



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

**Mk6
Evolution**

MM60001/E

Mini Mk6

MMM60016

**Mini Mk5
Evolution**

MMM5002/E

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

Overview and Introduction to the Features and Benefits of the M.M./E.G.A. System.

1**M.M.**

Micro Modulation Fuel Air Ratio Control, Control Box Functions & P.I.D. Load Controller.

2**E.G.A.**

Exhaust Gas Analysis Trim System CO₂ + CO + O₂ + Flue Temp. + Eff. Monitoring NO & SO₂.

3**I.B.S.**

Intelligent Boiler Sequencing Lead Lag Selection.

4**W.L.**

Water Level Control, First Out Annunciation, Bottom Blowdown and TDS Management

5**D.T.I.**

Data Transfer Interface Remote Control, Monitoring and Data Acquisition from Total System.

6

Application Possibilities for the M.M. E.G.A. System.

7

Ancillary & Peripheral Equipment for the M.M. E.G.A. System, Oil & Gas Valves, Positioning Motors, Load Detectors.

8

Miscellaneous Component Information: Parts List.

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Appendix: Approvals, Compatibility, Warranty, Terms and Conditions etc.

10

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.

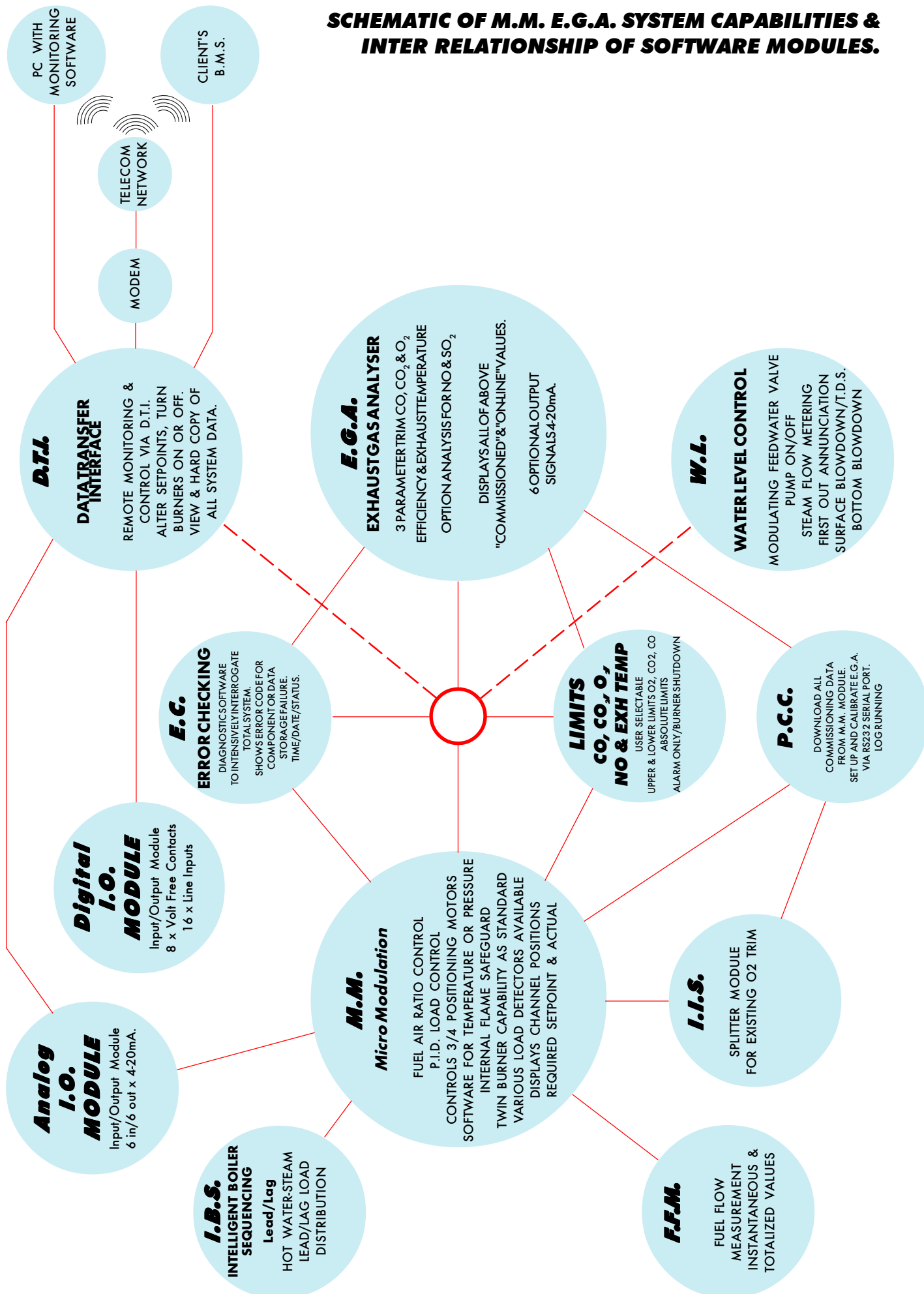
The warranty assumes that all equipment supplied will be used for the purpose that it was intended and in strict compliance with our technical recommendations. Autoflame's warranty and guarantee is limited strictly to product build quality, and design. Excluded absolutely are any claims arising from 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

- 1.1 Schematic of M.M./E.G.A. System Capabilities and Inter-Relationship of Software Modules
- 1.2 Schematic Illustrating Burner Combination Possibilities
- 1.3 Schematic Illustrating Typical System Application
- 1.4 Burner Management Systems Comparison
- 1.5 Overview of Micro Modulation System
- 1.6 Overview of Exhaust Gas Analysis
- 1.7 Overview of Intelligent Boiler Sequencing
- 1.8 Overview of the Data Transfer Interface
- 1.9 Overview of the Additional Modules
- 1.10 Overview of P.C. Compatibility
- 1.11 Overview of the Analogue Output Unit

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 O₂, CO₂ and CO
- * Displays O₂, CO₂, CO Efficiency, Delta T and exhaust gas temperature
- * NO, SO₂ (or NO₂) monitoring
- * Local display for re-calibration, changing cells, user configuration and stand-alone operation
- * Upper/lower/absolute limits for O₂, CO₂, 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

I.I.F. O₂ Interface Module, Splitter Module

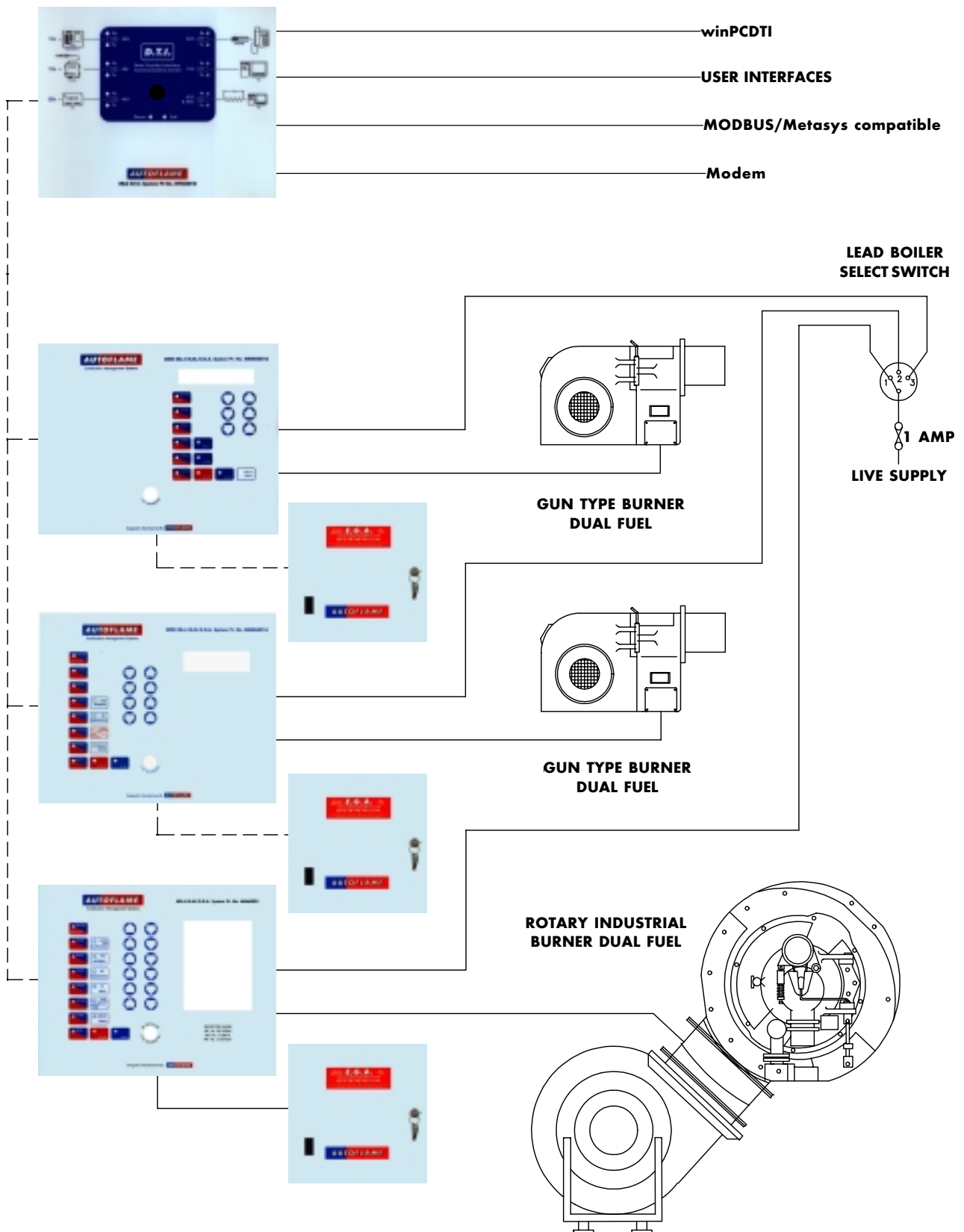
- * Interface with existing on-line O₂ analysers via 4-20mA
- * Split one E.G.A. signal for two M.M.s for use on common or twin furnace boilers

P.C.C. Personal Computer Compatible

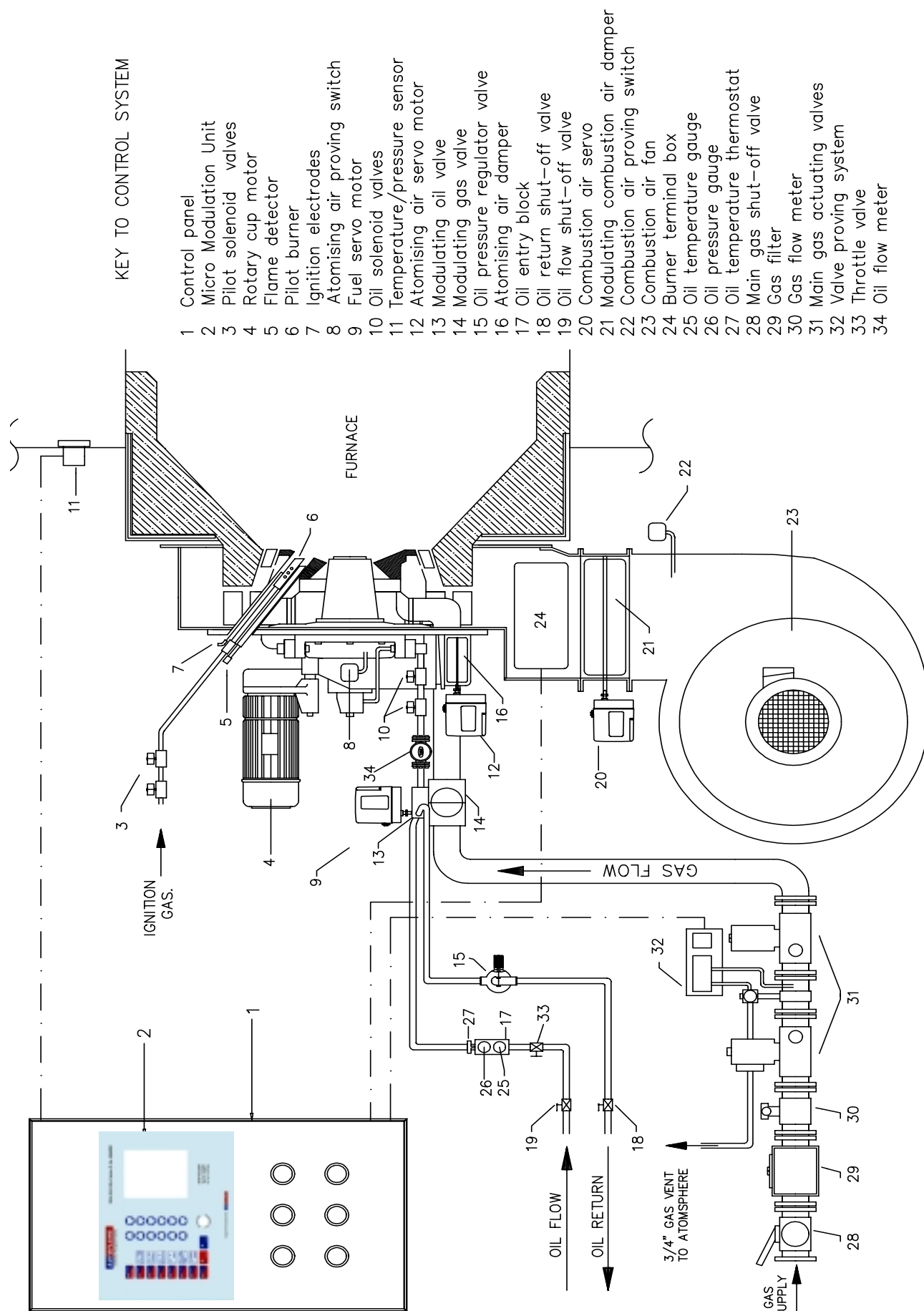
- * Down load all commissioning data from M.M. module
- * Set up and calibrate E.G.A. via RS232 serial port

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



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



	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)			
CO ₂ , O ₂ , CO trim	✓	✓	✓
CO ₂ , O ₂ , CO, NO, SO ₂ displayed	✓	✓	✓
Exhaust temperature and combustion efficiency displayed	✓	✓	✓
User definable limits to CO ₂ , O ₂ , 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 infinitely 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 fired to achieve the target value and that at no time irrespective of load change is this target exceeded or fallen short of.

The inherent hysteresis 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.

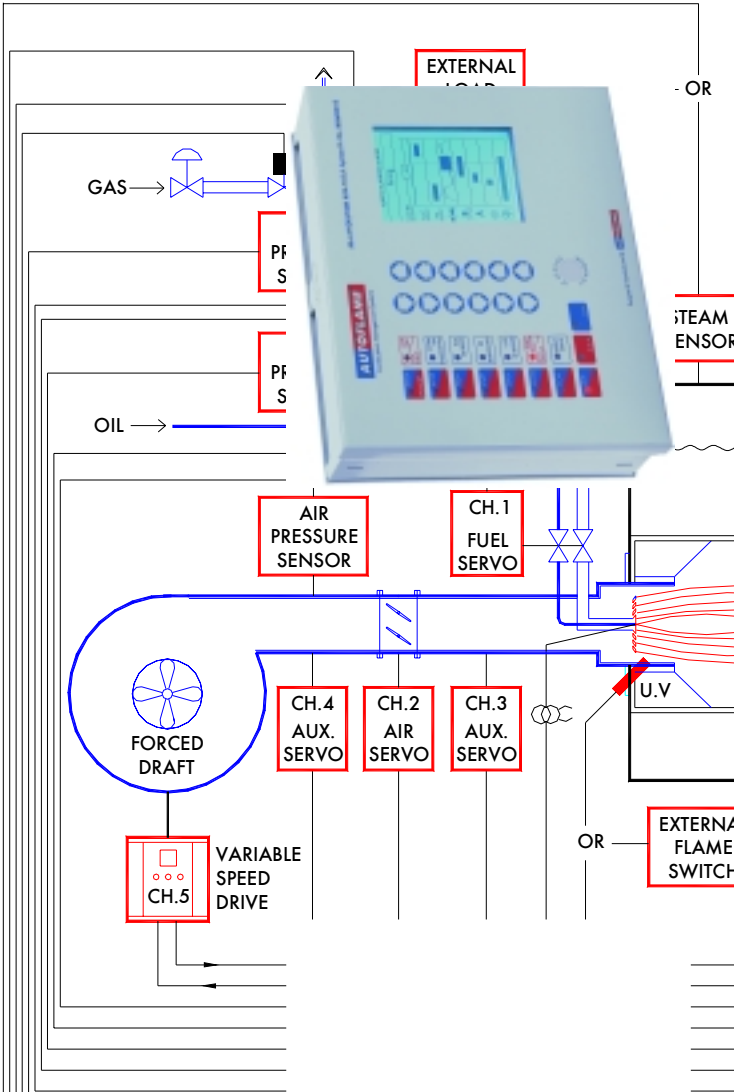
This new system of burner control achieves 'Locked On' near stoichiometric air fuel mixing throughout the fuel input range of the boiler while maintaining exact temperature or pressure target values. The load control incorporates user variable P.I.D. values.

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 setback 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- CO₂, O₂ & CO
- Combustion efficiency calculation- net or gross displayed
- NO and SO₂ monitoring & display
- User definable combustion limits on all CO₂, O₂ & 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 381 kW (1.3 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 1172 kW (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, its 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.

Additional information available if system has E.G.A.:

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.

DTI control input values:

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.

Additional information available if system has Water Level controls:

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 O₂ measuring device is fitted the O₂ interface module can receive a 4-20mA signal from the O₂ probe and a 0-10V signal from the thermocouple mounted in the stack for use by the M.M. for one parameter O₂ trim. Values for CO₂, 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 O₂%, CO₂%, COppm, NOppm, SO₂ppm, Ambient Temperature, Exhaust temperature, Delta T, Efficiency % for commissioned, and also autotrim values of O₂, CO₂ 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

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Section 2.14: Mk6 M.M. Micro Modulation

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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 combustion conditions, e.g. moving the fuel valve to the open position without increasing the air damper.

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).

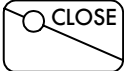
On a newly installed system the following procedures should be carried out as listed.

1. Check all interconnecting wiring between the M.M. and external components is correct.
2. Set options required (refer to option section 2.14.2.4).
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  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  to display the channel 1 to 6 values.

Press  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 times regardless of the actual value).

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.

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  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 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 

5. The display indicates angular position of servo motors. After the internal checks are made (CLOSE

flashes). Press  to start entering the close position.

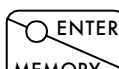
6. Use CH1 to CH4 (as optioned)   buttons to set positioning motors to 0.0.

Press  (OPEN flashes).

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



9. Press  (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.

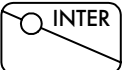
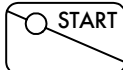
11. Press  (Burner ignites, HIGH flashes).



12. Press  (HIGH steady, ENTER MEMORY 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.

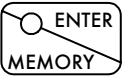
14. Press  (INTER, or INTER and START flash).

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  or  (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.

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

16. Press  to set system into normal modulating mode.

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 2.14.2.3.3
Layout of large positioning motor, refer to	Section 2.14.2.3.3
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 swap 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.**

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.

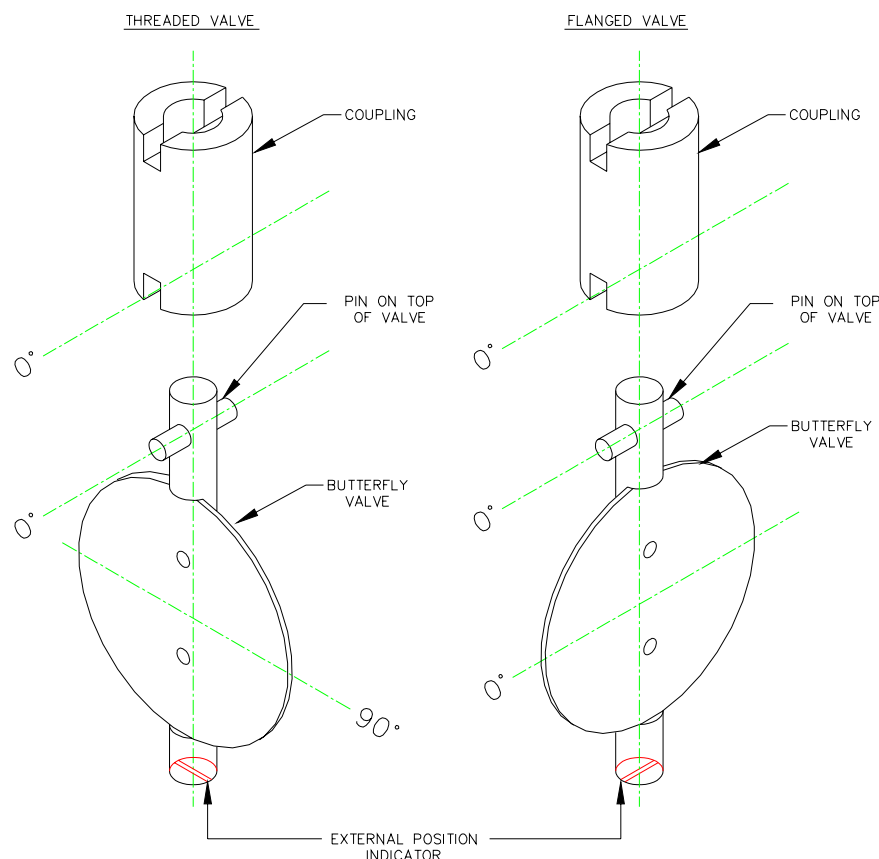
Important Note for Autoflame valves:

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

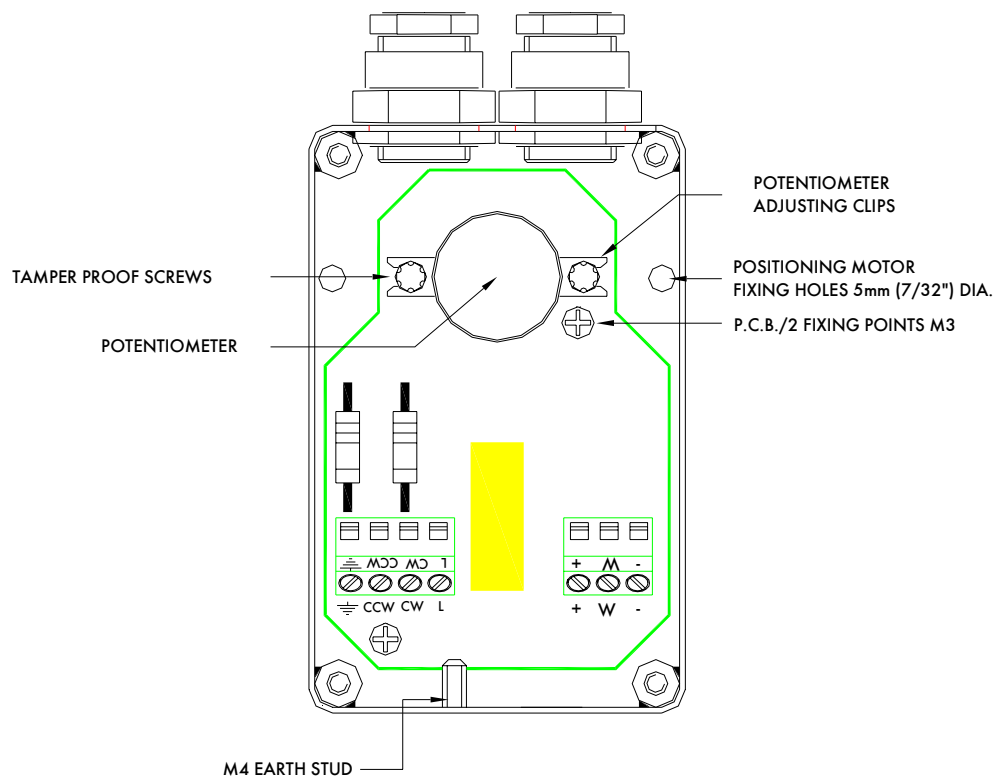
On flanged valves, the pin on the top of the valve is in line with the position of the butterfly valve.

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

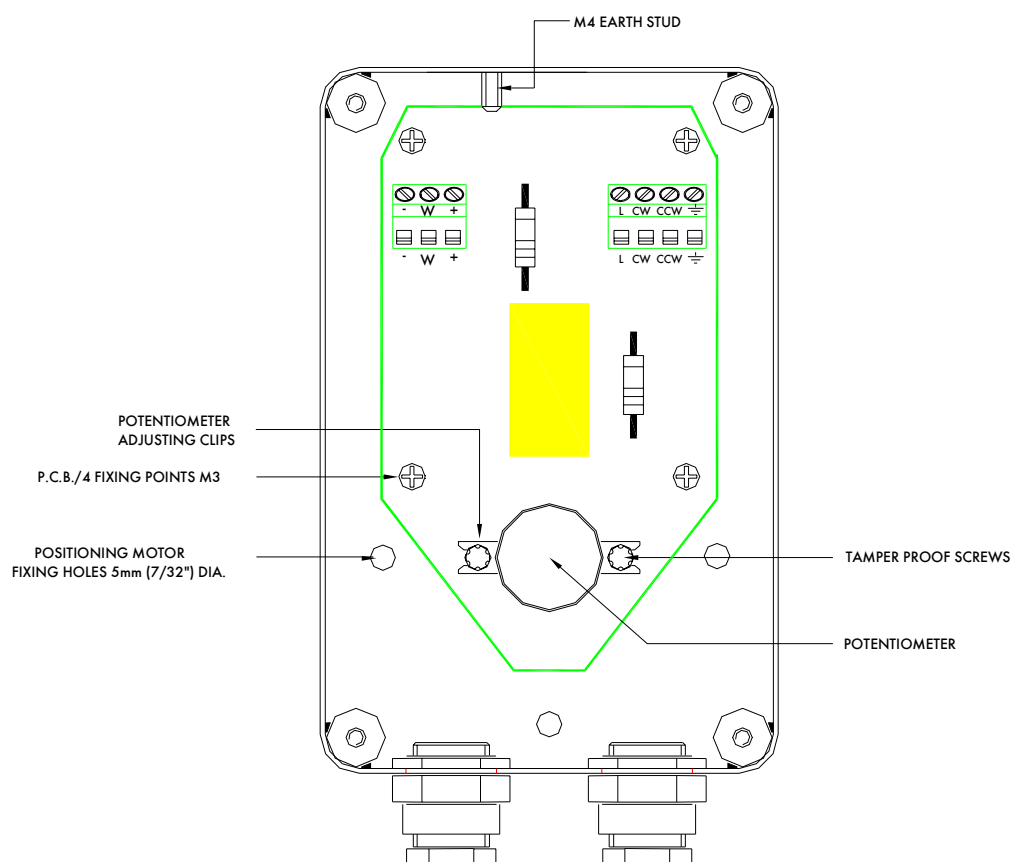
Regardless of the type of valve being used, the servomotor is dispatched from the factory with the potentiometer in the zero position. The same servomotor will be correct for both types of valve, as the servomotor for the threaded valve is mounted at 90 degrees different from the flanged valve.



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

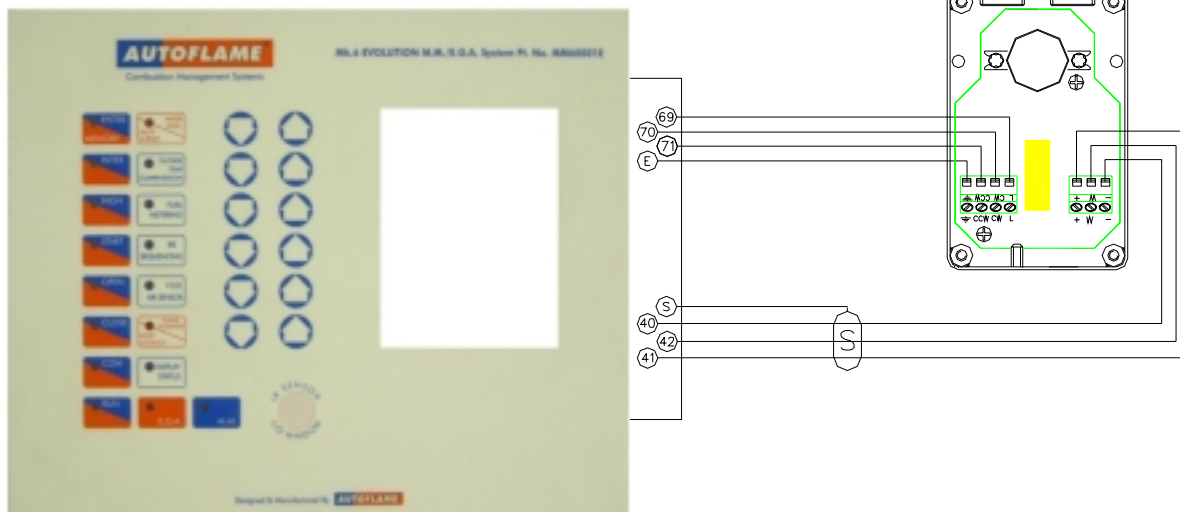
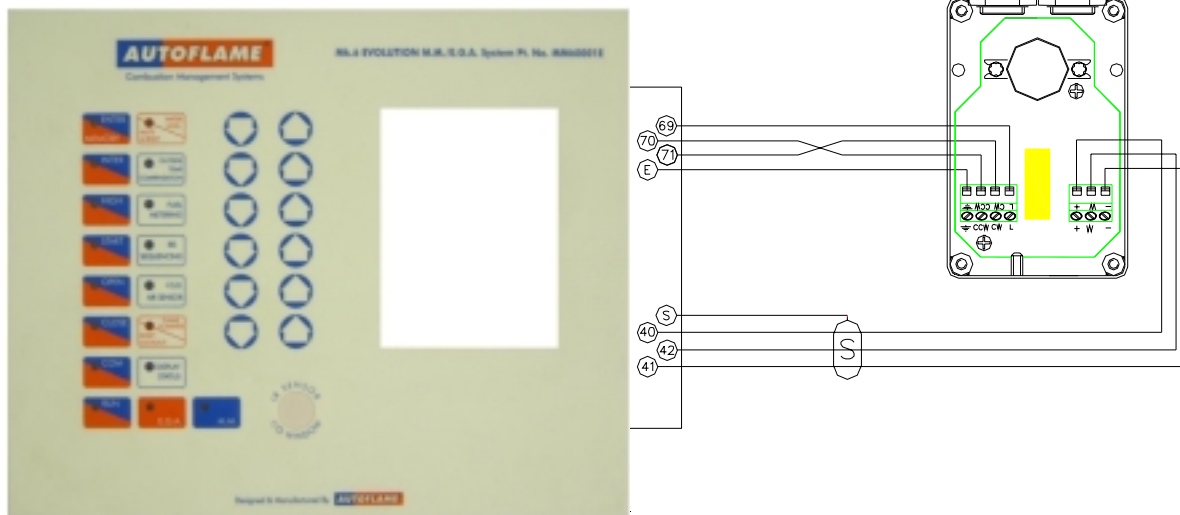


FIG. B

M.M. MODULE

MOTOR ANTICLOCKWISE ROTATION



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, verification that the physical position of the fuel/air/FGR valve/damper, e.t.c. is correct with the potentiometer feed back as displayed on the Autoflame controller, i.e. 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.

Servicing- it is good practice to periodically 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 training and understanding of these settings/adjustments may place themselves and others in a potentially dangerous situation.

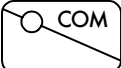
If in doubt contact Autoflame technical support directly (+44 (0) 20 8695 2001).

To Select Options Mode.

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



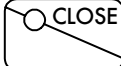
Option values can be changed by entering the option mode. The password must first be entered. To enter the password follow the steps listed:

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

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

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

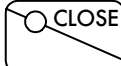
"ENTER PASSWORD" is displayed.

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

"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 .


On the following screen "Select  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.

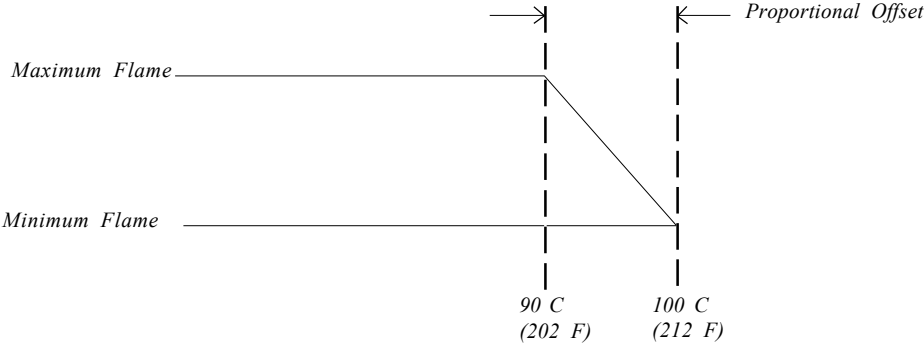
To change the value use the CH3   buttons.

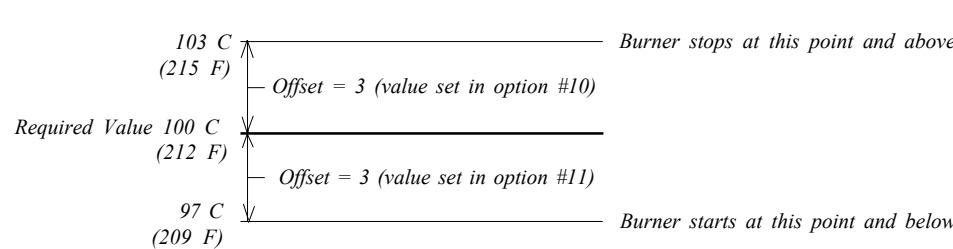
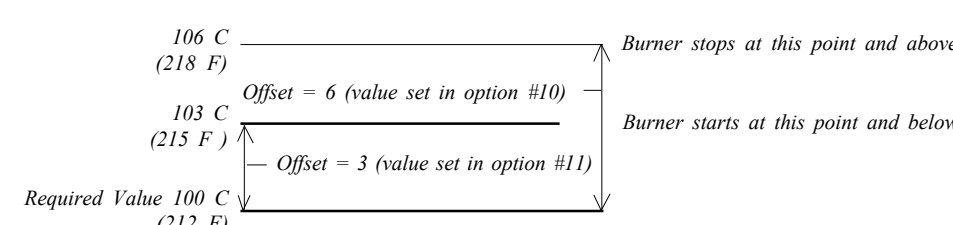
Any number of option values can be changed when in option mode.

When changes have been made press .

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° to 90°			
				60 = 120 seconds from 0° to 90°			
				240 = 390 seconds from 0° to 90°			
3.	0		Unused: This option only applies to the mini Mk5.				
4.	0		Unused: This option only applies to the mini Mk5.				
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	5-250 0.5-25.0	<p>Proportional control (P): This option sets the proportional band. This is the offset point at which the burner will begin to change modulation.</p> <p><i>Example of proportional band offset: Required setpoint = 100 C, Proportional offset = 10 (i.e. option 6 set to value 10).</i></p>  <p>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.</p> <p>If Centigrade, Fahrenheit or PSI units effective.</p> <p>If Bar units effective.</p> <p>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.</p>
7.	60	OFF-250	<p>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.</p> <p>Seconds.</p> <p>Note: Integral is equivalent to 'Reset'.</p>
8.	1	1 2 3	<p>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).</p> <p>Channels 1 & 2 in use.</p> <p>Channels 1, 2 & 3 in use.</p> <p>Channels 1, 2, 3 & 4 in use.</p> <p>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.</p>

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.
<i>Option #9 = 1, example using 100 C (212 F). Required setpoint.</i>			
			
<i>Option #9 = 2, example using 100 C (212 F). Required setpoint.</i>			
			
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 0.2-5.0		If Centigrade, Fahrenheit or PSI units effective. 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 0.2-5.0		If Centigrade, Fahrenheit or PSI units effective. 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 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 energised in the event of an E.G.A. error.
	3			Same as 1, except terminal #79 is not energised in the event of an E.G.A. error.
	4			Same as 2, except terminal #79 is not 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 not energised in the event of an E.G.A. error.
	9			Same as 6, except terminal #79 is not 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 % O₂: 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			Upper offset limit % CO₂:
	0-10.0		% CO ₂
21. 0			Upper offset limit ppm CO:
	0-200		ppm CO

Option No.		Factory Setting	Option Value	Description
22.	0	0-10.0		Lower offset limit % O₂: % O ₂
23.	0	0-10.0		Lower offset limit % CO₂: % CO ₂
24.				Unused:
25.	0	0-20.0		Absolute value % O₂: System checks for O ₂ values lower than value specified in this option regardless of the commissioned values. % O ₂
26.	0	0-20.0		Absolute value % CO₂: System checks for CO ₂ values higher than value specified in this option regardless of the commissioned values. % CO ₂
27.	0	0-200		Absolute value ppm CO: System checks for CO readings higher than value specified in this option regardless of the commissioned values. ppm CO
28.	20	0-50 0-5.0		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. If Centigrade, Fahrenheit or PSI units effective. If Bar units effective.
29.	1	0 1		Golden start: See section 2.14.12. Parameter #15-sets the time the golden start is maintained from the ignition point. Golden Start operates. Golden Start does not operate.
30.	50	5-9990 0.5-999.5		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. If Centigrade, Fahrenheit or PSI units effective. 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.
		0	SO ₂ Off
		1	Off
		2	On
		3	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: <u>Note:</u> <table><tr><td>"Time Between Readings"</td><td>set to 20 seconds.</td></tr><tr><td>"Deadband"</td><td>set to 2 °C (2 °F.)</td></tr><tr><td>"Response Sensitivity"</td><td>set to 10%.</td></tr></table> Setpoint Information: <table><tr><td>"Required Setpoint"</td><td>set to 90 °C (190 °F.)</td></tr><tr><td>"Actual Value"</td><td>reads 86 °C (186 °F.)</td></tr></table> Firing Rate Information: <table><tr><td>Burner firing</td><td>at 50% of capacity.</td></tr></table> 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.	"Time Between Readings"	set to 20 seconds.	"Deadband"	set to 2 °C (2 °F.)	"Response Sensitivity"	set to 10%.	"Required Setpoint"	set to 90 °C (190 °F.)	"Actual Value"	reads 86 °C (186 °F.)	Burner firing	at 50% of capacity.
"Time Between Readings"	set to 20 seconds.															
"Deadband"	set to 2 °C (2 °F.)															
"Response Sensitivity"	set to 10%.															
"Required Setpoint"	set to 90 °C (190 °F.)															
"Actual Value"	reads 86 °C (186 °F.)															
Burner firing	at 50% of capacity.															
		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 1	Disabled. 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 1	3 state steam sequencing- LEAD, STANDBY, OFF, OFF, OFF, OFF... 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 0-10.0	If Centigrade, Fahrenheit or PSI units effective. If Bar units effective.
43.	5			Offset above phantom setpoint when the burner stops:
			2-50 0.2-5.0	If Centigrade, Fahrenheit or PSI units effective. If Bar units effective.
44.	5			Offset below phantom setpoint when the burner starts up:
			2-50 0.2-5.0	If Centigrade, Fahrenheit or PSI units effective. If Bar units effective.

Option No.	Factory Setting	Option Value	Description
45.	0		<p>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.</p> <p>0 Disabled.</p> <p>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.</p> <p>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.</p> <p>3 Enabled- load sensor used for working stat facility and for local display of pressure/temperature. Required setpoints displayed. External working stat not required.</p> <p>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.</p>
46.	0		Unused:
47.	0		<p>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.</p> <p>0 Off.</p> <p>1-2000 Number of minutes cold start operates.</p> <p>Note: The cold start routine cannot be used with external modulation (options #45/55 are used).</p>
48.	0		<p>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.</p> <p>0-600 Seconds.</p>

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 0-5.0	If Centigrade, Fahrenheit or PSI units effective. 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 1	Not optioned. 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 selectable using terminal #88: (Cannot be used with lead lag/intelligent boiler sequencing)
		0 1	Normal operation- internal PID. 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.
		2		Totalised fuel flow metering is reset to zero for the selected fuel.
58.	15			Unused:
59.	0			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		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	6 Btu x 1000 /hr
	1	Kg x 100 /hr	7 Hp x 10 /hr
	2	MW /hr	8 lbs x 1000 /hr
	3	Btu x 100 /hr	9 Btu x 1000 000 /hr
	4	Hp x 100 /hr	
	5	lbs x 100 /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
			<p>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.</p> <p>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.</p>
110. 1			<p>Burner flame scanner type:</p> <p>1 Internal non-permanent operation- standard scanner. 2 Internal permanent operation- self-check scanner.</p>
111. 0			<p>Pilot:</p> <p>0 Interrupted pilot. 1 Intermittant pilot (expanding flame).</p>
112. 40			<p>Pre purge time:</p> <p>05-300 Seconds/minutes- see option #135.</p>
113. 3			<p>Pre ignition time: Time ignition transformer is on before pilot gas valve opens.</p> <p>3-5 Seconds.</p>
114. 3			<p>First safety time: Time pilot valve is open before UV is checked.</p> <p>3-10 Seconds.</p>

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.
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.
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.
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.
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).

Option No.	Factory Setting	Option Value	Description
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		Maximum 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.
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.



Option No.	Factory Setting	Option Value	Description
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 commissioned 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 commissioned 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 (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 Autoflame air pressure sensor and terminal #54 (applies to all 4 fuels).

Option No.	Factory Setting	Option Value	Description
149.	0.3		Minimum air pressure proving value: Air pressure switch function.
	0.3 - 4.9 1 - 12.5		" wg. 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 recomission (see section 2.14.18.2 in the technical manual for more information).
<p>For safety reasons, options #110 to 150 also have to be entered in as parameters.</p> <p>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.</p>			

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  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 



"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 

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

To select the 'SET PARAMETERS' screen, press  and  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 

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: $\div 4$ = % of air damper movement. Amount of auto commission trim. Applies to air (-) only.
14	20	1-200		E.G.A: $\div 2$ 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 ($\div 2 =$ 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 \div 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			E.G.A: Trim- add air when CO present. When trim is taking place, if the O ₂ and CO ₂ 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 ($\div 5 =$ deg C).
28	200	0-255		E.G.A: Maximum operating temperature ($\div 5 =$ 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).																				
			<table><tr><td>Example 1: Pressure Application</td><td>Example 2: Temperature Application</td></tr><tr><td>Required/Actual Range- 0.0-100.0bar</td><td>Required/Actual Range- 1000-2000F</td></tr><tr><td>Input Signal- 0-10 Volts</td><td>Input Signal- 1-6 Volts</td></tr><tr><td>Option 1- 11</td><td>Option 1- 10</td></tr><tr><td>Option 65- metric units</td><td>Option 65- imperial units</td></tr><tr><td>Parameter 52- 1</td><td>Parameter 52- 0</td></tr><tr><td>Parameter 53- 1000</td><td>Parameter 53- 2000</td></tr><tr><td>Parameter 54- 10.0</td><td>Parameter 54- 6.0</td></tr><tr><td>Parameter 55- 00</td><td>Parameter 55- 1000</td></tr><tr><td>Parameter 56- 0.0</td><td>Parameter 56- 1.0</td></tr></table>	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 65- metric units	Option 65- imperial 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
Example 1: Pressure Application	Example 2: Temperature Application																						
Required/Actual Range- 0.0-100.0bar	Required/Actual Range- 1000-2000F																						
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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				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				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			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.
73-79				Unused:
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.
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.

Parameter No.		Factory Setting	Parameter Value	Description
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.
93				Unused:
94	0			Upper offset limit ppm NO:
		0-200		ppm NO.
95	0			Unused:
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:

Parameter No.	Factory Setting	Parameter Value	Description
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.
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.
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 VALVE PROVING

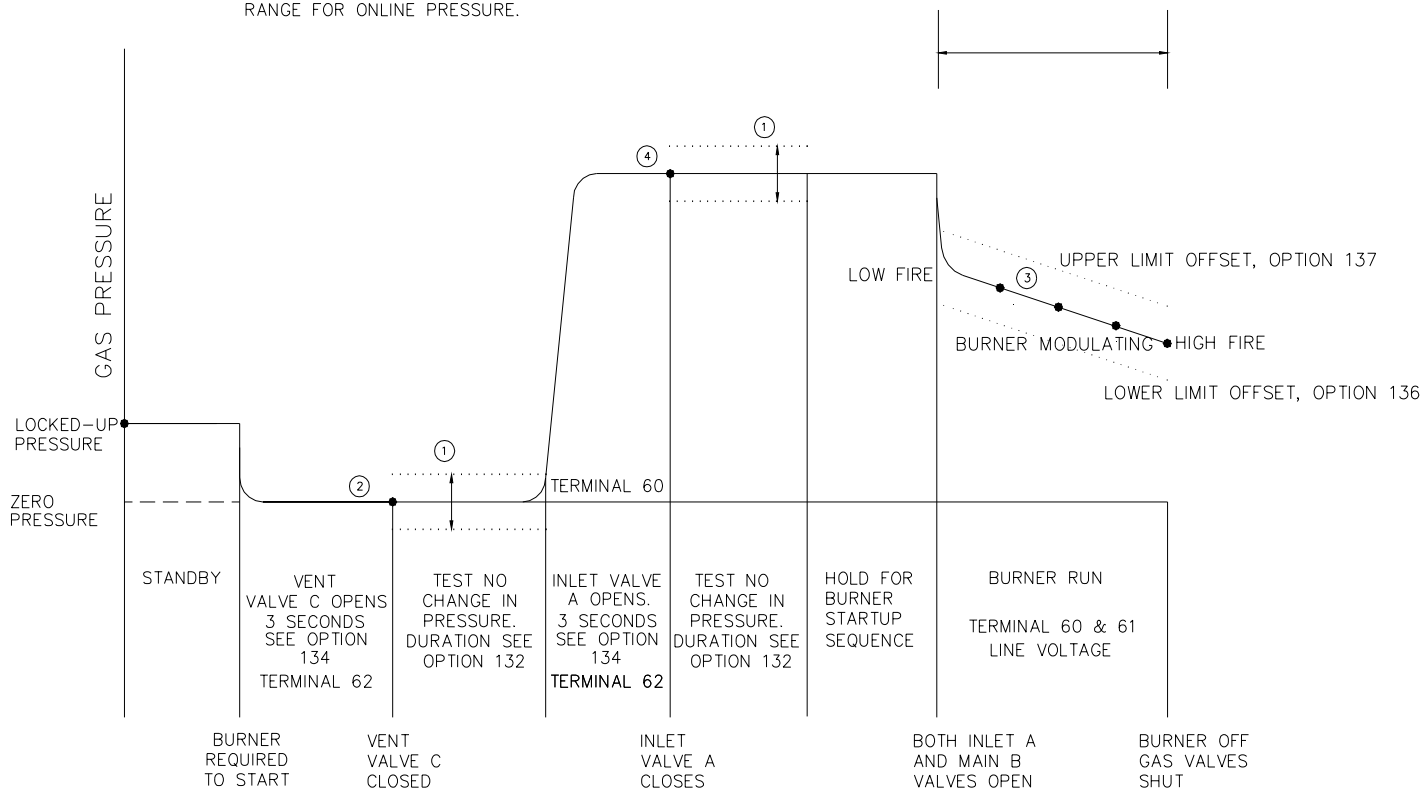
MK6 GAS VALVE PROVING/ OIL HIGH – LOW PRESSURE LIMIT

1: MAXIMUM PRESSURE CHANGE (SEE OPTION 133) ALLOWED DURING PROVING TIME
SEE OPTION 132

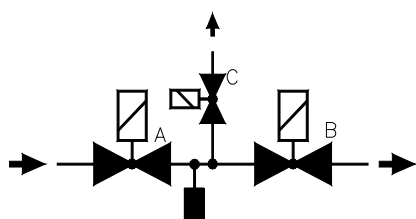
2: ZERO PRESSURE (ATMOSPHERE)
COMMISSIONED VALUE MEMORISED

3: DURING COMMISSIONING HIGH, LOW AND UP TO 15 INTER
VALUES ARE STORED THROUGHOUT THE BURNER FIRING
RANGE FOR ONLINE PRESSURE.

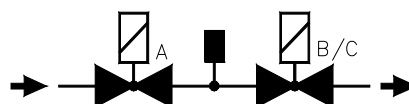
FOR OIL VALVE PROVING, ONLY THIS SECTION
APPLICABLE SEE OPTIONS 139 & 140



4: STATIC LINE PRESSURE COMMISSIONED VALUE MEMORISED.



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

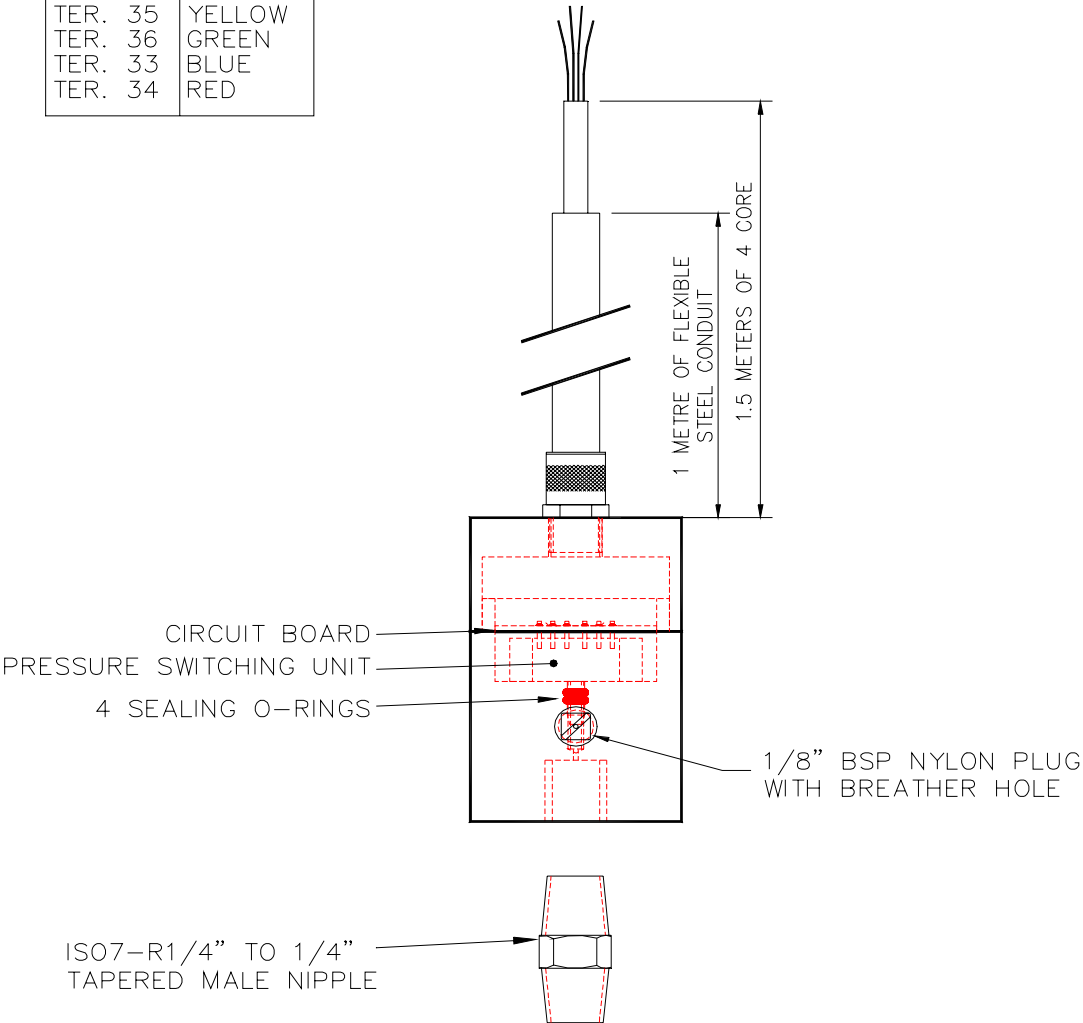


2 VALVE PROVING
A – T60, B/C – T61

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	00
HOUSING & LID	ALLUMINIUM
POWER CONSUMPTION	0.1 WATTS
MOUNTING	VERTICAL AS SHOWN. BREATHER HOLES AWAY FROM ANY WATER SOURCE.

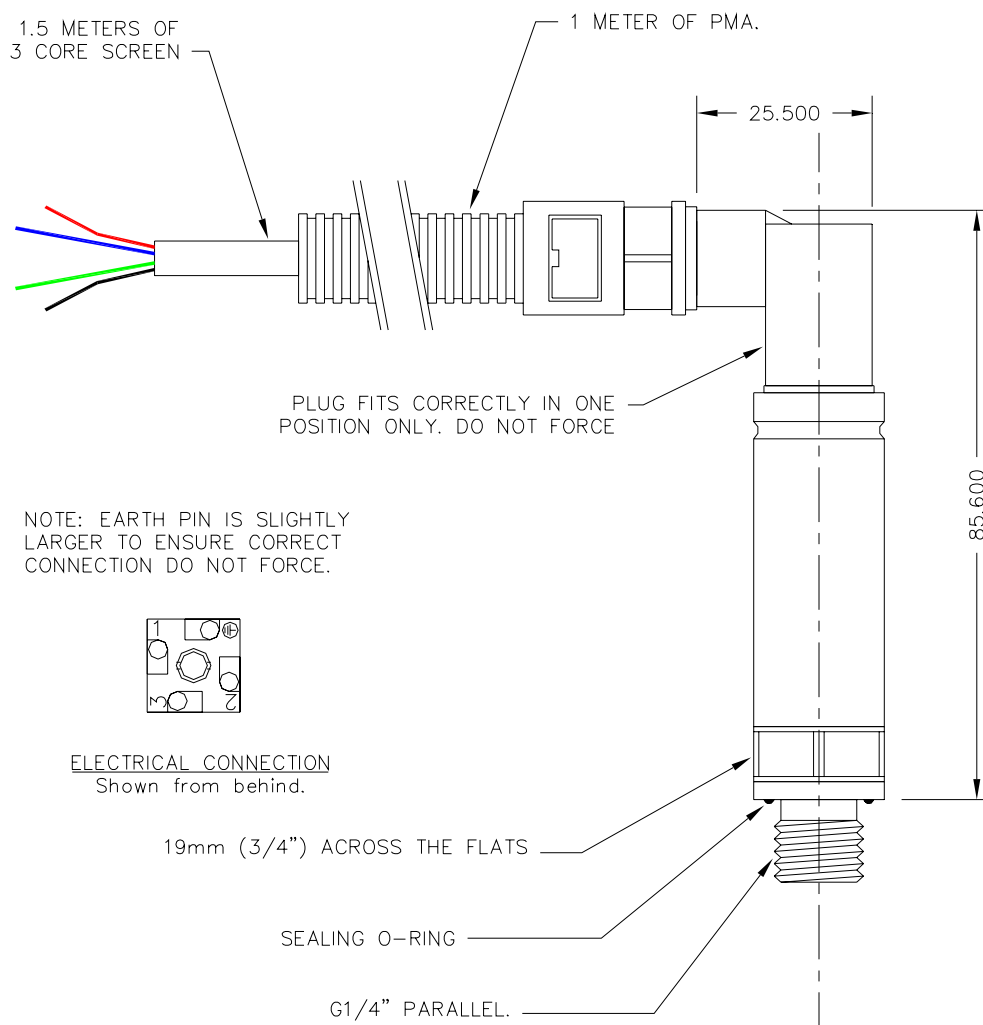
	Actual Operating Range											
	mbar				" w.g.				psi			
	min.	max.	†	zero range	min.	max.	†	zero range	min.	max.	†	zero range
MM60006	-2.5	65	1373.8	-2.5 to 1.25	-1	25	554	-1.0 to 0.5	-0.04	1	20	-0.04 to 0.02
MM60008	-12.5	340	1373.8	-12.5 to 6.25	-5	135	554	-5.0 to 2.5	-0.2	5	20	-0.2 to 0.1
MM60011	-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

AUTOFLAME OIL PRESSURE SENSOR
PART No.MM60009/9U

PRESSURE SENSOR ELECTRICAL CONNECTIONS

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



NOTES: MAXIMUM 2.5mm FLAT BLADE SCREW DRIVER FOR ELECTRICAL CONNECTIONS
I.P. RATING : 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)

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:

- V_{pt} - Valve proving time in seconds.
- I_p - Inlet pressure in millibars.
- P_v - Pipe volume in litres (volume = $\pi r^2 \times \text{length}$).
- M_{tp} - Maximum gas throughput in litres per hour.

Formula:

$$V_{pt} = 4 \times \left[\left[\frac{I_p \times P_v}{M_{tp}/1000} \right] + 1 \right]$$

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

Pressure change:

Formula:

$$0.25 \times \text{Nominal inlet pressure (mBar)}.$$

Example:

Proving Time -

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

$$V_{pt} = 4 \times \left[\frac{50 \times 5}{100,000 / 1000} + 1 \right]$$
$$= 14 \text{ seconds.}$$

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.

$$0.25 \times 100 = 25.0 \text{ mBar.}$$

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

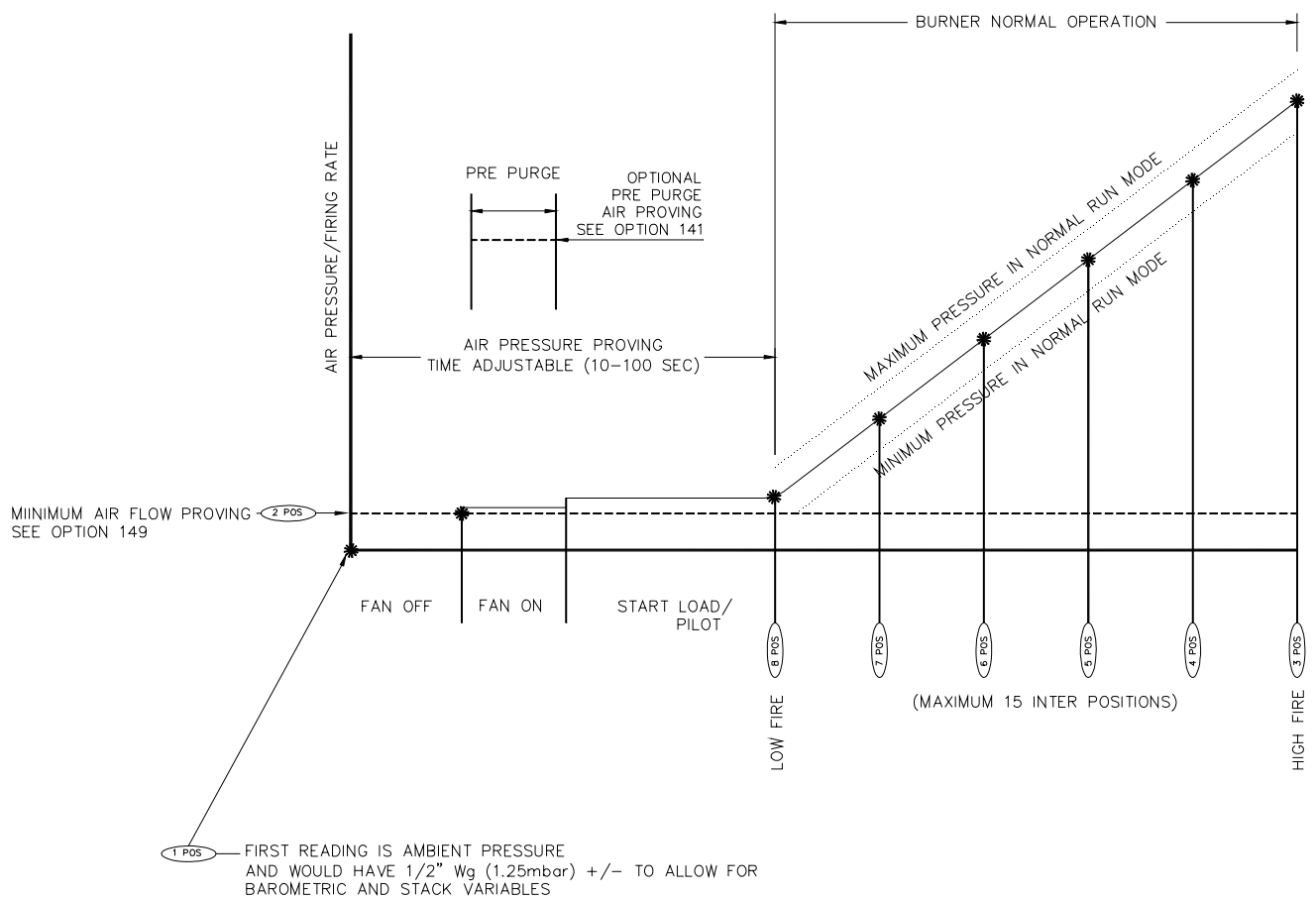
General Note

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

2.14.2.7 AIR PRESSURE PROVING

COMBUSTION AIR PRESSURE MONITORING PHILOSOPHY OF THE MK6 SYSTEM

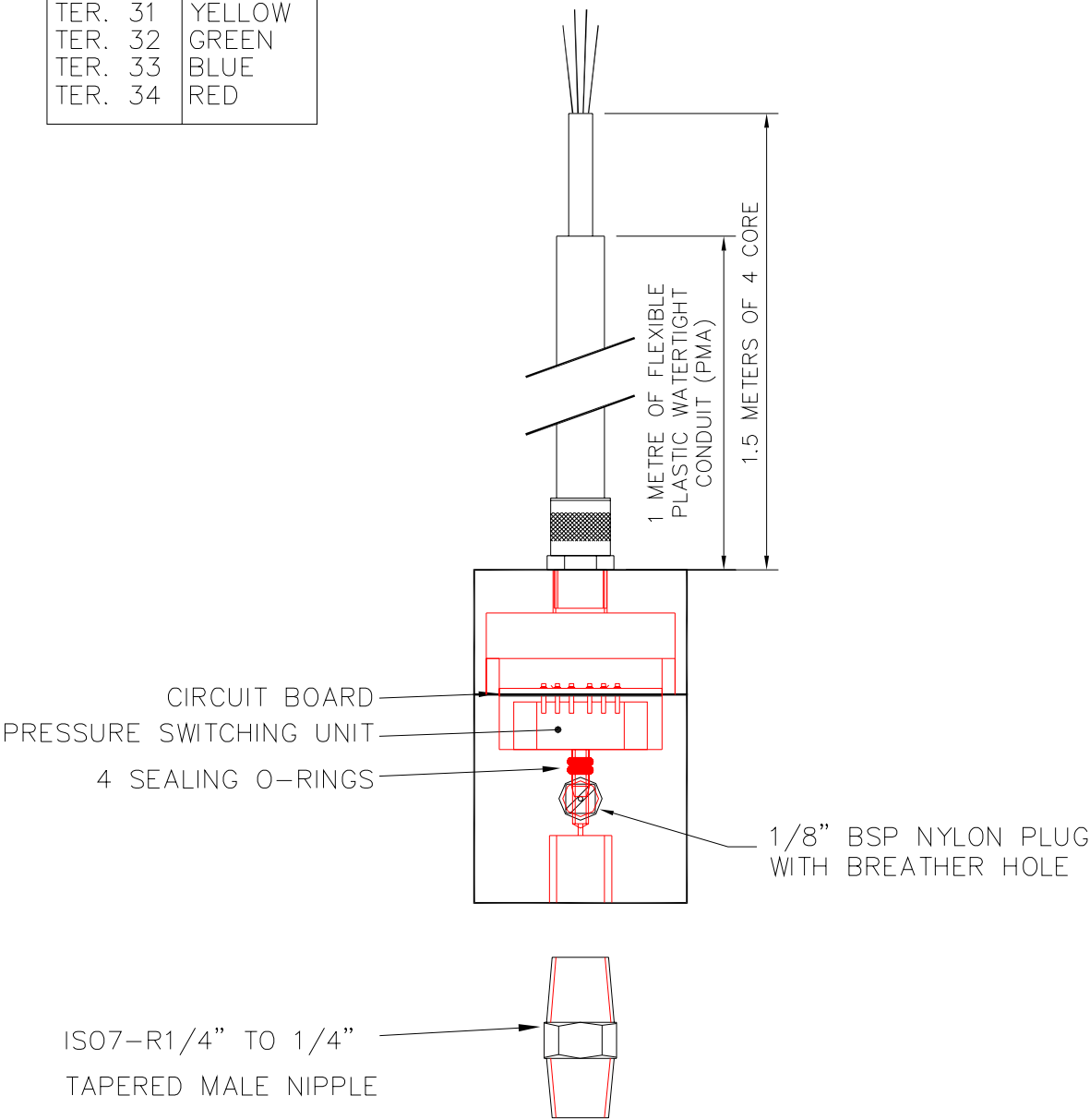
MK6 PRESSURE SENSORS ARE DUAL CHANNEL & SELF CHECK.



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

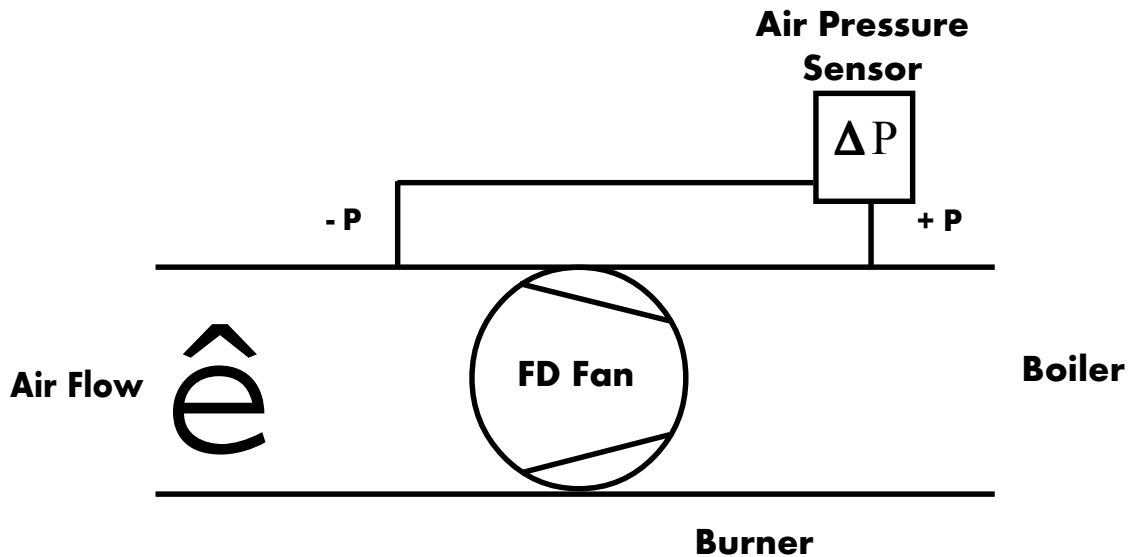
CONNECTIONS		
MK.6	MM	SENSOR
TER.	31	YELLOW
TER.	32	GREEN
TER.	33	BLUE
TER.	34	RED



NOTES:	
IP	00
HOUSING & END CAP :	ALUMINIUM
POWER CONSUMPTION :	0.1 WATTS
MOUNTING :	VERTICAL AS SHOWN
	PORTS MUST BE KEPT FREE FROM WATER
	RUN TUBING TO PORTS DOWNWARDS
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 2.5 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.

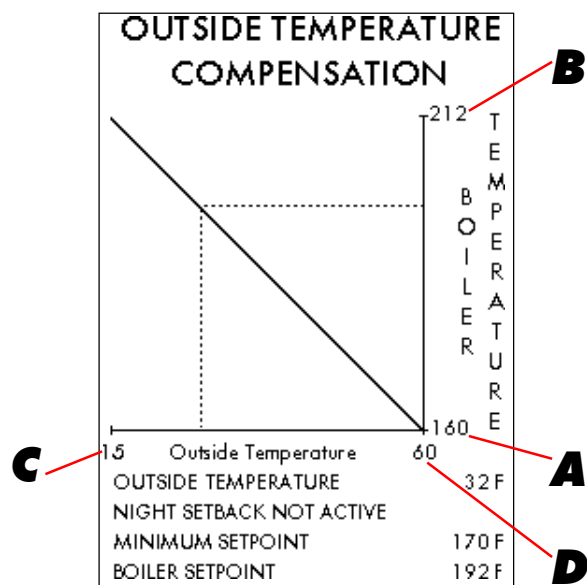


See options #145 to 149

2.14.2.8 OUTSIDE AIR TEMPERATURE COMPENSATION

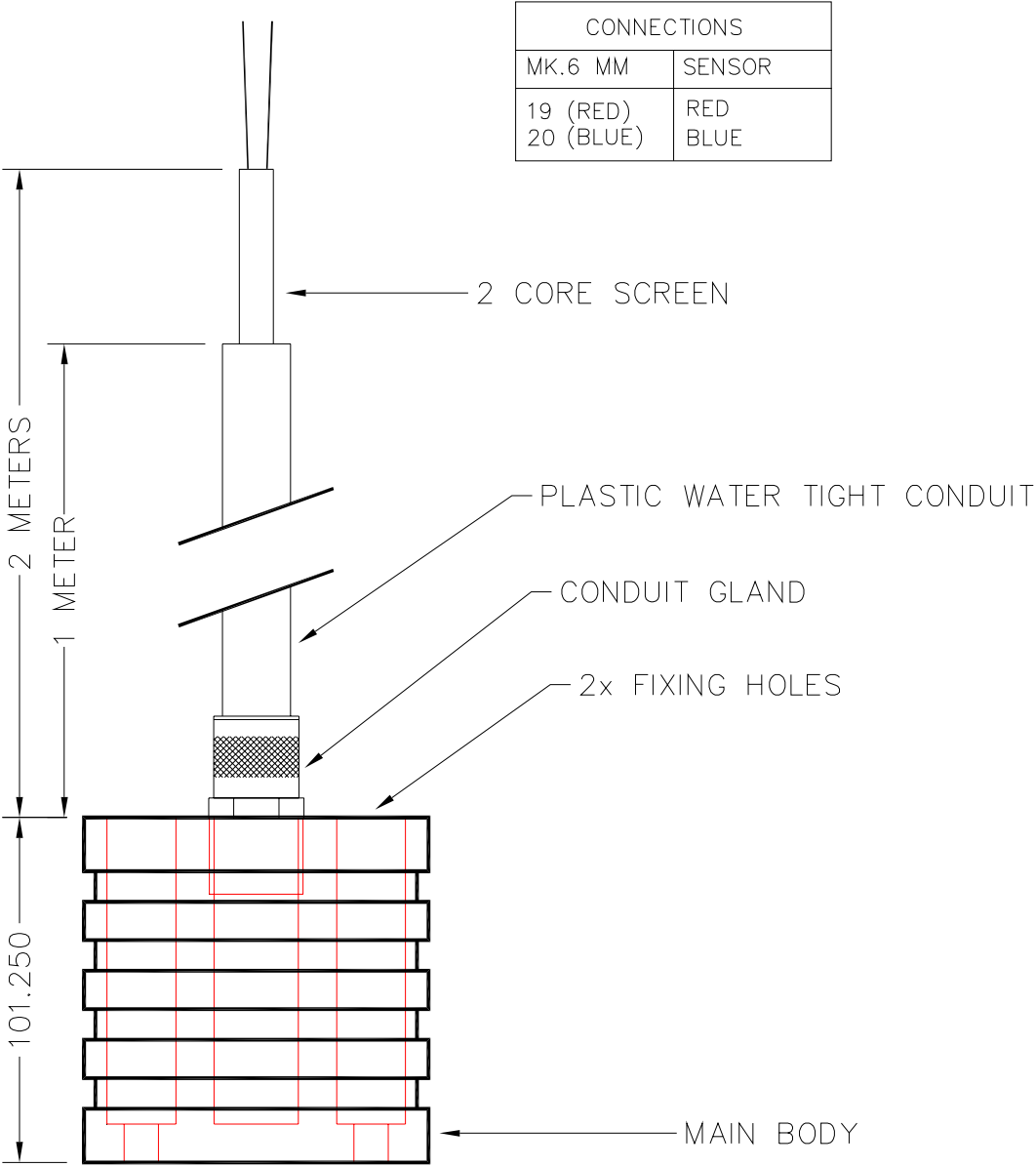
This enables the boiler setpoint to be varied according to the outside air temperature, i.e. as the air temperature drops the boiler setpoint can be increased accordingly.

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. Previously on the Mk6, the outside temperature scale ran from right to left as the outside temperature increased and nominal values were set.



	Option No.	Factory Setting	Option Value	Description
A	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.
	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

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



NOTE: IP 54
HOUSING : ALUMINIUM
POWER CONSUMPTION : POWERED BY MK.6 MM
MOUNTING : ANY ORIENTATION

2.14.2.9 Mk.6 Electrical Specifications

2.14.2.9.1 Classifications

Classification According to EN298 - F B L L J B

Mains Supply: 230V, +10%/-15% } 47.5 - 63 Hz, Unit max. power consumption 45W
120V, +10%/-15% }

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. 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		
		64	250mA	To drive relay/lamp only	
		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		
		64	250mA		
		78	100mA	To drive relay only - switched neutral	
		79	100mA	To drive relay/lamp only -switchedneutral	
Analogue I/O.s		240 Ω or less.			

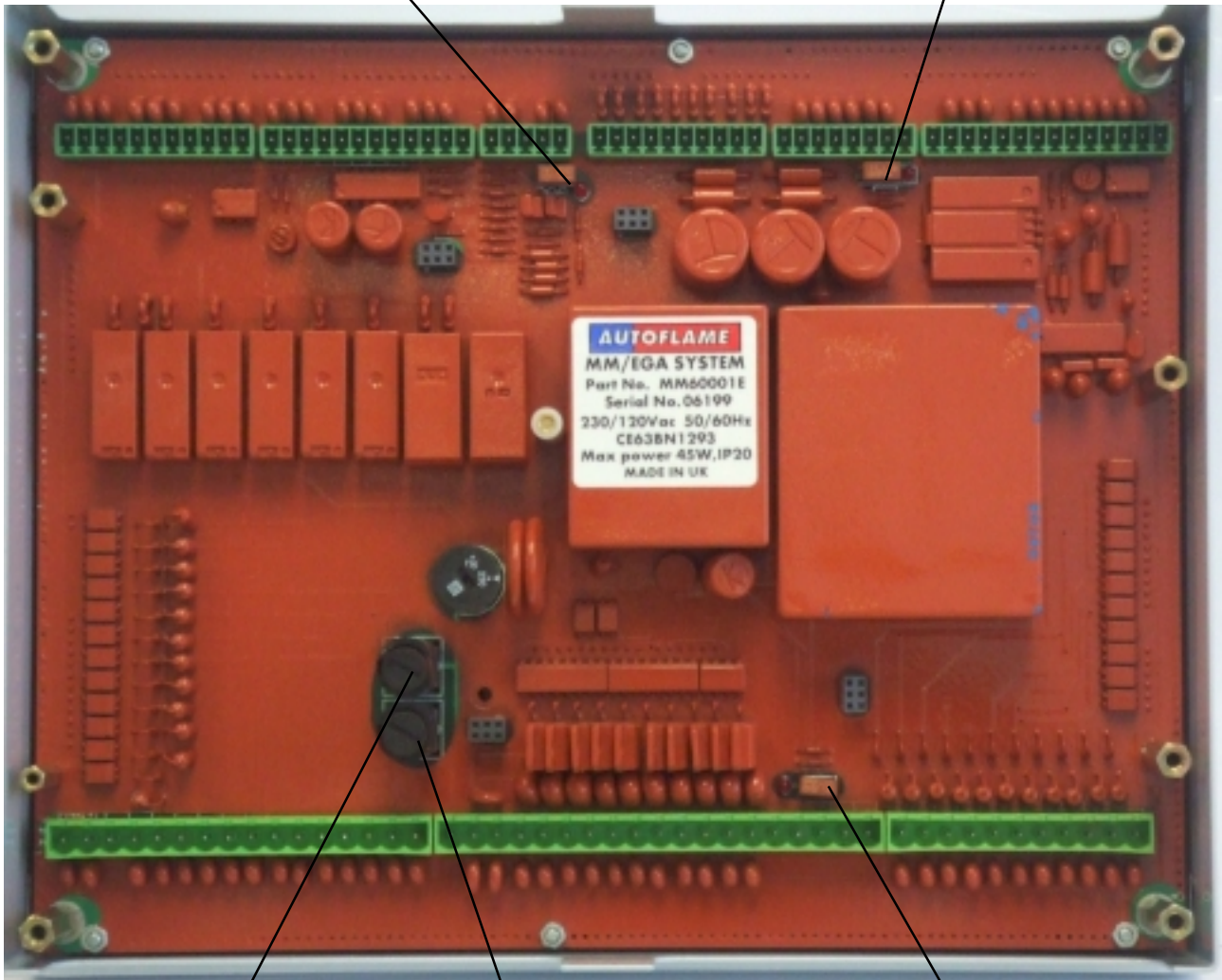
Note:

- 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.

2.14.2.9.2 Fuse Ratings

630mA(T) Time lag
Part No. FU10028
(Internal Electronic
Fault)

2A(T) Time lag
Part No. FU10027
(Short Circuit on 12V)



230V/110V Mains Supply
230V - 2A(T) Time lag
120V - 2A(T) Time lag
Part No. FU10034
(Servo Short Circuit)

6.3A(T) Time lag
Part No. FU10026
(Terminals #50 to 64)

630mA(T) Time lag
Part No. FU10028
(UV Shutter Short
Circuit)

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.

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 setpoint- 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 to the mains earth/ground terminal 66. 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;

2. 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 drawing #3246- 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.

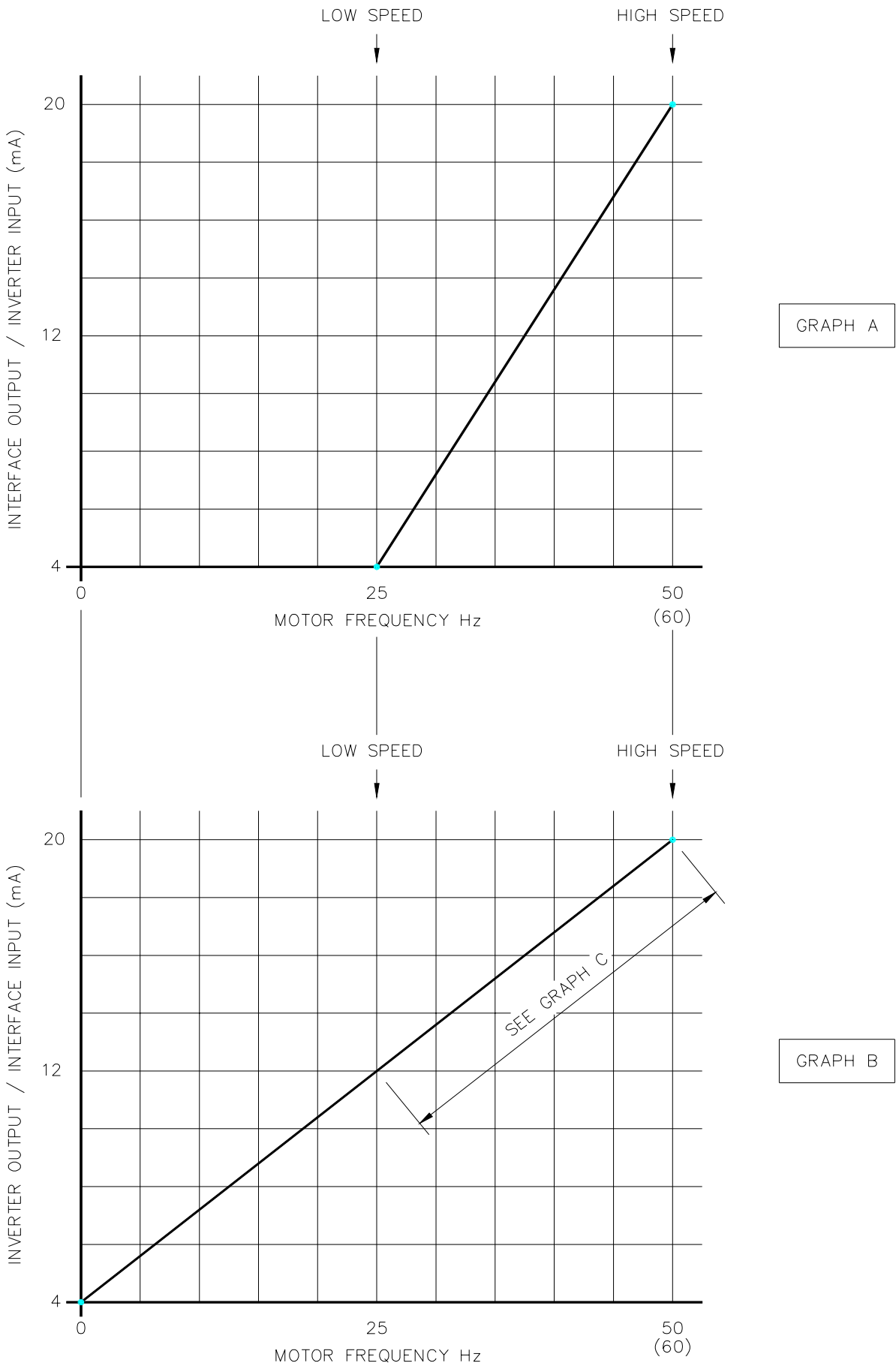
Disturbances caused by radiation from the motor cable can be reduced by installing in-line chokes in the motor cable. However, these chokes may reduce the motor voltage and the maximum available torque. If noise problems exist and unstable output signals cannot be contained within the window and disparity band shown on drawing #2335 (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.

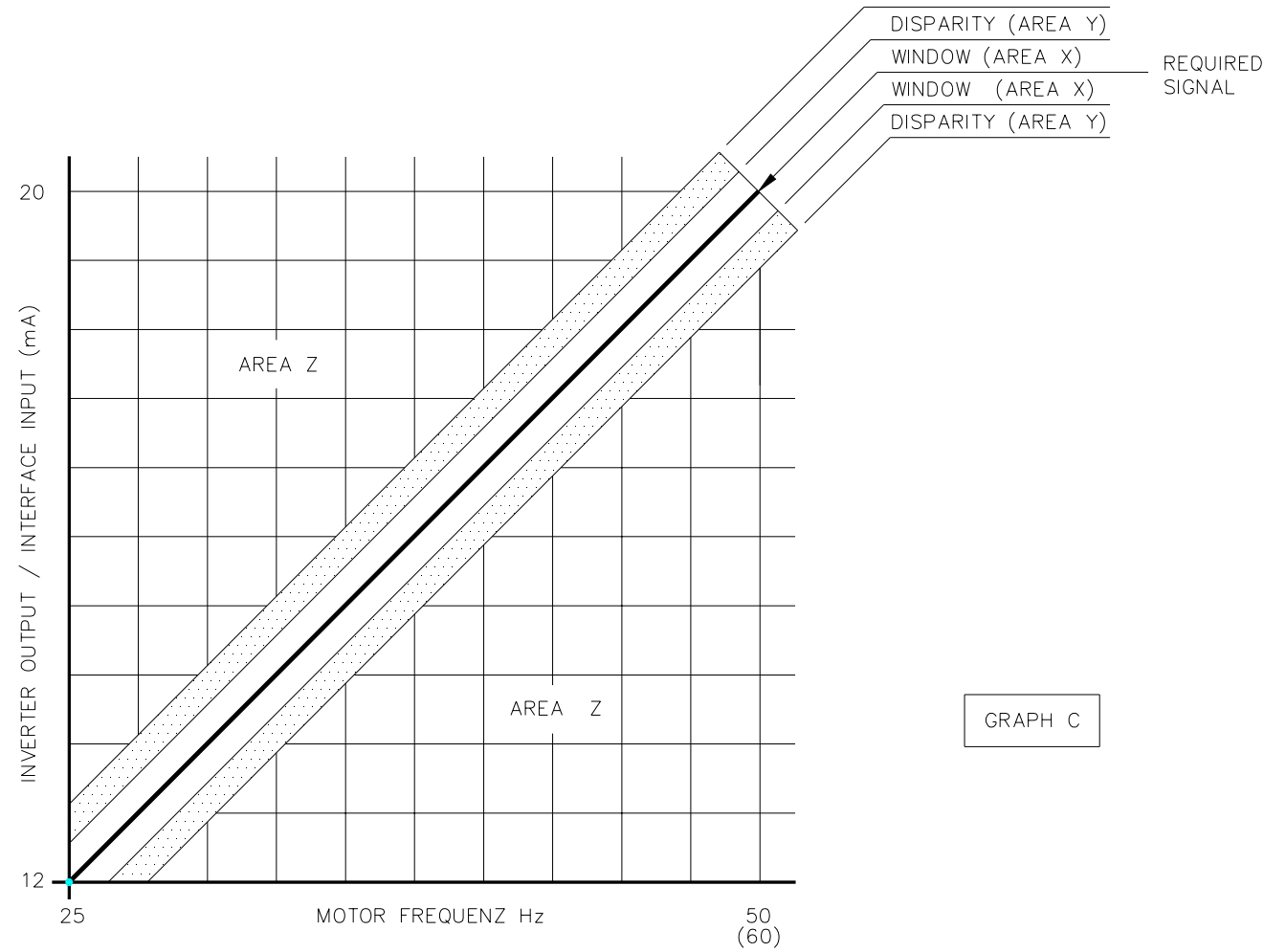
Normal settings would be, low speed 25Hz and high speed 50/60Hz. It is not recommended to set low speed lower than 20Hz. This is because the feed back signal tends to be unstable in this range and over heating of the motor may occur.

Input and Output Signals in Relationship to Frequency



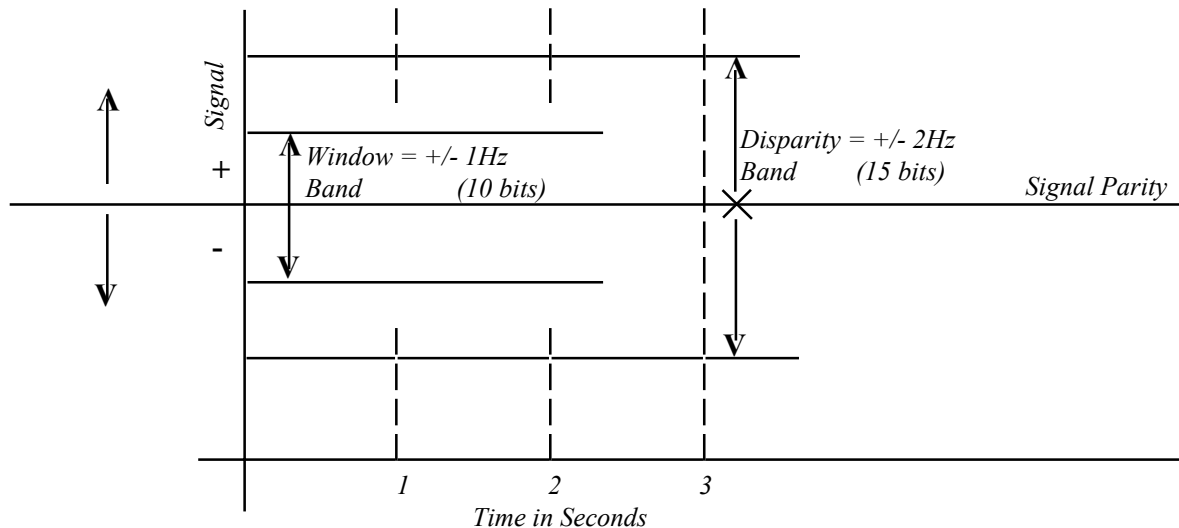
Operational Characteristics of Inverter Output/Interface Input in Relationship to Frequency

WINDOW: CORRECT SIGNAL $\pm 0.4\text{mA}$ or 0.2V
DISPARITY: SIGNAL CORRECTS FOR 3 SECONDS $\pm 0.8\text{mA}$ or 0.4V



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.

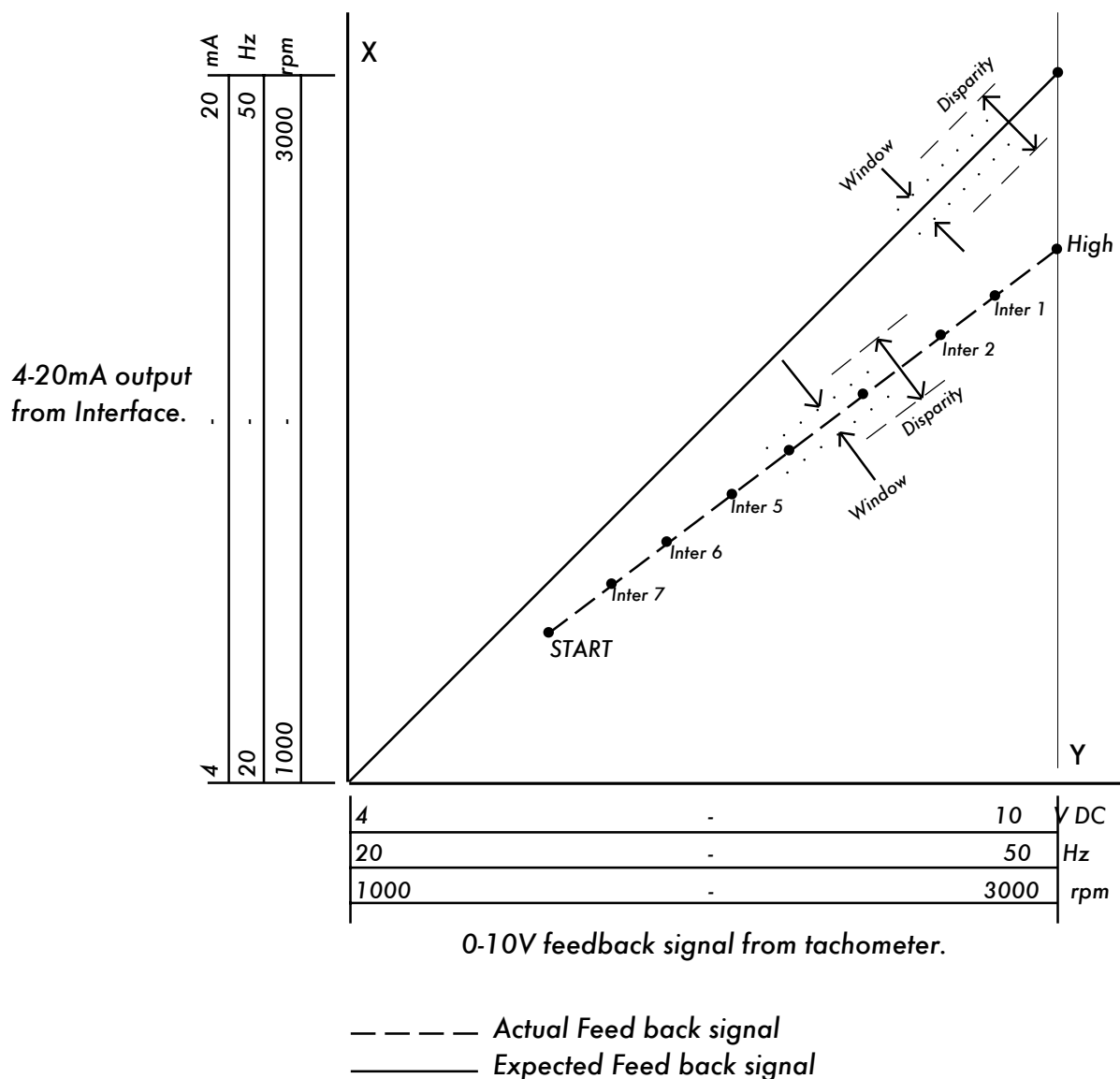
- Notwithstanding the above, to deal with transients of a very small time scale but of an amplitude greater than the disparity (area Y) as in drawing #2335 (section 2.14.2.10.3), there is an additional mechanism in the software that allows transient deviations of any amplitude to be tolerated for a duration of less than one second. Under these conditions an error will not be flagged.
Note: Drawing #2335 (area Z). Any signal deviation longer than one second in area Z will activate safety errors. The tolerance safety time is set for 3 seconds.
- The "Window" tolerance is ± 5 bits = 1 Hz = 58rpm (on a motor rotating at 2900rpm at 50Hz).
- 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.
- Fan laws state that:
 - Speed and volume are a direct linear progression.
 - Speed increase as a percentage affects pressure produced by the fan as a square root function.
- 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

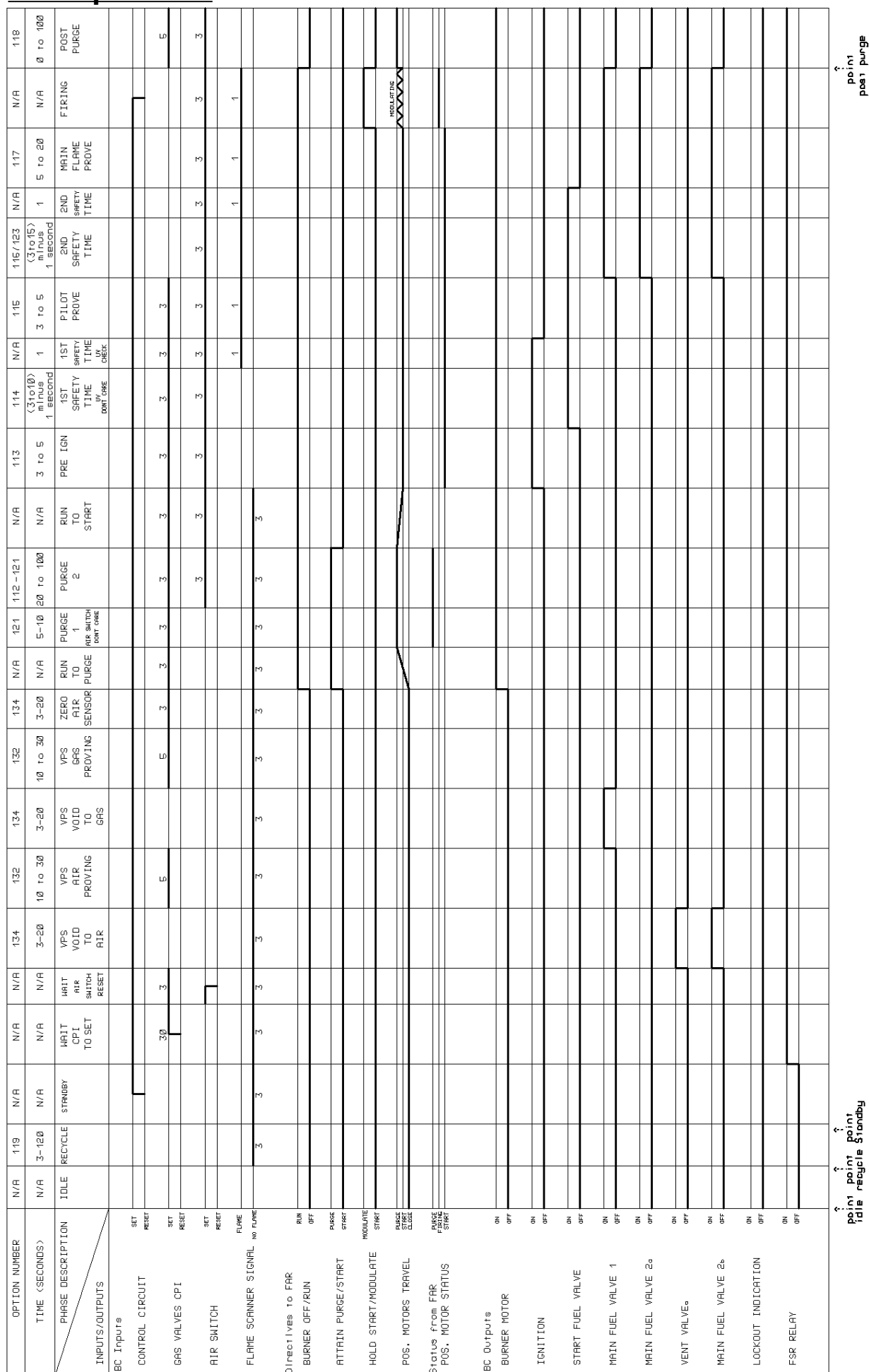
When the installation and all burner adjustments are completed, the entire burner control system should be tested in accordance with the manufacturer's instructions. The procedure should verify the correct operation of:

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

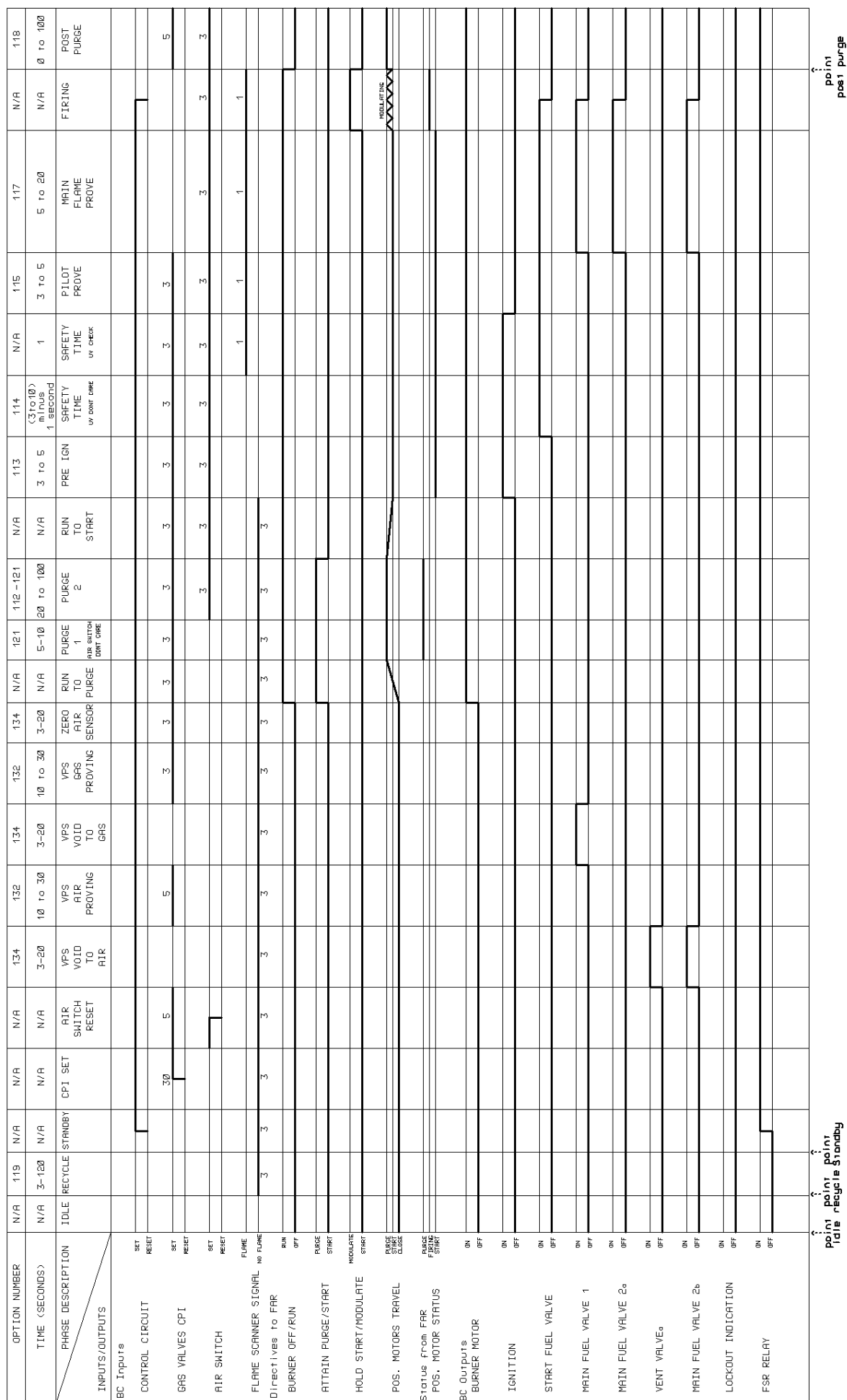
1. Close manual main shut-off valve.
2. Recheck all limit circuit wiring for proper operation and correct connection.
3. Confirm that the automatic main fuel valves are wired correctly.
4. Power the control and electronically check the proper sequence of operation.
5. After assuring yourself that all 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.

