



BIM

Boiler Interface Module Installation and Operation



750-376
03/2015

TO: Owners, Operators and/or Maintenance Personnel

This operating manual presents information that will help to properly operate and care for the equipment. Study its contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood.

It is the responsibility of the owner to provide training and advice in all aspects of safety not only to his or her personnel, but to any contractors' personnel who will be servicing, repairing, or operating the equipment.

Cleaver-Brooks equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical devices supplied as part of the unit were chosen because of their known ability to perform; however, proper operating techniques and maintenance procedures must be followed at all times.

Any "automatic" features included in the design do not relieve the attendant of any responsibility. Such features merely eliminate certain repetitive chores, allowing more time for the proper upkeep of equipment.

It is solely the operator's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning and this manual is not intended to relieve the operating personnel of the responsibility for proper operation. On the other hand, a thorough understanding of this manual is required before attempting to operate, maintain, service, or repair this equipment.

Operating controls will normally function for long periods of time and we have found that some operators become lax in their daily or monthly testing, assuming that normal operation will continue indefinitely. Malfunctions of controls lead to uneconomical operation and damage and, in most cases, these conditions can be traced directly to carelessness and deficiencies in testing and maintenance.

The operation of this equipment by the owner and any operating personnel must comply with all requirements or regulations of the insurance company and/or other authority having jurisdiction. In the event of any conflict or inconsistency between such requirements and the warnings or instructions contained herein, please contact Cleaver-Brooks before proceeding.

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1 - Introduction

The Cleaver-Brooks Boiler Interface Module (BIM) is a control system specifically designed to operate a boiler to meet a desired set point for a building heating system or similar process heating application. In addition, the BIM can provide boiler start permissive interlock control for combustion air dampers, draft controls, gas boosters, etc., or any combination thereof.

The BIM performs PID set point control to maintain the proper firing rate of the boiler.

The BIM accepts 4-20mA current inputs for the boiler inlet and outlet temperatures. As an alternative, the boiler inlet temperature input can be configured to act as a remote setpoint or modulation signal. Digital inputs include flame safeguard status signals, domestic hot water (DHW) demand priority, and boiler pump and damper proves. The BIM can also receive a remote set point from an energy management system via Modbus RTU.

The BIM includes a 3.5" monochrome touch-screen display and two RTD temperature inputs used for boiler modulation, boiler outlet temperature limiting and boiler pump modulation. Boiler monitoring and control connections are made between the boiler controls and BIM. Boiler specific parameterization is done at the BIM including, low fire hold time, outlet temperature limit, boiler pump/valve configuration and damper interlock assignment.

1.1 - Principle of Operation

The BIM monitors the temperature at the outlet of the boiler and uses this value to determine the modulation rate for the boiler to maintain an operator-entered setpoint.

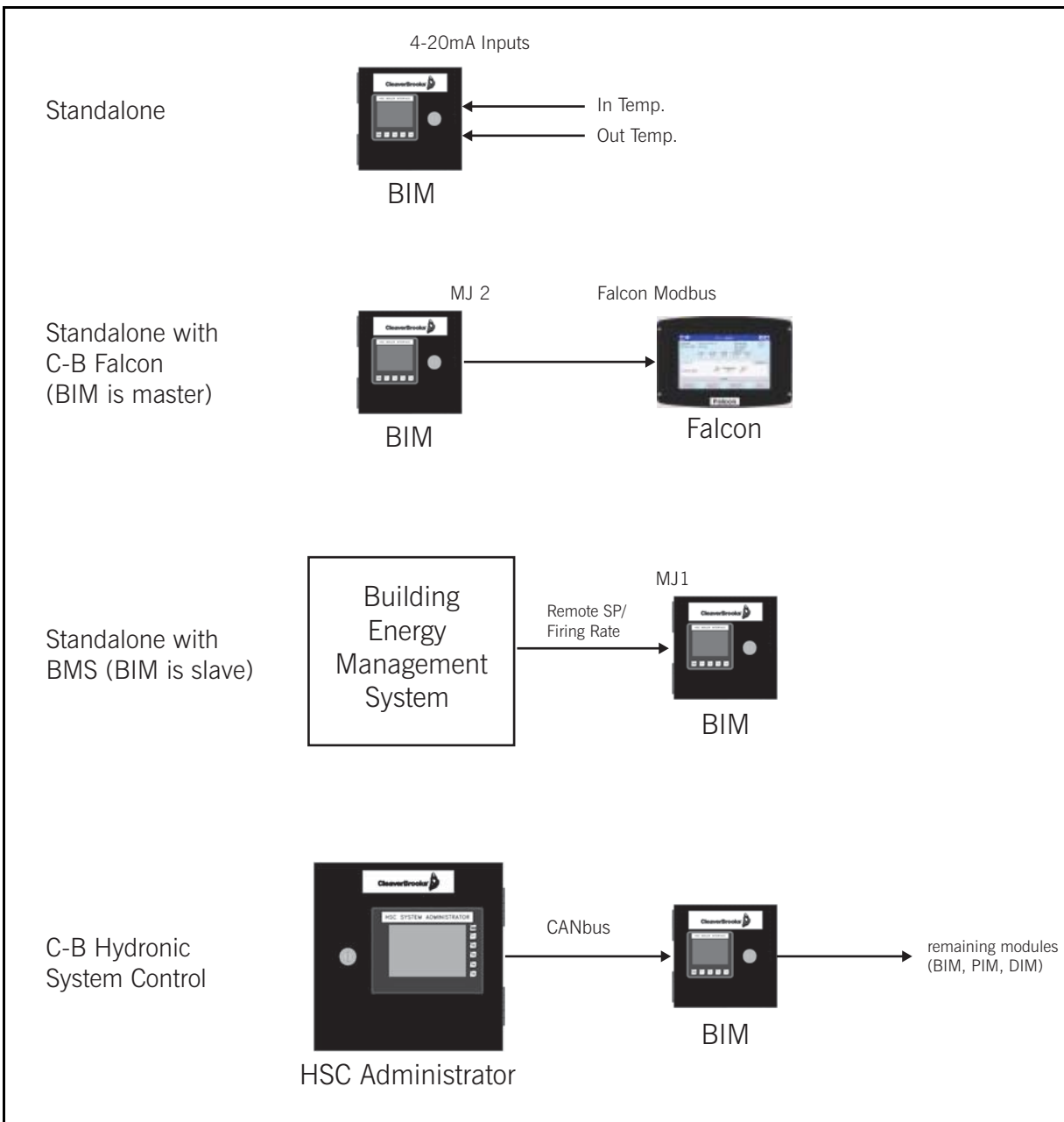
The BIM has the ability to enable and modulate a connected boiler pump and/or isolation valve.

