

Trinity Lx

Model Numbers: Lx200-800

Version Date: 2011-02-17

NEW FEATURES
Internal Lead-Lag Control
Modulation Sensor Alternatives



APPENDIX C - WATER HEATER APPLICATIONS: PLUMBING AND WIRING INSTRUCTIONS

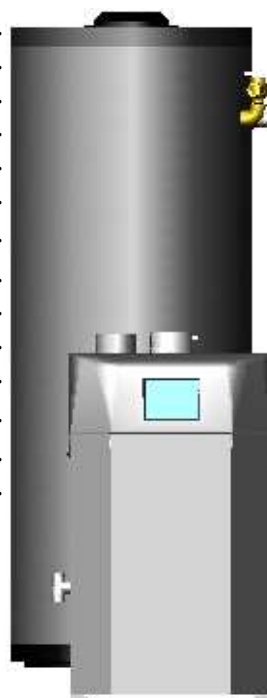
Optional Configuration: Refer to "Appendix B - Boiler Applications"

Companion Storage Products: TRIN & STOR Storage Tanks

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TRIN & STOR



Lx 200-800

HAZARD SYMBOLS AND DEFINITIONS



Danger Sign: Indicates a hazardous situation which, if not avoided, will result in serious injury or death.



Warning Sign: Indicates a hazardous situation which, if not avoided, could result in serious injury or death.



Caution Sign plus Safety Alert Symbol: Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION

Caution Sign without Safety Alert Symbol: Indicates a hazardous situation which, if not avoided, could result in property damage.

NOTICE

Notice Sign: Indicates a hazardous situation which, if not avoided, could result in property damage.



This Water Heater must be installed by a licensed and trained Heating Technician or the **Warranty is Void**. Failure to properly install this unit may result in property damage, serious injury to occupants, or possibly death.

1.0 INTRODUCTION

IMPORTANT

Water Heater Applications – These instructions apply to plumbing and wiring of Trinity Lx200-800 units operating as water heaters and covers instructions that are specific to water heater applications. When these units are installed and operated as a boiler, and not used for direct fired potable or process water heating, refer to "Appendix B - Boiler Applications: Plumbing & Wiring Instructions". See Table 1-1 for a list of Application Manuals.

Terminology – The following terms in the instruction manuals are used to differentiate between which instructions are common-to-both and which are appliance-specific. The term "**APPLIANCE**" applies to both kinds of applications (boiler and water heater) and is used when conveying instructions which are common-to-both. The term "**BOILER**" or "**WATER HEATER**" is used when conveying instructions which are appliance-specific or specific to one or the other, but not both.

Table 1-1 Instruction Manuals

Appliance	Model No.	Common-to-Both (Trinity Lx Series)		Appliance-Specific (Application Based)	
Boiler	Lx150-800	Installation and Operation Instructions	Appendix A - Controller and Touchscreen Display Instructions	Appendix B - Boiler Applications: Plumbing and Wiring Instructions	n/a
Water Heater	Lx200-800	Installation and Operation Instructions	Appendix A - Controller and Touchscreen Display Instructions	n/a	Appendix C - Water Heating Applications: Plumbing and Wiring Instructions

Notes

¹ The conversion kit is required to convert the Appliance so it will safely operate with Propane Gas (Lx150-400).

² Do not convert the Lx600-800 to Propane (LP). Operate with Natural Gas only.

General Installation Requirements

The installation of your NTI Trinity gas water heater must conform to the requirements of this manual, your local authority, and the National Fuel Gas Code ANSI Z223.1 and or CAN/CGA B149 Installation Codes. Where required by the Authority, the installation must conform to the standard for "Controls and Safety Devices for Automatically Fired Boilers ANSI/ASME CSD-1.

This document pertains to the correct installation and operation of NTI Trinity water heaters models Lx200, Lx300, Lx400, Lx500, Lx600, Lx700 and Lx800. The instructions detailed in this document supersede any and all previous instructions provided by NTI, written or otherwise. Each unit is provided with various manuals and a Natural to LP Conversion Kit for applicable models. See notes and list of Instruction Manuals in Table 1-1.

⚠ DANGER

Natural Gas Only - The Lx600-800 are not approved for operation with Propane (LP Gas). Failure to comply with instructions will result in damage, serious injury or death.

⚠ DANGER

Be Informed - Read and understand this entire document prior to proceeding with the installation of the Trinity Lx water heater. Failure to follow the instructions outlined in this document will result in property damage, serious injury or death.

⚠ WARNING

Service - Failure to have the water heater properly service and inspect on a regular basis by a qualified service technician may result in property damage, serious injury or death.

⚠ CAUTION

Intended Use - This appliance is not intended to convey or dispense water for human consumption such as drinking or cooking.

Mandatory Wall Mounting Protection



The following is to be read in conjunction with the wall mounting installation instructions in Section 3.0 of "Installation and Operation Instructions For Trinity Lx Series". Failure to follow these instructions may result in property damage, serious injury or death.

The Trinity Lx requires zero clearance to combustible walls; however, code requires all wall mounted instantaneous water heaters be provided with suitable protection extending the full length and width of the water heater. This is simply because the heat exchanger is surrounded by air, rather than water, which exposes the burner flame to the surrounding air in the combustion chamber. Check with local authorities regarding acceptable protection materials.

General Water Treatment

Prior to connecting plumbing to the water heater, flush the entire system to ensure it is free of sediment, flux, solder, scale, debris or other impurities that may be harmful to the system and water heater. Toxic chemicals, such as used for boiler treatment, shall not be introduced into the potable water system.

Potable Water Systems

This water heater is suitable for water (potable) heating and space heating. The water heater can be configured for "water (potable) heating only" or "combination space heating" and is subject to the following requirements:

- 1) Piping and components connected to the water heater for use with water (potable) heating or combination space heating applications shall be suitable for use with potable water.
- 2) Toxic chemicals, such as used for boiler treatment, shall not be introduced into the potable water system.
- 3) This water heater which will be used to supply potable water shall not be connected to any heating system or component(s) previously used with a non-potable water heating appliance.
- 4) When the system requires water for space heating at temperatures higher than required for other uses, a means such as a mixing valve shall be installed to temper the water for those uses in order to reduce scald hazard potential. These instructions shall include a piping diagram(s) for a typical installation.

Definitions of Potable Water Systems

Each potable water system described below is meant to be used with a storage tank (refer to Table 1-1):

- **Water (Potable) Heating Only** - refers to an open potable water system dedicated to providing domestic hot water and is not intended for space heating.
- **Combination Space Heating** - refers to an open potable water system where the domestic hot water and heating system water are drawn from the same storage tank. Heat exchange typically takes place in the water heater and there is no separation or differentiation between water used for domestic hot water and water used for space heating.
- **Storage Tank (Vessel)** - refers to a tank used to store hot water that is heated indirectly by a water heater external to the tank or a container provided for storage of hot water under pressure.

Users Responsibility - This appliance may only be installed and serviced by a qualified installer/service technician. For normal residential applications this water heater must be serviced/inspected annually, by a qualified heating technician. Other applications with more strenuous conditions, such as commercial, may require more frequent service/inspection. As the User/Owner of this equipment, you are responsible for ensuring the maintenance is performed at the required intervals.



Failure to have your potable water system regularly inspected and maintained may result in possible illness or death.

Installers Responsibility - Although most provinces and states follow a national or international building code, some municipalities impose additional or unique requirements that go beyond what the nationally accepted standard requires. Combination space heating systems are no exception. Since it is impossible for a manufacturer to know the particulars of all provincial, state and local codes, it is the **installer's responsibility** to consult with the local regulatory authorities and verify that combination space heating systems are allowed in your particular jurisdiction. A suggested piping diagram has been included in this manual for information purposes only. In the interest of public health and safety, it is imperative that any combination space heating system be approved by local regulatory authorities and installed in accordance with applicable codes and current regulations.

⚠ WARNING **Combination Space Heating** - A boiler with indirect fired water heater is the preferred method for combination space heating; therefore, the building owner assumes all risk and responsibility with respect to installation, maintenance, and operation of this water heater in a combination space heating application. Failure to follow instructions may result in possible illness or death.

Safe Temperatures for Potable Water

Two factors used to determine safe hot water temperatures are Legionella and scalding. Potable water needs to be stored at temperatures hot enough to limit the growth of Legionella, yet be cool enough to prevent scalding. Since both hazards present a potential risk to the user, they must be monitored and controlled. Table 1-1 indicates how water temperature affects Legionella bacteria and contributes to scald injury. Use of a thermostatic mixing valve in the water heater plumbing system can help protect against both of these hazards. By storing potable water at higher temperatures, bacteria growth is controlled, while still providing high temperature water for dishwasher applications and low temperature water for bathing. Before proceeding, read the following carefully and take all necessary pre-cautions to avoid potential illness and/or injury that can result from Legionella or scalding hazards.

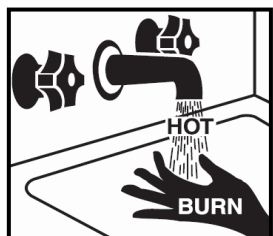
⚠ WARNING **Legionella Hazard** - This bacteria is naturally occurring in surface water and ponds. It can also be found in man-made water systems around the world such as water storage tanks, water distribution systems, fountains, hot tubs, humidification systems, refrigeration systems and grocery produce misters. Health authorities agree that Legionella bacteria most often enter the lungs due to aspiration when contaminated water spray is breathed in as opposed to ingesting drinking water contaminated with the bacteria. Typical illnesses attributed to Legionella include flue like symptoms (Pontiac Fever) and a potentially fatal type of pneumonia (Legionnaires' disease). Failure to follow instructions may result in illness or death.

