INTELLIGENT HEATING MANAGER

MIURA XJ1-W

FOR HOT WATER BOILER

MIURA BOILER CO., LTD.

BRANTFORD, ONTARIO

*** INFORMATION IN THIS MANUAL MAY BE CHANGED WITHOUT NOTICE.**

OWNER SHALL MAINTAIN THIS MANUAL IN LEGIBLE CONDITION FOR FUTURE REFERENCE.

VER. 2010 Revised 2/22/05

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SECTION 1 GENERAL ARTICLES

1.1 DEFINITIONS AND SYMBOLS

Note, Caution and Danger are used throughout this manual with the following definitions and symbols.

NOTE: indicates an area or subject of special merit, emphasizing either the product capabilities or common errors in installation, operation or maintenance.

CAUTION: indicates possible damage to equipment. It also indicates any condition or practice, which if not observed or remedied could result in damage or destruction of equipment.

DANGER: indicates any condition or practice, which if not observed, could result in personal injury or possible death.

1.2 EQUIPMENT

This specification describes the microcomputer approval by UL for control Miura Hot water Boiler.

Name: Boiler Control microcomputer system
Model: XJ1-120-W.
Components: CPU board assemblies part number XJ1-120-CPU-W.
Master relay board part number XJ1-120-RY.
Keypad board part number BG1-200-SW.
Display board part number CX-009-E.
Power supply board part number BG1-200-PW.

1.3 ENVIRONMENT SPECIFICATIONS

- *Power requirements:* Single phase, 120 VAC, 60 Hz. Supplied by boiler control power circuit.
- *Allowable voltage variation:* 90 to 132 VAC.
- *Power failure actions:* For loss of power greater than 0.2 seconds, the power failure sequence program will activate and stop the boiler requiring manual restart. For power failures of less than 0.2 seconds, but greater than 10 milli-seconds, the boiler will automatically re-start. If the power failure is less than 10 milli-seconds, the boiler will continue to run.
- *Line voltage spike tolerance:* The CPU is tolerant of line voltage spike up to 1500V for 60 seconds or 1800V for 1 second with no affect on CPU. Voltage measured between hot and common (ground) of CPU power supply.

- *Insulation resistance:* Dielectric resistance is 500MΩ as measure between line and ground when measured by 500VDC Megger.

- *Electrical noise tolerance:* The equipment will operate without adverse effect when subjected to no more than 2kV voltage spike between power supply lines or between power supply and ground.

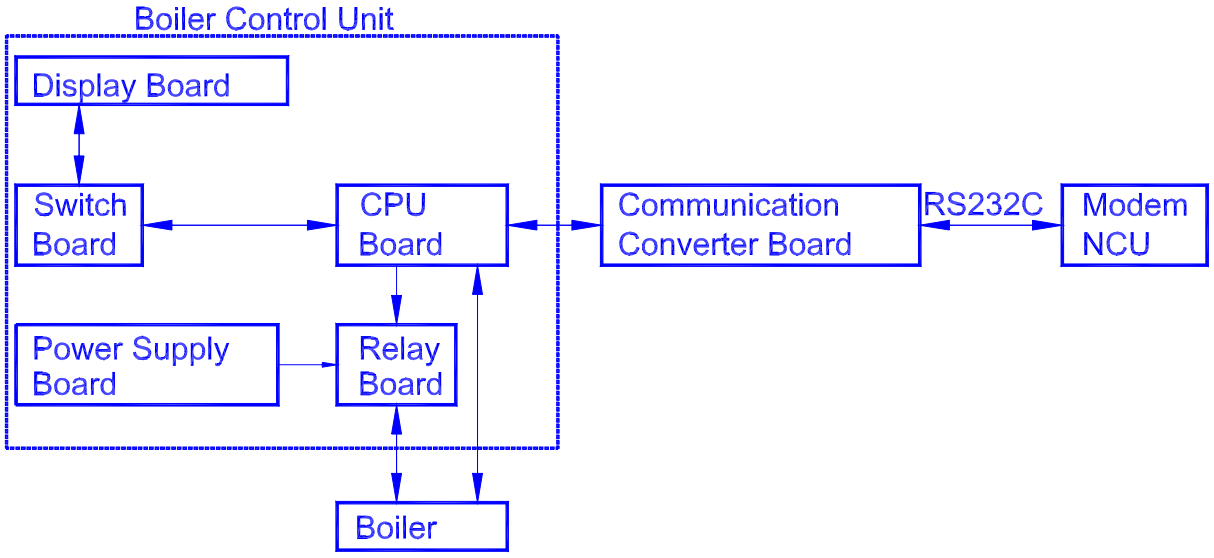
- *Memory backup:* No loss of alarm settings and operating history will occur for up to 240 hours when AC power is lost to the boiler. Time is based on maximum ambient temperature and no backup battery warning at time of loss of power.

- *Ambient conditions:*
  - Operating temperature ("OPERATION" switch on): 32°F to 140°F.
  - Storage temperature ("OPERATION" switch off): -4°F to 158°F.
  - Humidity: 20% to 90% relative humidity provided that dew or ice do not form on the circuit boards.

- *Vibration tolerance:*
  - In operation, vibration shall be less than 0.4G with complex amplitude less than 0.5mm peak to peak, frequency less than 20Hz.
  - In transport, vibration shall be less than 2.0G with complex amplitude less than 0.5mm peak to peak, frequency less than 20Hz.

