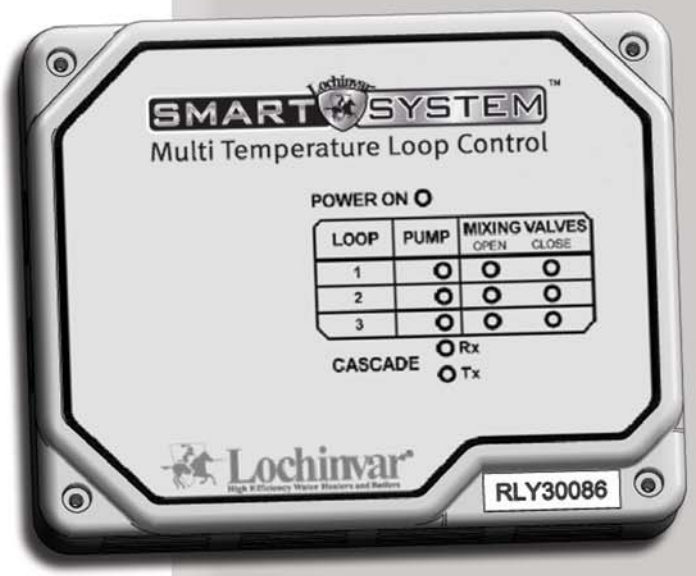
SMART SYSTEM™
Multi Temperature Loop Control

MULTI-TEMPERATURE LOOP CONTROL BOARD INSTRUCTIONS

Models: KB 81 - 286, KBXL 400 - 801, WB 51 - 211, FTX 400 - 850 and WH 55 - 399



C SA® US

⚠ WARNING This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual, the Installation and Operation Manual, and the Service Manual, before installing. Perform steps in the order given. Failure to comply could result in severe personal injury, death, or substantial property damage.

Save this manual for future reference.

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

Contents

Hazard definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important information concerning the life of the product.

⚠ DANGER DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE NOTICE indicates special instructions on installation, operation, or maintenance that are important but not related to personal injury or property damage.

1 Introduction

The information contained in this manual provides installation and operation instructions for the addition of the Multi-Temperature Loop Control Board in conjunction with the Lochinvar Knight (KB(N/L) 81-286), Knight XL (KB(N/L) 400 -801), Wall Mount (WB(N/L) 51-211, WH(N/L) 55-399) and FTXL (FTX 400 - 850) boilers.

When connected on the Cascade communication bus to the boiler control, the Multi-Temperature Loop Control Board (MTLCB) will actively control the water temperature supplied, up to three (3) loops. The MTLCB will control the 3-way mixing valves and pumps for each of these loops, and provide the actual loop temperatures to the boiler for display.

The MTLCB has been tested, and is in compliance with the following standards:

- CSA Standard C22.2 No 0 - General Requirements - Canadian Electrical Code, Part II
- CSA Standard C22.2 No 24 - Temperature-Indicating & Regulating Equipment
- ANSI/UL 873 - Temperature Indicating and Regulating Equipment

2 Components and Hydronic Piping

Components

The multi-temperature loop control consists of four (4) major components in conjunction with the boiler system. These components are as follows:

- Multi-Temperature Loop Control Board
- Loop Temperature Sensors
- Mixing Valves
- Loop Pumps

In order for the system to work properly the components listed above must be installed correctly. Reference the piping illustrations included in this section (FIG.'s 2-1 and 2-2) for suggested guidelines in piping.

NOTICE

Please note that the piping illustrations (FIG.'s 2-1 and 2-2) are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

1. **Multi-Temperature Loop Control Board (MTLCB):**

   The MTLCB communicates with the boiler's SMART SYSTEM control for operation of the mixing valves and loop pumps to regulate each loop temperature. The power supply required for the MTLCB is 120 V/60 Hz at less than 12 amps.

2. **Loop Temperature Sensors:**

   The loop temperature sensors measure the temperature of each loop. Each sensor should be placed on the discharge side of the loop pump as shown in FIG.'s 2-1 and 2-2 on pages 5 and 6 of this manual. Use only the three (3) NTC thermistor sensors supplied. If a replacement sensor is needed, order Lochinvar part number TST2032. For the best reading, the sensor should be securely fastened to the pipe and insulated.