⚠ WARNING **High Risk Application** - Combination space heating systems can present a significantly higher risk of developing Legionella than dedicated domestic hot water systems, especially during non-heating seasons or low temperature water applications. Using higher temperature tank water, routinely maintaining your water system, and having your water tested annually are considered "good practice" when it comes to controlling conditions that contribute to Legionella. See Table 1-1. Failure to monitor and maintain your combination space heating system may result in illness or death.

Contributing Factors to Legionella - Experts acknowledge that Legionella is an identified risk in most water systems. Although eradicating Legionella is improbable, pre-cautions can be taken to control and monitor conditions that promote bacteria growth. According to the World Health Organization (WHO); American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE); Canada Safety Council (CSC); and Centers for Disease Control (CDC), contributing factors to the growth of Legionella in potable water systems include:

- Minerals and nutrients present in the source water and systems materials
- Stagnation or low flow characteristic of dead ends in distribution piping systems and storage tanks
- Scale, corrosion, and bio film
- Tepid water in cold water lines
- Water storage temperatures optimal for bacteria growth
- Chlorine concentration

⚠ WARNING **Scald Hazard** - Hotter water increases the risk of scald injury. There is a hot water scald potential if the storage tank thermostat is set too high. Before changing the temperature setting on the tank thermostat, refer to the thermostat manufacturers recommended settings. Failure to follow these instructions may result in serious injury or death.



A scald injury can occur when hot steam or liquid makes contact with one or more layers of skin. Scald severity (degree of burn) is directly impacted by exposure time and temperature. Refer to Table 1-1. The following basic precautions are common sense:

- Young children and elderly adults burn more quickly and should use cooler water.
- Never leave a child alone while drawing water in a bathtub.
- Test the water temperature before bathing or showering.
- Turn cold water on first, then add hot water until the temperature is comfortable.

⚠ WARNING

Thermostatic Mixing Valve - When the system requires water at temperatures higher than required for other uses, such as high temperature applications typically greater than 46°C (115°F), a means such as a thermostatic mixing valve shall be installed to temper the water for those uses in order to reduce scald hazard potential. Anti-scald devices such as a thermostatic mixing valve allows potable water to be stored at a higher temperature to limit bacteria growth, and allows water at the tap to be delivered at a lower temperature to prevent scalds. Failure to follow these instructions may result in serious injury or death.

⚠ CAUTION

Intended Use - This appliance is not intended to convey or dispense water for human consumption such as drinking or cooking.

IMPORTANT

Legislation and Guidelines - At the time this document was written, standards and guidelines regulating the prevention of Legionella in the United States and Canada were mostly voluntary. The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) is currently in the process of converting its guideline entitled "Minimizing the Risk of Legionellosis Associated with Building Water Systems" (ASHRAE Guideline 12-2000) into an official standard. Consult with your local authorities as to recommended guidelines for controlling Legionella in potable water systems.

General Guidelines - In the absence of a National standard or local codes, the following are general guidelines for "good practice" on maintaining, monitoring and operating your potable water system:

- Store hot water at temperatures $\geq 60^{\circ}\text{C}$ (140°F) for "water (potable) heating only" applications.
- Store hot water at temperatures $\geq 80^{\circ}\text{C}$ (176°F) for "combined space heating" applications.
- Store and distribute cold water at temperatures below 20°C (68°F).
- System supply for uses other than high temperature applications typically greater than 46°C (115°F) shall be equipped with a thermostatic mixing valve on the hot water outlet to reduce potential scald hazards.
- Clean aerators and nozzles on water fixtures on a regular basis to reduce scale build-up.
- Clean storage tanks and remove sediment. Flush storage tanks and piping systems regularly for 10-30 minutes at high water temperatures (depending on guidelines used) to rid the system of sediment and scale that develops, typically in the bottom of storage tanks where water temperature is coolest and piping runs where water can stagnate.
- Abandoned water lines should be capped off at the distribution main, not at the most convenient place.
- Avoid dead-ends in piping system. If unavoidable, provide a drainage port in these areas at the lowest point to flush out stagnant water regularly.
- Insulate DHW recirculation lines and keep pipe runs as short as possible.
- Recommend annual water testing of water in your tank and piping system(s) to monitor water conditions.
- Keep a maintenance record of when your water heater and storage tank were cleaned, piping systems flushed and who did the service work.

Table 1-1 How Water Temperature relates to Legionella and Scald Hazard

Water Temperature ¹		Legionella Bacteria ¹	Water Temperature ^{2,5}		Exposure Time vs Burn ⁵
158-176°F	70-80°C	Disinfection range	158°F	70°C	1 second - 2 nd or 3 rd degree burn
140-149°F	60-65°C	Bacteria die within minutes	140°F	60°C	5 seconds - 2 nd or 3 rd degree burn
122-131°F	50-55°C	Bacteria die within hours	131°F	55°C	5 seconds - 1 st degree burn
68-113°F	20-45°C	Bacteria thrive and multiply	122°F	50°C	1 minute - 1 st degree burn
below 68°F	below 20°C	Bacteria is dormant	111°F	44°C	5 hours - 1 st degree burn ^{3,4}

Notes:

¹ Published by Chartered Institute of Plumbing and Heating Engineering, Databyte series, "Safe Hot Water Temperatures".

² The elderly and small children are susceptible to bad burns at shorter exposure times than listed in this table.

³ A thermostatic mixing valve should be installed on DHW storage tanks when outlet temperatures exceed 115°F [46°C].

⁴ Typical water temperature for bathing or showering range between 98-113°F [37-45°C].

⁵ Temperature-Time-Burn Chart published by John Hopkins University, excluding notes.

2.0 WATER HEATER SYSTEM PIPING

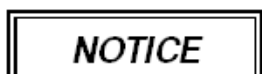
The heat exchanger of the Trinity Lx water heater is designed to attain the highest level of heat transfer in a compact design. To accomplish this, the heating water flows through a series of fin shaped tubes, designed to maximize the heat transfer area. To maintain the efficient and reliable operation of the heat exchanger, and to avoid heat exchanger failure, it is critical to ensure the rules and guidelines in this section are followed.



WARNING Failure to follow the instructions provided in this section will void the NTI warranty and may result in property damage, fire, serious injury or death.

Water Chemistry - The installer of the Trinity Lx water heater must consider the condition of the water in the water heating system. Ensure the water hardness condition falls within the following recommended parameters to avoid scale build-up and aggressive PH levels that can result in corrosive reactions and damage to the heat exchanger and system components:

- Water hardness – between 5 and 25 Grains/gal.



NOTICE Water heater water that falls outside of the parameters listed above must only be conditioned or treated with products approved for potable hot water systems. Toxic chemicals, such as used for boiler treatment must not be introduced into the potable water system.

System Preparation - During the assembly of the water heating system, it is important to keep the inside of the piping free of any debris including construction and copper dust, sand and dirt. For retrofits, this water heater which will be used to supply potable water shall not be connected to any heating system or component(s) previously used with a non-potable water heating appliance. All systems, old and new, must be cleansed to remove flux, grease and carbon residue.

Near Water Heater Plumbing

Pressure Relief Valve - All Trinity Lx models dual certified as either a boiler or a water heater (Lx200-800) have an additional factory supplied pressure relief valve. For water heater installations, use the higher pressure relief value along with the corresponding higher pressure gauge. See Table 2-1 for pressure relief valve sizes. The pressure relief valve must be installed at the water heater outlet and in the vertical position with the drain pipe outlet exiting the side of the pressure relief valve horizontally and elbowing down. See Figures 2-1(a),(b).



CAUTION If installed with the incorrect orientation (horizontally with drain pipe out the bottom) the relief valve may not function properly resulting in property damage or personal injury.



WARNING The Trinity Lx water heater is provided with a pressure relief valve. For safe operation of the water heater, the relief valve(s) must not be removed from its designated point of installation or plugged. Failure to follow these instructions may result in serious injury or death.



WARNING Ensure the discharge of the pressure relief is piped to a location where the steam or water will not cause property damage or serious injury.

Pressure Gauge - All Trinity Lx models dual certified as either a boiler or a water heater (Lx200-800) have an additional factory supplied pressure gauge which must be installed at the water heater outlet prior to any circulators, and in the vicinity of the pressure relief valve. Figures 2-1(a),(b). When using a higher pressure relief valve, such as 125PSI, ensure the pressure gauge is sized to display the higher pressure value (e.g. 160PSI pressure gauge). See Table 2-1 for pressure gauge sizes.

