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Variable Refrigerant Flow Systems

VRF

Variable Refrigerant Flow

Agenda

- Who is Jacco
- Who is Samsung
- What Is VRF
- System Piping
- Condensing Unit Features
- Compressor Features
- Vapor Injection
- Robust Design
- Indoor Unit Line-up and Features
- Control Options
- Start Up
- DVM Pro Program
- Training

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Who is Jacco

- Established 1968
  - Hudson, Ohio
  - Columbus, Ohio
  - Toledo, Ohio
- Focused on the Engineered Environment
  - Systems Knowledgeable
    - HVAC Systems
    - Service & Maintenance
    - Parts
- Full Circle Support
- 30 Minute Design

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Who is Jacco

- Operations Group
  - –Brenda Homjak
  - –Mike Spangler
  - –Chad Russell

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Purpose Statement

The purpose of our Company is to solve our customers problems, in the most economical way, at all times optimizing the owning experience.

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Who is Jacco

- 30 Minute Design
  - Unit Performance
  - Drawing
  - Weights
  - Electrical
  - Specifications?
  - Sequence of Operation?
  - Cartoon?
  - Narrative?

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Who is Jacco

2015 Seminars

Seminars	Instructor	Date
Psychrometrics	JKC	14-Jan
The Refrigeration Cycle	JKC	11-Feb
Energy Recovery	GAD	11-Mar
Applied Rooftop Systems	JKC	8-Apr
VRF Design & Installation	GAD	13-May
Geothermal Systems	GAD	10-Jun
Chilled Beam, Radiant Cooling & DOAS	JKC	12-Aug
Vertical Market Systems	GAD	9-Sep
Building Pressure & Air Flow Measurement	GAD	14-Oct
Controlling HVAC Systems - Sequence of Operations	JKC	11-Nov

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Who is SAMSUNG

- The World's 14th Largest Company
- The World's Largest Information & Technology Company
- The World's 8th Most Valuable Brand Name
- The World's #1 Flat Screen TV Manufacturer
- The World's #1 Smart Phone Manufacturer
- Samsung Revenues = 17% of South Korean Economy
- 425,000 Employees Worldwide
- R & D Staff = 40,000 Employees

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Brand Value

- Samsung ranked 8th among global companies in 2013

※ Source : BusinessWeek , Interbrand (Oct. 2013)

※ Value : US$ Billion

Patent Leadership

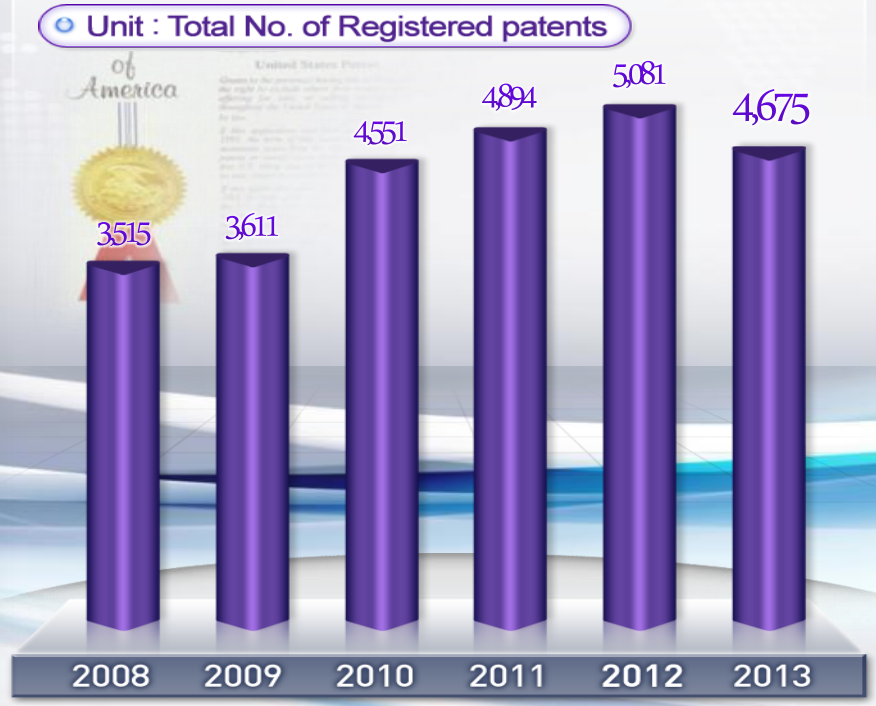
Patent leadership in the electronics industry

Top Patent Winners (2013, US)

Rank	Company
1	IBM
2	Samsung Electronics
3	Canon
4	Sony
5	Microsoft
6	Panasonic
7	Toshiba
8	Hon Hai
9	Qualcomm
10	LG Electronics

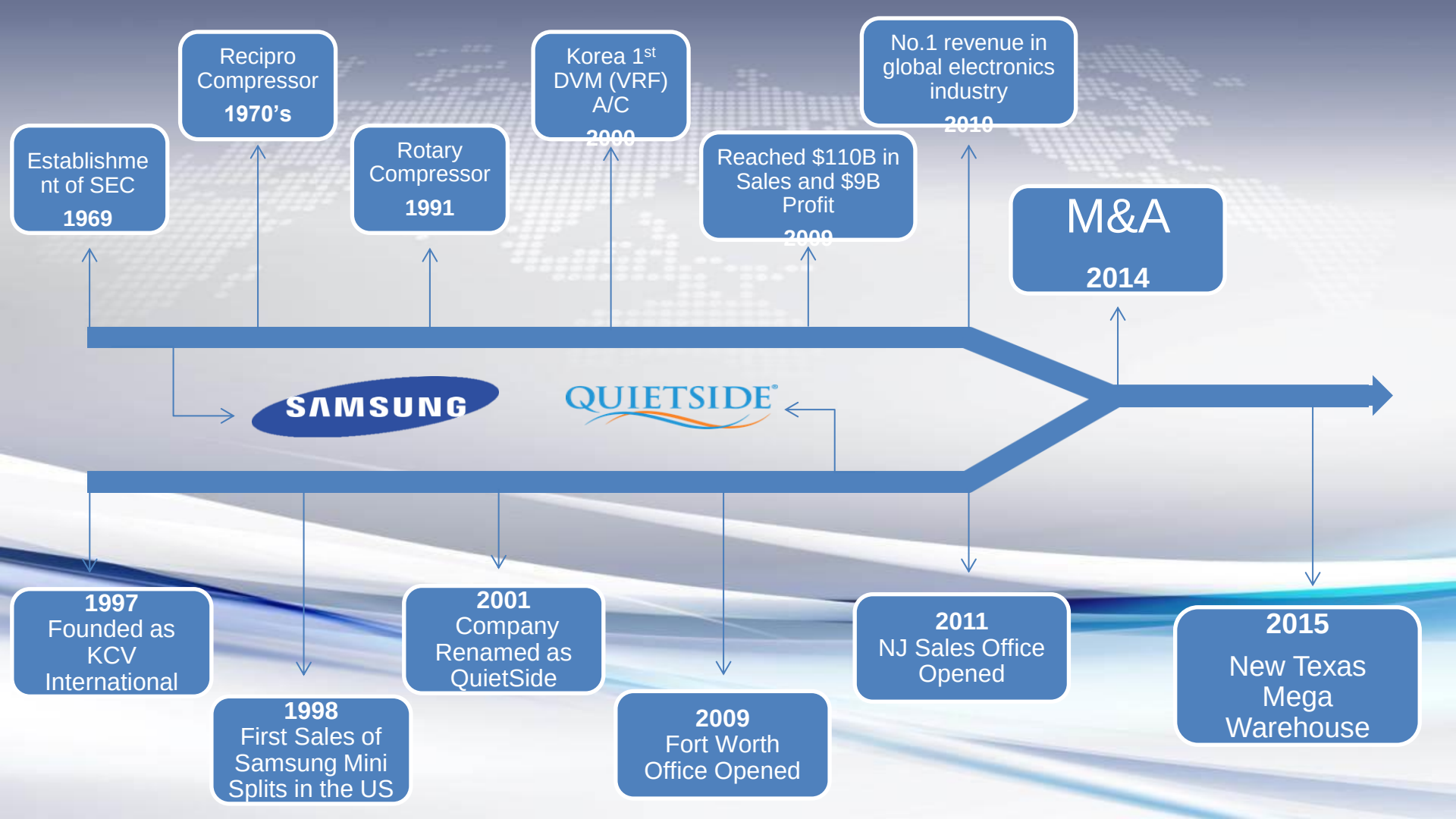
※ Source : USPTO, Based on registration

Samsung Patent Status in U.S.



Global Network

※ Feb. 2014 (excluding domestic sites)


Establishment of SEC
1969
Recipro Compressor
1970's
Rotary Compressor
1991
Korea 1st DVM (VRF) A/C
2000
Reached $110B in Sales and $9B Profit
2009
No.1 revenue in global electronics industry
2010
M&A
2014
SAMSUNG
QUIETSIDE
1997
Founded as KCV International
1998
First Sales of Samsung Mini Splits in the US
2001
Company Renamed as QuietSide
2009
Fort Worth Office Opened
2011
NJ Sales Office Opened
2015
New Texas Mega Warehouse

http://www.jacco.com/

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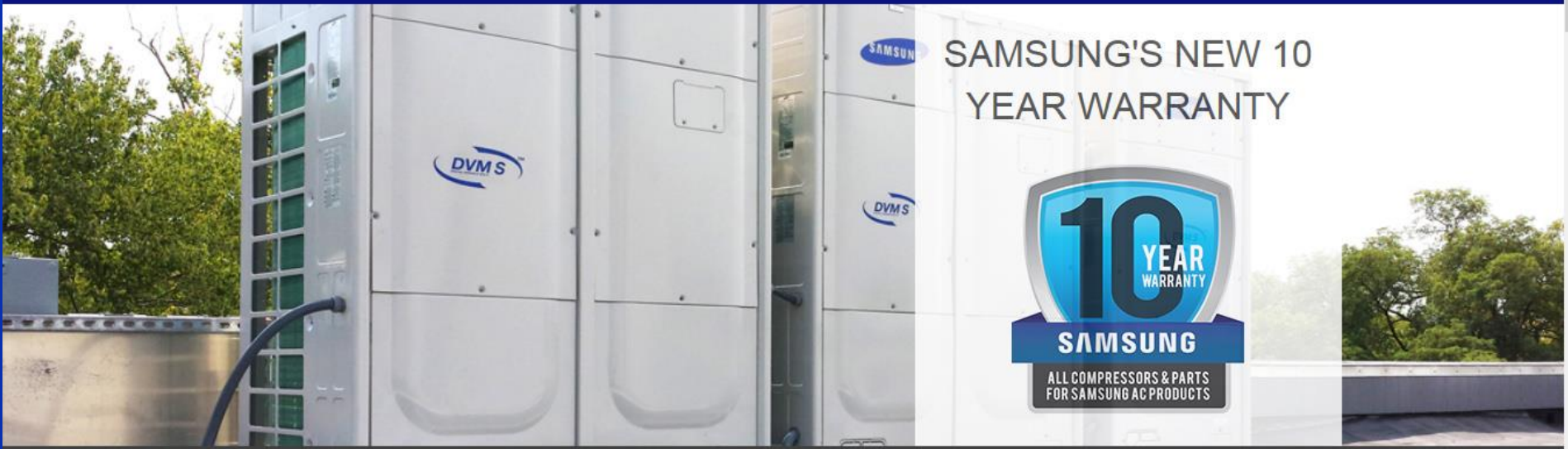
PARTS & SERVICES 330-463-0100



ABOUT US NEWS HVAC SYSTEMS SERVICE PARTS PORTFOLIO NATIONAL ACCOUNTS SEMINARS 30 MIN DESIGN CONTACT

12:53 AM
5/13/2015

DVM S Installations

La Sierra University

Product: DVM S Heat Recovery
Application: University - dorms and commons area
Location: Riverside, CA
Tonnage: 120 tons
Installing Contractor: American Comfort Systems
# of Outdoor Units: 15
# of Indoor Units: 143

DVM S Installations

Sienna Mercato

Product: DVM S Heat Pump & Heat Recovery
Application: Restaurant
Location: Pittsburgh, PA
Installing Contractor: JB Mechanical
Tonnage: 54 tons
Control: 1 Programmable MWR-WE10N Wired Remote
# of outdoor units: 5 (3 on 1st and 2nd floors, 2 on 3rd floor)
# of indoor units: 29 (18 on 1st and 2nd floors, 11 on 3rd floor)

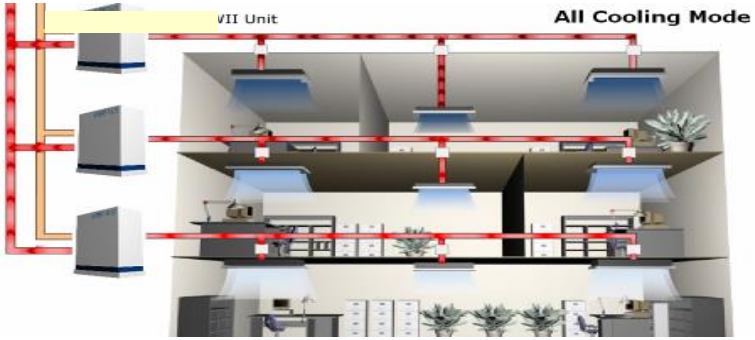
What is VRF?

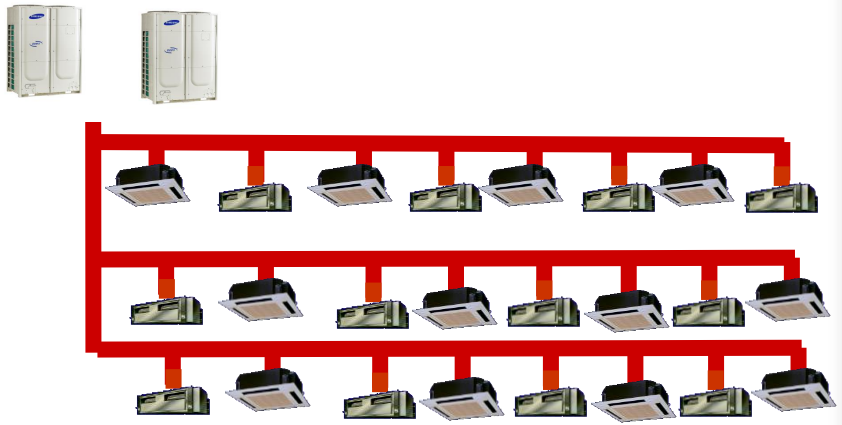
VRF – Variable Refrigerant Flow, is a method of heating and cooling using refrigerant and variable capacity compressors.

- VRF systems can be Heat Pump, or Heat Recovery systems.
- One of the biggest difference between manufactures is piping layout

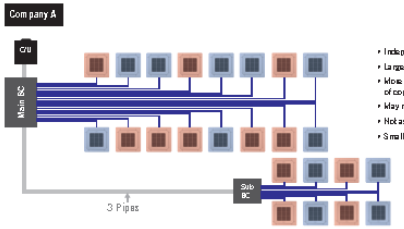
VRF Concept

- Multiple indoor units connected to one outdoor unit
- Up to 64 on **a single** refrigerant piping network
- Available in either **air cooled** or **water cooled**

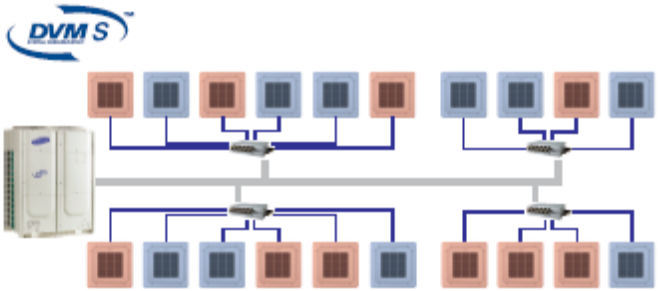




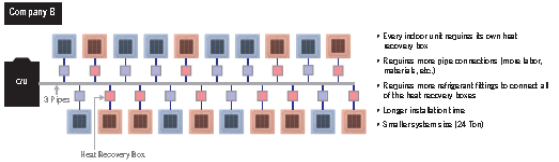
Piping Layout



- Independent heat / cool
- Larger pipe diameter pipe from CU to main BC
- More pipe backtracking (uses more linear feet of copper)
- May need separate machine room for Main BC
- Not as flexible for multiple floor installation
- Smaller system size (28 Ton)



- Totally independent indoor unit heating and cooling operation (simultaneous heating and cooling)
- Better heating performance than 2 pipe heat recovery systems at low ambient temperatures (liquid / gas mixture type)
- Less refrigerant pipe backtracking
- Flexible installation with 4 and 6 port MCU options (can connect 1 – 6 indoor units to MCU's)
- Highest simultaneous heat and cool efficiency
- Lower installation and running energy cost



- Every indoor unit requires its own heat recovery box
- Requires more pipe connections (more labor, materials, etc.)
- Requires more refrigerant fittings to connect all of the heat recovery boxes
- Longer installation time
- Smaller system size (24 Ton)

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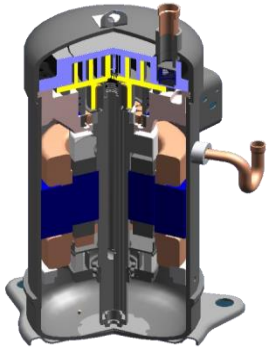
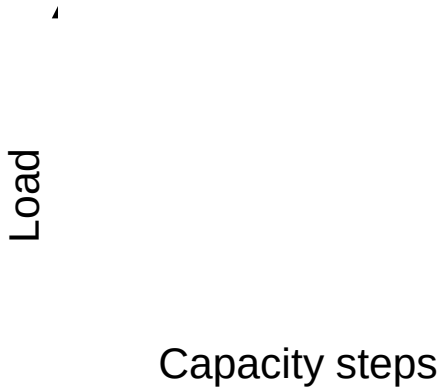
VRF Concept

System Capacity Control - Inverter

- An Inverter is a Variable Speed Drive that changes the Frequency being fed to an Electric Motor (VFD)
- Exactly the right amount of refrigerant is supplied to meet the cooling or heating requirements





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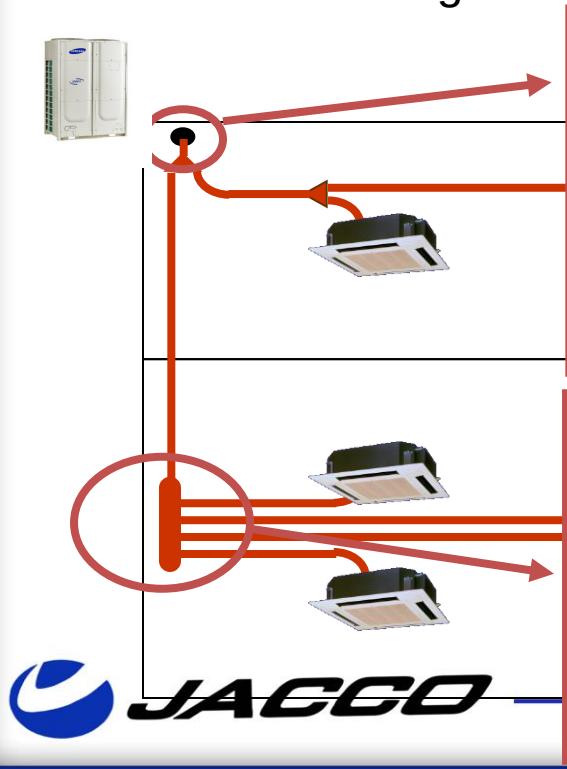
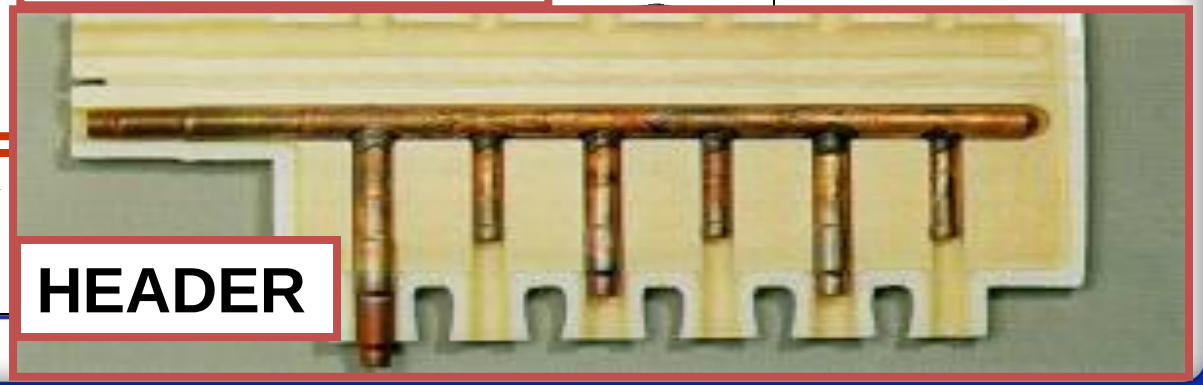
VRF Concept

Simple Pre-Engineered Piping Installation

Standard refrigerant balancing joint and header



Y-JOINT



HEADER

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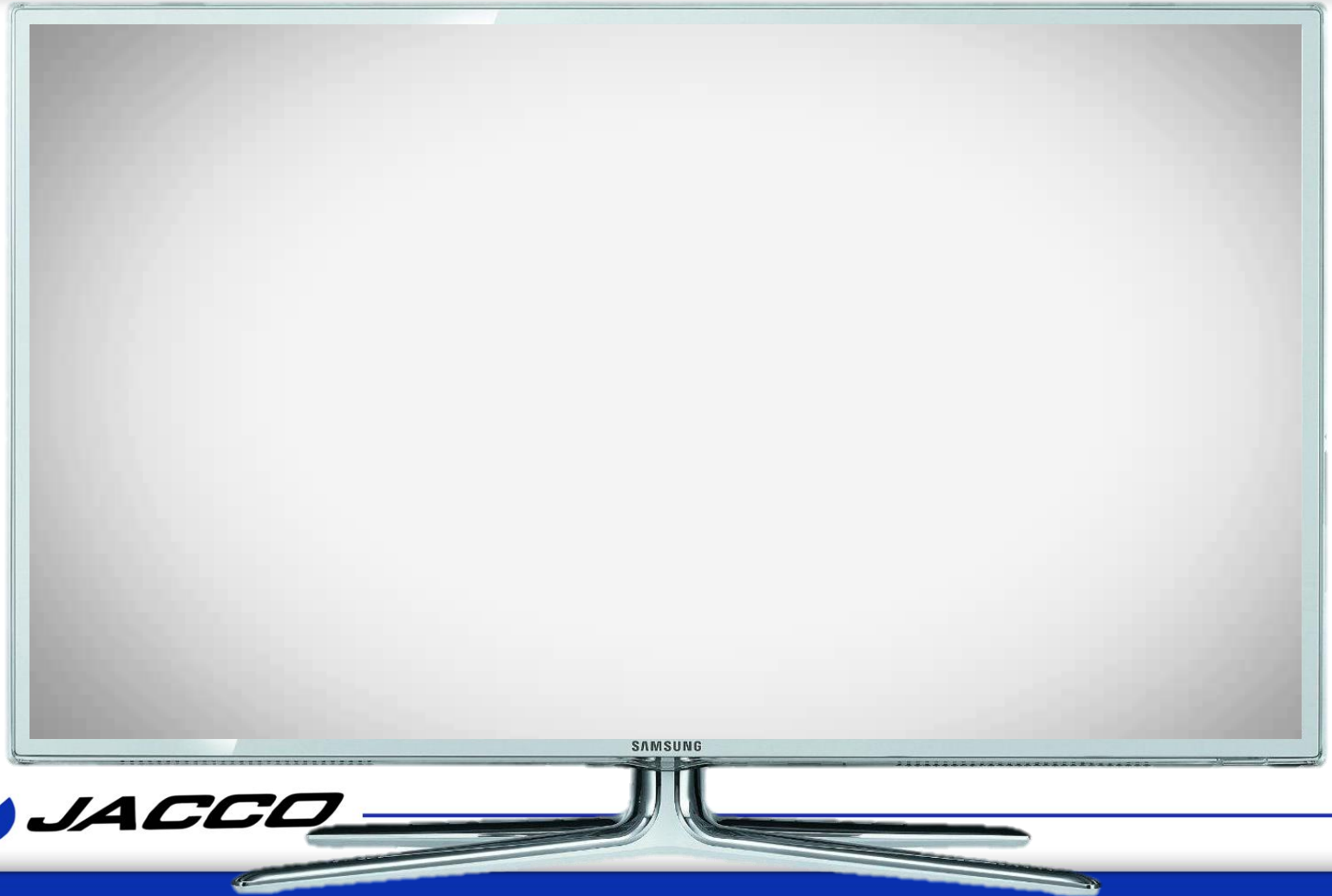
Heat Recovery – Mode Change Units (MCU)

