

# Installation Guide

## Variable Refrigerant Flow (VRF) System Single-Phase Outdoor Unit Series

**Models:** 4TVH0036B100NC  
4TVH0048B100NC  
4TVH0053B100NC

### **⚠ SAFETY WARNING**

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.



# Introduction

Read this manual thoroughly before operating or servicing this unit.

## Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

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The three types of advisories are defined as follows:

- ⚠ WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
  - ⚠ CAUTION** Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
  - NOTICE** Indicates a situation that could result in equipment or property-damage only accidents.
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## Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs such as HCFCs and HFCs.

## Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

**⚠ WARNING**

**Proper Field Wiring and Grounding Required!**

**Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.**

**⚠ WARNING****Personal Protective Equipment (PPE) Required!**

Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.

- Before installing/servicing this unit, technicians **MUST** put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). **ALWAYS** refer to appropriate Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate MSDS/SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.
- If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

Failure to follow instructions could result in death or serious injury.

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## Revision History

VRF-SVN33B added communication wiring specifications and updated the clearance section.

VRF-SVN33C updated the refrigeration piping section.

VRF-SVN33D-EN updated outdoor option setting to include manual night set-back option.

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# Model Number Description

<b>4</b>	<b>T</b>	<b>V</b>	<b>H</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>6</b>	<b>B</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>N</b>	<b>C</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>

**Digit 1: Refrigerant**

4 = R-410A

**Digit 2: Brand Name**

T = Trane (American Standard dual label)

**Digit 3: System Type**

V = Variable Refrigerant Flow

**Digit 4: Functional Type Outdoor Unit**

H = Heat pump, rotary (VRF)

**Digit 5: Reserved for future use**

0 = Standard

**Digit 6, 7, 8: Nominal capacity (Btu/h x 1,000)**

036 = 36,000 Btu/h  
 048 = 48,000 Btu/h  
 053 = 53,000 Btu/h

**Digit 9: Major development sequence**

A = First development sequence  
 B = Second development sequence  
 C = Third development sequence

**Digit 10: Electric power supply characteristics**

1 = 208-230/60/1

**Digit 11: Reserve for future use**

0 = Standard

**Digit 12: Reserved for future use**

0 = Not currently used

**Digit 13: Region of sale**

N = North America (VRF)

**Digit 14: Minor design sequence**

A = First design sequence  
 B = Second design sequence  
 C = Third design sequence

**Digit 15: Service digit (not used for ordering)**

A = First sequence  
 B = Second sequence

# Preparing for Installation

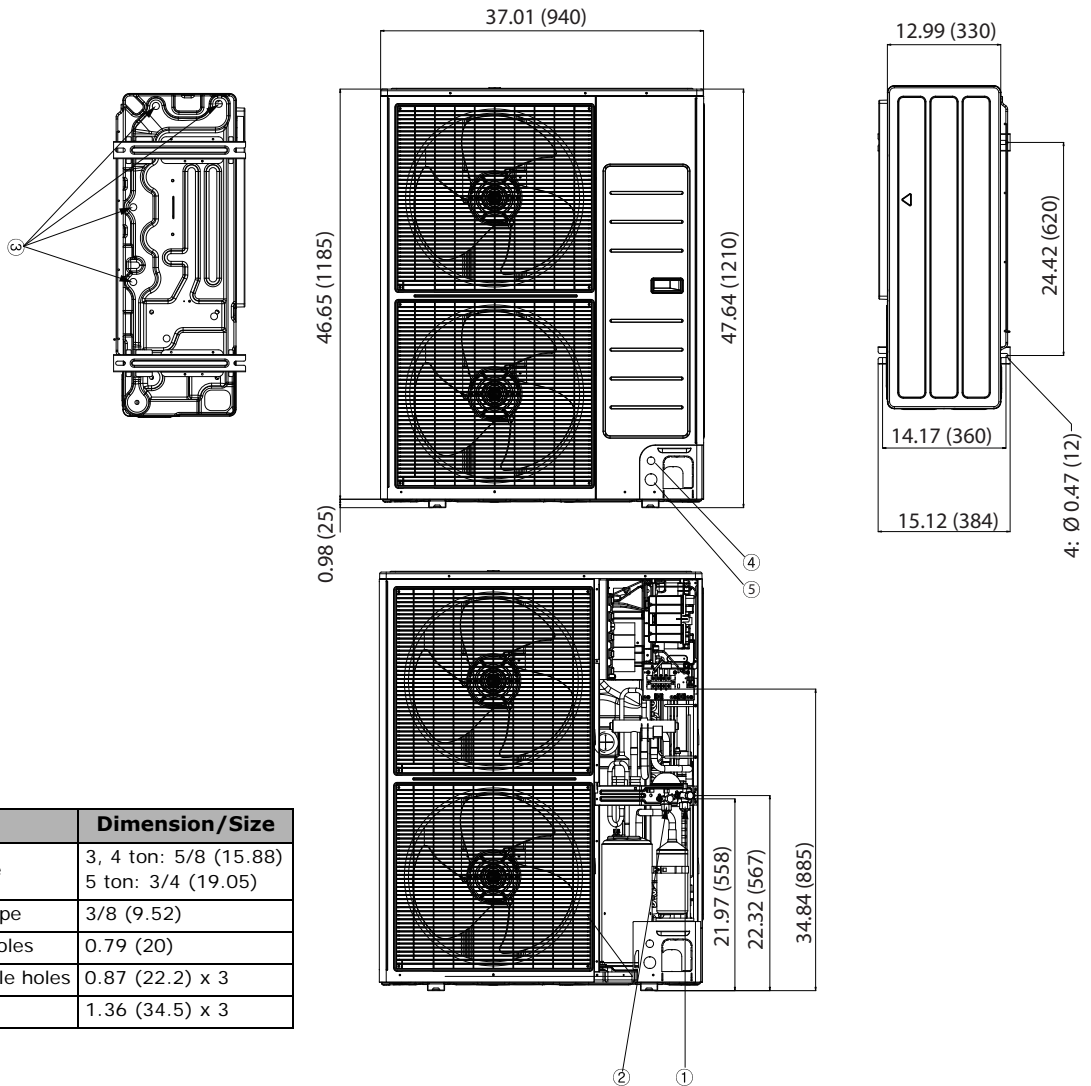
## Unit Dimensions and Weights

Table 1. Unit dimensions and weights

Unit model number	Dimensions (WxHxD) in. (mm)	Weight lb (kg)	Shipping dimensions (WxHxD) in. (mm)	Shipping weight lb (kg)
4TVH0036B100NC	37 (940) x 47.6 (1210) x 13 (330)	220.5 (100.0)	39.2 (995) x 54.6 (1388) x 16.8 (426)	231.5 (105.0)
4TVH0048B100NC		227.1 (103.0)		238.1 (108.0)
4TVH0053B100NC				

## Dimensional Drawing

Unit : inch (mm)



No.	Item	Dimension/Size
1	Gas refrigerant pipe	3, 4 ton: 5/8 (15.88) 5 ton: 3/4 (19.05)
2	Liquid refrigerant pipe	3/8 (9.52)
3	Condensate drain holes	0.79 (20)
4	Communication cable holes	0.87 (22.2) x 3
5	Power cable holes	1.36 (34.5) x 3

## Maximum Quantity of Indoor Units by Single-Phase Outdoor Unit Capacity

To prevent reducing indoor unit capacity, the sum capacity of indoor units connected to a single-phase outdoor unit should be no greater than the capacity of the single-phase outdoor unit. Refer to [Table 2](#).

**Table 2. Maximum number of indoor units determined by single-phase outdoor unit capacity**

Single-phase outdoor unit model number	Single-phase outdoor unit capacity (tons)	Maximum quantity of indoor units connected to a single-phase outdoor unit	Combination ratio (indoor unit combined capacity divided by outdoor unit capacity)
4TVH0036B100NC	3	6	50-130%
4TVH0048B100NC	4	8	
4TVH0053B100NC	5	9	
<b>Note:</b> VRF selection software governs the maximum number of indoor units and the min/max combination ratio. Use VRF selection software for all installed systems.			

## Minimum Operating Clearances

Install units as shown in the illustrations below ([Figure 1](#), [Figure 2](#), and [Figure 3](#)), observing ventilation and service requirements. Space requirements are based on cooling mode operation and an outdoor temperature of 95°F (35°C). More space is required if the outdoor temperature is higher than 95°F (35°C) or if the area is easily heated by solar radiation.

**Note:** The front of the unit is curved and has the name brand logo on it.

**Figure 1. Air flow direction**

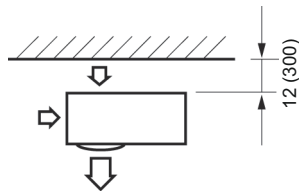




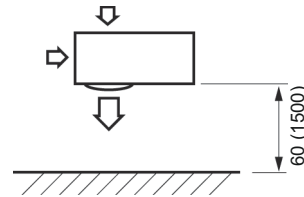
**Figure 2. Minimum operating clearances for a single unit installation**

**Note:** Clearances listed in this manual are minimum for system operation. All installations shall comply with codes and standards adopted by the Authority Having Jurisdiction (AHJ).

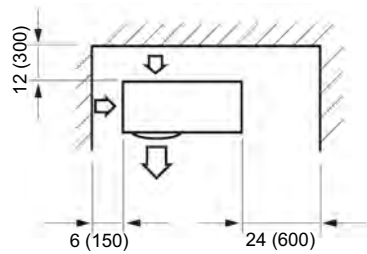
When the air outlet is opposite a wall



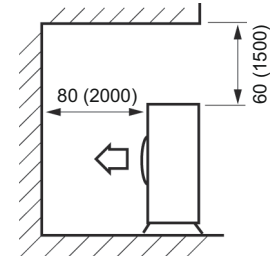
When air outlet is toward a wall



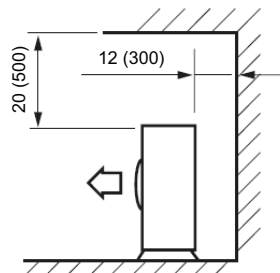
When three sides are blocked by a wall



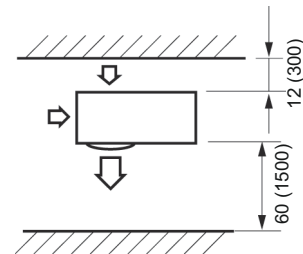
Top of unit is blocked and the air outlet is toward a wall



When top of unit is blocked and the air outlet is opposite the wall



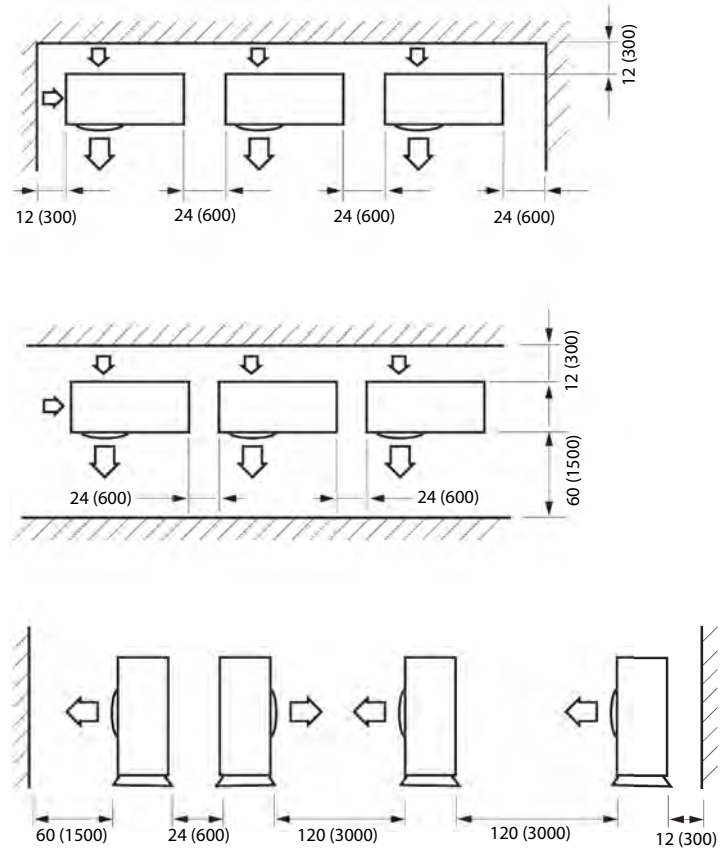
When front and back of unit are blocked by walls



## Preparing for Installation

**Figure 3. Minimum operating clearances for a multiple unit installation.**

**Note:** Clearances listed in this manual are minimum for system operation. All installations shall comply with codes and standards adopted by the Authority Having Jurisdiction (AHJ).

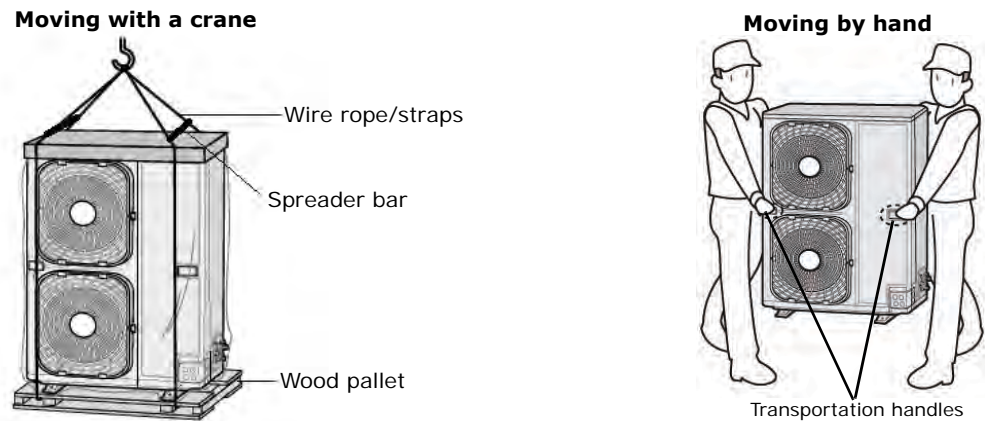


## Moving the Single-Phase Outdoor Unit

Follow these guidelines when moving the single-phase outdoor unit:

- Before moving the unit, determine a path that can support its weight.
- Do not lay the unit on its side and do not slant the unit more than 30 degrees.
- Take care to avoid injury while moving the unit; the surface of the heat exchanger is sharp.
  - If moving the unit with a crane, fasten the wire rope as shown in [Figure 4](#). To protect damage or scratches to the unit, use a spreader bar.
  - If the unit is being moved a short distance by hand, two people should lift and carry it together using the transportation handles on the side of the unit, as shown in [Figure 4](#).

**Figure 4. Moving the single-phase outdoor unit**



## Location Considerations

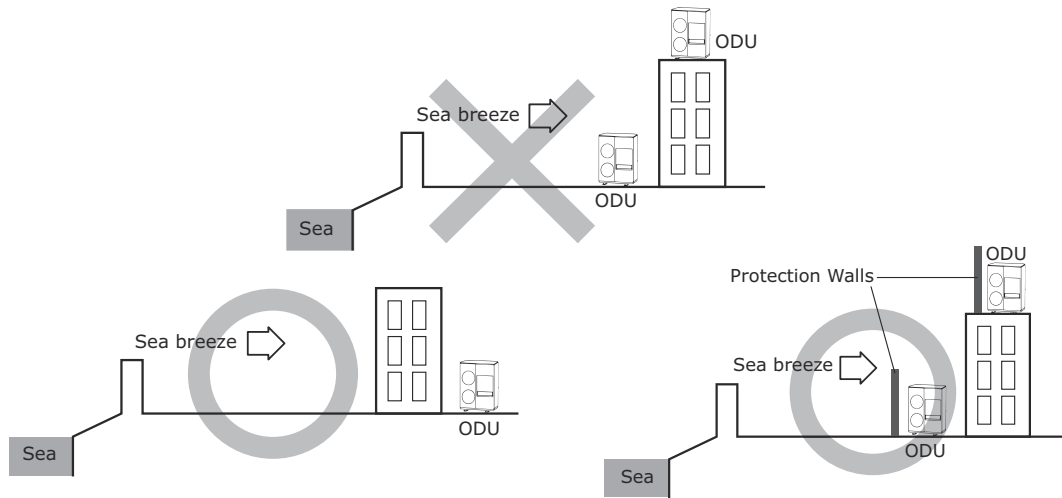
Choose an installation location based on the following considerations.

- Install the outdoor unit:
  - On a supporting structure that can bear the weight of the outdoor unit. The supporting structure can be a base on the ground, on a waterproof roof, or in a pit.
  - With sufficient clearances around the unit for service and repairs.
  - On a flat surface that does not collect rain water.
  - In a well ventilated location.
  - Away from strong wind.
  - Away from direct exposure to rain or snow.
  - Where there is no risk of flammable vapor leakage.
  - Where there is no exposure to salt, machine oil, sulfide gas, or corrosive environmental conditions.
  - Away from sea breeze.

**Note:** For seacoast applications, block the unit from direct exposure to sea breeze by installing the unit behind a structure such as a building or a protective wall that is 1.5 times higher than the unit. For air circulation, leave 60 in. (1.5 m) of space between the wall and the fan outlet side of the unit or 12 in. (0.5 m) of space between the wall and the fan intake side of the unit. Consult an installation expert about taking anti-corrosion measures, such as removing salinity on the heat exchanger and applying a rust inhibitor more frequently than once a year.

## Preparing for Installation

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- At least 9.84 ft (3 m) away from equipment that generates electromagnetic waves.
- Away from interfering sources, such as radio, computer, and stereo equipment.
- Far enough away from people living and working nearby so that hot discharge air or noise do not disturb them.
- Away from inflammable materials.
- Ensure that condensate water generated by the outdoor unit can drain smoothly away from the unit.
- Install the power and communication cables in a separately installed enclosure.
- If installing on a high place such as a roof, a fence or guard rail should be installed around the unit to safeguard it from falling.
- If there is a potential for accumulated snow to block the air inlet or heat exchanger, install the unit on a higher base.
- R-410A refrigerant is a safe, nontoxic and nonflammable refrigerant. However, if there is a concern about a dangerous level of refrigerant concentration in the case of refrigerant leakage, add extra ventilation.
- Avoid installing the outdoor unit where corrosive gases, such as sulfur oxides, ammonia, and sulfurous gas, are produced. If unavoidable, consult with an installation specialist about using a corrosion-proof or anti-rust additive to protect the unit coils.
- Apply corrosion protection and any other protective coatings to the unit as appropriate to the environment.

# Unit Installation

Follow these guidelines for installing the single-phase outdoor unit.

**Important:** *The manufacturer is not responsible for damage incurred for installations that have not followed these guidelines.*

The unit must be installed:

- On a horizontally level surface.
- On a surface that is strong enough to support the unit and to minimize noise.

## Base Recommendations

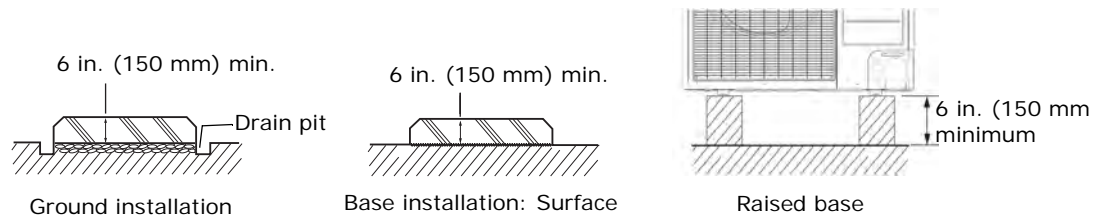
### General guidelines

A supporting base for the single-phase outdoor unit:

- Is typically made of concrete.
- Should typically be 1.5 times larger than the bottom of the unit. However, for installations that are subject to snow accumulation, the base should be no larger than the bottom of the unit.
- Should be 6 in. (150 mm) or higher to protect the unit from rain water or other conditions that may cause damage to the unit.

