DAIKIN UNIVERSITY

Daikin Controls Integrator Training

Participant Guide

Daikin BACnet Interface – DMS502B71 Programming Guide

Rev 4.0

2/4/2013

Daikin AC - Controls Engineering Dept.

Contents

VRV Overview

- Great for comfort zoning – efficient to meet load time by time
- Quiet operation
- Multi-split with one refrigerant network
- Scalable
- Heat Pump, Heat Recovery system
- Air cooled, Water cooled
- 208/230, 460V 3phase; 208/230 1phase
- Simple communication network – DIII-NET
- Light Commercial – office, school, hotel etc.
- Residential

VRV Condensing Units

VRV III-S Heat Pump

3 and 4 Ton
208-230V/60Hz/1Ph

VRV III Heat Pump / Heat Recovery

6 to 20 Ton
208-230V/60Hz/3Ph &
460V/60Hz/3ph

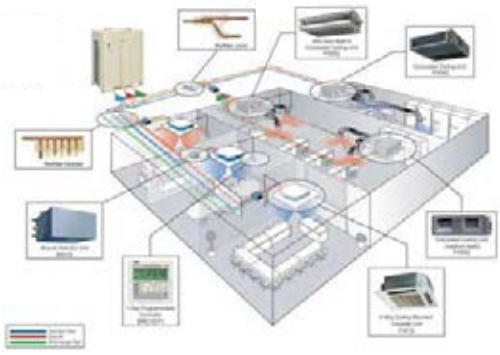
VRV-WIII Water cooled Heat Pump / Heat Recovery

5 to 21 Ton
208-230V/60Hz/3Ph

VRV - How does it work

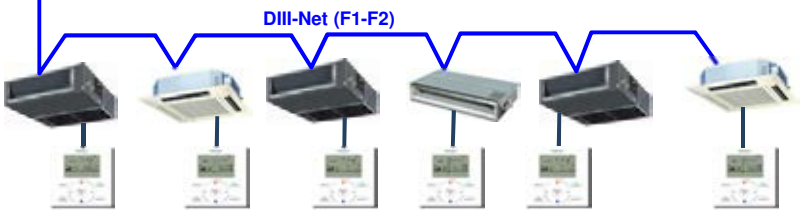
- Heat Pump System

- Heat Recovery System



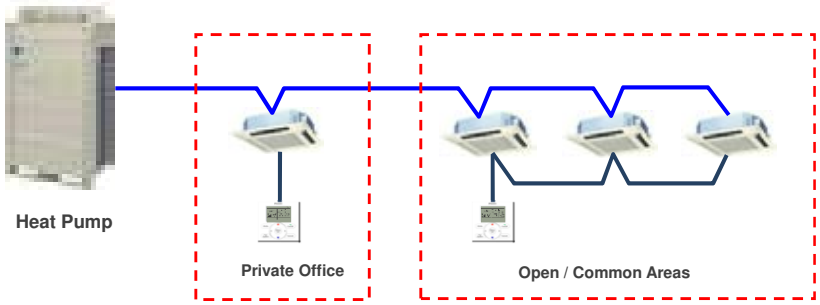
VRV Control Concepts → VRV System

- Variable Refrigerant Volume Application Flexibility
  - Variable loads meet variable capacity – Individual setpoints
  - Staggered occupancy and space utilization
  - Simultaneously heat and cool for ultimate efficiency
  - The keyword "zoning" drives Daikin control philosophy
  - PID Adaptive control technology optimizes efficiency
  - Automatic device addressing at start-up
  - Rethinking traditional means of air conditioning control



Individual Zone Controls

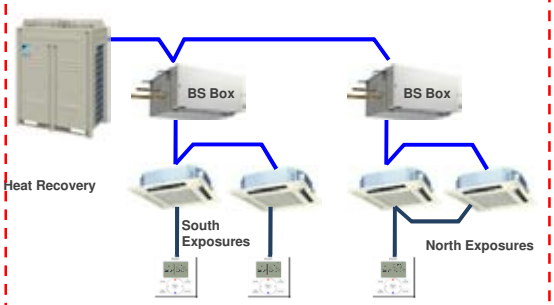
- Heat pump system applications – Remote control groups



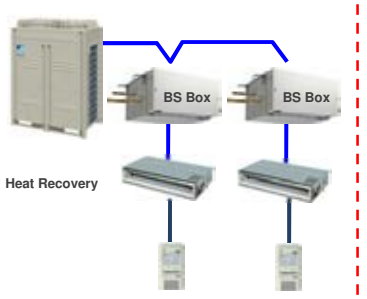
- Benefits
  - One setpoint for multiple indoor units allows effective zoning
  - Individual indoor units in a group control to their respective setpoints independent of the load on that unit or the system
  - Give occupants the freedom to control their own environment
  - Control groups reduce material and labor costs

Individual Zone Controls

- Heat recovery system applications – Zoning principals



Office Application – Controls accommodating exposure affected loads



Hotel application – Individual control is satisfied

- Benefits
  - Exploits efficiency potential of the heat recovery technology
  - Individual control is maintained where expected
  - Control groups reduce cost and complexity
  - Up to 16 indoor units on a single controller

Indoor Unit has information and a control logic

- Daikin individual zone controllers serve as a sort of browser into the current settings residing in the indoor unit PCB (on/off, temperature set-point, mode, etc.)
- Information is stored within the indoor unit's PCB
- Changes are initiated by the user at the controller and pushed to the indoor unit PCB
  - Exceptions include navigation controller (BRC1E71/72) where some functions – schedule, auto changeover, etc. occur in the controller, however once a multi zone controller such like BACnet Interface and I-Touch Controller is connected, these functions would be disabled. *

* They can be re-enabled with a field setting

Indoor Unit Control Logic

- Daikin individual zone controllers serve as a sort of browser into the current settings residing in the indoor unit PCB (On/Off, Setpoint, Mode, etc.)
- The changes/settings are stored within the indoor unit's PCB
  - Exceptions include Navigation / Programmable Controllers where some functions – Schedule, Auto-changeover, etc. occur in the controller. However, once a Multi-zone Controller such as the BACnet® Interface and I-Touch Controller are connected, these functions are disabled* in the local controller.
- Change commands sent to the in door unit are based on last command
  - Regardless of whether a command is sent from the Remote Controller, I-Touch Controller, or BMS (BACnet/ LonWorks), the last command received will be stored in the indoor unit

Indoor Unit Logic
On/Off
Mode
Setpoint
Fan Speed
Vane Position

Navigation Controller Logic
Setpoint Range Limit
Auto-Changeover
Schedule
Setback

* NAV Controller settings can be re-enabled with a field settings

VRV Controls Concepts → Controllers

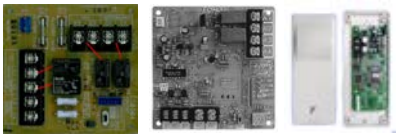
- Daikin Controls Matrix – What are your choices?

Individual Zone Controllers

Multi-zone Controllers

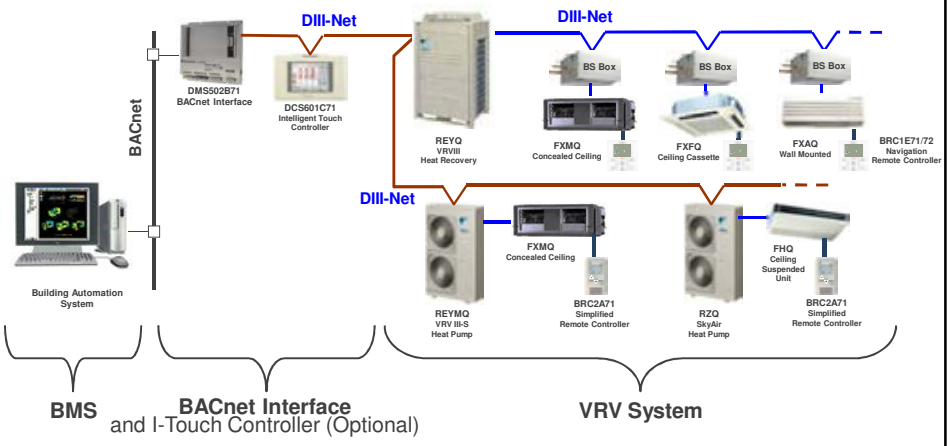
Open Protocol Interfaces

Adapter PCB's



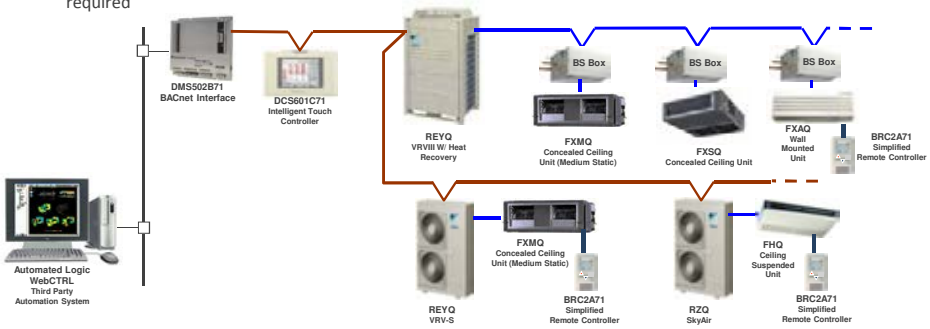
Typical BACnet project Configuration

- BMS controls / monitors each indoor unit in VRV systems through the BACnet and DIII-Net communications with BACnet Interface which is a gateway between BACnet and DIII-Net.



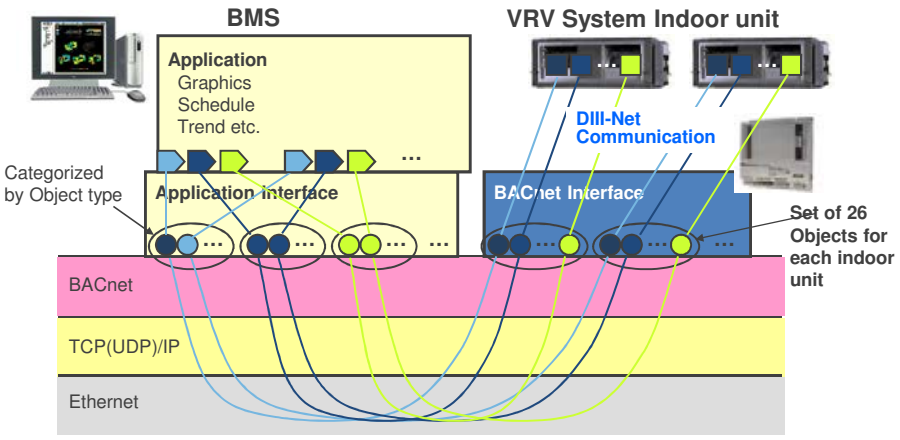
Case Study

- **ASHRAE Headquarters in Atlanta, GA**
  - Two Daikin 14-Ton VRV*III* heat recovery systems for optimum efficiency
  - One 4-Ton VRV-S and Two 3-Ton SkyAir systems
  - 25 indoor units
  - BACnet® integration to Automated Logic's WebCTRL® automation system
  - Includes Daikin's Intelligent Touch Controller for backup operation
  - Internet access via web portal and email notification of system alarms
  - Daikin simplified remote controller for local control where required



Mechanism Overview

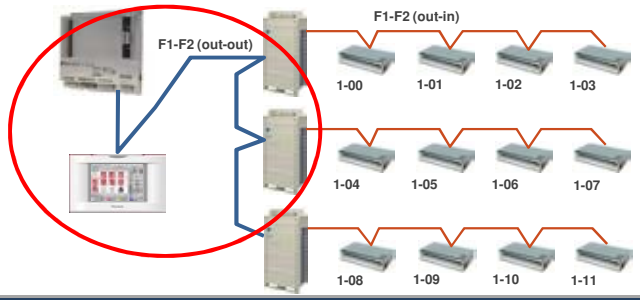
- Available a set of 26 BACnet objects for each indoor unit which is connected to the DIII-Net system
- Daikin BACnet Interface is a gateway between BACnet and DIII-Net



DIII-NET

- Daikin VRV communication protocol
  - Max length 3300ft Total length 6600ft
  - 10 outdoor units
  - 64 indoor unit groups (128 indoor units)

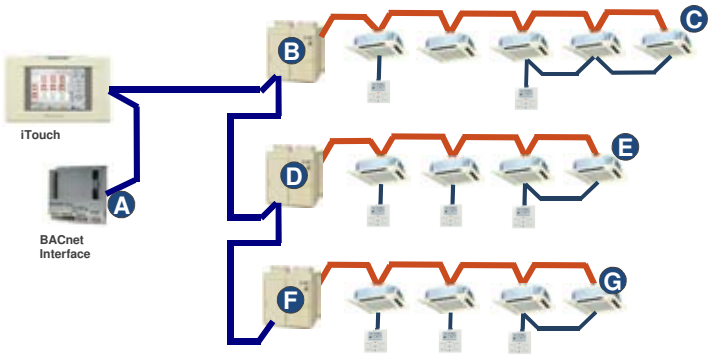
- Easy to add multi zone controller, iTC, BACnet/Lon Interface.
  - Just daisy chain condensing units and a multi-zone controller
  - No additional control wiring



DIII-Net

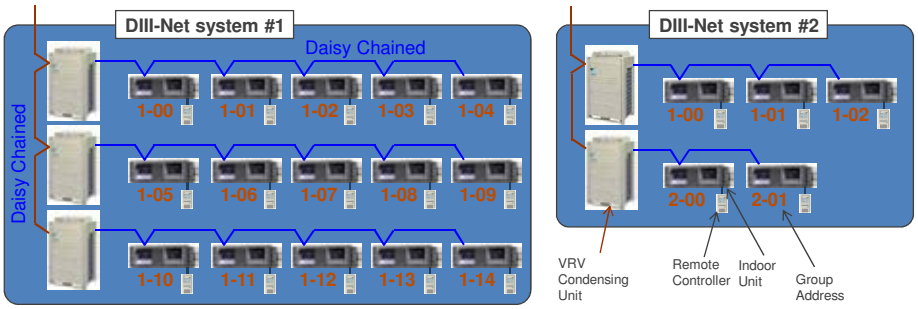
F1-F2 Length Limitation

- 18-2AWG stranded, No polarity, **3300 ft. max distance**, **6600 ft. max total distance**
- Maximum distance in the example below is the longest of either
  - (A) to (C), (A) to (E), (A) to (G), (C) to (E), (C) to (G), or (E) to (G)
  - Should be less than equal 3300 ft.
- Total distance is (A to F) + (B to C) + (D to E) + (F to G)
  - Should be less than equal 6600 ft