3. **Mixing Valves:**

   Field supplied. The MTLCB is designed to control 24 VAC floating 3-way mixing valves with open and close signals. These valves have an actuator (motor) time from full open to full close. The time in seconds must be consistent across all 3-way valves installed. For information on programming the mixing valve time into the boiler, reference Section 4 , Boiler Parameter Setup. For 3-way valve requirements, reference Table 2A.

***Table 2A** 3-Way Valve Requirements*

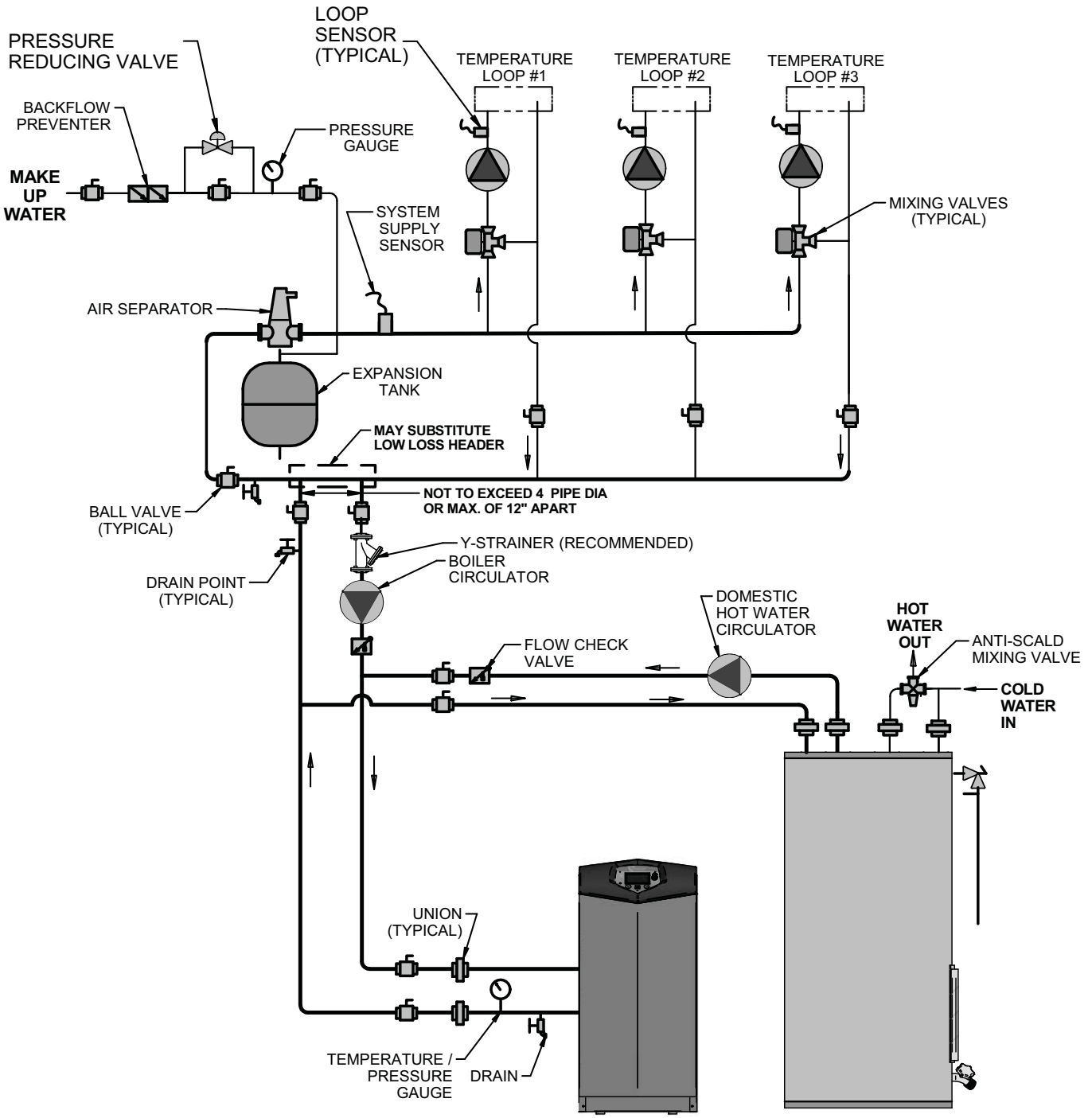
3-Way Valve Requirements	
Item Description	**Limit**
Power Supply	24 VAC
Maximum Load	.25 Amps
Control Signal	3-Point (Open, Close, Com)
Action Type	Floating / Modulating

4. **Loop Pumps:**

   Field supplied. The MTLCB provides 120 VAC power to operate three (3) loop pumps. The maximum current rating for each pump cannot exceed 1.8 amps.