Interrupted Pilot



OPTION NUMBER	TIME <SECONDS>	N/A	N/A
PHASE DESCRIPTION			
INPUTS/OUTPUTS		NORMAL LOCKOUT	SPECIAL LOCKOUT
BC Inputs			
CONTROL CIRCUIT	SET RESET		
GAS VALVES CPI	SET RESET		
AIR SWITCH	SET RESET		
FLAME SCANNER SIGNAL	FLAME NO FLAME		
Direcitives 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	PURGE START		
POS. MOTOR STATUS			
BC Outputs			
BURNER MOTOR	ON OFF		
IGNITION	ON OFF		
START FUEL VALVE	ON OFF		
MAIN FUEL VALVE 1	ON OFF		
MAIN FUEL VALVE 2 _a	ON OFF		
VENT VALVE _a	ON OFF		
MAIN FUEL VALVE 2 _b	ON OFF		
LOCKOUT INDICATION	ON OFF		
FSR RELAY	ON OFF		

Intermittent Pilot



Section 2.14.3.1.4

[illegible]

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 1 second or the front facia lockout reset button is pressed for 1 second.

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 special lockout 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.

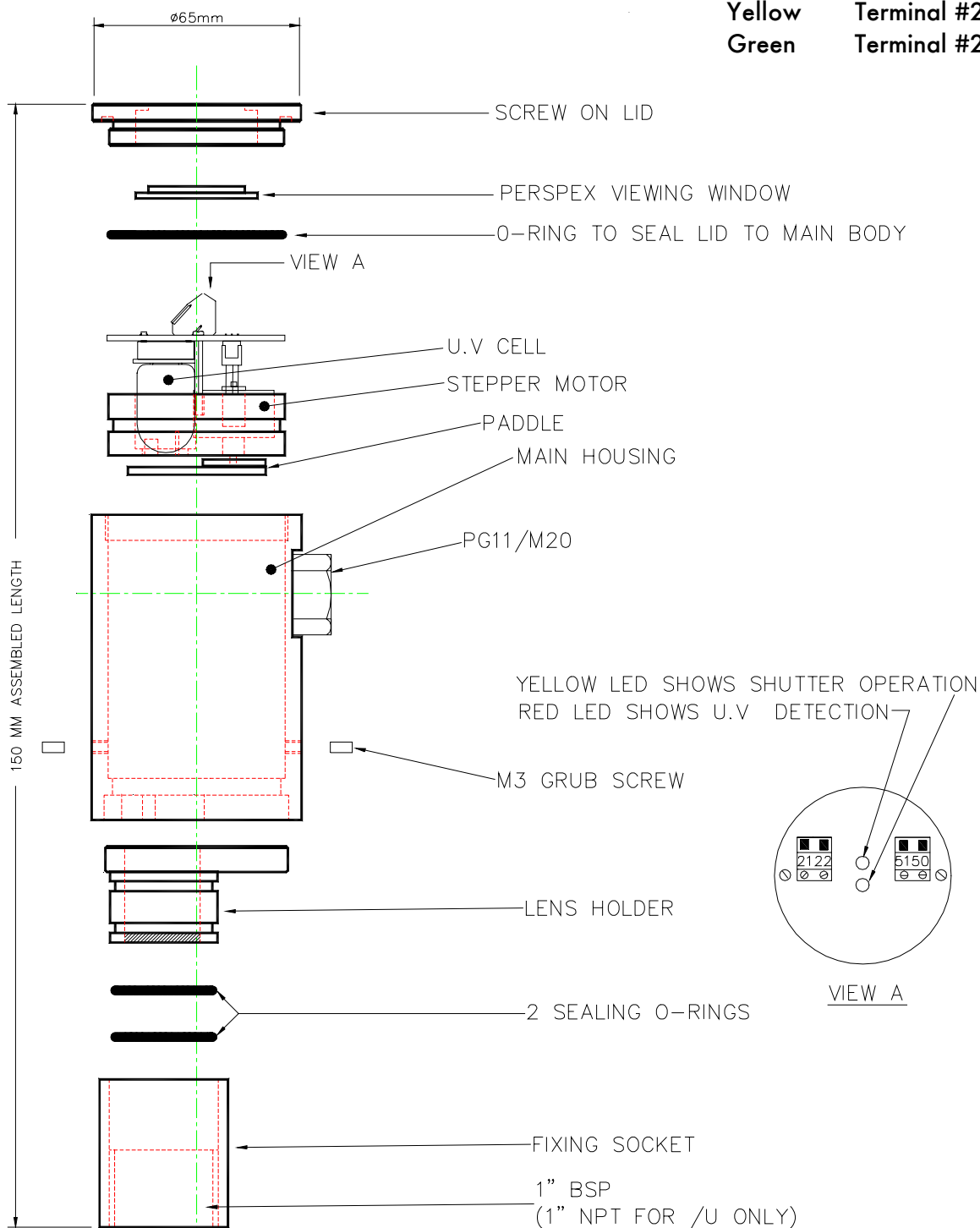
2.14.3.2 Self Check UV Scanner

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

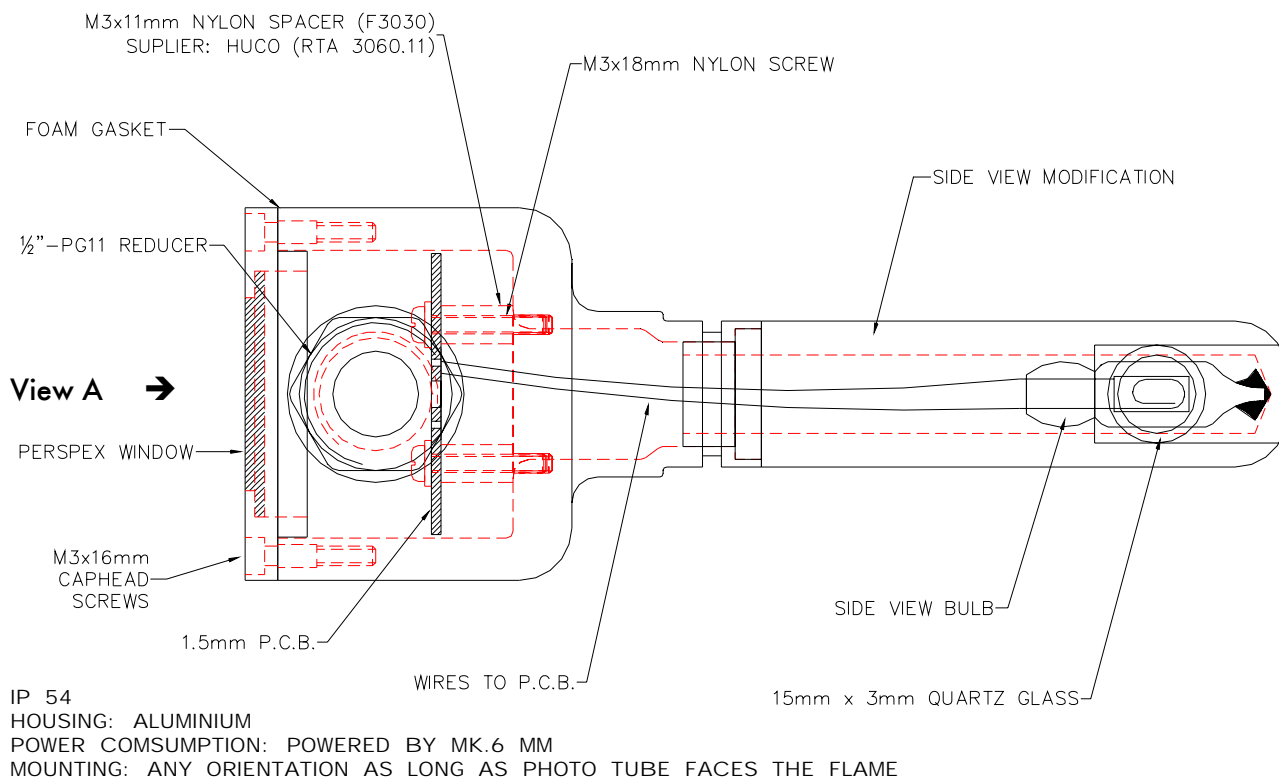


28:10:99/3406/JCF

2.14.3.3 Standard European UV Scanner - Side-viewing

Part Numbers: MM60004
MM60004/HS

Maximum operating temperature- 60°C / 140°F



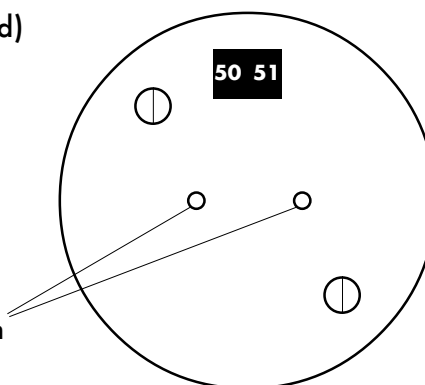
Connections

Red	Terminal 51
Blue	Terminal 50
Black	Screen

View A
(with cover removed)

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

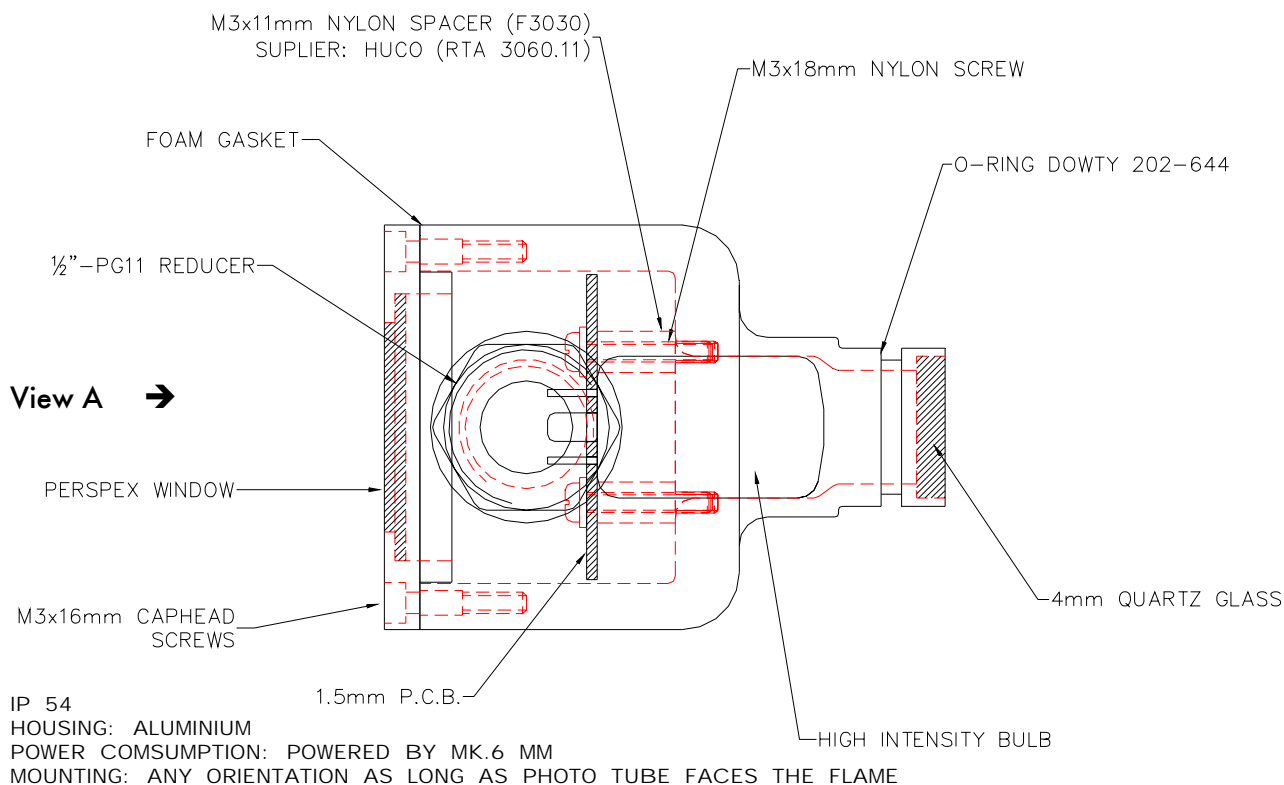
Two red LEDs show UV detection



2.14.3.4 Standard North American UV Scanner - End viewing

Part Numbers: MM60004/U
MM60004/HSU

Maximum operating temperature- 60°C / 140°F



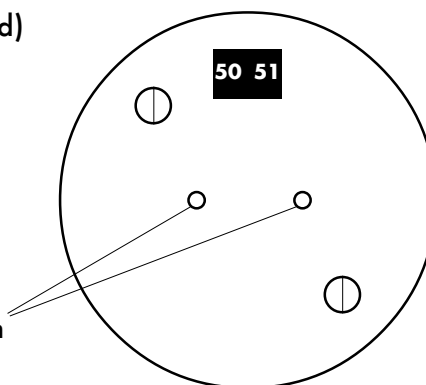
Connections

Red	Terminal #51
Blue	Terminal #50
Black	Screen

View A
(with cover removed)

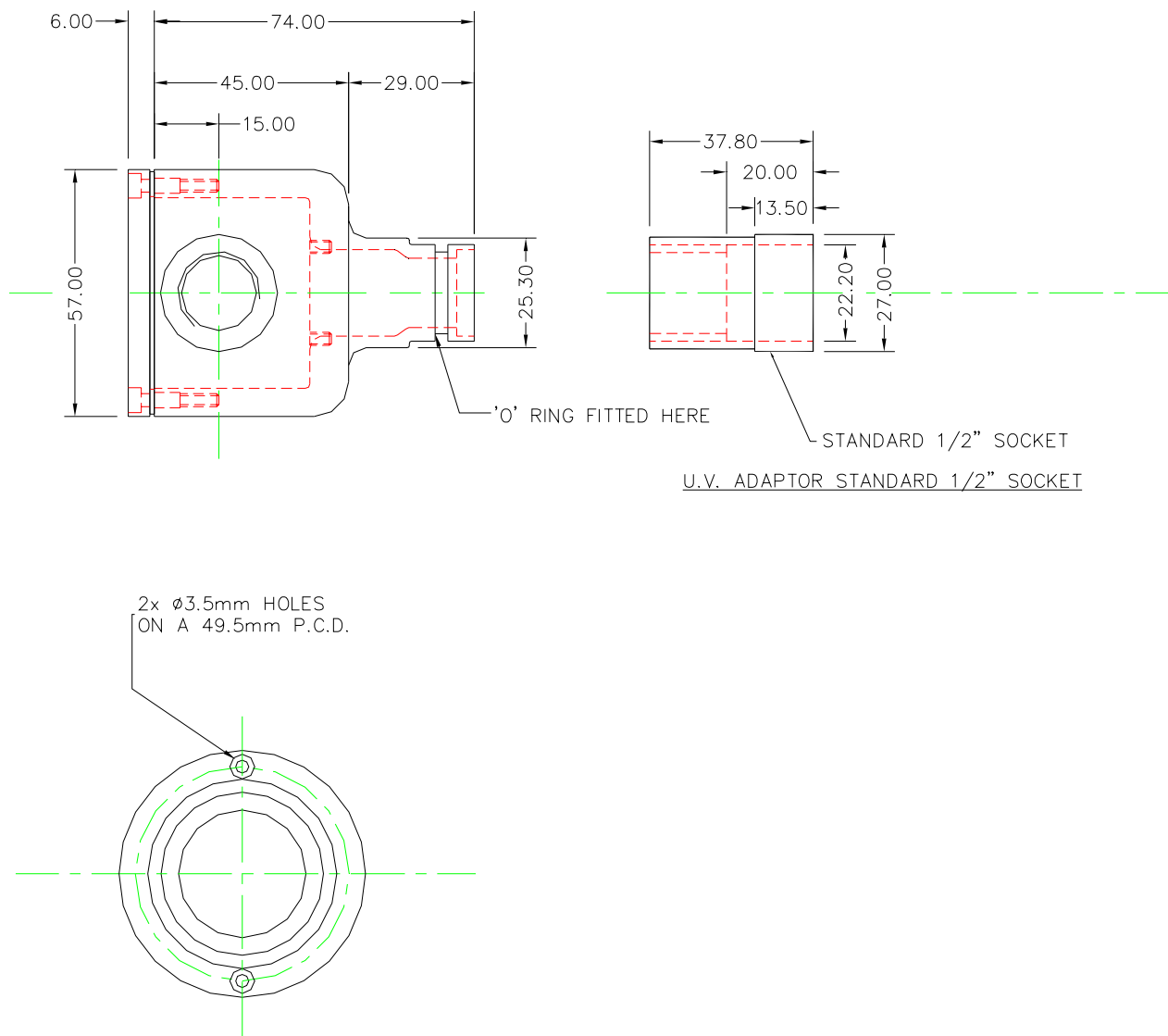
Note: If wired incorrectly a limited U.V. will be detected but the L.E.D. will not illuminate.

Two red LEDs show UV detection



2.14.3.4 Standard North American UV Scanner - End Viewing 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

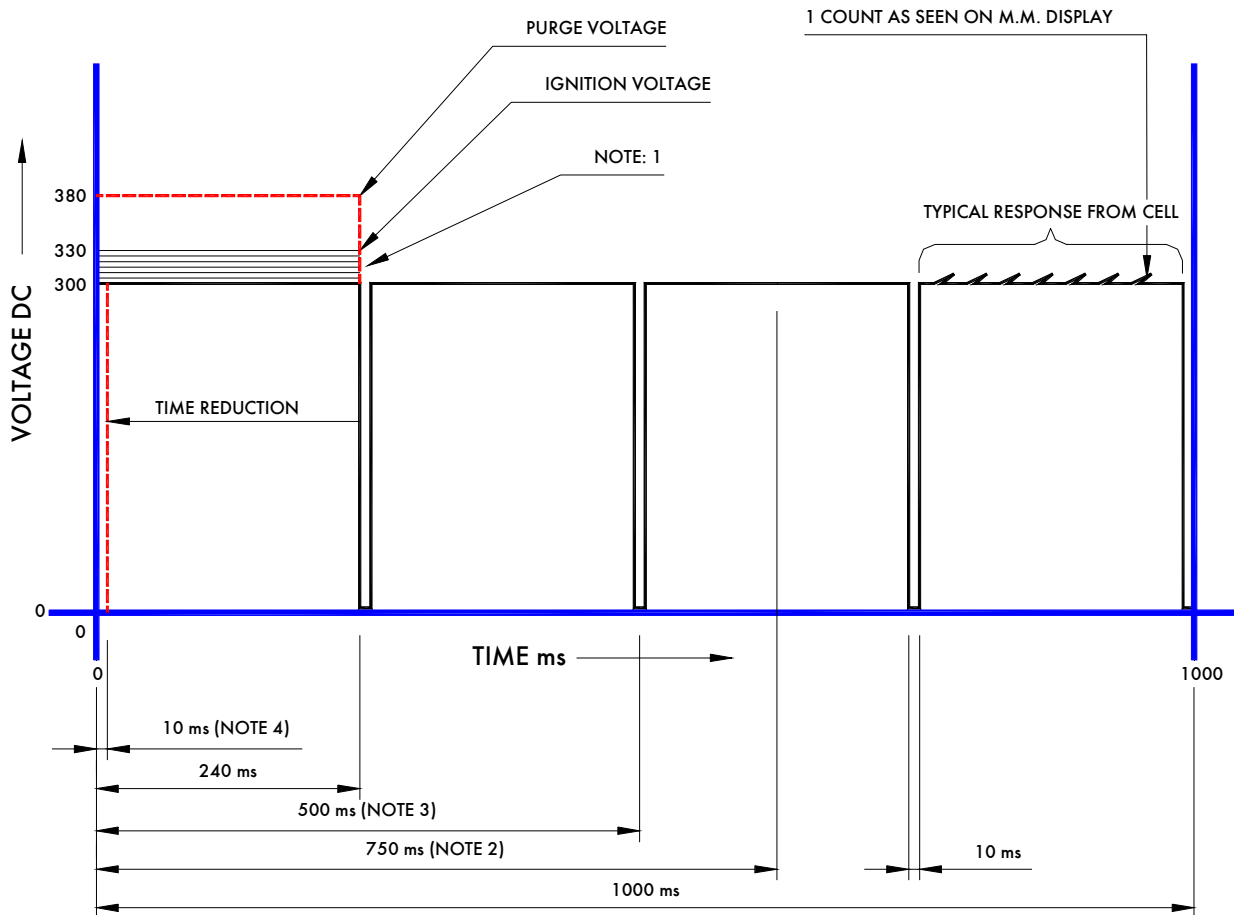
If the distance from the UV scanner to the flame exceeds 20 inches (500mm) the high sensitivity UV scanner types are recommended. The maximum distance from the flame is dependant on the amount of radiated UV. This will vary between applications but the typical maximum distance is 6ft (1500mm).

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, 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.

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
CH2 Positioning Error	02
CH3 Positioning Error	08
CH4 Positioning Error	09
CH1 Gain Error	41
CH2 Gain Error	42
CH3 Gain Error	43
CH4 Gain Error	46
CH5 VSD Error	80
CH6 VSD Error	81
CH5 VSD Feedback Error	83
CH6 VSD Feedback Error	84
	- CH5 variable speed drive error
	- CH6 variable speed drive error
	- CH5 variable speed drive feedback signal different to commissioned values
	- 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
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
Vent valve output fault
Main gas output 1 fault
Main gas output 2 fault
Start gas output fault
Motor output fault
Ignition output fault

57
62
61
60
59
58
63

These terminals are self checked within the Mk6. If a voltage is detected when the output is off (and vice versa) a lockout occurs.

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
Watchdog fault 1b
Watchdog fault 1c
Watchdog fault 1d
Watchdog fault 2a
Watchdog fault 2b
Watchdog fault 2c
Watchdog fault 2d

Internal fault diagnostics - contact
Autoflame and report code displayed.

Ram test failed
Prom test failed
CPU test failed
Input fault
BC input short
Lockout 198
Lockout 199
Lockout 200
Lockout 201
Lockout 202

Internal fault diagnostics - contact
Autoflame and report code displayed.

Terminal 86 inverse

Terminals #85/86 both have an input or terminals #85/86 both do not have an input when using the flame switch operation- see option #122

Terminal 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

Option 118 incorrect

If using the NFPA post purge (option #135 = 2) then option #118 must have a setting of 15 or above.

Gas Sensor Related

Sensor supply voltage
Zero low gas sensor
Zero high gas sensor
Excessive VPS Operations
Signal dev - gas sensor
Counts low - gas sensor
Counts high - gas sensor
Signal high - gas sensor
Gas sensor (+ number)

12V supply to sensor outside limits (11.75 - 12.25V)
see section 2.14.2.6.2 for zero limits
see section 2.14.2.6.2 for zero limits
VPS has operated 3 times without burner firing
redundant signals from sensor do not match
sensor fault - stuck on signal value
sensor fault - stuck on reference value
gas pressure exceeds maximum range value
sensor/Mk6 internal fault - report to Autoflame

Air Sensor Related


Sensor supply voltage
Zero low air sensor
Zero high air sensor
Signal dev - air sensor
Counts low - air sensor
Counts high - air sensor
Signal high - air sensor
Air sensor (+ number)

12V supply to sensor outside limits (11.75 - 12.25V)
lower limit is -1.0"w.g.
upper limit is +0.5"w.g.
redundant signals from sensor do not match
sensor fault - stuck on signal value
sensor fault - stuck on reference value
air pressure exceeds maximum range value
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.

2.14.4.3 TROUBLESHOOTING

Gas/air sensor Diagnostic Codes

Shown at the bottom of the  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.

AC Drive Diagnostic Codes

Shown at bottom right of the  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

2.14.5 END USER DAY TO DAY OPERATION

2.14.5.1 Normal Run Operation

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.

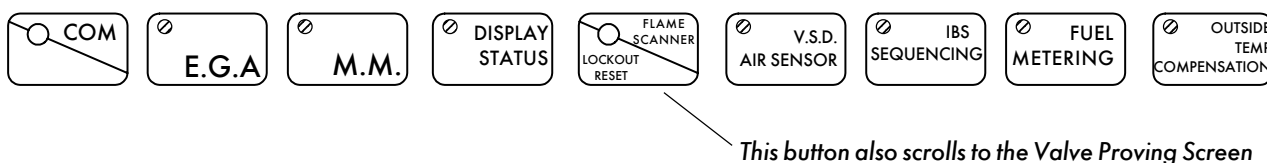
To adjust the required setpoint press  and use the third   row accordingly.

To adjust the second/reduced required setpoint press  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:



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, 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 EGA or COM modes are selected.

The software version number can be displayed 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. FUEL AIR RATIO		
CONTROL	POSITION	CHANNEL
GAS	90.0 °	CH 1
AIR	65.0 °	CH 2
FGR	51.0 °	CH 3
SLEEVE	56.0 °	CH 4
VFD	20.0 mA	CH 5
VFD	20.0 mA	CH 6

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.

IBS STATUS Steam Sequencing	
This Boiler	No.1
Lead Boiler	No.2
Reduced Setpoint	100 PSI
Warming	10 min in 60 min
Current Status	STANDBY

IBS Status

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

E.G.A. STATUS (ON LINE VALUES)		
O ₂	2.2	%Vol
CO ₂	10.5	%Vol
CO	12	ppm
NO	35	ppm
SO ₂	0.0	ppm
Exhaust	210	deg C
Ambient	21	deg C
ΔT	189	deg C
Eff	81.1	%

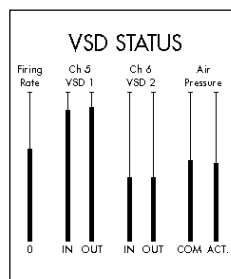
E.G.A. On Line Values

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.

LOCKOUT RECORD		
Occurred	5 March 1998	21:08:46
		Low gas pressure
Reset	5 March 1998	21:52:30
Occurred	5 March 1998	21:54:30
		Air sensor fail
Reset	5 March 1998	21:59:40
Occurred	5 March 1998	22:03:40
		Flame failure
Reset	5 March 1998	22:04:25
Thursday	5 March 1998	23:01:57

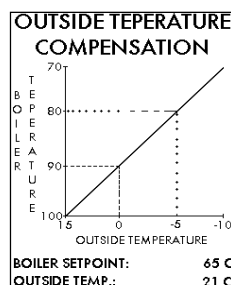
Lockout History.

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



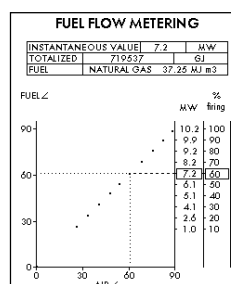
Variable Speed Drive

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.



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.



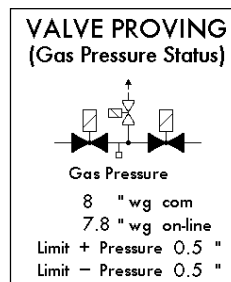
Fuel Metering Status

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

STATUS	
78 %	FIRING RATE
REQUIRED ACTIVE	
REQUIRED	130 PSI
REDUCED	70 PSI
REQUIRED-REDUCED LOCKED	
ACTUAL	115 PSI
T53 ON	
BURNER STOP	140 PSI
BURNER START	125 PSI
FUEL 1	NATURAL GAS

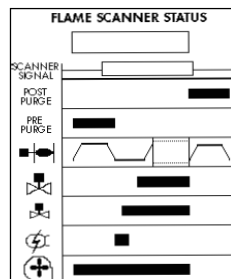
System Status

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



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.



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



light will be flashing and you have 5 seconds to press it).

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

'Set Clock' screen is displayed:

SET CLOCK	
DAY	MONDAY
DATE	17
MONTH	NOVEMBER
YEAR	97
HOURS	12
MINUTES	30

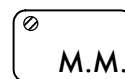
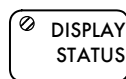
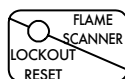
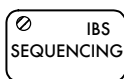
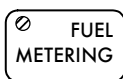
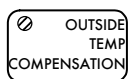
24 hour clock

To adjust the values use the corresponding buttons.

When finished press the flashing button to submit to memory.

Adjusting the Screen Contrast

Hold down any of the screen select buttons:



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 and the CH3 simultaneously.

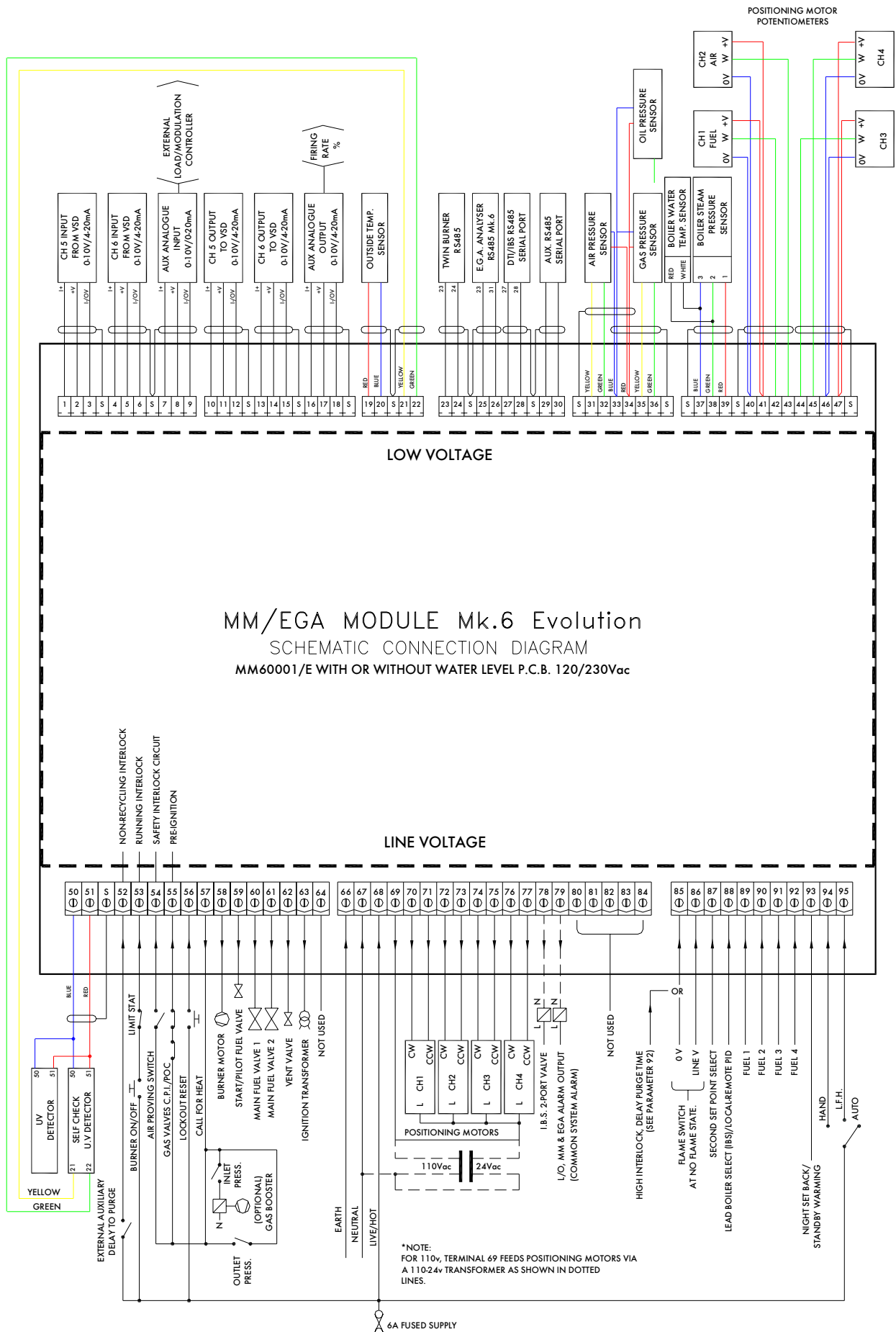
To decrease press and the CH3 .

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	5.03
MM	6.20
DI	6.20

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

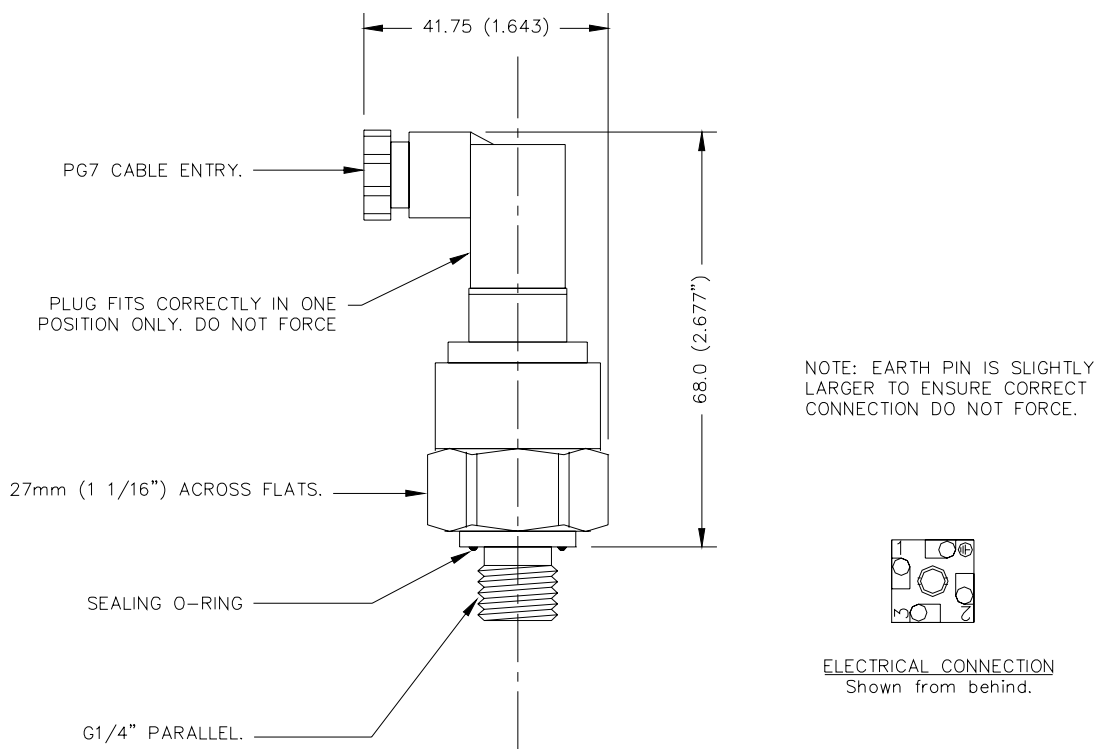


AUTOFLAME PRESSURE SENSOR PLUG TYPE
PART No.MM10008/9/10/16

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

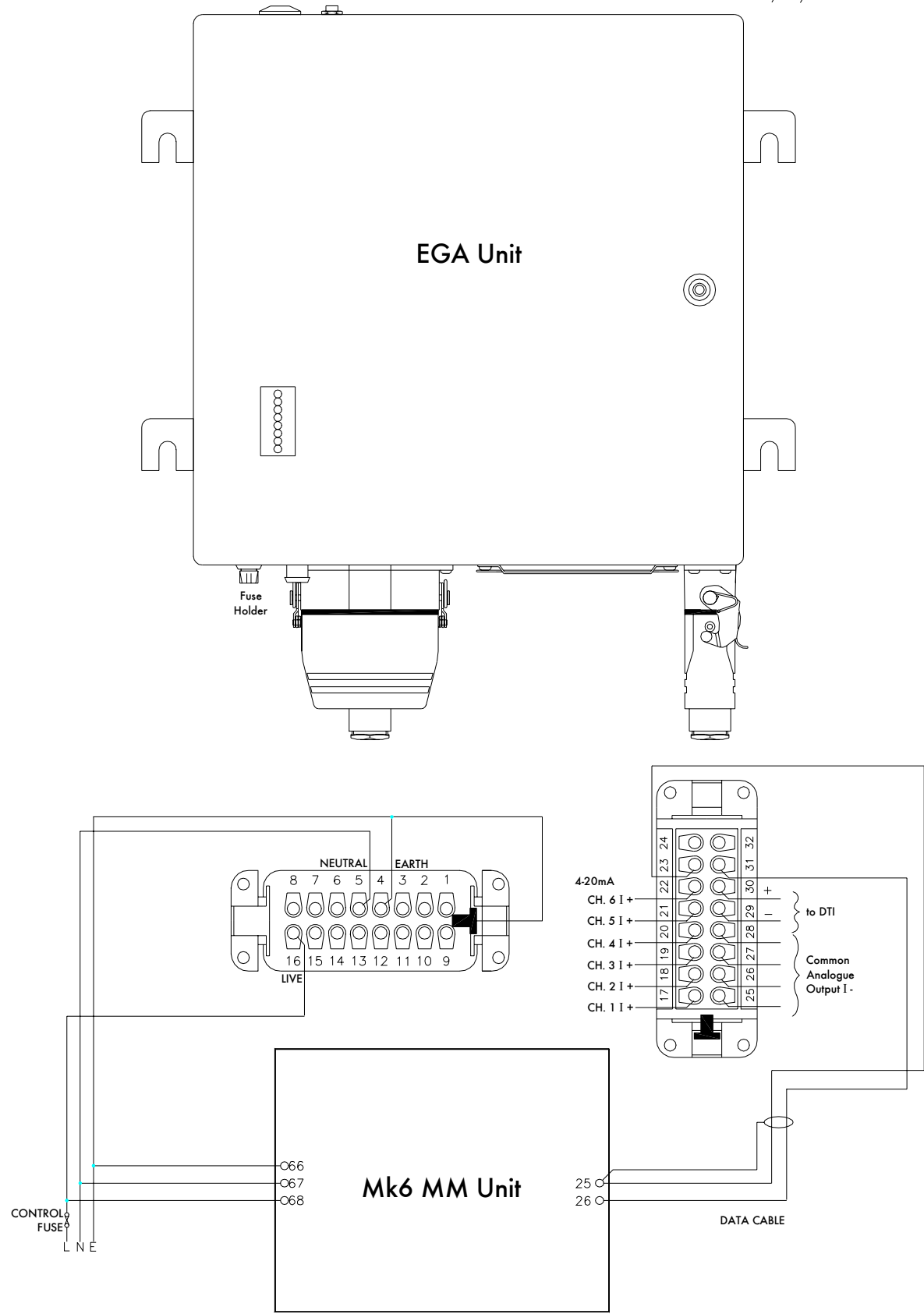
FOR CORRECT OPERATION THE DETECTOR MUST BE INSTALLED WITH A PRESSURE SIPHON LOOP. DO NOT INSTALL AN ISOLATION VALVE BETWEEN DETECTOR AND PRESSURE VESSEL



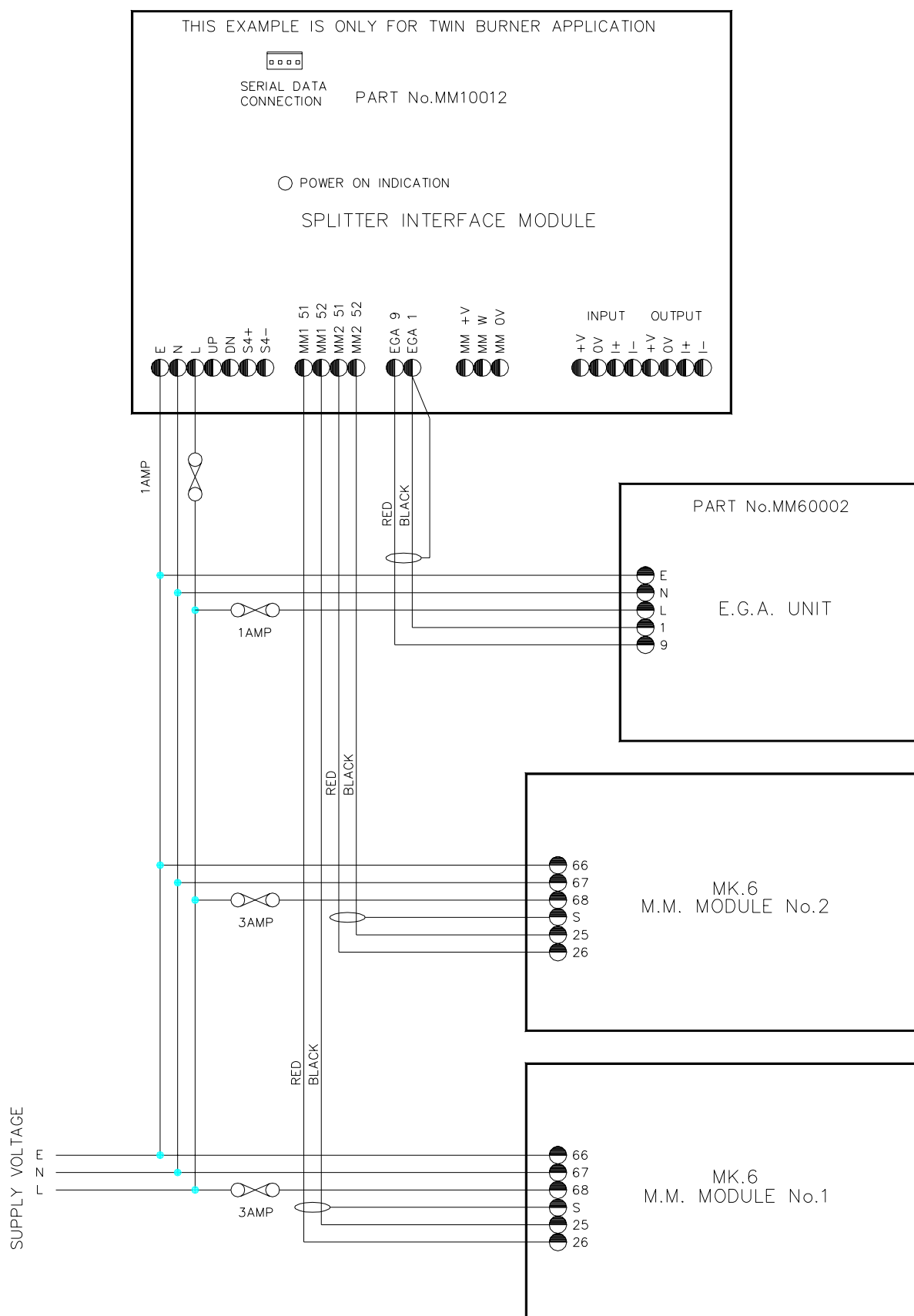
NOTES: MAXIMUM 2.5mm FLAT BLADE SCREW DRIVER FOR ELECTRICAL CONNECTIONS
I.P. RATING : 65 , NEMA 4
TORQUE SETTING = 15-20Nm
DO NOT USE CASE TO TIGHTEN PRESSURE CONNECTION.
O-RING MATERIAL = VITON
MAX. STORAGE TEMP. -25 TO +85 DEG. C
MAX. OPERATING TEMP. -25 TO +85 DEG. C
MEDIA TEMP (STEAM) -25 TO 85 DEG.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

<u>Pressure Sensor</u>	<u>Part no.</u>	<u>Actual Range</u>	<u>Proof Pressure</u>
0-18 Bar	MM10008	0 - 23.0 bar (30 - 330 P.S.I.)	450 psi
0-30 Bar	MM10009	0 - 38.0 bar (30 - 550 P.S.I.)	750 psi
0-3.0 Bar	MM10010	0 - 3.80 bar (3.0 - 55.0 P.S.I.)	200 psi

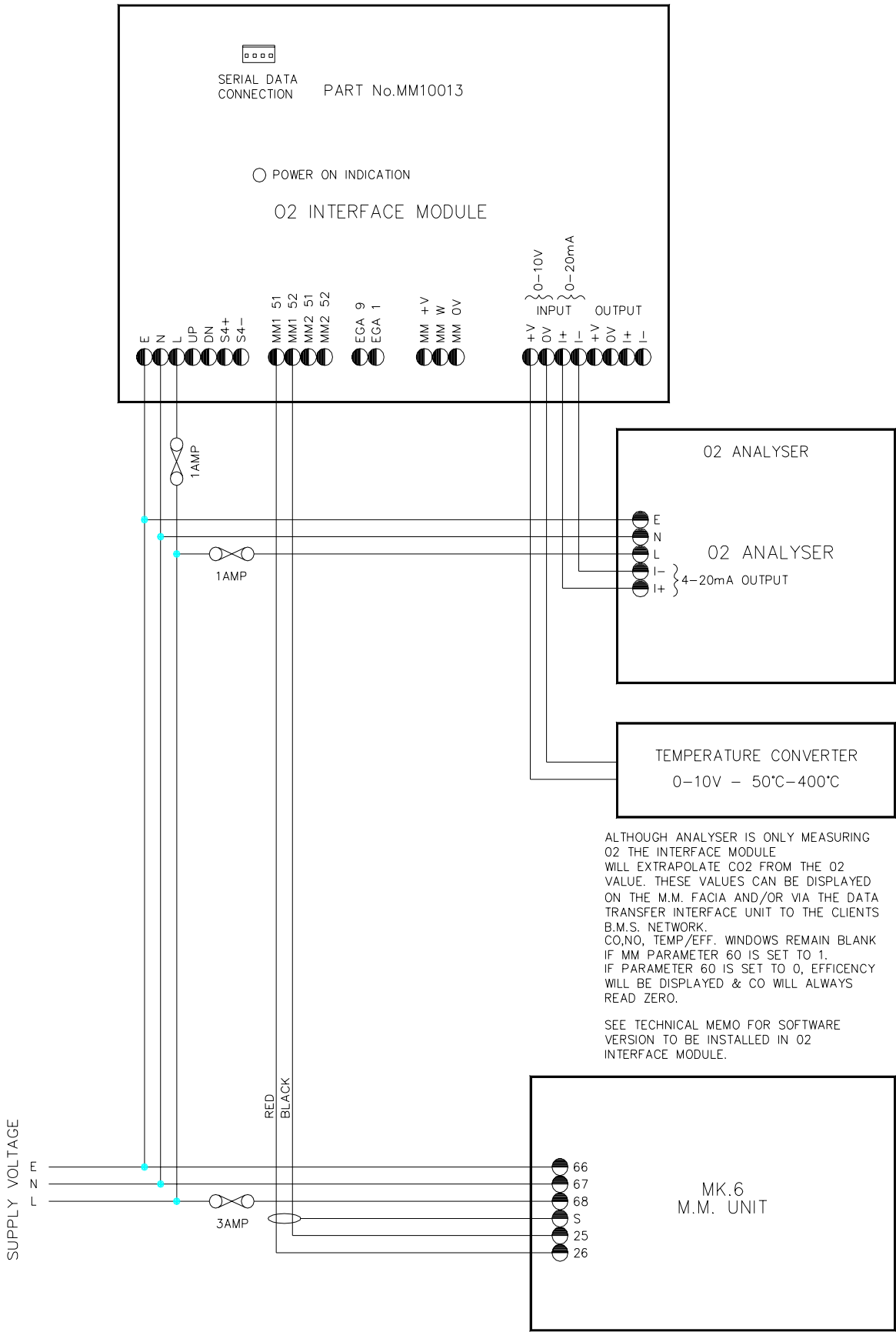
INTERCONNECTION BETWEEN MM MODULE
& EGA SAMPLING UNIT Mk.6
SERIAL No.2026 ONWARDS-6/9/99



INTERCONNECTIONS BETWEEN TWO M.M. MODULES & ONE E.G.A. UNIT VIA THE SPLITTER INTERFACE MODULE



INTERCONNECTION DIAGRAM FOR APPLICATION TO CONVERT O2 AND TEMPERATURE
SIGNALS FOR USE WITH MM VIA O2 INTERFACE MODULE



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 can 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  and  on one of the M.M. units.

Within 10 seconds press  and  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 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.

One M.M. unit will remain at the low fire position until the other unit is at the low fire position before outputting the low position interlock to the burner control box.

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.

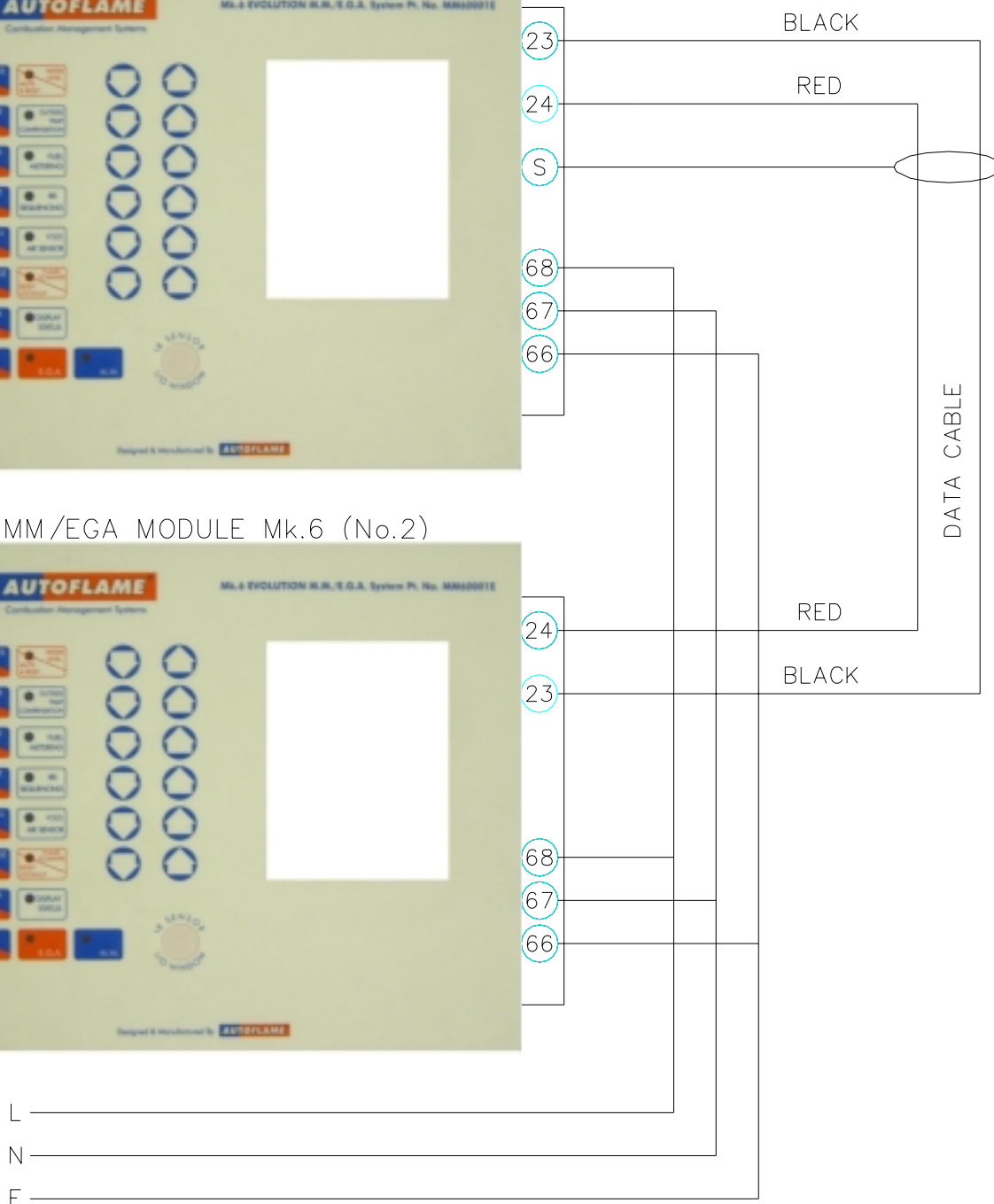
INTERCONNECTION BETWEEN MM/EGA
MODULES Mk.6

DIAGRAM SHOWN FOR TWIN BURNER APPLICATION

MM/EGA MODULE Mk.6 (No.1)



MM/EGA MODULE Mk.6 (No.2)



MAINS SUPPLY

NOTES:

DATA CABLE TYPE: BELDON 9501

CONNECT SCREEN OF DATA CABLE TO MM/EGA MODULE No.1 ONLY

The same arrangement applies to the Mini Mk6.

2.14.8 HAND/AUTO AND LOW FLAME HOLD 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 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 modulates according to the PID control.

Low flame hold is brought into operation if terminal #94 has a signal applied when the ignition part of the burner start up cycle takes place. The minimum flame position will be maintained from now on, until the input from terminal #94 is removed. Low flame hold will be established again by applying an input to terminal #94 again. During low flame hold the PID control is ignored.

'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 there is a mains signal on terminal #95. Once the burner is firing the 'hand' position can be adjusted by

switching to the M.M. 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.

2.14.9 FAULT FINDING

WARNING!!!!

**MAINS AND HIGHER VOLTAGES EXIST ON THE M.M. AND POSITIONING MOTORS.
THE SYSTEM CONTROLS A COMBUSTION PROCESS.**

Only competent personnel aware of the implications of the above warning should attempt fault finding. Personnel must be responsible for the conditions under which fault finding takes place. (e.g. isolation of fuel supply)

Note: Personnel not familiar with the system should carry out tests in the order written.

The method of fault finding described is for a system that has been working correctly and has gone wrong. It is not for trouble shooting new systems which may for example have incorrect wiring. It also will not turn up faults which are a result of tampering.

Before commencing any fault finding:-

Set option #12 to 0.

Set option #9 to value 0 (NOTE - only limit stat effective) or ensure that the actual value is sufficiently less than the required setpoint in order to allow the system to start up and run for a prolonged period.

The internal stat must be made in order for the stat circuit to be complete.

PRELIMINARY CHECK

If display is blank check for RUN led, if RUN led is also blank check mains supply to unit. Remove back cover of M.M. and check mains supply on terminals #66/67/68. If supply to unit is good, remove supply to unit and check fuse.

If unit is still blank it is likely there is a fault on the M.M.

Ensure there is no lockout condition.

Deselect fuel

Select fuel

Press  before COM l.e.d. stops flashing (5 seconds).

Check stat circuit is made.

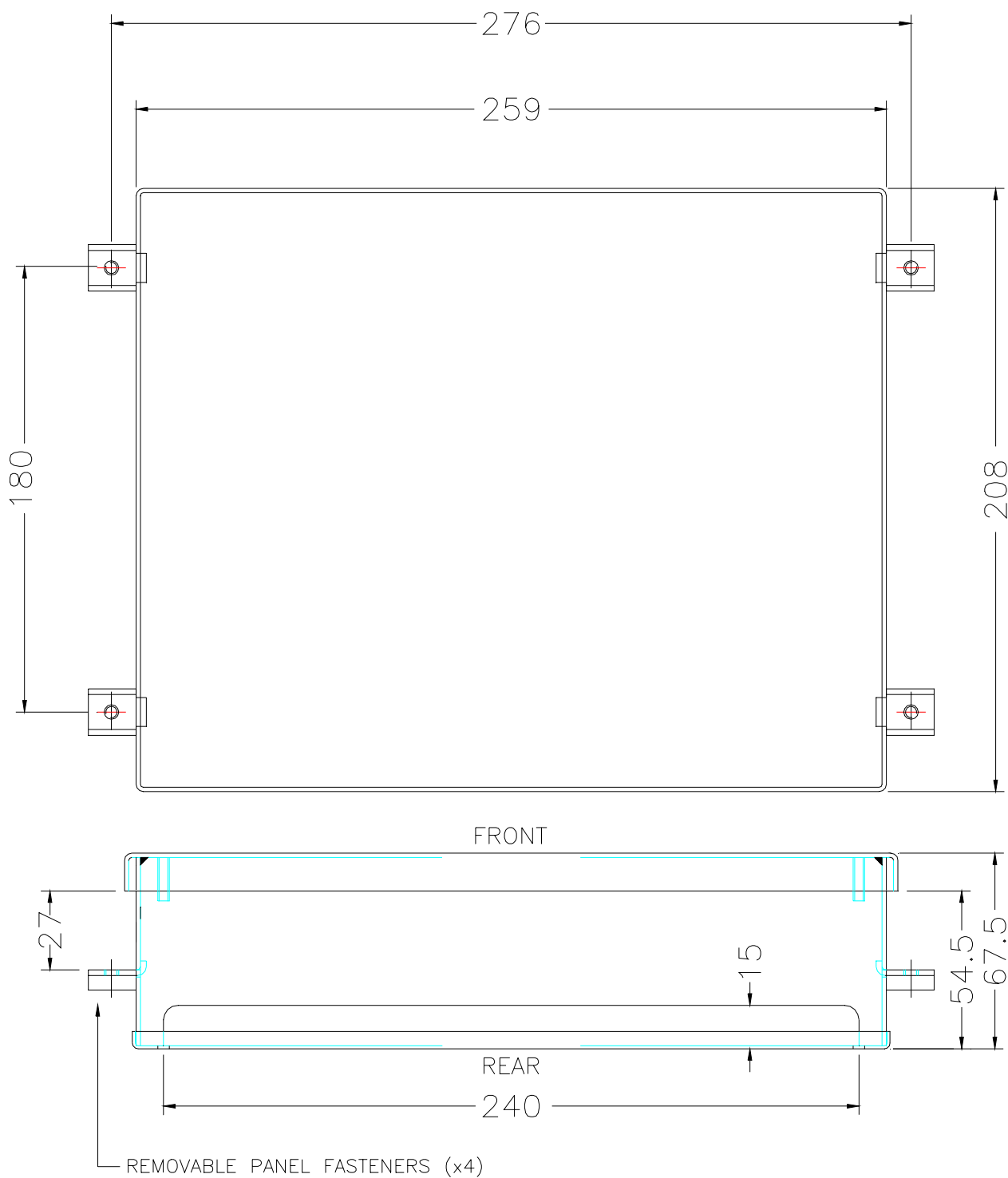
Refer to section 2.14.3.1 for the burner start up sequence and timings. Follow these through to find a possible fault.

2.14.10 OTHER INFORMATION AND ILLUSTRATIONS

2.14.10.1 Mk6 Evolution M.M. Front Facia Details

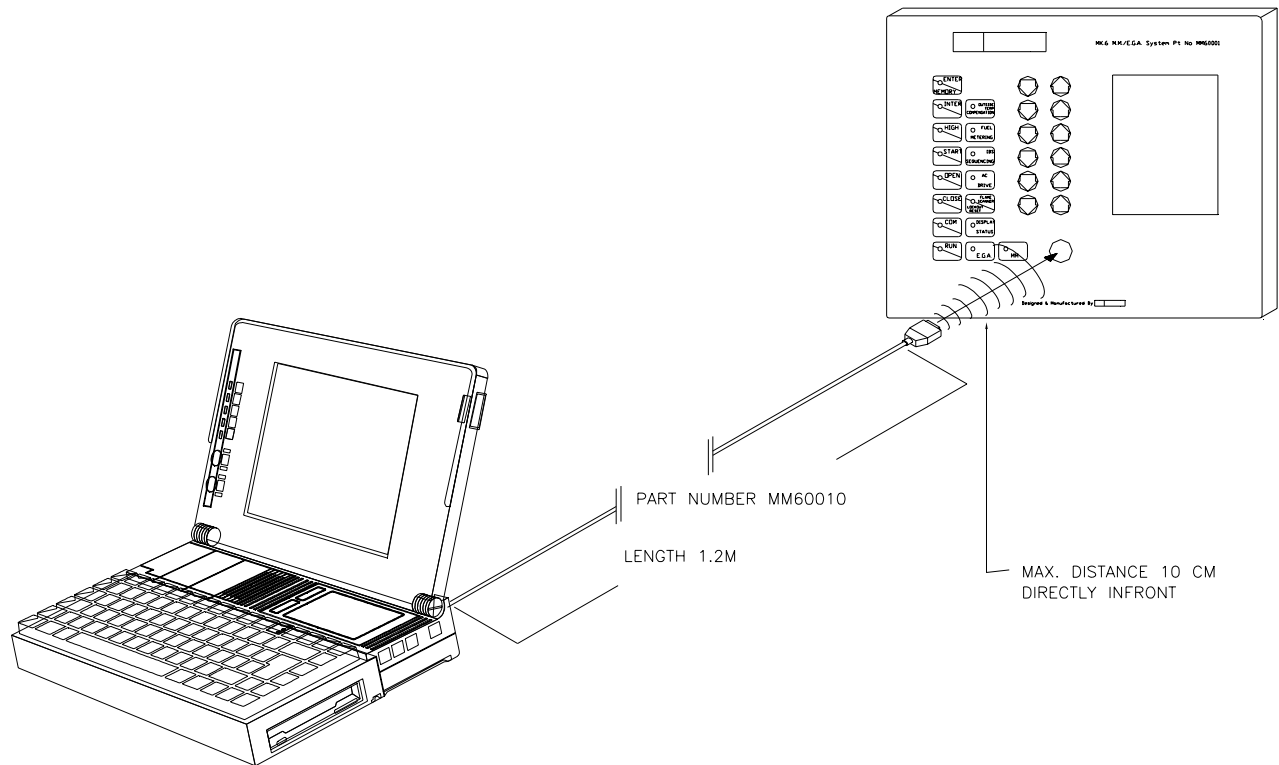


2.14.10.2 Mk.6 M.M. Fixing Holes & Dimensional Details



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 OPERATOR TO ENSURE THAT AFTER AN UPLOAD ALL THE OPTIONS, PARAMETERS AND FUEL/AIR RATIO COMMISSION DATA ARE CHECKED FOR CORRECTNESS.

2.14.10.4 Maintenance and Servicing




The Micro Modulation unit uses solid state technology. It requires no routine maintenance. If it develops a fault that it can diagnose and display it will do so.

The positioning motors/gas/oil valves also do not require routine maintenance. Any fault associated with these parts is usually diagnosed by the M.M.

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 at the top of a high rise building where radio systems exist then additional EMC (Electro Magnetic Compatability) measures may have to be considered

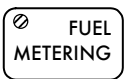

2.14.11 FUEL FLOW MEASUREMENT AND METERING OPERATION

1. Go to options, set option #57 to 1 (default 0).
2. When the above is displayed press , 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 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 #1 is maximum flame and point #10 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.
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  button is then pressed and the value is logged in the M.M. memory.

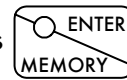
6. The above detailed data entry routine is repeated until all 10 points have flow values allocated to them.
7. When the last (10th) point has been entered the burner continues to fire.
8. To display Fuel Flow Metering press  button.
9. To reset the totalising value to 0 (zero) for the individual fuel selected set option #57 to 2, press  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. Previously this was counted from the ignition output and a delay time then had to be set via option #58. This option no longer applies with the Mk6 Evolution.

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.

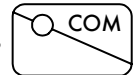
To enable this facility to go to option #29, set to 0 (default value = 1) and press



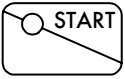
To disable this facility go to option #29, set to 1 and press



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



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  , LED will remain stable, adjust the fuel/air positioning motors to give the ideal ignition/start up position.

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

Notes:

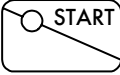
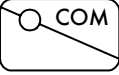
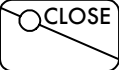
1. The golden start/ignition position of the fuel and air positioning motors is completely independent from the modulating load index commissioned value data.
2. The facility is particularly useful on combustion systems with large turndowns and when firing heavy fuel oil, as it enables the burners to 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 0-255 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 ONE POINT CHANGE

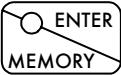


To change a point:-

Start up the burner in the normal way.

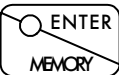



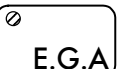
Once modulating press  and  simultaneously. 'ENTER PASSWORD' should be displayed. Set the password and press  in the same way as if going into normal

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 . 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 . 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 . If an E.G.A. is optioned the 

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  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 NO_x 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 TURN DOWN/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 OPERATOR TO ENSURE THAT USE OF THE PAUSE FACILITY DOES NOT LEAD TO A HAZADOUS SITUATION.

2.14.16 TIME CLOCK FACILITY

Time Clock Set Up

To adjust the time clock settings go into commissioning 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** 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.

Time Clock Operation

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 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 (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 7 then the enter button pressed. Options/parameters 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. Options/parameters 147 must also be adjusted to their appropriate values.

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 OPERATOR 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 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.

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

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 be the inverse of terminal 85.

If terminal #85 is at 0Vac, terminal #86 must be at mains voltage.

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.


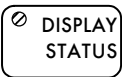


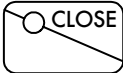



Flame switches often provide a volt free change over contact to indicate the flame status. Alternatively, they may provide a pair of 'inverse' outputs. If the flame switch only provides a single output terminal, a relay will have to be installed between the flame switch and the M.M. to provide a set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

2.14.20 ON-LINE 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.

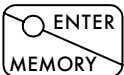


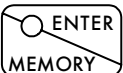
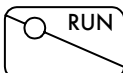
To make on-line changes

1. It is important to firstly be in the  screen.
2. Press  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 . 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  to select it.

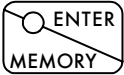

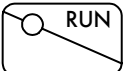
Note:  can be pressed at any time in order to return to normal operation.

The current selected function will only be updated if the  button is pressed.

Lock-Unlock Required Setpoint and Reduced Setpoint

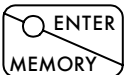
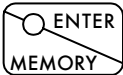
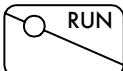
If  is pressed when 'LOCK REQUIRED VALUE' is displayed it is possible to lock or unlock the required and reduced setpoints. Use the CH1  button to lock the setpoints. Use the CH1  button to unlock the setpoints. Press  to permanently save the setting. The 'SELECT FUNCTION' screen will now be displayed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

Options

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

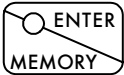
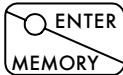
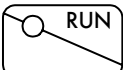
Note: Certain options will not be available for changing whilst the burner is running. These include all burner control options (options #110-150), number of servomotors, E.G.A. option #12, VSD options #90/100.

Parameters

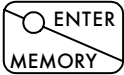
If  is pressed when 'PARAMETERS' is displayed then the 'SET PARAMETERS' screen will be displayed and parameters are able to be changed on-line (whilst in run-mode, burner on/off). Refer to section 2.14.2.5 for instructions on changing parameters. Press  to permanently save the setting. The 'SELECT FUNCTION'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

Changing the Channel Labels

If  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.

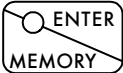
To change the channel 4 label use the CH4   buttons.

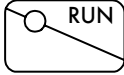
To change the channel 5 label use the CH5   buttons.

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  to permanently save the setting. The 'SELECT FUNCTION' screen will now be

displayed again. It is now possible to press  to return to normal operation, or make further changes on-line.

Section 2.15: Mini Mk6 M.M. Micro Modulation

- 2.15.1 Mini Mk.6 M.M. Control Unit
- 2.15.2 Commissioning
 - 2.15.2.1 Options
 - 2.15.2.2 Parameters
 - 2.15.2.3 Fuel Flow Metering
- 2.15.3 End User Day to Day Operation
 - 2.15.3.1 Normal Run Operation
 - 2.15.3.2 Routine Adjustments
 - 2.15.3.3 EPROM Version Numbers
- 2.15.4 Other Information and Illustrations
 - 2.15.4.1 Mini Mk.6 M.M. Facia
 - 2.15.4.2 Mini Mk.6 M.M. Enclosure Dimensions
 - 2.15.4.3 Schematic Connection Diagram
 - 2.15.4.4 Mini Mk.6 M.M. Specifications
 - 2.15.4.5 Terminal Description

2.15.1 MINI MK.6 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 MK.6 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  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:

P A S S W O R D	0
P A S S W O R D	0
F 1 C O M M I S S I O N E D	2 3

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

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

O P T I O N	N o	1 =	3
B O I L E R	S E N S O R	T Y P E	
T E M P E R A T U R E	S E N S O R		
0 - 4 0 0	C ,	3 - 7 3 0	F

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

To change the Option number use the CH2   buttons

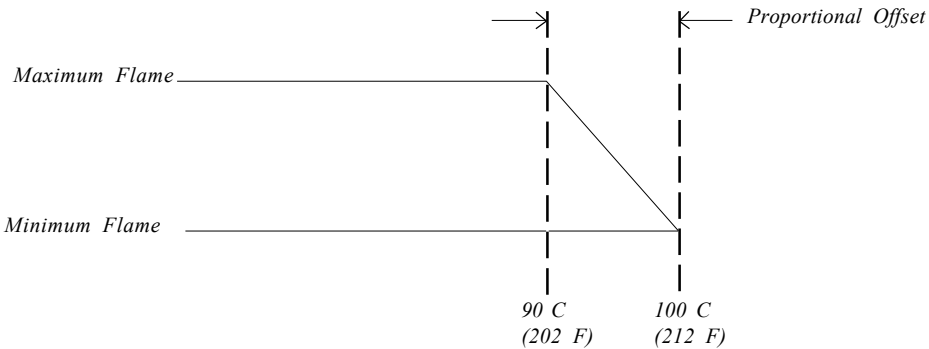
To change the value use CH3   buttons

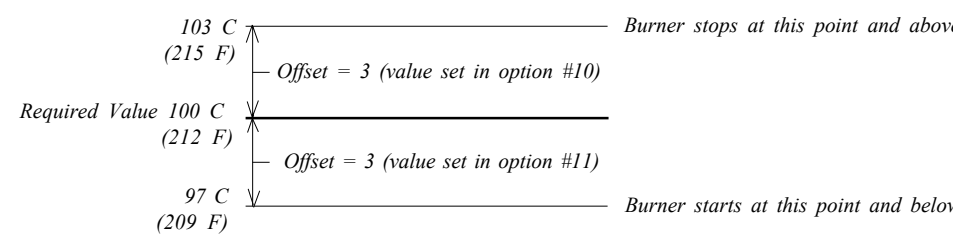
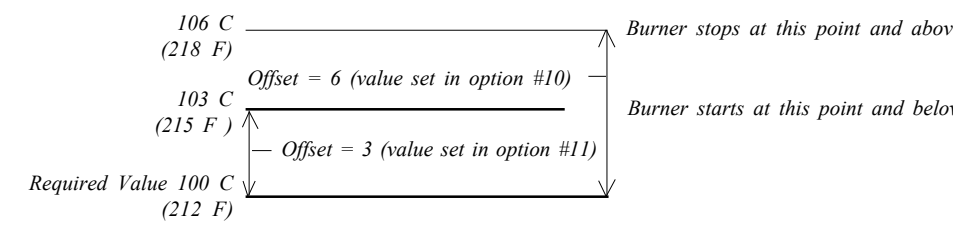
Any number of Option values can be changed when in Option mode

When changes have been made press 

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° to 90° 60 = 120 seconds from 0° to 90° 240 = 390 seconds from 0° to 90°
3.	0			Unused: This option only applies to the mini Mk5.
4.	40			Unused: This option only applies to the mini Mk5.
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		<p>Proportional control (P): This option sets the proportional band. This is the offset point at which the burner will begin to change modulation.</p> <p><i>Example of proportional band offset: Required setpoint = 100 C, Proportional offset = 10 (i.e. option 6 set to value 10).</i></p>  <p>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.</p> <p>5-250 If Centigrade, Fahrenheit or PSI units effective. 0.5-25.0 If Bar units effective.</p> <p>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.</p>
7.	60		<p>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.</p> <p>OFF-250 Seconds.</p> <p>Note: Integral is equivalent to 'Reset'.</p>
8.	1		<p>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).</p> <p>1 Channels 1 & 2 in use. 2 Channels 1, 2 & 3 in use. 3 Channels 1, 2, 3 & 4 in use.</p> <p>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.</p>

Option No.	Factory Setting	Option Value	Description
9. 1		0 1 2	<p>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.</p> <p>Internal stat always closed.</p> <p>Burner starts below required setpoint.</p> <p>Burner starts above required setpoint.</p> <p><i>Option #9 = 1, example using 100 C (212 F). Required setpoint.</i></p>  <p><i>Option #9 = 2, example using 100 C (212 F). Required setpoint.</i></p> 
10. 3		2-50 0.2-5.0	<p>Offset above required setpoint at which the burner is stopped: (Only relevant if option #9 is set to 1 or 2).</p> <p>If Centigrade, Fahrenheit or PSI units effective.</p> <p>If Bar units effective.</p>
11. 3		2-50 0.2-5.0	<p>Offset below/above required setpoint at which the burner is started: (Only relevant if option #9 is set to 1 or 2).</p> <p>If Centigrade, Fahrenheit or PSI units effective.</p> <p>If Bar units effective.</p>

Option No.		Factory Setting	Option Value	Description
12.	0			<p>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 'CR' relay will open and stop the burner. If this type of option is set, the 'CR' relay will not close until the E.G.A. has cooled down to it's operating temperature. 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, alternatively the 'CR' relay can be optioned to open. A last Option exists to enable an E.G.A. to give readings on the M.M. for just monitor 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.</p>
			0	E.G.A. not optioned.
			1	System reverts to M.M. only operation if E.G.A. error.
			2	'CR1' relay opens 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, 'CR' relay opens if E.G.A. error or limit exceeded.
			7	System commissioned on M.M. only, E.G.A. used as monitor.
13.	0			<p>Restore Factory Settings: To set all Options back to their original factory set values, set Option 13 value to 26 and press enter.</p>
			0-30	
14.	0			<p>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.</p>
			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			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 connecting line voltage to terminal 88 of the appropriate M.M.. Only 1 M.M. may be selected at a time or the sequencing will not operate. Alternatively the lead boiler can be selected via the D.T.I. For this to be effective all the M.M.s on the system must have terminal 88 volt free.
		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 2,3 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 % O₂. 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 % CO₂.
		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
22.	0			Lower offset limit % O₂
		0-10.0		% O ₂

Option No.		Factory Setting	Option Value	Description
23.	0	0-10.0		Lower offset limit % CO₂ % CO ₂
24.				Unused.
25.	0	0-20.0		Absolute value % O₂. (System checks for O ₂ values lower than value specified in this Option). % O ₂
26.	0	0-20.0		Absolute value % CO₂. (System checks for CO ₂ values higher than value specified in this Option). % CO ₂
27.	0	0-200		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. CO ppm
28.	20	0-50 0-5.0		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 0 for the EGA to operate when external modulation is optioned. If Centigrade, Fahrenheit or p.s.i. units effective. If Bar units effective.
29.	1	0 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. Golden Start operates. Golden Start does not operate.
30.	50	5-995 0.5-99.5		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. If Centigrade, Fahrenheit or p.s.i. units effective. If Bar units effective.
31.	100	5-995 0.5-99.5		Maximum Limit. If Centigrade, Fahrenheit or p.s.i. units effective. 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. Period (seconds) after ignition no sampling takes place.
			0-250	
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 .
			0	SO ₂ NO Off Off
			1	Off On
			2	On Off
			3	On On
37.	0			Time Between Readings
			0	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=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		<p>Response Sensitivity.</p> <p>%</p> <p>The Sensitivity Number indicates the amount of percentage firing rate increase or decrease that is inflicted by the Derivative action;</p> <p>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%.</p> <p>The following is an example of the above control philosophy in action:</p> <p><u>Note:</u></p> <table><tr><td>"Time Between Readings"</td><td>set to 20 seconds.</td></tr><tr><td>"Deadband"</td><td>set to 2 °C (2 °F.)</td></tr><tr><td>"Response Sensitivity"</td><td>set to 10%.</td></tr></table> <p>Setpoint Information:</p> <table><tr><td>"Required"</td><td>set to 90 °C (190 °F.)</td></tr><tr><td>"Actual"</td><td>reads 86 °C (186 °F.)</td></tr></table> <p>Firing Rate Information:</p> <table><tr><td>Burner firing</td><td>at 50% of capacity.</td></tr></table> <p>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.</p> <p>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.</p> <p>By careful selection of "Time Between Readings" "Deadband" and "Response Sensitivity" an ideal response to rate of change over time can be configured.</p> <p>The control philosophy detailed operates inversely if the "Actual" temperature exceeds the Setpoint and is outside the "Deadband".</p> <p>To enable or switch on the Derivative action the "Time Between Readings" must be set in excess of 10 seconds.</p>	"Time Between Readings"	set to 20 seconds.	"Deadband"	set to 2 °C (2 °F.)	"Response Sensitivity"	set to 10%.	"Required"	set to 90 °C (190 °F.)	"Actual"	reads 86 °C (186 °F.)	Burner firing	at 50% of capacity.
"Time Between Readings"	set to 20 seconds.															
"Deadband"	set to 2 °C (2 °F.)															
"Response Sensitivity"	set to 10%.															
"Required"	set to 90 °C (190 °F.)															
"Actual"	reads 86 °C (186 °F.)															
Burner firing	at 50% of capacity.															
40.	0	0 1		<p>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.</p> <p>Disabled Enabled</p>												

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 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.
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

Option No.	Factory Setting	Option Value	Description
47. 0	0 1		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. Off 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	0 1		Flue Gas Recirculation - Flue Gas Temperature. Not optioned. 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	0 1		Units of Temperature. NB. When changing units adjust all other relevant options respectively. All temperature readings displayed in Celsius. All temperature readings displayed in Fahrenheit.
52. 0	0 1		Units of Pressure. NB. When changing units adjust all other relevant options respectively. All pressure readings displayed in Bar. All pressure readings displayed in p.s.i.
53. 1	1-200		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. Burner "Off" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
54. 5	1-30		Burner 'On' Time Burner "On" time (minutes) during warm up cycle. (Intelligent Boiler Sequencing. Steam boiler applications).
55. 0	0 1		Internal PID/External Modulation Selectible using terminal 88. (Cannot be used with Sequencing/IBS) Normal operation, Internal PID or External Modulation if Option 45=1. Terminal 88 = 0 V - internal PID. Terminal 88 = Line Voltage - External Modulation, CR1 always closed.

Option No.		Factory Setting	Option Value	Description
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
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

Option No.		Factory Setting	Option Value	Description
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.
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.

Option No.	Factory Setting	Option Value	Description
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.
90-109.			Unused.
110. 1			Burner control.
		1	Internal - Standard Scanner
		2	Internal - Self-check Scanner
111. 0			Pilot
		0	Interrupted pilot
		1	Intermittant pilot (expanding flame)

Option No.	Factory Setting	Option Value	Description
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.			Unused.
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
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)

Option No.	Factory Setting	Option Value	Description
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.
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.
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.
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.
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.

Option No.	Factory Setting	Option Value	Description
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		Maximum 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.
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 commissioned 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)

Option No.	Factory Setting	Option Value	Description
137.	1.0		Gas pressure switch- offset upper limit: This is an offset from the commissioned 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.
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:

Option No.	Factory Setting	Option Value	Description
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.
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).

Option No.	Factory Setting	Option Value	Description
			<p>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.</p> <p>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.</p>

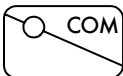
2.15.2.2 Parameters

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  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.

P A S S W O R D	0
P A S S W O R D	0
F 1 C O M M I S S I O N E D	2 3

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

The parameters screen will then be displayed as below:

P A R A M E T E R S	N O	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.

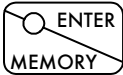
Any number of Parameter values can be changed when in Parameter mode.

When changes have been made press 



All new Parameter values are then permanently stored.

The operation of the Mini MK6 parameters are similar to the MK6. For further information refer to section 2.14.2.5.

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  , 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  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  button.

9. To reset the Totalised value to zero set Option 57 to 2, press  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 Normal Run Operation

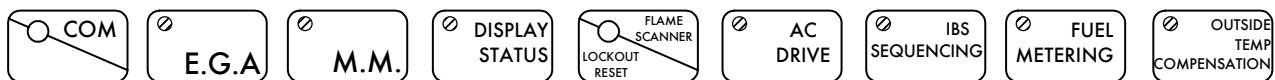
Upon initial selection of a commissioned fuel, a logo screen flashes up followed by the 'MM STATUS' display. The COM l.e.d. flashes for five seconds.

To adjust the Required value press  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:





This button also scrolls to the Valve Proving Screen

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 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	12ppm	NO	30ppm
AHB	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 occurred. 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	CUMTRS
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	82C
ACTUAL	45C

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


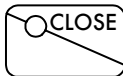
FIRING	
FLAME SIGNAL	27
TIME 12:25 23:JUN:00	

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

 LED will be flashing and you have 5 seconds to press it. Then the password screen is displayed. Set password to: **10 10**, Press 

'Set Clock' screen is displayed:

DAY	FRI	DATE	23
MONTH	JUN	YEAR	00
HOURS	12	MIN	28

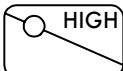
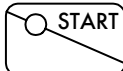
Use the buttons as detailed below to adjust the values appropriately.


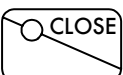
Channel 1   Day

Channel 2   Date

Channel 3   Month

Channel 4   Year

  Hours

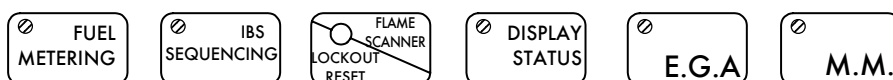
  Minutes



When finished press the flashing  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,



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.

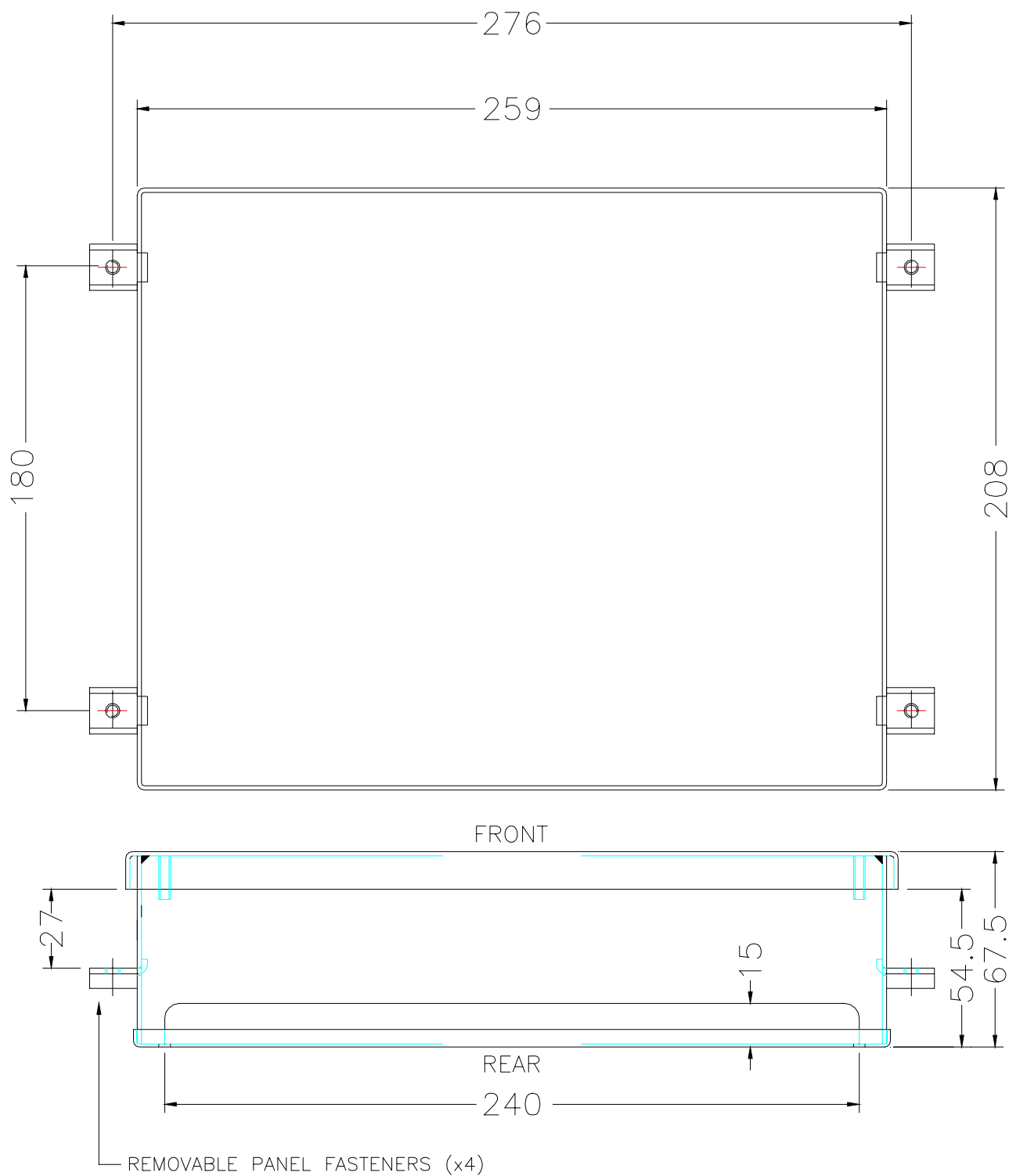
S O F T W A R E									
m	i	n	i	6		B	C		
4	1	.	0	1					
m	i	n	i	5		H	M		
4	2	.	0	2					

2.15.4 OTHER INFORMATION AND ILLUSTRATIONS

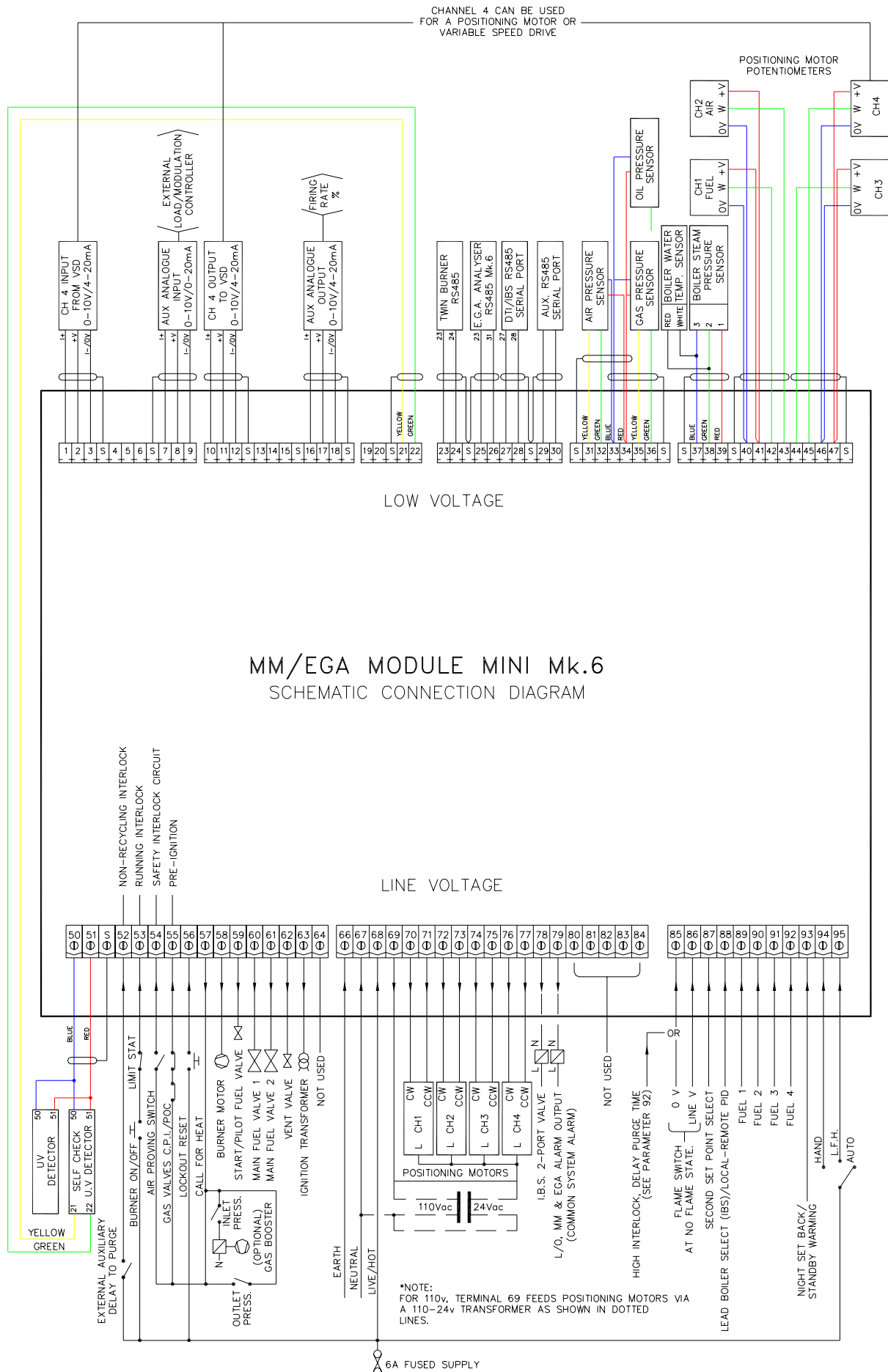
2.15.4.1 Mini Mk.6 MM Facia



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 Classifications

Classification According to EN298 - F B L L J B

Mains Supply:	230V, +10%/-15% } 47.5 - 63 Hz, Unit max. power consumption 45W 120V, +10%/-15% }
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		
		64	250mA	To drive relay/lamp only	
		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		
		64	250mA		
		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, 0-20mA. 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, 0-20mA. 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 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 | 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 setpoint- 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 to the mains earth/ground terminal 66. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, e.g. section 2.14.6.1.

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

- 2.16.1 Mini Mk5 EVO M.M. Control Unit
- 2.16.2 Commissioning
 - 2.16.2.1 Options
 - 2.16.2.2 Parameters
 - 2.16.2.3 Fuel Flow Metering
- 2.16.3 End User Day to Day Operation
 - 2.16.3.1 Normal Run Operation
 - 2.16.3.2 Routine Adjustments
 - 2.16.3.3 EPROM Version Numbers
- 2.16.4 Other Information and Illustrations
 - 2.16.4.1 Mini Mk.5 EVO M.M. Facia
 - 2.16.4.2 Mini Mk.5 EVO M.M. Enclosure Dimensions
 - 2.16.4.3 Schematic Connection Diagram- 120V/240V
 - 2.16.4.4 Mini Mk.5 EVO M.M. Specifications
 - 2.16.4.5 Terminal Description
 - 2.16.4.6 External Modulation (0-10V)



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  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:

P A S S W O R D	0
P A S S W O R D	0
F 1 C O M M I S S I O N E D	2 3

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

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

O P T I O N	N o	1 =	3
B O I L E R	S E N S O R	T Y P E	
T E M P E R A T U R E	S E N S O R		
0 - 4 0 0	C ,	3 - 7 3 0	F

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

To change the Option number use the CH2   buttons

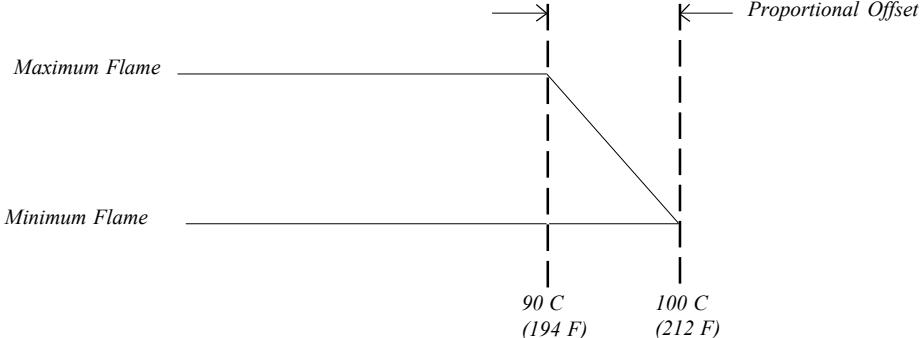
To change the value use CH3   buttons

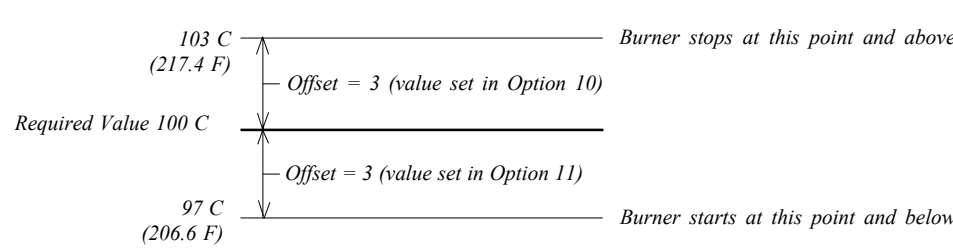
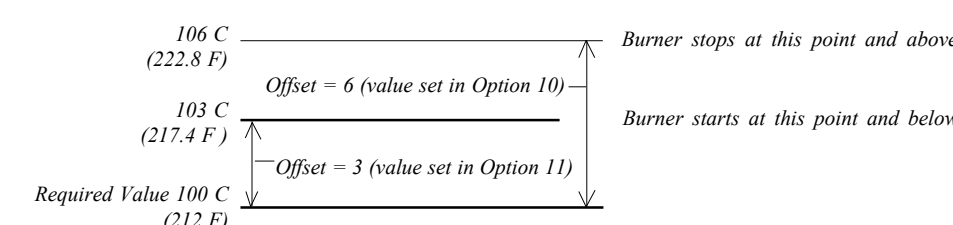
Any number of Option values can be changed when in Option mode

When changes have been made press 

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)

6.	10	Option No. Factory Setting Option Value	Description
			<p>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.</p> <p><i>Example of proportional band offset: Required value = 100 C, Proportional offset = 10 (i.e. Option 6 set to value 10).</i></p>  <p>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).</p> <p>5-50 0.5-5.0</p> <p>For Centigrade, Fahrenheit and p.s.i. selections, If Bar is selected.</p>
7.	60	OFF-250	<p>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')</p> <p>Seconds.</p>
8.	1	1 2	<p>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) .</p> <p>Channels 1-2 In use. Channels 1-3 In use.</p>

Option No.	Factory Setting	Option Value	Description
9	1		<p>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.</p> <p>0 Internal stat always closed (must be set for external modulation- option #45).</p> <p>1 Burner stops below Required setpoint.</p> <p>2 Burner stops above Required setpoint.</p> <p><i>Option 9 = 1, example using 100 C (212 F). Required Value.</i></p>  <p><i>Option 9 = 2, example using 100 C (212 F). Required Value.</i></p>  <p>10. 3 Offset above required setpoint at which the burner is stopped: (Only relevant if option #9 is set to 1 or 2).</p> <p>2-50 0.2-5.0 If Centigrade, Fahrenheit or p.s.i. units effective. If Bar units effective.</p> <p>11. 3 Offset below/above required setpoint at which the burner is started: (Only relevant if option #9 is set to 1 or 2).</p> <p>2-50 0.2-5.0 If Centigrade, Fahrenheit or p.s.i. units effective, If Bar units effective.</p>

Option No.		Factory Setting	Option Value	Description
12.	0			<p>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.</p> <p>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.</p>
			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			<p>Restore Factory Settings: To set all Options back to their original factory set values, set Option 13 value to 26 and press enter.</p>
			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 fascia 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 % O₂. 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 % CO₂.
	0-10.0		% CO ₂
21. 0			Upper offset limit CO.
	0-2000		CO
22. 0			Lower offset limit % O₂
	0-10.0		% O ₂

Option No.		Factory Setting	Option Value	Description
23.	0	0-10.0		Lower offset limit % CO₂ % CO ₂
24.				Unused.
25.	0	0-20.0		Absolute value % O₂. (System checks for O ₂ values lower than value specified in this Option). % O ₂
26.	0	0-20.0		Absolute value % CO₂. (System checks for CO ₂ values higher than value specified in this Option). % CO ₂
27.	0	0-2000		Absolute value ppm CO. (System checks for CO readings higher than values specified in this Option). CO ppm
28.	20	0-50 0-5.0		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 0 for the E.G.A. to operate when external modulation is optioned. If Centigrade, Fahrenheit or p.s.i. units effective. If Bar units effective.
29.	1	0 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. Golden Start operates. Golden Start does not operate.
30.	50	5-995 0.5-99.5		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. If Centigrade, Fahrenheit or p.s.i. units effective. If Bar units effective.
31.	100	5-995 0.5-99.5		Maximum Limit. If Centigrade, Fahrenheit or p.s.i. units effective. 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 ₂ sensors. The following option is for selecting the type of Sensor required: Part No. EGA20005 for NO; EGA20008 for SO ₂ .
			0	SO ₂ NO Off Off
			1	Off On
			2	On Off
			3	On On
37.	0			Time Between Readings
			0	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=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		<p>Response Sensitivity.</p> <p>%</p> <p>The Sensitivity Number indicates the amount of percentage firing rate increase or decrease that is inflicted by the Derivative action;</p> <p>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%.</p> <p>The following is an example of the above control philosophy in action:</p> <p><u>Note:</u></p> <table><tr><td>"Time Between Readings"</td><td>set to 20 seconds.</td></tr><tr><td>"Deadband"</td><td>set to 2 °C (2 °F.)</td></tr><tr><td>"Response Sensitivity"</td><td>set to 10%.</td></tr></table> <p>Setpoint Information:</p> <table><tr><td>"Required"</td><td>set to 90 °C (190 °F.)</td></tr><tr><td>"Actual"</td><td>reads 86 °C (186 °F.)</td></tr></table> <p>Firing Rate Information:</p> <table><tr><td>Burner firing</td><td>at 50% of capacity.</td></tr></table> <p>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.</p> <p>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.</p> <p>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".</p> <p>To enable or switch on the Derivative action the "Time Between Readings" must be set in excess of 10 seconds.</p>	"Time Between Readings"	set to 20 seconds.	"Deadband"	set to 2 °C (2 °F.)	"Response Sensitivity"	set to 10%.	"Required"	set to 90 °C (190 °F.)	"Actual"	reads 86 °C (186 °F.)	Burner firing	at 50% of capacity.
"Time Between Readings"	set to 20 seconds.															
"Deadband"	set to 2 °C (2 °F.)															
"Response Sensitivity"	set to 10%.															
"Required"	set to 90 °C (190 °F.)															
"Actual"	reads 86 °C (186 °F.)															
Burner firing	at 50% of capacity.															
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 minimum, 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
78-85.			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.
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).
		3-10	(Not Applicable to expanding flame - see option 111) Seconds
117.	5		Main flame prove time.
		5-20	Seconds

Option No.	Factory Setting	Option Value	Description
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
123.	3		Fuel 2 Second safety time (Main trial for ignition MTFI).
			(Not Applicable to expanding flame - see option 111)
		3-15	Seconds
124-134			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.			

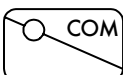
2.16.2.2 Parameters

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.




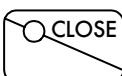
Either deselect and then select fuel or power down and then up.

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.

P A S S W O R D	0
P A S S W O R D	0
F 1 C O M M I S S I O N E D	2 3

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:

P A R A M E T E R S	N D	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. - $\div 4$ = % of Air damper. Amount of Autocommission trim. Applies to Air (-)only.
14	20	1-200		E.G.A. - $\div 2$ 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, ($\div 2$ = 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.

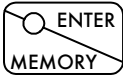
Parameter No.		Factory Setting	Parameter Value	Description																				
41	5			Unused.																				
42	4			Unused.																				
43	7			Unused.																				
44	0.4	0-4.0		E.G.A. - O ₂ window inside which no further trim takes place.																				
45	0.2	0-2.0		E.G.A. - 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.																				
				<table><tr><th>Example 1: Pressure Application</th><th>Example 2: Temperature Application</th></tr><tr><td>Required/Actual Range- 0.0-100.0bar</td><td>Required/Actual Range- 1000-2000F</td></tr><tr><td>Input Signal- 0-10 Volts</td><td>Input Signal- 1-6 Volts</td></tr><tr><td>Option 1- 11</td><td>Option 1- 10</td></tr><tr><td>Option 52- pressure units</td><td>Option 51- temperature units</td></tr><tr><td>Parameter 52- 1</td><td>Parameter 52- 0</td></tr><tr><td>Parameter 53- 1000</td><td>Parameter 53- 2000</td></tr><tr><td>Parameter 54- 10.0</td><td>Parameter 54- 6.0</td></tr><tr><td>Parameter 55- 00</td><td>Parameter 55- 1000</td></tr><tr><td>Parameter 56- 0.0</td><td>Parameter 56- 1.0</td></tr></table>	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
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  , 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  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  button.

