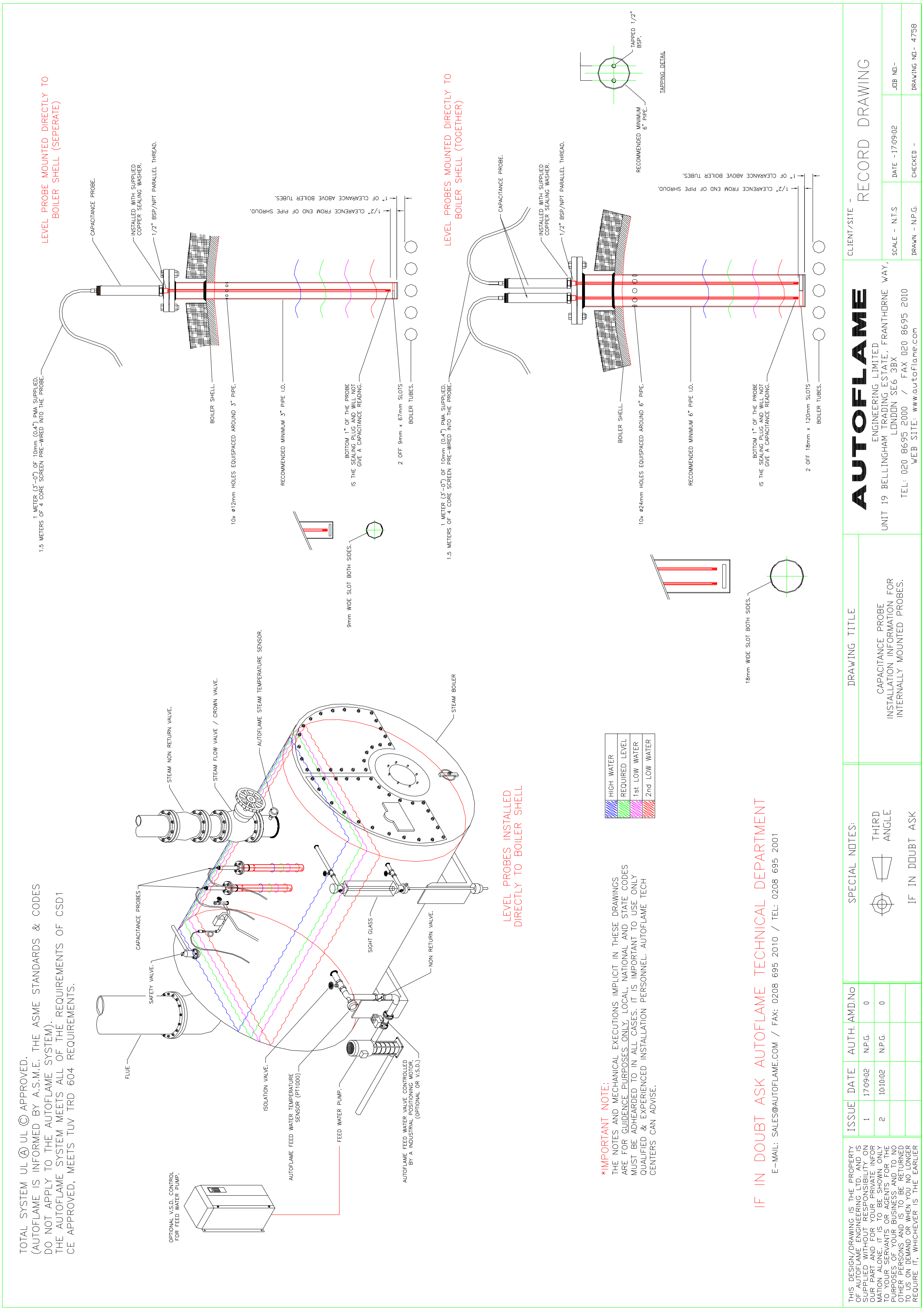
5.9.5 Capacitance Probe- General Installation Information



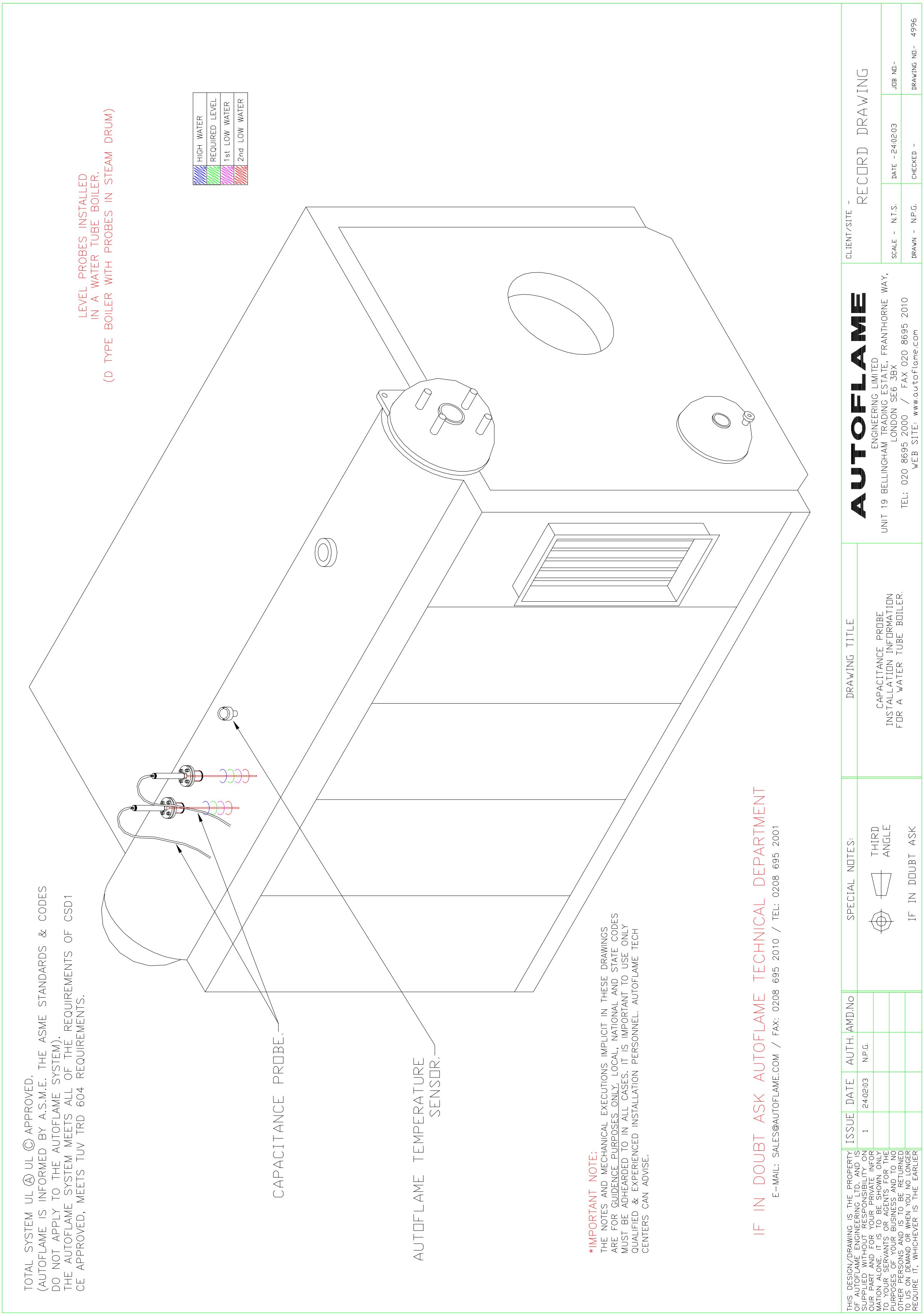
5.9.6 Capacitance Probe- Externally Mounted Pots



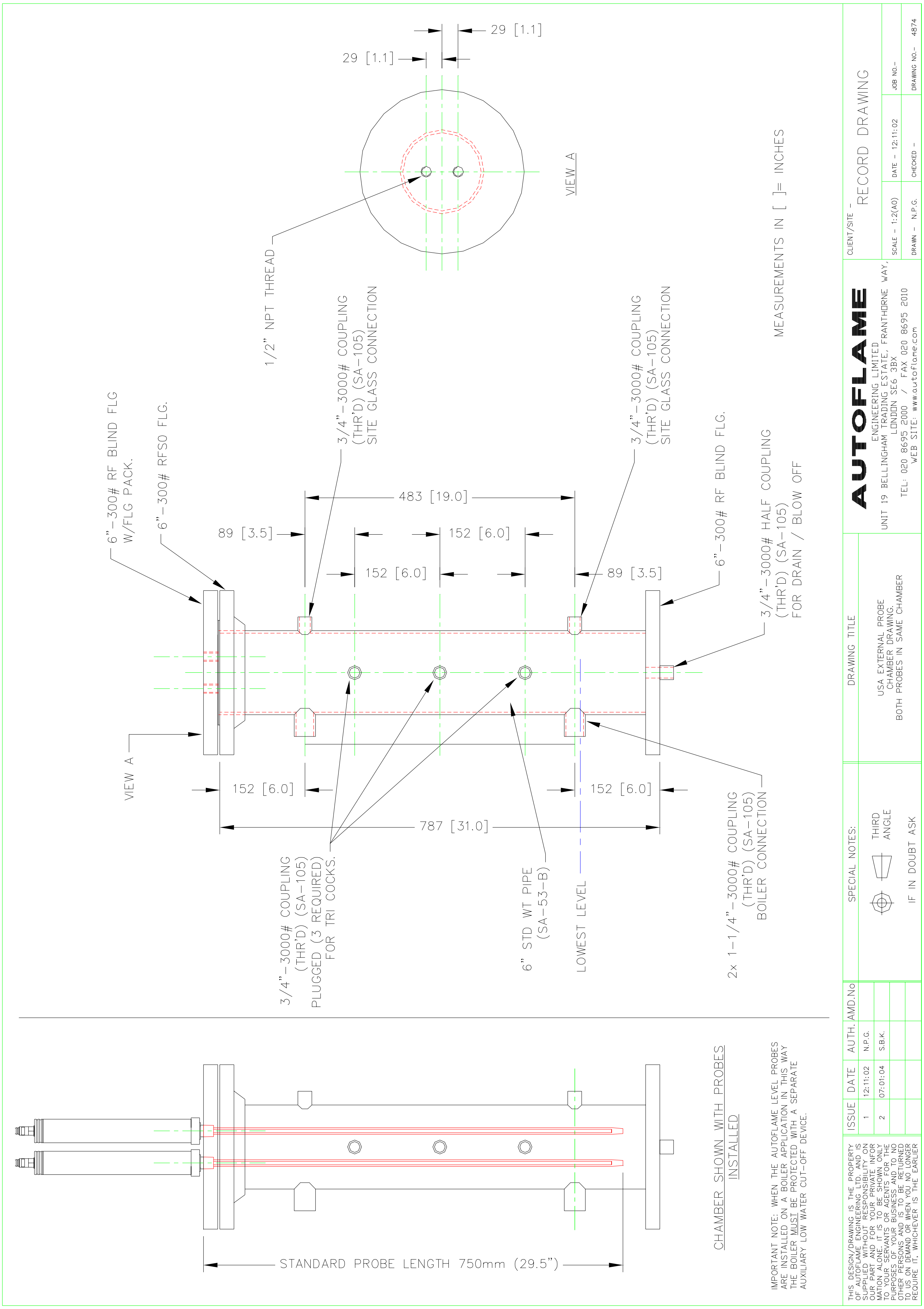
5.9.7 Capacitance Probe- Internally Mounted Probes



5.9.8 Capacitance Probe- Installation Information For A Water Tube Boiler



5.9.9 External Probe Chamber Dimensions



5.9.10 Capacitance Probe Specification

Capacitance Probe Specification

Probe connection: ½"
Standard probe length: 20", 30", 40", 50" and 60"
Other probe lengths available upon request
Stainless steel probe
PTFE coated
IP 68 rating
Temperature rating of housing: 0-70C (32-158F)- ambient temperature of air around the boiler

Note: The probes must not be cut. If the probes are cut this will act as a short between the positive and negative plates of the capacitor and will stop the probes from working.

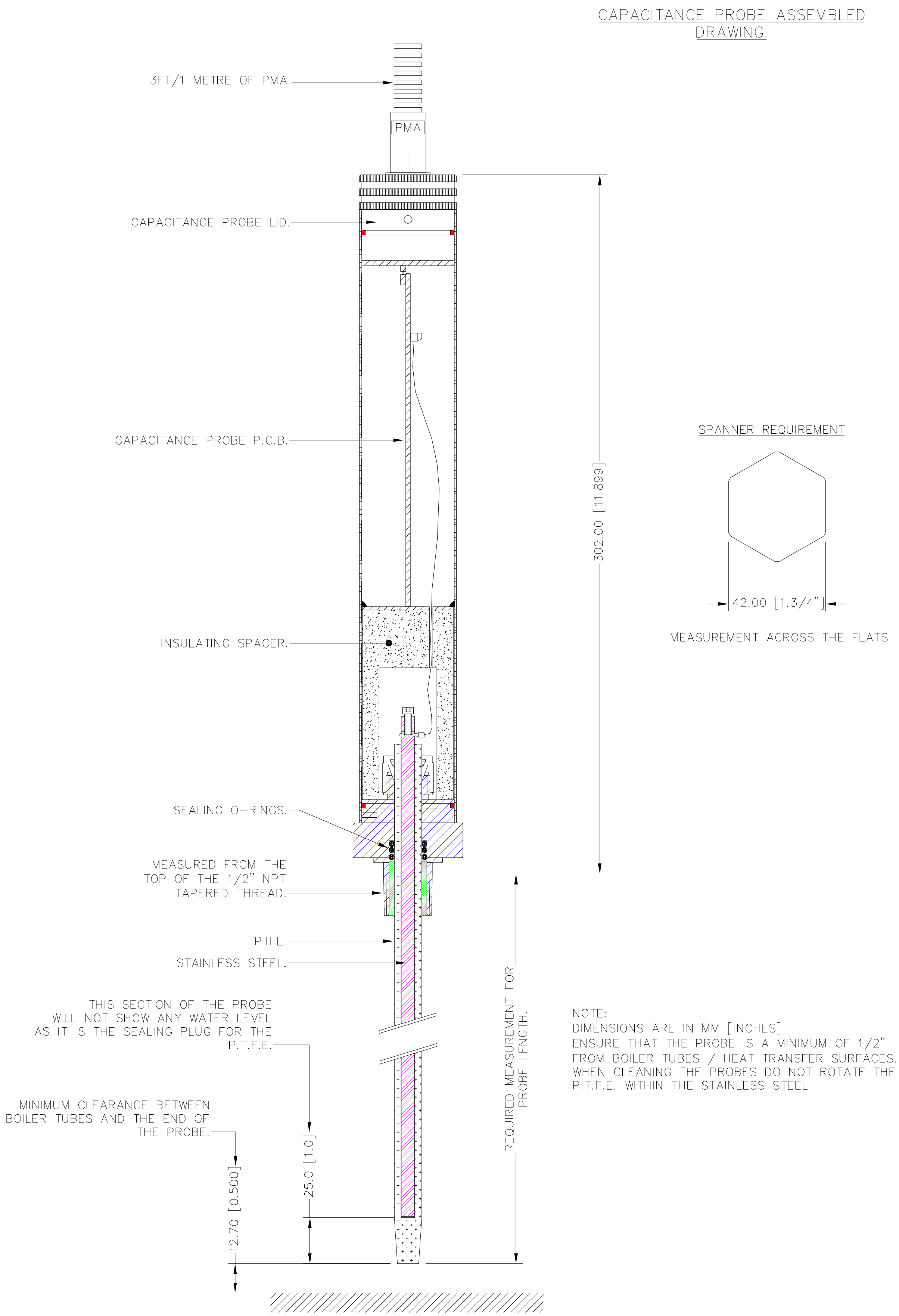
High temperature probes are available for high pressure/temperature applications.

If the probes are mounted directly into the boiler shell it is important to lag the flanges in order to avoid overheating of the electronics.

The following table illustrates the pressure tests on the probes:

Nominal Size of Line	Maximum allowable Pressure	Maximum allowable Temperature	Test Pressure
1/2" (15mm)	464 psi (32 bar)	446 F (230C)	870 psi (60 bar)

5.9.10.2 Capacitance Probe Assembly Drawing



NOTE:
DIMENSIONS ARE IN MM [INCHES]
ENSURE THAT THE PROBE IS A MINIMUM OF 1/2" FROM BOILER TUBES / HEAT TRANSFER SURFACES.
WHEN CLEANING THE PROBES DO NOT ROTATE THE P.T.F.E. WITHIN THE STAINLESS STEEL

5268/23:10:03/ISSUE 1/N.P.G.

5.9.10.3 Feedwater Valve Specification

Feed Water Valve

Valve sizes: ½" to 2"
Stainless steel body, bronze bobbin, stainless steel top and bottom plates and aluminium mounting plate
Servo Torque: 37ft.lb
NEMA 4 rated
IP65 rated
Position feed back potentiometer from servomotor
Flange spec: ANSI 300lb or PN40

Note: The feedwater valve is not classed as a full shut off valve (bubble tight). However, the tolerances are set very tight thus restricting flow through the valve. For this reason it is advised to place a normally closed solenoid valve in series with the feedwater valve. The further advantage of this is that in the event of a power failure the feedwater valve will remain in the position at loss of power, however, the normally closed solenoid valve will shut off restricting flow to the boiler.

It is essential that an adequate strainer is placed on the feedwater inlet line. The pressure drop across the strainer must be taken into account when sizing the feedwater valve.

The following table illustrates the pressure tests on the valves:

Nominal Size of Line	Maximum allowable Pressure	Maximum allowable Temperature	Test Pressure
1/2" (15mm)	580 psi (40 bar)	446 F (230C)	870 psi (60 bar)
3/4" (20mm)	580 psi (40 bar)	446 F (230C)	870 psi (60 bar)
1" (25mm)	580 psi (40 bar)	446 F (230C)	870 psi (60 bar)
1 1/2" (40mm)	580 psi (40 bar)	446 F (230C)	870 psi (60 bar)
2" (50mm)	580 psi (40 bar)	446 F (230C)	870 psi (60 bar)

5.9.10.4 Feedwater Valve Sizing Calculations

Autoflame Part No. WLCVO15 - ½" feed water valve water flow calculations @20°c							
Ft/sec	ΔP PSI	ΔP Bar	G/hr (imp)	lbs/hr	GPM (imp)	US GPM	Kg/hr
6	1	0.07	160	1600	2.6	3.2	727
9	2	0.14	235	2350	3.9	4.7	1068
15	5	0.34	380	3800	6.3	7.6	1727
21	10	0.68	560	5600	9.3	11.2	2545
26	15	1.03	700	7000	11.6	14	3182
32	20	1.38	820	8200	13.6	16.4	3727

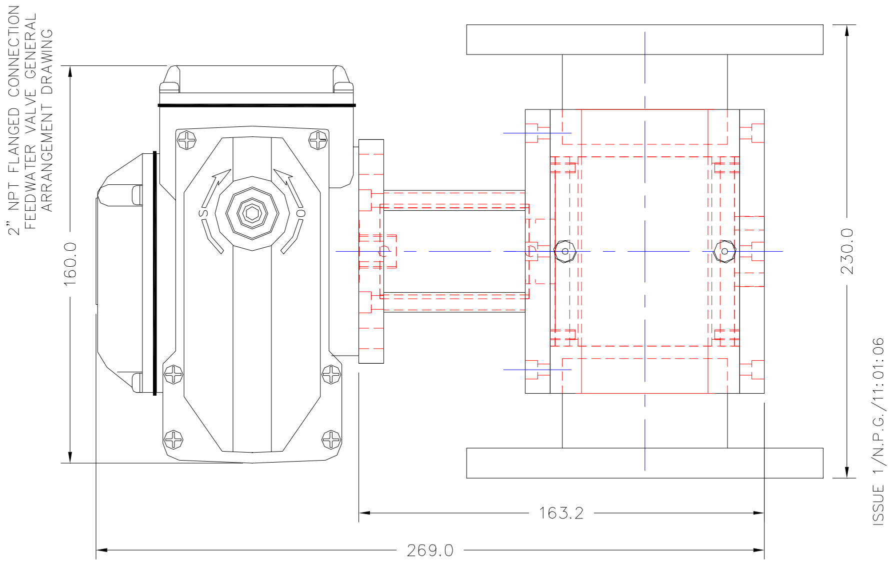
Autoflame Part No. WLCVO20 - ¾" feed water valve water flow calculations @20°c							
Ft/sec	ΔP PSI	ΔP Bar	G/hr (imp)	lbs/hr	GPM (imp)	US GPM	Kg/hr
8	1	0.07	460	4600	7.7	9.2	2090
12	2	0.14	665	6650	11	13.3	3022
19	5	0.34	1100	11000	18.3	22	5000
28	10	0.68	1630	16300	27.1	32.63	7409
34	15	1.03	2000	20000	33.3	40	9090
40	20	1.38	2400	24000	40	48	10909

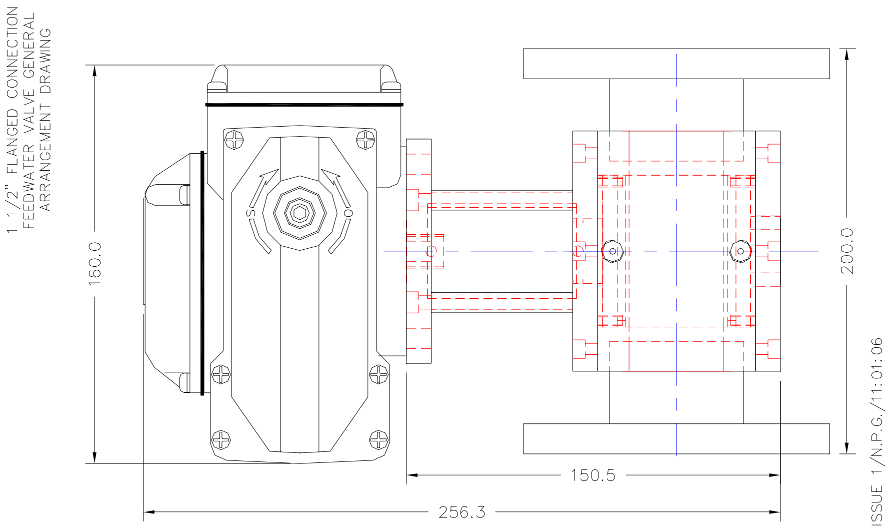
Autoflame Part No. WLCVO25 - 1" feed water valve water flow calculations @20°c							
Ft/sec	ΔP PSI	ΔP Bar	G/hr (imp)	lbs/hr	GPM (imp)	US GPM	Kg/hr
13	1	0.07	1560	15600	26	31.2	7091
21	2	0.14	2300	23003	38.3	46	10456
32	5	0.34	3800	38005	63.3	76	17275
46	10	0.68	5600	56007	93.3	112	25458
60	15	1.03	7000	70008	116.6	140	31822
70	20	1.38	8200	82011	136.6	164	37278

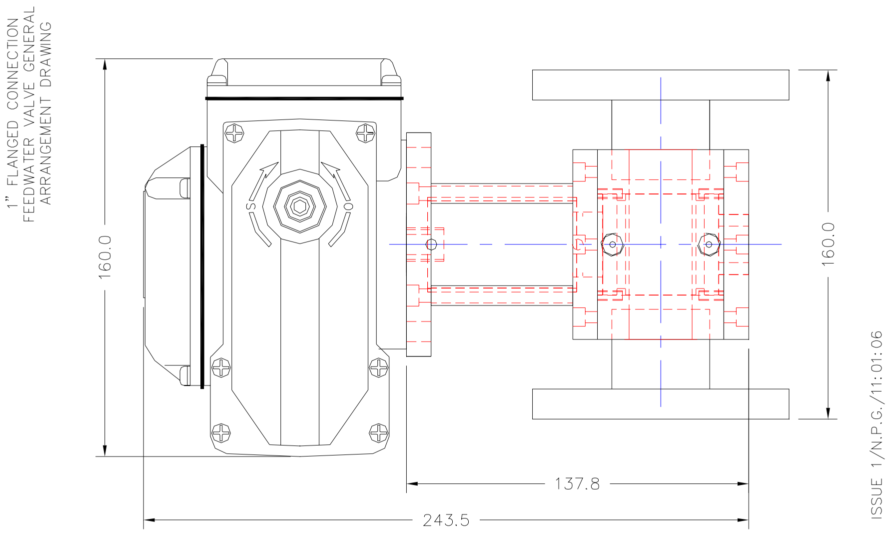
Autoflame Part No. WLCVO40 - feed water valve water flow calculations @20°c							
Ft/sec	ΔP PSI	ΔP Bar	G/hr (imp)	lbs/hr	GPM (imp)	US GPM	Kg/hr
17	1	0.07	4700	47005	78.3	94	21366
25	2	0.14	6700	67007	11.6	134	30458
39	5	0.34	11200	112015	186.6	224	50916
60	10	0.68	16500	165022	275	330	75010
75	15	1.03	20000	200028	333.3	400	90922
90	20	1.38	24000	240033	400	480	109106

Autoflame Part No. WLCVO50 - 2" feed water valve water flow calculations @20°c							
Ft/sec	ΔP PSI	ΔP Bar	G/hr (imp)	lbs/hr	GPM (imp)	US GPM	Kg/hr
21	1	0.07	10000	100014	166.6	200	45461
31	2	0.14	15000	150020	250	300	68191
46	5	0.34	24000	240033	400	480	109106
72	10	0.68	36000	360049	600	720	163659
85	15	1.03	44000	440061	733	880	200028
110	20	1.38	51000	510072	850	1021	231851

5.9.10.5 Feedwater Valve GA Drawings







5.10 Water Level Setups

To Select Water Level Setups Mode

(Note: Ch1, Ch2, Ch3, Ch4, Ch5 and Ch6 refer to the rows of buttons respectively starting with Ch1 at the top)

Water level setup values can be changed by entering the water level setup mode. The password must first be entered.
To enter the password follow the steps listed:

Either deselect and then select fuel, or power down and then up.

If system is already commissioned, press COM before the COM L.E.D. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

"ENTER PASSWORD" is displayed.

Use the Ch1 and Ch2 to set the Password codes. Then press CLOSE

"SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

On this additional password screen, it is necessary to set both Ch1 and Ch3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 standard use without the water level system. It is also necessary to set the Ch5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable the First Out Annunciation, i.e.First Out locks out.

Then press ENTER MEMORY

The WATER LEVEL and CLOSE lights will flash.

To enter water level commissioning press WATER LEVEL

To enter water level setups press the Ch6 simultaneously.

To select a setup use the Ch2 buttons.

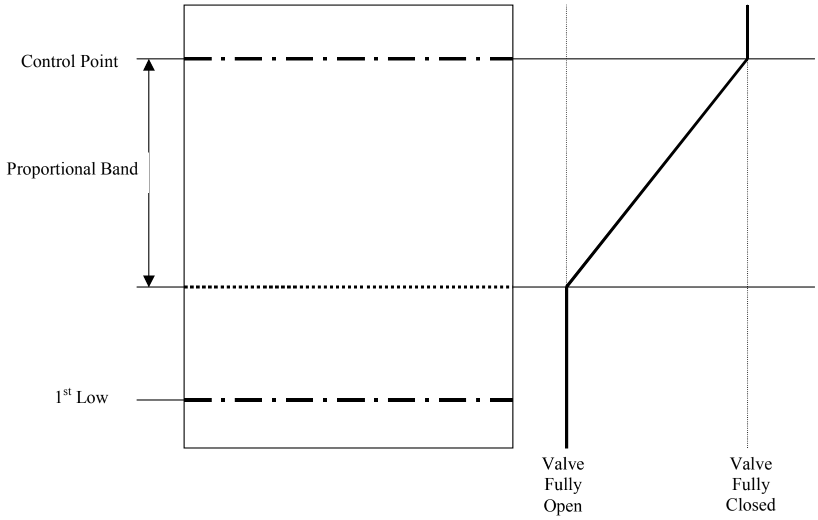
To change the setups value use the Ch3 buttons.

Any number of water level setup values can be changed when in this mode.

When changes have been made press ENTER MEMORY

All new Water Level Setup values are then permanently stored.

Setup No.	Factory Setting	Setup Value	Description
1.1	Modulating Standard		**Control Type:** Configures the boiler feedwater control type.
		Modulating Standard	Boiler feedwater is fitted with a motorised valve or variable speed drive capable of adjusting the feedwater flow rate. This technique uses PID control to position the feedwater valve to match demand.
		On/Off	Boiler feedwater has no variable flow adjustment and only provides on/off pump control through hysteresis. Using this configuration requires "pump on" and pump off" levels to be set during commissioning. When operating, the feedwater pump will continue to remain ON until the "pump off" point is reached. The pump will then be stopped (OFF) until the water has fallen below the "pump on position before turning back ON. This method does not utilize PID control
		Modulating High High	As modulating standard with additional 'High High' Water position. Boiler feedwater output turns OFF when water level reaches High High water position. Boiler feedwater turns ON when water level falls to the operating level position.
		Modulating Pre-alarms	As modulating standard with two additional level controls. These include a 1st low pre-alarm and a high water pre-alarm. If the water level reaches the pre-alarm levels then the burner will continue to fire. A pulsed audible alarm will become active. The operator can mute this alarm by pressing the water level button on the Mk6 screen. The visual alarm will still be displayed until the fault condition has cleared, i.e. the water level reaches the operating level. See section 5.10.9 for a schematic on the pre-alarm levels.
2.1	Ball Valve		**Feedwater Control Element:** Required for display purposes.
		Ball Valve	Autoflame motorised ball valve.
		VSD	AC Variable Speed Drive.

Setup No.	Factory Setting	Setup Value	Description
3.1	50%	5% – 100%	**Proportional Band:** When using PID, the controller output is proportional to the error between the current water level and the required operating level. This setup represents a percentage of the total band between 1st low and the control point used to proportion the output. The following diagram illustrates this: 
4.1	20 seconds	0 - OFF 1–100 seconds	**Integral Time**: This setup is used to set a period of time n for integral action. At these intervals a percentage (See Integral Factor) of the present offset from the control point variable is added or subtracted to the present proportional value. N.B. If configured as OFF no integral action is performed. Only applies when modulating control type is configured.
4.2	10%	1% - 50%	**Integral Factor**: This setup is used to set the percentage of the present offset from the control point variable to be added or subtracted from the present proportional value. N.B. Only applies when modulating control type is configured. See Also: Integral Time, Proportional Band.
5.1	OFF	OFF 1-100 seconds	**Derivative Time**: With derivative action, the controller output is proportional to the rate of change of the water level. This setup controls the time interval between the controller comparing the current water level and the required water level points. N.B. If configured as OFF no derivative action is performed. Only applies when modulating control type is configured. See Also: Derivative Deadband, Derivative Response Sensitivity.
5.2	10%	1%-50%	**Derivative Deadband**: This setup is used to configure the margin above and below the required level within which there is no derivative action. N.B. Only applies when modulating control type is configured. See Also: Derivative Time, Derivative Response Sensitivity.

Setup No.	Factory Setting	Setup Value	Description
5.3	10%	1%-100%	**Derivative Response Sensitivity**: This setup indicates the percentage of feedwater increase or decrease that is inflicted by the derivative action. N.B. Only applies when modulating control type is configured. See Also: Derivative Time, Derivative Deadband.
6.1	152	50-4050	**Potentiometer Close Position:** Servo potentiometer feed-back at close position. N.B. This is only required when configured for use with a motorized valve. See Also Potentiometer Open Position
6.2	2432	50-4050	**Potentiometer Open Position:** Servo potentiometer feed-back at open position. N.B. This is only required when configured for use with a motorized valve. See Also Potentiometer Close Position
			Sudden Pressure Drop: If enabled setup 7 temporarily raises the water level control point in the event of a sudden boiler pressure drop. A change of pressure over time is tested for. If the pressure change is greater than the amount specified the water level control point is raised on a scaled basis according to the deviation of the boiler Required setpoint and Actual values. Once the boiler pressure is within a band of the required value the raised control point effect is cleared. This band is the same amount as set in 7.2. The function can be disabled altogether see 7.1.
7.1	OFF	OFF 1-120	**Sudden Pressure Drop- Time Between Readings:** Period of seconds over which the change of pressure is tested. (OFF - sudden pressure drop function disabled)
7.2	5	1-100	**Sudden Pressure Drop- Change in Pressure (and clear band):** Amount of pressure drop over time (specified in 7.1) that must occur for raised control point to be triggered.
7.3	30	10-100%	**Sudden Pressure Drop- Percent Increase Scale:** Water level control point percent increase scale.
7.4	10	5-100	**Sudden Pressure Drop- Pressure Scale:** Pressure scale - offset from Required value.

Setup No.	Factory Setting	Setup Value	Description
8.1	RUNS	RUNS STOPS	**Burner Operation at High Water:** Sets whether the boiler should continue to run or stop when a high water condition exists.
9.1	1.0%	0-2.00%	**Boiler Standing Losses:** Percentage of boiler Maximum Continous Rating. N.B. For the purpose of steam flow metering only.
10.1	1.0%	0-10.0%	**Boiler Blow Down Losses:** Percentage of boiler Maximum Continous Rating. N.B. For the purpose of steam flow metering only.
10.2	constant		**Boiler Blow Down Loss Calculation Method:**
		constant propor- tioned	Fixed loss rate. Loss rate proportioned to firing rate.
11.1	30%	0-100%	**Pump Turn Off Point:** When the water level increases above the control point the pump can be set to turn off at the point selected by this setup. The point is the percentage distance between the working control point and high water. N.B. Only applies when modulating control type is configured.
12.1	enabled	enabled disabled	**Auxiliary Alarm Inputs:** If enabled the auxiliary mains voltage terminals for 2nd LOW, 1st LOW & HIGH WATER are brought into effect. These operate in addition to the two capacitance probes.
20.1	10.0	0.1- 999.9	**Deairator Make Up Water Flow Range:** Only relevant if Deairator feedwater method in use. Set value that represents flow at 20mA - Gallons per Minutes if Imperial Units, Litres per Second if Metric. (4mA represents zero flow)
20.2	10.0	0.1- 999.9	**Deairator Return (Condensate) Water Flow Range:** Only relevant if Deairator feedwater method in use. Set value that represents flow at 20mA - Gallons per Minutes if Imperial Units, Litres per Second if Metric. (4mA represents zero flow)
21.1	80F 26C	32-212F 0-100C	**Default Feedwater Temperature:** Feedwater temperature value used if Feedwater Temperature sensor(s) not fitted. Displayed as F or C according to Units set (Option 65).

Setup No.	Factory Setting	Setup Value	Description
22.1	0		**TB Output Terminal Function:**
		0	TDS Top Blowdown
		1	ON Above Switch Point (value set in 22.2)
		2	ON Below Switch Point (value set in 22.2)
22.2	0	1-80	**Switch Point:** (only relevant if 22.1 = 1 or 2)
22.3	0	1-50	**Switch Point Hysteresis:** (only relevant if 22.1 = 1 or 2) If 22.1 = 1 the TB output switches ON when the modulating value angle becomes greater than the switch point (22.2). The TB output switches OFF when the modulating value angle becomes less than the switch point minus the hysteresis amount (i.e. 22.2 minus 22.3). If 22.1 = 2 the TB output switches ON when the modulating value angle becomes less than the switch point (22.2). The TB output switches OFF when the modulating value angle becomes more than the switch point plus the hysteresis amount (i.e. 22.2 plus 22.3). In either case ensure the values entered are rational - IE in the caseof a valve the ON/OFF points are between 1 to 89 degrees.
23.1	disabled	enabled disabled	**TOP BLOW DOWN MANAGEMENT:** If enabled the Top Blow Down Management screen will be displayed when appropriate - see TDS section of this manual. Setup 22.1 must be set to 0 so the TB output terminal performs the Top Blow Down function.
24.1	Type 2		**WATER LEVEL PCB TYPE:**
		Type 1	First issue Water Level PCB.
		Type 2	Second Issue Water Level PCB - includes Top Blow Down & De-Aireator facilities
25.1	300	30-600	Test time to 1st low
25.2	300	30-60	Test time to 2nd Low

5.10.1.6 Water Level Parameters

N.B. The software is fixed to operate on 2 probes

To enter the water level parameters:
Set parameter 109 to 1 and press enter. Go into the water level commissioning mode and enter water level setups. After setup 12.1, these extra setups will be entered.
To reset all the water level set-ups and water level parameters to their default settings, set setup 6.1 to 51 and 6.2 to 4049.

Setup No.	Factory Setting	Setup Value	Description
A.1	10 (secs)	1-20	Probe filtering time. Every second each probe takes 10 readings. This is then averaged over the value set in this parameter.
B.1	5 (secs)	1-100	Control element update time. This is how often the modulating feed water valve will be moved in response to variations in the water level.
C.1	2.0%	0.1-20% 0=off	Control point deadline. No further modulation will occur wihin 2.0% of the control point 0 = control point 100 = 1st low
D.1	1 (secs)	1-20	PK PK sampling period. Peak to peak sampling period (highest/lowest).
D.2	1 (secs)	1-20	PK PK update time.
E.1	1500Hz	0-2000	Min mismatch. 1500Hz = 3" or 75mm Probe 1 is used as the reference based on the commissioning data. This probe assesses the value of probe 2 to establish if there is a mismatch present (outside 1500Hz). Mismatch is a serious prolem ans is safety critical. If a probe mismatch occurs the probes may need cleaning.
E.2	0	0-2000	Max mismatch.
E.3	1.5	1-10	Mismatch multiplier.
E.4	30 (secs)	1-200	Mismatch time. If the mismatch exceeds 30 seconds then the system will shut down. If the value of probe 2 moves back inside the 1500 window then this timer is reset. **N.B. First low takes priority over mismatch.**
F.1	0.9	0-5	Tubrbulence factor. This value corresponds to the predicted water level.

Setup No.	Factory Setting	Setup Value	Description
G.1	0%	0-100%	Expansion offset.
G.2	10 (secs)	0-50	Expansion turb time.
G.3	10	1-100	Expansion turb amount.
H.1	1		Control point method.
		1	Averages the data between both probes.
		0	Works off the readings from probe 1 only (control probe). The checks between the 2 probes are still carried out.
J.1	1mm	1-100	Detect turbulence level. If the water is still the frequency will drop below 10Hz and a fault will occur. This is non-movement detection.
		0	Disabled
J.2	10 (secs)	1-100	Detect turbulence time. **N.B. If J.1 or J.2 is set to 0, then this function is disabled.**
K.1	5 PSI	1-100	Steam flow start pressure offset. This is the required pressure. If there is pressure, no steam will be produced if within 5 PSI of hte required value. The system is deemed to be producing steam so steam flow metering will commence.
K.2	5 PSI	1-100	Steam flow stop pressure offset. Steam is produced until the pressure drops below 5 PSI of the required value.
L.1	1500 Hz	1-3000	Max probe drift.
		0	Disabled

MM requesting data from the water level board

Proportional value- probe 1

Proportional value- probe 2

Average of P1 and P2

Integral built up so far

Derivative- avoid using

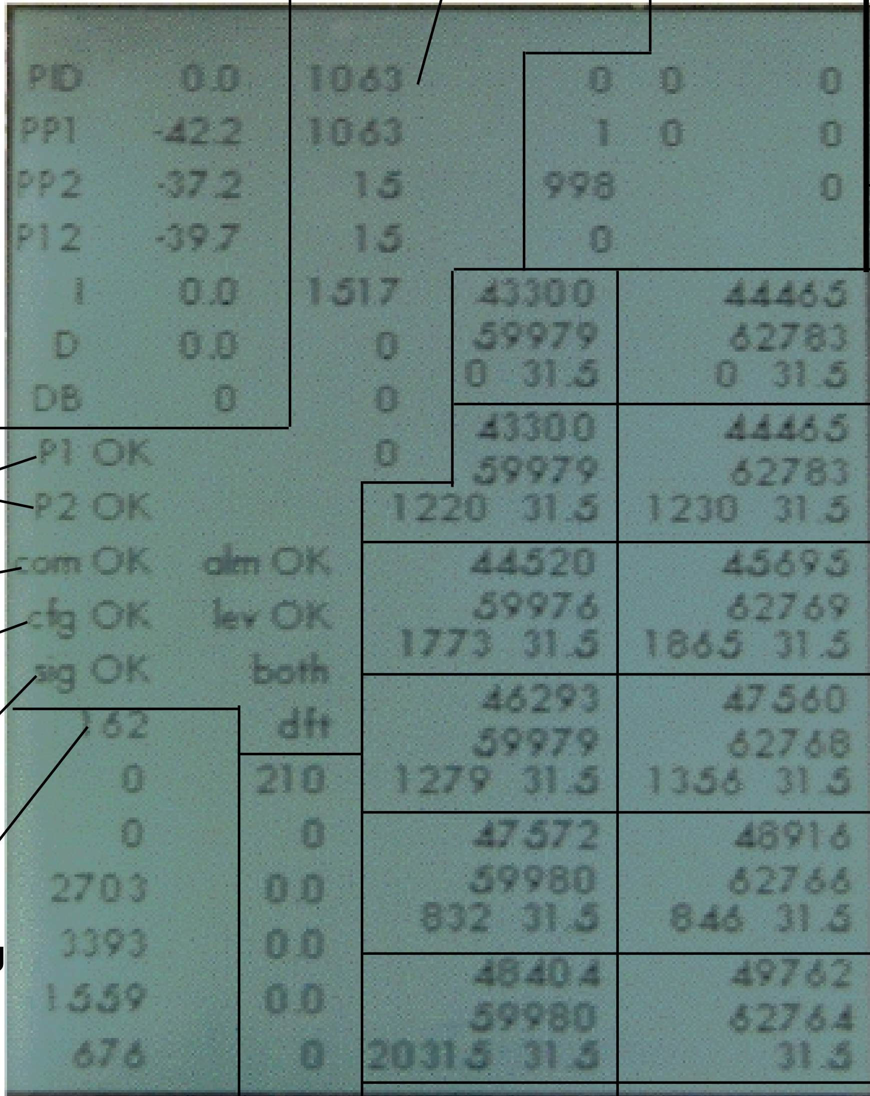
Check that probes 1/2 are present.
If not a COMMS error would occur

Checking for a valid set of commissioning data

Checking for valid setups

Checking for communication between the MM and water level board
NOK= not OK

Signal from the modulating feed water valve
Value between 152 (close) and 2432 (open)



Set of 7 analogue inputs

PROBE 1

PROBE 2

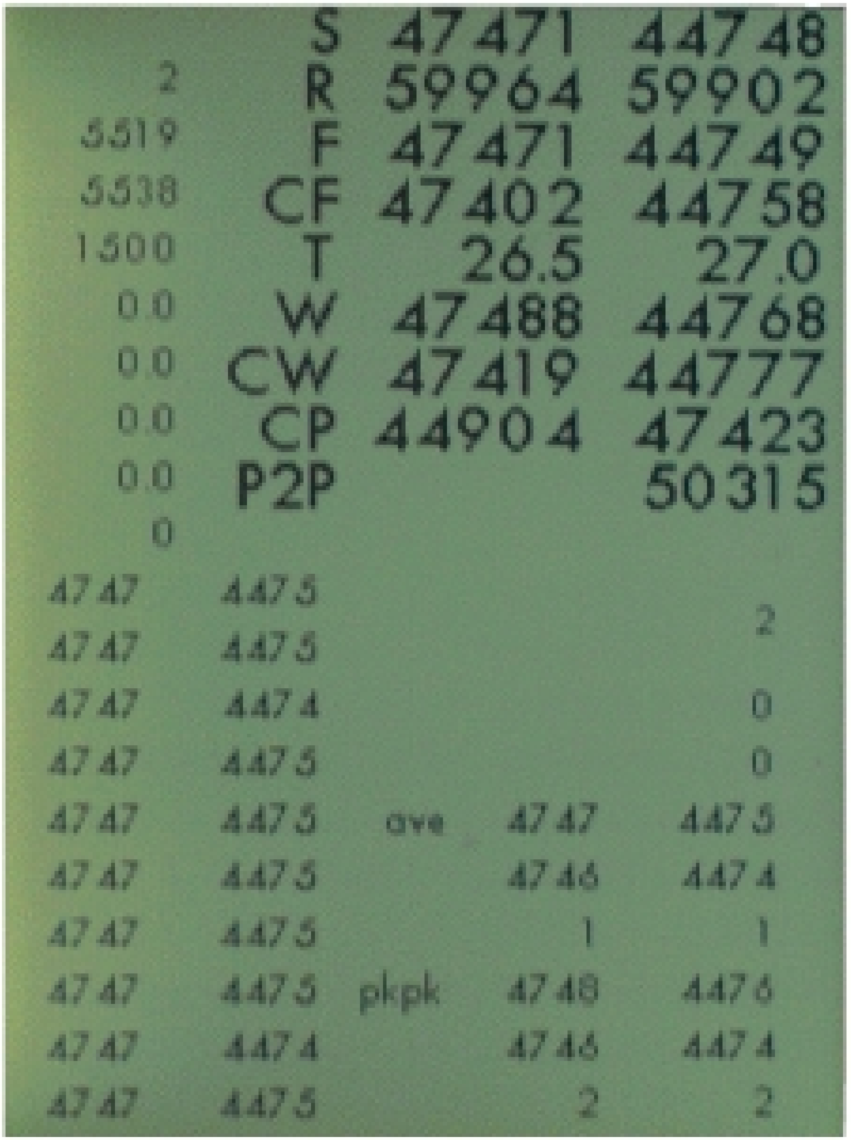
Full set of commissioned data:

First line: Actual commissioned value (Hz)
Second line: Nominal reference value (Hz)
Third line: Difference between this commissioned value and one below AND Temperature (C) of sensor on PCB at commissioning

There are 2 possibilities:

1- Using the modulating water system	**2- Using the pump on/off system**
REPEAT OF HIGHWATER LEVEL DATA	HIGHWATER LEVEL
HIGHWATER LEVEL	PUMP ON
CONTROL POINT	PUMP OFF
1ST LOW LEVEL	1ST LOW LEVEL
2ND LOW LEVEL	2ND LOW LEVEL
END OF PROBE LEVEL	END OF PROBE LEVEL

Probe 1 Probe 2



Signal from probe

Reference signal from reference capacitor

Filtered value of signal

Corrected filtered value

Working temperature

Filtered reading of the 10 values

Corrected to reference- drift

Control point value- at commissioning

Average of probe 1 and probe 2- based on several factors

10 readings for probes 1 and 2: Made over a 1 second period- every 100 milliseconds

Interim values based on 10 readings

5.10.3 Replacing the servo motor/actuator for a feed water valve

READ ALL THOROUGHLY BEFORE COMMENCING WORK

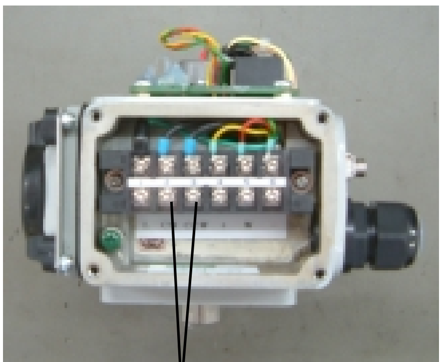
1) Firstly, power to the system must be removed in order to make mechanical adjustments.

2) In order to ensure that the valve is fully closed the following pictures must be followed:
It is essential to check the feed water valve position and adjust this to the close position. This is done using the crank and checking the position of the valve stem out of the valve.

3) The coupling must then be attached to the feed water valve and correctly alligned as in the picture, and the servo motor/actuator must be at exactly 90 degrees to the feed water valve (flow through the valve). When the servo motor is supplied, it comes in the 0 degree position.

4) After these mechanical changes, the allignment may be correct. Check the display diagnostics as covered in parts 6 and 7.

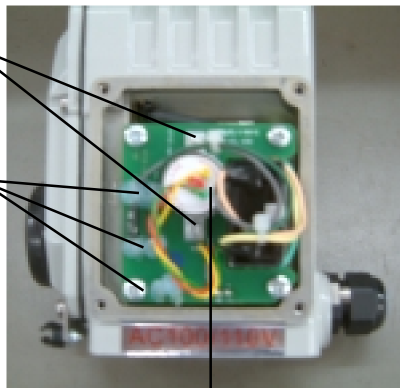
5) The next procedure is to make electrical changes (please check that there is still no power to the system)
Remove the lid and the end covering as shown in the diagrams below. In the end section the wires labelled CW (clockwise wire) and CCW (counterclockwise wire) must be removed since if present they will make the valve search for the operating position. All other wires must be kept in place including the ones on top.



Wires to be removed

Tamper proof screws to be loosened in order to move the potentiometer

DANGER:
120 volt live connections

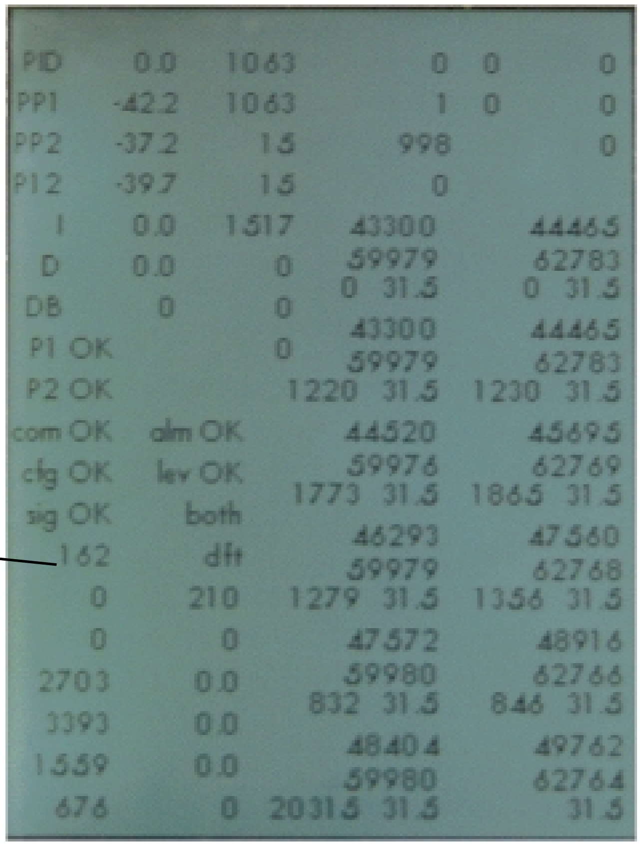


Carefully rotate the potentiometer to change the diagnostic readings on the MM display

6) Be careful: in the next procedure there are live connections showing. Turn the power on to the system and enter the commissioning mode on the MM screen. In parameters, change parameter 83 to 1 (on) to display the diagnostics. Then enter this and re-enter commissioning mode and go into water level commisssioning. The screen below is one of the diagnostic displays available.

7) It is now necessary to carefully rotate the potentiometer position, checking the MM screen and watching the value indicated below. The close position value is 152, so a value of 152-170 will correspond to the close position.

Diagnostic value that needs to be adjusted to 152-170
As the potentiometer is rotated this value will change



Once this has been adjusted, tighten the tamper proof screws on the potentiometer, remove power from the system, reconnect the CW and CCW wires and replace the end and top coverings.

The feed water valve should now be ready for operation.

5.10.4 Commissioning Water Level Positions

(Note: Ch1, Ch2 etc refers to the rows of buttons with Ch1 at the top)

Note: Throughout the commissioning procedure the COM l.e.d. is illuminated.

1. Select fuel. CLOSE flashes and 'ENTER PASSWORD' is displayed.

   Note: If fuel selected is being re-commissioned, press COM before COM l.e.d. stops flashing (five seconds).

2. Enter Access Code. Adjust the numbers using the CH1 and CH2 buttons.

   When numbers are set, press CLOSE

3. "SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

On this additional password screen, it is necessary to set both Ch1 and Ch3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 standard use without the water level system. It is also necessary to set the Ch5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable the First Out Annunciation, i.e.First Out locks out.

   Then press ENTER MEMORY

4. Display shows message to indicate commissioning mode.

   Press WATER LEVEL to enter Water Level Commission Mode.

   Press CLOSE to commission Fuel Air Ratio positions.

5. Use Ch2 to control the position of the feedwater valve (if optioned) and

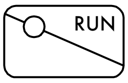
   Ch1 to control the pump operation (OFF / ON)

6. Current position to be commissioned is indicated by flashing message showing End of Probe. Increase the water level until it approaches the bottom of the probe. As the water level exceeds the bottom of the probe, the displayed probe values will begin to change. Once this point has been found press ENTER MEMORY to save.

7. Display shows 2nd Low flashing. Increase the water level to the desired 2nd Low Level using Ch1 and Ch2 . After allowing a period for the values to stabilise press ENTER MEMORY to save the current water level.

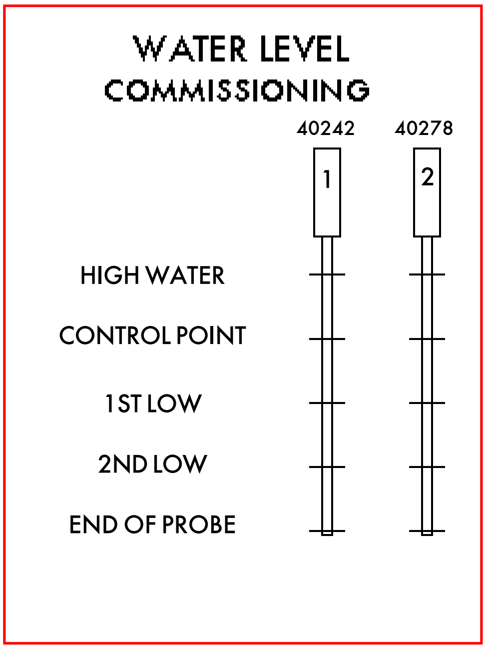
8. If the unit is configured for On/Off operation repeat step 6 for: 1st Low, Pump On, Pump Off, and High Water Positions otherwise if the unit if configured for modulating control repeat step 6 for: 1st Low, Control Point and High Water (and High High water if applicable) Levels. At each level the display will flash the position currently being commissioned. When the last point has been entered the Water Level Commission data will be permanantely saved. Pro ceed to step 8. Note that after each point is entered it is necessary to press the Water Level button to confirm the commissioning of the next point, thereafter the ENTER led will start flashing again.

9. After entering the final position (High Water) the RUN L.E.D. will begin to flash. Before proceding further reduce the water level to the control point level (or pump on). This will prevent the unit from registering a high water alarm immediately after the system has reset.

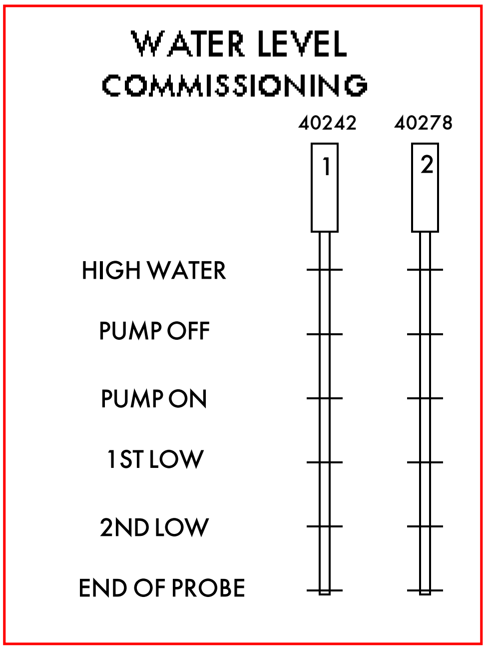
10. Press 

to exit commissioning mode and return to normal (FAR) Fuel Air Ratio Commissioning. If FAR is not required deselect and then reselect fuel to return to RUN mode.

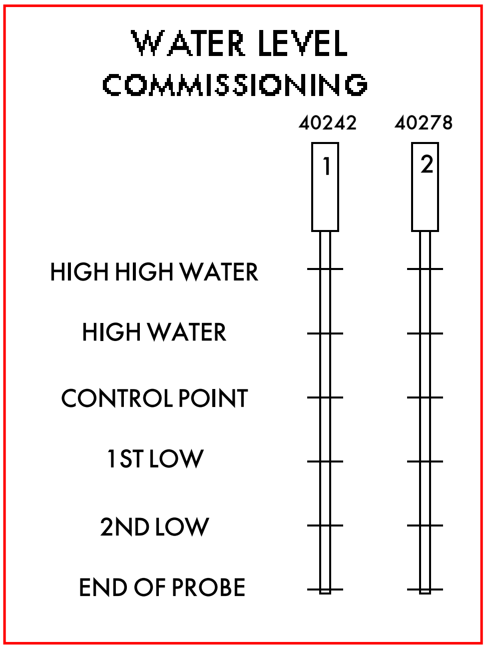
5.10.4.1 Commissioning Screens



Commissioning screen displayed for standard modulating water control.

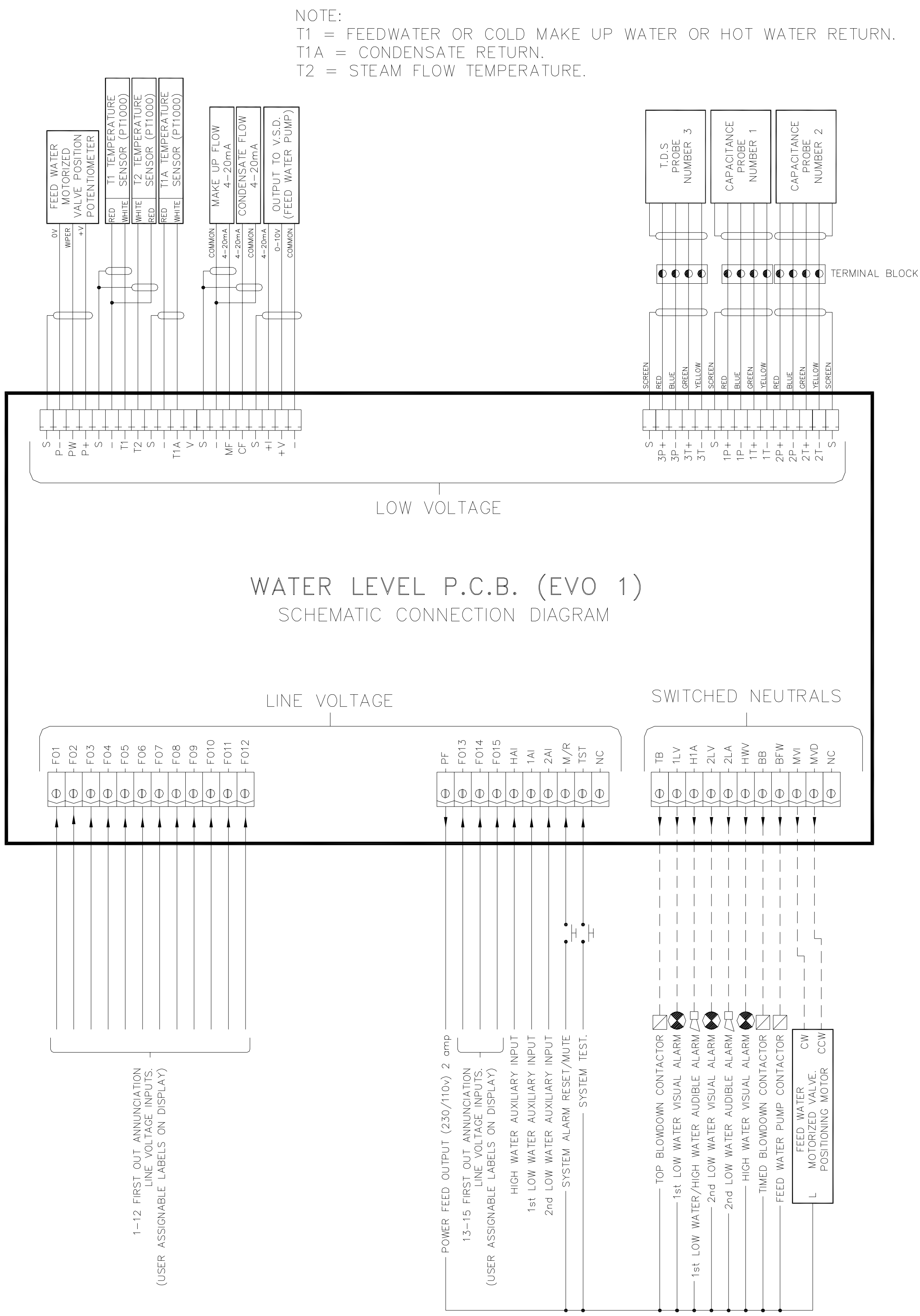


Commissioning screen displayed for on/off water control

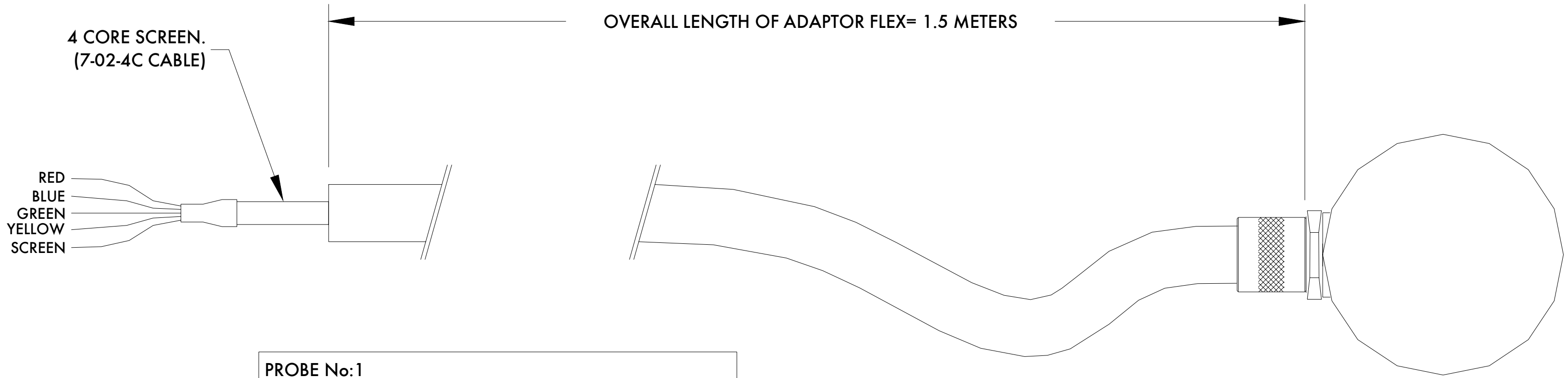


Commissioning screen displayed for modulating water control with High High water

5.10.4.2 Expansion PCB Connection Terminals



5.10.4.3 Capacitance Probe Connections



PROBE No:1

COLOUR	DESCRIPTION	TERMINAL
RED	POWER SUPPLY +	1P+
BLUE	POWER SUPPLY -	1P-
GREEN	DATA TRANSMISION +	1T+
YELLOW	DATA TRANSMISION -	1T-

PROBE No:2

COLOUR	DESCRIPTION	TERMINAL
RED	POWER SUPPLY +	2P+
BLUE	POWER SUPPLY -	2P-
GREEN	DATA TRANSMISION +	2T+
YELLOW	DATA TRANSMISION -	2T-

DWG No:4363/ISSUE 2/12:06:02

5.10.5 Operational Checks

All local & national codes for safe operation of boiler plant must be respected. If in any doubt contact your local specialist authority.

Water level operation must be checked after commissioning or subsequent to modification of any setups.

Set the system to RUN mode and allow the burner to fire. With the boiler supplying steam at a steady rate check that the water level is maintained at the control point. Note: This is for modulating control. If the system is configured for on/off control check that the boiler feedwater pump turns on and off appropriately at the commissioined points. Ensure that all audible and visual alarm indicators are inactive.

Reduce the level of the water (by blow down or other suitable means). Check that a 1st low alarm occurs when the water level is just below the commissioned 1st low level. Note: The burner will stop in this condition.

Ensure that the 1st low audible and visual indicators are active.
If fitted, press the external mute/reset button and check that the audible alarm is muted.

Reduce the level of the water further and check that the 2nd low alarm is displayed when the water level is just below the commissioned 2nd low level. Note: The burner will remain stopped in this condition.

Ensure that the 2nd low audible and visual indicators are active.
If fitted, press the external mute/reset button and check that the audible alarm is muted.

All 1st Low/2nd low alarm conditions must be cleared before proceeding to test the high water.
To test high water it will be necessary to increase the water level to just above that of the commissioned high water position. If there is no means to manually increase the level of the water it is possible to select Water Level Commission mode and increase the level of the water manually. This can be performed by using the Ch1 and Ch2 controls. The unit can then be restarted by de-selecting and re-selecting the fuel. The unit will restart in RUN mode and should report a high water alarm. Check the burner operation runs or stops according to the set up (8.1).

Ensure that the high water audible and visual indicators are active.
If fitted, press the external mute/reset button to check that the audible alarm is muted.

Check the operation of the TB output terminal.

5.10.6 Terminal Description - TDS version system

P-	Feedwater control valve potentiometer excitation voltage -ve.
PW	Feedwater control valve potentiometer wiper
P+	Output. Feedwater control valve potentiometer excitation voltage +ve. Max load 5mA.
T1	Feed water temperature sensor.
T2	Steam temperature sensor.
T1A	Condensate water temperature sensor.
V	Unused
MF	4-20mA input - Make up Water Flow
CF	4-20mA input - Condensate Water Flow
+I +V	Outputs. Analog signals to control VSD. Max output under normal operation 10V/20mA. (Current Input impedance max 250R)
3T- 3T+ 3P- 3P+	Connections solely dedicated to Autoflame TDS Probe
1T- 1T+ 1P- 1P+	Connections solely dedicated to Autoflame capacitance Probe 1
2T- 2T+ 2P- 2P+	Connections solely dedicated to Autoflame capacitance Probe 2
FO1 - FO15	First Out annunciation inputs (mains voltage input)
HAI	High water Auxiliary Input (mains voltage input)
1AI	1st low water Auxiliary Input (mains voltage input)
2AI	2nd low water Auxiliary Input (mains voltage input)
M/R	Water Level Alarm mute/reset (mains voltage input)
TST	Test Facility Activate (mains voltage input)
PF	Mains supply live/hot to alarm devices/motorized valve etc.
TB	Top Blow Down (ouput switched neutral)
1LV	1st Low visual alarm (output switched neutral).
H1A	High and 1st low water audible alarm (output switched neutral).
2LV	2nd Low visual alarm (output switched neutral).
2LA	2nd Low audible alarm (output switched neutral).
HWV	High water visual alarm (output switched neutral).
BB	Bottom Blow Down (ouput switched neutral)
BFW	Feedwater pump on/off. (output switched neutral)
MVI	Feedwater control valve motor drive – increase. (output switched neutral)
MVD	Feedwater control valve motor drive – decrease. (output switched neutral)
NC	No Connection

Note that all the "-" & P- terminals on the top left connection strip are common to each other, All of the circuitry assosciated with this terminal strip (analog inputs and outputs) is isolated from earth potential (i.e. floating). If a VSD is not used, or a VSD is used that has isolated input signal circuitry, link one of the "-" terminals to an S terminal (EG between P- and the adjacent S terminal to its left). If using a VSD and the VSD signal input circuitry is earthed do NOT install a link.

ALL TERMINALS MARKED S ARE CONNECTED TO MAINS EARTH TERMINAL 66 ON THE MK6EVO AND ARE ONLY FOR CONNECTION TO CABLE SCREENS.

5.10.7 Water Level Electrical Specification

Classifications

Outputs: 120/230 V

MVD	1.5A	
MVI	1.5A	
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)
TB	250mA	Must be connected through contactor

PF Maximum 2A (load currents for above terminals)

Note MVD MVI only one output switched at a time.
Max number of alarm indicators on at any time is 3 (1LV, 2LA, 2LV)
Use 4-core screened cable to connect capacitance probes. Refer to section 2.9.11.2

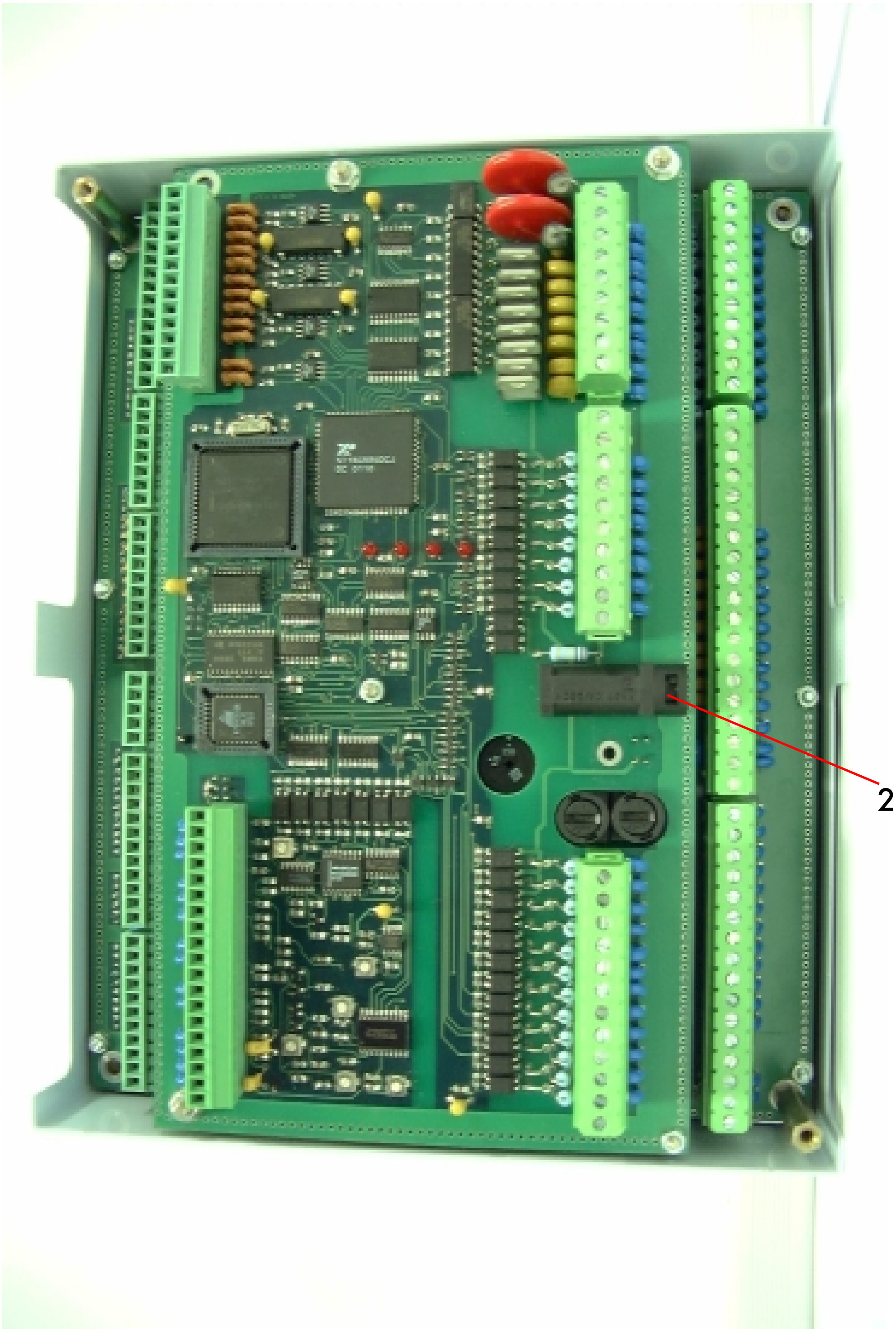
Main Voltage Signal Inputs

At 120V Current Loading Aprroximately 0.6mA
At 230V Current Loading Approximately 1.15mA

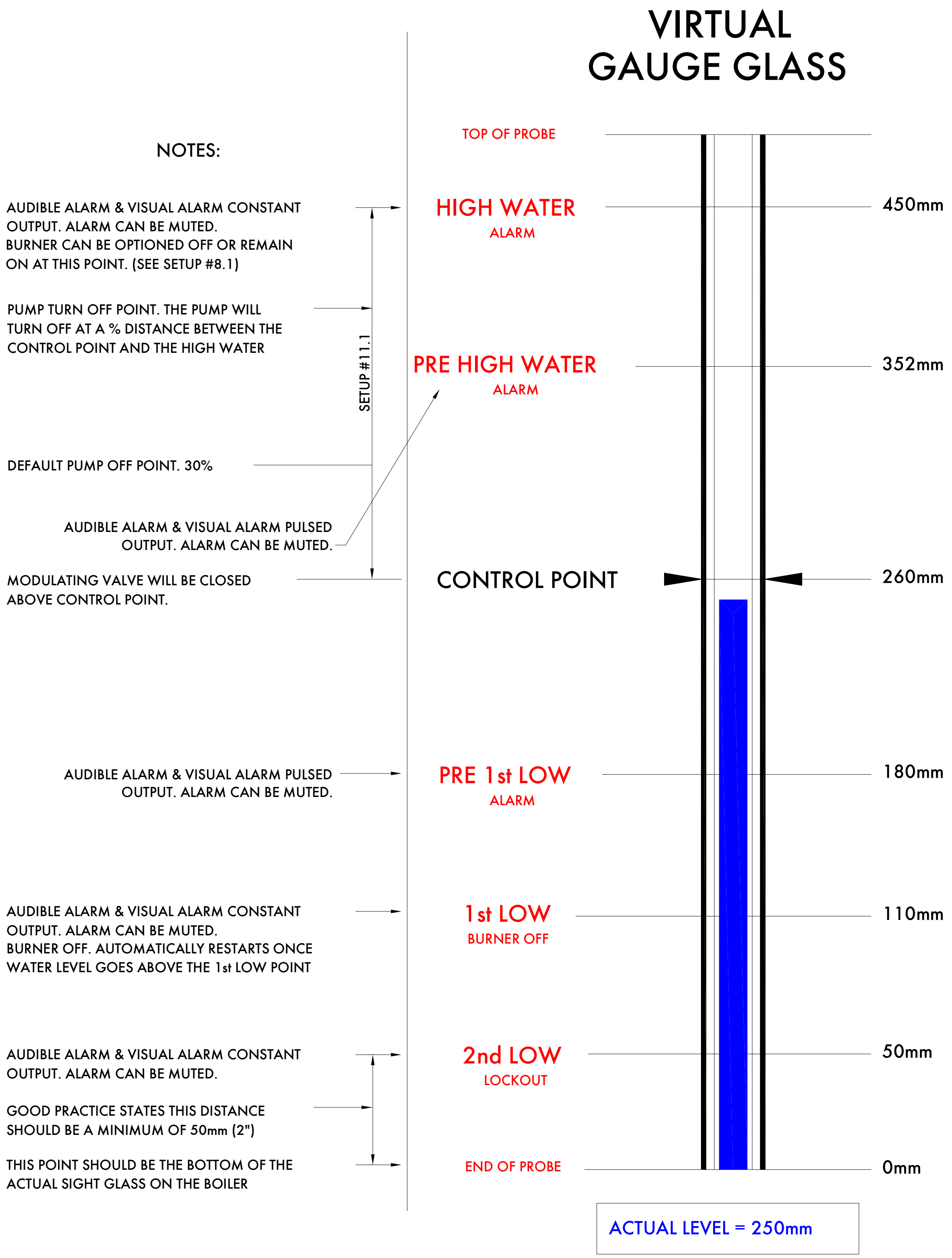
Refer to MK6 Electrical Specifications Section (2.14.2.9) for other general ratings.

5.10.8 Fuse Position/Rating

MK6 EVOLUTION WITH WATER LEVEL P.C.B. FITTED



5.10.9 Display on the DTI (Data Transfer Interface)



5.10.10 Bottom Blowdown Configuration

Within the Mk6 water level control, a facility exists in which an automatic bottom blowdown can be set. Up to 4 automatic bottom blowdowns can be set to occur within a 24 hour period. The following describes how to initiate this procedure.

