LG
Life's Good

MULTI V™ WATER MINI

Installation, Operation & Maintenance Manual

Variable Refrigerant Flow Water Source Units

3.0, 4.0, and 4.4 Tons

Heat Pump 208-230V, 60Hz, 1 Phase

ARWN038GA2 ARWN048GA2 ARWN053GA2

PROPRIETARY DATA NOTICE

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This document is for design purposes only.

Do not throw away, destroy, or lose this manual.

Please read carefully and store in a safe place for future reference.
Content familiarity required for proper installation.

The instructions included in this manual must be followed to prevent product malfunction, property damage, injury, or death to the user or other people. Incorrect operation due to ignoring any instructions will cause harm or damage. The level of seriousness is classified by the symbols described below.

"⚠**WARNING**" *This symbol indicates that the action or lack thereof could possibly cause death or personal injury.*

"⚠**CAUTION**" *This symbol indicates that the action or lack thereof could possibly cause property damage.*

"⚠ ***Note:*** " *This symbol indicates that the action or lack thereof could possibly cause equipment malfunction or failure.*

" " *This symbol indicates that the following action should not be performed.*

A summary list of safety precautions begins on page 4.

For more technical materials such as submittals, engineering databooks, and catalogs, visit www.lg-vrf.com.

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" " *This symbol indicates that the following action should not be performed.*

INSTALLATION

⚠WARNING

Do not install, remove, or re-install the unit by yourself (customer). Ask the dealer or an authorized technician to install the unit.
Improper installation by the user may result in water leakage, fire, explosion, electric shock, physical injury or death.

For replacement of an installed unit, always contact an authorized LG service provider.
There is risk of fire, electric shock, explosion, and physical injury or death.

Do not install the water-source units outside.
There is risk of fire, electric shock, explosion, and physical injury or death.

Be very careful when transporting the product.
- *One person should not carry the product.*
- *Some products use polypropylene bands for packaging. Do not use polypropylene bands to lift the unit.*
- *Suspend the water source unit from the base at specified positions. Support the water source unit a minimum of four points to avoid slippage from rigging apparatus.*

The water source unit is shipped with refrigerant and the service valves closed. Do not open service valves on the water source unit until all non-condensable have been removed from the piping system and authorization to do so has been obtained from the commissioning agent.
There is a risk of equipment damage, refrigerant contamination, refrigerant loss, physical injury or death.

The water source unit is shipped with a refrigerant and service valves closed. Do not run the compressor with the service valves closed.
There is a risk of equipment damage, explosion, physical injury, or death.

Dispose the packing materials safely.
- *Packing materials, such as nails and other metal or wooden parts, may cause puncture wounds or other injuries.*
- *Tear apart and throw away plastic packaging bags so that children may not play with them and risk suffocation and death.*

Install the unit considering the potential for strong winds or earthquakes.
Improper installation may cause the unit to fall over, resulting in physical injury or death.

If the air conditioner is installed in a small space, take measures to prevent the refrigerant concentration from exceeding safety limits in the event of a refrigerant leak.
Consult the latest edition of ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers) Standard 15. If the refrigerant leaks and safety limits are exceeded, it could result in personal injuries or death from oxygen depletion.

Wear protective gloves when handling equipment. Sharp edges may cause personal injury.

Do not install the unit on a defective stand.
It may result in an accident that causes product damage or personal injury or death.

Do not change the settings of the protection devices.
If the pressure switch, thermal switch, or other protection device is shorted and forced to operate improperly, or parts other than those specified by LG are used, there is risk of fire, electric shock, explosion, and physical injury or death.

Do not store or use flammable gas or combustibles near the unit.
There is risk of product failure, fire, explosion, and physical injury or death.

INSTALLATION, CONTINUED

⚠ WARNING

Replace all control box and panel covers.
If cover panels are not installed securely, dust, water and animals may enter the water source unit, causing fire, electric shock, and physical injury or death.

Install the unit in a safe location where nobody can step on or fall onto it.
There is risk of unit damage, physical injury or death.

Always check for system refrigerant leaks after the unit has been installed or serviced.
Low refrigerant levels may cause product failure, and exposure to high concentration levels of refrigerant gas may lead to illness or death.

⚠ CAUTION

Keep the unit upright during installation.
To avoid vibration or water leakage.

When installing the water source unit in a low-lying area, or a location that is not level, use a raised concrete pad or concrete blocks to provide a solid, level foundation.
This may prevent water damage and reduce abnormal vibration.

Properly insulate all cold surfaces to prevent "sweating."
Cold surfaces such as uninsulated piping can generate condensate that may drip and cause a slippery floor condition and / or water damage to walls.

When installing the unit in a hospital, data center, or similar electromagentic field (EMF) sensitive environment, provide sufficient protection against electrical noise.
Inverter equipment, power generators, high-frequency medical equipment, or radio communication equipment may cause the air conditioner to operate improperly. The unit may also affect such equipment by creating electrical noise that disturbs medical treatment or image broadcasting.

Do not use the product for special purposes such as preserving foods, works of art, wine coolers, or other precision air conditioning applications. The equipment is designed to provide comfort cooling and heating.
There is risk of property damage.

⚠ *Note:*

Do not make refrigerant substitutions. Use R410A only.
If a different refrigerant is used, or air mixes with original refrigerant, the unit will malfunction and be damaged.

When connecting refrigerant tubing, remember to allow for pipe expansion.
Improper piping may cause refrigerant leaks and system malfunction.

Do not install the water source unit in a noise sensitive area.

Take appropriate actions at the end of HVAC equipment life to recover, recycle, reclaim or destroy R410A refrigerant according to applicable U.S. Environmental Protection Agency (EPA) rules.

WIRING

⚠ WARNING

The information contained in this manual is intended for use by an industry-qualified, experienced, certified electrician familiar with the U.S. National Electric Code (NEC) who is equipped with the proper tools and test instruments.
Failure to carefully read and follow all instructions in this manual can result in equipment malfunction, property damage, personal injury or death.

All electric work must be performed by a licensed electrician and conform to local building codes or, in the absence of local codes, with the National Electrical Code, and the instructions given in this manual.
If the power source capacity is inadequate or the electric work is not performed properly, it may result in fire, electric shock, physical injury or death.

High voltage electricity is required to operate this system. Adhere to the NEC code and these instructions when wiring.
Improper connections and inadequate grounding can cause accidental injury or death.

Always ground the unit following local, state, and NEC codes.
There is risk of fire, electric shock, and physical injury or death.

Properly size all circuit breakers or fuses.
There is risk of fire, electric shock, explosion, physical injury or death.

Refer to local, state, and federal codes, and use power wires of sufficient current capacity and rating.
Wires that are too small may generate heat and cause a fire.

Secure all field wiring connections with appropriate wire strain relief.
Improperly securing wires will create undue stress on equipment power lugs. Inadequate connections may generate heat, cause a fire and physical injury or death.

Properly tighten all power lugs.
Loose wiring may overheat at connection points, causing a fire, physical injury or death.

Do not change the settings of the protection devices.
If the pressure switch, thermal switch, or other protection devices are bypassed or forced to work improperly, or parts other than those specified by LG are used, there is risk of fire, electric shock, explosion, and physical injury or death.

Turn the power off at the nearest disconnect before servicing the equipment.
Electrical shock can cause physical injury or death.

⚠ *Note:*

Do not supply power to the unit until all installation and pre-commissioning tasks are complete and the commissioning agent indicates it is safe to do so.

OPERATION

⚠ WARNING

Do not allow water, dirt, or animals to enter the unit.
There is risk of unit failure, fire, electric shock, physical injury or death.

Do not provide power to or operate the unit if it is flooded or submerged.
There is risk of fire, electric shock, physical injury or death.

Use a dedicated outlet for this product.
There is risk of fire, electric shock, physical injury or death.

Do not operate the disconnect switch with wet hands.
There is risk of fire, electric shock, physical injury or death.

Periodically verify the equipment mounts have not deteriorated.
If the base collapses, the unit could fall and cause property damage, product failure, physical injury or death.
Do not touch the refrigerant piping during or after operation.
It can cause burns or frostbite.

Do not operate the unit with the panel(s) or protective cover(s) removed; keep fingers and clothing away from moving parts.
The rotating, hot, cold, and high-voltage parts of the unit can cause physical injury or death.

If gas leaks out, ventilate the area before operating the unit.
Leaking gas may cause fire, electric shock, explosion, physical injury or death if the water source unit is mounted in an enclosed, low-lying, or poorly ventilated area and the system develops a refrigerant leak.

To avoid physical injury, use caution when cleaning or servicing the air conditioner.

The water source unit is shipped with refrigerant and the service valves closed. Do not open service valves on the water source unit until all non-condensable have been removed from the piping system and authorization to do so has been obtained from the commissioning agent.
There is a risk of equipment damage, refrigerant contamination, refrigerant loss, physical injury or death.

The water source unit is shipped with a refrigerant and service valves closed. Do not run the compressor with the service valves closed.
There is a risk of equipment damage, explosion, physical injury, or death.

⚠ CAUTION

Do not use this equipment in mission critical or special-purpose applications such as preserving foods, works of art, wine coolers or refrigeration. The equipment is designed to provide comfort cooling and heating.
Oil, steam, sulfuric smoke, etc., can significantly reduce the performance of the unit, or damage its parts.

Do not turn off the main power switch after operation has been stopped.
Wait at least five (5) minutes before turning off the main power switch, otherwise it may result in product malfunction.

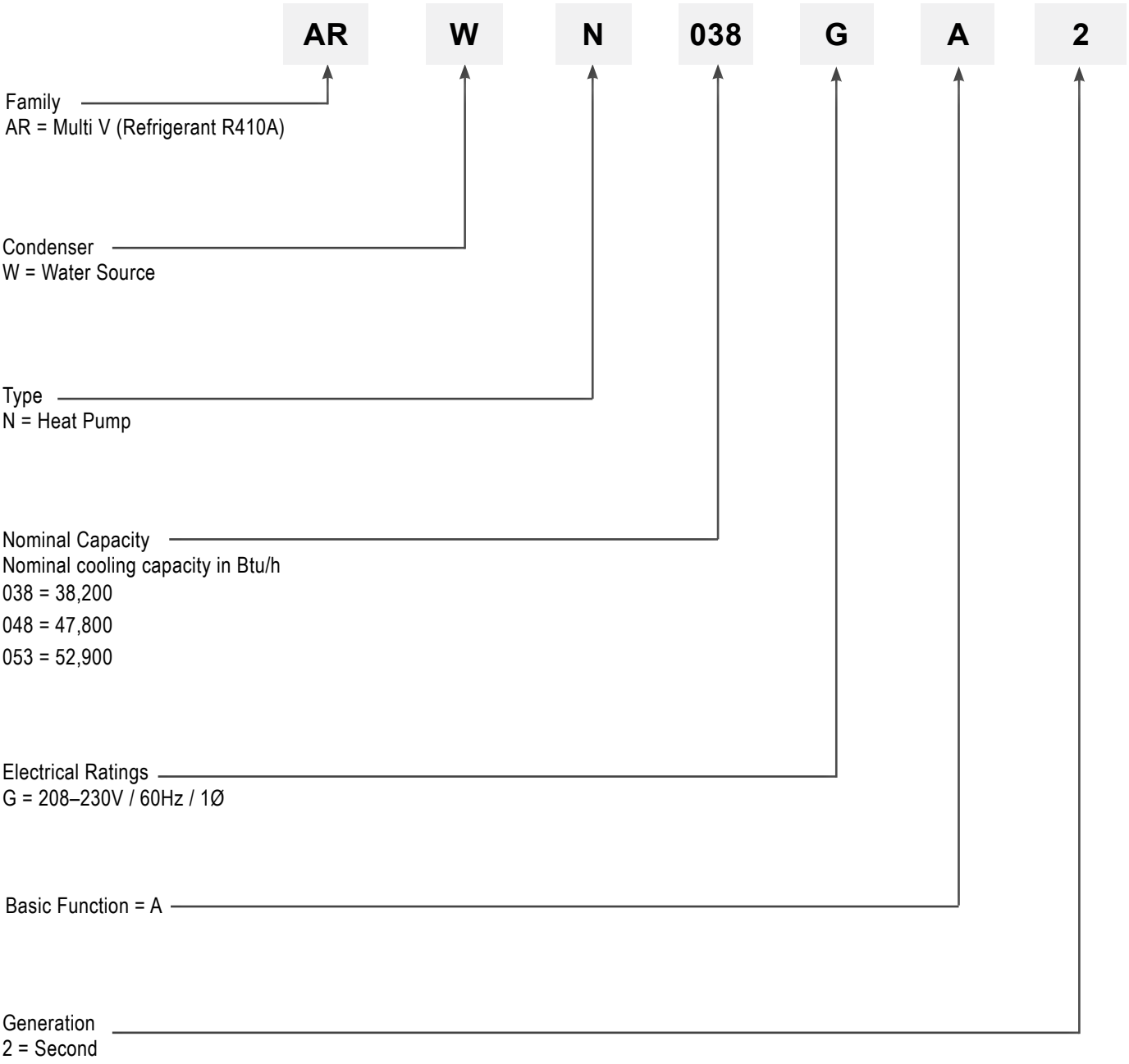
Provide power to the compressor crankcase heaters at least six (6) hours before operation begins.
Starting operation with a cold compressor sump(s) may result in severe bearing damage to the compressor(s). Keep the power switch on during the operational season.

Clean up the site after servicing is finished, and check that no metal scraps, screws, or bits of wiring have been left inside or surrounding the unit.

UNIT NOMENCLATURE

Water Mini Unit

Water Source Units (WSU)



GENERAL DATA

Water Mini Unit Specifications and Electrical Data

Table 1: General Data—ARWN038GA2, ARWN048GA2, ARWN053GA2 Water Mini Units.

	3.0 Ton	4.0 Ton	4.4 Ton
Model Number	ARWN038GA2	ARWN048GA2	ARWN053GA2
Nominal Capacity / Input Power			
Cooling Capacity (Btu/h)[1]	38,200	47,800	52,900
Cooling Input Power (kW)	2.1	2.7	3.2
Heating Capacity (Btu/h)[1]	42,600	54,600	61,400
Heating Input Power (kW)	2.2	2.9	3.5
Compressor			
Type	Inverter Rotary	Inverter Rotary	Inverter Rotary
Power Supply (volt/hz/phase)[2]	208-230 / 60 / 1	208-230 / 60 / 1	208-230 / 60 / 1
MCA (A)	26	26.5	27
MOP (A)	45	45	45
System Data			
Sound Pressure (dBA)[3]	52	53	54
Heat Rejected to Equipment Room (Btu/h)	512	512	512
Net Weight (lbs)	168	168	168
Shipping Weight (lbs)	181	181	181
Dimensions (W x H x D)	20-5/8 x 42-1/2 x 13-1/8	20-5/8 x 42-1/2 x 13-1/8	20-5/8 x 42-1/2 x 13-1/8
Max. Qty Indoor Units	6	8	9
Refrigerant Piping Connections[4]			
Vapor Line OD (in)	3/4 Braze	3/4 Braze	3/4 Braze
Liquid Line OD (in)	3/8 Braze	3/8 Braze	3/8 Braze
Expansion Device	Electronically Controlled (EEV)	Electronically Controlled (EEV)	Electronically Controlled (EEV)
Factory Refrigerant Charge (R410A [lbs])	2.2	2.2	2.2
Water Side			
Heat Exchanger	Stainless Steel Plate	Stainless Steel Plate	Stainless Steel Plate
Water Volume in Heat Exchanger (gal.)	0.2	0.2	0.2
Water Inlet/Outlet Connection Size (in)	1-1/4 FPT	1-1/4 FPT	1-1/4 FPT
Nominal Flow Rate Total (GPM)	10.6	13.2	15.9
Range of Flow (GPM)	5.5-13.3	6.9-16.5	8.3-19.9
Entering water temp. range (°F)– Cooling	50-113	50-113	50-113
Entering water temp. range (°F)– Heating	23-113	23-113	23-113
Total Heat of Rejection (Btu/h)	44,330	55,550	56,640
Total Heat of Absorption (Btu/h)	35,087	44,697	49,448
Pressure Drop (ft)	4.7	6.9	9.5
Maximum Water Pressure (psi)	640	640	640
ΔT (°F)[5]	8	8	7

[1]Cooling – Indoor 80°F DB/66°F WB, Water Temp. Entering 86°F; Heating- Indoor 68°F DB, Water Temp. Entering 68°F.

[2]Voltage tolerance is ±10%.

[3]Sound pressure levels as tested in anechoic chamber under ISO Standard 3745.

[4]Refer to the Refrigerant Piping Section of this manual for correct line sizing. Contractor MUST use LG manufactured Y-branch fittings only. Designer must verify refrigerant piping design configuration using LG's computerized refrigerant piping CAD/calculation (LATS) Software to layout and design the refrigerant piping system.

[5]Calculated from ΔT = Total Heat of Rejection / (Nominal flow rate x 500).

Table 2: 208-230V, 60Hz, 1-Phase Water Mini Unit Electrical Characteristics.

Nominal Tons	Unit Model No.	Compressor Qty.	Compressor Motor RLA	MSC	MCA	MOP
3.0	ARWN038GA2	1	20.8	-	26	45
4.0	ARWN048GA2	1	21.2	-	26.5	45
4.4	ARWN053GA2	1	21.6	-	27	45

MCA = Minimum Circuit Ampacity.

MOP = Maximum Overcurrent Protection is calculated as follows: (Largest motor FLA x 2.25) + (Sum of other motor FLA) rounded down to the nearest standard fuse size.

Allowable voltage range is between 208–230 volts only (tolerance is 10%).

Maximum allowable voltage imbalance is 2%.

Power wiring to be sized to meet local or NEC codes.

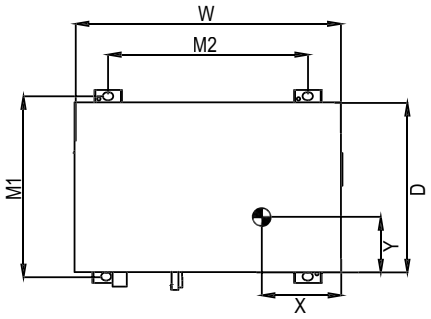
Measurements are taken with no attenuation and units operating at full load nominal operating condition.

Measurements are taken 4.9 feet above the finished floor and a distance of 3.3 feet from the face of the fan discharge.

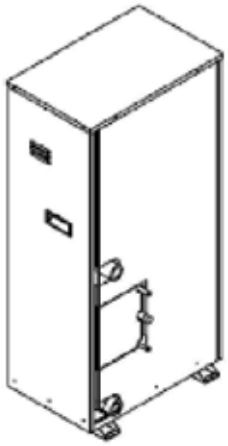
DIMENSIONS

ARWN038GA2, ARWN048GA2, ARWN053GA2

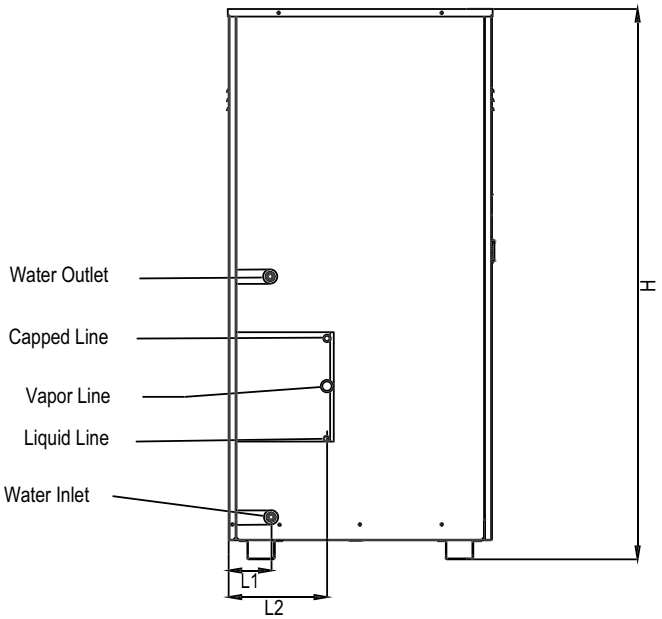
Figure 1: ARWN038GA2, ARWN048GA2, ARWN053GA2 Dimensions.



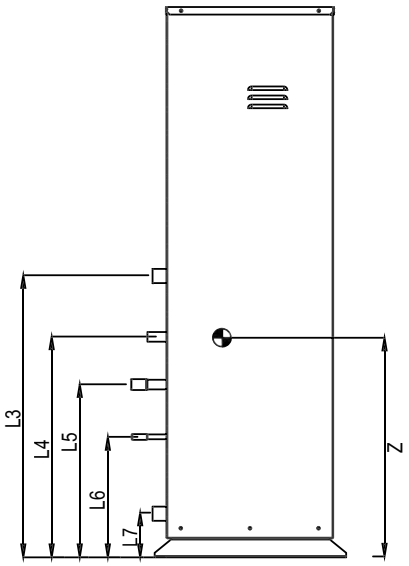
Top View



Isometric



Front View

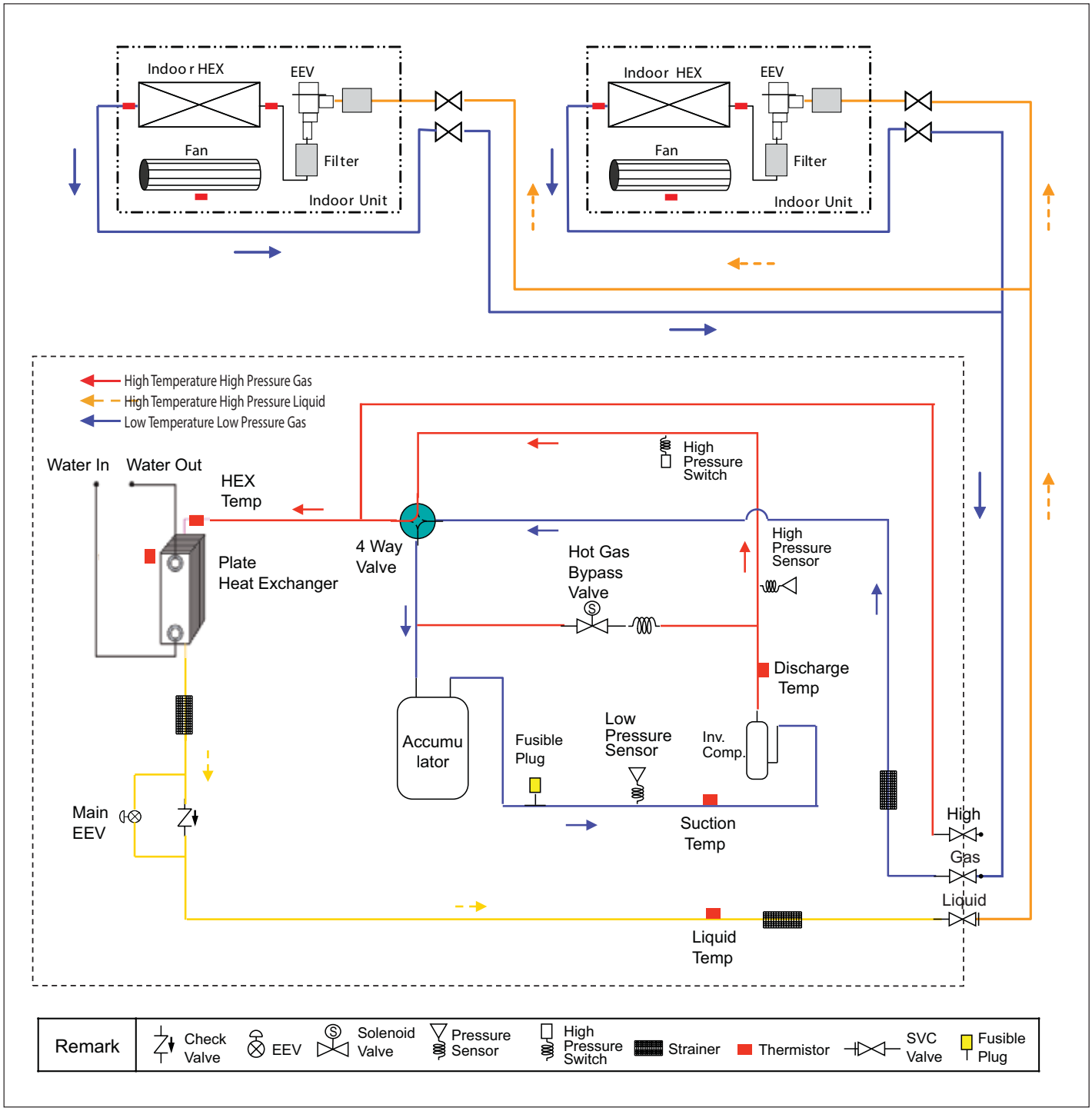


Side View

W	20-5/8″
D	13-1/8″
H	42-1/2″
L1	3-5/16″
L2	7-5/8″
L3	21-13/16″
L4	17-1/16″
L5	13-5/8″
L6	9-5/16″
L7	3-7/16″
L8	23-11-16″
M1	13-15/16″
M2	15-1/4

X	8-5/16″
Y	4-7/16
Z	15-7/8

Figure 2: ARWN038GA2, ARWN048GA2, ARWN053GA2—Cooling Mode.



REFRIGERANT FLOW DIAGRAMS

MULTI V WATER MINI

Heating Mode

ARWN038GA2, ARWN048GA2, ARWN053GA2

Figure 3: ARWN038GA2, ARWN048GA2, ARWN053GA2—Heating Mode.

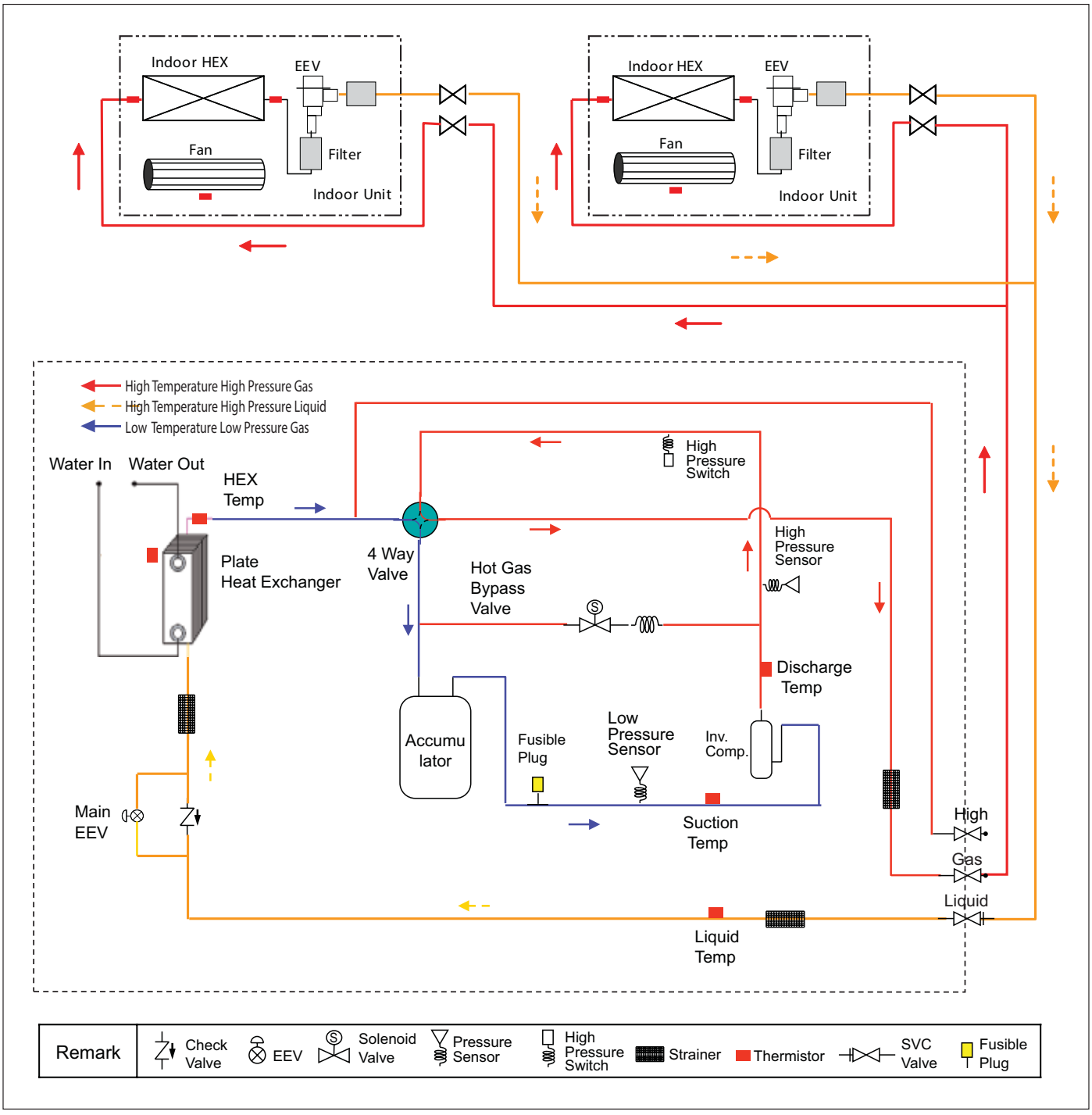


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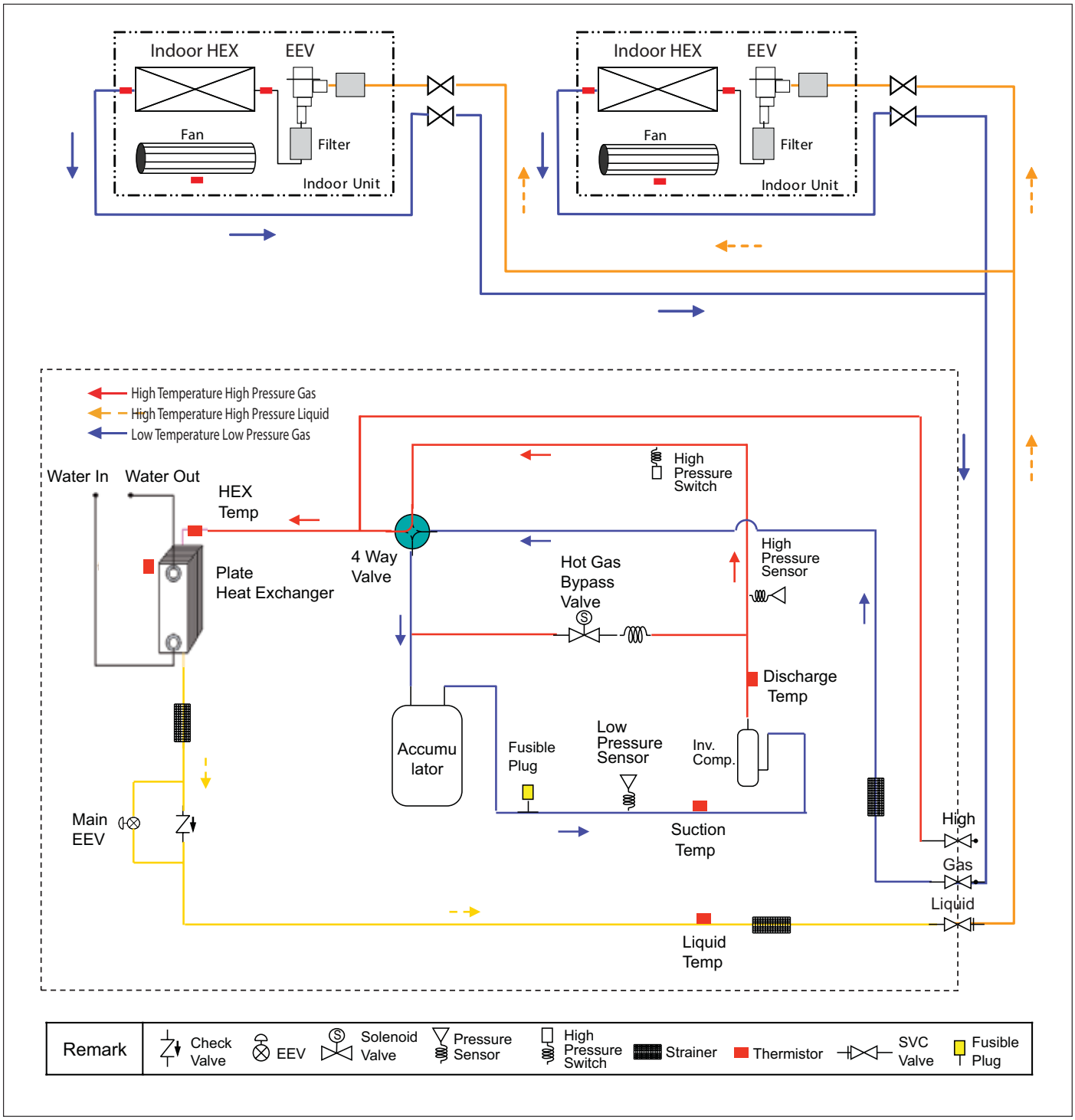
Figure 4: ARWN038GA2, ARWN048GA2, ARWN053GA2—Oil Return.

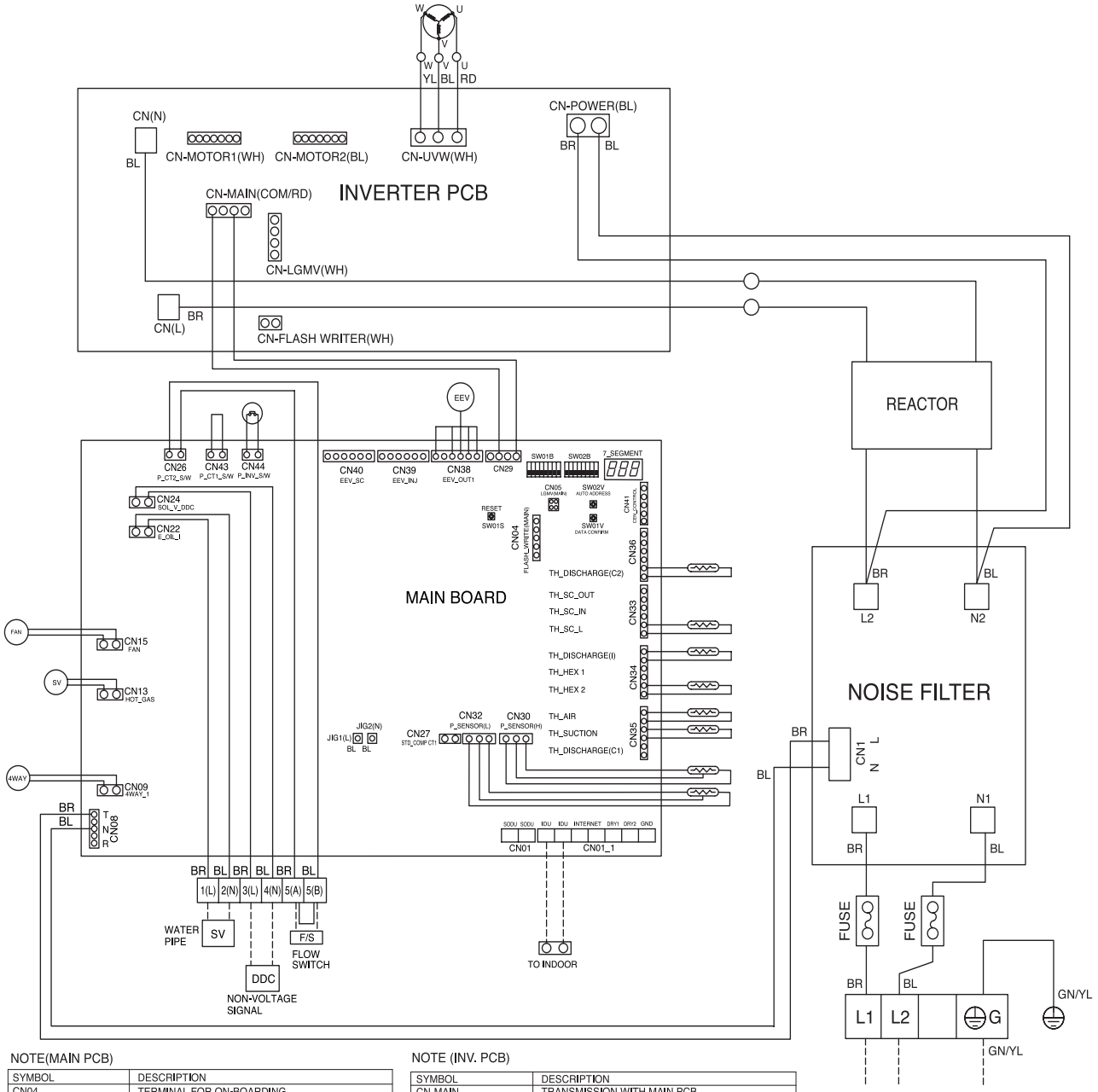


WIRING DIAGRAM

ARWN038GA2, ARWN048GA2, ARWN053GA2

MULTI V WATER MINI

Figure 5: ARWN038GA2, ARWN048GA2, ARWN053GA2 Wiring Diagram.