When the boiler outlet temperature drops below the 'On Point', the boiler is called to start. Upon successful ignition and completion of low fire hold, the BIM provides a modulating firing rate signal to the boiler.

When the system temperature exceeds the 'Off Point', the boiler will be stopped.

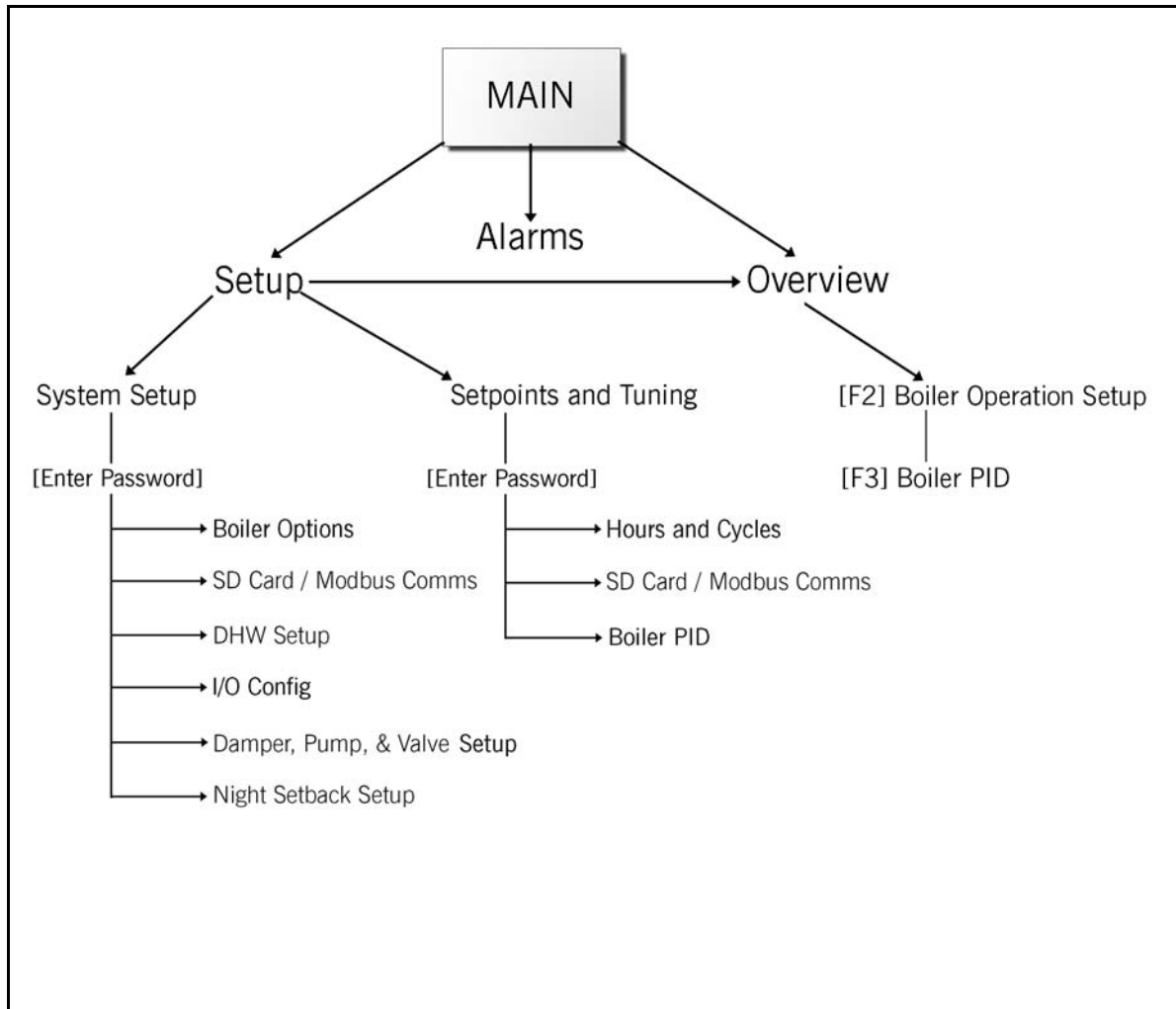
1.2 - Applications

The BIM will work in standalone mode either as an independent boiler modulating control, or in conjunction with a C-B Falcon control or building Energy Management System. In addition, the BIM functions as an integral component of the C-B Hydronic System Control.



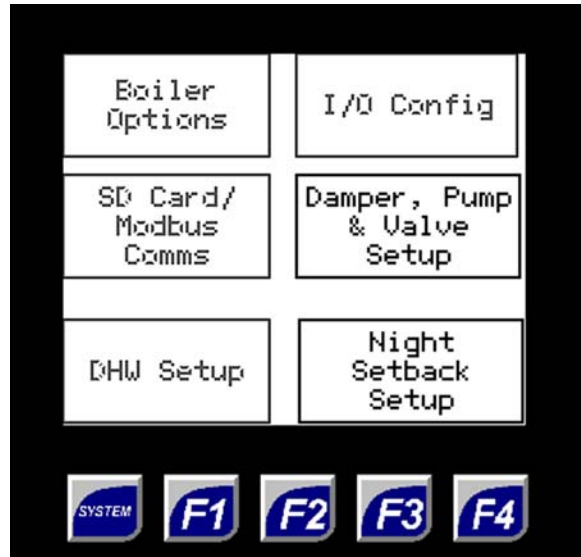
1.3 - Screen Navigation

