# SCC Inc.
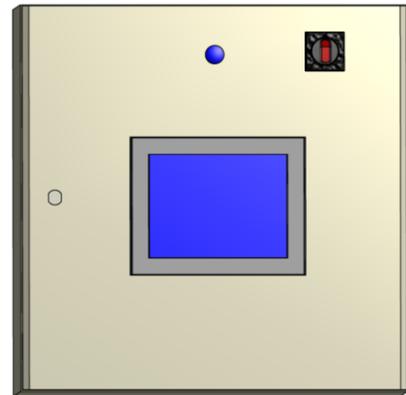
# TS Series

## TS-MS… Master Panels for Boiler Management, Lead/Lag, and Building Management System Interface

## Description

A TS-MS… Series Master Lead/Lag Panel sequences and controls up to eight boilers equipped with TS… communication kits (see Document No. TS-1000 or TS-1050) or TS… complete combustion control enclosures (see Document No. TS-4000).

A master panel controls hot water or steam boilers with Siemens LMV series linkageless control systems.  Each panel includes a 7.5", 10" or 12" touchscreen with a programmable logic controller.

Flexible communication interface options to the building management system (BMS) provide streamlined data collection, monitoring and controls.  Additional options include pump controls and programmable analog and digital outputs.

# Table of Contents

# Table of Contents (continued)

# Compatible Controls and Accessories

Controls

- LMV5... with internal load controller
- LMV5... with RWF40 or RWF55 external load controller
- LMV3... with RWF10, RWF40 or RWF55 external load controller

Accessories

- Feedwater control via RWF40 or RWF55 (steam boilers only)
- Connection to SCC-supplied variable speed drives (combustion air fan)
- SCC Inc. Expanded Annunciation system

## Physical Connections

The Lead/Lag Master connects to individual Touchscreen Kits via Ethernet.

The Lead/Lag Master can also communicate with the connected equipment directly via Modbus.  Connect any RS-485 devices in a daisy-chain with termination at the end of the chain (typically a 120-Ohm resistor).  The following addresses are required for the connected equipment:

**Table 1:  Required Addressing of Controllers (x = Boiler Number)**

| Device | Required Address | Communication Type |
|---|---|---|
| LMV3x (via OCI412.10) | x1 | Modbus RTU (RS-485) |
| LMV5x | x1 | Modbus RTU (RS-232) |
| RWF10 (for load control) | x2 | Modbus RTU (RS-485) |
| RWF40 (for load control) | x2 | Modbus RTU (RS-485) |
| RWF55 (for load control) | x2 | Modbus RTU (RS-485) |
| RWF40 (for feedwater) | x3 | Modbus RTU (RS-485) |
| RWF55 (for feedwater) | x3 | Modbus RTU (RS-485) |

For example, boiler 1 LMV would be address 11 and boiler 4 feedwater would be address 43.

Communication via Modbus must be set with the following values:
- 19200 baud
- 8 stop bits
- 1 data bit
- no parity

See the appendices for Modbus configuration details for each device.

# Logging In

When the Lead/Lag Master is powered up, the OVERVIEW screen will appear.
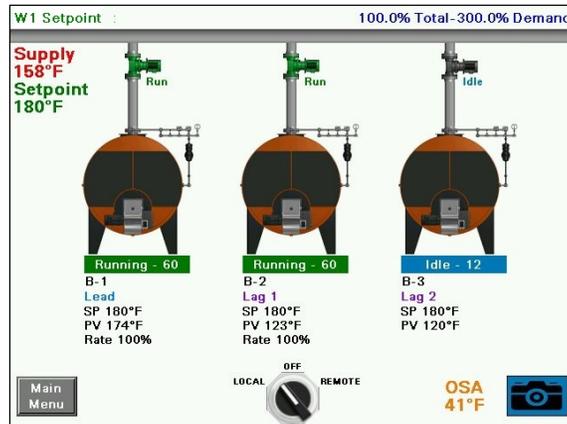


Press **MAIN MENU** in the lower left corner to go to the MAIN MENU screen.



From here, different screens can be accessed depending on the access level.  There are three
access levels available:
- USER:  Allows access to viewing data, changing setpoints, and manual operation.  No
  username or password required.
- TECH:  Same access as USER level as well as access to changing operational parameters.
  Username and password required.  The username is TECH.  The default password is
  9876.
- SETUP:  Same access as TECH level as well as access to programming touchscreen
  configuration settings.  Username and password required.  The username is SETUP.  The
  default password is START.

NOTE:  If the ACTIVATION screen appears instead of the OVERVIEW screen, see the *Activation*
section for additional detail.

## Logging In (continued)

In order to log in at the desired access level, press **LOG IN**.  The LOGIN screen will appear.
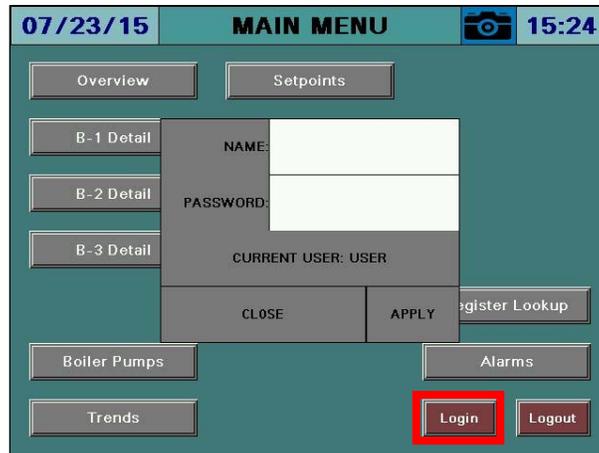


Tap the area next to NAME and a keypad will appear.



Use the keypad to enter the username for the desired access level.  When finished, press **ENTER**.

Next, tap the area next to PASSWORD and the same keypad will appear again.  Enter the password and then press **ENTER**.

When both the username and password have been entered, press **APPLY**.  If successful, the CURRENT USER will change from USER to TECH or SETUP depending on the username and password that were entered.  Hit **CLOSE** to leave the login screen.

## System Setup

Access level:  **SETUP**

The Lead/Lag Master needs to be configured for the connected equipment.  Press **SYSTEM SETUP** to display the SYSTEM SETUP screen.

**HYDRONIC**                                                           **STEAM**
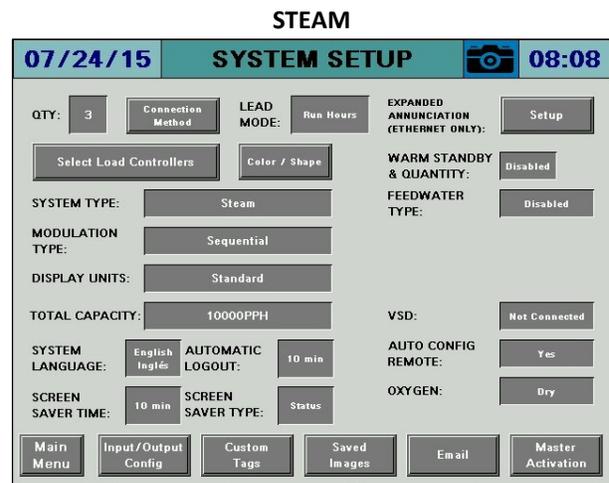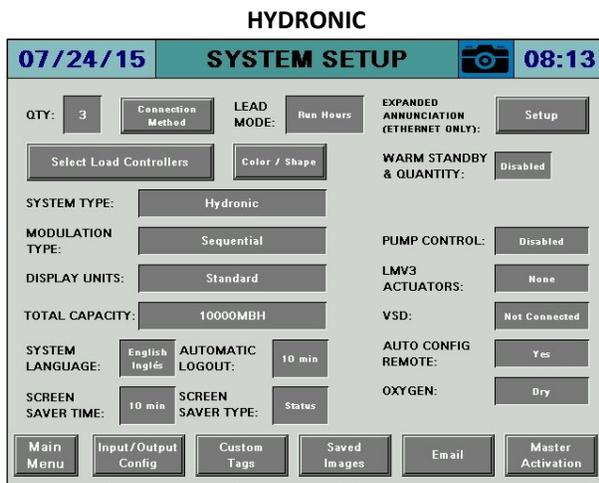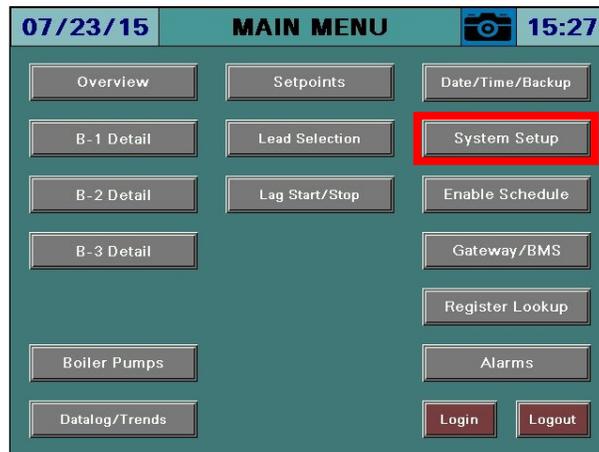
**QTY –** Sets the total number of boilers connected to the system (1 to 8).

# System Setup (continued)

**CONNECTION METHOD –** Displays a window used to select the connection method of each boiler.
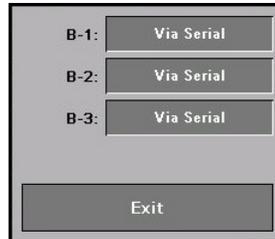


- **Via Serial:** Select this option if the boiler is connected using serial communication.
- **Via Serial/Ethernet:** Select this option if the boiler is connected using serial communication through an Ethernet adapter.
- **Via Ethernet:** Select this option if the boiler has a Touchscreen Kit.

**LEAD MODE –** Selects the desired lead rotation method.
- **Run Hours** - Choose this option to alternate the lead boiler by elapsed run hours as counted by the Lead/Lag Master.
- **By LMV Startups** - Choose this option to alternate the lead boiler to obtain even LMV accumulated startup cycles. This is the best option when there is greater than one startup per hour and the desired outcome is to balance the LMV run time.
- **By LMV Hours** - Choose this option to alternate the lead boiler to obtain even LMV accumulated run hours. This is the best option when there is fewer than one startup per hour and the desired outcome is to balance the LMV run time.
- **Force Lead** - Choose this option to disable alternation.

# System Setup (continued)

**SELECT LOAD CONTROLLERS –** Displays a window used to select which Siemens controller(s) are connected to the Lead/Lag Master.

| | |
|---|---|
| B-1: | LMV5x Only |
| B-2: | LMV5x Only |
| B-3: | LMV5x Only |
| | Exit |

- **LMV5x Only:**  Select this option when using an LMV5x and its internal load controller.
- **LMV5x/RWF40:**  Select this option when using an LMV5x with an RWF40 as an external load controller.
- **LMV5x/RWF55:**  Select this option when using an LMV5x with an RWF55 as an external load controller.
- **LMV3x Only:**  Select this option when using an LMV3x with no load controller.
- **LMV3x/RWF10:**  Select this option when using an LMV3x with an RWF10 as an external load controller.
- **LMV3x/RWF40:**  Select this option when using an LMV3x with an RWF40 as an external load controller.
- **LMV3x/RWF55:**  Select this option when using an LMV3x with an RWF55 as an external load controller.

**COLOR/SHAPE –** Displays a window used to select the graphical image for each boiler.
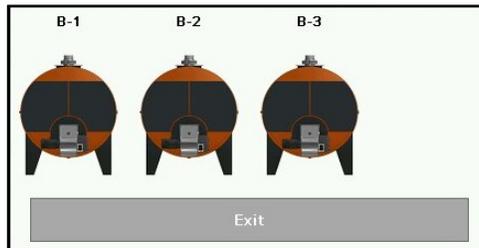
**SYSTEM TYPE –** Selects the type of system that the Lead/Lag Master is controlling.
- **Steam**
- **Hydronic**

**MODULATION TYPE –** Selects the type of modulation that the Lead/Lag Master will use.
- **Parallel:** The firing rates of the boilers are based upon one central load demand and each running boiler will fire to that load demand.  See **Appendix - Parallel Modulation** for specific detail and examples.
- **Sequential:** The firing rates of each boiler are based upon one central load demand and each new running boiler will begin modulating when the previous boiler has reached the base firing rate.  See **Appendix - Sequential Modulation** for specific detail and examples.

# System Setup (continued)

**DISPLAY UNITS –** Selects the type of units that the Lead/Lag Master will use.
- **Metric**
- **Standard**

**TOTAL CAPACITY –** Sets the total MBH or PPH of the system.  If a value is entered, a scaled estimate of the current output will be displayed based upon the load demand.

**MASTER LANGUAGE –** Selects the display language that the Lead/Lag Master will use.
- **English**
- **Spanish**

**SCREEN SAVER –** Select between off (no screen saver), 1m, 2m, 5m, 10m, 30m or 60m.

**SAVER TYPE –** Select the screen saver type.
- **Status:** Shows the process variable, setpoint and current status in a large font.



- **Blank:** Screen saver is a blank screen.

**AUTO LOG OUT –** Sets how long a user remains logged in.  Select between 5m, 10m, 30m, 60m or 120m.

# System Setup (continued)

**EXPANDED ANNUNCIATOR SETUP –** Displays a window used to enable the Expanded Annunciator and options in connected Touchscreen Kits.



- **EXPANDED ANNUNCIATOR:** Select whether the Expanded Annunciator option is present.
- **RTD CARD –** Select whether the RTD input option is enabled in the Expanded Annunciator (only shows up when EA optioned, requires RTD input option).
  - **Disabled**
  - **Enabled**
- **ANALOG CARD –** Select whether the analog input option is enabled in the Expanded Annunciator (only shows up when EA optioned, requires RTD input option).
  - **Disabled**
  - **Enabled**
- **ECONOMIZER –** Select whether the economizer option is enabled in the Expanded Annunciator (only shows up when EA optioned, requires RTD input option or economizer RTD input option).
  - **Disabled**
  - **Enabled:** Uses economizer RTD input option for Pt100/Pt1000 temperature sensors. The LMV5x stack temperature sensor may be used for one of the inputs.
  - **Use RTD:** Same as above, but uses the regular RTD input option for the economizer. Setting this option will automatically set the **RTD CARD** option to **Enabled**.
- **DRAFT CONTROL –** Select whether the draft control option is enabled in the Expanded Annunciator (only shows up when EA optioned, requires analog input option and RTD input option).
  - **Disabled**
  - **Enabled:** Uses three EA digital inputs for status, one RTD input for resistance feedback and one analog input for the draft sensor.  Setting this option will automatically set the **ANALOG CARD** and **RTD CARD** options to **Enabled**.
- **EXTRA RWF –** Select whether additional RWF55 controls are connected serially via RS-485 to the Expanded Annunciator (only shows up when EA optioned, standard EA feature).
  - **None**
  - **1x RWF55:** Use Modbus address 1, 19200 baud, 8 stop bits, 1 data bit, no parity.
  - **2x RWF55:** Use Modbus addresses 1 & 2, 19200 baud, 8 stop bits, 1 data bit, no parity.

# System Setup (continued)

**FEEDWATER –** Choose whether a feedwater system is installed with a Siemens controller (only shows up for steam boilers).
- **Disabled**
- **RWF40:**  Select this option if the feedwater is being controlled by an RWF40.
- **RWF55:**  Select this option if the feedwater is being controlled by an RWF55.

**PUMP CONTROL –** Select whether the boiler circulating pump is controlled by the EA (only shows up for hydronic boilers with EA optioned).
- **Disabled**
- **Enabled:**  The pump will be commanded on when the boiler is commanded on.  The pump will remain on after the boiler command is removed for the duration of the off delay period.
- **Lead Run Continuous:**  The pump will be commanded on as long as the HAND-OFF-AUTO switch is not in OFF on the REMOTE OPERATION screen.
- **Locally:**  Select this option to command the pump from the Expanded Annunciator.

**LMV3 ACTUATORS –** Select the actuators being used on an LMV3x controller (only shows when LMV3 selected).
- **None**
- **Air Only:**  Choose this option when only an air actuator is being used.
- **Fuel Only:**  Choose this option when only a fuel actuator is being used.
- **Air & Fuel:**  Choose this option when both air and fuel actuators are being used.

**VSD –** Select whether an SCC-supplied VSD system is installed on the combustion air fan.
- **Disabled**
- **Yaskawa:**  Select this option if the SCC-supplied VSD system is manufactured by Yaskawa.

**AUTO CONFIG REMOTE –** Select whether configuration parameters are pushed to connected Touchscreen Kits.
- **Yes:** Configuration at the Touchscreen Kits is locked out (use when universal configuration is present).
- **No:** Configuration must take place at the Touchscreen Kits individually (use when different configurations are desired by boiler).

**$O_2$ –** Select whether the $O_2$ and efficiency are calculated using the dry or wet method (only shows when LMV5 selected).
- **Dry:** The dry basis $O_2$ trim data (efficiency, $O_2$) is calculated from the wet basis $O_2$ trim data supplied by the LMV52.  $CO_2$ and excess air are also calculated.
- **Wet:** The wet basis $O_2$ trim data (efficiency, $O_2$) is supplied by the LMV52.

# System Setup (Input / Output Config)

Press **INPUT/OUTPUT CONFIG** to configure analog and digital inputs and outputs.

# System Setup (Input / Output Config continued)

Analog Input Configuration



**NAME –** Sets the user-configured name for each input.  The name may be up to 20 characters long.  Press **RESET TAG** to clear the name and reset input configuration (requires > 1s press).

Once a name is entered, the input is activated and the remaining configuration information will appear.

**UNIT –** Sets the user-configured unit tag.  The name may be up to 4 characters long.

**TYPE –** Select between 0-10V, 2-10V, 0-20mA or 4-20mA.

**FILTER –** Sets the filter time used to average the incoming signal.  This is useful when the signal is not steady (such as a draft sensor).

**MIN, MAX –** Sets the range of the input.

**TOTALS –** Sets the totalization for the input.
- **None**
- **Minute:**  Totalization is calculated by the minute (i.e. gallons per minute).
- **Hour:**  Totalization is calculated by the hour (i.e. gallons per hour).

# System Setup (Input / Output Config continued)

**LOW, HIGH –** Sets the alarm setpoints for the input.  When the input is below the low setpoint it generates a low alarm and when the input is above the high setpoint it generates a high alarm.

**ALARM –** Select the alarms generated by the input.  Manual reset alarms may be reset by pressing **ALARM RESET** on the ALARMS page.
- **None**
- **Low Only:**  Only an auto reset low alarm is generated.
- **LowMR:**  Only a manual reset low alarm is generated.
- **High Only:**  Only an auto reset high alarm is generated.
- **HighMR:**  Only a manual reset high alarm is generated.
- **Low High:**  Both an auto reset low alarm and auto reset high alarm are generated.
- **LowMR High:**  Both a manual reset low alarm and auto reset high alarm are generated.
- **Low HighMR:**  Both an auto reset low alarm and manual reset high alarm are generated.
- **LowMR HighMR:**  Both a manual reset low alarm and manual reset high alarm are generated.

## System Setup (Input / Output Config continued)

Monitored Outputs (Analog)

The monitored analog outputs can be configured to take an action based upon the value in any of the Modbus registers.
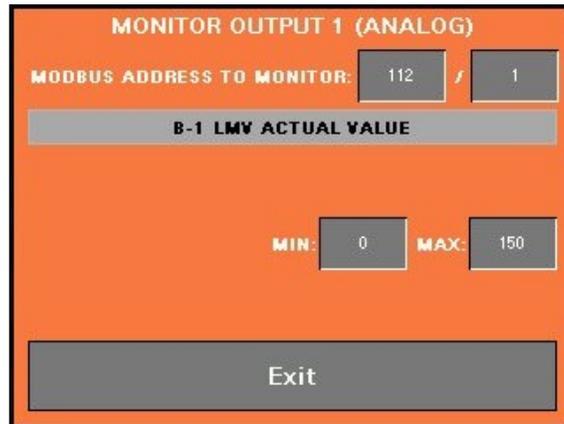


**MODBUS ADDRESS TO MONITOR –** Sets the Modbus register index to monitor and the divider to apply to it.  The name of the chosen address will then be displayed.

**MIN, MAX –** Sets the scale for the analog output.  If the actual value falls outside of the scaled range, the minimum or maximum value will be the output.  For example, if address 112, 'B-1 LMV ACTUAL VALUE' is being monitored with a range of 0-150 (psi) and the actual is 160PSI, the output would be 100%.  If it were 75PSI, the output would be 50%.

# System Setup (Input / Output Config continued)

RTD Input Configuration



**NAME –** Sets the user-configured name for each input.  The name may be up to 20 characters long.  Press **RESET TAG** to clear the name and reset input configuration (requires > 1s press).

Once a name is entered, the input is activated and the remaining configuration information will appear.

**TYPE –** Select between Pt1000 or Pt100.

**OFFSET –** Sets the offset in degrees applied to the input.  This may be used to compensate for errors introduced by long wire runs.

**LOW, HIGH, ALARM –** See the section *System Setup (Input / Output Config) → Analog Input Configuration* for additional detail.

# System Setup (Input / Output Config continued)

<u>Monitored Outputs (Digital)</u>

The monitored digital outputs can be configured to take an action based upon the value in any of the Modbus registers.  Each monitored digital output can consider two conditions using a logical function.  To enable or disable the second condition, touch the slider switch.



Each monitored digital output can consider two conditions using a logical function.

<u>Conditions</u>

**MODBUS ADDRESS TO MONITOR –** Sets the Modbus register index to monitor and the divider to apply to it.  The name of the chosen address will then be displayed.

**WHEN –** Select the logic applied to the value.  Can be <, <=, >, >=, = or a BIT comparison.

**SETPOINT –** Select the setpoint that the logic will be used to compare against.  For bit comparisons, setpoint must be the specific bit of the word (0-15) for the result to be accurate.

# System Setup (Input / Output Config continued)

Logic

**CONDITION –** Select whether the condition is normal or inverted.
- **CONDITION:**  Will apply the result of the condition.
- **INVERTED CONDITION:**  Will apply the opposite of the result of the condition.

**LOGIC –** Select the logic applied between the conditions.  See *Appendix - Logic Definitions* for additional detail.
- **AND:**  Will apply AND gate (and) logic.
- **OR:**  Will apply OR gate (or) logic.
- **NAND:**  Will apply NAND gate (negative and) logic.
- **NOR:**  Will apply NOR gate (negative or) logic.
- **XOR:**  Will apply XOR gate (exclusive or) logic.
- **XNOR:**  Will apply XNOR gate (negative exclusive or) logic.

**APPLY –** Select whether any delay is applied to the output.
- **NO DELAY:**  Will turn the output on or off immediately.
- **DELAY ON:**  Will turn the output on only after the specified delay.
- **DELAY OFF:**  Will turn the output off only after the specified delay.