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

2.16.3 End User Day to Day Operation

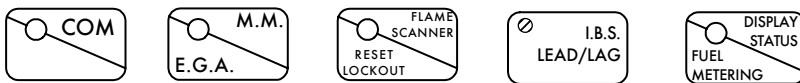
2.16.3.1 Normal Run Operation

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 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      12ppm 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 occurred. 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 82C
ACTUAL 45C
    
```

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

```


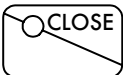
FIRING
FLAME ROD SIGNAL 27
TIME 12:25 23:JAN:05
    
```

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







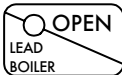
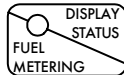
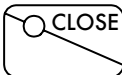
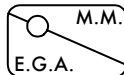
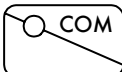
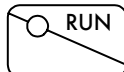
To adjust the time and date settings go into COM mode. Power down the unit and restart. The

 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 

'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
 		Year
 		Hours
 		Minutes

When finished press the flashing  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,

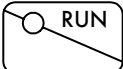



and then use the top   row to adjust the contrast accordingly.

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.

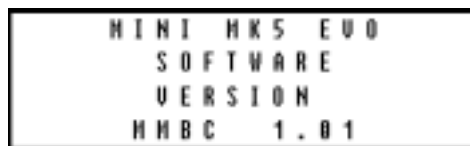
Lead Boiler Select

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

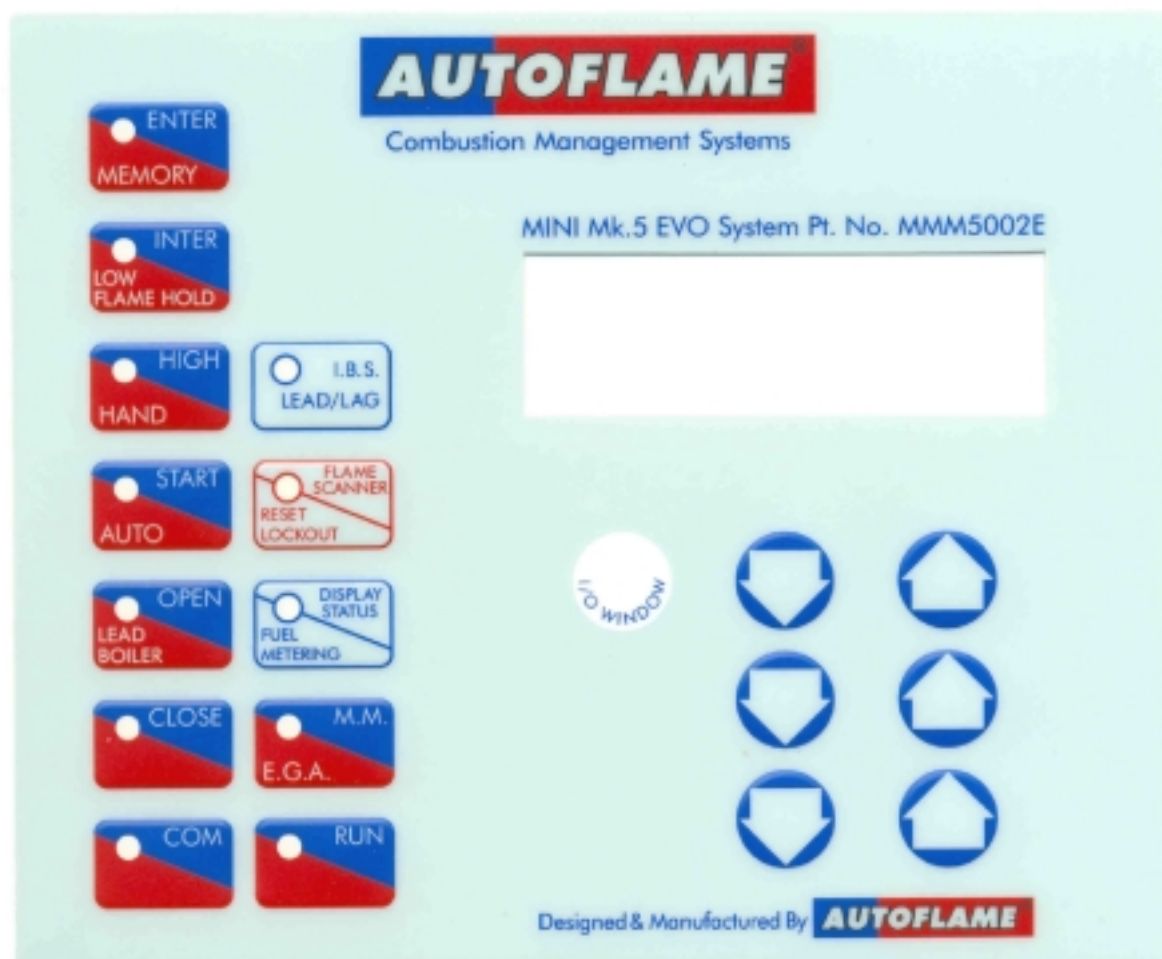
To display the software version number select the M.M. Display screen, then press Channel 1 Up and Down simultaneously.



MINI MK5 EVO
SOFTWARE
VERSION
HHBC 1.01

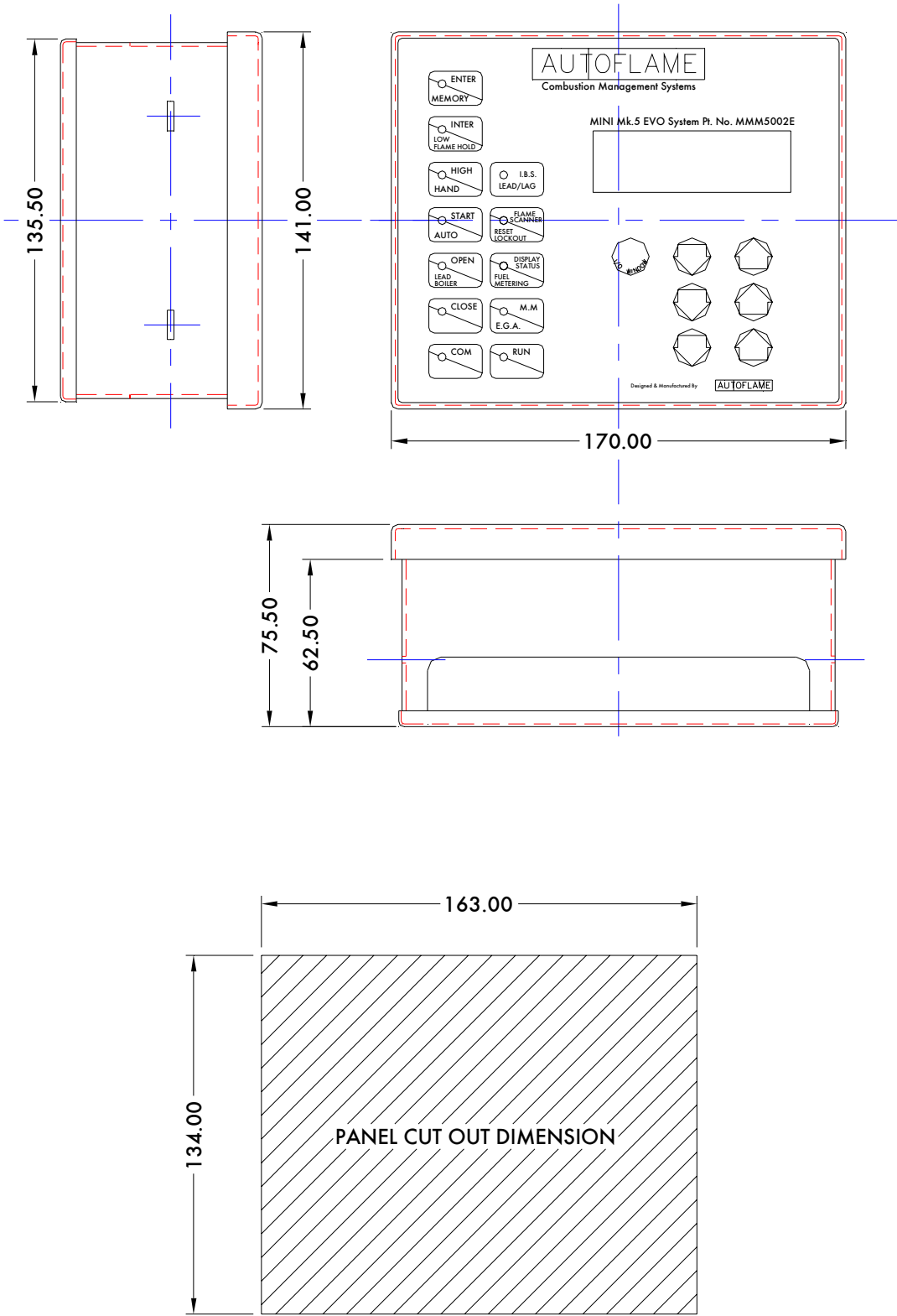
2.16.4 OTHER INFORMATION AND ILLUSTRATIONS

2.16.4.1 Mini Mk.5 EVO M.M. Facia

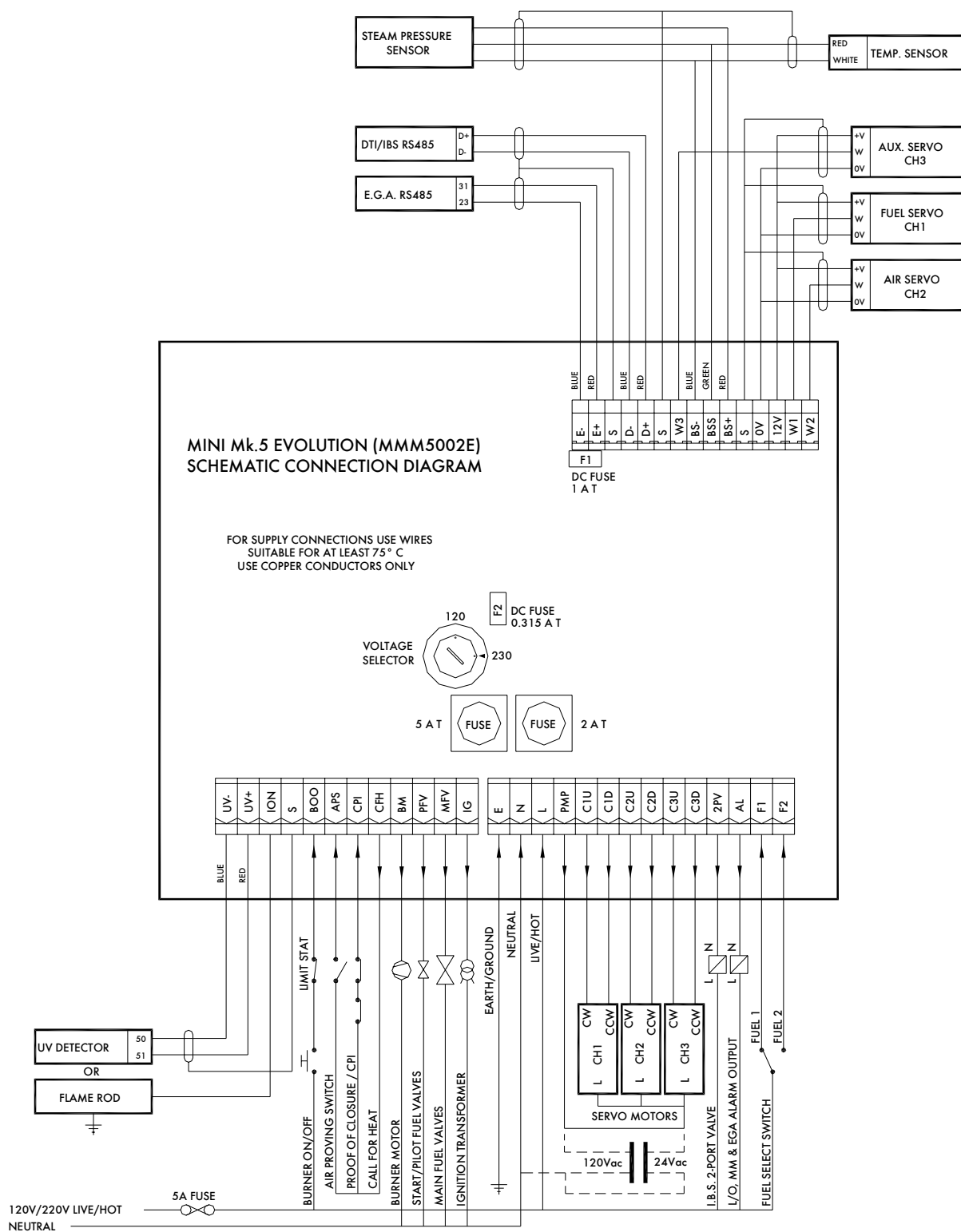


2.16.4.2 **Mini Mk.5 EVO M.M. Enclosure Dimensions**

MINI MK5 EVOLUTION OUTSIDE
DIMENSIONS / CUT OUT DETAILS



2.16.4.3 Schematic Connection Diagram



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			Total Max. Load 3.5 Amp.
Outputs	Terminal				
	CFH	250 mA		Must be connected through contactor	
	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:		Max			Total Max. Load 5 Amp.
Outputs	Terminal				
	CFH	250 mA		Must be connected through contactor	
	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.

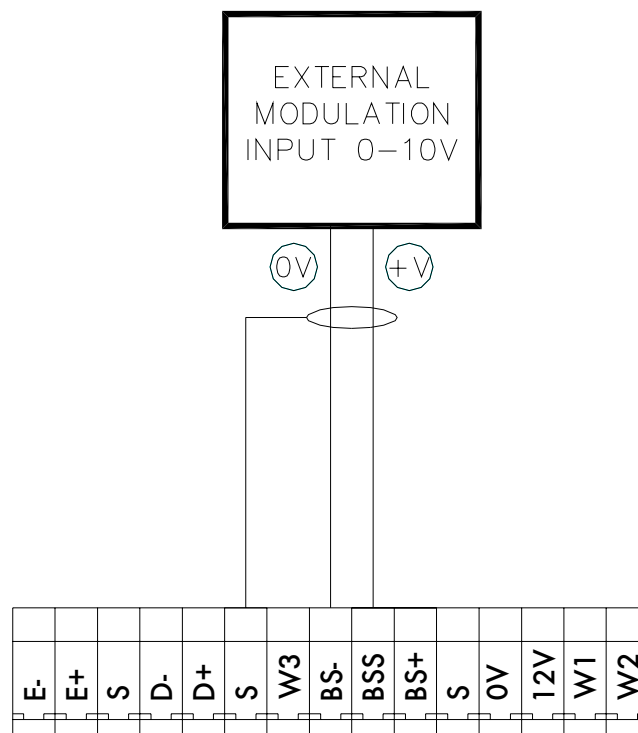
2.16.4.5.2 UV and ionisation terminals

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 to the mains earth/ground terminal E. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, eg section 2.16.4.3.

2.16.4.4 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 characteristics:

Signal isolation voltage- 3.75kV

Creepage- 5mm

Clearance- 4mm

The equipment and cables must be housed in a clean environment- IP55

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

- 3.1 Introduction
 - 3.1.1 Features and Benefits
 - 3.1.2 Overview of System Operation
 - 3.1.3 An inside view
 - 3.1.3.1 An inside view Schematic
- 3.2 Sensor Characteristics
 - 3.2.1 O₂ Sensor
 - 3.2.2 CO, NO and SO₂ Sensors
 - 3.2.3 CO₂ Sensor
- 3.3 Commissioning and Setting up Procedures
 - 3.3.1 Introduction
 - 3.3.2 Programming of Fuel/Air Positions
 - 3.3.3 Combustion Trim Operation
 - 3.3.4 Trim Timing Operation
 - 3.3.5 Graphical Trim Operation
 - 3.3.6 Efficiency Calculation
- 3.4 Error Checking, Self Diagnostics
 - 3.4.1 Keys to Errors Detected
 - 3.4.2 LED Status Indication
- 3.5 End user Day to Day Operation
 - 3.5.1 Normal run Operation
- 3.6 Electrical Schematics Showing all Terminal Interconnections
 - 3.6.1 Interconnections Between M.M and EGA Mk6
 - 3.6.2 Interconnections Between MM, EGA and DTI
- 3.7 Test and Calibration
 - 3.7.1 Approach to Testing & Calibrating on EGA Mk.6
- 3.8 EGA Local Display



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

- 3.9 EGA Setup Software Introduction
 - Using the Software (EGATOPC)
 - 3.9.1 Calibrate Sensor (Replacing a Sensor)
 - 3.9.2 Status
 - 3.9.3 Options
 - 3.9.3.1 4-20mA outputs
 - 3.9.3.2 EGA Operating Mode
 - 3.9.3.3 Pinch Valve Control
 - 3.9.3.4 System Configuration
 - 3.9.3.5 Test & Calibration Menu
 - 3.9.3.6 Return to Main Menu
 - 3.9.3.7 Quit
- 3.10 Limits on Five Measured Combustion Parameters:- O₂, CO₂, CO, NO and Exhaust Gas Temperature
 - 3.10.1 Overview of System Operation Features & Benefits
 - 3.10.2 Example of Limits for O₂
 - 3.10.3 Example of Limits for CO₂
 - 3.10.4 Example of Limits for CO
- 3.11 EGA Dimensions & Fixing Details
- 3.12 Standard EGA Sampling Probe
 - 3.12.1 Installation and Maintenance
 - 3.12.2 EGA Sampling Probe Assembly
 - 3.12.3 EGA Sampling Probe Assembled
 - 3.12.4 Maintenance of Sampling Probe
 - 3.12.5 Installation Precautions
 - 3.12.6 Servicing the Sampling Probe
- 3.13 Internal Tubing Diagram
- 3.14 EGA with Bubble Filter
- 3.15 High Temperature Probes
- 3.16 Shipping the EGA



3.1 Introduction

3.1.1 Features and Benefits

The E.G.A. Mk.6 is the accomplishment of ten years on-going research and development for the exhaust gas sampling system. The E.G.A. can be used for two 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.

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 OR
NO ₂	Nitrogen Dioxide	ppm
Combustion Efficiency		% (a calculation of CO ₂ and temperature)
Exhaust gas temperature		Degrees Celsius or Fahrenheit
Ambient temperature		Degrees Celsius or Fahrenheit
Delta temperature		Degrees Celsius or Fahrenheit

NO and SO₂ or NO₂ are monitored only, not used for combustion trim.

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 2mm; 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.

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 4.5 minutes automatically through the drain solenoid.

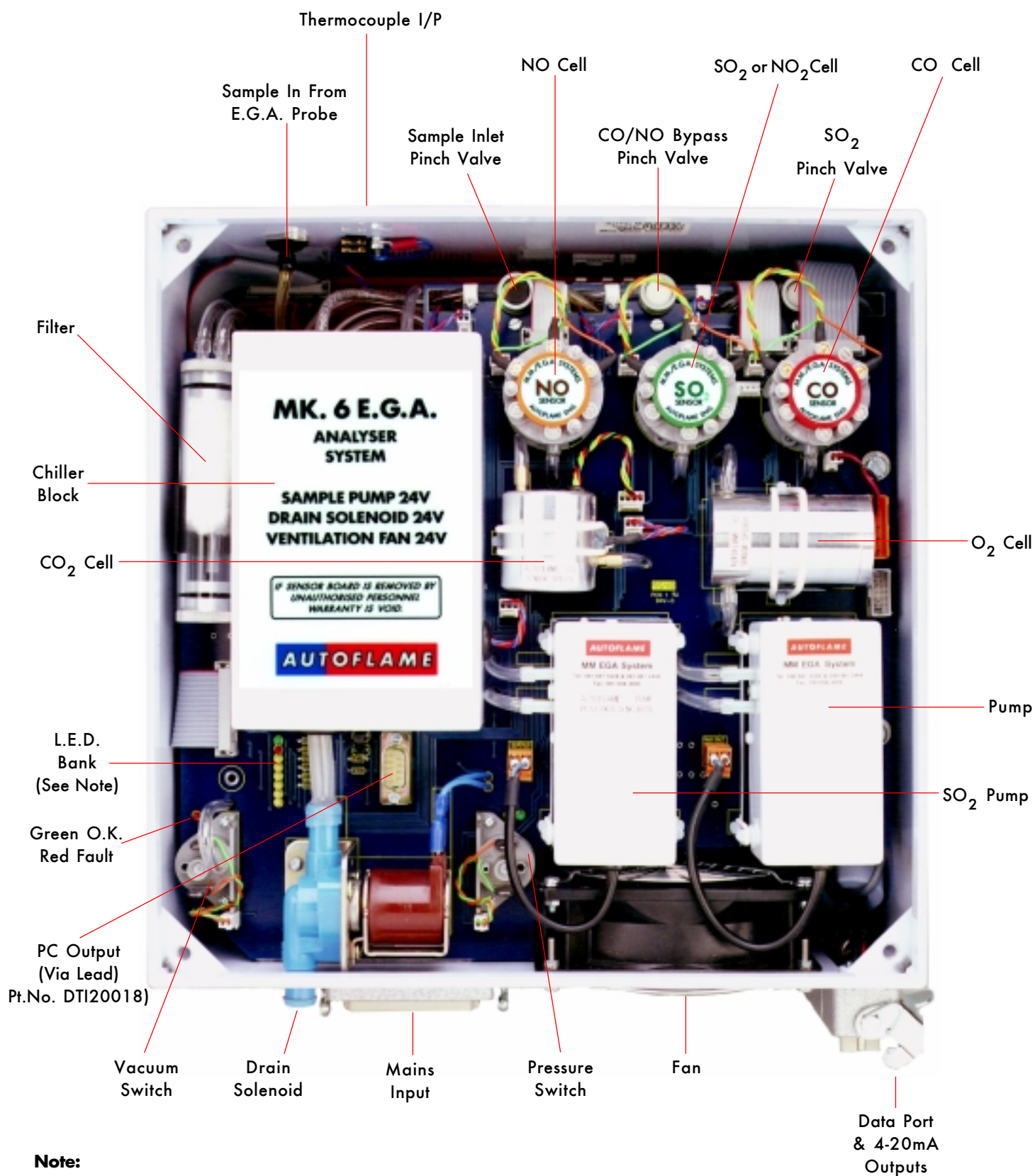
The exhaust gas is then filtered through the dry filter. This is a fine filter which removes any dust particles carried over from the cooling process. On leaving the filter the exhaust gas is checked to ensure a vacuum is maintained prior to entering the pump. On exiting the pump the exhaust gas is again 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 exiting the E.G.A. unit. This is located on the outside of the E.G.A. box 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.

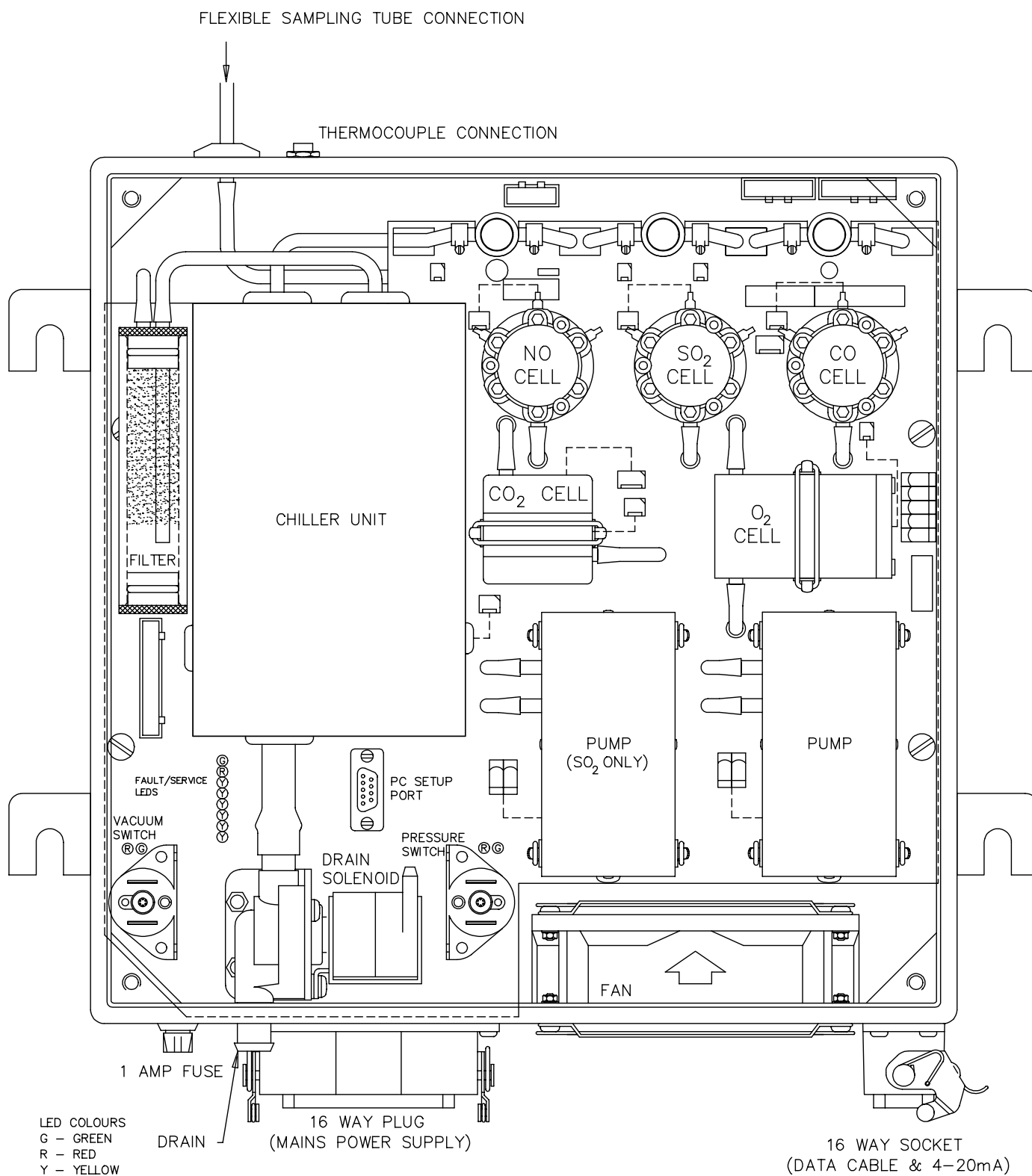
3.1.3 E.G.A. Mk.6 an Inside View (cover removed)



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
--------------	---	--------------------

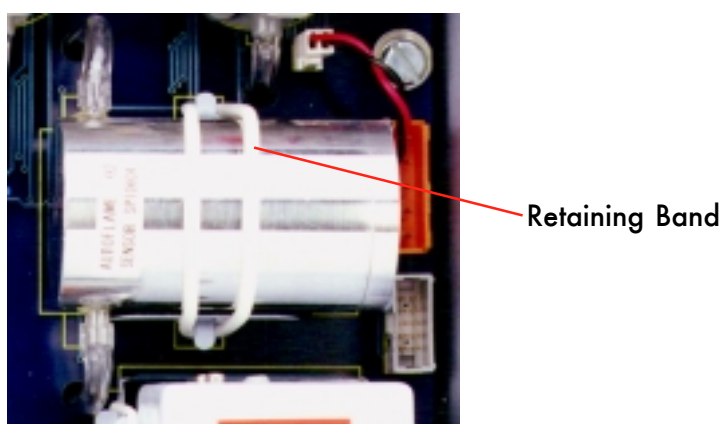
3.1.3.1 E.G.A. Mk.6 an Inside View (cover removed)

3.2 Sensor Characteristics

3.2.1 O₂ Sensor

This is a newly developed electrochemical cell 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:

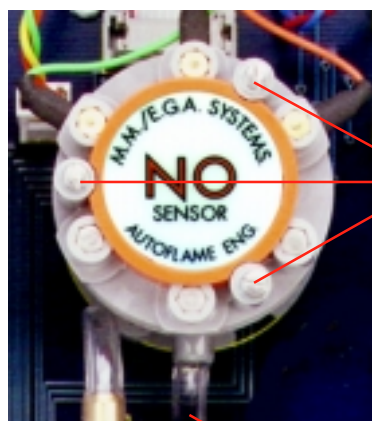
Virtually no influence from CO, H₂, S, NO_x, SO_x and H₂, i.e. no cross sensitivity.
No warm up time required.

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 SO₂ 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 $\pm 5\%$ at 100ppm. From our experience over the last five years we would expect to see a drift of ± 10 ppm per annum without calibration. In our view this drift would not be detrimental to the operation or application of the E.G.A. 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 O₂ & CO₂ readings are restored to a level within the pre-programmed limits.



Retaining Screws, Remove when replacing Sensor

Input Tube

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	1 ppm
Repeatability	1% of signal
Shelf life	6 months from date of dispatch

NO Measurement:

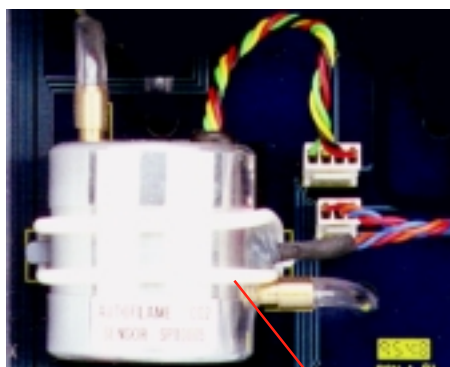
On Gas Fuel	Measuring Range 0-1000ppm
On Fuel Oil	Optional, NO is not normally measured as standard
Resolution at 20 deg C	1 ppm
Repeatability	2% of signal
Shelf life	6 months from date of dispatch

SO₂ 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	1 ppm
Repeatability	1% of signal
Shelf life	6 months from date of dispatch

3.2.3 CO₂ 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 $\pm 0.3\%$ 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.



Retaining Band

Measuring Range
Shelflife

0-20%
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 operator 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.

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.

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 #2.1 4.2.4).
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  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 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 

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

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


Press  (OPEN flashes).

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

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



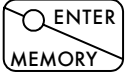
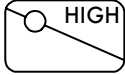





This is nominally 90.0 for gas butterfly valves and burner air dampers, but may be set to less than 90.0 degrees if there are mechanical stops/limits.

The E.G.A. unit will now carry out a calibration for 2 minutes.

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

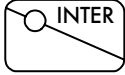
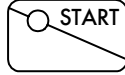







9. Press  (START steady, ENTER MEMORY flashes).

****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  (Burner ignites, HIGH flashes).
12. Press  (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  (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  (HIGH steady, EGA flashes).
Make adjustments to fuel and/or air valve positions. Go to step #14.
16. Press  (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  or  (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  (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  (START or INTER steady, MM steady, EGA flashes).
21. Use CH1 to CH6   to adjust valve settings. Go to step #19.
22. Press  (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  or  (START or INTER steady, MM steady, EGA flashes).

Go to step #18.

24. Press  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.

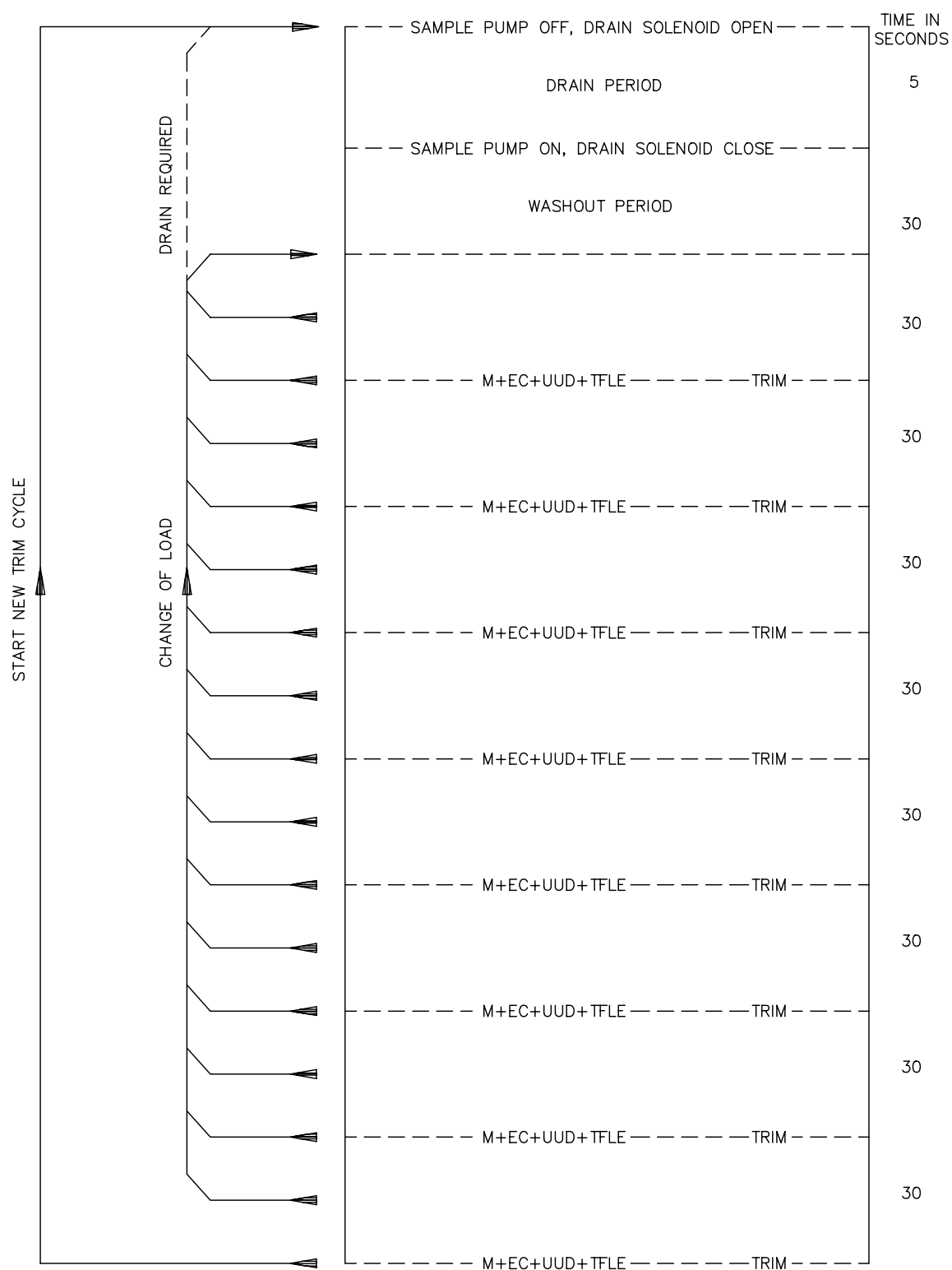
3.3.3 E.G.A. combustion trim operation

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. At the same time 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. Channel 2 would normally be controlling the air damper. These minute changes ensure that the originally entered commissioning data is adhered to, irrespective of variations in stack pressure or barometric conditions.

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 E.G.A. control strategy operates error checking self diagnostic software for self identification of system component or data handling failure.

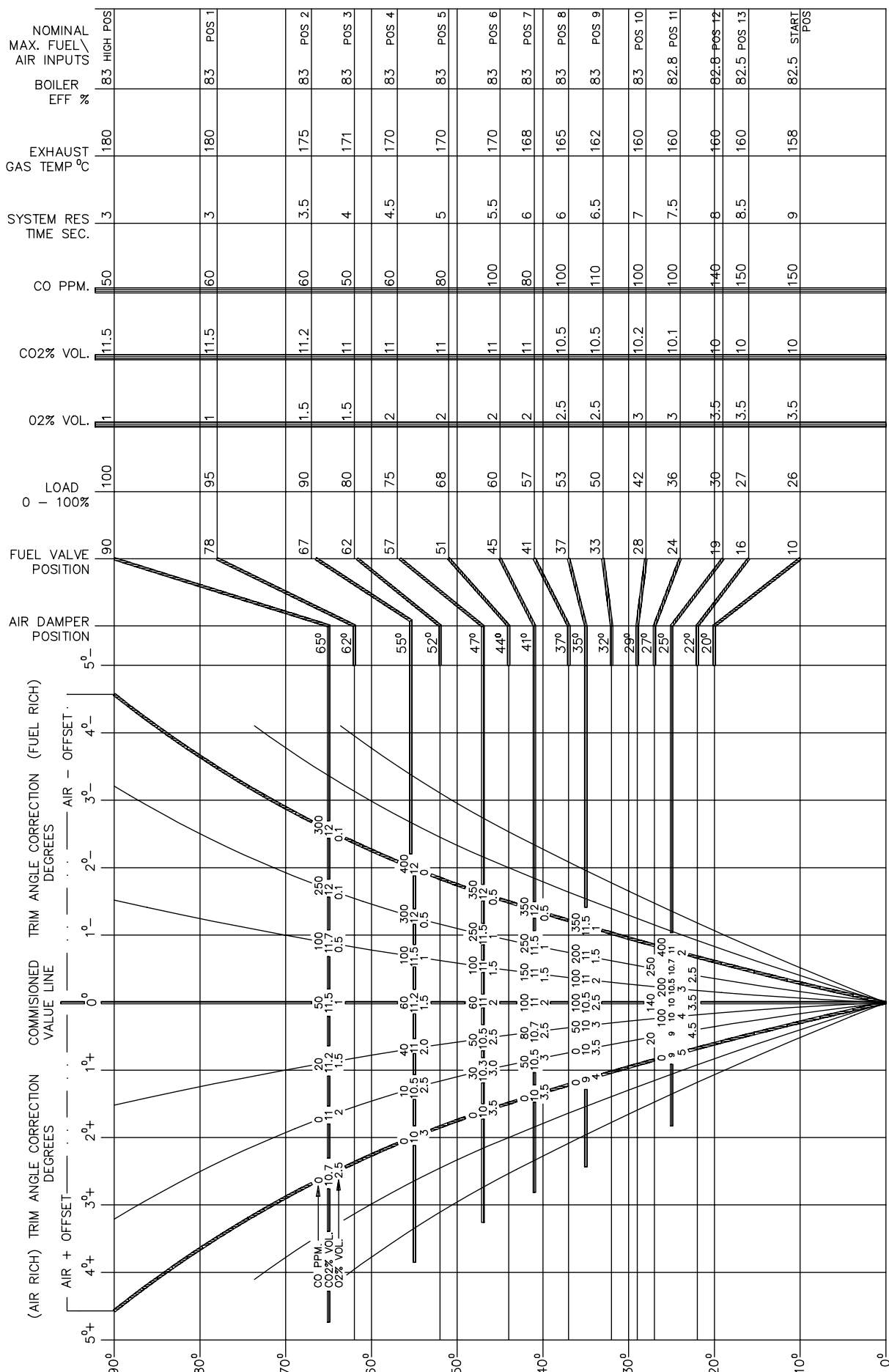
3.3.4 Trim Timing Operation



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:

$$\% \text{ Combustion Efficiency} = 100 - (\text{sensible heat loss} + \text{Hydrogen and moisture loss}).$$

$$= 100 - \left(\left(\frac{K1 (TG-TA)}{\%CO_2} + (K2 (1121.4 + (TG-TA))) \right) \right)$$

$$K1=0.38 \text{ Natural Gas (F1)}$$

$$K1=0.56 \text{ Fuel Oil (F2/F3)}$$

$$K2=0.0083 \quad \text{Natural Gas (F1)}$$

$$K2=0.0051 \quad \text{Fuel Oil (F2/F3)}$$

European Calculation:

$$\% \text{ Combustion Efficiency} = 100 - \text{sensible heat loss}$$

$$= 100 - ((TG-TA) \times ((A/(20.9-02)) + B))$$

$$A=0.66 \quad \text{Natural Gas (F1)}$$

$$A=0.68 \quad \text{Fuel Oil (F2/F3)}$$

$$B=0.009 \quad \text{Natural Gas (F1)}$$

$$B=0.007 \quad \text{Fuel Oil (F2/F3)}$$

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 EGA part of the system are indicated when COM or EGA display modes are selected.

CH1	—	ERR
CH2	—	EGA
CH3	—	Error number

Error Number

Fault Description

01	No communications to EGA
08	O ₂ Upper limit exceeded
09	CO ₂ Upper limit exceeded
10	CO Upper limit exceeded
11	O ₂ Lower limit exceeded
12	CO ₂ Lower limit exceeded
14	O ₂ Absolute limit exceeded (O ₂ less than specified value)
15	CO ₂ Absolute limit exceeded (CO ₂ greater than specified value)
16	CO Absolute limit exceeded (CO greater than specified value)
20	Pump fault — pump failed/sample system blocked
21	O ₂ Cell failure
22	CO ₂ Cell failure
23	CO Cell failure
24	Flow pressure switch failure
25	Trim threshold exceeded
30	NO Upper limit exceeded
33	Exhaust temperature upper limit exceeded
35	Exhaust temperature absolute limit exceeded (exhaust temperature greater than specified value)

If any of the above EGA errors occur the action taken will depend on the EGA option selected: (see option #12).

In the event of a fault being detected by the internal fault diagnostic system, contact Autoflame for advice.

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. 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.

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 necessary to fix the EGA and set commissioning mode again (reselect fuel).

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:

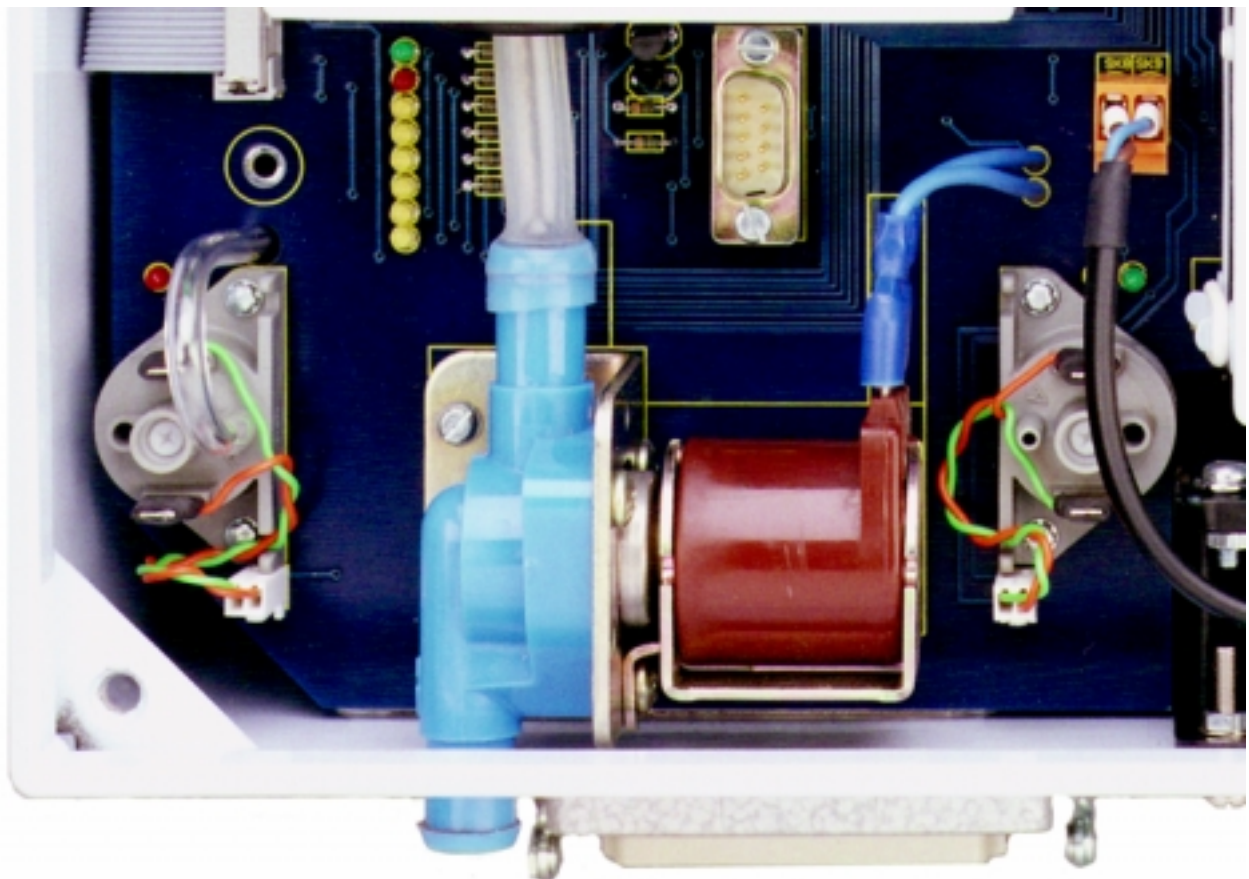
- Green = O.K. System operates correctly.
- Red = Fault.
- Yellow = 6 L.E.D.'s each L.E.D. indicates a 2 month operation period.
(1 L.E.D. is extinguished every 2 months- this time is also active during storage).
- Red = Pressure switch fail (located: right of drain solenoid).
- Green = Pressure switch 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.

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.

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.



3.5 End User Day to Day Operation

3.5.1 Normal Run Operation

Upon initial selection of a commissioned fuel, the display shows F1, F2 or F3 depending on which fuel is selected. The COM l.e.d. flashes for five seconds. During this time a number is displayed in the actual window. This number indicates the number of times this fuel has been commissioned. After these 5 seconds the M.M. positioning motor values are displayed.

To adjust the required value press **STATUS** and use the required   accordingly.

The range of the required value is limited according to the type of sensor being used (see option section).

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. The four display windows will display values according to the selected display mode. There are four possible display modes: E.G.A. Commission values, E.G.A. Actual values, M.M. Positioning motor values and Status. To select one of the display modes just press:

COM **E.G.A.** **M.M.** or **STATUS** respectively.

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. exists on the system. In the COM and E.G.A. modes there is a further choice of either Exhaust temperature /Efficiency/CO/NO/SO₂. Select these by

pressing      accordingly.

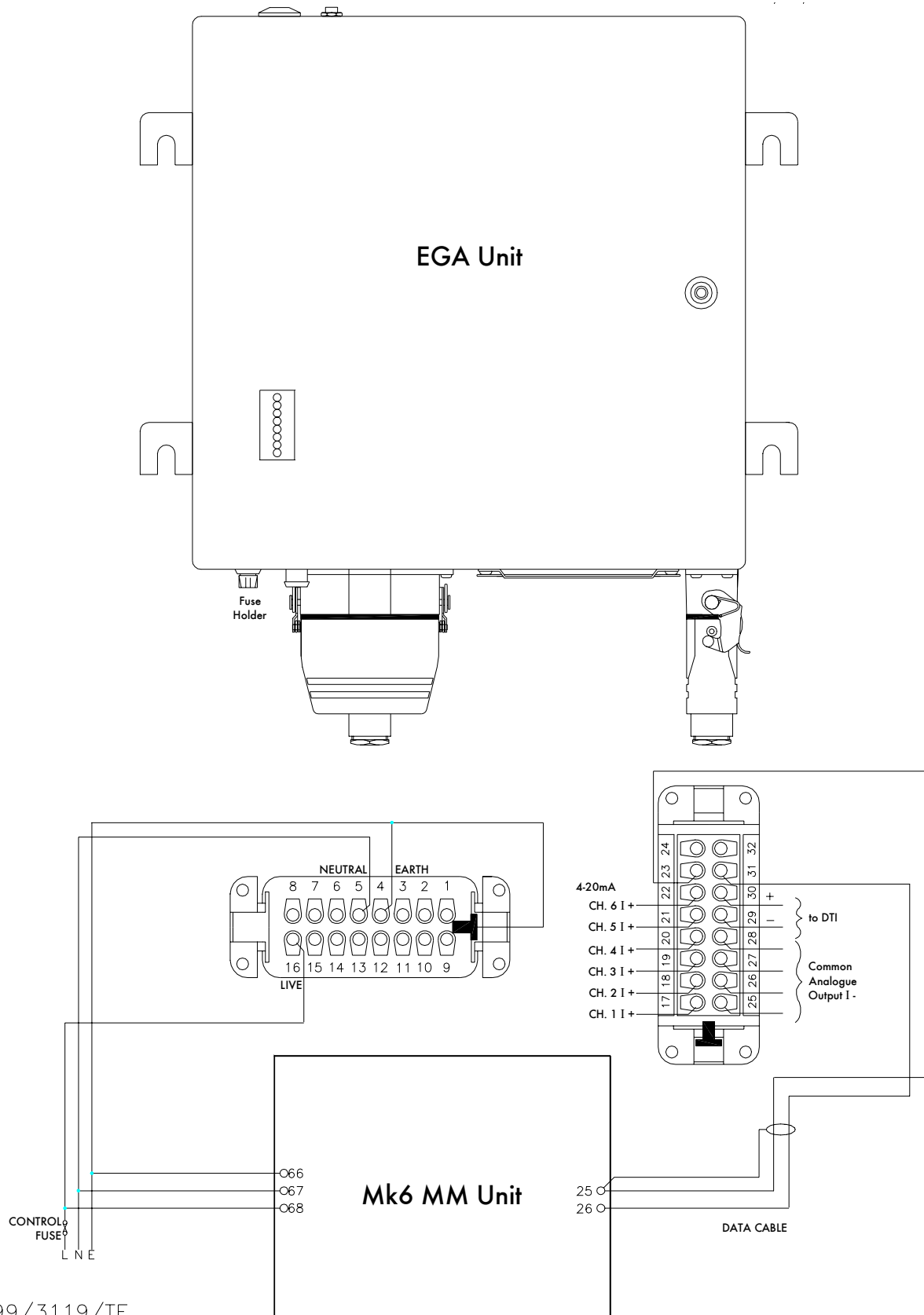
In the event of the system being powered down, these selections will be memorised as is all commission data, Options and required value. During normal run operation the RUN led is on all the time. When no fuels are selected only the RUN LED remains illuminated.

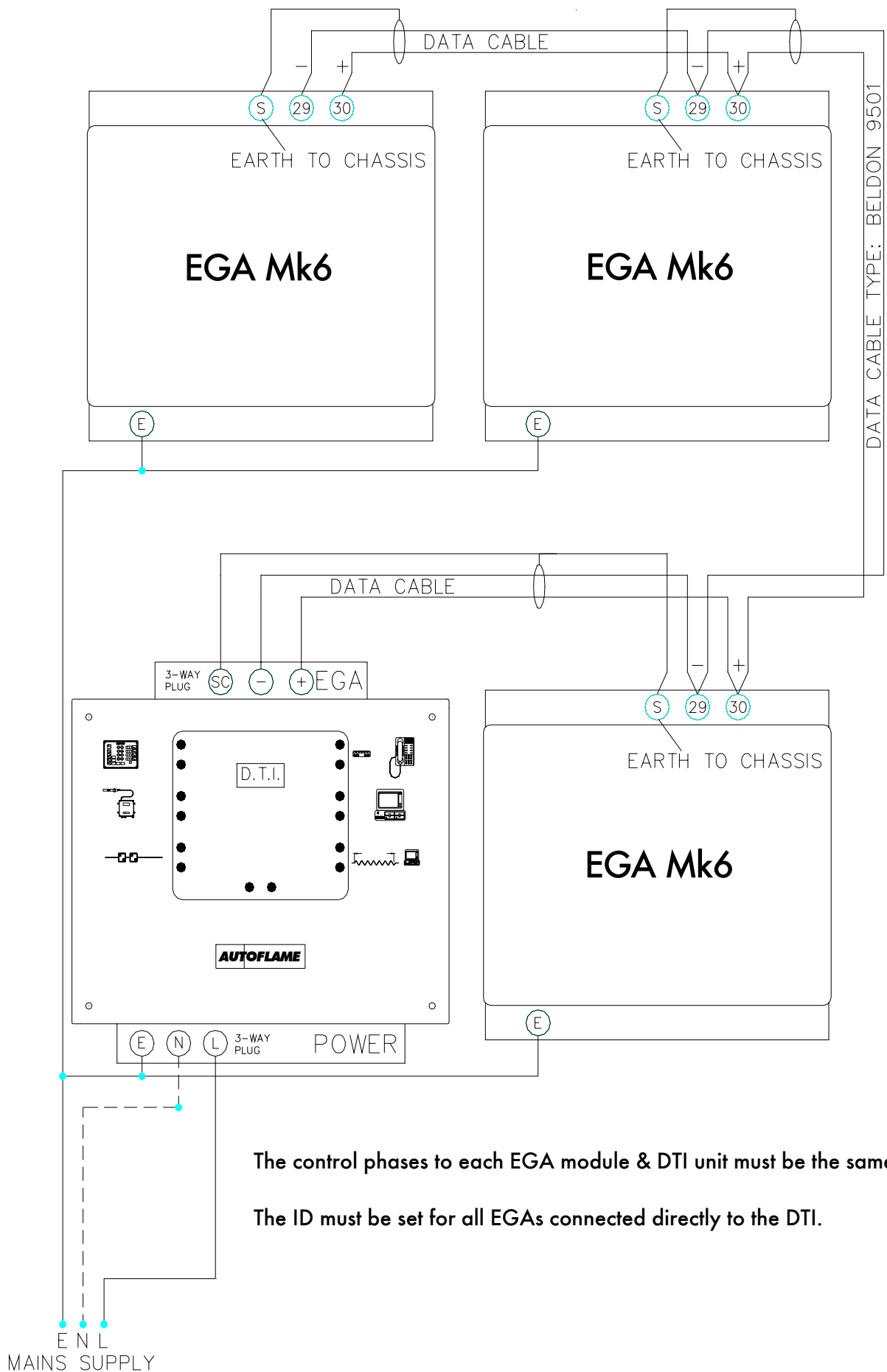
If an E.G.A. is operative on the system it will calibrate every time the burner starts and stops. When COM or EGA display modes are selected 'CAL' is displayed in the Temp/Eff. window when the EGA is calibrating. If the E.G.A. is cooling, 'COOL' is displayed. If the burner is not firing, EGA is displayed in the top window. When the burner is firing and both the COM and E.G.A. modes show 'E.G.A.' in the top window, this indicates that 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 and issue can be displayed on the M.M. by pressing the Channel 1   simultaneously.

3.6 Electrical Schematics

3.6.1 Interconnection between Mk6 EGA and Mk6 MM Module



3.6.2 Interconnection between Mk6 EGA modules and DTI unit

3.7 Testing & Calibration

!!! WARNING !!!

As always observe health and safety procedures. An operator working on the EGA 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. Mk.6

The information contained in this manual provides a comprehensive understanding and operation of the Mk.6 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 mono-chrome/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 SO₂ or NO₂ sensor it is necessary to press  again to view these online values.

The online display shows:

- O₂- %
- CO₂- %
- CO- ppm
- NO- ppm (if optioned)
- Ambient temperature- °C or °F
- Exhaust gas temperature- °C or °F
- Delta temperature- °C or °F
- Combustion efficiency- %
- SO₂- ppm (if optioned) OR NO₂- ppm (if optioned)

3.8.1 Fault history


Press  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  to move through each one.


3.8.2 E.G.A. Status

Press  to view the various E.G.A. status screens.

The first status screen shows:

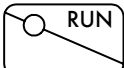
- E.G.A. operating mode- with MM or stand alone
- Software version
- Fuel selected
- Date, month, year and time






Press the  button to move to the next status screen. This shows the number of hours run in each fuel.

Press the  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  button to display the online combustion values.

Press  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  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  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 .




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  to return to the "SELECT FUNCTION" menu.





3.8.2.3 Configuration of the E.G.A.


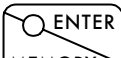
Once "E.G.A. CONFIGURE" is displayed press 




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 units	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  to set the correct outputs and signal range.






The CH1   selects which output (1-6) is to be changed. When the correct output is displayed press  to make the changes.






Use the CH1   to select which output signal is required.




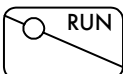
The possible output signals are listed below:

O_2 - %
 CO_2 - %
 CO - ppm
 NO - ppm
 Exhaust temperature- $^{\circ}C$ or $^{\circ}F$
 Efficiency- %
 SO_2 - ppm
 Smoke density
 Air temperature- $^{\circ}C$ or $^{\circ}F$
 Ambient temperature- $^{\circ}C$ or $^{\circ}F$
 Ready Status

Once the desired output signal is selected press . For each output (1-6) and chosen output signal it is necessary to set a range (4-20mA).

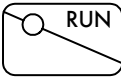
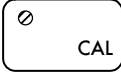
Firstly the lower range is set (4mA). The CH1   changes the units (i.e. 0.1%, 1ppm,e.t.c) and the CH2   changes the tens (i.e. 1.0%, 10ppm, e.t.c). When the correct lower range is set press .



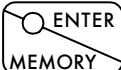
Next the upper range is set (20mA). The CH1   changes the units (i.e. 0.1%, 1ppm,e.t.c) and the CH2   changes the tens (i.e. 1.0%, 10ppm, e.t.c). When the correct upper range is set press .

The next 4-20mA signal will now need to be set. Once these are all set (or the desired outputs are set), use the CH1   buttons to scroll to the "RETURN TO SELECT FUNCTION" screen and press , or press  to return to the online combustion 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  button is illuminated. Hold down the  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  to proceed.


3.8.3.1 Calibration code

Once  has been pressed "SELECT CELL TYPE" will appear. Use the CH1   to select the cell that is to be replaced and then press .

It is now necessary to enter the 15 digit code. This code contains information regarding the manufacture date and range it was set for.

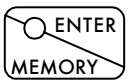




To do this use the CH1   buttons to move left and right to select the digit to change. Then use the CH2   buttons to change the value for each digit.

Once the correct code has been entered press .

If the wrong code has been inputted, then "INCORRECT CODE" is displayed. Press  to return to the "SELECT CELL TYPE" screen and start again.





Press  when finished to go back to the online combustion values.

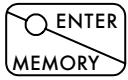

3.8.3.2 Gas calibration

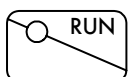
Once  has been pressed "SELECT CAL GASES" is displayed. Use the CH1   to select the gas and use CH2   to select "YES/NO" for each gas.

Once the correct test gas constituents are selected press to  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  to continue. The E.G.A. will perform 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  to perform the test gas calibration.

Press  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 the user.

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 MSDos 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.

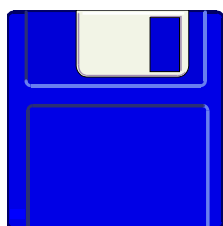
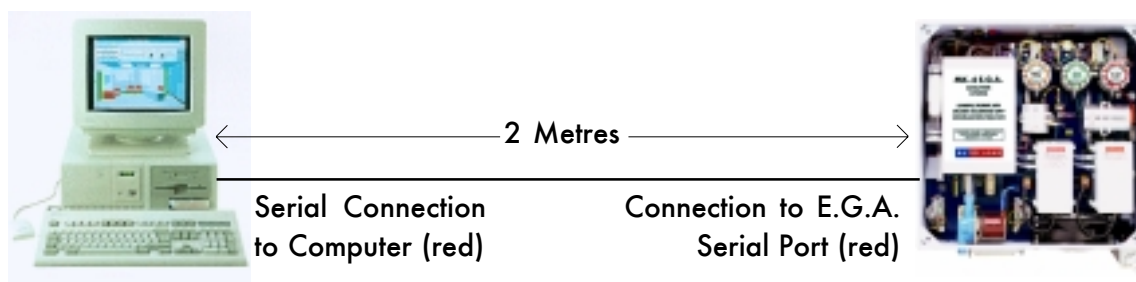
To ensure the combustion readings are correct the E.G.A. should be either checked or calibrated once a year. Error codes and information displayed on the remote display Pod (used for Stand Alone Analyser) or the Micro Modulation unit (used for combustion trim) must be observed.

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 Possibilities

The E.G.A. 6 channel 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.

Selecting the output signals of the 4-20mA

There are eleven possibilities:-

1. O₂ range adjustable
2. CO₂ range adjustable
3. CO range adjustable
4. NO range adjustable
5. SO₂ 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,

a) For O₂ and CO₂ sensors disconnect the corresponding plug 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, SO₂ and NO sensors, disconnect the corresponding plug 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.