Table 2-1 Corresponding Pressure Relief Valve & Pressure Gauge Sizes

Trinity Model	Application	MAWP	Pressure Relief Valve	Pressure Gauge
Lx150 (Canada Only)	Boiler	30PSI	30PSI	30PSI
Lx150-200, Lx400		145PSI	30PSI	30PSI
Lx300		160PSI	30PSI	30PSI
Lx500-800		160PSI	50PSI	60PSI
Lx200, Lx400	Water Heater	145PSI	125PSI	160PSI
Lx300		160PSI	125PSI	160PSI
Lx500-800		160PSI	150PSI	160PSI

Figure 2-1(a) Lx200-400 Models

Near Water Heater Piping

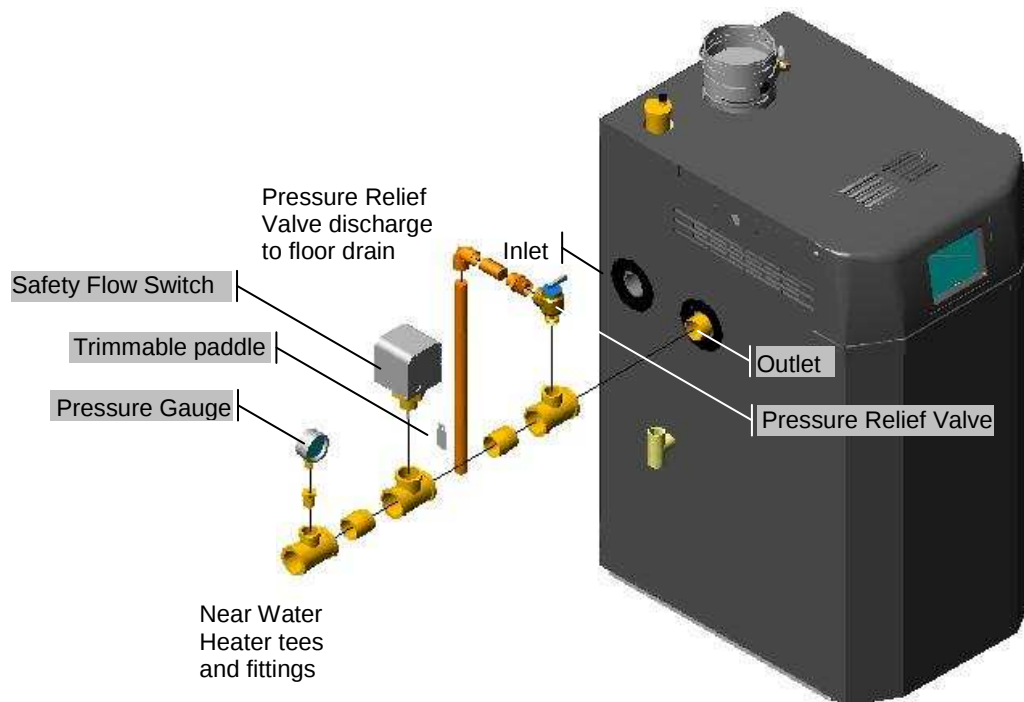
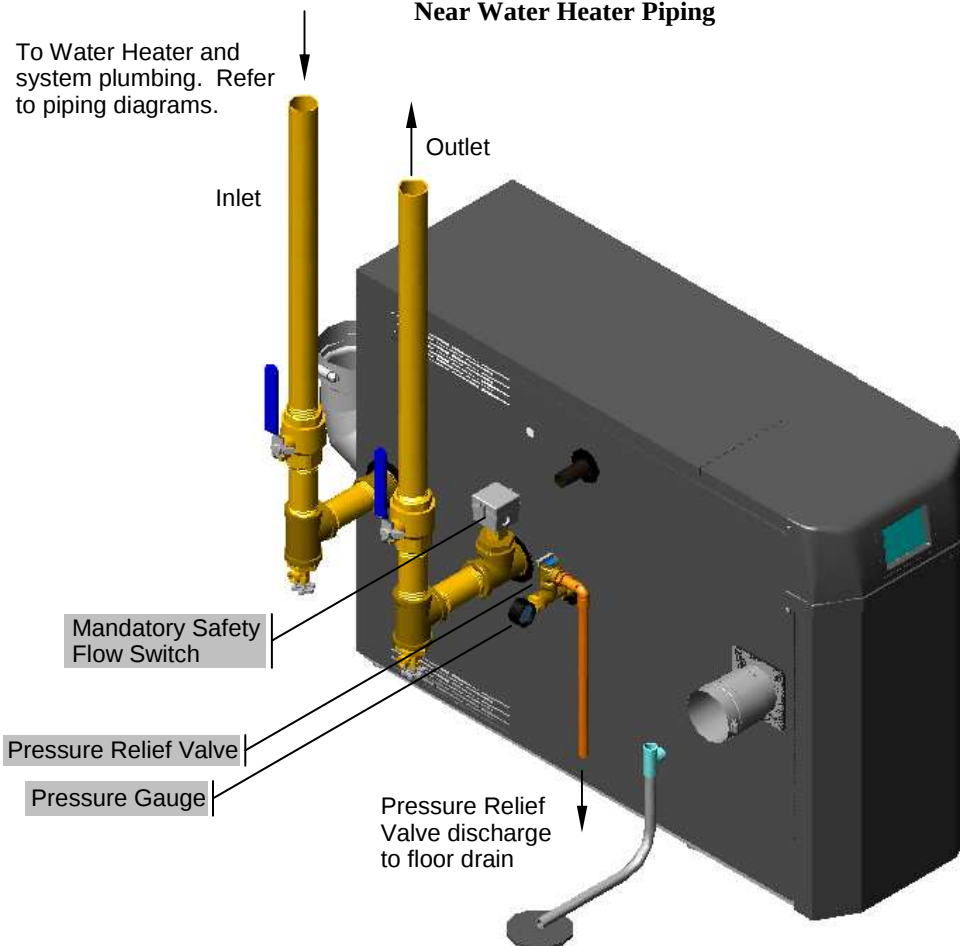


Figure 2-1(b) Lx500-800 Models

Near Water Heater Piping



Safety Flow Switch - A safety flow switch is required by code to ensure a sufficient rate of water supply is available for proper operation of the water heater. The Lx500-800 are the only NTI models factory equipped with flow switch. Locate the flow switch in series with the water heater and in accordance with the instructions provided with the safety flow switch. NTI recommends a safety flow switch with a **trigger point no lower than** the gpm specified in Table 2-2. Install the flow switch in a 1" diameter line for model Lx200 and a 1-1/4" diameter line for model Lx300-400 at the appliance outlet.

Table 2-2 Flow Switch Installation Requirements

Model	Trigger Point (no lower than)	Line Size for Flow Switch	IMPORTANT: After the flow switch, <u>increase</u> pipe diameter to the size specified in Tables 2-4 or 2-5. Refer to Section 3.0 for instructions on wiring the safety flow switch.
Lx200	6 gpm	1	
Lx300	9 gpm	1-1/4"	
Lx400	12 gpm	1-1/4"	

NOTICE

When external safety devices are used, such as a LWCO, Flow Switch, or a Temperature Limiting Switch, they must be wired as per the instructions provided in this manual. Refer to Section 3.0 for more information.

NOTICE

When external safety devices are used, such as Safety Flow Switch, they must be wired as per the instructions provided in this manual. Check with your local authorities as to the requirements of these devices prior to installing the water heater as a LWCO is not required on Instantaneous Water Heaters. Refer to Section 3.0 Field Wiring for more information.

Water Heater System Plumbing

The Trinity water heater uses a low mass heat exchanger that requires a minimum rate of forced water circulation any time the burner is operating (See Table 2-3 for minimum flow rates). To ensure the minimum flow rate is attained, the water heater must be installed with a safety flow switch (see Figure 2-2 for suggested plumbing diagram). A properly installed system will as a minimum include the major components in Table 2-3.

Table 2-3 System Major Component Checklist

Factory Supplied Components	Field Supplied Components
☐ Pressure Relief Valve (125PSI)	☐ Bronze/Stainless Steel Water Heater Circulator (Pump B in Figure 2-2)
☐ Pressure Gauge (160PSI)	☐ System Backflow Preventor (check if required by local codes)
☐ Flow Switch (Lx500-800 only)	☐ DHW/Potable Water Expansion Tank (check if required by local codes) *
	☐ DHW Storage Tank
	☐ Tank Temperature and Pressure Relief Valve
	☐ Tank Thermostat (aquastat)
	☐ Thermostatic (Anti-Scald) Mixing Valve
	☐ Safety Flow Switch
General Notes	
¹ Expansion Tank is <u>mandatory</u> if using a System Backflow Preventor.	

Water Heater Circulator - The Lx water heater is equipped with three 120VAC pump outputs (Pump A, B and C). Use only Pump Output B for the Water Heater Circulator. Note that bronze or stainless steel circulators are required for potable water systems. Ensure that circulators (pumps) are oriented as per the pump manufacturers' instructions. See Section 3.0 for wiring details.

NOTICE

Circulators responsible for forcing the water flow rate through the water heater must be sized according to Table 2-4.



WARNING

The installer must ensure a sufficient rate of water supply is available for proper operation of the water heater prior to installation. A safety flow switch must be installed on the hot water outlet side to ensure the minimum water flow rate through the water heater. Failure to follow instructions will not only void the warranty but may also result in fire, property damage, serious injury or death.

⚠ WARNING This water heater must have water flowing through it whenever the burner is on or it will damage the unit and void the warranty. Failure to follow these instructions may result in fire, property damage, serious injury or death.