This chart shows the BIM's menu structure. The [F1] key goes to the previous screen or back to the Main screen. After reaching the Main screen, [F1] toggles between the Main and Overview screens.

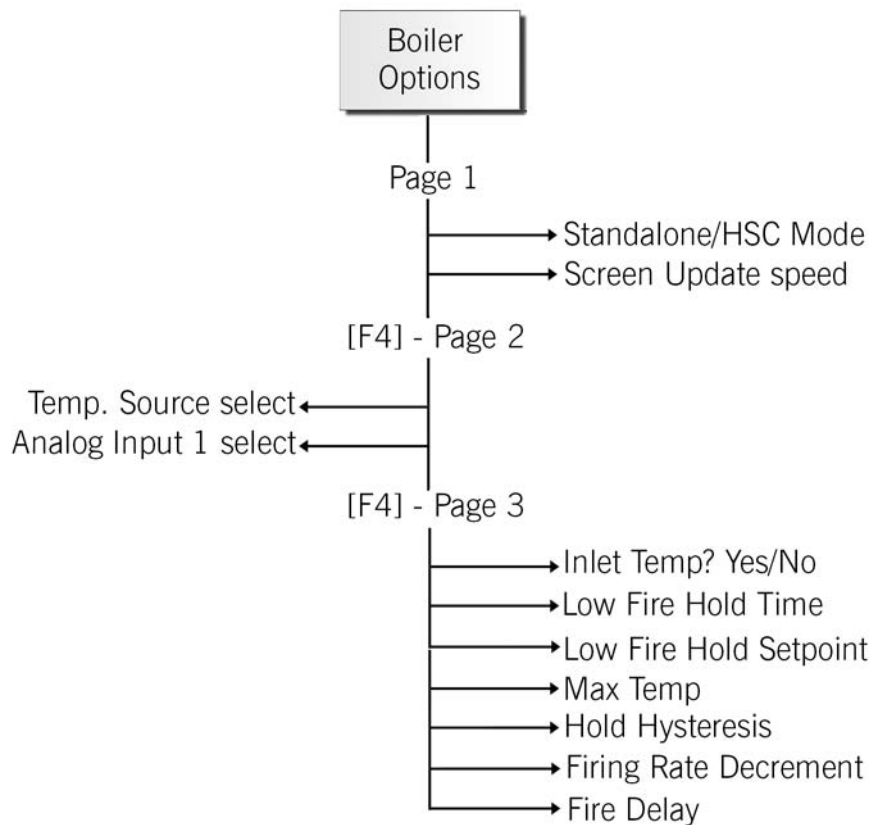


2 - System Setup

The System Setup menu accesses initial configuration settings to prepare the BIM for basic operation in a standalone or networked setting. After pressing <System Setup> you will be prompted to enter a password. Press <Password:> and enter password using the numeric keypad, then press <Enter>.



2.1 - Boiler Options



<Boiler Options> accesses three pages of menu selections. Navigate between pages using [F4] (forward) and [F1] (back).

PAGE 1**Standalone/HSC Mode**

Set to **Standalone** if this BIM is controlling a boiler that is not part of an HSC network.

