DAIKIN ZONING KIT
APPLICATION GUIDE

ENERGY-INTELLIGENT™ TECHNOLOGY
HEATING AND COOLING SYSTEMS

04.16

ABOUT DAIKIN

Daikin Industries, Ltd. (DIL) is a global Fortune 1000 company, which celebrated its 90th anniversary in May 2014. The company is recognized as one of the largest HVAC (Heating, Ventilating, Air Conditioning) manufacturers in the world. DIL is primarily engaged in developing indoor comfort products, systems, and refrigeration products for residential, commercial, and industrial applications. Its consistent success is derived, in part, from a focus on innovative, energy-efficient, and premium quality indoor climate and comfort management solutions.

A WORLD LEADING MANUFACTURER OF HVAC PRODUCTS

FOUNDED IN 1924

OVER 60,0000 DAIKIN VRV SYSTEMS OPERATING THROUGHOUT NORTH AMERICA

RESEARCH & DEVELOPMENT OVER $300 MILLION

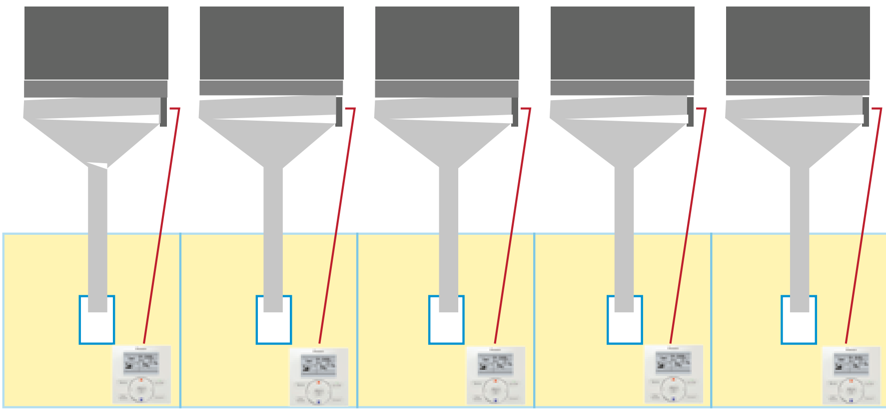
Contents

Unique Feature & Benefits

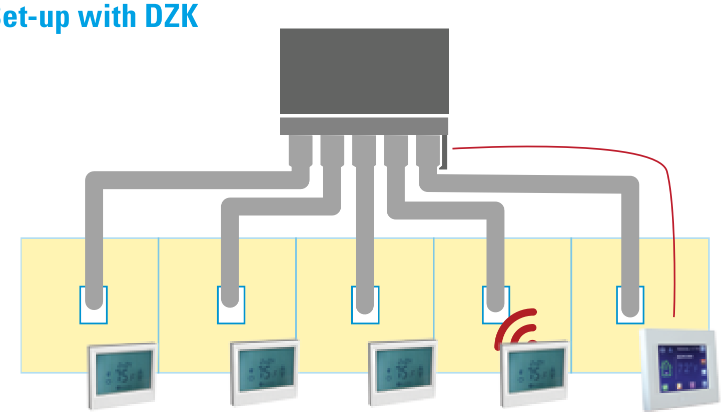
This guide serves as a reference for the Daikin Zoning Kit. The DZK is one of many innovations that have been developed to enhance the operation and flexibility of the VRV system.

The basic premise of the DZK is to serve several small zones without the need for an excessive number of indoor units and yet still provide individual temperature control to each area served.