(Top view without cover)

- Mandatory for heat recovery systems. 3 pipes in from outdoor unit(s), 2 pipes out to indoor units.
- 4 and 6 zone options

MCU Video



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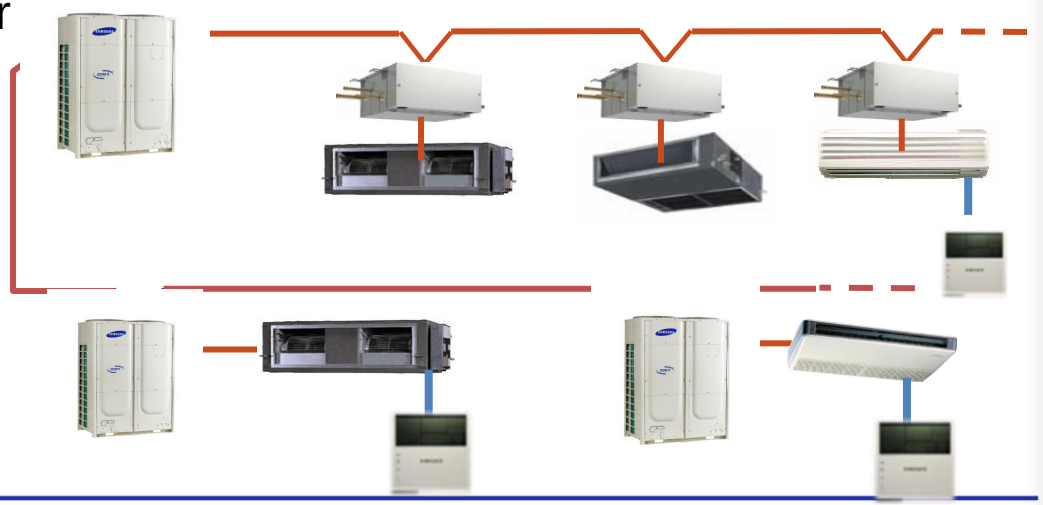
VRF Concept

Simple, Easy, Flexible Wiring Installation

- A simple 2 wire daisy chain communication system
  - 16-2 gauge AWG shielded
  - Not polarity sensitive
  - Up to 2085 F1/F2ft of total system wiring
  - Longest 328ft Controller



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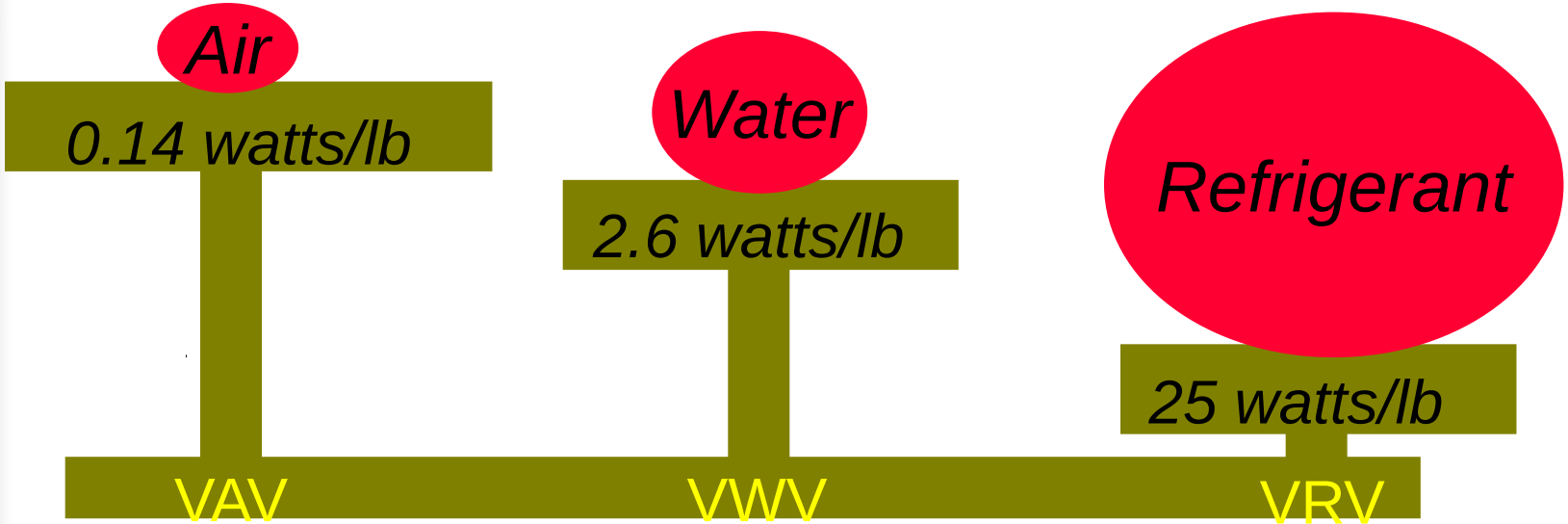
Heat Transfer Media



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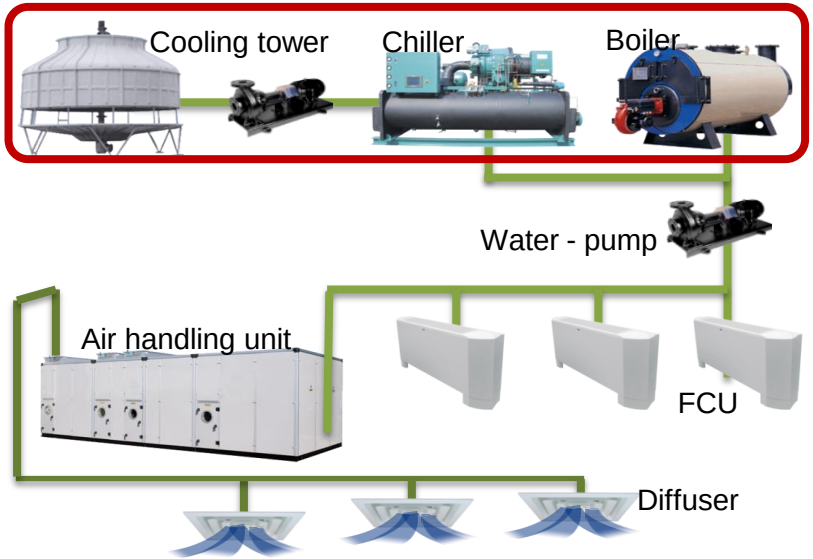
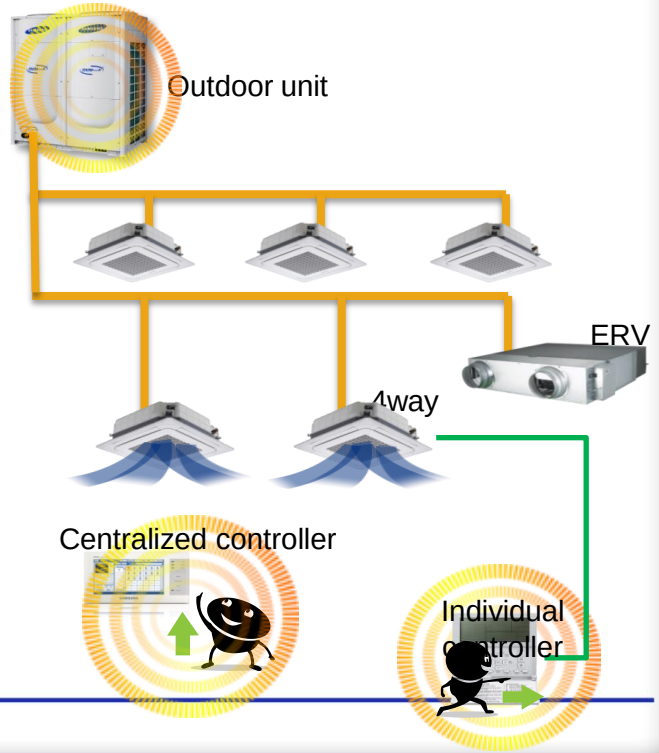
Comparison between Chiller and DVM

: Benefits Ease control





Where does VRF Fit ???

BUILDING SIZE						
	<50 TONS	<100 TONS	<250 TONS	<500 TONS	<1000 TONS	>1000 TONS
VRV	✓	✓	✓	✓	✓	✓
PTAC	✓	✓				
SPLIT SYSTEM	✓	✓				
CV RTU	✓	✓				
VAV ROOFTOP		✓	✓			
AIR COOLED CHILLER		✓	✓	✓		
WATER COOLED CHILLER				✓	✓	✓
CENTRAL AHU	✓	✓	✓			
CUSTOM AHU				✓	✓	✓
FAN COIL		✓	✓			
UNIT VENTILATOR	✓	✓	✓			

Where does VRF Fit ???

VERTICAL MARKETS

	DATA CENTERS	DORMS	HEALTH	OFFICES	RES HOUSING	SCHOOLS	SKILLED CARE	CHURCH	HOTELS	LIBRARIES
VRV		✓	✓	✓	✓	✓	✓	✓	✓	✓
PTAC		✓		✓	✓		✓		✓	
SPLIT SYSTEM		✓		✓	✓		✓	✓		
CV RTU				✓		✓		✓		
VAV ROOFTOP				✓		✓	✓	✓		✓
AIR COOLED CHILLER	✓	✓	✓	✓		✓	✓	✓	✓	✓
WATER COOLED CHILLER	✓	✓	✓	✓		✓	✓		✓	✓
CENTRAL AHU	✓		✓	✓		✓	✓	✓		✓
CUSTOM AHU	✓		✓	✓		✓				
FAN COIL		✓		✓	✓	✓	✓	✓	✓	
WATER SOURCE HP		✓		✓	✓	✓	✓		✓	
UNIT VENTILATOR				✓		✓				

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Why does VRF Fit ???

ATTRIBUTES	DORMS	OFFICES	RES HOUSING	SCHOOL	SKILLED CARE	CHURCH	HOTELS	LIBRARY
EFFICIENCY	✓	✓	✓	✓	✓	✓	✓	✓
LEED, TAX CREDITS, ETC.	✓	✓		✓		✓	✓	✓
SOUND	✓	✓		✓		✓	✓	✓
MAINTENANCE	✓		✓	✓	✓	✓	✓	✓
INSTALLATION EASE	✓		✓	✓	✓	✓	✓	✓
ELECTRICAL BENEFITS	✓	✓	✓	✓	✓	✓	✓	✓
STRUCTURAL BENEFITS	✓	✓	✓	✓	✓	✓	✓	✓
1ST COST	✓	✓	✓	✓	✓			✓

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What is AHRI 1230?

- AHRI 1230 is a testing and rating standard specially designed for VRF systems 2011
- This allows manufacturer's to show VRF efficiency levels for:
  - Full Load
  - Part Load/Seasonal Cooling Performance
  - Heat Recovery

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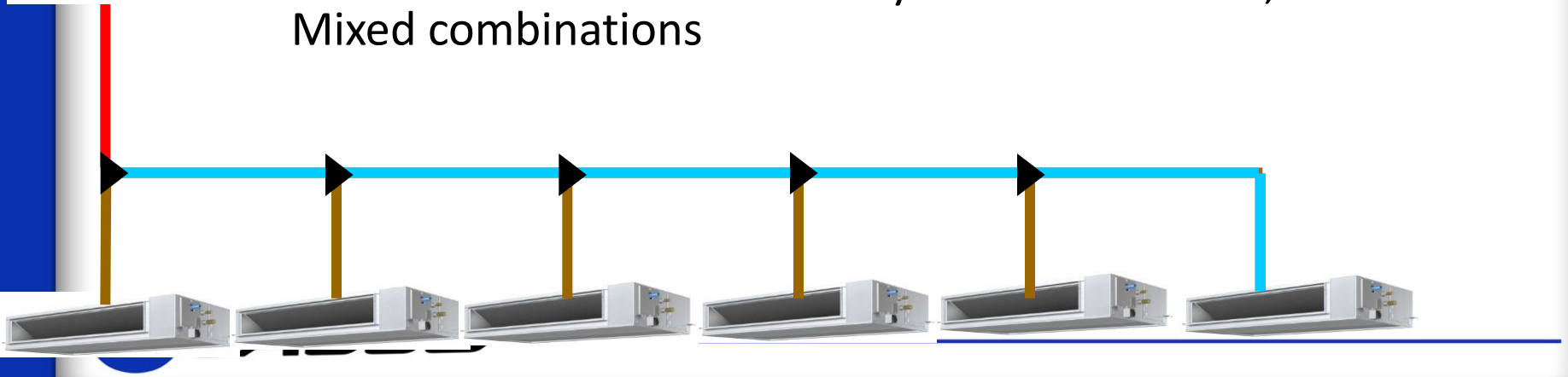
Efficiency Metrics

- All efficiency values are based on the entire system performance including
  - Outdoor unit energy input/output
  - Energy input/output of indoor units
  - Piping loss correction factors to reflect real life building performance (longer piping for larger capacity systems)
- We are able to show efficiency levels for Ducted, Ductless and Mixed combinations



Efficiency Metrics

How are we going to measure this?

EER (95F)	IEER	COP (47F)	COP (17F)	SCHE
System full load cooling operation	System seasonal cooling efficiency	Full Load Heating Performance at 47F	Full Load Heating Performance at 17F	Simultaneous Cooling and Heating Efficiency (approx 50-50%)

ASHRAE – Std 15 (2010)

Safety Requirements for Refrigerating Systems

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Definitions

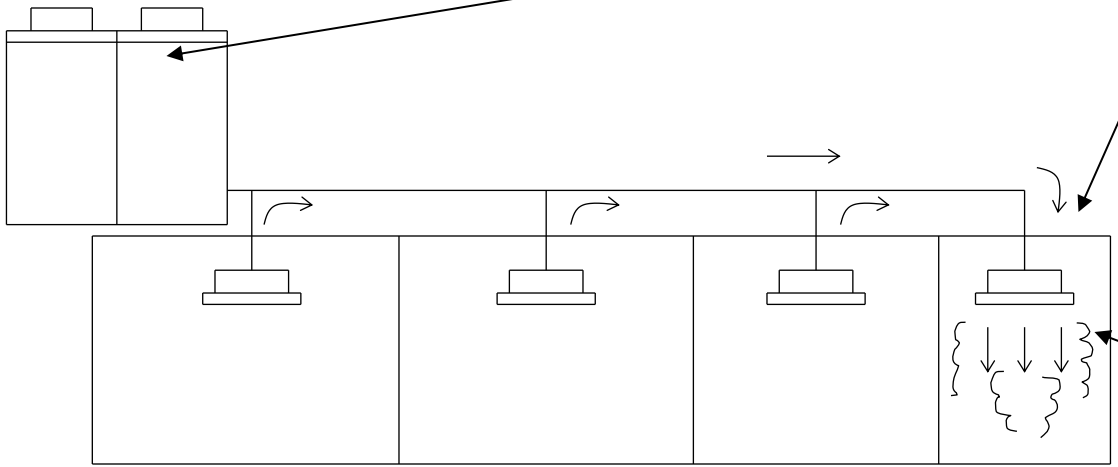
- **Occupied Space:** That portion of the premises accessible to or occupied by people, excluding machinery rooms.
- **Institutional Occupancy:** A premises or that portion of a premises from which, because they are disabled, debilitated, or confined, occupants cannot readily leave without the assistance of others. Institutional occupancies include, among others, hospitals, nursing homes, asylums, and spaces containing locked cells.

Overview

- Specifies minimum safety requirements in the event of a refrigerant leak into an occupied space.
- Safety Issues:
  1. Flammable refrigerants causing injury or death by fire.
  2. Toxic refrigerants possibly causing injury or death by poisoning.
  3. Non flammable and non toxic refrigerants causing injury or death by asphyxiation from oxygen displacement.

- Samsung uses R-410A which concerns item 3.

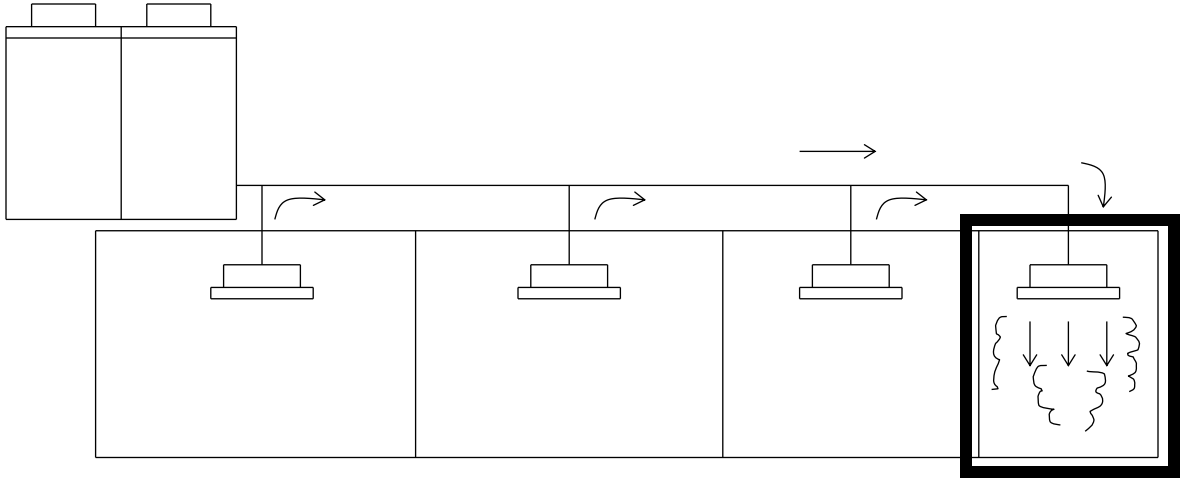
Example


8 Ton VRV R/C CU
12000 btu/h VRV FCU
Occupied space
12 x 12 x 9 ft
= 1296 ft3

Occupied Space

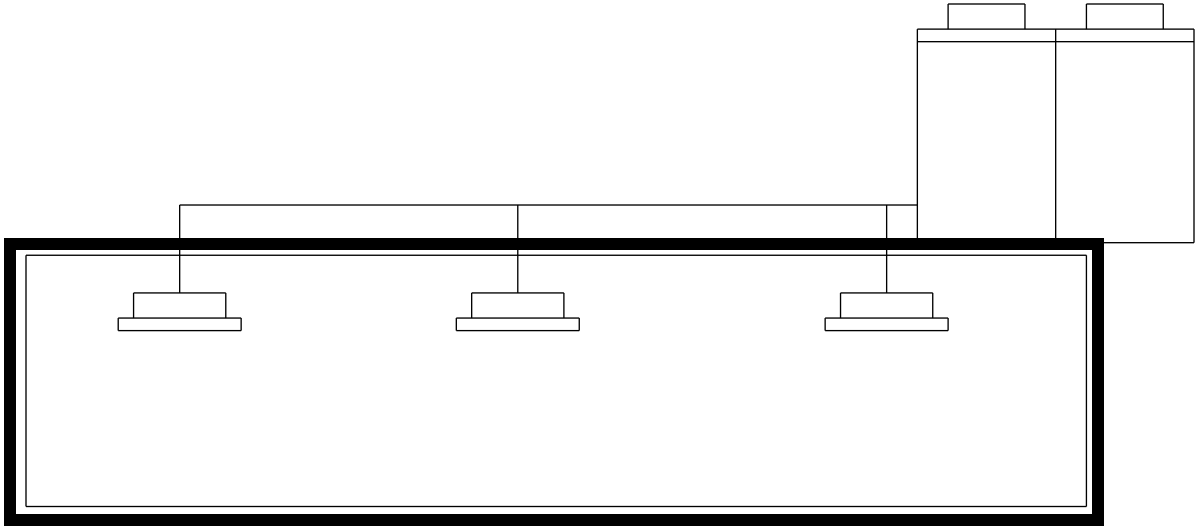
- Occupied space is the smallest room volume.
- Other spaces not air tight to the smallest room are considered as part of it.
  - Example:
    - False ceiling voids.
    - Crawl ways.
    - Ducts.
    - Movable partitions.
    - Doors with transfer grilles.

Basic Example



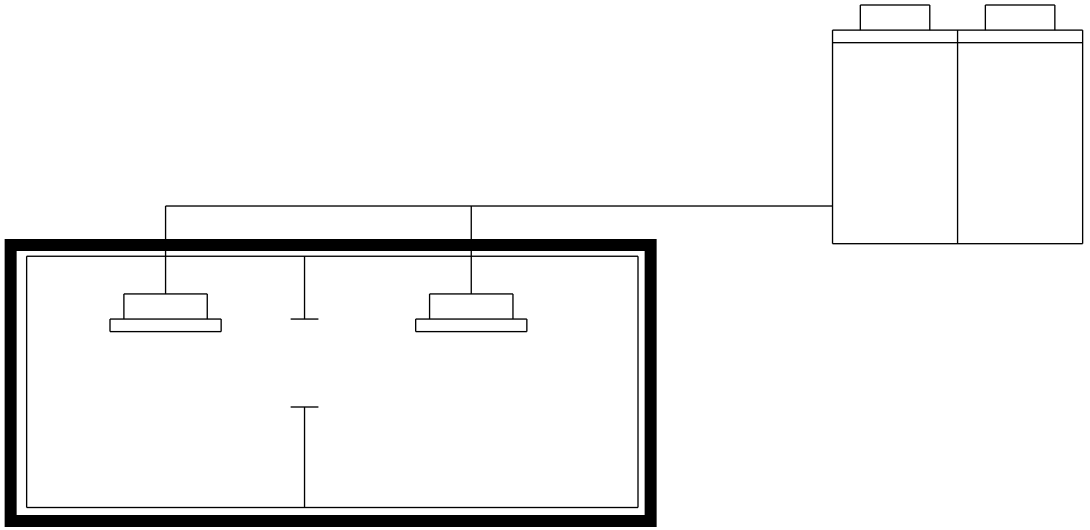
Occupied space = Smallest air tight room volume