**Note:** *The base height or, if the unit is installed on a frame (see “[Minimizing Vibration](#),” p. 14), the base height plus the frame height, should be greater than the highest expected snowfall.*

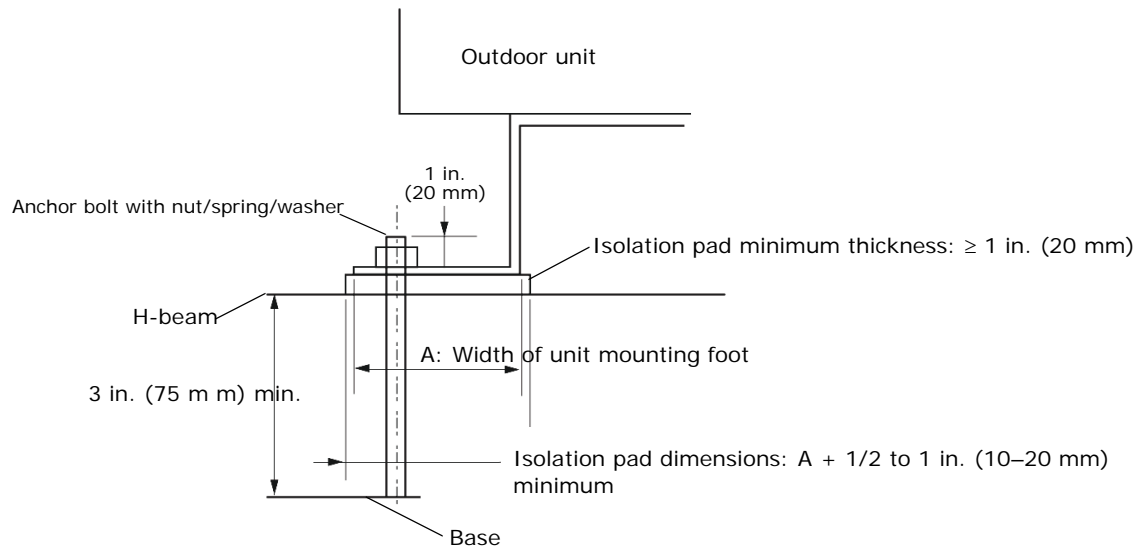
- If necessary, has wire mesh or steel bars added to the concrete to prevent damages or cracks.



## Minimizing Vibration

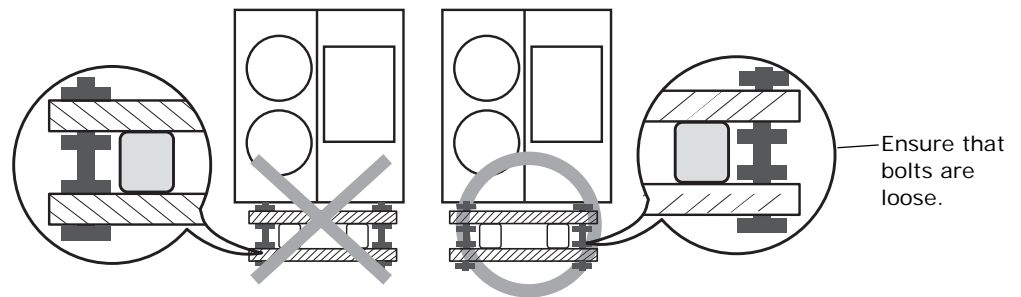
When installing multiple single-phase outdoor units side by side, or when there is a need to minimize unit vibrations, use a vibration-minimizing structure such as an H-beam frame or a vibration-isolation frame, and an isolation pad. Refer to the specifications in [Figure 5](#). After installation, apply corrosion-protection to the frame.

**Figure 5. Vibration-minimizing structure specifications**



After installing a vibration-isolation frame, loosen the bolts so that the isolators are capable of absorbing vibrations ([Figure 6](#)).

**Figure 6. Bolts on vibration-isolation frame**

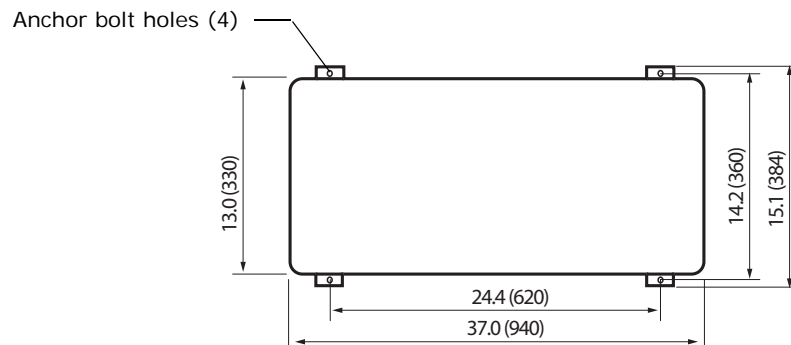


## Securing the Single-Phase Outdoor Unit

Secure the unit firmly to the base with M10 anchor bolts (see [Figure 7](#)).

- Use zinc-plated or stainless steel nuts and bolts.
- Use a rubber washer between the bolt and the unit to prevent bimetallic corrosion.
- Consult with the authority having jurisdiction regarding adopted building codes and standards that detail securing the unit to withstand wind and seismic interruptions.

**Figure 7. Anchor bolt positions**

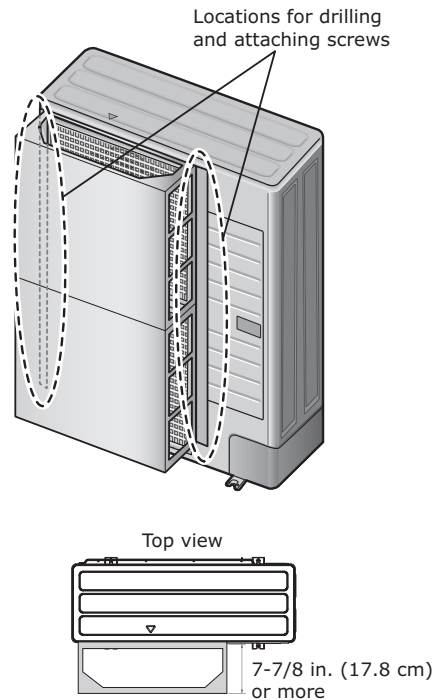


### Wind Baffle

If the outdoor unit is exposed to direct strong winds, a wind baffle should be installed (model number CSERWINDBFL36AA).

Refer to [Figure 8](#). Follow the instructions provided with the wind baffle kit to ensure proper installation.

**Figure 8. Wind baffle installation**



**Notes:**

- The wind baffle should be used only when the baffle is installed into the prevailing wind. The rear of the unit should be oriented towards an adequately sized wall or wind block. The wind baffle may not be effective if wind impinges on the sides or rear of the unit.
- Do not install a wind baffle if there are obstructions to the sides or above the unit.
- The outdoor unit must comply with operating clearances as described in ["Minimum Operating Clearances," p. 8](#).
- If the application does not conform to the above recommendations, contact your local manufacturer sales office for further assistance.



# Refrigerant Piping

This section contains information on selecting, storing, and connecting refrigerant piping.

## Selecting Refrigerant Piping

Refrigerant piping diameter, thickness, and temper is selected according to length, as specified in this section.

**Note:** Use insulated, unwelded, degreased, and de-oxidized copper pipe (Cu-DHP type according to ISO 1337 or UNI EN 12735-1) suitable for an operating pressure of at least 609.15 psi (4200 kPa) and a burst pressure of at least 3002.28 psi (20,700 kPa). Copper pipe for hydro-sanitary applications is unsuitable.

All systems must be selected through the manufacturer’s provided selection software and reviewed by the local sales office to ensure that all required components are accounted for and that system performance meets the specific job requirements.

Use the following procedure:

1. Obtain the selection report from the designer.
2. Mark the piping “tree” diagram with job site changes:
  - Line length changes
  - Vertical changes between components
  - Indoor unit location changes
  - Outdoor unit location changes
  - The VRF Select tool assumes the vapor line and liquid line follow the same pathway.
3. Submit changes to the designer and obtain the final report to ensure that the refrigeration lines are correctly sized and the system weigh-in charge is accurate.

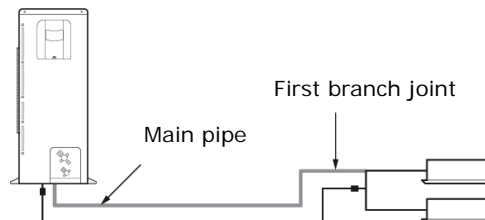
## Pipe Diameter

Table 3 specifies the diameter of the main pipe based on unit capacity.

**Table 3. Single-phase outdoor unit main pipe size based on unit capacity**

Single-phase outdoor unit capacity		Liquid pipe in. (mm)	Vapor pipe <sup>(a)</sup> in. (mm)
Ton	MBH		
3	38	3/8 in. (9.52 mm)	5/8 in. (15.88 mm)
4	48		
5	53		3/4 in. (19.05 mm)

**(a)** Increase the vapor pipe from the outdoor unit to the first branch joint by one size if the pipe length between the outdoor unit and the farthest indoor unit, including the elbow, exceeds 295 ft (90 m); or if the outdoor unit capacity declines due to pipe length. If this change is required, it will be noted in the report generated by the VRF Selection software.



## Refrigerant Piping

Table 4 specifies the pipe size between branch joints.

**Table 4. Pipe sizes between branch joints**

Indoor unit total capacity (MBH)	Pipe size (OD)	
	Liquid in. (mm)	Vapor in. (mm)
Less than 51	3/8 (9.52)	5/8 (15.88)
51-69		3/4 (19.05)

## Branch Joint Selection

Table 5 specifies the first branch joint according to single-phase outdoor unit capacity.

**Table 5. First branch joint according to single-phase outdoor unit capacity**

Single-phase outdoor unit total capacity (ton)	Branch joint model
3	4YDK1509B0051A
4	
5	4YDK2512B0138A

Table 6 specifies branch joints connected after the first branch, according to the total capacity of all indoor units connected after the first branch.

**Table 6. Branch joints connected after the first branch, according to total indoor unit capacity**

Total indoor unit capacity (MBH)	Branch joint model
Less than 51	4YDK1509B0051A
51-69	4YDK2512B0138A

## Pipe Thickness and Temper Grade

Table 7 specifies pipe minimum thickness and temper grade based on pipe diameter.

<b>⚠ CAUTION</b>	
<b>Risk of Pipes Breaking!</b>	
If pipes with a diameter larger than 3/4 in. (19.05 mm) are specified, use semi-hard (C1220T-1/2H) or hard (C1220T-H) copper piping. If a softer copper pipe (C1220T-O) is used, the pipe may break due to its low pressure resistance and cause personal injury.	

**Table 7. Refrigerant pipe minimum thickness and temper grade**

Outer diameter in. (mm)	Minimum thickness in. (mm)	Temper grade
1/4 (6.35)	0.028 (0.70)	Annealed (C1220T-O)
3/8 (9.52)	0.028 (0.70)	
1/2 (12.70)	0.031 (0.80)	
5/8 (15.88)	0.039 (1.00)	
3/4 (19.05)	0.035 (0.9)	Drawn (C1220T-1/2H or C1220T-H)
7/8 (22.22)	0.035 (0.9)	

## Piping Length

**Table 8. Basic refrigerant piping length rules for the single-phase outdoor unit**

	Piping location	ft (m)
<b>Maximum piping length</b>	Total length: Main Pipe (A) + Branch Pipe (B) + Branch Pipe (C) + Branch Pipe (D) + Branch Pipe (E). (See <a href="#">Figure 9</a> and <a href="#">Figure 10, p. 20.</a> )	984.0 (299.9)
	From the outdoor unit to the indoor unit that has the longest length of piping. (See <a href="#">Figure 11</a> and <a href="#">Figure 12, p. 21.</a> )	492.0 (150.0)
	From the outdoor unit to the first Y-joint. (See <a href="#">Figure 13, p. 22.</a> )	361.0 (110.0)
	Main pipe from outdoor unit to distribution header. (See <a href="#">Figure 14, p. 22.</a> )	361.0 (110.0)
	From the first Y-joint to farthest indoor unit. (See <a href="#">Figure 15, p. 23.</a> )	131.0 (39.9)
	From the distribution header to farthest indoor unit. (See <a href="#">Figure 16, p. 23.</a> )	131.0 (39.9)
	Nearest indoor unit to farthest indoor unit. (See <a href="#">Figure 17, p. 24</a> , <a href="#">Figure 18, p. 24</a> , <a href="#">Figure 19, p. 25</a> , and <a href="#">Figure 20, p. 26.</a> )	131.0 (39.9)
	From single-port EEV kit to indoor unit. (See <a href="#">Figure 21, p. 27.</a> )	6.5 (2.0)
	From multi-port EEV kit to indoor unit. (See <a href="#">Figure 22, p. 28.</a> )	65.0 (19.8)
<b>Maximum vertical change</b>	Outdoor unit above lowest indoor unit. (See <a href="#">Figure 23, p. 29.</a> )	164.0 (50.0)
	Outdoor unit below highest indoor unit. (See <a href="#">Figure 24, p. 29.</a> )	131.0 (39.9)
	Highest indoor unit to lowest indoor unit. (See <a href="#">Figure 23</a> and <a href="#">Figure 24, p. 29.</a> )	49.0 (14.9)
<b>Y-joint to Y-joint</b>	Y-joints placed after the first Y-joint must fall within the 131 ft (39.9 m) maximum distance between the first Y-joint and the farthest indoor unit.	
<b>Y-joint to distribution header</b>	Distribution headers placed after the first Y-joint must fall within the 131 ft (39.9 m) maximum distance between the first Y-joint and the farthest indoor unit.	
<b>Distribution header to Y-joint, or distribution header to distribution header</b>	Not allowed. After a distribution header, the refrigerant line feeds an indoor unit (or is capped off per instruction). No Y-joints or distribution headers are allowed after a distribution header.	
<b>Notes:</b>		
<ol style="list-style-type: none"> <li>Rules detailed in table are for estimating purposes only and are useful when determining feasibility. However, all piping lengths must be input into the VRF selection software in order to determine capability, line sizing, system capacity loss, and additional system charge.</li> <li>It is assumed that the vapor line and liquid line follow the same pathway. Every effort should be made to assure compliance with this assumption.</li> </ol>		

# Refrigerant Piping

Figure 9. Systems using Y-joints: Total piping length

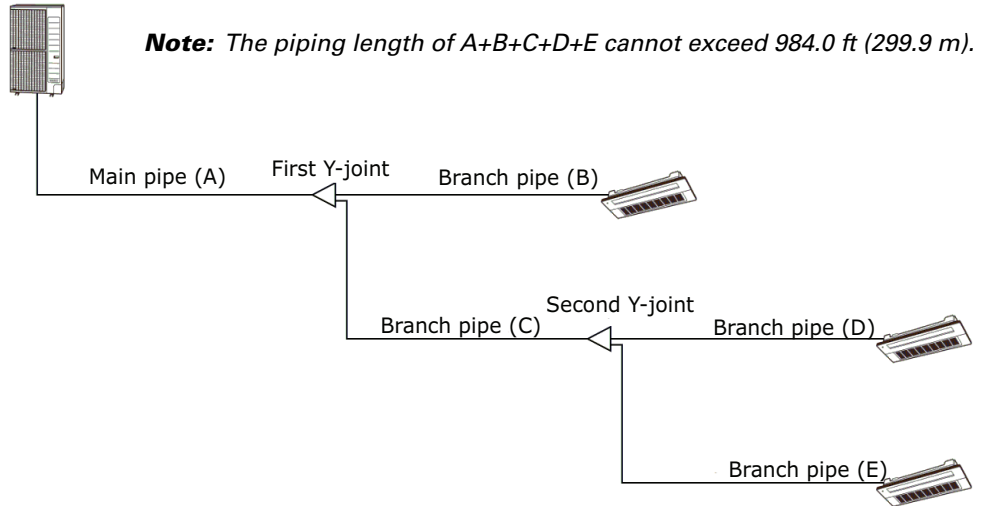


Figure 10. Systems using a distribution header: Total piping length

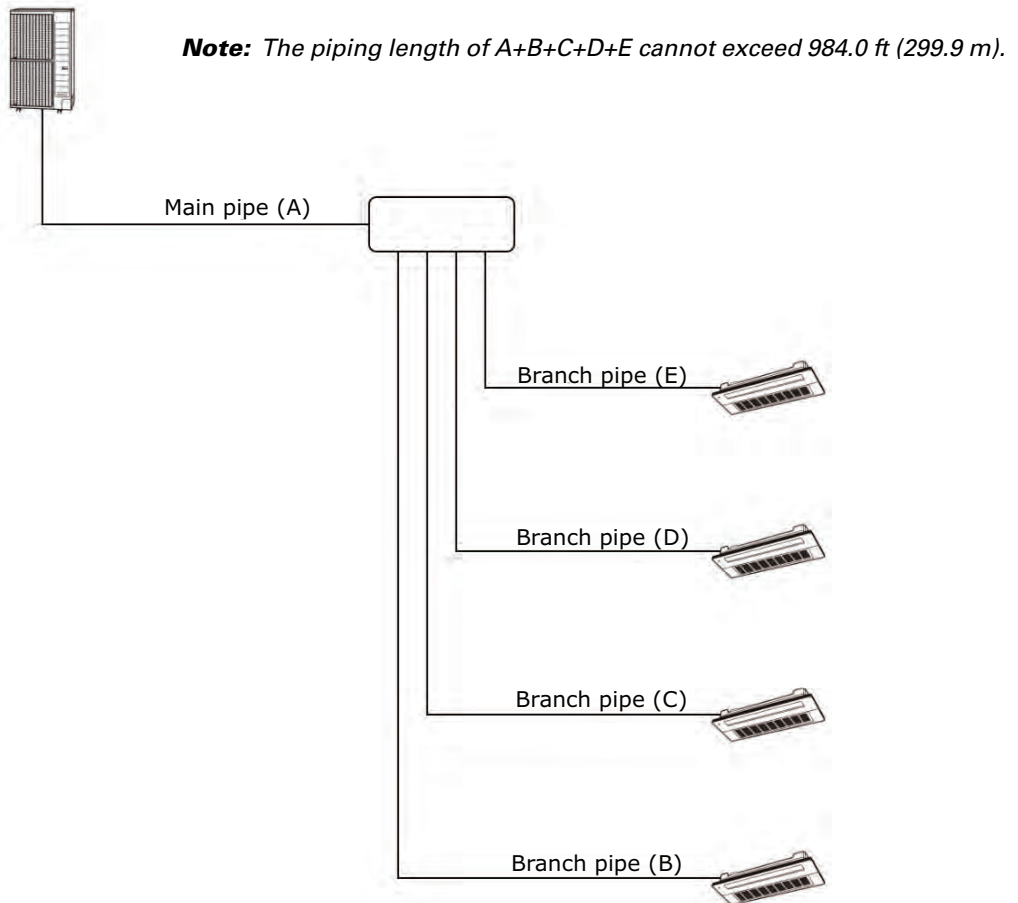


Figure 11. Systems using Y-joints: Maximum piping length from outdoor unit to farthest indoor unit