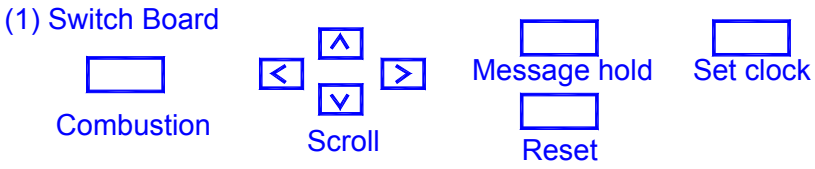
SECTION 2 HARDWARE CONFIGURATION

2.1 BOARD CONFIGURATION

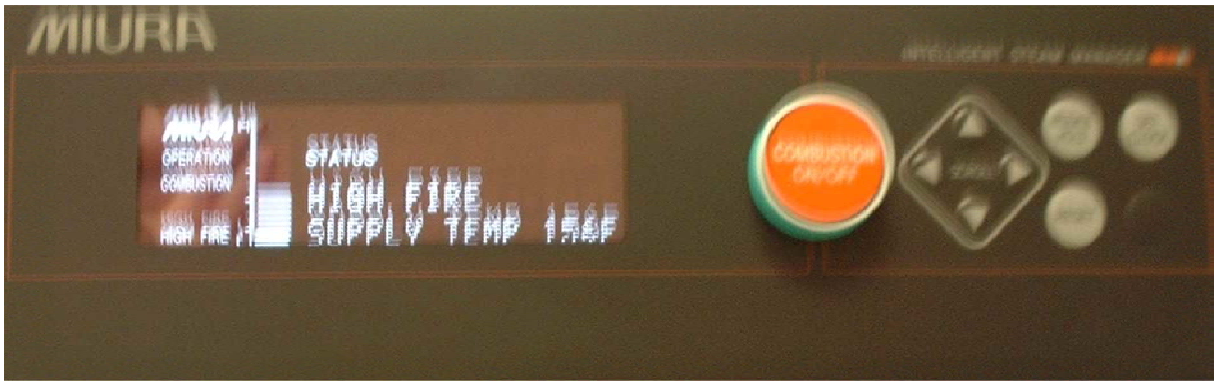


2.2 DISPLAY & OPERATING UNIT

2.2.1 Names and switch layout

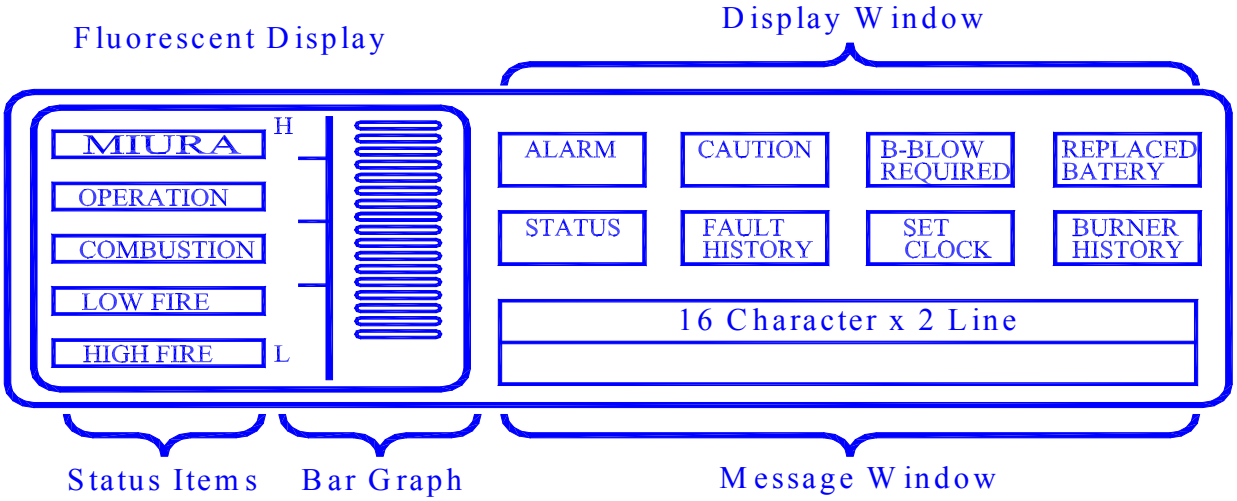


2.2.1.1 SWITCHBOARD



Note: An audible beep sounds when any button is pushed to verify input.

2.2.1.2 DISPLAY BOARD



Display window : Red (Alarms, Cautions, Replace Battery)
: White (Status, Fault History, Set clock, Burner History)
Message window : White
Bar Graph : White (Supply water temperature)
Status Messages : White

Note: "B-BLOW REQUIRED" is not use for Hot water boiler.

2.2.2 Functions

1. "OPERATIONAL" Switch
   When "OPERATIONAL" switch is placed in the "ON" position, the boiler control power is supplied to the control circuits. The boiler combustion protect relay is energized and starts the 10 second self test routine. When this switch is placed in the "OFF" position, the boiler control circuits are de-energized except for the XJ1-W microcomputer.

2. "OPERATION" indicator [White]
   This indicator will be illuminated when the OPERATION switch is ON and the boiler control circuit is energized. (Circuit breaker CB5 must be shut.)

3. "COMBUSTION" indicator [White]
   This indicator will be illuminated when the COMBUSTION button is pushed to start combustion. The indicator remains on when the boiler is in the STANDBY mode due to water temperature above the set point, Lead-Lag control has ordered the boiler into STANDBY mode.

4. "LOW FIRE" Indicator [White]
   This indicator will be illuminated when the boiler has established combustion in the low fire rate.

5. "HIGH FIRE" Indicator [White]

This indicator will be illuminated when the boiler has established combustion in the high fire rate.

6. "COMBUSTION ON/OFF" push button [Red, Momentary type]
   Used for starting/stopping combustion cycle. Pushing this button will change the display from "ENABLE" to "STAND-BY" until a call for heat is detected. When call for heat is detected, the combustion sequence will start. When the OPERATION switch is turned "OFF", the "COMBUSTION ON/OFF" switch will also changes to "OFF." Unless automatic restart on loss of power is enabled and power is off for less than one minute.

7. RESET push button [Momentary type]
   This push button is for clearing the alarm and caution messages. The ALARM message remains on until COMBUSTION button is turned "OFF", the alarm condition is cleared AND the reset button is pushed. The CAUTION message remains until the caution condition clears and the reset switch is pushed. If the caution condition is cleared, the display will return to normal. The red CAUTION light will remain on until the boiler OPERATION switch is turned "OFF" and then back "ON". This condition is designed to remind the operator that a problem has occurred.

8. MESSAGE HOLD push button [Momentary type]
   When the alarm or caution occurs, pushing this button will display the recommend actions to correct the alarm or warning. For example, if the ALARM condition is "LOW GAS PRESS", pushing the MESSAGE HOLD button will display "OPEN GAS VALVE & RESET SWITCH"

9. SET CLOCK push button [Momentary type]
   This button is for adjusting the clock. Push and hold when the date and time are displayed, then change number by using UP/DOWN scroll buttons. Use LEFT/RIGHT scroll buttons to move to the next character in the display. This button is also used to set temperature for overheat protection and gas metter settings.

10. Scroll button [Momentary type]
    Operate the same as the scroll buttons on a computer keyboard. Used to scroll horizontally to select one of the four menus. The menu choices are:

    STATUS FAULT HISTORY SET CLOCK BURNER HISTORY

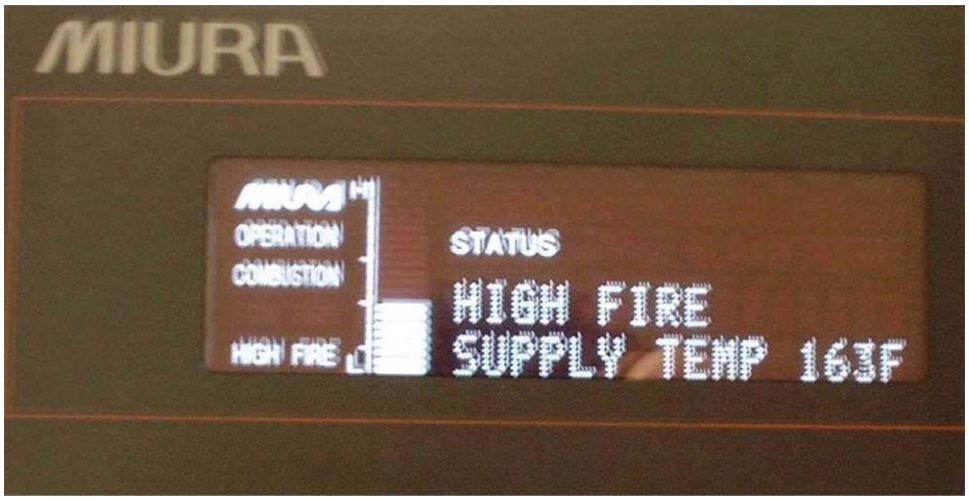
    Operating the up or down buttons will scroll up and down the list of items under the selected menu.