Multiple FCU Example



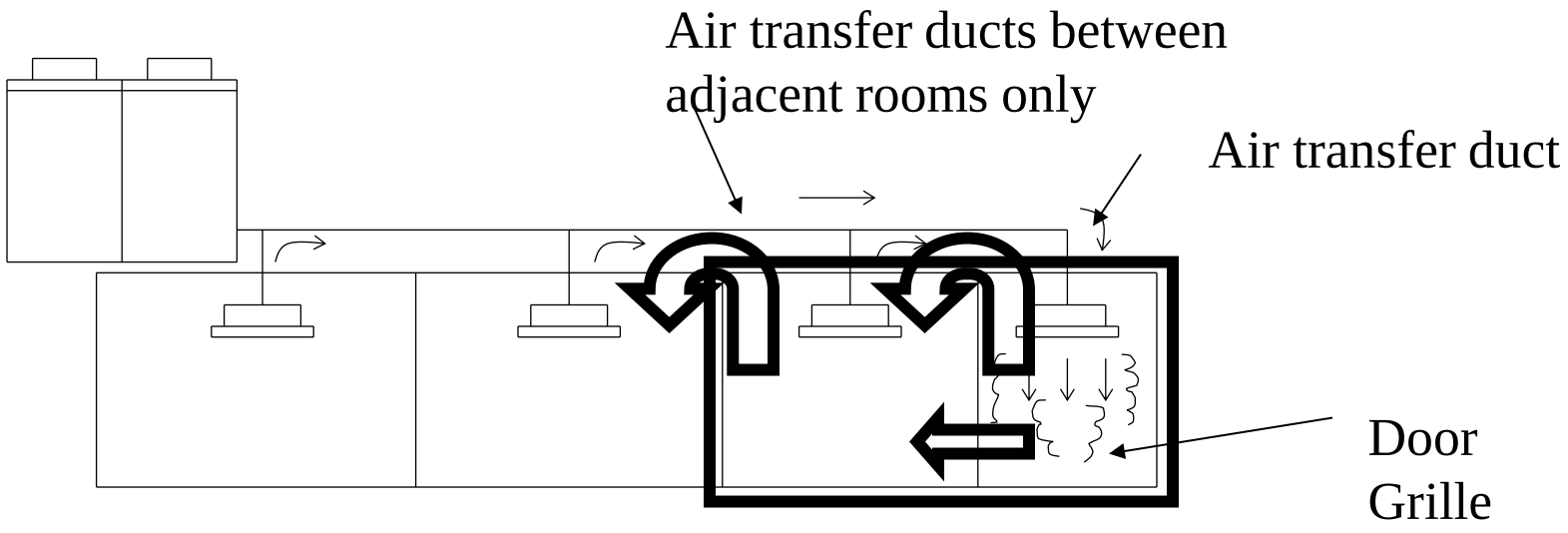
Occupied space = Total room volume

Partition Example



Occupied space = Volume of both rooms

Transfer Grille Example



Occupied space = Volume of both rooms

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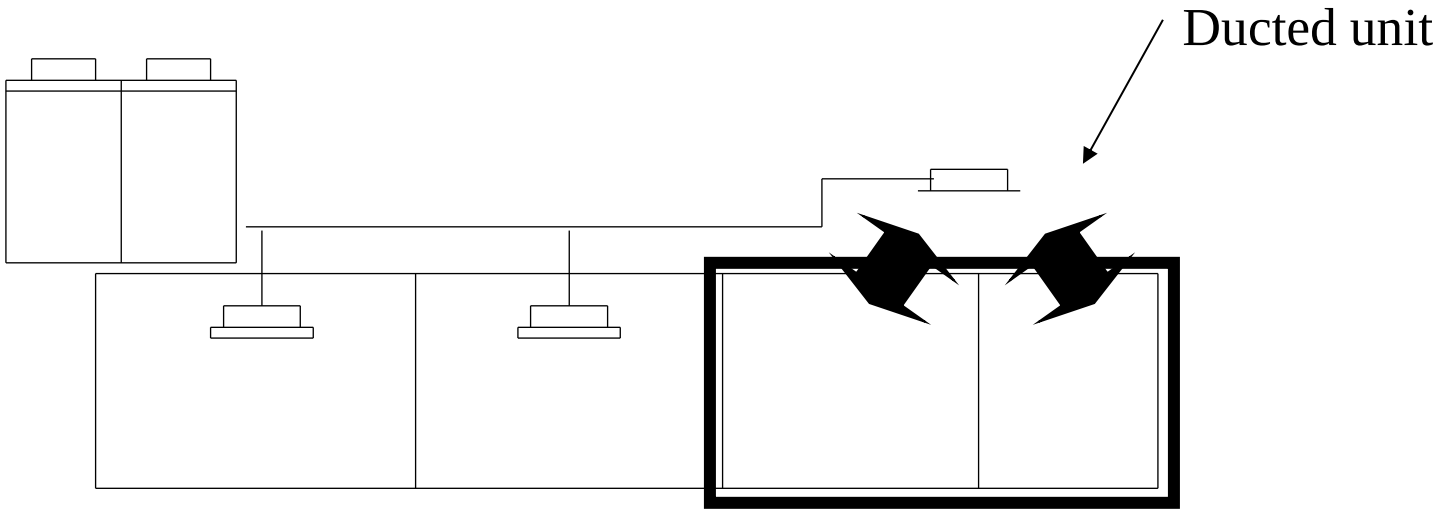
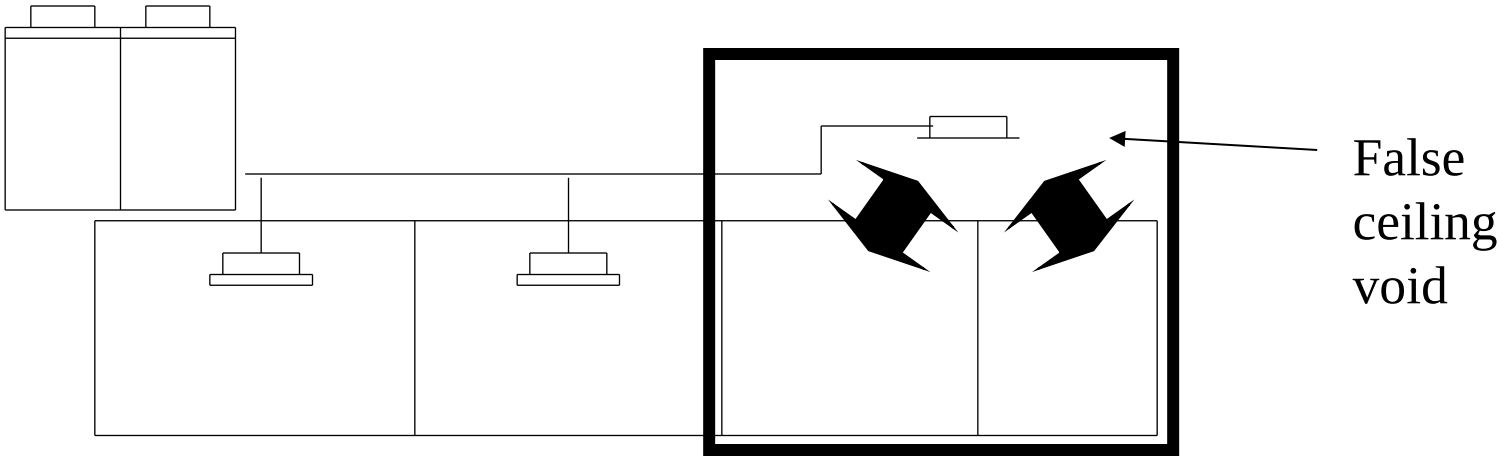
Ducted Example



Occupied space = Volume of both rooms

False Ceiling Example



Occupied space = Volume of both rooms and false ceiling void

Refrigerant Alarms

- Refrigerant detectors and alarms are permitted by the standard.
- Detector and alarm must be appropriately maintained.
- Refrigerant detectors cost about $500 each.

Compliance Responsibilities

- Specifies application, not manufacturing requirements.
- Impossible for a unit to comply, only an application can comply.
- Designing consultant engineer and/or contractor is responsible for assessment and compliance.

Considerations for Design

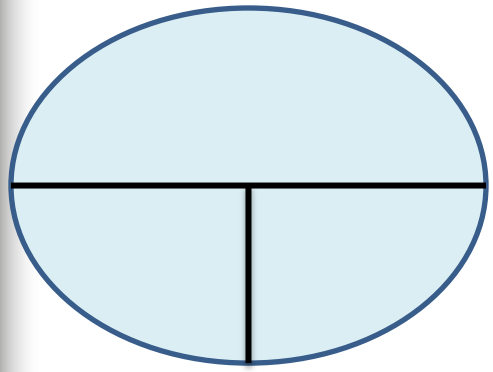
- Safety Requirements
- Institutional Occupancies
- Smallest Occupied Space
- Occupied Space
- Refrigerant Alarms
- Ventilation
- Compliance Responsibilities

ASHRAE Standard 15 & 34
Refrigerant Concentration Limits

If you know any 2,
you can calculate the answer.

A. RC/RCL=Cu.Ft.
B. RC/Cu.Ft.=RCL
C. RCL X Cu.Ft.= RC

Perform your calculation in this Calculation Area



RC
Refrigerant Charge
Total of all refrigerant in system, including the pipes.

A.
If RC is known (29lbs), and you want to determine smallest Cu.Ft. Room acceptable
29/.026=1115 Cu.Ft. or less.

B.
If RC is known (29lbs), to determine what the RCL is for a certain sized room. (1500 Cu.Ft.)
29/1500=.019

RCL
Refrigerant Concentration Limit Has to be .026* or less

The RCL HAS to be EQUAL to or LESS than .026 for every room the refrigerant piping goes through.
.0259 is OK
.0260 is OK
.0261 is TOO HIGH

Cu.Ft.
Room Cu.Ft . Cu.Ft. Room = Sq.Ft. X Height

RULE #1
1,000 Cu.Ft. room can handle 26 lbs. of R-410A.

C.
The engineer knows the RC and the room Cu.Ft.
If the RC is 39lbs. and the Cu.Ft. is 1500
39/1500=.026 is OK.

If you want to determine the maximum RC you can have for the smallest Cu.Ft. room you have
Max RCL (.026) X Rm Cu.Ft.

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*Addendum I to Standard ASHRAE 34-2010

SAMSUNG

DVM S™
DIGITAL VARIABLE MULTI

Product Overview

What is the DVM S VRF System?

- **Indoor unit nominal capacity can total up to 130% of the total condenser nominal capacity**
- **This it referred to as “diversity”**
- **Samsung’s acceptable range: 50% - 130%**

Example: 144,000 Btu/h total nominal indoor capacity = 120%

What is the DVM S VRF System?

- Outdoor units are available in 6, 8, 10, 12, 14, and 16 ton nominal capacities
- Any combination of up to 3 outdoor units can be piped together to achieve desired capacity up to 48 tons.
- Air and Water Cooled Units available in every size.

What is DVM S

System Types – Single and Modular

- Single – One outdoor unit
- Modular – Two or three outdoor units piped together

Current system combinations

System Outdoor Unit Module Quantity	Nominal System Capacity (Tons)	Outdoor Unit Module Quantity				Maximum Indoor Unit Quantity
		6 Tons	8 Tons	10 Tons	12 Tons	
1 	6	1				12
	8		1			16
	10			1		20
	12				1	25
2 	14	1	1			29
	16	1		1		33
	18	1			1	37
	20			2		41
	22			1	1	45
	24				2	49
3 	26	1	1		1	54
	28	1		1	1	62
	30	1			2	64
	32			2	1	64
	34			1	2	64
	36				3	64

New system combinations with new 14 and 16 ton outdoor units (available Q2, 2015)

System Outdoor Unit Module Quantity	Nominal System Capacity (Tons)	Outdoor Unit Quantity						Maximum Indoor Unit Quantity
		6 Tons	8 Tons	10 Tons	12 Tons	14 Tons	16 Tons	
1 	6	1						12
	8		1					16
	10			1				20
	12				1			25
	14					1		29
	16						1	33
2 	18	1			1			37
	20	1				1		41
	22	1					1	45
	24				2			49
	26				1	1		54
	28					2		62
3 	30	1			2			64
	32	1			1	1		64
	34	1			1		1	64
	36				3			64
	38			1		2		64

DVM S Installing Outdoor Unit - Securing

- Make sure outdoor unit is secured to the building or ground appropriately for regional requirements
- Be aware of local and state regulations

DVM S

Installing Outdoor Unit - Securing

- The outdoor units must be secured to the building or ground, especially in areas with high winds
- The systems in this example have structural bracing to prevent the units from tipping over
- Vibration isolation should also be considered when placing units on a rooftop

JACCO

DVM-S Water-Cooled Systems

- Indoor Condensing units
- Up to 48 Tons Capacity Per System
- Most efficient VRF system on the market
- Heat Pump and Heat Recovery Systems
- Same compressors as air cooled units
- 6, 8, 10 , 12, 14, and 16 Ton Modules
  - Units Can be “Twinned Together”

JACCO

What is DVM S?

DVM S Water

- Water Cooled units are available in 6, 8, 10, and 16 ton nominal capacities
- Any combination of up to 3 Compressor units can be piped together to achieve desired capacity up to 48 tons.
- Heat pump or heat recovery – configured during installation

Nominal Tons	Module Qty.	DVM S Water Unit Combinations			
		6 Tons	8 Tons	10 Tons	16 Tons
6	1	1			
8			1		
10				1	
12	2	2			
14		1	1		
16	1				1
18	2		1	1	
20				2	
22		1			1
24			1		1
26				1	1
28	3	2			1
30		1	1		1
32	2				2
34	3		1	1	1
36				2	1
38		1			2
40			1		2
42				1	2
48					3

Mini DVM S Eco

Mini DVM S Eco – Heat Pump 3 Ton, 4 Ton and 5 Ton

- **Can connect up to 9 indoor units, same mixed lineup to blend with any interior design up to 130% design diversity**
- **Same control system as DVM-S**

	3Ton	4Ton	5Ton
DVM mini	●	●	●
D	●	●	X
M	●	●	●

Mini DVM S Eco Outdoor Units

- Operating conditions:
  - Cooling: 23^{0} – 115^{0}
  - Heating: -4^{0} – 74^{0}

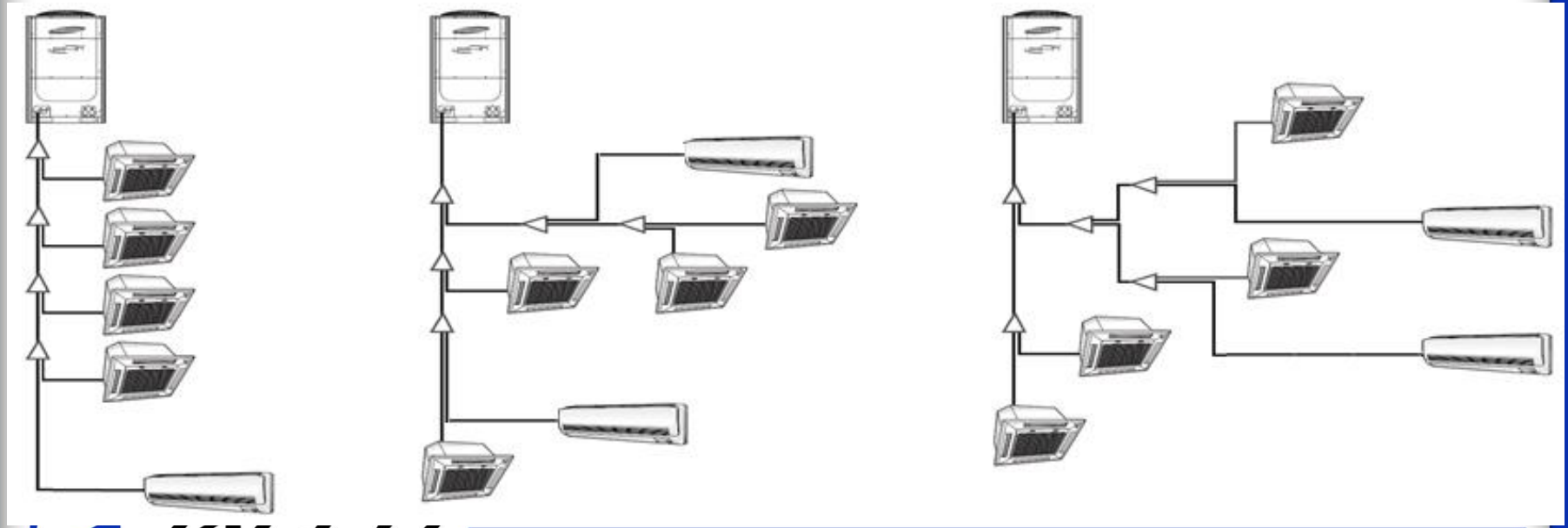
What is the DVM S VRF System?

- Overall system capacity modulates based on load demand of the conditioned space
- Nominal condenser capacity ranges from 7,513 Btu/h to 100% of overall system capacity
- Capacity is calculated based on delta between T room and set point T set
- T room is measured at the indoor unit, at the wired control, or by a separate room sensor, depending on application

What is the DVM S VRF System?

System Type – Heat Pump

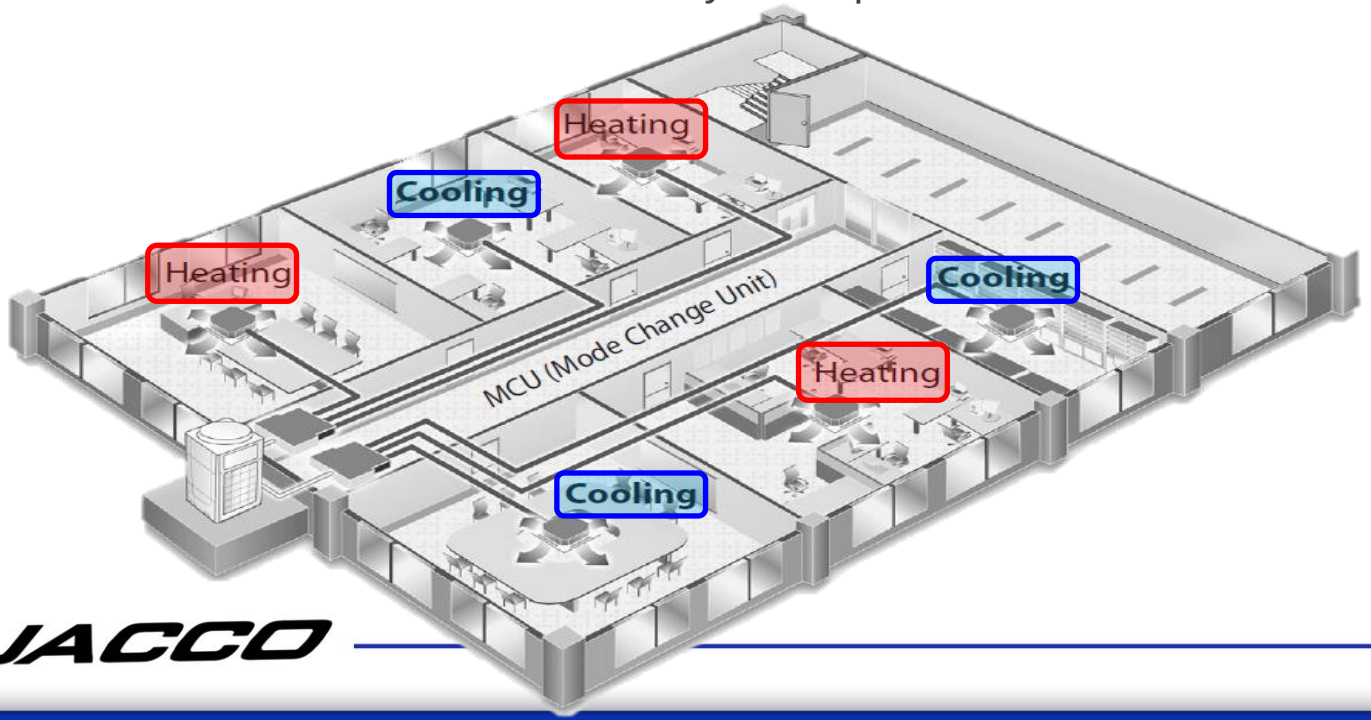
- Operates entirely in either cooling or heating mode, mixed operation is not allowed



What is the DVM S VRF System?

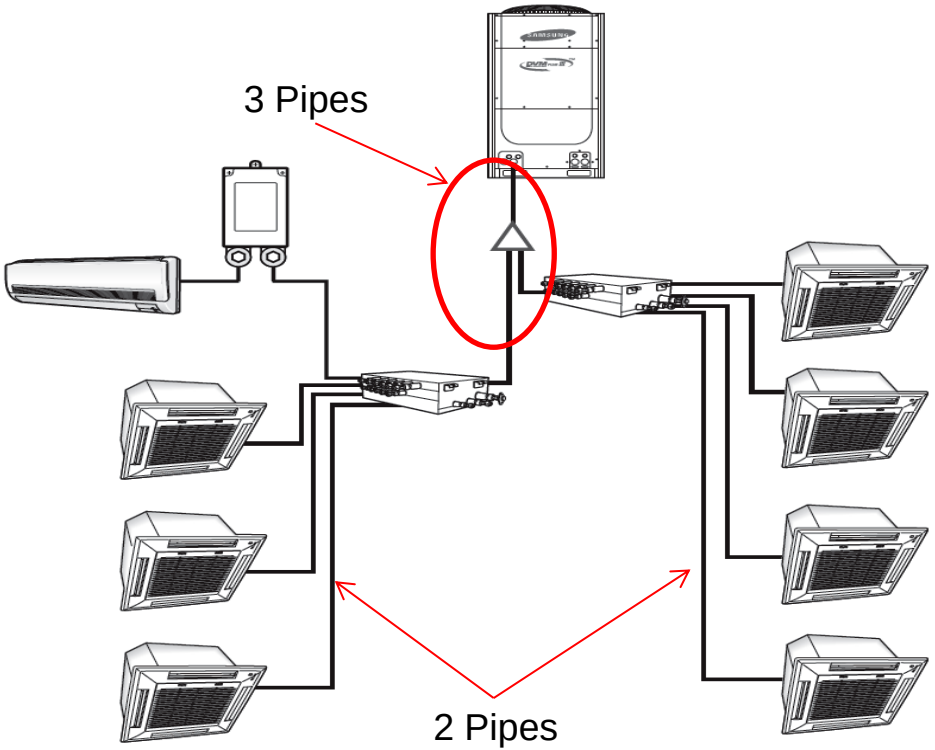
System Types – Heat Recovery

- Allows simultaneous heating and cooling on a single system. One indoor unit can operate in cool mode while another unit on the same system operates in heat mode.



What is the DVM S VRF System?

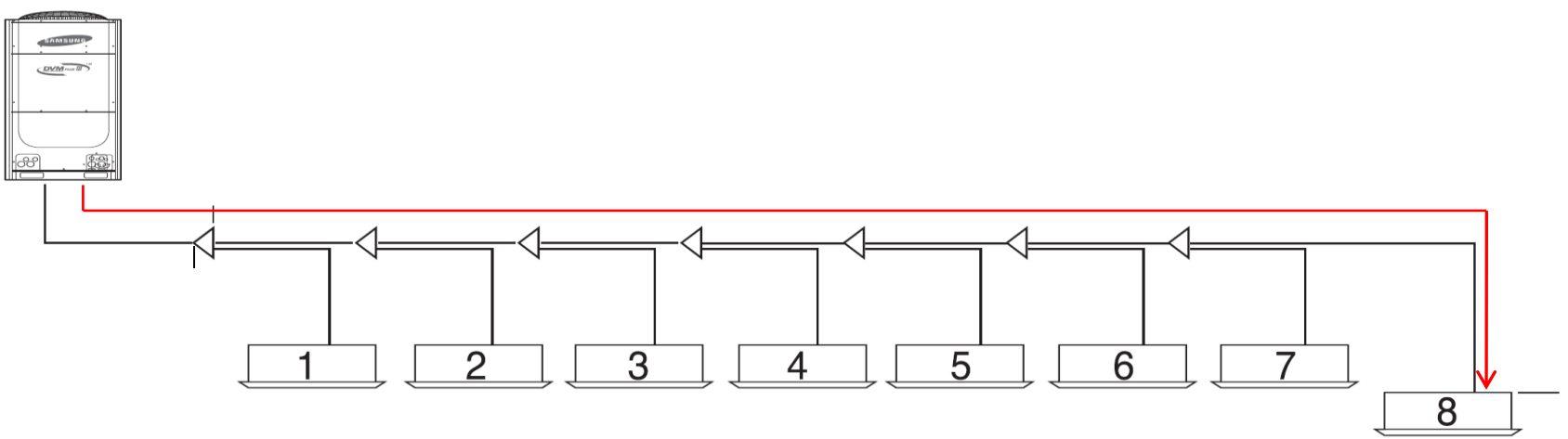
Heat Recovery, 3 Pipes & MCU's



DVM S

Maximum Piping Lengths

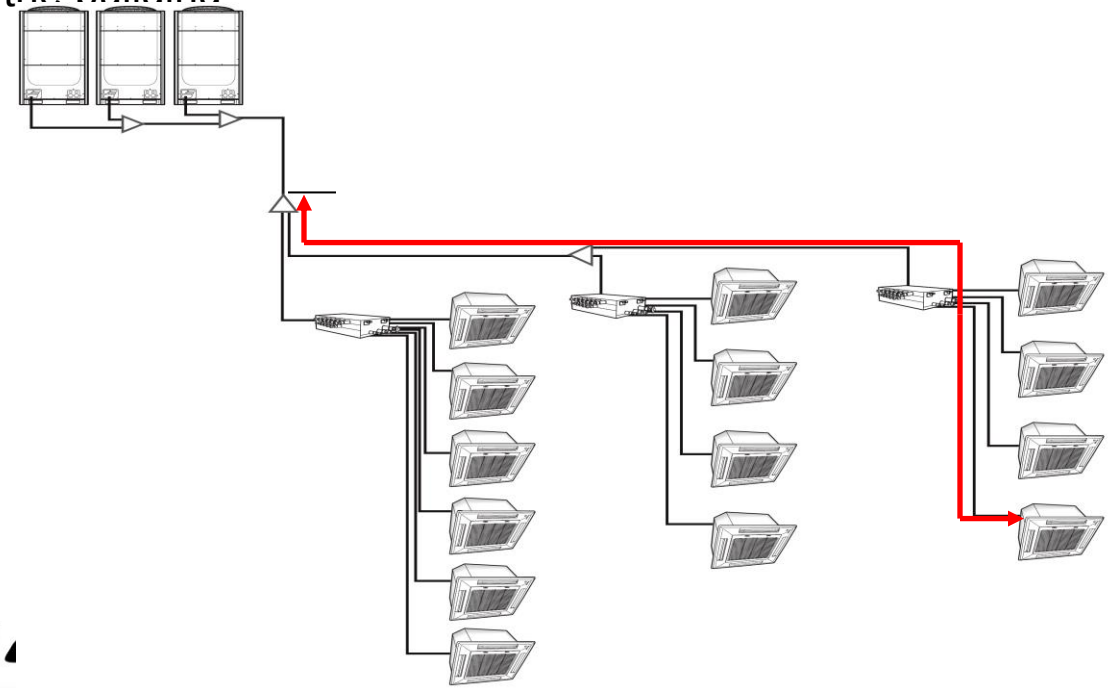
- Maximum 656’ actual, 722’ equivalent, from the outdoor unit(s) to the farthest indoor unit(s) (heat pump and heat recovery)



DVM S

Maximum Piping Lengths

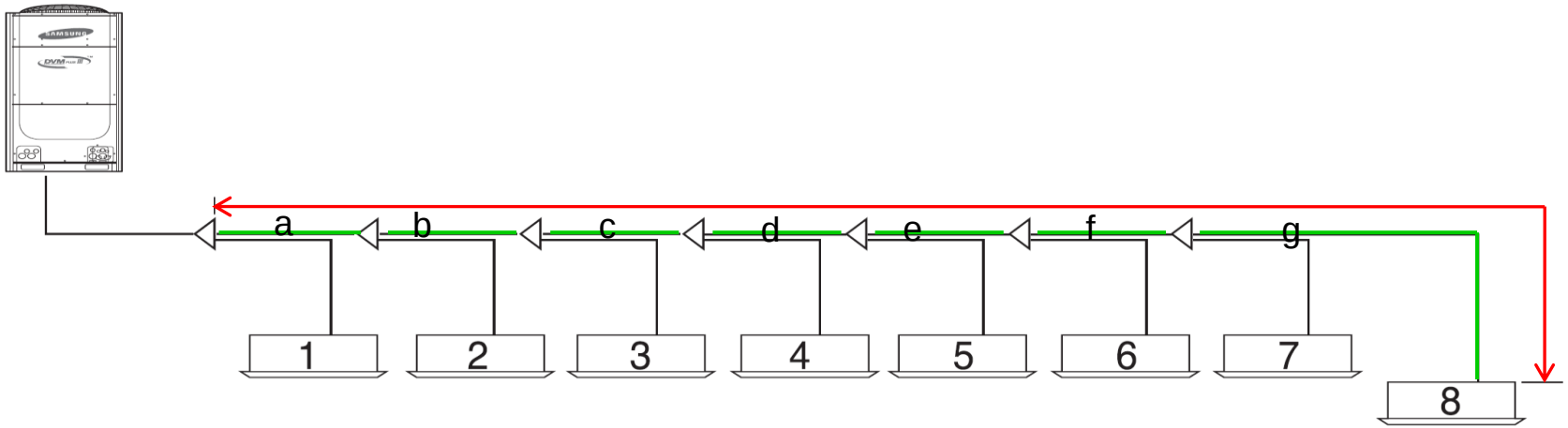
- For heat recovery systems, maximum 148’ from the first branch to the farthest indoor unit
- If this length is over 148’ while designing a system, consider putting the first branch joint further into the building



DVM S
Maximum Piping Lengths

- Maximum 295’ from the first Y-joint to the farthest indoor unit (heat pump systems)

- If the distance from the first branch joint to the farthest indoor unit is ≥149’ increase the main branch liquid and suction pipes from the first branch joint throughout the system (sections: a,b,c,d,e,f,g below).