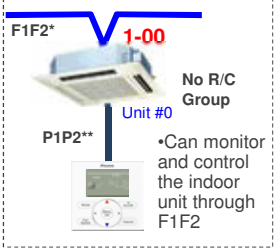
DIII-Net system and Group address

- You can recognize the specific indoor unit with the DIII-Net system number and the indoor unit group address. BACnet Interface can handle up to 4 DIII-Net systems. (2 in 4 as option)
- DIII-Net system
  - Up to 10 VRV condensing units (Daisy chained)
  - Up to 64 “Indoor unit Groups” = 64 remote controllers, up to 128 indoor units
- Group address
  - Unique address in the DIII-Net system, configured manually in VRV commissioning
    - 1-00 to 1-15, 2-00 to 2-15, 3-00 to 3-15, 4-00 to 4-15 (64 addresses at maximum)



Remote Control Group and Group Address

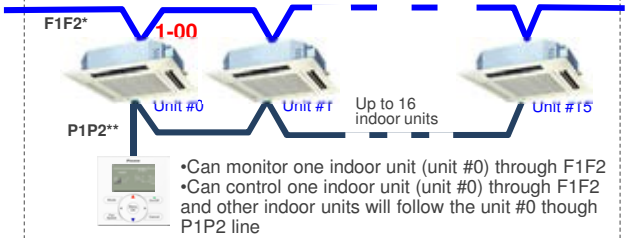
Assign a group address to an indoor unit



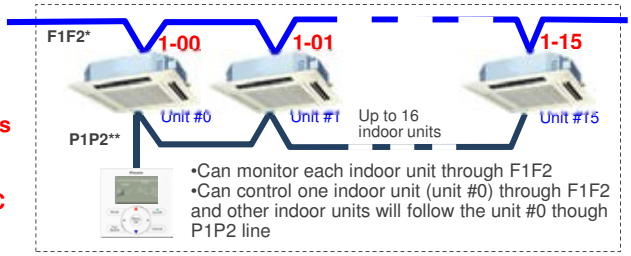
* F1F2 = DIII-Net
** P1P2 = R/C line

BMS can monitor the indoor unit which the group address is assigned
BMS can control the indoor unit which is Unit #0 in a R/C group

Assign a group address to a R/C group

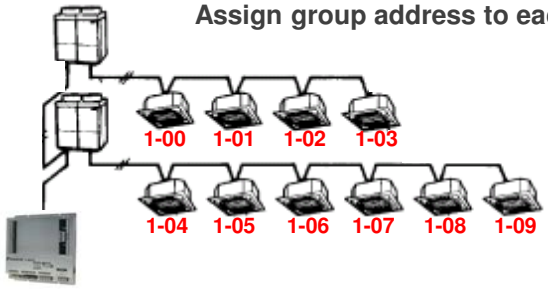


Assign a group address to each indoor unit in a R/C group



Remote Controller-less System

Assign group address to each indoor unit



All indoor unit would be the Unit #0, so that you can monitor and control each indoor unit.

Changeover Master Unit

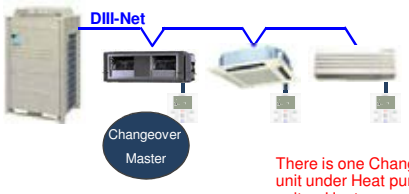
Heat Pump System

- You can change the operation mode to Cool or Heat on only a changeover master unit.
- Other units under the same condensing unit will follow the operation mode of the changeover master unit.

Heat Recovery System

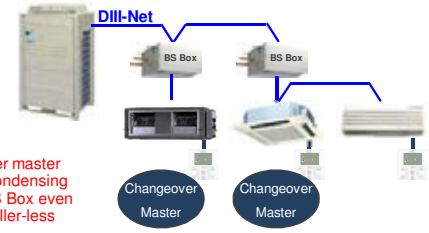
- You can change the operation mode to Cool or Heat on only a changeover master unit under a BS unit.
- Other units under the same BS unit will follow the operation mode of the changeover master unit.
- In case of only one indoor unit connected a BS unit, you can change to Cool or Heat on individual indoor unit.

Heat Pump System



There is one Changeover master unit under Heat pump condensing unit or Heat recovery BS Box even in case of remote controller-less system.

Heat Recovery System



Changeover Master and Followers

Cool / Heat Mode Selection Availability

- "Cool", "Heat" and "Auto" are all only available for selection on the cool/heat changeover master indoor unit. The following table indicates the available operating modes of the other indoor units on the system based upon the selected mode of the master indoor unit.

When the master indoor unit is set to	The other indoor units in the system can be set to			
	Cool	Dry	Heat	Fan
Cool mode	✓	✓		✓
Dry mode	✓	✓		✓
Heat mode			✓	✓
Fan mode				✓
~~Auto mode (Cooling operation)~~	✓	✓		✓
~~Auto mode (Heating operation)~~			✓	✓

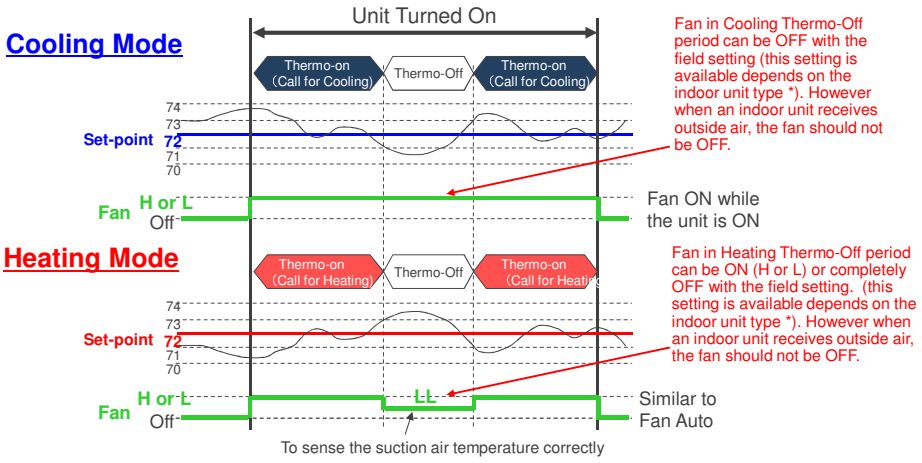
Auto mode is not recommended to set because of a potential wide room temperature swing range. (See slide 22)
I-TC V6.02 overrides Auto mode with Cool or Heat mode once Auto mode in an indoor unit is detected.

Indoor unit

- Indoor unit has a control logic to maintain a room temperature adjusting a refrigerant flow and has the following data points
  - Unit On/Off – On/Off
  - Operation mode – Cool/Dry/Heat/Fan (Auto would not work well)
  - Setpoint (16C to 32C, 0.1C basis / 60F to 90F, 1F basis from mid-Jan 2012)
  - Room temperature (read only)
  - Fan Speed (H/L or H/M/L depends of the indoor unit type)
  - Air flow direction (if an indoor unit has a louver)
  - Alarm status (read only)
  - Malfunction code (read only) etc.

- BMS can change them or get the latest ones to control / monitor the indoor unit through BACnet Interface.
- There are no data points for the condensing unit except for the Compressor status.
  - Since VRV is a packaged system, you don't have to worry about the condensing unit. If something wrong in the system, Alarm status and Malfunction code will show you.

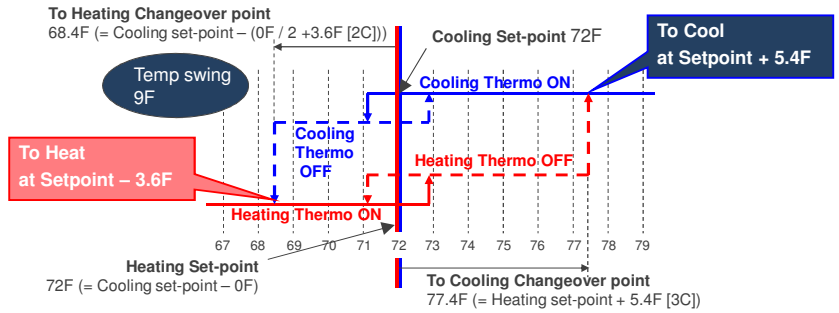
Daikin Indoor unit Sequence of Operation
Cooling & Heating



* Field setting: see slide 70, 71 for details.

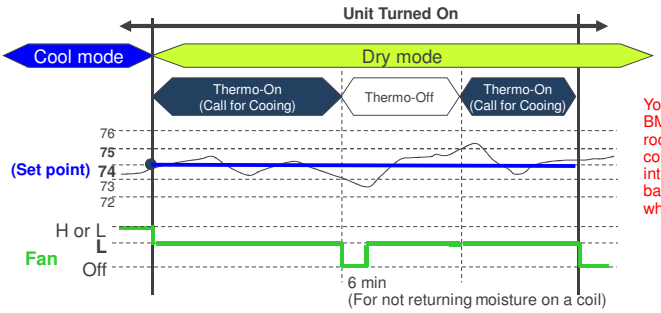
Auto mode in H/R

In the cooling mode, thermo on and off is working with +/- 1F(speaking precisely, 0.9F [0.5C]) basis around a cooling set-point.
When a room temperature comes down 3.6F below the cooling set-point, it goes into the heating mode with a heating set-point that is the cooling set-point minus the differential (0F). As the chart shows, it goes into the heating thermo-on mode, not thermo off mode, because the room temperature is below heating set-point minus 1F at the changeover point.
In the heating mode, thermo on and off is working with +/- 1F basis around a heating set-point.
When a room temperature comes up 5.4F above the heating set-point, it goes into the cooling mode with the cooling set-point that is the heating set-point plus the differential (0F). As the chart shows, it goes into the cooling thermo-on mode, not thermo off mode, because the room temperature is above cooling set-point plus 1F at the changeover point.



Dry Mode

- **Set-point is determined based on the room temperature internally when the Dry mode is set, so as to not further cool down the room temperature**
  - **Set-point ← RETURN AIR (in case of RETURN AIR <= 75)**
  - **Set-point ← RETURN AIR – 1F (in case of RETURN AIR > 76)**
- **The set-point is not displayed on the remote controller when Dry mode is engaged**



You can set Dry mode from a BMS only when you confirm the room temperature to be in a comfortable range because an internal cooling setpoint is set based on a room temperature when Dry mode is selected.

Room Temperature

- Room Temperature is either
  - Indoor unit Return air sensor,
  - Remote sensor (alternative of Return air sensor), or
  - Sensor in the BRC1E71/72 (Remote controller)
- It depends on the VRV indoor unit configuration (Field Setting *).

- An indoor unit works with one of them. BMS can not provide the room temperature to the indoor unit.

Return Air Sensor implemented in the unit

Remote Sensor should be installed when Return Air Sensor cannot sense room temperature correctly
(Remote sensor physically replace the Return Air Sensor)

BRC1E71/72 has a sensor
(BRC2A71 doesn't)

Room Temperature Sensing

- Use one sensor to control indoor unit, display temp on RC (and use for auto changeover & setback control), send to ITC and BACnet/LON Interface

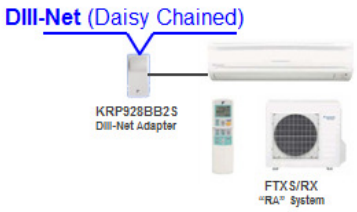
Return Air Sensor (or Remote Sensor)

RC Sensor

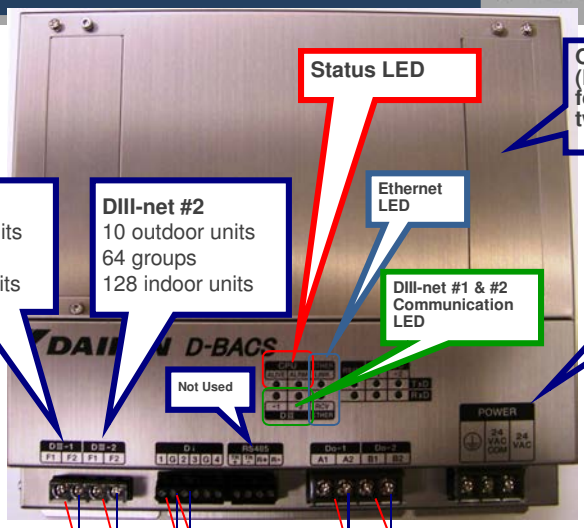
Which single sensor is used?	For indoor unit control (Cool/Dry/Heat VRV and thermo-on/off control)	For BRC1E71/72 control (Auto changeover and setback control)	For Multi-zone Control	
BRC1E71/72	10-2-03 (Only the RC thermistor used to sense room temperature)	1C-1-02 (default) (Room temperature display provided by RC thermistor)	10-5-02 (RC thermistor room temp reading used by multi-zone controller	Recommended
Remote sensor (or Return air sensor)	10-2-02 (it is always available)	1C-1-01	10-5-01 (default)	

SkyAir and Mini-split

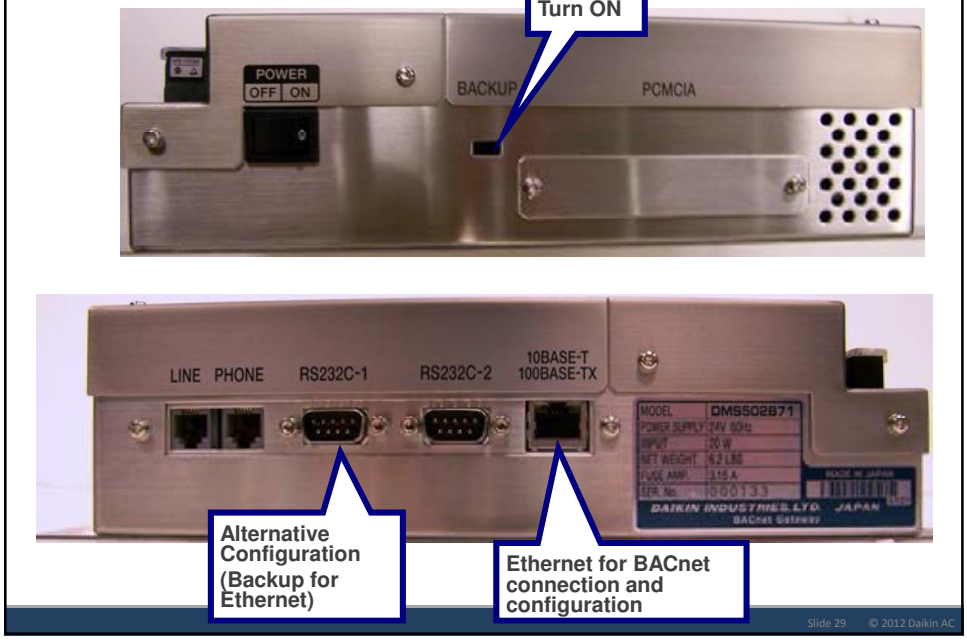
- SkyAir* is connected to DIII-Net system directly
  - Recognized as VRV III-S system which has only one indoor unit.
  - All objects are available.
- Mini-split is connected to the DIII-Net system with an optional adapter, KRP928BB2S
  - KRP928BB2S is connected to the indoor unit
  - If it is a multi system, each indoor unit has to have KRP928BB2S.
  - Basic objects are available.