    NOTES:
    a) When the alarm or caution condition occurs, the STATUS, FAULT HISTORY, and BURNER HISTORY indicators will not be illuminated.
    b) Any time the buttons are not used for four minutes, the display returns to STATUS and defaults to the first menu item, which is supply water temperature. This occurs unless the ALARM or CAUTION condition has not been reset.

c) When scrolling left or right, the selected menu displays the first item by default. For example, if the operator has scrolled down the STATUS menu to look at the flue gas temperature, and then wants to return to indicating supply water temperature. The operator can scroll right (or left) and back to STATUS and the display will indicate supply water temperature. The operator can also scroll up or down to return to supply water temperature. Or the operator can do other tasks for 4 minutes and the display will automatically return to the STATUS menu and display supply water temperature.

d) Some settings have prescribed limits. For example the high fire supply water temperature setting cannot be changed to less than 120°F. Pushing the scroll down button will not have any effect once the lower limit is reached. The operator must use the scroll up button in this example to reach the proper setting.

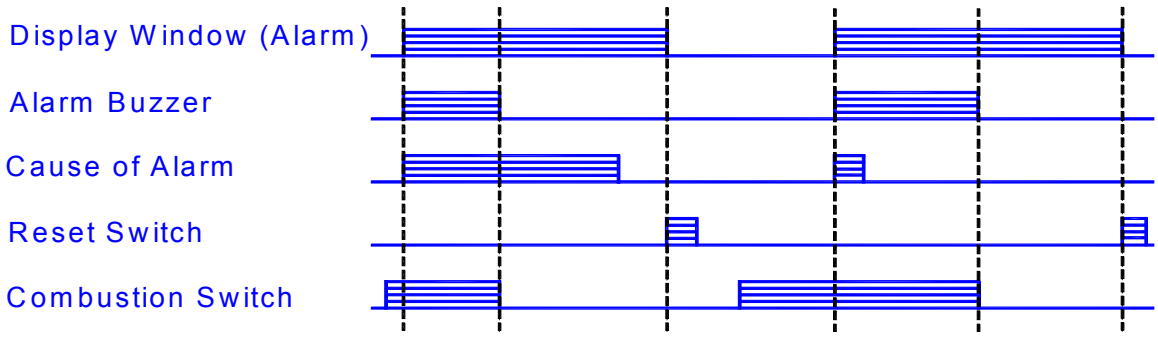
2.2.3 Display Window



2.2.3.1 ALARM INDICATION

The ALARM indicator is turned on when an alarm condition occurs. The indicator remains on until the alarm condition is cleared, the COMBUSTION switch has been pushed to stop the bell, and then, the RESET button is pushed. While the ALARM indicator illuminated, the message windows will state the reason for the alarming condition. For example, if the alarm condition is due to the loss of combustion air, the display will indicate “AIR PRESSURE FAULT”. Pushing the “MESSAGE HOLD” button will display the recommended action for the alarm or warning. In this example, the message is “CHECK AIR SWITCH & PIPE & BLOWER”.

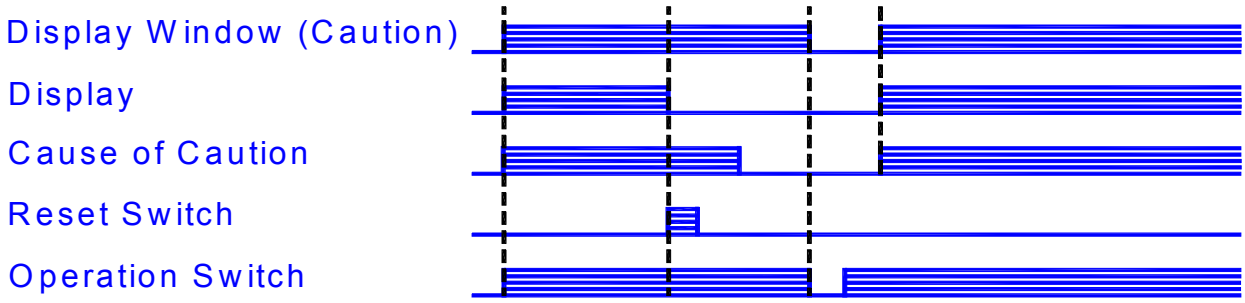
The alarm wills continue to ring until the COMBUSTION ON/OFF switch is pushed.



2.2.3.2 CAUTION INDICATION

The CAUTION indicator will be illuminated when a caution condition occurs. The cause of the caution will also be displayed. The display will not return to normal indication until the RESET button is pushed. The CAUTION indicator will remains on until the boiler is stopped and the OPERATION switch is turned off.

If the CAUTION indicator is illuminated, the same caution condition will not cause another warning to be displayed until the RESET button is pushed. However, a different caution condition will be displayed. For example, if the air filter clogged alarms, a CAUTION message will be displayed telling the operator to clean the air filter. When the condition is corrected, the operator can return to normal operation by pushing the RESET button. If the OPERATION switch is NOT cycled ON – OFF – ON, then a second air filter alarm will NOT cause an additional CAUTION warning message. But a different warning condition, such as high ambient temperature, will be displayed. In this case the display will read "HI AMBIENT TEMP", pushing the MESSAGE HOLD button will display "REDUCE ROOM TEMP".