NOTE(MAIN PCB)

SYMBOL	DESCRIPTION
CN04	TERMINAL FOR ON-BOARDING
CN05	TERMINAL FOR LGMV JIG
CN08	AC POWER
CN09	4WAY REVERSING VALVE
CN10	INVERTER COMP CRANK HEATER
CN13	HOT GAS BYPASS VALVE
CN15	AC POWER TO FAN
CN29	TRANSMISSION WITH INVERTER PCB
CN30	HIGH PRESSURE SENSOR
CN32	LOW PRESSURE SENSOR
SW01S	RESET BUTTON
SW02V	AUTO ADDRESSING BUTTON
CN33(SC_L)	SUBCOOLING LIQUID PIPE THERMISTOR
CN34(DIACHARGE(I))	INVERTER COMP. DISCHARGE PIPE THERMISTOR
CN34(HEX1)	CONDENSOR PIPE THERMISTOR 1
CN35(AIR)	OUTDOOR AIR THERMISTOR
CN35(SUCTION)	SUCTION PIPE THERMISTOR
CN36(DIACHARGE(C2))	TH_WATER
CN38	ELECTRIC EXPANSION VALVE(MAIN)
CN40	ELECTRIC EXPANSION VALVE(SUBCOOLING)
CN41	TERMINAL FOR CENTRAL CONTROL UNIT
CN44	INV. COMP. HIGHT PRESSURE SWITCH

NOTE (INV. PCB)

SYMBOL	DESCRIPTION
CN-MAIN	TRANSMISSION WITH MAIN PCB
CN-FLASH-WRITER	TERMINAL FOR ON-BOARDING
CN-POWER	AC POWER
CN-LGMV	TERMINAL FOR LGMV JIG
CN-UVW	TERMINAL FOR L U.V.W OUTPUT
CN(L)	LIVE INPUT
CN(N)	NEUTRAL INPUT
CN-MOTOR1	TRANSMISSION & POWER INPUT OF FAN MOTOR1
CN-MOTOR2	TRANSMISSION & POWER INPUT OF FAN MOTOR2

COLOR

SYMBOL	RD	BL	WH	BK	BR	YL	GY	GN/YL
COLOR	RED	BLUE	WHITE	BLACK	BROWN	YELLOW	GRAY	GREEN/YELLOW

NOTES

1. THIS WIRING DIAGRAM IS APPLIED ONLY TO THE MAIN CONTROL BOX.
2. – – – – – – – – – – – – : FIELD WIRING

LG

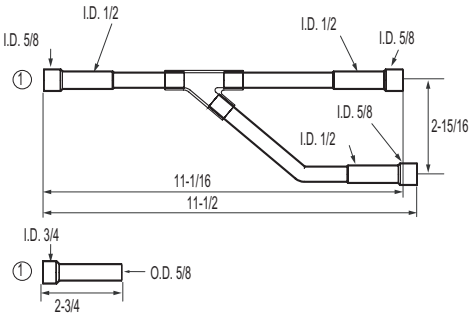
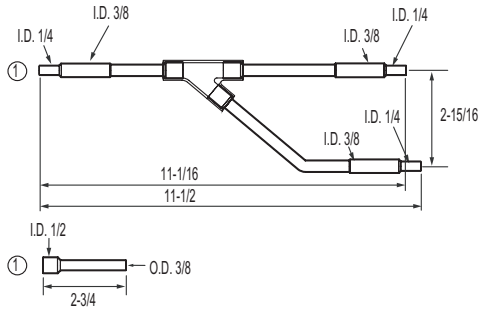
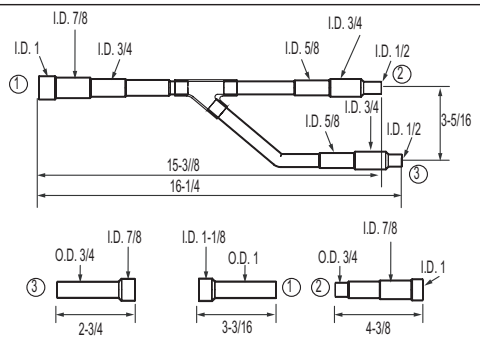
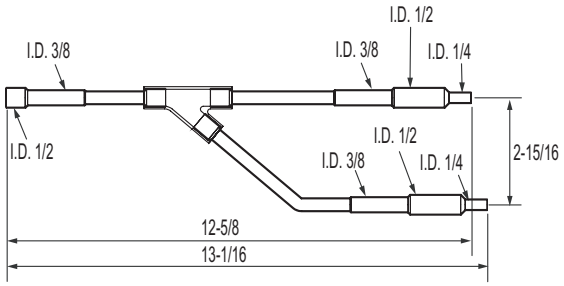
Table 4: Required Accessories.

Required Accessories	Model No.		
Y-branches (for indoor unit connection)	ARBLN01621		
	ARBLN03321		
Headers (for indoor unit connection)	Four (4) branch	Seven (7) branch	Ten (10) branch
	ARBL054	ARBL057	ARBL1010
	ARBL104	ARBL107	ARBL2010

Y-branches (for indoor unit connection)

Table 3: Y-branch Table.

Unit: Inch

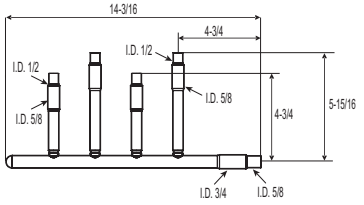
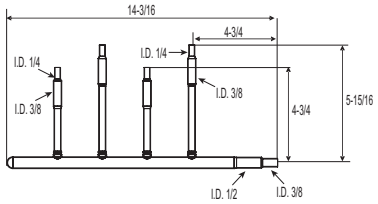
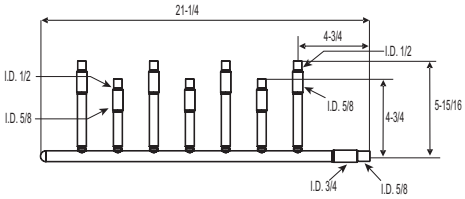
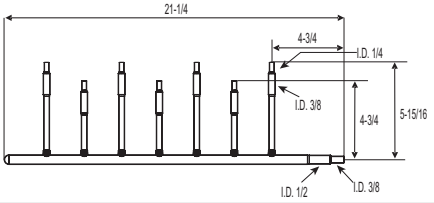
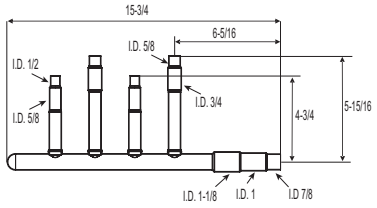
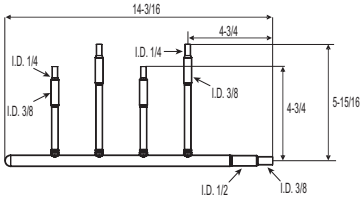
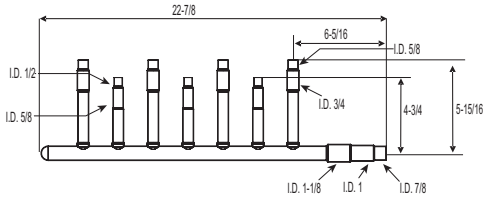
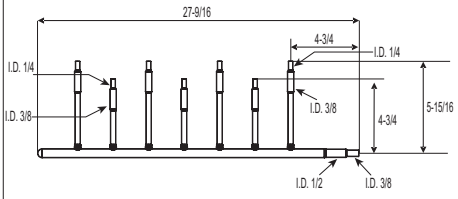
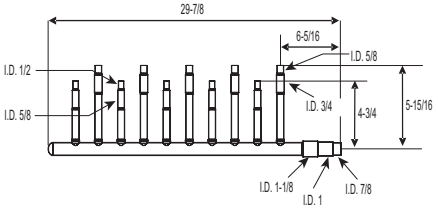
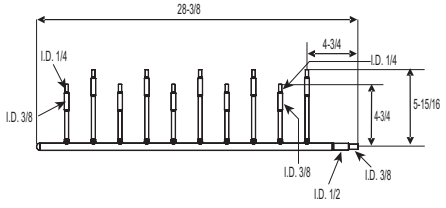
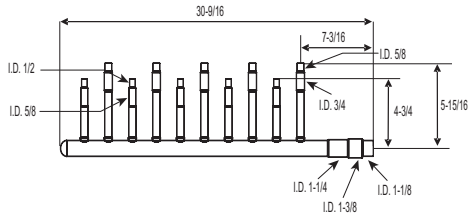
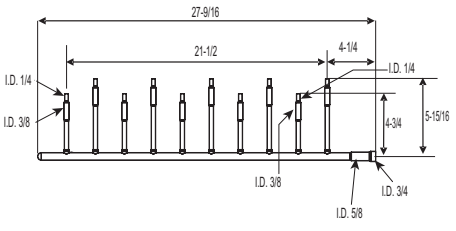
Models	Vapor pipe	Liquid pipe
ARBLN01621		
ARBLN03321		

Product Data

Headers (for indoor unit connection)

Table 5: Header Table.

Unit: Inch

Models	Vapor pipe	Liquid pipe
4 branch ARBL054		
7 branch ARBL057		
4 branch ARBL104		
7 branch ARBL107		
10 branch ARBL1010		
10 branch ARBL2010		

Selecting the Best Location

The water source unit must be installed indoors in a mechanical room. The mechanical room must be designed such that equipment vibration or noise does not affect surrounding rooms, and is properly ventilated or conditioned to maintain an acceptable ambient temperature range between 32°F and 104°F. Mechanical room temperature is required to be maintained between 32°F and 104°F. The water source unit will reject heat to the mechanical room. See the “General Data” on page 9 for the amount of heat rejected to the equipment room.

- The water source unit must also be located where the refrigerant pipe system is designed within the piping limitations set forth in the Water Mini Engineering Manual. Location of the water source unit should be strategically located in the building to minimize refrigerant piping materials, labor, and refrigerant.

- The underlying structure or foundation must be designed per local codes and support the weight of the unit. Units can be stacked above each other as long as each water source unit is independently supported. Minimum clearances must be maintained either per recommendations shown in Figures 2 and 3 or local codes, whichever is greater. Include enough space in the installation area for service access (refer to the installation space requirements).

- The mechanical room floor should be made waterproof. Periodic flushing of the water heat exchanger will be required, and a floor drain installed nearby the equipment will help facilitate this maintenance.

- The water-source unit should be installed with a closed-loop water system. If an open-loop system is used, it is recommended that an intermediate heat exchanger be installed.

- When piping, towers, or other system components that contain water and are exposed to ambient air temperatures below 32°F, an anti-freeze solution must be used. Frozen water will damage the plate heat exchanger. A typical antifreeze solution consists of a proper mixture of ethylene glycol, propylene glycol, or methanol mixed with water. The designer should also consider the use of a supplemental boiler / heater to maintain minimum temperatures.

⚠ ***Note:***

Avoid exposing the water-source unit to oil, steam, combustible gases, acidic solutions or sprays, carbon fiber, sulfur, or other corrosive gases. Avoid exposure to electromagnetic waves from EMF radiating machinery such as generators, MRI equipment, or other equipment that emits electromagnetic energy. The control system may be affected by electromagnetic energy, which may result in abnormal system operation. Also, the inverter components in the water source units may generate electromagnetic noise, therefore, ensure the water-source unit is placed at an acceptable distance from computer, audio, and other sensitive electronic equipment. Route power wiring and communications cables in separate conduits.

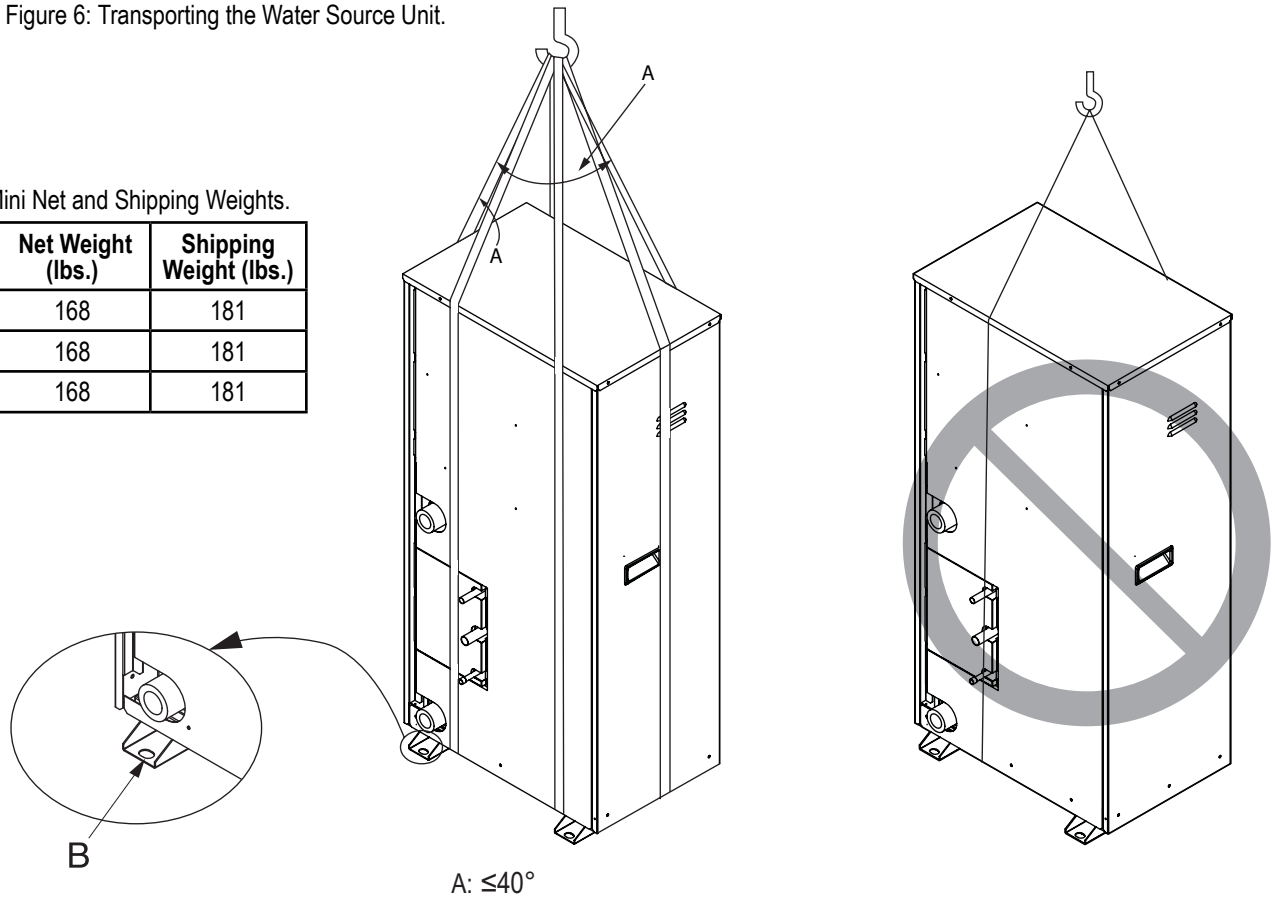
INSTALLATION

Transporting / Lifting the Water Source Unit

Transporting / Lifting

- When lifting the unit, use lifting straps and place around the unit as shown below.
- Always lift the unit using properly sized lifting straps rated to carry the unit weight.
- Ensure the straps are long enough to maintain a maximum of a 40° angle as shown at “A”.

Figure 6: Transporting the Water Source Unit.



A: ≤40°
B: Mounting Rail

Table 6: Water Mini Net and Shipping Weights.

Capacity (ton)	Net Weight (lbs.)	Shipping Weight (lbs.)
3.0	168	181
4.0	168	181
4.5	168	181

⚠WARNING

- *One person should not carry the product.*
- *Some products include polypropylene bands around the unit for packaging. Do not use polypropylene bands to lift the unit.*
- *Tear apart and throw away plastic packaging bags so that children may not play with them and risk suffocation and death.*
- *Lift the water source unit from the base at specified locations. Support the water source unit at a minimum of six (6) points to avoid slippage from the rigging apparatus.*
- *Do not drop the unit when carrying it with a forklift.*
- *Use a minimum of three (3) lifting straps.*
- *Place a protective cloth or other soft material at the locations where the casing comes in contact with the lifting straps to prevent damage to painted surfaces.*
- *Always know where the center of gravity of the water source unit is before lifting. Hoist the unit with the center of gravity centered among the lifting straps.*

⚠CAUTION

Caution when using forklift to transport an unpackaged unit. Consider the unit’s center of gravity when lifting. Protect the painted surfaces as necessary to prevent damage to the unit finish.

Installation Space

When installing the water-source unit, provide service requirements as illustrated. If local code requires additional clearance area, comply with local codes.

Note:

Job site conditions may require routing utilities—including the refrigerant piping and electrical wiring—under the unit base. If job site conditions warrant, consider adding mounting rails under the unit.

Figure 7: Required Minimum Space for Water Mini Unit Installation.

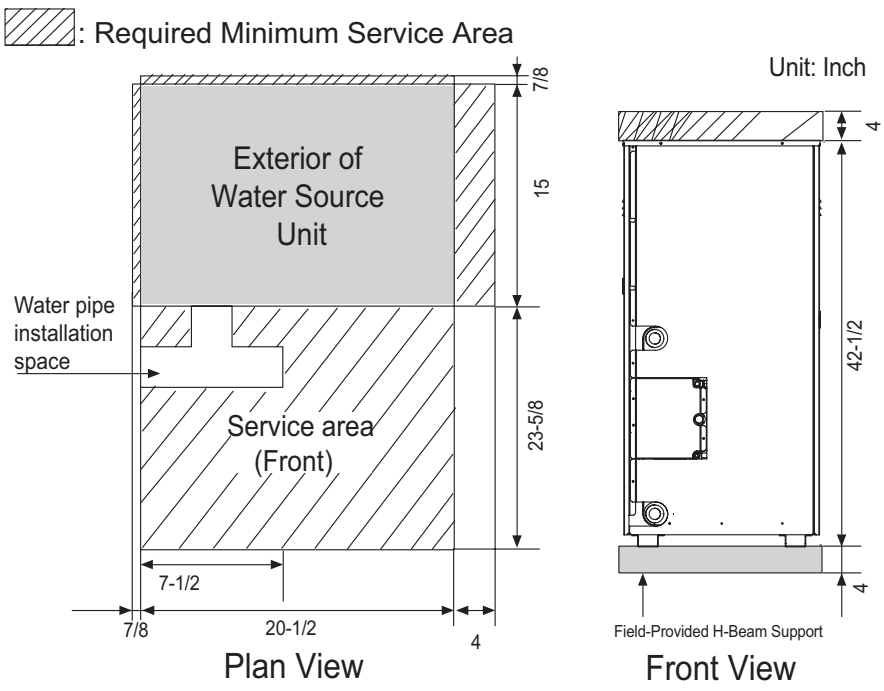
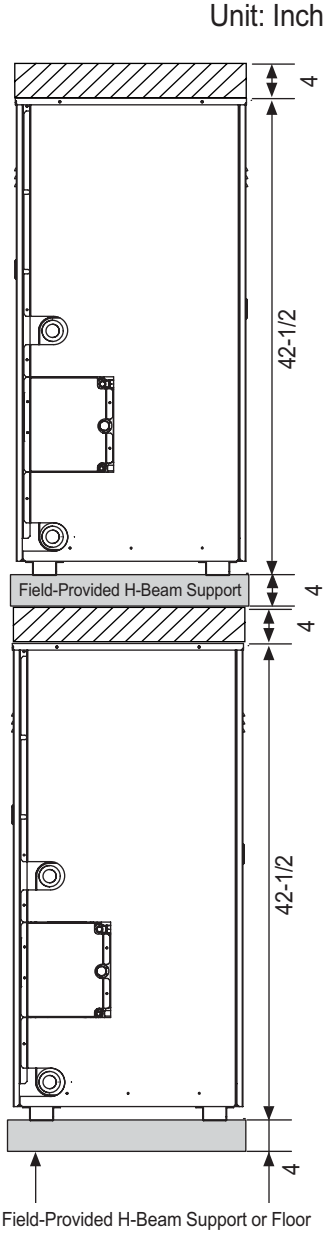


Figure 8: Stacked Water Source Units.



General Mounting

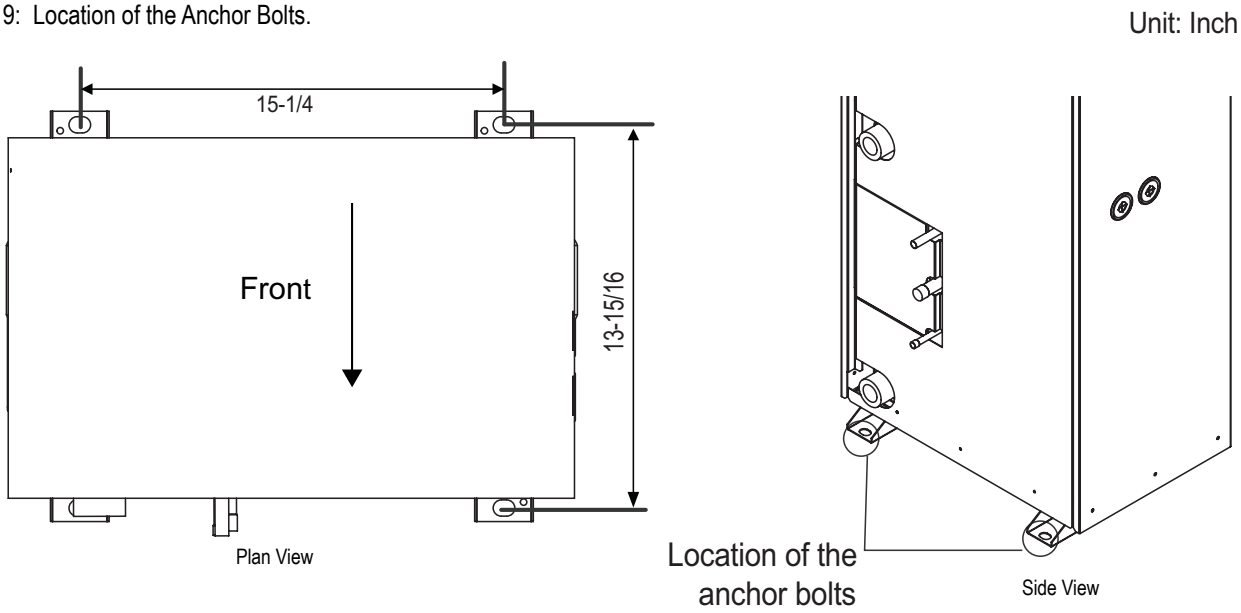
Securely attach the water source unit to a concrete pad, base rails, or other mounting platform that is anchored to the building structure. Avoid placing the unit in a low lying area where water may accumulate. Refer to dimensional drawing in the “Product Data” section on page 10, and follow the applicable local code for clearance, mounting, anchor, and vibration attenuation requirements.

⚠ WARNING

- *When building a base support for the water source unit, ensure that the floor surface / location has enough strength to support the weight of the unit, and enough space for pipes and wiring.*
- *Install the water source unit to a base and in a manner approved by the structural engineer to minimize damage to the unit in the event of an earthquake. Any deficiency in installation may cause unit to fall, resulting in physical injury or death.*

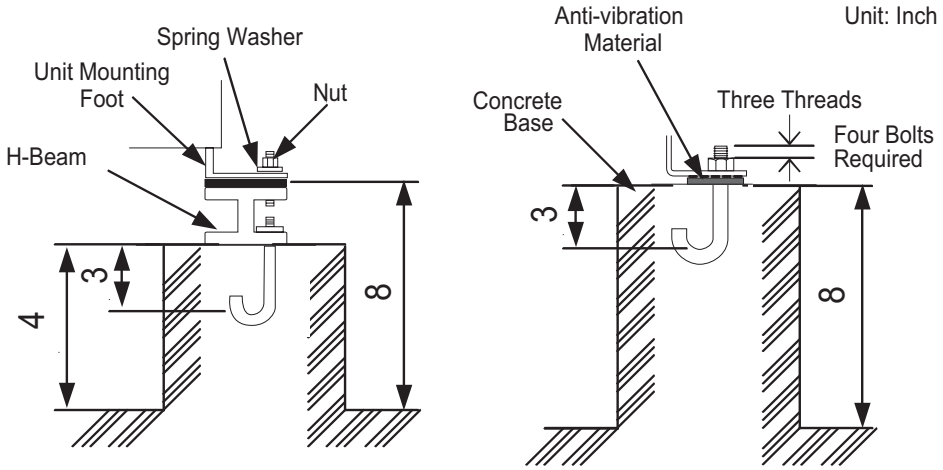
Anchoring the Water Source Unit

Figure 9: Location of the Anchor Bolts.



- Securely fasten all four (4) corners to the supporting base.
- If not otherwise directed by the structural engineer or local codes, Use a 7/16 inch or 1/2 inch diameter J-bolt. Use a hexagon nut with a spring washer.
- Include anti-vibration material chosen by the acoustics engineer.
- Include enough space for refrigerant piping and electrical wiring when installing through the bottom of the unit.
- Use an H-beam, concrete support, or other acceptable support structure designed by a structural engineer.

Figure 10: Close up of Anchor Bolts.



⚠ Note:

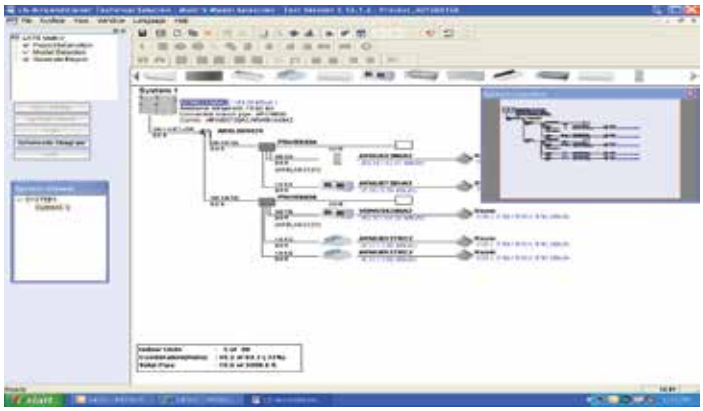
All referenced materials are to be field-supplied. Images are not to scale, are for reference only, and are not intended to be used for design purposes.

LG

LATS Multi V Piping Design Software

The proper design and installation of the refrigerant piping system is a critical element of the Multi V system. Multi V Water Mini requires two pipes between system components – a liquid line and a vapor line. A properly designed refrigerant piping system ensures that refrigerant is delivered to the evaporator coil's electronic expansion valve (EEV) in a pure liquid state free of gas bubbles. A proper design also ensures a sufficient refrigerant gas flow rate in the vapor line that eliminates the possibility of refrigeration oil from collecting in the vapor lines.

Figure 11: LATS Pipe System Design Tool in Tree Mode.



Refrigerant Piping Quality Assurance

LG's LATS Multi V software makes designing the refrigerant system easy. LATS Multi V is a Windows®-based application that assists the engineer in the design of the refrigeration distribution pipe system, verifies the design complies with pipe design limitations, applies capacity correction factors, and calculates the system refrigerant charge. The piping system can be entered manually into LATS from a one-line pipe diagram. **To ensure that the refrigerant piping design meets LG's quality standards, a LATS refrigerant piping design must be provided with every Multi V Water Mini order. Following the installation, if any changes or variations to the design were necessary, a new "as-built" LATS piping design software report must be created and provided to LG prior to system commissioning.**

Systems that are close to the standard application limits may be converted into a conditional application by field changes to pipe equivalent lengths. User should always check the LATS report actual pipe layout versus pipe limits. The user may want to increase pipe lengths when design conditions are approaching the Standard Application Piping Rule limits to force the LATS program to engineer the system using the "Conditional Application Pipe Rules," which will increase the diameter of the main and a few branch segments to minimize the possibility of required pipe changes due to field installation variations.

> ⚠ ***Note:***
> ***Any field changes, such as re-routing, shortening or lengthening a pipe segment, adding or eliminating elbows and/or fittings, re-sizing, adding, or eliminating indoor units, changing the mounting height or moving the location of a device or fitting during installation should be done with caution and ALWAYS VERIFIED in LATS MULTI V SOFTWARE BEFORE supplies are purchased or installed. Doing so may lead to a more profitable installation, reduce the potential for rework, and will reduce the potential for multiple visits to the job site to complete the system commissioning.***

Adjusting LATS Multi V Output for Altitude

When a system is installed at elevations significantly above sea level, the designer must also consider the impact air density has on the capacity of the indoor and water source units. LATS does not de-rate indoor unit capacity for high altitude applications. Locally accepted altitude correction factors must be applied to indoor unit capacities.

Creating a Balanced Piping System

Unlike designing duct-work or chilled and hot water pipe systems where balancing dampers, ball valves, orifices, circuit setters, or other flow control devices can be installed to modify or balance the flow of cooling medium, these cannot be used in a VRF system. Therefore, variable refrigerant flow systems have to be designed to be "self balanced." Balanced liquid refrigerant distribution is solely dependent on the designer choosing the correct pipe size for each segment. Pipe sizing considerations include pipe length, pipe segment pressure drop relative to other pipe segments in the system, type and quantity of elbows, bends present, fitting installation orientation, and end use device elevation differences.

> ⚠ ***Note:***
> *It is imperative the designer avoids creating excessive pressure drop. When liquid refrigerant is subjected to excessive pressure drop, liquid refrigerant will change state and "flash" to vapor. Vapor present in a stream of liquid refrigerant before reaching the electronic expansion valve (EEV) results in a loss of system control and causes damage to the valve. The pipe system must be designed in a manner that avoids the creation of unwanted vapor.*

Device Connection Limitations

- The minimum number of connected and operating indoor units to a Multi V Water Mini system is one, taking into consideration of the minimum combination ratio.
- The maximum number of indoor units on a Multi V Water Mini heat pump systems is:

ARWN038GA2 = 6 ARWN048GA2 = 8 ARWN053GA2 = 9

One of the most critical elements of a Multi V Water Mini system is the refrigerant piping. The table below lists pipe length limits that must be followed in the design of a Multi V Water Mini refrigerant pipe system:

Table 7: Multi V Water Mini Liquid Refrigerant Pipe Design Limitations.

Pipe Length (ELF = Equivalent Length of pipe in Feet)	**Longest total equivalent piping length**	≤475.7 feet
	Longest distance from water source unit to indoor unit	230 feet (Actual) 295.2 feet (Equivalent)
	Distance between fittings and indoor units	≥20 inches
	Distance between fittings and Y-branches	≥20 inches
	Distance between two Y-branches	≥20 inches
	Distance between Header and indoor units	≥20 inches
	Minimum distance between indoor unit to any Y-branch	3 feet from indoor unit to Y-branch
	Maximum distance between first Y-branch to farthest indoor unit	≤ 131 feet
Elevation (All Elevation Limitations are Measured in Actual Feet)	**Water-source unit above or below indoor unit**	≤ 98.4 feet
	Between any two indoor units	≤ 49 feet

Table 8: Equivalent Piping Length for Y-branches, Headers, and Typical Refrigeration Elbows.

Component	Size (Inches)													
	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4	2-1/8
Elbow (ft.)	0.5	0.6	0.7	0.8	1.2	1.3	1.5	1.6	1.8	2.0	2.1	2.3	2.5	2.8
Y-branch (ft.)[1]	1.6													
Header (ft.)	3.3													

[1]Kit contains two Y-branches: one for liquid and one for vapor.

Selecting Field-Supplied Copper Tubing

Copper is the only approved refrigerant pipe material for use with LG Multi V commercial air conditioning products, and LG recommends seamless phosphorous deoxidized ACR type copper pipe, hard-drawn rigid type "K" or "L", or annealed-tempered, copper pipe.

- Drawn temper (rigid) ACR copper tubing is available in sizes 3/8 through 2-1/8 inches (ASTM B 280, clean, dry, and capped).
- Annealed temper (soft) ACR copper tubing is available in sizes 1/4 through 2-1/8 inches (ASTM B 280, clean, dry, and capped).

Tube wall thickness should meet local code requirements and be approved for an operating pressure of 551 psi. If local code does not specify wall thickness, LG suggests using tube thickness per table below. When bending tubing, try to keep the number of bends to a minimum, and use the largest radii possible to reduce the equivalent length of installed pipe; also, bending radii greater than ten (10) pipe diameters can minimize pressure drop. Be sure no traps or sags are present when rolling out soft copper tubing coils.

Table 9: ACR Copper Tubing Material.

Type	Seamless Phosphorous Deoxidized
Class	UNS C12200 DHP
Straight Lengths	H58 Temper
Coils	O60 Temper

Table 10: Piping Tube Thicknesses.

OD (in)	1/4	3/8	1/2	5/8	3/4	7/8	1-1/8	1-3/8
Material	Rigid Type "K" or "L" and Soft ACR Acceptable			Rigid Type "K" or "L" Only				
Min. Bend Radius (in)	.563	.9375	1.5	2.25	3.0	3.0	3.5	4.0
Min. Wall Thickness (in)	.03	.03	.035	.040	.042	.045	.050	.050

Table 11: ACR Copper Tubing Dimensions and Physical Characteristics[1-4]

Nominal Pipe Outside Diameter (in)	**Actual Outside Diameter (in)**	**Drawn Temper**			**Annealed Temper**		
		Nominal Wall Thickness (in)	**Weight (lb/ft)**	**Cubic ft per Linear ft**	**Nominal Wall Thickness (in)**	**Weight (lb/ft)**	**Cubic ft per Linear ft**
1/4	0.250	--	--	--	0.030	0.081	.00020
3/8	0.375	0.030	0.126	.00054	0.032	0.134	.00053
1/2	0.500	0.035	0.198	.00101	0.032	0.182	.00103
5/8	0.625	0.040	0.285	.00162	0.035	0.251	.00168
3/4	0.750	0.042	0.362	.00242	0.042	0.362	.00242
7/8	0.875	0.045	0.455	.00336	0.045	0.455	.00336
1-1/8	1.125	0.050	0.655	.00573	0.050	0.655	.00573

[1]All dimensions provided are in accordance with ASTM B280 – Standard.
[2]Design pressure = 551 psig.
[3]ACR Tubing is available as hard drawn or annealed (soft) and are suitable for use with R410A refrigerant.
[4]The Copper Tube Handbook, 2010, Copper Development Association Inc., 260 Madison Avenue, New York, NY 10016.