**(DELAY TIME) OF –** Sets the delay setpoint in seconds.

**OPTIONS –** Select the additional output options.  Latched outputs may be reset by pressing **ALARM RESET** on the ALARMS page.
- **LATCH = NO, ALARM = NO:**  Will not latch the output or generate an alarm with the output.
- **LATCH = YES, ALARM = NO:**  Will latch the output but will not generate an alarm with the output.
- **LATCH = NO, ALARM = YES:**  Will not latch the output but will generate an alarm with the output.
- **LATCH = YES, ALARM = YES:**  Will latch the output and will generate an alarm with the output.

The current state of the logic is also displayed with true in green and false in red.

# System Setup (Input / Output Config continued)

<u>Assigning Inputs To System Variables</u>

Any of the analog inputs or RTD inputs can be assigned to the required system variables by assigning the proper name.  The list of names (case-sensitive) and permitted inputs are shown in **Table 1**.

Table 1:  System Variables

| Name | Description | Inputs Allowed |
|---|---|---|
| REMOTE SETPOINT REMOTE SP | Remote analog setpoint. | AI1-4 |
| HEADER | Steam system header pressure (process variable). | AI1-4 |
| LOOP SUPPLY | Hydronic system loop supply temperature (default process variable). | AI1-4, RTD1-4 |
| LOOP RETURN | Hydronic system loop return temperature. | AI1-4, RTD1-4 |
| LOOP RETURN PV | Hydronic system loop return temperature (use as process variable). | AI1-4, RTD1-4 |
| OUTSIDE AIR | Hydronic system outside air temperature, used for setpoint reset. | AI1-4, RTD1-4 |

# System Setup (Custom Tags)

Press **CUSTOM TAGS** to configure custom tags for the boilers and the fuels.
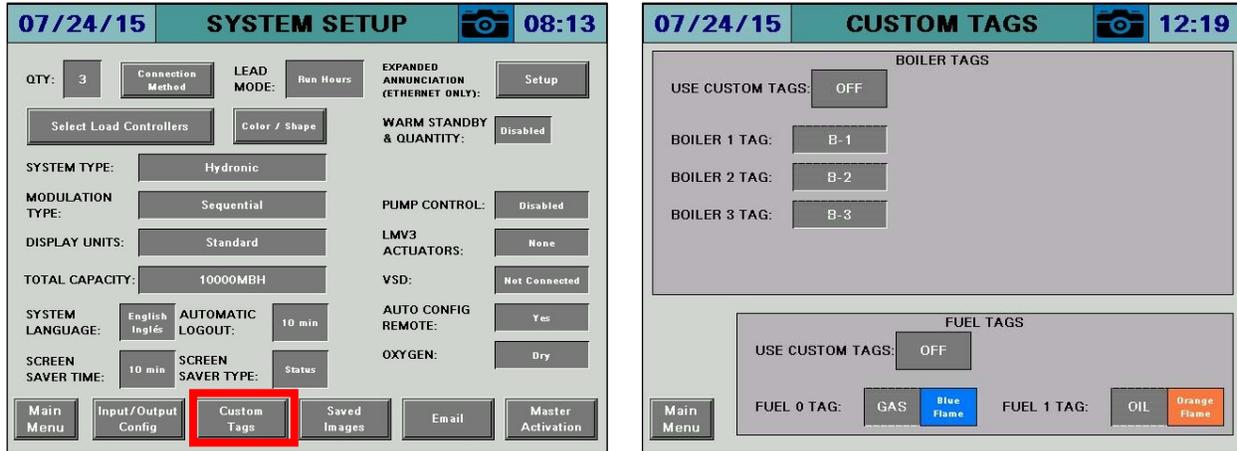


Boiler Tags

**USE CUSTOM TAGS –** Select whether to use custom or default tags.
**BOILER x TAG –** Sets the custom tag name for the boiler (up to six characters).

Fuel Tags

**USE CUSTOM TAGS –** Select whether to use custom or default tags.
**FUEL x TAG –** Sets the tag name for the fuel (up to six characters) and selects whether the fuel should represent a blue or an orange flame.

## System Setup (Saved Images)

Press **SAVED IMAGES** to view screen captures stored on the USB drive.
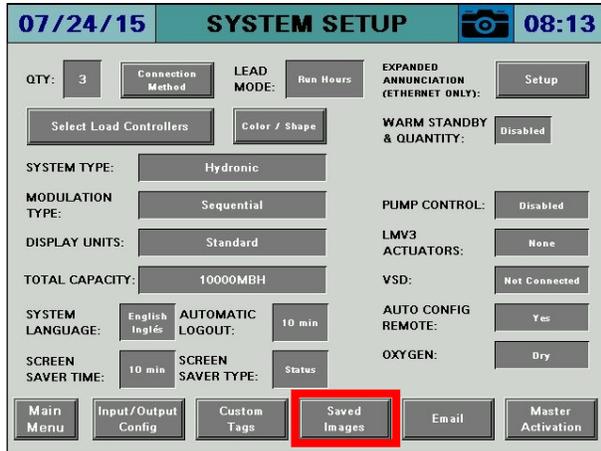
# System Setup (Email)

Press **EMAIL** to configure email settings.
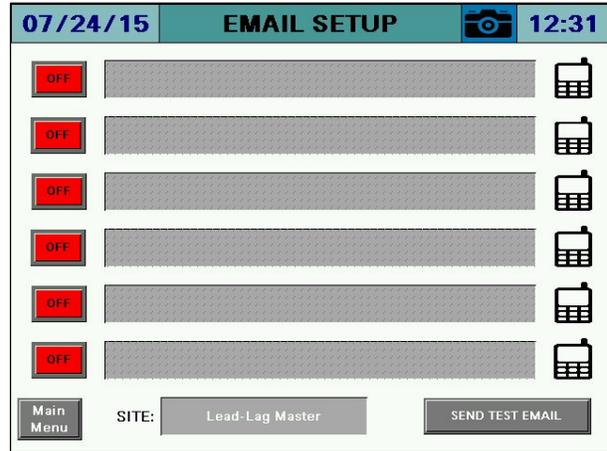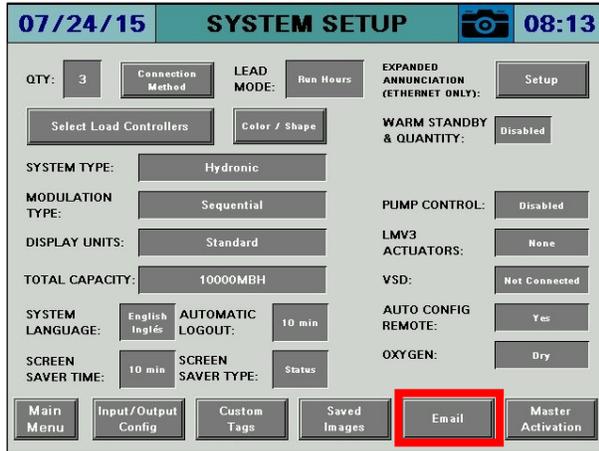


The touchscreen can be configured to send email to up to six addresses.  This requires that the touchscreen is connected to a network with Internet access.  Emails are sent automatically when alarms occur and may be sent manually to send screen captures and other data from the touchscreen.  To configure an email address, press the **ON/OFF** button to the left of the address line, then enter the address.

## System Setup (Email continued)

A template is provided to allow text messages to be sent via email.  Press the phone icon on the right to bring up the template.
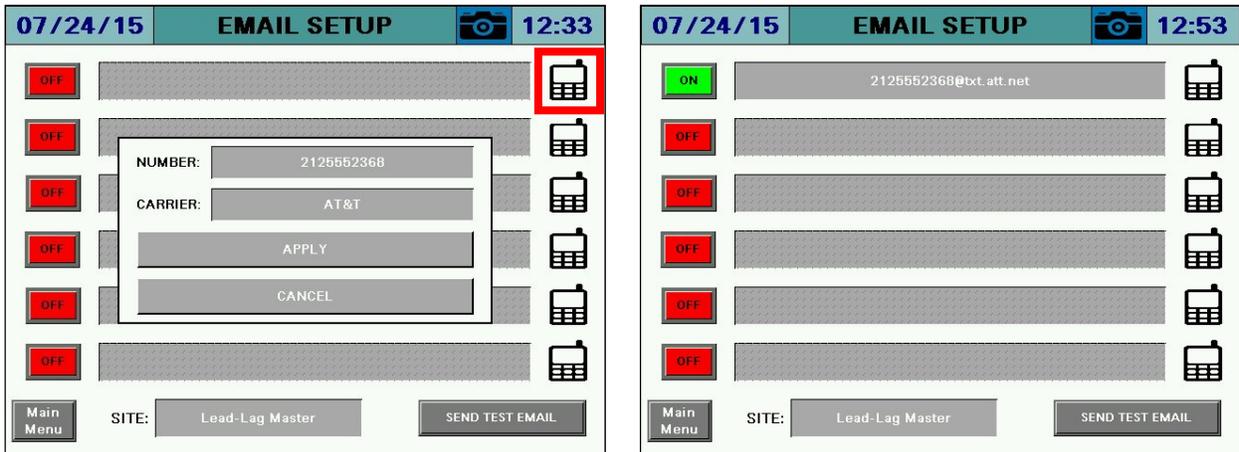


To check that the email addresses are valid and were entered correctly, press **SEND TEST EMAIL**.

# System Overview

Access level:  **USER**

The system overview screen displays the real-time data for the boiler system.  From the MAIN MENU screen, press **OVERVIEW**.  The OVERVIEW screen will appear.



Only the parameters that are optioned and active are shown.  Any others are hidden from the display for clarity.  The following parameters may be shown on the overview screen:

**SETPOINT TYPE –** Displays the source of the current setpoint.
- **W1 Setpoint:**  The system is using the W1 setpoint.  Applies when the system is in LOCAL or is in REMOTE (with no remote setpoint present).
- **W2 Setpoint:**  The system is using the W2 setpoint.  Applies when the system is in LOCAL or is in REMOTE (system is not OFF).  When activated, W2 overrides all other setpoints.
- **Remote Setpoint:**  The system is using the remote setpoint.  Applies when the system is in REMOTE (with a valid remote setpoint present).
- **OSA Setpoint:**  The system is using the outside air reset setpoint (hydronic systems only).  Applies when the system is in LOCAL and an outside air sensor is connected (with a valid signal).
- **W1 Setpoint (OSA Fault):**  The system is using the W1 setpoint.  Applies when the system is in LOCAL (with an invalid outside air sensor temperature).
- **System Disabled:**  The system is commanded off.  Applies when the system is in OFF or is in REMOTE (with a disable command).

**DEMAND –** Displays the capacity demand (0-100%), total throughput in MBH or PPH (if configured) as well as the system demand (0-100% per boiler additive, i.e. three boilers = 300%).

# System Overview (continued)

**HEADER –** Displays the header pressure (steam systems only).

**SETPOINT –** Displays the current setpoint as a pressure or temperature.

**PUMP STATUS –** Displays the pump status as running, fail or idle (hydronic systems only).
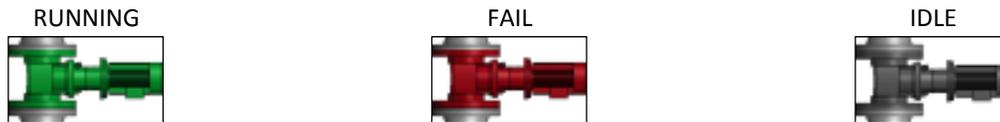
RUNNING                                    FAIL                                       IDLE

**STATUS BAR –** Displays the current phase description and number as well as the status (running, fail or idle).

- **RUNNING:** The status is displayed in green text, i.e. `Running - 60`
- **FAIL:** The status is displayed in red text, i.e. `Alarm - 0`
- **IDLE:** The status is displayed in blue text, i.e. `Idle - 12`

**BOILER TAG –** Displays the programmed boiler tag.

**LEAD/LAG STATUS –** Displays the current lead/lag status.

- **Comm Fault:** The boiler is not communicating with the lead/lag master.
- **Lead:** The boiler is the lead boiler.
- **Lag 1-7:** The boiler is a lag boiler in the designated position.
- **Not Available:** The boiler is not available due to one of the following reasons (boiler control switch is off, boiler is not in automatic mode, boiler is in lockout, or boiler with LMV5x controller is not set for "IntLC Bus" or "ExtLC Bus").

**SP –** Displays the current setpoint of the boiler.

**PV –** Displays the actual value of the boiler.

**RATE –** Displays the firing rate in percent if modulating, or number of stages active if staged.

**OSA –** Displays the outside air temperature if connected (hydronic systems only).

**SYSTEM LOCAL-OFF-REMOTE –** Sets the mode of the system.

- **LOCAL:** The system is enabled.
- **OFF:** The system is disabled.
- **REMOTE:** The system enable/disable is provided by remote system. Defaults to enabled if no remote system is connected.

# System Overview (continued)

System Local-Off-Remote Switch

There are two ways to change the position of the LOCAL-OFF-REMOTE switch. Touching the switch for > 1s will toggle the switch to the next position.  Touching the 'LOCAL', 'OFF' or 'REMOTE' text for > 1s will switch to that position directly.  See *Appendix - System Local-Off-Remote Flowchart* for additional detail.
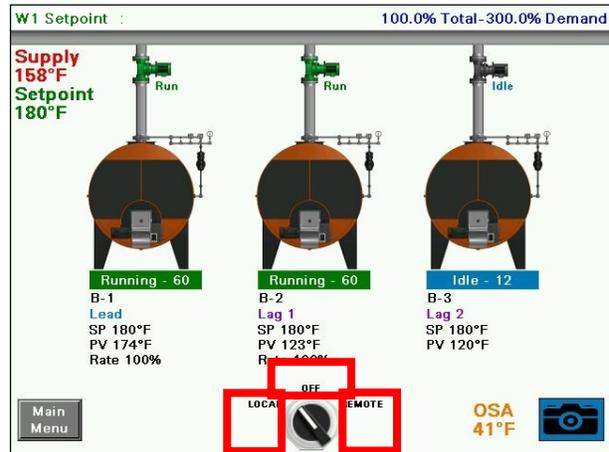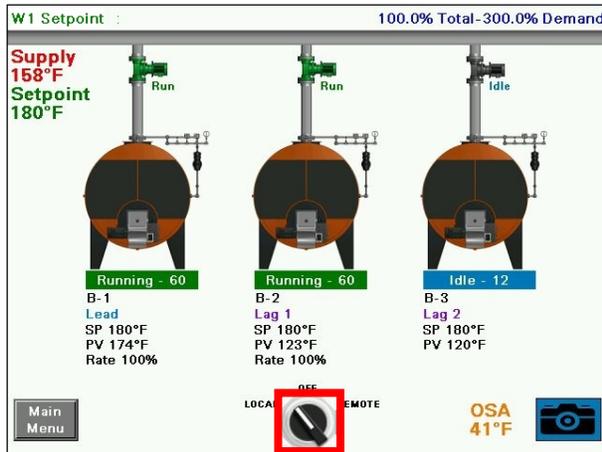
# System Overview (continued)

<u>Shortcut Navigation From Overview</u>

Touching the boiler image will navigate to the BOILER OVERVIEW screen (see *Boiler Overview* section for additional detail).
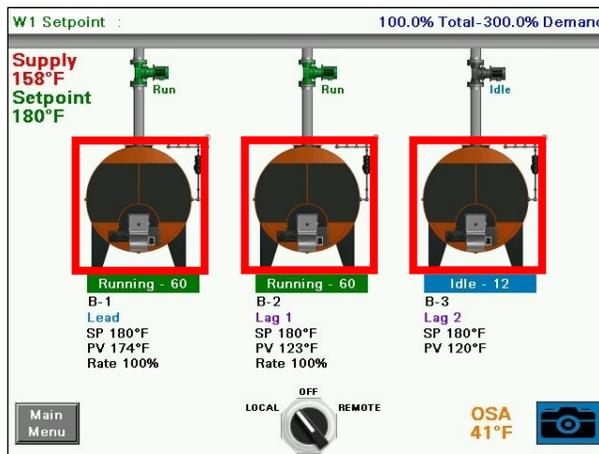


Touching the boiler information will display the boiler HAND-OFF-AUTO switch (see *Boiler Overview → Hand-Off-Auto* section for additional detail).
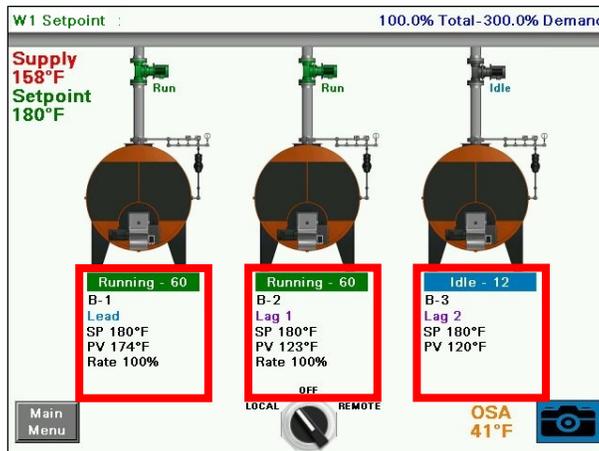
# System Overview (continued)

Boilers 5-8

Systems with greater than four boilers connected will have a split overview screen.  To see boilers 5-8, press **CONTINUE>>**.  To return to boilers 1-4, press **<<BACK**.
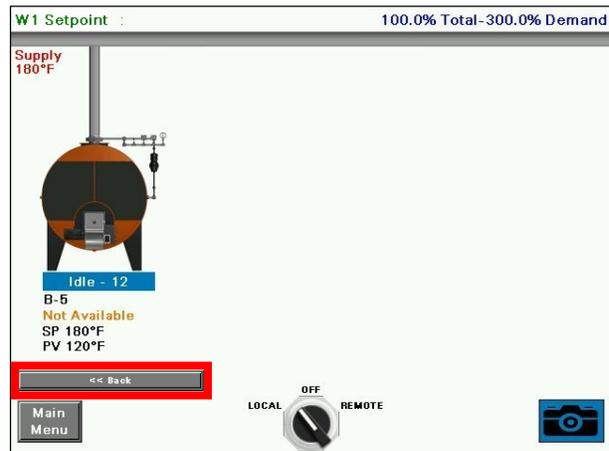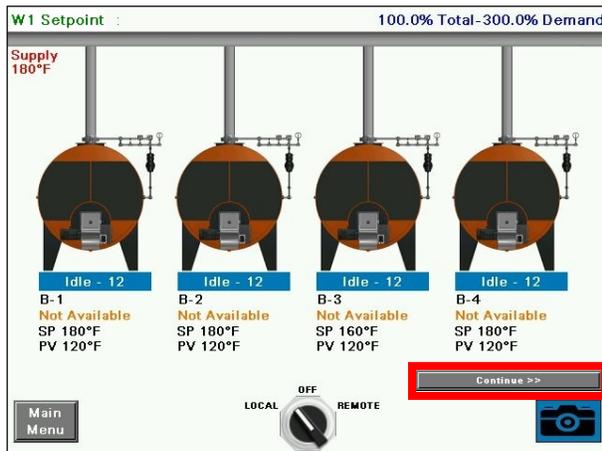


Forcing Screen Saver

To force the display of the screen saver, press one of the top corners from the SYSTEM OVERVIEW screen.
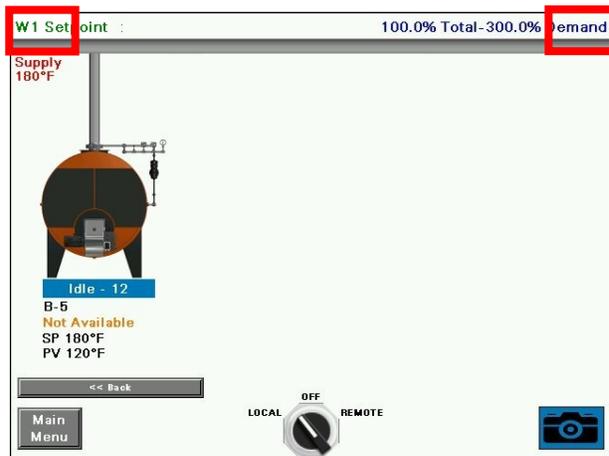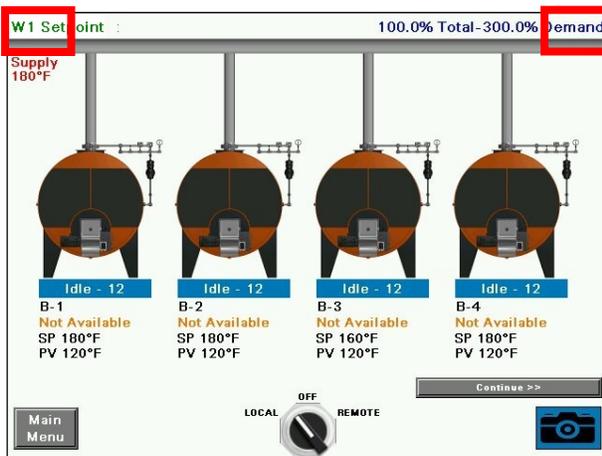
# Boiler Overview

Access level:  **USER**

The boiler overview screen displays the real-time data for the specific boiler.  From the MAIN MENU screen, press **B-x DETAIL**.  The BOILER OVERVIEW screen will appear for the selected boiler.



HYDRONIC                                              STEAM
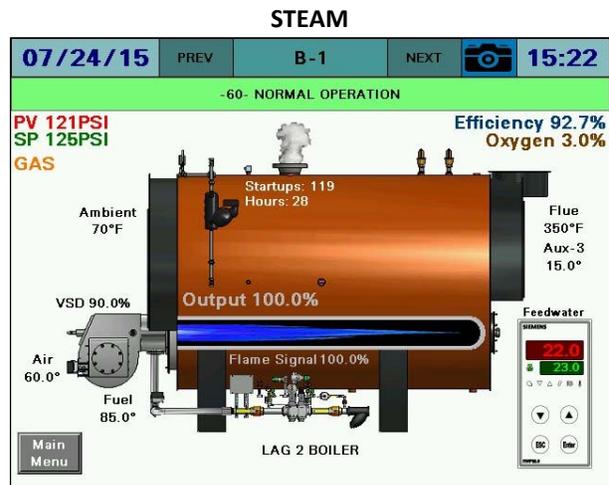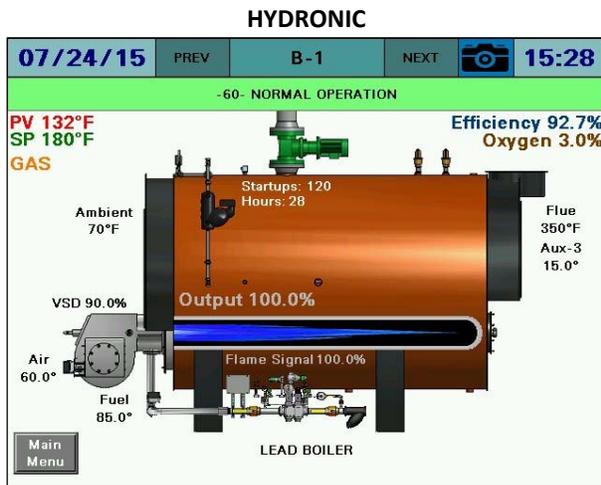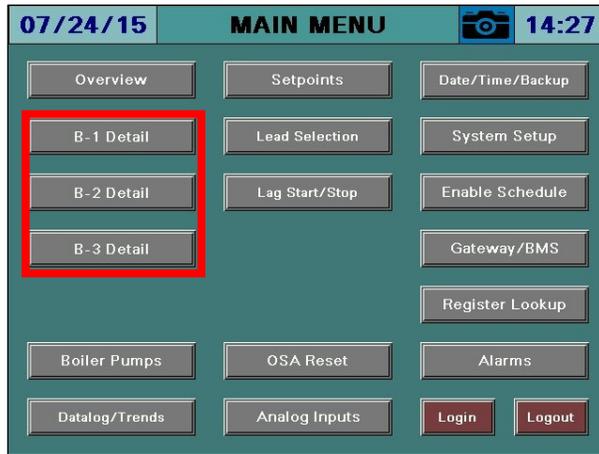


Use the **PREV** and **NEXT** buttons to navigate between boilers.

