DAIKIN
AIR INTELLIGENCE™

VRV

VRV Reference Guide

About Daikin:

Daikin Industries, Ltd. (DIL) is a global Fortune 1000 company which celebrated its 95th anniversary in May 2019. The company is recognized as one of the largest HVAC (Heating, Ventilation, Air Conditioning) manufacturers in the world. DIL is primarily engaged in developing indoor comfort products and refrigeration systems for residential, commercial and industrial applications. Its consistent success is derived, in part, from a focus on innovative, energy-efficient and premium quality indoor climate and comfort management solutions.

A WORLD LEADING MANUFACTURER OF HVAC PRODUCTS

FOUNDED IN 1924

OVER 60,000 DAIKIN VRV SYSTEMS OPERATING THROUGHOUT NORTH AMERICA

RESEARCH & DEVELOPMENT OVER $300 MILLION

TABLE OF CONTENTS

VRV

System Overview

The Features of *VRV*

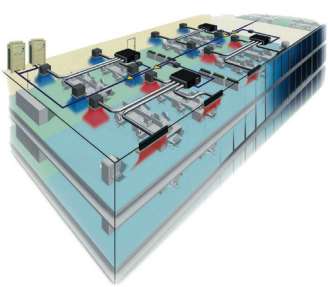
Features & Benefits to Using *VRV*

A *VRV* system is similar to a chiller but circulates refrigerant to each zone instead of water

A *VRV* heat pump system has performance and design attributes similar to a 2 pipe chiller

A *VRV* heat recovery system has performance and design attributes similar to a 4 pipe chiller system

- Industry Leadership since 1982, *VRV* is a registered Trademark (TM)
- 8 development series and 4 generations of *VRV* technology
- Scalable project opportunities with modular design
- Broad coverage of most vertical markets and climates
- Tested and Rated in accordance with AHRI Std 1230
- Individual zone control for Advanced zoning capabilities
- Can operate up to 64 indoor fan coil units
- Auto charging function
- Continuous heating during defrost operation
- Flexible piping limitations to meet a variety of building needs
- Excellent energy efficiency, especially at part load conditions (IEER)
- Daikin's optimized scroll compressor designed for R-410A provides a quiet, reliable energy-efficient operation
- Anti-corrosion treatment standard on exterior metal parts and heat exchanger
- Fully compatible with the complete Daikin control suite including *intelligent Touch Controller (iTC)* and *intelligent Touch Manager (iTM)*
- Tie in to open protocol Building Automation systems through LonWorks® and BACnet™ gateways
- 10-Year Limited Parts Warranty*



* Complete warranty details are available from your local Daikin manufacturer's representative or distributor or online at www.daikincomfort.com.

The benefits of *VRV* equipment can be categorized by three core features:

Simple Modular Design

Outdoor Unit

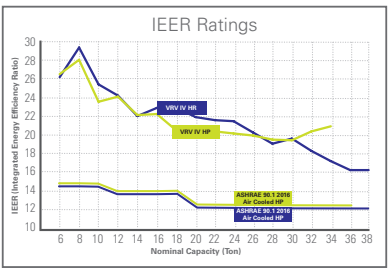
Indoor Units

Piping

Controls

The ease of both design and installation has been a major factor in the success of *VRV* in the global market. Simple methodology sees *VRV* regularly utilized in all project sizes from 3 ton to several 1,000 ton.

Ultra-High Energy Efficiencies



Direct expansion systems (those that use refrigerant to directly condition the space) provide an extremely efficient method of heat exchange.

Inverter controlled compressors also ensure optimized system performance.

Optimum refrigerant & system control sees Daikin *VRV* far exceed industry energy efficiency requirements.

Exceptional Comfort control

Wireless unit Controller

Room or Group Controller

Central Controller

BMS Interface

From controlling temperature in individual areas to the remote monitoring and control of multiple sites, the Daikin *VRV* system has a wealth of propriety control options to cover all end user requirements and ensuring exceptional levels of comfort control.

Key Points for Selection

System Diversity vs Connection Ratio

Optimizing *VRV* System Selection

» The most successful users of *VRV* equipment understand the importance of a fully optimized design

» A key factor that ensures optimized *VRV* equipment selection is to understand the correlation between SYSTEM DIVERSITY & CONNECTION RATIO

A fully optimized design can realize a number of benefits:

» Cheaper equipment & installations costs

» Less outdoor unit footprint

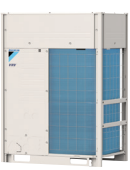
» A greater energy efficient system

» Far better control of room temperature

» A significant increase in the probability of winning a project

Peak Loads & Block Loads

The first step to optimization is to understand the different load demands of the equipment to be selected:

Unit Type	Selection Scope	Selection Approach
	PEAK Load	Each Indoor unit should be sized to deliver the PEAK load (total and/or sensible) of the area it is to serve, at the entering air design conditions, determined by the building load calculations
	BLOCK Load	Outdoor units should be selected to meet the BLOCK Cooling & Heating capacities (The maximum simultaneous load demand of all attached indoor units at a given time of day) determined by the same LOAD Calculations

System Diversity & Connection Ration – What's the Difference?

Connection Ratio:

» Both indoor & outdoor units have a Capacity Index number (e.g. FXMQ30PBVJU indoor unit & RXYQ192TTJU outdoor unit)

Total sum of IDU index numbers ÷ ODU index number = CONNECTION RATIO

» This ratio is defined as a percentage:

Example: 8 x FXMQ30P connected to 1 x RXYQ192T= 240 / 192 = 1.25

– Therefore the Connection Ratio = 125%

System Diversity:

System DIVERSITY is the difference between the Maximum System Load demand and the Maximum Capacity of the outdoor unit, at design conditions

» The *VRV*Xpress tool can define diversity - also as a percentage

Example: 8 x FXMQ30P connected to 1 x RXYQ168T

– Maximum Load required at any given time: 170,269 btu

– Maximum Capacity of the ODU at design conditions: 166,315 btu

– *VRV* defines the DIVERSITY of the system at: -2%

» In this example, if the maximum load is called for, the outdoor unit will fall short of demand by 3,954btu – This *VRV* design has a 2% system diversity

In Summary:
Connection Ratio does NOT indicate the diversity of a *VRV* system. Use of the *VRV*Xpress selection tool will indicate clearly if selected equipment has a system diversity or not.

Key Points for Selection

Oversized for cooling

Before selection of any *VRV* system, a minimum amount of information is required for accurate equipment selection and to apply an optimized design

For an accurate selection of indoor units the following information is required:

PEAK Cooling Loads	PEAK Heating Loads	DESIGN AIR Conditions
» Engineers will usually provide both Total & Sensible loads which should be entered » However it is possible to select equipment using only Total or Sensible load	» Required when either Heating is the dominant operation or the heating design condition is below 32°F	» The dry & wet bulb temperature entering the coil » Also known as "air-on" or "mixed air" conditions » Nominal conditions are typically 80°F db & 67°F wb but rarely reflect actual conditions » Design air-on can also be given as db/RH% (e.g. 74°F & 50% RH)

For an accurate selection of outdoor units the following information is required:

AMBIENT Conditions	PIPE LENGTH
» The design ambient temperature for the location of the project » Both engineers and D&B contractors should have this information » If this information is not at hand then use ASHRAE standard design conditions for the location	» The estimated distance between the outdoor unit and the furthest indoor unit » This is the linear length from one point to another NOT the total amount of piping » Both engineers and D&B contractors should be able to pin point the outdoor unit location » Be sure to calculate and include the vertical height between outdoor & furthest indoor unit

Connection Ratio Limits

SYSTEM TYPE	AIR-COOLED				*VRV-IV-X* GAS FURNACE	WATER-COOLED	
	ALL VRV-IV (3-PHASE)			*VRV-S*		T-Series	
Indoor Unit Type	All FXDQ All FXMQ(P) All FXAQ FXSQ07T-54T	FXSQ-05T FXZQ-05T FXFQ-07 FXFQ-09	All Other Units	All Units	All Units	FXDQ FXMQ(P) FXSQ07-54T FXAQ	FXZQ-05 FXFQ07/09 FXSQ-05T and All Other Units
Single Module	200%	180%	200%	130%	130%	150%	150%
Dual Module		160%	160%	N/A			130%
Triple Module*		130%	130%				130% 120% @36 Ton

Notes:

1. Minimum connection ratio for Class 72 (6 ton) models is 70%
2. Minimum Connection Ratio for all other standard Air-Cooled and Water-Cooled models: 50%.
3. When systems are designed to >130% connection ratio, indoor units in thermo ON are set to low fan speed by default. This function can be overridden at commissioning stage, if desired.

SYSTEM TYPE	AIR-COOLED		
	ALL *AURORA* (3-PHASE)		
Indoor Unit Type	All FXDQ, All FXMQ(P), All FXAQ FXSQ07T-54T	FXSQ-05T FXZQ-05T FXFQ-07 FXFQ-09	All Other Units
Single Module	200%	180%	200%
Dual Module		160%	160%

Note: Minimum Connection Ratio for all *AURORA* models is 70%

Capacity Index Table

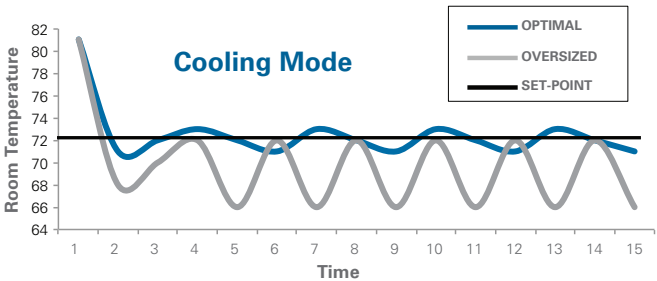
Indoor Unit Size													
5	*7*	*9*	*12*	*15*	*18*	*24*	*30*	*36*	*42*	*48*	*54*	*60*	*72*	*96*
Indoor Unit Capacity Index														
5.8	**7.5**	**9.5**	**12**	**15**	**18**	**24**	**30**	**36**	**42**	**48**	**54**	**60**	**72**	**96**

Key Points for Selection

Oversized for cooling

Despite advanced control methods, oversizing of equipment, even with Variable Refrigerant Volume technology, can lead to indoor units overcooling the space and cycling on and off. This results in poor temperature control.

In addition to large temperature swings, an indoor unit that cycles on and off does not provide continuous de-humidification. This can lead to higher humidity levels than desired.

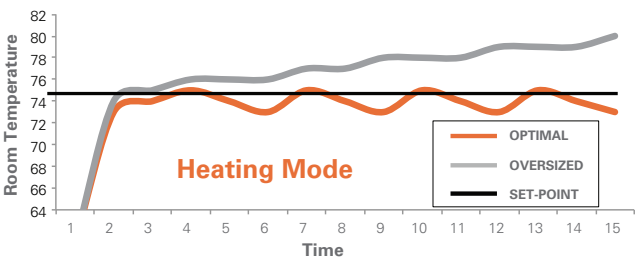


Oversized for heating

In areas of very cold climates, there is a temptation to 'up-size' indoor units in the belief that this ensures capacity in extreme conditions below design temperature

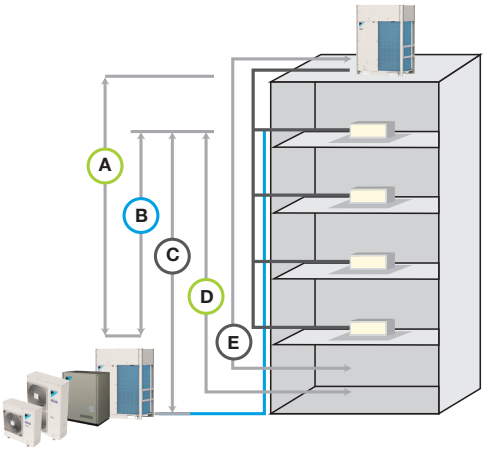
The reality is correct load calculation and good design ensures the best performance

In heating mode, the expansion device never fully closes. Therefore a unit that continuously cycles on and off will, in time, see a steady increase in temperature above set point