Table 2-4 Minimum Water Heater Circulator and Pipe Sizes

Model	Restriction Head Loss	Min. Pipe Size	Min. Flow (GPM)	Max. Temp. Rise	Maximum Current Load	Minimum Pump Size ¹			
						B&G	Grundfos	Armstrong	Taco
Lx200	17' at 16 GPM	1-1/4"	16	23°F	5 A or 2/5 hp	PL-36B	-	E8B	0013-SF
Lx300	17' at 24 GPM	1-1/2"	24	23°F	5 A or 2/5 hp	PL-36B	-	E14B/E9B ³	2400-30S ³
Lx400	22' at 32 GPM	2"	32	23°F	5 A or 2/5 hp	PL-55B	-	E24B	2400-45S
Lx500	17' at 40 GPM	2"	40	23°F	See Note ²	PDB-35	UPS 32-160	E14B ⁴	2400-50S ⁴
Lx600	23' at 48 GPM	2-1/2"	48	23°F	See Note ²	PDB-37	UPS 32-160	E-22B ⁵	-
Lx700	19' at 56 GPM	2-1/2"	56	23°F	See Note ²	PDB-37	UPS 32-160	E-33B ⁶	2400-70S
Lx800	28' at 64 GPM	2-1/2"	64	23°F	See Note ²	PDB-38	UPS 40-160	-	-

Notes:

¹ Pump models listed are for bronze or stainless steel circulators only; cast iron pumps are not permitted.

² Maximum Current Load 1-1/2hp @ 120VAC or 3hp @ 240VAC.

³ Armstrong pumps E10B-E13B, and Taco pump 2400-40S are not recommended.

⁴ Armstrong pumps E15B-17B, and Taco pump 2400-60S are not recommended.

⁵ Armstrong pump E23B-E33B not recommended.

⁶ Armstrong pumps E22B and E24B also recommended.

System Backflow Preventor - Check if a backflow preventor is required by local codes. This manufacturer and most plumbing codes require a thermal expansion control device be installed if a backflow preventor, pressure reducing valve or check valve is installed on a domestic supply line. Installing an expansion tank approved for use with potable water is mandatory in applications using a System Backflow Preventor device.

DHW/Potable Water Expansion Tank - Check if an expansion tank is required by local codes. If required, the expansion tank must be suitable for use with potable water and be sized in accordance with the water volume of the system as well as the firing rate of the appliance. The expansion tank must be installed downstream of any backflow prevention device used to control system thermal expansion. See examples in Figure 2-3.

⚠ CAUTION Ensure the expansion tank cannot become isolated from the water heater anytime the system is operating. Failure to follow these instructions may result in discharge of the Pressure Relief Valve may result in property damage or personal injury.

DHW Storage Tank - Storage vessels shall be equipped with a drain valve to facilitate emptying the tank for cleaning or flushing debris or foreign deposits. Drain valves on counter type water heaters shall be accessible from the front of the heater. In Canada, glass-lined storage tanks for household hot water service must comply with the current performance requirements in CAN/CSA C309.

NOTICE The DHW storage tank should be located in an area where leakage or connections will not result in damage to the area adjacent to the appliance or to lower floors of the structure. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance. This manufacturer is not responsible for any water damage that may occur in connection with the storage tank or any of its components.

Tank Temperature and Pressure Relief Valve - The storage tank will require a temperature and pressure relief valve sized to ASME specifications and that complies with the Standard for Relief Valves for Hot Water Supply Systems, ANSI Z21.22•CSA 4.4. The relief valve is to be installed on the storage tank in accordance with Figure 2-3 and must be accessible for servicing or replacement. No valve is to be placed between the T&P Relief Valve and the storage tank. Check if local codes require storage tanks to have any additional valves.

⚠ WARNING Ensure the discharge of the temperature and pressure relief valve is piped to a drain or a location where steam or water will not cause property damage, serious injury or death.

Tank Thermostat (AquaStat) - The aquastat is intended to allow the water heater to monitor and control tank temperature, improve response time, and prevent short cycles of operation. Check that the aquastat will mate with the tapping on the storage tank prior to commencing installation. Install the aquastat on the storage tank as per the manufactures' instructions. Refer to Section 3.0 field wiring details.

Thermostatic (Anti-Scald) Mixing Valve - An anti-scald mixing valve is recommended when storing domestic hot water above 46°C (115°F) and should be used on branches supplying low temperature water to endpoint plumbing fixtures. A mixing valve is optional on high temperature water applications, including but not limited to process water, clothes washers, dishwashers or sanitizers, depending on the temperature desired at the appliance and water storage temperature.



When the system requires water at temperatures higher than required for other uses, a means such as a mixing valve shall be installed to temper the water for those uses in order to reduce scald hazard potential. Failure to follow these instructions may result in serious injury or death.

Stand Alone Water Heater Applications

In a stand alone (single) water heater application, the thermostat (aquastat) in the storage tank is connected to the water heaters low voltage terminal strip and is used to trigger a DHW demand by completing the "DHW" to "Sensor COM" circuit. See Table 3-2 for more details. Figures 2-2 is an example of a plumbing configuration for stand alone water heaters using a single system circulator. This schematic also illustrates an optional low temperature and/or high temperature return loop.

Figure 2-2: Stand Alone Water Heater Applications - This piping diagram demonstrates both a low temperature water application, such as bathing, and a high temperature water application, such as commercial process water heating or laundry. When the system requires water at temperatures higher than required for other uses, a thermostatic (anti-scald) mixing valve shall be installed to temper the water for those uses in order to reduce scald hazard potential, see Table 1-1. An optional DHW Recirculation Return may be used on long plumbing runs to prevent wait times for hot water on both low and high temperature water applications. The Water Heater Circulator (Pump B) must be sized according to Table 2-4 to provide adequate circulation through the water heater. Refer to Section 3.0 for field wiring instructions.

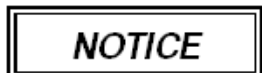
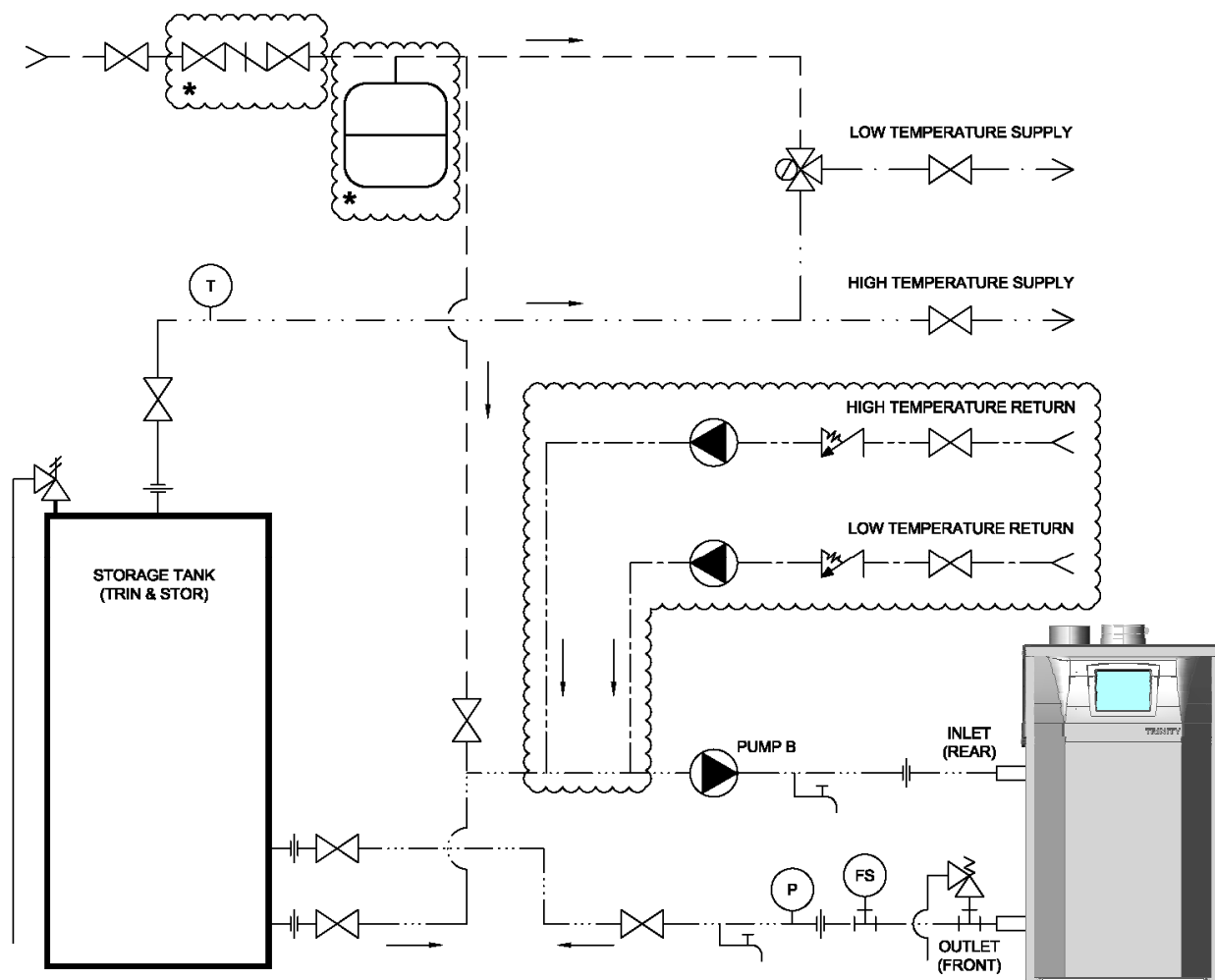


Figure 2-2 illustrates a typical piping system. The Water Heater Plumbing Schematic does not illustrate all of the required concepts and components required to have a proper installation. Concepts not shown include: prevention of thermal-siphoning (i.e. heat traps), isolation valves, drain and purge valves, etc. It is the responsibility of the installing contractor and system designer to consider all aspects of a proper system design including compliance with local codes. Contractor modifications to these instructions may be required, based upon existing piping and system design.