DVM S

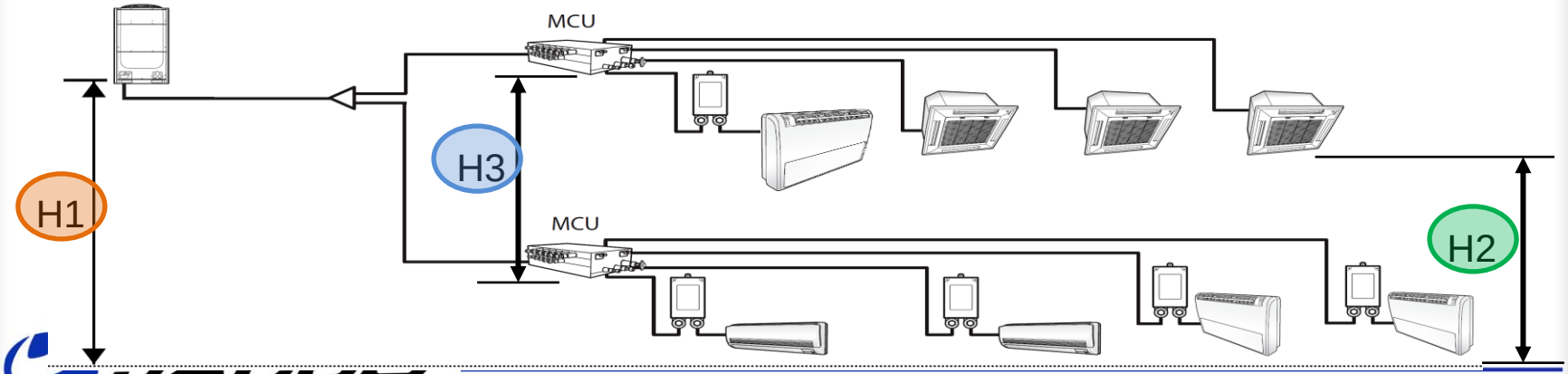
Maximum Piping Lengths – Heat Recovery Vertical Separation

Maximum height difference from outdoor unit to lowest indoor unit (H1):

- When condenser is above indoor units (ex: rooftop): 164’ (standard), 360’ with PDM kit
- When condenser is below indoor units (ex: ground level): 131’

Maximum height difference between indoor units (H2): 49’

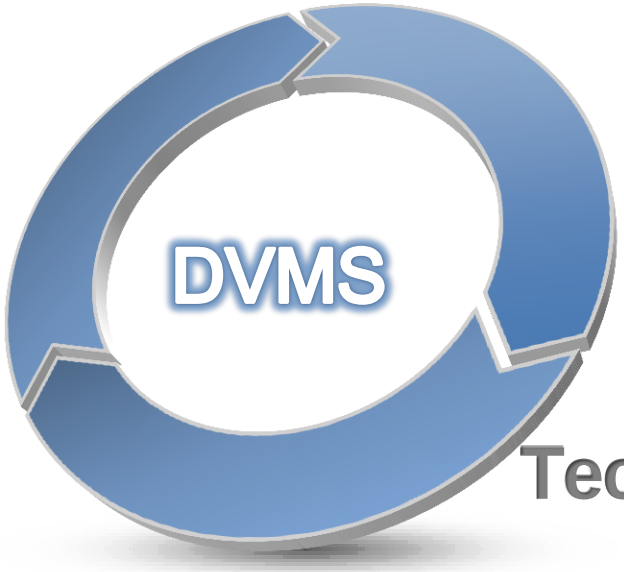
Maximum height difference between MCU’s (H3): 49



- If vertical separation is ≥ 164’ but ≤ 360, contact Quietside for modified pipe design with PDM kit.
- When vertical separation is >295 a PDM kit is required. Use Samsung’s DVM E-Solution software to select PDM kit

DVMS VRF Product Features

Robust Design



Innovation

Twin Variable Scroll +

Vapor Injection

= Higher Energy Efficiency

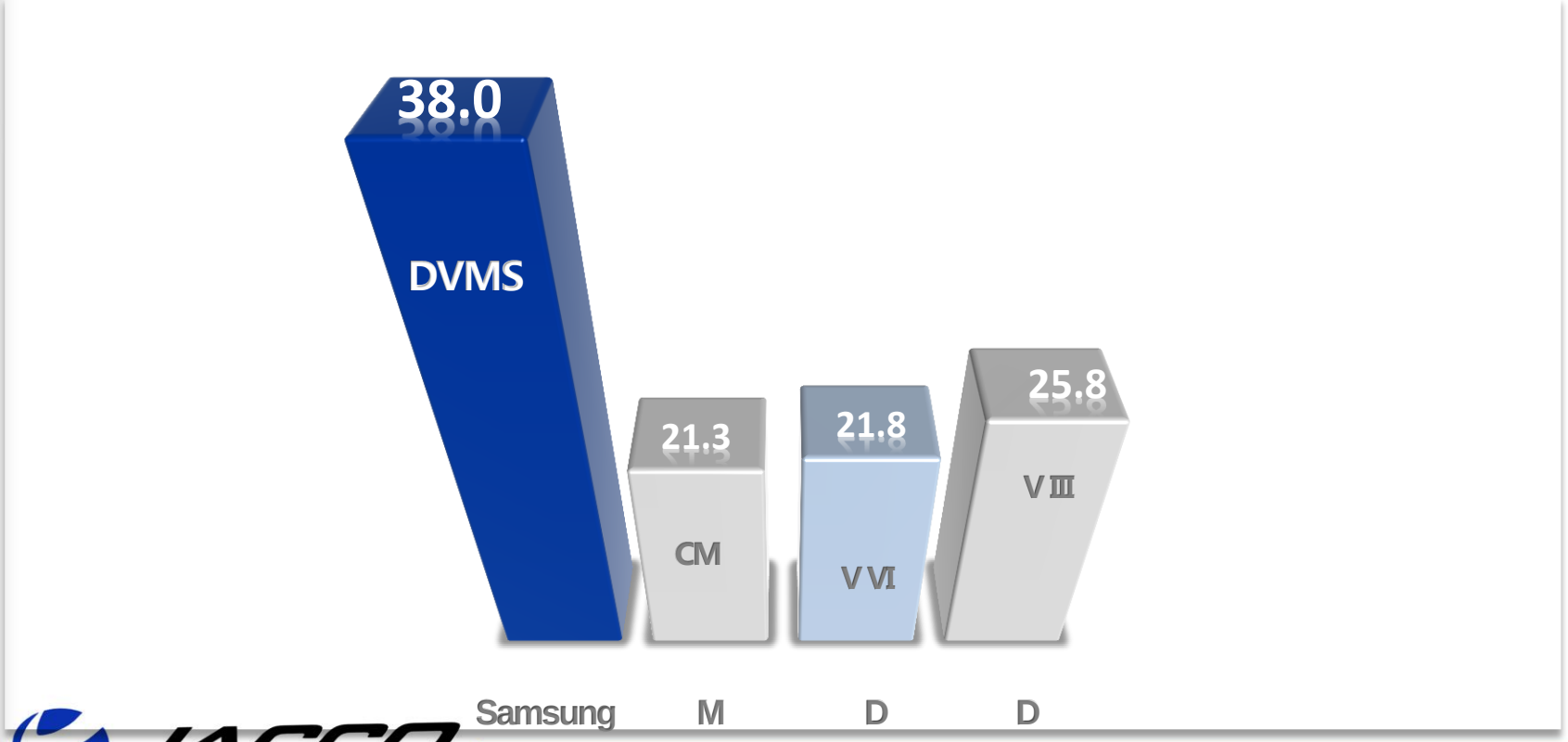
Technology

Inverter Technology

Vapor Injection

JACCO

VRF Class Leading Energy Efficiency



JACCO

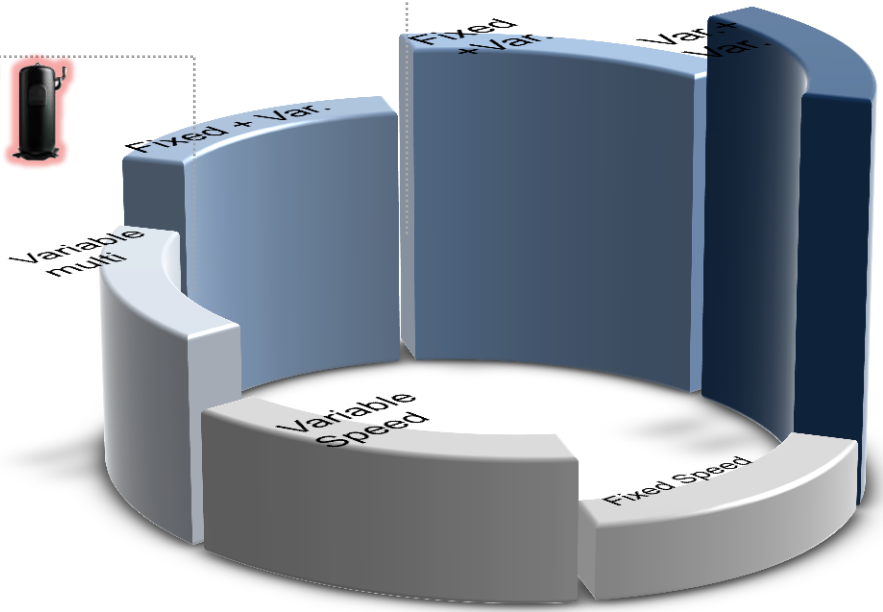
SCHE

AHRI Test Result, Please refer AHRI VRF Directory

Twin Variable Scroll Inverter

2nd Gen.

1st Gen



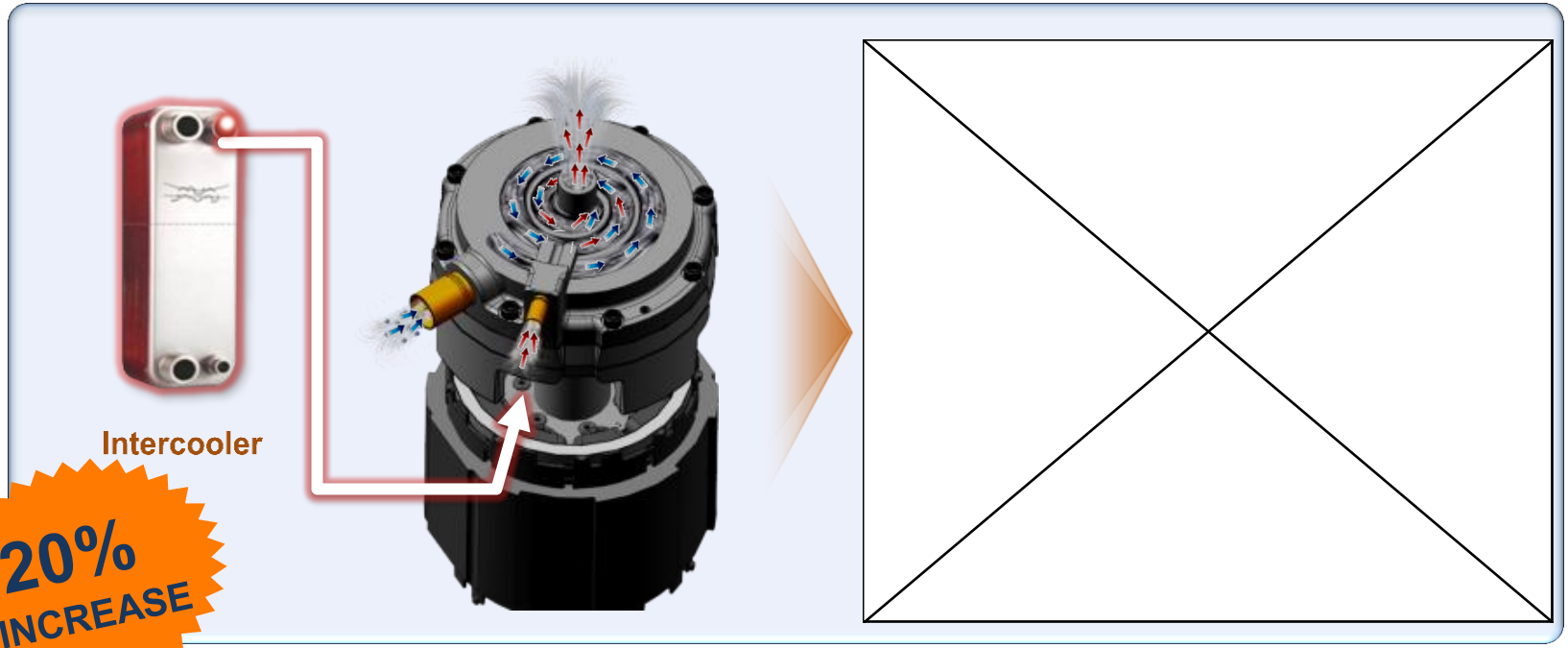
3rd Gen.

- Dual Inverter System
- 3rd Gen. Vapor Injection
  (Maximize Low-Temp Performance)
- Maximize Energy Efficiency

JACCO

VAR Fix

Samsung Scroll inverter Compressor

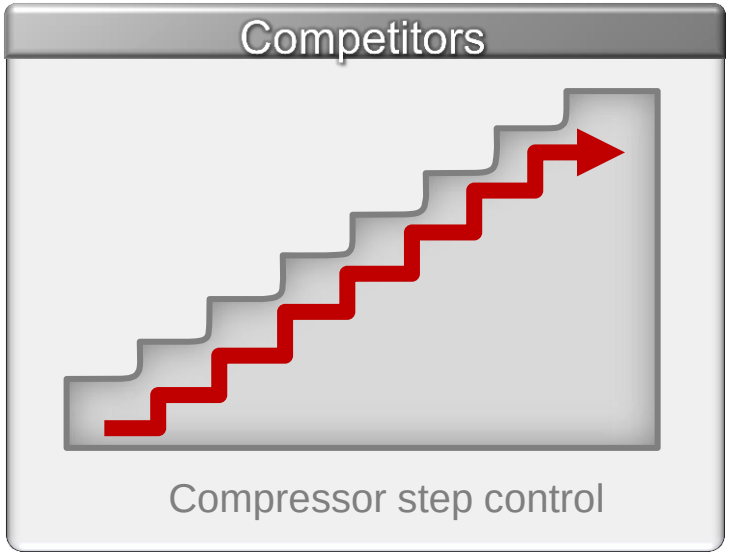


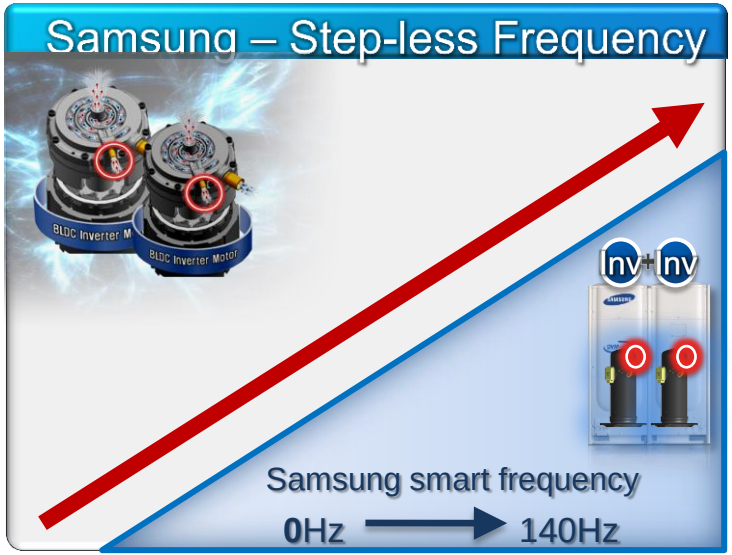
By using Vapor Injection, heating performance increases by 20 %
Plus improves Sub cooling to reduce capacity drop during cooling operation

JACCO

Samsung Smart Inverter Technology

1. Precise Speed Control



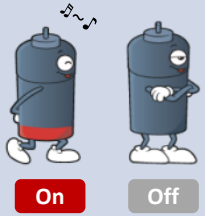
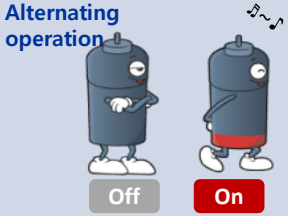
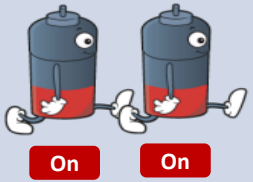
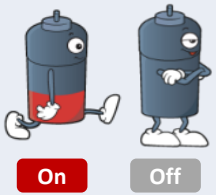
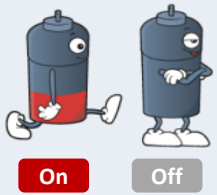


Samsung's unique adaptive sine wave control technology for high precision control, better energy efficiency and comfort

JACCO

Samsung Smart Inverter Technology

3. Alternating Operation

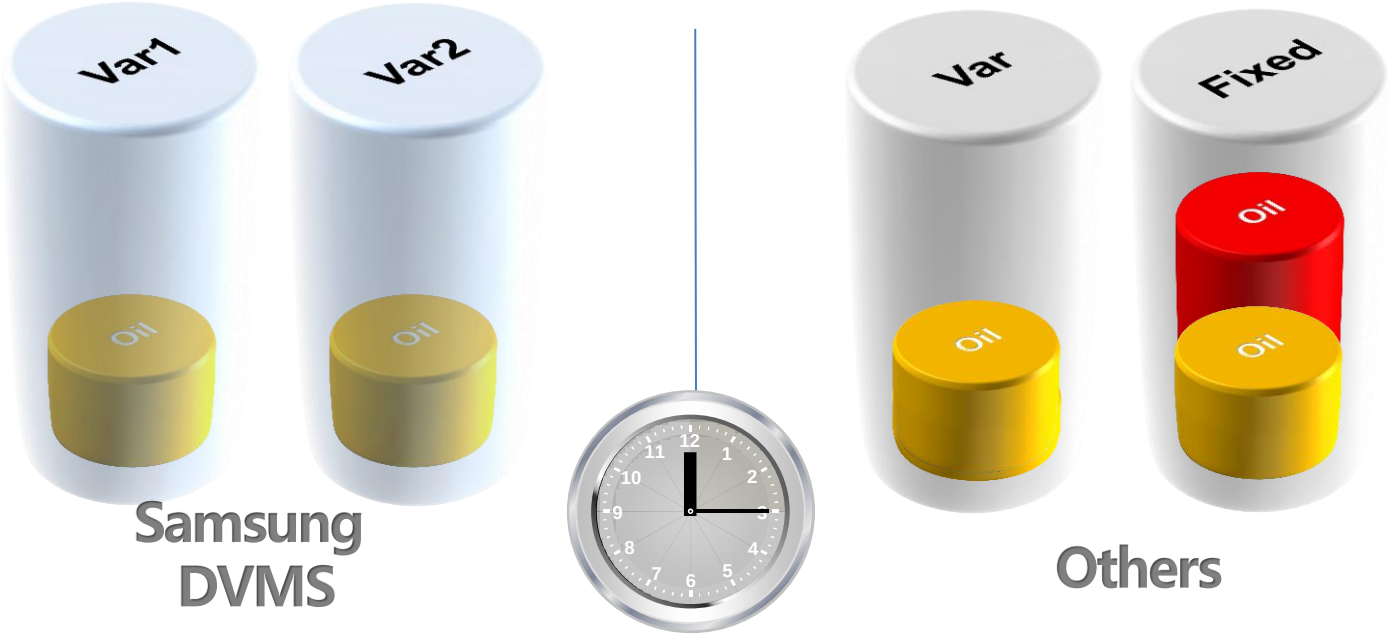
	Case 1	Case 2	Case 3
DVM S (INV+INV)			
INV+FIXED Or Vari. +Fixed			

By Alternating compressor starts, it evens each compressors share of load for enhanced compressor reliability

Samsung Smart Inverter Technology

1. Oil Balancing Capability

☞ Elimination of oil connection between outdoor units



Samsung Smart Inverter Technology

Oil Control

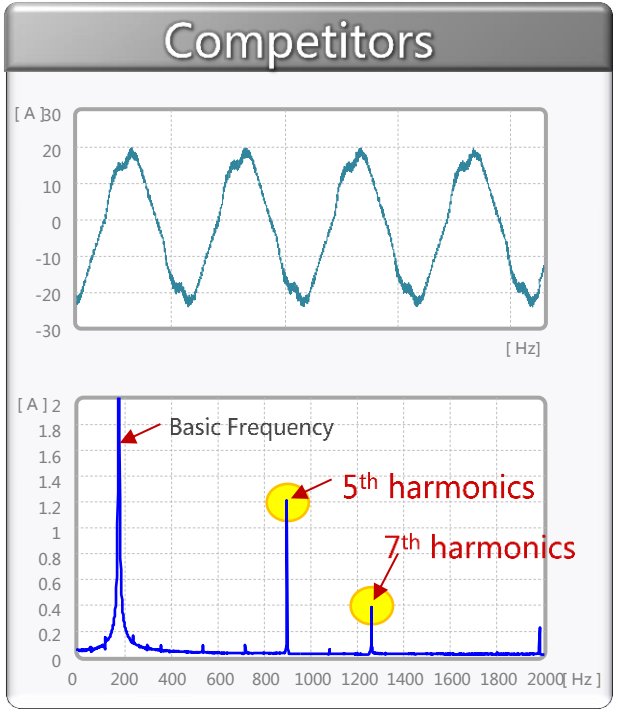
	Samsung	L	M
Need to stop heating every eight hours for oil return?	No!	Yes	Yes
Need ‘s oil balance pipe between condensers?	No!	Yes	Yes
Need to wait for 10+ min to return to set temperature since system went to cooling cycle ?	No!	Yes	Yes

JACCO

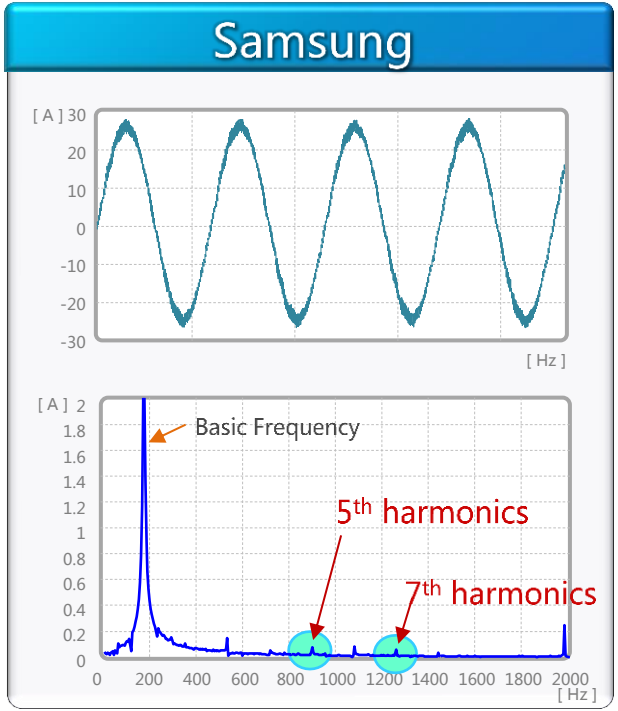
Robust Design

2. Adaptive Sine Wave technology

Competitors



Samsung

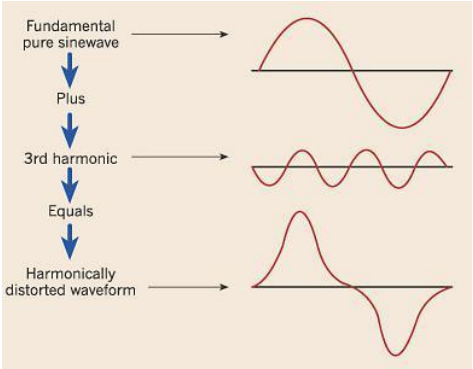


JACCO

Robust Design

Why harmonic distortion is bad?

