Document 4232B

Installation and Operation Manual

M4-LHS

Modulating and Condensing / Non-condensing Boiler control

Hybrid Multi-Boiler Control



⚠ WARNING

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water heater/boiler controls installation and maintenance. This manual is intended for anyone who will install, operate or maintain the control system. Before you begin installation and operation of this control, it is important that you thoroughly review this manual. Improper installation and operation could result in damage to equipment and possibly even personal injury. Laars Controls are not intended for use as operation safety limit controls. Another control, that is intended and certified as a high limit control, must be in the water heater/boiler control circuit.

LAARS® Heating Systems Company

A subsidiary of BRADFORD WHITE® Corporation

HTC# 059295-00 B

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HYBRID LOGIC OVERVIEW

In response to new advancement in condensing boiler design and size, many applications utilize multiple condensing boilers in addition to the non-condensing boilers. That triggered Laars's design of the M4-LHS. It is intended to manage the two groups of boilers to maximize system efficiency at the lowest operating cost while maintaining the desired comfort. When Hybrid is selected as the Boiler Type, the M4-LHS will select the lead group based on the Target temperature switching set point. See "Switch Set Point" on page 20. The Condensing group of boilers will be the Lead group when the System Temperature is below the System Target Switching Set Point. However, when the System Temperature rises above the Switching Set Point, the Non-Condensing boiler group will be the lead group and the Condensing Group will be the lag group.

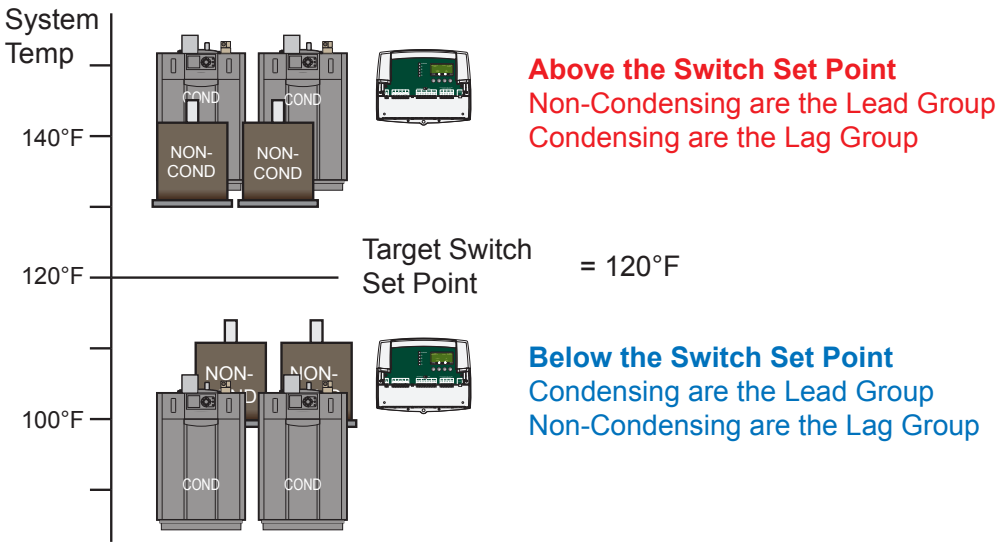
Basically, the M4-LHS will allow the condensing group of boilers to operate as along as the System sensor is below the Switching Set Point. See"Switch Set Point" on page 20. During that period, if additional output boilers are needed, the M4-LHS may energize the Non-Condensing boilers to meet the load depending on the Heavy Load Sequence 2nd Group setting. See"Heavy Load Sequence 2nd Group" on page 21. When less output is required the M4-LHS will de-energize the lag group of boilers prior to de-energizing the lead group of boilers.

To eliminate any short-cycling due to rapid changes in the Target Temperature used in the switching, an adjustable Switching Delay has been incorporated. See"Switch Delay" on page 21.

Each of the condensing and non-condensing groups of boilers can be either modulating or staging. Modulating boilers can be of 4-20mA modulating signal or 0-10V modulating signal. See "Modulating Output Type" on page 23. Staging boilers can be On/Off, 2-Staeg, 3-Stage, or 4-Stage. See "Staging Output Type" on page 22.

For Hybrid settings, See "Boiler Type" on page 19.
To set the Condensing and Non-Condensing boiler types See "HYBRID Modulating Boiler Settings" on page 22.

SWITCH MODE = Target Temperature



MODULATING LOGIC OVERVIEW

The Modulation PID logic is capable of controlling multiple modulating current or voltage boilers. When heat is required, the control PID activates the lead boiler and starts its purge. See "Purge Delay" on page 31. This is followed by the initiation of its modulation at the Ignition %. See "Ignition %" on page 40. When additional heat is needed, the control starts to increase the lead boiler modulation until the Modulation Start % has been reached. See "Modulation Start %" on page 40. Any additional heat requirement starts the lag boiler purge. While the lag boiler is in purge, the lead boiler resumes its modulation until it reaches full fire (100% modulation). Additional heat requirements triggers the control to increase the lag boiler modulation.

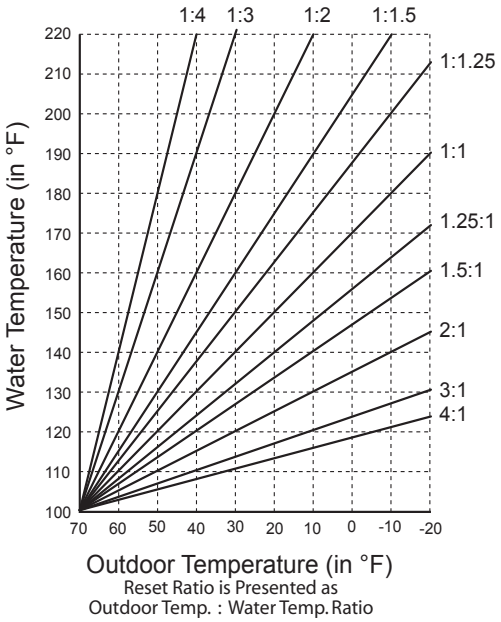
When the M4-LHS PID requires reduced output, it will reduce the modulation of the lag boiler until it reaches its Ignition %. That shall be followed by the reduction of modulation of the lead boiler until it reaches 40% percent of the Modulation Start %. This shall trigger the control to turn off the lag boiler. The control will keep reducing the lead boiler modulation until it reaches its Ignition %. If the Last Stage Hold was activated, the control will hold the lead boiler at the Ignition % until the System Temperature exceeds the Target Set Point by the Last Stage hold setting. See "Last Stage Hold" on page 32.

For Modulating boilers, See "Boiler Type" on page 19. Also, See "HYBRID Modulating Boiler Settings" on page 22.

OUTDOOR RESET CONCEPT

The M4-LHS has multiple operating modes that satisfy most hydronic systems. It changes the System Set Point based on outdoor temperature (Outdoor Reset). The M4-LHS varies the temperature of the circulating heating water in response to changes in the outdoor temperature. The heating water temperature is controlled through the modulation or sequencing of the stages.

The M4-LHS also controls the system circulating pump with an adjustable Outdoor Cutoff. When the outdoor temperature is above the Outdoor Cutoff, the pump is off and no heating water is circulated through the system. When the outdoor temperature drops below the Outdoor Cutoff, the system pump relay is activated and the heating water circulates through the system. The temperature of the heating water is controlled by the Reset Ratio, Water Offset, and changes with Outdoor Temperature.



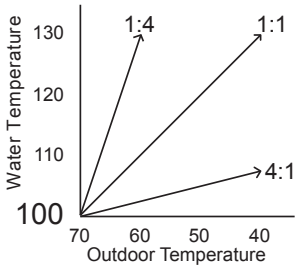
Reset Ratio Curves

Reset Ratio/Outdoor Reset

When a building is being heated, heat escapes through the walls, doors, and windows to the colder outside air. The colder the outside temperature, the more heat escapes. If you can input heat into the building at the same rate that it is lost out of the building, then the building temperatures will remain constant. The Reset Ratio is an adjustment that lets you achieve this equilibrium between heat input and heat loss.

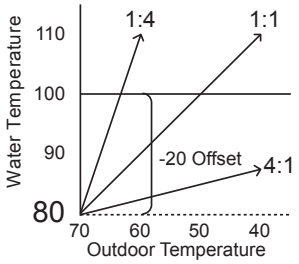
The starting point for most systems is the 1.00 (OD):1.00 (SYS) (Outdoor Temperature : Heating Water Temperature) ratio. This means that for every degree the outdoor temperature drops, the temperature of the heating water increases by one degree. The starting point of the curves is adjustable, but comes factory selected at 70°F Outdoor Temperature and 100°F Water Temperature. For example with a 1.00 (OD):1.00 (SYS) ratio, if the outdoor temperature is 50°F, this means the temperature has fallen 20° from the starting point of 70°F. Therefore, the heating water temperature shall increase 20° to 120°F.

With a 0° Offset, the Reset curves begin at 100° Water Temperature.



Each building has different heat loss characteristics. A very well insulated building will not lose much heat to the outside air, and may need a Reset Ratio of 2.00 (OD):1.00 (SYS) (Outdoor:Water). This means the outdoor temperature would have to drop 2° to increase the water temperature 1 degree. On the other hand, a poorly insulated building with insufficient radiation may need a Reset Ratio of 1.00 (OD):2.00 (SYS). This means that for each degree the outdoor temperature dropped the water temperature increases by 2°. The M4-LHS has a full range of Reset Ratios to match any buildings heat loss characteristics.

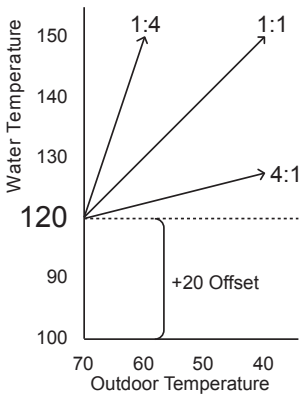
With a -20° Offset, the Reset curves begin at 80° Water Temperature.



A heating curve that relies not only on Outdoor Temperature but also on the type of radiation improves heat comfort. The following are suggested initial settings for different types of radiation based on average building insulation and heat loss. The contractor can fine tune these adjustments based on the specific building need.

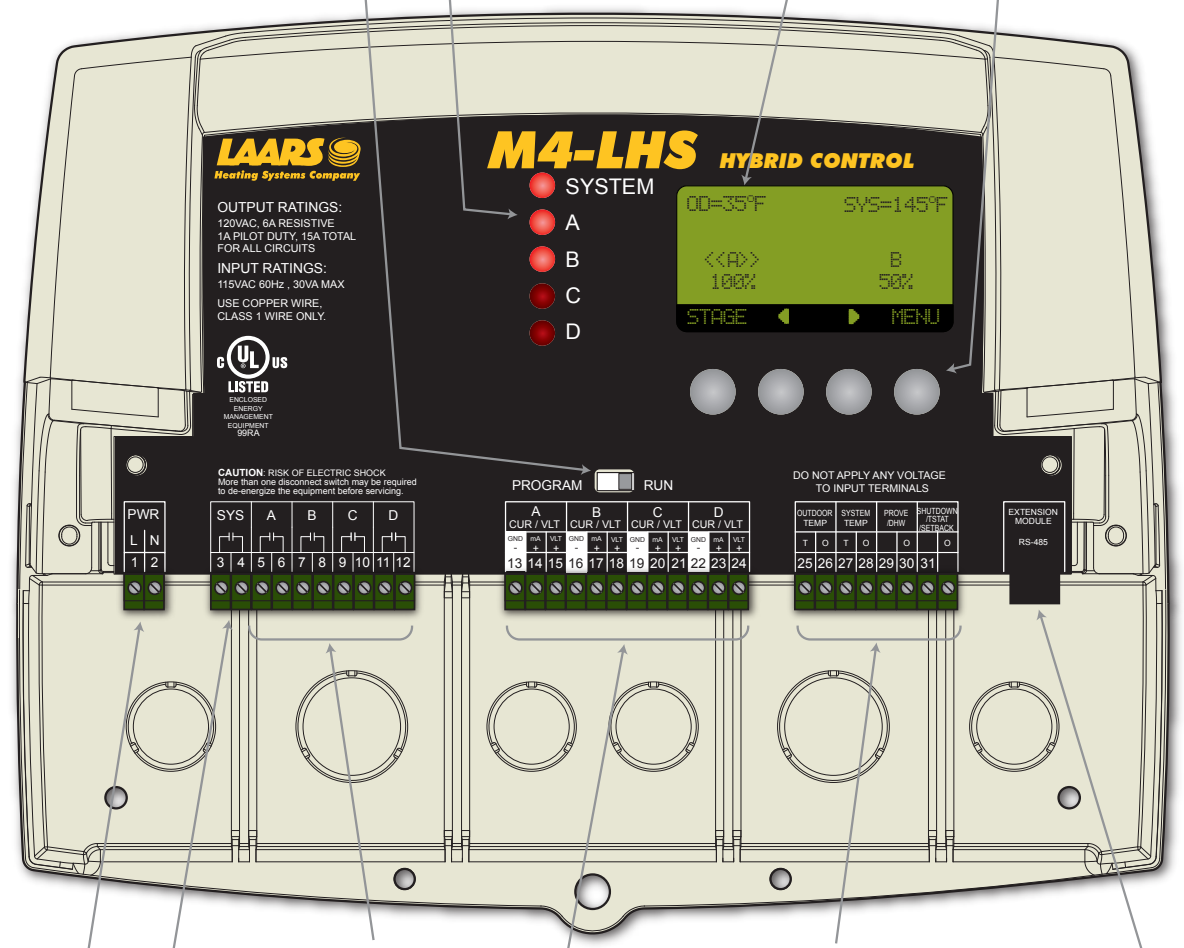
Type of Radiation in Building	Reset Ratio	Offset
Radiators (Steel & Cast Iron)	1.00 (OD) : 1.00 (SYS)	0˚F
Baseboard (Finned copper tube& Cast Iron)	1.00 (OD) : 1.00 (SYS)	0˚F
Radiant (High Mass/Concrete)	4.00 (OD) : 1.00 (SYS)	-10˚F
Radiant (Low Mass/Joists)	2.00 (OD) : 1.00 (SYS)	-10˚F
Fan Coils & Air Handlers	1.00 (OD) : 1.00 (SYS)	20˚F

With a +20° Offset, the Reset curves begin at 120° Water Temperature.



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CONTROL LAYOUT



Program Switch to restrict access to function changes. This switch is covered with Wiring Enclosure.

The digital display shows the system status, set point, lead stage <in brackets>, and status of each stage. To view and adjust settings, press the appropriate buttons.

LED indicates the associated relay status.

Buttons function is presented on Bottom Row of display.

120VAC Power

Four N.O. Boiler startup relay outputs. Each is wired in series with each boiler's limit circuit.

When connecting the control Outdoor Air Sensor and System Sensor, no polarity is observed. Prove terminals must be connected for control to operate boilers.

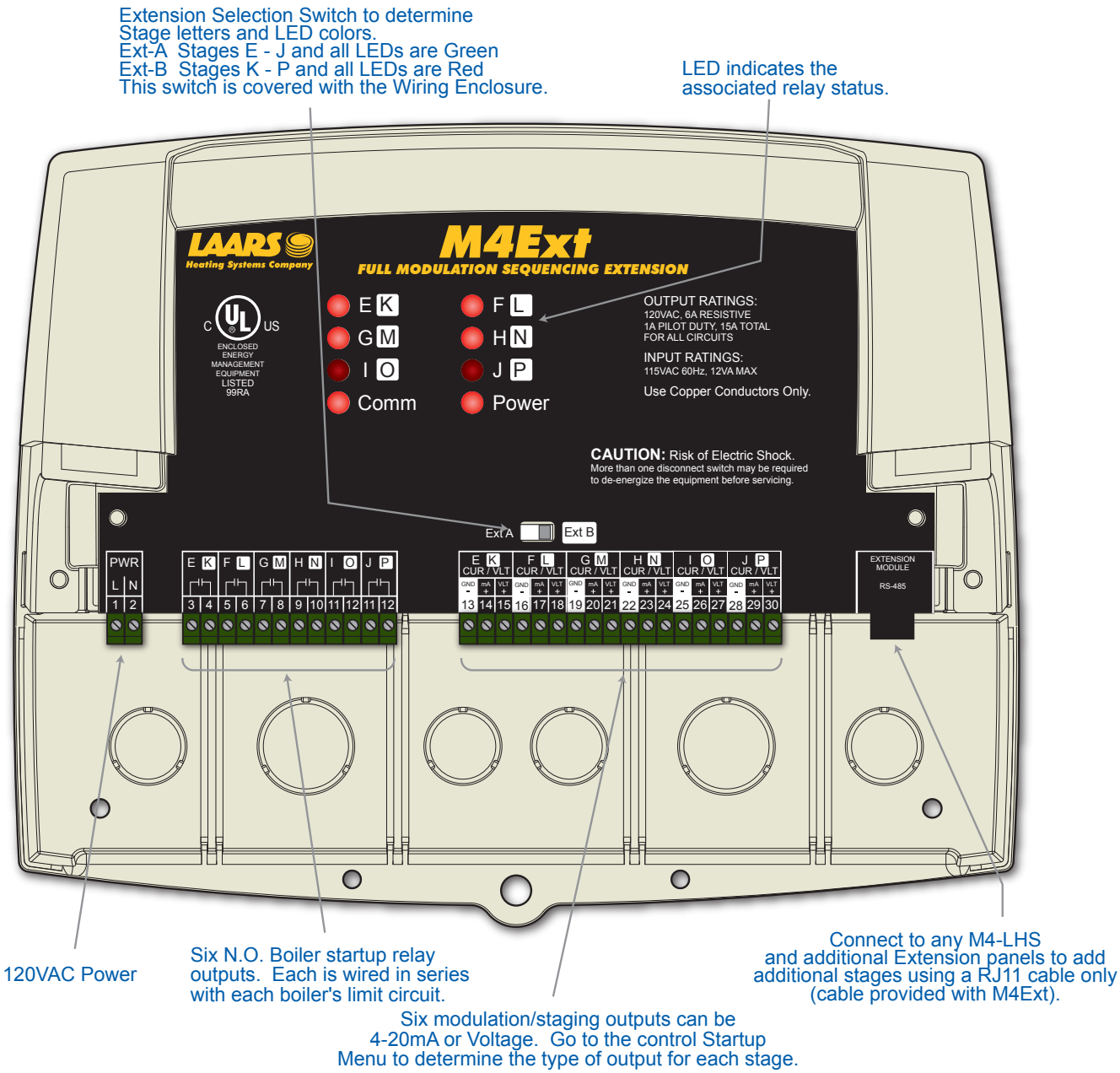
System Output controls pumps, valves, or other system components.

Four modulation/staging outputs can be 4-20mA or Voltage. Go to Startup Menu to determine the type of output for each stage.

Connect Extension panels to add additional stages using a RJ11 cable(cable provided with Extension) and RJ45-RJ11 Adaptor (Supplied with control) only or add X-BAC BACnet Interface Module using RJ45 (cable provided with X-BAC Module)

PART NUMBER # CA009200

EXTENSION LAYOUT



PART NUMBER # CA004400

FEATURES

Laars designed the M4-LHS with Hydronic building heating, using both condensing and non-condensing boilers, as the primary purpose. In addition, the M4-LHS is capable of controlling modulating and staging boilers. With this in mind, many of the M4-LHS features can be utilized to ease, enhance, and improve your system performance.

Condensing and Non-Condensing Boilers Can be Modulating or Multi-Stage.

The M4-LHS can operate both modulating and staging boilers. Just specify each of the Condensing and Non-Condensing boiler group type and the M4-LHS activates the groups based on an adjustable set of criteria.

PID Type Logic

The M4-LHS's control algorithms allow it to look at the rate of change in the system. If the system temperature is changing quickly, the M4-LHS reacts quickly to adjust the modulating stages' output. If the system temperature changes slowly, the M4-LHS shall make slow and gradual output adjustments. Therefore, the M4-LHS adapts to specific system requirements and minimizes fluctuations around the set point.

Controls 0-10 V or 4-20 mA modulating Burners

Whenever any of the Condensing or Non-Condensing group type is set to Modulating, the M4-LHS accurately controls the output from 0 to 100% of modulation for each of these different types of motors. Moreover, a single M4-LHS can control multiple modulating burners each with a different modulating signal.

Controls On/Off, 2-Stage, 3-Stage, or 4-Stage Burners

Whenever one of the Condensing or Non-Condensing group Type is set to Staging, the M4-LHS accurately sequences the stages using a PID logic.

Digital Display of all System Settings

The M4-LHS's alphanumeric digital display names each system parameter in simple English and shows its precise value. The easy to follow menu system allows users to quickly make changes to any system setting without having to learn any specialized codes or keyboard commands.

Automatic Rotation among Stages

Rotating the lead stage of each group promotes even wear. The M4-LHS has three modes of rotation: Manual, Last On, or Time. The Time rotates the lead stage every selected period from every hour to every 60 days.

Outdoor Reset or Set Point

The M4-LHS has a hydronic outdoor temperature reset function. This allows the M4-LHS to change the set point based on outdoor temperature. Furthermore, additional settings have been added to fine tune this operation, like Offset, Minimum, and Maximum Water Temperature and night setback schedule.

System Output

This output can be used to activate a system pump, combustion air damper, or perform any other function that is required when any stage is active. It energizes whenever the outdoor temperature is below the Outdoor Cutoff setting. A System Prove input checks the status of components activated by the System output before stages can be activated.

Normal or Parallel Modulation

The M4-LHS can stage modulating boilers as needed. In Normal Modulation, it increases the lead boiler modulation until it reaches its Modulation Start percent adjustment. Then, the M4-LHS starts the next boiler and so on. Moreover, the M4-LHS offers a parallel mode that can modulate several boilers together as a single large boiler. This mode is useful when used with condensing boilers as they run more efficient at lower modulation. Thus, it is better to run several boilers at lower modulation than to run a single boiler at full fire.

Add up to 16 Boiler Stages (Optional)

As a stand-alone, the M4-LHS is designed to control four stages. However, it has the capability of expanding its control to two extension panels each with six boiler stages. Thus, the M4-LHS can control a total of up to 16 boiler stages.

Setback or Day/Night Scheduling

Two Setback modes are available for the M4-LHS:

- The Day/Night Scheduling provides an adjustable time-based schedule for the Setback (only available when Shutdown or Tstat is selected as the Setback/Shutdown Startup option). See "Shutdown/Tstat/Setback Mode" on page 24.
- The Setback mode uses an external signal to switch the operation of the M4-LHS in and out of setback mode (only available when Setback is selected as the Setback/Shutdown Startup option).