# Boiler Overview (continued)

**Phase:**  The phase of the boiler is always displayed in a horizontal bar at the top of the screen.
**PV:**  Displays the actual value of the boiler.
**SP:**  Displays the current setpoint of the boiler.
**Fuel In Use:**  Displays the current fuel being used (uses fuel tags).
**Firing Rate:**  Displays the firing rate of the boiler from 0-100%.
**Manual Active**:  Displayed in red text if the boiler is in manual mode.
**Air Actuator:**  Displays the position of the air actuator.
**Fuel Actuator:**  Displays the position of the current fuel actuator.
**Aux Actuators:**  Displays the position of the auxiliary actuators if equipped (LMV5x only).
**VSD Output:**  Displays the speed of the VSD from 0-100%.
**Shell Temp:**  Displays the current boiler shell temperature.
**Startups:**  Displays the number of boiler startups on the selected fuel.
**Hours:**  Displays the number of hours run on the selected fuel.
**$O_2$:**  Displays the current $O_2$ percentage in the stack (LMV5x only).
**Flue Temp:**  Displays the current flue gas temperature (LMV5x only).
**Ambient:**  Displays the current ambient temperature (LMV5x only).
**Efficiency:**  Displays the current combustion efficiency (LMV5x only).
**Feedwater:**  Displays the current RWF data.  The red display is the actual level and the green display is the setpoint (steam systems only).
**Pump Status:**  Displays the current boiler pump status.  A green pump indicates running, a red pump indicates pump alarm and a gray pump indicates idle (hydronic systems only).
**Lead/Lag Status:**  Displays the current lead/lag status.  See **Table 2** for a full list of messages.

**Table 2:  Lead/Lag Status Messages**

| Message | Definition |
| --- | --- |
| LEAD/LAGx BOILER | The current boiler designation. |
| LEAD/LAGx BOILER - WSB ACTIVE ON TEMP | The current boiler designation, also indicates that warm standby is active due to temperature. |
| LEAD/LAGx BOILER - WSB MIN RUN | The current boiler designation, also indicates that warm standby is active due to unsatisfied minimum run timer after temperature satisfied. |
| FORMER LEAD – CHANGEOVER IN PROGRESS | The boiler is transitioning from a lead boiler to a lag boiler. |
| BOILER NOT AVAILABLE | The boiler is not available due to one of the following reasons (boiler control switch is off, boiler is not in automatic mode, boiler is in lockout, or boiler with LMV5x controller is not set for "IntLC Bus" or "ExtLC Bus"). |
| OVERRIDE MODE | The override input on the lead/lag master is activated and is the source of control. |

# Boiler Overview (continued)

Hand-Off-Auto
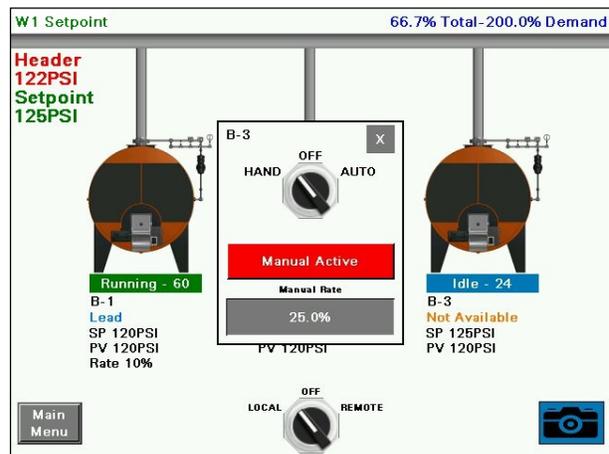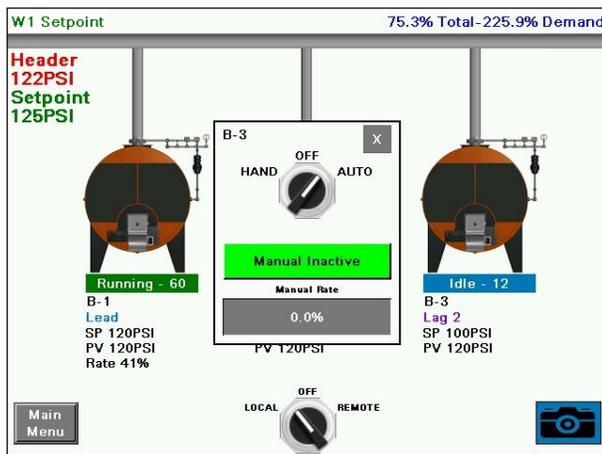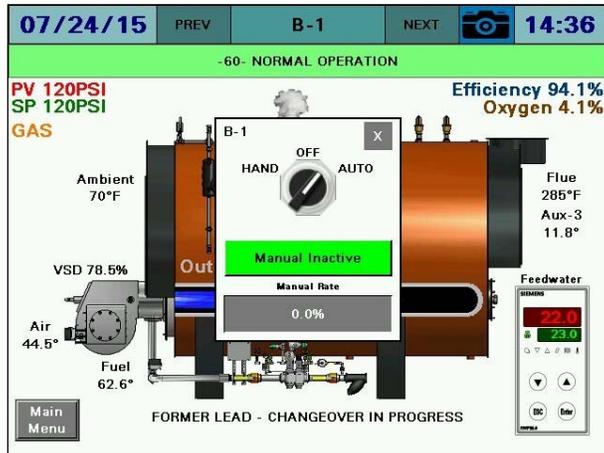




**HAND-OFF-AUTO –** Sets the mode of the boiler to manually on, manually off, or automatic.  See **Table 3**, *Appendix - Boiler Hand-Off-Auto Flowchart (Serial Connection)* or *Appendix - Boiler Hand-Off-Auto Flowchart (Touchscreen Kit)* for additional detail.  The position will synchronize with the HAND-OFF-AUTO switch located on the touchscreen kit, if applicable.

- **HAND:**  The boiler is commanded to run.
- **OFF:**  The boiler is commanded to remain off.
- **AUTO:**  The boiler is commanded to operate via the Lead/Lag Master commands.

⚠ **Warning:**  If the LMV5 is in firing rate control mode, an external automatic reset temperature control must be present on the boiler since the internal load control thermostat function is not active in this mode.

# Boiler Overview (continued)

**MANUAL ACTIVE/INACTIVE –** Select manual forced operation when in **HAND**.
- **INACTIVE**
- **ACTIVE**

**MANUAL RATE –** Sets the firing rate when manual operation is enabled.

<div align="center"><strong>Table 3:  LMV Actions in HAND/OFF/AUTO</strong></div>

| Position | Local/Remote | Remote Mode | Setpoint Used | Firing Rate Used |
|---|---|---|---|---|
| HAND (Manual Inactive) | Local | n/a | W1/W2 | Internal LC |
| HAND (Manual Active) | Remote | Burner On | W3 | Remote |
| OFF | Remote | Burner Off | W3 | n/a |
| AUTO (Commanded On) | Remote | Burner On | W3 | Remote |
| AUTO (Commanded Off) | Remote | Burner Off | W3 | n/a |

# Setpoints

Access level:  **USER / TECH / SETUP**

The setpoint setup screen displays system setpoint configuration.  From the MAIN MENU screen, press **SETPOINTS**.  The SETPOINTS screen will appear.
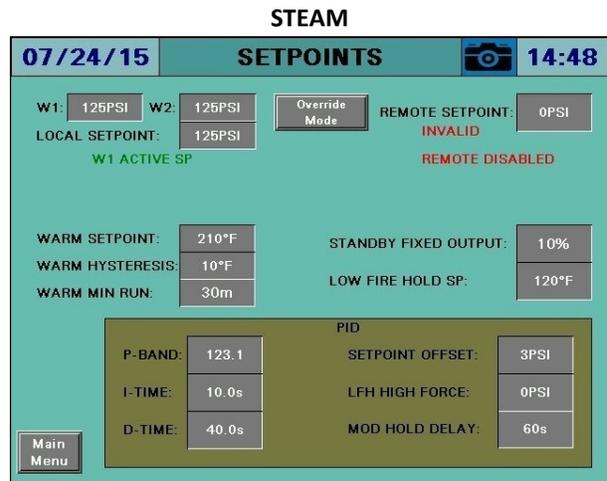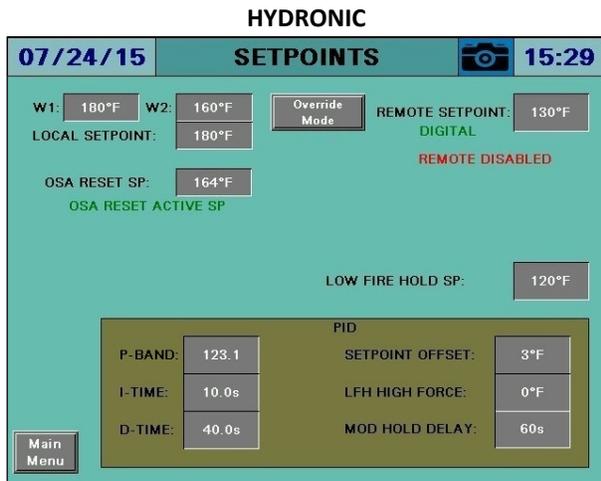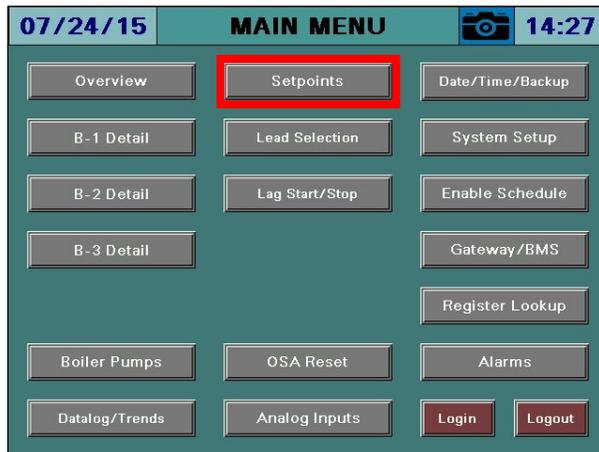


**HYDRONIC**



**STEAM**

# Setpoints (continued)

<u>System Setpoints</u>

**W1, W2 SETPOINT –** Sets the W1 or W2 setpoint (TECH required).  In hydronic systems, W1 is used in the absence of a valid outside air setpoint.  In steam systems W1 is the header setpoint.  On all systems, W2 is the overriding setpoint when the 'W2' digital input is activated.  Also indicates if W1 or W2 is active.

**LOCAL SETPOINT –** Sets the desired local boiler setpoint (TECH required).  *This setpoint must be higher than the system setpoint to prevent local boiler cycling and to ensure proper system operation.*  When an RWF40 or RWF55 is used as the load controller, the on hysteresis is fixed at -5 and the off hysteresis is fixed at 5.

**REMOTE SETPOINT –** Displays the remote setpoint.  Also displays the status of the remote setpoint.  'INVALID' indicates inactive communication, 'REM OK' indicates active communication and 'DIGITAL' indicates a hardwired remote setpoint.

**REMOTE STATUS –** Displays the remote enable status.  If the remote setpoint is 'REM OK' or 'DIGITAL', the remote status of 'REMOTE DISABLED' or 'REMOTE ENABLED' will be followed when the system is in remote control mode.

**OSA RESET SP –** Displays the calculated outside air reset setpoint when an outside air sensor is connected (hydronic systems only).  Also indicates when the outside air reset setpoint is active.

<u>Boiler Protection</u>

**WARM SETPOINT –** Sets the warm standby setpoint (TECH required).  This is the nominal temperature that the configured standby boilers will maintain while idle.

**WARM HYSTERESIS –** Sets the hysteresis band for the warm standby setpoint (TECH required).  The off point will be (setpoint + hysteresis) and the on point will be (setpoint - hysteresis).
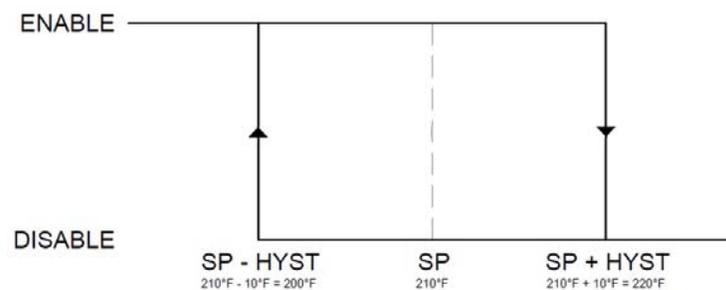


**WARM MIN RUN –** Sets the minimum run time for the warm standby enable (TECH required).  Prevents short-cycling during warm standby operation.

**STANDBY FIXED OUTPUT –** Sets the firing rate used when warm standby is active (TECH required).

**LOW FIRE HOLD SP –** Sets the low fire hold setpoint (TECH required).  Whenever the boiler shell (steam) or actual (hydronic) temperature is below this setpoint only low fire operation will be allowed.

# Setpoints (continued)

<u>Demand (PID)</u>

**PROPORTIONAL –** Sets the proportional band for PID control (TECH required).  The proportional portion of the control output is generated by the actual value relative to the setpoint less the proportional band.  A smaller proportional band has a larger impact upon the process.  For example, if the actual value is 95, the setpoint is 100 and the proportional band is 20, the control output will be 25% of the PID scale (setpoint minus actual, divided by the proportional band).  The control output will modulate whenever the actual value is within the effective proportional band (80 to 100 in example).  If the actual value is above or below the proportional band limits the control output will be the PID maximum or PID minimum.  Setting the proportional band to 0 effectively disables the PID control.

**INTEGRAL –** Sets the integral time for PID control (TECH required).  The integral portion of the control output makes continuous adjustments based upon the error between the setpoint and the actual value.  A shorter integral time has a larger impact upon the process.  For example, if the output using the proportional band alone is 25% and the integral time is set to 15s, the control output will double to 50% in 15s if the control variables remain constant.  This 'integral windup' will continue until the control output reaches the PID maximum or PID minimum.  Setting the integral time to 0 disables the integral portion.

**DERIVATIVE –** Sets the derivative time for PID control (TECH required).  The derivative portion of the control output makes periodic adjustments based upon the rate of change in the actual value.  A larger derivative time has a larger impact upon the process.  For example, if the output using the proportional band alone is 25%, the derivative time is set to 10s and the actual value decreases by 2, the control output will increase by 20% (10 x 2) in anticipation of how much the current rate of change would affect the process 10s into the future.  Setting the derivative time to 0 disables the derivative portion.  Derivative should be used with caution as it can create an unstable control loop.  When used, it is recommended that derivative time not exceed 25% of the integral time.

**SETPOINT OFFSET –** Sets the setpoint offset for the PID control (TECH required).  The setpoint offset is added to the desired setpoint to create the effective setpoint used by the PID control.  For example, if the setpoint is 100 and the setpoint offset is 3, the setpoint used by the PID control would be 103.

**LFH HIGH FORCE –** Sets the setpoint for forcing modulation toward low fire at the individual boilers (TECH required).  LFH high force is added to the local setpoint to create the effective high force setpoint.  For example, if LFH high force is 3 and the local setpoint is 180, modulation toward low fire will be forced when the individual boiler pressure (steam) or temperature (hydronic) equals 180 and low fire will be achieved after 183.  If LFH high force is -3 and the local setpoint is 180, modulation toward low fire will be forced when the individual boiler pressure (steam) or temperature (hydronic) equals 177 and low fire will be achieved after 180.

**MOD HOLD DELAY –** Sets the time that low fire operation will continue after being released to modulation (TECH required).  This delay applies after any condition that calls for low fire (initial run, low fire hold on temperature or LFH high force).

# Setpoints (continued)

Override Mode

An override mode is available that will force specific commands to each boiler when the 'Override' digital input is activated.  This can be used for a manual warm-up or for a forced production output.  In this mode, the PID will operate from 0% to 100% based on demand.  From the SETPOINTS screen press **OVERRIDE MODE** to display the OVERRIDE MODE window (TECH required).
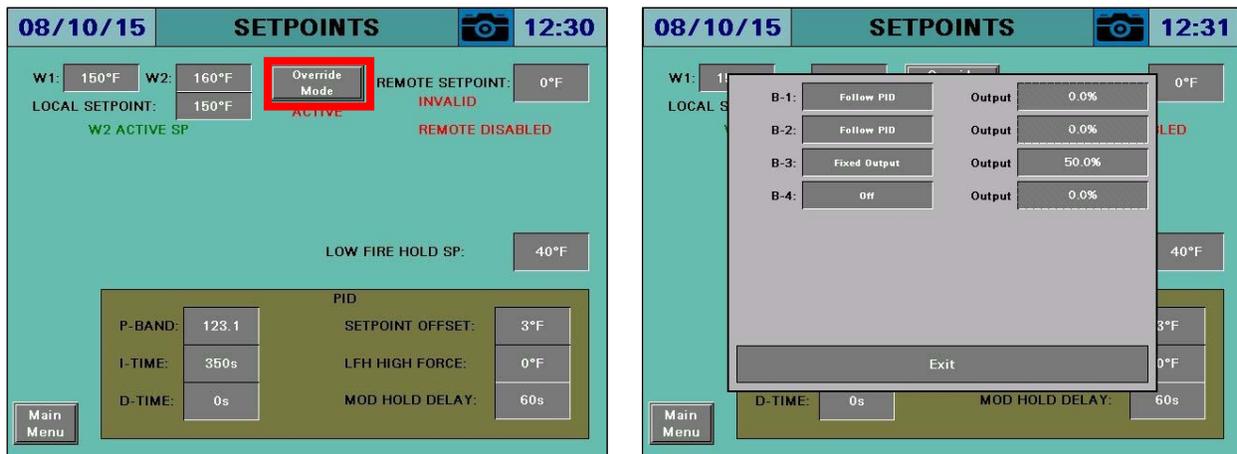


**BOILER COMMAND –** Selects the desired override action.
- **Local Operation:**  The boiler will be commanded to run in local mode.
- **Fixed Output:** The boiler will be commanded to run using a fixed output.  This is similar to manual operation (see *Boiler Overview → Hand-Off-Auto* section for additional detail).
- **Off:** The boiler will be commanded off.
- **Follow PID:** The boiler will be commanded to follow the PID output.   There are no start/stop points in this mode, the boiler will always be commanded to run.

⚠ **Warning:**  If the LMV5 is in firing rate control mode, an external automatic reset temperature control must be present on the boiler since the internal load control thermostat function is not active in this mode.

# Lead Selection

Access level:  **USER / TECH / SETUP**

The lead selection setup screen displays lead boiler configuration.  From the MAIN MENU screen, press **LEAD SELECTION**.  The LEAD SELECTION screen will appear.



**LEAD BY ALTERNATION**



**LEAD BY LMV STARTUPS OR LMV HOURS**
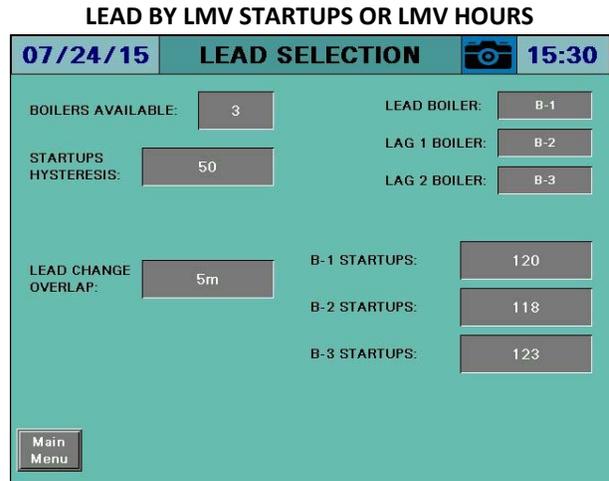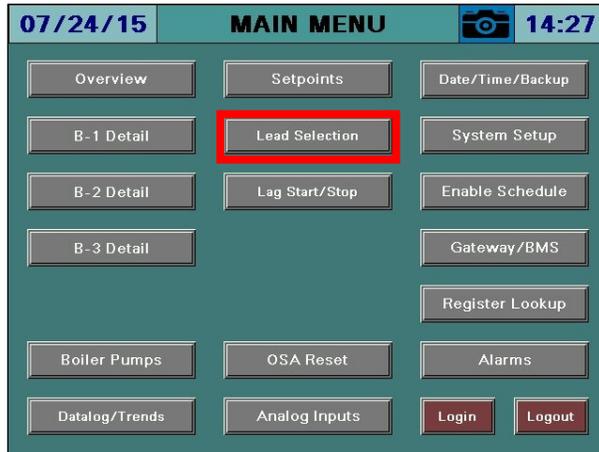
# Lead Selection (continued)

Two methods of lead alternation are provided.  See *System Setup* for further information about selecting and configuring the lead mode.

**BOILERS AVAILABLE –** Displays the number of boilers that are available to the system.
**ALTERNATION SETPOINT (ALTERNATION)–** Sets the desired alternation setpoint (TECH required).
**STARTUPS, HOURS HYSTERESIS (STARTUPS, HOURS) –** Sets the desired hysteresis setpoint (TECH required).  Whenever a lag boiler counter (startups or hours as selected) trails the lead counter by more than the hysteresis setpoint, that lag boiler will become the new lead.
**HOURS, MINUTES REMAINING –** Displays how many hours and minutes remain until automatic alternation occurs.
**LEAD CHANGE OVERLAP –** Sets the desired lead change overlap time (TECH required).  This determines how long that the former lead boiler will continue to follow the lead boiler commands following a change in the lead boiler, ensuring no interruption in the system.
**MANUAL ALTERNATION TO NEXT LEAD (ALTERNATION) –** Press to manually change to the next available lead boiler (TECH required).
**RESET ALTERNATION COUNTER (ALTERNATION) –** Press to reset the alternation counter (TECH required).
**LEAD, LAG BOILERS –** Displays the current assignments of the lead and lag boilers.
**BOILER STARTUPS, HOURS (STARTUPS, HOURS) –** Displays the startups or hours of the boilers.