Application Limits

Refrigerant Piping Limits



PIPING LIMITATIONS Liquid Line Max (ft)		AIR-COOLED				WATER-COOLED	
		VRV-IV Heat Pump	*VRV-IV / X* Heat Recovery	*VRV IV-S* (3 Ton)	*VRV IV-S* (4 & 5 Ton)	*VRV* PC-Series	*VRV* T-Series
A	Vertical Drop	164 (295)[1]	164 (295)[1]	98	98	164	164
B	Between IDU	100	100 (49)[3]	33	49	49	98
C	Vertical Rise	130 (295)[1]	130 (195)[1]	98	98	130	130
D	From 1st Joint	130 (295)[2]	130 (295)[2]	130	130	130	295
E	Linear Length	540	540	164	230	390	540
	Total Network	3280[4]	3280[4]	820	984	980	980

[1] Setting adjustment on condensing unit required.
[2] Application rules apply. Refer to Installation Manual for further details.
[3] When linear length exceeds 390 ft. Possible refrigerant noise can be mitigated (via setting adjustments on ODU)
[4] *AURORA VRV* is limited to 1640 ft total network

Application Limits

Capacity Range

AIR-COOLED HEAT PUMP

Capacity MBH (Tn)	Voltage	# of Modules	# of Compressors	Max. # IDU[1]
36 (3)	1 Phase: 208-230V	1	1	6
48 (4)				8
60 (5)				9
72 (6)	3 Phase: 208-230V ~ 460V ~ 575V*			12
96 (8)				16
120 (10)				20
144 (12)			2	25
168 (14)				29
192 (16)		2		33
216 (18)				37
240 (20)				41
264 (22)			3	45
288 (24)			4	49
312 (26)				54
336 (28)				58
360 (30)		3	3	62
384 (32)			4	64
408 (34)	230V 460V		5	64

AIR-COOLED HEAT RECOVERY

Capacity MBH (Tn)	Voltage	# of Modules	# of Compressors	Max. # IDU[1]
72 (6)	3 Phase: 208-230V ~ 460V ~ 575V	1	1	12
96 (8)				16
120 (10)				20
144 (12)				25
168 (14)				29
192 (16)		2	2	33
216 (18)				37
240 (20)				41
264 (22)				45
288 (24)				49
312 (26)				54
336 (28)				58
360 (30)		3	3	62
384 (32)				64
408 (34)	230V 460V			64
432 (36)				64
456 (38)				64

Capacity Range

AURORA (HP & HR)*				
Capacity MBH (Tn)	Voltage	# of Modules	# of Compressors	Max. # IDU[1]
72 (6)	3 Phase: 208-230V ~ 460V ~ 575V	1	1	12
96 (8)				16
120 (10)				20
144 (12)		2	2	25
192 (16)				33
240 (20)				41

WATER-COOLED (HP & HR)				
Capacity MBH (Tn)	Voltage	# of Modules	# of Compressors	Max. # IDU[1]
72 (6)*	3 Phase: 208-230V ~ 460V ~ 575V	1	1	12
96 (8)				16
120 (10)				20
144 (12)				25
168 (14)		2	2	29
192 (16)				33
216 (18)				37
240 (20)				41
264 (22)				45
288 (24)				49
312 (26)		3	3	54
336 (28)				58
360 (30)				62
384 (32)				64
408 (34)				64
432 (36)				64

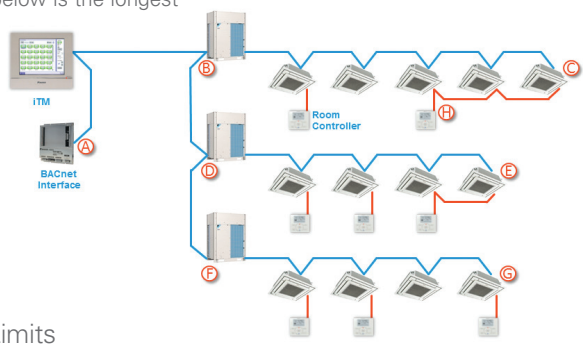
*PC Series Model - Not available in 575V

Application Limits

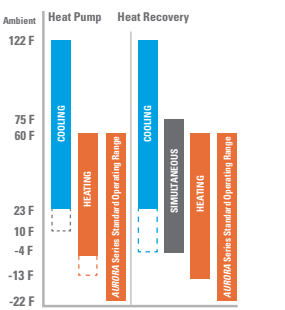
Wiring Parameters

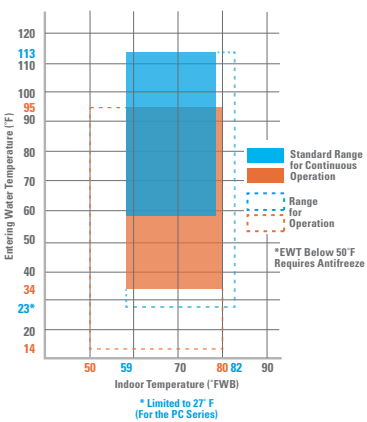
Communication Wiring should be:

- » 18-2AWG stranded
- » No polarity
- » No shielding
- » Maximum linear distance = 3280 ft.
- » Maximum total distance = 6560 ft.
- » Maximum linear distance in the example below is the longest of either
- » (A) to (C), (A) to (E), (A) to (G) or (C) to (G)
- » Maximum total distance is (A to F) + (B to C) + (D to E) + (F to G)
- » Each local controller (H to C) can run up to a distance of 1640 ft.



Ambient Limits





Nomenclature

How to Read Model Number

Indoor Units

FX M Q 24 P VJ U

Indoor Unit Category
FX: *VRV* system indoor unit

Indoor unit type
Example:
M: Concealed ceiling ducted
Z: 4-way ceiling mounted cassette

Refrigerant type
Q: R-410A

Nominal cooling capacity
Example:
Btu/h (Tons)
24 = 24000 (2)
60 = 60000 (5)

Series/ Design Change
Major Design Change

Power supply symbol
VJ: 1 phase, 208/230V, 60 Hz

Standard compatibility symbol
U: United States of America

Outdoor Units

R EL Q 192 T A YC U

Outdoor Unit Category
R: Air-Cooled
RW: Water-Cooled

Mode of Operation
XY: Heat Pump
EY: Heat Recovery
XT: Heat Pump (1ø)
EL: Heat Recovery cold climate
XL: Heat Pump cold climate

Refrigerant type
Q: R-410A

Nominal cooling capacity
Example:
Btu/h (Tons)
192 = 192,000 (16)
456 = 456,000 (38)

Series / Design Change
Major Design Change

Series / Design Change
Minor Design Change

Power supply symbol
TJ: 3ø,208/230V, 60 Hz
YD: 3ø, 460V, 60 Hz
YC: 3ø, 575, 60 Hz
VJ: 1ø, 208/230V, 60 Hz

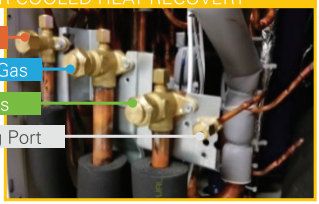
Standard compatibility symbol
U: United States of America

Piping and Electrical Wiring Guide

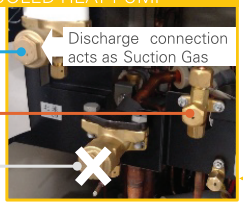
Condensing Unit Pipe Connections

AIR-COOLED HEAT PUMP

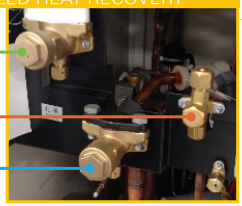
AIR-COOLED HEAT RECOVERY



WATER-COOLED HEAT PUMP

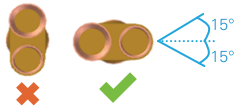


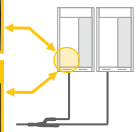
WATER-COOLED HEAT RECOVERY



- Heat Pump & Heat Recovery *VRV*-W systems use the same condensing unit models
- With Heat Pump installations, Discharge (Hi/Lo) Gas connection becomes Suction Gas

Install Multi Connector Kits no more than 15° from horizontal



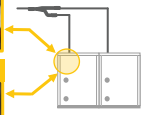


A single multi-connector kit is supplied for both 2 & 3 multi condensing unit installations

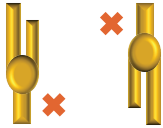
Multi-Connector Pipe Kit

BHFP22P100U

Ensure the caution label (attached to the joint) is facing up

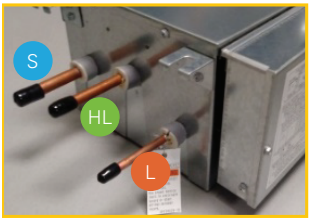


Vertical mounting of these branches is NOT possible



Branch Selector Box Connections

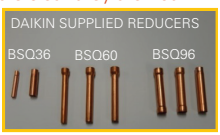
Single-Port Boxes

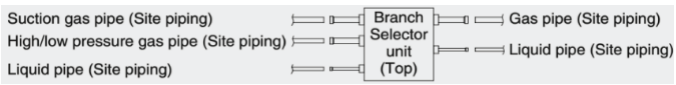


S Suction Gas HL Hi/Lo Gas L Liquid

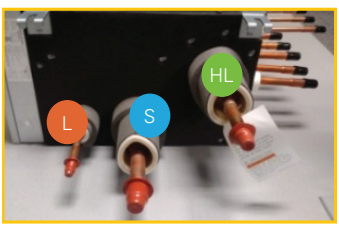
Pipe reducers are provided with each box for when the connection does not match the required pipe size (either upstream or downstream). DO NOT DISCARD any accessory until it is clear they are not required

NOTE: Any pipe reducers required on the ODU side are field supply



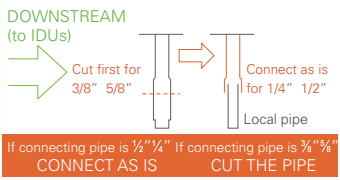


Multi-Port Boxes



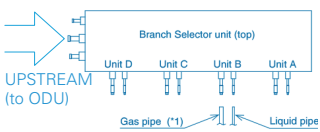
L Liquid S Suction Gas HL Hi/Lo Gas

- Single & multi-port box pipe orders differ
- All piping on BS boxes are female connectors

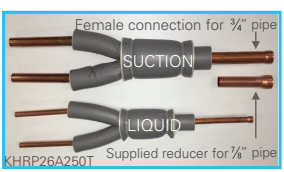


Multi-Port Twinning Joint

When larger indoor units (72 & 96 MBH models) are connected to a multi-port box a "twinning" joint is required to join 2 ports



Port Twinning Options:
A & B
C & D
E & F
G & H
I & J
K & L

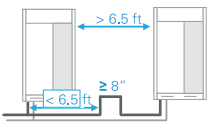


Model	Suction	Hi/Lo Gas	Liquid
BS4Q54	7/8"	3/4"	3/8"
BS6Q54	1 1/8"	3/4"	1/2"
BS8Q54	1 1/8"	3/4"	1/2"
BS10Q54	1 1/8"	1 1/8"	5/8"
BS12Q54	1 1/8"	1 1/8"	5/8"

Oil Trap Requirements

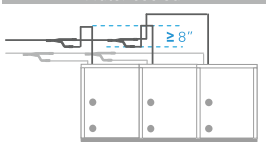
When 2 or 3 condensing units are linked together on a single refrigerant circuit, oil equalization becomes an important factor. The following diagrams illustrate when and where oil traps are required. Applies to Heat Pump & Heat Recovery

Air cooled



When piping lengths between modules exceeds 6.5' provide a rise of 8" or more in the gas line (no more than 6.5' from the pipe branch)

Water cooled



All gas lines from multi-connected water cooled ODUs must have oil traps (8" minimum)

REFNET Branch Pipe Kits

All Daikin *VRV* systems are supplied with REFNET branch kits which must be used in installation

Each branch has varying diameters for the different pipe sizes that need to connect to it. Cut the pipe accordingly

Vertical installation of REFNETs is acceptable on vertical pipe runs

On horizontal runs, ensure all REFNETs lie flat in the horizontal plane

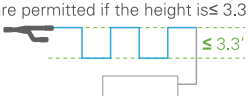
Install the 'Y' REFNET no more than 30° from the horizontal plane

Piping Rules

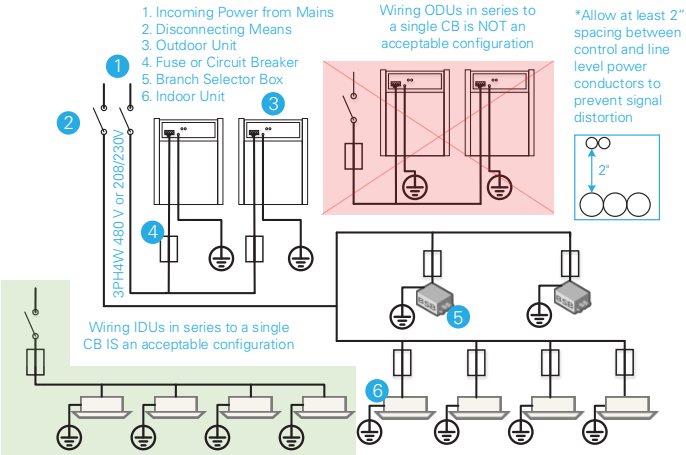
12" minimum

All fixings (refnets, boxes, fan coils, etc.) require a minimum 12" of straight pipe from pipe bends and from each other (e.g. refnet to refnet). Note this distance needs to increase if mitigating refrigerant noise is critical

Small loops on horizontal runs are permitted if the height is≤ 3.3'



Power Wiring



NEC requires all IDU Fan Coils be connected to a 15A fuse breaker by default, though multiple can be connected to the same circuit. The chart below can be used to determine the amount of units that can be strung together.