Remote Set point (EMS 4-20mA)

By connecting the control to the optional 4-20mA EMS Interface (X-SIG), the control shall be capable of accepting a remote set point.

BACnet MS/TP Communication

An optional BACnet Interface Module (X-BAC) (CA009100) can be used to connect the control to a BACnet MSTP network for remote access.

MAKE SURE YOU HAVE THE RIGHT CONTROL

If you need the M4-LHS to do additional tasks that either are not listed or do not know how to configure them, contact your local Laars representative.

Setting an Initial Program will ease the configuration of the M4-LHS and will give the opportunity to utilize many of the energy saving features while giving comfortable heat when needed.

The program should consist of the following:

- Selecting the features that your system can utilize.
- Installation: Install the Control, switches and sensors. See"Installation" on page 10
- Setting the System Startup. See "Startup Settings" on page 19.
- Setting the System Operating Settings. See "Operating Settings" on page 27
- Setting the Stages. See "Modulating Boiler Operating Settings" on page 33. Also, see "Staging Boiler Operating Settings" on page 34
- Adjusting Reset Ratio and Water Offset (In Reset Mode Only). See "Reset Ratio" on page 27

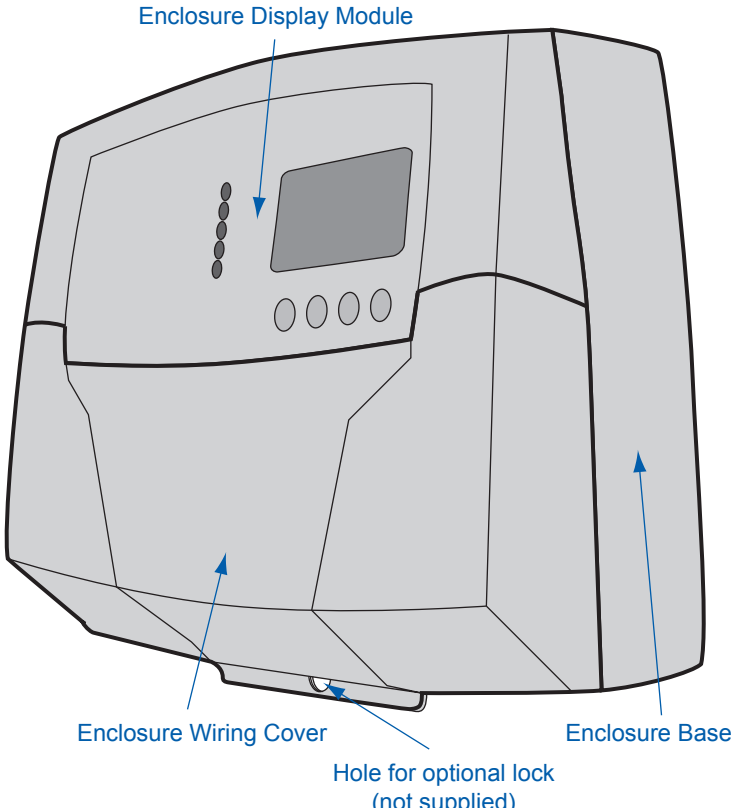
INSTALLATION

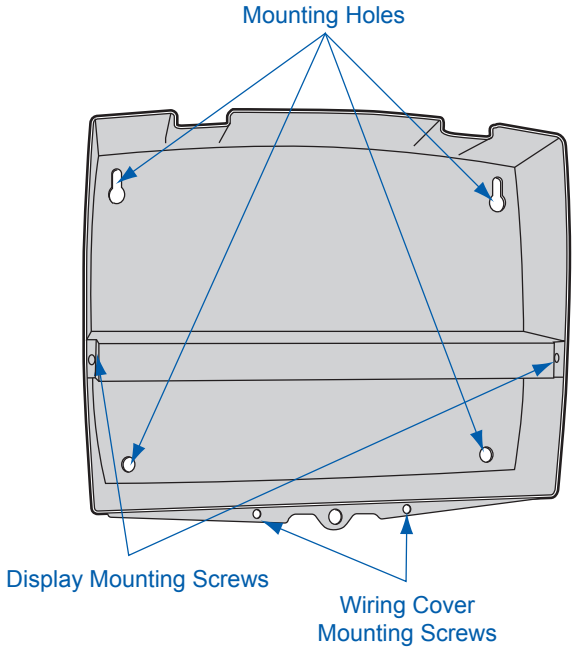
Each of the M4-LHS or Extension consists of three primary enclosure components.

- **The Enclosure Display Module:** contains the control electronic board, display, buttons, LEDs, and electric wiring terminals. It has two screws to hold it to the base. A program configuration switch, used to adjust the control settings, is placed above the terminals. This switch is enclosed with the enclosure wiring cover for security. Wiring terminals are of the plug-in type to ease installation and removal.
- **The Enclosure Base:** contains the holes to mount and hold the control against the wall or any flat surface. All other enclosure components mount on the base. The bottom section of the Enclosure Base contains the wiring chamber with knockouts on the bottom to ease installation.
- **The Enclosure Wiring Cover:** seals the wires from the external environment. It has two screws to hold it the base and a hole to secure a lock on the wiring enclosure. A plastic web that separates the wiring chamber into high and low volt sections has been provided.

MOUNTING THE ENCLOSURE

- Select a location near the equipment to be controlled.
- The surface should be flat and sufficiently wide and strong to hold the M4-LHS or the Extension.
- Keep the control away from extreme heat, cold, or humidity. Ambient operating temperature is from 20 to 120°F.
- Remove the Enclosure Wiring Cover from the control enclosure by removing the two bottom screws.
- Remove the Enclosure Display Module by removing the enclosure middle screws.
- Screw the Enclosure Base to the surface through the upper and lower mounting holes on the back of the enclosure.
- Replace the Enclosure Display Module and replace the enclosure middle screws.
- Do not replace the enclosure wiring cover until all wiring is done.
- When purchasing a padlock for the enclosure, the maximum shank diameter should not exceed ¼"



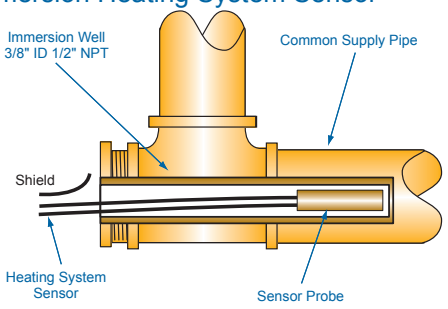


INSTALL THE SENSORS

System Sensor Installation

- Only use the System sensor (CA002500 or equivalent) provided with the unit.
- The sensor wires can be extended up to 500' using a shielded 2-conductor cable (Belden #8760 or equivalent). Do not ground the shield at the sensor but at the panel using one of the terminals marked with an "O".
- Do not run sensor wires in conduit with line voltage wiring.
- Install a 3/8"ID 1/2"NPT immersion well.
- If installing the system sensor on the supply, insert the sensor in a well with heat paste approximately 5' feet past the boiler loop outlet on the common supply header but before any major takeoffs. The sensor must be located where it sees the output of all the boiler stages. If a boiler is piped so that the sensor does not see its output, the M4-LHS will not sequence the boilers correctly.
- The sensor can also be installed on the return to the boilers after all major returns and before any boiler. However, when setting the reset ratio and the offset, the user must consider the temperature drop across the building loop.

Immersion Heating System Sensor



⚠ ALERT

If the HSS can not sense the correct water temperature, the M4-LHS will not provide comfortable heat levels.

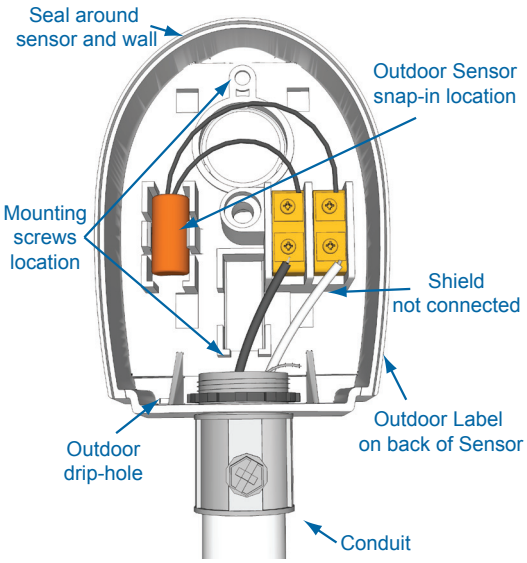
⚠ WARNING

Use only the System and Outdoor Air sensors included with the control. Do not use boiler sensors as it will cause operational problems.

Outdoor Sensor Installation

- Only use the Laars Outdoor Air Sensor group included with the unit (CA006500).
- Locate the sensor in the shade on the north side of the building. The sensor should never be in direct sunlight.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources.
- The sensor should be mounted approximately 10' feet above ground level.
- Adhere the Outdoor Label provided to the back of the sensor base.
- Use the Enclosure Base bottom knockout for the conduit. Use the locknut to hold the conduit and enclosure base together. Screw the cover to the base.
- If screws are used to affix the enclosure to the wall, make sure to seal around the sensor and wall except from the bottom.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable (#18/2). Do not ground the shield at the sensor but at the control using the terminal marked with an "O".
- Do not run sensor wires in conduit with line voltage wiring.

Outdoor Sensor

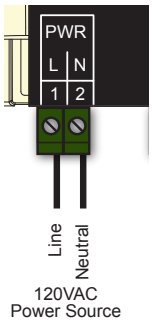


⚠ ALERT

Determining the proper location of the Outdoor Sensor is very important. The M4-LHS will base the heat on the outdoor temperature information it receives from this location. If the sensor is in the sun, or covered with ice, its reading will be different from the actual Outdoor Temperature (OD).

WIRING

- All wiring must enter the enclosure through the bottom knockouts.
- Class 1 voltage wiring must utilize a different knockout and conduit from any Class 2 voltage wiring.



Wiring the Power

(Terminals 1, 2)

- Bring the 120VAC 60Hz power wires through the bottom left knockout of the enclosure.
- Connect the hot line to terminal marked L.
- Connect the neutral line to the terminal marked N.
- Laars recommends installing a surge suppressor on the power source to the M4-LHS.

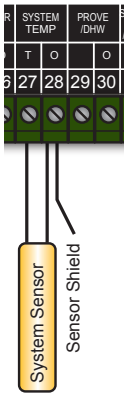
⚠ WARNING

Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring. Laars recommends installing a surge suppressor on the power source to the M4-LHS.

Wiring the Sensors

⚠ WARNING

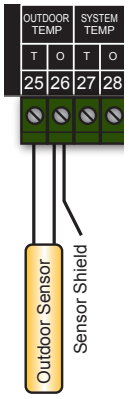
Connect the shield at the control terminal end and cut the shield wire at the sensor end. To avoid operational problems, use only the System and Outdoor Air sensors included with the control.



System Sensor Wiring

(Terminals 27, 28)

- A M4-LHS must be connected to a System Temperature sensor (CA002500 or equivalent) located in the common header. The sensor must be inserted in a 3/8 ID well using heat paste.
- Temperature sensor wires can be extended up to 500' by splicing its wires with a shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- Temperature sensors have no polarity. Connect the two wires from the sensor to the M4-LHS terminals marked *SYSTEM TEMP 27, 28*.
- Connect the sensor shield to the circled terminal 28 with one of the sensor wires.



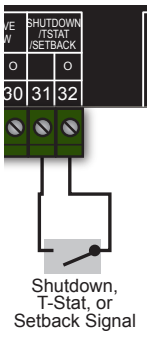
Outdoor Sensor Wiring

(Terminals 25, 26)

- The M4-LHS will vary the system Set Point based on outdoor temperature. In addition, the Outdoor Air Sensor group (CA006500) is used as an Outdoor Cutoff. The M4-LHS will disable all boilers when the outdoor temperature is above the adjustable Outdoor Cutoff temperature.
- For an outdoor sensor use the outdoor sensor provided.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- Temperature sensors have no polarity. Connect the wires from the outdoor sensor to the M4-LHS terminals marked *OUTDOOR TEMP - 25, 26.*
- Connect the shield to the circled terminal *26* with one of the sensor wires.

Wiring the Shutdown, Tstat, or Setback

(Terminals 31, 32)

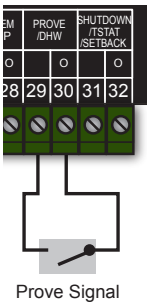


- The Shutdown will be available when selected as the Shutdown/Tstat/Setback mode from the Startup menu. See "Shutdown/Tstat/Setback Mode" on page 24. This will provide the user with an adjustable Day/Night Schedule. See "Day - Night Schedule" on page 36.
- The Shutdown feature can be used whenever it is desirable to turn off the M4-LHS stage outputs from a remote location or another controller (i.e. EMS input).
- The Tstat option, when selected from the Shutdown/Tstat/Setback startup menu, offer the capability of controlling the operation of the M4-LHS based on a thermostat input. This will provide the user with a adjustable Day/Night Schedule.
- The thermostat will send the M4-LHS a call for heat by shorting terminals 31 and 32.

- When the Shutdown input is enabled by closing the dry contact, or when the Tstat input is disabled by opening the dry-contact, all active modulating boilers will immediately modulate down to low for the Soft-Off period, then turn off. All staging boilers will turn off immediately.
- The System Output relay will remain active until the System Run-On Delay expires and then it will turn off.
- When Setback is selected in the Startup, a BMS/EMS or external clock can provide a Setback signal using these input terminals. See "Shutdown/Tstat/Setback Mode" on page 24. No Day/Night Schedule will be available when Setback is selected from the Shutdown/Tstat/Setback mode in the Startup menu.
- Bring the two wires from the dry contact to the terminals marked *SHUTDOWN/TSTAT/SETBACK- 31,32*.
- The signal must be a dry contact only. No voltage can be placed across the *SHUTDOWN/TSTAT/SETBACK* terminals.

Wiring the Prove

(Terminals 29, 30)



Prove Signal

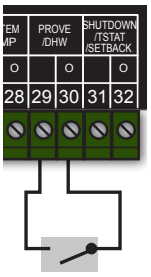
- The Prove feature checks system component operation and must be selected in the Startup Menu from the Prove/DHW Sharing menu. See "Prove/Indirect Domestic Hot Water (DHW) Priority" on page 24.
- A typical use of this feature is to check for pump flow or combustion air damper status before firing any boiler.
- If the PROVE input is open on a call for heat, the M4-LHS enables only the System Output. All boiler outputs will be off when the *PROVE* input is open.
- A factory-installed jumper provides the System Prove signal. Do not remove the jumper unless it is replaced with a System Prove signal or these terminals are to be used for DHW call input.
- Bring the two wires from the dry contact to the terminals marked *PROVE - 29, 30*.
- Prove Input terminals can accept a dry-contact signal only. No voltage can be placed across these terminals.

⚠ WARNING

The PROVE input cannot be used as a safety limit. All equipment must have its own certified limit and safety controls as required by local codes. If Prove is selected in the startup menu, no boiler stage will start unless Prove terminals are shorted. DO NOT remove the PROVE jumper supplied unless replacing it with a Prove signal.

Wiring the Indirect Domestic Hot Water (DHW) Call

(Terminals 29, 30)

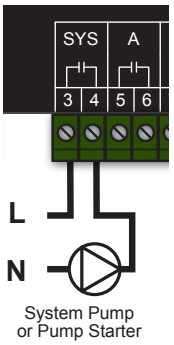


Indirect
DHW Signal

- DHW can be used to raise system Set Point to the DHW Set Point as well as manage the System Pump according to the DHW Priority setting. One of the DHW options must be selected from the Prove/DHW Sharing Startup menu. See "Prove/Indirect Domestic Hot Water (DHW) Priority" on page 24.
- Remove the existing jumper and wire an aquastat or a control to provide dry-contact closure to the *DHW Call - 29, 30* terminals.
- DHW Call terminals can accept dry contact signals only. No voltage can be placed across these terminals.

Wiring the System Output

(Terminals 3, 4)

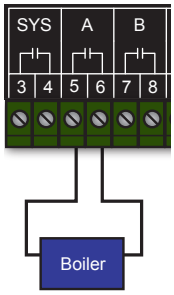


System Pump
or Pump Starter

- The SYS output relay will energize and remain constantly energized whenever the outdoor temperature is below the Outdoor Cutoff.
- When the outdoor temperature rises 2°F above the Outdoor Cutoff, the SYS output will remain energized for the period set by the System Run-On then de-energize. See "System Run-On" on page 31.
- In addition, the System output will energize during summer DHW calls when DHW No Priority is selected. See "Prove/Indirect Domestic Hot Water (DHW) Priority" on page 24.
- The SYS output has one Normally Open (N.O.) relay contact rated for (1/8 HP).
- The N.O. contacts are dry contacts only. They do not source any voltage.
- Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring.

Wiring the Boilers

- When wiring Condensing and Non-Condensing boilers make sure that the Condensing boilers use the first stages and the Non-Condensing boilers use the following stages. That is, if the installation had two Condensing Modulating boilers and two Non-Condensing Staging On/Off boilers, Stage A and B must be used by the Condensing boilers while Stage C and D must be used by the Non-Condensing boilers.



Boiler Enable Output

Wiring Boiler Activation or On/Off Staging Boilers

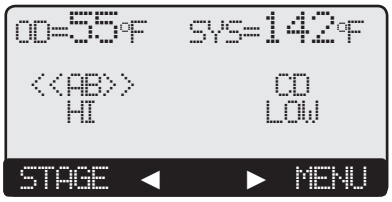
(A Terminals 5, 6), (B Terminals 7, 8), ...

- Each boiler output has a Normally Open (N.O.) dry-contact relay. They do not source any power.
- Wire the N.O. relay contacts in series with the unit's limit circuit.
- Note that some modulating boilers may not require the use of these outputs.

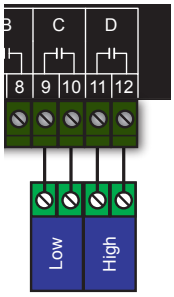
Wiring Multi-Stage Boilers

(For Staging Boiler Types Only) See Page 19

- Each stage on a multi-stage boiler must use one of the N.O. relays.
- Note that on the display of the M4-LHS each multi-stage boiler will consist of a multiple letters.
- Each stage output has one Normally Open (N.O.) relay contact that does not source any power.



Multi-Stage Boiler



2-Stage Boiler

⚠ WARNING

Class 1 voltages must enter the enclosure through a different opening from any Class 2 voltage wiring.

Wiring to Modulating Boilers

The M4-LHS can modulate any combination of current or voltage boiler signals. See "Modulating Output Type" on page 23. Some modulating boilers may require the use of the stage output relays in addition to the modulating output.

⚠ WARNING

The Modulating Output Type must be set to match the boiler modulating signal prior to wiring the boiler signal to avoid control or equipment damage.

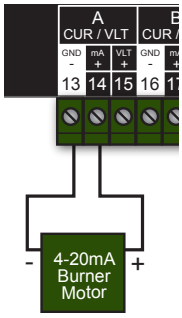
Wiring the 4-20mA Modulating Boilers

(A Terminals 13, 14), (B Terminals 16, 17),...

- The M4-LHS can operate up to four 4-20 mA modulating motors.
- The Extension can operate up to six 4-20 mA modulating motors.
- The M4-LHS and the Extension sources excitation voltage for the 4-20mA signal.
- Wire the (-) from the boiler modulating motor to the (GND) terminal on the M4-LHS. That is for boiler A, the modulating (GND) terminal will be 13.
- Wire the (+) from the boiler modulating motor to the (mA+) terminal on the M4-LHS. That is for boiler A, the modulating (mA+) terminal will be 14.



Modulating Boiler (Modulating Boiler Type)

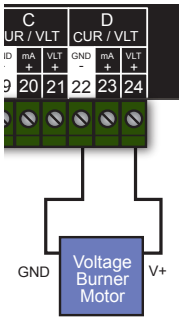


Boiler 4-20mA Modulation Output

Wiring Voltage Modulating Boilers

(A Terminals 13, 15), (B Terminals 16, 18),...

- The M4-LHS can operate up to four 0-10V modulating motors.
- The Extension can operate up to six 0-10V modulating motors.
- Wire the (GND) from the boiler modulating motor to the (GND) terminal on the M4-LHS. For boiler D, the modulating (GND) terminal is be 22.
- Wire the (VLT+) from the boiler modulating motor to the (VLT+)terminal on the M4-LHS. For boiler D, the modulating (VLT+) terminal is be 23.