2 Components and Hydronic Piping *(continued)*

Figure 2-1_Single Boiler Multi-Temperature



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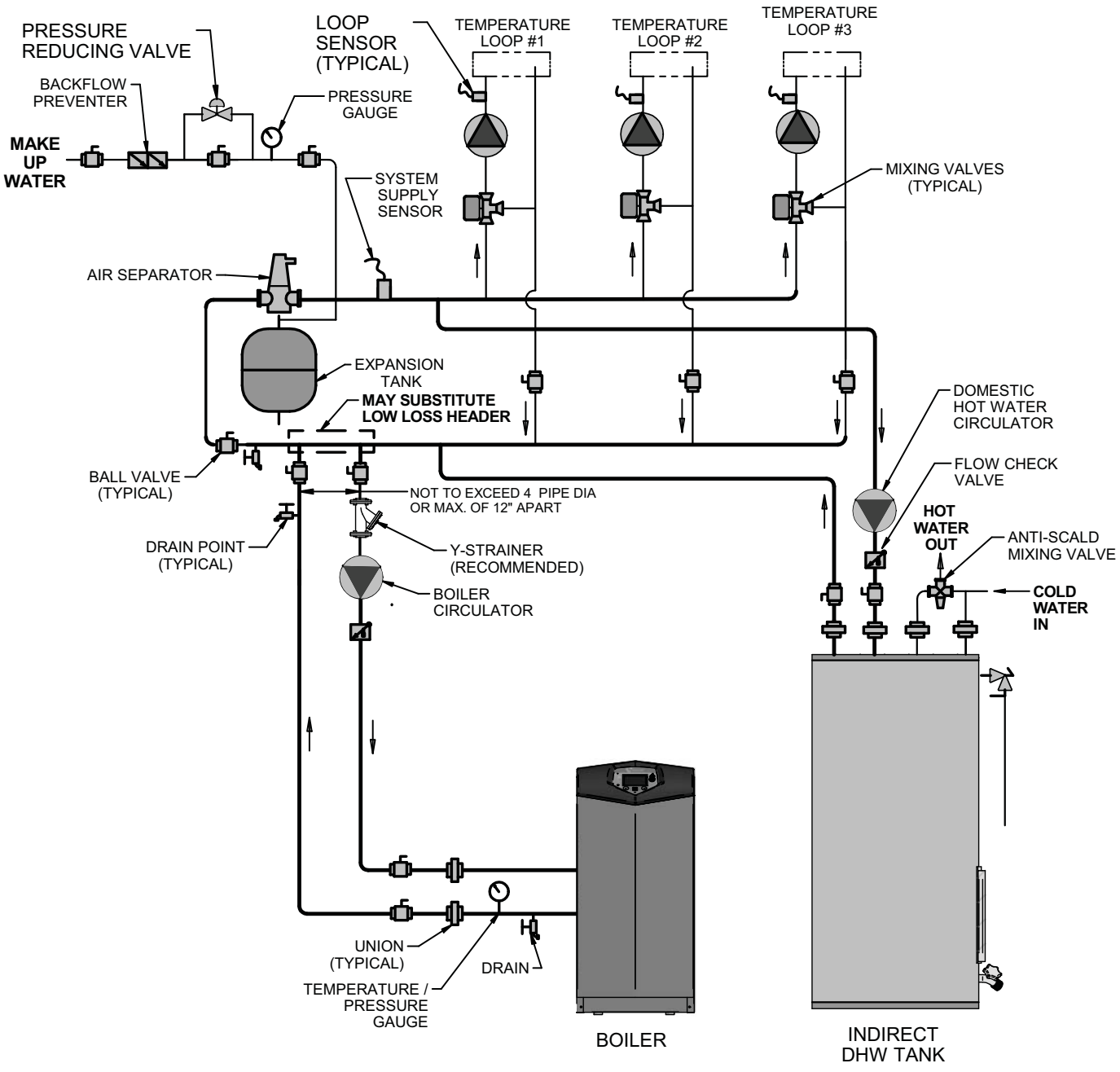
NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE A system supply sensor MUST BE installed for proper boiler operation to occur.