# Lag Start / Stop

Access level:  **USER / TECH / SETUP**

The lag start/stop setup screen displays lag boiler sequencing configuration.  From the MAIN MENU screen, press **LAG START/STOP**.  The LAG START/STOP screen will appear.



**PARALLEL MODULATION**



**SEQUENTIAL MODULATION**
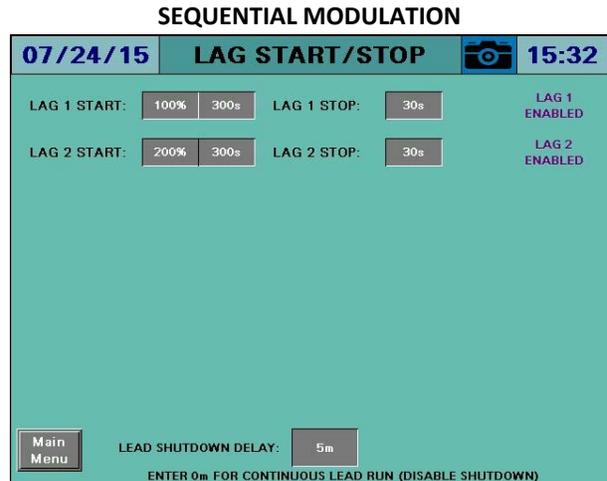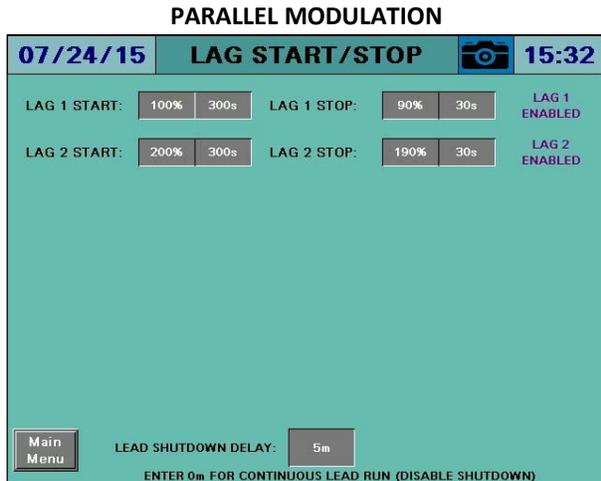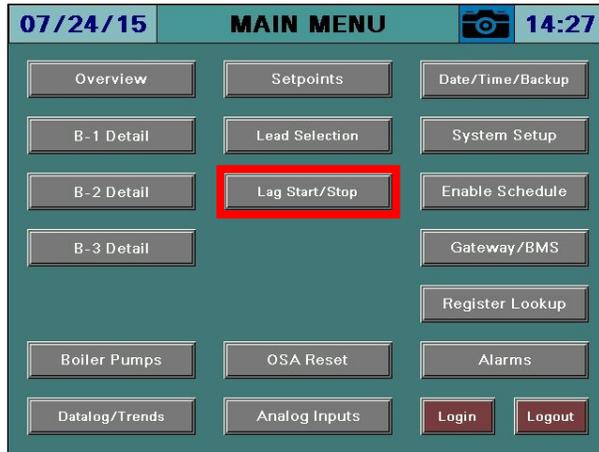
# Lag Start / Stop (continued)

Two methods of modulation are provided.  See *System Setup* for further information about configuring the modulation mode.  Also see **Appendix - Parallel Modulation** and **Appendix - Sequential Modulation** for more specific detail and examples.

**LAG STARTS (PERCENT AND TIME) –** Sets the start point and delay time for each lag boiler (TECH required).  When the load demand exceeds the start point for the time duration specified it will become enabled.

**LAG STOPS (PERCENT AND TIME) –** Sets the stop point and delay time for each lag boiler (TECH required).  When the load demand falls below the stop point for the time duration specified it will become disabled.  When sequential modulation is selected, the stop timer counts when the lag boiler is at low fire (stop percentage not used).

**LAG ENABLE STATUS –** Displays 'LAG x ENABLED' whenever a lag boiler is enabled.

**LEAD SHUTDOWN DELAY –** Sets the duration that the lead boiler must run at low fire (no demand) before shutting down (TECH required).  Setting this value to 0 disables lead boiler shutdown.

# Boiler Pumps

Access level:  **USER / TECH / SETUP**

The boiler pump setup screen displays boiler pump configuration.  From the MAIN MENU screen, press **BOILER PUMPS**.  The BOILER PUMPS screen will appear.



In a hydronic system, boiler circulating pumps or isolation valves can be cycled with the boiler.

**BOILER PUMP OFF DELAY –** Sets the duration that the boiler pump will continue to be enabled after the boiler has been disabled (TECH required).  This is used to remove latent heat from the vessel.

**BOILER START DELAY –** Sets the duration that the boiler pump will be enabled prior to the boiler being enabled (TECH required).  This is used to promote flow in the boiler and equalize the internal temperatures.

# OSA Reset

Access level:  **USER / TECH / SETUP**

The outside air temperature reset setup screen displays outside air temperature reset configuration.  From the MAIN MENU screen, press **OSA RESET**.  The OSA RESET PUMPS screen will appear.



In a hydronic system, the setpoint can be generated based upon the outside air temperature. The outside air temperature sensor is polled once every five minutes to update the current setpoint (maximum 12 setpoint changes per hour).  If the outside air temperature reading is invalid or the sensor becomes inoperative, the default setpoint will be used.

# OSA Reset (continued)

**MINIMUM, MAXIMUM SETPOINT –** Sets the allowable range of the outside air reset setpoint (TECH required).

**MINIMUM, MAXIMUM OSA TEMP –** Sets the allowable range of the outside air temperatures used to calculate the outside air reset setpoint (TECH required).

**OSA SETPOINT –** Displays the calculated outside air setpoint.  This is a linear calculation based upon the minimum and maximum setpoints and OSA temperatures entered.  When the outside air temperature is outside of the minimum and maximum limits, the setpoint will stay at the minimum or maximum as applicable.  It will never exceed the entered minimum or maximum.
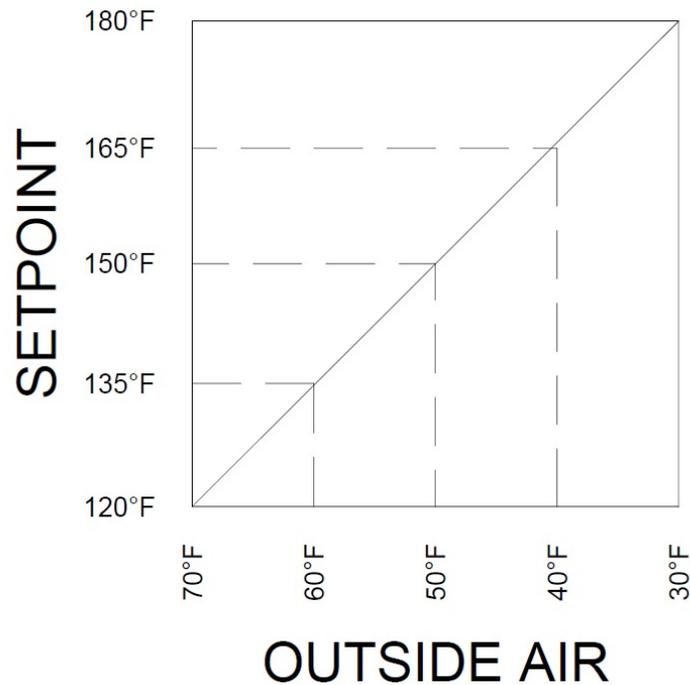


**OSA TEMPERATURE –** Displays the current outside air temperature.

## Analog Inputs

Access level:  **USER**

The analog inputs screen displays analog input information.  From the MAIN MENU screen, press **ANALOG INPUTS**.  The ANALOG INPUTS screen will appear.



If totalization is enabled for any of the analog inputs, touching the totalized value > 1s will reset the value to 0 (TECH required).

# Datalog / Trends

Access level:  **USER / TECH / SETUP**

Six trends are available that can record two variables at user-defined intervals. Datalogging up to twelve variables to a USB drive is also available.  From the MAIN MENU screen, press **TRENDS** (USER) or **DATALOG TRENDS** (TECH or SETUP).  The TREND 1 or DATALOG screen will appear.
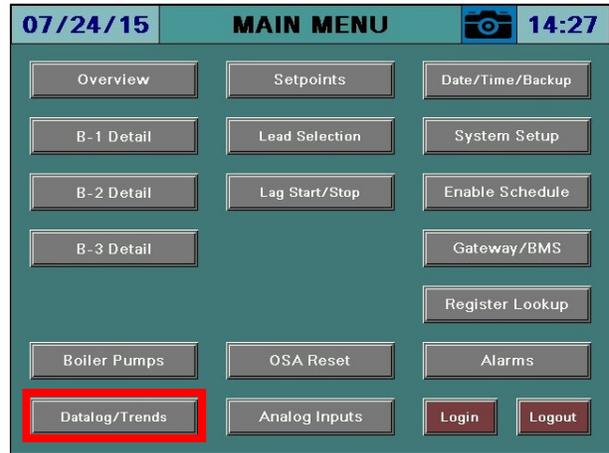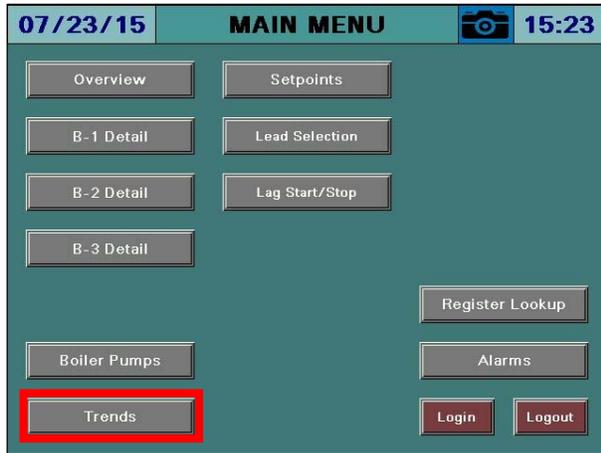
# Datalog / Trends (continued)

Trends
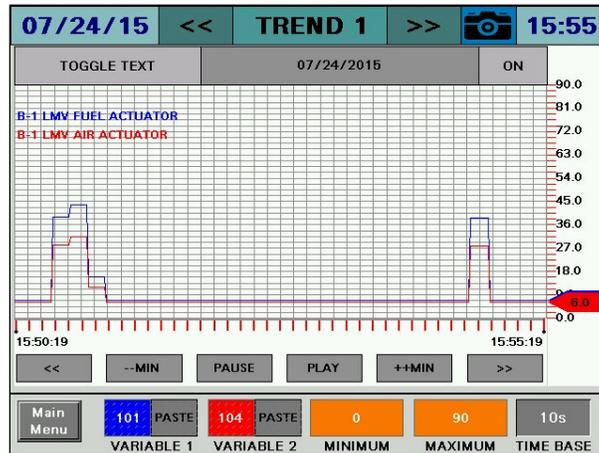


To scroll between the four trends, press **<<** and **>>** beside the title bar.

**TOGGLE TEXT –** Toggles the text display for the variables being trended.
**ON/OFF –** Enables or disables the selected trend.

**TREND NAVIGATION**
- **<< –** Scroll back to view previous trend data.  The trend will scroll back by a minute, hour or day depending upon the setting of the **--MIN/--HOUR/--DAY** button. This will pause the trend display automatically.
- **--MIN, --HOUR, --DAY –** Sets the scroll back range for viewing previous trend data.
- **PAUSE –** This will pause the trend display.  'PAUSED' will display in the upper right corner above the variable text.
- **PLAY –** This will resume the trend display if it is paused.
- **++MIN, ++HOUR, ++DAY –** Sets the scroll forward range for viewing previous trend data.
- **>> –** Scroll forward when viewing previous trend data.  The trend will scroll back by a minute, hour or day depending upon the setting of the **--MIN/--HOUR/--DAY** button.

**VARIABLES TO LOG (BLUE, RED) –** Sets the Modbus register index to trend (TECH required).
**MIN, MAX –** Sets the range for the trend data (TECH required).
**TIME BASE –** Select a time base for trending.  Choices are 10s, 20s, 30s, 1m, 2m, 5m, 10m, 15m, 30m, 60m (TECH required).

# Datalog / Trends (continued)

Datalog



**LOG VALUES –** Sets the Modbus register index to log (TECH required).

**ON/OFF –** Enables or disables logging the selected value (TECH required).

**TIME BASE –** Select a time base for logging. Choices are 10s, 20s, 30s, 1m, 2m, 5m, 10m, 15m, 30m, 60m (TECH required).

**START LOG/STOP LOG –** Enables or disables all logging (TECH required).

**RESET –** Sets all log values to '0' (TECH required).

**TRENDS –** Navigates to the TREND 1 screen (TECH required).

The resulting CSV file is in a tab-separated format and can be viewed with any text editor or spreadsheet application. On the USB drive, data can be found at:

Path = \PUBLIC\PROJECTS\MASTERxx\DATA\TEXT, xx is 7 for 7", 10 for 10", 12 for 12"

Filename = DATALOG_mm_dd_yyyy.CSV, mmddyyyy are date

## Register Lookup

Access level:  **USER / TECH / SETUP**

Modbus register indices can be looked up using text strings.
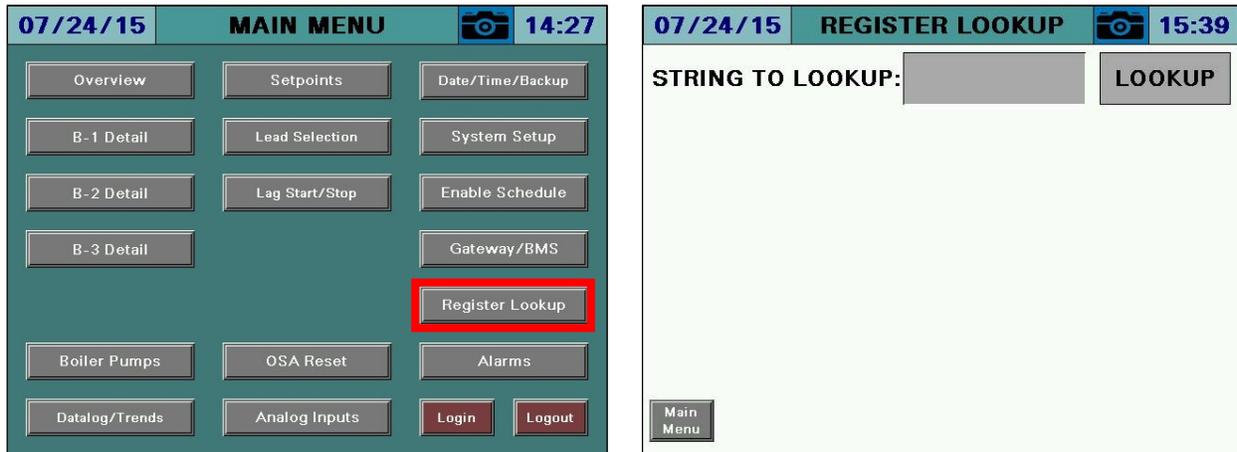


Enter a string or register index to search, then press **LOOKUP**.
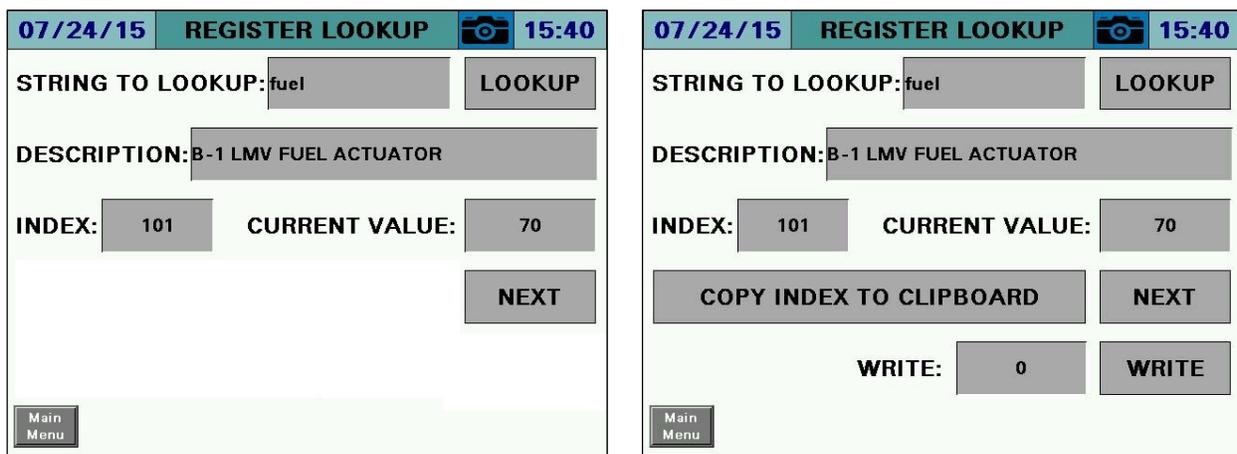


**STRING TO LOOKUP –** Input the string or register number to search for.  Examples are 'FUEL' or '12' (would display the description of index 12).
**DESCRIPTION –** Displays the full name of the register containing the search string.
**INDEX –** Displays the index of the register that matches the description.
**CURRENT VALUE –** Displays the current value of the register.  This is a raw value (not scaled).
**COPY INDEX TO CLIPBOARD –** Copies the register index and matching divider to the clipboard. This can be pasted into monitored output, trend or datalog configuration (TECH required).
**NEXT –** Scroll to the next register index matching the description.  'END OF LIST REACHED' will display if there are no more matching descriptions.

# Register Lookup (continued)

**WRITE –** Sets the value to manually write to a register.  This can be used to test functionality such as remote setpoint or enables.  Press **WRITE** to apply value (TECH required).

<u>Using the Clipboard</u>

If there is data in the clipboard, the configuration screens for the monitored outputs, trends and the datalog will have corresponding buttons that can be used to paste the data.
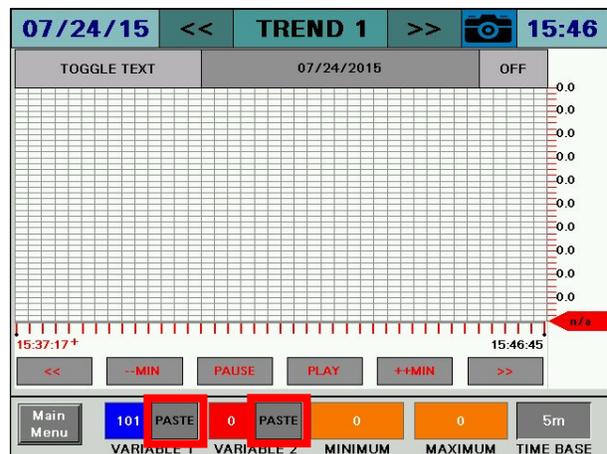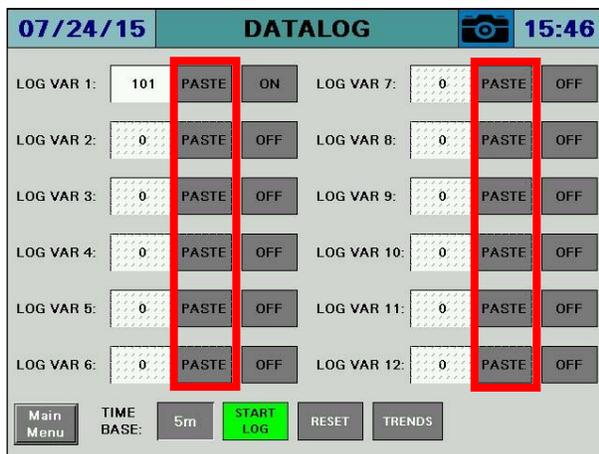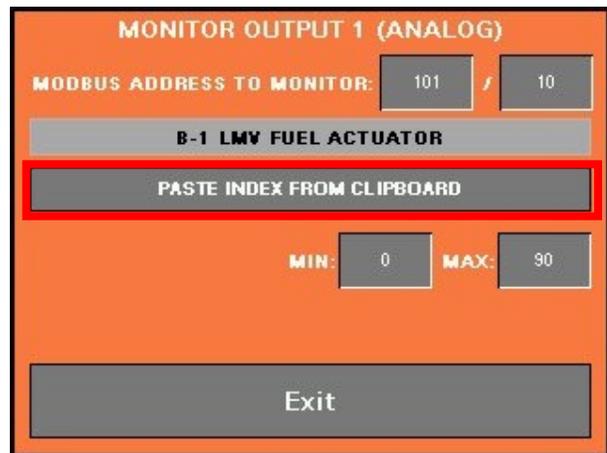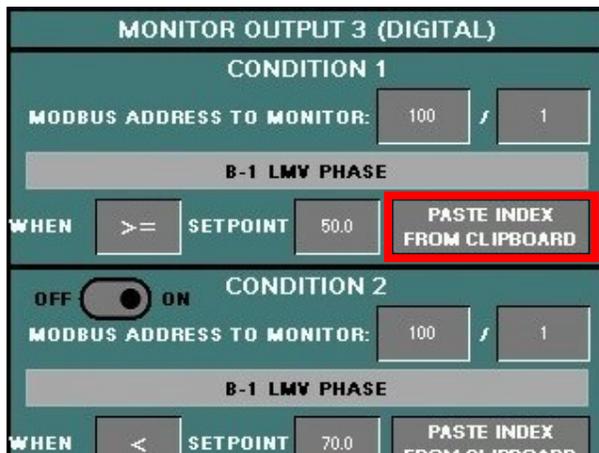
# Alarms

Access level:  **USER**

Alarms are displayed on a dedicated alarm screen.  The last 250 alarms are stored in memory and time stamped.  When an alarm is present, a link to the alarm screen will flash over the title bar of the OVERVIEW screen.  Otherwise, this screen may be accessed from the main menu.

To access the alarm screen from the main menu, press **ALARMS**.  The ALARMS screen will appear.



The ALARMS screen lists current alarms as well as older alarms.  The color of the alarm indicates the category of the alarm.