Indoor Unit Model

Size (BtUh)

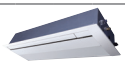
	FXFQ-T		FXZQ		FXUQ		FXEQ		FXDQ		FXMQ-PB		FXMQ-M		FXAQ		FXHQ		FXLQ		FXTQ-TA		FXSQ	
	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA	FLA	MCA
5			0.2	0.3																			0.6	0.8
7	0.2	0.3	0.2	0.3			0.2	0.3	0.7	0.9	0.5	0.6			0.3	0.4							0.6	0.8
9	0.2	0.3	0.2	0.3			0.3	0.4	0.7	0.9	0.5	0.6			0.3	0.4					3.9	4.9	0.6	0.8
12	0.2	0.3	0.3	0.4			0.3	0.4	0.7	0.9	1.1	1.4			0.3	0.4	0.6	0.8	0.4	0.5	3.9	4.9	0.7	0.8
15	0.3	0.4	0.3	0.4			0.4	0.5			1.2	1.5											1.2	1.4
18	0.5	0.6	0.5	0.6	0.5	0.6	0.4	0.5	1	1.3	1.3	1.6			0.4	0.5			0.5	0.6	3.9	4.9	1.3	1.6
24	0.5	0.7			0.5	0.6	0.5	0.7	1.1	1.4	1.4	1.8			0.5	0.6	0.8	1	0.5	0.6	3.9	4.9	1.4	1.8
30	1	1.3			1.1	1.4					2.2	2.3									3.9	4.9	1.5	1.8
36	1.2	1.5			1.1	1.4					2.3	2.9					1.1	1.4			3.9	4.9	2	2.5
42																					5.2	6.5		
48	1.4	1.8									2.7	3.4									5.2	6.5	2	2.8
54											2.7	3.4									6.9	8.6	2.6	3.3
60																					6.9	8.6		
72													7.6	9.5										
96													8.6	10.7										

VRV

System Selection

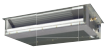
Indoor Unit Range

Sizes & Accessories Available of all IDU's

TYPE	MODEL	BUILT-IN / OPTION
ROUNDFLOW (3' x 3') CASSETTE	FXFQ 	
7 9 12 15 18 24 30 36 48		
VISTA (2' X 2') CASSETTE	FXZQ-T 	
5 7 9 12 15 18		
1 WAY FLOW CASSETTE	FXEQ 	
7 9 12 15 18 24		
4 WAY FLOW UNDER CEILING	FXUQ 	
18 24 30 36		
1 WAY FLOW UNDER CEILING	FXHQ 	
12 24 36		
WALL-MOUNTED	FXAQ 	
7 9 12 18 24		
FLOOR-MOUNTED	FXLQ 	
7 9 12 18 24		
CONCEALED FLOOR-MOUNTED	FXNQ 	
7 9 12 18 24		

= Filter Included =Pump Included =OA Connection 36 =IDU size available

= Filter Options =Pump Options =OA Kit Option

TYPE	MODEL	BUILT-IN / ADD ON
MULTI POSITION AHU	FXTQ 	OSA
9 12 18 24 30	36 42 48 54 60	
LSP SLIM CONCEALED DUCTED	FXDQ 	OSA
7 9 12 18 24		
MSP CONCEALED DUCTED	FXSQ 	OSA
5 7 9 12 15 18 24	30 36 48 54	
HSP CONCEALED DUCTED	FXMQ-P 	OSA
7 9 12 15 18 24	30 36 48 54	
HSP HIGH CAPACITY CONCEALED DUCTED	FXMQ-M 	OSA
	72 96	

A-Coil & Gas Furnace units will always be selected together.
Refer to selection tool to determine which combination is both suitable and acceptable.

A-COIL	CXTQ 	
24 36 48 60		
GAS FURNACES	FURNACES 	OSA
40 60 80 100 120		

Accessories

The best location to find a comprehensive list of accessories for each unit type is via the WEBXpress selection tool. Default (automatically selected) accessories are listed at the bottom of the unit 'properties' window. Click on the Options tab of any item to reveal the following page:

Example Options Page

Remote Controllers		Options
1	BRC1E73	new Navigation Remote Controller (Prefe...
Options		
1	BYCQ125B-W1	Standard Decoration Panel (Preferred)

Options Indoor Unit FXFQ30TVJU

Remote Controllers		
☐	BRC1E52A7	Navigation Controller
1	BRC1E73	new Navigation Remote Controller (Preferred)
0	BRC2A71	Simplified Wired Controller
Remote Sensors		
☐	KRCS01-4B	Remote Sensor Kit - FXTQ, FXMQ-P, FXFQ-P
Options		
0	BRC1E72RF	BRC1E72 Face Decal (Fan and Single Setpoint)
0	BRC1E72RF2	BRC1E72 Face Decal (Fan and Dual Setpoints)
0	BRC1E72RM	BRC1E72 Face Decal (Mode and Single Setpoint)
0	BRC1E72RM2	BRC1E72 Face Decal (Mode and Dual Setpoints)
0	BRC1E72RMF	BRC1E72 Face Decal (Mode, Fan and Single Setpoint)
0	BRC1E72RMF2	BRC1E72 Face Decal (Mode, Fan and Dual Setpoints)
0	BRC2A71R	Optional Controller Faceplate (No Fan Speed)
0	BRC2A71RS	Optional Controller Faceplate (Mode & Fan Button)
0	BRC2A71RU	Optional Controller Faceplate (No Mode Button)
☑	BYCQ125B-W1	Standard Decoration Panel (Preferred)
☐	BYCQ125BGW1	Self Cleaning Decoration Panel
☐	DACA-FQP13-1B	MERV 13 Replacement Filters
☐	DACA-FQP13-1K	Merv 13 Filter Kit
☐	DACA-KRCSPW404B	Remote Sensor Cable - Plenum Rated - 40ft - KRCS01-4B
☐	DACA-KRCSPW804B	Remote Sensor Cable - Plenum Rated - 80ft - KRCS01-4B
☐	DTA104A62	Outdoor unit External Control PCB - FXFQ/FXHQ
☐	KDBHQ55B140	Sealing material for air discharge outlet
☐	KDBP55H160FA	Panel Spacer - Round Flow FXFQ
☐	KDDP55B160K	Air intake kit, with T pipe (for Std Panel - BYCQ125B-W1)
☐	KDDQ55B140	Air intake kit, w/o T pipe (for Std Panel - BYCQ125B-W1)
☐	KJB211A	Electrical Fixing Box
☐	KRP1C75	Adaptor PCB (Aux Heat, Humidifier, OSA, Damper etc) - Round
☐	KRP1H98	Installation Box for Adapter PCB when using sensor flow panel
☐	KRP1J98	Installation box for Self-Cleaning Filter Panel
☐	KRP4A74	Group Control / DDC Adaptor PCB - FXDQ

Indoor Unit Considerations

CASSETTE UNITS provide the best combination of economic installation with a good level of flexible project design. Fresh air supply is possible but limited

Considerations:

- » Is there a ceiling void space?
- » What is the height of the void space?
- » What type of ceiling (grid or hardboard)?*
- » Is there a requirement to introduce fresh air?

*Note: In hard-board ceilings, service hatches are required

Cassette Range		Model Size	In-Ceiling Height	Approx. Air Throw	Maximum Outside Air
	FXFQ	07 ~ 30	10"	16 ft. (per outlet)	20% of unit air flow rate*
		36-48	11¾"		
	FXZQ-T	All	11¾"	12 ft. (per outlet)	3% of unit air flow rate
	FXUQ	All	0 ~ 2¼" (sits below ceiling)	17 ft. (per outlet)	N/A
	FXEQ	All	10"	15ft	15% of unit air flow rate

*requires outdoor air kit (or else only 3% maximum)

Note: Air throws are subjective. The data provided here is for guideline purposes only.

Application Examples		
	FXZQ-T	Small Offices – 2' x 2' ceiling grids – Corridors
	FXFQ	Large open plan areas – Shallow Void Spaces
	FXUQ	Retail Outlets – Restricted or No Void Spaces
	FXEQ	Hotel Bedrooms – Retail – Corridors

Indoor Unit Considerations

DUCTED units offer the ultimate in flexibility of design, air distribution and integration of ventilation. It also tends to be the most expensive installed cost option. However cost can be minimized by serving multiple rooms with a single unit - the loss of individual room units can be countered with thoughtful control design.

Considerations:

- » Is there a ceiling void space?
- » What is the height of the void space?
- » What level of ESP is likely to be required
- » Is there a requirement to introduce ventilation into the space via the FCU?
- » What level of control is required?

Note: Multiple rooms can be served by one unit (See DZK control section)

Ducted Range		Model Size	In-Ceiling Height	ESP		Maximum Outside Air
				Standard	Max	
	FXDQ	07 ~ 12	$7^{7}/_{8}$"	0.04"	0.12"	20% of units air flow rate
		18 ~ 24		0.06"	0.17"	
	FXSQ	05 ~ 48	$9^{11}/_{16}$"	0.20"	0.60"	
		54			0.56"	
	FXMQ-P	07 ~ 12	$11^{13}/_{16}$"	0.20"	0.40"	
		15 ~ 48		0.40"	0.80"	
		54		0.40"	0.56"	
	FXMQ-M	72 ~ 96	$18^{1}/_{8}$"	0.96"		
				1.03"		

Application Examples		
	FXMQ-P	Most applications – Multiple room zoning
	FXMQ-M	Large open plan areas – High ESP requirements
	FXDQ FXSQ	Bulkheads – Hotels – Assisted Living

CONCEALED units offer the opportunity to hide away the equipment when there is no ceiling void but the client does not wish to use exposed units or else has similar equipment existing and sees the benefit of retro fitting with minimum disruption and expense.

In areas where heating is the primary role of the system, floor standing units are sometimes installed around the perimeter of a building for optimum air flow.

Considerations:

- Is there an existing unitary type system?
- Is heating the primary requirement?
- Does the client prefer not to 'see' the units?
- Is there a requirement to introduce fresh air?

Concealed		Model	Height	Max. WG	Typical O.A.
	FXNQ	All	24	Minimal	10% AFR*
	FXTQ	09 - 36	45"	0.9"	20% AFR
		42 - 48	53 ½"		
		54 - 60	58"		

*Via underside - no duct

Application Examples		
	FXNQ	Perimeter Heating – Hallways
	FXTQ	Condo's – Closet spaces – Retrofits

Indoor Unit Considerations

EXPOSED units usually offer the client the most economical installed cost solution on a *VRV* system. These types of units are most often used when there are budget constraints or where an area has no void space/enclosure to conceal other unit types. None of these units have integral condensate pumps fitted.

Considerations:

» How big is the space?
» Where can the unit be located?
» Is piping / condensate run clear?
» Is the client accepting of exposed units?

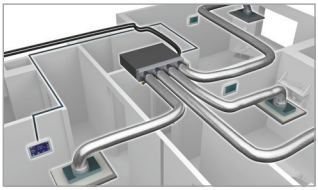
Exposed Units		Model	Approx. Air Throw	Max. WG	Typical O.A.
	FXHQ	All	20'	N/A	NONE
	FXAQ	All	13'		
	FXLQ	All	7'		

Application Examples		
	FXHQ	Classrooms – Retail – Restaurants
	FXAQ	Hotels – Small Offices
	FXLQ	Perimeter heating – Condos – Churches

Note: Air throws are subjective. The data provided here is for guideline purposes only.