⚠ Note:

- *Commercially available piping often contains dust and other materials. Always blow it clean with a dry inert gas.*
- *Prevent dust, water or other contaminants from entering the piping during installation.*

LG Engineered Y-branch Kits and Header Kits

LG Y-branch and Header kits are highly engineered devices designed to evenly divide the flow of refrigerant, and are used to join one pipe segment to two or more segments.

No Substitutions

Only LG supplied Y-branch and Header fittings (as referenced below; sold separately) can be used to join one pipe segment to two or more segments. Third-party or field-fabricated Tee's, Y-fittings, Headers, or other branch fittings are not qualified for use with LG Multi V Water Mini systems. The only field-provided fittings allowed in a Multi V Water Mini piping system are 45° and 90° elbows.

Table 12: Y-Branches and Headers.

Y-branches	Headers		
	4 branch	7 branch	10 branch
ARBLN01621	ARBL054	ARBL057	ARBL1010
ARBLN03321	ARBL104	ARBL107	ARBL2010

- *If the diameter of the branch pipe segments differ from that of the designated refrigerant piping, trim the to the desired section using a pipe cutter, and then use an adapter to connect.*
- *Always follow manufacturer's guidelines on refrigerant piping restrictions such as maximum length, elevation difference, and diameters. Failure to do so can result in reduced heating / cooling performance or equipment malfunction.*

LG Y-branch kits consist of:

- Y-branches (liquid line, vapor lines).
- Reducer fittings as applicable.
- Molded clam-shell type insulation covers.

LG Header kits consist of:

- Two Headers (one liquid line, one vapor line).
- Reducer fittings as applicable.
- Molded clam-shell type insulation covers.

Y-Branch Kits

LG supplied Y-branches must be used at each transition. Field-supplied "T" fittings or "Y" branches are not acceptable. Each LG supplied Y-branch kit comes with two (2) Y-branches for indoor units, step-down pipe reducers, and insulation covers.

Y-branches may be installed in horizontal or vertical configurations. When installed vertically, position the Y-branch so the straight-through leg is ±3° of plumb. When installed horizontally, position the Y-branch so the take-off leg is level and shares the same horizontal plane as the straight-through leg ±5° rotation.

There is no limitation on the number of Y-branches that can be installed, but there is a limitation on the number of indoor units connected to a single water source unit.

Y-branches should always be installed with the single port facing the water-source unit, the two-port end facing indoor units (Do not install Y-branches backwards as shown in Figure 15.) Refrigerant flow cannot make U-turns through Y-branches. The first Y-branch kit must be located at least three (3) feet from the water source unit. Provide a minimum of 20 inches between a Y-branch and any other fittings or indoor unit piped in series. It is recommended that when a Y-branch is located in a pipe chase or other concealed space, access doors should be provided for inspection access. The equivalent pipe length of each Y-branch (1.6') must be added to each pipe segment entered into LATS piping design software.

Figure 12: Y-branch Connections.

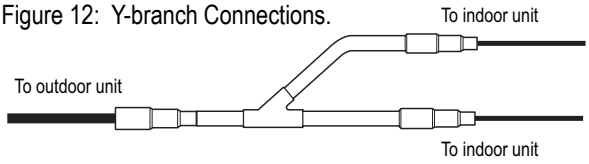


Figure 13: Y-branch Installation Alignment Specification.

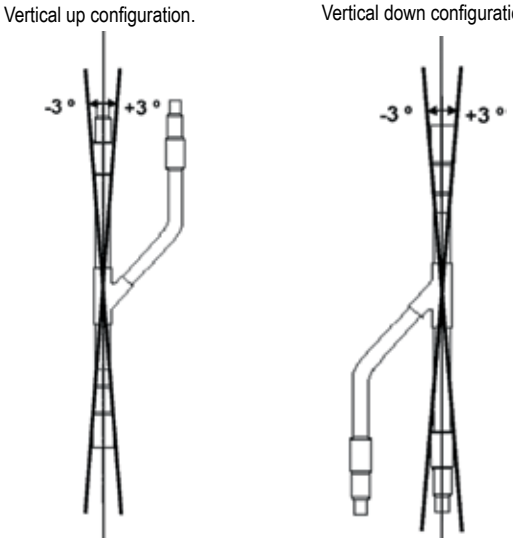


Figure 14: Horizontal Configuration End View.

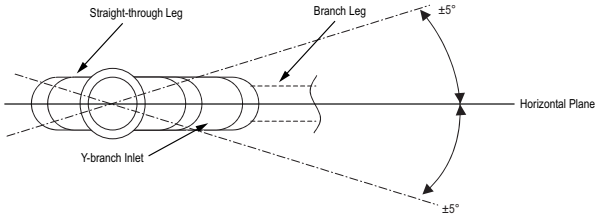
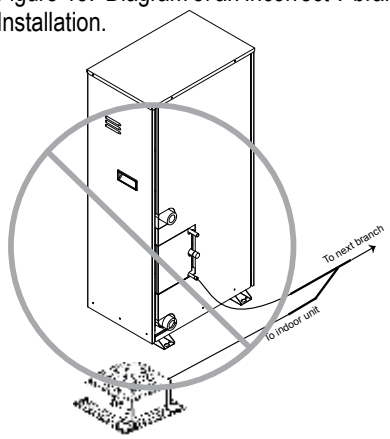


Figure 15: Diagram of an Incorrect Y-branch Installation.

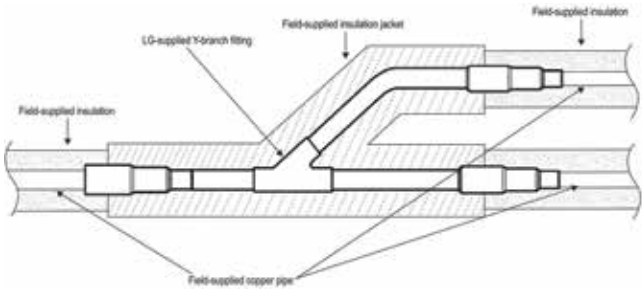


Y-branch Insulation

Each Y-branch kit comes with clam-shell type peel-and-stick insulation jackets molded to fit the Y-branch fittings—one for the liquid line, one for the vapor line.

- Check the fit of the Y-branch clam-shell insulation jacket after the Y-branch is installed.
- Mark the pipe where the insulation jacket ends.
- Remove the jacket.
- Install field-provided insulation on the three (3) pipes first.
- Peel the adhesive glue protector slip and install the clam-shell jacket over the fitting.

Figure 16: Y-branch Insulation and Pipe Detail.



Header Kits

⚠ *Note:*

Install Correctly

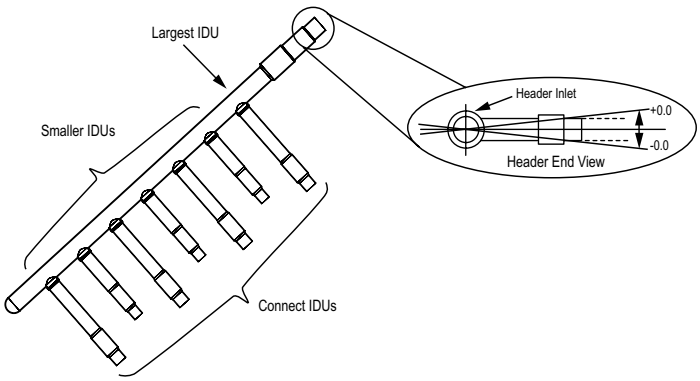
- *Y-branches can be installed upstream between the Header and the water-source unit, but a Y-branch cannot be installed between a header and an indoor unit.*
- *To avoid the potential of uneven refrigerant distribution through a header fitting, minimize the difference in equivalent pipe length between the header fitting and each connected indoor unit.*

Header kits are intended for use where multiple indoor units are in the same vicinity and it would be better to "home-run" the run-out pipes back to a centralized location. If connecting multiple indoor units that are far apart, Y-branches may be more economical. See page 16 for Header kit specifications and capacities.

Y-branches can be installed between the Header and the water source unit, but a Y-branch cannot be installed between a Header and an indoor unit. Headers must be installed in a horizontal and level position with the distribution ports of the fitting in the same horizontal plane as the straight-through branch.

When connecting indoor units to a Header, always connect the unit with the largest nominal capacity to the port closest to the water source unit. Then install the next largest indoor unit to the next port, working down to the smallest indoor unit. Do not skip ports.

Figure 18: Header Kit—Horizontal Rotation Limit (Must be Installed Level with No Rotation).

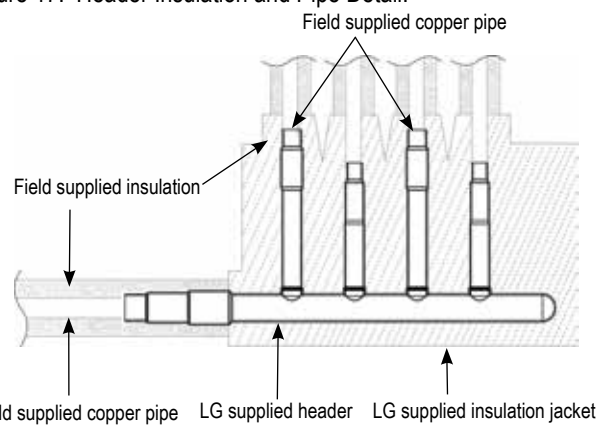


All indoor units must be mounted at an elevation below the Header fitting. All indoor units connected to a single Header fitting should be located with an elevation difference between indoor units that does not exceed 49 feet. If indoor units are located at an elevation the same as or above the Header fitting, do not use a Header. Instead, install a Y-branch fitting between the water source unit and the Header fitting, and connect the elevated indoor unit to the Y-branch.

Header Insulation

Each Header kit comes with clam-shell type peel and stick insulation jackets molded to fit the Header fittings—one for the liquid line and one for the vapor line.

Figure 17: Header Insulation and Pipe Detail.



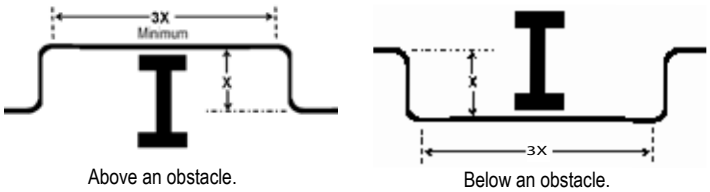
No Pipe Size Substitutions

Use only the pipe size selected by the LATS Multi V pipe system design software. Using a different size is prohibited and may result in a system malfunction or failure to work at all.

Obstacles

When an obstacle, such as an I-beam or concrete T, is in the path of the planned refrigerant pipe run, it is best practice to route the pipe over the obstacle. If adequate space is not available to route the insulated pipe over the obstacle, then route the pipe under the obstacle. In either case, it is imperative the length of the horizontal section of pipe above or below the obstacle be a minimum of three (3) times the longest vertical rise (or fall) at either end of the segment.

Figure 19: Installing Piping Above and Below an Obstacle.



Above an obstacle. Below an obstacle.

Copper Expansion and Contraction

Under normal operating conditions, the vapor pipe temperature of a Multi IV system can vary as much as 280°F. With this large variance in pipe temperature, the designer must consider pipe expansion and contraction to avoid pipe and fitting fatigue failures.

Refrigerant pipe along with the insulation jacket form a cohesive unit that expands and contracts together. During system operation, thermal heat transfer occurs between the pipe and the surrounding insulation.

If the pipe is mounted in free air space, no natural restriction to movement is present if mounting clamps are properly spaced and installed. When the refrigerant pipe is mounted underground in a utility duct stacked among other pipes, natural restriction to linear movement is present. In extreme cases, the restrictive force of surface friction between insulating jackets could become so great that natural expansion ceases and the pipe is “fixed” in place. In this situation, opposing force caused by change in refrigerant fluid/vapor temperature can lead to pipe/fitting stress failure.

The refrigerant pipe support system must be engineered to allow free expansion to occur. When a segment of pipe is mounted between two fixed points, provisions must be provided to allow pipe expansion to naturally occur. The most common method is the inclusion of expansion Loop or U-bends. See Figure 20 on page 28. Each segment of pipe has a natural fixed point where no movement occurs. This fixed point is located at the center point of the segment assuming the entire pipe is insulated in a similar fashion. The natural fixed point of the pipe segment is typically where the expansion Loop or U-bend should be. Linear pipe expansion can be calculated using the following formula:

$LE = C \times L \times (T_r - T_a) \times 12$

LE	=	Anticipated linear tubing expansion (in.)
C	=	Constant (For copper = 9.2×10^{-6} in./in.°F)
L	=	Length of pipe (ft.)
T_R	=	Refrigerant pipe temperature (°F)
T_a	=	Ambient air temperature (°F)
12	=	Inches to feet conversion (12 in./ft.)

1. From Table 13, find the row corresponding with the actual length of the straight pipe segment.
2. Estimate the minimum and maximum temperature of the pipe. In the column showing the minimum pipe temperature, look up the anticipated expansion distance. Do the same for the maximum pipe temperature.
3. Calculate the difference in the two expansion distance values. The result will be the anticipated change in pipe length.

General Example:

A Multi V system is installed and the design shows that there is a 130 feet straight segment of tubing between a Y-branch and an indoor unit. In heating, this pipe transports hot gas vapor to the indoor units at 120°F. In cooling, the same tube is a suction line returning refrigerant vapor to the water source unit at 40°F. Look up the copper tubing expansion at each temperature and calculate the difference.

Vapor Line

Transporting Hot Vapor: 130 ft. pipe at 120°F = 1.54 in.
Transporting Suction Vapor: 130 ft. pipe at 40°F = 0.52 in.
Anticipated Change in Length: 1.54 in. – 0.52 in. = 1.02 in.

Liquid Line

The liquid temperature remains relatively the same temperature; only the direction of flow will reverse. Therefore, no significant change in length of the liquid line is anticipated.

When creating an expansion joint, the joint height should be a minimum of two times the joint width. Although different types of expansion arrangements are available, the data for correctly sizing an Expansion Loop is provided in Table 14. Use soft copper with long radius bends on longer runs or long radius elbows for shorter pipe segments. Using the anticipated linear expansion (LE) distance calculated, look up the Expansion Loop or U-bend minimum design dimensions. If other types of expansion joints are chosen, design per ASTM B-88 Standards.

See table below for precalculated anticipated expansion for various pipe sizes and lengths of refrigerant tubing.

To find the anticipated expansion value:

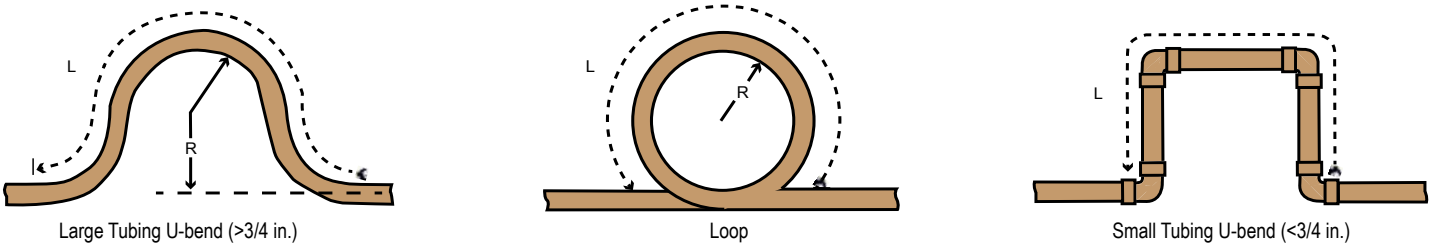
1. From the table below, find the row corresponding with the actual feet of the straight pipe segment.
2. Estimate the minimum and maximum temperature of the pipe.
3. In the column showing the minimum pipe temperature, look up the anticipated expansion distance corresponding to the segment length. Do the same for the maximum pipe temperature.
4. Calculate the difference in the two expansion distance values. The result will be the change in pipe length.

Table 13: Linear Thermal Expansion of Copper Tubing in Inches.

Pipe Length[1]	Fluid Temperature °F																			
	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°	125°	130°
10	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.12	0.13	0.14	0.15	0.15
20	0.08	0.08	0.10	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.22	0.23	0.26	0.28	0.29	0.30
30	0.12	0.12	0.15	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.32	0.35	0.39	0.42	0.44	0.45
40	0.16	0.16	0.20	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.43	0.46	0.52	0.56	0.58	0.60
50	0.20	0.20	0.25	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.54	0.58	0.65	0.70	0.73	0.75
60	0.24	0.24	0.30	0.36	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.65	0.69	0.78	0.84	0.87	0.90
70	0.28	0.28	0.35	0.42	0.46	0.49	0.53	0.56	0.60	0.63	0.67	0.70	0.74	0.77	0.76	0.81	0.91	0.98	1.02	1.05
80	0.32	0.32	0.40	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.86	0.92	1.04	1.12	1.16	1.20
90	0.36	0.36	0.45	0.54	0.59	0.63	0.68	0.72	0.77	0.81	0.86	0.90	0.95	0.99	0.97	1.04	1.17	1.26	1.31	1.35
100	0.40	0.40	0.50	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.08	1.15	1.30	1.40	1.45	1.50
120	0.48	0.48	0.60	0.72	0.78	0.84	0.90	0.96	1.02	1.08	1.14	1.20	1.26	1.32	1.30	1.38	1.56	1.68	1.74	1.80
140	0.56	0.56	0.70	0.84	0.91	0.98	1.05	1.12	1.19	1.26	1.33	1.40	1.47	1.54	1.51	1.61	1.82	1.96	2.03	2.10
160	0.64	0.64	0.80	0.96	1.04	1.12	1.20	1.28	1.36	1.44	1.52	1.60	1.68	1.76	1.73	1.84	2.08	2.24	2.32	2.40
180	0.72	0.72	0.90	1.08	1.17	1.26	1.35	1.44	1.53	1.62	1.71	1.80	1.89	1.98	1.94	2.07	2.34	2.52	2.61	2.70
200	0.80	0.80	1.00	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.16	2.30	2.60	2.80	2.90	3.00
220	0.88	0.88	1.10	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20	2.31	2.42	2.38	2.53	2.86	3.08	3.19	3.30
240	0.96	0.96	1.20	1.44	1.56	1.68	1.80	1.92	2.04	2.16	2.28	2.40	2.52	2.64	2.59	2.76	3.12	3.36	3.48	3.60
260	1.04	1.04	1.30	1.56	1.69	1.82	1.95	2.08	2.21	2.34	2.47	2.60	2.73	2.86	2.81	2.99	3.38	3.64	3.77	3.90
280	1.12	1.12	1.40	1.68	1.82	1.96	2.10	2.24	2.38	2.52	2.66	2.80	2.94	3.08	3.02	3.22	3.64	3.92	4.06	4.20
300	1.20	1.20	1.50	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.15	3.30	3.24	3.45	3.90	4.20	4.35	4.50
320	1.28	1.28	1.60	1.92	2.08	2.24	2.40	2.56	2.72	2.88	3.04	3.20	3.36	3.52	3.46	3.68	4.16	4.48	4.64	4.80
340	1.36	1.36	1.70	2.04	2.21	2.38	2.55	2.72	2.89	3.06	3.23	3.40	3.57	3.74	3.67	3.91	4.42	4.76	4.93	5.10
360	1.44	1.44	1.80	2.16	2.34	2.52	2.70	2.88	3.06	3.24	3.42	3.60	3.78	3.96	3.89	4.14	4.68	5.04	5.22	5.40
380	1.52	1.52	1.90	2.28	2.47	2.66	2.85	3.04	3.23	3.42	3.61	3.80	3.99	4.18	4.10	4.37	4.94	5.32	5.51	5.70
400	1.60	1.60	2.00	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.00	4.20	4.40	4.32	4.60	5.20	5.60	5.80	6.00
420	1.68	1.68	2.10	2.52	2.73	2.94	3.15	3.36	3.57	3.78	3.99	4.20	4.41	4.62	4.54	4.83	5.46	5.88	6.09	6.30
440	1.76	1.76	2.20	2.64	2.86	3.08	3.30	3.52	3.74	3.96	4.18	4.40	4.62	4.84	4.75	5.06	5.72	6.16	6.38	6.60
460	1.84	1.84	2.30	2.76	2.99	3.22	3.45	3.68	3.91	4.14	4.37	4.60	4.83	5.06	4.97	5.29	5.98	6.44	6.67	6.90
480	1.92	1.92	2.40	2.88	3.12	3.36	3.60	3.84	4.08	4.32	4.56	4.80	5.04	5.28	5.18	5.52	6.24	6.72	6.96	7.20
500	2.00	2.00	2.50	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.40	5.75	6.50	7.00	7.25	7.50

[1]Pipe length baseline temperature = 0°F. "Expansion of Carbon, Copper and Stainless Steel Pipe," The Engineers' Toolbox, www.engineeringtoolbox.com.

Figure 20: Coiled Expansion Loops and Offsets.



Large Tubing U-bend (>3/4 in.) Loop Small Tubing U-bend (<3/4 in.)

Table 14: Radii of Coiled Expansion Loops and Developed Lengths of Expansion Offsets.

Anticipated Linear Expansion (LE) (in)		Nominal Tube Size (OD) inches						
		1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
1/2	R[1]	6	7	8	9	11	12	13
	L[2]	38	44	50	59	67	74	80
1	R[1]	9	10	11	13	15	17	18
	L[2]	54	63	70	83	94	104	113
1-1/2	R[1]	11	12	14	16	18	20	22
	L[2]	66	77	86	101	115	127	138
2	R[1]	12	14	16	19	21	23	25
	L[2]	77	89	99	117	133	147	160
2-1/2	R[1]	14	16	18	21	24	26	29
	L[2]	86	99	111	131	149	165	179
3	R[1]	15	17	19	23	26	29	31
	L[2]	94	109	122	143	163	180	196
3-1/2	R[1]	16	19	21	25	28	31	34
	L[2]	102	117	131	155	176	195	212
4	R[1]	17	20	22	26	30	33	36
	L[2]	109	126	140	166	188	208	226

[1]R = Centerline Length of Pipe.
[2]L = Centerline Minimum Radius (inches).

LG

Pipe Bends

When bending soft copper, use long radius bends. Refer to the "Radii of Coiled Expansion Loops and Developed Lengths of Expansion Offsets" table for minimum radius specifications, page 28.

In-line Refrigeration Components

Components such as oil traps, solenoid valves, filter-dryers, sight glasses, tee fittings, and other after-market accessories are not permitted on the refrigerant piping system between the water source units and the indoor units. Multi V Water Mini systems are provided with redundant systems that assure oil is properly returned to the compressor. Sight-glasses and solenoid valves may cause vapor to form in the liquid stream. Over time, dryers may deteriorate and introduce debris into the system. The designer and installer should verify the refrigerant piping system is free of traps, sagging pipes, sight glasses, filter dryers, etc.

Field-provided Isolation Ball Valves

LG allows the installation of field-supplied ball valves with Schrader ports at each indoor unit. Full-port isolation ball valves with Schrader ports (positioned between valve and indoor unit) rated for use with R410A refrigerant should be used on both the liquid and vapor lines.

If valves are not installed and a single indoor unit needs to be removed or repaired, the entire system must be shut down and evacuated. If isolation ball valves are installed, and an indoor unit needs to be repaired, the unaffected indoor units can remain operational. Reclamation of refrigerant, then, can be restricted to a single indoor unit.

Position valves with a minimum distance of three (3) to six (6) inches of pipe on either side of the valve, and placed between six (6) and twelve (12) inches from the Y-branch or header connecting the run-out pipe to the upstream main or branch pipe. If ball valves are installed closer to the indoor unit, a section of pipe becomes a dead zone when the valves are closed where oil may accumulate.

Valves shall be accessible for service. If necessary, install drywall access doors or removable ceiling panels, and position the valves to face the access door or ceiling panel opening. Mount valves with adequate space between them to allow for placement of adequate pipe insulation around the valves. Recommended best practice is to clearly label and document locations of all service valves, Y-branches, and headers.

Using Elbows

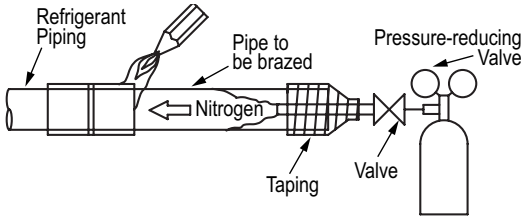
Field supplied elbows are allowed as long as they are designed for use with R410A refrigerant. The designer and installer, however, should be cautious with the quantity and size of fittings used, and must account for the additional pressure losses in equivalent pipe length calculation for each branch. The equivalent pipe length of each elbow must be added to each pipe segment in the LATS program. See page 22 for equivalent lengths.

Installation of Refrigerant Piping / Brazing Practices

⚠ ***Note:***
It is imperative to keep the piping system free of contaminants and debris such as copper burrs, slag, or carbon dust during installation.

1. All joints are brazed in the field. Multi V Water Mini refrigeration system components contain very small capillary tubes, small orifices, electronic expansion valves, oil separators, and heat exchangers that can easily become blocked. Proper system operation depends on the installer using best practices and utmost care while assembling the piping system.
   - Store pipe stock in a dry place; keep stored pipe capped and clean.
   - Blow clean all pipe sections with dry nitrogen prior to assembly.
2. Proper system operation depends on the installer using best practices and the utmost care while assembling the piping system.
   - Use adapters to assemble different sizes of pipe.
   - Always use a non-oxidizing material for brazing. Do not use flux, soft solder, or anti-oxidant agents. If the proper material is not used, oxidized film may accumulate and clog or damage the compressors. Flux can harm the copper piping or refrigerant oil.
   - Use a tubing cutter, do not use a saw to cut pipe. De-bur and clean all cuts before assembly.
3. Brazing joints:
   - Use a dry nitrogen purge operating at a minimum pressure of three (3) psig and maintain a steady flow.
   - Use a 15% silver phosphorous copper brazing alloy to avoid overheating and produce good flow.
   - Protect isolation valves, electronic expansion valves, and other heat-sensitive control components from excessive heat with a wet rag or heat barrier spray.

Figure 21: Refrigerant Pipe Brazing.

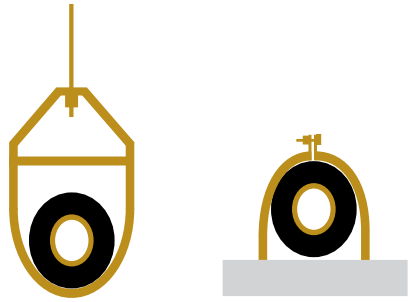


Pipe Supports

A properly installed pipe system should be adequately supported to avoid pipe sagging. Sagging pipes become oil traps that lead to equipment malfunction.

Pipe supports should never touch the pipe wall; supports shall be installed outside (around) the primary pipe insulation jacket (see Figure 22). Insulate the pipe first because pipe supports shall be installed outside (around) the primary pipe insulation jacket. Clevis hangers should be used with shields between the hangers and insulation. Field provided pipe supports should be designed to meet local codes. If allowed by code, use fiber straps or split-ring hangers suspended from the ceiling on all-thread rods (fiber straps or split ring hangers can be used as long as they do not compress the pipe insulation). Place a second layer of insulation over the pipe insulation jacket to prevent chafing and compression of the primary insulation within the confines of the support pipe clamp.

Figure 22: Pipe Hanger Details.



A properly installed pipe system will have sufficient supports to avoid pipes from sagging during the life of the system. As necessary, place supports closer for segments where potential sagging could occur. Maximum spacing of pipe supports shall meet local codes.

If local codes do not specify pipe support spacing, pipe shall be supported:

- Maximum of five feet (5') on center for straight segments of pipe up to 3/4" outside diameter size.
- Maximum of six feet (6') on center for pipe up to one inch (1") outside diameter size.
- Maximum of eight feet (8') on center for pipe up to two inches (2") outside diameter size.

Wherever the pipe changes direction, place a hanger within twelve (12) inches on one side and within twelve to nineteen (12 to 19) inches of the bend on the other side as shown in Figure 23. Support piping at indoor units as shown in Figure 24. Support Y-Branch and Header fittings as shown in Figures 25 and 26.

Figure 23: Typical Pipe Support Location—Change in Pipe Direction.

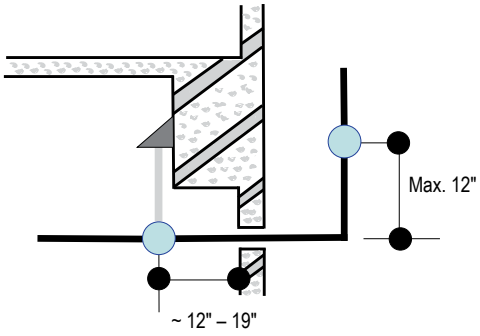


Figure 24: Pipe Support at Indoor Unit.

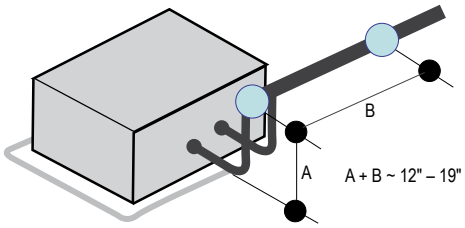


Figure 25: Pipe Support at Y-branch Fitting.

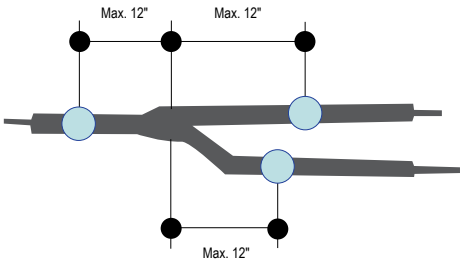
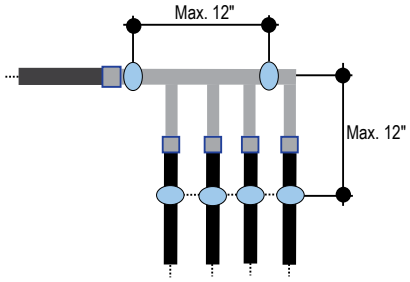


Figure 26: Pipe Support at Header Fitting.



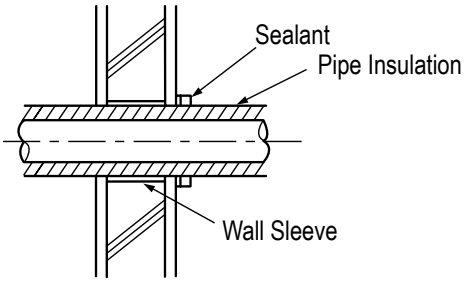
Pipe Slope

The horizontal pipe slope cannot exceed 5° up or down.

Pipe Sleeves and Wall Penetrations

LG requires that all pipe penetrations through walls, floors, and pipes buried underground be properly insulated and routed through an appropriate wall sleeve of sufficient size to prevent compression of refrigerant pipe insulation and free movement of the pipe within the sleeve. Underground refrigerant pipe shall be routed inside a protective sleeve to prevent insulation deterioration.

Figure 27: Typical Pipe Penetration.



The following is an example of manual pipe size calculations. Designers are highly encouraged to use LATS instead of manual calculations.

System Using Y-branches

Example: Five (5) indoor units connected

Water-Source Units (WSU).

IDU: Indoor Units.

A: Main Pipe from Water-Source Unit to Y-branch.

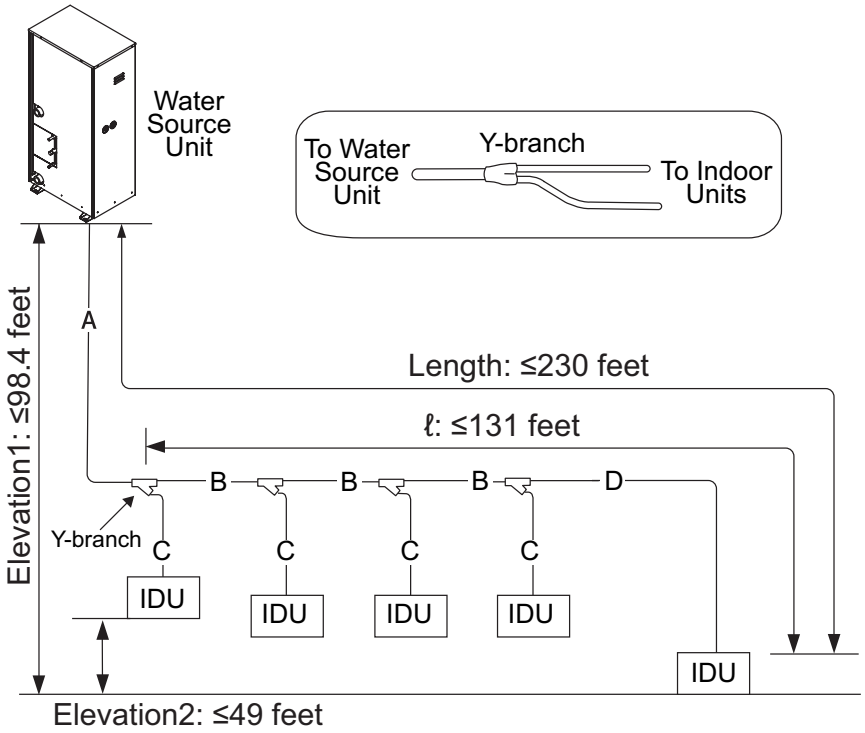
B: Y-branch to Y-branch.

C: Y-branch to Indoor Unit.

D: Y-branch to Farthest Indoor Unit.

Note:

- *Always reference the LATS Multi V software report.*



Note:

See pages 32-33 for refrigerant pipe diameter and pipe length tables.

System Using a Header

Example: Six (6) indoor units connected

Water-Source Units (WSU).

IDU: Indoor Units.

Header.

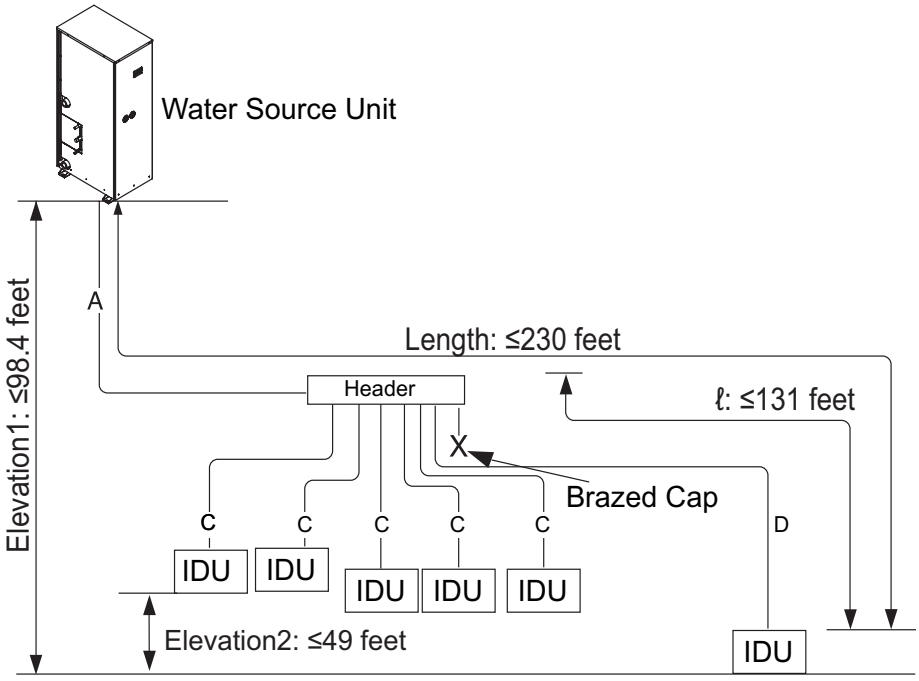
A: Main Pipe from Water-Source Unit to Header.