Standard Ducted Set-up



Ducted Set-up with DZK



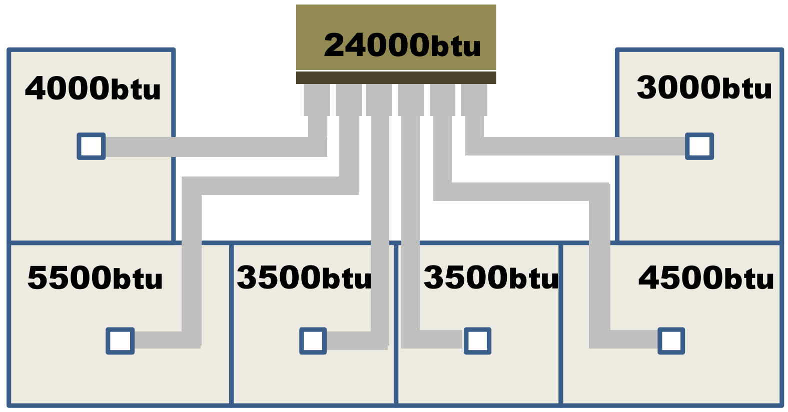
The core benefits of applying this product:

- Less equipment cost compared to traditional ducted systems
- Less cost to install than individual VRV indoor units
- Can be used to assist in addressing ASHRAE standard 15 application related matters.
- Greater control of air & temperature in areas requiring 7500btu or less compared to traditional ducted systems
- Individual control of even the smallest room

Suitable DZK Applications

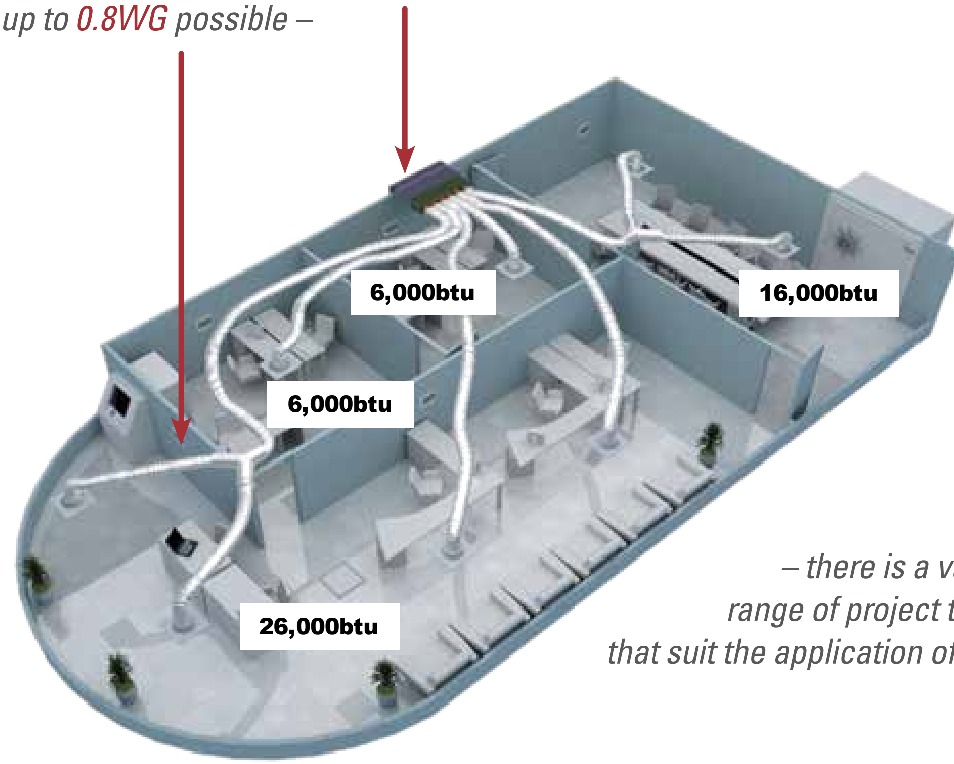
Small & Low Load Areas

The benefits of the systems are most realized when applied to a group of small rooms that have heat loads below the capacity of the smallest VRV indoor unit, which is typically 7000 Btu/hr (FXMQ-07 ducted unit).



