TOSHIBA CARRIER

SINGLE-PHASE VRF OVERVIEW

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Agenda

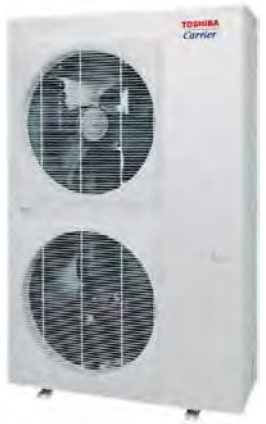
VRF Comfort.

Built on

Toshiba

Carrier

Confidence.



TOSHIBA
Carrier

SINGLE-PHASE VRF
PRODUCT OVERVIEW

Toshiba Carrier VRF

We Don’t Just Build Units.
We Help You Engineer Comfort.

Designed and engineered specifically for North America, Toshiba Carrier VRF joins two early innovators of variable refrigerant flow for one total system solution.

What is VRF?

- Variable Refrigerant Flow or VRF is a scalable zoning system that utilizes a centralized outdoor unit serving multiple individually-controlled indoor units.
- A project with a VRF system can achieve higher levels of comfort and control while saving energy and operational costs.
- The ability to control multiple rooms at different temperatures for total occupant comfort.
- Refrigerant flows to the unit that is calling for heating or cooling. heating will be a super heated gas and cooling is a sub cooled refrigerant sent to the indoor units.
- Indoor unit fan coils can be controlled individually or by group controls.

Heat Pump

Fan coils are capable of providing either cooling or heating based on outdoor unit mode.

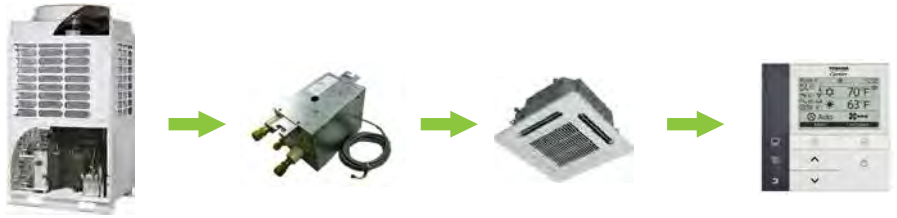
Outdoor Unit
- Controls compressor speed
- Maintains operational mode

Indoor Units
- Transfers heating and cooling to space
- Allows for optimal zoning

Controls
- Controls space temperature and indoor unit fan
- Remote and/or central

Heat Recovery

Fan coils are capable of providing simultaneous heating or cooling, by thermal zone, when operation temperatures are permitted.



Outdoor Unit
- Controls compressor speed
- Maintains operational mode

Flow Selector
- Reverses flow at indoor unit
- Simultaneous cooling and heating

Indoor Units
- Transfers heating and cooling to space
- Allows for optimal zoning

Controls
- Controls space temperature and indoor unit fan
- Remote and/or central

Why Single-Phase VRF?

Personalized Comfort and Control to Every Room, Virtually Every Application

Single-phase VRF Benefits:

- Compact footprints and slim profiles
- Precise temperature control
- Excellent energy efficiency
- Simplified equipment selection with a wide-variety of indoor unit options
- Quieter operation and higher efficiencies
- Flexible zoning options while providing better comfort.
- Single-phase power equipment available for residential and light commercial buildings, eliminating the need for costly phase conversion

Single Phase VRF Heat Pump

Heat Pump – Single Phase

- **3, 4, 5 ton models** (40A requirement for each ODU)
- Connect 1 indoor unit or up to 9 indoor units per system
- Up to 22.7 SEER
- Sound pressure levels from 52-58 dba
- Total piping up to 591’
- Local and centralized control offerings

Model Name (MCY-)	MAP0367HS-UL	MAP0487HS-UL	MAP0607HS-UL
Ton	3	4	5
Power Supply	208/230V/1ph/60Hz		
Cooling Capacity (kBtu/h)	36	48	60
Heat Capacity (kBtu/h)	40	54	66
Dimension (Height * Width * Depth)	61.0x 39.8 x 14.6 inch		
Unit Weight (lbs)	310.6		
Max. No. of Connected Indoor Units	6	8	9
Operation Temp Range (Cooling) (° FDB)	23 to 122		
Operation Temp Range (Heating) (° FWB)	-13 to 60		

Single-Phase VRF Heat Pump

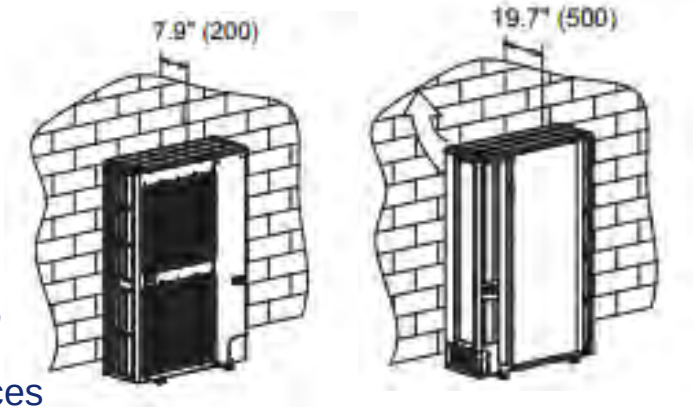
ODU Clearances and Mounting

- Slim design for a smaller footprint
- Local stand options available
- Slap mounted
- Wall mount available

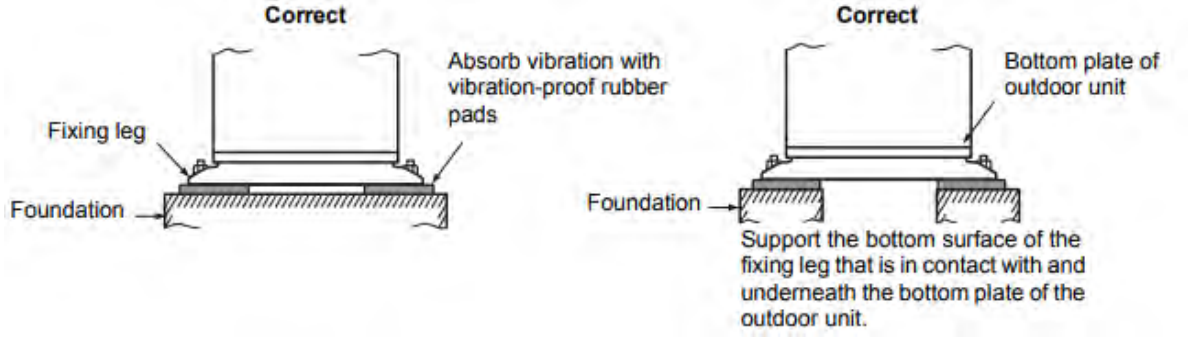
Dimension	SMMS-e 3,4,5 ton VRF
Height (In)	61.0
Width (In)	39.8
Depth (In)	14.6
Weight (lbs)	310.6
Refrigerant R410A*(lbs)	14.8

Clearances:

- Backside: 7.9” clearance
- Front of Unit: 19.7” clearance
- Unit Depth: 14.6”
- Total space needed including unit: 42.2”
- Always refer to local code and ordinances



Mounting units on the ground:



When installing the foundation for an outdoor unit with downward piping, consider the piping work.

Single Phase VRF

Non-Ducted Units

4-Way Cassette
Model MMU2
10 Sizes Available
7,500 Btu/h – 42,000 Btu/h

Compact 4-Way Cassette
Model MMUM
5 Sizes Available
7,500 Btu/h – 18,000 Btu/h

Floor Console Recessed
Model MMLB
6 Sizes Available
7,500 Btu/h – 24,000 Btu/h

Underceiling
Model MMC1
4 Sizes Available
18,000 Btu/h – 42,000 Btu/h

High Wall
Model MMK3
6 Sizes Available
7,500 Btu/h – 24,000 Btu/h

Floor Console Exposed
Model MML4
6 Sizes Avialable
7,500 Btu/h – 24,000 Btu/h

Ducted Units

Slim Duct (Low Profile)
Model MMDP
5 Sizes Available
7,500 Btu/h – 18,000 Btu/h

High Static Duct
Model MMD4
5 Sizes Available
30,000 Btu/h – 96,000 Btu/h

VRF RTU Fan Coil
Model 40QQ
3 Sizes Available
36,000 Btu/h – 60,000 Btu/h

Concealed Duct (Mid-Static)
Model MMDB
11 Sizes Available
7,500 Btu/h – 48,000 Btu/h

Outside Air Unit
Model MMD1
3 Sizes Available
48,000 Btu/h – 60,000 Btu/h

Vertical AHU
Model MMDV
8 Sizes Available
12,000 Btu/h – 60,000 Btu/h

Same indoor units are used for the three phase power VRF systems

Controller Options

Wired Remote Controller

The Wired Remote Controller (programmable) is a low voltage thermostat mounted on the wall that maintains room temperature by controlling system operation.

- Programmable scheduling
- Dual set-point
- Fan speed control
- Status code display
- Powered from indoor unit

RBC-AMS54E-UL

24V Thermostat Interface

The 24V Interface allows third-party conventional thermostat to communicate and operate Toshiba Carrier VRF indoor fan coil units.

Controls Advantages

- Full inverter control

Features

- Fan speed control: high, med, and low
- Operating modes: cooling, heating, fan and off

TCB-1FTH1GUL

Size: Length 5.1”, Width is 4.6”, Depth 1.1”

Touchscreen Central Controller

The Touchscreen Central Controller is a line voltage controller mounted on the wall with a touch screen LCD display panel. This controller enables the customer to control and monitor the operation of the VRF system.

- Grouping based on floor, unit, area, tenant and level
- Master Scheduler—Weekly, five special days, monthly
- Alarm display with history
- Web browser monitoring and control (for Intranet PC)
- Up to two concurrent users can be connected
- Additional digital input / output device available
- Maximum of 512 indoor units can be connected

BMS-CT5120UL

Note: 24v Power, Field Supplied

Why Single-Phase VRF?

Zoning Capabilities

Ability to connect up to 9 indoor units on a single outdoor unit

Indoor Unit Options

3,4,5-ton multi-positional AHUs available for 1:1 systems (No downward flow)

Up to 12 different indoor units available.

Capacity ranging from 7,500 btu – 96,000 btu

Same indoor units as 3-phase giving the option to expand into larger projects

Expanded Piping Lengths

Vertical separations between indoor units up to 49’. ODU to IDU separation of up to 164’

Use of Y-joints and branch headers

Single phase heat pump piping flexibility up to 591 feet

Expanded Controls Options

Local controllers , central controller, and 24V interfaces for third party thermostats including Wi-Fi

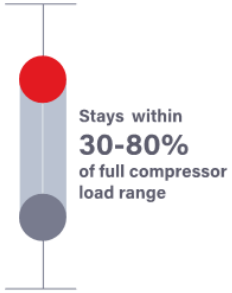
Home automaton capabilities

Local CN accessories: Ability for command input and output controls. (occupancy sensors & economizers)

Inverter Control

Tighter turn down capabilities giving more energy savings. Tighter heating capacity output meaning 100% heating capacity down to 5°.

Gas pedal control



Heat Recovery Option

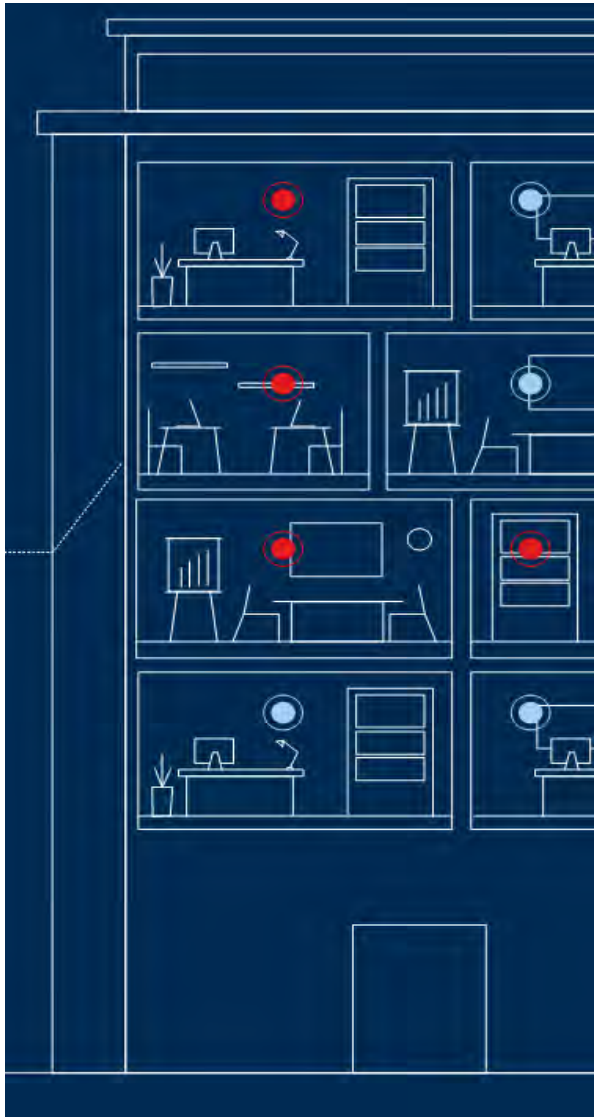
Simultaneous heating and cooling for total occupant comfort. Giving your end user absolute control of their space. Up to 12-tons per system!

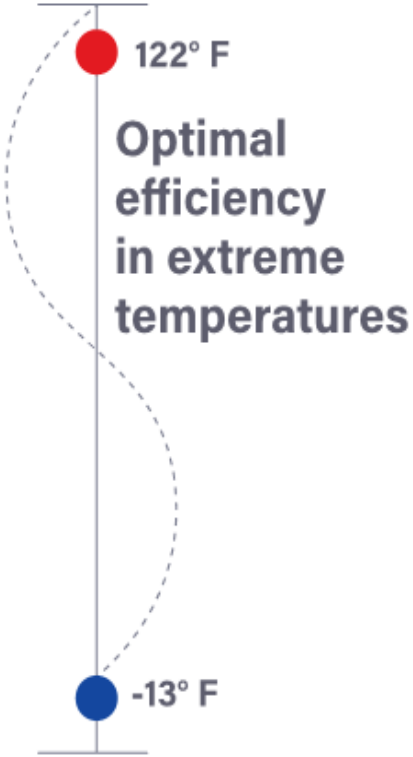
Piping lengths up to 3,280 feet offering greater flexibility with outdoor unit location and piping layout.

Single-Phase VRF Heat Recovery

Heat Recovery – Single Phase (208/230-1-60)

- **6 ton or twinned 12 ton**
- 12 different indoor unit options available
- Option for 2-12 IDUs on the 6-ton and up to 25 on the 12-ton
- Different styles and sizes of flow selectors (FS) boxes
- Flexible piping arrangements (Determined by Vroom software)
- Local and centralized control offerings





SINGLE-PHASE VRF
PRE PLANNING AND UNIT PLACEMENT

INSTALLATION

Pre-Planning

- Unit placement
- Piping
- Refrigerant addition
- Electrical
- Sizing and connection

INSTALLATION

Pre-Planning

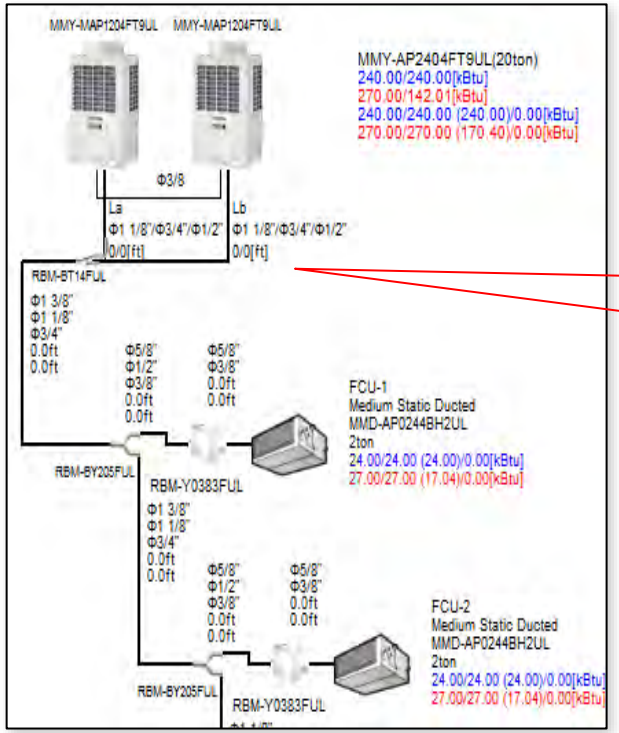
Must know where the ODU(s) and IDU(s) will be placed:

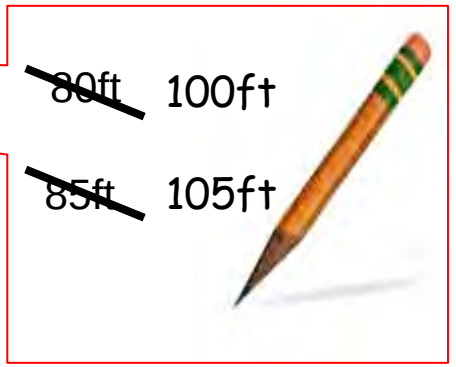
- Will they be placed on the ground?
- Will they be placed on the roof?
- Does the placement of the ODU(s) & IDU(s) match that of the selection software drawing?

INSTALLATION

Pre-Planning

- Walk the job and verify ODU and IDU placement.
- Make any changes in the selection software drawing.
- Deliver updated selection software drawing back to the designer for records.
- This is necessary to verify that piping rules haven't been broken and that actual distances haven't altered the corrected capacity of the equipment.





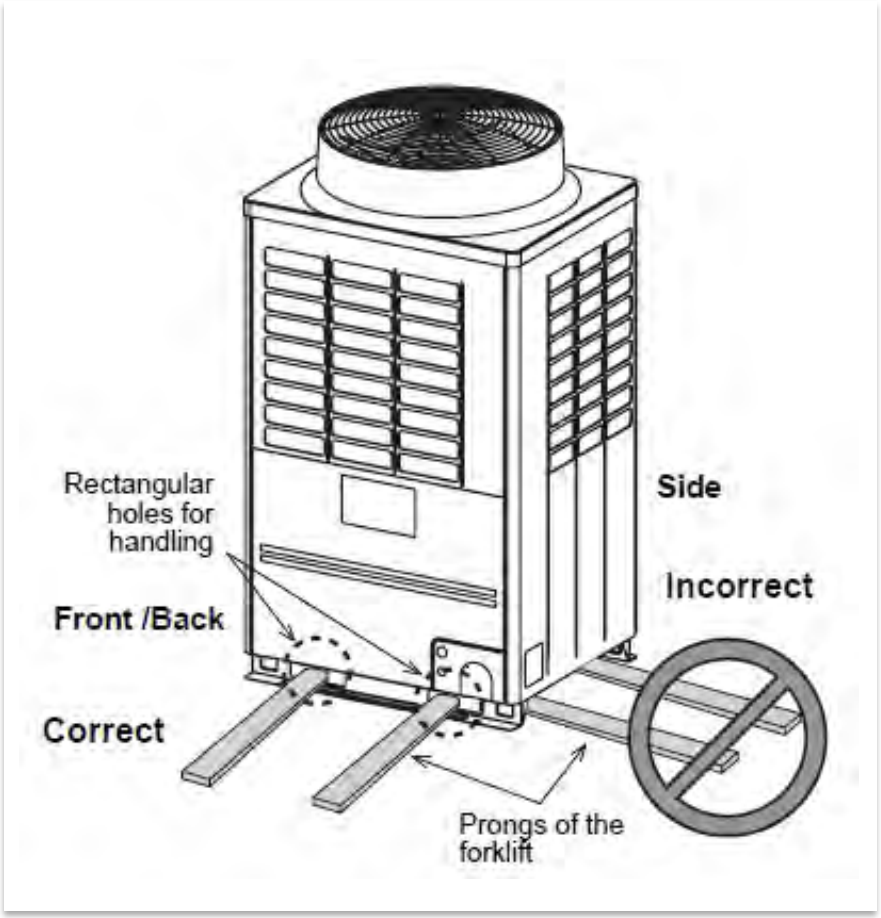
INSTALLATION

Moving the Outdoor Unit

WHEN USING A FORKLIFT

The forks **must** be inserted through the slots in the unit base rails as shown.

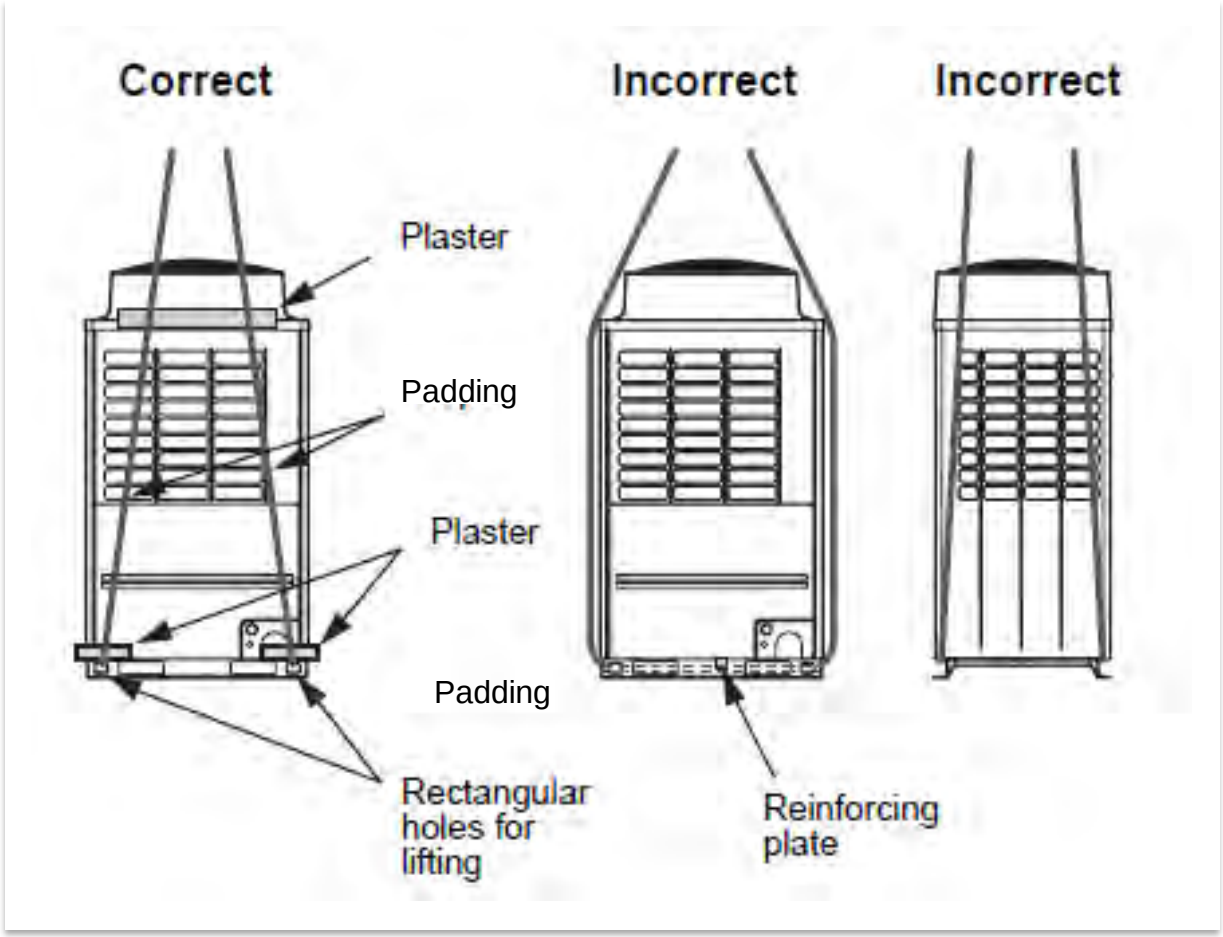
Do Not lift the Outdoor unit with the forks directly against the base as this can cause damage to the equipment.



INSTALLATION

Moving the Outdoor Unit

If lifting is required rig as shown to avoid damage

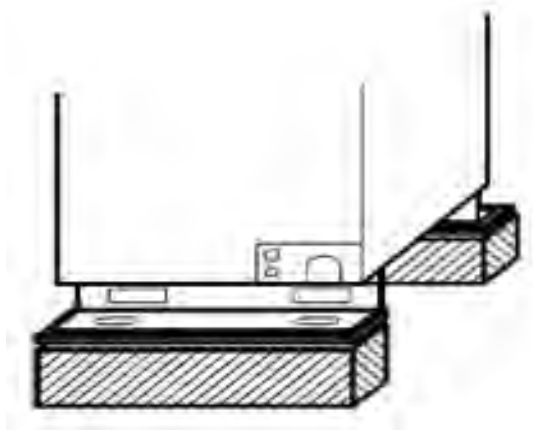


INSTALLATION

Anchoring

- Fix the outdoor unit with anchor bolts (4 positions/unit)
- Ensure entire surface of mounting feet are supported (not just the 4 corners)
  Do the same for applications requiring vibration insulators

CORRECT



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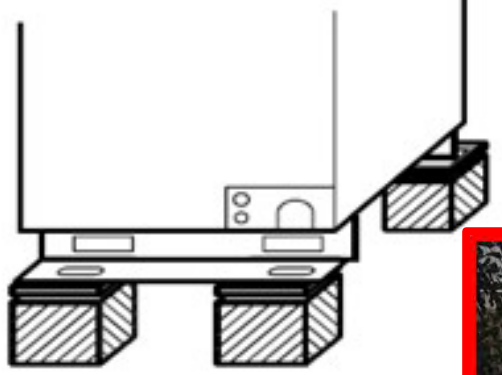
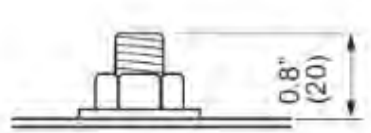
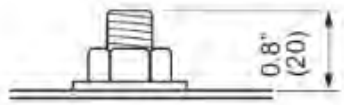




INSTALLATION

Anchoring



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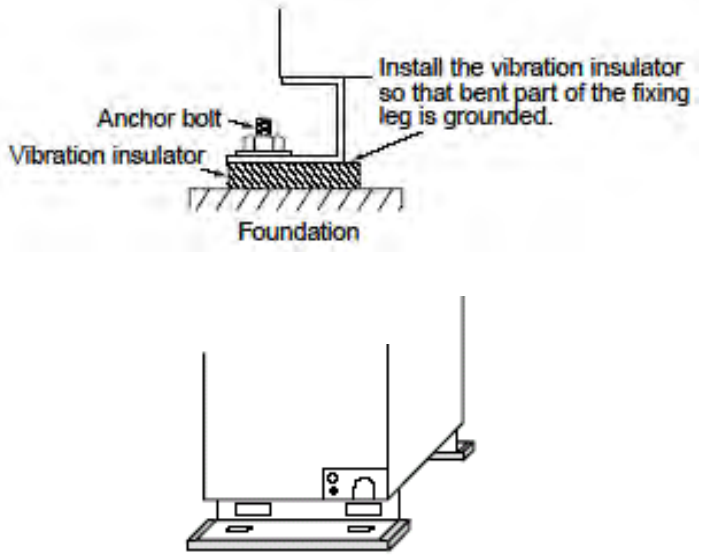

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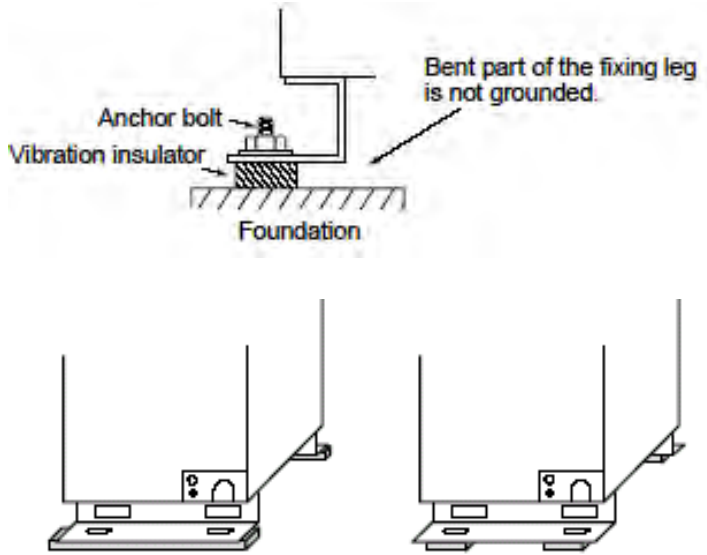
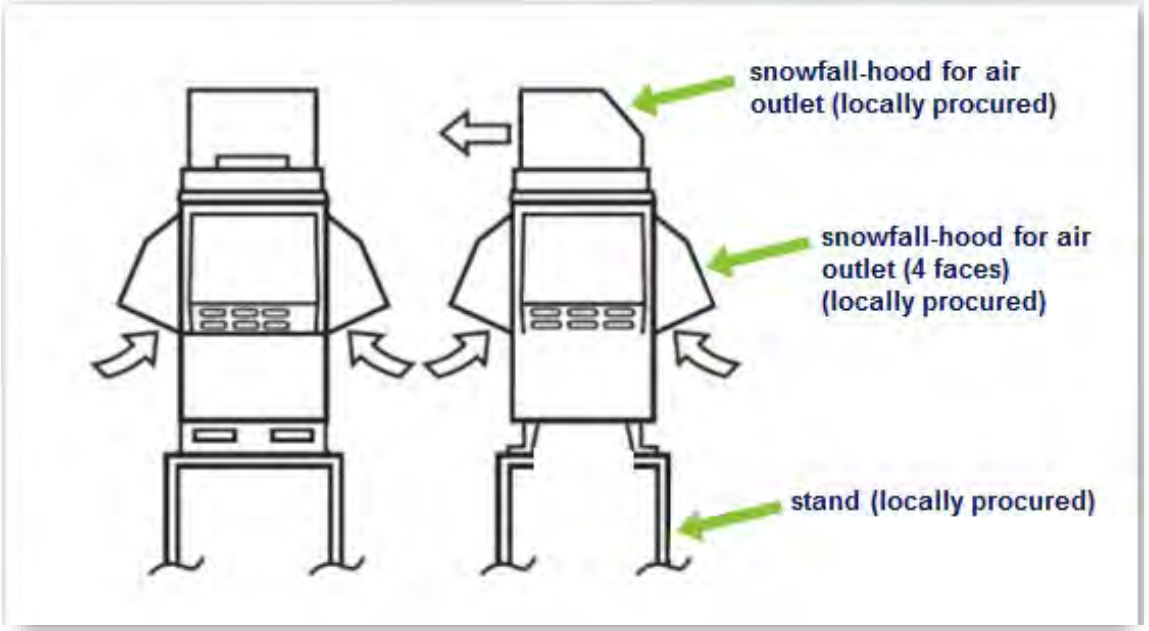


INSTALLATION

Mounting Base

In high snow fall, or cold climate areas the units should be equipped with a tall mounting base **(24” minimum)** plus snow hoods as shown below. Stand and hoods should be procured locally.