C: Header to Indoor Unit.

D: To Farthest Indoor Unit.

Note:

- *Indoor units should be installed at a lower position than the Header.*
- *Y-branch pipes cannot be used after Headers.*
- *Install the Header so that the pipe distances between the between the connected indoor units are minimized. Large differences in pipe distances can cause indoor unit performances to fluctuate.*
- *Always reference the LATS Multi V software report.*



Note:

See pages 32-33 for refrigerant pipe diameter and pipe length tables.

REFRIGERANT PIPING DESIGN

Pipe Sizing

The following is an example of manual pipe size calculations. Designers are highly encouraged to use LATS instead of manual calculations.

System Using Y-branches and Header

Example: Five (5) indoor units connected

Water-Source Units (WSU).

IDU: Indoor Units.

Y-branches.

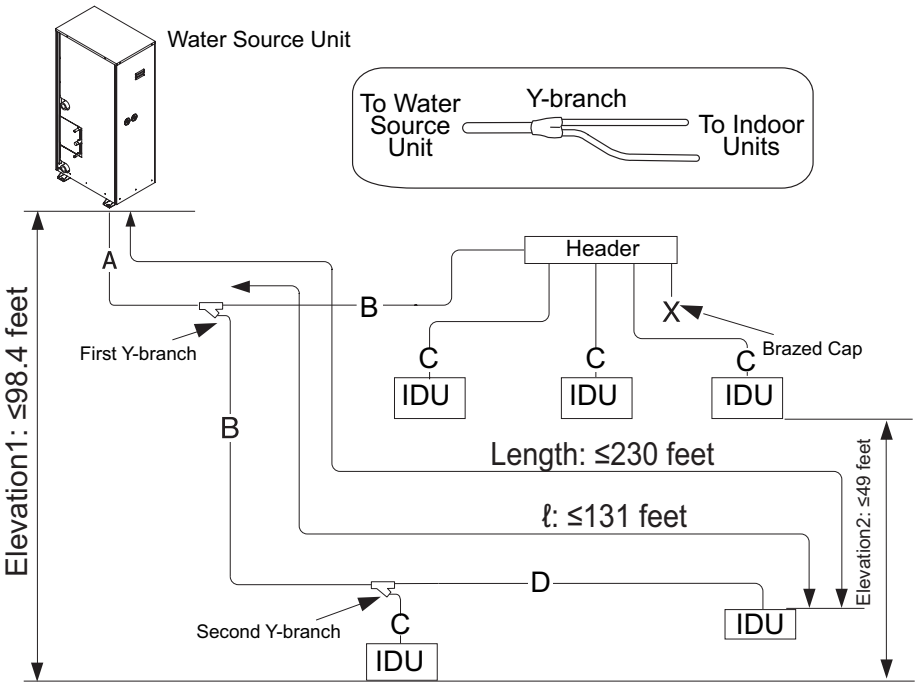
Header.

A: Main Pipe from First Y-branch.

B: Pipe from Y-branch to Y-branch or Header.

C: Pipe from Y-branch or Header to Indoor Unit.

D: Pipe to Farthest Indoor Unit.



⚠ *Note:*

- *Indoor units should be installed at a lower position than the Header.*
- *Y-branch pipes cannot be used after Headers.*
- *Install the Header so that the pipe distances between the between the connected indoor units are minimized. Large differences in pipe distances can cause indoor unit performances to fluctuate.*
- *Always reference the LATS Multi V software report.*

Table 15: Pipe Capabilities.

Length	Total pipe length	Longest actual pipe length	Longest Equivalent pipe length[1]
	A + ΣB + ΣC + D ≤475.7 feet	A + B + D ≤230 feet	A + B + D ≤295.2 feet
ℓ	Longest pipe length after first branch		
	B + D ≤ 131 feet		
Elevation1	Elevation differential (Water-source unit ↔ Indoor unit)		
	≤ 98.4 feet		
Elevation2	Elevation differential (Indoor unit ↔ Indoor unit)		
	≤ 49 feet		
Distance between fittings and indoor units		≥20 inches	
Distance between fittings and Y-Branches		≥20 inches	
Distance between two Y-Branches		≥20 inches	
Distance between Header and indoor units		≥20 inches	

[1]*For calculation purposes, assume equivalent pipe length of Y-branch is 1.6 feet, and equivalent pipe length of header is 3.3 feet.*

Table 16: Refrigerant Pipe Diameter (B) from Y-branch to Y-branch / Header.

Downstream Total Capacity of IDUs (Btu/h)	Liquid Pipe (Inches O.D.)	Vapor Pipe (Inches O.D.)
≤19,100	Ø1/4	Ø1/2
< 54,600	Ø3/8	Ø5/8
≤76,400	Ø3/8	Ø3/4

⚠ *Note:*

- *Connection piping from branch to branch cannot exceed the main pipe diameter (A) used by the water-source unit.*
- *Y-branches and other header branches cannot be installed downstream of the initial header branch.*

The following is an example of manual pipe size calculations. Designers are highly encouraged to use LATS instead of manual calculations.

Selecting the Refrigerant Piping

Example: Five (5) indoor units connected

Water-Source Units (WSU).

IDU: Indoor Units.

A: Main Pipe from Water-Source Unit to Y-branches.

B: Branch Piping.

C: Branch Piping to Indoor Unit (IDU).

Figure 28: Selecting Refrigerant Piping.

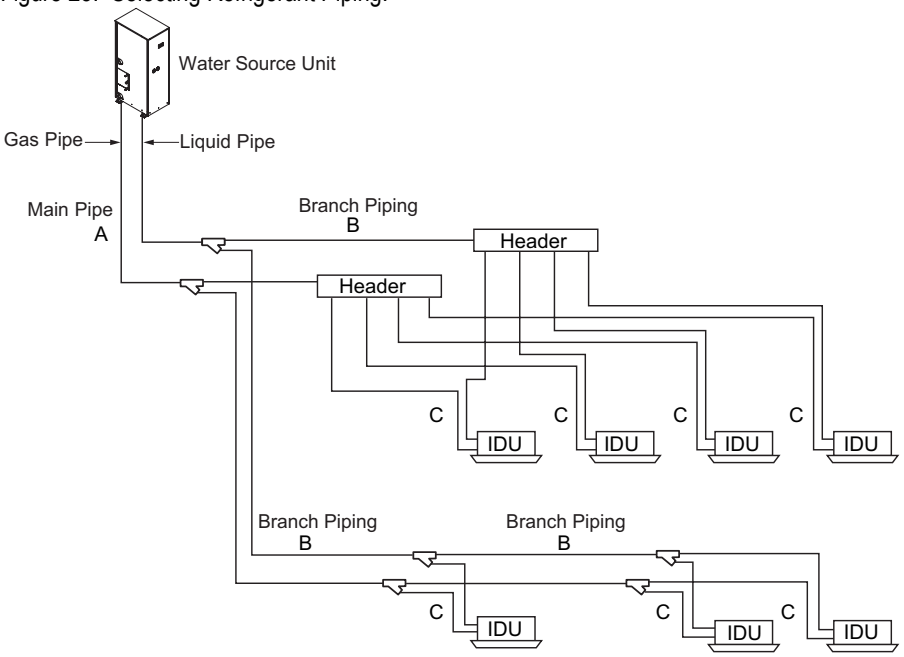


Table 17: Size of Main Pipe (A) (From Water-Source Unit to Y-branches).

Water-Source Unit Capacity (Btu/h)	Liquid Pipe (Inches O.D.)	Gas Pipe (Inches O.D.)
37,500	Ø3/8	Ø5/8
49,500	Ø3/8	Ø5/8
54,600	Ø3/8	Ø3/4

Table 18: Size of Branch Piping (B) to Branch Piping (B).

Indoor Unit Capacity (Btu/h)	Liquid Pipe (Inches O.D.)	Gas Pipe (Inches O.D.)
19,100	Ø1/4	Ø1/2
54,600	Ø3/8	Ø5/8
76,400	Ø3/8	Ø3/4

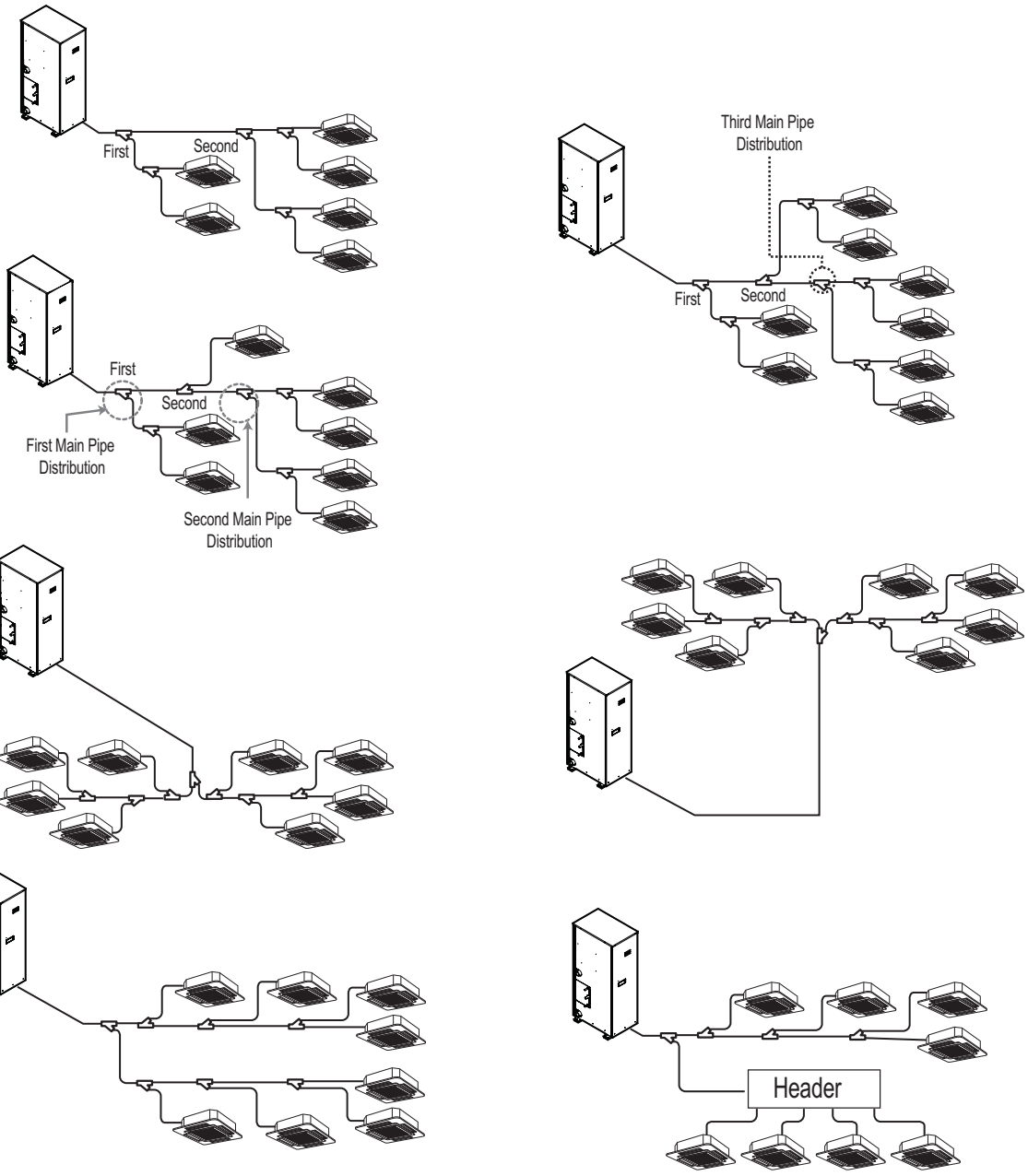
Table 19: Size of Branch Piping to Indoor Unit (C).

Indoor Unit Capacity (Btu/h)	Liquid Pipe (Inches O.D.)	Gas Pipe (Inches O.D.)
19,100	Ø1/4	Ø1/2
54,600	Ø3/8	Ø5/8

REFRIGERANT PIPING DESIGN

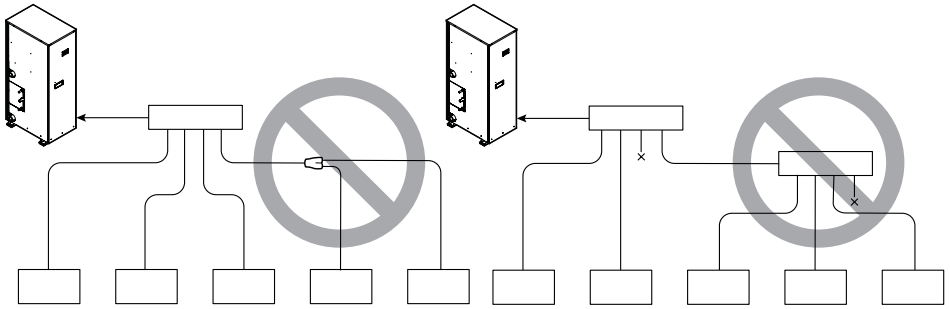
Pipe Sizing

Various Acceptable Layouts



Unacceptable Piping System Layouts

A second branch cannot be installed after a header.



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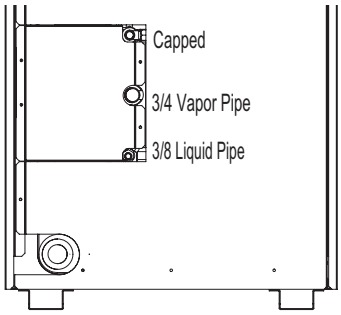
Before connecting the piping:

- Remove the front panel.
- Check all pipes (liquid and vapor).

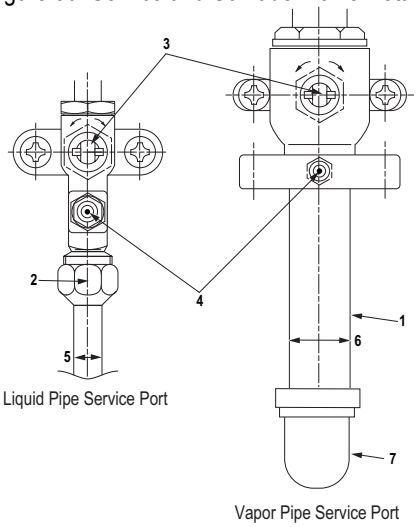
Figure 29: Water Mini Unit Front Panel.



Water Mini Unit Service Valves

1. Field piping.
2. Flare nut.
3. Ball type service valves.
4. Schrader valves.
5. Liquid pipe.
6. Vapor pipe.
7. Field-supplied 90° elbow.

Figure 30: Service and Schrader Valve Detail.



Note:

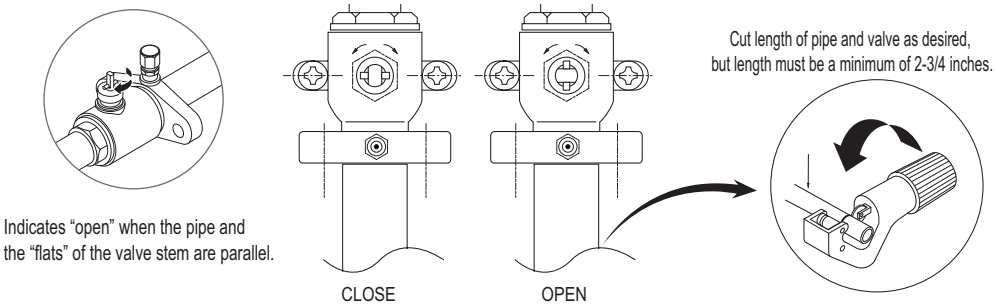
Do not expose the service valves of the water source unit to heat. Protect the service valve with a wet towel during brazing.

Operating the Service Valves

1. Loosen or tighten the flare nut by using a torque wrench and backup wrench. Coat the flare connection with polyvinyl ether (PVE) refrigeration oil.
2. Remove service valve cap. To operate the shutoff valve, turn ball valve stem 90° using an open-end wrench. Always backseat the valve. After operation, always replace the caps (Tightening torque of service valve cap: =18.0 lb-ft).
3. Evacuate the system, and then charge the refrigerant using the Schrader valve. Reattach the Schrader valve cap after servicing is complete. (Tightening torque of service cap: =10.0 lb-ft).

- The unit ships with a factory charge of refrigerant. When connecting and brazing the vapor line, protect the service and Schrader valves from excessive heat using a wet rag or cooling gel product.
- After connections are complete, verify that the service ports and caps are securely tightened to prevent leaking refrigerant gas.

Figure 31: Service Valves - Open and Closed Positions.



Note:

- *When connecting the refrigerant piping, make sure the service valves of the water source unit are completely closed (factory setting). Do not open the service valves or attempt to operate the system until the refrigerant pipe system installation has been completed. Never open the valves before a pressure test is performed, the system is evacuated, a leak test performed, and the Commissioning Agent provides authorization to do so.*
- *Do not use polyolester (POE) or any other type of mineral oil as a thread lubricant. If introduced to the refrigerant circuit, will create oil sludge leading to system malfunction.*
- *Use steel wool or comparable material to fill gaps between the unit case and the refrigerant and electrical connections to prevent rodent and animal entry.*

WARNING

- *Always take extreme caution to prevent refrigerant gas (R410A) from leaking during use, around fire or flame, and during brazing. If the refrigerant gas comes in contact with a flame from any source, it may break down and generate a poisonous gas. Never braze in a room that is not ventilated. After refrigerant piping work is complete, securely tighten both service and Schrader valves to help prevent refrigerant gas from leaking. Verify the system is free of leaks after refrigerant piping installation is complete.*
- *Do not attempt to remove the service valve stem and packing or Schrader valve core. Physical injury or death may occur from the uncontrolled rapid release of refrigerant.*

REFRIGERANT PIPING DESIGN

MULTI V WATER MINI

Refrigerant Pipe Connections

⚠ WARNING

- *Do not allow the refrigerant to leak during brazing; if the refrigerant combusts, it generates a toxic gas.*
- *Do not braze in an enclosed location, and always test for gas leaks before / after brazing.*

Water Mini Pipe Connections

1. Do not use kinked pipe caused by excessive bending in one specific area on its length.
2. Braze the pipes to the service valve pipe stub of the water source unit.
3. After brazing, check for refrigerant gas leaks.
4. When selecting flare fittings, always use a 45° fitting rated for use with high pressure refrigerant R410A. Selected fittings must also comply with local, state, or federal standards.

Creating a Flare Fitting

One of the main causes of refrigerant leaks is defective flared connections. Create flared connections using the procedure below.

1. Cut the pipe to length.

- Measure the distance between the indoor unit and the water source unit.
- Cut the pipes a little longer than measured distance.

2A. Remove the burrs.

- Completely remove all burrs from pipe ends.
- When removing burrs, point the end of the copper pipe down to avoid introducing foreign materials in the pipe.

2B. Slide the flare nut onto the copper tube.

3. Flaring the pipe end.

- Use the proper size flaring tool to finish flared connections as shown.
- ALWAYS create a 45° flare when working with R410A.

4. Carefully inspect the flared pipe end.

- Compare the geometry with the figure to the right and dimensions as detailed in Figure 32.
- If the flare is defective, cut it off and re-do procedure.
- If flare looks good, blow clean the pipe with dry nitrogen.

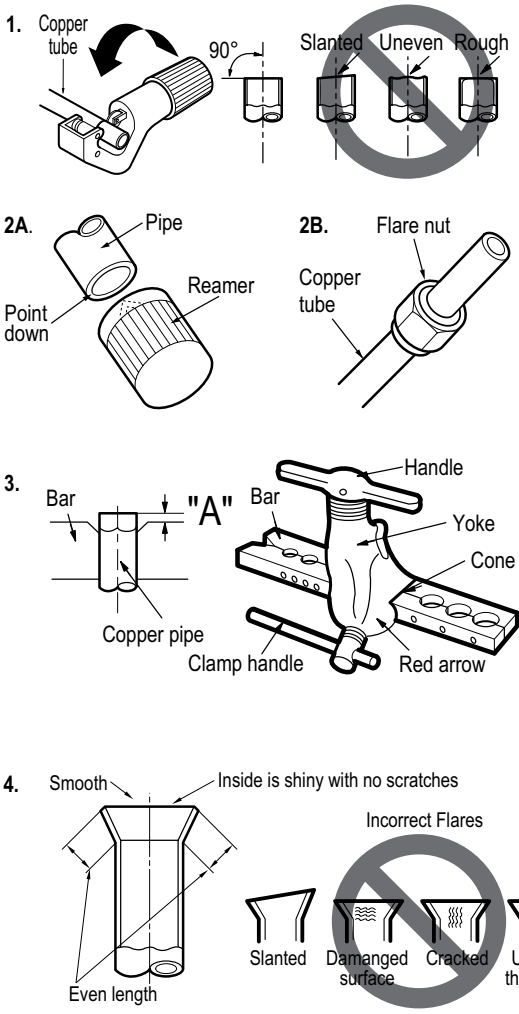


Figure 32: Dimensions of the Flare.

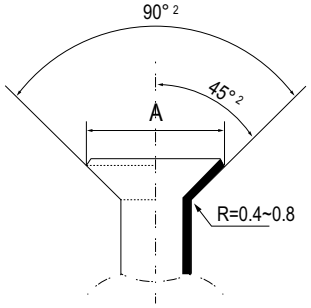


Table 20: Flared Connection Dimensions.

Indoor unit (Btu/h)	Pipe		"A"	
	Vapor (in. O.D.)	Liquid (in. O.D.)	Vapor (in.)	Liquid (in.)
≤19,100	1/2	1/4	5/8 ~ 11/16	7/16 ~ 1/2
<54,600	5/8	3/8	5/8 ~ 11/16	5/8 ~ 11/16
≤76,400	3/4	3/8	3/4 ~ 13/16	5/8 ~ 11/16

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Tightening the Flare Nuts

Figure 33: Tightening the Flare Nuts.

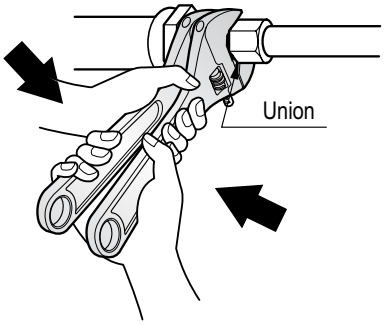


Table 21: Tightening Torque for Flare Nuts.

Pipe size (Inches O.D.)	Tightening torque (ft-lbs)	Width of the flare (A [inches])
3/8Ø	24.1 - 29.4	1/2
1/2Ø	36.5 - 44.5	5/8
5/8Ø	45.5 - 55.6	3/4

1. When connecting the flare nuts, coat the flare (inside and outside) with polyvinyl ether (PVE) refrigeration oil only.

Note:

Do not use polyolester (POE) or any other type of mineral oil as a thread lubricant. These lubricants are not compatible with PVE oil used in this system and create oil sludge leading to equipment damage and system malfunction.

2. Initially hand tighten the flare nuts using three (3) or four (4) turns.
3. To finish tightening the flare nuts, use both a torque wrench and a backup wrench.
4. After all the piping has been connected and the caps have been tightened, check for refrigerant gas leaks.

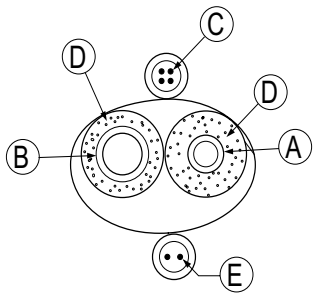
Loosening the Flare Nuts

Always use two (2) wrenches to loosen the flare nuts.

Refrigerant Piping System Insulation

To prevent heat loss/heat gain through the refrigerant piping, all refrigerant piping including liquid lines and vapor lines must be insulated separately. Insulation must be a minimum 1/2" thick, and thickness may need to be increased based on ambient conditions and local codes. All refrigerant piping including Y-branch and Header connections, field-provided isolation ball valves, service valves, and elbows must be completely insulated using closed-cell pipe insulation. All insulation joints must be glued with no air gaps. Insulation material must fit snugly against the refrigeration pipe with no air space between it and the pipe. Insulation passing through pipe hangers, inside conduit, and/or sleeves must not be compressed. Protect insulation inside hangers and supports with a second layer. All pipe insulation exposed to direct sunlight and deterioration-producing elements must be properly protected with a PVC-aluminum vapor barrier jacket, or alternatively placed in a weather-resistant enclosure such as a pipe rack with a top cover. The design engineer should perform calculations to determine if the factory-supplied insulation jackets have sufficient thickness to meet local codes and to avoid sweating at jobsite conditions. Maximum refrigerant pipe temperature is 227°F; minimum refrigerant pipe temperature is -4°F. Add additional insulation if necessary.

Figure 34: Typical Pipe Insulation, Power Wire and Communications Cable Arrangement.



Ⓐ Liquid Pipe
Ⓑ Gas Pipe
Ⓒ Power Wiring
Ⓓ Insulation
Ⓔ Communication Cables

Figure 35: Typical Insulation Butt-Joint at Indoor Unit Casing.

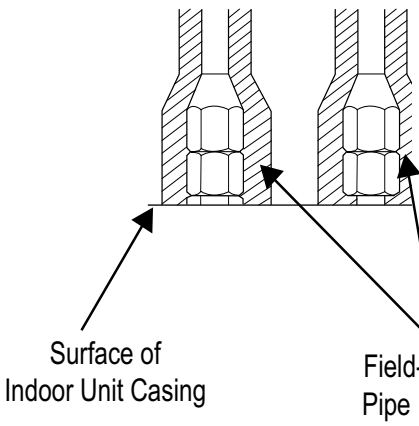
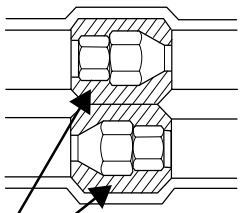


Figure 36: Typical Refrigerant Flare Fitting Insulation Detail.



REFRIGERANT PIPING DESIGN

MULTI V WATER MINI

Insulating the Refrigerant Piping

⚠ Note:

Always properly insulate the piping. Insufficient insulation will result in condensation, reduced heating/cooling performance, etc. Also, if the pipes aren't insulated properly, condensation could potentially cause damage to building finishes. Pay special attention to insulating the pipes installed in the ceiling plenum.

⚠ Note:

Follow locals codes and the designer's instructions when selecting EPDM insulation wall thickness.

Table 22: Minimum Refrigerant Pipe EPDM Insulation Wall Thickness Requirements.[1]

Classification / Piping O.D.		Air-conditioned location		Non-air conditioned location	
		1. Typical Conditioned Location	2. Special Conditioned Location	3. Typical Unconditioned Location	4. Special Unconditioned Location
Liquid pipe	ø1/4 inches	>1/2 inches	>1/2 inches	>1/2 inches	>1/2 inches
	ø3/8 inches				
	≥ø1/2 inches	>1/2 inches	>1/2 inches	>1/2 inches	>1/2 inches
Vapor pipe	ø3/8 inches	>1/2 inches	>3/4 inches	>3/4 inches	>1 inch
	ø1/2 inches				
	ø5/8 inches				
	ø3/4 inches				
	ø7/8 inches				
	ø1 inch				
	ø1-1/8 inches	>3/4 inches	>1 inch	>1 inch	
	ø1-1/4 inches				
	ø1-3/8 inches				
	ø1-1/2 inches				
	ø1-3/4 inches				

[1]*The thickness of the above insulation material is based on heat conductivity of 0.61 Btu/in/h/ft²/°F.*

1. Typical Conditioned Location

A building plenum or space that contains conditioned air that does not exceed 80°F DB.

2. Special Conditioned Location

1. When the location is air conditioned, but there is severe temperature/humidity difference due to high ceilings

• Church, auditorium, theater, lobby, etc.

2. When the location is air conditioned, but internal temperature/humidity are high

• Bathroom, swimming pool, locker room, etc.

3. Typical Unconditioned Location

An unconditioned space inside a building.

4. Special Unconditioned Location: If conditions 1 and 2 below are present.

1. An unconditioned space or plenum of a building.
2. An area where there is an elevated humidity level.

5. Additional Insulation for Indoor Units May be Required in Humid Environments.

The air conditioner factory insulation has been tested according to "ISO Conditions with Mist," and it satisfies the requirements. If the system has been operating for a long time in a high humidity environment (dew point temperature: more than 73°F), condensate is likely to form. If this happens, install 3/8 inch thick ethylene propylene diene methylene (EPDM) insulation that is plenum-rated with a heat-resistance factor of more than 248°F.

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Applying Insulation to Y-Branch and Header Fittings

Check the fit of the insulation jacket provided with the LG Y-branch and Header kits after all pipes are brazed to fittings. Mark all pipes at the point where the insulation jacket ends. Remove the jacket. Install field-supplied insulation on the pipe segments first, and then install the LG provided insulation plugs on the ends of all unused Header ports. Apply the clam-shell insulation on jackets to Y-branch and Header fittings last. Peel the adhesive glue protector slip from the insulation jacket and install the clam-shell jacket over the fitting.

Figure 39: Y-Branch Insulation.

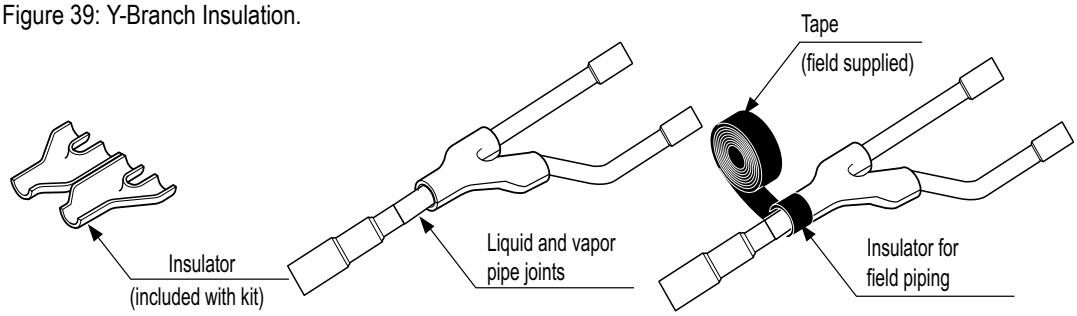


Figure 40: Header Insulation.

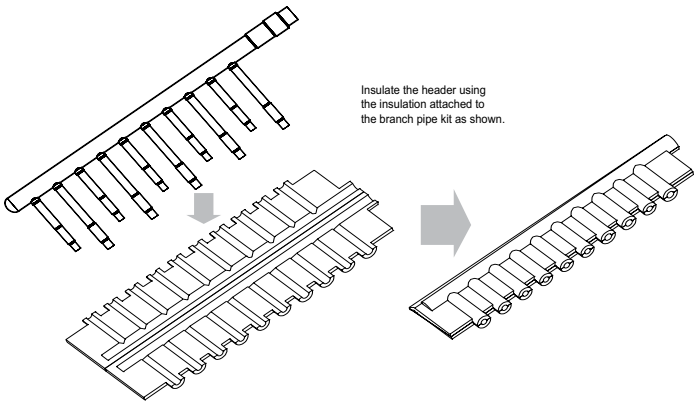


Figure 37: Joints between branch and pipe should be sealed with tape included in each kit.

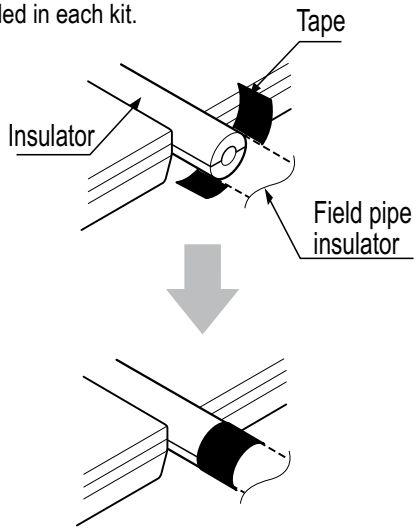
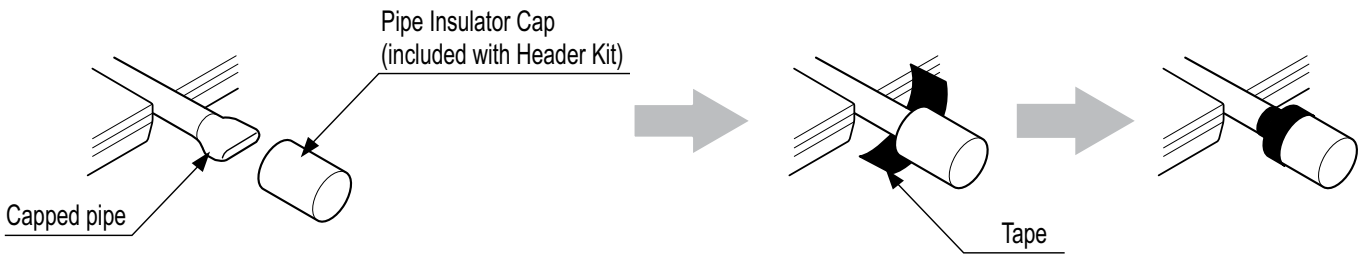


Figure 38: Cap pipes should be insulated using the insulator included in each kit, and then taped as shown.



⚠ *Note:*

Additional Insulation for Y-Branches and Headers May be Required in Humid Environments.

If the system has been operating for a long time in a high humidity environment (dew point temperature: more than 73°F), condensate is likely to form. If this happens, install 3/8 inch thick ethylene propylene diene methylene (EPDM) insulation that is plenum-rated with a heat-resistance factor of more than 248°F.

Note:

Open all isolation valves that may have been installed in the piping system. Water source unit service valves must remain closed.

Perform a Pressure (Leak) Test

Use medical grade dry nitrogen, and pressure test the refrigerant piping system using a multi step process that will assist in locating leaks (if any).

1. Pressure test the main piping only using field installed Schrader valves and pressure gauges. If the test is successful the main lines do not have leaks.
   - 150 psi for a period of 5 minutes
   - 300 psi for a period of 15 minutes
   - 550 psi for a period of 24 hours

2. Next pressure test the piping up to and including the indoor units. If the test is successful the run-out pipes and indoor units do not have leaks.
   - 150 psi for a period of 5 minutes
   - 300 psi for a period of 15 minutes
   - 550 psi for a period of 24 hours

Design Steps

The Multi V Water Mini unit will require a water cooling / heating source. This year-round heating and cooling system will use a two (2) pipe closed loop water circuit which circulates water continuously and maintains water temperature between 50°F and 113°F for cooling mode, 23°F and 113°F for heating mode. See capacity tables provided in the Multi V Water Mini Engineering Manual for performance at different entering water temperatures. At the high end of this temperature range, heat is rejected through a cooling tower (dry cooler or geothermal well), while at the low end of the temperature range an auxiliary heat source like a boiler, solar panel, or geothermal well adds heat.

Piping, pumps, and accessories shall be sized to provide adequate water flow to the water cooled unit based on nominal flow rates listed per model number.

Design Schematic

The Multi V Water Mini units have factory installed stainless steel plate heat exchangers. In order to protect these heat exchangers, it is recommended to use closed cooling towers. If open cooling towers or other open loop systems are used, an intermediate heat exchanger should be added to protect the water cooled unit from contaminants and debris in the water system that may foul or clog the heat exchanger. Open loop systems without an intermediate heat exchanger are not recommended due to risk of freezing, reduction of flow due to scaling or clogging, or other potential problems caused by improper water quality.

Figure 41: Cooling Cycle Diagram.