Note: Local and national codes must be adhered to.

To Select Bottom Blowdown Configuration Mode
(Note: Ch1, Ch2, Ch3, Ch4, Ch5 and Ch6 refer to the rows of buttons respectively starting with Ch1 at the top)

Bottom blowdown values can be changed by entering the bottom blowdown configuration mode. The password must first be entered.
To enter the password follow the steps listed:

Either deselect and then select fuel, or power down and then up.

If system is already commissioned, press COM before the COM L.E.D. stops flashing.

If system is not already commissioned, commissioning mode will be set automatically.

"ENTER PASSWORD" is displayed.

Use the Ch1 and Ch2 to set the Password codes. Then press CLOSE

"SYSTEM ACTIVATE, WATER LEVEL CONFIGURE" is displayed.

On this additional password screen, it is necessary to set both Ch1 and Ch3. These are both set to #3 if the Autoflame water level system is to be active. Alternatively, these are both set to #7 for Mk6 standard use without the water level system. It is also necessary to set the Ch5 value for First Out Annunciation. Set this to #0 to disable the First Out Annunciation, #1 to display the First Out Annunciation (but not to lock out) and to #2 to enable the First Out Annunciation, i.e. First Out locks out.

Then press ENTER MEMORY

The WATER LEVEL and CLOSE lights will flash.

To enter water level commissioning press WATER LEVEL

To enter water level setups press the Ch5 simultaneously.

"BOTTOM BLOW DOWN MANAGEMENT" is displayed at the top of the screen.

Pressing CH3 "up/down" changes whether a blowdown is active or inactive at the selected number. If a blowdown time is not active an X is displayed in the blowdown number. If a blowdown is enabled the rest of the items show (blowdown time, duration and repeats). If you disable blowdown 2, then 3 & 4 will also be disabled.

Pressing CH1 "up/down" moves up and down the Autoflame blowdown number column (1st column)

Pressing CH2 "up/down" moves right and left on the screen to select the blowdown time, duration (0-60s) and repeats (0-10) at each number

The item that can be changed flashes.

Once the blowdown values have been configured then, press ENTER (flashing).

In **run** mode the blowdown screen is displayed by pressing the WATER LEVEL button until the BOTTOM BLOW DOWN MANAGEMENT screen appears.

During **run,** if the time of a blowdown is reached the word "IMMINENT" appears in the status box. When "IMMINENT" is displayed, checks are being carried out to see if another MM is blowing down. This may take up to 40 seconds if no other MM's with water level control are blowing down. If another MM with water level control is blowing down it will take longer as the blowdown taking place will be allowed to finish before another one can start. Once established that the blowdown can take place the status box displays "OFF" when the blowdown output is off and "ACTIVE" when the blowdown output is on. During the blowdown OFF/ACTIVE sequence the message BLOWDOWN IN PROGRESS flashes up under the status box.

Please note that the blowdown information from the other MM's with water level control is via the RS485 connection on terminals #27/28 and is combined into the sequencing communication data. If there are two or more boilers and there is no RS485 connection on terminals #27/28 between the units or the ID settings are incorrect, a blowdown may occur on more than one boiler at the same time.

The blowdown output uses what was the High Water Audible output; it is a switched neutral and must drive a relay/contactor. The High Water Audible alarm is now shared with the 1st Low Audible output. Therefore, whenever a 1st Low or High Water occurs this output is set on. The High Water and 1st Low outputs are still separate as before.

Notes:

If a boiler with the MM and water level control is alongside another boiler without an MM system or an older MMM without the water level control then consideration must be given to the overall blowdown arrangements.

The **run** mode Bottom blowdown screen is the same as the figure in section 5.3 except the time is displayed in the box at the bottom of the screen.

Local and national codes must be adhered to. If regulations do not allow the use of automatic bottom blowdown then this feature must remain disabled in order to comply with code.

5.10.11 Shunt Switch Philosophy

The operation of the shunt switch philosophy follows the following procedure:

1. While the burner is either firing or in the standby state, press the 'Water Level' and 'Enter Memory' buttons simultaneously.

2. The Mk.6 screen would show "Implement level Control Test Procedure".

3. The operator would have to either confirm that he wanted to proceed by pressing 'Enter Memory' or press 'Run' to exit.

4. If the operator proceeded to press the 'Enter Memory' button, the Mk.6 screen would then display 'Feed Water Valve Shut' and close the feed water valve.

5. The burner would continue to operate. At this time the operator would either let the water evaporate automatically or physically blow down the water column or boiler. A user-definable amount of time (time A) is set in the water level set-ups, during which time the 1st Low must be reached. If not, the burner will revert back to the run condition.

6. The 1st Low Alarm would be initiated and the alarm would sound. The operator has the option of muting the alarm. The burner continues to operate.

7. The operator would continue to decrease the water level in the column or boiler or allow the water to continue evaporating. A user-definable amount of time (time B) is set in the water level set-ups, during which time the 2nd Low must be reached. If not the burner will turn off.

8. The 2nd Low Alarm would be initiated and the alarm would sound. The operator again has the option of muting the alarm. The burner continues to operate.

9. 3 seconds after the 2nd Low Alarm has been initiated the Mk.6 screen would display 'Feed Water Valve Open'. The water level would start to increase.

10. The Mk.6 would expect to see the water level rise above the 2nd Low Level within 30 seconds (default value) or time B of the valve opening. Should the level not increase a 2nd Low Alarm will be initiated, causing the burner to turn off and a lockout to occur, requiring a manual reset to recycle the system.

11. Once the water level increased above the 2nd Low Level the Mk.6 would allow a further 30 seconds (default value) or time A for the water level to rise above the 1st Low Level. Again should the level not increase a 1st Low Alarm will be initiated, causing the burner to turn off and an alarm to sound. The system would automatically recycle the system once the water level is above the 1st Low Level.

12. Once the level returns to above the 1st Low Level the screen would display 'Test Complete, Normal Operating Level Restored'

5.11 Normal Operation

5.11.1 End User Day to Day Operation

The WLC product is designed to report and control levels of water within industrial steam boilers. The key features of the system are as follows:

- Reporting Level Alarms
- Feedwater Control
- Steam Flow Metering

Alarm level reporting deals with the ability to determine whether the current water level 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. For each installation there are a minimum of five level indication points representing the following levels:

- High High Water:
- High Water:
- High Water Pre-alarm:
- Control Point:
- 1st Low Pre-alarm:
- 1st Low:
- 2nd Low:
- Bottom of probe:

(Note: the above arrangement is for water level modulation control. In the event of on/off level control there are six level indication points (pump on & pump off replace control point. These are the only two types of level control).

5.11.2 Water Level Operation

It is ideal to maintain an amount of water in the boiler 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. In extreme cases there is the potential for the boiler to explode. The WLC herein is designed to maintain a satisfactory level of water in the boiler, whilst controlling and reporting low water level conditions. Its operation is as follows:

The water levels detailed above are described below:

High Water:
A high water level, although not dangerous is undesirable as water may infiltrate the steam header. If the boiler water level goes above this point the burner may or may not continue to run depending on the system configuration. If a high water level condition is detected high water audible and visual indicators are activated to notify the user. The audible indicator may be muted by means of the mute/reset push button.

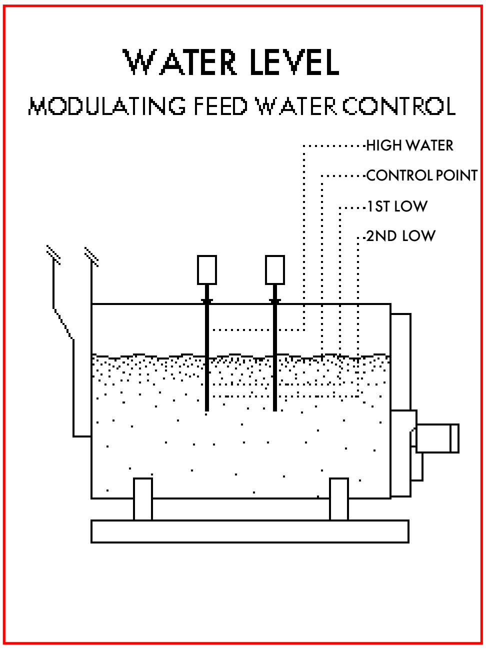
Control Point:
Ideal water level regulation point. There are no audible or visual indicators active.

1st Low:
A 1st low water level is a point below the control point at which the burner will turn off. If the water level falls below this point 1st low audible and visual indicators are activated. The audible indicator may be muted by means of the mute/reset push button. If the water level is restored above this point the burner will start automatically and all indicators will be reset.

2nd Low:
A 2nd low water level is a point below 1st Low at which the burner will remain off. If the water level falls below this point 2nd low audible and visual indicators are activated. The audible indicator may be muted by means of the mute/reset push button. Even if the water level is restored above this point the burner will remain off. Operator intervention is required to manually reset the system and can only be performed once the level is above the 2nd Low point - the water level L.E.D will flash when this condition is satisfied. The 2nd low reset condition is non-volatile - if the system is powered down the reset condition will be restored when power is reapplied. In this scenario the operator reset will still be necessary.

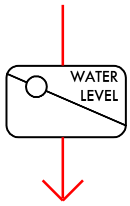
Bottom of probe:
The bottom of probe level is used to identify the point below which the probe cannot obtain a valid water level. It has no operational use.

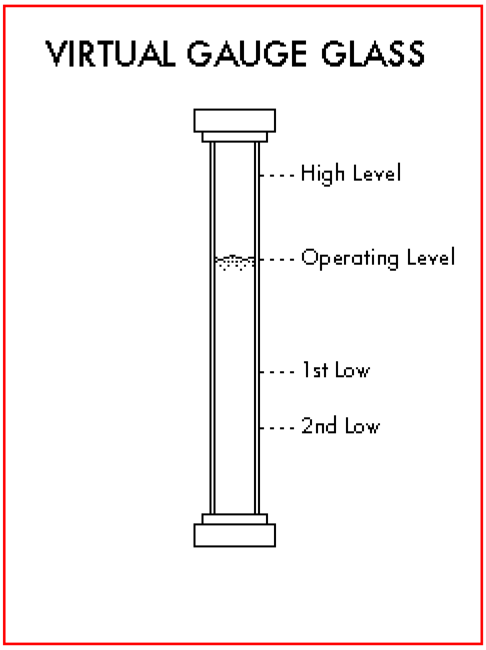
Several different displays are available to provide the operator with information when using the Water Level Control.



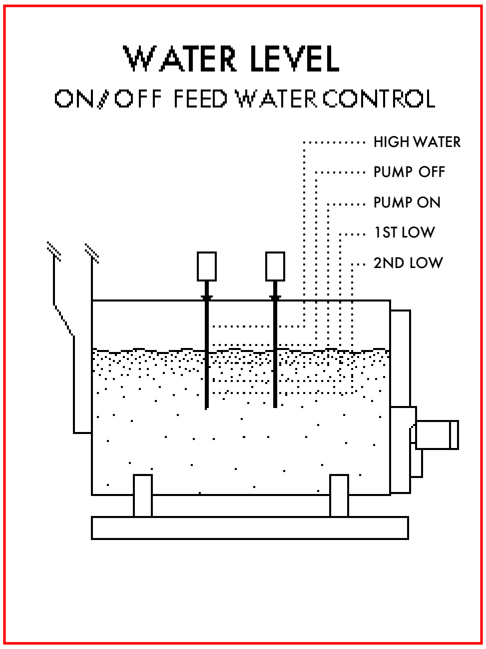
Boiler water level screen displayed for modulating standard water control.

PRESS



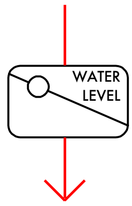


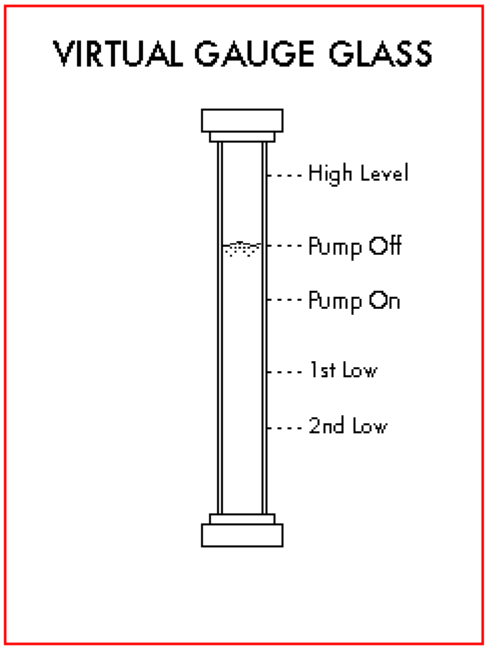
Virtual guage glass screen displayed for modulating standard water control.



Boiler water level screen displayed for on/off water control.

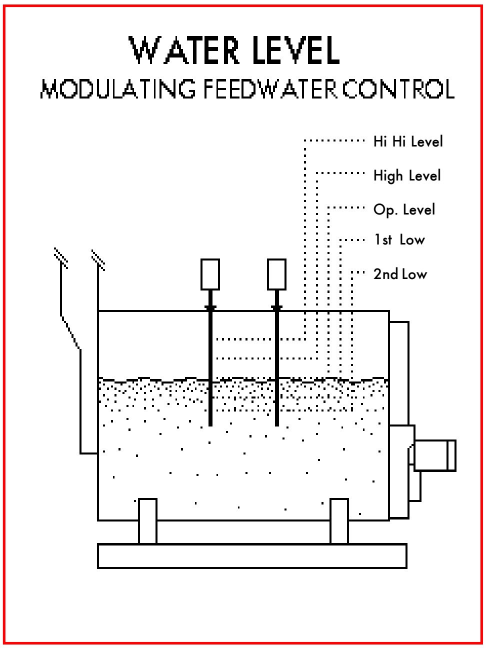
PRESS





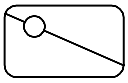
Virtual guage glass screen displayed for on/off water control.

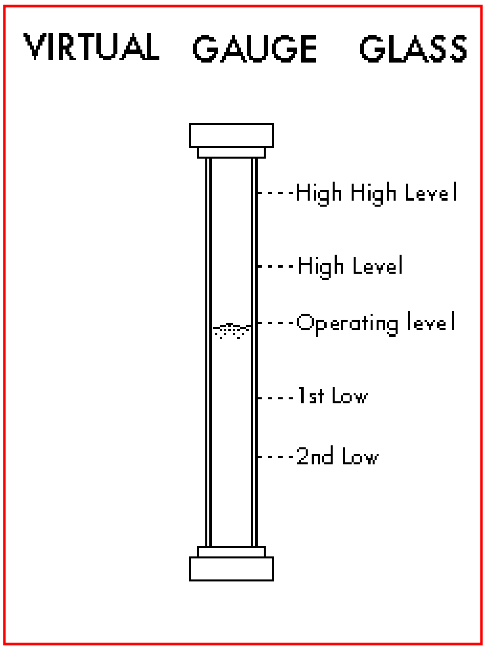
Several different displays are available to provide the operator with information when using the Water Level Control.



Boiler water level screen displayed for modulating high high water control.

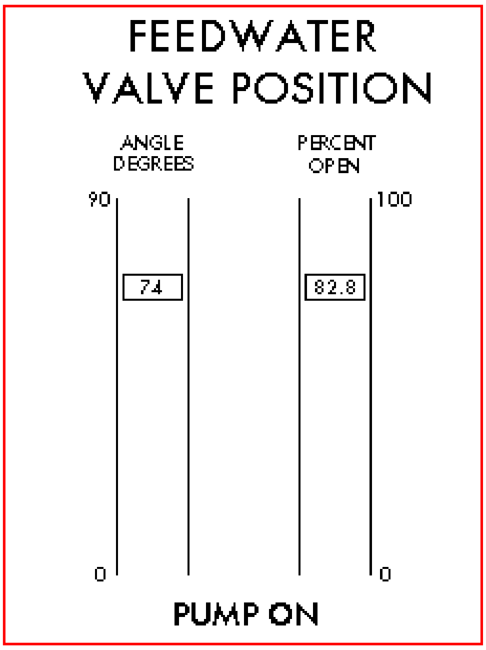
PRESS WATER LEVEL





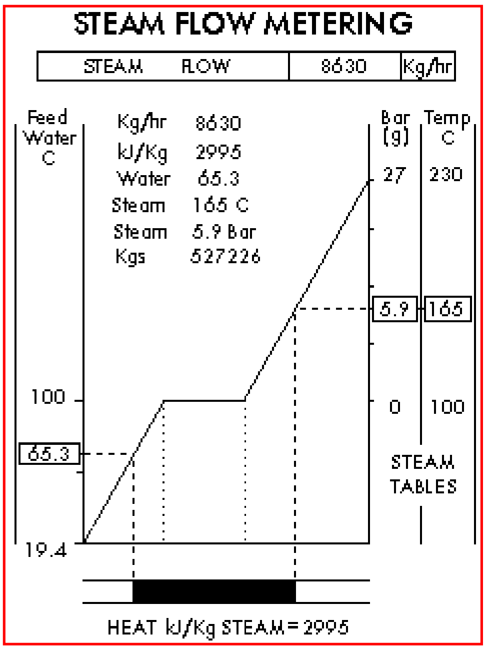
Virtual guage glass screen displayed for modulating high high water control.

From Virtual Gauge Glass Screen

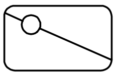


Feedwater Valve Screen
Autoflame Ball Valve

PRESS WATER LEVEL



Steam Flow Screen
Metric Units

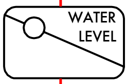


STEAM FLOW SCREEN

UNITS DISPLAYED

	IMPERIAL	METRIC
Steam Flow	lb/hr	Kg/hr
Heat/Steam	Btu/lb	KJ/Kg
Feedwater Temp.	F	C
Steam Temp.	F	C
Steam Pressure	PSI	Bar
Totalised Steam	lbs	Kgs

From Steam Flow Screen

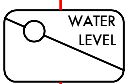
PRESS 

WATER LEVEL
ALARM RECORD

Occurred	26 November 2001	12:02:53
		2nd Low
Reset	26 November 2001	12:04:30
Occurred	26 November 2001	13:10:41
		1st Low
Reset	26 November 2001	13:15:07

Tuesday 27 November 2001 14:57:41

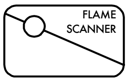
Water Level Alarm Record Screen

PRESS 

To Boiler Water Level Screen

5.11.3 First Out Status

If a water level control board is fitted, fifteen mains voltage inputs are available for first out status indication.

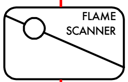
To select the first out status screen press 

until the screen is displayed. It is displayed between the VPS and lockout record screens.

The first out status indications are for monitoring only, they perform no burner control functions.

The descriptive labels for each input can be individually programmed by means of the infra-red upload software facility.

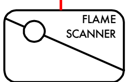
From VPS Status Screen

PRESS 

FIRST OUT STATUS

INPUT	TITLE	STATUS
1	SYSTEM PRESSURE LOW	NORMAL
2	BOILER HIGH LIMIT STAT	FAIL
3	HIGH GAS PRESSURE	NORMAL
4	BOILER FLOW SWITCH	NORMAL
5	FIRE CIRCUIT	NORMAL
6	LOW GAS PRESSURE	NORMAL
7		
8		
9		
10		
11		
12		
13		
14		
15		

First Out Status Screen

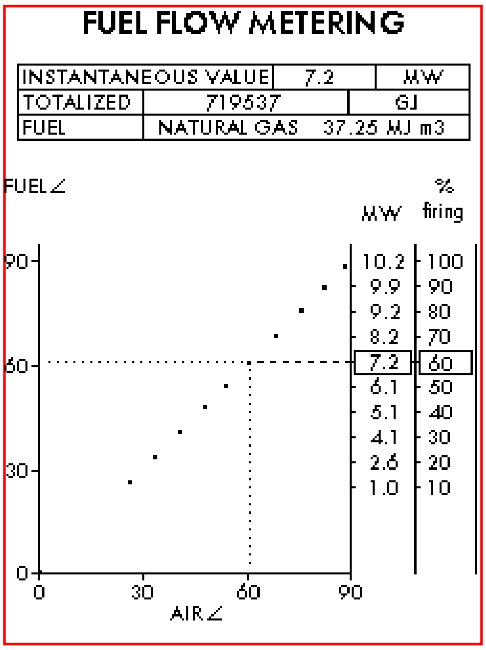
PRESS 

To Lockout Record Screen

For each input a status of FAIL indicates a mains voltage on the input to that particular terminal. A value of NORMAL indicates no mains voltage to the input.

Fuel Flow Metering

PRESS FUEL METERING



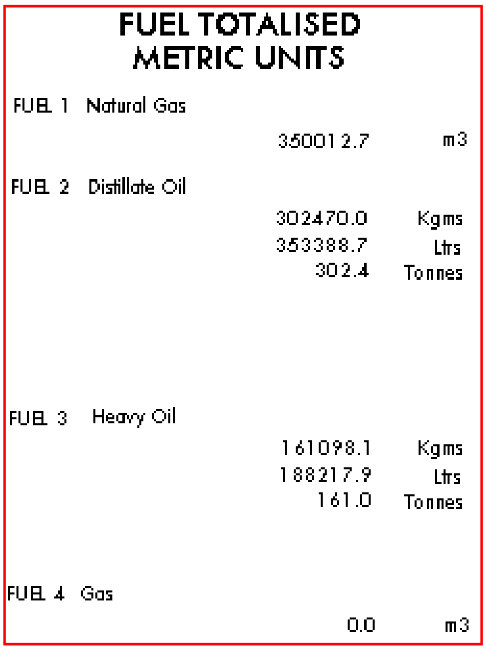
Fuel Flow Metering Screen
Metric Units

FUEL FLOW METERING SCREEN

As well as fuel flow metering information, this screen also shows a graphical profile of the FUEL/AIR ration profile derived from the CH1 and CH2 angular positions.

	UNITS DISPLAYED	
	IMPERIAL	METRIC
Instaneous Flow	Mbtu/hr	MW
Totalised Flow	Mbtus	GJ

PRESS FUEL METERING



Fuel Totalised Screen
Metric Units

FUEL TOTALISED SCREEN

	UNITS DISPLAYED	
	IMPERIAL	METRIC
Fuel 1	CUFt	m3
Fuel 2	lbs US glns US tons	Kgms Ltrs Tonnes
Fuel 3	lbs US glns US tons	Kgms Ltrs Tonnes
Fuel 4	CuFt	m3

5.11.4 Key to Alarms

2nd Low Level: The water level has fallen below the commissioned 2nd low position. If the alarm was preceded by a 1st Low alarm, the 1st low entry will be automatically replaced within the alarm log.

1st Low Level: The water level is currently below the commissioned first low position. If the alarm precedes a 2nd Low alarm, it will be automatically replaced by a 2nd Low alarm in the log. If the water returns to a level above the commissioned 1st Low level the entry will remain within the log but will be automatically reset.

High Water Level: The water level is currently above the commissioned high water position. This alarm will clear automatically when the water level is reduced below the commissioned High Water level.

Probe1/Probe2 Communications Failure The communications between the water level control and this probe have failed, exceeding the maximum allowed period of 3 seconds. Check Probe Wiring / Failed Probe

Probe1/Probe2 Short Circuit Failure: This probe's water level is currently outside of the normal operating limits range. This may be caused by a probe hardware failure. Contact your supplier for further details.

Probe Mismatch: The probe levels are not currently in line with commissioned levels suggesting a probe failure or alteration. This can also be caused by overheating of the electronics. It is important to lag the flanges if the probes are mounted directly into the boiler shell.

Probe1/Probe2 Temperature Compensation (TC) Failure: This probe's water level is currently outside of normal operating conditions when compensating the water level. Contact your supplier for further details.

Probe1/Probe2 Incorrect Commissioning Data: The commission data for this probe is corrupted/not valid. Contact your supplier for further details.

Probe1/Probe2 still water: The signal from this probe appears static indicating that the probe is not in water.

Probes Diverse: One probe is reading above high water, the other below 1st low water. Usually caused by auxiliay inputs incorrectly connected/optioned

Configuration Range Check Failed: One or more of the configuration options is outside of the allowed range. Contact your supplier for further details.

5.11.4 Key to Alarms

Permanent Reset Input:	The water level control or MM mute/reset button was pressed for longer than 10 seconds. To reset this alarm ensure that both buttons are not pressed for at least 10 seconds. This will then become a keystuck-reset alarm.
Keystuck Reset:	This alarm will occur after a permanent reset input fault.
Permanent Test Input:	The water level contrrol test input button was pressed for longer than 60 seconds.
Incompatible Configuration:	The configuration and commission data do not have matching control type options. This would occur if the configuration has been changed after commissioning.
Power Up EEPROM Failure:	The water level control has not been used before or has a faulty EEPROM. If the problem persists contact you supplier for further information.
Power Up- Incorrect state saved in EEPROM	The water level control has a corrupted EEPROM. If the problem persists contact your supplier for further information.

5.12 T.D.S. (Total Dissolved Solids) Management

5.12.1 The Philosophy of the T.D.S control system

To manage a steam boiler for optimum efficiency and reliability an important requirement is to ensure that the Total Dissolved Solids (T.D.S) in the water are measured and controlled to not exceed a nominated level. It is generally accepted that for water tube boilers the level of T.D.S measured should not exceed 1,500 PPM by volume and for smoke tube boilers the T.D.S should not be higher than 2,500 PPM by volume. The figures stated are not definitive and in all applications the recommendations of the boiler manufacturer or water treatment chemist should be implemented.

1) It has been established that the conductivity of water is proportional to the measured T.D.S as long as the temperature remains constant. Any variations in temperature will affect the measured conductivity by nominally 2% per 1degree C. It follows that the temperature of the water must be measured and the conductivity reading must be adjusted before a T.D.S reading can be extrapolated from this line of data.

The Autoflame system incorporates a temperature measurement sensor in the steam drum to establish the steam temperature. This data stream is used to constantly correct the conductivity value.

2) A second variable that effects the conductivity measurement is polarization of the water sample. This occurs when electrical energy from the probe builds up a relatively tiny offset above or below the earth (0 volt value). This polarization value is typically noticeable when a continuous frequency is being emitted from the probe as part of the conductivity measurement method.

The Autoflame system deals with the potential problem of polarization in the following manner. The probe measures any build up of voltage potential above or below earth or 0V in the water sample. The measured polarization voltage data is used to modify the conductivity calculation. The Autoflame system emits electrical energy at a rate of 10x 300 microsecond pulses every second. This translates into a method where we are emitting electrical energy for 0.6% of the sample time. All other manufacturers who use the frequency method are emitting electrical energy for 100% of the sample time. It follows that the polarization problem in these cases would be 167 times greater!.

3) A third problem that effects the accuracy of the T.D.S measurement is the build up of scale on the probe electrode. By design the water sampling container has been arranged so that the turbulence created during the blow down sequence will ensure that the probe remains effectively free of scale or deposited solids that could be held in suspension.

4) The sampling container has a known orifice size. From this it is possible to calculate the percentage losses due to surface blowdown. This is possible because the following parameters are known: Hole size, temperature, pressure, pressure drop across the solenoid and the time that the solenoid is open for.

It can be seen from the above that the Autoflame T.D.S system deals succinctly with three of the main problem areas that are encountered when designing an accurate T.D.S control solution.

5.12.2 T.D.S Calibration (User Calibration Method)

The calibration of the Autoflame T.D.S control system should be carried out as detailed below.

1) When the boiler is at operating pressure/temperature and in a steady state condition the calibration should be initiated by pressing the "COM" button with respect to the T.D.S. This will implement a top blow down and sample sequence (see pages 5.12.6.1 and 5.12.6.2). At this time a conductivity value at a specific temperature and pressure will be measured and stored in the systems memory (see point A on diagram, page 5.12.7).

2) A sample of boiler water can be taken via the probe container and cooled nominally to 25 degrees C / 77 degrees F. Autoflame can supply a cooler that is close coupled to the T.D.S probe mounting pot (see schematic pages 5.12.5.1 and 5.12.5.2).

3) The cooled sample must be analyzed for T.D.S content (PPM by volume). A hand held portable instrument typically as manufactured by "Hanna Instruments" can be used for this purpose (type HI98312). It is a vital part of this process that the hand held instrument is correctly calibrated in the manufactures recommended calibration solution. A water treatment chemist can carry out this task if required.

4) When a T.D.S level is displayed on the chosen portable instrument, this value can then be entered into the Autoflame T.D.S control system (see point D on diagram page 5.12.7). This action will establish the relationship between T.D.S PPM by vol with the conductivity value that is already held in memory (point A on diagram page 5.12.7).

5) When the above sequence of events have been implemented the "RUN" button with respect to T.D.S can be pressed and the system will be calibrated and ready to setup the designed operational profile (see page 5.12.4).

5.12.3 T.D.S Calibration (Automatic Internal Calibration Method)

The calibration of the Autoflame T.D.S control system should be carried out as detailed below.

1) When the boiler is at operating pressure/temperature and in a steady state condition the calibration should be initiated by pressing the "COM" button with respect to the T.D.S. This will implement a top blow down and sample sequence (see pages 5.12.6.1 and 5.12.6.2). At this time a conductivity value at a specific temperature and pressure will be measured and stored in the systems memory (see point A on diagram, page 5.12.7).

2) When the above sequence of events have been implemented wait one minute then the "RUN" button with respect to T.D.S can be pressed and the data at point 'B' (se page 5.12.7) will be calculated and entered into the system memory. The system is now calibrated and the setup of the designed operational profile of the system can now be made (see page 5.12.4).

5.12.4 Control & Management of Total Dissolved Solids in a steam boiler. T.D.S Top Blowdown

The sampling and control sequence is as detailed below.

1) If the boiler water sample is above the required T.D.S value the system will open the top blowdown control valve for 5-300 seconds. This time duration is user variable and is designated B.D.T (Blow Down Time).

2) After blow down the system invokes a 5 second settlement interval.

3) After the settlement period a 5 second measurement routine is carried out to establish the current T.D.S. level, (see page 5.12.6.1, figure 1) schematic for measurement and sampling sequence.

4) If the boiler water sample is still above the required T.D.S. value the system will repeat the top 'BlowDown Time' routine as detailed above in 1) B.D.T.

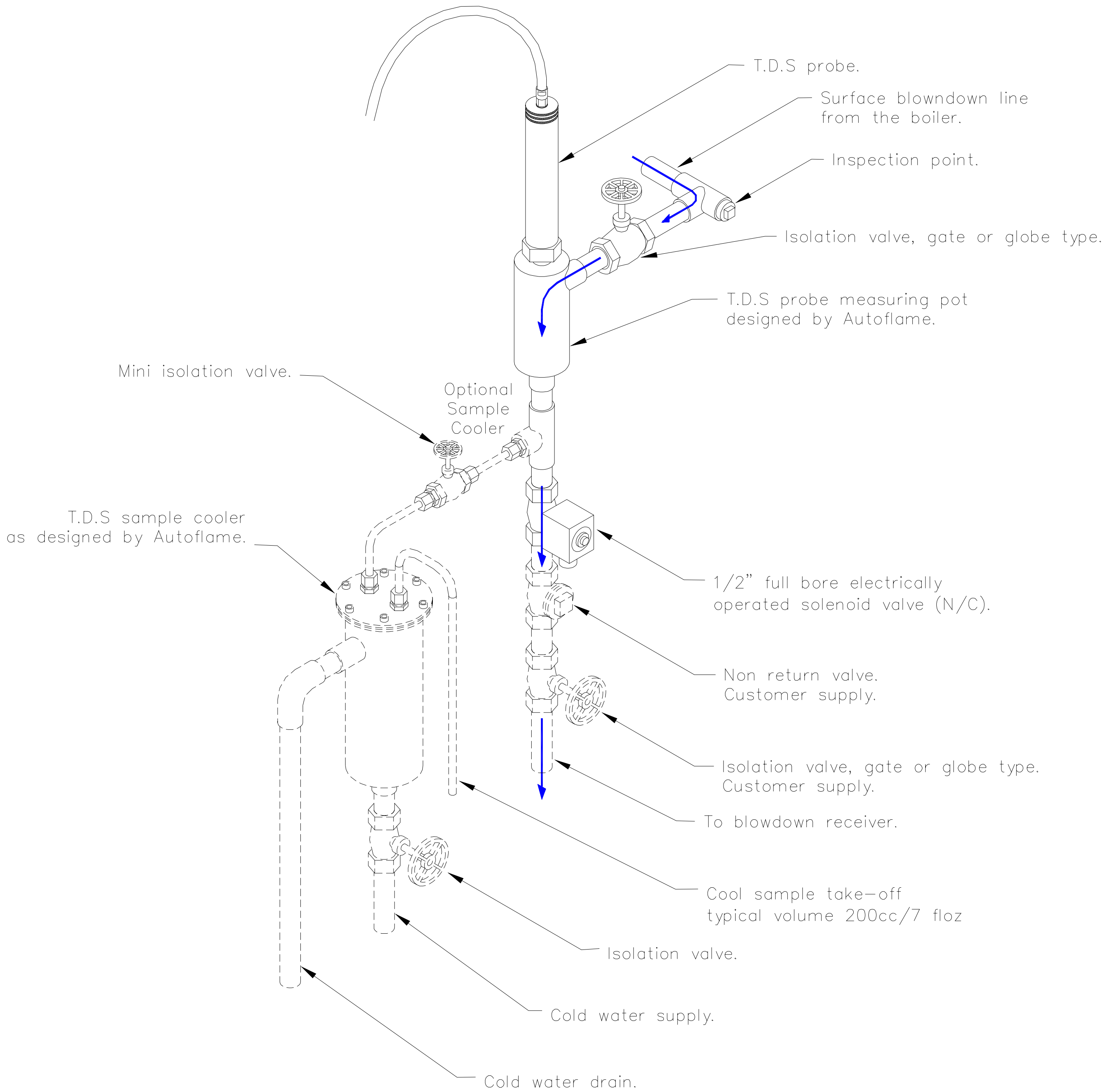
5) When the boiler water sample is measured as below the required T.D.S. level, the system will then take a sample every 60-300 seconds. (S.T.I.) This 'sample time interval' is user variable.

6) The 'duration of the sample time' is 3-10 seconds. (D.S.T) This is user variable.

7) When the boiler water sample is measured as above the required T.D.S level
item 1) is repeated.

5.12.5.1 Installation of the T.D.S. probe assembly

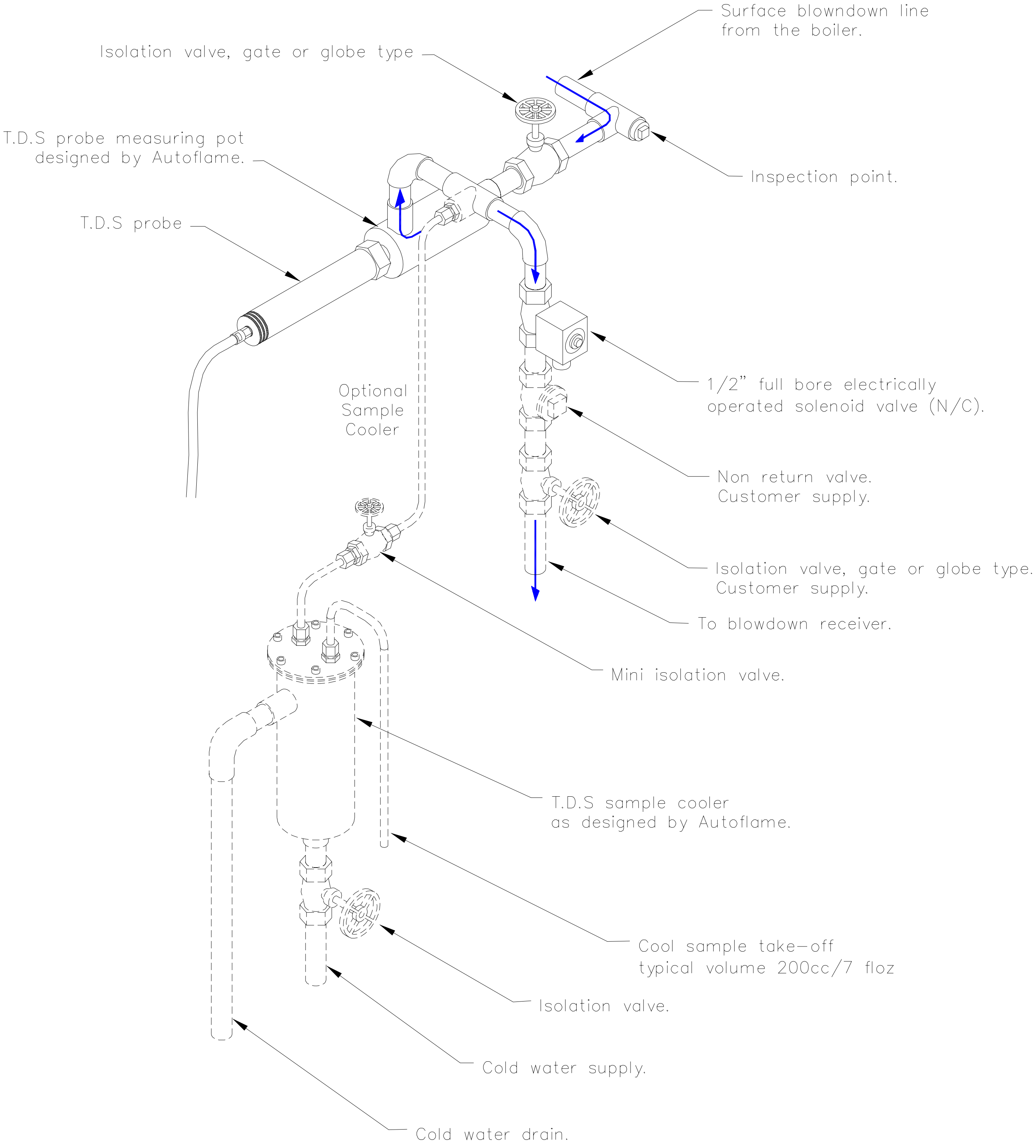
Illustrated below are two installation methods for the T.D.S probe incorporating Autoflame's sampling system.



All dotted componients supplied by the customer.

Option 1: Vertically mounted

Option 2: Horizantally mounted



All dotted components supplied by the customer.

5.12.6 Schematic detail of the measurement and sample routine.

The time for one complete measurement cycle is 3 Milliseconds. It can be seen that 10 measurement cycles are made within one second. These measurements are averaged over one second. Conductivity is calculated by dividing measured milliamps by 0.5 volts which gives a value in micro siemens.

At the start of each measurement cycle the sample is checked for polarization. This background voltage effect is taken into the conductivity calculations.

Temperature and pressure is measured by the Autoflame system and this information is used to continually modify the calculated conductivity/T.D.S value from its calibrated point. Nominally for every 1 degree C increase or decrease, 2% is added or subtracted from the conductivity value. The exact figure is calculated by the system.

The system relates conductivity in micro siemens to T.D.S in P.P.M by a 0.7 multiplier. Within the control software there is an adjustment of +/- 7% for this multiplier which is user variable.

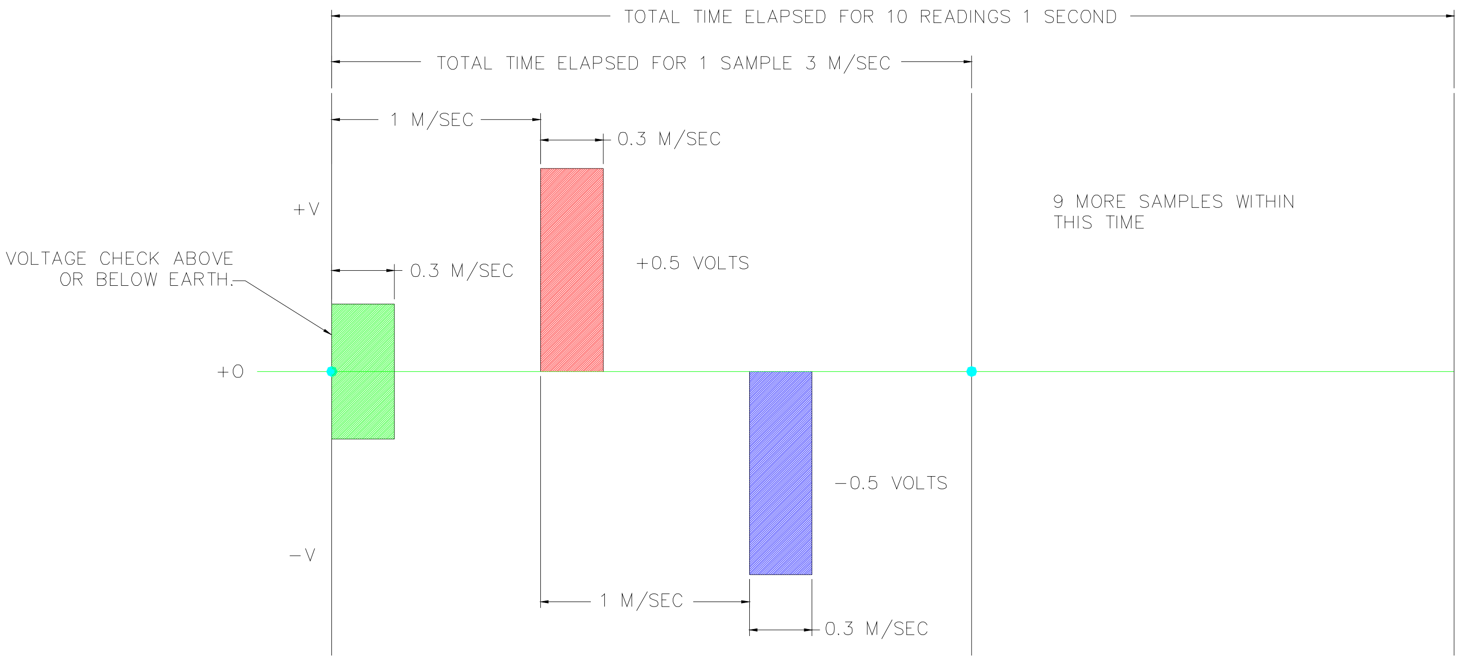


figure 1.

The T.D.S system logs each of the samples within the 1 second time period, It takes all 10 sample values, adds them together then divides them by 10 to obtain the average T.D.S value for the one second period as illustrated in figure 2.

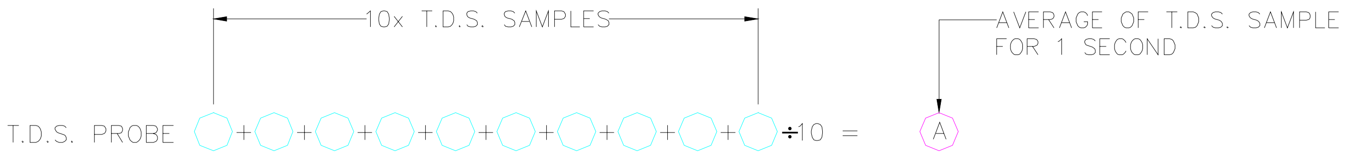


figure 2.

Once the T.D.S software has calculated the average T.D.S value for the 10 samples within one second, it will then extract these averages and add the last 10 together and divide them by ten to give the actual T.D.S reading as shown in figure 3. This value will be displayed on the MM.

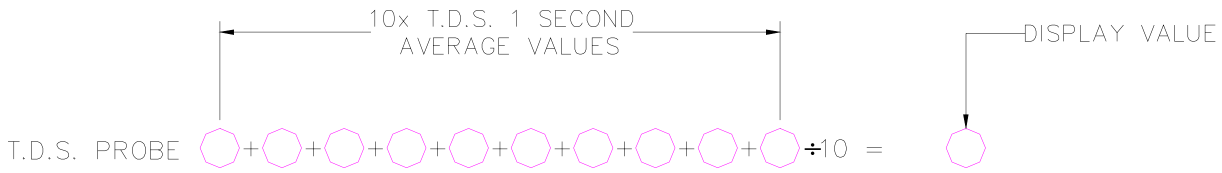
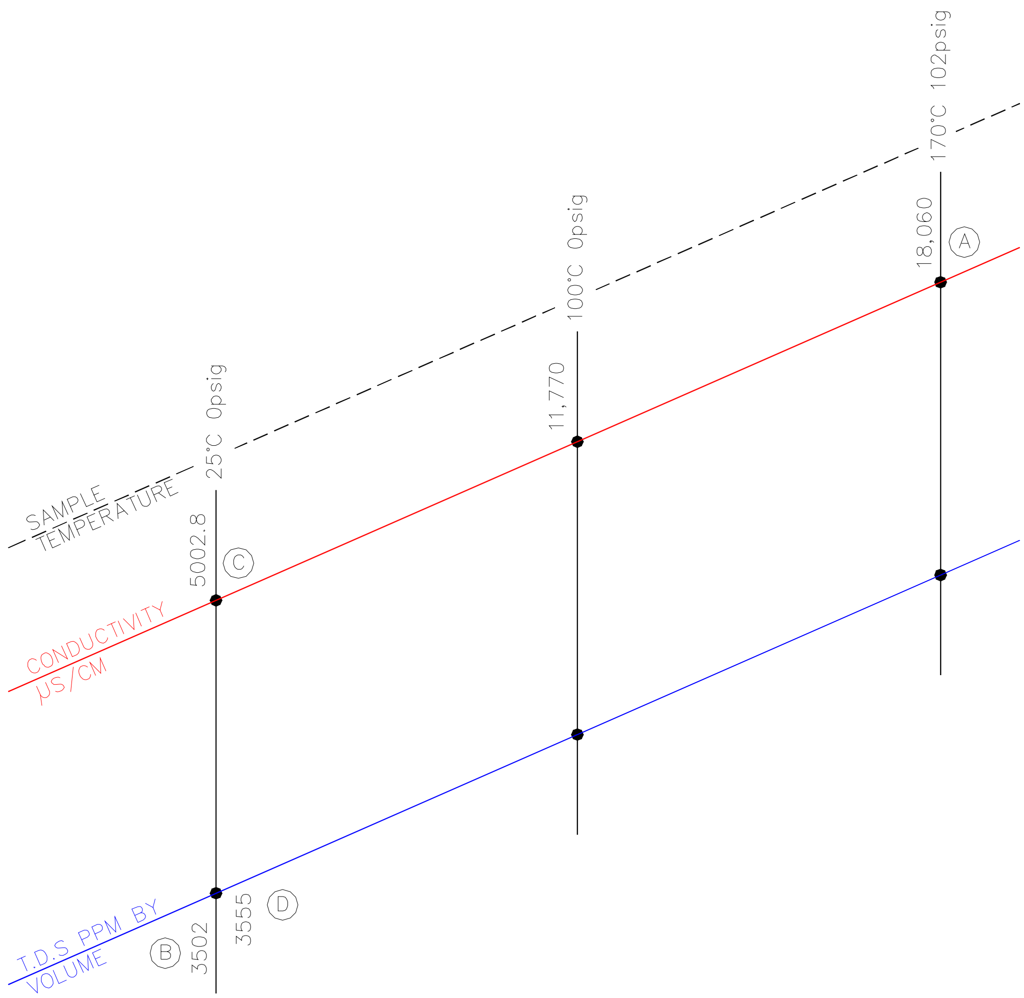


figure 3.

When a new average of the 1 second samples is obtained the software will utilize the last 9 averages, It will then add the new average to them and divide it by 10 to obtain the new T.D.S value.

5.12.7 Relationship between Conductivity, Temp and T.D.S values.

A = These values measured by probe & sensors at operating steady state conditions.
B = This value is conductivity value multiplied by 0.7 (TDS in PPM)
C= This conductivity value temperature corrected to 25 degrees C / 77 degrees F.
D= This is measured T.D.S value entered into the system to effect a user "calibration".



1) Conductivity measurement corrected at 2% per 1 degree C.
2) At 25 degrees C T.D.S in PPMv is calculated by multiplying the conductivity value by 0.7.
3) Both of the above multipliers are user variable to accommodate specific site conditions.

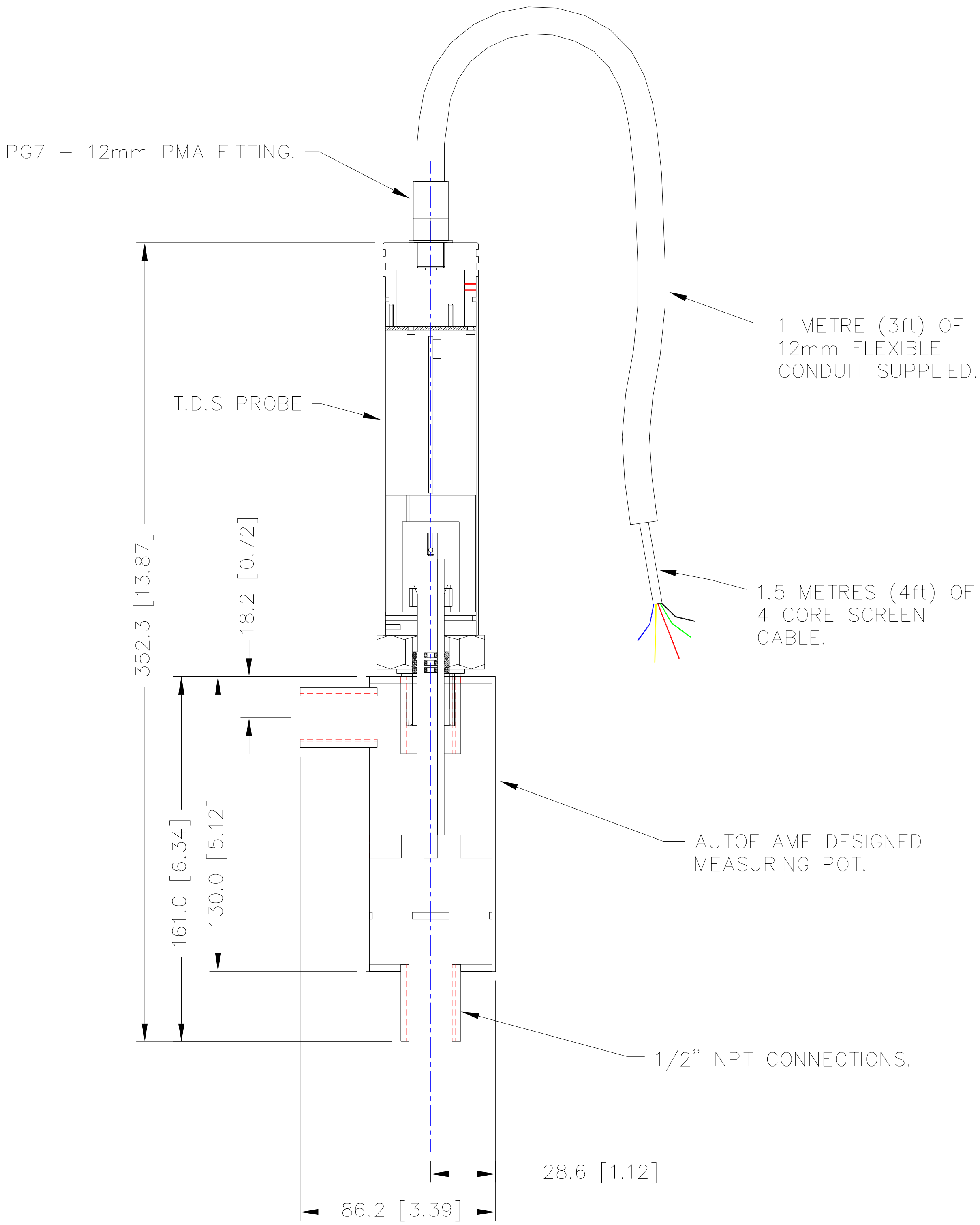
1: At the time of manufacture every T.D.S. probe has buried in its electronics memory a "Calibration Correction Coefficient" or C.C.C. This is effected as set out under.

The T.D.S probe in a sampling vessel is immersed in a boiler water sample of a known T.D.S (i.e. 3500 ppm for example). This is carried out at 25 degrees C (77 degrees F) which would give a reading in microsiemens of 5000. If the reading off of the probe electronics does not agree with this a correction multiplier or divider is implanted into this specific probes electronic memory. This is its own dedicated C.C.C value.

2: The perfect solution for T.D.S control would be that the minimum amount of surface blowdown is carried out to keep the dissolved solids at or below the nominated value set on the controller. It follows that the amount of surface blowdown required is directly proportional to the evaporation rate and therefore the firing rate of the boiler/burner unit.

If for example the boiler is operating at a steady state rate of 50% evaporation the amount of blowdown time would have to be doubled at 100% rate or M.C.R and halved if working at 25% or 4:1 turn down. There is an option within the software to enable this facility which will guarantee that minimum energy is lost to surface blowdown while ensuring sufficient blowdown is implemented to keep T.D.S levels at the desired value. This is possible because the Autoflame system knows the firing rate of the burner.

5.12.8 T.D.S Probe and Autoflame Sampling Vessel



<u>5.12.9 Top Blow Down Management</u>

The day to day Top Blow Down Management user screen is shown below. The system will open the top blow down valve on an intelligently timed basis such that the MEASURED value of Total Dissolved Solids (TDS) is maintained at or just below the TARGET value. The screen is selected by means of the WATER LEVEL button and appears next after the Bottom Blow Down screen. The screen will only be displayed if Water Level setup 23.1 is set to Enabled.

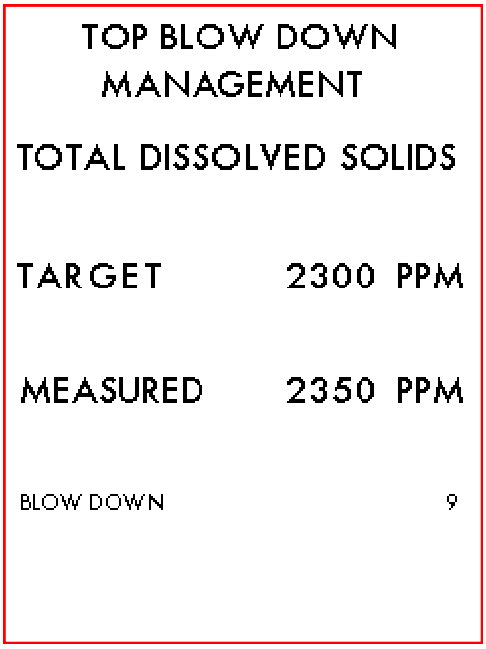
At the bottom of the screen the various stages of top blow down are displayed as they occur, with a down counter indicating the number of seconds left for this stage. When the Top Blow Down is operating the possible messages are:

BLOW DOWN MEASURE
SETTLEMENT
MEASUREMENT
BLOW DOWN
INTERVAL

If the burner is not firing the following is displayed:
TOP BLOW DOWN NOT OPERATING
BURNER NOT FIRING

If the buner is firing and steam pressure is not up to the Threshold Offset the following is displayed:
TOP BLOW DOWN NOT OPERATING
STEAM PRESSURE BELOW THRESHOLD

If there is no data being received from the TDS probe following is displayed:
TOP BLOW DOWN NOT OPERATING
WARNING PROBE FAULT



5.12.9.2 Adjustment of T.D.S. Target Value

Whilst the day to day Top Blow Down Management screen is being displayed press the COM button for 2 seconds. The SET TDS TARGET VALUE screen shown below will be displayed. The WATER LEVEL & COM leds will be on & the RUN led flashing. Use the channel 3 UP/DOWN buttons to adjust the TARGET value units. The channel 5 UP/DOWN buttons can also be used to change the value by 10s. Note while in this screen there is no top blown down operation. Press RUN to go back to normal operation. When the run button is pressed the new TARGET value is stored in memory.

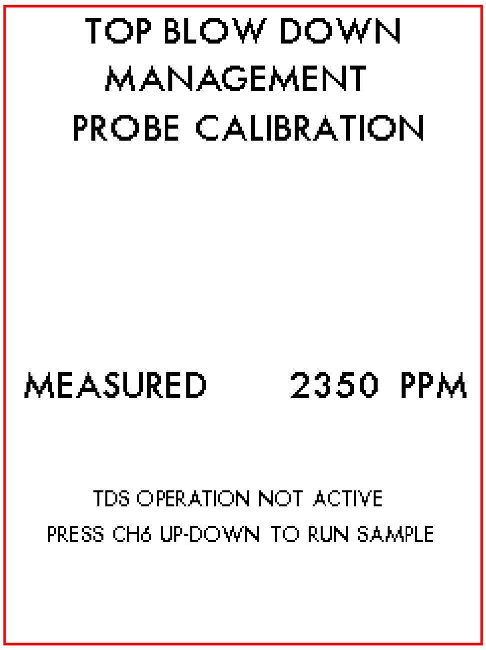
TOP BLOW DOWN
MANAGEMENT
SET TDS TARGET VALUE

2300 PPM

5.12.9.3 T.D.S. Probe Calibration

If it is deemed necessary to adjust the TDS probe calibration proceed as follows.

Whilst the day to day Top Blow Down Management screen is being displayed press the COM button for 2 seconds so that the SET TDS TARGET VALUE screen is shown. The WATER LEVEL & COM leds will be on & the RUN led flashing. Press the Water Level button once. The PROBE CALIBRATION screen shown below should be displayed. Note while in this screen there is no top blown down operation. Press the channel 6 UP/DOWN buttons simultaneously to invoke a single BLOW DOWN MEASURE sequence to bring new boiler water sample into the TDS probe measurement chamber. If necessary repeat this process until a stable reading is produced. Use the channel 3 UP/DOWN buttons to fine adjust the MEASURED value. The channel 5 UP/DOWN buttons can also be used to provide a coarse adjustment. Adjust the value a little at a time - it takes one or two seconds for the value to respond to the change. If the value overshoots adjust back as necessary. Press RUN to return to normal operation. When the run button is pressed the corrected reading is stored in memory.



5.12.9.4 Top Blow Down Adjusters

The Top Blow Down Adjusters allow the Top Blow Down Operation to be adjusted to suit boiler run conditions.

Whilst the day to day Top Blow Down Management screen is being displayed press the COM button for 2 seconds so that the SET TDS TARGET VALUE screen is shown. The WATER LEVEL & COM leds will be on & the RUN led flashing. Press the Water Level button twice. The ADJUSTERS screen shown below should be displayed. Note while in this screen there is no top blown down operation.

Use the channel 2 UP/DOWN buttons to select the item to be adjusted EG Sample Interval Time. Use the channel 3 UP/DOWN buttons to adjust the value units. Where appropriate the channel 5 UP/DOWN buttons can also be used to change the value by 10s. Press RUN to return to normal operation. When the run button is pressed all Adjuster values are stored in memory.

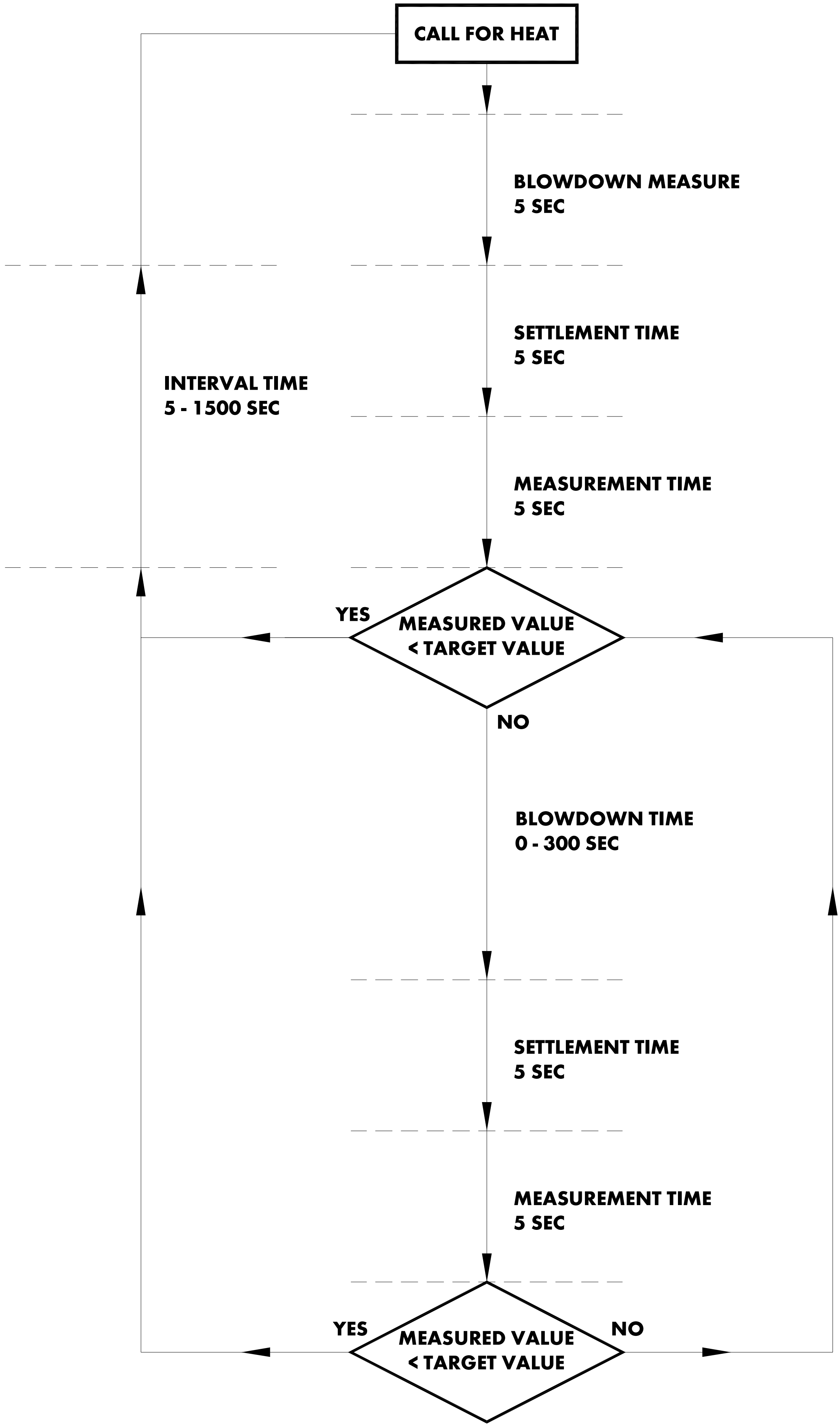
TOP BLOW DOWN
MANAGEMENT
ADJUSTERS
Blow Down Time

CURRENT SETTING: 50

50 Seconds

Factory Setting	Setup Value	Description
60	0-300	**Blow Down Time:** Time the Top Blow Down valve is opened for.
60	5-1500	**Interval Time:** Time between Top Blow Down samples.
Disabled	Disabled 1-100% enabled disabled	**Load Dependant Blow Down Timing:** If disabled not effected. Value entered is a load index reference point - ideally the load index point at which the Top Blow Down operation was set up. For example: set to 50%. When the top Blow Down takes place if the current load index postion is 100% the Blow Down Time will be doubled. (100/50). If at 25% the Blow Down Time will be halved (25/50). Note the Load Index must be entered before Top Blow Down is commisioned. (See Options 57&65)
0.70	0.50- 1.50	**MicroSiemens To TDS Factor:** The TDS probe measures conductivity in microSiemens. This factor is used to derive the TDS value in ppm. EG 5000uS * 0.7 = 3500 ppm.
Disabled	Disabled 1-50PSI 1-5.0BAR	**Steam Pressure Threshold Offset Below Required:** If the MM ACTUAL value is less than the REQUIRED value minus this offset then the Top Blow Down does not operate. For example: Required = 100PSI Offset value = 10PSI. Top Blow Down starts to operate when steam pressure reaches 90PSI. Once this threshold is met after the burner fires Top Blow Down stays operating even if the presure drops below thereafter.
NO	NO YES	**Reset defaults:** Resets all adjusters to default values & TDS probe to preset calibration. Select YES then press RUN.
ppm	ppm uS	**Sets ppm or microSiemens (uS):** ppm microSiemens
0	0- 1-	**High limit alarm:** Disabled. Enabled- value set is an offset above the target value at which alarm trips. **Note:** Once the limit has been exceeded terminal #79 will be set, the top blowdown screen will be displayed and the water level LED will flash. Press the water level button to mute the alarm. The alarm limit value will flash until the measured TDS value has fallen below the limit value. Another alarm will not be generated until the measured TDS value has been continuously below the limit value for 10 minutes.

<u>5.12.9.6 T.D.S. Timing Diagram</u>



Section 6: D.T.I. Data Transfer Interface

6.1 Data Transfer Interface Module

6.1.2 Overview of Data Transfer Interface Operation

By means of the Autoflame Data Transfer Interface (D.T.I.) module, all of the operational data, stored within each of up to ten M.M. modules, can be collected by the D.T.I. for transmission to a local terminal (PC), screen and printer, Building Management System (B.M.S.) or PLC. This facility can also be achieved remotely via modem/telecom link up. This cost effective system more than meets the requirements of today's E.M.S. and B.M.S. systems in providing all the necessary operational and alarm status and control of boiler plant to achieve its maximum energy efficient operation.

Up to a maximum of ten M.M. modules (one per burner) can be connected to one D.T.I. module by means of a series RS485 data link (daisy chain). The information gathered by the D.T.I. from each M.M. module is then available for transmission to the E.M.S. or B.M.S. via either an RS232 data link, an RS422 data link, an RS485 data link or modem/telecom data link. The RS232 and RS422 data links are used to send the data via the Autoflame software package for PC management or MODBUS communications for a Building Management System. The RS485 data link is used to send the data via Metasys communications.

Remote on/off control of the burners can also be achieved as well as adjustment of the temperature or pressure setpoints and selection of sequencing order. To accommodate the status information from other plant related equipment, the D.T.I. can handle upto 160 direct mains voltage inputs, 80 volt free outputs, 60 4-20mA inputs and 60 4-20mA outputs. Typical remote E.M.S., B.M.S. information and operational facilities that can be achieved are as follows, but are subject to the particular site and management system requirements that are to be accommodated.

The capability exists within the standard D.T.I. software for the end user to label any mains voltage signal input as an "Alarm" condition. When labelled as an "Alarm" condition the system can 'autodial' out onto the general telephone network to a remote office. It is also possible via a MODBUS to Ethernet converter to utilise this feature for data aquisition.

6.2 Information avaiable from the DTI

DTI Information:

MM Information:

Required boiler temperature (deg. C/F) or pressure (Bar/psi).
Actual boiler temperature (deg. C/F) or pressure (Bar/psi).
Burner on/off status.
Burner maximum firing rate.
Burner firing rate (%).
Fuel selected.
Control detector type (temperature/pressure).
Error conditions.
Low flame hold operation.
Hand operation.
Channel 1-Channel 4 positioning motor feedback signal
Channel 5-Channel 6 output and input signals to the VFD (inverter)
Maximum set point accepted from DTI.
Minimum set point accepted from DTI.
Lead boiler status.
Burner firing status (off, firing, purge, ignition).
Sequencing optioned.
Sequence status (on, stand-by, warm, off).
Enabled/disabled status.
Total hours run and number of start-ups per fuel.
Fuel type, instantaneous flow rates and totalised flows per fuel.
Online air and fuel pressure values.

EGA Information:

EGA operation optioned.
Flue gas oxygen present value.
Flue gas carbon dioxide present value.
Flue gas carbon monoxide (unburnt combustibles) present value.
Flue gas nitirc oxide present value.
Flue gas sulphur dioxide present value.
Flue gas exhaust temperature, ambient temperature and delta temperature present value.
Combustion efficiency present value.
Flue gas oxygen commission value.
Flue gas carbon dioxide commission value.
Flue gas carbon monoxide (unburnt combustibles) commission value.
Flue gas nitirc oxide commission value.
Flue gas sulphur dioxide commission value.
Flue gas exhaust temperature, ambient temperature and delta temperature commission value.
Combustion efficiency commission value.
Cooler condition.
Identification number.
Fuel selected.
EGA error conditions.

DTI Information:

DTI Input values:

Boiler enable/disable.
Change required set point.
Select lead boiler.
Shuffle sequencing.
Set Load Index.