If the boiler will be connected to an HSC system, select **HSC**, then press <HSC BIM Add> to set the CANbus Node Address. BIMs for condensing boilers use the address range 11-20 and for non-condensing boilers 21-30. A password prompt will appear. NOTE: condensing boilers must start at 11 and be numbered consecutively. Non-condensing boilers must start at 21 and be numbered consecutively. For HSC operation see Cleaver-Brooks manual 750-350.

Screen Update adjusts the refresh time of the BIM screen (from 20=slowest to 50=fastest). Faster update times may slow down overall processor performance.

PAGE 2

Temp. Source sets the type of temperature PV input to the BIM. Select **4-20mA** or **MB** (Modbus) **Read**.

Analog Input 1 is configured for the type of signal expected - **In Temp** (inlet temperature), **Remote SP** (setpoint), or **Remote FR** (firing rate).

Analog Input 2 is reserved for Outlet Temperature.

PAGE 3

Inlet Temp? Select **Yes** if using ΔT for boiler pump control.

The **Low Fire Hold** settings determine the interval during which the boiler will remain at low fire upon startup, before beginning modulated firing.

Low Fire Hold Spt. (sec)

Low Fire Hold Spt. (deg)

Max Temp - should be set at or below boiler's local high limit setting. This parameter will prevent boiler dropping out of rotation due to a high limit alarm.

Hold Hyst - when **Max Temp** minus **Hold Hyst** is reached, boiler will return to firing rate modulation.

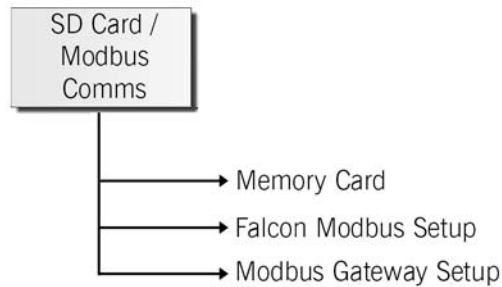
FR Dec - when **Max Temp** is reached, boiler will modulate down by this amount.

Fire Delay - if boiler is called but does not start, the BIM will wait for this interval before alarming.

2.2 - SD Card - Modbus Comms

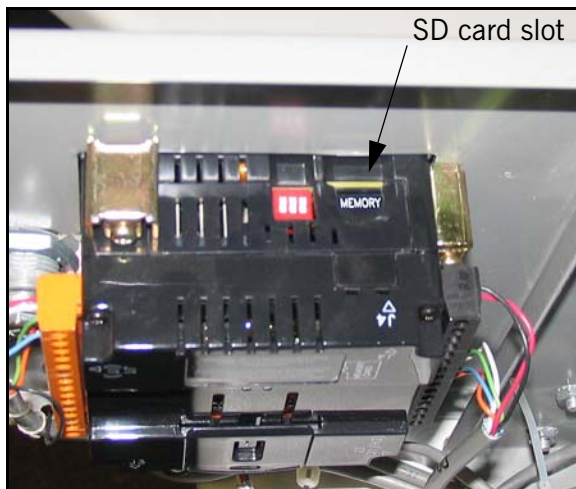
Memory Card functions are used to back up and restore the BIM's parameter settings, to clone settings from one BIM to another, and for data logging.

Modbus parameters are for establishing communications with a CB Falcon or a Building Management System.



SD MEMORY CARD

Insert the SD card into the MEMORY slot on the top of the BIM unit. Press gently until the card clicks into place. With the card inserted press <Memory Card> to access the card functions.



Toggle <Card Off/On> to ON to enable reading from/writing to the SD card. If the card requires formatting, <Removable Media> will remain flashing. Press <Removable Media> then <Format>. When the card is formatted, backup/restore and data logging functions will be available.

<Backup> will load the current set of BIM parameters to the SD card.

<Restore> will load a previously backed up parameter set into the BIM. Backup and Restore operations will normally take about 30 seconds.

<Data Off/On> is used to activate/deactivate BIM data logging. When data logging is ON the BIM will create a log file every 60 minutes, with individual entries logged at the interval specified in <Log Interval>. Data are saved in ,CSV file format.

NOTE: Before removing the SD card, go to the Memory Card screen and toggle <Card Off/On> to OFF.

FALCON MODBUS SETUP

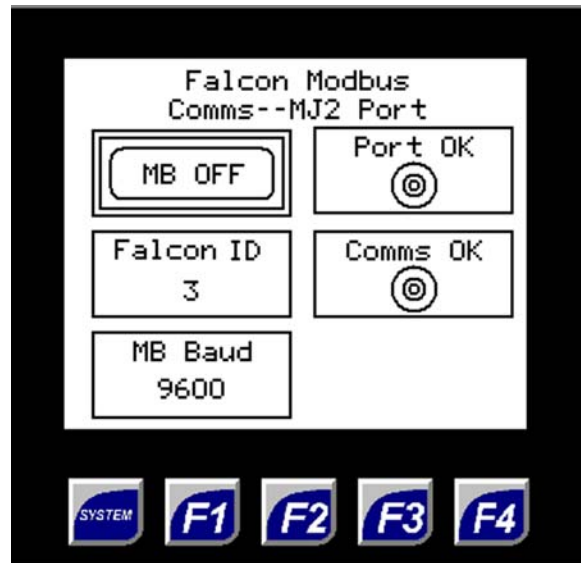
When linked by Modbus to a C-B Falcon control, the BIM is the master unit in a master-slave configuration. The connection is made from the BIM MJ2 port to Falcon Modbus MB2. Press <Falcon Modbus Setup> for parameter access.