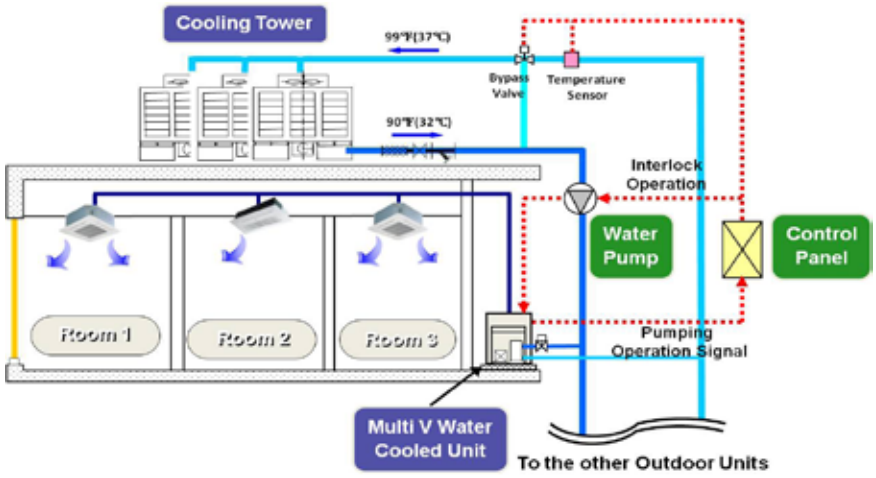
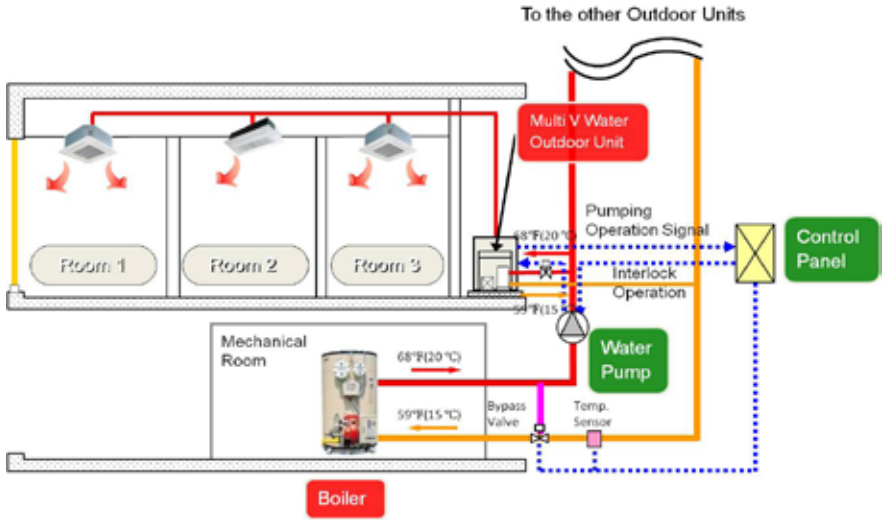


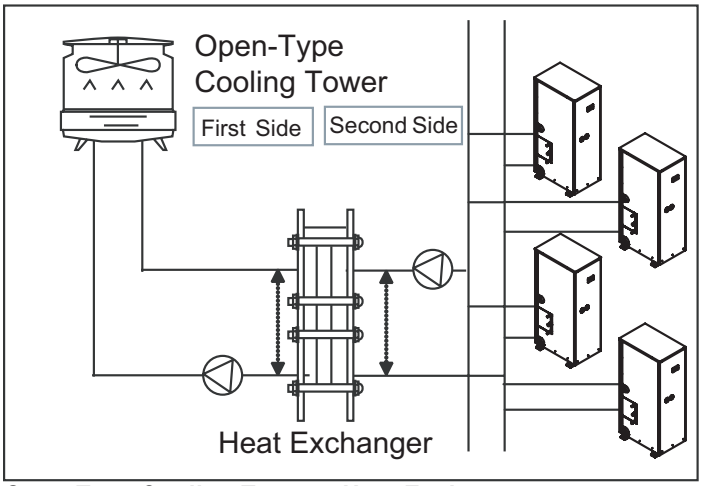
Figure 42: Heating Cycle Diagram.



WATER CIRCUIT INSTALLATION

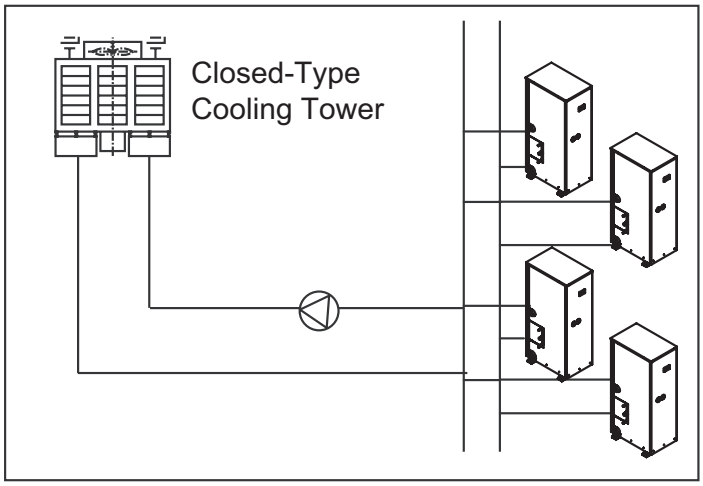
Water Circuit Design

Figure 43: Open-Type and Closed-Type Tower Design Schematic.



Open-Type Cooling Tower + Heat Exchanger

Heat exchanger is installed between the cooling tower and water source unit system piping, and the temperature difference between the first and second sides is maintained constantly.



Closed-Type Cooling Tower

Heat-source water of the cooling tower is supplied directly to the water source unit system.

⚠ ***Note:***

When using an open cooling tower or open geothermal wells, an intermediate heat exchanger is recommended to be installed to protect the water source unit from contamination.

Expansion Tank

All closed loop systems should have a bladder type expansion tank installed. The expansion tank will protect the equipment from excess pressures due to expansion and contraction of water in the loop as the temperature changes.

Heat Source and Storage Tank

There are several sources for heat that can be used for this system. They include the following:

- Electric boiler
- Gas boiler
- Solar heat with storage tanks
- Ground source heat
- Steam heat from remote central plant

To deal with thermal flux of the system, if floor space is allowed, a heat storage tank can be installed. The heat storage tank can store surplus heat or store heat at nighttime when electric rates are lower. Closed type storage tanks are recommended to prevent contamination of the water system.

Geothermal Water Circuit Design

In lieu of a cooling tower / boiler, Multi V Water Mini units may use a geothermal system that is properly sized to match the water cooled unit capacity. This year round heating and cooling system will utilize a two (2) pipe closed loop water circuit that circulates water continuously, maintaining water temperatures between 23°F and 113°F for heating, 50°F and 113°F for cooling. When the Multi V Water Mini unit is in cooling mode, heat is rejected to the geothermal system. When the Multi V Water Mini unit is in heating mode, heat is absorbed from the geothermal system.

Multi V Water Mini units have factory-installed stainless steel plate heat exchangers. To protect these heat exchangers, it is recommended to use closed geothermal water loops. Should open geothermal systems be used, an intermediate heat exchanger should be installed to isolate Multi V Water Mini units from contaminants in the water system. Open geothermal loops may contain minerals, biological contaminants, corrosive agents, or other substances which can cause scale, fouling or corrosion, that could degrade performance or shorten the life of the heat exchanger and unit.

Antifreeze can be used for all geothermal applications. Refer to antifreeze information on page 44 for recommended levels of antifreeze and correction factors.

Piping System

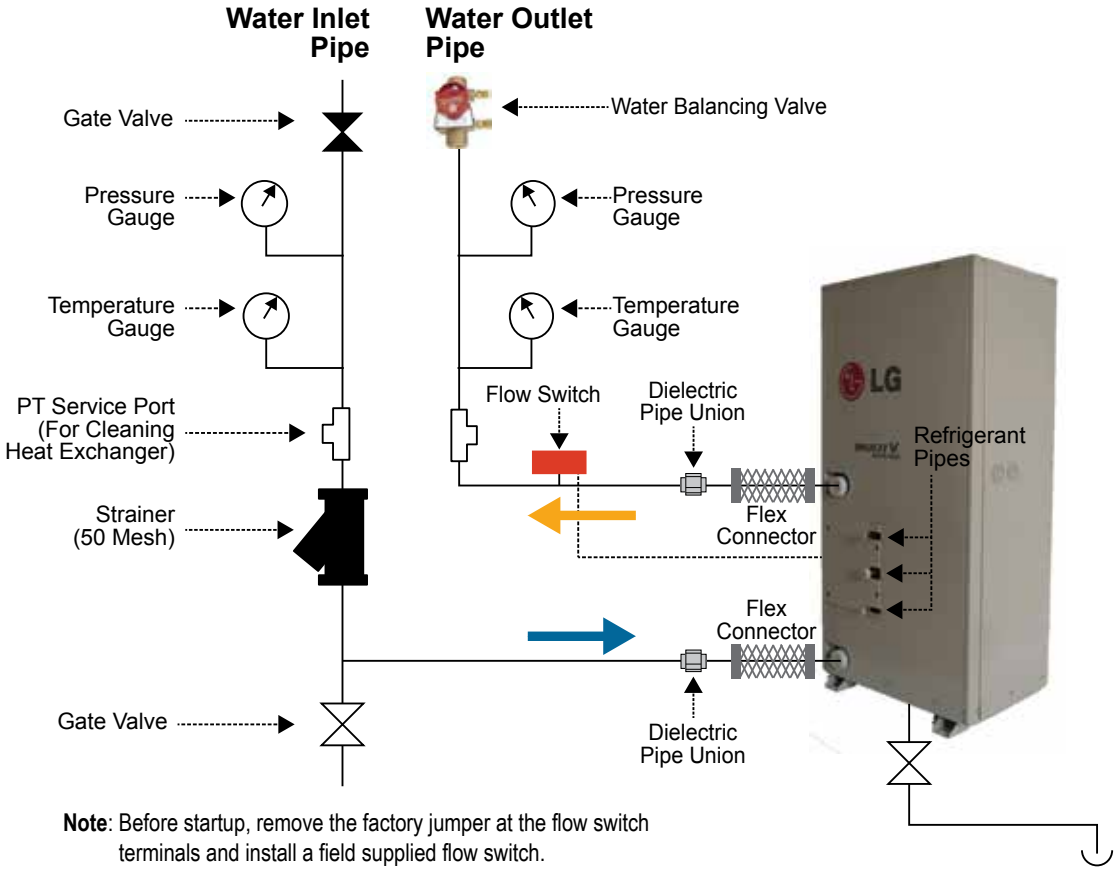
As shown on the "Typical connections for water cooled units" diagram below, the following components should be installed at each Multi V Water Mini unit (field supplied):

- Flow switch at outlet in the horizontal pipe. Wire the flow switch to communication terminals and set to shut off the WSU if flow falls below 50% of WSU design flow. The flow switch must be the normally-closed type. The flow switch must be installed within at least five (5) pipe diameters downstream and at least three (3) pipe diameters upstream of elbows, valves, or reducers which can cause turbulence and lead to flow switch flutter.
- Strainer with minimum 50 mesh screen at inlet. Clean the mesh screen twenty-four (24) hours after startup, and then clean regularly to prevent water flow blockage.
- A water balancing valve, circuit setter, or flow control valve to regulate proper water flow to each WSU.
- Dielectric pipe unions to prevent the possibility of galvanic corrosion.
- Pressure gauges at inlet and outlet.
- Thermometers at inlet and outlet.
- Flexible connectors at inlet and outlet.
- Shutoff valves at the inlet and outlet to permit service of the WSU.
- Condensate drain trap per local code.
- Service port with hose connections at inlet and outlet to flush the WSU heat exchanger when isolated from the water loop system.

Other considerations:

- Inhibitors should be used in the water loop, especially if water temperature operates above 104°F.
- Maintain water quality requirements.

Figure 44: Typical connections for water cooled units (all components shown here are field-supplied).



Note: Before startup, remove the factory jumper at the flow switch terminals and install a field supplied flow switch.

WATER CIRCUIT INSTALLATION

MULTI V WATER MINI

Piping System Specifications

Freeze Protection

The piping system should be protected from freezing during winter conditions. Heating mode of the water cooled unit will reduce water loop temperature and methods should be taken to prevent slush from forming and / or freezing of the loop water. In applications with leaving water temperatures below 40°F, freeze protection should be considered. Use of ethylene glycol, propylene glycol, or methanol is acceptable. Recommended levels of concentration (shown below) should be followed, however, the addition of antifreeze may lower the performance of the water cooled unit due to reduced heat transfer and added pressure drop.

1. Find the corresponding correction factor from table below.
2. Multiply by the water cooled unit capacity to find the net water cooled unit capacity.
3. Apply the corresponding pressure drop correction factor from table below, and multiply by the water cooled unit pressure drop to find the net water cooled unit pressure drop.

Table 23: Antifreeze Correction Factors.

Antifreeze Type	Item	Antifreeze % by Weight				
		10%	20%	30%	40%	50%
Methanol	Cooling	0.998	0.997	0.995	0.993	0.992
	Heating	0.995	0.99	0.995	0.979	0.974
	Pressure Drop	1.023	1.057	1.091	1.122	1.160
Ethylene Glycol	Cooling	0.996	0.991	0.987	0.983	0.979
	Heating	0.993	0.985	0.997	0.969	0.961
	Pressure Drop	1.024	1.068	1.124	1.188	1.263
Propylene Glycol	Cooling	0.993	0.987	0.98	0.974	0.968
	Heating	0.986	0.973	0.96	0.948	0.935
	Pressure Drop	1.040	1.098	1.174	1.273	1.405

Figure 45: Cooling Capacity Correction Factor Chart.

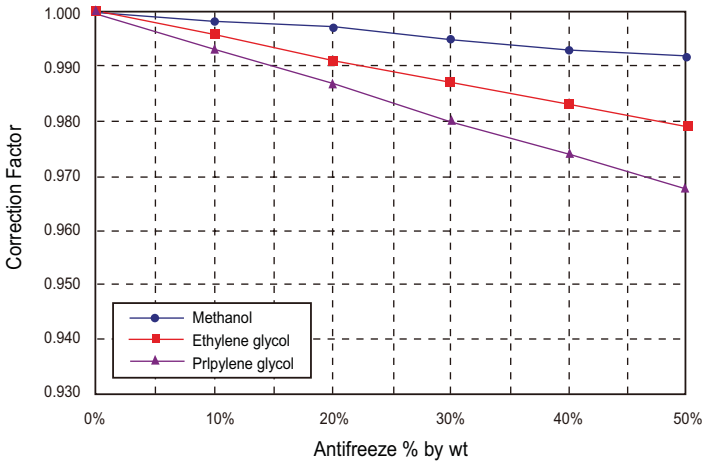
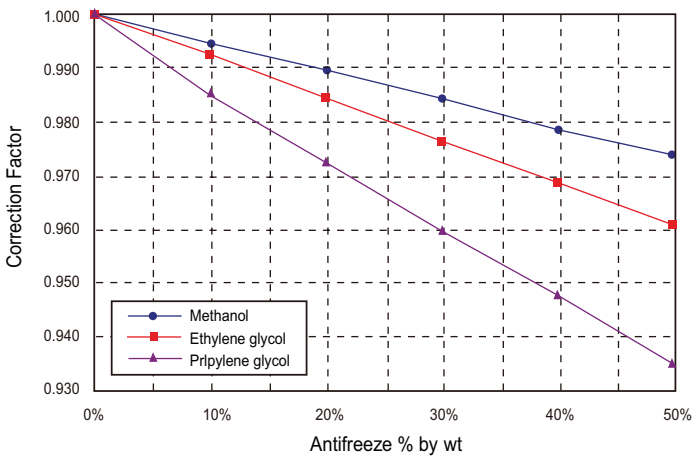


Figure 46: Heating Capacity Correction Factor Chart.



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Water Quality Requirements

Impurities in the water can influence the performance and life expectancy of the water cooled unit. The water should be tested and treated using a local water treatment professional. The following levels should be maintained:

Table 24: Minimum Water Quality Requirements.

	Closed Type System		Effect	
	Circulating Water	Supplemented Water	Corrosion[1]	Scale[1]
Basic Item				
pH (77°F)	7.0 ~ 8.0	7.0 ~ 8.0	●	●
Conductivity (77°F) mS/m	Below 30	Below 30	●	●
Chlorine ions (mg Cl^-/ℓ)	Below 50	Below 50	●	
Sulfate ions (mg SO_4^{2}/ℓ)	Below 50	Below 50	●	●
Acid consumption (pH4.8) (mg$CaCO_3$/ℓ)	Below 50	Below 50		●
Total Hardness (mg $CaCO_3$/ℓ)	Below 70	Below 70		●
Calcium Hardness (mg $CaCO_3$/ℓ)	Below 50	Below 50		●
Ionic-static silica (mg SiO_2/ℓ)	Below 30	Below 30		●
Reference Item				
Iron (mg Fe/ℓ)	Below 1.0	Below 0.3	●	●
Copper (mg Cu/ℓ)	Below 1.0	Below 0.1	●	
Sulfate ion (mg SO42/ℓ)	Must not be detected	Must not be detected	●	
Ammonium ion (mg NH4+)ℓ	Below 0.3	Below 0.1	●	
Residual chlorine (mg Cl/ℓ)	Below 0.25	Below 0.3	●	
Free carbon dioxide (mg CO2/ℓ)	Below 0.4	Below 4.0	●	
Stability index			●	●

[1]The "●" mark for corrosion and scale means that there is a possibility of occurrence.

⚠ Note:

- *Inhibitors should be used in the water loop, especially if water temperature operates above 104°F.*
- *Air shall be purged from the system.*

Pipe Insulation

Water pipe insulation is suggested in the following conditions:

- Where water pipe is subject to freezing.
- Water pipe where water can condense on surface of pipe from ambient room temperatures higher than temperature of water in the pipe. If water temperature is maintained at 68°F in winter and 86°F in summer, insulation will not be required.
- On boiler water pipes to save energy losses from heat source.
- On condensate drain lines.
- Where required by local code.

WATER CIRCUIT INSTALLATION

Piping System Specifications

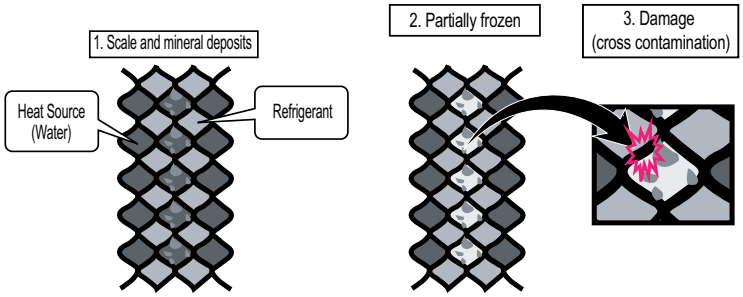
Device Protection Details

Strainer on Water Pipe

To protect the water source unit, a strainer with ≥50 mesh must be installed on the water source unit inlet piping. If not installed, the heat exchanger can be damaged by particles in the water supply.

1. The water-supply circuitry within the plate-type heat exchanger is comprised of many small paths / channels.
2. If a strainer with 50 mesh or more is not included, foreign particles can partially block the water flow.
3. When the system operates in heating, the plate-type heat exchanger functions as an evaporator, therefore, the temperature of the coolant supply drops the temperature of the heat source water supply, which can result in ice forming in the water circuitry.
4. As heating operation progresses, the channels can be partially frozen, which may damage the plate-type heat exchanger.
5. If the heat exchanger is damaged, the coolant supply and the heat-source water supply will mix, and the system will not function.

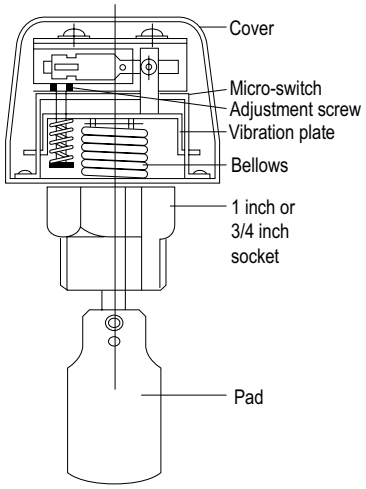
Figure 47: Potential Heat Exchanger Damage.



Flow switch

- It is recommended to install a flow switch on the water pipes that are connected to the water source unit.
- Flow switch should be rated for 208-230V and be a normally closed type. (Flow switch will perform as the first protection device when heated water is not supplied. If the required water level is not present after installing the flow switch, the water source unit will display a CH24 error code and will stop operating.)
- When setting the flow switch, it is recommended to use the default set value of the water source unit to satisfy the minimum flow rate.
  (Minimum flow rate range is 50%; Reference flow rate: 3-ton - 10.6 gpm, 4-ton - 13.2 gpm, 4.4-ton - 15.9 gpm.)
- Select a flow switch following the pressure specification of the water supply system.

Figure 48: Flow Switch Schematic.



⚠ Note:

- *If the set value does not satisfy the minimum flow rate, or if the set value is changed by the user arbitrarily, it can result in performance deterioration or system failure.*
- *If the water source unit operates with a hard water supply, the heat exchanger can be damaged or system failure can occur.*
- *If the water source unit displays a CH24 or CH180 error code, it is possible that the interior of the plate-type heat exchanger is partially frozen. If this occurs, resolve the partial freezing issue and then operate the water source unit again. (Causes of partial freezing: Insufficient heat water flow rate, water not supplied, insufficient coolant, foreign particles inside plate-type heat exchanger.)*

WATER CIRCUIT INSTALLATION

Flow Switches and Solenoid Valve Wiring

See diagrams below for suggested flow switch wiring. Also shown is wiring for solenoid valves (optional) to turn water flow on / off to the unit.

Figure 51: Water Solenoid Valve Controlled by Building Management System (BMS).

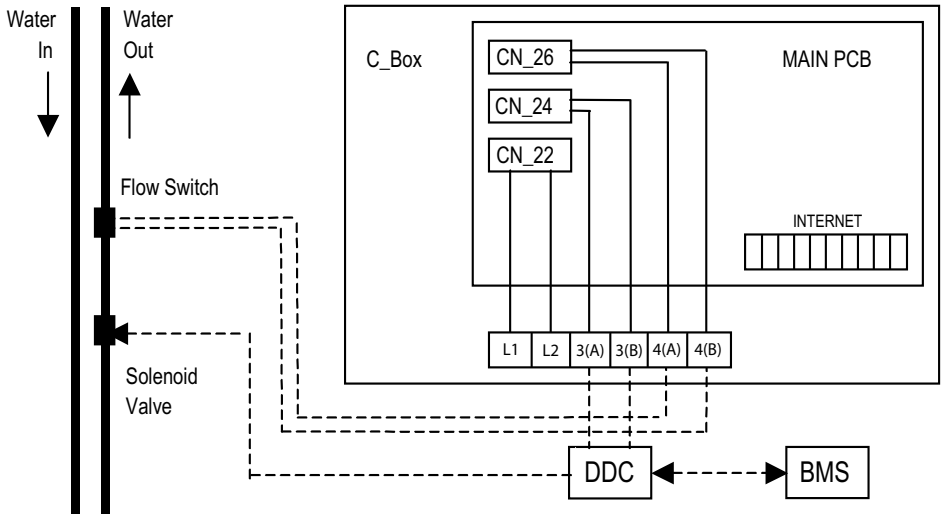


Figure 50: Water Solenoid Valve Controlled by Water Source Unit.

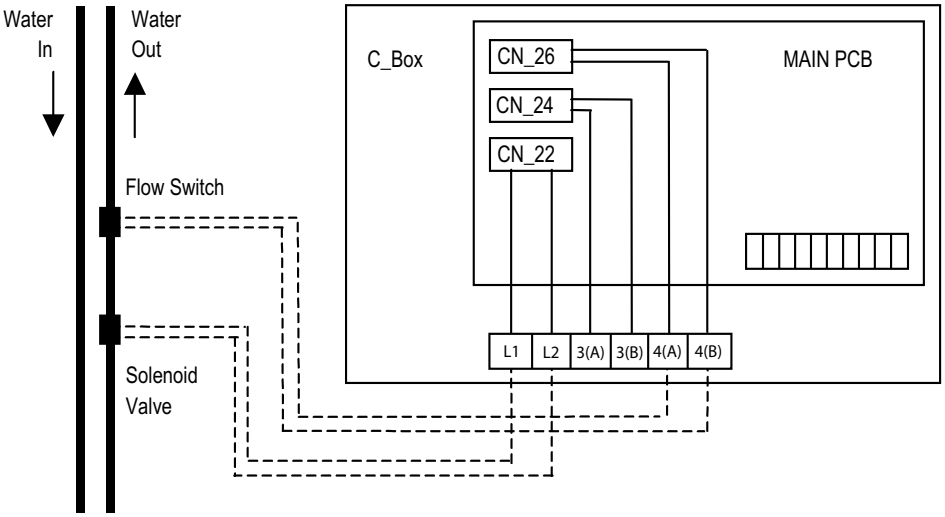
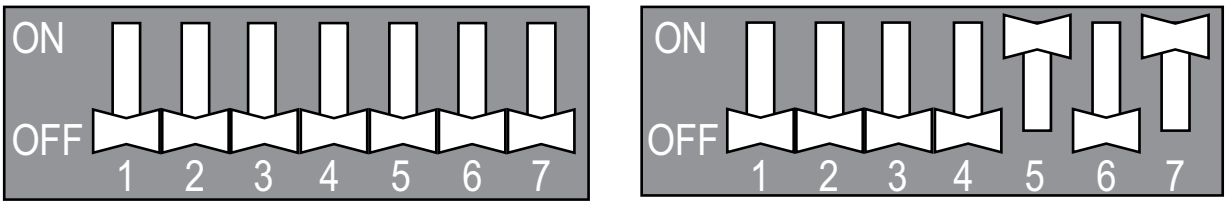


Figure 49: Set the DIP switches as below and turn on the power (For water solenoid valve controlled by water source unit).



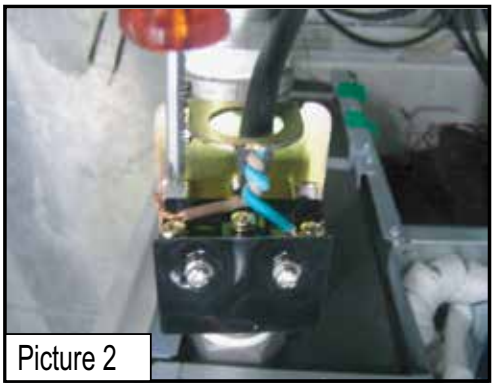
WATER CIRCUIT INSTALLATION

MULTI V WATER MINI

Flow Switches and Solenoid Valves

- The flow switch must be installed at the horizontal pipe of the water source unit's heat water-supply outlet. Verify the direction of the water flow before installation. (Picture 1)
- Remove the jumper wire and connect to the communication terminals (4[A] and 4[B]) of the water source unit's control box. (Pictures 2, 3) Open the flow switch cover and check the wiring diagrams before connecting the wires. Wiring methods can vary by flow switch manufacturer.
- If necessary (and after consulting with an LG representative), use the flow rate detection contact to adjust flow rate to within the minimum range. (Picture 4)
  Minimum flow rate range of this product is 50%. Adjust the flow switch to the contact point when the flow rate reaches 50%.
  (Minimum flow rate range is 50%; Reference flow rate: 3-ton - 10.6 gpm, 4-ton - 13.2 gpm, 4.4-ton - 15.9 gpm.)

Picture 1



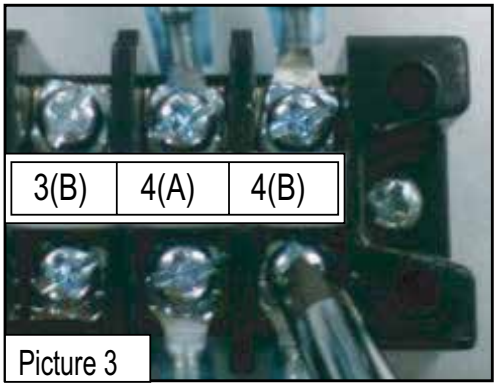
Picture 2

⚠ Note:

- *If the product operates while the flow switch contact point is out of the permitted range, it can result in performance deterioration or system failure.*
- *A normally closed type of flow switch must be used.*

Solenoid Valves (Optional)

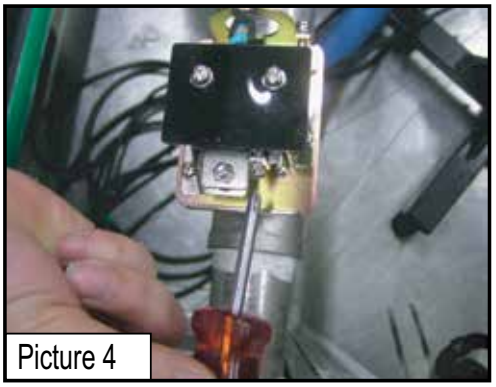
Solenoid valves may be installed to shut off water flow to the water source unit when the unit turns off. Solenoid valves are field supplied, must be rated for 208-230V, and shall be wired to terminals L1 and L2 on the water source unit PCB.



Picture 3

⚠ Note:

Field-supplied solenoid valve must be a normally closed type.



Picture 4

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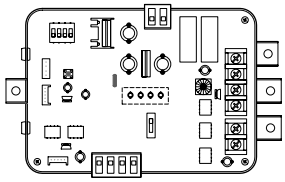
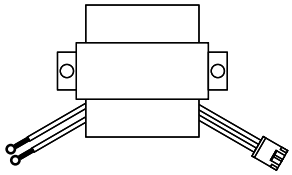
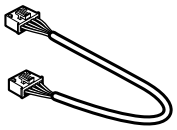
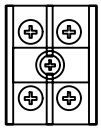
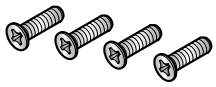
WATER CIRCUIT INSTALLATION

Variable Water Flow Control Kit

Variable Water Flow Control Kit (Model No. PRVC1) allows connection of Multi V Water Mini units to a variable pumping condenser water systems. The control board, transformer, and wiring provide connections to a field-supplied modulating water valve.

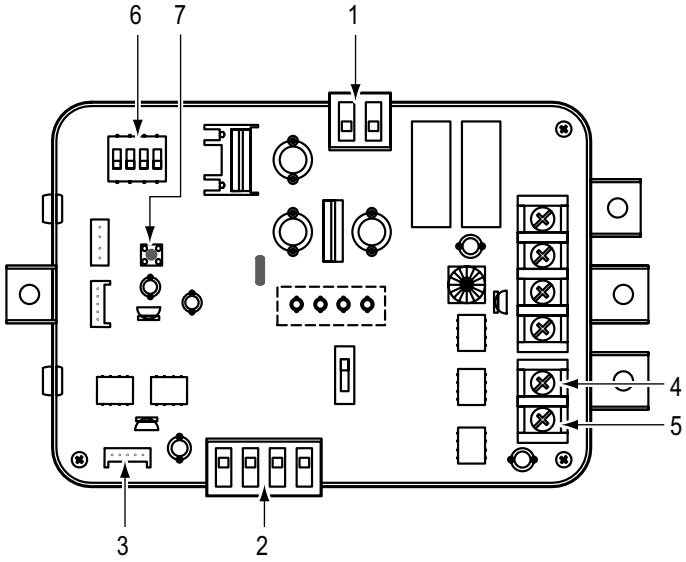
Variable Water Flow Control Kit Parts (included)

 Variable Water Flow Control PCB	 Transformer
 Cable Assembly	 Terminal Block Assembly
 Screws	

Variable Water Flow Control Kit PCB

1. CN_PWR: Power input terminal (DC 12V)
2. CN_AO: Signal output terminal to control a water flow control valve (DC 0~10V)
3. CN_OUT: Water source unit connector
4. BUS_A: RS-485 (+) terminal
5. BUS_B: RS-485 (-) terminal
6. SWDIP: Switch to select main function
7. SW1: Reset switch

Figure 52: Variable Water Flow Control Kit PCB Diagram.



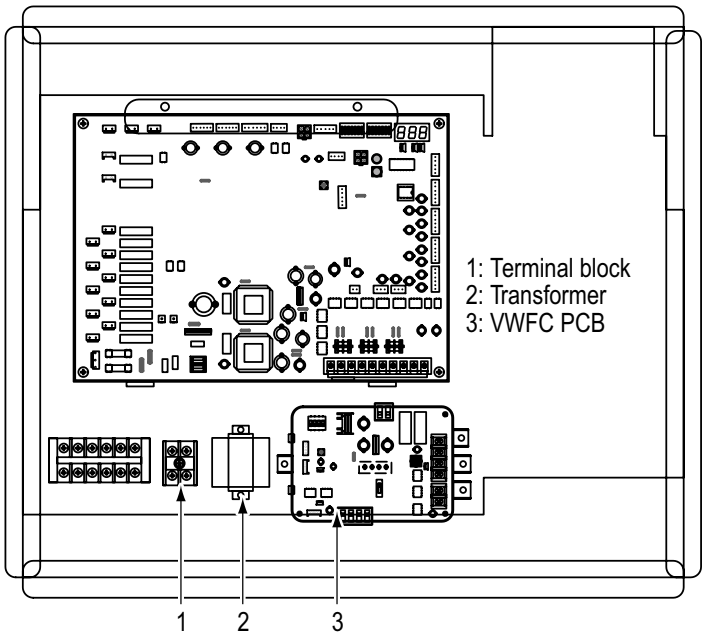
WATER CIRCUIT INSTALLATION

Variable Water Flow Control Kit

Installation

1. Shut off the main power to the water source unit.
2. Install the Variable Water Flow Control (VWFC) PCB in the control box by using the included screws.
3. Install the transformer in the control box by using the included screws.
4. Install the terminal block in the control box by using the included screws.
5. Connect the Main PCB (CN41) to the VWFC (CN_OUT) by using the cable assembly.
6. Connect the blue wire of transformer to the Main PCB (JIG1[L], JIG2[N]).
7. Connect the red wire of transformer to the terminal block (two-pin, yellow terminal block).
8. Connect a power cable (DC 12V) to CN_PWR (12V, GND) of the VWFC.
9. Connect a signal cable (DC 0~10V) of the water flow control valve to CN_AO (AO_01[A+], GND[A-]) of the VWFC.
10. Case of two water flow control valve, Connect a signal cable (DC 0~10V) of water flow control valve to CN_AO (AO_02[B+], GND[B-]) of VWFC.
11. Connect a power cable (AC 24V) of the water flow control valve to the terminal block (two-pin, yellow terminal block, max. current 0.42A).
12. Connect the RS-485 communication cable to CN_COMM (BUS_A, BUS_B) of VWFC.
13. Set the main function dip switch of the VWFC PCB.
14. Set the dip switch of the water source unit main PCB.
15. Turn on the main power to the water source unit.
16. Check the signal of water flow control valve to CN_AO (AO_01, GND) of VWFC, and check the water flow rate.

Figure 53: Control Kit within the Water Mini Unit.