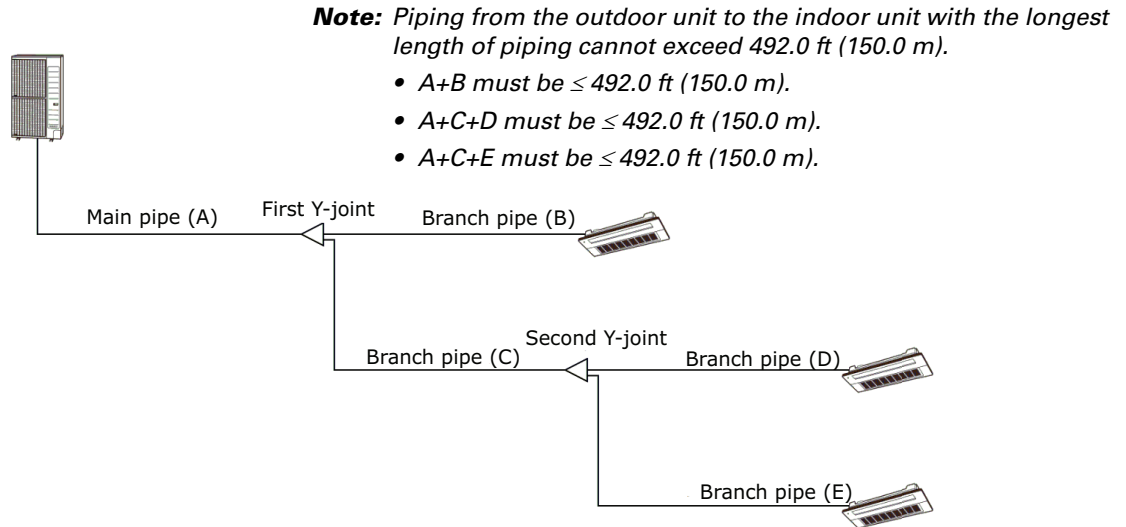
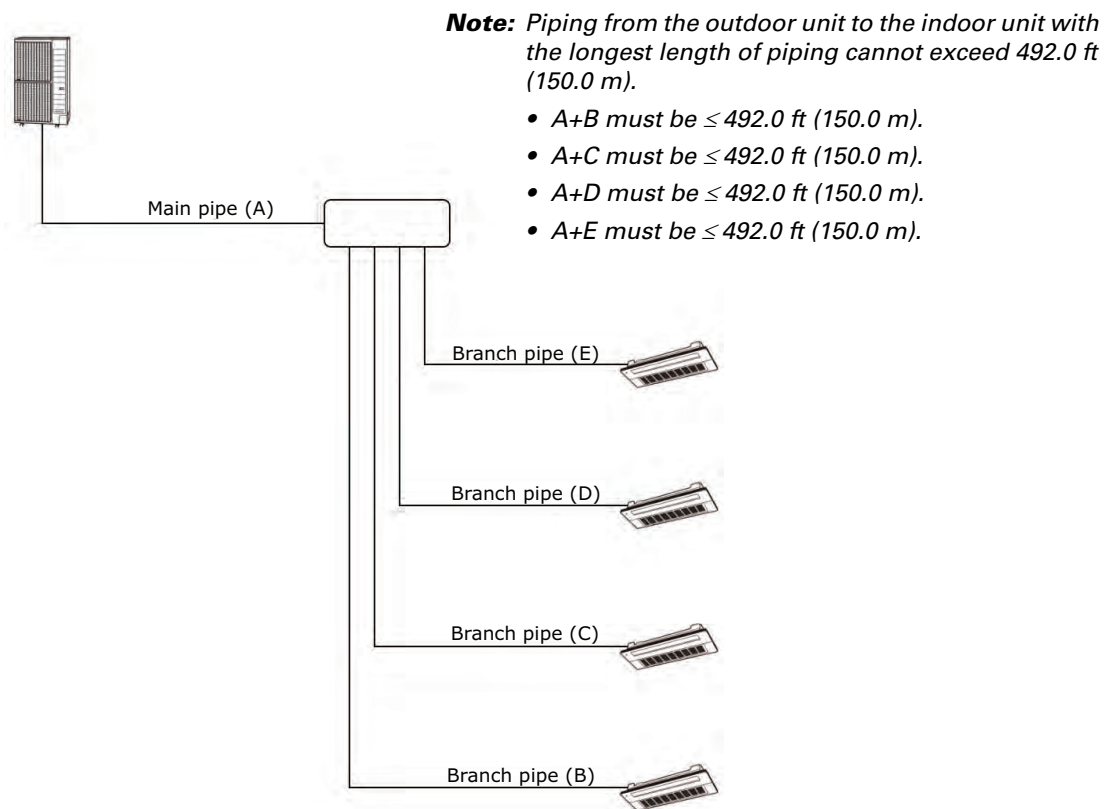


Figure 12. Systems using a distribution header: Maximum piping length from outdoor unit to farthest indoor unit



## Refrigerant Piping

Figure 13. Systems using Y-joints: Maximum piping length from outdoor unit to first Y-joint

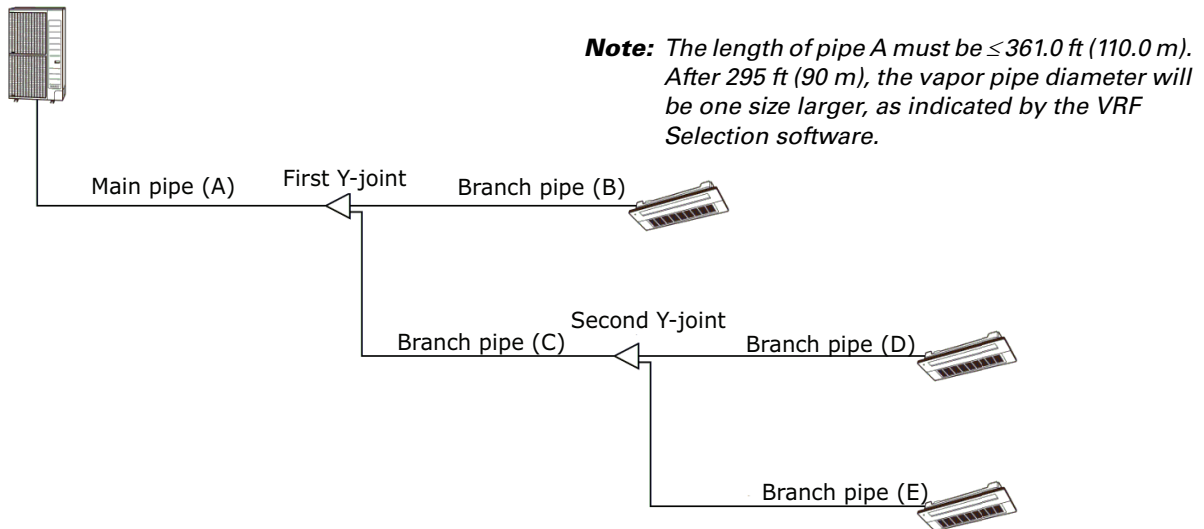


Figure 14. Systems using a distribution header: Maximum piping length from outdoor unit to distribution header

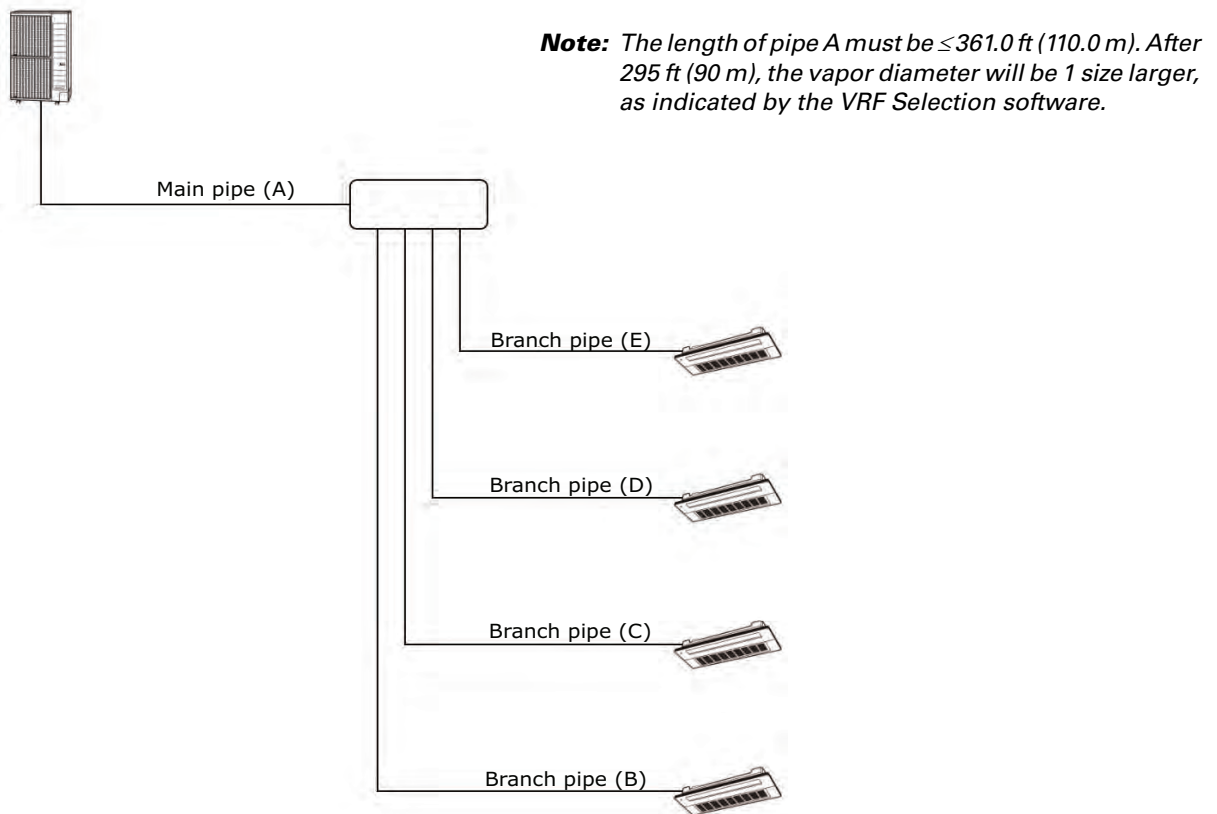


Figure 15. Systems using Y-joints: Maximum piping length from first Y-joint to farthest indoor unit

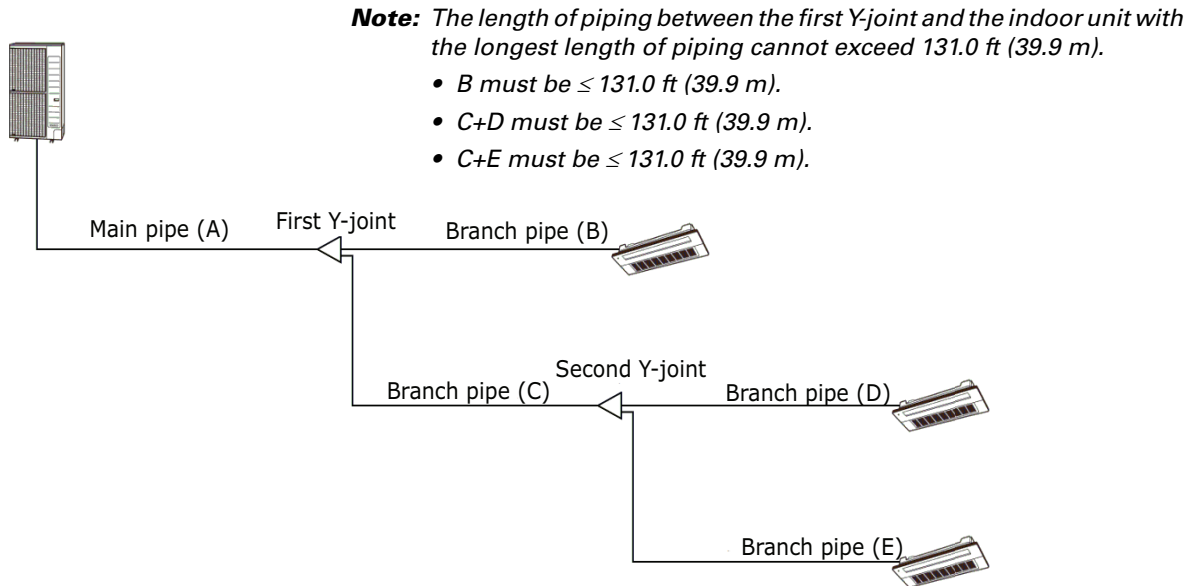
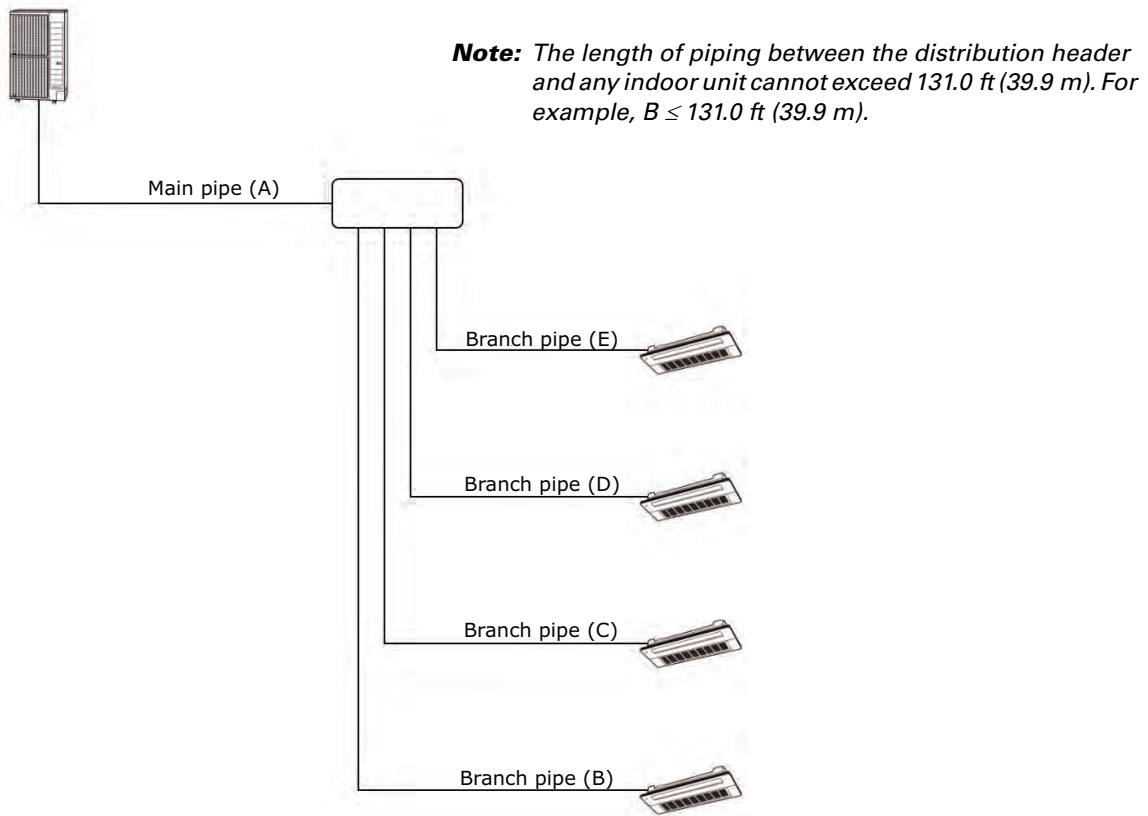
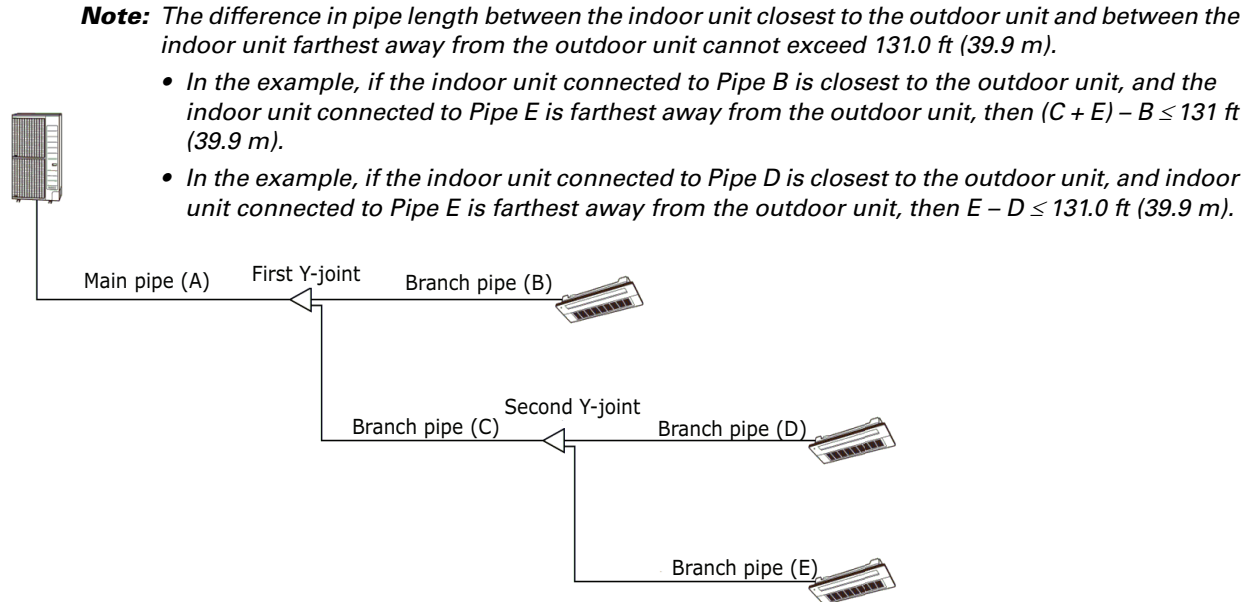


Figure 16. Systems using a distribution header: Maximum piping length from distribution header to farthest indoor unit



## Refrigerant Piping

**Figure 17. Systems using Y-joints: Distance between the indoor unit closest to the outdoor unit and between the indoor unit farthest away from the outdoor unit**



**Figure 18. Systems using a distribution header: Distance between the indoor unit closest to the outdoor unit and between the indoor unit farthest away from the outdoor unit**