2 Components and Hydronic Piping

Figure 2-2_Single Boiler Multi-Temperature DHW Zoned



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE A system supply sensor MUST BE installed for proper boiler operation to occur.

3 Wiring Requirements

⚠ WARNING ELECTRICAL SHOCK HAZARD – For your safety, turn off electrical power supply before making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.

NOTICE Wiring must be N.E.C. Class 1.

If original wiring as supplied with boiler must be replaced, use only type 105°C wire or equivalent.

Boiler must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 – latest edition.

⚠ CAUTION Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Installation must comply with:

1. National Electrical Code and any other national, state, provincial, or local codes, or regulations.
2. In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any local codes.

Line voltage connections

1. Connect 120 VAC power wiring to the line voltage terminal strip in the junction box, as shown in FIG. 3-1 on page 8.
2. Wire the loop pumps (provided by the installer) as shown in FIG. 3-1.

NOTICE The loop pump connections provide 120 VAC power to the pumps at a maximum current rating of 1.8 amps for each pump.

Loop sensors

1. Install the kit provided loop temperature sensors (see FIG.'s 2-1 and 2-2).
2. Route the sensor wires through a knockout on the side of the MTLCB (FIG. 3-1).
3. Connect the loop temperature sensors to the SEN1, SEN2, and SEN3 terminals on the MTLCB.

Mixing valves

1. Install the mixing valves as shown in FIG.'s 2-1 and 2-2.
2. Route the mixing valve wires through a knockout on the right side of the MTLCB (FIG. 3-1).
3. Connect the mixing valve wires to terminals MV1, MV2, and MV3 on the MTLCB.