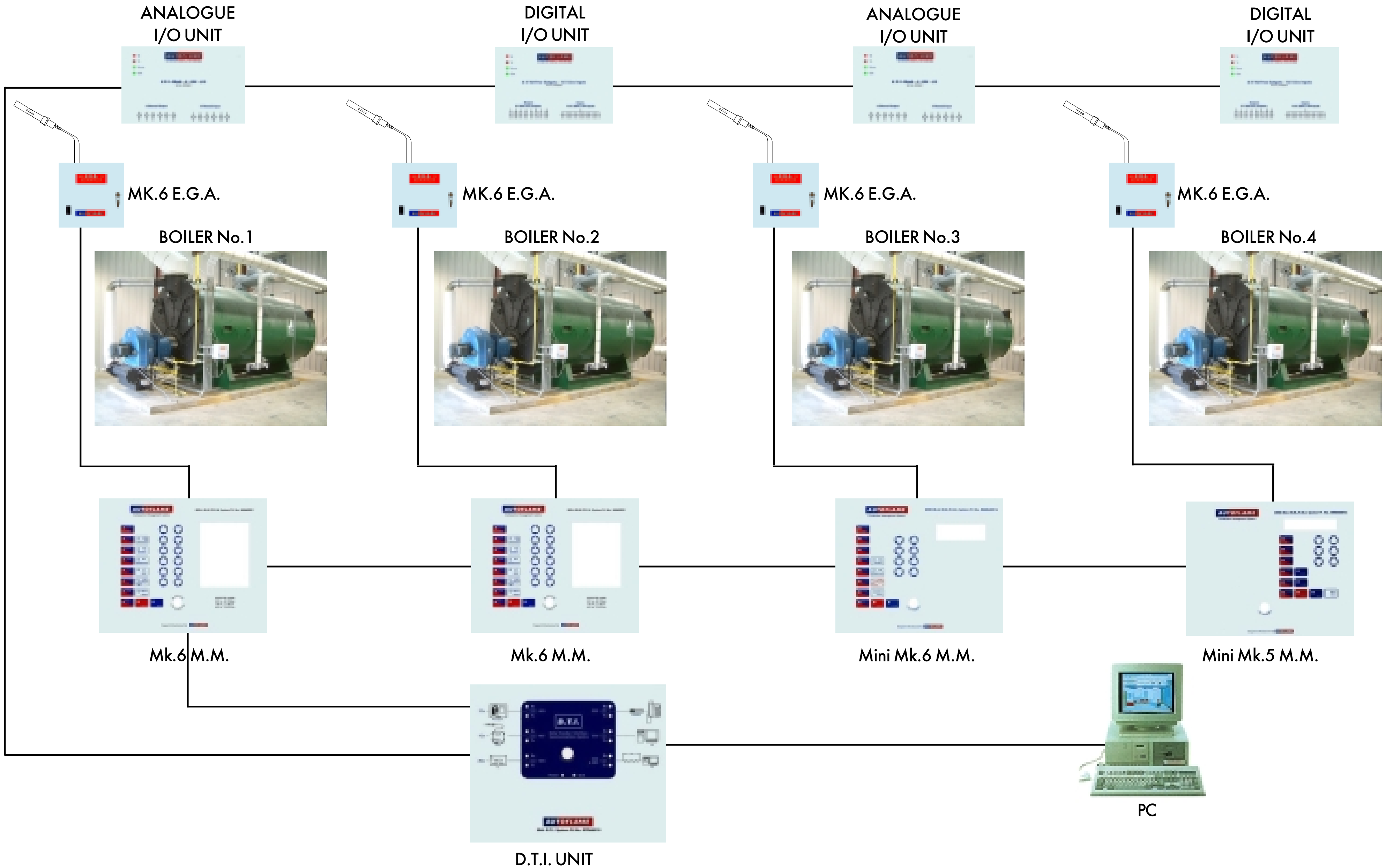
Water Level Information:

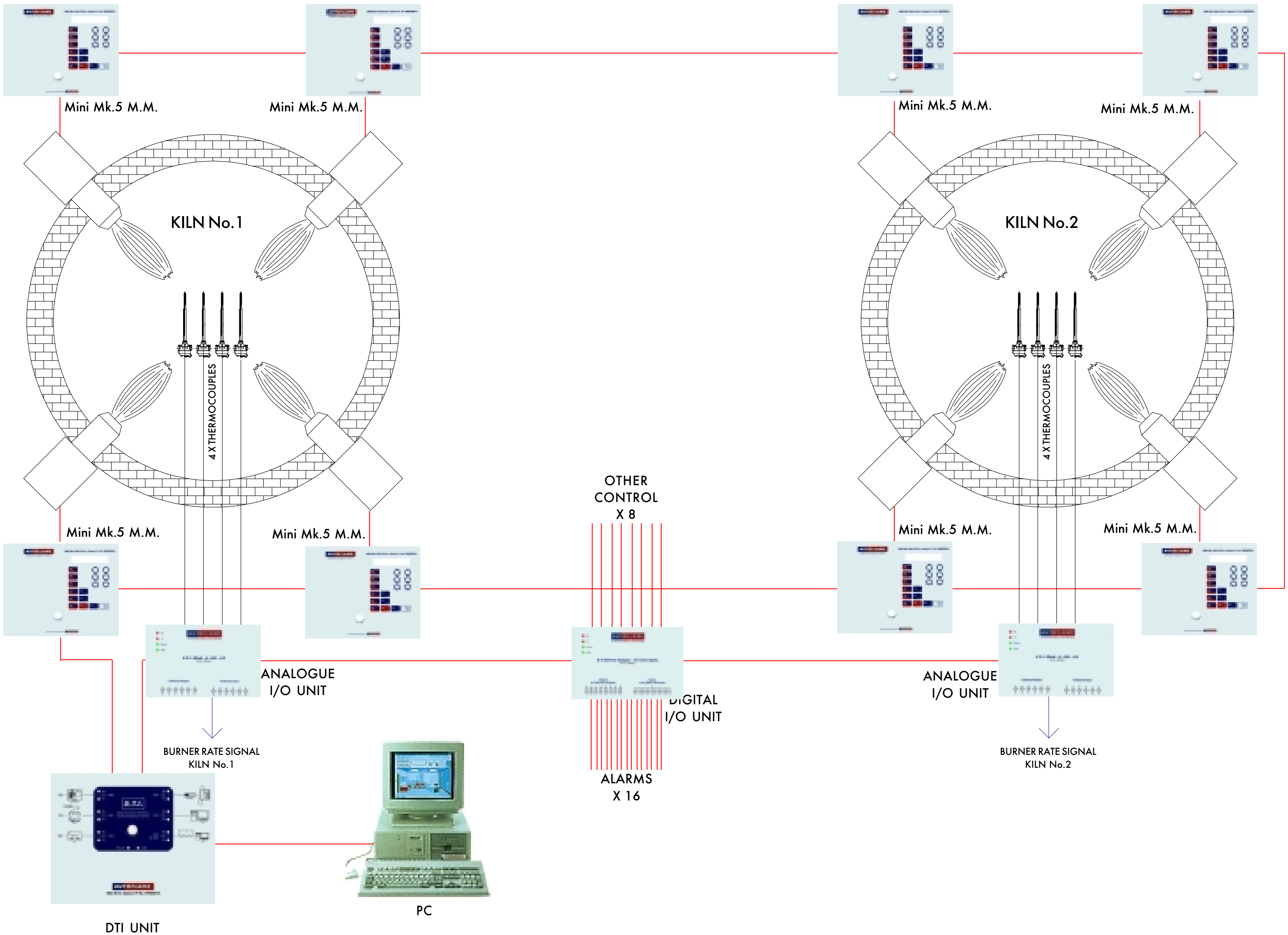
Actual Water Level
End of probe position
2nd low position
1st low position
1st low pre-alarm position
Control point position or pump on and pump off positions
High water pre-alarm position
High water position
15 First Out Annunciation inputs status
Instantaneous steam flow metering
Totalised steam flow metering
Feed water temperature
Steam temperature

Continuous Emissions Monitoring Software (CEMS):

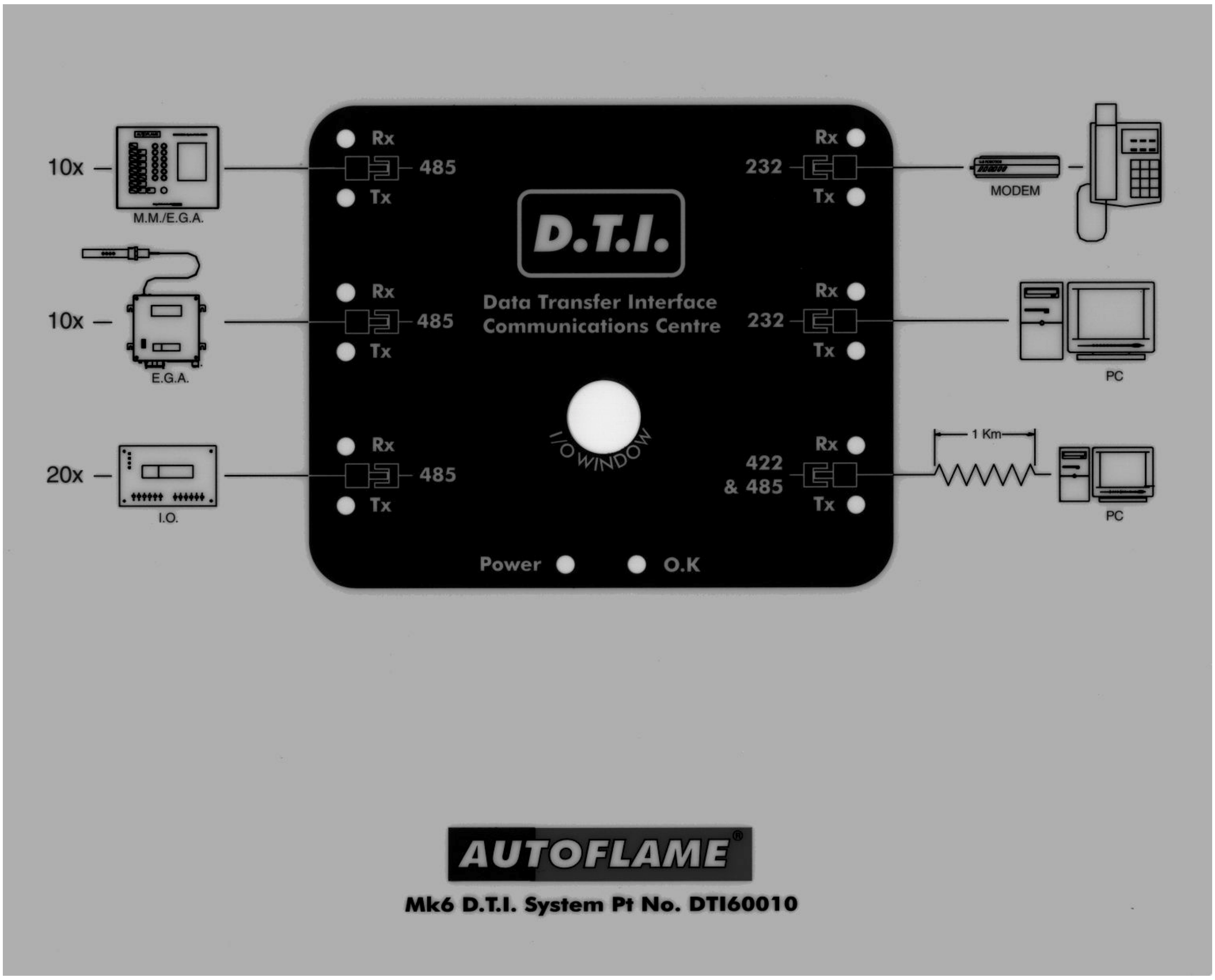
Current emissions by weight and volume (O_2, CO_2, CO, NO, SO_2, H_2O, N_2, Total)
Totalised emissions by weight (O_2, CO_2, CO, NO, SO_2, H_2O, N_2, Total)
Efficiency
Exhaust temperature
Boiler exit velocity
Total heat input into boiler
Net useful heat into boiler
Heat loss to stack
Fuel flow

Complete DTI Standard System Application Example

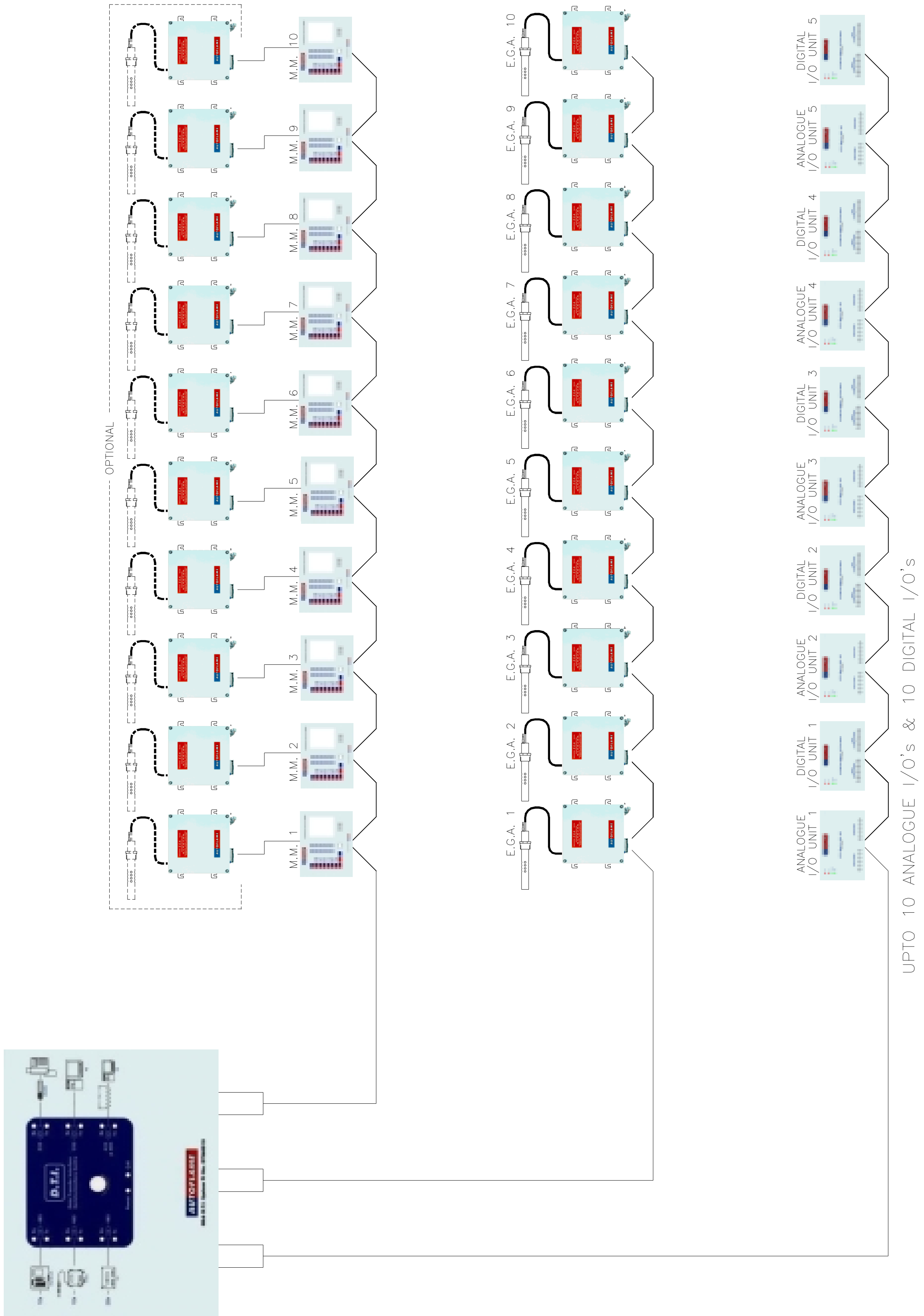



Mini Mk.5 M.M.
Mini Mk.5 M.M.
Mini Mk.5 M.M.
Mini Mk.5 M.M.
KILN No.1
KILN No.2
4 X THERMOCOUPLES
4 X THERMOCOUPLES
Mini Mk.5 M.M.
Mini Mk.5 M.M.
Mini Mk.5 M.M.
Mini Mk.5 M.M.
OTHER
CONTROL
X 8
ANALOGUE
I/O UNIT
DIGITAL
I/O UNIT
ANALOGUE
I/O UNIT
BURNER RATE SIGNAL
KILN No.1
BURNER RATE SIGNAL
KILN No.2
ALARMS
X 16
DTI UNIT
PC

6.5 Front Facia Layout



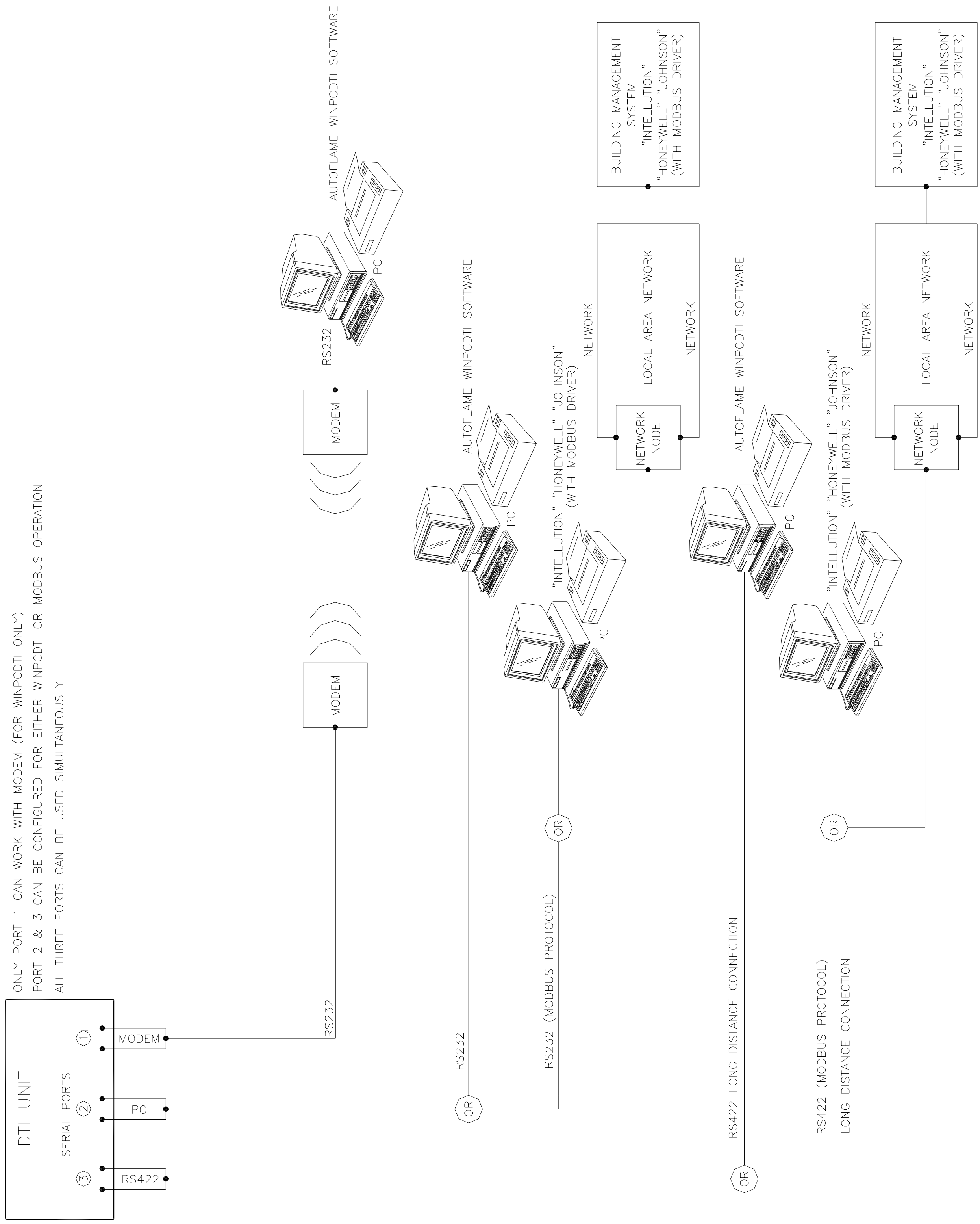
6.7 Input/Output System Capabilities



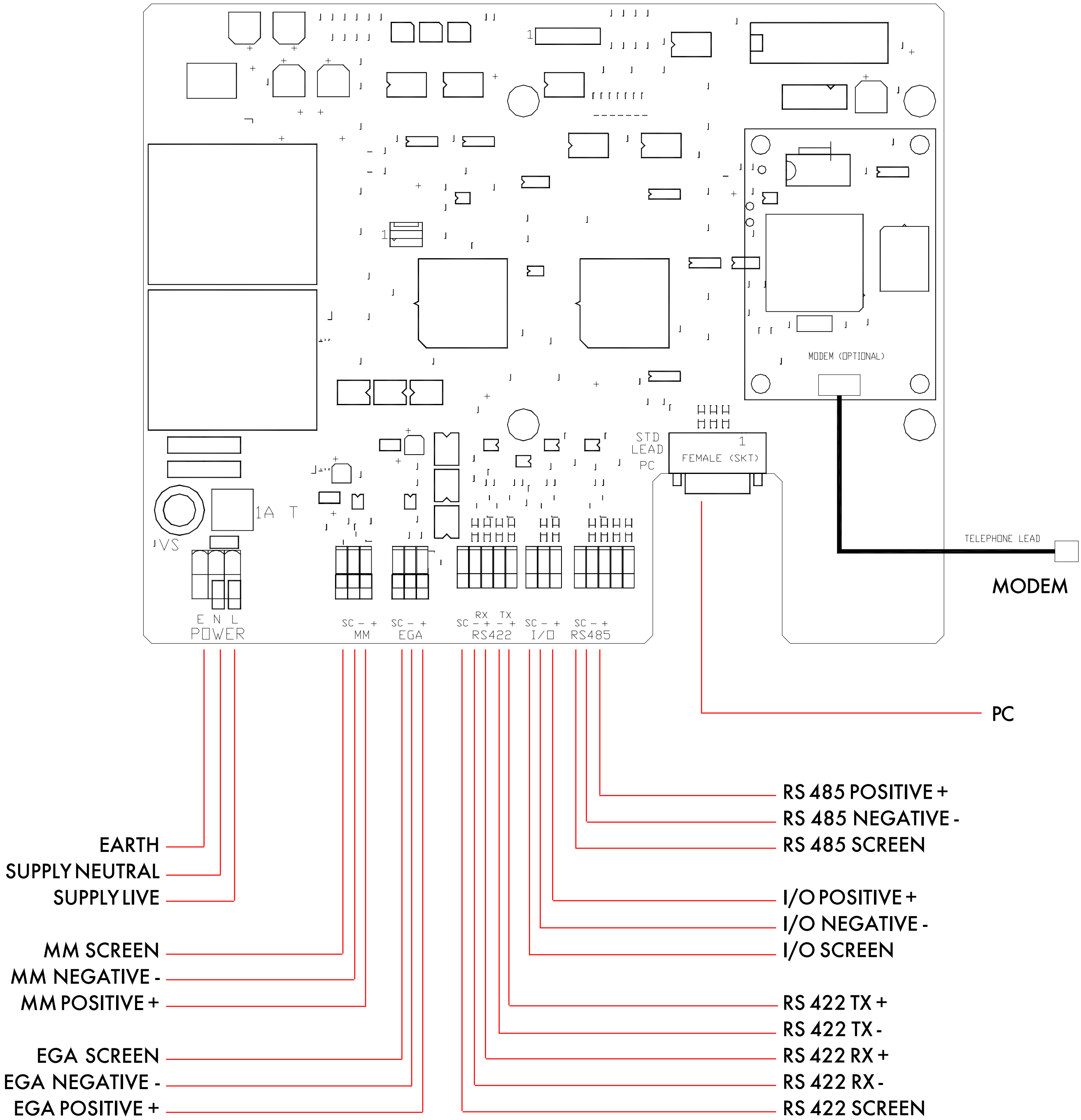
6.8 Communication Interface Schematic System Capabilities

The following communications ports are available on the DTI (contact Autoflame sales for other applications or other required protocols, i.e. BacNet, Ethernet, e.t.c.):

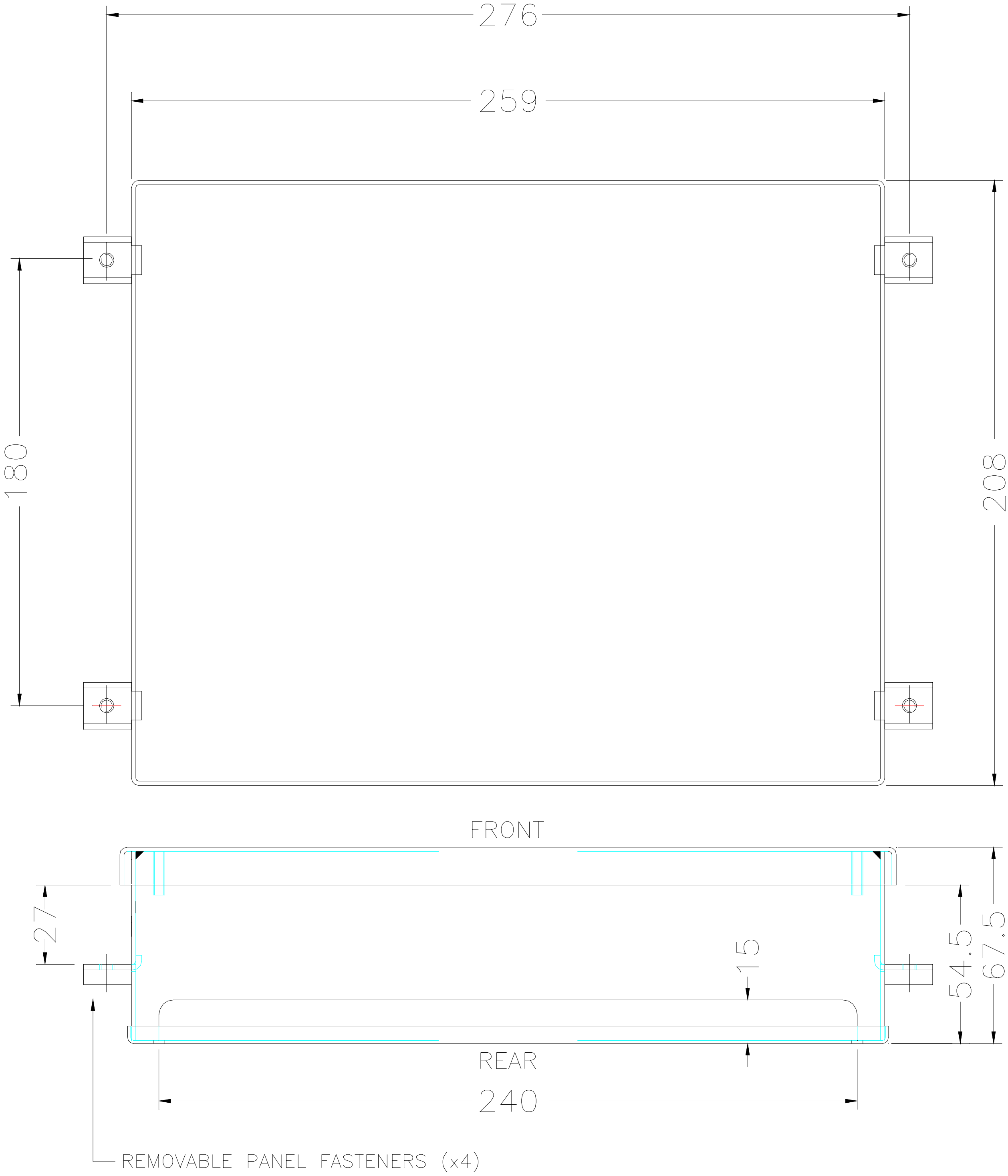
RS232 (serial port)- used for local PC's (less than 10m/40ft) using the Autoflame software or MODBUS
RS422 port- used for remote PC's (up to 1000m/4000ft) using the Autoflame software or MODBUS
RS485 port- used strictly for Metasys communications only
Modem port- used for telephone communications and the Autoflame software



6.9 Wiring Connection Terminals Diagram

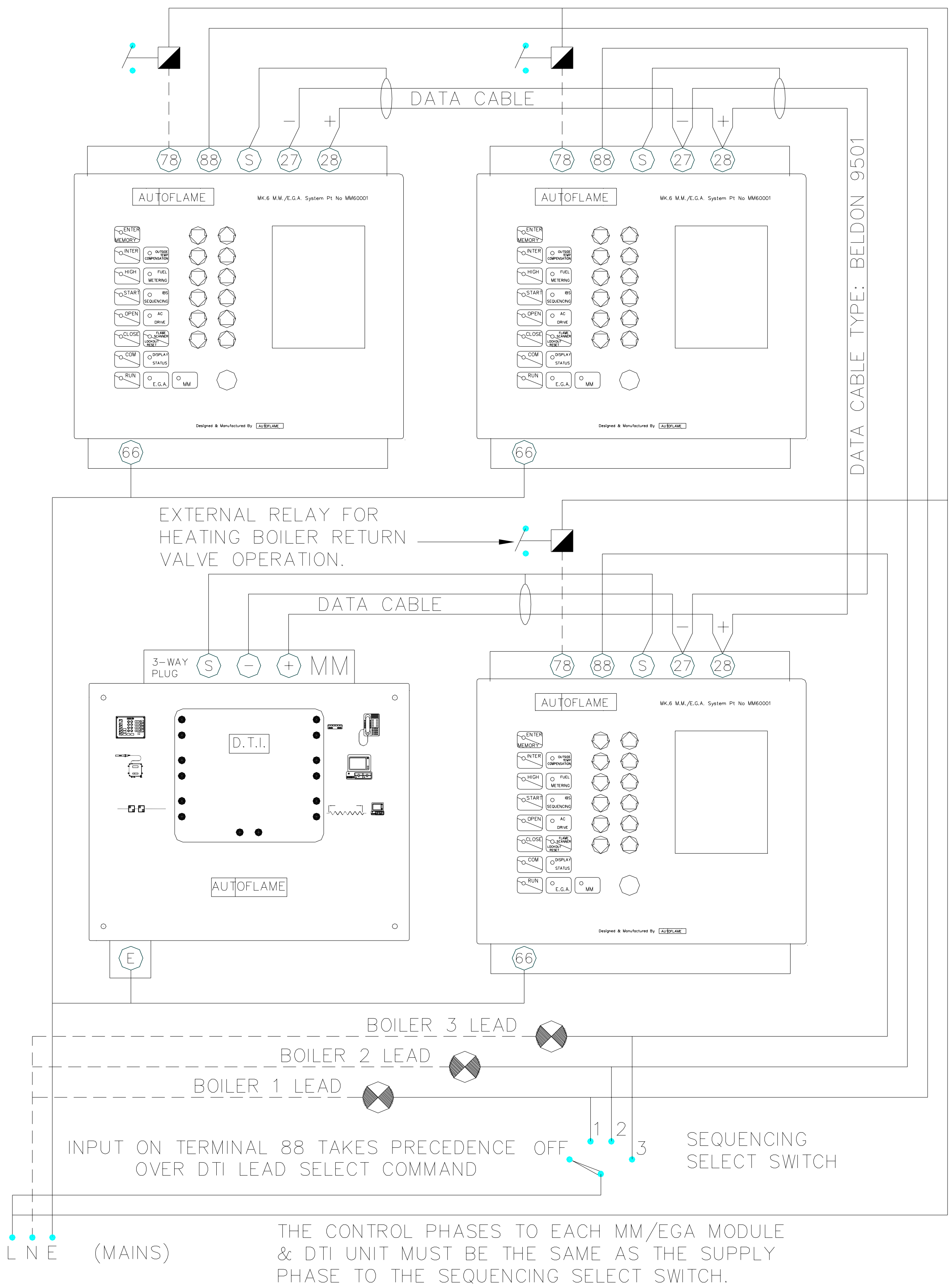


6.10 DTI Fixing Holes and Dimensions

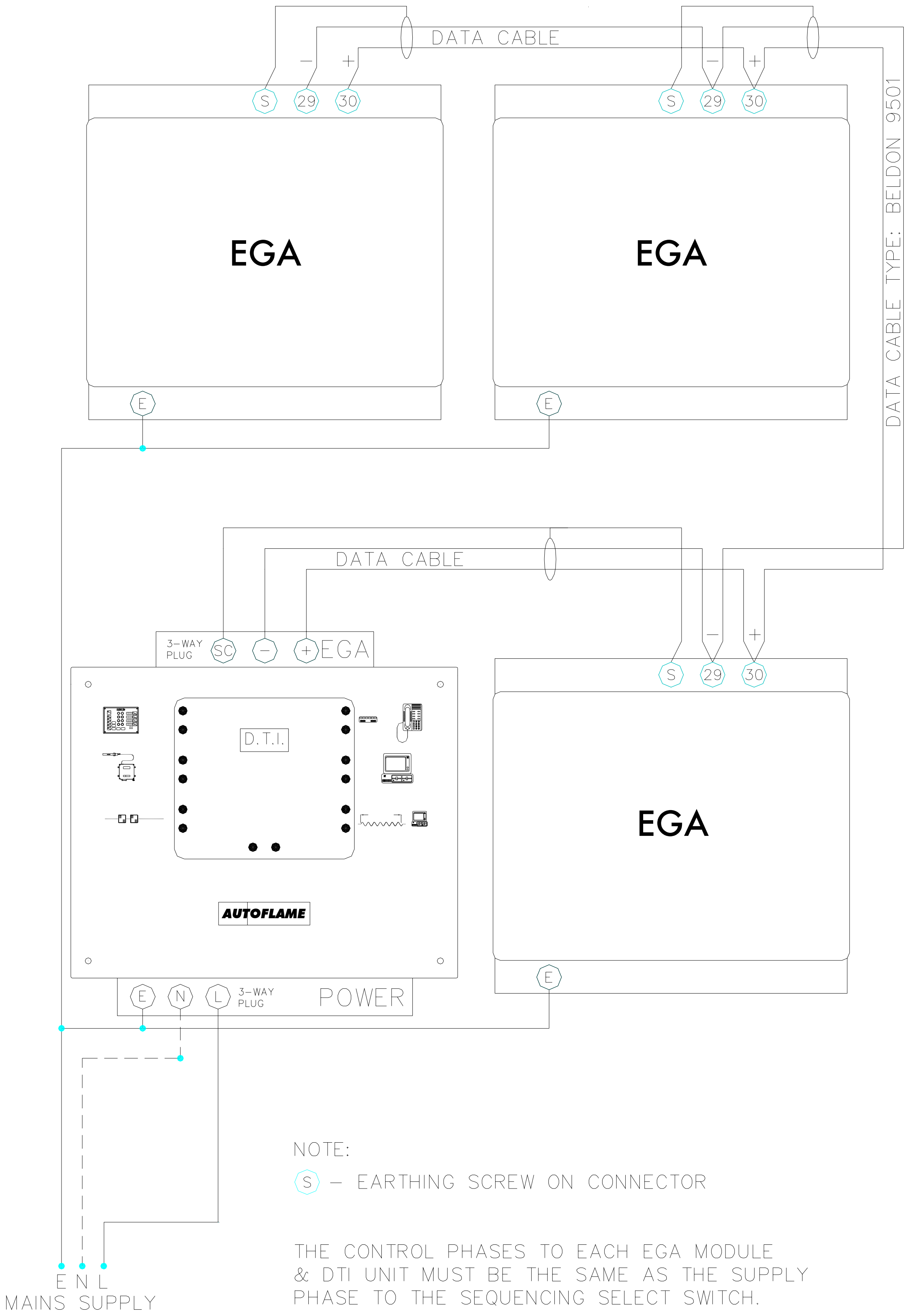


6.11 DTI Interconnections

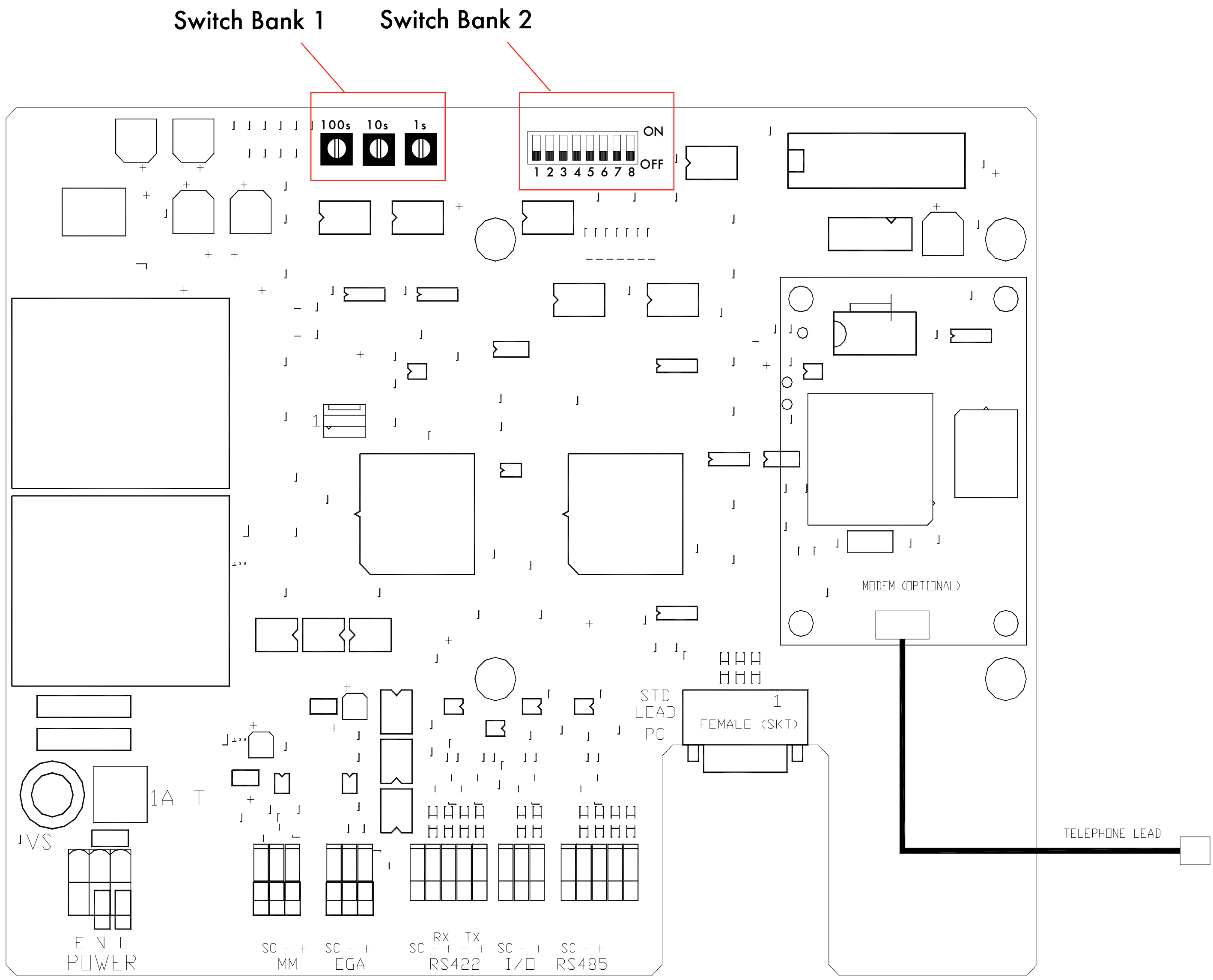
6.11.1 M.M. Modules (M.M./E.G.A.)



6.11.2 E.G.A. Modules (standalone E.G.A.)



6.12 PCB Switch Settings



<u>Standard DTI - when used with WinPCDTI Software</u>

Switch Bank 1 - not relevant, set to 001

Switch Bank 2 - ways 1 to 8 all set to off unless using the older Mk5 and mini Mk5 M.M. modules

Way 8 MM Port Baud Rate
off - 9600 (Mk6, Mini Mk6 and Mini Mk5 MMs)
on - 4800 (Older Mk5 and Mini MMs)*

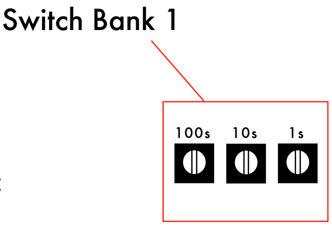
* Technical Memo: Data Communication Compatibility 3/9/1999

Settings for switch banks 1 & 2 may be different if the DTI is used for both WinPCDTI and Modbus/ Metasys operation. See sections 6.17.6.

6.12.1 To Restore Factory Settings

This procedure clears all congifuration data in the DTI and sets it back to default settings (configuration data includes, for example, alarm trigger conditions and labels).

Procedure



1. Power off the unit.

2. Set Switch Bank 1 address value to 789:
100s = 7
10s = 8
1s = 9

(Switch Bank 2 settings are irrelevant).

3. Power up.

4. Wait until the I/O transmit LED flashes (approx. 25 seconds)

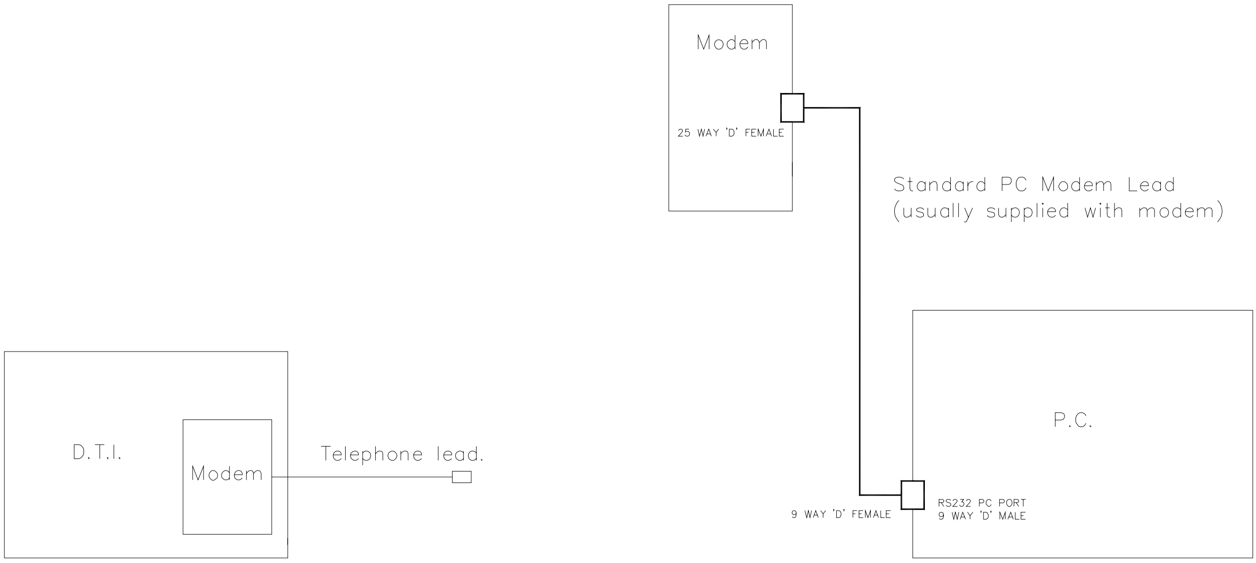
5. Power off.

6. Set switches back to the required operational settings.

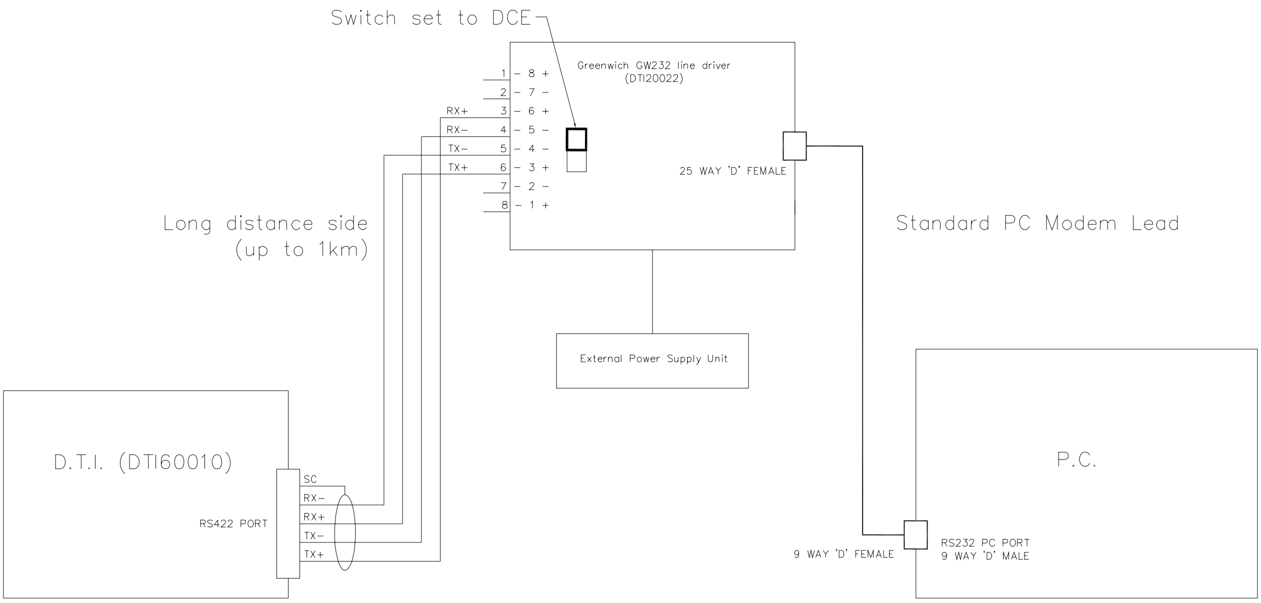
7. Power on unit.

6.13 DTI, PC and Modem Interconnections

Connection between PC and DTI MODEM

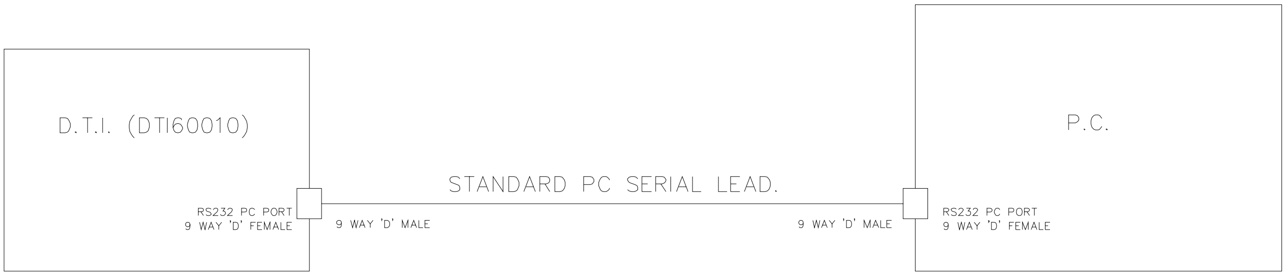


Connection between PC and DTI RS-422 port

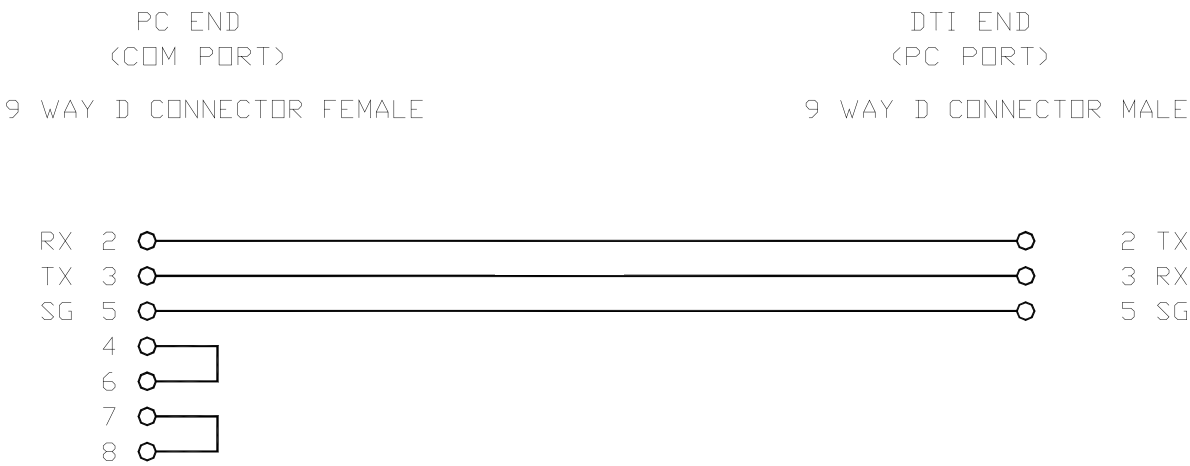


Example shown using line drive type GW232F made by Greenwich Instruments Limited.

Direct connection between PC and DTI RS-232 PC port



PC-DTI Cable (for older DTI units that do not use a standard PC serial lead)



Section 6.14: Analogue Input/Output Module Index

6.14.1 Introduction, Features and Benefits

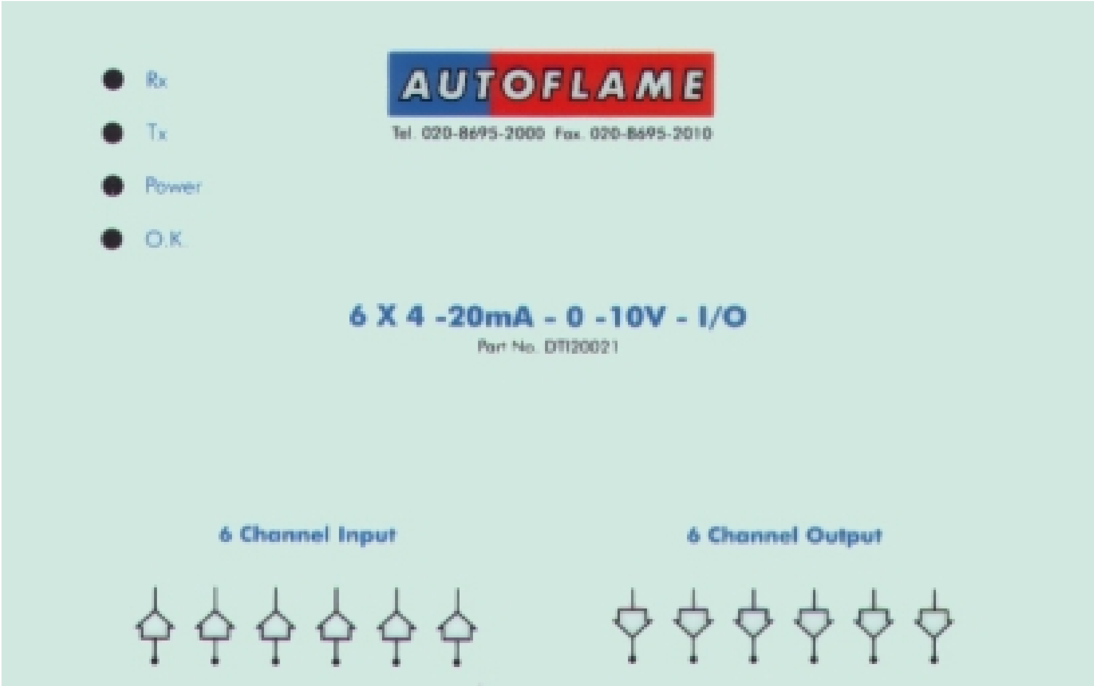
Each analogue I/O unit has 6 analogue inputs and 6 analogue outputs. Each analogue input can be individually configured for 0-10 V, 0-20 mA or 4-20 mA, and each analogue output can be individually configured for 0-10 V or 4-20 mA. The unit is primarily for use with a Data Transfer Interface (DTI) unit. However, it can also be used in conjunction with most M.M. units to convert M.M. items of data to analogue outputs. Before operation the unit must be setup for its particular modes of operation by means of a serial port and a personal computer (emulating a terminal, e.g. windows hyperterminal).

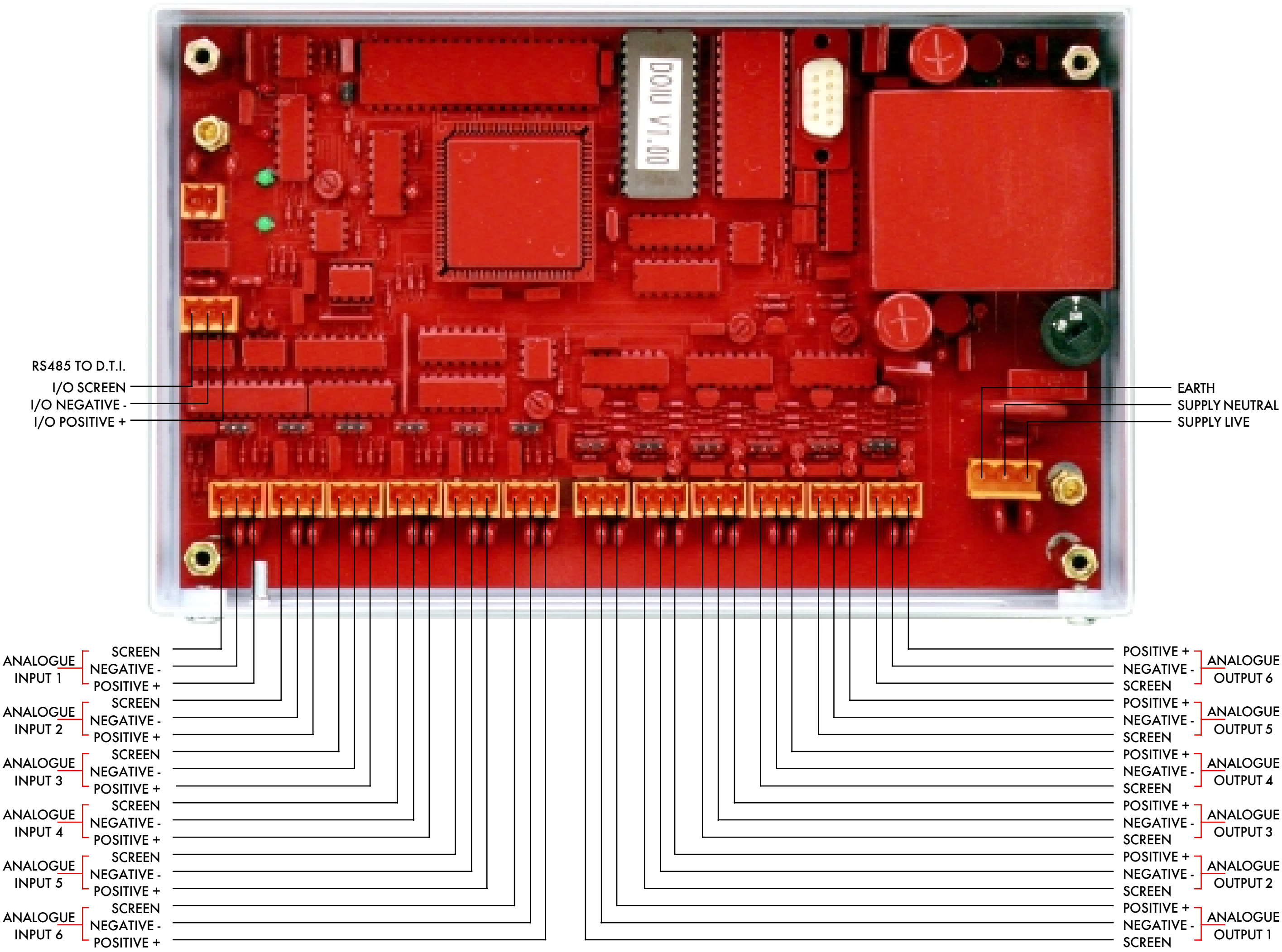
When used with a DTI, up to 10 analogue input/output units can be linked together. These are linked in series (daisy chain) using an RS485 2-core shielded data cable. As well as the actual analogue inputs and outputs being configurable, the data range for each input and output can also be individually set. Text labels can also be assigned to each input and output. The latter items (data range/text labels) can be of use when the DTI is being used for a building management system or programmable logic controller type interface. It is also possible to set each of the analogue inputs to simply monitor the required control signal or this can be set to alarm if the signal exceeds a user-defineable value or if the signal drops below a user-defineable value. These alarm settings are unique for each input and also carry a time delay setting until the alarm is actually recorded. This ensures that if the signal is fluctuating, annoyance alarms are avoided. The analogue inputs can also be set to totalise and so an instantaneous reading is recorded and displayed, but a totalising value is also stored in the background and is viewable. However, in the vast majority of cases, these setups can be left as supplied.

Notes:

An external PSU is not required for the analogue outputs.
The maximum permissable load on each analogue output is 250Ω.
All the negative terminals are common to each other.
The analogue outputs as a whole are isolated.
The analogue inputs are not powered internally by the analogue I/O module and so a 24V dc supply may be required for each input, depending on the controller.

6.14.2 Facia Layout and Internal Connections





N.B. All Negative connections are common to each other.

6.14.3 Setup Configuration for direct connection to M.M. unit

SETUP

To configure the unit connect a pc serial port to the setup port (use the Autoflame I/O setup lead). The pc must be running a terminal emulation program with the transmit and receive parameters set as follows:

Baud rate:	4800
Data bits	8
Parity	none
Stop bits	1

(Check the COM port is set to the one actually being used).

Pressing the <return> key should bring up the following opening message:

Analog I/O unit setup mode

Pressing the <ESC> key at any time during setup will cause exit from setup. If no keys are pressed for a period of approximately 5 minutes the unit will automatically exit from setup and revert to normal operation. During setup the unit will not carry out its normal functions. A test mode can be invoked during set up so the operation of the inputs and outputs can be checked. Every detail of the setup is not covered here as it is very repetitive. Experience can be quickly gained by working with an actual unit in setup mode (note that during normal operation if the PC is connected textual messages are displayed indicating communication between input/output units and the DTI).

If an existing setting is to be left unchanged then just press the <return> key.

The following shows samples of the various items that can be set. Text that is displayed on the screen is shown in bold.

Present input range for analog input 1 is A 0-10 volts

Ranges available
0 - 10 volts A
0 - 20 milliamps B
4 - 20 milliamps C

Make new selection or <return>
This can be set for all 6 inputs.

Present mode of operation is with DTI
Press M to set MM mode or <return to proceed>

If DTI mode is selected, by just pressing <return> in this example, the following items are displayed (if M.M. is selected please see later in this section):

Address is currently set to 1

Press <return> or enter new address(1-10) then <return>:

The address must be set in sequence for each analog I/O unit, e.g. if there are 3 analogue I/O units on the system the first should be set address 1, the second to address 2 and the third to address 3. Conflicts will occur if addresses are not set correctly and communications issues will occur.

Input number 1:-
Present label : Analog Input 1
Enter new label : Up to 30 alpha numeric characters can be used for a label

Present low range digital value : 0
Enter new low range value : This is the low data range value, it must be in the range 0-255

Present high range digital value : 255
Enter new high range value : This is the high data range value, it must be in the range 0-255

The label, low range and high range values can be set for all 6 inputs and all 6 outputs. After the ouput 6 high range value the setup mode is exited and the following appears on the screen:

SETUP TERMINATED !

Operation will revert to normal.

If the MM mode of operation is selected then the following items are displayed

Firing rate	**A**
Required value	**B**
Actual value	**C**
Channel 1 position	**D**
Channel 2 position	**E**
Channel 3 position	**F**
Channel 4 position	**G**
MM error	**H**
EGA error	**I**
O2 value	**J**
CO2 value	**K**
CO value	**L**
NO value	**M**
SO2 value	**N**
Exhaust Temperature	**O**
Efficiency	**P**

Present selection for analogue output 1 is : A - Firing rate
Present low range value : 0
Present high range value : 100

If the <return> key is pressed the screen refreshes with the same display but for analogue output 2. If a selection is made then a low range value and a high range value are subsequently requested. The low and high range values are values at which the output ranges itself from zero to span, i.e. 0-10V or 4-20 mA. After all 6 analogue outputs have been covered the setup mode is automatically exited and the screen displays:

SETUP TERMINATED !

It must be noted that the numeric values for the low and high range do not accept decimal points. If the value normally has a decimal point then the value should be entered without the decimal point, e.g. for the channel 2 position, if the output was set to give 0-10 volts over 10.0 to 80.0 degrees then the low and high range should be entered as 100 and 800 respectively.

Configuration of M.M. when used directly with an analogue I/O unit

If an analogue I/O unit is connected directly to an M.M. to provide analogue outputs, the first analogue input may be used to set the the required setpoint. Analogue input channels 2 to 6 are of no relevance when the unit is used with an M.M.

If the required setpoint is to be set by the channel 1 input then the following options/parameters should be set on the M.M. (see section 2.14.2.4)

Option #16 = 2
Option #30 = lowest required setpoint
Option #31 = highest required setpoint
Option #33 = 1 (identification number)
Parameter #49 = 1

The channel 1 input can be configured for voltage/current as described in the earlier sections of the setup procedure.

On later versions of the analogue I/O unit software (3.01 onwards) there is an additional set up to set the type of MM connected.

Example:

RS485 port baud rate is set at 9600 (Mk6, MiniMk6, MiniMk5)
Press 4 to set to 4800 <return> to proceed.

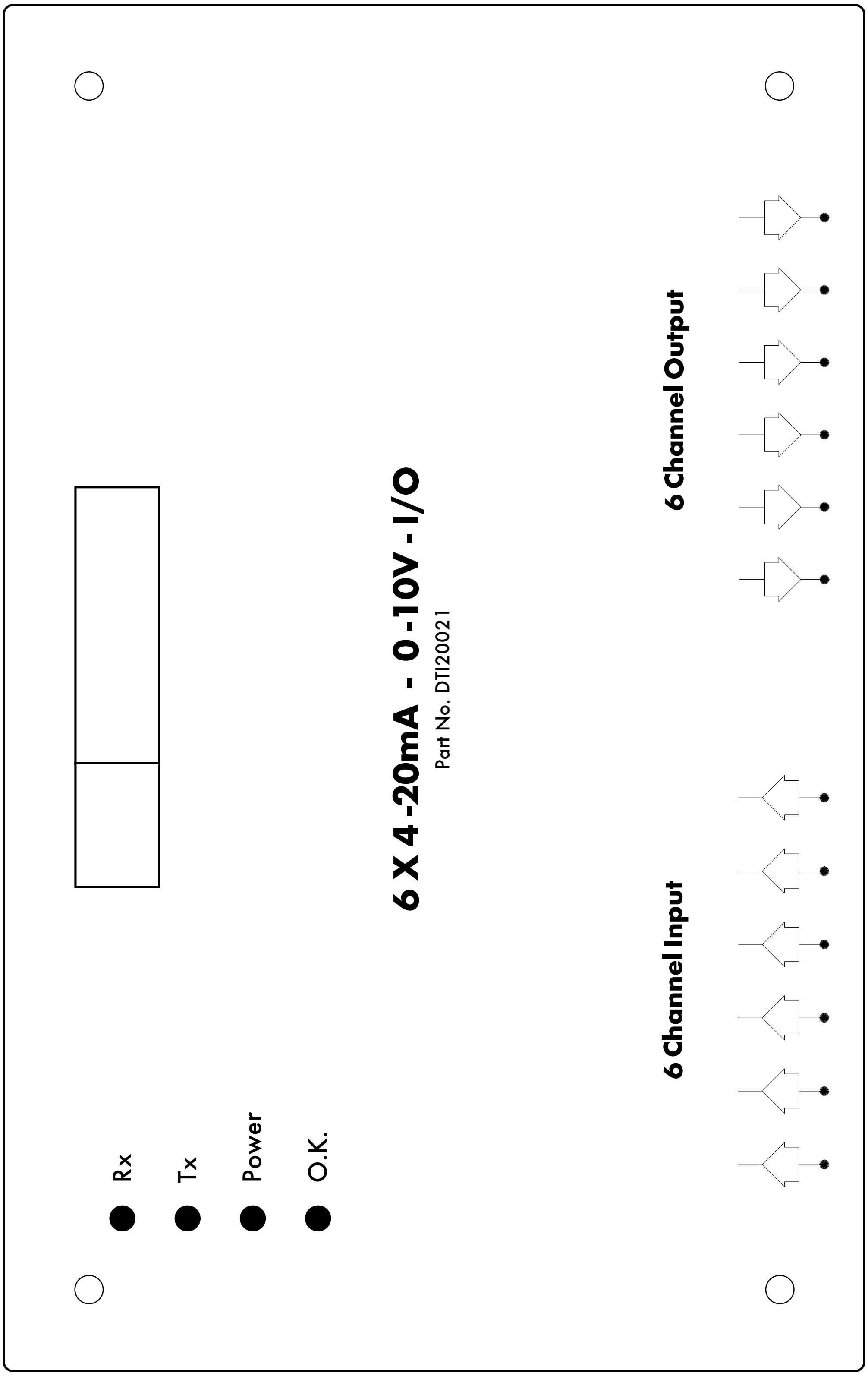
Also on the later versions the following text is displayed when not in set up mode.

MM comms = nnn   required value = nnn

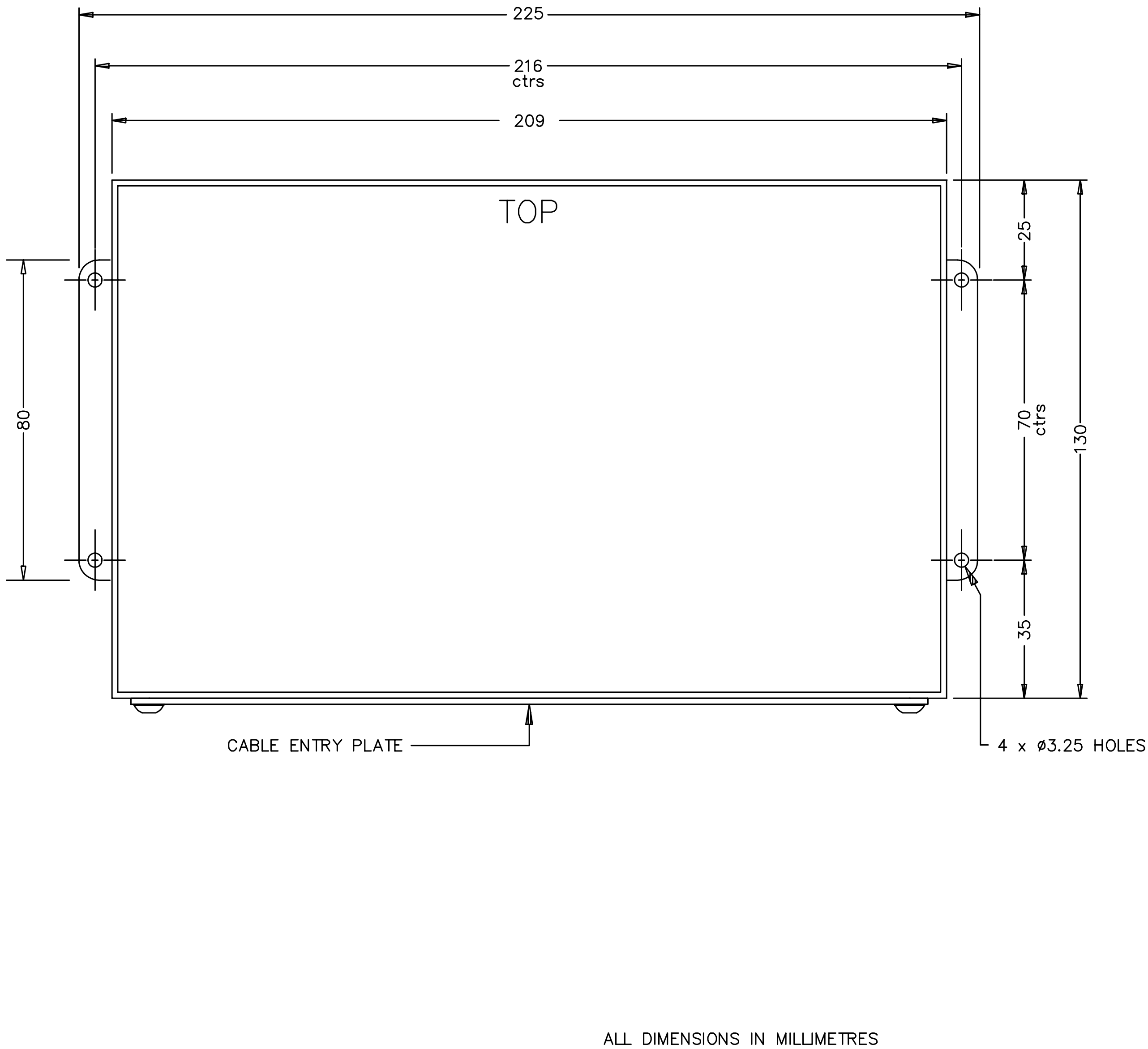
M.M. comms increments each time the analogue I/O unit receives data from the M.M. Required value is the value that has been calculated for transmission back to the M.M.

Note: Sequencing/D.T.I. and analogue I/O unit cannot be used at the same time if the analogue I/O module is to be used for setpoint changes on the M.M. If the analogue I/O module is used for monitoring and standard DTI operation then all of these features are available.

6.14.4 Front Facia Layout with LED Description

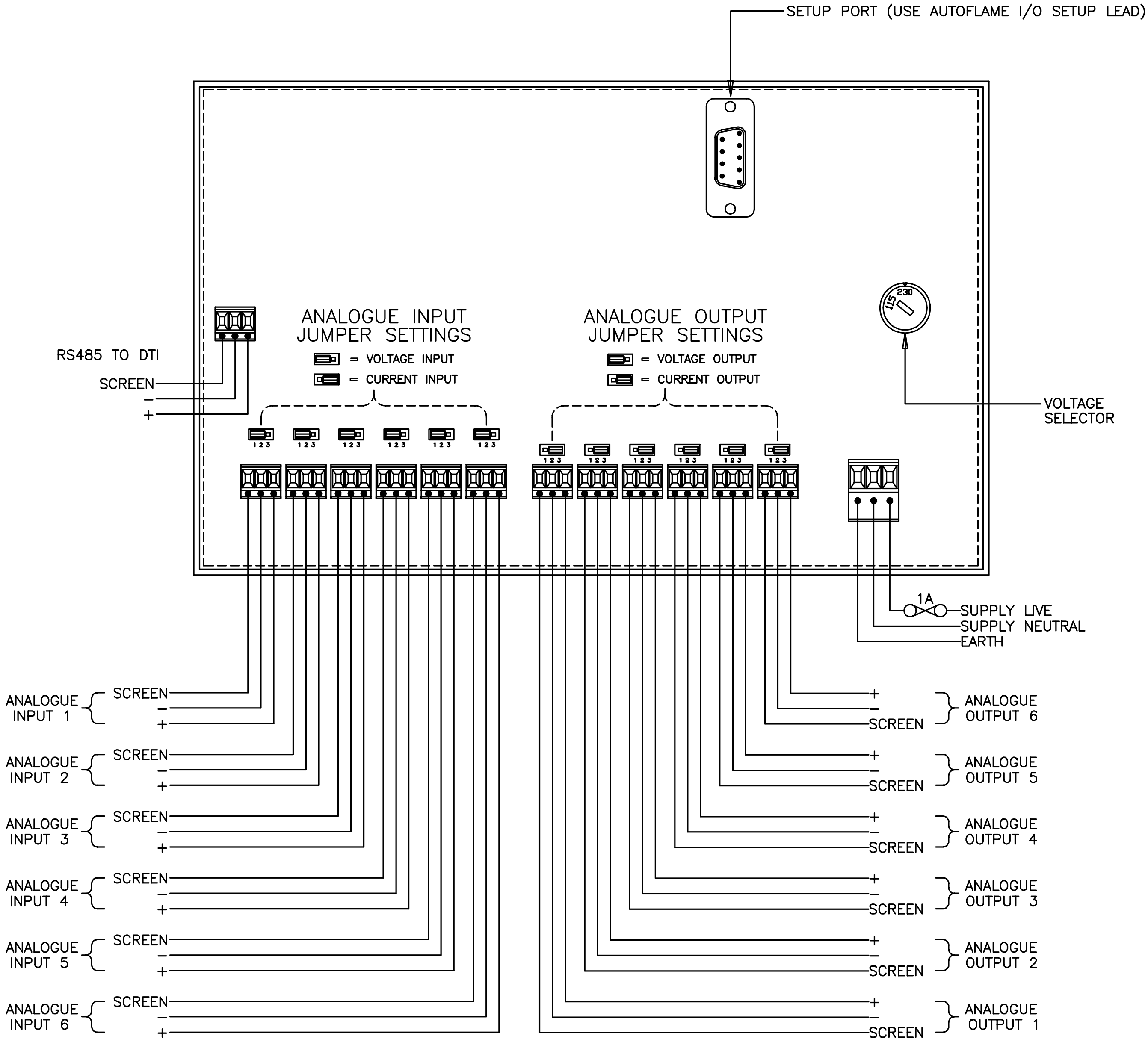


6.14.5 Fixing Holes & Dimensional Details

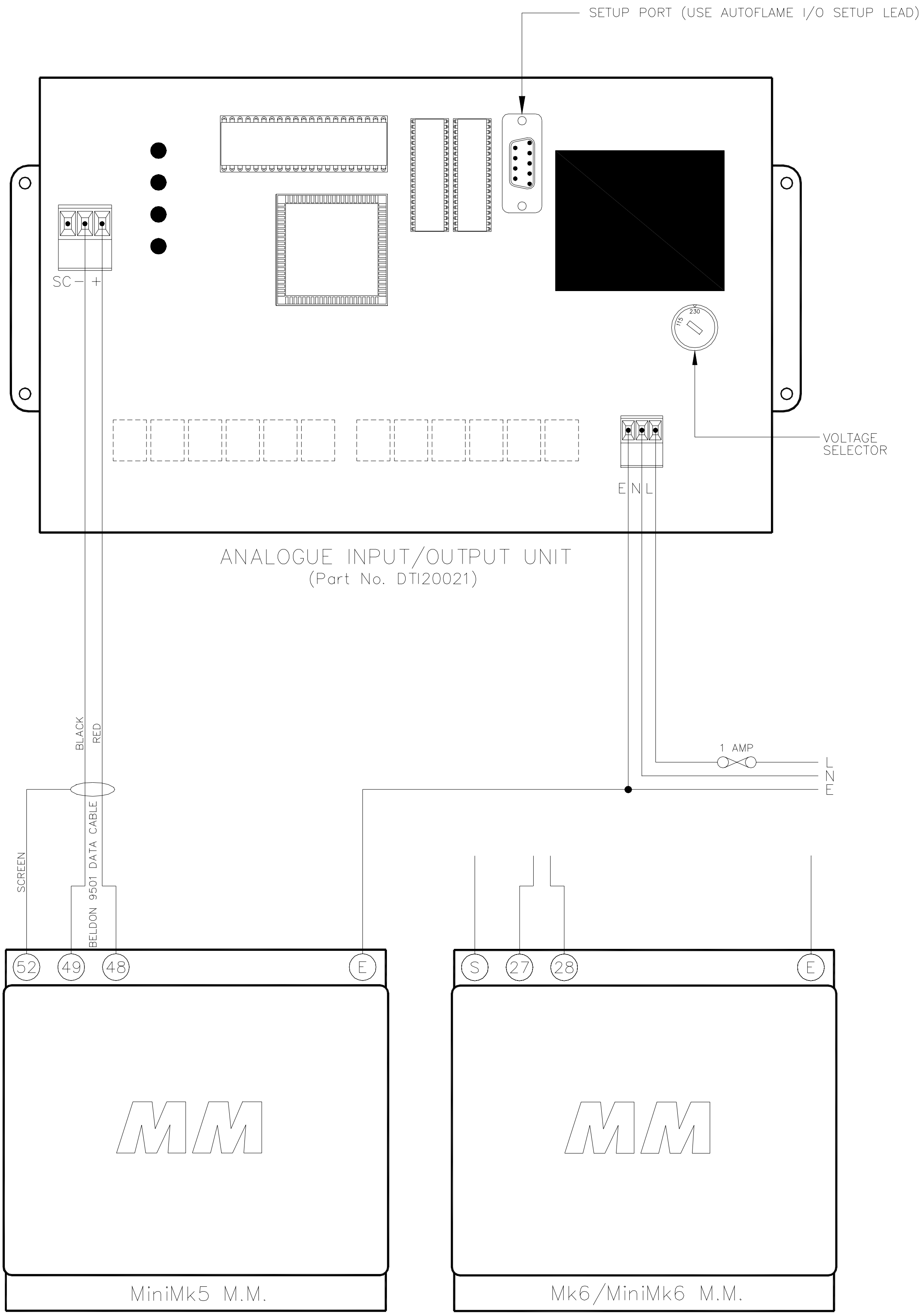


The depth of the unit is 38mm (1.5").
These units are back plate mounted not mounted on the front.