* Except for RXS30/36HVJU + FTXS30/36HVJU which requires KRP928BB2S as same as Mini-split.



* LED are good for troubleshooting. See slide 54, 55 for details.



Daikin BACnet Object List

- One indoor unit has the following 26 objects

Member number	Standard name	Object name (XXX represents the air conditioner number.)	Object type	Unit				
				Inactive	Active			
				Text-1	Text-2	Text-3	Text-4	Text-5
1	Start / stop (setting) (Note 2)	StartStopCommand_XXX	BO	Stop	Operation			
2	Start / stop (status)	StartStopStatus_XXX	BI	Stop	Operation			
3	Alarm	Alarm_XXX	BI	Normal	Malfunction			
4	Malfunction code	MalfunctionCode_XXX	MI	Normal	Manufacturer specific			
5	Air-conditioning mode (setting) (Note 2)	AirConModeCommand_XXX	MO	Cooling	Heating	Fan	Auto	Dry
6	Air-conditioning mode (status)	AirConModeStatus_XXX	MI	Cooling	Heating	Fan		Dry
7	Air flow rate level (setting) (Note 2)	AirFlowRateCommand_XXX	MO	Low	High			
8	Air flow rate level (status)	AirFlowRateStatus_XXX	MI	Low	High			
9	Measured room temperature (Note 1)	RoomTemp_XXX	AI	°C				
10	Set room temperature (Note 2)	TempAdjust_XXX	AV	°C				
11	Filter sign signal	FilterSign_XXX	BI	No				
12	Filter sign signal reset	FilterSignReset_XXX	BV	Reset				
13	Remote controller enable / disable (start / stop)	RemoteControlStart_XXX	BV	Enabled	Disabled			
14	Remote controller enable / disable (air-conditioning mode)	RemoteControlAirConModeSet_XXX	BV	Enabled	Disabled			
15	Blank							
16	Remote controller enable / disable (set temperature)	RemoteControlTempAdjust_XXX	BV	Enabled	Disabled			
(*)17	Central control (lower central control disable)	CL_Rejection_XXX	BV	Enabled	Disabled			
18	Accumulated Gas	GasTotal_XXX	Accumulator					
19	Accumulated power	PowerTotal_XXX	Accumulator					
20	Communication status	CommunicationStatus_XXX	BI	Some communication error	Communication error			
(*)21	Forced system stop	SystemForcedOff_XXX	BV	Clearance	Forced stop			
22	Air direction (setting) (Note 2)	AirDirectionCommand_XXX	AV					
23	Air direction (status)	AirDirectionStatus_XXX	AI					
24	Forced thermostat disable (setting)	ForcedThermoOFFCommand_XXX	BO	Clearance	Set			
25	Forced thermostat disable (status)	ForcedThermoOFFStatus_XXX	BI	Clearance	Set			
26	Energy saving (setting)	EnergyEfficiencyCommand_XXX	BO	Clearance	Set			
27	Energy saving (status)	EnergyEfficiencyStatus_XXX	BI	Clearance	Set			
28	Thermostat status	ThermoStatus_XXX	BI	OFF	ON			
29	Compressor status	CompressorStatus_XXX	BI	Stop	Operation			
30	Indoor fan status	IndoorFanStatus_XXX	BI	Stop	Operation			
31	Heater operation status	HeaterStatus_XXX	BI	Stop	Operation			

Central control (lower central control disable) and forced system stop are only available for 000, 064, 128, and 192.

Celsius (Fahrenheit available in mid-Jan 2012)

#15 Reserved

#17, 21 Available for each DIII-Net system

#18, 19 Accumulated Gas, Accumulated Power are not supported

Fahrenheit Software

- Shipped with Fahrenheit software from mid-Jan, 2012
- Software upgradable to Fahrenheit/Celsius in the field

Software version		Celsius	Fahrenheit
		V6.32.00 or previous	V6.33.00
Object	Item	Spec	Spec
Set room temperature (AV)	Resolution	0.1C	1F
TempAdjust_XXX	Range	16.0C – 32.0C	60F – 90F
	COV Increment	1C	1F
Measured room temperature (AI)	Resolution	0.1C	0.1F (Fahrenheit temperature has 0.1C accuracy)
RoomTemp_XXX	Range	-10.0C – 50.0C	14.0F – 122.0F
	COV Increment	1C	1F

Object ID Format

- One indoor unit has the following 26 objects, highlighted

Object Type **Instance Number**

31 – 22	21 – 16	15 – 8	7 – 0
BACnet Object Type	Not Used (Zero)	Air conditioner number	Member Number
0 - 5, 13, 14	0	0 – 255 Mapped with DIII-Net system and Group Address (See the next page)	1 - 14, 16, 17, 20 - 31 26 objects per indoor unit (See the previous page)

Object type	Object number
AI	0
AO	1
AV	2
BI	3
BO	4
BV	5
MI	13
MO	14

Specify Indoor unit | Specify Object

Example

Setpoint of DIII-Net system 2 and Group address 1-2
- Object type AV → Object Number: 2
- DIII-Net 2 & 1-2 → A/C number: 66
- Setpoint → Member number: 10

Instance Number = 16,906 (0x420A) = (66 * 2^8) + (10)
Object ID = 8,405,514 (0x80420A) = (2 * 2^22) + Instance Number

Air conditioner number

- Air conditioner (Indoor unit) number (0 to 255) is mapped with the DIII-Net System number (1 to 4) and Group Address (1-00 to 4-15)

DIII-Net System	Group Addr.	A/C Num.
1 (Port 1)	1-00	0
	1-01	1
	⋮	⋮
	1-15	15
	2-00	16
	2-01	17
	⋮	⋮
	2-15	31
	3-00	32
	3-01	33
	⋮	⋮
	3-15	47
	4-00	48
	4-01	49
	⋮	⋮
	4-15	63

DIII-Net System	Group Addr.	A/C Num.
2 (Port 2)	1-00	64
	1-01	65
	⋮	⋮
	1-15	79
	2-00	80
	2-01	81
	⋮	⋮
	2-15	95
	3-00	96
	3-01	97
	⋮	⋮
	3-15	111
	4-00	112
	4-01	113
	⋮	⋮
	4-15	127

DIII-Net System	Group Addr.	A/C Num.
3 (Port 3)	1-00	128
	1-01	129
	⋮	⋮
	1-15	143
	2-00	144
	2-01	145
	⋮	⋮
	2-15	159
	3-00	160
	3-01	161
	⋮	⋮
	3-15	175
	4-00	176
	4-01	177
	⋮	⋮
	4-15	191

DIII-Net System	Group Addr.	A/C Num.
4 (Port 4)	1-00	192
	1-01	193
	⋮	⋮
	1-15	207
	2-00	208
	2-01	209
	⋮	⋮
	2-15	223
	3-00	224
	3-01	225
	⋮	⋮
	3-15	239
	4-00	240
	4-01	241
	⋮	⋮
	4-15	255

VRV System Point List

- Send Operation mode command to the changeover master unit

Group Address			BACnet Interface	VRV system
DIII Port Number	Upper address	Lower address	Unit number (A/C No.)	Changeover Master
1	1	00	0	X
1	1	01	1	X
1	1	02	2	X
1	1	03	3	X
1	1	04	4	X
1	1	05	5	X
1	1	06	6	X
1	1	07	7	6
1	1	08	8	6
1	1	09	9	6
1	1	10	10	6
1	1	11	11	6
1	1	12	12	X
1	1	13	13	12
1	1	14	14	X
1	1	15	15	14
1	2	00	16	X
1	2	01	17	X
1	2	02	18	X
1	2	03	19	X
1	2	04	20	X
1	2	05	21	X
1	2	06	22	X
1	2	07	23	X
1	2	08	24	X
1	2	09	25	X
1	2	10	26	X
1	2	11	27	X
1	2	12	28	X
1	2	13	29	X
1	2	14	30	X
1	2	15	31	X

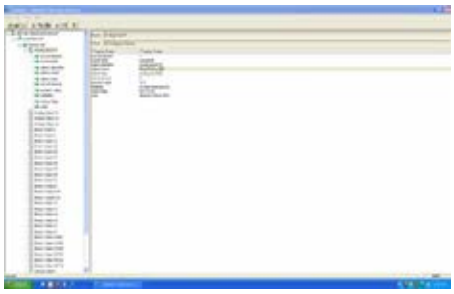
Master

Master

Follower

Auto-discovery

- Object list can be created with the Point List creation tool. See BACnet Interface Design Guide. (See Slide 53)
- The BMS will get all available objects from the Daikin BACnet interface by reading the object list property in the Device object.



Cimetrics BACnet Explorer

Wireshark Network Analyzer

BACnet Control Points

Operation, configuration, and monitoring	Start / stop operation	Starts / stops the air conditioner and monitors the result.
	Air-conditioning mode setting	Sets the cooling / heating / ventilating / auto air-conditioning mode and monitors the result. Dry mode is also available.
	Room temperature setting	Sets the room temperature of the air conditioner and monitors the result.
	Filter sign and reset	Checks if the filter is clogged and resets the status as required.
	Remote controller enable / disable	Enables or disables the remote controller so that it can or cannot be used to control the air conditioner's start / stop / air-conditioning mode / room temperature.
	Lower central device operation enable / disable (per DIII-net)	Enables or disables operation of a central device connected to the DIII network.
	Air flow rate setting	Sets the air flow rate and monitors the result.
	Air direction setting	Sets the air direction and monitors the result.
	Forced system stop (per DIII-net)	In response to the forced stop command, checks whether clearance or setting is required and performs the required action.
	Forced thermostat disable	In response to the forced thermostat disable command, checks whether clearance or setting is required and performs the required action.
	Energy saving	In response to the energy saving command, checks whether clearance or setting is required and performs the required action.

* Increase internal setpoint +2C in cooling, and decrease -2C in heating in an indoor unit. Actual setpoint is not changed.

BACnet Monitoring Points

Monitor	Start / stop status	Monitors the start / stop status of the air conditioner.
	Alarm	Monitors whether or not the air conditioner is operating normally, and issues an alarm if the air conditioner has a malfunction.
	Malfunction code	Displays a malfunction code specified by the manufacturer if an air conditioner in the system has a malfunction.
	Air-conditioning mode	Monitors if the air conditioner is cooling, heating, or ventilating.Dry mode as well.
	Room temperature	Monitors and displays the room temperature.
	Filter sign	Checks if the filter is clogged and monitors whether or not it can still be used.
	Thermostat status	Monitors whether or not the air conditioner is properly controlling the temperature.
	Compressor status	Monitors if the compressor of the outdoor unit connected to the indoor unit is properly operating.
	Indoor fan status	Monitors if the indoor unit's fan is properly operating.
	Heater operation status	Monitors if the indoor unit's heater is properly operating.

Note: Monitor unit status by StartStopStatus_XXX not StartStopCommand_XXX. Commands will not always match input status.

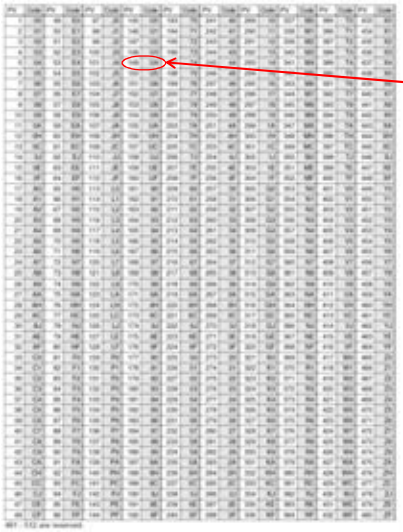
Typical Objects for Indoor Unit

- Although a set of 26 objects for each indoor unit is available, you will use only some of them.

Item	Monitor Status (Read)	Control (Write)	Object Name (_XXX means A/C number)	Object type	Member Number
Unit On/Off		X	StartStopCommmand_XXX	BO	1
	X		StartStopStatus_XXX	BI	2
Operation mode		X	AirConModeCommand_XXX	MO	5
	X		AirConModeStatus_XXX	MI	6
Room Temperature	X		RoomTemp_XXX	AI	9
Setpoint	X	X	TempAdjust_XXX	AV	10
Fan Speed		X	AirFlowRateCommand_XXX	MO	7
	X		AirFlowRateStatus_XXX	MI	8
Air Flow Direction (When indoor unit has a louver)		X	AirDirectionCommand_XXX	AV	22
	X		AirDirectionStatus_XXX	AI	23
Alarm Status	X		Alarm_XXX	BI	3
Malfunction Code	X		MalfunctionCode_XXX	MI	4
R/C On/Off button prohibit	X	X	RemoteControlStart_XXX	BV	13
R/C Ope. mode button prohibit	X	X	RemoteControlAirConModeSet_XXX	BV	14
R/C SP adjust button prohibit	X	X	RemoteControlTempAdjust_XXX	BV	16

Malfunction Code

- Decode Present value of Malfunction code to Daikin Error code



VRV Service manual provide troubleshooting flow chart for each Error code.

Example: Present Value 149 = U4 error

Optional Objects for Indoor Unit

- The following objects are also available

Item	Monitor Status (Read)	Control (Write)	Object Name (_XXX means A/C number)	Object type	Member Number
Air Filter Sign	X		FilterSign_XXX	BV	11
Air Filter Sign Reset		X	FilterSignReset_XXX	BV	12
Communication Status	X		CommunicationStatus_XXX	BI	20
Call for Cool/Heat Status (Thermo-on Status)	X		ThermoStatus_XXX	BI	28
Compressor Status	X		CompressorStatus_XXX	BI	29
Indoor Fan Status	X		IndoorFanStatus_XXX	BI	30
Heater Status	X		HeaterStatus_XXX	BI	31
Forced disable Call for Coo/Heat (Forced Thermo-off)		X	ForcedThermoOFFCommand_XXX	BO	24
	X		ForcedThermoOFFStatus_XXX	BI	25
Energy Saving		X	EnergyEfficiencyCommand_XXX	BO	26
	X		EnergyEfficiencyStatus_XXX	BI	27

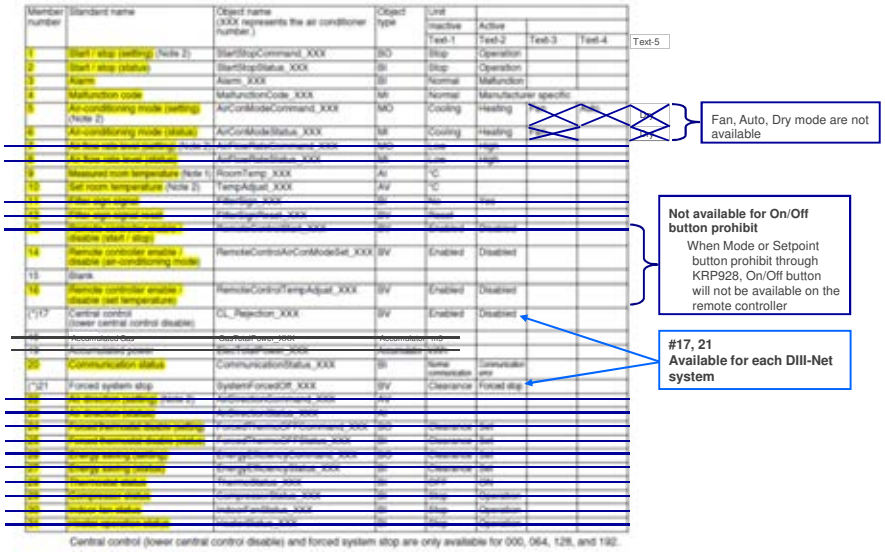
Optional Objects for DIII-Net

- The following objects are for the DIII-net system.
- Assigned at Group address 1-00 on each DIII-Net system. Therefore air conditioner numbers are 0, 64, 128 and 192.