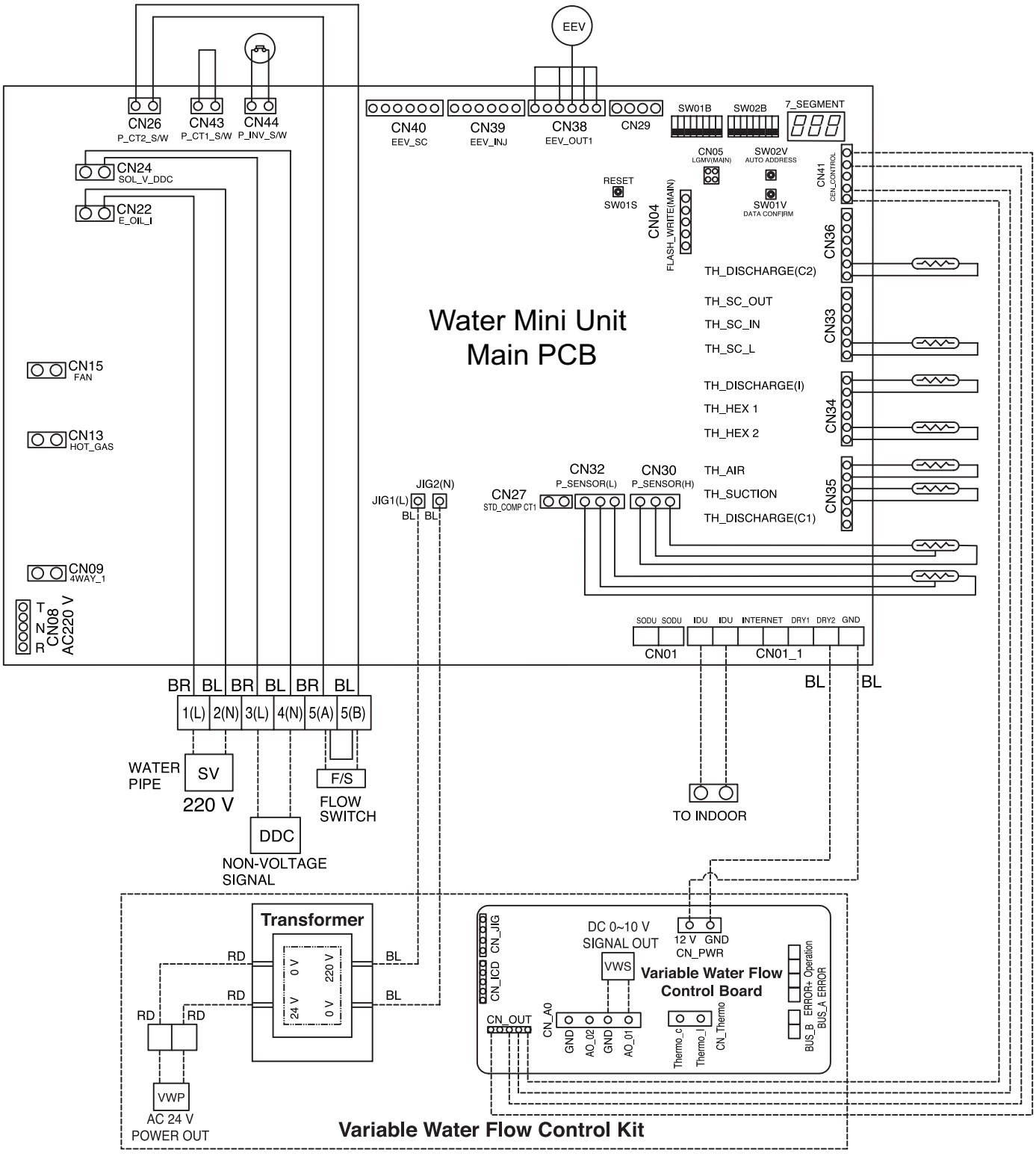


Note:

- *Install the product on a flat surface with the enclosed screws, otherwise, the VWFC PCB may not be anchored properly.*
- *Do not damage the case of the Variable Water Flow Control Kit as it may cause the PCB to malfunction.*

Variable Water Flow Control Kit Wiring Diagram

Figure 54: Variable Water Flow Control Kit Wiring Diagram.

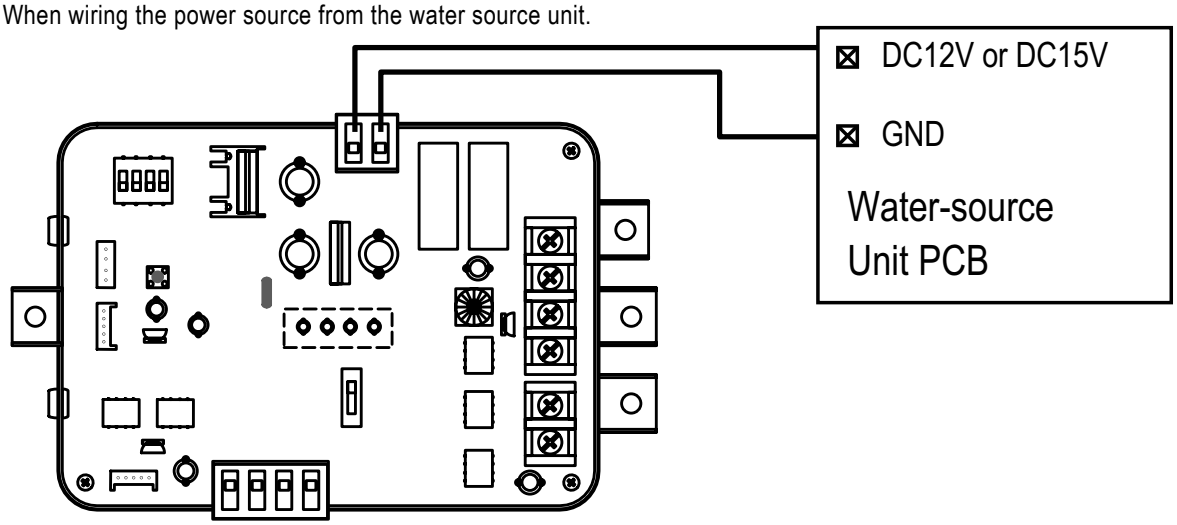


WATER CIRCUIT INSTALLATION

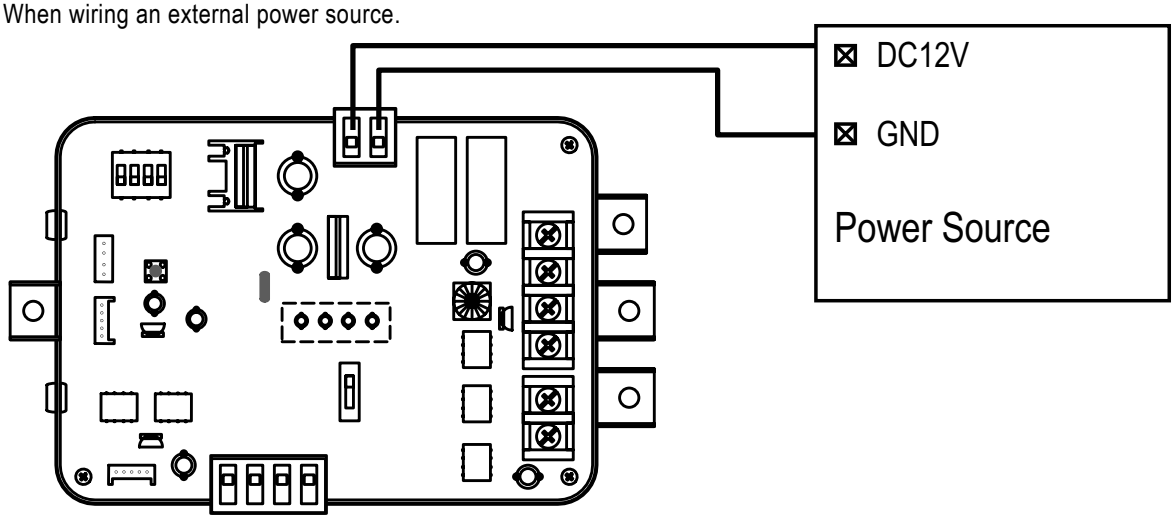
Variable Water Flow Control Kit

Variable Water Flow Control Kit Power Source Input

When wiring the power source from the water source unit.



When wiring an external power source.

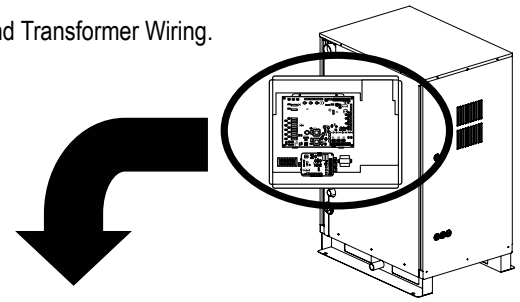


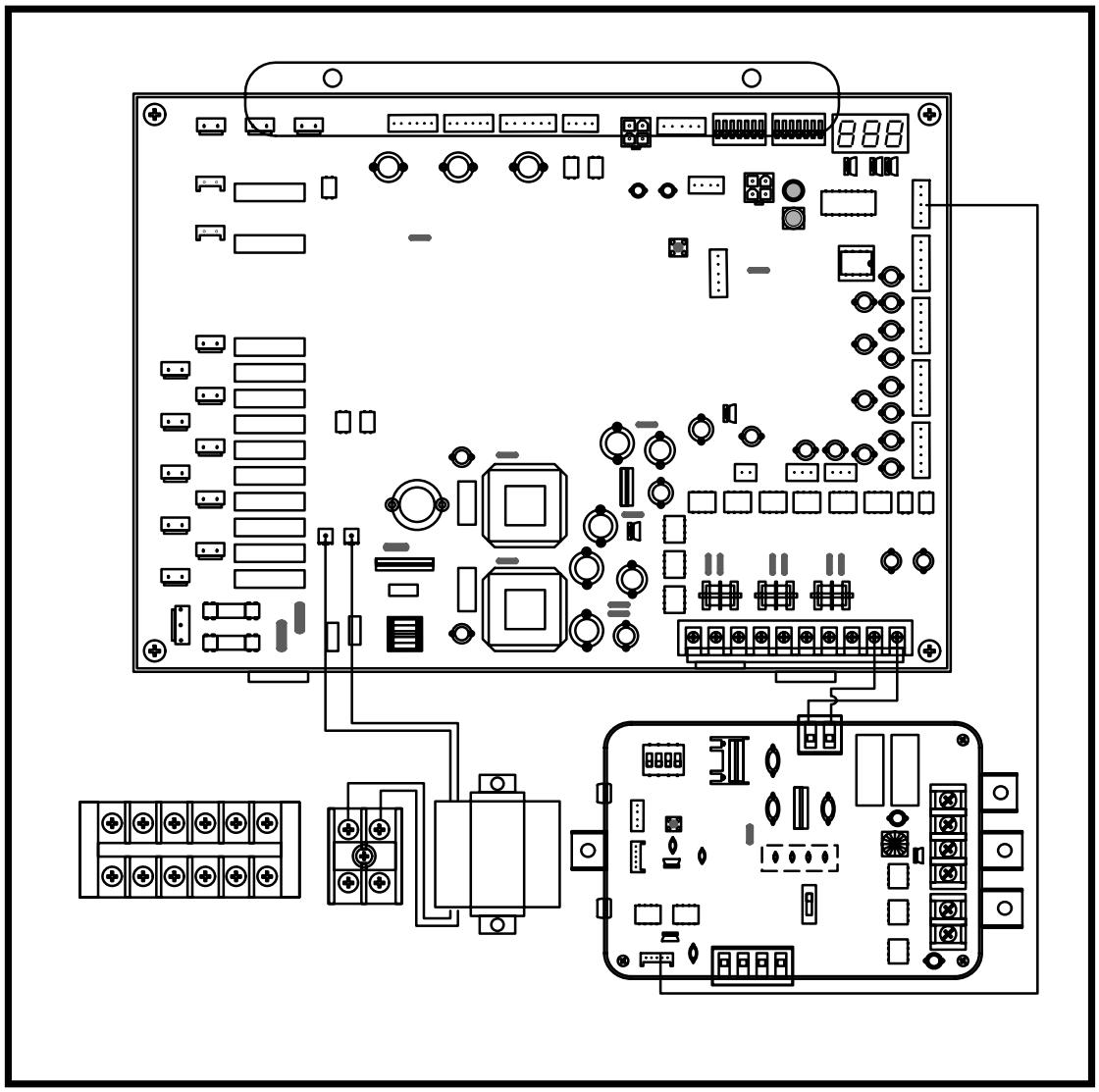
⚠ ***Note:***

- *The Variable Water Flow Control Kit can accept only DC power input. Do not use 220VAC power input as it will damage the unit.*
- *The use of an external power source is recommended.*

Wiring for the Variable Water Flow Control Kit Power Source PCB and Transformer

Figure 55: Variable Water Flow Control Kit Power Source PCB and Transformer Wiring.



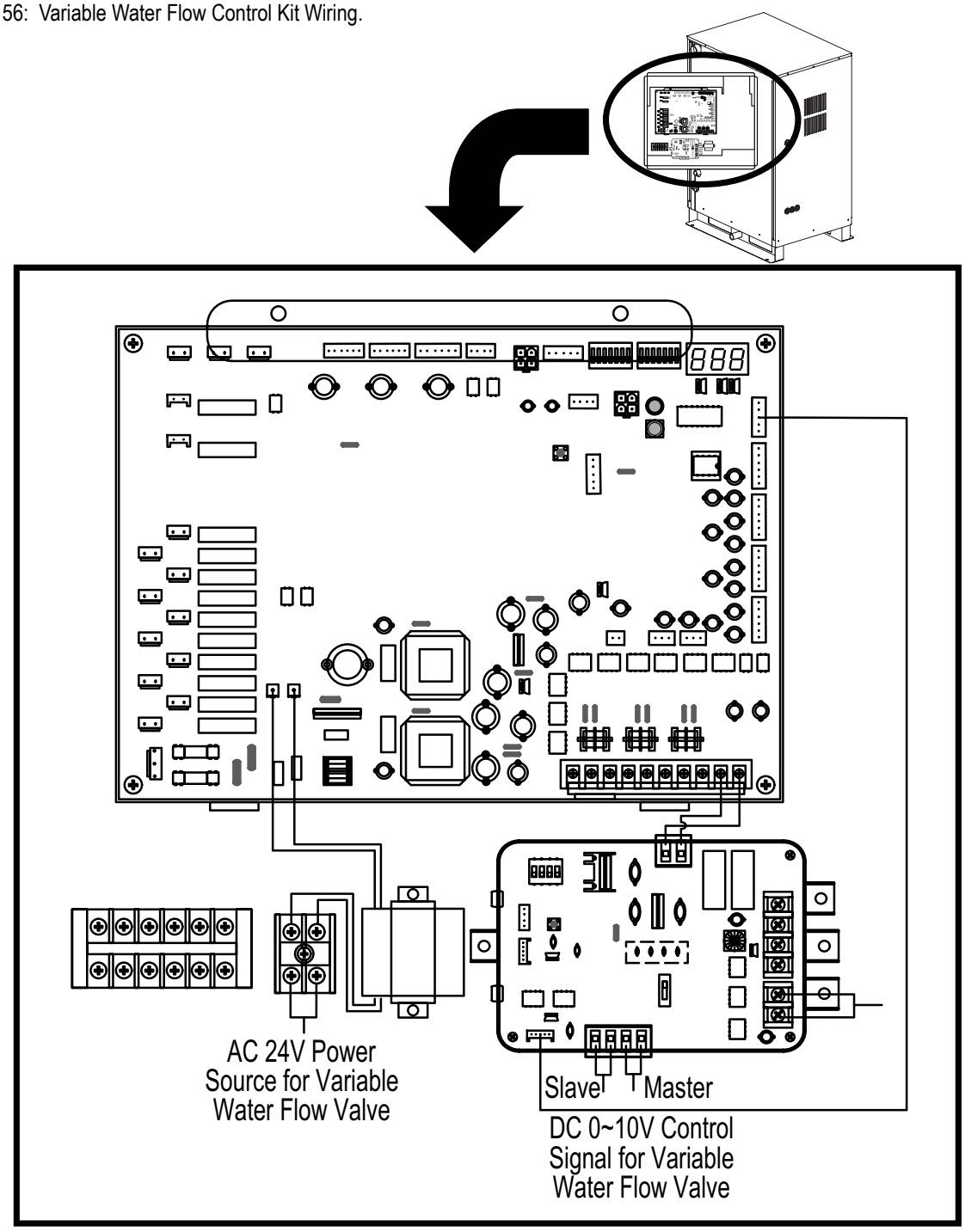


Note:

- *PCB and transformer can accept only DC 12V power input. Do not use AC power input as it will damage the unit.*
- *AWG 23 wiring is recommended for the power (DC 12V) line.*

Wiring for the Variable Water Flow Control Kit Valve

Figure 56: Variable Water Flow Control Kit Wiring.



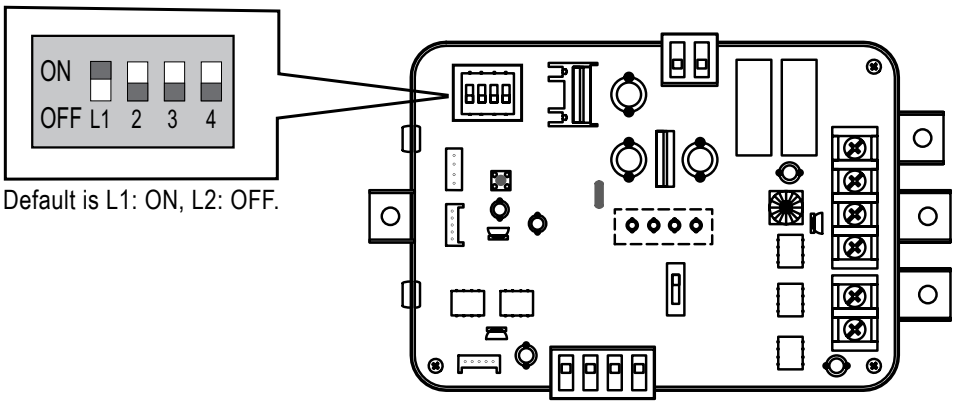
Note:

- *The Variable Water Flow Control Kit can control a maximum of two valves. If only one valve is present, then the slave signal connector must not be used.*
- *AWG 23 wiring is recommended for the power (AC 12V) line and signal (DC 0~10V) line.*

Variable Water Flow Control Kit DIP Switch Settings

Using 'SWDIP', select the control function using the DIP switches as described below.

Figure 57: DIP Switch Setting.



Default is L1: ON, L2: OFF.

Table 25: Output Signal Setting.

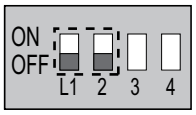
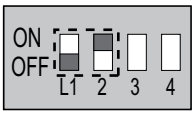
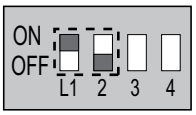
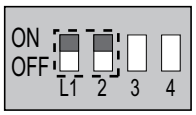
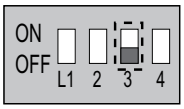
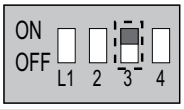
DIP Switch Setting	Function
	Control signal : DC 0V(OFF), DC 8~10V(ON)
	Control signal : DC 0V(OFF), DC 6~10V(ON)
	Control signal : DC 0V(OFF), DC 4~10V(ON) Default status
	Control signal : DC 0V(OFF), DC 2~10V(ON)

Table 26: RS-485 Communication Function Setting.

DIP Switch Setting	Function
	RS-485 communication function enable
	RS-485 communication function disable

⚠ *Note:*

- *After the DIP switch is changed, the reset switch must be pressed to reflect the setting.*
- *Before operating the water source unit, check the water flow rate and the PCB voltage signal.*
- *Minimum flow rate recommended 40% of rated flow rate; if the flow rate is lower, it will damage the water source unit.*

WATER CIRCUIT INSTALLATION

Variable Water Flow Control Kit

Water Source Unit DIP Switch Settings

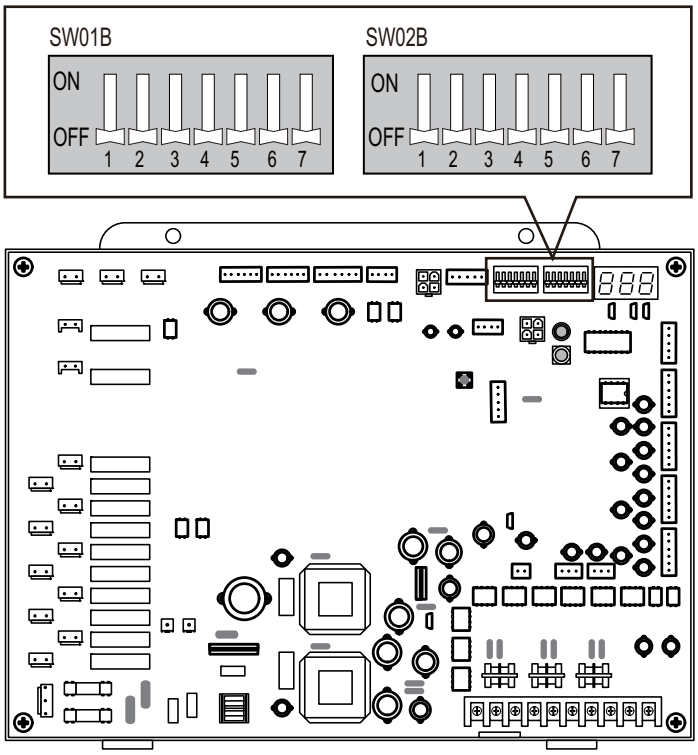
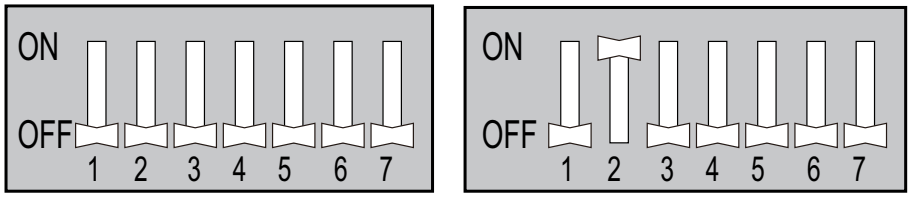


Table 27: Water Source Unit DIP Switch Settings.

DIP Switch Setting	Function
	Variable Water Flow Control Mode

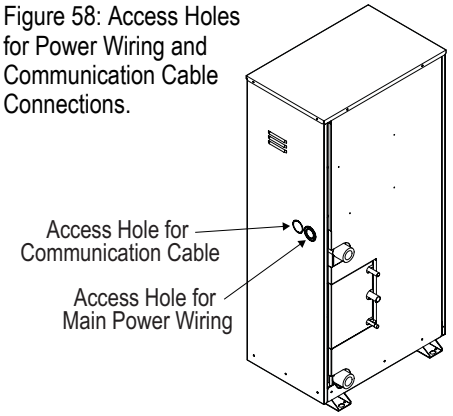
⚠ ***Note:***

- *After the DIP switch is changed, the reset switch must be pressed to reflect the setting.*
- *Before operating the water source unit, check the water flow rate and the PCB voltage signal.*
- *Minimum flow rate recommended 40% of rated flow rate; if the flow rate is lower, it will damage the water source unit.*

⚠ WARNING

- *All power wiring and communication cable installation must be performed by authorized service providers working in accordance with local, state, and NEC regulations related to electrical equipment and wiring, and following the instructions in this manual.*
- *Undersized wiring may lead to unacceptable voltage at the unit and may cause unit malfunction and be a fire hazard.*
- *Properly ground the water source unit and indoor units. Ground wiring must always be installed by a qualified technician. Do not connect ground wire to refrigerant, gas, or water piping; to lightening rods; to telephone ground wiring; or to the building plumbing system. Failure to properly provide an NEC approved earth ground can result in equipment malfunction, property damage, electric shock, physical injury or death.*

Figure 58: Access Holes for Power Wiring and Communication Cable Connections.



- *Install appropriately sized breakers / fuses / overcurrent protection switches and wiring in accordance with local, state, and NEC regulations related to electrical equipment and wiring, and following the instructions in this manual. Generated overcurrent may include some amount of direct current. Using an oversized breaker or fuse may result in equipment malfunction, property damage, electric shock, physical injury or death.*
- *Consider ambient conditions (temperature, direct sunlight, inclement weather, etc.) when selecting, installing, and connecting the power wiring.*

Separating Power Wires and Communication Cables

- Position the power wiring a minimum of two (2) inches away from the communication cables to avoid operation problems caused by electrical interference. Do not run both in the same conduit.
- If it is necessary to run the power wiring and communication cable alongside each other and cannot be avoided, table below for minimum recommended distances.

Table 28: Power Wire and Communications Cable Minimum Required Separation Minimum Allowable Distances.

Capacity of Power Supply Wiring (current)		Recommended Minimum Distance[1,2]
100V or more	10A	11-13/16 inches
	50A	19-11/16 inches
	100A	39-3/8 inches
	Exceed 100A	59-1/16 inches

[1]The figures above are based on parallel lengths up to 328 feet long. For lengths in excess of 328 feet, the distances will have to be recalculated in direct proportion to the additional line lengths involved.
[2]If the power supply waveform continues to exhibit some distortion, the space between the power wiring and communication cable should be increased.

⚠ *Note:*

- *Do not bunch the power wiring and communication cables together.*
- *Do not run the power wiring and the communication cable in the same conduit.*

ELECTRICAL SYSTEM INSTALLATION

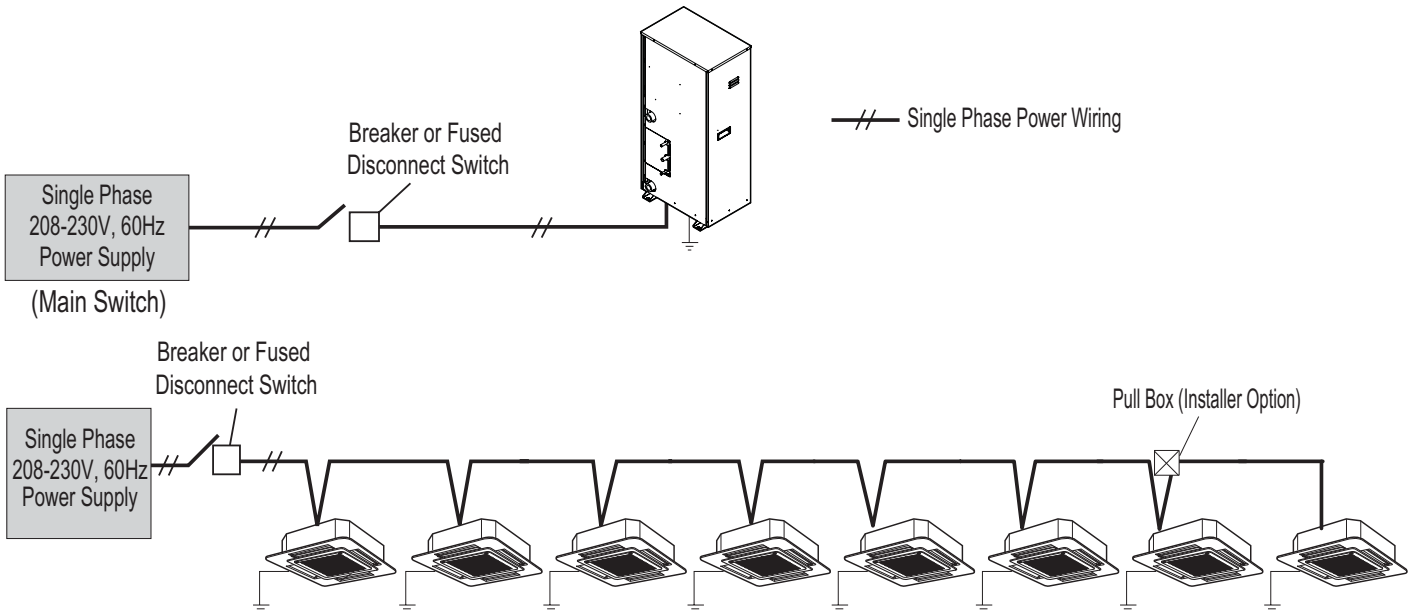
MULTI V WATER MINI

Power Wiring

Power Supply / Power Wiring Specifications

1. Water source unit and indoor units must obtain power from separate breakers:
   - Water source unit: 1Ø, 208-230V, 60Hz
   - Indoor units: 1Ø, 208-230V, 60Hz (Indoor units draw minimal power. Where permitted by NEC and local code, it may be prudent to connect multiple indoor units to a properly sized breaker.)
2. Power supply wire type and size should be selected based on NEC and local codes. Maximum allowable voltage fluctuation ±10% or nameplate rated value.
3. Properly ground the water source unit and indoor units per NEC and local code.

Figure 59: Schematic of Suggested Power Wiring.



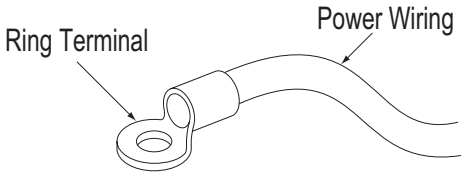
Connecting the Power Wiring

Best practice dictates using ring or spade terminals to terminate power wiring at the power terminal block.

If ring terminals or spade clips are not available, then:

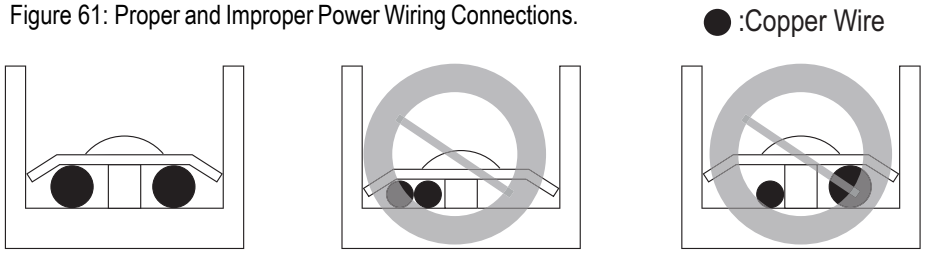
- Do not terminate different gauge wires to the power terminal block. (Slack in the wiring may generate heat.)
- When terminating wires of the same thickness, follow the instructions demonstrated in the figures below.

Figure 60: Close up of a Typical Ring Terminal.



- Firmly attach the wire; secure in a way to prevent external forces from being imparted on the terminal block.
- Use an appropriately sized screwdriver for tightening the terminals.
- Do not overtighten the connections; over-tightening may damage the terminals.

Figure 61: Proper and Improper Power Wiring Connections.



⚠WARNING

If power wires are not properly terminated and firmly attached, there is risk of fire, electric shock, and physical injury or death.

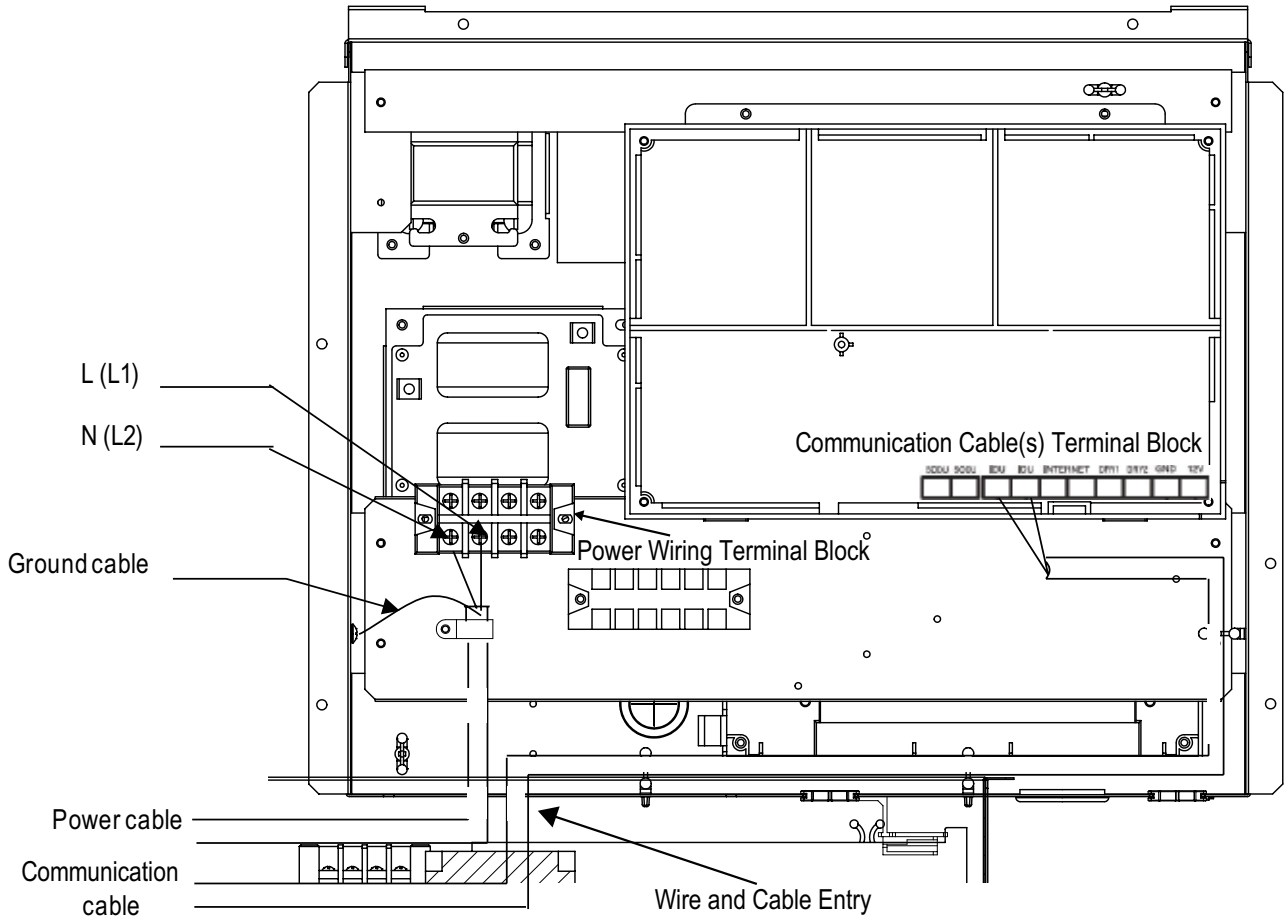
LG

ELECTRICAL SYSTEM INSTALLATION

Wiring and Cable Terminations

1. Connect power supply wire to terminal block of control case using clamps on the supporter and control case as shown in Figure 62.
2. Connect communication wire to main PCB terminal block using clamps on the supporter and main PCB case as shown in Figure 62.

Figure 62: Power Wiring and Communication Cable Connections in the Water Source Unit.



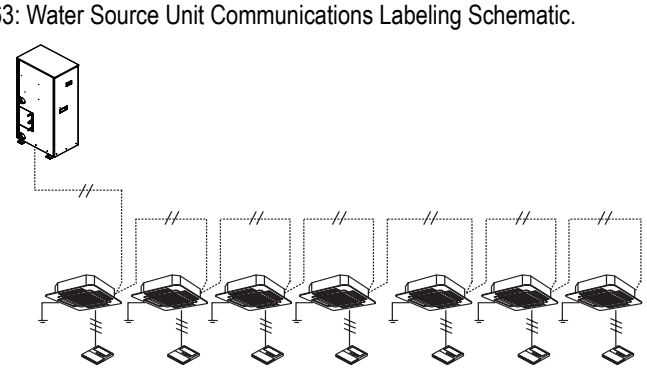
Note:

- *Never apply line voltage power to the communications cable terminal block. If contact is made, the PCBs may be damaged.*
- *Always include some allowance in the wiring length when terminating. Provide some slack to facilitate removing the electrical panels while servicing.*

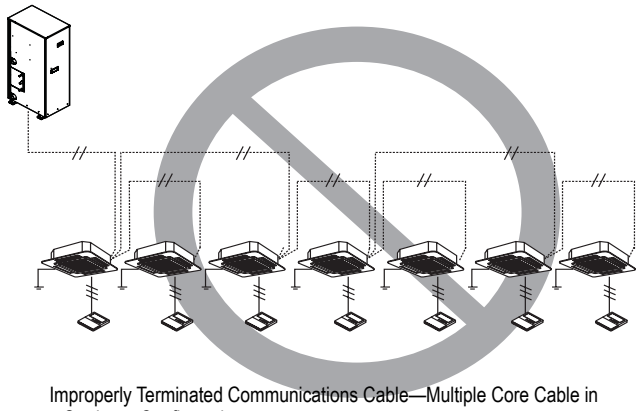
General Communication Cable Specifications

- Use a two-core, shielded, stranded cable between the water source unit and the indoor units.
  - Minimum 18 gauge shielded CVVS or CPEVS cable
  - Insulation material as required by local code
  - Rated for continuous exposure of temperatures up to 140°F
  - Maximum allowable cable length: 984 feet.
- Use copper-bearing ring or spade terminals to terminate communication cables.
- Firmly attach the cable; provide slack but secure in a way to prevent external forces from being imparted on the terminal block.
- Communications cable connecting the water source unit an indoor unit(s) should be installed and terminated in a daisy chain (BUS) configuration starting at the water source unit.
- Terminate the cable shield to a grounded surface at the water source unit only. Cable shields between connected devices shall be tied together and continuous from the water source unit to the last device connected.