- May cause Transformer Fail
- Malfunctioning of Micro Processor
- Overheating in neutral conductors. transformers, or motors
- Deterioration or failure of capacitors
- Erratic operation of breakers and relays
- Pronounced magnetic fields near transformers



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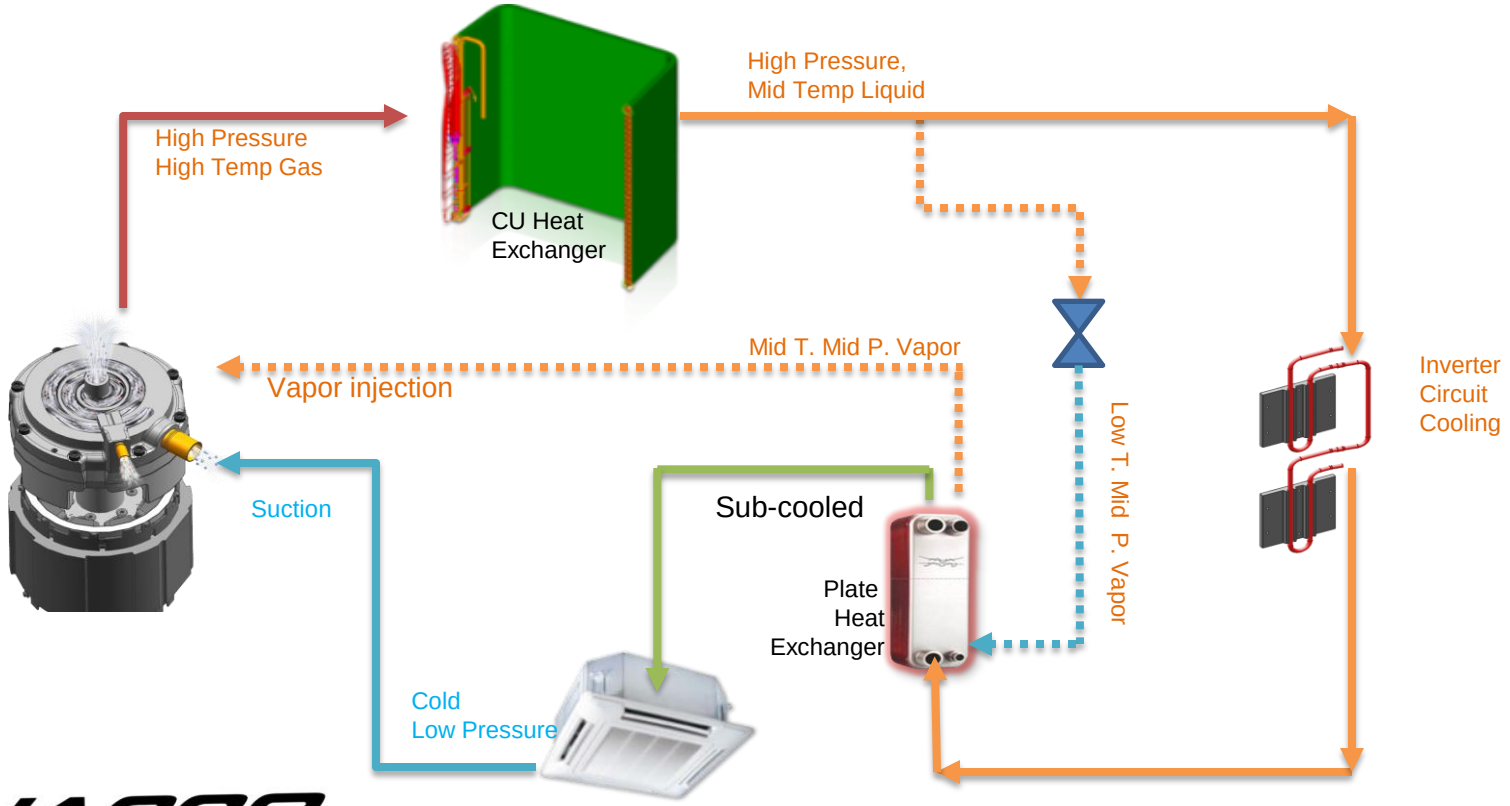
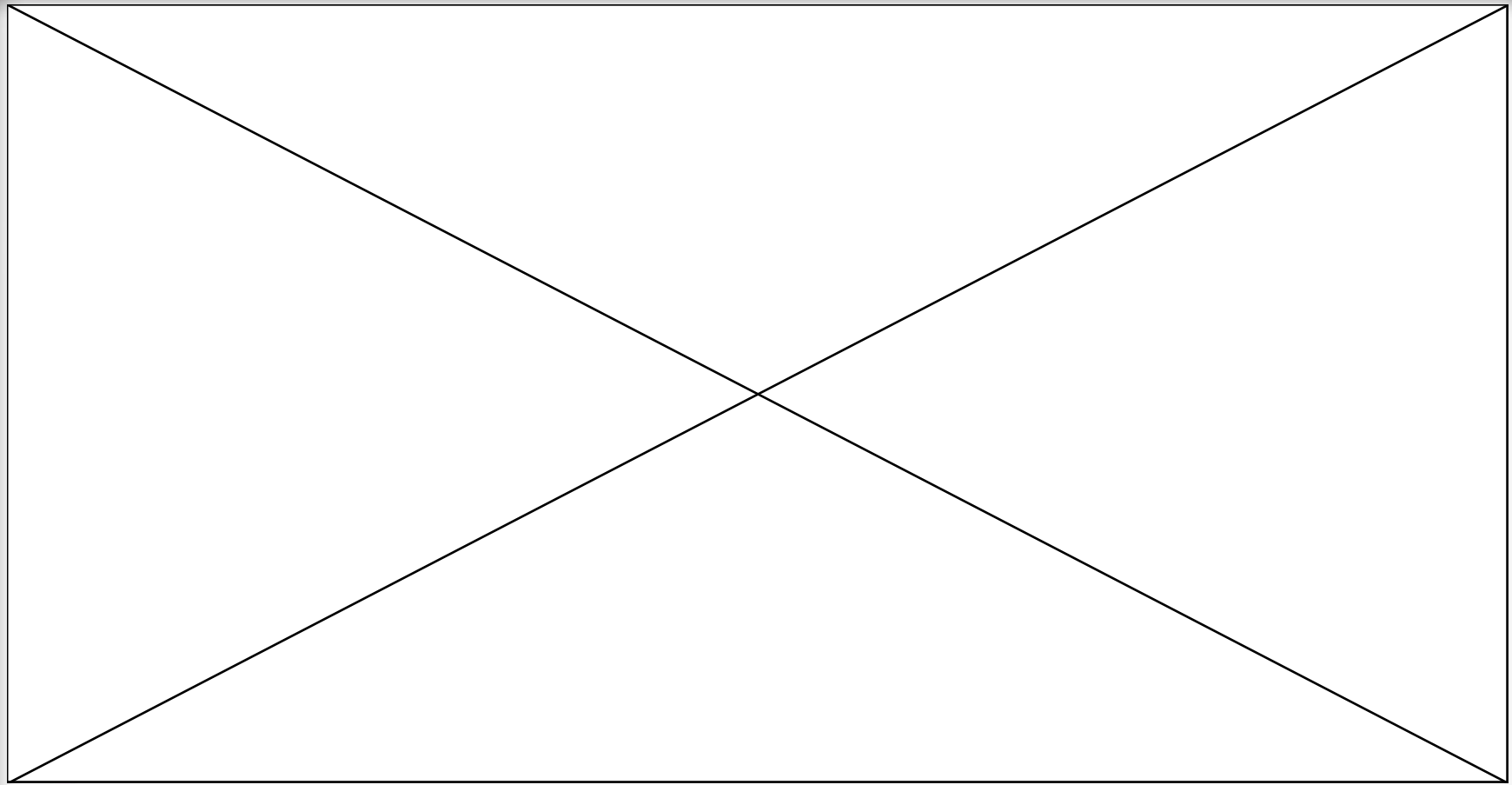
Samsung Scroll inverter Vapor injection



JACCO



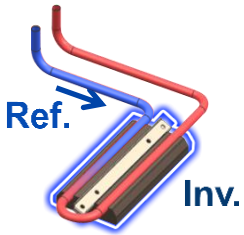
Product Advantages

Air cooled Equipment

8 Ton – Samsung vs Hyper Heat

At 100% Diversity and DB Temp of 70								% of Capacity vs Samsung				
Temperature	Samsung		Daikin	LG	Mitsubishi	Hyper Heat		Daikin	LG	Mitsubishi	Hyper Heat	
DB	BTU	kW	BTU	BTU	BTU	BTU	kW					
-13	80,997	11.41		67,600		89,600	16.72	0%	83%	0%	111%	147%
-7	89,096	11.88		75,000		98,200	17.07	0%	84%	0%	110%	144%
-4	93,446	12.11	71,400	79,500	64,800	103,600	17.60	76%	85%	69%	111%	145%
-2	95,547	12.13	72,600	84,700	65,880	106,000	17.33	76%	89%	69%	111%	143%
2	99,540	12.39	78,600	87,500	69,120	112,300	17.33	79%	88%	69%	113%	140%
6	103,110	11.90	81,900	91,600	72,300	116,600	17.07	79%	89%	70%	113%	143%
10	105,933	11.55	85,700	98,700	73,400	114,400	15.44	81%	93%	69%	108%	134%
13	107,996	10.96	87,900	105,400	75,600	112,300	14.52	81%	98%	70%	104%	132%
17	107,996	10.27	89,700	108,000	82,000	106,000	13.20	83%	100%	76%	98%	129%
19	107,996	9.66	92,800	108,000	84,200	106,000	12.76	86%	100%	78%	98%	132%
23	107,996	8.97	95,400	108,000	86,400	108,000	11.88	88%	100%	80%	100%	132%
26	107,996	8.39	101,000	108,000	92,800	108,000	11.44	94%	100%	86%	100%	136%
30	107,996	7.67	107,000	108,000	99,300	108,000	10.56	99%	100%	92%	100%	138%
35	107,996	7.41	108,000	108,000	105,800	108,000	10.12	100%	100%	98%	100%	137%
39	107,996	7.17	108,000	108,000	108,000	108,000	9.24	100%	100%	100%	100%	129%
44	107,996	6.86	108,000	108,000	108,000	108,000	8.80	100%	100%	100%	100%	128%
47	107,996	6.69	108,000	108,000	108,000	108,000	7.92	100%	100%	100%	100%	118%
51	107,996	6.37	108,000	108,000	108,000	108,000	7.48	100%	100%	100%	100%	117%
54	107,996	6.07	108,000	108,000	108,000	108,000	7.48	100%	100%	100%	100%	123%
57	107,996	5.80	108,000	108,000	108,000	108,000	7.04	100%	100%	100%	100%	121%
60	107,996	5.61	108,000	108,000	108,000	108,000	7.04	100%	100%	100%	100%	125%

Designed for reliability



Adaptive Sine Wave

Stable sine wave

Significant reduction in electro-magnetic Interference over the wide range of capacity

Refrigerant Cooling System

No over heating of inverter PCB

Innovative inverter cooling technology to ensure reliable performance.

Resonance Avoidance Technology

No Inverter Resonance

Enhance reliability of the system due to resonant frequency avoidance

Oil Balancing

Enhanced reliability / Installation

Easy installation, Compressor liability

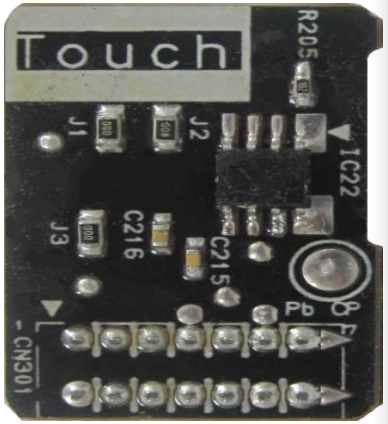
JACCO

Indoor and Outdoor PCB Removable EEPROM

Keep system information during service or PCB replacement

Outdoor unit main PCB

Front



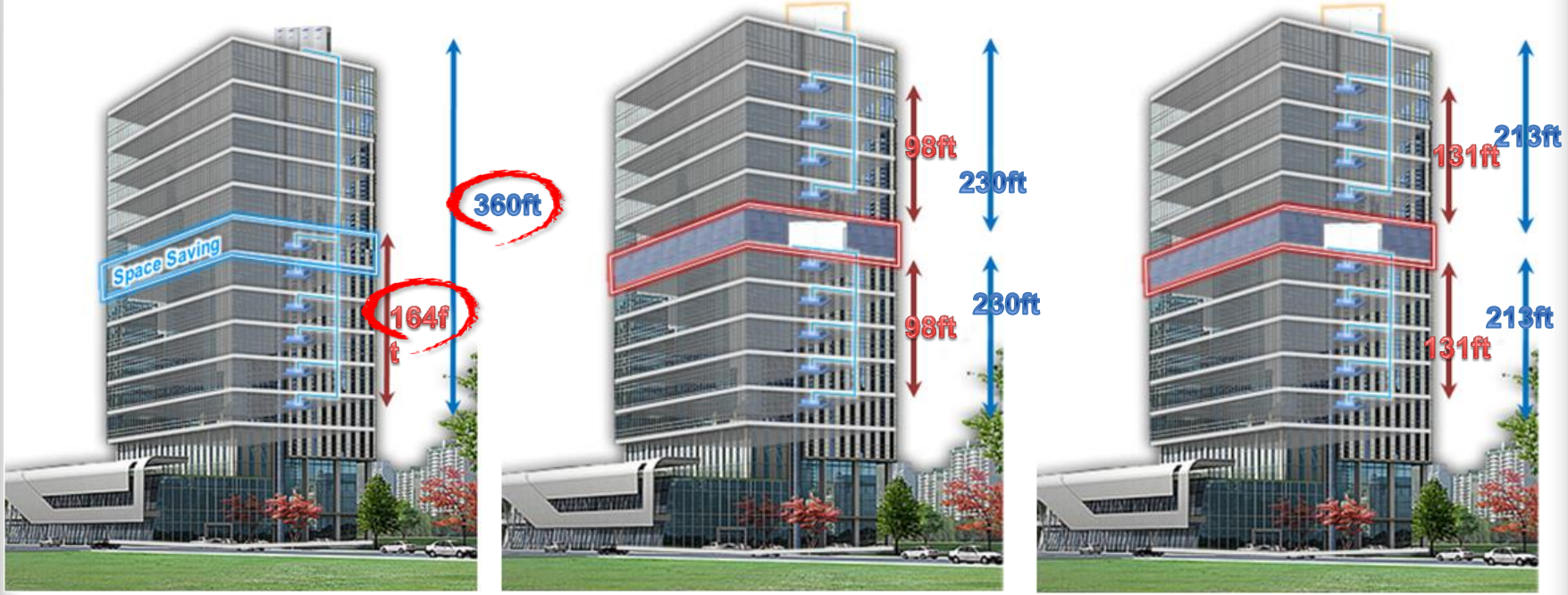
Back

- Model/Serial Number/Unit Name/Tag Number Storage
- No Dip Switches
- Error back up data (30min)
- Allows Updates Without Disturbing Tenant/Classroom/Workers
- Open-Ended, Accepts New Programming

DVM-S VRF System Refrigerant Line Sets

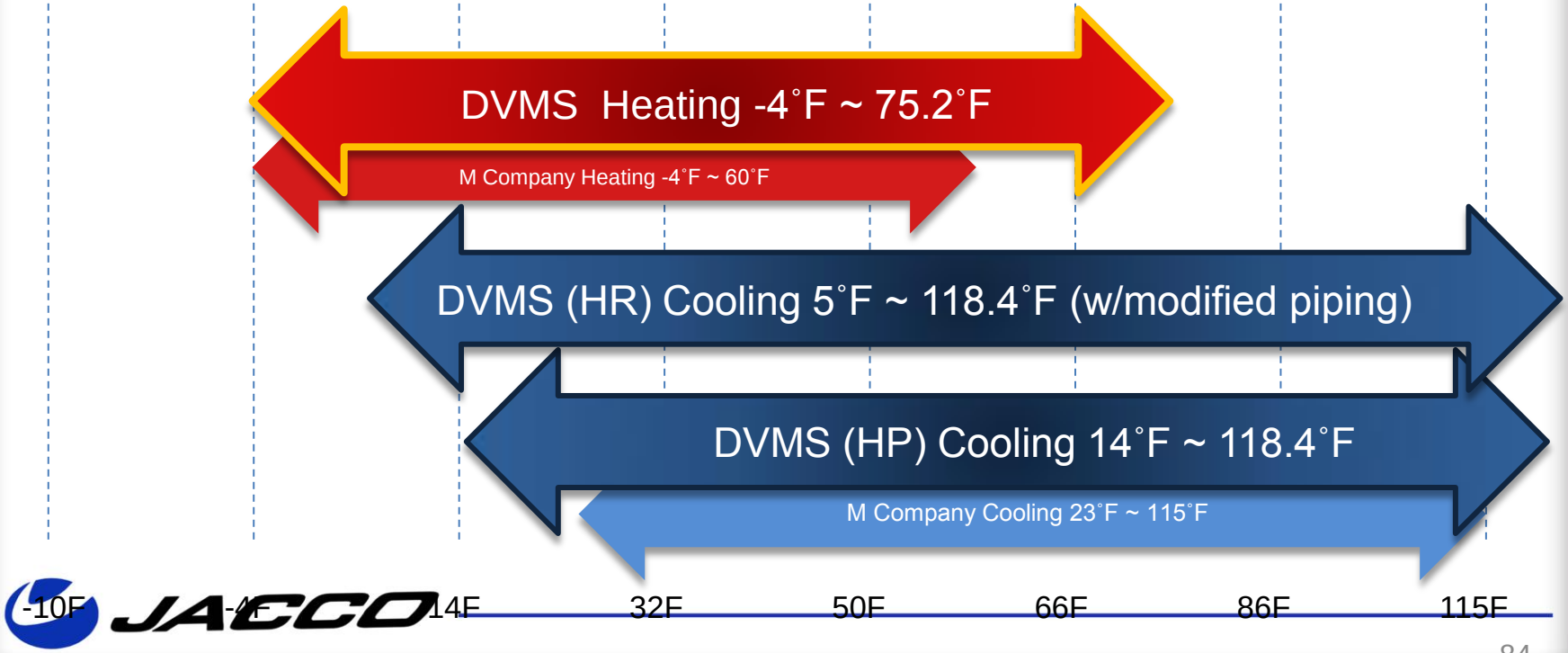
Maximum Line Set Length – Outdoor Unit to Furthest Indoor Unit – **656ft**

Total Overall line set Length - **3280ft**



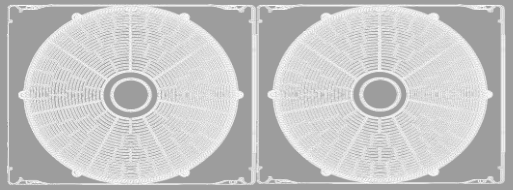
Height difference between Indoor and Outdoor units: Max 360ft (HP systems, with PDM kit)

DVMS VRF System Operating Temperature Range



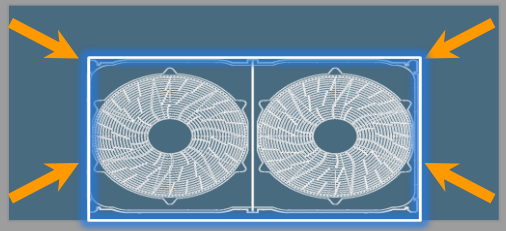
Smaller Footprint

Competitor (22 HP)		DVM S (22 HP)	
15.3 ft²	Footprint	10.7 ft²	30% ↓
1,058 lb	Weight	661 lb	37% ↓



VS

DVM S Space 30% ↓



JACCO

Seamless Operation Mode Change

Samsung DVMS VRF systems have the ability to change operation mode without stopping the compressors

Heating Operation

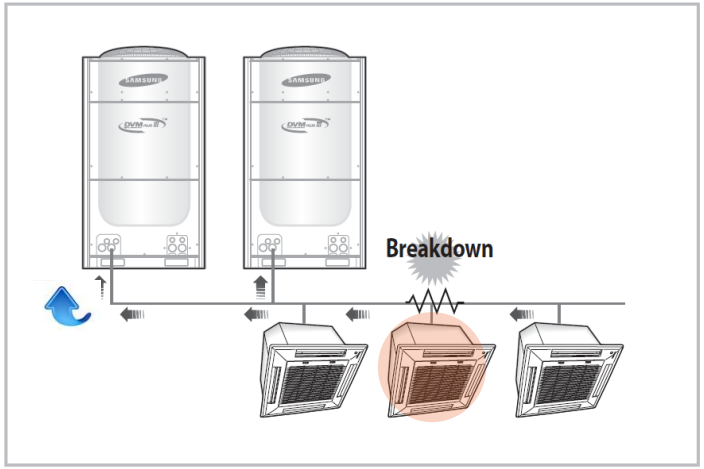
Cooling Operation

Cooling Operation

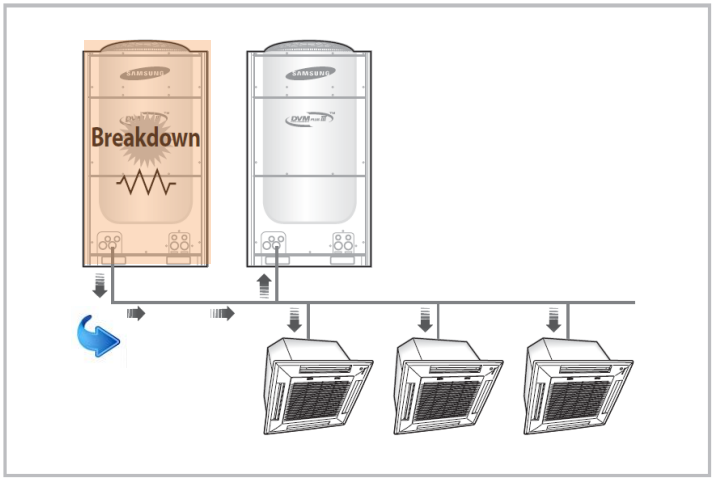
Heating Operation

Rotational Defrost (HR model, modular systems only)

Refrigerant Pump-down & Pump-out



If maintenance of the indoor units is necessary, the system refrigerant can be pumped into the outdoor unit(s) to allow access to the indoor piping system



If maintenance of the outdoor units is necessary, the refrigerant can be pumped out of the outdoor unit(s) into the system piping and indoor units

JACCO

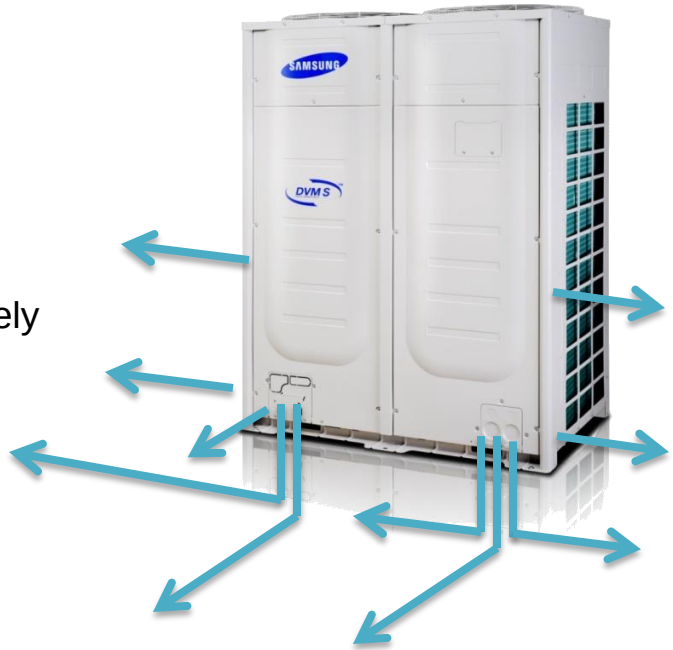
Snow Removal Function

- Snow prevention function removes accumulated snow
- Outdoor units will blow away covered snow every 30 minutes to prevent any damage that can be caused by snow accumulation 40 F
- Upon start of this feature, the PCB will detect if snow is actually present to proceed with snow blowing or not.