Zoning *VRV* systems with DZK

VRV Meets VAV - Features & Benefits



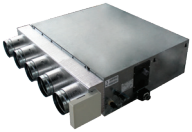
DZK - Daikin Zoning Kit

The DZK solution increases the flexibility of *VRV* applications by allowing multiple zones to be served by one indoor unit fan coil while still providing individual temperature control.

Up to 6 separate dampers supply variable air flow to the zones in response to individual zone thermostats.

Zoning Box

The zoning box is a plenum with motorized dampers that constantly modulate the conditioned air flow into each zone through standard ductwork, in response to the demand from the individual zone thermostat.



Wired Thermostat

The main thermostat is a wired color touch display master unit used to configure the DZK system. It can also be used as the thermostat for one or all of the zones.

Wireless Thermostat

The Wireless thermostat is a battery powered, touch display unit that is used for one zone. Each zone thermostat monitors and allows the user to select a comfortable room temperature, and program or adjust the control functions for the room.

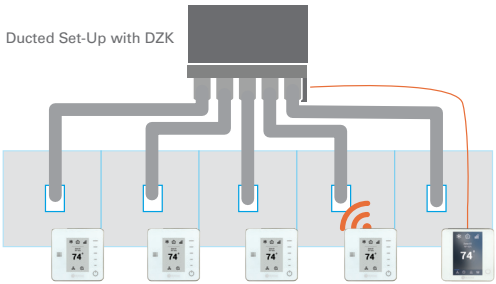
Wireless Lite Thermostat

This is a simplified wireless controller that allows a 3 degree differential (higher and lower) from a default temperature set point interface

DZK BACnet™ Gateway Module

The DZK *BACnet* Gateway interface allows individual room control via any *BACnet*/IP compatible Building Management System.

Zoning *VRV* systems with DZK



Advantages

» Reduces system hardware cost - fewer Indoor units required
» Increases comfort levels by allowing more individual zone control
» Reduces installation expense and maintenance costs
» Reduces the amount of refrigerant required in the installation
» Increases the flexibility of the *VRV* application design

	DZKS Zoning Box Range for FXSQ Units					
Product Reference	DZKS015E3-3	DZKS015E4-3	DZKS030E4-3	DZKS030E5-3	DZKS048E4-3	DZKS048E6-3
Compatible Ducted Unit	FXSQ15TA		FXSQ18 ~ 30TA		FXSQ36 ~ 48TA	
No. of Air Duct Outlets	3 x ø8"	4 x ø6"	4 x ø8"	5 x ø6"	4 x ø8"	6 x ø6"
Number of Zones	2 to 3	2 to 4	2 to 4	2 to 5	2 to 4	2 to 6

	DZKS Zoning Box Range for FXMQ Units			
Product Reference	DZK030E4	DZK030E5	DZK048E4	DZK048E6
Compatible Ducted Unit	FXMQ15PB ~ FXMQ24PB		FXMQ30PB ~ FXMQ54PB	
No. of Air Duct Outlets	4 x ø8"	5 x ø6"	4 x ø8"	6 x ø6"
Number of Zones	2 to 4	2 to 5	2 to 4	2 to 6

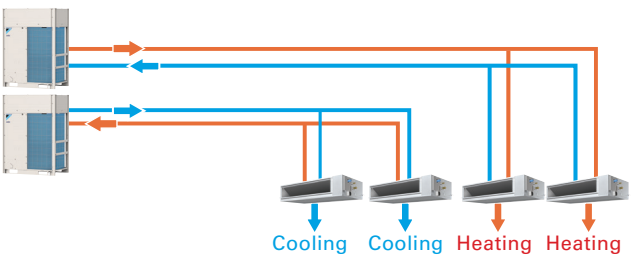
Note: Each FXMQ or FXSQ indoor unit must still be connected to a BRC1E73 room controller

Heat Pump or Heat Recovery?

The Various Heat/Cool Changeover Options

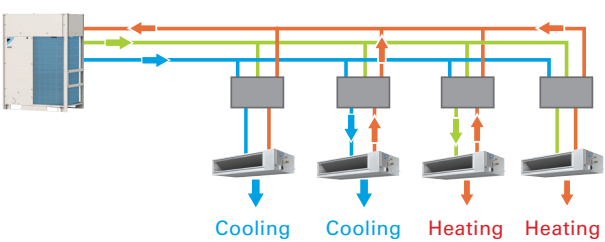
Heat Pump (HP)

» The 2 pipe Heat Pump system is the equivalent of a 2-pipe chilled water system
» A Heat Pump system provides the means of heating OR cooling at any given time
» Multiple Heat Pump systems can be zoned and will work independently of each other
» When demand is met by an indoor unit the unit will work on fan only or the fan will cycle on/off until demand returns or mode change occurs



Heat Recovery (HR)

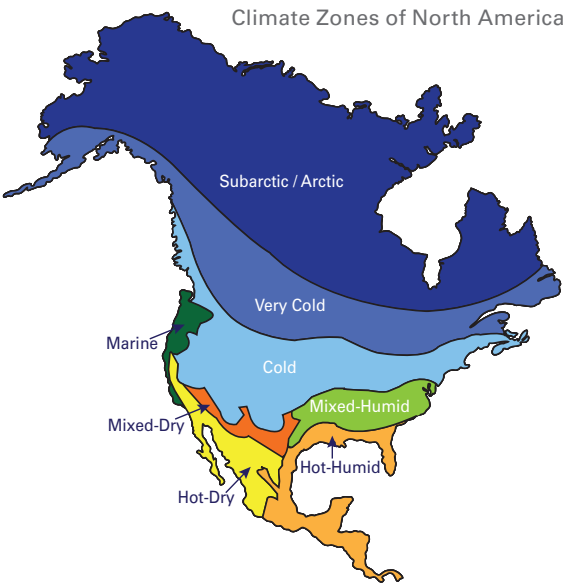
» The 3 pipe Heat Recovery system is the equivalent of a 4-pipe chilled water system
» A Heat Recovery system has the ability to provide simultaneous heating AND cooling
» When both heating and cooling occur simultaneously, system and building energy can be better utilized
» When demand is met by an indoor unit the unit will work on fan only or the fan will cycle on/off until demand returns



Heat Pump or Heat Recovery?

Should I Use Heat Pump or Heat Recovery?

There are three main factors that dictate whether a HP or HR system should be selected. All these factors should be considered in each case to determine an appropriate selection:

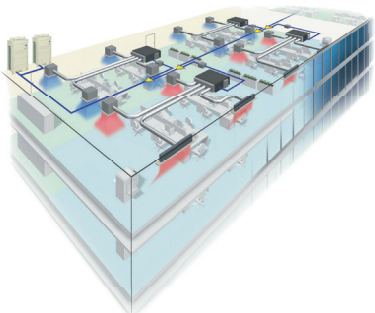


GEOGRAPHY

The location or the project will often dictate what type of system will be required. Projects in temperate climates tend to use Heat Recovery due to the changeable load demands that can occur through the course of a day. However areas with defined seasons or little demand for simultaneous heating or cooling throughout the year will usually utilize Heat Pump.

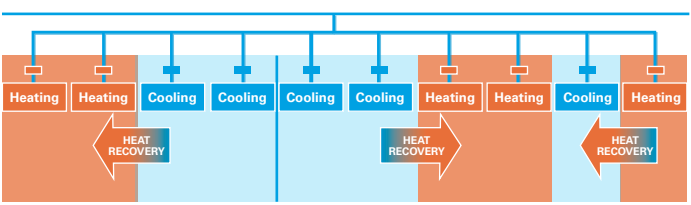
BUILDING LAYOUT

Sites with open plan areas and/or similar orientation will often be satisfied by a Heat Pump system, irrespective of geography. On the other hand, if the site has many aspects, individual rooms and/or heat loads, this may define the client requirement toward Heat Recovery. Differing internal room load demands may see the need for cooling for longer periods of the year.



OCCUPANCY

The type of end user will often trump any other consideration. Typically a multi-tenanted site will require a heat recovery system as the ability for individual mode control is paramount. Typical examples of this include hotels, assisted living, condos as well as offices. It is always important to establish from the outset if an office application is to have multiple tenants.



Ultimately there are many applications where the answer will be **both Heat Pump AND Heat Recovery**

Air-Cooled or Water-Cooled?

Factors that Benefit the use of *VRV* Water-Cooled Series

Air to air *VRV* systems make up the majority of *VRV* installations This is due to the following:

» Ease of installation (no water system required)

» Less initial capital costs

However Water-Cooled *VRV* can have certain advantages:

» Greater energy efficiencies

» Localized CU installation (reduced pipe runs)

These advantages come in to play when the following are present:

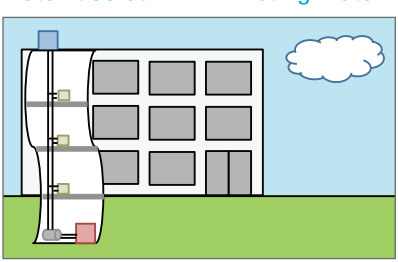
» An existing chilled water loop

» Extreme ambient conditions

» An ability & desire to utilize a local geothermal source

Internal Plate Heat Exchanger

Water-Cooled *VRV* - Existing Water Loop



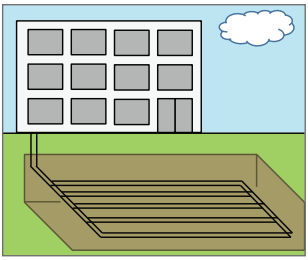
Boiler ~ Tower Water Loop

By utilizing an existing water loop in the building, the advantages of greater energy efficiency can be promoted without having to offset capital costs. In addition *VRV* Water-Cooled Series CUs are usually located locally to the area they are serving and will typically attach to the water loop already running through the building. This negates the need to run copper piping through risers to a remote plant space (be aware that *VRV* Water-Cooled Series CUs are internal mounting units).

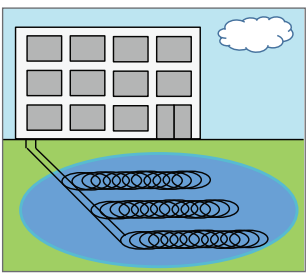
Water-Cooled *VRV* - Geothermal

A ground-source *VRV* heat pump system combines the advantages of both technologies into one system, making it one of the most efficient HVAC systems available and achieving savings over either GSHP or VRF on their own. The constant ambient conditions below ground also ensure that these savings are realized year round.

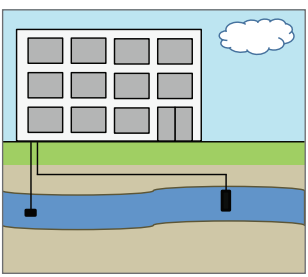
There are two main types of systems: closed loop and open loop. Closed loops bury water pipes either in solid ground or in a water source (like a pond or lake). An open loop draws from groundwater, like a well, and returns it back to source.



Closed Loop Buried in Ground



Closed Loop in Surface Water



Open Loop using Ground Water

Air-Cooled or Water-Cooled?

Design Criteria:

Water loop design is the responsibility of the engineer. However, two facts are needed from Daikin:

The minimum & maximum entering water temperatures:

» 50°F - 113°F for Cooling
» 23°F - 113°F for Cooling on a Geothermal System
» 50°F - 113°F for Heating
» 14°F - 95°F for Heating on a Geothermal System

A suitable water flow rate:

» 13.2 gpm to 39 gpm per module Boiler & Tower System
» 21 gpm to 39 gpm per module with glycol use

* (Be aware that conditions need to be met when EWT for heating is required below 50°F – seek assistance for these applications)

Other consideration:

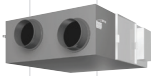
» When *VRV* is to be applied with an open loop system, a 3rd party heat exchanger is required to ensure the plate heat exchanger of the *VRV* condensing unit operates in a closed loop system.
» The *VRV* condensing units have a heat output into the adjacent mechanical room (see table). Where multiple units are placed in an enclosed area, any potential heat buildup must be addressed (either with adequate ventilation or even a fan coil unit). RWEQ_TA series units have the ability to configure the unit to reject this heat to the refrigerant circuit. See Installation manual for further details.
» From the CU pipe connection to the fan coils, the equipment, controls & selection process is identical to Air-Cooled *VRV*.