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, SO₂, CO₂ and O₂.

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 or below +5 deg C the Pod or M.M. unit will display "EGA HI" or "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 P.C. 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 P.C. 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 Mk.6 E.G.A. unit is supplied with 6 channels of 4 - 20mA. 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 permissible 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 EGA 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 SO₂ 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
 NO₂ 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 programme should always be used for the operating 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) This pinch valve is located at the top of the cell P.C.B. .Second from the left, with a brown top to the valve.

V2 = Pinch valve No.2: SO₂ Pinch valve

To check the pinch valves operate correctly:

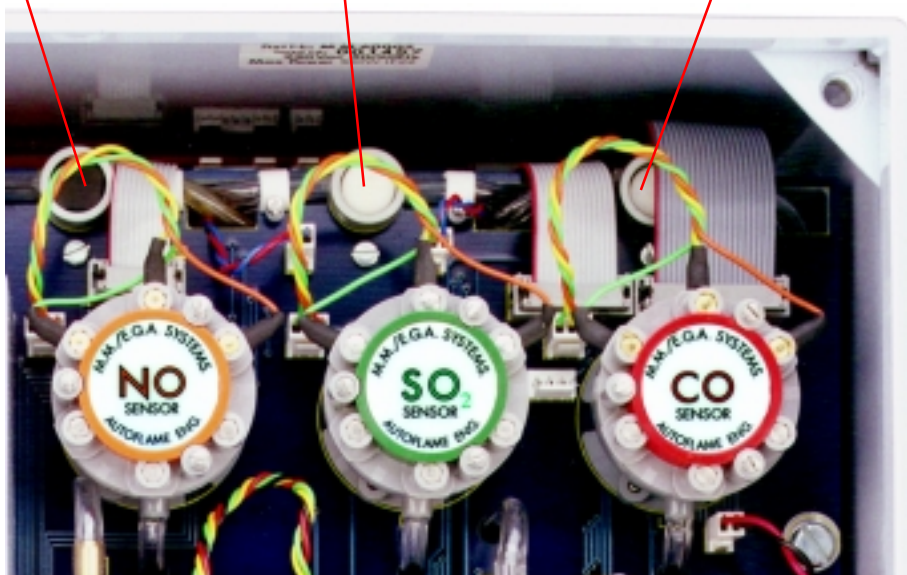
The Pinch valves are checked in the M.M. Run mode. Select fuel 1 (F1), Press E.G.A. to display the E.G.A. information. Check that pinch valve 1 is open. The black topped pinch valve should close when an E.G.A. calibration takes place, at this stage the sample line is closed and the drain solenoid is opened. At all other times (i.e. when no calibration is taking place) the black topped valve should be open.

Select fuel 2. 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 Pinch Valve Control.

V3 pinch valve.

V1 Pinch valve No.1

V2 Pinch valve No 2.



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 Three Measured Combustion Parameters O_2 , CO , CO_2

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 and lower limits on either or all of the three combustion parameters that the E.G.A. system measures; O_2 , CO_2 , CO . 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 listing detailed and listed elsewhere in this publication.

"Standard" Limits:

"Standard" Limits are a set percentage volume above or below the commissioned value for O_2 and CO_2 . In the case of CO , it is a specific amount of p.p.m. (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: In the case of CO , an ultimate high value in p.p.m. may be 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. 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. 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 on the switch facia simultaneously.

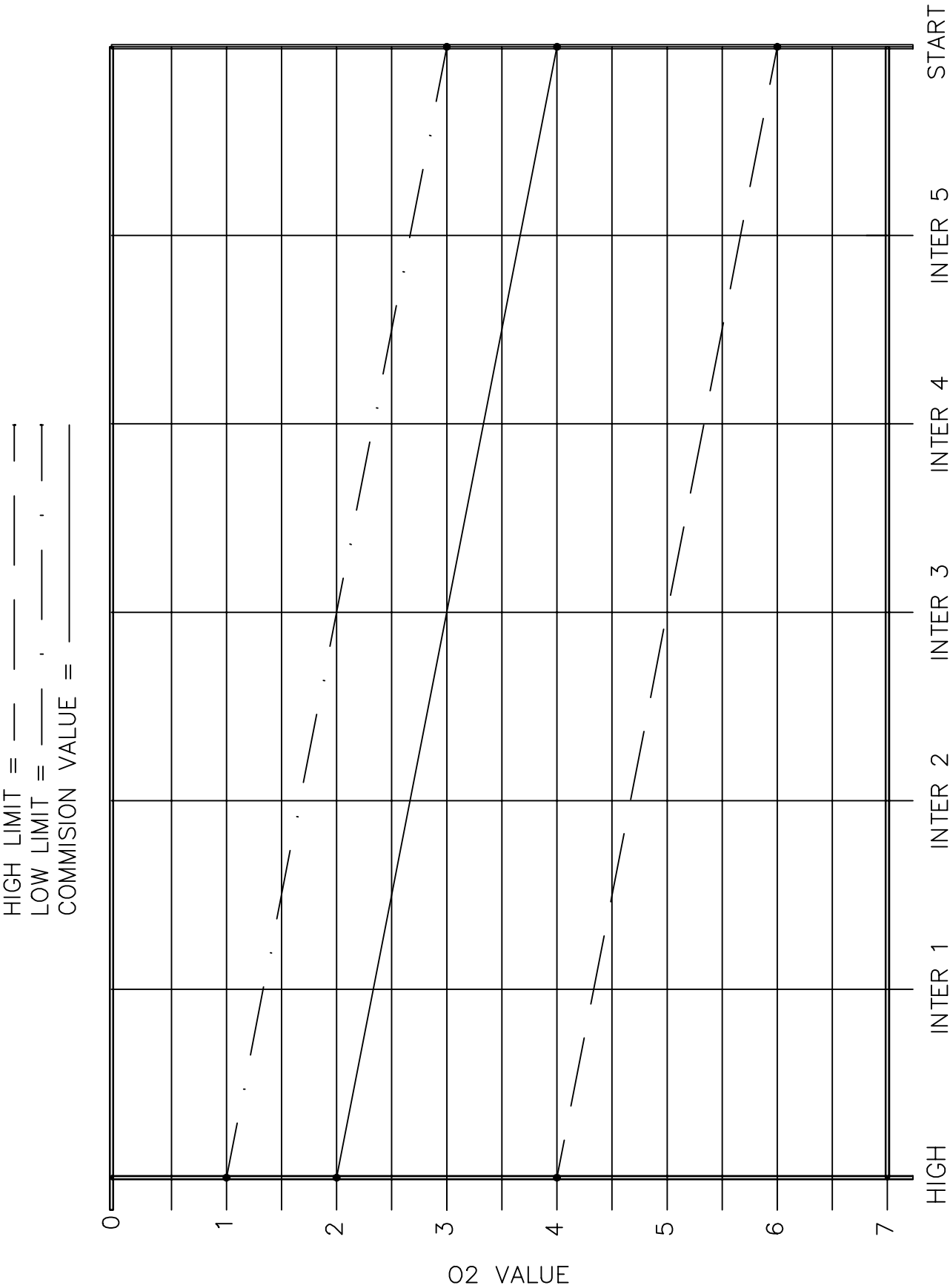
Control Function 2.

The combustion system is shut down (the CR relays are opened). 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 on the switch facia simultaneously.

(See relevant data sheets and drawings showing the control forms and facilities detailed above).

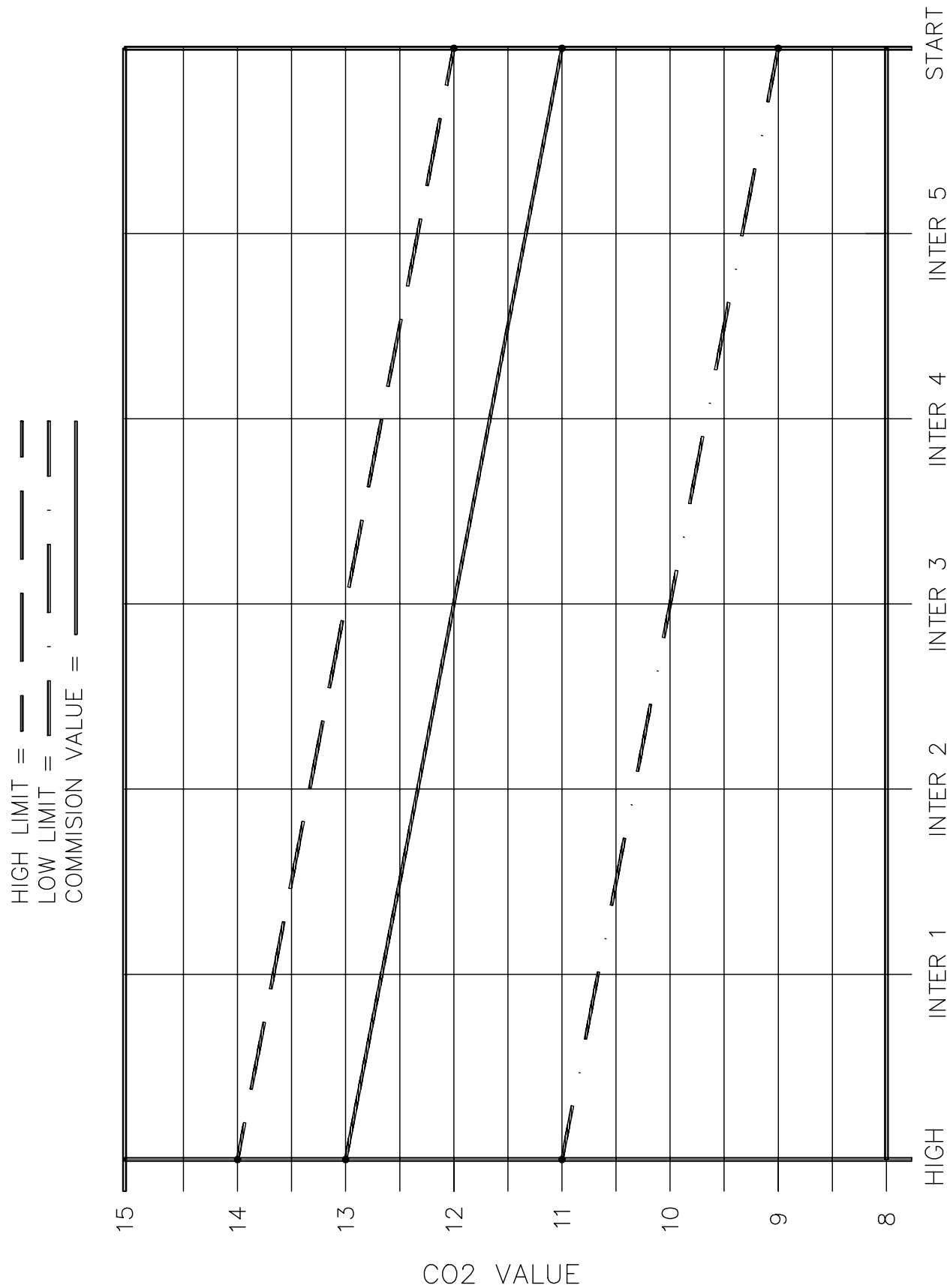
3.10.2

EXAMPLE OF LIMITS ON
O₂ MEASUREMENT



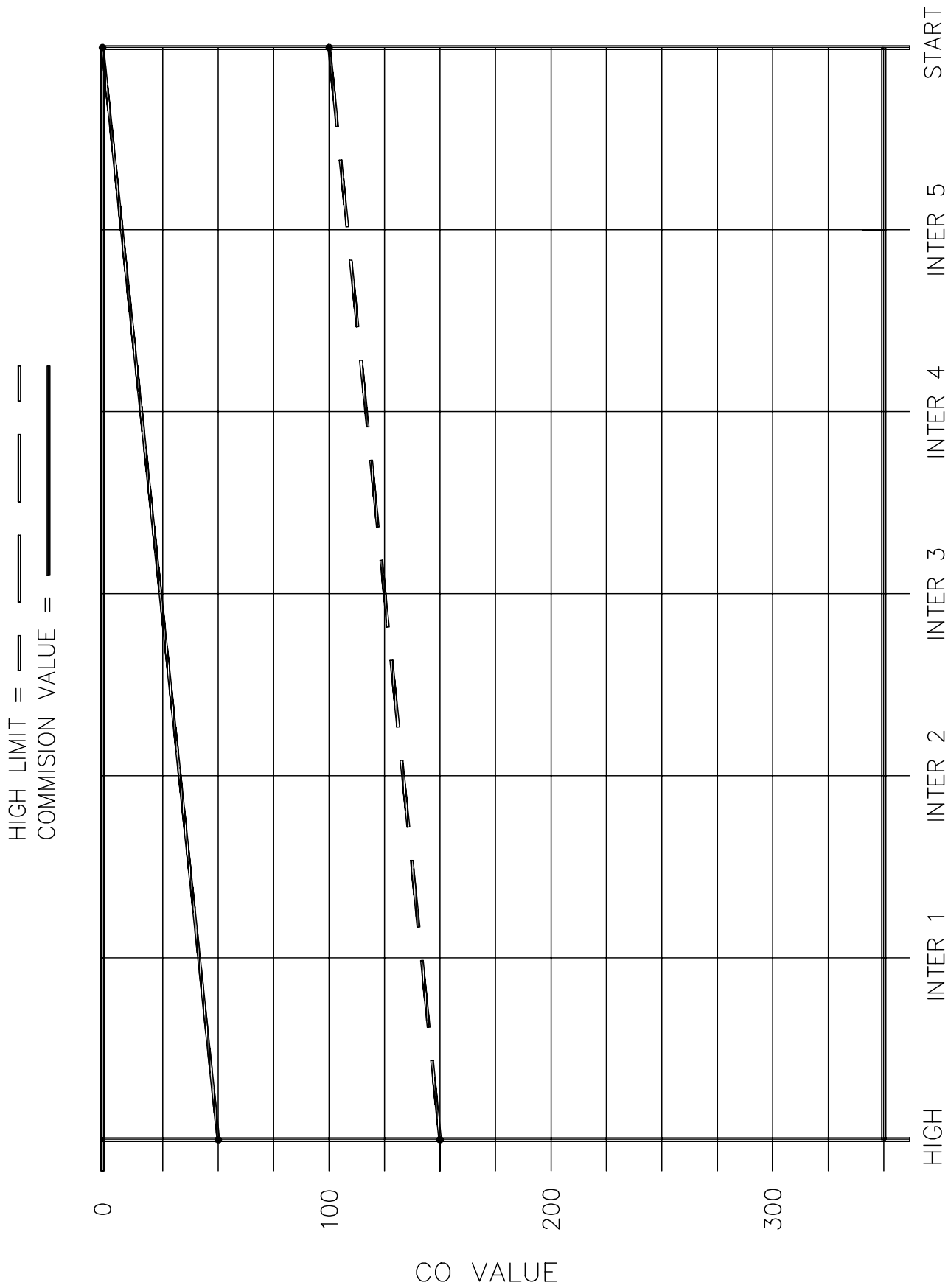
3.10.3

EXAMPLE OF LIMITS ON
CO₂ MEASUREMENT

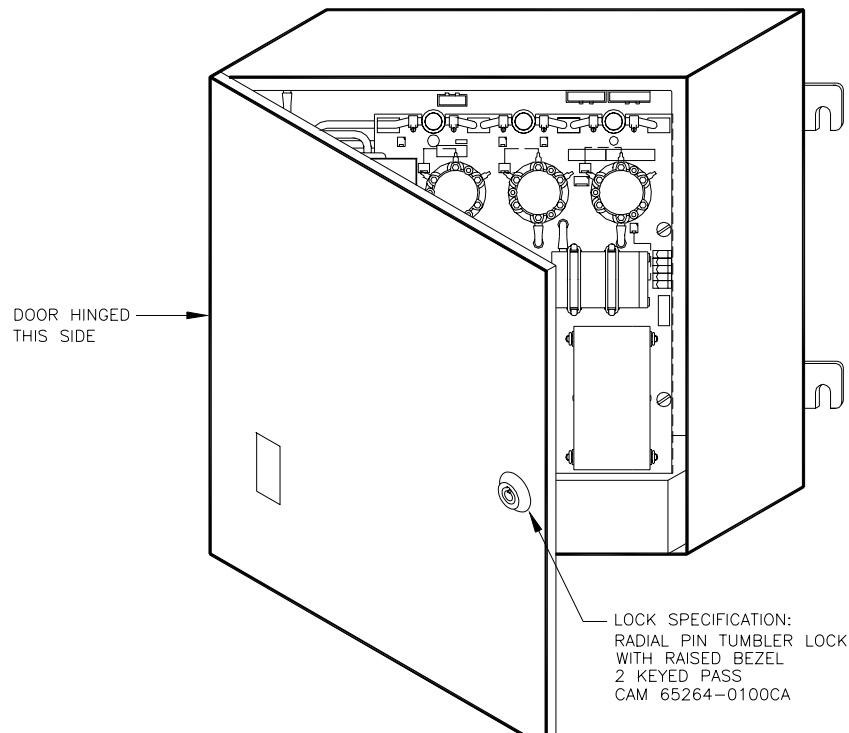


3.10.4

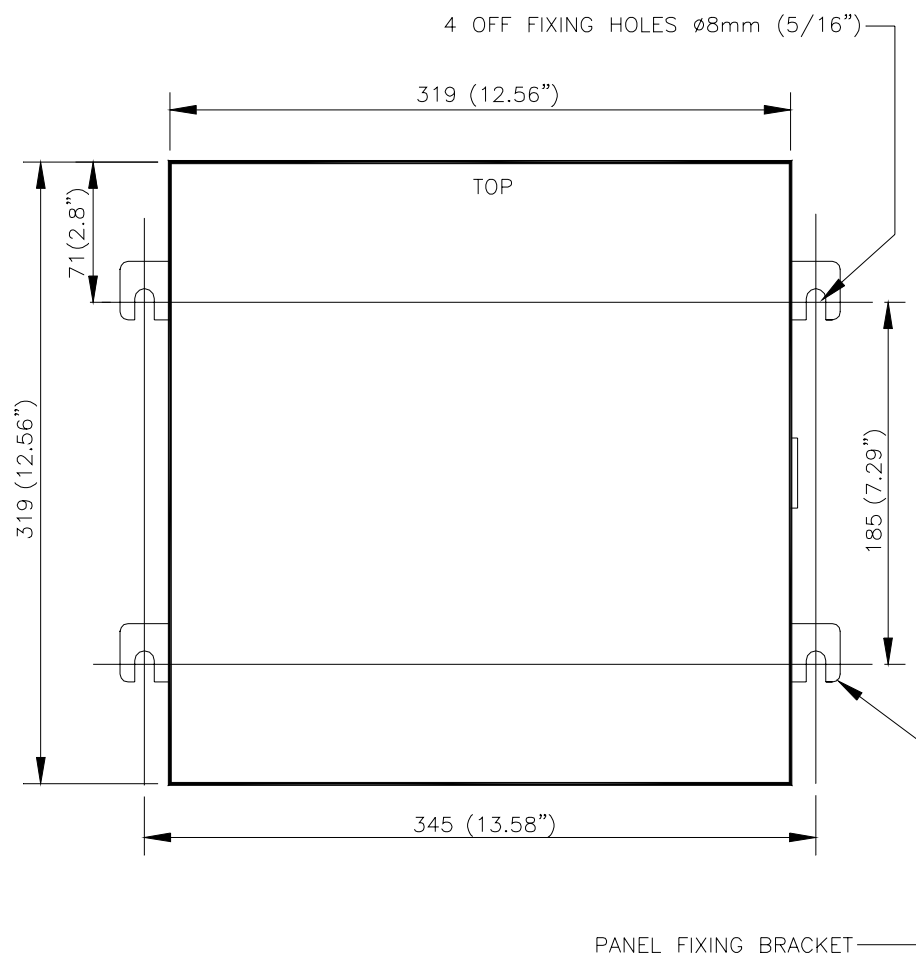
EXAMPLE OF LIMITS ON
CO MEASUREMENT



3.11 EGA Dimensions



NOTE:
DEPTH OF PANEL WITH FIXING BRACKETS = 181mm (7.125")



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 EGA 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 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 EGA 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

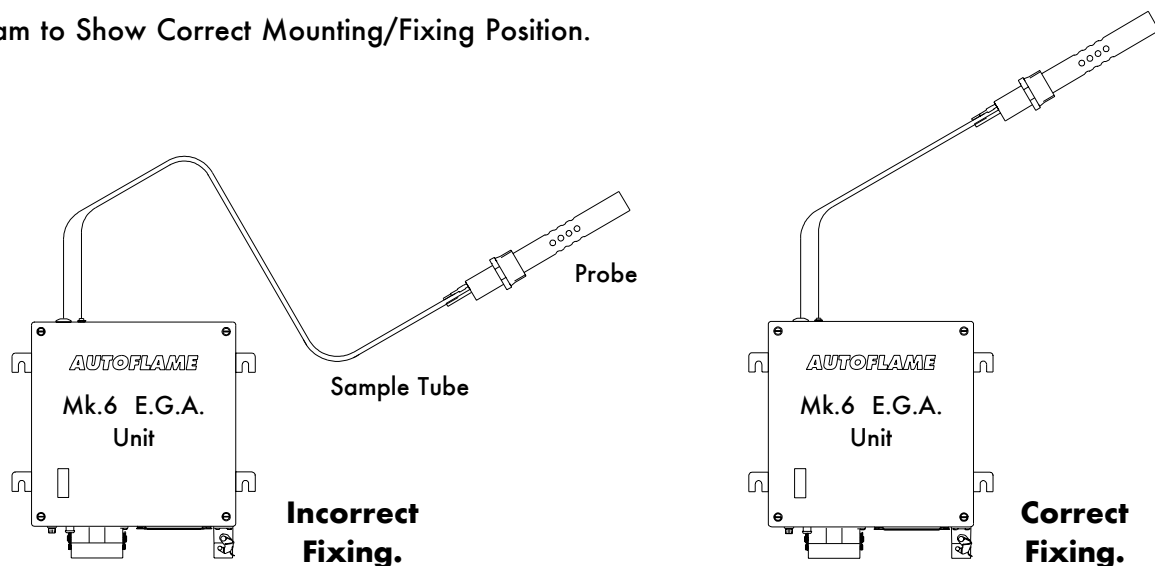
Push the sample tube onto the inlet tube. Plug the thermocouple connector into the socket and tighten the screw.

To obtain optimum performance and reliability do not mount the unit in ambient temperatures above 45 degrees C. 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 45 degrees C.

Do not mount the units where excessive vibration occurs (floor standing racks are available from Autoflame Eng.).

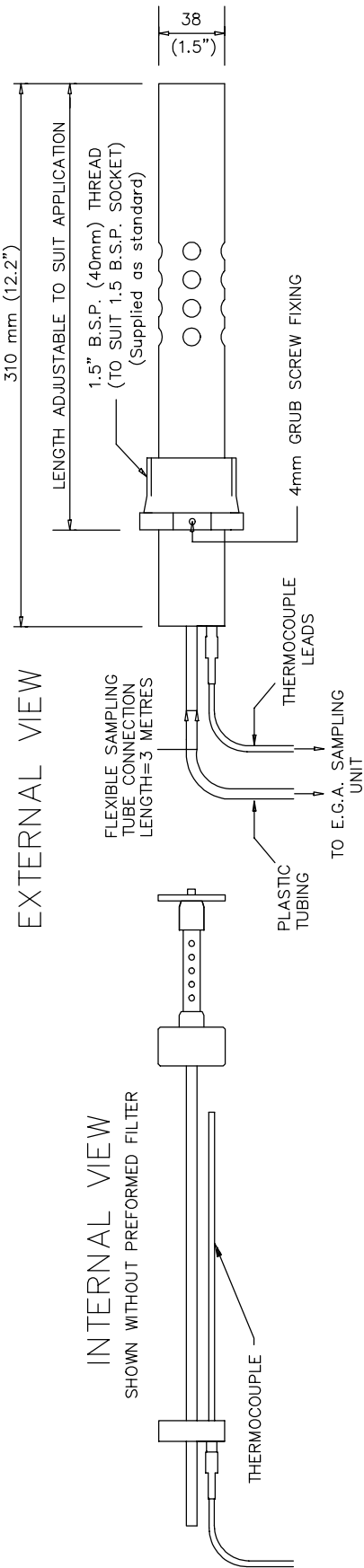
Position the sample tube so that the sample slopes down to the EGA unit at all times. The E.G.A. unit must always be mounted lower than the EGA probe.

Diagram to Show Correct Mounting/Fixing Position.

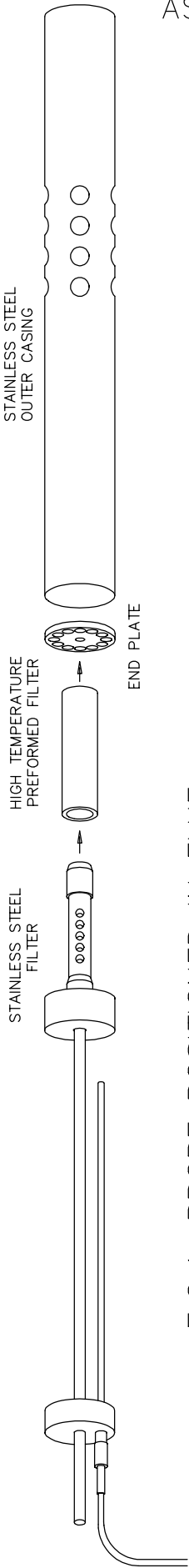


3.12.2

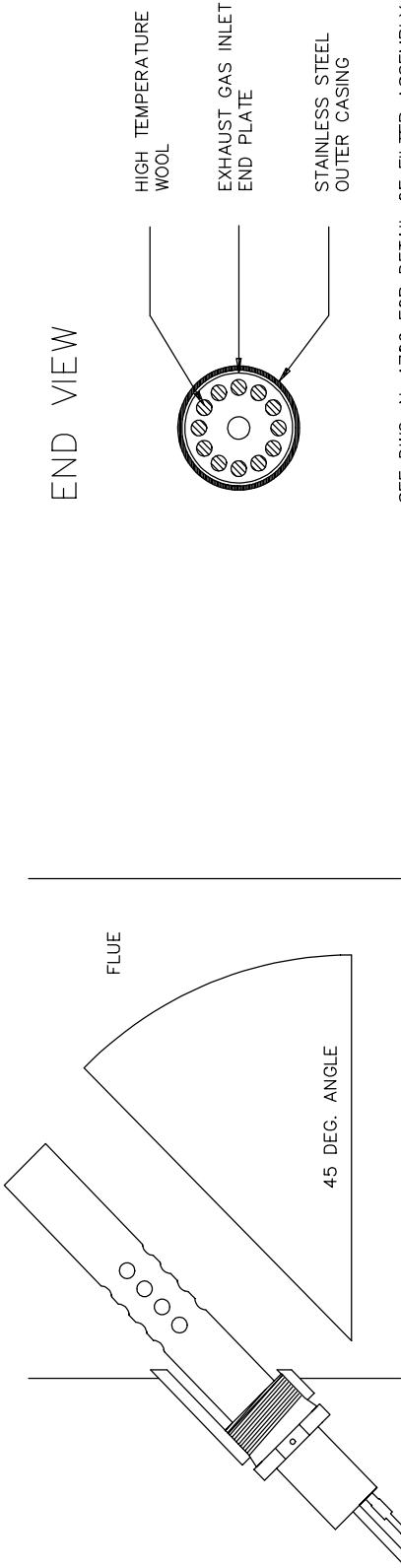
E.G.A. SAMPLING PROBE ASSEMBLY



ASSEMBLY OF E.G.A. PROBE

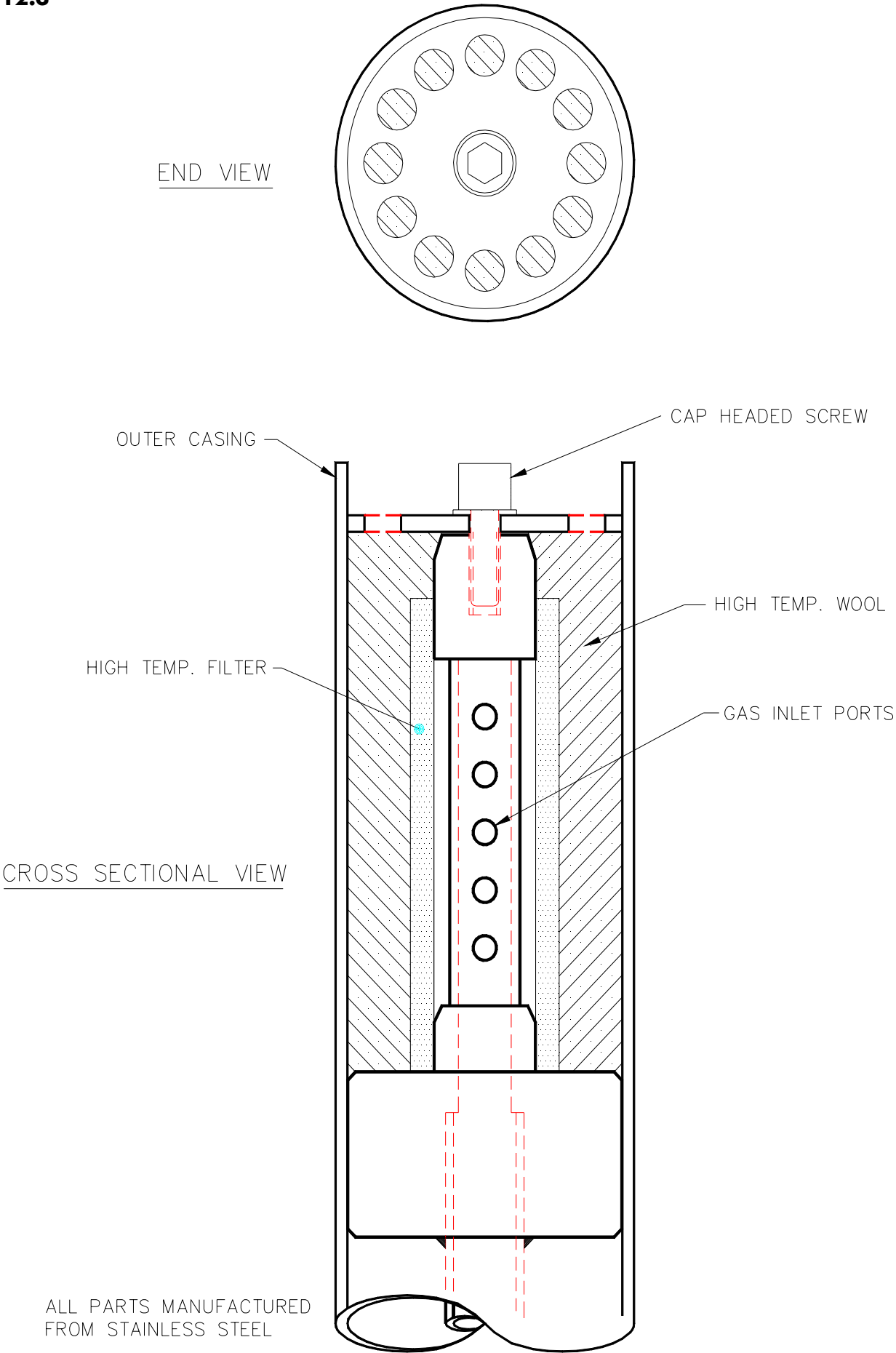


E.G.A. PROBE POSITIONED IN FLUE



SEE DWG. No.1706 FOR DETAIL OF FILTER ASSEMBLY

3.12.3

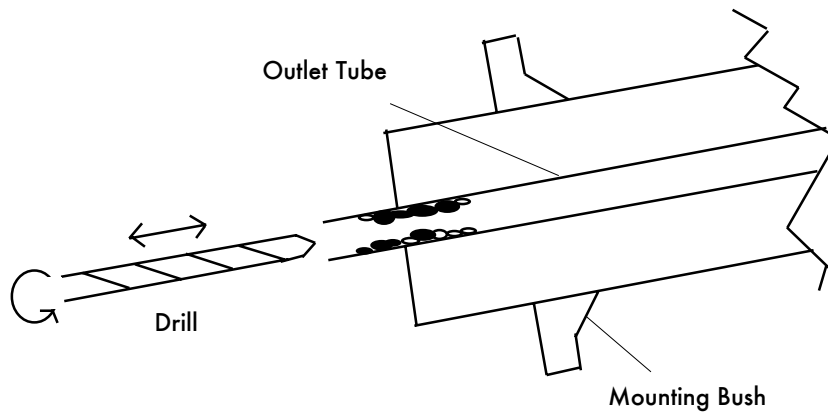


3.12.4 Maintenance of Sampling Probe

On gas only applications it is unlikely that there should be any maintenance on the stack mounting probe. On heavy or solid fuel applications, deposits may build up in the outlet part of the tube. If the tube blocks "ERR EGA 20" 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.

Sectional Diagram to Show Method of Clearing a Blocked Outlet Tube.



3.12.5 Installation Precautions

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

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.

Plug in the thermocouple lead and set the M.M. to read E.G.A. Values in Commissioning Mode. Apply heat to the thermocouple (put a soldering iron through the holes in the outer casing) and check that the thermocouple gives a reading.

If there is any doubt to the accuracy of the thermocouple then replacement is advised.

Mk.6 EGA Internal Tubing Pipework



Section 3.14 E.G.A. with Bubble Filter

3.14.1	Overview.
3.14.2	Operation.
3.14.3	Maintenance.
3.14.4	Standard Setup.
3.14.5	Fault Finding.
3.14.6	Technical Specifications.
3.14.7	General Assembly of Bubble Filter & EGA Display Pod.
3.14.8	Plan view of Connection (Actual & Schematic)
3.14.9	Enlarged View of Bubble Filter Pot top cap Connections.
3.14.10	Wiring Diagram Display Pod & EGA Sampling Unit.
3.14.11	Mk.6 EGA Internal Layout (Shown without cover)
3.14.12	General Assembly of Dry Filter.
3.14.13	General Assembly & Exploded View of Particulate Filter.
3.14.14	General Assembly of Bubble Pot.
3.14.15	"S" Type High Temperature Thermocouple Assembly.

3.14.1 Overview

The Exhaust Gas Analyser in its standard form is a tried tested and approved apparatus for the continuous on-line monitoring of exhaust gases on packaged boiler plant.

The versatility of the product enables monitoring of all types of commercially available fuels on both packaged light, commercial & industrial process plant.

For Clinical waste incineration there are 3 parameters of importance to the environmental authorities:- O_2 , CO, & Exhaust gas temperature.

The use of electro chemical cells enables a cost effective package offering the accuracy required for clinical waste monitoring.

The "Bubble Pot" continuous wash filter ensures all acids & metals are absorbed from the sample before entering the EGA unit, preventing a corrosive attack of the system.

Data from the unit is available in two forms:-

1. Remote Display Pod
2. 6 x 4-20mA outputs for connection to PLC

The unit carries out nightly "Autocal" checks to ensure the cells are operating within specified tolerances. Any discrepancies are signalled on the display pod facia using the error codes detailed in section 5

A PC software package & lead are available which allow a service technician to carry out simple setup & calibration tasks. Replacement cells are supplied with their own unique calibration no.

When a cell is replaced the calibration number is entered via the PC ensuring minimum downtime and costly on site service charge. (Part No. DT1120018)

3.14.2 Operation

The E.G.A. & filters are designed to operate with the minimum amount of user input.

The unit is supplied prewired & prepiped ensuring simple installation.

Section A1 shows a typical layout for the unit with all connection information detailed separately under their respective figure illustrations.

Day to day Operation.

Once installed all necessary inputs & outputs are automatic.

The unit must always be powered.

A mains 230Vac input on terminal 7 tells the unit when to start sampling. This signal should come from the PLC & should be set to give an output when the furnace temperature has reached 1000 deg C.

NB. Experience shows that when the furnace is below 1000 deg C considerable amounts of unburnt ash/solids are given off which quickly block the sampling system. It is not advisable to control the process until the combustion has reached a steady state condition.

Setting up Water Flow.

Water input must be greater than water out through the drain,.

The greater the water flow, the more acids are absorbed from the sample.

Ideally water "in" should = water "out", however on initial start-up the filter would not be able to fill,

therefore the water "in" should be slightly greater than the water "out". If the difference is too great the water "in" solenoid will be constantly be turning on & off creating a pulsed sample, a control regulating valve on the inlet water line will enable optimum setup.

3.14.3 Maintenance

The on/off signal for sampling is controlled by the PLC.

Daily Checks

1. Check the condition of the hot filter on the end of the probe.
experience shows that this needs replacing every 2 to 3 days depending on waste being burnt. (see section A1)
2. Check there is a gentle flow of water from the bottom of the Bubble Filter.

The unit has self diagnostic error checking software & any fault conditions are notified via error codes on the facia. (see *fault finding* Section 3.14.5)

Monthly Checks

4. Remove EGA lid and visually check the condition of the E.G.A. "Dry" filter, (see section 3.14.12) the condition of this filter varies greatly with the type of waste being burnt. All the following conditions necessitate change:-
 - a) Discoloration of the wool filter.
 - b) Build up of white deposit in the filter.
 - c) Any signs of condensate.

3.14.4 Standard Setup

The EGA is setup to work with a display pod & Bubble Pot. If any item is not connected an error condition will be signalled.

4-20mA Output Setup

CHANNEL	DESCRIPTION	4mA	20mA
1	O2%	0	16
2	-	-	-
3	CO ppm	0	200
4	Type "K" Thermocouple	500	1600
5	Type "S" Thermocouple	500	1600
6	Fault - -operational	Fault	Operational

The above are factory set. These can be changed at time of manufacture or by the user with the aid of the EGATOPC software disk & lead.

Possible Problems

01 ——— Check Wiring connection between EGA & Pod. (see section A4)

20 ——— Pump failure/Sampling Blockage, remove sample tube at inlet to EGA
If error goes then the sampling line/Bubble Pot has a blockage.
Isolate each section & check for blockage.

If error persists then blockage/Fault is within the EGA.

Remove the input to pump (lower pipe connection)

If error persists then faulty pump.

If input clears then the pump is O.K.

check the following:-

a) Filter

b) Visually check sampling line.

If unable to find problem then contact your distributor. (see section A5)

21 ——— Replace O₂ cell.

23 ——— Replace CO cell.

24 ——— Change pressure switch.

26 ——— Replace NO Cell.

27 ——— Water has filled but will not drain.

Possible Problems:-

a) Drain cock is blocked.

b) Blockage in Sampling probe.

28 ——— Bubble Pot wiring fault.

Check the connector for the Bubble Pot is securely fixed.

Check wiring.

29 ——— Flood condition - Water has reached the high level water probe.

Possible Problems:-

a) Sampling probe/Line Blocked.

b) Small restriction in drain cock.

N.B. For both 26 & 27 if the sampling probe is significantly blocked, atmospheric air will enter through the drain hole.

Other Possible Problems**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 O₂ Reading at 20.9%

- Check all piping is airtight
- Check sample tube is not blocked.
- Check air solenoid is closed.
- Check air is not being drawn from the Bubble Pot drain.
- Check Bubble Pot head for cracks.

!!Warning!!

The Bubble Pot head is made of a corrosive resistant medical grade plastic, the top is drilled & tapped to accept the small tapered pipe fittings, the Bubble Pot is working at a minimal pressure of 10" WG. Fittings need only be finger tight, overtightening these tapered fittings will build up mechanical stress in the plastic resulting in hairline cracking.

Water level

If the water level continually oscillates no sampling takes place, depending on the type of water being used, electrolysis can cause a build up of non conducting solids on the water level probes. This is simply cured by cleaning the probes (see Section A5.4 for assembly of Bubble Pot)

High displayed on Pod Facia.

The ambient is in excess of 40 deg C and the chiller cannot cool down.

Low displayed on Pod Facia.

The ambient temp is less than 5 deg C

3.14.6 Technical Specifications

Electrical Supply:- 230V/50Hz or 110V/60Hz (Selectable)

Pump Flow:- 0.5L @ 60" W.G.

Water Supply:- This should be a constant head of between 10' & 15' of clean water from the header tank,
DO NOT CONNECT DIRECTLY TO THE MAINS SUPPLY

Temperature Range:-

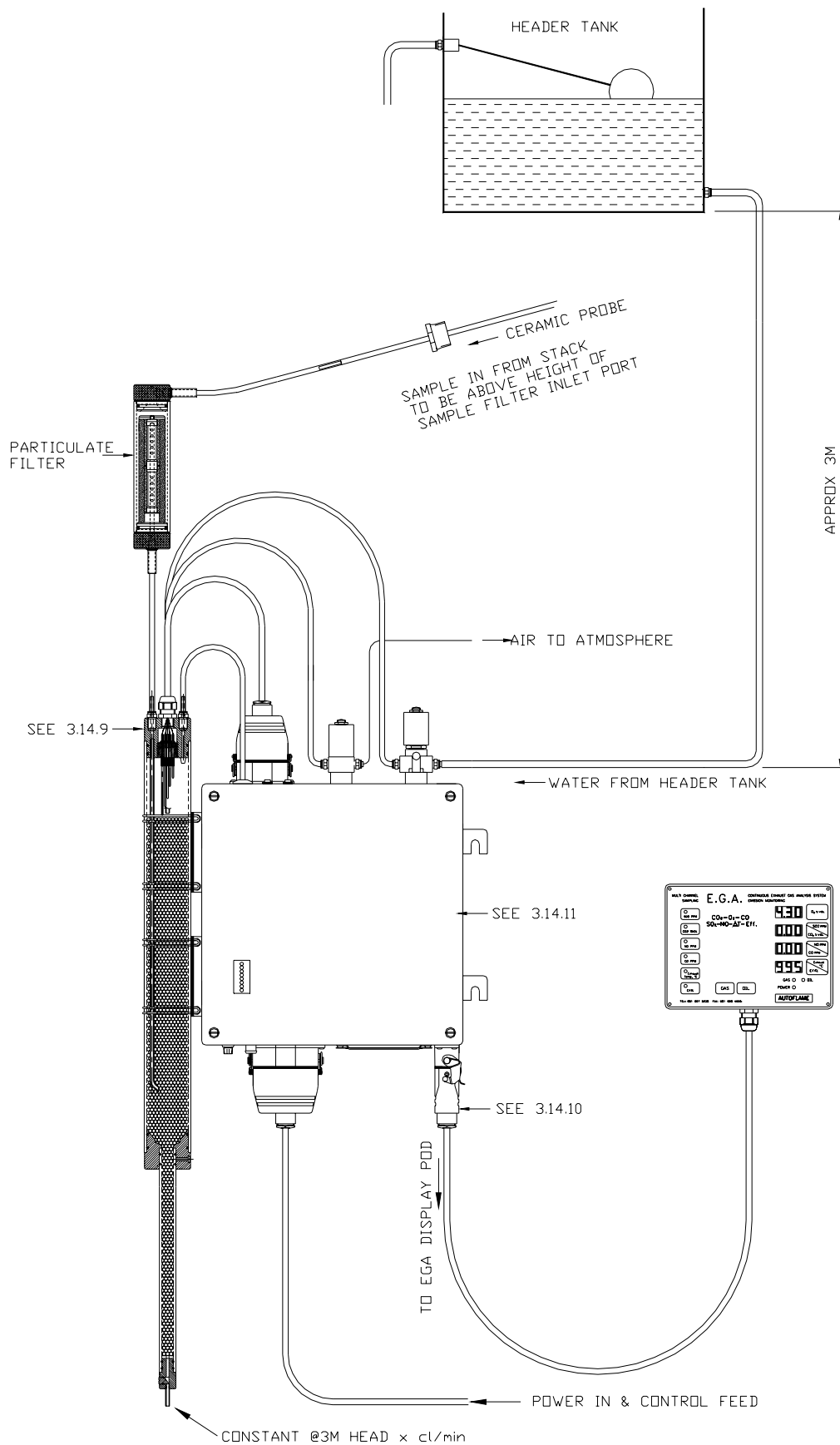
Min. +10 deg C
Max. +40 deg C

Ceramic sampling Probe 0 - 1600 deg C

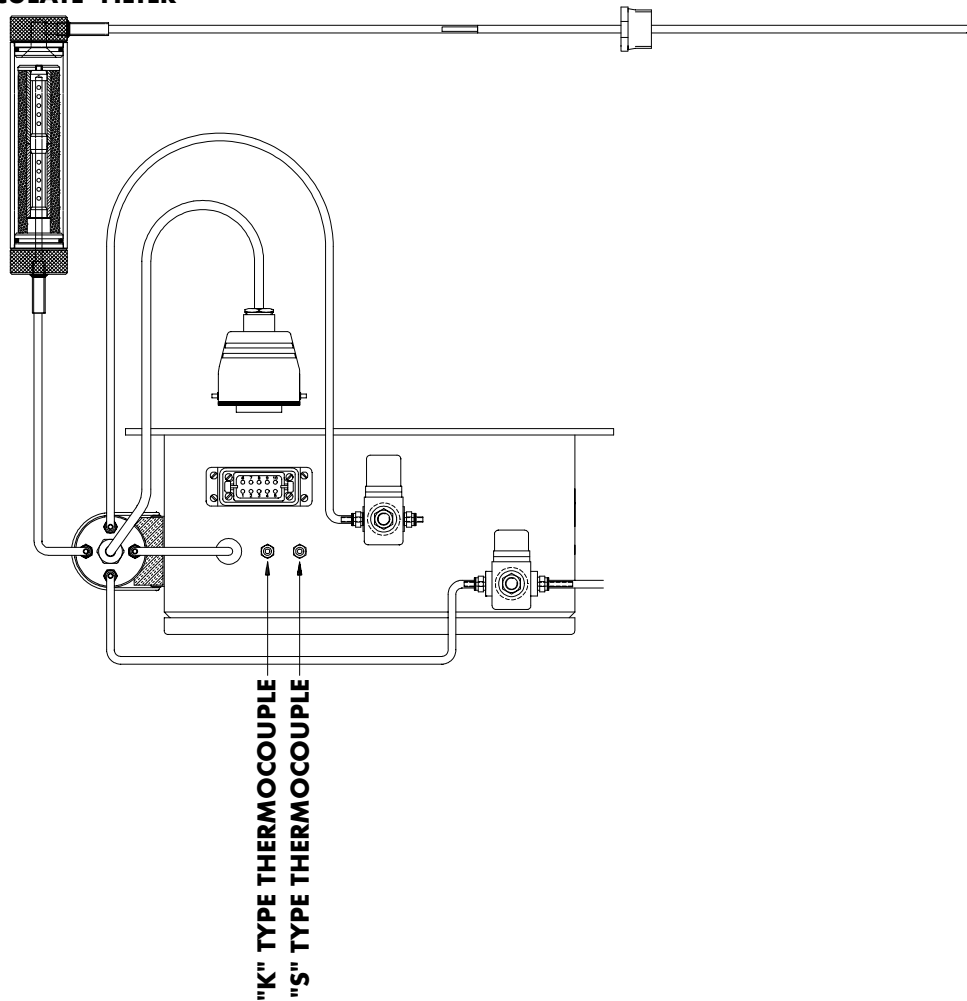
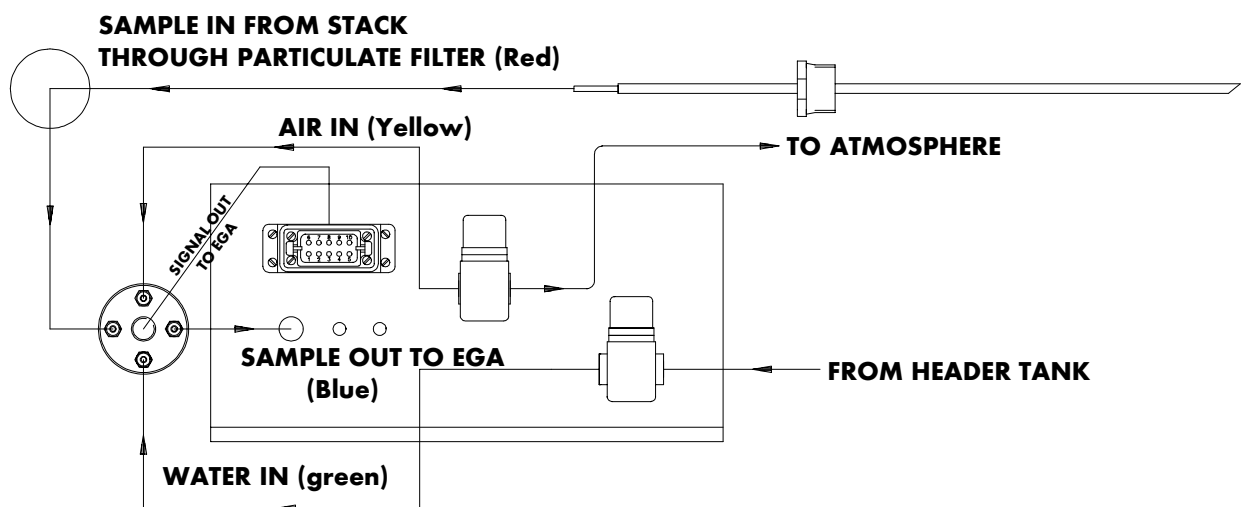
Type "S" Thermocouple 0 - 1600 deg C

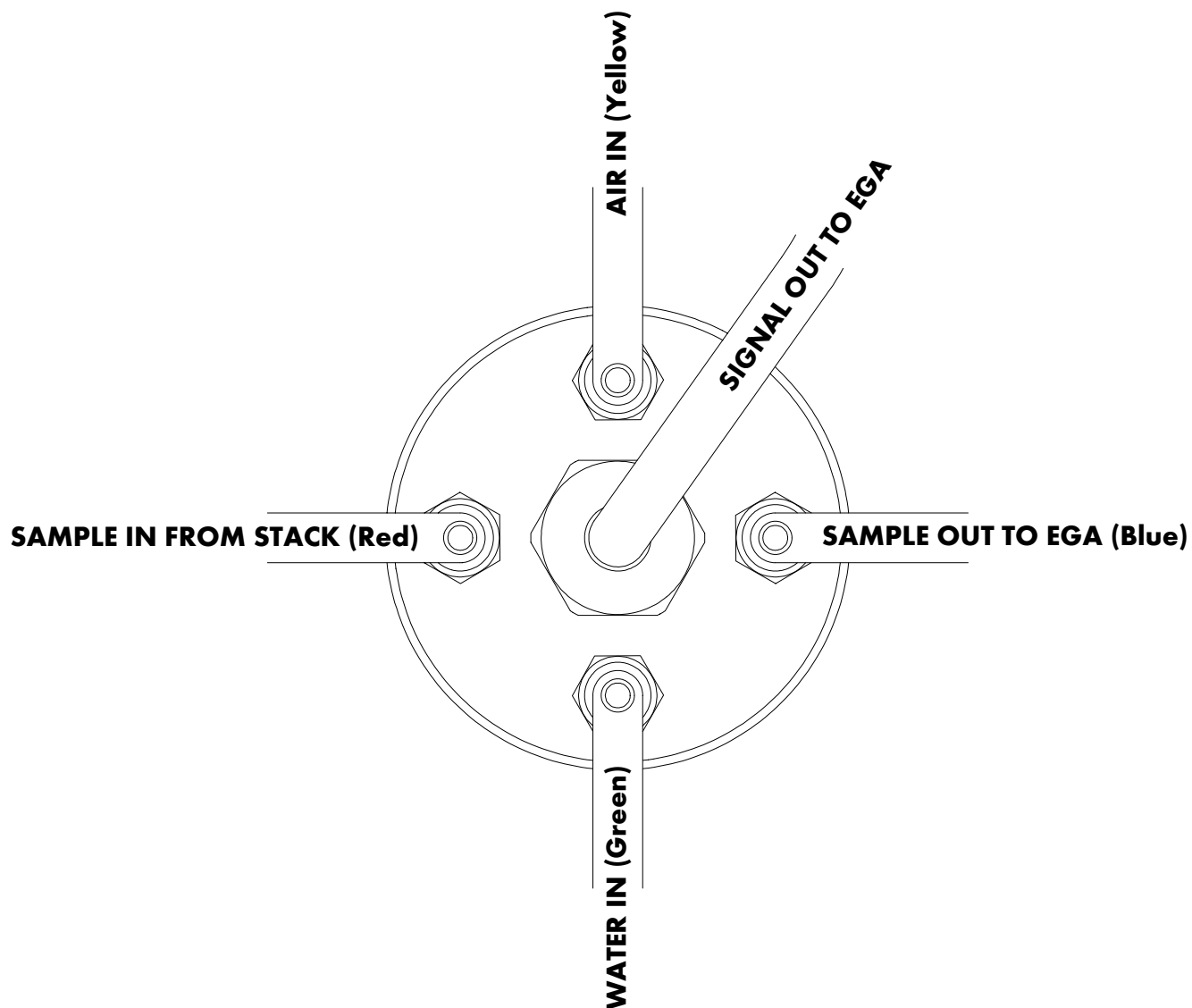
Type "K" Thermocouple 0 - 400 deg C

3.14.7 General Assembly of Bubble Filter & EGA/EGA Display Pod



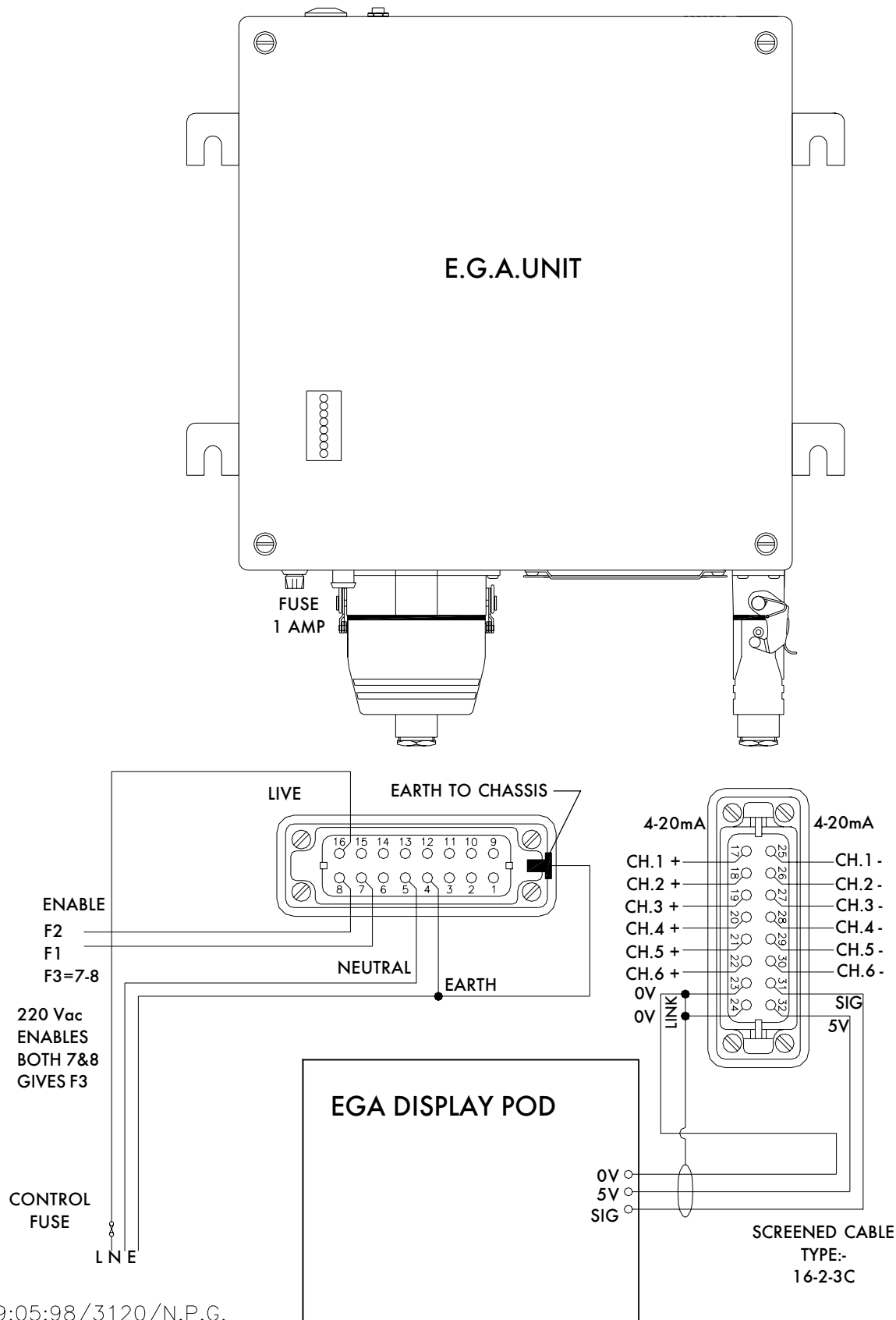
01:06:98/3572/JCF

3.14.8a Plan View of Connections (Actual)**PARTICULATE FILTER****3.14.8b Plan View of Connections (Schematic)**

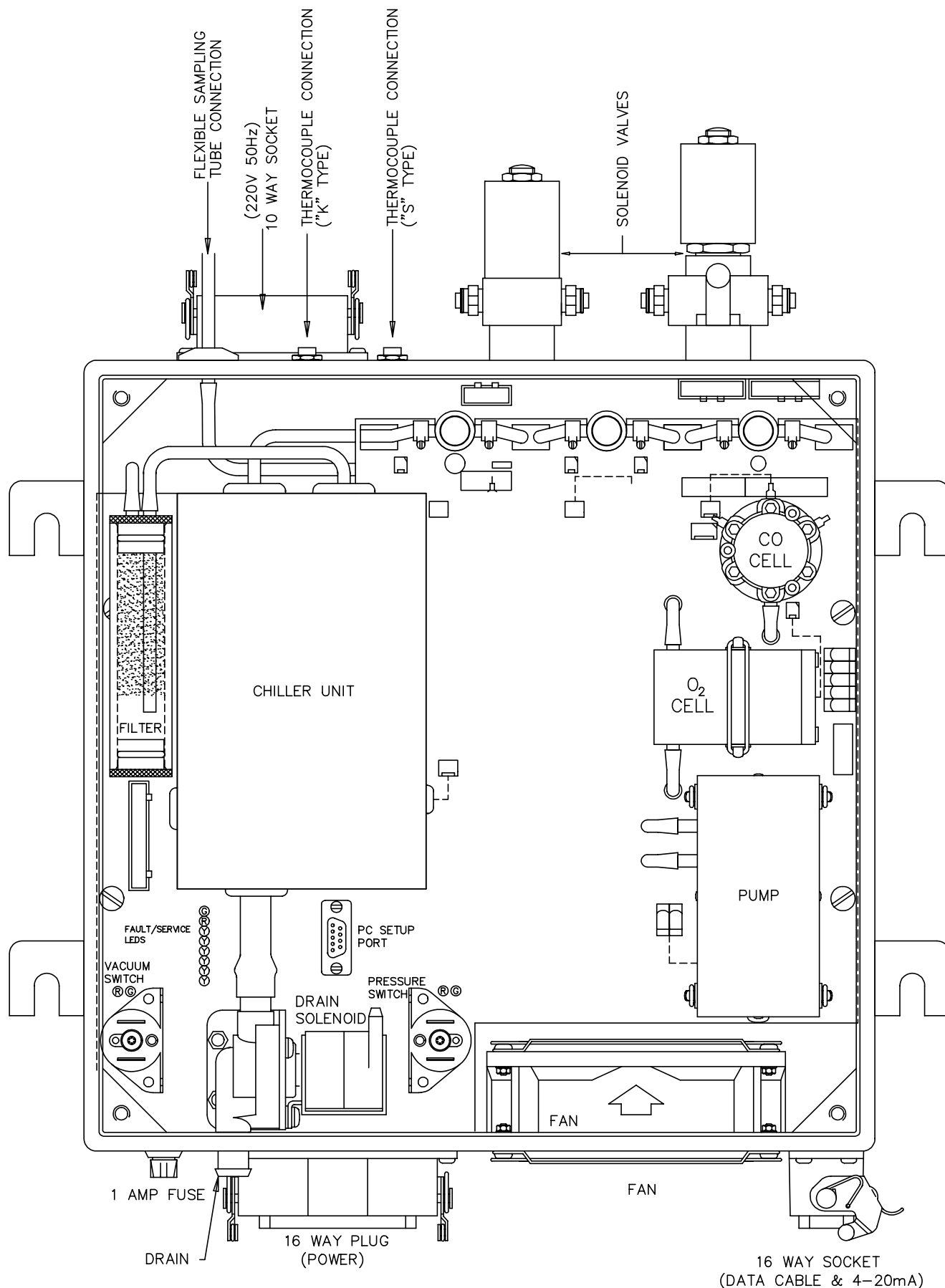
3.14.9 Enlarged View of Bubble Filter Top Cap Connections

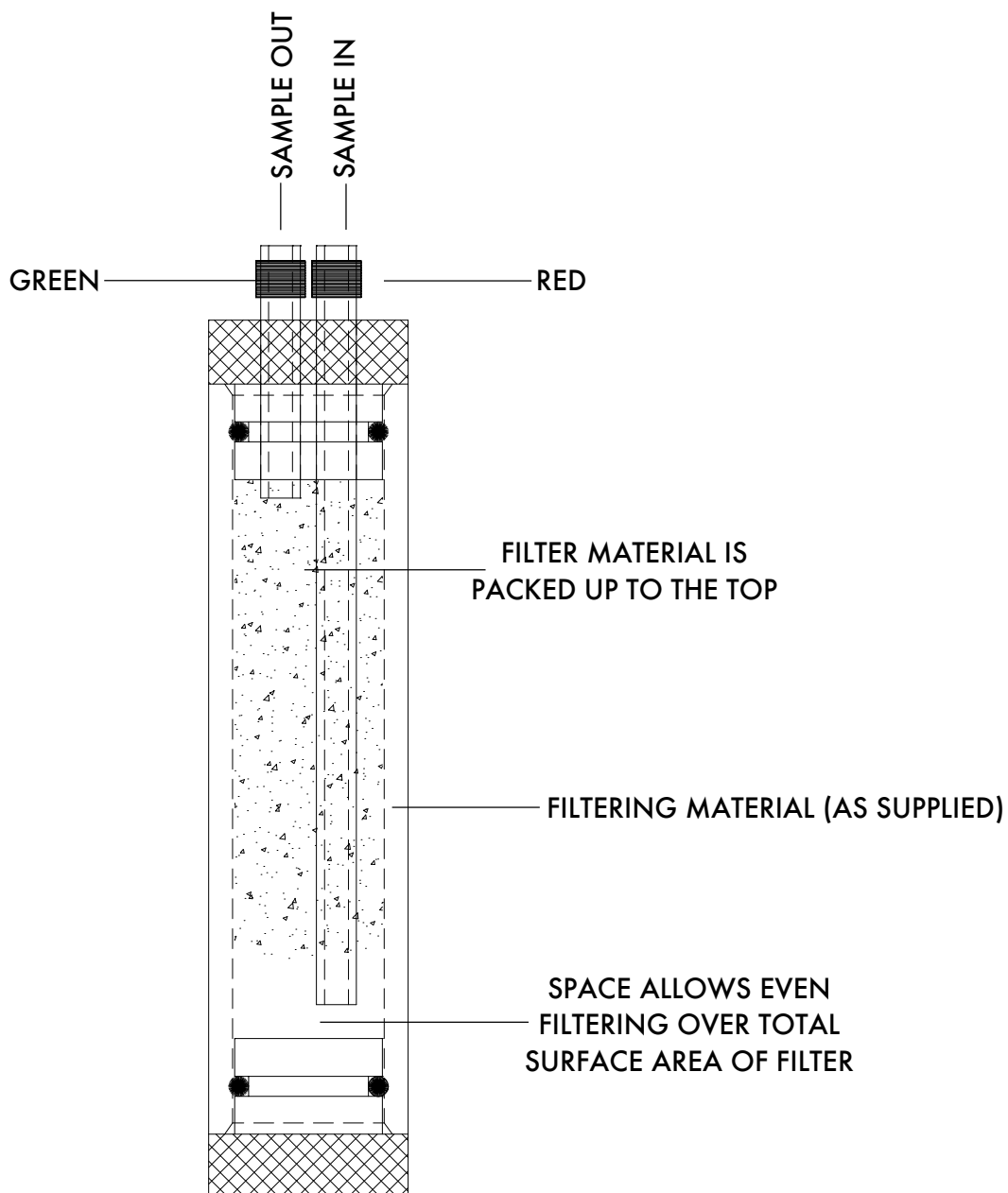
3.14.10

INTERCONNECTION BETWEEN DISPLAY POD
& EGA SAMPLING UNIT Mk.6

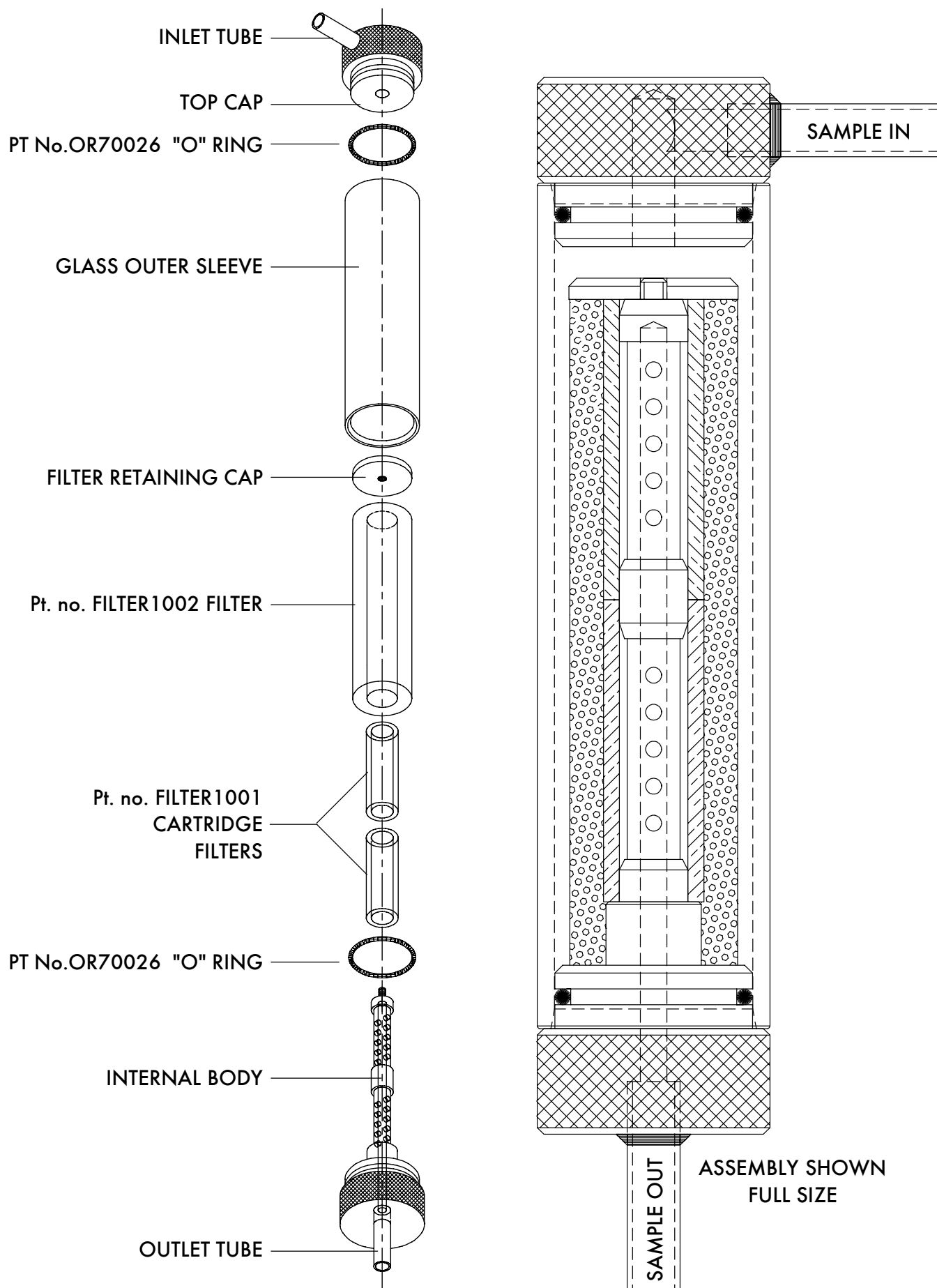


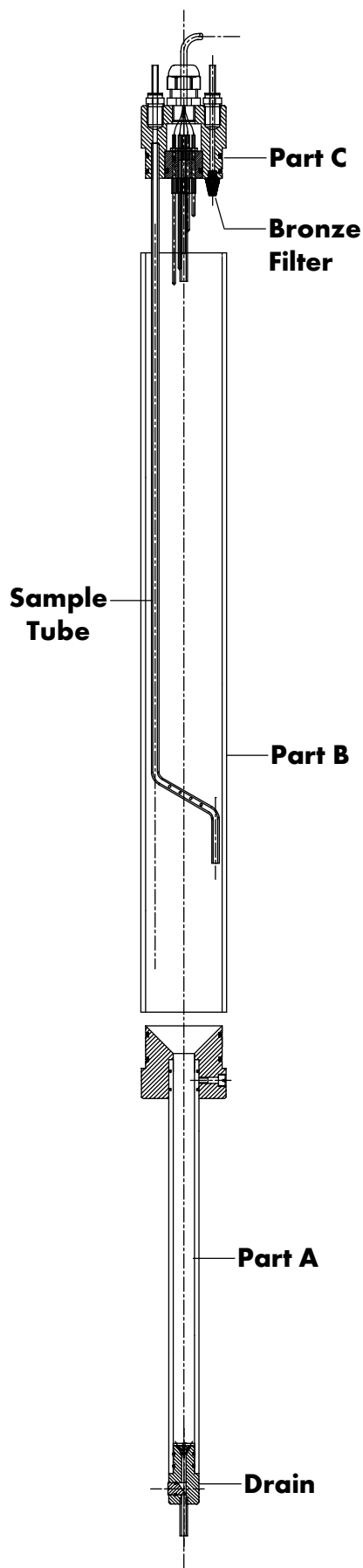
3.14.11 Mk.6 EGA Internal Layout (Shown without cover, for Clinical Waste Application e.g. O₂ & CO Cells only).



3.14.12 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.

3.14.13 General Assembly & exploded view of the Particulate Filter

3.14.14 General Assembly of Bubble Pot

To Dissassemble the unit:-

1. Disconnect all piping & wiring from Part C
2. Allow water level to drain out.
3. Place over clean bucket & remove Part A from Part B by gently rotating.
4. Once all the glass filter balls have been removed Part C is free to be disengaged.

Note*

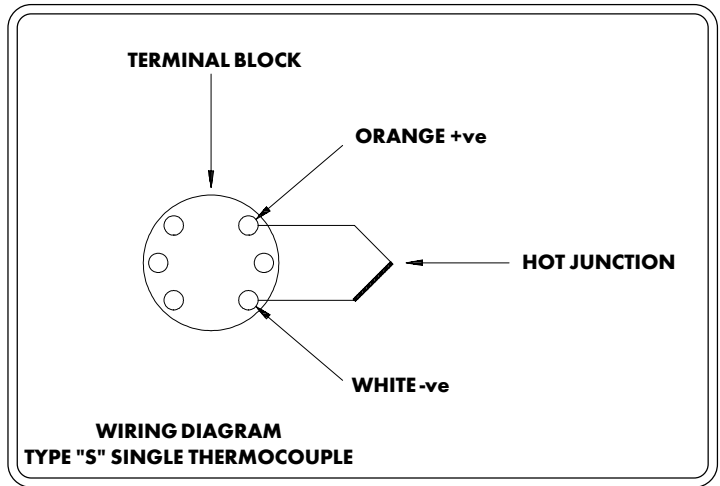
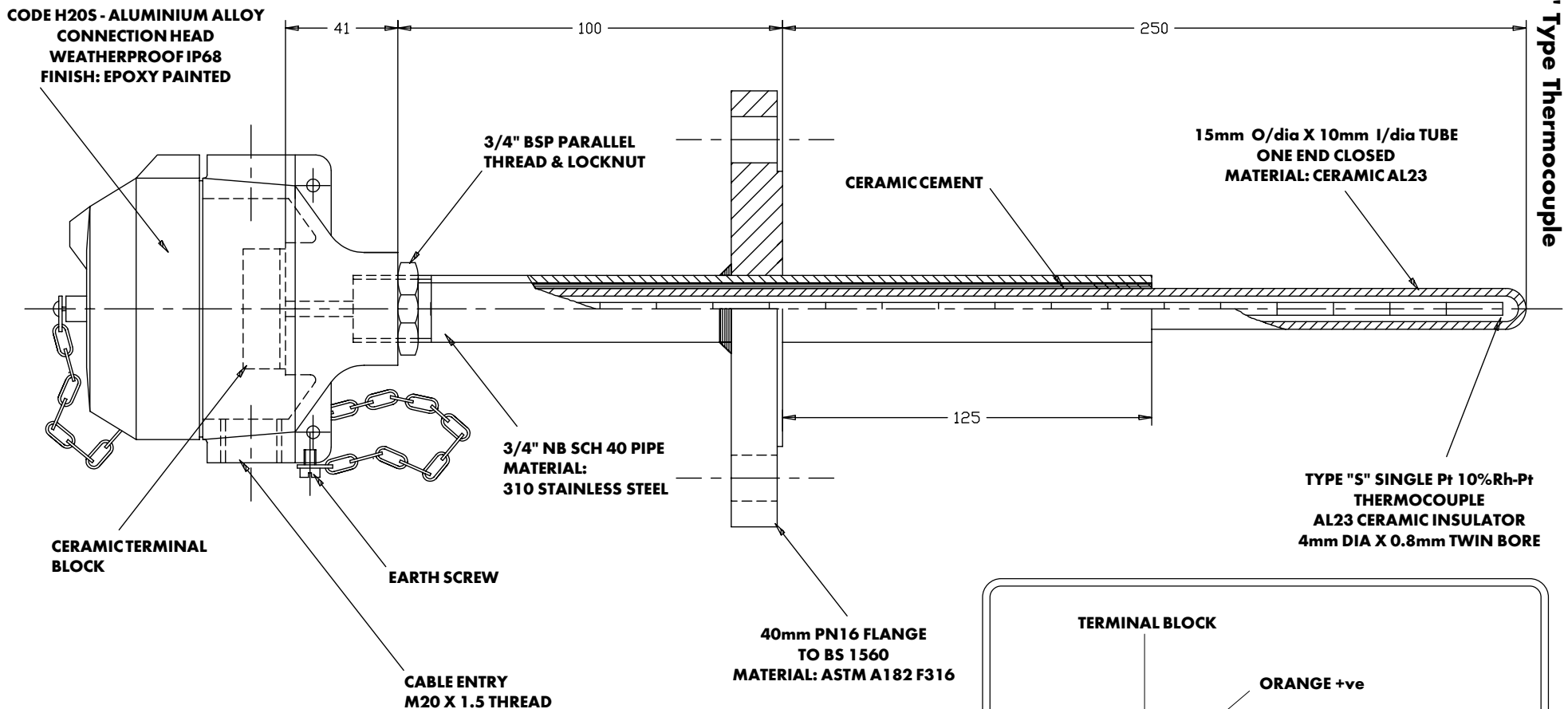
If Part C is rotated whilst all the glass filter balls are in place the "Sample in Tube" will be damaged.

To Assemble the unit:-

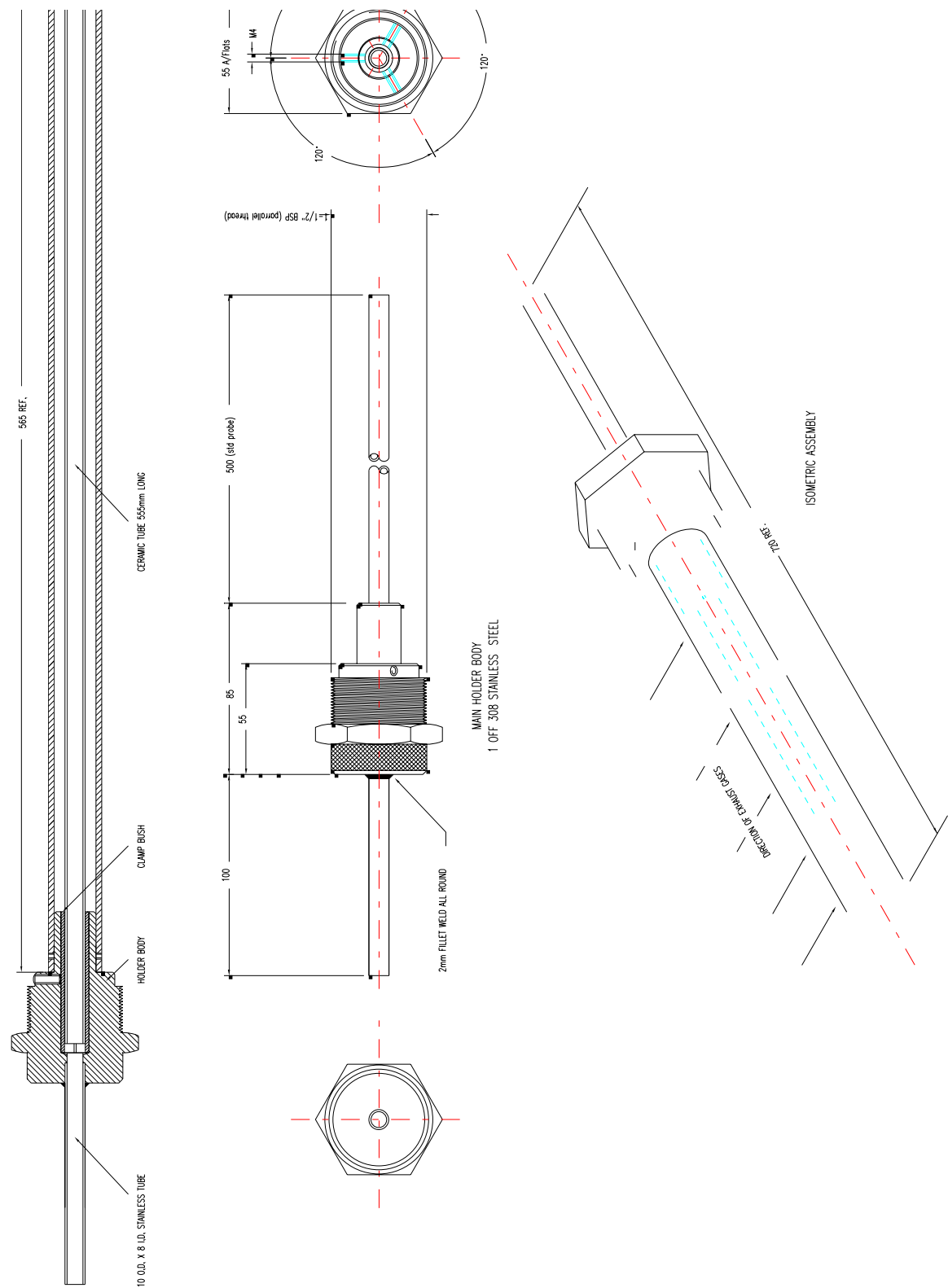
1. Fit Part B & Part C together.
2. Fill the unit with the glass filter balls.
3. Insert Part A by gently rotating.
4. Place unit upright & ensure glass filter balls fill down to the drain.
5. Connect pipework & wiring.

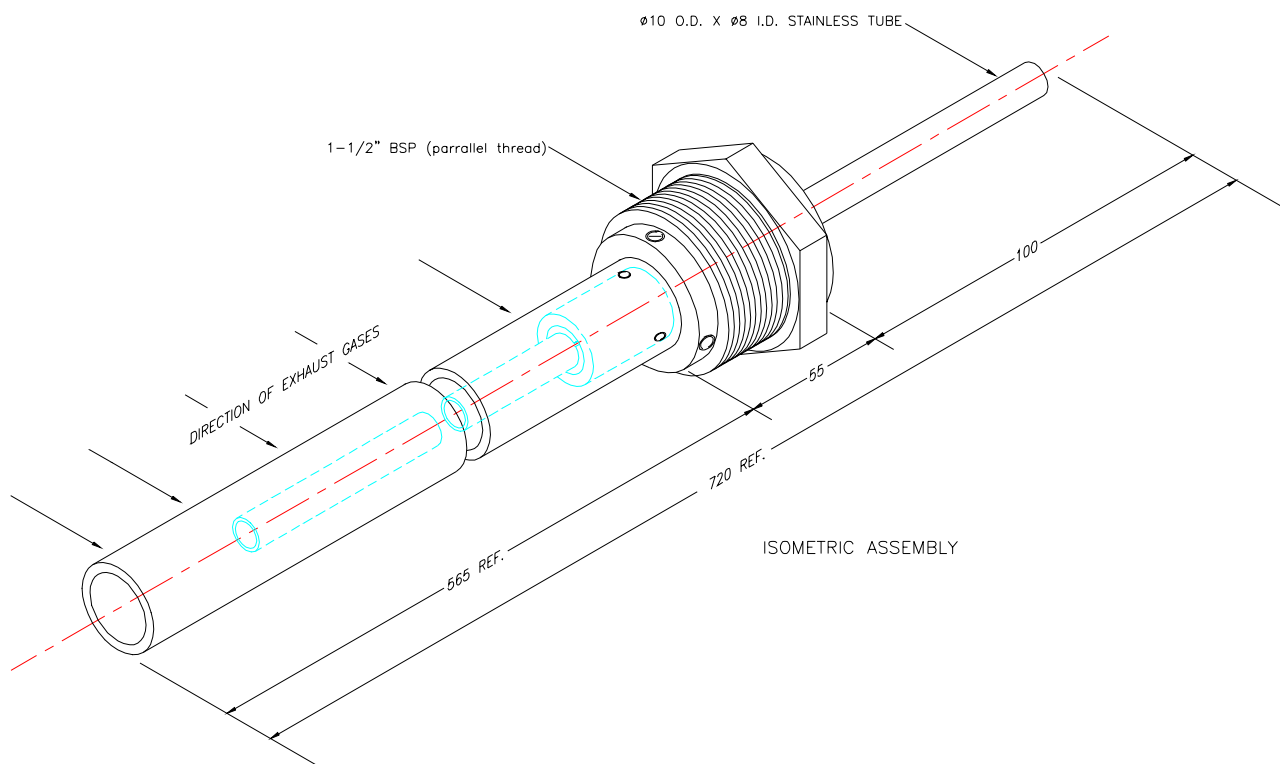
3.14.15 "S" Type Thermocouple

"S" TYPE HIGH TEMPERATURE THERMOCOUPLE ASSEMBLY



3.15 High Temperature Probes



3.15.1 Ceramic Sampling Probe Assembly

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 scientific 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 Overview - Features & Benefits of I.B.S. control
- 4.2 Commissioning and Setting Up Procedure
 - 4.2.1 Guide to Commissioning Sequencing
- 4.4 Electrical Schematics Showing all Terminal Interconnections
 - 4.4.1 Sequencing Connection Diagram
 - 4.4.2 DTI/Sequencing Connection Diagram
- 4.5 Other Information and Illustrations.
 - 4.5.1 Sequencing Operation
 - 4.5.2 Sequencing Combinations
 - 4.5.3 Diagram showing Data Transmission/Reception
 - 4.5.4 Mini Mk5 Sequencing Status Information

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.

IBS Intelligent Boiler Sequencing

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.




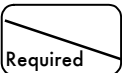


Note:

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.

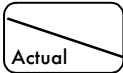
The load index is implemented using the same ten point load index entry method used for the Flow Metering as detailed in Sections 2 and 3 of the manual. If the Flow Metering has already been optioned and the ten point load index entered then it is not necessary to enter this again. However if it is not entered, proceed as detailed below.

1. Set Option 57 to Value 1 (Refer to Section 2.2.4 - Setting Options).
2. Press  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  window will show fuel value in degrees angular.
The  window will be blank.
The  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  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

 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



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.

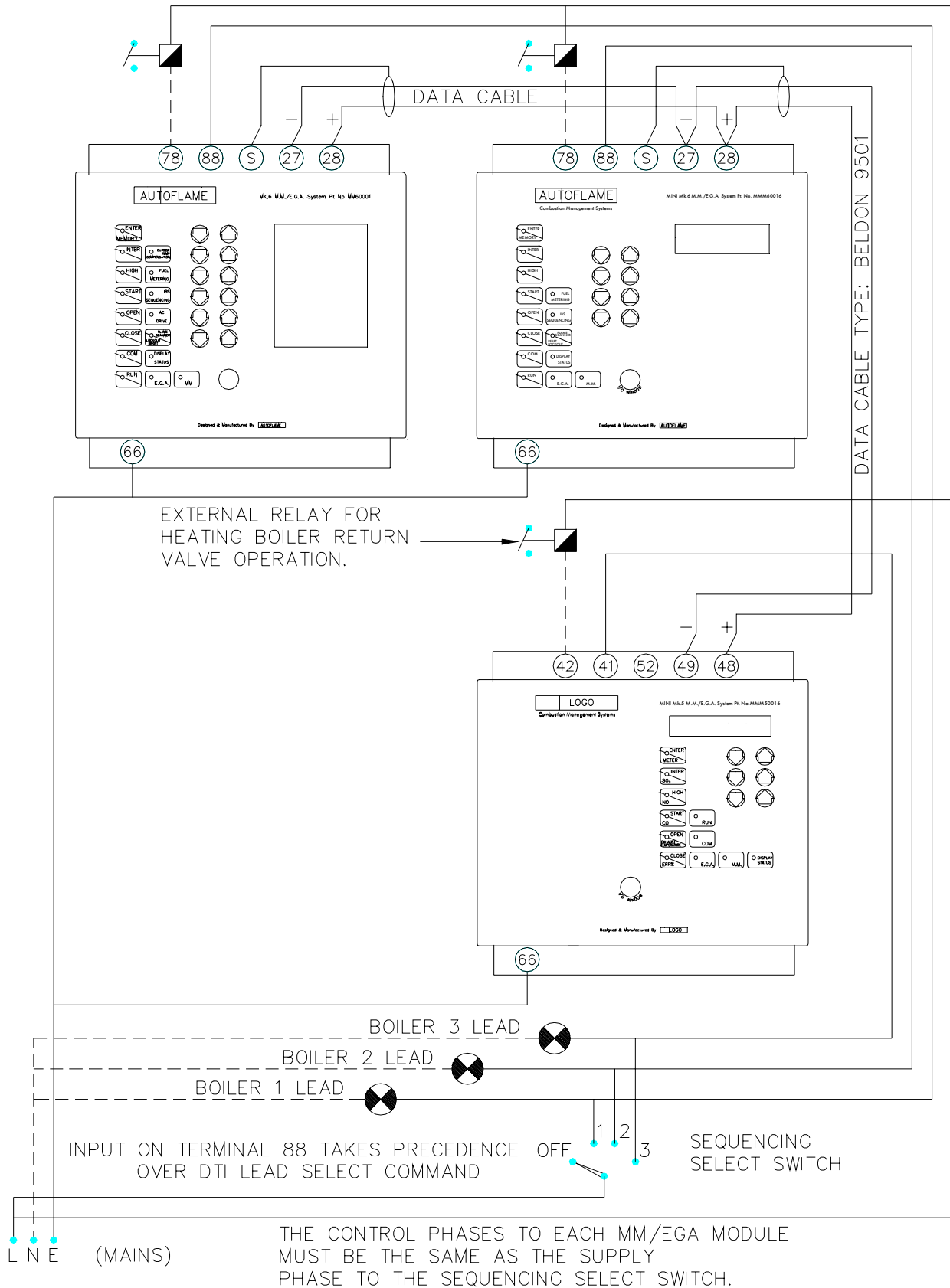
Set Option 53 to the time required for the boiler to be off.

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

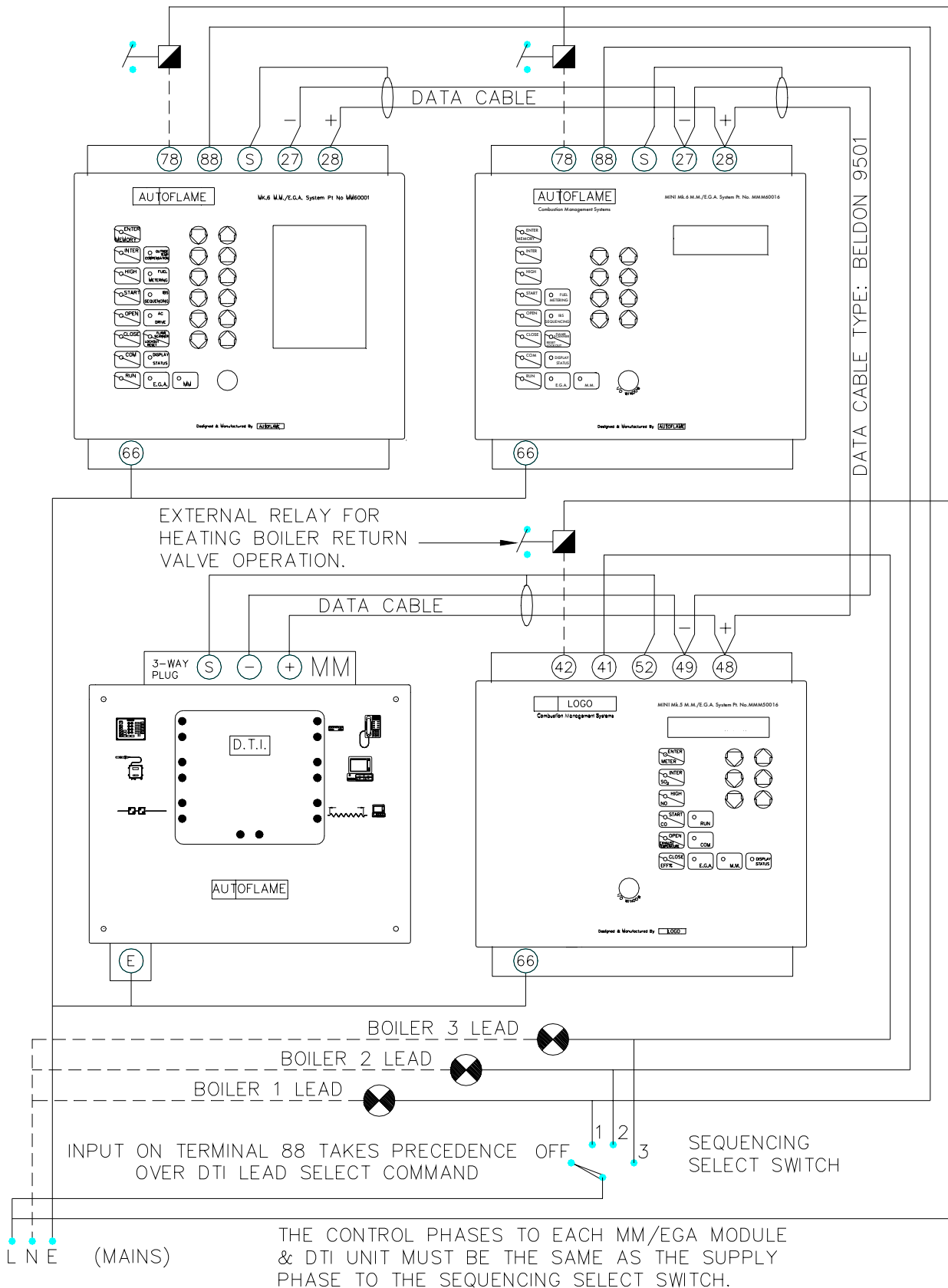
Sequencing Connection Diagram



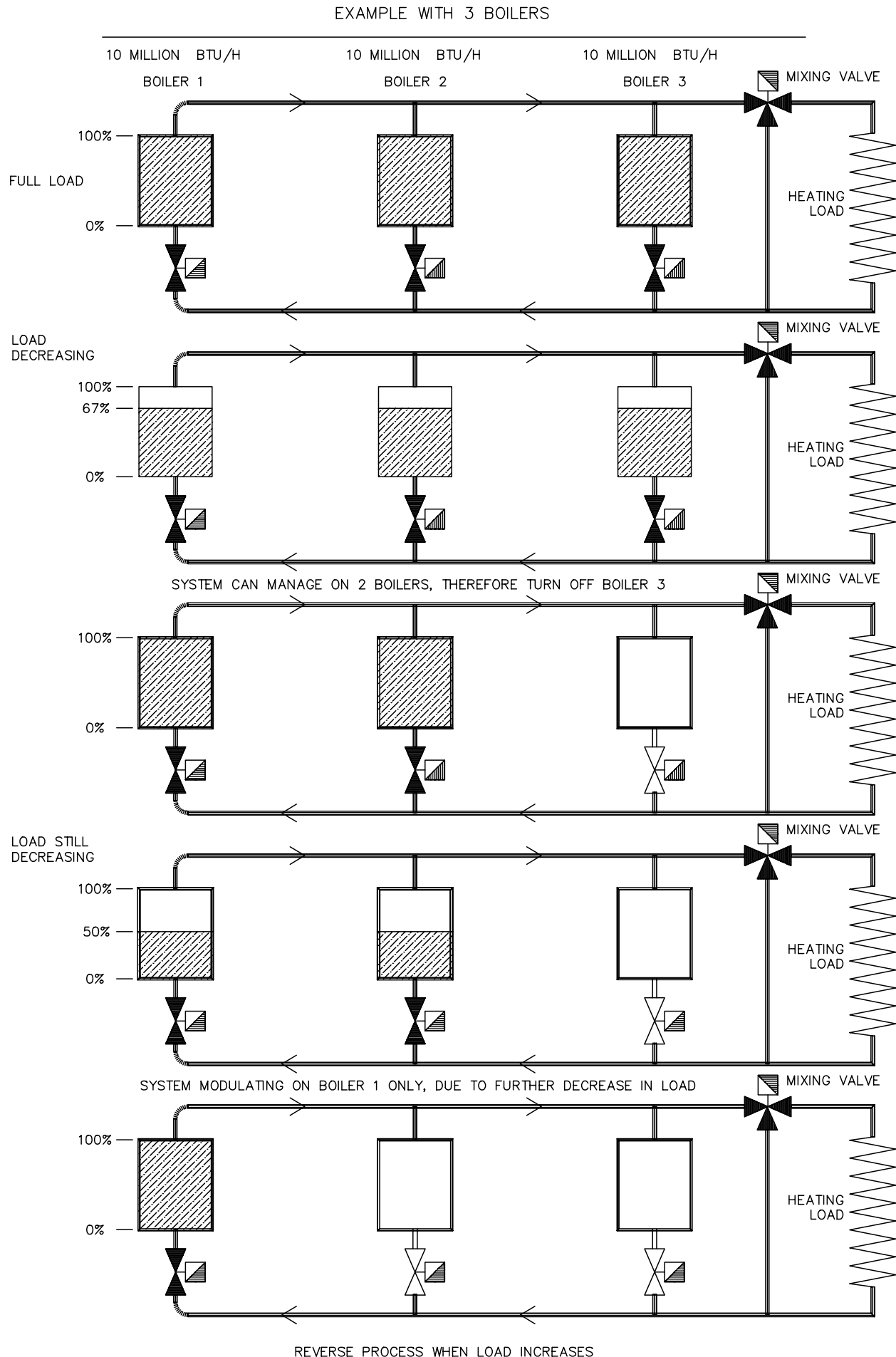
16:08:00/4263/JCF

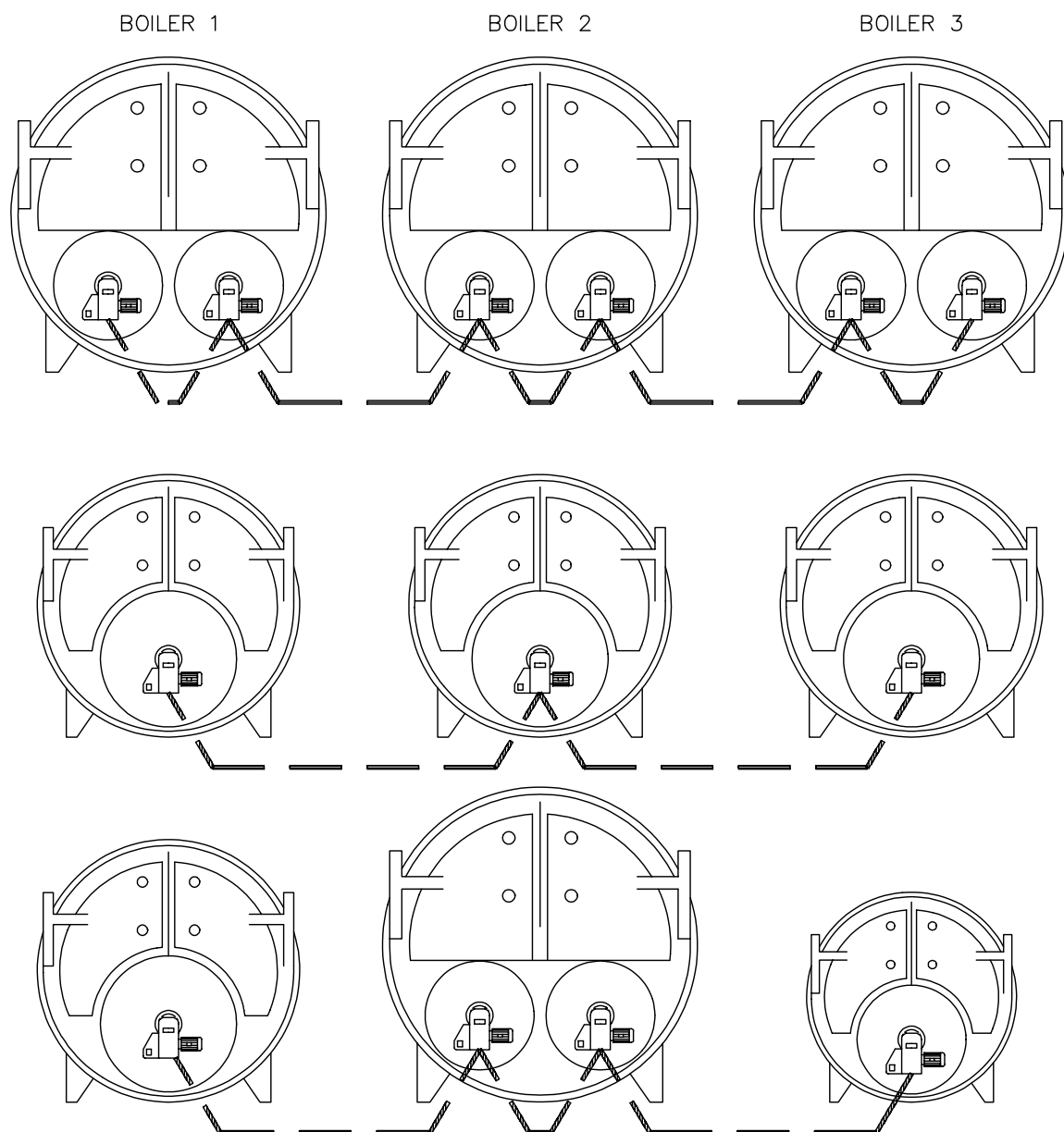
DTI/Sequencing Connection Diagram

If a voltage on terminal 88 is used to select lead boiler, it will take priority over a lead boiler set via the DTI.



16:08:00/4262/JCF

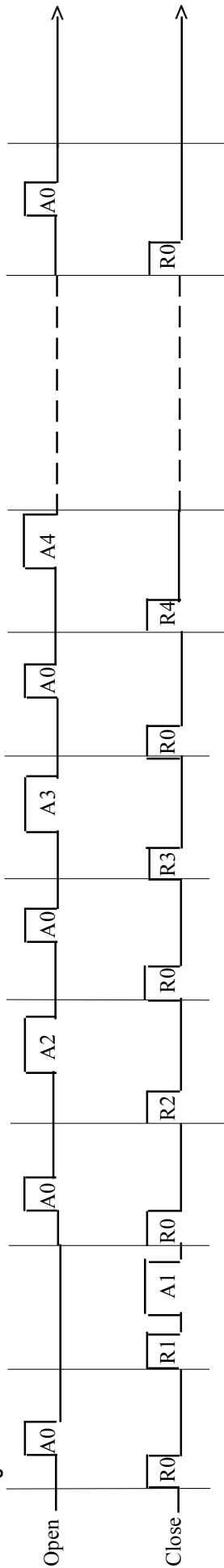




NOTE: TO OPERATE AUTOFLAME SEQUENCING A D.T.I. UNIT IS NOT REQUIRED

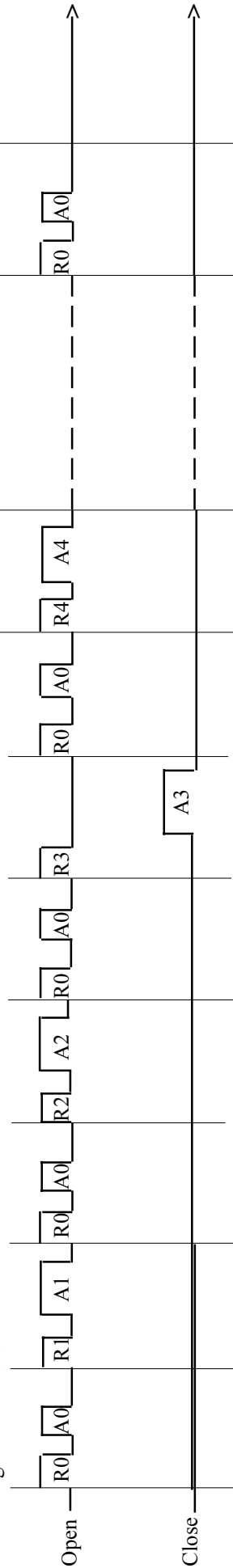
Diagram showing Example of Data Communications with Reference to Flickering L.E.D.s

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.

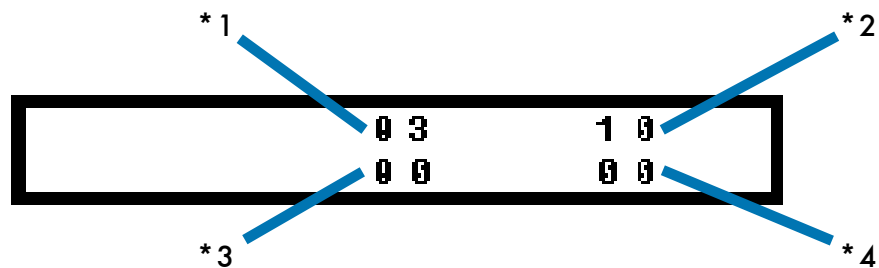
This is an M.M. that is not working communications.
Eg.: M.M. No. 3.



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

<u>Sequence Code:</u>		<u>Sequence Code:</u>		
<u>Steam</u>		<u>Hot Water</u>		
0	On		On	* 1
1	Standby/Warming		Off	
2	Off		Off	
3	Off		Off	
Receiving Sequencing Information		CR1 Relay Status		Working Communications/ Sequencing
0	= No	0	= Off	0 = No
1	= Yes	1	= On	1 = Yes
Unused		Status of Input 41		Disabled Status
		0	= 0V AC	0 = Enabled
		1	= 230V AC (110V AC)	1 = Disabled
Lead Boiler				
0	=	No Lead Boiler Selected		* 4
1 to 10	=	Number of Lead Boiler		

Section 5: Water Level Control and T.D.S. Management

- 5.1 Introduction
 - 5.1.1 Water Level System Schematic
 - 5.1.2 Method of Operation and Control Philosophy
 - 5.1.3 Movement Detection of Water
 - 5.1.4 Swell Management
- 5.2 "2nd Low" Switching Philosophy
- 5.3 Bottom Blowdown/External Probe Chamber Blowdown Management
- 5.4 Historical Alarm Record
- 5.5 First Out Annunciation
- 5.6 Integration of External Water Level Controls
- 5.7 Steam Flow Metering
 - 5.7.1 Steam Flow Metering Incorporating a Deaerator
 - 5.7.2 Calculation of Steam Flow Metering for Multiple Boilers with Deaerators
 - 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 and Hot Water Flow Metering
 - 5.8.1 Calculation of Heat Output and Volume Flow
 - 5.8.2 Schematic for Heat Flow Metering Application
- 5.9 Technical Data Sheets (to assist in understanding and applying the system)
 - 5.9.1 Wave Signature Explanation
 - 5.9.1.1 Breaking Bubble/Spray
 - 5.9.1.2 Thermal Currents (heat energy in water)
 - 5.9.1.3 Steam Flow Induced Surge
 - 5.9.1.4 Foaming
 - 5.9.2 Schematic Explanation of Water Level Probes
 - 5.9.3 Schematic of the Probe Sampling Hardware
 - 5.9.4 Capacitance Probe Operation
 - 5.9.5 Capacitance Probe- General Installation Information
 - 5.9.6 Capacitance Probe- External Mounted Pots
 - 5.9.7 Capacitance Probe- Internally Mounted Probes
 - 5.9.8 Capacitance Probe- Water Tube Boiler
 - 5.9.9 External Probe Chamber Dimensions
 - 5.9.10 Capacitance Probe and Feed Water Valve Details

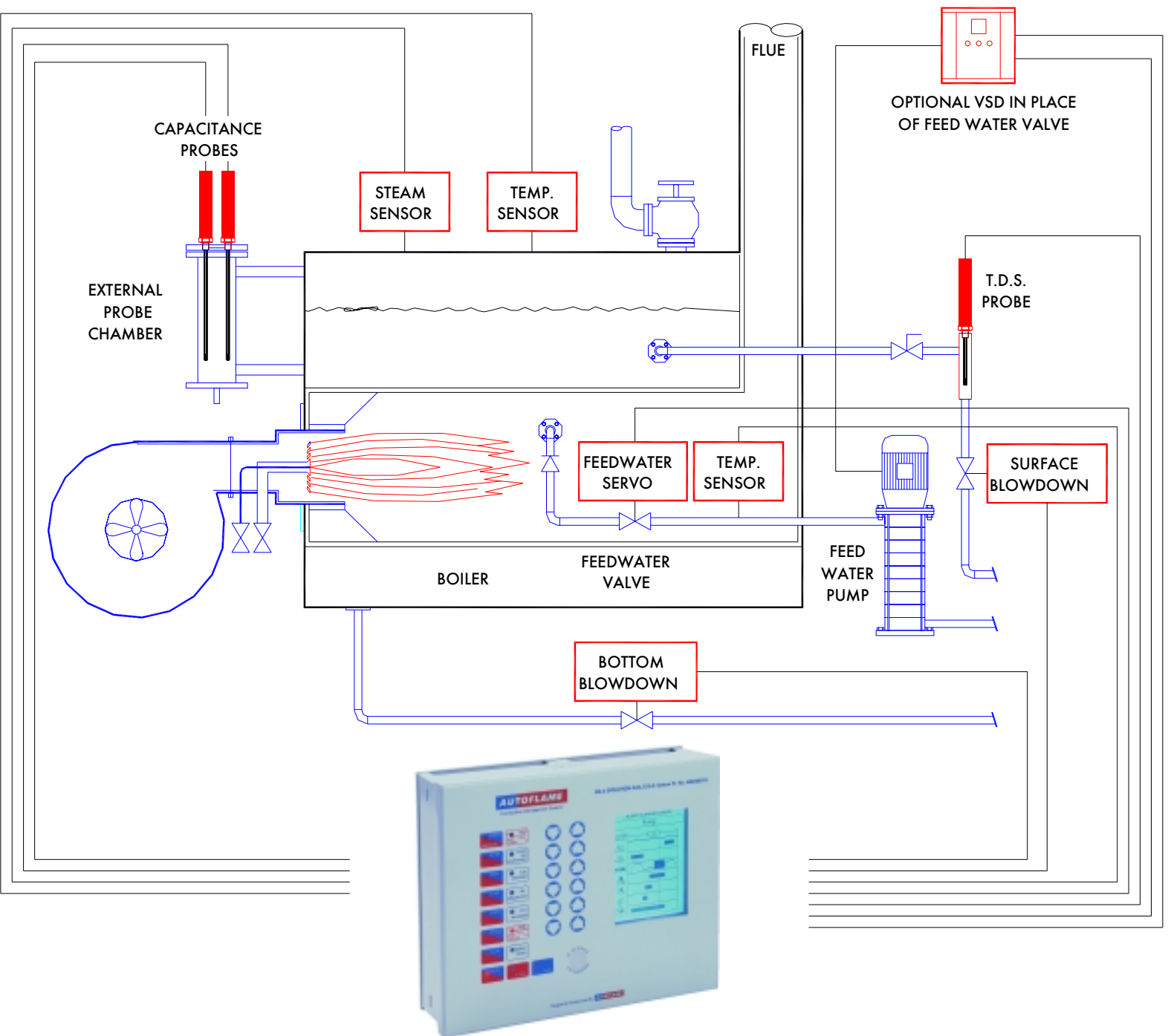


Section 5: Water Level Control And T.D.S. Management

- 5.10 Commissioning and Set-up Procedure
 - 5.10.1 Water Level Set-ups
 - 5.10.2 Diagnostics Screens
 - 5.10.3 Replacing the Servo Motor on a Feed Water Valve
 - 5.10.4 Commissioning the Water Level Positions
 - 5.10.4.1 Commissioning Screens
 - 5.10.4.2 Expansion PCB Connection Terminals
 - 5.10.4.3 Capacitance Probe Connections
 - 5.10.5 Operational Checks
 - 5.10.6 Terminal Descriptions
 - 5.10.7 Electrical Specification
 - 5.10.8 Fuse Position/Rating
 - 5.10.9 Pre-alarm Display
- 5.11 Normal Operation
 - 5.11.1 End User Day to Day Operation
 - 5.11.2 Water Level Operation
 - 5.11.3 First Out Status
 - 5.11.4 Key to Alarms
- 5.12 Surface Blowdown/T.D.S. (Total Dissolved Solids) Management
 - 5.12.1 Philosophy of the T.D.S. Control System
 - 5.12.2 T.D.S. Calibration (User Calibration Method)
 - 5.12.3 T.D.S. Calibration (Automatic Internal Calibration Method)
 - 5.12.4 Control and Management of T.D.S. in a Steam Boiler
 - 5.12.5 Installation of the T.D.S. Probe Assembly
 - 5.12.5.1 Vertically Mounted
 - 5.12.5.2 Horizontally Mounted
 - 5.12.6 Schematic Detail of the Measurement and Sample Routine
 - 5.12.7 Relationship between Conductivity, Temperature and T.D.S. values
 - 5.12.8 Schematic of the T.D.S. Probe and Sampling Vessel
 - 5.12.9 Top Blowdown Management Set-Up and User Guide
 - 5.12.9.1 Top Blowdown Management
 - 5.12.9.2 Adjustment of the T.D.S. Target value
 - 5.12.9.3 T.D.S. Probe Calibration
 - 5.12.9.4 Top Blowdown Adjusters
 - 5.12.9.5 Top Blowdown Adjusters Settings and Values
 - 5.12.9.6 T.D.S. Timing Diagram



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.

BOTTOM BLOW DOWN MANAGEMENT				
No	BLOW/DOWN TIME	DURATION	REPEATS	
1	24 00	3	2	
2	06 00	3	2	
3	12 00	3	2	
4	18 00	3	2	
BLOWDOWN STATUS		OFF		
MONDAY 20TH JANUARY 17:35				

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.

5.4 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
Occured	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