JACCO

Easy to install

The knock-out holes for piping, power, and communication cables are located in a variety of directions, allowing for more convenient installation of DVMS since the piping and cable direction can be freely selected from the front, left, and right side.



JACCO

Condenser Discharge Ducting

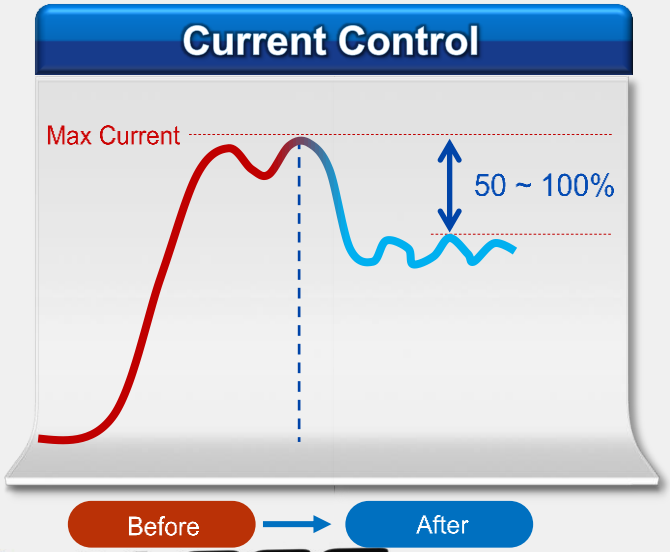
Improve installation flexibility with Outdoor unit ESP of 0.3”WC

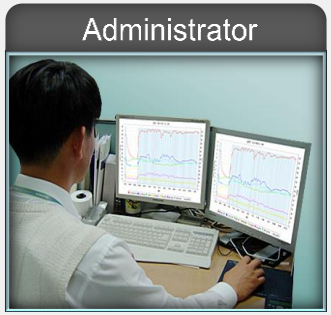
Ensure reliable installation and operation
even with high external static pressure
in applications such as a high rise building

JACCO

Current Control

Ensure simple energy management by real-time control of the maximum operation current during reduced power supply or excessive energy usage



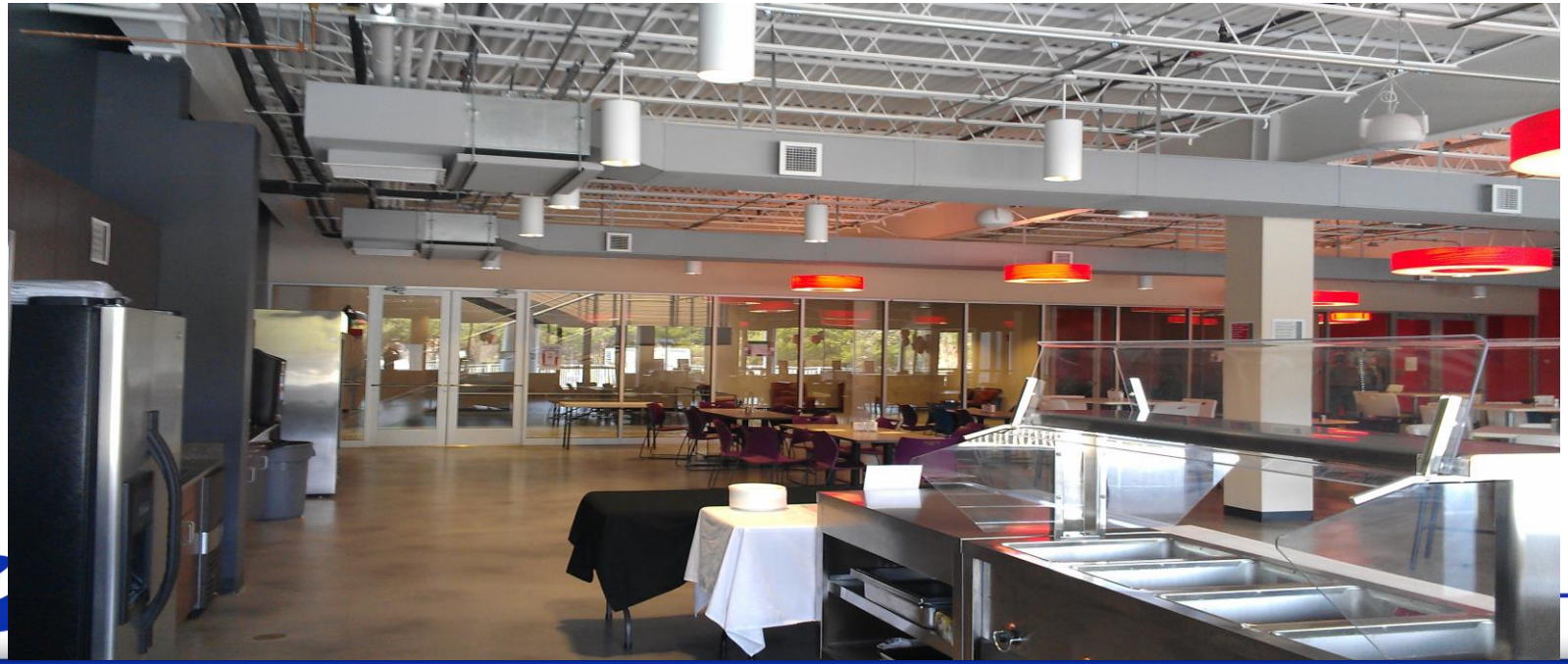


Current Control

Set current limit by 11 steps with a range from 50 to 100% of maximum operation current

JACCO

DVMS VRF System Indoor Unit Models



Indoor Line-up

BTU	7,500	9,500	12,000	18,000	20,000	24,000	30,000	36,000	48,000	76,800	96,000
Wall Unit	✓	✓	✓	✓	✓	✓					
4 Way		✓		✓		✓	✓	✓	✓		
Mini 4 Way		✓	✓	✓	✓						
1 Way	✓	✓	✓								
Slim Duct	✓	✓	✓	✓		✓	✓	✓	✓		
MSP Duct				✓		✓	✓	✓	✓		
HSP Duct								✓	✓	✓	✓
Under Ceiling				✓	✓						
Vertical Concealed			✓	✓	✓	✓	✓	✓	✓	✓	

4-Way Cassette

Sub Duct & Fresh Air Knockouts

Condensate Pump 29” Lift

4 X auto-swing louvers

Power button, status indicator, and filter reminder lights

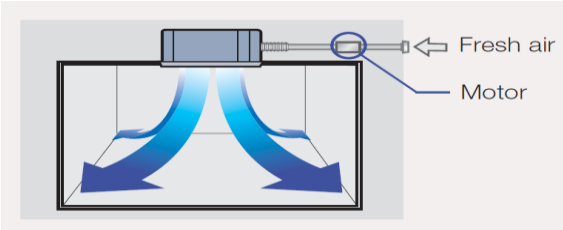
Center return with washable, pleated, electrostatic filter

Built-in IR receiver for easy wireless control addition

AM0**FN4DCH/AA

	AM009FN4DCH/AA	AM018FN4DCH/AA	AM024FN4DCH/AA	AM030FN4DCH/AA	AM036FN4DCH/AA	AM048FN4DCH/AA
Nominal Cooling Capacity (Btu/h)	9,000	18,000	24,000	30,000	36,000	48,000
Nominal Heating Capacity (Btu/h)	10,000	20,000	27,000	34,000	40,000	54,000

4-Way Cassette
(AM0**FN4DCH/AA)



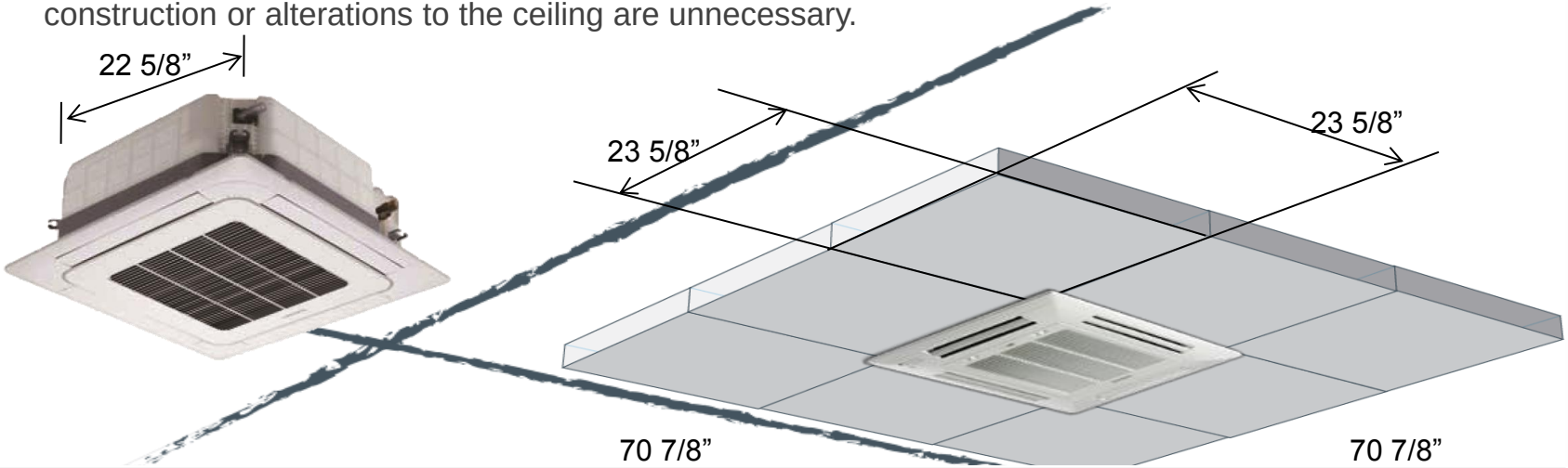
- Fresh air can be introduced through the fresh air knock-out to supply up to 4.2% of rated CFM of fresh air (≈4”)
- This is a 0” static unit so a booster fan must be used to force air into the cassette unit
- 12 VDC contacts are available to control booster fan when the indoor fan is on.

- Fresh air must be filtered (enters after cassette filter)

Mini 4-Way Cassette

Ideal Compact Size

Without any unnecessary alterations to the ceiling, The Mini 4Way cassette indoor unit can be installed in one standard ceiling tile (24 x 24) so construction or alterations to the ceiling are unnecessary.



AM0**FNNDCH/AA

	AM009FNNDCH/AA	AM012FNNDCH/AA	AM018FNNDCH/AA	AM020FNNDCH/AA
Nominal Cooling Capacity (Btu/h)	9,500	12,000	18,000	20,000
Nominal Heating Capacity (Btu/h)	10,500	13,500	20,000	23,000

1-Way Cassette

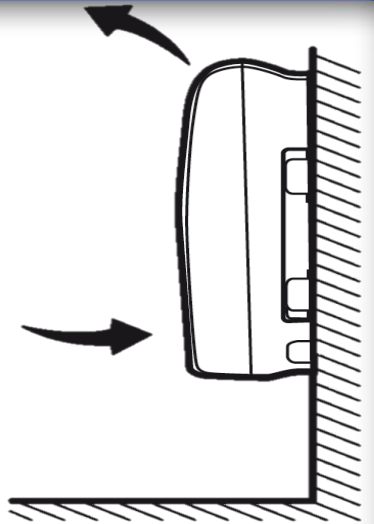
Only 5 3/8”mm thick

Samsung introduces the slimmest in class indoor air conditioner unit. Only 5 3/8”mm thick, the Slim 1Way cassette air conditioner can be installed practically anywhere.

Company	Height
SAMSUNG	5 3/8”
“D”	8 ½”
“M”	9”

AM0**FN1DCH/AA			
	AM007FN1DCH/AA	AM009FN1DCH/AA	AM012FN1DCH/AA
Nominal Cooling Capacity (Btu/h)	7,500	9,500	12,000
Nominal Heating Capacity (Btu/h)	8,500	10,500	13,500

Under-Ceiling Unit
(AM0**FNCDCH/AA)



- Can install under the ceiling or on a wall (low wall)
- Sleek, simple design
- 1 X Auto swing louver
- IR receiver built-in
- Power button and status

JACCO

Under-Ceiling Unit
(AM0**FNCDCH/AA)

- EEV not inside unit to reduce noise (external EEV must be supplied)

- 1, 2, and 3 indoor unit EEV kits are available

AM0**FNCDCH/AA		
	AM018FNCDCH/AA	AM024FNCDCH/AA
Nominal Cooling Capacity (Btu/h)	18,000	24,000
Nominal Heating Capacity (Btu/h)	20,000	27,000

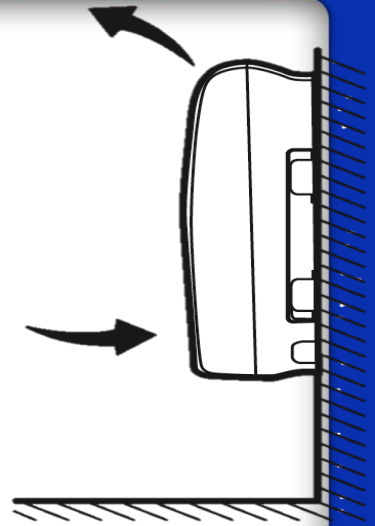
Neo Forte – High Wall Unit

- Sleek, simple design
- Bottom opening front panel
- Advanced air purification with anti-allergy Catechin and deodorizing filters
- Wireless controller included

AM0**FNTDCH/AA						
	AM007FNTDCH/AA	AM009FNTDCH/AA	AM012FNTDCH/AA	AM018FNTDCH/AA	AM020FNTDCH/AA	AM024FNTDCH/AA
Nominal Cooling Capacity (Btu/h)	7,500	9,500	12,000	18,000	20,000	23,200
Nominal Heating Capacity (Btu/h)	8,500	10,500	13,500	20,000	23,000	23,800

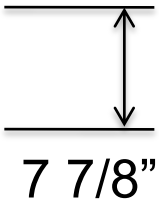
Ceiling/Floor Unit

- Sleek, simple design
- Can install under ceiling or low on wall
- Auto swing louver
- EEV not inside unit to reduce noise (external EEV is necessary)
- Chassis is able to conceal 3rd party condensate pumps



AM0**FNCDCH/AA		
	AM018FNCDCH/AA	AM024FNCDCH/AA
Nominal Cooling Capacity (Btu/h)	18,000	24,000
Nominal Heating Capacity (Btu/h)	20,000	27,000

Slim Duct

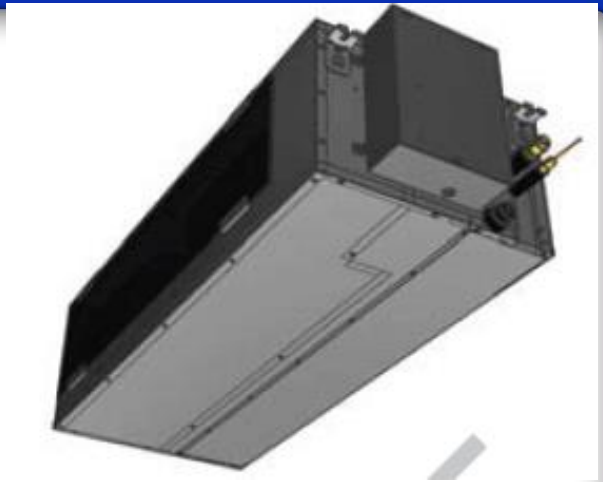


- **Optional Samsung condensate pump with a 29” lift and check valve.**
- **Quick Lock has been added to the drain hose.**
- **The fan motor adjusts speed according to ESP**
- **Standard ESP - .08” WC. Max ESP - .16” WC**

AM0**FNLDCH/AA							
	AM007FNLDCH/AA	AM012FNLDCH/AA	AM018FNLDCH/AA	AM024FNLDCH/AA	AM030FNLDCH/AA	AM036FNLDCH/AA	AM048FNLDCH/AA
Nominal Cooling Capacity (Btu/h)	7,500	12,000	18,000	24,000	30,000	36,000	48,000
Nominal Heating Capacity (Btu/h)	8,500	13,500	20,000	27,000	34,000	40,000	54,000

MSP Duct

- Built-In Condensate Pump w/ 29” of Lift
- The fan motor adjusts speed according to ESP
- Sizes: 7k, 9k, 12k, 15k, 18k, 24k, 27k, 30k, 36k, 48k



Static Pressure		
	7K BTU – 18k BTU	24k BTU – 48k BTU
Standard ESP (“ WC)	0.04”	0.12”
Min. Static (“WC)	0	0
Max. Static (“WC)	0.59”	0.79”

HSP Duct

- Optional Samsung condensate pump
- The fan motor adjusts speed according to ESP
- HSP units will not work with Mini DVM

Static Pressure				
	AM036FNHDCH/AA	AM048FNHDCH/AA	AM072FNHDCH/AA	AM096FNHDCH/AA
Standard ESP (“ WC)	0.39	0.39	0.59	0.59
Min. Static (“WC)	0.2	0.2	0.2	0.2
Max. Static (“WC)	0.79	0.79	0.98	1.10

AM0**FNHDCH/AA				
	AM036FNHDCH/AA	AM048FNHDCH/AA	AM076FNHDCH/AA	AM096FNHDCH/AA
Nominal Cooling Capacity (Btu/h)	36,000	48,000	76,800	96,000
Nominal Heating Capacity (Btu/h)	40,000	54,000	85,200	108,000

Global Duct – Low to High Static

COMING SOON

- Horizontal installation
- Optional Samsung condensate pump (external mount)
- Built-in EEV

Global Duct								
Nominal Cooling Capacity (Btu/h)*	6,000	9,500	12,000	18,000	24,000	30,000	36,000	48,000
Max. Static (“WC)*	0.6”						0.8”	

*Final technical specifications may vary.

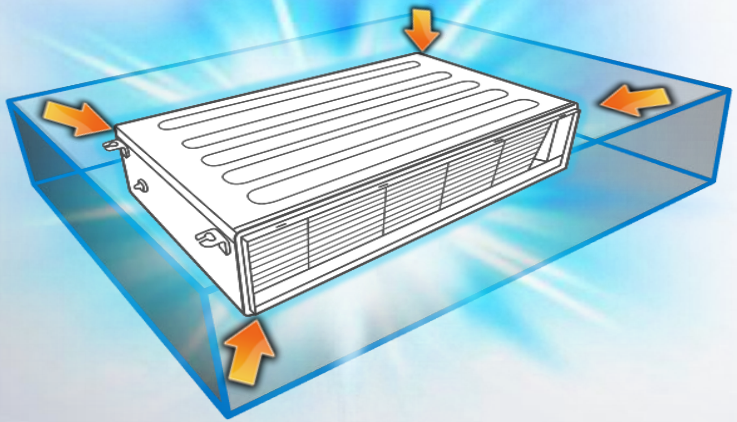
JACCO

Smart Installation

Duct S coming in 2015!

- It Can Be Installed Anywhere, Anyplace thanks to the Ultimate Compact Design
- Up to .80 ESP

Less Volume by 30%
vs D Company



- Reduces Its Volume by 30% Compared with D company

Samsung New Ducted AC	*D company*	*M company*
7.4 SQFT	10.4 SQFT	9.8 SQFT
	40% less 	33% less 

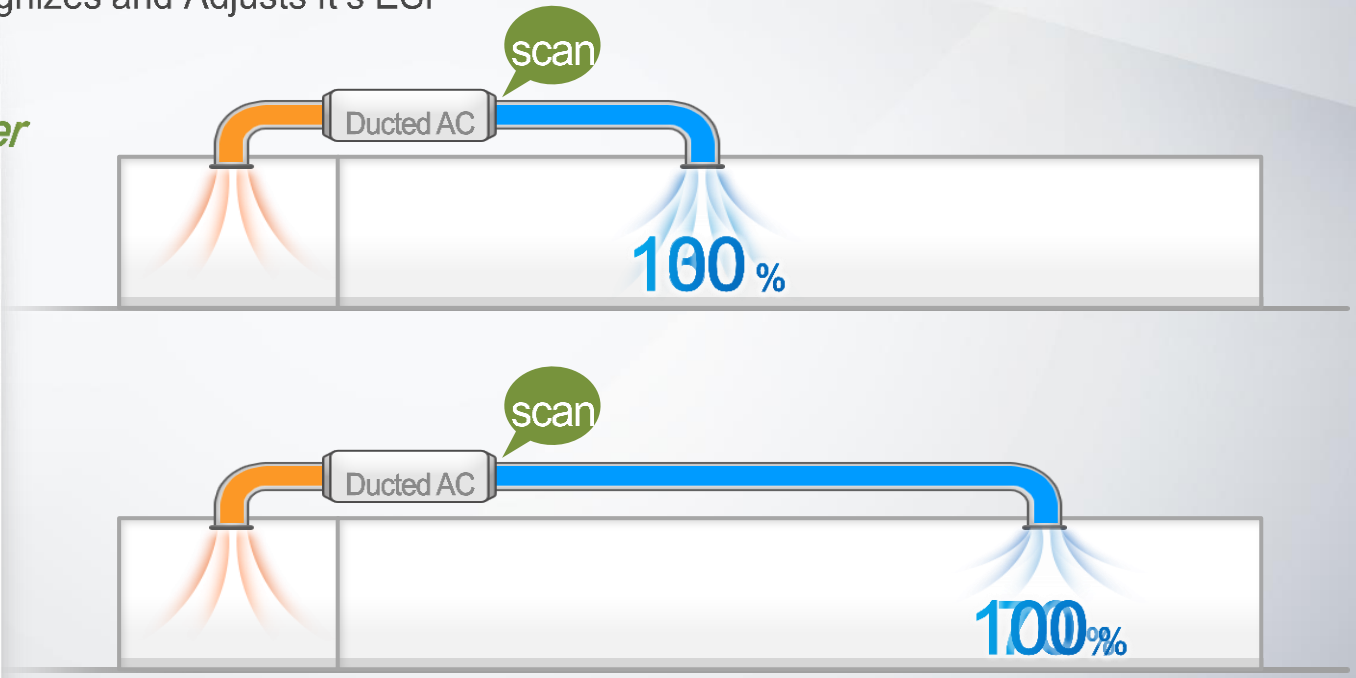
[10kW Inverter Deluxe]

Smart Commissioning

Automatic Air-volume

- Always Keep the Optimum Air-volume Whatever the Length of Duct is about
  - Automatically Recognizes and Adjusts It's ESP

With Wired Controller



* ESP : External Static Pressure

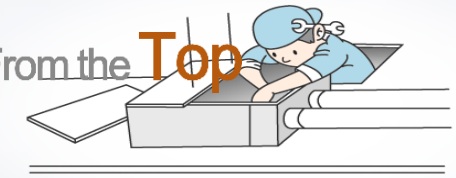
* Standard Wired Controlle
* Zone Controller