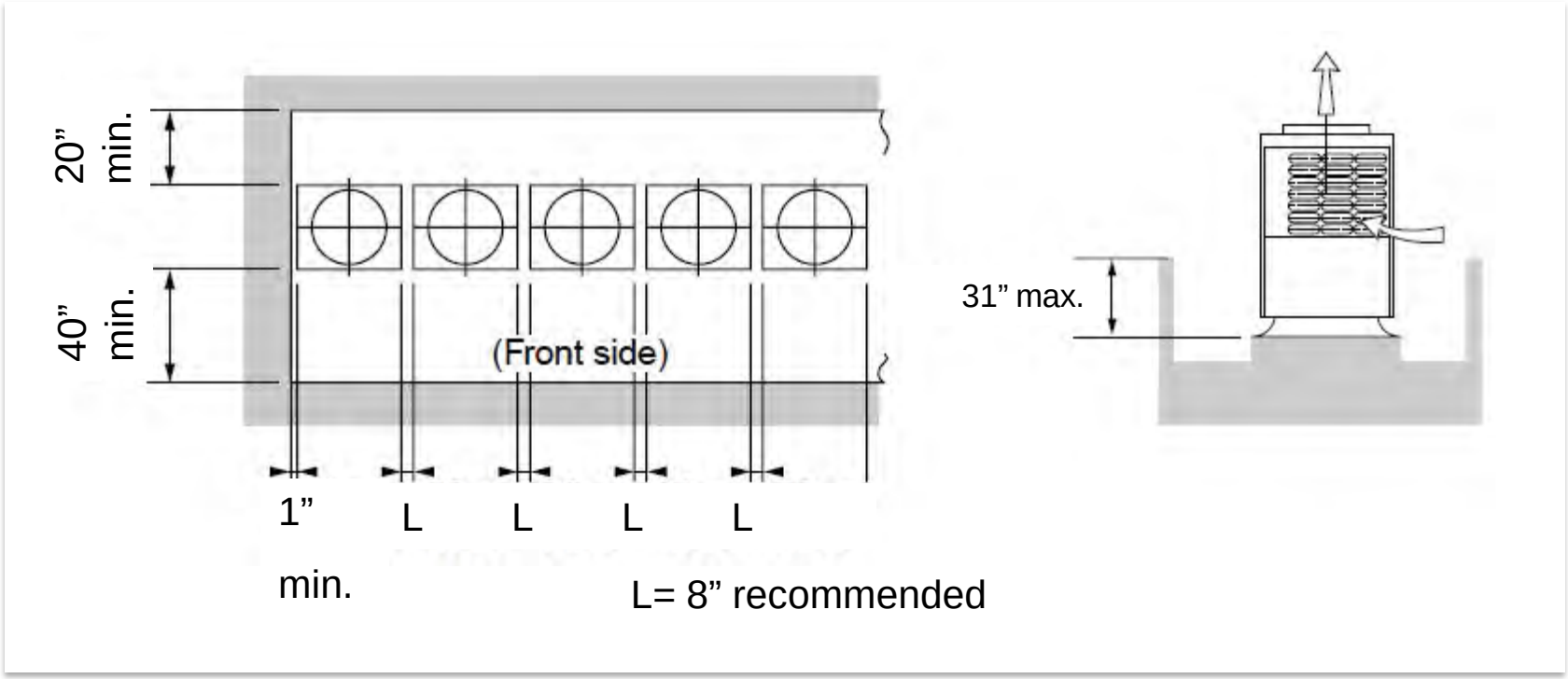
For specifications please contact your RSM.

INSTALLATION

Multiple Unit Installation

IF A SURROUNDING WALL IS SHORTER THAN THE OUTDOOR UNITS

1. One-row installation:

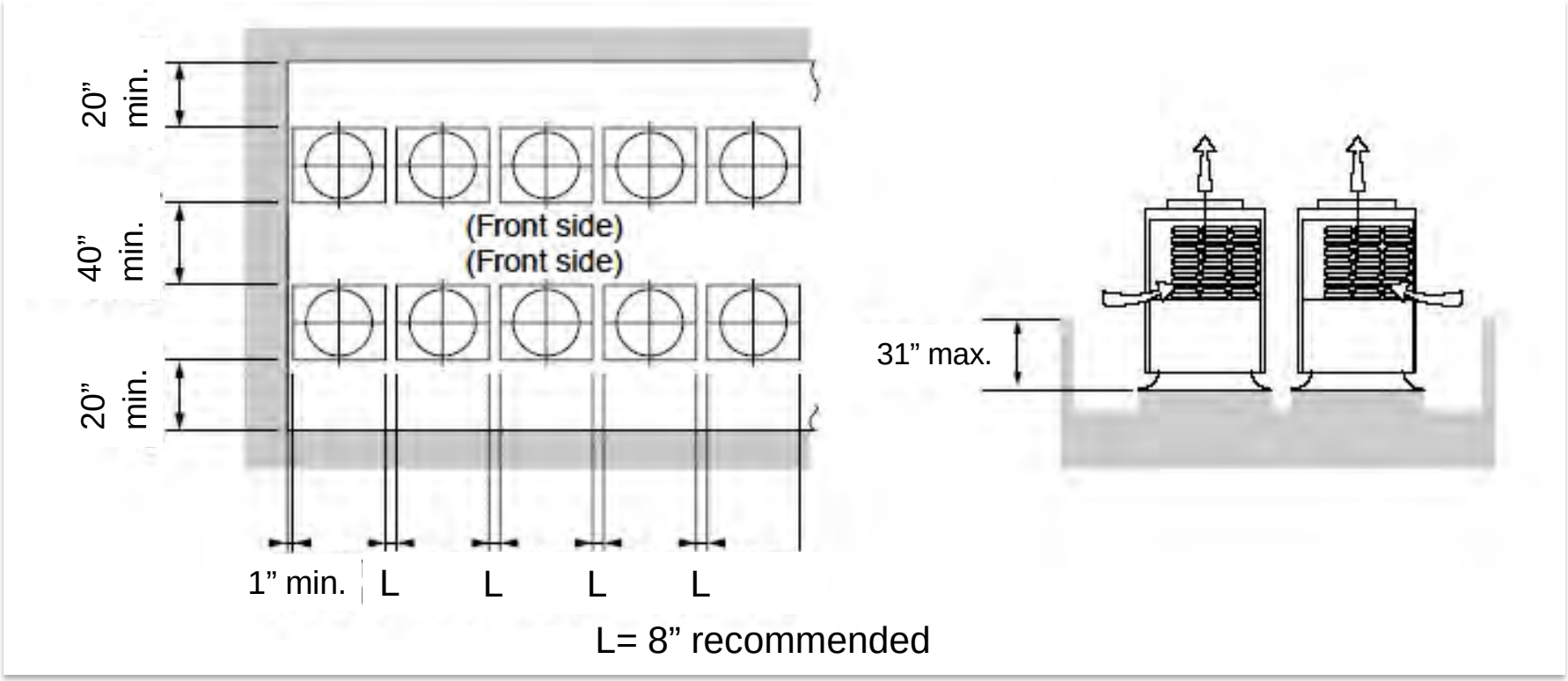


INSTALLATION

Multiple Unit Installation

IF A SURROUNDING WALL IS SHORTER THAN THE OUTDOOR UNITS

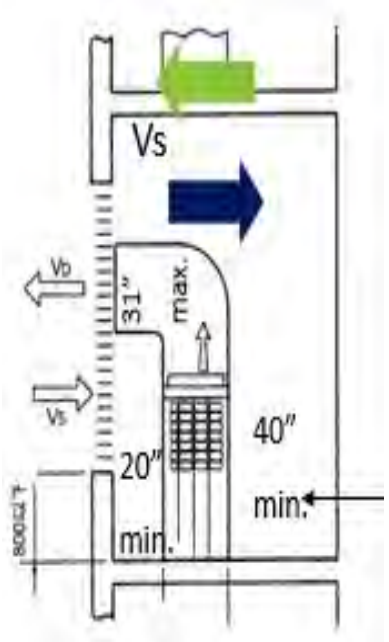
2. Two-row installation:

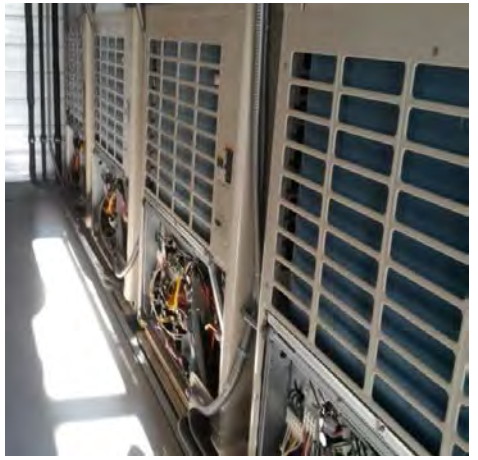


INSTALLATION

Multiple Unit Installation

ODUs in a heated doghouse or penthouse





INSTALLATION

Outdoor Fan High Static Pressure Shift (SW10)

SETUP

Turn “Bit 2” of the Dip switch (SW10) on the interface P.C. board of the outdoor unit to ON side.

SINGLE-PHASE VRF
PIPING DEEP DIVE / FUNDAMENTALS

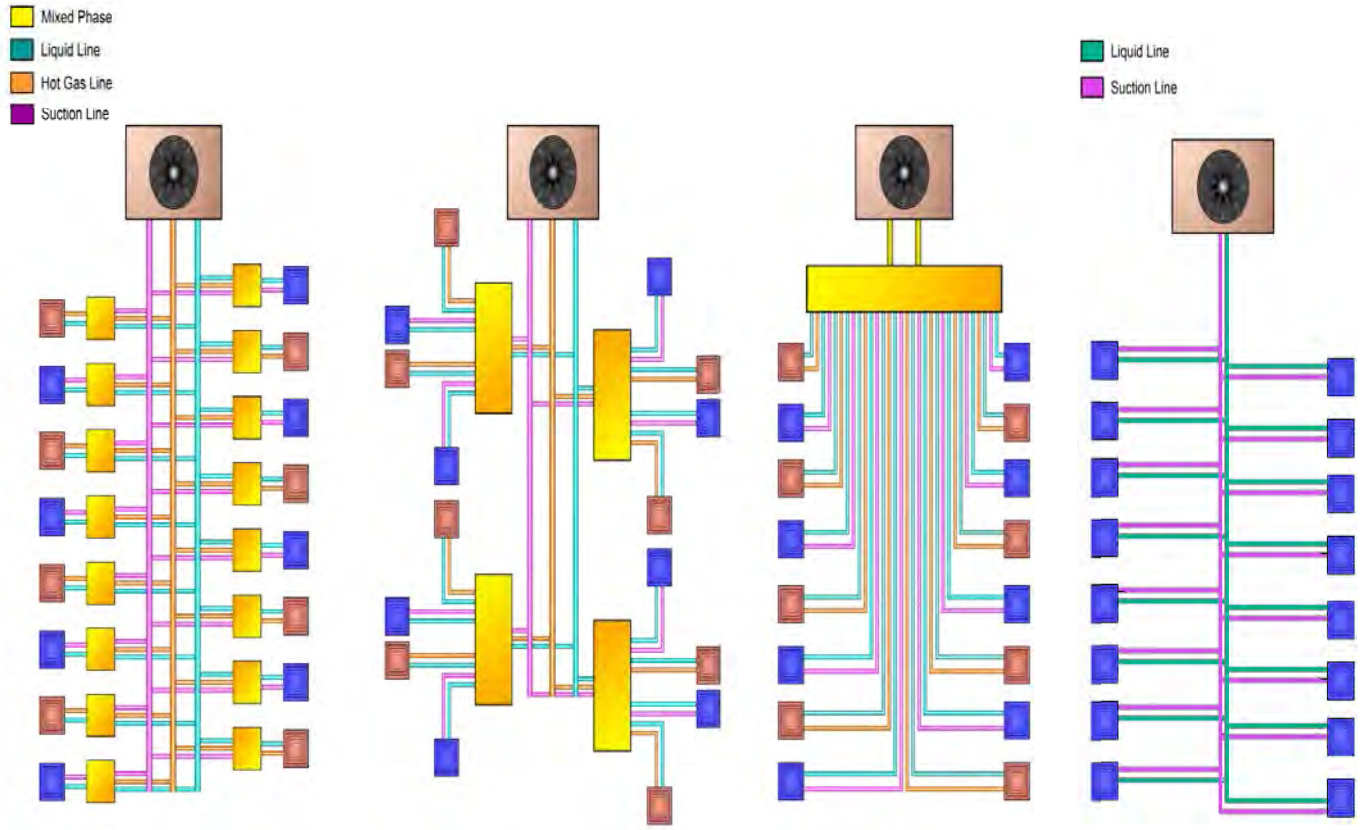
Piping Fundemantals

System Types

3 pipe heat recovery – 3 connecting pipes from outdoor unit to changeover box – this system can simultaneously heat and cool

2 pipe heat recovery – 2 connecting pipes from outdoor unit to changeover box – this system can simultaneously heat and cool

2 pipe heat pump – 2 connecting pipes from outdoor unit to indoor units. This system doesn't have a changeover box. The outdoor unit is piped directly to the indoor units through Y branches. This system will only operate in heating or cooling. It CANNOT run heat and cool simultaneously.



Piping Fundementals

Heat Recovery Systems – Three Pipe

The largest line is the refrigerant vapor return line. This line is typically cool and referred to as the suction line.

The middle-sized line is the refrigerant hot gas line. This line is supplying the inside units with heat. This line can be very hot and sometimes referred to as the discharge line.

The smallest of the three lines is the refrigerant liquid line. This line flows outside to inside for cooling and inside to outside in heating. This line is usually within 10 degrees of ambient conditions.

Piping Fundementals

Heat Pump Systems – Two Pipe

The largest line is a refrigerant vapor return linen in cooling and hot gas line in heating. This line will be hot when in heating mode and cool in cooling mode.

The small line is the liquid line. In cooling the flow is from outside to inside. In heating mode, from inside to outside. This line is usually within 10 degrees of ambient conditions.

Piping Fundementals

Variable Refrigerant Flow systems are unique to typical DX piping. Because the systems must perform by supplying equal refrigerant flow throughout the operating range, but also take into consideration oil return in low capacity (turn down) range.

One way of remembering VRF design considerations is by the acronym:

C.L.O.N.E.

C.L.O.N.E.

- Contamination
- Laminar Flow
- Oil Return
- Noise
- Expansion – Structural and Thermal

Piping Fundementals

Contamination

A carbonized brazing flame will produce enough carbon inside the tubing to cause a restriction.

Normal DX systems can use filter driers to help clean up poor piping practices. VRF does not, except in rare circumstances , allow for filter driers.

During construction keep the open pipes taped off for debris/ dust contamination prevention.

Moisture and other non-condensables cause high pressure expansion, frozen moisture can restrict orifices and acid will form in the system. This is usually caused by leaks and a poor evacuation procedure.

Piping Fundementals

Contamination

Installer must use ACR rated (dehydrated) hard drawn copper

Soft copper must also be ACR rated and typically only allowed after the changeover box. Soft copper is harder to keep level necessary for oil return.

Nitrogen purging is required while brazing. Typical flow requirements are 1-3 psi. The nitrogen displaces the oxygen around the braze. This stops the carbon from forming.

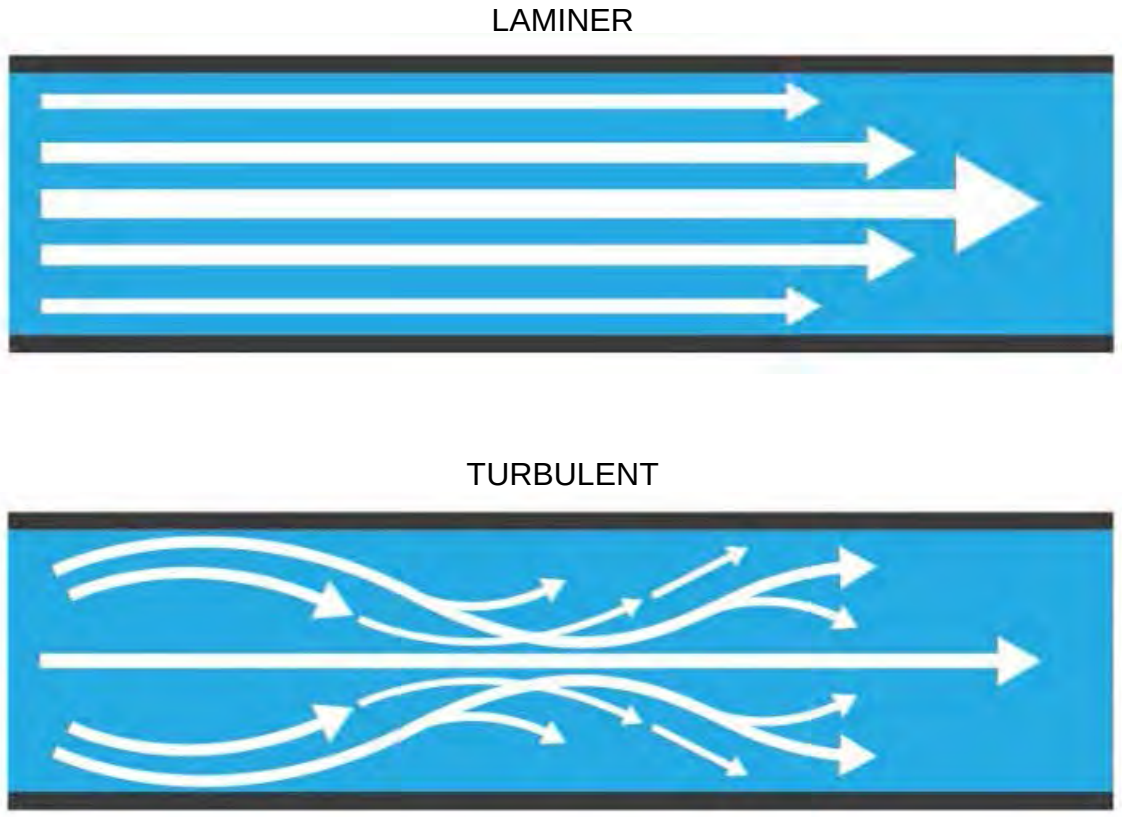
Flushing products are NOT recommended – there is no way to know if the solvent came out.

Piping Fundementals

Laminar Flow

Laminar flow is the emphasis on equal available flow to all air handlers based upon capacity. VRF uses piping diameters and Y-branch layout to ensure equal, sustained, needed volumetric flow throughout the system. The systems operate at variable speeds which also impact flow availability.

The goal of a VRF is to match horsepower to load. This means that the volume will change over a wide variety of conditions.



Piping Fundamentals

Laminar Flow

All VRF manufacturer's have proprietary software that ensures laminar flow while performing system lay-out.

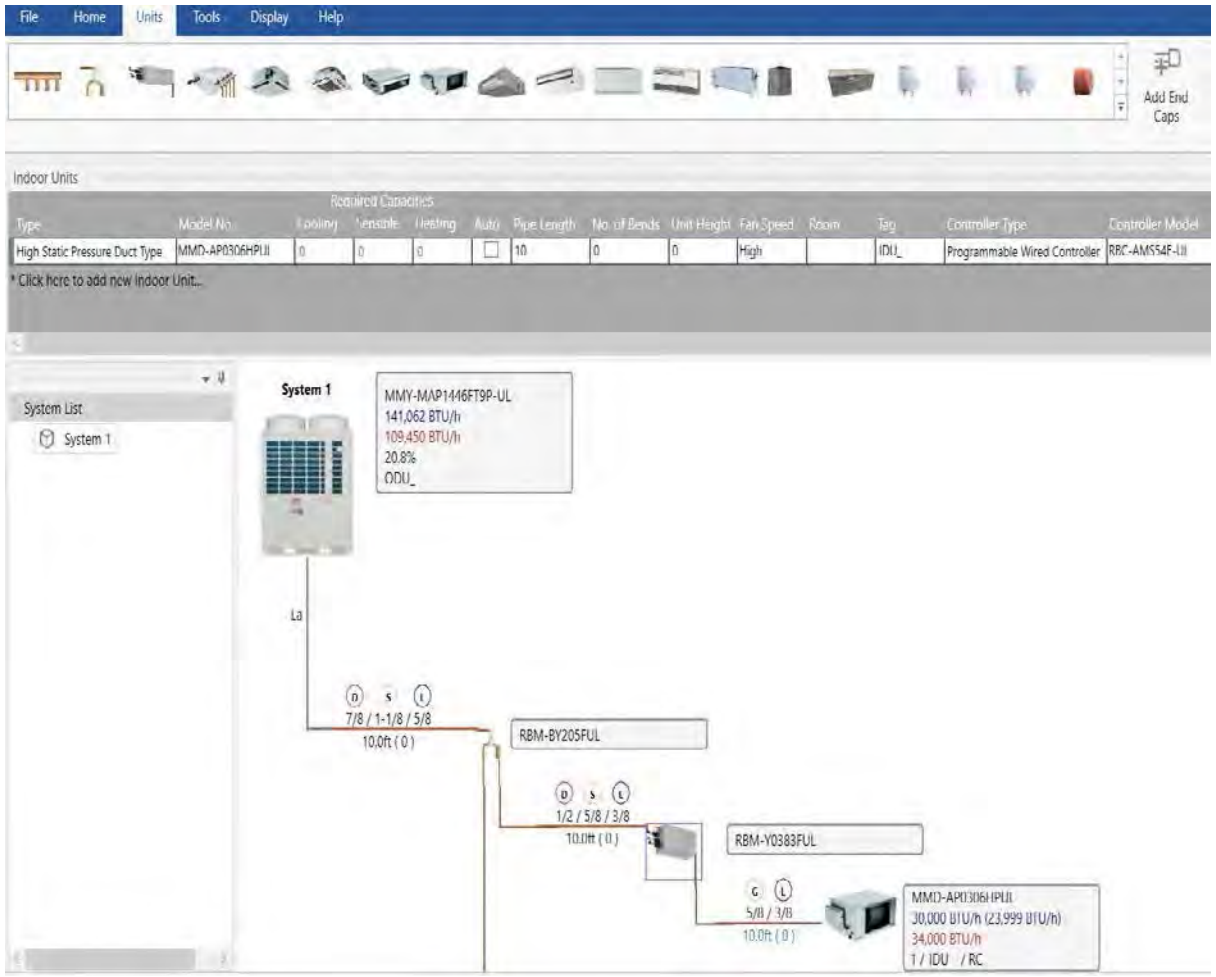
You enter each zone with capacity sizes and job specific lay-out.

When designing the job layout, take into consideration reducing the amount of piping and fittings – This will reduce material and labor cost – the quickest path is a straight line

This will supply you with appropriate Y-branches and piping diameters.

These drawings must be drawn/updated as the system is:

1. Submitted
2. Routing lay-out is complete and approximate distances are confirmed
3. Final measurements are entered/ trim charge is determined



Piping Fundamentals

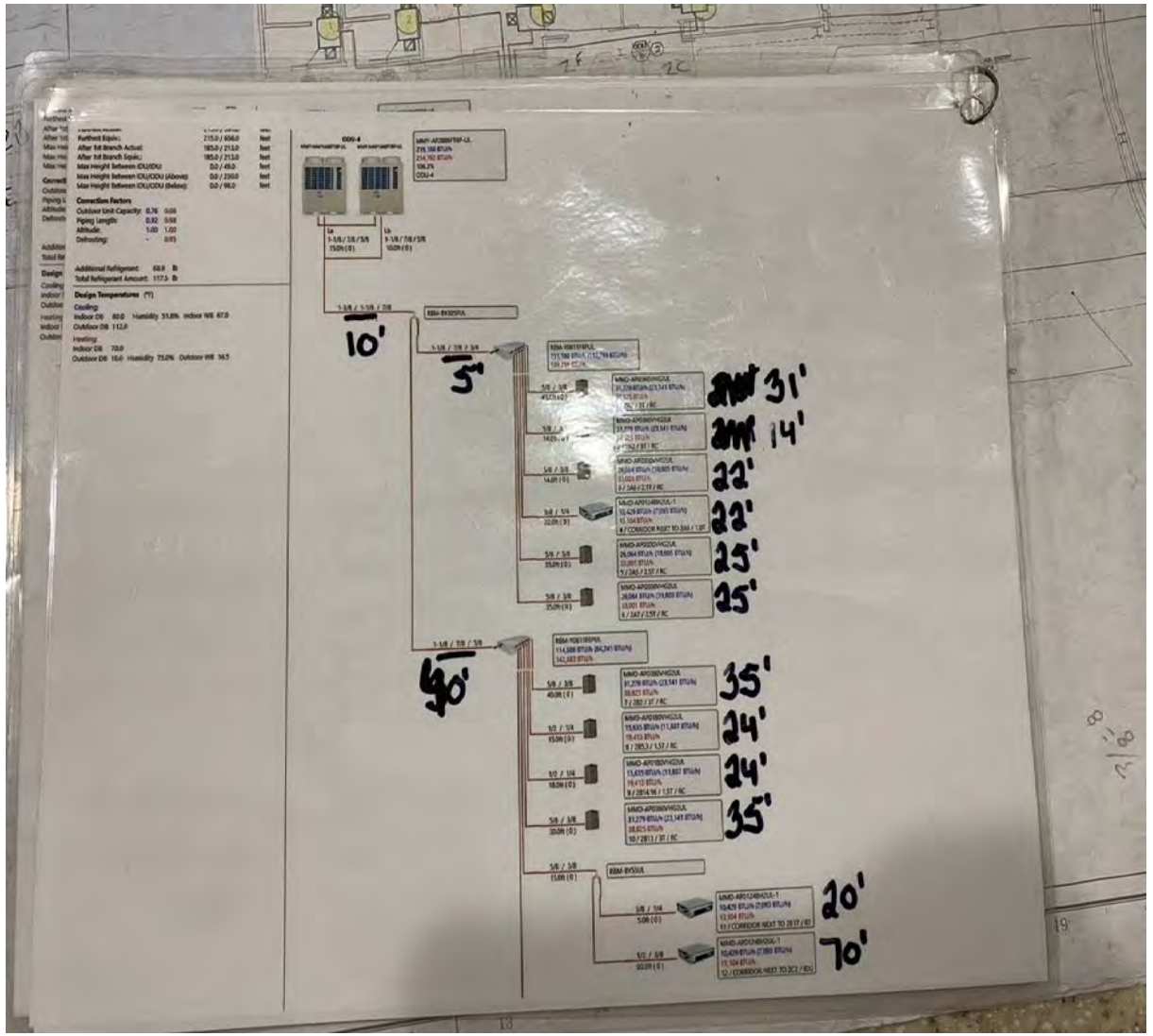
Laminar Flow

Final charge is typically determined by liquid line/ mixed phase line lengths.

90-degree long radius elbow quantities determine equivalent lengths but are not an impact in final charge. Usage of longer sweeping turns are recommended for added efficiency due to a lower friction loss.

Noise in the refrigerant lines are usually an impact in laminar flow, so noise considerations should also be evaluated.

Distance limitations also would be critical because they would limit available flow for the appropriate capacity.

