

Test Report 8184347.


Autoflame Eng Ltd

Introduction.

This report has been prepared by Mustanir Ali and relates to the activity detailed below:

Job/Registration Details	Client Details
Job number: 8184347 Job type: Review Start Date: 21/07/2014 Test type: Certification Sample ID: 010836 Registration: CE 617229 Scheme: GAD 2009/142/EC Annex II.1 Protocol: PP 441 Scheme Mgr: Robert Floyd	Autoflame Engineering Ltd Unit 1-2, Concorde Business Centre Airport Industrial Estate Wireless Road Biggin Hill Westerham TN16 3YN United Kingdom

The report has been approved for issue by Krishna Patel – Team Leader.

Approved For Issue	
	Issue Date: 27 th July 2015

Product Scope.

Mk7 M.M. electronic fuel/air ratio control with integrated burner control.

Objectives.

Document review and limited testing of Mk7 M.M. software and hardware changes for continued compliance to BS EN 298:2003 Automatic gas burner control systems for gas burners and gas burning appliances with or without fans.

The Mk7 M.M. has previously been tested to BS EN 298:2003, please see GL test report **TR/09/208**.

Report Summary.

Relevant documentation and a type sample of the above control has been tested and examined to the relevant requirements of the above specification and has been found to continue to comply with these requirements as reported in GL test report **TR/09/208**, subject to the implementation of any corrective actions detailed in this test report.

Test Samples.

Sample Id	ER Number	Description
1	010836	Mk7 M.M. and test rig
2	011027	Mk7 M.M PCB assembly

Description of Documents.

Document no. / reference	Issue/date	Description
Hardware updates	24/09/2014	Variation notification for Updates to Autoflame Hardware
Software updates	12/06/2014	Variation notification for Updates to Autoflame Software
Software updates	07/07/2014	Variation notification for Updates to Autoflame Software
Software updates	15/05/2015	Variation notification for Updates to Autoflame Software
Software updates	22/06/2015	Variation notification for Updates to Autoflame Software
7012 Rev 2a 1of2	Rev 2a	Board 7012 schematic sheet 1
7012 Rev 2a 2of2	Rev 2a	Board 7012 schematic sheet 2
7012 2a TL	Rev 2a	Board 7012 PCB layout Top Layer
7012 2a BL	Rev 2a	Board 7012 PCB layout Bottom Layer
7013 Rev 2 Top Layer	Rev 2	Board 7013 PCB layout Top Layer
7013 Rev 2 Bottom Layer	Rev 2	Board 7013 PCB layout Bottom Layer
Continuous Pilot Sequence with intermittent Pilot	28/04/2015	Programme sequence flowchart for continuous pilot with intermittent pilot
Continuous Pilot Sequence with interrupted Pilot	28/04/2015	Programme sequence flowchart for continuous pilot with interrupted pilot

Test Equipment.

Number	Description	Cal Due Date
9000609	PJ300 profile projector	25/11/2015
125.0069	Temp/humidity sensor	-
201.0003	Barometer	11/03/2016
3200795	Multimeter	28/08/2015
9621.0417	Stopwatch	24/03/2017
9622.0004	Variac	-

Description of Test Samples.

The Autoflame Mk7 Micro Modulation system is a touch screen electronic fuel/air ratio control with integrated burner control.

