LIPTEN™
ENERGY SOLUTIONS

CombustionPac™

Installation, Operation and Maintenance Manual

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Ver. 2.3 9/10

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Overview

This manual discusses the installation and operation of the Lipten ***CombustionPac***™ burner/boiler control system. Dual programmable logic controllers, one for the Burner Management System (BMS) and one for the Combustion Control System (CCS), control all aspect of the burner and boiler operation. Flame supervision is provided by a UL and FM approved integral flame switch.

WARNING: These instructions are intended for use only by qualified personnel only. Adjustment of this equipment or its accessories by unqualified personnel can result in fire, explosion, severe personal injury, or death.

Receiving and Inspecting

This equipment has been carefully inspected and tested before packing. It was shipped in good condition (large or heavy equipment will be shipped on wooden pallets).

When receiving this equipment, inspect the wooden pallet(s), packaging and equipment, and check to see if there is any damage. Then check the equipment model and all items according to the packing list.

If there is any damage to the equipment or any missing parts, report it to your local Lipten representative or the equipment supplier immediately. Do not attempt to operate the equipment until any damaged or missing parts are obtained and are installed correctly.

In the event your merchandise arrives damaged, the Consignee is responsible for following the below procedures.
FAILURE TO DO SO FORFEITS CONSIGNEE'S CLAIM FOR REIMBURSEMENT AND ANY WARRANTY CLAIM.

Shipping Policy for Freight Transportation: (Roadway, Yellow, Fedex National etc.)

- Consignee must inspect packages and contents before delivery service leaves. FAILURE TO DO SO WILL FORFEIT FULL/PARTIAL REIMBURSEMENT. If damage occurs:
- Consignee must note all damage, overage and shortage exceptions with the driver and note on the deliver receipt.
- Consignee must accept or decline damaged goods.
- If accepting damaged goods:
    - Consignee is responsible for filing claim with shipping company and purchasing replacement product if needed. Please note when filing a claim you should request total value of damaged product + cost of shipping. You

must hold onto the original packaging and damaged goods for optional inspection by shipping company. Please note that hold time can vary with the freight company, please contact the freight company for additional information.

- If rejecting damaged goods:
  - Contact Lipten Company within two (2) days of rejection. A claims form will be emailed to the Consignee. Consignee is responsible for filing a claims form within two business days upon receipt.
- CONCEALED DAMAGE: Note that while at times a box may appear undamaged, the product may have incurred damage in transit. You must inspect the contents (not only the packaging) before signing the delivery receipt. Report concealed damage within (2) two business days of receiving your order. IF THE CONSIGNEE FAILS TO NOTE THE CONCEALED DAMAGE ON THE DELIVERY RECEIPT, THE CONSIGNEE IS RESPONSIBLE FOR FILING A CLAIM WITH THE SHIPPING COMPANY AND PURCHASING A REPLACEMENT.
- INSPECTION OF DAMAGED PRODUCTS: Freight companies request that the consignee holds all damaged products for 120 days, for inspection purposes. Day one begins when claim is filed with shipper. The consignee is responsible for holding the damaged goods for up to 120 Days. Failure to do so will terminate the claim with no reimbursement or replacement product.

Claims Policy for Parcel: (i.e. UPS, FedEx, DHL)

- Consignee is responsible for inspecting all products at time of delivery.
- If Damage Occurs:
  - Consignee must notify Lipten Company within two business days of receiving damaged goods.
  - The Lipten Company will issue a claims form that must be completely filled out and returned.
  - Consignee must hold damaged products, boxes, and packaging material for 14 business days. (Day one begins the day after filing a claim).
  - Shipping company will contact consignee to schedule inspection pickup date and time. If shipping company does not contact consignee within the 14-business day deadline, please contact Lipten Company.

General Safety Rules

There is a certain amount of hazard and danger involved with the use of industrial equipment. Using the equipment with the respect and caution demanded as far as safety precautions are concerned will considerably lessen the possibility of personal injury. However, if normal safety precautions are overlooked or ignored, severe personal injury to the operator can occur.

1. Read the operation manual before operating this equipment.
2. If you are not thoroughly familiar with the equipment operation, obtain advice from a supervisor or other qualified person.
3. The equipment should be disconnected from the power source before performing maintenance or adjustments to the internal mechanisms, or when making repairs.
4. After maintenance job is finished, check to see if there are any tools or objects left on the equipment. Close all safety guards.
5. Before leaving the equipment, make sure the work area is clean.
6. Learn the equipment's applications and limitations, as well as the specific potential hazards peculiar to it. Keep the equipment in top condition for best and safest performance.
7. Keep all guards in place and in working order.
8. Do not operate the equipment while under the influence of drugs, alcohol, or any other medication.
9. The employer/installer is responsible for selecting competent and qualified employees.
10. The employer/installer must make sure that employees study and utilize this safety information.
11. Supervisors must alert personnel of any unsafe practices they observe.
12. Protective guards and shields must be in place at all times unless they must be removed for specific service or maintenance. They should be immediately replaced when service or maintenance is completed.
13. Make sure that operator clearly knows how to stop the equipment before starting work.
14. Maintain the equipment in good operating condition. Report unusual conditions or equipment malfunctions immediately.
15. Do not alter or remove guards and warning labels.
16. Keep the immediate area clean. Do not allow the floor to become slippery, or covered with debris. Debris that accumulates in the work area is a hazard that can cause you to fall or slip against the equipment or its controls.
17. Employees should be required to report to their supervisors any hazardous condition of the equipment or in the immediate area.

Electrical Safety Rules

1. Remove electrical power before performing any electrical service work or maintenance!
2. Do not alter or bypass any protective interlock.
3. Before starting the equipment, read and observe all warning labels and markings such as nameplates and identification plates.
4. Only personnel who are properly trained and have adequate knowledge and skill should undertake all electrical/electronic troubleshooting and repair.
5. Use extra precautions in damp areas to prevent yourself from accidental grounding.
6. Make sure your body and your tools are clear of electrical grounding.
7. The control panel doors should be opened only when it is necessary to check the electrical equipment or electrical wiring.
8. Before applying power to any equipment, establish without a doubt that all persons are clear.
9. Be alert and be sure you can work with no outside distractions.
10. Avoid wearing metal frame glasses or wearing a metallic necklace or chain, and never work on electrical equipment while wearing rings, watches, or bracelets.
11. When replacing conductors, make sure they conform to the manufacturer's specifications, including proper color-coding.
12. Do not alter the electrical circuits. If equipment damage is caused by an unauthorized alteration, the user is responsible, not the manufacturer.
13. Always assume the electrical power is ON and treat circuit as live. This caution develops a habit that may prevent an accident.
14. Use proper test equipment to make certain you have an open circuit. Test equipment must be checked and calibrated at regular intervals.
15. Open the control panel doors only when it is necessary to check the electrical equipment or wiring.
16. All covers on junction boxes, actuators, switches, transmitters, valves, burners etc. must be closed before leaving any job.

Installation

MOUNTING OVERVIEW

The Lipten ***CombustionPac™ control*** panel kit is designed for new installations as well as to replace existing boiler control systems. Standard enclosure is NEMA 12 rated. Continuous operation is guaranteed over a 32-122°F ambient temperature range without de-rating. The control panel should not be subjected to excessive vibration, explosive atmospheres or harsh chemicals.

WARNING: This equipment is commonly used to control potentially dangerous combustion and chemical processes..

VERIFY THAT THE PROCESS BEING CONTROLLED HAS BEEN SAFELY SECURED, ISOLATED, OR BYPASSED (AS REQUIRED BY THE SITE CONDITIONS) BEFORE REMOVING POWER FROM THE CONTROLLER. FAILURE TO DO SO CAN RESULT IN EQUIPMENT DAMAGE, OPERATOR INJURY, OR DEATH.

It is very common to have multiple sources of power among the wires connected to the controller. VERIFY THAT ALL SOURCES OF POWER HAVE BEEN DISCONNECTED BEFORE WORKING ON WIRING.

FAILURE TO DO SO CAN RESULT IN INJURY OR DEATH.

WARNING: All panel and field wiring should conform to national and local electrical codes.

FIELD WIRING COMPARTMENT

All field-wiring connections are inside the Boiler Control Panel. Screw type terminals are provided. Terminal block rail (TB2) is provided for120Vac connections; terminal block rail (TB1) is provided for 24Vdc, signal (analog), and other low voltage connections.

120 VAC POWER AND GROUND

Incoming power terminals are grouped together for ease of wiring on the left side of TB2. Connect the incoming AC power ground (i.e. “Green Wire”) to the terminal marked “G”. Connect the 120 Vac power supply to the terminals marked “L1” for hot and “L2” for neutral.

WIRE TYPE

All wiring (AC, DC, and shielded cable) should be copper, stranded, 150 V min., and 75° C minimum. Higher temperature rated (105° C) wires may be required in certain instances due to localized, high temperature areas/components. Review boiler mounted equipment such as level probes, float switches, steam pressure switches and burner mounted equipment such as flame scanner, igniter, actuators, etc. to determine temperature rating of wire required.

SHIELDED CABLE

All analog signal wiring should be 18 gauge, shielded, (Belden 8760 (2) conductor or 8770 (3) conductor) or equal. 100% foil shielding is preferred, instead of braided shielding. The shields of all cables should be connected at one end only, preferably at the control panel end. Shields connected at both ends, or unintentionally grounded can add extra noise to a signal instead of reducing noise. To prevent noise pick-up, shielded cable field wiring should never be run in conduits or trays with AC wiring (any voltage). Ignition transformer and variable frequency drive AC wiring is particularly noisy and must be run in separate conduit from all DC signal wiring. Within the Boiler Control Panel, minimize the distance that DC and AC wires are run together. Wherever possible, cross AC and DC wires at a 90 degree angle to each other.

DC SIGNAL COMMON ISOLATION

A thorough understanding of the signal common will prevent “ground loop” problems. Ground loops can cause lower than expected 4-20 mA values at an input due to a portion of the current bypassing the intended circuit path and traveling through some unintended parallel path.

500 OHM RESISTORS FOR BASE UNIT 4-20 mA INPUTS

The MicroLogix® 1100 base unit analog input channels use an external 500 ohm precision resistor, if the channel is to be used with 4-20 mA inputs. This 500 ohm resistor converts a 4-20 mA signal into a 2-10 Vdc signal. The 1762-IF4 analog input modules are already set to use a 4-20 mA signal, so no external resistor is required. Note: the 1762-IF4 module is capable of accepting either 0-10Vdc or 4-20mA signals, if

replacing a module, verify the module is set (dip switches) to receive 4-20mA (current) signals.

FUSES

Fuse holders used in the ***CombustionPac***™ have built-in fuse blown indicators. When lit, the indicator signals that a fuse has blown or has been removed. This feature is provided as a troubleshooting aid in the event of a malfunction.

SYSTEM DRAWINGS

See the complete system drawing package provided for each panel for a detailed connection of field devices to the panel.

Field Wiring

Refer to the wiring diagrams for terminations of typical field devices.

Operating Instructions

Overview

The sections below outline the sequence of operation for a ***dual fuel, full metered scheme*** boiler using an **optional** *Oxygen Sensor with Auxiliary Low Oxygen Level Alarm Contact.* The automatic start-up and shutdown of the system are discussed, as well as various aspects of the burner ignition and purge systems. In the following description, combustion air damper and fuel control valves are individually controlled. The fuel flow and air flow are measured; the fuel valves and air damper are adjusted to maintain an optimum stoichiometric ratio.

Initiating System Start-Up – Natural Gas

WARNING: The fuel must be selected before proceeding with boiler startup. Moving the fuel selector switch during any part or the startup sequence or during boiler operation will cause an immediate shutdown of the boiler.

1. The system is in stand-by, natural gas is the selected fuel.
2. If the main low gas and high gas pressure switches are OK, the operator may proceed. If either of these switches is faulted, the system will remain in stand-by.
3. The combustion air fan VFD panel must be set to “AUTO” mode.
4. The operator initiates the Boiler by pressing Start on the HMI.
5. If the gas and combustion air damper actuators’ light off position limit switches are closed, the system will go to step 7. If the switches are not closed, a fault will be generated.
6. The combustion air fan will start automatically.
7. If the combustion air fan is proven running and its minimum combustion air flow is proven, the sequence will proceed to step 9. If either of these is not true, a fault will be generated.
8. If the burner safety interlock is satisfied the system will go to step 10. If any of the safety interlocks are not satisfied, a fault will be generated. For the safety interlock to be satisfied the following conditions have to be met.
    a. Not low water cutoff
    b. Not auxiliary low water cutoff
    c. Not excessive high steam pressure

d. Not high steam pressure
e. Combustion air fan running
f. Minimum combustion air flow proven
g. Not low oxygen level – (Optional)
h. Not low main natural gas
i. Not high main natural gas

9. The Burner Management System (BMS) sends a "Purge" command to the Combustion Control System (CCS). The combustion air damper moves to its purge position.
10. If the air damper purge position limit switch is proven, the system will proceed to step 12. If the switch is not proven, a fault will be generated.
11. The BMS will initiate the purge timer (time set to achieve a minimum number of complete air exchanges as required by code) and the system proceeds to step 13. If the purge position limit switch or purge air flow switch does not remain closed for the purge time, a fault will be generated.
12. Upon completion of the purge, the BMS will send a low fire "Light Off Position" command to the CCS, and the combustion air damper will move to the light off position.
13. When the combustion air damper and gas valve low fire limit switches are proven, the BMS PLC will energize the "Burner Start" relay which will initiate the burner ignition sequence. The system will then proceed to step 15. If the limit switches are not proven, a fault will be generated.
14. The BMS will energize the pilot gas safety shut off valves, gas vent valve, ignition transformer, the flame monitoring relay, and initiate a 10-second pilot time trial for ignition.
15. After 5 seconds, the ignition transformer de-energizes.
16. If pilot flame is detected on the burner, the BMS will initiate the main flame start sequence, and the system will proceed to step 18. If the pilot flame is not detected, the burner light off attempt will be aborted, and a fault will be generated.
17. The main gas safety shut off valves will open and the main gas vent valve will close for a ten second proof of ignition period.
18. After 10 seconds, the pilot valves will de-energize. If main flame is detected on the burner, the BMS will start a 10-second main flame stability cycle and monitor the system. If the main flame is not detected, the burner light off attempt will be aborted, and a fault will be generated.
19. After the main flame stability period has been completed. The *low fire hold* temperature switch**,** prevents the BMS from releasing the burner to modulate if the boiler temperature is below the low fire hold temperature switch set point. The burner continues to operate at low fire, but will not attempt to reach final steam pressure set point. Once the boiler warms

up, and the temperature has reached the low fire hold switch set point, the boiler BMS sends a signal to the CCS releasing the burner for modulation.