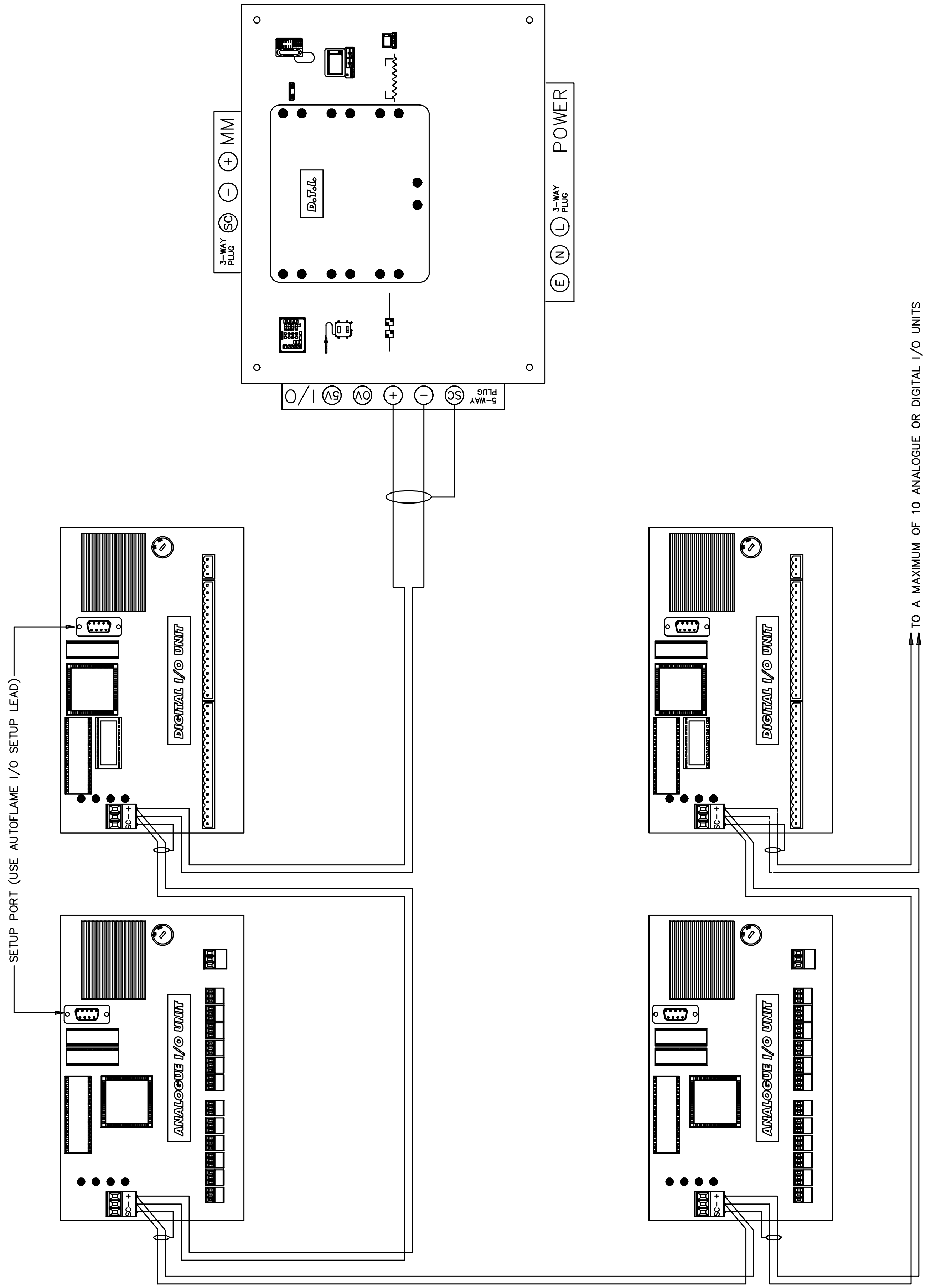
6.14.6 Wiring Connections Diagram



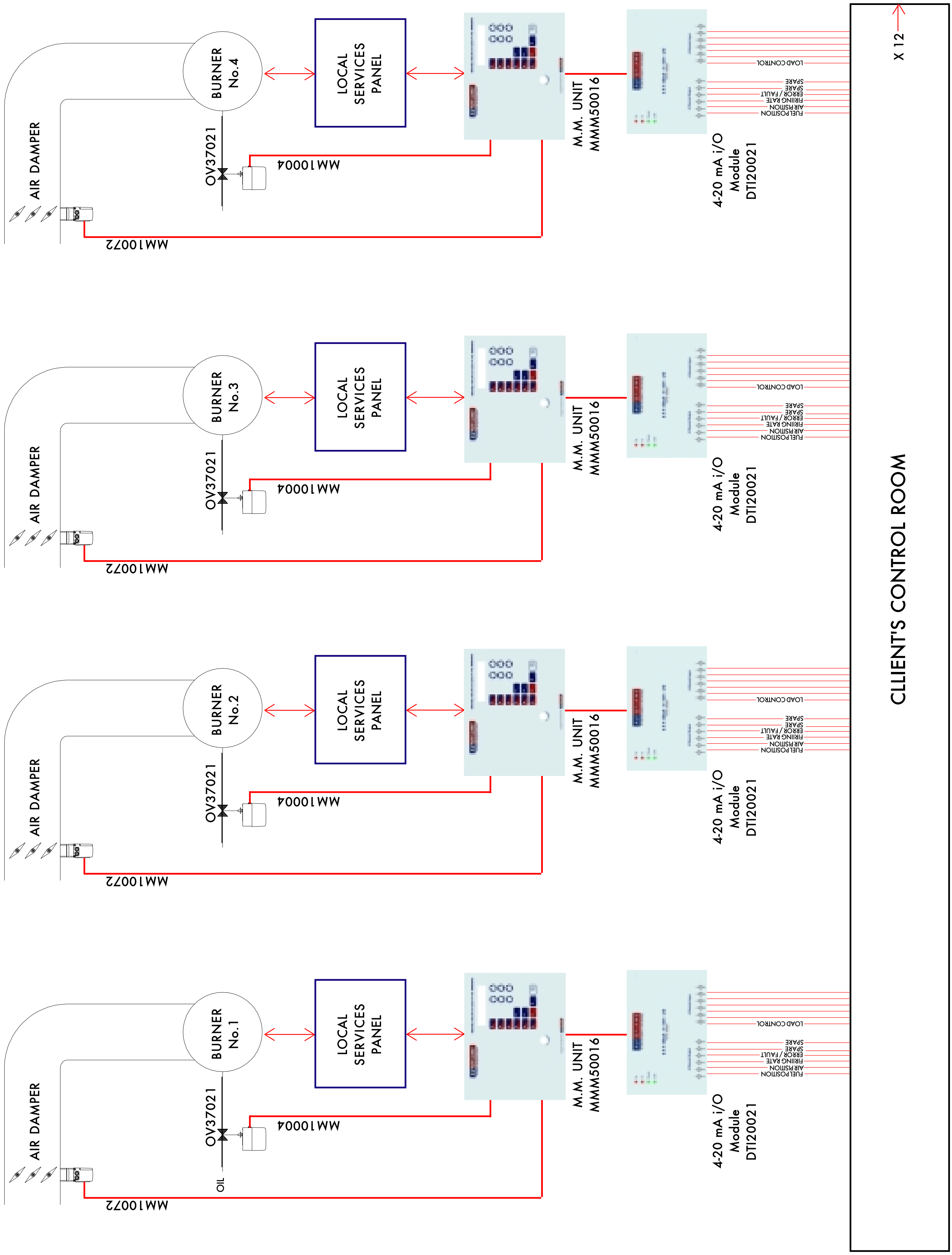
6.14.7 M.M. to Analogue Input/Output Unit Connection Diagram



6.14.8 DTI to Analogue Input/Output Unit Connection Diagram



6.14.9 Application Example: M.M. unit to Analogue Input/Output Unit Direct Connection

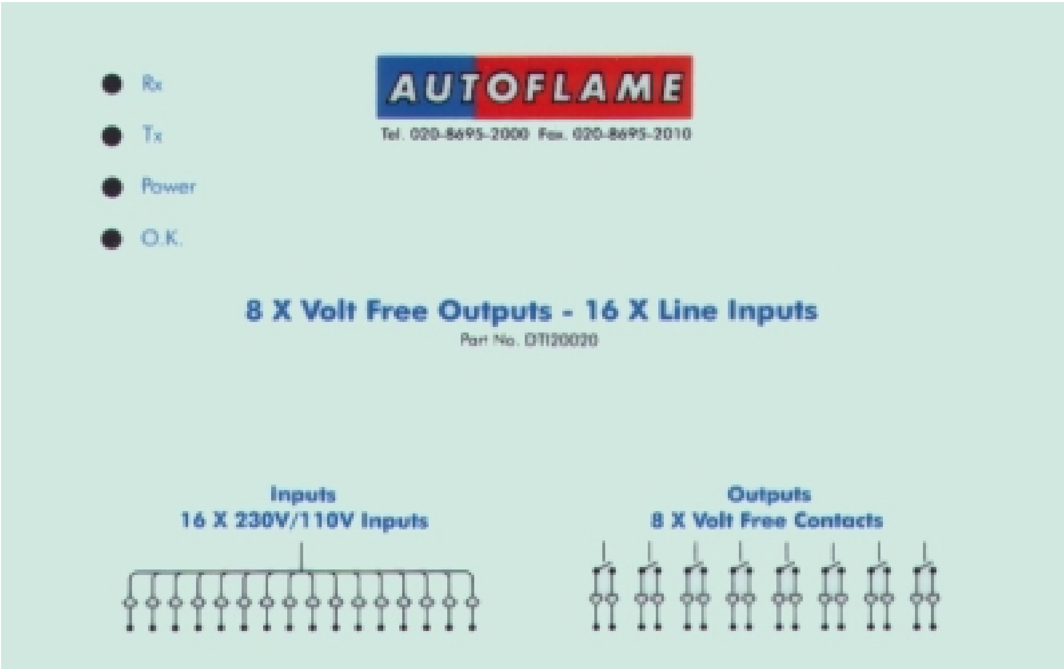


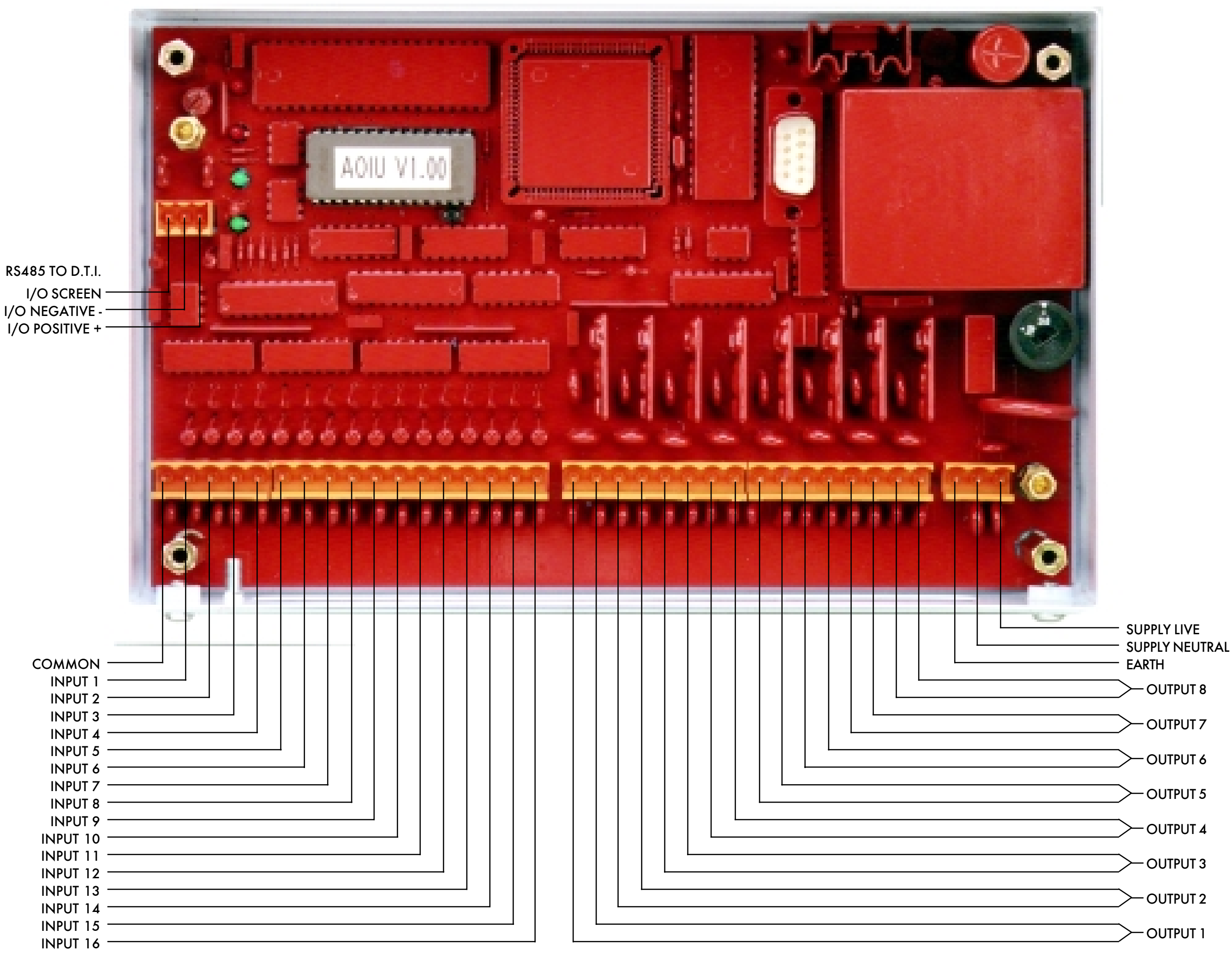
Section 6.15: Digital Input/Output Module Index

6.15.1 Introduction, Features and Benefits

Each digital I/O unit has 16 mains voltage inputs and 8 individual volt free mains voltage switches. The unit is used in conjunction with a Data Transfer Interface (DTI) unit. The mains voltage inputs can be used to wire in any alarms from the boiler house. The volt free mains voltage switches can be used to turn various components on/off. Before operation the unit must be setup for operation by means of a serial port and a personal computer (emulating a terminal). Up to 10 digital input/output units can be chained together. Text labels can also be assigned to each input and output. The latter items (data range / text labels) can be of use when the DTI is being used for a building management system or programmable logic controller type interface. It is also possible to set each of the digital inputs to simply monitor the required control signal or this can be set to alarm if the input signal is present ot not present, i.e. high or low. These alarm settings are unique for each input and also carry a time delay setting until the alarm is actually recorded. This ensures that if the signal is fluctuating, annoyance alarms are avoided.
Refer to DTI manual for interconnections between the digital I/O unit & the DTI.

6.15.2 Facia Layout and Internal Connections





6.15.3 Setup configuration for direct connection to D.T.I. unit

To configure the unit connect a pc serial port to the setup port (use the Autoflame I/O setup lead). The pc must be running a terminal emulation program with the transmit and receive parameters set as follows:

Baud rate:	4800
Data bits	8
Parity	none
Stop bits	1

(Check the COM port is set to the one actually being used).

Pressing the <return> key should bring up the following opening message:

Digital I/O unit setup mode

Pressing the <ESC> key at any time during setup will cause exit from setup. If no keys are pressed for a period of approximately 5 minutes the unit will automatically exit from setup and revert to normal operation. During setup the unit will not carry out its normal functions. A test mode can be invoked during set up so the operation of the inputs and outputs can be checked. Every detail of the setup is not covered here as it is very repetitive. Experience can be quickly gained by working with an actual unit in setup mode. Note that during normal operation if the PC is connected textual messages are displayed indicating communication between input/output units and the DTI.

If an existing setting is to be left unchanged then just press the <return> key.

The following shows samples of the various items that can be set. Text that is displayed on the screen is shown in bold.

Address is currently set to 1

Press <return> or enter new address(1-10) then <return>:

The address must be set in sequence for each digital I/O unit, e.g. if there are 3 digital I/O units on the system the first should be set to address 1, the second to address 2 and the third to address 3. Conflicts will occur if addresses are not set correctly.

Input number 1:-
Present label : Digital Input 1
Enter new label : Up to 30 alpha numeric characters can be used for the label

Present Monitor/Alarm status is : Monitor
Enter M/A or <return to proceed>

Present Active High/Low status is : High
Enter H/L or <return> to proceed

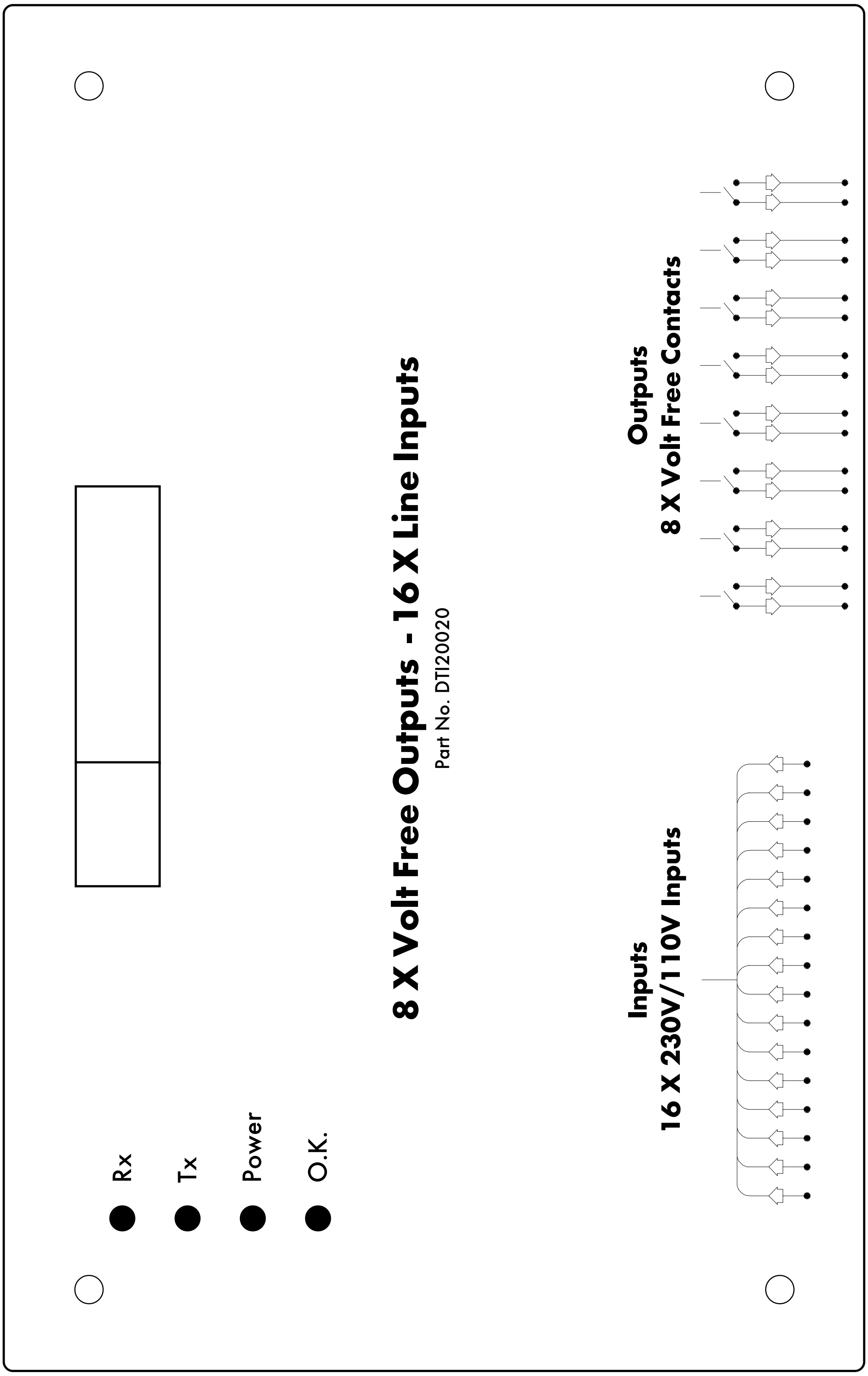
The label, M/A status and H/L status are repeated for all 16 inputs.

Output number 1:-
Present label : Digital Output 1
Enter new label : Up to 30 alpha numeric characters can be used for the label.

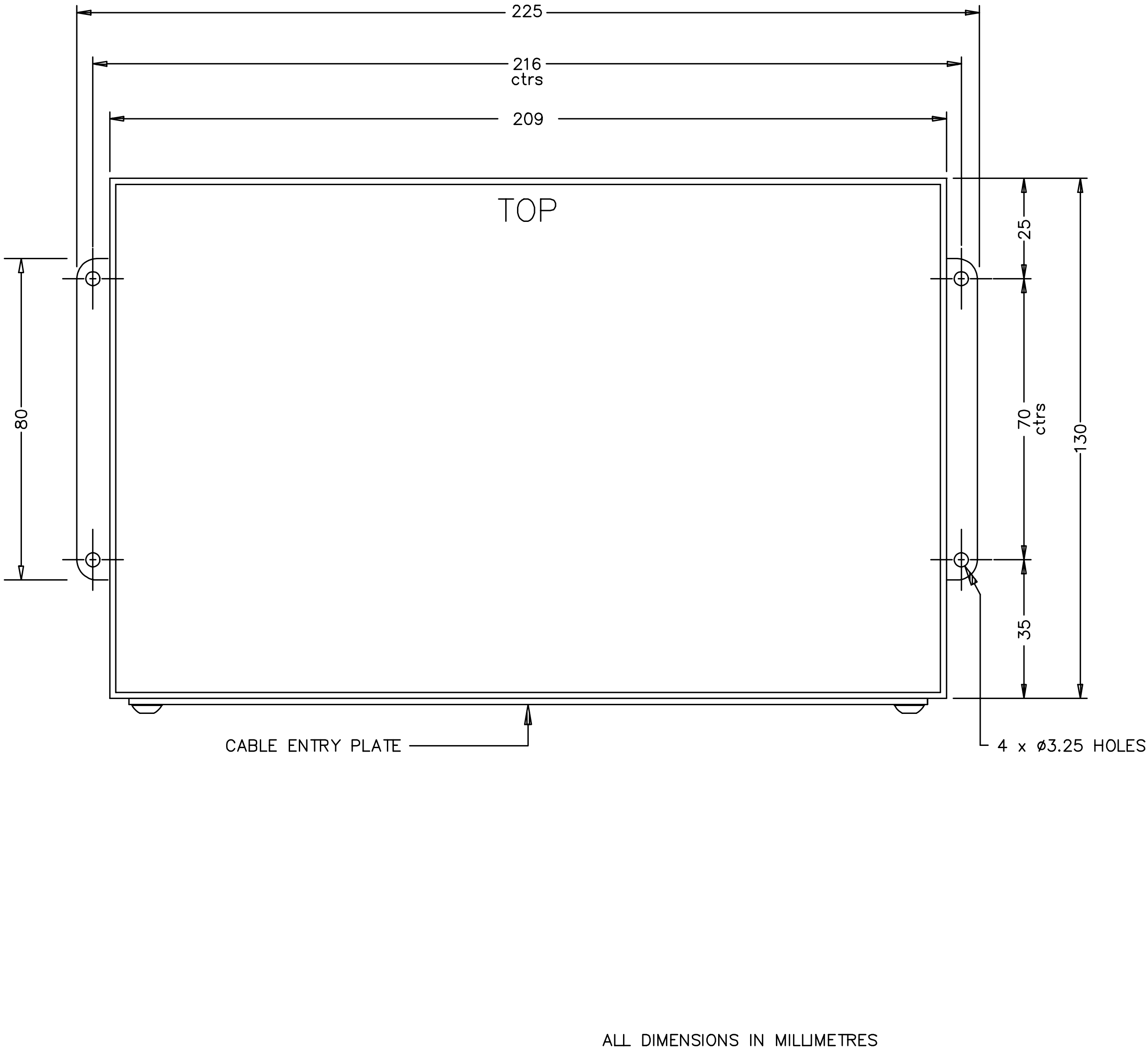
The label entry is repeated for all eight outputs. After all 8 digital outputs have been covered the setup mode is automatically exited and the screen displays

SETUP TERMINATED !

6.15.4 Front Facia Layout with LED Description

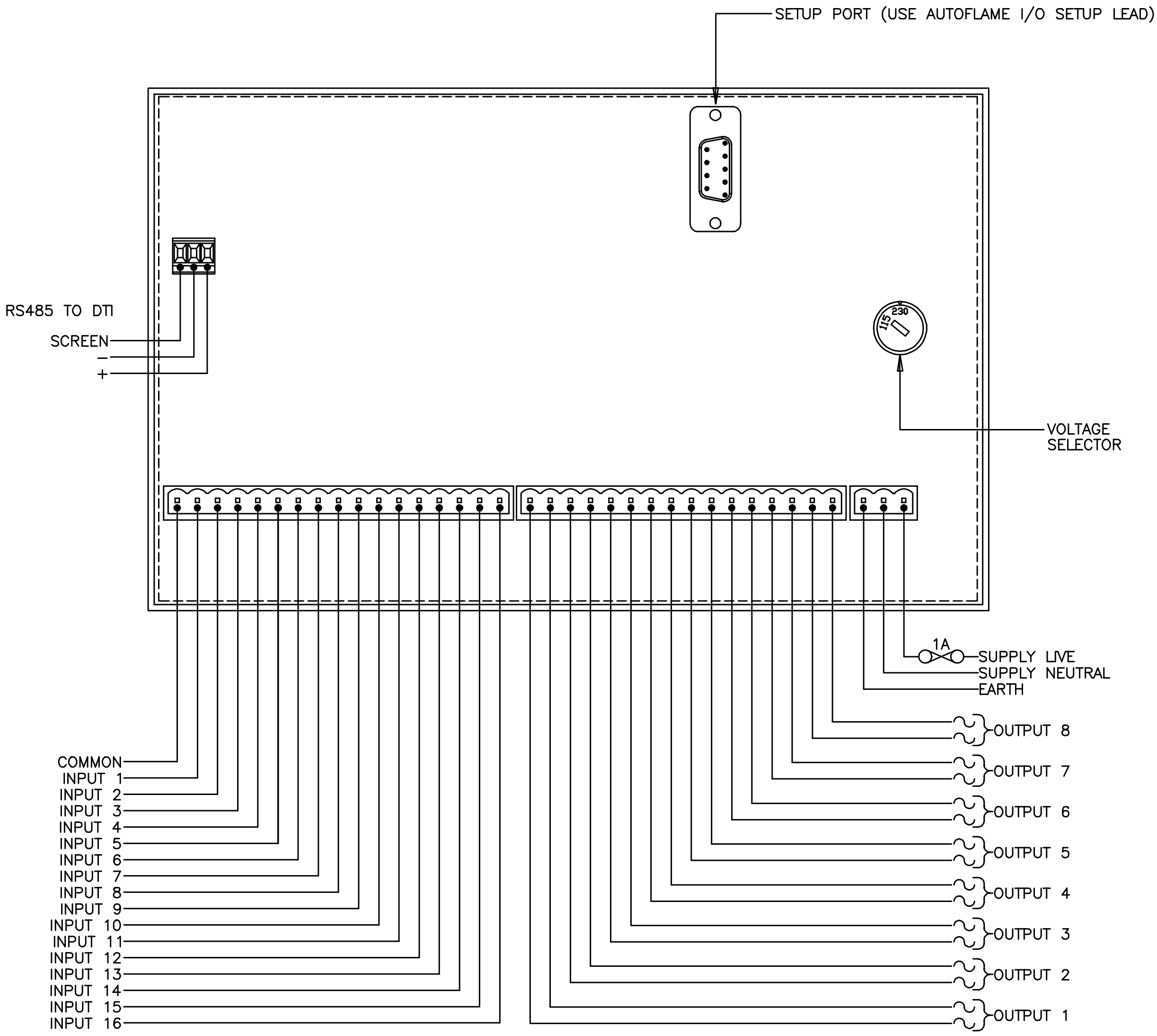


6.15.5 Fixing holes & Dimensional Details

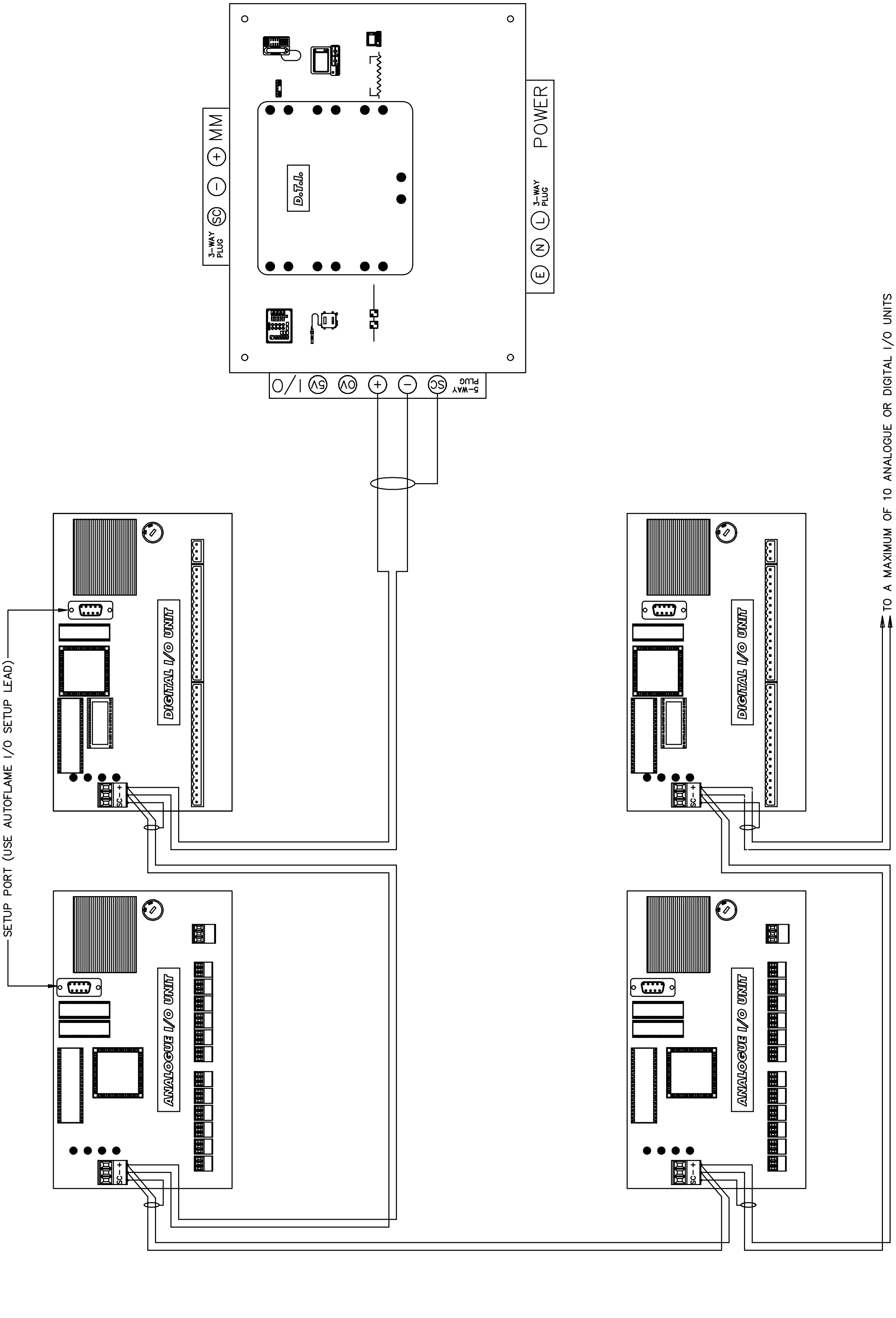


The depth of the unit is 38mm (1.5").
These units are back plate mounted not mounted on the front.

6.15.6 Wiring Connection Diagram



6.15.7 DTI to Digital Input/Output Unit Connection Diagram



Section 6.17: Modbus Interface Index

6.17.1 Overview

This manual details information regarding the Data Transfer Interface (DTI) 'Modbus' type interface. This interface allows the DTI to simultaneously communicate with the standard Autoflame Windows 95 PCDTI System.

Some knowledge of the Micro Modultion system is necessary to appreciate the meaning of the information contained within this manual.

6.17.2 0X Reference Addresses - Coils

6.17.2.1 Enable/Disable command for each MM

MM ID number		Reference Address
1		00001
2		00002
3		00003
4		00004
5		00005
6		00006
7		00007
8		00008
9		00009
10		00010

6.17.2.2 Digital I/O module output

Digital I/O Module Number		**Output Number**							
		1	2	3	4	5	6	7	8
1		00017	00018	00019	00020	00021	00022	00023	00024
2		00025	00026	00027	00028	00029	00030	00031	00032
3		00033	00034	00035	00036	00037	00038	00039	00040
4		00041	00042	00043	00044	00045	00046	00047	00048
5		00049	00050	00051	00052	00053	00054	00055	00056
6		00057	00058	00059	00060	00061	00062	00063	00064
7		00065	00066	00067	00068	00069	00070	00071	00072
8		00073	00074	00075	00076	00077	00078	00079	00080
9		00081	00082	00083	00084	00085	00086	00087	00088
10		00089	00090	00091	00092	00093	00094	00095	00096

6.17.3 1X Reference Addresses - Inputs

6.17.3.1 Digital Input

Digital I/O Module Number		**Input Number** 1	2	3	4	5	6	7	8
1		10001	10002	10003	10004	10005	10006	10007	10008
2		10017	10018	10019	10020	10021	10022	10023	10024
3		10033	10034	10035	10036	10037	10038	10039	10040
4		10049	10050	10051	10052	10053	10054	10055	10056
5		10065	10066	10067	10068	10069	10070	10071	10072
6		10081	10082	10083	10084	10085	10086	10087	10088
7		10097	10098	10099	10100	10101	10102	10103	10104
8		10113	10114	10115	10116	10117	10118	10119	10120
9		10129	10130	10131	10132	10133	10134	10135	10136
10		10145	10146	10147	10148	10149	10150	10151	10152

Digital I/O Module Number		**Input Number** 9	10	11	12	13	14	15	16
1		10009	10010	10011	10012	10013	10014	10015	10016
2		10025	10026	10027	10028	10029	10030	10031	10032
3		10041	10042	10043	10044	10045	10046	10047	10048
4		10057	10058	10059	10060	10061	10062	10063	10064
5		10073	10074	10075	10076	10077	10078	10079	10080
6		10089	10090	10091	10092	10093	10094	10095	10096
7		10105	10106	10107	10108	10109	10110	10111	10112
8		10121	10122	10123	10124	10125	10126	10127	10128
9		10137	10138	10139	10140	10141	10142	10143	10144
10		10153	10154	10155	10156	10157	10158	10159	10160

6.17.3.2 1X Reference Addresses - input

	MM Number 1	2	3	4	5
CR1 Relay Status	10193	10273	10353	10433	10513
	10194	10274	10354	10434	10514
	10195	10275	10355	10435	10515
	10196	10276	10356	10436	10516
	10197	10277	10357	10437	10517
	10198	10278	10358	10438	10518
	10199	10279	10359	10439	10519
	10200	10280	10360	10440	10520
Boiler Temp/Pressure	10201	10281	10361	10441	10521
	10202	10282	10362	10442	10522
	10203	10283	10363	10443	10523
	10204	10284	10364	10444	10524
	10205	10285	10365	10445	10525
	10206	10286	10366	10446	10526
	10207	10287	10367	10447	10527
	10208	10288	10368	10448	10528
	10209	10289	10369	10449	10529
Flow Metering On	10210	10290	10370	10450	10530
CO displayed on F2/F3	10211	10291	10371	10451	10531
	10212	10292	10372	10452	10532
C or F	10213	10293	10373	10453	10533
Bar or PSI	10214	10294	10374	10454	10534
External Voltage	10215	10295	10375	10455	10535
	10216	10296	10376	10456	10536
EGA Optioned	10217	10297	10377	10457	10537
Actual up to Trim Threshold	10218	10298	10378	10458	10538
Cooler Ready	10219	10299	10379	10459	10539
Ambient Temp OK	10220	10300	10380	10460	10540
NO optioned	10221	10301	10381	10461	10541
SO2 optioned	10222	10302	10382	10462	10542
Temp HI/LO	10223	10303	10383	10463	10543
OK to sample	10224	10304	10384	10464	10544
Sequencing optioned	10225	10305	10385	10465	10545
Setpoint/Enable Accepted	10226	10306	10386	10466	10546
	10227	10307	10387	10467	10547
	10228	10308	10388	10468	10548
	10229	10309	10389	10469	10549
	10230	10310	10390	10470	10550
	10231	10311	10391	10471	10551
	10232	10312	10392	10472	10552

Addresses with no detailed function are unused.

1X Reference Addressees - inputs

	MM Number 1	2	3	4	5
Hand Operation	10233	10313	10393	10473	10553
Low Flame Hold	10234	10314	10394	10474	10554
	10235	10315	10395	10475	10555
	10236	10316	10396	10476	10556
	10237	10317	10397	10477	10557
	10238	10318	10398	10478	10558
MM working COMMS	10239	10319	10399	10479	10559
Input 41 status	10240	10320	10400	10480	10560
Lead boiler status	10241	10321	10401	10481	10561
Disabled status	10242	10322	10402	10482	10562
	10243	10323	10403	10483	10563
	10244	10324	10404	10484	10564
	10245	10325	10405	10485	10565
	10246	10326	10406	10486	10566
	10247	10327	10407	10487	10567
	10248	10328	10408	10488	10568
Slave burner left/right	10249	10329	10409	10489	10569
	10250	10330	10410	10490	10570
	10251	10331	10411	10491	10571
	10252	10332	10412	10492	10572
	10253	10333	10413	10493	10573
	10254	10334	10414	10494	10574
	10255	10335	10415	10495	10575
	10256	10336	10416	10496	10576
	10257	10337	10417	10497	10577
	10258	10338	10418	10498	10578
	10259	10339	10419	10499	10579
	10260	10340	10420	10500	10580
	10261	10341	10421	10501	10581
	10262	10342	10422	10502	10582
	10263	10343	10423	10503	10583
	10264	10344	10424	10504	10584
	10265	10345	10425	10505	10585
	10266	10346	10426	10506	10586
	10267	10347	10427	10507	10587
	10268	10348	10428	10508	10588
	10269	10349	10429	10509	10589
	10270	10350	10430	10510	10590
	10271	10351	10431	10511	10591
	10272	10352	10432	10512	10592

Addresses with no detailed function are unused.

1X Reference Addresses - inputs

	MM Number 6	7	8	9	10
CR1 Relay Status	10593	10673	10753	10833	10913
	10594	10674	10754	10834	10914
	10595	10675	10755	10835	10915
	10596	10676	10756	10836	10916
	10597	10677	10757	10837	10917
	10598	10678	10758	10838	10918
	10599	10679	10759	10839	10919
	10600	10680	10760	10840	10920
Boiler Temp/Pressure	10601	10681	10761	10841	10921
	10602	10682	10762	10842	10922
	10603	10683	10763	10843	10923
	10604	10684	10764	10844	10924
	10605	10685	10765	10845	10925
	10606	10686	10766	10846	10926
	10607	10687	10767	10847	10927
	10608	10688	10768	10848	10928
	10609	10689	10769	10849	10929
Flow Metering On	10610	10690	10770	10850	10930
CO displayed on F2/F3	10611	10691	10771	10851	10931
	10612	10692	10772	10852	10932
C or F	10613	10693	10773	10853	10933
Bar or PSI	10614	10694	10774	10854	10934
External Voltage	10615	10695	10775	10855	10935
	10616	10696	10776	10856	10936
EGA Optioned	10617	10697	10777	10857	10937
Actual up to Trim Threshold	10618	10698	10778	10858	10938
Cooler Ready	10619	10699	10779	10859	10939
Ambient Temp OK	10620	10700	10780	10860	10940
NO optioned	10621	10701	10781	10861	10941
SO2 optioned	10622	10702	10782	10862	10942
Temp HI/LO	10623	10703	10783	10863	10943
OK to sample	10624	10704	10784	10864	10944
Sequencing optioned	10625	10705	10785	10865	10945
Setpoint/Enable Accepted	10626	10706	10786	10866	10946
	10627	10707	10787	10867	10947
	10628	10708	10788	10868	10948
	10629	10709	10789	10869	10949
	10630	10710	10790	10870	10950
	10631	10711	10791	10871	10951
	10632	10712	10792	10872	10952

Addresses with no detailed function are unused.

1X Reference Addresses - inputs

	MM Number				
	6	7	8	9	10
Hand Operation	10633	10713	10793	10873	10953
Low Flame Hold	10634	10714	10794	10874	10954
	10635	10715	10795	10875	10955
	10636	10716	10796	10876	10956
	10637	10717	10797	10877	10957
	10638	10718	10798	10878	10958
MM working COMMS	10639	10719	10799	10879	10959
Input 41 status	10640	10720	10800	10880	10960
Lead boiler status	10641	10721	10801	10881	10961
Disabled status	10642	10722	10802	10882	10962
	10643	10723	10803	10883	10963
	10644	10724	10804	10884	10964
	10645	10725	10805	10885	10965
	10646	10726	10806	10886	10966
	10647	10727	10807	10887	10967
	10648	10728	10808	10888	10968
Slave burner left/right	10649	10729	10809	10889	10969
	10650	10730	10810	10890	10970
	10651	10731	10811	10891	10971
	10652	10732	10812	10892	10972
	10653	10733	10813	10893	10973
	10654	10734	10814	10894	10974
	10655	10735	10815	10895	10975
	10656	10736	10816	10896	10976
	10657	10737	10817	10897	10977
	10658	10738	10818	10898	10978
	10659	10739	10819	10899	10979
	10660	10740	10820	10900	10980
	10661	10741	10821	10901	10981
	10662	10742	10822	10902	10982
	10663	10743	10823	10903	10983
	10664	10744	10824	10904	10984
	10665	10745	10825	10905	10985
	10666	10746	10826	10906	10986
	10667	10747	10827	10907	10987
	10668	10748	10828	10908	10988
	10669	10749	10829	10909	10989
	10670	10750	10830	10910	10990
	10671	10751	10831	10911	10991
	10672	10752	10832	10912	10992

Addresses with no detailed function are unused.

1X Reference Addresses - inputs

The information on this page is only relevant to standalone EGAs connected directly to the DTI via the EGA port

	EGA Number				
	1	2	3	4	5
Air Calibration in progress	10993	11009	11025	11041	11057
Gas Calibration in progress	10994	11010	11026	11042	11058
Cooler ready	10995	11011	11027	11043	11059
Ambient temperature OK	10996	11012	11028	11044	11060
Ambient temperature HIGH	10997	11013	11029	11045	11061
Ambient temperature LOW	10998	11014	11030	11046	11062
	10999	11015	11031	11047	11063
EGA ready	11000	11016	11032	11048	11064
CO optioned	11001	11017	11033	11049	11065
NO optioned	11002	11018	11034	11050	11066
SO2 optioned	11003	11019	11035	11051	11067
°C(0) or °F(1) optioned	11004	11020	11036	11052	11068
Sampling optioned	11005	11021	11037	11053	11069
2nd thermocouple optioned	11006	11022	11038	11054	11070
Voltage input optioned	11007	11023	11039	11055	11071
	11008	11024	11040	11056	11072

	EGA Number				
	6	7	8	9	10
Air Calibration in progress	11073	11089	11105	11121	11137
Gas Calibration in progress	11074	11090	11106	11122	11138
Cooler ready	11075	11091	11107	11123	11139
Ambient temperature OK	11076	11092	11108	11124	11140
Ambient temperature HIGH	11077	11093	11109	11125	11141
Ambient temperature LOW	11078	11094	11110	11126	11142
	11079	11095	11111	11127	11143
EGA ready	11080	11096	11112	11128	11144
CO optioned	11081	11097	11113	11129	11145
NO optioned	11082	11098	11114	11130	11146
SO2 optioned	11083	11099	11115	11131	11147
°C(0) or °F(1) optioned	11084	11100	11116	11132	11148
Sampling optioned	11085	11101	11117	11133	11149
2nd thermocouple optioned	11086	11102	11118	11134	11150
Voltage input optioned	11087	11103	11119	11135	11151
	11088	11104	11120	11136	11152

1X Reference Addresses - On line/Off line Status

In all cases, off line is indicated by 0, on line by 1.

MM No.	Reference Address
1	11793
2	11794
3	11795
4	11796
5	11797
6	11798
7	11799
8	11800
9	11801
10	11802

EGA No.	Reference Address
1	11809
2	11810
3	11811
4	11812
5	11813
6	11814
7	11815
8	11816
9	11817
10	11818

Digital I/O No.	Reference Address
1	11825
2	11826
3	11827
4	11828
5	11829
6	11830
7	11831
8	11832
9	11833
10	11834

Analogue I/O No.	Reference Address
1	11841
2	11842
3	11843
4	11844
5	11845
6	11846
7	11847
8	11848
9	11849
10	11850

1X Reference Addresses- Water Level

	MM Number				
	1	2	3	4	5
Water level optioned- no(0)/yes(1)	12001	12201	12401	12601	12801
Units- imperial(0)/metric(1)	12002	12202	12402	12602	12802
Feed water pump- off(0)/on(1)	12003	12203	12403	12603	12803
TDS units- ppm(0)/uSiemens(1)	12004	12204	12404	12604	12804
WL ready- no(0)/yes(1)	12005	12205	12405	12605	12805
TDS optioned- no(0)/yes(1)	12006	12206	12406	12606	12806
First out 1- normal(0)/fail(1)	12009	12209	12409	12609	12809
First out 2- normal(0)/fail(1)	12010	12210	12410	12610	12810
First out 3- normal(0)/fail(1)	12011	12211	12411	12611	12811
First out 4- normal(0)/fail(1)	12012	12212	12412	12612	12812
First out 5- normal(0)/fail(1)	12013	12213	12413	12613	12813
First out 6- normal(0)/fail(1)	12014	12214	12414	12614	12814
First out 7- normal(0)/fail(1)	12015	12215	12415	12615	12815
First out 8- normal(0)/fail(1)	12016	12216	12416	12616	12816
First out 9- normal(0)/fail(1)	12017	12217	12417	12617	12817
First out 10- normal(0)/fail(1)	12018	12218	12418	12618	12818
First out 11- normal(0)/fail(1)	12019	12219	12419	12619	12819
First out 12- normal(0)/fail(1)	12020	12220	12420	12620	12820
First out 13- normal(0)/fail(1)	12021	12221	12421	12621	12821
First out 14- normal(0)/fail(1)	12022	12222	12422	12622	12822
First out 15- normal(0)/fail(1)	12023	12223	12423	12623	12823

	MM Number				
	6	7	8	9	10
Water level optioned- no(0)/yes(1)	13001	13201	13401	13601	13801
Units- imperial(0)/metric(1)	13002	13202	13402	13602	13802
Feed water pump- off(0)/on(1)	13003	13203	13403	13603	13803
TDS units- ppm(0)/uSiemens(1)	13004	13204	13404	13604	13804
WL ready- no(0)/yes(1)	13005	13205	13405	13605	13805
TDS optioned- no(0)/yes(1)	13006	13206	13406	13606	13806
First out 1- normal(0)/fail(1)	13009	13209	13409	13609	13809
First out 2- normal(0)/fail(1)	13010	13210	13410	13610	13810
First out 3- normal(0)/fail(1)	13011	13211	13411	13611	13811
First out 4- normal(0)/fail(1)	13012	13212	13412	13612	13812
First out 5- normal(0)/fail(1)	13013	13213	13413	13613	13813
First out 6- normal(0)/fail(1)	13014	13214	13414	13614	13814
First out 7- normal(0)/fail(1)	13015	13215	13415	13615	13815
First out 8- normal(0)/fail(1)	13016	13216	13416	13616	13816
First out 9- normal(0)/fail(1)	13017	13217	13417	13617	13817
First out 10- normal(0)/fail(1)	13018	13218	13418	13618	13818
First out 11- normal(0)/fail(1)	13019	13219	13419	13619	13819
First out 12- normal(0)/fail(1)	13020	13220	13420	13620	13820
First out 13- normal(0)/fail(1)	13021	13221	13421	13621	13821
First out 14- normal(0)/fail(1)	13022	13222	13422	13622	13822
First out 15- normal(0)/fail(1)	13023	13223	13423	13623	13823

6.17.4 3X Reference Addresses - Input Registers

Analog Inputs

Analogue I/O Module Number		**Input Number** 1	2	3	4	5	6
1		30017	30018	30019	30020	30021	30022
2		30025	30026	30027	30028	30029	30030
3		30033	30034	30035	30036	30037	30038
4		30041	30042	30043	30044	30045	30046
5		30049	30050	30051	30052	30053	30054
6		30057	30058	30059	30060	30061	30062
7		30065	30066	30067	30068	30069	30070
8		30073	30074	30075	30076	30077	30078
9		30081	30082	30083	30084	30085	30086
10		30089	30090	30091	30092	30093	30094

Software Version

30097 Software Version Number
30098 Software Issue Number

3X Reference Addresses - Input Registers

	MM Number				
	1	2	3	4	5
Load index	30101	30151	30201	30251	30301
Startup/firing status	30102	30152	30202	30252	30302
Sequence status	30103	30153	30203	30253	30303
Burner rating	30104	30154	30204	30254	30304
Actual value	30105	30155	30205	30255	30305
Required value	30106	30156	30206	30256	30306
Fuel selected	30107	30157	30207	30257	30307
Number of channels	30108	30158	30208	30258	30308
Channel 1 position	30109	30159	30209	30259	30309
Channel 2 position	30110	30160	30210	30260	30310
Channel 3 position	30111	30161	30211	30261	30311
Channel 4 position	30112	30162	30212	30262	30312
MM error number	30113	30163	30213	30263	30313
Single/twin operation	30114	30164	30214	30264	30314
Run O2	30115	30165	30215	30265	30315
Run CO2	30116	30166	30216	30266	30316
Run CO	30117	30167	30217	30267	30317
Run exhaust temperature	30118	30168	30218	30268	30318
Run efficiency	30119	30169	30219	30269	30319
Run NO	30120	30170	30220	30270	30320
Run SO2	30121	30171	30221	30271	30321
Comm. O2	30122	30172	30222	30272	30322
Comm. CO2	30123	30173	30223	30273	30323
Comm. CO	30124	30174	30224	30274	30324
Comm. Exhaust temperature	30125	30175	30225	30275	30325
Comm. Efficiency	30126	30176	30226	30276	30326
Comm. NO	30127	30177	30227	30277	30327
Comm. SO2	30128	30178	30228	30278	30328
EGA error number	30129	30179	30229	30279	30329
Minimum required value	30130	30180	30230	30280	30330
Maximum required value	30131	30181	30231	30281	30331
Present flow units	30132	30182	30232	30282	30332
Present flow thousands	30133	30183	30233	30283	30333
Fuel 1 flow total units	30134	30184	30234	30284	30334
Fuel 1 flow total thousands	30135	30185	30235	30285	30335
Fuel 1 flow total millions	30136	30186	30236	30286	30336
Fuel 2 flow total units	30137	30187	30237	30287	30337
Fuel 2 flow total thousands	30138	30188	30238	30288	30338
Fuel 2 flow total millions	30139	30189	30239	30289	30339
Fuel 3 flow total units	30140	30190	30240	30290	30340
Fuel 3 flow total thousands	30141	30191	30241	30291	30341
Fuel 3 flow total millions	30142	30192	30242	30292	30342
Run ambient	30143	30193	30243	30293	30343
Run delta T	30144	30194	30244	30294	30344
COM ambient	30145	30195	30245	30295	30345
COM delta T	30146	30196	30246	30296	30346
Mk6/Mini6/Mini5 (0,4,5)	30147	30197	30247	30297	30347

3X Reference Addresses - Input Registers

	MM Number				
	6	7	8	9	10
Load index	30351	30401	30451	30501	30551
Startup/firing status	30352	30402	30452	30502	30552
Sequence status	30353	30403	30453	30503	30553
Boiler capacity	30354	30404	30454	30504	30554
Actual value	30355	30405	30455	30505	30555
Required value	30356	30406	30456	30506	30556
Fuel selected	30357	30407	30457	30507	30557
Number of channels	30358	30408	30458	30508	30558
Channel 1 position	30359	30409	30459	30509	30559
Channel 2 position	30360	30410	30460	30510	30560
Channel 3 position	30361	30411	30461	30511	30561
Channel 4 position	30362	30412	30462	30512	30562
MM error number	30363	30413	30463	30513	30563
Single/twin operation	30364	30414	30464	30514	30564
Run O2	30365	30415	30465	30515	30565
Run CO2	30366	30416	30466	30516	30566
Run CO	30367	30417	30467	30517	30567
Run exhaust temperature	30368	30418	30468	30518	30568
Run efficiency	30369	30419	30469	30519	30569
Run NO	30370	30420	30470	30520	30570
Run SO2	30371	30421	30471	30521	30571
Comm. O2	30372	30422	30472	30522	30572
Comm. CO2	30373	30423	30473	30523	30573
Comm. CO	30374	30424	30474	30524	30574
Comm. Exhaust temperature	30375	30425	30475	30525	30575
Comm. Efficiency	30376	30426	30476	30526	30576
Comm. NO	30377	30427	30477	30527	30577
Comm. SO2	30378	30428	30478	30528	30578
EGA error number	30379	30429	30479	30529	30579
Minimum required value	30380	30430	30480	30530	30580
Maximum required value	30381	30431	30481	30531	30581
Present flow units	30382	30432	30482	30532	30582
Present flow thousands	30383	30433	30483	30533	30583
Fuel 1 flow total units	30384	30434	30484	30534	30584
Fuel 1 flow total thousands	30385	30435	30485	30535	30585
Fuel 1 flow total millions	30386	30436	30486	30536	30586
Fuel 2 flow total units	30387	30437	30487	30537	30587
Fuel 2 flow total thousands	30388	30438	30488	30538	30588
Fuel 2 flow total millions	30389	30439	30489	30539	30589
Fuel 3 flow total units	30390	30440	30490	30540	30590
Fuel 3 flow total thousands	30391	30441	30491	30541	30591
Fuel 3 flow total millions	30392	30442	30492	30542	30592
Run ambient	30393	30443	30493	30543	30593
Run delta T	30394	30444	30494	30544	30594
COM ambient	30395	30445	30495	30545	30595
COM delta T	30396	30446	30496	30546	30596
Mk6/Mini6/Mini5 (0,4,5)	30397	30447	30497	30547	30597

3X Reference Addresses - Input Registers

	MM Number				
	1	2	3	4	5
Fuel 4 flow total units	30801	30851	30901	30951	31001
Fuel 4 flow total thousands	30802	30852	30902	30952	31002
Fuel 4 flow total millions	30803	30853	30903	30953	31003
Channel 5 output 0-255	30804	30854	30904	30954	31004
Channel 5 input 0-255	30805	30855	30905	30955	31005
Channel 6 output 0-255	30806	30856	30906	30956	31006
Channel 6 input 0-255	30807	30857	30907	30957	31007
Option 1	30808	30858	30908	30958	31008
Option 77	30809	30859	30909	30959	31009
Option 90	30810	30860	30910	30960	31010
Option 91	30811	30861	30911	30961	31011
Option 92	30812	30862	30912	30962	31012
Option 93	30813	30863	30913	30963	31013
Option 94	30814	30864	30914	30964	31014
Option 95	30815	30865	30915	30965	31015
Option 96	30816	30866	30916	30966	31016
Option 97	30817	30867	30917	30967	31017
Option 98	30818	30868	30918	30968	31018
Option 99	30819	30869	30919	30969	31019
Option 100	30820	30870	30920	30970	31020
Option 101	30821	30871	30921	30971	31021
Option 102	30822	30872	30922	30972	31022
Option 103	30823	30873	30923	30973	31023
Option 104	30824	30874	30924	30974	31024
Option 105	30825	30875	30925	30975	31025
Option 106	30826	30876	30926	30976	31026
Option 107	30827	30877	30927	30977	31027
Option 108	30828	30878	30928	30978	31028
Option 109	30829	30879	30929	30979	31029
Lockout code	30830	30880	30930	30980	31030
Option 71 fuel 1 type	30831	30881	30931	30981	31031
Option 72 fuel 2 type	30832	30882	30932	30982	31032
Option 73 fuel 3 type	30833	30883	30933	30983	31033
Option 74 fuel 4 type	30834	30884	30934	30984	31034
Option 61 flow units fuel 1	30835	30885	30935	30985	31035
Option 62 flow units fuel 2	30836	30886	30936	30986	31036
Option 63 flow units fuel 3	30837	30887	30937	30987	31037
Option 64 flow units fuel 4	30838	30888	30938	30988	31038
Fuel 1 hours run	30839	30889	30939	30989	31039
Fuel 2 hours run	30840	30890	30940	30990	31040
Fuel 3 hours run	30841	30891	30941	30991	31041
Fuel 4 hours run	30842	30892	30942	30992	31042
Fuel 1 start ups	30843	30893	30943	30993	31043
Fuel 2 start ups	30844	30894	30944	30994	31044
Fuel 3 start ups	30845	30895	30945	30995	31045
Fuel 4 start ups	30846	30896	30946	30996	31046
Air pressure	30847	30897	30947	30997	31047
Air pressure coding	30848	30898	30948	30998	31048
Gas pressure	30849	30899	30949	30999	31049
Gas pressure coding	30850	30900	30950	31000	31050

3X Reference Addresses - Input Registers

	MM Number				
	6	7	8	9	10
Fuel 4 flow total units	31051	31101	31151	31201	31251
Fuel 4 flow total thousands	31052	31102	31152	31202	31252
Fuel 4 flow total millions	31053	31103	31153	31203	31253
Channel 5 output 0-255	31054	31104	31154	31204	31254
Channel 5 input 0-255	31055	31105	31155	31205	31255
Channel 6 output 0-255	31056	31106	31156	31206	31256
Channel 6 input 0-255	31057	31107	31157	31207	31257
Option 1	31058	31108	31158	31208	31258
Option 77	31059	31109	31159	31209	31259
Option 90	31060	31110	31160	31210	31260
Option 91	31061	31111	31161	31211	31261
Option 92	31062	31112	31162	31212	31262
Option 93	31063	31113	31163	31213	31263
Option 94	31064	31114	31164	31214	31264
Option 95	31065	31115	31165	31215	31265
Option 96	31066	31116	31166	31216	31266
Option 97	31067	31117	31167	31217	31267
Option 98	31068	31118	31168	31218	31268
Option 99	31069	31119	31169	31219	31269
Option 100	31070	31120	31170	31220	31270
Option 101	31071	31121	31171	31221	31271
Option 102	31072	31122	31172	31222	31272
Option 103	31073	31123	31173	31223	31273
Option 104	31074	31124	31174	31224	31274
Option 105	31075	31125	31175	31225	31275
Option 106	31076	31126	31176	31226	31276
Option 107	31077	31127	31177	31227	31277
Option 108	31078	31128	31178	31228	31278
Option 109	31079	31129	31179	31229	31279
Lockout code	31080	31130	31180	31230	31280
Option 71 fuel 1 type	31081	31131	31181	31231	31281
Option 72 fuel 2 type	31082	31132	31182	31232	31282
Option 73 fuel 3 type	31083	31133	31183	31233	31283
Option 74 fuel 4 type	31084	31134	31184	31234	31284
Option 61 flow units fuel 1	31085	31135	31185	31235	31285
Option 62 flow units fuel 2	31086	31136	31186	31236	31286
Option 63 flow units fuel 3	31087	31137	31187	31237	31287
Option 64 flow units fuel 4	31088	31138	31188	31238	31288
Fuel 1 hours run	31089	31139	31189	31239	31289
Fuel 2 hours run	31090	31140	31190	31240	31290
Fuel 3 hours run	31091	31141	31191	31241	31291
Fuel 4 hours run	31092	31142	31192	31242	31292
Fuel 1 start ups	31093	31143	31193	31243	31293
Fuel 2 start ups	31094	31144	31194	31244	31294
Fuel 3 start ups	31095	31145	31195	31245	31295
Fuel 4 start ups	31096	31146	31196	31246	31296
Air pressure	31097	31147	31197	31247	31297
Air pressure coding	31098	31148	31198	31248	31298
Gas pressure	31099	31149	31199	31249	31299
Gas pressure coding	31100	31150	31200	31250	31300

3X Reference Addresses - Input Registers

The information on this page is only relevant to standalone EGAs connected directly to the DTI via the EGA port.

	EGA Number				
	1	2	3	4	5
Fuel selected	30601	30621	30641	30661	30681
% O2	30602	30622	30642	30662	30682
% CO2	30603	30623	30643	30663	30683
ppm CO	30604	30624	30644	30664	30684
ppm NO	30605	30625	30645	30665	30685
ppm SO2	30606	30626	30646	30666	30686
Exhaust temperature	30607	30627	30647	30667	30687
Efficiency	30608	30628	30648	30668	30688
Error number	30609	30629	30649	30669	30689
% voltage input	30610	30630	30650	30670	30690
Exhaust ? T	30611	30631	30651	30671	30691
Ambient	30612	30632	30652	30672	30692
Auxiliary temperature	30613	30633	30653	30673	30693
Service L.E.D.'s	30614	30634	30654	30674	30694

	EGA Number				
	6	7	8	9	10
Fuel selected	30701	30721	30741	30761	30781
% O2	30702	30722	30742	30762	30782
% CO2	30703	30723	30743	30763	30783
ppm CO	30704	30724	30744	30764	30784
ppm NO	30705	30725	30745	30765	30785
ppm SO2	30706	30726	30746	30766	30786
Exhaust temperature	30707	30727	30747	30767	30787
Efficiency	30708	30728	30748	30768	30788
Error number	30709	30729	30749	30769	30789
% voltage input	30710	30730	30750	30770	30790
Exhaust ? T	30711	30731	30751	30771	30791
Ambient	30712	30732	30752	30772	30792
Auxiliary temperature	30713	30733	30753	30773	30793
Service L.E.D.'s	30714	30734	30754	30774	30794

3X Reference Addresses - Input Registers

MM Number		
1	Error	31301
2	Error	31302
3	Error	31303
4	Error	31304
5	Error	31305
6	Error	31306
7	Error	31307
8	Error	31308
9	Error	31309
10	Error	31310

Please see section 6.17.8.4 for a list of the error codes that can be seen for each Modbus address.

MM Number		
1	Lockout	31311
2	Lockout	31312
3	Lockout	31313
4	Lockout	31314
5	Lockout	31315
6	Lockout	31316
7	Lockout	31317
8	Lockout	31318
9	Lockout	31319
10	Lockout	31320

Please see section 6.17.8.5 for a list of the lockout codes that can be seen for each Modbus address.

3X Reference Addresses - Analogue inputs- totalised values

Analogue I/O Module Number		**Channel Number** 1	2	3	4	5	6
1	byte 7/6	31324	31328	31332	31336	31340	31344
	byte 5/4	31323	31327	31331	31335	31339	31343
	byte 3/2	31322	31326	31330	31334	31338	31342
	byte 1/0	31321	31325	31329	31333	31337	31341
2	byte 7/6	31348	31352	31356	31360	31364	31368
	byte 5/4	31347	31351	31355	31359	31363	31367
	byte 3/2	31346	31350	31354	31358	31362	31366
	byte 1/0	31345	31349	31353	31357	31361	31365
3	byte 7/6	31372	31376	31380	31384	31388	31392
	byte 5/4	31371	31375	31379	31383	31387	31391
	byte 3/2	31370	31374	31378	31382	31386	31390
	byte 1/0	31369	31373	31377	31381	31385	31389
4	byte 7/6	31396	31400	31404	31408	31412	31416
	byte 5/4	31395	31399	31403	31407	31411	31415
	byte 3/2	31394	31398	31402	31406	31410	31414
	byte 1/0	31393	31397	31401	31405	31409	31413
5	byte 7/6	31420	31424	31428	31432	31436	31440
	byte 5/4	31419	31423	31427	31431	31435	31439
	byte 3/2	31418	31422	31426	31430	31434	31438
	byte 1/0	31417	31421	31425	31429	31433	31437
6	byte 7/6	31444	31448	31452	31456	31460	31464
	byte 5/4	31443	31447	31451	31455	31459	31463
	byte 3/2	31442	31446	31450	31454	31458	31462
	byte 1/0	31441	31445	31449	31453	31457	31461
7	byte 7/6	31468	31472	31476	31480	31484	31488
	byte 5/4	31467	31471	31475	31479	31483	31487
	byte 3/2	31466	31470	31474	31478	31482	31486
	byte 1/0	31465	31469	31473	31477	31481	31485
8	byte 7/6	31492	31496	31500	31504	31508	31512
	byte 5/4	31491	31495	31499	31503	31507	31511
	byte 3/2	31490	31494	31498	31502	31506	31510
	byte 1/0	31489	31493	31497	31501	31505	31509
9	byte 7/6	31516	31520	31524	31528	31532	31536
	byte 5/4	31515	31519	31523	31527	31531	31535
	byte 3/2	31514	31518	31522	31526	31530	31534
	byte 1/0	31513	31517	31521	31525	31529	31533
10	byte 7/6	31540	31544	31548	31552	31556	31560
	byte 5/4	31539	31543	31547	31551	31555	31559
	byte 3/2	31538	31542	31546	31550	31554	31558
	byte 1/0	31537	31541	31545	31549	31553	31557

3X Reference Addresses - Water Level Input Registers

	MM Number				
	1	2	3	4	5
Probe 1 signal	32001	32101	32201	32301	32401
Probe 1 reference	32002	32102	32202	32302	32402
	32003	32103	32203	32303	32403
Probe 1 Version/Issue (ms/ls byte)	32004	32104	32204	32304	32404
Probe 2 signal	32005	32105	32205	32305	32405
Probe 2 reference	32006	32106	32206	32306	32406
	32007	32107	32207	32307	32407
Probe 2 Version/Issue (ms/ls byte)	32008	32108	32208	32308	32408
Alarm status	32009	32109	32209	32309	32409
Level status	32010	32110	32210	32310	32410
WL version/Issue (ms/ls byte)	32011	32111	32211	32311	32411
Alarm code	32012	32112	32212	32312	32412
	32013	32113	32213	32313	32413
Steam temperature °C	32014	32114	32214	32314	32414
Feed water temperature °C	32015	32115	32215	32315	32415
Steam rate lb/hr	32016	32116	32216	32316	32416
Heat to steam Btus/lb	32017	32117	32217	32317	32417
Control element %	32018	32118	32218	32318	32418
	32019	32119	32219	32319	32419
Control point raised	32020	32120	32220	32320	32420
	32021	32121	32221	32321	32421
FO CRC	32022	32122	32222	32322	32422
Totalised steam lbs (ls word)	32023	32123	32223	32323	32423
Totalised steam lbs (ms word)	32024	32124	32224	32324	32424
Steam temperature F	32025	32125	32225	32325	32425
Feed water temperature F	32026	32126	32226	32326	32426
Steam rate Kgs/hr	32027	32127	32227	32327	32427
Heat to steam KJ/Kg	32028	32128	32228	32328	32428
Totalised steam Kgs (ls word)	32029	32129	32229	32329	32429
Totalised Steam Kgs (ms word)	32030	32130	32230	32330	32430
Probe 1 temperature °C	32031	32131	32231	32331	32431
Probe 2 temperature °C	32032	32132	32232	32332	32432
Probe 1 temperature °F	32033	32133	32233	32333	32433
Probe 2 temperature °F	32034	32134	32234	32334	32434
Max load index (%)	32035	32135	32235	32335	32435
Min load index (%)	32036	32136	32236	32336	32436
Cold start status- off(0)/on(1)	32037	32137	32237	32337	32437
Probe 1 corrected working	32038	32138	32238	32338	32438
Probe 2 corrected working	32039	32139	32239	32339	32439
TDS target	32040	32140	32240	32340	32440
TDS measured	32041	32141	32241	32341	32441
WL commdata CRC	32042	32142	32242	32342	32442
WL control type	32043	32143	32243	32343	32443

3X Reference Addresses - Water Level Input Registers

	MM Number				
	6	7	8	9	10
Probe 1 signal	32501	32601	32701	32801	32901
Probe 1 reference	32502	32602	32702	32802	32902
	32503	32603	32703	32803	32903
Probe 1 Version/Issue (ms/ls byte)	32504	32604	32704	32804	32904
Probe 2 signal	32505	32605	32705	32805	32905
Probe 2 reference	32506	32606	32706	32806	32906
	32507	32607	32707	32807	32907
Probe 2 Version/Issue (ms/ls byte)	32508	32608	32708	32808	32908
Alarm status	32509	32609	32709	32809	32909
Level status	32510	32610	32710	32810	32910
WL version/Issue (ms/ls byte)	32511	32611	32711	32811	32911
Alarm code	32512	32612	32712	32812	32912
	32513	32613	32713	32813	32913
Steam temperature °C	32514	32614	32714	32814	32914
Feed water temperature °C	32515	32615	32715	32815	32915
Steam rate lb/hr	32516	32616	32716	32816	32916
Heat to steam Btus/lb	32517	32617	32717	32817	32917
Control element %	32518	32618	32718	32818	32918
	32519	32619	32719	32819	32919
Control point raised	32520	32620	32720	32820	32920
	32521	32621	32721	32821	32921
FO CRC	32522	32622	32722	32822	32922
Totalised steam lbs (ls word)	32523	32623	32723	32823	32923
Totalised steam lbs (ms word)	32524	32624	32724	32824	32924
Steam temperature F	32525	32625	32725	32825	32925
Feed water temperature F	32526	32626	32726	32826	32926
Steam rate Kgs/hr	32527	32627	32727	32827	32927
Heat to steam KJ/Kg	32528	32628	32728	32828	32928
Totalised steam Kgs (ls word)	32529	32629	32729	32829	32929
Totalised Steam Kgs (ms word)	32530	32630	32730	32830	32930
Probe 1 temperature °C	32531	32631	32731	32831	32931
Probe 2 temperature °C	32532	32632	32732	32832	32932
Probe 1 temperature °F	32533	32633	32733	32833	32933
Probe 2 temperature °F	32534	32634	32734	32834	32934
Max load index (%)	32535	32635	32735	32835	32935
Min load index (%)	32536	32636	32736	32836	32936
Cold start status- off(0)/on(1)	32537	32637	32737	32837	32937
Probe 1 corrected working	32538	32638	32738	32838	32938
Probe 2 corrected working	32539	32639	32739	32839	32939
TDS target	32540	32640	32740	32840	32940
TDS measured	32541	32641	32741	32841	32941
WL commdata CRC	32542	32642	32742	32842	32942
WL control type	32543	32643	32743	32843	32943

6.17.5 4X Reference Addresses - Holding Registers

Individual Required value for each Micro Modulation unit

MM ID number		Reference Address
1		40001
2		40002
3		40003
4		40004
5		40005
6		40006
7		40007
8		40008
9		40009
10		40010

Global Required Value for all MMs

40011

Lead Boiler selection

40012

Reserved - DO NOT USE

40013 - 40016

Load Index commands- ability to change the firing rate remotely

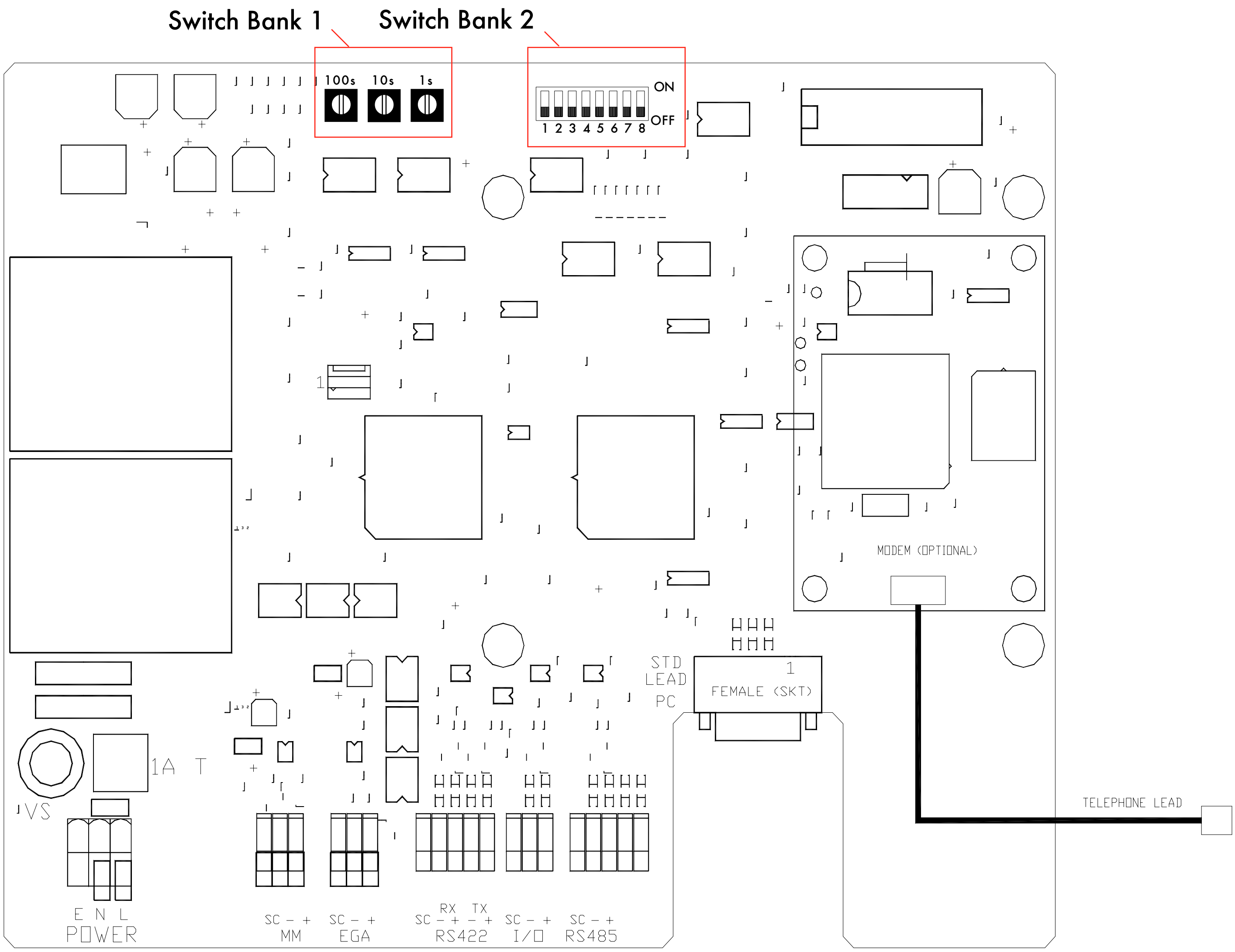
	MM Number				
	1	2	3	4	5
DTI load index value	40121	40122	40123	40124	40125
DTI load index command- off(0)/on(1)	40131	40132	40133	40134	40135

	MM Number				
	6	7	8	9	10
DTI load index value	40126	40127	40128	40129	40130
DTI load index command- off(0)/on(1)	40136	40137	40138	40139	40140

4X Reference Addresses - Holding Registers

Analogue I/O Module Number		**Output Number** 1	2	3	4	5	6
1		40017	40018	40019	40020	40021	40022
2		40025	40026	40027	40028	40029	40030
3		40033	40034	40035	40036	40037	40038
4		40041	40042	40043	40044	40045	40046
5		40049	40050	40051	40052	40053	40054
6		40057	40058	40059	40060	40061	40062
7		40065	40066	40067	40068	40069	40070
8		40073	40074	40075	40076	40077	40078
9		40081	40082	40083	40084	40085	40086
10		40089	40090	40091	40092	40093	40094

6.17.6 Switch Settings - Modbus Operation



Switch Bank 1

Set the Modbus address accordingly.

For example, to set address number 123:

100s	= 1
10s	= 2
1s	= 3

Switch Bank 2

1 off - Modbus 'ASCII' mode
on - Modbus 'RTU' mode

2 Transmission settings
off - 8 data bits, 1 stop bit, no parity.
on - 8 data bits, 1 stop bit, even parity.

3-5 no user function, must be set off

6 Windows PCDTI/MODBUS operation
off - 422 port set for Windows PCDTI
on - 422 port set for MODBUS

7 Windows PCDTI/MODBUS operation
off - PC port set for WinPCDTI
on - PC port set for MODBUS

8 MM Port Baud Rate
off - 9600 (Mk6, Mini Mk6 and Mini Mk5 MMs)
on - 4800 (Older Mk5 and Mini MMs)*

* Technical Memo: Data Communication Compatibility 3/9/1999

6.17.7 Other Information

Modbus Transmission Interface

There is no hardware or software flow control on any port.

Baud Rate 9600.

Supported MODBUS Commands

1	Read coil status
2	Read input status
3	Read holding registers
4	Read input registers
5	Force single coil
6	Preset single register
15	Force multiple coils
16	Preset multiple registers

6.17.7.3 Supported Exception Responses

Exception responses are not supported. No response is given to an unrecognised request.

6.17.7.4 Serial Port Connections

RS232 'PC' port - 9 Way Female D connector

PIN	Function
2	Data out
3	Data in
5	Signal ground

RS422 port - Screw terminal blocks

Receive and transmit connections are as identified on printed circuit board.

6.17.8 Relevance of MM/EGA data

Each MM/EGA can provide the following information. All values are instantaneous. Each MM/EGA system updates the DTI approximately once every 20 seconds. Certain values and some values under certain conditions may require a decimal point. In these cases the user must add the decimal point accordingly (* only valid if EGA operational on system)

Digital Inputs (1x references)

Command status of M.M. 'CR Relay'	0- Off 1- On
Flow detector type	0- Temperature 1- Pressure
Optioned for flow metering	0- No 1- Yes
CO off/on on fuel 2 (fuel 1 CO always on)	0- Off 1- On
Temperature units	0- C 1- F
Pressure units	0- bar 1- psi
Optioned for voltage input modulation	0- No 1- Yes
Optioned for EGA	0- No 1- Yes
Boiler up to 'trimming' temperature	0- No 1- Yes
EGA cooler temperature ready	0- No 1- Yes
EGA ambient temperature OK	0- No 1- Yes
Optioned to display NO	0- No 1- Yes
Option to display SO_2	0- No 1- Yes
EGA ambient temperature low/high (relevant if bit 3 (ambient temperature) is 0)	0- LOW 1- HIGH
Optioned for sequencing	0- NO 1- YES
Setpoint/Disable commands accepted	0- NO 1- YES
Hand operation status	0- Modulating 1- Hand Operation
Low flame hold status	0- Modulating 1- Low Flame Hold
This MM controlling DTI bus communication	0- NO 1- YES
Input 88/41 set (lead boiler select)	0- NO 1- YES

Lead boiler status	0- not lead boiler 1- lead boiler
'Disabled' status	0- enabled 1- disabled
Slave burner indication status - test bit 0	0- master plus one 1- master minus one

Analogue Inputs (3x references)

0-100	Firing rate/load index - percentage	
0-250	Maximum firing rate- value number entered in option #34	
0-999 0.0-99.9	Actual value of boiler flow temperature/pressure- degrees C/F/psi Pressure- bar	
0-999 0.0-99.9	Required setpoint of boiler flow temperature/pressure- degrees C/F/psi Pressure- bar	
0-2	Present fuel selected	0- Fuel 1 (usually GAS) 1- Fuel 2 (usually OIL) 2- Fuel 3 (usually OIL)
1-7	Number of channels in operation (add one to this to get total number)	
-6.0-96.0	CH1 positioning motor position degrees angular	
-6.0-96.0	CH2 positioning motor position degrees angular	
-6.0-96.0	CH3 positioning motor position degrees angular	
-6.0-96.0	Ch4 positioning motor position degrees angular	
0-N	Fatal Error Code Value is as MM ERR display	0 - System is OK 1 - N system shut down
0-2	Single/twin burner operation 0 - single burner 1 - twin burner (both together only) 2 - twin burner (both together/one or the other)	
0-25.5	Present value percentage oxygen in flue gas	
0-25.5	Present value percentage carbon dioxide in flue gas	
0-999	Present value ppm carbon monoxide in flue gas	
0-999	Present value flue gas temperature	
0-99.9	Present value percentage combustion efficiency	
0-999	Present value NO	
0-999	Present value SO_2	

0-25.5	Commissioned value percentage oxygen in flue gas
0-25.5	Commissioned value percentage carbon dioxide in flue gas
0-999	Commissioned value ppm carbon monoxide in flue gas
0-999	Commissioned value flue gas temperature
0-99.9	Commissioned value percentage combustion efficiency
0-999	Commissioned value NO
0-999	Commissioned value SO_2
0-N	EGA error code normal- 0. Any other value indicates an error.
0-99.9	Minimum setpoint accepted(0-999, 0-99.9)
0-99.9	Minimum setpoint accepted(0-999, 0-99.9)
0-999	Flow value units
0-999	Flow value thousands (multiply thousands value by 1000 then add units value then divide by 100 to get flow value)
0-999	Fuel 1 totalised value units
0-999	Fuel 1 totalised value thousands
0-999	Fuel 1 totalised value millions
0-999	Fuel 2 totalised value units
0-999	Fuel 2 totalised value thousands
0-999	Fuel 2 totalised value millions
0-999	Fuel 3 totalised value units
0-999	Fuel 3 totalised value thousands
0-999	Fuel 3 totalised value millions
-6.0-96.0	Ch5 positioning motor position degrees angular
-6.0-96.0	Ch6 positioning motor position degrees angular
-6.0-96.0	Ch7 positioning motor position degrees angular
-6.0-96.0	Ch8 positioning motor position degrees angular

The following table lists the startup/firing status codes along with an explanation of what the codes mean. This is for Modbus addresses:

30102 MM ID #1
30152 MM ID #2
30202 MM ID #3
30252 MM ID #4
30302 MM ID #5
30352 MM ID #6
30402 MM ID #7
30452 MM ID #8
30502 MM ID #9
30552 MM ID #10

Code		Explanation
19		Waiting for stat circuit to complete
20		Waiting for command to drive air damper to purge position
21		Driving air damper to purge position
22		Purging: Waiting for command o drive valves to ignition position
23		Driving valves to ignition position
24		Ignition taking place
25		Burner firing and modulating
26		Post purge taking place

If 0, then the indicated transmission is direct from an E.G.A.