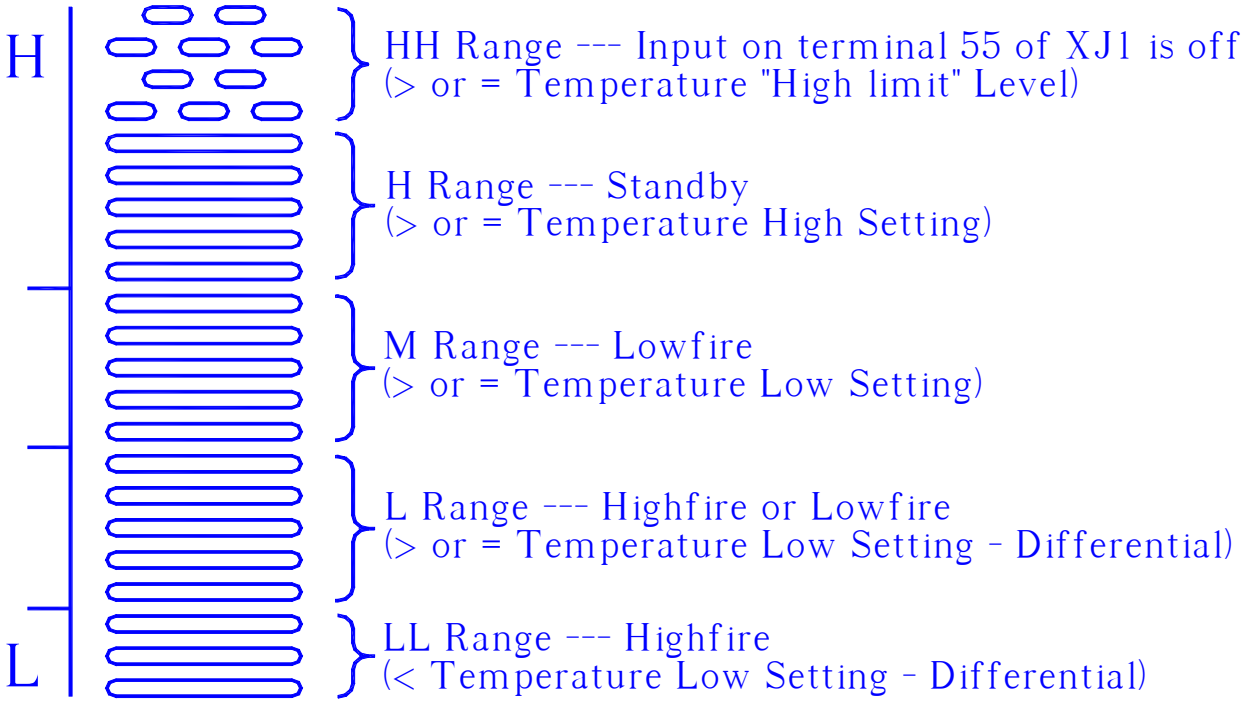


2.2.3.3 REPLACE BATTERY INDICATION

The indicator will be illuminated when the battery for memory backup requires replacement.

2.2.3.4 BAR GRAPH

When DIP switch 1-1 is ON and the OPERATION switch is ON, the bar graph indicates the simulate supply water temperature



NOTES:
1. When supply water thermocouple fault occurred, the bar graph indicates “H” range.

2.2.4 Message window

The message area is a two-lines, sixteen character display. This is the section immediately under the menu lights.

2.2.4.1 STATUS MODE

The status of the control equipment is indicated in the upper section of the display. Each monitored item is indicated on the line below. When the boiler is operating normally, the status messages indicated show the current step in the combustion sequence.

Top line, operating messages displayed

Condition or sequence step to be displayed		Messages		
No.	Status	Normal	Abnormal	
1	OPERATION switch OFF	DISABLE	DISABLE	##,##,##
2	OPERATION switch ON	ENABLE	ENABLE	##,##,##
3	Standing by (waiting for call-for-heat)	STAND-BY	STAND-BY	##,##,##
4	Pre-Purge	PREPURGE	PREPURGE	##,##,##
5	Trial for Ignition	IGNITION	IGNITION	##,##,##
6	Pilot burner Only	PILOT	PILOT	##,##,##

7	Low Fire	LOW FIRE	LOW FIRE	##,##,##
8	High Fire	HIGH FIRE	HIGH FIRE	##,##,##
9	Post Purge	POSTPURGE	POSTPURGE	##,##,##
10	Low Fire Hold	LOW FIRE HOLD	LF Hold	##,##,##

NOTE:

- "##, ##, ##' indicates the date and time the Alarm or Caution occurred.
- Item #10 time indicates the time the boiler executed the order to remain in low fire. Not the time the switch was placed in low fire hold.

Bottom line, Status indicator on, status messages selectable by UP/DOWN scroll buttons.

No.	Monitored Item	Message
1	Supply water temperature	SUPPLY TEMP 999F
2	Return water temperature	RETURN TEMP 999F
3	Flue gas Temperature	FLUE GAS 999F
4	Overheat Thermocouple temperature	HIGH LIMIT 999F
5	Flame Voltage	FLAME SIGNAL 5.0V
6	Date and Time	1/10/98 24:00

Example:

PRE PURGE	<- operation status	(Top line)
SUPPLY TEMP 180F	<-monitored item	(Bottom Line)

NOTE:

1. *Temperature indications:* The range of indicated temperature is –58°F to +932°F (-50°C to +500°C) with increments of 1°F. The accuracy in the range of common use is within ± 4ºF (2ºC). The temperature over 932ºF is indicated as "HH".

2. When the Thermocouples have a detected fault, the indication message is "—". If the thermocouple output rises over -58ºF, the temperature is indicated again.

2.2.4.2 FAULT HISTORY MODE

The controller maintains the 5 most recent Alarms and Cautions in memory. The fault name, the operating condition at the time of the fault and the time the Alarm/Caution occurred are retained. Use the Left/Right scroll buttons until the FAULT HISTORY menu indicator is illuminated. The display will indicate the most recent fault. Using the Up/Down scroll buttons will display the 5 most recent faults. When all faults have been shown, the top line will indicate "END" and the bottom line will indicate the ROM version of the CPU. If there are no faults, the top line will indicate "NO DATA" and the bottom line will indicate ROM version.

When an ALARM or CAUTION condition occurs, the display will only indicate the name of the condition. To read the message associated, push the MESSAGE HOLD button before pushing the RESET button.

For example, if the ALARM is High Gas Pressure, the display will read:

HIGH GAS PRESS

Pushing the MESSAGE HOLD button, before pushing the RESET button will display:

CHECK GAS PRESS
& RESET SWITCH

The ALARM/CAUTION message display takes precedence over all other menu selections EXCEPT Clock Set Mode. When in CLOCK Set Mode, if any ALARM or CAUTION occurs the indicator will be illuminated immediately, the operator must exit Clock Set mode by pushing the Clock Set Button and then the ALARM/CAUTION message will be displayed immediately.

