



Master Panel 4

**Four Boiler Lead Lag Control
Operation Manual**



750-383
06/16

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 train and advise not only his or her personnel, but the contractors' personnel who are servicing, repairing, or operating the equipment, in all safety aspects.

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 free him of certain repetitive chores and give him more time to devote to 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 his operating personnel must comply with all requirements or regulations of his 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.

Cleaver-Brooks

Master Panel 4

Four Boiler Lead Lag Control

Operation Manual

Please direct purchase orders for replacement manuals to your local Cleaver-Brooks authorized representative

Manual Part No. 750-383
06/16

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Section 1 Overview

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The Cleaver-Brooks Master Panel 4 master boiler room control system provides lead/lag control for up to four boilers when used in conjunction with CB integrated boiler controls.

A. FEATURES

- Lead/lag control for up to four boilers.
- Warm-up routine for hot standby (hot water units only).
- Ethernet I/P communication with individual boilers.
- Boilers' parameters are available from the master panel to customer BMS.
- Individual boiler indicating screens.
- Web server for remote monitoring through a web browser.

New features 2016:

- 2 User defined configurable 4-20mA analog inputs with trending.
- PLC Hardware and PLC I/O Screens
- 'Boiler 1-4 is Lead' outputs, optional.
- Update date/time from application without the need to go to PV+ Configuration.
- Contact info entry, password protected, and viewing of contact information.
- Ability to communicate to 2 separate (1 DA and 1 Surge) ADAC controls.

B. COMPONENTS

1. Control panel, which houses the following components:

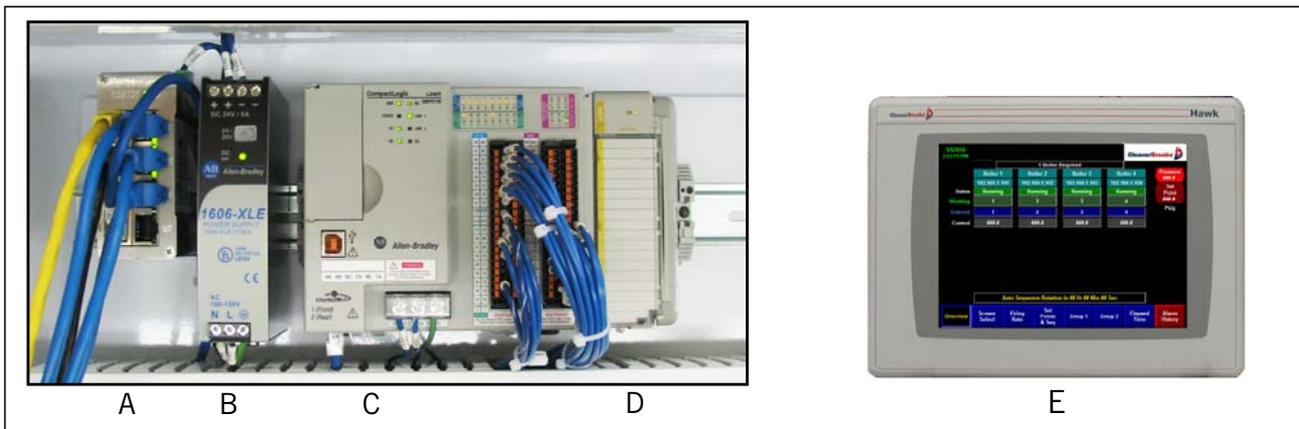


Figure 1-1 Master Panel Components

- A. Ethernet switch
- B. 24 VDC power supply
- C. PLC with 16 in/16 out digital, 4 in/2 out analog imbedded I/O
- D. Analog Output module
- E. Display (Allen Bradley PanelView Plus) — displays various data and allows input of the configurable parameters.

2. Pressure (steam system) or temperature (hot water system) transmitter with well (shipped loose). Transmitter must be mounted in a common outlet header.

C. INPUTS/OUTPUTS

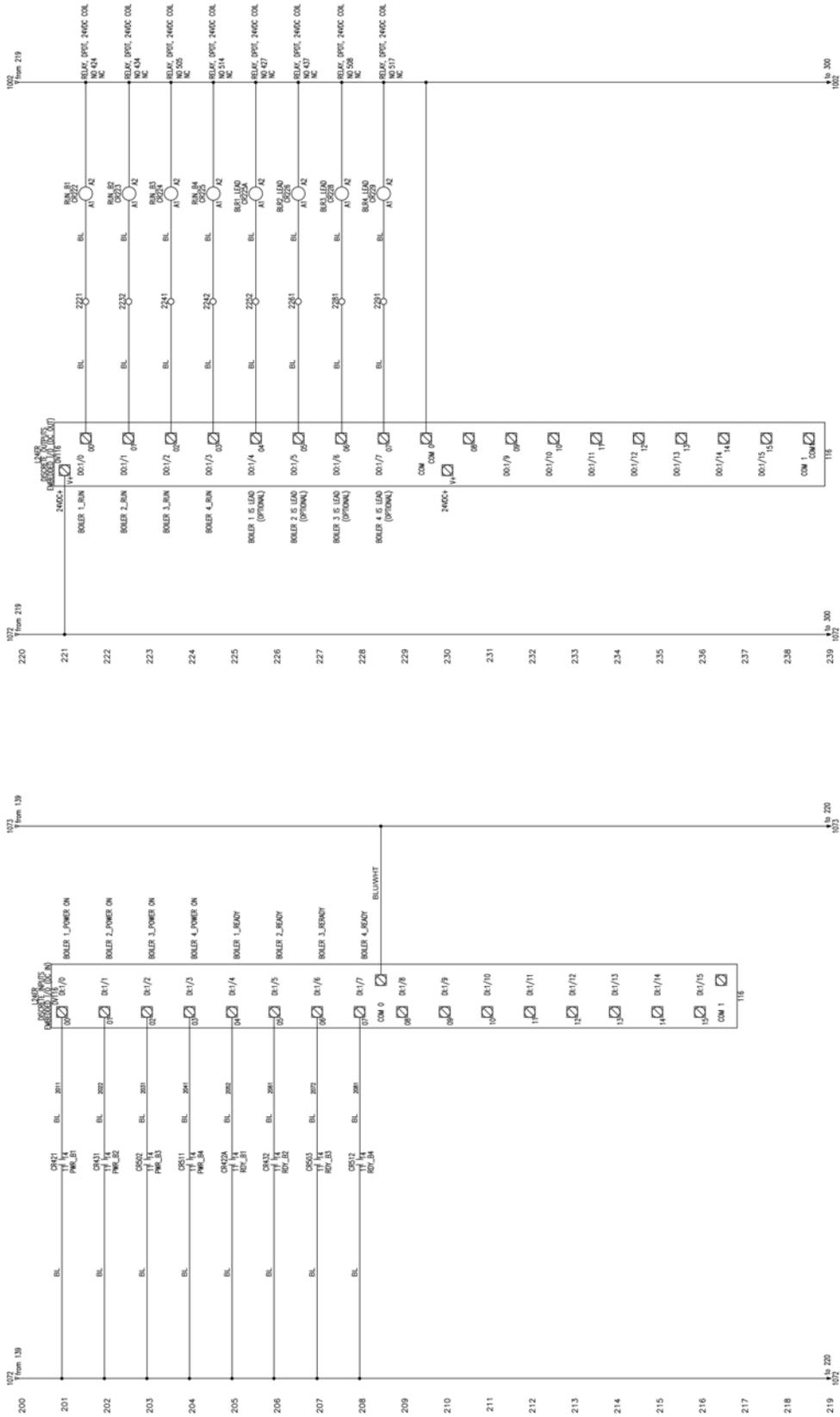
Processor - Slot 0						Analog Output	
Embedded I/O - Slot 1-3						Slot 4	
		Dig IN	Dig OUT	Anlg IN	Anlg Out		
Boiler 1 Power On	I1/0	1				O4/0	Boiler 3 Firing Rate 1
Boiler 2 Power On	I1/1	1				O4/1	Boiler 4 Firing Rate 1
Boiler 3 Power On	I1/2	1					
Boiler 4 Power On	I1/3	1					
Boiler 1 Ready	I1/4	1					
Boiler 2 Ready	I1/5	1					
Boiler 3 Ready	I1/6	1					
Boiler 4 Ready	I1/7	1					
Spare	I1/8	1					
Spare	I1/9	1					
Spare	I1/10	1					
Spare	I1/11	1					
Spare	I1/12	1					
Spare	I1/13	1					
Spare	I1/14	1					
Spare	I1/15	1					
Boiler 1 Run	O1/0		1				
Boiler 2 Run	O1/1		1				
Boiler 3 Run	O1/2		1				
Boiler 4 Run	O1/3		1				
Boiler 1 is Lead Boiler	O1/4		1				
Boiler 2 is Lead Boiler	O1/5		1				
Boiler 3 is Lead Boiler	O1/6		1				
Boiler 4 is Lead Boiler	O1/7		1				
Spare(s)	O1/8-O1/15		8				
Steam Pres (ST) / Supply Temp (HW)	I2/0			1			
Outdoor Temp/Remote SP	I2/1			1			
User Defined 1	I2/2			1			
User Defined 2	I2/3			1			
Boiler 1 Firing Rate	O2/0				1		
Boiler 2 Firing Rate	O2/1				1		