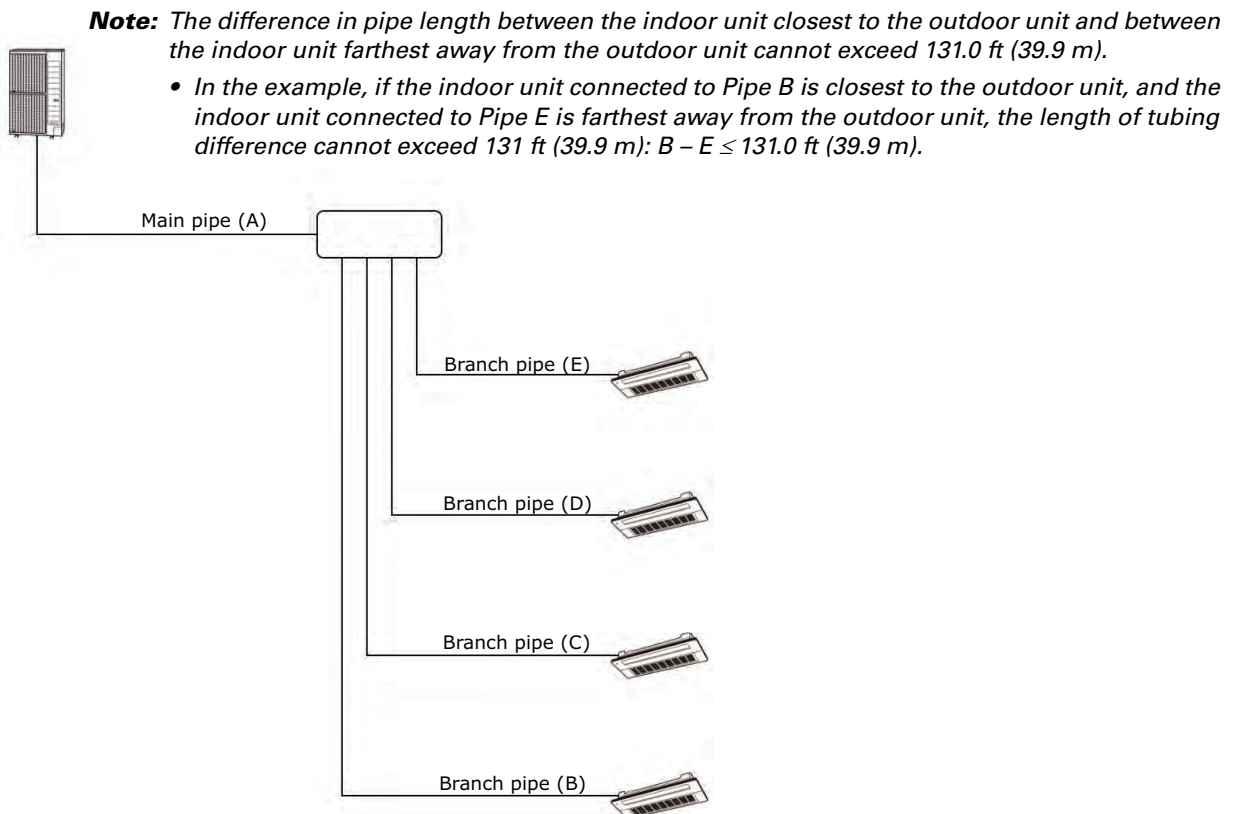
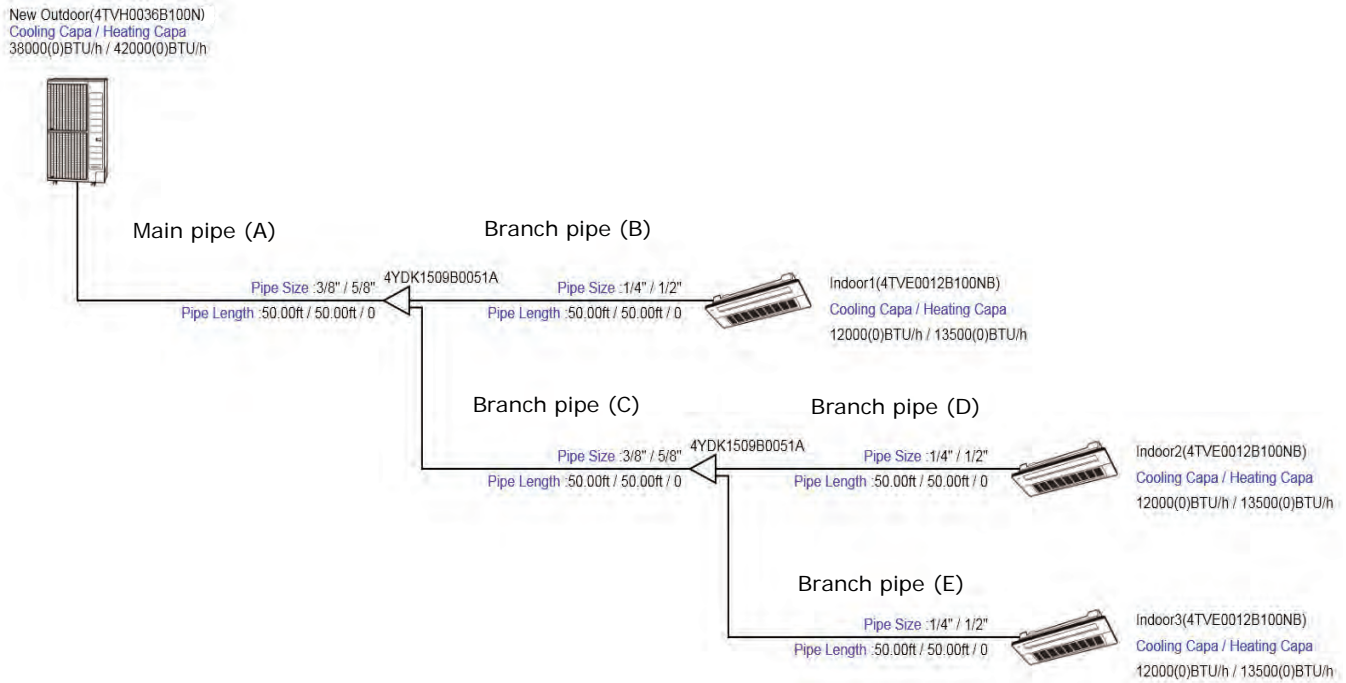




Figure 19. Maximum piping length between nearest and farthest indoor units (50 ft example)

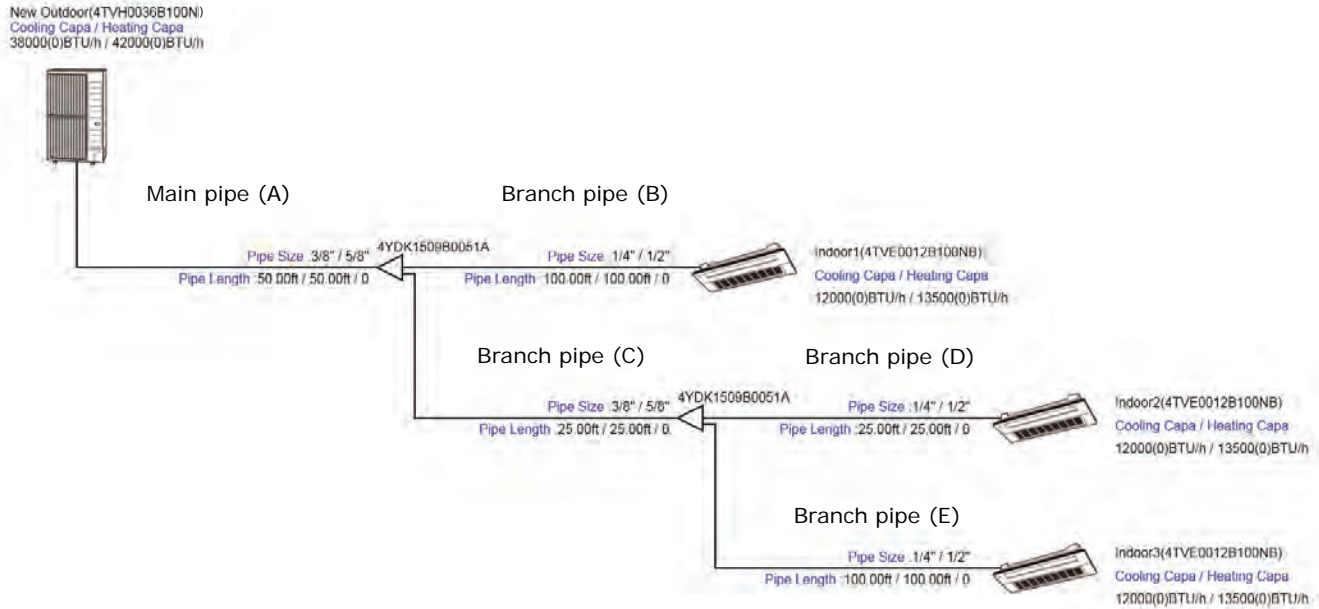


In the example in Figure 19, the distance between the nearest and farthest indoor unit  $((C+E) - B) = 50 \text{ ft}$  (15.2 m). VRF Selection software calculates this value.

Checklist	Restriction	Result value	Result	Description
Maximum piping length	492.13 ft	151.97 ft	OK	
Total Piping Length	984.25 ft	251.97 ft	OK	
Main Piping Length	360.89 ft	50.00 ft	OK	
Distance of the first branch joint to the farthest ID unit	131.23 ft	101.97 ft	OK	
<b>Distance of the nearest ID unit to the farthest ID unit</b>	<b>131.23 ft</b>	<b>50.98 ft</b>	<b>OK</b>	
Level difference (OD locates upper than ID unit)	164.00 ft	0.00 ft	OK	
Level difference (OD locates lower than ID unit)	131.00 ft	6.56 ft	OK	
Level difference between ID units	49.00 ft	0.00 ft	OK	
Maximum equivalent piping length	574.15 ft	153.28 ft	OK	
Additional refrigerant amount		7.781 lbs	INFO	Additional refrigerant amount = 7.781 lbs

## Refrigerant Piping

**Figure 20. Maximum piping length between nearest and farthest indoor units (75 ft example)**



In the example in Figure 20, the distance between the nearest and farthest indoor unit (E – D) = 75 ft (22.9 mm).

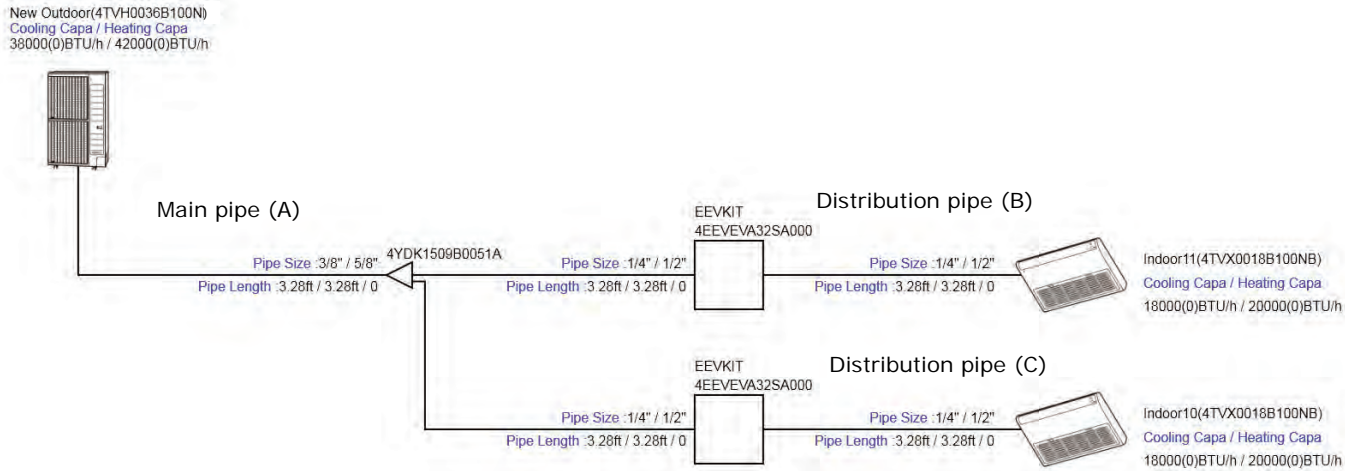
**Explanation:**

- From outdoor unit to indoor unit 1 = 150 ft (45.7 m)
- From outdoor unit to indoor unit 2 = 100 ft (30.5 m)
- From outdoor unit to indoor unit 3 = 175 ft (53.3 m)

Therefore, the indoor unit closest to the outdoor unit is Indoor Unit 2 @100 ft (30.5 m) and the indoor unit farthest away from the outdoor unit is Indoor Unit 3 @ 175 ft (53.3 m). The distance between Indoor Unit 3 and Indoor Unit 2 is 75 ft (22.8 m). This distance cannot be >131 ft (39.9 m).

Checklist	Restriction	Result value	Result	Description
Maximum piping length	492.13 ft	176.97 ft	OK	
Total Piping Length	984.25 ft	301.97 ft	OK	
Main Piping Length	360.89 ft	50.00 ft	OK	
Distance from the first branch joint to the farthest ID unit	131.23 ft	126.97 ft	OK	
<b>Distance from the nearest ID unit to the farthest ID unit</b>	<b>131.23 ft</b>	<b>75.00 ft</b>	<b>OK</b>	
Level difference (OD locates upper than ID unit)	164.00 ft	0.00 ft	OK	
Level difference (OD locates lower than ID unit)	131.00 ft	6.56 ft	OK	
Level difference between ID units	49.00 ft	0.00 ft	OK	
Maximum equivalent piping length	574.15 ft	178.28 ft	OK	
Additional refrigerant amount		7.781 lbs	INFO	Additional refrigerant amount = 7.781 lbs

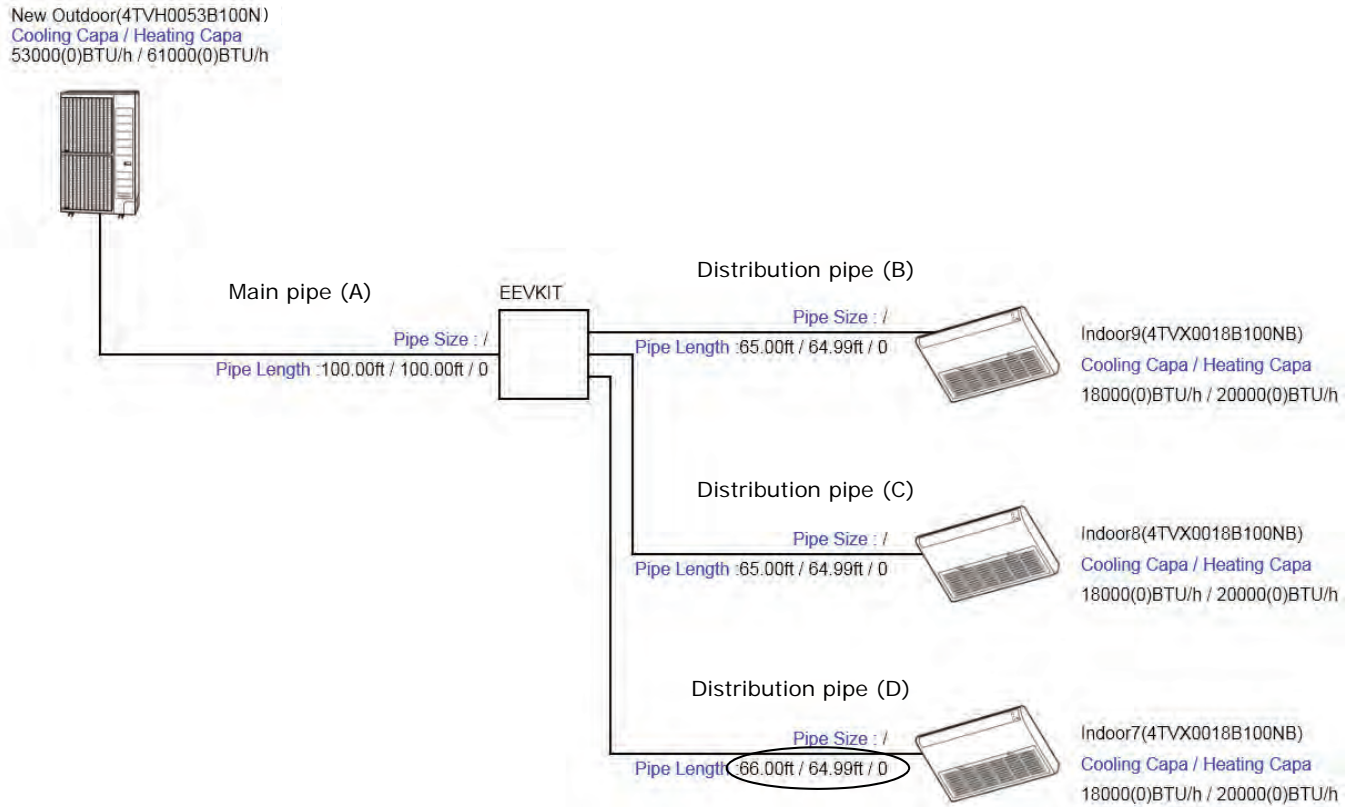
**Figure 21. Maximum piping length between the single-port EEV and the indoor unit being fed by the EEV**



The distance between the single-port EEV and the indoor unit being fed by the EEV cannot exceed 6.5 ft (2 m).

## Refrigerant Piping

**Figure 22. Maximum piping length between the multi-port EEV and any indoor unit being fed by the EEV**

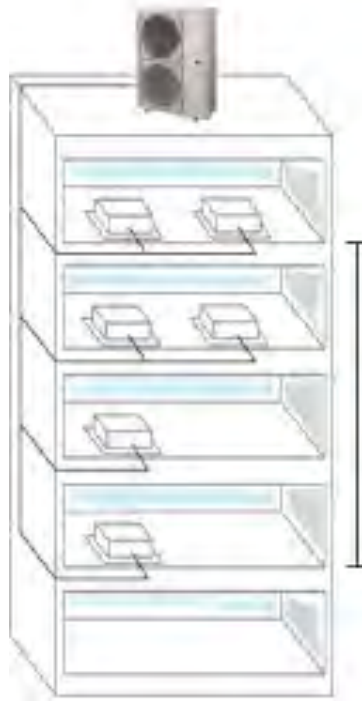


The distance between the multi-port EEV and any indoor unit being fed by the EEV cannot exceed 65 ft (19.8 m). VRF Selection software points out the excessive length in the distribution pipe (D).

Checklist	Restriction	Result value	Result	Description
Maximum piping length	492.13 ft	166.49 ft	OK	
Total Piping Length	984.25 ft	296.49 ft	OK	
Main Piping Length	360.89 ft	100.00 ft	OK	
Distance of the first branch joint to the farthest ID unit	131.23 ft	66.49 ft	OK	
Distance of the nearest ID unit to the farthest ID unit	131.23 ft	1.00 ft	OK	
Level difference (OD locates upper than ID unit)	164.00 ft	3.28 ft	OK	
Level difference (OD locates lower than ID unit)	131.00 ft	0.00 ft	OK	
Level difference between ID units	49.00 ft	0.00 ft	OK	
Maximum equivalent piping length	574.15 ft	166.98 ft	OK	
<b>Distance of distribution kit to ID unit</b>	<b>65.62 ft</b>	<b>66.00 ft</b>	<b>ERROR</b>	<b>Fail: Distance of distribution kit to ID unit</b>
Additional refrigerant amount		7.928 lbs	INFO	Additional refrigerant amount = 7.928 lbs

**Figure 23. Maximum vertical change between outdoor unit and lowest indoor unit**

The outdoor unit cannot be greater than 164 ft (50 m) above the lowest indoor unit.



Maximum vertical distance between the lowest and highest indoor units cannot exceed 49 ft (15 m).

**Figure 24. Maximum vertical change between outdoor unit and highest indoor unit**

The outdoor unit cannot be greater than 131 ft (40 m) below the highest indoor unit.

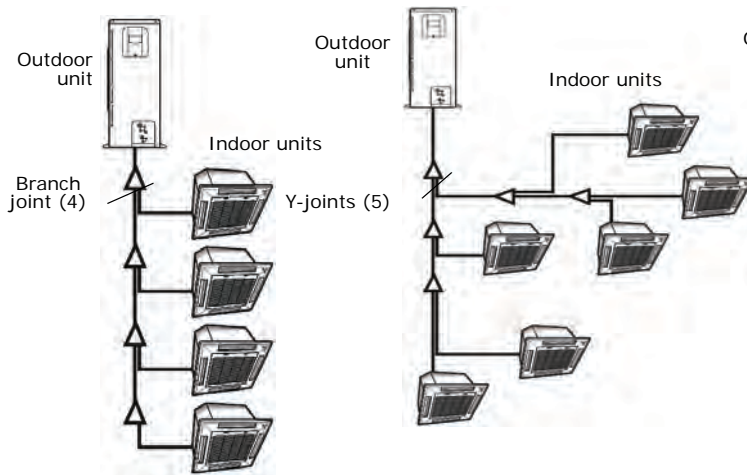


Maximum vertical distance between the lowest and highest indoor units cannot exceed 49 ft (15 m).