Item	Monitor Status (Read)	Control (Write)	Object Name (_XXX means A/C number)	Object type	Member Number
Central Control	X	X	CL_Rejection_XXX	BV	17
Forced System Stop	X	X	SystemForcedOff_XXX	BV	21

Limitation of KRP928BB2S

- 11 essential objects are available for mini-split, multi-split & FTXS_30/36 SkyAir



Central control (lower central control disable) and forced system stop are only available for 000, 064, 128, and 192.

Available Objects Comparison

Member Numer	Point Name	Object Name	VRV, Skyair indoor unit	Mini-Split through KRP928BBS2	For DIII-Net
1	ON/OFF (setting)	StartStopCommand_xxx	X	X	
2	ON/OFF (status)	StartStopStatus_xxx	X	X	
3	Alarm Sign	Alarm_xxx	X	X	
4	Error Code	MalfunctionCode_xxx	X	X	
5	Operation Mode (setting)	AirConModeCommand_xxx	X	X (Cool, Heat only)	
6	Operation Mode (status)	AirConModeStatus_xxx	X	X (Cool, Heat only)	
7	Airflow Rate (setting)	AirFlowRateCommand_xxx	X		
8	Airflow Rate (status)	AirFlowRateStatus_xxx	X		
9	Measured Room Temperature	RoomTemp_xxx	X	X	
10	Set Room Temperature	TempAdjust_xxx	X	X	
11	Filer Limit Sign	FilterSign_xxx	X		
12	Filter Limit Sign Reset	FilterSignReset_xxx	X		
13	Remote Control Operation (ON/OFF)	RemoteControlStart_xxx	X		
14	Remote Control Operation (Operation Mode)	RemoteControlAirConModeSet_xxx	X	X	
15	Blank				
16	Remote Control Operation (Set Temperature)	RemoteControlTempAdjust_xxx	X	X	
17	Central Control (lower Central Contoll disable)	CL_Rejection_xxx			X
~~18~~	~~Accumulated Gas~~	~~GasTotalPower_XXX~~			
~~19~~	~~Accumulated Power~~	~~ElecTotalPower_XXX~~			
20	Communication Status	CommunicationStatus_xxx	X	X	
21	System Forced OFF	SystemForcedOff_xxx			X
22	Air Direction (setting)	AirDirectionCommand_xxx	X		
23	Air Direction (status)	AirDirectionStatus_xxx	X		
24	Forced Thermostat OFF (setting)	ForcedThermoOFFCommand_xxx	X		
25	Forced Thermostat OFF (status)	ForcedThermoOFFStatus_xxx	X		
26	Energy Efficiency Command (setting)	EnergyEfficiencyCommand_xxx	x		
27	Energy Efficiency Command (status)	EnergyEfficiencyStatus_xxx	x		
28	Thermostat Status	ThermoStatus_xxx	x		
29	Compressor Status	CompressorStatus_xxx	X		
30	Indoor Fan Status	IndoorFanStatus_xxx	x		
31	Heater Operation Status	HeaterStatus_xxx	X		

Control Requirements

- Typical requirements in different applications

Requirements		Description	Application		
			Office / School	Hotel / Nursing Home	Residential
Setpoint	Dual SP (Cool/Hest SP)	Cool SP is 2 to 3F higher than Heat SP	✓		✓
	Single SP	Easy for occupants	(✓)	✓	
Setpoint Range Limitation		Not to have extremely high or low setpoint for energy saving	✓	✓	✓
Setback	Weekly Schedule (7, 5+2, 5+1+1)	Occ/unocc period for office/school (override in unocc) 4 period for residential	✓		✓
	Non schedule	Setback while nobody in a room		✓	
Auto Changeover		Region where it is cold in the morning and hot in the afternoon To maintain room temp in a certain range	✓	✓	✓
RC Buttons Prohibition		Prohibit unnecessary buttons	✓	✓	

BACnet / LON Interface

- Single setpoint
- The followings should be programmed in BMS
  - Setpoint Range Limit
  - Setback Control
  - Schedule
  - Auto changeover
- Temperature unit is Fahrenheit 1°F basis (Celsius 0.1°C basis) for BACnet integration
- Temperature unit is Celsius only, 0.1°C basis for LON integration
- RC button prohibition through BACnet object or LON NV
  - On/Off button, Mode button and Setpoint up/down button
- No profile on LON for VRV/VRF systems

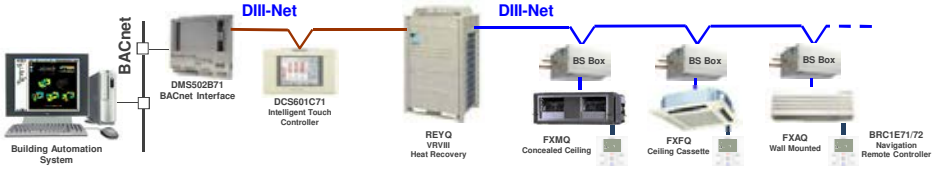
BMS Operator

Typical monitoring status

- Room Temperature
- Unit on/off *
- Operation mode *
- Setpoint *
- Setpoint range (Max, Min)
- Setback setpoints (Max, Min)
- Thermostat status (unit call for cool or heat status)
- Button prohibit status

*** Will be changed in daily operation / maintenance**

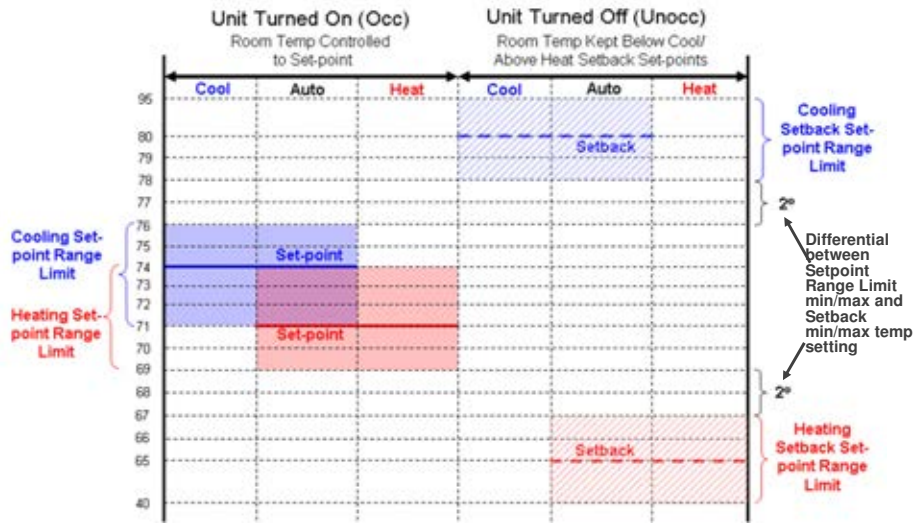
Control Strategy



- BMS is just a monitoring system
  - BMS doesn't change anything but monitor the operation status, room temperature and alarm.
- BMS take care of the control requirement
  - Dual/Single setpoint, Setpoint range limitation, Schedule, Setback, Auto changeover.
- BMS take care of the control requirement utilizing ITC V6.02 functionality
  - Setpoint range limitation on ITC
  - Auto changeover with Single setpoint on ITC
  - Setback – BMS to control. ITC setback should not be used.
    - BMS can see the unit on/off status. It cannot recognize if ITC setback turned on the unit or a user turned it on.
  - Remote controller button prohibit – BMS to control

ITC V6 - Setpoint Range

- Same concept as NAV but ITC overrides setpoint to keep the range



ITC V6.04 - Auto Changeover

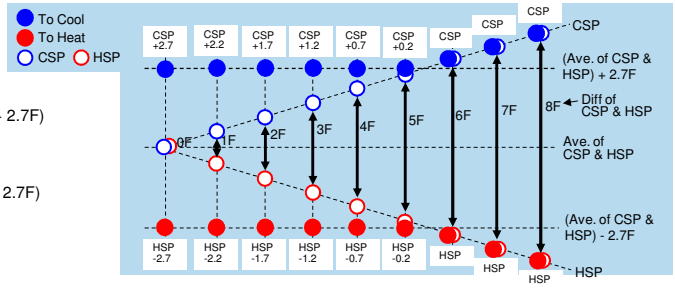
- Zone can manage Auto-changeover of indoor units in the Zone

Configuration Type	Changeover evaluated by	Changeover affects to	Good for	
			Heat Pump	Heat Recovery
Individual	Room temperature and setpoints of the individual indoor unit group in the Zone	Individual indoor unit group in the zone		✓
Fixed	Room temperature and setpoints of the representative unit (first registered unit) in the Zone	All indoor unit groups in the zone	✓	✓
Averaging	Room temperature and setpoints of the average of all indoor unit groups in the Zone		✓	✓

- Changeover point

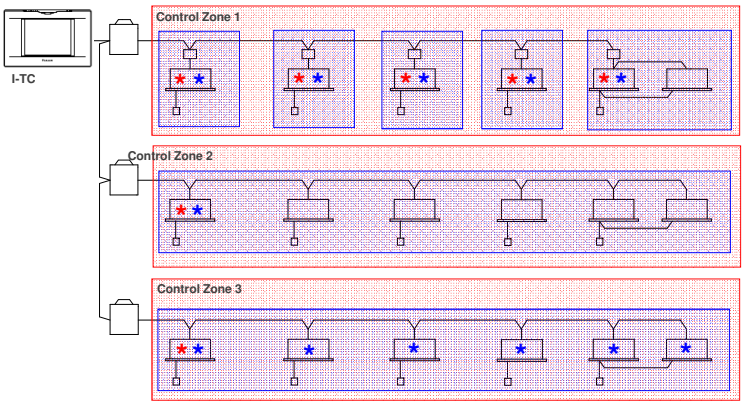
  To Cool:
  (RT >= CSP) &
  (RT >= Ave. of CSP & HSP + 2.7F)

  To Heat:
  (RT <= HSP) &
  (RT <= Ave. of CSP & HSP - 2.7F)



- 1 Hour Guard timer
  - Upon changeover, guard timer will prevent another changeover during this period.
  - Guard timer is ignored by a change of setpoint manually (from either I-TC or Remote Controller) or by schedule.
  - 60 min as default, configurable to 15, 30 or 90 min (Service Settings Menu)

- ***Auto-changeover – Individual vs. Fixed vs. Averaging***



Individual: *Groups change individually based on setpoint/room temperature. Good for the Heat Recovery system*

Fixed: *Entire zone change based on setpoint/room temperature of first unit registered in zone.*

Averaging: *Entire zone change based on average setpoint/room temperature of all operating units registered in zone.*

= *Zone*

= *Changeover Members*

★ **Changeover Master Unit**

★ **Unit Space Temp and Setpoint Included in Changeover Calculation**

Point list with ITC configuration

- Auto changeover and Setpoint range configurations on Zone
- Zone configuration
  - All zone is available as default and include all indoor units
  - If you need different changeover and setpoint range configuration, zones should be created on ITC

Group Address			BACnet Interface Unit number (A/C No.)	VRV system Changeover Master	ITC		
DIII Port Number	Upper address	Lower address			Zone	Auto Changeover	Setpoint Range
1	1	00	0	X	All	Individual	C: 68-74 H: 68-74 (Same range)
1	1	01	1	X			
1	1	02	2	X			
1	1	03	3	X			
1	1	04	4	X			
1	1	05	5	X			
1	1	06	6	X			
1	1	07	7	6			
1	1	08	8	6			
1	1	09	9	6			
1	1	10	10	6			
1	1	11	11	6			
1	1	12	12	X			
1	1	13	13	12			
1	1	14	14	X			
1	1	15	15	14			
1	2	00	16	X			
1	2	01	17	X			
1	2	02	18	X			
1	2	03	19	X			
1	2	04	20	X			
1	2	05	21	X			
1	2	06	22	X			
1	2	07	23	X			
1	2	08	24	X			
1	2	09	25	X			
1	2	10	26	X			
1	2	11	27	X			
1	2	12	28	X			
1	2	13	29	X			
1	2	14	30	X			
1	2	15	31	X			

Control Strategy with NAV

- BMS take care of the control requirement utilizing NAV Controller functionality
  - Schedule and Auto changeover on NAV are disabled when a multi zone controller (BACnet Interface, ITC etc.) is connected. However they will be available with the field setting of NAV.
  - Setpoint range limitation on NAV
  - Auto changeover with single setpoint on NAV
    - Indoor unit Auto mode is taken over by NAV Auto changeover
    - ITC should not be connected. Auto mode of indoor unit is overwritten to Cool or Heat by ITC V6.02.
  - Setback – BMS to control. NAV setback should not be used.
    - BMS can see the unit on/off status. It cannot recognize if NAV setback turned on the unit or a user turned it on.
  - Remote controller button prohibit – BMS to control or NAV access level control (prohibit buttons individually)

Navigation Controller BRC1E71/72

CL Rejection and DIII-Net

Backup Control

- When CL Rejection is enabled for a DIII-Net line, a lower classified multi zone controller such like iTC on the same line is completely disabled.
  - Manual operations are no longer available
  - Any functions on iTC would be disabled
- iTC would be resumed once CL Rejection is disabled, or 5 minutes after BACnet Interface is disconnected (or powered off).
  - If BMS is disconnected keeping CL Rejection enabled, M8 error would occur on iTC in 5 minutes, and it is the time when iTC is resumed.