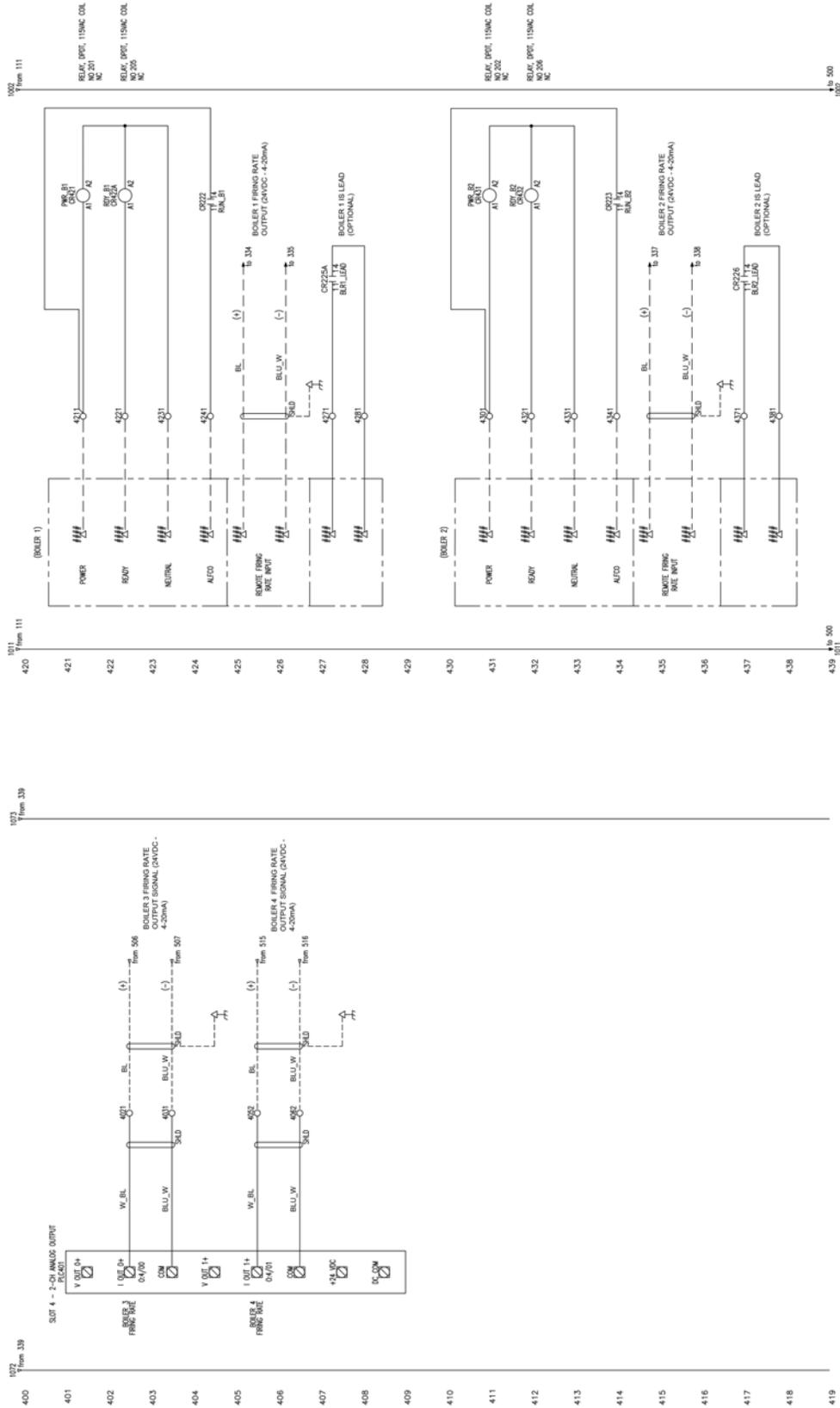
D. SPECIFICATIONS

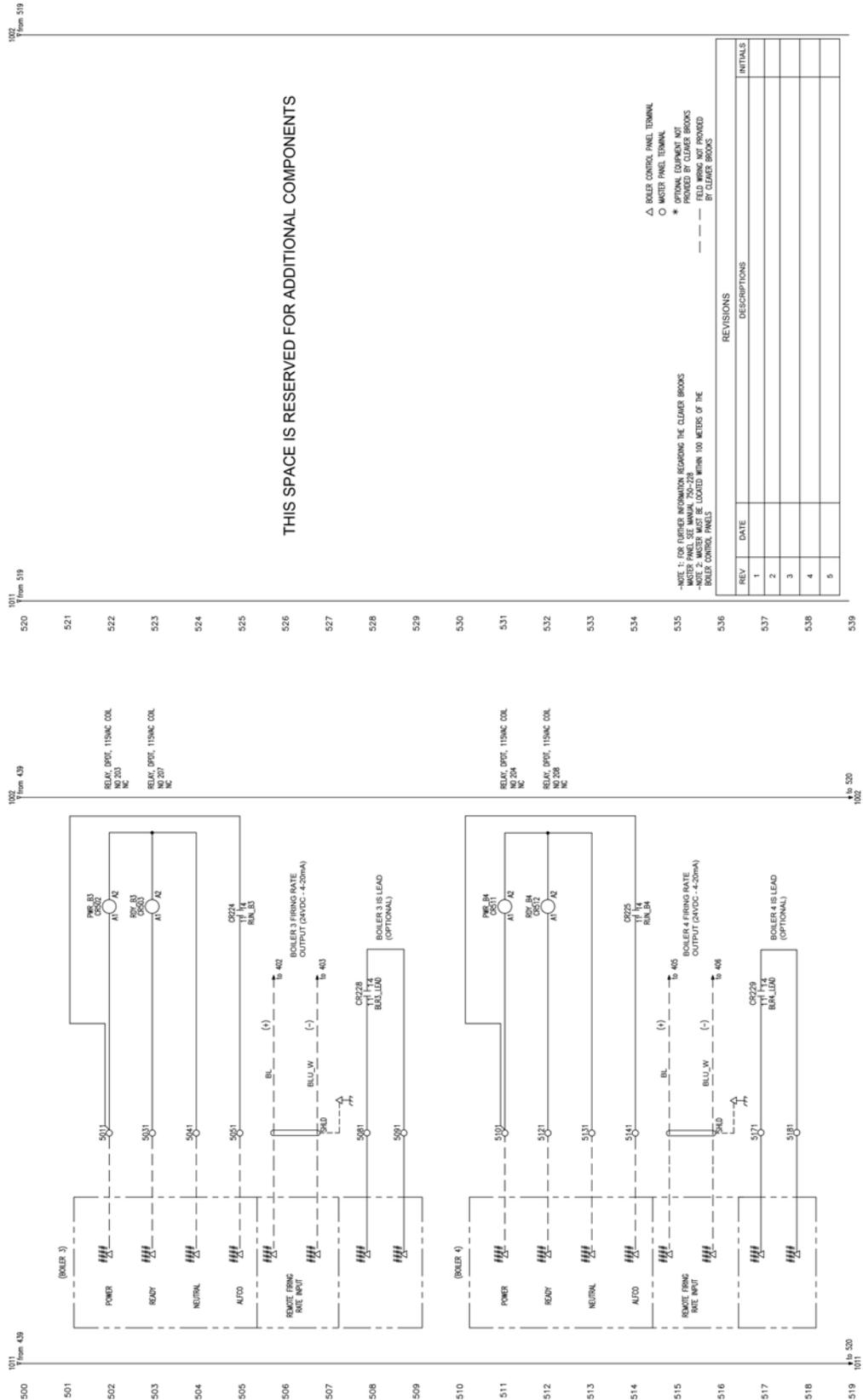
Cleaver-Brooks Master Panel 4 operational and environmental specifications are as follows:

Table 1-1. Operational and Environmental Specifications

Description	Specification
Maximum connecting units	4 boilers
Power Supply Voltage	120 VAC (+10%/-15%)
Power Supply Frequency	50 or 60 Hz
Fusing:	
Touch Screen HMI (7")	2A
Analog Power Supply	2.1A
PLC Power Supply	2A
Ambient Operating Temperature Limits	32° to 130°F (0° to 54°C)
Humidity	85% RH continuous, non-condensing
Vibration	Continuous to 0.5 G
Communication Protocol	Ethernet I/P









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A. INITIAL SETUP

Note: Prior to the commissioning of the lead/lag system all boilers have to be started and combustion set.

1. I/P Addressing (individual boilers)

Addresses have to be assigned to the individual boilers. This can be done using the Ethernet Set Up screen on each boiler panel.

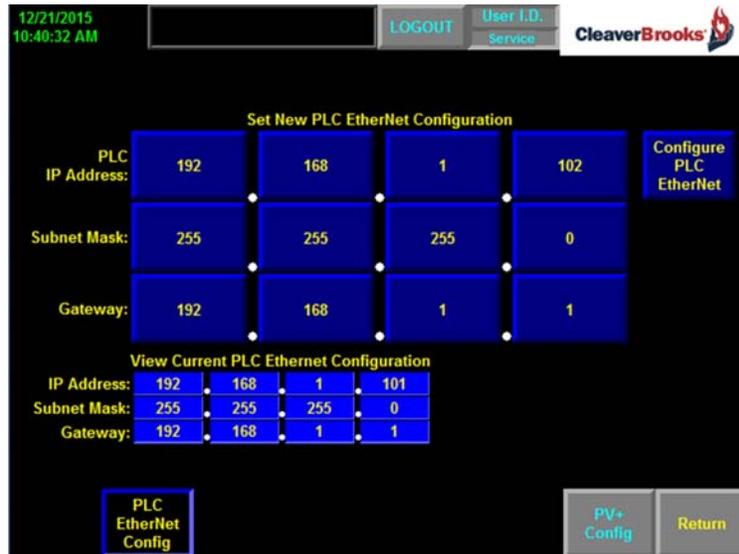


Figure 2-1 Ethernet config boiler

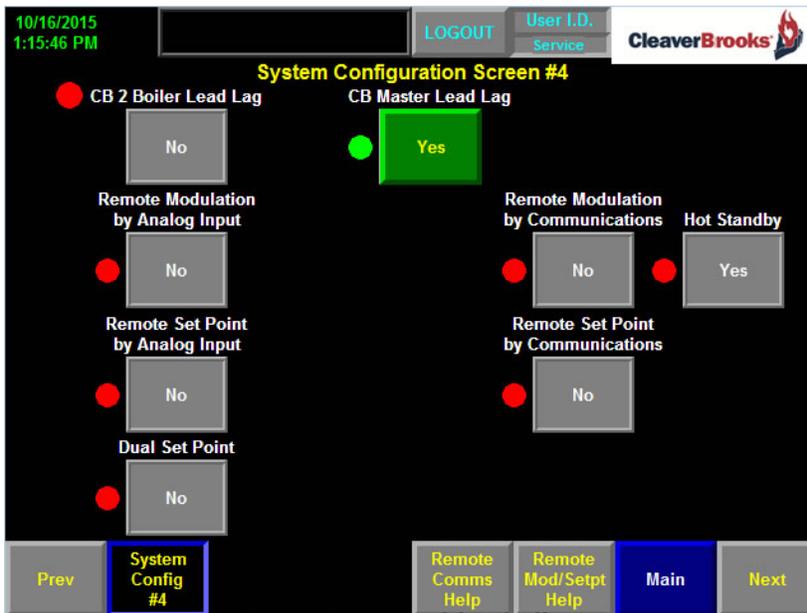
Unless otherwise noted, IP addresses should be configured according to the following table:

	Boiler A	Boiler B	Boiler C	Boiler D
IP Address	192.168.1.101	192.168.1.102	192.168.1.103	192.168.1.104
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	192.168.1.1	192.168.1.1	192.168.1.1	192.168.1.1

2. Boiler lead lag/remote configuration

On Configuration Screen #4 of the boiler panel select <CB Master Lead Lag>.

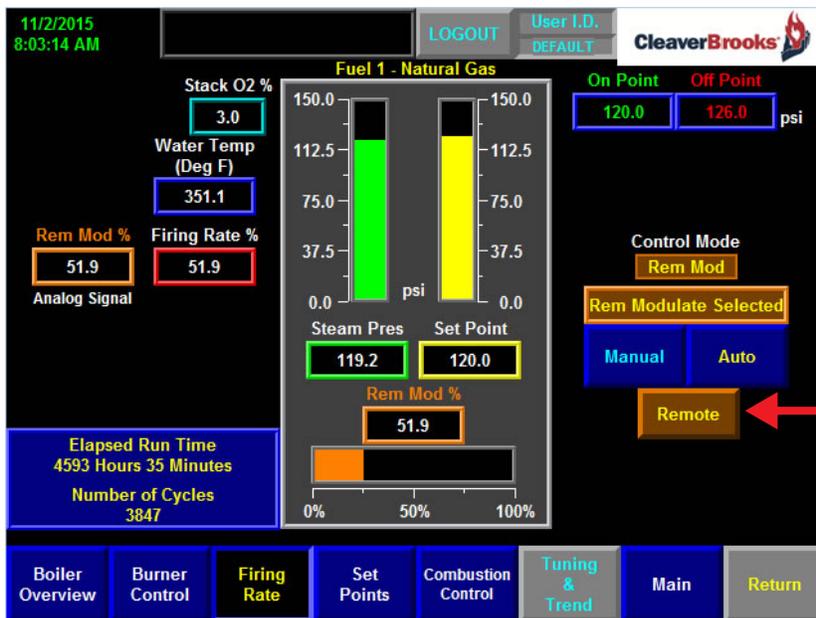
Individual boiler configuration may vary depending on Hawk version. Refer to the boiler controls manual for additional information.



Note: These settings are made at the boiler control panel, not at the Master Panel.

Figure 2-2 Lead lag boiler

On the boiler Firing Rate Screen, <Remote> must be selected for the firing rate control mode.



Note: This setting is made at the boiler control panel, not at the Master Panel.

Figure 2-3 Remote mod boiler

3. I/P Addressing (master panel)

To set the Master Panel Ethernet configuration, first go to System Configuration. Observe the screen warning: Lead/Lag control will not function while in system configuration and the master panel firing rate control will be forced to manual. Changing Ethernet settings may cause a loss of communication.

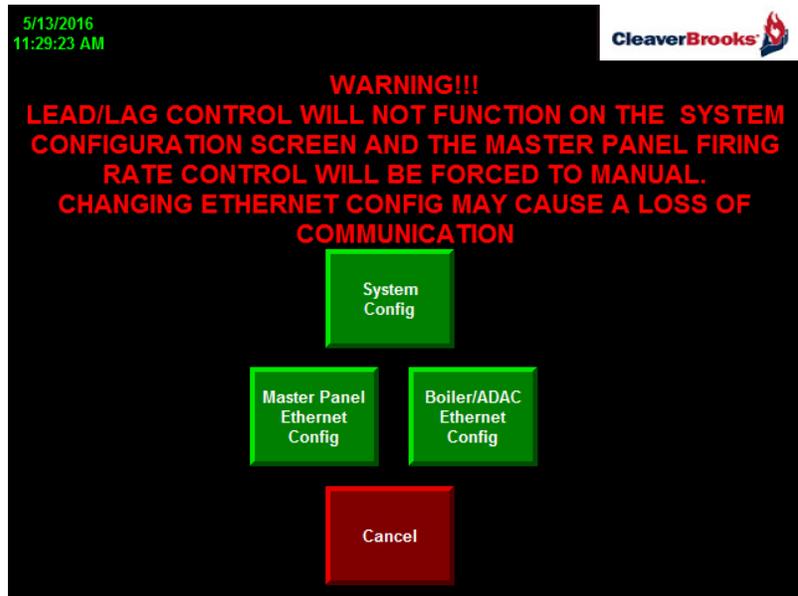


Figure 2-4 Warning

Press <Master Panel Ethernet Config> for the following screen:

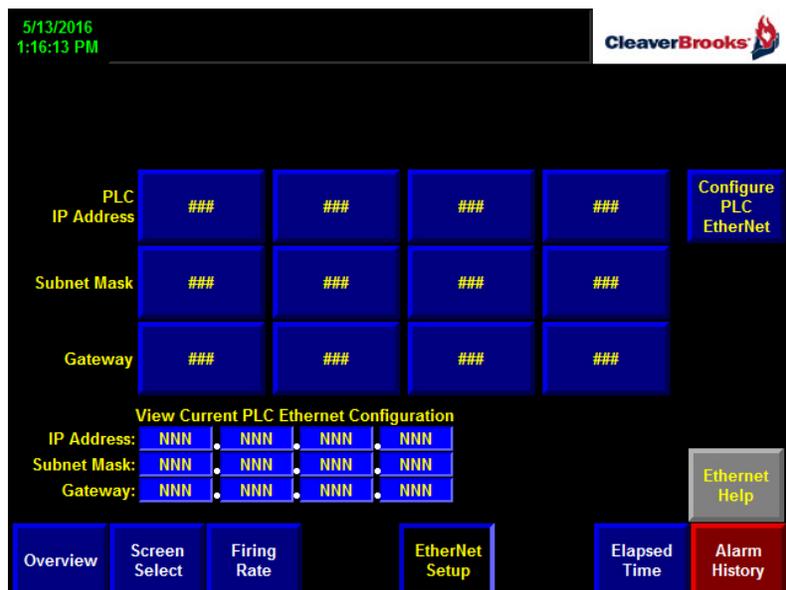


Figure 2-5 Master Ethernet config

On this screen the IP Address, Subnet Mask, and Gateway are set for the Master Panel PLC. A help screen is available. When settings are complete, press <Configure PLC Ethernet> to confirm. This will bring up the following window:

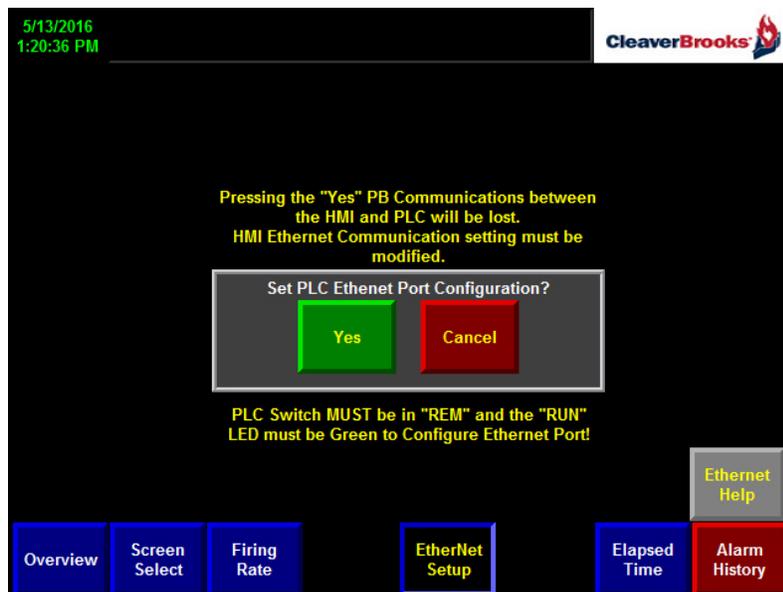


Figure 2-6 Confirm IP address

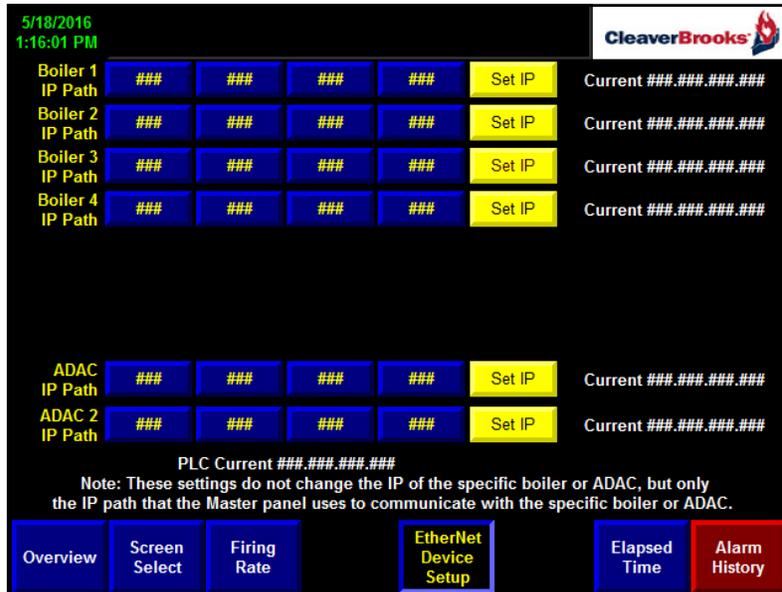
After confirming a new IP address for the PLC, this address must be entered into the PanelView configuration settings.

1. Go to <PanelView Configuration> and from the PV Config main screen select <Terminal Settings>.
2. From the Terminal Settings menu choose Networks and Communications, then select RSLinx Enterprise Communications and press the Enter arrow.
3. Highlight the Ethernet IP address for the PLC and press <Edit Device>.
4. Press <Device Address> and enter the correct PLC IP address for this system.
5. Press Enter, then <OK>.

4. Boiler/ADAC Ethernet Configuration

The individual boiler (see **SECTION A** above) and ADAC IP paths need to be configured in the Master Panel.

From the System Configuration screen, go to <Ethernet Device Setup>.



Enter each path according to the IP address set on the individual boiler/ADAC control panel. **Note:** the settings on this screen do not change the IP address of the associated boiler or ADAC; they only specify the path used by the Master Panel to communicate with each unit.

5. List of setpoints and parameters

Make appropriate selections on the Master Panel HMI screen. The following tables give parameter descriptions and default settings. It is recommended to make a record of the actual settings.

Table 1: Steam System Set Points and Sequence Screen Settings

Parameter Name	Description	Units	Minimum Limit	Maximum Limit	Factory Default Setting	Actual Setting
Number of Units*	Number of boilers		2	8	4	
Max Pressure*	Maximum design pressure	PSI or Bar	15 PSI (1 Bar)	500 PSI (34.4 Bar)	150 PSI	
Lead Boiler On dp	On differential for lead boiler start point.	%	-50	Off dp	0	
Lead Boiler Off dp	Off differential for lead boiler start point.	%	On dp	(Max Press./SP)*100-100	10	
Operating Set Point	Desired header steam pressure	PSI or Bar	0	Lead Boiler Off Point	120 PSI	
SP Limit Low	Minimum limit for Operating Set Point	PSI or Bar	5 PSI (0.3 Bar)	SP Limit High	5 PSI	
SP Limit High	Maximum limit for Operating Set Point	PSI or Bar	SP Limit Low	90% of the Max Pressure	135 PSI	
Boiler ID A*	Boiler name for boiler A			8 characters	Boiler A	
Boiler ID B*	Boiler name for boiler B			8 characters	Boiler B	
Boiler ID C*	Boiler name for boiler C			8 characters	Boiler C	
Boiler ID D*	Boiler name for boiler D			8 characters	Boiler D	
Boiler Seq New					N/A	
Boiler Seq Exist A	Order of firing for boiler A		1	8	1	
Boiler Seq Exist B	Order of firing for boiler B		1	8	2	
Boiler Seq Exist C	Order of firing for boiler C		1	8	3	
Boiler Seq Exist D	Order of firing for boiler D		1	8	4	
Auto Rotation Days	Timer for automatic order of firing selection	Days	1	60	1	
Auto Rotation On/Off	Enables/disables Auto Rotation				Off	
English/Metric	Selects PSI or Bar as units of pressure				English	
Modulation	Selects unison or lead/lag modulation				Unison	

*These parameters located on configuration screen

Table 2: Hot Water System Set Points and Sequence Screen Settings

Parameter Name	Description	Units	Minimum Limit	Maximum Limit	Factory Default Setting	Actual Setting
Number of Units*	Number of Boilers		2	8	4	
Max Temp*	Design water temperature	°F or °C	200° F (93.3°C)	450° F (232° C)	250° F	
Lead Boiler On dp	On differential for lead boiler start point.	%	-50	Off dp	0	
Lead Boiler Off dp	Off differential for lead boiler start point.	%	On dp	(Max Temp/ SP)*100-100	10	
Operating Set Point	Desired header water temperature	°F or °C	170° F (76.7° C)	Lead Boiler Off Point	200° F	
SP Limit Low	Minimum limit for Operating Set Point	°F or °C	170° F (76.7° C)	SP Limit High	170° F	
SP Limit High	Maximum limit for Operating Set Point	°F or °C	SP Limit Low	95% of the Max Temp	237.5° F	
Boiler ID A*	Boiler name for boiler A			8 characters	Boiler A	
Boiler ID B*	Boiler name for boiler B				Boiler B	
Boiler ID C*	Boiler name for boiler C				Boiler C	
Boiler ID D*	Boiler name for boiler D				Boiler D	
Boiler Seq New			1	8	N/A	
Boiler Seq Exist A	Order of firing for boiler A		1	8	1	
Boiler Seq Exist B	Order of firing for boiler B		1	8	2	
Boiler Seq Exist C	Order of firing for boiler C		1	8	3	
Boiler Seq Exist D	Order of firing for boiler D		1	8	4	
Auto Rotation Days	Timer for automatic order of firing selection	Days	1	60	1	
Auto Rotation On/Off	Enables/disables Auto Rotation				Off	
English/Metric	Selects Degrees F or C as units of temperature				English	

*These parameters are located on the configuration screen

Table 3: Set Up 1 Screen Parameters Settings

Parameter Name	Description	Units	Minimum Limit	Maximum Limit	Factory Default Setting	Actual Setting
Lag Boiler 1 Boiler Start Point	Control signal to lead boiler at which Lag Boiler 1 will start	%	Lag Boiler 1 Stop Point	100	80	
Lag Boiler 1 Boiler Start Delay	Time delay before lag boiler 1 will start	seconds	0	900	120	
Lag Boiler 1 Boiler Stop Point	Control signal to Lag Boiler 1 at which Lag Boiler 1 will be shut down	%	0	Lag Boiler 1 Boiler Start Point	20	
Lag Boiler 1 Boiler Stop Delay	Time delay before Lag Boiler 1 will be shut down	seconds	0	900	60	
Lag Boiler 2 Boiler Start Point	Control signal to Lag Boiler 1 at which Lag Boiler 2 will start	%	Lag Boiler 2 Stop Point	100	85	
Lag Boiler 2 Boiler Start Delay	Time delay before lag boiler 2 will start	seconds	0	900	120	
Lag Boiler 2 Boiler Stop Point	Control signal to Lag Boiler 2 at which Lag Boiler 2 will be shut down	%	0	Lag Boiler 2 Boiler Start Point	20	
Lag Boiler 2 Boiler Stop Delay	Time delay before Lag Boiler 2 will be shut down	seconds	0	900	60	
Lag Boiler 3 Boiler Start Point	Control signal to Lag Boiler 2 at which Lag Boiler 3 will start	%	Lag Boiler 3 Stop Point	100	90	
Lag Boiler 3 Boiler Start Delay	Time delay before Lag Boiler 3 will start	seconds	0	900	120	
Lag Boiler 3 Boiler Stop Point	Control signal to Lag Boiler 3 at which Lag Boiler 3 will be shut down	%	0	Lag Boiler 3 Boiler Start Point	20	
*Following selections only applicable to steam systems when lead/lag modulation selected						
Lag Boiler 1 Mod Start*	Control signal to lead boiler at which Lag Boiler 1 starts modulation	%	0	100	100	
Lag Boiler 2 Mod Start*	Control signal to Lag Boiler 1 at which Lag Boiler 2 starts modulation	%	0	100	100	
Lag Boiler 3 Mod Start*	Control signal to Lag Boiler 2 at which Lag Boiler 3 starts modulation	%	0	100	100	

Table 4: Set Up 2 Screen Parameters Settings

Parameter Name	Description	Units	Minimum Limit	Maximum Limit	Factory Default Setting	Actual Setting
Boiler A Shutdown Delay	Time delay for Boiler A start output to be deenergized after Boiler Stop Delay expires	Seconds	0	1200	180	
Boiler B Shutdown Delay	Time delay for Boiler B start output to be deenergized after Boiler Stop Delay expires	Seconds	0	1200	180	
Boiler C Shutdown Delay	Time delay for Boiler C start output to be deenergized after Boiler Stop Delay expires	Seconds	0	1200	180	
Boiler D Shutdown Delay	Time delay for Boiler D start output to be deenergized after Boiler Stop Delay expires	Seconds	0	1200	180	
Boiler A in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
Boiler B in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
Boiler C in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
Boiler D in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
Boiler A in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
Boiler A in sequence	Selection if boiler is a part of the lead/lag sequence	Yes/No			Yes	
The following selections applicable to hot water units only						
Boiler A Warm-Up Blr Off	Time delay set to initiate warm up cycle. Delay is activated by the main fuel valve.	minutes	60	1440	240	
Boiler A Warm-Up Blr On	Time delay set to stop warm up cycle. Delay is activated by the main fuel valve.	minutes	5	360	20	
Boiler B Warm-Up Blr Off	Time delay set to initiate warm up cycle. Delay is activated by the main fuel valve.	minutes	60	1440	240	
Boiler B Warm-Up Blr On	Time delay set to stop warm up cycle. Delay is activated by the main fuel valve.	minutes	5	360	20	
Boiler C Warm-Up Blr Off	Time delay set to initiate warm up cycle. Delay is activated by the main fuel valve.	minutes	60	1440	240	
Boiler C Warm-Up Blr On	Time delay set to stop warm up cycle. Delay is activated by the main fuel valve.	minutes	5	360	20	
Boiler D Warm-Up Blr Off	Time delay set to initiate warm up cycle. Delay is activated by the main fuel valve.	minutes	60	1440	240	
Boiler D Warm-Up Blr On	Time delay set to stop warm up cycle. Delay is activated by the main fuel valve.	minutes	5	360	20	
Boiler A Warm-Up Enable	Enable or disable warm up routine				OFF	
Boiler B Warm-Up Enable	Enable or disable warm up routine				OFF	
Boiler C Warm-Up Enable	Enable or disable warm up routine				OFF	
Boiler D Warm-Up Enable	Enable or disable warm up routine				OFF	

NOTE: Refer to wiring diagram supplied with unit for job specific information and terminal designations.