MB ON/OFF toggles Modbus communications on and off.

Falcon ID is the unique identifier for the Falcon on this Modbus network.

MB Baud sets the Modbus baud rate.

The **Port OK** indicator indicates proper functioning of the BIM Modbus port when on (solid black). The **Comms OK** indicator flashes when the BIM and Falcon are communicating.



MODBUS GATEWAY SETUP

When linked by Modbus to a Building Management System, the BIM is the slave and receives a master signal from the BMS.

MB ON/OFF toggles Modbus communications on and off.

Slave ID is the unique identifier for the BIM on this Modbus network.

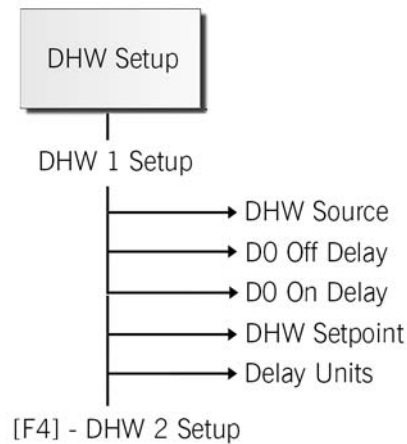
MB Baud sets the Modbus baud rate.

The **Port OK** indicator indicates proper functioning of the BIM Modbus port when on (solid black). The **Comms OK** indicator flashes when the BIM and BMS are communicating.

BMS Write Setup enables/disables the BIM Modbus bank write capability and selects the type of signal (Remote Firing Rate or Remote Setpoint) to be written from the BMS.

2.3 - DHW Setup

The BIM accepts up to 2 digital inputs for Domestic Hot Water (DHW) priority. When the inputs are made, up to two digital outputs are activated and the boiler setpoint is increased to the DHW Setpoint value.



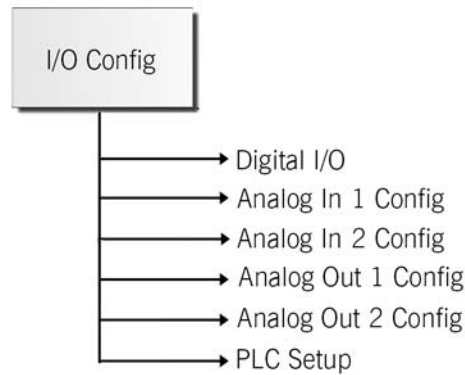
DHW Source - The system may be configured in one of two modes:

MODE 1 - DHW Input #1 activates DHW#1 Output, #2 Input activates #2 Output. Setpoint is high select between **DHW Setpoint** and CH Setpoint.

MODE 2 - DHW#1 Input activates both DHW Outputs. Setpoint is high select between **DHW Setpoint** and CH Setpoint.

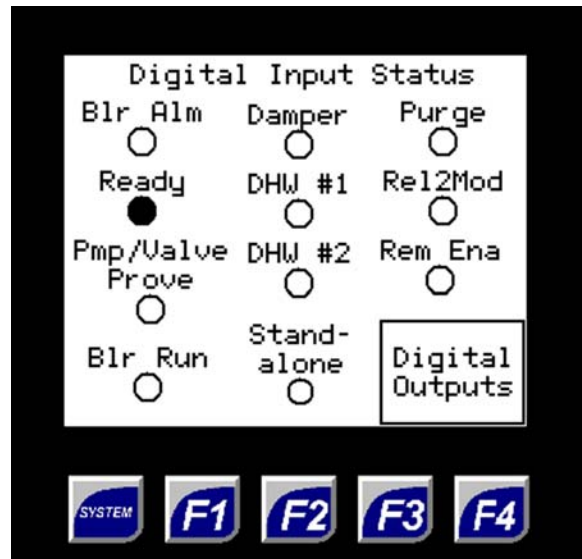
Each of the DHW outputs has configurable time delays (**DO On/Off Delay**) for turning on and for turning off after the DHW input signal is turned on/off.

2.4 - I/O Config

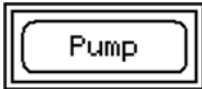



<I/O config> accesses various features related to the BIM's digital and analog inputs and outputs.

Press <I/O config>, then <Digital I/O> for the Digital Input Status screen. A solid black indicator means the input is on/energized.



<Digital Outputs> goes to the DO Status/Test screen. The buttons serve as status indicators and as manual force switches:

White border indicates output is OFF. 

Black border indicates output is ON. 

Press and hold a button that is ON to force the output OFF, and vice-versa.

These are momentary switches - releasing the button will return the output to its former state.

The Analog Out 1 (Firing Rate) and Analog Out 2 (Pump/Recirc Valve) screens have identical parameters:

Scale Min - percent control output corresponding to **Out Min** (minimum desired mA output within the 4-20 mA range).

Scale Max - percent control output corresponding to **Out Max** (maximum desired mA output within the 4-20 mA range).