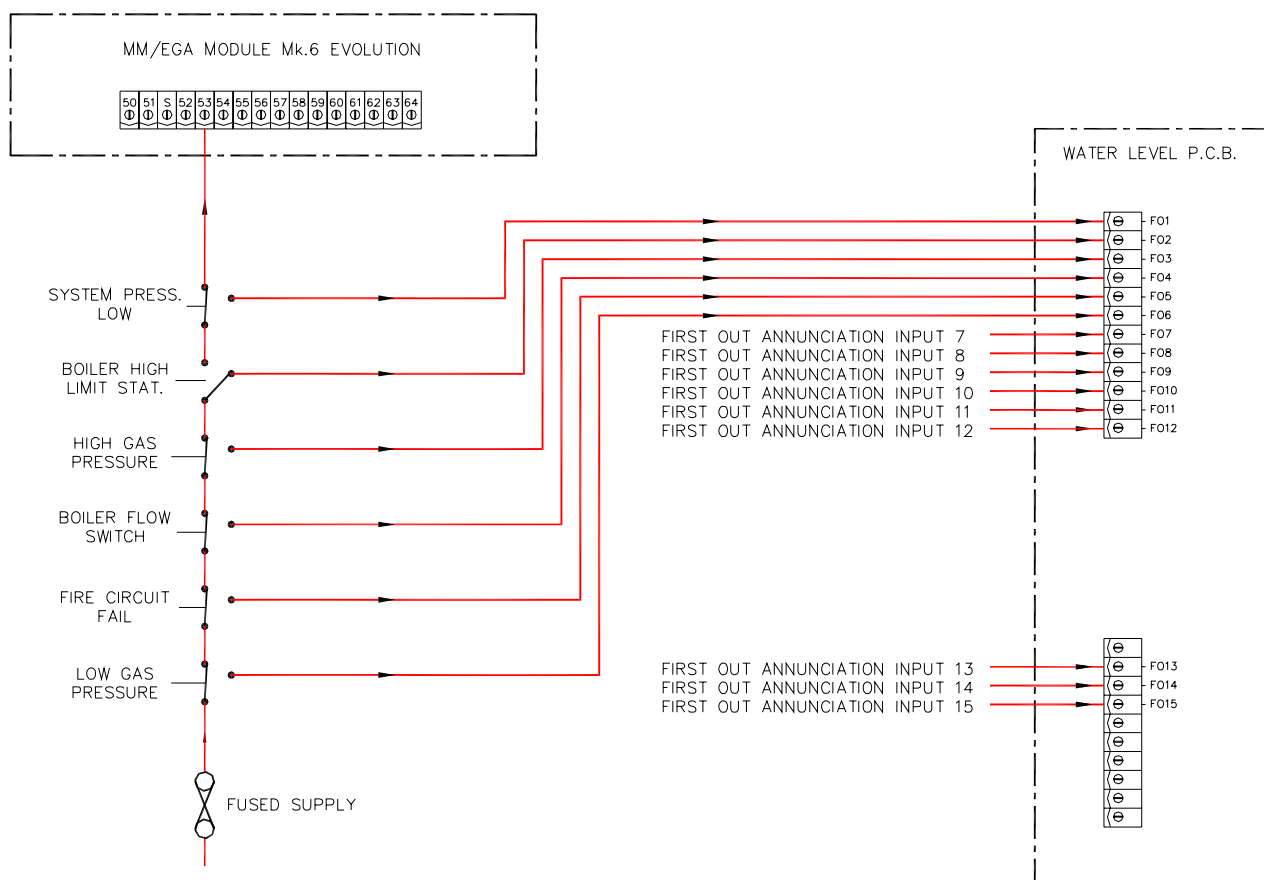
When the control circuit has a long series chain of various thermostat and switching elements, it is sometimes difficult to identify which element has opened the control circuit (see schematic detail under).

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 device being a gas pressure switch, announced on MA1.

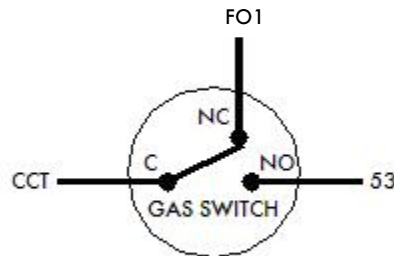


Fig 1. Switch shown in a failed condition.

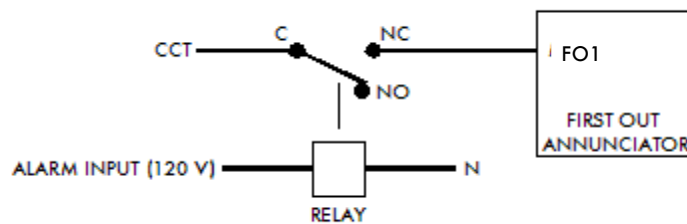
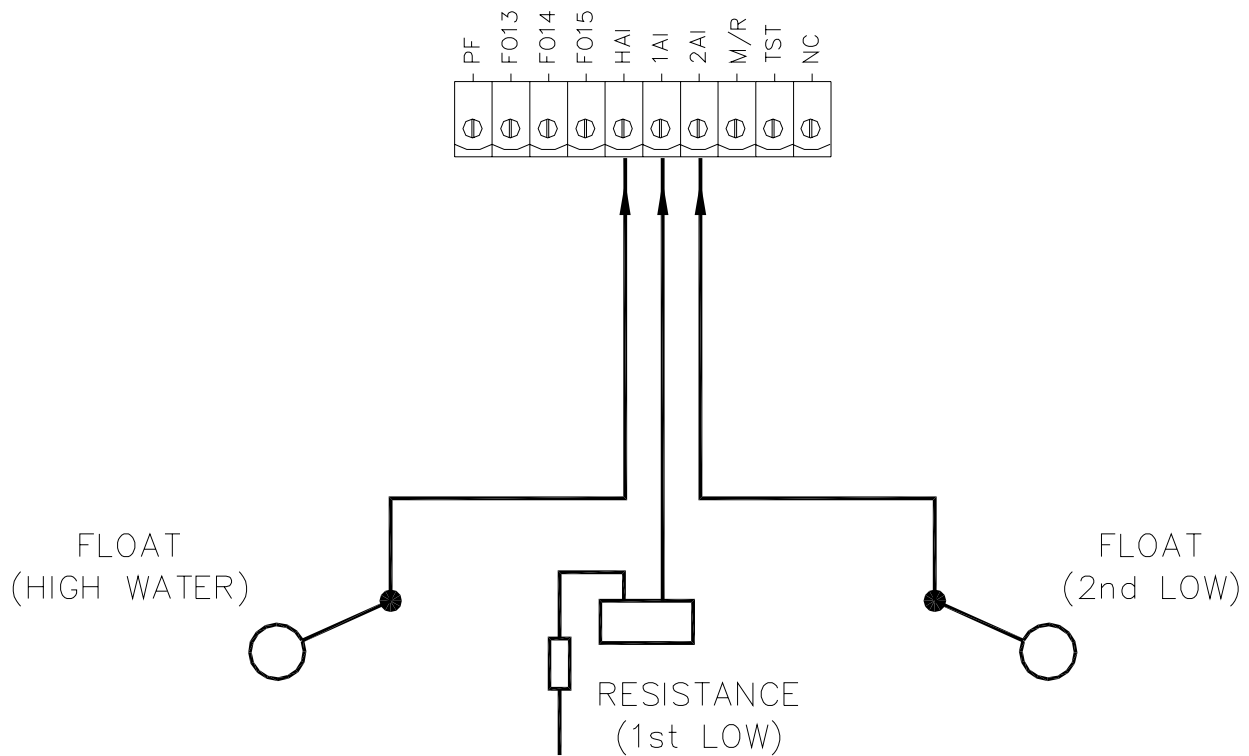


Fig 2. Alarm input shown inverse condition i.e. voltage input signal removed.

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.



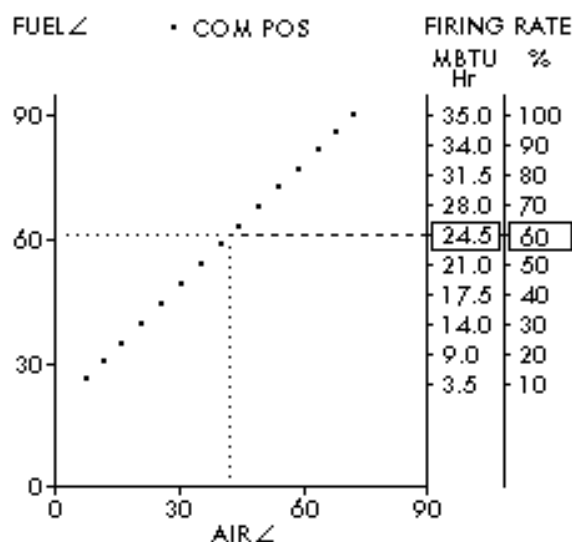
Example of non Autoflame level control elements being incorporated into the Autoflame Water Level Control System.

5.7 Steam Flow Metering

Steam flow metering is a very commercially attractive capability that exists within the Autoflame level control package. 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. An explanation of how this is achieved is detailed below.

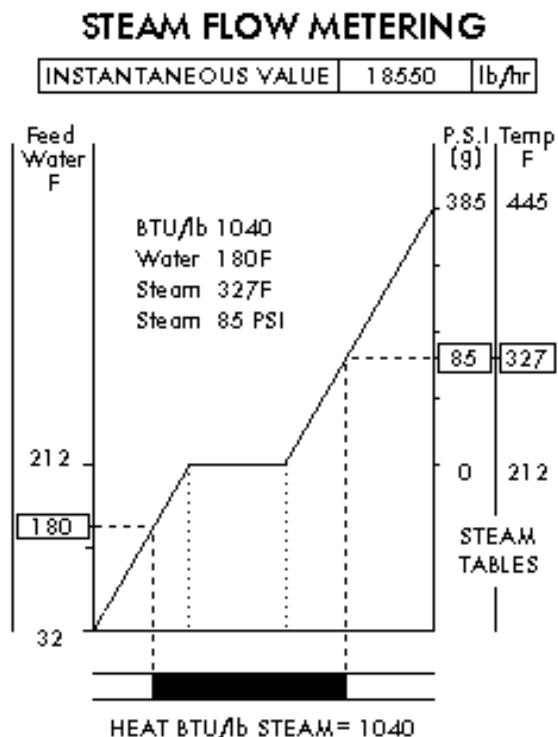
FUEL FLOW METERING

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.

$$19,124 \times 0.97 = 18,550 \text{ lbs/hr Steam Flow.}$$

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

$$T \text{ ave} = T1A - \frac{(\%Mu \times (T1A - T1))}{100}$$

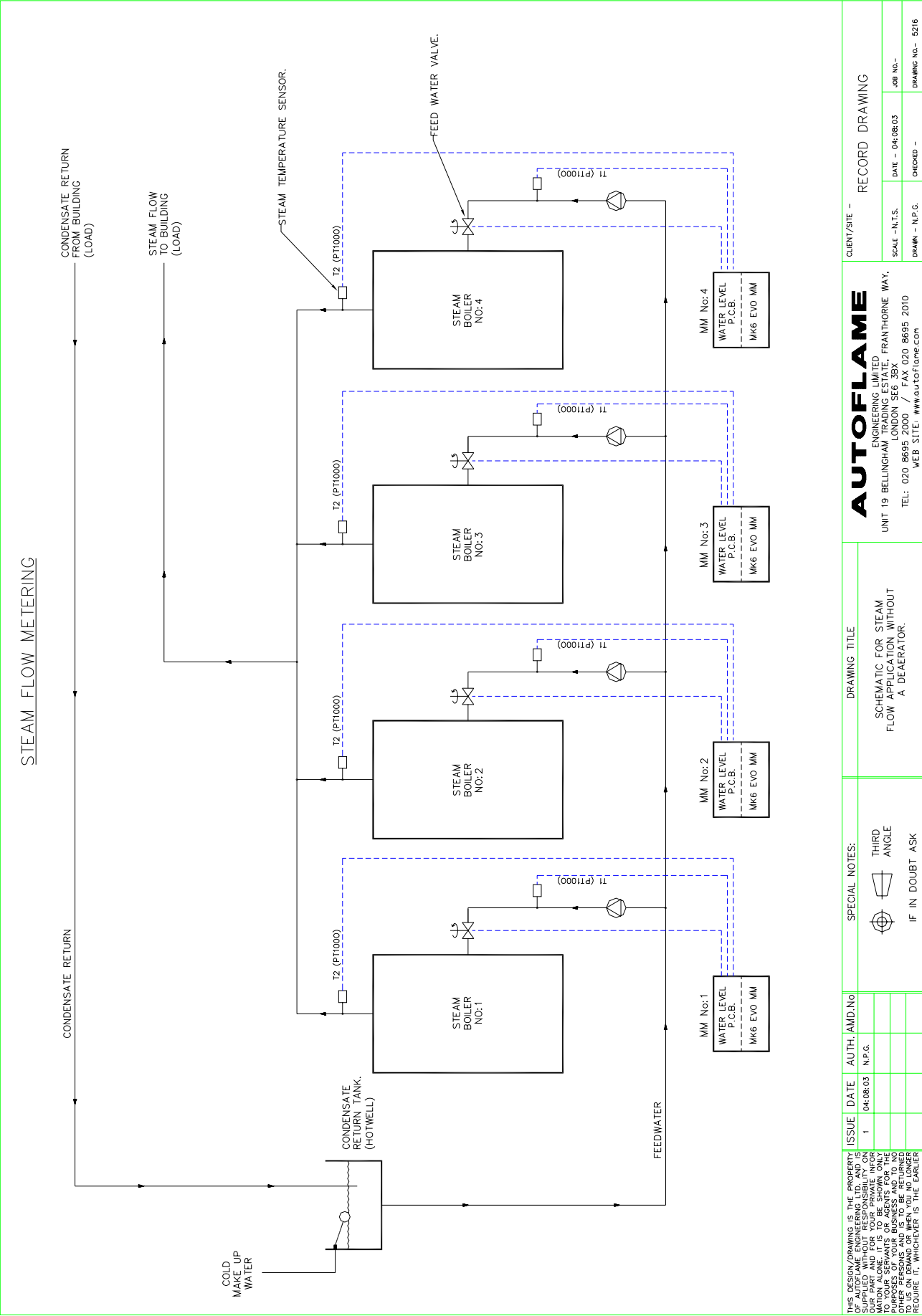
Example: 2

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%

$$\text{Weighted average} = 176 - \frac{(16.7 \times (176 - 41))}{100} = 153.4^\circ\text{F}$$

To implement the above control form the following calculations have been imbedded in the revised software to obtain the "Weighted Average Temperature" (T ave).

5.7.4 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 = $100 - \text{combustion efficiency}$.

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

<u>Description</u>	<u>Imperial units</u>	<u>Metric Units</u>
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%

$$\text{Efficiency \%} = 100 - (\text{stack loss} + \frac{\text{radiation losses} \times 100}{75\%})$$

$$\text{Therefore Efficiency} = 100 - (18\% + \frac{1\% \times 100}{75\%}) = 80.67\%$$

$$\text{Useful heat into water} = \text{Total Heat} \times \frac{\text{Efficiency}}{100}$$

5.8.1 Heat Flow & Hot Water Flow Metering

$$\text{Therefore U.H.W} = 20,472,840 \times \frac{80.67}{100} = 16,515,440 \text{ BTU Hr}$$

$$\text{Volume Flow in lbs hr} = \frac{\text{Useful heat M BTU Hr}}{\text{SP Ht BTU /lb/}^\circ\text{F} \times (\text{Flow Temp} - \text{Return Temp})}$$

$$\text{Therefore lbs hr} = \frac{16,515,440}{1 \times (185 - 167)} = 917,397 \text{ lb Hr}$$

Note: - Density of water at 176 °F = 60.68 lbs cu ft

$$\text{Therefore Cu ft Hr} = \frac{917,397}{60.68} = 15,118 \text{ cu ft Hr}$$

Note: - 1 cu ft Hr = 0.124676 US G.P.M

$$\text{Therefore } 15118 \times 0.124676 = 1884.85 \text{ US G.P.M}$$

$$\text{Volume flow in US G.P.M} = 1884.85$$

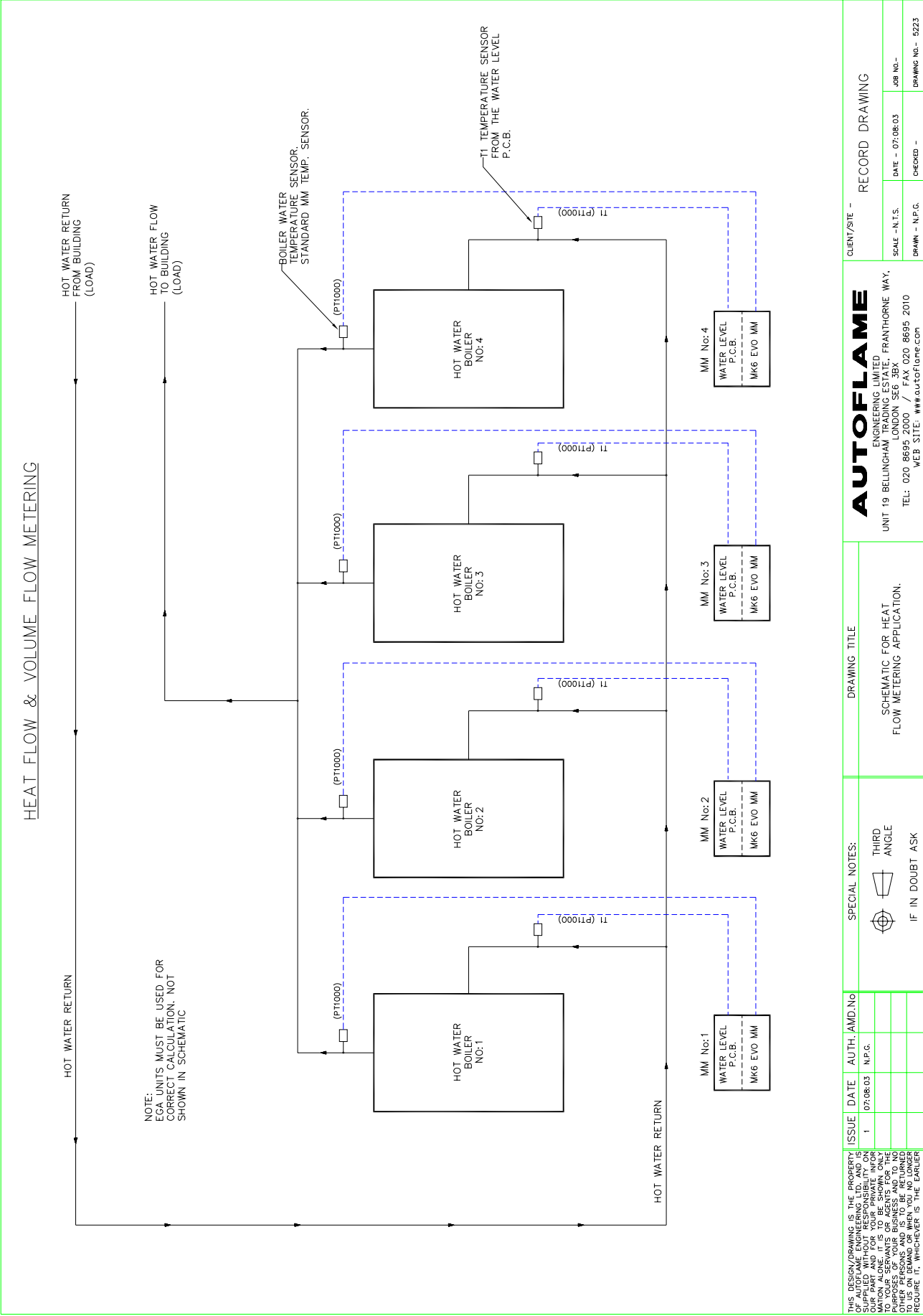
It can be seen from the above that by adding the water level P.C.B and a return temperature detector to the MK6 system that you get the following additional useful information.

"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

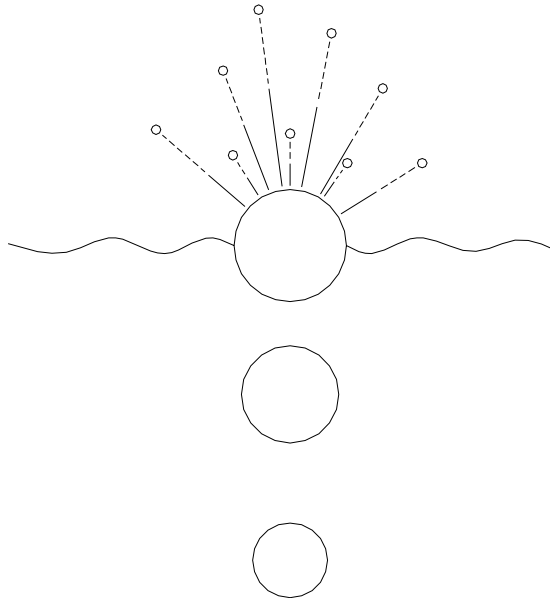


5.9.1 Wave Signature Explanation

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.



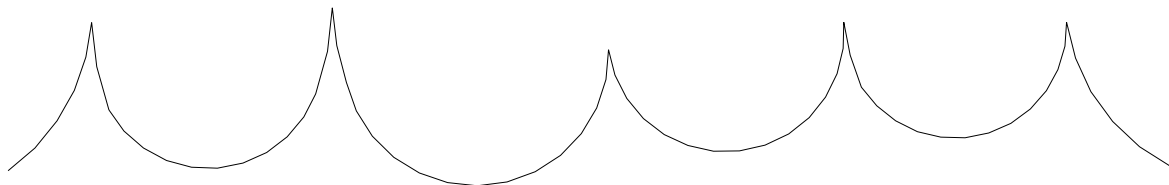
Surface tension of bubble bursts releasing droplets.

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)

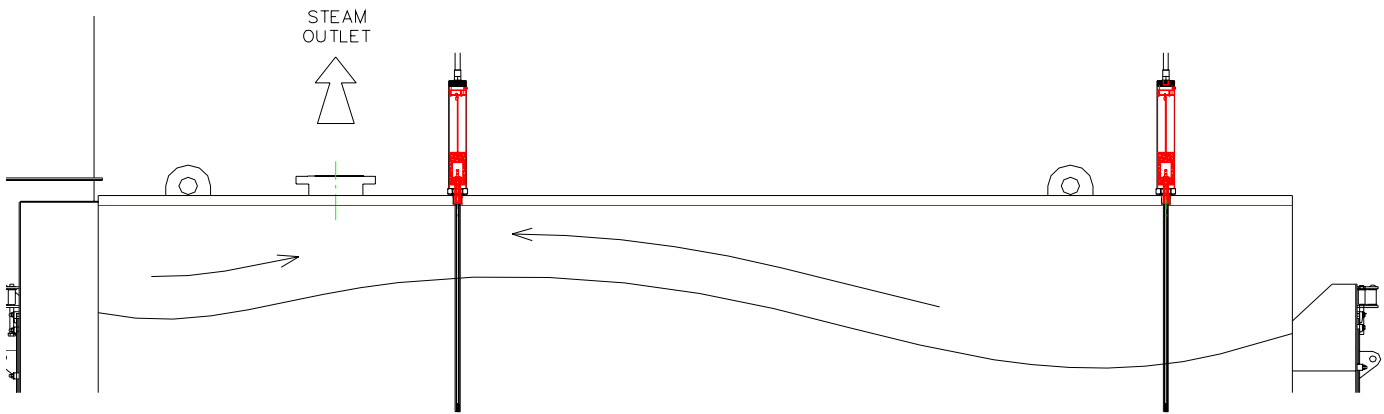
Many bubbles breaking simultaneously and thermal currents from the furnace tube and 2nd, 3rd, 4th pass smoke tube create their own turbulence/wave signature on the surface of the water. The typical result is short choppy/peaky wave patterns as below.



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.

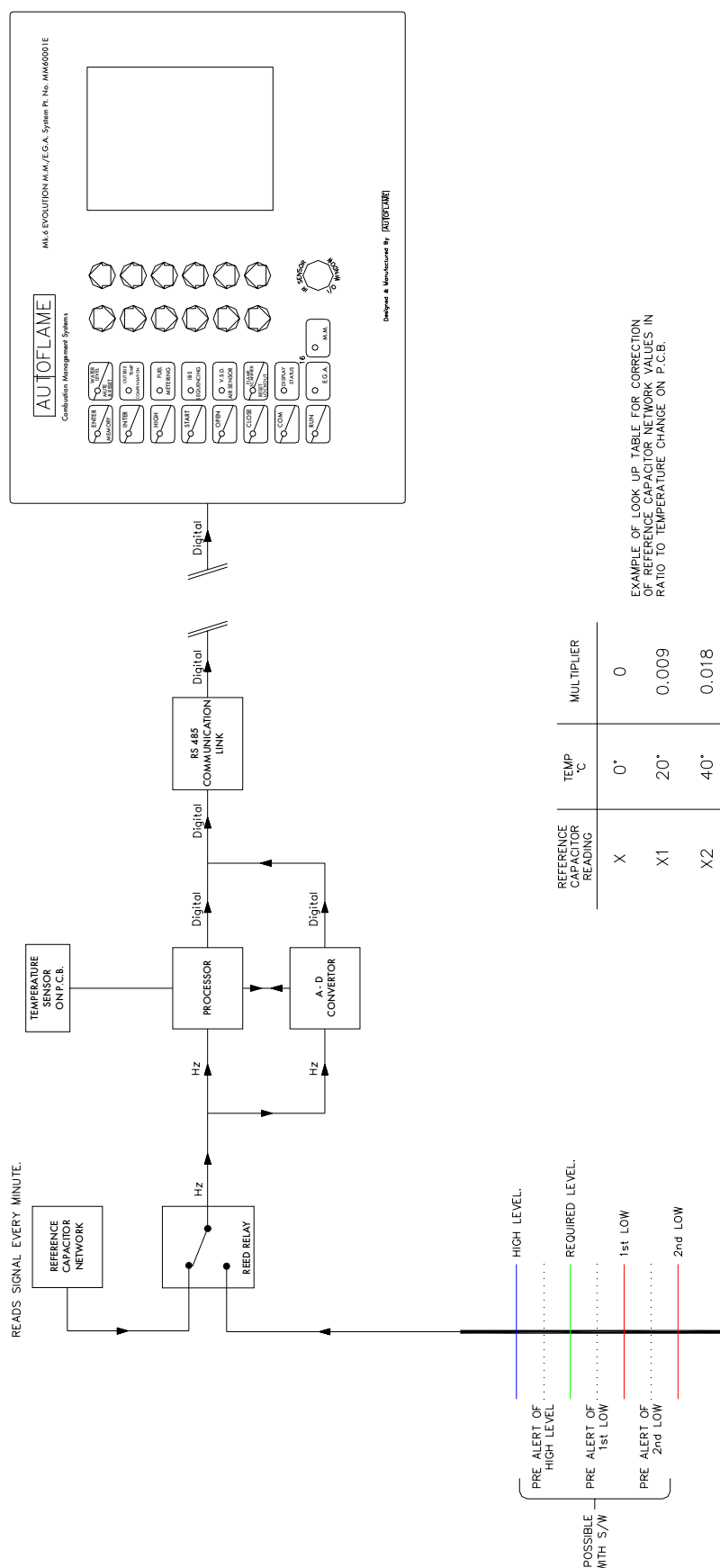
5.9.1.4 **Foaming**



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 insufficient 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.

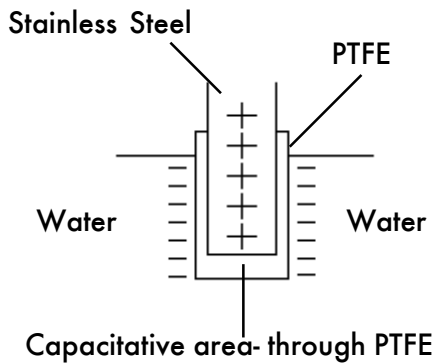
5.9.3 Schematic Of The Probe Sampling Hardware



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1	20-01-03	N.P.G.			THIRD ANGLE 		PROBE SAMPLING HARDWARE & DATA READING FOR SAFETY & ACCURACY				SCALE - N.T.S.		DATE - 20-01-03		JOB NO-					
2	20-02-03	N.P.G.	638		IF IN DOUBT ASK						TEL: 020 8695 2000 / FAX 020 8695 2010 WF SITE: www.autoflame.com		DRAWN - N.P.G.		CHECKED -		DRAWING NO. - 4961			

5.9.4 Capacitance Probe Operation

Variations in the capacitance effect the frequency of the signal response to AC signal.



Water is earthed. This is part of the regulations, ensuring the boiler vessel must be earthed.

As the water level drops, the capacitance drops and the frequency increases.
As the water level rises, the capacitance increases and the frequency decreases.

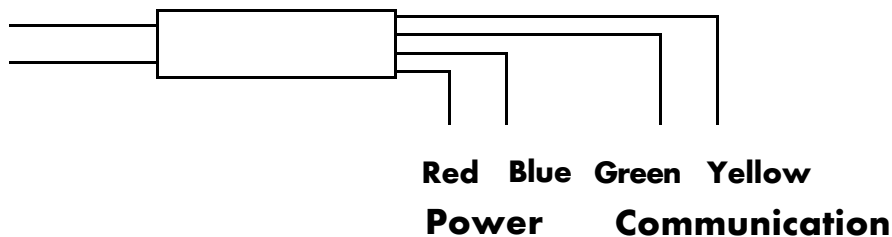
With the water level system, very small capacitances are recorded ($\sim 10\text{-}20\text{pF}$)

The numbers shown at the top of the probes during commissioning represent the frequency (Hz), approximately 40,000 depending on probe length.

Over time, the circuit will drift with temperature change and long term drift (this is the change due to time). This is accounted for in the Autoflame system, by the following procedures:

- A temperature sensor on the circuit board corrects for variation in temperature and subsequent frequency changes. This sensor on the PCB changes the input into the microprocessor.
- A reference capacitor has a frequency of 60,000 Hz nominal (± 2000 Hz). If when the reference capacitor is switched on, the value is out of this range then the system will show a TC error. This reference capacitor has negligible long term drift and is quoted as drift-free (this capacitor can drift by as much as 1500 by default. This is set within the water level parameter C.1. TC error then displayed). During commissioning, the system notes the temperature, the frequency and the reference capacitor value (the reference value measured in the last minute) when each point is added. The reference value is checked once every 60 seconds (the signal moves away from the working capacitor to the reference capacitor). During operation, the system uses the stored reference value (at each point) to correct for long term drift in the signal coming off the probe, i.e.
 - Control point- 41500
 - If reference 59500, drifts to 59200 (change of 0.05%)
 - Then the control point decreases by 0.05%

Note: although reference capacitor will not drift the, the electronics can and the system would correct the control point by this 0.05%. The value is corrected by percentage, not actual value!



The probe head is rated for 0-70°C (ambient temperature of air around boiler).

The electronics are rated for 0-85°C.

The boiler must be insulated, or the radiated temperature will create problems.

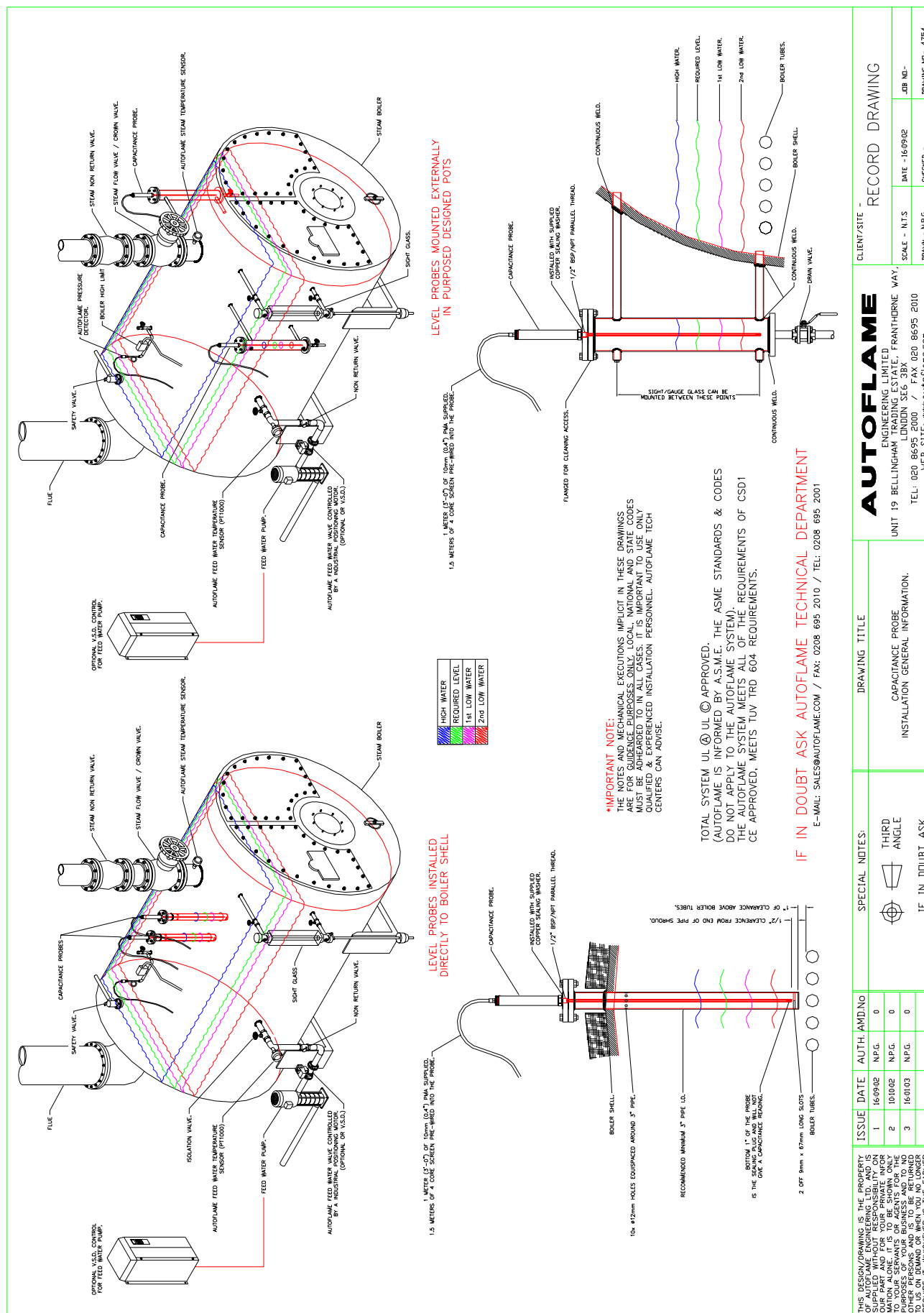
Capacitance probe rating- IP68.

The reference frequency will drop as the temperature rises (50Hz per °C).

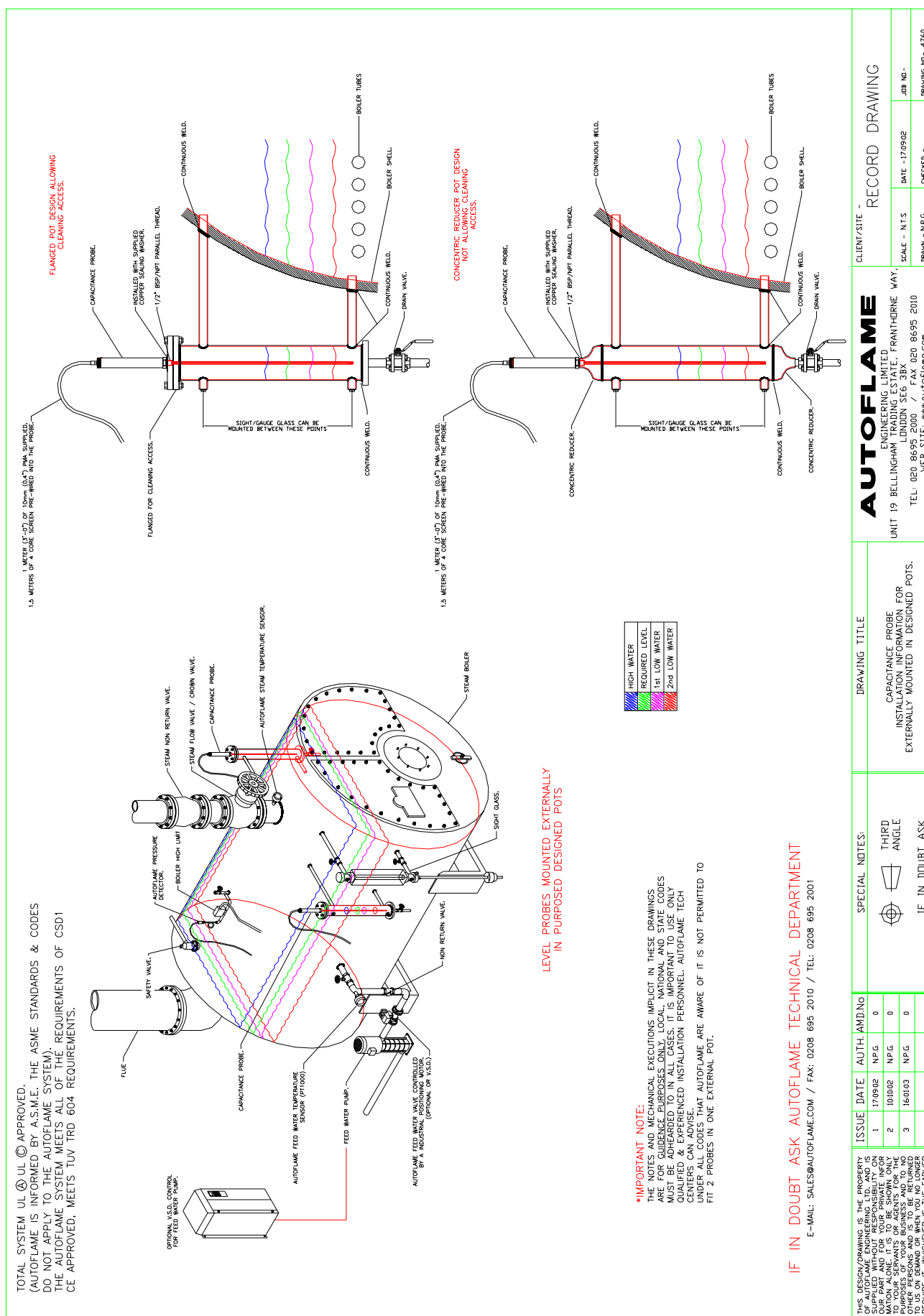
For every 1mm change in the water level, the frequency will change by 20Hz.

Swell management takes care of many variations between commissioned level and every day values.

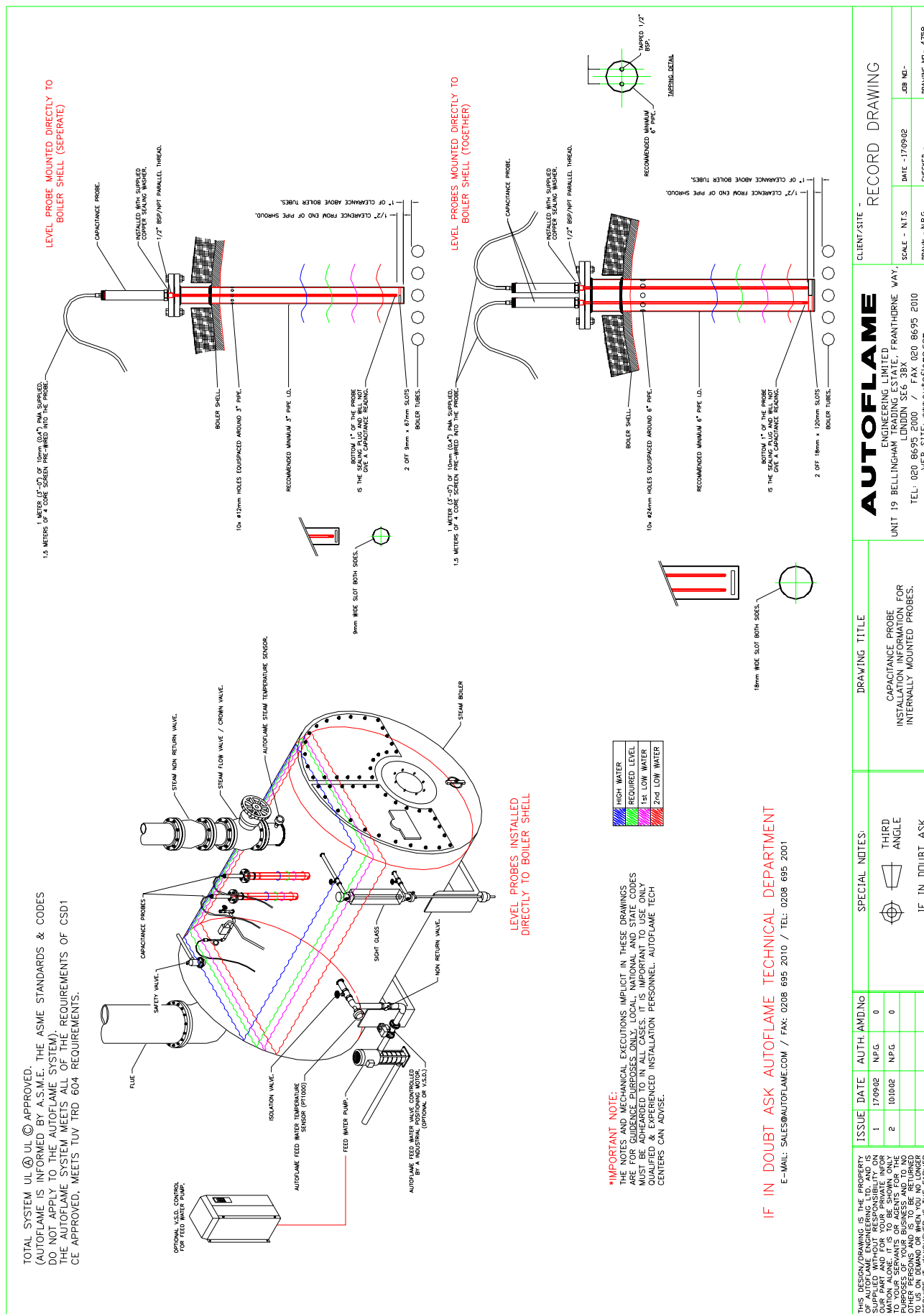
5.9.5 Capacitance Probe- General Installation Information



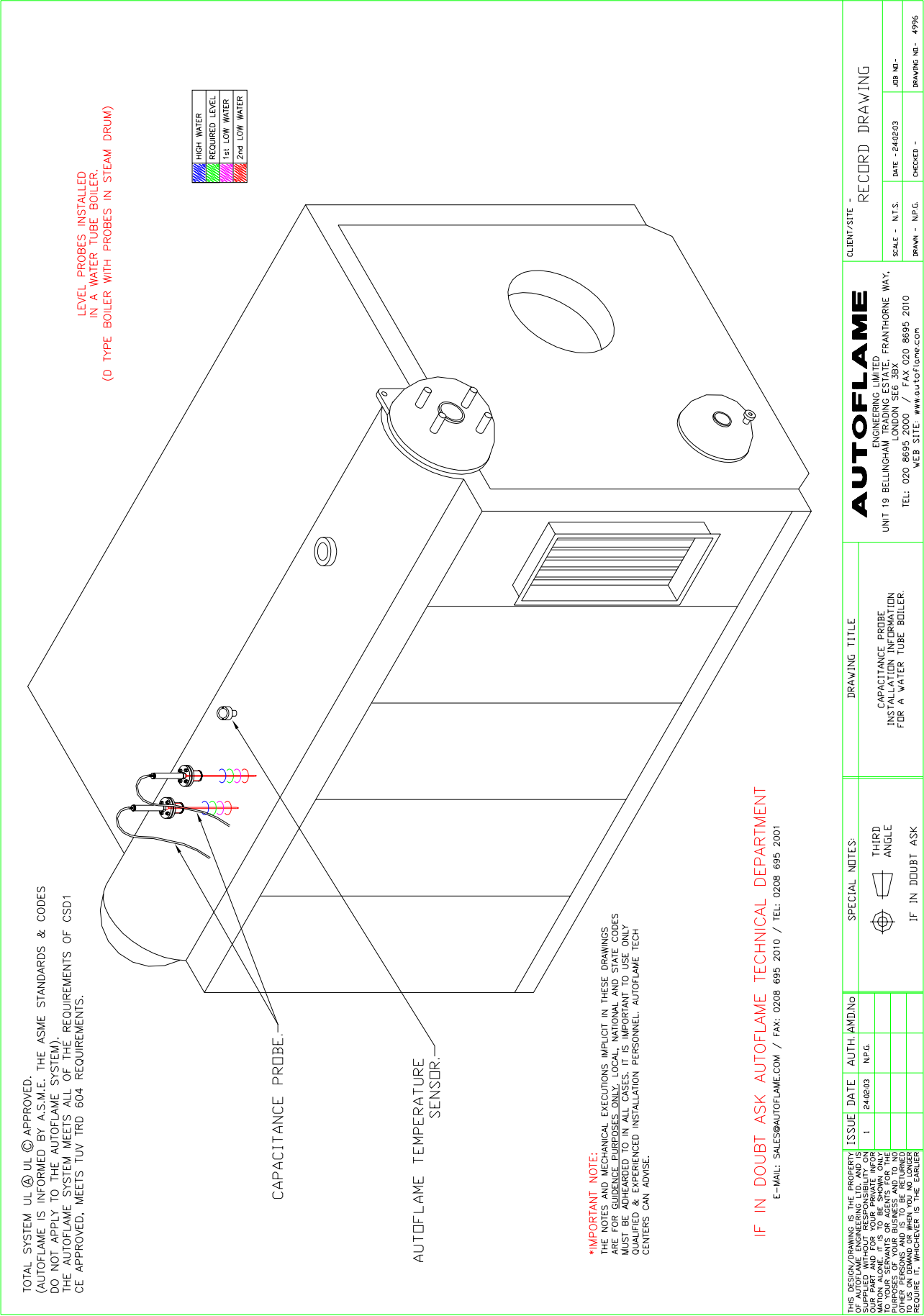
5.9.6 Capacitance Probe- Externally Mounted Pots



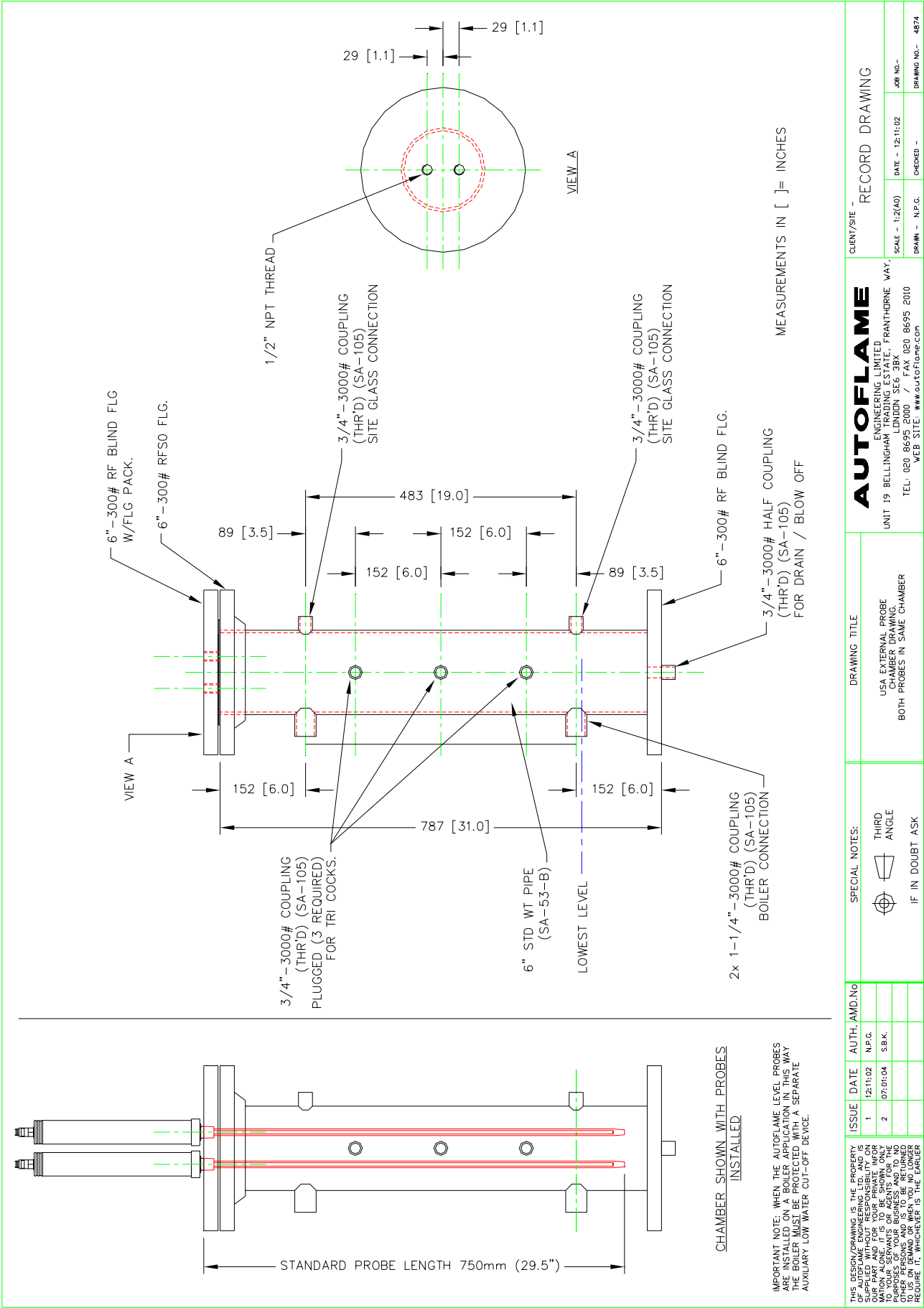
5.9.7 Capacitance Probe- Internally Mounted Probes



5.9.8 Capacitance Probe- Installation Information For A Water Tube Boiler



5.9.9 External Probe Chamber Dimensions



5.9.10 **Capacitance Probe and Feed Water Valve Details**



Capacitance Probes

Probe connection: 1/2"
Probe length: 20" - 60"
Stainless Steel
PTFE coated

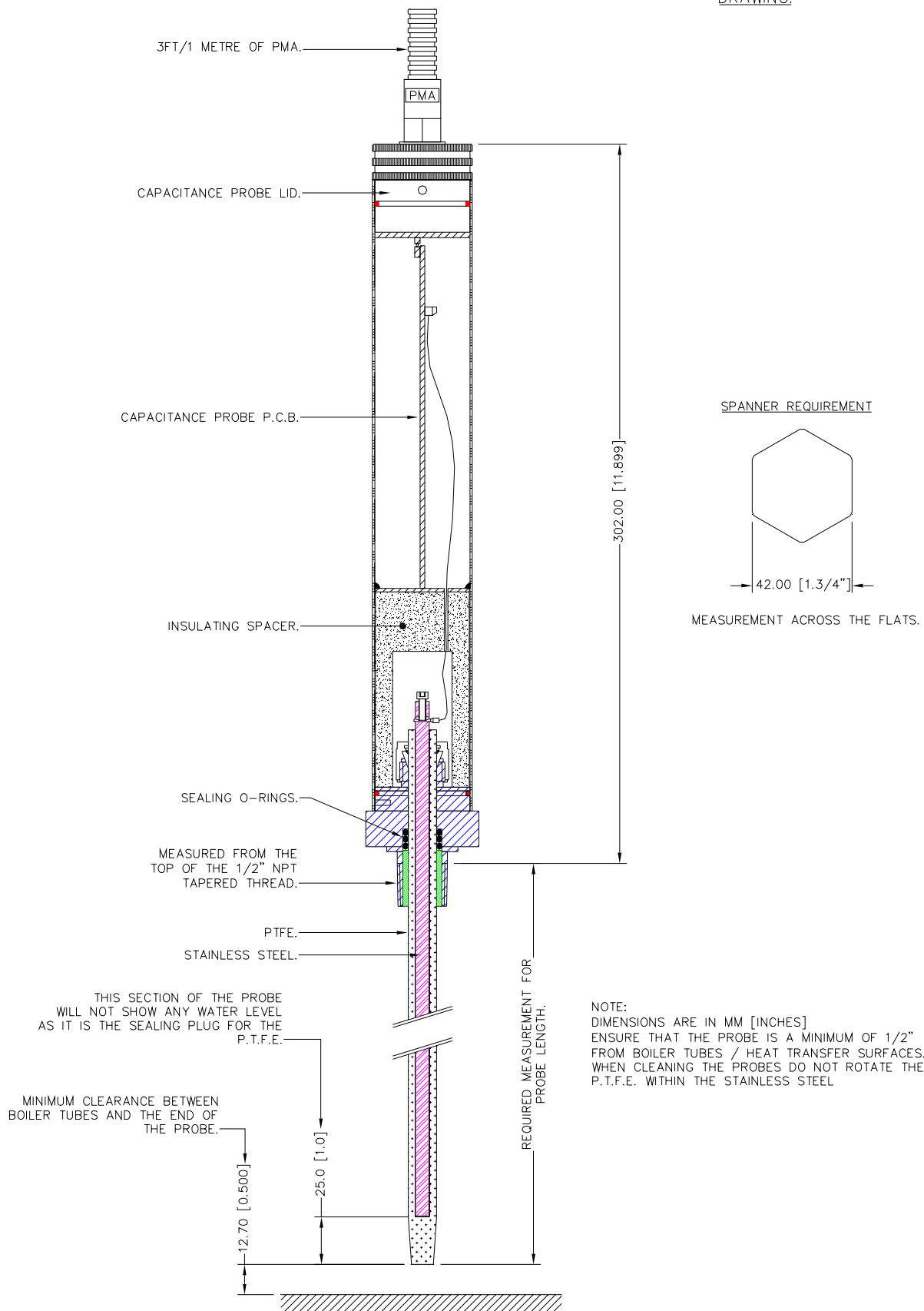


Feed Water Valve

Valve sizes: 1/2" to 2"
Carbon steel valve, stainless steel
ball & stem
Servo Torque: 37ft.lb
NEMA 4 rated
Position feed back potentiometer
Flange spec: ANSI 300lb
Maximum pressure: 300psi
Maximum volume: 11,000gal/hr

5.9.11 Capacitance Probe Assembly Drawing

CAPACITANCE PROBE ASSEMBLED
DRAWING.



5268/23:10:03/ISSUE 1/N.P.G.

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  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 .



“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 .

The WATER LEVEL and CLOSE lights will flash.

To enter water level commissioning press .

To enter water level setups press the Ch6   simultaneously.

To select a setup use the Ch2   buttons.

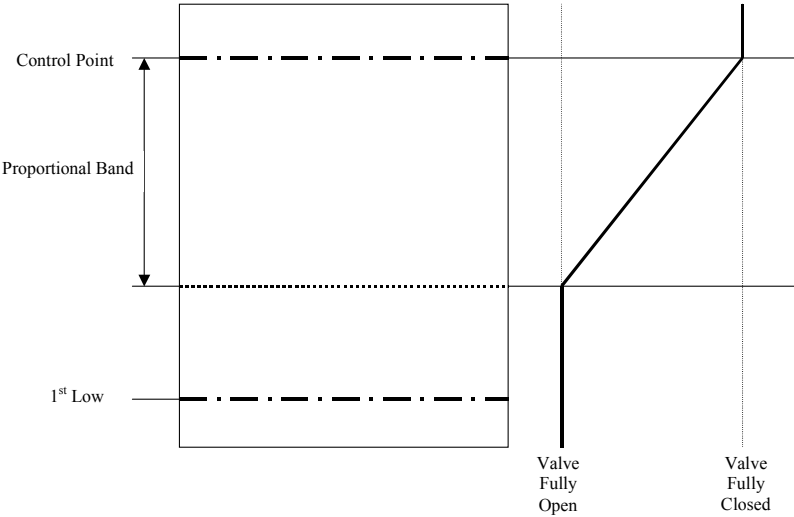
To change the setups value use the Ch3   buttons.

Any number of water level setup values can be changed when in this mode.

When changes have been made press .

All new Water Level Setup values are then permanently stored.

Setup No.	Factory Setting	Setup Value	Description
1.1	Modulating Standard	Modulating Standard	Control Type: Configures the boiler feedwater control type. 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	Ball Valve VSD	Feedwater Control Element: Required for display purposes. Autoflame motorised ball valve. AC Variable Speed Drive.

Setup No.	Factory Setting	Setup Value	Description
3.1	50%	5% - 100%	<p>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:</p> 
4.1	20 seconds	0 - OFF 1-100 seconds	<p>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.</p>
4.2	10%	1% - 50%	<p>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.</p>
5.1	OFF	OFF 1-100 seconds	<p>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.</p>
5.2	10%	1%-50%	<p>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.</p>

Setup No.	Factory Setting	Setup Value	Description
5.3	10%	1%-100%	<p>Derivative Response Sensitivity: This setup indicates the percentage of feedwater increase or decrease that is inflicted by the derivative action.</p> <p>N.B. Only applies when modulating control type is configured.</p> <p>See Also: Derivative Time, Derivative Deadband.</p>
6.1	152	50-4050	<p>Potentiometer Close Position: Servo potentiometer feedback at close position.</p> <p>N.B. This is only required when configured for use with a motorized valve.</p> <p>See Also Potentiometer Open Position</p>
6.2	2432	50-4050	<p>Potentiometer Open Position: Servo potentiometer feedback at open position.</p> <p>N.B. This is only required when configured for use with a motorized valve.</p> <p>See Also Potentiometer Close Position</p> <p>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.</p>
7.1	OFF	OFF 1-120	<p>Sudden Pressure Drop- Time Between Readings: Period of seconds over which the change of pressure is tested. (OFF - sudden pressure drop function disabled)</p>
7.2	5	1-100	<p>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.</p>
7.3	30	10-100%	<p>Sudden Pressure Drop- Percent Increase Scale: Water level control point percent increase scale.</p>
7.4	10	5-100	<p>Sudden Pressure Drop- Pressure Scale: Pressure scale - offset from Required value.</p>

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 Continuous 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 Continuous Rating. N.B. For the purpose of steam flow metering only.
10.2	constant	constant proportioned	Boiler Blow Down Loss Calculation Method: 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	0 1 2	TB Output Terminal Function: TDS Top Blowdown ON Above Switch Point (value set in 22.2) 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 case of 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	Type 1 Type 2	WATER LEVEL PCB TYPE: First issue Water Level PCB. 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 within 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 problem and 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.
F.1	0.9	0-5	Turbulence 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	1 0	Control point method. Averages the data between both probes. 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 0	Detect turbulence level. If the water is still the frequency will drop below 10Hz and a fault will occur. This is non-movement detection. 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 the 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 0	Max probe drift. 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 be-
tween 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

PID	0.0	1063	0	0	0
PP1	-42.2	1063	1	0	0
PP2	-37.2	15	998	0	0
P12	-39.7	15	0	0	0
I	0.0	1517	43300	44465	0
D	0.0	0	59979	62783	0
DB	0	0	0 31.5	0 31.5	0
P1 OK	0	0	43300	44465	0
P2 OK	0	0	59979	62783	0
com OK	0	1220	31.5	1230	31.5
cfg OK	0	0	0	0	0
sig OK	0	0	0	0	0
162	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
2703	0.0	0	0	0	0
3393	0.0	0	0	0	0
1559	0.0	0	0	0	0
676	0	0	0	0	0

Full set of commissioned data:

First line: Actual commissioned value (Hz)

Second line: Nominal reference value (Hz)

Third line: Difference between this commis-
sioned value and one below

AND Temperature (C) of sensor on PCB
at commissioning

There are 2 possibilities:

1- Using the modu- lating 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

		Probe 1	Probe 2	
	S	47 471	447 48	Signal from probe
2	R	59964	59902	Reference signal from reference capacitor
5519	F	47 471	447 49	Filtered value of signal
5538	CF	47 402	447 58	Corrected filtered value
1500	T	26.5	27.0	Working temperature
00	W	47 488	447 68	Filtered reading of the 10 values
00	CW	47 419	447 77	Corrected to reference- drift
00	CP	44904	47 423	Control point value- at commissioning
00	P2P		50315	Average of probe 1 and probe 2- based on several factors
0				
47 47	447 5			
47 47	447 5		2	
47 47	447 4		0	
47 47	447 5		0	
47 47	447 5	ave	47 47	447 5
47 47	447 5		47 46	447 4
47 47	447 5		1	1
47 47	447 5	pkpk	47 48	447 6
47 47	447 4		47 46	447 4
47 47	447 5		2	2

Interim values based on 10 readings

10 readings for probes 1 and 2:
Made over a 1 second period-
every 100 milliseconds

5.10.3 Replacing the servo motor/actuator for a feed water valve

READ ALL THOROUGHLY BEFORE COMMENCING WORK

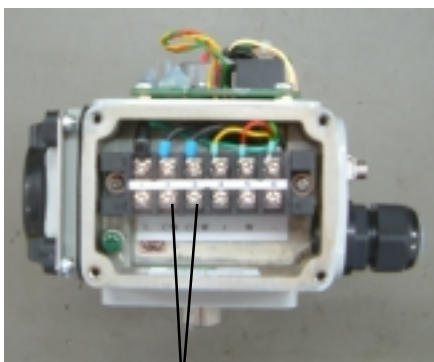
- 1) Firstly, power to the system must be removed in order to make mechanical adjustments.
- 2) In order to ensure that the valve is fully closed the following pictures must be followed:
It is essential to check the feed water valve position and adjust this to the close position. This is done using the 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 aligned 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 alignment 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)

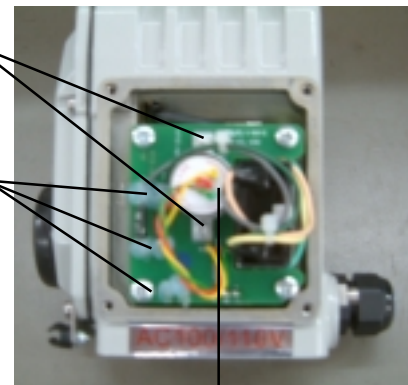
Remove the lid and the end covering as shown in the diagrams below. In the end section the wires labelled CW (clockwise wire) and CCW (counterclockwise wire) must be removed since if present they will make the valve search for the operating position. All other wires must be kept in place including the 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 commissioning. 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

PID	0.0	1063	0	0	0
PP1	-42.2	1063	1	0	0
PP2	-37.2	1.5	998		0
P12	-39.7	1.5	0		
I	0.0	1517	43300		44465
D	0.0	0	59979		62783
DB	0	0	0 31.5		0 31.5
P1 OK		0	43300		44465
P2 OK			59979		62783
com OK	alm OK		1220 31.5	1230	31.5
clg OK	lev OK		44520		45695
sig OK	both		59976		62769
	dft	1773 31.5		1865	31.5
		46293			47560
		59979			62768
		0 210	1279 31.5	1356	31.5
		0	47572		48916
		2703	0.0	59980	62766
		3393	0.0	832 31.5	846 31.5
		1359	0.0	48404	49762
		676	0	59980	62764
			2031.5 31.5		31.5

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.

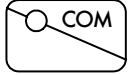
The feed water valve should now be ready for operation.

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  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 

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 

4. Display shows message to indicate commissioning mode.




Press  to enter Water Level Commission Mode.

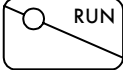
Press  to commission Fuel Air Ratio positions.

5. Use Ch2   to control the position of the feedwater valve (if optioned) and
Ch1   to control the pump operation ( OFF /  ON)

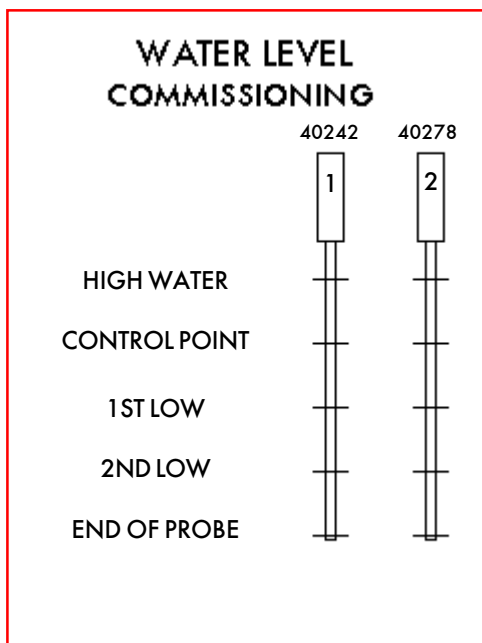
6. Current position to be commissioned is indicated by flashing message showing End of Probe. Increase the water level until it approaches the bottom of the probe. As the water level exceeds the bottom of the probe, the displayed probe values will begin to change. Once

this point has been found press  to save.

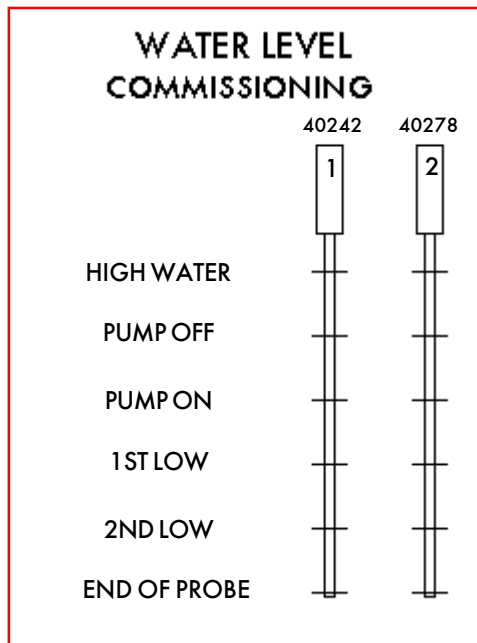
7. Display shows 2nd Low flashing. Increase the water level to the desired 2nd Low Level using
Ch1 and Ch2   . After allowing a period for the values to stabilise press  to save the current water level.

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 is 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 permanently saved. Proceed 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 proceeding 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.

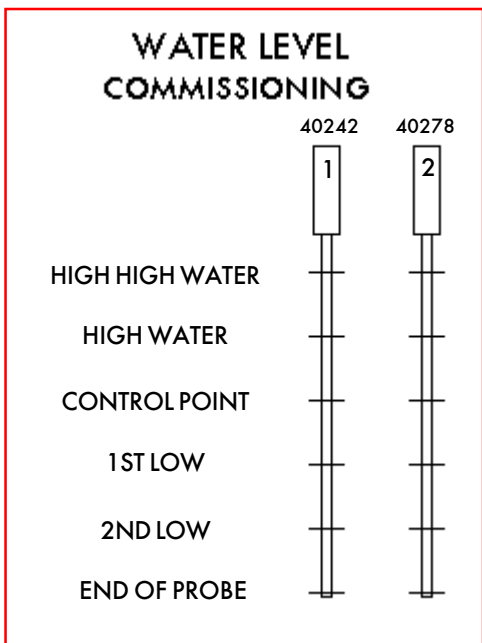
5.10.4.1 Commissioning Screens



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

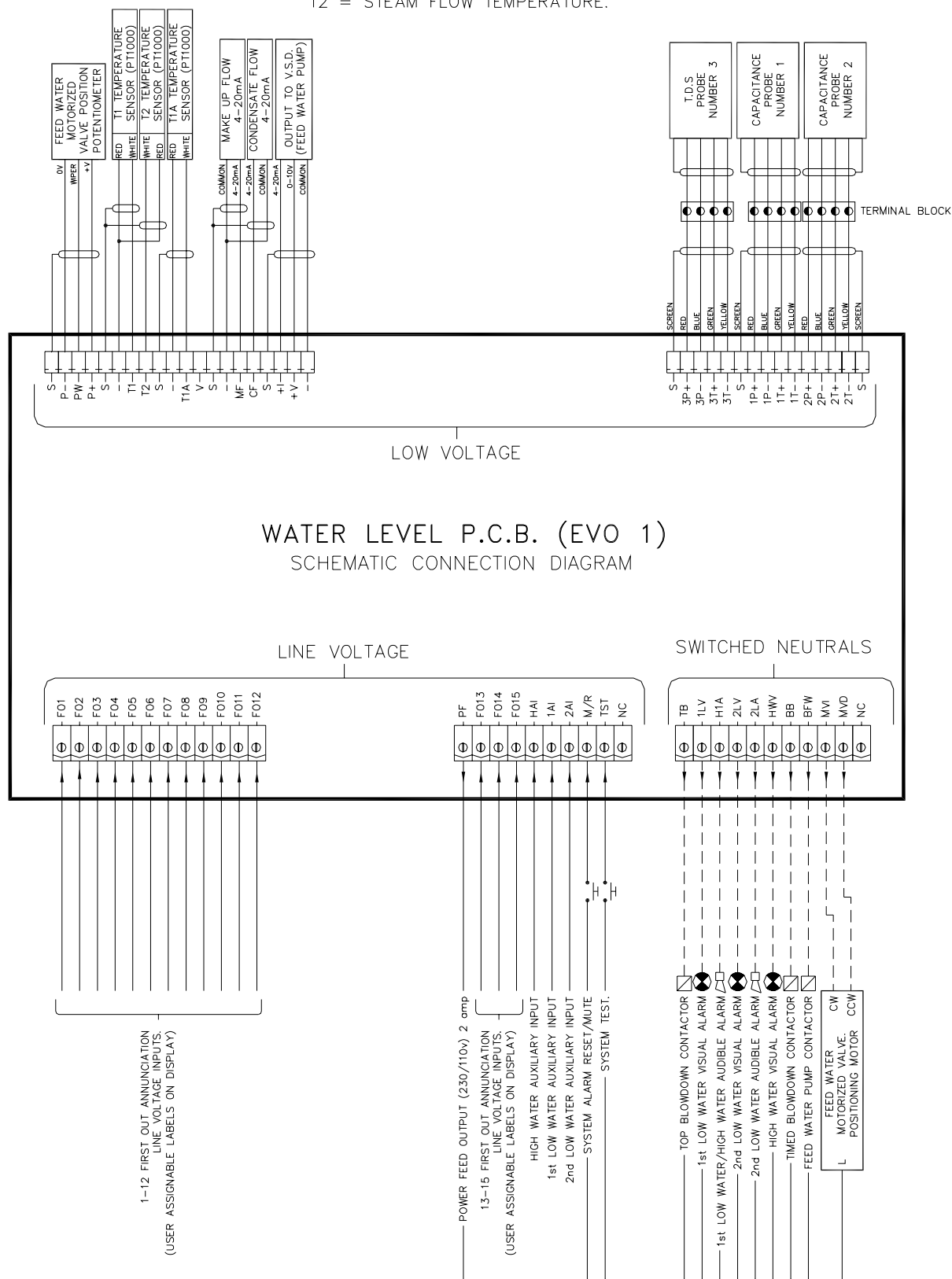
5.10.4.2 Expansion PCB Connection Terminals

NOTE:

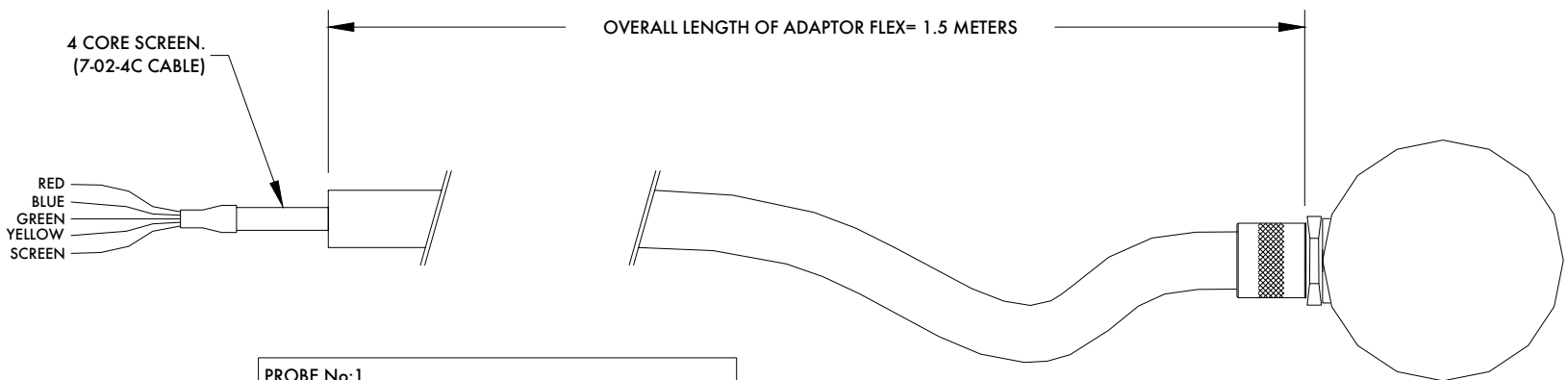
T1 = FEEDWATER OR COLD MAKE UP WATER OR HOT WATER RETURN.

T1A = CONDENSATE RETURN.

T2 = STEAM FLOW TEMPERATURE.



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 commissioned 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	1 st 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 associated 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

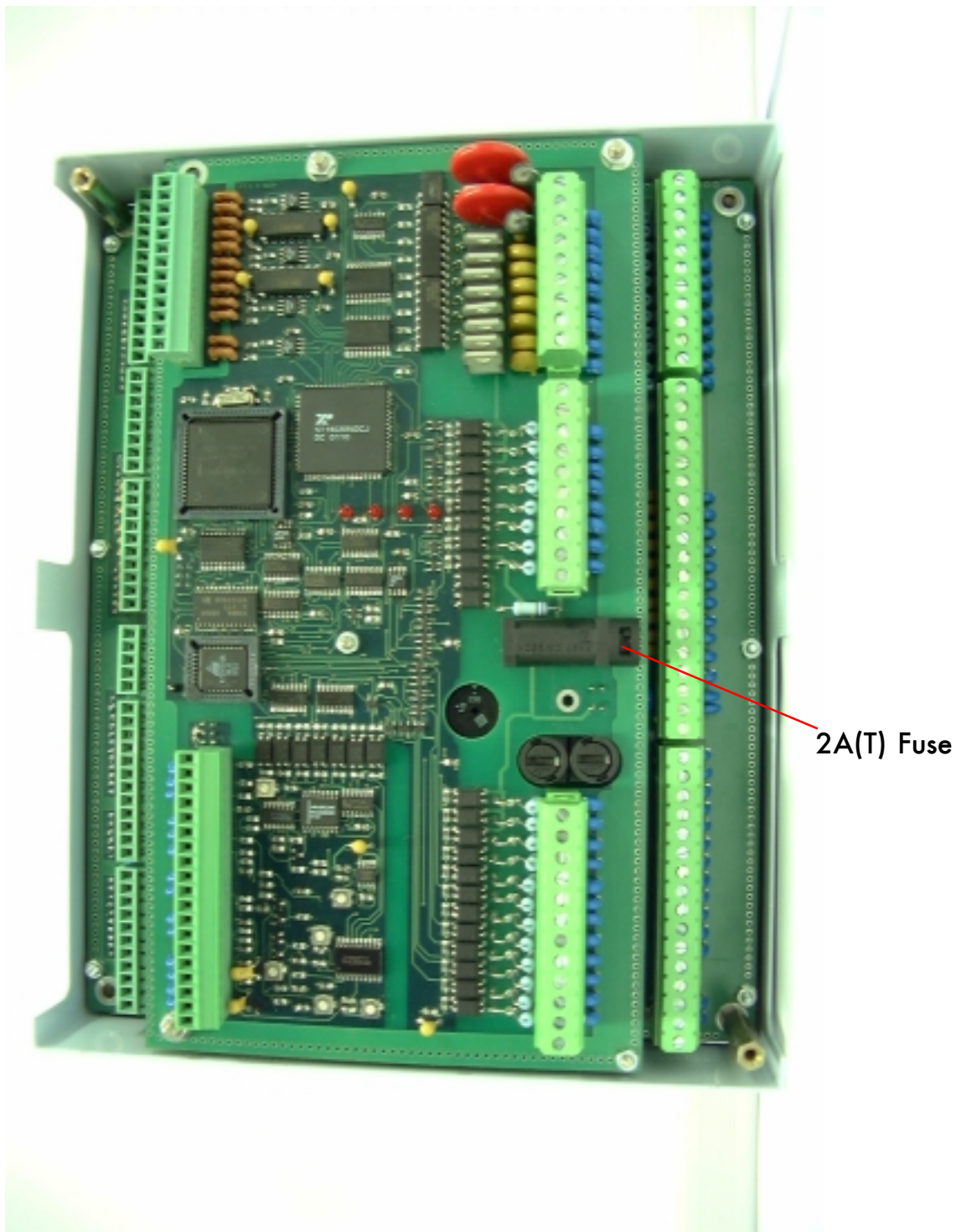
At 120V Current Loading Approximately 0.6mA

At 230V Current Loading Approximately 1.15mA

Refer to MK6 Electrical Specifications Section (2.14.2.9) for other general ratings.

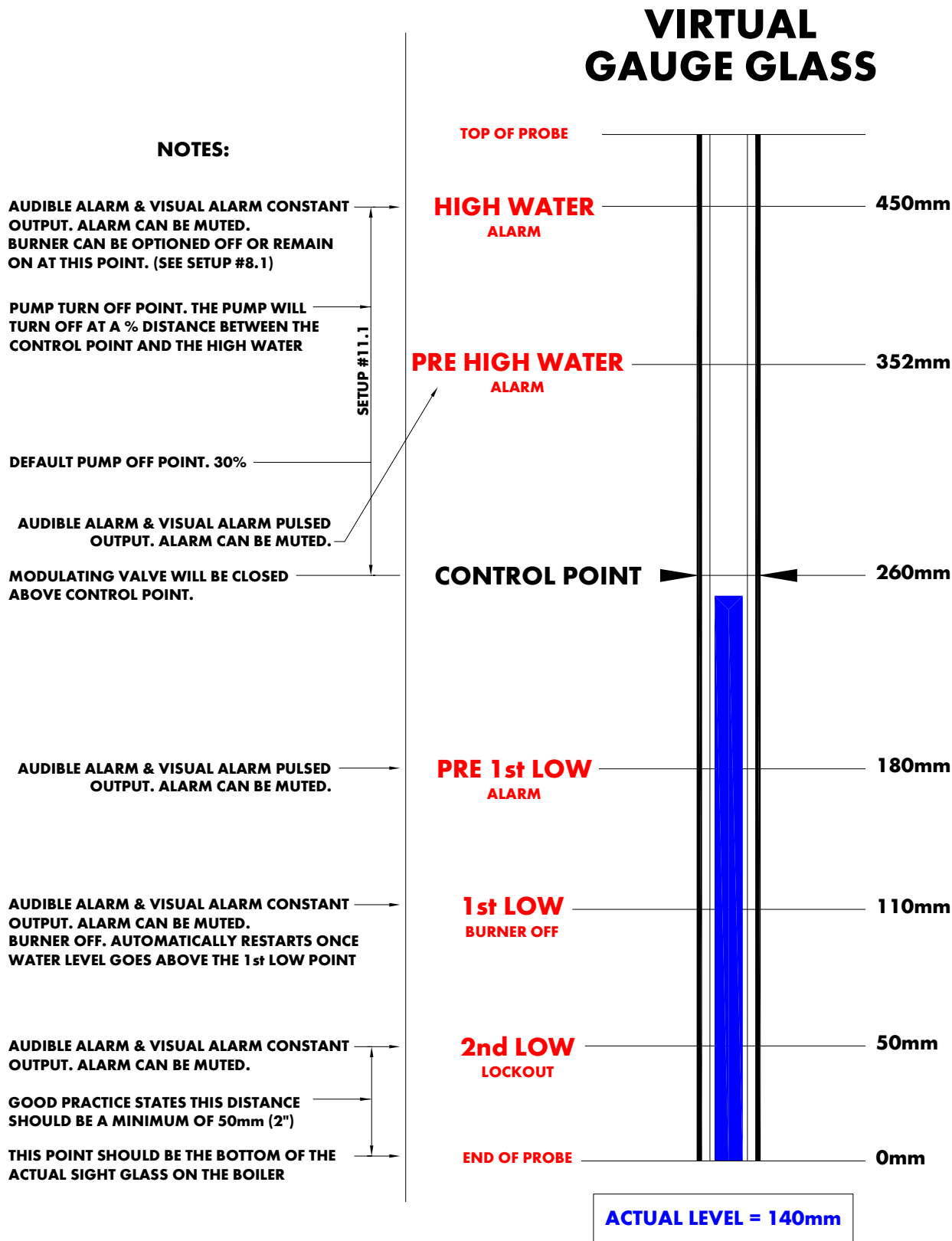
5.10.8 Fuse Position/Rating

MK6 EVOLUTION WITH WATER LEVEL P.C.B. FITTED



5.10.9 Display on the DTI (Data Transfer Interface)

INFORMATION AS DISPLAYED THROUGH THE WINPCDTI SOFTWARE.



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.

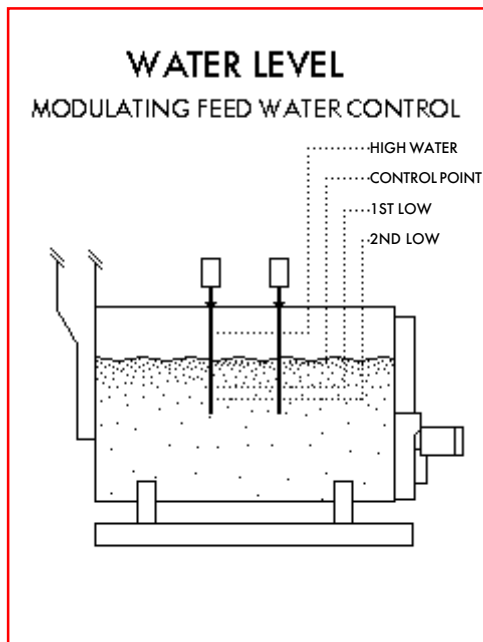
2nd Low:

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.

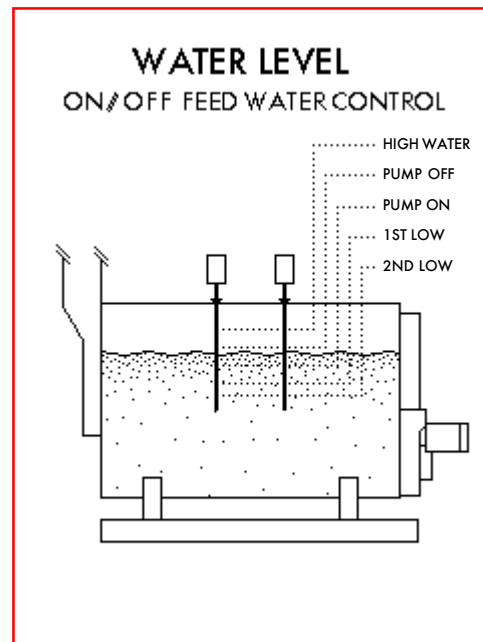
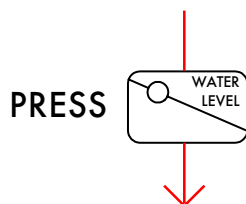
Bottom of probe:

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.

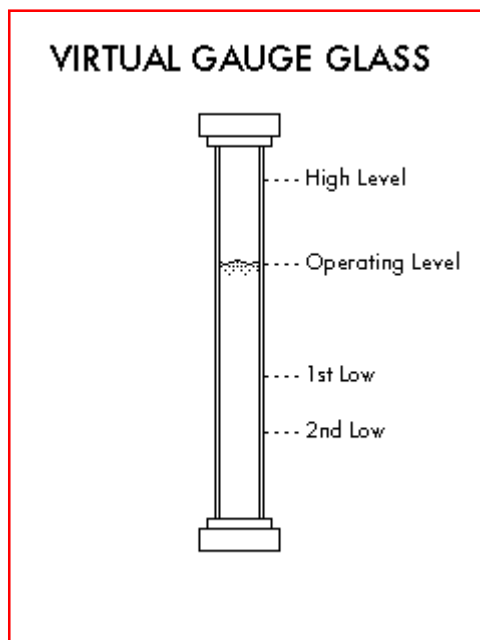
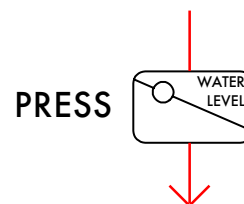
Several different displays are available to provide the operator with information when using the Water Level Control.



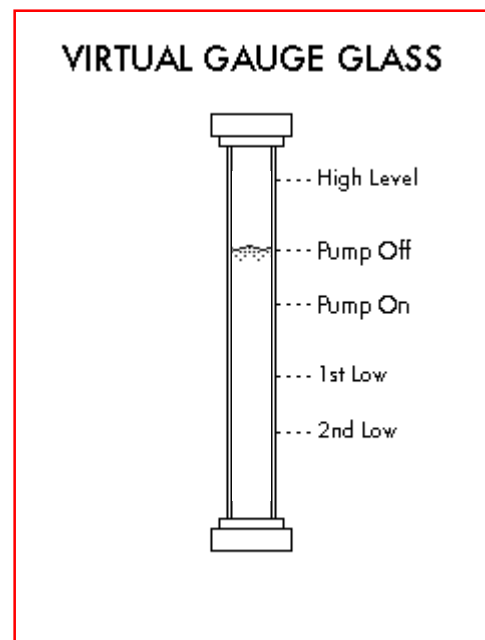
Boiler water level screen displayed for modulating standard water control.



Boiler water level screen displayed for on/off water control.

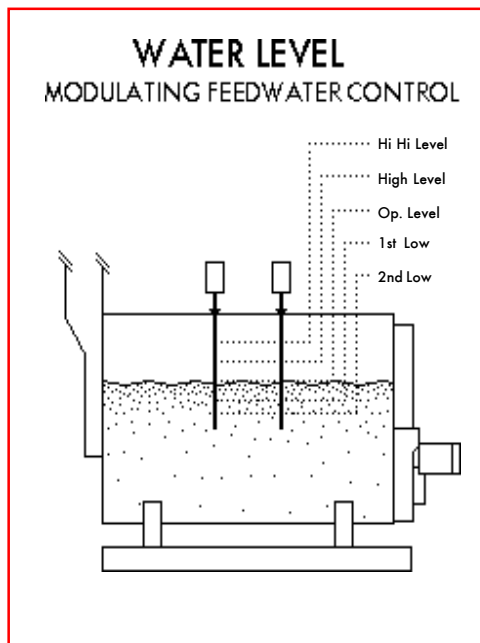


Virtual guage glass screen displayed for modulating standard water control.

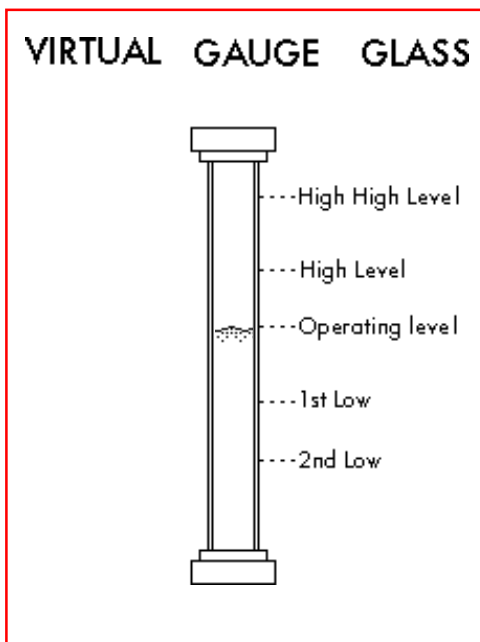
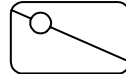


Virtual guage glass screen displayed for on/off water control.

Several different displays are available to provide the operator with information when using the Water Level Control.

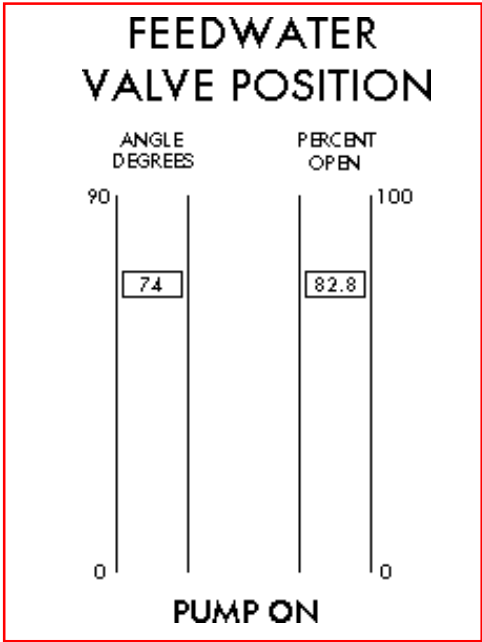


Boiler water level screen displayed for modulating high high water control.

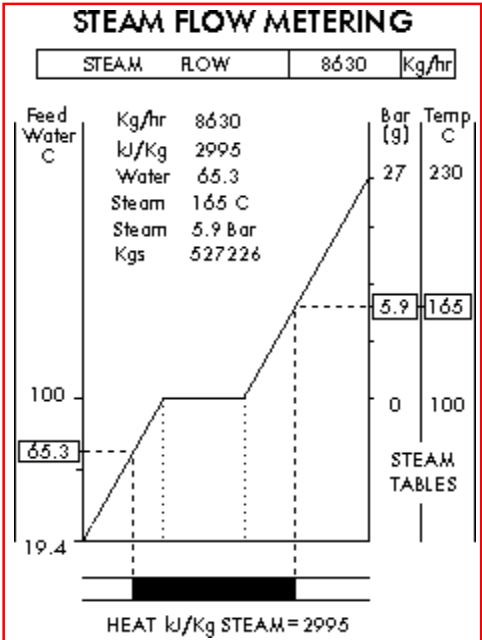
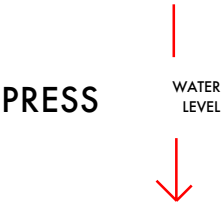


Virtual guage glass screen displayed for modulating high high water control.

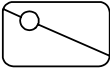
From Virtual Gauge Glass Screen



Feedwater Valve Screen
Autoflame Ball Valve



Steam Flow Screen
Metric Units



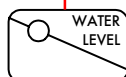
STEAM FLOW SCREEN

UNITS DISPLAYED

IMPERIAL	METRIC
lb/hr	Kg/hr
Btu/lb	KJ/Kg
F	C
F	C
PSI	Bar
lbs	Kgs

From Steam Flow Screen

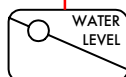
PRESS



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

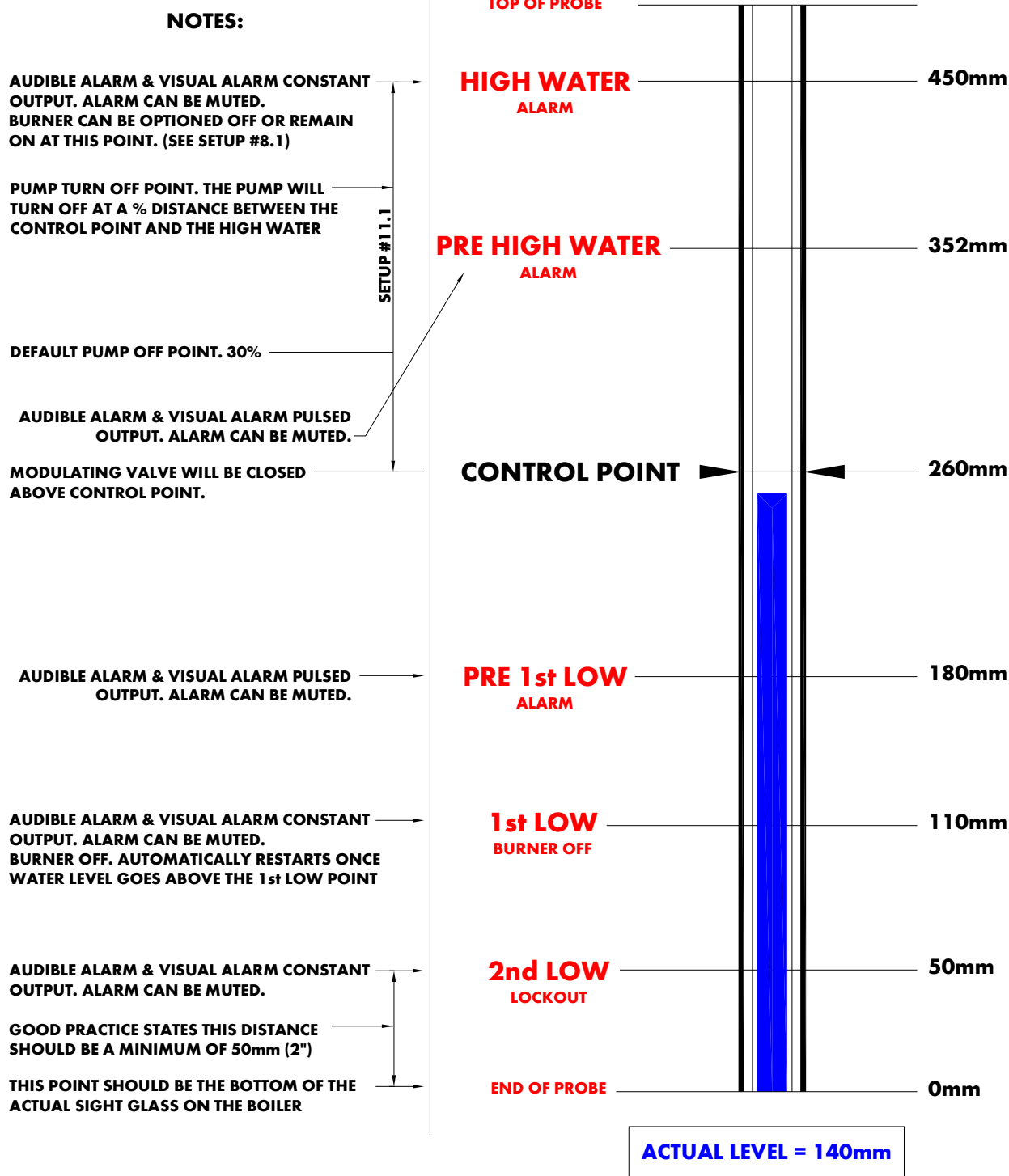
PRESS



To Boiler Water Level Screen

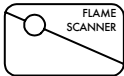
INFORMATION AS DISPLAYED THROUGH THE WINPCDTI SOFTWARE.

VIRTUAL GAUGE GLASS



5.11.3 First Out Status

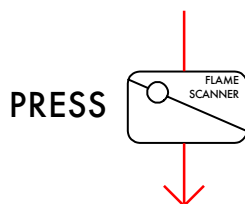
If a water level control board is fitted, fifteen mains voltage inputs are available for first out status indication.

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.

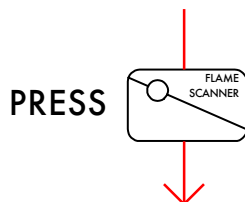
The descriptive labels for each input can be individually programmed by means of the infra-red upload software facility.

From VPS Status Screen



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		

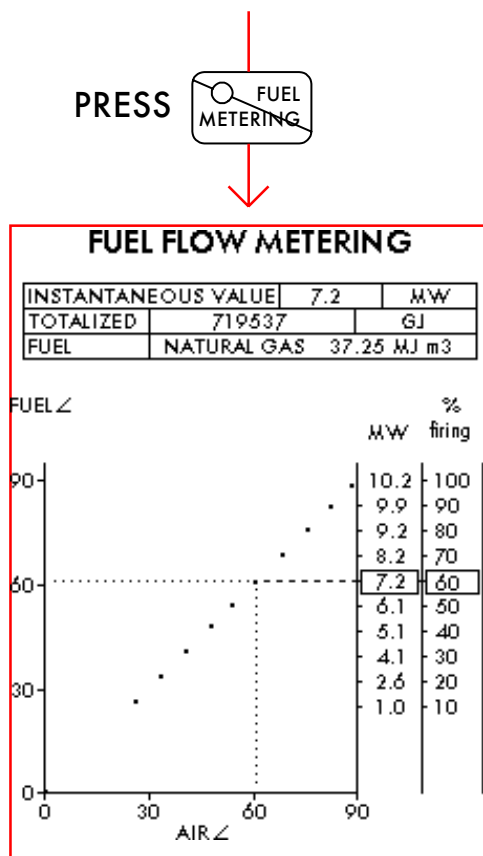
First Out Status Screen



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



Fuel Flow Metering Screen
Metric Units

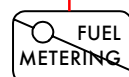
FUEL FLOW METERING SCREEN

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 TOTALISED
METRIC UNITS**

FUEL 1 Natural Gas	350012.7	m3
FUEL 2 Distillate Oil	302470.0	Kgms
	353388.7	Ltrs
	302.4	Tonnes
FUEL 3 Heavy Oil	161098.1	Kgms
	188217.9	Ltrs
	161.0	Tonnes
FUEL 4 Gas	0.0	m3

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.

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 auxiliary 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 control 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 your 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 1 degree 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).

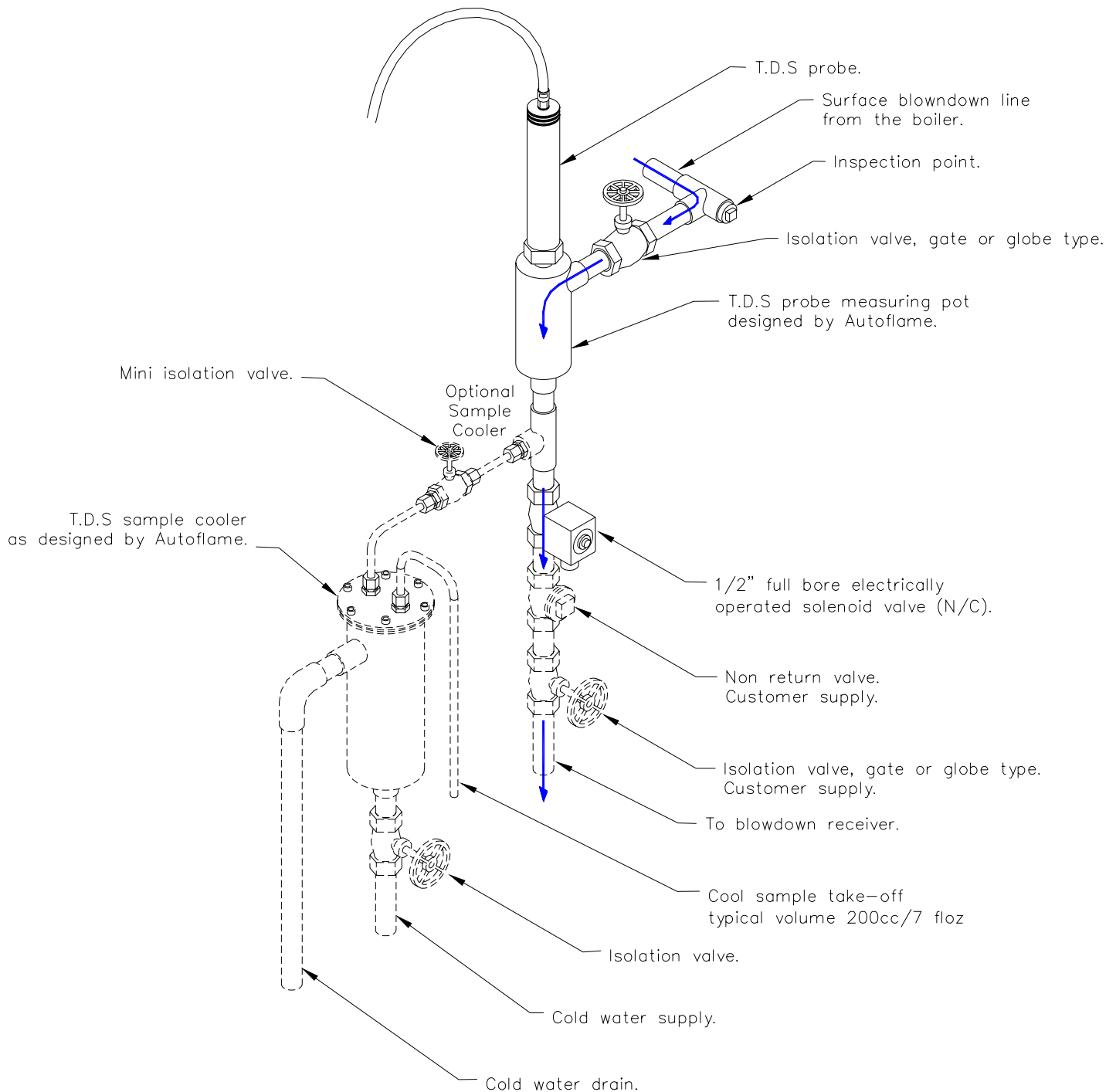
5.12.4 Control & Management of Total Dissolved Solids in a steam boiler. T.D.S Top Blowdown