B. DISPLAY NAVIGATION AND PARAMETER ENTRY

The following appear on all screens:

- Day and time
- Current alarm
- Cleaver-Brooks logo
- Screen selection buttons

1. Screen Select

This is a navigational screen from which all other screens can be accessed.

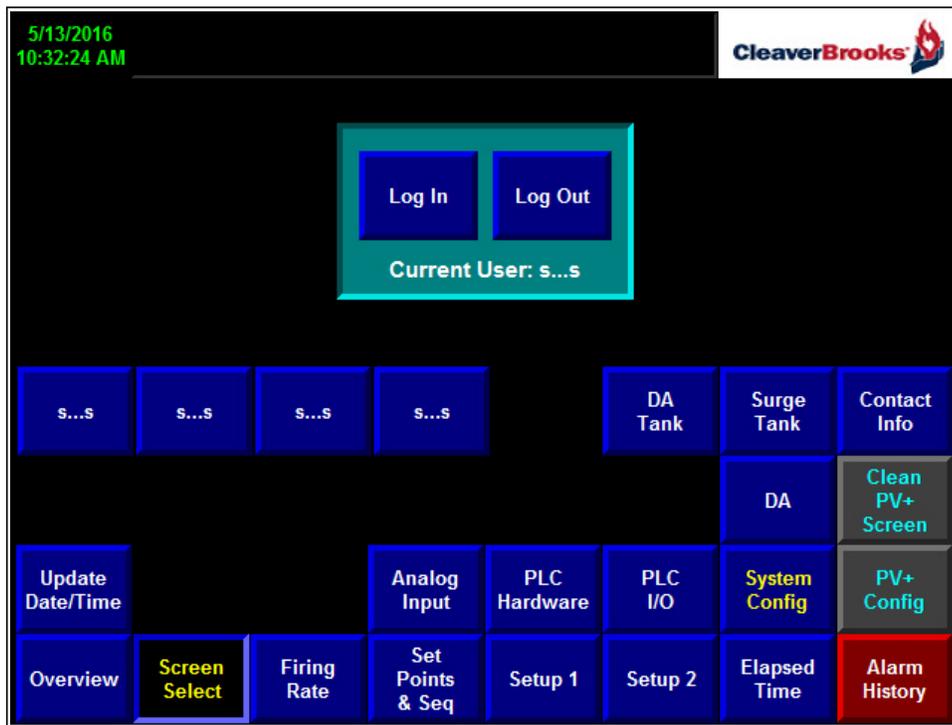


Figure 2-7 Screen Select

2. Overview Screen

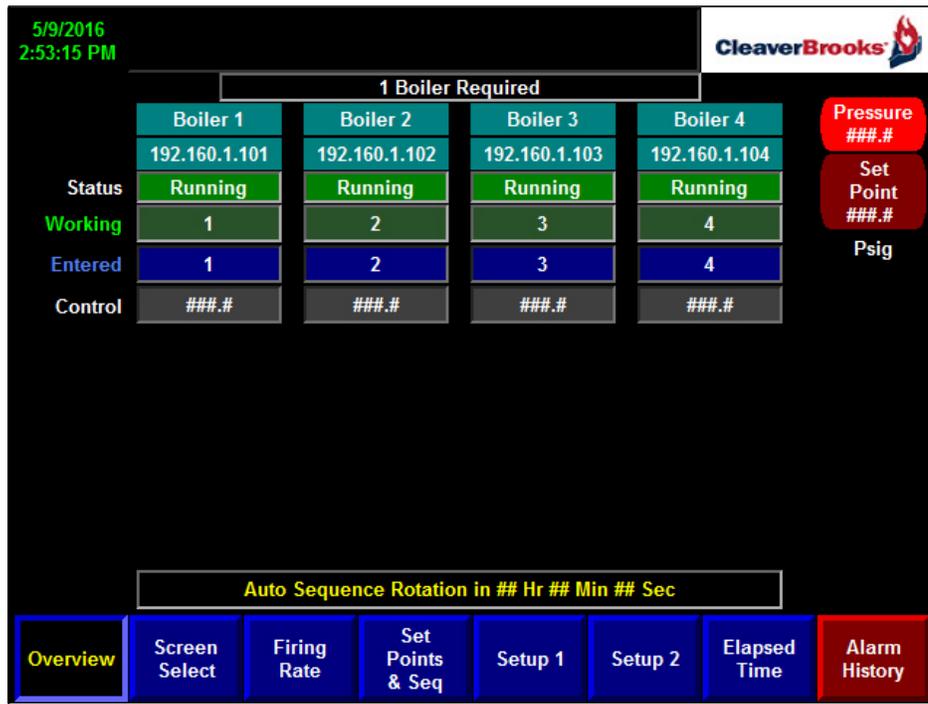


Figure 2-8 Overview Screen

Press (Temp) — indicates supply pressure (steam) or temperature (hot water).

Set Point — Operating set point indicator.

Under each boiler name are indicators of the boiler’s working status:

- **Idle** — boiler is not called to start from lead/lag panel.
- **Warm-Up** — boiler is in warm-up cycle (hot water only).
- **Running** — boiler is running at the indicated control rate.
- **Unavailable** — boiler is not available and is not part of lead/lag sequence.

Working — Indicates current sequence in which boilers are brought on line (1 = Lead Boiler, 2 = Lag Boiler 1, 3 = Lag Boiler 2, etc.).

Entered — indicates the sequence of firing selected by the operator. Working and entered numbers will be identical if all boilers are available. If one or more of the boilers are not available, the sequence will be shifted by the number of units which are not available (see Figure 2-4).

Control — Indicates the firing rate control signal to each boiler (from 0 to 100%).

Auto Sequence Rotation In — Indicates the time remaining until automatic rotation (if selected).

Psig (Bar) or Deg F (C) — indicates units used for pressure (steam) or temperature (hot water) measurement.

If entered sequence is:

Boiler A - 1
 Boiler B - 3
 Boiler C - 4
 Boiler D - 2

then if Boiler D drops out (becomes Unavailable) the working sequence will be:

Boiler A - 1
 Boiler B - 2
 Boiler C - 3
 Boiler D - 0

(0 = Boiler is not part of lead/lag sequence)

Figure 2-9 Example Working Sequence

3. PLC Hardware Overview

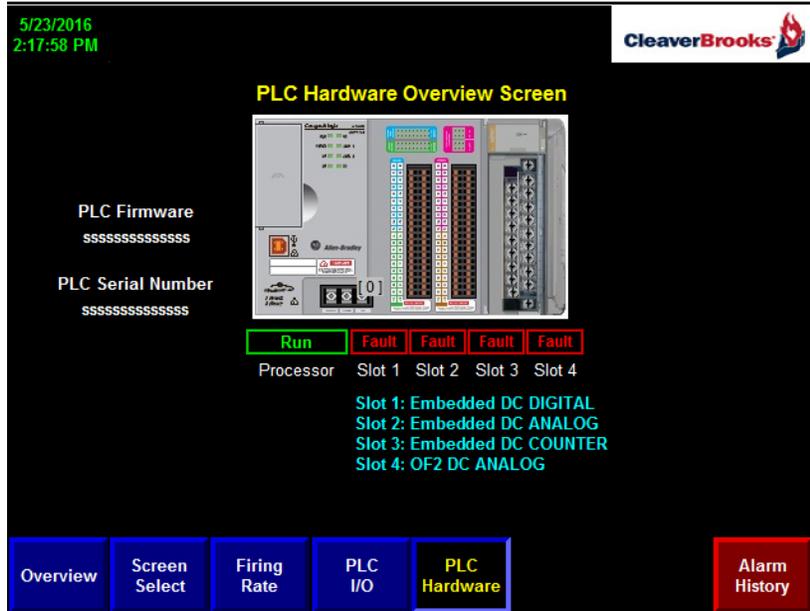
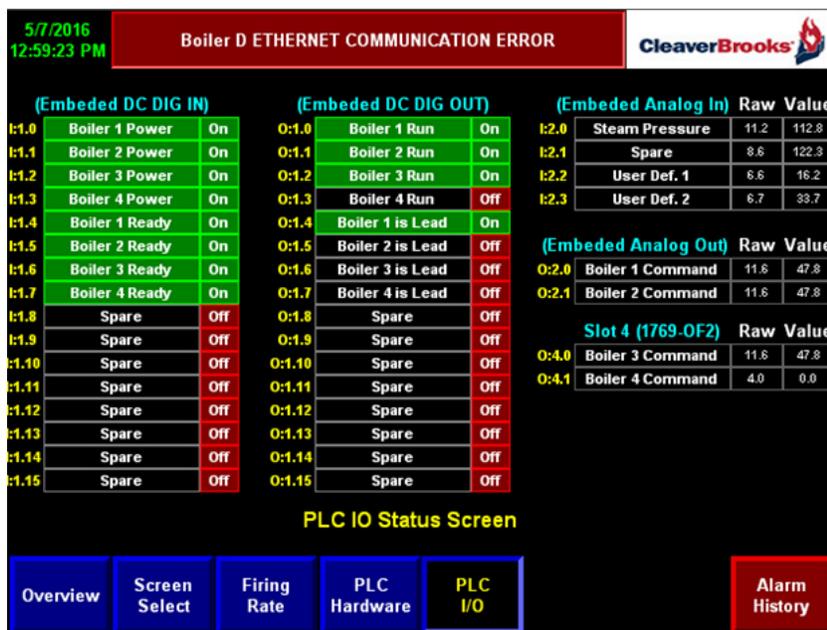


Figure 2-10 PLC Hardware Overview

This screen shows the installed hardware devices and displays the PLC firmware number and serial number.

4. I/O Status Screen



On/Off status is shown for digital inputs. Analog inputs show Raw (mA) and Value (engineering units)

5. Set Points and Sequence Screen

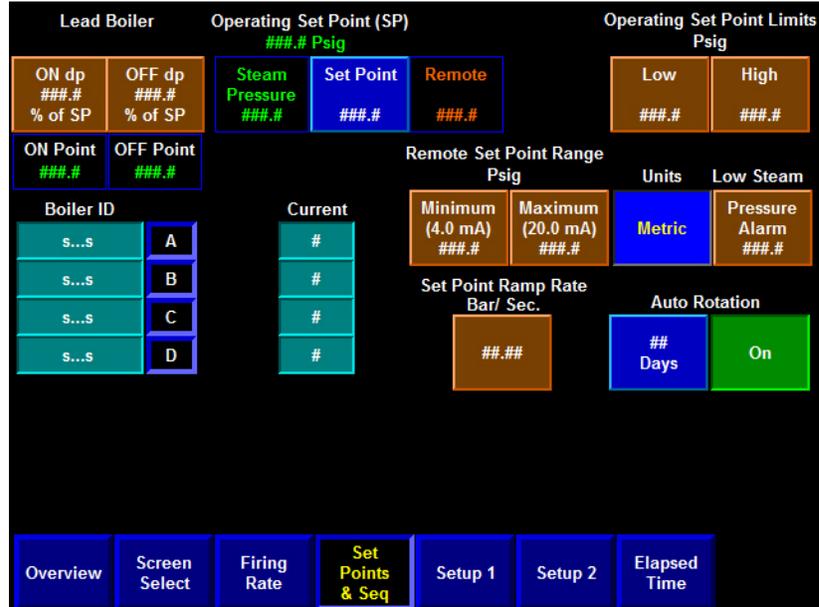


Figure 2-11 Setpoints and Sequence Screen

Lead Boiler On and Off Point — This is the water temperature (steam pressure) at the header for the lead boiler to start and stop. These values are calculated based on the values entered for set point and On/Off dp (see below).