Example: For firing rate limiting, lower the Analog Out 1 Out Max value.

Force Value - manual control of the analog output.

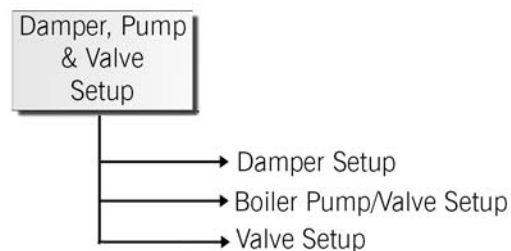
Pressing <Force Value> will bring up a numeric keypad where the desired % output can be entered.

Firing Rate (Boiler Pump) Analog Out - shows the mA output corresponding to the entered Force Value.

Also accessible from the I/O configuration screen is <PLC Setup> - this provides access to diagnostic information and various BIM hardware settings. Screen contrast, screen saver, beeper enable, and date/time settings can be accessed here.

The diagnostic features under PLC Setup are primarily for troubleshooting the BIM's internal processor.

2.5 - Damper, Pump, & Valve Setup



DAMPER SETUP

If a damper, draft control, gas booster, or other start-permissive interlock is required, setup can be performed under <Damper Setup>.

Toggle **Damper** to YES if using a damper or other device. **Prove Req?** should be YES if the BIM will be receiving a feedback signal from the device. **Time to Prove** is the time allowed for device to prove input before indicating a boiler start failure.

Off Delay is the time after boiler shutdown until the output to the device is de-energized.

Control - if set to Local, device will be controlled from this BIM. Remote control allows the damper to be controlled by a DIM module connected by CANbus to the BIM. An additional screen, Remote DIM Setup, allows entry of the DIM module and damper numbers.

VALVE SETUP

If an isolation valve is connected to the BIM, switch **Valve** to Yes.

Valve Off Delay sets the time after boiler shutdown until the valve closes.

Valve On Delay sets the time before the valve will open upon a Boiler Start request.

BOILER PUMP/VALVE SETUP

Output - select Constant for enable/disable signal (no modulation) or Modulation if a modulating pump/valve.

Pump Off Delay sets the boiler pump overrun time after a boiler shutdown.

Pump On Delay sets the boiler pump start delay after a boiler start request.

Prove Required - if Yes, boiler will not start unless pump/valve proven.

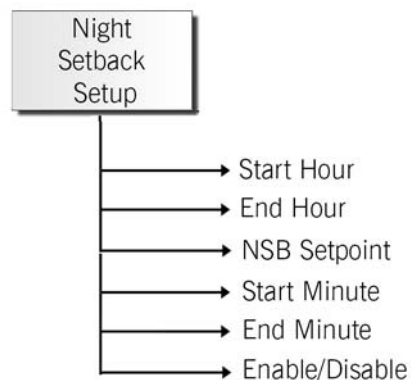
On Page 2 select either **Delta T** or **In Temp** pump control.

When Modulation is selected, upon startup the pump will run at **Pump Speed Hold %** for the **Pump Speed Hold Time** before release to modulation.

2.6 - Night Setback Setup

The BIM allows the choice of a setpoint for lower operating temperatures during nighttime operation. Setback start and end time for each day of a 7 day schedule can also be selected. Selection must be set up on the HMI and night setback enabled.

There is a stepped transition between setpoints for smooth operation.

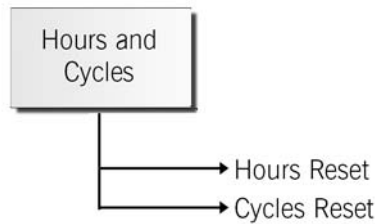


[F4] cycles through Day 1 - Day 7

3 - Setpoints and Tuning

3.1 - Hours and Cycles

Hours and Cycles displays the number of on/off cycles and cumulative run time for this boiler.

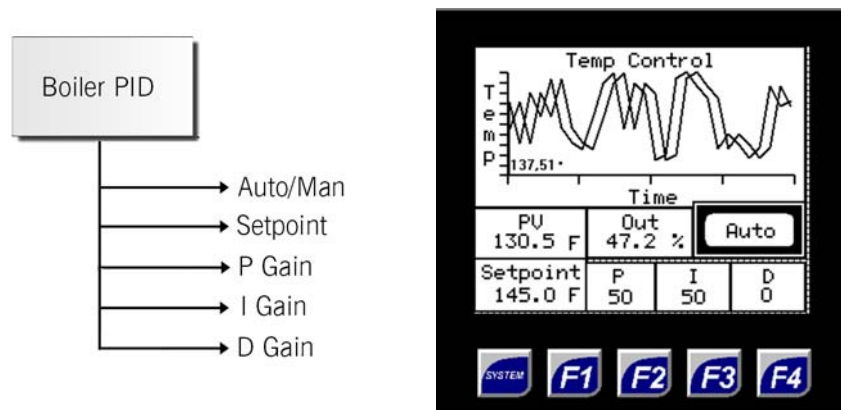


3.2 - SD Card - Modbus Comms

See Section 2.2

3.3 - Boiler PID

Boiler PID accesses PID settings for boiler firing rate control. A trend display shows setpoint and actual process value in real time.