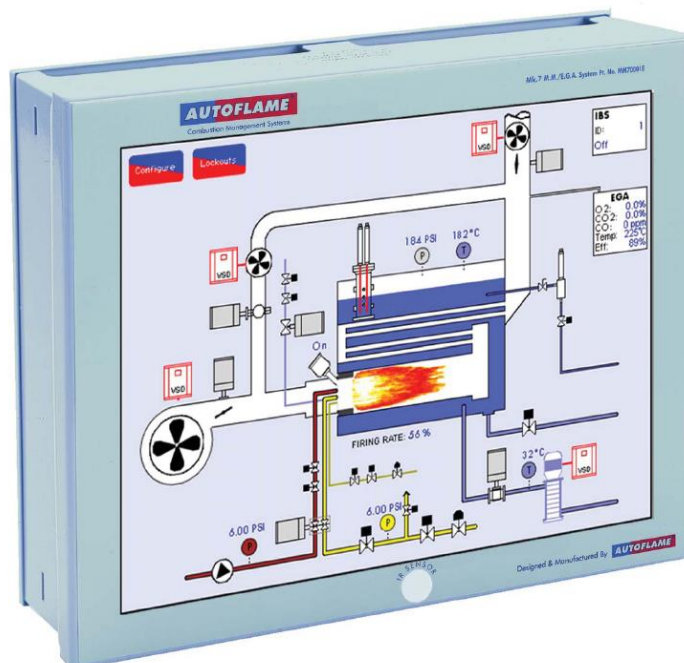
The Mk7 MM is based on a previously assessed Mk6 MM control, the safety critical hardware and software is identical to the Mk6. The Mk7 has been upgraded to include a full colour touch screen and extra circuitry for better de-coupling and EMC on power supply.

In addition to the Mk7 providing control over a burner motor, pilot valve and main gas valves the unit has four actuator outputs intended to control fuel, air and auxiliary servo-valves. The position of these valves is fed back to the unit via potentiometers incorporated in the servo units.

Ignition is provided by the connection of an external ignition transformer to the relevant output of the control, following ignition the flame presence can be sensed via an ionisation based, IR flame sensor or UV flame sensor (specified in software on commissioning).

The unit has provision for the connection of an external EGA unit (Exhaust Gas Analyser), Valve proving system, Water level system, Steam pressure sensor and temperature sensor.

The control is supplied at mains voltage which can be selected as either 120V or 230V AC, protection against electric shock is provided by incorporating the unit in a cabinet or other housing (not provided by Autoflame – the user must mount the control in an enclosure according to their own requirement).



Declared Data.

Name of manufacturer	Autoflame Engineering Ltd
Type number/model reference	Mk7 Evolution M.M.
Mode of Operation	Permanent / Non-Permanent (switchable)
Lockout Type	Non-Volatile
Rated supply voltage	120V~ or 230V~ options available; 50/60Hz
Protection class of housing	Front facia IP65 Back facia IP20
Range of ambient temperatures	0°C - 40°C
Start-gas valve output rating	230V~ / 1.0 A Maximum
Main-gas valve output rating	230V~ / 1.0 A Maximum
Fan output rating	230V~ / 250 mA (switched through contactor)
Lockout output rating	230V~ / 0.1 A Maximum
Pre-purge or Waiting time	5-300 s
First safety time	3-10 s
Start-gas flame proving period	3-5 s
Main-gas flame proving period	5-20 s
Post-purge time	0-100 s
Flame failure response time	< 3 s
Time to achieve safety shut down	< 3 s
Time to achieve lockout	< 30 s
Time for spark restoration	N/A
Number of ignition attempts	1
Software Version	Burner Control (BC) 7.39 Micro Modulation (MM) 7.80 Display (DI) 7.71
Software Class	BC + MM: Class C DI: Class A

Evaluation.

Software changes

The manufacturer has made the following incremental software updates to the Mk7 M.M which have been reviewed for this test report.

Burner control software updates:

Version number	Changes made
BC 7.35	BC and MM comms actively checked. No Comms between the BC and MM eproms will reset the Mk7 to prevent loss of steam. This loss of comms is due to power or EMF surges from on-site equipment. If a power or EMF surge disrupts comms on the unit the burner would stop firing, but would need to be restarted to re-establish comms. This fix allows the unit to restart automatically, once the burner has been safely shut down as normal.
BC 7.36	Updated to prevent disappearing pilot on Display screen. Improvement affects display only.
BC 7.37	NFPA Post purge does not run until "Run to ignition" phase has been reached. National Fire Protection Association NFPA 85: BOILER AND COMBUSTION SYSTEMS HAZARDS CODE states that on a shutdown the following step must be carried out: <i>Perform a postpurge of the furnace and boiler gas passes; the duration of the postpurge must be no less than 15 seconds at an airflow rate not exceeding that at which the unit was shut down.</i> This fix stops this happening until after the run to ignition, where previously it would operate after initial startup which was not required and could cause possible triple purges, cooling the boiler down (e.g. first start, shut down, second start).
BC 7.38	This version incorporates functionality for continuous pilot modes for use with the normal MM software. This allows the burner control to restart the ignition and pilot, prior to the main valve being turned off, to maintain a flame in the boiler so there is no requirement for a purge on start up. The servos are driven to the 'light off' position as a known safe position and monitored, the CPI is monitored once the valves are shut, as well as the UV being in constant operation; if any are found in the wrong state the unit shuts down and a lockout is displayed.
BC 7.39	This version incorporates functionality for V.P.S. pre and post burner operation for use with the normal MM software (in addition to pre or post operation).

Micro modulation software updates:

Version number	Changes made
MM 7.57	Bug Fixes for WL code and options/parameters sent to the display.
MM 7.58	Fix for disappearing on screen WL graphics. Improvement affects display only.
MM 7.60	Improvement to speed up WL Comms
MM 7.62	Allows on screen serial numbers to be changed using CH1-CH4. Improvement affects internal production only.
MM 7.63	Fix for issues with upload / download functions. Improvement makes the process of uploading and downloading more user-friendly.
MM 7.64	MM updated to continue sending data to the DTI when an MM error occurs.
MM 7.65	A change has been made to on how FAR information is displayed on screen.
MM 7.67	First software release in support of the Mk7 DTI. Changes made support a higher baud rate between sequenced boilers
MM 7.68	Adds support for stopping and EGA using first out when correctly configured. An error triggered by loss of EGA comms will be automatically cleared when comms are re-established.
MM 7.69	First new-card-engine compatible release. Adds Draught Control, Bottom Blowdown Reduction. Allows purge at high fire position. Fixes related to phantom setpoint.
MM 7.70	Adds a fix to stop random burner startups due to comms failures when sequencing.
MM 7.71	Stops Invalid WL PROM errors occurring when no expansion board fitted.

MM 7.76	Negative steam flow on EGA error fix, Mk8 EGA comms, OTC module communications to work with Mk7 on data bus, Shutter Fault display bug fix, carry forward of negative trim fix
MM 7.77	Bottom Blowdown timer fix; Bottom Blowdown comms fix; Improved draft control
MM 7.78	This version integrates Pre & Post VPS operation into the regular MM software when used in conjunction with Burner Control v7.39
MM 7.79	Fix for EGA efficiency calculation including pre and post purge. Fix for reduced setpoint/ time clock not working
MM 7.80	Deaerator functionality added for monitoring of steam usage