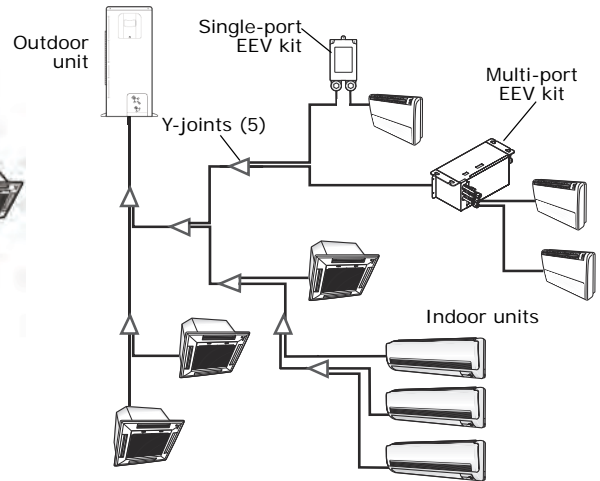
## Refrigerant Piping

### Refrigerant Piping Installation Examples

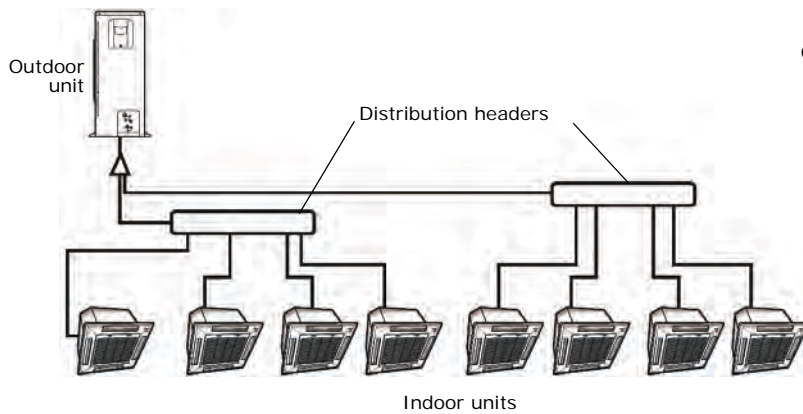
**Example with Y-joints**



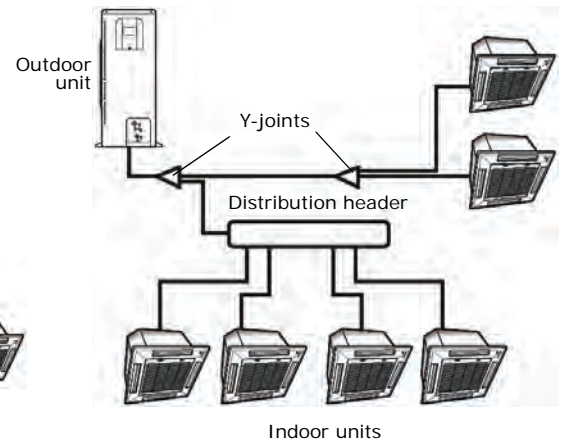
**Example with Y-joints and EEV kits**



**Example with distribution headers**



**Example with Y-joints and distribution header**



## Storing Refrigerant Piping

To prevent foreign materials or water from entering the pipe, storing method and sealing method (especially during installation) is very important. Apply correct sealing method depending on the environment (see [Table 9](#)).

**Table 9. Refrigerant pipe storage factors**

Storage location	Storage time	Sealing type
Outdoor	Longer than one month	Pipe pinch
	Shorter than one month	Taping
Indoor	—	Taping

## Installing Refrigerant Piping

### ⚠ WARNING

#### Hazard of Explosion and Deadly Gases!

Failure to follow all proper safe refrigerant handling practices could result in death or serious injury. Never solder, braze or weld on refrigerant lines or any unit components that are above atmospheric pressure or where refrigerant may be present. Always remove refrigerant by following the guidelines established by the EPA Federal Clean Air Act or other state or local codes as appropriate. After refrigerant removal, use dry nitrogen to bring system back to atmospheric pressure before opening system for repairs. Mixtures of refrigerants and air under pressure may become combustible in the presence of an ignition source leading to an explosion. Excessive heat from soldering, brazing or welding with refrigerant vapors present can form highly toxic gases and extremely corrosive acids.

### NOTICE:

#### System Component Damage!

Do not remove the seal caps from refrigerant connections, or open the service valves until prepared to braze refrigerant lines to the connections. Excessive exposure to atmosphere (> 5 min.) may allow moisture or dirt to contaminate the system, damaging valve seals and causing ice formation in system components.

## Overview

1. Cut or extend field-supplied piping as needed. To extend pipes, braze or use flared pipe connections (not supplied). Refer to ["Pipe Cutting," p. 31](#), ["Nitrogen Flushing While Brazing," p. 32](#), and ["Flared Pipe Connections," p. 32](#).
2. Make sure that pipes are free of dirt, debris, and moisture, and do not leak. (Refer to ["Leak Testing Pipe Connections," p. 42](#)).
3. Braze or use flared pipe connections to install piping. Refer to ["Connecting Piping to the Single-Phase Outdoor Unit," p. 33](#).

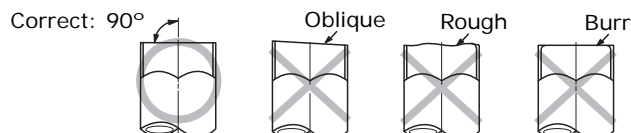
## Pipe Cutting

Required tools:

- Pipe cutter
- Reamer
- Pipe holder

1. Using a pipe cutter, cut the pipe so that the cut edge is at 90° to the side of the pipe.
2. Use a reamer to remove all burrs at the cut edge.

Examples of correctly and incorrectly cut pipes.



### Nitrogen Flushing While Brazing

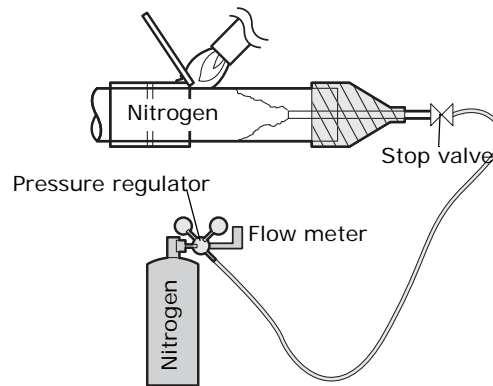
#### **NOTICE**

#### **Avoid Unit Damage!**

**Never braise pipe connections without performing nitrogen flushing. Failure to perform this procedure will damage the unit, resulting in capacity loss and reduced long-term reliability.**

While brazing refrigerant pipes, flush them with nitrogen gas. Use a pressure regulator to maintain a flow rate of 1.76 ft<sup>3</sup>/h (0.05 m<sup>3</sup>/h) or more.

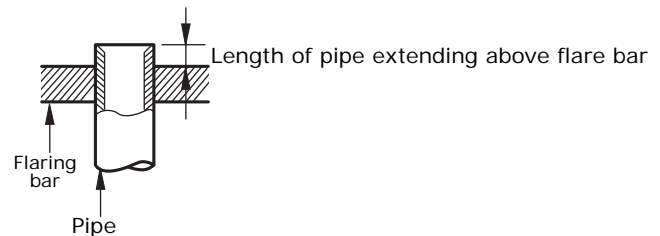
**Figure 25. Nitrogen flushing while brazing refrigerant pipes**



### Flared Pipe Connections

Use a flaring tool specifically designed for flare joints in R-410A systems, which creates deeper flares than those by made by traditional flaring tools. This flaring tool has an eccentric mandrel and clutch type handle. Follow the flare tool manufacturer's directions for using the tool.

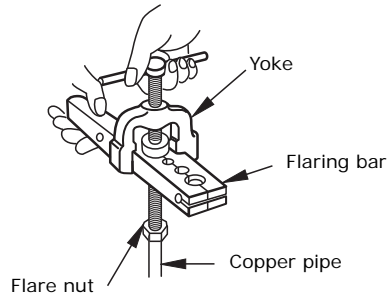
1. Slide the flare nut over the pipe to be flared.
2. Slide the end of the pipe into the hole on the flaring bar that fits the pipe, leaving a length of pipe, determined by tool type (see table), extending above the flaring bar. Clamp it down.



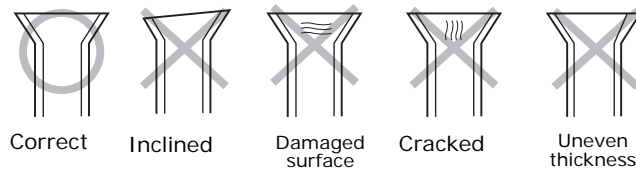
3. Attach the yoke to the flaring bar, centering the conical part over the end of the pipe that is extending above the flaring bar.



- Tighten the yoke securely to flare the end of the pipe.



- Remove the pipe. The end of the pipe that you flared should look like the end of a trumpet. See examples of correctly and incorrectly flared pipes.



- Align the pipes and tighten the flare nuts manually and then with a spanner torque wrench, applying the torque according to pipe dimensions:

Outer diameter in. (mm)	Connection torque (ft·lb)	Flare dimension (in.)	Flare shape (in.)
1/4 (6.35)	10.3–13.3 ft·lb	0.34–0.36	
3/8 (9.52)	25.1–31.0 ft·lb	0.50–0.52	
1/2 (12.70)	36.1–45.0 ft·lb	0.64–0.65	
5/8 (15.88)	50.2–60.5 ft·lb	0.76–0.78	

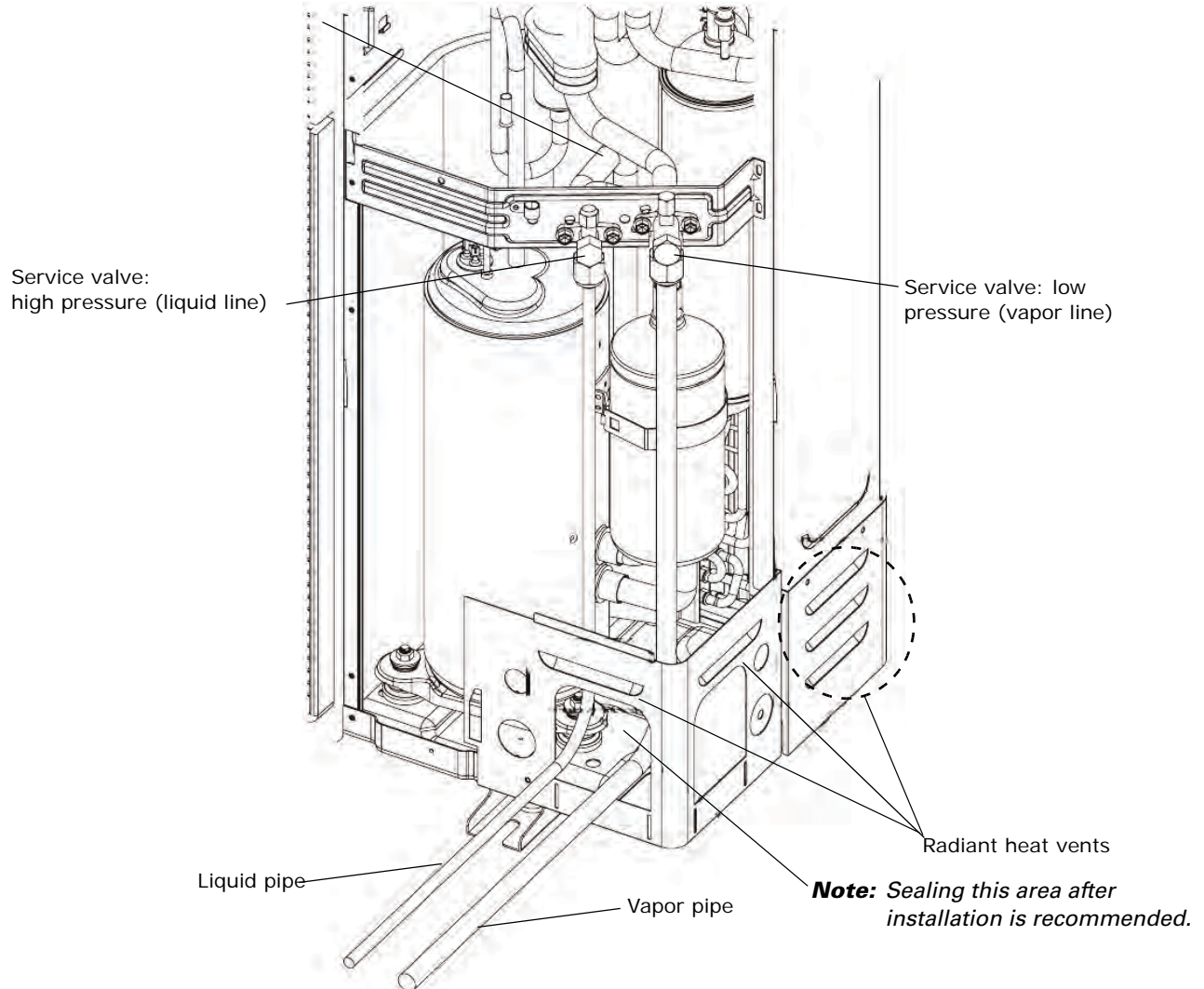
## Connecting Piping to the Single-Phase Outdoor Unit

**Important:** Ensure that all pipe connections are accessible for servicing and maintenance.

Pipes can be connected to the single-phase outdoor unit at the front, back, bottom, left, or right of the unit:

- Remove the pipe cover from the unit. See [Table 26, p. 34](#).

Figure 26. Pipe connections on unit



2. Remove the knock-out that you are going to use. Unused knock-outs should remain closed to prevent damage to the unit.
  - Take care to prevent damage to the exterior of the unit.
  - Remove burrs from knock-out hole edges and apply rust inhibitor.
3. Connect the pipes to the unit using flared connections or by brazing. If brazing the pipe connection, avoid damaging the service valves by wrapping them with a wet cloth.
  - Avoid damaging the temperature sensor.
  - Ensure that the connected pipes do not touch each other or make contact with the unit.
4. After making electrical connections (see [“Electrical Wiring,” p. 35](#)) and insulating the pipes (see [“Insulating Refrigerant Pipes,” p. 45](#)), replace the pipe cover and close the remaining gap. Make sure the radiant heat vents ([Figure 26, p. 34](#)) are not blocked.

# Electrical Wiring

Observe the following precautions when making electrical connections and refer to the wiring diagram (Figure 27, p. 36).

## WARNING

### **Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

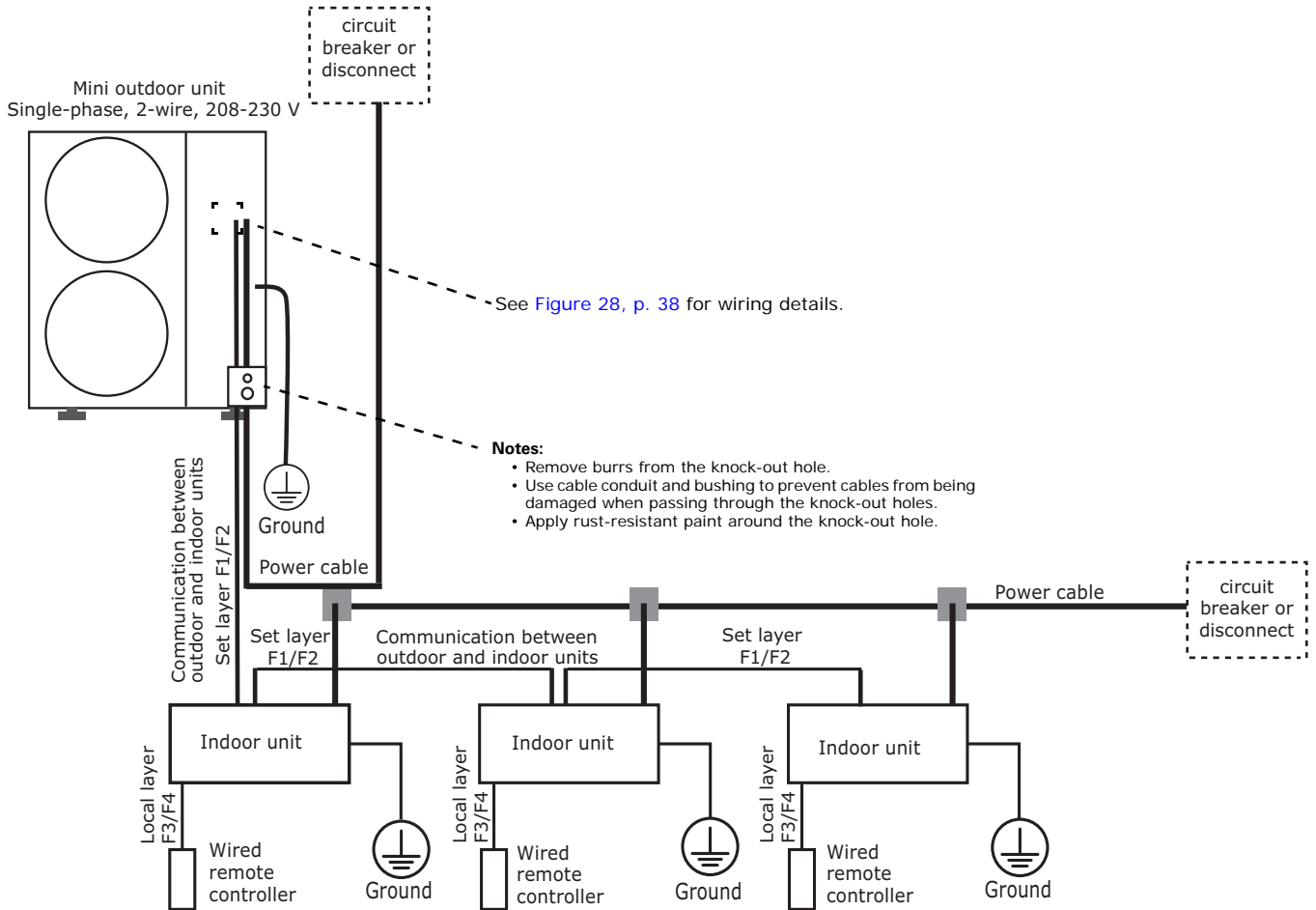
## NOTICE

### **Use Copper Conductors Only!**

**Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.**

- Make all electrical connections in accordance with electrical codes and ordinances.
- Multi-pole circuit breaker or disconnect is required to fully isolate the unit from all power.
- Install circuit breakers/disconnects in accordance with local and national codes.
- Select the power cable in accordance with relevant local and national regulations.
- Power cable specifications are based on the following conditions: underground/ambient temperature of 86°F (30°C), single multi-conductor cables.  
***Note:** If conditions are different from these, consult an electrical installation expert and re-select the power cable. If the length of power cable exceeds 164.04 ft (50 m), re-select the power cable considering the voltage drop.*
- Use a power cable made out of incombustible material for the insulator (inner cover) and the sheath (outer cover).
- All wiring must be protected from weather and damage.
- Do not use power cable that has exposed wire.
- Do not disconnect or change the factory wiring inside the unit.
- Provide strain relief for power and communication cables.
- Unbalanced power must be maintained within 10% of supply rating among all indoor units or the unit will stop and an error code will be generated. (Significantly unbalanced power may shorten the life of the system.)
- Maintain a distance of 2 in. (50 mm) or more between power and communication cables to prevent interference.

Figure 27. Typical system installation wiring



**Note:** This figure illustrates the need for separate electrical branch circuits for the indoor units and the outdoor unit. The Authority Having Jurisdiction (AHJ) shall be consulted to assure the adopted codes and standards regarding disconnects and branch circuit protection are followed.

## Power Wiring

**⚠ WARNING**

**Avoid Risk of Fire or Explosion!**

**Do not let the power cable come into contact with the pipes inside the outdoor unit. If the power supply cable touches the pipes, the vibration of the compressor will be transferred to the pipes and can damage the power supply cables or pipes. The damage could result in fire or explosion, causing death or serious injury.**

1. Refer to the unit nameplate for Minimum Circuit Ampacity (MCA) and maximum Over-current Protection (MOP) rating.
2. Refer to the adopted codes and standards by the Authority Having Jurisdiction (AHJ) for electrical conduit application guidelines. In the absence of codes and standards, refer to the latest edition of the National Electrical Code - NFPA 70.