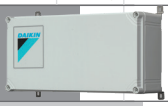
Module Model	Ventilation Load (BTU/hr)
RWEYQ72PC	2,200
RWEYQ84PC	2,450
RWEQ96TA	2,730
RWEQ120TA	3,412
RWEQ144TA	4,436

Solutions for Ventilation

Range & Limitations of our Ventilation Options

CFM	300	1000	1500	2000	2500	3000	5000	7500	10000+
Daikin	VAM -300-1200 Energy Recovery Ventilator								
Daikin		FXMQ_MF OA Processing Unit 630 – 1230							
Daikin			*DVS* DOAS AHU Unit 670 – 4000						
Daikin		AHU Integration Kit Single or Interlaced circuits HP coil paired with *VRV* CU system (4-34 ton)							
Daikin Applied			Destiny AHU Only 600-15000 cfm options						
Daikin Applied				Vision AHU Only 900-100,000 cfm options					
Daikin Applied				Rebel Rooftop (DOAS) 6-28 tons – 900 - 7,500 cfm					
Daikin Applied							Maverick II Rooftop (DOAS) 15-75 ton or 4500 - 23,000 cfm		





Solutions for Ventilation

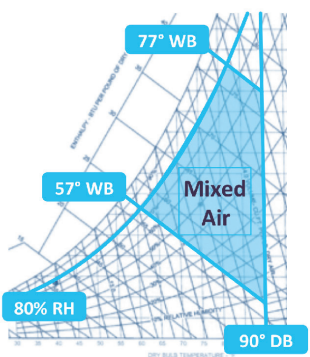
Allowable Ventilation Air %

Typically Daikin equipment has been applied using a standard rule of thumb that a maximum of 20% OA can be incorporated into a ducted fan coil unit (FXMQ, FXSQ, FXDQ, FXTQ and FXNQ). However, this practice is not always applicable as this rule of thumb is based upon introducing OA at nominal conditions.

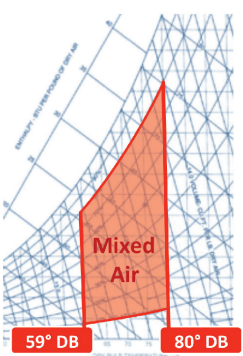
Basic Rules

1. COOLING: Any percentage of OA can be used as long as the resulting mixed air is between 57 and 77˚F WB and 80% RH or lower.
2. HEATING: Any percentage of OA can be used as long as the resulting mixed air is between 59 and 80˚F DB and 80% RH or lower.

COOLING
Between 57° and 77°F WB
and 80% RH or lower



HEATING
Between 59° and 80°F DB
and 80% RH or lower



Note: Space temperature sensing should be done via the room zone controller or remote sensor kit if a "mixed air" approach is taken.

VRV Ventilation Methods

Direct Method

Untreated outside air is mixed with return air either in the return air ductwork or enters the *VRV* IDU directly

Application Consideration

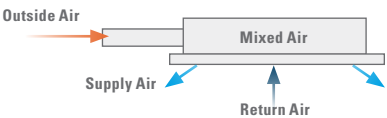
» IDU must be sized for both space and ventilation loads

» IDU fan speed varies with the different modes, affecting the amount of entering OA. A fixed speed is available through a field setting.

» OA should always be pre-filtered

Ducted IDUs *Mixed Air conditions must be within acceptable range*

Ductless IDUs *Defined max % of OA (3% to 20%)*



Pros	Cons
» Lowest cost	» Indoor fans must operate continuously to provide ventilation during scheduled occupancy » Limited OA (Mixed air limitation) » Indoor unit must be sized to handle the entire ventilation and internal load

	Scope	Options	Entering Air Limits	Connection Ratio Limits
Direct Method	1. Untreated ventilation is supplied directly to the indoor unit 2. Small projects where low CFM volumes are low CFM volumes are required 3. Projects with budget constraints 4. Suitable for mild climates	FXMQ FXDQ FXNQ FXTQ FXFQ* FXZQ* FXSQ FXEQ*	Cooling 57°–77°F WB Heating 59° F – 80°F DB	Follow the standard *VRV* CU to IDU connection ratio limitation (See table on page 11)

*Consider Booster Fan and OA% Scope

VRV Ventilation Methods

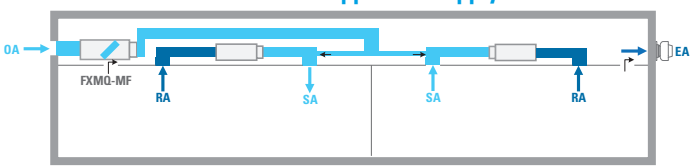
Integrated Method

The OA is conditioned by mechanical means before being supplied to the *VRV* indoor unit for distribution.

Application Consideration

» Allows the ventilation air unit (100% OA Unit, DOAS, HRV or ERV) to handle all or part of the OA load. The IDU is sized for the internal space load, and possibly part of the OA load.

Conditioned Outside air supplied to supply side of IDU



Pros

» Less ductwork and diffuser

» Opportunity for plenum condensation is reduced since OA is not introduced into IDU mix air plenum

» IDU capacity is not de-rated since they are handling only warm return air

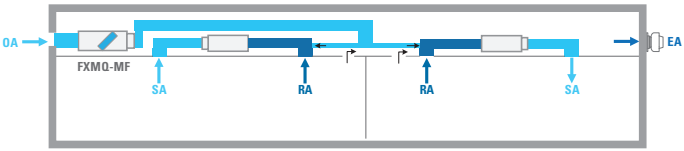
Cons

» IDU fan must run constant

» Difficult to balance

Integrated Method

Conditioned Outside air supplied to return side of IDU



Pros

» Less ductwork and diffusers

Cons

» IDU Fan must run constant

» Risk for condensation in the mixing plenum

» Indoor Unit capacity de-rate due to cool mix air temp

Integrated Method	Scope	Options	Entering Air Limits		Connection Ratio Limits	
	1. Pretreated ventilation is supplied directly to the indoor unit 2. Small to medium applications 3. Suitable for all climates 4. Allows for sharing load between ventilation system and *VRV* system	VAM	Cooling	122°F DB	Standard Connection Ratio Limits	
			Heating	5°F DB		
		FXMQ-MF	Cooling	Std Config: 90°F WB	Dedicated**	Std Config: 50-100%
				Enhanced Config: 78 (82*)°F WB		Enhanced Config: 50-130%
			Heating	Std Config: 23°F DB	Combined***	Std Config: 50-100% (FXMQ-MF <=30%)
				Enhanced Config: 59 (50*)°F DB		Enhanced Config: 50-130% (FXMQ-MF <=50%)

* Warm Up/Pull Down Operation
** Dedicated FXMQ-MF unit(s) and *VRV* CU
*** FXMQ-MF unit(s) combined with other Daikin IDU on a *VRV* CU system

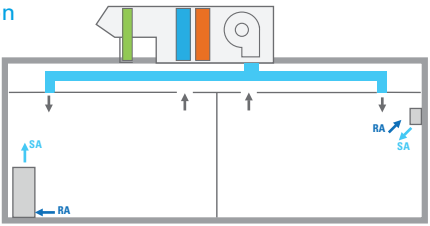
VRV Ventilation Methods

Separate Method (Decoupled)

OA is supplied directly to the space being conditioned. A separate ventilation system using conventional technology and a Daikin *VRV* system can both be installed where the *VRV* system function is to maintain comfort.

Application Consideration

» Allows the DOAS to handle the entire OA load. IDUs sized only for the internal space load.



Pros

» Opportunity to cycle off the local IDU fan

» Allows the OA unit to operate during unoccupied periods (for after hours humidity control or pre-occupancy purge)

» Flexible layout

» Can meet strict filtration requirement

» Larger OA volume

Cons

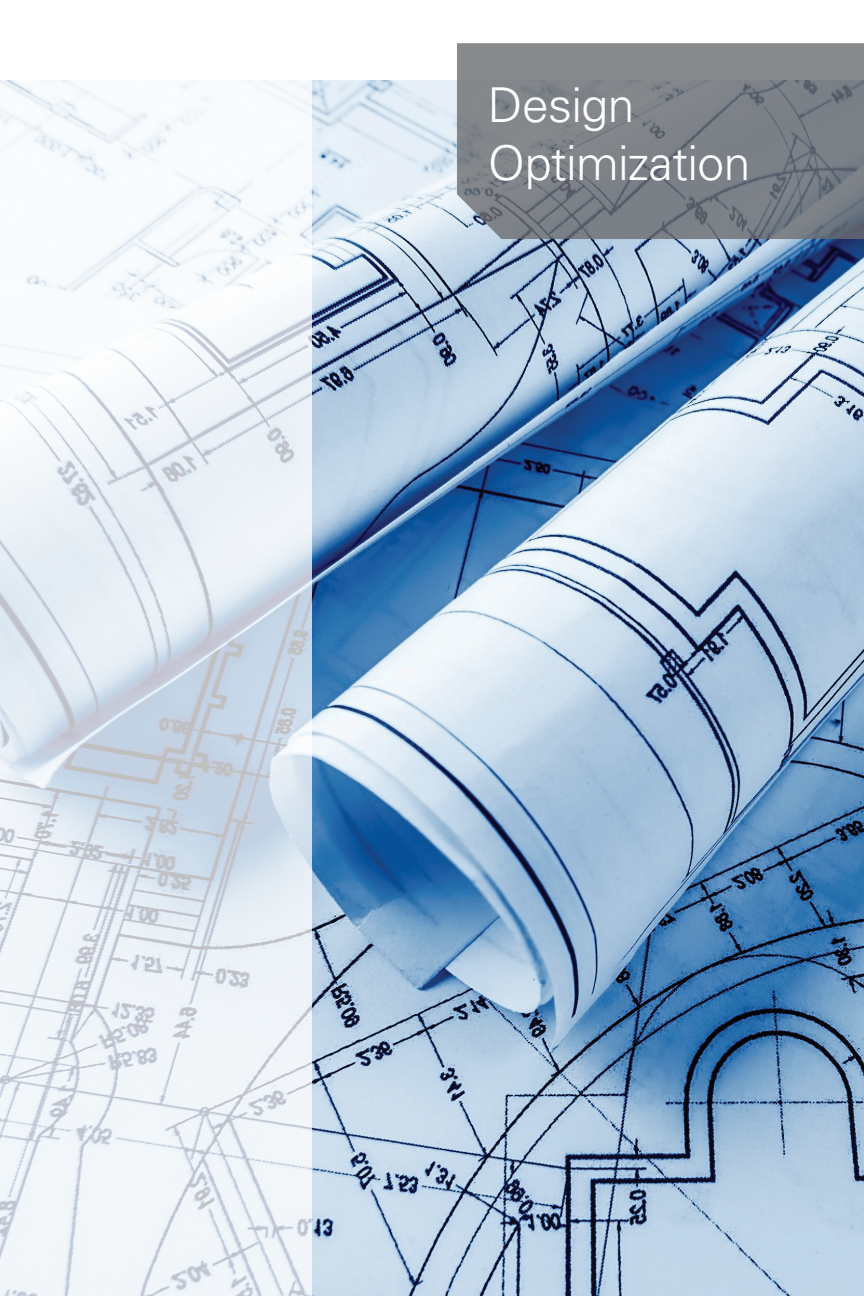
» Requires installation of additional ductwork and separated diffuser

» Many require multiple diffusers to ensure that OA is adequately dispersed through-out the zone

Separate (de-coupled) Method	Scope	Options	Entering Air Limits		Connection Ratio Limits
	1. Pretreated ventilation directly to the space 2. Suitable for all applications and climates 3. Allows for sharing load between ventilation system and *VRV* system 4. Most flexible layout	EKEQFCBA	Cooling	95°F DB	90 - 110%
			Heating	50°F DB	
		DVS	Cooling	115°F DB	50 – 120% (100%)***
			Heating	23°F DB**	
		Destiny Vision Rebel Maverick	Select options based on manufacturer guidelines. Integrate controls where it makes sense.		

** -20°F with gas heat
*** Triple Module

Design Optimization

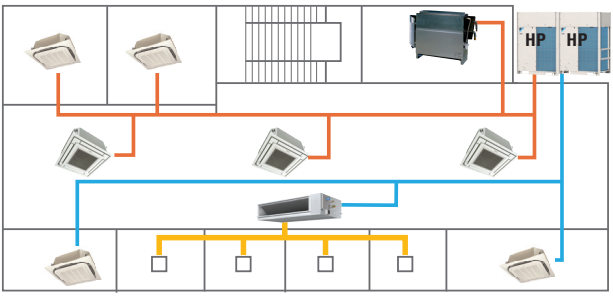


System Zoning

Guideline to Optimized Zoning of Systems

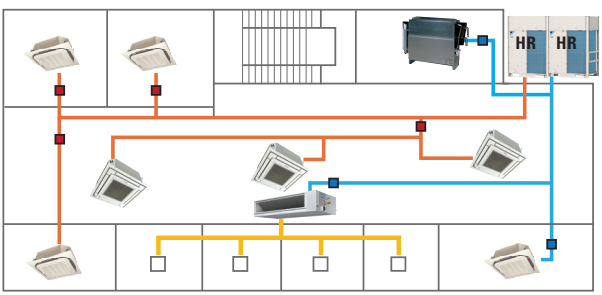
Typical Zoning of Heat Pump

When more than one system is required, it is good practice to zone units that are positioned on the same orientation or are subject to common load profiles. This maximizes the scope for correct heating/cooling demands to be met.