With the **Auto/Manual** switch in Manual, a control output % can be entered by pressing <Out %>. Proportional, Integral, and Derivative gain can be adjusted using the <P/I/D> buttons.

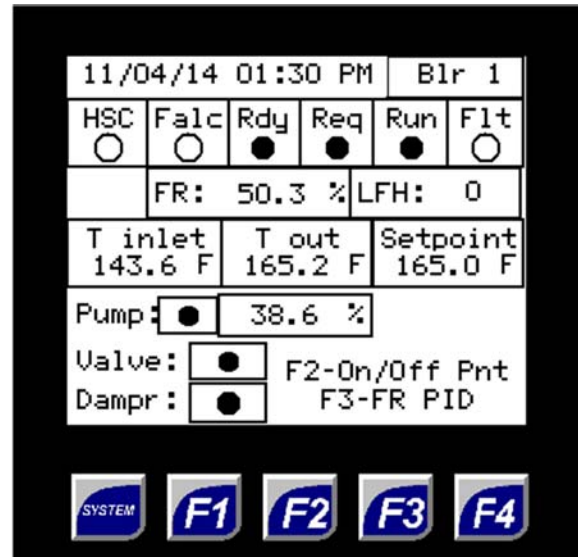
4 - Overview Screen

The top row of indicators show boiler status (Ready, Heat Request, Run, or Fault) and whether the BIM is connected to an HSC or Falcon.

Also displayed are firing rate, low fire hold time, and outlet temperature. A <Setpoint> button allows user adjustment of setpoint.

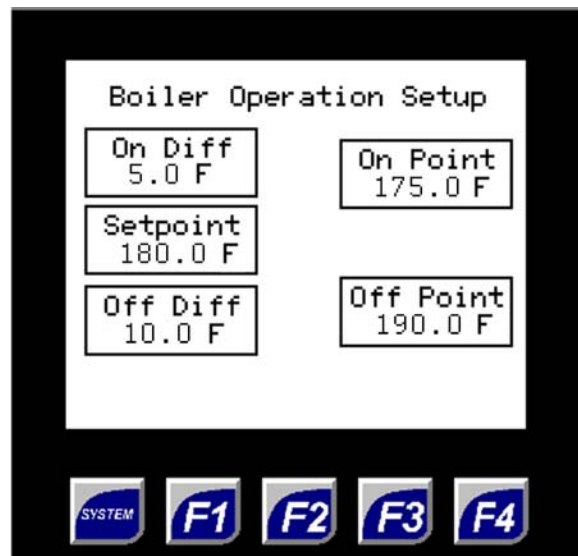
On/Off Pump, Valve, and Damper indicators will be shown if the system is so configured. Pump will display % output if pump modulation is used.

Pres [F2] for the Boiler Operation Setup screen (see section 4.1) or [F3] for the Firing Rate screen with trend display.



4.1 - Boiler Operation Setup

This screen is used to define the on/off points for the boiler. The user enters the desired setpoint and on and off differentials. The differential values are added (**Off Diff**) and subtracted (**On Diff**) from setpoint to define the boiler on point and the boiler off point.



5 - BIM Parameter List

Boiler Interface Module Parameter List

Setup/Configuration Screen or Parameter	Description	Units	Range	Default
<System Setup>				
<Boiler Add>	Boiler CANbus Node Address assignment -- Condensing Boilers start with 11 and are addressed in sequential order up to 20; Non-Condensing Boilers start with 21 and are addressed in sequential order up to 30.		11 - 30	11
<Boiler Options>	Boiler configuration screen			
- Temp. Input: <RTD> or <4-20mA>	Boiler Inlet/Outlet Temperature Input type -- Hardware/program default is RTD (PT100). (Contact factory for non-standard 4-20mA inputs.)			RTD
- Inlet Temp?	Boiler Inlet Temperature sensor connected? Inlet Temperature sensor required for Boiler Pump speed control.			No
- Low Fire Hold	Low Fire Hold Time after initial Boiler Prove --	seconds		
- Max Temp	Maximum allowable operating temperature for boiler. This firing rate limiting function prevents nuisance high limit shut-downs where there may be a mismatch between firing rate and water flow rate through the boiler.	deg F		180.0
- Hold Hyst	Boiler Outlet Limiting hold temperature differential. Boiler Outlet Limiting remains active until the outlet temperature drops to a temperature below Max Temp minus this value.	deg F		10.0
- FR Dec	Percentage decrease in the boiler's firing rate when the Boiler Outlet Limiting function is activated.	%		25.0
- Fire Delay	Upon Boiler Start request, Fire Delay is the time allowed for Boiler Prove input. If Boiler Prove is not present within this setting, the Administrator will call the next Lag boiler in the sequence.	seconds		180
<I/O Config>				
<Digital I/O>	Digital Input status			
- <Digital Outputs>	Switch to Digital Output status screen -- each DO can be momentarily energized to test by pressing the respective output button.			
<Analog Out 1 Config>	Switch to Analog Output 1 screen - Boiler Modulation signal			
- Scale Min	Minimum control output percentage corresponding to Output Min setting	%		0.0
- Scale Max	Maximum control output percentage corresponding to Output Max setting	%		100.0
- Output Min	Minimum current output signal corresponding to Scale Min setting -- used for zero value of modulation input signal of boiler (i.e. Low Fire).	mA		4.0
- Output Max	Maximum current output signal corresponding to Scale Max setting -- used for 100% modulation input signal of boiler. Can be utilized to limit maximum firing rate.	mA		20.0
<Analog Out 2 Config>	Switch to Analog Output 2 screen - Boiler Pump Modulation signal			
- Scale Min	Minimum control output percentage corresponding to Output Min setting	%		0.0