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**

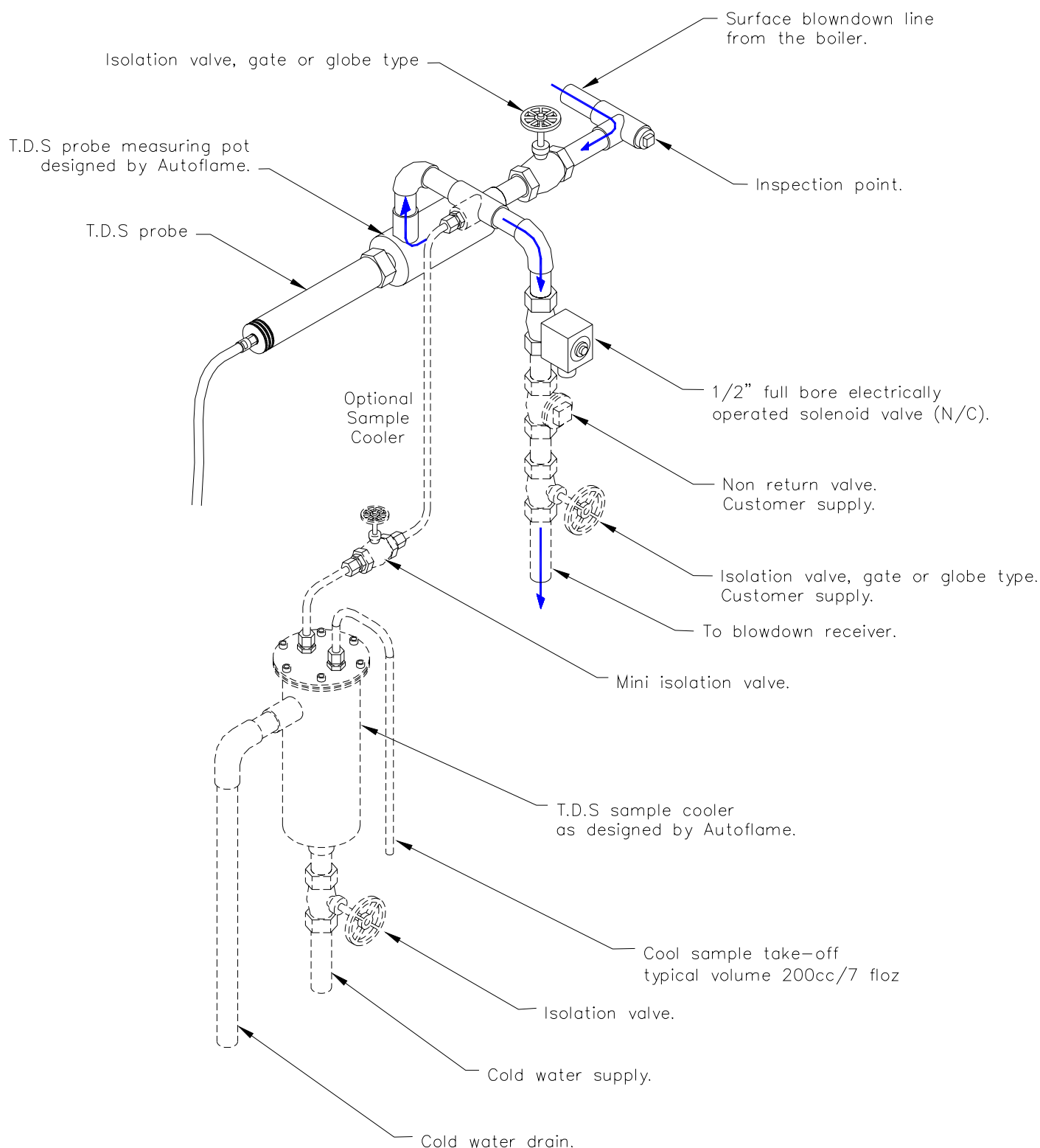
Illustrated below are two installation methods for the T.D.S probe incorporating Autoflame's sampling system.



All dotted components supplied by the customer.

Option 1: Vertically mounted

Option 2: Horizontantly 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.

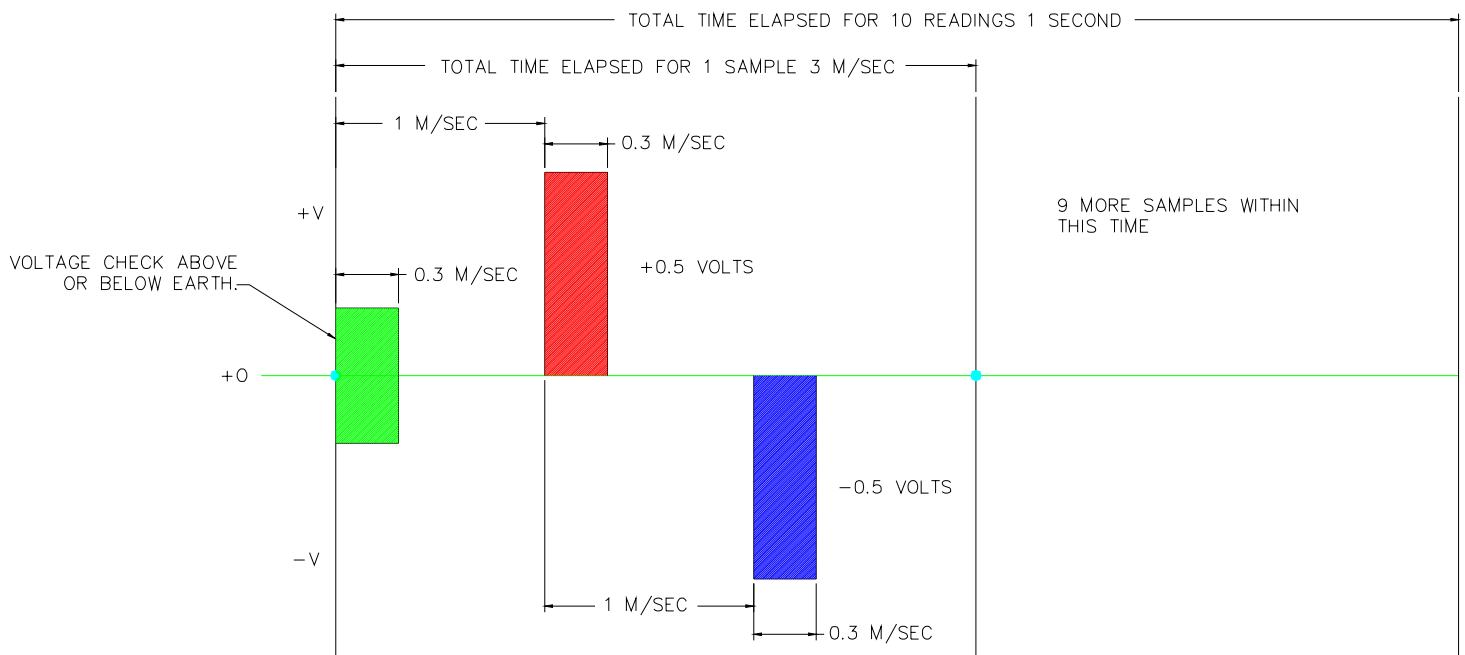


figure 1.

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.

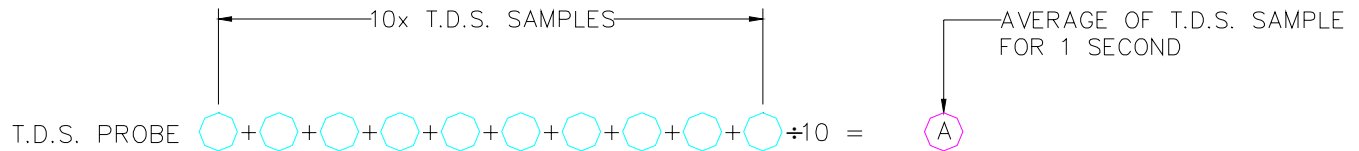


figure 2.

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.

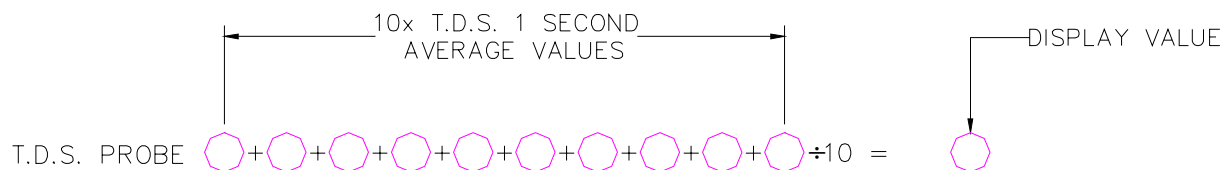
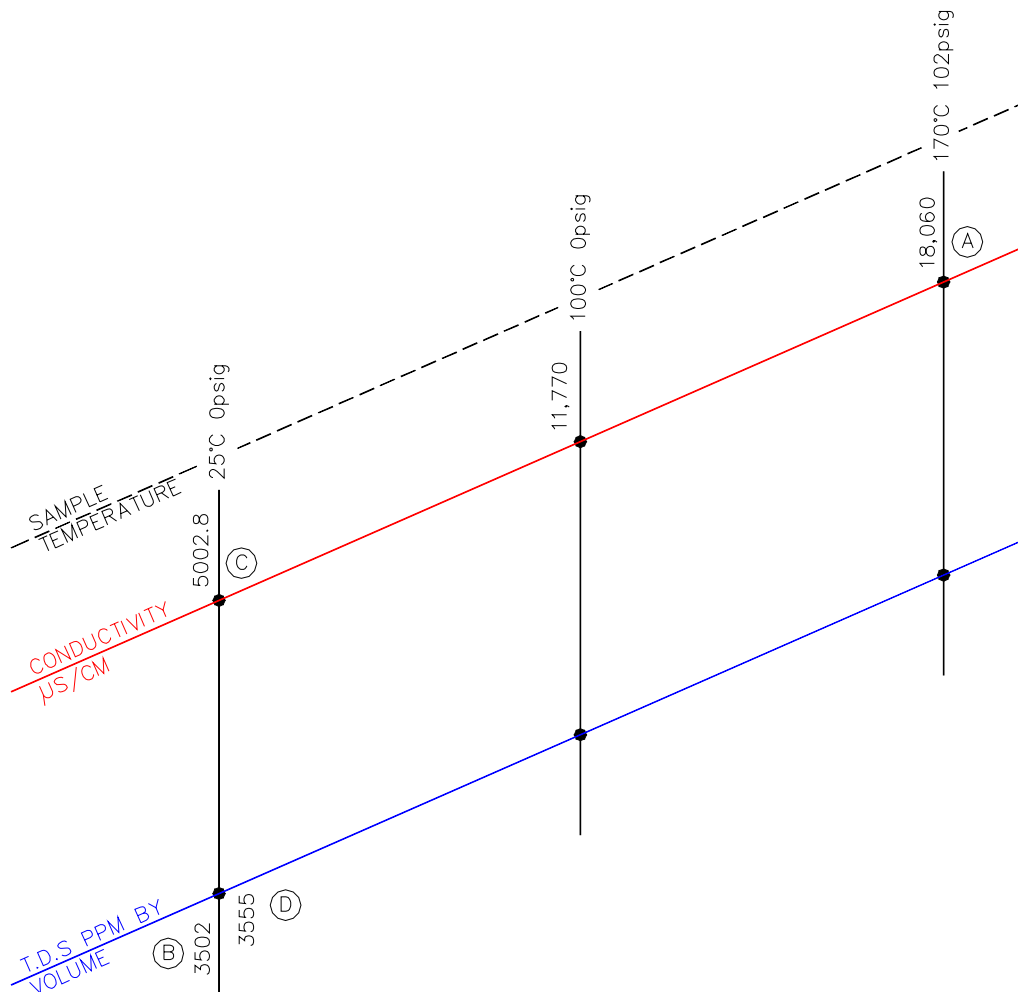


figure 3.

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.

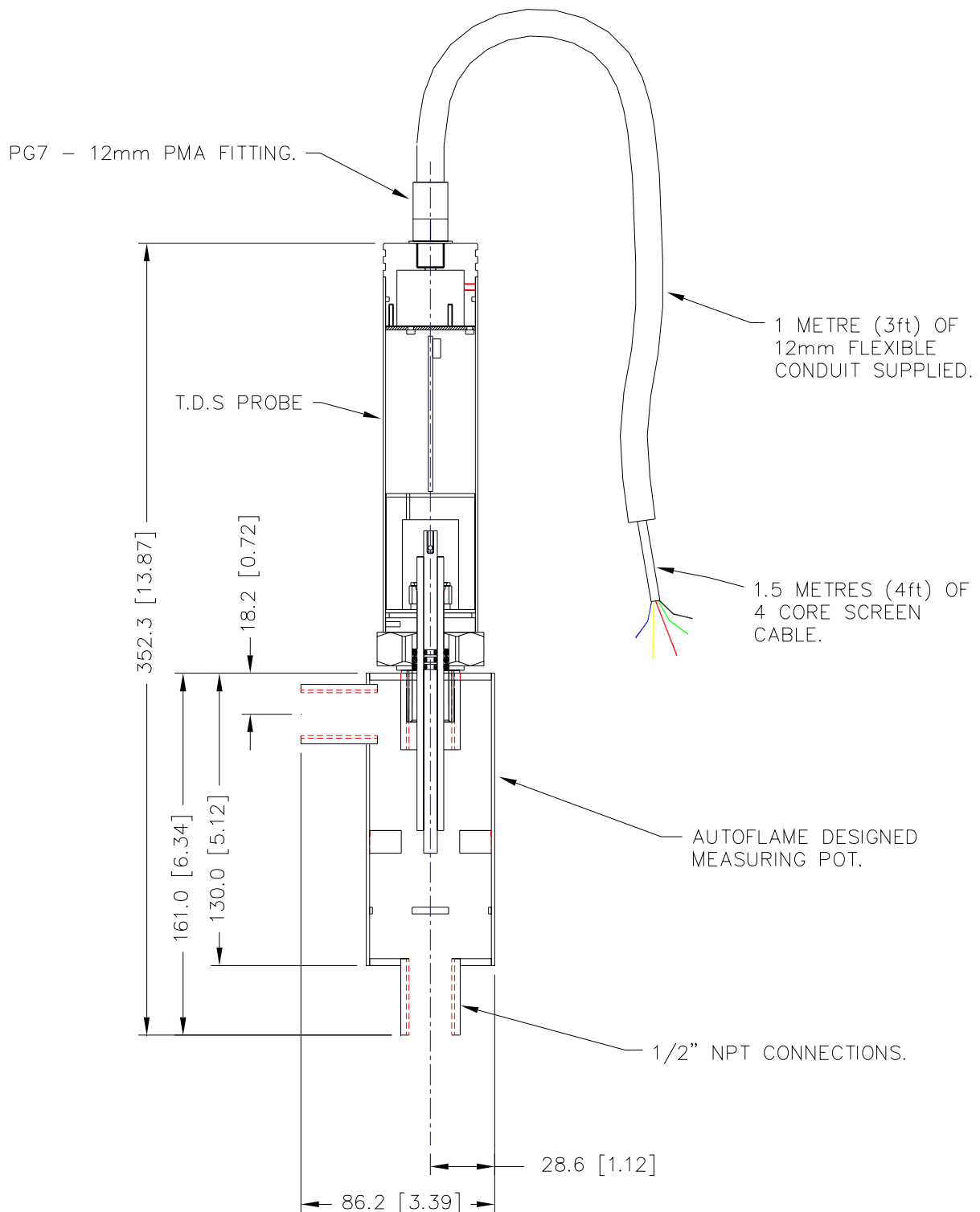
1: At the time of manufacture every T.D.S. probe has buried in its electronics memory a "Calibration Correction Coefficient" or C.C.C. This is effected as set out under.

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



5.12.9 Top Blow Down Management

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.

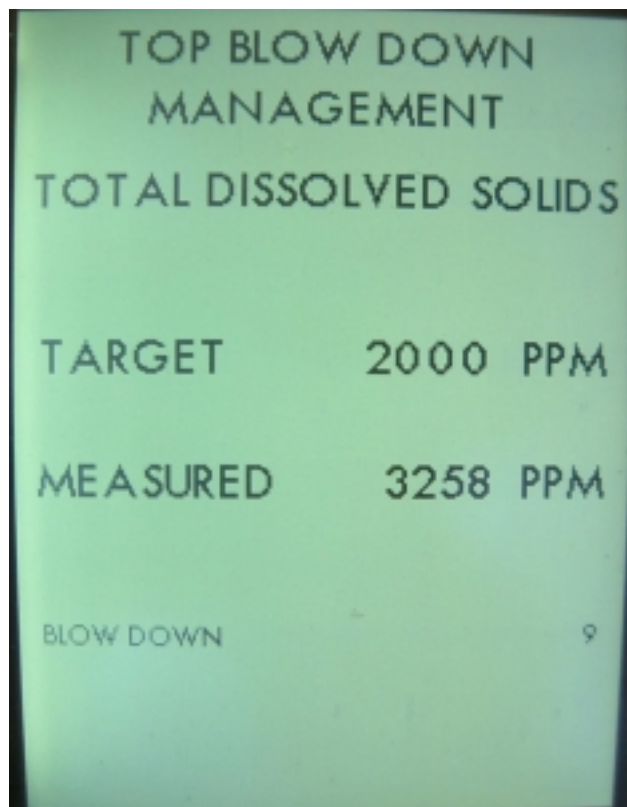
At the bottom of the screen the various stages of top blow down are displayed as they occur, with a down counter indicating the number of seconds left for this stage. When the Top Blow Down is operating the possible messages are:

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

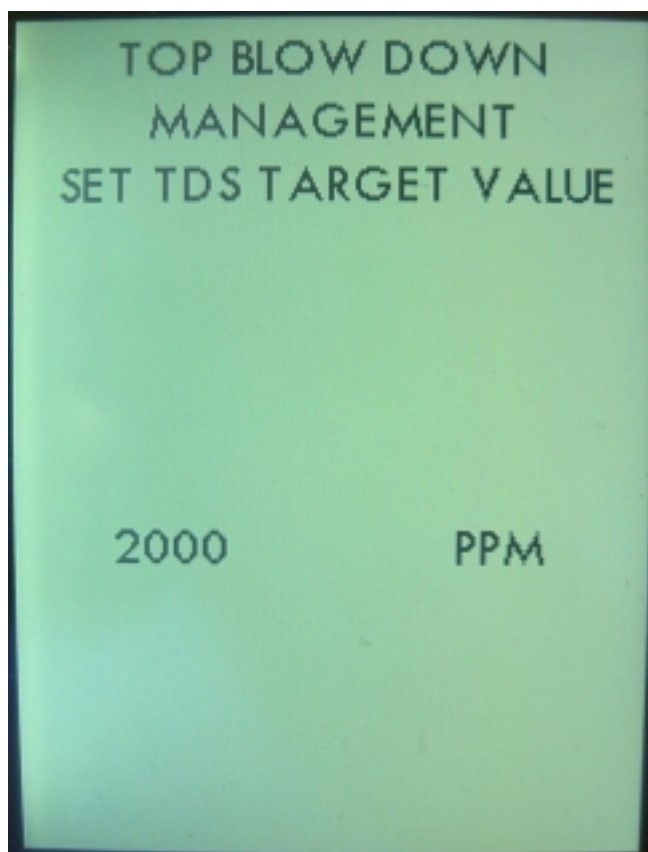
If the burner is firing and steam pressure is not up to the Threshold Offset the following is displayed:
TOP BLOW DOWN NOT OPERATING
STEAM PRESSURE BELOW THRESHOLD

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.



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.

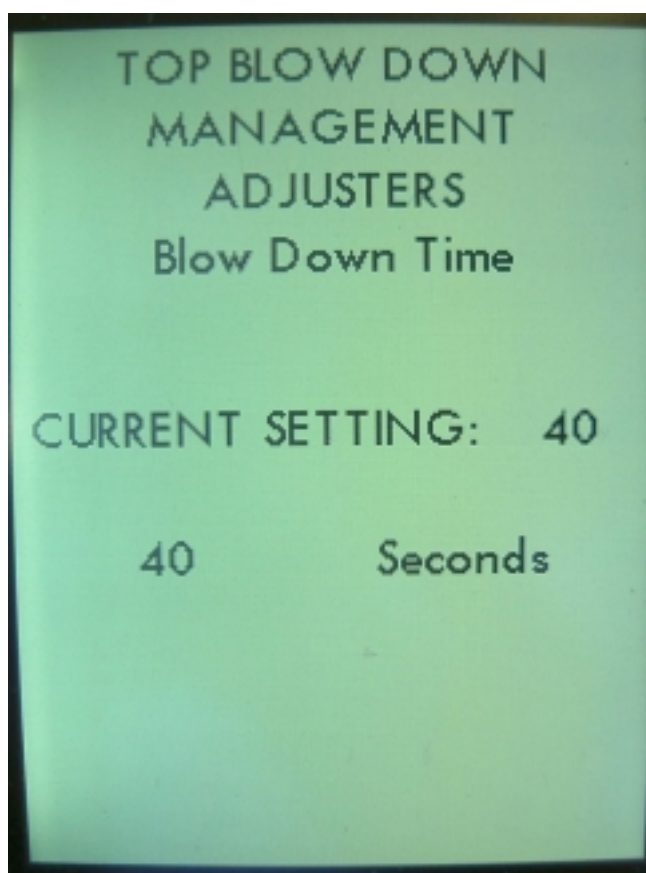


5.12.9.4 Top Blow Down Adjusters

The Top Blow Down Adjusters allow the Top Blow Down Operation to be adjusted to suit boiler run conditions.

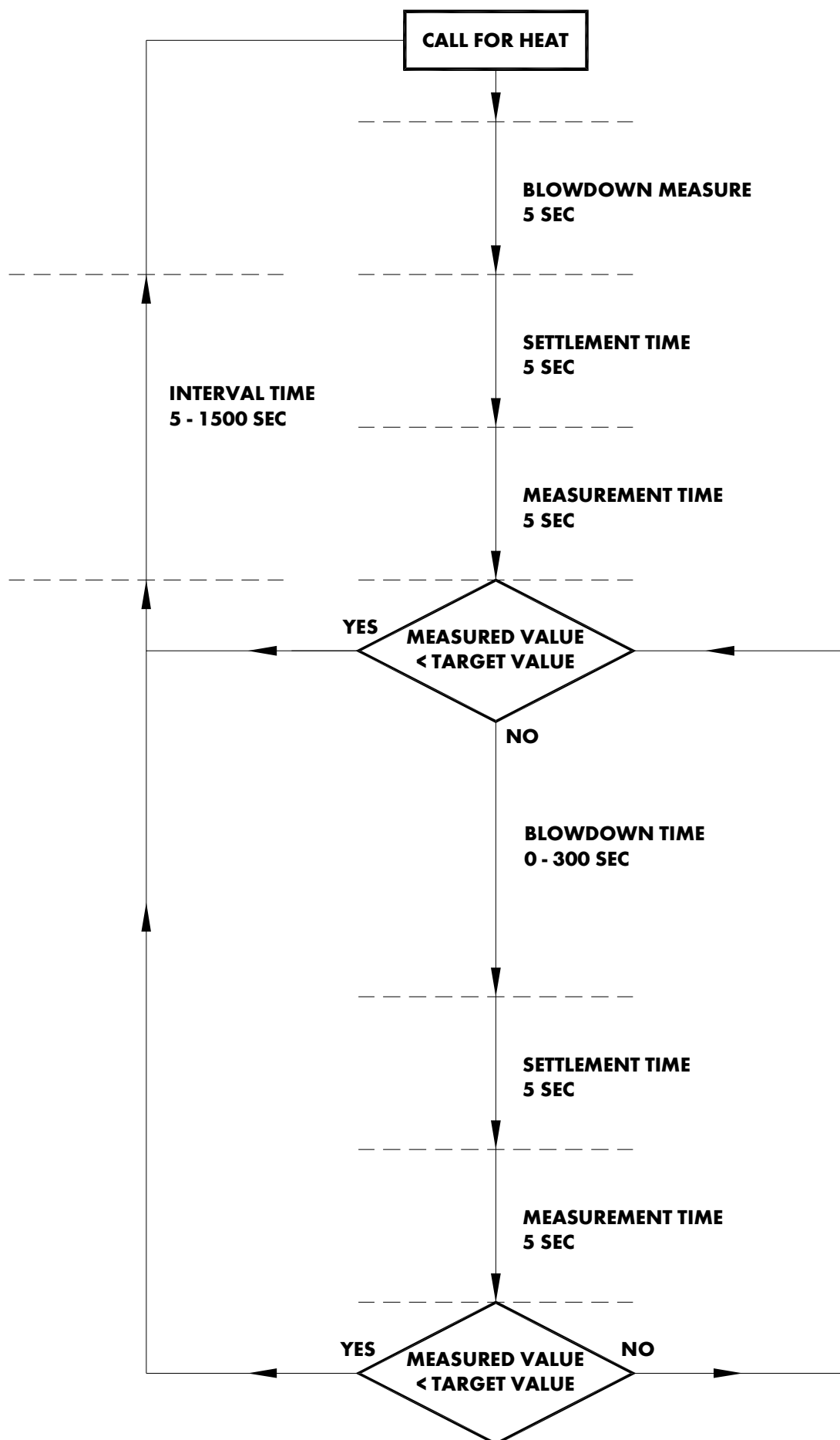
Whilst the day to day Top Blow Down Management screen is being displayed press the COM button for 2 seconds so that the SET TDS TARGET VALUE screen is shown. The WATER LEVEL & COM leds will be on & the RUN led flashing. Press the Water Level button twice. The ADJUSTERS screen shown below should be displayed. 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.



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 position 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 commissioned. (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 $5000\mu S * 0.7 = 3500 \text{ ppm}$.
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 pressure 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.

5.12.9.6 T.D.S. Timing Diagram



Section 6: D.T.I. Data Transfer Interface

- 6.1 DTI Module
- 6.2 Information Available from the DTI system
- 6.3 Complete DTI Standard System Application Example
- 6.4 Multi Kiln DTI Special System Application Example
- 6.5 Front Facia Layout
- 6.7 I/O System Capabilities
- 6.8 Communication Interface schematic system capabilities
- 6.9 Wiring Connection Terminals Diagram
- 6.10 DTI Fixing Holes and Dimensional Details
- 6.11 DTI Interconnections
 - 6.11.1 MM Modules
 - 6.11.2 EGA Modules
- 6.12 PCB Switch Settings and Link Arrangements
 - 6.12.1 Restore To Factory Settings
- 6.13 DTI, PC and Modem Interconnections
- 6.14 Analogue Input/Output Module Index
- 6.15 Digital Input/Output Module Index
- 6.17 Modbus Interface Index
- 6.18 Autoflame WinPCDTI Software
- 6.19 Johnson Metasys Interface Index
- 6.20 Other Information and Illustrations
 - 6.20.1 Loop Back Test
 - 6.20.2 Communication Interfaces

6.1 DTI MODULE



6.2 INFORMATION AVAILABLE FROM THE DTI

DTI Information:

MM Information:

Required boiler temperature (deg. C) or pressure (Bar).
Actual boiler temperature (deg. C) or pressure (Bar).
Burner on/off (CR relay 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 8, CH1-CH8 Positioning Motors (Angular Deg.)
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.

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 exhaust 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 exhaust temperature commission value.
Combustion efficiency commission value.
EGA error conditions.

DTI Input values:

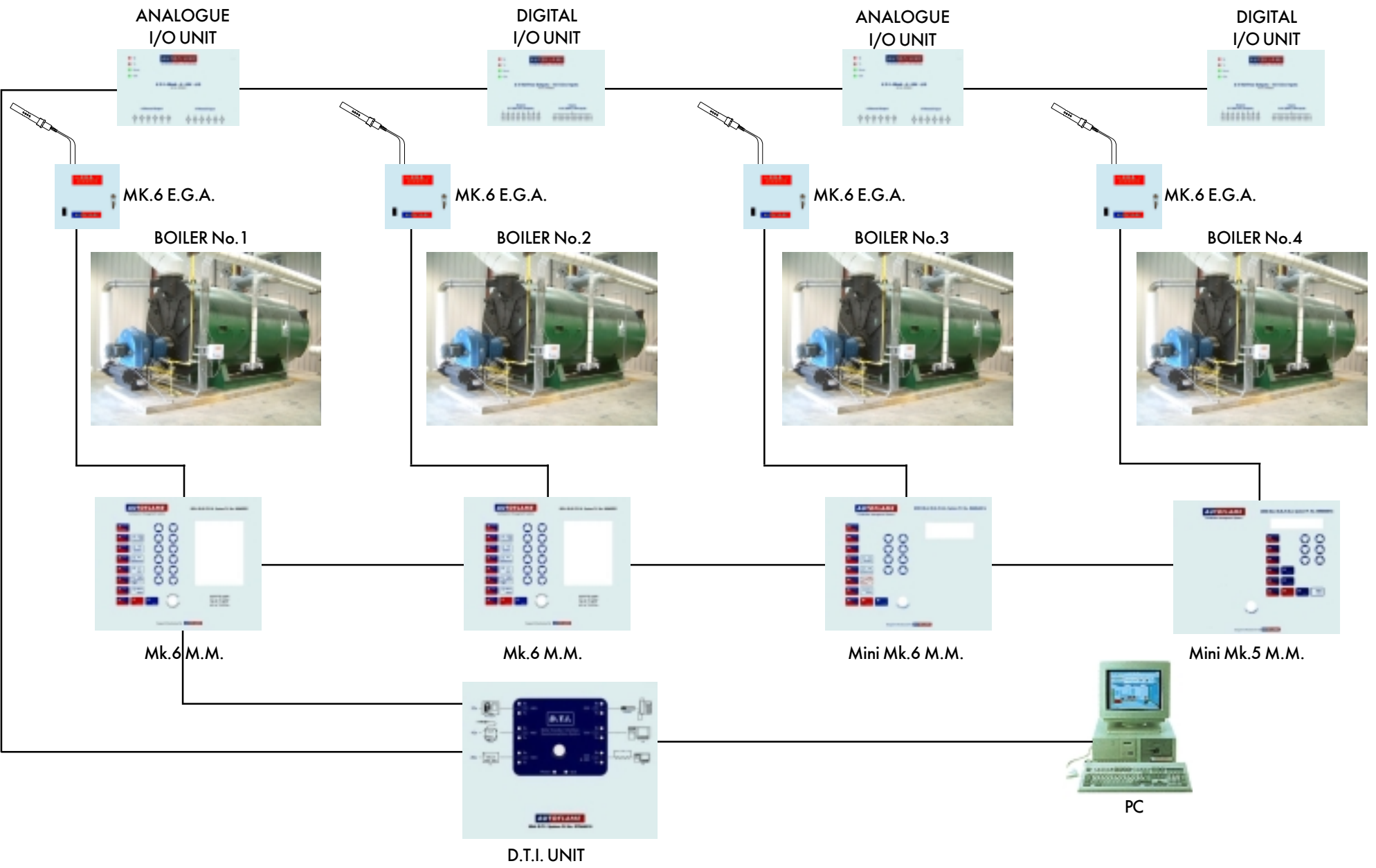
Boiler enable/disable.
Change required set point.
Select lead boiler.
Shuffle Sequencing.
Set Load Inedex.

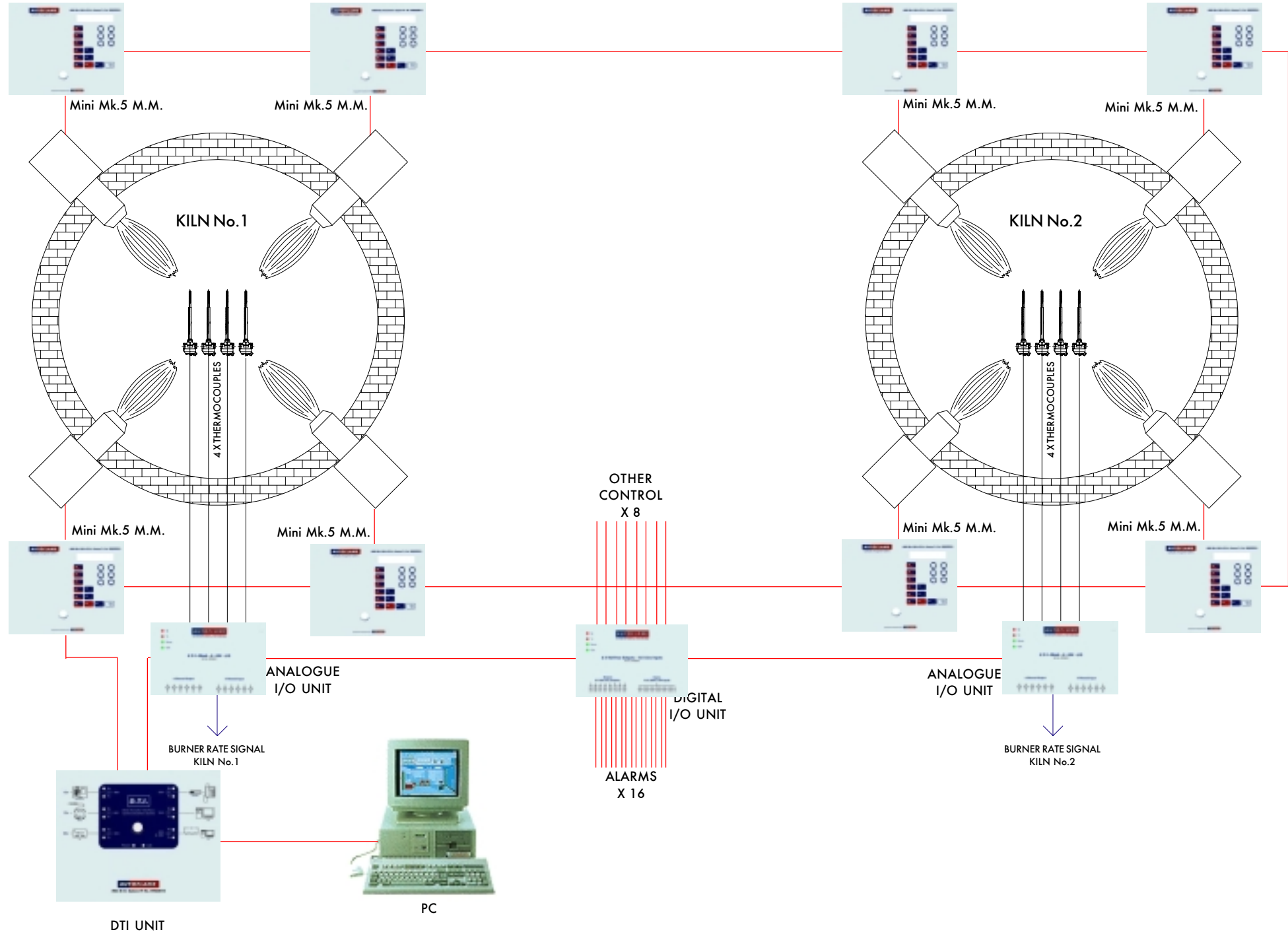
DTI Information:Water Level Information:

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

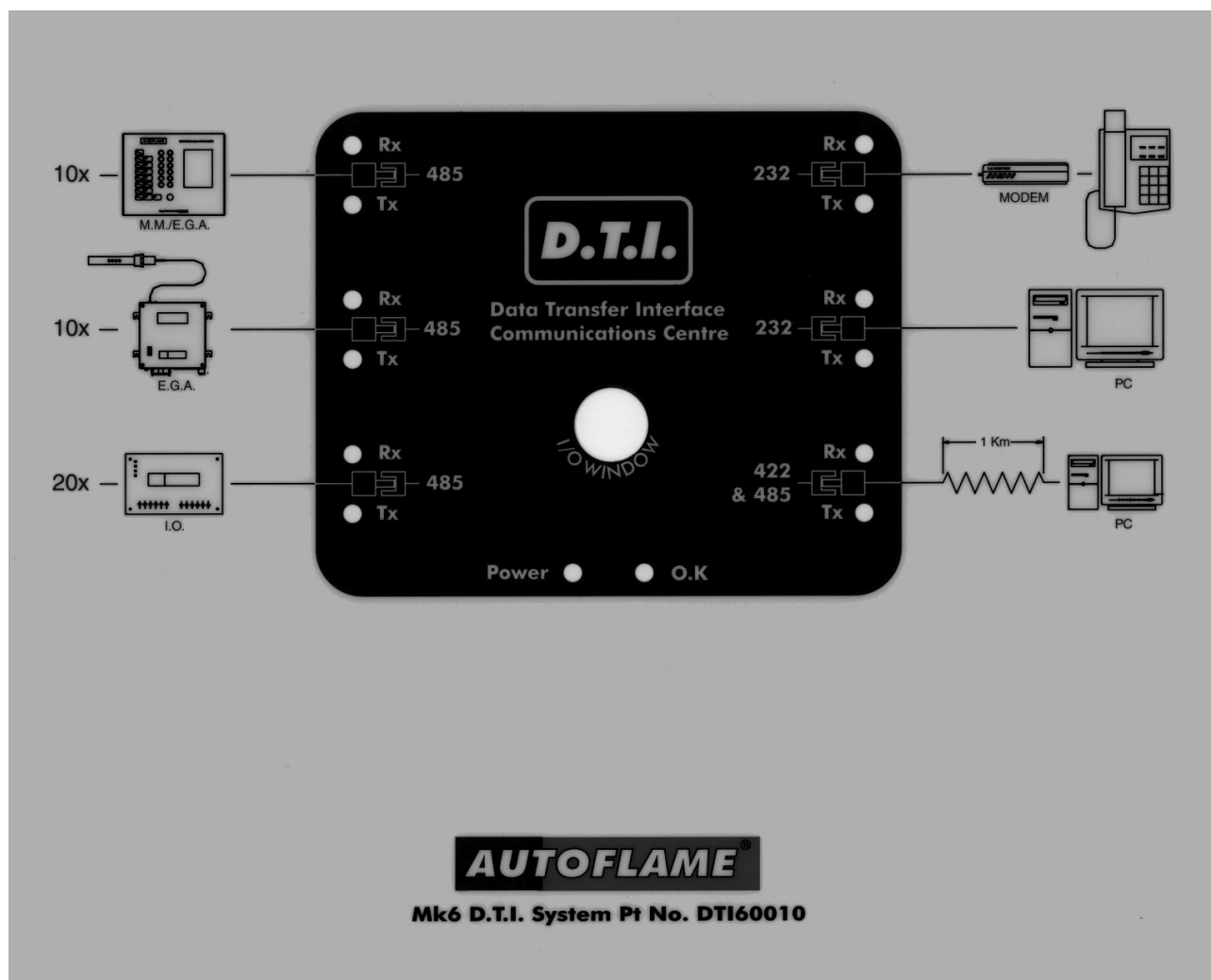
Continuous Emissions Monitoring Software (CEMS):

Current emissions by weight and volume (O₂, CO₂, CO, NO, SO₂, H₂O, N₂, Total)
Totalised emissions by weight (O₂, CO₂, CO, NO, SO₂, H₂O, N₂, Total)
Efficiency
Exhaust temperature
Boiler exit velocity
Total heat input into boiler
Net useful heat into boiler
Heat loss to stack
Fuel flow

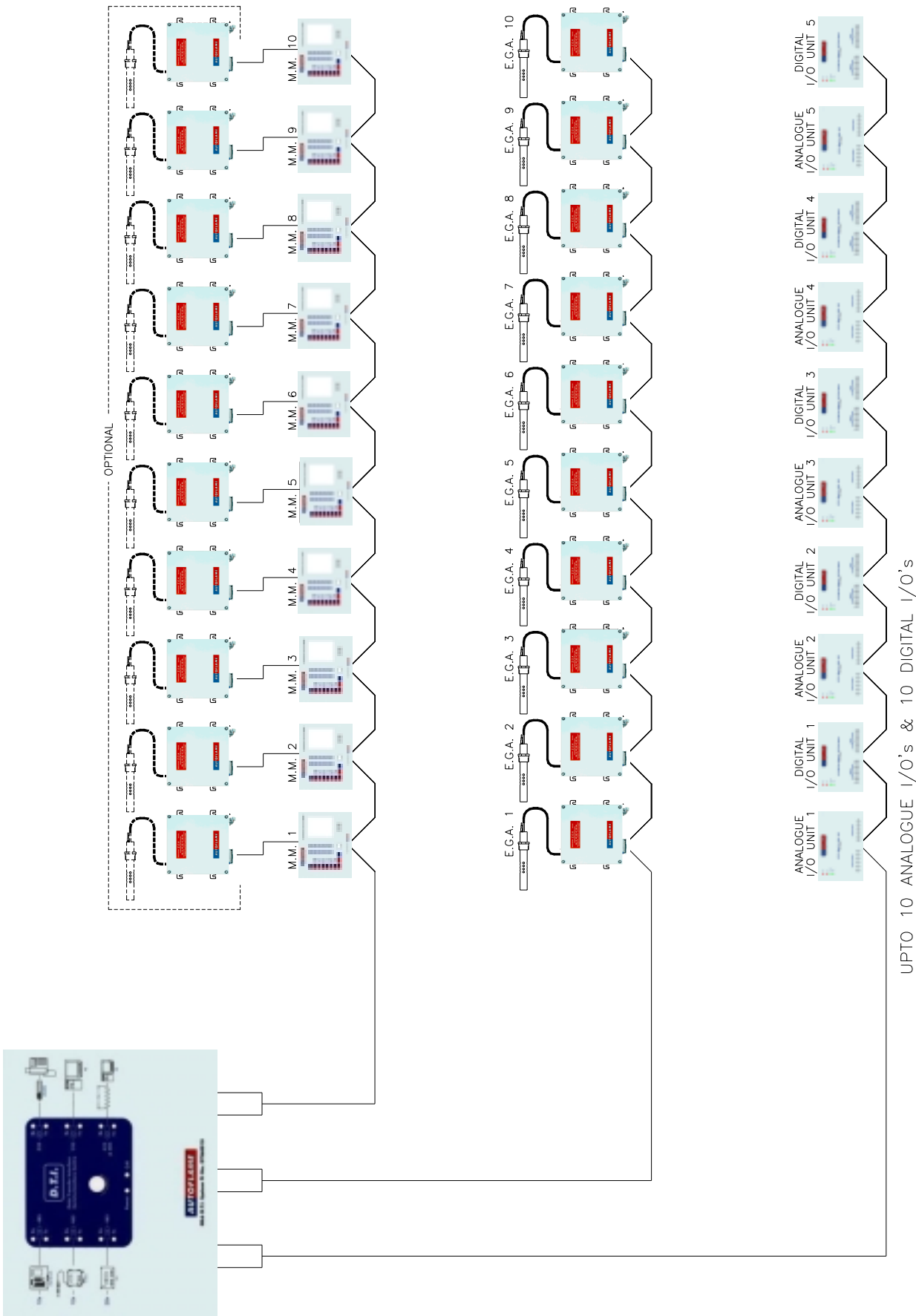




6.5 FRONT FACIA LAYOUT

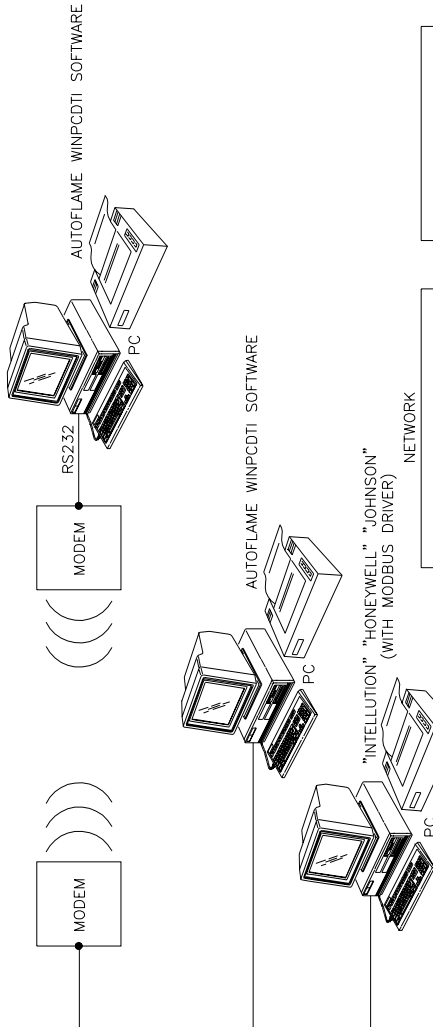


6.7 INPUT/OUTPUT SYSTEM CAPABILITIES

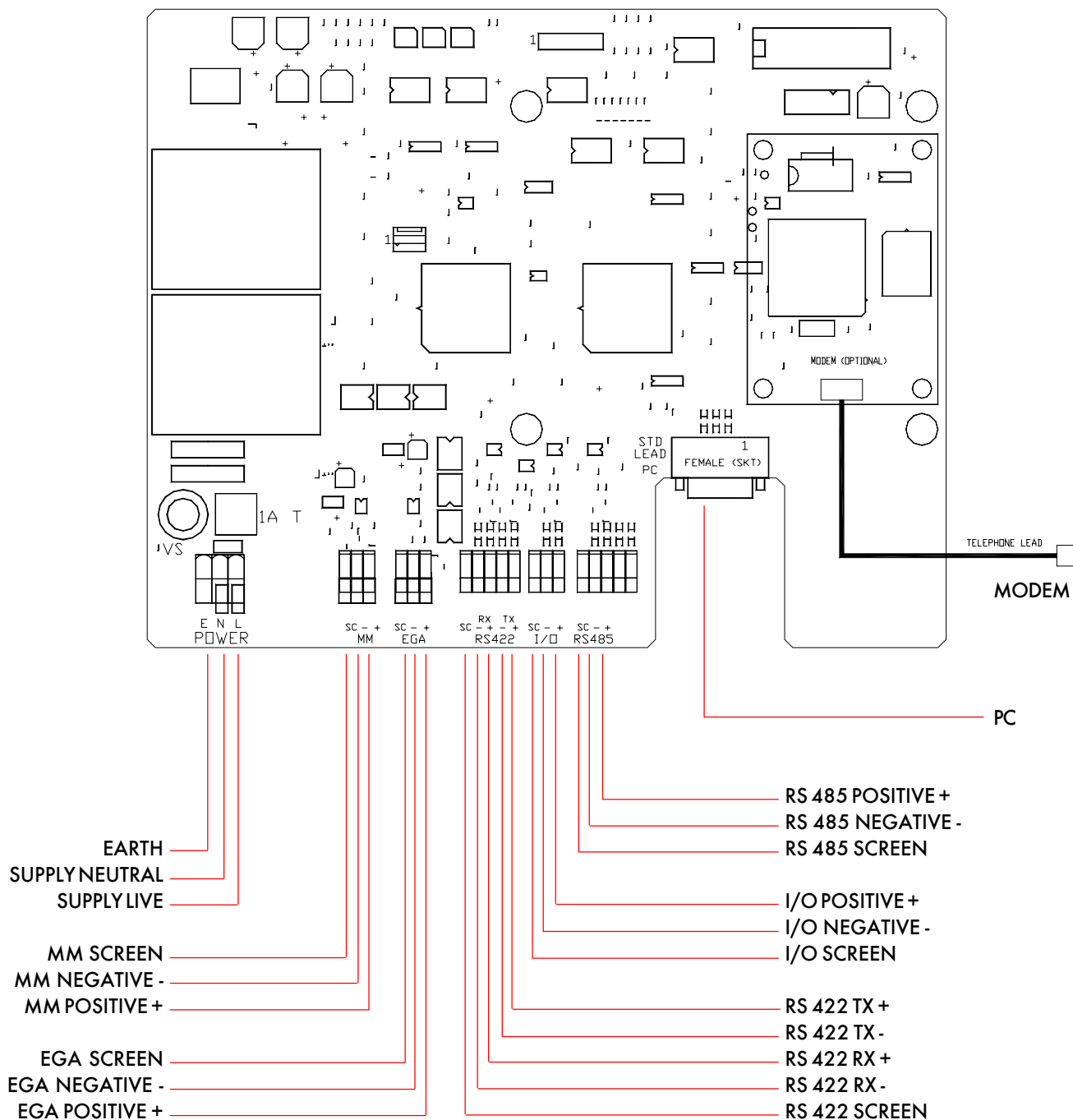


6.8 COMMUNICATION INTERFACE SCHEMATIC SYSTEM CAPABILITIES

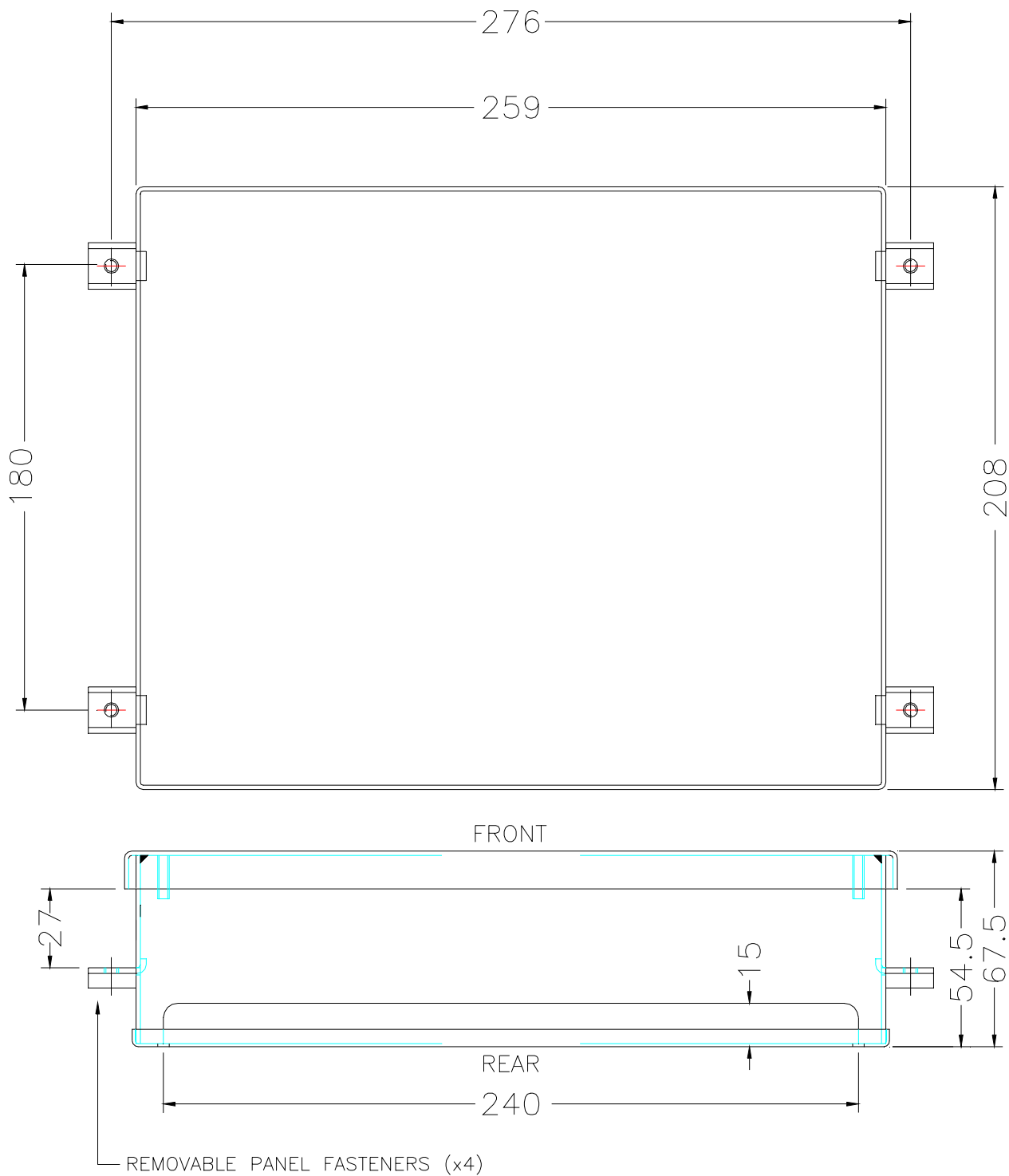
MODEM (FOR WINPCDTI ONLY)
ED FOR EITHER WINPCDTI OR MODBUS OPERATION
SIMULTANEOUSLY



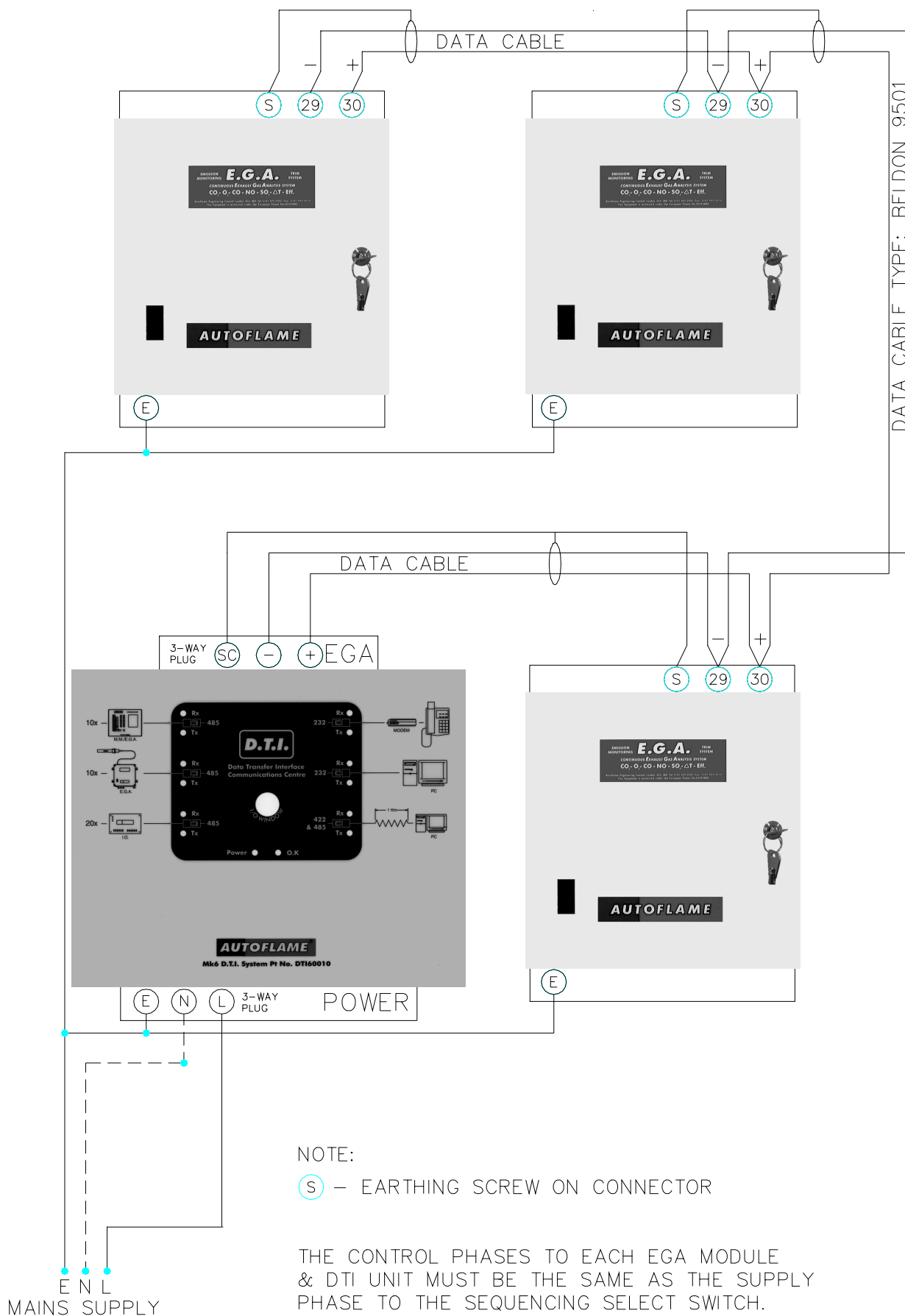
6.9 WIRING CONNECTION TERMINALS DIAGRAM



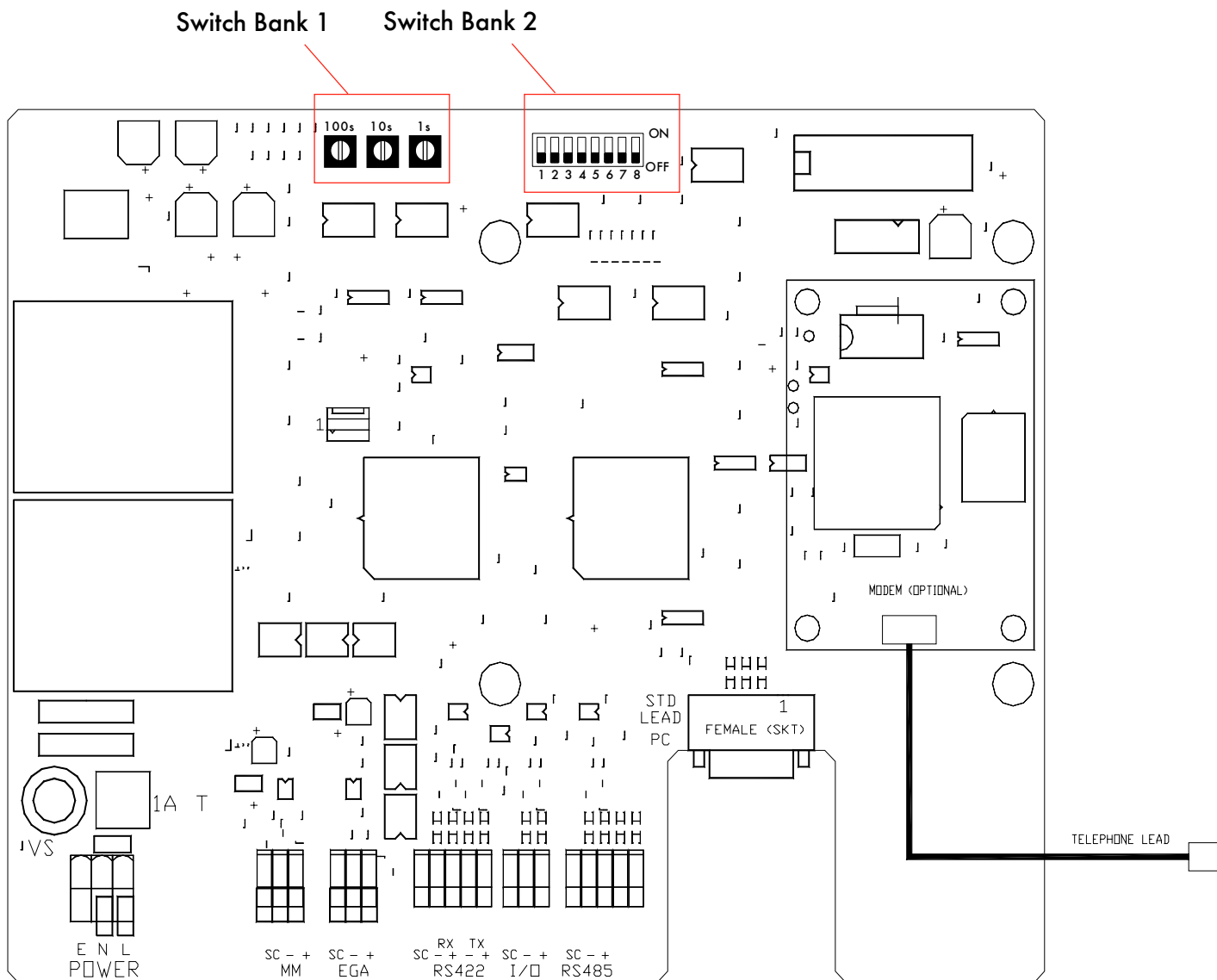
6.10 DTI FIXING HOLES AND DIMENSIONS



6.11.2 EGA Modules (Standalone EGA)



6.12 PCB SWITCH SETTINGS



Standard DTI - when used with WinPCDTI Software

Switch Bank 1 - not relevant, set to 001

Switch Bank 2 - ways 1 to 7 all set to off

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.

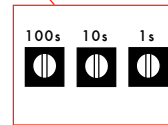
6.12.1 To Restore Factory Settings

This procedure clears all configuration data in the DTI and sets it back to default settings. (Configuration data includes, for example, alarm trigger conditions and labels).

Procedure

Switch Bank 1

1. Power off the unit.
2. Set Switch Bank 1 address value to 789:
100s = 7
10s = 8
1s = 9

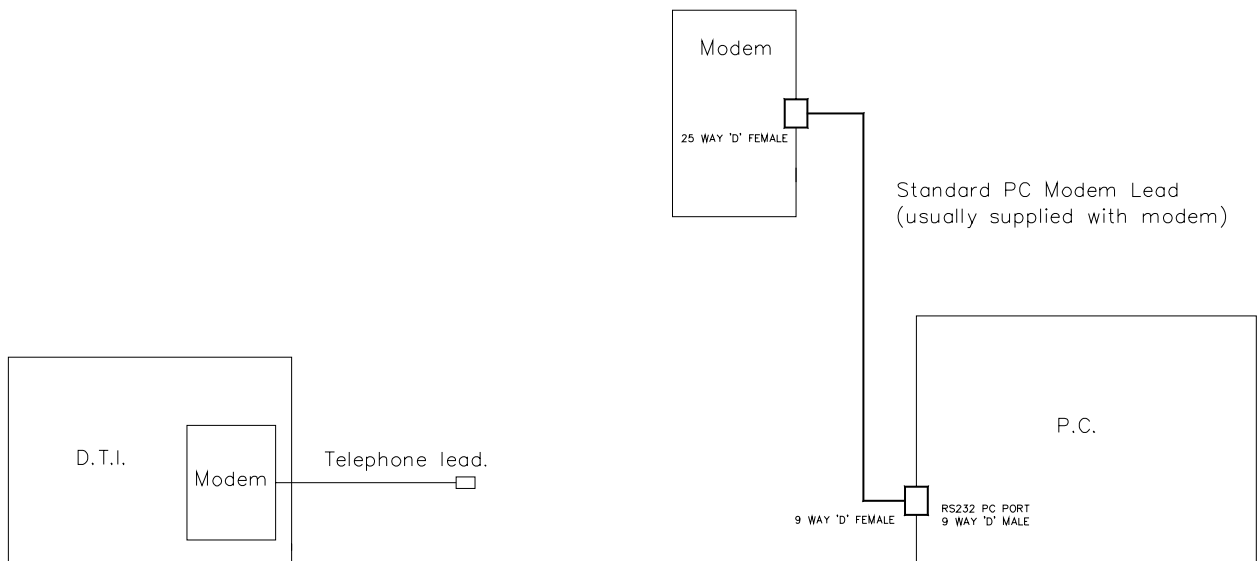


(Switch Bank 2 settings are irrelevant).

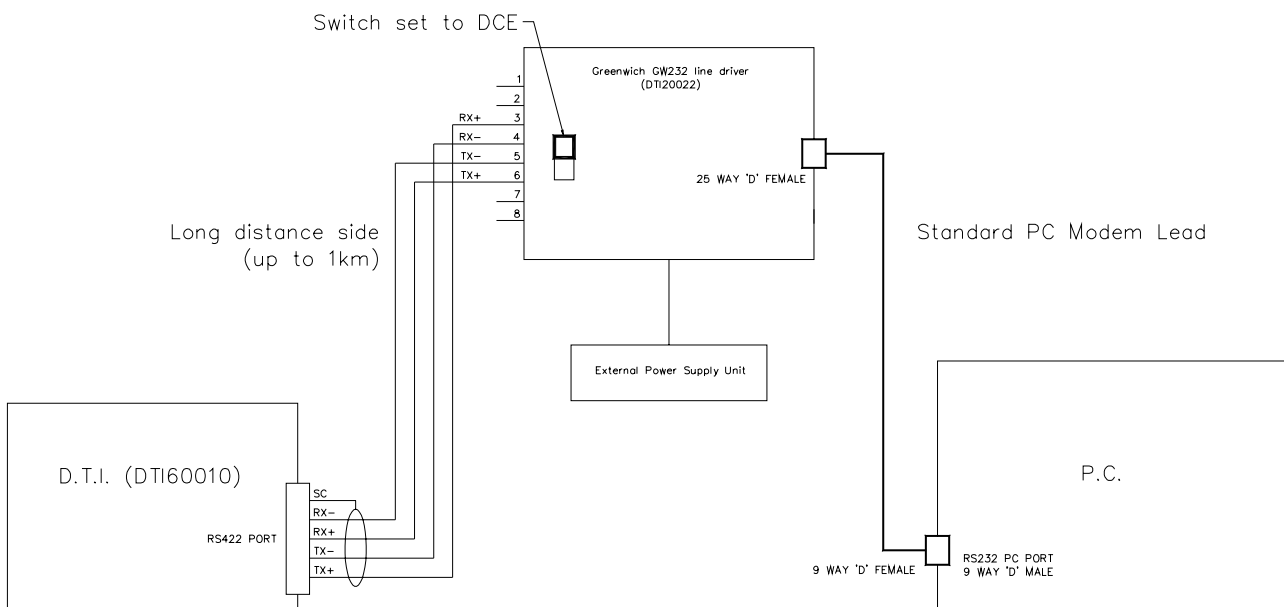
3. Power up.
4. Wait until the I/O transmit LED flashes (approx. 25 seconds)
5. Power off.
6. Set switches back to the required operational settings.
7. Power on unit.

6.13 DTI, PC AND MODEM INTERCONNECTIONS

Connection between PC and DTI MODEM

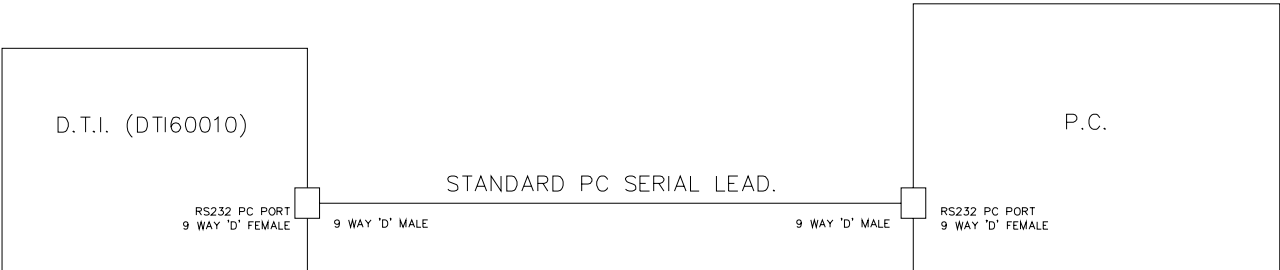


Connection between PC and DTI RS-422 port

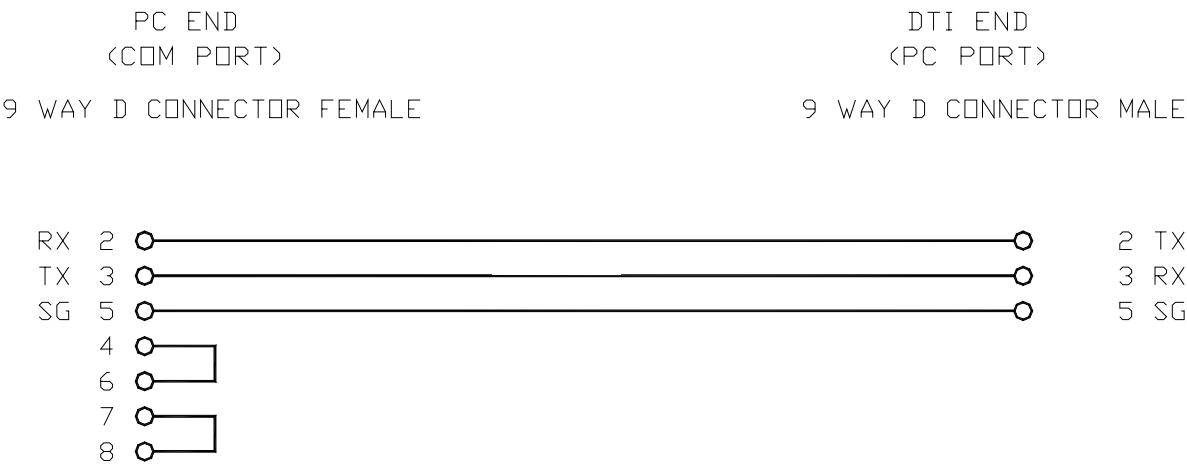


Example shown using line drive type
GW232F made by Greenwich Instruments
Limited.

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 & Benefits
- 6.14.2 Facia Layout and Internal Connections
- 6.14.3 Setup Configuration for direct connection to M.M. unit
- 6.14.4 Front Facia Layout with LED description
- 6.14.5 Fixing Holes & Dimensional Details
- 6.14.6 Wiring Connection 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

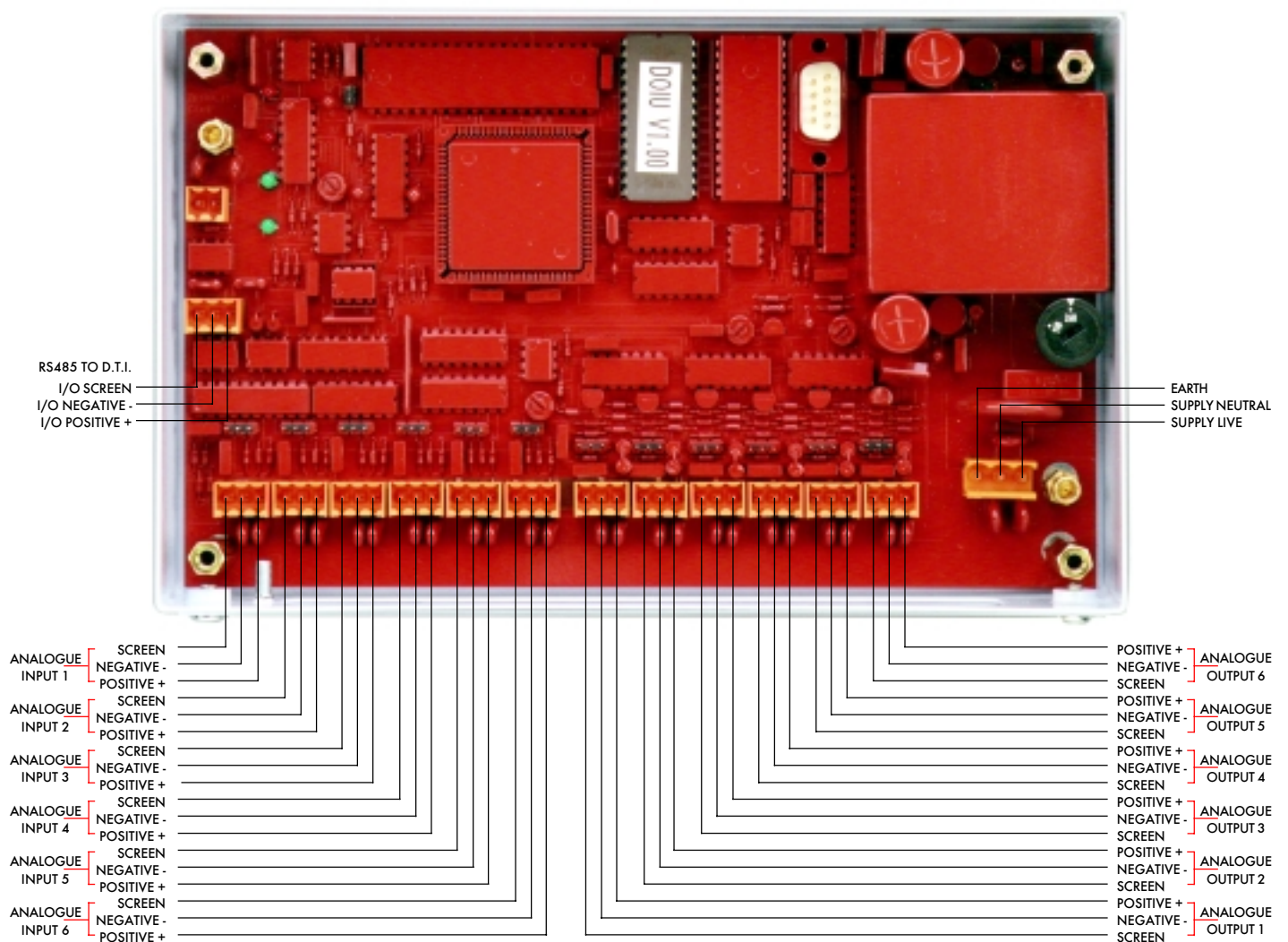
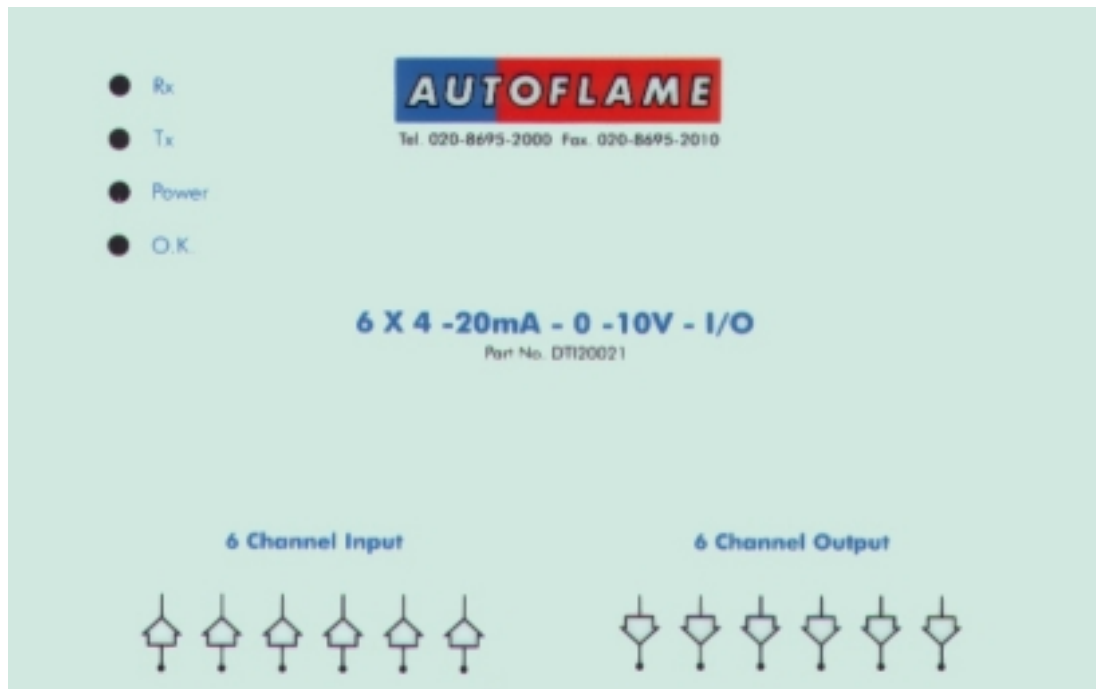
6.14.1 Introduction , Features and Benefits

This unit has 6 analogue inputs and 6 analogue outputs. Each analog input can be individually configured for 0-10 Volts, 0-20milliamps or 4-20 milliamps. Each analog output can be individually configured for 0-10 Volts or 4-20 milliamps. The unit is primarily for use with a Data Transfer Interface (DTI) unit. It can also be used in conjunction with most MM units to convert MM 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). Each analog input and output must also have a jumper set to select voltage or current operation.

When used with a DTI up to 10 analogue input/output units can be linked together. 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. However, in the vast majority of cases, these setups can be left as supplied. Refer to DTI manual for interconnections between the Analogue I/O unit & the DTI.

An external PSU is not required for the analogue outputs. The maximum permissible load on each analogue output is 250Ω. All the negative terminals are common to each other. The analogue outputs as a whole are isolated.

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. The appropriate link on the circuit board must be set for current/voltage. The link for each input is directly behind the 3 way terminal block.

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

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, the third to address 3. Conflicts will occur if addresses are not set correctly.

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 output 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 (ie 0-10 volts or 4-20 milliamps). After all 6 analog 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 MM when used directly with an Analogue I/O unit

If an analog I/O unit is connected directly to an MM to provide analog outputs, the first analogue input may be used to set the Required value. (Input channels 2 to 6 are of no relevance when the unit is used with an MM).

If the Required value is to be set by the channel 1 input then the following options/parameters should be set on the MM.

- Option 16 = 2
- Option 30 = lowest Required value
- Option 31 = highest Required value
- Option 33 = 1
- 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 for to set to 4800 <return> to proceed.

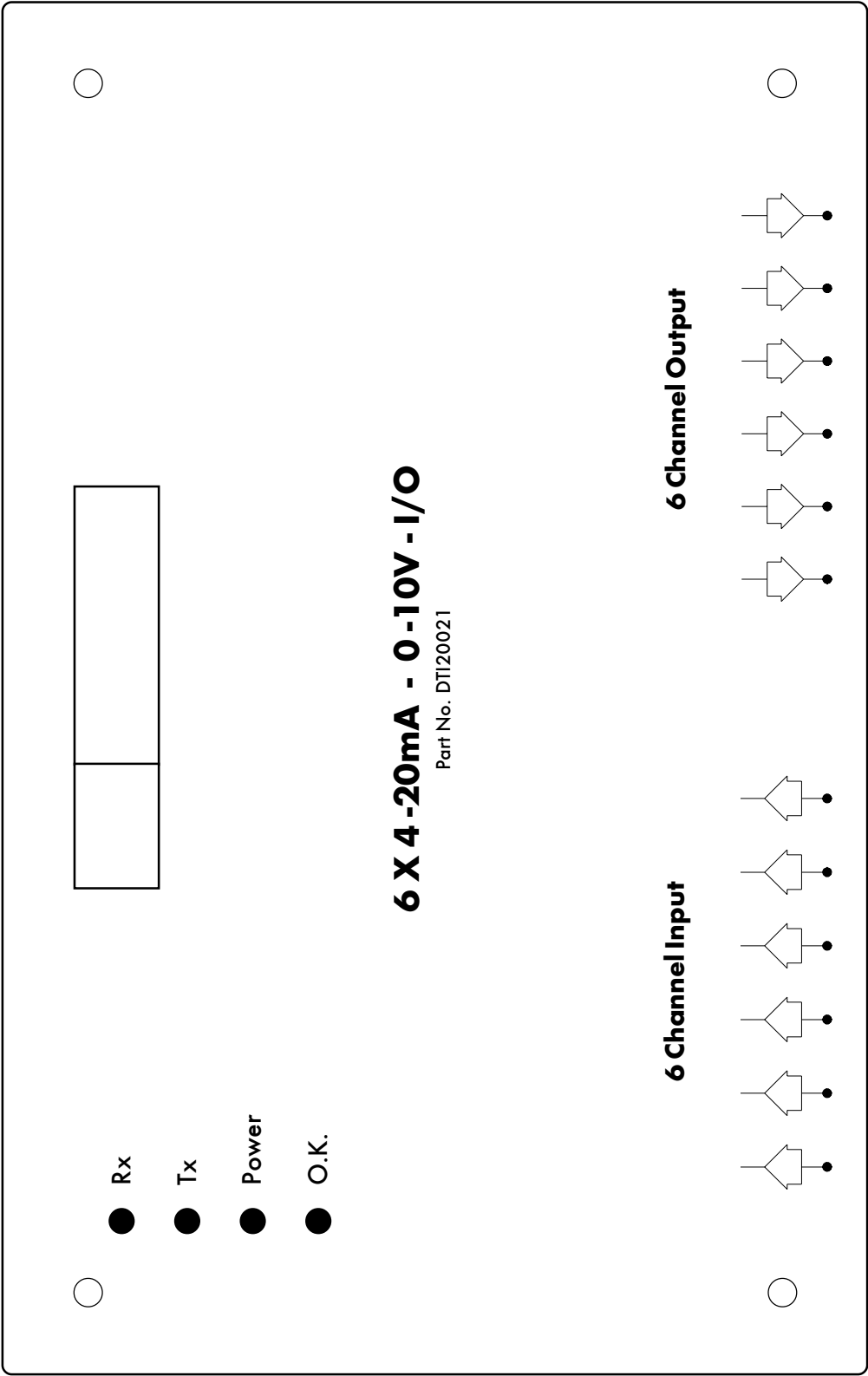
Also on the later versions the following text is displayed when not in set up mode.

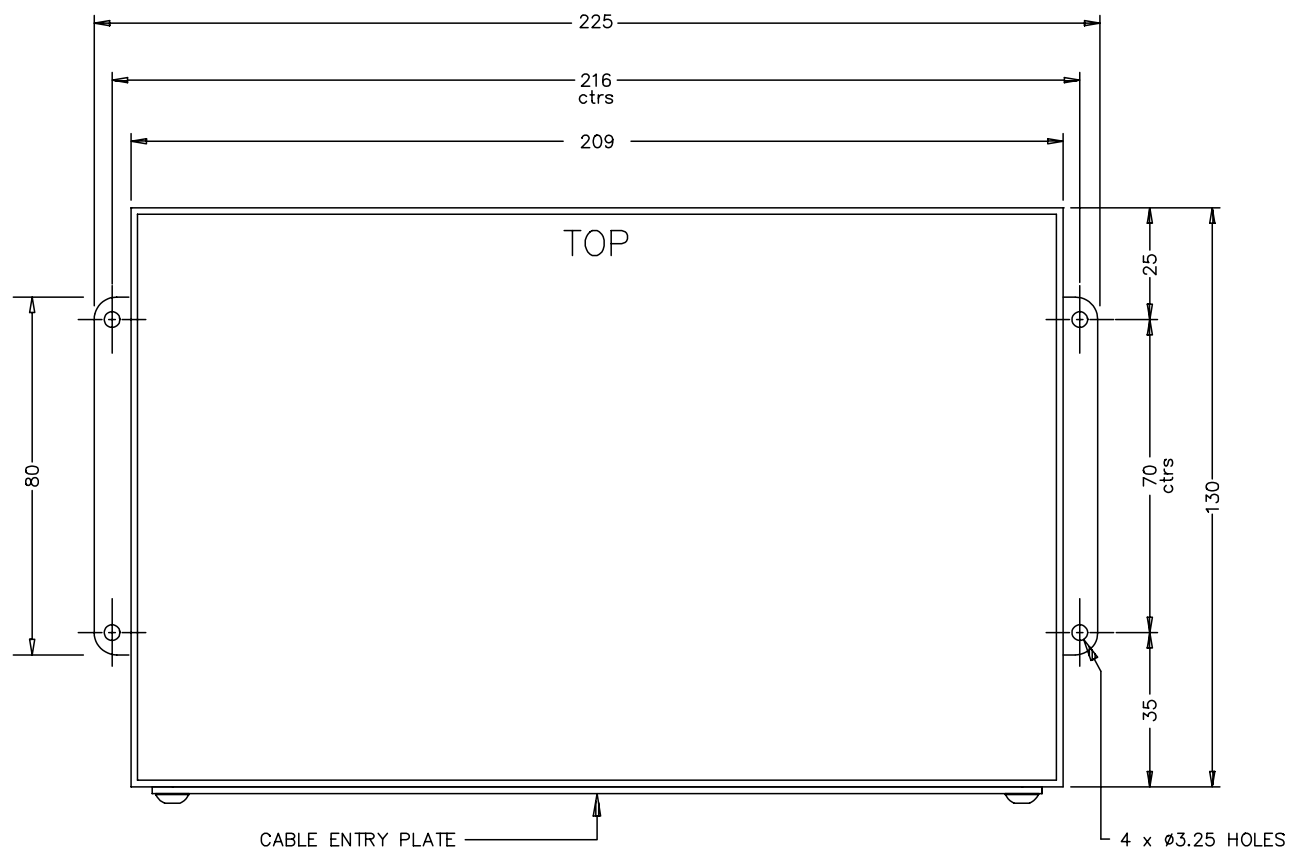
MM comms = nnn required value = nnn

MM comms increments each time the Analogue I/O unit receives data from the MM. Required value is the value that has been calculated for transmission back to the MM.

NB: Sequencing/D.T.I. and Analogue I/O unit cannot be used at the same time.

6.14.4 Front Facia Layout with LED Description



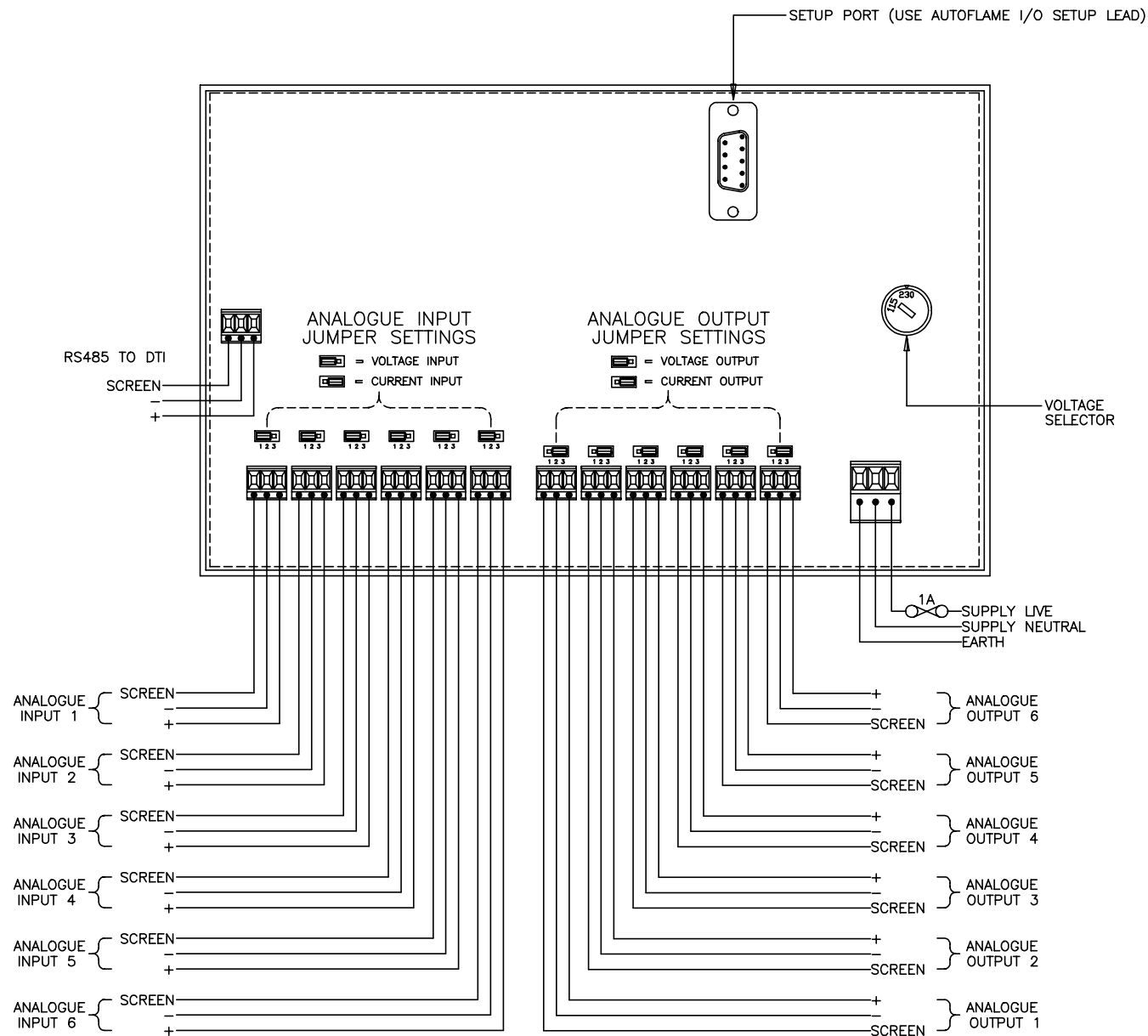
6.14.5 Fixing Holes & Dimensional Details

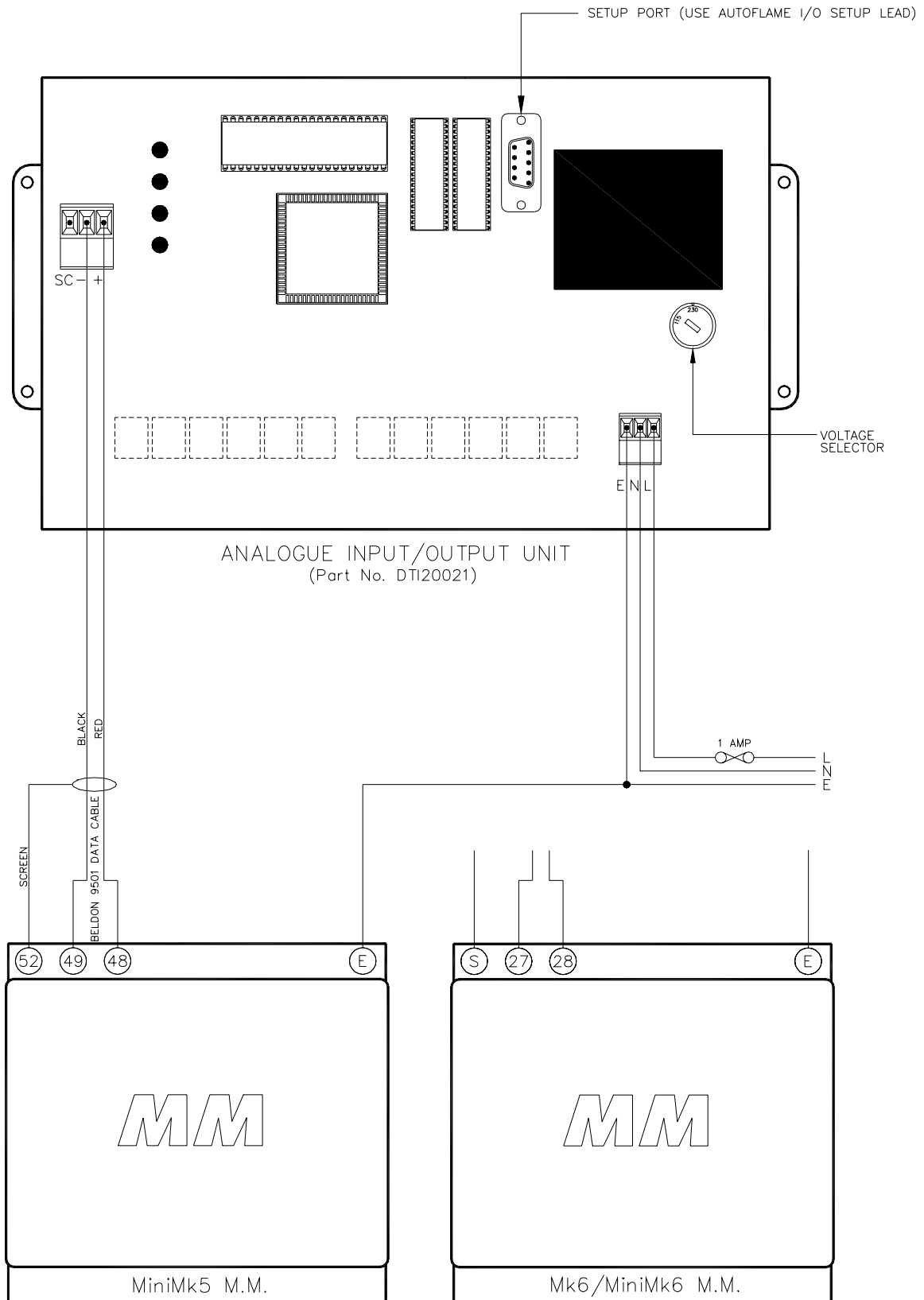
ALL DIMENSIONS IN MILLIMETRES

The depth of the unit is 38mm (1.5").

These units are back plate mounted not mounted on the front.

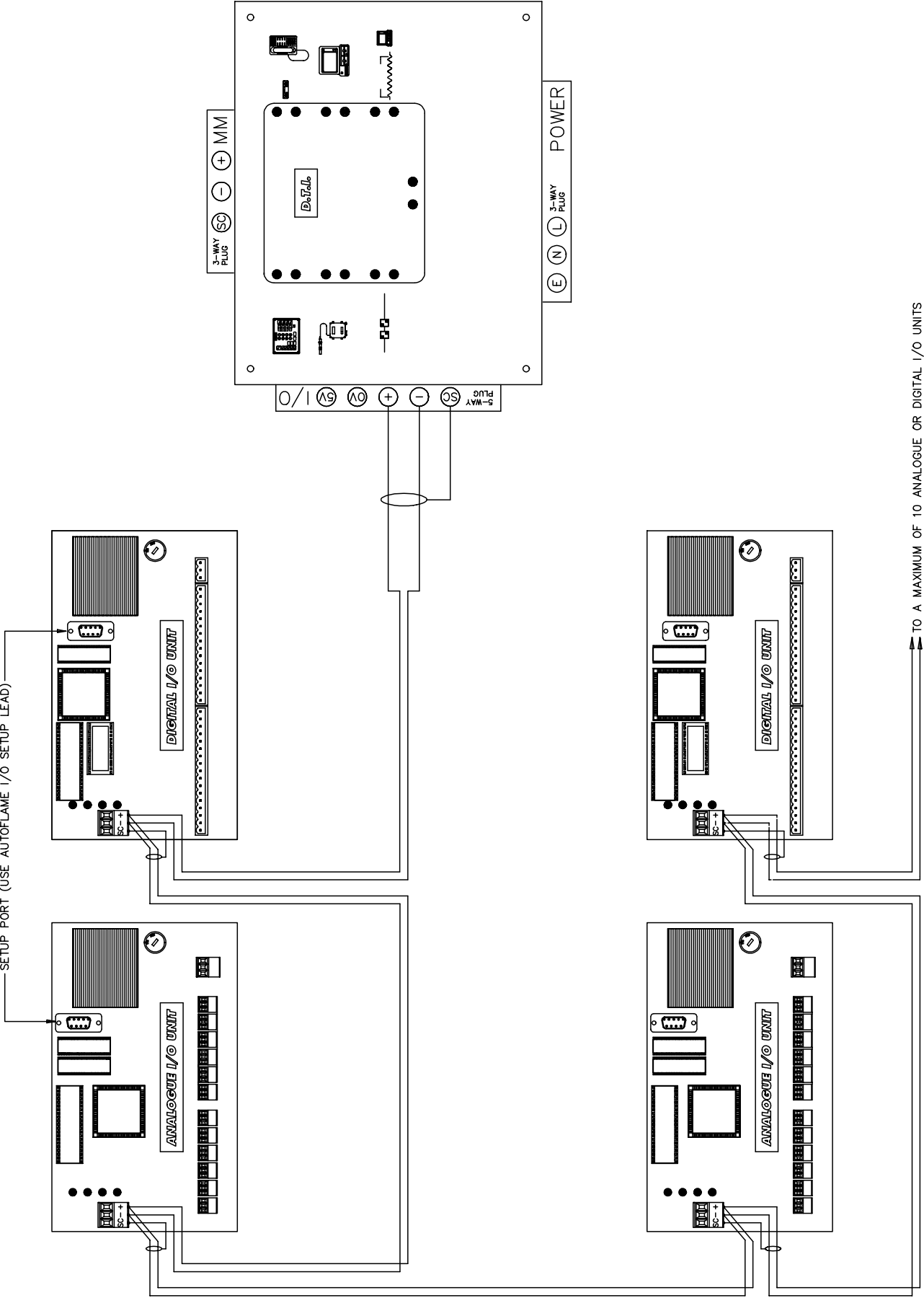
6.14.6 Wiring Connections Diagram



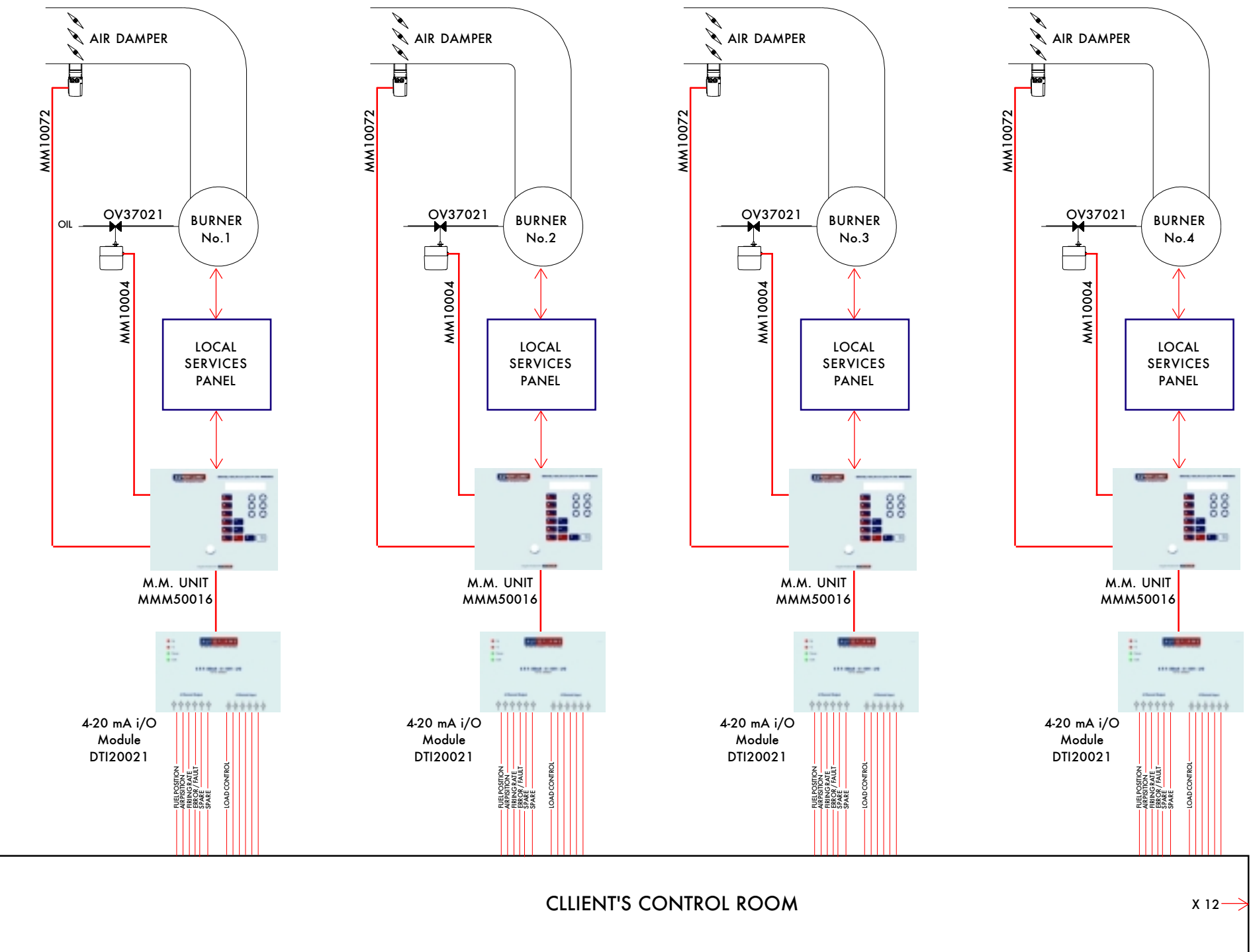
6.14.7 M.M. to Analogue Input/Output Unit Connection Diagram

16:10:99/4318/TF

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 & Benefits
- 6.15.2 Facia Layout and Internal Connections
- 6.15.3 Setup Configuration for direct connection to DTI unit only
- 6.15.4 Front Facia Layout with LED Description
- 6.15.5 Fixing Holes & dimensional Details
- 6.15.6 Wiring Connection Diagram
- 6.15.7 DTI to Digital Input/Output Unit Connection Diagram

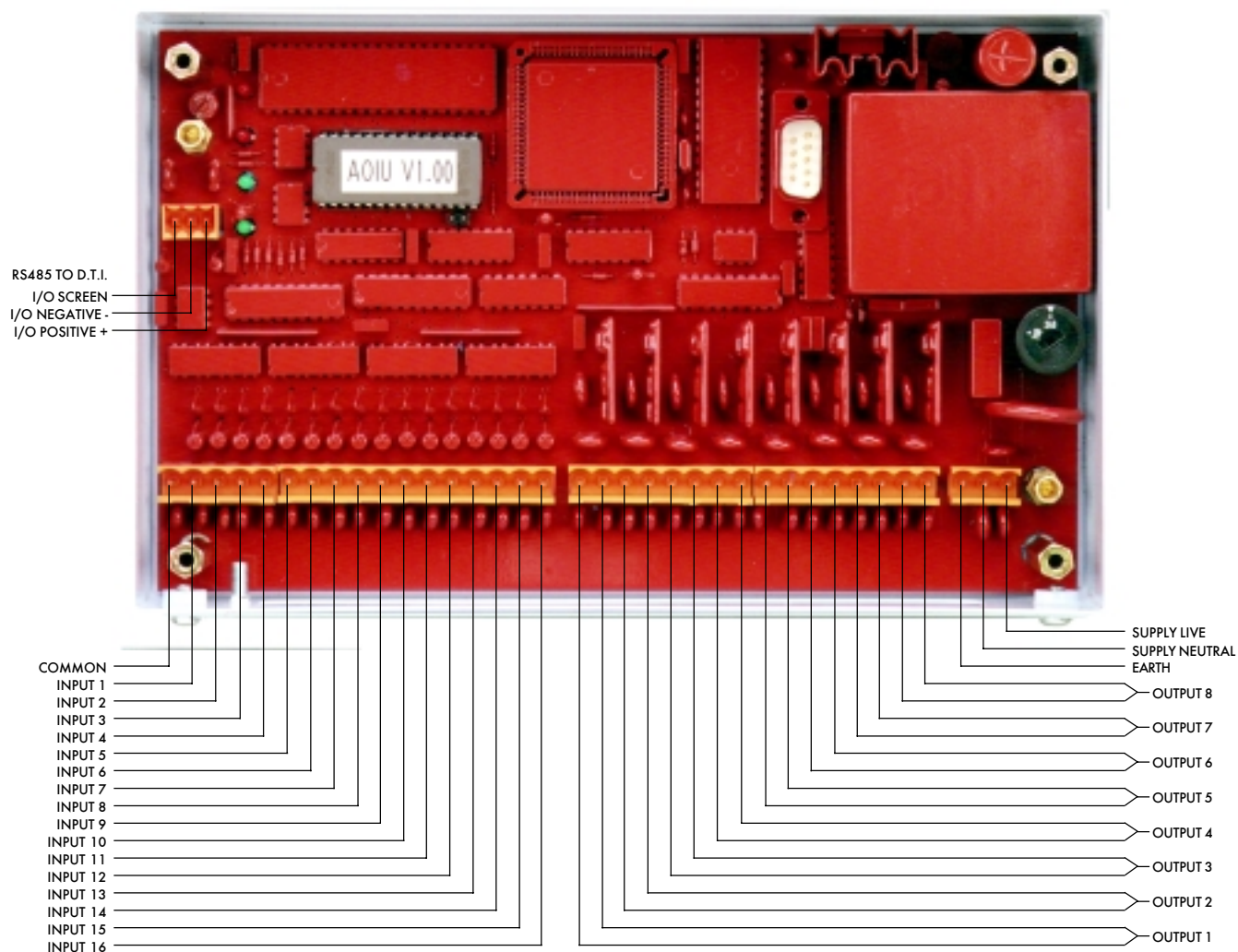
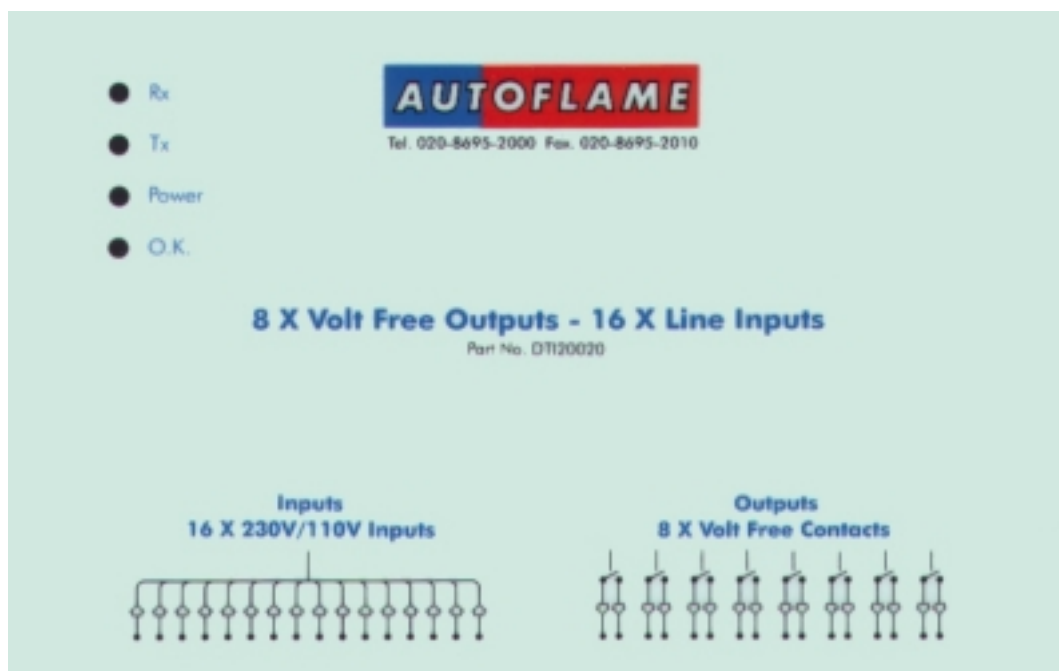
6.15.1 Introduction , Features and Benefits

This 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. Before operation the unit must be setup for operation by means of a serial port and a personal computer (emulating a terminal). A special lead supplied by Autoflame is required to connect the personal computer to the unit. 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.

Refer to DTI manual for interconnections between the Analogue 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 address 1, the second to address 2, 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

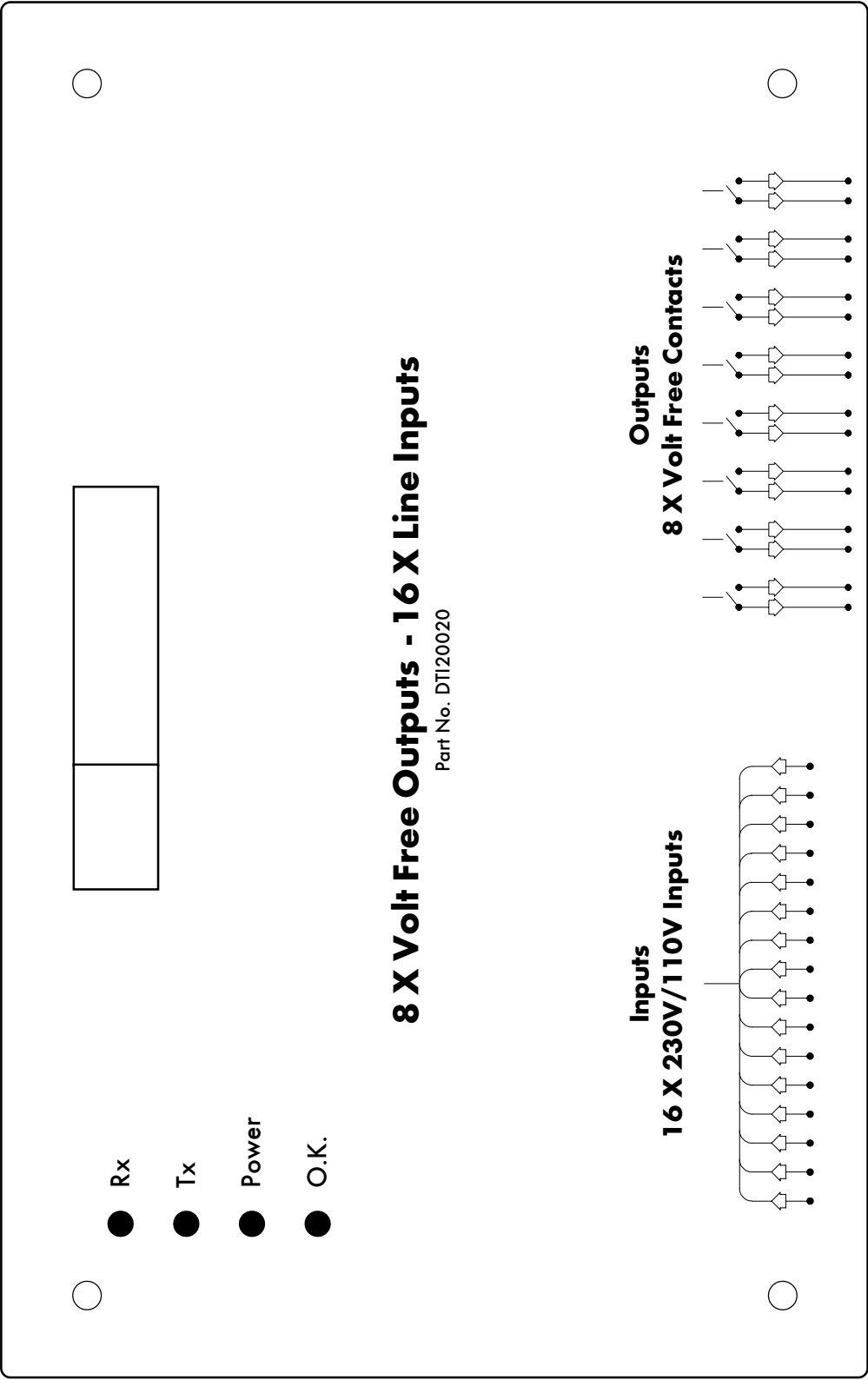
The label, M/A status and H/L status are repeated for all 16 inputs.

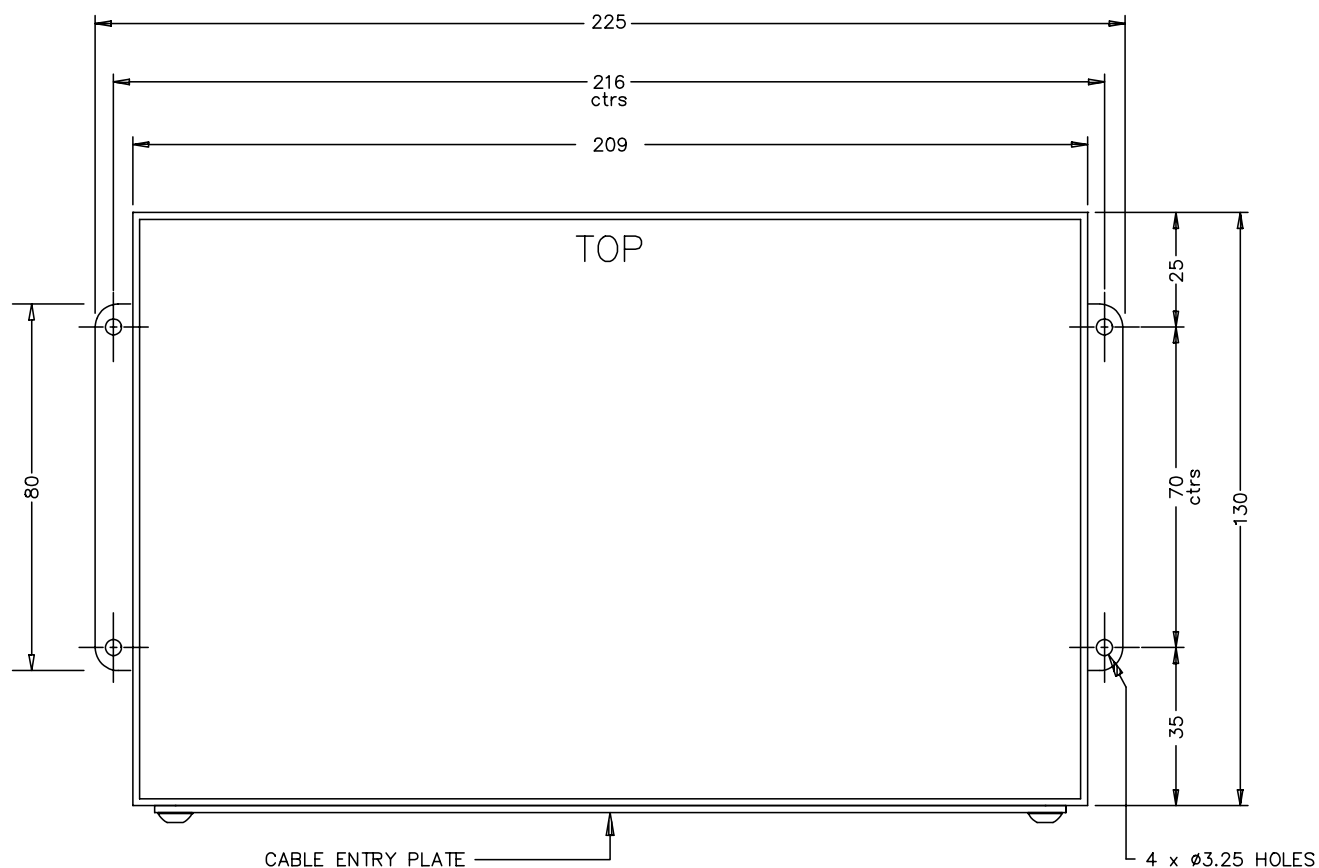
Output number 1:-**Present label : Digital Output 1****Enter new label :** Up to 30 alpha numeric characters can be used for the label.

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



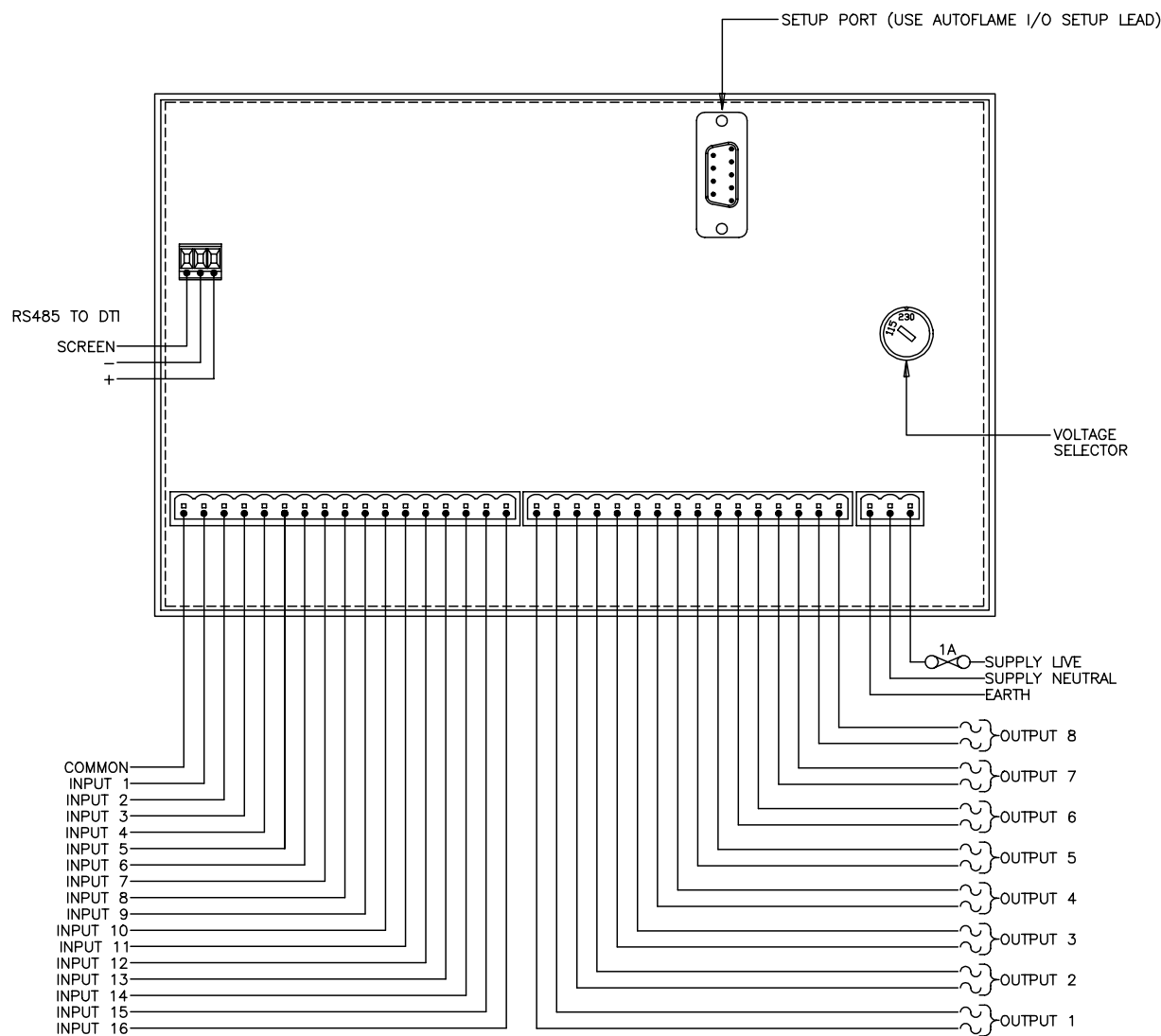
6.15.5 Fixing holes & Dimensional Details

ALL DIMENSIONS IN MILLIMETRES

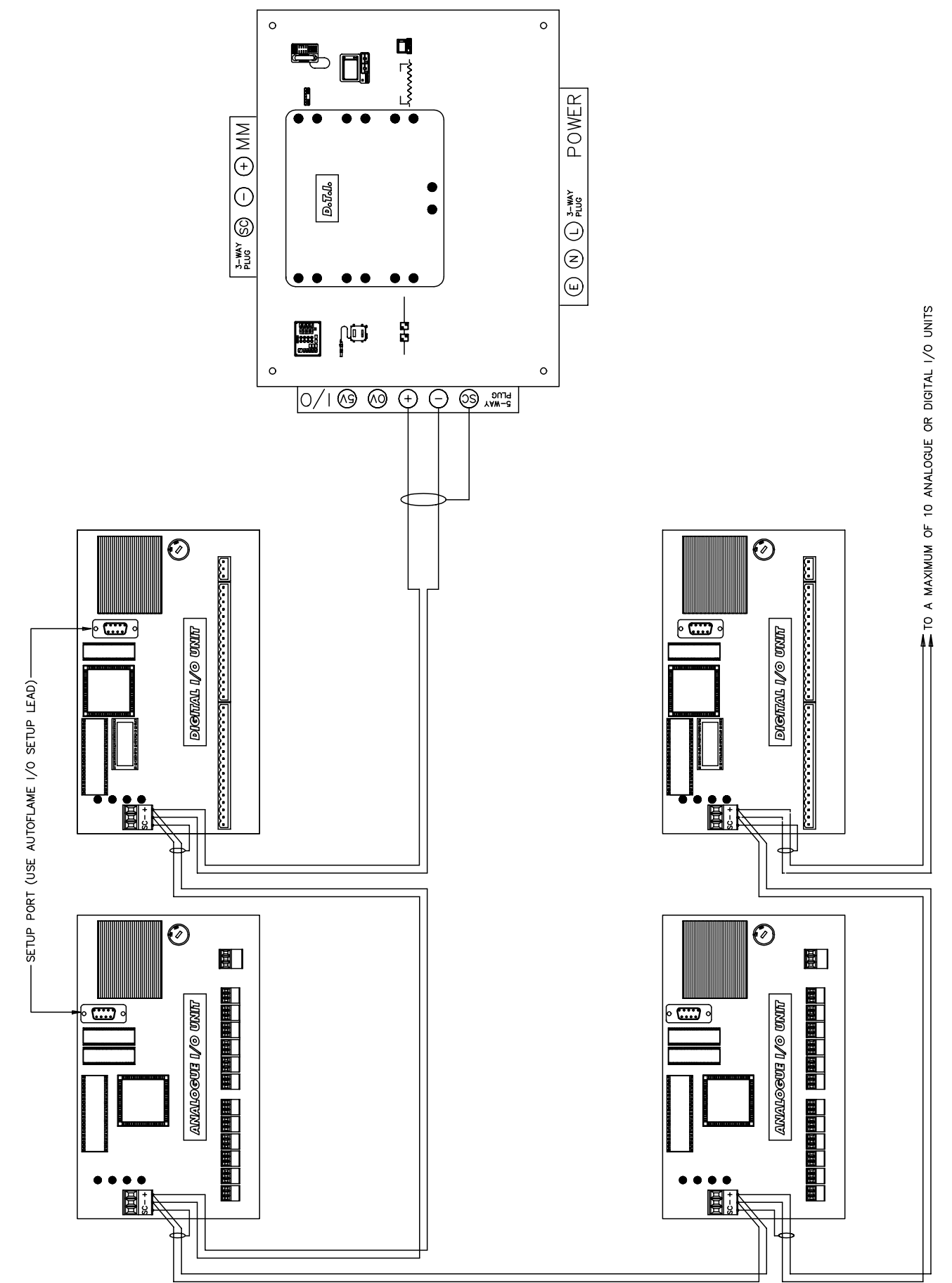
The depth of the unit is 38mm (1.5").

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
- 6.17.2 OX References - coils
 - 6.17.2.1 Enable/Disable commands for each M.M
 - 6.17.2.2 Digital Input/Output module outputs
- 6.17.3 1X References - Inputs
 - 6.17.3.1 Digital Input/Output module
 - 6.17.3.2 M.M. System
 - 6.17.3.3 E.G.A. System
 - 6.17.3.4 Online Offline Status
- 6.17.4 3X References - Input Registers
 - 6.17.4.1 Analogue Input/Output module
 - 6.17.4.2 M.M. System
 - 6.17.4.3 E.G.A. System
- 6.17.5 4X References - Holding Registers
 - 6.17.5.1 M.M. System
 - 6.17.5.2 Analogue Input/Output module outputs
- 6.17.6 PCB Switch Settings
- 6.17.7 Other Information
 - 6.17.7.1 Modbus Transmission Serial Port Settings
 - 6.17.7.2 Supported Commands
 - 6.17.7.3 Supported Exception Responses
 - 6.17.7.4 Serial Port Connections
- 6.17.8 Relevance of MM/EGA Data
- 6.17.9 Further Information

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 Modulation 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
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
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/lb 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/lb byte)	32008	32108	32208	32308	32408
Alarm status	32009	32109	32209	32309	32409
Level status	32010	32110	32210	32310	32410
WL version/Issue (ms/lb 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
	32022	32122	32222	32322	32422
Totalised steam lbs (lb 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 (lb 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

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/lb 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/lb byte)	32508	32608	32708	32808	32908
Alarm status	32509	32609	32709	32809	32909
Level status	32510	32610	32710	32810	32910
WL version/Issue (ms/lb 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
	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

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

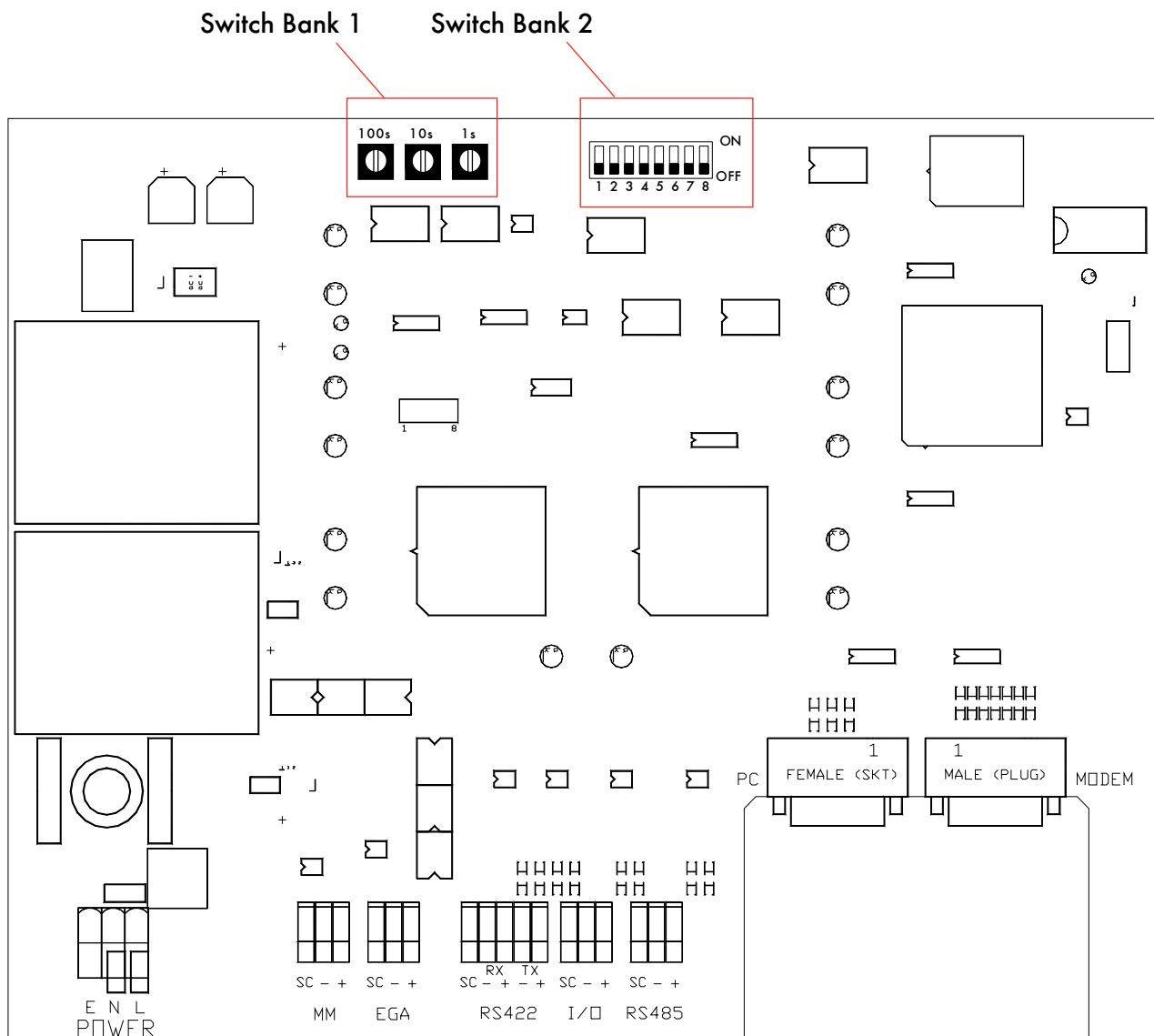
Reserved - DO NOT USE

40013 - 40016

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'	O - Off, 1 - On
Flow detector type	O - Temperature, 1 - Pressure
Optioned for flow metering	O - No, 1 - Yes
CO off/on on fuel 2 (fuel 1 CO always on)	O - Off, 1 - On
Temperature units	O - C, 1 - F
Pressure units	O - bar, 1 - psi
Optioned for voltage input modulation	O - No, 1 - Yes
Optioned for EGA	O - No, 1 - Yes
Boiler up to 'trimming' temperature	O - No, 1 - Yes
EGA cooler temperature ready	O - No, 1 - Yes
EGA ambient temperature OK	O - No, 1 - Yes
Optioned to display NO	O - No, 1 - Yes
Option to display SO	O - No, 1 - Yes
EGA ambient temperature low/high (relevant if bit 3 (ambient temperature) is O)	O - LOW, 1 - HIGH
Optioned for sequencing	O - NO, 1 - YES
Setpoint/Disable commands accepted	O - NO, 1 - YES
Hand operation status	O - Modulating, 1 - Hand Operation
Low flame hold status	O - Modulating 1 - Low Flame Hold
This MM controlling DTI bus communication	O - NO, 1 - YES
Input 41 set (lead boiler select)	O - 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
19-26	Indicates burner firing status
	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 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 indicated transmission is direct from EGA)
0-3	Sequencing command status for this boiler
	Sequence state
	0 - ON
	1 - STANDBY
	2 - WARM
	3 - OFF
0-250	Maximum firing rate - just the number entered in option 34
0-999	Actual value of boiler flow temperature - degrees C
0.0-99.9	(Pressure Bar)
0-999	Desired value of boiler flow temperature - degrees C
0.0-99.9	(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
	0 - System is OK
	1 - N system shut down
	Value is as MM ERR display
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	Actual value NO
0-999	Actual value SO2
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	Commission value NO
0-999	Commission value SO2
0-N	EGA error code normal - 0 any other value is 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

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

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	Commission 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 feedback signal error
92	Air pressure outside limits
100	Twin burner communications failed

D.T.I. Data Transfer Interface

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	Code	Lockout Message
1	CPI wrong state	27	Watchdog fail 2c
2	No air proving	28	Watchdog fail 2d
3	Ignition output fault	29	Input faulty
4	Motor output fault	30	Gas sensor error
5	Start gas output fault	31	Air sensor error
6	Main gas output 1 fault	32	Low gas pressure
7	Main gas output 2 fault	33	VPS air zeroing fail
8	Vent valve output fault	34	VPS gas pressure low
9	Fail safe relay fault	35	UV short circuit
10	Simulated flame	36	Oil pressure too low
11	VPS air proving fail	37	Oil pressure too high
12	VPS gas proving fail	38	CPU test failed
13	No flame signal	39	Freeze timeout
14	Shutter fault	40	Purge air pressure low
15	No cpi reset	41	Option 141 incorrect
16	Lockout permanently active	42	Terminal 86 inverse
17	Gas pressure too low	43	Terminal 85-86 fault
18	Gas pressure too high	44	Prove cct fail
19	RAM test failed	45	No prove cct set
20	PROM test failed	46	No prove cct reset
21	Watchdog fault 1a	198	BC input short
22	Watchdog fault 1b	199	Lockout 199
23	Watchdog fault 1c	200	
24	Watchdog fault 1d	201	Lockout 201
25	Watchdog fail 2a	202	EEPROM faulty
26	Watchdog fail 2b		

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 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.

Software Installation

To install WinPCDTI to your computer, follow the instructions supplied with the diskettes.

During the installation, you will be prompted for your serial number. This is the four part code printed on one side of your dongle, e.g. DTI-1111-AAAA-1111.

The dongle must be attached to your PC for WinPCDTI to operate. The first time the program is run, the Welcome screen prompts the user to select the mode of operation, either Plant Manager or Plant Supervisor. You will need to specify which serial port you are using (COM1/COM2).

Section 6.19: Johnson Metasys Interface Index

- 6.19.1 Overview
- 6.19.2 Connecting the DTI to Metasys
- 6.19.3 Network Point Table
 - 6.19.3.1 First 10 addresses (MM/EGA units)
 - 6.19.3.2 Eleventh address (I/O units)

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 Analog and/or Digital units. This section details information regarding the Data Transfer Interface (DTI) 'Metasys' interface.

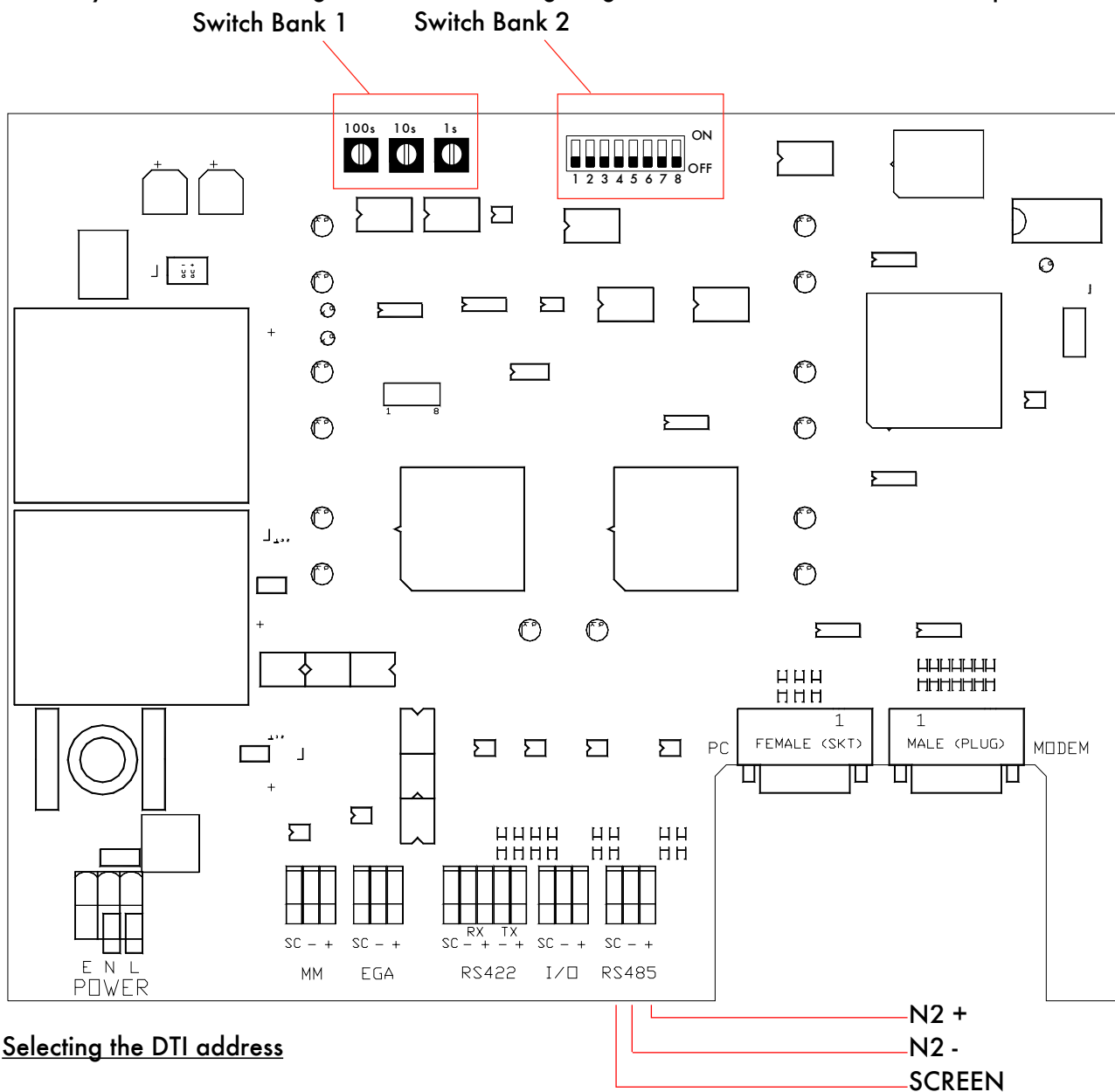
6.19.1.2 **Requirements**

Compatible software versions are:

DTI unit (DTI20010)	Serial number 095132 onwards
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.



Selecting the DTI address

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:

$$\begin{aligned} 100s &= 1 \\ 10s &= 2 \\ 1s &= 3 \end{aligned}$$

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) address on the network. The first 10 address are used to read data from the 10 MM/EGA systems. The last address is used to read and write data to the analog and digital units. This address is also used to read the status of MM/EGA systems and write values to them. To summarize the first 10 addresses are read only and are only used for the MM/EGA's. The last (eleventh) address is used to read and write values to both the analog and digital units as well as the MM's. All of the systems addresses implement internal integer and byte values only. A full network point table follows.

Technical Note

Please be aware that the Change of State feature is not implemented on the DTI/Metasys interface. Therefore, normal Metasys COS (Alarm Limits for analog 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 as the Associated In
- 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.

Analog/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 valves 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	

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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

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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

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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		

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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 1 Version/Issue		ms/l's 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/l's byte
ADF	129		Alarm Status		0 - OK 1 - High Water 2 - 1 st Low 3 - 2 nd Low
ADF	130		Level Status		As Alarm Status just above
ADF	131		WL Version/Issue		ms/l's byte
ADF	132		Alarm Code		0-OK 1-2 nd 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-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 18-1 st Low 19-High Water 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		

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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		

D.T.I. Data Transfer Interface

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 valves 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	

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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.)

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	100		Gas Pressure Coding	8 Bit Pattern	Bit ₀ = 0 = off 1 = on Bit ₁ : Bit ₂ = 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 ₄ = unused Bit ₅ = unused Bit ₆ = 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 1 Version/Issue	U integer	ms/l's 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/l's byte
ADI	129		Alarm Status	U integer	0 - OK 1 - High Water 2 - 1 st Low 3 - 2 nd Low
ADI	130		Level Status	U integer	As Alarm Status just above