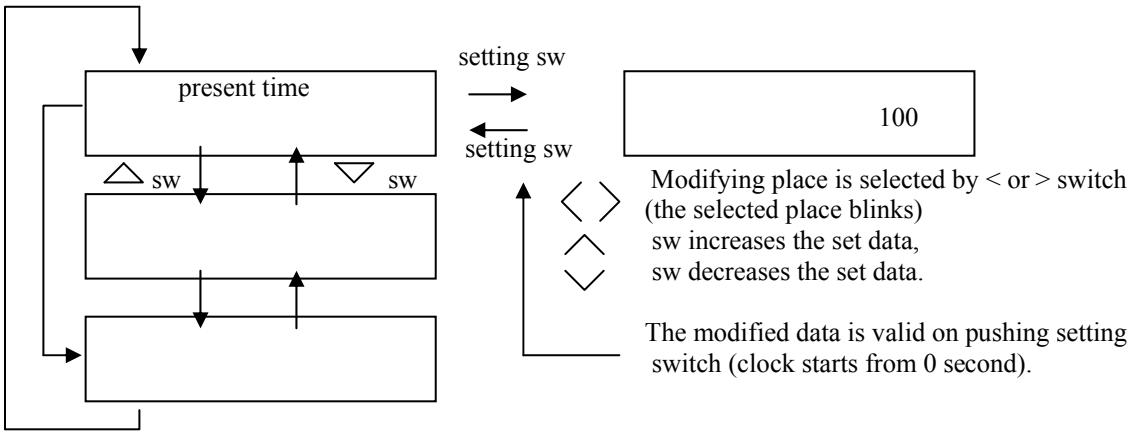
ALARM MESSAGE TABLE

CODE	ITEM	TITLE	MESSAGE
A004	supply water thermocouple fault	S. WATER T.C. FLT	CHECK SUPPLY WATER T.C.
A007	emergency stop	EMERGENCY STOP	EMERGENCY STOP RESET
A010	flame failure (from protect relay)	FLAME FAILURE	INSPECT BURNER & OPEN FUEL VALVE
A012	flame detected (from protect relay)	FLAME DETECTED	FLAME IN FURNACE CLOSE FUEL VALVE
A013	air pressure fault	AIR PRESS FAULT	CHECK AIR SWITCH & PIPE & BLOWER
A018	circulation water flow switch	LOW FLOW	OPEN VALVE & VENT AIR & INSPECT PUMP
A020	low water level	LOW WATER LEVEL	OPEN VALVE & VENT AIR & INSPECT PUMP
A030	overheat thermocouple working	HIGH W TUBE TEMP	CHECK WATER FLOW INSPECT WTR TUBE
A031	overheat thermocouple fault	O.HEAT T.C.FAULT	CHECK OVER HEAT THERMOCOUPLE
A040	power failure	POWER FAILURE	CHECK POWER RESTART BOILER
A049	FGR damper fault	FGR DAMPER FAULT	CHECK MIC SWITCH
A114	high gas pressure	HIGH GAS PRESS	CHECK GAS PRESS & RESET SWITCH
A214	low gas pressure	LOW GAS PRESS	OPEN GAS VALVE & RESET SWITCH
A449	flue damper fault	CHIMNEY DAMPER	CHECK MIC SWITCH
A502	low oil pressure	LOW OIL PRESS	CHECK OIL PIPING & OIL PUMP

CAUTION MESSAGE TABLE			
CODE	ITEM	TITLE	MESSAGE
F005	air filter clogged	AIR FILTER	CLEAN & INSPECT AIR FILTER
F031	Return water thermocouple fault	R. WATER T.C. FLT	CHECK RETURN WATER T.C.
F032	exhaust gas temperature sensor disconnection	FLUE GAS TC FLT	CHECK FLUE GAS THERMOCOUPLE
F033	high board temperature	HI AMBIENT TEMP.	REDUCE ROOM TEMP
F054	low battery	LOW BATTERY	CHANGE BATTERY
F090	communication error	COMM. ERROR	CALL FOR SERVICE

2.2.4.3 SET CLOCK MODE

Clock, Calendar and Set point data are entered and adjusted in this mode. When this mode is selected by the horizontal Left/Right scroll buttons, the date and time are displayed on the top line. Pushing the SET CLOCK switch can modify the Calendar and set point data. The clock is in 24 military time format.



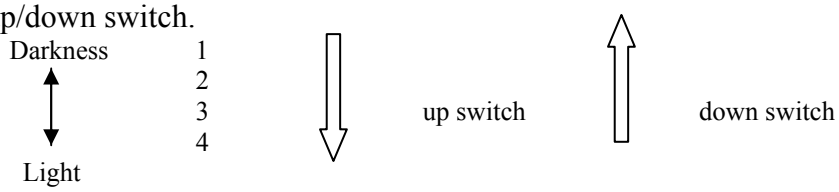
DANGER: Do not change other setting without first consulting your nearest authorized MIURA dealer

NO.	ITEM	MESSAGE	INITIAL VALUE	RANGE	INC.
1	Time set	TIME SET MM/DD/YY HH:MM	1/1/98	-	-
2	Supply water temp (Low)	TEMP SET LOW 999 F	160	120 - 250	1

3	Supply water temperature Low setting differential	TEMP DIFFER LOW 99 F	10	3 – 30	1
4	Supply water temp (High)	TEMP SET HIGH 999 F	180	120 - 250	1
5	Supply water temperature High setting differential	TEMP DIFFER HIGH 99 F	10	3 – 30	1
6	Overheat Thermocouple	OVERHEAT TEMP. 99F	660	250-850	1
7	Heat Output	HEAT OUTPUT 99999 x 1000 BTU/HR	6695	1500-15000	1
8	Display Brightness Adjustment	BRIGHTNESS ADJ. 3	3	1-4	1
9	Commissioning Date	START UP DATE MM/DD/YY	1/1/98		
10	Date Changed Data	CHANGE DATA DATE MM/DD/YY	1/1/98		
11	Fuel gas temperature	SUPPLY GAS TEMP. 999F	70	0 - 150	1
12	Supply gas pressure	SUPPLY GAS PRESS. 999IN	138	6 - 600	1
13	Gas meter pulse unit	GAS METER PULSE 999 CFT/PULSE	0	0 - 300	1

NOTE:

1) The brightness can be tuned in to four pitches, and the status is indicated and modified by up/down switch.



2.2.4.4 BURNER HISTORY

The burner history is indicated on the top line of the display, and each boiler data item is indicated on the lower line.
For Example:

PREPURGE
H FIRE TOT 15924

The available history items are:

ITEM	MESSAGE DISPLAYED	UNIT
Total time of High Fire Burner Operation	H FIRE TOT 99999	Hour
Total time of Low Fire Burner Operation	L FIRE TOT 99999	Hour
Total number of Burner Combustion Start Cycles	CYCLES 999999	Times

Note: time is rounded to nearest whole hour.