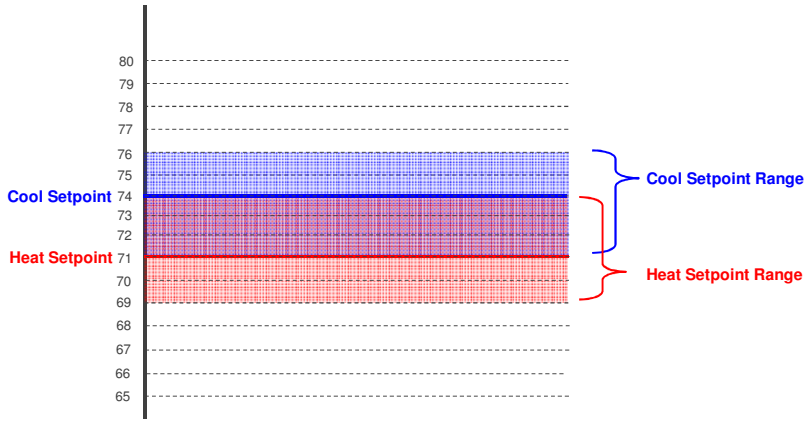
Real Project Progress

- VRV system is up and running with iTC and NAV
- BMS installed later
  - What functions on iTC/NAV should be disabled before BMS installed?
    - Setpoint range limitation
    - Setback schedule
    - Auto changeover
  - What functions should be programmed on BMS?

BMS to Satisfy Control Requirements

- **Setpoint Range Limitation on Remote Controller**
  - Monitor and override setpoint when out of range.
  - Prohibit Remote Controller if necessary.
  - Limit Setpoint Range by iTouch or Navigation Controller. Cannot be adjusted through BMS.
- **Auto Changeover**
  - Indoor unit auto changes to cooling at 5.4F above the setpoint, and to heating at 3.6F below the setpoint. Total 9F room temperature swing would occur theoretically.
  - BMS should control changeover when tighter control is necessary.
  - Mode change must be sent to changeover master. See the slide 18 and 33.
- **Setback Schedule**
  - BMS should turn off the unit to enable setback.
  - BMS should turn the unit on when setback setpoints have been reached and turn the unit off when room temperature has recovered.
  - Changing of occupied setpoints is not necessary.

BMS Setpoint Range Limit



BMS Setpoint Range Limit

Sequence of Operation

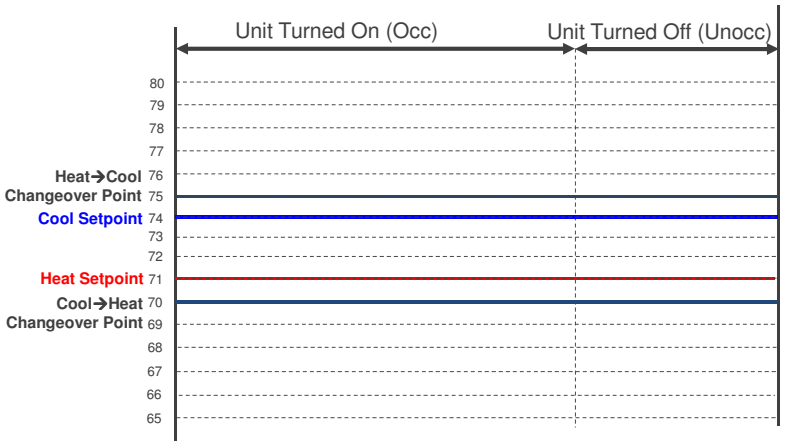
Points Used – TempAdjust_XXX

Control Logic

BMS shall monitor temperature setpoint. When BMS detects point out of range, it shall override the setpoint to acceptable value.

To detect setpoint change by a end user in a timely fashion, COV would be considered. (COV is disabled at factory default)

BMS Autochangeover - Dual Setpoint



BMS Auto-changeover

Dual Setpoint

Sequence of Operation

Points Used – RoomTemp_XXX, AirConMode_XXX, TempAdjust_XXX

Control Logic

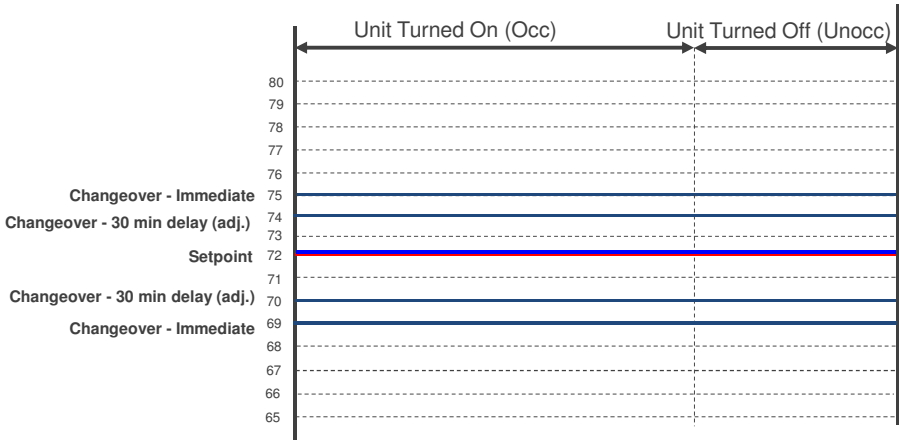
BMS shall monitor space temperature and temperature setpoint.

When space temperature rises to 1ºF (adj.) above cooling setpoint, BMS shall command the unit into cooling and command a new setpoint.

When space temperature drops to 1ºF (adj.) below heating setpoint, BMS shall command the unit into heating and command a new setpoint.

* When using independent cooling and heating setpoints, the new setpoint must be communicated with every mode change as both heating and cooling setpoint memory locations are simultaneously overwritten when TempAdjust_XXX command is used. A 1 hour guard timer is recommended with this sequence to prevent excessive mode changeovers.

BMS Autochangeover – Single Setpoint



BMS Auto-changeover

Single Setpoint

Sequence of Operation

Points Used – RoomTemp_XXX, AirConMode_XXX, TempAdjust_XXX

Control Logic –

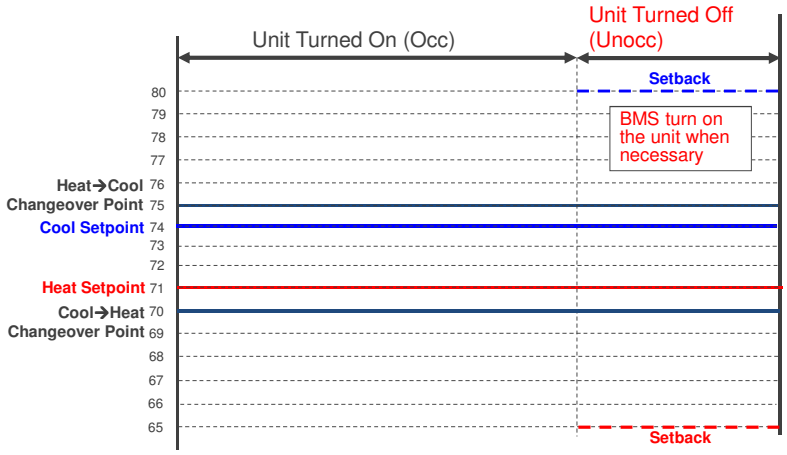
BMS shall monitor space temperature and temperature setpoint.

When space temperature rises to 2°F (adj.) above cooling setpoint and maintains for 30 min, BMS shall command the unit into cooling. When space temperature rises to 3°F (adj.) above setpoint, BMS shall command the unit into cooling.

When space temperature drops to 2°F (adj.) below heating setpoint and maintains for 30 min, BMS shall command the unit into heating. When space temperature drops to 3°F (adj.) below setpoint, BMS shall command the unit into heating.

* Commanding of new setpoints is not necessary. A 1 hour guard timer is recommended with this sequence to prevent excessive mode changeovers.

BMS Setback



BMS Setback

Sequence of Operation

Points Used – RoomTemp_XXX, StartStopCommand_XXX

Control Logic –

BMS shall energize the unit once setback setpoints have been reached. Unit shall try and control to occupied setpoints.

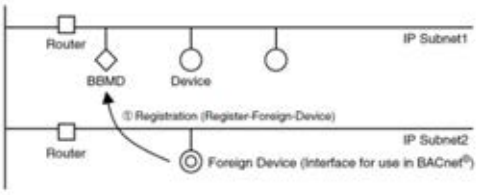
BMS shall de-energize the unit once temperature has dropped (when cooling) or risen (when heating) the set differential which is adjustable.

Notes to program

- C/F conversion
  - Since Daikin BACnet Interface supports Celsius only, so that you may have to make conversion program if BMS doesn't support it natively.
- EEPROM
  - Every change you made will be transferred to an Indoor unit.
  - The Indoor unit stores the latest setting in EEPROM which has the maximum writable number of 100,000 times. With this, the indoor unit will resume with the previous setting from power failure.
  - Do not change anything frequently and you will be ok. Keep below 19 average per day.
- Priority Array
  - An object in the BACnet Interface has a priority array, so that the highest priority value would be transferred to the indoor unit.
  - The indoor unit doesn't have priority. The last change would be valid in the indoor unit either from BACnet Interface or Remote Controller. Releasing BMS value by sending a NULL command will revert point to default settings stored in the BACnet Interface of 25°C (77°F).

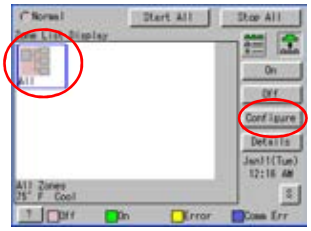
Foreign Device

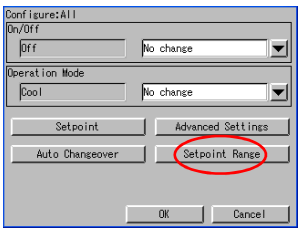
- When BACnet Interface is in a different subnet from BMS, a BBMD is required and should register BACnet Interface as a Foreign Device.
- BACnet Interface should also be configured as a Foreign Device and set BBMD IP address and port No.

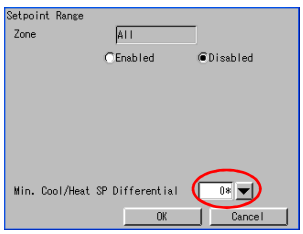


iTC V6.04

- When you install iTC V6.04 as a backup controller, disable all controls such as schedule, setpoint range limitation, and auto changeover.
- Also configure it as a Single Setpoint Mode
  - Set Min. C/H setpoint differential to 0* (single setpoint mode)
  - Otherwise when BMS change the mode, iTC would change the setpoint because iTC manages individual C/H setpoints.







- Or enable CL Rejection, and iTC control is disabled.

Q & A

Q. What changes can be globally applied vs. individually applied?
A. SystemForcedOff_XXX and CL_Rejection_XXX can be applied globally.

Q. Can the BACnet gateway be configured to report temperature values in ºF?
A. No. The BACnet interface can only handle values in ºC. Fahrenheit software will be available from Jan, 2012

Q. What ASHRAE std. does the BACnet gateway comply with? Is the gateway BTL certified?
A. The Daikin BACnet Interface was designed per ASHRAE std. 135-2004 and BTL certified in 2007.

Q. How to execute Gateway self-discovery? Capability of this function? Limitations?
A. The BMS will get all available objects from the Daikin BACnet interface by reading the object list property in the Device object. Allows for less potential for error as manual command which can require matching up Port Number, Object ID, and Instance Number for each point. No limitations that I'm aware of.

Q. Most efficient way to address indoor units?
A. Units must be addressed individually at the remote controller. There is currently no auto-addressing capability.

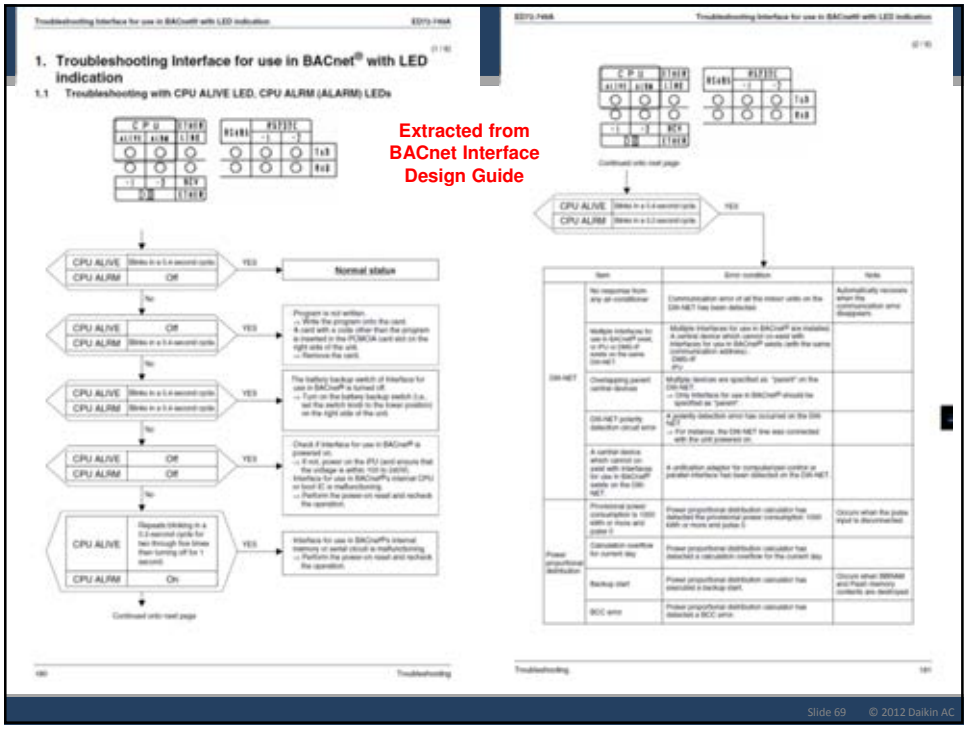
Q. Must mode changes be done unit by unit or can they be done globally?
A. Send mode command to the changeover master unit. Operation mode will affect to the VRV H/P system or the BS unit system in VRV H/R system.

Q. Can the BACnet gateway be set up as a BACnet Broadcast Management Device (BBMD)?
A. No, however it can be setup as a foreign device to communicate directly with a BBMD on a different subnet.