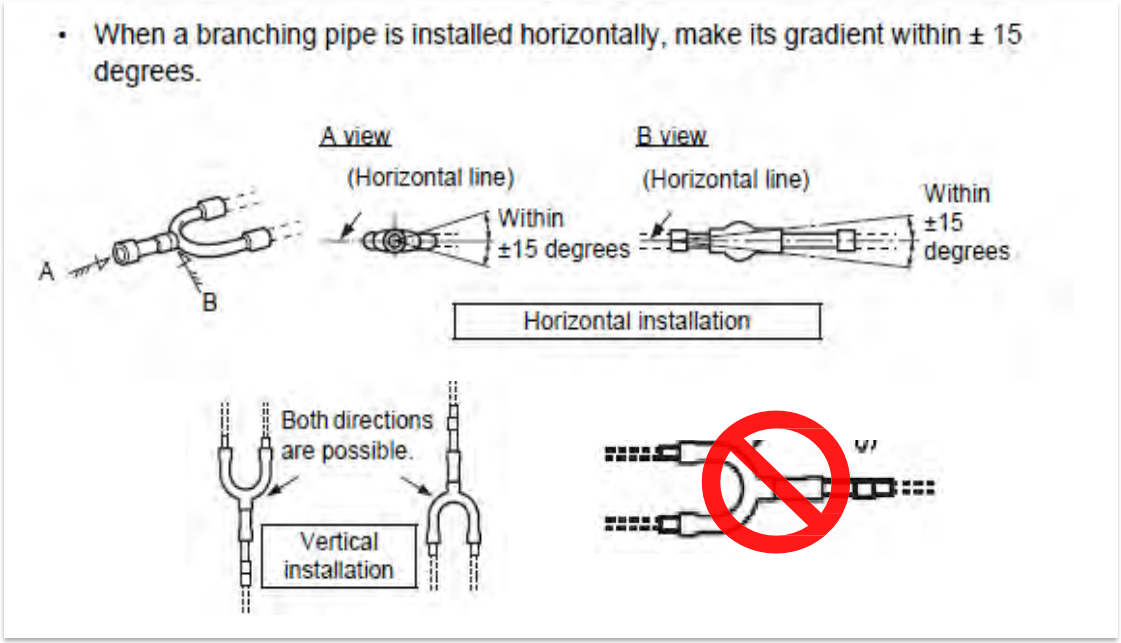


Piping Fundamentals

Laminar Flow

All Y-Branches need to be installed correctly. When the piping enters the Y-branch horizontally they need to be level. They can be installed with the piping entering and leaving vertically.

There is also a limit capacity, in BTUs, for the changeover box porting. This limit is typically around 61,000 BTUs. Anything beyond 61,000 BTUs will need a single port box that can handle larger tonnage fan coils 72-96 BTU.



Connectable Capacity	Model Number	Connectable Indoor Units*
61,000-96,000 Btu/h	RBM-Y0963FUL	8

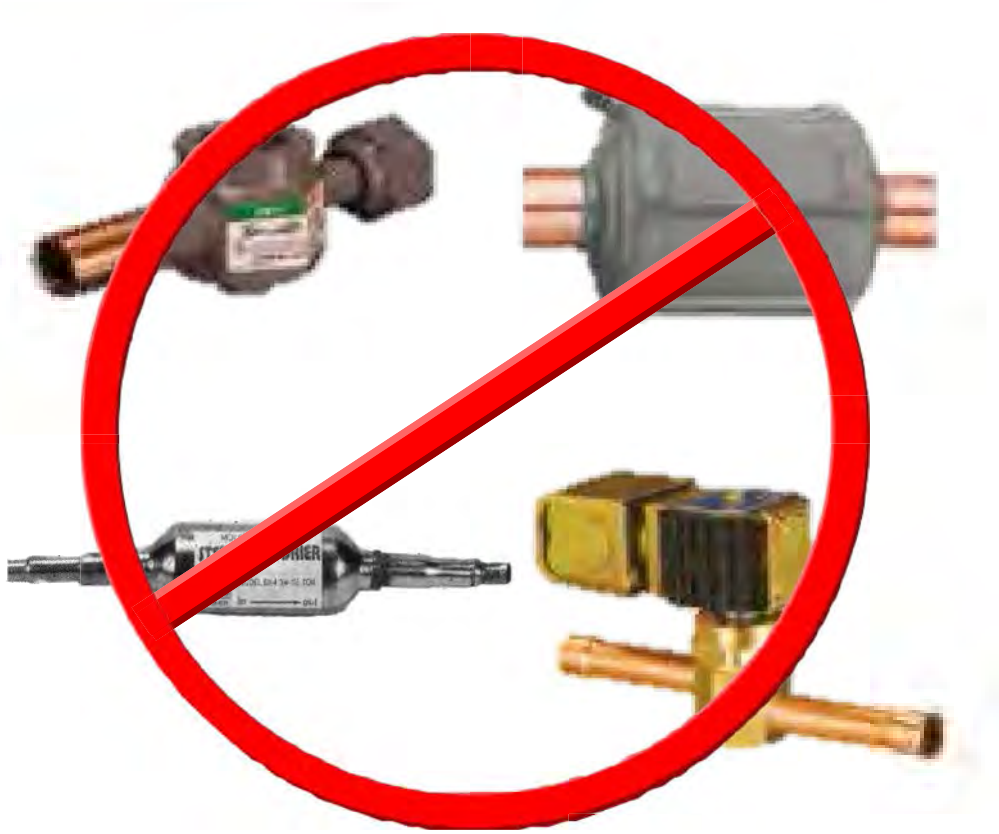
Piping Fundamentals

Oil Return

All refrigeration systems must take oil return into consideration. In normal DX systems you may encounter the need for vertical traps, inverted traps, long line set guidelines and dual risers.

With very few exceptions, all refrigerant oil traps (standard and inverted), filter driers and sight glasses are prohibited. Refrigerant ball valves must be manufacturer approved.

In VRF this concept is critical because, under a minimum load, we will not have sufficient volume of refrigerant flow to carry and return oil through obstacles.

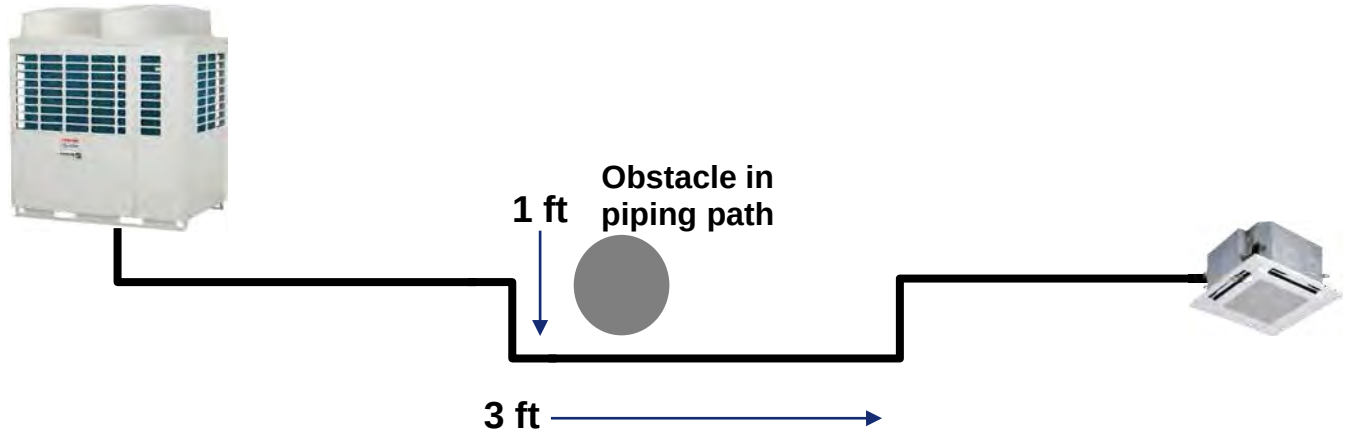


Piping Fundamentals

Oil Return

Piping design can have horizontal offsets, but all vertical offsets should be avoided. If the piping is running horizontally, and a vertical offset is needed first try running the piping at the correct needed level. If the offset can't be avoided, this must comply with the 3-1 rule.

The 3-1 rule is this: if the piping is running across the ceiling and needs to drop 1 foot to run under a support beam, the horizontal run before it raises back up 1 foot needs to be at least 3 feet long. This can also be aided by using 45-degree elbows rather than 90-degree elbows.



Piping Fundamentals

Oil Return

If shut off isolation valves are approved for use, they must be installed as close to the feeding Y-branch as possible. If the system has a branch isolated for repair, the piping can accumulate and pool with oil. Because of the lack of refrigerant flow, the unit can’t pull the oil out of the dead piping. This could starve and seize the compressors. Any ball valve used must be specifically for VRF applications.

In the same way shut off valves can cause pooling of oil return, so can unused changeover box ports. Using the closest ports and the last ports will ensure the box will have constant refrigerant flow through it picking up any oil drops.

Piping Fundamentals

Noise

Most manufacturers have some piping requirements for the prevention of noise. This noise is typically caused by the release of high-pressure refrigerant, flow turbulence, valve buzzing, oil return cycle flow and minimum flow bleed through.

Design suggestions are as follows:

Don’t install changeover boxes over sleeping quarters or quiet offices

Do suspend changeover boxes rather than on a solid object

Ensure at least 24” (some 36”) inlet and outlets to changeover boxes Y branches and even elbows – consult with the manufacturer for their requirements

Piping Fundamentals

Noise

Don’t install high wall/ ceiling suspended units above or around a bed or quiet office. When the unit goes through oil return or minimum position, you can hear the flow and it can be annoying. When the unit is operating, the noise is typically drowned out by the fan noise. This fan won’t be on when the system isn’t on, but the valve may still bleed through.

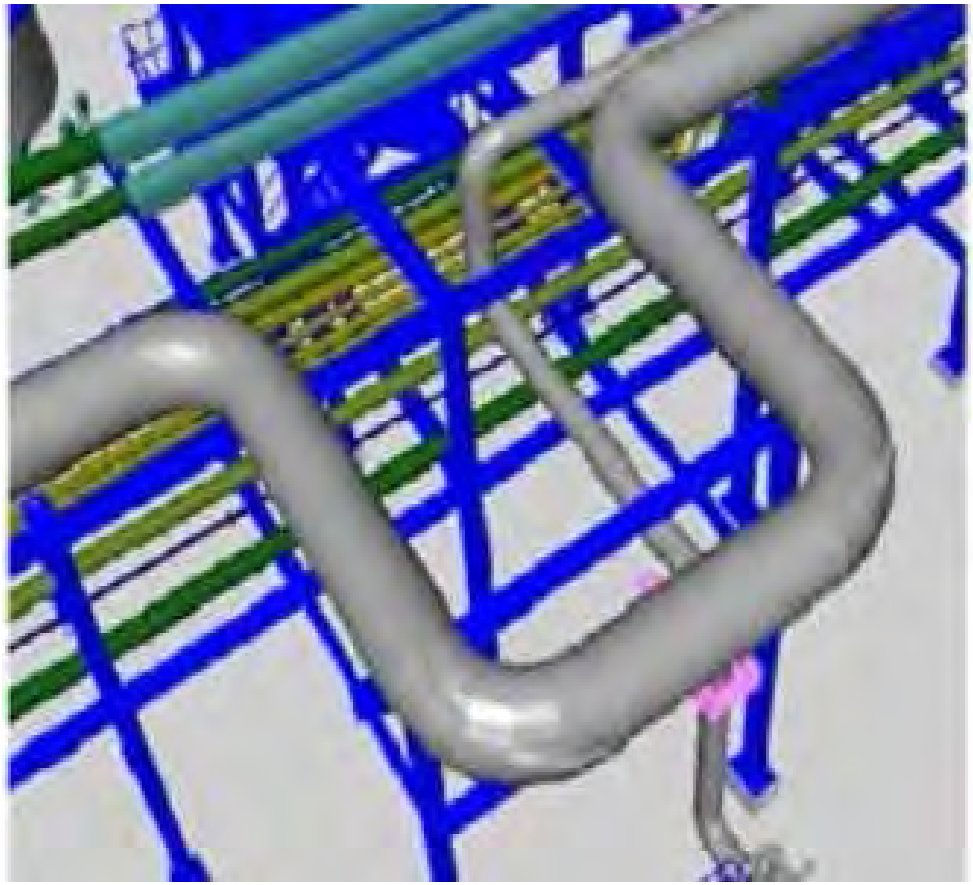
Avoid installing vibration isolators in the piping – this can cause a whirring noise under full flow. If so required, noise may be an issue. The I.D. on some vibration isolators is reduced to the required I.D. in the engineered pipe requirements. This may reduce capacity downstream.

Piping Fundamentals

Expansion- Structural

Expansion joints in VRF typically fall into two categories, structural and thermal.

In California most piping systems require structural “expansion joints” to be installed in all piping – These consist of a pre-manufactured “U” traps with vibration isolators along each side. These may cause noise through the isolator, must be verified where the I.D. must coincide with the required I.D. and must be installed horizontally to prevent the oil trap. If they are still required, please make all parties aware.



Piping Fundamentals

Expansion- Structural

Thermal expansion assemblies need to be installed at the piping professional's discretion. When you have a heating discharge line increase in temperature from room temperature to 250 degrees, the copper expands dramatically. If you don't install thermal expansion assemblies, the piping can break. Breaks usually occur at any 45-degree offset, or any weak point where the piping is pinned together. It can break through piping supports and piping racks.

Piping Fundamentals

Expansion- Structural

Take your heating line max, cooling line minimum and distance – find the difference

As you can see – at 200 feet in heating the hot gas line could be 130 degrees – this would represent 3.0” the same supply line suction in cooling could be 40 degrees – 0.8” a difference of 2.2”

Use 2.2” on the next slide

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

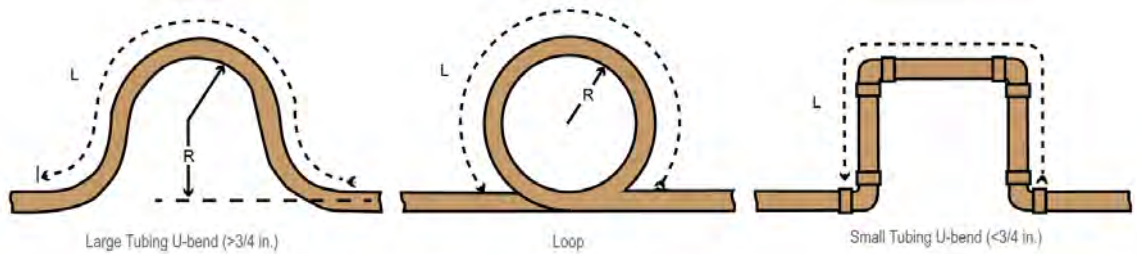
Piping Fundamentals

Expansion- Structural

Thermal Expansion joint design
Use the 2.2” on the left - I do not recommend loop design

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).*



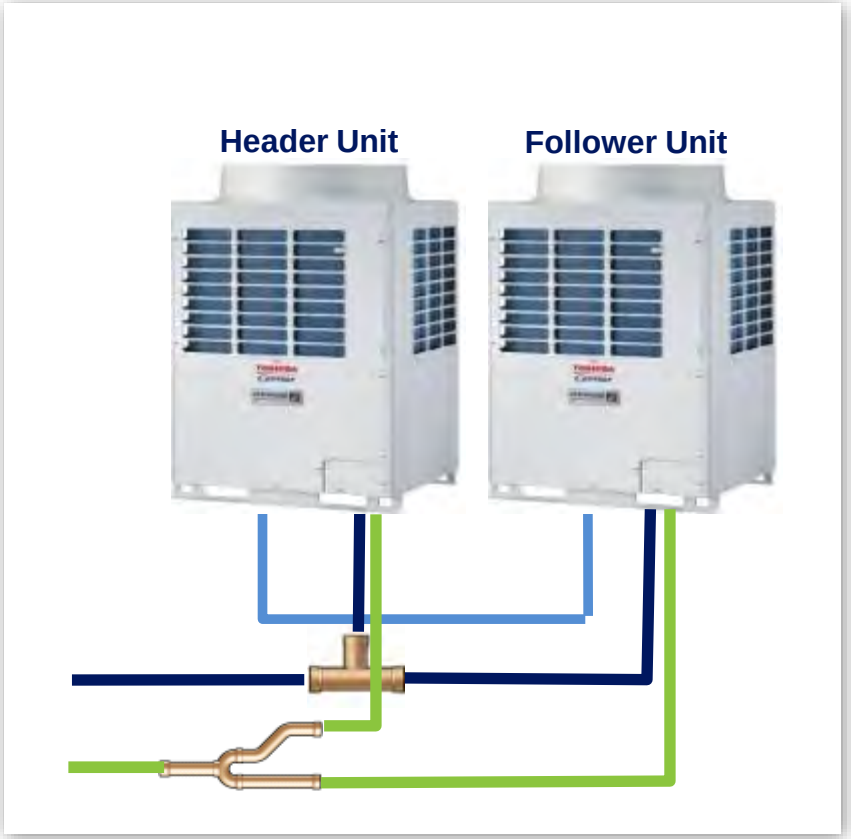
SINGLE-PHASE VRF
OUTDOOR UNIT PIPING

INSTALLATION

Heat Pump Outdoor Unit Piping Arrangement

Install the outdoor units in order of capacity

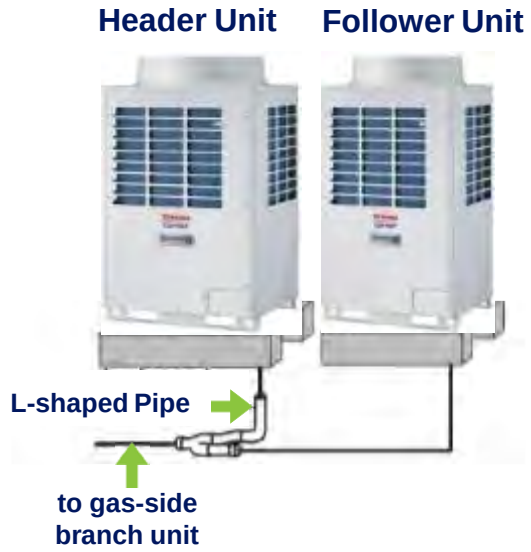
(Header Unit >= Follower Unit)



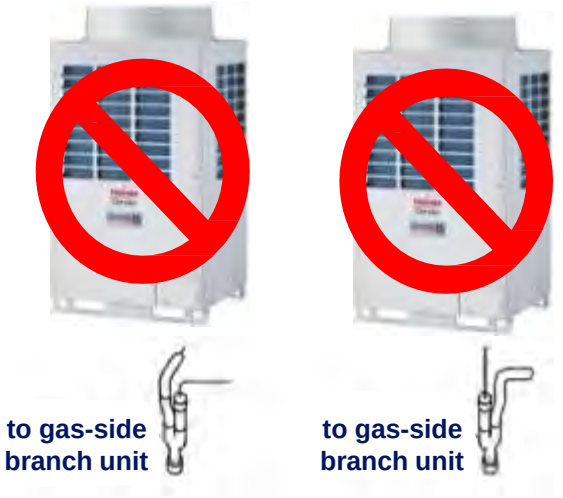
INSTALLATION

Piping Basics

CORRECT



INCORRECT



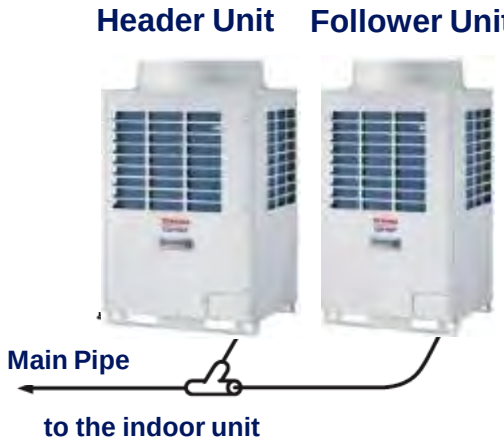
- Piping exit through unit bottom
- Y – branch must be installed horizontally

INSTALLATION

Piping Basics

LIQUID PIPE CONFIGURATION

CORRECT



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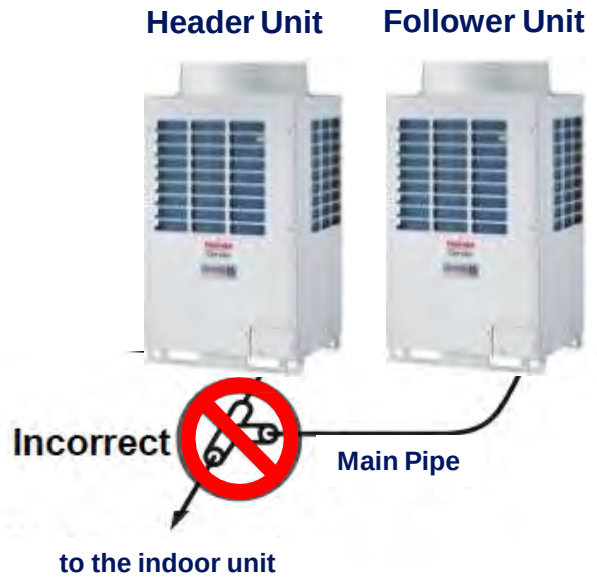
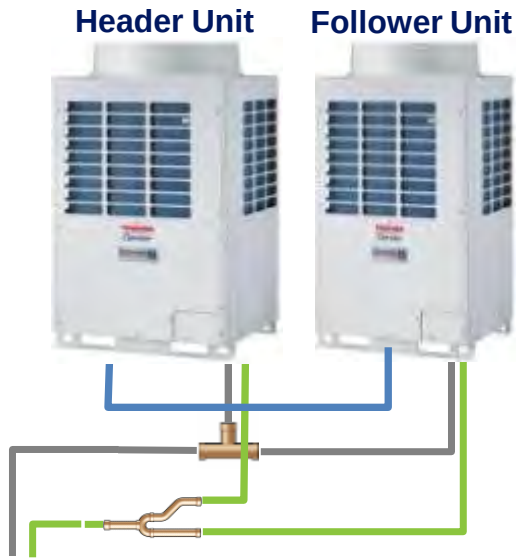


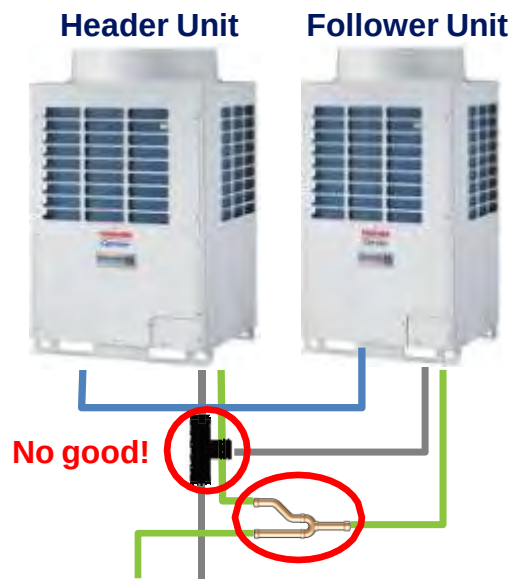
INSTALLATION

Heat Pump Outdoor Piping Arrangement

CORRECT



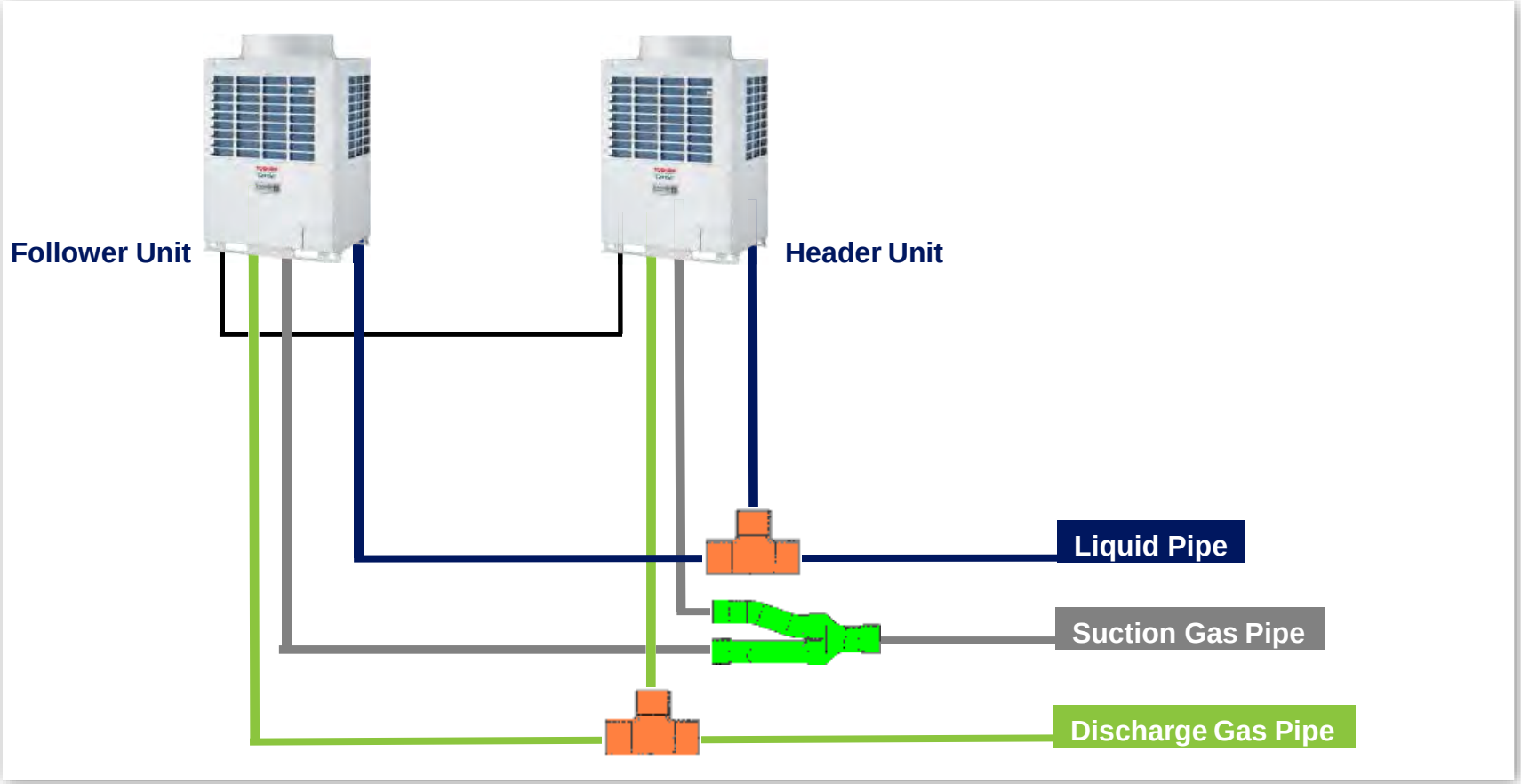
INCORRECT



INSTALLATION

Heat Recovery Outdoor Piping Arrangement

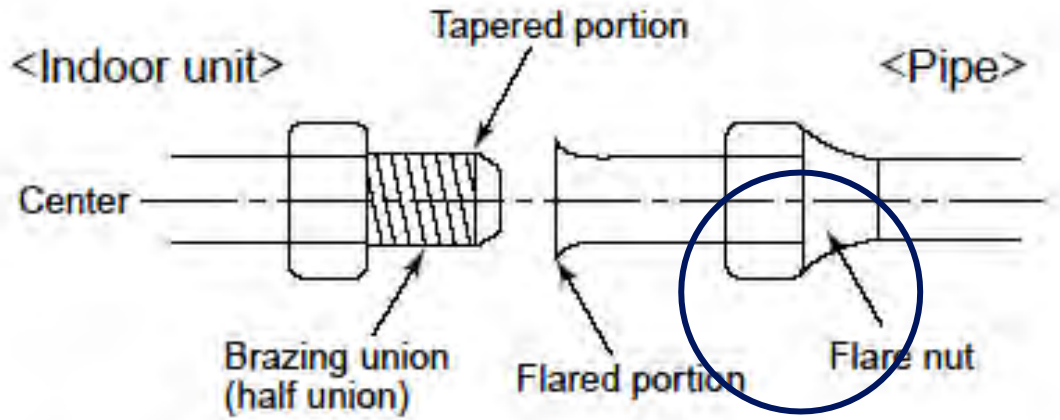
DUAL-MODULE PIPING



INSTALLATION

Indoor Unit Piping

CONNECTING AND CENTERING



Flare is standard 45 degree flare used for R-410a

INSTALLATION

Indoor Unit Piping

WHY A DEDICATED R410A FLARING TOOL?

✓R-410a Flaring Tool

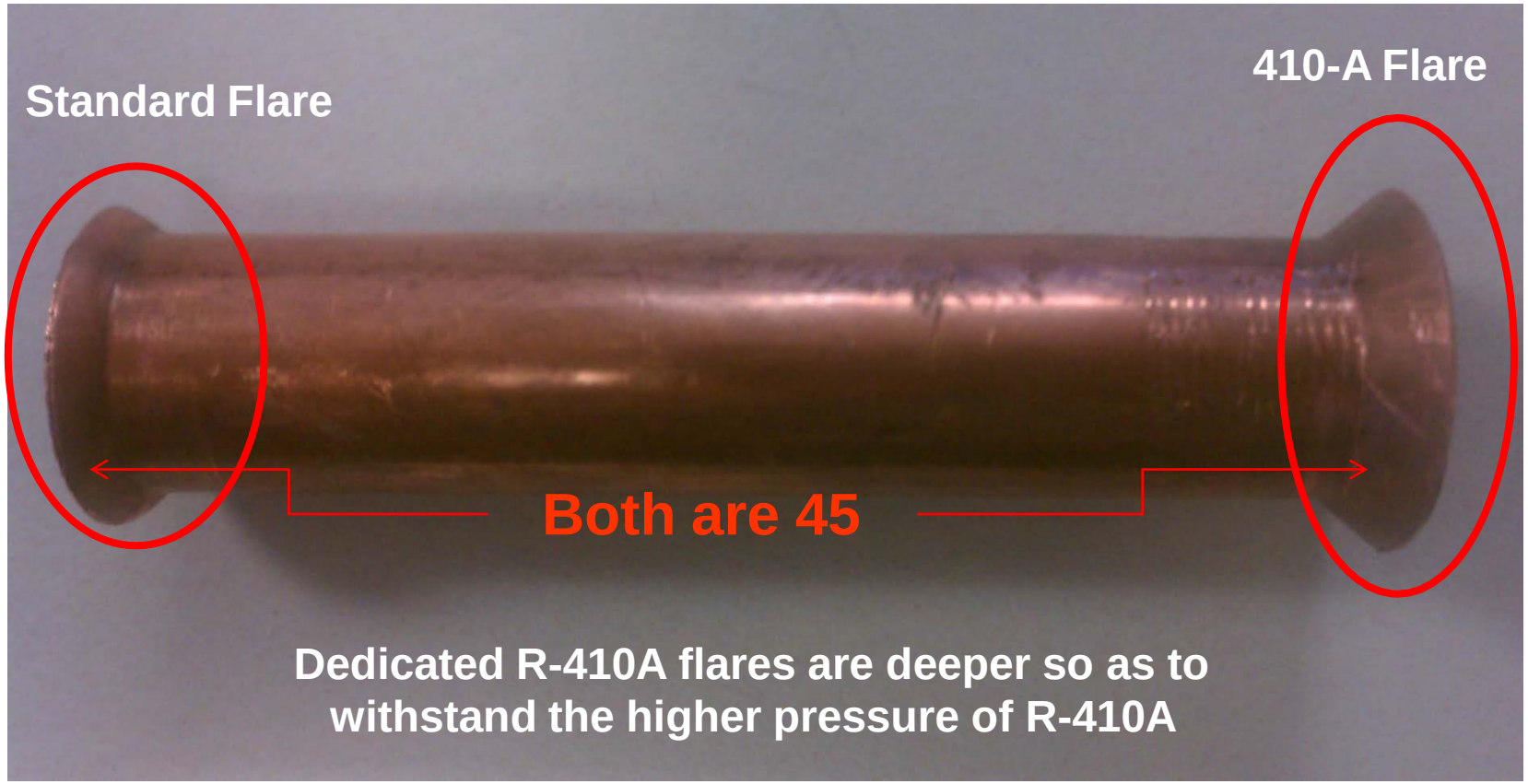
R410A systems operate at high pressures

- The clutched handle prevents the crushing of the copper tube at the point of the flare. This helps maintain the strength and integrity of the copper tubing so it will withstand the higher operating pressures.
- The concentric cone helps make a uniform flare and reduces the thinning of the tube wall, this also eliminates the need of oil on the inside of the flare which can result in contamination and acid formation within the operating system.