Figure 63: Water Source Unit Communications Labeling Schematic.



Recommended—Two-Core Shielded, Stranded Cable in a Daisy Chain Configuration



Improperly Terminated Communications Cable—Multiple Core Cable in a Starburst Configuration

⚠ Note:

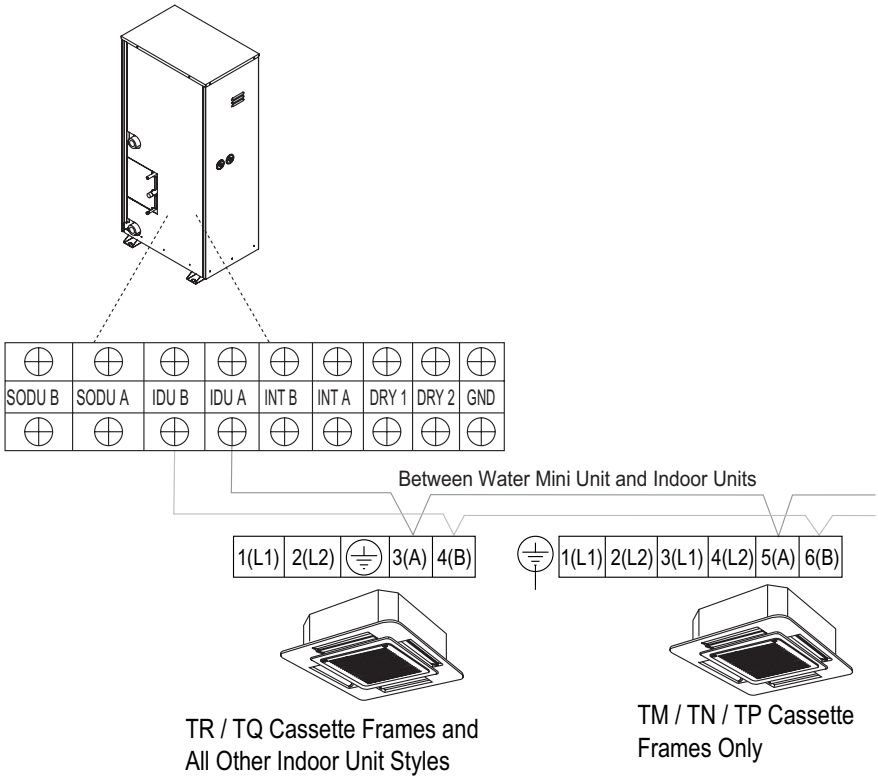
- *Ring and spade terminals used to connect communications cables MUST be copper bearing. Do NOT use terminals that are galvanized or nickle plate over steel.*
- *Always verify the communication cable is connected to a communications terminal on the water source unit. Never apply line voltage power to the communication cable connection. If contact is made, the PCBs may be damaged.*
- *The shield of the communications cable connecting the water source unit to the indoor units should be grounded only to the water source unit frame. Tie the shield of each cable segment together using a wire nut at each indoor unit.*
- *Never ground the shield of the communications cable to the indoor unit frame or other grounded entities of the building.*
- *Position the water source unit communications cables away from the power wiring. Refer to minimum spacing requirements provided in Table 28.*
- *Never use a common multiple-core communications cable. Each communications bus shall be provided a separate cable (i.e., between water source units and indoor units, water source units and central controller(s). If communications cables of separate systems are wired using a common multiple-core cable, it will result in a poor communications signal and unacceptable system operation.*

LG

Communication Cables Between the Water Source Unit and the Indoor Units

- Field Provided 18 Gauge Stranded Two-core Cable (Shielded)
- Insulation material as recommended by local code.

Figure 64: Water Source to Indoor Unit Communications Cable Termination Detail.



⚠ ***Note:***
The terminal tagged "GND" on the water source unit main PCB is not an earth ground terminal. It is a neutral (-) terminal provided to connect the water source unit to central control devices.

Communication Cables Between the Water Source Unit and the Central Control Device

- Field Provided 18 Gauge Stranded Two-core Cable (Shielded)
- Insulation material as recommended by local code.

Connect all central control devices such as AC Smart II, AC Smart Premium, ACP, BACnet and LonWorks gateways, and energy recovery ventilators all on the same cable. Order does not matter. Polarity does. Keep "A" terminals with "A" terminals, and "B" terminals with "B" terminals. Starting at the water source unit, terminate the cable on terminals Internet A and Internet B. Route the cable as needed between each device.

⚠ ***Note:***
Connect the shield to ground ONLY at the water source unit. Tie shields together at each termination point.

ELECTRICAL SYSTEM INSTALLATION

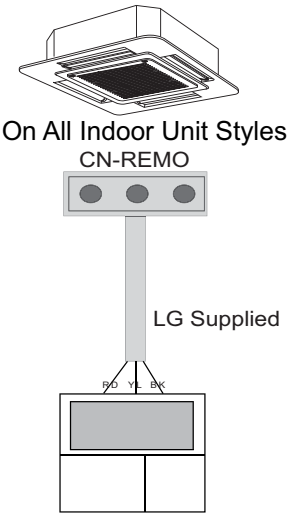
Communications Cables

Communication Cables Between the Indoor Units and the Wall-Mounted Zone Controller

- Only use LG provided three-core communications cable between the indoor unit and the wall-mounted zone controller.
- NEVER splice, cut, or extend cable length with field provided cable. If the length needs to be extended, the LG Extension Kit (sold separately) must be used. A maximum of four (4) kits (up to 165 feet) can be used.
- Set the indoor unit operating parameters using DIP switches or by setting up the zone controller. Refer to the indoor unit installation manuals for more details.

⚠ ***Note:***
Cable connected to Zone Controller is the factory default connection.

Figure 65: Indoor Unit to Zone Controller Connection.

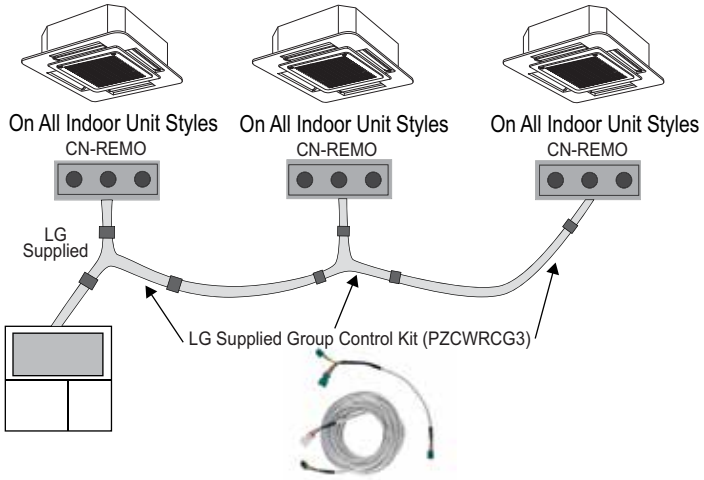


Communication Cables Between Multiple Indoor Units Operating as a Group (Group Control)

- If any indoor units were specified to operate in unison, use one (or multiple) three-core Group Control Kit (sold separately) containing extension and Y-splitter cables. One (1) group control cable kit for each indoor unit in the group except for the last indoor unit.
- Always use an LG provided group control communications cable (Group Control Kit; sold separately) between the indoor unit and the wall-mounted zone controller.
- NEVER splice, cut, or extend cable length with field provided cable.
- Before running cable, decide which indoor unit will be the “Master.” The zone controller will be connected to the “master.
- Identity each indoor unit operating as a group as “Master” or “Slave”. Adjust the pertinent DIP switch at each indoor unit. On wall mounted indoor unit models, set the assignment using the handheld remote controller.
- Use a daisy chain configuration and connect all of the group’s indoor units together starting at the “Master” unit.

⚠ ***Note:***
Cable connected to Zone Controller is the factory default connection.

Figure 66: Indoor Unit Group to Zone Controller Connections.



Prepare the Electrical System

Verify correct, clean, specified power is at the line side of each system component's disconnect.

1. Note if the green LED light on the component PCB board is illuminated.
2. If a Dynamic V-8 VL air cleaner is installed on a high static ducted model indoor unit, verify power has been provided to the air cleaner controller. Verify by observing the LED in the center of the disconnect plate is illuminated.
3. If a zone controller (Remote Unit controller on the Hydro Kit) is connected to the component, verify the LCD screen displays current operational characteristics.

Indoor Unit Auto Addressing

⚠ WARNING

Disconnects should only be operated by a properly licensed electrician at this time. Never look at a disconnect switch when closing. Turn away from the switch when closing. Incorrect wiring could cause the disconnect to explode, physical injury, and / or death.

⚠ *Note:*

During the pre-commissioning process, do not change any DIP switch settings. All switches should be left in the OFF position on both DIP switches SW01B and SW02B.

Initiate the Auto Addressing Procedure

⚠ *Note:*

If the Auto Address Procedure has never been successfully completed for the water source system, the compressor(s) will not start when power is applied to the unit.

1. Verify all that all indoor units connected to the system have power to the PCB board AND all zone controller system start buttons are OFF.
2. Remove the maintenance access panel and unit control box cover from the water source unit. Place panels and screws in a secure area.
3. Verify the communications cable between the indoor units and the water source unit is terminated at the water source unit terminals IDU(A) and IDU (B).
4. Verify the shield on the communications cable is grounded at the water source unit.
5. At the water source unit PCB, verify all DIP switches are "OFF" on DIP switches SW01B and SW02B.
6. Cycle power on the water source unit. Leave disconnect in the "ON" position.
7. Check the water source unit current configuration code(s). Observe the unit setup codes using the LED display found on the water source units PCB. Each code will display for two (2) seconds.

Table 29: Code Display Sequence.

Sequence	Code	Description
1	-	Model code
2	-	Total capacity in horsepower
3	2	Heat pump model
4	25	Normal mode display (If the DIP switch is not set correctly, this number is not displayed.)
5	136	Model type (Water Mini)

Table 30: Water Mini Unit Model Identification Codes.

Model Code	Capacity (Horsepower / Tons)	Power Supply	Refrigerant
120	4 / 3.0	1Ø, 208/230V	R410A
121	5 / 4.0		
122	6 / 4.4		

⚠ *Note:*

While this routine runs, the unit runs a self-diagnostics check. At completion, the LED should be clear and nothing displayed. Diagnostic process should take from three (3) to seven (7) minutes.

Initiate the Auto Addressing Procedure, continued

8. Know how many indoor units are connected to the system.

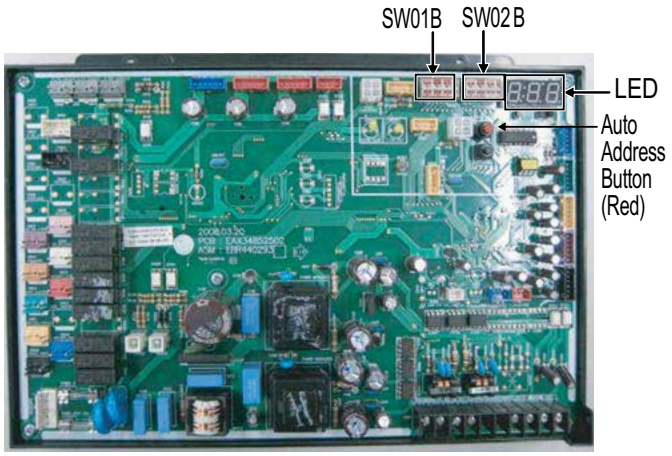
9. Press and hold red Auto Address Button for about five (5) seconds. Release when “88” appears on the LED. After three (3) to seven (7) minutes, the display will flash a number for about ten (10) seconds indicating how many indoor units the system successfully communicated with.

10. This number should match the known installed number of indoor units if the auto addressing procedure was successful.

11. Upon completion of the auto addressing routine, the display will be blank and the system will be in standby waiting for another command.

12. Upon successful completion of the auto address procedure, record the system address assigned to each indoor unit by the auto address procedure in the column provided on the Pre-commissioning Device Configuration Worksheet.

Figure 65: Auto Address Button Location.



13. After recording the system addresses assigned to each device, open the water source unit disconnect. Remove the water source unit to indoor unit communications cable from terminals IDU(A) and IDU(B). Protect conductors by placing electrical tape over the bare ends.

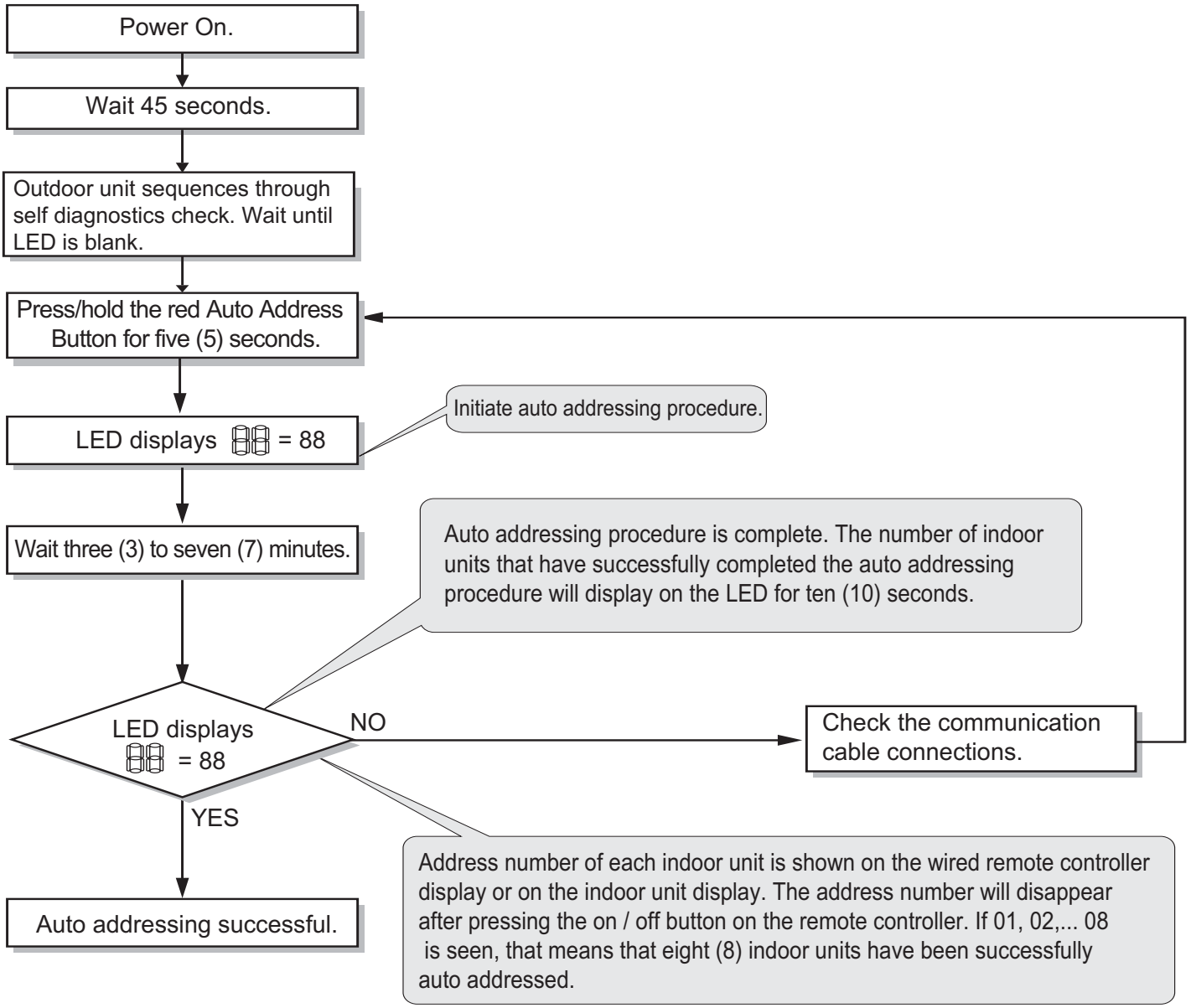
14. Close the disconnect to reapply power to the water source unit and energize the compressor crankcase heater. Once again, verify the water source unit to indoor unit(s) communications cable is not connected to terminals IDU(A) and IDU(B) of the water source unit.

15. Replace the control panel door.

⚠ WARNING

Upon successful completion of the auto addressing function, an unintentional compressor start can occur unless the communications cable to the indoor units is removed from the water source unit terminals IDU(A) and IDU(B). Do NOT open the service valves or attempt to start water source unit compressors or until directed by the Commissioning Agent. Major damage to the unit piping and compressors will occur, and there is a risk of explosion, suffocation, physical injury, and / or death.

Figure 66: Indoor Unit Auto Addressing Procedure Flowchart.



Troubleshooting a Failed Indoor Unit Auto Addressing Procedure

If the quantity of indoor units the auto addressing procedure found is incorrect, or the “88” never disappears from the display for the seven (7) minutes, the auto address routine has failed and a communications problem exists. If the Auto Address Procedure failed:

1. Verify ALL indoor unit ON/OFF buttons are in the OFF position (i.e., on/off button NOT illuminated).

2. Check the terminations, polarity, and continuity of each conductor on the communications cable between the water source unit and the indoor units. Verify the indoor unit to water source unit communications cable is wired correctly.
   - Verify the conductor connected to the “3 (or “5” in the case of cassette frame codes TP, TN, TM) terminals on all indoor units and is terminated on the water source unit terminal tagged IDU(A).
   - In a similar fashion, verify the conductor connected to all indoor units on the “4” (or “6” in the case of cassette chassis codes TP, TN, TM) terminals and is terminated on the water source unit terminal tagged IDU(B).

3. Verify the shield of the communications cable is grounded at the water source unit only. All segment shields should be spliced together at each indoor unit and NOT grounded.

4. After repairing the communications cable, go to Step 9 of the Initiate the Auto Addressing Procedure and repeat the process until successful: Press and hold red Auto Address Button for about five (5) seconds. Release when “88” appears on the LED. After three (3) to seven (7) minutes, the display will flash a number for about ten (10) seconds indicating how many indoor units the system successfully communicated with.

5. This number should match the known installed number of indoor units if the auto addressing procedure was successful.

6. Upon completion of the auto addressing routine, the display will be blank and the system will be in standby waiting for another command.

7. Record the system address the water source unit assigned to each indoor unit by the auto address procedure in the column provided on the Pre-commissioning Device Configuration Worksheet.

8. After recording the system addresses assigned to each device, open the water source unit disconnect. Remove the water source unit to indoor unit communications cable from terminals IDU(A) and IDU(B). Protect conductors by placing electrical tape over the bare ends to prevent an accidental compressor start from occurring before the Commissioning Agent arrives..

9. Close the disconnect to reapply power to the water source unit and energize the compressor crankcase heater. Once again, verify the water source unit to indoor unit(s) communications cable is not connected to terminals IDU(A) and IDU(B) of the water source unit.

10. Replace the control panel cover.

Terminating Group Controlled Indoor Units

If any of the indoor units were specified to operate in unison, create a group control communications circuit between the indoor units using a group control cable kit consisting of three (3) cables:

- One pigtail cable.
- One Y-cable.
- One extension cable segment.

1. Before proceeding with group control cable terminations, verify power is off at all indoor units effected.
2. Identify which indoor unit will be the “Master” unit of the group. If not already recorded, record the "Master" and the "Slave" identity assignment to each indoor unit in the group on the Pre-commissioning Device Configuration Worksheet.
3. Termination Procedure:
   - Starting with the Master unit, plug in the male end of the pigtail cable into the CN-REMO socket. At the last Slave indoor unit in the group, a pigtail cable is not required. Plug the male end of the extension cable coming from the previous indoor unit into the CN-REMO socket.
   - Plug the Y-cable into the pigtail at each indoor unit except for the last Slave indoor unit in the group where no Y-cable cable will be needed.
   - Connect two extension cable segments to each “Y” cable except for the “Y” cable connected to the Master indoor unit. At the Master indoor unit, connect one extension cable and the communications cable from the zone controller to the Y-cable.

Plan the Central Control Addresses Assignments

Check with the building’s Chief Engineer and gather any preferences he may have. If there are no preferences:

- Hex assignments do not have to be assigned in any particular order, or an order defined by the routing of the communications cable between the indoor units. In most cases, Hex addresses can be skipped.[1]
- All members of a Hex Group are not required to be on the same Multi V system.
- Addresses can be assigned at random, not in any particular order, and can be skipped.[1]

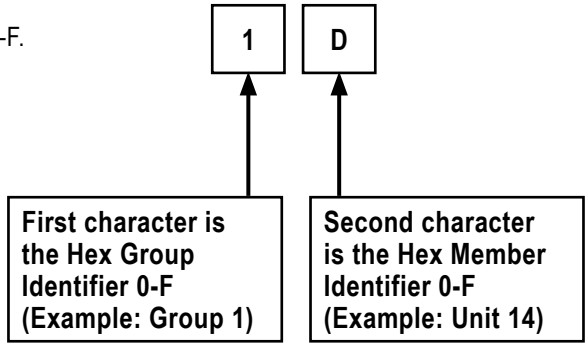
[1]On AC EZ, do not skip addresses. Start with Hex address 0. Buttons have pre-assigned Hex addresses. If an address is skipped, the associated button will do nothing.

Indoor Unit Central Control Address Assignments

A central control address is made up of two hexadecimal characters.

- The first character in the central control address is the Hex Group Identifier. Possible Hex Group Identifiers (in order of lowest to highest) are 0-9 followed by A-F.
- The second character in the address is the Hex Member Identifier in a Hex Group. Hex Member Identifiers (in order from lowest to highest) are 0-9 followed by A-F.

Figure 67: Central Control Address Nomenclature.



Hex Address Assignment Limitations

- There is a limit of 16 Members per Hex Group
- There is a limit of 16 Hex Groups per VRF system.
- There is a limit of 256 possible Member Identifiers per Central Control (See Central Controller Communications Limitations on the next page).

Central Controller Communications Limitations

Each type of Central Controller device is designed to communicate with a limited quantity of indoor units. The quantity of indoor units that can be connected to a single central control communications cable, therefore, will be defined by the central control device on that cable with the smallest Maximum Indoor Unit Quantity as shown at right.

Table 31: Central Controller Indoor Unit Connection Limitations.

Central Control Device	Maximum Indoor Unit Quantity
AC EZ	32
AC Smart II	64
AC Smart II with Expansion Kit	128
AC SMART Premium	128
LonWorks Gateway	64
BACnet Gateway	256
Advanced Control Platform	256

Group Number

If the building operator wants to know which indoor units are on each water source unit, and multiple systems serve a building:

- Assign a Group Number to each system. If there are more than 16 indoor units on a system, multiple Group Numbers may be necessary.

If the building owner wants to know which indoor units are on each floor:

- Assign a different group number for each floor. If there are more than 16 indoor units on a floor, multiple Group Numbers may be necessary.

Member Number

Can be assigned at will or for example, can follow the room layout on each floor.

For each LG Central Controller product provided on the project, devise a central control address schedule and assign a central control address to each indoor unit(s) Hydro Kit(s), and ERV(s) units. Record this central control address for each component in the column provided on the Pre-commissioning Device Configuration Worksheet.

Upload Central Control Address to the Indoor Units

For all ducted, vertical and floor standing indoor units, the central control address must be assigned using a wired zone controller. Wall-mount, ceiling cassette, ceiling suspended, and the wall/ceiling convertible indoor units, the central control address can be assigned using a wireless handheld controller or a wired zone controller.

Power Up All Indoor Unit PCBs

Turn the disconnect for each indoor unit to the “ON” position. **DO NOT** turn the unit ON (on/off button remains off).

⚠ ***Note:***

During the following procedure, NEVER PUSH the ON/OFF (Enable operation) Button on the zone controller.

For Indoor Units That Are NOT Being Controlled as a Group

1. Verify the zone controller cable is plugged into CN-REMO socket on the indoor unit PCB.
2. Using the controller, go to the setup function 02 (icons are different for each controller. Refer to the controller user's manual for more information.)
3. Type in the Hex Central Control address that has been designated to the unit.
4. Repeat Steps 1 through 3 for each indoor unit in the building.

For Indoor Units That Are Being Controlled as a Group

1. Before attempting to assign a central control address to an indoor unit controlled as a group, identify which unit in the group will be identified as the Master indoor unit and which indoor units are going to be identified as Slave units.
2. Go to the Master indoor unit, and access the PCB.
3. Verify a group control pigtail cable is plugged into the CN-REMO socket on the indoor unit PCB. If it is not, do so now by plugging the communications cable pigtail into the CN-REMO socket.
4. If the group control extension cable between the indoor units is plugged into the Y-cable, unplug the extension cable from the Y-cable.
5. If not already present, plug the zone controller communications cable into the pigtail cable.
6. Using the controller, go to the setup function 02 (icons are different for each controller. Refer to the controller user's manual for more information.) Type in the Central Control address designated for the Master indoor unit.
7. Disable power to the Master indoor unit. Do not restore Power to the Master indoor unit at this time. It shall be restored in step 18.
8. If the zone controller and associated communications cable has already been permanently mounted in place, plug the Y-cable back into the pigtail and obtain a loose zone controller with a communications cable to continue programming the Slave indoor units.
9. Go to the first Slave indoor unit and disconnect the Y-cable from the pigtail.
10. Plug the zone controller communications cable into the socket on the pigtail cable. Do not push the ON / OFF button or enable indoor unit operation.
11. Using the controller, go to the setup function 02 (icons are different for each controller. Refer to the controller user's manual for more information.) Type in the Hex address assigned to the unit.
12. Change DIP switch No. 3 on the indoor unit PCB to the "ON" position.
13. Disable power to the indoor unit using the disconnect switch. Wait one (1) minute.
14. While power is off, unplug the zone controller cable from the pigtail socket.
15. Plug the group control Y-cable back into the pigtail.
16. Restore power to that Slave indoor unit, and go to the next Slave indoor unit.
17. Repeat Steps 9 to 16 for each Slave indoor unit except the last one in the group. At the last Slave indoor unit, the process is the same except unplug the group control cable from socket CN-REMO on the indoor unit PCB board and plug the zone controller cable into the same socket.
18. After all Slave indoor unit have addresses assigned, go back to the Master indoor unit and restore power.

Indoor Unit Temperature Sensing Location Selection

For each indoor unit connected to a wired zone controller, select a zone temperature sensing option. Assign one of three methods for the indoor unit to sense the zone temperature. Skip this step for indoor units controlled from a handheld (wireless) controller. Record the sensing for each indoor unit on the Pre-commissioning Device Configuration Worksheet. There are three possible strategies:

1. Use the unit-mounted return air sensor (or the optional remote wall-mounted sensor).

2. Use the sensor mounted in the zone controller.

3. Sense the temperature at the unit-mounted return air sensor (or the optional remote wall-mounted sensor) and sensor mounted in the zone controller, then control based on the temperature reading using the sensor that is farthest from set-point.

Conduct an Air Balance for Ducted Indoor Units

For each ducted model indoor unit, confirm that the Test and Balance contractor adjusted the fan speed setting values. Recorded the actual fan setting value used to deliver cataloged CFMs at the jobsite static pressure conditions in the appropriate column on the Pre-Commissioning Device Configuration Worksheet. If the fan setting value was left at the factory default insert “00” in the blank.

⚠ ***Note:***

It is always best if the air balance is completed prior to a request for a commissioning agent. If the air balancing contractor has not completed the work before commissioning, the Commissioning Agent is not responsible for setting the indoor unit air flow rates, fan speed, or insure the air volume delivered at each indoor unit is per project specifications, only to spot check. Excessive or restricted airflow may impact the ability of the Commissioning Agent to successfully complete system commissioning. If problem exists, request verification from the Test and Balance contractor. If necessary, provide instruction to the air balance technician on how to adjust the indoor unit fan setting value.

⚠ *Note:*

Open all isolation valves that may have been installed in the piping system. Water source unit service valves must remain closed.

Perform a Pressure (Leak) Test

Use medical grade dry nitrogen, and pressure test the refrigerant piping system using a multi step process that will assist in locating leaks (if any). Pressure test the segment of piping between the water source unit and the main pipes. If the test is successful the pipes do not have leaks.

- 150 psi for a period of 5 minutes
- 300 psi for a period of 15 minutes
- 550 psi for a period of 24 hours

Evacuate the Refrigerant Piping System

⚠ *Note:*

The water source unit may be put in "vacuum mode". Generally, using the vacuum mode feature does assist with the vacuum process and is not necessary if a vacuum pump is connected to all charging ports at the water source unit simultaneously as suggested herein. See the Technical Service Manual for this product for more information.

1. Release the Pressure Test dry nitrogen charge from all refrigerant pipes.
2. Verify ALL field installed isolation ball valves are OPEN (including those that are capped for future use).
3. Remove and discard the Schrader valve cores at the water source unit charging ports. (This is a preventive step that ensures that valves used after charging the system have not been subjected to the high pressure value used during the Pressure Test.)
4. Attach a 5/16" core removal tool equipped with ball valve and a fresh core to each charging port on the water source unit.
5. Check the vacuum pump(s) you intend to use and verify the oil in the sump is fresh and not contaminated..
6. Attach the vacuum pump(s) to each charging port simultaneously using high quality refrigerant vacuum hoses.
7. Perform a triple evacuation.
8. Achieve a micron gauge reading of less than 500 microns.
9. At 500 microns, valve off the charging port by closing the core removal tool ball valves.
10. Remove the vacuum hoses and pumps.

⚠ *Note:*

Do not open the water source unit service valves and release the factory refrigerant charge until the Commissioning Agent authorizes to do so.

11. Leave the refrigerant piping system in a vacuum until the Commissioning Agent arrives and is satisfied with the micron gauge reading.

⚠ *Note:*

- *There is no danger in doing this as all piping and equipment are dry and have never had oil in them.*
- *The system must be left in a vacuum until the Commissioning Agent arrives and verifies the quality of the evacuation process. If the evacuation procedure was not conducted properly, the system will likely malfunction and operate erratically. Significant costs may be incurred including but not limited to refrigerant reclaim, recycle, and replacement.*

Preparing the Water Circuit

1. Verify the specified waterside piping specialties such as temperature and pressure gauges, Pete's plugs, water balancing valves, shutoff valves, strainers, air vent(s), etc., were installed.
2. Verify the water circuit pump is operating correctly and the proper flow and temperature of water is provided to the water source unit.
3. Thoroughly flush the water circuit. Continually check and clean strainers as necessary. Continue flushing until strainers remain clean.
4. Purge all air from the water circuit. Check all auto or manual air valves installed.

⚠ ***Note:***

To prevent the heat exchanger from freezing, drain water out of the unit before charging the refrigerant.

Balance the Water Circuit Flow Distribution

The water flow balancing contractor must complete their work prior to commissioning and verifying the water flow rate is within project specifications. Excessive or restricted water flow may impact the ability of the Commissioning Agent to successfully complete system commissioning. It is best if the water flow balancing is completed prior to initiating a request for a Commissioning Agent. Upon completion of the waterside balancing, the report should provide the maximum flow rate (GPM) at the water source unit.

⚠ ***Note:***

The Commissioning Agent is not responsible for setting the water flow rate, only to spot check. If a problem exists, request verification from the Test and Balance technician. If necessary, provide instruction to the technician on how to adjust the setting(s).

Prepare Pre-commissioning Package Documents

1. A copy of the refrigerant piping system(s) shop drawing(s) generated by LATS Multi V pipe design software.
2. A copy of the pipe fitter's pipe changes and field notes.
3. A verified copy of the "As-Built" LATS Multi V Project file (*.mtv) that includes all changes noted by the pipe fitter(s) in 2. Notes should include changes to the line lengths and # elbows used for each liquid line segment
4. A copy of a completed and verified Installation Checklist for the water source unit, indoor units, ERVs, Air Cleaners, and Control Devices. Correct any needing attention before continuing.
5. A copy of the water circuit control sequence of operation.
6. A water circuit flow balancing report.
7. A completed Pre-commissioning Device Configuration Worksheet.
8. A completed copy of the Pre-commissioning Checklist.
9. If an AC Smart Central Controller is provided and it is to be connected to the building network, record the IP Address on the Pre-commissioning Device Configuration Worksheet.

Optional, but Highly Recommended

It is always best if the air balance is completed prior to a request for a commissioning agent to insure the air volume delivered at each indoor unit is per project specifications. The commissioning agent is not responsible for setting the indoor unit fan speed or ensure the air volume delivered at each indoor unit is per project specifications. Excessive or restricted airflow may impact the ability of the commissioning agent to successfully complete system commissioning. Upon completion of the air balance, the report should include the adjusted indoor unit's fan speed (i.e., fan setting value) set by the Test and Balance technician to deliver cataloged air volume (CFM) at jobsite static pressure conditions.

Initiate a Request for a System Commissioning

Contact your LG Applied Representative's Project Manager or your account representative and request a System Commissioning. Provide all the documents listed in "Prepare Pre-commissioning Package" section above.

System Commissioning

The Multi V System commissioning process and procedures are provided in a separate manual and/or in training materials provided by the LG Academy Training Team. To obtain a copy, you must be a certified LG commissioning agent.

After Commissioning Has Been Requested

The commissioning agent may contact you to discuss specific job points, scheduled day(s) and expected duration. It is the contractor's responsibility to provide all of the necessary start-up labor, refrigerant, tools and test equipment needed to complete the process in the expected time frame. Please note that the commissioning agent's allotted time at your project DOES NOT include owner training.

It is understood that the contractor is to request for a commissioning agent when all required project readiness points are complete; not based on an "expected" completion date. The contractor also acknowledges that they will assume all responsibility for costs incurred by the commissioning agent including but not limited airfare, travel costs, transportation, shipping, labor, and tool costs due to lack of readiness.

The commissioning agent's schedule is usually very rigid, and may have no flexibility regarding duration. It also involves advance travel arrangements that may be impractical or impossible to change.

Freight Damage and Unit Replacements ..... Your LG Manufacturer Representative
Missing Parts ..... Your LG Manufacturer Representative
Received Wrong Water Source Unit Model ..... Your LG Manufacturer Representative
Installation, Startup, and Commissioning Technical Assistance 1-888-865-3026

MAINTENANCE

Maintaining the Heat Exchanger

To prevent heat exchanger damage and decreased system performance from scaling, the heat exchanger should be inspected once (1) per year or more often depending on the quality of the water and the water treatment program. For systems using an open tower, clean the heat exchanger annually or more often if local conditions require. Systems using closed cell towers need to be cleaned a minimum of once every five (5) years or more often if local conditions require.