**Notes:**

- Voltage tolerance is  $\pm 10\%$ .
- Maximum allowable voltage between phases is 2%

**Table 10. Cable conduit specifications**

Name	Temper grade	Application conditions
Flexible PVC conduit	PVC	If conduit is installed indoors and not exposed to outside elements (embedded in concrete)
Class 1 flexible conduit	Galvanized steel sheet	If conduit is installed indoors but exposed to outside elements
Class 1 PVC-coated flexible conduit	Galvanized steel sheet and soft PVC compound	If conduit is installed outdoors and requires waterproofing

3. Cut the power cable to an appropriate length and connect it to terminals L and N in the power supply box with a solderless ring terminal (see [Figure 28](#)).

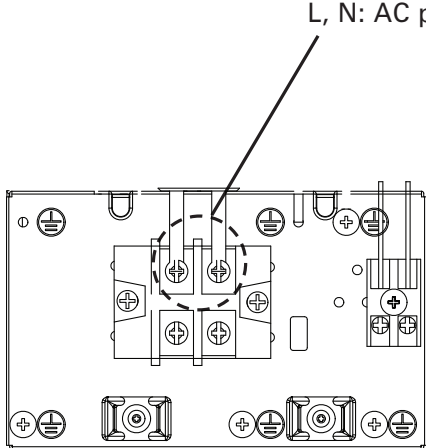
Screw	Tightening torque for terminal	Terminals
M4	0.9–1.3 lbf/ft (1.2–1.8 N·m)	Communication: F1, F2
M5	1.5–2.2 lbf/ft (2.0–3.0 N·m)	Single-phase AC power: L1, L2

4. If two cables are connected to one terminal, place the cables back to back with the thin cable upward and the thick cable downward, as shown in the detail in [Figure 28](#).
5. Secure the cable(s) with a cable tie and provide strain relief.
6. Replace the cover on the terminal board.

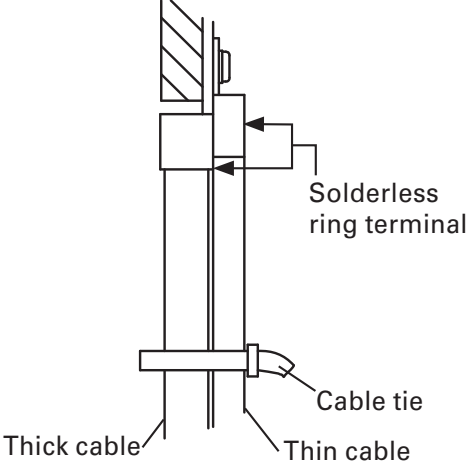
**Note:** Make sure that the section of the power supply cable that has the sheath removed is inside the power supply box. If this is not possible, connect the power cable conduit to the power supply box.

7. Pull the power cable through the designated knock-out at the bottom right of the single-phase outdoor unit (refer to [Figure 27, p. 36](#)).

Figure 28. Power wiring connections



Detail for connecting two cables to one terminal

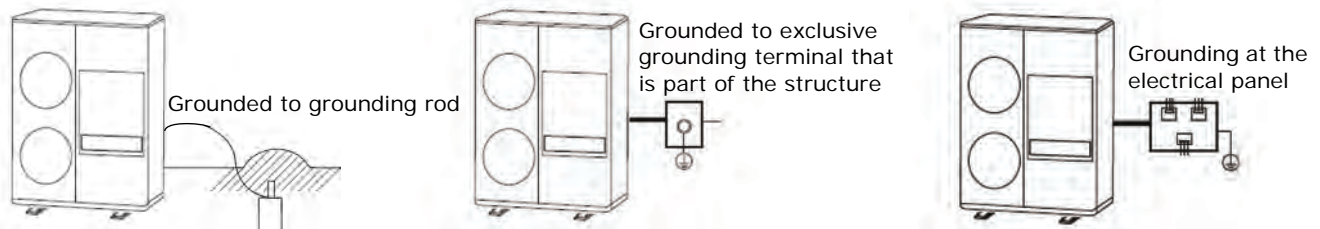


## Grounding

**Important:** Grounding must be done by a qualified electrician. The unit cannot be grounded by a gas or water pipe, a lightning rod, or a telephone line grounding wire.

Ground the unit at an exclusive grounding terminal, at the electrical panel (see [Figure 29](#)), or—if the power distribution circuit is not grounded or its grounding does not comply with electrical codes and specifications—to a grounding rod.

**Figure 29. Single-phase outdoor unit grounding examples**



### Installing a Grounding Rod

If the installation requires a grounding rod is required, follow this procedure:

1. Select a grounding rod that complies with national and local codes.
2. Select a location for the grounding rod that:
  - Contains hard damp soil rather than loose sand or gravel.
  - Is located away from underground structures such as gas and water pipes, telephone lines, and underground cables.
  - Is at least 6.6 ft (2 m) away from a lightning conductor.
3. Install the grounding rod in accordance with national and local codes.
4. Proceed with [“Installing the Grounding Cable.”](#)

### Installing the Grounding Cable

1. Select rated grounding cable by referring to the single-phase outdoor unit power cable specifications. Refer to the adopted codes and standards of the Authority Having Jurisdiction (AHJ) for electrical conduit application guidelines and wiring selection guidelines. In the absence of codes and standards, refer to the latest edition of the National Electrical Code (NFPA 70).
2. Connect the grounding cable to the grounding hole inside the power supply box and pull it through the designated grounding knock-out.
 

**Note:** If the grounding cable length needs to be extended, make the cable connection in accordance with national and local codes.
3. If a grounding rod was installed to ground the unit, measure the resistance with a ground resistance tester. Refer to [Table 11](#) for resistance requirements.
  - If the resistance is above the requirements, drive the grounding rod deeper into the ground or increase the number of grounding rods until the resistance requirement is achieved.

## Electrical Wiring

- If you have grounded the unit to a grounding terminal or electrical panel, ensure that the resistance meets the requirements.

**Table 11. Grounding resistance requirements**

Power condition at installation site	High or average humidity	Low humidity
Voltage to ground is $\leq 150$ V	<ul style="list-style-type: none"> <li>• Ensure that the grounding resistance is <math>&lt;100 \Omega</math>.</li> <li>• If a circuit breaker is installed that disconnects the circuit within 0.5 seconds, the allowable grounding resistance is 30–500 <math>\Omega</math>.</li> </ul>	<ul style="list-style-type: none"> <li>• Ideally, grounding resistance should be <math>&lt;100 \Omega</math>, and should not exceed 250 <math>\Omega</math>.</li> </ul>
Voltage to ground is $> 150$ V		<ul style="list-style-type: none"> <li>• Ensure that the grounding resistance is <math>&lt;100 \Omega</math>.</li> <li>• If a circuit breaker is installed that disconnects the circuit within 0.5 seconds, the allowable grounding resistance is 30–500 <math>\Omega</math>.</li> </ul>

## Communications Wiring

Use 18 AWG, 25 pF/ft nominal, 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire for communications wiring.

Refer to [Table 10, p. 37](#) for cable conduit specifications.

### ⚠ WARNING

#### Hazardous Voltage!

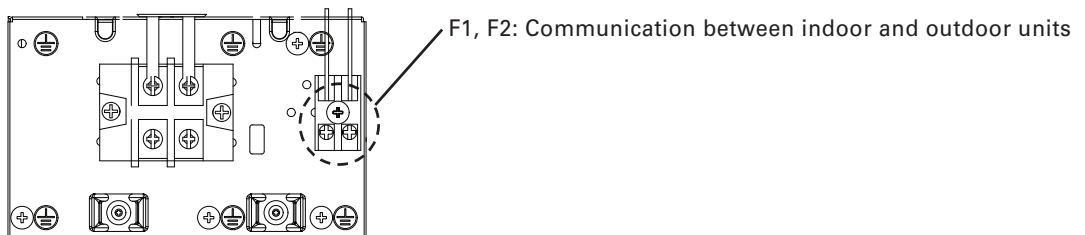
**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

1. Connect the communications cable wires to the terminals, as shown in [Figure 30](#).

#### Notes:

- Ensure that more than 1 in. (20 mm) of the outer sheath of the power and communication cable conduit are inside the electrical component box.
- To reduce interference, ensure that power and communication cables run in parallel with a minimum space of 2 in. (50 mm) between the cables or, if crossing is necessary, cross at 90 degrees.
- The communication cable between single-phase outdoor units and between indoor and outdoor units has no polarity.

**Figure 30. Communications board and wiring terminals**



2. Provide strain relief for the communications cable.
3. Pull the communications cable through the designated knock-out at the bottom right of the single-phase outdoor unit (refer to [Figure 27, p. 36](#)).

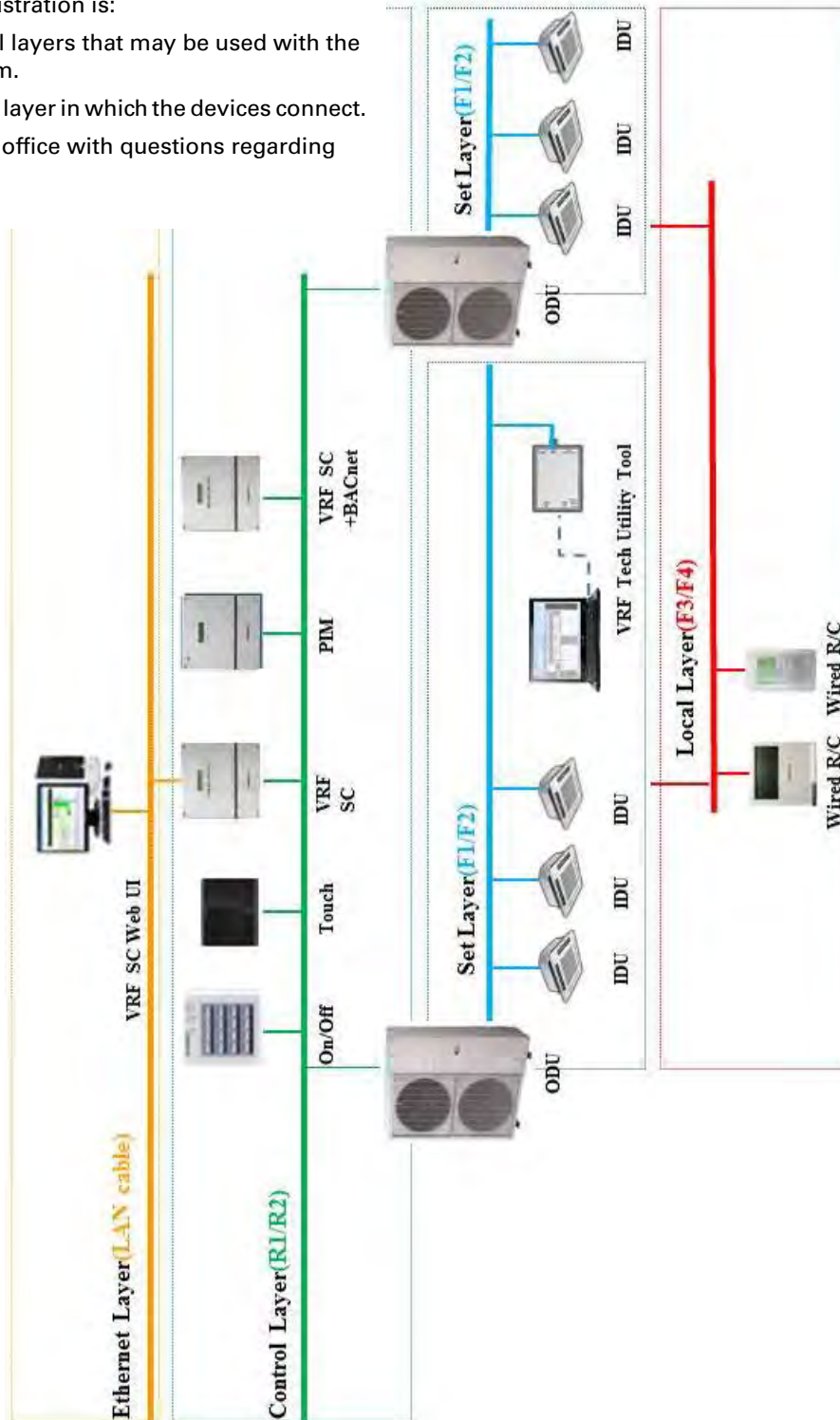


**Figure 31. VRF Single-phase system control layer scheme**

The purpose of this illustration is:

- To show the control layers that may be used with the single-phase system.
- To show the control layer in which the devices connect.

Contact the local sales office with questions regarding control wiring.



# Leak Testing Pipe Connections

Before leak testing pipe connections, read all safety precautions and notes.

## WARNING

### Confined Space Hazards!

Do not work in confined spaces where refrigerant or other hazardous, toxic or flammable gas may be leaking. Refrigerant or other gases could displace available oxygen to breathe, causing possible asphyxiation or other serious health risks. Some gases may be flammable and or explosive. If a leak in such spaces is detected, evacuate the area immediately and contact the proper rescue or response authority. Failure to take appropriate precautions or to react properly to such potential hazards could result in death or serious injury.

## WARNING

### Explosion Hazard!

Never use an open flame to detect gas leaks. It could result in an explosion. Use a leak test solution for leak testing. Failure to follow recommended safe leak test procedures could result in death or serious injury or equipment or property-only-damage.

Use only dry nitrogen with a pressure regulator for pressurizing unit. Do not use acetylene, oxygen or compressed air or mixtures containing them for pressure testing. Do not use mixtures of a hydrogen containing refrigerant and air above atmospheric pressure for pressure testing as they may become flammable and could result in an explosion. Refrigerant, when used as a trace gas should only be mixed with dry nitrogen for pressurizing units. Failure to follow these recommendations could result in death or serious injury or equipment or property-only damage.

Do not exceed unit nameplate design pressures when performing a leak test. Failure to follow these instructions could result in an explosion causing death or serious injury.

### Notes:

- All required piping pressure tests must be completed in accordance with national and/or local codes.
- When leak-testing refrigerant systems, observe all safety precautions.
- Leak test only one circuit at a time to minimize system exposure to potentially harmful moisture in the air.
- Use R-410A refrigerant vapor as a tracer for leak detection and use oil-pumped dry nitrogen to develop required test pressures.
- Use tools rated for R-410A.
- Do not remove the valve core of the charging port.
- Perform the leak test with the outdoor unit service valves closed.

Use the following procedure for leak testing pipe connections.

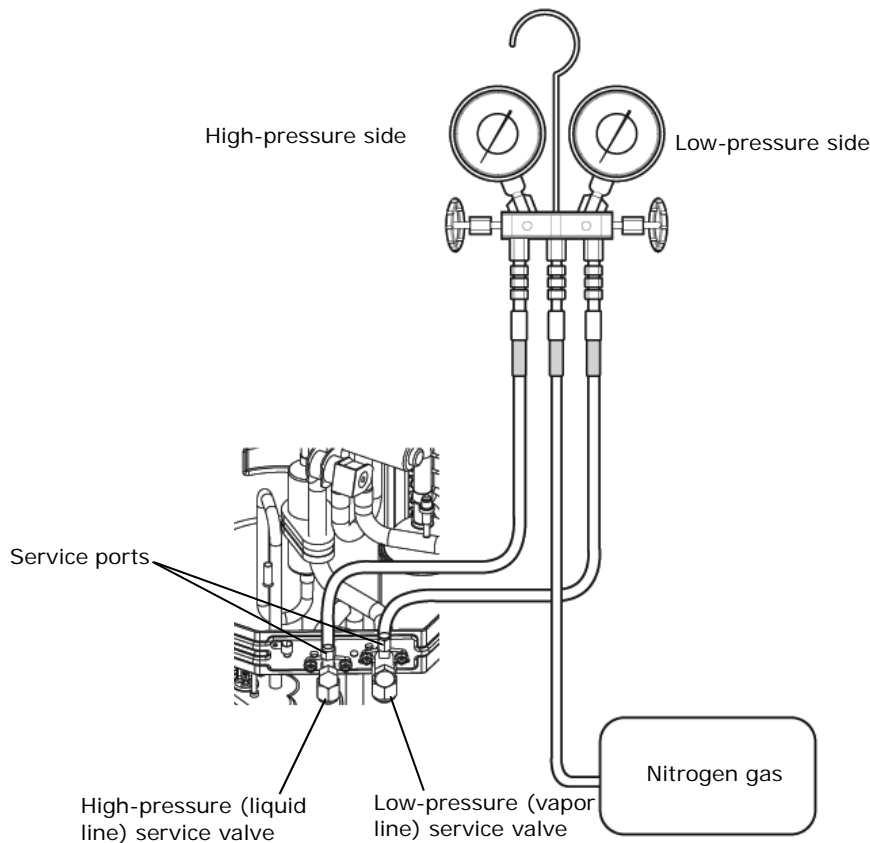
### **NOTICE**

#### **Refrigerant Pipe Damage!**

**When performing a leak test, use a pressure regulator to prevent an excess amount of nitrogen (over 594.6 psi [4.1 MPa]) from entering the pipes. If the pipe is filled with more than the specified amount of nitrogen in a short period of time, pipe damage may occur.**

1. Connect the refrigerant manifold gauge hoses to the liquid side and gas side service ports on the unit, and connect the center hose to a nitrogen gas tank fitted with a pressure regulator (see [Figure 32](#)).

**Figure 32. Leak testing pipe connections with a manifold gauge**



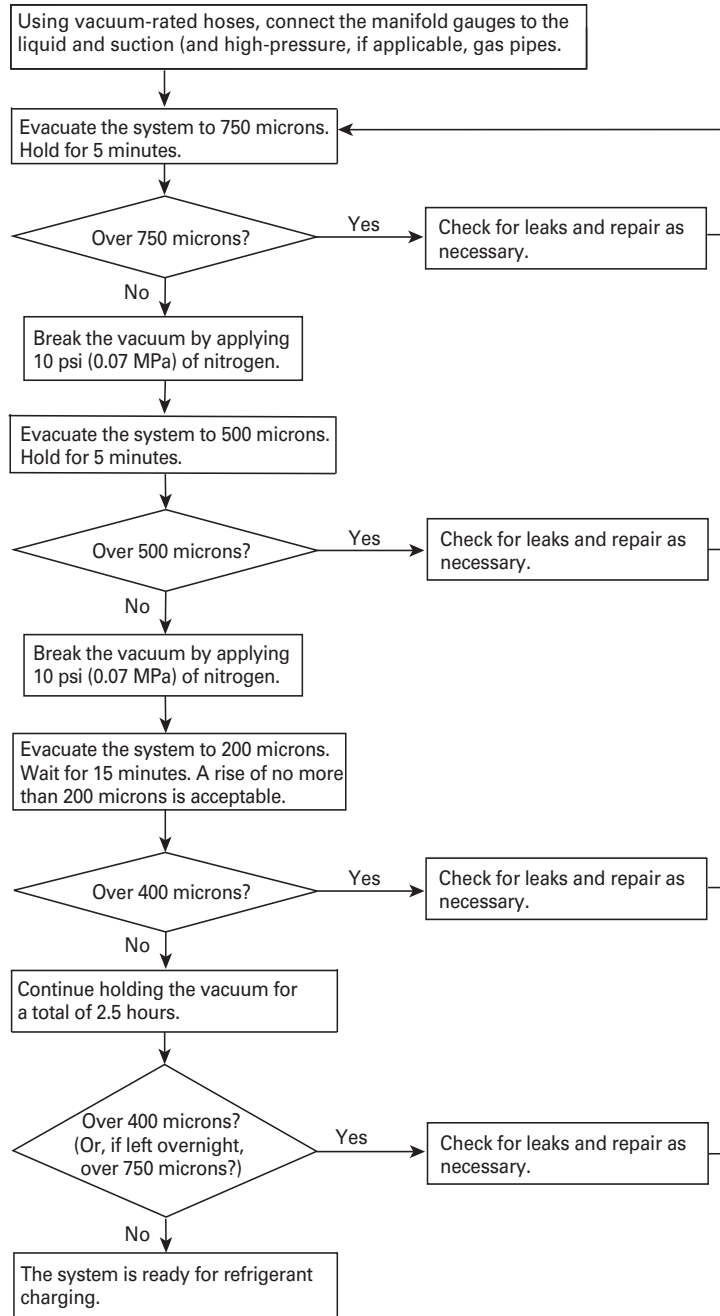
2. Fill the lines with nitrogen to no more than 594.6 psi (4.1 MPa).
3. Monitor the pressure periodically for a minimum of 24 hours. If the pressure drops, use soapy water to check for leaks. Bubbles will occur if joints are not tight.
4. Release pressure in pipelines gradually.
5. Repair leaks.
6. Repeat the previous steps until the pressure remains constant.
7. Maintain 145 psi (1.0 MPa) of pressure for 15 minutes and check for further leakage. If the pressure drops, check for leaks and repair them. Repeat this step as necessary until 145 psi (1.0 MPa) of pressure is maintained for 15 minutes.
8. Remove hoses from service ports.