The following table lists the sequence status for each M.M. This is for Modbus addresses:

30103 MM ID #1
30153 MM ID #2
30203 MM ID #3
30253 MM ID #4
30303 MM ID #5
30353 MM ID #6
30403 MM ID #7
30453 MM ID #8
30503 MM ID #9
30553 MM ID #10

Code		Explanation
0		On
1		Standby
2		Warm
3		Off

The following table lists the error codes along with an explanation of what the codes mean. This is for Modbus addresses:

31301	MM ID #1
31302	MM ID #2
31303	MM ID #3
31304	MM ID #4
31305	MM ID #5
31306	MM ID #6
31307	MM ID #7
31308	MM ID #8
31309	MM ID #9
31310	MM ID #10

Code		**Error Message/Explanation**
1		CH1 positioning error
2		CH2 positioning error
3		load detector
4		Software error
5		PROM memory fault
6		Commisssion data fault
7		RAM memory fault
8		CH3 positioning error
9		CH4 positioning error
40		CR1 test failure
41		CH1 gain error
42		CH2 gain error
43		CH3 gain error
44		5 volt supply error
45		Watchdog- CR2 safety test failed
46		CH4 gain error
47		A/D converter
80		CH5 error
81		CH6 error
83		CH5 feedback signal error
84		CH6 feedbcak signal error
92		Air pressure outside limits
100		Twin burner communications failed

The following table lists the lockout codes along with an explanation of what the codes mean. This is for Modbus addresses:

31311	MM ID #1
31312	MM ID #2
31313	MM ID #3
31314	MM ID #4
31315	MM ID #5
31316	MM ID #6
31317	MM ID #7
31318	MM ID #8
31319	MM ID #9
31320	MM ID #10

Code		Lockout Message
1		CPI wrong state
2		No air proving
3		Ignition output fault
4		Motor output fault
5		Start gas output fault
6		Main gas output 1 fault
7		Main gas output 2 fault
8		Vent valve output fault
9		Fail safe relay fault
10		Simulated flame
11		VPS air proving fail
12		VPS gas proving fail
13		No flame signal
14		Shutter fault
15		No cpi reset
16		Lockout permanently active
17		Gas pressure too low
18		Gas pressure too high
19		RAM test failed
20		PROM test failed
21		Watchdog fault 1a
22		Watchdog fault 1b
23		Watchdog fault 1c
24		Watchdog fault 1d
25		Watchdog fail 2a
26		Watchdog fail 2b
27		Watchdog fail 2c
28		Watchdog fail 2d
29		Input faulty
30		Gas sensor error
31		Air sensor error
32		Low gas pressure
33		VPS air zeroing fail
34		VPS gas pressure low
35		UV short circuit
36		Oil pressure too low
37		Oil pressure too high
38		CPU test failed
39		Freeze timeout
40		Purge air pressure low
41		Option 141 incorrect
42		Terminal 86 inverse
43		Terminal 85-86 fault
44		Prove cct fail
45		No prove cct set
46		No prove cct reset
198		BC input short
199		Lockout 199
200		
201		Lockout 201
202		EEPROM faulty

The following lists show the various codes for the water level Modbus addresses:

WL control type:

0- Modulating standard
1- On/off
2- Modulating high high
3- Modulating pre 1st low/pre high

Level status- the is the current level of the water:

0- Ok
1- High water
2- 1st low
3- 2nd low
4- High high water
5- Pre 1st low
6- Pre high water

Alarm code:

0- Ok
1- 2nd low
2- probe 1 comms
3- Probe 2 comms
4- Probe 1 short
5- Probe 2 short
6- Probe mismatch
7- Probe 1 TC
8- Probe 2 TC
9- Permanent reset
10- Permanent test
11- Keystuck reset
12- PU Eeprom
13- PU bogus EE state
14- Incompatible config
15- Probe 1 bogus comm data
16- Probe 2 bogus comm data
17- Config range check fail
18- 1st low
19- High water
20- Probe 1 still water
21- Probe 2 still water
22- Probes diverse
23- Pre 1st low
24- Pre high water

See section 5 for further explanation of the alarm codes.

6.17.9 Further Information

For more detailed information regarding the Modbus protocol, refer to the following publication:

Modicon Modbus Protocol Reference Guide,
PI-MBUS-300

Also visit the website: www.modicon.com

6.18 Autoflame winPCDTI Software

The Autoflame WinPCDTI software runs under Windows 95/98/NT4/XP and brings together our current range of products.

There are two modes of program operation:

Plant Supervisor for local control
Plant Manager for remote monitoring via modem for a number of sites

The software is presented in an intuitive graphical format where pictures and buttons are used to lead the operator through all the available functions.

Win PC DTI Operation (local PC connected directly)

The procedure detailed below indicates the set-up of the Autoflame winPCDTI software installed on a local PC connected directly to the DTI via a standard serial lead from the serial port on the back of the DTI to the serial port on the PC.

Components Checklist

1 x DTI*
1 x DTI to PC comms lead*
1 x DTI System CD-ROM*
1 x PC running Windows
* Included in the DTI System Package

Instructions

1. Wire all the MM and EGA modules, EGA units that are being used for standalone analysis and I/O modules to the DTI as shown in section 6.11.

2. On the back of the DTI, set the switches as shown in section 6.17.6 for winPCDTI operation. Usually, the rotary switches on switch bank 1 will be set to 001 and ways 1-8 on switch bank 2 will all be set to off.

3. Connect the DTI to the PC via a serial lead. One end will connect to the DTI's RS232 PC Port. The other will connect to the PC's serial port, usually COM1 or COM2.

4. Power up the DTI and the PC.

5. Insert the DTI system CD-ROM into the PC. Follow the instructions on the CD case to install the Autoflame winPCDTI software.

6. When the installation is complete, run winPCDTI. As this is the first time that the software has been run, it will prompt you to select Plant Manager/Plant Supervisor mode. Select Plant Supervisor.

If the DTI and other MM/EGA system modules are operational, they should appear on-line and be accessible from the PC.

6.18.1.2 Win PC DTI Operation (remote PC connected via modem)

The procedure detailed below indicates the set-up of the Autoflame winPCDTI software installed on a remote PC connected to the DTI via the modem on the DTI.

Components Checklist

1 x DTI* (this must be part number DTI60100/MD- DTI with internal modem)
2 x Modem and PC serial lead (one installed on the back of the DTI as supplied)
1 x DTI System CD-ROM*
1 x PC running Windows
* Included in the DTI System Package

Instructions

1. Wire all the MM and EGA modules, EGA units that are being used for standalone analysis and I/O modules to the DTI as shown in section 6.11.

2. On the back of the DTI, set the switches as shown in section 6.17.6 for winPCDTI operation. Usually, the rotary switches on switch bank 1 will be set to 001 and ways 1-8 on switch bank 2 will all be set to off.

3. Connect the modem on the DTI to the telephone socket.

4. Power up the DTI.

5. At the PC, connect the modem to the PC and the modem to the telephone socket.

6. Power up the modem and the PC.

7. Insert the DTI system CD-ROM into the PC. Follow the instructions on the CD case to install the Autoflame winPCDTI software.

8. When the installation is complete, run winPCDTI. As this is the first time that the software has been run, it will prompt you to select Plant Manager/Plant Supervisor mode. Select Plant Manager.

9. The site list will be empty to start of with. Click New Site to create a site entry in the data-base. Enter a name and telephone number for the site and save the changes.

10. Go back to the site list, click on your site and click Connect to dial into the remote DTI. If the other MM/EGA system modules are operational, they should appear on-line and be accessible from the PC.

6.18.1.3 Win PC DTI Operation (remote PC connected via a line driver)

The procedure detailed below indicates the set-up of the Autoflame winPCDTI software installed on a remote PC (up to 1km/4000ft) connected to the DTI via the RS422 port on the DTI to a line driver.

Components Checklist

1 x DTI*
1x Line driver and power supply
1x Standard PC modem lead
1 x DTI System CD-ROM*
1 x PC running Windows
* Included in the DTI System Package

Instructions

1. Wire all the MM and EGA modules, EGA units that are being used for standalone analysis and I/O modules to the DTI as shown in section 6.11.

2. On the back of the DTI, set the switches as shown in section 6.17.6 for winPCDTI operation. Usually, the rotary switches on switch bank 1 will be set to 001 and ways 1-8 on switch bank 2 will all be set to off.

3. Connect the long distance wiring to the RS422 port of the DTI as shown in section 6.13. At the PC end, connect the long distance wiring to the line driver. Set the switch on the line driver to DCE and plug the line driver to the PC using a standard PC Modem lead.

4. Power up the DTI, the PC and then the line driver (using its external power supply).

5. Insert the DTI system CD-ROM into the PC. Follow the instructions on the CD case to install the Autoflame winPCDTI software.

6. When the installation is complete, run winPCDTI. As this is the first time that the software has been run, it will prompt you to select Plant Manager/Plant Supervisor mode. Select Plant Supervisor.

If the DTI and other MM/EGA system modules are operational, they should appear on-line and be accessible from the PC.

Section 6.19: Johnson Metasys Interface Index

6.19.1 Overview

Autoflame's DTI unit interfaces with the Autoflame MM/EGA system. In doing so it provides a simple means of gathering information and presenting it to a bus or network. The DTI will interface with up to ten MM/EGA systems and up to ten analogue and/or digital units. This section details information regarding the Data Transfer Interface (DTI) 'Metasys' interface.

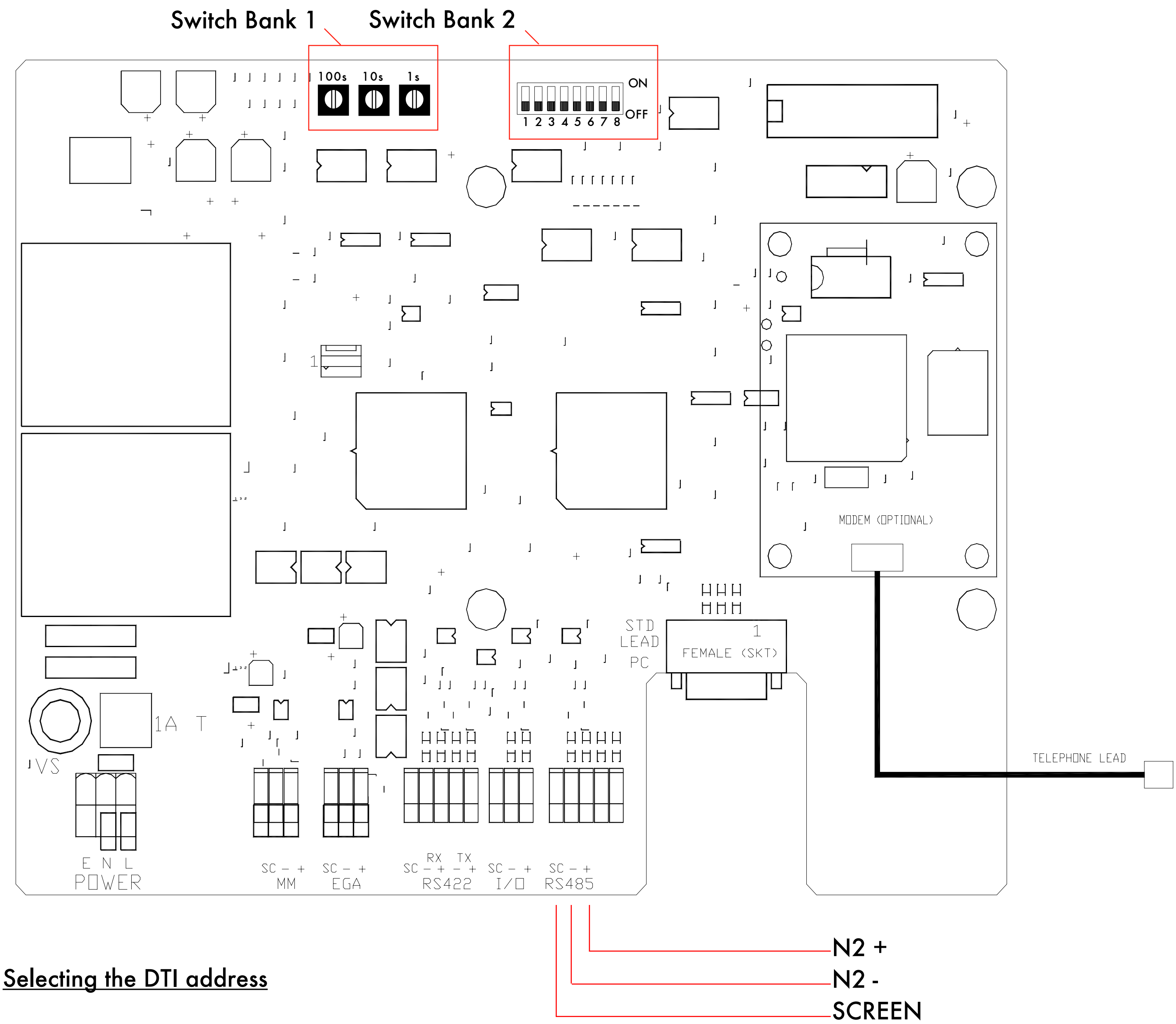
6.19.1.2 Requirements

Compatible software versions are:

DTI unit (DTI60100)	All serial numbers
DTI unit (DTI60100/MD)	All serial numbers
Mk6 unit	All serial numbers
Mini Mk6 unit	All serial numbers
Mini Mk5 evo	All serial numbers
Old DTI unit (DTI20010)	Serial number 095132 onwards
Old DTI EPROM	Metasys v1.02 onwards
MM Mk5 EPROM	300/0/15/4
mini Mk5 EPROM (2channel)	610/1/15/3
mini Mk5 EPROM (3channel)	620/1/15/3

6.19.2 Connecting the DTI to Metasys

The DTI has a port which provides direct access to the Metasys network. Connection is made via a screw terminal block labelled 'RS485+', 'RS485-' and 'RS485 screen'. Only the DTI address needs to be set by the installation engineer. The following diagram illustrates the connections required.



<u>Selecting the DTI address</u>

The DTI N2 address is selected by means of Switch Bank 1. Set the three rotary switches appropriately. For example, to set address number 123:

100s = 1
10s = 2
1s = 3

The DTI can occupy any address on the Metasys network, however the DTI requires eleven free consecutive address, starting from and including the address selected using the switches. If the DTI is given address 30, 30 is selected on SW1. However addresses 31 to 40 must also be free on the network.

If Metasys operation is required alongside Modbus operation, the Metasys address and Modbus address will have to be the same.

If winPCDTI/Modbus/Metasys combinations are used, the required value and enable/disable commands can be implemented by any of these three means.

6.19.3 Network Point Table

The DTI occupies 11 (eleven) addresses on the network. The first 10 address are used to read data from the 10 MM/EGA systems and only the MM/EGa systems. The last (eleventh) address is used to read and write data to the analogue and digital units. This address is also used to read the status of MM/EGA systems and write values to them. All of the systems addresses implement internal integer and byte values only. A full network point table follows.

<u>Technical Note</u>

Please be aware that the Change of State feature is not implemented on the DTI/Metasys interface. Therefore, normal Metasys COS (alarm limits for analogue values and normal condition for binary) notification will be defeated. If COS notification is required, then it is necessary for the operator to:

- Map the specific object(s) requiring COS to a CS object
- Define a AD or BD object with the CS object of the required COS point
- Assign Alarm Limits to the AD
- The AD or BD point will only be scanned at a minimum of 30 seconds
- The normal state of the BO must be updated (written to) by GPL

Analogue/binary input points that are mapped in directly that do not support COS will never report a change of state condition. They will report the current value when read but no alarm notification will occur. A read will only occur if a focus window is open or a feature requires the current value.

Network point table for first 10 (ten) addresses (read values from MM/EGA systems).

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
AI	Not used	-	-	-	-
BI	Not used	-	-	-	-
AO	Not used	-	-	-	-
BO	Not used	-	-	-	-
NPT	**NPA**	**UNITS**	**DESCRIPTION**	**RANGE**	**NOTE**
ADF	01	%	Load index	0 to 100.0	
ADF	02		Startup/Firing status	19 - 28	19 = Waiting for stat. circuit to complete. 20 = Waiting for command to drive air damper to purge position. 21 = Driving air damper to purge position. 22 = Purging, waiting for command to drive values to ignition position. 23 = Driving valves to ignition position. 24 = Ignition taking place. 25 = Burner firing and modulating. 26 = Post purge taking place. 27 = Not used. 28 = Golden start.
ADF	03		Sequence status	1 to 10	
ADF	04		Boiler capacity		see option 34 on MM
ADF	05		Actual value		For units see Options 1, 51, and 52 on associated MM
ADF	06		Required value		For units see Options 1, 51, and 52 on associated MM
ADF	07		Fuel selected	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	08		Number of channels	0 to 8	
ADF	09		Channel 1 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	10		Channel 2 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	11		Channel 3 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	12		Channel 4 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	13		MM error number	00 to 73	see section 2.3.1.2 of manual
ADF	14		Single/Twin operation	0 to 1	0 = single 1 = twin burner
ADF	15	%	Run O_2	0 to 20.9	Displayed as 0 to 20.9
ADF	16	%	Run CO_2	0 to 15	Displayed as 0 to 15.0
ADF	17	ppm	Run CO	0 to 999.0	
ADF	18		Run exhaust temperature	0 to 999.0	for units see option 51 on MM
ADF	19	%	Run efficiency	0 to 100.0	
ADF	20	ppm	Run NO	0 to 999.0	
ADF	21	ppm	Run SO_2	0 to 999.0	
ADF	22	%	Comm. O_2	0 to 20.9	Displayed as 0 to 20.9
ADF	23	%	Comm. CO_2	0 to 15.0	Displayed as 0 to 15.0
ADF	24	ppm	Comm. CO	0 to 999.0	
ADF	25		Comm. exhaust temp	0 to 999.0	for units see option 51 on MM
ADF	26	%	Comm. efficiency	0 to 100.0	

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADF	27	ppm	Comm. NO	0 to 999.0	
ADF	28	ppm	Comm. SO_2	0 to 999.0	
ADF	29		EGA error number	0 to 25	see section 3.4.1 of manual
ADF	30		Minimum required value		For units see Options 1, 51, and 52 on associated MM
ADF	31		Maximum required value		For units see Options 1, 51, and 52 on associated MM
ADF	32		Present flow units	0 to 999.0	
ADF	33		Present flow thousands	0 to 999.0	
ADF	34		Fuel 1 flow total units	0 to 999.0	
ADF	35		Fuel 1 flow total units	0 to 999.0	
ADF	36		Fuel 1 flow total thousands	0 to 999.0	
ADF	37		Fuel 1 flow total millions	0 to 999.0	
ADF	38		Fuel 2 flow total units	0 to 999.0	
ADF	39		Fuel 2 flow total thousands	0 to 999.0	
ADF	40		Fuel 2 flow total millions	0 to 999.0	
ADF	41		Fuel 3 flow total units	0 to 999.0	
ADF	42		Fuel 3 flow total thousands	0 to 999.0	
ADF	43		Fuel 3 flow total millions	0 to 999.0	
ADF	44		Channel 5 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	45		Channel 6 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	46		Channel 7 position	-6.0 to 90.0	Displayed as –6.0 to 96.0
ADF	47		Channel 8 position	-6.0 to 96.0	Displayed as –6.0 to 96.0
ADF	48		Not Used		
ADF	49		Not Used		
ADF	50		Not Used		
ADF	51		Fuel 4 flow total units	0 to 999.0	
ADF	52		Fuel 4 flow total thousands	0 to 999.0	
ADF	53		Fuel 4 flow total millions	0 to 999.0	
ADF	54		Channel 5 output	0 to 255.0	
ADF	55		Channel 5 input	0 to 255.0	
ADF	56		Channel 6 output	0 to 255.0	
ADF	57		Channel 6 input	0 to 255.0	
ADF	58		Option 1	3 to 8	See option table in manual
ADF	59		Option 77	0 to 5	See option table in manual
ADF	60		Option 90	0 to 1	See option table in manual
ADF	61		Option 91	0 to 2	See option table in manual
ADF	62		Option 92	1 to 200	See option table in manual
ADF	63		Option 93	1 to 200	See option table in manual
ADF	64		Option 94	0 to 2	See option table in manual
ADF	65		Option 95	0 to 1	See option table in manual
ADF	66		Option 96	0 to 200	See option table in manual
ADF	67		Option 97	0 to 200	See option table in manual
ADF	68		Not Used		
ADF	69		Not Used		
ADF	70		Option 100	0 to 1	See option table in manual
ADF	71		Option 101	0 to 2	See option table in manual
ADF	72		Option 102	1 to 200	See option table in manual
ADF	73		Option 103	1 to 200	See option table in manual
ADF	74		Option 104	0 to 2	See option table in manual

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADF	75		Option 105	0 to 1	See option table in manual
ADF	76		Option 106	0 to 200	See option table in manual
ADF	77		Option 107	0 to 200	See option table in manual
ADF	78		Not Used		
ADF	79		Not Used		
ADF	80		Lockout Code	0 to 255	See option table in manual
ADF	81		Option 71 Fuel 1 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	82		Option 72 Fuel 2 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	83		Option 73 Fuel 3 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	84		Option 74 Fuel 4 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	85		Option 61 Flow Units Fuel 1	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADF	86		Option 62 Flow Units Fuel 2	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADF	87		Option 63 Flow Units Fuel 3	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADF	88		Option 64 Flow Units Fuel 4	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADF	89		Fuel 1 Hours Run	0 to 9999.0	
ADF	90		Fuel 2 Hours Run	0 to 9999.0	
ADF	91		Fuel 3 Hours Run	0 to 9999.0	
ADF	92		Fuel 4 Hours Run	0 to 9999.0	
ADF	93		Fuel 1 Start ups	0 to 999.0	
ADF	94		Fuel 2 Start ups	0 to 999.0	
ADF	95		Fuel 3 Start ups	0 to 999.0	
ADF	96		Fuel 4 Start ups	0 to 999.0	
ADF	97		Air Pressure	0 to 999.0	Value is correctly scaled by DTI dependent on ADI 98

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADF	98		Air Pressure Coding	8 Bit Pattern	Bit_0 = 0 = off 1 = on Bit_1 = 0 = "WG 1 = mbar Bit_2 + Bit_3 =00 = 0 decimal places 01 = 1 decimal places 10 = 2 decimal places 11 = 3 decimal places Bit_4 = unused Bit_5 = unused Bit_6 = unused Bit_7 = unused
ADF	99		Gas Pressure	0 to 999.0	Value is correctly scaled by DTI dependent on ADI 100
ADF	100		Gas Pressure Coding	8 Bit Pattern	Bit_0 = 0 = off 1 = on Bit_1 + Bit_4 =00 = "WG 10 = mbar 01 = BAR 11 = PSI Bit_2 + Bit_3 =00 = 0 decimal places 01 = 1 decimal places 10 = 2 decimal places 11 = 3 decimal places Bit_5 = unused Bit_6 = unused Bit_7 = unused
ADF	101		Fuel Selected	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADF	102	%	E.G.A. O_2	0 to 20.9	Displayed as 0 to 209
ADF	103	%	E.G.A. CO_2	0 to 15.0	Displayed as 0 to 15.0
ADF	104	ppm	E.G.A. CO	0 to 999.0	
ADF	105	ppm	E.G.A. NO	0 to 999.0	
ADF	106	ppm	E.G.A. SO_2	0 to 999.0	
ADF	107		E.G.A. Exhaust temp	0 to 999.0	
ADF	108	%	E.G.A. Efficiency	0 to 100.0	
ADF	109		E.G.A. Error Number	0 to 25.0	
ADF	110	%	E.G.A. Voltage Input	0 to 100.0	
ADF	111		E.G.A. Exhaust ΔT	0 to 999.0	
ADF	112		E.G.A. Ambient	0 to 50.0	
ADF	113		E.G.A. Auxiliary Temp	0 to 999.0	
ADF	114		Service LEDS	8 Bit Pattern	Bit_0 to Bit_5 = 000000 = EGA requires servicing 000001 = 2 Months to service 000011 = 4 Months 000111 = 6 Months 001111 = 8 Months 011111 = 10 Months 111111 = 1 Year Bit_6 = 1 = System Fault Bit_7 = 1 = O.K. – EGA can run
ADF	115		Not Used		
ADF	116		Not Used		
ADF	117		Not Used		
ADF	118		Not Used		
ADF	119		Not Used		

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADF	120		Not Used		
ADF	121	Hz	Probe 1 Signal		Frequency
ADF	122	Hz	Probe 1 Reference		Frequency
ADF	123		Not Used		
ADF	124		Probe 1Version/Issue		ms/ls byte
ADF	125	Hz	Probe 2 Signal		Frequency
ADF	126	Hz	Probe 2 Reference		Frequency
ADF	127		Not Used		
ADF	128		Probe 2 Version/Issue		ms/ls byte
ADF	129		Alarm Status		0 – OK 1 – High Water 2 – 1st Low 3 – 2nd Low
ADF	130		Level Status		As Alarm Status just above
ADF	131		WL Version/Issue		ms/ls byte
ADF	132		Alarm Code		0-OK 1-2nd Low 2-Probe 1 Comms 3-Probe 2 Comms 4-Probe 1 Short 5-Probe 2 Short 6-Probe Mismatch 7-Probe 1 TC 8-Probe 2TC 9-Permanent Reset 10-Permanent Test 11-Keystuck Reset 12-Power Up EEprom 13-Bogus EEprom State 14-Incompatible Config 15-Probe 1 Bogus Comm Data 16-Probe 2 Bogus Comm Data 17-Config Range Check Fail 18-1st Low 19-HighWater 20-Probe 1 Still Water 21-Probe 2 Still Water 22-Probes Diverse 255-OK/Reset
ADF	133		Not Used		
ADF	134	C	Steam Temp		
ADF	135	C	Feed Water Temp		
ADF	136	lb/hr	Steam Rate		
ADF	137	Btus/lb	Heat to Steam		
ADF	138	%	Control Element		
ADF	139		Not Used		
ADF	140	%	Control Point Raised		0-Normal 1 to 99 - % raised between 'Control Point' and 'High Water' positions
ADF	141		Not Used		
ADF	142		Not Used		
ADF	143	lbs	Totalised Steam		
ADF	144				
ADF	145	F	Steam Temp		
ADF	146	F	Feed Water Temp		
ADF	147	Kgs/hr	Steam Rate		

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADF	148	KJ/Kg	Heat to Steam		
ADF	149	Kgs	Totalised Steam		
ADF	150		Not Used		
ADF	151	C	Probe 1 Temperature		
ADF	152	C	Probe 2 Temperature		
ADF	153	F	Probe 1 Temperature		
ADF	154	F	Probe 2 Temperature		

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	01	%	Load index	0 to 100	
ADI	02		Startup/Firing status	19 – 28	19 = Waiting for stat. circuit to complete. 20 = Waiting for command to drive air damper to purge position. 21 = Driving air damper to purge position. 22 = Purging, waiting for command to drive values to ignition position. 23 = Driving valves to ignition position. 24 = Ignition taking place. 25 = Burner firing and modulating. 26 = Post purge taking place. 27 = Not used. 28 = Golden start.
ADI	03		Sequence status	1 to 10	
ADI	04		Boiler capacity		see option 34 on MM
ADI	05		Actual value		see option 1 on MM
ADI	06		Required value		see option 1 on MM
ADI	07		Fuel selected	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADI	08		Number of channels	0 to 8	
ADI	09		Channel 1 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	10		Channel 2 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	11		Channel 3 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	12		Channel 4 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	13		MM error number	00 to 73	see section 2.3.1.2 of manual
ADI	14		Single/Twin operation	0 to 1	0 = single 1 = twin burner
ADI	15	%	Run O_2	0 to 20.9	Displayed as 0 to 209
ADI	16	%	Run CO_2	0 to 15	
ADI	17	ppm	Run CO	0 to 999	
ADI	18		Run exhaust temperature	0 to 999	for units see option 51 on MM
ADI	19	%	Run efficiency	0 to 100	
ADI	20	ppm	Run NO	0 to 999	
ADI	21	ppm	Run SO_2	0 to 999	
ADI	22	%	Comm. O_2	0 to 20.9	Displayed as 0 to 209
ADI	23	%	Comm. CO_2	0 to 15	
ADI	24	ppm	Comm. CO	0 to 999	
ADI	25		Comm. exhaust temp	0 to 999	for units see option 51 on MM
ADI	26	%	Comm. efficiency	0 to 100	
ADI	27	ppm	Comm. NO	0 to 999	
ADI	28	ppm	Comm. SO_2	0 to 999	
ADI	29		EGA error number	0 to 25	see section 3.4.1 of manual
ADI	30		Minimum required value		see option 30 on MM
ADI	31		Maximum required value		see option 31 on MM
ADI	32		Present flow units	0 to 999	
ADI	33		Present flow thousands	0 to 999	
ADI	34		Fuel 1 flow total units	0 to 999	
ADI	35		Fuel 1 flow total units	0 to 999	
ADI	36		Fuel 1 flow total thousands	0 to 999	
ADI	37		Fuel 1 flow total millions	0 to 999	

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	38		Fuel 2 flow total units	0 to 999	
ADI	39		Fuel 2 flow total thousands	0 to 999	
ADI	40		Fuel 2 flow total millions	0 to 999	
ADI	41		Fuel 3 flow total units	0 to 999	
ADI	42		Fuel 3 flow total thousands	0 to 999	
ADI	43		Fuel 3 flow total millions	0 to 999	
ADI	44		Channel 5 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	45		Channel 6 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	46		Channel 7 position	-6.0 to 90.0	Displayed as -60 to 960
ADI	47		Channel 8 position	-6.0 to 96.0	Displayed as -60 to 960
ADI	48		Not Used		
ADI	49		Not Used		
ADI	50		Not Used		
ADI	51		Fuel 4 flow total units	0 to 999	
ADI	52		Fuel 4 flow total thousands	0 to 999	
ADI	53		Fuel 4 flow total millions	0 to 999	
ADI	54		Channel 5 output	0 to 255	
ADI	55		Channel 5 input	0 to 255	
ADI	56		Channel 6 output	0 to 255	
ADI	57		Channel 6 input	0 to 255	
ADI	58		Option 1	3 to 8	See option table in manual
ADI	59		Option 77	0 to 5	See option table in manual
ADI	60		Option 90	0 to 1	See option table in manual
ADI	61		Option 91	0 to 2	See option table in manual
ADI	62		Option 92	1 to 200	See option table in manual
ADI	63		Option 93	1 to 200	See option table in manual
ADI	64		Option 94	0 to 2	See option table in manual
ADI	65		Option 95	0 to 1	See option table in manual
ADI	66		Option 96	0 to 200	See option table in manual
ADI	67		Option 97	0 to 200	See option table in manual
ADI	68		Not Used		
ADI	69		Not Used		
ADI	70		Option 100	0 to 1	See option table in manual
ADI	71		Option 101	0 to 2	See option table in manual
ADI	72		Option 102	1 to 200	See option table in manual
ADI	73		Option 103	1 to 200	See option table in manual
ADI	74		Option 104	0 to 2	See option table in manual
ADI	75		Option 105	0 to 1	See option table in manual
ADI	76		Option 106	0 to 200	See option table in manual
ADI	77		Option 107	0 to 200	See option table in manual
ADI	78		Not Used		
ADI	79		Not Used		
ADI	80		Lockout Code	0 to 255	See option table in manual
ADI	81		Option 71 Fuel 1 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	82		Option 72 Fuel 2 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADI	83		Option 73 Fuel 3 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADI	84		Option 74 Fuel 4 Type	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADI	85		Option 61 Flow Units Fuel 1	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADI	86		Option 62 Flow Units Fuel 2	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADI	87		Option 63 Flow Units Fuel 3	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADI	88		Option 64 Flow Units Fuel 4	0 to 4	0 = Cubic Feet 1 = Cubic Meters 2 = Kilograms 3 = Litres 4 = US Gallons
ADI	89		Fuel 1 Hours Run	0 to 9999	
ADI	90		Fuel 2 Hours Run	0 to 9999	
ADI	91		Fuel 3 Hours Run	0 to 9999	
ADI	92		Fuel 4 Hours Run	0 to 9999	
ADI	93		Fuel 1 Start ups	0 to 999	
ADI	94		Fuel 2 Start ups	0 to 999	
ADI	95		Fuel 3 Start ups	0 to 999	
ADI	96		Fuel 4 Start ups	0 to 999	
ADI	97		Air Pressure	0 to 999	See point 98 for units
ADI	98		Air Pressure Coding	8 Bit Pattern	Bit_0 = 0 = off 1 = on Bit_1 = 0 = "WG 1 = mbar $Bit_2 + Bit_3$ = 00 = 0 decimal places 01 = 1 decimal places 10 = 2 decimal places 11 = 3 decimal places Bit_4 =unused Bit_5 =unused Bit_6 =unused Bit_7 =unused
ADI	99		Gas Pressure	0 to 999	See point 100 for units

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	100		Gas Pressure Coding	8 Bit Pattern	Bit_0 = 0 = off 1 = on Bit_1 + Bit_4 = 00 = "WG 10 = mbar 01 = BAR 11 = PSI Bit_2 + Bit_3 =00 = 0 decimal places 01 = 1 decimal places 10 = 2 decimal places 11 = 3 decimal places Bit_5 =unused Bit_6 =unused Bit_7 =unused
ADI	101		Fuel Selected	0 to 3	0 = Fuel 1 (usually gas) 1 = Fuel 2 (usually oil) 2 = Fuel 3 (usually oil) 3 = Fuel 4 (Aux.)
ADI	102	%	E.G.A. O_2	0 to 20.9	Displayed as 0 to 209
ADI	103	%	E.G.A. CO_2	0 to 15	
ADI	104	ppm	E.G.A. CO	0 to 999	
ADI	105	ppm	E.G.A. NO	0 to 999	
ADI	106	ppm	E.G.A. SO_2	0 to 999	
ADI	107		E.G.A. Exhaust temp	0 to 999	
ADI	108	%	E.G.A. Efficiency	0 to 100	
ADI	109		E.G.A. Error Number	0 to 25	
ADI	110	%	E.G.A. Voltage Input	0 to 100	
ADI	111		E.G.A. Exhaust ΔT	0 to 999	
ADI	112		E.G.A. Ambient	0 to 50	
ADI	113		E.G.A. Auxiliary Temp	0 to 9999	
ADI	114		Service LEDS	8 Bit Pattern	Bit_0 to Bit_5 = 000000 = EGA requires servicing 000001 = 2 Months to service 000011 = 4 Months 000111 = 6 Months 001111 = 8 Months 011111 = 10 Months 111111 = 1 Year Bit_6 = 1 = System Fault Bit_7 = 1 = O.K. – EGA can run
ADI	115-120		Not Used		
ADI	121	Hz	Probe 1 Signal	U integer	Frequency
ADI	122	Hz	Probe 1 Reference	U integer	Frequency
ADI	123		Not Used		
ADI	124		Probe 1Version/Issue	U integer	ms/ls byte
ADI	125	Hz	Probe 2 Signal	U integer	Frequency
ADI	126	Hz	Probe 2 Reference	U integer	Frequency
ADI	127		Not Used		
ADI	128		Probe 2 Version/Issue	U integer	ms/ls byte
ADI	129		Alarm Status	U integer	0 – OK 1 – High Water 2 – 1st Low 3 – 2nd Low
ADI	130		Level Status	U integer	As Alarm Status just above
ADI	131		WL Version/Issue	U integer	ms/ls byte

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	132		Alarm Code	U integer	0-OK 1-2nd Low 2-Probe 1 Comms 3-Probe 2 Comms 4-Probe 1 Short 5-Probe 2 Short 6-Probe Mismatch 7-Probe 1 TC 8-Probe 2TC 9-Permanent Reset 10-Permanent Test 11-Keystuck Reset 12-Power Up EEprom 13-Bogus Eeprom State 14-Incompatible Config 15-Probe 1 Bogus Comm Data 16-Probe 2 Bogus Comm Data 17-Config Range Check Fail 18-1st Low 19-HighWater 20-Probe 1 Still Water 21-Probe 2 Still Water 22-Probes Diverse 255-OK/Reset
ADI	133		Not Used		
ADI	134	C	Steam Temp	U integer	
ADI	135	C	Feed Water Temp	U integer	
ADI	136	lb/hr	Steam Rate		USE ADF
ADI	137	Btus/lb	Heat to Steam		USE ADF
ADI	138	%	Control Element	U integer	Mod Valve close-open as percentage VSD min/max speed as percentage
ADI	139		Not Used		
ADI	140	%	Control Point Raised	U integer	0-Normal 1 to 99 - % raised between 'Control Point' and 'High Water' positions
ADI	141		Not Used		
ADI	142		Not Used		
ADI	143	lbs	Totalised Steam		USE ADF
ADI	144		Not Used		USE ADF
ADI	145	F	Steam Temp	U integer	
ADI	146	F	Feed Water Temp	U integer	
ADI	147	Kgs/hr	Steam Rate		USE ADF
ADI	148	KJ/Kg	Heat to Steam		USE ADF
ADI	149	Kgs	Totalised Steam		USE ADF
ADI	150		Not Used		
ADI	151	C	Probe 1 Temperature	U integer	
ADI	152	C	Probe 2 Temperature	U integer	
ADI	153	F	Probe 1 Temperature	U integer	
ADI	154	F	Probe 2 Temperature	U integer	

N.B. In the case of ADI/ADF points 101 through 114, values correspond to an EGA address not an MM address e.g. address 1 would correspond to E.G.A. #1 etc.

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD	01		CR Relay status	1 = burner run 0 = burner off	
BD	02		Not used		
BD	03		Not used		
BD	04		Not used		
BD	05		Not used		
BD	06		Not used		
BD	07		Not used		
BD	08		Not used		
BD	09		Temp./Pressure	0 = Temp. 1 = Press.	
BD	10		Not used		
BD	11		Not used		
BD	12		Not used		
BD	13		Not used		
BD	14		Not used		
BD	15		Not used		
BD	16		Not used		
BD	17		Not used		
BD	18		Flowmetering on	1 = yes 0 = no	
BD	19		CO displayed on F2/F3	1 = Displayed 0 = not displayed	
BD	20		Not used		
BD	21		^{o}C or ^{o}F	1 = F 0 = C	
BD	22		Bar or PSI	1 = PSI 0 = Bar	
BD	23		External Voltage	1 = yes 0 = no	
BD	24		Not used		
BD	25		EGA optioned	1 = yes 0 = no	
BD	26		Actual up to trim threshold	1 = yes 0 = no	
BD	27		E.G.A. cooler ready	1 = yes 0 = no	
BD	28		E.G.A ambient temp OK	1 = yes 0 = no	
BD	29		Optioned to display NO	1 = yes 0 = no	
BD	30		Optioned to display SO_2	1 = yes 0 = no	
BD	31		E.G.A. ambient temp. low/high	1 = Hi 0 = Lo	
BD	32		Not used		
BD	33		Sequencing optioned	1 = yes 0 = no	
BD	34		Setpoint/Enable commands accepted	1 = yes 0 = no	
BD	35		Not used		
BD	36		Not used		
BD	37		Not used		
BD	38		Not used		
BD	39		Not used		

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD	40		Not used		
BD	41		Hand operation status	1 = Hand operation 0 = Modulating	
BD	42		Low flame hold status	1 = Low flame hold 0 = Modulating	
BD	43		Not used		
BD	44		Not used		
BD	45		Not used		
BD	46		Not used		
BD	47		MM working comms	1 = yes 0 = no	
BD	48		Input 41 set (lead boiler select)	1 = yes 0 = no	
BD	49		Lead boiler status	1 = Lead boiler. 0 = Not lead boiler.	
BD	50		'Disabled' status	1 = Disabled 0 = Enabled	
BD	57		Slave burner left/right	1 = 0 =	
BD	58-80		Not Used		
BD	81		Water Level Enabled		
BD	82		Units imp(0)metric(1)		
BD	83		Feed Water Pump ON/OFF		
BD	84-88		Not Used		
BD	89		First Out 1		
BD	90		First Out 2		
BD	91		First Out 3		
BD	92		First Out 4		
BD	93		First Out 5		
BD	94		First Out 6		
BD	95		First Out 7		
BD	96		First Out 8		
BD	97		First Out 9		
BD	98		First Out 10		
BD	99		First Out 11		
BD	100		First Out 12		
BD	101		First Out 13		
BD	102		First Out 14		
BD	103		First Out 15		
BD	104-112		Not Used		

Network point table for last (eleventh) address (read/write values from/to analog and digital units also to MM/EGA).

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
AI	Not used	-	-	-	-
BI	Not used	-	-	-	-
AO	Not used	-	-	-	-
BO	Not used	-	-	-	-
NPT	**NPA**	**UNITS**	**DESCRIPTION**	**RANGE**	**NOTE**
ADF	01		MM 1 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	02		MM 2 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	03		MM 3 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	04		MM 4 new required value	see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	05		MM 5 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	06		MM 6 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	07		MM 7 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	08		MM 8 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	09		MM 9 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	10		MM 10 new required value	for range see option 30 and 31 on MM	for units see Options 1, 51, and 52 on associated MM write only – floating point representation.
ADF	11		Global required value		for units see Options 1, 51, and 52 on MM 1 write only – floating point representation.

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	01		MM 1 new required value	for range see option 30 and 31 on MM	write only
ADI	02		MM 2 new required value	for range see option 30 and 31 on MM	write only
ADI	03		MM 3 new required value	for range see option 30 and 31 on MM	write only
ADI	04		MM 4 new required value	see option 30 and 31 on MM	write only
ADI	05		MM 5 new required value	for range see option 30 and 31 on MM	write only
ADI	06		MM 6 new required value	for range see option 30 and 31 on MM	write only
ADI	07		MM 7 new required value	for range see option 30 and 31 on MM	write only
ADI	08		MM 8 new required value	for range see option 30 and 31 on MM	write only
ADI	09		MM 9 new required value	for range see option 30 and 31 on MM	write only
ADI	10		MM 10 new required value	for range see option 30 and 31 on MM	write only
ADI	11		Global required value		write only
ADI	12		Lead boiler select	1 to 10	write only
ADI	13		Number of MM's on system	1 to 10	write only
ADI	14		Not used		
ADI	15		Not used		
ADI	16		Not used		
ADI	17		Analog unit 1 output 1	0 to 255	read and write
ADI	18		Analog unit 1 output 2	0 to 255	read and write
ADI	19		Analog unit 1 output 3	0 to 255	read and write
ADI	20		Analog unit 1 output 4	0 to 255	read and write
ADI	21		Analog unit 1 output 5	0 to 255	read and write
ADI	22		Analog unit 1 output 6	0 to 255	read and write
ADI	23		Not used		
ADI	24		Not used		
ADI	25		Analog unit 2 output 1	0 to 255	read and write
ADI	26		Analog unit 2 output 2	0 to 255	read and write
ADI	27		Analog unit 2 output 3	0 to 255	read and write
ADI	28		Analog unit 2 output 4	0 to 255	read and write
ADI	29		Analog unit 2 output 5	0 to 255	read and write
ADI	30		Analog unit 2 output 6	0 to 255	read and write
ADI	31		Not used		
ADI	32		Not used		
ADI	33		Analog unit 3 output 1	0 to 255	read and write
ADI	34		Analog unit 3 output 2	0 to 255	read and write
ADI	35		Analog unit 3 output 3	0 to 255	read and write

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	36		Analog unit 3 output 4	0 to 255	read and write
ADI	37		Analog unit 3 output 5	0 to 255	read and write
ADI	38		Analog unit 3 output 6	0 to 255	read and write
ADI	39		Not used		
ADI	40		Not used		
ADI	41		Analog unit 4 output 1	0 to 255	read and write
ADI	42		Analog unit 4 output 2	0 to 255	read and write
ADI	43		Analog unit 4 output 3	0 to 255	read and write
ADI	44		Analog unit 4 output 4	0 to 255	read and write
ADI	45		Analog unit 4 output 5	0 to 255	read and write
ADI	46		Analog unit 4 output 6	0 to 255	read and write
ADI	47		Not used		
ADI	48		Not used		
ADI	49		Analog unit 5 output 1	0 to 255	read and write
ADI	50		Analog unit 5 output 2	0 to 255	read and write
ADI	51		Analog unit 5 output 3	0 to 255	read and write
ADI	52		Analog unit 5 output 4	0 to 255	read and write
ADI	53		Analog unit 5 output 5	0 to 255	read and write
ADI	54		Analog unit 5 output 6	0 to 255	read and write
ADI	55		Not used		
ADI	56		Not used		
ADI	57		Analog unit 6 output 1	0 to 255	read and write
ADI	58		Analog unit 6 output 2	0 to 255	read and write
ADI	59		Analog unit 6 output 3	0 to 255	read and write
ADI	60		Analog unit 6 output 4	0 to 255	read and write
ADI	61		Analog unit 6 output 5	0 to 255	read and write
ADI	62		Analog unit 6 output 6	0 to 255	read and write
ADI	63		Not used		
ADI	64		Not used		
ADI	65		Analog unit 7 output 1	0 to 255	read and write
ADI	66		Analog unit 7 output 2	0 to 255	read and write
ADI	67		Analog unit 7 output 3	0 to 255	read and write
ADI	68		Analog unit 7 output 4	0 to 255	read and write
ADI	69		Analog unit 7 output 5	0 to 255	read and write
ADI	70		Analog unit 7 output 6	0 to 255	read and write
ADI	71		Not used		
ADI	72		Not used		
ADI	73		Analog unit 8 output 1	0 to 255	read and write
ADI	74		Analog unit 8 output 2	0 to 255	read and write
ADI	75		Analog unit 8 output 3	0 to 255	read and write
ADI	76		Analog unit 8 output 4	0 to 255	read and write
ADI	77		Analog unit 8 output 5	0 to 255	read and write
ADI	78		Analog unit 8 output 6	0 to 255	read and write
ADI	79		Not used		
ADI	80		Not used		
ADI	81		Analog unit 9 output 1	0 to 255	read and write
ADI	82		Analog unit 9 output 2	0 to 255	read and write
ADI	83		Analog unit 9 output 3	0 to 255	read and write
ADI	84		Analog unit 9 output 4	0 to 255	read and write

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	85		Analog unit 9 output 5	0 to 255	read and write
ADI	86		Analog unit 9 output 6	0 to 255	read and write
ADI	87		Not used		
ADI	88		Not used		
ADI	89		Analog unit 10 output 1	0 to 255	read and write
ADI	90		Analog unit 10 output 2	0 to 255	read and write
ADI	91		Analog unit 10 output 3	0 to 255	read and write
ADI	92		Analog unit 10 output 4	0 to 255	read and write
ADI	93		Analog unit 10 output 5	0 to 255	read and write
ADI	94		Analog unit 10 output 6	0 to 255	read and write
ADI	95		Not used		
ADI	96		Not used		
ADI	97		Not used		
ADI	98		Not used		
ADI	99		Not used		
ADI	100		Not used		
ADI	101		Not used		
ADI	102		Not used		
ADI	103		Not used		
ADI	104		Not used		
ADI	105		Not used		
ADI	106		Not used		
ADI	107		Not used		
ADI	108		Not used		
ADI	109		Not used		
ADI	110		Not used		
ADI	111		Not used		
ADI	112		Analog unit 1 input 1	0 to 255	read only
ADI	113		Analog unit 1 input 2	0 to 255	read only
ADI	114		Analog unit 1 input 3	0 to 255	read only
ADI	115		Analog unit 1 input 4	0 to 255	read only
ADI	116		Analog unit 1 input 5	0 to 255	read only
ADI	117		Analog unit 1 input 6	0 to 255	read only
ADI	118		Not used		
ADI	119		Not used		
ADI	120		Analog unit 2 input 1	0 to 255	read only
ADI	121		Analog unit 2 input 2	0 to 255	read only
ADI	122		Analog unit 2 input 3	0 to 255	read only
ADI	123		Analog unit 2 input 4	0 to 255	read only
ADI	124		Analog unit 2 input 5	0 to 255	read only
ADI	125		Analog unit 2 input 6	0 to 255	read only
ADI	126		Not used		
ADI	127		Not used		
ADI	128		Analog unit 3 input 1	0 to 255	read only
ADI	129		Analog unit 3 input 2	0 to 255	read only
ADI	130		Analog unit 3 input 3	0 to 255	read only
ADI	131		Analog unit 3 input 4	0 to 255	read only
ADI	132		Analog unit 3 input 5	0 to 255	read only
ADI	133		Analog unit 3 input 6	0 to 255	read only

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	134		Not used		
ADI	135		Not used		
ADI	136		Analog unit 4 input 1	0 to 255	read only
ADI	137		Analog unit 4 input 2	0 to 255	read only
ADI	138		Analog unit 4 input 3	0 to 255	read only
ADI	139		Analog unit 4 input 4	0 to 255	read only
ADI	140		Analog unit 4 input 5	0 to 255	read only
ADI	141		Analog unit 4 input 6	0 to 255	read only
ADI	142		Not used		
ADI	143		Not used		
ADI	144		Analog unit 5 input 1	0 to 255	read only
ADI	145		Analog unit 5 input 2	0 to 255	read only
ADI	146		Analog unit 5 input 3	0 to 255	read only
ADI	147		Analog unit 5 input 4	0 to 255	read only
ADI	148		Analog unit 5 input 5	0 to 255	read only
ADI	149		Analog unit 5 input 6	0 to 255	read only
ADI	150		Not used		
ADI	151		Not used		
ADI	152		Analog unit 6 input 1	0 to 255	read only
ADI	153		Analog unit 6 input 2	0 to 255	read only
ADI	154		Analog unit 6 input 3	0 to 255	read only
ADI	155		Analog unit 6 input 4	0 to 255	read only
ADI	156		Analog unit 6 input 5	0 to 255	read only
ADI	157		Analog unit 6 input 6	0 to 255	read only
ADI	158		Not used		
ADI	159		Not used		
ADI	160		Analog unit 7 input 1	0 to 255	read only
ADI	161		Analog unit 7 input 2	0 to 255	read only
ADI	162		Analog unit 7 input 3	0 to 255	read only
ADI	163		Analog unit 7 input 4	0 to 255	read only
ADI	164		Analog unit 7 input 5	0 to 255	read only
ADI	165		Analog unit 7 input 6	0 to 255	read only
ADI	166		Not used		
ADI	167		Not used		
ADI	168		Analog unit 8 input 1	0 to 255	read only
ADI	169		Analog unit 8 input 2	0 to 255	read only
ADI	170		Analog unit 8 input 3	0 to 255	read only
ADI	171		Analog unit 8 input 4	0 to 255	read only
ADI	172		Analog unit 8 input 5	0 to 255	read only
ADI	173		Analog unit 8 input 6	0 to 255	read only
ADI	174		Not used		
ADI	175		Not used		
ADI	176		Analog unit 9 input 1	0 to 255	read only
ADI	177		Analog unit 9 input 2	0 to 255	read only
ADI	178		Analog unit 9 input 3	0 to 255	read only
ADI	179		Analog unit 9 input 4	0 to 255	read only
ADI	180		Analog unit 9 input 5	0 to 255	read only
ADI	181		Analog unit 9 input 6	0 to 255	read only
ADI	182		Not used		

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	183		Not used		
ADI	184		Analog unit 10 input 1	0 to 255	read only
ADI	185		Analog unit 10 input 2	0 to 255	read only
ADI	186		Analog unit 10 input 3	0 to 255	read only
ADI	187		Analog unit 10 input 4	0 to 255	read only
ADI	188		Analog unit 10 input 5	0 to 255	read only
ADI	189		Analog unit 10 input 6	0 to 255	read only

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDREAD	01		Digital unit 1 input 1	0 or 1	see digital unit setup
BDREAD	02		Digital unit 1 input 2	0 or 1	see digital unit setup
BDREAD	03		Digital unit 1 input 3	0 or 1	see digital unit setup
BDREAD	04		Digital unit 1 input 4	0 or 1	see digital unit setup
BDREAD	05		Digital unit 1 input 5	0 or 1	see digital unit setup
BDREAD	06		Digital unit 1 input 6	0 or 1	see digital unit setup
BDREAD	07		Digital unit 1 input 7	0 or 1	see digital unit setup
BDREAD	08		Digital unit 1 input 8	0 or 1	see digital unit setup
BDREAD	09		Digital unit 1 input 9	0 or 1	see digital unit setup
BDREAD	10		Digital unit 1 input 10	0 or 1	see digital unit setup
BDREAD	11		Digital unit 1 input 11	0 or 1	see digital unit setup
BDREAD	12		Digital unit 1 input 12	0 or 1	see digital unit setup
BDREAD	13		Digital unit 1 input 13	0 or 1	see digital unit setup
BDREAD	14		Digital unit 1 input 14	0 or 1	see digital unit setup
BDREAD	15		Digital unit 1 input 15	0 or 1	see digital unit setup
BDREAD	16		Digital unit 1 input 16	0 or 1	see digital unit setup
BDREAD	17		Digital unit 2 input 1	0 or 1	see digital unit setup
BDREAD	18		Digital unit 2 input 2	0 or 1	see digital unit setup
BDREAD	19		Digital unit 2 input 3	0 or 1	see digital unit setup
BDREAD	20		Digital unit 2 input 4	0 or 1	see digital unit setup
BDREAD	21		Digital unit 2 input 5	0 or 1	see digital unit setup
BDREAD	22		Digital unit 2 input 6	0 or 1	see digital unit setup
BDREAD	23		Digital unit 2 input 7	0 or 1	see digital unit setup
BDREAD	24		Digital unit 2 input 8	0 or 1	see digital unit setup
BDREAD	25		Digital unit 2 input 9	0 or 1	see digital unit setup
BDREAD	26		Digital unit 2 input 10	0 or 1	see digital unit setup
BDREAD	27		Digital unit 2 input 11	0 or 1	see digital unit setup
BDREAD	28		Digital unit 2 input 12	0 or 1	see digital unit setup
BDREAD	29		Digital unit 2 input 13	0 or 1	see digital unit setup
BDREAD	30		Digital unit 2 input 14	0 or 1	see digital unit setup
BDREAD	31		Digital unit 2 input 15	0 or 1	see digital unit setup
BDREAD	32		Digital unit 2 input 16	0 or 1	see digital unit setup
BDREAD	33		Digital unit 3 input 1	0 or 1	see digital unit setup
BDREAD	34		Digital unit 3 input 2	0 or 1	see digital unit setup
BDREAD	35		Digital unit 3 input 3	0 or 1	see digital unit setup
BDREAD	36		Digital unit 3 input 4	0 or 1	see digital unit setup
BDREAD	37		Digital unit 3 input 5	0 or 1	see digital unit setup
BDREAD	38		Digital unit 3 input 6	0 or 1	see digital unit setup
BDREAD	39		Digital unit 3 input 7	0 or 1	see digital unit setup
BDREAD	40		Digital unit 3 input 8	0 or 1	see digital unit setup
BDREAD	41		Digital unit 3 input 9	0 or 1	see digital unit setup
BDREAD	42		Digital unit 3 input 10	0 or 1	see digital unit setup
BDREAD	43		Digital unit 3 input 11	0 or 1	see digital unit setup
BDREAD	44		Digital unit 3 input 12	0 or 1	see digital unit setup
BDREAD	45		Digital unit 3 input 13	0 or 1	see digital unit setup
BDREAD	46		Digital unit 3 input 14	0 or 1	see digital unit setup
BDREAD	47		Digital unit 3 input 15	0 or 1	see digital unit setup
BDREAD	48		Digital unit 3 input 16	0 or 1	see digital unit setup
BDREAD	49		Digital unit 4 input 1	0 or 1	see digital unit setup
BDREAD	50		Digital unit 4 input 2	0 or 1	see digital unit setup
BDREAD	51		Digital unit 4 input 3	0 or 1	see digital unit setup
BDREAD	52		Digital unit 4 input 4	0 or 1	see digital unit setup
BDREAD	53		Digital unit 4 input 5	0 or 1	see digital unit setup

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDREAD	54		Digital unit 4 input 6	0 or 1	see digital unit setup
BDREAD	55		Digital unit 4 input 7	0 or 1	see digital unit setup
BDREAD	56		Digital unit 4 input 8	0 or 1	see digital unit setup
BDREAD	57		Digital unit 4 input 9	0 or 1	see digital unit setup
BDREAD	58		Digital unit 4 input 10	0 or 1	see digital unit setup
BDREAD	59		Digital unit 4 input 11	0 or 1	see digital unit setup
BDREAD	60		Digital unit 4 input 12	0 or 1	see digital unit setup
BDREAD	61		Digital unit 4 input 13	0 or 1	see digital unit setup
BDREAD	62		Digital unit 4 input 14	0 or 1	see digital unit setup
BDREAD	63		Digital unit 4 input 15	0 or 1	see digital unit setup
BDREAD	64		Digital unit 4 input 16	0 or 1	see digital unit setup
BDREAD	65		Digital unit 5 input 1	0 or 1	see digital unit setup
BDREAD	66		Digital unit 5 input 2	0 or 1	see digital unit setup
BDREAD	67		Digital unit 5 input 3	0 or 1	see digital unit setup
BDREAD	68		Digital unit 5 input 4	0 or 1	see digital unit setup
BDREAD	69		Digital unit 5 input 5	0 or 1	see digital unit setup
BDREAD	70		Digital unit 5 input 6	0 or 1	see digital unit setup
BDREAD	71		Digital unit 5 input 7	0 or 1	see digital unit setup
BDREAD	72		Digital unit 5 input 8	0 or 1	see digital unit setup
BDREAD	73		Digital unit 5 input 9	0 or 1	see digital unit setup
BDREAD	74		Digital unit 5 input 10	0 or 1	see digital unit setup
BDREAD	75		Digital unit 5 input 11	0 or 1	see digital unit setup
BDREAD	76		Digital unit 5 input 12	0 or 1	see digital unit setup
BDREAD	77		Digital unit 5 input 13	0 or 1	see digital unit setup
BDREAD	78		Digital unit 5 input 14	0 or 1	see digital unit setup
BDREAD	79		Digital unit 5 input 15	0 or 1	see digital unit setup
BDREAD	80		Digital unit 5 input 16	0 or 1	see digital unit setup
BDREAD	81		Digital unit 6 input 1	0 or 1	see digital unit setup
BDREAD	82		Digital unit 6 input 2	0 or 1	see digital unit setup
BDREAD	83		Digital unit 6 input 3	0 or 1	see digital unit setup
BDREAD	84		Digital unit 6 input 4	0 or 1	see digital unit setup
BDREAD	85		Digital unit 6 input 5	0 or 1	see digital unit setup
BDREAD	86		Digital unit 6 input 6	0 or 1	see digital unit setup
BDREAD	87		Digital unit 6 input 7	0 or 1	see digital unit setup
BDREAD	88		Digital unit 6 input 8	0 or 1	see digital unit setup
BDREAD	89		Digital unit 6 input 9	0 or 1	see digital unit setup
BDREAD	90		Digital unit 6 input 10	0 or 1	see digital unit setup
BDREAD	91		Digital unit 6 input 11	0 or 1	see digital unit setup
BDREAD	92		Digital unit 6 input 12	0 or 1	see digital unit setup
BDREAD	93		Digital unit 6 input 13	0 or 1	see digital unit setup
BDREAD	94		Digital unit 6 input 14	0 or 1	see digital unit setup
BDREAD	95		Digital unit 6 input 15	0 or 1	see digital unit setup
BDREAD	96		Digital unit 6 input 16	0 or 1	see digital unit setup
BDREAD	97		Digital unit 7 input 1	0 or 1	see digital unit setup
BDREAD	98		Digital unit 7 input 2	0 or 1	see digital unit setup
BDREAD	99		Digital unit 7 input 3	0 or 1	see digital unit setup
BDREAD	100		Digital unit 7 input 4	0 or 1	see digital unit setup
BDREAD	101		Digital unit 7 input 5	0 or 1	see digital unit setup
BDREAD	102		Digital unit 7 input 6	0 or 1	see digital unit setup
BDREAD	103		Digital unit 7 input 7	0 or 1	see digital unit setup
BDREAD	104		Digital unit 7 input 8	0 or 1	see digital unit setup
BDREAD	105		Digital unit 7 input 9	0 or 1	see digital unit setup
BDREAD	106		Digital unit 7 input 10	0 or 1	see digital unit setup
BDREAD	107		Digital unit 7 input 11	0 or 1	see digital unit setup

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDREAD	108		Digital unit 7 input 12	0 or 1	see digital unit setup
BDREAD	109		Digital unit 7 input 13	0 or 1	see digital unit setup
BDREAD	110		Digital unit 7 input 14	0 or 1	see digital unit setup
BDREAD	111		Digital unit 7 input 15	0 or 1	see digital unit setup
BDREAD	112		Digital unit 7 input 16	0 or 1	see digital unit setup
BDREAD	113		Digital unit 8 input 1	0 or 1	see digital unit setup
BDREAD	114		Digital unit 8 input 2	0 or 1	see digital unit setup
BDREAD	115		Digital unit 8 input 3	0 or 1	see digital unit setup
BDREAD	116		Digital unit 8 input 4	0 or 1	see digital unit setup
BDREAD	117		Digital unit 8 input 5	0 or 1	see digital unit setup
BDREAD	118		Digital unit 8 input 6	0 or 1	see digital unit setup
BDREAD	119		Digital unit 8 input 7	0 or 1	see digital unit setup
BDREAD	120		Digital unit 8 input 8	0 or 1	see digital unit setup
BDREAD	121		Digital unit 8 input 9	0 or 1	see digital unit setup
BDREAD	122		Digital unit 8 input 10	0 or 1	see digital unit setup
BDREAD	123		Digital unit 8 input 11	0 or 1	see digital unit setup
BDREAD	124		Digital unit 8 input 12	0 or 1	see digital unit setup
BDREAD	125		Digital unit 8 input 13	0 or 1	see digital unit setup
BDREAD	126		Digital unit 8 input 14	0 or 1	see digital unit setup
BDREAD	127		Digital unit 8 input 15	0 or 1	see digital unit setup
BDREAD	128		Digital unit 8 input 16	0 or 1	see digital unit setup
BDREAD	129		Digital unit 9 input 1	0 or 1	see digital unit setup
BDREAD	130		Digital unit 9 input 2	0 or 1	see digital unit setup
BDREAD	131		Digital unit 9 input 3	0 or 1	see digital unit setup
BDREAD	132		Digital unit 9 input 4	0 or 1	see digital unit setup
BDREAD	133		Digital unit 9 input 5	0 or 1	see digital unit setup
BDREAD	134		Digital unit 9 input 6	0 or 1	see digital unit setup
BDREAD	135		Digital unit 9 input 7	0 or 1	see digital unit setup
BDREAD	136		Digital unit 9 input 8	0 or 1	see digital unit setup
BDREAD	137		Digital unit 9 input 9	0 or 1	see digital unit setup
BDREAD	138		Digital unit 9 input 10	0 or 1	see digital unit setup
BDREAD	139		Digital unit 9 input 11	0 or 1	see digital unit setup
BDREAD	140		Digital unit 9 input 12	0 or 1	see digital unit setup
BDREAD	141		Digital unit 9 input 13	0 or 1	see digital unit setup
BDREAD	142		Digital unit 9 input 14	0 or 1	see digital unit setup
BDREAD	143		Digital unit 9 input 15	0 or 1	see digital unit setup
BDREAD	144		Digital unit 9 input 16	0 or 1	see digital unit setup
BDREAD	145		Digital unit 10 input 1	0 or 1	see digital unit setup
BDREAD	146		Digital unit 10 input 2	0 or 1	see digital unit setup
BDREAD	147		Digital unit 10 input 3	0 or 1	see digital unit setup
BDREAD	148		Digital unit 10 input 4	0 or 1	see digital unit setup
BDREAD	149		Digital unit 10 input 5	0 or 1	see digital unit setup
BDREAD	150		Digital unit 10 input 6	0 or 1	see digital unit setup
BDREAD	151		Digital unit 10 input 7	0 or 1	see digital unit setup
BDREAD	152		Digital unit 10 input 8	0 or 1	see digital unit setup
BDREAD	153		Digital unit 10 input 9	0 or 1	see digital unit setup
BDREAD	154		Digital unit 10 input 10	0 or 1	see digital unit setup
BDREAD	155		Digital unit 10 input 11	0 or 1	see digital unit setup
BDREAD	156		Digital unit 10 input 12	0 or 1	see digital unit setup
BDREAD	157		Digital unit 10 input 13	0 or 1	see digital unit setup
BDREAD	158		Digital unit 10 input 14	0 or 1	see digital unit setup
BDREAD	159		Digital unit 10 input 15	0 or 1	see digital unit setup
BDREAD	160		Digital unit 10 input 16	0 or 1	see digital unit setup

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDREAD	161		MM 1 on/off line status	0 = off line 1 = on line	
BDREAD	162		MM 2 on/off line status	0 = off line 1 = on line	
BDREAD	163		MM 3 on/off line status	0 = off line 1 = on line	
BDREAD	164		MM 4 on/off line status	0 = off line 1 = on line	
BDREAD	165		MM 5 on/off line status	0 = off line 1 = on line	
BDREAD	166		MM 6 on/off line status	0 = off line 1 = on line	
BDREAD	167		MM 7 on/off line status	0 = off line 1 = on line	
BDREAD	168		MM 8 on/off line status	0 = off line 1 = on line	
BDREAD	169		MM 9 on/off line status	0 = off line 1 = on line	
BDREAD	170		MM 10 on/off line status	0 = off line 1 = on line	
BDREAD	171-192		Not used		
BDREAD	193		Digital unit 1 on/off line status	0 = off line 1 = on line	read only
BDREAD	194		Digital unit 2 on/off line status	0 = off line 1 = on line	read only
BDREAD	195		Digital unit 3 on/off line status	0 = off line 1 = on line	read only
BDREAD	196		Digital unit 4 on/off line status	0 = off line 1 = on line	read only
BDREAD	197		Digital unit 5 on/off line status	0 = off line 1 = on line	read only
BDREAD	198		Digital unit 6 on/off line status	0 = off line 1 = on line	read only
BDREAD	199		Digital unit 7 on/off line status	0 = off line 1 = on line	read only
BDREAD	200		Digital unit 8 on/off line status	0 = off line 1 = on line	read only
BDREAD	201		Digital unit 9 on/off line status	0 = off line 1 = on line	read only
BDREAD	202		Digital unit 10 on/off line status	0 = off line 1 = on line	read only
BDREAD	203		Not used		
BDREAD	204		Not used		
BDREAD	205		Not used		
BDREAD	206		Not used		
BDREAD	207		Not used		
BDREAD	208		Not used		
BDREAD	209		Analog unit 1 on/off line status	0 = off line 1 = on line	read only
BDREAD	210		Analog unit 2 on/off line status	0 = off line 1 = on line	read only
BDREAD	211		Analog unit 3 on/off line status	0 = off line 1 = on line	read only
BDREAD	212		Analog unit 4 on/off line status	0 = off line 1 = on line	read only
BDREAD	213		Analog unit 5 on/off line status	0 = off line 1 = on line	read only
BDREAD	214		Anal4og unit 6 on/off line status	0 = off line 1 = on line	read only

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDREAD	215		Analog unit 7 on/off line status	0 = off line 1 = on line	read only
BDREAD	216		Analog unit 8 on/off line status	0 = off line 1 = on line	read only
BDREAD	217		Analog unit 9 on/off line status	0 = off line 1 = on line	read only
BDREAD	218		Analog unit 10 on/off line status	0 = off line 1 = on line	read only

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD_{WRITE}	1		MM 1 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	2		MM 2 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	3		MM 3 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	4		MM 4 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	5		MM 5 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	6		MM 6 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	7		MM 7 Enable/disable	1 = off line 0 = on line	writ only
BD_{WRITE}	8		MM 8 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	9		MM 9 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	10		MM 10 Enable/disable	1 = off line 0 = on line	write only
BD_{WRITE}	11		Not used		
BD_{WRITE}	12		Not used		
BD_{WRITE}	13		Not used		
BD_{WRITE}	14		Not used		
BD_{WRITE}	15		Not used		
BD_{WRITE}	16		Not used		
BD_{WRITE}	17		Digital unit 1 output 1	0 = off, 1 = on	write only
BD_{WRITE}	18		Digital unit 1 output 2	0 = off, 1 = on	write only
BD_{WRITE}	19		Digital unit 1 output 3	0 = off, 1 = on	write only
BD_{WRITE}	20		Digital unit 1 output 4	0 = off, 1 = on	write only
BD_{WRITE}	21		Digital unit 1 output 5	0 = off, 1 = on	write only
BD_{WRITE}	22		Digital unit 1 output 6	0 = off, 1 = on	write only
BD_{WRITE}	23		Digital unit 1 output 7	0 = off, 1 = on	write only
BD_{WRITE}	24		Digital unit 1 output 8	0 = off, 1 = on	write only
BD_{WRITE}	25		Digital unit 2 output 1	0 = off, 1 = on	write only
BD_{WRITE}	26		Digital unit 2 output 2	0 = off, 1 = on	write only
BD_{WRITE}	27		Digital unit 2 output 3	0 = off, 1 = on	write only
BD_{WRITE}	28		Digital unit 2 output 4	0 = off, 1 = on	write only
BD_{WRITE}	29		Digital unit 2 output 5	0 = off, 1 = on	write only
BD_{WRITE}	30		Digital unit 2 output 6	0 = off, 1 = on	write only
BD_{WRITE}	31		Digital unit 2 output 7	0 = off, 1 = on	write only
BD_{WRITE}	32		Digital unit 2 output 8	0 = off, 1 = on	write only
BD_{WRITE}	33		Digital unit 3 output 1	0 = off, 1 = on	write only
BD_{WRITE}	34		Digital unit 3 output 2	0 = off, 1 = on	write only
BD_{WRITE}	35		Digital unit 3 output 3	0 = off, 1 = on	write only
BD_{WRITE}	36		Digital unit 3 output 4	0 = off, 1 = on	write only
BD_{WRITE}	37		Digital unit 3 output 5	0 = off, 1 = on	write only
BD_{WRITE}	38		Digital unit 3 output 6	0 = off, 1 = on	write only
BD_{WRITE}	39		Digital unit 3 output 7	0 = off, 1 = on	write only
BD_{WRITE}	40		Digital unit 3 output 8	0 = off, 1 = on	write only
BD_{WRITE}	41		Digital unit 4 output 1	0 = off, 1 = on	write only
BD_{WRITE}	42		Digital unit 4 output 2	0 = off, 1 = on	write only
BD_{WRITE}	43		Digital unit 4 output 3	0 = off, 1 = on	write only
BD_{WRITE}	44		Digital unit 4 output 4	0 = off, 1 = on	write only
BD_{WRITE}	45		Digital unit 4 output 5	0 = off, 1 = on	write only

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BDWRITE	46		Digital unit 4 output 6	0 = off, 1 = on	write only
BDWRITE	47		Digital unit 4 output 7	0 = off, 1 = on	write only
BDWRITE	48		Digital unit 4 output 8	0 = off, 1 = on	write only
BDWRITE	49		Digital unit 5 output 1	0 = off, 1 = on	write only
BDWRITE	50		Digital unit 5 output 2	0 = off, 1 = on	write only
BDWRITE	51		Digital unit 5 output 3	0 = off, 1 = on	write only
BDWRITE	52		Digital unit 5 output 4	0 = off, 1 = on	write only
BDWRITE	53		Digital unit 5 output 5	0 = off, 1 = on	write only
BDWRITE	54		Digital unit 5 output 6	0 = off, 1 = on	write only
BDWRITE	55		Digital unit 5 output 7	0 = off, 1 = on	write only
BDWRITE	56		Digital unit 5 output 8	0 = off, 1 = on	write only
BDWRITE	57		Digital unit 6 output 1	0 = off, 1 = on	write only
BDWRITE	58		Digital unit 6 output 2	0 = off, 1 = on	write only
BDWRITE	59		Digital unit 6 output 3	0 = off, 1 = on	write only
BDWRITE	60		Digital unit 6 output 4	0 = off, 1 = on	write only
BDWRITE	61		Digital unit 6 output 5	0 = off, 1 = on	write only
BDWRITE	62		Digital unit 6 output 6	0 = off, 1 = on	write only
BDWRITE	63		Digital unit 6 output 7	0 = off, 1 = on	write only
BDWRITE	64		Digital unit 6 output 8	0 = off, 1 = on	write only
BDWRITE	65		Digital unit 7 output 1	0 = off, 1 = on	write only
BDWRITE	66		Digital unit 7 output 2	0 = off, 1 = on	write only
BDWRITE	67		Digital unit 7 output 3	0 = off, 1 = on	write only
BDWRITE	68		Digital unit 7 output 4	0 = off, 1 = on	write only
BDWRITE	69		Digital unit 7 output 5	0 = off, 1 = on	write only
BDWRITE	70		Digital unit 7 output 6	0 = off, 1 = on	write only
BDWRITE	71		Digital unit 7 output 7	0 = off, 1 = on	write only
BDWRITE	72		Digital unit 7 output 8	0 = off, 1 = on	write only
BDWRITE	73		Digital unit 8 output 1	0 = off, 1 = on	write only
BDWRITE	74		Digital unit 8 output 2	0 = off, 1 = on	write only
BDWRITE	75		Digital unit 8 output 3	0 = off, 1 = on	write only
BDWRITE	76		Digital unit 8 output 4	0 = off, 1 = on	write only
BDWRITE	77		Digital unit 8 output 5	0 = off, 1 = on	write only
BDWRITE	78		Digital unit 8 output 6	0 = off, 1 = on	write only
BDWRITE	79		Digital unit 8 output 7	0 = off, 1 = on	write only
BDWRITE	80		Digital unit 8 output 8	0 = off, 1 = on	write only
BDWRITE	81		Digital unit 9 output 1	0 = off, 1 = on	write only
BDWRITE	82		Digital unit 9 output 2	0 = off, 1 = on	write only
BDWRITE	83		Digital unit 9 output 3	0 = off, 1 = on	write only
BDWRITE	84		Digital unit 9 output 4	0 = off, 1 = on	write only
BDWRITE	85		Digital unit 9 output 5	0 = off, 1 = on	write only
BDWRITE	86		Digital unit 9 output 6	0 = off, 1 = on	write only
BDWRITE	87		Digital unit 9 output 7	0 = off, 1 = on	write only
BDWRITE	88		Digital unit 9 output 8	0 = off, 1 = on	write only
BDWRITE	89		Digital unit 10 output 1	0 = off, 1 = on	write only
BDWRITE	90		Digital unit 10 output 2	0 = off, 1 = on	write only
BDWRITE	91		Digital unit 10 output 3	0 = off, 1 = on	write only
BDWRITE	92		Digital unit 10 output 4	0 = off, 1 = on	write only
BDWRITE	93		Digital unit 10 output 5	0 = off, 1 = on	write only
BDWRITE	94		Digital unit 10 output 6	0 = off, 1 = on	write only
BDWRITE	95		Digital unit 10 output 7	0 = off, 1 = on	write only
BDWRITE	96		Digital unit 10 output 8	0 = off, 1 = on	write only

6.20 Other Information and Illustrations

6.20.1 Loop Back Test

A facility exists which enables the hardware connection to the RS232 PC port and the RS422 port to be checked.

On the dual inline switch (switch bank 2) set way 5 on and all other ways off.

Any character on the receive line is then echoed back immediately on the transmit line.

This facility is intended to be used in conjunction with a terminal emulator, such as Hyperterminal (hypertrm.exe) which is included with Windows.

The communications settings should be as follows:

Bits per second: 9600
Data bits: 8
Parity: none
Stop bits: 1
Flow control: None (i.e. no hardware or software flow control)

Full duplex.

6.20.2 Setting up the Hyperterminal for the DTI echo test

Connect the DTI to the PC via a serial lead.

Click on the Windows start button and choose Run.

Type hypertrm.exe in the Open box and press Enter.

Wait for the Connection Description box to appear.

In the name box type Autoflame DTI Echo Test and click OK.

Under Connect Using choose Direct to COM1.