Display software updates

Version number	Changes made
DI 7.35	Parameter 74 added: trim method. Combustion map screen and quick commission buttons available with new quick trim method.
DI 7.36	A change has been made to allow options 133, 136, 137, 139, 140, 141, 147 and 149 to show air and gas pressure limits/units.
DI 7.37	Setpoint is correctly displayed on status screen when setpoint is being changed.
DI 7.38	A change has been made to accommodate blowdown feature.
DI 7.39	Servo-motors have been sped up during commissioning. Changes been made to channel labels across a reboot.
DI 7.40	Changes to sequencing – when a WLC (water level control) board was connected for first outs without probes connected, it caused the sequencing to drop out and loss of stand by boilers; this was incorrect.
DI 7.41	A change has been made to allow sequencing communication with EGA.
DI 7.42	Miscellaneous changes for minor display fixes.
DI 7.43	Changes to option 12 for EGA and also WLC commissioning.
DI 7.44	Changes to DTI comms.
DI 7.45	Changes to EGA comms.
DI 7.47	Changes to shuffle sequencing.
DI 7.48	Changes to IRUD upload and login screen.
DI 7.49	Changes to first outs to allow boiler to be removed immediately from sequencing.
DI 7.50	UART configuration changed to improve stability and performance of comms with EGA.
DI 7.51	Screensaver improvements.
DI 7.52	SD Card driver updated. Changes to parameter 57 for even number of MMs.
DI 7.54	Changes to commissioning buttons when loading SD card in alternate language.
DI 7.55	First release in support of Mk7 DTI with added new functionality; still supports older MM PROMS.
DI 7.56	Can stop EGA via First Out. Adds Bulgarian and Dutch languages.
DI 7.57	Fixes a bug that caused a freeze when expansion board optioned but unit not commissioned
DI 7.58	Updated comms between Mk7 and Mk6 MMs.
DI 7.59	Fix to incorrect display of phantom setpoints. Fix to 2 state steam seq when no OFF time set.
DI 7.60	First new-card-engine release. REQUIRES IR Upload download v5.25 or later.
DI 7.65	This released (in combination with MM/BC upgrade) enables pre & post VPS operation in the standard Mk7 MM software. Addition of Mk8 EGA functionality, shutter fault 1 display fix
DI 7.66	Combustion Map, exit button fix, new bottom blowdown screens Single EGA via Twin burner option fix
DI 7.67	Display fix for totalised Volumetric Fuel Flow.
DI 7.68	Fix for data sent to Mk6 DTI for modbus startup/firing status TDS adjusters description changed for clarity
DI 7.69	Fix to the duration of the bottom blowdown sent from the MM to the bottom blowdown controller
DI 7.70	Improved Water level history logging screen, Chinese language file fix
DI 7.71	Added Deaerator screen

These changes are not intended to affect the safeguarding functions of the Mk7 M.M. software.

Additional information:

According to the manufacturer, the resetting of the unit on loss of comms (BC 7.35) does not produce a lockout; if the burner is firing then the system shuts down and reboots. If a lockout occurs at this stage for other reasons, then this lockout will remain on restarting the unit with the proms back in communication.

Continuous pilot modes have been introduced in BC 7.38. In continuous pilot modes, when the burner output setpoint (temperature or pressure) is reached exceeded, rather than proceed to shut down and post purge, the control shuts off the main burner flame and maintains the pilot flame. When the burner is needed again, the main flame can then be relit without a full startup sequence. During the continuous pilot mode, fault times and responses (i.e. safety shut down and lockout) are maintained for example, on loss of flame sense or air proving. The control executes its normal shut down and post-purge sequence when the demand stat switch is opened as usual. The continuous pilot can be set to automatically extinguish (i.e. safety shut down followed by post-purge sequence) after a defined time period without the main flame relighting, configurable from 0 – 1440 minutes, with 0 (infinite) being the default setting.

Two continuous pilot modes are available - Continuous Pilot Sequence with intermittent Pilot and Continuous Pilot Sequence with interrupted Pilot. Interrupted pilot mode shuts off the pilot flame when the main flame has established, and relights the pilot from the main flame before shutting off the main flame for continuous pilot mode. Intermittent pilot mode maintains the pilot flame throughout. In both cases, safety times, response times and other aspects of the programme sequence remain as previously approved.

Note: Care should be taken to ensure that in applications for non-permanent operation, the burner – including continuous pilot – is shut down at least once in any 24 hour period.

Hardware changes

The manufacturer has made the following hardware updates to the Mk7 M.M which have been reviewed for this test report.

The new card-engine introduced with software updates MM 7.69 & DI 7.60 is identical to that used in the Autoflame Mk8 Mini M.M. as evaluated and reported in BSI test report **8240607**. The card-engine drives the display and touch-interface and only contains low voltage circuits with no safety-critical functionality.