Typical Zoning of Heat Recovery

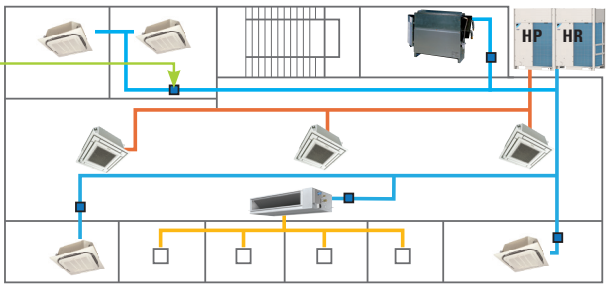
Conversely, with heat recovery it is better to ensure that units on different orientations are matched together. This ensures more potential for heat recovery to occur at any given time and thereby optimizing energy savings.



Note: Changing systems from HR to HP through the design process is not uncommon It does NOT affect initial indoor unit selection however re-zoning of fan coil units is may be required.

Optimized (mixed)

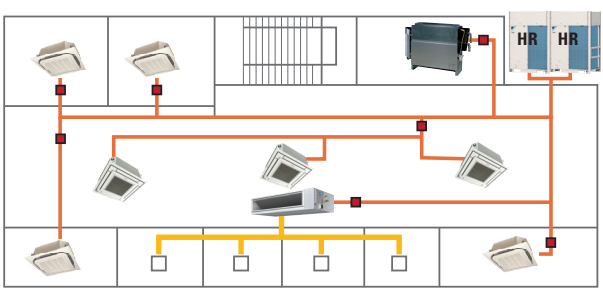
It is important to avoid defining a project as a 'heat recovery job' or 'heat pump job'. There are often applications where a mixture of both types is the best design practice - and can reduce costs to the client.



Note: The use of heat recovery does not always mean a branch selector box for each for each indoor unit or even each area – this is a good way to reduce costs further without compromising flexibility.

When to use MULTIPLE MODULES

There are advantages to linking *VRV* condensing units together. There may be less piping & total refrigerant and a greater likelihood of heat recovery (on 3-pipe) occurring due to the increase in varying zones on the systems.

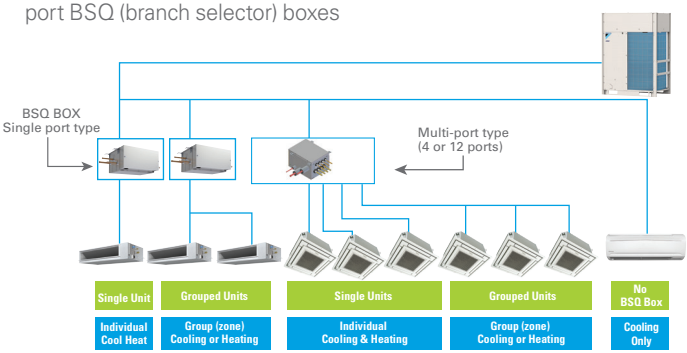


Note: This design option is often overlooked due to refrigerant limitations in small spaces set by ASRAE Std. 15
Current ASHRAE Std. 34 Regulations: 26lbs of R410A refrigerant per 1000ft³ (0.026lbs/ft³) in normal occupancies.

Branch Selector Boxes

Overview of BSQ Box Range & Features

Daikin heat recovery systems provide the option of single or multiple port BSQ (branch selector) boxes



Note: When multiple units are grouped together on a single port, although a single heat/cool zone is created, units still operate independent of each other irrespective of whether they are grouped together on one room controller or individual controllers.

Connection Limitations	Model	Max Units per PORT	Max Capacity per PORT	Max Capacity per BOX
	BSQ36	4	36 MBH	36 MBH
	BSQ60	8	60 MBH	60 MBH
	BSQ96	8	96 MBH	96 MBH
	BS4Q54	5	54 MBH	144 MBH
	BS6Q54	5	54 MBH	216 MBH
	BS8Q54	5	54 MBH	290 MBH
	BS10Q54	5	54 MBH	290 MBH
	BS12Q54	5	54 MBH	290 MBH

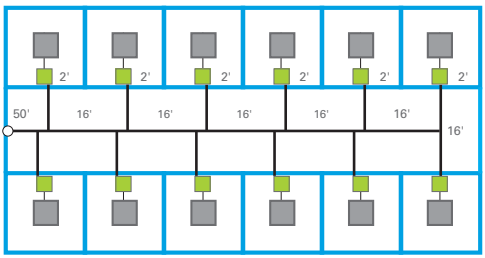
Single or Multi BSQ Boxes?

Optimized Selection of BSQ Boxes

» HEAT RECOVERY systems using single BSQ boxes generally require much less piping & refrigerant than a multiport box application.

» In addition noise levels of single port boxes are a lot less – this allows flexibility of location

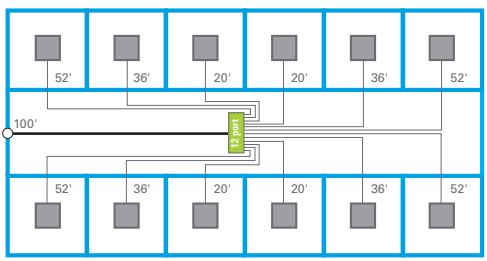
TOTAL PIPING REQUIRED	726 ft
REFNET JOINT SETS	11
BRAZED CONNECTIONS	186
BSQ BOX HANGING RODS	48



Single-Port Boxes = Up to 40% Less Piping Significantly Reduced Refrigerant

» HEAT RECOVERY systems using multi BSQ boxes will often demonstrate a reduction on installation costs

TOTAL PIPING REQUIRED	1164 ft
REFNET JOINT SETS	0
BRAZED CONNECTIONS	54
BSQ BOX HANGING RODS	4



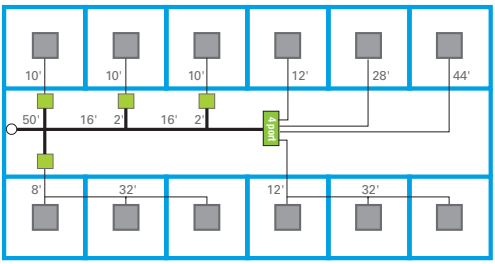
Multi-Port Boxes = Much less brazing, hanging rods and pipe branches

= BSQ Box | = Indoor Unit

Single or Multi BSQ Boxes?

Optimized Selection of BSQ Boxes

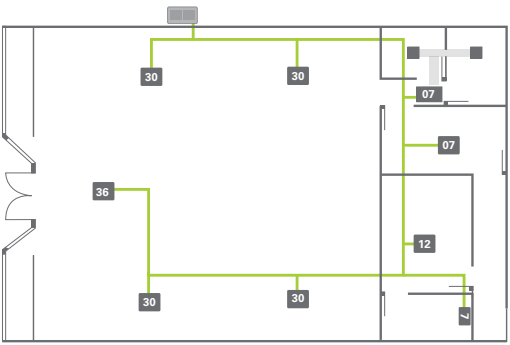
TOTAL PIPING REQUIRED	714 ft
REFNET JOINT SETS	8
BRAZED CONNECTIONS	102
BSQ BOX HANGING RODS	20



As shown in this scenario, being able to select single or multiple BSV boxes, in addition to zoning some units together on a single port, Daikin heat recovery allows the ultimate in flexibility, even on a single system.

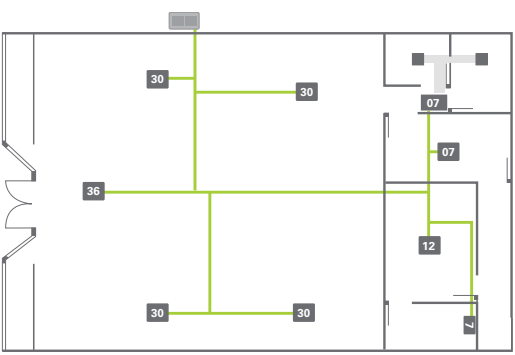
Optimized Pipe Routes

A factor not often considered before installation is establishing an optimum pipe route. This can be due to the limited choice of riser or outdoor unit location. However, establishing an optimum pipe route and order of unit attachment can realize significant reduction in pipe REFNET joint sizes, as well as refrigerant charge.



MAIN LINE PIPING (ODU to Last REFNET)	JOINT SIZES
70 ft of 1 1/8	5 x Large (size 72)
20 ft of 7/8	2 x Med (size 33)
4 ft of 3/4	1 x Small (size 22)
(NO 5/8)	
TOTAL REFRIGERANT: 37.5 lbs.	

Example 1 – LINEAR PIPE ROUTE



MAIN LINE PIPING (ODU to Last REFNET)	JOINT SIZES
32 ft of 1 1/8	3 x Large (size 72)
2 ft of 7/8	1 x Med (size 33)
19 ft of 3/4	4 x Small (size 22)
48 ft of 5/8	
TOTAL REFRIGERANT: 34.6 lbs.	

Example 2 - BRANCHING PIPE ROUTE

Outdoor Unit Installation Space

Minimum Space Requirements

At concept stage one of the most common requirements, especially in built up areas, is to establish that there is space to fit the outdoor equipment. The 'decentralized' nature of *VRV* provides a great deal of flexibility however the multitude of service space combinations in the engineering book still do not cover fully the bespoke nature of project application. Therefore it is important to have a grasp of minimum space requirements.

The 3 criteria to overcome are:

AIR STARVATION • SHORT CIRCUITING • SERVICE SPACE

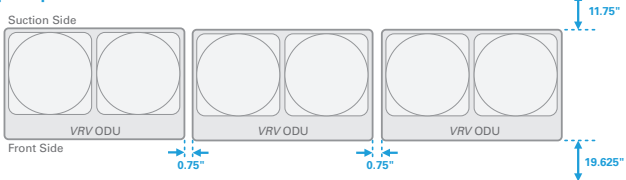
There are two constants regardless of the application, system type or series:

» *VRV* ODU's require a minimum of **11.75"** (300mm) **at the Rear** (or air side) of the unit

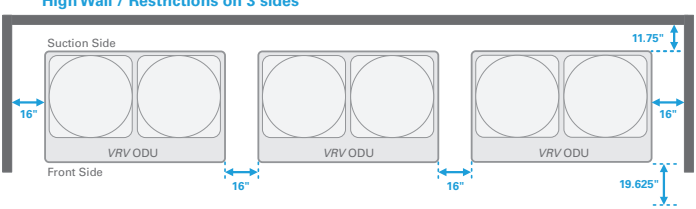
» *VRV* ODU's require a minimum of **19.625"** (500mm) **at the Front** (or service side) of the unit

***Note:** Local code may require a greater distance

Open Space / Minor Restrictions



High Wall / Restrictions on 3 sides



The complexity of design comes in to play when multiple units are to be installed into a restrictive area. The space between units in scenario 1 above are minimal and is only required to avoid any possible issues of vibration.

However when wall heights exceed those shown in the data book (as they usually do) rather than move units away from the wall, the better practice (if the space allows) is to move the units further apart from each other. The distance can vary according to a number of factors however 16" between units will cover most all scenario's.

Therefore, a great rule of thumb to ensure that a space is suitable for *VRV* equipment is: 12" x 16" x 20"

Think of the service engineer!

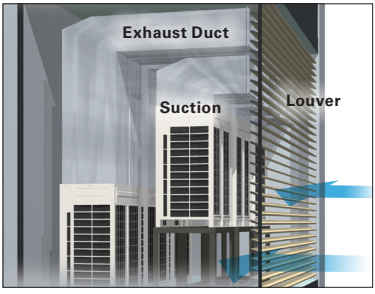
» The minimum service space (20") allows for the removal of a compressor however if rows of units are to be located in one area then place the units front to front and allow 40" between each row (24" air side to air side).