Energy Efficiency - Although the Trinity Lx Water Heater is an energy efficient appliance, insulating long pipe runs can improve the overall system efficiency by conserving energy and reducing standby losses.

Figure 2-2 All Models
Stand Alone Water Heater Plumbing Configuration



LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
— — —	DOMESTIC COLD WATER		PRESSURE RELIEF VALVE		FLOW SWITCH
— . —	DHW LOW TEMPERATURE SUPPLY		THERMOSTATIC MIXING VALVE		SPRING CHECK VALVE
-----	DHW LOW TEMPERATURE RETURN		TEMPERATURE AND PRESSURE RELIEF VALVE		PUMP
— . . —	DHW HIGH TEMPERATURE SUPPLY		DRAIN VALVE		UNION
-----	DHW HIGH TEMPERATURE RETURN		TEMPERATURE GAUGE		TEE
— . . . —	WATER HEATER LOOP		EXPANSION TANK		FLOW DIRECTION
	ISOLATION VALVE		OPTIONAL		CHECK LOCAL CODES
	BACKFLOW PREVENTOR		PRESSURE GAUGE		

Multiple Water Heater Applications

The Lx controller has the internal capacity to stage or Lead-Lag up to 8 water heaters. This Lead-Lag capability allows a designated "Master" water heater to communicate with and effectively control each water heater in a multiple water heater system. This function is accomplished by "Daisy Chaining" a 3-wire cable between each of the water heaters and enabling the Master parameter in the water heater of your choice. The water heater with the Master parameter enabled becomes the single point of contact for the DHW set-point, as well as system control wiring such as the tank thermostat demand and system water temperature.

In contrast to stand alone (single) water heater applications which use the tank thermostat to make-and-break the "DHW" to "Sensor COM" circuit, multiple water heater applications use the tank thermostat to make-and-break the "CH2 (LL)" to "R" circuit. See Table 3-2 for more details.

Whether cascading multiple boilers or water heaters, the LL Central Heat (CH) settings control the LL system settings. *Example:* For multiple water heaters, the "LL CH set-point" effectively becomes the "LL DHW set-point". Features such as Outdoor Reset and Warm Weather Shutdown are not applicable when cascading water heaters, effectively eliminating the need to install the factory supplied outdoor and system sensors. Figure 2-3 is an example of a multiple water heater plumbing configuration illustrating an optional low temperature and/or high temperature return loop.

IMPORTANT

Modbus Address – Each water heater in a cascade arrangement (lead-lag) must have a unique modbus address between 1 and 8, inclusive. For detailed instructions on how to set the modbus address for each Lx controller, refer to "System Identification & Access" in Appendix A.

Figure 2-3: Multiple Water Heater Applications – Used in applications where the DHW load is too large to be satisfied by a single water heater. Multiple water heaters can be staged in a cascade (lead-lag) arrangement to meet large DHW requirements. In this example, Water Heaters 1, 2 and 3 are LL slaves, with unit 3 being enabled as the designated "Master" which receives a DHW demand call directly from the storage tank thermostat (aquastat). During a DHW demand the Master communicates the call to the applicable water heater(s); units attempting to satisfy the DHW demand will energize their local pump contacts B. Refer to Section 3.0 for field wiring details.

Table 2-5 Minimum Pipe Sizes for Multiple Water Heater Applications

# of Units	Lx200 Pipe Size	Lx300 Pipe Size	Lx400 Pipe Size	Lx500 Pipe Size	Lx600 Pipe Size	Lx700 Pipe Size	Lx800 Pipe Size
2	2"	2-1/2"	3"	3"	4"	4"	4"
3	2-1/2"	3"	4"	4"	4"	4"	4"
4	3"	4"	4"	4"	4"	5"	5"
5	3"	4"	4"	4"	5"	5"	5"
6	4"	4"	4"	5"	5"	5"	5"
7	4"	4"	5"	5"	5"	6"	6"
8	4"	4"	5"	5"	5"	6"	6"

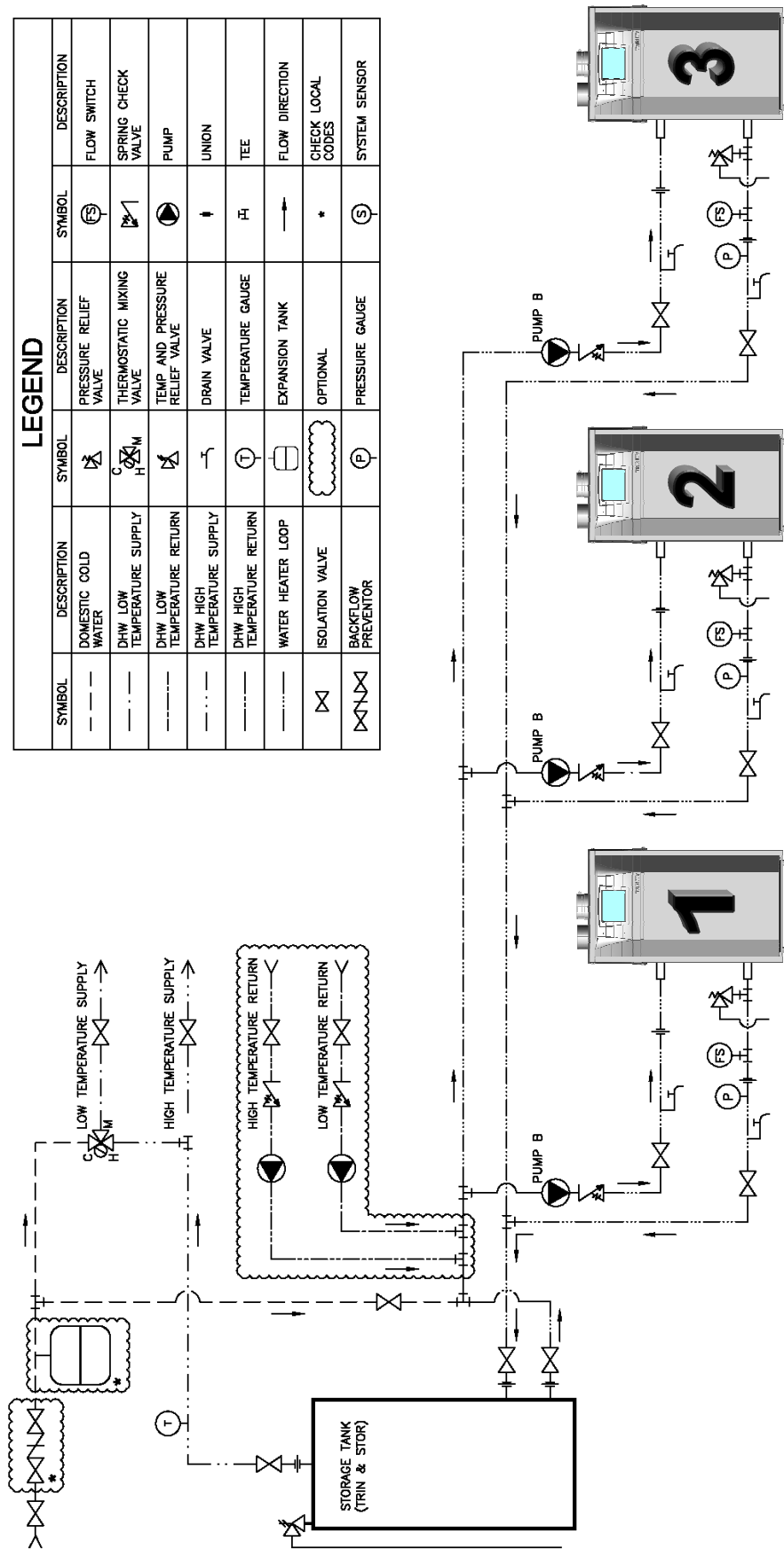
NOTICE

All Water Heater piping in **Multiple Water Heater Applications** must be sized based on Table 2-5 in accordance with the number of units the piping supports.

NOTICE

All water heater circulators (Pump B) must be sized according to Table 2-4.

Figure 2-3 All Models
Multiple Water Heater Lead-Lag Plumbing Configuration



3.0 FIELD WIRING

All wiring must be in accordance with the Canadian Electrical code, CSA C22.2 and any applicable local codes. Ensure that the wiring complies with this manual. The water heater must be electrically grounded in accordance with the National Electrical Code ANSI/NFPA 70, local codes, and/or the Canadian Electrical Code CSA C22.1.

⚠ WARNING **Avoid Shocks** - To Avoid Electrical Shock, turn off electrical power to the water heater prior to opening any electrical box within the unit. Ensure the power remains off while any wiring connections are being made. Failure to follow these instructions may result in component failure, serious injury or death.

⚠ CAUTION **Field Wiring** - Wire grommets must be used to secure wiring and prevent chafing when passing wiring through the cabinet wall. Failure to follow instructions may damage unit.

Line Voltage Connections

Electrical rating for the Trinity Lx is 120V/1 Phase/60 Hz /12A. The Trinity Lx line voltage junction box is located in the lower right corner of the water heater cabinet on model Lx200 and can be accessed by removing the front door of the water heater, followed by the removal of the line voltage junction box cover. On Lx300 and Lx400 models, the line voltage junction box is located at the top of the cabinet on the right hand side and can be accessed by removing the top front cover of the water heater. On Lx500-800 models, the line voltage junction box is located at the back of the cabinet on the power switch side. Remove the top back cover of the water heater to access the three holes / knockouts needed for routing field wiring into the line voltage junction box. Line voltage field connections are to be installed in accordance with Figures 3-1 and Tables 3-1 respectively.