# System Evacuation Procedure

After performing a leak test, use a vacuum pump to triple evacuate the system as described below:

**Notes:**

- Use a vacuum pump with a check valve to prevent pump oil from flowing backward while the vacuum pump is closed.
- Completely close the liquid-vapor line service valves of the outdoor unit.



# Insulating Refrigerant Pipes

After determining that there are no leaks in the refrigerant pipes, insulate them as described:

- Use [Table 12](#) to select the insulation thickness according to pipe size and humidity conditions. The table contains the minimum requirements; consequently, insulation thickness may be governed by the adopted codes and standards by the authority having jurisdiction (AHJ). Please consult with the AHJ to sure compliance.

**Table 12. Pipe insulation selector**

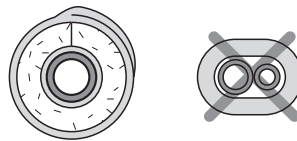
Pipe	Pipe size in. (mm)	Insulation Type	
		Standard conditions 86°F (30°C), < 85%	High humidity conditions <sup>(a)</sup> 86°F (30°C), ≥ 85%
		EPDM or NBR (in. (mm))	
Liquid pipe	1/4 (6.35) – 3/8 (9.52)	3/8 (9)	3/8 (9)
	1/2 (12.70) – 2 (50.80)	1/2 (13)	1/2 (13)
Gas pipe <sup>(b)</sup>	1/4 (6.35)	1/2 (13)	3/4 (19)
	3/8 (9.52)	3/4 (19)	1.0 (25)
	1/2 (12.70)		
	5/8 (15.88)		
	3/4 (19.05)		
	7/8 (22.23)		

(a) When installing insulation in any of the following environments, use insulation required for high humidity conditions: Buildings with close proximity to bodies of water or hot springs or on the side of a hill in which the building is partly covered by earth; ceilings frequently exposed to moisture such as in restaurants, saunas, swimming pools, and corridors of dormitories or studios near a frequently-used outdoor exit; buildings with no ventilation system.  
 (b) Internal temperature of gas pipe is higher than 248°F (120°C).

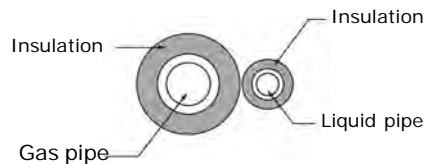
- Wrap insulation around the entire surface of each pipe, including the refrigerant pipes from the indoor unit to the service valves inside the outdoor unit, the branch joints, distribution header, and connection points on each pipe.

**Note:** For details on insulating branch joints, refer to the branch joint installation manual (VRF-SVN41).

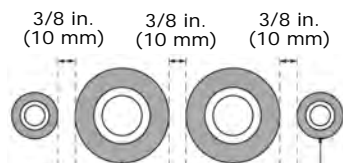
- Do not wrap the vapor and liquid refrigerant pipes together.



- If vapor and liquid pipes are in contact with one another, use thicker insulation and make sure the pipes are not pressing tightly against one another.



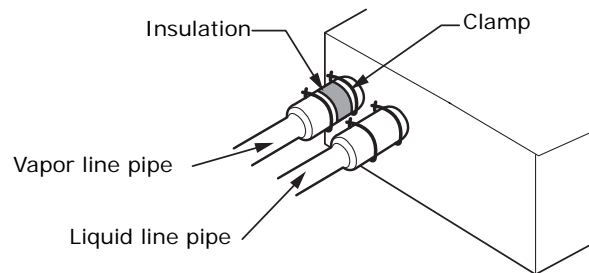
- Pipe connections between the indoor unit and EEV kit: Leave 3/8 in. (10 mm) of space between vapor and liquid pipes.



## Insulating Refrigerant Pipes

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- Overlap insulation to avoid gaps.
  - Avoid compressing the insulation as much as possible.
  - Be sure there are no cracks or deformities in the insulation at bends in pipes or where hangers are attached to pipes.
  - If necessary, double the insulation to prevent condensation from forming in warm or humid areas.
3. Clamp insulation tightly to pipes.



4. Cut off excess insulation.

# Refrigerant

After successful leak testing and vacuum drying, calculate the amount of refrigerant needed and then charge the system, as explained in this section.

## Calculating the Refrigerant

The initial refrigerant quantity (given in [Table 13](#)) is charged into the unit at the factory.

**Table 13. Initial refrigerant quantity for each single-phase outdoor unit model**

Model	4TVH0036B100NC (3 ton)	4TVH0048B100NC (4 ton)	4TVH0053B100NC (5 ton)
<b>Initial refrigerant quantity: lb (kg)</b>	7.1 (3.2)	7.1 (3.2)	7.3 (3.3)

**Important:** The manual charge calculation information given in this section is for reference only and may be useful while planning a VRF System job. However, for accurate piping, system validation, and system charge calculations, VRF selection software must be used.

**Manual charge calculation reference:**

- 3/8 in. liquid line requires 0.04 lbs of R-410A per each linear feet of copper tubing.
- 1/4 in. liquid line requires 0.013 lbs of R-410A per each linear feet of copper tubing.

Therefore, the total additional refrigerant (in lbs R-410A) = (total length of 3/8 in liquid line in feet x 0.040) + (total length of 1/4 in liquid line in feet x 0.013) + the total refrigerant quantity for all connected indoor units (refer to [Table 14](#)).

**Table 14. Refrigerant quantity for each indoor unit**

Model	Capacity (MBH)												60	
	7.5	9	9.5	12	15	18	20	24	27	30	36	42		48
	<b>Refrigerant quantity: lb (kg)</b>													
<b>1-way cassette (4TVE00**B100NB)</b>	0.55 (0.25)		0.55 (0.25)	0.55 (0.25)										
<b>Mini 4-way cassette (4TVB00**B100NB)</b>			0.82 (0.37)	0.82 (0.37)		0.82 (0.37)	0.82 (0.37)							
<b>4-way cassette (4TVC00**B100NB)</b>		0.99 (0.45)		0.99 (0.45)		0.99 (0.45)		0.99 (0.45)		1.52 (0.69)	1.52 (0.69)		1.52 (0.69)	
<b>Slim duct (4TVL00**B100NB)</b>	0.53 (0.24)		0.53 (0.24)	0.53 (0.24)		0.99 (0.45)		0.99 (0.45)		0.93 (0.42)	0.93 (0.42)		1.37 (0.62)	
<b>MSP duct (4TVD00**B100NB)</b>						0.62 (0.28)		0.62 (0.28)		1.19 (0.54)	1.19 (0.54)		1.50 (0.68)	
<b>MSP duct (standard condensate pump) (4TVD00**C100NA) (4TVD00**C100NB)</b>	0.81 (0.37)		0.81 (0.37)	0.81 (0.37)	1.19 (0.54)	1.19 (0.54)		1.04 (0.47)	1.04 (0.47)	1.04 (0.47)	1.50 (0.68)		1.50 (0.68)	
<b>HSP duct (4TVA00**B100NB)</b>											1.50 (0.68)		1.50 (0.68)	
<b>High-wall (4TVW00**B100NC)</b>	0.53 (0.24)		0.53 (0.24)	0.53 (0.24)		0.79 (0.36)	0.79 (0.36)	0.79 (0.36)						
<b>Convertible ceiling/floor (4TVX00**B100NB)</b>						0.86 (0.39)		0.86 (0.39)						
<b>Convertible Air Handling Unit (4TVM00**B100NB)</b>		0.33 (0.7)		0.33 (0.7)		0.50 (1.10)		2.10 (0.95)		2.10 (0.95)	2.10 (0.95)	2.70 (1.22)	2.70 (1.22)	3.50 (1.58)

## Charging the Refrigerant

After calculating the correct amount of refrigerant needed by the system (see [“Calculating the Refrigerant,”](#) p. 47), charge the system as described in the following procedure:

### ⚠ WARNING

#### Hazard of Explosion and Deadly Gases!

Do not heat the refrigerant container to speed up the charging process. An explosion could result, resulting in death or serious injury.

### NOTICE

#### Risk of Unit Malfunction!

Do not leave the front panel open while charging refrigerant. If the front panel is open, the amount charged into the unit will be incorrect.

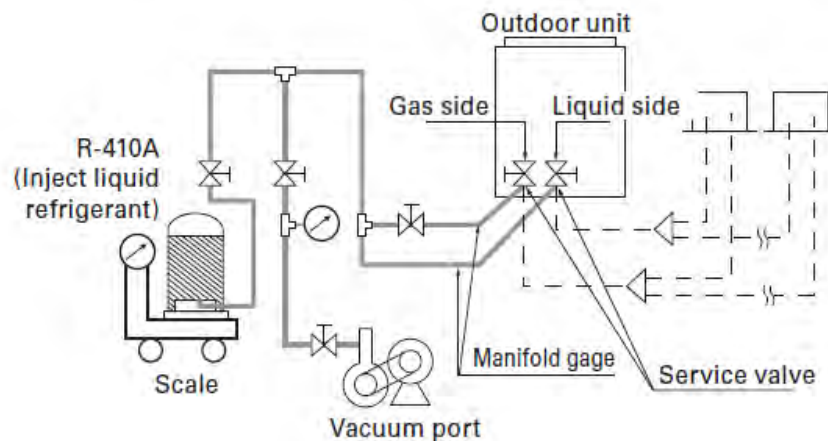
### NOTICE

#### Unit Component Damage!

Open the gas side and liquid side service valves completely after charging the refrigerant. If you operate the unit with the service valves closed, the unit may be damaged.

1. Attach the liquid manifold hose to the liquid side service port and open the manifold gauge valve.
2. Add the liquid refrigerant, making sure the refrigerant bottle is held in an upright position. Use a scale to determine that the correct amount has been added.
3. Close the refrigerant container immediately after adding the refrigerant.
4. If you are unable to add all of the refrigerant needed into the liquid side, close the liquid side service port and remove the liquid manifold hose.
5. Attach the gas manifold hose to the gas side service port and open the manifold gauge valve.

Figure 33. Charging additional refrigerant



6. Press K2 once to initiate refrigerant charging in cooling mode.
7. To determine if the amount of refrigerant added is correct, use the automatic refrigerant function (see [“Refrigerant Detection Operation,”](#) p. 60).
8. After charging the refrigerant, close the service valves and replace caps.

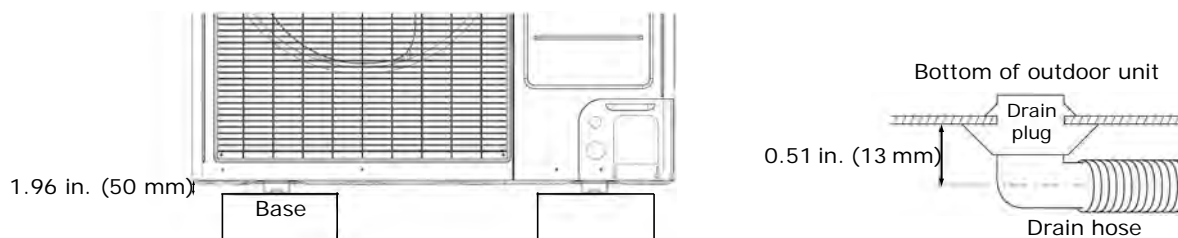


## Connecting the Drain Hose

When using the air conditioner in the heating mode, ice may accumulate. When the unit is in defrost mode, condensed water must be safely drained away from the unit through a drain hose.

To install the drain hose:

**Note:** A minimum space of 1.96 in. (50 mm) must be allowed between the bottom of the single-phase outdoor unit and the supporting base to facilitate drain hose installation.



1. Insert the drain connector into the drain hole on the underside of the single-phase outdoor unit.
2. Connect the drain hose to the drain connector.
3. Plug the unused drain holes with drain plugs.

# Control System

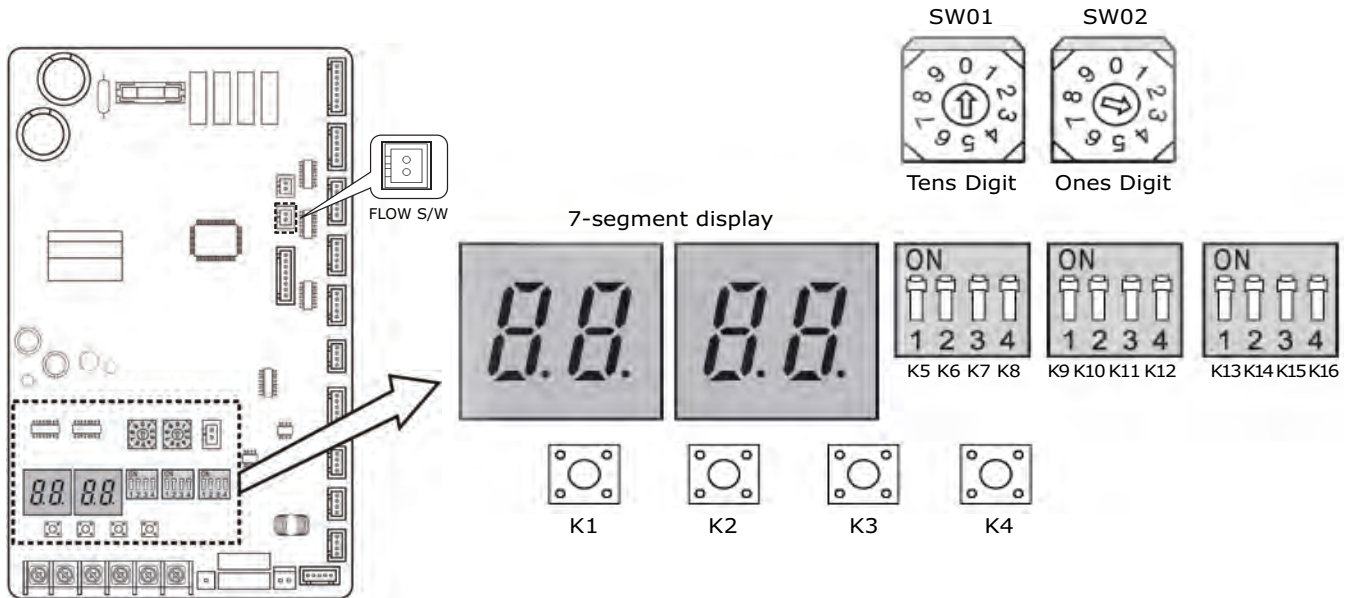
The control board contains a 7-segment display, three DIP switches, two rotary switches, and four buttons, as shown in Figure 34. Their functions are explained in this section.

**⚠ WARNING**

**Hazardous Voltage!**

Before making contact with the inverter circuit board, wait for at least 15 minutes after powering down the single-phase outdoor unit to allow the unit to fully discharge high DC voltage. Failure to allow the high DC voltage to discharge completely could result in death or serious injury.

Figure 34. Control board



## System Monitoring

The 7-segment display indicates system power and communication status.

Table 15. 7-segment display

Event	Digit 1	Digit 2	Digit 3	Digit 4
Power up <sup>(a)</sup>	"8"	"8"	"8"	"8"
Establishing communication between outdoor and indoor units	"A"	"d"	Number of connected indoor units	
Transmit/receive (normal operation)	Indoor unit: "A"	Indoor unit: "0"	Unit address (decimal number)	

(a) 7-segment display example showing power-up is shown in Figure 34.

## Configuring the System

The control board contains two rotary switches and three DIP switches (shown in [Figure 34](#)). The following tables explain their functions.

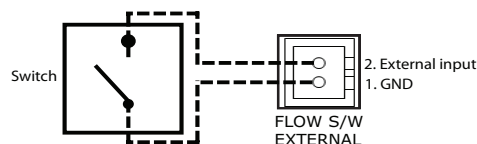
**Table 16. Configuration using rotary switches SW01 and SW02**

SW01/SW02	Total number of installed indoor units
Tens digit/Ones digit	Use to set total number of installed indoor units. <b>Notes:</b> <b>1.</b> For example, if 3 indoor units are installed: Set SW01 to "0"; set SW02 to "3". <b>2.</b> Set at single-phase outdoor unit only.

**Table 17. Configuration using DIP switches K5–K8**

DIP switch	Setting	Function description
K5	On	Automatic night time silent mode
	Off	Manual night time silent mode <sup>(a)</sup>
<b>Snow prevention control</b>		
K6	On	Disables snow prevention control (default).
	Off	Enables snow prevention control. <sup>(b)</sup>
<b>Cooling capacity correction<sup>(c)</sup></b>		
K7	On	44.6–48.2°F (7–9°C) (default)
K8	On	
K7	On	41.0–44.6°F (5–7°C)
K8	Off	
K7	Off	48.2–51.8°F (9–11°C)
K8	On	
K7	Off	50.0–53.6°F (10–12°C)
K8	Off	

(a) When DIP switch K5 is set to Off (manual mode), the night time silent mode option is controlled by dry contacts (relay, timer, etc.). These dry contacts (field provided and field installed) are connected to the port labeled "FLOW S/W" and are located on the main communication board.



Drawing for illustration purposes only. Be sure to include plug for wire connected to FLOW S/W. All wiring must conform to codes and adopted by the Authority Having Jurisdiction (AHJ).

(b) If enabled, the single-phase outdoor unit fan will operate for 1 minute every 30 minutes to prevent snow build-up.

(c) Maintain optimal evaporating temperature in the cooling mode if long line lengths exist. Refer to cooling long pipe performance data in the technical data book. If you upgrade the performance at your discretion, low discharge air temperature of an indoor unit might cause discomfort.

**Table 18. Configuration using DIP switches K9–K12**

DIP switch	Setting	Function description
<b>Night-time silent mode<sup>(a)</sup></b>		
K9	On	Disable
K10	On	
K9	On	Mode 1
K10	Off	3 ton: 600 rpm
		4 ton: 600 rpm
		5 ton: 620 rpm
K9	Off	Mode 2
K10	On	3 ton: 540 rpm
		4 ton: 540 rpm
		5 ton: 560 rpm
K9	Off	Mode 3
K10	Off	3 ton: 480 rpm
		4 ton: 480 rpm
		5 ton: 500 rpm
<b>Heating capacity correction<sup>(b),(c),(d),(e)</sup></b>		
K11	On	Default: 426.7 psi
K12	On	
K11	On	Default – 28.4 psi
K12	Off	
K11	Off	Default – 14.2 psi
K12	On	
K11	Off	Default + 14.2 psi
K12	Off	

(a) Reduces fan speed for quiet operation.