Graphics board 6528 has changed from version Rev 5 to Rev 12:

Version	Changes made
Rev 5a	QUAD UART chip select and interrupt buffering changed. QUAD UART chip select and interrupt buffering changed.
Rev 6	No component changes, battery holder rotated, capacitor moved.
Rev 7	DTI prototype (not released)
Rev 8	DTI prototype (not released)
Rev 9	DTI prototype (not released)
Rev 10	DTI only not used in MM, support for full SD card interface added.
Rev 11	DTI prototype (not released)
Rev 12	Removal of SD card interface chip and direct connection to card engine connector.

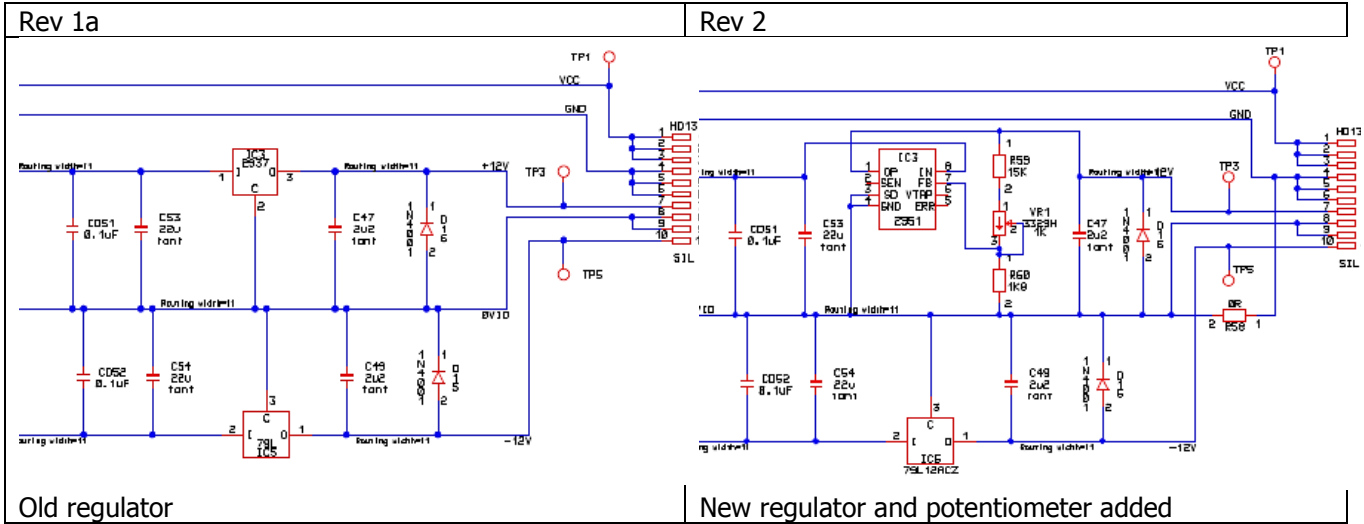
Note: DTI = Data Transfer Interface

The above changes are not safety critical.

Board 7012 has changed from version Rev 1a to Rev 2a:

Version	Changes made
Rev 2	+12V regulator changed from 2937 to 2951 and adjustment potentiometer added
Rev 2a	UV shutter changed to be supplied directly from 15V supply.

See below for detail of the change made for board Rev 2.



The change of Rev 2a is to overcome an issue with the UV flame scanner self-check. The UV shutter motor is rated from 12-15 V but the original design running at 12 V was found to be too low on some UV shutters resulting in occasional no operation, leading to nuisance lockouts.

Board 7013 has changed from version Rev 1a to Rev 2:

Version	Changes made
Rev 2	Pads for unused filter removed from oscillator. Spare connector removed.

The above changes to boards 7012 and 7013 have no impact to the safeguarding and safety critical functions of the hardware, with the exception of the change of 7012 Rev 2a which improves the operation of the UV self-check function.

These updates resulted in minimal changes to the track layouts with no negative implications to track clearances or general operation.

Conditions of Issue.

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