MENU

Access from 3-directions

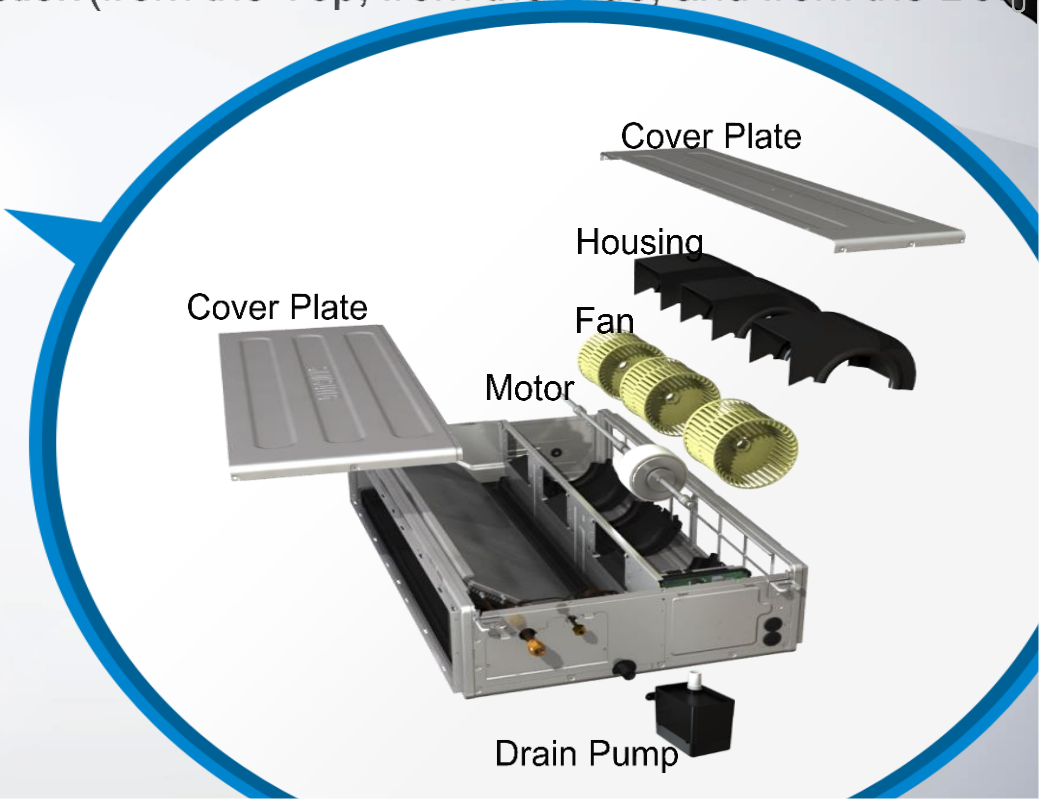
- **It Can Be Accessed from Any Direction** (from the Top, from the Side, and from the Bot
  - Heavy Work (Wood Truss Roof)

1 From the Top



2 From the Bottom

3 From the Side



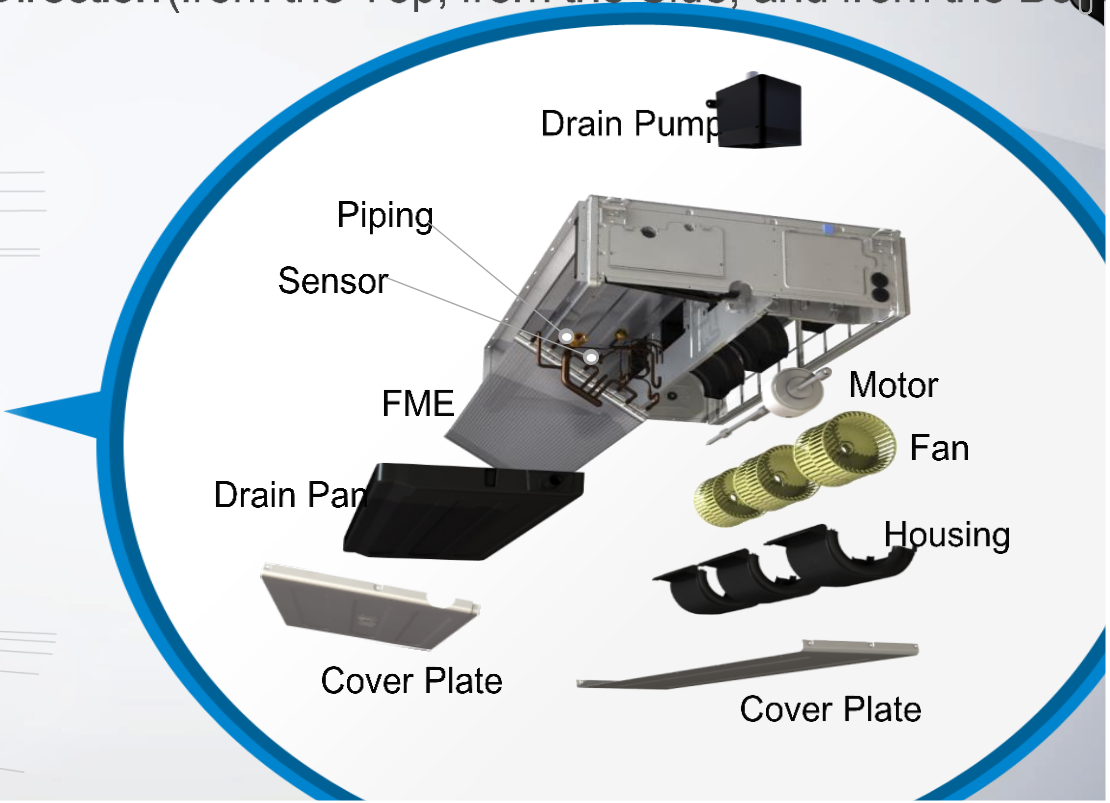
Access from 3-directions

- **It Can Be Accessed from Any Direction** (from the Top, from the Side, and from the Bo
  - Heavy Work

1 From the Top

2 From the Bottom

3 From the Side



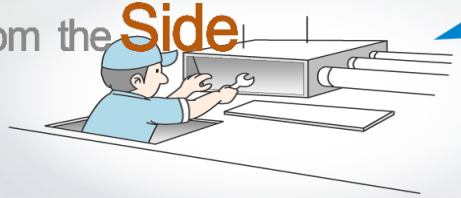
Access from 3-directions

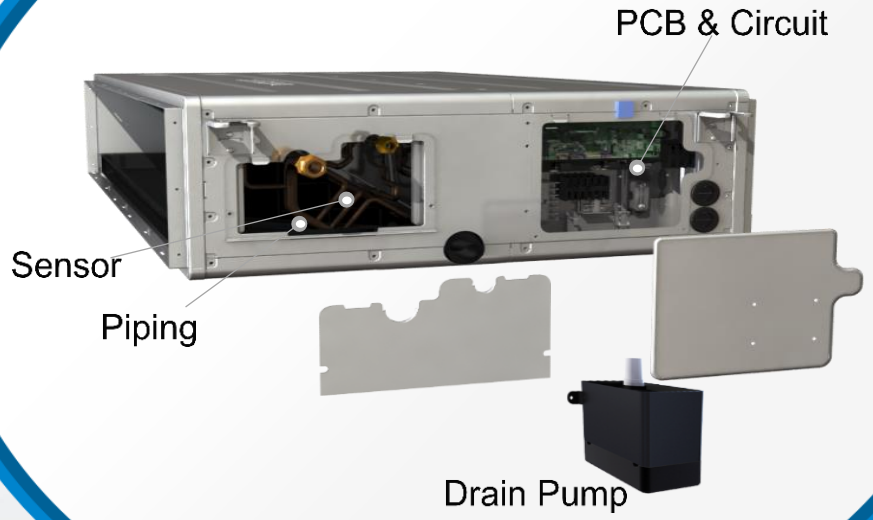
- **It Can Be Accessed from Any Direction** (from the Top, from the Side, and from the Bot
  - Light Work

1 From the Top

2 From the Bottom

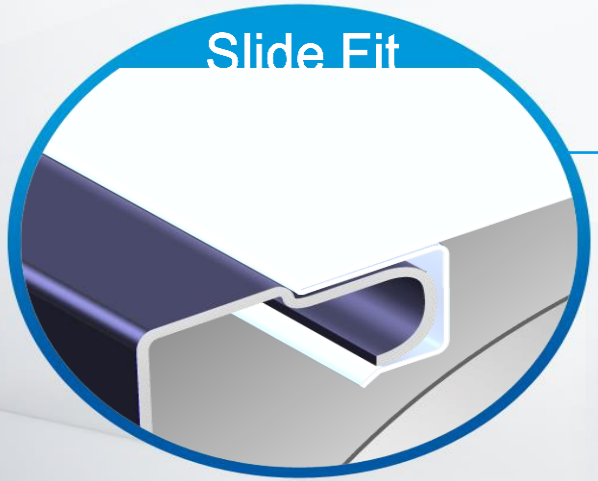
3 From the Side





Access from 3-directions

- By Adopting Slide Fit
  Much Easier Maintenance
  - No Need to Disassemble Supply(or Return) Chamber While Maintenaning



Much Easier to Disassemble

Vertical AHU

- **Multiposition – Vertical, Horizontal Left, Horizontal Right**
- **Can Add Electric Heating Element**
- **ESP Min – 0.4”, ESP Max – 1.0”**

AM0**FNHDCH/AA					
	AM012GNVQCH	AM018GNVQCH	AM024GNVQCH	AM030GNVQCH	AM036GNVQCH
Nominal Cooling Capacity (Btu/h)	12,000	18,000	24,800	30,000	36,000
Nominal Heating Capacity (Btu/h)	13,500	22,000	27,000	34,000	40,000

	AM048GNVQCH	AM054GNVQCH	AM060GNVQCH	AM072GNVQCH
Nominal Cooling Capacity (Btu/h)	48,000	54,000	60,000	72,000
Nominal Heating Capacity (Btu/h)	54,000	60,000	64,000	80,000

DVMS VRF System – Control Solution

JACCO

DVM S Controls

Individual Control

MR-DH00U
Wireless Controller

MRK-A10N
Wireless Signal Receiver

MWR-WE10N
Programmable Wired Controller

MWR-SH00N
Simplified Wired Controller

MRW-WE10N
External Temperature Sensor

MCR-SMA MDS
Motion Sensor
Mini 4 Way only

MIM-B14
External Contact Control

MCM-C210N
Multi-Tenant Controller

JACCO

SAMSUNG

DVM S Controls

Centralized Control

MCM-A300N
Touch Controller

S NET3
Software

MIM-B17N
BACnet Gateway

MIM-B18N
LON Gateway

MIM-D00AN
DMS 2.0 Data
Management Server

MCM-C200
Operation Mode
Selector

MCM-A202DN
On/Off Controller

MIM-B16N PIM
Pulse Input Module

MIM-N01
Interface Module
Communication Adaptor

JACCO

SAMSUNG

Individual Control System

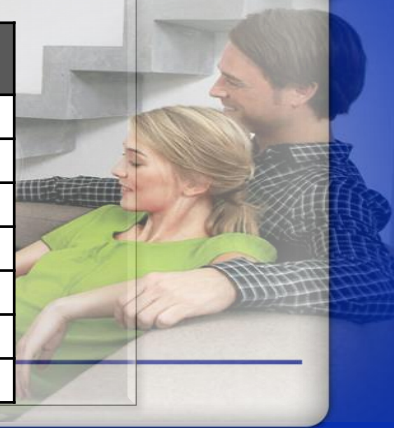
Wired Controllers

Multi function
MWR-WE10N

Touch Controller
MCM-A300N

Simple Controller

Menu	MWR-WE10N	MCM-A300N	Simple Controller
Size (W x H x D)	120 x 124 x 19	190 x 160 x 39	
A/C control function	O	O	O
ERV control function	O	O	O
Scheduler	O	O	X
Energy saving mode	O	X	X
Temperature sensor	O	X	X
Clock (Summer time)	O	O	X

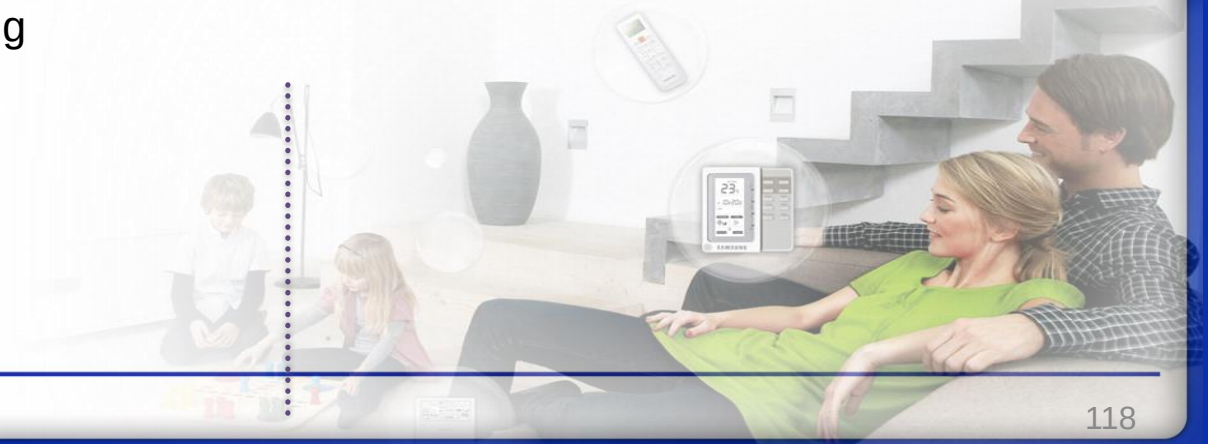


Individual Control System

Wireless Controller

MR-DH00U

- Simple schedule control (ON/OFF timer)
- Wide display
- Soft touch button
- On/off, operation mode, fan speed, Airflow, temperature setting
- Individual blade control
- Filter replacement alarm reset
- Multi-channel wireless remote control (maximum of 4 channels)
- Address and option setting



JACCO

Individual Control System

MRK-A00N (Wireless Signal Receiver)

- Allows wireless control of concealed ducted units
- ON/OFF control button
- Operation indication
- Error Indication
- Filter replacement sign
- Recessed installation
- **Includes interconnect cable**

Individual Control System

MRW-TA (external room temperature sensor)

- External room sensor to sense more exact user environment temperature

- Supports all types of indoor units

- Includes 39’ of connection wire

Individual Control System

MCR-SMA motion sensor for mini 4-way cassettes

MDS (Motion Detection Sensor)

- Senses motion
- Detects temperature stratification throughout room
- Can enable and disable via MWR-WE10N wired controller
- Easily snaps into mini 4-way cassette panel
- Connection cable included
- Plugs into “human sensor” plug on PCB (CN401)
- Options are specified when programming the indoor unit(s)
- Learns your schedule

More control details in system programming section

Individual Control System

Multifunction Wired Controller – MWR-WE10N

- **Unified controller** (A/C, ERV, ERV Plus, AHU)
- **Can connect up to 16 indoor units**
- A/C ON/OFF, operation mode, setting temperature, air flow, fan speed
- ERV ON/OFF, operation mode, fan speed
- Sleep & Silent mode
- Clear & Bright screen with LCD backlight
- Error display
- Filter replacement alarm display and reset
- Single or multiple control (Max 16 Indoor unit + Samsung ERV)
- **Weekly operating schedule** (A/C only, ERV only, A/C + ERV)
- Upper/Lower temperature limit setting
- Automatic operation stop function
- **Energy saving operation mode**
- **Child lock**
- **Different button permission levels.**
  (Operation mode, temperature setting, ON/OFF, fan speed)
- Wireless remote control restriction
- Real-time clock function : current time/day display, summer time
- **Built-in room temperature sensor**
- **Individual blade control**
- Motion detection sensor function
- Master indoor unit setting
- Service mode support

Individual Control System

Simplified Wired Controller – MWR-SH00N

- Indoor unit operation ON/OFF
- Can connect up to 16 indoor units
- Indoor unit operation mode, set temperature, and fan speed
- Error display
- Filter replacement alarm display and reset
- Single indoor unit control or multiple unit control (maximum 16 units)
- Partial controller button lock (operation mode button, temperature setting buttons, fan speed button, timer button, and lock mode button)
- Upper and lower temperature setting restriction
- Auto mode skip
- Heat mode skip (cooling only)
- Restrict wireless controller signal (optional)
- Louver position setting (cassette and wall units)
- Single event timer function (ON/OFF control, 30 minutes ~ 18 hours timer setting options)
- System/indoor unit function and operation indication (defrost, error, restricted controller, SPi status)
- Quiet Mode setting (for supported units)
- Service mode for connected indoor unit operation monitoring, addressing, and setup
- Can be used to specify "Mode Master" while connected to a single indoor unit when used with heat pump systems
- **Does not have temperature sensor**

System Communication

Outdoor Unit Communication Connections

F1 / F2

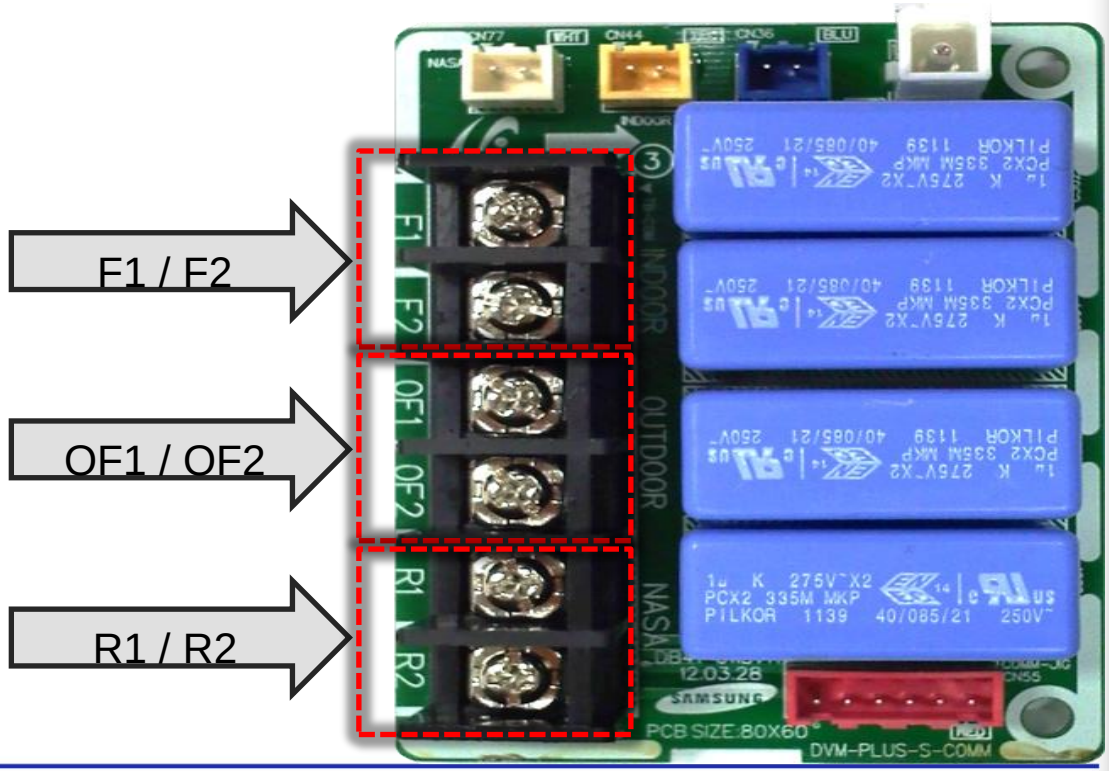
Communication from the MAIN outdoor unit to all indoor units, MCU's, and EEV kits on that refrigerant system (more details on next page)

OF1 / OF2

Communication from the MAIN outdoor unit to the SUB1 and SUB2 outdoor units (only used when the system has more than 1 outdoor unit).

R1 / R2

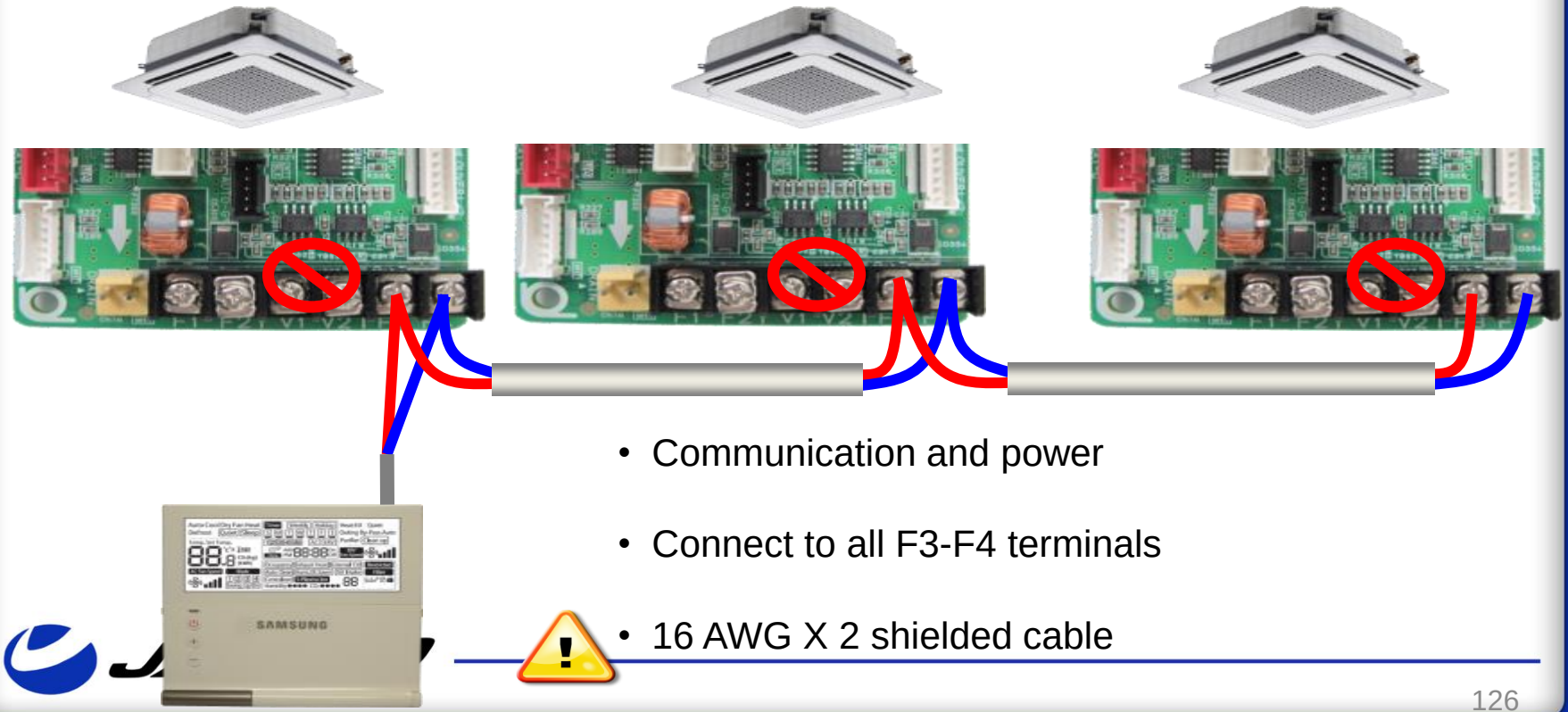
Communication from the MAIN outdoor unit to central control options (DMS2, BACnet, LON, touch controller)



Individual Control System

Wired Controller – MWR-WE10N

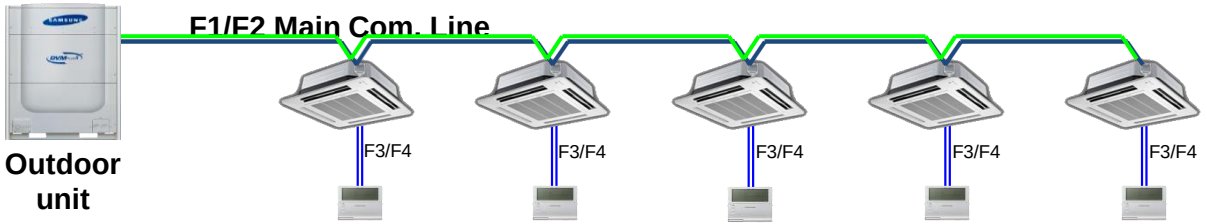
Can connect up to 16 indoor units to one wired controller