INSTALLATION

Indoor Unit Piping

WHY A DEDICATED R410A FLARING TOOL?



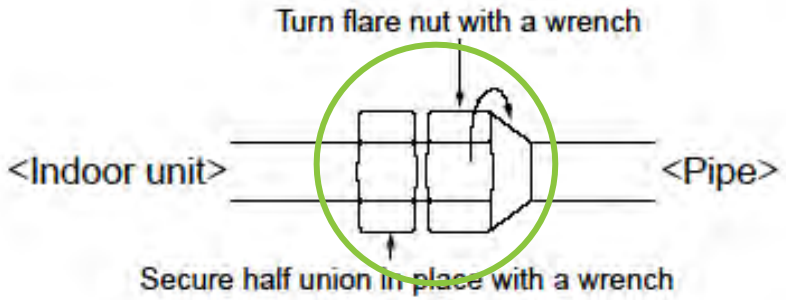
INSTALLATION

Indoor Unit Piping

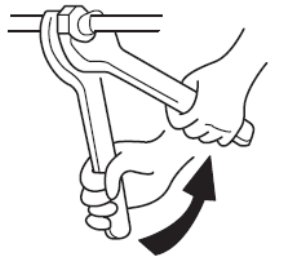
TIGHTENING THE FLARE NUT

Connecting Pipe Outer Dia. (in)	Ft-lbs.
Ø1/4”	10 to 13
Ø3/8”	24 to 31
Ø1/2”	37 to 46
Ø5/8”	50 to 60

Torque wrench

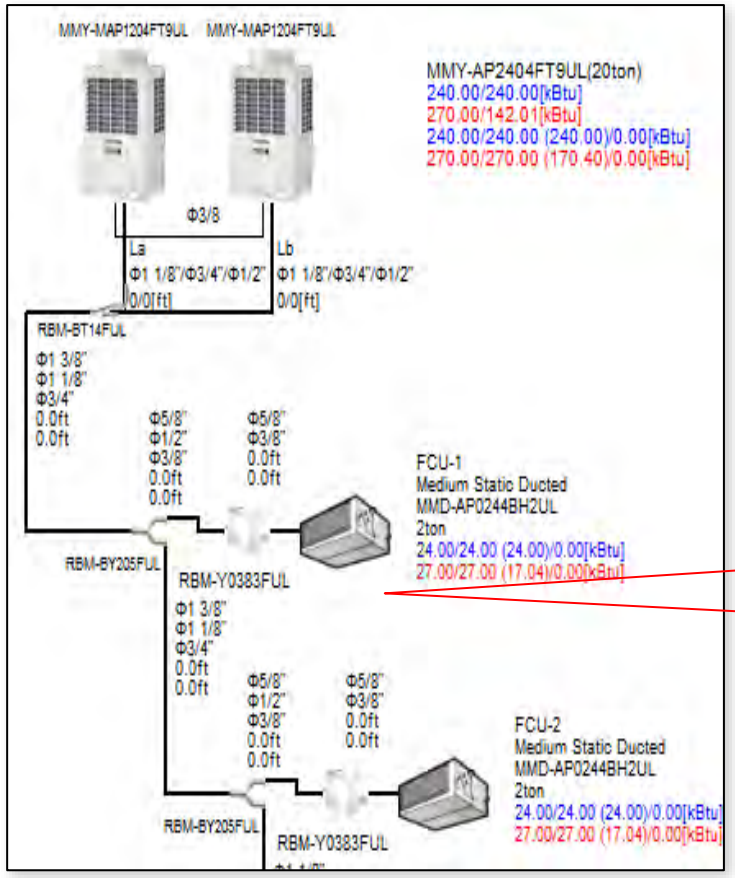


Use a backup wrench



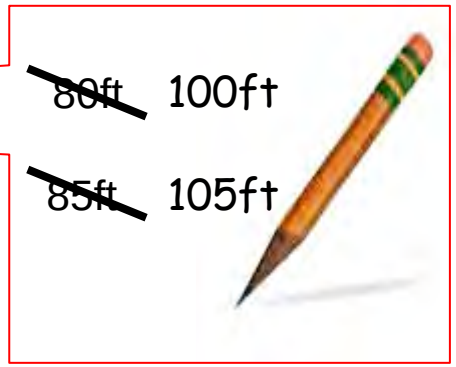
INSTALLATION

As-Built Line Lengths



DON'T FORGET!!!!

Keep track of installed Liquid refrigerant pipe lengths by size to ensure correct refrigerant charge



SINGLE-PHASE VRF
INSULATION AND CONDENSATE

INSTALLATION

Insulation Work

MATERIAL

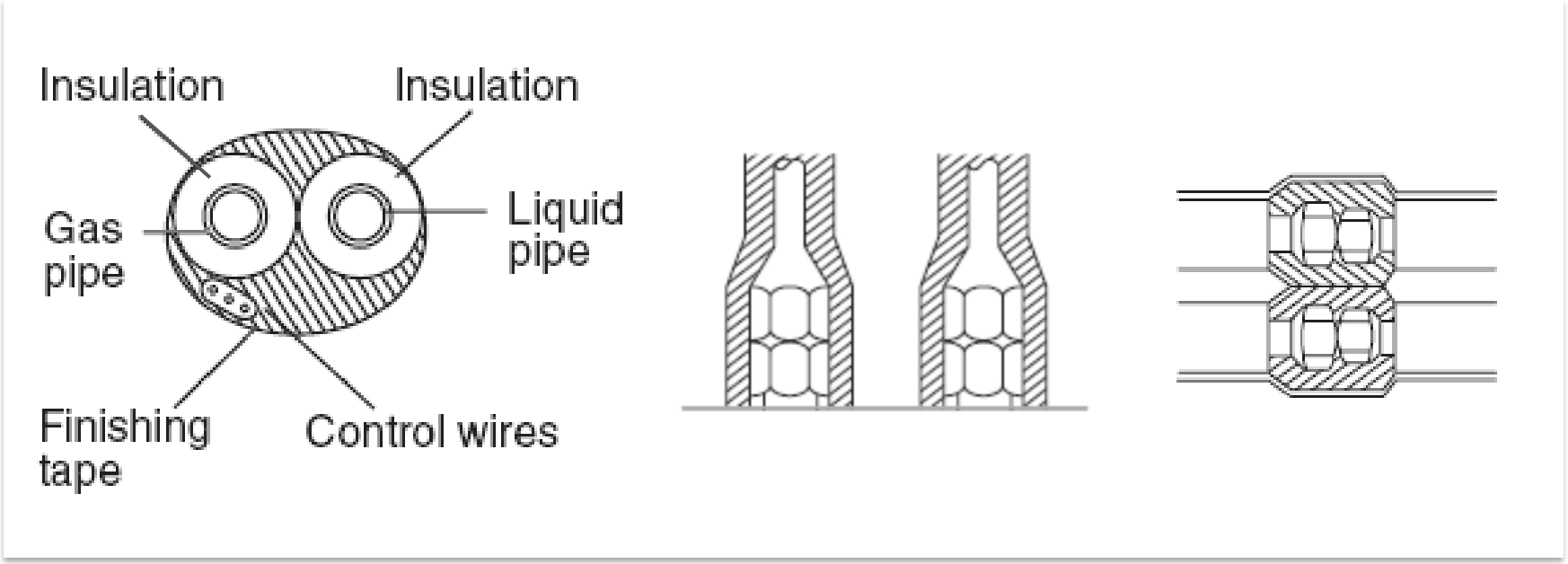
245º F Closed cell foam pipe insulation material as specified by local and national codes

INSTALLATION

Insulation Work

INSULATION GUIDELINES

Insulating the gas pipe and liquid pipe individually, all piping joints must be insulated and sealed to the main pipe insulation.



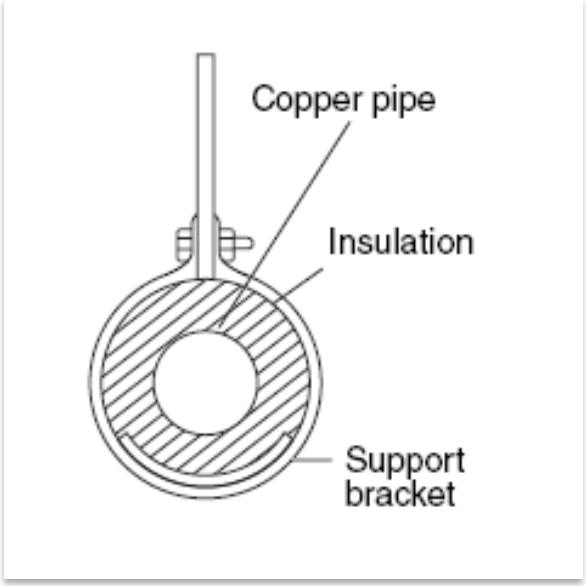
INSTALLATION

Insulation Work

INSULATION GUIDELINES

When insulating a supported section:

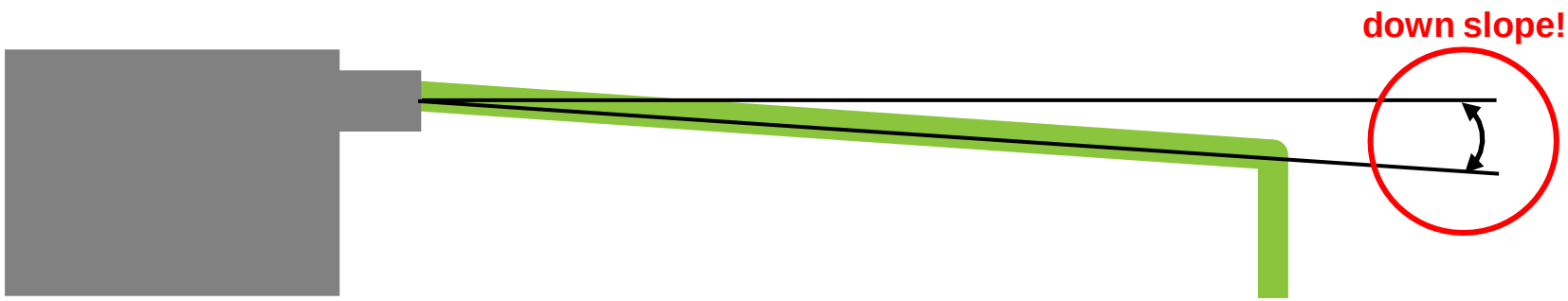
the slit in the insulation should be on the top side of the pipe as shown



INSTALLATION

Drain Piping

DRAIN PIPE PITCH

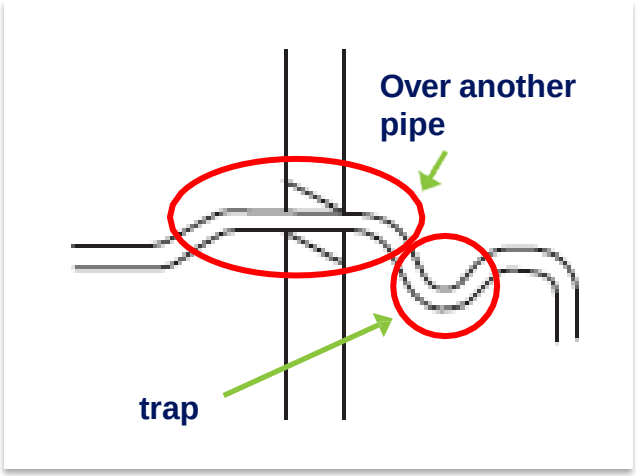


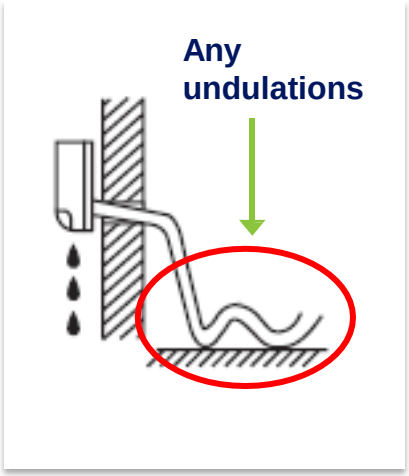
Minimum pitch to comply with local codes

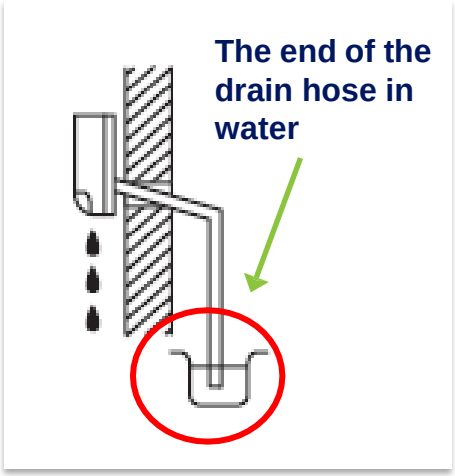
INSTALLATION

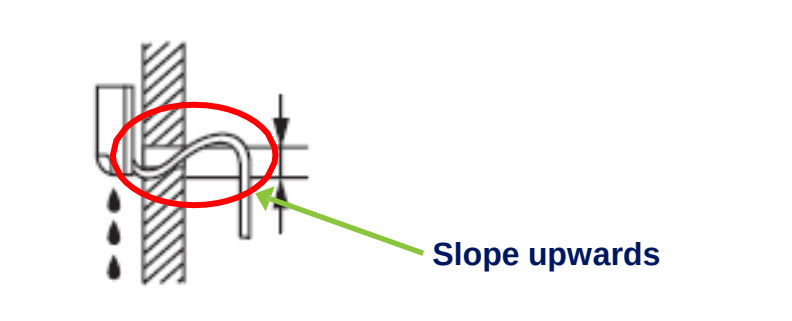
Drain Piping

DRAIN PIPING ERRORS





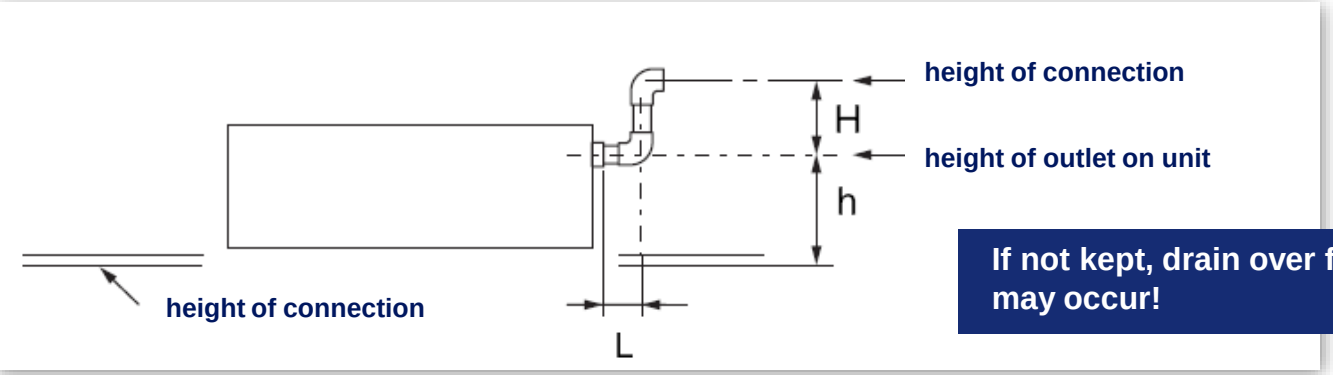




INSTALLATION

Height Of A High Drain Outside Of The Unit

Indoor unit type	Allowable height of drain-up outside of unit (Condition)		
	Position of main unit drain port	**Allowable height of drain-up** (From drain port of main unit)	**L**
FCU with Factory Pump	h = 7.5	H = 26	12 or less
Compact 4-Way cassette type	h = 9	H = 25	12 or less



If not kept, drain over flow trouble may occur!

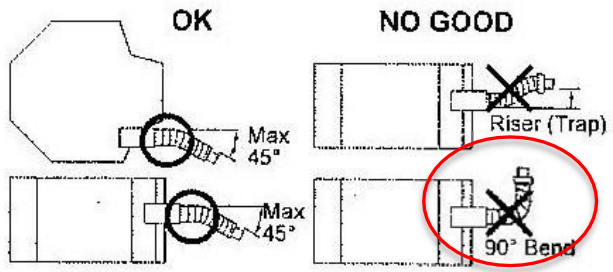
INSTALLATION

Flexible Hose—No 90-degree Bends

■ Flexible hose

Use the attached flexible hose to adjust center discrepancy of the hard vinyl chloride pipe or to adjust the angle.

- Do not use the flexible hose as stretched, or do not deform it more extent than that in the following figure.
- Fix the soft end of the flexible hose with the attached hose band.
- Use the flexible hose on a horizontal level.



Piping Install

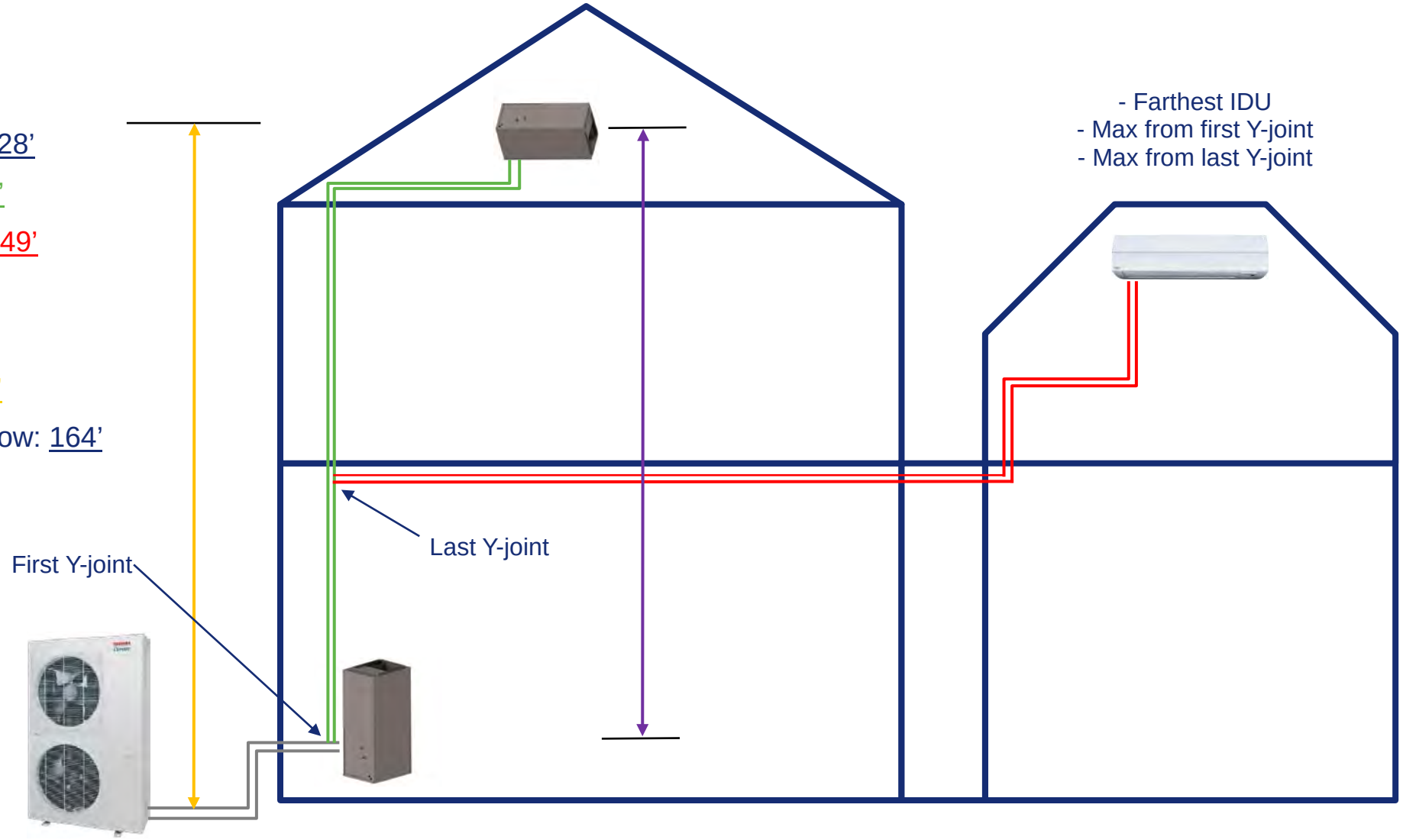
Piping Abilities

Line Lengths

- Farthest indoor unit from ODU: 328’
- Max from first y-joint/header: 115’
- Max run from last y-joint/header: 49’

Vertical Separations

- ODU below the indoor units: 131’
- ODU on the roof with indoors below: 164’
- Indoor unit to indoor unit: 49’



Piping Selection

Piping Sizes

- Select the ODU based on block load
- Selecting indoor units for peak loads
- Piping sizes based on downstream working from the ODU in to IDUs.

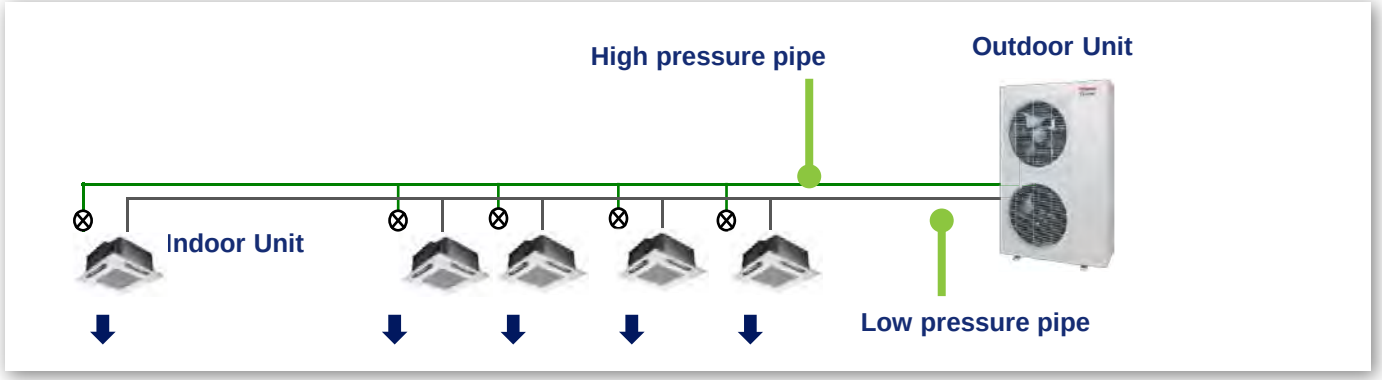
Vroom will auto select piping sizes and generate in the output. This will save time in the field

<table>
<tr><th>No.</th><th>Piping parts</th><th>Name</th><th>Selection of pipe size</th><th>Remarks</th></tr>
<tr><td>(1)</td><td>Outdoor unit
↓
1st branching section</td><td>Main pipe</td><td>Size of main pipe
<table><tr><th>Outdoor unit capacity type</th><th>Gas pipe</th><th>Liquid pipe</th></tr><tr><td>0367 type</td><td>Ø5/8"</td><td>Ø3/8"</td></tr><tr><td>0487 type</td><td>Ø5/8"</td><td>Ø3/8"</td></tr><tr><td>0607 type</td><td>Ø3/4"</td><td>Ø3/8"</td></tr></table></td><td>Same as the outdoor unit's connecting pipe size.</td></tr>
<tr><td>(2)</td><td>Branching section
↓
Branching section</td><td>Branching pipe</td><td>Pipe size between branching sections
<table><tr><th>Total capacity codes of indoor units at down stream side
Equivalent to capacity</th><th>Gas pipe</th><th>Liquid pipe</th></tr><tr><td>Below 23</td><td>Ø1/2"</td><td>Ø3/8"</td></tr><tr><td>23 to below 61</td><td>Ø5/8"</td><td>Ø3/8"</td></tr><tr><td>61 or more</td><td>Ø3/4"</td><td>Ø3/8"</td></tr></table></td><td>Pipe size differs based on the total capacity code value of the indoor units at the downstream side. If the total value exceeds the capacity code of the outdoor unit, apply the capacity code of the outdoor unit. (See Table 1 and 2.)</td></tr>
<tr><td>(3)</td><td>Branching section
↓
Indoor unit</td><td>Indoor unit connecting pipe</td><td>Connecting pipe size of indoor unit
<table><tr><th>Capacity rank</th><th>Gas pipe</th><th>Liquid pipe</th></tr><tr><td>007 to 012 type</td><td>Ø3/8"</td><td>Ø1/4"</td></tr><tr><td>015 to 018 type</td><td>Ø1/2"</td><td>Ø1/4"</td></tr><tr><td>021 to 048 type</td><td>Ø5/8"</td><td>Ø3/8"</td></tr></table></td><td></td></tr>
<tr><td>(4)</td><td>Branching section</td><td>Y-shaped branching joint</td><td>Selection of branching section (Y-shaped branching joint)
<table><tr><th></th><th>Model name</th></tr><tr><td>Y-shape branch joint</td><td>RBM-BY55UL</td></tr></table></td><td></td></tr>
<tr><td>(5)</td><td>Branching section</td><td>Branching header</td><td>Selection of branching section (Branching header)
<table><tr><th colspan="2"></th><th>Model name</th></tr><tr><td rowspan="2">Branching header*</td><td>For 4 branches</td><td>RBM-HY1043UL</td></tr><tr><td>For 8 branches</td><td>RBM-HY1083UL</td></tr></table>* A capacity code up to a maximum of 57 is connectable to one line after branching from the header.</td><td></td></tr>
</table>

Piping Selection

Additional Piping Considerations

- Condensate consideration
- Filter driers are not needed for VRF. They can create a pressure drop and the strainers catch containments
- Service valve consideration



Cooling: Expansion at Indoor Unit
Heating: Expansion at Outdoor Unit

Performance Results

Indoor Units:	1 / 1 to 9	
Capacity:	60 / 30 to 60 (100.0%)	
Total Pipe Length:	25.0 / 591.0	feet
Furthest Actual:	25.0 / 328.0	feet
Furthest Equiv.:	25.0 / 410.0	feet
After 1st Branch Actual:	0.0 / 115.0	feet
After 1st Branch Equiv.:	0.0 / 115.0	feet
Max Height Between IDU/IDU:	0.0 / 49.0	feet
Max Height Between IDU/ODU (Above):	0.0 / 98.0	feet
Max Height Between IDU/ODU (Below):	0.0 / 66.0	feet

Correction Factors

Outdoor Unit Capacity:	0.98	0.92
Piping Length:	1.00	1.00
Altitude:	1.00	1.00
Defrosting:	-	0.95

Additional Refrigerant:	2.0	lb
Total Refrigerant Amount:	16.8	lb

Design Temperatures (°F)

Cooling:
Indoor DB 80.0 Humidity 51.8% Indoor WB 67.0
Outdoor DB 96.0

Heating:
Indoor DB 70.0
Outdoor DB 18.0 Humidity 75.0% Outdoor WB 16.5

Startup for leak test steps:

- Triple Evacuation
- Then charge your system based on Vroom output

SINGLE-PHASE VRF
WIRING AND COMMUNICATION

Power Wiring

Power Wiring:

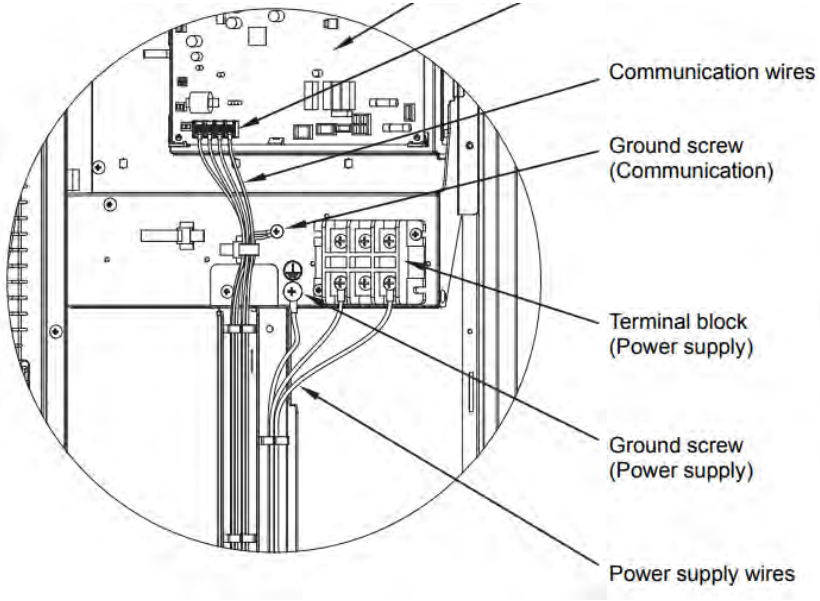
- Outdoor units powered separately
- Indoor units powered separately
- Controller powered from indoor unit
- IDUs generally have a very low amp draw giving you the ability to wire multiple indoors to a single breaker

- **Power supply wiring shall be installed in compliance with NEC and local codes.**

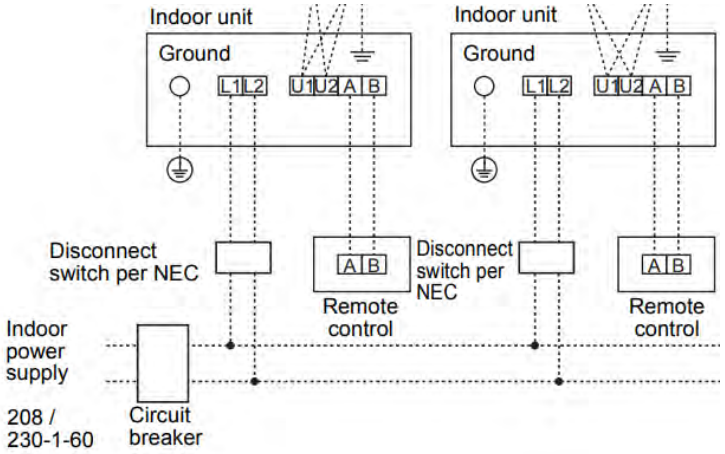
Single-Phase Heat Pump ODUs

Tons	Volts-Ph-Hz	Recommended Fuse Size (A)
3 (MCY-MAP0367HS-UL)	208/230 - 1 - 60	40
4 (MCY-MAP0487HS-UL)	208/230 - 1 - 60	40
5 (MCY-MAP0607HS-UL)	208/230 - 1 - 60	40

Power at outdoor unit

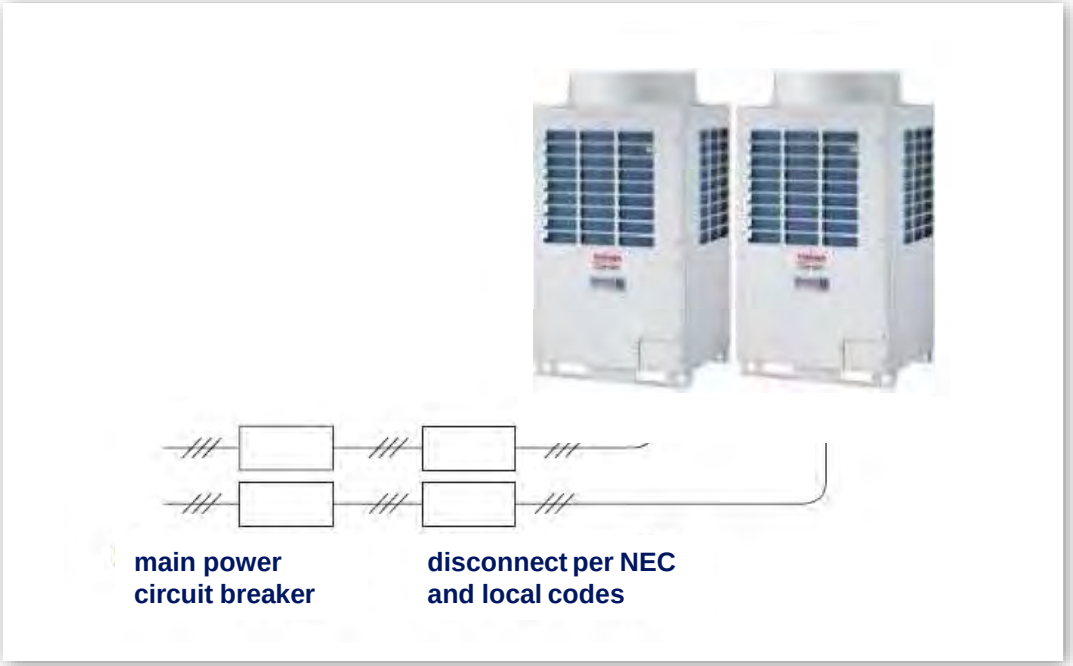


Power at Indoor unit



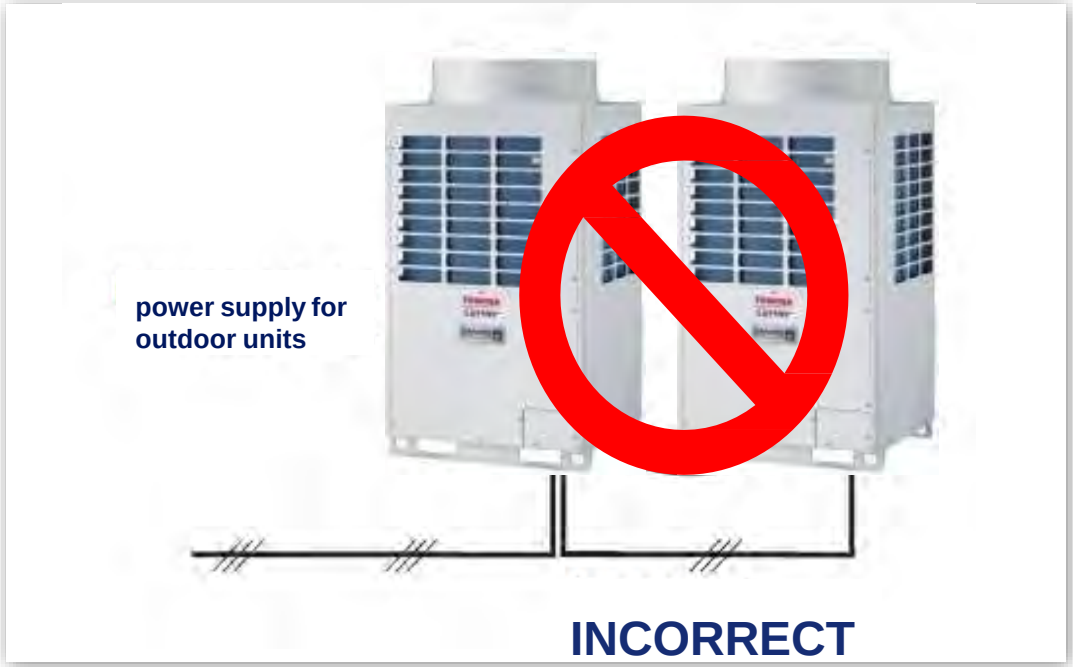
Power Wiring

ALL OUTDOOR UNIT FIELD POWER MUST BE WIRED INDIVIDUALLY



Power Wiring

POWER WIRING FOR OUTDOOR UNIT

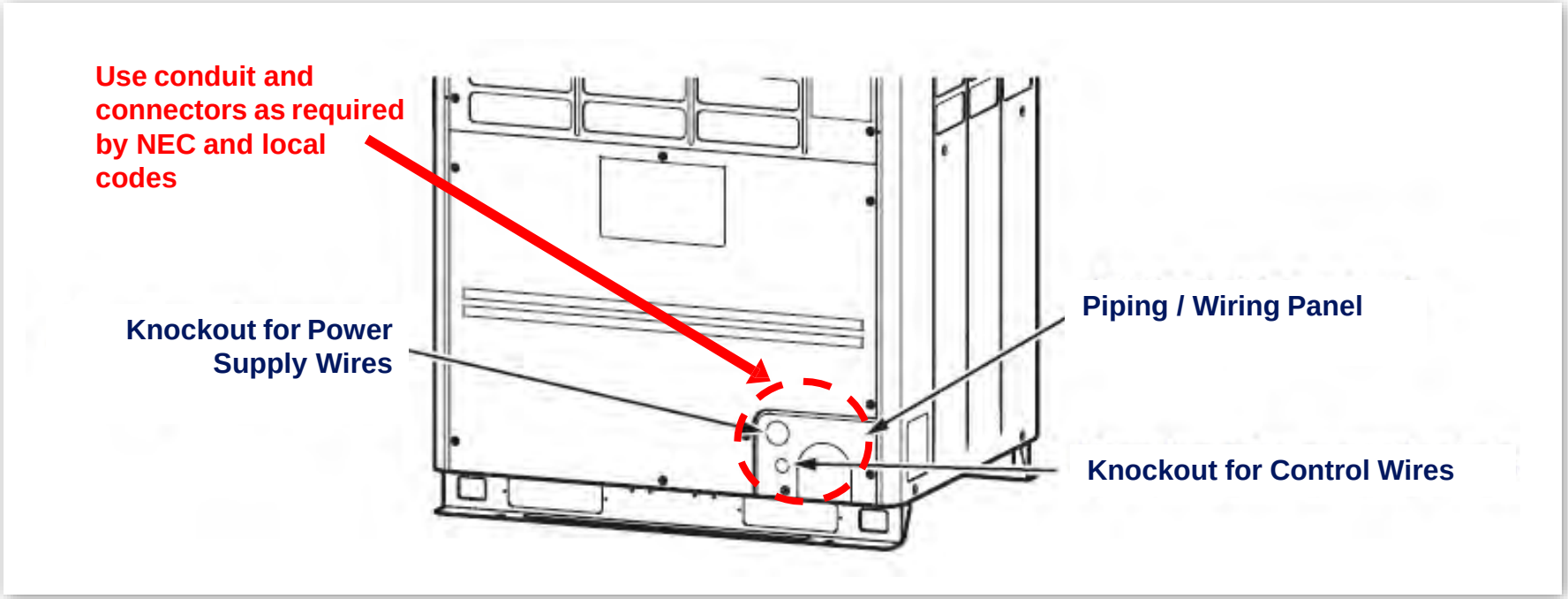


Do not connect field power wiring from unit to unit (No Daisy Chain)

Power Wiring

CONNECTION OF POWER WIRING TO OUTDOOR UNIT

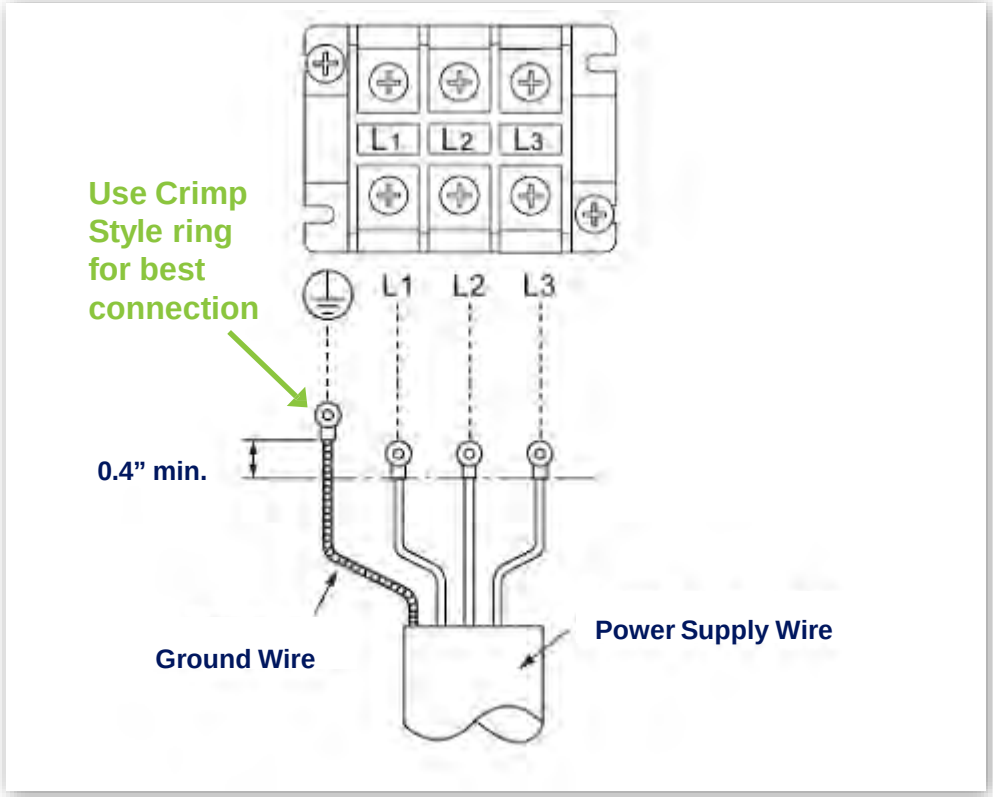
Keep power wires and control wires separate at all times.



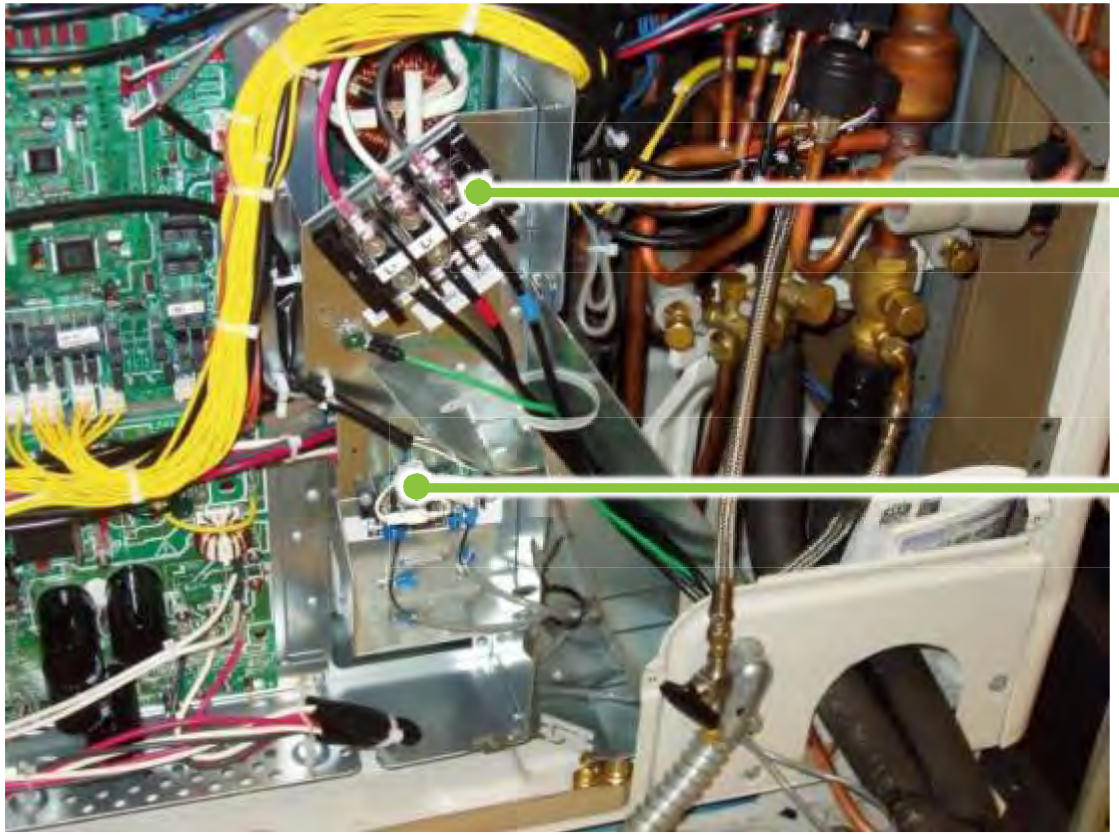
INSTALLATION

Power Wiring For Outdoor Unit

POWER SUPPLY TERMINAL BLOCK



Power Wiring



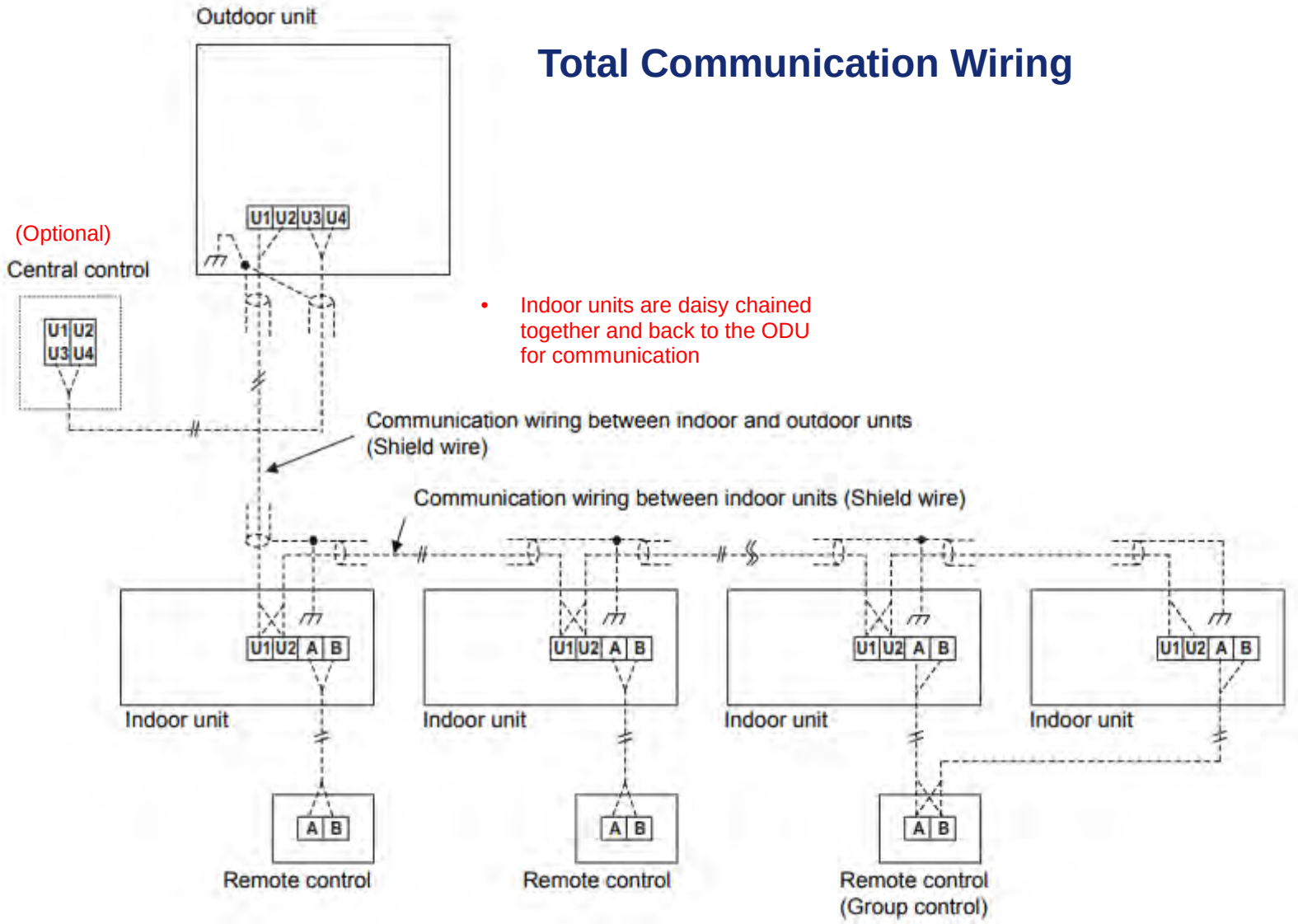
Communication Wiring

Control Wiring:

- ODU to IDU: 2-core, non-polarity shielded wire.
- Total wiring lengths: AWG16 up to 3,280’ and AWG14 up to 6,560’
- IDU to controller: 2-core AWG20 – AWG14
- Total wiring length for controller up to 1,640’

- Ground wire will be run throughout the system as shown as it acts as part of the communication

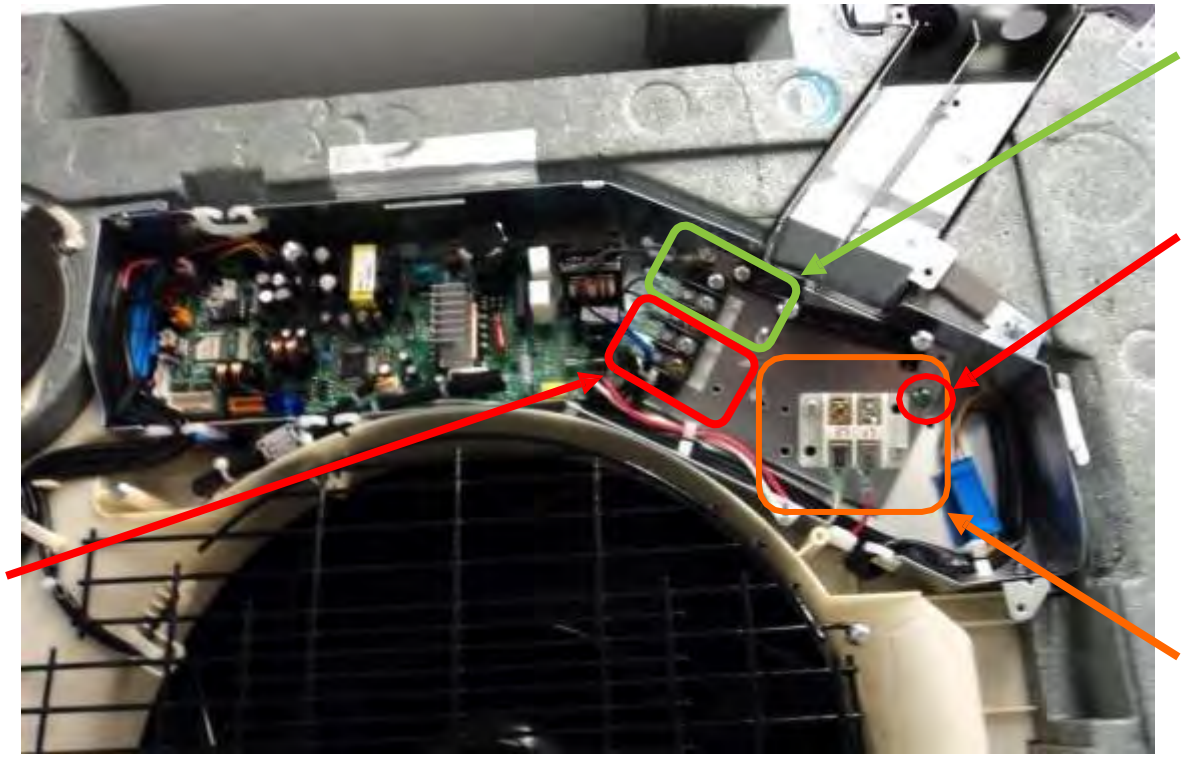
Total Communication Wiring



- Indoor units are daisy chained together and back to the ODU for communication

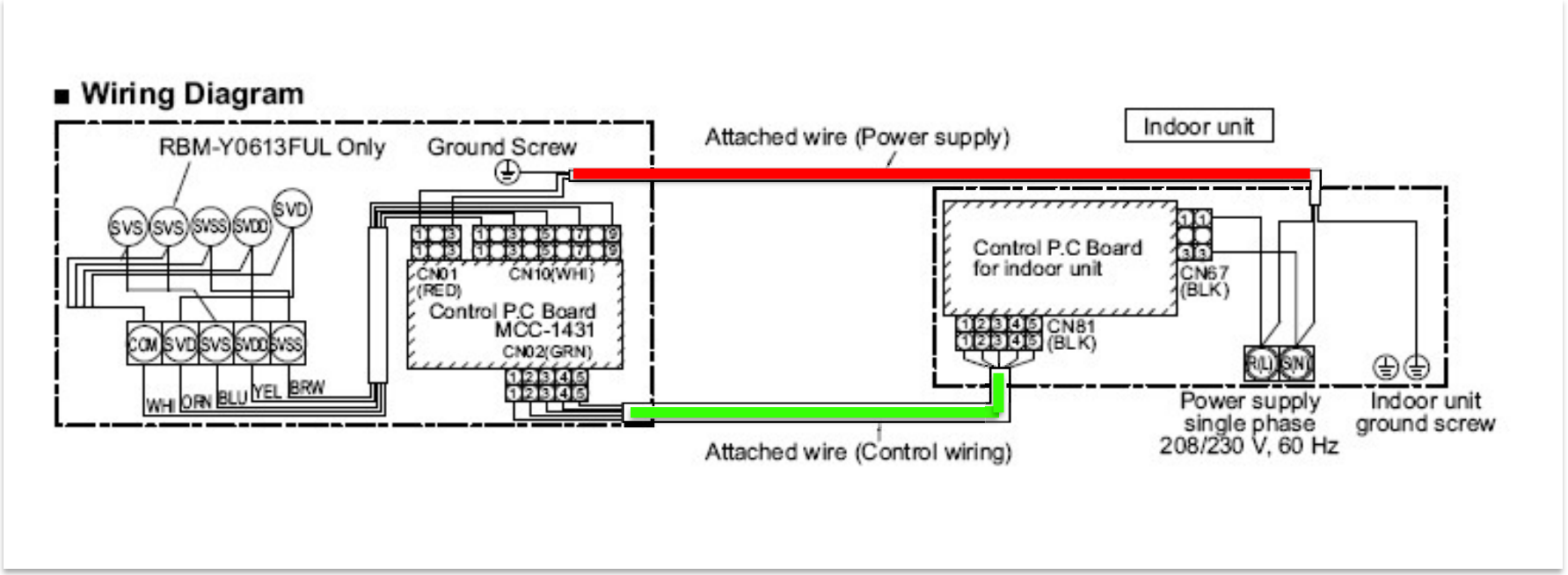
CONNECTION OF INDOOR UNIT TERMINAL

Sample: 4-way Cassette Type



INSTALLATION

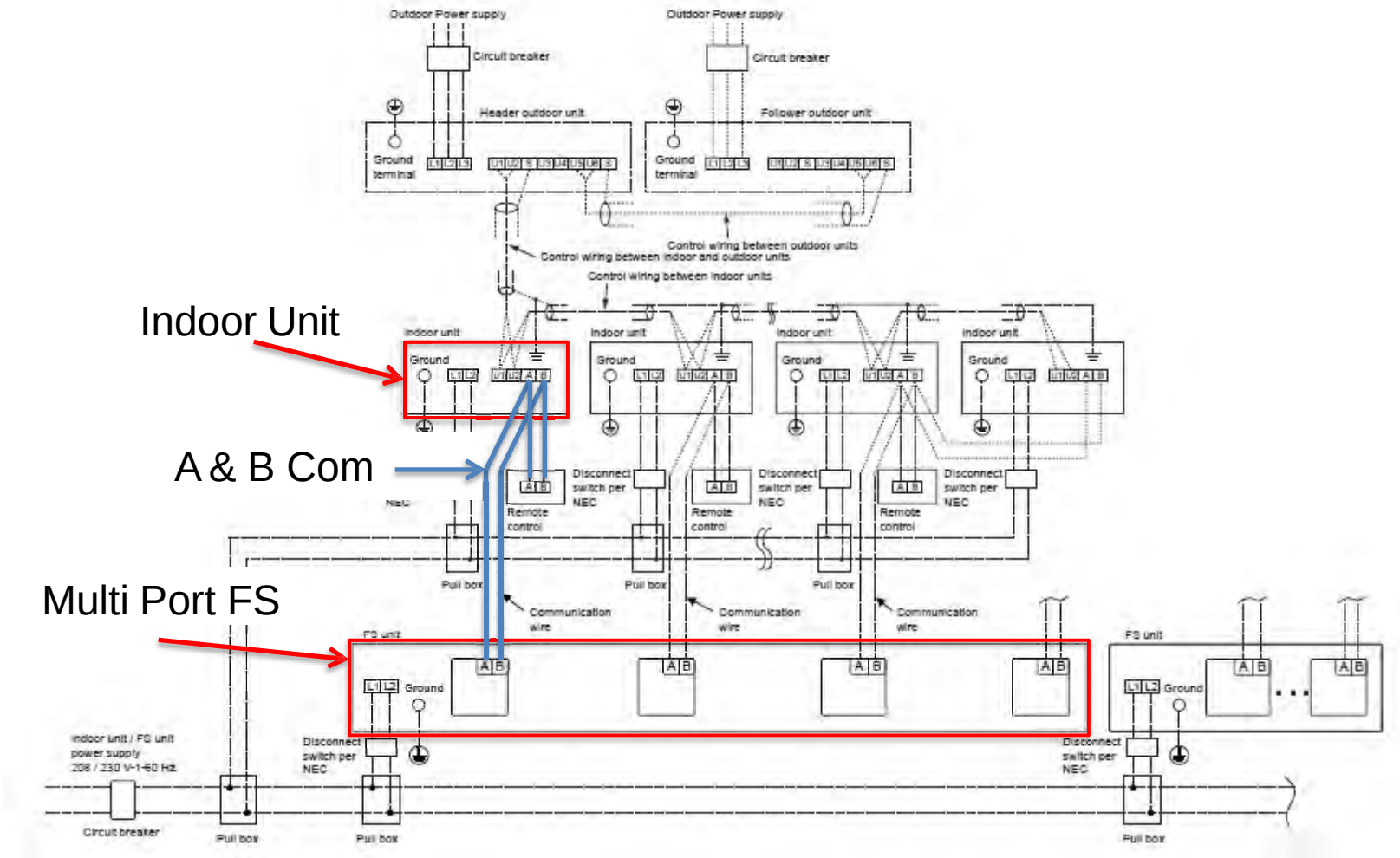
Single Port Flow Selector Wiring



Power wiring must follow NEC and or Local Codes.