BACnet Interface DMS502B71

Online Documentation

- **Installation Manual**
  - http://www.daikinac.com/DOC/BACnet%20Gateway%20DMS502B71%20-%20Installation%20Manual%20-%20Daikin.pdf
- **Design Guide**
  - http://www.daikinac.com/DOC/BACnet%20Gateway%20DMS502B71%20-%20%20Design%20Guide%20-%20ED72-749A%20-%20Daikin.pdf
- **Protocol Implementation Conformance Statement (PICS)**
  - http://www.daikinac.com/commercial/documents/BACnet%20gateway%20PICS%20statement%20Ver%206.20%20-%20Daikin.pdf
- **Submittal Data Sheet**
  - http://www.daikinac.com/commercial/documents/sds/SDS%20DMS502B71.pdf
- **BTL Product Listing**
  - http://www.bacnetinternational.net/btl/index.php?m=29

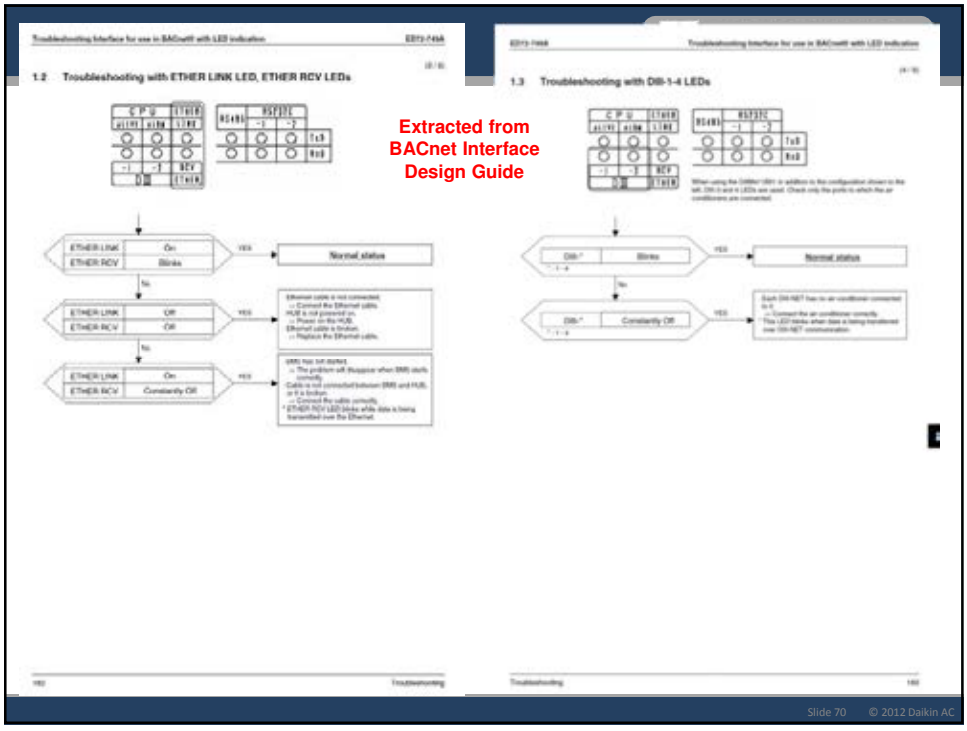


1. Troubleshooting Interface for use in BACnet® with LED indication

1.1 Troubleshooting with CPU ALIVE LED, CPU ALRM (ALARM) LEDs

Extracted from BACnet Interface Design Guide

Slide 69 © 2012 Daikin AC



1.2 Troubleshooting with ETHER LINK LED, ETHER RCV LEDs

1.3 Troubleshooting with DIII-1-4 LEDs

Extracted from BACnet Interface Design Guide

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Field Settings – Indoor unit

Field Settings – Indoor Units (Control Related)

Mode No. (Note 1)	First Code No.	Description	Second Code No. (Note 2) (Cells in bold are factory default settings) 01	02	03	04
10(20)	2	Priority of thermistor sensors for space temperature control	The return air thermistor is primary and the remote controller thermistor Is secondary.	Only the return air thermistor will be utilized.	Only the remote controller thermistor will be utilized.	--
	5	Room temperature value reported to multizone controllers	Return air thermistor	Thermistor designated by 10-2 above **(Note 3)**	--	--
	6	The remote controller thermistor is used in Remote Controller Group	No	Yes	--	--
12(22)	0	KRP1B71 X1-X2 status output	Indoor unit Thermo-On/Off status	--	Indoor unit Operation On/Off status	Indoor unit Alarm status
	1	Indoor unit T1-T2 input	Forced Off Closed Contact-Indoor unit is forced off and Central Control icon is displayed. Unit cannot be turned on manually. Operation can be overridden by central control. Open Contact-Indoor unit can resume normal operation. Unit must be turned on manually or by central control.	On/Off Closed Contact-Indoor unit is turned on. Open Contact-Indoor unit is turned off. Unit responds to last command, i.e., unit can be turned on manually or by central control after circuit has opened. Operation is prohibited when remote controller On/Off control is restricted by a multizone controller.	External Protection Device Closed contact-Unit shall resume normal operation. Open contact-Unit shall shut down and generate an A0 error.	
	2	Thermo-On/Off deadband **(Note 4)**	2F (1C)	1F (0.5C)	--	--
	3	Fan Speed in Heating Thermo-Off	LL	User set	Off	--
	6	Fan Speed in Cooling Thermo-Off	LL	User set	Off	--
	8	Return air sensor offset	2C	None (for remote sensor)		

For Indoor unit Fan Control

1. **Field settings are normally applied to the entire remote control group, however if individual indoor units in the remote control group require specific settings or for confirmation that settings have been established, utilize the mode number in parenthesis.**
2. **Any features not supported by the installed indoor unit will not be displayed.**
3. **When mode 10-2-01 is selected, only the return air temperature value is reported to the multi-zone controller.**
4. **The actual default deadband value will depend upon the indoor unit model.**

Field Setting Availability by Indoor unit type

Availability of Indoor Unit Field Settings (Control Related)

As of 12/01/2012

For Indoor unit Fan Control

Mode No.	10				12						
First Code No.	2		5	6	0	1	2 (***)	3		6	8
Second Code No.	01/02	03	01/02	01/02	01/03/04	01/02/03	01/02	01/02	03	01/02/03	01/02
FXSQ_MVJU	X	X**	X**	X	X	X	X (02)	X	X**	X*	n/a
FXMQ_MVJU	X	X*	X*	X	X	X	X (02)	X	X*	X*	n/a
FXMQ72/96MVJU	X	X	X	X	X	X	X (02)	X	X	X	n/a
FXMQ_PVJU FBQ_PVJU	X	X	X	X	X	X	X (02)	X	X	X	n/a
FXDQ_MVJU	X	X	X	X	X	X	X (02)	X	X	n/a	n/a
FXTQ_PVJU FTQ_PAVJU FTQ_PBVJU	X	X	X	X	X	X	X (02)	X	X	X	n/a
BEQ_MVJLR1 (FXOQ)	X	X	X	X	X	X	X (02)	X	X	X*	n/a
FXLQ_MVJU	X	X*	X*	X	X	X	X (02)	X	X*	X*	n/a
FXNQ_MVJU	X	X*	X*	X	X	X	X (02)	X	X*	X*	n/a
FXAQ_MVJU FAQ_MVJU FAQ_PVJU	X	X*	X*	X	n/a	X	X (01)	X	X*	n/a	n/a
FXAQ_PVJU	X	X	X	X	n/a	X	X (01)	X	X	n/a	n/a
FXZQ_M7VJU	X	X*	X*	X	X	X	X (01)	X	X*	X*	n/a
FXFQ_MVJU FCQ_MVJU FCQ_PVJU	X	n/a	n/a	n/a	X	X	X (01)	X	n/a	n/a	n/a
FXFQ_PVJU FCQ_PAVJU	X	X	X	X	X	X	X (01)	X	X	X	X
FXHQ_MVJU FHQ_MVJU FHQ_PVJU	X	n/a	n/a	n/a	X	X	X (01)	X	n/a	n/a	n/a

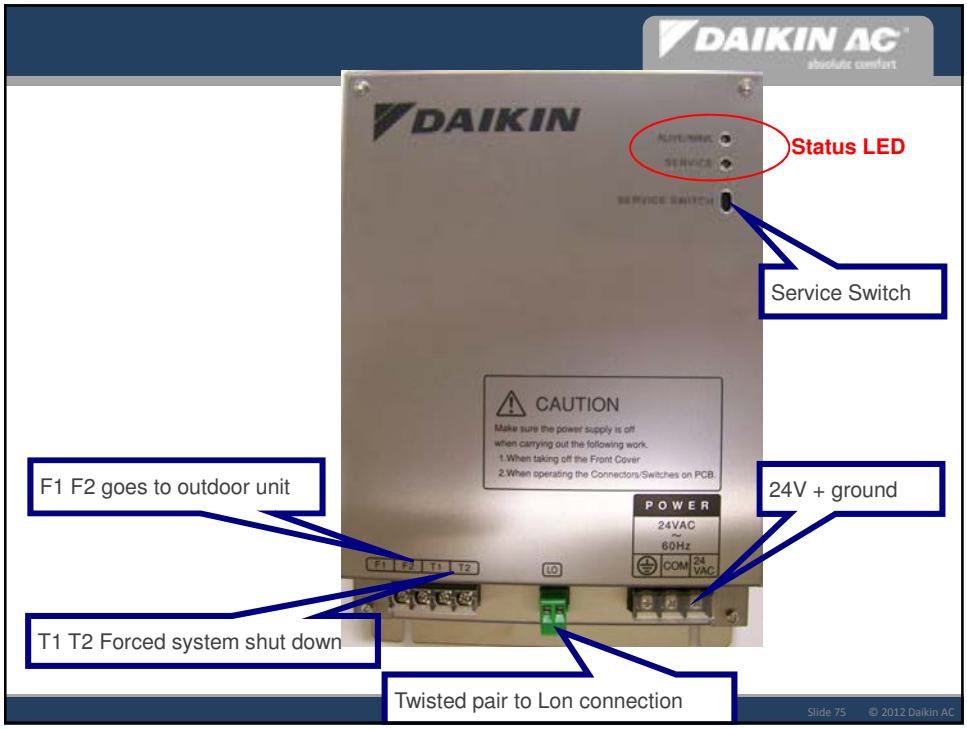
* Field settings highlighted in orange may not be available in units manufactured before 9/1/2009.
** Field settings highlighted in blue may not be available in units manufactured before 1/1/2007.
*** Factory default value is indicated in parenthesis.

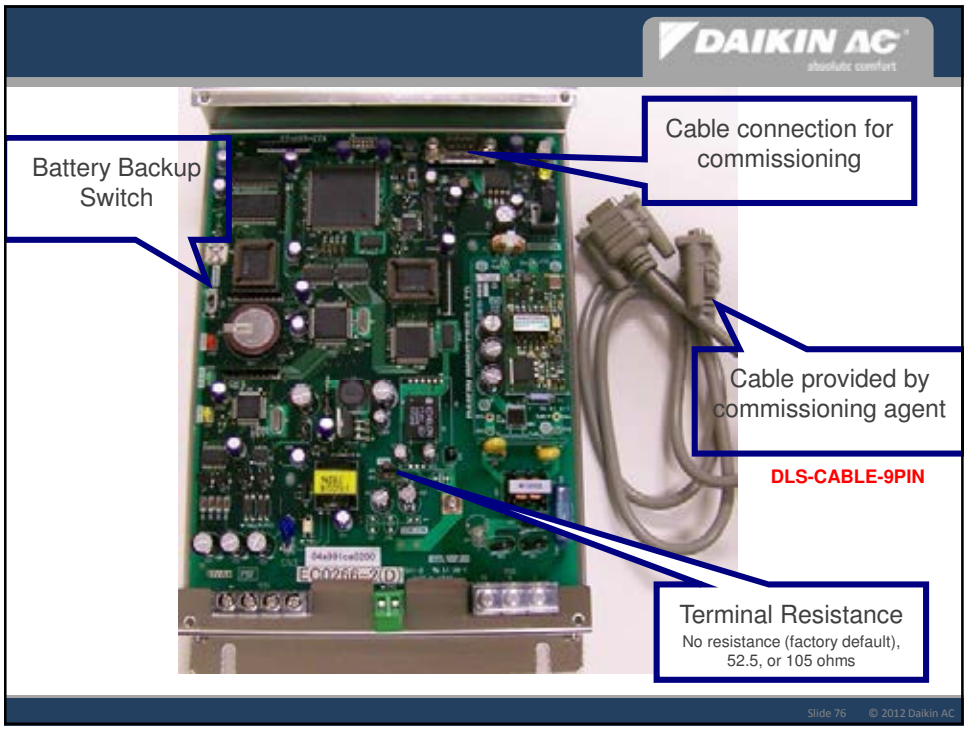
LONWORKS Interface

Open Protocol Solutions

- Gateways to Open Protocol Networks
  - Vendor neutral control for Daikin air conditioning products

	DMS502B71  BACnet® Interface	DMS504C71  LonWorks® Interface
Communications	BACnet IP Data Link Layer (Annex J)	LonTalk® Protocol
Connectivity (Network)	10/100 BASE-T Ethernet	FT-X1 (78Kbps Free Topology)
Connectivity (Daikin)	DIII-Net x 2 channels Another 2 channels *with DAM411B51 Option*	DIII-Net x 1 channel
VRV outdoor unit quantity	20 → *40 with DAM411B51 Option*	10
VRV indoor unit quantity	128 → *256 with DAM411B51 Option*	64
Control points	Monitor & control VRV indoor units	Monitor & control VRV indoor units
Power supply	24 VAC 50/60Hz	24VAC 50/60Hz
Applicable Daikin products *KRP928B2S DIII-net adapter required.	VRV (All Unit Types and Sizes) SkyAir Single Split Systems* Multi Split Systems*	VRV (All Unit Types and Sizes) SkyAir Single Split Systems* Multi Split Systems*


DAIKIN AC
absolute comfort
DAIKIN
Status LED
Service Switch
CAUTION
Make sure the power supply is off when carrying out the following work.
1.When taking off the Front Cover
2.When operating the Connectors/Switches on PCB.
POWER
24VAC
60Hz
F1 F2 goes to outdoor unit
24V + ground
T1 T2 Forced system shut down
Twisted pair to Lon connection
Slide 75
© 2012 Daikin AC


DAIKIN AC
absolute comfort
Battery Backup Switch
Cable connection for commissioning
Cable provided by commissioning agent
DLS-CABLE-9PIN
Terminal Resistance
No resistance (factory default), 52.5, or 105 ohms
Slide 76
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LonWorks SNVT List

		Function	Description
Monitoring points		ON / OFF Status	Monitors the start / stop status of the indoor unit.
		Operation Mode Status	Monitors whether the indoor unit is in the cooling, heating or fan mode.
		Temperature Setpoint	Reports the current temperature setpoint of the indoor unit.
		Room Temperature (Note 1)	Reports the current return air or room temperature of the indoor unit. (Note 1)
		Airflow rate	Reports the current fan speed setting of the indoor unit.
		Filter Indication Status	Reports the status of the filter maintenance icon on the indoor unit remote controller.
		Error Status	Monitors the indoor unit malfunction status.
		Error Code	Reports a specific malfunction code for an indoor unit in alarm state.
		Thermo Status	Reports whether the indoor unit is demanding heating or cooling capacity or if it is in a satisfied state.
		Forced Thermostat Off Status	Reports whether the indoor unit is forced to a satisfied state.
		Remote Controller ON / OFF Restriction Status	Indicates the restriction status of the indoor units remote controller ON / OFF button.
		Remote Controller Operating Mode Restriction Status	Indicates the restriction status of the indoor units remote controller operation mode button.
		Remote Controller Temperature Setpoint Restriction Status	Indicates the restriction status of the indoor units remote controller temperature setpoint buttons.
		System Forced OFF Setting Status	Monitors the system forced off status for all indoor units connected to the Lon gateway.
		Sub-group Control Operation Restriction Setting Status	Monitors the network variable input status for permission / prohibition of centralized control devices on the DIII-Net bus.
		A/C Communication Status	Monitors the communication status of the indoor unit to the DIII-Net.
Operation, configuration, and control points		ON / OFF Command	Starts and stops the indoor unit. (Note 2)
		Operating Mode	Sets the cooling / heating / ventilating / auto mode for the indoor unit. (Note 2)
		Temperature Setpoint	Commands the temperature setpoint for the indoor unit. (Note 2)
		Airflow Rate (Fan Speed)	Sets the fan speed (high, low) for the indoor unit. (Note 2)
		Filter Indicator Reset	Resets the filter maintenance indicator on the indoor unit.
		Forced Thermo OFF Setting	Forcibly stops all cooling or heating capacity for the indoor unit.
		Remote Controller ON / OFF Restriction Setting	Disables the operation of the indoor unit remote controller ON / OFF button.
		Remote Controller Operating Mode Restriction Setting	Disables the operation of the indoor unit remote controller MODE button.
		Remote Controller Temperature Setpoint Restriction Setting	Disables the operation of the indoor unit remote controller temperature setpoint buttons.
		System Forced OFF Setting	Forcibly stops / resets all indoor units that are under control of the Lon interface. Units cannot be started by a remote controller or centralized controller while in this state.
		Sub-group Control Restriction Setting	Network variable input to permit or prohibit the operation of Daikin centralized control devices on the DIII-Net bus.