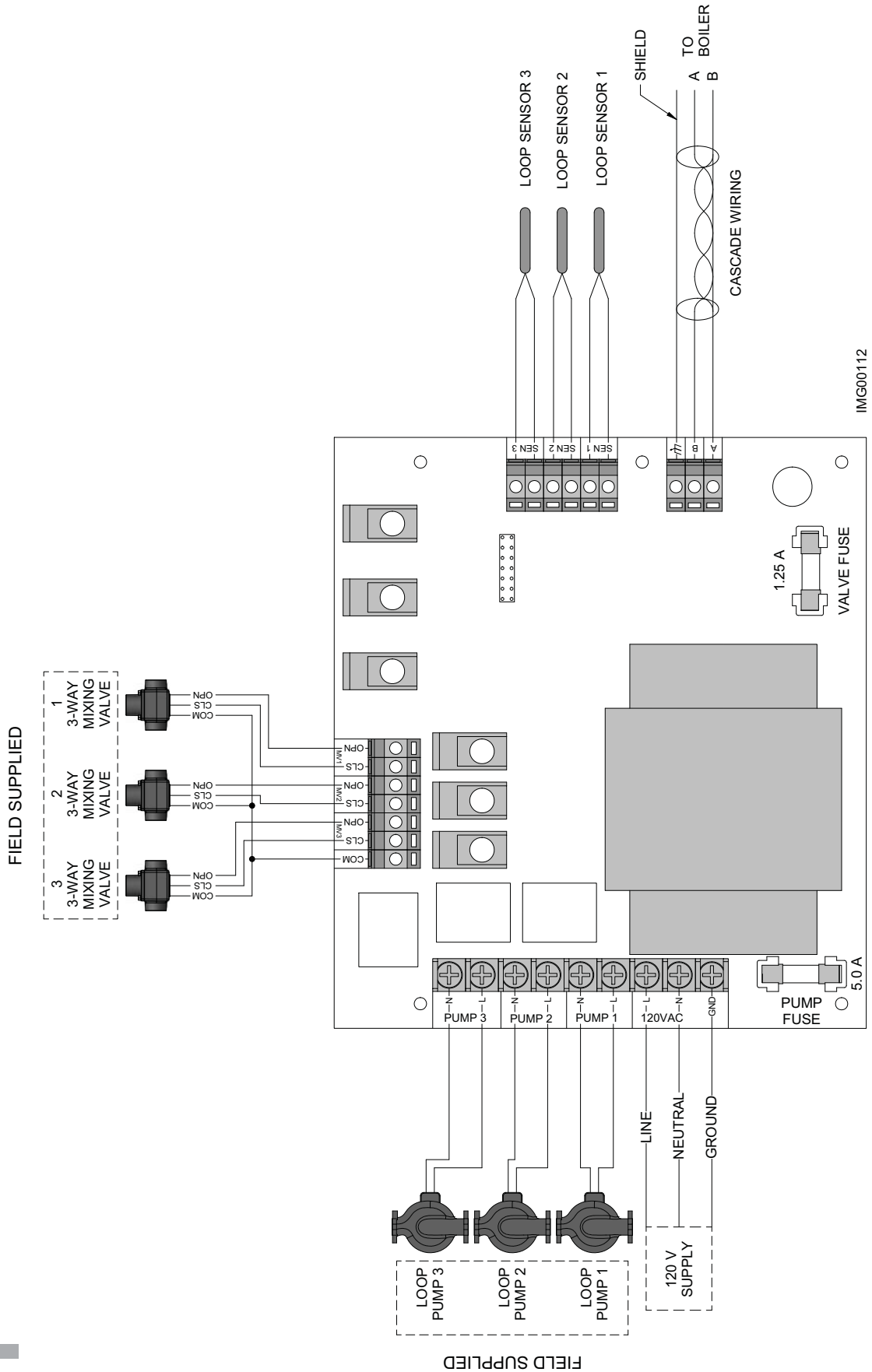
Wiring of the cascade

Communication between the boiler and the MTLCB is accomplished using shielded, 2-wire twisted pair communication cable. Try to keep the cable as short as possible.

1. Connect one end of the twisted pair wires to Cascade terminals A and B on the Low Voltage Connection Board of the boiler (see FIG. 3-2 on page 9).
2. Connect the other end of the twisted pair wires to MTLCB terminals A and B (FIG. 3-1).
3. Connect the shield wires to one of the shield terminals on the Low Voltage Connection Board (FIG. 3-2) and the MTLCB (FIG. 3-1).