20. Then the fuel and combustion air damper PID loops moves into “AUTO”. The burner will now modulate automatically as required to reach steam header pressure set point or meet the demand signal input.

Master Fuel Trip Initiated Shutdown

Any one of the following conditions shall initiate the shutdown of the main fuel supply, as well as the shutdown of the burner. The Master Fuel Trip relay will remain de-energized until the system’s interlocks allow it to be reset.

1. Loss of the combustion air fan “Running”
2. Low combustion air flow
3. Loss of the burner flame
4. Emergency stop
5. High gas pressure
6. Low gas pressure
7. Low water cutoff
8. Aux low water cutoff
9. High steam pressure
10. Excess high steam pressure
11. Low oxygen level – (Optional)

When a master fuel trip occurs, the BMS shall sound an alarm and initiate a 1-minute boiler system ventilation post-purge. The boiler dampers will remain in the same position as before the trip occurred. At the completion of the ventilation cycle, the BMS shall shut down the combustion air fan.
The cause of the shutdown must be determined, and necessary corrective action taken to ensure the system is within specified operating conditions. Reset the system as necessary.
The system may be re-started in accordance with NFPA-85; “A Trained Operator Shall Initiate the restart“, via the normal boiler start-up sequence.

Operator Initiated Shutdown

1. The operator initiates a burner shutdown, via the HMI. The following will occur:
    a. The HMI indicates the burner stop command has been received.
    b. The BMS de-energizes the main gas safety valves. The shut off valves will close and the vent valve will open. The valves are proven closed or fault is generated.

c. The BMS initiates the "Post Purge" time (30 seconds). The boiler dampers will remain in the same position as before the shutdown was initiated.

d. After the "Post Purge" time has elapsed, the BMS sends the "Low Fire" command to the CCS. Then the gas valve and combustion air damper will move to their low fire light off positions.

e. When the gas valve and combustion air fan damper are at low fire light off position, the BMS will stop the combustion air fan.

Initiating System Start-Up – Fuel Oil

WARNING: The fuel must be selected before proceeding with boiler startup. Moving the fuel selector switch during any part or the startup sequence or during boiler operation will cause an immediate shutdown of the boiler.

1. The system is in stand-by, #2 fuel oil is the selected fuel.
2. The combustion air fan VFD panel must be set to "AUTO" mode.
3. The operator initiates the Boiler by pressing Start on the HMI.
4. If the oil and combustion air damper actuators' light off position limit switches are closed, the system will go to step 7. If the switches are not closed, a fault will be generated.
5. The combustion air fan and oil pump will start automatically. The oil atomization air valve will also open.
6. If the combustion air fan is proven running and its minimum combustion air flow is proven, the sequence will proceed to step 9. If either of these is not true, a fault will be generated.
7. If the low oil pressure switch and low atomizing air switch are OK, the operator may proceed. If either of these switches is faulted, the system will remain in stand-by.
8. If the burner safety interlock is satisfied the system will go to step 10. If any of the safety interlocks are not satisfied, a fault will be generated. For the safety interlock to be satisfied the following conditions have to be met.
    a. Not low water cutoff
    b. Not auxiliary low water cutoff
    c. Not excessive high steam pressure

d. Not high steam pressure
e. Combustion air fan running
f. Minimum combustion air flow proven
g. Not low oxygen level – (Optional)
h. Not low oil pressure
i. Not low atomizing air pressure

9. The Burner Management System (BMS) sends a “Purge” command to the Combustion Control System (CCS). The combustion air damper moves to its purge position.
10. If the air damper purge position limit switch is proven, the system will proceed to step 12. If the switch is not proven, a fault will be generated.
11. The BMS will initiate the purge timer (time set to achieve a minimum number of complete air exchanges as required by code) and the system proceeds to step 13. If the purge position limit switch or purge air flow switch does not remain closed for the purge time, a fault will be generated.
12. Upon completion of the purge, the BMS will send a low fire “Light Off Position” command to the CCS, and the combustion air damper will move to the light off position.
13. When the combustion air damper and oil valve low fire limit switches are proven, the BMS PLC will energize the “Burner Start” relay which will initiate the burner ignition sequence. The system will then proceed to step 15. If the limit switches are not proven, a fault will be generated.
14. The BMS will energize the pilot gas safety shut off valves, gas vent valve, ignition transformer, the flame monitoring relay, and initiate a 10-second pilot time trial for ignition.
15. After 5 seconds, the ignition transformer de-energizes.
16. If pilot flame is detected on the burner, the BMS will initiate the main flame start sequence, and the system will proceed to step 18. If the pilot flame is not detected, the burner light off attempt will be aborted, and a fault will be generated.
17. The main oil safety shut off valves will open for a ten second proof of ignition period.
18. After 10 seconds, the pilot valves will de-energize. If main flame is detected on the burner, the BMS will start a 10-second main flame stability cycle and monitor the system. If the main flame is not detected, the burner light off attempt will be aborted, and a fault will be generated.
19. After the main flame stability period has been completed. The *low fire hold* temperature switch**,** prevents the BMS from releasing the burner to modulate if the boiler temperature is below the low fire hold temperature switch set point. The burner continues to operate at low fire, but will not attempt to reach final steam pressure set point. Once the boiler warms

up, and the temperature has reached the low fire hold switch set point, the boiler BMS sends a signal to the CCS releasing the burner for modulation.

20. Then the fuel and combustion air damper PID loops moves into “AUTO”. The burner will now modulate automatically as required to reach steam header pressure set point or meet the demand signal input.

Master Fuel Trip Initiated Shutdown

Any one of the following conditions shall initiate the shutdown of the main fuel supply, as well as the shutdown of the burner. The Master Fuel Trip relay will remain de-energized until the system’s interlocks allow it to be reset.

1. Loss of the combustion air fan “Running”
2. Low combustion air flow
3. Loss of the burner flame
4. Emergency stop
5. Low oil pressure
6. Low atomizing air pressure
7. Low water cutoff
8. Aux low water cutoff
9. High steam pressure
10. Excess high steam pressure
11. Low oxygen level – (Optional)

When a master fuel trip occurs, the BMS shall sound an alarm and initiate a 1-minute boiler system ventilation post-purge. The boiler dampers will remain in the same position as before the trip occurred. At the completion of the ventilation cycle, the BMS shall shut down the combustion air fan.
The cause of the shutdown must be determined, and necessary corrective action taken to ensure the system is within specified operating conditions. Reset the system as necessary.
The system may be re-started in accordance with NFPA-85; “A Trained Operator Shall Initiate the restart“, via the normal boiler start-up sequence.

Operator Initiated Shutdown

1. The operator initiates a burner shutdown, via the HMI. The following will occur:
    a. The HMI indicates the burner stop command has been received.
    b. The BMS de-energizes the main oil safety valves. The shut off valves will close. The valves are proven closed or fault is generated.

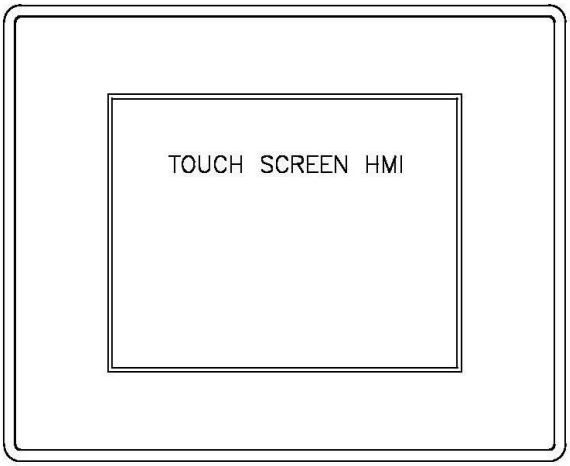
c. The BMS initiates the “Post Purge” time (30 seconds). The boiler dampers will remain in the same position as before the shutdown was initiated.

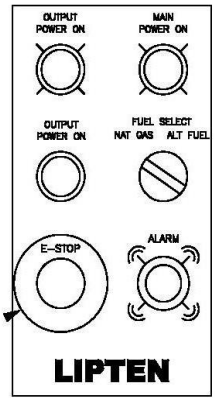
d. After the “Post Purge” time has elapsed, the BMS sends the “Low Fire” command to the CCS. Then the oil valve and combustion air damper will move to their low fire light off positions.

e. When the oil valve and combustion air fan damper are at low fire light off position, the BMS will stop the combustion air fan, oil pump and atomizing air.

Front Panel

The exterior of the control panel door contains the HMI display and several pilot devices:





- E-Stop Pushbutton – This is a push/pull maintained position device used to immediately shutdown boiler operation by removing control voltage to all essential ***output devices***. This removes power to fan run permissives, fuel valves, solenoids and the internal relays used to enable these devices. This allows for a direct hardwired shutdown of the combustion process while leaving power on to monitor discrete and analog inputs. The system retains the ability to monitor critical boiler inputs. The E-Stop pushbutton can be "reset" by pulling the pushbutton back out. The E-Stop should never be used for normal boiler shutdown; it should only be used in extreme situations when the boiler or fan has to be stopped very quickly. If the e-stop is pressed, while the system is running, the alarm horn/beacon will become active. *In some situations damage to the equipment is possible, as the shutdown is immediate and not controlled.* ***Caution: control power is still active, maintenance personnel must be aware voltages are still present in certain devices!***
- Output Power On Pushbutton – This button is used to energize an *Output Power Relay* which *enables* the control valves and output power devices. This pushbutton works in conjunction with the E-Stop pushbutton. The E-Stop pushbutton must be in the pulled-out or "reset" position; this allows the *Output Power On Pushbutton* to energize the *Output Power Relay*. *Note: This relay is held in by a seal circuit, if for any reason incoming power to the panel is lost, the Output Power On Pushbutton will have to pressed again to enable the circuitry.*
- Output Power On Pilot Light – This is an *amber* indicator light used to inform the operator and maintenance personnel at a glance the control panel status. When this light is on, it indicates power is being supplied to the panel, the e-stop is not activated and panel output power has been enabled. This indicates the normal operating mode and must be on for boiler operation. If the e-stop is pressed, this indicator light will extinguish. If the e-stop is pressed, while the system is running, the light will extinguish and the alarm horn/beacon will become active.

- Main Power On Pilot Light - This is a *red* indicator light used to inform the operator and maintenance personnel at a glance the control panel status. When this light is on, it indicates incoming (120VAC) power is being supplied to the panel **and** 1CB circuit breaker is on. This indicates the normal operating mode and must be on for boiler operation. Loss of this indicator may indicate CB1 has tripped or has been turned off, or there is a loss of incoming supply power. *Caution: Pilot light utilizes a long life LED, multi-bulb array. While this type of bulb has an extremely long life, it is possible it may burn out and/or otherwise stop working. For this reason, never assume because the light is not on, that there is no voltage present.*
- Alternate Fuel Selector Switch (Optional) – This is a two (2) position "maintained" selector switch. The operator uses this switch to select the fuel type the system will operate on. The switch indicator lines up with the fuel chosen. The fuel chosen will also be displayed on the HMI status screen.
- Alarm Horn/Beacon Indicator – This indicator is a dual function device, providing both visual and audio indication of a fault or alarm condition. When activated it produces flashing red light (strobe) along with a pulsing audible signal. This indicator provides system status at a glance, to determine the cause of the alarm; the operator will review the *active* alarm screen on the HMI. It is at the HMI the alarm must be acknowledged and reset. If the alarm is not still active, it may be reset, if the alarm is still active the cause of the alarm must be remedied first. Once reset, the alarm horn/beacon will turn off.
- HMI Display - Most of the operator interface is done through the HMI display. This display is located on the front door of the control panel. Detailed information on HMI navigation and samples of screens are provided under "**Display Navigation**".

COMBUSTIONPAC SOFTWARE SECURITY

The Lipten CombustionPac line of boiler control systems employ several types and levels of security to deter untrained personnel from making changes to the PLC programs or critical operating parameters.

The PLC programs are password protected and accessible only by Lipten's engineers. There is no reason in the course of normal operation or maintenance that the PLC programs need to be accessed. Any change to a PLC program would need to be made by a Lipten engineer and only after careful investigation of the need and consequences of any such change.

Controls available through the HMI have four levels of access. All but the operator level require a user name and password to access. Logins are recorded and time stamped. The available levels are:

Operator
Operator may view boiler status and alarm screens, start and stop the boiler, acknowledge alarms, view trend screens, view I/O status screens and operate the boiler master control.