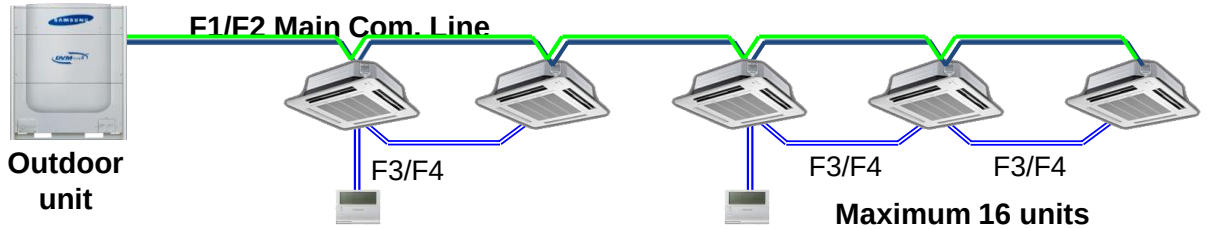


- Communication and power
- Connect to all F3-F4 terminals
- 16 AWG X 2 shielded cable
- Provides group control only

Individual Control System

Wired Controller Connection Examples

Individual control	One indoor unit for one remote controller
	
Control	- The connected indoor unit
Display	- Operation display of the connected indoor unit

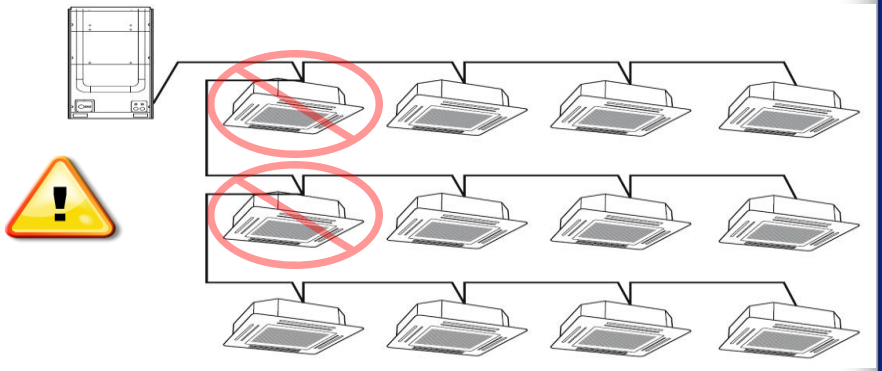
Group control	Multiple indoor units for one remote controller
	
Control	- All the connected indoor units
Display	- One of the connected indoor units on a random basis

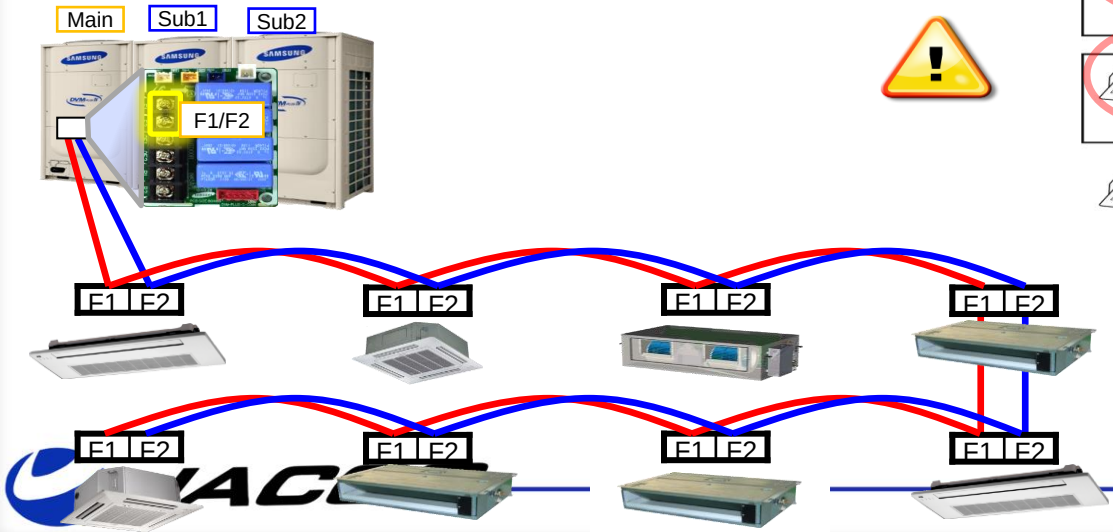
System Communication

F1/F2

- Avoid making a single piece of equipment a “hub” for communication connections

- Daisy chain from one unit to the next

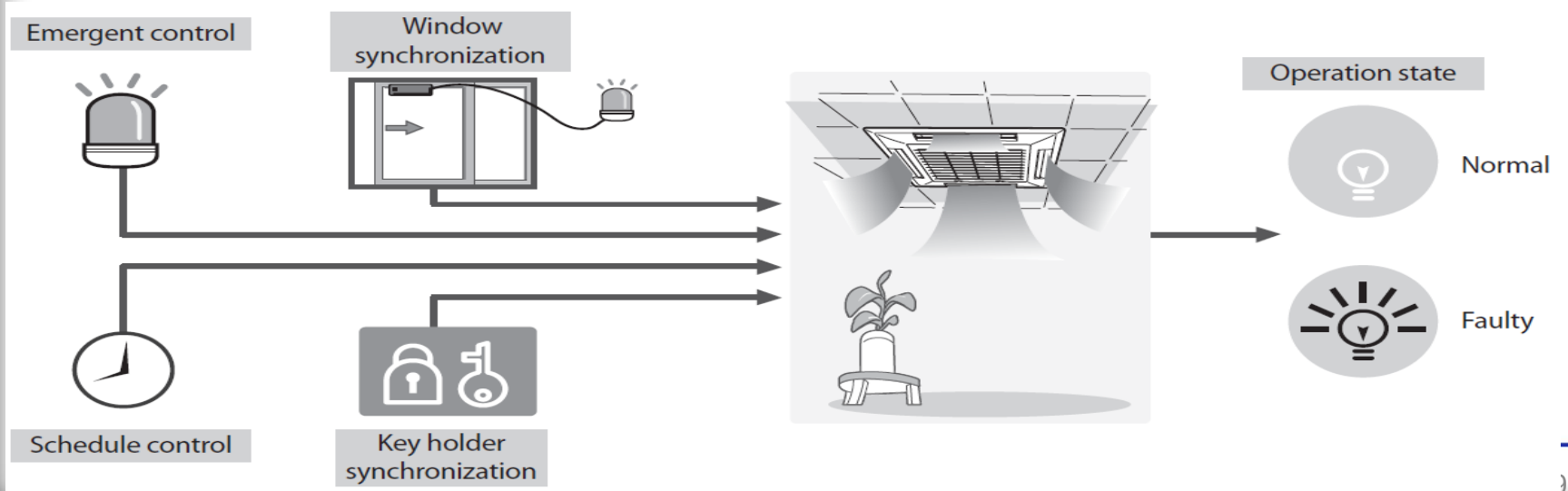




Guest Room Management

MIM-B14

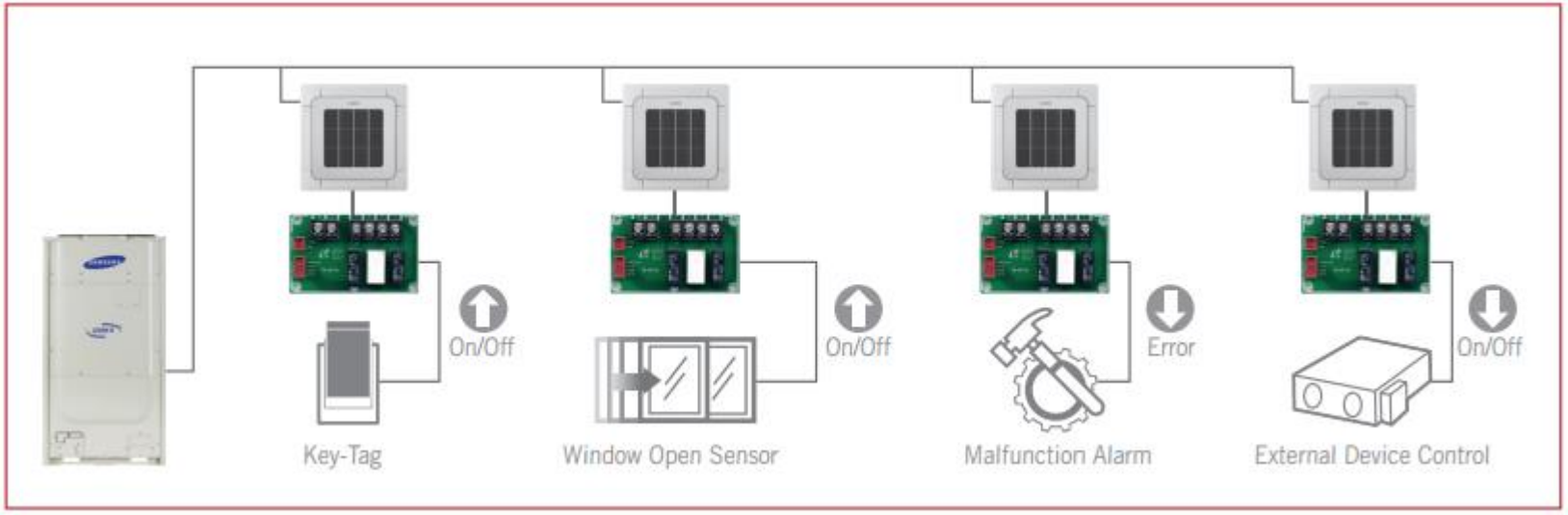
- Control options to enable/disable and monitor individual indoor units
- MIM-B14 and modules will give you different ways to control individual areas



Individual Control System

External Contact Controller

- Direct Indoor Unit Control by Auxiliary Contact Signal
- Window-synchronized Indoor Unit Control
- Emergency Control with Simple Contact Input



Integrated Management System

DMS 2

Samsung's Data Management Server (DMS) lets you monitor and control your on-site air conditioning needs remotely. It's the easiest and most convenient way to manage a large number of air conditioning units at once.

DMS 2

- 24 hour stand-alone web-server
- No special software required
- All management functions integrated

Easy Control & Monitoring

Max. 256 indoor unit
Floor/Area control
Set temperature limit
Operation lock
Cycle data monitoring

Schedule Control

Daily/Weekly schedule
Holiday setting
Schedule history

Web-server Service

Multiple remote access
Local/Internet control

Power Distribution System

Power distribution
to a maximum of
256 indoor units

Error Management

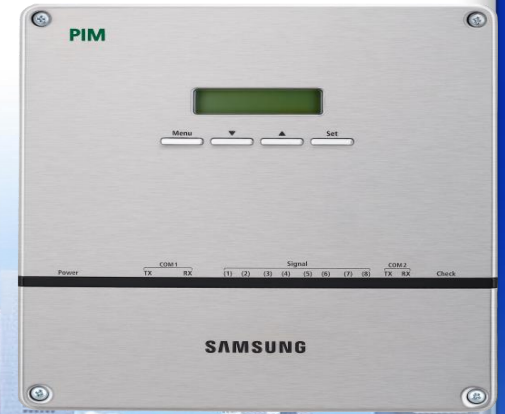
Max. 256 errors
Error storage to memory
Error query
Error notification

JACCD

Integrated Management System

Power Monitoring

MIM-B16



- Opto-isolated Interface with pulse-type watt-hour meters for electricity billing system
- Power data storage in non-volatile memory (8 channels)
- Data recovery from power failure
- Current time setting and display
- Configuration information display on LCD
- Error display (communication, out-of-range pulse width..)

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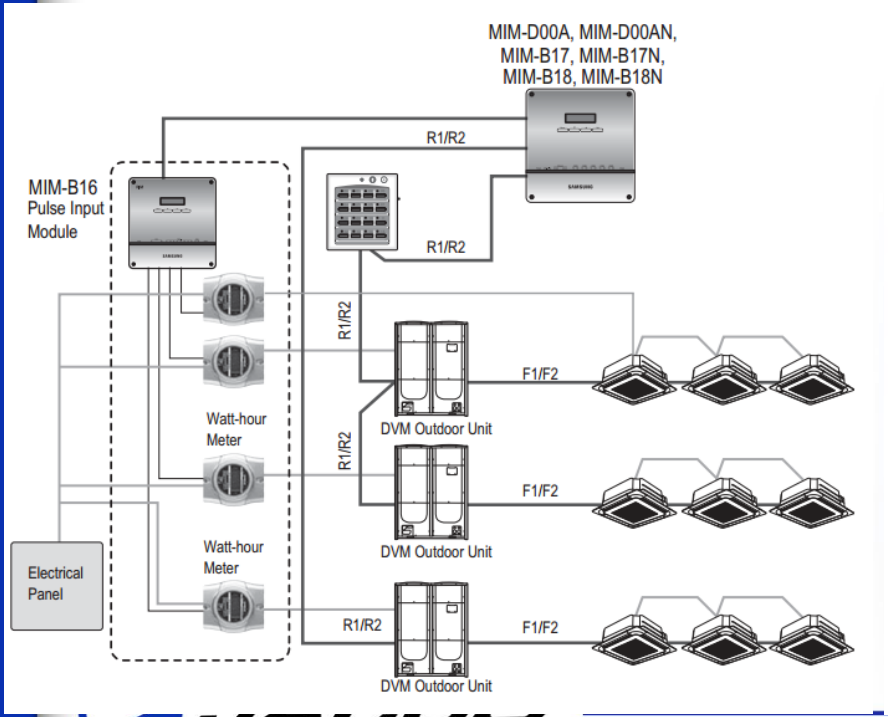
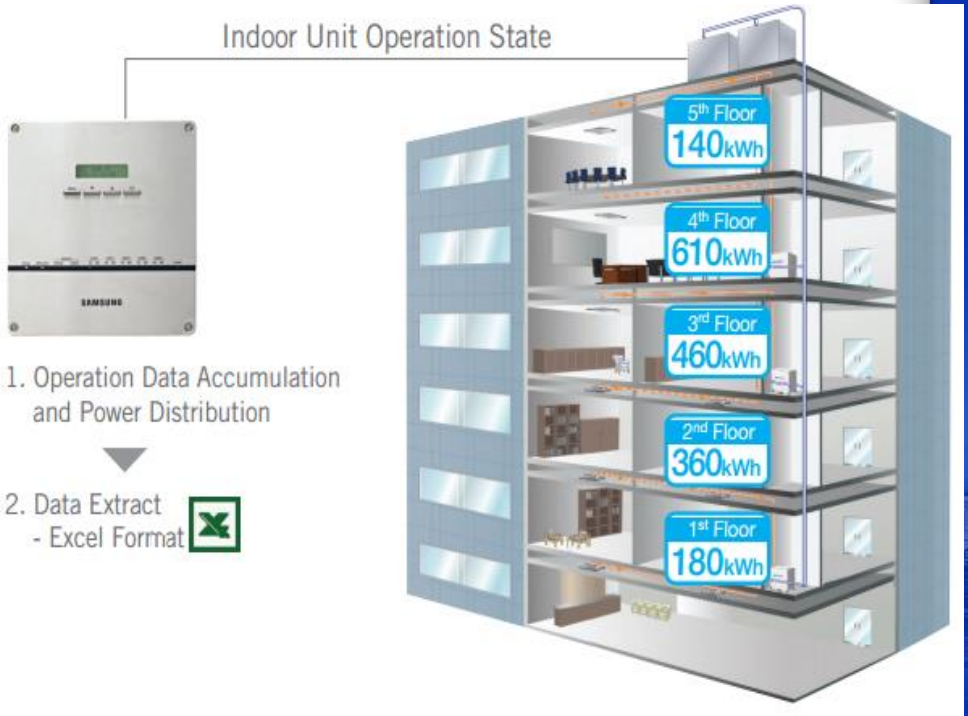
Integrated Management System

Power Monitoring Example



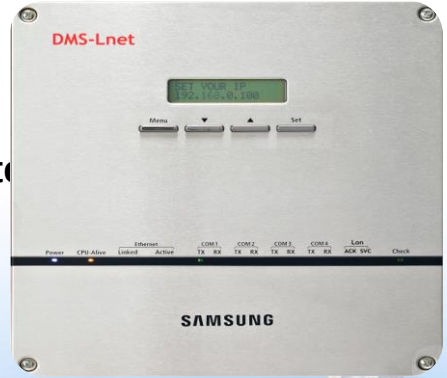


Integrated Management System

Lon Works & BACNET

DMS-Lnet

- Interface for Lon-Connection to LonWorks management syst
- Central management of up to 128 indoor units
- Combination use of S-NET3
- Included DMS2 function
- Communication : 485 to LonWorks
- Upper physical layer : FTT-10A



DMS-Bnet

- Interface for BACnet management system
- Central management of up to 256 indoor units
- Combination use of S-NET3
- Included DMS2 function
- Communication : 485 to BACnet
- Upper physical layer : Ethernet

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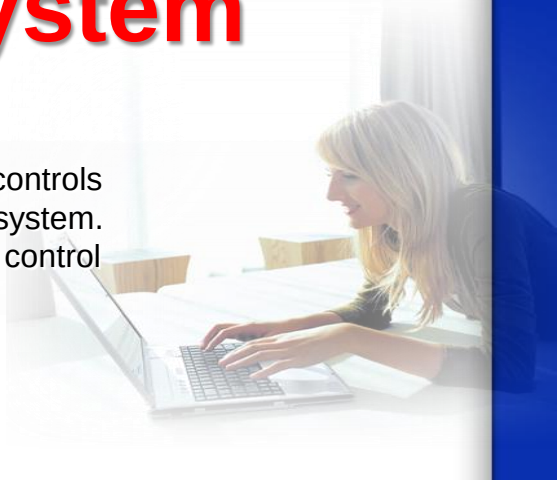
Integrated Management System

SNET 3 (MST-P3P)

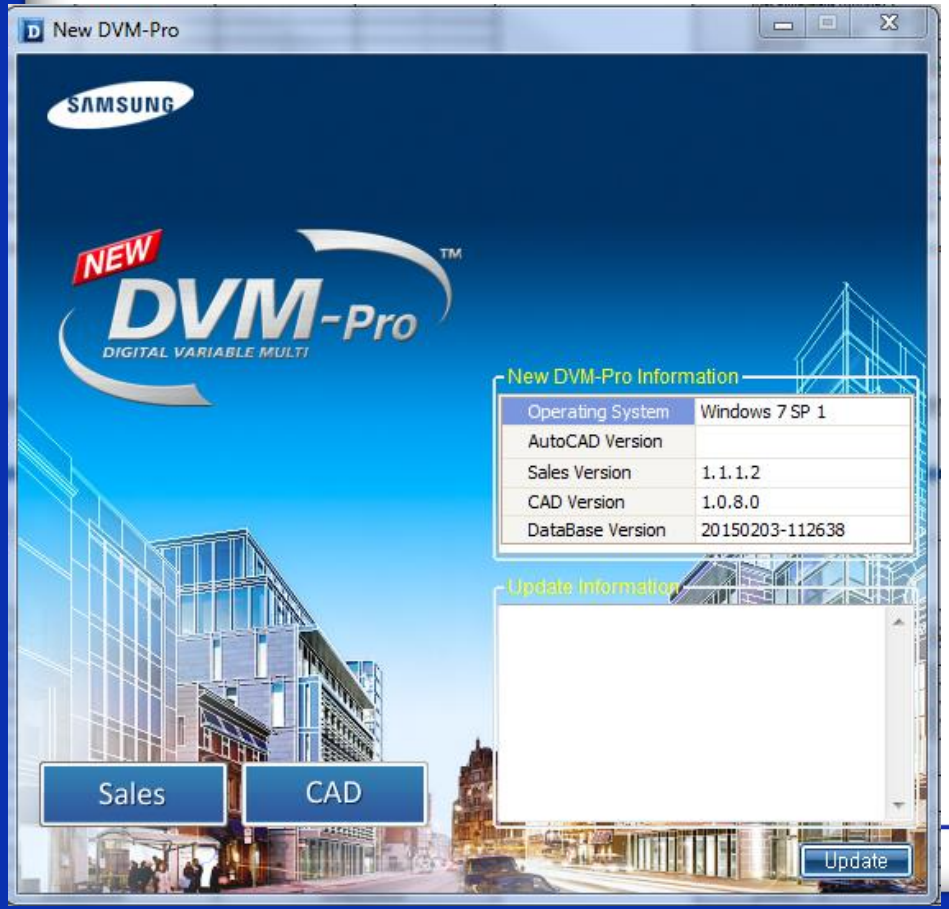
S-NET 3 is a complex management program that controls and monitors a complete air conditioner network system. The S-NET series provides flexible and complete control for a variety of applications.

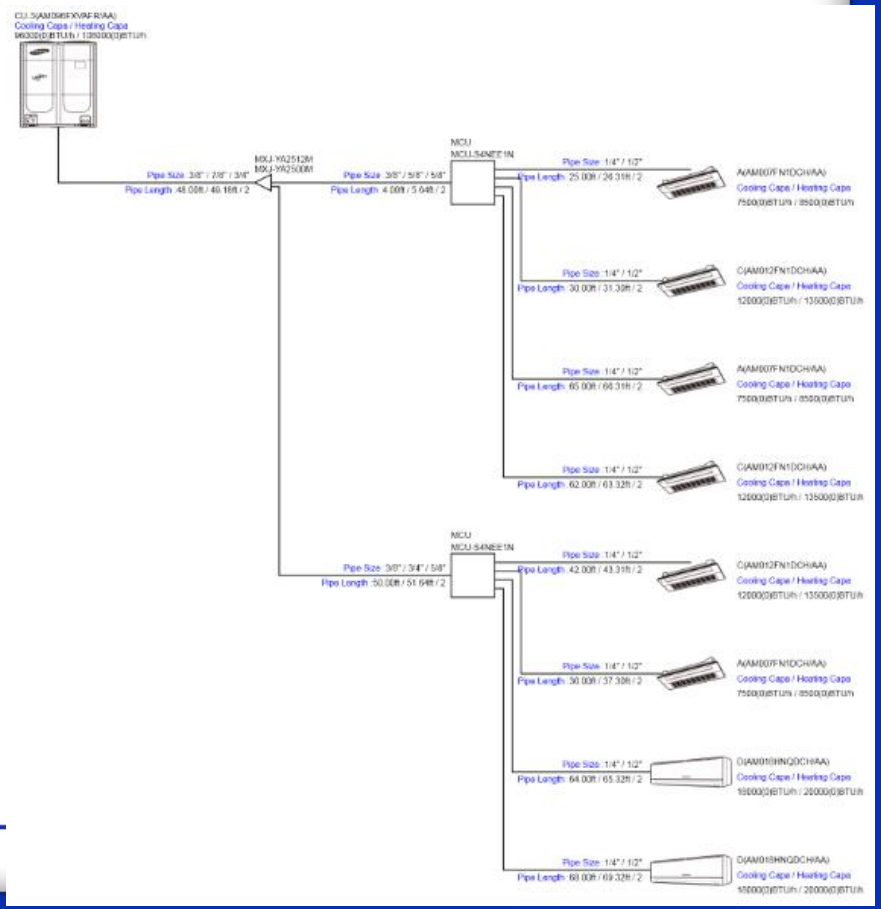
- Fully integrated PC management software
- **For large site. (Ex. University)**



Up to **16 DMSs** connection through the Ethernet

DVM Pro Selection Software





Installation & Startup

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Refrigerant Pipe Installation

- Soft Copper Up to 5/8”
- Hard Copper At or Above ¾”
- Use Nitrogen When Brazing Pipe
- All Distribution Kits To Be Installed Horizontally w/ 20” minimum any elbow or distribution kit
- Install Hanger Directly Before & After Each Distribution Kit
- Make Sure To Follow The Piping Diagram Provided With Submittals. If Anything Needs To Be Changed, Notify Your Sales Engineer

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System Communication Installation

- F1/F2 (Com 1) Is What Allows Communication Between Outdoor Units, Indoor Units, and MCU's
- RS485 Communication
- Always Use 16AWG Shielded Cable
- Daisy Chain Indoor Units
- Multiple Options To Wire In MCU

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Pre Startup Procedure

- Make Sure All EEV's are open
- Follow Leak Test Procedure
- Insulate All Refrigerant Pipe
- Follow System Evacuation Procedure
- Add Additional Refrigerant
- Jacco Support Will Be Provided Throughout The Process To Eliminate Possible Costly Mistakes
- We Will Provide Factory Certified Startup For The System

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Training

DVM S
DIGITAL VARIABLE MULTI

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Technical Training (TX – Installer Certification class)

- Product Concept
- Controls
- Piping Provisions, Installation Guidelines
- S-Net Pro and commissioning software
- Startup & charging
- General Troubleshooting
- DVM Pro design software and sizing

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Technical Training (TX, PA, CA – Only for certified* contractors)

** Mitsubishi, Daikin, LG – certification*

- One day training
- Controls
- Piping Provisions, Installation Guidelines
- S-Net Pro and commissioning software
- Startup & charging
- General Troubleshooting
- DVM Pro design software and sizing

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SAMSUNG

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Thank you for attending!