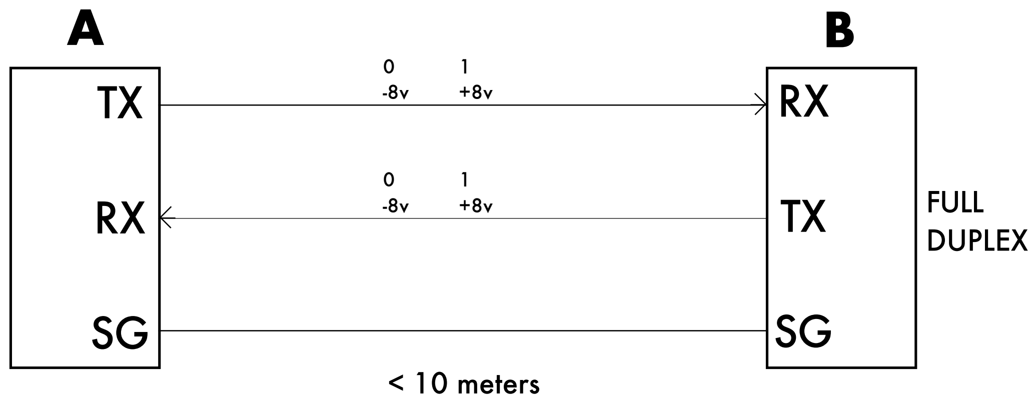
Use the following Port Settings for COM1 and choose OK:

Bits per second (baud rate): 9600
Data bits: 8
Parity: none
Stop bits: 1
Flow control: None (i.e. no hardware or software flow control)
(Full duplex if necessary)

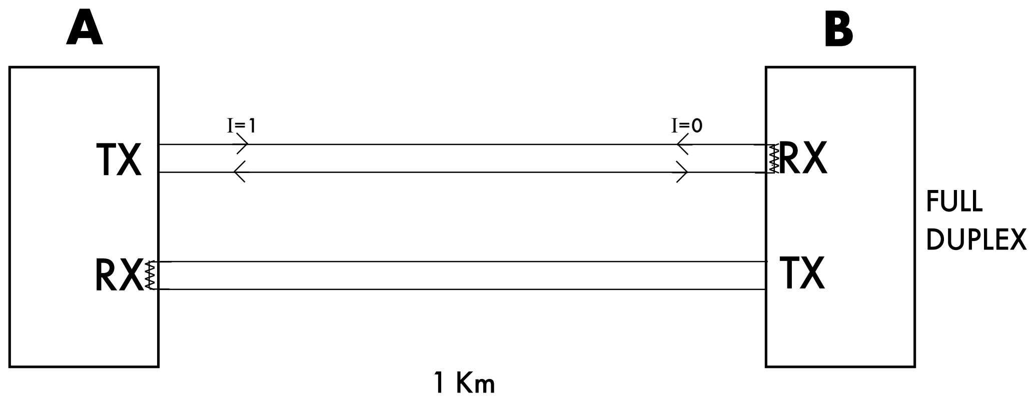
6.20.2 Communication Interfaces

This page is for information only.

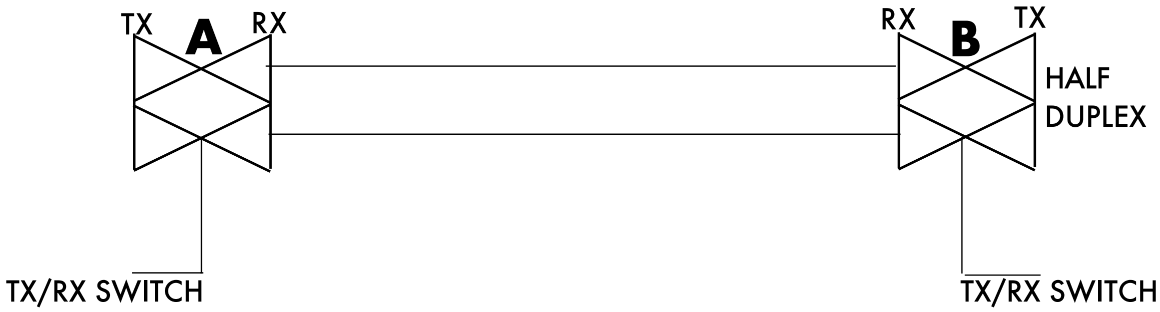
RS 232



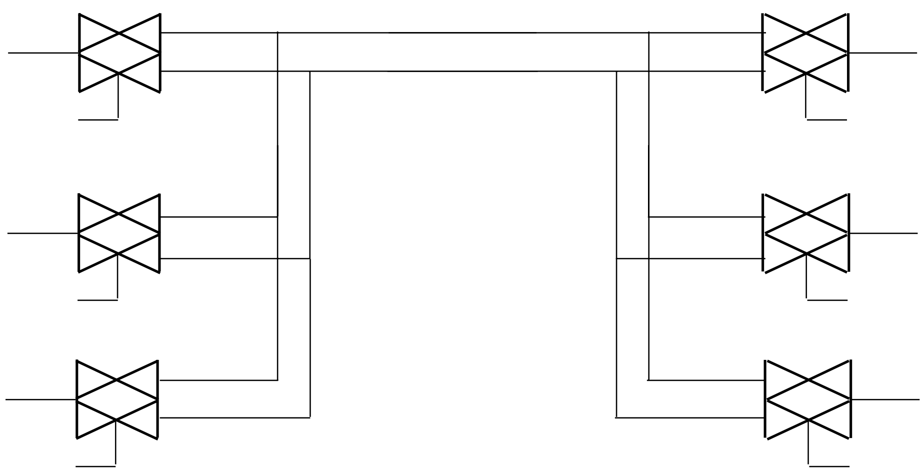
RS 422



RS 485



Example of a network



Section 7: Application Possibilities for M.M./E.G.A.

7.1 Application Possibilities for M.M./E.G.A. System

The M.M. system is basically a fuel/air ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner. The ability to control up to 6 channels, however, greatly expands the areas in which it can be used and any application in which it is necessary to precisely mix fuel and air from up to 6 sources is a possibility.

Pressure Jet/Gun Type Burners

The simplest system requiring only two servo motors for control. The energy saving benefits come from several sources:

a) Elimination of mechanical hysteresis due to cams and linkages.

b) Precise control of the fuel/air ratio throughout the combustion range without the compromises which limit a cam.

c) Control of the setpoint to ±1 degree C. (± 2 degrees F.) or ±1.5 psi via the PID controller, eliminating the wastage or pressure higher than required. This is set internally within the M.M. controller and is a 4-term PID loop controller.

d) No compromise required when changing between fuels since the air/fuel ratio for each are completely seperate.

e) The ability to maximise the turndown capability of the burner without compromising the start position. This is achieved by the ability to use a golden start position.

7.2 Application Possibilities for M.M./E.G.A. System

Rotary Burners

The M.M. system is basically a fuel/air ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner.

The ability to control up to 6 channels however greatly expands the areas in which it can be used. Any application in which it is necessary to precisely mix fuel and air from up to 8 sources is a possibility and one of the possible applications is the use of rotary burners.

The benefits of this system are similar to that of pressure jet/gun burners but by utilising the third channel , to control the primary air supply, the best possible mixing is achieved. The energy saving benefits are as follows:

a) Elimination of mechanical hysteresis due to cams and linkages;

b) Precise control of the fuel/air ratio throughout the combustion range without the compromises which limit a cam.

c) Control of the output to ±1 degree C. (± 2 degrees F.) or ± 1.5 psi via the P.I.D. controller, eliminating the wastage or pressure higher than required. This is set internally within the M.M. controller and is a 4-term PID loop controller.

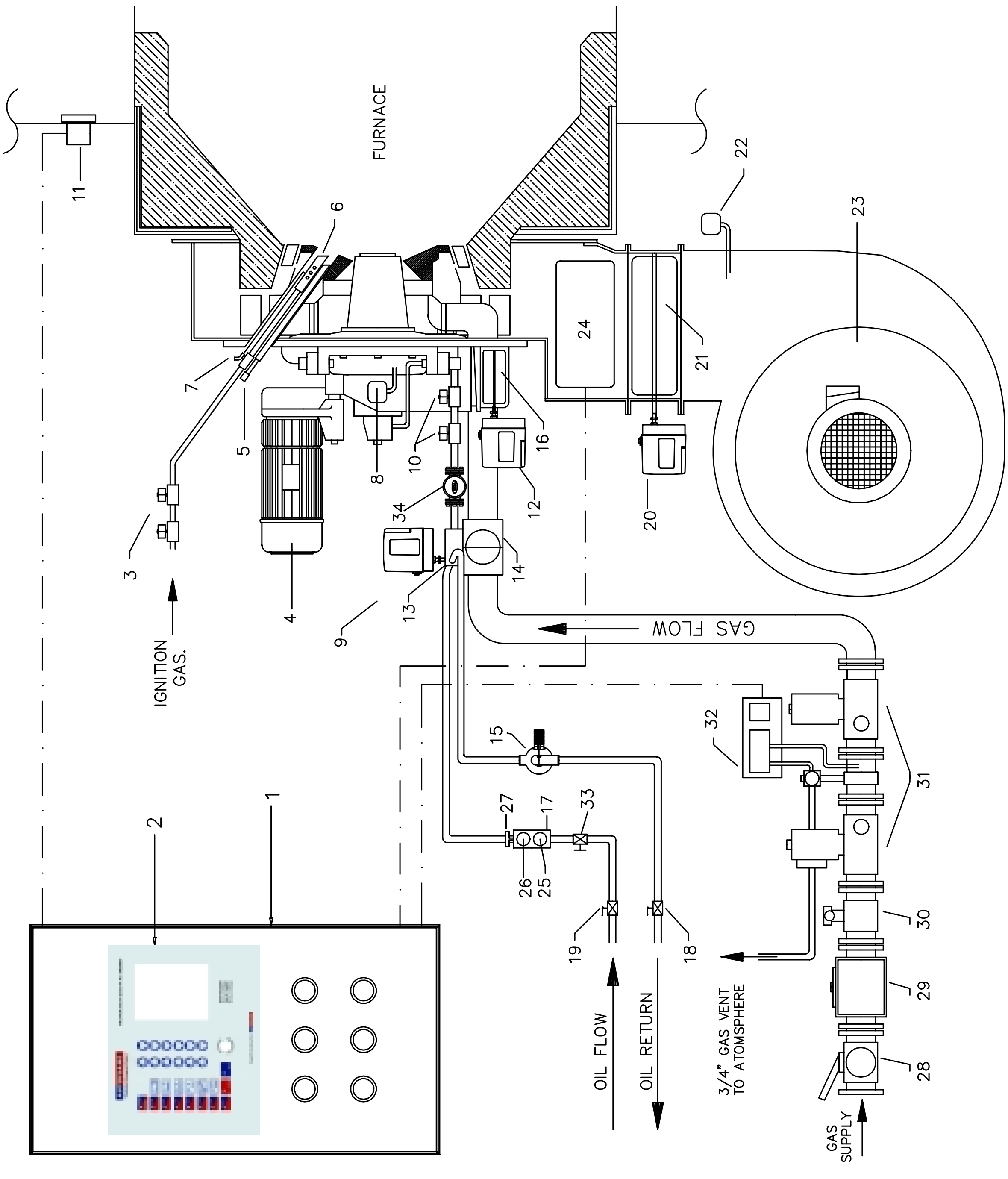
d) No compromise required when changing between fuels since the air/fuel ratio for each are completely seperate.

e) The ability to maximise the turndown capability of the burner without compromising the start position. This is achieved by the ability to use a golden start position.

LAYOUT OF DUAL FUEL ROTARY CUP
BURNER CONTROLS & M.M. SYSTEM

KEY TO CONTROL SYSTEM

1 Control panel
2 Micro Modulation Unit
3 Pilot solenoid valves
4 Rotary cup motor
5 Flame detector
6 Pilot burner
7 Ignition electrodes
8 Atomising air proving switch
9 Fuel servo motor
10 Oil solenoid valves
11 Temperature/pressure sensor
12 Atomising air servo motor
13 Modulating oil valve
14 Modulating gas valve
15 Oil pressure regulator valve
16 Atomising air damper
17 Oil entry block
18 Oil return shut-off valve
19 Oil flow shut-off valve
20 Combustion air servo
21 Modulating combustion air damper
22 Combustion air proving switch
23 Combustion air fan
24 Burner terminal box
25 Oil temperature gauge
26 Oil pressure gauge
27 Oil temperature thermostat
28 Main gas shut-off valve
29 Gas filter
30 Gas flow meter
31 Main gas actuating valves
32 Valve proving system
33 Throttle valve
34 Oil flow meter



7.3 Application Possibilities for M.M./E.G.A. System

Flue Gas Re-Circulation Control (NOx)

The M.M. system is basically a fuel/air ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner. The ability to control up to 6 channels, however, greatly expands the areas in which it can be used and any application in which it is necessary to precisely mix fuel and air from up to 6 sources is a possibility.

The additional channels can be used to control a recirculation damper which is a common method in the control of NOX production. As with most forms of NOX control this method reduces the temperature in the combustion chamber and hence reduces thermal efficiency. Use of the M.M./E.G.A. will minimise the excess air to the burner which itself reduces NOX and will also affect some of this loss of efficiency.

7.4 Application Possibilities for M.M./E.G.A. System

Steam Generator Feed Water Control

The M.M. system is basically an air/fuel ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner. The ability to control up to 6 channels however greatly expands the areas in which it can be used and any application in which it is necessary to precisely mix fuel and air from up to 6 sources is a possibility.

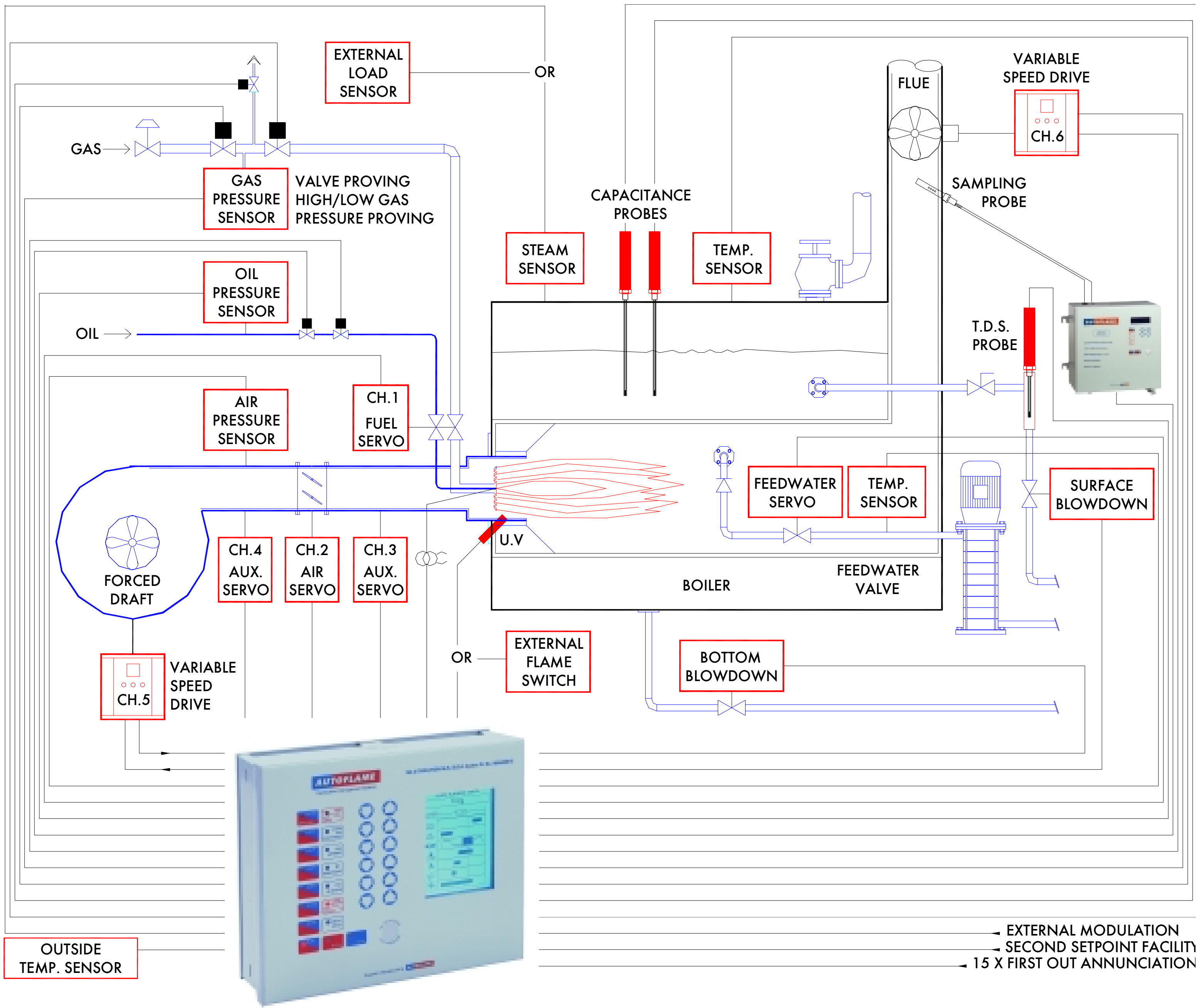
The 3rd channel can also be used to control the feed water.

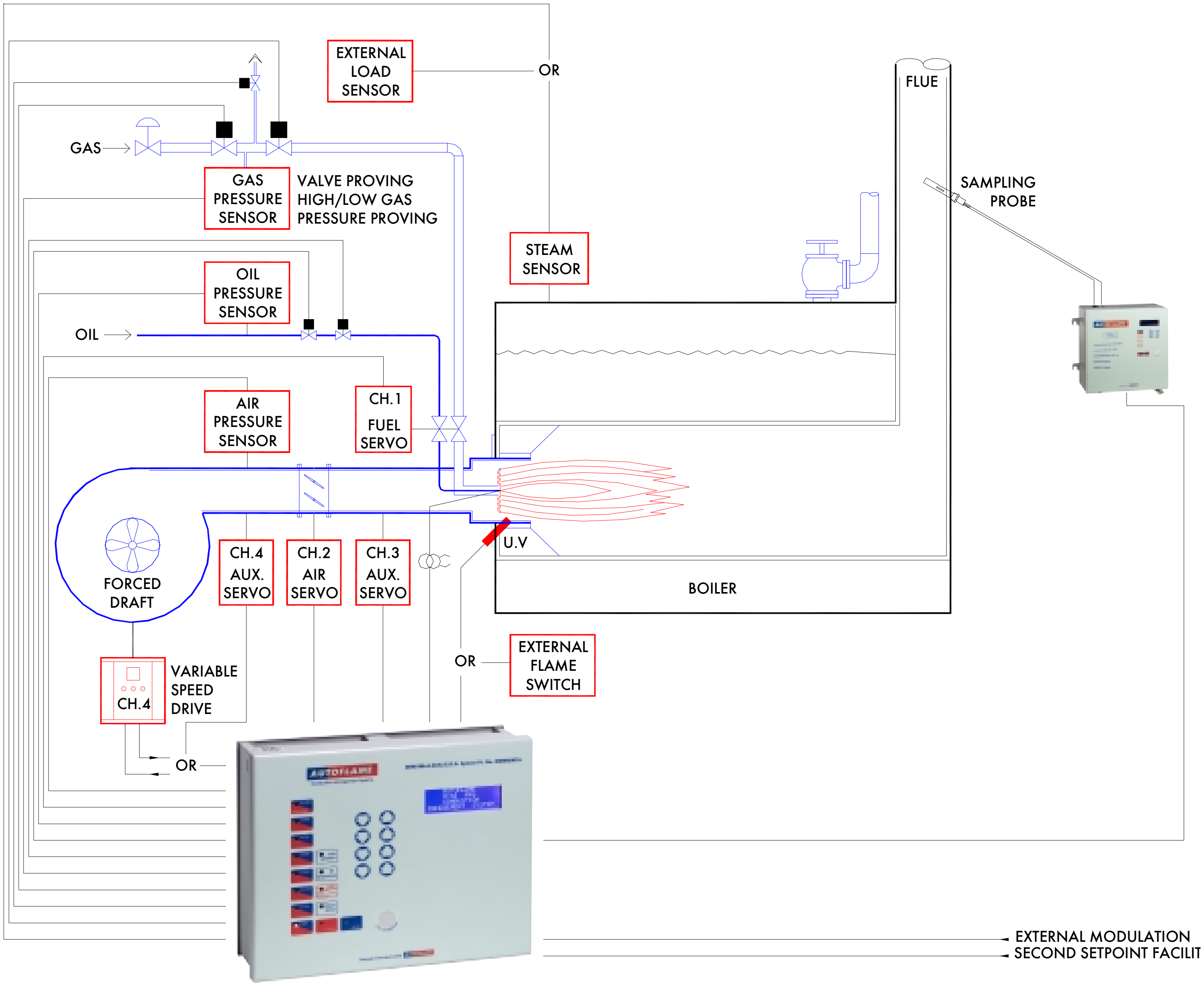
7.5 Application Possibilities for M.M./E.G.A. System

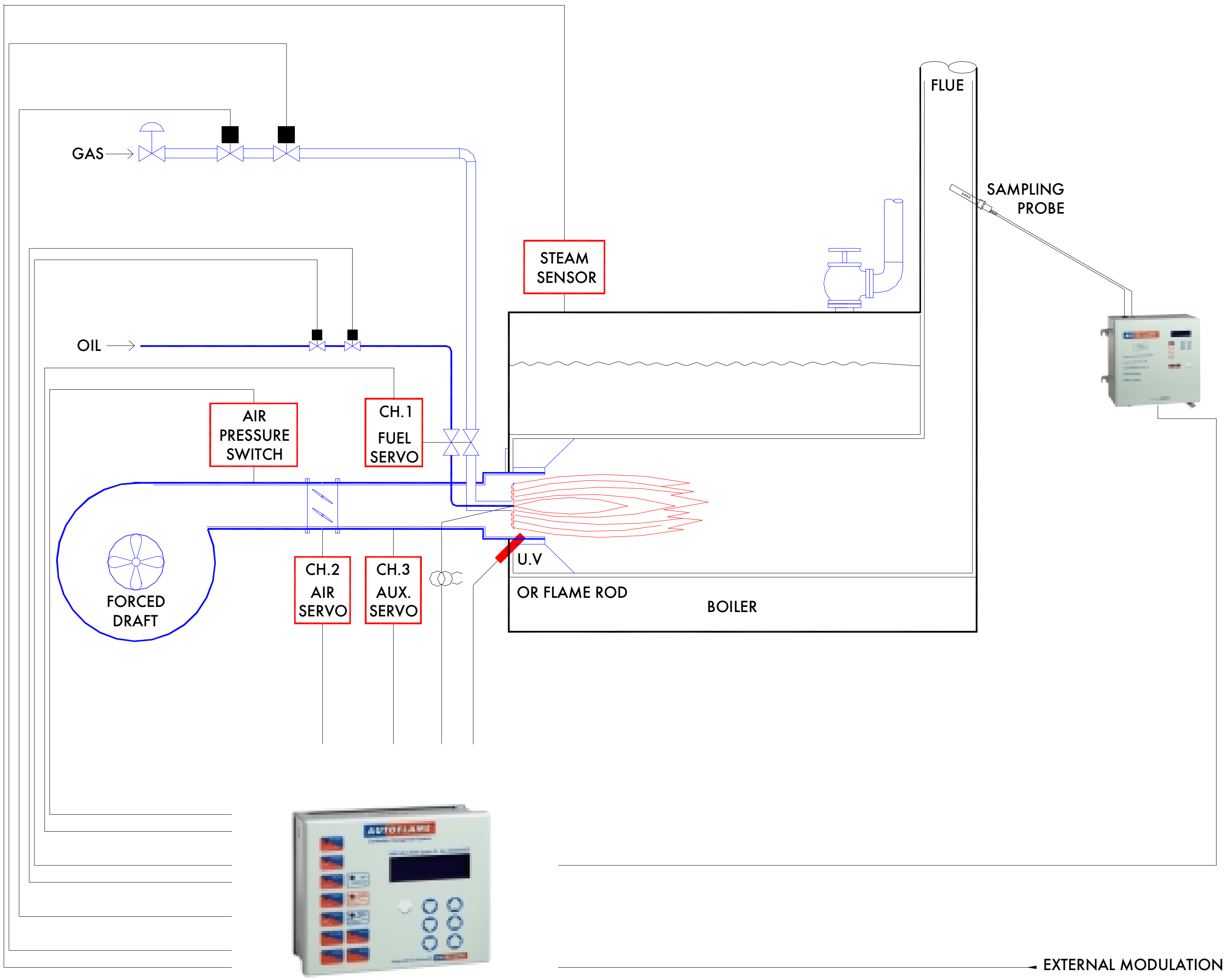
Water Injection

The M.M. system is basically an air/fuel ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner. The ability to control up to 6 channels however greatly expands the areas in which it can be used and any application in which it is necessary to precisely mix fuel and air from up to 6 sources is a possibility.

The 3rd channel can be used in this instance to control the water injection.


EXTERNAL LOAD SENSOR
OR
GAS
GAS PRESSURE SENSOR
VALVE PROVING HIGH/LOW GAS PRESSURE PROVING
OIL PRESSURE SENSOR
OIL
AIR PRESSURE SENSOR
CH.1 FUEL SERVO
FORCED DRAFT
CH.4 AUX. SERVO
CH.2 AIR SERVO
CH.3 AUX. SERVO
VARIABLE SPEED DRIVE
CH.5
U.V
OR
EXTERNAL FLAME SWITCH
OUTSIDE TEMP. SENSOR
STEAM SENSOR
CAPACITANCE PROBES
TEMP. SENSOR
FLUE
VARIABLE SPEED DRIVE
CH.6
SAMPLING PROBE
T.D.S. PROBE
FEEDWATER SERVO
TEMP. SENSOR
SURFACE BLOWDOWN
BOILER
FEEDWATER VALVE
BOTTOM BLOWDOWN
AUTOFLAME
EXTERNAL MODULATION
SECOND SETPOINT FACILITY
15 X FIRST OUT ANNUNCIATION


EXTERNAL LOAD SENSOR
OR
FLUE
GAS
GAS PRESSURE SENSOR
VALVE PROVING HIGH/LOW GAS PRESSURE PROVING
SAMPLING PROBE
STEAM SENSOR
OIL PRESSURE SENSOR
OIL
AIR PRESSURE SENSOR
CH.1 FUEL SERVO
FORCED DRAFT
CH.4 AUX. SERVO
CH.2 AIR SERVO
CH.3 AUX. SERVO
U.V
BOILER
OR
EXTERNAL FLAME SWITCH
VARIABLE SPEED DRIVE
CH.4
OR
EXTERNAL MODULATION
SECOND SETPOINT FACILIT


GAS
OIL
STEAM SENSOR
FLUE
SAMPLING PROBE
AIR PRESSURE SWITCH
CH.1 FUEL SERVO
CH.2 AIR SERVO
CH.3 AUX. SERVO
FORCED DRAFT
U.V
OR FLAME ROD
BOILER
EXTERNAL MODULATION

7.8 Application Possibilities for M.M./E.G.A. System

Changeover on the Fly

Changeover on the fly software enables up to two fuels to be accommodated (not four as on the standard Mk6 product) and if two fuels are commissioned they can run independently or simultaneously. Changing between the fuels is possible without the need to shutdown the burner. The system and burner suitability must be considered for each COF application.

Hardware requirements:

- Autoflame manufactured control panel housing the following units:
  - Mk6 MM Evolution (software- BC 20.x; MM 20.x; DI 20.x)
  - Digital IO unit modified for COF (software- 1.00 modified for COF)

The digital IO must be set with identification #1 (use the PC & IO setup lead and follow the instructions in section 6 of the technical manual- if any other identification number is set then the communications to the MM will fail). The MM identification number (option #33) can be set to any number as usual.

Communications to the digital IO module is via the twin burner terminals #23/24 (so twin burner operation is not possible).

Operational Components:

Terminal #89 input selects fuel 1
Terminal #90 input selects fuel 2
Terminal #91 input selects simultaneous firing
Terminal #92 input is unused

Three or four servomotors must be used and all servomotors must be connected at all times.

- Channel 1 must be fuel 1, e.g. gas
- Channel 2 must be air
- Channel 3 must be fuel 2, e.g. oil

A VSD can be optioned. If a VSD is optioned then the low flame positions/settings on the drive must be the same for both fuels. Fuel and air positions may vary.

An EGA (Exhaust Gas Analyser) can be used but trim can only be selected on channel 2 (air damper) and no trim is available on channel 5 (VSD).

COF will not operate if the target 'change over' curve is not commissioned.

The fuel flow metering or 10 point load index entry is referenced to channel 2 (air).

A type 1 c/o (changeover) sequence is where the air opens then the valve opens
A type 2 c/o is where the valve closes then the air closes

Changeover on the Fly

Important options/parameters to set:

- Option #111 must be set = 0 (interrupted pilot)
- Option #8 must be set = 2 (i.e. 3 channels)
- Option #69 must be set = 1 (channel 3 at close for purge position)
- Parameter #108 = 0 (pilot off during fuel 2 burn)
- Parameter #108 = 1 (pilot on during fuel 2 burn)

COF Operation:

For a detailed schematic of the COF procedures please see the attached block diagrams. For these please use the following key:

F1 = Fuel 1 (Propane in this case)
F2 = Fuel 2 (Hydrogen in this case)

CH1 = Channel 1
CH2 = Channel 2
CH3 = Channel 3

C1 = Curve 1 (uses F1 select input terminal #89) = Propane (Channel 1 and 2)
C2 = Curve 2 (uses F2 select input terminal #90) = Hydrogen (Channel 2 and 3)
C3 = Curve 3 (uses F3 select input terminal #91) = Propane + Hydrogen (Channel 1,2,3)

LF = Low flame

Only 1 fuel may be selected during burner start-up. If more than 1 input is selected the MM will reset.

Once the burner is firing/modulating the appropriate indication output will be set (during commissioning the indication outputs do not operate). Once an indication output is set, COF may be carried out.
A 'non current' input must be set for 5 seconds for it to be recognised. Once recognised it must not reset or the MM will reset causing the burner to stop. The 'current' input may be deselected any time from now on. The changeover will take place. Once the burner is modulating on the new fuel the inputs are looked at again. If two inputs are left permanently set, changeovers will occur repeatedly.

If a COF is attempted and the target fuel 'fuel available' input is reset a COF will not be initiated.
If a fuel is burning and its 'fuel available' input becomes reset then a lockout is set.
The fuel available input for the selected fuel must be set at all times this fuel is selected.

The COF input has to be set for the COF operation to take place. When the COF input is set there is a 5 second filter time on the fuel select inputs to allow the inputs to be switched. When the COF input is reset, the fuel select inputs respond as a standard Mk6 and stop the burner immediately when deselected. The burner will restart when a fuel is next selected.

The proof of closure inputs must be set when a valve is closed and reset when open. Both inputs are monitored regardless of which fuel is selected.

Changeover on the Fly

COF lockout messages:

Dio ignition check

- Input 1 of the digital IO (monitoring the ignition relay) is not in the correct state– the output/relay is apparently on when should be off (or vice versa).

Dio pilot check

- Input 2 of the digital IO (monitoring the pilot relay) is not in the correct state– the output/relay is apparently on when should be off (or vice versa).

Dio fuel 1 check

- Input 3 of the digital IO (monitoring the fuel 1 relay) is not in the correct state– the output/relay is apparently on when should be off (or vice versa).

Dio fuel 2 check

- Input 4 of the digital IO (monitoring the fuel 2 relay) is not in the correct state– the output/relay is apparently on when should be off (or vice versa).

Dio off line

- There is no communication between the Mk6 control & the digital IO unit.

Fuel 1 loss

- Fuel 1 available (digital IO input #15) is/has become reset when this fuel selected.

Fuel 2 loss

- Fuel 2 available (digital IO input #16) is/has become reset when this fuel selected.

Fuel 1 cpi

- The cpi (poc) input for fuel 1 (digital IO input #5) is not in the correct state.

Fuel 2 cpi

- The cpi (poc) input for fuel 2 (digital IO input #6) is not in the correct state.

7.9 Application Possibilities for M.M./E.G.A. System

No pre-purge

In the Mk6 Evolution unit it is now possible to allow the burner to start-up as quickly as possible without the need for a pre-purge, i.e. the pre-purge is bypassed. The major advantage of this control means that the overall boiler efficiency is increased by minimising the heat loss to the stack during a purge cycle. Also, the burner starts-up quicker so reaching setpoint in a reduced time is achieved. According to the EN676 European regulation, the burner is allowed to restart without a pre-purge if the burner has recycled due to operational temperature/pressure or when the burner on-off switch has been cycled, i.e. loss of input on terminal #53. When the burner is stopped by a lockout then this procedure is not allowed and the burner will have to start-up in the normal manner with a pre-purge. In order for no pre-purge to be allowed, there is one thing that needs to take place and that is that before the start without a pre-purge, valve proving (VPS) must take place and finish successfully. If this VPS operation is successful and all of the valves are checked then the burner may start-up without a pre-purge.

This is has been incorporated into the following software revision and is not in the standard Mk6 software control. Please contact Autoflame Engineering Ltd for such applications.

B C	6.26
M M	6.28
D I	6.29

Operation:

In order to initiate the no pre-purge software, option and parameter #143 must be set to a value of 1. During the first start-up the burner will start in the usual manner and a pre-purge will be initiated. Until the complete commissioning program has been entered and the burner started successfully, the burner will start-up every time with the VPS operation and a pre-purge.

Once fully commissioned and the burner started successfully then the system will now allow the no pre-purge software to be initiated. If the burner goes above its setpoint and so turns off in a controlled manner, or if the input on terminal #53 (burner on/off switch) is lost, then the next time the burner starts-up, it will go through the VPS operation and then light off without a pre-purge, i.e. the burner has shutdown in a controlled manner and the gas valves have been checked for integrity.

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

According to the EN 676 regulation, the burner is only allowed to work in this manner if option and parameter #129 is set to a value of 0, i.e. the VPS must operate before the burner starts–up.

The start sequence without pre-purge is as follows. Firstly the system goes through its internal tests and relay checks as per the usual start-up sequence. Then the call for heat on terminal #57 activates and the system will go through the VPS operation. If this operation is successful then the Mk6 will drive the channels to the light off or start position. Once all channels reach the start position then the burner will light off in the usual manner.

It is important to note that this control logic only conforms with European regulations at present and does not conform with NFPA and UL.

7.10 Application Possibilities for M.M./E.G.A. System

Hot Standby

In the Mk6 Evolution unit it is now possible to enable hot standby control (continuous pilot) which means that when the burner goes above its switching point, i.e. off differential, then the burner continues to fire with only the pilot valves energised.

This is has been incorporated into the following software revision and is not in the standard Mk6 software control. Please contact Autoflame Engineering Ltd for such applications.

B C 6.32
M M 6.32
D I 6.32

Operation:

To set up this facility option #9 must be set to a value of 3 or 4. This means that once the boiler gets up to temperature (pressure), the burner will not switch off but will in fact switch to pilot firing. These additional settings work in the same way as settings 1 and 2 but enable this continuous pilot operation. If option #9 is set to 3 then the burner goes to pilot firing at an offset above setpoint (set in option #10) and will switch back to main flame a number of degrees below the setpoint as set in option #11. If option #9 is set to 4 then the burner goes to pilot firing at an offset above setpoint (option #10) and will switch back to main flame a number of degrees above setpoint as set in option #11. When you put option #9 to a value of 3 or 4 then an external on/off thermostat or pressure switch must be installed.

In the situation when the burner switches back to pilot flame then the burner will open the pilot valves and after the same time as the second safety time (option #116), the burner will close its main valves. Also during the hot standby position the gas pressure is checked by the gas sensor, so it is important that the main valves and pilot valves are connected with a small measuring pipeline. When the burner comes back to the point when it should go back to main flame the main fuel valves will open and after the second safety time the pilot valves will be closed and the normal operation will start again.

7.11 Application Possibilities for M.M./E.G.A. System

Staged Combustion for Oil Firing

In the Mk6 Evolution unit it is now possible to use staged combustion when firing on fuel #2 (oil). This allows full modulating control when firing on fuel #1/3/4 (natural gas) but allows this staged combustion control, i.e. energising solenoids, on fuel #2. This is has been incorporated into the following software revision and is not in the standard Mk6 software control. Please contact Autoflame Engineering Ltd for such applications.

B C	5.03
M M	7.01
D I	7.01

The software works as follows:

When firing on fuels #1/3/4, the standard Mk6 operation is observed for full modulation when commissioning the fuel and air ratio curve. The standard PID control is used.

When firing on fuel #2, there are 4 outputs that can be implemented in order to allow up to 4 stages for staged combustion. These can be used for bypass solenoids or simply to allow additional fuel to be inputted. These terminals are:

Terminal #60- mains voltage output for solenoid 1
Terminal #74- switched neutral to relay contact for solenoid 2
Terminal #75- switched neutral to relay contact for solenoid 3
Terminal #76- switched neutral to relay contact for solenoid 4

The first nozzle comes on with terminal #60 from the burner control main fuel valve output. The number of nozzles on is set by offsets from the required setpoint. The offsets are adjustable between 2 to 50. The three offsets are set by:

Parameter #47	= 1st offset	default 5
Parameter #48	= 2nd offset	default 5
Parameter #107	= 3rd offset	default 5

Nozzle 1&2 on when first offset below required.	2 nozzles on
Nozzle 1&2&3 on when first+second offset below required	3 nozzles on
Nozzle 1&2&3&4 on when first+second+third offset below required	4 nozzles on

Parameter #108 (range 1 to 9, default 7) sets a point between each commissioned point where the nozzle turns on as a compromise for the transient experienced between air rich & air lean.

Staged Combustion for Oil Firing

Commissioning for fuel #2:

Set the close and open positions as standard. Also set the first start position as standard, i.e. nozzle 1 will be energised at this point.
The start button will flash again- press enter. Adjust and set accordingly using the EGA values and then press enter- this sets the combustion for nozzle 1 which is already on.
The inter button flashes, press inter and adjust the elements to a point where flame should be maintained ready for nozzle 2 to be set on- press enter- nozzle 2 opens. Adjust and set accordingly using the EGA values and then press enter- this sets the combustion for nozzle 2.
Inter flashes again- proceed as for nozzle 2- this time for nozzle 3.
High flashes- enter as for previous nozzle- this time for nozzle 4
Enter- RUN flashes- will run to low flame.
Press RUN when low flame attained progresses to modulation.

On fuel #2, all points entered must be ascending including VSD channels

Limitations:

1- Channels #3/4 are switched neutrals and are used for the staged combustion control. Therefore, these cannot be used as standard for servomotors when firing on fuels #1/3/4, i.e. FGR will not operate on any fuel (flue gas recirculation).
2- Channels #5/6 can be used on fuel #1, but only channel #5 can be used on fuel #2, i.e. channel #6 cannot be used on fuel #2.
3- If the burner locks out or restarts during commissioning on fuel #2, then the system will see this as if the system had been powered down (fuel deselected) and will reset itself.
4- If low flame hold is selected, then the burner runs to low flame- just one nozzle on (terminal #60 nozzle).
5- If hand is selected, then the burner will go to high fire- all 4 nozzles.
6- Option #147, the air checking window with the air sensor does not check on fuel #2- this is checked on other fuels.
7- One point change is not possible- the system will reset if attempted.
8- Twin burner cannot be used.
9- There is no EGA trim on fuel #2, only the EGA run screen can be selected. The other fuels #1/3/4 operate in the normal method.
10- There is no fuel flow metering on fuel #2. The other fuels #1/3/4 operate in the normal method.
11- The download will not read correctly on fuel #2. The other fuels #1/3/4 operate in the normal method

Section 8: Ancillary & Peripheral Equipment.

8.0 VALVE SPECIFICATIONS

When using high viscosity low temperature fuel oils through smaller valves, turbulent flow characteristics can reduce volume throughput significantly.

All flow pressure graphs published for oil valves are using light distillate oil @ 20°C and a viscosity of 5 centistokes.

Autoflame will carry out flow characteristic tests on specific valves against customer fuel/viscosity and temperature specifications. Price on application.

Standard oil valve build execution is stainless steel valve body with stainless steel bobbin. The top and bottom closing plates are manufactured out of aluminium.

All valves can be supplied in non-standard material at extra cost. Price on application.

The standard execution of the gas valve is an aluminium body with stainless steel metering disk and stem. The gas valves can also be supplied for corrosive/contaminated fuels in all stainless steel construction. Price on application.

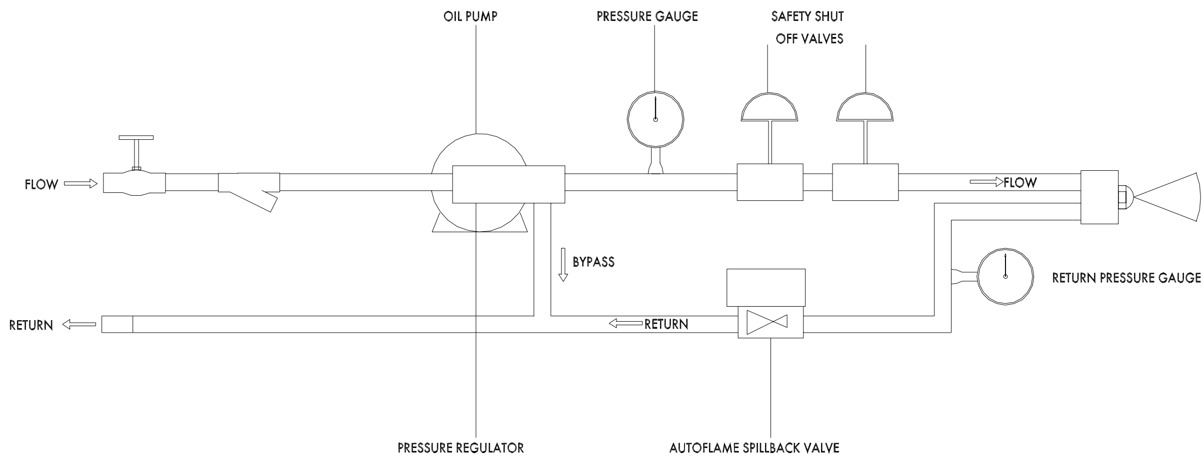
The standard execution of the FGR valve (flue gas recirculation) is an aluminium body with stainless steel disk and stem but is dependent upon the application. Two grease nipple points are used for easy service of the FGR valves.

Maximum pressure is 350 psi (oil valves); 10 psi (GV4 gas valves); 25psi (GVF gas valves).

For further information please contact Autoflame sales.

8.0.1 Oil Valve Selection

8.0.1.1 Spillback/Bypass Application



INFORMATION REQUIRED	ACTUAL DATA	TYPICAL DATA
OIL PUMP FLOW:		1.6X NOZZLE SIZE
OIL PUMP PRESSURE::		350 - 400 PSI
SOLENOID DETA P. (BOTH VALVES):		4 TO 20 PSI
NOZZLE MAXIMUM WORKING PRESSURE:		300 PSI
NOZZLE SIZE (IBS/HR)		1000 IB/HR
RETURN OIL PRESSURE AT LOW FIRE:		80 TO 120 PSI
OIL TYPE: #2,#4 OR #6		#2

WHEN SIZING THE OIL VALVE FOR BYPASS SYSTEMS. WE HAVE TO DETERMINE THE AMOUNT OF OIL BEING RETURNED TO THE PUMP/TANK AT LOW FIRE AND AT WHAT PRESSURE. THIS INFORMATION IS THEN USED AGAINST THE VALVE CHARTS IN THE AUTOFLAME MANUAL.
AT LOW FIRE IS WHEN THE VALVE IS MOST OPEN AND PRODUCING MAXIMUM FLOW.

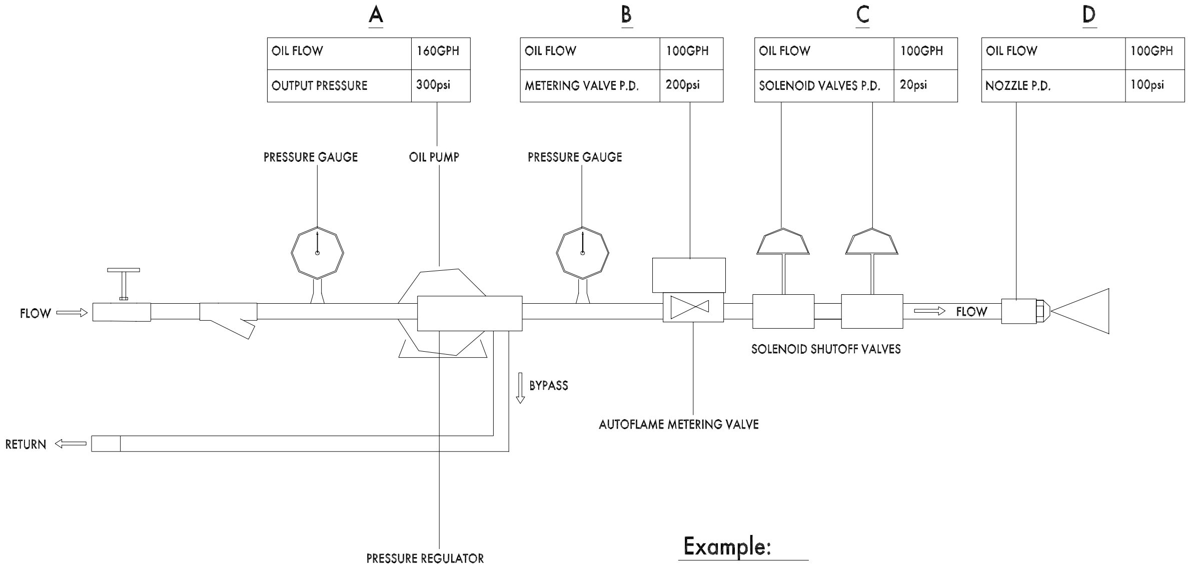
BASED ON THE ABOVE EXAMPLE:

100O IB/HR X 1.6	=	1600 IB/HR
LOW FIRE OIL REQUIREMENT	=	250 IB/HR (BASED AT 4 : 1 TURN DOWN. 1000 / 4)
1600 IB/HR - 250 IB/HR	=	1350 IB/HR
SPILLBACK OIL FLOW	=	1350 IB/HR @ 100 PSI

THEREFORE THE CORRECT VALVE WILL BE THE TYPE: 5

For assistance, fill in the actual data and return to Autoflame.

8.0.1.2 Metering/Simplex Application



Example:

Known parameters are pump max flow and pressure output

Now determine the flow and pressure drop across the nozzle

The difference between VALUE A, C and D
is what is applied to the autoflame charts

From above example 300 - 100 - 20 = 180

From Autoflame charts in section 8.6.1 - 8.6.8
select valve that gives flow of 100GPH @ 180psi P.D.

VALVE SIZING METHOD

THE FOLLOWING INFORMATION MUST BE COMPLETED BEFORE THE OIL VALVE CAN BE CORRECTLY SIZED

FILL IN BOX "A" ABOVE
FILL IN BOX "C" ABOVE
FILL IN BOX "D" ABOVE

A - C - D = B

THE RESULTS OF BOX B NOW MUST BE APPLIED TO THE CHARTS IN THE AUTOFLAME MANUAL

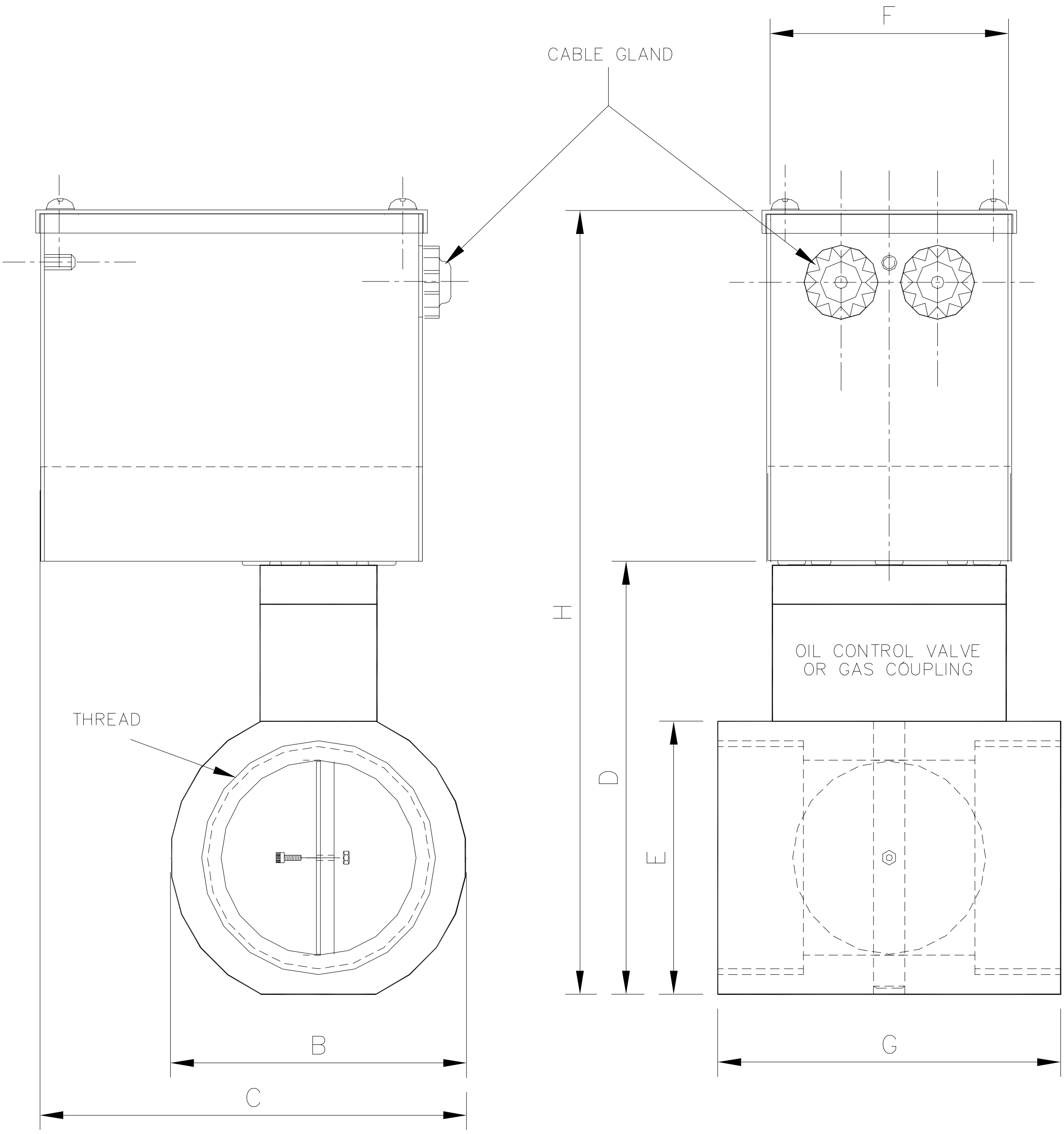
For assistance, fill in the fields below and return to Autoflame:

A: __________

C: __________

D: __________

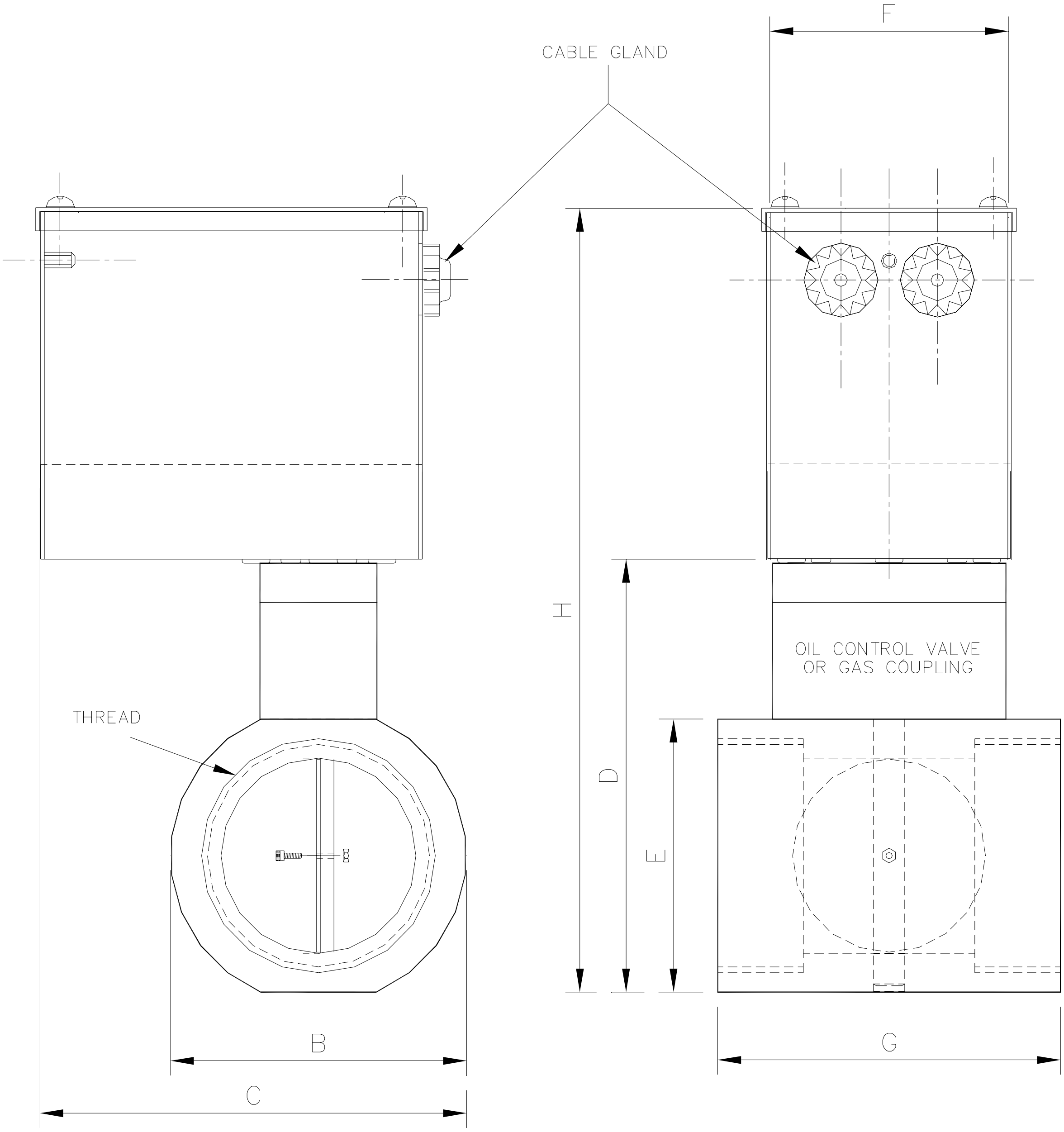
8.1.1 Gas Valve- threaded (metric)- small positioning motor



PART No.	A	B	C	D	E	F	G	H	VALVE SIZE
GV42521	100	54	97	85	45	65	88	180	25 (1")
GV44022	100	67	103.5	100	60	65	88	195	40 (1.5")
GV45023	100	76	108	110	70	65	88	205	50 (2")
GV46524	100	90	115	124	85	65	88	220	65 (2.5")
GV48025	100	105	123	140	100	65	88	235	80 (3")

ALL MEASUREMENTS IN MILLIMETRES UNLESS STATED OTHERWISE.

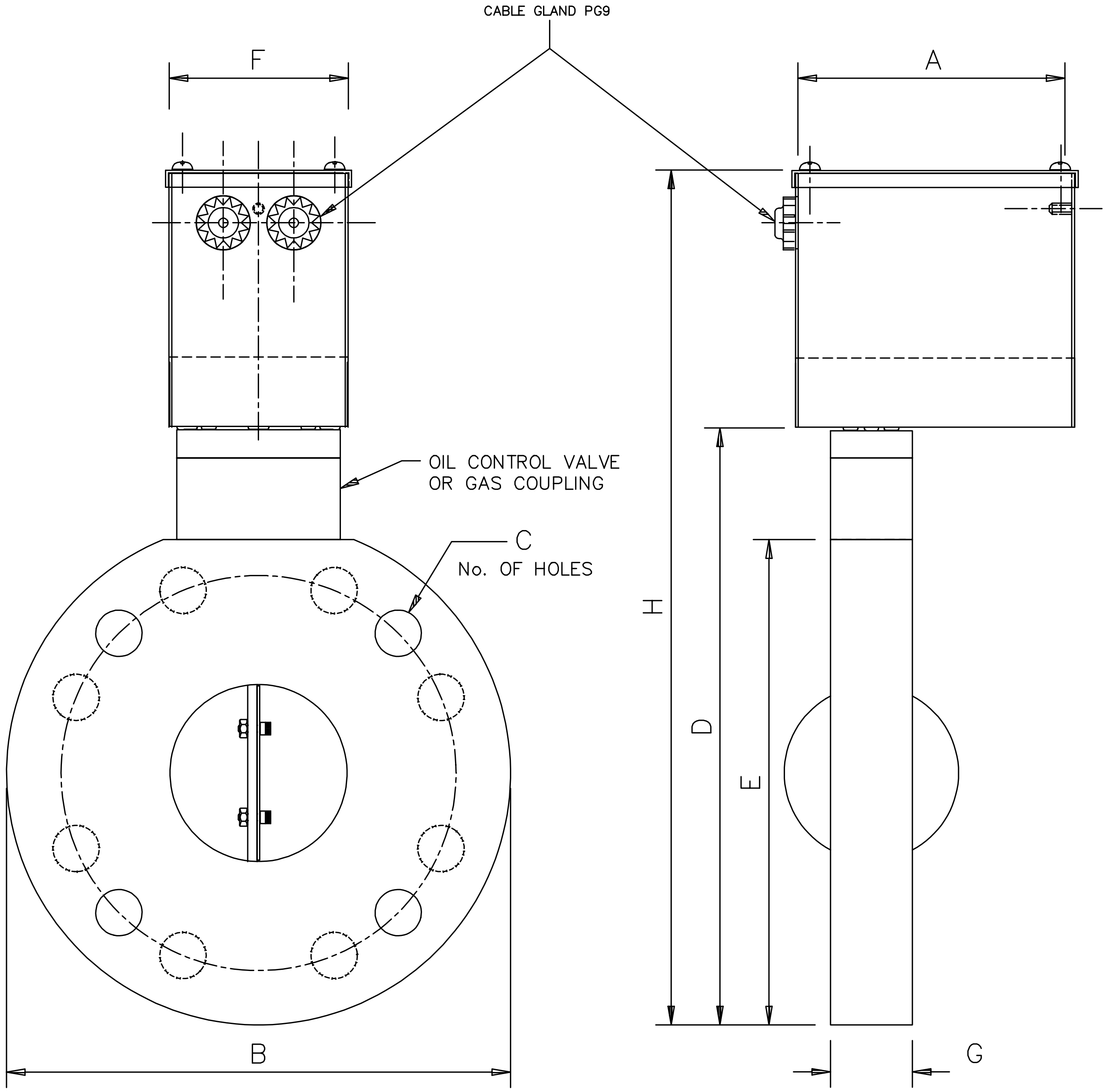
8.1.2 Gas Valve- threaded (imperial)- small positioning motor



PART No.	A	B	C	D	E	F	G	H	VALVE SIZE
GV42521	4"	2.125"	3.80"	3.35"	1.75"	2.56"	3.47"	7.09"	1"
GV44022	4"	2.64"	4.08"	4"	2.375"	2.56"	3.47"	7.67"	1.5"
GV45023	4"	3"	4.25"	4.375"	2.75"	2.56"	3.47"	8.07"	2"
GV46524	4"	3.50"	4.50"	5"	3.35"	2.56"	3.47"	8.66"	2.5"
GV48025	4"	4.125"	4.85"	5.50"	4"	2.56"	3.47"	9.25"	3"

ALL MEASUREMENTS IN IMPERIAL UNLESS STATED OTHERWISE.

8.2.1 Gas Valve- flanged (30mm thick metric)- small positioning motor

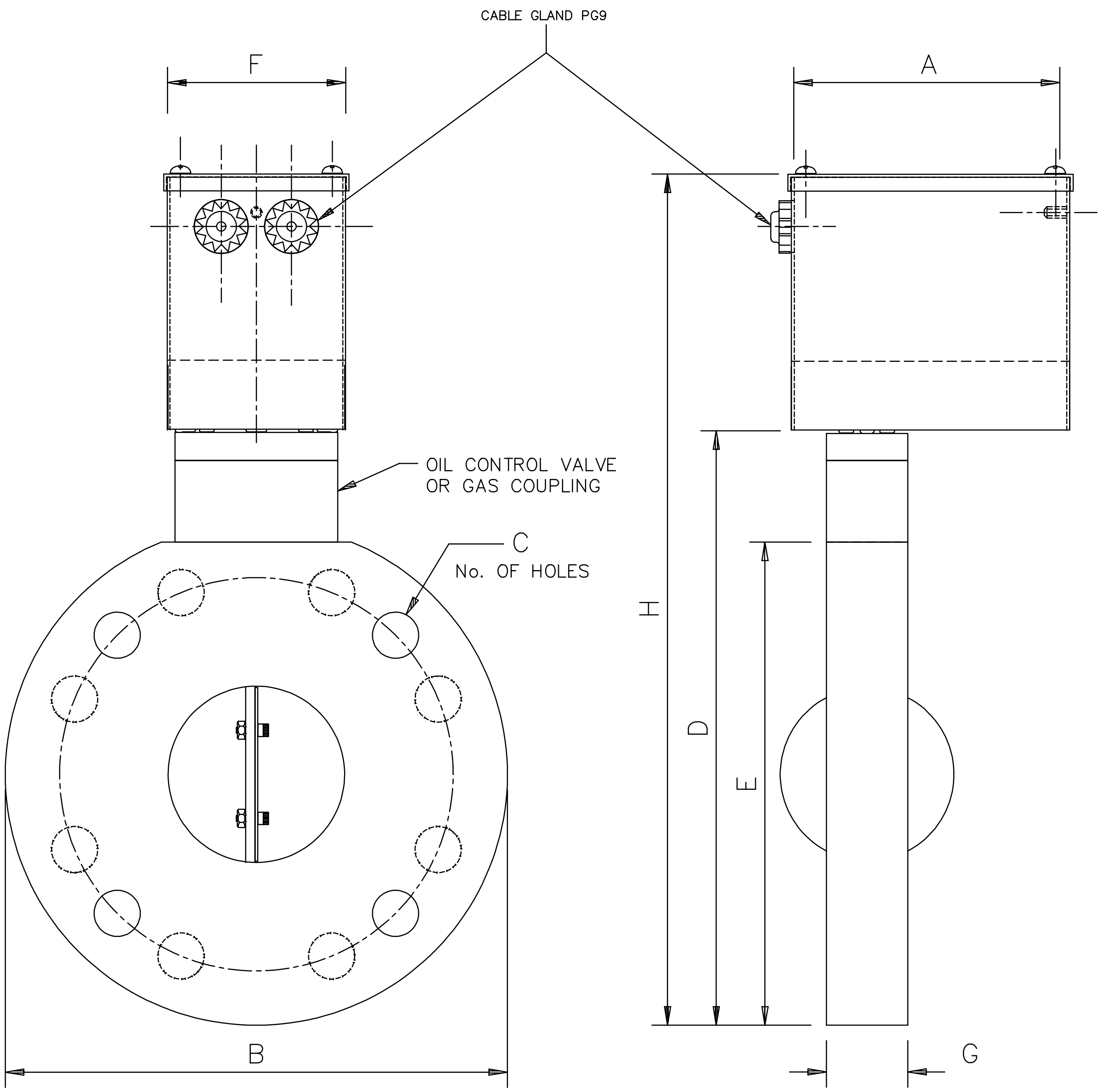


PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/30	100	165	4	200	160	65	30	297	M16 X 110	50 (2")
GVF46526/30	100	185	4	218	178	65	30	315	M16 X 110	65 (2.5")
GVF48027/30	100	200	8	236	196	65	30	330	M16 X 110	80 (3")
GVF410026/30	100	220	8	254	214	65	30	350	M16 X 110	100 (4")
GVF12527/30	100	250	8	285	245	65	30	380	M16 X 110	125 (5")
GVF415028/30	100	285	8	321	281	65	30	415	M16 X 110	150 (6")

ALL MEASUREMENTS IN MILLIMETRES UNLESS STATED OTHERWISE.

MATING FLANGES, RUBBER GASKETS & BOLTS ARE NOT SUPPLIED UNLESS SPECIFIED ON ORDER.

8.2.2 Gas Valve- flanged (30mm thick imperial)- small positioning motor

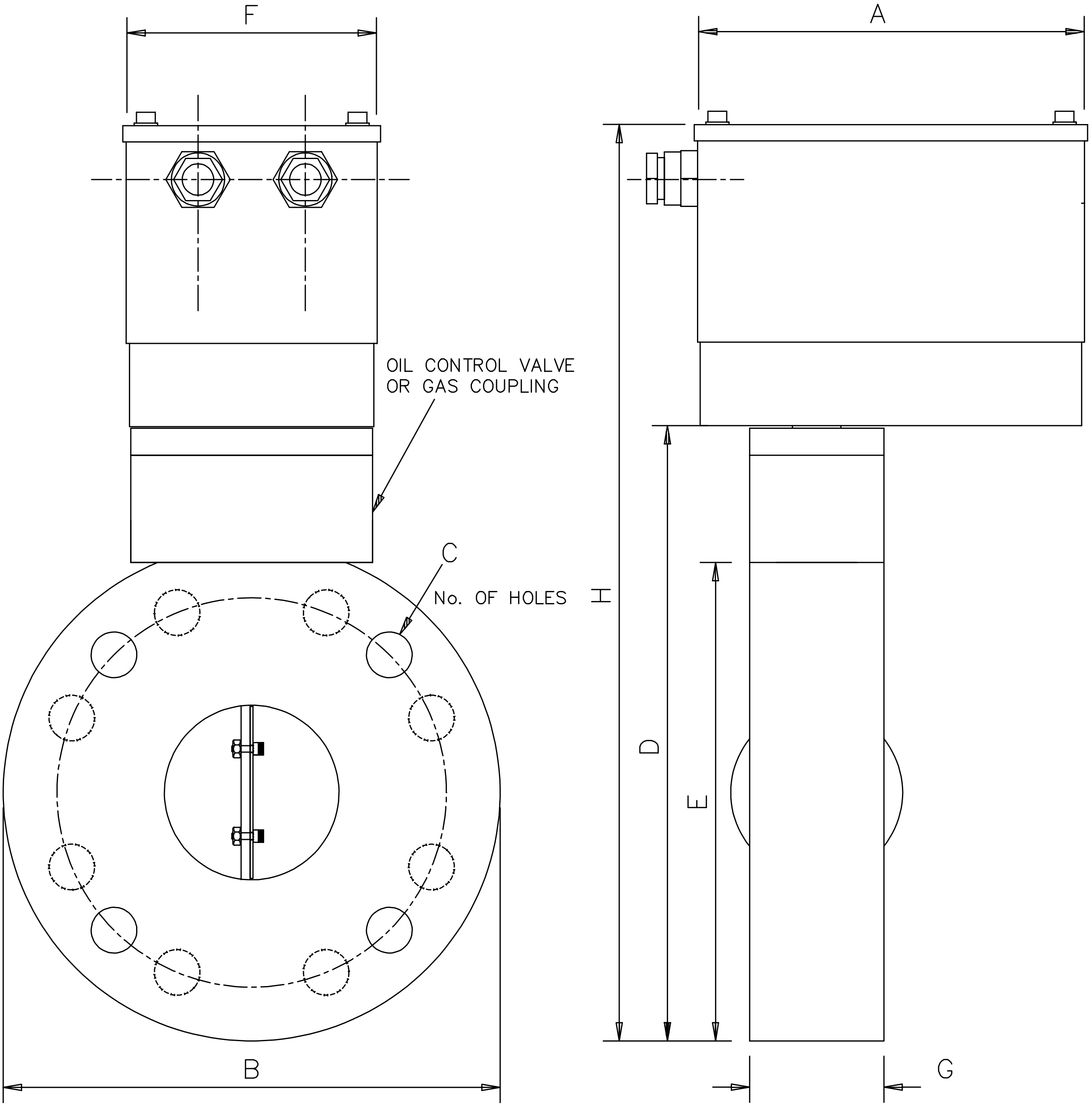


PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/30	3.9"	6"	4	8"	6.25"	2.5"	1.125"	11.7"	1/2" X 4"	2"
GVF46526/30	3.9"	7"	4	8.6"	7"	2.5"	1.125"	12.40"	5/8" x 4"	2.5"
GVF48027/30	3.9"	7.5"	4	9.375"	7.75"	2.5"	1.125"	13.00"	5/8" x 4"	3"
GVF410026/30	3.9"	9"	8	10"	8.5"	2.5"	1.125"	8.75"	5/8" x 4"	4"
GVF12527/30	3.9"	10"	8	11"	9.75"	2.5"	1.125"	9.5"	3/4" x 4"	5"
GVF413028/30	3.9"	11"	8	12.5"	11"	2.5"	1.125"	10.25"	3/4" x 4"	6"

ALL MEASUREMENTS IN IMPERIAL UNLESS STATED OTHERWISE.

MATING FLANGES, RUBBER GASKETS & BOLTS ARE NOT SUPPLIED UNLESS SPECIFIED ON ORDER.

8.3.1 Gas Valve- flanged (50mm thick metric)- large positioning motor

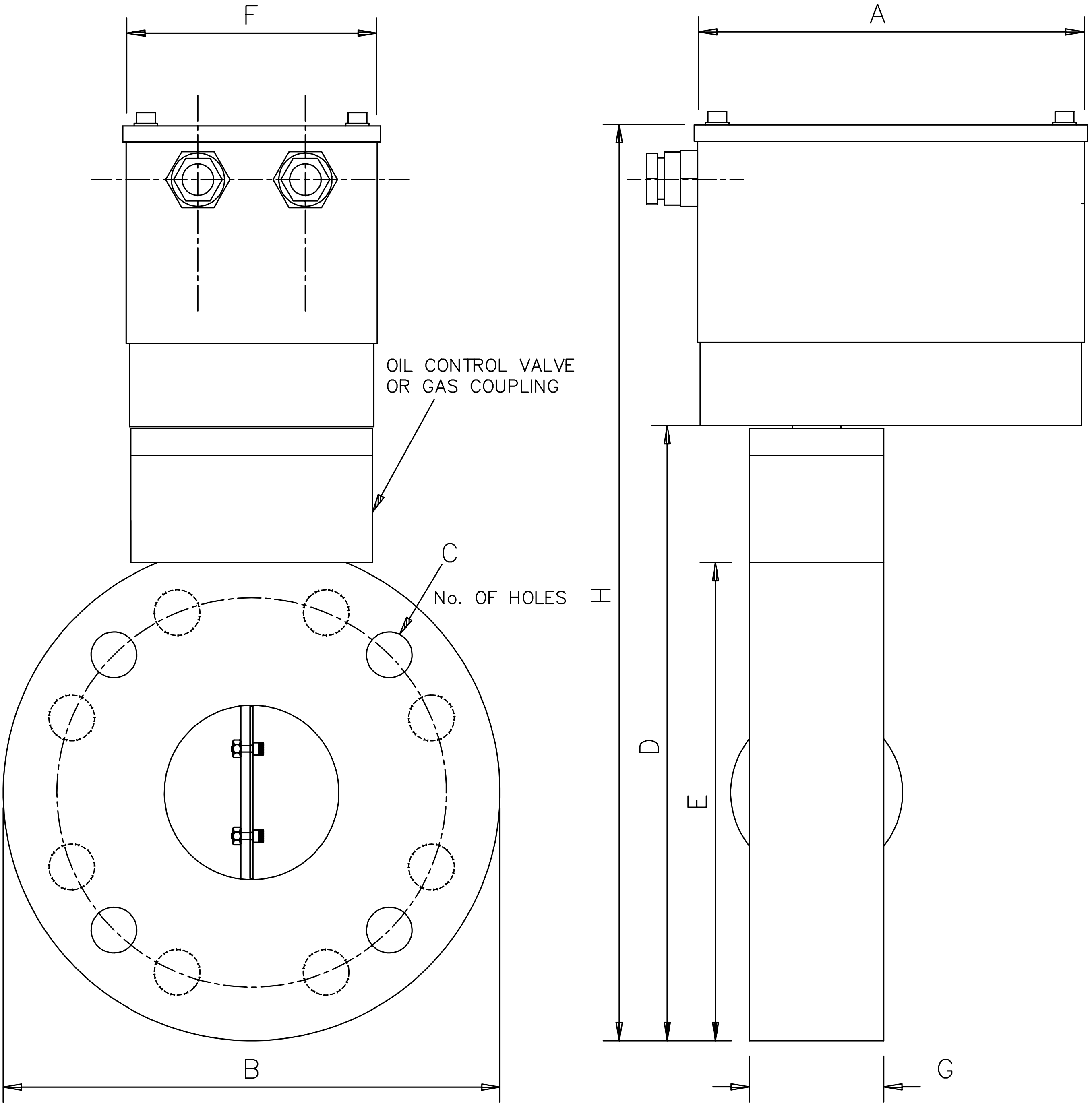


PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/50	142	165	4	200	160	93	50	315	M16 X 130	50 (2")
GVF46526/50	142	185	4	218	178	93	50	343	M16 X 130	65 (2.5")
GVF48027/50	142	200	8	236	196	93	50	362	M16 X 130	80 (3")
GVF410026/50	142	220	8	254	214	93	50	380	M16 X 130	100 (4")
GVF12527/50	142	250	8	285	245	93	50	410	M16 X 130	125 (5")
GVF415028/50	142	285	8	321	281	93	50	446	M16 X 130	150 (6")

ALL MEASUREMENTS IN MILLIMETRES UNLESS STATED OTHERWISE.

MATING FLANGES, RUBBER GASKETS & BOLTS ARE NOT SUPPLIED UNLESS SPECIFIED ON ORDER.