ON and OFF dp — these are differentials expressed as a % of set point. Valid entries for “ON dp” are from -50 to “Off dp”. Valid entries for “Off dp” are from “On dp” to:

$$\left(\frac{\text{maxpressure}}{SP} \times 100 \right) - 100$$

Example: Max Pressure = 250 psig

SP = 200 psig

“Off dp” maximum setting = 25

Operating Set Point — This button allows changing of the water temperature (steam pressure) set point. This is the value at which controller will try to maintain water temperature (steam pressure) at the header. Valid entries for hot water system are from 170°F (76.7°C) to the “Off” point setting. Valid entries for steam system are from 0 PSI (0 Bar) to the “Off” point setting. Set point setting is also limited by the low and high limits that can be set on this screen.

Remote Set Point if enabled can also be entered on this screen. Remote Set Point is enabled using “Select Set Point” on the Firing Rate screen (see below).

Water Temp (Steam Press) — Displays water temperature (steam pressure) at the common header.

SP Limit — These keys are used for setting of the high and low operating set point limits.

Hot Water System: Valid entries for the “Low Limit” are from 170°F (76.7°C) to the “High Limit” setting. Valid entries for

“High Limit” setting are from the “Low Limit” to 95% of the maximum temperature.

Steam System: Valid entries for the “Low Limit” are from 5 PSI (0.3 Bar) to the “High Limit” setting. Valid entries for “High Limit” setting are from the “Low Limit” to 90% of the maximum pressure.

Remote Set Point Range — sets the range of the remote 4-20 mA signal when using remote set point. <Minimum> sets the set point corresponding to a 4 mA signal and <Maximum> the set point corresponding to a 20 mA signal.

Set Point Ramp Rate — limits the rate of change of the remote set point signal.

Boiler ID — Shows the boiler name as entered on the Configuration screen.

Boiler Seq.

New — Allows the selection of a new firing sequence for the boilers. To select the appropriate sequence: press the button corresponding to the specific boiler. The numeric keypad will appear. Select one of the following numbers:

(1 = Lead Boiler, 2 = Lag Boiler 1, 3 = Lag Boiler 2, 4 = Lag Boiler 3, etc.).

Make a selection for each boiler (duplicate numbers are not allowed)). When finished, press the <**Enter New Order**> button. If the order is valid, the numbers in the existing column will change. If the order is invalid, an “Invalid Order” message is displayed.

Current — Displays the existing firing sequence.

Auto Rotation Days — With auto rotation selection “On” boiler firing sequence will rotate automatically. When auto rotation time expires, each boiler sequence number will be shifted to the left by one. Valid entry is from 1 to 60 days.

(Example: Sequence before rotation – 1234; Sequence after rotation – 4123. Auto rotation timer is reset every time sequence is changed.)

Auto Rotation On/Off — “On” enables auto sequence rotation.

Units — This button toggles between English and Metric units of measure.

Low Steam Pressure (Water Temp.) Alarm — This push button is used to set the alarm activation point for low steam pressure (water temperature).

Changing Parameter Values

In order to change a value, Press the <**Change**> button. The numeric keypad display will appear. Select desired number. Press <enter> key and then push the button corresponding to the number to be changed. If the entry is invalid, the display will show “Out of Range”.

6. Set-Up 1 Screen

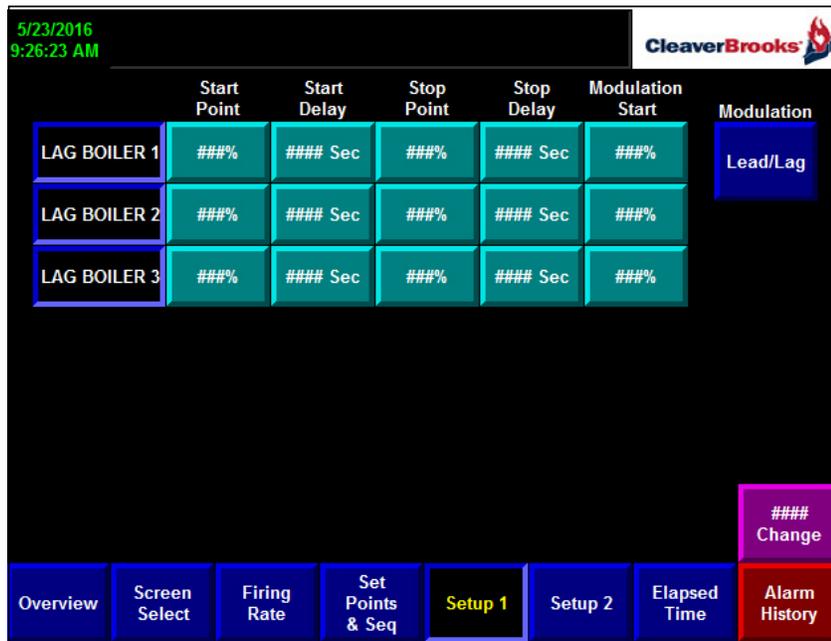


Figure 2-12 Set-Up 1 Screen

This screen is used to enter boiler timers' start and stop points.

Start Point — Control signal to the previous-in-sequence boiler at which this boiler will start. Valid entry is from Boiler Stop Point to 100.

Start Delay — Time delay before the boiler will start. The time delay is initiated when the Start Point is reached. A valid entry is from 0 to 900 seconds.

Stop Point — Firing rate of the boiler at which this boiler will stop. Valid entry is from 0 to the Boiler Start Point.

Stop Delay — Time delay before the boiler is commanded to stop. The time delay is initiated when the Stop Point is reached. A valid entry is from 0 to 900 seconds.

Mod Start — This selection is available only on a steam system when lead/lag modulation is selected. This is the firing rate for the previous boiler at which this boiler will start modulation.

Modulation — On steam systems unison or lead/lag modulation can be selected. *Note: hot water systems are unison modulation only.*

(Example: Boiler #1 is the lead boiler, Boiler #2 is Lag Boiler 1, and Boiler #3 is Lag Boiler 2. Boiler Start point is set to 80%. Boiler start delay is set to 90 seconds. Boiler stop point is set to 20%. Boiler stop delay is set to 60%. The Shut Down delay for all units are set to 180 seconds. When the control signal to the boiler #1 is greater or equal to 80% for more than 90 seconds, run command will be given to the boiler #2. If control signal to the boiler #2 drops below 20% for more than 60 seconds, stop command will be given to the boiler #2. Boiler will stay on for another 180 seconds and then shuts down.)

7. Set-Up 2 Screen



Figure 2-13 Set-Up 2 Screen (steam)

Shut Down Delay — Time delay for boiler shut down after the stop command is received. Valid entry is from 0 to 1200 seconds.

Boiler In Sequence — Valid selections are “Yes” or “No”. “Yes” indicates that the unit is part of the lead/lag sequence.

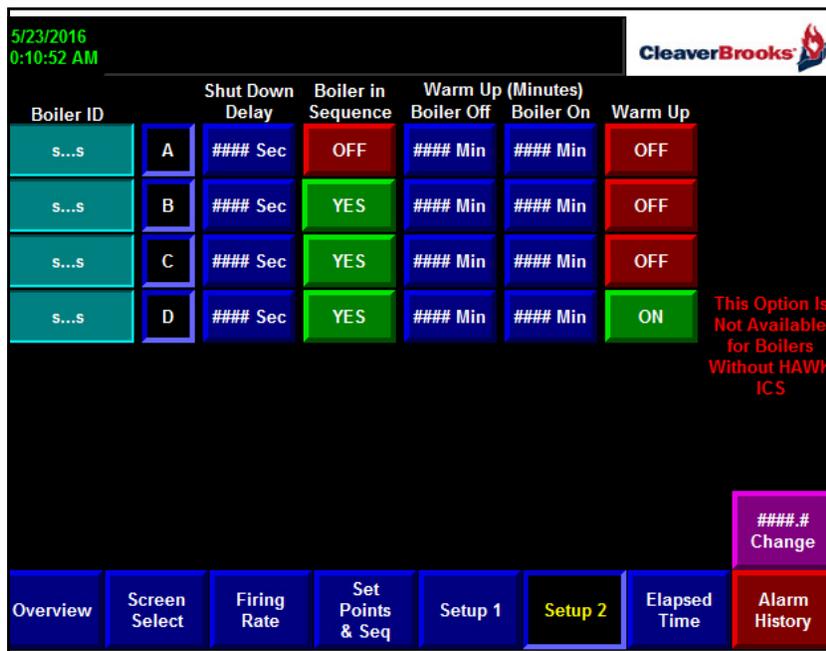


Figure 2-14 Set-Up 2 Screen (hot water)

Warm-up Blr Off (hot water only) — This timer is activated when the main fuel valves for the specific boiler are de-energized. Upon expiration of this timer, the boiler enters the warm-up sequence.

Warm-up Blr On (hot water only) — This timer is activated when the main fuel valves for the specific boiler are energized. Upon expiration of this timer, the warm-up sequence stops.

Warm-Up On/Off — Enables and disables the warm-up feature.

Warm-up sequence is not available for boilers without Hawk controls.

8. Firing Rate Screen

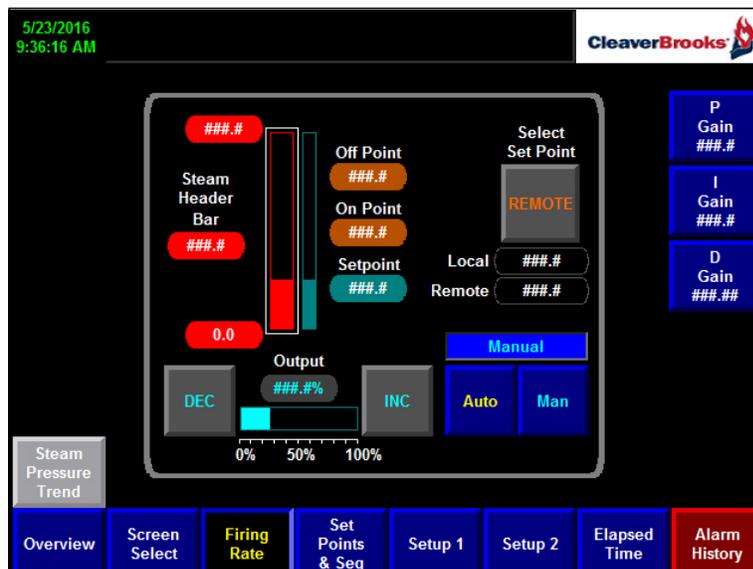


Figure 2-15 Firing Rate Screen

Water temperature (steam pressure) bar graph with display — Displays outlet water temperature (steam pressure) in a common header. Water temperature (steam pressure) is displayed digitally to the left of the bar graph.

Set point temperature (pressure) bar graph with display — Displays water temperature (steam pressure) set point. Set point is displayed on the right side of the bar graph. Lead boiler's "On" and "Off" points are displayed above set point.

Control Output — bar graph displays control output (0 – 100%).

Select Set Point — selects Local or Remote set point control.

Mode — There are two modes for controlling firing rate, Manual (Man) and Automatic (Auto).

Manual mode should be used for set up purposes only. Increase and decrease output using the + and – buttons.

Automatic mode is used for normal operation. In this mode water temperature (steam pressure) in the common header is compared with the set point and control is achieved by executing PID (Proportional Integral Derivative) control algorithm.

- P** — Proportional gain (unitless)
- I** — Integral gain (1/minutes)
- D** — Derivative gain (minutes)

9. Elapsed Time Screen

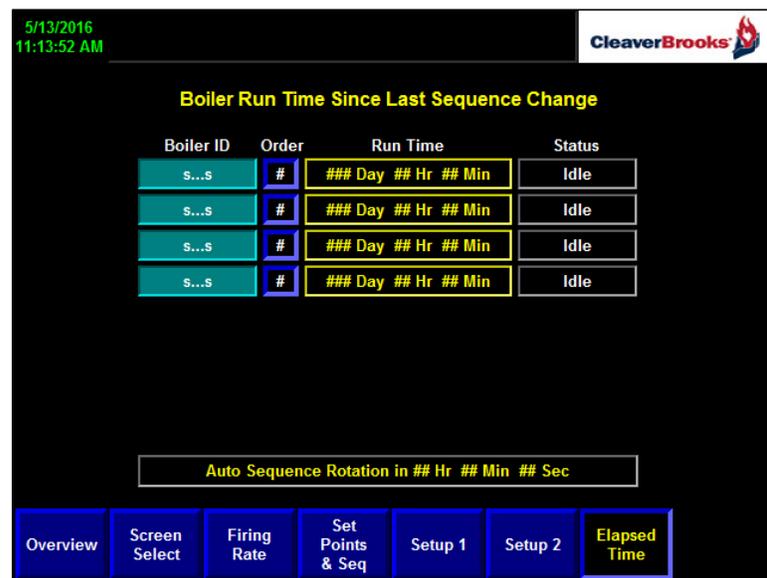


Figure 2-16 Elapsed Time Screen

This screen is informational only. The following parameters are displayed:

- **Order** column displays current firing order.
- **Run Time** column displays the individual boiler run time since the last rotation.
- **Status** column shows current boiler status (Idle, Running, Unavailable, or Warm-Up).