2.3 CPU BOARD

CAUTION: These DIP switches have been configure to your application. It is very important not to make any change without first consulting your nearest authorized MIURA dealer

2.3.1 DIP Switch settings.

DIP SW	Function	ON/OFF
DIP 1-1	Indicate bar graph (supply water temperature)	yes/no
1-2	FGR Damper present	yes/no
1-3	Automatic restart after power failure < 60 seconds	yes/no
1-4	reserved	
1-5	reserved	
1-6	reserved	
1-7	Type of protect relay. (Air flow switch check)	yes/no
1-8	reserved	
DIP 2-1	Communication initialize	ON/OFF
2-2	Communication type	Modem/MTU
2-3	Transmit failure messages	yes/no
2-4	reserved	
2-5	reserved	
2-6	reserved	
2-7	reserved	
2-8	reserved	

2.3.2 DIP switch functions

1. *Indicating Supply water temperature:* DIP 1-1 ON (up) enable bar graph display for supply water temperature.
2. *FGR Damper:* DIP 1-2 ON (up) enable FGR damper control for Flue Gas Recirculation option.
3. *Restart after power failure:* DIP1-3 ON (up) enables automatic boiler re-starts on power failure if less than 60 seconds. This will allow re-start of the boiler without operator intervention IF no ALARMS or CAUTION conditions occur during power outage.
4. *Type of protect relay:* DIP 1-7 OFF (down) for standard protect relay Honeywell RM7895.
5. *Communication initialize:* DIP 2-1 ON (up) enables modem communication features. When DIP 2-1 switch is cycled OFF-ON-OFF, online communication features are initialized.
6. *Communication type:* DIP 2-2 ON (up) sets communications on single boiler with modem. Switch OFF (down) sets communication with MTU board is used for multiple boilers installation.
7. *Transmit failure messages:* DIP 2-3 ON (up) enables boiler to call out and report an alarm condition to a central location computer that is running the MIURA Boiler Monitoring software.
8. *Clear switch 1:* This switch resets CPU.

9. *Clear switch 2:* This switch clears RAM, and all setting data are returned to the initial condition. This switch is valid only during operating switch is off.

2.3.3 Relay Board Operation

2.3.3.1 LOW FIRE HOLD TOGGLE SWITCH.

Switch up (ON) disables boiler operation in High Fire for testing and trouble shooting; allows burner combustion to be adjustment at low fire rate.

SECTION 3 BOILER CONTROL

3.1 FLUE GAS RE-CIRCULATION (FGR) DAMPER CONTROL

FGR system is active ONLY when DIP 1-2 is up (ON).

For boilers equipped with the low NOx Flue Gas Recirculation option, the boiler will operate as follows:

PREPURGE
PILOT
LOW FIRE

The boiler will remain in low fire until the Flue Gas thermocouple indicates over 90°C (194°F). Then the computer will order the FGR damper to the open position. When the FGR damper micro-switch indicates the FGR damper is open, the computer waits 20 seconds for the flame to stabilize. After the 20 second delay normal operation is resumed and the boiler switches between High and Low fire automatically based on supply water temperature.

NOTES:

1. If the FGR damper micro switch does not indicate damper in the open position in 30 seconds, the boiler will lock out and display "FGR DAMPER FAULT".
2. If the flue gas thermocouple is faulty, the boiler is held in Low Fire until the condition is corrected. The boiler will display a CAUTION message, "FLUE GAS TC FLT" and the action message will read "CHECK FLUE GAS THERMOCOUPLE".
3. The FGR damper is shut for post purge.
4. If the flue gas does not go over 90°C (194°F), the boiler is placed in low fire hold until the problem is corrected.

3.2 AUTOMATIC RE-START AFTER POWER FAILURE

The boiler will restart automatically if all of the below listed conditions are satisfied:

1. DIP 1-3 is up (ON) enabling this feature.
2. The power failure occurred with the COMBUSTION switch ON.
3. Elapsed time of power failure is less than 60 seconds.
4. The boiler OPERATING switch remains in the ON position.

3.3 CHIMNEY FLUE DAMPER (OPTIONAL)

An option flue damper can be installed in the chimney. The damper is externally controlled to open prior to the boiler starting the combustion sequence. The microcomputer verifies the damper is open, before the boiler fan starts, by checking the status of the stack damper micro switch.

3.4 XJ1-W MICROCOMPUTER RELAY FUNCTIONS

1. RY1-1 Alarm Bell. Relay ON when an ALARM condition exists and COMBUSTION switch is ON.
2. RY2-1 N/A for hot water boiler.

3. RY2-2 N/A for hot water boiler.
4. RY2-3 N/A for hot water boiler.
5. RY2-4 FGR Damper. Relay ON to open FGR damper. See section 3.1
6. RY1-3 Low Fire/High Fire Damper control.

Pilot Valve (Terminal 38)	Main Fuel Valve (Terminal 5)	Condition of RY1-3
OFF	OFF	ON
ON	OFF	OFF
ON	ON	OFF
OFF	ON	ON (After 10 second Low Fire Hold on Main Burner Ignition) ON (For High Fire) OFF (For Low Fire)

NOTE: For supply water temperature control operation, see section 3.5

7. RY1-4 Reset relay. Relay ON when RESET button is pushed during the COMBUSTION switch is OFF.
8. RY1-2 Call-For-Heat. Relay ON, if the following conditions are satisfied:
   a) Terminal 52 input is ON.
      i. Lead-Lag controller is ON. If Lead-Lag Controller is not installed, the jumper is installed between terminal strip terminals 1 and 2.
      ii. The external temperature controller, 23WH, located above the electrical control box, is ON (switch shut).
   b) The COMBUSTION switch is ON.
   c) No Interlock condition exists.
   d) The protect relay alarm (terminal 32) is OFF.
   e) The supply water temperature is below the TEMP. SET HIGH setting minus the HIGH TEMP DIFFERENTIAL setting.

3.5 OPERATION OF THE SUPPLY WATER TEMPERATURE CONTROL SYSTEM

The boiler is equipped with a K type thermocouple. The thermocouple measures supply water temperature in the boiler. The thermocouple is connected directly to the XJ1-W microcomputer. The microcomputer has four field adjustable settings to control the combustion of the boiler.

In addition, the boiler is equipped with a simple Aquastat (temperature switch). This backup aquastat, 23WH, is installed to allow operation of the boiler if the thermocouple fails. The setting of the switch is field adjustable.

The boiler also has a high temperature limit switch, 23WHA, that requires manual reset if it reaches the high temperature limit setting. This switch is also field adjustable and normally set at the maximum allowable temperature of the boiler.