Boiler Interface Module Parameter List (Continued)

Setup/Configuration Screen or Parameter	Description	Units	Range	Default
- Scale Max	Maximum control output percentage corresponding to Output Max setting	%		100.0
- Output Min	Minimum current output signal corresponding to Scale Min setting -- used for zero value of modulation input signal of VSD boiler pump. Can be utilized to limit minimum pump speed.	mA		4.0
- Output Max	Maximum current output signal corresponding to Scale Max setting -- used for 100% modulation input signal of VSD boiler pump. Can be utilized to limit maximum pump speed.	mA		20.0
<PLC Setup>	Switch to hardware utilities screen -- used for utilities such as setting screen contrast, troubleshooting operational status, program version upgrades, etc.			
<Damper & Valve Setup>	Configuration of damper/draft control interlock and connected isolation valve			
<Damper Setup>	Switches to Damper Interlock (combustion air dampers, draft controls, gas boosters, etc.) with Boiler Start configuration screen.			
- Damper control	Is there a damper, draft control, gas booster, etc. Boiler Start interlock required?			No
- Control: Local or Remote	Select Local for device (e.g. damper) connected directly to Boiler; select Remote for device(s) connected to remote Damper Interface Module (DIM)			Local
- DIM Module	DIM number assignment for connected Boiler Start interlock device.			DIM1
- Damper #	Specific Discrete Output assignment for the specified DIM to interlock this Boiler's Start			1
- Off Delay	Damper request Off Delay time after boiler shutdown. If more than one boiler is assigned to the same DIM output device, all assigned boilers must be off before the specific digital output is de-energized.	seconds		120
- Time to Prove	Time allowed for device (e.g. damper) Prove input before indicating Boiler Start failure and moving to next Lag Boiler in sequence.	seconds		45
- Valve control	Is an isolation valve connected to BIM?			No
- Valve Off Delay	Valve close delay time after boiler shutdown	seconds		600
- Valve On Delay	Valve open delay upon Boiler Start request	seconds		0
<Blr Pump/Recirc Valve Setup>	Switches to connected Boiler Pump/Recirc Valve configuration screen			
- Output	Select Constant speed or Modulation speed Boiler Pump			
- Pump Off Delay	Boiler Pump overrun time after boiler shutdown	seconds		600
- Pump On Delay	Boiler Pump start delay after Boiler Start request	seconds		5
- Prove Required	Is Pump or Valve Prove required prior to Boiler Start?			No
- Temp. PID Action	Select control action to match pump or valve action (e.g. for Delta T SP control with VSD pump, select Reverse -- increase pump speed to decrease Delta T)			Reverse
- Process Variable select: Delta T or Temp.	Delta T or Minimum Temp modulation control			Delta T

Boiler Interface Module Parameter List (Continued)

Setup/Configuration Screen or Parameter	Description	Units	Range	Default
<SP & Tuning>				
< Hours and Cycles>				
<Memory Card>	Switches to Memory Card screen for BIM SD Card operations			
- Card On/Off	Enable BIM SD Card operations			Card Off
- Data On/Off	Enable Data Logging at BIM			Data Off
- Log Interval	Data log interval time	seconds		60
- <Backup>	Backup of parameters settings -- press once and wait 30 seconds for indicator to indicate successful Backup			
- <Restore>	Restore of previously backed up parameter settings -- press once and wait 30 seconds for indicator to indicate successful Restore			
- Memory Card capacity	Indicates memory used on card			
<Boiler PID>	Switches to Local Boiler modulation PID tuning screen			
- <P Gain>	Proportional Gain			10
- <I Gain>	Integral Gain			10
- <D Gain>	Derivative Gain			0
- <Auto/Manual>	Switch from Auto to Manual or Manual to Auto			Auto
- <Out>	Current firing rate (control output) percentage; when in manual, firing rate can be forced	%		0.0
- <Setpoint>	In the case of loss of communication with Administrator, local Boiler Outlet Temperature Setpoint can established for local boiler modulation control.	deg F		160.0
<Temp. PID>	Switches to Boiler Pump/Valve modulation PID tuning for Delta T or Minimum Temp control			
- <P Gain>	Proportional Gain			10
- <I Gain>	Integral Gain			10
- <D Gain>	Derivative Gain			0
- <Auto/Manual>	Switch from Auto to Manual or Manual to Auto			Auto
- <Out>	Current modulation (control output) percentage; when in manual, modulation output can be forced	%		0.0
- <Setpoint>	Delta T Setpoint for Delta T modulation; Minimum Inlet Temperature Setpoint for Temp. modulation (set at Admin NC Low Limit).	deg F		30.0



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