Commercial/ Retail

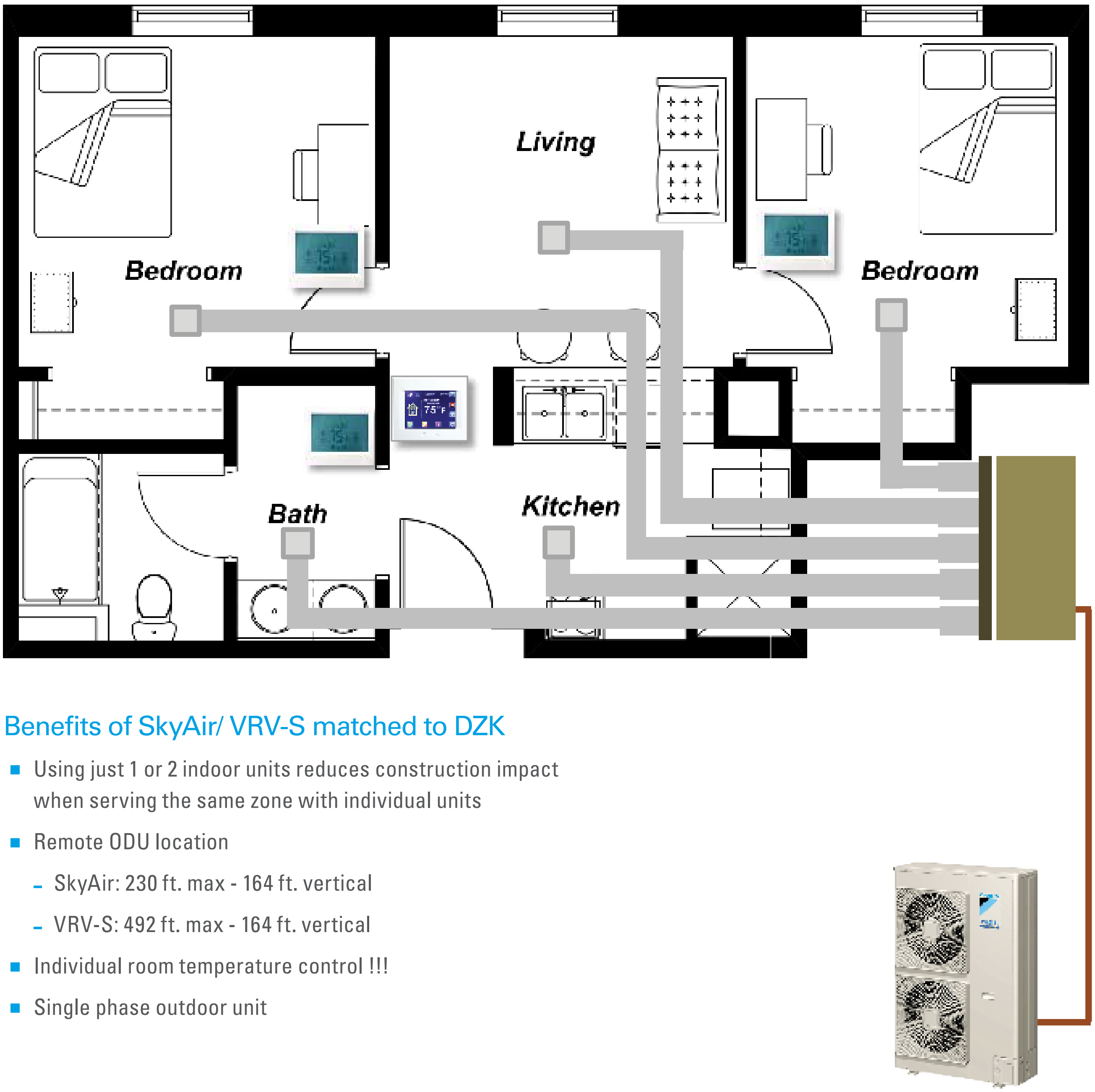
However, with capacities up to 54MBH and ducting up to 0.8WG possible –



– there is a varied range of project types that suit the application of DZK

Residential with SkyAir/ VRV-S

It is possible to combine the flexibility of a SkyAir or VRV-S outdoor unit with the exceptional level of control provided by DZK to provide the ultimate residential system.