Boiler Voltage Modulation Output

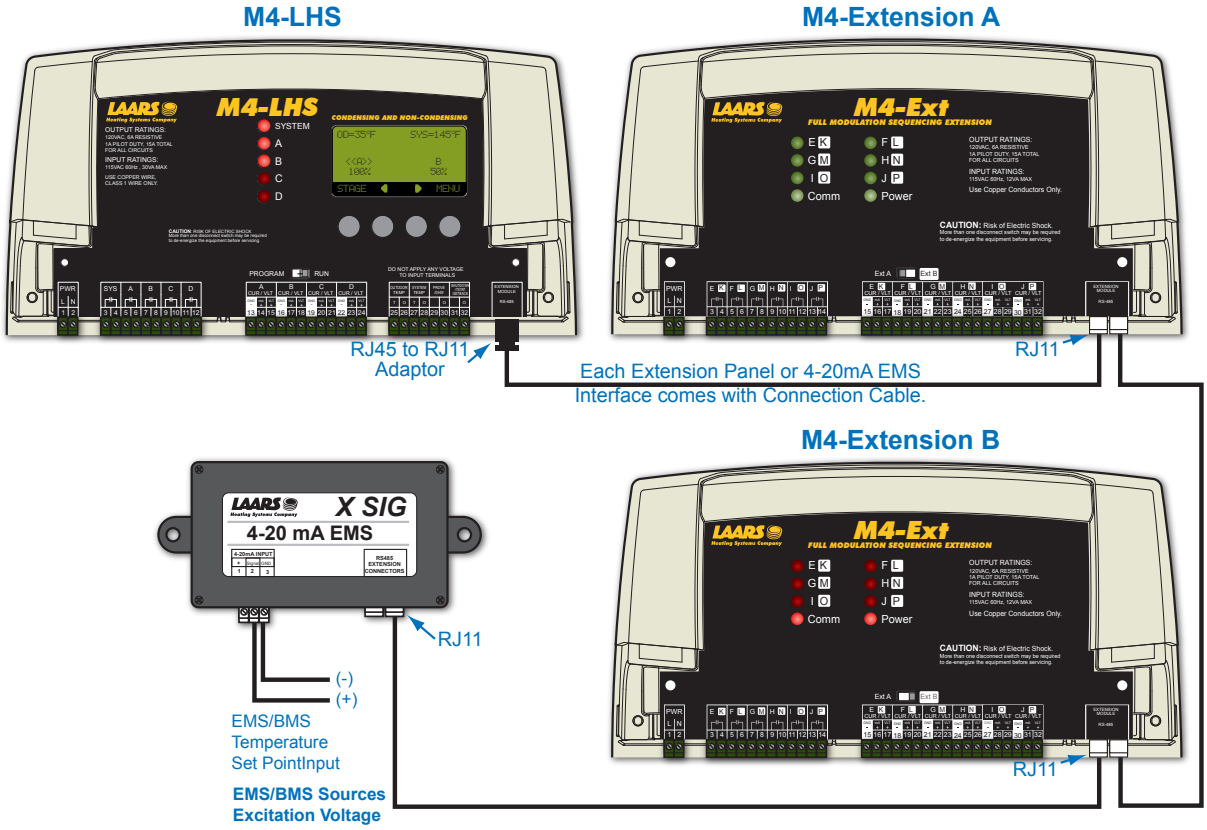
Connecting to the Extensions and 4-20mA EMS Interface

PROGRAM RUN

⚠ ALERT

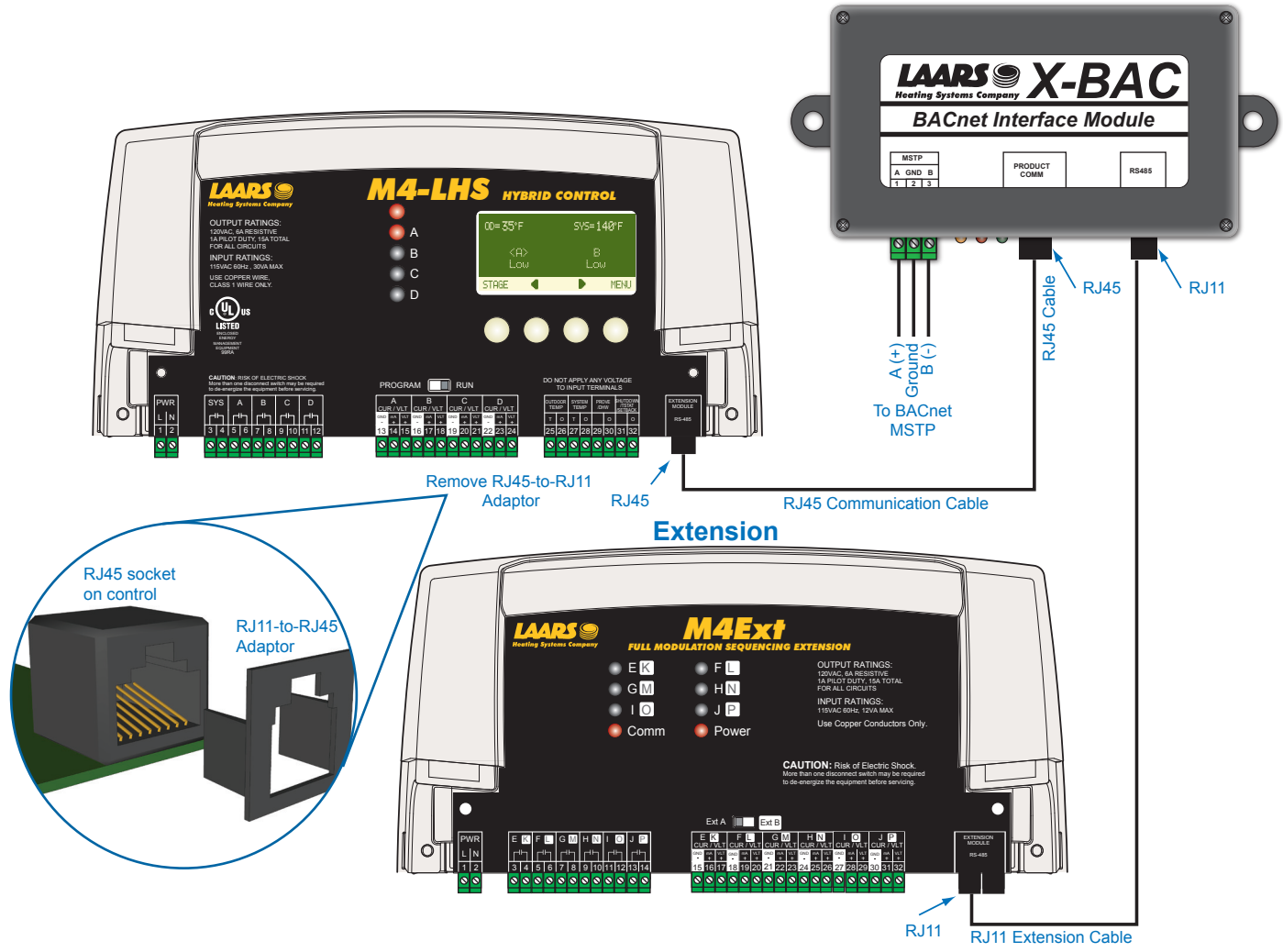
To set the Extension to a specific letter, remove the wiring cover and switch the Ext A/Ext B to the desired letter. DO NOT set both extensions to the same letter to avoid errors.

- The M4-LHS is equipped with a RJ45 socket and a RJ45 to RJ11 Adaptor to connect to extension panels and X-SIG 4-20mA EMS Interfaces. The Extension is equipped with two RJ11 sockets. It comes packaged with a RJ11 cable to connect to M4-LHS and an additional Extension. Use the RJ45 to RJ11 Adaptor on the M4-LHS.
- The order in which the control, the extensions, and the interface are wired is not observed.
- Set each Extension to a different letter (EXT-A or EXT-B). The M4-LHS assigns the stage letters based on the extension letter selected.
- Extension-A operates stages (E - J) and all the LEDs are Green. However, Extension-B operates stages (K - P) and all the LEDs are Red. .
- Configure the Modulating and Sequencing Output Types after connecting the Extension panels to be able to configure their outputs. See "Boiler Type" on page 19
- Use the 6-wire RJ11 cable supplied with the extension for proper operation.



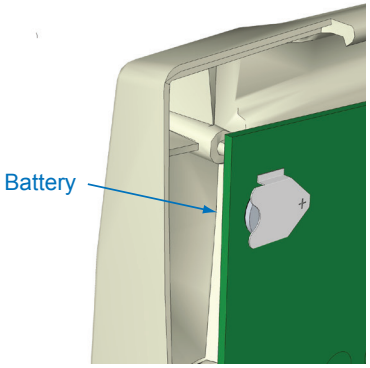
Connecting to BACnet Interface Module

- The M4-LHS can communicate to BACnet MSTP networks when used the X-BAC BACnet Interface Module (CA009100). The module must be purchased separately.
- The BACnet Interface Module comes with an RJ45 cable.
- Both the M4-LHS and the BACnet Interface Module are equipped with a RJ45 socket (RS485) to connect to communicate to each other.
- The Interface BACnet Module must be wired to the BACnet MSTP network using the RS485 terminals A, GND, and B.
- If both an extension panel and the BACnet Interface Module are to be used, connect the RJ11 socket on the BACnet Interface Module to the extension.
- Set the BACnet parameters. See "BACnet MSTP Communication Menu" on page 26.



ACTIVATE THE BATTERY

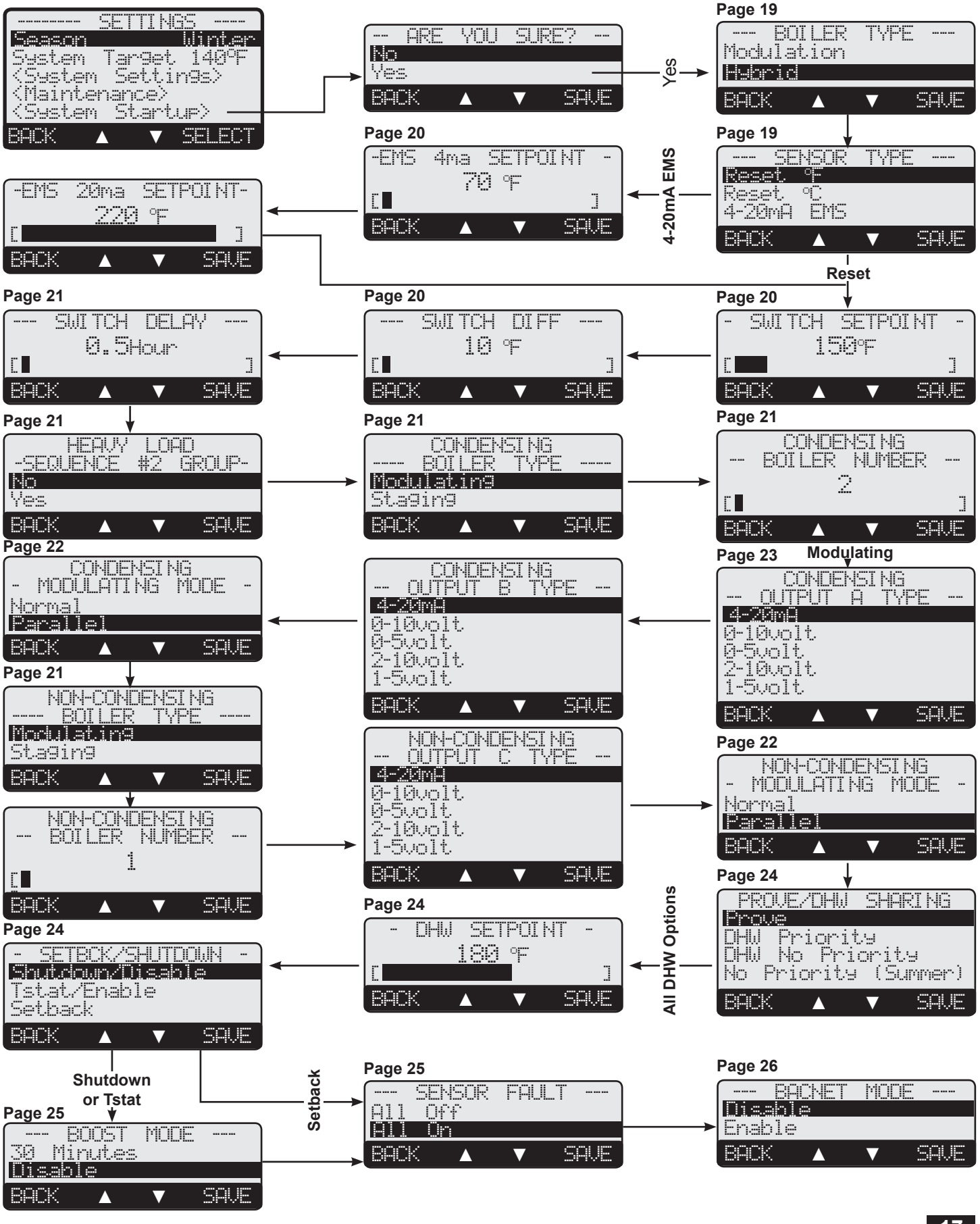
- The battery enables to control to maintain the clock time.
- Unscrew and remove the Enclosure Display Module to reveal the back of the control CPU Board.
- Remove the plastic strap that covers the battery. The battery holder contacts should be touching the battery. The control has a coin Lithium battery (CR2032) that is used to maintain the control's time during power outages. This battery can maintain the clock for up to a total of 100 days.



⚠ ALERT

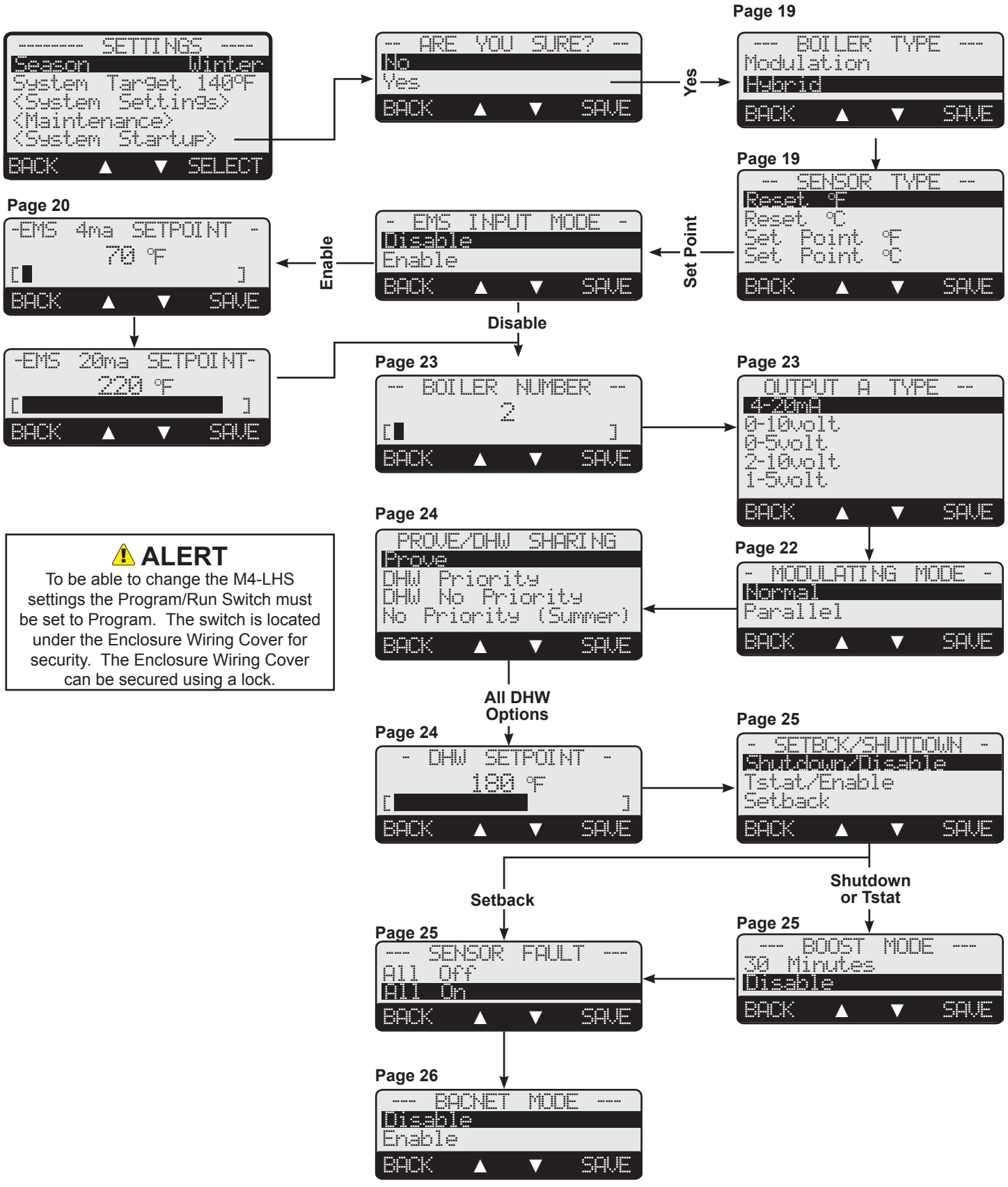
Do not install the battery unless you plan to keep the control continuously powered. If the control has no power, the battery will lose its charge in 100 days.

HYBRID STARTUP MENU



HT# 059295-00 B

MODULATING STARTUP MENU



⚠ ALERT

To be able to change the M4-LHS settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be secured using a lock.

STARTUP SETTINGS

Program Change Switch Setting



To be able to change the M4-LHS settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security.

Startup Sequence



Button: *MENU/<System Startup>*

- When powered, the M4-LHS performs a self diagnostics-test.
- On the first power up, the System Startup screen will appear after the initialization is complete. If it doesn't, the M4-LHS has already been configured.
- The System Startup menu sets the main parameters that relate to the heating application. These settings must be set by the installer.

Boiler Type



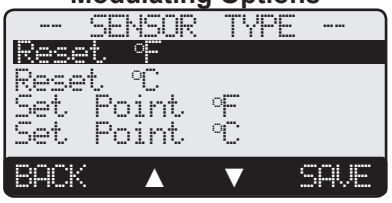
Modulation, Hybrid **Default: Modulation**

Button: *MENU/<System Startup>/..../Boiler Type*

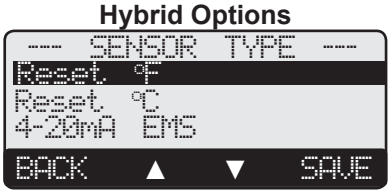
- The same Laars control can operate modulating boilers or a combination of both types.
- The Modulation option will operate a variety of modulating boiler signals.
- The Hybrid option will sequence two groups of boilers, condensing and non-condensing. Each group could be of a different boiler type (Modulation or Staging). See "Hybrid Logic Overview" on page 3. Each Multi-Stage boiler will use a single output relay for each stage.
- If BACnet is to be used, each of the Boiler Type modes will have a different set of BACnet variables. See "Hybrid - Outdoor Reset - BACnet Variable list" on page 44.

Sensor Type

Modulating Options



Hybrid Options



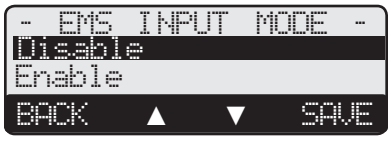
Reset °F, Reset °C, Set Point °F, Set Point °C, 4-20mA EMS **Default: Reset °F**

(Set Point Options are Not Available with Hybrid Boiler Type)

Button: *MENU/<System Startup>/..../Sensor Type*

- If Reset °F is selected, all temperatures and settings will be displayed in degrees Fahrenheit and the control will use Reset Ratios to adjust the system set point.
- If Reset °C is selected, all temperatures and settings will be displayed in degrees Celsius and the control will use Reset Ratios to adjust the system set point.
- If Set Point °F is selected, all temperatures and settings will be displayed in degrees Fahrenheit and the control will have an adjustable system set point.
- If Set Point °F is selected, all temperatures and settings will be displayed in degrees Celsius and the control will have an adjustable system set point.
- The 4-20mA EMS option is only available to the Hybrid Boiler Type option. To use 4-20mA EMS with Modulating Boiler Type, select one of the Set Point options and the EMS Input Mode menu will follow to offer the 4-20mA EMS option.
- The use of the 4-20mA EMS option requires the purchase of the 4-20mA EMS Interface. It gives the M4-LHS the capability of accepting a remote 4-20mA signal from a BMS or EMS system as the target set point.
- If BACnet is to be used, each of the Sensor Type modes will have a different set of BACnet variables. See "Hybrid - Outdoor Reset - BACnet Variable list" on page 44.

EMS Input Mode



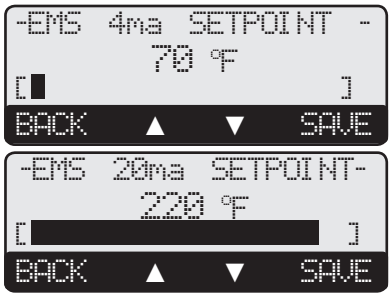
Disable, Enable **Default: Disable**

(Available after Set Point with Modulation Boiler Types)

Button: *MENU/<System Startup>/..../Boiler Type/Sensor Type / EMS Input Mode*

- It allows the M4-LHS to utilize the 4-20mA EMS Interface to accept a remote 4-20mA signal from a BMS or EMS system as the target set point.

EMS 4mA and 20mA Set Points



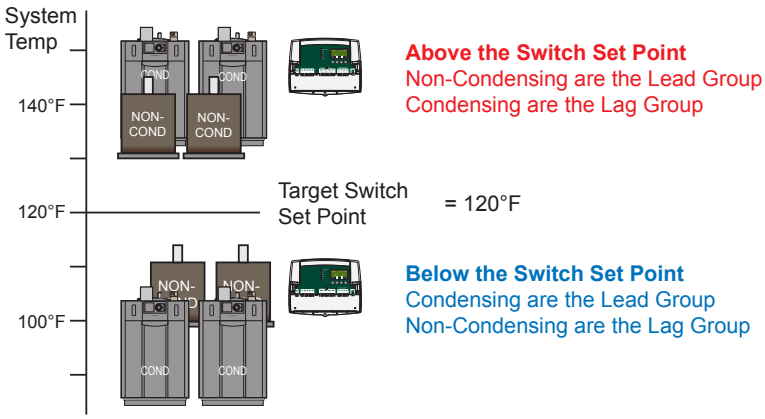
4mA: can be set from 50°F/ 10°C to 200°F/93°C **Default: 70°F/ 21°C**
20mA: can be set from 70°F/ 21°C to 220°F/104°C **Default: 220°F/ 104°C**
Button: *MENU/<System Startup>/..../Sensor Type / EMS Input Mode/EMS 4mA Set Point*

- With the use of the 4-20mA EMS Interface, the M4-LHS will be able to receive a 4-20mA signal as a set point from a BMS or an EMS system as the target set point.
- The 4mA and 20mA Set Point menus will follow the selection of the 4-20mA EMS sensor type option or EMS input Mode.
- There must be at least a 20°F differential between the 4mA and 20mA temperature settings.
- Connect the 4-20mA EMS Control Interface to the M4-LHS RS485 connection.
- Any signal below 2.4mA or above 21.6mA will start an EMS shutdown. The display will indicate that by displaying the message "Shutdown by EMS".

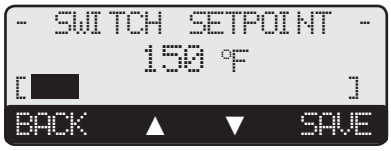
HYBRID STARTUP SETTINGS

See "Hybrid Logic Overview" on page 3.

SWITCH MODE = Target Temperature



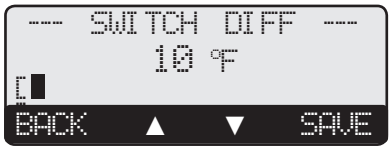
Switch Set Point



From 0°F/ -18°C to 200°F/ 94°C **Default: 150°F/ 66°C**
Button: *MENU/<System Startup>/..../Sensor Type/Switch Setpoint*

- It is the set point at which the M4-LHS will switch between the Condensing Boiler Group and Non-Condensing Boiler Group.
- The Condensing Boiler group will be the lead group when the Target Temperature is below the Target Switch Set Point. However, the Non-Condensing Group will be the lead group when the Target Temperature is above the Target Switch Set Point.