» The minimum space between units of 0.75" can make removing the top plate awkward. If space allows, always leave at least 4" between units (although this is not a necessity).

Mechanical Rooms & Acoustic Enclosures

» The same space rules apply in enclosed areas however the air side of a unit can be positioned closer than 12" to a louvered wall. Each unit has a maximum static pressure of 0.32"

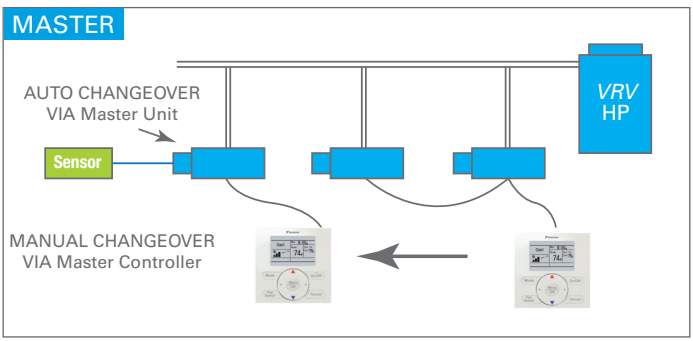
» Short circuiting and air starvation must also be addressed. This is specially so when units are to be situated behind acoustic louvers and when multiple units are to be positioned together in a single enclosure.



Heat Pump Changeover

The Various Heat/Cool Changeover Options

There are no less than six ways to provide heat/cool changeover on a heat pump system. Most of these also apply to heat recovery FCU's grouped on a single port of a BS Box (think of the BS box as a mini heat pump system).



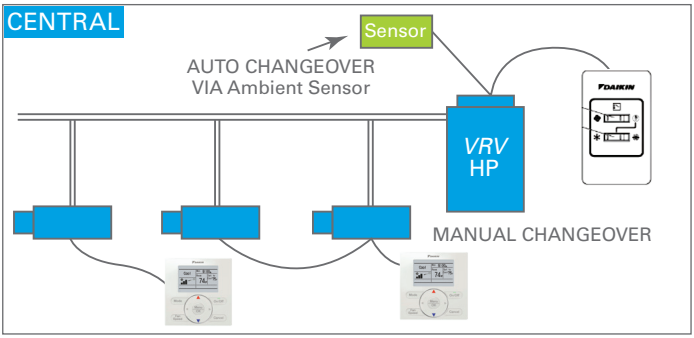
Master Unit:

The simplest way to address heat / cool changeover **automatically** is to nominate a master unit. When the unit's return air sensor measures outside the temperature set point limitation, he unit switches itself and all other units on the system to the different mode.

Master Controller:

Similar to the option above except mode selection is made **manually** by via a designated master controller. Again, all other units on the system then switch mode in unison.

Note: A common pitfall is to elect an area that is not in constant use or has no easy access (e.g. managers office) In both options above, if the unit isn't running then mode change is not possible without the intervention of some form of central control.



Summer / Winter Switch:

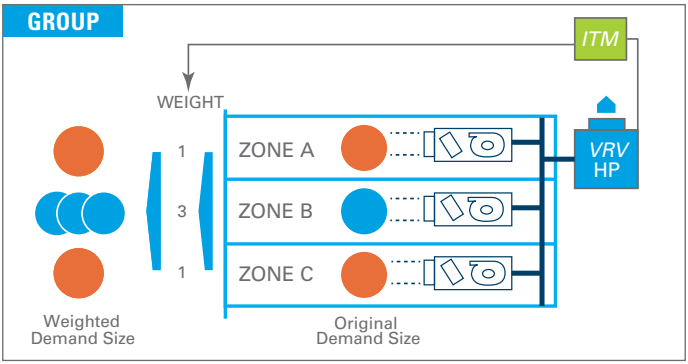
A Daikin supplied switch is attached to "ABC" terminals on the external unit to allow **manual** changeover from a central location. This is commonly found on sites with facilities managers or multi-tenant sites such as hotels where heat pump was installed in an exclusively cooling region.

3rd Party Ambient Sensor:

This option was developed to provide an **automatic** version of the summer winter switch. A remote ambient sensor will dictate when mode change occurs. Occasionally used in temperate climates where budget constraints push the application towards heat pump but is an option rarely seen in this market.

Note: Both the central mode control options above are only utilized on heat pump systems.

Heat Pump Changeover



Averaging Sensors:

Historically, a popular method is to elect all units to act as joint 'master' units. Automatic mode change occurs when the majority of units demand it.

Voting System:

The most flexible auto change over is the voting system. Changeover operates by continually calculating the demand load of each room by measuring the temperature differential of the set point against the room temperature. Modes are regularly changed accordingly.

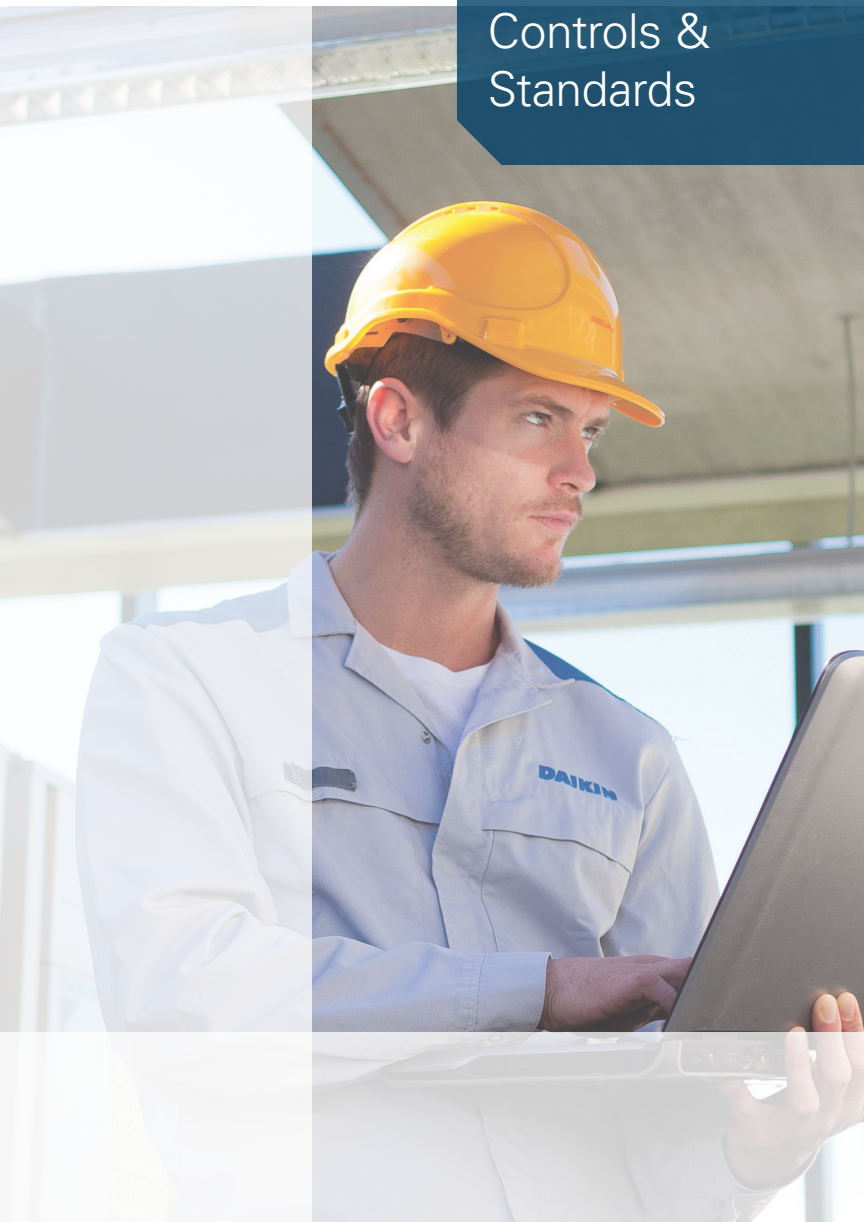
This method can be tailored on each application by 'weighting' the demand of a room based on it's importance. Note that this method can be used for units grouped together on a single port of a heat recovery system.

Note: Both "Group" changeover methods require a Daikin i-Touch Manager to operate.

In Summary:

With ALL changeover options, when a system mode is changed, the indoor units on the system are not forced into heating or cooling. If there is no demand in the room for the mode that has been selected, the unit(s) will run in fan only mode.

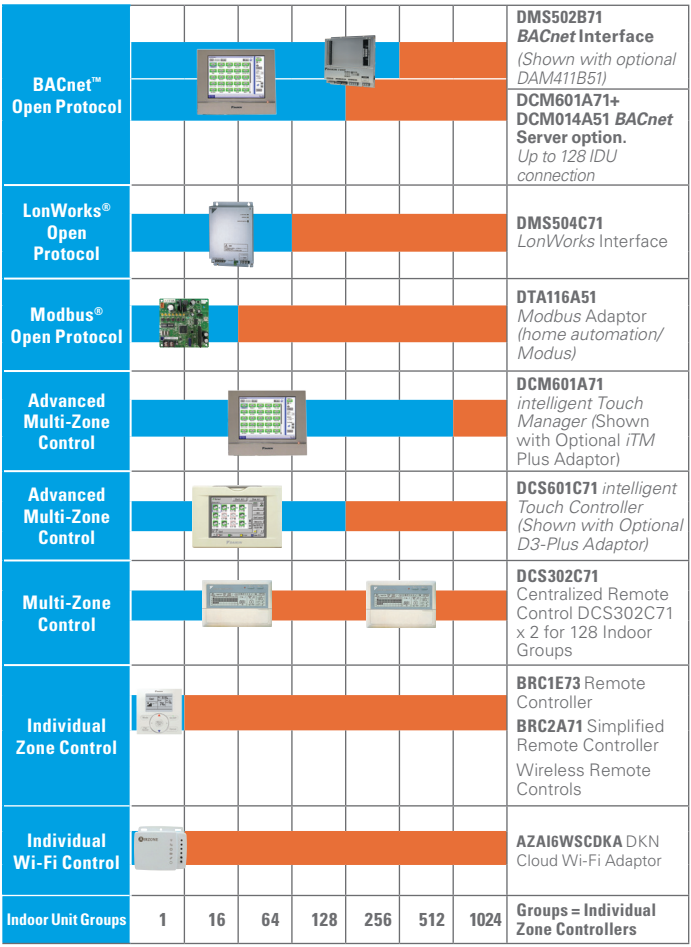
Controls & Standards



Controls Portfolio

Range of Zone and Centralized Controllers

Scalable controls offering to match a building's requirement



= Indicates that requirements can be met with the application of multiple devices

Project requirements drive the controls selection process

Project Requirements		Daikin *VRV* Controls			
	 AZAI6WSCDKA DKN Cloud Wi-Fi Adaptor	 BRC1E73 *Navigation* remote controller	 BRC2A71 Simplified remote controller	 DCS302C71 Centralized remote controller	 DCS301C71 Unified remote controller
Simple individual zone control	●	●	●		
Independent Cool and Heat set-points	●	●			
Individual zone control with weekly programmable scheduling	●	●			
Multi-zone control without scheduling functions				●	●
Basic central point on/off control of all air handling units				●	●
Multi-zone control of small to medium size projects				●	●
Multi-zone control of large commercial projects				●	
Advanced multi-zone control with scheduling logic and calendar					
Automatic cooling/heating changeover for heat pump systems	●	●			
Single input batch shutdown of all connected air handlers				●	●
Web browser control and monitoring via Intranet and Internet					
E-mail notification of system alarms and equipment malfunctions					
Multiple tenant power billing for shared condenser applications					
Temperature set-point range restrictions		●			
Remote control and monitoring through smartphone app	●				

*Requires one or more DEC102A51-US2 party energy management system

● Native application or feature Digital Input/Output units.

Project requirements drive the controls selection process (cont.)