Benefits of SkyAir/ VRV-S matched to DZK

- Using just 1 or 2 indoor units reduces construction impact when serving the same zone with individual units
- Remote ODU location
  - SkyAir: 230 ft. max - 164 ft. vertical
  - VRV-S: 492 ft. max - 164 ft. vertical
- Individual room temperature control !!!
- Single phase outdoor unit

DZK Range

Equipment Line-up

VRV Ducted Unit

The FXMQ-PB ducted indoor unit is the range of VRV equipment required for use with the DZK kit. It is also possible to link DZK to the FBQ SkyAir ducted split systems.

NOTE: The standard NAV room controller is required for the DZK main stat to communicate with the indoor unit. It is NOT required in the room space and would typically be installed by the unit.

Zoning Box

The Zoning Box is a plenum with motorized dampers that constantly modulates the conditioned air flow into each zone through standard ductwork, in response to the demand from the individual Zone Thermostats.

Main Thermostat

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

Zone Thermostat

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

DZK Box & VRV Ducted Indoor Unit Range

DZK Box & VRV Ducted Indoor Unit Range

Product Reference		Compatible Ducted Unit	No. of Air Duct Outlets	Number of Zones
	DZK030E4	FXMQ15P FXMQ18P FXMQ24P	4 x Ø8"	2 to 4
	DZK030E5		5 x Ø6"	2 to 5
	DZK048E4	FXMQ30P FXMQ36P FXMQ48P FXMQ54P	4 x Ø8"	2 to 4
	DZK048E6		6 x Ø6"	2 to 6

	Air flow Rates (cfm)			Max Static (WG)
	H	M	L	
FXMQ15P	560	530	500	0.8"
FXMQ18P	635	582	529	0.8"
FXMQ24P	688	618	565	0.8"
FXMQ30P	1094	953	812	0.8"
FXMQ36P	1130	953	812	0.8"
FXMQ48P	1377	1165	988	0.8"
FXMQ54P	1624	1377	1130	0.56"

- Each duct outlet has a modulating damper which can be independently controlled to modulate the air flow and control room temperature
- There are 4 DZK box types to match the range of VRV ducted indoor units and area configuration
- The number outlets from any box can be reduced to suit the application
- Additionally, more than one outlet can be combined to provide sufficient air flow rates to larger areas

Wiring and Controls

Controls Portfolio

Main Thermostat

Main Thermostat Features

- Graphic color touch interface/thermostat
- Zone On/Off
- Set point temperature setting
- Sleep Function
- Operation mode selection for the system
- Time schedule programming & operation mode scheduling
- Remote zone control
- Setting of system parameters

Zone Thermostat

Zone Thermostat Features

- Graphic monochrome wireless touch interface
- Zone On/Off
- Set point temperature setting
- Sleep function
- Schedule control
- Battery powered
  - 2 x AAA
  - 2 years (Typical Battery Life)

Main Thermostat	
Model Reference	DZK-MTS-2-W
Communication Cable	AWG 20 - 4 wired (Shielded)
Maximum Wiring Length (Control Board to Main Thermostat)	130 ft (40 m)
Power	12VDC supplied from main control box (1.47 VA maximum)
Comfort Set point Range	59° to 86° F (15° to 30° C)
Setback Set point Range	50° to 95° F (10° to 35° C)
Operating Temp Range	32° to 122° F (0° to 50 ° C)
Operating Humidity Range	5% to 90 % (non-condensing)
Dimensions (W x H x D)	6.10 x 5.04 x 0.94 inch (105 x 91 x 24 mm)
Weight	0.4lb (0.18 kg)

Zone Thermostat	
Model Reference	DZK-ZTS-2-W
Wireless Communication	915 MHZ – 12 dBm
Total Reach (Line of sight to control board)	164 ft (50 m)
Power	3 VDC supplied by internal batteries
Batteries	2 x 1.5 V Type AAA (Approx. 2 years)
Comfort Set point Range	59° to 86° F (15° to 30° C)
Setback Set point Range	50° to 95° F (10° to 35° C)
Operating Temp Range	32° to 122° F (0° to 50 ° C)
Operating Humidity Range	5% to 90 % (non-condensing)
Dimensions (W x H x D)	6.10 x 5.04 x 0.94 inch (105 x 91 x 24 mm)
Weight	0.46lb (0.21 kg)