If Auto Rotation is enabled, screen will show time remaining until sequence rotation.

10. Alarm History Screen

This screen is information-only. The PanelView display stores up to 100 alarms. The Alarm history table contains the following information.



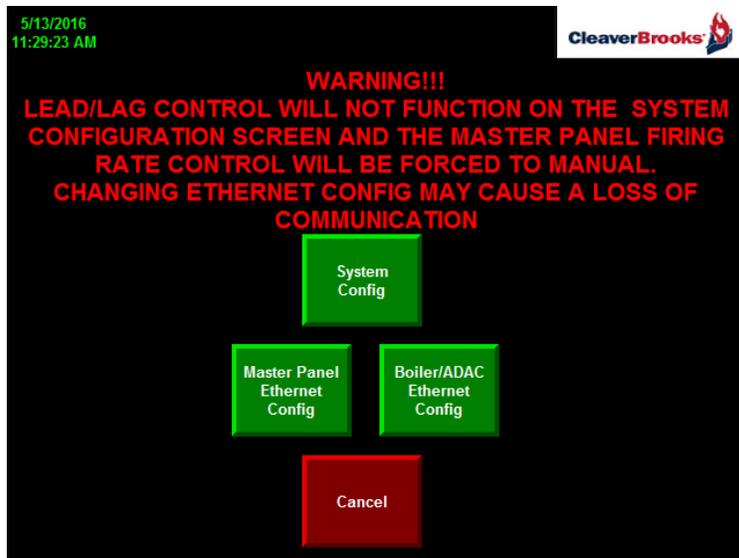
Figure 2-17 Alarm History Screen

Table 2-1. Alarm History

Column # from the Left	Description
1	Alarm date
2	Alarm time
3	Alarm acknowledge date
4	Alarm acknowledge time
5	Alarm name

11. Configuration Screen

This screen is password protected. Entering a valid password will cause the following warning to appear:



Press the desired configuration screen button to continue (Master Panel and Boiler/ADAC Ethernet configuration are covered in Section 3) or press <Cancel> to return to the previous screen.

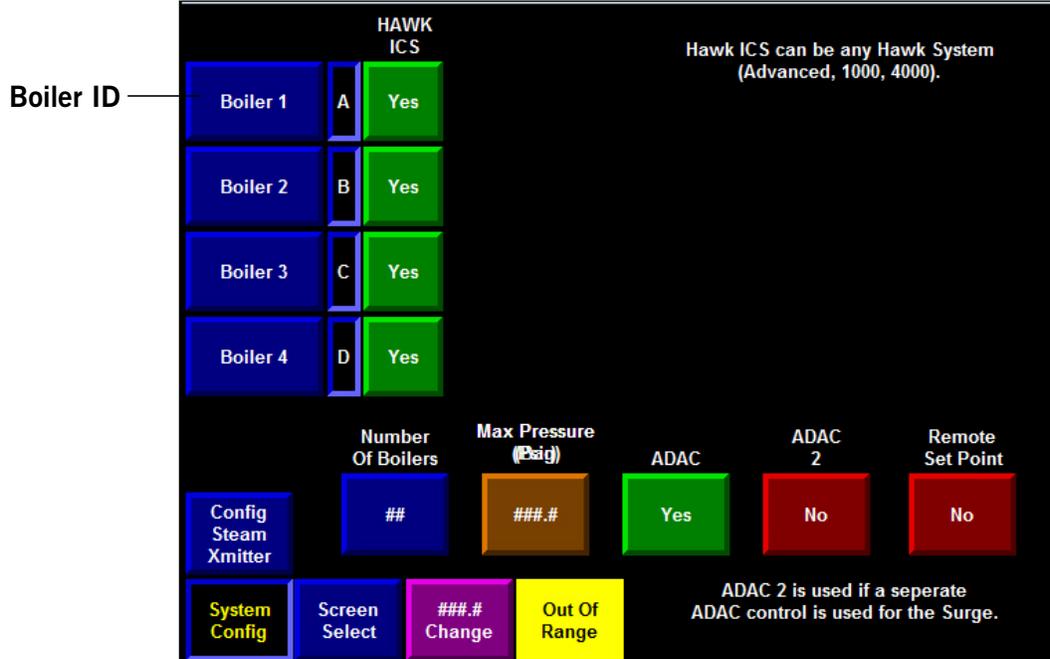


Figure 2-18 System Configuration Screen

Boiler ID — These buttons allow changing boiler name. To assign a name to a boiler, touch Boiler ID display for the specific boiler. The keypad display will appear. Type new boiler name (up to 8 characters) and press enter key.

HAWK ICS selection — indicates whether individual boilers use a HAWK system. This can be any Hawk system (Hawk ICS Advanced; Hawk 1000, or Hawk 4000).

Note: Some Master Panel options are unavailable for units without HAWK controls.

Number of Boilers — Selects number of boilers for lead/lag sequence. Valid entry is 2 to 4.

Max Temp (hot water) / **Max Press** (steam) — Selects maximum design water temperature or steam pressure. Make sure that this value agrees with the maximum design temperature/pressure for the boiler. Valid entries for a hot water system are from 200° F (93.3° C) to 450° F (232° C). Valid entries for a steam system are from 15 PSI (1 Bar) to 500 PSI (34.4 Bar).

Remote Set Point/Outdoor Reset — Select <Yes> to enable.

ADAC — To establish communications with an ADAC deaerator control system, select <ADAC> on the Configuration screen. Select <ADAC 2> if a separate ADAC control is used for the surge tank. When communicating with ADAC controls, additional screens for deaerator, surge, or duo tank equipment will be accessible as appropriate for your system.

12. Change Date and Time

To set the date and time, press <Update Date/Time> from the Screen Select menu.



Figure 2-19 Date/Time Screen

13. PanelView Configuration

Certain PanelView internal settings can be accessed through PanelView Configuration. Press <PV+ Config> from the Screen Select menu.

Most of these settings should not require user configuration. For more information refer to the Allen-Bradley PanelView Plus manual.

Caution

Only authorized personnel should make changes in the configuration section. Improper settings may result in system malfunction.

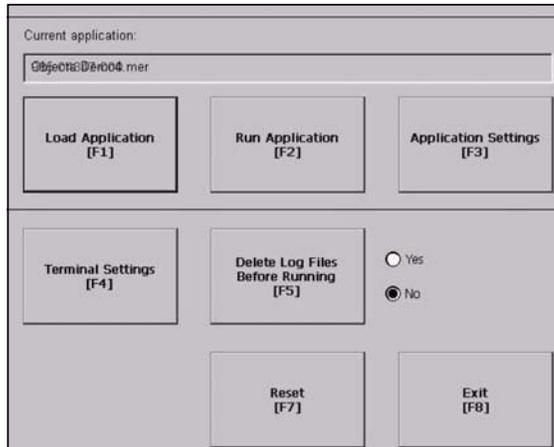


Figure 2-20 PV Configuration Main Screen

Press <Terminal Settings> to see the Terminal Settings menu. These are settings specific to the PanelView device and are independent of the currently loaded application.

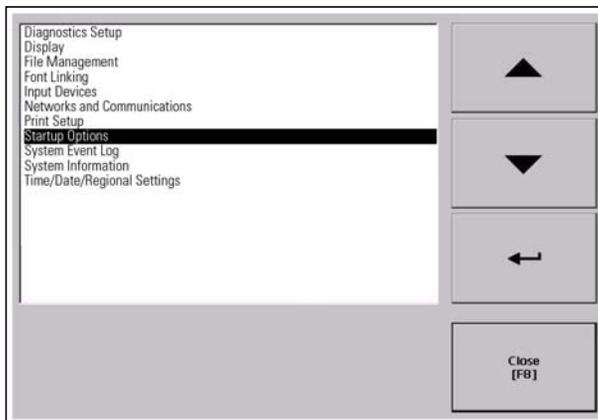


Figure 2-21 Terminal Settings

Select “Time/Date/Regional Settings” to change the date, time, time zone, or display language (date and time can also be set directly from the HMI without entering PV+ configuration; see above).

To change the display brightness, contrast, and screen saver settings, select “Display”.

14. Individual Boiler Overview Screen

This is an information-only screen. It displays information pertaining to the selected individual boiler.

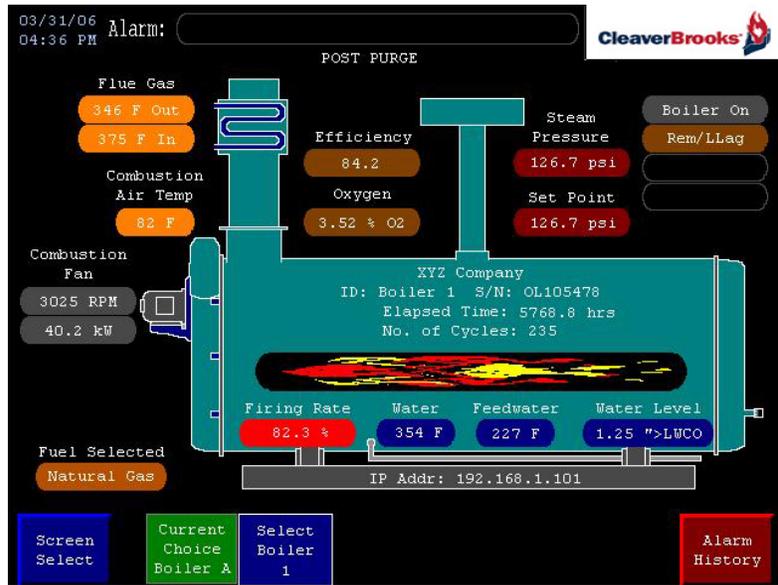


Figure 2-22 Boiler Overview

To select a boiler press the appropriate button (<Boiler A> etc.) from the Screen Select menu. Overview screens for the Deaerator/Surge will also be available for systems so equipped.

15. User Defined Inputs

Two user-defined analog inputs are available. Each features totalization (for flow inputs) and trending. A 4-20 mA signal is required at I2:3/I2:4 (embedded analog inputs).

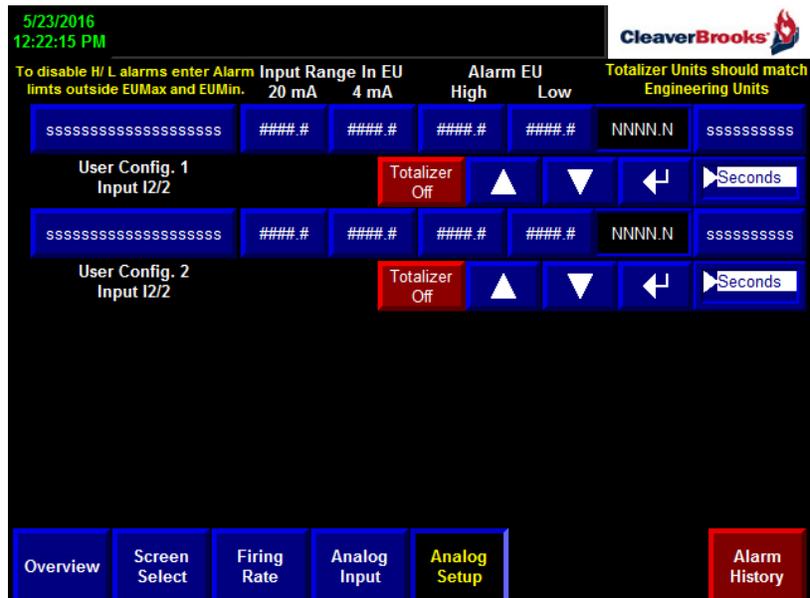


Figure 2-23 Analog Input Setup

Input range, high/low alarm points, and engineering units are configured here. The units selected should be appropriate for the input device used.

Once an input is configured, a bar graph and numeric totalizer will appear on the Analog Input screen.

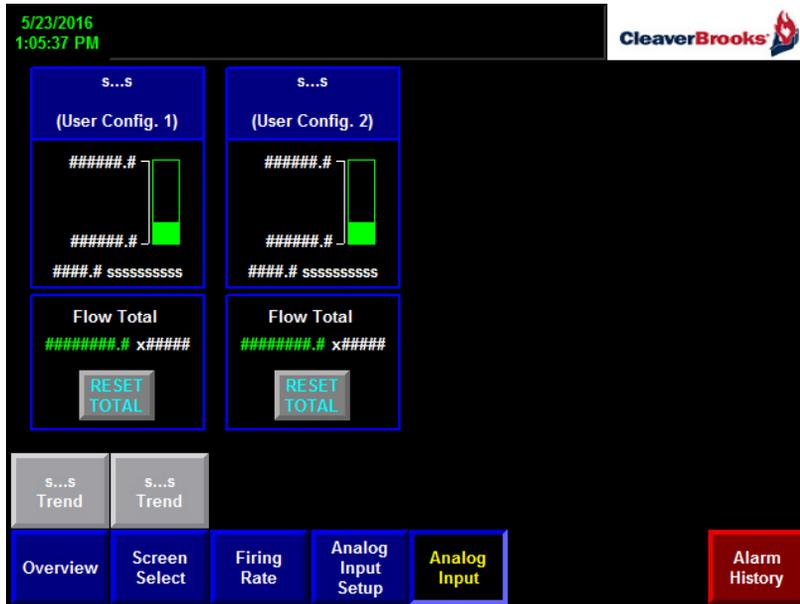


Figure 2-24 Analog Inputs

Selecting <Trend> for the desired input will display the Trend Screen. A real time graph of the selected input is displayed with x=time and y=engineering units.