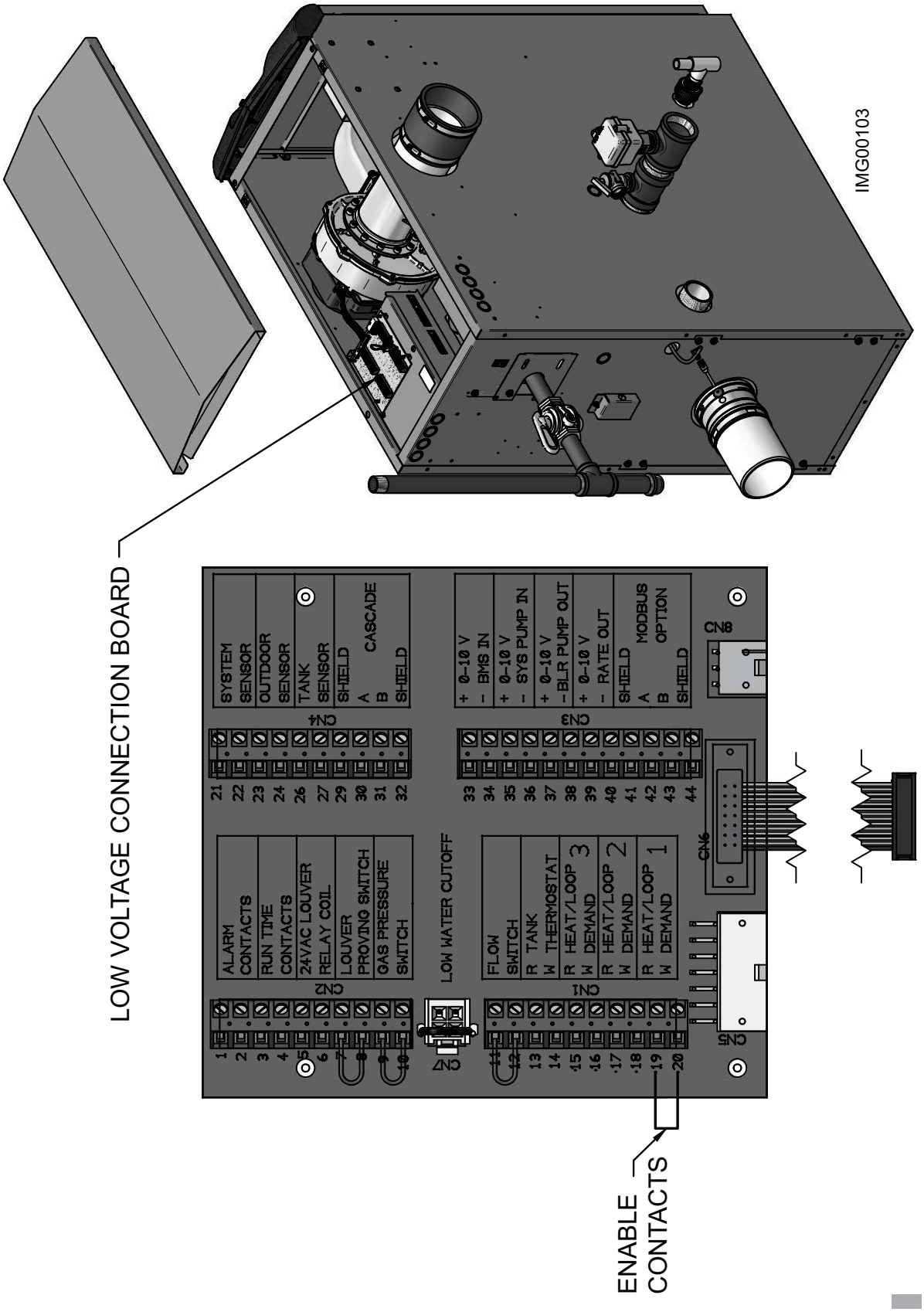
3 Wiring Requirements

Figure 3-1_Multi-Temperature Loop Control Board (MTLCB)



3 Wiring Requirements *(continued)*

Figure 3-2_Terminal Strip Connections to the Boiler's Low Voltage Connection Board (Knight/Knight XL shown below for illustration purposes)



4 Boiler Parameters Setup

Once the wiring requirements of all the MTLCB components are complete, the next step is to adjust the following parameters through the boiler's display:

- Cascade Address
- Loop Temperature Settings
- 3-Way Valves
- Pumps

Power ON the boiler and place into Shutdown Mode, leaving the MTLCB powered OFF. With the boiler in Shutdown Mode, all calls for heat are disabled and the above parameters can be adjusted.

Cascade communication setup

When the MTLCB is used with a single boiler, the boiler must be programmed as a Cascade Leader by setting its Cascade address to 0.

To access cascade address:

1. While on the Menu Selection Screen, select [CONTROL MODES].
2. In the Control Modes Menu (FIG. 4-1 and FIG. 4-2), select [CASCADE ADDRESS] and set to [0].
3. Press the RIGHT SELECT [SAVE] key.
4. Press the [HOME] key to exit and download all parameters.

To adjust the set points for each space heat/loop, reference the Service Manual for a detailed explanation.

The 3-Way Mixing Valve Time can be accessed as shown below:

NOTICE Please note that the brackets ([]) denote screen status.

3-way valve setup

1. Press and hold the LEFT SELECT [MENU] key.
2. Enter the pass code.
3. Scroll down and select [TEMPERATURE SETTINGS].
4. Scroll down and select 3-Way Valve Time by pressing the NAVIGATION dial (FIG. 4-5 - FIG. 4-6).
5. Scroll to the intended value.
6. Press the RIGHT SELECT [SAVE] key.
7. Exit one level.

Once all the parameters have been adjusted for the application, power ON the MTLCB. TX and RX LED's will light up to signify data is being sent and received from the boiler's control. With successful communication, the SH1, SH2, and SH3 temperatures can be read with a clockwise rotation of the NAVIGATION dial (see FIG. 4-3 & FIG. 4-4). If successful communication does not occur, reference FIG. 4-1 & FIG 4.-2 for set up of the Cascade address.