8.3.2 Gas Valve- flanged (50mm thick imperial)- large positioning motor



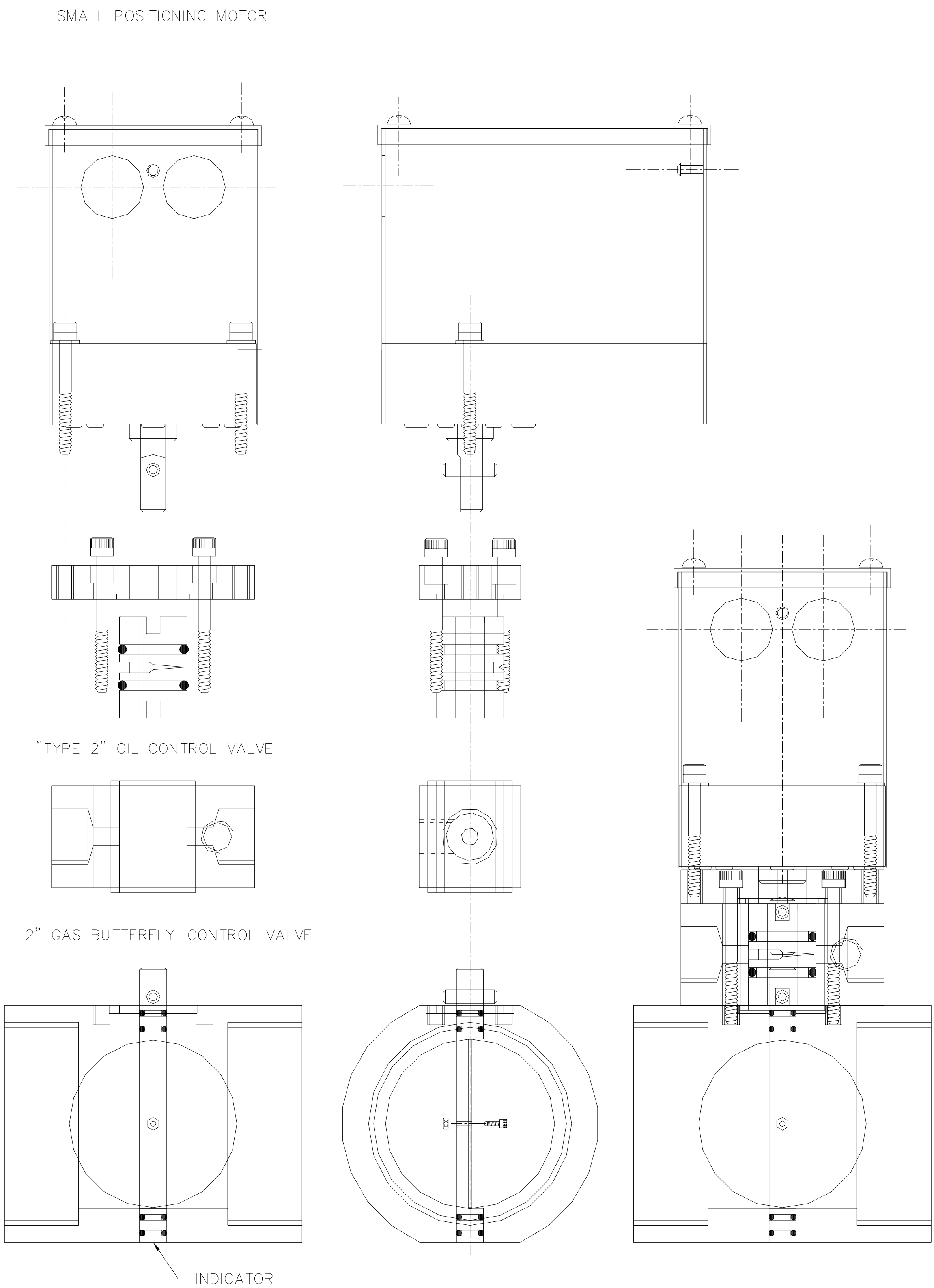
PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/50	4.60"	6"	4	8"	6.25"	3.66"	2"	12.40"	1/2" X 5"	2"
GVF46526/50	4.60"	7"	4	8.6"	7"	3.66"	2"	13.50"	5/8" x 5"	2.5"
GVF48027/50	4.60"	7.5"	4	9.375"	7.75"	3.66"	2"	14.25"	5/8" x 5"	3"
GVF410026/50	4.60"	9"	8	10"	8.5"	3.66"	2"	14.92"	5/8" x 5"	4"
GVF12527/50	4.60"	10"	8	11"	9.75"	3.66"	2"	16.14"	3/4" x 5"	5"
GVF415028/50	4.60"	11"	8	12.5"	11"	3.66"	2"	17.56"	3/4" x 5"	6"

ALL MEASUREMENTS IN IMPERIAL UNLESS STATED OTHERWISE.

MATING FLANGES, RUBBER GASKETS & BOLTS ARE NOT SUPPLIED UNLESS SPECIFIED ON ORDER.

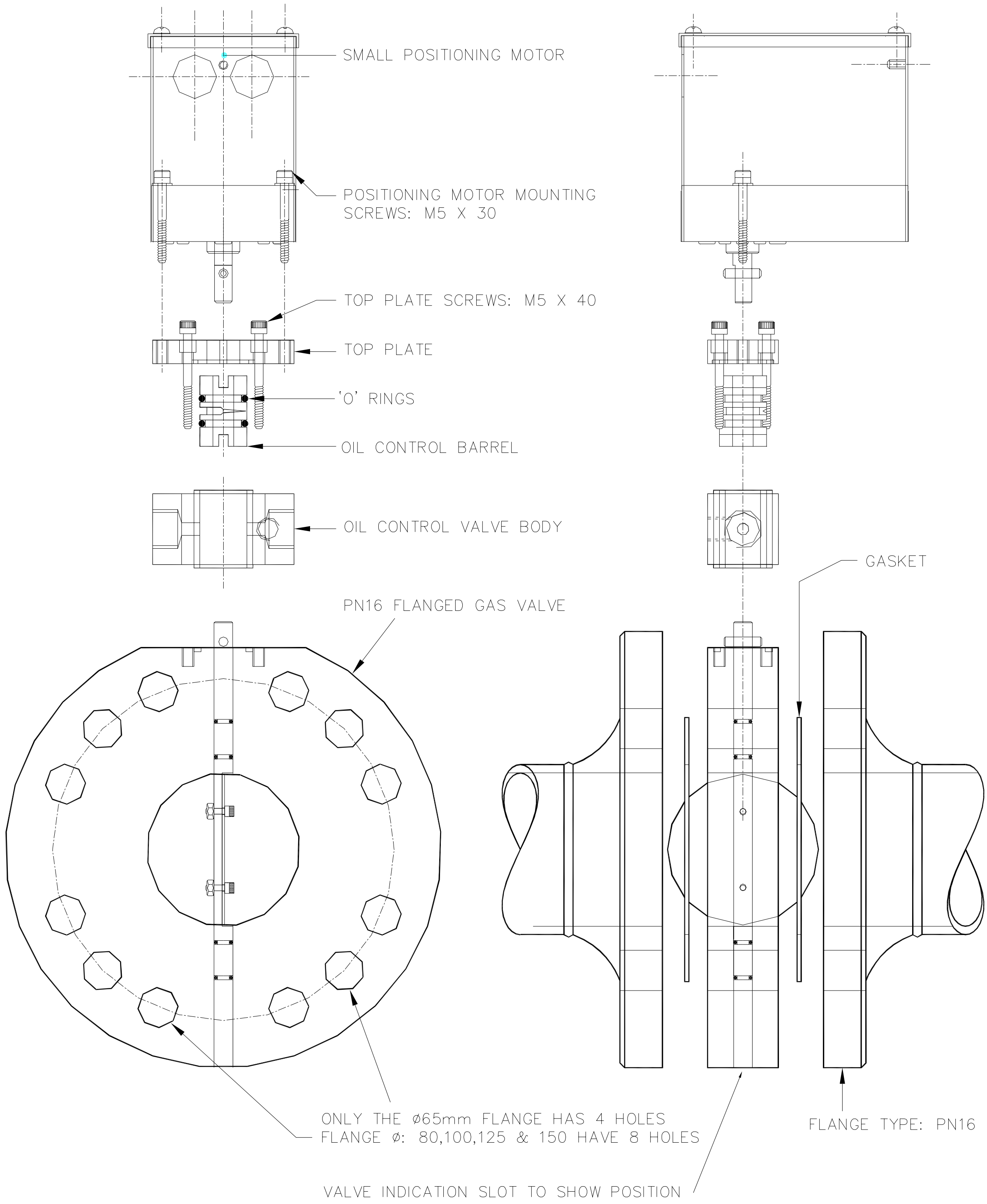
8.3.3 Piggy-back Assembly of gas and oil valve

The example shown below shows the design behind utilising one servomotor for both the gas and the oil valve. This shows a Type 2 oil valve with a 2" threaded gas valve using only one small positioning servomotor.



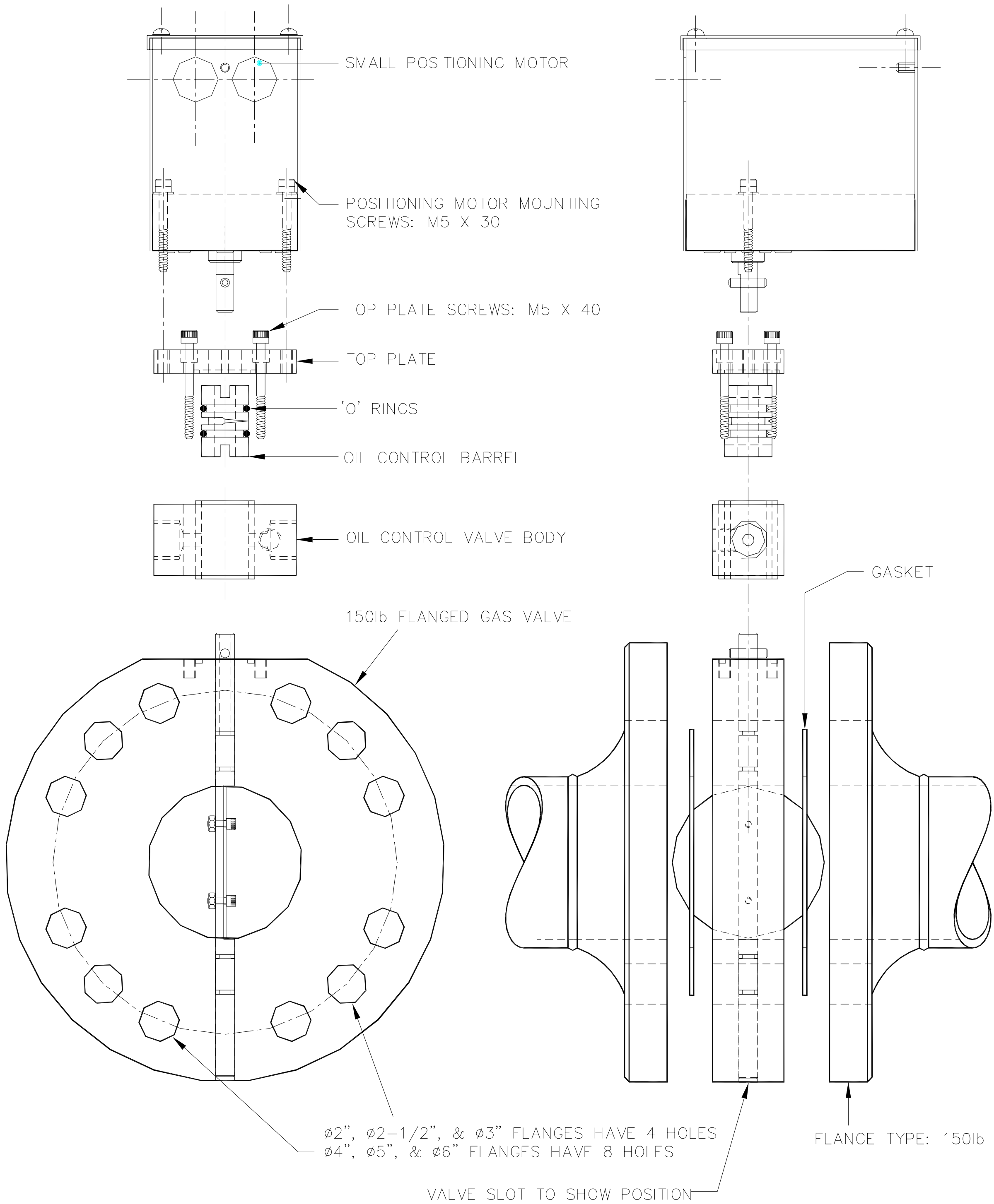
8.3.4 Piggy-back Assembly of gas and oil valve- metric

The example shown below shows the design behind utilising one servomotor for both the gas and the oil valve. This shows a Type 2 oil valve with a flanged gas valve using only one small positioning servomotor.

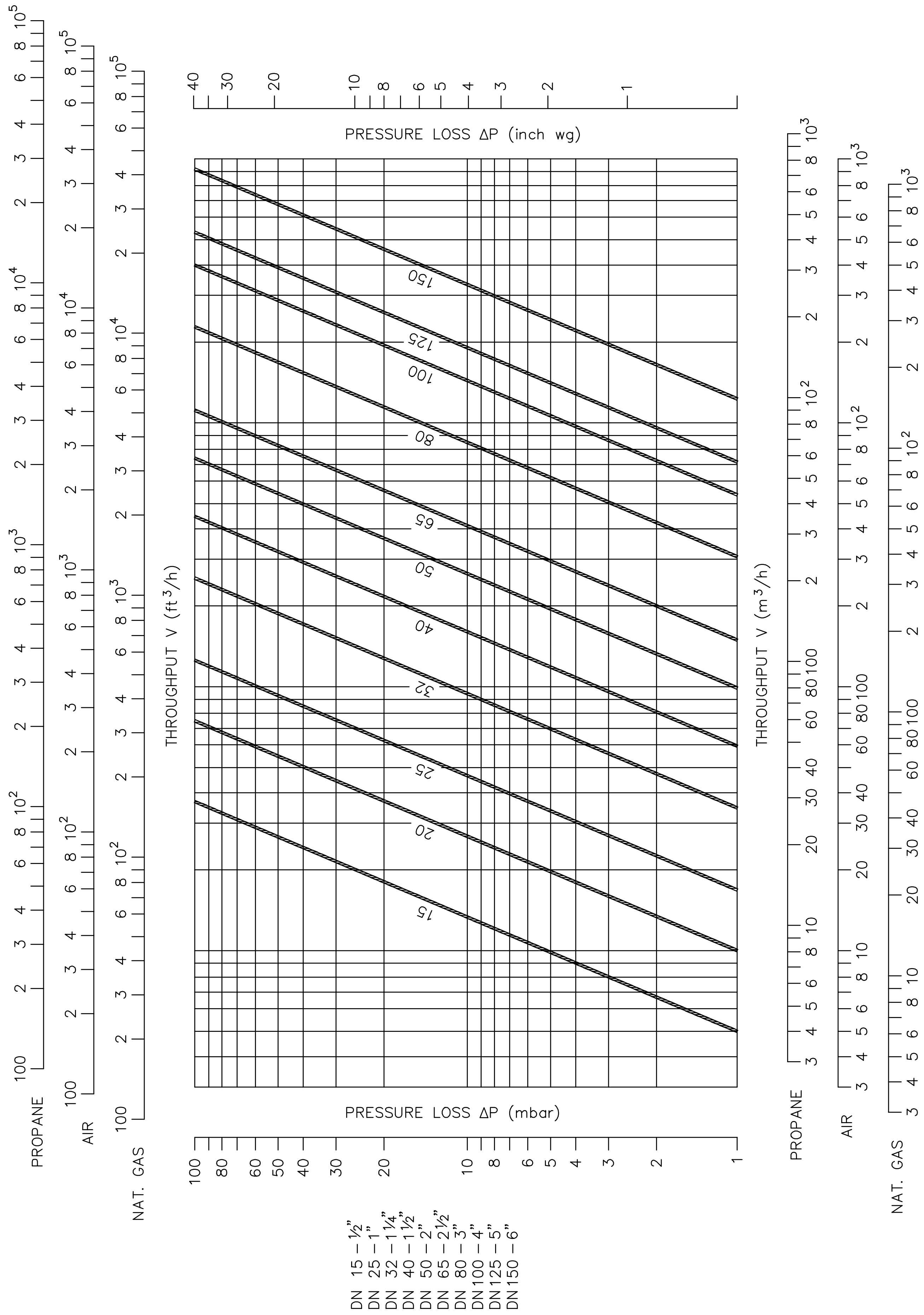


8.3.5 Piggy-back Assembly of gas and oil valve- imperial

The example shown below shows the design behind utilising one servomotor for both the gas and the oil valve. This shows a Type 2 oil valve with a flanged gas valve using only one small positioning servomotor.



8.3.6 Autoflame Butterfly valve flow data (valve sizing)

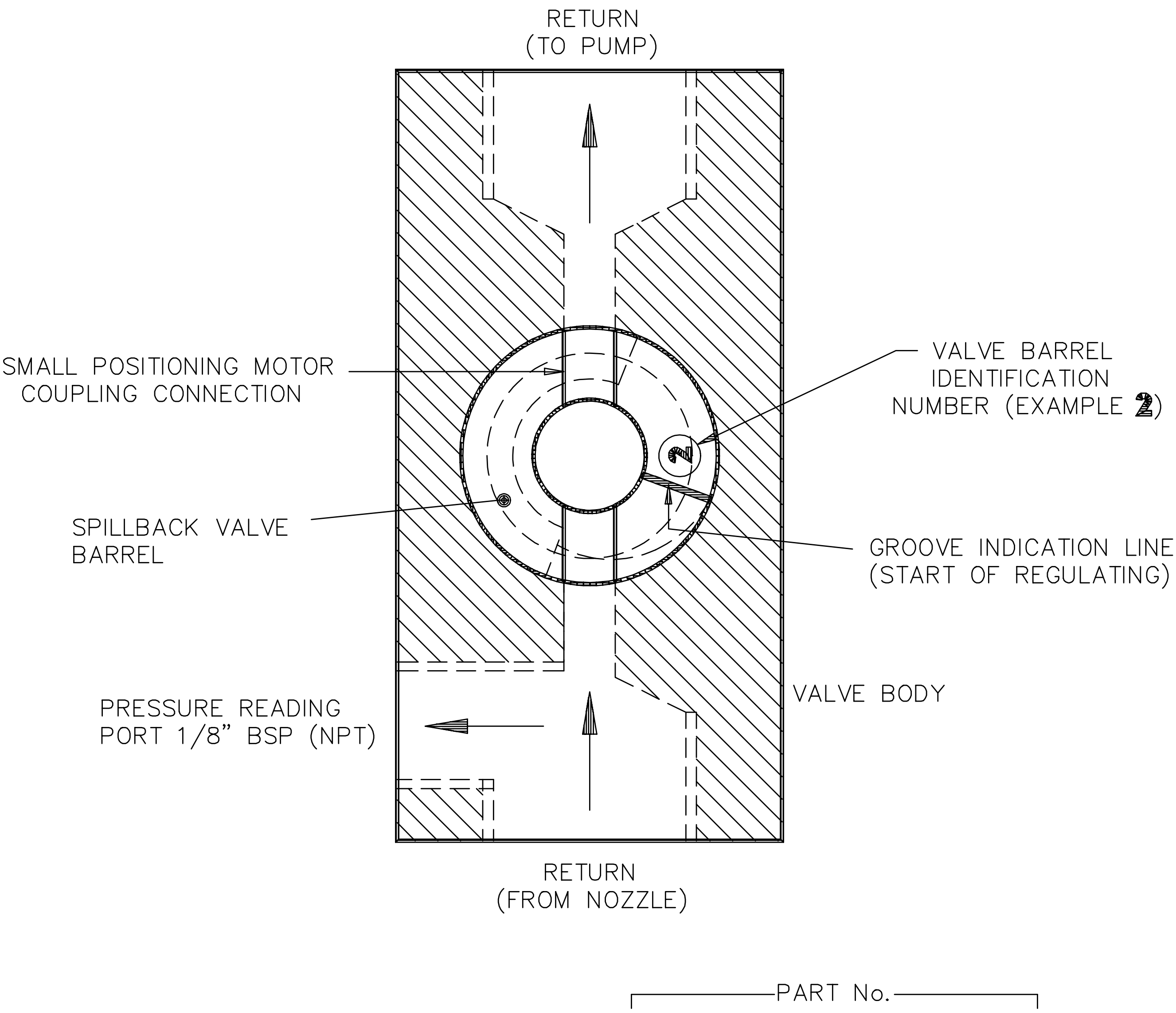


8.4 Oil Control Valves

All of the Autoflame oil valves (types 1-9) can be supplied as metering/simplex or spillback/bypass. There are eighteen different oil valves available, nine metering and nine spillback valves. Each valve has different flow charcteristics as shown in this section of the manual. It is important to ensure the correct oil valve selection for the application, otherwise the correct input and turndown available for the burner will not be met.

When using the oil control valve for a dual fuel application, i.e. gas and oil, and if the valves are to be piggy-backed, then the bottom aluminium plate of the oil valve must be removed for assembly with the gas control valve as in section 8.3.3.

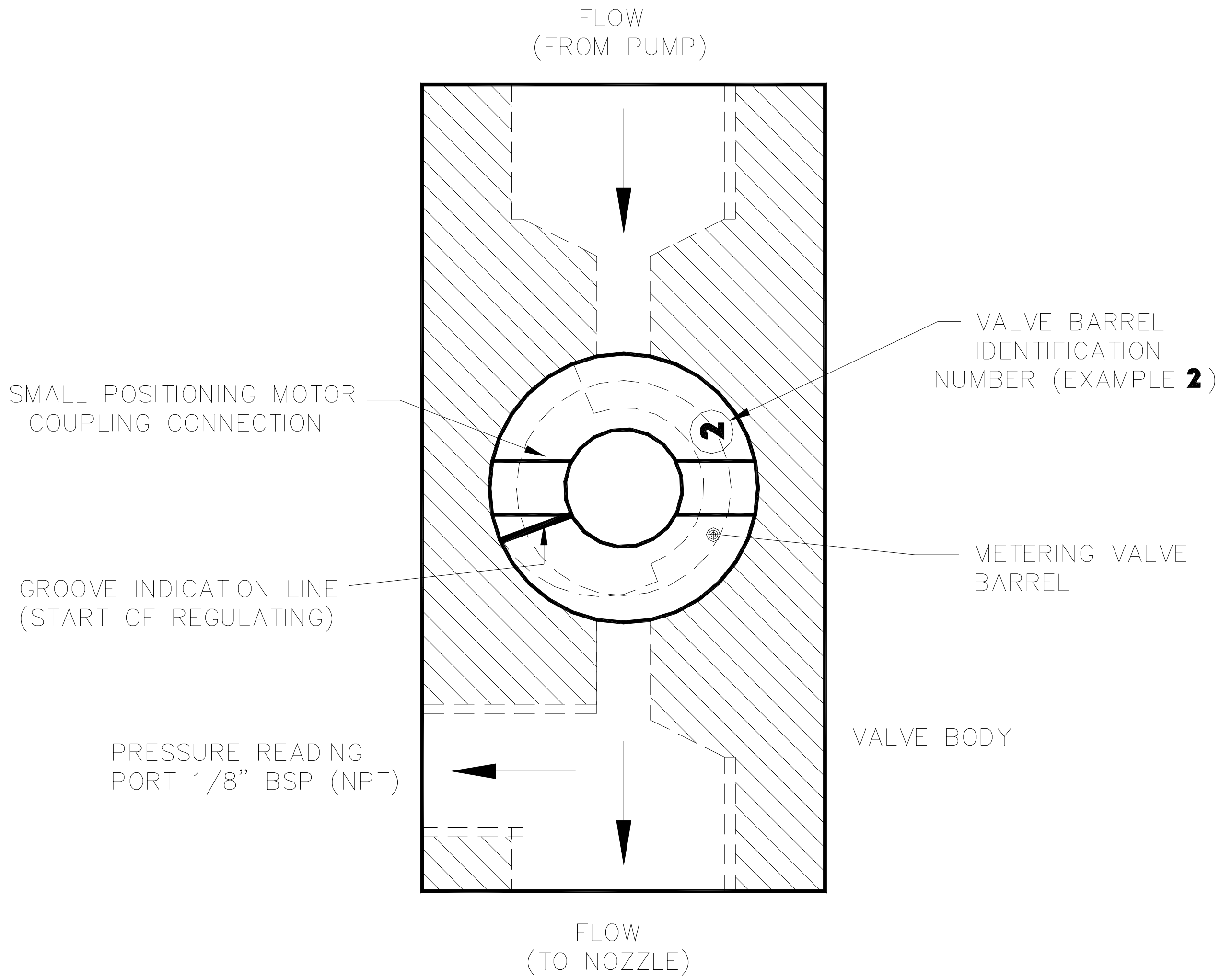
8.4.1 Spillback/bypass application



VALVE TYPE	PIPE THREAD	PART No. SPILLBACK	PART No. METERING
1	1/4" BSP.	OVS31015	OVM31015
2	3/8" BSP.	OVS32016	OVM32016
5	3/8" BSP.	OVS35019	OVM35019
6	3/8" BSP.	OVS36020	OVM36020
8	3/8" BSP.	OVS38022	OVM38022
9	3/8" BSP.	OVS39023	OVM39023

8.4.2 Metering/simplex application

The metering valves are identifiable by the prefix OVM whereas the spillback valves have the prefix OVS.



VALVE TYPE	PIPE THREAD	METERING PART NUMBER
1	1/4" BSP.	OVM31015
2	3/8" BSP.	OVM32016
5	3/8" BSP.	OVM35019
6	3/8" BSP.	OVM36020
8	3/8" BSP.	OVM38022
9	3/8" BSP.	OVM39023

For the small oil control valves, types 1/2/5/6/8/9, they have the following dimensions:

Height: 50mm (2") including bottom plate
Width: 30mm (1.125")
Length: 60mm (2.375")

The small oil control valves use a small servomotor for positioning control.

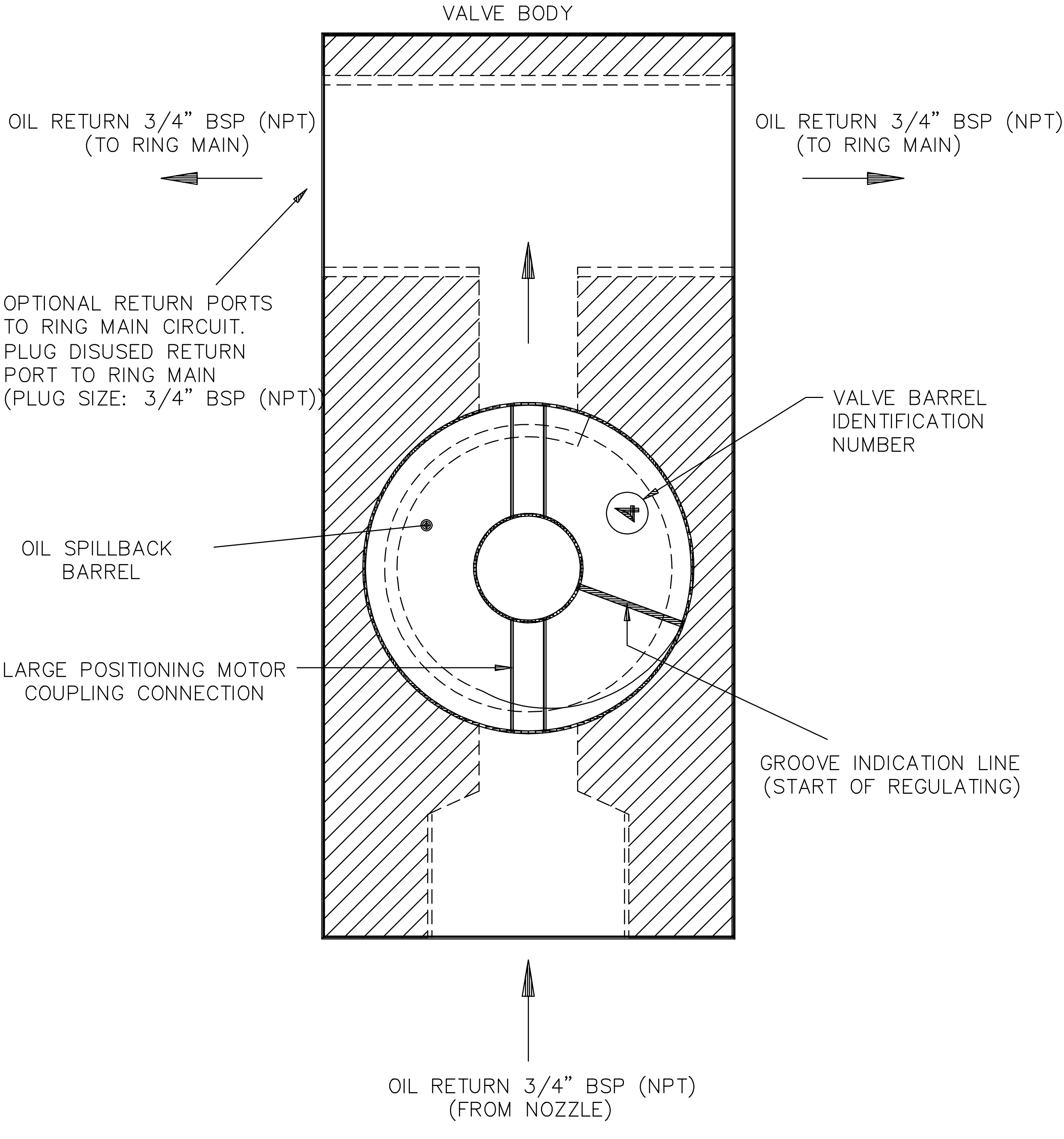
8.5 Large oil valve

For the large oil control valves, types 3/4/7, they have the following dimensions:

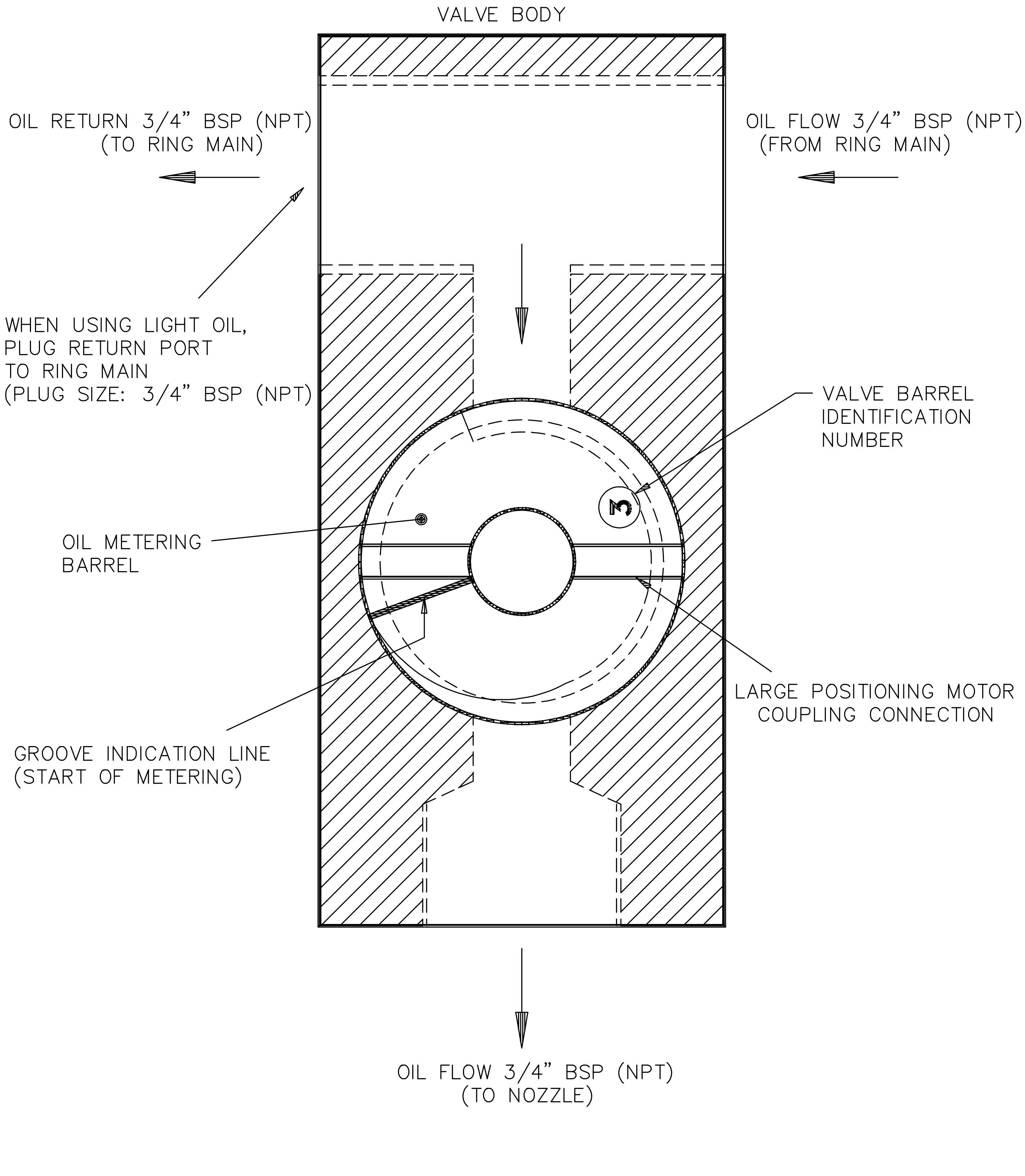
Height: 70mm (3") including bottom plate
Width: 50mm (2")
Length: 110mm (4.375")

The large oil control valves use a large servomotor for positioning control.

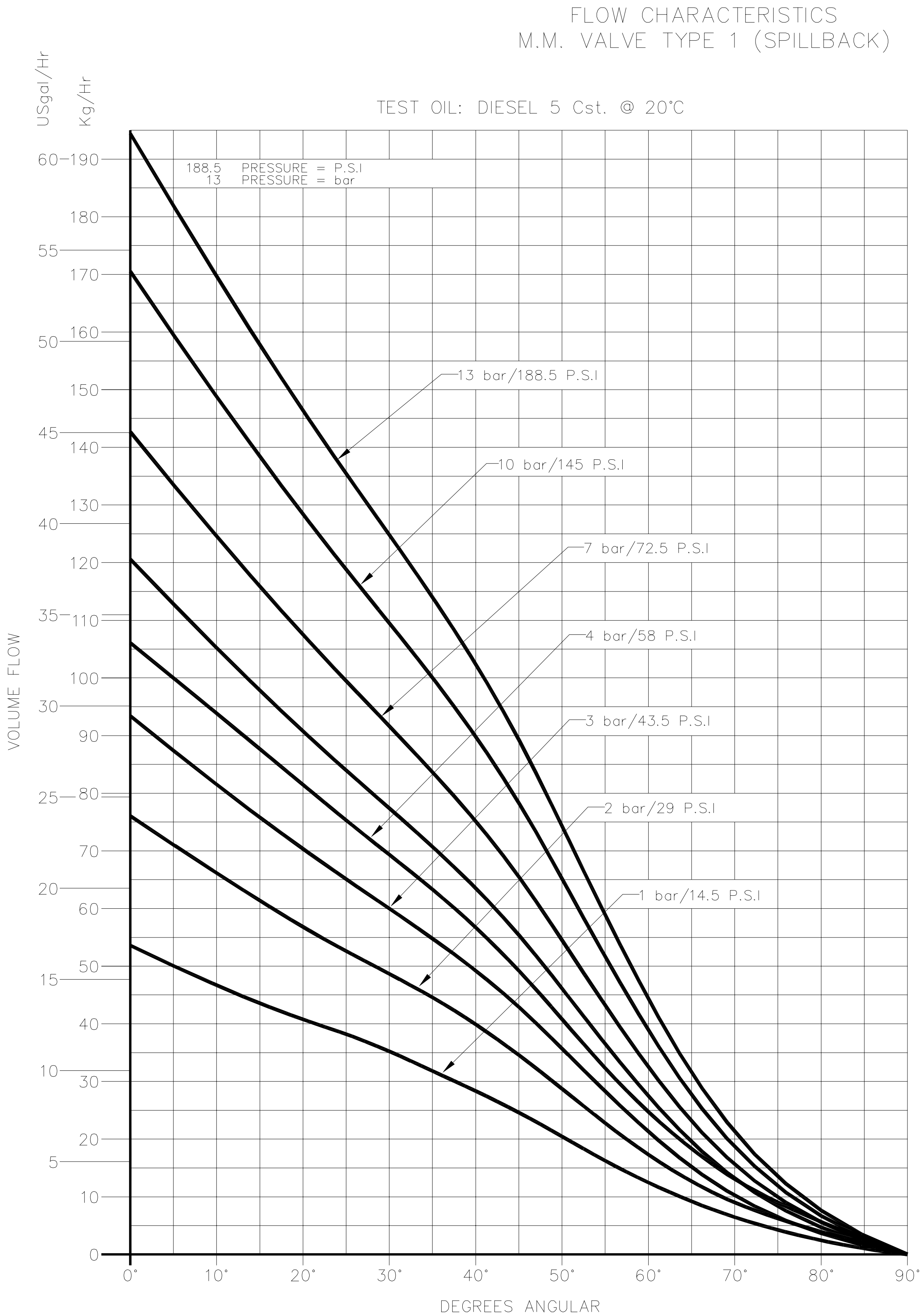
8.5.1 Spillback/bypass application

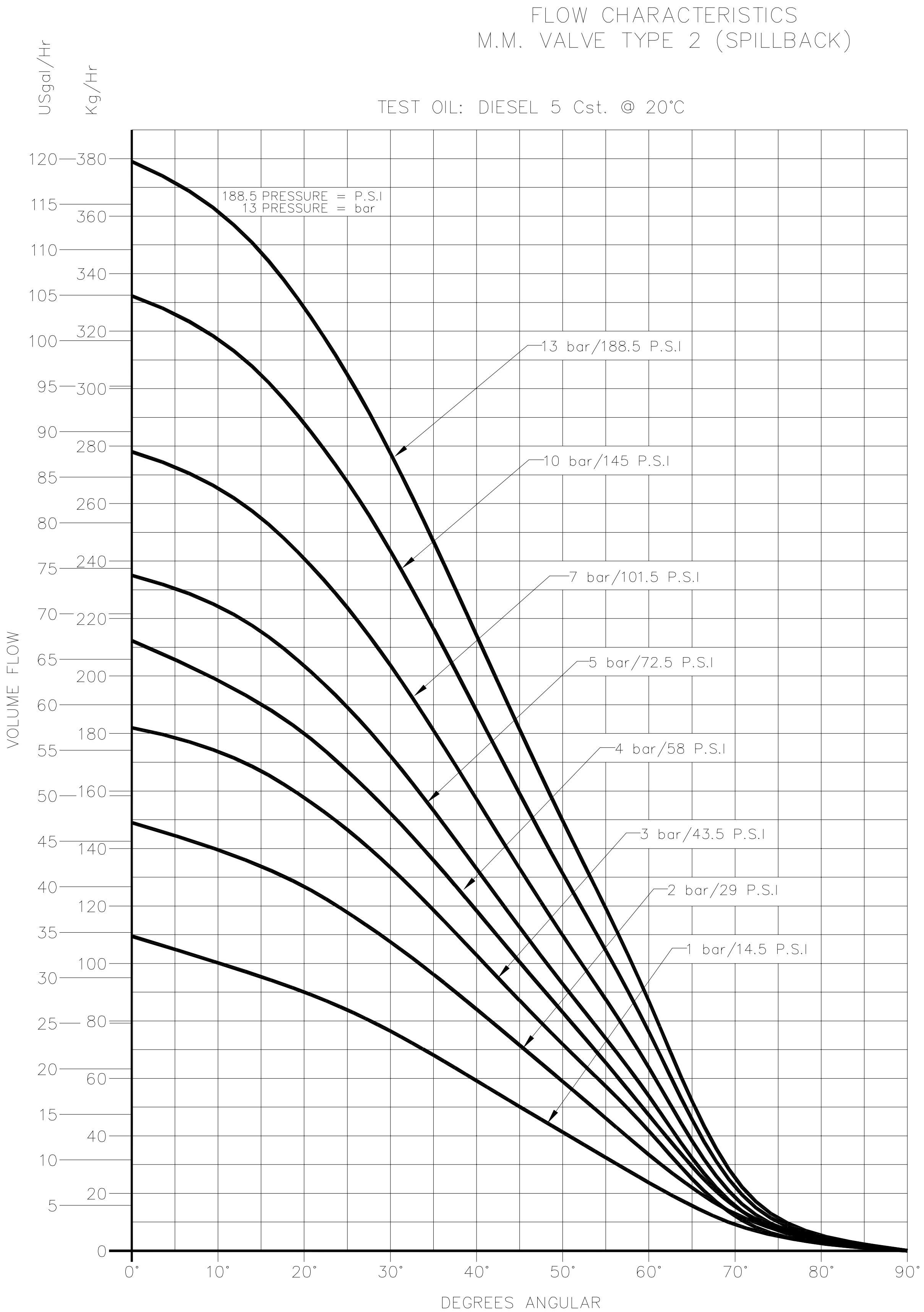


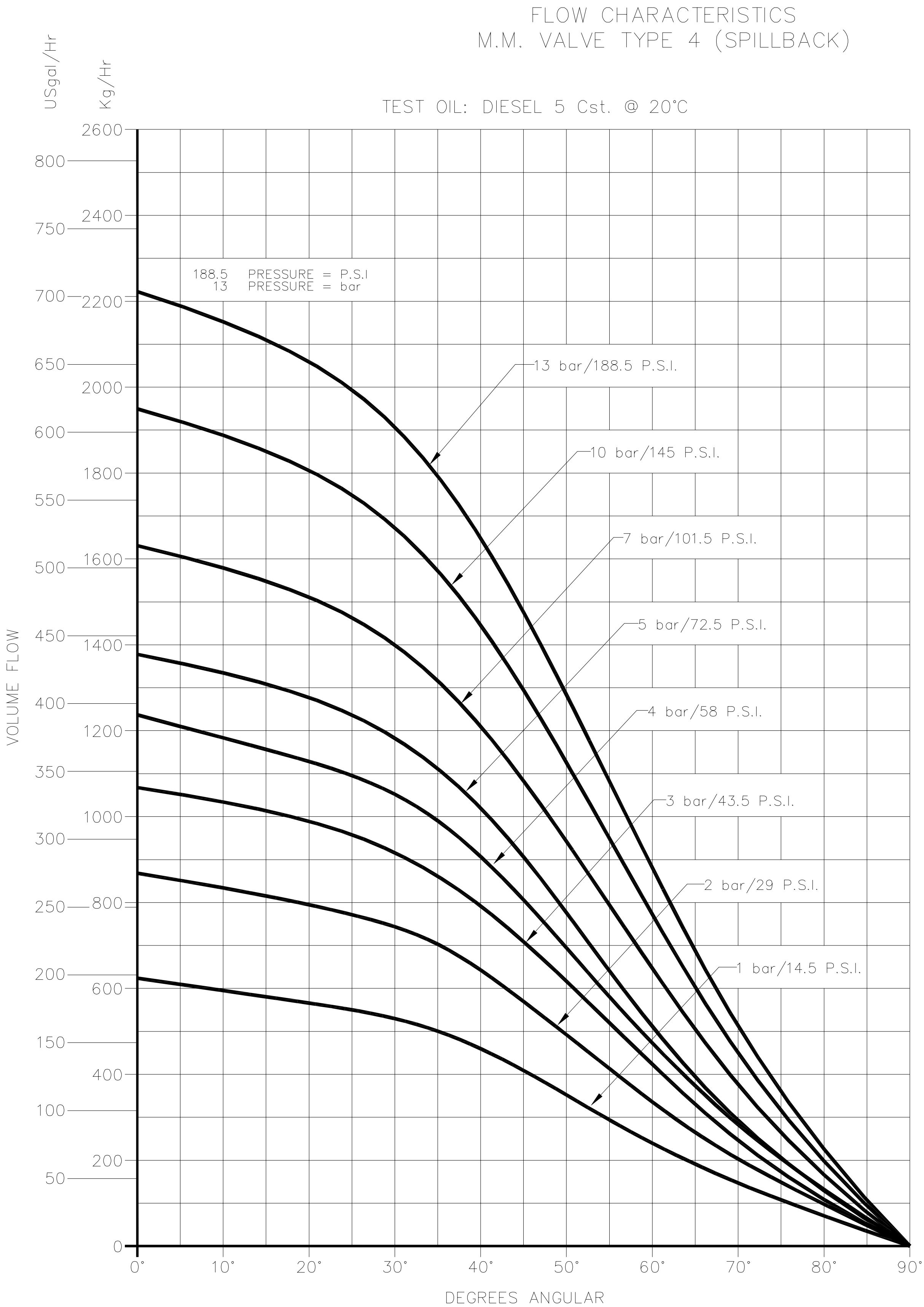
8.5.2 Metering/simplex application

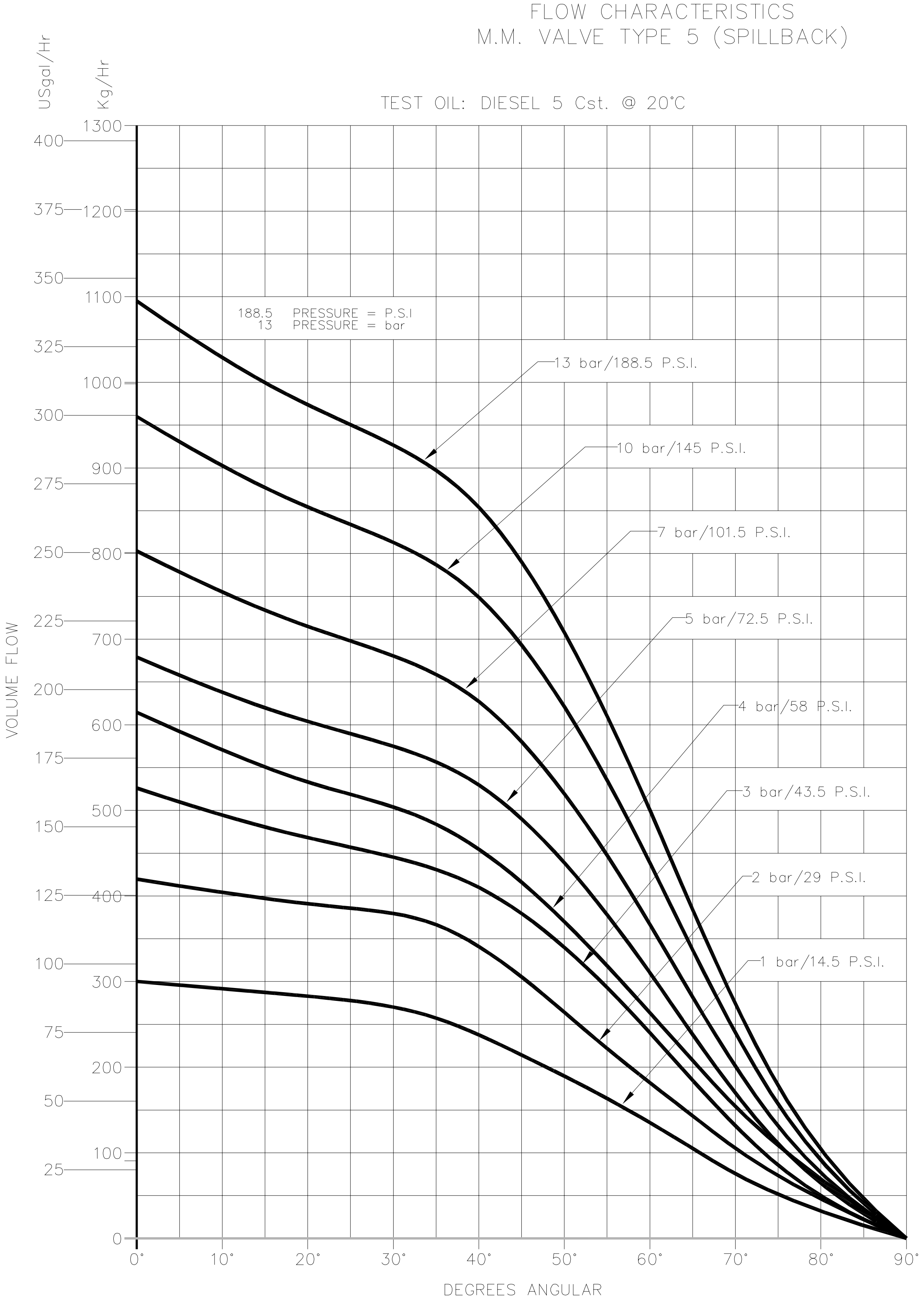


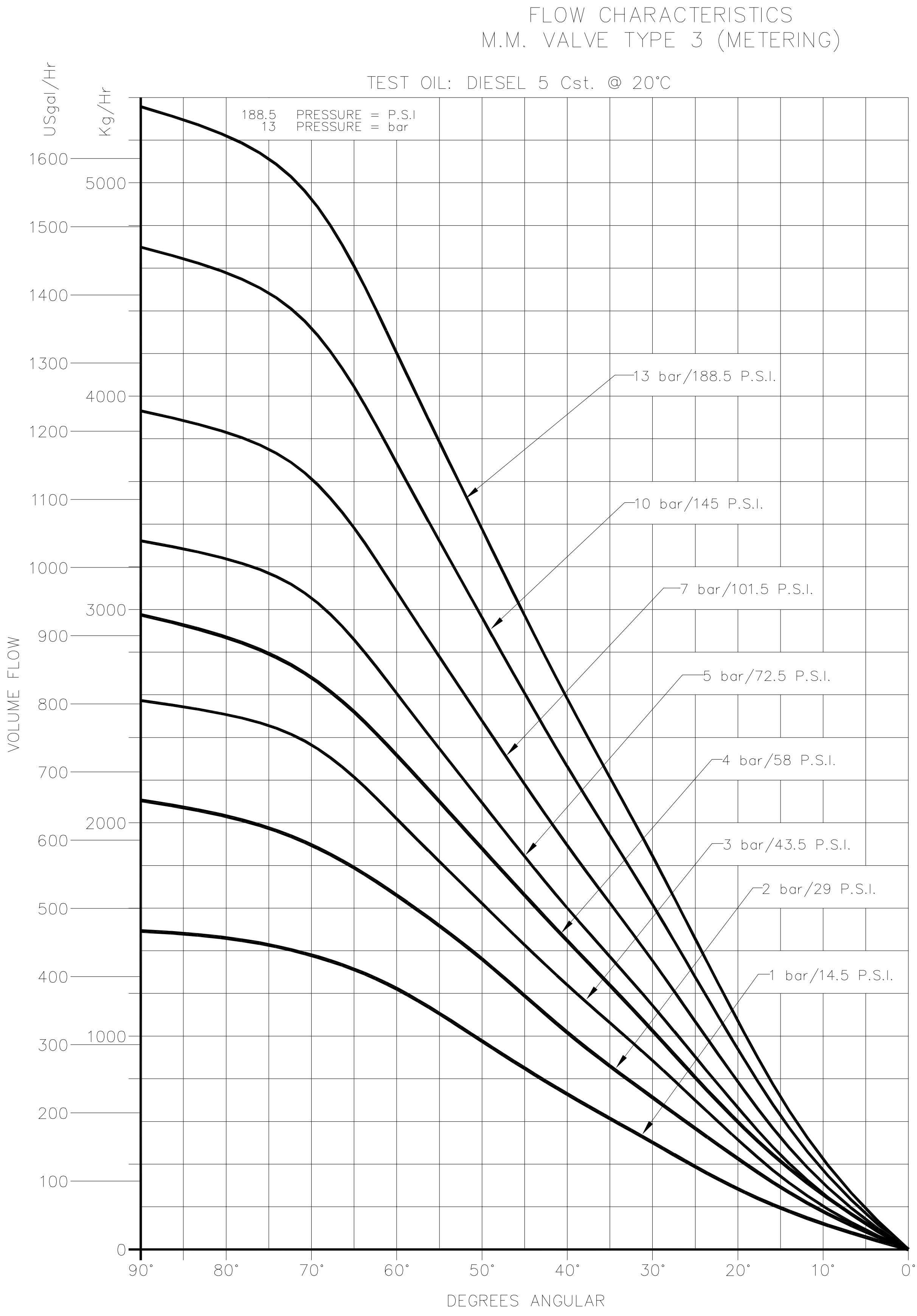
8.6 Oil Valve flow characteristics

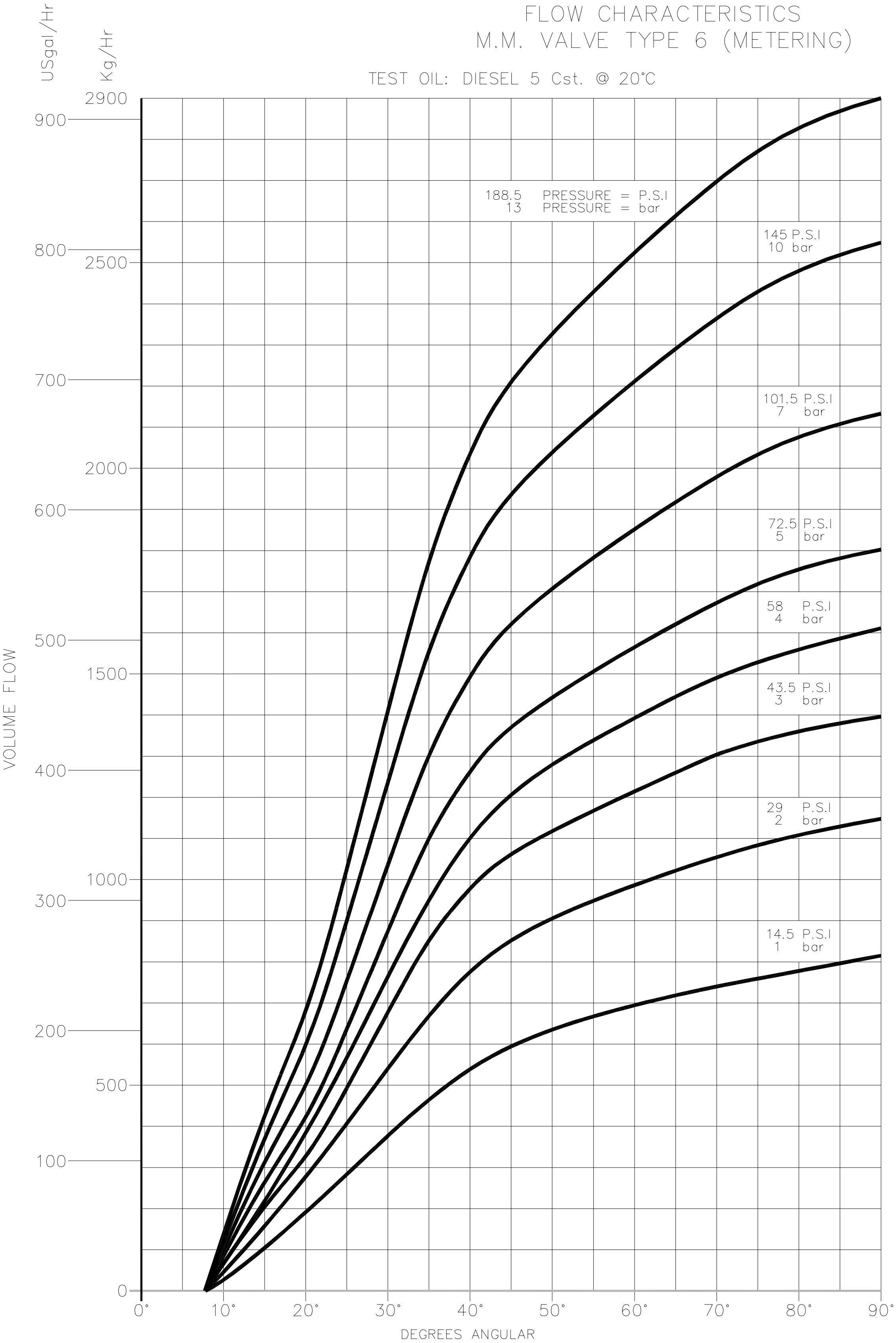


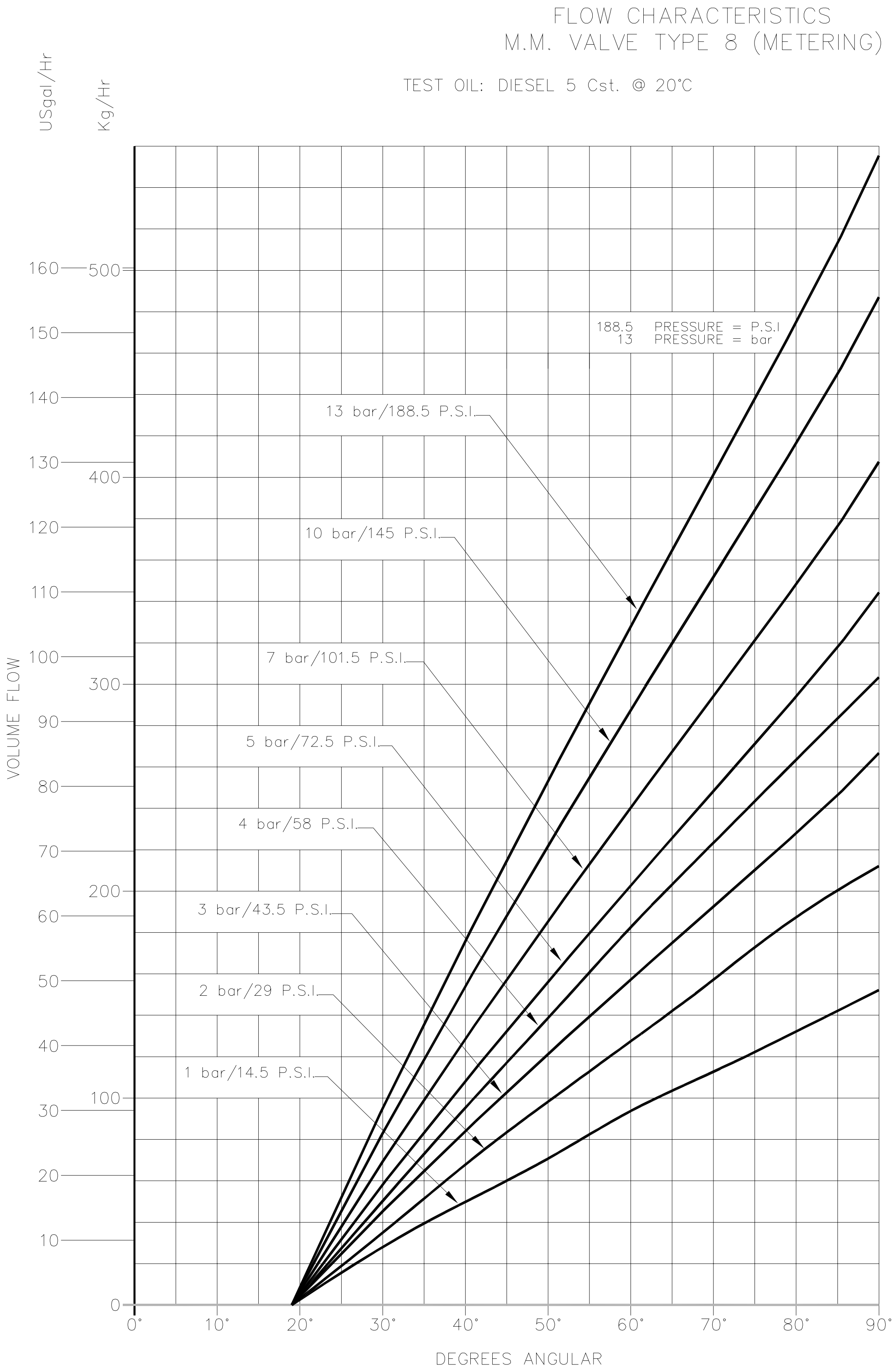

FLOW CHARACTERISTICS
M.M. VALVE TYPE 2 (SPILLBACK)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
VOLUME FLOW
DEGREES ANGULAR
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
13 bar/188.5 P.S.I
10 bar/145 P.S.I
7 bar/101.5 P.S.I
5 bar/72.5 P.S.I
4 bar/58 P.S.I
3 bar/43.5 P.S.I
2 bar/29 P.S.I
1 bar/14.5 P.S.I
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°


FLOW CHARACTERISTICS
M.M. VALVE TYPE 4 (SPILLBACK)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
VOLUME FLOW
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
13 bar/188.5 P.S.I.
10 bar/145 P.S.I.
7 bar/101.5 P.S.I.
5 bar/72.5 P.S.I.
4 bar/58 P.S.I.
3 bar/43.5 P.S.I.
2 bar/29 P.S.I.
1 bar/14.5 P.S.I.
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800
200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°
DEGREES ANGULAR

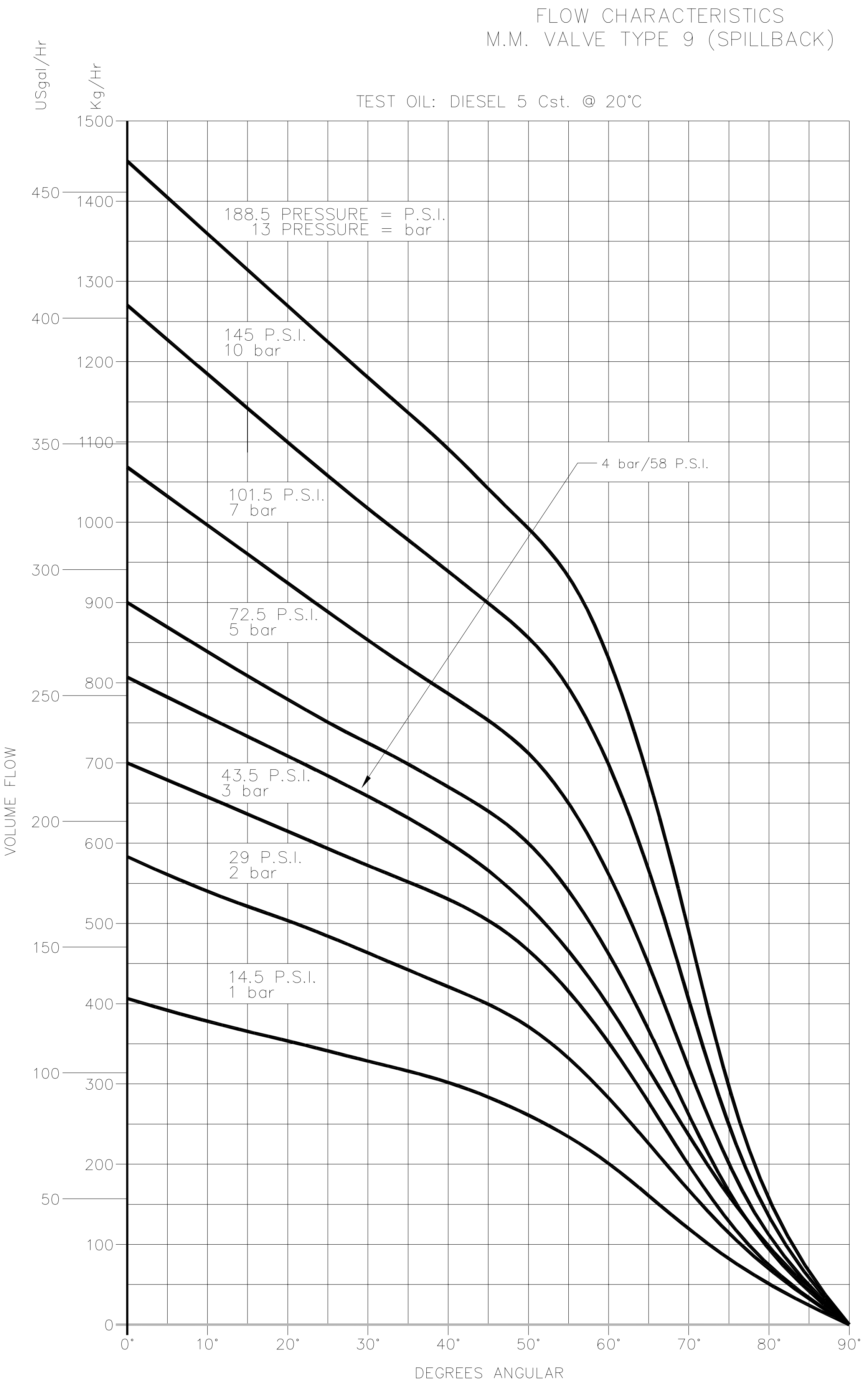

FLOW CHARACTERISTICS
M.M. VALVE TYPE 5 (SPILLBACK)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
VOLUME FLOW
DEGREES ANGULAR
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
13 bar/188.5 P.S.I.
10 bar/145 P.S.I.
7 bar/101.5 P.S.I.
5 bar/72.5 P.S.I.
4 bar/58 P.S.I.
3 bar/43.5 P.S.I.
2 bar/29 P.S.I.
1 bar/14.5 P.S.I.
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°


FLOW CHARACTERISTICS
M.M. VALVE TYPE 3 (METERING)
TEST OIL: DIESEL 5 Cst. @ 20°C
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
USgal/Hr
Kg/Hr
VOLUME FLOW
13 bar/188.5 P.S.I.
10 bar/145 P.S.I.
7 bar/101.5 P.S.I.
5 bar/72.5 P.S.I.
4 bar/58 P.S.I.
3 bar/43.5 P.S.I.
2 bar/29 P.S.I.
1 bar/14.5 P.S.I.
DEGREES ANGULAR

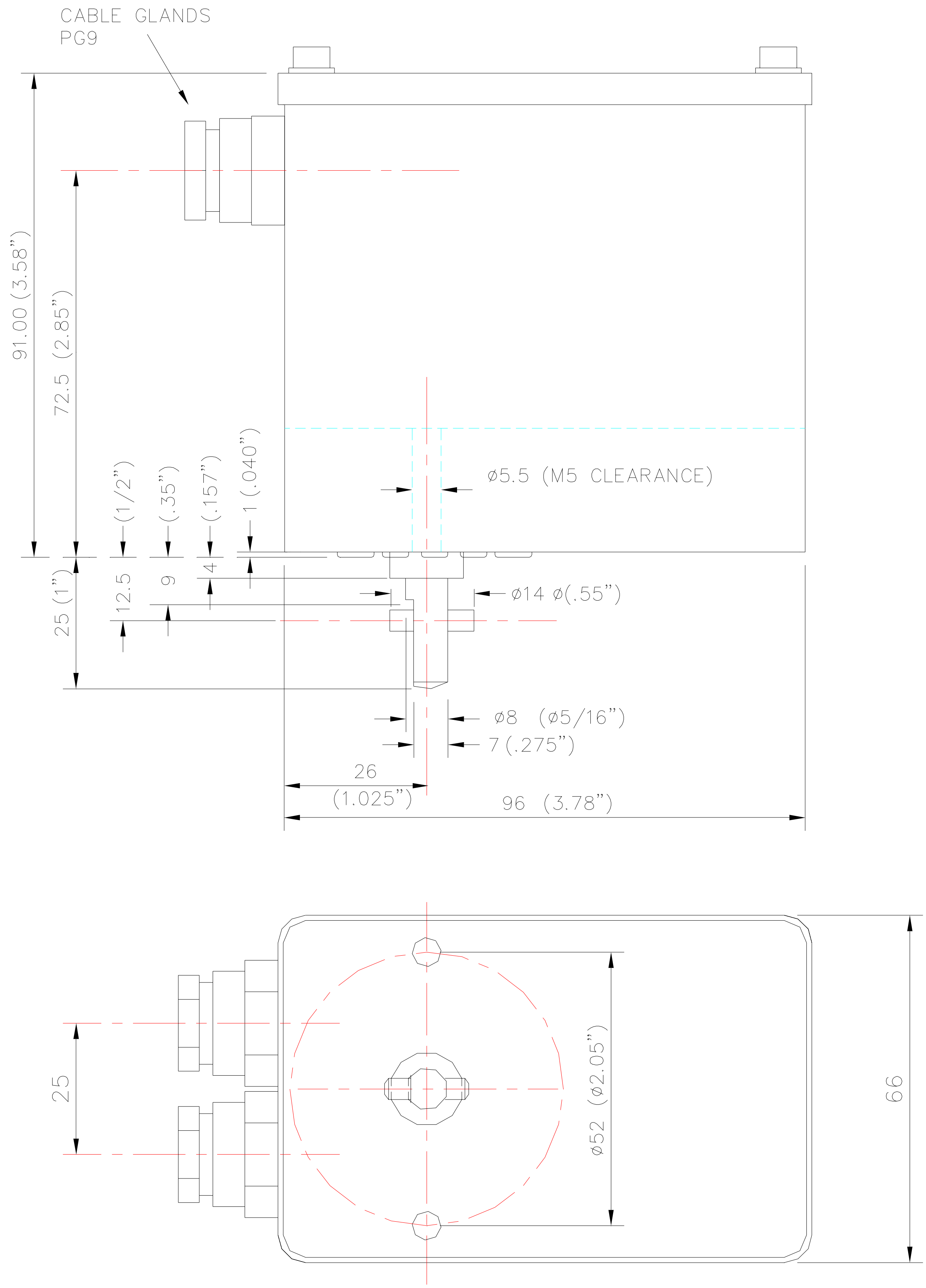

FLOW CHARACTERISTICS
M.M. VALVE TYPE 6 (METERING)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
VOLUME FLOW
2900
900
800
2500
700
2000
600
500
1500
400
1000
300
200
500
100
0
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
145 P.S.I
10 bar
101.5 P.S.I
7 bar
72.5 P.S.I
5 bar
58 P.S.I
4 bar
43.5 P.S.I
3 bar
29 P.S.I
2 bar
14.5 P.S.I
1 bar
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
DEGREES ANGULAR



FLOW CHARACTERISTICS
M.M. VALVE TYPE 8 (METERING)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
188.5 PRESSURE = P.S.I
13 PRESSURE = bar
13 bar/188.5 P.S.I.
10 bar/145 P.S.I.
7 bar/101.5 P.S.I.
5 bar/72.5 P.S.I.
4 bar/58 P.S.I.
3 bar/43.5 P.S.I.
2 bar/29 P.S.I.
1 bar/14.5 P.S.I.
VOLUME FLOW
DEGREES ANGULAR
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
100 200 300 400 500


FLOW CHARACTERISTICS
M.M. VALVE TYPE 9 (SPILLBACK)
TEST OIL: DIESEL 5 Cst. @ 20°C
USgal/Hr
Kg/Hr
VOLUME FLOW
DEGREES ANGULAR
188.5 PRESSURE = P.S.I.
13 PRESSURE = bar
145 P.S.I.
10 bar
101.5 P.S.I.
7 bar
72.5 P.S.I.
5 bar
4 bar/58 P.S.I.
43.5 P.S.I.
3 bar
29 P.S.I.
2 bar
14.5 P.S.I.
1 bar
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
450
400
350
300
250
200
150
100
50
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°

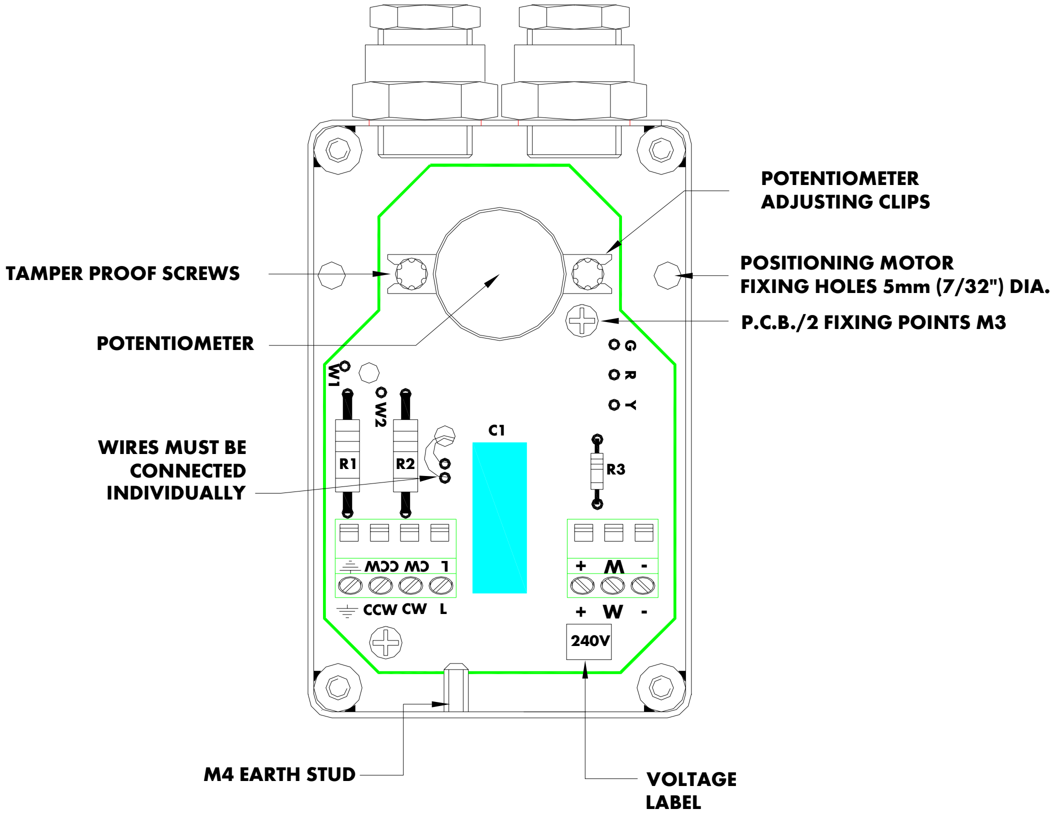
8.7 Small Positioning Servomotor- part number MM10005



Note:

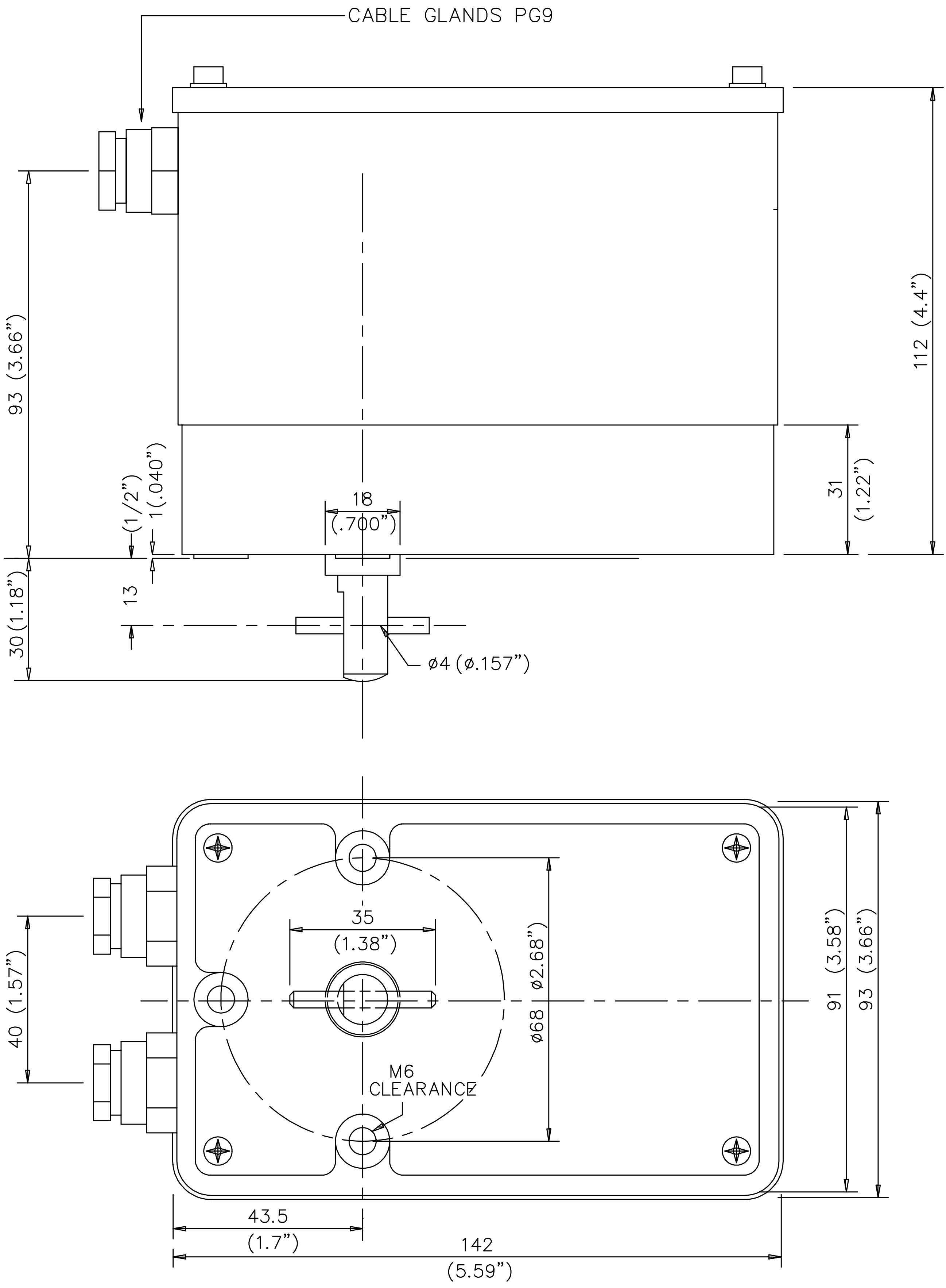
The Autoflame product must only be installed, set-up, commissioned and adjusted by an Autoflame certified technical engineer.