= Control Items pertaining to the entire system

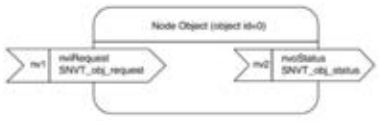
Network Variables

Air Conditioner Objects

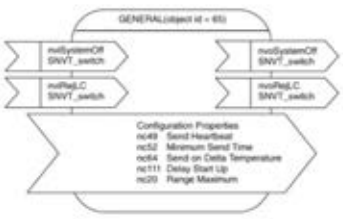
It features objects for a group of 64 indoor units.
As shown below, the object name and the last "_nn" in the "nv Name" correspond with the DIII-NET location setting address.

Indoor Unit Location Setting Address	A/C Object	nv Name (Example)
1-00 - 1-15	AC_01 - AC_16	nviOnOff_01 - nviOnOff_16
2-00 - 2-15	AC_17 - AC_32	nviOnOff_17 - nviOnOff_32
3-00 - 3-15	AC_33 - AC_48	nviOnOff_33 - nviOnOff_48
4-00 - 4-15	AC_49 - AC_64	nviOnOff_49 - nviOnOff_64

Node Objects



DIII-NET Common Objects




DAIKIN AC
absolute comfort
Thank You
PT-CNL-0113PP0-01A
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DAIKIN UNIVERSITY

Daikin Dealer Key Points

Participant Guide


DAIKIN
COMFORT FOR LIFE

Purpose

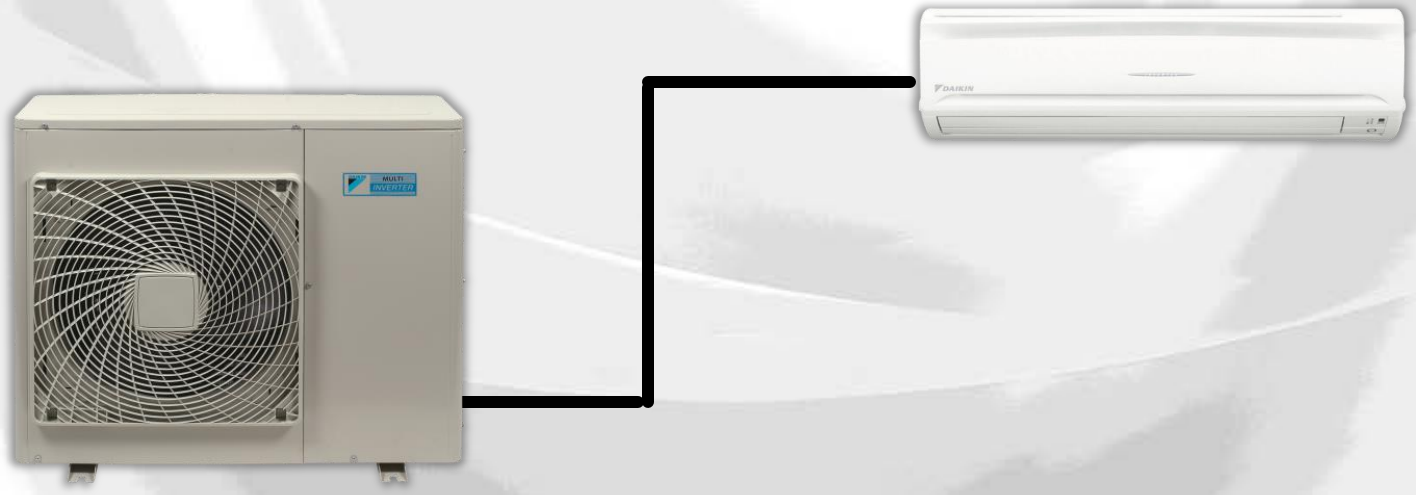
The purpose of this presentation is to give the Daikin distributor the key selling points on Daikin's equipment and tools to facilitate and close the sale on the contractor level.

Dealer loyalty tools such as the Dealer Sales Presentation, the Daikin eQuip app, Dr. Daikin, and the Energy Calc tool can be used to enhance this presentation.

Additional product, service, and installation training is available from www.daikinuniversity.com.

Key Sales Points for Dealers

Daikin Mini Split Systems



Key Selling Points

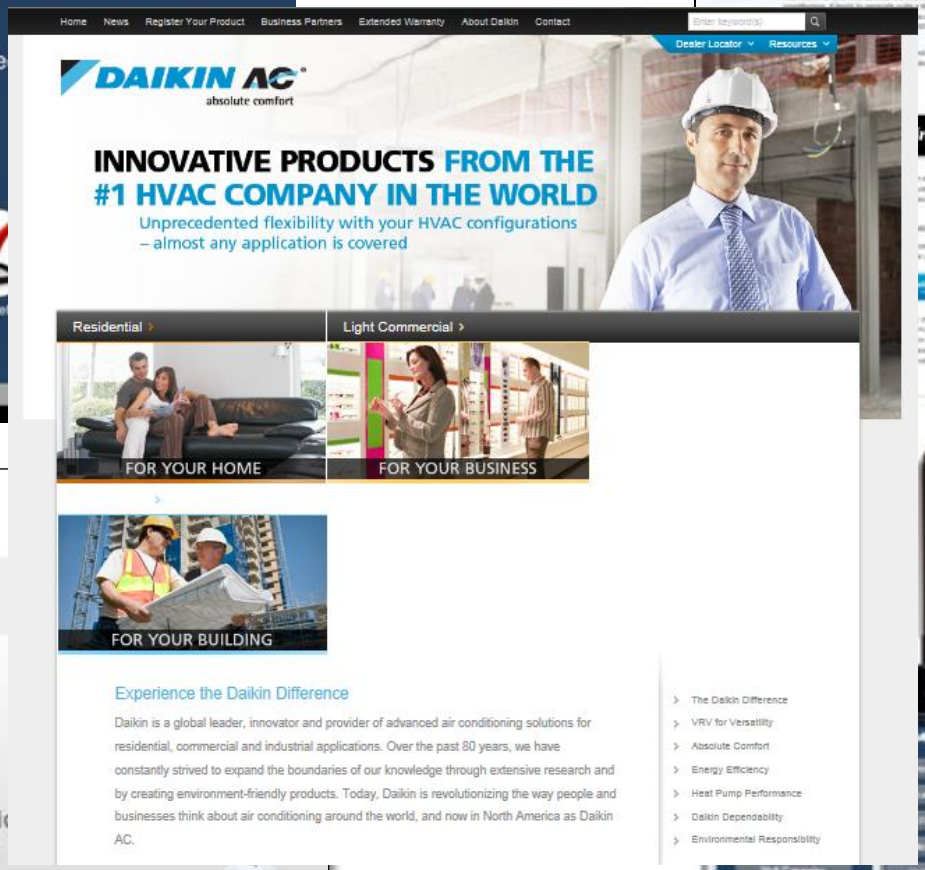
1. Get to know us (state your company information here)
2. Trust & world-class product support
3. World's largest manufacturer of HVAC products
4. Product design delivers a wide range of performance and reliability
5. Industry leading energy efficiencies
6. Precision zone control
7. Inverter compressor delivers wide range of heating & cooling performance
8. Ultra low sound levels
9. Installation flexibility
10. Industry leading warranties

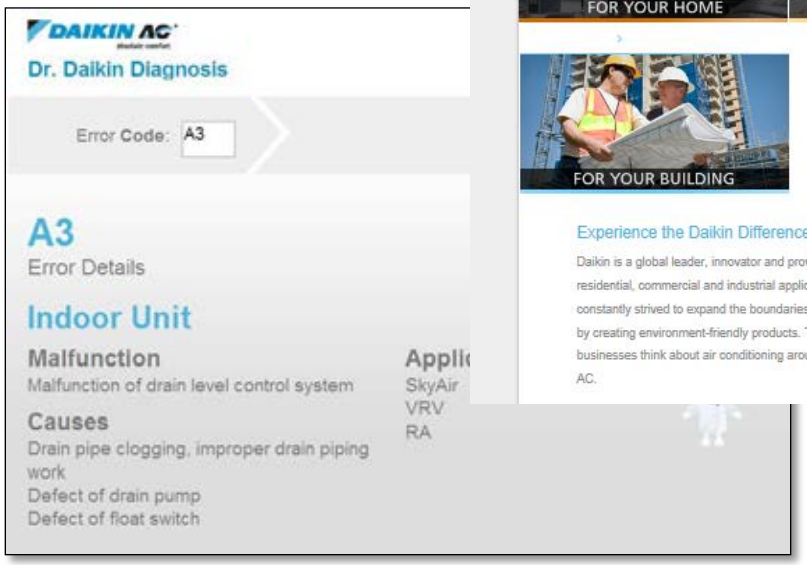
Distributor: Who Am I?

[Placeholder for Distributor's Marketing Message]

Note: *Daikin's marketing is contractor focused vs. brand focused, world class contractor training*

Trust & World-Class Support





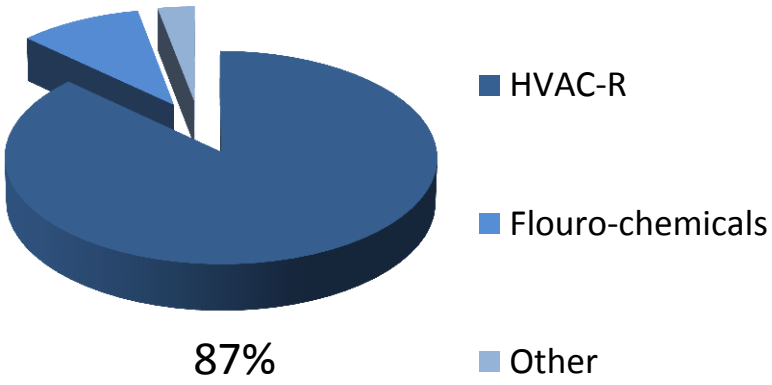
Daikin Dominates

- **We are successful:** Largest HVAC-R manufacturer in the world
- **Longevity means we will be around to support you for a long time:** In business since 1924
  - Revolutionized the industry in 1982 with the introduction of the first “VRV” technological performance to HVAC equipment.
  - Focus on Daikin manufactured components i.e. (compressors g-type) boards and other components
- **High quality, comfort and low utility bills for your customers:** Industry leading technology
- **We have the experience. Our products fit most applications (not just sun rooms)!:** Over 1,000,000 ductless installations world-wide - tried and tested
- **We care like you do about the environment:** Environmentally friendly
  - Low carbon footprint in manufacturing process
- **We are experts!:** Our core business is heating and air conditioning
  - Tighter quality controls – less third party reliability to components
- **Our focus is HVAC**
  - ***Every investment that we make goes back into better products and service for you***

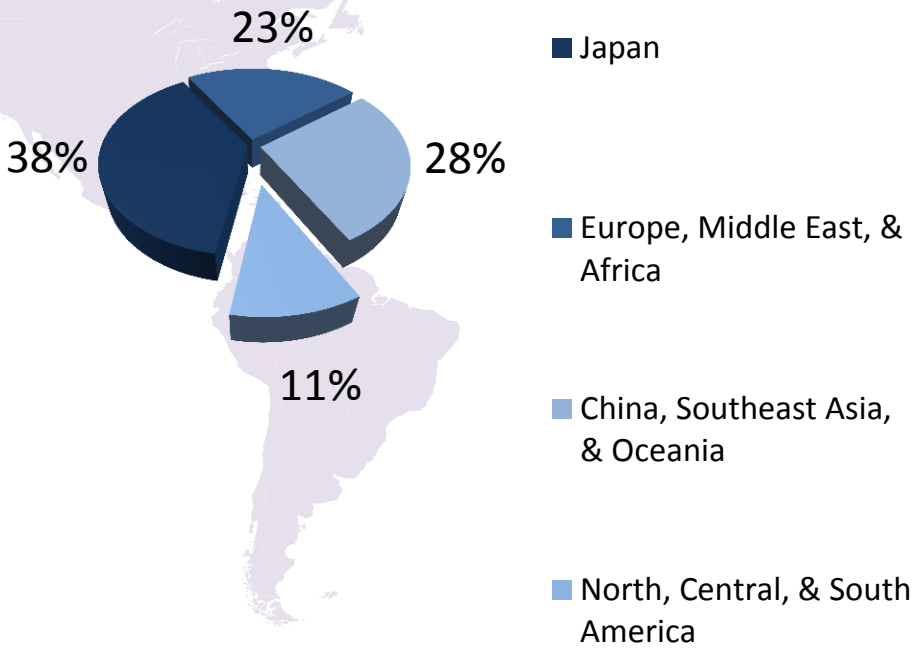
Daikin Dedication

As the only company in the world dedicated to heating and air conditioning systems and refrigerants, almost 90% of Daikin's core business is focused on HVAC-R. Daikin leads the way in energy efficiency, individualized comfort, and quality and is the #1 in HVAC manufacturing sales worldwide.

Sales



10.8 Billion USD World Wide



Daikin's Investments

Who has made the largest investment in the North American HVAC industry over the last 8 years? *Daikin*.

Product Attributes & Design Flexibility

Attributes

- More jobs through design flexibility
- Increased profitability
  - Less material cost
- Reduced labor costs
- Daikin is the only company that makes every major component of its system
- The compressor, motors, and refrigerant are designed to work flawlessly with each other to maximize performance
- Daikin goes above and beyond the ordinary for fit, finish, and component quality– our stuff looks good, reduced homeowner concern over cost – get what pay for, high quality
- Happy customers – good for reputation, fewer call backs!