Figure 2-25 Trend Screen

C. CONTACT INFO

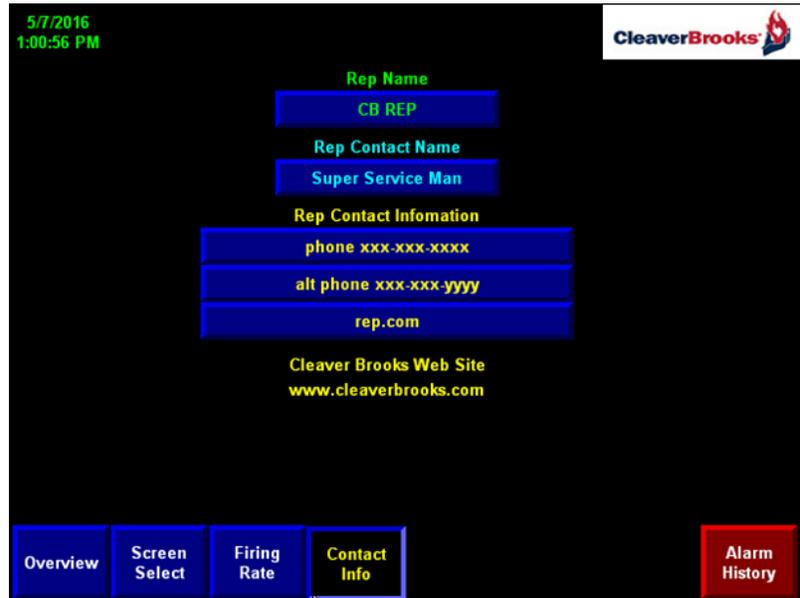


Figure 2-26 Contact Info Screen

The Contact Info screen can be filled in by the C-B representative with the appropriate contact information.

D. SEQUENCE OF OPERATION

1. Boiler Start and Stop

Header steam pressure (water temperature) is compared with the set point and the Master Panel PLC processor executes PID (Proportional, Integral, and Derivative) control algorithm. The lead boiler is commanded to come on line first. The lag boiler #1 is commanded to come on line when firing rate signal for the lead boiler reaches the lag boiler #1 start point and the time delay is expired. Subsequent lag boilers are commanded to start in a similar manner.

Lag boilers are commanded to shut down in reverse order. If one of the boilers is unavailable, it will be replaced by the next available unit in the firing sequence.

When the previous boiler in selected firing sequence becomes available, and is required, the boiler will be started and inserted back into the proper sequence. The last boiler in the sequence will be shut down as required by the load.

Once the firing rate for the previous-in-sequence boiler reaches this boiler stop point and time delay expired, boiler will be shut down.

The lead boiler is shut down when the steam pressure (water temperature) in the header exceeds the setting of the lead boiler off point.

2. Lead Lag Modulation (*steam systems*)

Control output of the firing rate controller is divided into equal segments according to the number of boilers available. For example: with the number of boilers available equal to 4, firing rate control signal for lead boiler of 0 – 100% corresponds to the control output from the lead/lag controller of 0 – 25%. Firing rate control signal to the lag boiler 1 of 0 – 100% corresponds to the control output from the lead/lag controller 25 – 50%. Firing rate control signal for the lag boiler 2 of 0 – 100% corresponds to the control output from lead/lag controller of 50 – 75%. Firing rate control signal to the lag boiler 3 of 0 – 100% corresponds to control output 75 – 100%. Values can be shifted depending on the ModShift parameter.

3. Warm-Up Sequence (*hot water units*)

If the boiler was off (fuel valve deenergized) for the duration of the setting for “Warm-Up Boiler Off” timer, the boiler will start and stay at low fire for the duration of the “Warm-Up Boiler On” timer. If during this period there is a demand for this boiler, the boiler will be released for modulation after the “Warm-Up Boiler On” timer expires. If there is more than one boiler in standby, only one can be fired in the warm-up cycle at the same time.

4. Unison Modulation (*hot water and steam boilers*)

The control signals to all boilers on line are equal to the lead lag PID output.

Control output to the boilers is calculated using the following equation:

$$0 \leq CV_n = (CV_{MAIN} \times N) - ((n-1) \times 100) + (100 - \text{ModShift}) \leq 100$$

Where CV_n = control output to boiler #n
 (For lead boiler n = 1, for lag #1 n = 2, etc.)
 CV_{MAIN} = lead/lag PID control output (0-100%)
 N = number of boilers available
 ModShift = percent of previous-in-sequence boiler's firing rate control signal at which current boiler starts to modulate (ModShift not applicable to lead boiler)

Example: $CV_{MAIN} = 35\%$
 ModShift = 100 for all boilers
 Number of boilers available N = 4
 Control output to the lead boiler
 For Lead boiler n = 1

Using above equation,
 $CV_1 = 35 \times 4 - ((1-1) \times 100) = 140\%$
 Since firing rate cannot exceed 100%, $CV_1 = 100\%$

For the first lag boiler n = 2.
 $CV_2 = 35 \times 4 - ((2-1) \times 100) + (100 - 100) = 40\%$

For the second lag boiler n = 3
 $CV_3 = 35 \times 4 - ((3-1) \times 100) + (100 - 100) = -60\%$
 Since firing rate cannot be below 0%, $CV_3 = 0\%$

Note: Second lag may be off depending on the setting of start and stop points

For the third lag boiler n = 4.
 Third lag boiler will not be commanded to fire, since firing rate of second lag boiler is 0% and start point cannot be set at 0%.
 $CV_4 = 0\%$

Figure 2-27 Lead/Lag Modulation (4 boilers available)

Seq Number	1	2		3		4	
Mod Shift		80	100	60	100	40	100
PID Out	CONTROL OUTPUT NO LIMITS						
0	0	-80	-100	-160	-200	-240	-300
5	20	-60	-80	-140	-180	-220	-280
10	40	-40	-60	-120	-160	-200	-260
15	60	-20	-40	-100	-140	-180	-240
20	80	0	-20	-80	-120	-160	-220
25	100	20	0	-60	-100	-140	-200
30	120	40	20	-40	-80	-120	-180
35	140	60	40	-20	-60	-100	-160
40	160	80	60	0	-40	-80	-140
45	180	100	80	20	-20	-60	-120
50	200	120	100	40	0	-40	-100
55	220	140	120	60	20	-20	-80
60	240	160	140	80	40	0	-60
65	260	180	160	100	60	20	-40
70	280	200	180	120	80	40	-20
75	300	220	200	140	100	60	0
80	320	240	220	160	120	80	20
85	340	260	240	180	140	100	40
90	360	280	260	200	160	120	60
95	380	300	280	220	180	140	80
100	400	320	300	240	200	160	100

$$CV_n = (CV_{MAIN} \times N) - ((n-1) \times 100) + (100 - \text{ModShift})$$



Section 3 Troubleshooting

A. General	3-2
B. Ethernet Troubleshooting	3-2
C. Loading PLC Program	3-6
D. Web Server	3-10

A. GENERAL

Table 3-1. Troubleshooting

Problem	Possible Cause	Recommended Action
Boiler unavailable on the Master Panel overview screen.	CB Master Lead/Lag not selected	On Configuration Screen #2 toggle CB Master Lead/Lag to YES (green)
	Rem/Llag not selected at boiler	On boiler Firing Rate screen, select Rem/Llag
	Active alarms	<ul style="list-style-type: none"> • Correct alarm condition • On Alarm History screen acknowledge and reset alarms
	Boiler ready input is off (see I/O list)	Check interconnect wiring between boiler and master panel
	Boiler ready output is off	Put burner switch on. Make sure no alarms are present at the boiler.
Burner does not go to the correct firing rate	Boiler is in Warm-Up or Hot Standby	Wait for boiler to warm up.
Boiler stays at maximum firing rate.	Boiler analog input incorrectly wired	Check boiler input wiring.
“Remote Modulation Signal Failed” alarm at the boiler	<ul style="list-style-type: none"> • Analog input not wired • Wrong polarity 	<ul style="list-style-type: none"> • Connect input • Check polarity
“Boiler Power Failure” alarm on the Master Panel	Jumper power input or neutral is missing	Install jumper
“Ethernet Communication Failure” alarm	<ul style="list-style-type: none"> • Wrong boiler processor selected • Boiler I/P address not set • Cable problem 	<ul style="list-style-type: none"> • Select correct processor on Master Panel Configuration screen • Set I/P address • Check cables <p>Note: See also ETHERNET TROUBLESHOOTING below.</p>
Steam pressure (water temperature) different from gauge reading	Improper maximum pressure/temperature selection	Correct max pressure/temperature setting on Master Panel Configuration screen.

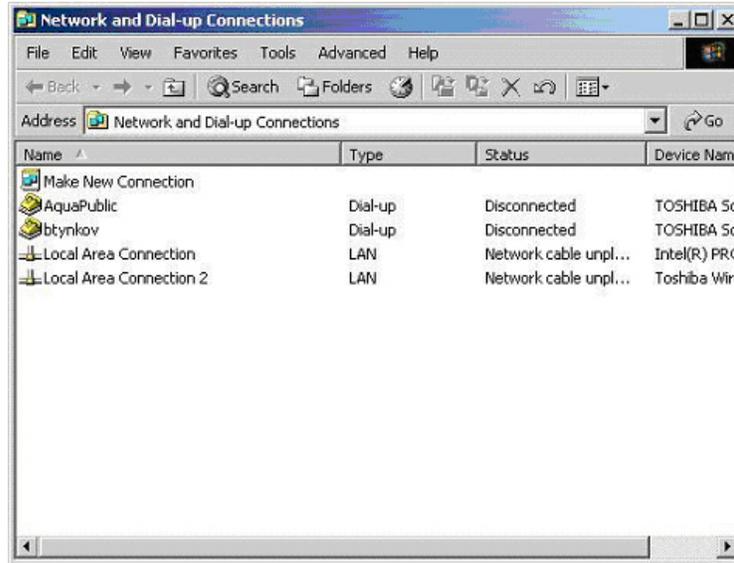
B. ETHERNET TROUBLESHOOTING

To troubleshoot ethernet communication problems requires the following:

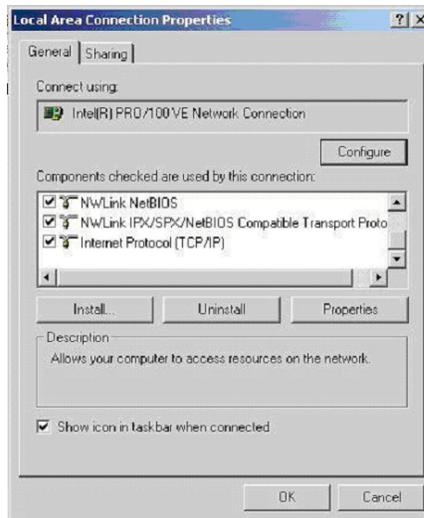
- PC with Ethernet ready connection
- Regular Ethernet cable

To proceed:

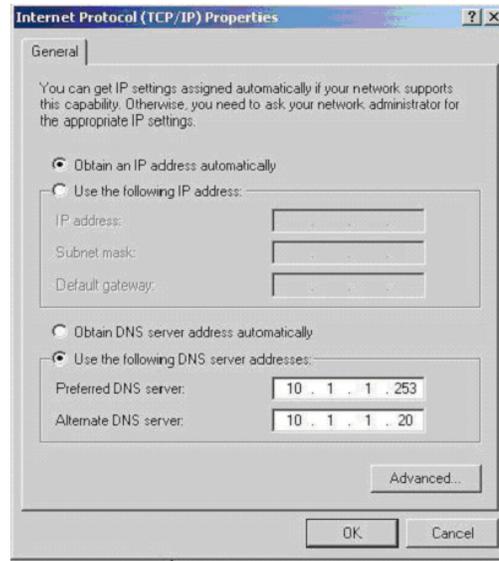
1. On the desk top click “Start”
2. From “Settings” select “Network and Dial-up Connections”



3. Select "Local Area Connection"



4. Select "Internet Protocol (TCP/IP)"



Write down the current TCP/IP properties.

5. Change properties to the following:
 - IP address: 192.168.1.50
 - Subnet mask: 255.255.255.0
 - Default gateway: 192.168.1.1

It is not necessary to change DNS server parameters.