Fuses (120VAC) – The Trinity Lx is equipped with either one or two 7 Amp fuses to protect 120VAC system components. The fast-acting fuses are located on the front of the control panel box and can be easily accessed from the outside of the control panel.

Lx200-400 Control Panel:

- Fuse A: Protects the blower, spark generator and PUMP B output circuits.
- Fuse B: Protects PUMP A and C output circuits.

Lx500-800 Control Panel:

- Fuse A: Protects the 120VAC circuits within the appliance.

Pump Relays (Lx500-800) – In lieu of the 120VAC pump outputs, the Lx500-800 incorporates three non-powered isolation relay contacts for switching high capacity pumps. Contact Secondary Maximum rating is 1.5HP @ 120V, 3.0HP @ 240V, or 30A. Refer to Figure 3-3(b) for Field Wiring requirements.

⚠ WARNING **Wire Protection** - When passing any wiring through the cabinet of the water heater, the installer must use wire grommets suitable for securing the wiring and preventing chafing. Failure to follow these instructions may result in component failure, serious injury or death.

⚠ WARNING **Power Supply** - The Trinity Lx is designed to be powered by a single phase 120VAC power supply that is fused (or protected via a circuit breaker) to allow a maximum of 15 Amps. Failure to follow instructions may result in component failure, serious injury or death.

⚠ CAUTION **Labeling** - Label all wires prior to disconnecting them when servicing controls. Wiring errors can cause improper and dangerous operation. Failure to follow instructions may result in property damage or personal injury.

⚠ CAUTION **Continuity** - Before connecting line voltage wiring, perform a continuity check between all wires and ground to make sure that there are no electrical leaks that could blow a fuse or damage electrical components. Also check the polarity of the line and neutral wires. Line must measure 120VAC to ground; neutral must measure zero. Failure to follow instructions may damage the unit.

NOTICE **Max Load** - Pump output B is used to control the Water Heater Circulator and is limited to operating a circulator with a maximum current load of 5 Amps or a maximum 2/5 hp motor. See Table 3-1. Circulator outputs PUMP A and C are not to be used for water heater applications.

Figure 3-1(a) Lx200-400 Models

Line Voltage Field Wiring

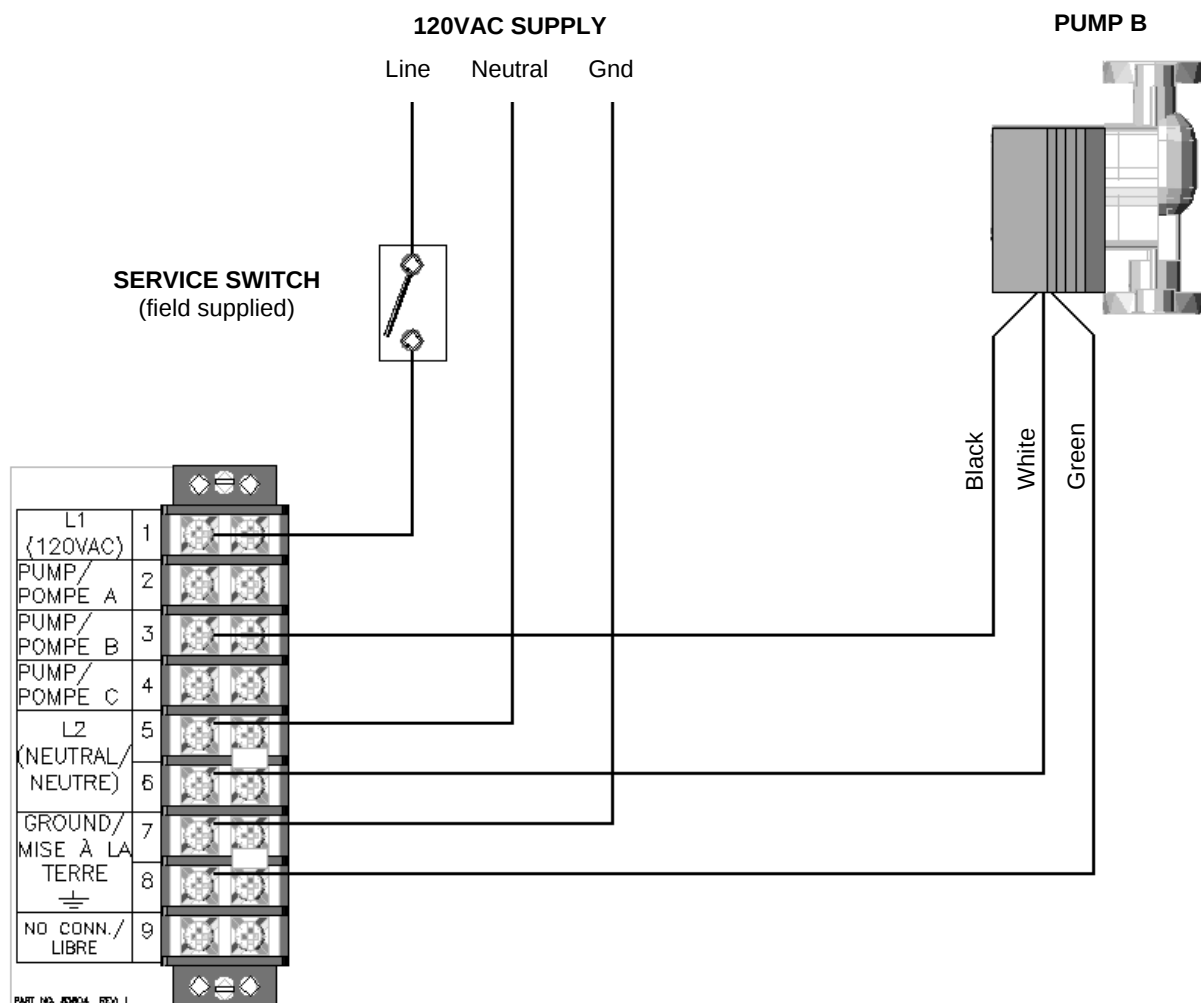


Table 3-1 Line Voltage Field Connections

Connection	Location	Description
L1 (120VAC)	1	120VAC Hot - Location for connecting line voltage of the power supply. Note most installation codes require the installation of a service switch to break line voltage to the appliance.
PUMP A	2	Not used.
PUMP B	3	DHW Demand - Output to the Water Heater Circulator, powered during tank demand.
PUMP C	4	Not used.
L2 (Neutral)	5	120VAC Common - Location for connecting neutral of the power supply and circulator.
	6	
Ground	7	120VAC Ground - Location for connecting ground of the power supply and circulator.
	8	
No Conn.	9	Factory Wiring - This terminal is used only for factory wiring. Do not add or remove wires from this location.

Figure 3-1(b) Lx500-800 Model

Line Voltage Field Wiring

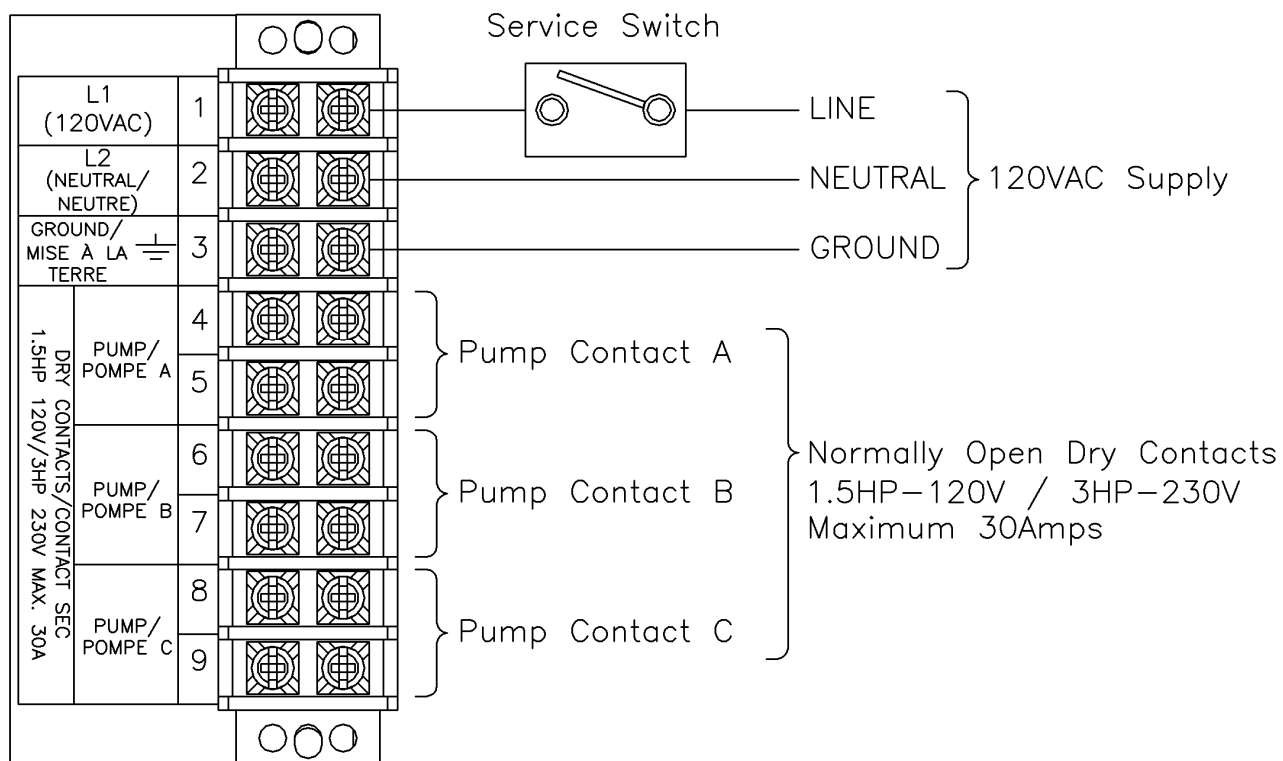


Table 3-1(b) Line Voltage Field Connections (Lx500-800)