Switch Differential



Adjustable from 5F° / 3C° to 20F° / 11C° **Default: 10F° / 6C°**
Button: *MENU/<System Startup>/..../Switch Setpoint/Switch Diff*

- The Switch Differential controls the group switching. It allows the Calculated Target to drop a specified number of degrees below the Switch Set Point before changing the lead group over.
- The default value is a good start to avoid oscillation between Condensing and Non-Condensing Boiler groups, particularly if no Switch Delay was set. See next setting.

Switch Delay

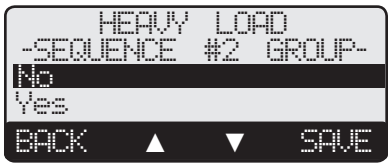


Adjustable from 0.0 to 12.0 Hours **Default: 0.5 hours**

Button: *MENU/<System Startup>/..../Switch Setpoint/Switch Diff/Switch Delay*

- The Switch Delay is an additional layer of assurance used to reduce the intermittent change of the lead group.
- To switch the lead group when the temperature is dropping, the sensor temperature must remain below the Switch Set Point less the Switch Differential for the complete Switch Delay period before the switching of the lead group.
- I.e., if the Switch Set Point was set to 135ºF, and the Switch Differential was set to 5ºF, then the Target Temperature must drop below 130ºF for the complete Switch Delay for the lead group to change from Condensing to Non-Condensing.
- To switch the lead group when the temperature is rising, the Target Temperature must rise above the Switch Set Point for the complete Switch Delay before the switching of the lead group could take effect.

Heavy Load Sequence 2nd Group



Yes, No **Default: No**

Button: *MENU/<System Startup>/..../Switch Delay/Heavy Load Seq#2 Group*

- This option makes the second group of boilers act as a backup in heavy load conditions. Thus, allowing them to start after all lead group boilers have run at their maximum capacity.
- If the system was designed to operate both groups of boilers in heavy load conditions, then select Yes.
- Selecting No will only allow the lead group to operate. The secondary group will remain off even if the system cannot reach the desired set point.

Condensing and Non-Condensing Boiler Type

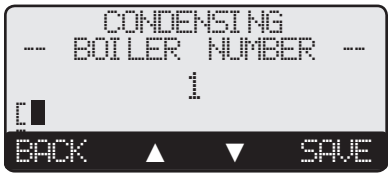


Modulating, Staging **Default: Modulating**

Button: *MENU/<System Startup>/..../Heavy Load Seq#2 Group/Condensing Boiler Type*

- Select the appropriate boiler type from the list. Each of the types will be followed by a related additional configuration settings to adjust.

Condensing and Non-Condensing Boiler Number



Adjustable from 1 to 15 **Default: 1**

Button: *MENU/<System Startup>/..../Condensing Boiler Type/ Condensing Boiler Number*

- Select the number of condensing boilers. These boilers will occupy the first letters of the wiring stages on the M4-LHS starting with Stage-A.
- Then, select the number of non-condensing boilers later in the Startup menu. See "HYBRID Startup Menu" on page 17.
- Note that, each Multi-Stage boiler requires the use of single output stage relay.

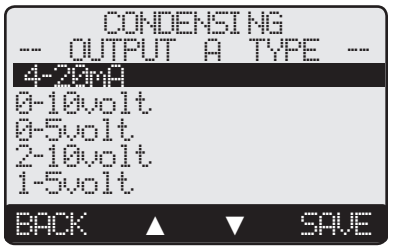
HYBRID MODULATING BOILER SETTINGS

Modulating Output Type

4-20mA, 0-10V, 1-10V (Custom) Outputs **Default: 1-10v Custom**

Button: *MENU/<System Startup>/..../Condensing Boiler Number/Output A Type*

- If either of the Condensing or Non-Condensing Boiler groups was set to Modulating as the Boiler Type, the M4-LHS will offer the capability of controlling a variety of modulating signals. Each boiler can be configured to have a different modulating signal.
- The modulating output for each boiler can be configured to 4-20mA operation (Current) or any of the voltage options. Check the boiler to determine its signal requirements.
- When using the Extension, connect it to the M4-LHS prior to configuring the Output Type. Otherwise, the M4-LHS might not recognize the Extension stages.



⚠ WARNING

Make sure that boiler modulation wiring matches the signal selected. Warranty will not cover failed components caused by improper wiring. See "Wiring the Boilers" on page 14.

Modulating Mode

Normal, Parallel **Default: Normal**

Button: *MENU/<System Startup>/..../Output A Type/Condensing Modulating Mode*

- Some modulating boilers perform better at higher modulation. For these units, it is advantageous to run one unit at high modulation than several units at lower modulation. If the units used are of this type, select Normal. This is the recommended setting for boilers with low turndown ratios.
- Most condensing boilers run more efficiently at lower modulation. If it is more energy efficient to run several units at lower modulation than one at high. In this case select Parallel. This is typically used on condensing boilers or boilers with high turndown ratios.
- For best Parallel performance, set the Modulation Start % to be equivalent to the lowest firing rate of the boiler multiplied by 2. That is, if the lowest firing of the boiler was 20%, set your Modulation Start% to 40%. See "Modulation Start %" on page 40.
- Set the Lag Delay to 0 for better parallel performance. See "Lag Delay" on page 33.





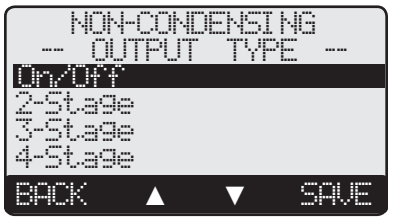
HYBRID STAGING BOILER SETTINGS

Staging Output Type

On/Off, 2-Stage, 3-Stage, 4-Stage Outputs **Default: On/Off**

Button: *MENU/<System Startup>/..../Non-Condensing Output Type*

- The M4-LHS can sequence multi-stage boiler starting with a single On/Off and up to a 4-stages. Just select the number of stages per boiler from this menu option.
- For each boiler stage a single output relay will be used. That is a 2-stage boiler will use two of the control stages.
- The number selected applies to all sequencing boilers within that group whether it is Condensing or Non-Condensing.
- The maximum number of stages the control can operate is 4. But with the addition of up to two extensions, it can handle up to a total of 16 stages.

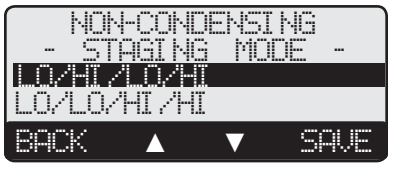


Staging Mode

Lo/Hi/Lo/Hi, Lo/Lo/Hi/Hi **Default: Lo/Hi/Lo/Hi**

Button: *MENU/<System Startup>/..../Non-Condensing Output Type/Non-Cond Staging Mode*

- During low load conditions, some boilers run more efficient when the lower stages are energized alone than with the higher stages. For these types of boilers select Lo/Lo/Hi/Hi. Then, the M4-LHS will sequence the lower stages of all boilers set to Auto before sequencing the higher stages.
- For the rest of the boiler types, the Lo/Hi/Lo/Hi should allow the staging of the lower stage of the lead boiler followed by the higher stage of the same boiler. Then when more stages are needed, it will fire the lower stage of the lag boiler followed by the higher stages



MODULATING BOILER SETTINGS

Boiler Number

Adjustable from 1 to 15 **Default: 1**

Button: *MENU/<System Startup>/Boiler Type/.../Boiler Number*

- Select the number of modulating boilers.

Modulating Output Type

4-20mA, 0-10V, 1-10V (Custom) Outputs **Default: 1-10v Custom**

Button: *MENU/<System Startup>/..../Boiler Number/Output A Type*

- The M4-LHS will offer the capability of controlling a variety of modulating signals. Each boiler can be configured to have a different modulating signal. Check the boiler to determine its signal requirements.

- When using the Extension, connect it to the M4-LHS prior to configuring the Output Type. Otherwise, the M4-LHS might not recognize the Extension stages.

Modulating Mode

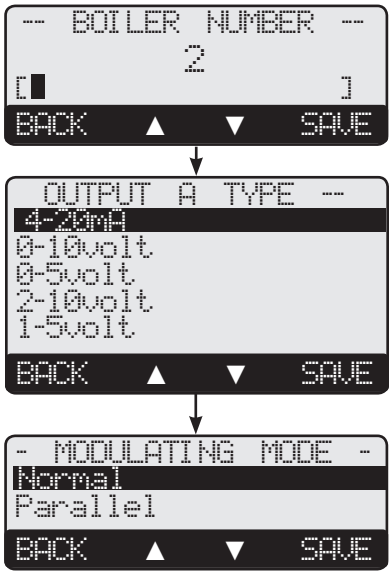
Normal, Parallel **Default: Normal**

Button: *MENU/<System Startup>/..../Output A Type/Modulating Mode*

- Some modulating boilers perform better at higher modulation. For these units, it is advantageous to run one unit at high modulation than several units at lower modulation. If the units used are of this type, select Normal. This is the recommended setting for typical steel and cast iron boilers or boilers with low turndown ratios.
- There are many condensing boilers that run more efficiently at lower modulation. If it is more energy efficient to run several units at lower modulation than one at high, select Parallel. This is typically used on condensing boilers or boilers with high turndown ratios.
- For best Parallel performance, set the Modulation Start % to be equivalent to the lowest firing rate of the boiler multiplied by 2. That is, if the lowest firing of the boiler was 20%, set your Modulation Start% to 40%. See "Modulation Start %" on page 40.
- Set the Lag Delay to 0 for better parallel performance. See "Lag Delay" on page 33.

⚠ WARNING

Make sure that boiler modulation wiring matches the signal selected. Warranty will not cover failed components caused by improper wiring. See "Wiring the Boilers" on page 14.



STARTUP SETTINGS (CONTINUED)

Prove/Indirect Domestic Hot Water (DHW) Priority



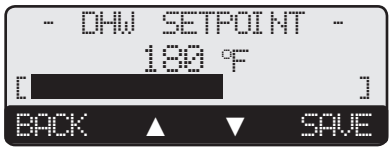
Prove, DHW Priority, DHW No Priority, No Priority (Summer) **Default: Prove**

Button: *MENU/<System Startup>/..../Prove-DHW Sharing*

- This setting determines the functionality of input terminals *29 and 30*.
- When Prove is selected, the M4-LHS will not start any boiler unless the Prove terminals are shorted/closed. However, it will allow the System relay to operate normally.
- There are three DHW Priority options. In all the options, a DHW call will raise the calculated water temperature to the DHW Set Point (See next setting).
- The Domestic Hot Water Priority option de-energizes the System relay during domestic hot water calls for a period of one hour. If after the priority period the DHW call did not expire, the System relay will energize providing heat to the building and the temperature target will remain at the DHW Set Point. After the DHW call ends, the set point will drop to satisfy the reset ratio or set point.
- Domestic Hot Water No Priority option allows the System relay to remain energized during a domestic hot water call (aquastat call on terminals *29 and 30*). However, in Summer, Shutdown, No Tstat call for heat, or when the outdoor temperature is above Outdoor Cutoff, a DHW call will energize the System relay. After the DHW call terminates, the System relay will continue to run for the System Run-On period before turning off.
- Domestic Hot Water No Priority (Summer) behaves the same as the DHW No Priority. The only difference is that in Summer, Shutdown, No Tstat call for heat, or when outdoor temperature is above Outdoor Cutoff, a DHW call WILL NOT energize the System relay except for the Run-On delay after the DHW call ends.

Indirect Domestic Hot Water Set Point

(Available with any of the DHW Priority options)



Adjustable from 140°F/60°C to 200°F/93°C **Default: 180°F/82°C**

Button: *MENU/<System Startup>/..../Prove-Setpoint*

- On a DHW call, the M4-LHS will raise the target temperature to the DHW Set Point until the DHW call expires.

Shutdown/Tstat/Setback Mode



Shutdown Input, Tstate Input, Setback Input **Default: Shutdown Input**

Button: *MENU/<System Startup>/..../Setback\Shutdown*

- This menu determines the functionality of terminals *31 and 32*.
- The M4-LHS has two levels of heat, a Normal/Day and a Setback/Night. The Normal/Day is good for when buildings are occupied and people are active. The Setback/Night holds a lower system temperature for night periods or when buildings are unoccupied.
- When Shutdown or Tstat is selected, the Day/Night Schedules will be available in the operating menu. See next settings. Terminals *31 and 32* will function as a Shutdown (Turn off boilers when shorted) or as a Tstat (Turn off boilers when opened). However, a call for indirect DHW will bring the boilers on.
- When Setback is selected, the External Signal option will switch the M4-LHS to Setback mode when terminals *31 and 32* are shorted. This allows an external device or control to provide the setback signal. No scheduling or boost menu options will be available with Setback.

Boost Mode

(Not Available in Setback Mode)

30 Minutes, Disabled **Default: Disable**

Button: *MENU/<System Startup>/..../Boost Mode*



- The morning Boost is designed to return the building to comfortable ambient temperatures after the cooler Night (Setback) period. The control will accomplish this by running elevated water temperatures (will add Setback setting to calculated water temperature) for 30 minutes before the start of the Day schedule setting. That is, if the normal day set point at a specific outdoor was 145˚F and the Setback setting was 20˚F, the boost will raise the system calculated temperature to 165˚F for 30 minutes before the start of the Day Schedule setting.
- If no Boost is needed, then simply select Disabled from the Boost Menu.
- Boost is only available if Shutdown or Tstat is selected as an option. See previous setting.

Sensor Fault

All Off, All On **Default: All On**

Button: *MENU/<System Startup>/..../Sensor Fault*



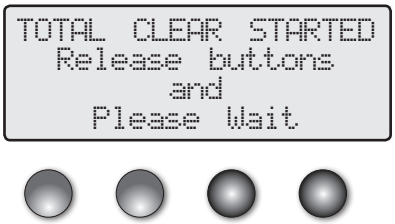
- The Sensor Fault will determine the operating status of all output stages that has their Mode set to Auto when a sensor reads Short or Open.
- When All-Off is selected, the control will turn all boilers Off when the System sensor reads Short or Open. However, when the Outdoor sensor reads Short or Open, the control will try to maintain the Minimum Water Temperature.
- When All-On is selected and the Boiler Type was set to other than Hybrid, the control will turn all boilers On to a 100% when the System sensor reads Short or Open and the outdoor temperature is below Outdoor Cutoff. However, when the Outdoor sensor reads Short or Open, the control will try to maintain the Maximum Water Temperature.
- When All-On is selected and the Boiler Type was set to Hybrid, the control will turn all Non-Condensing boilers On to full fire when the System sensor reads Short or Open and the outdoor temperature is below Outdoor Cutoff. During that time all Condensing boilers will turn Off. When the Outdoor sensor reads Short or Open, the control will try to maintain the Maximum Water Temperature.

⚠ ALERT

A good practice after performing any Startup menu modification is to check all operating settings and adjustments to match the new settings.

SETTING THE CONTROL TO FACTORY DEFAULTS

To Reset the M4-LHS control to its original factory defaults, power down the control. Hold down the two right most buttons while powering the control back up until the TOTAL CLEAR STARTED screen appears. The Display will direct you to the Startup menu to program the control after the defaults are loaded.

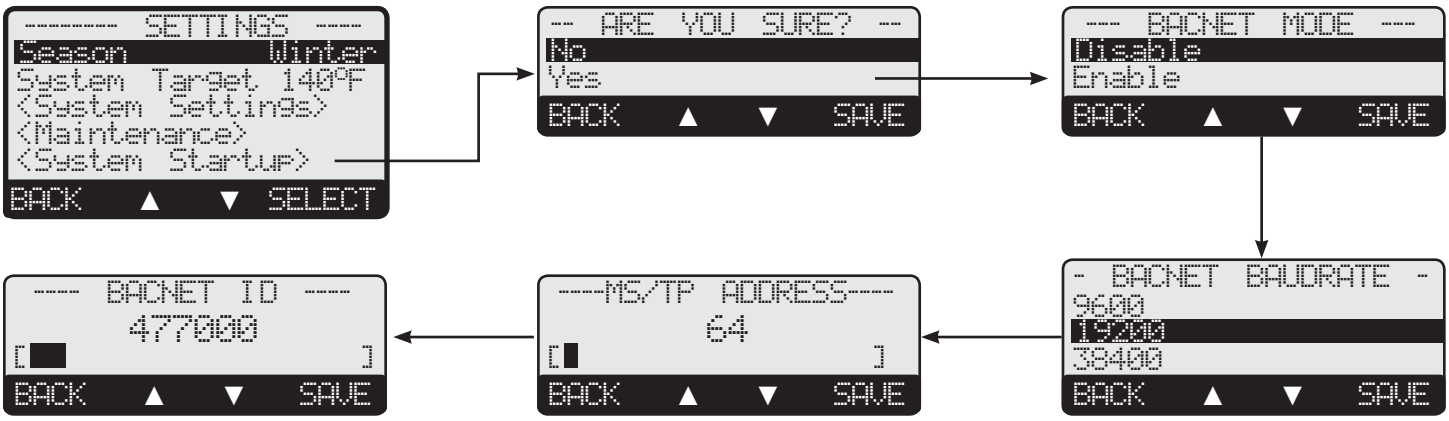


NOTE: When resetting the control to original factory defaults all control settings will be overwritten and will no longer exist.

⚠ ALERT

Do not turn off power to control until all Startup settings have been made. Otherwise, the next power-up will be set to many Startup factory settings that may not fit your application.

BACNET MSTP COMMUNICATION MENU



When using the M4-LHS in a BACnet MS/TP network, the use of BACnet Interface Module is required. In addition, each of the Boiler Type and Sensor Type Startup menu option will offer a different list of BACnet variables. See "Boiler Type" on page 19. See "Sensor Type" on page 19. Also, see "Hybrid - Outdoor Reset - BACnet Variable list" on page 44

BACnet Mode



Enable, Disable **Default: Disable**

Button: *MENU/<System Startup>/.... Sensor Fault/BACnet Mode*

- This menu option enables or disables the BACnet MSTP capability. When enabled, additional BACnet settings shall be available for further customizing.
- Note that if this option was enabled while no BACnet communication is present, the BAcnet error message will supersede other messages. See "Display Messages" on page 38.

BACnet Baud Rate



9600, 19200, 38400 **Default: 19200**

Button: *MENU/<System Startup>/.... Sensor Fault/BACnet Mode/BACnet Baudrate*

- For the control to communicate over a BAcnet MS/TP network, it must use the same Baud rate as the rest of the network. The control offers three Baud Rates.
- If communication was not successful, the baud rate could be the cause. Check with the network administrator for the network baud rate. Then match it on the control.

MS/TP Address



1 to 127 **Default: 64**

Button: *MENU/<System Startup>/.... /BACnet Mode/BACnet Baudrate/ MSTP Address*

- Each device on the MS/TP network must have a unique address.
- This is the MS/TP address on a RS485 network. Its MS/TP range is 1 though 127.
- The MS/TP address must be provided by the Network Administrator.

BACnet ID



1 to 4,000,000 **Default: 477,000**

Button: *MENU/<System Startup>/.... / MSTP Address / BACnet ID*

- The BACnet ID is a unique 32 bit number that identifies the control within the BACnet network. No two ID shall be the same even if dealing across networks.
- It must be provided by the BACnet Network Administrator.

OPERATING SETTINGS

Program Change Switch Setting



To be able to change the M4-LHS settings, the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security.

Season



Winter, Summer **Default: Winter**

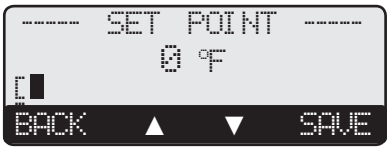
Button: *MENU/Season*

- The M4-LHS will turn all boiler relays off when it is in Summer setting. However, an indirect DHW call will bring boilers back on when needed. The Message Display Line will display Summer to show the status.
- In Winter, the M4-LHS will activate the System relay whenever the Outdoor Temperature (OD) falls below the Outdoor Cutoff setting. The Message Display Line will not show any season information when in Winter.
- When the heating season is over, it is a good practice to switch the M4-LHS to Summer setting. This will allow the control to sequence the boilers on an indirect DHW call.

⚠ ALERT

DO NOT turn power off to the M4-LHS when heating season is over. If you do so, the battery will run down and will have to be replaced. Instead, switch to Summer.

Set Point



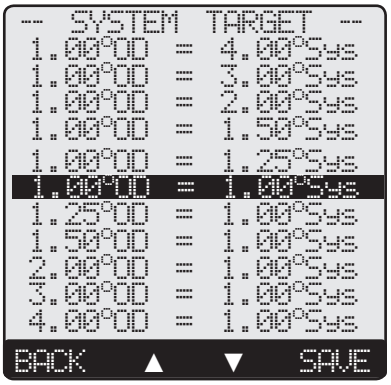
Adjustable 70°F - 250°F **Default: 70°F**

(Not Available for Hybrid Boiler Types)

Button: *MENU/Set Point*

- The Set point is the temperature value the M4-LHS will use to control the system.
- The M4-LHS will increase, decrease or hold the modulation of the boilers to maintain the system temperature around the Set point.
- The system can be expected to fluctuate around the set point. The amount of fluctuation depends on the modulation settings and stage Settings.
- If the EMS Input Mode was Enabled, the Set Point will be set by the EMS system and will be available to be read but not changed on the display. See "EMS Input Mode" on page 19.