DZK BACnet Gateway Module

DZK BACnet® Interface Module Features

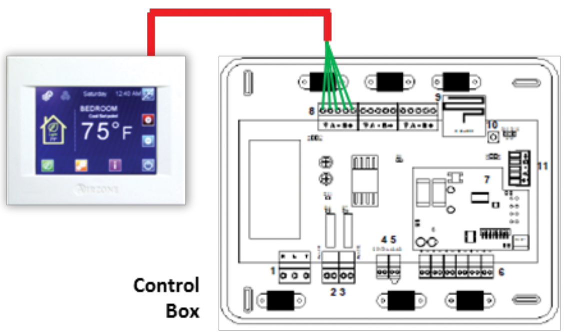
- Allows individual room control via any BACnet/IP compatible Building Management System.
- BACnet Client option allows the intelligent Touch Manager (iTM) to provide individual room control.

Wiring and Controls

Control Wiring Logic - Wired or Wireless Control?

Each DZK Unit requires a main (wired) thermostat. This can control ALL zones or just a single zone. The options available to the user are as follows:

Single Wired Controller

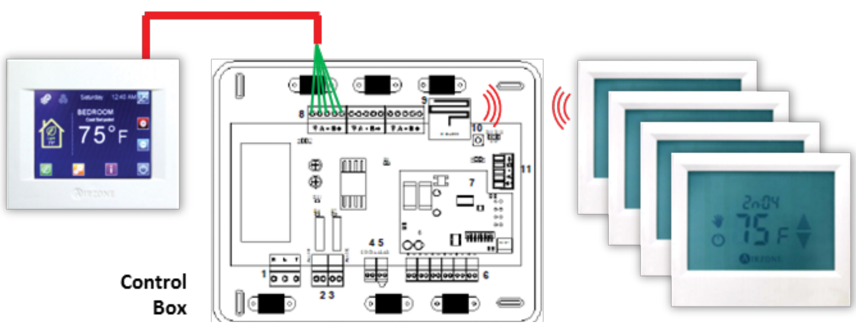


- Each zone controlled from a single wired controller
- Every zone still has individual set point ability

Advantages:

- Reduced equipment and installation cost when using a single controller for multiple zones
- Single management of temperature setting
- Reduces chance of set point abuse
- Setting of system parameters

Main Controller + Wireless Controllers

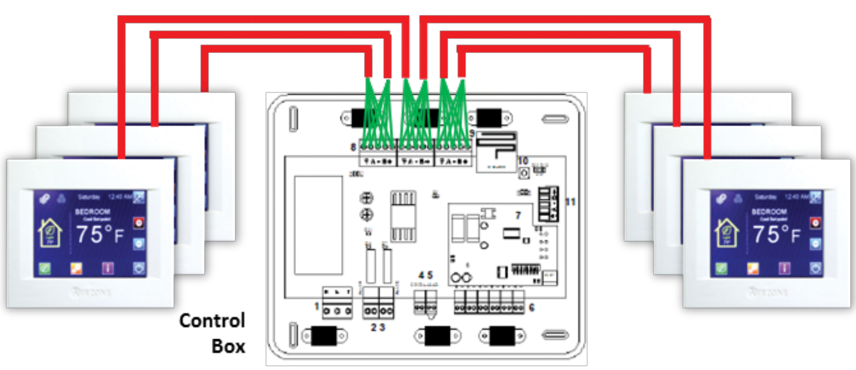


- Each zone controlled at source
- Up to 164 ft "line of site" distance from control box

Advantages:

- Minimal wiring necessary
- Flexibility of control location

All Wired Controllers



- Up to 6 wired controllers can be linked together
- Each of the 3 terminal connections can support 2 wired controllers*