Connection		Location	Description
L1 (120VAC)		1	120VAC Hot - Location for connecting line voltage of the power supply. Note most installation codes require the installation of a service switch to break line voltage to the appliance.
L2 (Neutral)		2	120VAC Common - Location for connecting neutral of the power supply and circulator.
Ground		3	120VAC Ground - Location for connecting ground of the power supply and circulator.
Non-Powered Dry Contacts	PUMP A	4	Not used.
		5	
	PUMP B	6	DHW Demand - Dry Contact for Water Heater circulator; Coil B powered during tank demands.
		7	
	PUMP C	8	Not used.
		9	

Low Voltage Connections

The Trinity Lx low voltage junction box is located in the lower left corner of the water heater cabinet on Lx200 models and can be accessed by removing the front door of the water heater, followed by the removal of the low voltage junction box cover. On Lx300 and Lx400 models, the low voltage junction box is located at the top of the water heater cabinet on the left hand side and can be accessed by removing the top front cover of the water heater. The water heater is provided with one hole and two knockouts for routing field wiring into the low voltage junction box. Low voltage field connections identified in Table 3-2 to be read in conjunction with Figure 3-2 for stand alone water heaters and Figures 3-3 for multiple water heater applications.

Table 3-2 Low Voltage Field Connections

Connection		Location	Description
COM (24VAC)		1	24VAC Common – Neutral for the 24VAC power supply within the water heater.
R (24VAC)		2	24VAC Hot - Power supply for inputs LIM, CH1, and CH2 (LL).
		3	
LIM		4	External Limit – Input requiring 24VAC from terminal R to permit the burner to operate. Comes factory equipped with a jumper to the R terminal. Remove the factory installed jumper and install the normally open isolated contacts of the field supplied Safety Flow Switch.
CH1 *		5	Local Central Heat Demand – Input requiring 24VAC from terminal R to initiate a “local” CH call. Switch is made using an isolated end switch (dry contact) via thermostat, zone controller or other device. Typically used with boilers. * Not applicable for Water Heater Applications.
CH2 (LL)		6	Lead-Lag Central Heat (DHW) Demand – Input requiring 24VAC from terminal R to initiate a “lead-lag” DHW call. Switch is made using an isolated end switch (dry contact) via the storage tank thermostat (aquastat). Typically used as a lead-lag input for cascaded water heaters, where the LL central heat settings are used as the LL DHW settings.
Sensor	DHW	7	DHW Tank Demand – Input requiring closure of terminals 7 and 10 to initiate a demand for DHW. Switch made via isolated end switch (dry contact) from the storage tank thermostat (aquastat).
	OD SENSOR *	8	Outdoor Temperature Sensor – A wall mountable OD Sensor is included with each unit. Typically used with boilers. * Not applicable for Water Heater Applications.
	SYSTEM *	9	System Water Temperature – A strap-on System Sensor is included with each appliance. Typically used with boilers. * Not applicable for Water Heater Applications.
	SENSOR COM	10	System Common – Common port for field inputs DHW, OD Sensor and System Sensor.
4-20mA		11	External Modulation Control – Using a 4-20mA signal, an external control can be used to directly modulate the burner firing rate or adjust the active set point. This can be useful for applications using external staging controls or Building Automation Systems.
		12	
Communications	DATA +	13	Remote Display – Terminals 13 through 16 can be used to connect a second user interface remotely.
	12VDC	14	
	COM	15	Lead-Lag – Terminals 13, 15 and 16 can be "daisy-chained" to multiple water heaters (up to 8 total) for the purpose of staging.
	DATA -	16	
ALARM		17	Normally Open Alarm Contacts – Contacts close during a lockout or other alarm condition. May be connected to a BMS, maximum capacity of 0.63Amps at 24VAC.
		18	

* Asterisk indicates connection not used or applicable for Water Heater Applications. See descriptions in Table 3-2.

Table 3-2(b) Low Voltage Field Connections (Lx500-800)

Connection		Location	Description
COM (24VAC)		1	24VAC Common – Neutral for the 24VAC power supply within the water heater.
R1/R2 (24VAC)		2	24VAC Hot - Power supply for inputs EXT. LIM, CH1, and CH2 (LL).
		3	
EXT. LIM		4	External Limit – Input requiring 24VAC from terminals R1/R2 to permit the burner to operate. Comes factory equipped with a jumper to the R2 terminal. For installations requiring the use of an additional safety switch, such as a LWCO or auxiliary temperature limit, remove the factory installed jumper and install the normally open isolated contacts of the field supplied additional limit in place of jumper. Flow Switch factory installed and prewired in series with EXT LIMIT jumper.
GAS LO PR.		5	Gas Low Pressure Switch (Optional) – Comes factory equipped with a jumper. For applications requiring a Low Gas Pressure Switch, remove jumper and connect normally open isolated contacts of the Gas Low Pressure Switch. Switch must be installed external to unit (24VAC circuit). For preapproved High Gas Pressure Switch, see Note 1 below.
		6	
AUX. PROOF		7	Auxiliary Proof – Comes factory equipped with a jumper. For applications using Indoor Combustion Air (Lx500-800 only), remove jumper and replace with field supplied end switch incorporated with motorized damper/louver control.
		8	
CH1 *		9	Local Central Heat Demand – Input requiring 24VAC from terminal R to initiate a “local” CH call. Switch is made using an isolated end switch (dry contact) via thermostat, zone controller or other device. Typically used with boilers. * Not applicable for Water Heater Applications.
CH2 (LL)		10	Lead-Lag Central Heat (DHW) Demand – Input requiring 24VAC from terminal R to initiate a “lead-lag” DHW call. Switch is made using an isolated end switch (dry contact) via the storage tank thermostat (aquastat). Typically used as a lead-lag input for cascaded water heaters, where the LL central heat settings are used as the LL DHW settings.
Sensor	DHW	11	DHW Tank Demand – Input requiring closure of terminals 11 and 14 to initiate a demand for DHW. Switch made via isolated end switch (dry contact) from the storage tank thermostat (aquastat).
	OD / SYS SENSOR *	12	Outdoor Temperature Sensor – A wall mountable OD Sensor is included with each unit. Typically used with boilers. * Not applicable for Water Heater Applications. System Water Temperature – A strap-on System Sensor is included with each appliance. Typically used with boilers. * Not applicable for Water Heater Applications.
	TOD	13	Time of Day (Night Time Setback) – Input requiring closure of terminals 13 and 14 to initiate TOD setback setting. Switch is made using an isolated end switch (dry contact) using a timer, BAS or other device.
	SENSOR COM	14	System Common – Common port for field inputs DHW, OD Sensor and System Sensor.
4-20mA (– / +)		15	External Modulation Control – Using a 4-20mA signal, an external control can be used to directly modulate the burner firing rate or adjust the active set point. This can be useful for applications using external staging controls or Building Automation Systems.
		16	
Communications	DATA +	17	Remote Display – Terminals 17 through 20 can be used to connect a second user interface remotely.
	12VDC	18	
	COM	19	Lead-Lag – Terminals 17, 19 and 20 can be "daisy-chained" to multiple water heaters (up to 8 total) for the purpose of staging.
	DATA –	20	
ALARM (A & B)		21	Normally Open Alarm Contacts – Contacts close during a lockout or other alarm condition. May be connected to a BMS, maximum capacity of 0.63Amps at 24VAC.
		22	
Notes ¹ For applications requiring a High Gas Pressure Switch, see supplemental instructions included with NTI High Gas Pressure Switch Kit, P/N 84094. Note that this is the only High Gas Pressure Switch that has been tested with the unit and preapproved for field installation within the appliance cabinet. * Asterisk indicates connection not used or applicable for Water Heater Applications. See descriptions in Table 3-2.			

Single DHW Input (DHW) - Terminal DHW in combination with Sensor COM is used as the DHW demand call for single or stand-alone water heater applications. See Figure 3-2 for low voltage field wiring schematic.

Multiple DHW Input [CH2 (LL)] - Terminal CH2 (LL) in combination with R (24VAC) is used in lead-lag applications as the DHW demand call for multiple water heater applications. See Figure 3-3 for low voltage field wiring schematic.

IMPORTANT

CH2 (LL) Input - To use CH2 (LL) for staging water heaters, Master enable must be set to "Enabled". See "Lead Lag Master Configuration" in Appendix A.

IMPORTANT

Modbus Address - In a multiple water heater Lead Lag cascaded installation, each controller's Modbus Address must be set to a unique value between 1 and 8, inclusive. See "System Identification & Access" in Appendix A for more details.

Modulation Sensor - The temperature sensor used for modulating the water heater firing rate; the controller attempts to make the temperature sensed at the "Modulation Sensor" equal to the programmed set point. See Table 3-3.