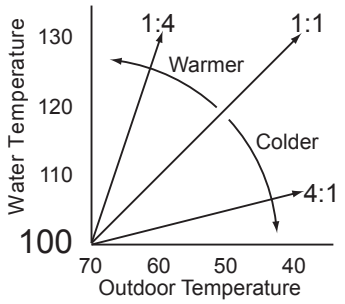
Reset Ratio



Adjustable 1.00°OD : 4.00°Sys to 4.00°OD : 1.00°Sys **Default: 1.00°OD : 1.00°Sys**

Button: *MENU/System Target*

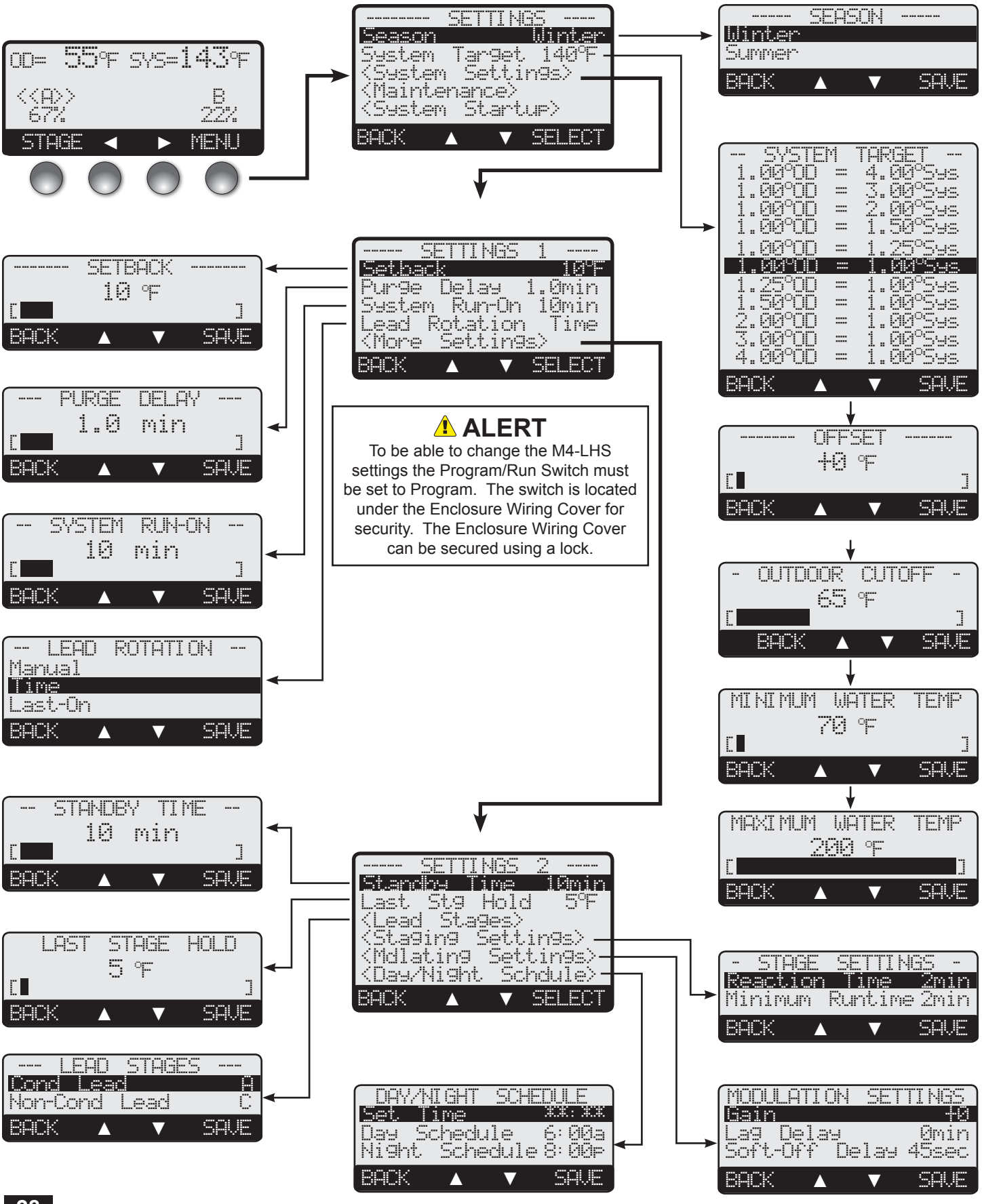
- The Reset Ratio determines how the System water temperature (SYS) will vary with Outdoor Temperature (OD). With any of the ratios, the colder it becomes outside, the hotter the temperature of the system water. See "Outdoor Reset Concept" on page 5.
- With a 1.00 (OD):4.00 (SYS) ratio, the System water temperature (SYS) will increase rapidly as the outside temperature falls, hitting the maximum of 240°F at 24°F outside temperature. With a 4.00 (OD):1.00 (SYS) ratio, the System water temperature (SYS) will increase slowly as the outside temperature falls. Even at -30°F, the system water will only be 125°F, and at 24°F outside, the system water will be 112°F. Such a low Reset Ratio might be used with radiant floor heating applications.
- With most baseboard heating applications, a 1.00 (OD):1.00 (SYS) setting is a good place to start. With a 1.00 (OD):1.00 (SYS) ratio, for every degree the outside temperature falls, the system water temperature is increased one degree.
- If required: **Adjust the RESET RATIO in cold weather.** If the ambient building temperatures are too low in cold weather, move the ratio to a higher selection. That is, if 1.00 (OD):1.00 (SYS) was initially selected, change the selection to 1.00 (OD):1.25 (SYS). If the building temperatures are too warm in cold weather, move the ratio to a lower selection. That is, if 1.00 (OD):1.00 (SYS) was initially selected, change the selection to 1.25 (OD):1.00 (SYS).



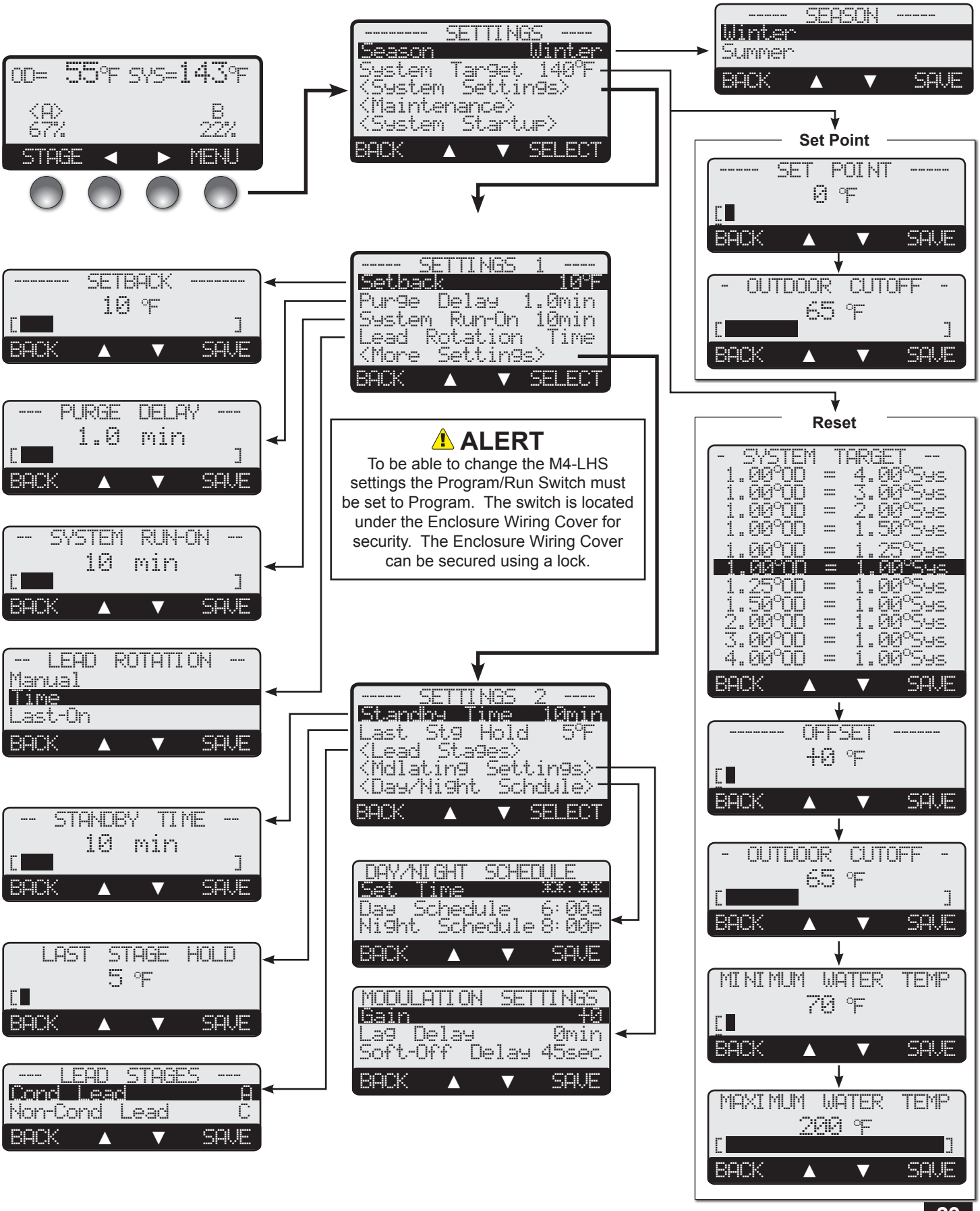
Reset Ratio

HT# 059295-00 B

HYBRID OPERATING MENU



MODULATING OPERATING MENU



HT# 059295-00 B

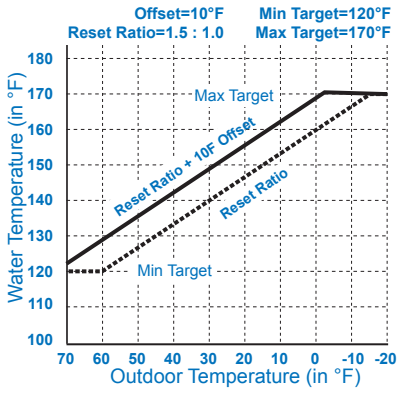
Offset



Adjustable from 50F°/28C° to -50F°/-28C° **Default: 0F°/0C°**

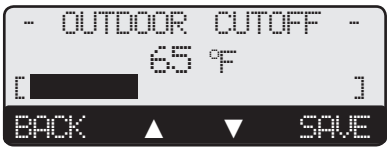
Button: *MENU/System Target/Offset*

- The Offset adjust the starting points of the Reset Ratio curve. This means that, regardless of the Outdoor Temperature (OD) or the Reset Ratio that has been selected, when the Offset setting is changed, that change is directly added to or subtracted from the calculated temperature. For example, if the Set Point was 130°F and the Offset was changed from 0F° to 10F° (an increase of 10F°), then the Set Point temperature would increase to 140°F.
- The Offset setting does not change the ratio selection. What the Offset does is add or subtract a constant temperature value. See "Outdoor Reset Concept" on page 5.
- If required: **Adjust the Water Offset in mild weather**. If the ambient building temperatures are too warm in mild weather, decrease the offset. If the ambient building temperatures are too cold in mild weather, increase the Water Offset.
- The rule of thumb for baseboard radiation is to change the offset 4°F for every 1°F you wish to change the building temperature. In radiant heat applications, change the offset 1F° or 2F° for every 1F° you wish to change the building temperature.



Target Offset

Outdoor Cutoff Temperature



Adjustable: Off, from 20°F / 70°C - 100°F / 38°C, On **Default: 65°F/ 18°C**

Button: *MENU/System Target/Offset/Outdoor Cutoff*

- The control will turn heating off if the outside temperature rises above the Outdoor Cutoff. This setting shall not affect any indirect DHW requirement.
- The Outdoor Cutoff screen will automatically appear after setting the Offset.
- When the outdoor temperature falls to the adjustable Outdoor Cutoff temperature, the M4-LHS will operate the boilers to hold the calculated temperature.
- When the outdoor temperature rises to the Outdoor Cutoff plus a 2°F differential, the M4-LHS will turn all boilers off. The System relay will remain energized for the Run-On delay then de-energize.
- The Outdoor Cutoff can be set from 20°F to 100°F. In addition, it can be set to ON or OFF. In the ON position, the System Relay will run regardless of the Outdoor Temperature (OD) and the burner stages will be active to hold the calculated water temperature. (Note: The lowest water temperature the M4-LHS will circulate is 70°F. If the Outdoor Cutoff is turned ON and the Season is set to Winter, the M4-LHS will circulate at least 70°F water even in the hottest of weather.) In the OFF position, the system pump will always be off and all burner stages will be off.

Minimum Water Temp

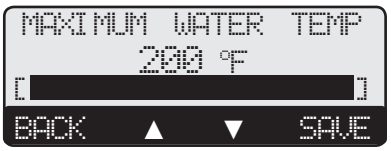


Adjustable from 50°F/10°C to 180°F/82°C **Hybrid Default: 70°F/ 21°C**
Modulation Default: 120°F/ 49°C

Button: *MENU/System Target/Offset/Outdoor Cutoff/Minimum Water Temp*

- The Minimum Water Temperature must be set to the boiler manufacturer's specification. The M4-LHS will calculate the Set Point based on the Outdoor Temperature (OD), the Reset Ratio, and the Offset value. The M4-LHS will control all boilers to hold either the Set Point temperature, or the Minimum Water Temperature, whichever is higher.
- The Minimum Water Temperature must be at least 20°F lower than the Maximum Temperature (See next setting).

Maximum Water Temp



Adjustable 70°F/21°C - 220°F/104°C **Default: 200°F/93°C**

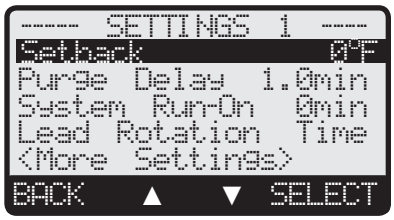
Button: *MENU/System Target/Offset/..../Maximum Water Temperature*

- This is the highest temperature heating water the M4-LHS will circulate through the heating system.
- When using a radiation system, it should be set according to the tubing or floor manufacturer's specification.
- The Maximum Temperature must be at least 20°F higher than the Minimum Temperature (See previous setting).

SYSTEM SETTINGS

Button: *MENU/<System Settings>*

Settings 1 and Settings 2 menus provide access to adjusting and fine-tuning the system for enhanced comfort and better fuel savings. The M4-LHS behaves differently based on the selected modes. See "Startup Settings" on page 19.





ALERT

To be able to change the M4-LHS settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be secured using a lock.

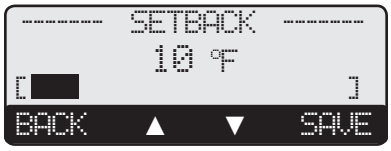
Setback

Adjustable from 0F°/0C° to 75F°/42C° **Default: 10F°/6C°**

Button: *MENU/<System Settings>/Setback*

- The Setback feature can be used to provide the M4-LHS with a lower temperature Set Point when less load is required.
- The lower Set Point will appear on the main display indicating this condition.
- For example, if the calculated temperature is 180°F and the Setback is 20°F, then when in Setback or Night Schedule, the M4-LHS will hold a Set Point of 160°F = 180°F- 20°F. See "Day - Night Schedule" on page 36.
- A typical use for the Setback is to provide less system temperature to a building during the Night Schedule or on the weekends when people are asleep or when the building is not occupied, but heat is still needed.
- The amount of Setback selected is subtracted from the Set Point when a Setback Input Signal is received or the Night Time schedule setting started.
- If Setback is selected as the Shutdown/Tstat/Setback Mode (See "Shutdown/Tstat/Setback Mode" on page 24.), the Setback will not be activated unless a Short dry-contact signal is received on terminals (*31 and 32*).
- If Shutdown or Tstat is selected as the Shutdown/Tstat/Setback Mode (See "Shutdown/Tstat/Setback Mode" on page 24.), the Setback will be activated only during the Night Schedule.

PROGRAM RUN



ALERT

When using Soft-Off and Last Stage Hold, the last boiler stage will not turn off until both parameters have elapsed. In this case, Soft-Off will start after the Last Stage Hold.

Purge Delay

Adjustable from 0.0 min to 10.0 min **Default: 1.0 min**

Button: *MENU/<System Settings>/Purge Delay*

- Many boilers go through a purge cycle before they are brought on line. When the M4-LHS activates a boiler, it does not start to calculate its output until the Purge Delay is over. This allows the boiler to fully come online and begin producing.
- The Purge Delay helps prevent short cycling of any newly activated burner. Once the burner is activated, it **MUST** run through the entire Purge Delay period.
- The minimum Purge Delay setting **MUST** be set to the time required by the boiler manufacturer. Time entry is in 0.1 of a minute (i.e. 1.5 minute will equal 90 seconds.)
- The Message Display Line will display Purge Delay and the remaining time.



ALERT

Set Purge Delay as per boiler manufacturer recommendation.

System Run-On

Adjustable from 0 min to 360 min **Default: 10 min**

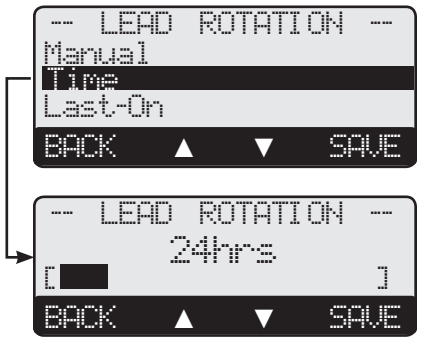
Button: *MENU/<System Settings>/System run-On*

- A common use for the System Run-On is to control a system pump in a heating system. The extra time helps transfer the boiler residual heat to the heating system.
- The System relay will energize whenever the outdoor temperature is below the Outdoor Cutoff and the Shutdown is Open or the Tstat is closed. When the Outdoor Temperature rises 2°F above the Outdoor Cutoff or the control is switched to Summer and after the last burner relay has de-energized, the System relay will remain energized for the System Run-On period.



- The System Run-On time should be set based on the size and type of the boilers and pumps used. In general, when setting the System Run-On consult the boiler and pump manufacturers for the best setting.
- When the System relay is in the Run-On period, the Message Display Line will indicate that status and the remaining time.

Lead Boiler Rotation



Adjustable Manual, Time (1 hr to 60 Days), Last-On **Default: Time (24Hours)**

Button: *MENU/<System Settings>/Lead Rotation*

- The Lead Boiler is the first boiler brought on when an output is needed.
- The Lead Boiler can be rotated automatically every specified time period, manually, or based on Last-On. Time rotation is recommended.
- The Lead Group Lead Boiler is shown in bracket layers on the main display. The Lag Group lead Boiler is shown in a single bracket. See "Boiler Status" on page 38.
- Only boilers which are set to Auto Mode can be Lead. Therefore, not all the boilers may be available when manually selecting a new Lead Boiler.

Standby Time



Adjustable from 1 min to 60 min **Default: 10 min**

Button: *MENU/<System Settings>/<More Settings>/Standby Time*

- Standby boilers are used for backup or extreme load conditions only. A Standby boiler can never be a Lead Boiler.
- The Standby Time only applies to boilers set to Standby.
- A boiler can be set to be a Standby boiler using the Stage Menu. See "Mode" on page 39.
- A Standby boiler can only be activated after all the boilers in Auto Mode have run at 100% modulation for the full Standby Time.
- The full Standby Time must always elapse regardless of what happens to the system temperature. Therefore, shorter Standby Times will result in smoother set point operation in extreme conditions. On the other hand, longer Standby Times may prevent a Standby boiler from firing if the other boilers can eventually meet the load, or if the load decreases.

Last Stage Hold



Adjustable from 0F°/0C° to 30F°/17C° **Default: 5F°/3C°**

Button: *MENU/<System Settings>/<More Settings>/Last Stg Hold*

- The Last Stage Hold prevents short cycling of the Lead Stage during low demand periods.
- In these conditions, the system might require less output than the lowest lead Stage. When the M4-LHS brings on the Lead Stage, the Set Point is quickly exceeded, and the M4-LHS turns the Lead Stage off.
- To prolong the run time during this type of condition, use the Last Stage Hold setting to let the system temperature exceed the Set Point by the number of degrees selected.
- For example, with a Set Point of 160°F and a Last Stage Hold setting of 10°F, the Lead Stage boiler will de-energize after the Set Point exceeds 170°F (160°F + 10°F).
- In many cases, it is better to overshoot slightly than to short cycle a boiler.
- When Soft-Off is set to other than 0 seconds, the Lead Boiler will need to remain at or exceed the Last Stage Hold for the Soft-Off period before turning off.

Lead Stages



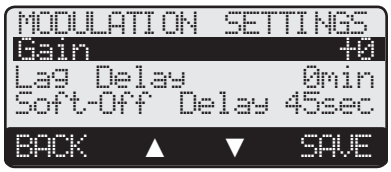
Condensing Lead, Non-Condensing Lead **Default: 1st boiler in the Group**

Button: *MENU/<System Settings>/<More Settings>/Lead Stages*

- In addition to having a lead group, each group of boilers, Condensing Group and Non-Condensing Group, will have its own lead boiler that can be selected from this menu.
- After assigning the lead boiler for each group, the lead will rotate based on the Lead Rotation option selected. See "Lead Boiler Rotation" on page 32.
- The Lead Group Lead Boiler can be identified by the two brackets <<A>>.
- The Lag Group Lead Boiler can be identified by the one bracket <C>.

MODULATING BOILER OPERATING SETTINGS

Gain





Adjustable from -10 to +10 **Default: 0**

Button: *MENU/<System Settings>/<More Settings>/<Modulating Settings>/Gain*

- The Gain adjusts the aggressiveness of the modulating PID logic. It controls how much modulation is changed when the system temperature is different from the Set Point.
- A Gain of 0 is a good starting point for all systems.
- If during normal load conditions, the system temperature tends to oscillate significantly, decrease the Gain by two numbers (for example, from 0 to -2). Wait for at least 15 minutes before evaluating how the change has affected the system.
- If during normal load conditions the system temperature tends to remain consistently below the Set Point (or consistently above the Set Point), increase the Gain by two numbers (for example, from 0 to 2). Wait for at least 15 minutes before evaluating how the change has affected the system.

Lag Delay

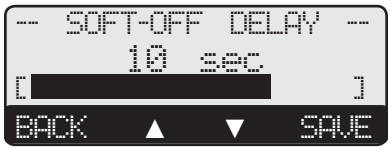


Adjustable from 0min to 60min **Default: 0min**

Button: *MENU/<System Settings>/<More Settings>/<Modulating Settings>/Lag Delay*

- The Lag Delay requires the lead stage to remain at 100% modulation for the full period of the Lag Delay before the lag stage can be activated. For example, if the Lag Delay was set to 10 minutes, the Lead Stage must remain at 100% modulation for the full ten minutes before the lag stage could be activated. The Message Display Line will display Lag Delay and the remaining time.
- The Lag Delay is useful in installations where one unit should usually have enough output to hold the load unless it fails or load conditions become extreme.
- The Lag Delay overrides the Modulation Start % selected for each stage. Regardless of that setting, the previous stage must reach and stay at 100% before the lag stage can be activated.
- The full Lag Delay must elapse regardless of what happens to the system temperature. Therefore, set the Lag Delay to 0 minutes to achieve smooth operation.
- Note that if Parallel was selected as the Modulation Mode (See "Modulating Logic Overview" on page 4), this value must be set to 0 minutes to avoid having the lead boiler going to 100% modulation prior to firing the lag boiler.