ADI	131		WL Version/Issue	U integer	ms/l's byte

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
ADI	132		Alarm Code	U integer	0-OK 1-2 nd 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-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 18-1 st 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.

D.T.I. Data Transfer Interface

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		°C or °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		

D.T.I. Data Transfer Interface

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		

D.T.I. Data Transfer Interface

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.

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

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		

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD _{READ}	01		Digital unit 1 input 1	0 or 1	see digital unit setup
BD _{READ}	02		Digital unit 1 input 2	0 or 1	see digital unit setup
BD _{READ}	03		Digital unit 1 input 3	0 or 1	see digital unit setup
BD _{READ}	04		Digital unit 1 input 4	0 or 1	see digital unit setup
BD _{READ}	05		Digital unit 1 input 5	0 or 1	see digital unit setup
BD _{READ}	06		Digital unit 1 input 6	0 or 1	see digital unit setup
BD _{READ}	07		Digital unit 1 input 7	0 or 1	see digital unit setup
BD _{READ}	08		Digital unit 1 input 8	0 or 1	see digital unit setup
BD _{READ}	09		Digital unit 1 input 9	0 or 1	see digital unit setup
BD _{READ}	10		Digital unit 1 input 10	0 or 1	see digital unit setup
BD _{READ}	11		Digital unit 1 input 11	0 or 1	see digital unit setup
BD _{READ}	12		Digital unit 1 input 12	0 or 1	see digital unit setup
BD _{READ}	13		Digital unit 1 input 13	0 or 1	see digital unit setup
BD _{READ}	14		Digital unit 1 input 14	0 or 1	see digital unit setup
BD _{READ}	15		Digital unit 1 input 15	0 or 1	see digital unit setup
BD _{READ}	16		Digital unit 1 input 16	0 or 1	see digital unit setup
BD _{READ}	17		Digital unit 2 input 1	0 or 1	see digital unit setup
BD _{READ}	18		Digital unit 2 input 2	0 or 1	see digital unit setup
BD _{READ}	19		Digital unit 2 input 3	0 or 1	see digital unit setup
BD _{READ}	20		Digital unit 2 input 4	0 or 1	see digital unit setup
BD _{READ}	21		Digital unit 2 input 5	0 or 1	see digital unit setup
BD _{READ}	22		Digital unit 2 input 6	0 or 1	see digital unit setup
BD _{READ}	23		Digital unit 2 input 7	0 or 1	see digital unit setup
BD _{READ}	24		Digital unit 2 input 8	0 or 1	see digital unit setup
BD _{READ}	25		Digital unit 2 input 9	0 or 1	see digital unit setup
BD _{READ}	26		Digital unit 2 input 10	0 or 1	see digital unit setup
BD _{READ}	27		Digital unit 2 input 11	0 or 1	see digital unit setup
BD _{READ}	28		Digital unit 2 input 12	0 or 1	see digital unit setup
BD _{READ}	29		Digital unit 2 input 13	0 or 1	see digital unit setup
BD _{READ}	30		Digital unit 2 input 14	0 or 1	see digital unit setup
BD _{READ}	31		Digital unit 2 input 15	0 or 1	see digital unit setup
BD _{READ}	32		Digital unit 2 input 16	0 or 1	see digital unit setup
BD _{READ}	33		Digital unit 3 input 1	0 or 1	see digital unit setup
BD _{READ}	34		Digital unit 3 input 2	0 or 1	see digital unit setup
BD _{READ}	35		Digital unit 3 input 3	0 or 1	see digital unit setup
BD _{READ}	36		Digital unit 3 input 4	0 or 1	see digital unit setup
BD _{READ}	37		Digital unit 3 input 5	0 or 1	see digital unit setup
BD _{READ}	38		Digital unit 3 input 6	0 or 1	see digital unit setup
BD _{READ}	39		Digital unit 3 input 7	0 or 1	see digital unit setup
BD _{READ}	40		Digital unit 3 input 8	0 or 1	see digital unit setup
BD _{READ}	41		Digital unit 3 input 9	0 or 1	see digital unit setup
BD _{READ}	42		Digital unit 3 input 10	0 or 1	see digital unit setup
BD _{READ}	43		Digital unit 3 input 11	0 or 1	see digital unit setup
BD _{READ}	44		Digital unit 3 input 12	0 or 1	see digital unit setup
BD _{READ}	45		Digital unit 3 input 13	0 or 1	see digital unit setup
BD _{READ}	46		Digital unit 3 input 14	0 or 1	see digital unit setup
BD _{READ}	47		Digital unit 3 input 15	0 or 1	see digital unit setup
BD _{READ}	48		Digital unit 3 input 16	0 or 1	see digital unit setup
BD _{READ}	49		Digital unit 4 input 1	0 or 1	see digital unit setup
BD _{READ}	50		Digital unit 4 input 2	0 or 1	see digital unit setup
BD _{READ}	51		Digital unit 4 input 3	0 or 1	see digital unit setup
BD _{READ}	52		Digital unit 4 input 4	0 or 1	see digital unit setup
BD _{READ}	53		Digital unit 4 input 5	0 or 1	see digital unit setup

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD _{READ}	161		MM 1 on/off line status	0 = off line 1 = on line	
BD _{READ}	162		MM 2 on/off line status	0 = off line 1 = on line	
BD _{READ}	163		MM 3 on/off line status	0 = off line 1 = on line	
BD _{READ}	164		MM 4 on/off line status	0 = off line 1 = on line	
BD _{READ}	165		MM 5 on/off line status	0 = off line 1 = on line	
BD _{READ}	166		MM 6 on/off line status	0 = off line 1 = on line	
BD _{READ}	167		MM 7 on/off line status	0 = off line 1 = on line	
BD _{READ}	168		MM 8 on/off line status	0 = off line 1 = on line	
BD _{READ}	169		MM 9 on/off line status	0 = off line 1 = on line	
BD _{READ}	170		MM 10 on/off line status	0 = off line 1 = on line	
BD _{READ}	171- 192		Not used		
BD _{READ}	193		Digital unit 1 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	194		Digital unit 2 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	195		Digital unit 3 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	196		Digital unit 4 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	197		Digital unit 5 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	198		Digital unit 6 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	199		Digital unit 7 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	200		Digital unit 8 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	201		Digital unit 9 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	202		Digital unit 10 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	203		Not used		
BD _{READ}	204		Not used		
BD _{READ}	205		Not used		
BD _{READ}	206		Not used		
BD _{READ}	207		Not used		
BD _{READ}	208		Not used		
BD _{READ}	209		Analog unit 1 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	210		Analog unit 2 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	211		Analog unit 3 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	212		Analog unit 4 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	213		Analog unit 5 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	214		Analog unit 6 on/off line status	0 = off line 1 = on line	read only

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD _{READ}	215		Analog unit 7 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	216		Analog unit 8 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	217		Analog unit 9 on/off line status	0 = off line 1 = on line	read only
BD _{READ}	218		Analog unit 10 on/off line status	0 = off line 1 = on line	read only

D.T.I. Data Transfer Interface

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

D.T.I. Data Transfer Interface

NPT	NPA	UNITS	DESCRIPTION	RANGE	NOTE
BD _{WRITE}	46		Digital unit 4 output 6	0 = off, 1 = on	write only
BD _{WRITE}	47		Digital unit 4 output 7	0 = off, 1 = on	write only
BD _{WRITE}	48		Digital unit 4 output 8	0 = off, 1 = on	write only
BD _{WRITE}	49		Digital unit 5 output 1	0 = off, 1 = on	write only
BD _{WRITE}	50		Digital unit 5 output 2	0 = off, 1 = on	write only
BD _{WRITE}	51		Digital unit 5 output 3	0 = off, 1 = on	write only
BD _{WRITE}	52		Digital unit 5 output 4	0 = off, 1 = on	write only
BD _{WRITE}	53		Digital unit 5 output 5	0 = off, 1 = on	write only
BD _{WRITE}	54		Digital unit 5 output 6	0 = off, 1 = on	write only
BD _{WRITE}	55		Digital unit 5 output 7	0 = off, 1 = on	write only
BD _{WRITE}	56		Digital unit 5 output 8	0 = off, 1 = on	write only
BD _{WRITE}	57		Digital unit 6 output 1	0 = off, 1 = on	write only
BD _{WRITE}	58		Digital unit 6 output 2	0 = off, 1 = on	write only
BD _{WRITE}	59		Digital unit 6 output 3	0 = off, 1 = on	write only
BD _{WRITE}	60		Digital unit 6 output 4	0 = off, 1 = on	write only
BD _{WRITE}	61		Digital unit 6 output 5	0 = off, 1 = on	write only
BD _{WRITE}	62		Digital unit 6 output 6	0 = off, 1 = on	write only
BD _{WRITE}	63		Digital unit 6 output 7	0 = off, 1 = on	write only
BD _{WRITE}	64		Digital unit 6 output 8	0 = off, 1 = on	write only
BD _{WRITE}	65		Digital unit 7 output 1	0 = off, 1 = on	write only
BD _{WRITE}	66		Digital unit 7 output 2	0 = off, 1 = on	write only
BD _{WRITE}	67		Digital unit 7 output 3	0 = off, 1 = on	write only
BD _{WRITE}	68		Digital unit 7 output 4	0 = off, 1 = on	write only
BD _{WRITE}	69		Digital unit 7 output 5	0 = off, 1 = on	write only
BD _{WRITE}	70		Digital unit 7 output 6	0 = off, 1 = on	write only
BD _{WRITE}	71		Digital unit 7 output 7	0 = off, 1 = on	write only
BD _{WRITE}	72		Digital unit 7 output 8	0 = off, 1 = on	write only
BD _{WRITE}	73		Digital unit 8 output 1	0 = off, 1 = on	write only
BD _{WRITE}	74		Digital unit 8 output 2	0 = off, 1 = on	write only
BD _{WRITE}	75		Digital unit 8 output 3	0 = off, 1 = on	write only
BD _{WRITE}	76		Digital unit 8 output 4	0 = off, 1 = on	write only
BD _{WRITE}	77		Digital unit 8 output 5	0 = off, 1 = on	write only
BD _{WRITE}	78		Digital unit 8 output 6	0 = off, 1 = on	write only
BD _{WRITE}	79		Digital unit 8 output 7	0 = off, 1 = on	write only
BD _{WRITE}	80		Digital unit 8 output 8	0 = off, 1 = on	write only
BD _{WRITE}	81		Digital unit 9 output 1	0 = off, 1 = on	write only
BD _{WRITE}	82		Digital unit 9 output 2	0 = off, 1 = on	write only
BD _{WRITE}	83		Digital unit 9 output 3	0 = off, 1 = on	write only
BD _{WRITE}	84		Digital unit 9 output 4	0 = off, 1 = on	write only
BD _{WRITE}	85		Digital unit 9 output 5	0 = off, 1 = on	write only
BD _{WRITE}	86		Digital unit 9 output 6	0 = off, 1 = on	write only
BD _{WRITE}	87		Digital unit 9 output 7	0 = off, 1 = on	write only
BD _{WRITE}	88		Digital unit 9 output 8	0 = off, 1 = on	write only
BD _{WRITE}	89		Digital unit 10 output 1	0 = off, 1 = on	write only
BD _{WRITE}	90		Digital unit 10 output 2	0 = off, 1 = on	write only
BD _{WRITE}	91		Digital unit 10 output 3	0 = off, 1 = on	write only
BD _{WRITE}	92		Digital unit 10 output 4	0 = off, 1 = on	write only
BD _{WRITE}	93		Digital unit 10 output 5	0 = off, 1 = on	write only
BD _{WRITE}	94		Digital unit 10 output 6	0 = off, 1 = on	write only
BD _{WRITE}	95		Digital unit 10 output 7	0 = off, 1 = on	write only
BD _{WRITE}	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 RS-232 PC port and the RS-422 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 Hyperterminal (hypertrm.exe) which is included with Windows.

The communications settings should be as follows:

Bits per second: 9600

Data bits: 8

Parity: none

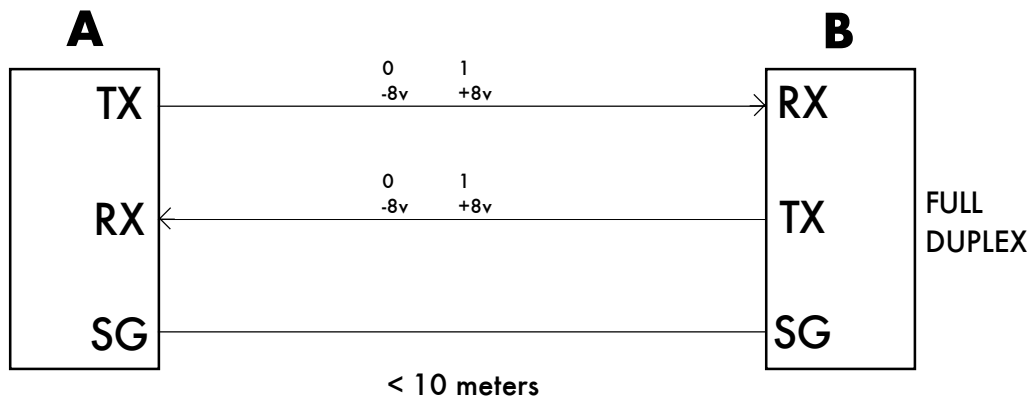
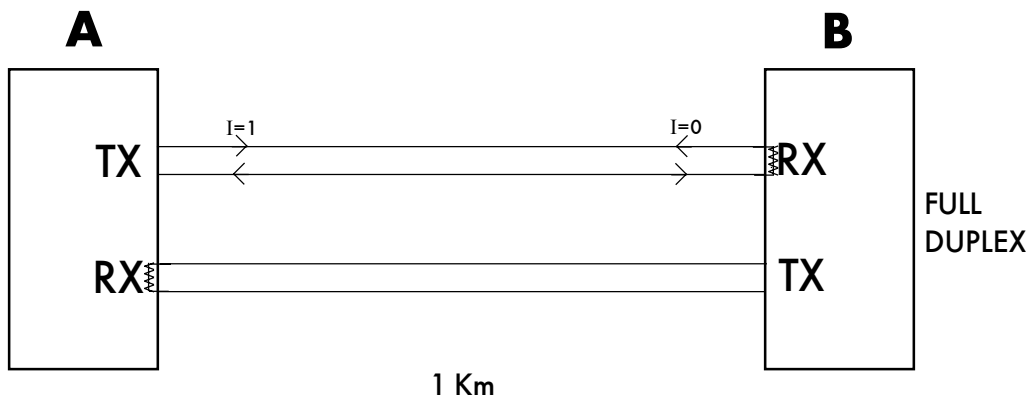
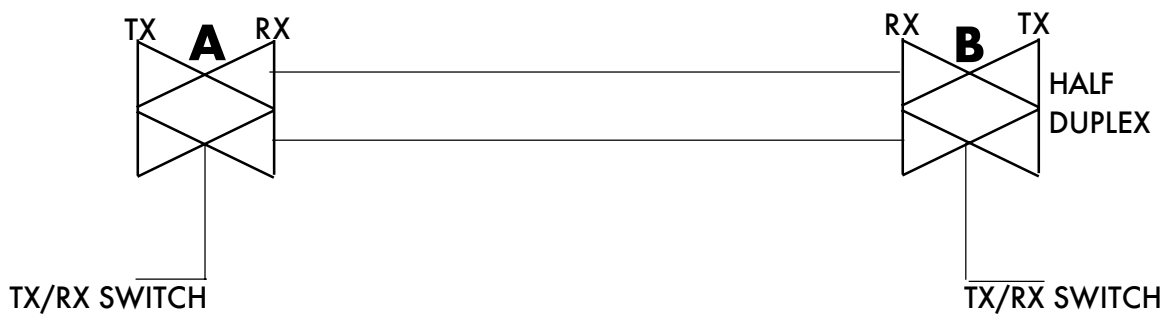
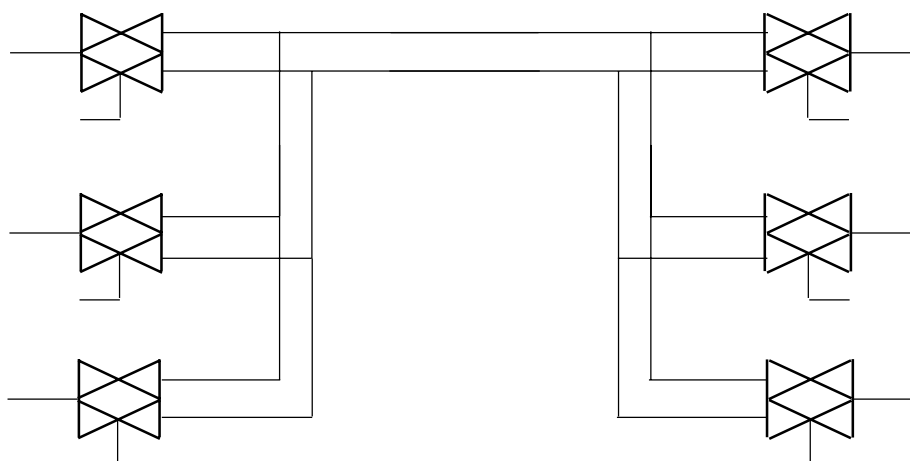
Stop bits: 1

Flow control: None (i.e. no hardware or software flow control)

Full duplex.

6.20.2 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 Pressure Jet/Gun Type Burners
- 7.2 Rotary Burners
 - 7.2.1 Diagram showing System with Rotary Burner
- 7.3 Flue Gas Recirculation Control (NO_x).
- 7.4 Steam Generator Feed Water Control
- 7.5 Water Injection
- 7.7 System Configurations
 - 7.7.1 Mk.6 EVO MM/EGA System Schematic
 - 7.7.2 Mini Mk.6 MM/EGA System Schematic
 - 7.7.3 Mini Mk.5 EVO MM/EGA System Schematic

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 four 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 output to ± 1 degree C. (± 2 degrees F.) or ± 1.5 psi via the PID controller, eliminating the wastage or pressure higher than required.
- d.) No compromise required when changing between fuels since the air/fuel ratio for each are completely separate.

7.2 APPLICATION POSSIBILITIES FOR M.M. /E.G.A. SYSTEM

Rotary Burners

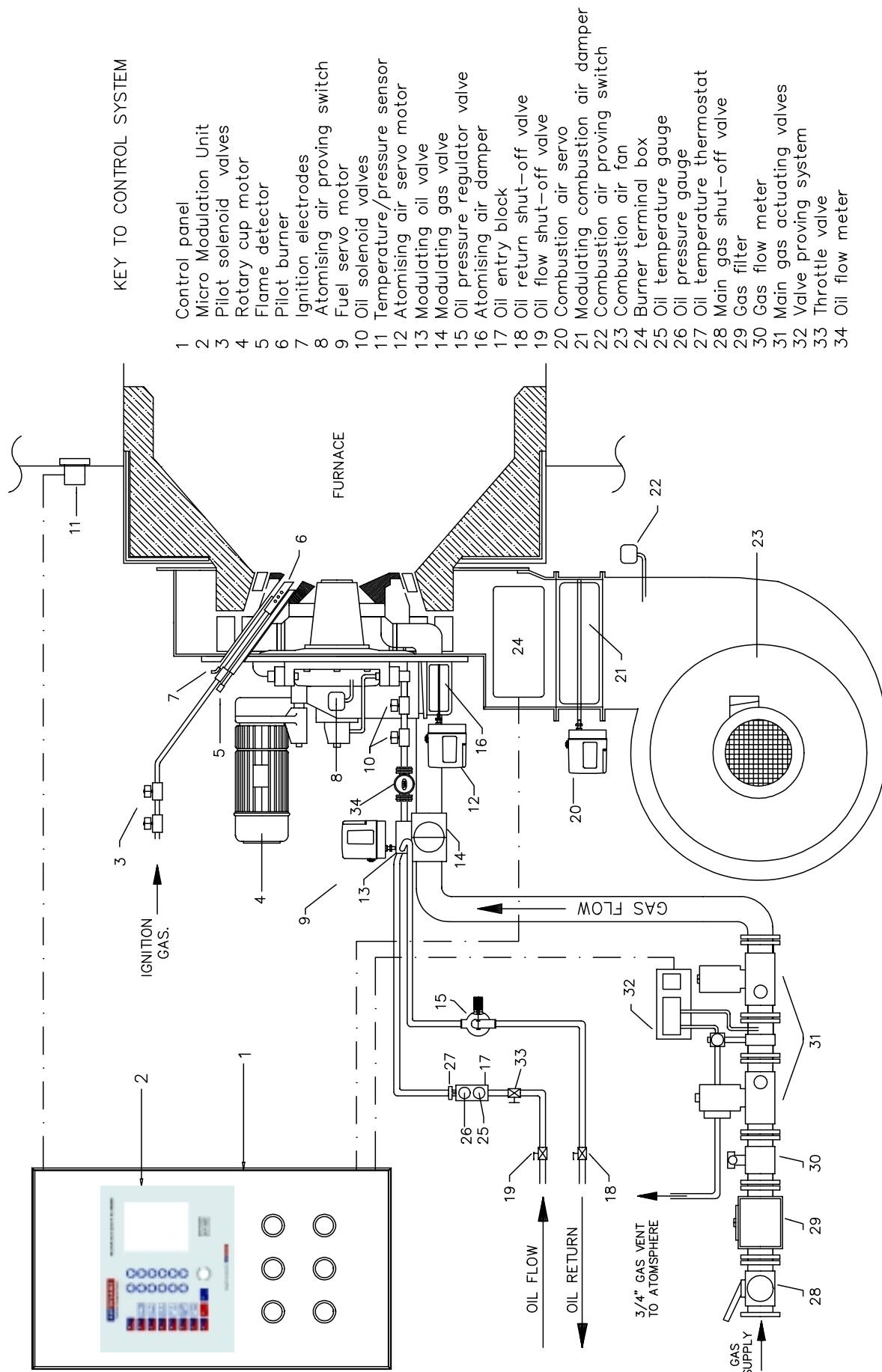
The M.M. system is basically a fuel/air ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner.

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.
- d.) No compromise required when changing between fuels since the air/fuel ratio for each are completely separate.

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



7.3 APPLICATION POSSIBILITIES FOR M.M. /E.G.A. SYSTEM

Flue Gas Re-Circulation Control (NO_x)

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 8 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 8 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.

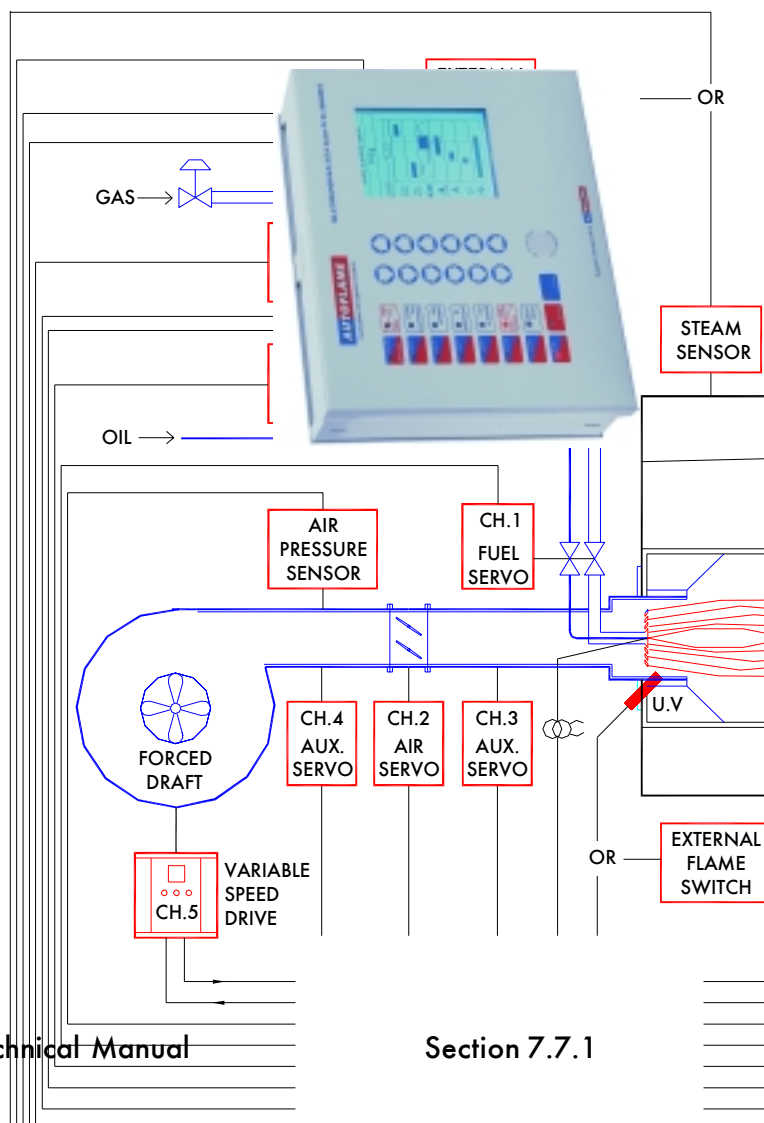
7.5 APPLICATION POSSIBILITIES FOR M.M. /E.G.A. SYSTEM

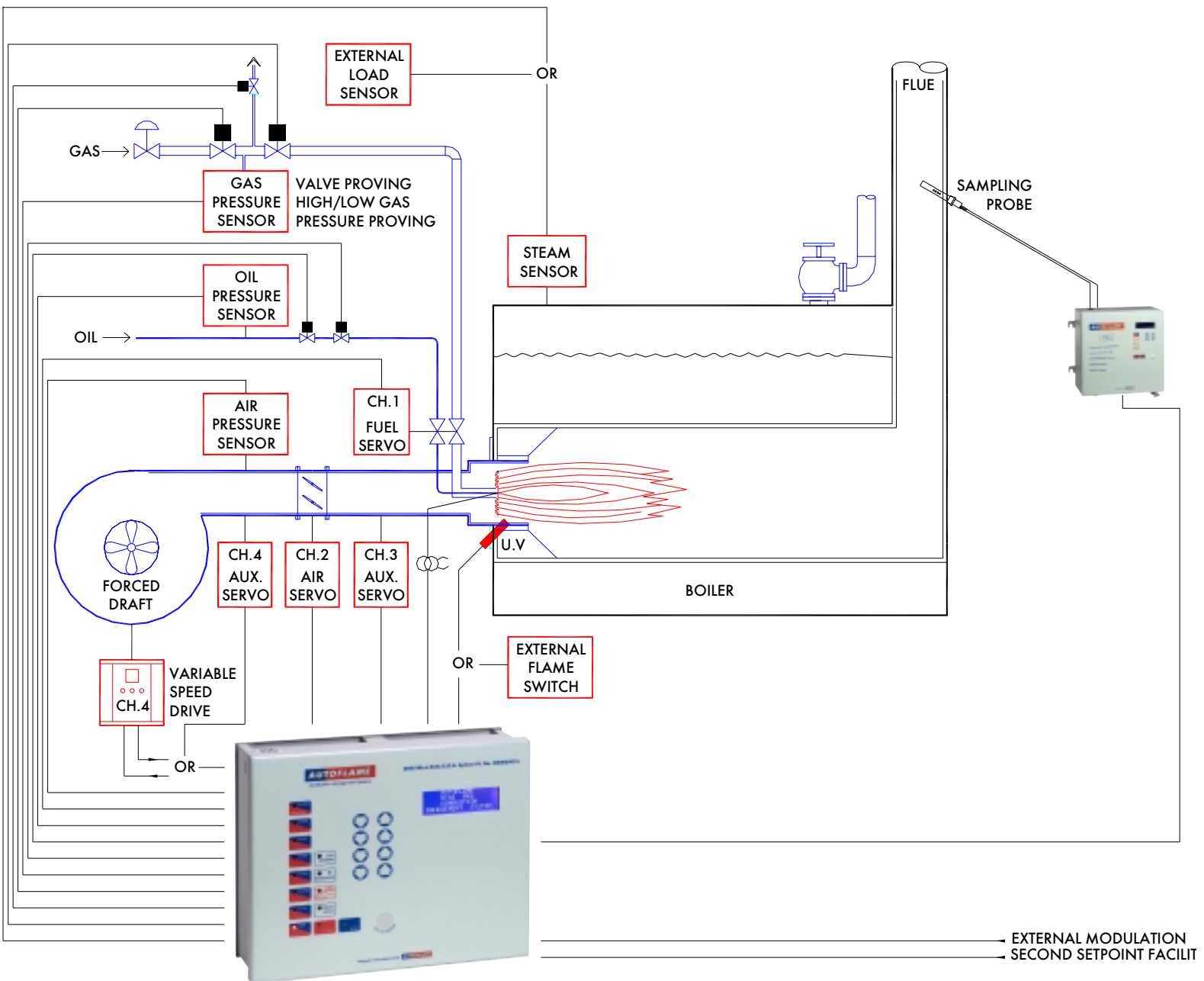
Water Injection

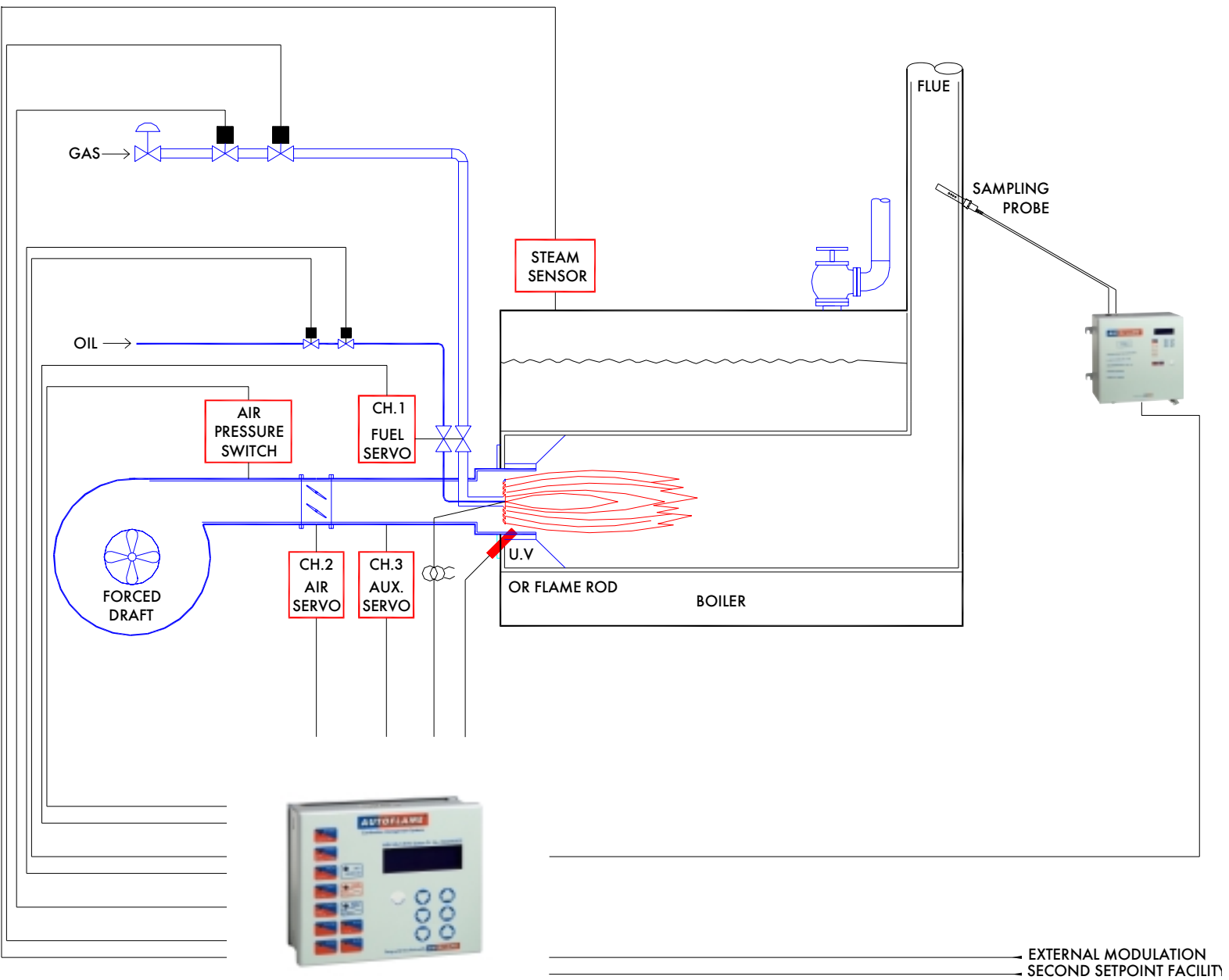
The M.M. system is basically an air/fuel ratio control designed to improve the energy efficiency and control of a standard pressure jet or rotary burner. The ability to control up to 8 channels however greatly expands the areas in which it can be used and any application in which it is necessary to precisely 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.

7.7.1 MK6 EVO MM/EGA







Section 8: Ancillary & Peripheral Equipment.

Gas Valves:	8.0	Valve Specifications
	8.0.1	Oil Valve Selection
	8.1	Screwed Gas Valves (small positioning motor)
	8.2	Flanged Gas Valves (small positioning motor)
	8.3	Flanged Gas Valves (large positioning motor)
	8.3.1	Screwed Gas Valve + Oil Valve + Small positioning motor
	8.3.2	Flanged Gas Valve + Oil Valve + Small positioning motor
	8.3.3	Gas Valve Pressure Drop Graph
Oil Valves:	8.4	Type 1,2,5,6,8,9, Oil Control Valves Small positioning motor
	8.4.1	Small Metering Valve
	8.5	Type 4 Oil Control Valve Large positioning motor
	8.6	Type 3 Oil Control Valve Large positioning motor
	8.6.1	Type 1 Spillback Graph
	8.6.2	Type 2 Spillback Graph
	8.6.3	Type 4 Spillback Graph
	8.6.4	Type 5 Spillback Graph
	8.6.5	Type 3 Metering Graph
	8.6.6	Type 6 Metering Graph
	8.6.7	Type 8 Metering Graph
	8.6.8	Type 9 Metering Graph
Positioning Motors:	8.7	Small Positioning Motor
	8.8	Large Positioning Motor
Load Detectors:	8.9	Temperature Detector
	8.9.1	Pressure Detector
	8.10	Industrial Positioning Motor
	8.10.0	Overview
	8.10.1	External Drawings
	8.10.2	Specification
	8.10.3	Installation
	8.10.4	Manual Operation
	8.10.5	Troubleshooting

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 cast bronze metering bobbin. The top and bottom closing plates are aluminium.

All valves can be supplied in non-standard material at extra cost, price on application.

For very heavy fuel oil or contaminated fuels it is recommended that execution is a stainless steel bobbin. The cost for all stainless steel construction is standard price x3.

Gas Valve's standard execution is an aluminium body with stainless steel metering disk. Gas valves can also be supplied for corrosive/contaminated fuels in all stainless steel construction at standard price x4.

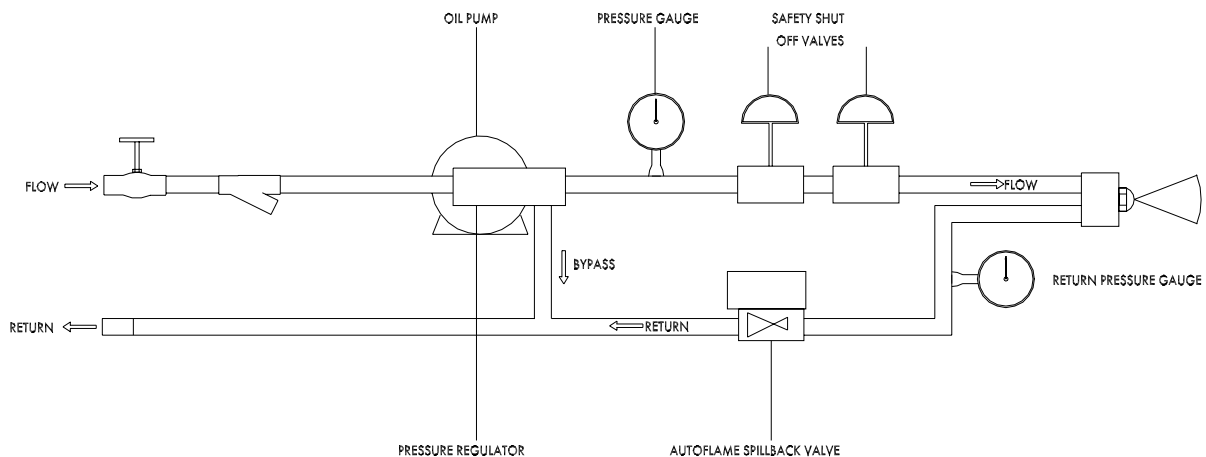
Maximum pressure is 350 psi (oil valves); 10 psi (GV4 gas valves); 25psi (GVF gas valves).

For further information please contact your supplier.



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.

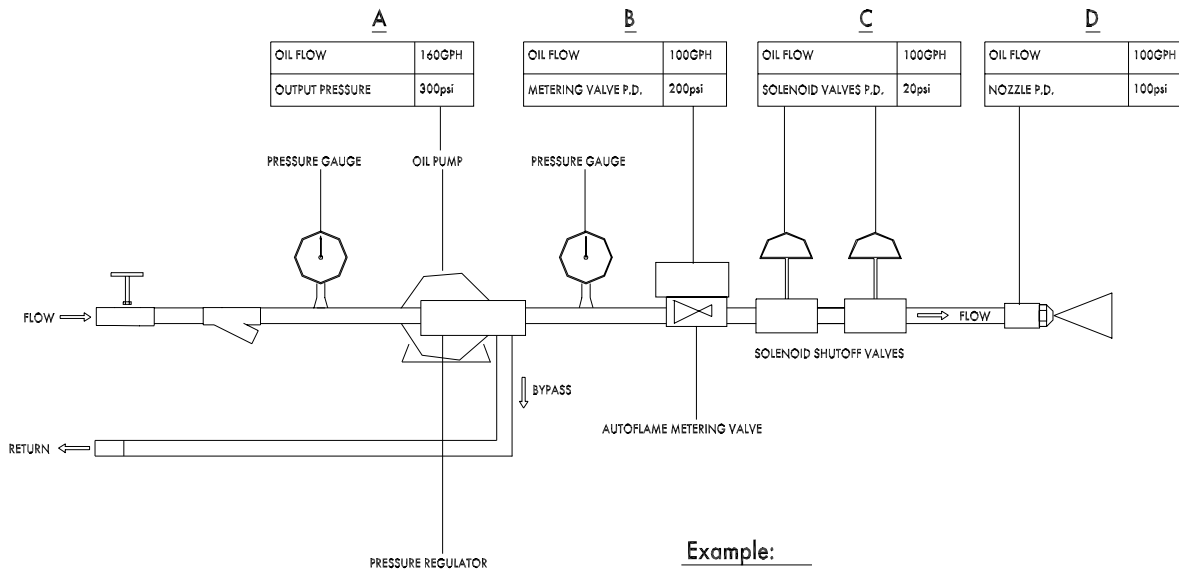
BASED ON THE ABOVE EXAMPLE:

$1000 \text{ IB/HR} \times 1.6 = 1600 \text{ IB/HR}$
 LOW FIRE OIL REQUIREMENT = 250 IB/HR (BASED AT 4 : 1 TURN DOWN. $1000 / 4$)
 $1600 \text{ IB/HR} - 250 \text{ IB/HR} = 1350 \text{ IB/HR}$
 SPILLBACK OIL FLOW = $1350 \text{ IB/HR @ 100 PSI}$

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

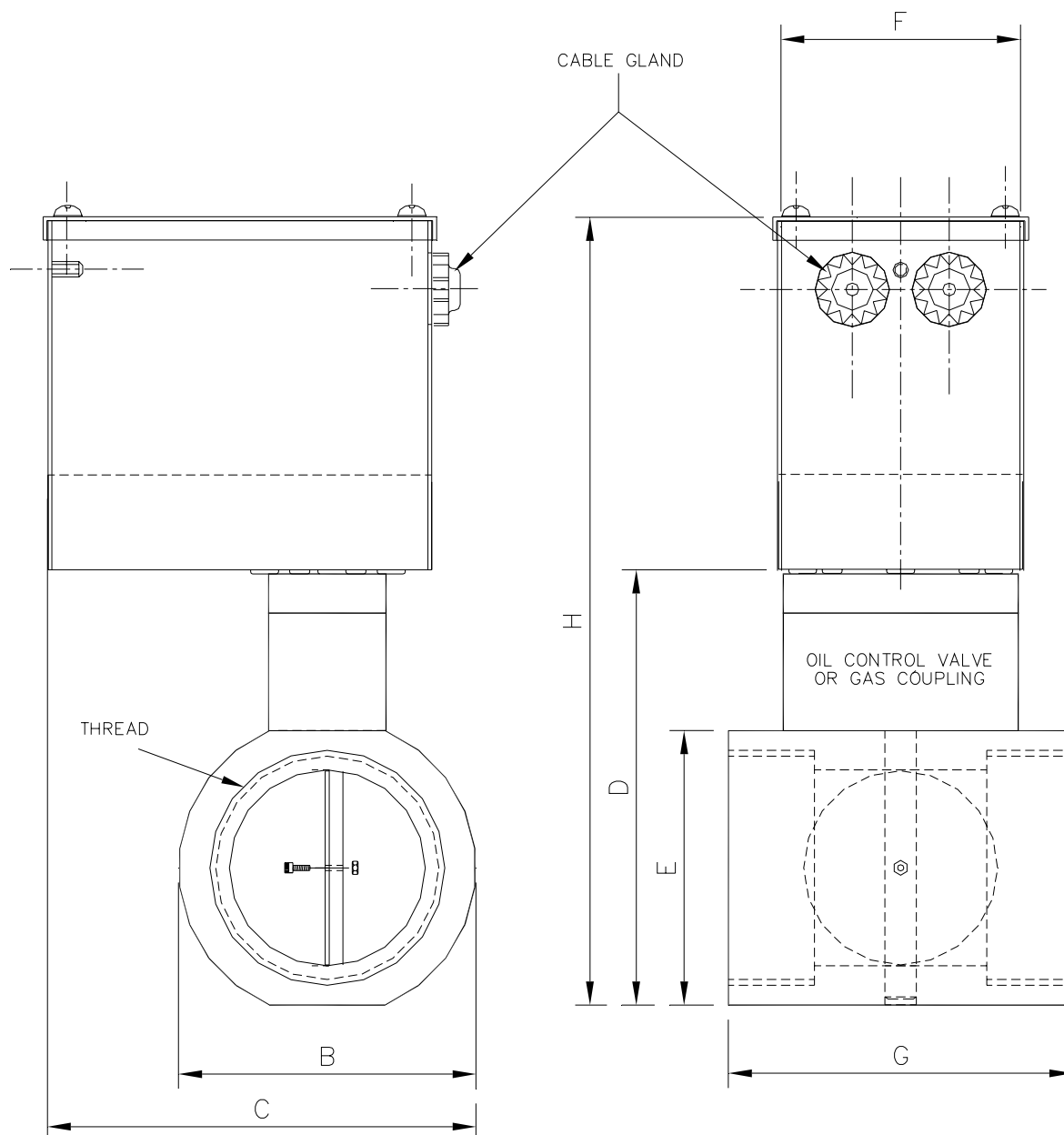
For assistance, fill in the fields below and return to Autoflame:

A: _____

C: _____

D: _____

GAS CONTROL VALVES SCREWED TYPE
(SMALL POSITIONING MOTOR)

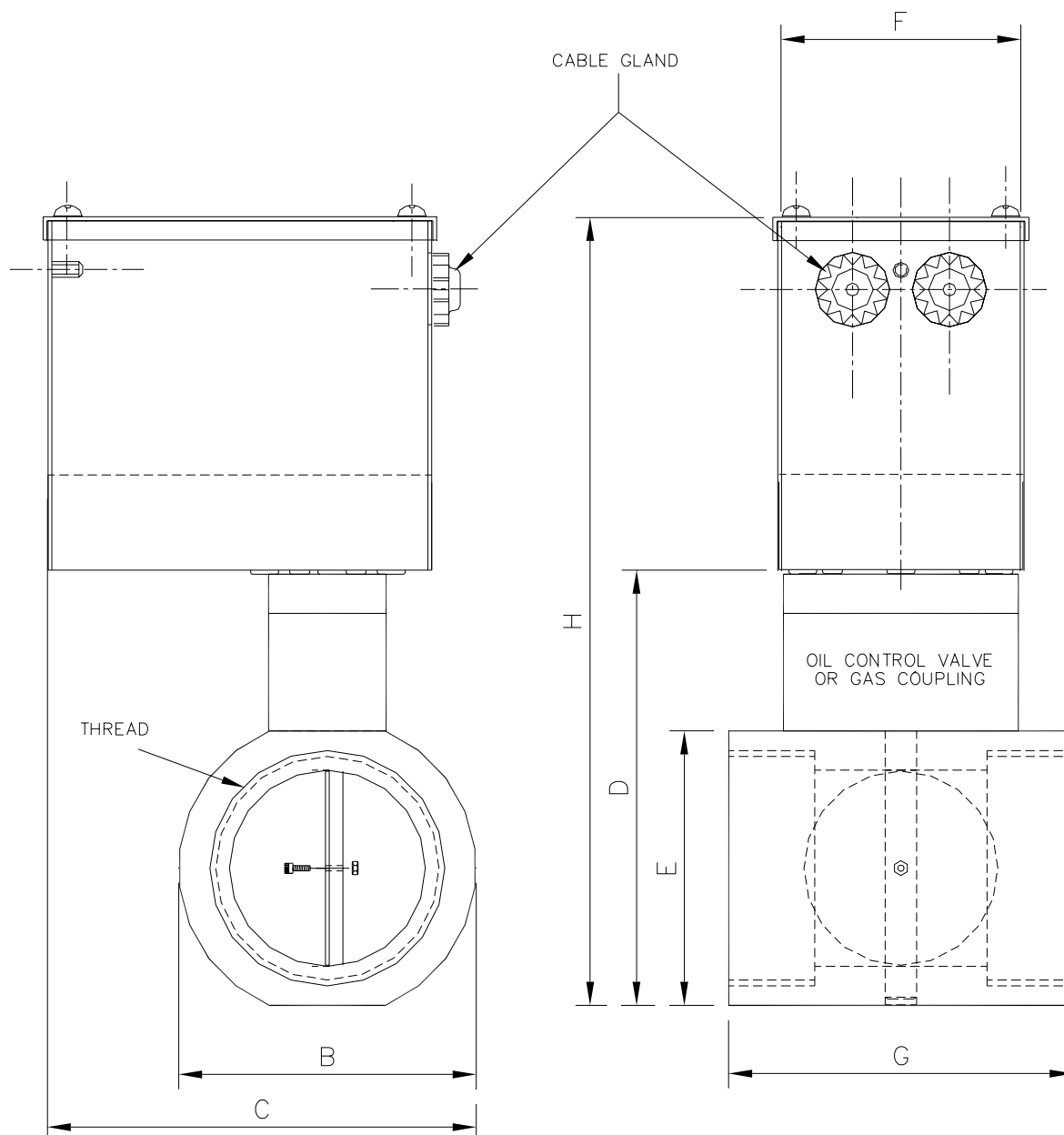


PART No.	A	B	C	D	E	F	G	H	VALVE SIZE
GV42521	100	54	97	85	45	65	88	180	25 (1")
GV44022	100	67	103.5	100	60	65	88	195	40 (1.5")
GV45023	100	76	108	110	70	65	88	205	50 (2")
GV46524	100	90	115	124	85	65	88	220	65 (2.5")
GV48025	100	105	123	140	100	65	88	235	80 (3")

ALL MEASUREMENTS IN MILLIMETRES UNLESS STATED OTHERWISE.

8: 11: 96/1529/GM

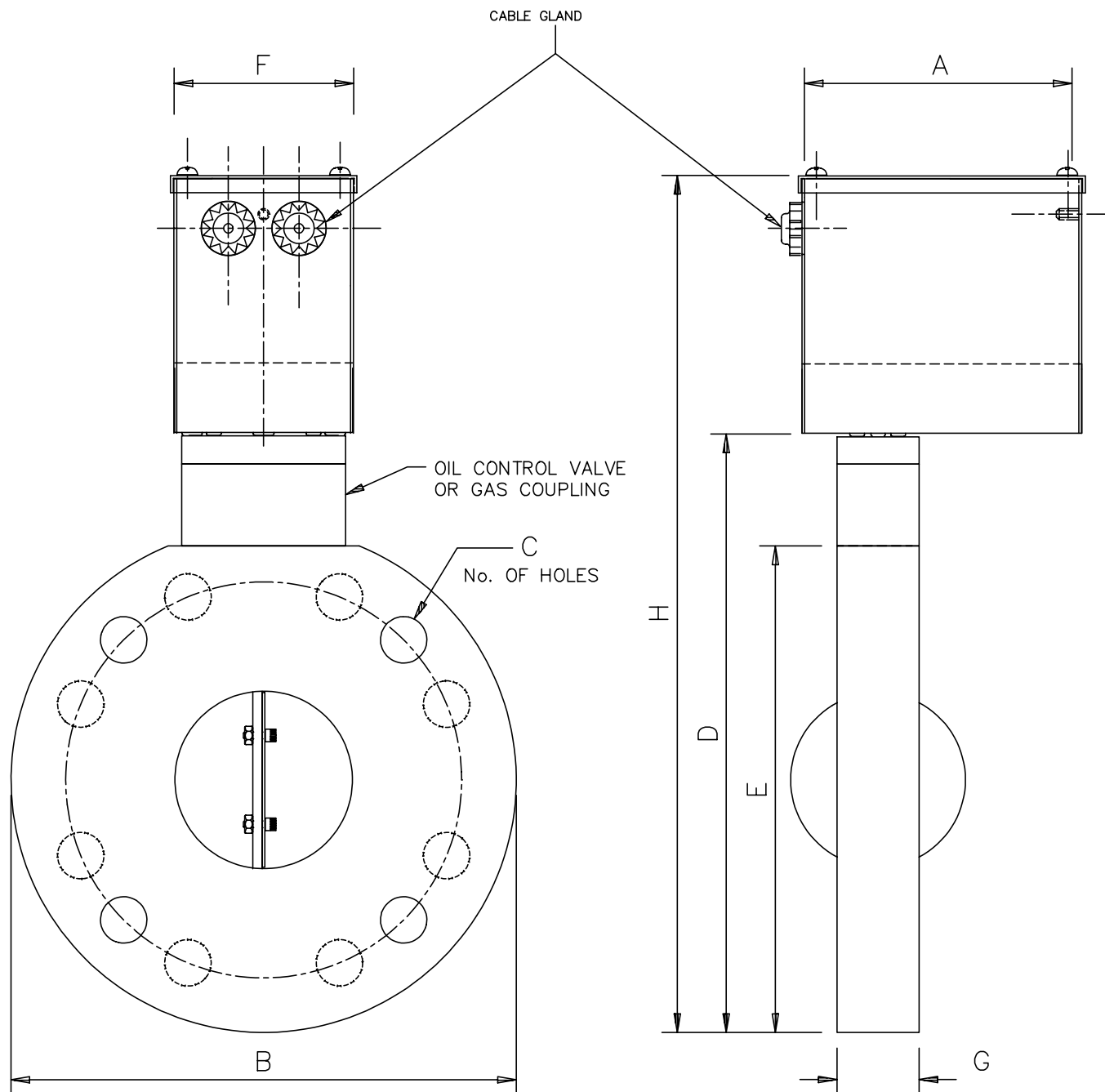
GAS CONTROL VALVES SCREWED TYPE
(SMALL POSITIONING MOTOR)



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.

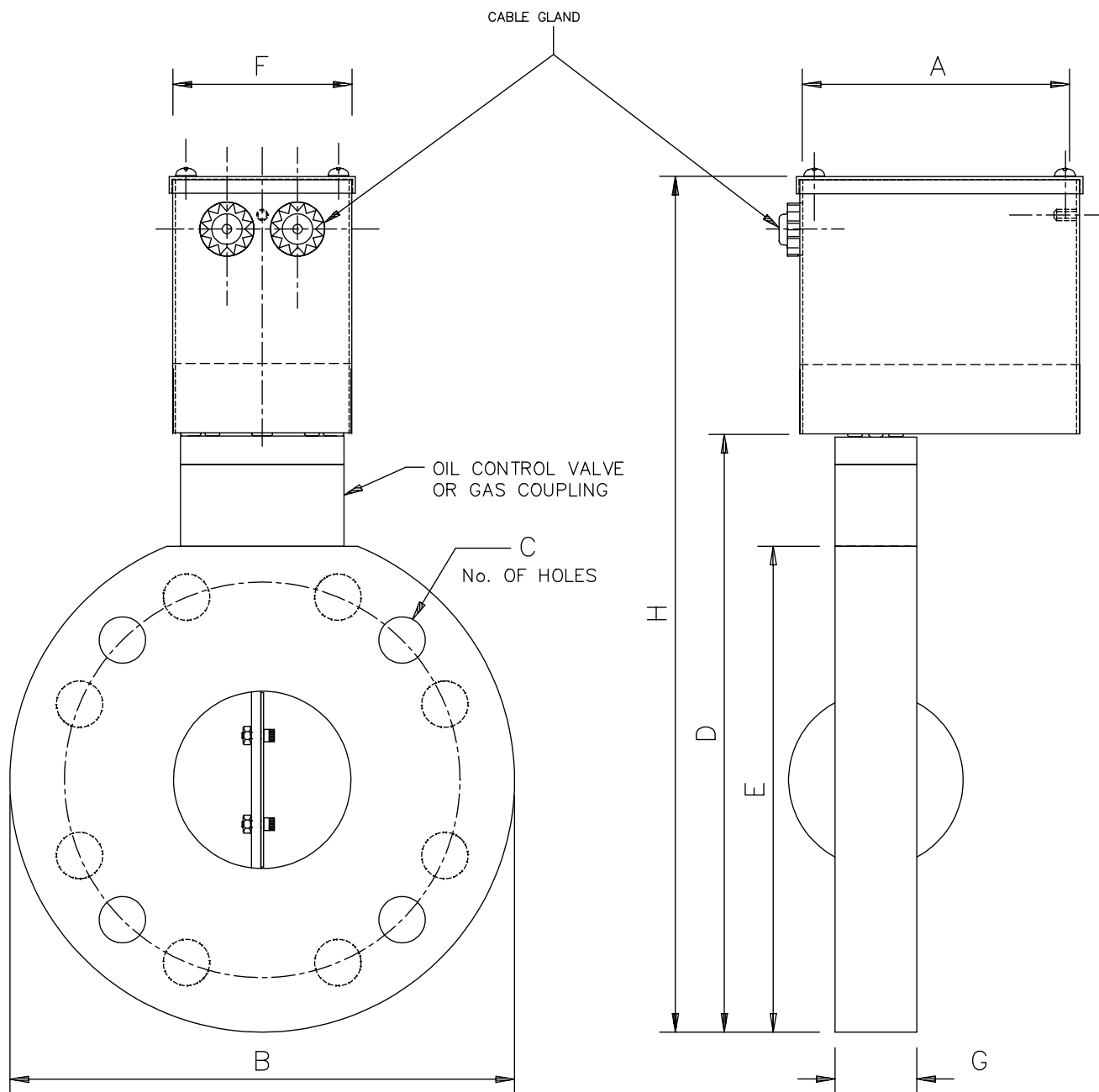
8: 11: 96/2658/GM



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.

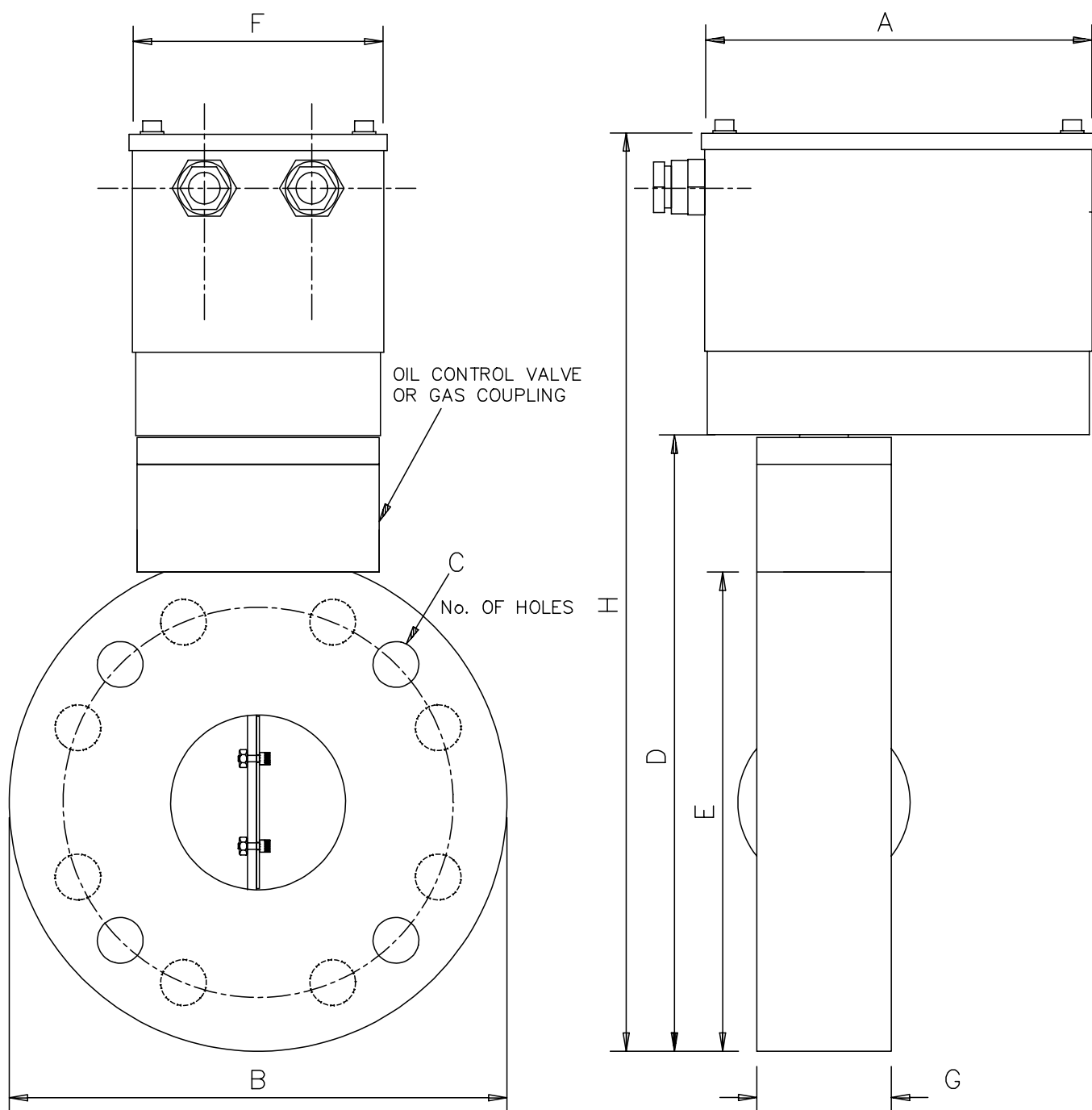


PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/30	3.9"	6"	4	8"	6.25"	2.5"	1.125"	11.7"	1/2" x 4"	2"
GVF46526/30	3.9"	7"	4	8.6"	7"	2.5"	1.125"	12.40"	5/8" x 4"	2.5"
GVF48027/30	3.9"	7.5"	4	9.375"	7.75"	2.5"	1.125"	13.00"	5/8" x 4"	3"
GVF410026/30	3.9"	9"	8	10"	8.5"	2.5"	1.125"	8.75"	5/8" x 4"	4"
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.

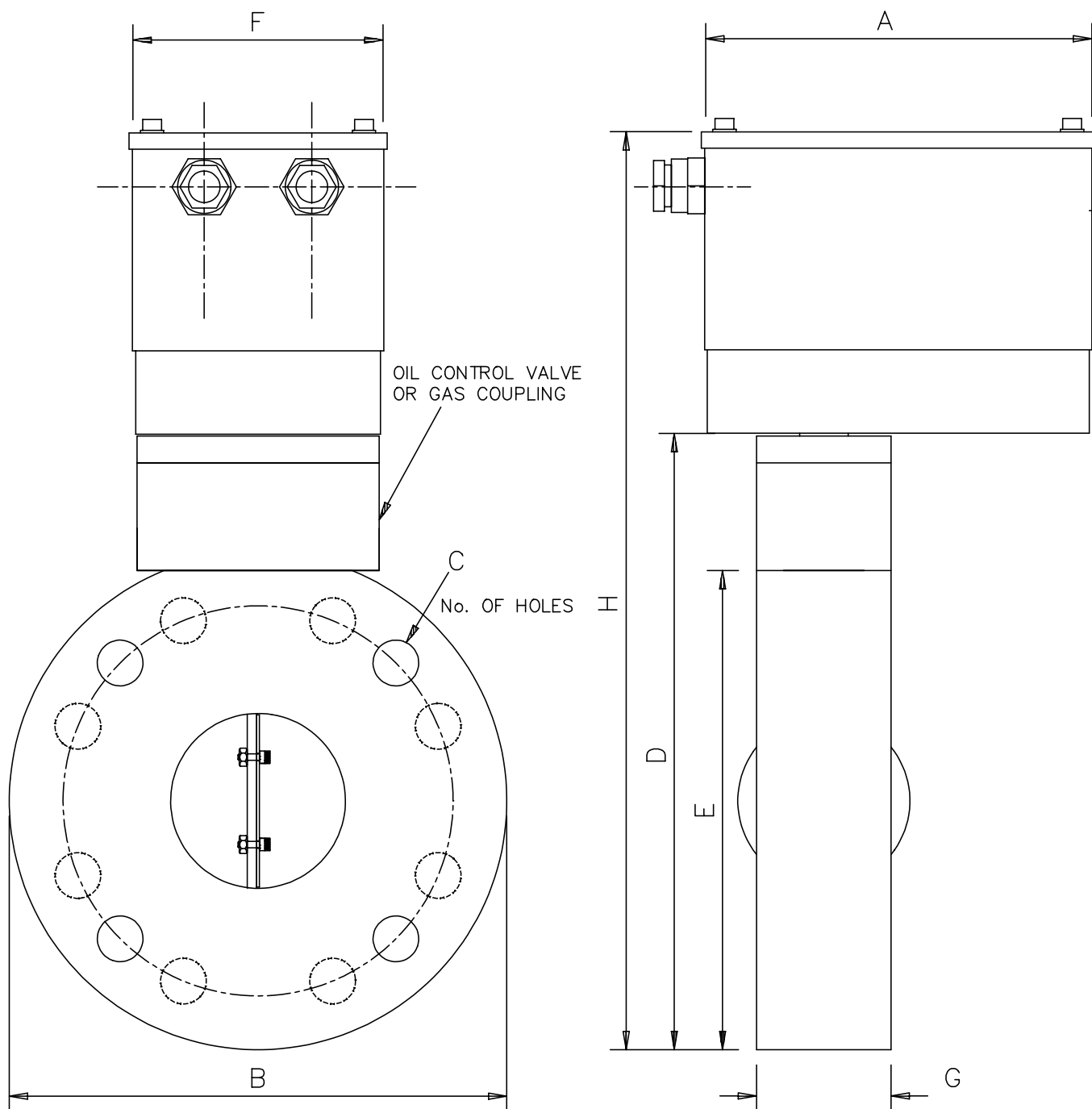
10: 2: 95/2660/GM



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.



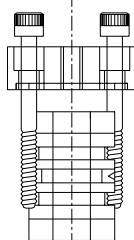
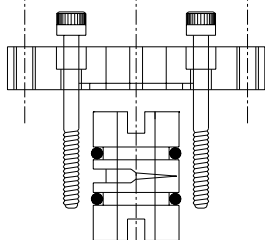
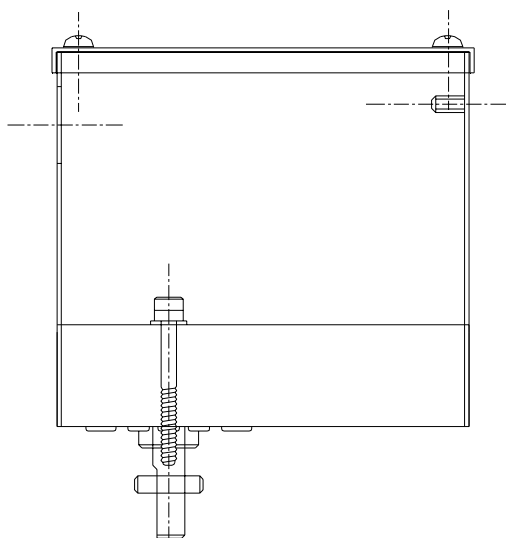
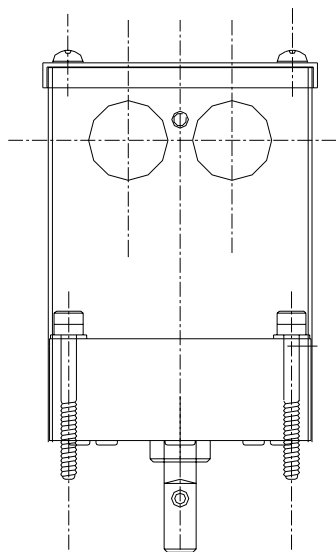
PART No.	A	B	C	D	E	F	G	H	BOLTING	VALVE SIZE
GVF45028/50	4.60"	6"	4	8"	6.25"	3.66"	2"	12.40"	1/2" x 5"	2"
GVF46526/50	4.60"	7"	4	8.6"	7"	3.66"	2"	13.50"	5/8" x 5"	2.5"
GVF48027/50	4.60"	7.5"	4	9.375"	7.75"	3.66"	2"	14.25"	5/8" x 5"	3"
GVF410026/50	4.60"	9"	8	10"	8.5"	3.66"	2"	14.92"	5/8" x 5"	4"
GVF12527/50	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.

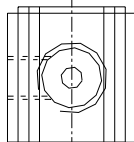
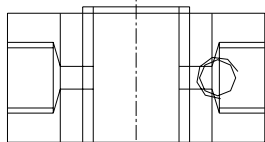
MATING FLANGES, RUBBER GASKETS & BOLTS ARE NOT SUPPLIED UNLESS SPECIFIED ON ORDER.

ASSEMBLY OF MM/EGA SYSTEM SCREWED GAS
BUTTERFLY VALVE & OIL CONTROL VALVE
WITH SMALL POSITIONING MOTOR

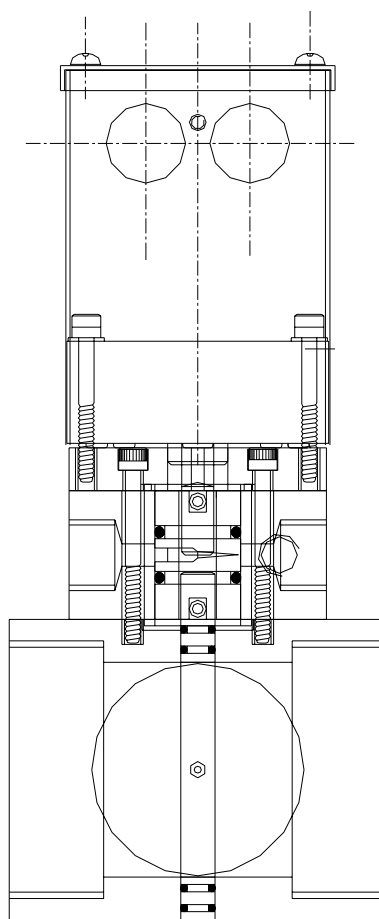
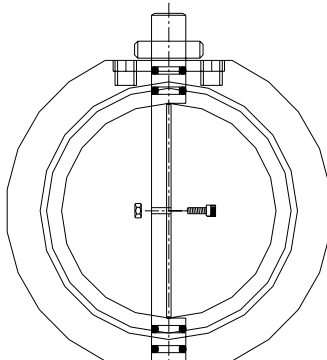
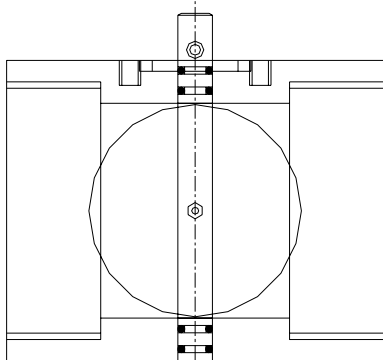
SMALL POSITIONING MOTOR



"TYPE 2" OIL CONTROL VALVE



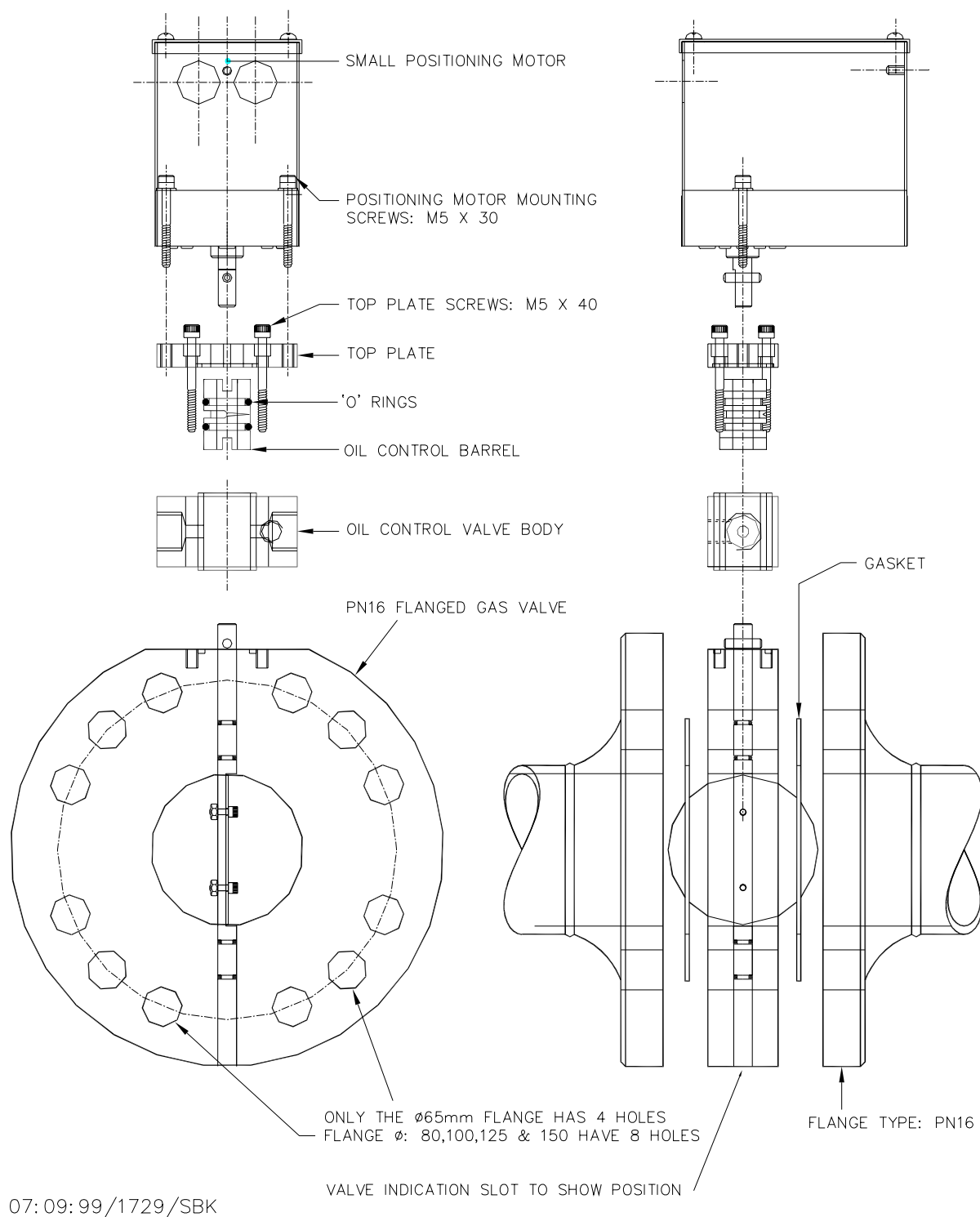
2" GAS BUTTERFLY CONTROL VALVE



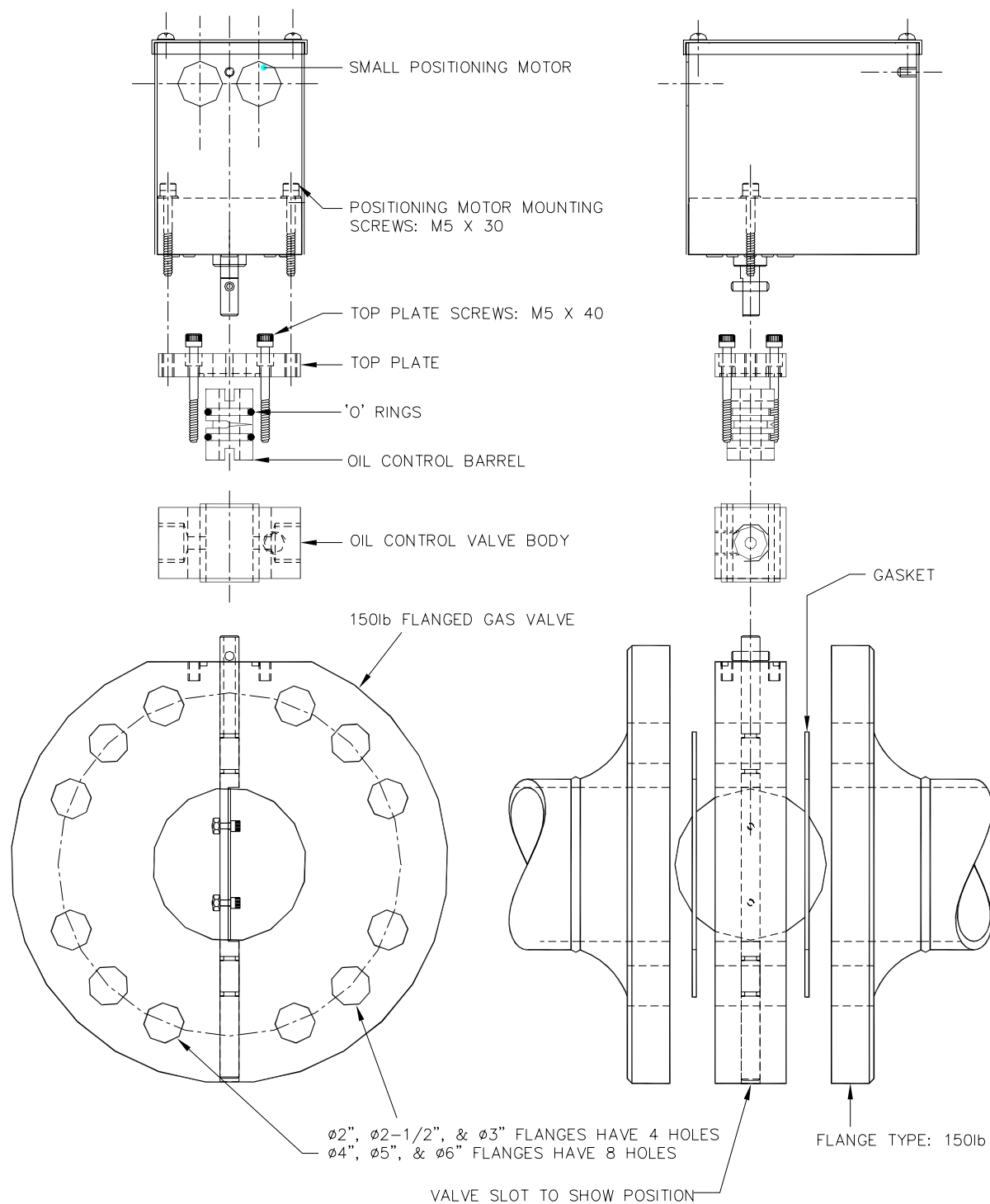
INDICATOR

11: 3: 96/1530/SBK

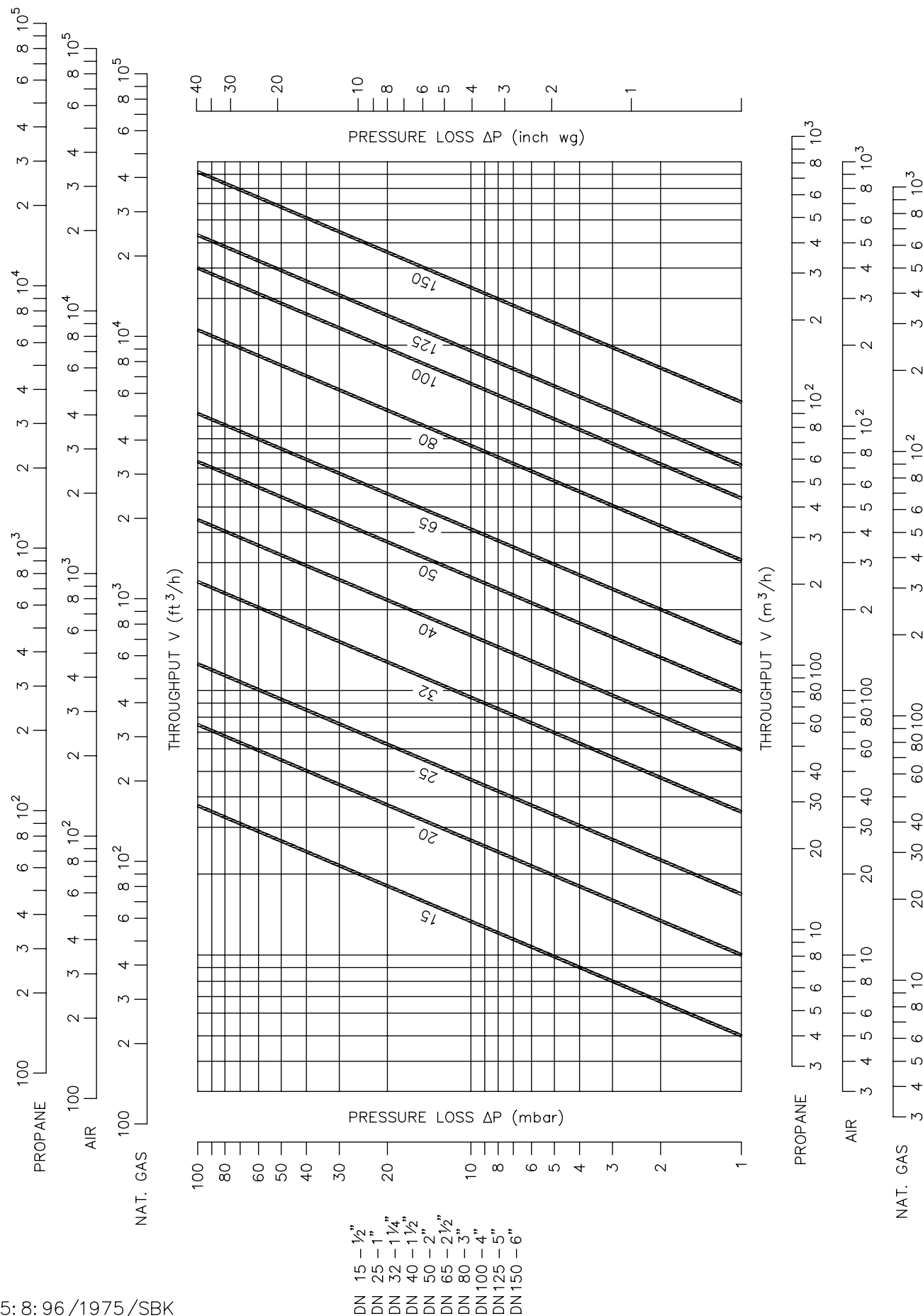
ASSEMBLY OF MM/EGA SYSTEM FLANGED GAS
BUTTERFLY VALVE & OIL CONTROL VALVE
WITH SMALL POSITIONING MOTOR



ASSEMBLY OF MM/EGA SYSTEM FLANGED GAS
BUTTERFLY VALVE & OIL CONTROL VALVE
WITH SMALL POSITIONING MOTOR



1: 3: 96/2657/GM



5: 8: 96/1975/SBK

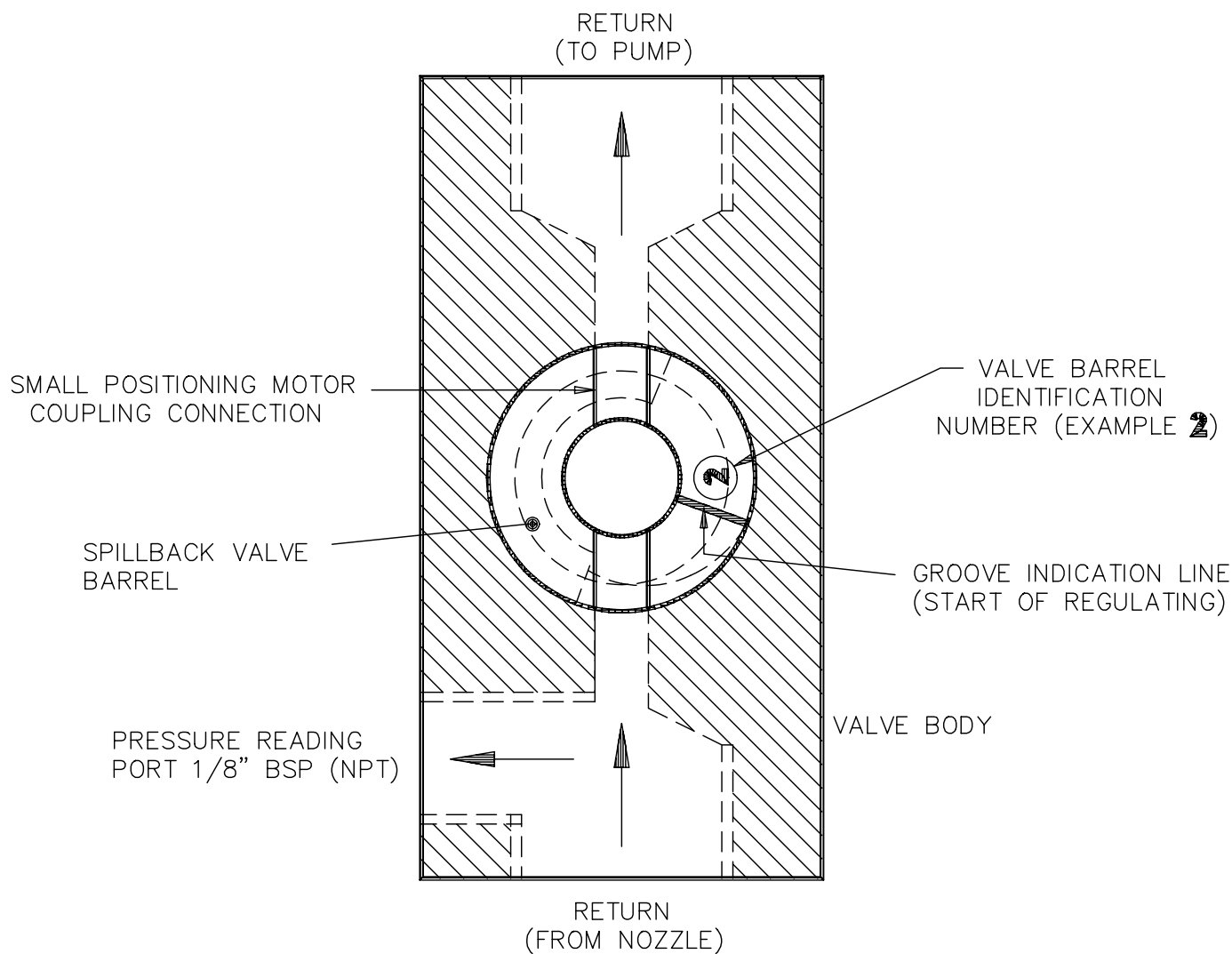
THESE VALVES CAN BE SUPPLIED AS BOTH METERING OR SPILLBACK.
(PLEASE NOTE PART NUMBER.)

WHEN USING CONTROL VALVE FOR A DUAL FUEL APPLICATION ie. GAS + OIL
THE BOTTOM PLATE OF THE OIL VALVE MUST BE REMOVED FOR ASSEMBLY
WITH THE GAS CONTROL VALVE.

HEIGHT: 50mm (2") (WITH BOTTOM PLATE)

WIDTH: 30mm (1.125")

LENGTH: 60mm (2.375")

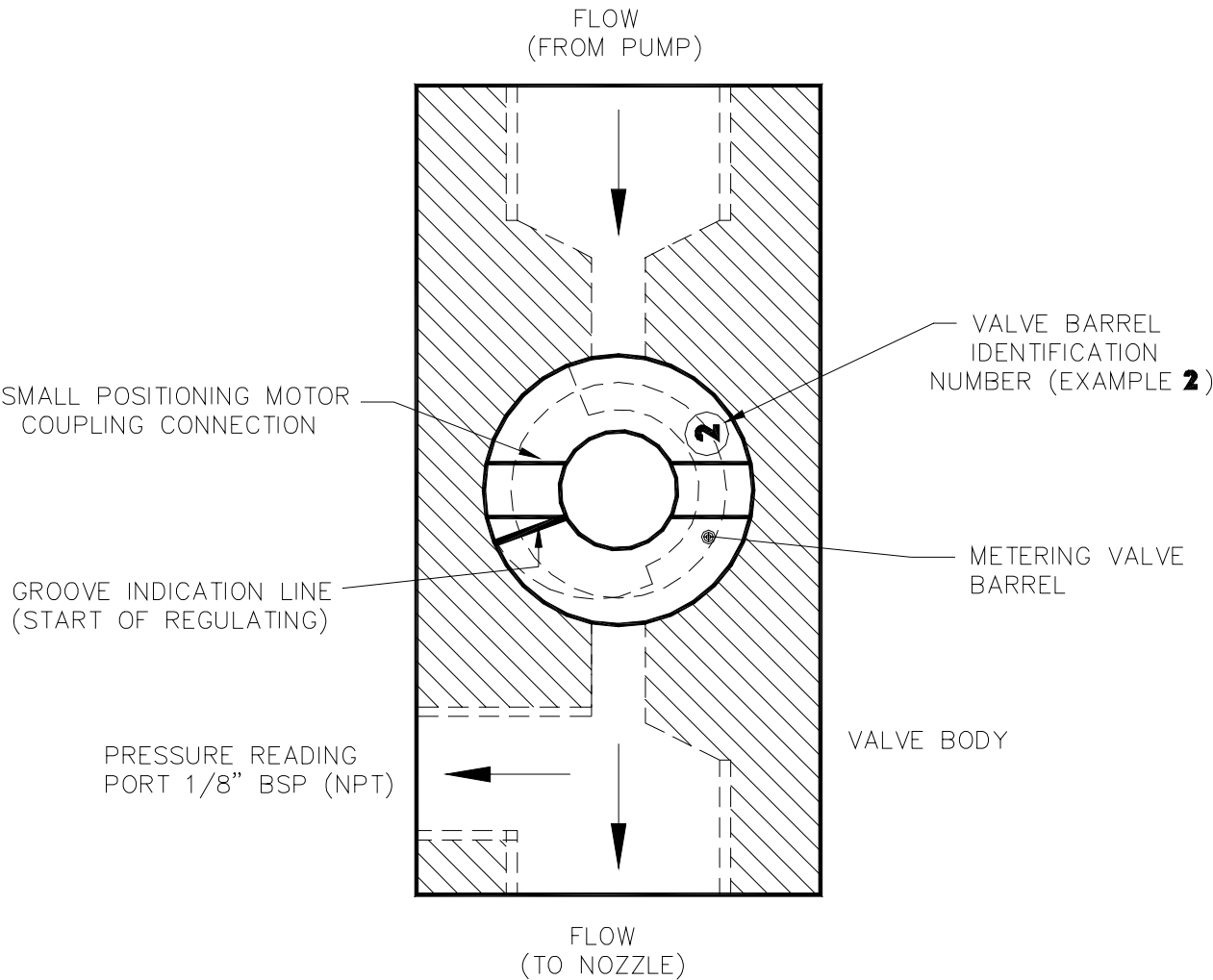


VALVE TYPE	PIPE THREAD	PART No.	
		SPILLBACK	METERING
1	1/4" BSP.	OVS31015	OVM31015
2	3/8" BSP.	OVS32016	OVM32016
5	3/8" BSP.	OVS35019	OVM35019
6	3/8" BSP.	OVS36020	OVM36020
8	3/8" BSP.	OVS38022	OVM38022
9	3/8" BSP.	OVS39023	OVM39023

TYPE: SMALL METERING OIL CONTROL
VALVE CONNECTION DIAGRAM

THIS TYPE OF VALVE IS SPECIFIC TO METERING TYPE OPERATION
THE VALVE IS IDENTIFIABLE BY THE PART NUMBER OVM
WHERE AS THE SPILLBACK (BY-PASS) TYPE VALVE IS IDENTIFIED BY OVS

WHEN USING CONTROL VALVE FOR A DUAL FUEL APPLICATION ie. GAS + OIL
THE BOTTOM PLATE OF THE OIL VALVE MUST BE REMOVED FOR ASSEMBLY
WITH THE GAS CONTROL VALVE.
HEIGHT: 50mm (2") (WITH BOTTOM PLATE)
WIDTH: 30mm (1.125")
LENGTH: 60mm (2.375")



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

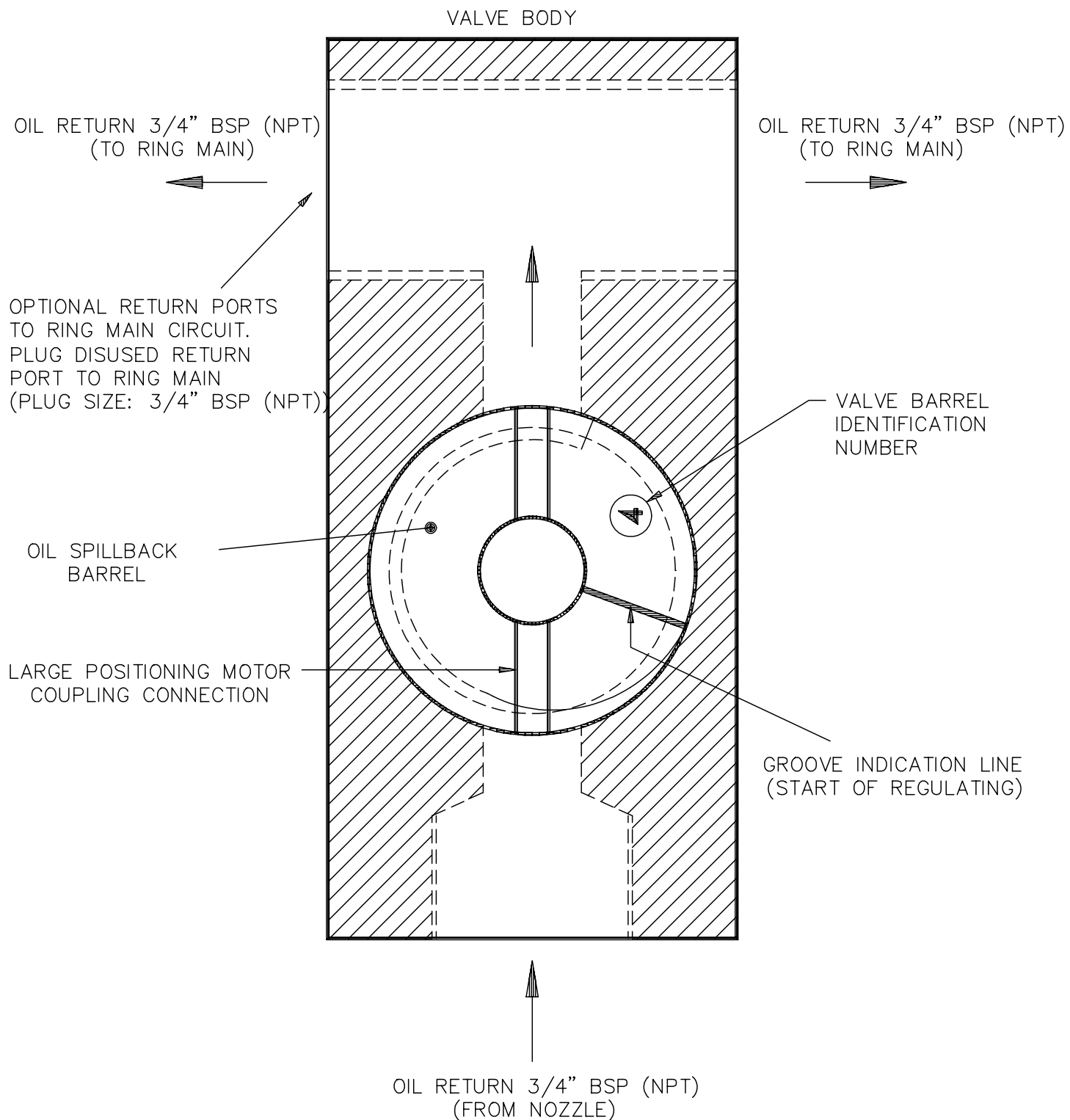
THIS CAN ALSO BE USED AS A METERING VALVE, PART No. OVM34L18

WHEN USING CONTROL VALVE FOR A DUAL FUEL APPLICATION ie. GAS + OIL
THE BOTTOM PLATE OF THE OIL VALVE MUST BE REMOVED FOR ASSEMBLY
WITH THE GAS CONTROL VALVE.

HEIGHT: 70mm (3") (WITH BOTTOM PLATE)

WIDTH: 50mm (2")

LENGTH: 110mm (4.375")



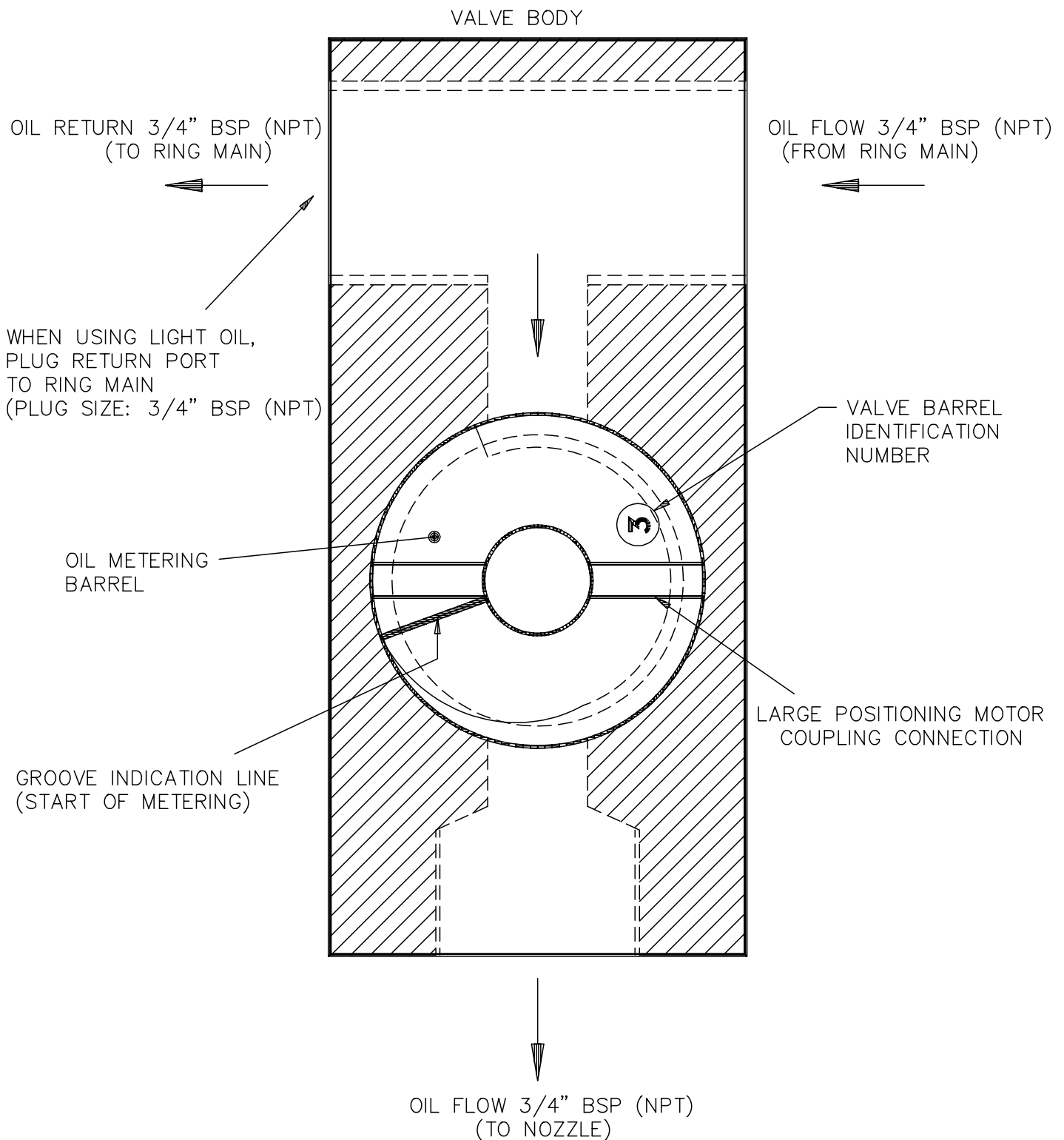
THSI CAN ALSO BE USED AS A SPILLBACK VALVE PART No. OVS33L17

WHEN USING CONTROL VALVE FOR A DUAL FUEL APPLICATION ie. GAS + OIL
THE BOTTOM PLATE OF THE OIL VALVE MUST BE REMOVED FOR ASSEMBLY
WITH THE GAS CONTROL VALVE.

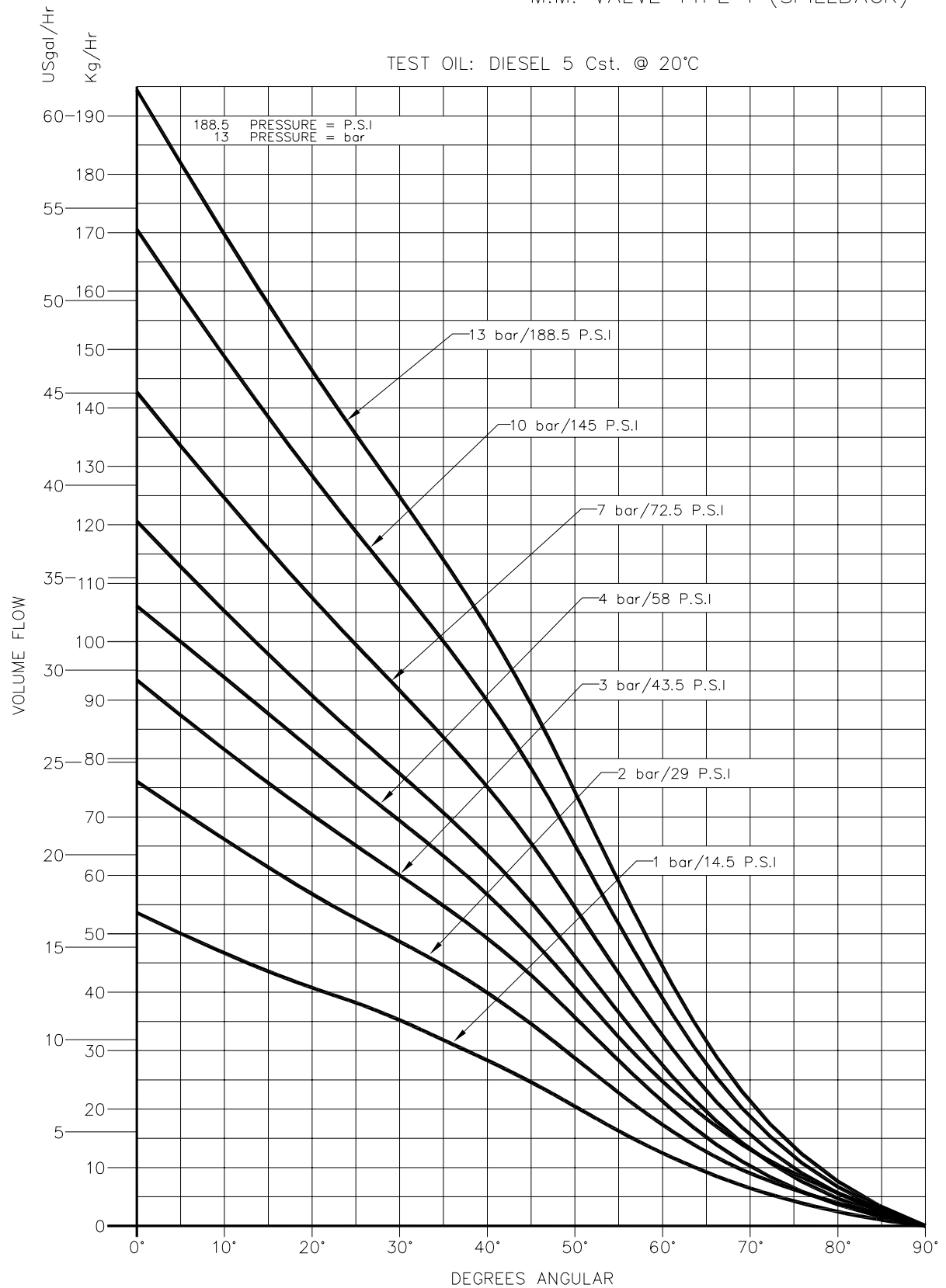
HEIGHT: 70mm (3") (WITH BOTTOM PLATE)

WIDTH: 50mm (2")

LENGTH: 110mm (4.375")



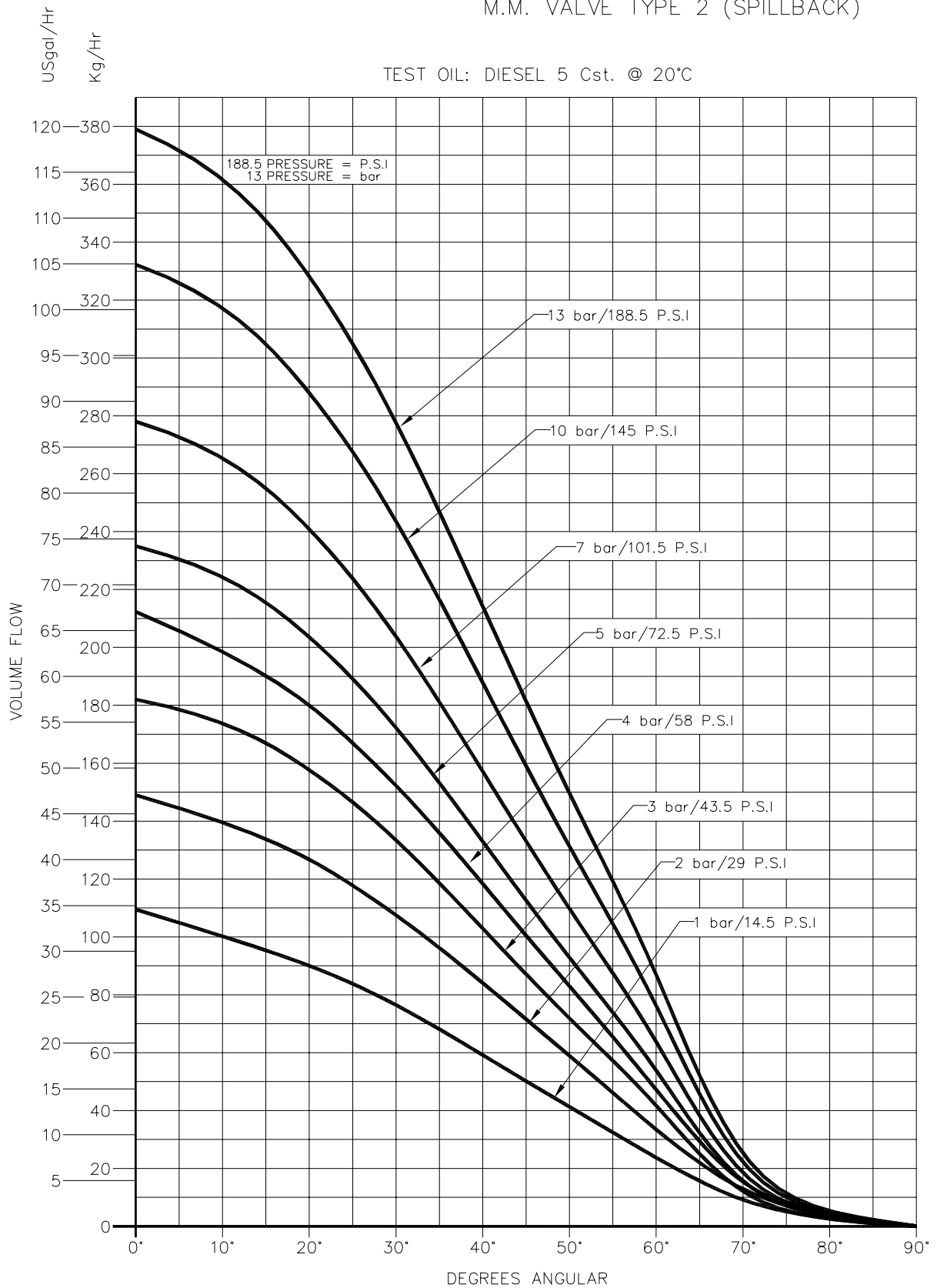
FLOW CHARACTERISTICS
M.M. VALVE TYPE 1 (SPILLBACK)



17:11:05/5040/JCF

FLOW CHARACTERISTICS
M.M. VALVE TYPE 2 (SPILLBACK)

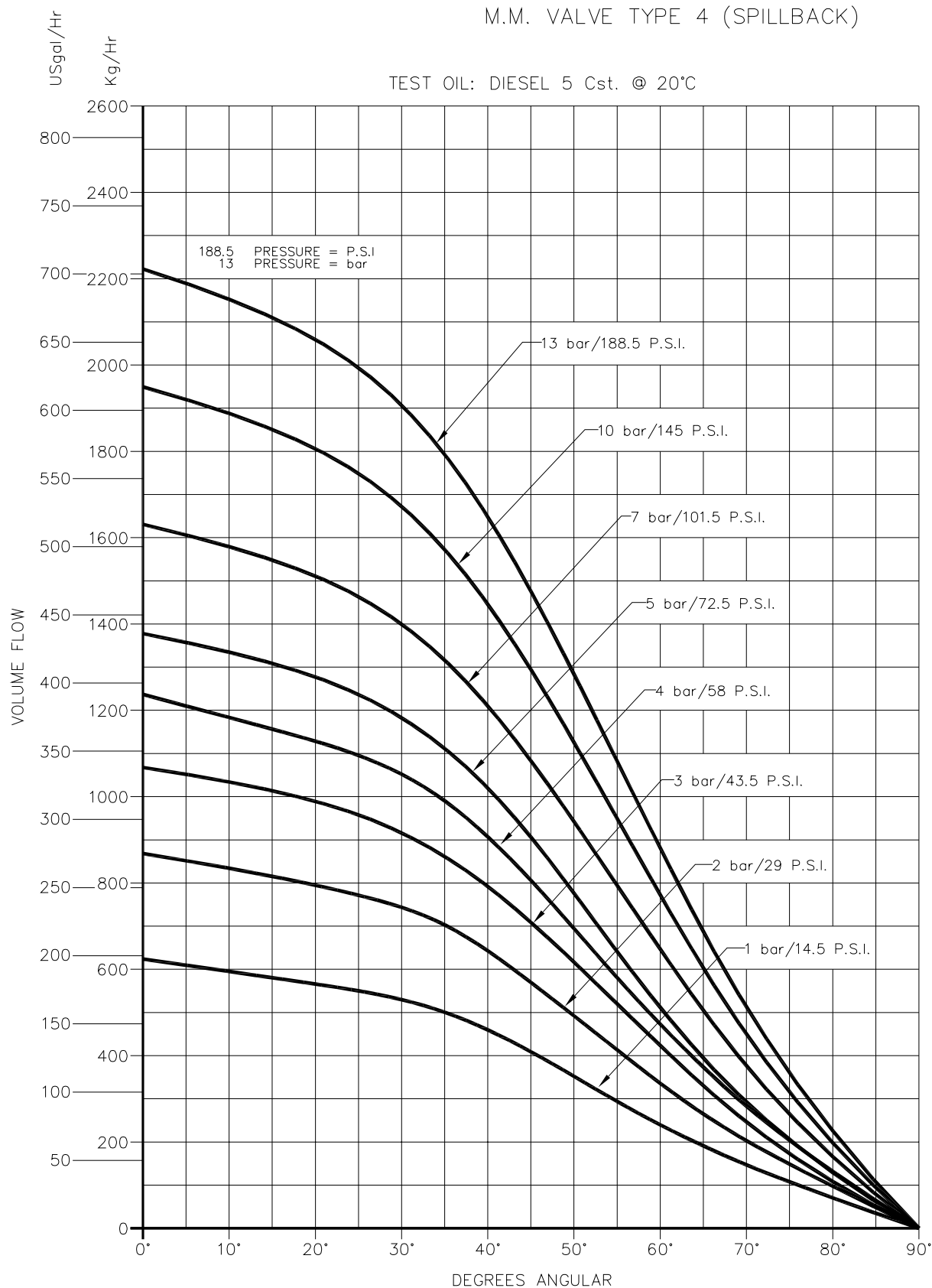
TEST OIL: DIESEL 5 Cst. @ 20°C



17:11:05/4041/JCF

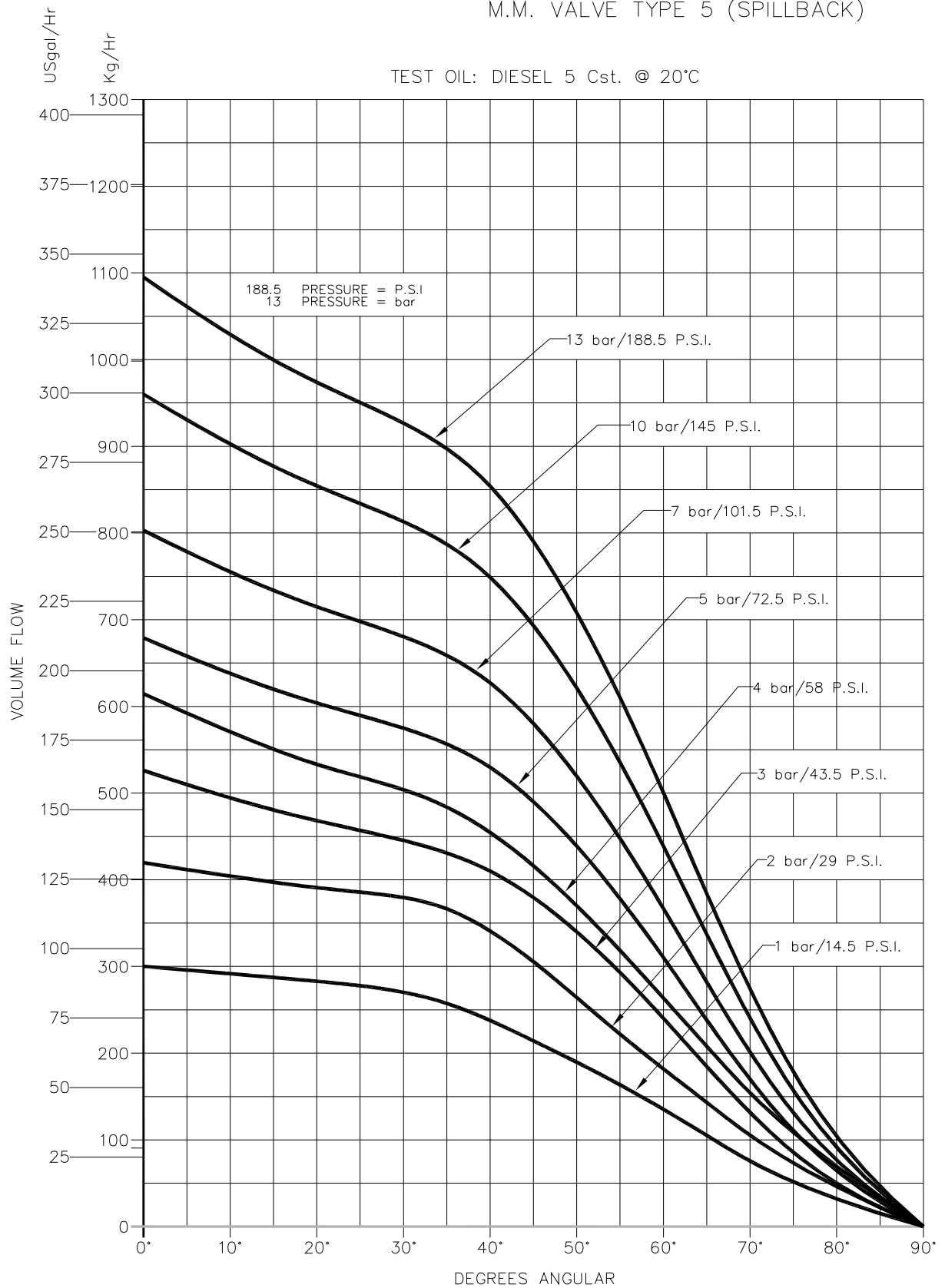
FLOW CHARACTERISTICS M.M. VALVE TYPE 4 (SPILLBACK)

TEST OIL: DIESEL 5 Cst. @ 20°C



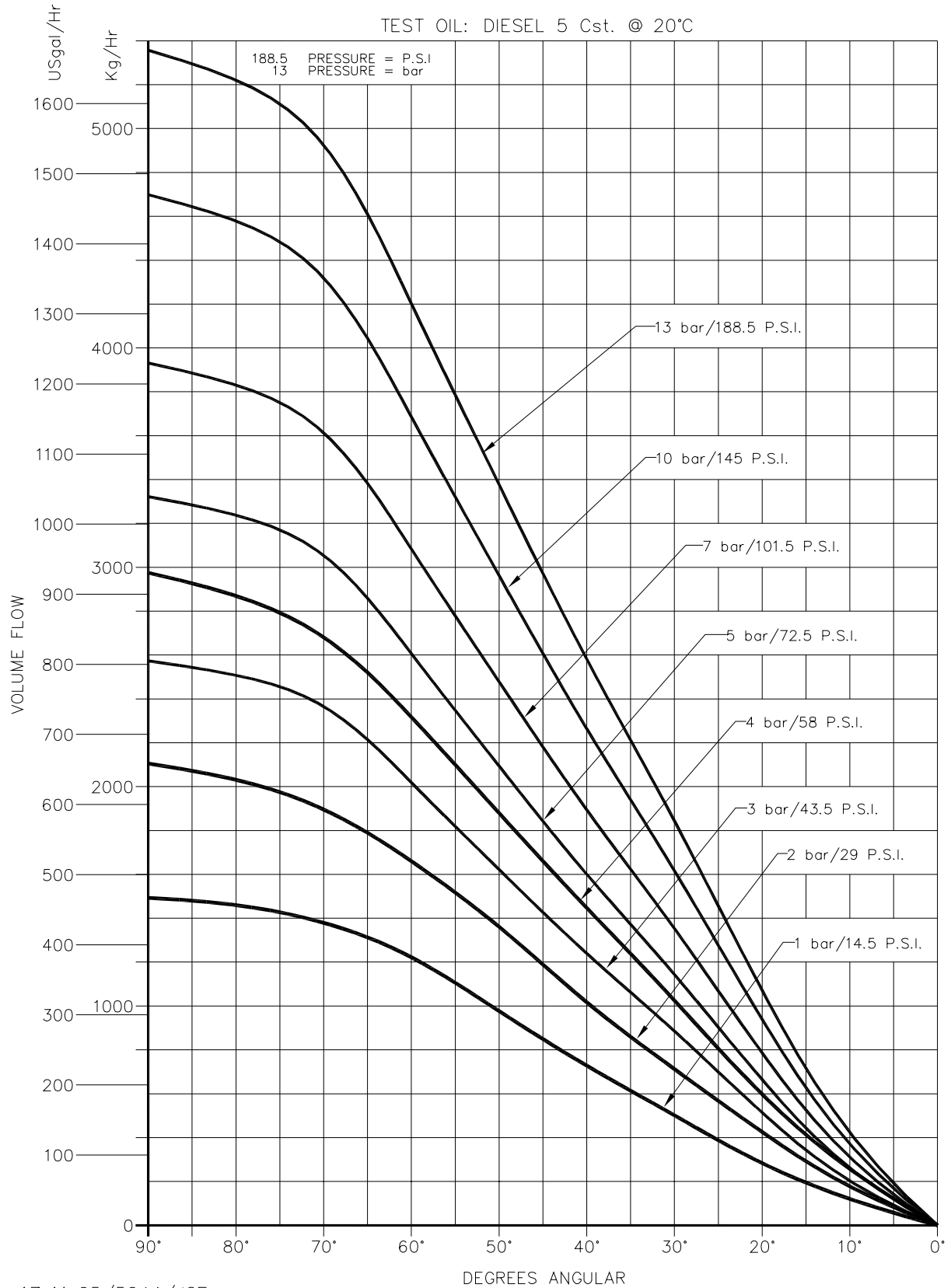
17:11:05/5042/JCF

FLOW CHARACTERISTICS M.M. VALVE TYPE 5 (SPILLBACK)

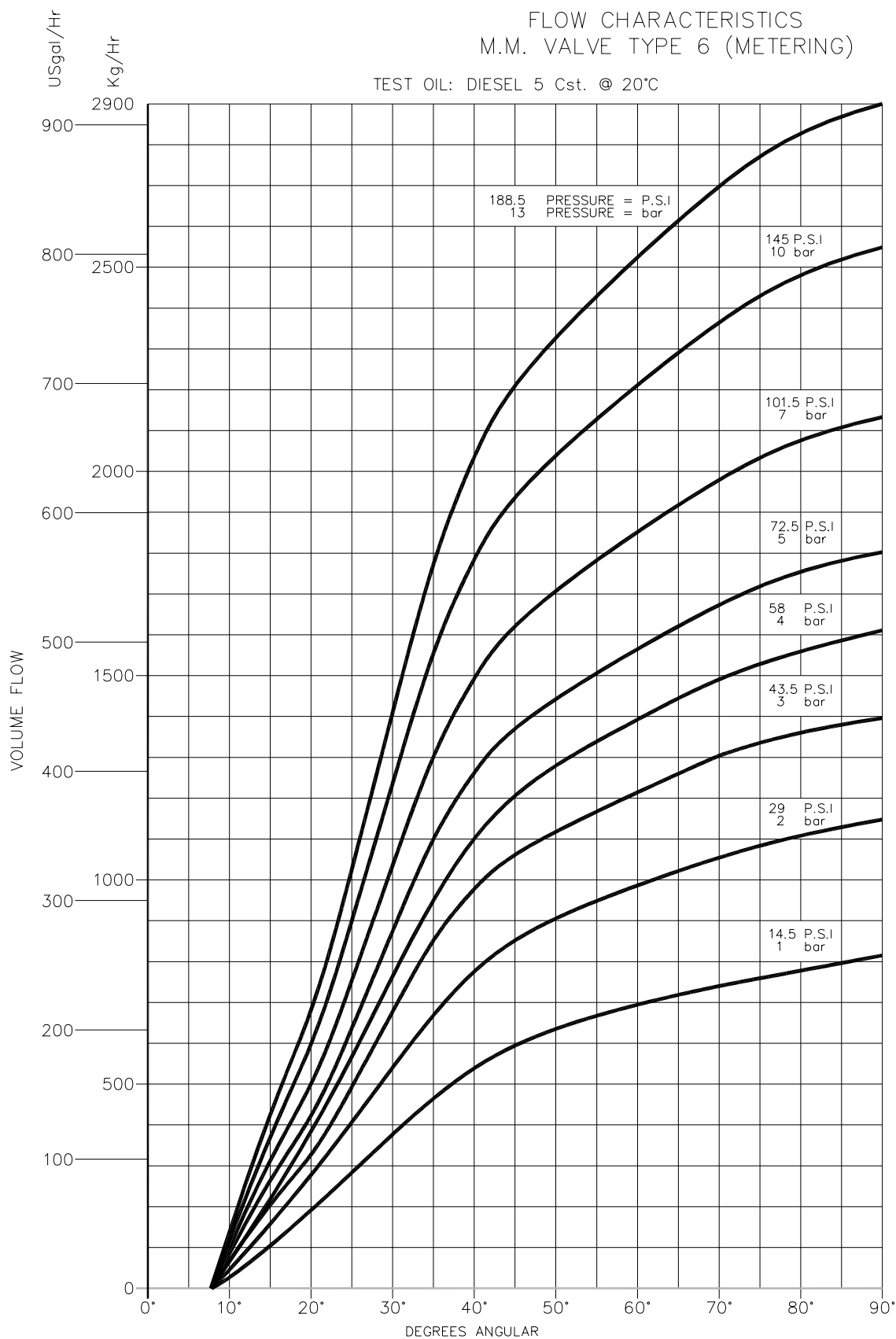


17:11:05/5043/JCF

FLOW CHARACTERISTICS
M.M. VALVE TYPE 3 (METERING)



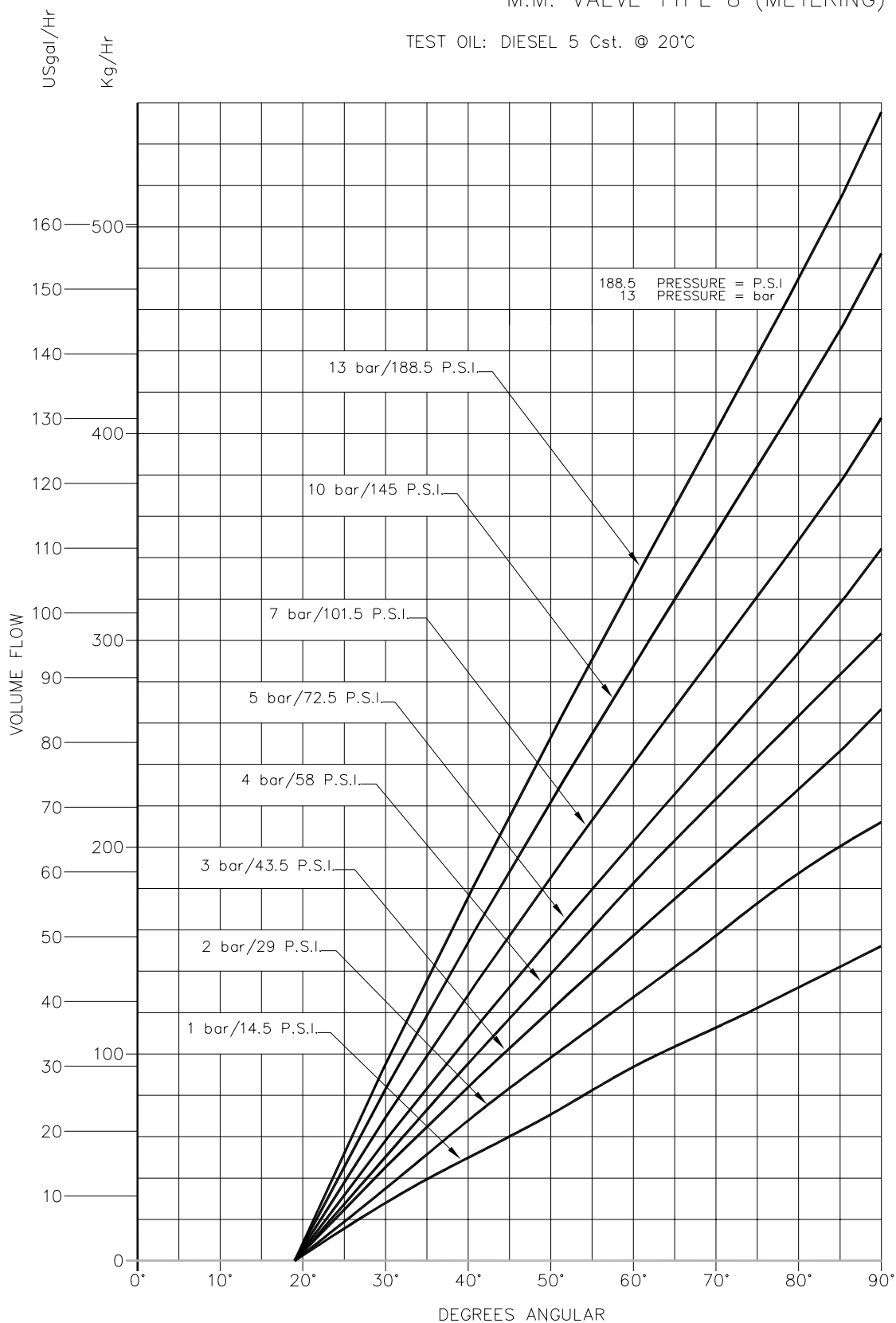
17:11:05/5044/JCF



17:11:05/5045/JCF

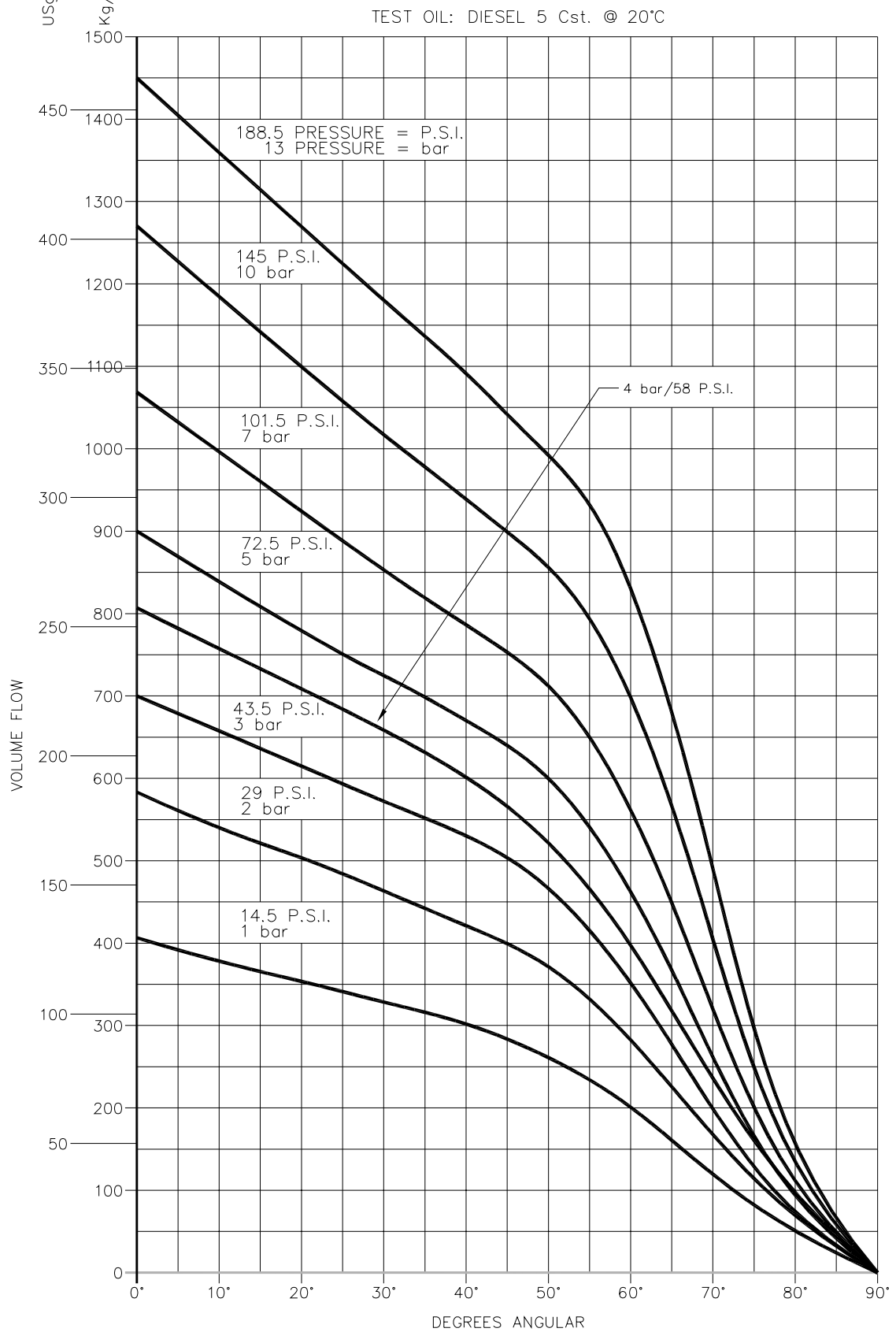
FLOW CHARACTERISTICS M.M. VALVE TYPE 8 (METERING)

TEST OIL: DIESEL 5 Cst. @ 20°C



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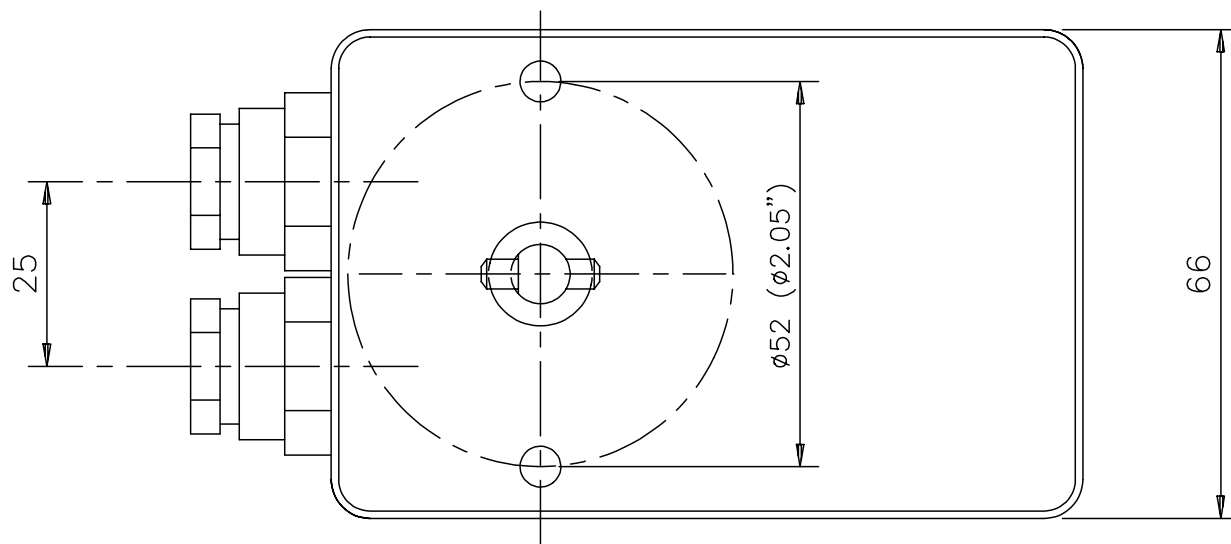
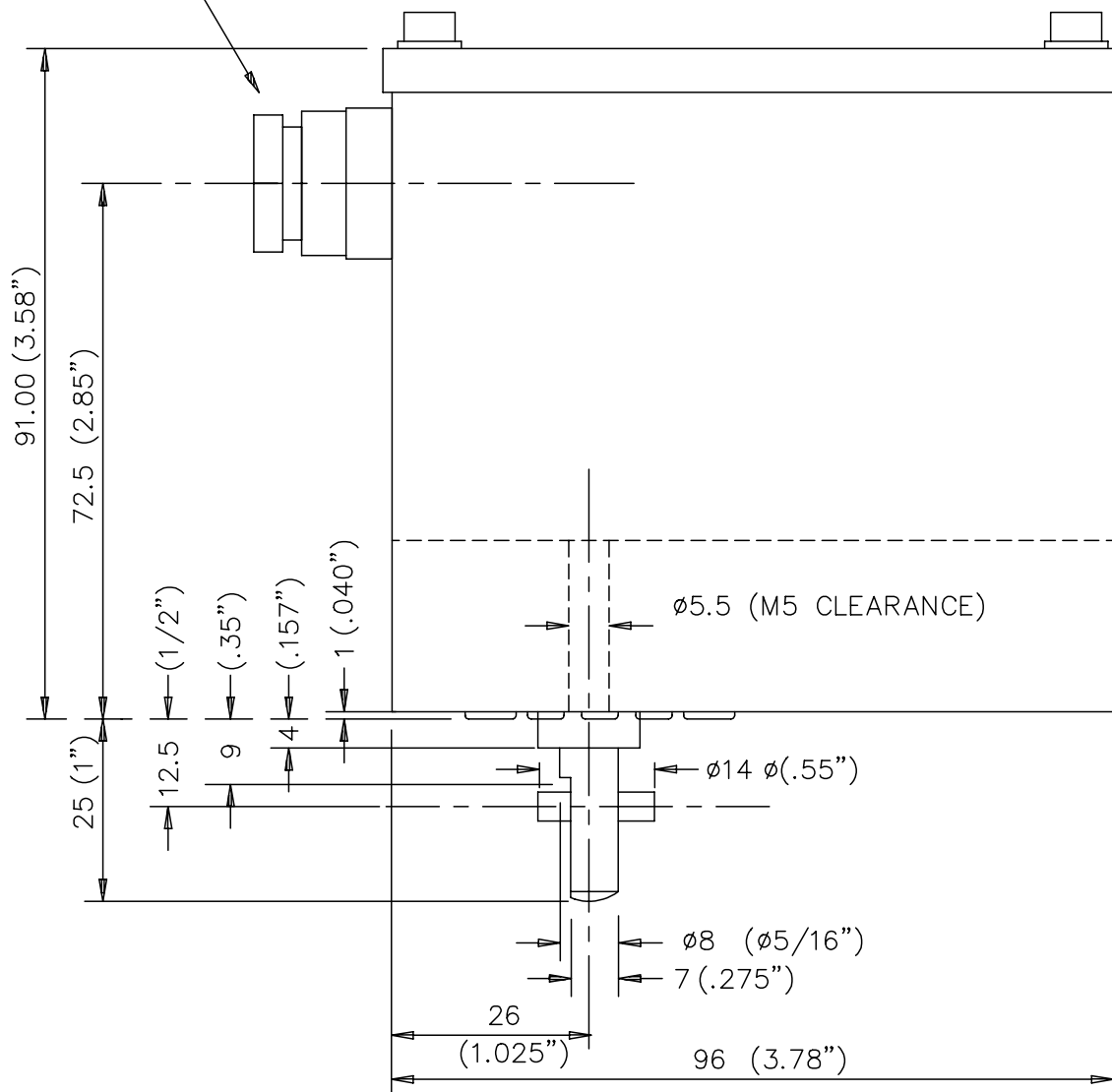
FLOW CHARACTERISTICS
M.M. VALVE TYPE 9 (SPILLBACK)

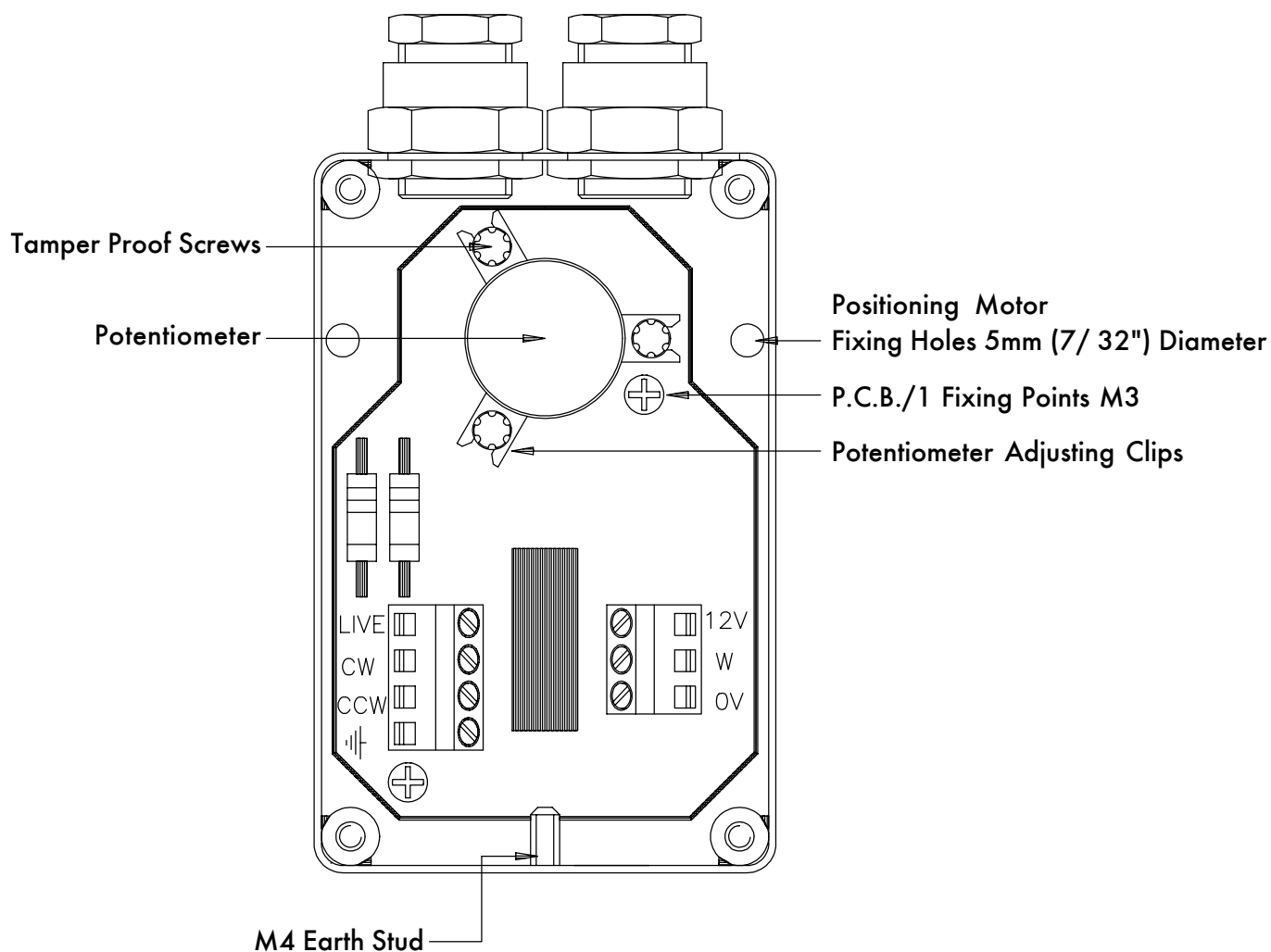


M.M./E.G.A. Peripherals

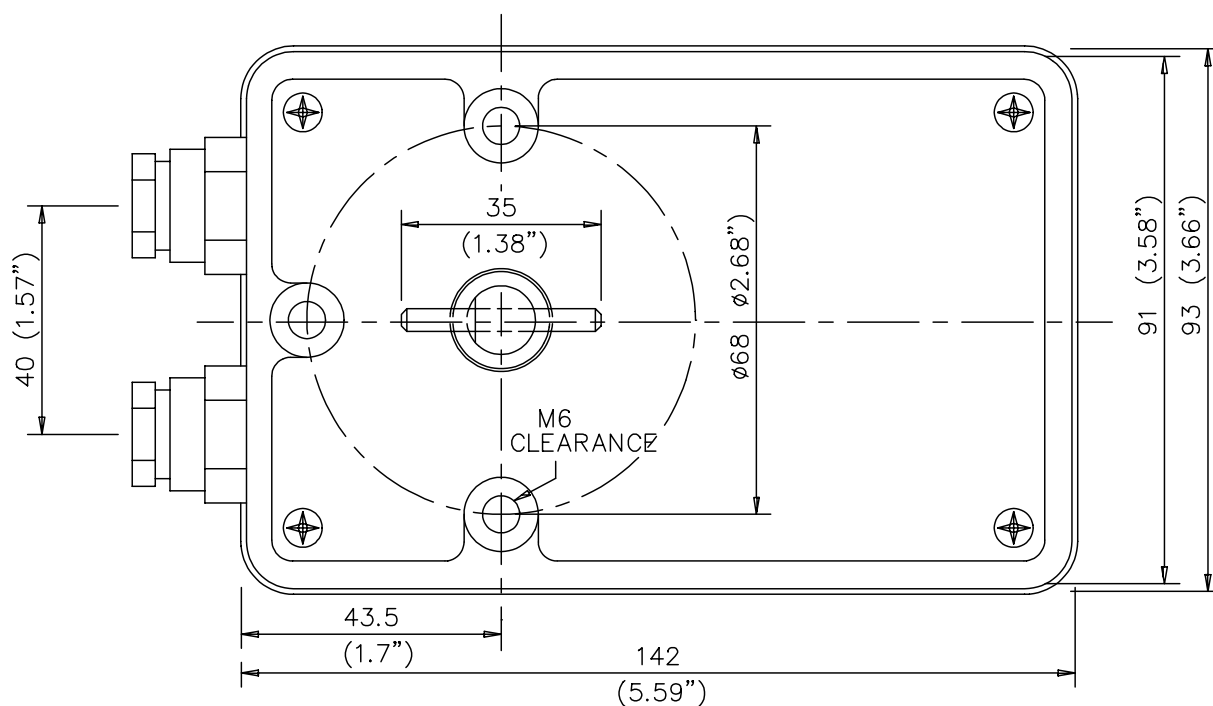
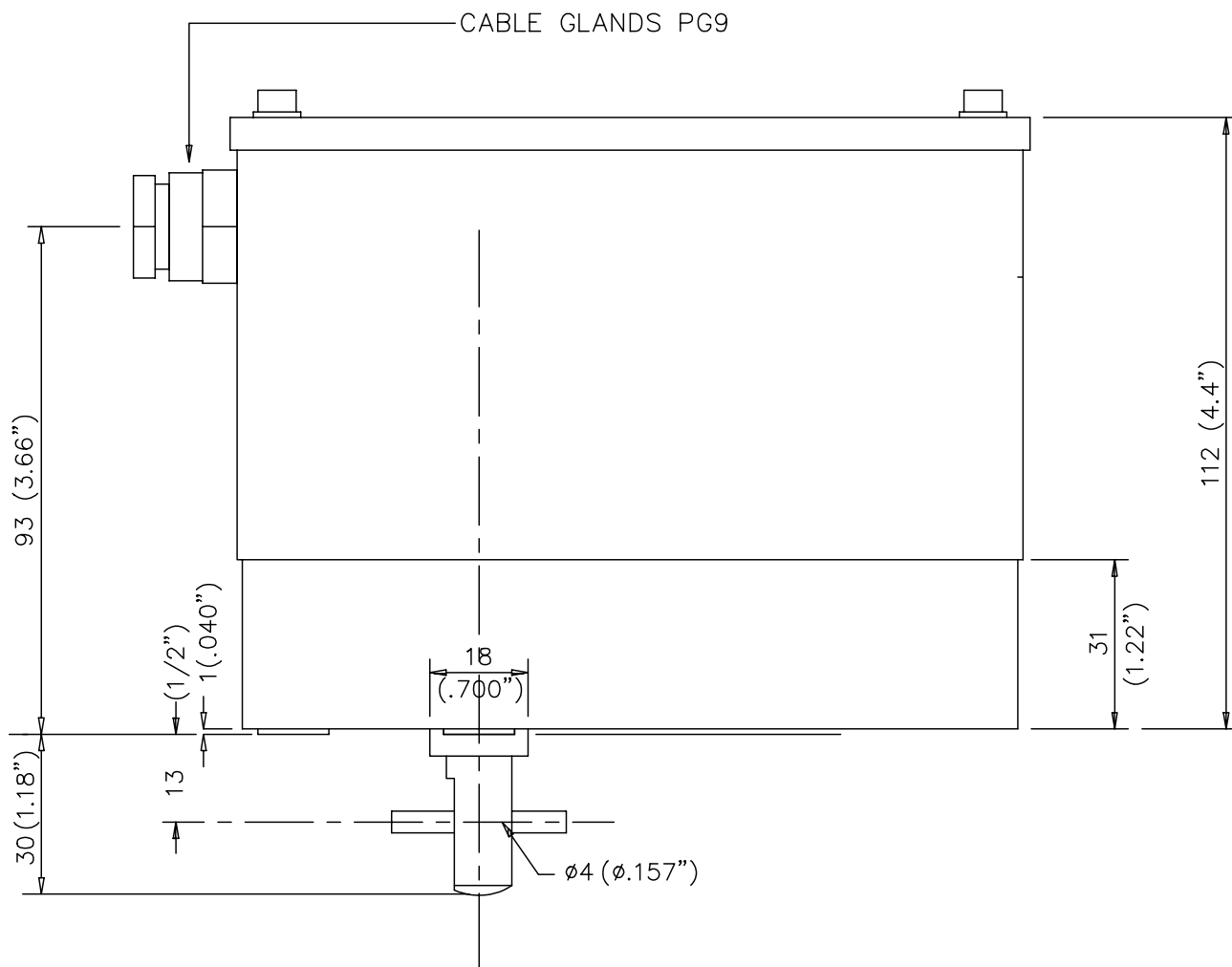
CABLE GLANDS
PG9

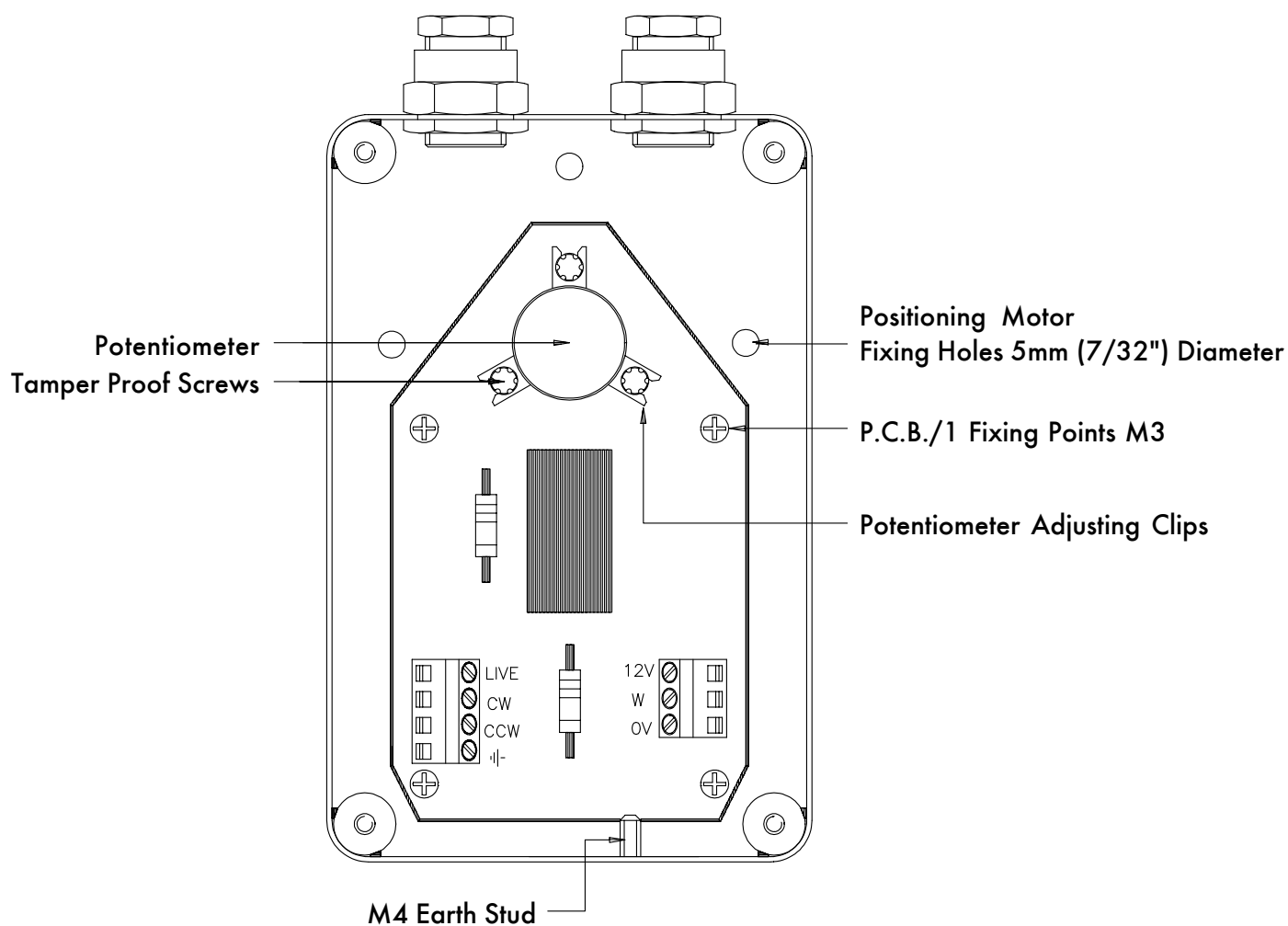
SMALL POSITIONING MOTOR
OUTLINE & MOUNTING DRAWING
PART No.MM10005





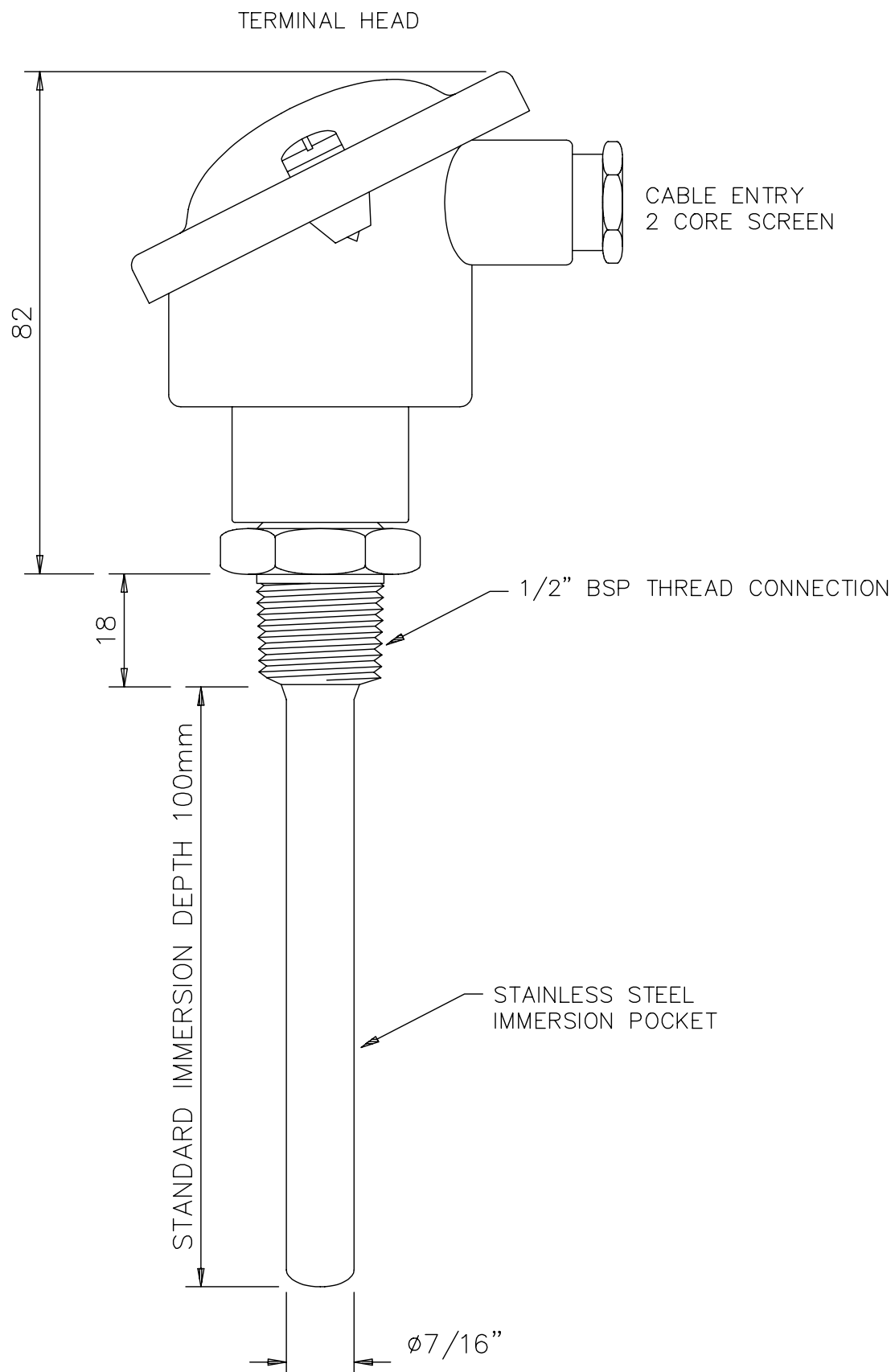
Specification	
Supply Voltage	24/230V, 50/60Hz
Output Shaft Torque	1.2Nm
Operating Angle	0-90°
Operating Time	Nominal 20 seconds
Max Rated Power	3W