**Red –** LMV lockouts.  The text flashes when the alarm is currently active.
**Orange –** LMV faults.
**Yellow/Green –** Communication faults.  The background is yellow when the alarm is currently active and green when communication is present.
**Blue –** All other alarms such as analog alarms, pump alarms, and expanded annunciator alarms. The text flashes when the alarm is currently active.

Information about the most recent 250 alarms will be displayed with the following information:

**No. –** Number of the alarm in the list (1 is most recent).
**Date –** Displays the date that the alarm occurred.
**Active –** Displays the time when the alarm became active.
**Cleared –** Displays the time when the alarm was cleared.

# Alarms (continued)

The icons at the top of the screen may be used to navigate through the list of alarms:

Move up one alarm on list.

Move down one alarm on list.

Navigate up one page on list.

Navigate down one page on list.

# Date / Time / Defaults

Access level:  **TECH / SETUP**

The Lead/Lag Master will automatically synchronize the date and time with any connected LMV5 controllers and/or Touchscreen Kits.

Setpoint, lead selection, lag start/stop and other operating data can be saved in profiles for backup or quick change purposes.  For example, separate profiles for summer and winter could be created if needed.

To access the date/time/defaults screen from the main menu, press **DATE/TIME/DEFAULTS**. The DATE/TIME/DEFAULTS screen will appear.
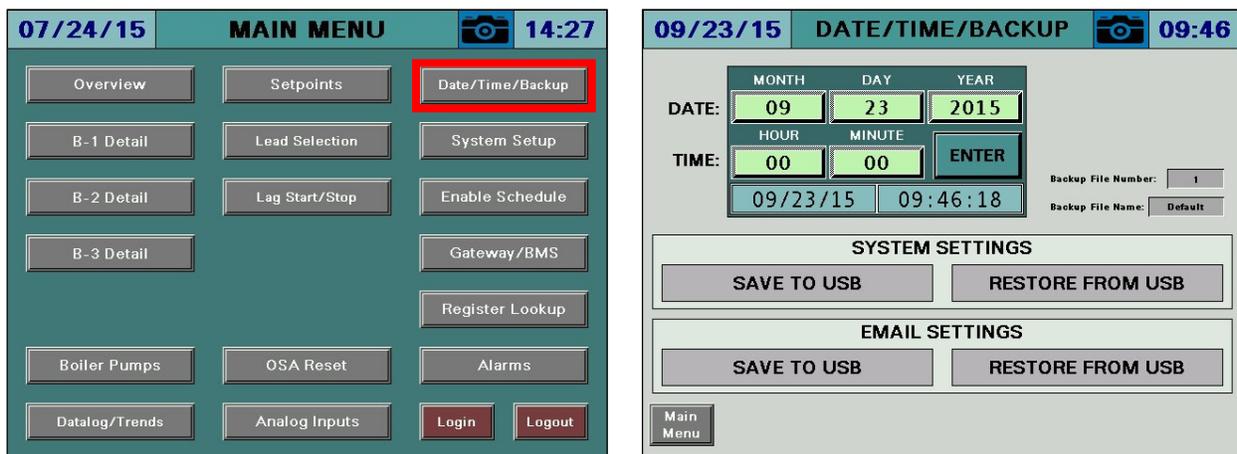


Date and Time

To change the date and time, press **ENTER** after entering the desired new date and time.  The system will then update the date and time.  Any datalogging or trending that is currently in operation will reset whenever the date and time are changed.

# Date / Time / Defaults (continued)

System Settings

System settings can be saved to a CSV file for archiving and migrating settings.  Up to 999 backup files can be saved.  To load a file, specify the file number in the **Backup File Number** field and then press **RESTORE FROM USB**.  If a valid backup file is present with that number, it will load all of the system settings.  To save a file, assign a backup file number and a backup file name in the **Backup File Name** field and then press **SAVE TO USB**.  The save process may take a few seconds to complete and it is best to leave the USB inserted for an additional five seconds after the operation has completed to ensure that everything is successfully saved.  An error will appear if the USB drive is not inserted or if the specified file is not present.

If an implausible value is specified for any parameter, an error message will appear to indicate that one or more values were invalid.  Any remaining valid parameters will continue to load.

The resulting CSV file is in a tab-separated format and can be viewed with any text editor or spreadsheet application.  On the USB drive, data can be found at:
Path = \PUBLIC\PROJECTS\MASTERxx\DATA\TEXT, xx is 7 for 7", 10 for 10", 12 for 12"
Filename = LLMSETUP_xxx.CSV, xx is the backup file number

| | A | B |
|---|---|---|
| 1 | SCC Lead/Lag Master System Configuration | |
| 2 | //Setup | |
| 3 | NUMBER | 1 |
| 4 | NAME | Default |
| 5 | SITE | Lead/Lag Master |
| 6 | SSTYPE | 0 |
| 7 | SSTIME | 60 |
| 8 | LOGOUTTIME | 60 |
| 9 | QUANTITY | 5 |
| 10 | CONNMETB1 | 0 |
| 11 | CONNMETB2 | 1 |

# Date / Time / Defaults (continued)

Email Settings

Email settings can be saved to a TXT file for archiving and migrating settings.  Up to six email addresses can be entered.  If an email address is not used, enter 'none'.  Press **SAVE TO USB** to save the existing settings or press **RESTORE FROM USB** to restore the saved settings.  Email will be automatically enabled for any valid entries.

The resulting TXT file is a text file and can be viewed with any text editor.  On the USB drive, data can be found at:
Path = \PUBLIC\PROJECTS\MASTERxx\DATA\TEXT, xx is 7 for 7", 10 for 10", 12 for 12"
Filename = EMAIL.TXT
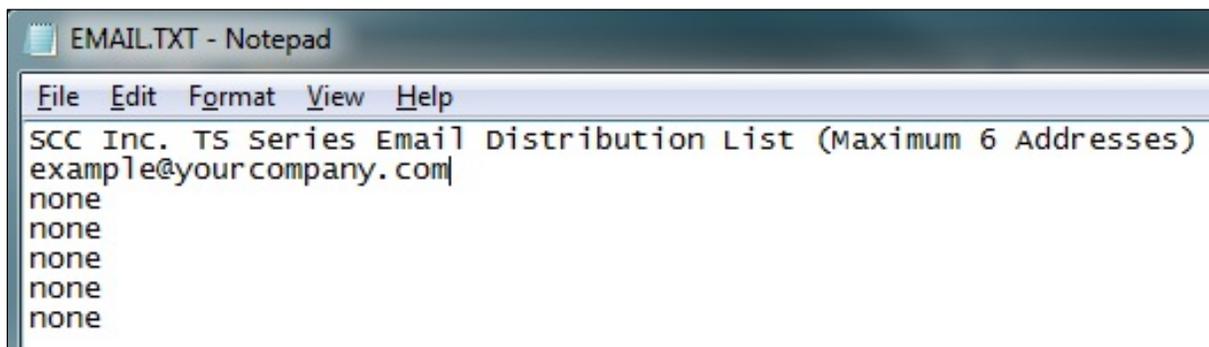
# Enable Schedule

Access level:  **TECH / SETUP**

The Lead/Lag Master can be programmed with a schedule to enable/disable the system or change setpoints as desired.  When enabled, the system will use this schedule whenever the system is in remote mode (see *System Overview* for additional detail).

To access the enable schedule screen from the main menu, press **ENABLE SCHEDULE**.  The ENABLE SCHEDULE screen will appear.
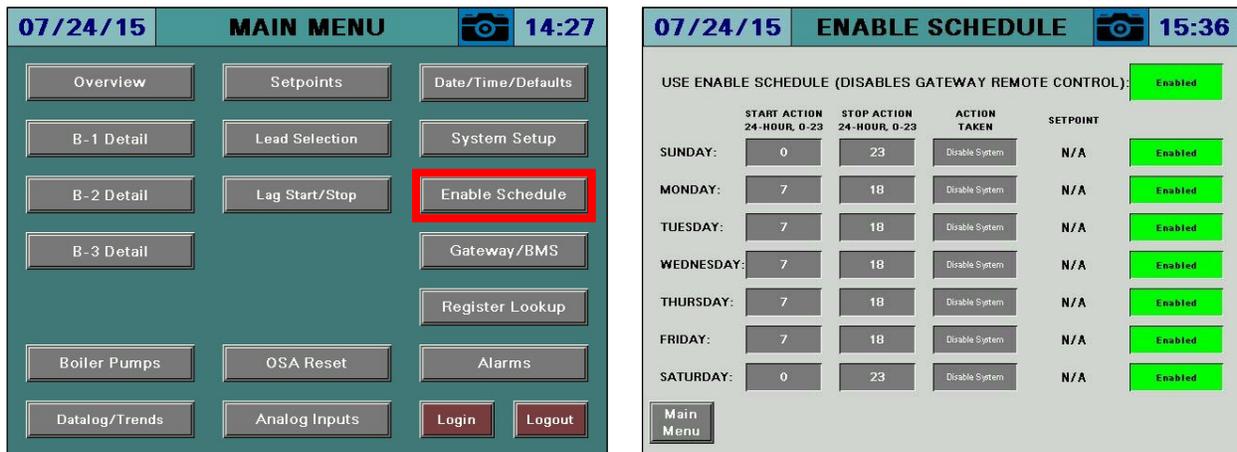


**USE ENABLE SCHEDULE –** Enables or disables the schedule function.
**START ACTION BY DAY OF WEEK –** Sets the starting hour for the action in 24-hour format.
**STOP ACTION BY DAY OF WEEK –** Sets the ending hour for the action in 24-hour format.

The action is active when the time is between the start (inclusive) and stop (inclusive).  For example, if the start hour is 7 and the stop hour is 18, the action is active from 07:00 until 18:59.

**ACTION TAKEN –** Selects which action to take when active.
- **DISABLE SYSTEM  –** Sets the system enable to disabled.
- **ENABLE SYSTEM  –** Sets the system enable to enabled.
- **CHANGE SP DURING ACTION  –** Sets the system to use the entered setpoint.
- **CHANGE SP OUTSIDE ACTION  –** Sets the system to use the entered setpoint only when the action is not active.

**SETPOINT –** Sets the desired remote setpoint to use when a change setpoint action is selected.
**ENABLE DAILY ACTION –** Enables or disables the schedule function for the selected day of week.

## Screen Captures / USB

Access level:  **USER**

A USB drive can be used to save screen captures, datalogs and to backup Expanded Annunciator configurations.  A display reading 'The USB device is connected.' will appear to confirm that the USB drive is ready to use.
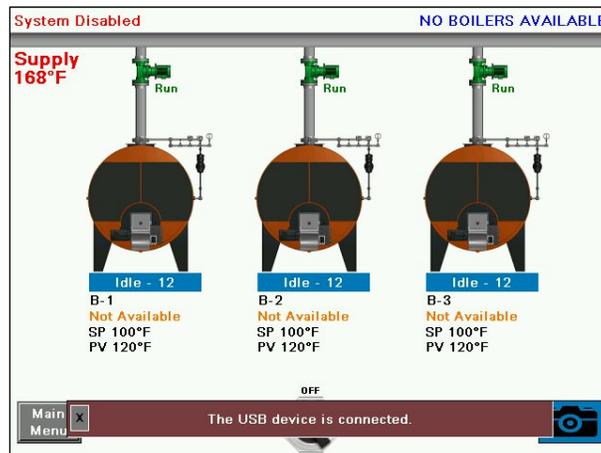


The current screen image may be copied to a USB drive.  Any screen may be captured by pressing the camera icon > 5s until the screen displays 'SNAPSHOT SAVED TO USB'.
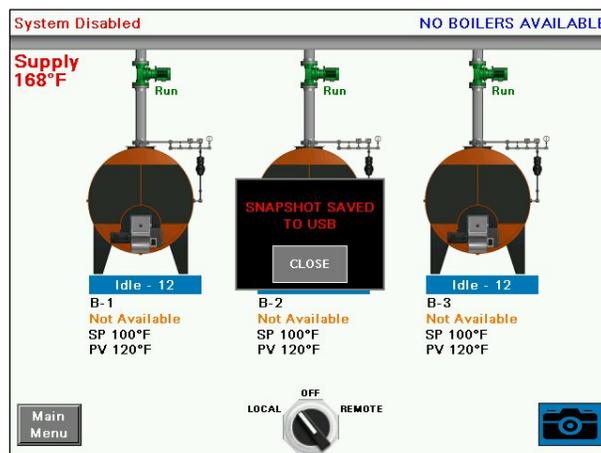
## Screen Captures / USB (continued)

If there is no USB drive inserted or there is an error while trying to save the snapshot, a message will display saying 'SNAPSHOT SAVE ERROR'.
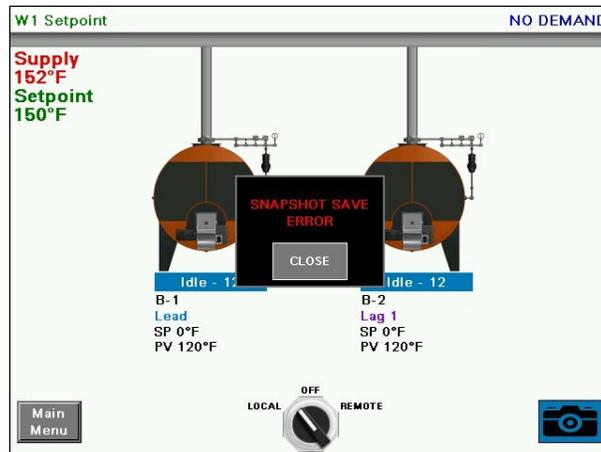
If email is configured, an email containing the screen capture as an attachment can be sent by pressing **EMAIL**.  Note that screen captures always require a USB drive to be inserted, even to send an email.
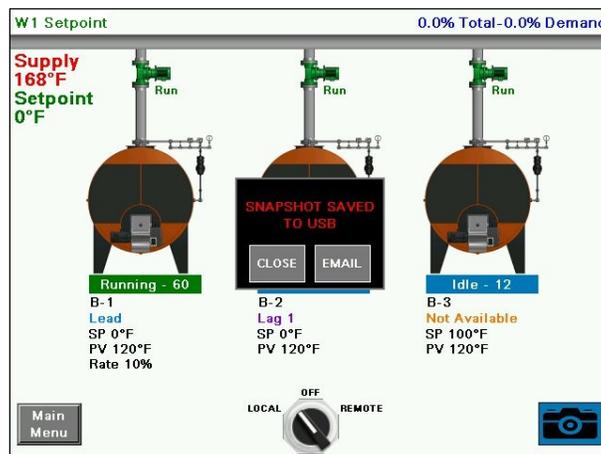
There is no limit to the number of screen captures that may be saved to the USB drive other than the capacity of the USB drive itself.

See the section *System Setup (Saved Images)* for additional detail on viewing or deleting images from the touchscreen.

# Changing Passwords

Access level:  **SETUP**

By default, the TECH access level password is 9876 and the SETUP access level password is START.  These default passwords may be changed at any time.  To change passwords, press **LOGIN** from the main menu.  Enter the appropriate information to log in at the SETUP access level and press **APPLY**.  The CURRENT USER will change to SETUP.
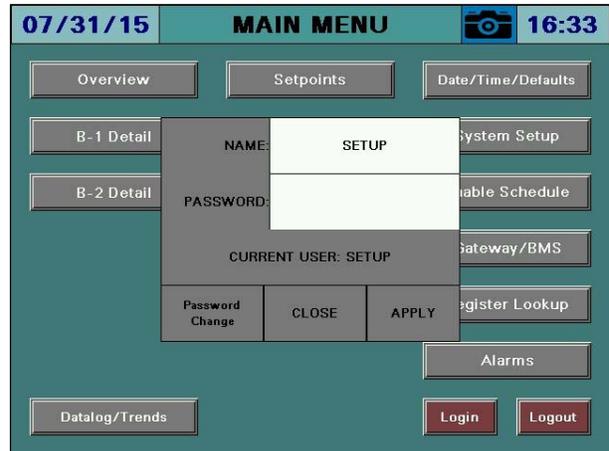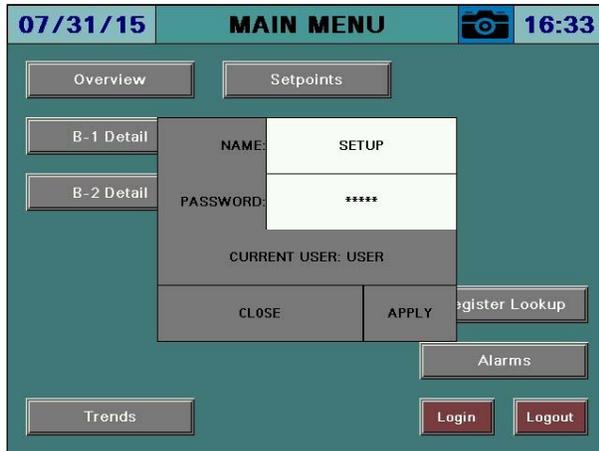


After that is done, press **PASSWORD CHANGE.**
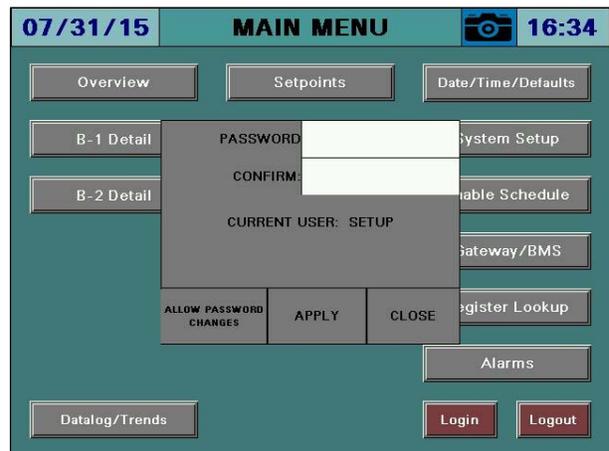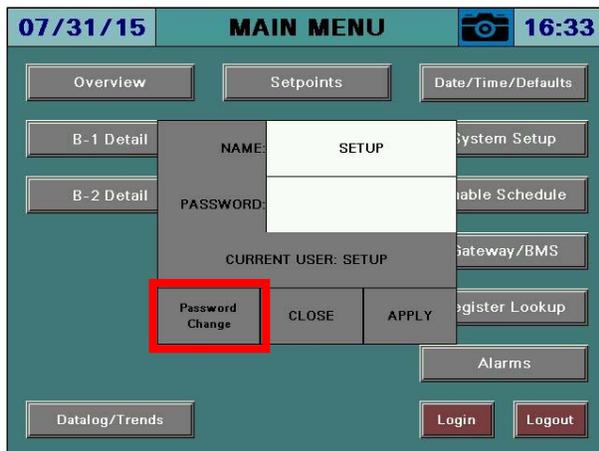
# Changing Passwords (continued)

The SETUP password may be changed from this screen.  Enter the new password twice and press **APPLY** to make the change.  To allow the TECH user access to change the TECH password, press **ALLOW PASSWORD CHANGES.**
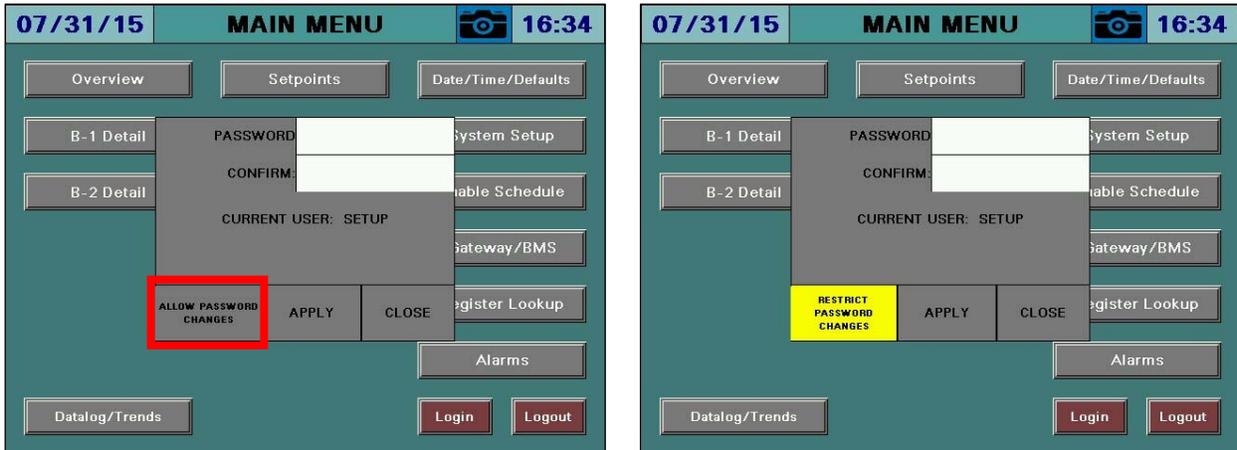


If password changes have been allowed, the TECH user may now change their password by following the same procedure as described above for the SETUP user.  To disallow the TECH user from changing the TECH password, press **RESTRICT PASSWORD CHANGES**.

# Gateway / BMS

Access level:  **TECH / SETUP**

The Lead/Lag Master has three available ports (RS-232, RS-485 or Ethernet) that can be used for BMS communication via Modbus.  Only one port can be configured as active.

The following dditional protocols are available with an TS Series Protocol Converter (see Document No. TS-6100 for additional detail):
- BACnet/IP
- BACnetMS/TP
- Metasys N2
- Lonworks

To access the gateway screen from the main menu, press **GATEWAY/BMS**.  The GATEWAY/BMS screen will appear.
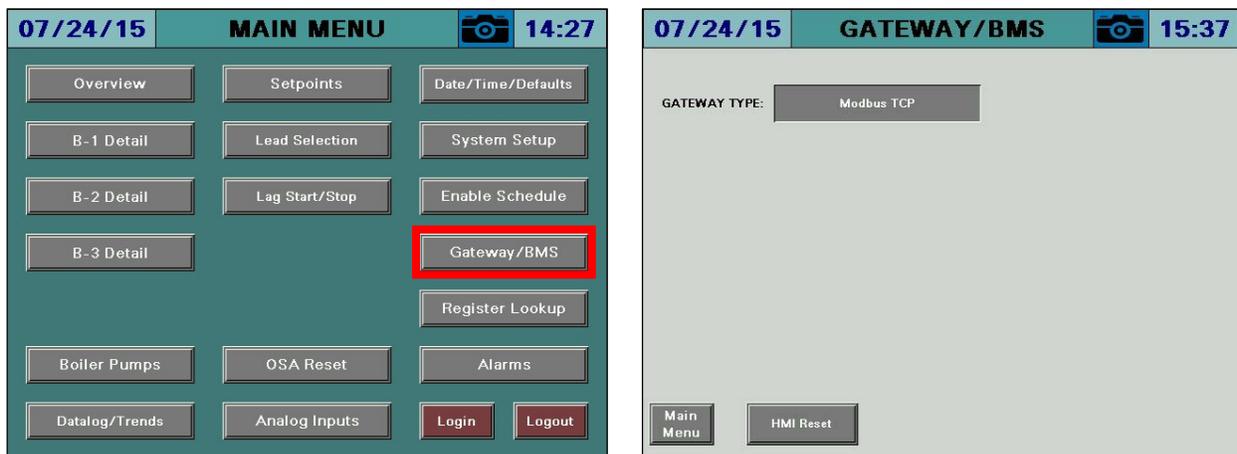


**GATEWAY TYPE –** Selects which port to make active for BMS communication.
- **MODBUS TCP  –** Sets the active port to Modbus TCP/IP via the Ethernet port.  The default IP address is 192.168.1.69 and the standard port is 502.  These settings cannot be changed.
- **MODBUS RTU COM1 (RS-232)  –** Sets the active port to Modbus RTU via the COM1 serial port (RS-232).  The default setting for this port is address 1, 19,200 baud, 8 data bits, 1 stop bit, no parity.
- **MODBUS RTU COM2 (RS-485)  –** Sets the active port to Modbus RTU via the COM2 serial port (RS-485).  The default setting for this port is address 1, 38,400 baud, 8 data bits, 1 stop bit, no parity.