Soft-Off Delay



Adjustable from 0sec to 60sec **Default: 10 sec**

Button: *MENU/<System Settings>/<More Settings>/<Modulating Settings>/Soft-Off Delay*

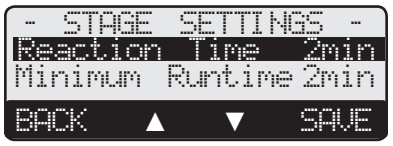
- When a boiler is no longer needed, the Soft-Off keeps that boiler in Low Fire prior to turning it off.
- The display will show a percent that is equal to the Ignition % for the stage in Soft-Off delay. That number will blink for the Soft-Off delay period.
- If during the Soft-Off delay period the M4-LHS needed that stage to turn back on, the stage will be released from the Soft-Off delay and resume normal operation.
- On a Shutdown initiation or Tstat termination any stage that was On will go into Soft-Off delay before fully turning off.

⚠ ALERT

When using Soft-Off and Last Stage Hold, the last boiler will not turn off until both parameters have elapsed. In this case, Soft-Off will start after the Last Stage Hold.

STAGING BOILER OPERATING SETTINGS

Reaction Time





Adjustable from 1 to 10 minutes **Default: 2 minutes**

Button: *MENU/<System Settings>/<More Settings>/<Stage Settings>/Reaction Time*

- It is the amount of time it takes a single stage to affect the system.
- After the control turns on a stage trying to meet the set point, it will not turn on another stage until the Reaction Time has elapsed.
- To determine the optimum time, start with a hot system. Then, turn on a single stage and calculate how long it takes until the system temperature begins to respond to that stage. That period should be set as the Reaction Time.

Minimum Runtime



Adjustable from 1 to 60 minutes **Default: 2 minutes**

Button: *MENU/<System Settings>/<More Settings>/<Stage Settings>/Min Runtime*

- This is the minimum amount of time any stage will run.
- For the lowest stage of a unit, the Minimum Runtime starts after the purge cycle.
- The Runtime does not apply to the last stage online. The Last Stage Hold applies in that case.
- Initially, set the Minimum Runtime to half the Reaction Time.
- If the system tends to overshoot, reduce the Minimum Runtime. However, if boilers tend to short cycle, increase the Minimum Runtime.

Avoiding Conflicting Boiler Limits

The temperature limits set on the boilers MUST be set considerably higher than the M4-LHS's Set Point for the reasons detailed below.

- The M4-LHS sensor is located in a common header some distance from the boilers.
- As the temperature rises in the header and before reaching the sensor location, energy is dissipated. Therefore, the temperature in the header could be lower than that registered by boiler sensors.
- In addition to the normal drop experienced between the boiler's temperature and that read by the M4-LHS sensor, the Last Stage Hold setting must be accounted for. The boiler limit must be set above the Set Point PLUS the Last Stage Hold PLUS the normal drop experienced in the piping.
- Using the previous example of a 10°F Last Stage Hold with a 160°F Set Point, the boilers' limits must be set enough over 170°F to prevent the boilers' internal limits being reached. In this situation, the boiler high limit should be set higher than 180°F to prevent erratic operation.

⚠ WARNING

The temperature limits set on the boilers must be higher than the M4-LHS Max Water Temp. Read the left section for details that will prevent erratic system operation.

Avoiding Conflicting Boiler Limits

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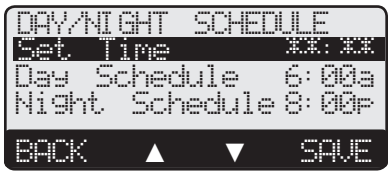
⚠ WARNING

The temperature limits set on the boilers must be higher than the M4-LHS Max Water Temp. Read the left section for details that will prevent erratic system operation.

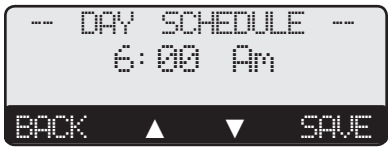
DAY - NIGHT SCHEDULE

(Available when "Shutdown or Tstat" is selected from the Shutdown/Tstat/ Setback Startup menu option only)

Button: *MENU/<System Settings>/<More Settings>/Day/Night Schedule*



- The M4-LHS has two levels of heat. The Day (Normal) level is used when a building is occupied and people are active.
- The Night (Setback) level is used when a building is not occupied, or when people are sleeping. This setting reduces the calculated temperature by the Setback setting. See "Setback" on page 31. If the Day calculated water temperature was 150˚F and the Setback was 20˚F, the Night Schedule will run at (150˚F - 20˚F) = 130˚F.
- If the Boost feature is being used, it uses the Day Schedule as the Boost ending point. See "Boost Mode" on page 25. That is, if the Day Schedule is set to start at 6:00AM, the Boost will start 30 minutes prior to the Day setting at 5:30AM. The M4-LHS will then raise the calculated water temperature by the Setback amount. Using the previous example, at 5:30AM the M4-LHS will raise the calculated water to 170˚F = (150˚F + 20˚F) until 6:00AM.



Set Time

Button: *MENU/<System Settings>/<More Settings>/Set Time*



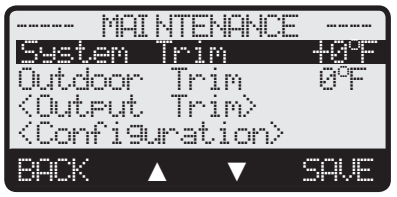
- Adjust the time by selecting Set Time from the menu and then scrolling through the hours then select Save. If the hours are to be set to PM, scroll through the AM hours to reach the PM hours. Then, scroll through the minutes then select Save.

> **⚠ ALERT**
> Remember that the battery is the backup for the Time. If no power is supplied to the M4-LHS and there was no battery or the battery had no power, time values will be lost and will need to be reset.

MAINTENANCE

Button: *MENU/<Maintenance>*

The Maintenance menu gives access to sensor and modulating output trimming. In addition, you'll have access to view the Startup configuration settings.





> **⚠ ALERT**
> To be able to change the M4-LHS settings the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be secured using a lock.

System & Outdoor Sensor Trim

Adjustable from -5F°/-3C° to +5F°/+3C° **Default: 0°F**

Button: *MENU/<Maintenance>/System Trim*

Button: *MENU/<Maintenance>/Outdoor Trim*





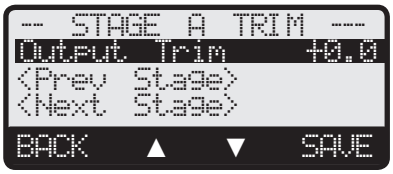
- The Laars thermistor type sensors are very accurate, and normally require no calibration. Sometimes it may be desirable to make small adjustments to the displayed value for either the Outdoor Temperature (OD) or the System Temperature (SYS). The Trim setting is used to adjust the displayed value.
- Do not use the Trim setting to make the Outdoor Temperature sensor match that reported on the radio or TV. Outdoor Temperature can vary widely over a broadcast range. Only trim the outdoor sensor based on an accurate thermometer reading taken where the sensor is located.

Output Modulation Trim

(Available for modulating boilers only)

Adjustable from -1.0 to +1.0 **Default: 0.0**

Button: *MENU/<Maintenance>/Output Trim*



- Each of the modulating stages controlled has a separate Output Trim setting.
- Output Trim acts as an adjustment to a stage output percent to match the burner motor.
- After adjusting the Output Trim, test the operation to make sure the results match your expectation.

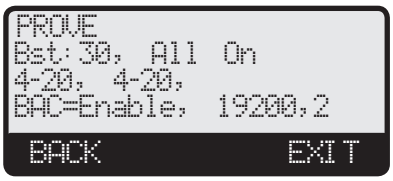
> **⚠ ALERT**
>
> DO NOT use the Output Trim for a Stage unless it is absolutely necessary. Test burner operation and modulation output matching after adjusting the Output Trim.

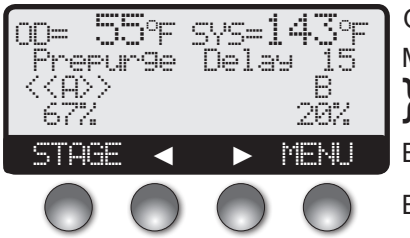
Configuration

Button: *MENU/<Maintenance>/<Configuration>*

- This menu option provides a consolidated view of the M4-LHS's Startup and Stage settings.







Outdoor and System Temperature

Messages

}Boilers and Their Status

Button Functions

Buttons

DISPLAY

The M4-LHS display layout provides a variety of information that gives an immediate picture of the operation status. The display shows two boilers at a time. When extensions are present, the two middle buttons (◄ ►) scroll the screen to view additional boilers. Moreover, all the information displayed can be viewed in brightly or dimly lit rooms.

- The buttons' functionality changes based on the screen and menu level. The buttons' functionality is displayed on a dark background on the screen bottom line.
- (◄ ►) Horizontal arrows are to scroll through the available stages.
- (▲ ▼) Vertical arrows are to scroll through the menu functions when in menus or to change settings when in a setting screen.
- The Top line displays the Outdoor and System sensor values.
- The second line displays all messages pertaining to the operation or status. See "Display Messages" on the next page.
- The third line will list the boiler stages. Additional stages can be scrolled to using the two middle buttons. The lead boiler letter will be bracketed. See "Lead Boiler Rotation" on page 32. The lead boiler in the lead group will have two sets of brackets.
- The fourth line lists each boiler modulation or sequencing status. See "Boiler Status" on the next page.

BOILER STATUS

The M4-LHS boiler status gives immediate access to each boiler stages or modulation.

- --- Boiler is off due to no call for heat.
- <<A>> A is the lead boiler in the lead Hybrid group. See "Lead Stages" on page 32.
- <C> C is the lead boiler in the lag Hybrid group or the lead boiler in Modulating Boiler Type. See "Lead Stages" on page 32.
- C/E Extension panel is NOT communicating back to the M4-LHS. See "Connecting to the Extensions and 4-20mA EMS Interface" on page 15.
- mON All boiler stages are set to ON.
- mOFF All boiler stages are set to OFF.

Display Modulating Boiler Status

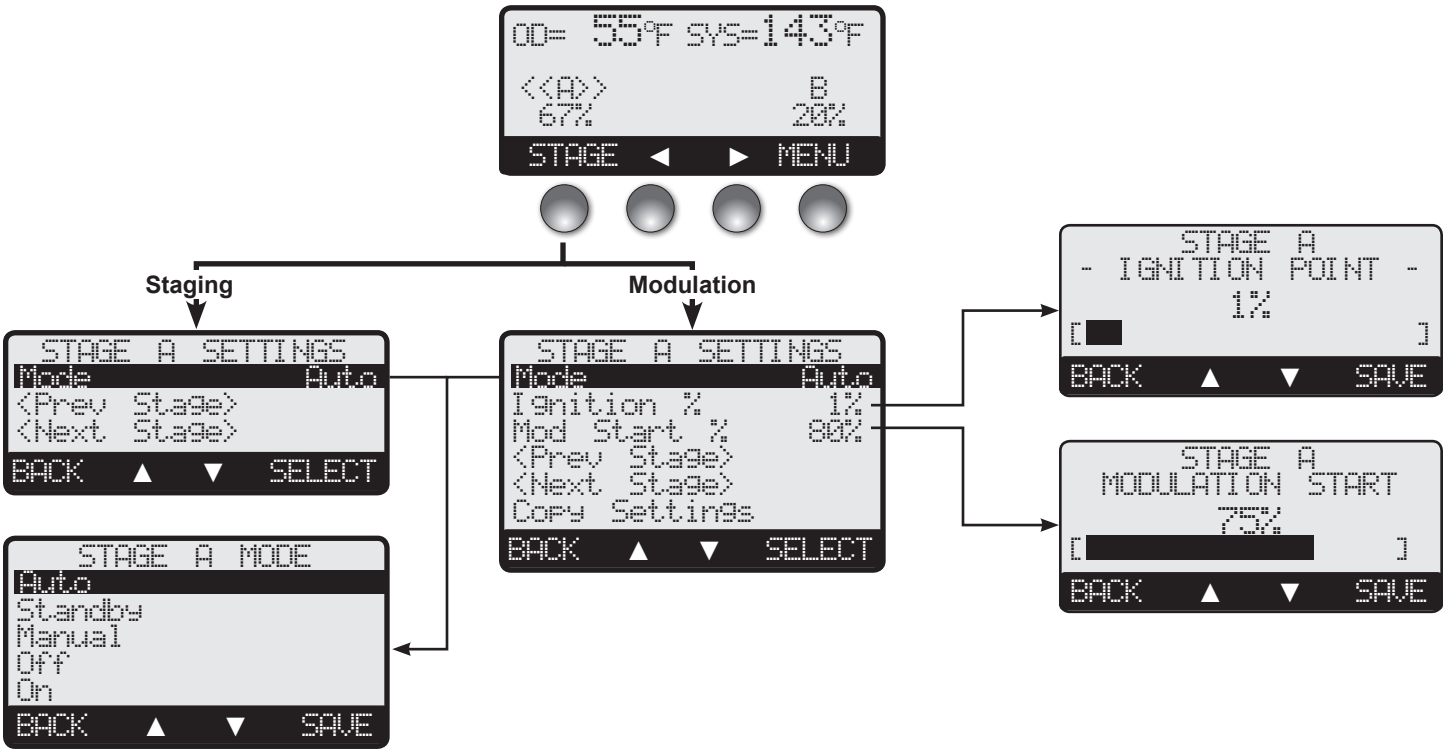
- 97% Boiler is modulating at the indicated percentage.
- m95% Boiler Stage Mode is set to Manual Modulation to the specified percent. See "Mode" on page 39.
- h50% Boiler is in post purge for 30 seconds.

DISPLAY MESSAGES

The M4-LHS display layout reserved the second line for message indications. The following is a list of the most common Message Display Line information:

- Boost To 170˚F The Boost has started 30 minutes before the Day Schedule setting and the Boost temperature is 170˚F. See "Boost Mode" on page 25.
- DHW Call (180˚F) There is an indirect DHW call. The M4-LHS will raise the system Set Point to the indicated temperature. DHW increases calculated temperature to the DHW Set Point. See "Indirect Domestic Hot Water Set Point" on page 24.
- Holding Until 150˚F The Lead boiler is in Last Stage Hold. This example shows that the lead stage will turn off when system temperature reaches 150˚F. See "Last Stage Hold" on page 32.
- Interface Module Error There is no communication to the BACnet Module Interface while the BACnet Mode is set to Enable. See "BACnet Mode" on page 26.
- Lag Delay: 123 The lead boiler is at 100% and the remaining purge time to start the lag boiler in seconds is 123. See "Lag Delay" on page 33.
- Outdoor Cutoff The outdoor temperature is above the Outdoor Cutoff setting. No boilers will be active for heating. See "Outdoor Cutoff Temperature" on page 30.
- Prove Failure After boilers have run for some time, Prove signal has ended. All boilers set to Auto or Standby will de-energize. However, the System relay will remain energized. See "Prove/Indirect Domestic Hot Water (DHW) Priority" on page 24 and "Wiring the Prove" on page 13.
- Purge Delay: 23 A boiler is in purge cycle and the remaining purge time in seconds is 23. See "Purge Delay" on page 31.
- Setback to: 130˚F The Night Schedule or Setback input is active. Current Setback temperature is 130˚F. See "Setback" on page 31. See "Day - Night Schedule" on page 36.
- Shutdown Active The Shutdown Terminals are Shorted. No boilers will be active. See "Shutdown/Tstat/Setback Mode" on page 24. Also See "Wiring the Shutdown, Tstat, or Setback" on page 12.
- Summer The control is set to Summer. No heat is active. See "Season" on page 27.
- Switch in: 00:30 The switch from one group to the other will take place after 30 minutes. See "Switch Delay" on page 21.
- System Run-On: 46 The System relay is ON for the System Run-On Delay. This example shows that it will remain in System Run-On for an additional 46 seconds before turning off. See "System Run-On" on page 31.
- Tstat Call The Tstat Terminals are Shorted. Boilers will be active. See "Shutdown/Tstat/Setback Mode" on page 24.
- Waiting for Prove The System relay is ON and the prove terminals are open before the lead boiler relay can energize. See "Prove/Indirect Domestic Hot Water (DHW) Priority" on page 24.

BOILER STAGE MENU

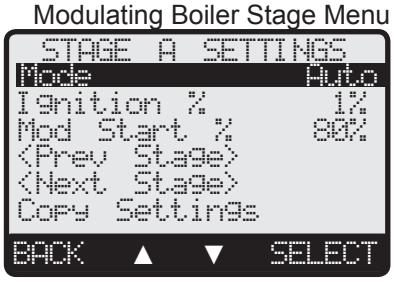


Button: *STAGE/*

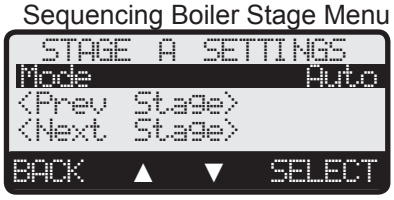
The Stage menu provides adjustment for each of the individually boiler operations.

- In most installations, all active boiler adjustments are the same, but each can be configured differently if desired.
- If the boilers are not set up properly, the M4-LHS operation may appear to be erratic.
- When the STAGE button is depressed, the Boiler A settings menu will be shown.
- Make all the appropriate settings for Boiler A (See below).
- After completing all the settings for Boiler A (See below), you have the option of copying these settings to all other modulating boilers. Everything but the Mode -- Auto/Standby/ Manual/Off/On -- will be copied.
- Then select the <Next Stage> option from the menu to reach the Boiler B settings menu. Continue until all boilers have been set.
- If an Extension is connected to the M4-LHS and the stages have been set through the Startup menu, then scrolling through stages using the <Next Stage> and <Prev Stage> menu options will scroll through the Extension stages as well.

Modulating Boiler Stage Menu



Sequencing Boiler Stage Menu



⚠ ALERT

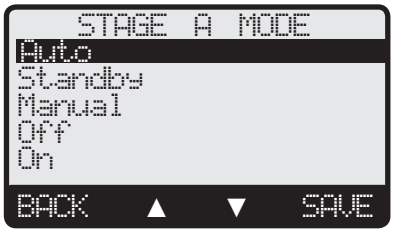
To change the M4-LHS settings, the Program/Run Switch must be set to Program. The switch is located under the Enclosure Wiring Cover for security. The Enclosure Wiring Cover can be secured using a lock.



Mode

Auto, Standby, Manual, Off, On **Default: Auto**

Button: *STAGE/Mode*



- The M4-LHS only controls the modulation of boilers set to Auto or (after a delay) those set to Standby. None of the other settings is recommended for outputs connected to active boilers.
- Any stage without an active boiler or stage connected must be set to Off.
- The following list describes the MODE options:

Auto The M4-LHS will control the boiler's operation to maintain the desired Set Point. Only boilers set to Auto can be Lead boilers.

Standby Standby boilers can only be activated when all boilers in Auto have been at 100% modulation or at High fire for the full Standby Time. Standby is generally used when you want a specific boiler to be available in extreme load conditions. Note that a Standby boiler Cannot be a Lead boiler.

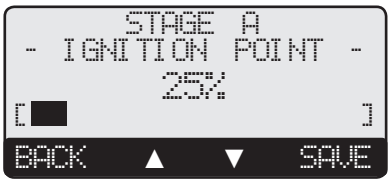
Manual Available For modulating boilers only. The Manual Mode should only be used when testing a boiler. Manual overrides the Prove input. For modulating boilers, the exact percent of modulation for a boiler can be set with the Manual mode. Once selected, the unit will immediately turn on and modulate to the selected percentage. See "Boiler Status" on page 38.

Off Any stage output not connected to a physical stage should be set to Off. The Off Mode can also be used to disable units that are being serviced.

On This mode should only be used when testing a boiler. This mode overrides the PROVE input, Season setting, Shutdown or Tstat status, and Sensor Fault status. Once set to On the boiler will immediately start firing at its highest rate.

Ignition %

(Modulating Boilers Only)



0-10VDC Adjustable from 1% to 50% **Default: 1%**

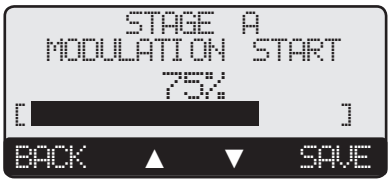
1-10VDC Custom Adjustable from 5% to 70% **Default: 25%**

Button: *STAGE/Ignition %*

- The Ignition % of a boiler is the lowest percent of modulation that boiler can achieve. That is for the 4-20mA and 0-10VDC if the Ignition % was set to 20%, the 0-10VDC terminals will output 2VDC. The 4-20mA terminals will output 7.2mA.
- The 1-10V custom boiler types will use the Ignition % when the boiler is activated. In this case, the Ignition % will be the level at which the control will output 1VDC.
- During the Soft-Off Delay, the boiler will remain at the Ignition % before turning Off.

Modulation Start %

(Modulating Boilers Only)



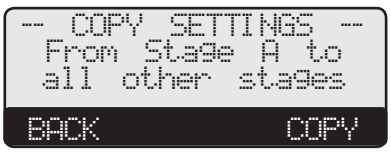
Adjustable from 0% to 100% **Default: 75%**

Button: *STAGE/Mod Start %*

- The Modulation Start determines at what modulation percent the previous boiler (lead boiler) should be for the lag boiler to be activated.
- For example, if the Modulation Start for Boiler B is set to 50%, then when Boiler A reaches 75% modulation (50% Mod Start % + 25% Ignition % = 75%), Boiler B will be brought on.
- When modulation is decreasing, the lag unit will remain on at the Ignition % modulation until the previous boiler reaches 40% of lag boiler's Modulation Start, or 2% above the Ignition Point, whichever is higher.
- Using the same example, as the load decreases, Boiler B will modulate down to its Ignition %. Boiler A will then modulate down to 30% (75% x 40%). Only then will Boiler B turn off.
- If the Lag Delay is set to anything other than 0, the lead boiler must reach 100% modulation before the lag boiler is activated. However, the Modulation Start % should still be set correctly, because it will be valid when modulation is decreasing. "Lag Delay" on page 33
- Laars suggests that when Parallel is selected as the Modulation Mode to set the Modulation percent equal to or slightly higher than double the Ignition %. This way, the lag boiler will only start if the load is large enough for two boilers to run at the lowest modulation. See "Modulating Logic Overview" on page 4.