Ambient Temperature	0°C to 60°C / 32°F to 140°F
Industrial Protection Rating	IP54 / NEMA 13
Mounting Angle	360°
Positioning	MM Drive
Drive Motor	Synchronous
Body Material	Mild Steel CR4
Coating	Interpon 700 Powder Coat
Weight	0.55kg
Dimensions	99x92x64mm
Wiring Connection	PG11 Gland



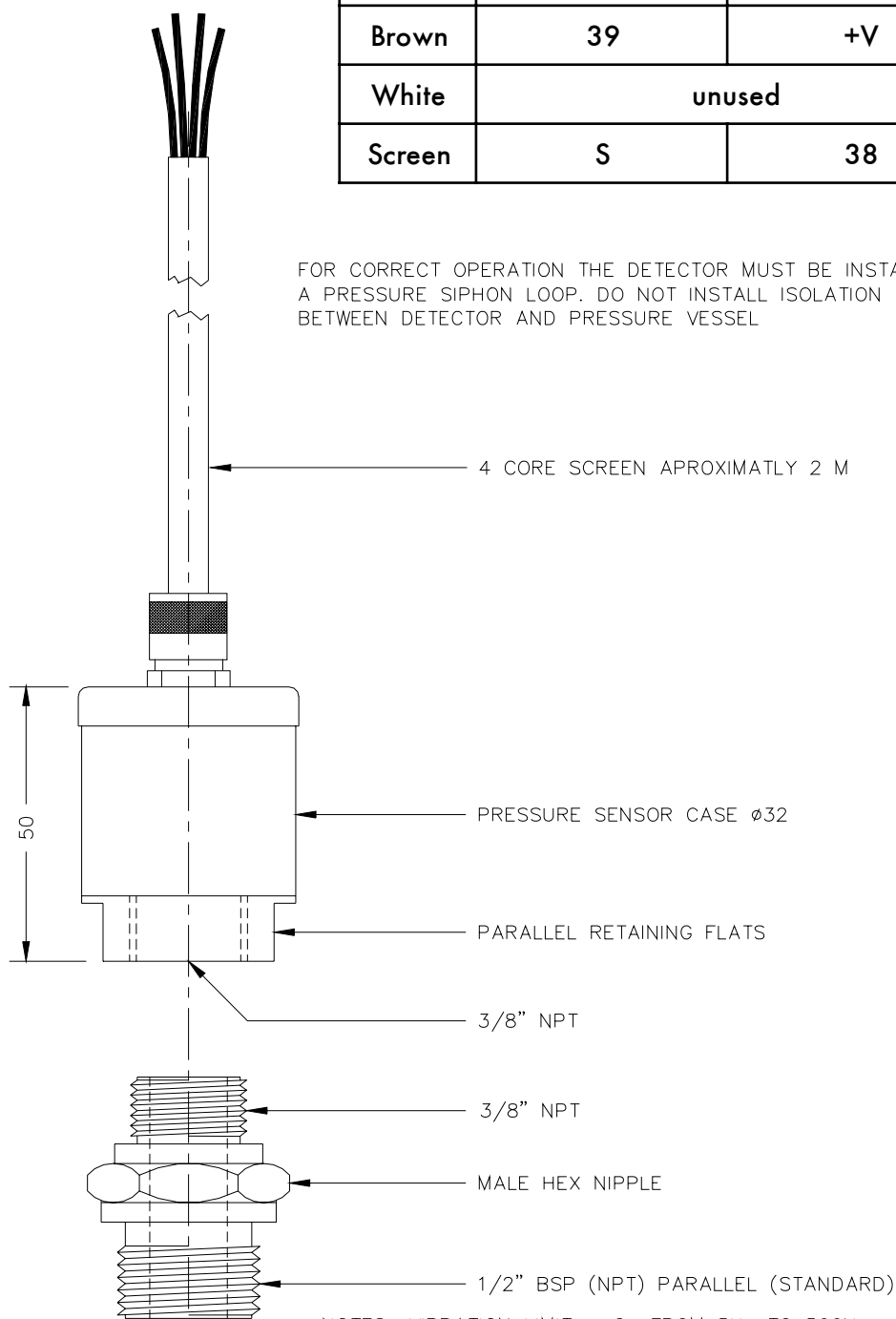


Specification	
Supply Voltage	24/230V, 50/60Hz
Output Shaft Torque	15Nm
Operating Angle	0-90°
Operating Time	Nominal 30 seconds
Max Rated Power	9W
Ambient Temperature	0°C to 60°C / 32°F to 140°F
Industrial Protection Rating	IP54 / NEMA 13
Mounting Angle	360°
Positioning	MM Drive
Drive Motor	Synchronous
Body Material	Mild Steel CR4
Coating	Interpon 700 Powder Coat
Weight	1.85kg
Dimensions	145x112x94
Wiring Connection	PG11 Gland

Autoflame Boiler Water Temperature Sensor
Part No. MM10006



Connections		
Sensor	Mk6/Mini Mk6	Mini Mk5
Green	38	61
Yellow	37	OV
Brown	39	+V
White	unused	
Screen	S	38



NB: Any physical damage to the stainless steel diaphragm may result in sensor failure. The maximum depth that a male fitting can be screwed into the sensor is 10mm.

NOTES: VIBRATION LIMIT = 2g FROM 5Hz TO 500Hz
I.P. RATING : 67 , SHOCK 50g
DO NOT TOUCH DIAPHRAGM.
DO NOT USE CASE TO TIGHTEN PRESSURE CONNECTION.
CABLE TYPE: 3-CORE SCREENED, 7/0.2 PVC INSULATED
OVERALL BRAID, PVC SHEATHED.
MAX. STORAGE TEMP. -55 TO +100 DEG. C
MAX. OPERATING TEMP. -40 TO +100 DEG. C
MEDIA TEMP (STEAM) -40 TO 125 DEG. C

20: 7: 99/3294/TF

8.10 INDUSTRIAL ACTUATOR

Part No. MM10072.

Overview/Outline

This system is a rotary type electric actuator, suitable for use with the M.M. module.

WARNING Must NOT be used without relays, and requires software version 309.

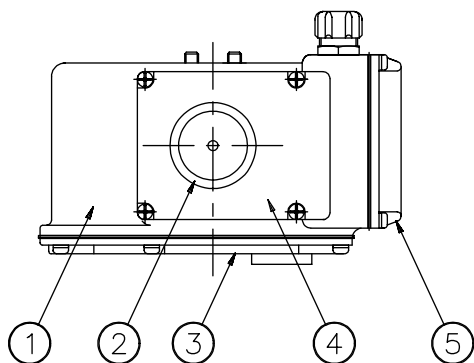
The body is made with aluminium die-cast, thus it is light, compact, highly efficient and powerful.

*** Features ***

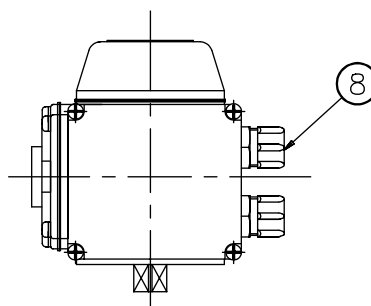
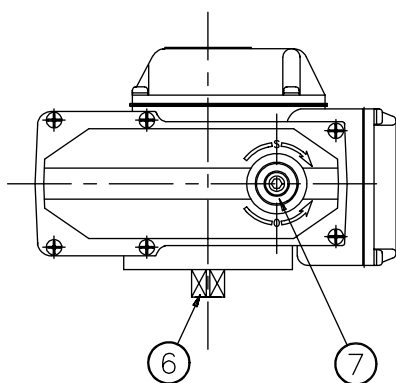
- * Light and compact.
- * Easy to handle and suitable for use in narrow spaces.
- * Simple structure design.
- * Trouble free mounting on air damper, maintenance and testing.
- * Manual operation function.
Manual operation is possible when the power is disconnected, with the attached manual crank handle.
- * 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

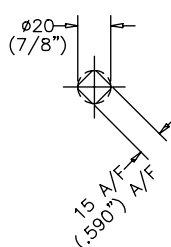
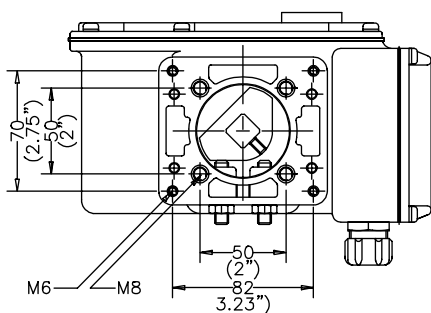
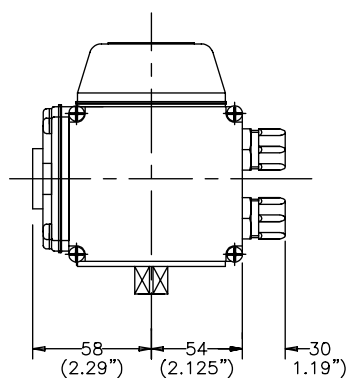
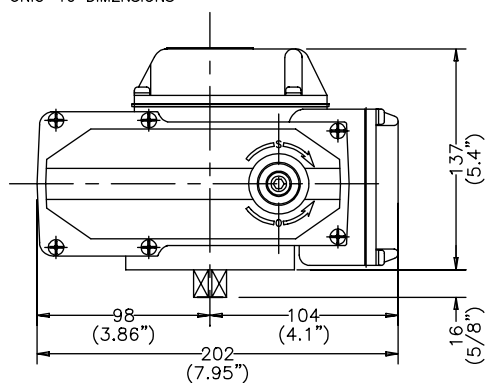
Appearance and Nomenclature



No.:	Name:
1	Body
2	Autoflame Feedback Potentiometer
3	Drive unit cover
4	Power Instruments cover
5	Control unit cover
6	Output shaft
7	Manual handle shaft
8	Cord lock



UNIC-10 DIMENSIONS



8.10.2 Specification

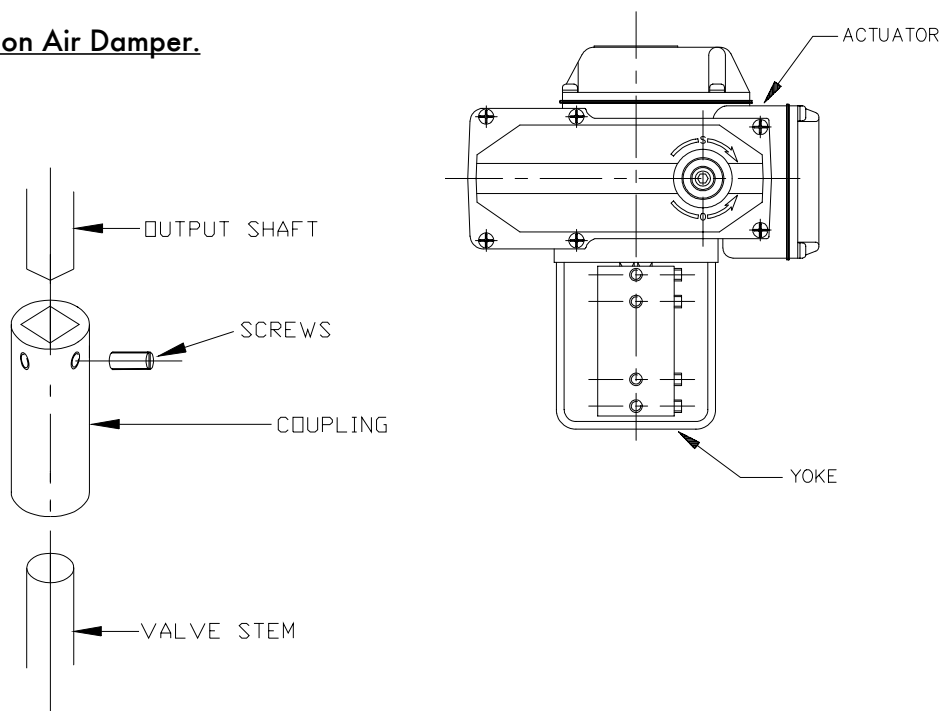
Type	UNIC 10/30
Power	220/240 VAC 50/60Hz(110V 60Hz)
Output Shaft Torque	10kg fm
Operating Angle	0-90°
Operating Time	30 sec/50Hz
Protect System	THERMAL PROTECTOR BUILT-IN
Ambient Temperature	-25°C - 50°C
Rated Power	0.4 A/100V
Insulation Resistance	100M W/500 V DC
Withstand Voltage	1500 V AC / Minute
Manual Operation	Crank Handle Attached
Stopper	Mechanical Stopper Open/Close Adjustable.
Enclosure	IP65 / NEMA 4
Mounting Angle	360° All Directions.
Positioning	M.M. Drive.
Drive Motor	20 W/E Type
Body Material	Aluminium Die-cast ADC12
Coating	Baking Varnish
Weight	4.5kg
Wiring Conduit	PF1/2 x1 Resin Connector Attached.

8.10.3 Installation

Place

- * Ambient temperature: Within -25°C to $+55^{\circ}\text{C}$ (-13°F. to $+131^{\circ}\text{F.}$)
- * Avoid hazardous ambience.
- * Depending on the condition of installation, consider to reserve spaces for wiring conduit cover, and manual maintenance works.

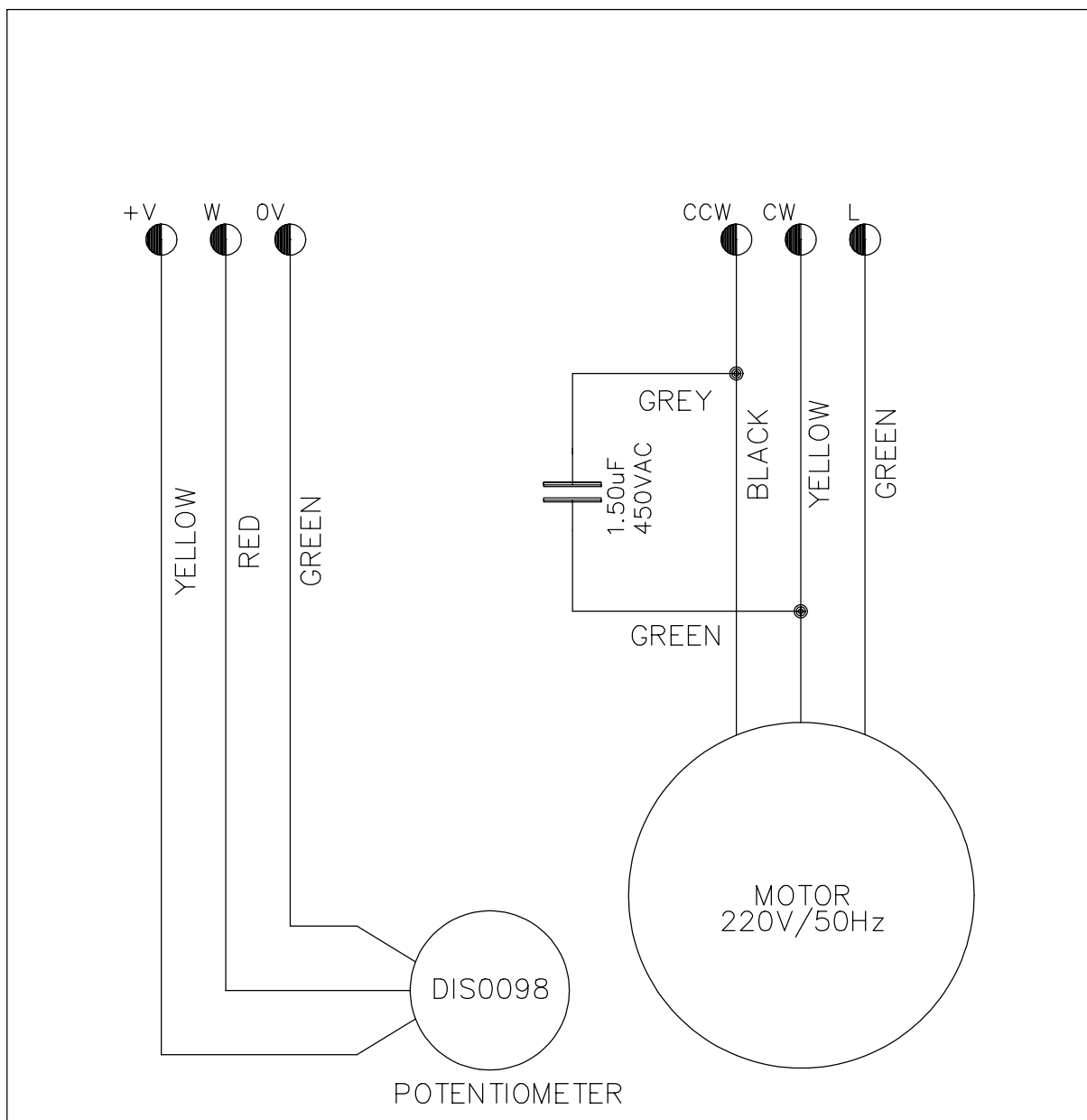
1. Mounting on Air Damper.



- * 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 and no decentering/inclination, by turning the manual handle.

8.10.3.1 Positioning Motor Connections

SERVO WIRING DIAGRAM FOR
UNIC 10 SERVO MOTOR

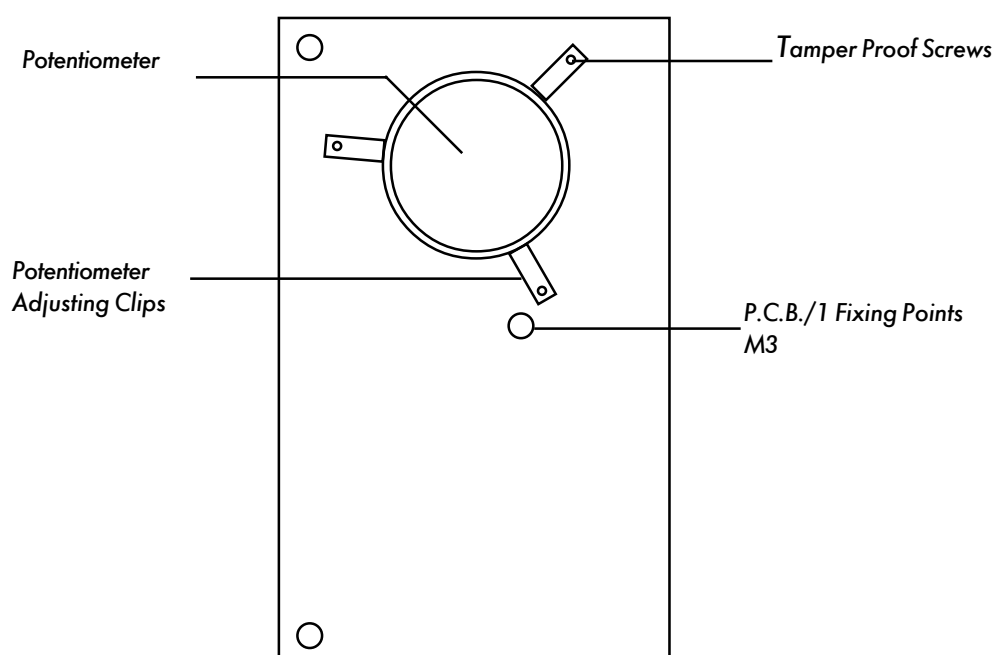


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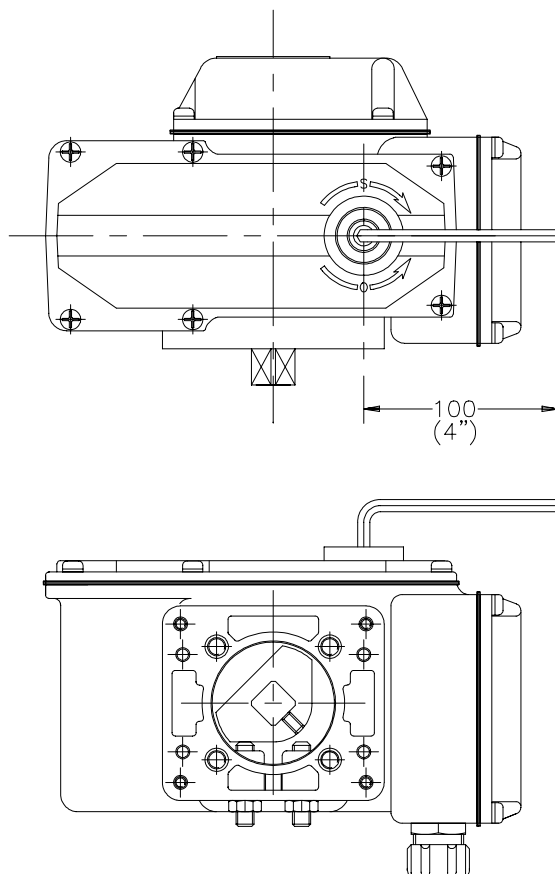
8.10.3.3 Positioning Motor

IMPORTANT NOTE:

TO ADJUST POTENTIOMETER LOOSEN TAMPER PROOF SCREWS, AFTER ADJUSTMENT DO NOT OVER TIGHTEN. USE FINGERS ONLY TO ADJUST POSITION OF POTENTIOMETER. DO NOT RAISE POTENTIOMETER FROM P.C.B.



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 to CLOSE direction.

Do not overturn the handle with an excessive strength, as otherwise, it may cause trouble with the other parts.

Dimensions of Manual Handle

Opposite side of hexagon (mm)	5
Number of turns	15
Length of handle (mm)	100

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, it is suggested to have a periodical test and check if there is no irregularity.

8.10.5 Troubleshooting

<u>Trouble</u>	<u>Probable Cause</u>	<u>Solution</u>
<u>Motor does not start</u>		
* Power switch is off		* Switch on
* Wire/terminal are broken or disconnected.		* Replace the wire or properly connect the terminal.
* Supplied voltage is too low or improper.		* Check the voltage with a tester.
* Effect of thermal protector (Due to a high ambient temp. or damper jammed).		* Lower the ambient temperature, or manually make test of open/close movement.

Section 9: Miscellaneous Component Information

9.1 Parts List

- 9.1.1 MM Control Units and UV Flame Scanners
- 9.1.2 Air/Gas/Oil Pressure Sensors
- 9.1.3 Boiler Load Detectors
- 9.1.4 Servo Motors
- 9.1.5 E.G.A. Components
- 9.1.6 Inverter, Splitter and Interface Modules
- 9.1.7 DTI Modules and PC Software and Accessories
- 9.1.8 Water Level Control Equipment
- 9.1.9 Oil Control Valves
- 9.1.10 Gas Control Valves- Screwed
- 9.1.11 Gas Control Valves- Flanged
- 9.1.12 Sundries and Spare Parts
- 9.1.13 MM System Spares and UV Scanner Spares
- 9.1.14 E.G.A. Spares and Gas/Oil Valve Spares
- 9.1.15 DTI Spares and Servomotor Spares
- 9.1.16 Demo/Test Equipment

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 Module, 230V	3.5	MMM50016
Mini Mk5 MM Module, 120V	3.5	MMM50016/110
Mini Mk5 MM Evolution Module, 230V	2.5	MMM5002/E
Mini Mk5 MM Evolution Module, 120V	2.5	MMM5002/E/110
Mk5 MM Module, 230V	3.2	MM50001
Mk5 MM Module, 120V	3.2	MM50001/110

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

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

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, 0-18 Bar	0.21	MM10008
Pressure Detector, 0-30 Bar	0.21	MM10009
Pressure Detector, 0-2 Bar	0.21	MM10010
Pressure Detector, 0-100 Bar	0.21	MM10017
Pressure Detector, 0-267 PSI	0.21	MM10008U
Pressure Detector, 0-435 PSI	0.21	MM10009U
Pressure Detector, 0-45 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 50/60Hz	0.55	MM10005/D
Industrial Servo Motor 10, 230V + Relay Kit	4	MM10072
Industrial Servo Motor 10, 120V + Relay Kit	4	MM10072/110
Industrial Servo Motor 20, 230V + Relay Kit	6	MM10074/B
Industrial Servo Motor 20, 120V + Relay Kit	6	MM10074/B/110
Industrial Servo Motor 40, 230V + Relay Kit	8	MM10078
Industrial Servo Motor 40, 120V + Relay Kit	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
E.G.A. Sampling System Mk6, 230V	11	MM60002 EGA20001
E.G.A. Sampling System Mk6, 110V	11	MM60002/110 EGA20001/110
E.G.A. Sampling Probe (0-400 °C)	1	EGA20002
E.G.A. Remote Display Pod	0.7	EGA20003
SO2 Sensor + Extra Pump (factory fitted)	0.2	EGA20008
NO Sensor (factory fitted)	0.2	EGA20005
NO2 Sensor (factory fitted)	0.2	EGA20009
Bubble Pot Acid Filtration System	15	EGA20102
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.
Inverter Interface Module, 230V	0.65	MM10011
Inverter Interface Module, 120V	0.65	MM10011/110
Splitter Module, 230V	0.65	MM10012
Splitter Module, 120V	0.65	MM10012/110
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	0.25	DTI60100/MD

PC Software and Accessories

Description	KGs	Part No.
MM Infrared Upload/Download Software and IR Lead	0.13	MM60010
M.M. to P.C. Software and Lead	0.5	DTI20017
E.G.A. to P.C. Software and Lead	0.5	DTI20018
I.I.F. to P.C. Software and Lead	0.5	DTI20019
DTI-PC Communication Lead- Standard Serial Lead	0.25	DTI60022
DTI-PC Communication Line Driver and Lead	0.5	DTI20012
I/O-PC Set-Up Lead	0.25	DTI20022

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 Assembly, 230V	3	TDS60001
Surface Blowdown, TDS Probe and Assembly, 120V	3	TDS60001/110
Feed Water Valve, PN16 20mm with Servo Motor Replacement Valve	9 5	WLCVA5/20 WLCV20
Feed Water Valve, PN16 25mm with Servo Motor Replacement Valve	10 6	WLCVA5/25 WLCV25
Feed Water Valve, PN16 40mm with Servo Motor Replacement Valve	13 7	WLCVA10/40 WLCV40
Feed Water Valve, PN16 50mm with Servo Motor Replacement Valve	14 8	WLCVA10/50 WLCV50
Feed Water Valve, ANSI 300lb, 0.75" with Servo Motor Replacement Valve	9 6	WLCVA5/20/U WLCV20/U
Feed Water Valve, ANSI 300lb, 1" with Servo Motor Replacement Valve	10 7	WLCVA5/25/U WLCV25/U
Feed Water Valve, ANSI 300lb, 1.5" with Servo Motor Replacement Valve	13 8	WLCVA10/40/U WLCV40/U
Feed Water Valve, ANSI 300lb, 2" with Servo Motor Replacement Valve	14 9	WLCVA10/50/U WLCV50/U

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

Sundries 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
Screened 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
Mounting Bracket for Feed Water Valve and Servo For MM10070	0.8	SP10028WL/05
Mounting Bracket for Feed Water Valve and Servo For MM10072	0.8	SP10028WL/10

Demo/Test Equipment

Description	KGs	Part No.
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
DTI Demo Case, 230V	12	MM10027
DTI Demo Case, 120V	12	MM10027/110
Mk6 Protection Test Tool	0.5	MM6000TB

Miscellaneous Component Information

Section 10: Appendix

10.1 Terms and Conditions

10.3 Patent Number Information Relevant to the System

10.4 International Type Approvals Information

10.5 Conversion Data

10.5.1 Calorific Fuel Data

10.5.2 Gas Volume Conversion Factors

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 separately on request.

All terms and conditions are subject to English law.

Appendix

10.3 Patent Numbers Relevant to the System

Patent No.:	Product:	Applicable Country:	
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.	
6024561	UV Scanner	USA	
1022515	UV Scanner	Europe-	U.K. Germany France Holland Italy
6520122	Water Level Control Steam Flow Metering Turbulence (pending)	USA	
1384944	Water Level Control Steam Flow Metering Turbulence	Europe-	U.K. Germany France Holland
	Surface Blowdown (pending)	USA UK	



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


A handwritten signature in black ink, appearing to read 'P. J. Cooper'.

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

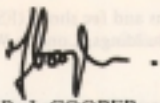


CERTIFICATE OF GRANT OF UNITED KINGDOM PATENT

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".

PROCEDURE FOR PAYMENT OF FEES

Dated this Twenty-ninth day of October, 1986


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)
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London
WC1V 7LH

A 226031



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Affaires commerciales Canada

Patent Office

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Canadian Patent

Brevet canadien

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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 a été délivré le:

Date MAY - 4 1993


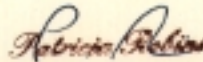


Canada

Commissioner of Patents - Commissaire des brevets



7530-21-000-0000 (5-93) 41

<p>Europäisches Patentamt</p>	<p>European Patent Office</p>	<p>Office européen des brevets</p>						
								
<p>URKUNDE</p>	<p>CERTIFICATE</p>	<p>CERTIFICAT</p>						
<p>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.</p>	<p>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.</p>	<p>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.</p>						
<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Europäisches Patent Nr.:</td> <td>Q195866</td> </tr> <tr> <td>European patent No.:</td> <td></td> </tr> <tr> <td>Brevet européen n°:</td> <td></td> </tr> </table>			Europäisches Patent Nr.:	Q195866	European patent No.:		Brevet européen n°:	
Europäisches Patent Nr.:	Q195866							
European patent No.:								
Brevet européen n°:								
<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Patentinhaber:</td> <td>Autoflame Engineering Limited</td> </tr> <tr> <td>Proprietor of the patent:</td> <td>Unit 19, Bellingham Trading Estate</td> </tr> <tr> <td>Titulaire du brevet:</td> <td>Franthorne Way Bellingham London SE6 3BX/GB</td> </tr> </table>			Patentinhaber:	Autoflame Engineering Limited	Proprietor of the patent:	Unit 19, Bellingham Trading Estate	Titulaire du brevet:	Franthorne Way Bellingham London SE6 3BX/GB
Patentinhaber:	Autoflame Engineering Limited							
Proprietor of the patent:	Unit 19, Bellingham Trading Estate							
Titulaire du brevet:	Franthorne Way Bellingham London SE6 3BX/GB							
<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">München, den</td> <td>29.05.91</td> </tr> <tr> <td>Munich,</td> <td></td> </tr> <tr> <td>Fait à Munich, le</td> <td></td> </tr> </table>			München, den	29.05.91	Munich,		Fait à Munich, le	
München, den	29.05.91							
Munich,								
Fait à Munich, le								
<div style="display: flex; align-items: center;">  <div> <p>.....</p> <p>Generaldirektion 2 – Formalprüfungsstelle Directorate-General 2 – Formalities Section Direction générale 2 – Section des formalités</p> </div> </div>								
<p>EPA/EPO/OEB Form 2031 03.83</p>								



THE EUROPEAN NETWORK FOR QUALITY SYSTEM ASSESSMENT AND CERTIFICATION

This is to state that

AUTOFLAME ENGINEERING LTD

holds the Quality System Certificate

FM 27218

*for the standard from the
ISO 9000 / EN 29000
series, and the scope as specified therein*

Signed for and on behalf of EQNet member



DATE: 2 September 1994

NUMBER: E10142/94

EQNet members are:

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The issuing member holds all other EQNet members harmless for any claims arising from the existence of this document

Certificate of Registration



Certificate Number FM 27218

AUTOFLAME ENGINEERING LTD
UNIT 19
BELLINGHAM TRADING ESTATE
FRANTHORNE WAY
BELLINGHAM
LONDON SE6 3BX

operate a quality management system which complies with the requirements
of BS EN ISO 9001:1994



Signed on behalf of BSI, N Overton, General Manager

Originally registered 04 February 1994 Amended on 28 May 1998

This certificate remains the property of British Standards Institution and shall be returned immediately upon request. This certificate does not expire. To check its validity telephone +44 (0) 2908 227700.
To be read in conjunction with attached Appendix.

The British Standards Institution is incorporated by Royal Charter.
BSI 389 Chiswick High Road London W4 4AL






Accredited by the Dutch
Council for Certification


Registration Number 003
ENIS Issue 5

EC TYPE-EXAMINATION CERTIFICATE			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.			
 <small>Centre of Gas Technology</small> GASTEC NV P.O. Box 137 7300 AC Apeldoorn The Netherlands Wilhelmsdijk 50 7327 AC Apeldoorn			

Number E 0455			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.			
		<small>GASTEC NV P.O. Box 137 7300 AC Apeldoorn The Netherlands Wilmsdorf 50 7327 AC Apeldoorn</small>	 <small>RvC</small>
<small>00/428</small>			

Number E 0455			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			
		<small>GASTEC NV P.O. Box 137 7300 AC Apeldoorn The Netherlands Willemoord 50 7327 AC Apeldoorn</small>	 <small>RvC</small>
<small>00/443</small>			

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<p>AUTOFLAME ENGINEERING LTD SOFTWARE ENGINEER BELLINGHAM TRADING ESTATE UNIT 19 FRANTHORNE WAY BELLINGHAM LONDON SE6 3BX ENGLAND UNITED KINGDOM</p>		
<p>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.</p>		
MJAT	March 18, 1997	
<p>Miscellaneous, Heating and Heating-Cooling Appliance Accessories</p>		
<p>AUTOFLAME ENGINEERING LTD 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.</p>		MH16179 (N)
<p>LOOK FOR LISTING MARK ON PRODUCT</p>		
<p>Replaces MH16179 dated October 31, 1996. 456637001</p>	<p>Underwriters Laboratories Inc.®</p>	<p>K11/0275474 24</p>
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YIOZ April 23, 1996
Valves, Electrically Operated

AUTOFLAME ENGINEERING LTD , SE6 3BX
ENGLAND UNITED KINGDOM

MH19399 (N)
(A card)

General purpose valves.

General purpose valves, Part No. MM10004 actuator with valve Part No. OVM33L17, OVM34L18, OVM37L21, OVS33L17, OVS34L18, OVS37L21, GVF46528/50, GVF48027/50, GVF410028/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part No. OVM33L17 and GVF46528/50, GVF48027/50, GVF410028/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVM34L18 and GVF46528/50, GVF48027/50, GVF410028/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVS33L17 and GVF46528/50, GVF48027/50, GVF410028/50, GVF12527/50, GVF415028/50 or GVF420028/50; or with valve Part Nos. OVS37L21 and GVF46528/50, GVF48027/50, GVF410028/50, 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,

456637001

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YIOZ April 23, 1996
Valves, Electrically Operated

AUTOFLAME ENGINEERING LTD

MH19399 (N)

(B-cont. from a card)
OVS35019, OVS38020, OVS38022, OVS39023, GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30, GV415028/30; or with valve Part Nos. OVM31015 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVM32016 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVM35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVM38020 and GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVM38022 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVM39023 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVS32016 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVS35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30; or with valve Part Nos. OVS35019 and GV42521, GV44022, GV45023, GV46524, GV48025, GV46526/30, GV48027/30, GV410026/30, GV410028/30, GV412527/30 or GV415028/30;

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SOFTWARE ENGINEER
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BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

Y10Z 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, GV48524, GV48025,
GVF46526/30, GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve
Part Nos. OVS36020 and GV42521, GV44022, GV45023, GV48524, GV48025, GVF46526/30,
GVF48027/30, GVF410026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos.
OV38022 and GV42521, GV44022, GV45023, GV48524, GV48025, GVF46526/30, GVF28027/
30, GVF10026/30, GVF12527/30 or GVF415028/30; or with valve Part Nos. OVS39023 and
GV42521, GV44022, GV45023, GV48524, GV48025, GVF46526/30, GVF48027/30,
GVF410026/30, GVF12527/30 or GVF15028/30.

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AUTOFLAME ENGINEERING LTD
SOFTWARE ENGINEER
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY
BELLINGHAM LONDON
SE6 3BX ENGLAND UNITED KINGDOM

YSY12 April 23, 1996
Component – Valve Parts, Electrically Operated

AUTOFLAME ENGINEERING LTD
BELLINGHAM TRADING ESTATE UNIT 19
FRANTHORNE WAY BELLINGHAM LONDON , SE6
3BX ENGLAND UNITED KINGDOM

MH19400 (N)

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, 410026/50, 12527/50,
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.

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01/0297305
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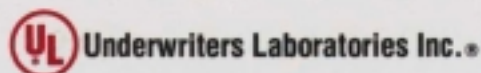
A not-for-profit organization dedicated to public safety and committed to quality service

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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
Controls, Primary Safety

July 7, 1998

AUTOFLAME ENGINEERING LTD
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.
MH25659 (N)
LOOK FOR LISTING MARK ON PRODUCT

456637001

Underwriters Laboratories Inc.®

K11/0348251
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For information on placing an order for UL Listing Cards in a 3 x 5 inch card format, please refer to the enclosed ordering information.

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10.4.11 Additional Approvals

Approval No.:

Product:

Applicable Type
Approval Authority:

MH25659

Mk6 Burner Management System

UL, CUL, UR



0063AT5181

Mk6 Burner Management System

CE



TU 12/94 0167

Mk5. M.M./E.G.A. System

T.U.V. Bayern e.v.

TU 12/96 171

Mini M.M./E.G.A. System

T.U.V. Bayern e.v.



10.5 CONVERSION DATA

10.5.1 Calorific Fuel Data

Stats	Kerosene SG	Gas Oil CI/SH
Relative density 15.6°C (60°F) approx. / = litres x = kg	0.79	0.835
Flash point (closed) min °C (°F)	37.8 (100)	65.6 (150)
Viscosity kinematic (cSt) at 15.6°C (60°F) approx.	-	-
37.8°C (100°F) approx.	2.0	-
82.2°C (180°F) approx.	-	3.0
Equivalent Redwood No.1 Viscosity at 37.8°C (100°F)	-	33 approx
Freezing point °C / °F	Below -40	Below -40
Cloud point °C max	-	-2.2
Gross calorific values KJ/kg approx.	46,520	45,590
Btu/lb approx.	20,000	19,600
KWh/litre approx.	10.18	10.57
Therms/gallon approx.	1.58	1.64
kW/kg	-	12.66
Sulphur content % wt.	0.2	0.6
Water content % vol.	Negligible	0.05
Sediment content % wt	-	Negligible
Ash content % wt	-	Negligible
Mean specific heat between 0°C - 100°C approx.	0.50	0.49
Volume correction factor per 1°C	0.00083	0.00083
Volume correction factor per 1°F	0.00046	0.00046
Btu/U.S. gallon (US standard)	-	140,000
Lb/U.S. gallon (US standard)	-	7.01
% lighter than water		20%
1 u.s. Gallon of oil / ft of air		1402

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 ₂ O	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:-

$$\text{Firing rate} = (\text{Measured Volumetric flow per minute} * 60 * \text{Conversion factor} * 1000) \text{ Btu/hr}$$