Yearly Inspection

The plate heat exchanger must be inspected once (1) a year, and should include:

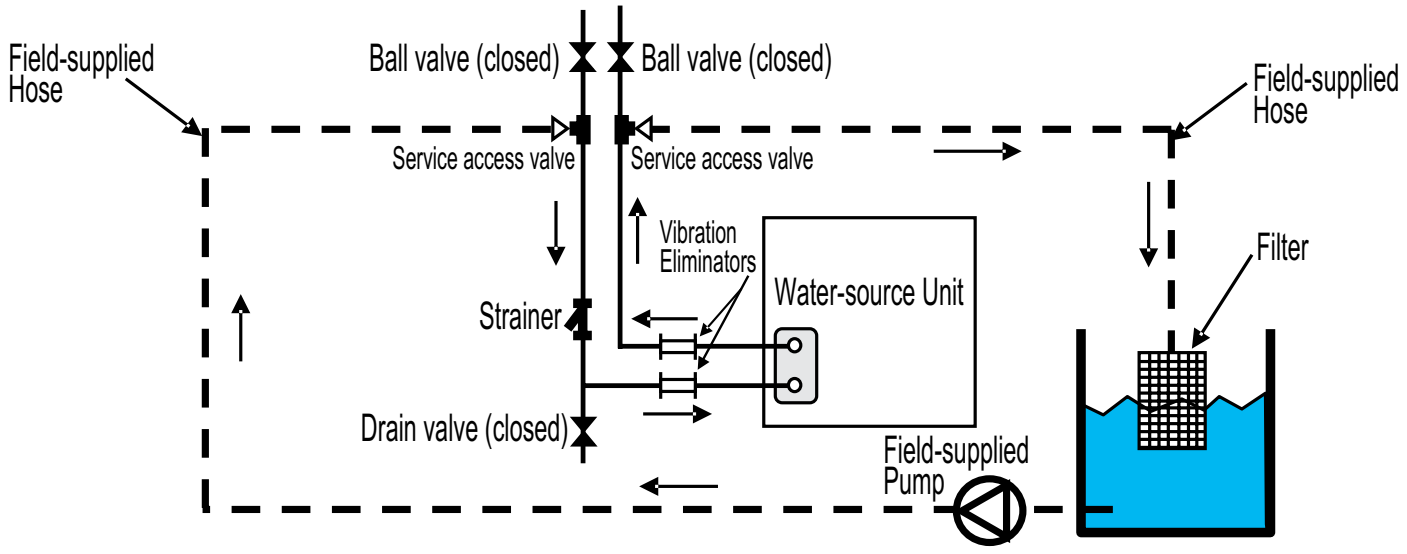
- Water should be tested to see if it is within quality levels listed in the water circuit installation section of this manual.
- Strainer should be cleaned.
- Water flow rate should be checked.
- Water pressure, flow, and inlet / outlet water temperatures should also be checked.

Five (5) Year Cleaning Procedure

The heat exchanger is not designed to be disassembled and does not contain any replaceable parts. If the heat exchanger cannot be cleaned, the entire exchanger must be replaced.

- Heat exchanger cleaning solutions can include 5% diluted formic acid, citric acid, oxalic acid, acetate acid, phosphoric acid. Make sure the cleaning solution used does not include chemicals such as hydrochloric acid, sulfuric acid, nitric acid or calcium chloride that are corrosive to 316 stainless steel or ACR copper.
- Isolate the unit from the pipe system by closing the inlet / outlet ball valves and the drain pipe valve.
- Connect a hose to the service port, fill the heat exchanger with cleaning solution heated to 122°F–140°F, and circulate the solution for two (2) to five (5) hours using the solution tank pump. Procedure time may depend on the cleaning solution temperature, or the amount of scaling present. Watch for a change in cleaning solution color to determine how long the procedure should last.
- After circulating the cleaning solution, drain the heat exchanger, fill it with 1%-2% NaOH (Sodium Hydroxide) or $NaHCO_3$ (Sodium Bicarbonate), and circulate for 15 to 20 minutes to neutralize the system.
- Flush the heat exchanger with clean water and measure pH. Once the pH is within recommended levels, open the isolation valves, purge air from the system, and check unit operation.

Figure 68: Schematic of Heat Exchanger Maintenance.



⚠ ***Note:***

Before using a chemical solution to clean the heat exchanger, note its potential to corrode stainless steel or copper. Consult the chemical solution manufacturer for more information.

MAINTENANCE

General Maintenance Schedule

1. Water Quality Control

- The heat exchanger is not designed to be disassembled, cleaned, and does not contain any replaceable parts. If the heat exchanger is not usable, the entire exchanger must be replaced.
- To prevent corrosion or scaling, water quality must be controlled. Refer to the recommendations in Table 32 for minimum water quality requirements.
- Use only anti-corrosion agents or corrosion inhibitor additives that do not contain chemicals which damage or attack 316 stainless steel and ACR copper.
- Drain and replace the water / glycol mixture on a regular basis as needed. Frequency will depend upon the quality of the water treatment program used.

Table 32: Minimum Water Quality Requirements.

	Closed Type System		Effect	
	Circulating Water	Supplemented Water	Corrosion[1]	Scale[1]
Basic Item				
pH (77°F)	7.0 ~ 8.0	7.0 ~ 8.0	●	●
Conductivity (77°F) mS/m	Below 30	Below 30	●	●
Chlorine ions (mg Cl^-/ℓ)	Below 50	Below 50	●	
Sulfate ions (mg SO_4^{2}/ℓ)	Below 50	Below 50	●	●
Acid consumption (pH4.8) (mg$CaCO_3$/ℓ)	Below 50	Below 50		●
Total Hardness (mg $CaCO_3$/ℓ)	Below 70	Below 70		●
Calcium Hardness (mg $CaCO_3$/ℓ)	Below 50	Below 50		●
Ionic-static silica (mg SiO_2/ℓ)	Below 30	Below 30		●
Reference Item				
Iron (mg Fe/ℓ)	Below 1.0	Below 0.3	●	●
Copper (mg Cu/ℓ)	Below 1.0	Below 0.1	●	
Sulfate ion (mg SO42/ℓ)	Must not be detected	Must not be detected	●	
Ammonium ion (mg NH4+)ℓ	Below 0.3	Below 0.1	●	
Residual chlorine (mg Cl/ℓ)	Below 0.25	Below 0.3	●	
Free carbon dioxide (mg CO2/ℓ)	Below 0.4	Below 4.0	●	
Stability index			●	●

[1]The "●" mark for corrosion and scale means that there is a possibility of occurrence.

2. Flow Rate Control

- The heat exchanger may freeze if water flow rate is insufficient.
- Check for a restricted strainer or if air is in the water piping system. Also measure the temperature and pressure difference between the inlet and outlet to verify the flow rate is per specifications.
- If the temperature and pressure difference is above the specified range, the flow rate is insufficient. Immediately cease system operation, locate the source of the problem and repair as needed. After any water circuit maintenance is preformed, always bleed air from the water system at all installed air vents.

3. Antifreeze Concentration Management

- Use the manufacturer's recommended type and amount of antifreeze. Do not use solutions with calcium chloride; these can corrode the heat exchanger.
- Maintain antifreeze levels. If there is a drop in the amount of antifreeze, the heat exchanger may freeze. Ensure that the antifreeze is not exposed to the atmosphere, and periodically measure antifreeze levels, adding as necessary.

MAINTENANCE

General Maintenance Schedule

Table 33: Minimum Maintenance Schedule.

Procedure \ Period (Year)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Product operating condition	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Heat exchanger cleaning (Wash)					●					●					●
Strainer cleaning	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Water quality check	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Refrigerant leakage check	●														●
Indoor unit filter cleaning	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

⚠ Note:

- *The checklist above is based on minimum requirements. Maintenance may need to be increased depending on operating condition and / or water quality.*
- *Before cleaning the heat exchanger, make sure that the water pipe connections are tight so that chemical detergent does not leak. When cleaning the heat exchanger, close the valves so that chemical detergent does not penetrate into the pressure gauge, etc.*
- *Dilute the chemical detergent as recommended by the chemical supplier. Note that cleaning the heat exchanger is easier at the initial stages and becomes difficult after scaling has accumulated. In areas where the water quality is poor, cleaning is required more often.*
- *Because chemical detergent has a strong acid content, the system must be flushed thoroughly with water after cleaning.*
- *To verify the system has been properly cleaned, remove the hose at the heat exchanger and, using a flashlight or other bright light source, visually inspect the interior surfaces of the heat exchanger.*
- *After completing the visual inspection and determining the heat exchanger is clean—free of debris and mineral deposits and the cleaning chemicals have been thoroughly flushed—close the system up, replace the water and purge the air from all air vents located on the pipe system. Purge the air inside the water piping.*
- *Always check if the water supply is flowing normally and in the correct direction before operating the unit.*

LG MONITORING VIEW (LGMV) DIAGNOSTIC SOFTWARE

LGMV software allows the service technician or commissioning agent to connect a computer USB port to the water source unit (WSU) main printed circuit board (PCB) using an accessory cable without the need for a separate interface device. The monitoring screen for LGMV allows the user to view the following real time data on one screen:

- Actual inverter compressor speed
- Target inverter compressor speed
- Actual superheat
- Target superheat
- Actual subcooler circuit superheat
- Target subcooler circuit superheat
- Main EEV position
- Subcooling EEV position
- Inverter compressor current transducer value
- Outdoor air temperature
- Actual high pressure/saturation temperature
- Actual low pressure/saturation temperature
- Suction temperature
- Inverter compressor discharge temperature
- Upper outdoor coil pipe temperature
- Lower outdoor coil pipe temperature
- Liquid line pipe temperature
- Subcooler inlet temperature
- Subcooler outlet temperature
- Four-way reversing valve operation indicator light
- Pressure graph showing actual low pressure and actual high pressure levels
- Error code display
- Operating mode indicator
- Target high pressure
- Target low pressure
- PCB (printed circuit board) version
- Software version
- Installer name
- Model number
- Site name
- Total number of connected IDUs
- Communication indicator
- IDU capacity
- IDU operating mode

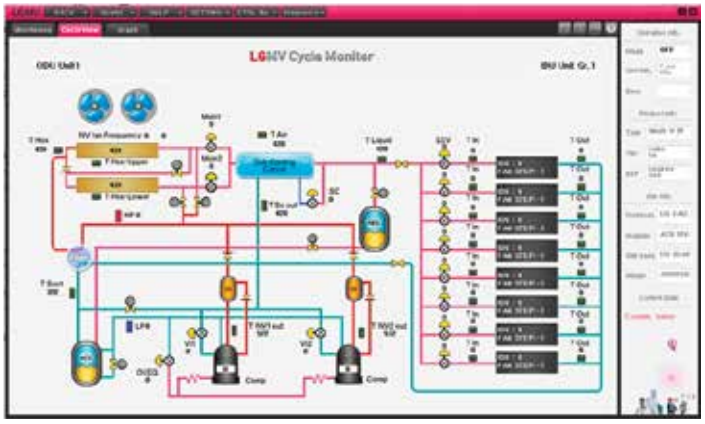
Figure 69: MV Real-time Data Screen.

- IDU fan speed
- IDU EEV position
- IDU room temperature
- IDU inlet pipe temperature
- IDU outlet pipe temperature
- IDU error code

Additional screens can be accessed by tabs on the main screen. Additional screens include the following:

1. Cycleview: Graphic of internal components including:
   - Compressors showing actual speeds
   - EEVs
   - IDUs
   - Temperature and pressure sensors
   - Four-way reversing valve
2. Graph: Full screen graph of actual high and low pressures and high and low pressure limits. A sliding bar enables user to go back in time and view data.
3. Control FTN: Enables user to turn on IDUs in 1.8°F increments.
4. Useful Tab
   - Unit Conversion: Converts metric values to imperial values.

Figure 70: MV Cycleview.



Note:

Images on these pages are examples of LGMV screenshots. Actual images may differ depending on the version of the software and the units installed.

LG MONITORING VIEW (LGMV) DIAGNOSTIC SOFTWARE

5. Data
   - Data Saving Start: Recording of real time data to a separate file created to be stored on the user's computer.
   - Data Loading Start: Recorded data from a saved ".CSV" file can be loaded to create an LGMV session.

6. Monitoring
   - Electrical: The lower half of main screen is changed to show Inverter Compressor Amps, Volts, Power Hz, Inverter control board fan Hz.

Figure 71: MV Control Indoor Units Screen.

Error Codes

LGMV software helps the service technician or commissioning agent to troubleshoot system operation issues by displaying malfunction codes. These error codes can be seen on the main screen of the LGMV software program. For an overview of Water Mini error codes, see page 79. For detailed information on how to troubleshoot individual error codes, see the Water Mini Service Manual.

Figure 72: Error Code Screen.

The software is available in a high version with all of the features listed above. The low version has all features as the high version without Target High Pressure and Target Low Pressure values shown on main screen.

In lieu of connecting to the WSU, user has the option to connect to IDU with the use of a USB to RS-485 connector kit. When connected through IDU, user will not be able to record data.

This software can be used to both commission new systems and troubleshoot existing systems. LGMV data can be recorded to a ".CSV" file and emailed to an LG representative to assist with diagnostic evaluations.

Recommended Minimum PC Configuration:

- CPU: Pentium® IV 1.6 GHz
- Main Memory: 1G
- Operating System: Windows® XP/Vista/7 32 bit (recommended), 64 bit
- Hard Disk: 600 MB when operating
- MS Office 2003, 2007 (recommended) for select reporting functions

Note:

Images on these pages are examples of LGMV screenshots. Actual images may differ depending on the version of the software and the units installed.

ERROR CODE TABLES

Error Codes

- Indicate different types of unit failures, assists in self-diagnosis and to track the frequency of occurrence.
- Error codes are shown on the LED of indoor units, wired remote controller, the water source unit control board, and LG Monitoring View (LGMV) Diagnostic Software.
- If two or more errors occur simultaneously, the lower error code number is displayed first.
- After error is resolved, the error code does not display.

Error Display

The first and second number on the LED indicates error number; the third number on LED indicates water source unit number.

Example: 01 = Error No. 1 on water source unit 1

Error Code Nomenclature Definitions

- MICOM: Non-volatile memory chip where unit setup information is stored.
- EPROM: Non-volatile memory chip where device identification, size, and factory defined default component operating parameters are stored.

Table 34: Error Codes.

	Error Code			Description	Details
Indoor Unit	0	1	-	Indoor unit return air or optional remote wall temperature sensor communications error.	Indoor unit air temperature sensor has disconnected or short circuited. (Check the wiring, connection at the CN Room socket on the indoor unit PCB, then check the thermistor.)
	0	2	-	Indoor unit inlet pipe temperature sensor communication error.	Indoor unit inlet pipe temperature sensor has disconnected or short circuited. (Check the connection at the CN-PIPE/IN socket on the indoor unit PCB, then check the thermistor.)
	0	3	-	Communication error between zone controller and indoor unit.	Indoor unit PCB has not received communications signal from zone controller.
	0	4	-	Indoor unit drain pump error.	Drain pump and/or flow switch is/are malfunctioning. Also check drain line for obstructions.
	0	5	-	Communication error between water source unit and indoor unit.	• Indoor unit has not received communications signal from water source unit. • Check indoor unit to water source unit communication cable for issues (Check A terminals are connected to indoor unit A and 3 (5 on 3 x 3 cassette) terminals; B connect to B or 4 (6 on 3 x 3 cassette) terminals.
	0	6	-	Indoor unit outlet pipe temperature sensor error.	Indoor unit outlet pipe temperature sensor has disconnected or short circuited. (Check the connection at the CN-PIPE/OUT socket on the indoor unit PCB, then check the thermistor.)
	0	7	-	Indoor units are not operating in the same mode.	Different operation mode between indoor units.
	0	9	-	Indoor unit EPROM error.	• Communication error between the indoor unit PCB board and its option card. (The option card is about 1' x 1' and is plugged into the indoor unit PCB board. Check the connection between the two.) • Communication error between EPROM chips on the indoor unit main PCB. • Indoor unit EPROM data is not available.
	1	0	-	Indoor unit BLDC fan motor communications error.	• Fan motor has been removed or is defective. Use the OHM and voltage check charts in the product service manual. • The system has detected the fan motor is not spinning. • On new installs, verify the installation manual and paperwork were removed from the fan discharge shroud before the unit was installed. • Check the wiring plug and connection at sockets CN-MOTOR1 and CN-MOTOR2 (if used).
Water Source Unit	2	1	1	Water source unit inverter compressor PCB error.	• Water source unit inverter compressor PCB error. • Under voltage • Refrigerant flow restriction from defective LEV or clogged strainer. • Refrigerant charge is too high (overcharge).
	2	2	1	Water source unit inverter board input overcurrent (RMS) error.	• Overcurrent of water source unit inverter board PCB. • Under voltage • Refrigerant flow restriction from defective LEV or clogged strainer. • Refrigerant charge is too high (overcharged).

For detailed information on how to troubleshoot each error, see the Water Mini Service Manual on www.lg-vrf.com.

Table 35: Error Codes, continued.

	Error Code			Description	Details
Water Source Unit	2	3	1	Low DC voltage sensed at the water source unit inverter compressor DC link.	DC voltage failed to charge on power up. (Start diagnosis at the CN inverter socket on the water source unit noise filter PCB.)
	2	6	1	Water source unit inverter compressor operation error.	Initial operation failure due to water source unit inverter compressor problem.
	2	8	1	Water source unit inverter DC link high voltage error.	Compressor shut off because water source unit inverter PCB DC link voltage is too high.
	2	9	1	Water source unit inverter compressor overcurrent error.	Water source unit inverter compressor current draw is too high.
	3	2	1	Excessive increase in water source unit inverter compressor gas discharge temperature.	• Shutdown due to excessive discharge gas pressure. • Check flow switch, clean the strainer, and verify pump is working properly.
	3	4	1	Compressor high pressure safety tripped.	• Shutdown due to excessive discharge gas pressure. • Water flow rate may be insufficient, or there is a problem with the flow switch. (Start diagnosis at the CN inverter socket on the water source unit noise filter PCB.)
	3	5	1	Low side pressure transducer senses pressure below allowable limits.	• Shutdown due to low suction pressure. • If operating in heating mode, check flow switch, clean the strainer, and verify pump is working properly.
	4	0	1	Water source unit inverter compressor current transducer (CT) sensor error.	Water source unit inverter compressor current transducer (CT) detection sensor has disconnected or short circuited.
	4	1	1	Water source unit inverter compressor discharge pipe temperature sensor error.	• Check the connection at the CN-34 socket on the water source PCB. • Thermistor has disconnected or short circuited.
	4	2	1	Water source unit low pressure transducer error.	• Check the connection at the CN-32 socket on the water source PCB. • Transducer has disconnected or short circuited.
	4	3	1	Water source unit high pressure transducer error.	• Check the connection at the CN-30 socket on the water source PCB. • Transducer has disconnected or short circuited.
	4	4	1	Water source unit ambient temperature sensor error. (TH_AIR)	• Check the connection at the CN-35 socket on the water source PCB. • Thermistor has disconnected or short circuited.
	4	5	1	Water source unit heat exchanger pipe temperature sensor (TH_HEX2) error.	• Check suction sensor in cooling mode; check hot gas sensor located near the heat exchanger in heating mode. • Check the connection at the CN-34 socket, connector tag TH_HEX2, on the water source PCB, then check if thermistor is open or shorted. • Thermistor has disconnected or short circuited.
	4	6	1	Water source unit compressor suction pipe temperature sensor (TH_SUCTION) error.	• Check the connection at the CN-35 socket, connector tag TH_SUCTION, on the water source PCB. • Thermistor has disconnected or short circuited.
	5	1	1	Combination ratio is out of range.	The total of the nominal indoor unit capacity is less than 50% or more than 130% of the nominal water source unit capacity.
	5	2	1	Communication error between water source unit main PCB and inverter PCB.	• Communication error between main PCB (CN-29) and inverter PCB CN-MAIN (COM/RD). • Check connections at both sockets. • Inspect interconnecting cable for wear.
	5	3	1	Communication error between water source unit main PCB and indoor unit(s) PCB.	• Check if water source to indoor unit(s) communications cable has disconnected or short circuited. • Check A terminals are connected to indoor unit A and 3 (5 on 3 x 3 cassette) terminals; B connect to B or 4 (6 on 3 x 3 cassette) terminals.
	6	0	1	Water source unit inverter PCB EPROM error.	• Verify the EPROM is present and in the socket correctly. • Check if all pins are in and are not bent. • Check if notch in the chip lines up with the arrow on the socket.

For detailed information on how to troubleshoot each error, see the Water Mini Service Manual on www.lg-vrf.com.

Table 36: Error Codes, continued.

	Error Code				Description	Details
Water Source Unit	8	6	1		Water source unit main PCB onboard EPROM error.	• Verify the EPROM is present and in the socket correctly. • Check if all pins are in and are not bent. • Check if notch in the chip lines up with the arrow on the socket.
	1	1	3	1	Water source unit liquid pipe temperature sensor (SC_L) error.	• Check the connection at the CN-33 socket on the water source PCB. • Thermistor has disconnected or short circuited.
	1	5	1	1	Water source unit four-way reversing valve switch (4WAY_1) error.	• Check the connection at the CN-09 socket on the water source PCB. • Thermistor has disconnected or short circuited.
	1	8	1	1	Inlet water temperature sensor error (DISCHARGE (C2).	• Check the connection at the CN-36 socket on the water source PCB. • Thermistor has disconnected or short circuited.

For detailed information on how to troubleshoot each error, see the Water Mini Service Manual on www.lg-vrf.com.

LG Multi V Pre-Commissioning Device Configuration Worksheet

Project Name:	**Building ID**
Date: AC Smart Static IP address:	**System ID** **Page #**
Mech Contractor Company Name	MEP Project Mngr Name
Pre-Com Tech Name/Ph#/email	Ph# / Email

IDU's

Unit Tag	Building Floor	Room ID	Type	Model	Serial #	Adjusted Fan Setting Value . Low | Medium | High			System Address	Central Control Address	Group member ID or N/A if not in a group	Group Function M=Master S=Slave	Sensor Strategy (RA/ZC/Both)

MULTI V WATER MINI

INSTALLATION CHECKLIST

LG

Major Component Rough-In

Description	Check
All Multi V water source units are connected properly per local code and the product installation procedures.	
All literature and bagged accessories have been removed from the fan discharge (ducted and cassette model indoor units).	
Indoor units are installed, properly supported, and located indoors in a non-corrosive environment.	
Duct work installation completed (ducted indoor units only).	
Water source unit's gravity condensate drain line was connected and properly routed to a drain terminal.	

Piping and Insulation

Description	Check
Copper	
Over 5/8 inches—Rigid ACR only.	
5/8 inches and under—Can use soft ACR.	
15% silver brazing material only.	
All refrigerant pipes and valves are insulated separately. Insulation butts up against the walls of the indoor units. No gaps or cracks. Insulation was not compressed at clamps and hangers.	
LG Y-branch fittings or headers were used as per LATS Multi V report.	
(Optional) Full port ball valves for all indoor units. (Schrader between the valve body and the indoor units.)	

Brazing Practices

Description	Check
Use medical grade (there are 4 available) dry nitrogen for purging during brazing (constant 3 psi while brazing).	
Minimum 3/4", maximum 1" condensate piping installed on indoor units–material used is acceptable under local code. Insulated as necessary to prevent condensation.	

Installation

(For more information on any procedure, refer to the detail provided in the Water Source and Indoor Unit Installation Manuals.)

Refrigerant Piping

Description	Check
You must have in your possession a copy of the "As-Designed" LATS Multi V piping tree diagram. BEFORE ANY FIELD PIPE SIZE OR LENGTH CHANGES ARE MADE, PROPOSED CHANGES MUST BE FORWARDED TO THE DESIGN ENGINEER SO THAT THEY CAN INPUT THE CHANGES INTO LATS and RE-ISSUE A NEW LATS MULTI V PIPING TREE DIAGRAM. Installer must receive change authorization from the design engineer, because any change made requires the review of the entire tree diagram and verification that the change did not impact the size of piping segments in other parts of the system.	
All pipe materials were properly stored, capped, and clean. All burrs were removed after cutting and pipe ends were reamed before brazing.	
During refrigerant pipe installation, for each segment of pipe, a record was made of the pipe length (including expansion loops, offsets, double-back sections), and sizes, as well as the quantity and type of elbows used.	
All long runs of straight pipe were provided with expansion loops.	
Insure Y-branch fittings are installed with no more than ±10° of horizontal.	
Insure Y-branch fittings are installed with no more than ±3° of vertical.	
Insure all Header fittings are installed horizontal at an elevation above all connected indoor units.	
A torque wrench and backup wrench were used to tighten all flare connections.	
The back side of all flares were lubricated with a small drop of PVE refrigeration oil before tightening flare fittings.	
Insure all field made flares are 45°. Use factory-supplied flare nuts only.	
All pipe segments were properly supported and all wall penetrations were sleeved.	
All pipe insulation is not compressed at any point.	
Y-branch and headers fittings were properly supported per details provided in the Water Source Unit Installation Manual.	
Insure Y-branch fittings are installed in the correct direction. Flow is always from the single end to the double end.	
No oil traps, solenoid valves, sight glasses, filter driers, or any other unauthorized refrigerant specialities are present.	
(Optional) High quality R410A rated full port ball valves with a Schrader port were used at all indoor units and at will in the refrigerant piping network. (Recommended for serviceability.)	
Best practice includes a minimum of 20" of straight pipe was installed between each elbow, and Y-branch or header fitting, and between two Y-branch fittings.	

INSTALLATION CHECKLIST

Water Piping

Description	Check
A No. 50 mesh (or better) minimum one inch diameter strainer is installed on the inlet pipe.	
Strainer service isolation valves, (optional bypass line and shutoff valve) provided on both ends of strainer. Strainer drain line installed.	
A balancing valve has been installed.	
A flow switch has been installed.	
Thermometers (or Pete's plugs) are installed on the inlet and outlet pipes.	
(Optional) Pressure gauges were installed on the inlet and outlet pipes.	
Piping is insulated properly per the design engineer's specifications.	
Pipes are properly supported. No lateral pressure is present on the inlet and outlet connections.	
The inlet and outlet pipes are connected at the water source unit. Water flow direction is correct (pipes are not reversed).	
Shutoff valves present at inlet and outlet of the water source unit.	

Condensate Pump / Drain Installation

Description	Check
Indoor unit condensate drain pipes were installed correctly.	
All condensate vertical risers are equal to or less than 27-1/2" from the bottom of the indoor unit.	
Indoor units with condensate pumps were level. Units with gravity drains were level or slightly canted toward the drain connection and are supported properly.	
Pumped condensate drain lines were properly connected (do not have traps, and connect to the top surface of the main drain line).	

Power Wire and Communications Cables

Description	Check
Power wiring was connected to a single phase 208-230V source.	
Ground wire was installed and properly terminated at the water source unit.	
The power supplied was clean with voltage fluctuations within specifications. (±10% of nameplate).	
Power wiring to the water-source unit(s) was installed per all local electrical code requirements.	
Power wiring to each indoor unit was installed per all local electrical code requirements.	
Communications cable between the water source unit and indoor units was connected in a daisy chain configuration (i.e., single parallel chain). No "Star" or multiple parallel circuits. No cable splices or wire caps were used to connect communications cables.	
LG-supplied cable was used between each indoor unit and its zone controller. No cables were spliced and no wire caps are present.	
Communication type RS-485–BUS type.	
All communications cables are a minimum of 18-Gauge, two conductor, stranded, with insulation material per local code. Cable segment shields were tied together. Cable shield is grounded at the water source unit only.	
Use appropriate crimping tool to attach ring or spade terminals at all power wiring and control cable terminations.	
Verify all ring and spade terminals are copper bearing in all communications daisy chains. Galvanized or nickel plated steel connectors were not used.	
All power and control wires were properly separated using the recommended distance provided in the product installation manual.	
Only LG-supplied Y-cables and extension cables were used between indoor units.	
Flow switch communications cable has been properly terminated at the switch and the water source unit.	

PRE-COMMISSIONING CHECKLIST

Job Name / Location _____ Tag # _____

Date: _____

Address: _____

_____

Refrigerant Circuit Preparation

Description	Check
Using a copy of the LATS Multi V pipe design diagram, verify the sum of the indoor unit nominal capacity connected to the piping system is between 50% and 130% of the water source unit's nominal capacity. If this rule is violated, the system will not start.	
Check all indoor units for power at the unit disconnect and power is present at the indoor unit PCB board. (LED is lit.) DO NOT TURN ON THE UNIT using the ON/OFF button.	
Successful auto address routine is complete. All device addresses have been recorded on the Indoor Unit Device Configuration Worksheet.	
Insure all field-installed full-port ball valves are open.	
The piping system held a constant 550 psig pressure for a minimum of 24 hours with all isolation valves open.	
A triple system evacuation has been performed. Micron gauge reading held at a minimum of 500 for 24 hours with all isolation valves open and without the vacuum pump connected.	
Power was energized to the water source unit at _____(time) on _____day to power the compressor crankcase heater(s). (Must be at least 6 hours before commissioning.)	
The communications cable to the indoor units has been disconnected from the IDU (B) and IDU (A) terminals at the water source unit.	
None of the water source unit service valves have been opened during the installation and preparation of the system for commissioning. (If the valves were opened, the factory refrigerant charge has been released.)	

Water Circuit Verification

Description	Check
System has been pressure tested to the designer's requirements. All unions and fittings are leak free.	
System has been filled with fluid, flushed, and all air has been purged from the piping circuit.	
Pump rotation direction is correct.	
Water flow enters on the water source unit inlet and leaves from the unit outlet.	
Pump and water source unit strainers are clean.	
Water balance has been completed.	
Proper water flow rate is present at each water source unit.	
Flow switch has been calibrated to trip at the water source unit's minimum flow requirement.	
Water has been properly treated with a rust inhibitor and fungicide chemicals.	
If required, an antifreeze chemical has been added to the water circuit.	

PRE-COMMISSIONING CHECKLIST

Prepare Pre-commissioning Package Documents

Include	Check
1. A copy of the refrigerant piping system(s) shop drawing(s) generated by LATS Multi V pipe design software.	
2. A copy of the pipe fitter's pipe changes and field notes.	
3. A verified copy of the "As-Built" LATS Multi V Project file (*.mtv) that includes all changes noted by the pipe fitter(s) in Number 2. The tree diagram notes should include changes to the line lengths used for each liquid line segment	
4. A copy of a completed and verified Installation Checklist for the water source unit, indoor units, ERVs, Air Cleaners, and Control Devices. Correct any procedures needing attention before initiating a request for commissioning..	
5. A copy of the air balance report showing proper airflow at all indoor units.	
6. A copy of the water circuit's control sequence of operation.	
7. A water circuit flow balancing report.	
8. A completed Pre-commissioning Device Configuration Worksheet.	
9. A completed copy of the Pre-commissioning Checklist.	
10. If available, a list of IP addresses obtained from the building owners IT department for each ACP, BacNet, LonWorks, AC Smart II, AC Smart Premium devices.	

Initiate a Commissioning Request

Description	Check
Verify this checklist and requirements herein have been met. Complete this checklist in its entirety BEFORE initiating a request for Commissioning..	
Send all Pre-commissioning Package Documents to your LG Applied Representative.	

Contractor Name: _____ _____

(Authorized Signature)

Address: _____

_____

Phone: _____ Date: _____

**This form must be completed and submitted to LG a minimum of three (3) weeks prior to final scheduling of any startup.*
Note: If any of the above items are not complete at time of start-up, back charges will be assessed for additional costs.

PRE-COMMISSIONING CHECKLIST

Notes for the Commissioning Agent

PRE-COMMISSIONING CHECKLIST

Notes for the Commissioning Agent

MULTI V WATER MINI

REFRIGERANT CHARGE WORKSHEET

LG

⚠ *Note:*

The system will stop operation due to excessive or insufficient refrigerant, therefore, always charge the unit properly. When servicing, always refer to any notes about system piping length and additional refrigerant amounts.

System Refrigerant Charge Calculator (lbs.).

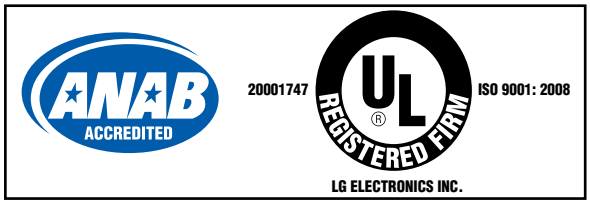
System Tag or ID_____	**Job Name**_____ **Project Manager**_____ **Date**_____

Line #	Description	Chassis I.D.		Size	Quantity	CF (Ref.)[1]	Total (lbs.)
1	Linear feet of 1/4" liquid line tubing[2]	—		—		0.015	
2	Linear feet of 3/8" liquid line tubing[2]	—		—		0.041	
3	Linear feet of 1/2" liquid line tubing[2]	—		—		0.079	
4	Linear feet of 5/8" liquid line tubing[2]	—		—		0.116	
5	Linear feet of 3/4" liquid line tubing[2]	—		—		0.179	
6	Linear feet of 7/8" liquid line tubing[2]	—		—		0.238	
7	Linear feet of 1" liquid line tubing[2]	—		—		0.323	
8	Wall Mounted + Art Cool Mirror	SE		7k to 15k		0.53	
9	Wall Mounted + Art Cool Mirror	S8, S5		18k to 24k		0.62	
10	1-Way Cassette	TJ		7k to 12k		0.44	
11	2-Way Cassette	TL		18k to 24k		0.35	
12	4-Way 2' x 2' Cassette	TR		5k to 7k		0.40	
13	4-Way 2' x 2' Cassette	TR		9k to 12k		0.55	
14	4-Way 2' x 2' Cassette	TQ		15k to 18k		0.71	
15	4-Way 3' x 3' Cassette	TN		9k to 15k		1.06	
16	4-Way 3' x 3' Cassette	TM		18k to 24k		1.41	
17	4-Way 3' x 3' Cassette	TP		24k to 28k		1.06	
18	4-Way 3' x 3' Cassette	TN		36k		1.41	
19	4-Way 3' x 3' Cassette	TM		42k to 48k		1.41	
20	High Static Ducted	BH		7k to 24k		0.57	
21	High Static Ducted	BG		15k to 42k		0.97	
22	High Static Ducted	BR		48k to 54k		1.37	
23	High Static Ducted	B8		76k to 95k		2.20	
24	Low Static Ducted, Low Static Ducted Bottom Return	B1, B3		7k to 15k		0.37	
25	Low Static Ducted, Low Static Ducted Bottom Return	B2, B4		18k to 24k		0.82	
26	Vertical / Horizontal Air Handling Unit	NJ		12k to 24k		1.04	
27	Vertical / Horizontal Air Handling Unit	NJ		30k		1.04	
28	Vertical / Horizontal Air Handling Unit	NJ		36k		1.57	
29	Vertical / Horizontal Air Handling Unit	NK		42k to 54k		2.00	
30	Ceiling Suspended	VJ		18k to 24k		0.77	
31	Convertible Surface Mount—Ceiling/Wall	VE		9k to 12k		0.22	
32	Floor Standing	CE (U)		7k to 15k		0.37	
33	Floor Standing	CF (U)		18k to 24k		0.82	
34	**Additional Refrigerant Charge Required**						
35a-c	Water source unit Factory Refrigerant Charge	36a	ARWN038GA2	38,200		2.2	
		36b	ARWN048GA2	47,800		2.2	
		36c	ARWN053GA2	52,900		2.2	
36	**Total System Charge: Sum of Additional Refrigerant Charge Required and Total Factory Refrigerant Charge**						

[1]CF (Ref.) = Correction Factor for Refrigerant Charge.

[2]For refrigerant charge purposes, consider only the liquid line; ignore the vapor line(s).

For further technical materials such as submittals, engineering manuals, service manuals, and catalogs, visit www.lg-vrf.com.



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