Project Requirements	Daikin *VRV* Controls					
	intelligent Touch Controller 	*intelligent Touch Manager* 			WAGO® I/O 	WAGO® BACnet™/IP Controller 
		Basic	BACnet™ Client Option	BACnet™ Server Option		
Independent Cool and Heat set-points	●	●		●		●
Individual zone control with weekly programmable scheduling	●	●				●
Basic central point on/off control of all air handling units	●	●		●		●
Advanced multi-zone control of small to medium size projects	●	●	●	●	●	●
Advanced multi-zone control of large commercial projects	●	●	●	●	●	●
Advanced multi-zone control with scheduling logic and calendar	●	●		●		●
Automatic cooling/heating changeover for heat pump systems	●	●		●		●
Single input batch shutdown of all connected air handlers	●	●		●		●
Web browser control and monitoring via Intranet and Internet	●	●				●
E-mail notification of system alarms and equipment malfunctions	●	●				●
Multiple tenant power billing for shared condenser applications	●	●				●
Temperature set-point range restrictions	●	●		●		●
Graphical user interface with floor plan layout		●				●
Start/Stop Control of External Equipment	●	●	●		●	●
Modulating Control of External Equipment			●			●
Custom Programming for external equipment control						●
Indoor and outdoor unit service data monitoring		●	●	●		

● Native application or feature for this device. ● Dependent upon controller programming

Project requirements drive the controls selection process (cont.)

Project Requirements	Daikin *VRV* Controls			
	BACnet™ Interface 		LonWorks® Interface 	Modbus® Adaptor 
	Basic	With BMS Plug-in		
Independent Cool and Heat set-points		●		
Individual zone control with weekly programmable scheduling				
Basic central point on/off control of all air handling units	●	●	●	●
Advanced multi-zone control of small to medium size projects	●	●	●	●
Advanced multi-zone control of large commercial projects	●	●	●	
Advanced multi-zone control with scheduling logic and calendar	●	●	●	●
Automatic cooling/heating changeover for heat pump systems	●	●	●	●
Single input batch shutdown of all connected air handlers	●		●	
Web browser control and monitoring via Intranet and Internet	●		●	●
E-mail notification of system alarms and equipment malfunctions	●		●	●
Multiple tenant power billing for shared condenser applications				
Temperature set-point range restrictions	●	●	●	●
Graphical user interface with floor plan layout	●	●	●	●

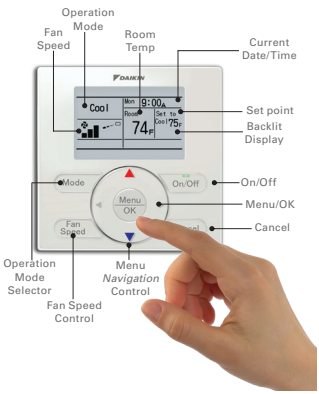
● Native application or feature for this device. ● Dependent upon capabilities of third party energy management system

Local Control Options

Features & Benefits of the Room Controller

BRC1E73 -*Navigation* Room Controller

Daikin room controllers offer a vast array of features that provide the ultimate in flexibility and benefits that many other manufacturers' are unable to offer.



The controllers operate on the basis of last command priority.

In addition to the basic functions that meet the zone control requirement of all *VRV* indoor units, the *Navigation* Remote Controller will provide advanced control functions that historically require a central controller to administer:

- » 7 day Schedule
- » Temperature Limiting
- » Control Lockout
- » Dual set-points
- » Auto cool/heat changeover
- » Automatic adjustment for Daylight Saving Time (DST)
- » Temperature sensor with configurable offset

AZAI6WSCDKA - DKN Cloud Wi-Fi Adaptor

The DKN Cloud Wi-Fi Adaptor enables the control of the P1P2 indoor units through a iOS/Android smartphone app. The adaptor is used as a sub controller on the P1P2 bus, thus a BRC1E73 controller is required to be used together with the Wi-Fi adaptor. The following functions are available on the smartphone app with this adaptor:

- » On/Off
- » Mode
- » Set-point
- » Fan speed
- » Room temperature
- » Error alert
- » Schedule
- » Leveled user authority

Featured Controllers

DCM601A71 – *intelligent Touch Manager*

The *intelligent Touch Manger* (*iTM*) is an advanced multi-zone controller that controls and monitors Daikin *VRV* system.

intelligent touch Manager

- » Easy operation and configuration with LCD touch screen
- » Advanced control functions includes dual setpoint, setback control, auto-changeover, setpoint range limitation, weekly schedule with optimum start and etc.
- » Indoor unit, outdoor unit, connected BACnet™ Client points, and WAGO® I/O operation data is stored in the *iTM* every minute for the previous 5 days. The operation data can be accessed and downloaded through the *iTM* web access or USB output.
- » Web Access and Alert Emails
- » Tenant Billing with PPD Option
- » Monitor and controls DI, DO, AI, AO signals of external equipment with *WAGO* I/O kit

DCM009A51 – *iTM BACnet* Client Option

The *iTM BACnet* Client Option enable the *iTM* to monitor and control external equipment through the *BACnet*/IP protocol.

- » Object Types: AI, AO, AV, DI, DO, DV, MSI, MSO, MSV
- » The operation data for indoor and outdoor unit *BACnet* Client points are available in the *iTM* every minute for the previous 5 days.
- » Applications: Integrate the *iTM* with sensors, lighting, pumps, fan, DOAS, and etc.

Featured Controllers

DCM002A71 - *iTM* Power Proportional Distribution (PPD) Option

With the PPD Option, energy consumption of the *VRV* system is proportionally calculated for each indoor unit.

DCM014A51 – *iTM* BACnet™ Server Gateway Option

With *iTM BACnet* Server Gateway Option, Building Management Systems (BMS) can monitor and/or control *VRV* indoor and outdoor units units via the *BACnet*/IP protocol. This option provides seamless control logic integration between *iTM* and BMS.

- *BACnet* virtual router function implemented to enable individual *BACnet* device ID for each indoor unit
- Indoor unit and outdoor unit service data points are available to be monitored by BMS
- *iTM*'s advanced control functions including dual set-points, setback control, auto-changeover, setpoint range limitation, and schedule can be accessed by the BMS
- Supports Change of Value (COV) and foreign device registration

DMS502B71 – Interface for use in *BACnet*

Interface for use in *BACnet* is a hardware gateway solution that enables the BMS to monitor and control the *VRV* indoor units through *BACnet*/IP protocol.

To resolve the challenges of integrating the *VRV* systems, Daikin provides BMS Plug-ins to the integrators for easy integration with the *VRV* system. BMS Plug-ins are pre-programmed objects and graphics built for Niagara AX® specifically for Daikin *VRV*. By the use of free-of-cost BMS Plug-ins, the integrators work load could be reduced to as little as point linking.

DTA116A51 – DIII-Net/Modbus® Communication Adaptor

The DIII-Net/*Modbus* Communication adaptor can be used for Home automation system integration. With the adaptor, up to 16 indoor units can be controlled through *Modbus*/RTU.

DMS504C71 – Interface for use in LonWorks®

Interface for use in *LonWorks* is a hardware gateway solution that enables the BMS to monitor and control the *VRV* indoor units through *LonWorks* communication.

750-831 - WAGO® BACnet™/IP Controller

The *WAGO BACnet*/IP Controller is a programmable controller that connects the *WAGO* I/O system to the *BACnet* protocol. With the customizable programming provide by the Daikin Controls team, *WAGO BACnet*/IP controller can help fulfill most project control requirements for Daikin and third-party equipment control.

Codes & Standards

Some Key Considerations

Category	Key Codes/ Standards	Situation for *VRV*
Safety and Electrical	UL 1995 Nat'l Electric Code NFPA 90A, 90B ASHRAE Std 15 Canada: B52	Daikin systems are UL 1995 certified. Install per NEC guidelines. Daikin systems comply via UL 1995. Std is applicable for APPLICATION, Not equipment. RcL not to exceed 26lbs/1000cuft (13lbs in restricted/institutional occupancies).
Efficiency & Performance	AHRI Std 1230 ASHRAE Std 90.1 ASHRAE Std 62	Daikin *VRV* is tested and rated to AHRI Std 1230. Daikin *VRV* performance ratings exceed ASHRAE Std 90.1 2010. Daikin *VRV* systems can be configured to satisfy ASHRAE Std 62 (Ventilation, IAQ) requirements.
Federal Trade Commission	Buy American Act Trade Agreements Act	U.S. DOE has issued waiver for Ductless and *VRV* products. All projects need to be confirmed through the Daikin legal dept. who can formally issue waiver notice and explanation for compliance purposes
Installation & Application	Int'l Building Code Int'l Energy Conservation Code Int'l Mechanical Code	Wind Loads – Use tie down drawings Seismic – Use OSHPD certification Economizer – Use optional accessory Insulation – Use ¾" thick Armaflex Condensate – Units with Pump & Float Switch are OK. Ductless units no need for secondary pan if level sensor used. Ventilation – similar to ASHRAE Std 62. Refrigeration – fittings used must be UL 1995 which Daikin's are.
Local Code	Code Adoption Varies	Local Code can introduce additional considerations on top of the national codes so always confirm requirements.

Where to find Official Information?

Product Detail		Design Guide	Eng. Data	IOM	Submittal	Option Handbook	SVM	Sales Bulletin
Features	**Summary**	◆	◆					◆
Specification	Summary Table		◆	◆			◆	◆
	Electrical		◆	◆	◆		◆	
Drawings	Dimension		◆		◆		◆	
	Piping		◆		◆		◆	
	Wiring		◆				◆	
Performance	Capacity Correction		◆		◆			
	Piping		◆		◆			
	Airflow / ESP		◆		◆			
	Sound Level		◆		◆			
Installation	Piping		◆	◆				
	Wiring		◆	◆				
	Fundamentals		◆	◆				
	Sizing & Charging		◆	◆				
Operation	How to use			◆				
	Controls	◆	◆	◆				◆
Accessories	Specification		◆			◆		◆
	Installation					◆		◆
Characteristics	Functions	◆					◆	
Set-up, Commissioning & Service	Test Operation			◆			◆	
	Troubleshooting						◆	
	Flow Charts						◆	
	Replace Procedure						◆	

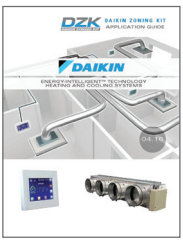
Further Documents and Data

Further information for the application of *VRV* is available in form of Best Practice Guides. Hard copies are available and can also be obtained online via daikincity.com

Best Practice Guides

Outdoor Unit Layout Guide
BPG-VRV4OD

Codes and Standards
BPG-CS



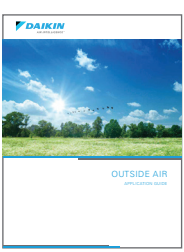
Daikin Zoning Kit
BPG-DZKAPP

Building Automation
BPG-BAS

VRV Extreme Climates
BPG-EXTAMB

Water-Cooled *VRV*
BPG-WTVR

Reference Guides



OA Integration
BPG-OAGUIDE
Coming Soon!

Single and Multi-Zone Systems Reference Guide
PM-DCRG

VRV LIFE
Reference Guide
PM-DKLIFE

Design Workshops

Regional training offered by Daikin Applications Engineering

Understanding the components and methods that create an optimized *VRV* design is key to continued success in the application of Daikin's flagship system. Application Engineering have developed a portfolio of Design Workshops (DWS) to support a wide range of products, topics and levels of experience with the *VRV* system.

What specific courses are available?

There are currently seven courses on offer. All require a full days attendance (unless indicated):

FOUNDATION LEVEL

- ***VRV* DESIGN WORKSHOP**
  This 2 day course is in high demand and is essential for anyone new to *VRV* design
- ***VRV* DESIGN AND BUILD**
  Geared toward D&B installers and those involved in light commercial applications
- ***VRV LIFE* DWS**
  Created to assist installers designing this system for the residential market

ADVANCED LEVEL

- **CODES & STANDARDS**
  Clarifying the regulations that often influence *VRV* design through to bid stage
- **COLD CLIMATE**
  Covers all the methods of supplemental heating used with *VRV* in colder climates
- **OUTSIDE AIR INTEGRATION**
  Understanding the various methods of outside air integration with *VRV* equipment
- **WATER-COOLED**
  All aspects of W-*VRV* and water loop integration to ensure optimized design

Who is eligible to attend?

The target audience is anyone involved in project design. This includes (but is not limited to) Daikin Manufacturer Representatives, Distributors, Dealers, Consulting Engineers and Installers.

What is the method of training?

All courses are structured into four main components:

- **Training:** Formal presentation covering the main topic and demonstration of the selection tool
- **Design:** Participants design a project based on a given scenario
- **Presentation:** Participants present their project design for review
- **Solution & Summary:** Trainer provides optimized solution(s) and summarizes learning

These "in-house" courses are available regionally and run by Daikin Application Engineers. We will come to you! Consult your Daikin representative for availability or contact our team directly at applications.engineering@daikincomfort.com

www.daikincity.com

For more information:

Sales and Technical Support: 1-855-DAIKIN1

www.daikincomfort.com or daikinac.com