Copy Settings - Boiler A Only

(Modulating Boilers Only)



Button: *STAGE/Copy Settings*

- If all the active modulating boilers are to be set to the same Ignition % and Modulation %, they can be set for Boiler A and then copied to the other modulating boilers.
- It is still required to select the Mode for all other boilers as the Mode is NOT copied.

⚠ ALERT

The Mode MUST be set for each boiler. The Copy Settings command will not set the Mode for the remaining boilers. Only Ignition % and Modulation Start % are copied.

TROUBLESHOOTING

SENSOR INPUTS

Display shows Sensor OPEN or SHORT

When the display shows sensor OPEN, short the control sensor input terminals. The display should change to read SHORT. This indicates that the sensor wires are not continuous. If the display does not SHORT, the M4-LHS may be damaged.

When the display shows sensor SHORT, remove the wires from the sensor terminals. The display should change to read OPEN. In this case, replace the sensor. Otherwise, if the display does not show OPEN, the M4-LHS may be damaged.

Display shows an Incorrect Temperature

Remove the wires from the sensor terminals. The display should change to read OPEN. If it does not, the M4-LHS may be damaged. Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the Temperature Sensor Chart. If it does not, the sensor may be damaged.

CONTROL OPERATION

No Heat

- **Season** - Make sure that the Season is set to Winter. See "Season" on page 27 and "Display Messages" on page 38.
- **Prove** - Even though, the system relay may be energized, the M4-LHS will not energize and stage relays unless the Prove is shorted. See "Display Messages" on page 38 and "Wiring the Prove" on page 13.
- **Shutdown** - The M4-LHS will deactivate stage outputs when the Shutdown terminals are shorted. See "Display Messages" on page 38 and "Wiring the Shutdown, Tstat, or Setback" on page 12.
- **Tstat** - The M4-LHS will deactivate stage outputs when the Tstat terminals are open. See "Display Messages" on page 38 and "Wiring the Shutdown, Tstat, or Setback" on page 12.
- **Sensor Fault** - When the Sensor Fault is set to All Off in the startup menu, the System sensor fault (in all Sensor Type modes) or the Outdoor sensor fault (in Reset mode) will de-energize all stage relays. See "Display Messages" on page 38 and "Sensor Fault" on page 25.
- **System or Outdoor Sensor** - If the System or Outdoor sensor reading was higher that the actual temperature, the M4-LHS might not bring any stage on. Check "Display shows an Incorrect Temperature" section.
- **Outdoor Cutoff** - If the Outdoor cutoff was set too low, the building might be allowed to cool more than is desired. A comfortable setting is between 60°F to 65°F. "Outdoor Cutoff Temperature" on page 30

Too Much Heat

- **Indirect Domestic Hot Water call** - The M4-LHS will raise the temperature of the system to the DHW Set Point on a DHW call, connected to terminals 29 and 30. Check to see if there is a call for DHW and the length of time it lasts.
- **Reset Ratio and Offset** - If excessive heat occurs only in certain weather conditions, adjust the Reset Ratio and Offset. See "Outdoor Reset Concept" on page 5. If excessive heat occurs year round, reduce the Offset.
- **Boiler Mode Settings** - The M4-LHS will only controls boilers their mode is set to Auto or Standby. Check if any boiler stage is set to Manual or On. See "Mode" on page 39.
- **Control Settings** - The Last Stage Hold will allow only the Lead boiler to stay on for an additional number of degrees. If the setting is too high, and only the Lead boiler is on, the system can over heat. Reduce the Last Stage Hold setting. See"Last Stage Hold" on page 32.

Temperature Sensor Chart

TEMPERATURE		Value (in Ohms)
°F	°C	
OPEN		150000
-30	-34	117720
-20	-29	82823
-10	-23	59076
0	-18	42683
10	-12	31215
20	-7	23089
25	-4	19939
30	-1	17264
35	2	14985
40	4	13040
45	7	11374
50	10	9944
55	13	8714
60	16	7653
70	21	5941
80	27	4649
90	32	3667
100	38	2914
110	43	2332
120	49	1879
130	54	1524
140	60	1243
150	66	1021
160	71	842
170	77	699
180	82	583
190	88	489
200	93	412
210	99	349
220	104	297
230	110	253
240	116	217
250	121	187
SHORT		100

Too Little Heat

- **Reset Ratio and Offset** - If reduced heat occurs only in certain weather conditions, adjust the Reset Ratio and Offset (See "Outdoor Reset Concept" on page 5). If reduced heat occurs year round, increase the Offset.
- **Setback and Day/Night Schedule** - If reduced heat occurs only during specific hours, check the Day/Night Schedule and the Setback values. Then, reduce the Setback setting. See "Setback" on page 31.
- **Boiler Mode Settings** - The M4-LHS will only control boilers their mode is set to Auto or Standby. Check if any boiler stage is set to Manual, Off, or Standby. See "Mode" on page 39.

Boilers are Short-Cycling

- **Lag Delay** - Increase the Lag Delay only if modulating boilers tend to short-cycle.
- **Minimum Runtime** - Increase the Minimum Runtime only if staging boilers tend to short-cycle.
- **Last Stage Hold** - Increase the Last Stage Hold only if the lead boiler tends to short-cycle.

System is Overshooting or Undershooting

Modulating Boilers

- **Gain** - If when using modulating boilers the system is overshooting reduce the Gain. See "Gain" on page 33.
- **Gain** - If when using modulating boilers the system is undershooting increase the Gain.

Staging Boilers

- **Reaction Time** - If when using staging boilers the system is overshooting increase the Reaction Time. As the stages will be turning on faster than they are affecting the system. If the system was undershooting for long periods, reduce the Reaction Time. See "Reaction Time" on page 34.
- **Minimum Runtime** - If when using staging boilers the system is overshooting reduce the Minimum Run Time. If the system was undershooting, increase the reaction time as it is turning off stages quicker than needed. See "Minimum Runtime" on page 34.

SPECIFICATIONS

Voltage Input: . . . . . 120 VAC 60 Hz
Power Consumption: . . . . . 12 VA Max
Operating Temperature: . . . . . 20°F/-6°C to 130°F/54°C
Operating Humidity: . . . . . 20% to 80% non-condensing
Dimensions: . . . . . 11"W x 9" H x 3 ¾" D
Weight: . . . . . 2.5 pounds

M4-LHS SPECIFICATIONS

Switch Between Boiler Groups Mode: . . . . . Using Target Temperature
Lead Stage Rotation: . . . . . Time (1 to 1440 Hours (60 days)), Manual, Last-On
Pump Output: . . . . . 1 N.O. S.P.S.T
Modulating Boiler Modes: . . . . . Auto, Manual, Standby, On, Off
Staging Boiler Modes: . . . . . Auto, Standby, On, Off
Standby Time: . . . . . 1 to 60 minutes
Modulating Output Types: . . . . . Current (4-20mA) and Voltage (0-10V, 0-5V, 2-10V, and 1-5V)
Sequencing Output Types: . . . . . On/Off, 2-Stage, 3-Stage, or 4-Stage
Output Relay Ratings: . . . . . 1 Amp inductive (⅛ HP), 6 Amp resistive at 120 VAC 60 Hz, 15 A total for all circuits
Add-On Extension Panels: . . . . . up two Extension Panels using RS485 (RJ45 or RJ11)
Ignition Point %: . . . . . 1 to 50%
Modulation Start Point %: . . . . . 0 to 100%
Modulation Modes: . . . . . Normal or Parallel
Sequencing Modes: . . . . . Lo/Hi/Lo/Hi or Lo/lo/Hi/Hi
Temperature Display: . . . . . Fahrenheit or Celsius
Display: . . . . . Graphical Alphanumeric (up to 7 rows x 21 char. each)
LED: . . . . . 1 System Output relay, 4 Boiler Output relays
Control Sensor Ranges: . . . . . Outdoor Temperature sensor - minus 35°F/-37°C to 250°F/121°C
Heating system sensor - minus 35°F/-37°C to 250°F/121°C
Outdoor Cutoff Range: . . . . . 20°F/-6°C to 100°F, ON and OFF
Reset Ratio Range: . . . . . (1:4) to (4:1) (Outdoor : System Water)
Offset Adjustment: . . . . . minus -40°F°/-22°C° to plus 40°F°/22°C°
Minimum Water Temperature: . . . . . 50°F/10°C to 170°F/77°C
Maximum Water Temperature: . . . . . 90°F/32°C to 240°F/116°C
Indirect Domestic Hot Water: . . . . . with Priority or without Priority
Pump Run-On: . . . . . 0 to 360 minutes
Purge Delay: . . . . . 0.0 to 10.0 minutes
Lag Delay: . . . . . 0 to 60 minutes
Last Stage Hold: . . . . . 0 to 30°F
Schedules: . . . . . 1 Day and 1 Night (Setback) setting per day
Night Setback: . . . . . 0°F°/0°C° to 75°F°/42°C°
Power Backup: . . . . . Lithium coin battery, 100 days minimum 5 year replacement (Maintains Clock in power outages)
External Inputs: . . . . . Shutdown, Tstat, and Setback Input, and Prove and DHW Call Input. (Dry Contacts Only)
Season: . . . . . Winter and Summer

EXTENSION SPECIFICATIONS

(Each Extension can add up to (6) additional boiler stages. A maximum of two Extensions can be used.)
Extension Numbering: . . . . . Toggle Switch A (Stages E - J, LEDs are Green) or B (Stages K - P, LEDs are Red)
Boiler Outputs: . . . . . (6) N.O. S.P.S.T.
Modulating Output Types: . . . . . (6) 4-20mA and 0-10V
Output Relay Ratings: . . . . . 1 Amp inductive (⅛ HP), 6 Amp resistive at 120 VAC 60 Hz, 15 A total for all circuits
Connection to M4-LHS and another extension: . . Two RS485 connections using 6 wire RJ11 cable (Cable is provided)

HT# 059295-00 B

HYBRID - OUTDOOR RESET - BACNET VARIABLE LIST

Hybrid	Object ID	Object Type	Object Value	Object Name	Units	Minimum	Maximum	Definition
Model	Device Object		Read Only	MODEL				
Serial Number	Device Object		Read Only	SNUMBER				
Version	Device Object		Read Only	VERSION				
Operation Mode	100	MULTISTATE-VALUE	Read Only	OPMODE		1	3	1= Hybrid, 2 = Modulation Setpoint, 3 = Modulation Reset
Outdoor Temperature	200	ANALOG-VALUE	Read Only	ODTEMP	Degree F			32000=OPEN,3201=SHORT
System Temperature	300	ANALOG-VALUE	Read Only	SYSSEN	Degree F			32000=OPEN,3201=SHORT
Control Status	400	MULTISTATE-VALUE	Read Only	CSTAT		1	15	1=SHUTDOWN,2=NO TSTAT CALL,3=PROVE FAILURE,4= PURGE DLEAY,5=WAITING FOR PROVE,6=SENSOR FAULT,7= LAG DELAY, 8=LAST STAGE HOLD,9=DHW CALL,10 = SYSTEM RUNON,11=SUMMER,12=OUTDOOR CUTOFF,13=BOOST MODE,14=SETBACK MODE,15 = NORMAL OPERATION
Season	500	MULTISTATE-VALUE	Read/Write	SEA		1	2	1= Winter, 2= Summer
Reset Ratio	600	MULTISTATE-VALUE	Read/Write	RR		1	11	1 =1.00 OD = 4.00 Sys,2 =1.00 OD = 3.00 Sys,3 =1.00 OD = 2.00 Sys, 4 =1.00 OD = 1.50 Sys,5 =1.00 OD = 1.25 Sys,6 =1.00 OD = 1.00 Sys,,7 =1.25 OD = 1.00 Sys,8 =1.50 OD = 1.00 Sys,9 =2.00 OD = 1.00 Sys,10 =3.00 OD = 1.00 Sys,11 = 4.00 OD = 1.00 Sys
Offset	700	ANALOG-VALUE	Read/Write	OFF	Degree F	-50	50	Integer Values Only (-1,0,1,2…)
Outdoor Cutoff	800	ANALOG-VALUE	Read/Write	CO	Degree F	19	101	Integer Values Only (19,20,21…)
Min Water Temp	900	ANALOG-VALUE	Read/Write	MINW	Degree F	50	180	Integer Values Only (50,51,52…)
Max Water Temp	1000	ANALOG-VALUE	Read/Write	MAXW	Degree F	70	220	Integer Values Only (70,71,72…)
Setback	1100	ANALOG-VALUE	Read/Write	SB	Degree F	0	75	Integer Values Only (0,1,2…)
Purge Delay	1200	ANALOG-VALUE	Read/Write	PDLY	Minutes	.1	10	.1 thru .9 after Integer Values Only (1,2…)
System Runon	1300	ANALOG-VALUE	Read/Write	RUNON	Minutes	0	360	Integer Values Only (0,1,2…)
Rotation Time	1400	ANALOG-VALUE	Read/Write	RTTIME	Hours	1	1440	Hours since last rotation Integer Values Only (1,2,3…)
Standby Time	1500	ANALOG-VALUE	Read/Write	STBYDLY	Minutes	1	60	Integer Values Only (1,2,3…)
Last Stage Hold	1600	ANALOG-VALUE	Read/Write	LSTHOLD	Degree F	0	30	Integer Values Only (0,1,2…)
Con Lead Stage	1700	MULTISTATE-VALUE	Read/Write	CLEAD		1	16	Represent the current lead boiler for the condensing group
Non-Con Lead Stage	1800	MULTISTATE-VALUE	Read/Write	NCLEAD		1	16	Represent the current lead boiler for the non-condensing group
Reaction Time	1900	ANALOG-VALUE	Read/Write	RETIME	Minutes	1	10	Integer Values Only (1,2,3…)
Min Run Time	2000	ANALOG-VALUE	Read/Write	MINRUN	Minutes	1	60	Integer Values Only (1,2,3…)
Gain	2100	MULTISTATE-VALUE	Read/Write	GAIN		1	10	
Lag Delay	2200	ANALOG-VALUE	Read/Write	LAGDLY	Minutes	0	60	Integer Values Only (0,1,2…)
Soft off	2300	ANALOG-VALUE	Read/Write	SOFF	Seconds	0	60	Integer Values Only (0,1,2…)
Set Time	2400	ANALOG-VALUE	Read/Write	PTIME	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Day Schedule	2500	ANALOG-VALUE	Read/Write	DSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Night Schedule	2600	ANALOG-VALUE	Read/Write	NSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
System Relay	2700	BINARY-VALUE	Read Only	SYSRLY		False	True	True = Energized, False = De-Engergized
Output Relays	2800 - Max Stages	BINARY-VALUE	Read Only	RY0 - RY Max Stages		False	True	True = Energized, False = De-Engergized

MODULATION - OUTDOOR RESET - BACNET VARIABLE LIST

Hybrid	Object ID	Object Type	Object Value	Object Name	Units	Minimum	Maximum	Definition
Model	Device Object		Read Only	MODEL				
Serial Number	Device Object		Read Only	SNUMBER				
Version	Device Object		Read Only	VERSION				
Operation Mode	100	MULTISTATE-VALUE	Read Only	OPMODE		1	3	1= Hybrid, 2 = Modulation Setpoint, 3 = Modulation Reset
Outdoor Temperature	200	ANALOG-VALUE	Read Only	ODTEMP	Degree F			32000=OPEN,3201=SHORT
System Temperature	300	ANALOG-VALUE	Read Only	SYSSEN	Degree F			32000=OPEN,3201=SHORT
Control Status	400	MULTISTATE-VALUE	Read Only	CSTAT		1	15	1=SHUTDOWN,2=NO TSTAT CALL,3=PROVE FAILURE,4= PURGE DLEAY,5=WAITING FOR PROVE,6=SENSOR FAULT,7= LAG DELAY, 8=LAST STAGE HOLD,9=DHW CALL,10 = SYSTEM RUNON,11=SUMMER,12=OUTDOOR CUTOFF,13=BOOST MODE,14=SETBACK MODE,15 = NORMAL OPERATION
Season	500	MULTISTATE-VALUE	Read/Write	SEA		1	2	1= Winter, 2= Summer
Reset Ratio	600	MULTISTATE-VALUE	Read/Write	RR		1	11	1 =1.00 OD = 4.00 Sys,2 =1.00 OD = 3.00 Sys,3 =1.00 OD = 2.00 Sys, 4 =1.00 OD = 1.50 Sys,5 =1.00 OD = 1.25 Sys,6 =1.00 OD = 1.00 Sys,,7 =1.25 OD = 1.00 Sys,8 =1.50 OD = 1.00 Sys,9 =2.00 OD = 1.00 Sys,10 =3.00 OD = 1.00 Sys,11 = 4.00 OD = 1.00 Sys
Offset	700	ANALOG-VALUE	Read/Write	OFF	Degree F	-50	50	Integer Values Only (-1,0,1,2…)
Outdoor Cutoff	800	ANALOG-VALUE	Read/Write	CO	Degree F	19	101	Integer Values Only (19,20,21…)
Min Water Temp	900	ANALOG-VALUE	Read/Write	MINW	Degree F	50	180	Integer Values Only (50,51,52…)
Max Water Temp	1000	ANALOG-VALUE	Read/Write	MAXW	Degree F	70	220	Integer Values Only (70,71,72…)
Setback	1100	ANALOG-VALUE	Read/Write	SB	Degree F	0	75	Integer Values Only (0,1,2…)
Purge Delay	1200	ANALOG-VALUE	Read/Write	PDLY	Minutes	.1	10	.1 thru .9 after Integer Values Only (1,2…)
System Runon	1300	ANALOG-VALUE	Read/Write	RUNON	Minutes	0	360	Integer Values Only (0,1,2…)
Rotation Time	1400	ANALOG-VALUE	Read/Write	RTTIME	Hours	1	1440	Hours since last rotation Integer Values Only (1,2,3…)
Standby Time	1500	ANALOG-VALUE	Read/Write	STBYDLY	Minutes	1	60	Integer Values Only (1,2,3…)
Last Stage Hold	1600	ANALOG-VALUE	Read/Write	LSTHOLD	Degree F	0	30	Integer Values Only (0,1,2…)
Gain	1700	MULTISTATE-VALUE	Read/Write	GAIN		1	10	
Lag Delay	1800	ANALOG-VALUE	Read/Write	LAGDLY	Minutes	0	60	Integer Values Only (0,1,2…)
Soft off	1900	ANALOG-VALUE	Read/Write	SOFF	Seconds	0	60	Integer Values Only (0,1,2…)
Set Time	2000	ANALOG-VALUE	Read/Write	PTIME	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Day Schedule	2100	ANALOG-VALUE	Read/Write	DSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Night Schedule	2200	ANALOG-VALUE	Read/Write	NSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
System Relay	2300	BINARY-VALUE	Read Only	SYSRLY		False	True	True = Energized, False = De-Engergized
Output Relays	2400 - Max Stages	BINARY-VALUE	Read Only	RY0 - RY Max Stages		False	True	True = Energized, False = De-Engergized

MODULATION - SET POINT - BACNET VARIABLE LIST

Hybrid	Object ID	Object Type	Object Value	Object Name	Units	Minimum	Maximum	Definition
Model	Device Object		Read Only	MODEL				
Serial Number	Device Object		Read Only	SNUMBER				
Version	Device Object		Read Only	VERSION				
Operation Mode	100	MULTISTATE-VALUE	Read Only	OPMODE		1	3	1= Hybrid, 2 = Modulation Setpoint, 3 = Modulation Reset
Outdoor Temperature	200	ANALOG-VALUE	Read Only	ODTEMP	Degree F			32000=OPEN,3201=SHORT
System Temperature	300	ANALOG-VALUE	Read Only	SYSSEN	Degree F			32000=OPEN,3201=SHORT
Control Status	400	MULTISTATE-VALUE	Read Only	CSTAT		1	15	1=SHUTDOWN,2=NO TSTAT CALL,3=PROVE FAILURE,4= PURGE DLEAY,5=WAITING FOR PROVE,6=SENSOR FAULT,7= LAG DELAY, 8=LAST STAGE HOLD,9=DHW CALL,10 = SYSTEM RUNON,11=SUMMER,12=OUTDOOR CUTOFF,13=BOOST MODE,14=SETBACK MODE,15 = NORMAL OPERATION
Season	500	MULTISTATE-VALUE	Read/Write	SEA		1	2	1= Winter, 2= Summer
Setpoint	600	ANALOG-VALUE	Read/Write	SETP	Degree F	70	250	Integer Values Only (70,71,72…)
Outdoor Cutoff	700	ANALOG-VALUE	Read/Write	CO	Degree F	19	101	Integer Values Only (19,20,21…)
Setback	800	ANALOG-VALUE	Read/Write	SB	Degree F	0	75	Integer Values Only (0,1,2…)
Purge Delay	900	ANALOG-VALUE	Read/Write	PDLY	Minutes	.1	10	.1 thru .9 after Integer Values Only (1,2…)
System Runon	1000	ANALOG-VALUE	Read/Write	RUNON	Minutes	0	360	Integer Values Only (0,1,2…)
Rotation Time	1100	ANALOG-VALUE	Read/Write	RTTIME	Hours	1	1440	Hours since last rotation Integer Values Only (1,2,3…)
Standby Time	1200	ANALOG-VALUE	Read/Write	STBYDLY	Minutes	1	60	Integer Values Only (1,2,3…)
Last Stage Hold	1300	ANALOG-VALUE	Read/Write	LSTHOLD	Degree F	0	30	Integer Values Only (0,1,2…)
Gain	1400	MULTISTATE-VALUE	Read/Write	GAIN		1	10	
Lag Delay	1500	ANALOG-VALUE	Read/Write	LAGDLY	Minutes	0	60	Integer Values Only (0,1,2…)
Soft off	1600	ANALOG-VALUE	Read/Write	SOFF	Seconds	0	60	Integer Values Only (0,1,2…)
Set Time	1700	ANALOG-VALUE	Read/Write	PTIME	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Day Schedule	1800	ANALOG-VALUE	Read/Write	DSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
Night Schedule	1900	ANALOG-VALUE	Read/Write	NSCHED	Minutes	1	1440	Time since midnight Integer Values Only (1,2,3…)
System Relay	2000	BINARY-VALUE	Read Only	SYSRLY		False	True	True = Energized, False = De-Energized
Output Relays	2100 - Max Stages	BINARY-VALUE	Read Only	RY0 - RY Max Stages		False	True	True = Energized, False = De-Engergized