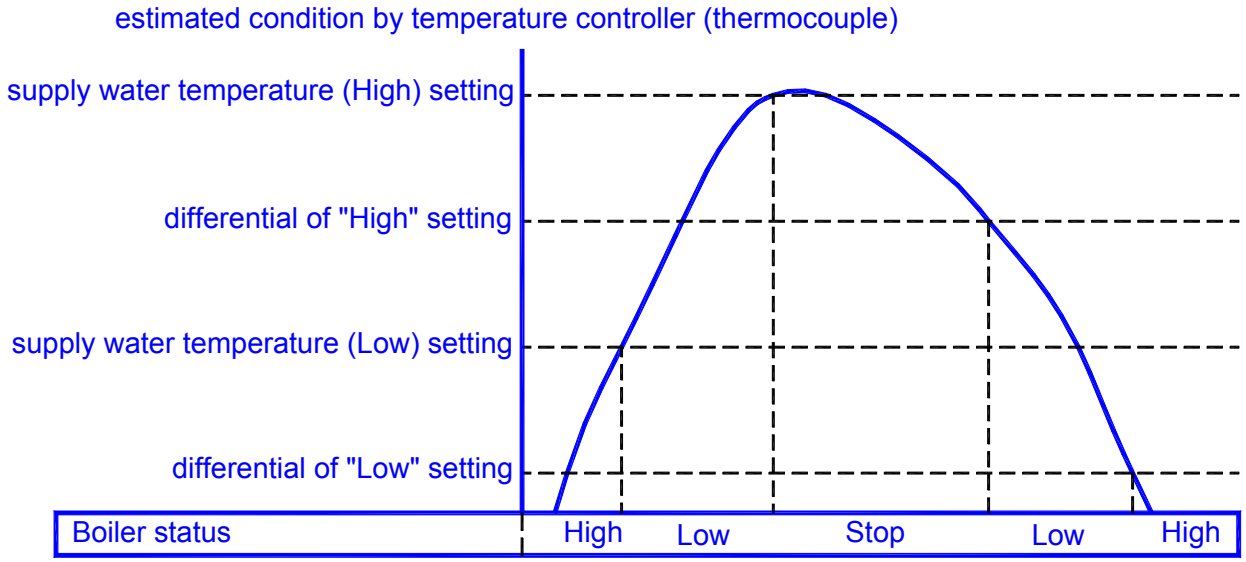
NOTE: The following example temperatures are for discussion only.

Control	Setting	Function/actions
External High temperature Limit setting (23WHA)	200°F	Lockout requiring manual reset on the aquastat controller
External operating control (23WH)	190°F	If the microcomputer thermocouple fails, this external aquastat controller operates the boiler ON/OFF in High Fire only. (Except that the boiler will perform a Low Fire Hold on Main burner Ignition). In this case the boiler is turned OFF (combustion stop) when temperature reaches 190°F.
External operating control differential	10°F	Controls the drop in supply water temperature, below the aquastat controller set temperature, before the switch will shut. In this case, the boiler will start in Low Fire combustion when pressure drops to 180°F.
Internal TEMPERATURE SET HIGH setting	180°F	Boiler turns OFF (combustion stop) when supply water temperature reaches this setting.
Internal TEMPERATURE DIFFER HIGH setting	10°F	Boiler starts combustion cycle when supply water temperature drops to 170°F.
Internal TEMPERATURE SET LOW setting	160°F	Boiler changes to low fire when supply water temperature is above this setting.
Internal TEMPERATURE DIFFER LOW setting	10°F	Boiler changes from Low Fire to High fire when temperature drops to 150°F.

Boiler operation sequence given settings listed in above table.
Sequence assumes that boiler is cold at time of start.

1. Operator starts the boiler by placing OPERATION switch in ON position.
2. Operator pushes COMBUSTION switch to start boiler.
3. Boiler microcomputer starts combustion sequence:
   a. PREPURGE
   b. PILOT valves open and IGNITION transformer ON.
   c. 5 seconds later IGNITION transformer OFF.
   d. 5 seconds PILOT flame verification.
   e. Main fuel valves open.
   f. 10 seconds later PILOT valves close.
   g. 5 seconds Low Fire Hold period to verify Main Flame Established.
   h. Boiler shifts to High Fire.
4. Boiler operates in High Fire until supply water temperature reaches 160°F. Then the boiler shifts to Low Fire.
5. Boiler operates in Low Fire until temperature reaches 180°F.
6. The boiler shuts Main Fuel Valves and starts POSTPURGE.
7. Boiler temperature drops below 170°F and the boiler starts in Low Fire.
8. Boiler supply water temperature continues to drop. When temperature reaches 150°F the boiler shifts to High Fire.

9. The boiler will then shift automatically between High-Fire and Low-Fire to maintain supply water temperature between 150 and 180°F depending on the heating demand.



SECTION 4 ALARMS AND CAUTIONS

4.1 LIST OF POSSIBLE ALARMS AND CAUTIONS

4.1.1 ALARM Conditions

Internal flag number	ALARM item
A004	Supply water thermocouple fault
A007	Emergency Stop
A010	Flame Failure
A012	Flamed Detected
A013	Air Pressure Fault
A018	Circulate water flowswitch
A020	Low Water Level
A030	Overheat Thermocouple
A031	Overheat Thermocouple Fault
A040	Power Failure
A049	FGR Damper Fault
A114	High Gas Pressure
A214	Low Gas Pressure
A449	Flue Damper Fault
A502	Low Oil Pressure

4.1.2 CAUTION Conditions

Internal Flag Number	CAUTION item
F005	Air Filter Clogged
F031	Return water thermocouple fault
F032	Exhaust Gas Temperature Sensor Fault
F033	High (circuit) Board Temperature
F054	Low Battery
F090	Communication Error

4.2 DISPLAY AND STORAGE OF ALARMS/CAUTIONS

4.2.1 ALARM

1. Maximum ALARMS dealt with simultaneously is two. For each ALARM, the corresponding function is performed, but only the first ALARM is indicated. When the first ALARM is reset, the second ALARM is indicated. The RESET switch is valid for the current ALARM only. If there are two different ALARMS, the RESET button must be pushed twice to clear the ALARMS.

2. The ALARMS are dealt with prior to the CAUTIONS. If the ALARM occurs when a CAUTION is indicated on the display, the ALARM interrupts the CAUTION and the ALARM is indicated.
3. The ALARMS are stored in order of occurrence, unless the same ALARM occurs again before the first occurrence is cleared. This is what happens if a LOW GAS PRESSURE ALARM occurs and the operator attempts to clear it while the Low Gas Pressure condition continues.
4. The microcomputer stores the five most recent ALARMS and CAUTIONS that can be recalled for display.

4.2.2 CAUTION

1. The maximum number of CAUTION warnings dealt with simultaneously is five. For each CAUTION, the corresponding action is performed, and each CAUTION message is displayed by turns and rotated every 2 seconds.
2. Pushing the RESET switch once clears all CAUTION conditions. However, the microcomputer will not return to normal operation until the OPERATION switch is turn OFF
3. In the event of the same CAUTION condition occurring twice before the RESET button is pushed, the older CAUTION is ignored.