Design Flexibility

- Never walk away from a job
- Every square foot of space remains usable in most cases
- Multiple units in single truck
- Fewer man hours to install
- Better instability
- Increased Profitability
- Less maintenance
- Serviceability
- Line set lengths up to 230 feet

Leading Energy Efficiencies

- **Increase your gross margin dollars per sale**
  - Higher ticket item versus traditional ducted
  - Less commodity items per project (no ductwork)
  - Lower labor content per job

- **Premium products with more features and benefits that separate you from your competition – which means easier to sell against competition**

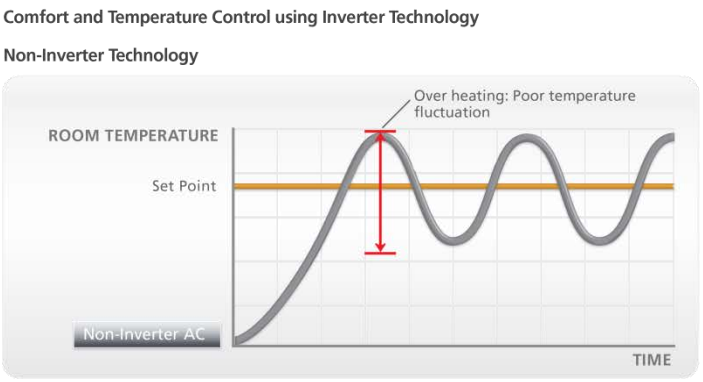
Precision Zone Control

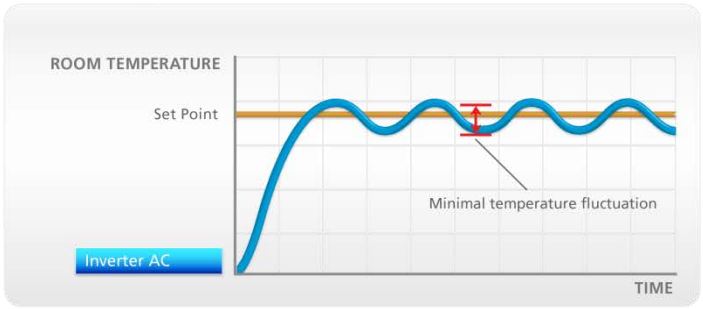
- **No hot or cold spots in your home**
- **Room by room temperature control**
  - "keeps you comfortable, so there's never an uncomfortable moment"
- **True zoning - no bypass dampers** (which wastes conditioned air the end user paid for)
- **No additional sensors required**
- **No third-party controls**
  - One-stop-shop

Daikin Compressor and Motors

Inverter Control (changes the comfort experience)

- **Power when needed ($) vs. 2-stage ($$) or 100% on for single stage ($$$)**
- **Fewer starts and stops = compressor longevity**
- **High heating capacities at low ambient temperatures**
  - Less energy used



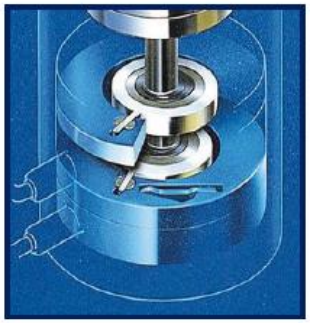


Daikin Swing Compressor

- **Roller and blade are integrated with the piston**
- **Friction and refrigerant leakage are suppressed**
- **Improved efficiency with increased energy savings**
- **Compressor life time is increased**

Competitors: *Rotary*

Daikin: *Swing*



Daikin Swing Compressor Features and Benefits	
Features	**Benefits**
Smooth rotation, little friction	High operation efficiency, energy savings
Smooth piston motion	Low vibrations, low sound levels
Few parts rubbing each other	High performance, high reliability

Compressors

Daikin Swing Compressor

Neodymium Magnets

- Neodymium magnet in the rotor – 7 times stronger than ferrite
- Increased power & decreased energy usage
- These magnets and our high RPM compressors allow line sets up to 230 feet

Compressor Summary

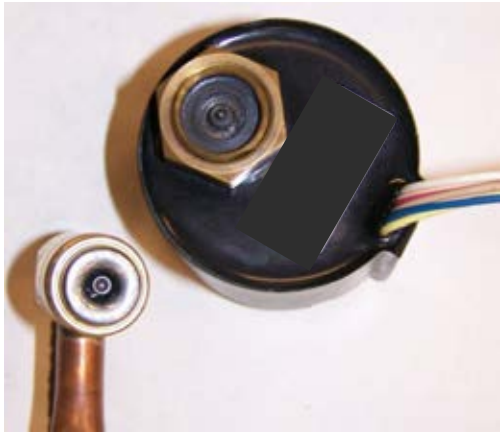
- An inverter is a variable speed drive that changes the electrical frequency being fed to a motor.
- When this technology is applied to a compressor's motor, we can easily vary the air conditioning system's operating capacity.
- Higher heating capacities due to inverter controlled compressor - up to 7200 RPM vs. 3200-3500 RPM.
- Think of the inverter drive controlling a compressor like a throttle pedal controls a cars engine.

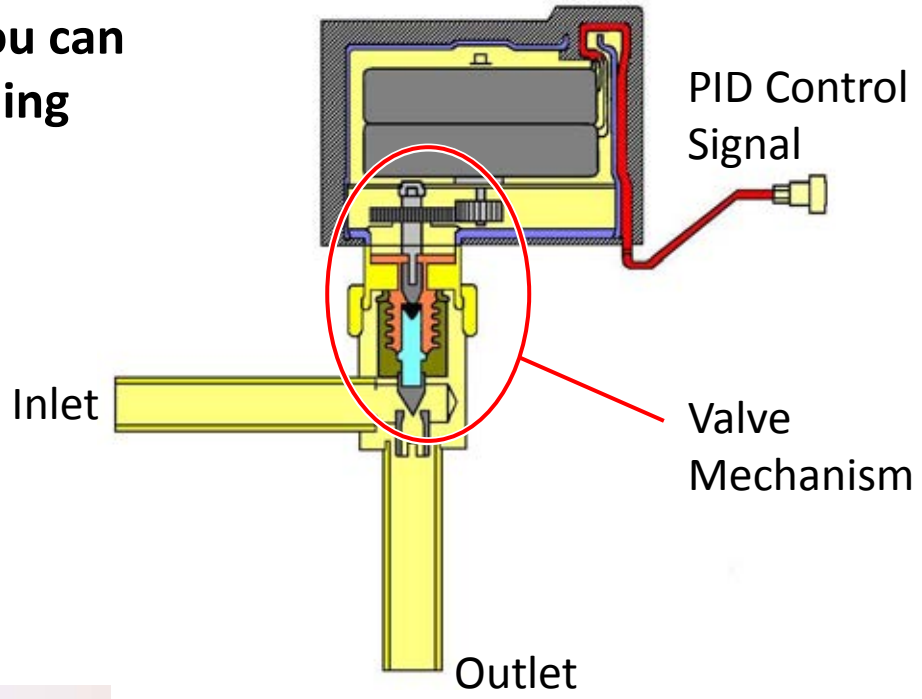
Additional Inverter Comp Advantages

- **Very low startup amperage –** save money
- **No locked rotor amps –** save money
- **No stress on windings or compressor frame –** long life
- **No "light flicker" –** fewer complaints
- **Lubrication of bearings increases before speed increases –** long life
- **System pressures increase gradually reducing vibration and stress on refrigerant circuit –** long life
- **Quiet compressor startup –** fewer complaints
- **Increased reliability. 70% to 80% operational time is less than the maximum speed (less wear) –** long life
- **Ideal for backup generator and off-grid photo voltaic solar applications –** peace of mind

Daikin Difference: Electronic Expansion Valve

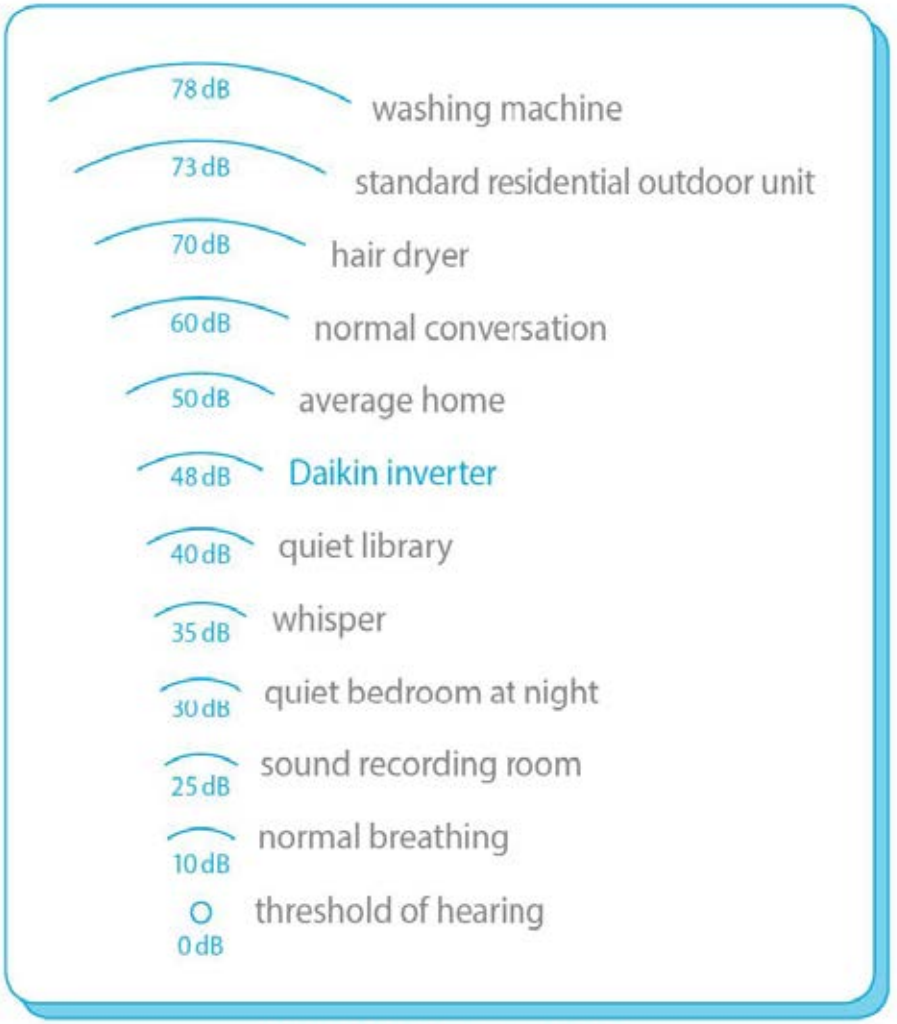
Allows precision metering and you can change the head without reclaiming the refrigerant.





Ultra Low Sound Levels

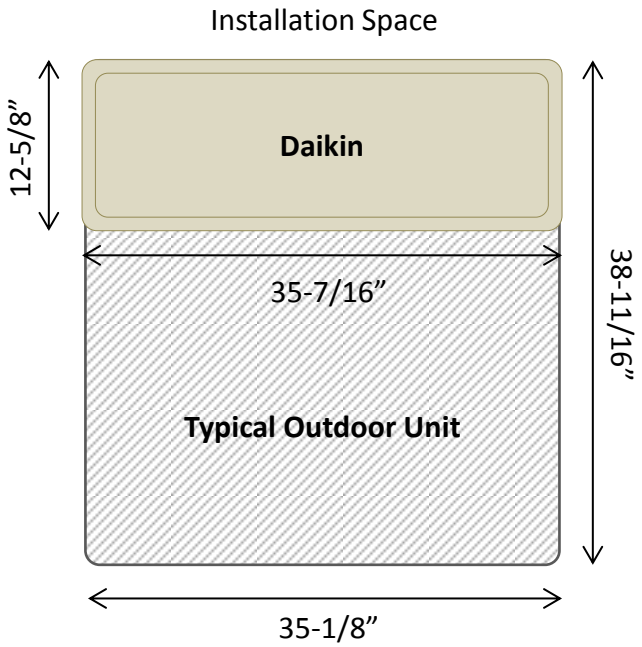
- Flexible installation
- More installation options
- Hang on side of wall
- Under decks
- Easier to sell
- Meets codes



Sound level comparison

Installation Flexibility

- **Does not distract from home exterior landscaping – curb appeal**
- **Compact unit footprint**
  – Keep more of your yard
- **Industry leading aesthetics and practicality**
- **Zero lot line clearances**
- **Easy to mount off the ground**



Industry Leading Warranties

- Peace of mind
- Warranty Plus exclusive to 3D Dealers
- Only mini-split systems with extended warranties – margin opportunity
- Easier to sell

Industry Leading Warranties

The standard warranty provides a solid level of protection with the warranty plus program offering additional protection – the best warranty program in the ductless industry.

	Standard Warranty
Product	**Compressor/Parts**
LV Series Single Split, Quaternity, Multi-Split	
KE Series	

Additional protection is available with 5 year and 10 year extended labor warranty options and programs are available to extend warranties on parts and compressors to 5 or 10 years, depending on the product.

Please refer to warranty documents for full warranty conditions.

How to be Successful Selling Daikin

- **Think bigger. Ductless is not a niche product.**
- **Focus on:**
  - Energy Efficiency & Return on Investment
  - Precision Zone Control
  - Inverter Compressor Technology
  - Ultra-low Sound Levels
  - Installation Flexibility
  - Warranties

Not a Niche Anymore (Residential Examples)

Daikin provides a portfolio of products and services that cover a broad scope of the residential market from Spot Cooling/Heating needs to the Whole House with effective Zoning and Controls

	Single Zone	Multi Zone	Whole House	Apartment/Condo
Vertical Markets				
Dealer Resources, Tools and Sales Leads	Full array of Dealer development and support tools Energy Savings Calculator, ROI, In Home Sales Guide, Library of YouTube Videos, Smartphone/Table App, Case Studies Effective Dealer Loyalty Program with Dealer resources and Lead execution			
Line Up, Solution Diversity	Good, Better, Best Product Line Different Efficiency Options User Friendly Controls Extended Warranty	Flexible selection of Indoor Unit for Zoning High Efficiency Ease of Install Ease of Maintenance	User Friendly Controls Ease of Replacement Cost Effectiveness Efficiency Warranty Zoning Kit, EH Options	Ease of Install Indoor Unit Options Flexible Piping Space Constrained Quiet Operation Limited Electric Load

Not a Niche Anymore

Residential Applications

- Whole house
- Renovations
- Additions
- Conversions
- New construction
- Retrofit
- Multi-family
  - Duplex
  - Condos
  - Mutliplex

Commercial Applications

- Classrooms
- Office space
- Medical offices
- Assisted Living
- Restaurants
- Dormitories
- Banks
- Elevator Rooms

The question is not where can you use Daikin, but where can't you use it?

DAIKIN

COMFORT FOR LIFE

Thank You