## Gateway / BMS (continued)



If a TS Series Protocol Converter is connected, 'EXTERNAL GATEWAY CONNECTED' will appear. The configured protocol and version is also displayed.

# Gateway / BMS (continued)

Changing Serial Port Parameters

To change the serial port parameters, the HMI CONFIGURATION screen must first be accessed. Navigate to **MAIN MENU**, then **SYSTEM SETUP**.
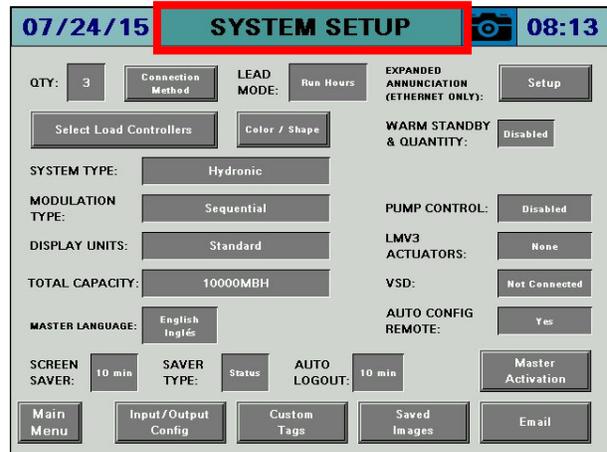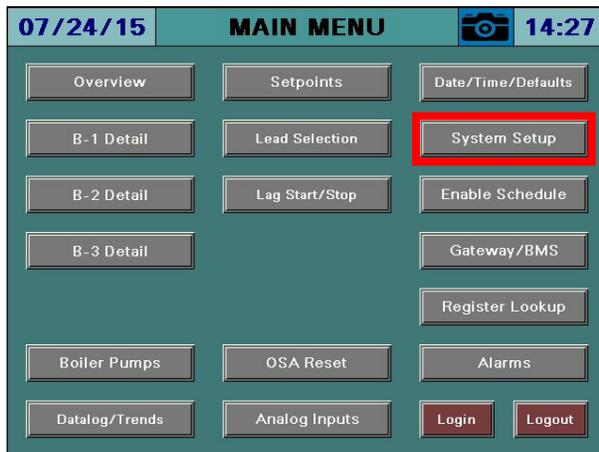


Press the SYSTEM SETUP title bar for >1s, then press the **HMI CONFIGURATION** button.  Once the HMI CONFIGURATION screen is displayed, press the **OFFLINE** tab.
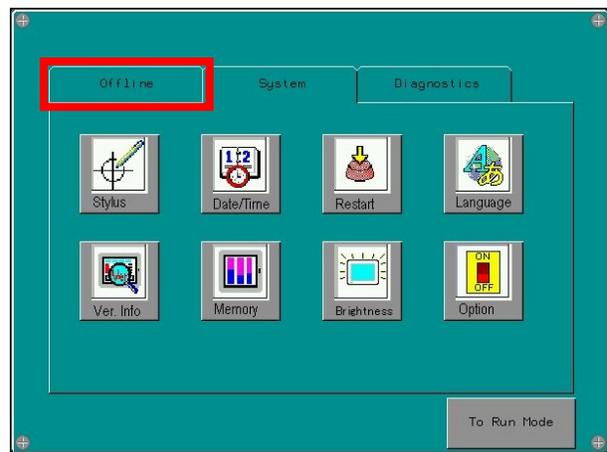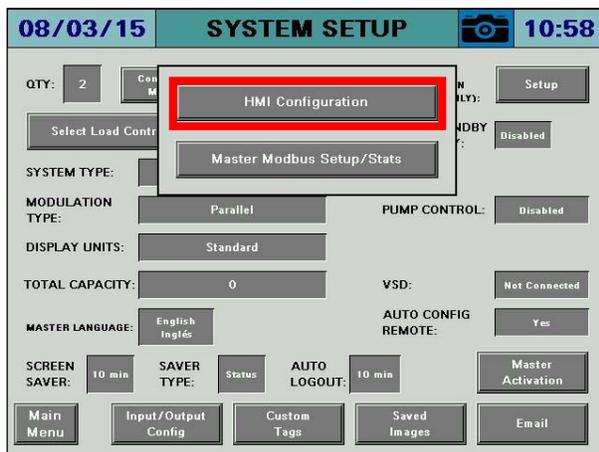
## Gateway / BMS (continued)

Once the OFFLINE tab is displayed, press **IO MANAGER**.  A warning will appear that the application must pause while the IO MANAGER screen is accessed.  Press **OK** to acknowledge this warning.
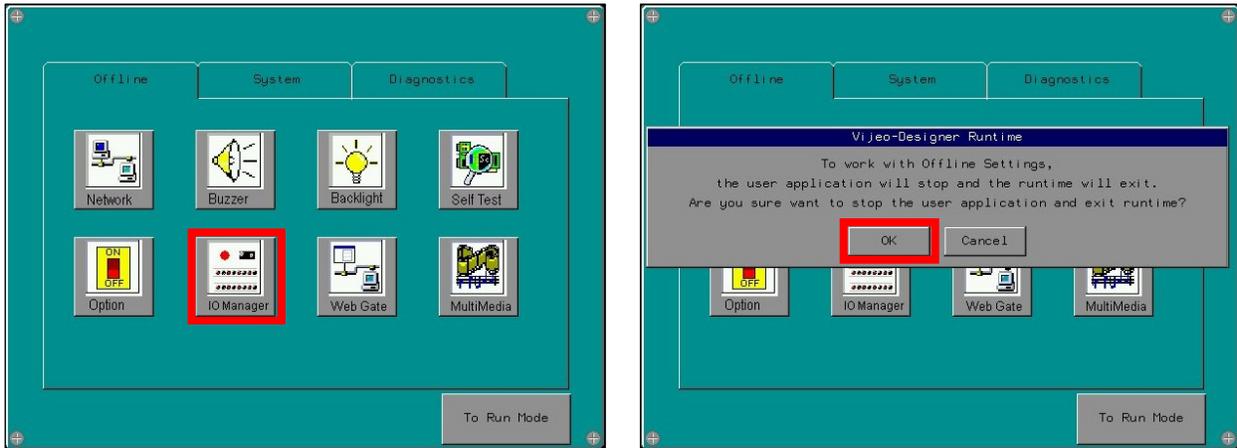


The screen will reboot into the IO MANAGER screen.  Press **EQUIPMENT CONFIG** to change the serial port parameters.  Choose the serial port desired from the dropdown menu.  'Converter' is COM2 (RS-485) and 'Converter2' is COM1 (RS-232).  Use the up/down arrows to scroll between the three pages of configuration, then press **OK** when finished.  From the IO MANAGER screen, press **RETURN**, then from the OFFLINE tab press **TO RUN MODE** to reboot the application.
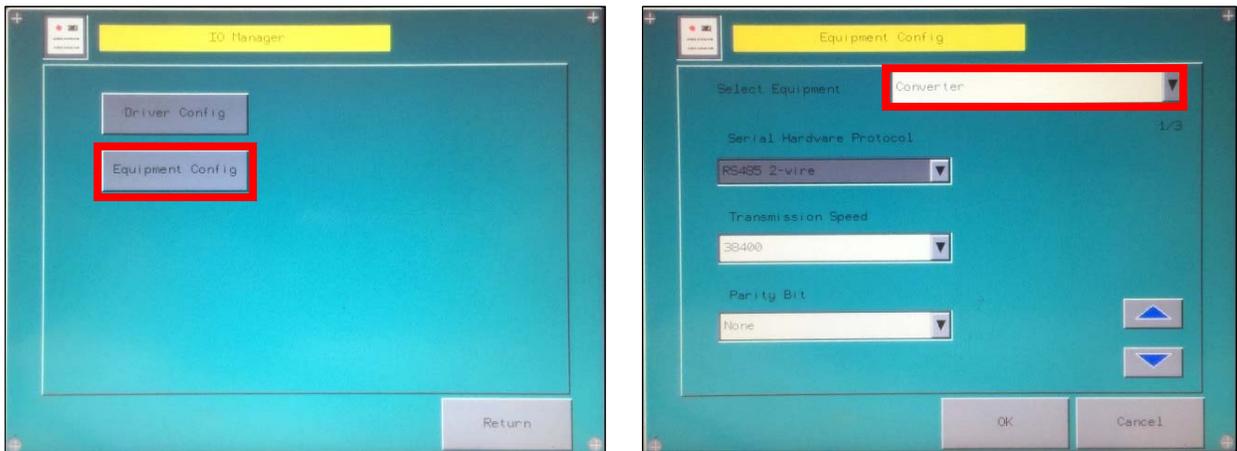
# Gateway / BMS (continued)

<u>Serial Port Wiring Interface</u>

If the desired serial port is not broken out into a terminal strip interface, it can still be used if connected directly to the desired touchscreen COM port.

### COM1 (RS-232)

| Pin Connection | Pin No. | RS-232C | | |
|---|---|---|---|---|
| | | Signal Name | Direction | Meaning |
| (Magelis GTO side) | 1 | CD | Input | Carrier Detect |
| | 2 | RD(RXD) | Input | Receive Data |
| | 3 | SD(TXD) | Output | Send Data |
| | 4 | ER(DTR) | Output | Data Terminal Ready |
| | 5 | SG | - | Signal Ground |
| | 6 | DR(DSR) | Input | Data Set Ready |
| | 7 | RS(RTS) | Output | Request to Send |
| | 8 | CS(CTS) | Input | Send possible |
| | 9 | CI(RI)/VCC | Input/– | Called Status Display +5V±5% Output 0.25A[*1] |
| | Shell | FG | – | Frame Ground (Common with SG) |
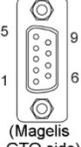
### COM2 (RS-485)

| Pin Connection | Pin No. | RS-485 | | |
|---|---|---|---|---|
| | | Signal Name | Direction | Meaning |
| Front | 1 | NC | - | - |
| | 2 | NC | - | - |
| | 3 | NC | - | - |
| | 4 | Line A | Input/Output | Transfer Data (RS-485) |
| | 5 | Line B | Input/Output | Transfer Data (RS-485) |
| | 6 | RS(RTS) | Output | Request To Send |
| | 7 | NC | - | - |
| | 8 | SG | - | Signal Ground |

To use COM1:
- Jumper pins 1, 4 and 6
- Jumper pins 7 and 8
- Receive on pin 2 (connect to transmit on client)
- Transmit on pin 3 (connect to receive on client)
- Common ground on pin 5 (must be connected)

To use COM2:
- Data+ / RS485+ / A on pin 4 (blue on typical Cat5 Ethernet cable)
- Data- / RS485- / B on pin 5 (white/blue on typical Cat5 Ethernet cable)
- Common ground on pin 8 (brown on typical Cat5 Ethernet cable, may be required)
- Some equipment refers to Data+ and Data- differently.  Change the polarity of the connection as a first test if communication cannot be established.

# Gateway / BMS (continued)

Modbus Mapping

The addresses shown are 0-based (begin at 0) and are in decimal format.

Supported function codes:
FC3  (read holding registers), address 0 = 40001.
FC4  (read input registers), address 0 = 30001.
FC6  (single register write), address 0 = 40001.
FC16  (multiple register write), address 0 = 40001.

Addresses with access R are read-only, access RW are read-write.

Modbus addresses designated as 'x00' through 'x99' are common to all connected boilers. Substitute the boiler number for the 'x'. For example, Modbus address 'x12' would equal Modbus address '112' for boiler 1, '212' for boiler 2, etc.

## Gateway / BMS - Global System Data

| ADDRESS | ACCESS | DESCRIPTION | FORMAT | NOTES |
|---|---|---|---|---|
| 0 | RW | LLM REMOTE ENABLE | Unsigned Int 16 | |
| 1 | RW | LLM REMOTE VALID | Unsigned Int 16 | |
| 2 | RW | LLM REMOTE SETPOINT | Unsigned Int 16 | |
| 3 | R | LLM LEAD BOILER | Unsigned Int 16 | |
| 4 | R | LLM ALTERNATION SETPOINT | Unsigned Int 16 | |
| 5 | R | LLM ALT HOURS REMAINING | Unsigned Int 16 | |
| 6 | R | LLM CURRENT SETPOINT | Unsigned Int 16 | |
| 7 | R | LLM TOTAL AVAILABLE | Unsigned Int 16 | |
| 8 | R | LLM ACTUAL VALUE | Unsigned Int 16 | |
| 9 | R | LLM RTD 1 | Unsigned Int 16 | x10 |
| 10 | R | LLM RTD 2 | Unsigned Int 16 | x10 |
| 11 | R | LLM RTD 3 | Unsigned Int 16 | x10 |
| 12 | R | LLM RTD 4 | Unsigned Int 16 | x10 |
| 13 | R | LLM ANALOG INPUT 1 U16 | Unsigned Int 16 | x10 |
| 14 | R | LLM ANALOG INPUT 2 U16 | Unsigned Int 16 | x10 |
| 15 | R | LLM ANALOG INPUT 3 U16 | Unsigned Int 16 | x10 |
| 16 | R | LLM ANALOG INPUT 4 U16 | Unsigned Int 16 | x10 |
| 17 | RW | LLM EXTRA INPUT | Unsigned Int 16 | |
| 18 | R | LLM ANALOG INPUT 1 FLOAT | Float 32 | |
| 20 | R | LLM ANALOG INPUT 2 FLOAT | Float 32 | |
| 22 | R | LLM ANALOG INPUT 3 FLOAT | Float 32 | |
| 24 | R | LLM ANALOG INPUT 4 FLOAT | Float 32 | |
| 26 | R | LLM LOAD DEMAND | Unsigned Int 16 | x10 |
| 27 | RW | LLM EXTRA OPTIONS | Unsigned Int 16 | |
| 28 | R | LLM ANALOG INPUT 1 TOTALIZED | Unsigned Int 32 | x10 |
| 30 | R | LLM ANALOG INPUT 2 TOTALIZED | Unsigned Int 32 | x10 |
| 32 | R | LLM ANALOG INPUT 3 TOTALIZED | Unsigned Int 32 | x10 |
| 34 | R | LLM ANALOG INPUT 4 TOTALIZED | Unsigned Int 32 | x10 |
| 49 | R | LLM WEEKDAY | Unsigned Int 16 | 0=Sun,1=Mon,2=Tue,etc. |
| 50 | R | LLM YEAR 2-DIGIT | Unsigned Int 16 | |
| 51 | R | LLM MONTH | Unsigned Int 16 | x10 |
| 52 | R | LLM DAY | Unsigned Int 16 | x10 |
| 53 | R | LLM HOUR | Unsigned Int 16 | x10 |
| 54 | R | LLM MINUTE | Unsigned Int 16 | x10 |
| 55 | R | LLM SECOND | Unsigned Int 16 | |
| 990 | R | LLM SOFTWARE MODEL STRING | String (5 words) | |
| 995 | R | LLM SOFTWARE VERSION STRING | String (2 words) | |

## Gateway / BMS - Data By Boiler

| ADDRESS | ACCESS | DESCRIPTION | FORMAT | NOTES |
|---|---|---|---|---|
| x00 | R | LMV PHASE | Unsigned Int 16 | |
| x01 | R | LMV FUEL ACTUATOR | Signed Int 16 | x10 |
| x02 | R | LMV GAS ACTUATOR | Signed Int 16 | x10 |
| x03 | R | LMV OIL ACTUATOR | Signed Int 16 | x10 |
| x04 | R | LMV AIR ACTUATOR | Signed Int 16 | x10 |
| x05 | R | LMV AUX1 ACTUATOR | Signed Int 16 | x10 |
| x06 | R | LMV AUX2 ACTUATOR | Signed Int 16 | x10 |
| x07 | R | LMV AUX3 ACTUATOR | Signed Int 16 | x10 |
| x08 | R | LMV VSD OUTPUT | Unsigned Int 16 | x10 |
| x09 | R | LMV CURRENT FUEL | Unsigned Int 16 | 0=gas/fuel0,1=oil/fuel1 |
| x10 | R | LMV CURRENT OUTPUT | Unsigned Int 16 | x10, see Note 1 below |
| x11 | R | LMV CURRENT SETPOINT | Unsigned Int 16 | |
| x12 | R | LMV ACTUAL VALUE | Unsigned Int 16 | |
| x13 | R | LMV FLAME SIGNAL | Unsigned Int 16 | x10 |
| x14 | R | LMV FUEL THROUGHPUT | Unsigned Int 16 | |
| x15 | R | LMV CURRENT $O_2$ | Unsigned Int 16 | x10 |
| x16 | R | BOILER AUTO | Unsigned Int 16 | 0=no,1=yes |
| x17 | R | BOILER AVAILABLE | Unsigned Int 16 | 0=no,1=yes |
| x18 | R | BOILER PUMP RUNNING | Unsigned Int 16 | 0=no,1=yes |
| x19 | R | BOILER PUMP ALARM | Unsigned Int 16 | 0=no,1=yes |
| x21 | R | LMV STARTUP COUNTER | Unsigned Int 32 | |
| x23 | R | LMV HOUR COUNTER | Unsigned Int 32 | |
| x25 | R | LMV CURRENT ERROR CODE | Unsigned Int 16 | |
| x26 | R | LMV CURRENT DIAGNOSTIC CODE | Unsigned Int 16 | |
| x27 | R | LMV CURRENT ERROR CLASS | Unsigned Int 16 | |
| x28 | R | LMV CURRENT ERROR PHASE | Unsigned Int 16 | |
| x29 | R | LMV TEMP LIMIT OFF THRESHOLD | Unsigned Int 16 | |
| x30 | R | LMV SUPPLY AIR TEMPERATURE | Unsigned Int 16 | |
| x31 | R | LMV FLUE GAS TEMPERATURE | Unsigned Int 16 | |
| x32 | R | LMV COMBUSTION EFFICIENCY | Unsigned Int 16 | x10 |
| x33 | R | LMV CURRENT $CO_2$ | Unsigned Int 16 | x10 |
| x34 | R | LMV CURRENT EXCESS AIR | Unsigned Int 16 | x10 |
| x35 | R | LMV INPUT WORD | Unsigned Int 16 | word of bits |
| x35 bit 0 | R | LMV CONTROLLER SWITCH | Boolean | |
| x35 bit 1 | R | LMV FAN CONTACTOR | Boolean | |
| x35 bit 2 | R | LMV OIL SELECTED | Boolean | |
| x35 bit 3 | R | LMV GAS SELECTED | Boolean | |
| x35 bit 5 | R | LMV OIL PRESS SW MAX | Boolean | |
| x35 bit 6 | R | LMV OIL PRESS SW MIN | Boolean | |
| x35 bit 7 | R | LMV VALVE PROVING SW | Boolean | |
| x35 bit 8 | R | LMV SAFETY LOOP | Boolean | |
| x35 bit 10 | R | LMV GAS PRESS SW MIN | Boolean | |
| x35 bit 11 | R | LMV GAS PRESS SW MAX | Boolean | |
| x35 bit 13 | R | LMV AIR PRESSURE SW | Boolean | |
| x35 bit 14 | R | LMV START RELEASE OIL | Boolean | |
| x35 bit 15 | R | LMV HEAVY OIL START | Boolean | |

# Gateway / BMS - Data By Boiler (continued)

| ADDRESS | ACCESS | DESCRIPTION | FORMAT | NOTES |
|---|---|---|---|---|
| x37 | R | LMV OUTPUT WORD | Unsigned Int 16 | word of bits |
| x37 bit 0 | R | LMV ALARM | Boolean | |
| x37 bit 4 | R | LMV IGNITION | Boolean | |
| x37 bit 5 | R | LMV START SIGNAL | Boolean | |
| x37 bit 6 | R | LMV FAN OUTPUT | Boolean | |
| x37 bit 7 | R | LMV OIL PUMP | Boolean | |
| x37 bit 8 | R | LMV FUEL VALVE SV OIL | Boolean | |
| x37 bit 9 | R | LMV FUEL VALVE V1 OIL | Boolean | |
| x37 bit 10 | R | LMV FUEL VALVE V2 OIL | Boolean | |
| x37 bit 11 | R | LMV FUEL VALVE V3 OIL | Boolean | |
| x37 bit 12 | R | LMV FUEL VALVE SV GAS | Boolean | |
| x37 bit 13 | R | LMV FUEL VALVE V1 GAS | Boolean | |
| x37 bit 14 | R | LMV FUEL VALVE V2 GAS | Boolean | |
| x37 bit 15 | R | LMV FUEL VALVE PV GAS | Boolean | |
| x38 | R | LMV PROGRAM STOP | Unsigned Int 16 | see Note 2 below |
| x39 | R | LMV LOAD CONTROL MODE | Unsigned Int 16 | see Note 3 below |
| x40 | R | LMV MANUAL/AUTOMATIC | Unsigned Int 16 | 0=auto,1=on,2=off |
| x41 | R | LMV MODBUS LOCAL/REMOTE | Unsigned Int 16 | 0=local,1=remote |
| x42 | R | LMV MODBUS WATCHDOG | Unsigned Int 16 | |
| x43 | R | LMV MODBUS OPERATING MODE | Unsigned Int 16 | 0=auto,1=on,2=off |
| x44 | R | LMV MODBUS SETPOINT W3 | Unsigned Int 16 | |
| x45 | R | LMV MODBUS OUTPUT | Unsigned Int 16 | x10, see Note 1 below |
| x46 | R | LMV MODBUS FUEL SELECTION | Unsigned Int 16 | 0=gas/fuel0,1=oil/fuel1 |
| x47 | R | LMV SETPOINT W1 | Unsigned Int 16 | |
| x48 | R | LMV SETPOINT W2 | Unsigned Int 16 | |
| x49 | R | LMV WEEKDAY | Unsigned Int 16 | |
| x50 | R | LMV YEAR 2-DIGIT | Unsigned Int 16 | |
| x51 | R | LMV MONTH | Unsigned Int 16 | |
| x52 | R | LMV DAY | Unsigned Int 16 | |
| x53 | R | LMV HOUR | Unsigned Int 16 | |
| x54 | R | LMV MINUTE | Unsigned Int 16 | |
| x55 | R | LMV SECOND | Unsigned Int 16 | |
| x60 | R | RWF E1 U16 | Unsigned Int 16 | x10 |
| x61 | R | RWF E2 U16 | Unsigned Int 16 | x10 |
| x62 | R | RWF E3 U16 | Unsigned Int 16 | x10 |
| x63 | R | RWF WR CURRENT SP U16 | Unsigned Int 16 | x10 |
| x64 | R | RWF SP1 U16 | Unsigned Int 16 | x10 |
| x65 | R | RWF LC INPUT WORD | Unsigned Int 16 | |
| x65 bit 12 | R | RWF LC INPUT 1 FAULT | Boolean | |
| x65 bit 13 | R | RWF LC INPUT 2 FAULT | Boolean | |
| x65 bit 14 | R | RWF LC INPUT 3 FAULT | Boolean | |
| x66 | R | RWF LC OUTPUT WORD | Unsigned Int 16 | |
| x66 bit 0 | R | RWF LC STAGE MODE | Boolean | |
| x66 bit 1 | R | RWF LC MANUAL OPERATION | Boolean | |
| x66 bit 2 | R | RWF LC BINARY INPUT 1 | Boolean | |
| x66 bit 3 | R | RWF LC BINARY INPUT 2 | Boolean | |