4.3 ALARM CONDITIONS

1. EMERGENCY STOP: Alarm occurs when there is an error in communication between CPU board and Relay Board. OR if the relay RY1-2 is ON indicating a call for heat and the High Limit aquastat controller, 63SHA is open or proof of closure switch on main gas valve (for boiler over 150 BHP) is open before main flame.
2. FLAME FAILURE: Alarm occurs when the Burner Protect Relay indicates a flame failure alarm.
3. AIR PRESSURE FAULT: Occurs in the condition where the combustion air blower is ON and the Air Pressure Switch, 63A, is OFF for greater than 1 second or damper position is incorrect or blower's thermal over load relay opens. This occurs at all times EXCEPT for the first 5 seconds after turning the fan ON.
4. LOW WATER LEVEL: The ALARM occurs any time the COMBUSTION switch is ON and the electrode is dry. Caused by switch 33WL1.
5. OVERHEAT THERMOCOUPLE: Occurs when the OPERATION switch is "ON" and the Overheat thermocouple measures a temperature above the set value or over 932°F for greater than 2 seconds.
6. OVERHEAT THERMOCOUPLE FAULT: Occurs when the thermocouple measures less than -58°F for more than 2 seconds. This indicates an open circuit on the thermocouple.
7. SUPPLY WATER THERMOCOUPLE FAULT: Occurs when the OPERATION switch is ON and the temperatures of the supply water thermocouple is less than -58°F for 2 seconds.
8. POWER FAILURE: Occurs when the COMBUSTION switch is ON and a less of Voltage occurs for longer than 0.2 seconds.

NOTES:

a) When this ALARM occurs, the POST PURGE function will not been performed.
b) If the power failure is less than 10milli-seconds, the boiler will continue to operate.

c) If the power failure is greater than 10 milli-seconds, but less than 0.2 seconds, the boiler will re-start after the PRE PURGE is complete.
d) If the power failure is less than 60 seconds, but greater than 0.2 seconds, AND DIP1-3 is up (ON), the boiler will automatically restart.
e) If the power failure is greater than 60 seconds, OR DIP1-3 is down (OFF) and the failure was greater than 1 second, then the power failure ALARM will occur.

9. LOW OIL PRESSURE: Occurs if oil pressure falls below the setting of Oil Pressure Switch, 63QL, for more than half second IF the boiler is selected to Oil burning, AND, the Blower is running. This evaluation is not made for the first 5 seconds after the combustion fan starts.
10. LOW GAS PRESSURE: Occurs when the Low Gas Pressure switch, 63GL, is OFF (OPEN) for over half second if the boiler is selected for Gas Fuel.
11. HIGH GAS PRESSURE: Occurs when the High Gas Pressure switch, 63GH, is OFF (OPEN) for over 0.5 second if the boiler is selected for Gas Fuel.
12. LOW CIRCULATION WATER FLOW: Occurs when the OPERATION switch is ON and the flow switch FS is OFF (OPEN) for over 0.5 second.
13. FLUE DAMPER FAULT: Occurs when the micro-switch for the Option Flue Damper Proof-of Damper-Open is not ON (SHUT) within 90 seconds of starting the blower for PRE PURGE. The PRE PURGE timer does NOT start until the FLUE DAMPER is verified open. It also occurs during combustion, if this micro-switch is opened for more than 1 second.
14. FGR DAMPER FAULT: Occurs when the option FGR Damper open micro-switch is not ON (switch SHUT) within 30 seconds of the damper open signal. And it also occurs after 30 seconds of the damper open signal has come. When the micro-switch is opened for more than 1 second or the micro-switch is closed for more than 3 seconds after damper close signal has come.
15. FLAME DETECTED: Occurs when protect relay detect flame during post-purge or standby period.

4.4 CAUTION CONDITIONS

1. AIR FILTER CLOGGED: Occurs when the Air Filter Differential Pressure Switch, 63AF, remains ON (SHUT) for more than 10 seconds.
2. HIGH BOARD TEMPERATURE: Occurs when the microcomputer circuit board temperature continues to be above 158°F (70°C) for over 5 minutes when the OPERATION switch is ON.
3. RETURN WATER THERMOCOUPLE FAULT: Occurs when the temperature of the return water thermocouple remains less than –58°F for more than 2 seconds when the OPERATING switch is ON.
4. LOW BATTERY: Occurs when the voltage of the data backup battery falls below 2.4v when power is available to the microcomputer.
5. COMMUNICATION ERROR: Occurs when the number of modem communication attempts, to report ALARMS or CAUTIONS, reaches 255.
6. EXHAUST GAS TEMPERATURE SENSOR FAULT: Occurs when the temperature of the Exhaust Gas thermocouple remains less than -58°F for more than 2 seconds when the OPERATION switch is ON.

SECTION 5 INPUT/OUTPUT FOR XJ1-W CONTROLLER

5.1 ANALOG INPUT

Terminal	Input Data	Description	Range	CPU Board	Relay Board	Switch Board
19+, 20-	Supply water temperature	thermocouple	-58 – 923°F	O		
21+, 22-	High Limit	thermocouple	-58 – 923°F	O		
23+, 24-	Return water	thermocouple	-58 – 923°F	O		
25+, 26-	Flue gas temperature	thermocouple	-58 – 923°F	O		
-	Circuit board temperature	thermistor	-4 - 176°F	O		
11+, 13-	Flame Voltage	XJ1 display	1 – 5 V	O		

5.2 GENERAL INPUT

Terminal	Input Data	Description	Controller	CPU Board	Relay Board	Switch Board
2	Blower Fan	120VAC			O	
5	Main gas valve	120VAC			O	
13	Operation switch	120VAC			O	
32	Protect relay alarm	120VAC			O	
33	Thermostat (Low)	120VAC - NC			O	
38	Pilot valve	120VAC			O	
43	Gas/Oil	120VAC	Energized at gas firing		O	
44	Air filter	120VAC - NO	63AF		O	
49	Air flow switch	120VAC - NC	63A, 88F, T1		O	
51	Low water	120VAC - NC	33WL1		O	
52	Heat demand	120VAC - NC	23WH		O	
55	High temperature Limit	120VAC - NC	23WHA		O	
56	Flow switch	120VAC - NC	FS		O	
57	Low gas Pressure	120VAC - NC	63GL		O	
58	(G) High Gas pressure (O) Low oil pressure	120VAC - NC	63GH 63QL		O	
91	Gas meter pulse	12VDC	Gas meter pulse		O	
92	FGR Damper	12VDC			O	
93	Chimney Damper	12VDC			O	
94	N/A	12VDC			O	
L	N/A	8VDC (2KHz)		O		
M	N/A	8VDC (2KHz)		O		
S	N/A	8VDC (2KHz)		O		
D	N/A	8VDC (2KHz)		O		

Terminal #90 is common terminal for the input from terminal 91 to 94. The contact duration must be longer than 100 mili-seconds.

5.3 OUTPUT

Terminal	Output Data	Description	Relay Board	Switch Board
13, 41	N/A		RY2-1	
13, 3	N/A		RY2-2	
13, 40	N/A		RY2-3	
13, 42	FGR Damper	Relay	RY2-4	
13, 22	Alarm	Buzz	RY1-1	
52, 54	Heat Demand		RY1-2	
60, 62	High fire		RY1-3	
63, 65	Reset		RY1-4	