Figure 4-1 Cascade Screen (Models KB, KBX, WB and WH)

Figure 4-2 Cascade Screen (FTXL Models)

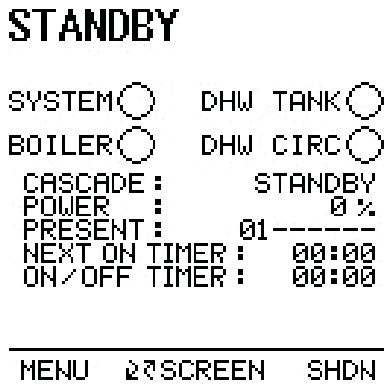


Figure 4-3_SH1, SH2, and SH3 Screen (Models KB, KBX, WB and WH)

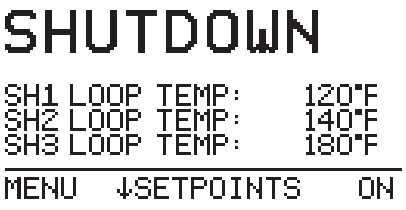
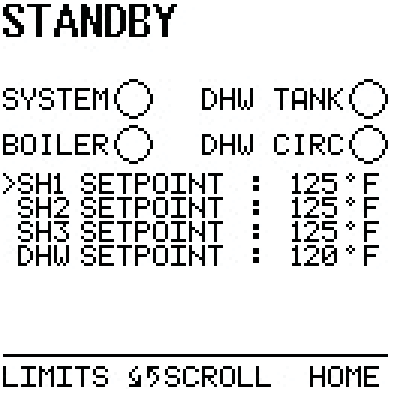


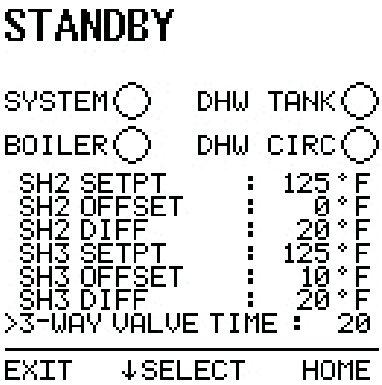
Figure 4-4_SH1, SH2, and SH3 Screen (FTXL Models)



4 Boiler Parameters Setup *(continued)*

Figure 4-5_3-Way Valve Time Screen (Models KB, KBX, WB and WH)

Figure 4-6_3-Way Valve Time Screen (FTXL Models)



24-hour pump in-activity operation

In the event there is not a call for heat in 24 hours, the loop pump will operate for the time of the system pump delay setting.

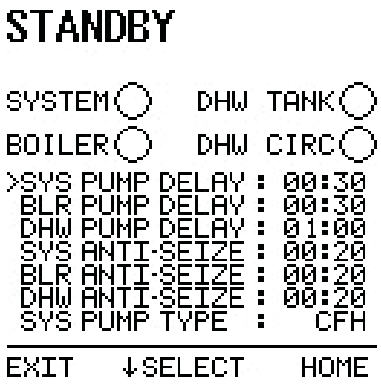
To set time for SYS PUMP DELAY:

1. While still on the Menu Selection Screen, scroll down and select [CIRCULATION PUMPS] by pressing the NAVIGATION dial.

2. In the CIRCULATION PUMPS Menu (FIG. 4-7 and FIG. 4-8), select [SYS PUMP DELAY], scroll to the intended time value and press the RIGHT SELECT [SAVE] key.

Figure 4-7_System Pump Delay Screen (Models KB, KBX, WB and WH)

Figure 4-8_System Pump Delay Screen (FTXL Models)



5 Basic Operation

The MTLCB serves as the controlling device for up to three (3) individual loops, branching off the system loop of a space heating system. It will control each loop pump and mixing valve position in order to satisfy the set point for that loop.

By installing the sensors (provided in kit) on the pipe, after the pump, a mixed temperature is relayed to the boiler display. Each thermostat input to the boiler should receive a loop temperature feedback for proper operation. Using this input, the MTLCB operates the 3-way valve to the correct position for mixed water supply. The pump will run continuously with the valve positioning until the thermostat set point is met or a Protection Mode is active.