# Gateway / BMS - Data By Boiler (continued)

| ADDRESS | ACCESS | DESCRIPTION | FORMAT | NOTES |
|---|---|---|---|---|
| x66 bit 4 | R | RWF LC STAT ACTIVE | Boolean | |
| x66 bit 5 | R | RWF LC UP ACTIVE | Boolean | |
| x66 bit 6 | R | RWF LC DOWN ACTIVE | Boolean | |
| x66 bit 7 | R | RWF LC K6 ACTIVE | Boolean | |
| x68 | R | RWF LC E1 FLOAT | Float 32 | |
| x70 | R | RWF LC E2 FLOAT | Float 32 | |
| x72 | R | RWF LC E3 FLOAT | Float 32 | |
| x74 | R | RWF LC WR FLOAT CURRENT SP | Float 32 | |
| x76 | R | RWF LC SP1 FLOAT | Float 32 | |
| x78 | R | LMV TOTAL VOLUME GAS/FUEL0 | Unsigned Int 32 | |
| x80 | R | LMV TOTAL VOLUME OIL/FUEL1 | Unsigned Int 32 | |
| x83 | R | LMV EXTRA TEMPERATURE SENSOR | Unsigned Int 16 | |
| x86 | R | FW E1 U16 | Unsigned Int 16 | x10 |
| x87 | R | FW E2 U16 | Unsigned Int 16 | x10 |
| x88 | R | FW WR CURRENT SP U16 | Unsigned Int 16 | x10 |
| x89 | R | FW SP1 U16 | Unsigned Int 16 | x10 |
| x90 | R | FW E1 FLOAT | Float 32 | |
| x92 | R | FW E2 FLOAT | Float 32 | |
| x94 | R | FW WR CURRENT SP FLOAT | Float 32 | |
| x96 | R | FW SP1 FLOAT | Float 32 | |

# Gateway / BMS - Data By Boiler (continued)

Notes

**Note 1 –** This value is a percent x10.  If the value exceeds 1000, it indicates stages.
- **1001:** 1 stage
- **1002:** 2 stages
- **1003:** 3 stages

**Note 2 –** LMV program stop.
- **0:** deactivated (LMV5,LMV3)
- **1:** prepurge phase 24 (LMV5,LMV3)
- **2:** prepurge FGR phase 32 (LMV5), ignition position phase 36 (LMV3)
- **3:** ignition position phase 36 (LMV5), interval 1 phase 44 (LMV3)
- **4:** interval 1 phase 44 (LMV5), interval 2 phase 52 (LMV3)
- **5:** interval 2 phase 52 (LMV5)
- **6:** postpurge phase 72 (LMV5)
- **7:** postpurge FGR phase 76 (LMV5)

**Note 3 –** LMV5 operating mode.
- **0:** external load control X5-03
- **1:** internal load control
- **2:** internal load control bus
- **3:** internal load control X62
- **4:** external load control X62
- **5:** external load control bus

## Appendix -LMV Phases

| NUMBER | DESCRIPTION |
|--------|-------------|
| 0 | LOCKOUT PHASE |
| 1 | SAFETY PHASE |
| 2 | SAFETY PHASE |
| 10 | HOME RUN POSITION |
| 12 | STANDBY STATIONARY |
| 20 | SAFETY RELAY ON |
| 21 | RELEASE OF STARTUP |
| 22 | FAN MOTOR ON |
| 24 | DRIVE TO PURGE |
| 30 | PREPURGE |
| 32 | PREPURGE FGR |
| 34 | PREPURGE |
| 36 | DRIVE TO IGNITION |
| 38 | PREIGNITION SPARK ON |
| 39 | GAS VALVE TEST MINIMUM PRESSURE |
| 40 | PILOT VALVE OPEN |
| 42 | SPARK OFF |
| 44 | INTERVAL 1 PILOT STABILIZE |
| 50 | FUEL VALVE OPEN SAFETY TIME 2 |
| 52 | PILOT VALVE CLOSED INTERVAL 2 MAIN FLAME |
| 54 | DRIVE TO LOW FIRE PRE |
| 60 | NORMAL OPERATION |
| 62 | DRIVE TO LOW FIRE POST |
| 70 | FV CLOSED AFTER BURN TIME |
| 72 | DRIVE TO POSTPURGE |
| 74 | MANDATORY POSTPURGE |
| 76 | MANDATORY POSTPURGE |
| 78 | OPTIONAL POSTPURGE |
| 79 | DIRECT START (APS CHECK) |
| 80 | GV TEST EVACUATION OF TEST SPACE |
| 81 | GV TEST ATMOSPHERIC PRESSURE TEST |
| 82 | GV TEST FILL TEST SPACE |
| 83 | GV TEST PRESSURE TEST |
| 90 | GAS SHORTAGE WAITING TIME |
| 97 | NO CONFIGURATION |
| 98 | WAITING TO ESTABLISH COMMUNICATION |
| 99 | COMMUNICATION FAULT |

# Appendix -LMV5 Lockout / Error Codes

| CODE DECIMAL | CODE HEX | DESCRIPTION |
|---|---|---|
| 0 | 0 | NO ERROR |
| 1 | 1 | ROM ERROR |
| 2 | 2 | RAM ERROR |
| 3 | 3 | INTERNAL COMMUNICATION ERROR |
| 4 | 4 | UNSUCCESSFUL SYNC OF 2uCs |
| 5 | 5 | FAULT DURING FLAME AMP TEST |
| 6 | 6 | FAULT INTERNAL HARDWARE TEST |
| 16 | 10 | DIGITAL OUTPUT FAULT |
| 17 | 11 | SHORT CIRCUIT CONTACT FEEDBACK |
| 21 | 15 | ACTUATOR FAULT/VSD SPEED NOT REACHED |
| 22 | 16 | FAULT IN RATIO CONTROL SYSTEM |
| 23 | 17 | LMV5 INTERNAL COM ERROR |
| 24 | 18 | CORRUPTION IN COMBUSTION CURVE DATA |
| 25 | 19 | ACTUATOR POT ERROR |
| 26 | 1A | ACTUATOR CURVE TOO STEEP |
| 27 | 1B | ACT CURVE PROGRAMMING ACTIVE PHASE 62 |
| 28 | 1C | ACTUATOR IGNITION POSITION NOT SET |
| 29 | 1D | RUNNING TIME FAULT ACTUATORS/VSD |
| 30 | 1E | ACTUATOR/VSD NOT REACHED POSITION |
| 31 | 1F | VSD MODULE CONNECTION ERROR |
| 33 | 21 | SAFETY LOOP OPEN |
| 34 | 22 | TEMP LIMITER OFF (CHECK SENSOR) |
| 35 | 23 | EXTRANEOUS LIGHT DURING STARTUP |
| 36 | 24 | EXTRANEOUS LIGHT DURING SHUTDOWN |
| 37 | 25 | NO FLAME AT END OF SAFETY TIME |
| 38 | 26 | LOSS OF FLAME PHASE 60-62 |
| 39 | 27 | AIR PROVE SW ON SHOULD BE OFF |
| 40 | 28 | AIR PROVE SW OFF SHOULD BE ON |
| 41 | 29 | FAN CONTACT SIGNAL ON SHOULD BE OFF |
| 42 | 2A | FAN CONTACT SIGNAL OFF SHOULD BE ON |
| 43 | 2B | FGR PRESSURE SW ON SHOULD BE OFF |
| 44 | 2C | FGR PRESSURE SW OFF SHOULD BE ON |
| 45 | 2D | CPI (POC) ON SHOULD BE OFF |
| 46 | 2E | CPI (POC) OFF SHOULD BE ON |
| 47 | 2F | LOW GAS PRESSURE SWITCH OPEN |
| 48 | 30 | HIGH GAS PRESSURE SWITCH OPEN |
| 49 | 31 | VALVE PROVE - GAS SIDE LEAK |
| 50 | 32 | VALVE PROVE - BURNER SIDE LEAK |
| 51 | 33 | OIL PRESSURE WHEN OIL PUMP OFF |
| 52 | 34 | LOW OIL PRESSURE WHEN PUMP RUNNING |
| 53 | 35 | HIGH OIL PRESSURE SWITCH OPEN |
| 54 | 36 | NO START RELEASE FOR OIL |
| 55 | 37 | NO HEAVY OIL DIRECT START |
| 56 | 38 | SHORTAGE OF GAS PROGRAM IN PROGRESS |
| 57 | 39 | PARAMETER OF MAX SAFETY TIME FAULTY |
| 58 | 3A | NO BURNER ID DEFINED |

# Appendix -LMV5 Lockout / Error Codes (continued)

| ` | CODE HEX | DESCRIPTION |
|---|---|---|
| 59 | 3B | NO SERVICE PASSWORD DEFINED |
| 64 | 40 | WRONG CONTACT POSITION OF SAFETY TIME |
| 65 | 41 | WRONG CONTACT POSITION OF IGNITION |
| 66 | 42 | WRONG CONTACT POSITION OF FUEL RELAY |
| 67 | 43 | PLAUSIBILITY CHECK FAULT |
| 68 | 44 | FAULT AT DEACTIVATED INPUTS |
| 69 | 45 | SHUTDOWN VIA SAFETY LIMIT TEST |
| 70 | 46 | PROGRAM STOP ACTIVATED |
| 71 | 47 | START RELEASE GAS IS OFF |
| 72 | 48 | TWO FLAME SIGNALS WITH ONE PARMETERIZED |
| 80 | 50 | FAULT DURING KEY VALUE CHECK |
| 81 | 51 | TIME BLOCK OVERFLOW |
| 82 | 52 | STACK ERROR |
| 83 | 53 | FAULTY RESET STATE OCCURRED |
| 88 | 58 | INTERNAL COMMUNICATION (uC1<>uC2) |
| 89 | 59 | EEPROM PAGE IS ON ABORT |
| 90 | 5A | CRC ERROR OF PARAMETER RANGE |
| 91 | 5B | PAGE ON ABORT |
| 92 | 5C | PAGE ON WR_RESTO (BACKUP RESTORE MADE) |
| 93 | 5D | PAGE OPEN TOO LONG |
| 94 | 5E | PAGE HAS UNDEFINED STATUS |
| 95 | 5F | LAST BACKUP RESTORE INVALID (INTERRUPTED) |
| 96 | 60 | FAULT COPYING A PARAMETER PAGE |
| 97 | 61 | FAULT WITH EEPROM INITIALIZATION |
| 112 | 70 | FAULT DURING RESTORING LOCKOUT INFO |
| 113 | 71 | MANUAL LOCKOUT VIA CONTACT |
| 114 | 72 | PLAUSIBILITY FAULT WITH FAULT ENTRY |
| 128 | 80 | WRONG STATE OF AUX3 ACTUATOR |
| 129 | 81 | WRONG STATE OF AIR ACTUATOR |
| 130 | 82 | WRONG STATE OF GAS ACTUATOR |
| 131 | 83 | WRONG STATE OF OIL ACTUATOR |
| 132 | 84 | WRONG STATE OF AUX1 ACTUATOR |
| 133 | 85 | WRONG STATE OF AUX2 ACTUATOR |
| 134 | 86 | WRONG STATE OF INTERNAL LOAD CONTROLLER |
| 135 | 87 | WRONG STATE OF AZL |
| 136 | 88 | PLAUSIBILITY FAULT (NMT) |
| 144 | 90 | ROM-CRC ERROR ON  AUX3 FEEDBACK |
| 145 | 91 | ROM-CRC ERROR ON AIR FEEDBACK |
| 146 | 92 | ROM-CRC ERROR ON GAS FEEDBACK |
| 147 | 93 | ROM-CRC ERROR ON OIL FEEDBACK |
| 148 | 94 | ROM-CRC ERROR ON AUX1 FEEDBACK |
| 149 | 95 | ROM-CRC ERROR ON AUX2 FEEDBACK |
| 150 | 96 | ROM-CRC ERROR ON LC FEEDBACK |
| 151 | 97 | ROM-CRC ERROR ON AZL FEEDBACK |
| 152 | 98 | CANBUS DEVICE WITH SAME ADDRESS CONFLICT |
| 153 | 99 | CANBUS IS OFF |

# Appendix -LMV5 Lockout / Error Codes (continued)

| CODE DECIMAL | CODE HEX | DESCRIPTION |
|---|---|---|
| 154 | 9A | CANBUS WARNING LEVEL |
| 155 | 9B | CANBUS QUEUE OVERRUN |
| 160 | A0 | AUX3 ACTUATOR DETECTED A FAULT |
| 161 | A1 | AIR ACTUATOR DETECTED A FAULT |
| 162 | A2 | GAS ACTUATOR DETECTED A FAULT |
| 163 | A3 | OIL ACTUATOR DETECTED A FAULT |
| 164 | A4 | AUX1 ACTUATOR DETECTED A FAULT |
| 165 | A5 | AUX2 ACTUATOR DETECTED A FAULT |
| 166 | A6 | LOAD CONTROL DETECTED A FAULT |
| 167 | A7 | AZL DETECTED A FAULT |
| 169 | A9 | VSD MODULE DETECTED A FAULT |
| 171 | AB | $O_2$ MODULE DETECTED A FAULT |
| 176 | B0 | FAULT DURING TEST OF PORT OUTPUTS |
| 177 | B1 | FAULT DURING SHORT CIRCUIT TEST |
| 181 | B5 | $O_2$ MONITOR FAULT |
| 186 | BA | $O_2$ SENSOR TEST FAILED |
| 191 | BF | $O_2$ CONTROL AUTO DEACTIVATION |
| 197 | C5 | AZL HAS DETECTED OLD UNIT VERSIONS |
| 209 | D1 | WRONG STATE OF VSD MODULE |
| 211 | D3 | WRONG STATE OF $O_2$ MODULE |
| 225 | E1 | ROM-CRC ERROR ON VSD MODULE FEEDBACK |
| 227 | E3 | ROM-CRC ERROR ON $O_2$ MODULE FEEDBACK |
| 240 | F0 | PLAUSIBILITY FAULT (INTERPOLATION) |
| 241 | F1 | FAULT CALCULATING PRECONTROL |
| 242 | F2 | FAULTY TEMP VALUES FROM $O_2$ MODULE |
| 87 | 57 | INVALID PARAMETERIZATION |
| 187 | BB | $O_2$ TRIM CONTROL REMOVED |
| 190 | BE | INVALID PARAMETERIZATION $O_2$ CONTROL |
| 243 | F3 | $O_2$ TRIM CONTROL FAULT |
| 244 | F4 | $O_2$ MODULE FAULT (FGR) |
| 245 | F5 | CANBUS FEEDBACK FAULT X60 TEMP INPUT |
| 246 | F6 | FGR FAULT |

# Appendix -LMV3 Error Codes

| CODE | DESCRIPTION |
|------|-------------|
| 2 | NO FLAME AT END OF SAFETY TIME |
| 3 | AIR PRESSURE FAILURE |
| 4 | EXTRANEOUS LIGHT |
| 7 | LOSS OF FLAME |
| 12 | VALVE PROVING |
| 14 | PROOF OF CLOSURE |
| 19 | COMBUSTION PRESSURE POC |
| 20 | PRESSURE SWITCH - MINIMUM |
| 21 | PRESSURE SWITCH - MAXIMUM |
| 22 | SAFETY LOOP / BURNER FLANGE |
| 50 | INTERNAL ERROR |
| 51 | INTERNAL ERROR |
| 55 | INTERNAL ERROR |
| 56 | INTERNAL ERROR |
| 57 | INTERNAL ERROR |
| 58 | INTERNAL ERROR |
| 60 | INTERNAL ERROR - NO VALID HEAT SOURCE |
| 61 | FUEL CHANGEOVER |
| 62 | INVALID FUEL SIGNALS OR INFORMATION |
| 65 | INTERNAL ERROR |
| 66 | INTERNAL ERROR |
| 67 | INTERNAL ERROR |
| 70 | INTERNAL ERROR - FUEL/AIR RATIO CONTROL |
| 71 | SPECIAL POSITION UNDEFINED |
| 72 | INTERNAL ERROR - FUEL/AIR RATIO CONTROL |
| 73 | INTERNAL ERROR - FUEL/AIR RATIO CONTROL |
| 75 | INTERNAL ERROR - FUEL/AIR RATIO CONTROL |
| 76 | INTERNAL ERROR - FUEL/AIR RATIO CONTROL |
| 80 | CONTROL RANGE LIMIT OF VSD |
| 81 | VSD ELECTROMAGNETIC INTERFERENCE |
| 82 | ERROR DURING VSD SPEED STANDARDIZATION |
| 83 | SPEED ERROR VSD |
| 84 | CURVE SLOPE ACTUATORS |
| 85 | ACTUATOR REFERENCING ERROR |
| 86 | ERROR FUEL ACTUATOR |
| 87 | ERROR AIR ACTUATOR |
| 90 | INTERNAL ERROR - BASIC UNIT |
| 91 | INTERNAL ERROR - BASIC UNIT |
| 93 | ERROR FLAME SIGNAL ACQUISITION |
| 95 | ERROR RELAY SUPERVISION |
| 96 | ERROR RELAY SUPERVISION |
| 97 | ERROR RELAY SUPERVISION |
| 98 | ERROR RELAY SUPERVISION |
| 99 | INTERNAL ERROR - RELAY CONTROL |
| 100 | INTERNAL ERROR - RELAY CONTROL |
| 105 | INTERNAL ERROR - CONTACT SAMPLING |

# Appendix -LMV3 Error Codes (continued)

| CODE | DESCRIPTION |
|------|-------------|
| 106 | INTERNAL ERROR - CONTACT REQUEST |
| 107 | INTERNAL ERROR - CONTACT REQUEST |
| 108 | INTERNAL ERROR - CONTACT REQUEST |
| 110 | INTERNAL ERROR - VOLTAGE MONITOR TEST |
| 111 | POWER FAILURE |
| 112 | MAINS VOLTAGE RECOVERY |
| 113 | INTERNAL ERROR - MAINS VOLTAGE |
| 115 | INTERNAL ERROR - SYSTEM COUNTER |
| 116 | DESIGN THRESHOLD EXCEEDED |
| 117 | LIFETIME EXCEEDED - OPERATION NOT ALLOWED |
| 120 | FUEL METERING INTERFERENCE |
| 121 | INTERNAL ERROR - EEPROM ACCESS |
| 122 | INTERNAL ERROR - EEPROM ACCESS |
| 123 | INTERNAL ERROR - EEPROM ACCESS |
| 124 | INTERNAL ERROR - EEPROM ACCESS |
| 125 | INTERNAL ERROR - EEPROM READ ACCESS |
| 126 | INTERNAL ERROR - EEPROM WRITE ACCESS |
| 127 | INTERNAL ERROR - EEPROM ACCESS |
| 128 | INTERNAL ERROR - EEPROM ACCESS |
| 129 | INTERNAL ERROR - EEPROM ACCESS |
| 130 | INTERNAL ERROR - EEPROM ACCESS |
| 131 | INTERNAL ERROR - EEPROM ACCESS |
| 132 | INTERNAL ERROR - EEPROM REG INITIALIZATION |
| 133 | INTERNAL ERROR - EEPROM REQUEST SYNC |
| 134 | INTERNAL ERROR - EEPROM REQUEST SYNC |
| 135 | INTERNAL ERROR - EEPROM REQUEST SYNC |
| 136 | RESTORE STARTED |
| 137 | INTERNAL ERROR - BACKUP/RESTORE |
| 146 | TIMEOUT - BAS MODBUS |
| 150 | TUV TEST |
| 165 | INTERNAL ERROR |
| 166 | INTERNAL ERROR - WATCHDOG TEST |
| 167 | MANUAL LOCKING |
| 168 | INTERNAL ERROR - MANAGEMENT |
| 169 | INTERNAL ERROR - MANAGEMENT |
| 170 | INTERNAL ERROR - MANAGEMENT |
| 171 | INTERNAL ERROR - MANAGEMENT |
| 200 | NO ERROR |
| 201 | PREVENTION OF STARTUP |
| 202 | INTERNAL ERROR - OPERATING MODE SELECT |
| 203 | INTERNAL ERROR |
| 204 | PROGRAM STOP |
| 205 | INTERNAL ERROR |
| 206 | COMBINATION OF UNITS NOT ALLOWED |
| 207 | AZL VERSION COMPATIBILITY ERROR |
| 208 | INTERNAL ERROR |

# Appendix -LMV3 Error Codes (continued)

| CODE | DESCRIPTION |
|------|-------------|
| 209 | INTERNAL ERROR |
| 210 | SELECTED MODE NOT RELEASED FOR BASIC UNIT |
| 240 | INTERNAL ERROR |
| 245 | INTERNAL ERROR |
| 250 | INTERNAL ERROR |

# Appendix - Parallel Modulation

Output
PID output ranges from 0% to (100% x number of boilers available).  An available boiler is one that can be operated by the Lead/Lag Master.  For example, if there are 5 boilers in a system but only 3 are available, the max PID output will be 300%.  If none are available, PID will be disabled to avoid wind-up and the screen will display 'NO BOILERS AVAILABLE' instead of a PID output percent.

Enables
The start and stop percentages will be based upon this total output percentage.   If lag 1 has a start percentage of 100%, the start timer will begin when the PID output exceeds 100% and the lead boiler is running.  The effect of this would be to start lag 1 when the lead boiler is at 100% firing rate.  The stop percentage must be lower than the start percentage, so that it will take effect when the demand begins to drop.  To follow this, lag 2 would have a start percentage of 200%, lag 3 300%, etc.  The start percentages can also be set lower as desired if parallel operation at lower firing rates is desired.