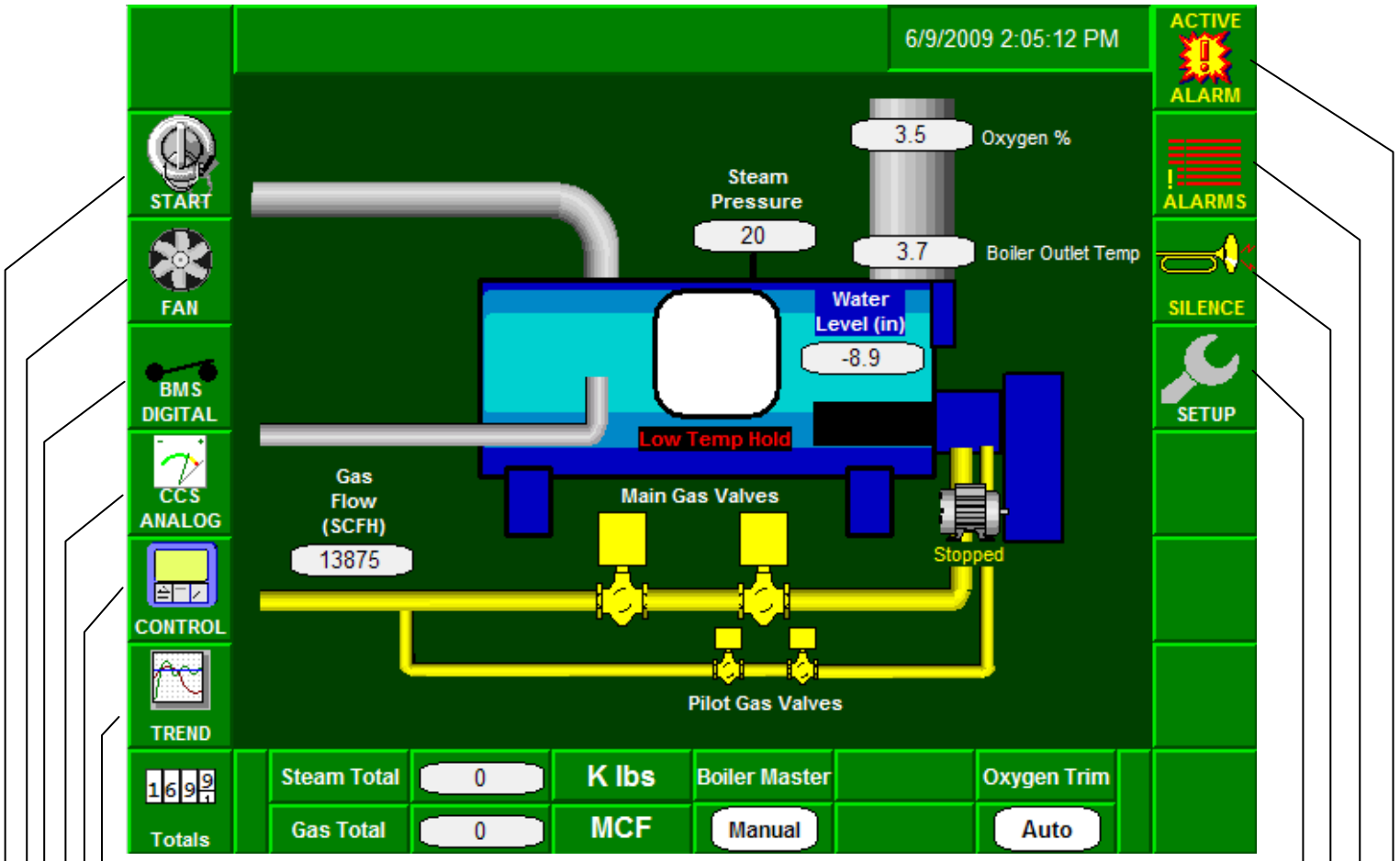
Maintenance
Maintenance mode allows all Operator level functions plus access to P&ID faceplates and adjustment to basic operational parameters.

Engineer
Engineer mode allows all Maintenance level functions plus access to the lookup tables for air and fuel and other boiler tuning functions.

Manufacturer
Manufacturer mode is reserved to Lipten's engineers only, allowing all above functions plus access to purge timers and other critical parameters not normally adjusted after system design.

Display Navigation

Main Overview Screen:



Select trend screen display

Select control screen (Page 23)

Select CCS Analog I/O screen

Select BMS I/O screen

Select fan control screen

Access Start/Stop Functions (Page 22)

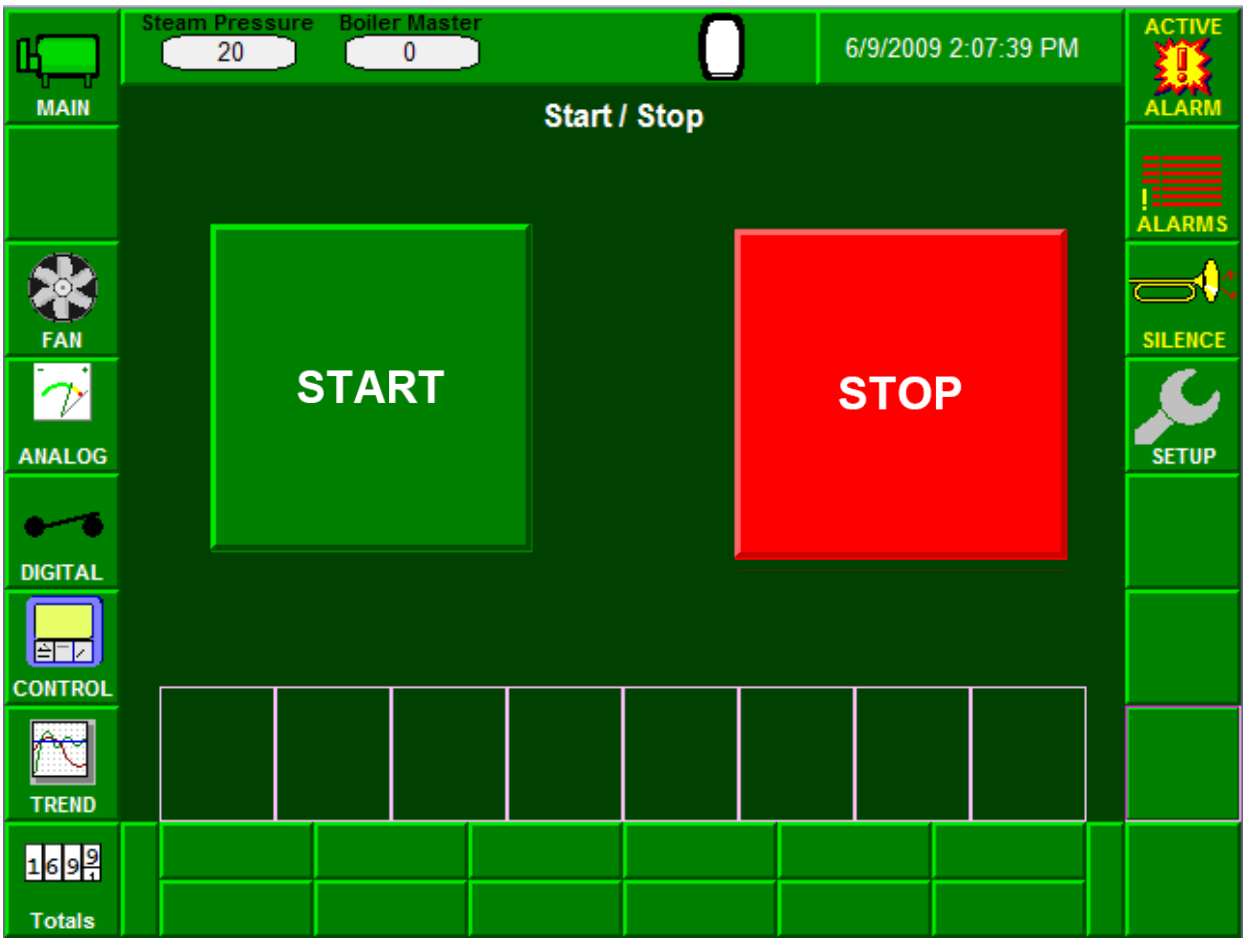
Access Setup Functions

Access Alarm Log

Silence Alarm Horn

View Active Alarm

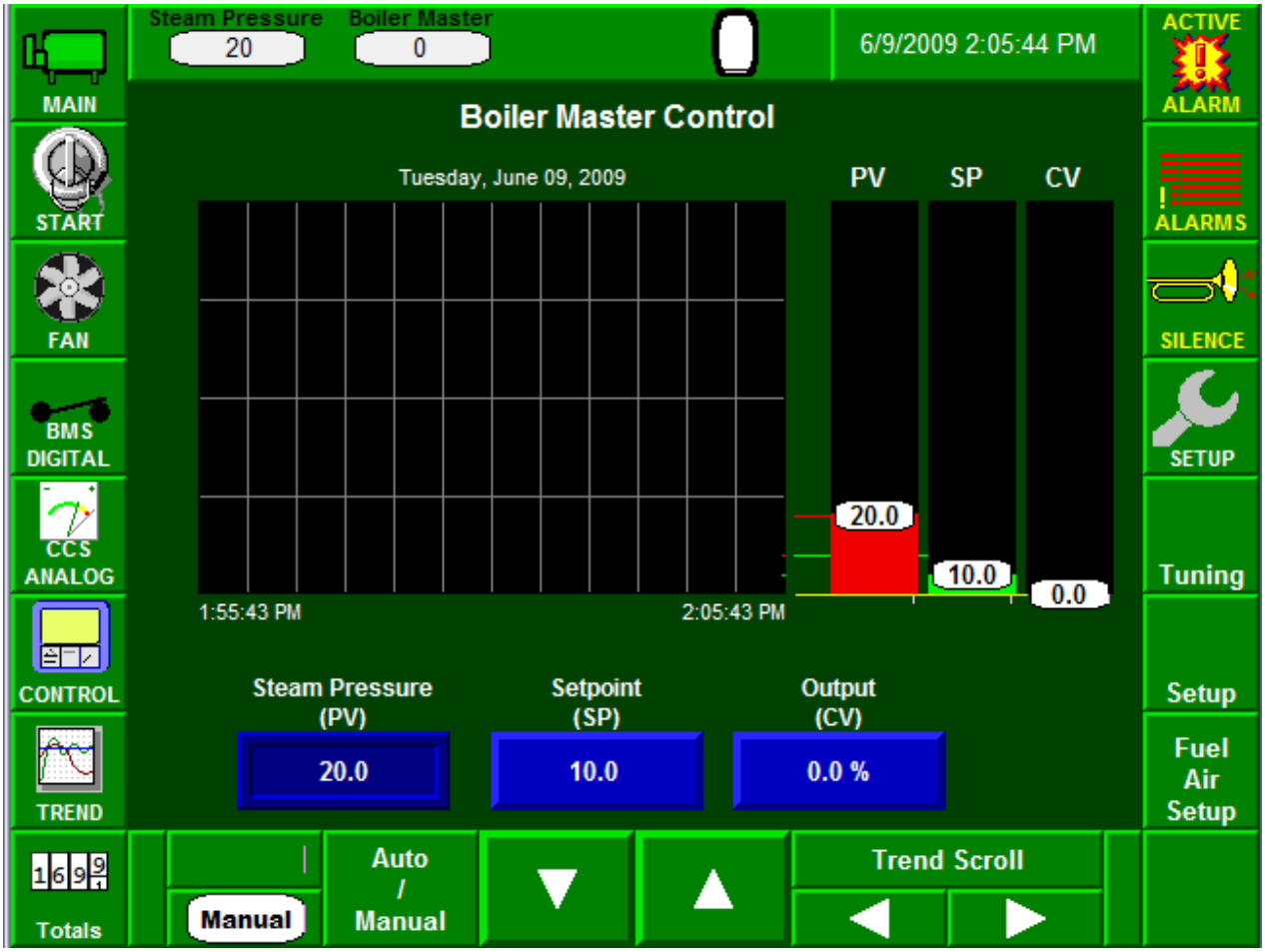
Start Stop:



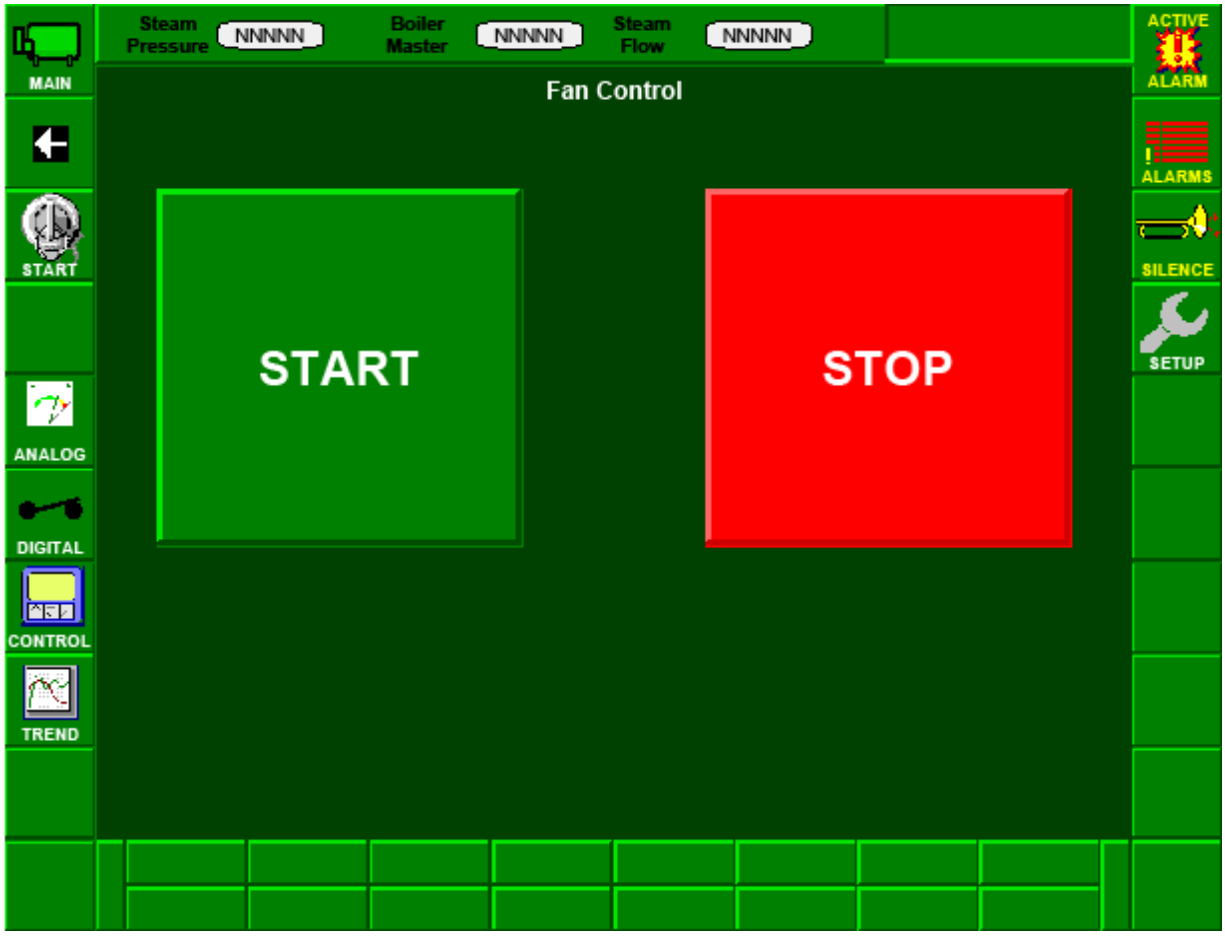
Master boiler Start / Stop Buttons

Control Main:

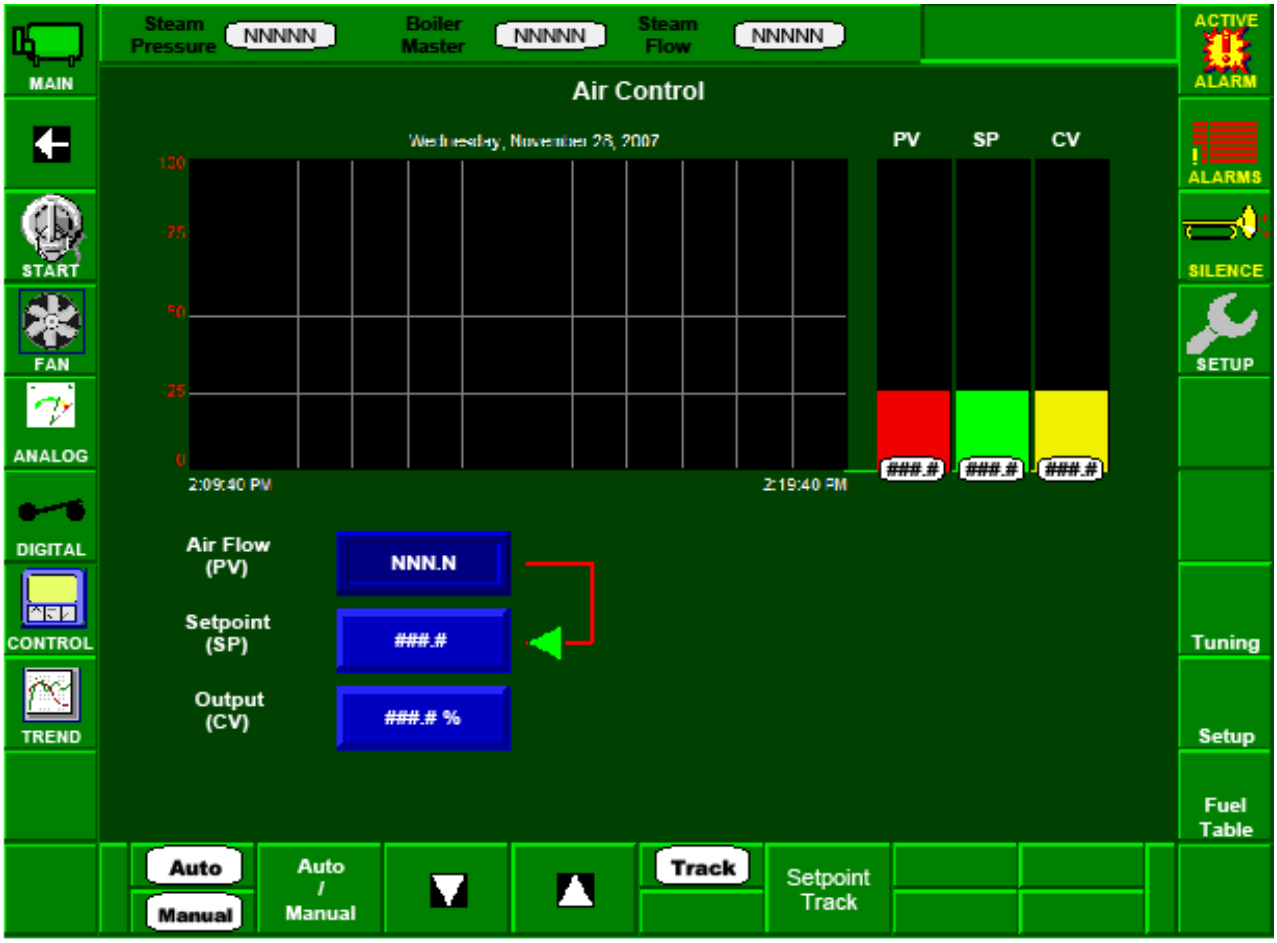
Boiler Master:



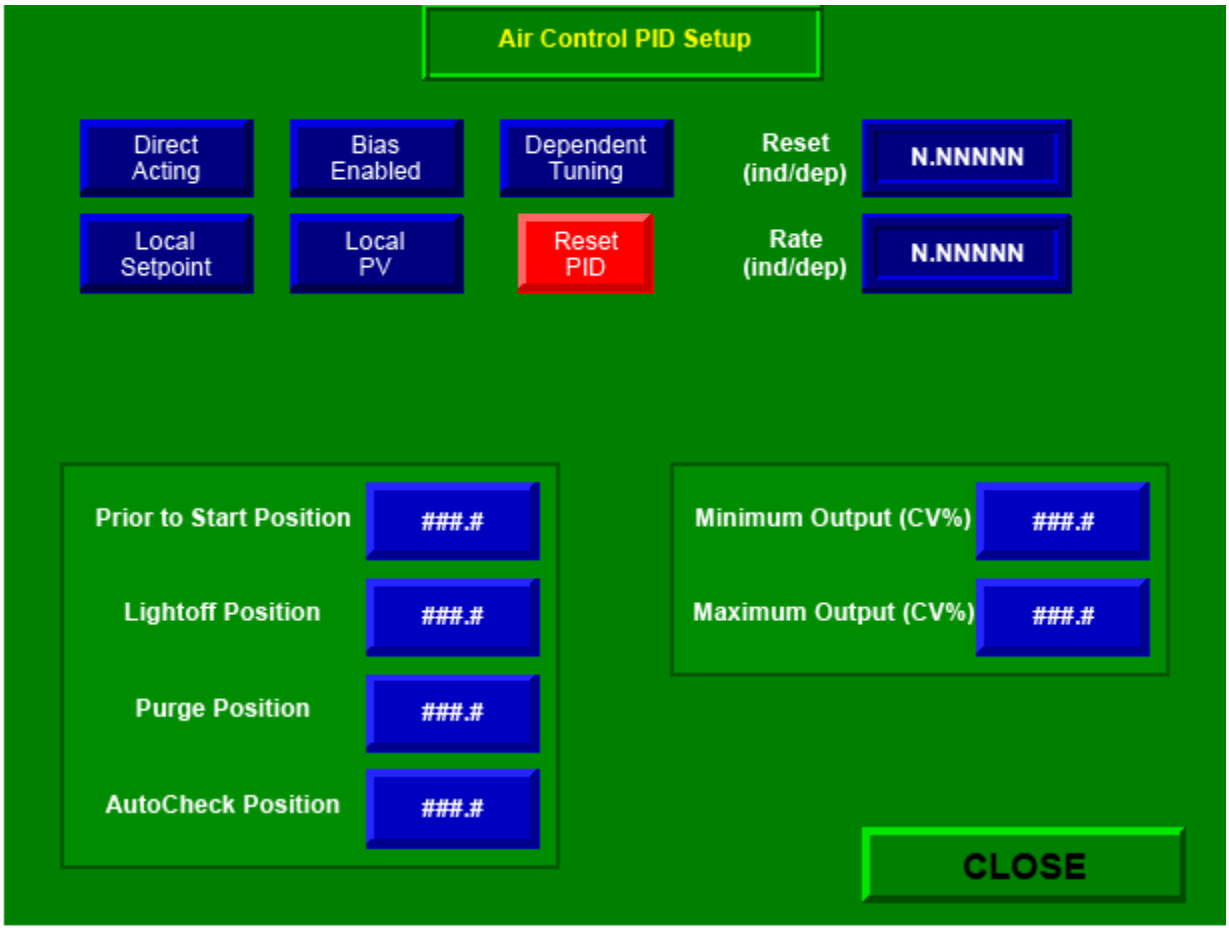
Fan Control:


Steam Pressure
NNNNN
Boiler Master
NNNNN
Steam Flow
NNNNN
Fan Control
MAIN
START
ANALOG
DIGITAL
CONTROL
TREND
ACTIVE ALARM
ALARMS
SILENCE
SETUP
START
STOP

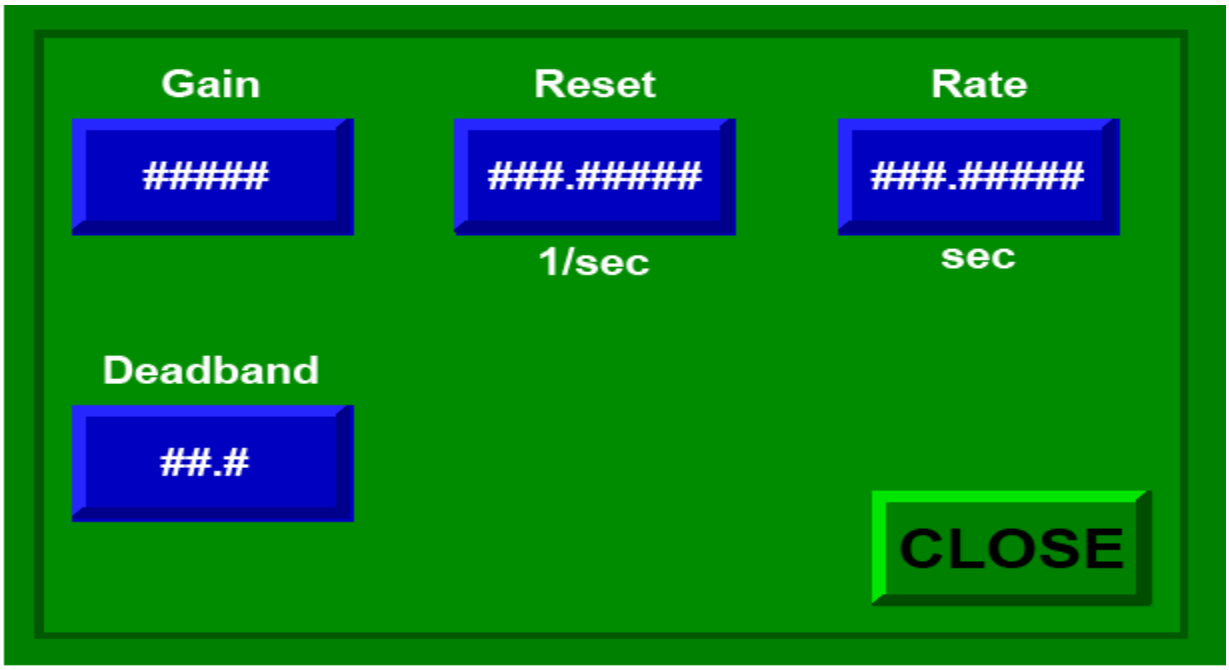
PID Air Control:



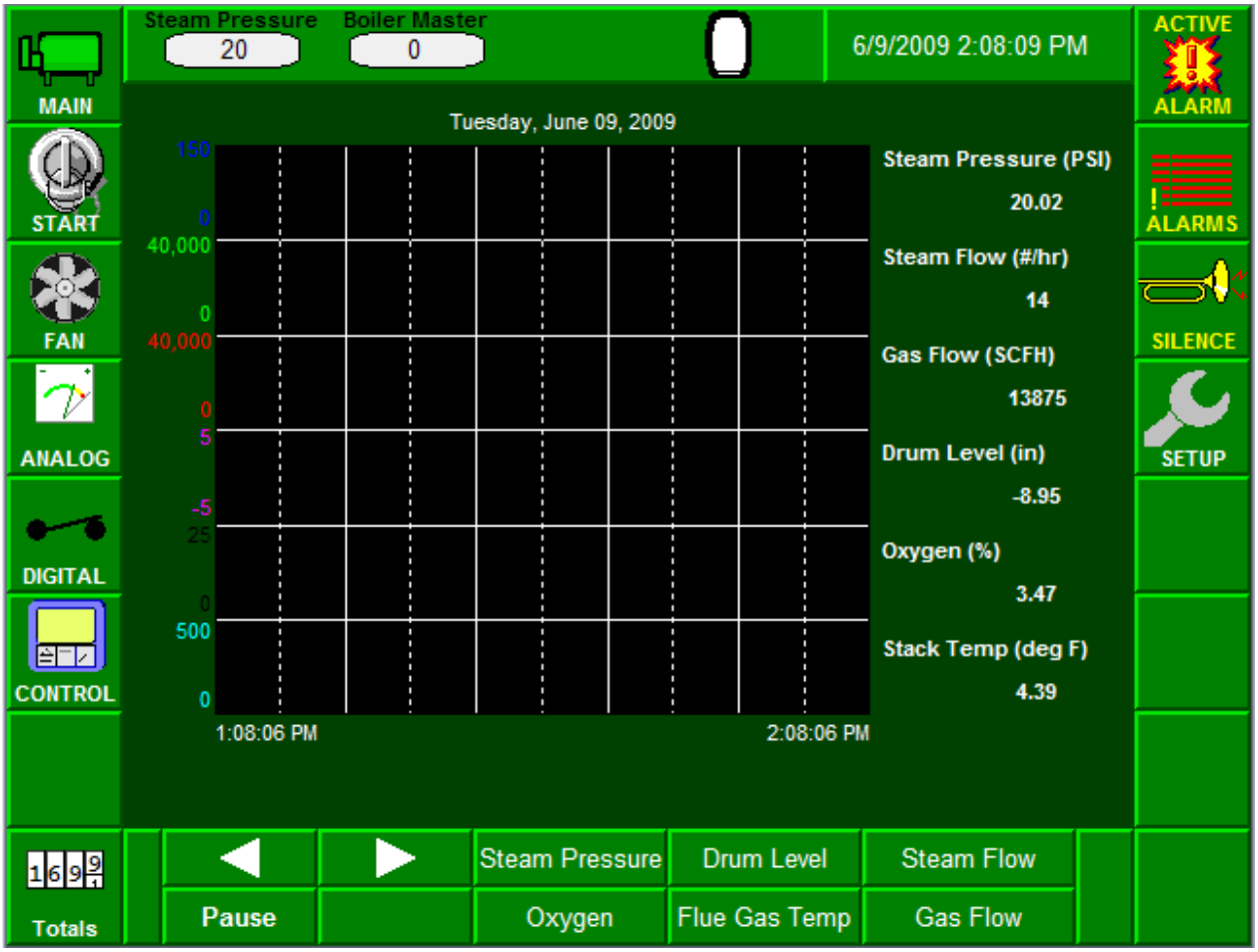
PID Air Control Setup:



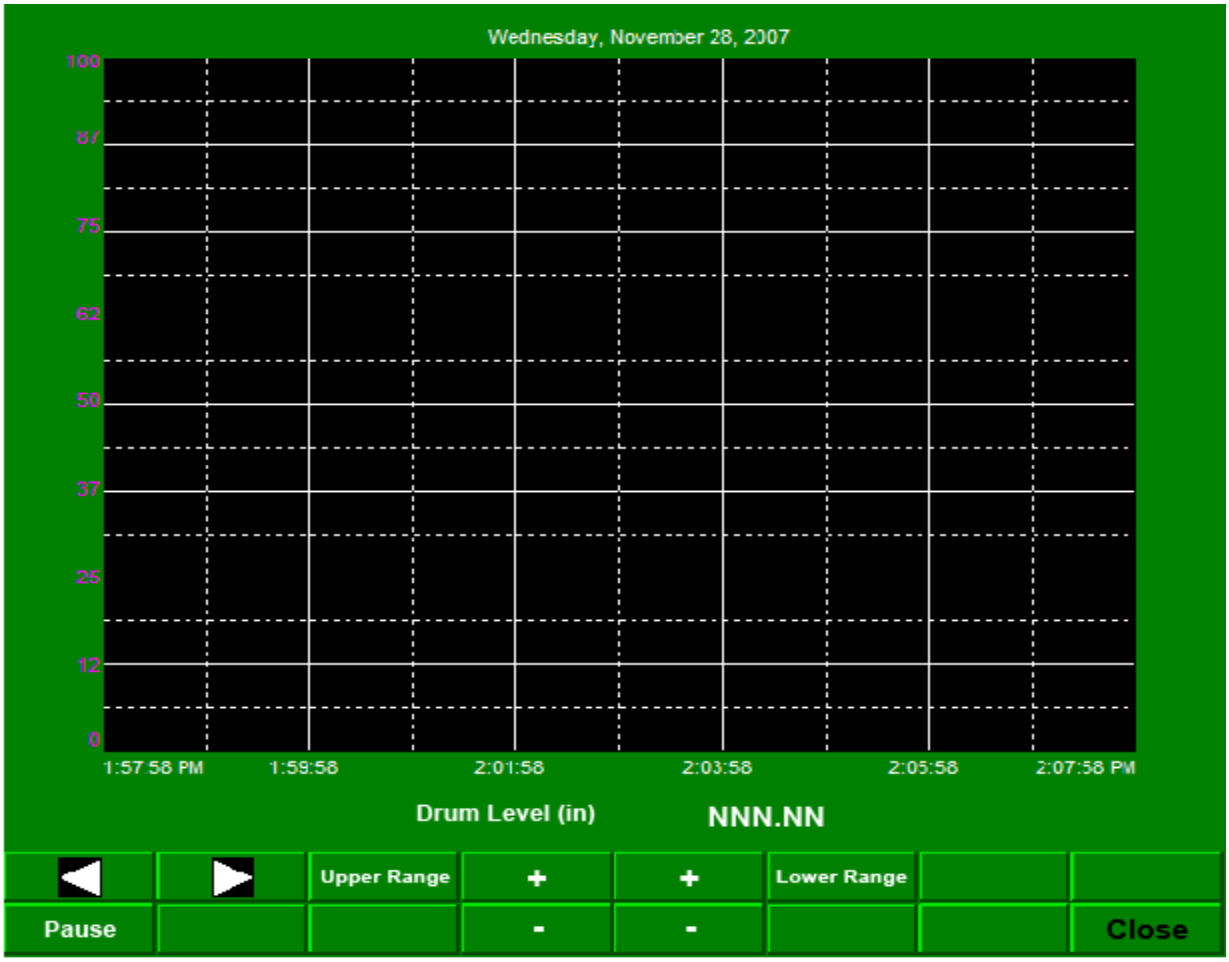
PID Air Control Tuning:



Trend Main:


Steam Pressure
20
Boiler Master
0
6/9/2009 2:08:09 PM
ACTIVE ALARM
MAIN
START
FAN
ANALOG
DIGITAL
CONTROL
ALARMS
SILENCE
SETUP
Tuesday, June 09, 2009
150
0
40,000
0
40,000
0
5
-5
25
0
500
0
1:08:06 PM
2:08:06 PM
Steam Pressure (PSI)
20.02
Steam Flow (#/hr)
14
Gas Flow (SCFH)
13875
Drum Level (in)
-8.95
Oxygen (%)
3.47
Stack Temp (deg F)
4.39
Totals
Pause
Steam Pressure
Drum Level
Steam Flow
Oxygen
Flue Gas Temp
Gas Flow

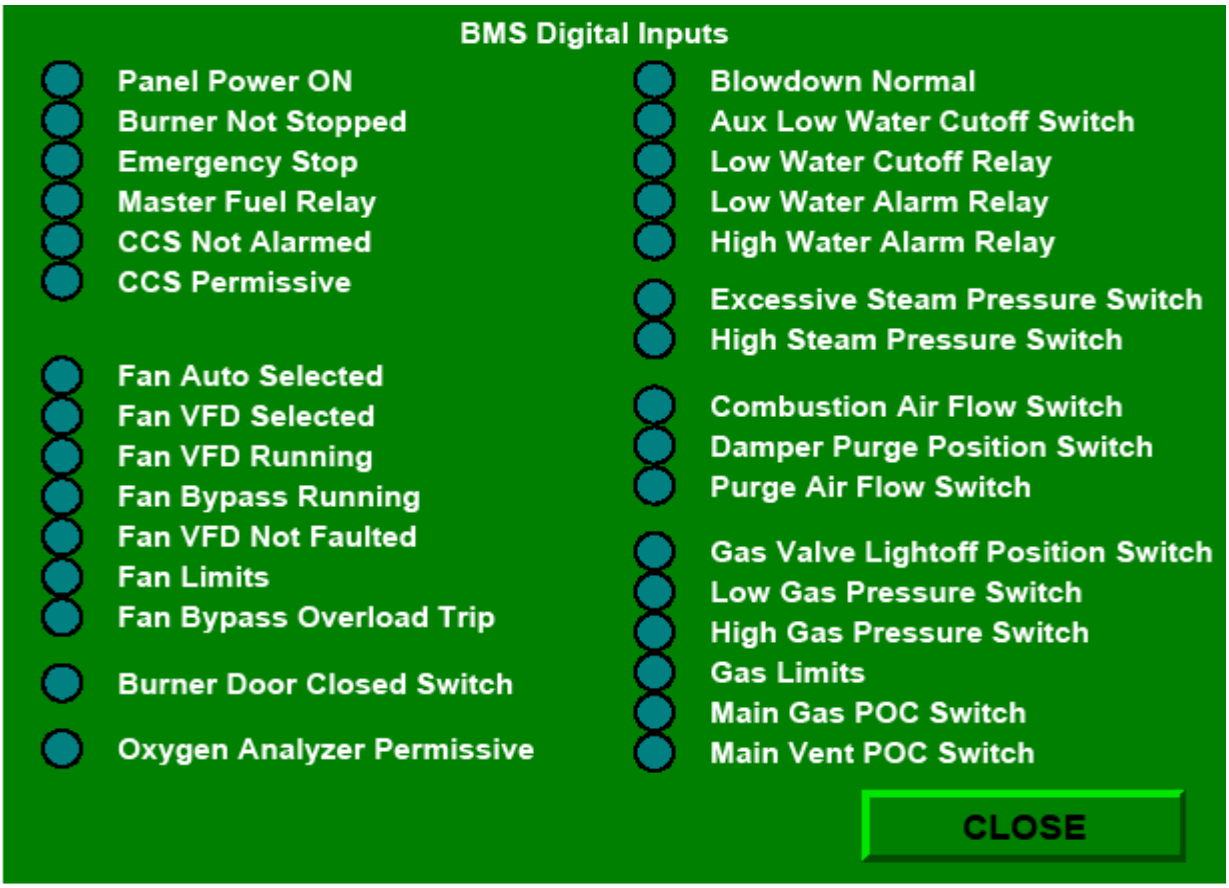
Optional, Trend Drum Level:



Optional, CCS Input Drum Level:

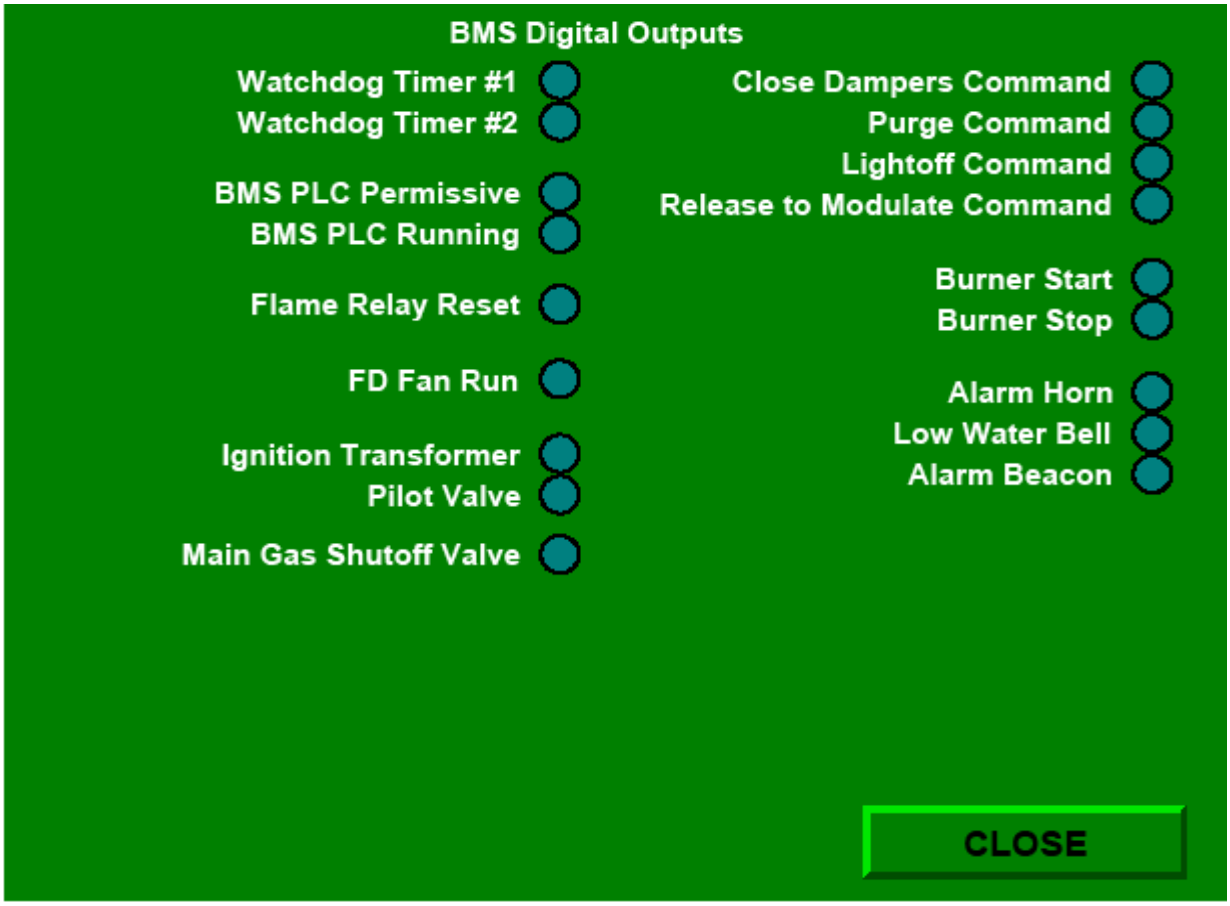
Digital I/O Overview:

Digital BMS Input:



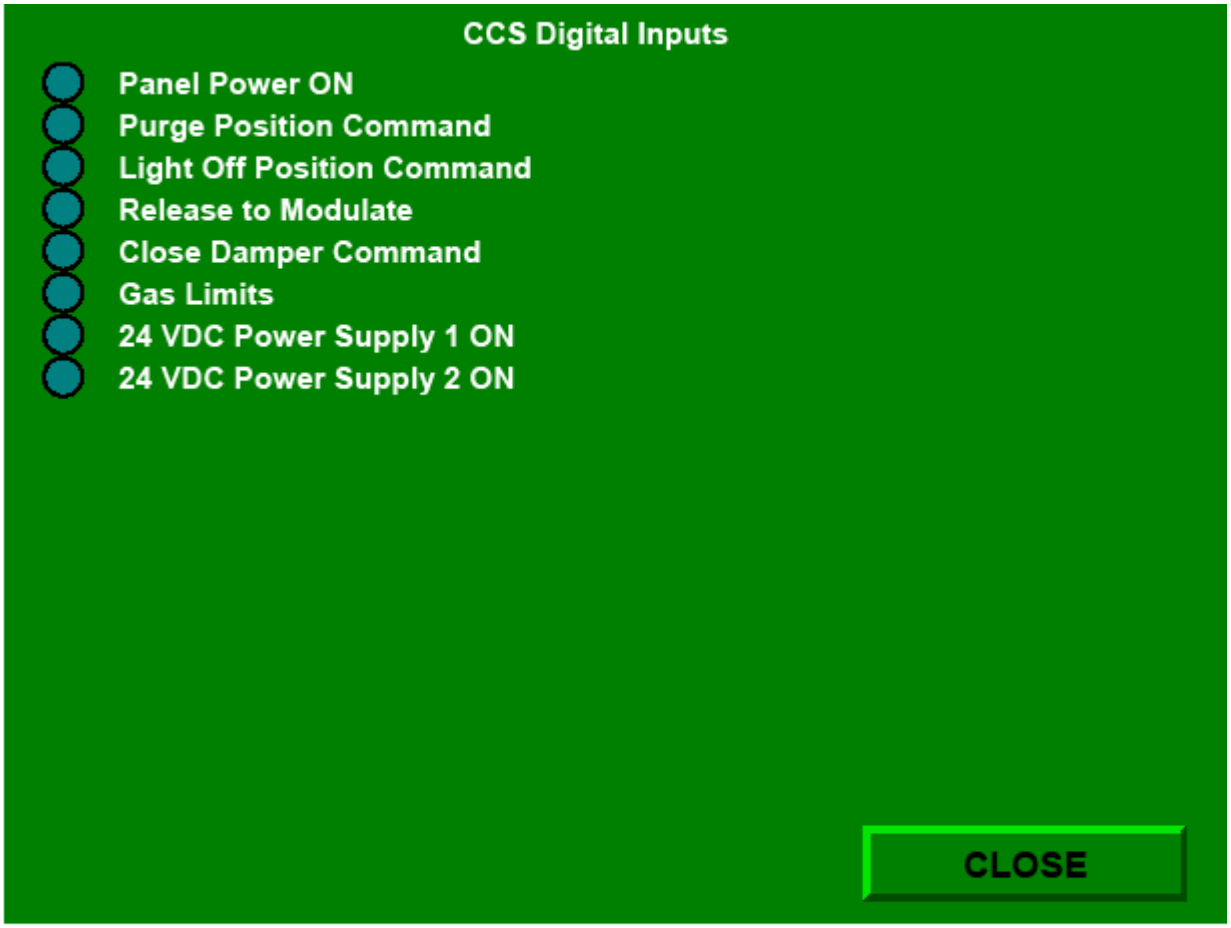
This screen displays only the state of the BMS digital inputs

Digital BMS Output:



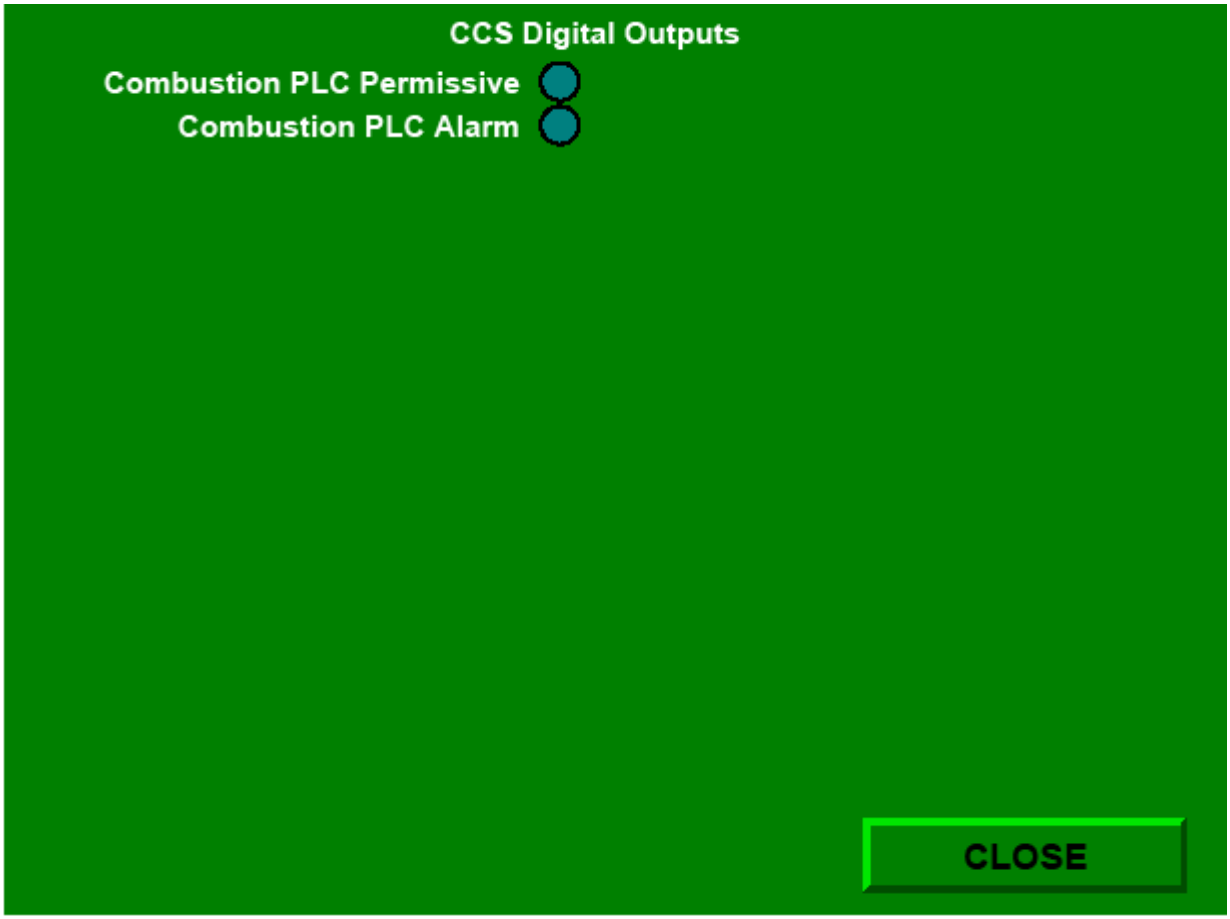
This screen displays only the state of the BMS digital outputs

Digital CCS Input:



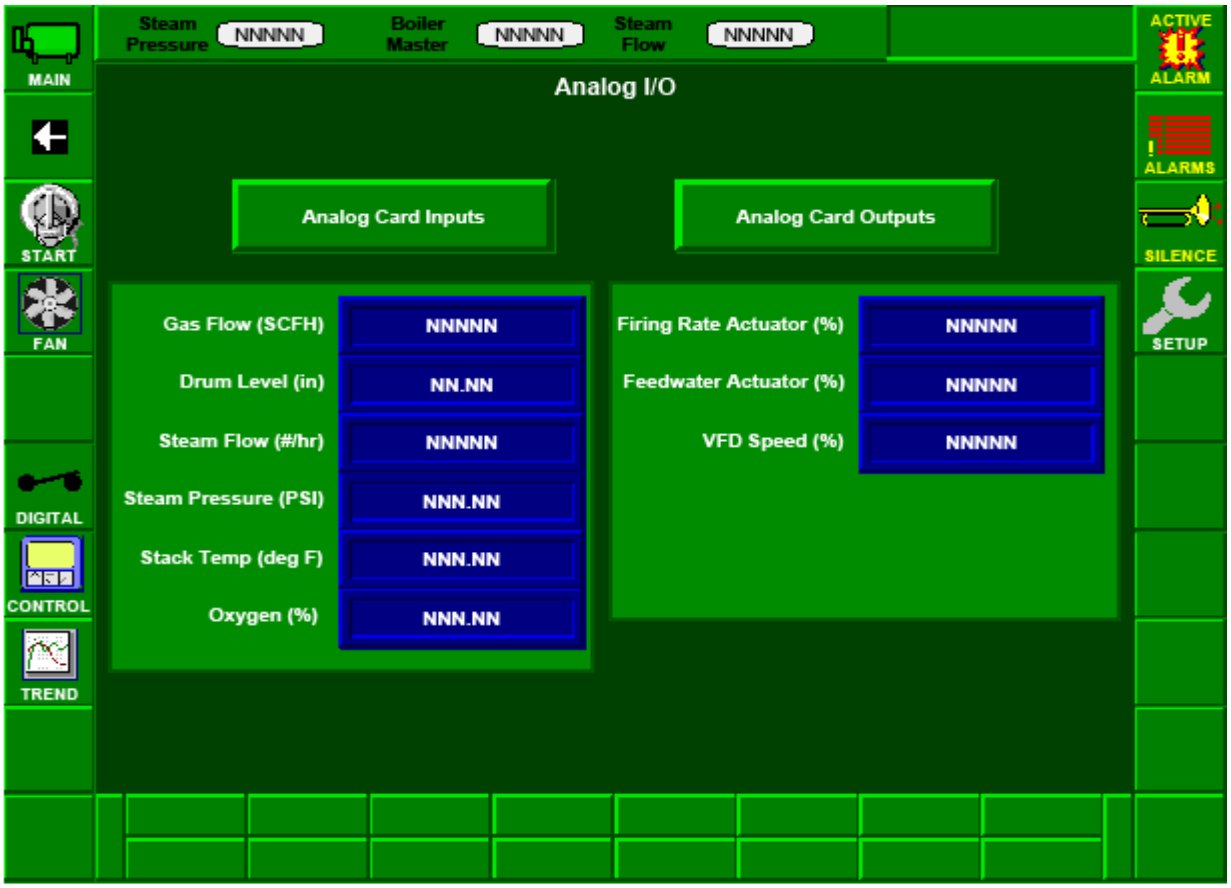
This screen displays only the state of the CCS digital inputs

Digital CCS Output:



This screen displays only the state of the CCS digital outputs

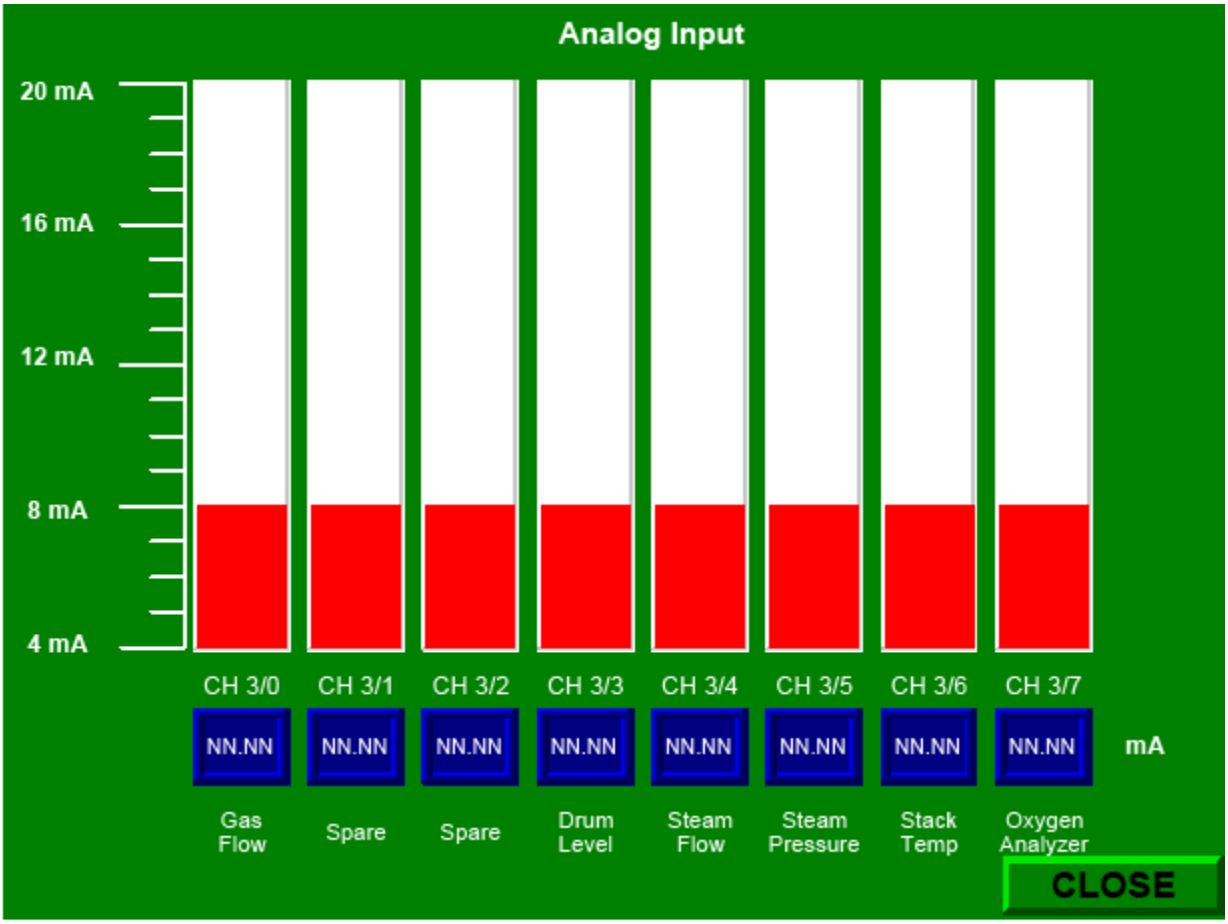
Analog I/O Numeric Data:



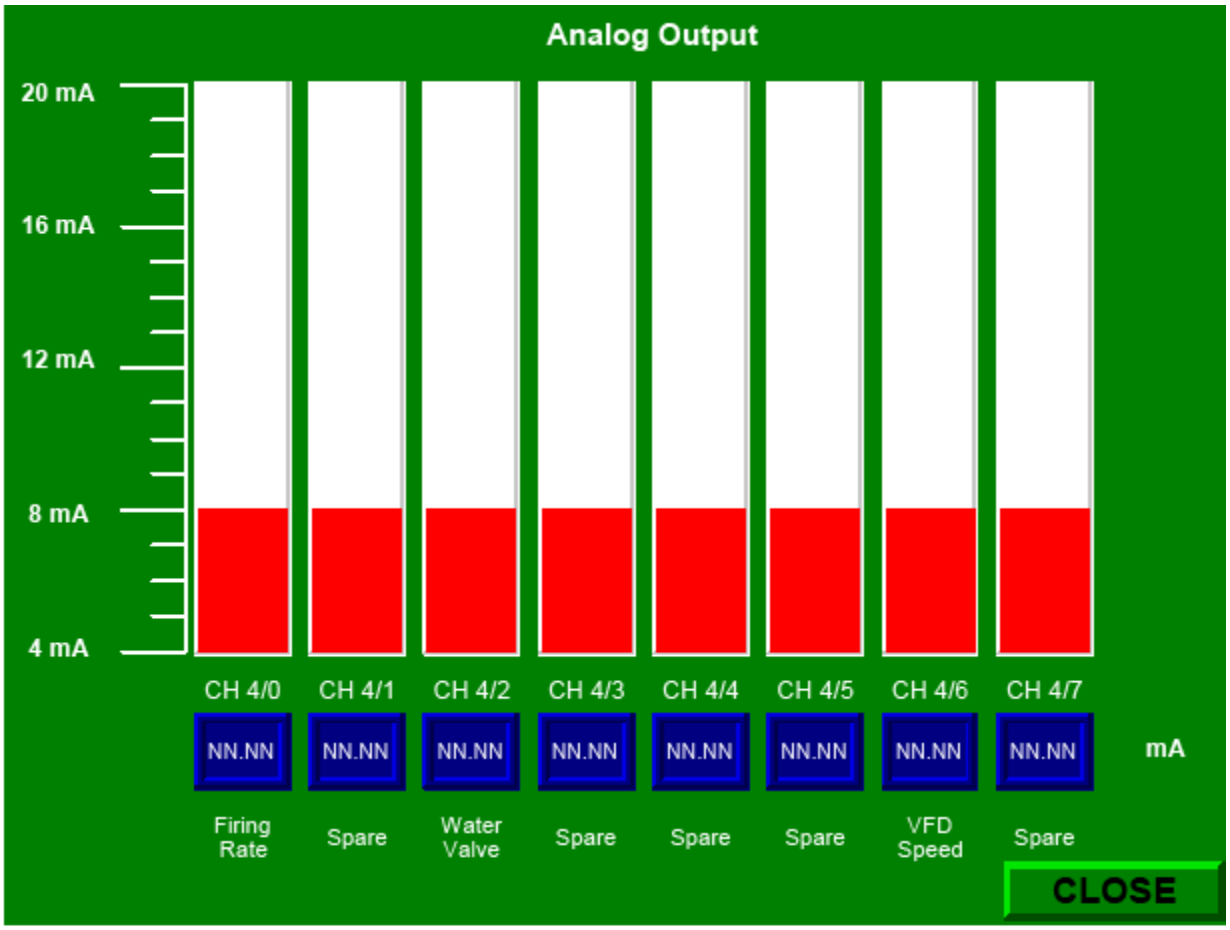
This screen displays the state of the CCS analog inputs and outputs in Engineering Units.

Selecting the “Analog Card Input” or “Analog Card Output” buttons will pop-up raw data display screens (Pages 38 and 39)

Analog Input Data:

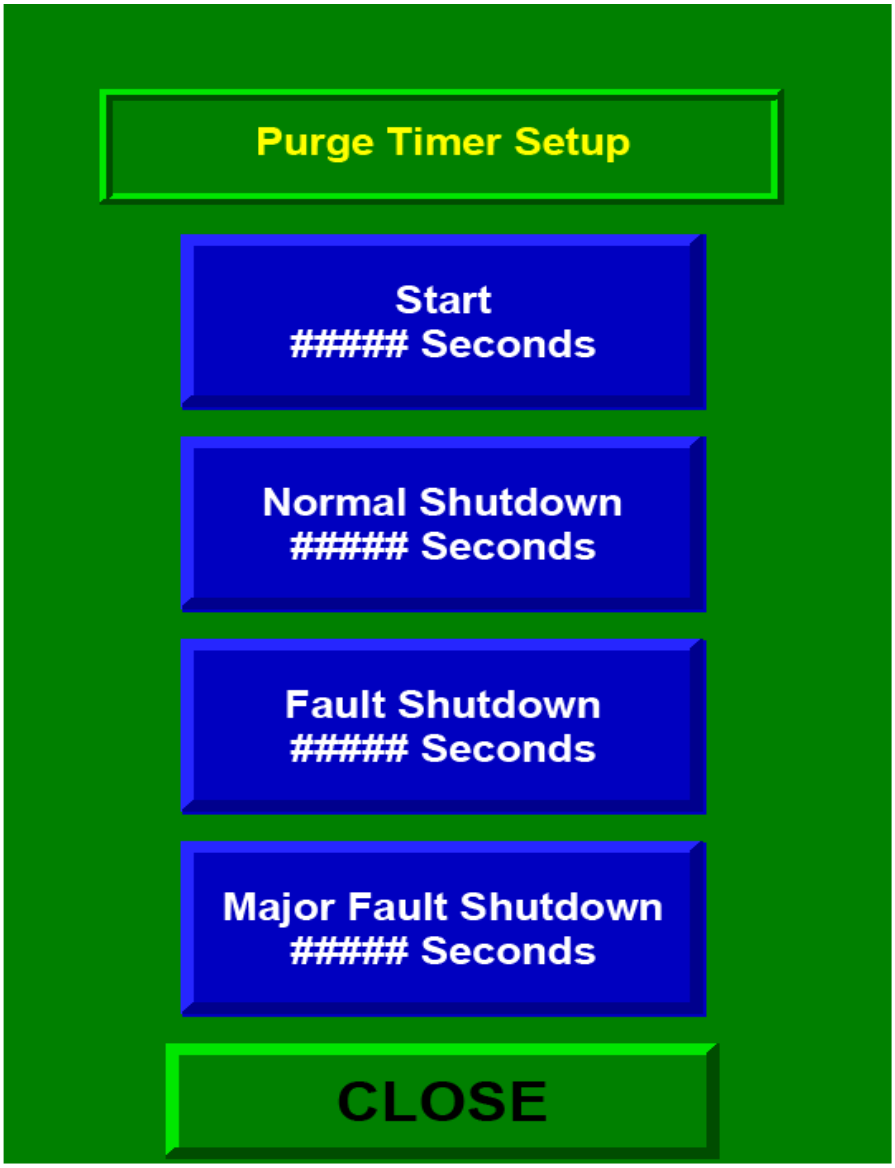


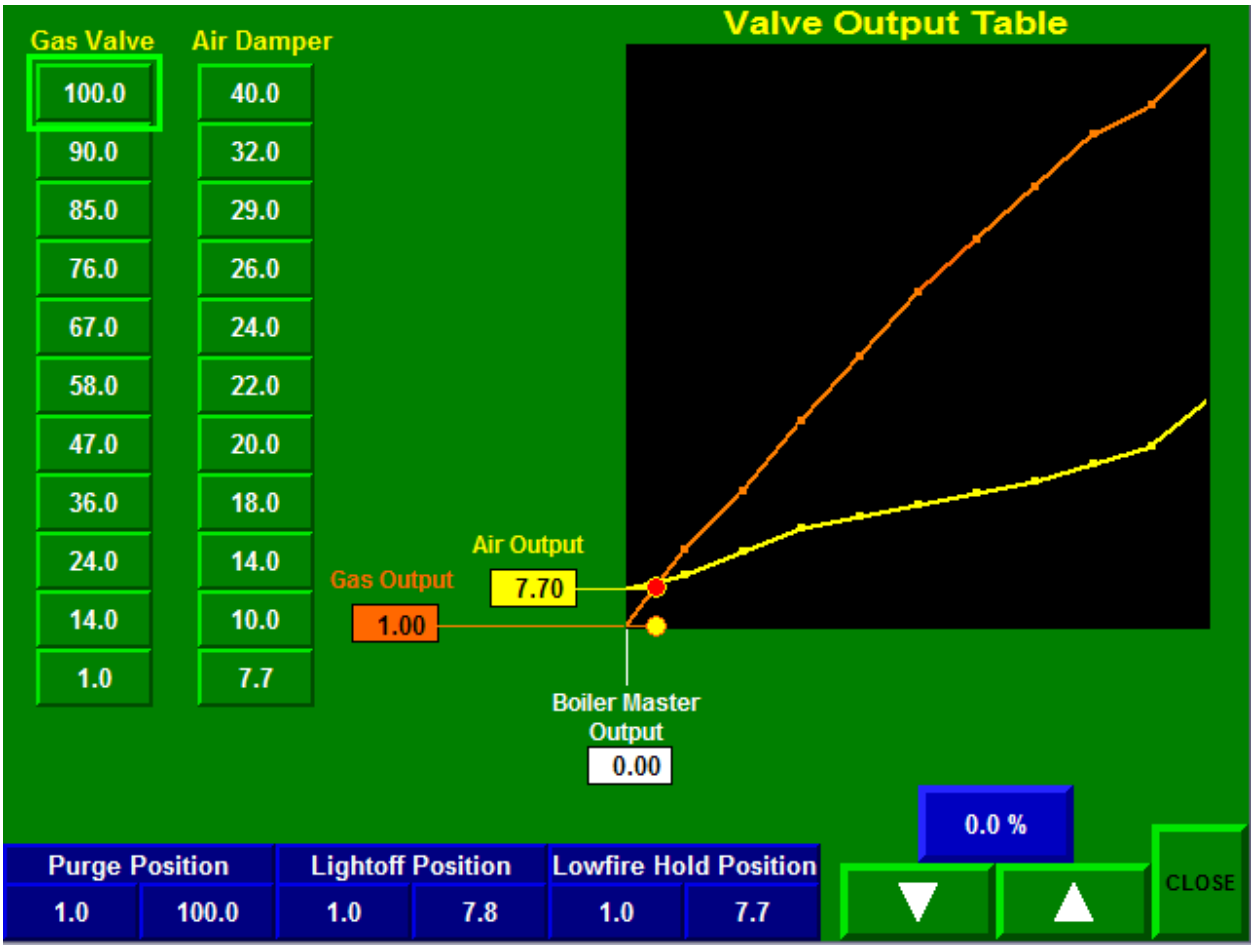
Analog Output Data:

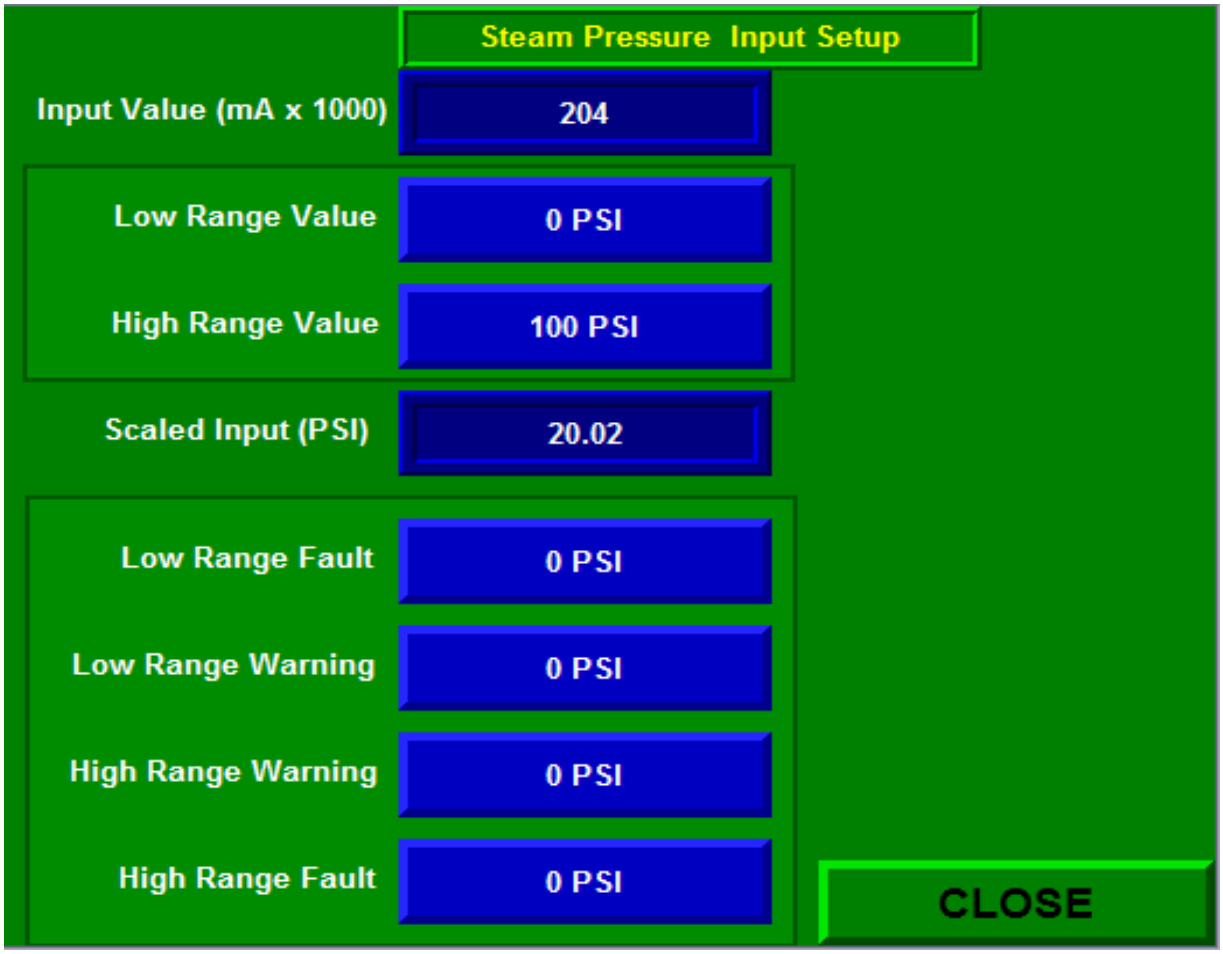


System Setup Screen:

Setup BMS Purge:




Valve Output Table
Gas Valve
Air Damper
100.0
40.0
90.0
32.0
85.0
29.0
76.0
26.0
67.0
24.0
58.0
22.0
47.0
20.0
36.0
18.0
24.0
14.0
14.0
10.0
1.0
7.7
Air Output
7.70
Gas Output
1.00
Boiler Master Output
0.00
0.0 %
CLOSE
Purge Position
1.0
100.0
Lightoff Position
1.0
7.8
Lowfire Hold Position
1.0
7.7


Steam Pressure Input Setup
Input Value (mA x 1000)
204
Low Range Value
0 PSI
High Range Value
100 PSI
Scaled Input (PSI)
20.02
Low Range Fault
0 PSI
Low Range Warning
0 PSI
High Range Warning
0 PSI
High Range Fault
0 PSI
CLOSE

Alarm History:

Troubleshooting

This section is to be reviewed when troubleshooting "Alarms" or "System Malfunctions".