CAUTION

Modulation Method - If modulating to return temperature via the Inlet Sensor, lower the maximum CH (DHW) set-point by 20 degrees to prevent temperature overshoot and/or damage to the unit. Failure to follow these instructions will result in higher than anticipated operating temperatures possibly resulting in personal injury or system damage.

Table 3-3 Modulation Sensor Settings

Demand Call	Application	Factory Default	Alternative Sensor	LL Master Configuration
DHW demand	Stand Alone (single)	Outlet Sensor	Inlet Sensor	n/a
CH2 (LL) demand	Lead Lag (multiple)	System Sensor ¹	Outlet Sensor	Enabled ²

Notes:

¹ The system sensor is the factory default, but it is not applicable for Water Heater Applications; therefore, CH2 will automatically modulate to the backup sensor (alternative sensor) if a system sensor is not installed.

² On multiple water heater applications using Lead-Lag [CH2 (LL) input], only the designated Master shall be "Master enabled".

CAUTION

Low Voltage Terminals - Terminals 2 and 3 (R) have 24VAC potential from the internal transformer. Do not connect power from these terminals to any other terminal other than terminals 4, 5 and/or 6 [LIM, CH1, and CH2 (LL)] via an isolated end switch (dry contact). Failure to follow these instructions may damage the unit.

NOTICE

Fuse (24VAC) - Trinity Lx150-400 models are equipped with a "blade style" 2 Amp fuse to protect the internal transformer located within the slide-out control panel box.

Figure 3-2 All Models (Lx150-400 shown)
Low Voltage Field Wiring
(Stand Alone Water Heater Configuration)

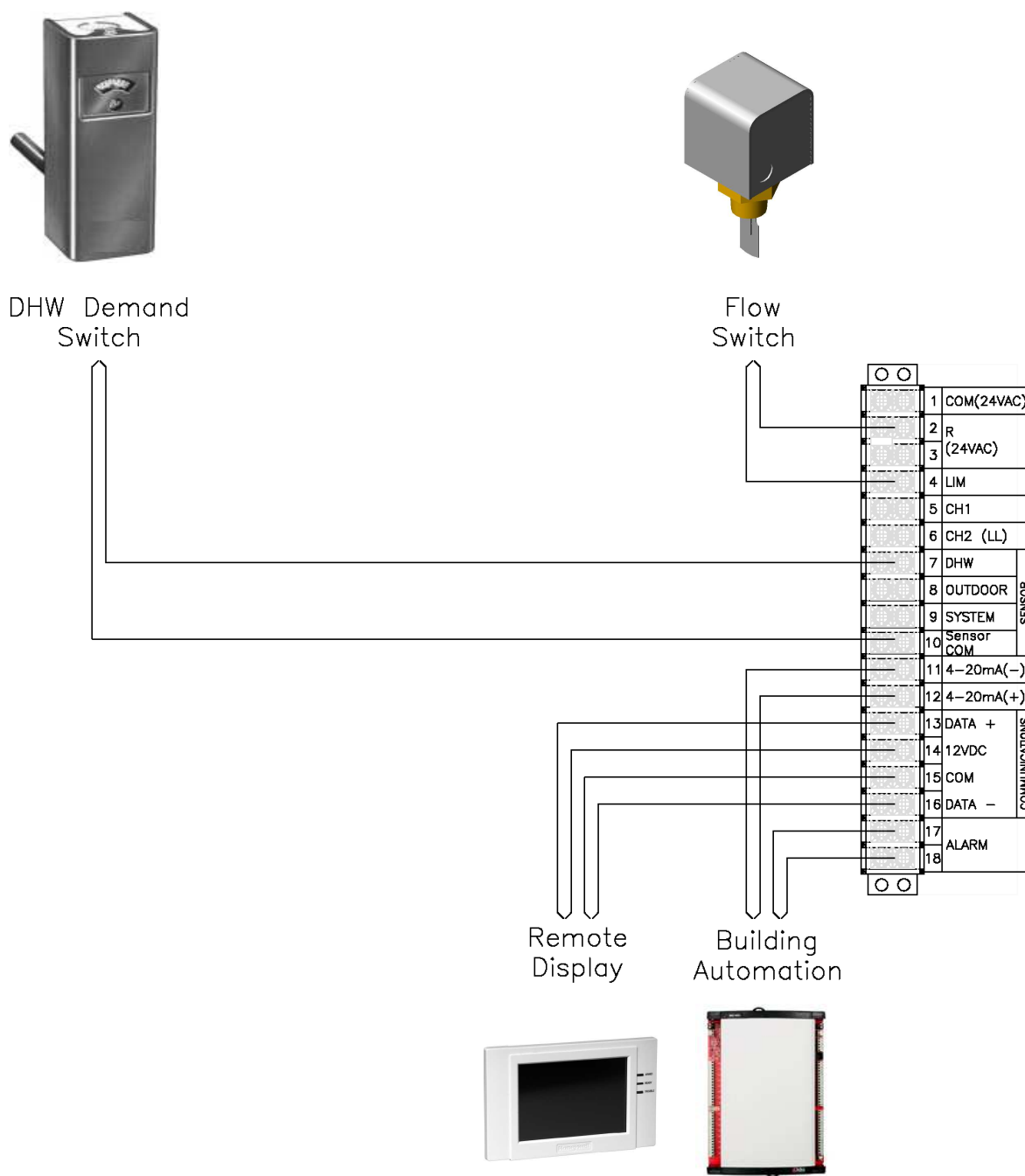
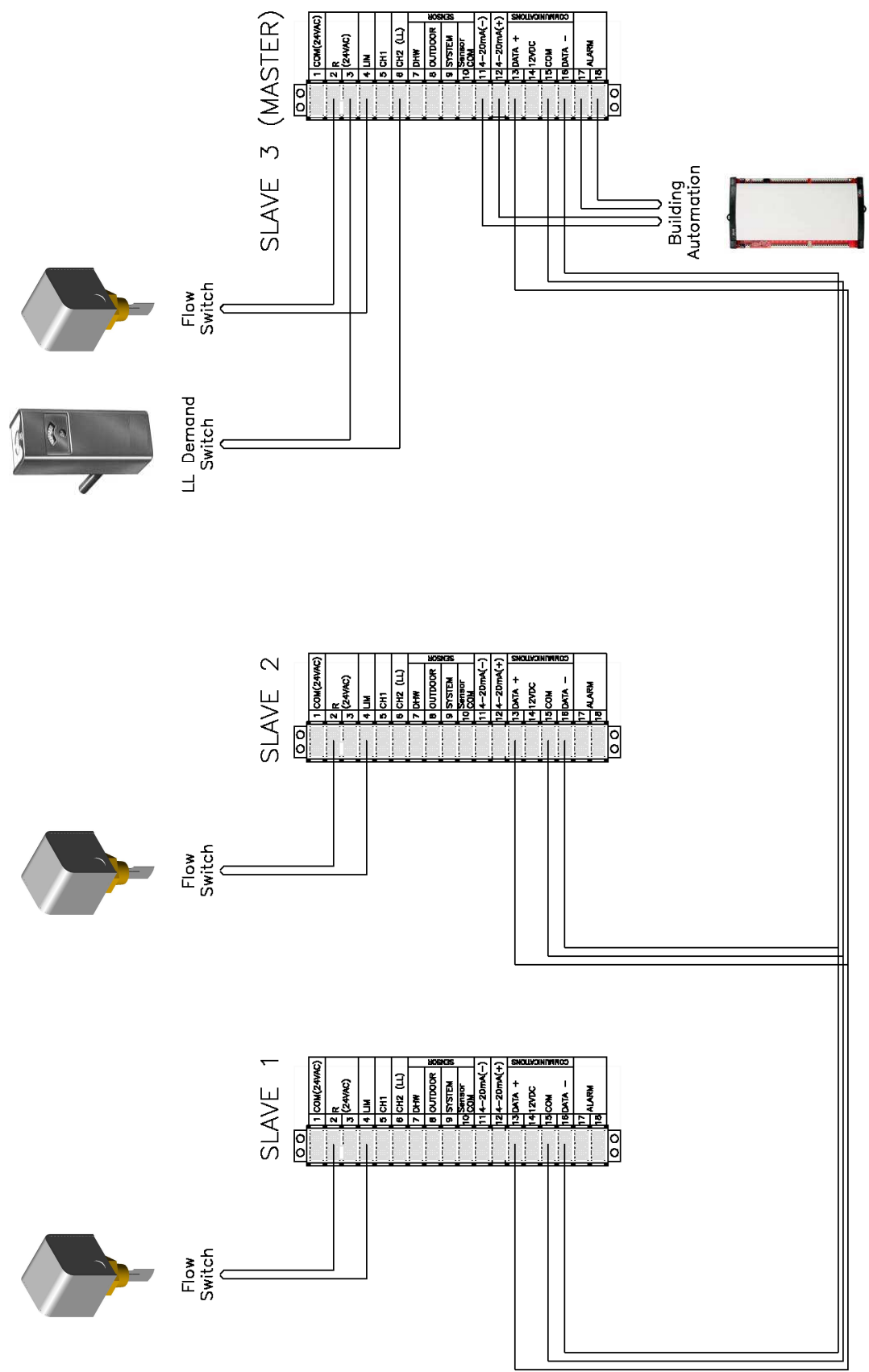


Figure 3-3 All Models (Lx150-400 shown)
Low Voltage Field Wiring
(Multiple Water Heater Lead-Lag Configuration)



NOTES

Lined area for notes.

NOTES

Lined area for notes.



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