To adjust the potentiometer loosen the tamper proof screws using a tamper proof screwdriver as supplied by Autoflame Engineering. After adjustment, ensure tightness but do not overtighten. Use fingers only to adjust the position of the potentiometer. Do not raise the potentiometer from the PCB.



Specification	
Supply Voltage	24/230V, 50/60Hz
Output Shaft Torque	1.2Nm / 0.89 ft lbs
Operating Angle	0-90°
Operating Time	Nominal 20 seconds
Max Rated Power	3W
Ambient Temperature	0°C to 60°C / 32°F to 140°F
Industrial Protection Rating	IP54 / NEMA 13
Mounting Angle	360°
Positioning	MM Drive
Drive Motor	Synchronous
Body Material	Mild Steel CR4
Coating	Interpon 700 Powder Coat
Weight	0.55kg
Dimensions	99x92x64mm
Wiring Connection	PG11 Gland

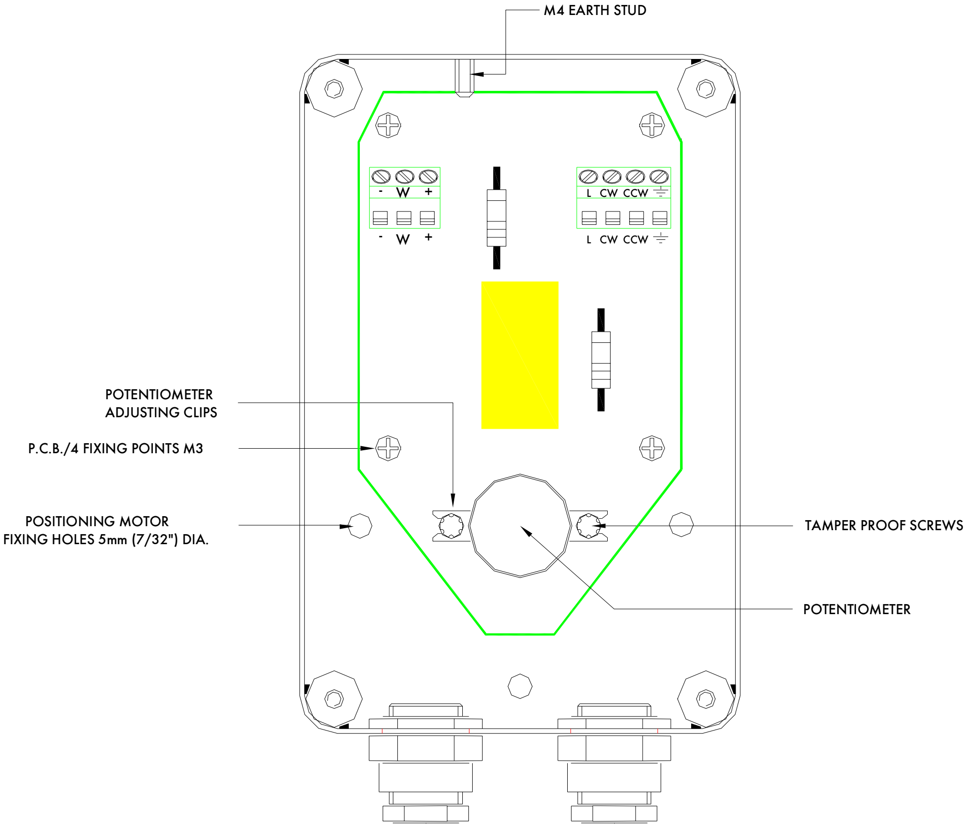
8.8 Large Positioning Servomotor- part number MM10004



Note:

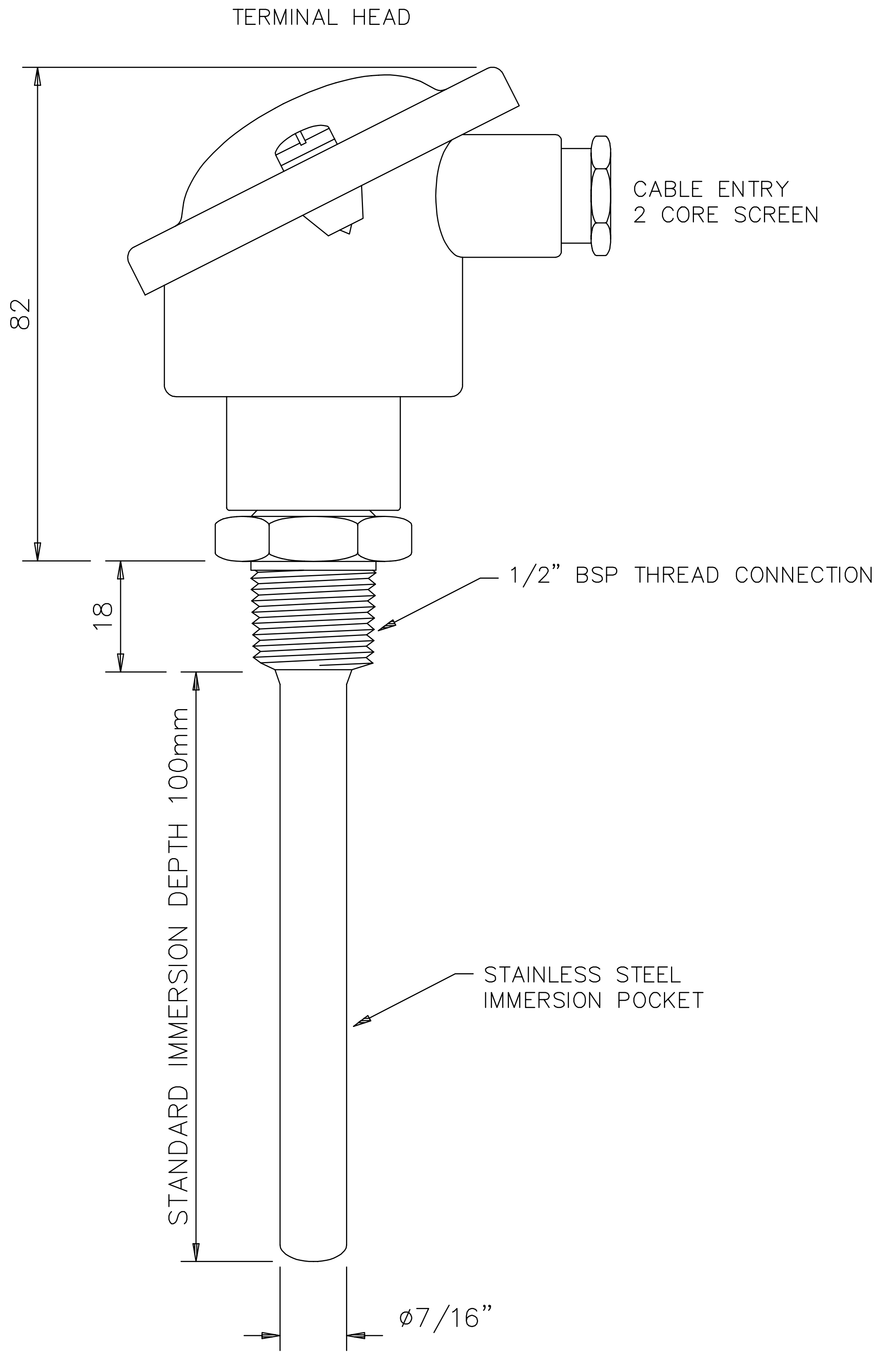
The Autoflame product must only be installed, set-up, commissioned and adjusted by an Autoflame certified technical engineer.

To adjust the potentiometer loosen the tamper proof screws using a tamper proof screwdriver as supplied by Autoflame Engineering. After adjustment, ensure tightness but do not overtighten. Use fingers only to adjust the position of the potentiometer. Do not raise the potentiometer from the PCB.



Specification	
Supply Voltage	24/230V, 50/60Hz
Output Shaft Torque	15Nm / 11 ft lbs
Operating Angle	0-90°
Operating Time	Nominal 30 seconds
Max Rated Power	9W
Ambient Temperature	0°C to 60°C / 32°F to 140°F
Industrial Protection Rating	IP54 / NEMA 13
Mounting Angle	360°
Positioning	MM Drive
Drive Motor	Synchronous
Body Material	Mild Steel CR4
Coating	Interpon 700 Powder Coat
Weight	1.85kg
Dimensions	145x112x94
Wiring Connection	PG11 Gland

8.9 Boiler Water Temperature Sensor- part number MM10006



8.10 Industrial Servomotor

Overview/Outline

This system is a rotary type electric actuator, suitable for use with the M.M. module.

The body is made with aluminium die-cast, thus it is light, compact, highly efficient and powerful.

Features

Light and compact.

Easy to handle and suitable for use in narrow spaces.

Simple structure design.

Trouble free mounting on air damper, maintenance and testing.

Manual operation function by crank handle supplied with the servomotor.
Manual operation is only possible when the power is disconnected, with the attached manual crank handle. If manual operation is performed whilst the unit has power this will cause damage.

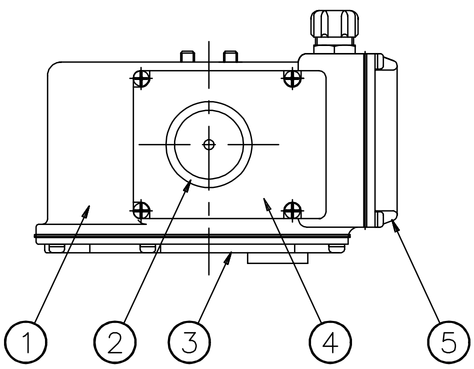
Protect function.
Thermal protector is built-in to prevent motor burn out by overloading.

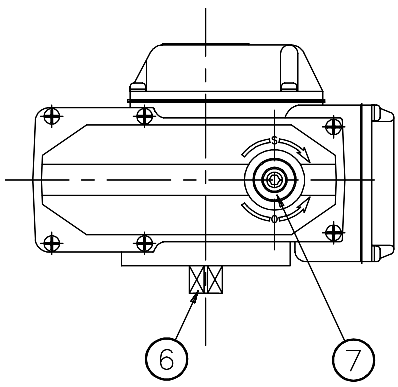
Easy for wiring.
Connection is simplified by a terminal block inside.

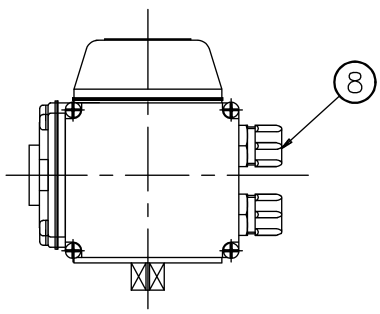
8.10.1 External Drawings

Appearance and Nomenclature

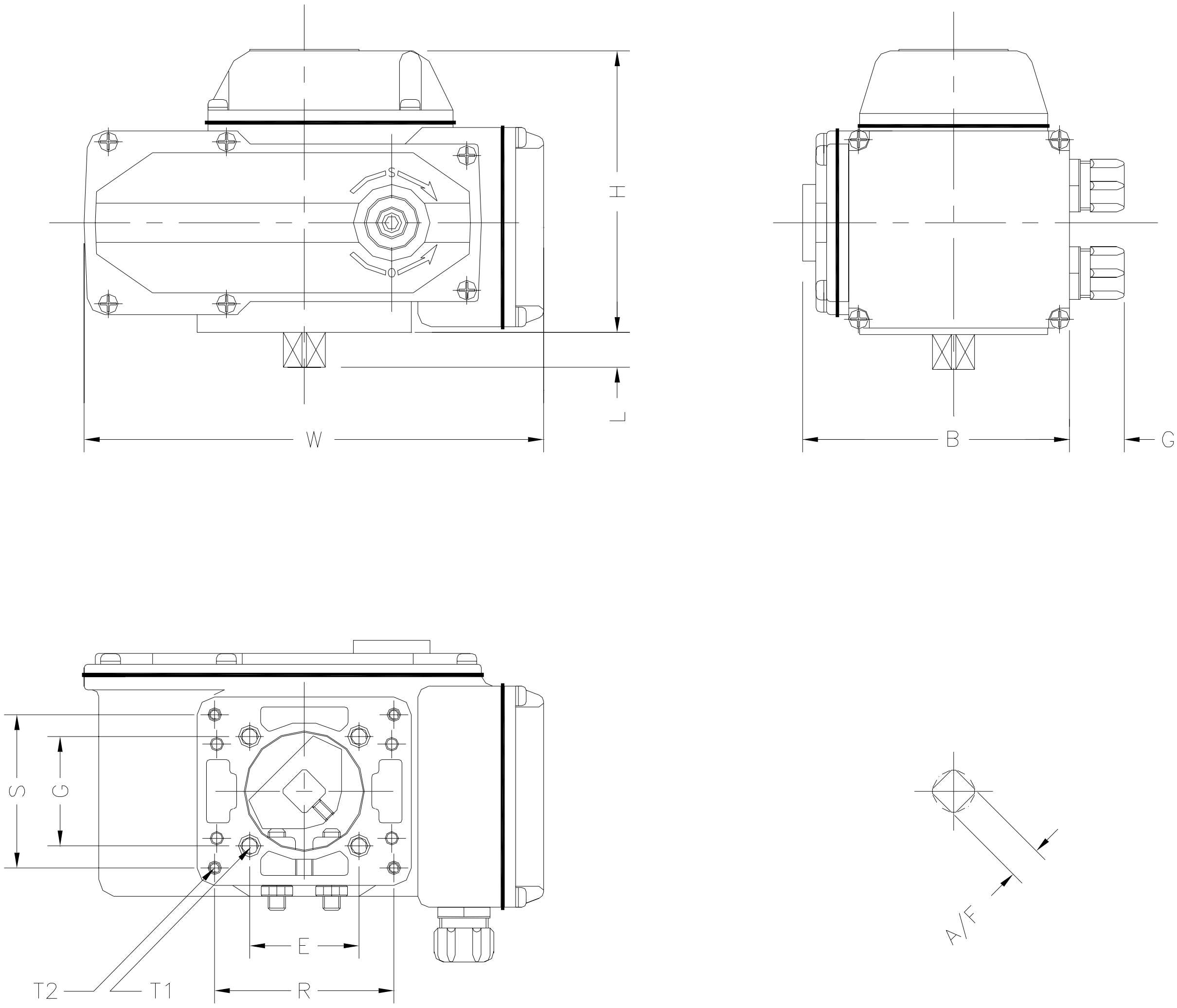
No	Name
1	Body
2	Autoflame feedback potentiometer
3	Drive unit cover
4	Power instruments cover
5	Control unit/terminal strip cover
6	Output shaft
7	Manual handle shaft
8	Cord lock for conduit connection







8.10.1.2 Dimensions



Metric Units:

Part Number	Torque	Dimensions			Shaft Dimensions		Mounting Detail Dimensions			
	Nm	W	H	B	L	A/F	R	S	T1	T2
MM10070	40	159	111	115	12	12	68	60	M8	M6
MM10072	98	208	137	123	16.5	15	82	70	M8	M6
MM10074	200	257	145	157	26.5	23	118	84	M10	M10
MM10078	400	257	145	157	26.5	23	118	84	M10	M10

Imperial Units:

Part Number	Torque	Dimensions			Shaft Dimensions		Mounting Detail Dimensions			
	ft lbs	W	H	B	L	A/F	R	S	T1	T2
MM10070	37	6.26	4.37	4.53	0.47	0.47	2.68	2.36	M8	M6
MM10072	72	8.19	5.39	4.84	0.65	0.59	3.23	2.76	M8	M6
MM10074	148	10.12	5.71	6.18	1.04	0.91	4.65	3.31	M10	M10
MM10078	295	10.12	5.71	6.18	1.04	0.91	4.65	3.31	M10	M10

8.10.2 Specification

Item	Specification
Power	220/240VAC 50/60Hz 110VAC 60Hz
Output Shaft Torque	MM10070- 40Nm (37ft lbs) MM10072- 98Nm (72 ft lbs) MM10074- 200Nm (148ft lbs) MM10078- 400Nm (295ft lbs)
Operating Angle	0-90 degrees
Operating Time	15-30 seconds/50Hz (nominal)
Protect System	Thermal protector built in
Ambient Temperature	-25C - 55C (-13F - 131F)
Rated Current	MM10070- 0.4A/200V (0.75A/100V) MM10072- 0.3A/200V (0.6A/100V) MM10074- 0.45A/200V (1A/100V) MM10078- 0.9A/200V (2A/100V)
Insulation Resistance	100Mohm/500VDC
Withstand Voltage	1500VAC/minute
Manual Operation	Crank handle attached
Stopper	Mechanical stopper- open/close adjustable
Enclosure	IP65/NEMA4
Mounting Angle	360 degrees- all directions
Positioning	M.M. drive
Drive Motor	MM10070- 8W (E type) MM10072- 20W (E type) MM10074- 30W (E type) MM10078- 90W (E type)
Body Material	Die cast aluminium ADC12
Coating	Baking varnish
Weight	MM10070- 2kg (4.4lbs) MM10072- 4.5kg (9.9lbs) MM10074- 9kg (19.8lbs) MM10078- 9.5kg (20.9lbs)
Wiring Conduit	PF1/2 x 1 Resin connector attached

8.10.3 Installation

The Autoflame product must only be installed, set-up, commissioned and adjusted by an Autoflame certified technical engineer.

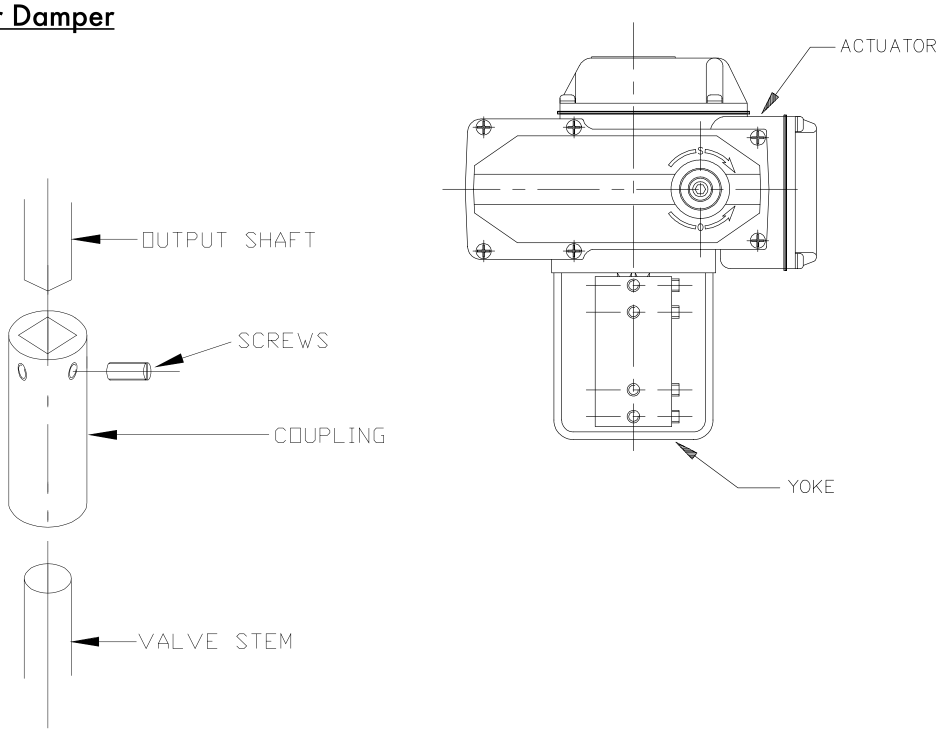
Positioning

Ambient temperature: Within -25°C to +55°C (–13 F. to +131 F.)

Avoid hazardous ambient conditions.

Depending on the condition of installation, consider to reserve spaces for wiring conduit cover, and manual maintenance works.

Mounting on Air Damper

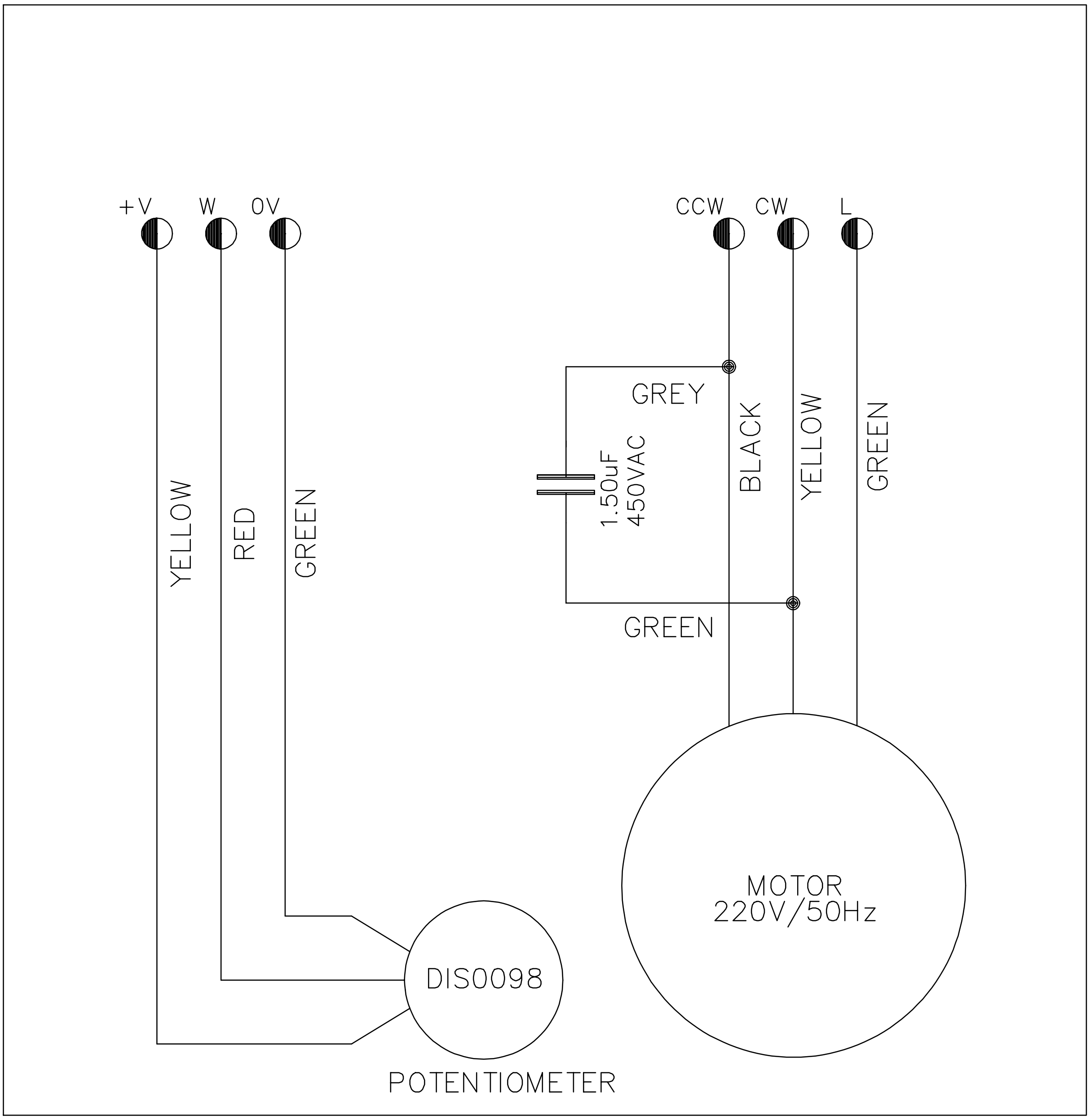


Ensure that the industrial servomotor is not powered before making manual operations.

Move the damper by hand and make sure that it is free then set it at totally closed position. Make sure that the shaft is smooth in motion and there is no decentering/inclination, by turning the manual handle.

Using the Autoflame supplied industrial servomotor mounting brackets, mount the servomotor to the bracket and secure. Then mount this assembly to the damper or valve ensuring that the damper or valve is in the fully closed position and then tighten the bolts and make sure that the assembly is fully secure.

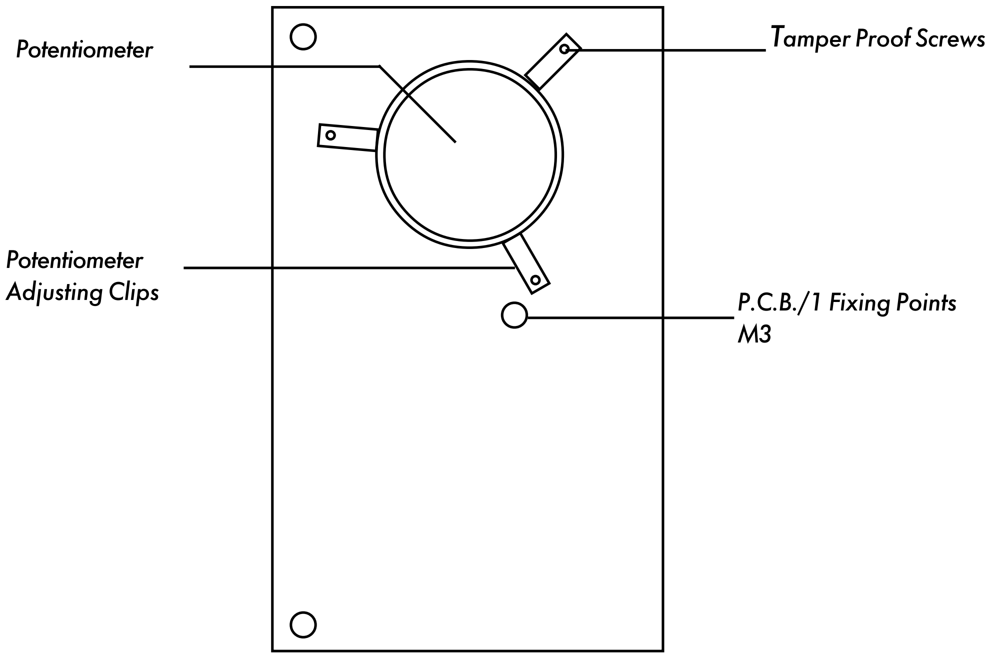
8.10.3.1 Positioning Motor Connections



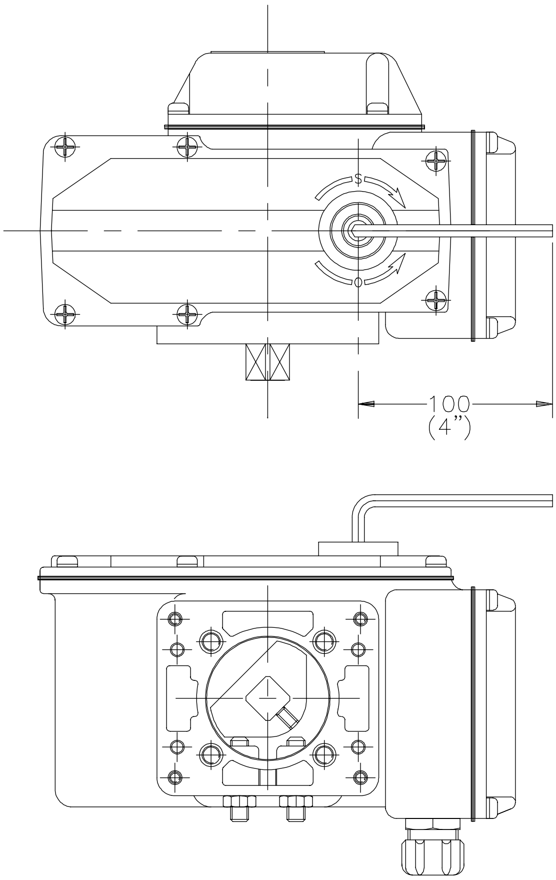
8.10.3.3 Positioning Motor

The Autoflame product must only be installed, set-up, commissioned and adjusted by an Autoflame certified technical engineer.

To adjust the potentiometer loosen the tamper proof screws using a tamper proof screwdriver as supplied by Autoflame Engineering. After adjustment, ensure tightness but do not overtighten. Use fingers only to adjust the position of the potentiometer. Do not raise the potentiometer from the PCB.



8.10.4 Manual Operation



Before starting manual operation, check that the power source is switched off.
Remove rubber cap of the drive unit, and insert the manual handle level into the hexagonal hole.
Turn the manual handle clockwise and the shaft moves in the CLOSE direction.
Turn the manual handle counter clockwise and the shaft moves in the OPEN direction.

Note:

Do not overturn the handle with excessive strength, as otherwise, it may cause problems with the other parts on the servomotor. Any excessive force may damage the servomotor.

If power is not removed then the servomotor will try to return to the original position during manual operation. This may damage the servomotor and may cause physical injury.

Dimensions of Manual Handle

Opposite sides of hexagon shaft (mm):	MM10070/MM10072	5mm
	MM10074/MM10078	6mm
Number of handle turns:	15	
Length of handle (mm):	MM10070/MM10072	100mm
	MM10074/MM10078	120mm

Maintenance

Lubrication:	Since the unit is sufficiently lubricated with a long life and pressure proof di-sulfied molybdenum grease (MOS2), no further lubrication is required.
Periodical Test:	In case the motor is very seldomly rotated or after a long period of rest, it is suggested to have a periodical test and check if there is no irregularity. Remove power to the servomotor and check manual operation as described above. Check wiring and visually inspect the integrity of the valve.

8.10.5 Troubleshooting

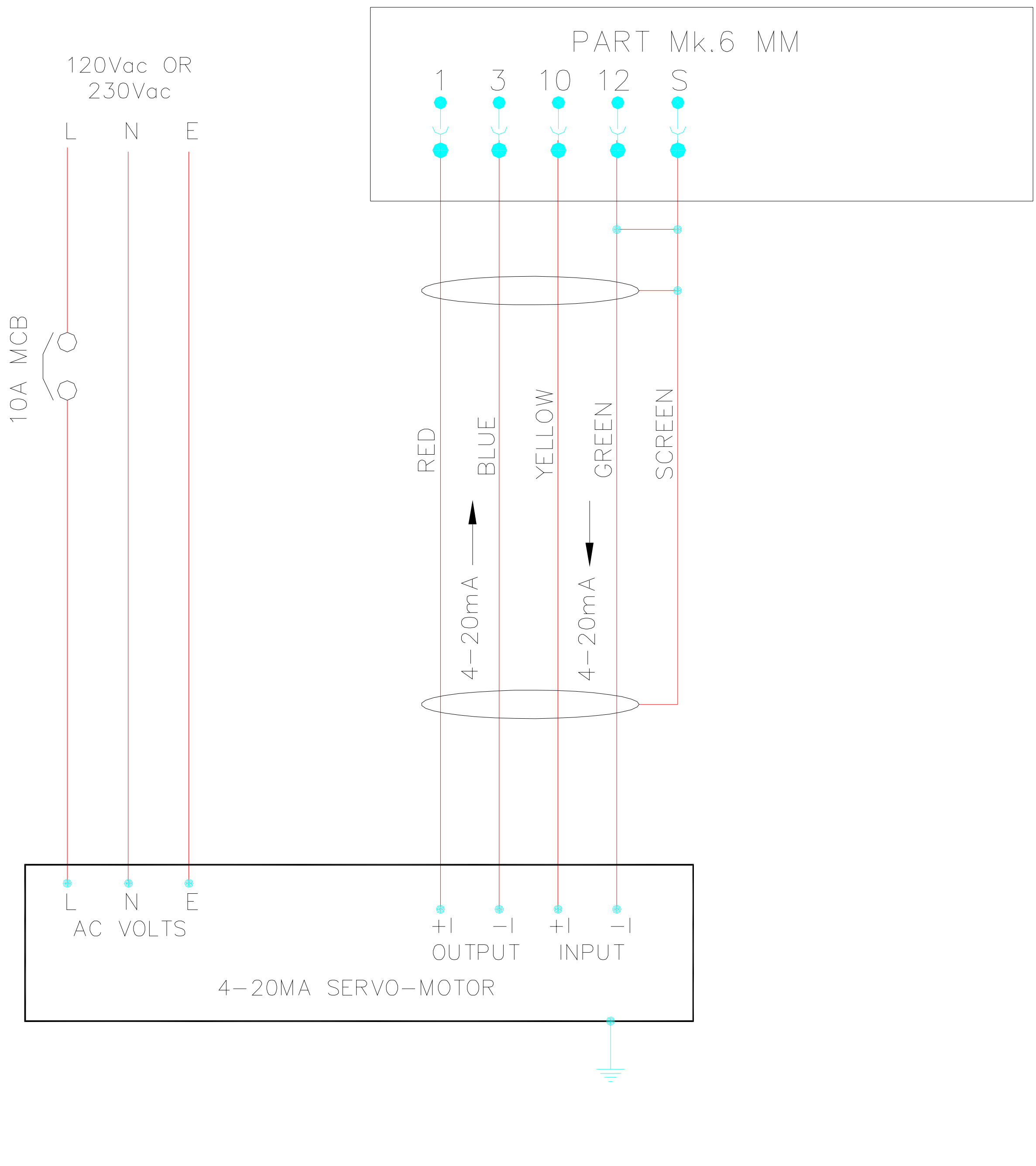
Trouble	Probable Cause	Solution
Motor does not start		
	Power switch is off	Switch on
	Wire/terminals are broken or disconnected	Replace the wire or properly connect the terminals
	Supply voltage is too low/high or incorrect	Check the voltage with a meter
	Effect of the thermal protector (due to a high/low ambient temperature or blocked damper	Lower/raise the ambient temperature or manually open/close the damper when power is removed from the motor

8.10.6 4-20mA Positioning Motor

Within the control of the Mk6 M.M. there are up to six channels of control for the fuel/air ratio. The fifth and sixth have typically been used for variable speed drive (VFD) control using a 4-20mA output to the drive and a 4-20mA feedback signal from the drive at each positon from high to low fire. It is now possible, using a new set of servomotors, to use these two channels for additional servomotor control. These servomotors use a 4-20mA input signal and send back a feedback signal to the M.M. control. Therefore, although these servomotors are similar in appearance and rating to the industrial servomotors, they operate in a different manner.

Please follow section 8.10 for an in depth user guide.

The diagram below shows the wiring between the 4-20mA servomotor and the Mk6 if the servomotor is used for channel 5. Please use terminals #4/6 and #13/15 for channel 6 use.



Section 9: Miscellaneous Component Information

MM Control Units

Description	KGs	Part No.
Mk6 MM Evolution Module, 230V	3.5	MM60001/E
Mk6 MM Evolution Module, 120V	3.5	MM60001/E/110
Mk6 MM Evolution Module + Expansion PCB, 230V	4.0	MM60001/E/WL
Mk6 MM Evolution Module + Expansion PCB, 120V	4.0	MM60001/E/WL/110
Mini Mk6 MM Module, 230V	3.5	MMM60016
Mini Mk6 MM Module, 120V	3.5	MMM60016/110
Mini Mk5 MM Evolution Module, 230V	2.5	MMM5002/E
Mini Mk5 MM Evolution Module, 120V	2.5	MMM5002/E/110

UV Flame Scanners

Description	KGs	Part No.
Self Check UV Sensor, End View	0.8	MM60003
Self Check UV Sensor, High Sensitivity, End View	0.8	MM60003/HS
Self Check UV Sensor, High Sensitivity, Side View	0.85	MM60003/HS/SV
Standard UV Sensor, Side View	0.2	MM60004
Standard UV Sensor, End View	0.2	MM60004/U
Standard UV Sensor, High Sensitivity, End View	0.2	MM60004/HSU
Swivel Mount Assembly, 1" Connection	1.5	UVM60003
Swivel Mount Assembly, 1/2" Connection	1.5	UVM60004

Air/Gas/Oil Pressure Sensors

Description	KGs	Part No.
Air Pressure Sensor 0 to 65 MBar, 0 to 25"wg, 0 to 1 PSI	0.42	MM60005
Air Pressure Sensor 0 to 130 MBar, 0 to 50"wg, 0 to 2 PSI	0.42	MM60013
Gas Pressure Sensor 12.5 to 65 MBar, 5 to 25"wg, 0.18 to 1 PSI	0.42	MM60006
Gas Pressure Sensor 52 to 340 MBar, 25 to 135"wg, 0.75 to 5 PSI	0.42	MM60008
Gas Pressure Sensor 115 to 750 MBar, 50 to 300"wg, 1.8 to 11 PSI	0.42	MM60011
Gas Pressure Sensor 207 to 1380 MBar, 83 to 550"wg, 3 to 20 PSI	0.42	MM60012
Gas Pressure Sensor 0 to 4 Bar, 162 to 1620"wg, 6 to 60 PSI	0.42	MM60014
Oil Pressure Sensor 0 to 40 Bar, 0 to 600 PSI	0.42	MM60009

Outside Temperature Sensors

Description	KGs	Part No.
Outside Air Temperature Sensor	0.32	MM60007
Outside Air Temperature Module		MM60015

Boiler Load Detectors

Description	KGs	Part No.
Temp. Detector, 100mm length	0.45	MM10006/100
Temp. Detector, 150mm length	0.45	MM10006/150
Temp. Detector, 200mm length	0.45	MM10006/200
Temp. Detector, 250mm length	0.45	MM10006/250
Temp. Detector, 400mm length	0.45	MM10006/400
Pressure Detector, 2-23 Bar	0.21	MM10008
Pressure Detector, 2-38 Bar	0.21	MM10009
Pressure Detector, 0.2-3.8Bar	0.21	MM10010
Pressure Detector, 0-100 Bar	0.21	MM10017
Pressure Detector, 30-267 PSI	0.21	MM10008U
Pressure Detector, 30-445 PSI	0.21	MM10009U
Pressure Detector, 1.5-44.5 PSI	0.21	MM10010U
Pressure Detector, 0-1500 PSI	0.21	MM10017U

Servo Motors

Description	KGs	Part No.
Large Servo Motor 15 Nm, 230V 50/60 Hz	1.85	MM10004
Large Servo Motor 15 Nm, 24V 50/60 Hz	1.85	MM10004/D
Small Servo Motor 1.2 Nm, 230V 50Hz	0.55	MM10005
Small Servo Motor 1.2 Nm, 230V 60HZ	0.55	MM10005/B
Small Servo Motor 1.2 Nm, 24V 50Hz	0.55	MM10005/C
Small Servo Motor 1.2 Nm, 24V 60Hz	0.55	MM10005/D
Industrial Servo Motor 05, 230V	4	MM10070
Industrial Servo Motor 05, 120V	4	MM10070/110
Industrial Servo Motor 10, 230V	4	MM10072
Industrial Servo Motor 10, 120V	4	MM10072/110
Industrial Servo Motor 20, 230V	6	MM10074/B
Industrial Servo Motor 20, 120V	6	MM10074/B/110
Industrial Servo Motor 40, 230V	8	MM10078
Industrial Servo Motor 40, 120V	8	MM10078/110

EGA Components

Description	KGs	Part No.
E.G.A. Sampling Unit Mk6 with Local Display, 230V	11	MM62004
E.G.A. Sampling Unit Mk6 with Local Display, 110V	11	MM62004/110
E.G.A. Sampling Probe (0-400°C)	1	MM10003
SO2 Sensor + Extra Pump (factory fitted)	0.2	EGA20008
NO Sensor (factory fitted)	0.2	EGA20005
NO2 Sensor (factory fitted)	0.2	EGA20009
EGA Mk6 External Particulate Filter	2	EGA20103
Ceramic Sampling Probe	1	EGA20105
EGA Mk6 High Temp. Thermocouple	4.5	EGA20104
Chilled E.G.A. Enclosure		EGAENC

Inverter, Splitter & Interface Modules

Description	KGs	Part No.
O2 Interface Module, 230V	0.65	MM10013
O2 Interface Module, 120V	0.65	MM10013/110

DTI Modules

Description	KGs	Part No.
Data Transfer Interface + Internal Modem, 230V	4.5	DTI60100/MD/230
Data Transfer Interface + Internal Modem, 120V	4.5	DTI60100/MD/110
Data Transfer Interface, 230V	4.5	DTI60100
Data Transfer Interface, 120V	4.5	DTI60100/110
Digital I/O Module, 230V	1	DTI20020
Digital I/O Module, 120V	1	DTI20020/110
Analogue I/O Module, 230V	1	DTI20021
Analogue I/O Module, 120V	1	DTI20021/110
DTI Internal Modem US	0.25	DTI20025
DTI Internal Modem Europe	0.25	DTI20026

PC Software and Accessories

Description	KGs	Part No.
MM Infrared Upload/Download Software and IR Lead	0.13	MM60010
E.G.A. to P.C. Software and Lead	0.5	DTI20018
DTI-PC Communication Lead- Standard Serial Lead	0.25	DTI60022
DTI-PC Communication Line Driver and Lead	0.5	DTI20012

Water Level Control Equipment

Description	KGs	Part No.
Expansion PCB with Extended Housing	0.75	WLCPCBH
Replacement Expansion PCb	0.55	WLCPCB
Capacitance Probe, 20" (500mm)	1.5	WLCP500
Capacitance Probe, 30" (750mm)	1.5	WLCP750
Capacitance Probe, 40" (1000mm)	1.5	WLCP1000
Capacitance Probe, 50" (1250mm)	1.5	WLCP1250
Capacitance Probe, 60" (1500mm)	1.5	WLCP1500
Surface Blowdown, TDS Probe and Assemby, 230V	3	TDS60001
Surface Blowdown, TDS Probe and Assembly, 120V	3	TDS60001/110

Flanged Feed Water Valves

Description	KGs	Part No.
Feed Water Valve, PN40, 25mm (1")	7	WLCVO25/FL
Feed Water Valve, PN40, 40mm (1.5")	8	WLCVO40/FL
Feed Water Valve, PN40, 50mm (2")	9	WLCVO50/FL
Feed Water Valve, ANSI 300lb, 1" (25mm)	7	WLCVO25/FLU
Feed Water Valve, ANSI 300lb, 1.5" (40mm)	8	WLCVO40/FLU
Feed Water Valve, ANSI 300lb, 2" (50mm)	9	WLCVO50/FLU

Threaded Feed Water Valves

Description	KGs	Part No.
Feed Water Valve, BSP/NPT Fitting, 0.5" (15mm)	4	WLCVO15
Feed Water Valve, BSP/NPT Fitting, 0.75" (20mm)	5	WLCVO20

Oil Control Valves

Description	KGs	Part No.
Type 1 - Spillback	0.6	OVS31015
Type 1 - Metering	0.6	OVM31015
Type 2 - Spillback	0.6	OVS32016
Type 2 - Metering	0.6	OVM32016
Type 3 - Spillback	1.8	OVS33L17
Type 3 - Metering	1.8	OVM33L17
Type 4 - Spillback	1.8	OVS34L18
Type 4 - Metering	1.8	OVM34L18
Type 5 - Spillback	0.5	OVS35019
Type 5 - Metering	0.5	OVM35019
Type 6 - Spillback	0.5	OVS36020
Type 6 - Metering	0.5	OVM36020
Type 7 - Spillback	1.8	OVS37L21
Type 7 - Metering	1.8	OVM37L21
Type 8 - Spillback	0.5	OVS38022
Type 8 - Metering	0.5	OVM38022
Type 9 - Spillback	0.5	OVS39023
Type 9 - Metering	0.5	OVM39023

Gas Control Valves - Screwed

Description	KGs	Part No.
BSP 25mm (1”)	0.55	GV42521
BSP 40mm (1.5”)	0.7	GV44022
BSP 50mm (2”)	0.74	GV45023
BSP 65mm (2.5”)	0.85	GV46524
BSP 80mm (3”)	0.98	GV48025
NPT 25mm (1”)	0.55	GV42521U
NPT 40mm (1.5”)	0.7	GV44022U
NPT 50mm (2”)	0.74	GV45023U
NPT 65mm (2.5”)	0.85	GV46524U
NPT 80mm (3”)	0.98	GV48025U

Gas Control Valves - 30mm Flanged

Description	KGs	Part No.
PN16 65 mm (2.5”)	5	GVF46526/30
PN16 80 mm (3”)	6	GVF48027/30
PN16 100 mm (4”)	7	GVF410026/30
PN16 125 mm (5”)	8	GVF12527/30
PN16 150 mm (6”)	9	GVF415028/30
ANSI 150lb 65 mm (2.5”)	5	GVF46526/30U
ANSI 150lb 80 mm (3”)	6	GVF48027/30U
ANSI 150lb 100 mm (4”)	7	GVF410026/30U
ANSI 150lb 125 mm (5”)	8	GVF12527/30U
ANSI 150lb 150 mm (6”)	9	GVF415028/30U

Gas Control Valves - 50mm Flanged

Description	KGs	Part No.
PN16 65 mm (2.5”)	9	GVF46526/50
PN16 80 mm (3”)	10	GVF48027/50
PN16 100 mm (4”)	11	GVF410026/50
PN16 125 mm (5”)	12	GVF12527/50
PN16 150 mm (6”)	13	GVF415028/50
ANSI 150lb 65 mm (2.5”)	9	GVF46526/50U
ANSI 150lb 80 mm (3”)	10	GVF48027/50U
ANSI 150lb 100 mm (4”)	11	GVF410026/50U
ANSI 150lb 125 mm (5”)	12	GVF12527/50U
ANSI 150lb 150 mm (6”)	13	GVF415028/50U

Sundires and Spare Parts

Description	KGs	Part No.
M.M./E.G.A. Technical Manual, Hard Copy	1	SP10001
M.M./E.G.A. Technical Manual, CD-ROM	0.1	SP10001/CD
Autoflame Sales Brochure	0.1	SP2000/US
Tamper Proof Screwdriver	0.07	SP10002
Transformer 230V/120V-24V	0.65	SP10003
Ferrite Core Set	0.22	SU10010
Anti Voltage Surge Module	0.15	SU10011

Cables

Description	KGs	Part No.
Screened Cable 1 core	0.05	CAB50001
Screened Cable 2 core	0.06	CAB50002
Screened Cable 3 core	0.07	CAB50003
Screened Cable 4 core	0.09	CAB50004
Sceened Cable 6 core	0.12	CAB50006
Screened Cable 8 core	0.14	CAB50008
Screened Cable 10 core	0.17	CAB50010
Screened Data Cable 1 pair	0.2	CAB50020

Relays

Description	KGs	Part No.
Relay LY2 12V DC	0.04	EC50200
Relay Base 12V	0.05	EC50201
Relay MY 240V AC	0.04	EC50206
Relay Base 240V	0.05	EC50207

MM System Spares

Description	KGs	Part No.
Mk6 EPROMS, Set of 3	0.2	MK6PROMS
Mk6/Mini Mk6 MM Fuse Set, (TE5) 2A (T)	0.1	FU10034
Mk6/Mini Mk6 MM Fuse Set, (TE5) 630mA (T)	0.1	FU10028
Mini Mk5 MM Fuse Set, .315A (T)	0.1	FU10024
Mini Mk5 MM Fuse Set, 630mA (T)	0.1	FU10025
Mk6 MM Connector Plugs	0.5	CON1060
Mk6 Water Level Control Connector Plugs	0.2	CON1065
Mini Mk6 MM Connector Plugs	0.5	CON1064
Mini Mk5 MM Connector Plugs	0.5	CON1063
Mk5 MM Connector Plugs	0.5	CON1050
MM Enclosure Mounting Clamps	0.1	ENC10061
MM Water Level Enclosure and Pillars	0.2	ENC10065

UV Scanner Spares

Description	KGs	Part No.
Replacement Bulb + PCB for MM60003	0.1	SP1036
Replacement Bulb + PCB for MM60003/HS	0.1	SP1036HS
Replacement Bulb + PCB for MM60004/U	0.1	SP1037U
Replacement Bulb + PCB for MM60004/HSU	0.1	SP1037HSU

EGA System Spares

Description	KGs	Part No.
O2 Sensor	0.02	SP10004
CO2 Sensor	0.09	SP10005
NO Sensor	0.04	SP10007
CO Sensor	0.04	SP10008
SO2 Sensor	0.01	SP10013
EGA Pump 230V	0.33	SP10009
EGA Pump 120V	0.33	SP10006
EGA Pump 24V	0.33	SP10010
EGA Replacement Internal Filter	0.06	SP10011
EGA Replacement Sampling Probe Filter	0.15	SP10012
EGA Replacement Particulate Filter	0.06	SP10018
Mk6 EGA Fuse Set	0.1	SP1040
EGA Connector Plugs	0.5	CON1010
EGA Type K Thermocouple only	0.25	SP1044
EGA Type K Thermocouple only	0.25	SP1044/5
EGA Type K Thermocouple only	0.25	SP1044/10
EGA Probe Sample Tube Set	0.01	SP10019
Mk6 EGA Spare Key	0.1	SP1045

Gas/Oil Valve Spares

Description	KGs	Part No.
O-ring Type 1,2,5,6,8,9 Small Oil Valve	0.01	OR70003
O-ring Type 3,4,7 Large Oil Valve	0.01	OR70004

DTI System Spares

Description	KGs	Part No.
Mk6 DTI Fuse Set	0.1	SP1060
Digital I/O Fuse Set	0.1	SP1061
Analogue I/O Fuse Set	0.1	SP1062
Mk6 DTI Connector Plugs	0.5	CON1065
Digital I/O Connector Plugs	0.5	CON1066
Analogue I/O Connector Plugs	0.5	CON1067

Servomotor Spares

Description	KGs	Part No.
Small Servo Fixing Screws	0.01	F5015
Small Servo Mounting Bracket/Coupling	0.5	SP10015
Small Valve to Large Servo Mounting Coupling	0.5	SP10017
Large Servo Fixing Screws	0.01	F6015
Large Servo Mounting Bracket/Coupling	0.5	SP10016
Industrial Servo 05 Mounting Bracket For MM10070	0.8	SP10028/05
Industrial Servo 10 Mounting Bracket For MM10072	0.8	SP10028/10
Industrial Servo 20/40 Mounting Bracket For MM 10074 & MM10078	1	SP10028/20

Demo/Test Equipment

Description	KGs	Part No.
Mk6 MM Water Level Demo Case, 230V	13	MM10022/WL
Mk6 MM Water Level Demos Case, 120V	13	MM10023/WL
Mk6 MM Demo Case, 230V	12	MM10022
Mk6 MM Demo Case, 120V	12	MM10023
Mini Mk6 Demo Case, 230V	12	MM10030
Mini Mk6 Demo Case, 120V	12	MM10030/110
Mini Mk5 Evo Demo Case, 230V	9	MM10032
Mini Mk5 Evo Demo Case, 120V	9	MM10032/110
DTI Demo Case, 230V	12	MM10027
DTI Demo Case, 120V	12	MM10027/110
Mk6 Protection Test Tool	0.5	MM6000TB

Section 10: Appendix

10.1 Terms and Conditions

All equipment and services offered and sold by Autoflame Engineering are subject to our published terms and conditions of business a copy of which is supplied with each consignment of goods and a copy of which will be supplied seperately on request.

All terms and conditions are subject to English law.

10.3 Patent Numbers Relevant to the System

Patent Number:	Product:	Applicable Country:	
US6,024,561	UV Scanner	USA	
CA2,295,458	UV Scanner	Canada (pending)	
EP1,022,515	UV Scanner	Europe-	U.K. Germany France Holland Italy
02138610	M.M.	U.K. Australia	
1317356	M.M.	Canada	
02169726	E.G.A.	U.K.	
00195866	E.G.A.	Europe-	U.K. Switzerland Belgium France Germany Holland Luxembourg Sweden
GB97 15898.4	Mk6	Worldwide	
PCT/GB97/02010	Mk6	Worldwide	
GB97 15899.2	Mk6	U.K.	
GB97 15900.8	Mk6	U.K.	
US6,520,122	Water Level Control Turbulence (pending)	USA	
EP1,384,944	Water Level Control Turbulence	Europe-	U.K. Germany France Holland Italy

10.3 Patent Numbers Relevant to the System

Patent Number:	Product:	Applicable Country:	
EP1,373,796	Steam Flow Metering	Europe-	U.K. Germany France Holland Italy
EP1,384,945	Capacitance Probes	Europe-	U.K. Germany France Holland Italy
EP1,384,946	Feedwater Flow	Europe-	U.K. Germany France Holland Italy
US6,978,741	Total Dissolved Solids (TDS)	USA	
GB04 15052.0	Total Dissolved Solids (TDS)	UK (pending)	
EP05 252163.0	Total Dissolved Solids (TDS)	Europe (pending)	

CERTIFICATE OF GRANT OF UNITED KINGDOM PATENT

In accordance with section 24(2) of the Patents Act, 1977, it is hereby certified that a patent having the specification No. 2169726 has been granted to Autoflame Engineering Limited (United Kingdom) in respect of an invention disclosed in an application for that patent having a date of filing of 20 November 1985 being an invention for "Fuel burner controller".

Dated this Twenty-third day of November, 1988

P. J. COOPER
Comptroller-General of Patents
Designs and Trade Marks

THE ATTENTION OF THE PROPRIETOR IS DRAWN TO THE IMPORTANT NOTES OVERLEAF

Autoflame Engineering Limited (United Kingdom)
C/o Abel & Imray
Northumberland House,
303-306 High Holborn,
London, WC1V 7LH

A 244067

CERTIFICATE OF GRANT OF UNITED KINGDOM PATENT

In accordance with section 24(2) of the Patents Act, 1977, it is hereby certified that a patent having the specification No. 2138610 has been granted to Autoflame Engineering Limited (United Kingdom) in respect of an invention disclosed in an application for that patent having a date of filing of 21 April 1983 being an invention for "Improvements in or relating to fuel burner control systems".

Dated this Twenty-ninth day of October, 1986

P. J. COOPER
Comptroller-General of Patents
Designs and Trade Marks

<u>THE ATTENTION OF THE PROPRIETOR IS DRAWN TO THE IMPORTANT NOTES OVERLEAF</u>

Autoflame Engineering Limited (United Kingdom)
C/o Abel & Imray
Northumberland House
303-306 High Holborn
London
WC1V 7LH

A 226031

Consumer and Corporate Affairs Canada — Consommation et Affaires commerciales Canada

Patent Office — Bureau des brevets

Canadian Patent — Brevet canadien

1317356

To all to whom these presents shall come:

Whereas a petition has been presented to the Commissioner of Patents praying for the grant of a patent for a new and useful invention, the title and description of which are contained in the specification of which a copy is hereunto attached and made an essential part hereof, and the requirements of the Patent Act having been complied with.

Now therefore the present patent grants to the applicant whose title thereto appears from the records of the Patent Office and as indicated in the said copy of the specification attached hereto, and to the legal representatives of said applicant for a period of seventeen years from the date of these presents the exclusive right, privilege and liberty of making, constructing, using and vending to the others in Canada the invention, subject to adjudication in respect thereof before any court of competent jurisdiction.

Provided that the grant hereby made is subject to the conditions contained in the Act aforesaid.

All patents are subject to annual maintenance fees subsequent to the modified Patent Act.

In testimony whereof, these letters patent bear the signature of the Commissioner and the seal of the Patent Office hereunto affixed at Hull, Canada.

This Patent was issued on:

A tous ceux qui les présentes verront:

Considérant qu'une requête a été présentée au Commissaire des brevets, demandant la délivrance d'un brevet pour une invention nouvelle et utile, dont le titre et la description apparaissent dans le mémoire descriptif et dont copie est annexée aux présentes et en fait partie essentielle, et que ladite requête satisfait aux exigences de la Loi sur les brevets.

A ces causes, le présent brevet confère au demandeur dont le titre de propriété dudit brevet est établi d'après les dossiers du Bureau des brevets et est indiqué dans ladite copie du mémoire descriptif ci-annexée, et aux représentants légaux dudit demandeur, pour une période de dix-sept ans, à compter de la date des présentes, le droit, la faculté et le privilège exclusifs de fabriquer, construire, exploiter et vendre à d'autres, au Canada l'invention, sauf jugement en l'espèce par un tribunal de juridiction compétente.

La concession faite par les présentes étant soumise aux conditions contenues dans la loi précitée.

Des frais annuels de maintien seront applicables pour tout brevet octroyé subséquemment à la Loi modifiant la Loi sur les brevets.

En foi de quoi, ces lettres patentes portent la signature du Commissaire ainsi que le sceau du Bureau des brevets apposé à Hull, Canada.

Ce Brevet à été delivré le:

Date MAY MAI - 4 1993

OFFICE • BUREAU DES BREVETS • CANADA • PATENT

Commissioner of Patents - Commissaire des brevets

Canada

Europäisches Patentamt | European Patent Office | Office européen des brevets

URKUNDE

Es wird hiermit bescheinigt, daß für die in der beigefügten Patentschrift beschriebene Erfindung ein europäisches Patent für die in der Patentschrift bezeichneten Vertragsstaaten erteilt worden ist.

CERTIFICATE

It is hereby certified that a European patent has been granted in respect of the invention described in the annexed patent specification for the Contracting States designated in the specification.

CERTIFICAT

Il est certifié qu'un brevet européen a été délivré pour l'invention décrite dans le fascicule de brevet ci-joint, pour les Etats contractants désignés dans le fascicule de brevet.

Europäisches Patent Nr.:
European patent No.:
Brevet européen n°: 0195866

Patentinhaber:
Proprietor of the patent:
Titulaire du brevet:
Autoflame Engineering Limited
Unit 19, Bellingham Trading Estate
Franthorne Way Bellingham London SE6 3BX/GB

München, den
Munich,
Fait à Munich, le 29.05.91

Generaldirektion 2 – Formalprüfungsstelle
Directorate-General 2 – Formalities Section
Direction générale 2 – Section des formalités

EPA/EPO/OEB Form 2031 03.83

Quality Management System Certificate

Issued by Advantica Certification Services

Certificate No.	QMS/05/001
Certification Body No.	079
Date	8 February 2005
Applicant	Autoflame Engineering Ltd Unit 19 Bellingham Trading Estate Franthorne Way Bellingham London SE6 3BX
Standard	BS EN ISO 9001:2000
Expiry Date	1 January 2008

Declaration

This is to certify that the Quality Management System has been assessed and registered by Advantica Certification Services for the scope of:

The design, manufacture, sales, installation and service of combustion control systems, combustion equipment and plant for use with liquid and gaseous fuels for light commercial to heavy industrial and process applications.

Signed on behalf of Advantica

Graham McKay, Manager, Certification Services
Advantica Limited, Ashby Road, Loughborough, Leicestershire LE11 3GR

UKAS QUALITY MANAGEMENT 079

ADVANTICA

10.3 Product Approvals to the System

Approval	**Component**
USR/CNR	Mk6 or mini Mk6 primary safety control system with No: MM60003/U, MM60004/U or MM60001 sensor sensor
	MM60001/EW combination primary safety control/limit control with No: MM60001, MM60003/U or MM60004/U flame sensor
	Actuator assemblies, parts MM10004 and MM10005
	Oil valves and gas valves sections- 10.4.8 and 10.4.9 remain the same
USL/CUL Listed	Mk6 Evo/Water Level Mini Mk5 Evo Mini Mk5 TDS probe Control Panels Actuators
EN298 2003	Mk6 Evo Mk6 Mini Mk5 Evo
EN230:2004	Mk6 Evo Mk6 Mini Mk6
FM	Mk6 Evo with Water Level control Mk6 Mini Mk6
PED(97/23/EC) (Pren12953.9)	Water Level probes

CERTIFICATE

CE
0063

EC TYPE-EXAMINATION CERTIFICATE

GASTEC NV, notified body **0063** hereby declares

that the **burner management system**

type **MM Mk6**

made by **Autoflame Engineering Ltd.**
Bellingham (London), United Kingdom,

comply with the essential requirements of the Gas Appliances Directive (90/396/EEC).

The compliance is based on examination to:
EN 298 (October 1993);
DRAFT prEN 1643 (July 1997);
FINAL DRAFT prEN 12067-1;
EN 1854 (August 1997).

PIN : 0063AT5181
Report number : see appendix to certificate
Manufacturer file number : E 0455

The products have been approved for:

Austria	Belgium	Denmark
Finland	France	Germany
Greece	Iceland	Ireland
Italy	Luxemburg	Norway
Portugal	Spain	Sweden
Switzerland	The Netherlands	United Kingdom

A description of the specific types is given in the appendices to this certificate.

Apeldoorn, **1 July 1998**

dr. L. Noordzij,
president.

Centre of Gas Technology
GASTEC

GASTEC NV
P.O. Box 137
7300 AC Apeldoorn
The Netherlands
Wilmersdorf 50
7327 AC Apeldoorn

Number E 0455

CE
0063

CERTIFICATE

GASTEC NV, hereby declares that the
Burner Management System, type

Mini Mk6 MM

made by **Autoflame Engineering Ltd.**

in **Bellingham (London), United Kingdom,**

complies with the essential requirements of the
Gas Appliances Directive (90/396/EEC).

The compliance is based on examination to:
EN 298 (October 1993)
FINAL DRAFT prEN 12067-1 (October 1997)

PIN : 0063BL1660
Report number : see appendix to certificate

The products have been approved for all EU and EFTA countries.

A description of the specific types is given in the appendix
to this certificate.

Apeldoorn, 1 July 2000

ing. F. Mutter,
Vice President International Operations.

GASTEC

GASTEC NV
P.O. Box 137
7300 AC Apeldoorn
The Netherlands
Wilmersdorf 50
7327 AC Apeldoorn

RvC

00/428

Number E 0455

0063

CERTIFICATE

GASTEC NV, hereby declares that the
Fuel/air Ratio Controller, type

Mini Mk5 MM

made by **Autoflame Engineering Ltd.**

in **Bellingham (London), United Kingdom,**

complies with the essential requirements of the
Gas Appliances Directive (90/396/EEC).

The compliance is based on examination to:
ENV 1954 (June 1996)
FINAL DRAFT prEN 12067-1 (October 1997).

PIN : 0063BL1659
Report number : see appendix to certificate

The products have been approved for all EU and EFTA countries.

A description of the specific types is given in the appendices to this certificate.

Apeldoorn, 15 July 2000

ing. F. Mutter
Vice President International Operations

GASTEC

GASTEC NV
P.O. Box 137
7300 AC Apeldoorn
The Netherlands
Wilmersdorf 50
7327 AC Apeldoorn

RvC

00/443

Santa Clara, California • (408) 985-2400
Research Triangle Park,
North Carolina • (919) 549-1400
Camas, Washington • (360) 817-5500

Underwriters Laboratories Inc.®

a century of
public safety
est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your UL project.

MJAT March 18, 1997
Miscellaneous, Heating and Heating-Cooling Appliance Accessories

AUTOFLAME ENGINEERING LTD **MH16179 (N)**
BELLINGHAM TRADING ESTATE UNIT 19 FRANTHORNE WAY
BELLINGHAM LONDON, SE6 3BX ENGLAND UNITED KINGDOM
Electronic gas analyzers, Models EGA, MK5, MK6.
Micromodulator, Model Mark 5.
Mini MM controller.

LOOK FOR LISTING MARK ON PRODUCT

Replaces MH16179 dated October 31, 1996.
456637001 **Underwriters Laboratories Inc.®** K11/0275474
24

For information on placing an order for UL Listing Cards in a 3 × 5 inch card format, please refer to the enclosed ordering information.

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization
dedicated to public safety and
committed to quality service

Underwriters Laboratories Inc.®

a century of public safety est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

YIOZ April 23, 1996
Valves, Electrically Operated

AUTOFLAME ENGINEERING LTD , SE6 3BX **MH19399 (N)**
ENGLAND UNITED KINGDOM **(A card)**

General purpose valves.

General purpose valves, Part No. MM10004 actuator with valve Part No. OVM33L17, OVM34L18, OVM37L21, OVS33L17, OVS34L18, OVS37L21, GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part No. OVM33L17 and GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVM34L18 and GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF15028/50 or GVF420028/50; or with valve Part Nos. OVM37L21 and GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVS33L17 and GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVS37L21 and GVF46526/50, GVF48027/50, GVF410026/50, GVF12527/50, GVF415028/50 or GVF420028/50.

General purpose valves, Part No. MM10005 actuator with valve Part No. OVM31015, OVM32016, OVM35019, OVM36020, OVM38022, OVM39023, OVS31015, OVS32016,

(Cont. on B card)
456637001 Underwriters Laboratories Inc.® K11/0297299
129

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

333 Pfingsten Road
Northbrook, Illinois 60062–2096, USA
708/272–8800
Telex: 6502543343
FAX No. (708) 272–8129

1285 Walt Whitman Road
Melville, L.I., New York 11747–3081, USA
516/271–6200
Telex No. 6852015
FAX No. (516) 271–8259

1655 Scott Blvd.
Santa Clara, California 95050–4169, USA
408/985–2400
FAX No. (408) 296–3256

12 Laboratory Drive
P.O. Box 13995
Research Triangle Park,
North Carolina 27709–3995, USA
919/549–1400
Telex No. 4937928
FAX No. (919) 549–1842

Underwriters Laboratories Inc.®

a century of public safety est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

YIOZ April 23, 1996
Valves, Electrically Operated

AUTOFLAME ENGINEERING LTD **MH19399 (N)**

(B–cont. from a card)

OVS35019, OVS36020, OVS38022, OVS39023, GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 GVF415028/30; or with valve Part Nos. OVM31015 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GFV415028/30; or with valve Part Nos. OVM32016 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVM35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVM36020 and GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVM38022 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF124527/30 or GVF415028/30; or with valve Part Nos. OVM39023 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVS32016 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVS35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OV35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30;

(Cont. on C card)

456637001 **Underwriters Laboratories Inc.®** K1I/0297300
130

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

333 Pfingsten Road
Northbrook, Illinois 60062–2096, USA
708/272–8800
Telex: 6502543343
FAX No. (708) 272–8129

1285 Walt Whitman Road
Melville, L.I., New York 11747–3081, USA
516/271–6200
Telex No. 6852015
FAX No. (516) 271–8259

1655 Scott Blvd.
Santa Clara, California 95050–4169, USA
408/985–2400
FAX No. (408) 296–3256

12 Laboratory Drive
P.O. Box 13995
Research Triangle Park,
North Carolina 27709–3995, USA
919/549–1400
Telex No. 4937928
FAX No. (919) 549–1842

Underwriters Laboratories Inc.®

a century of public safety est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

YIOZ April 23, 1996
Valves, Electrically Operated

AUTOFLAME ENGINEERING LTD **MH19399 (N)**

(C-cont. from b card)

or with valve Part Nos. OVS36020 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVS36020 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OV38022 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF28027/30, GVF10026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVS39023 and GV42521, GV44022, GV45023, GV46524, GV48025, GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF15028/30.

BELLINGHAM TRADING ESTATE UNIT 19 FRANTHORNE WAY
BELLINGHAM LONDON

LOOK FOR LISTING MARK ON PRODUCT

456637001 **Underwriters Laboratories Inc.®** KII/0297569
131

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

333 Pfingsten Road
Northbrook, Illinois 60062–2096, USA
708/272–8800
Telex: 6502543343
FAX No. (708) 272–8129

1285 Walt Whitman Road
Melville, L.I., New York 11747–3081, USA
516/271–6200
Telex No. 6852015
FAX No. (516) 271–8259

1655 Scott Blvd.
Santa Clara, California 95050–4169, USA
408/985–2400
FAX No. (408) 296–3256

12 Laboratory Drive
P.O. Box 13995
Research Triangle Park,
North Carolina 27709–3995, USA
919/549–1400
Telex No. 4937928
FAX No. (919) 549–1842

Underwriters Laboratories Inc.®

a century of public safety est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

YSYI2 April 23, 1996
Component – Valve Parts, Electrically Operated

AUTOFLAME ENGINEERING LTD **MH19400 (N)**
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY BELLINGHAM LONDON , SE6
3BX ENGLAND UNITED KINGDOM

Actuator assemblies, Part Nos. MM10004, -10005.
Valve assemblies, Part Nos. OV followed by M or S, followed by 31015, 32016, 33L17, 34L18, 35019, 36020, 37L21, 38022 or 39023. Part Nos. GV4 followed by 2521, 4022, 5023, 6524 or 8025. Part Nos. GVF followed by 46526/30, 46526/50, 48027/30, 410026/30, 12527/30, 415028/30, 46526/50, 48027/50, 410026/50, 12527/50, 415028/50 or 420028/50.
Marking: Company name and part designation.

LOOK FOR THE RECOGNITION MARK

See General Information Preceding These Recognitions.

For use only in equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

Reports: April 6, 1996; April 7, 1996.

456637001 Underwriters Laboratories Inc.® DII/0297305
83

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

333 Pfingsten Road
Northbrook, Illinois 60062–2096, USA
708/272–8800
Telex: 6502543343
FAX No. (708) 272–8129

1285 Walt Whitman Road
Melville, L.I., New York 11747–3081, USA
516/271–6200
Telex No. 6852015
FAX No. (516) 271–8259

1655 Scott Blvd.
Santa Clara, California 95050–4169, USA
408/985–2400
FAX No. (408) 296–3256

12 Laboratory Drive
P.O. Box 13995
Research Triangle Park,
North Carolina 27709–3995, USA
919/549–1400
Telex No. 4937928
FAX No. (919) 549–1842

Northbrook, Illinois • (847) 272-8800
Melville, New York • (516) 271-6200
Santa Clara, California • (408) 985-2400
Research Triangle Park,
North Carolina • (919) 549-1400
Camas, Washington • (360) 817-5500

Underwriters Laboratories Inc.®

a century of public safety est. 1894

AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your UL project.

MCCZ July 7, 1998
Controls, Primary Safety

AUTOFLAME ENGINEERING LTD MH25659 (N)
BELLINGHAM TRADING ESTATE UNIT 19 FRANTHORNE WAY
BELLINGHAM LONDON, SE6 3BX ENGLAND UNITED KINGDOM
Mark 6 primary safety control with, Type MM60003/U or MM60004/U combustion detector.

LOOK FOR LISTING MARK ON PRODUCT

456637001 Underwriters Laboratories Inc.® K11/0348251
58

For information on placing an order for UL Listing Cards in a 3 × 5 inch card format, please refer to the enclosed ordering information.

UNDERWRITERS LABORATORIES INC.

A not-for-profit organization dedicated to public safety and committed to quality service

10.5 CONVERSION DATA

10.5.1 Calorific Fuel Data

Stats	Kerosene SG	Gas Oil Cl/SH	Light fuel Oil SG	Medium fuel Oil SG	Heavy Fuel Oil SG
Relative density 15.6°C (60°F) approx. / = litres x = kg	0.79	0.835	0.93	0.94	0.96
Flash point (closed) min °C (°F)	37.8 (100)	65.6 (150)	65.6 (150)	65.6 (150)	65.6 (150)
Viscosity kinematic (cSt) at 15.6°C (60°F) approx. 37.8°C (100°F) approx. 82.2°C (180°F) approx.	- 2.0 - -	- - 3.0	- - - 12.5	- - - 30	- - - 70
Equivalent Redwood No.1 Viscosity at 37.8°C (100°F)	-	33 approx	250 max	1000 max	3500 max
Freezing point °C / °F	Below -40	Below -40	Below -40	Below -40	Below -40
Cloud point °C max	-	-2.2	-	-	-
Gross calorific values KJ/kg approx. Btu/ib approx. KWh/litre approx. Therms/gallon approx. kW/kg	 46,520 20,000 10.18 1.58 -	 45,590 19,600 10.57 1.64 12.66	 43,496 18,700 11.28 1.75 12.08	 43,030 18,500 11.22 1.74 -	 42,800 18,400 11.42 1.77 11.89
Sulphur content % wt.	0.2	0.6	2.3	2.4	2.5
Water content % vol.	Negligible	0.05	0.1	0.20	0.30
Sediment content % wt	-	Negligible	0.2	0.03	0.04
Ash content % wt	-	Negligible	0.02	0.03	0.04
Mean specific heat between 0°C - 100°C approx.	0.50	0.49	0.46	0.45	0.45
Volume correction factor per 1°C	0.00083	0.00083	0.00070	0.00070	0.00068
Volume correction factor per 1°F	0.00046	0.00046	0.00039	0.00039	0.00038
Btu/U.S. gallon (US standard)	-	140,000	-	150,000	160,000
Lb/U.S. gallon (US standard)	-	7.01	-	-	7.01
% lighter than water		20%			4%
1 u.s. Gallon of oil / ft of air		1402			

Conversion Factor for Imperial Gas Flow Meters

Required Data: Pressure of gas at meter in "wg
Required gas flow in ft^3/min

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

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

Correction Factor for burners significantly above sea level. I.e. >200m (1 ft = 0.3048m)

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

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

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

10.5 .2 Gas Volume Conversion Factors - Measured conditions to standard reference

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

"Wg	PSI	mmH_2O	mmHg	Kpa	Millibar	Conversion factor
1	0.036	25.4	1.867	0.249	2.490	1.0218
2	0.072	50.8	3.734	0.498	4.980	1.0243
3	0.108	76.2	5.601	0.747	7.470	1.0268
4	0.144	101.6	7.468	0.996	9.960	1.0293
5	0.181	127.0	9.335	1.245	12.451	1.0318
6	0.217	152.4	11.202	1.494	14.941	1.0343
7	0.253	177.8	13.069	1.743	17.431	1.0368
8	0.289	203.2	14.936	1.993	19.921	1.0393
9	0.325	228.6	16.804	2.242	22.411	1.0418
10	0.361	254.0	18.671	2.491	24.901	1.0443
15	0.542	381.0	28.006	3.736	37.352	1.0569
20	0.722	508.0	37.341	4.981	49.802	1.0694
25	0.903	635.0	46.677	6.227	62.253	1.0819
30	1.083	762.0	56.012	7.472	74.703	1.0944
35	1.264	889.0	65.347	8.717	87.154	1.1070
40	1.444	1016.0	74.682	9.963	99.604	1.1195
45	1.625	1143.0	84.018	11.208	112.055	1.1320
50	1.805	1270.0	93.353	12.453	124.505	1.1445
55	1.986	1397.0	102.688	13.699	136.956	1.1571
60	2.166	1524.0	112.024	14.944	149.406	1.1696
65	2.347	1651.0	121.359	16.189	161.857	1.1821
70	2.527	1778.0	130.694	17.435	174.307	1.1947
75	2.708	1905.0	140.030	18.680	186.758	1.2072
80	2.889	2032.0	149.365	19.925	199.208	1.2197
85	3.069	2159.0	158.700	21.171	211.659	1.2322
90	3.250	2286.0	168.035	22.416	224.109	1.2448
95	3.430	2413.0	177.371	23.661	236.560	1.2573
100	3.611	2540.0	186.706	24.907	249.010	1.2698
110	3.972	2794.0	205.377	27.397	273.911	1.2949
120	4.333	3048.0	224.047	29.888	298.812	1.3199
130	4.694	3302.0	242.718	32.379	323.713	1.3450
140	5.055	3556.0	261.388	34.869	348.614	1.3700
150	5.416	3810.0	280.059	37.360	373.515	1.3951
160	5.777	4064.0	298.730	39.851	398.416	1.4201
170	6.138	4318.0	317.400	42.341	423.317	1.4452
180	6.499	4572.0	336.071	44.832	448.218	1.4703
190	6.860	4826.0	354.741	47.323	473.119	1.4953
200	7.221	5080.0	373.412	49.813	498.020	1.5204

How to use this information:-

1. Measure Volumetric flow of gas for 1min in ft3 (i.e. ft3/min). Note 1m3 = 35.31ft3
2. Multiply this volume flow by 60 to give volumetric flow per hour (i.e. ft3/hr).
3. Measure the pressure of the gas supply.
4. Use the table above to obtain a conversion factor.
5. Multiply the volume flow per hour by the conversion factor to obtain a volume at reference conditions.
6. For natural gas, the calorific value is typically 1000 Btu/ft3. To obtain the firing rate of the boiler at standard reference conditions multiply the volume at reference conditions by 1000.

Represented as an equation:-

Firing rate = (Measured Volumetric flow per minute * 60 * Conversion factor * 1000) Btu/hr