INSTALLATION

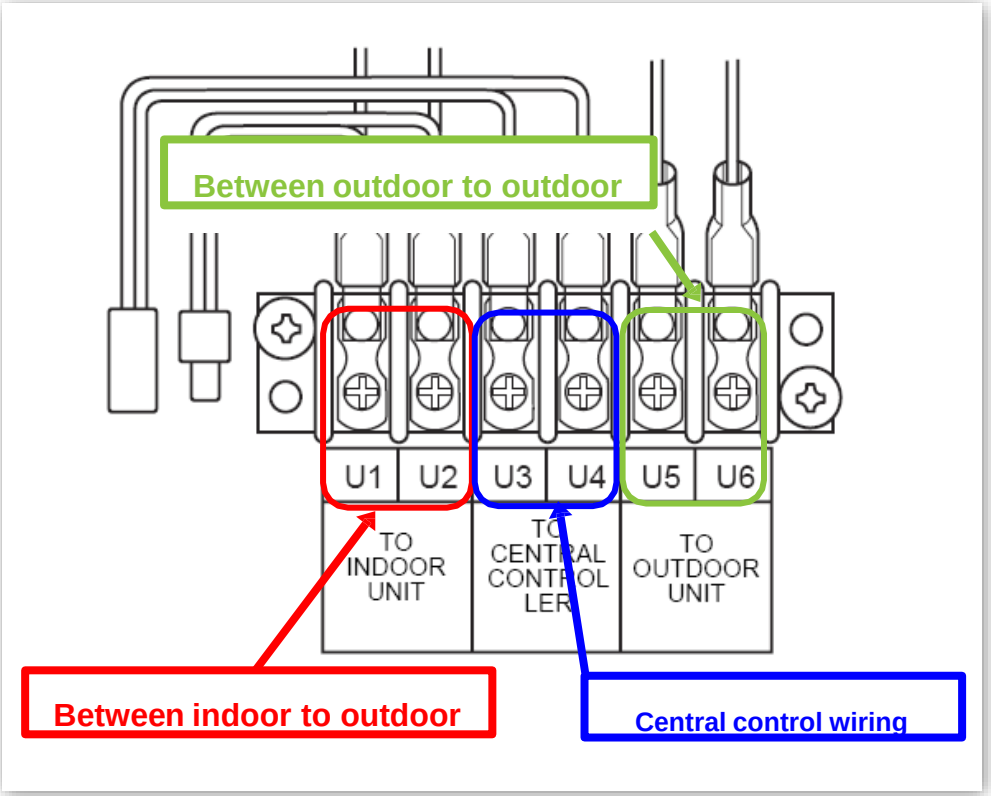
Multi port FS Box Wiring



INSTALLATION

Connection Of Outdoor Unit Terminal

COMMUNICATION TERMINAL BLOCK



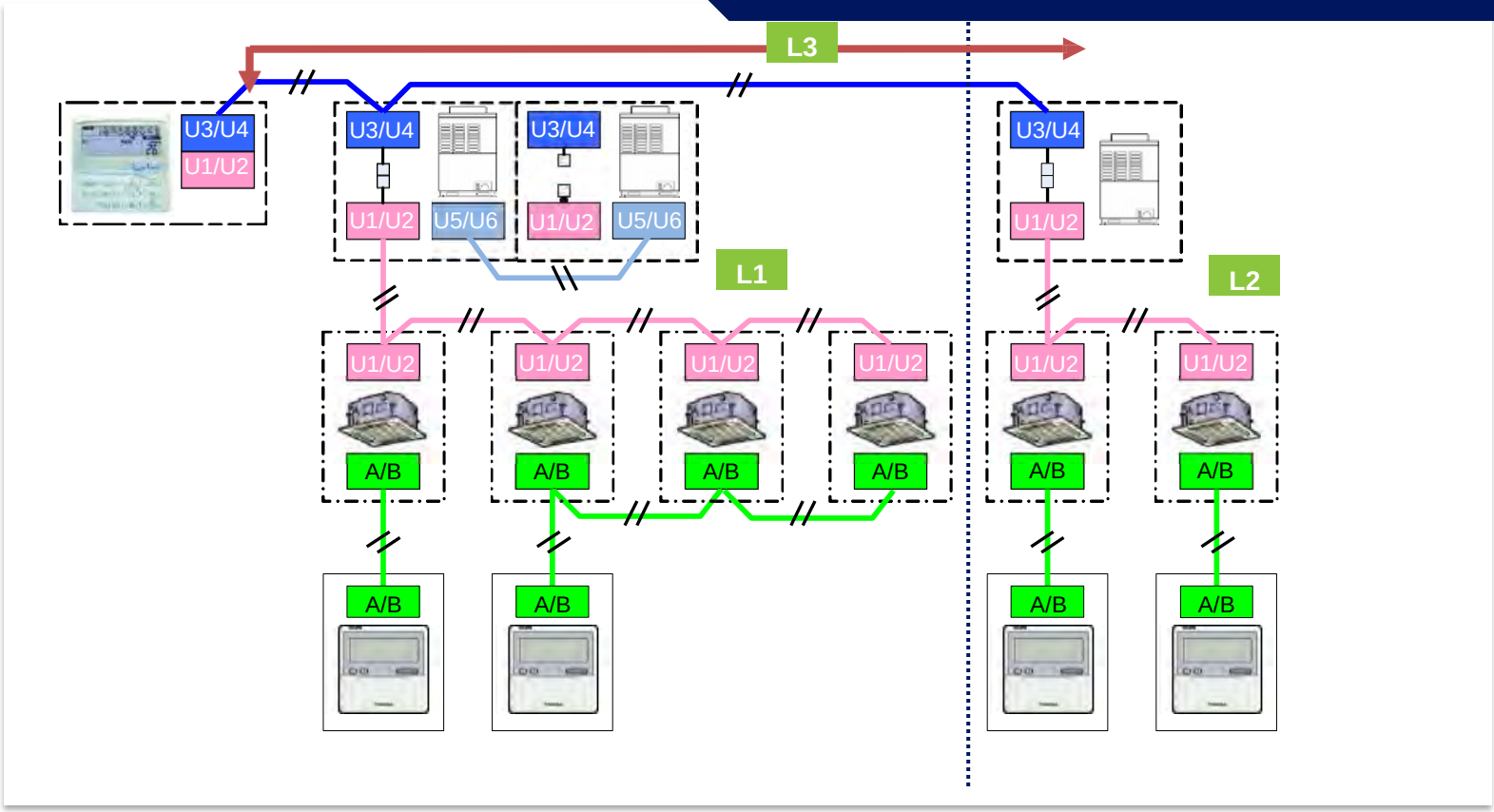
INSTALLATION

Electrical Work

CONTROL WIRING

"Outdoor to Indoor , Indoor to Indoor , Central control"

Type	2-core, Non-Polarity, Stranded Shielded wire
Length	L1 + L2 + L3
Size	16 AWG 3280 ft. max. , 14 AWG 6560 ft. max.



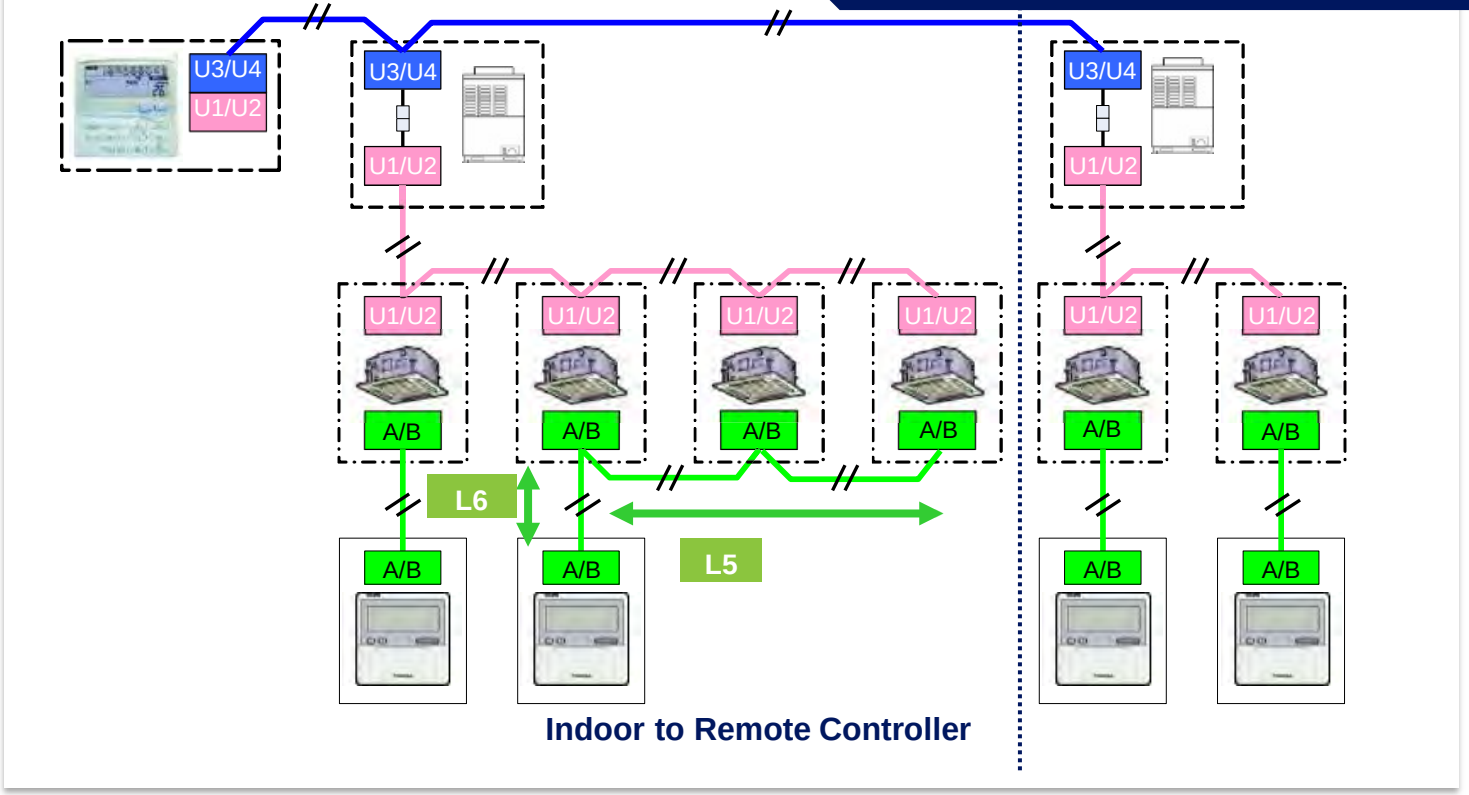
INSTALLATION

Electrical Work

CONTROL WIRING

"Indoor to Remote Controller"

Type	2-core, Non-Polarity, Shielded wire
Length	L5+L6: 1640 ft. max., 1310 ft. when wireless control is used; L5: 660 ft. max.
Size	20 AWG to 14 AWG

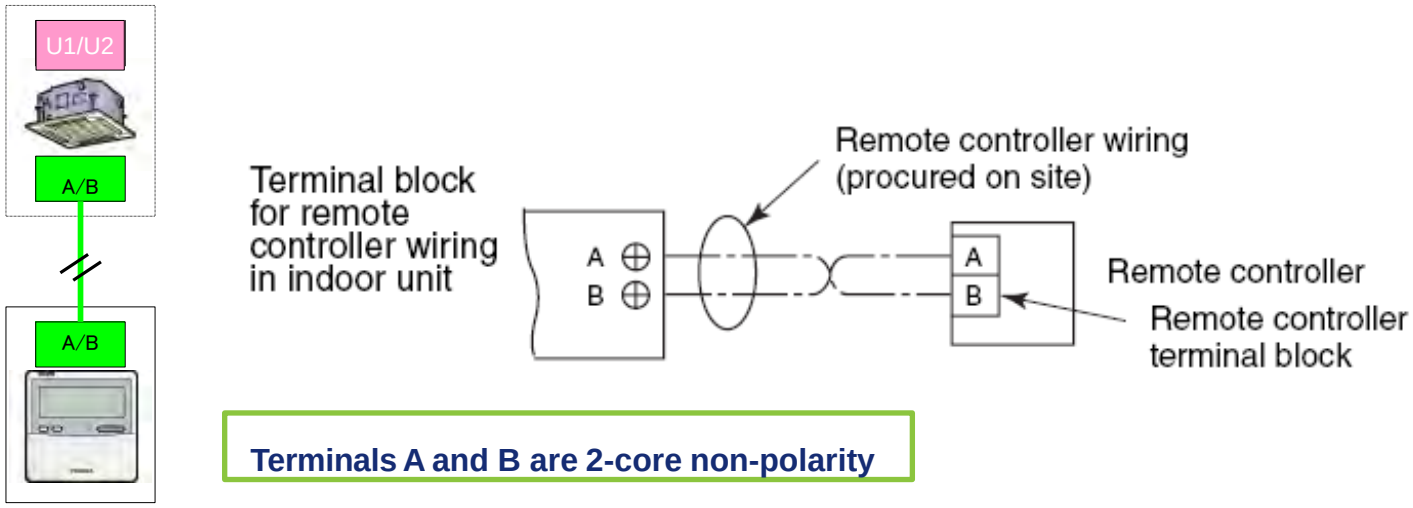


INSTALLATION

Electrical Work

CONNECTION OF REMOTE CONTROL

Individual Control (1:1)



Terminals A and B are 2-core non-polarity

INSTALLATION

Group Control Wiring

Max. 8 indoor units connectable for one group control.

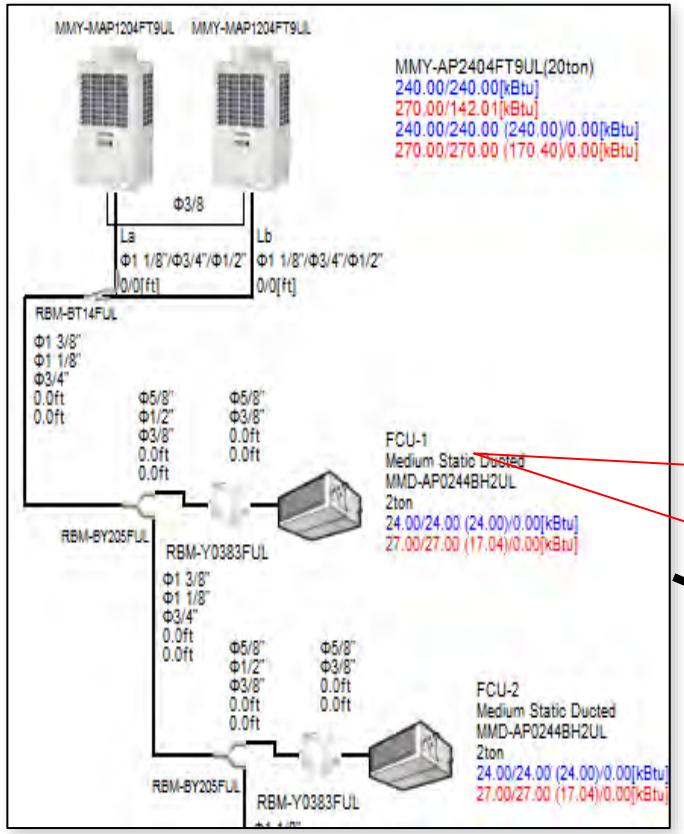
Communication Wiring

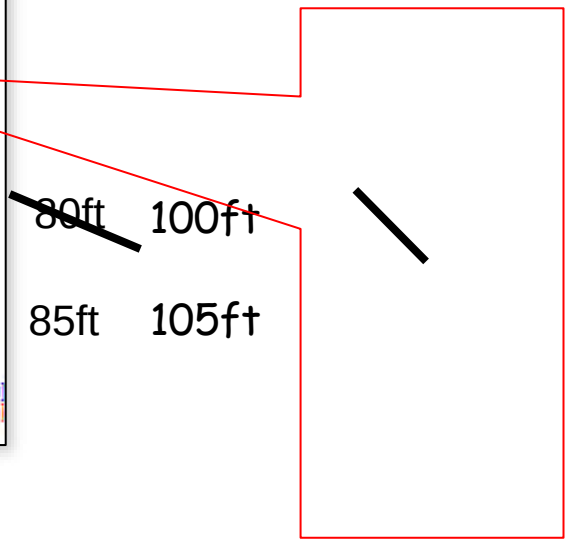
Communication Wiring

INSTALLATION

Pre-Planning

- Walk the job and verify ODU and IDU placement.
- Make any changes in the selection software drawing.
- Deliver updated selection software drawing back to the designer for records.
- This is necessary to verify that piping rules haven't been broken and that actual distances haven't altered the corrected capacity of the equipment.





SINGLE-PHASE VRF
ADDRESSING

START UP

Powering Up The System

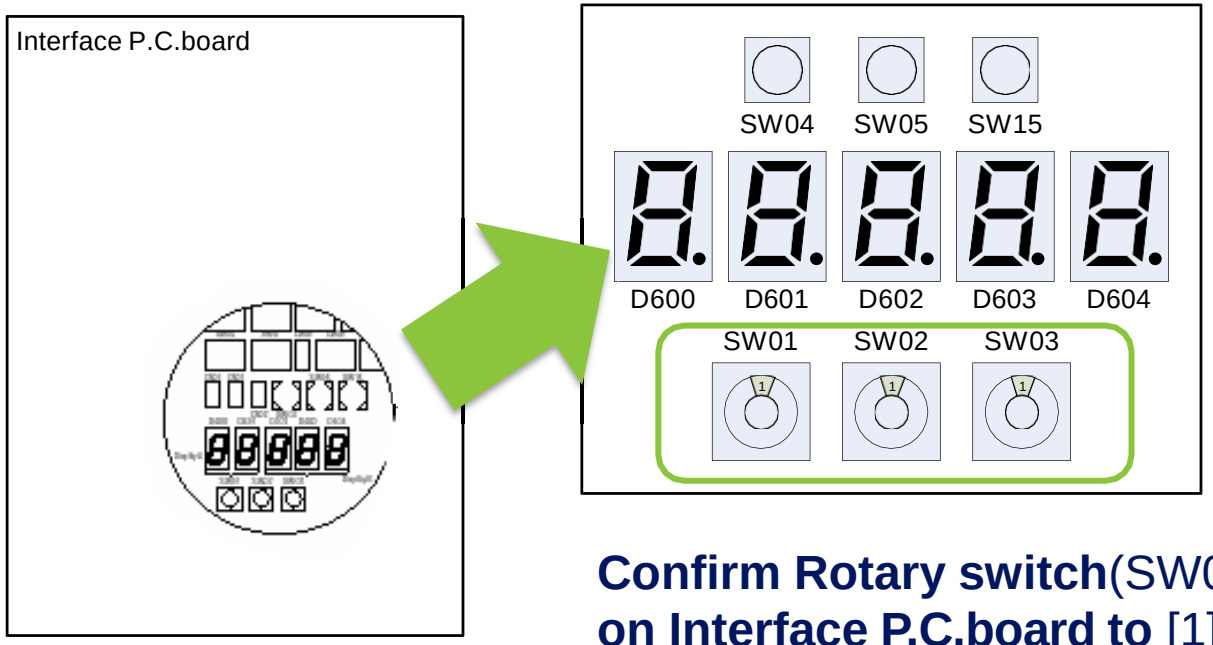
CAUTION

Prior to System Start up ensure that the system has had power energized for at least 24 hours

START UP

Addressing

CAUTION



Confirm Rotary switch(SW01 to 03)
on Interface P.C.board to [1][1][1]

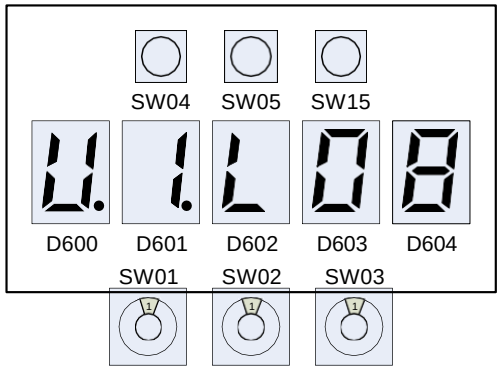
AUTOMATIC ADDRESS SETTING PROCEDURE 1

START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 1

STEP 1 ☑ Turn on the power of indoor units and VERIFY- Then cycle power on outdoor unit



STEP 2 ☑ Check [U.1. L08] is displayed on 7-segment display on interface P.C. board of header unit.

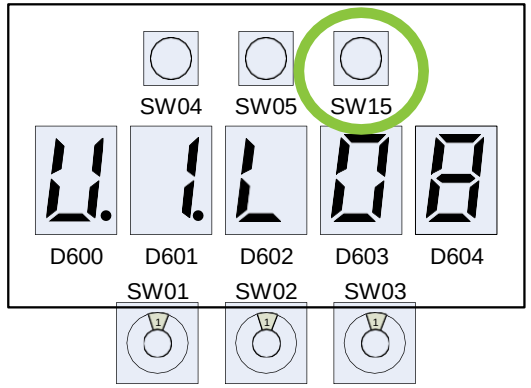
START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 1

STEP 3 ☑ Push SW15! Start automatic address setting.

STEP 4 ☑ Auto 1➔Auto 2➔Auto is displayed on 7-segment display during Automatic setting progress.

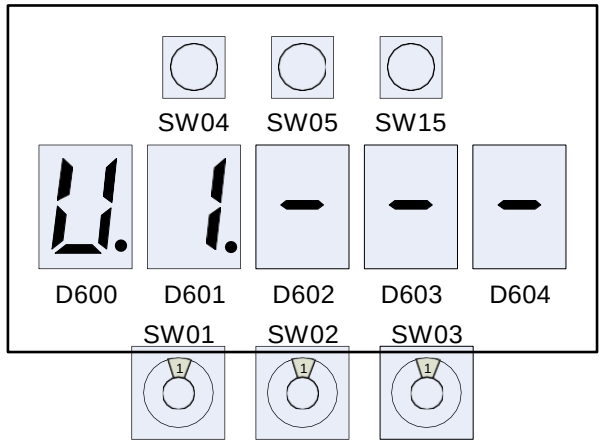


START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 1

STEP 5 ☑ When 7-segment display changes from **[U.1. - - -]** flash to **[U.1. - - -]** steady, Automatic setup finished.

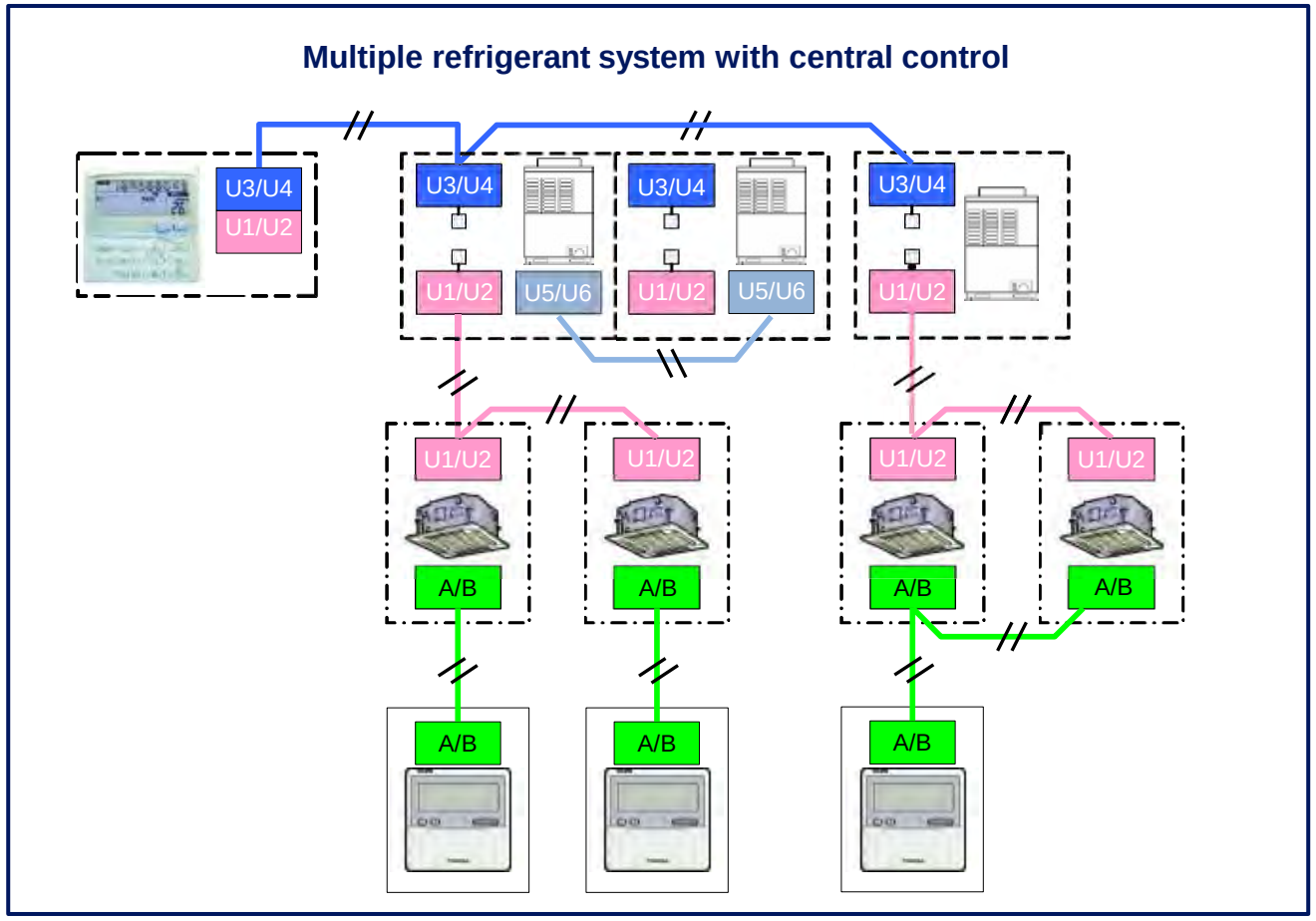


AUTOMATIC ADDRESS SETTING PROCEDURE 2

START UP

Address Setting

AUTOMATIC ADDRESS SETTING – PROCEDURE 2



START UP

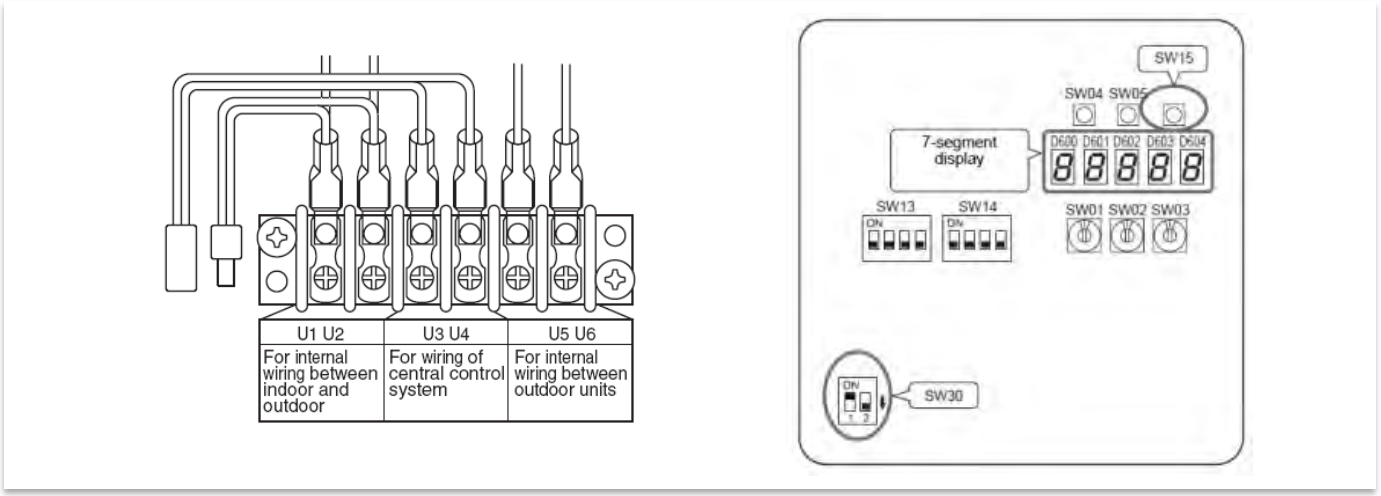
Addressing

RELAY CONNECTOR AND SW30-2

CAUTION

- **Don't** connect relay connector and **Don't** set SW30-2 on P.C. board until address setup completes and Trial operation for all refrigerant system.

Otherwise, address can't be set correctly!