(b) Maintaining factory default status is recommended. However, if the desire is to reduce energy consumption or improve heating performance, control the operation according to the surrounding environment.

(c) As the target high pressure is decreased, energy consumption and noise may decrease but the indoor air discharge temperature will also decrease.

(d) Heating operation increases frequency when the current high pressure is higher than the target high pressure; and vice versa.

(e) If the target high pressure is high, the discharge air temperature of an indoor unit will increase, but energy consumption will also increase.

Table 19. System configuration using DIP switches K13–K16






DIP switch		Maximum current per unit model		
		4TVH0036B100NC 3 ton	4TVH0048B100NC 4 ton	4TVH0053B100NC 5 ton
		Current limit option		
K13	On	Maximum current default: 22 A	Maximum current default: 24 A	Maximum current default: 32 A
K14	On			
K13	On	Default – 4 A	Default – 2 A	Default – 2 A
K14	Off			
K13	Off	Default – 6 A	Default – 4 A	Default – 4 A
K14	On			
K13	Off	Default – 8 A	Default – 6 A	Default – 6 A
K14	Off			
Defrost optimization <sup>(a),(b),(c)</sup>				
K15	On	Default: Mid		
K16	On			
K15	On	Default: Mid		
K16	Off			
K15	Off	Low1		
K16	On			
K15	Off	Low2		
K16	Off			

- (a) This option is used in locations where humidity is high and, as a result, defrost mode occurs frequently.
- (b) Maintaining factory default status is recommended. If set to Low, the temperature at which it enters defrost mode will decrease. If the temperature at which it enters defrost mode decreases, the duration of defrost operation will increase. As a result, the overall heating capacity will be reduced.
- (c) Defrost mode will start when the difference between the outdoor temperature and the outdoor coil temperature has exceeded its  $\Delta t$ .





## Initiating System Operations

Buttons K1, K2, and K3 are used to initiate system operations. The first two digits of the 7-segment display respond as shown in the last column of the following tables.

**Table 20. Button K1**

Number of times K1 is pressed	Operation	7-segment display: Digits 1 and 2
1 (hold for 5 seconds)	Test operation	
1	Refrigerant charging in heating mode	
2	Test operation in heating mode	
3	Pump down in heating mode	
4	Vacuum	
5	Completion	Blank

**Table 21. Button K2**

Number of times button K2 is pressed	Operation	7-segment display: Digits 1 and 2
1	Refrigerant charging in cooling mode	
2	Test operation in cooling mode	
3	Pump down in cooling mode	
4	Refrigerant detection operation	
5	Completion	Blank

**Table 22. Button K3**

Number of times button K3 is pressed	Operation	7-segment display
1	Initialize (reset) operation	Same as power up: "8888"

## Monitoring System Settings

Buttons K4 is used to monitor system settings and software versions.

**Table 23. Button K4**

Number of times button K4 is pressed	Setting	Description	7-segment display
			Digits 1, 2, 3, 4
1	Current frequency	15 Hz	1,0,1,5
2	Low pressure	37.0 psi (2.6 kg/cm <sup>2</sup> ) <sup>(a)</sup>	2,0,2,6
3	Outdoor temperature	74.3°F (23.5°C)	3,2,3,5
4	Discharge temperature	177.3°F (80.7°C)	4,8,0,7
5	OLP temperature	203°F (95°C)	5,9,5,0
6	COND Out temperature	79.3°F (26.3°C)	6,2,6,3
7	Double pipe out tube temperature	113°F (45°C)	7,4,5,0
8	High pressure value	221.9 psi (15.6 kg/cm <sup>2</sup> ) <sup>(a)</sup>	8,1,5,6
9	Fan speed	700 rpm	9,7,0,0
10	ESC(EVI)EEV	180 step	A,1,8,0
11	MAIN EEV	1500 step	B,1,5,0
12	Present running current	15 A	C,1,5,0
13	Number of connected indoor units	10	D,0,1,0
14	Number of operating single-phase outdoor units	8	E,0,0,8
15	Sum of indoor unit capacity	47,640 Btu/h (12,000 kcal/h)	F,1,2,0

(a) Gauge pressure

**Table 24. Button K4 (press and hold for 3 seconds)**





Number of times button K4 is pressed and held 3 seconds	Software version/ Unit address	7-segment display		
		Version examples Digits 1, 2, 3, 4		
0	Main circuit board version	0,9,1,2		
1	Inverter board version	0,9,1,2		
2	EEPROM version	0,9,1,2		
		Digit 1	Digit 2	Digit 3, 4
		Address examples		
3	Automatically assigned unit addresses	A	0	0, 5
4	Manually assigned unit addresses	A	0	0, 1

## Changing a Single-Phase Outdoor Unit Address

If multiple outdoor units are connected to a central control—VRF SC, VRF SC+BACnet®, or a VRF Touchscreen—it may be necessary to manually address the outdoor units.

Addresses available for a single-phase outdoor unit range from 00 to 15. To manually set a single-phase outdoor unit address, refer to [Table 25](#).

**Table 25. Address change for multiple single-phase outdoor units on VRF Central Control or Touchscreen Control**

Button K2 action	Operation	Display view
Press <b>K2</b> and hold for 2 seconds	Displays outdoor unit address. If auto addressed, <b>00 AU</b> will appear.	
	If manually addressed, the display will show <b>00 00</b> through <b>00 15</b> . The example in the next column shows that the address was manually set to <b>03</b> .	
Press and release <b>K2</b> repeatedly	Cycles through OD unit addresses: <b>00 00, 00 01, 00 02, . . . 00 15</b> , then back to <b>00 AU</b> .	
Press <b>K2</b> and hold until display flashes and relays click.	Saves the address that appears on the display. The example in the next column shows that the address was manually set to <b>02</b> .	
<p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• To exit without saving, press and release <b>K1</b>.</li> <li>• After saving the address setting, wait at least 3 minutes before starting the system.</li> <li>• After the manually set address is saved, the display will begin scrolling through the indoor unit addresses.</li> </ul>		



# Pre-Start Checks

After installation and before the test operation is conducted, perform the following pre-start checks:

**NOTICE**

**Avoid Damage to the Communication Circuit!**  
**Do not measure the communication terminal with an insulation tester. Doing so will damage the communication circuit.**

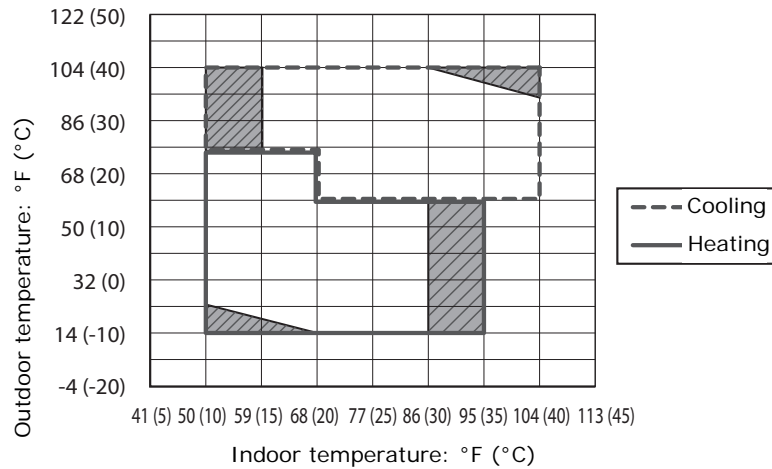
1. Ensure that the power and communication cables of the indoor and single-phase outdoor units are properly connected.
2. Before supplying power, use a resistance tester to verify that resistance to ground is greater than 30 MΩ .
3. Ensure that the indoor units are connected.
4. Check for a short-circuit between the communication terminal and ground.
5. Ensure that the pre-start checklist (Table 26) has been completed.

**Table 26. Pre-start checklist**

<b>Installation</b>	<b>Single-phase outdoor unit</b>	<ul style="list-style-type: none"> <li>• Have you checked the external surface and the inside of the unit for damage?</li> <li>• Is there any possibility of short circuit due to the heat produced by the outdoor unit?</li> <li>• Is the place well-ventilated and meets recommended requirements for clearances and service?</li> <li>• Is the outdoor unit installed securely to withstand external forces?</li> </ul>
	<b>Indoor unit</b>	<ul style="list-style-type: none"> <li>• Have you checked the external surface and the inside of the indoor unit?</li> <li>• Is there enough space for service?</li> <li>• Have you ensured that the center of the indoor unit is installed horizontally and is level?</li> </ul>
<b>Refrigerant pipe</b>		<ul style="list-style-type: none"> <li>• Have you selected the correct pipes?</li> <li>• Are the liquid and gas valve open?</li> <li>• Is the total number of connected indoor units within the allowable range?</li> <li>• Are the length and the height difference between the refrigerant pipes within the allowable range?</li> <li>• Are the branch joints properly installed?</li> <li>• Has the connection of liquid and gas pipes been correctly performed?</li> <li>• Have you selected correct insulator for pipes and insulated them correctly?</li> <li>• Is the pipe or connection part properly insulated?</li> <li>• Is the quantity of the additional refrigerant correctly weighed in? (You must record the amount of additional refrigerant charging on the service record paper placed outside the outdoor unit.)</li> </ul>
<b>Drain pipe</b>		<ul style="list-style-type: none"> <li>• Have you checked whether the drain pipes of the indoor unit and outdoor unit are connected together?</li> <li>• Have you completed the drain test?</li> <li>• Is the drain pipe properly insulated?</li> </ul>
<b>Electrical</b>		<ul style="list-style-type: none"> <li>• Are the power cable and communication cable tightened firmly on the terminal board within the rated torque recommendations?</li> <li>• Have you checked for cross connection of the power and communication cables?</li> <li>• Have the outdoor unit been properly grounded?</li> <li>• Is the communication cable shielded?</li> <li>• Is the wire length within the recommended limit?</li> <li>• Is the wiring route correct?</li> </ul>
<b>Setting address</b>		<ul style="list-style-type: none"> <li>• Are the address of the indoor and outdoor units properly set?</li> <li>• Are the address of the indoor and outdoor units properly set, if multiple remote controllers are to be used?</li> </ul>
<b>Option</b>		<ul style="list-style-type: none"> <li>• Ensure that the vibration-isolation structure is correctly installed or if one needs to be installed.</li> </ul>

# Test Operation

After all pre-start checks (refer to “Pre-Start Checks,” p. 57) have been completed, run the test operation under the following temperature conditions:



**Notes:**

- During the test operation, cooling/heating modes are selected automatically.
- Within the temperature range marked with hashed lines, system protection control may trigger during the test operation. If this occurs, test results may be inaccurate.
- When the temperature is outside of the guaranteed range, test accuracy may decrease to the borderline area shown in the graph.

**⚠ WARNING**

**Hazardous Voltage, Rotating Components!**

Do not operate the product with the panel or duct outlet protection net off. There is risk of personal injury from parts that rotate or contain high voltage.

**⚠ CAUTION**

**Risk of Burn or Frostbite!**

Refrigerant pipe may be hot or cold during or right after the operation depending on the status of the refrigerant which flows through the refrigerant pipe, compressor, and other parts of the refrigerant cycle. Do not touch the refrigerant pipe during or immediately after the operation to avoid getting burned or frostbitten.

**NOTICE**

**Avoid Unit Damage!**

Wait at least 5 minutes before turning off the main power after the test operation is finished. If you do not, water leakage or other problems may occur.

Wait at least 3 hours after power is supplied to the outdoor unit before operating it to allow time for the crank case heater to pre-heat. If the crank case heater is not pre-heated before operation, unit parts are at risk of being seriously damaged.

1. Before powering the unit, heed the precautions given above for the test operation.
 

**Note:** When power is supplied to the outdoor unit, it will check for and verify communications with the indoor units.
2. Ensure that the front of the outdoor unit is closed.

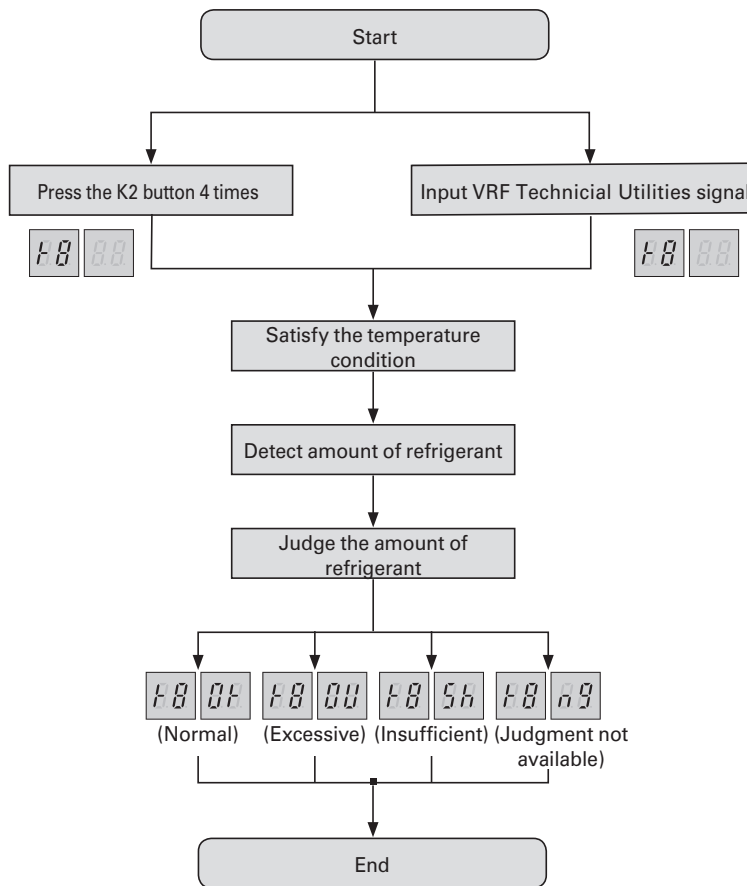
3. Press and hold button K1 for 5 seconds to run the test operation (see [Table 20, p. 54.](#))
  - During the test operation, the compressor is restricted from operating.
  - **UP** (for “unprepared”) will appear on the digital display. When the test operation has completed, the display will clear.
  - The test operation may continue from 30–50 minutes, depending on the operating status.
  - During the test operation, noise may occur due to valve inspection. (Examine the unit if abnormal noises continue to occur.)
4. When the test operation ends, use VRF Enterprise Management Software or VRF Auto-Commissioning Tool to issue a test results report. If any items in the report are marked with an “inspection required” sign, refer to the service manual for information on correcting the items and run the test operation again.
5. Ensure the following:
  - The system has the correct refrigerant amount (see “[Refrigerant Detection Operation,](#)” p. 60) after the unit has been operating in cooling mode for at least 30 minutes
  - Cooling/heating operation runs normally.
  - Air flow direction and fan speed of indoor units runs normally.
  - There are no abnormal operating noises from indoor or outdoor units.
  - During cooling operation, the indoor units drain properly.
6. Use VRF Enterprise Management Software to check operating status details.
7. Explain to the user how to use the indoor unit and leave them with the indoor unit manual for their reference.

# Refrigerant Detection Operation

Perform the refrigerant detection operation only under the following conditions:

- After the unit has been operating in cooling mode for at least 30 minutes.
- Within the following operating envelope:
  - Indoor: 68–86°F (20–30°C)
  - Outdoor: 41–109.4°F (5–43°C)

Failure to comply may result in the operation ending before completion or in inaccurate results. If the unit triggers protection control, the results may be inaccurate.



After the refrigerant detection operation is complete, take the following actions:

- If the amount of refrigerant is excessive, discharge 5% of the detected amount and restart the refrigerant amount detection operation.
- If the amount of refrigerant is insufficient, add 5% of the detected amount and restart the refrigerant amount detection operation.
- If the degree of supercooling is insufficient, add 10% of the detected amount of refrigerant and restart the refrigerant detection operation.
- If the result is unavailable, check that the refrigerant detection operation was conducted within the operating envelope stated above. Perform a test operation to determine if there are any other problems with the system.

# Service: Pump Down Process

The pump down process pulls all of the refrigerant in the system into the outdoor unit condenser so that repairs can be made to the system.

## ⚠ WARNING

### Refrigerant under High Pressure!

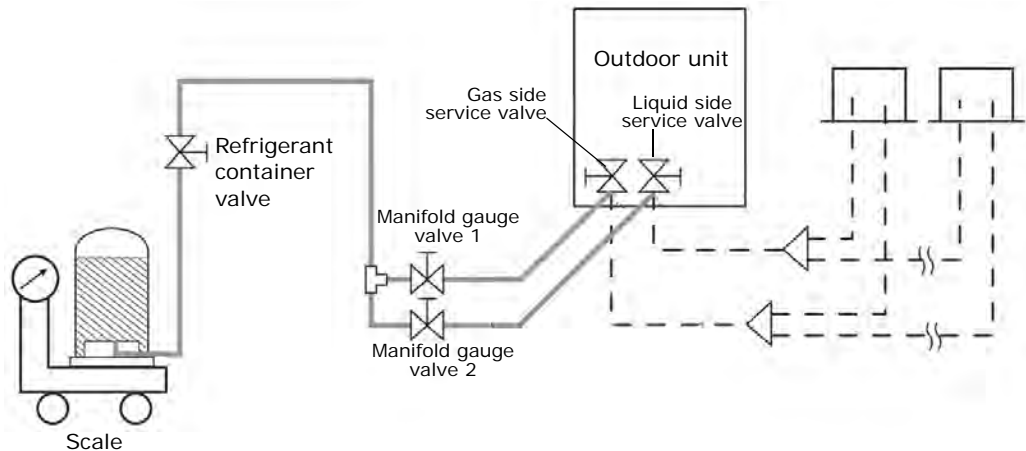
Failure to follow code concerning could result in an explosion which could result in death or serious injury or equipment damage. The refrigerant container used to collect refrigerant from the system must be one that is exclusively designed for that purpose.

## Collecting Refrigerant into a Refrigerant Container

The maximum amount of refrigerant that can be put into a single-phase outdoor unit is 176.4 oz. Because of this limitation, some of the refrigerant should be removed from the system to a refrigerant container before performing the pump down process.

1. Have ready an empty refrigerant container, a weighing scale, and a manifold gauge.
2. Determine through calculation the current amount of refrigerant in the system.
3. Connect the refrigerant container to the single-phase outdoor unit and operate 50% of all indoor units in cooling mode.

**Figure 35. Removing refrigerant from the system to a refrigerant container**



4. After 10 minutes of operation, use the manifold gauge to check the liquid side pressure. When the pressure is higher than 420.61 psig (2.9 MPa), decrease the number of operating indoor units.
5. Check the pressure again. When it has decreased to less than 420.61 psig (2.9 MPa), open the liquid side service valve and the manifold gauge valve that is connected to the liquid pipe to let the refrigerant run into the refrigerant container.

**Important:** The amount of refrigerant that can be put into the refrigerant container should be approximately 50% of the total refrigerant in the system. Do not fill the refrigerant container more than 85% of its capacity (average temperature 77°F).

6. Use the scale to determine how much refrigerant has been collected.
7. After the proper amount of refrigerant has been collected, turn off the manifold gauge valve and the liquid side service valve.

### Proceeding with the Pump Down Process

After refrigerant has been collected into a refrigerant container, proceed with the pump down process:

#### ***NOTICE***

#### **Equipment Damage!**

**Do not allow the amount of system refrigerant that is pulled into the outdoor unit during the pump down process to exceed the capacity of the outdoor unit or equipment damage may occur.**

1. Press the K2 button on the outdoor unit control board three times to initiate the pump down process ([Table 21, p. 54.](#))
2. Using a manifold gauge, observe the pressure drop when the compressor starts operating.
3. When the pressure reaches lower than 0 psig (0 MPa), turn off the gas side service valve.
4. Press the K3 button once.
5. Remove manifold gauge.



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