BACNET PICS STATEMENT

Product	Model Number	Protocol Revision	Software Version	Firmware Version
M4-LHS BACnet Control	Varies	1.5	2.0	2.0

Vendor	Vendor ID	Address and Phone
Laars		

Product Description

M4-LHS control for hot water heating applications. (see http://www.Laars.com for more information)

BACnet Standardized Device Profile (Annex L)

Product	Device Profile
M4-LHS BACnet Control	BACnet Application Specific Controller (B-ASC)

Supported BIBBs (Annex K)

Supported BIBBs	BIBB Name
DS-RP-B	Data Sharing-ReadProperty-B
DS-WP-B	Data Sharing-WriteProperty-B
DM-DDB-B	Device Management-Dynamic Device Binding-B
DM-DOB-B	Device Management-Dynamic Object Binding-B
DM-DCC-B	Device Management-DeviceCommunicationControl-B

Standard Object Types Supported

Object Type	Creatable	Deletable
Analog Value	No	No
Binary Value	No	No
Multi-State Value	No	No
Device	No	No

Data Link Layer Options (Annex J)

Product	Data Link	Options
M4-LHS BACnet Control	BACnet MS/TP	Baud Rates: 9600, 19200, 38400

Segmentation Capability

Segmentation Type	Supported	Window Size (MS/TP product limited to 1)
Able to transmit segmented messages	No	
Able to receive segmented messages	No	

Device Address Binding

Product	Static Binding Supported
M4-LHS BACnet Control	No

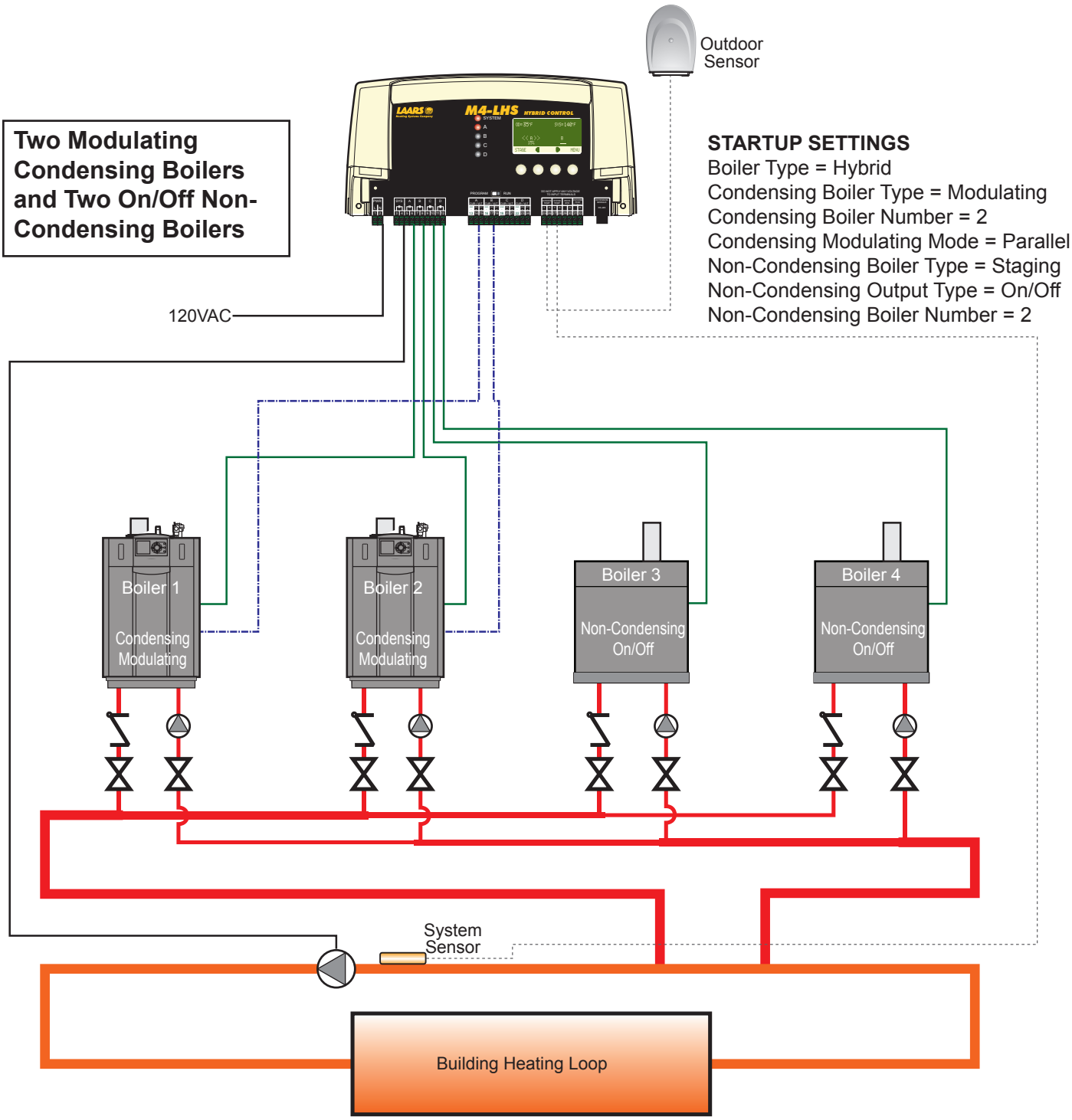
Character Sets

Product	Character Sets supported
M4-LHS BACnet Control	ANSI X3.4

PIPING AND WIRING DIAGRAMS

HYBRID PIPING DIAGRAM

Two Modulating Condensing Boilers and Two On/Off Non-Condensing Boilers

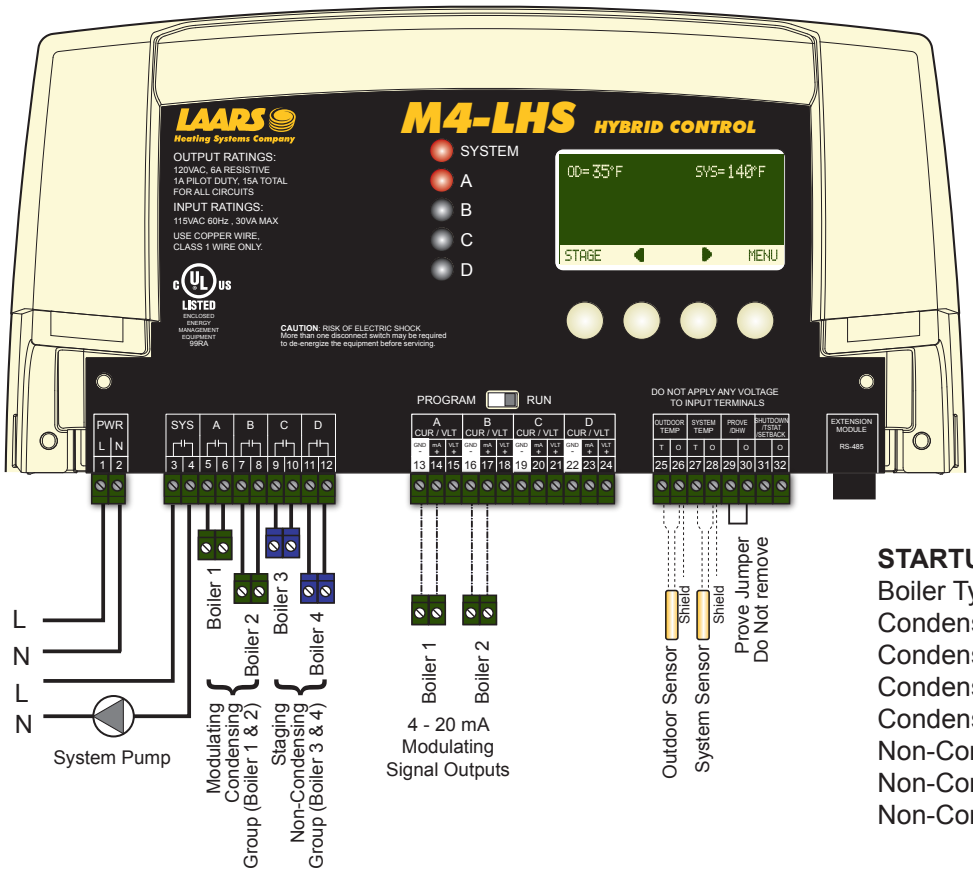


STARTUP SETTINGS
Boiler Type = Hybrid
Condensing Boiler Type = Modulating
Condensing Boiler Number = 2
Condensing Modulating Mode = Parallel
Non-Condensing Boiler Type = Staging
Non-Condensing Output Type = On/Off
Non-Condensing Boiler Number = 2

System:
The M4-LHS operates two modulating boilers and two On/Off Boilers. The boilers are piped in Reverse Return on the primary loop. The System output is controlling the System Pump.

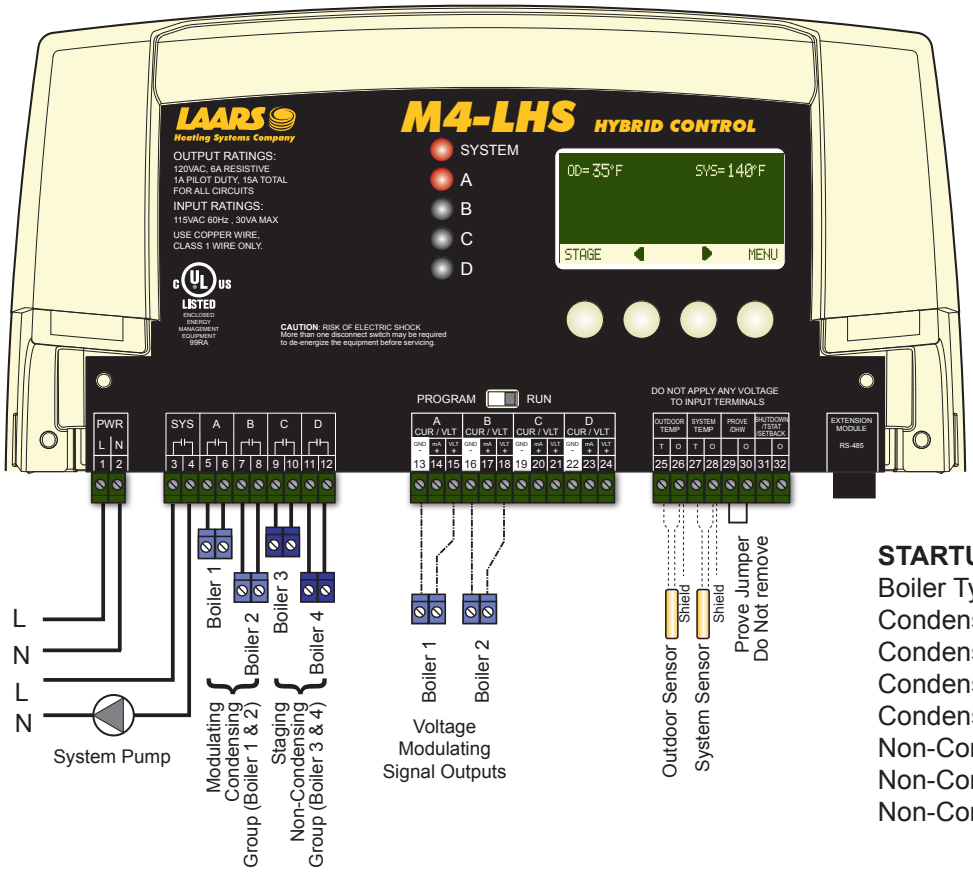
Laars is aware that each installation is unique. Thus, Laars is not responsible for any installation related to any electrical or plumbing diagram generated by Laars . The provided illustrations are to demonstrate Laars 's control operating concept only.

HYBRID WIRING DIAGRAM



Two 4-20mA Modulating Condensing Boilers and Two On/Off Non-Condensing Boilers

STARTUP SETTINGS
Boiler Type = Hybrid
Condensing Boiler Type = Modulating
Condensing Boiler Number = 2
Condensing Output Type = 4-20ma
Condensing Modulating Mode = Parallel
Non-Condensing Boiler Type = Staging
Non-Condensing Output Type = On/Off
Non-Condensing Boiler Number = 2

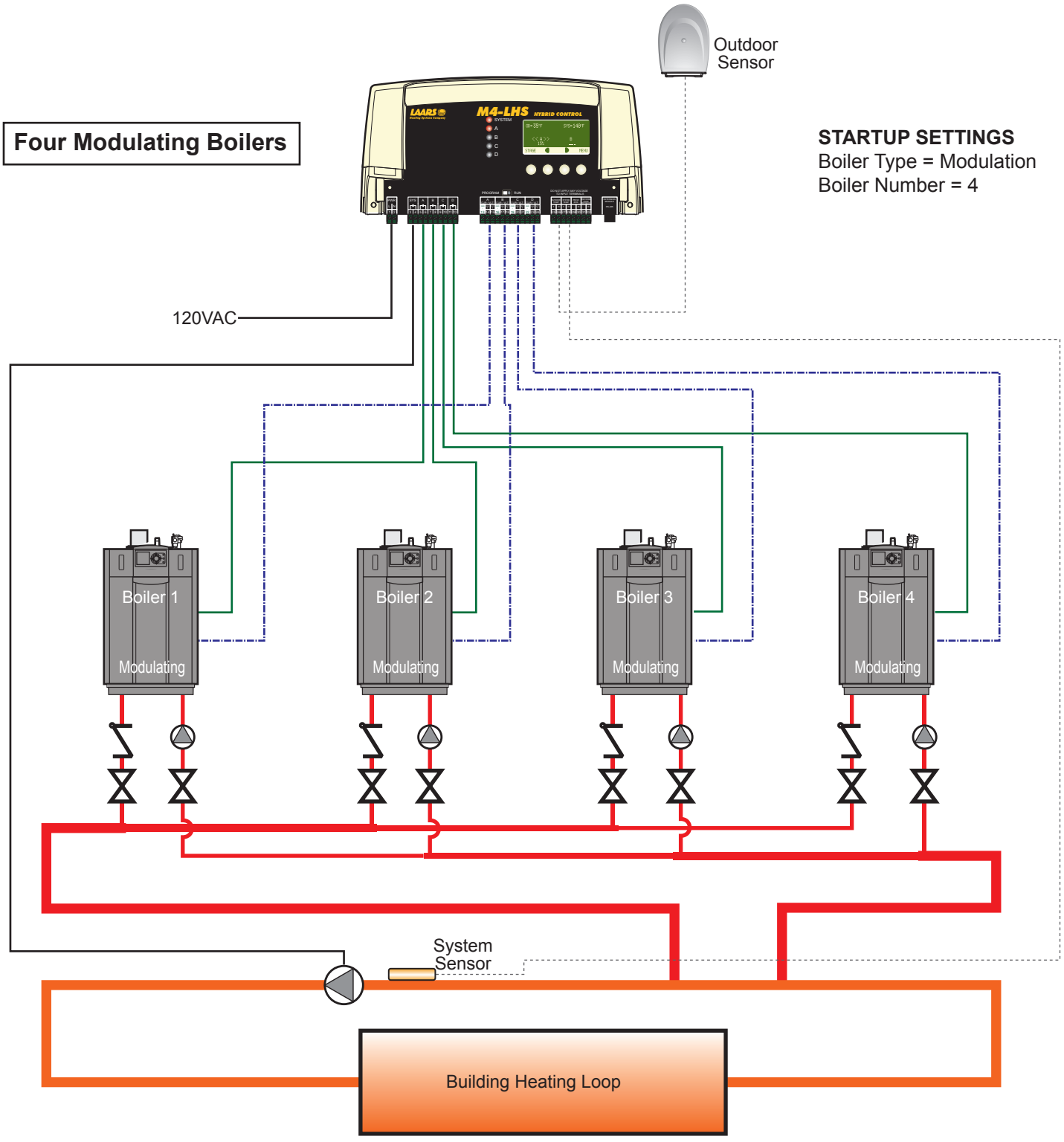


Two Voltage Modulating Condensing Boilers and Two On/Off Non-Condensing Boilers

STARTUP SETTINGS
Boiler Type = Hybrid
Condensing Boiler Type = Modulating
Condensing Boiler Number = 2
Condensing Output Type = Any voltage
Condensing Modulating Mode = Parallel
Non-Condensing Boiler Type = Staging
Non-Condensing Output Type = On/Off
Non-Condensing Boiler Number = 2

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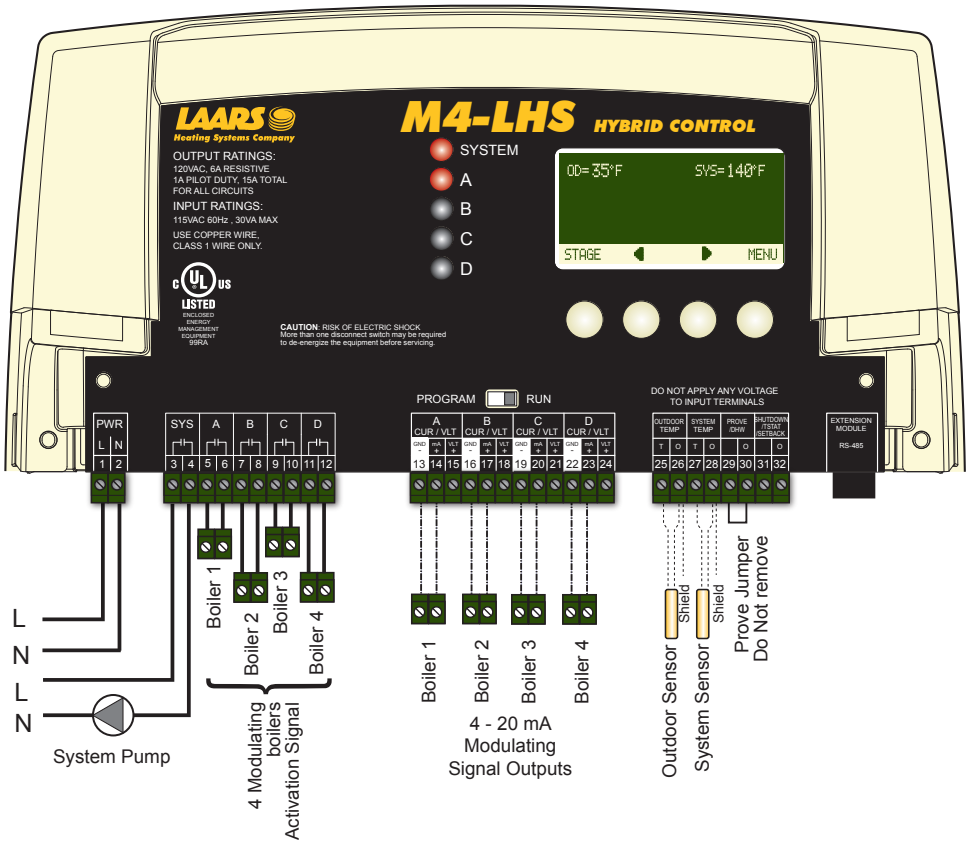
MODULATING PIPING DIAGRAM



System:
The M4-LHS operates four modulating boilers. The boilers are piped in Reverse Return on the primary loop. The System output is controlling the System Pump.

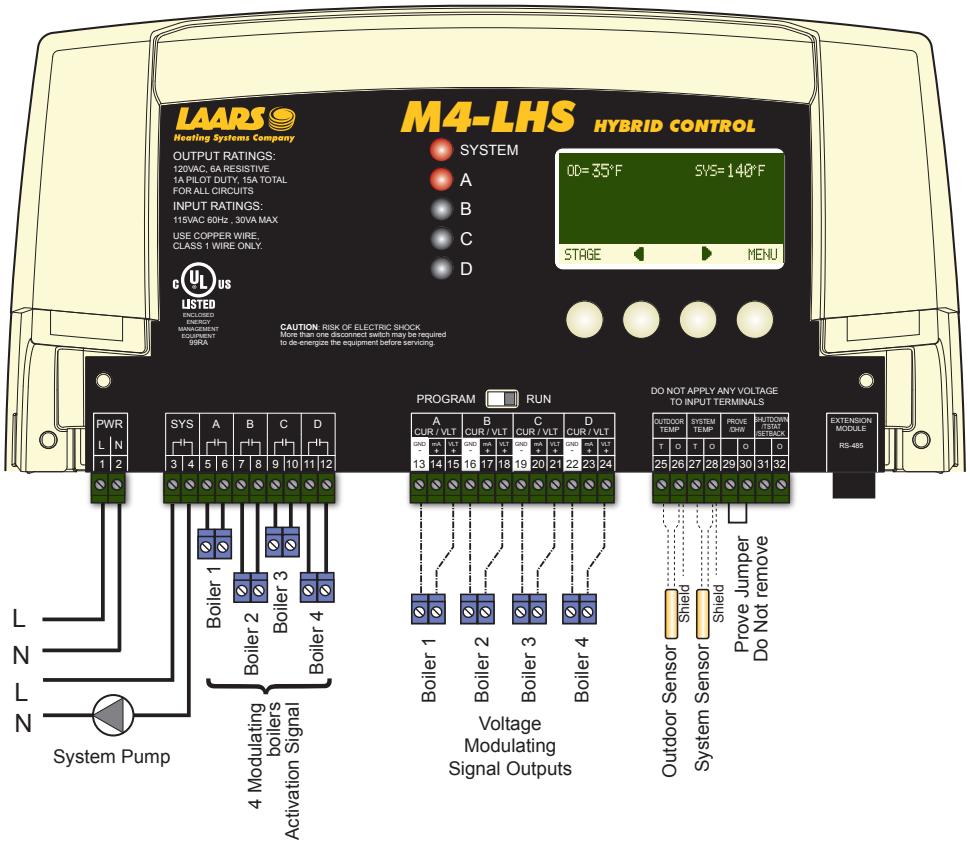
Laars is aware that each installation is unique. Thus, Laars is not responsible for any installation related to any electrical or plumbing diagram generated by Laars . The provided illustrations are to demonstrate Laars's control operating concept only.

MODULATING WIRING DIAGRAM



Four 4-20mA Modulating Boilers

STARTUP SETTINGS
Boiler Type = Modulation
Output Type = 4-20ma
Boiler Number = 4



Four Voltage Modulating Boilers

STARTUP SETTINGS
Boiler Type = Modulation
Output Type = Any Voltage Option
Boiler Number = 4

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