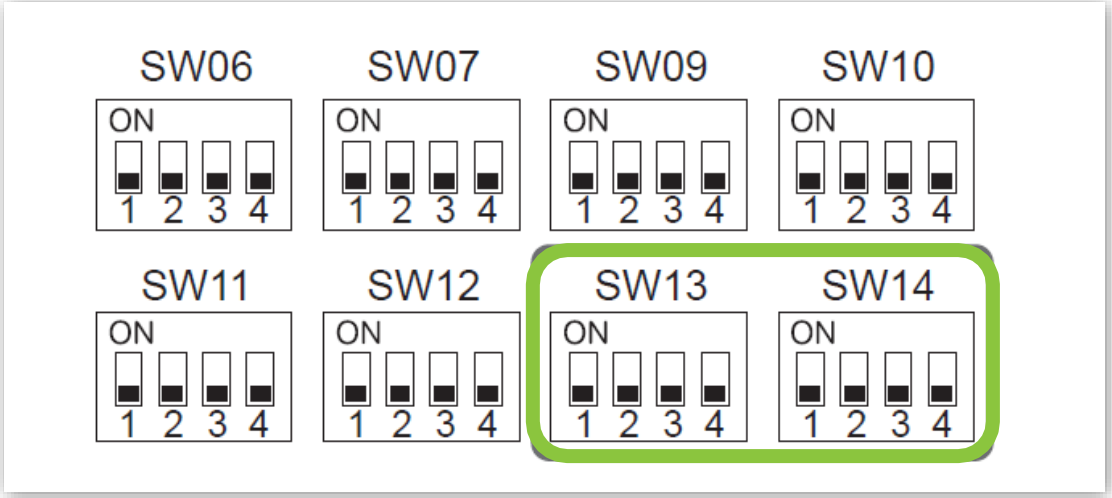
START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

Line Address

STEP 1 ☑ Set up line address by using SW13, SW14 on interface P.C.board



At shipment : Line Address is “1”

START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 1 ☑ Set up line address by using SW13, SW14.

Don't duplicate with other system.
Up to 28 can be selected for "Line Address".

Line address switches on the outdoor interface PC board (O : switch on, × : switch off)

Line address	SW13 1	2	3	4	SW14 1	2	3	4
1				×	×	×	×	×
2				×	O	×	×	×
3				×	×	O	×	×
4				×	O	O	×	×
5				×	×	×	O	×
6				×	O	×	O	×
7				×	×	O	O	×
8				×	O	O	O	×
9				×	×	×	×	O
10				×	O	×	×	O
11				×	×	O	×	O
12				×	O	O	×	O
13				×	×	×	O	O
14				×	O	×	O	O

Line address	SW13 1	2	3	4	SW14 1	2	3	4
15				×	×	O	O	O
16				×	O	O	O	O
17				O	×	×	×	×
18				O	O	×	×	×
19				O	×	O	×	×
20				O	O	O	×	×
21				O	×	×	O	×
22				O	O	×	O	×
23				O	×	O	O	×
24				O	O	O	O	×
25				O	×	×	×	O
26				O	O	×	×	O
27				O	×	O	×	O
28				O	O	O	×	O

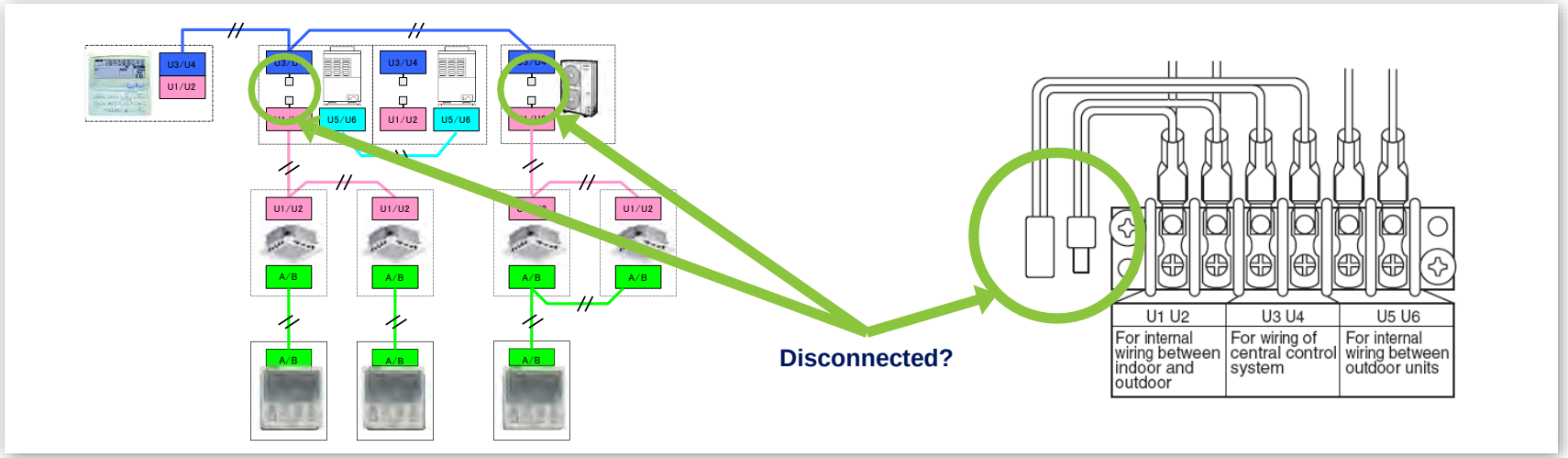
Not used for setup of line address (do not change setup.)

START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 2 ☑ Check that relay connectors are disconnected in all outdoor units.



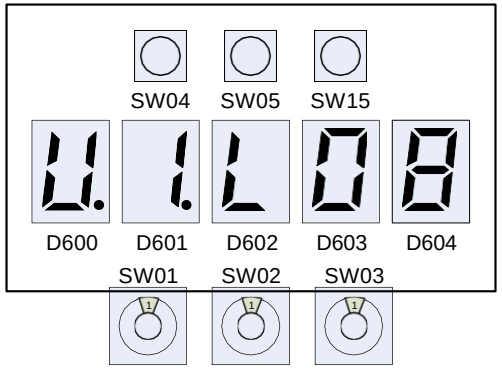
At shipment: Disconnected

START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 3 ☑ Turn on the power of indoor units and VERIFY- then cycle power on outdoor unit.



STEP 4 ☑ Check **[U.1. L08]** is displayed on 7-segment display on interface P.C. board of header unit.

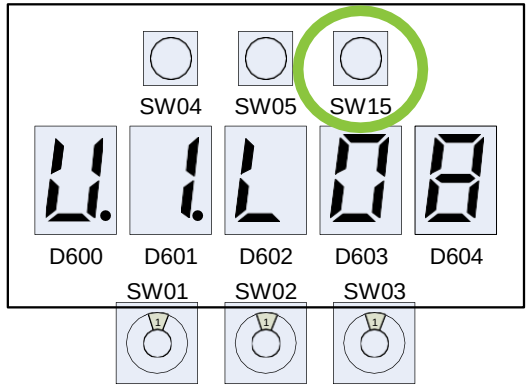
START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 5 ☑ Push SW15! Start automatic address setting.

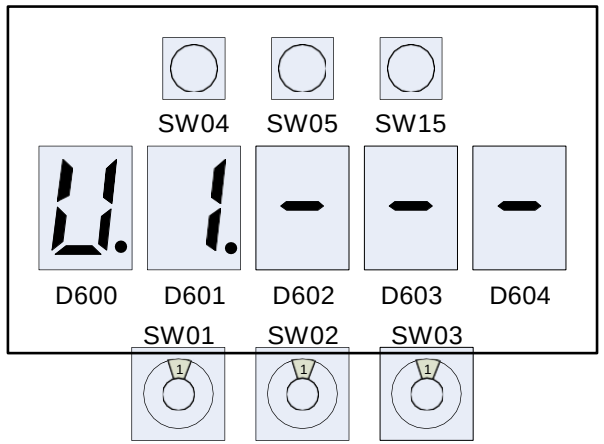
STEP 6 ☑ Auto 1 ➡ Auto 2 ➡ Auto 3 is displayed on 7-segment display during Automatic setting progress.



AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 7 ☑

When 7-segment display changes from **[U.1. - - -]** flash to **[U.1. - - -]** steady Automatic setup finished.



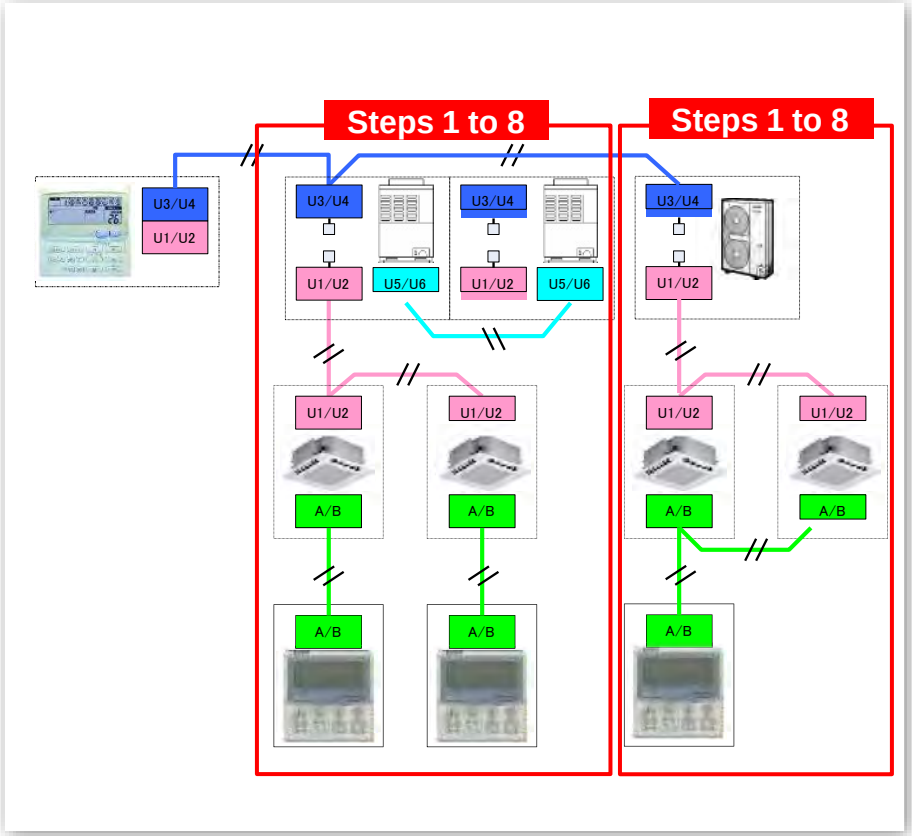
START UP

Addressing

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

STEP 8 ☑

Step 1 to 8 are repeated for other refrigerant system.

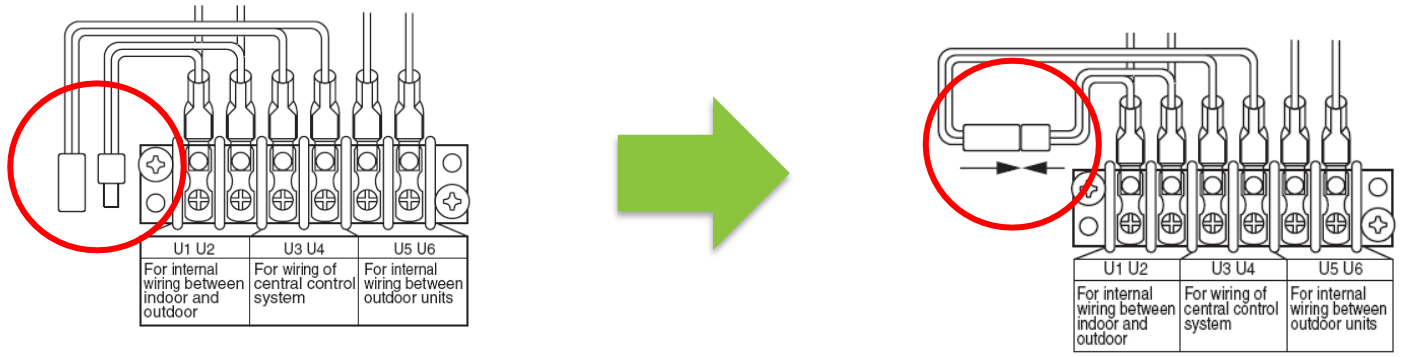


START UP

Address Setting

AUTOMATIC ADDRESS SETTING – PROCEDURE 2

Connect control jumper between U1/U2 and U3/U4 terminal for all outdoor units.



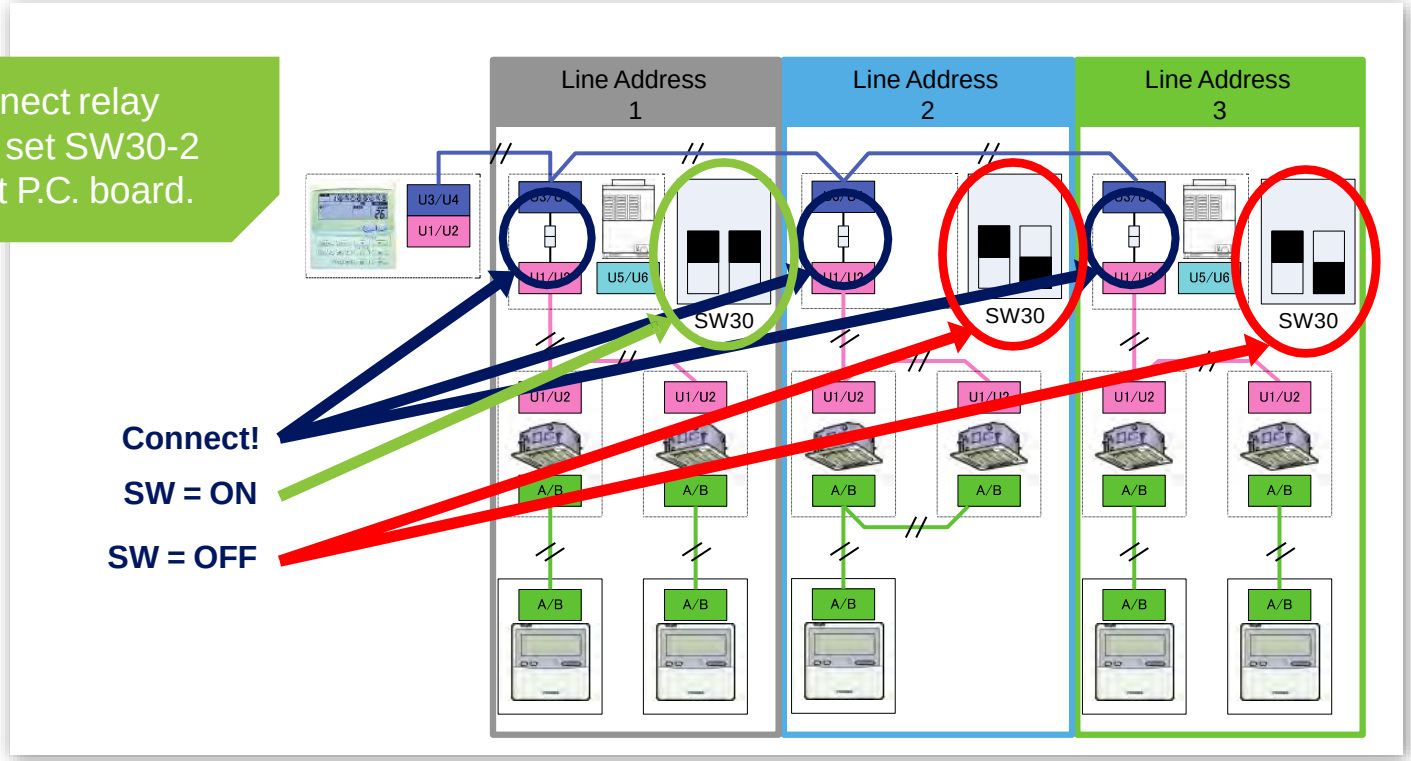
Connect Control Jumper and set SW30-2 for all other refrigerant systems.

START UP

Control Wire/Addressing (Group Address)

CENTRAL CONTROL ADDRESS SETTING CAUTION

Be sure to connect relay connector and set SW30-2 on outdoor unit P.C. board.



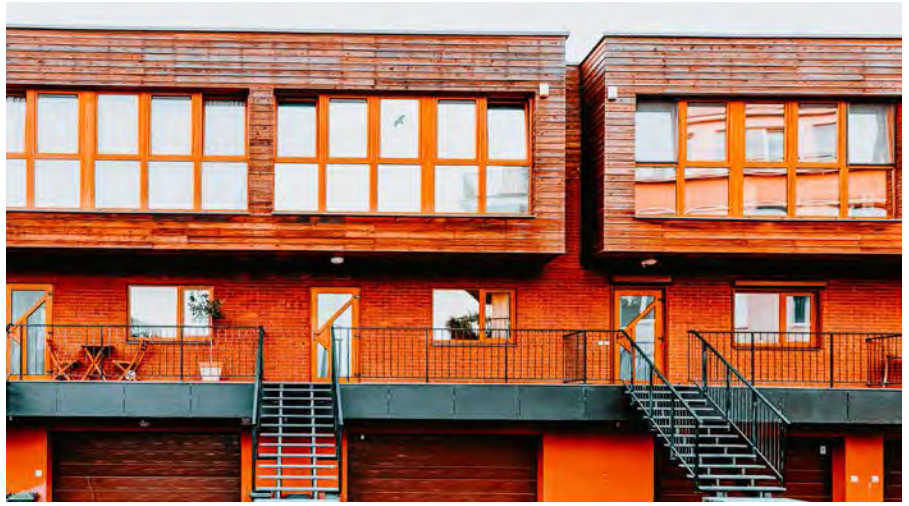
SINGLE-PHASE VRF
APPLICATION AND DESIGN

Single-Phase VRF Applications

Excellent solution for residential applications

Townhome

Single-Family



Multifamily

Single-Phase Applications

Ideal for many Light Commercial Applications

Bank

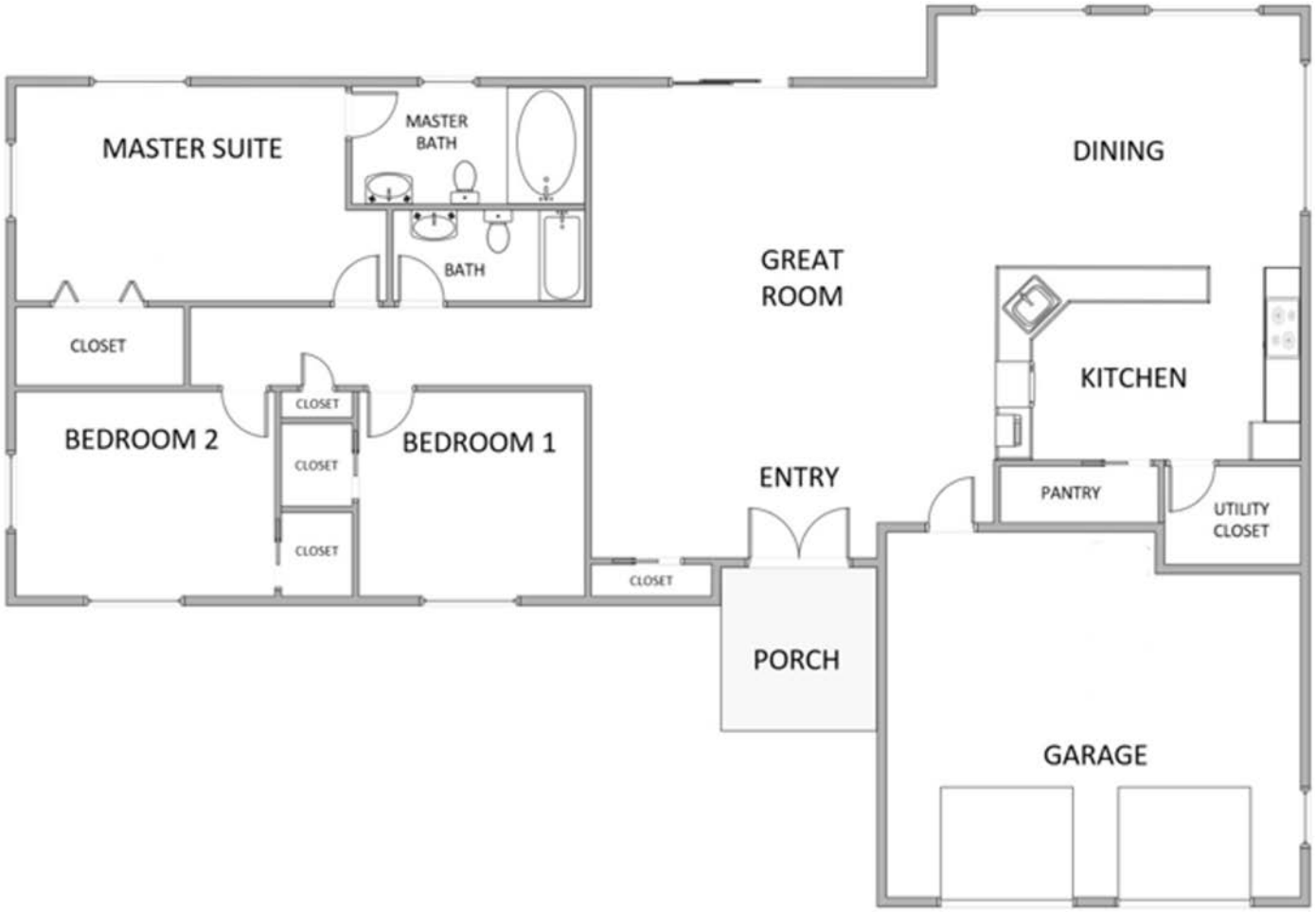
Small Office

Municipality

Application – Residential Home

Change Out Call

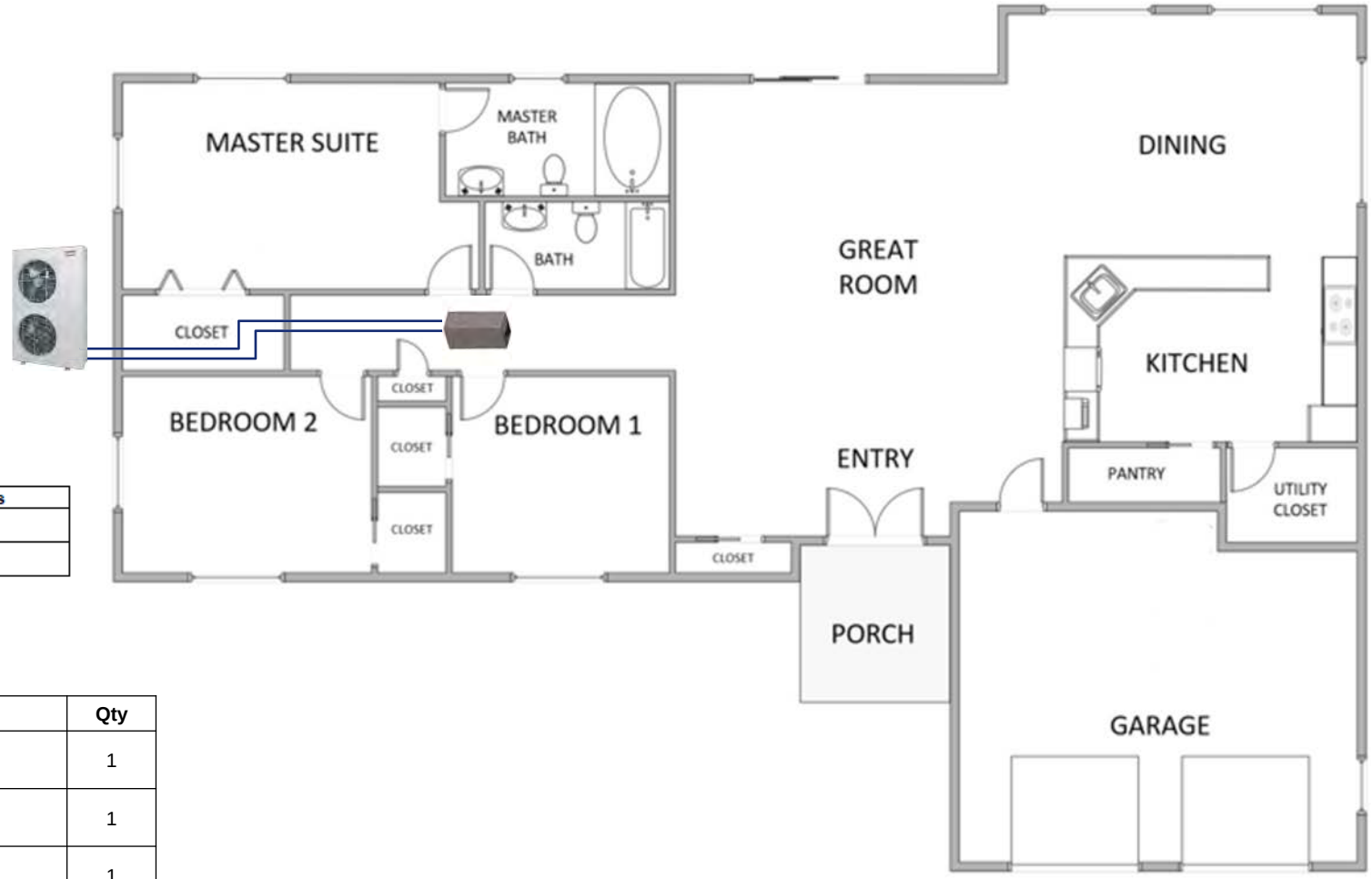
- Home owner is looking to replace their current 4 ton horizontal unit in their 2,300 square foot home.
- They want to replace the unit because of age, noise, and functionality. They also want to find a higher efficiency system.
- The home owner is also interested in an Wi-Fi thermostat.



Application – Residential Home

Change Out Call

- **Solution:** Toshiba Carrier 4-ton ODU connected to a 4-ton AHU and a 24V interface for connecting to a third party thermostat.
- AHU is multi-positional making a unit replacement in the attic easily connectable to existing duct.
- Full inverter control to replace the fixed speed equipment. Energy savings.



Refrigerant Piping Summary

Pipe Size (inch)	Total Length (feet)	Number of Bends
5/8	32	0
3/8	32	0

Additional Refrigerant: 1.5 lb
Total Refrigerant Amount: 16.3 lb

Type	Description	Model	Qty
Outdoor Units	1-Phase Heat Pump Series Outdoor Unit	MCY-MAP0487HS-UL	1
Indoor Units	Vertical Fan Coil Type Indoor Unit	MMD-AP0480VHG2UL	1
Controls	24V Thermostat Interface	TCB-IFTH1GUL	1

Application – Residential Home (2)

Replacement and addition:

- Homeowner would like to replace an older Carrier system in their space. They have 2,600 square feet of conditioned space in the home.
- The current air handling unit they have is a 4 ton but they still deal with hot spots in bedrooms (2) and (3).

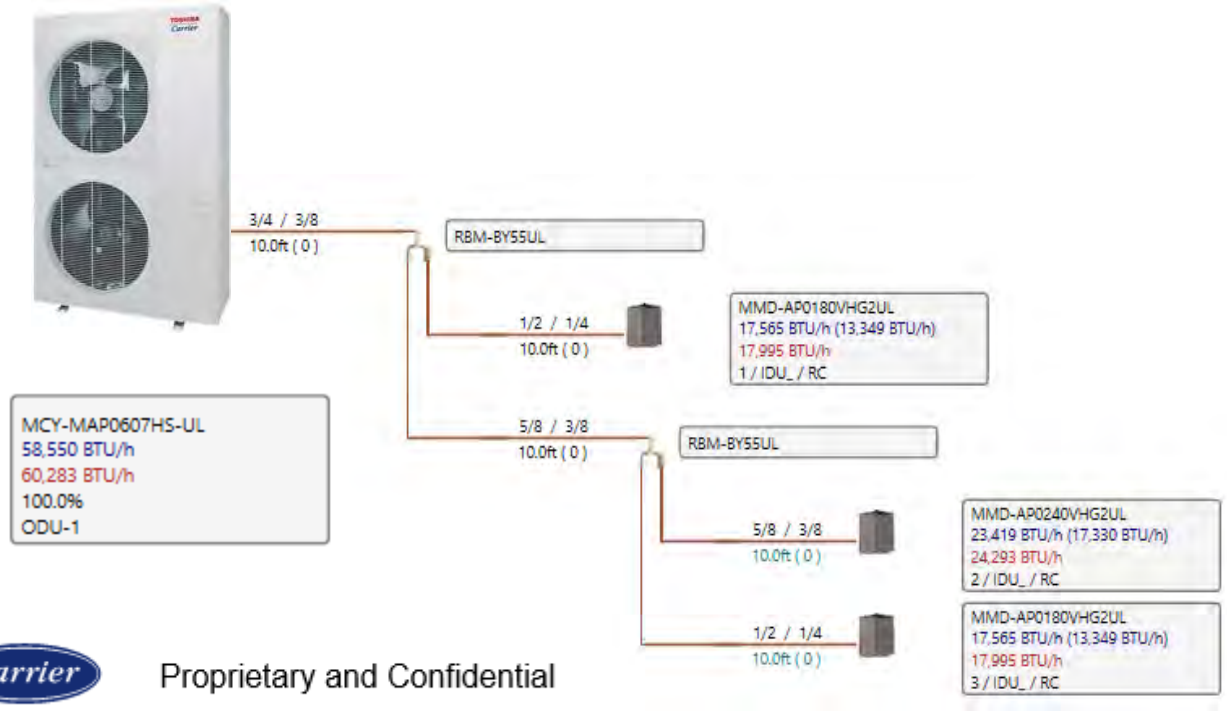
Questions to ask:

- Has a load calculation been done?
- Do they have existing ductwork?
- Do they want to close in the rear porch?
- Are they finishing a bonus room above the garage?
- What are the controls options they would like?
- Serviceability consideration and filter boxes?
- Is heat recovery an option?

Application – Residential Home (2)

Solution: Replaced the existing horizontal air handler with a (3) separate horizontal air handlers for better zoning. While still only using a single condensing unit.