The following notes contain important information regarding system limitations, features and specifications which may assist the user/installer while System Troubleshooting. **All Testing/Troubleshooting must be performed by qualified personnel, properly trained per the "Jurisdiction Having Authority"**.

- All fuse holders provided have "built-in" fuse-blown indicators. An LED on the fuse holder will illuminate when power is supplied but the fuse is blown or has been removed. The indicator only works when there is a load connected to the fuse holder.
- Terminals may utilize "link type" jumpers. These jumpers are used to reduce wiring and unnecessary clutter within the control panel. However they may not be readily visible, and may or may not be insulated, use Caution.
- Modifications to the factory shipped panel may be required to support user requirements and/or optional trim levels. Jumpers may need to be removed or added as required to achieve desired functionality. I.E. if using a "Remote E-Stop" pushbutton, the jumper between terminals 23 and 24 would need to be removed before the "Remote E-Stop" pushbutton to become functional. Review all wiring and installation notes.
- Special high density terminals (4 Deck) are used for analog signal wiring. These terminals are equipped with removable fuse holders mounted on top. For fuse replacement, the plug-in fuse holder must be removed from the terminal block. This is done by grasping the fuse holder and pulling straight out. The fuse can now be accessed by lifting open the side of the holder; a small flat blade screwdriver may be required as the indentation for prying open the door is relatively small. Once the side door is open the fuse can be accessed. **The fuse holder is keyed to prevent installing the holder in the wrong direction, note the raised groove along one side of the holder.**

Alarm and Event Summaries

This section gives a description of the cause and typical resolution of every alarm that can appear on the HMI.

All alarms must be tested during commissioning to ensure that the alarm is generated properly and the system responds properly. For testing procedures, refer to the following documents:

- BMS Fault Checkout.xls
- CCS Fault Checkout.xls

NOTE: Alarms are divided into two types: faults and warnings. Faults typically cause one or more system components to shut down. Warnings do not shut equipment down, but notify the operator of conditions that may eventually result in a fault.

NOTE: All alarms in the system are "latching." This means that the alarm will stay active until the alarm conditions are no longer true **and** the operator resets it via the pushbuttons on the HMI.
NOTE: The physical condition (the "CAUSE") must be rectified before the alarm may be reset from the HMI.
NOTE: Refer to the appropriate documentation when troubleshooting system components for more detailed information. The following is a guide to help assist in system troubleshooting; however this is not meant to replace specific and detailed information as supplied by individual equipment manufacturers.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
Control panel (120VAC) power is off (verify "mains power on" pilot light is off)	Fault	This fault will not be displayed on the HMI because the there will be no power to operate the display.	1. Check 120VAC, 15 amp circuit breaker, CB1. Verify breaker has not been turned off or has tripped. 2. Check for incoming power to CB1 for voltage. Check breaker panel or external 120VAC power source if no voltage is present.
Output power off	Fault	E-stop pressed Loss of power to CR1	1. Check "e-stop" pushbutton(s) are not pushed-in. Reset "e-stop" by pulling out pushbutton and pressing "output power on" pushbutton. 2. Fuse blown, check blown fuse indicators. Replace "blown" fuses as necessary. 3. Inspect relay CR1 for damage, make sure relay is securely seated in its socket and all attached wiring connections are tight.
Output power off	Fault	E-stop pressed Loss of power to CR1	1. Check "e-stop" pushbutton(s) are not pushed-in. Reset "e-stop" by pulling out pushbutton and pressing "output power on" pushbutton. 2. Fuse blown, check blown fuse indicators. Replace "blown" fuses as necessary. 3. Inspect relay CR1 for damage, make sure relay is securely seated in its socket and all attached wiring connections are tight.
FD fan fault	Fault	Loss of fan running signal	1. Check that fan is running. 2. Check wiring.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
Main gas low pressure	Fault	Low gas pressure switch is not made	Check the low gas pressure switch settings and verify gas pressure is within normal limits.
Main gas high pressure	Fault	High gas pressure switch is not made	Check the low high pressure switch settings and verify gas pressure is within normal limits.
Flame detected	Fault	Flame detected when no flame is expected	1. Check that flame is not present, check pilot valves, safety shutoff valves and correct any errors. Hot refractory can be another source of Ultra Violet radiation. 2. Check wiring and correct any errors. Make sure flame sensor wires are in a separate conduit and not run with 120VAC or ignition wiring. 3. Check flame detector. If applicable check detector status lights, displays etc. 4. If problem persist, replace flame detector.
Flame failure	Fault	Flame not detected when flame is expected	1. Check that flame is present, correct any errors. Verify flame signal strength at HMI if applicable. 2. Check wiring and correct any errors. Make sure flame sensor wires are in a separate conduit and not run with 120VAC or ignition wiring. 3. Check flame detector. If applicable check detector status lights, displays etc. 4. If problem persist, replace flame detector.
FD damper not at purge position fault	Fault	Damper is commanded to purge position, but actuator feedback signal is lost or indicates actuator not in position Note: Actuator setup and feedback parameters can be viewed/modified at the HMI with proper password/login	1. Check the FD damper actuator, if actuator is not in the correct position, check damper operation for “binding”. Correct any errors. 2. Verify actuator operation with linkages removed. HMI screen allows the actuator to be driven manually for testing and calibration. 3. If the actuator is working, the

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			feedback signal may need to be calibrated. Refer to the “start-up and commissioning” section, for information on how to calibrate actuators with feedback.
Gas valve not at light-off position fault	Fault	Valve is commanded to light-off position, but actuator feedback signal is lost or indicates actuator not in position Note: Actuator setup and feedback parameters can be viewed/modified at the HMI with proper password/login	1. Check the gas valve actuator, if actuator is not in the correct position, check valve operation for “binding”. Correct any errors. 2. Verify actuator operation with linkages removed. HMI screen allows the actuator to be driven manually for testing and calibration. 3. If the actuator is working, the feedback signal may need to be calibrated. Refer to the “start-up and commissioning” section, for information on how to calibrate actuators with feedback.
Minimum combustion air flow not proven	Fault	Combustion air flow (pressure) switch is not made	1. Check the combustion air flow switch settings and verify air flow is within normal limits. Check damper positions, grills and filters if applicable. 3. Check impulse tubing for damage or leaking fittings. Check that tubing is free of condensate liquid. Preferred method is to slope impulse tubing away from sensors and switches to prevent possible condensate contamination. 3. Check switch location and mounting. Mounting should be made on a solid surface free from vibration. Review device mounting orientation, some diaphragm type switches require vertical mounting.
Low water cut-off	Fault	Low water cut-off switch is not made	1. Check water level. 2. Check switch wiring. If using resistive probe type controls, make sure the probes have been correctly wired. Make sure there is a ground reference. Many

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			installations require high temp. wire at the probe or switch due to higher than ambient temperatures in these locations.
Auxiliary low water cut-off	Fault	Aux. low water cut-off switch is not made	1. Check water level. 2. Check switch wiring. If using a float type of switch there may be several sets of available contacts. Refer to the switch supplier documents for the correct termination points. Many installations require high temp. wire at the probe or switch due to higher than ambient temperatures in these locations. 3. Check switch operation, mechanical float switches can become "stuck" by debris or sludge build up.
High steam pressure	Fault	High steam pressure switch is not made	1. Electrical signal is not being received back from the switch. Check the pressure switch settings and verify steam pressure is within normal limits. Note: There should not be any isolation valves installed between this switch and the steam source as required by code. 2. Check switch wiring. Switch may have several sets of available contacts. Refer to the switch supplier documents for the correct termination points. 3. Check switch operation, mechanical switches can become "stuck" by debris or sludge build up.
Excessive high steam pressure	Fault	Excessive high steam pressure switch is not made	1. Electrical signal is not being received back from the switch. Check the pressure switch settings and verify steam pressure is within normal limits. Note: There should not be any isolation valves installed between this switch and the steam source as required by code.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			2. Check switch wiring. Switch may have several sets of available contacts. Refer to the switch supplier documents for the correct termination points. 3. Check switch operation, mechanical switches can become "stuck" by debris or sludge build up.
Low oxygen level **(Note: Aux. fuel trip device input terminals 44 and 45 can be used to monitor this or any dry contact. Contact must remain closed under normal operating conditions, refer to specifications for further information)**	Fault	Flue gas oxygen level transmitter sensing low oxygen condition **(Hardwired Alarm)**	1. **Optional oxygen level low alarm contact active**. Electrical signal is not being received back from the oxygen sensor alarm contact. Check oxygen level reading at the HMI. Compare oxygen level with configured alarm set point at oxygen transmitter. 2. Check transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Check oxygen transmitter/alarm contact wiring. Alarm contact must wired "fail safe". That is the contact must be closed and returning the 120VAC signal back to the panel when the oxygen level is above the alarm set point level (no alarm). 4. Refer to the transmitter supplier documents for information on how to calibrate/setup transmitters.
Low oxygen level (analog)	Fault	Flue gas oxygen level transmitter sensing low oxygen condition **(Analog Alarm)** Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Check oxygen level at the HMI. Compare oxygen level reading with user configured alarm set point parameters at HMI. 2. Check transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Check oxygen transmitter wiring.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			4. Possible calibration/setup may be required of the transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.
High oxygen level (analog)	Warning	Flue gas oxygen level higher than normal operating range condition **(Analog Alarm)** Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Check oxygen level at the HMI. Compare oxygen level reading with user configured alarm set point parameters at HMI. 2. Check transmitter, if applicable check transmitter status lights, displays etc. 3. Higher than anticipated oxygen levels may indicate that excess air is being supplied or that air is leaking into the combustion process. Check fans, dampers, linkages, hatches, inspection covers, viewing ports, broken seals etc. Anyplace that may be allowing too much air to enter the system. 4. Possible calibration/setup may be required of the transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.
Oxygen transmitter signal out of range	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			transmitters. 4. Possible calibration/setup may be required of the transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.
Low water level warning	Alarm	Water level is lower than normal operating range Note: Tank scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned set points, scaling factors and the analog signal received from the level transmitter. Verify water level and scaling/alarm settings. 2. Verify level transmitter, if applicable check transmitter status lights, displays etc. Check for "blown fuse" indicators. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the level transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup level transmitter.
High water level warning	Alarm	Water level is higher than normal operating range Note: Tank scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned set points, scaling factors and the analog signal received from the drum level transmitter. Verify water level and scaling/alarm settings. 2. Verify level transmitter, if applicable check transmitter status lights, displays etc. 3. Possible calibration/setup may be required of the level transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup level transmitter.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
Gas flow signal out of range	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace “blown” fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the transmitter. Refer to the “start-up and commissioning” section, for information on how to calibrate/setup transmitters.
Water level signal out of range	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace “blown” fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the transmitter. Refer to the “start-up and commissioning” section, for

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			information on how to calibrate/setup transmitters.
Steam flow signal out of range	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the transmitter. Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.
Steam pressure signal out of range Or Steam demand signal out of range Note: Actual fault displayed will depend on the user selected method of control.	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the transmitter.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.
Steam pressure low Note: This fault will be enabled if the user has selected "header pressure" as the control parameter.	Warning	Analog input signal is out of normal operating range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. 2. Verify actual steam pressure, check user configured parameters, scaling and alarm settings.
Steam pressure high Note: This fault will be enabled if the user has selected "header pressure" as the control parameter.	Warning	Analog input signal is out of normal operating range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. 2. Verify actual steam pressure, check user configured parameters, scaling and alarm settings.
Flue exhaust stack temp. signal out of range	Warning	Analog input signal is out of range Note: Scaling and alarm parameters can be viewed/modified at the HMI with proper password/login	1. Warning is generated based upon a comparison of user assigned parameter settings, set points, scaling factors and the analog signal received from the transmitter. Verify parameters, scaling and alarm settings. 2. Verify transmitter, if applicable check transmitter status lights, displays etc. Check blown fuse indicators. Replace "blown" fuses as necessary. 3. Verify conduit/wiring, low voltage DC wiring should be run separately from high voltage AC wiring. Shielded cable wire is recommended for analog transmitters. 4. Possible calibration/setup may be required of the transmitter.

Alarm Code	Severity	Possible Causes	Recommended Troubleshooting
			Refer to the "start-up and commissioning" section, for information on how to calibrate/setup transmitters.

Electrical Requirements:

- Incoming Panel Supply Power: 120Vac, 15 Amp, with external *branch circuit* over current protection. The ***CombustionPac™ control*** panel is provided with an internal 15 Amp *supplemental* circuit breaker (CB1).

Ordering Information

For systems, parts or service contact your local Lipten sales representative or Lipten Company directly at:

Lipten Company
28054 Center Oaks Ct.
Wixom, MI. 48331
1-800-860-0790 or 248-734-8910
248-734-8906 fax
www.lipten.com

For a list of local sales representatives visit www.lipten.com