When demands of more than one loop are active, the system set point is maintained at the highest space heat set point enabled. All enabled loops are actively satisfied together, with up to three (3) different set points mixing down for each set point temperature below the system.

NOTICE

At the beginning of successful communication, all 3-way valves will see a signal to close 125% of the time value entered in the General Setup Section, FIG. 4-3 and FIG. 4-4 on page 10.

Once a thermostat demand is enabled, the pump will run for one (1) minute to stabilize loop temperature before opening to system water. **Note:** For smaller systems, the use of Ramp Delay is recommended to prevent short cycling and extend runtime. At this time the 3-way valve will adjust, open to a calculated initial position based on the differential of the sensed temperature and set point. The MTLCB will continue to raise the mixed temperature of the loop toward its individual set point, while continuously relating to the loop's sensor input by a specific algorithm.

At the end of a loop demand cycle, the pump powers off, and the valve will move to the fully closed position.

Protections

Initial

In the event the sensed temperature continues to exceed the set point (set point + offset - 2°F, but within the set point + 20°F) for a given loop, a Protection Mode is entered to stop excessive temperatures from being reached. To prevent the loop temperature from exceeding this range, the following stages are enacted:

1. The pump active on the loop exceeding the set point temperatures is powered off.
2. The mixing valve is adjusted from the current position, plus 25% to the closed position.
3. The pump is powered ON for two (2) minutes.
4. If the temperature has not dropped below the [set point + offset - 2°F], the pump is turned OFF.

The control will automatically reset the demand as active once the sensor input is below the [set point + offset - 2°F].

Error Mode

If the sensed temperature rises above set point + 20°, the display of the boiler will present the sensor input with an exclamation mark (ex. 128°F!). The following protection algorithm will begin to prevent a lockout of the loop:

1. If running, the pump will immediately power off and the 3-way valve is adjusted 125% in the closed direction.
2. Once the close signal ends, the pump is powered back on for two (2) minutes. Within this time, the sensed temperature must drop below [set point + offset] or the pump will be powered off.
3. As a result, the temperature will drop below [set point + offset] and the error code (ex. 128°F!) is removed.

With the Initial and Error Mode Protections, the valve is fully closed to reduce the loop temperature by preventing continued hot water supply from the system. If the temperature sensed is not reduced within the steps listed above, the MTLCB will lockout this loop until temperatures below [set point + offset] are reached. During these scenarios, ensure the physical movement of the 3-way valve in the event the system needs to be repaired.

5 Basic Operation *(continued)*

Forced Change

It is necessary for the MTLCB to sense a temperature change of 2°F within the time of a call for heat and the initial position of the 3-way valve. This is a two-fold protection where the MTLCB protects the loop from continued normal operation when it cannot calculate the sensitivity of the valve movement needed.

As a secondary operation, the sequence below protects the loop when the loop temperature sensor is connected to the MTLCB but not installed properly, not installed, or malfunctioning.

1. With a call for heat the pump turns on.
2. The 3-way valve moves to the initial open position after the pump is on for one (1) minute.
3. If after three (3) minutes the initial position does not create a 2°F change in sensed temperature, the 3-way valve is moved to the closed position.
4. After two (2) minutes of closure, the 3-way valve is opened to the initial position.
5. Repeat Steps #3 and #4.
6. Once the 3-way valve is moved to the closed position, the loop is locked out for the duration of the call for heat.
7. The lockout continues for 30 minutes after the call for heat has ended.
8. After 30 minutes, the next call for heat will begin at Step #1.

Please note, the first two (2) steps are normal operation and at Step #3, if a 2°F change in temperature is not sensed, the protection process will begin. If at any point a 2°F change is sensed, normal operation will resume.

NOTES

NOTES

Revision Notes: *Revision A (ECO #C08954) initial release.*

Revision B (ECO C10236) reflects the update of the control image in Figure 3-1 on page 8.

Revision C (ECO #C11814) reflects edits made to place the check valves on the outlet side of the pump on both piping diagrams.

Revision D (ECO C15810) reflects the addition of FTXL models and screens.

LCB-I-O Rev D
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