Firing Rates
The firing rates sent to the boilers will be the PID output divided by the number of boilers running, clipped at 100%.  Each boiler is subject to a modulation delay once the fuel valve opens, and will hold at low fire until this is complete.  Other situations that force low fire operation are when a boiler local actual value is greater than the local boiler setpoint plus the "low-fire hold force above setpoint" parameter ("software relief valve") or when the boiler actual (hydronic) or shell (steam) temperature are below the "low fire hold setpoint".

Example
A system is set up for 3 boilers and all 3 are available.  Lag 1 is set to start at 80%, stop at 40% and lag 2 is set to start at 200%, stop at 150%.  The lead starts when the demand first exceeds 2% (a fixed value) and modulates directly to the PID output.  Once that exceeds 80%, the lag 1 timer starts.  By the time lag 1 begins running the output is 90%, so the lead and lag boiler each are sent a firing rate of 45%.  This causes the lead boiler to modulate down from 90% to 45%. The demand continues to increase, and once it exceeds 200% the process repeats for lag 2.  The lead and lag 1 modulate down from 100% each to 67% each, and lag 2 joins with a firing rate of 67% as well.  If demand increases to the max of 300%, all three will be at 100% firing rate.  If it drops below 150% (each at 50%), lag 2 is shed and the lead and lag 1 now operate at 75% each. Once it drops below 40%, lag 1 is also shed and the lead boiler goes up to 40% from 20% and will be the only boiler until the load is gone or increases again and lag 1 rejoins.

# Appendix - Sequential Modulation

Output

PID output ranges from 0% to (100% x number of boilers available).  An available boiler is one that can be operated by the Lead/Lag Master, i.e. one that is in Auto, has the control switch input made, isn't locked out, and is in a bus control mode (LMV5).  So, if there are 5 boilers in a system but only 3 are available, the max PID output will be 300%.  If none are available, PID will be disabled to avoid wind-up and the screen will display 'NO BOILERS AVAILABLE' instead of a PID output percent.

Enables

The start percentage for lag boilers is common to all and will be based upon a 100% individual firing rate.   If the start percentage is 80%, the start timer will begin when the PID output of the previous boiler is at 80% and the previous boiler is running.  The stop percentage in sequential mode is when the boiler is at low fire for the stop duration.

Firing Rates / Example

The firing rates sent to the boilers will be the PID output, sectioned off per boiler.  With 3 boilers, a max of 300% and a start percentage of 80%, the lead will modulate from 0%-80% from PID output 0-80%, then hold at 80%.  Lag 1 will then start and modulate 0%-80% from PID output 81%-160%.  If the PID output swings between 81% and 160%, only lag 1 will modulate while the lead will hold at 80%.  Lag 2 will then start and modulate 0%-80% from PID output 161%-240%.  Once the PID output reaches 240% and each boiler is running at 80%, the remaining 60% will be divided and added to each boiler in parallel.  So, if the output increases to 270%, each will run at 90%, 80% plus 10% (270% minus 240% divided by 3).

# Appendix - System Local-Off-Remote Flowchart
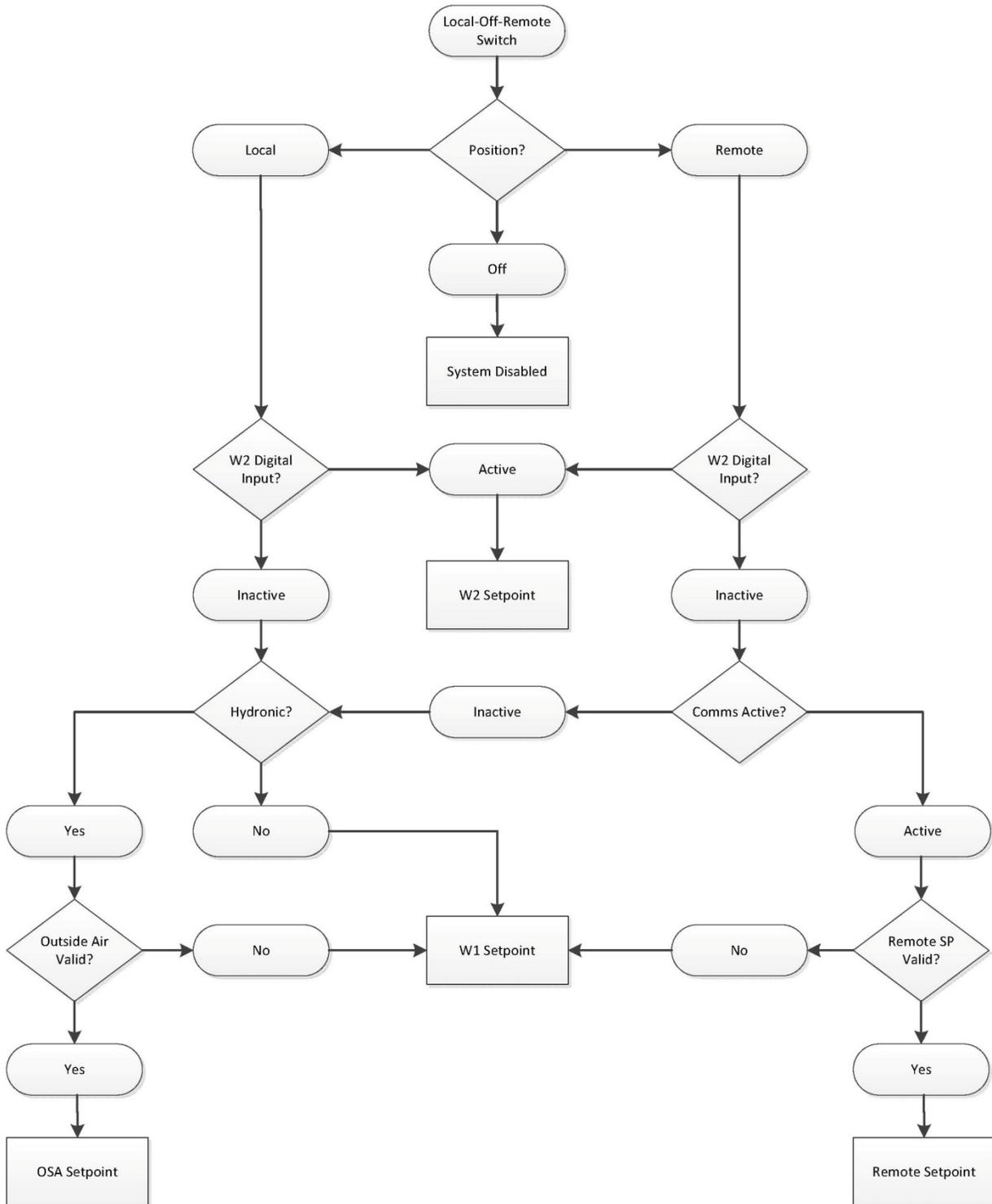
## Appendix - Boiler Hand-Off-Auto Flowchart (Serial Connection)

## Appendix - Boiler Hand-Off-Auto Flowchart (Touchscreen Kit)

```
                          ┌─────────────────┐
                          │  Hand-Off-Auto  │
                          │     Switch      │
                          └─────────────────┘
                                   │
                                   ▼
          ┌──────┐           ◇ Position? ◇           ┌──────┐
          │ Hand │ ◄─────────                ────────►│ Auto │
          └──────┘                                    └──────┘
             │                   │                        │
             ▼                   ▼                        ▼
         ◇ Manual? ◇        ┌─────────┐            ◇ Comms Active? ◇
                            │   Off   │
                            └─────────┘
                                 │
                                 ▼
                       ┌──────────────────────────┐
                       │ Local/Remote (41) = Remote│
                       │ Remote Mode (43) = Off    │
                       │ W3 Setpoint (44) = W1 Setpoint │
                       │ Remote Output (45) = N/A  │
                       └──────────────────────────┘

   ┌────────┐              ┌──────────┐                  ┌────────┐
   │ Active │              │ Inactive │                  │ Active │
   └────────┘              └──────────┘                  └────────┘
        │                       │                            │
        ▼                       ▼                            ▼
┌──────────────────┐  ┌──────────────────┐  ┌────────────────────────────┐
│Local/Remote (41)=│  │Local/Remote (41)=│  │Local/Remote (41) = From BMS/LLM│
│  Remote          │  │  Local           │  │Remote Mode (43) = From BMS/LLM │
│Remote Mode (43)= │  │Remote Mode (43)= │  │W3 Setpoint (44) = From BMS/LLM │
│  On              │  │  N/A             │  │Remote Output (45) = From BMS/LLM│
│W3 Setpoint (44)= │  │W3 Setpoint (44)= │  └────────────────────────────┘
│  W1 Setpoint     │  │  N/A             │
│Remote Output(45)=│  │Remote Output(45)=│
│  Manual Output   │  │  N/A             │
└──────────────────┘  └──────────────────┘
```
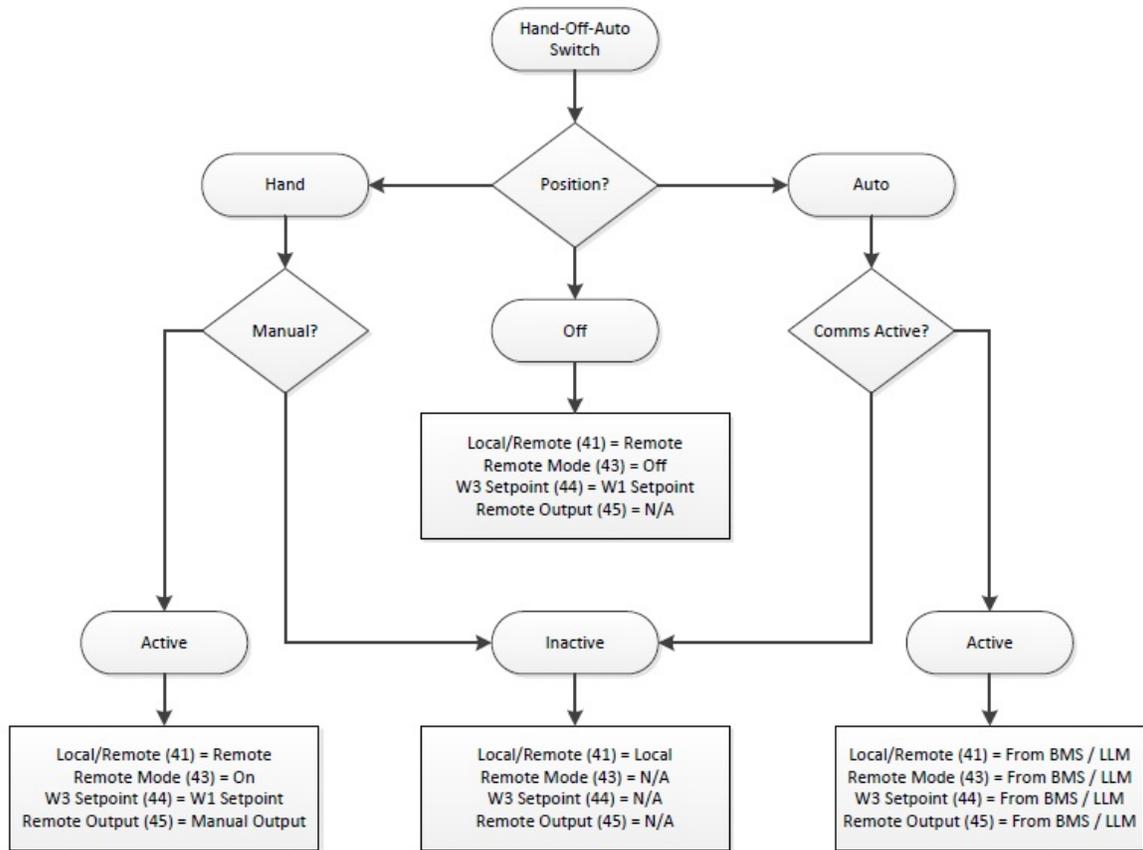
# Appendix - Logic Definitions

### AND
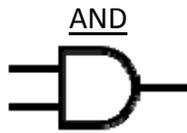
| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | FALSE |
| FALSE | TRUE | FALSE |
| TRUE | FALSE | FALSE |
| TRUE | TRUE | TRUE |

### OR

| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | FALSE |
| FALSE | TRUE | TRUE |
| TRUE | FALSE | TRUE |
| TRUE | TRUE | TRUE |

### NAND
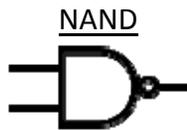
| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | TRUE |
| FALSE | TRUE | TRUE |
| TRUE | FALSE | TRUE |
| TRUE | TRUE | FALSE |

### NOR

| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | TRUE |
| FALSE | TRUE | FALSE |
| TRUE | FALSE | FALSE |
| TRUE | TRUE | FALSE |

### XOR

| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | FALSE |
| FALSE | TRUE | TRUE |
| TRUE | FALSE | TRUE |
| TRUE | TRUE | FALSE |

### XNOR
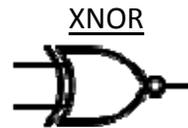
| CONDITION 1 | CONDITION 2 | RESULT |
|---|---|---|
| FALSE | FALSE | TRUE |
| FALSE | TRUE | FALSE |
| TRUE | FALSE | FALSE |
| TRUE | TRUE | TRUE |

## Appendix - Activation

Software upgrades to the touchscreen and/or lead/lag controller may require that an activation code is entered following the download.  If the touchscreen is started without activation, the activation screen will appear.  The touchscreen will automatically proceed to the SYSTEM SETUP screen for configuration once activated (see *System Setup* section for additional detail).
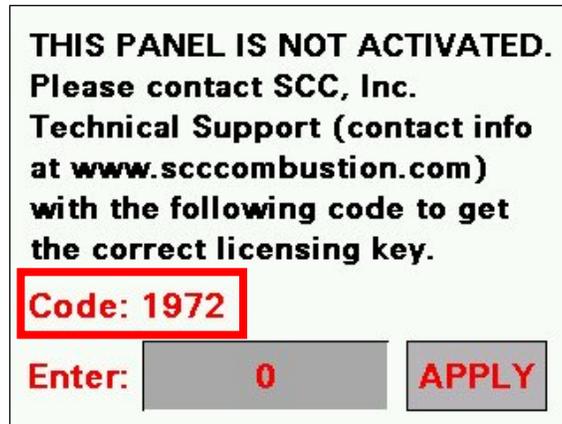


If the lead/lag controller is not activated, 'MASTER NOT ACTIVATED' will appear on the SYSTEM SETUP screen.  Press **Master Activation** to enter the activation code.
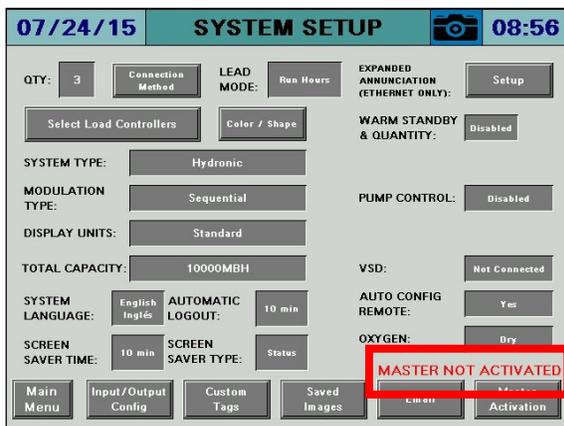


Contact SCC, Inc. technical support with the code listed and an activation key will be provided. Once it is entered, press **APPLY.**

# Appendix -LMV5 Configuration for Modbus (Serial Connection)

TheLMV5x controller must be properly configured for Modbus operation. Use the **Select <** and **Select >** buttons to navigate up and down the screen and the **Enter** button when the desired option is selected with the cursor. Use **Esc** to go back to the previous menu. When a parameter needs to be changed, the **Select <** and **Select >** buttons allow the value to be changed and **Enter** confirms the change. Press the **Esc** button to return after the change is made.

First, activate the Modbus port on the AZL (no password required):
1. Operation > OptgModeSelect > Type of Gateway = **Modbus**
2. Operation > OptgModeSelect > **GatewayBASon**
Note: Older AZL units may read 'GatewayDDCon' instead.
3. The AZL should now read 'Gateway Mode active'.

Next, set up the required parameters through the AZL (no password required):
1. Params & Display > Access w-out PW > AZL > Modbus > Address = **see note below**
2. Params & Display > Access w-out PW > AZL > Modbus > Baudrate = **19200 bit/s**
3. Params & Display > Access w-out PW > AZL > Modbus > Parity = **no**
4. Params & Display > Access w-out PW > AZL > Modbus > Timeout = **30s**

Last, change the controller mode to allow Modbus operation (no password required):
Params & Display > Access w-out PW > LoadController > Configuration > LC_OptgMode =
> **IntLC Bus**

The changes take effect immediately (no reboot required).

**NOTE:** The address is the (boiler number x 10) + 1. Boiler 1 = 11, Boiler 2 = 21, etc.

# Appendix -LMV3 Configuration for Modbus (Serial Connection)

TheLMV3x controller must have the OCI412.10 option installed in order to communicate with the system via Modbus.

The service (heating engineer) password must be entered for these parameters to be accessed. The default service password is 9876.  If the password has been changed, please consult the equipment OEM for the correct password.

To configure theLMV3x controller to communicate using Modbus, use the following procedure:
1. Hold down both the **F** and the **A** buttons until the display reads 'Code', followed by a string of seven underscores.
2. Use the **+** and - buttons to enter the password.  Press **ENTER** (the button to the right of the display) after each entry, and again once the complete password is entered.  If the password is incorrect, 'Error' will be displayed and the process will have to be restarted.
3. If the password is entered successfully, the screen will display 'Para' and then '400: Set' with the '400:' flashing.
4. Use the - button to navigate to '100: PArA', then press **ENTER**.
5. Use the **+** and **-** buttons to navigate to a flashing '141:'.  If this value does not read '1', press **ENTER** and then use the **+** and - buttons to change it to '1', then press **ENTER** to confirm the change.  This parameter activates Modbus. To return to the parameter navigation, press the **+** and **-**  buttons simultaneously (**ESC**). The display should return to flashing '141:'. This procedure will be used to change all parameters.
6. Change '142:' to 120. This parameter sets the timeout.
7. Change '145:' to **see note below**. This parameter sets the Modbus address.
8. Change '146:' to 1. This parameter sets the baud rate to 19200 bit/s.
9. Change '147:' to 0. This parameter sets the parity to none.
10. When all the parameters are entered, press **ESC** in two successions to back up to the main screen. The changes take effect immediately (no reboot required).

**NOTE:** The address is the (boiler number x 10) + 1.  Boiler 1 = 11, Boiler 2 = 21, etc.

# Appendix -RWF55 Configuration for Modbus (Serial Connection)

TheRWF55 must be properly configured for Modbus operation.

Use the up and down arrow buttons to navigate through the menus and the **Enter** button when the desired menu is selected.  Use **Esc** to go back to the previous menu. When a parameter needs to be changed, the up and down arrow buttons allow the value to be changed and **Enter** confirms the change.  The parameter name will flash on the green display when the parameter entry mode is entered.  Press the **Esc** button to return after the change is made.

To configure theRWF55 controller to communicate using Modbus, use the following procedure:
1. Press **Enter** to go into the menu list.  The green display should read 'OPr'.
2. ConF > IntF > r485 > bdrt = **2** (19200 bit/s baud rate)
3. ConF > IntF > r485 > dtt = **30** (timeout)
4. ConF > IntF > r485 > Adr = **see note below** (address for load control applications) **OR**
   ConF > IntF > r485 > Adr = **see note below** (address for feedwater applications)
5. Press **Esc** in four successions or until the parameter menus are completely exited. The changes take effect immediately (no reboot required).

**NOTE:** The address for load controllers is the (boiler number x 10) + 2.  Boiler 1 = 12, Boiler 2 = 22, etc.  The address for feedwater controllers is the (boiler number x 10) + 3.  Boiler 1 = 13, Boiler 2 = 23, etc.

# Appendix -RWF40 Configuration for Modbus (Serial Connection)

TheRWF40 must have the Modbus option in order to communicate with the system. The last three characters of the part number must be 'B97' for Modbus to be optioned. If the last three characters of the part number are 'A97', Modbus is not optioned.

To activate Modbus on theRWF40, make the following and parameters:
1. Press and hold **PGM** until the green display shows 'AL'.
2. Press and hold **PGM** until the green display shows 'C111'.
3. Press **PGM** twice so that the green display shows 'C113'.
4. Press the down arrow until the second red digit from the right flashes.  Use the up arrow to change this value to '7'. This parameter sets the baud rate at 19,200 bit/s.
5. Press the down arrow until the second red digit from the left flashes.  Use the up arrow to change this value to **see note below** if theRWF40 is being used as a load controller or to **see note below** if theRWF40 is being used for a feedwater control.  This parameter sets the Modbus address.
6. Press **PGM**. The red display should now read '0270' or '0370'.  If it does not, use the down and up arrows to adjust the value and then press **PGM** to confirm and save the values.
7. Press **EXIT** to return to the normal display. The changes take effect immediately (no reboot required).

**NOTE:** The address for load controllers is the (boiler number x 10) + 2.  Boiler 1 = 12, Boiler 2 = 22, etc.  The address for feedwater controllers is the (boiler number x 10) + 3.  Boiler 1 = 13, Boiler 2 = 23, etc.

# Appendix -RWF10 Configuration for Modbus (Serial Connection)

TheRWF10 must have the Modbus option in order to communicate with the system. This is an option card that is inserted into the controller when required.

To configure theRWF10 controller to communicate using Modbus, use the following procedure:
1. Press the **LEVEL** (left-most) button until the red display reads 'CN-t'.
2. Press the **LEVEL** button again; the red display should read 'PSEL'.
3. If the value of 'PSEL' does not read 'Mod', use the up and down arrow buttons to change the value.
4. Press the **MODE** (loop with arrow on end, second from left) button to move to the next parameter, 'U-No'.  Change the value to **see note below** with the up and down arrow buttons and then press **MODE**. This parameter sets the Modbus address.
5. Change parameter 'bPS' to '19.2' and then press **MODE**.  This parameter sets the baud rate to 19,200 bit/s.
6. Change parameter 'PRtY' to 'None' and then press **MODE**. This parameter sets the parity to none.
7. Change parameter 'SdWt' to '20' and then press **MODE**. This parameter sets the timeout.
8. Once 'PSEL' is displayed again, press and hold the **LEVEL** button to save the changes.  The unit will reboot with the new parameters and the changes will take effect immediately.

**NOTE:** The address is the (boiler number x 10) + 2.  Boiler 1 = 12, Boiler 2 = 22, etc.