6. Click OK, then OK again to return to desk top.
7. Reboot computer.
8. On the PanelView go to the Config 1 Screen and select Ethernet option. On the Ethernet setup screen change addresses according to the following table:

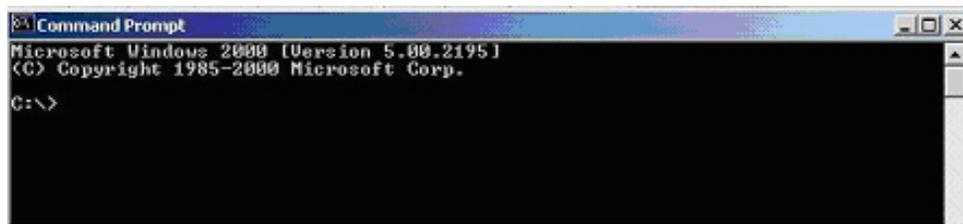
	Boiler A	Boiler B	Boiler C	Boiler D
IP address	192.168.1.101	192.168.1.102	192.168.1.103	192.168.1.104
Subnet mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Default gateway	192.168.1.1	192.168.1.1	192.168.1.1	192.168.1.1

Note: I/P address for Master Panel processor is 192.168.1.100

I/P address for Master Panel PanelView is 192.168.1.120

9. Using Ethernet cable connect Ethernet port of the computer to the Ethernet port of processor.

10. Go to MSDOS prompt on PC (under Start>Programs>Accessories>Command Prompt)



```
Command Prompt
Microsoft Windows [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\>
```

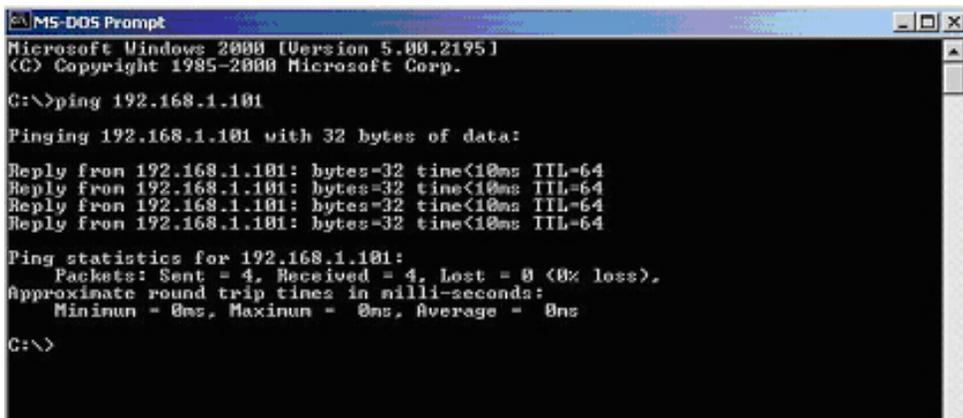
11. Type **ping <IP address>**, then press **Enter**.

Example: To “ping” Boiler 1, type

- ping 192.168.1.101

- 

The computer screen should resemble the following:



```
MS-DOS Prompt
Microsoft Windows [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\>ping 192.168.1.101

Pinging 192.168.1.101 with 32 bytes of data:

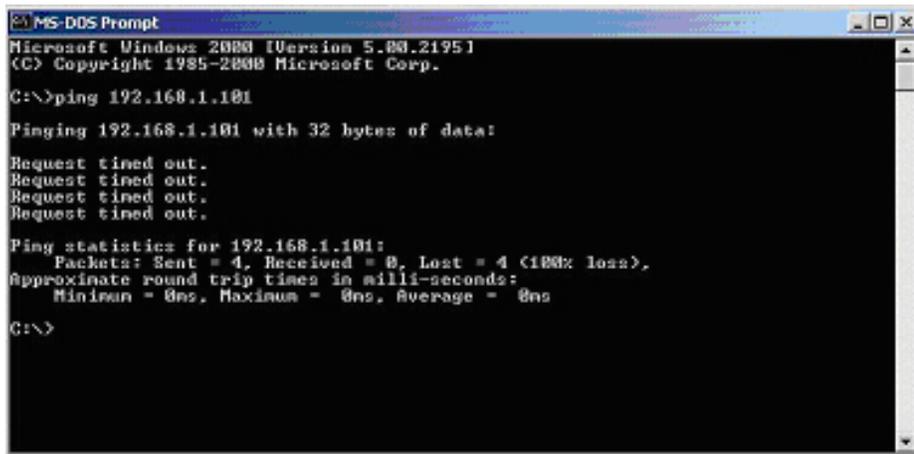
Reply from 192.168.1.101: bytes=32 time<10ms TTL=64

Ping statistics for 192.168.1.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

If computer display is as above, proceed to Step 12.

If computer shows no reply, as below:



```
Microsoft Windows [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\>ping 192.168.1.101

Pinging 192.168.1.101 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.101:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

then there may be a problem with processor ethernet. Check I/P address.

12. Using straight Ethernet cable connect computer to Ethernet switch in master panel.
13. Repeat Steps 10 and 11. If there is no reply from the processor the problem is with the Ethernet cable connection from the master panel to the boiler.

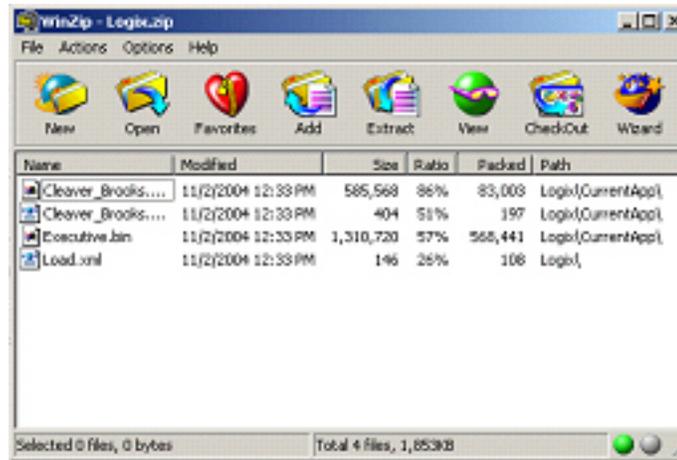
C. LOADING PLC PROGRAM

To load a program to the processor requires the following:

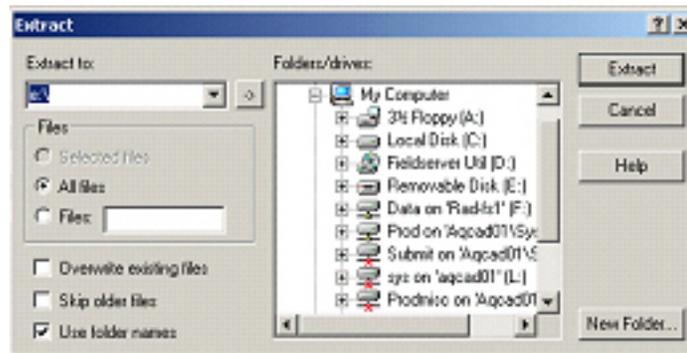
- SD memory card (recommended: SanDisk SD card A-B 1784-SD1 1GB capacity; supplied with processor).
- USB SD card reader
- Laptop computer

1. Loading program from laptop to SD card

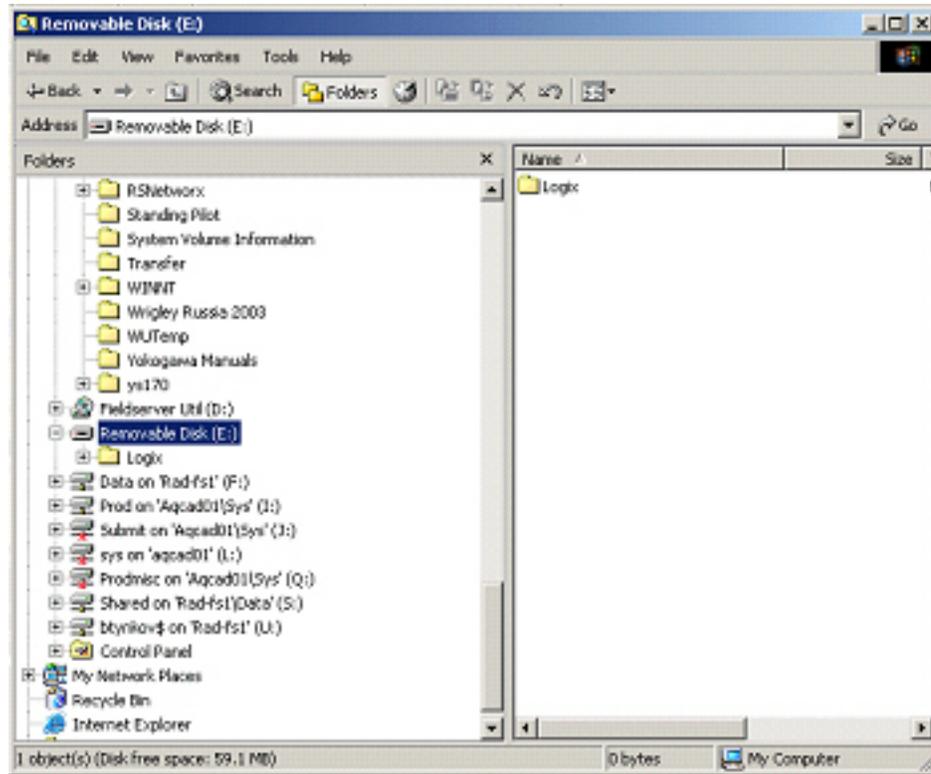
1. Insert USB reader with SD card into PC.
2. Locate logix.zip file on the computer drive and double click on it.



3. Double click on Extract.



4. Choose the drive where the SD card is located and click on Extract button. Close WinZip window.
5. Browse to the drive where SD card is located and make sure it contains the "Logix" directory.



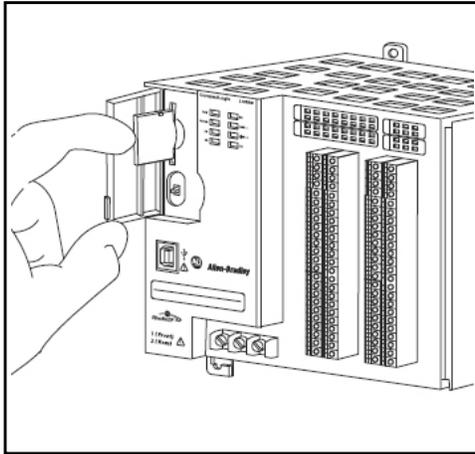
6. Using “Unplug and Eject Hardware” on your computer select the USB device.

A screen prompt will indicate that the device can be removed:

7. Remove card reader and remove SD card from reader.

2. Loading program from SD card to PLC

1. Insert SD card into the card slot of the processor. Take care to insert card in the correct orientation.



2. The PLC mode selection switch must be in PROG or RUN mode. No other files should be present on the SD card.*
3. Cycle power to the controller.
4. Allow about 60 seconds for the program to load.

*When backing up or saving a program *from* the PLC to an SD card, the PLC switch must be in PROG and the burner switch must be OFF.

D. WEB SERVER

It is possible to access the Master Panel HMI remotely from a PC for diagnostic/informational purposes.

From a computer on the same network as the Master Panel, enter the IP address of the PanelView Plus HMI in the computer's web browser.



The Master Panel HMI screens may now be viewed and navigated on the computer (parameter entry and operational functions not allowed).



Section 4 Parts

Master Panel 4 Parts List 4-3

Master Panel 4 Boiler Parts List

Description	CB Part #	
Processor L24ER	833-10039	
Display, 7 inch Touch Screen	817-04863	
Analog Output Module 2 Ch.	833-02844	
End Cap	833-02838	
Ethernet Switch 5 Port	833-09181	
Cable Ethernet Patch, CAT 5	826-00111	
24V DC Power Supply	832-02037	
Circuit Breaker 6 Amp	983-00083	
Circulating Cooling Fan	001-01476	
Ethernet I/P Router/Network Isolator 4 Port Switch	833-10807	optional
10 Inch PanelView Plus	833-03512	optional
Pressure Header Transmitters		
Steam 0-15 PSIG	817-04873	
Steam 0-50 PSIG	817-00002	
Steam 0-150 PSIG	817-04874	
Steam 0-250 PSIG	817-04875	
Steam 0-300 PSIG	817-04876	
Steam 0-350 PSIG	817-04877	
Steam 0-400 PSIG	817-04878	
Steam 0-450 PSIG	817-09768	
Hot Water Transmitters		
Supply Section 4 Boiler (max temp 250 F)	817-09776	
Return Section 4 Boiler (max temp 250 F)	817-09777	
Supply Section 1 Boiler (above 250 F)	817-09778	
Return Section 1 Boiler (above 250 F)	817-09777	



e-mail: info@cleaverbrooks.com
Web Address: <http://www.cleaverbrooks.com>