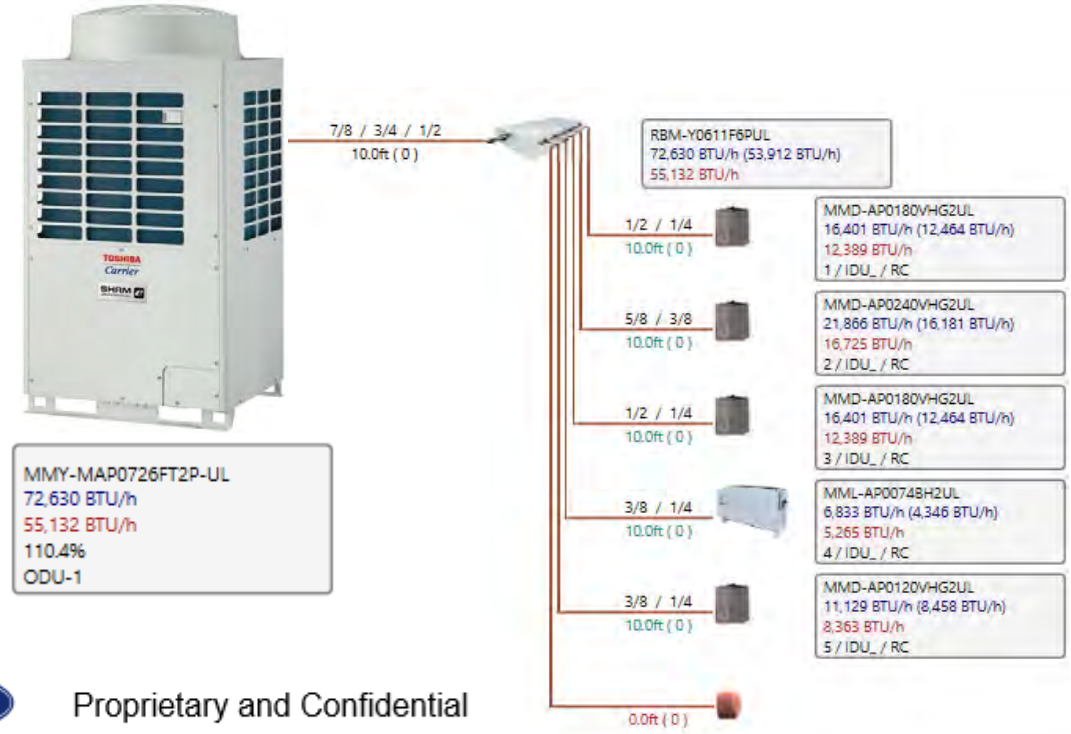
- Separating the west wing bedrooms, main living space and master suite all on their own thermostat.
- Included Equipment: (1) 2-ton and (2) 1.5 ton multi-positional air handling units with standard controllers. ODU is a 5-ton unit and we are connecting using y-joints.



Application – Residential Home (2)

Additional Solutions:

- Closing in the rear porch and finishing a bonus room above the garage.
- This will give the home owner roughly 500 square feet of conditioned space.
- Indoor unit selection and placement will make piping the heat recovery unit simple and serviceability easy.



Application – Townhomes

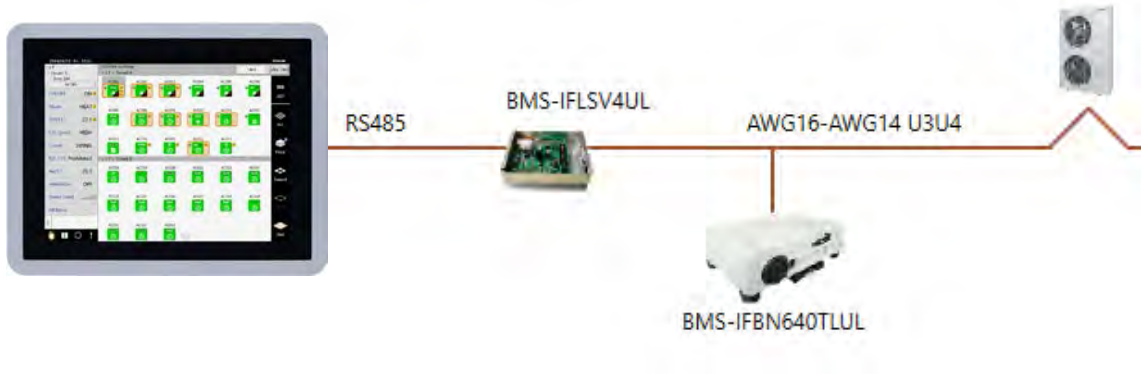
New Construction:

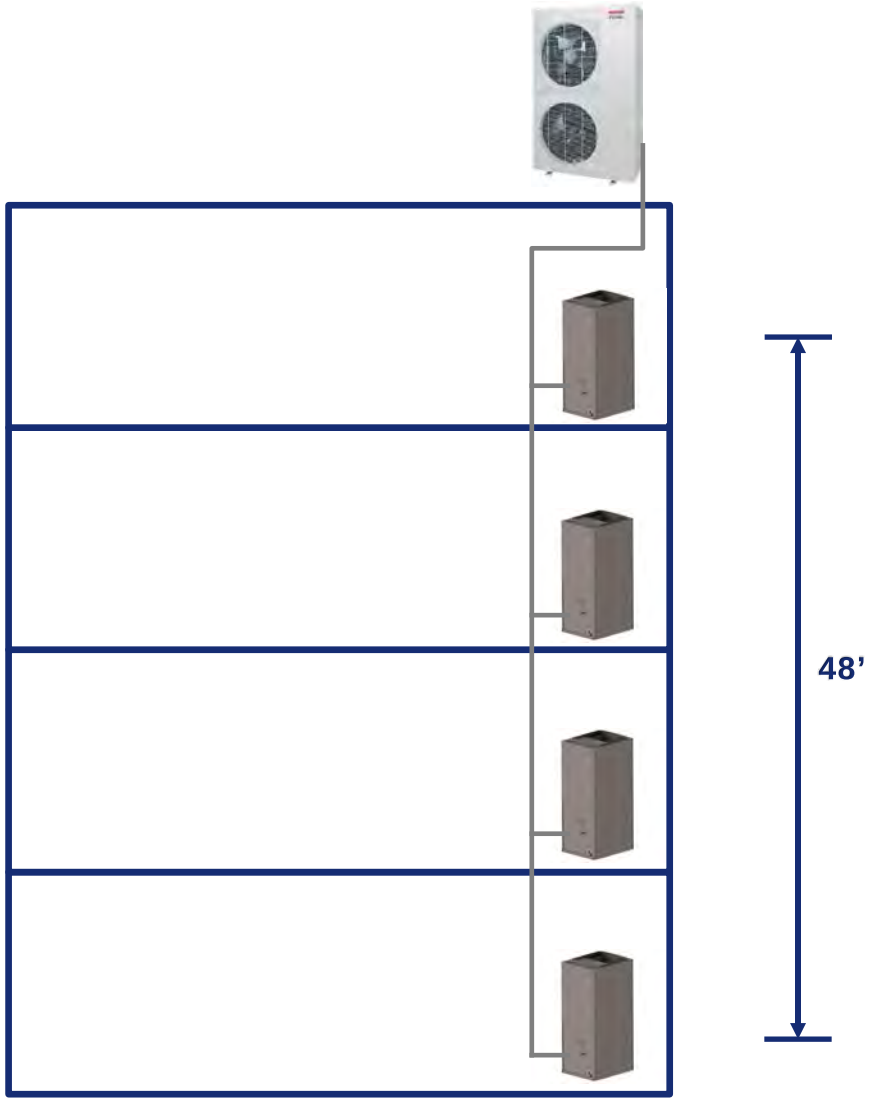
- Four-story townhomes are newly under construction in the area.
- The customer has asked for zoning on each floor (1.5 ton demand each floor).
- Home automation request from owner.
- HOA has a strict rule on equipment efficiency and condensing unit count.

Application – Townhomes

Solution:

- Total of 6-tons of capacity needed for peak loads and bock load is 5-tons. Always need a load calculation.
- Need to include the BACnet interface for home automation requirement.
- Central controller option as an add on for high end customer.
- Ability to use a single condensing unit.
- Vertical separation for the indoor units exceeded 40 feet.





Application – Residential Home (3)

- **Example:** Large 6,200 square foot home being built in a vacation area (specifically for this example a ski area). The home has very large glass windows for the mountain view causing a solar load increase during the day.
- Owners will be renting the space through a rental agency and want to keep the power bill low. They will want to remotely login to see what the system is doing once guest leave.
- The load in the space will require around (12) tons of capacity and we only have single phase power.
- The first solution was a single phase VRF heat pump with (3) ODUs and serving (5) indoor units or (2) 5-ton conventional units.
- Problems: The large windows cause heat spikes even on colder days creating demand for cooling.

Application – Residential Home (3)

Solution: HEAT RECOVERY SINGLE PHASE!

- Up to 12 tons of capacity for a single system.
- Ability to simultaneously heat and cool up to 25 zones (Limit this to be more cost competitive)
- More indoor unit selections to meet the architectural design and limited duct space for floor to ceiling windows.
- Total of (4) compressors for this system giving the ability for backup capability. Compressors are also varied in 0.1 hz for total comfort and efficiency.
- Better heating capacity
- Central controller allows for remote login.
- Total control for the home owner.

Type	Description	Model	Qty
Outdoor Units	1-Phase Heat Recovery Series Outdoor Unit	MMY-MAP0726FT2P-UL	2
FSUnits	4 Port FS Unit	RBM-Y0611F4PUL	3
Connection Kit	Outdoor Heat Recovery Connection	RBM-BT14FUL	1
Indoor Units	Vertical Fan Coil Type Indoor Unit	MMD-AP0240VHG2UL	3
	Compact 4-Way Cassette Type Indoor Unit	MMU-AP0071MH2UL	8
	High Wall Type Indoor Unit	MMK-AP0123H2UL	1
Branch Units	Y-Joint	RBM-BY205FUL	1
	Y-Joint	RBM-BY105FUL	1
Controls	Touch Screen Controller	BMS-CT5120UL	1
	Programmable Wired Controller	RBC-AMS54E-UL	12
	TCS-NET	BMS-IFLSV4UL	1
	Grille	RBC-UM11PG(W)-UL	8

Application – Doctors Office – Heat Recovery

Conversion Project:

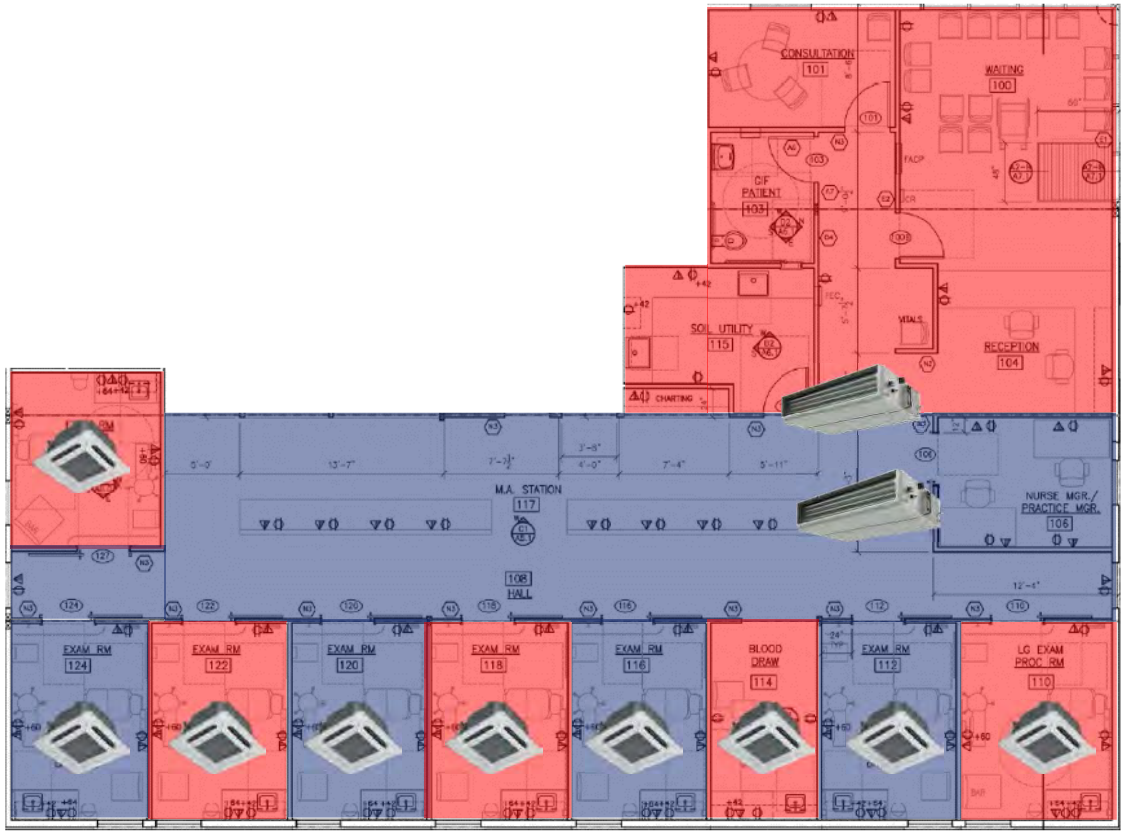
- We have an old residential home being remodeled into a doctors office in a rural area with only single phase power available but the owner is wanting complete zone control for occupant comfort.
- We have eight exam rooms, one blood draw rooms, waiting room, reception, break room, and bathrooms.
- Each exam room and doctors office will have its own zone and the rest of the rooms will be served by two ducted units.
- We have a request for (11) different zones for this application. The owner is wanting the ability to heat or cool these rooms based on occupant demand.

Application – Doctors Office – Heat Recovery

Conversion Project:

- Full simultaneous heating and cooling operation
- Single system up to 12-tons with 11 zones!

Type	Description	Model	Qty
Outdoor Units	1-Phase Heat Recovery Series Outdoor Unit	MMY-MAP0726FT2P-UL	2
FSUnits	4 Port FS Unit	RBM-Y0611F4PUL	1
	6 Port FS Unit	RBM-Y0611F6PUL	1
	1 Port FS Unit	RBM-Y0383FUL	1
Connection Kit	Outdoor Heat Recovery Connection	RBM-BT14FUL	1
Indoor Units	Compact 4-Way Cassette Type Indoor Unit	MMU-AP0071MH2UL	9
	Medium Static Pressure Duct Type Indoor Unit	MMD-AP0364BH2UL-1	2
Branch Units	Y-Joint	RBM-BY205FUL	1
	Y-Joint	RBM-BY105FUL	1
Controls	Programmable Wired Controller	RBC-AMS54E-UL	11
IU Accessories	Grille	RBC-UM11PG(W)-UL	9



Questions?

Questions or clarifications:

- ODU selection or information?
- Indoor unit selection?
- Piping?
- Power and communication?
- Applying this equipment?

Break Time.

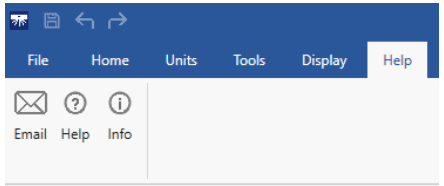
- Next section will be reviewing Vroom software. If you have not downloaded the software before class please begin that process.
- This training will not be recorded and is an in class training section.

VROOM

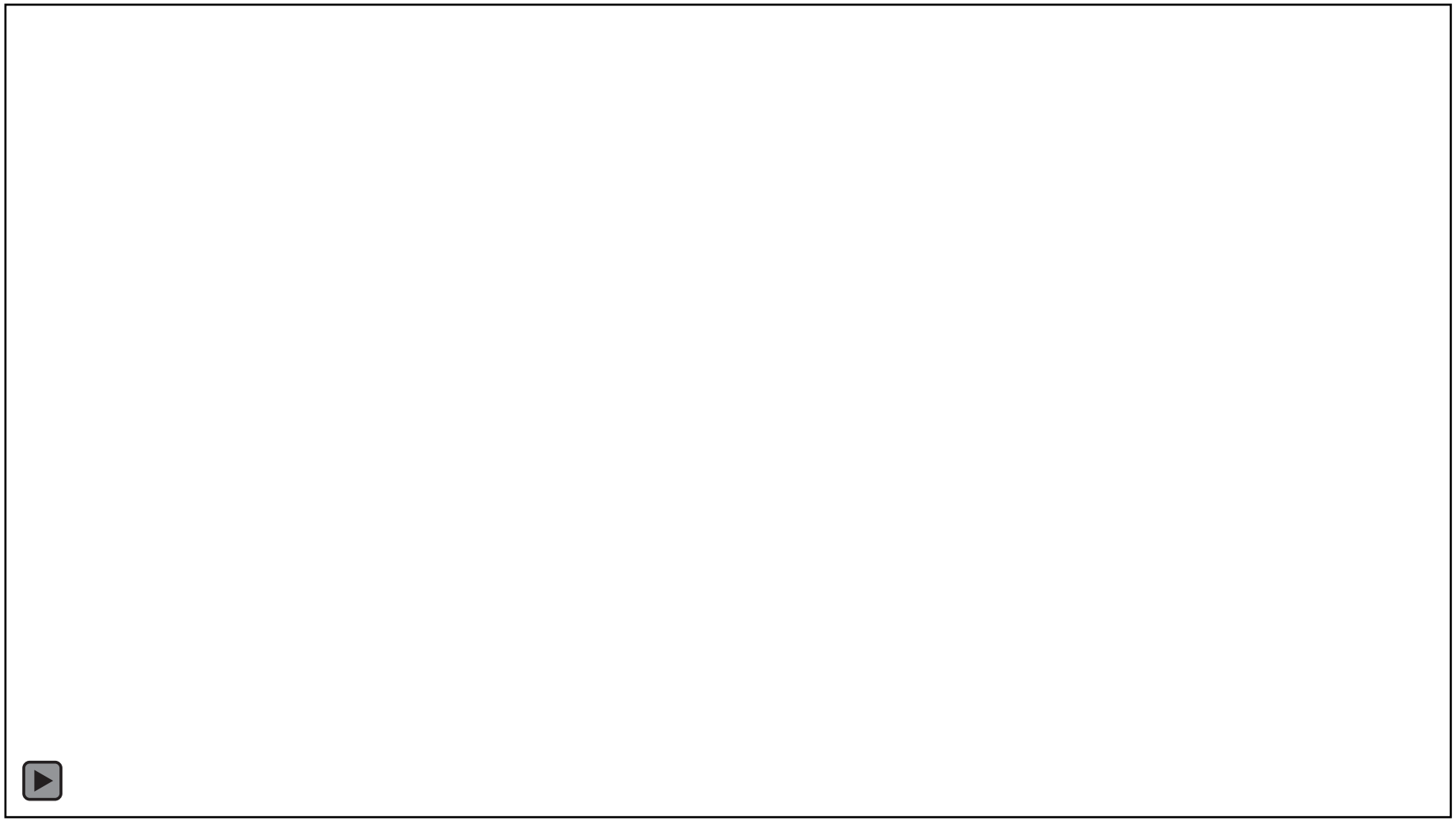
Downloading Vroom

- **Easy to use**
- **Calculates Refrigerant Charge**
- **Wiring Output**
- **Piping Output**
- **Easy system check for projects**
- **Save time and money**

- Vroom downloads: How to download and Install Vroom
  - https://hvacpartners.com/Pages/PS/Software/VRoom.aspx (Software location)
  - https://files.hvacpartners.com/docs/1001/ValCust/0B/VROOM-TIP-001.pdf (Download and Install)
  - https://files.hvacpartners.com/docs/1001/ValCust/0E/VROOM-TIP-002.pdf (Uninstall and Re-Install)
- Questions or Issues Installing:
  - How to get software support: Email vroomhelp@carrier.com
  - Bulletin on Contractor/Engineer download: https://files.hvacpartners.com/docs/1001/ChanPart/0F/103-18-09.pdf
- Vroom FAQ: List of common questions
  - https://hvacpartners.com/Pages/PS/Software/VRoom/FAQs.aspx
- Vroom Tutorial: Located in the software for future use.



Vroom Training Video



Vroom Outputs

- Load outputs based on design conditions
- Refrigerant piping sizes
- Refrigerant calculator
- Load outputs based on design conditions
- Submittals, Piping and wiring diagrams
- IDU and ODU Schedules
- System check – Approved system from Carrier
- The ability to output bill of materials and a pricing sheet. Work with your local ductless or VRF salesperson for more information.

Performance Results

Indoor Units:	1 / 1 to 9	
Capacity:	60 / 30 to 60 (100.0%)	
Total Pipe Length:	25.0 / 591.0	feet
Furthest Actual:	25.0 / 328.0	feet
Furthest Equiv.:	25.0 / 410.0	feet
After 1st Branch Actual:	0.0 / 115.0	feet
After 1st Branch Equiv.:	0.0 / 115.0	feet
Max Height Between IDU/IDU:	0.0 / 49.0	feet
Max Height Between IDU/ODU (Above):	0.0 / 98.0	feet
Max Height Between IDU/ODU (Below):	0.0 / 66.0	feet

Correction Factors

Outdoor Unit Capacity:	0.98	0.92
Piping Length:	1.00	1.00
Altitude:	1.00	1.00
Defrosting:	-	0.95

Additional Refrigerant: 2.0 lb
Total Refrigerant Amount: 16.8 lb

Design Temperatures (°F)

Cooling:
Indoor DB 80.0 Humidity 51.8% Indoor WB 67.0
Outdoor DB 96.0

Heating:
Indoor DB 70.0
Outdoor DB 18.0 Humidity 75.0% Outdoor WB 16.5

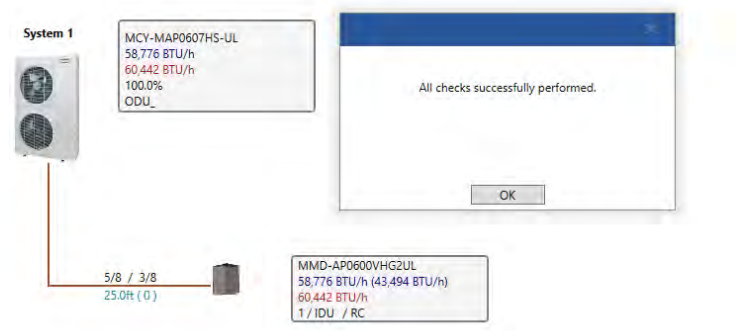
OUTDOOR UNIT SCHEDULE

System Tag		System 1
Tag Reference		ODU_
General Data	Make	Toshiba
	Model Number	MCY-MAP0607HS-UL
	Modules	
	Nominal Cooling Capacity (BTU/h)	60,000.0
	Nominal Heating Capacity (BTU/h)	66,000.0
Design Conditions	Project Design Cooling Outdoor Temp DB (°F)	96.0
	Project Design Heating Outdoor Temp WB (°F)	16.5
Performance Data	Corrected Cooling Total Capacity (BTU/h)	58,776.0
	Corrected Heating Capacity (BTU/h)	60,441.9
Electrical Data	Voltage / Phase	208/230V / 1-phase 3-wire
	MCA	36.3
	Recommended Fuse Size (RFS) [or MOCP]	40
Notes / Options	Applicable System Notes - See Notes Below	1, 2, 3, 4, 5, 6

INDOOR UNIT SCHEDULE

System Tag		System 1
Tag Reference		IDU_
General Data	Room Name	
	Make	Toshiba
	Model	MMD-AP0600VHG2UL
	Type	Vertical Fan Coil Type
	Nominal Cooling Capacity (BTU/h)	60,000.0
	Nominal Heating Capacity (BTU/h)	67,000.0
	Refrig Pipe Dimensions (inch)	5/8 / 3/8
Design Conditions	Project Cooling Design Entering Temp DB/WB (°F)	80.0 / 67.0
	Project Heating Design Entering Temp DB (°F)	70.0
Performance Data	Cooling Total Capacity (BTU/h)	58,776.0
	Cooling Sensible Capacity (BTU/h)	43,494.2
	Heating Capacity (BTU/h)	60,441.9
	Estimated Cooling Coil LAT (°F)	56.7
	Estimated Heating Coil LAT (°F)	101.7
Electrical Data	Voltage / Phase	208/230V / 1-phase
	MCA / MOCP	9.5 / 15
Fan Data	Selected Fan Speed	Med
	Rated Airflow at Selected Fan Speed (cfm)	1830
	Max Fan ESP Setting (IN WG)	0.1/0.5/0.8
Remote Controller	Zone Remote Controller 1	RBC-AMS54E-UL
	Zone Remote Controller 2	
	ERV (DI/DO) Interface Model Number	
Notes / Options	Applicable System Notes - See Notes Below	1, 2, 3

Pipe Size (inch)	Total Length (feet)	Number of Bends
5/8	25	0
3/8	25	0



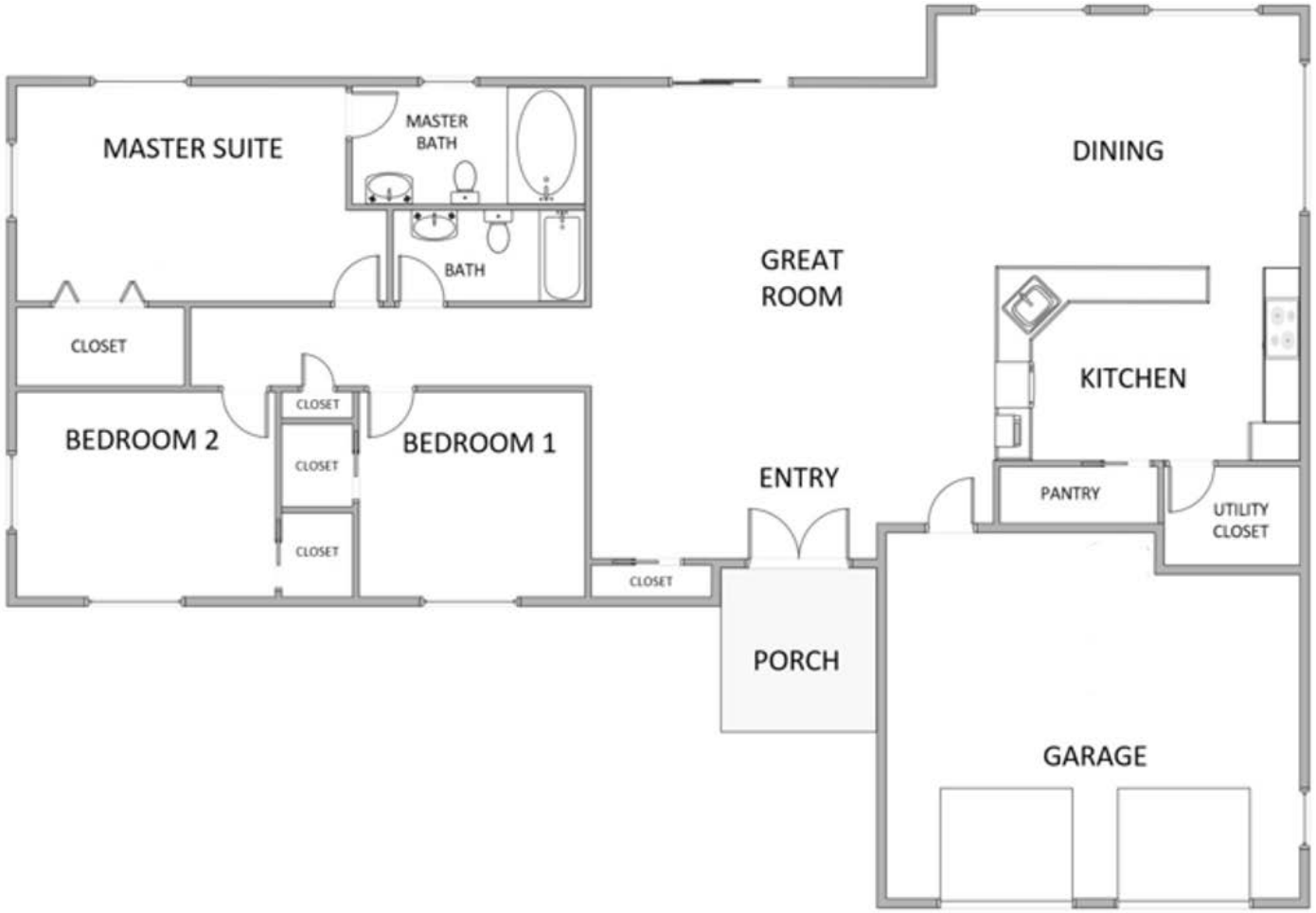
Vroom Example #1

Heat Pump:

- 4-ton ODU with horizontal air handler

Task:

1. Select ODU
2. Select IDU
3. Add in piping lengths
4. Select Controls
5. Output submittals
6. Output piping information
7. Output Refrigerant add



Vroom Example #2

Heat Pump 3:1:

- 5-ton ODU with multi-positional AHUs

Task:

1. Select ODU
2. Select IDUs
3. Select controls
4. Add in piping lengths and vertical separations
5. Output submittals
6. Output piping information
7. Output refrigerant add

Vroom Example #2

Heat Recovery:

- 12-ton ODU heat recovery selection

Task:

1. Select ODU
2. Select flow selectors
3. Select IDUs
4. Select controls
4. Add in piping lengths and vertical separations
5. Output submittals
6. Output piping information
7. Output refrigerant add

Vroom Example #3

Heat Recovery:

- 12-ton ODU heat recovery selection

Task:

1. Select ODU
2. Select IDUs
3. Add in piping lengths
4. Select flow selectors
5. Select controls
6. Output submittals
7. Output piping information
8. Output refrigerant add

TRAINING AND RESOURCES IN YOUR AREA

Local Tech Training and Calendar

https://www.siglers.com/training-registration

Ductless and VRF Team

Mark Lynn & Ashwinesh Singh

THANK YOU

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Customer Assurance Manager
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