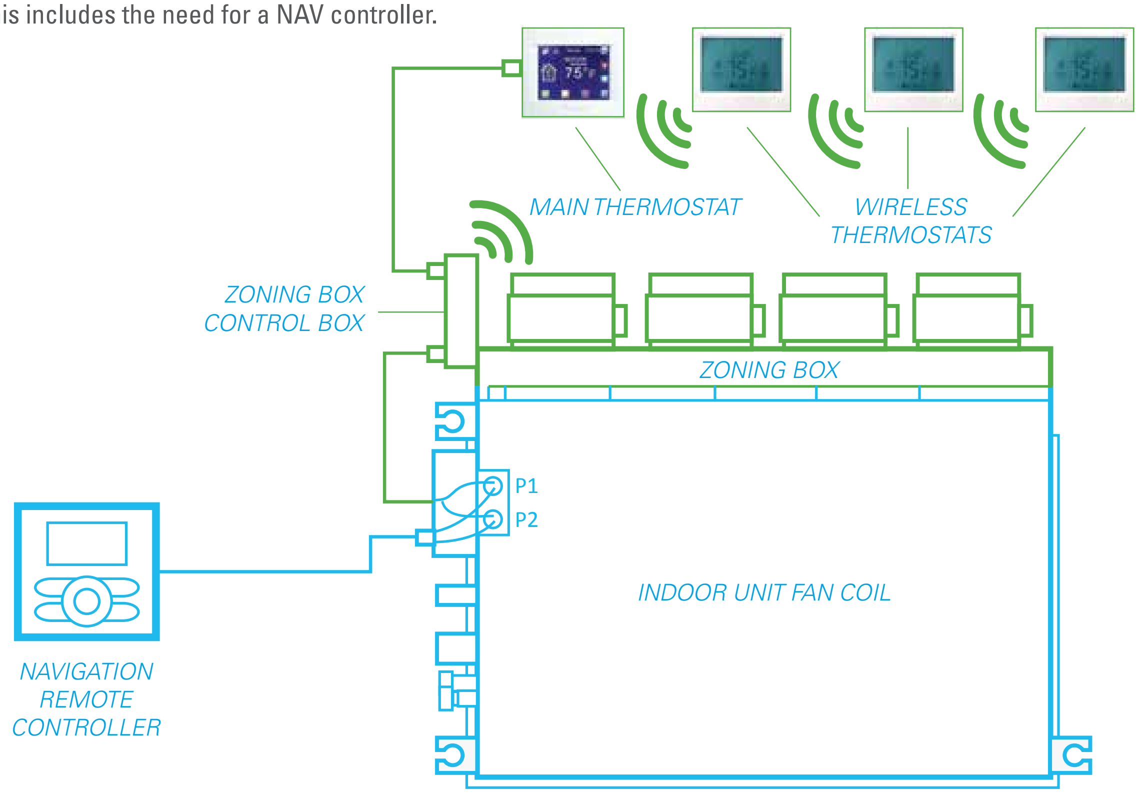
Advantages:

- Uniform appearance
- End user may prefer appearance of wired type controller
- Eliminates any possible wireless communication issues*

** Wired control is flexible: Either pair controllers to a terminal or daisy chain all/some controllers together. Total wiring allowable of EACH terminal is 130ft (e.g. 2 x controllers: 1st at 80ft the other at 50ft)*

Control Wiring Logic - Wired or Wireless Control? (cont.)

This diagram illustrates a standard procedure for DZK control wiring. All control wiring of the VRV system remains unchanged - this includes the need for a NAV controller.



Heat Pump Changeover

NOTE: This set-up is not required on a Heat Recovery system, when the equipment is being served by a separate selector box or port.

When a VRV Heat Pump system is commissioned, a "master" indoor unit is designated to dictate when the system is to operate in cooling or heating mode. This task is set up on the "Nav" controller of the unit in question.

Should the "master" unit be a DZK, the Main controller will indicate "M" in the AirNet address (as shown). Any DZK unit on a Heat Pump system that is NOT the master unit will instead show "S" (sub unit)

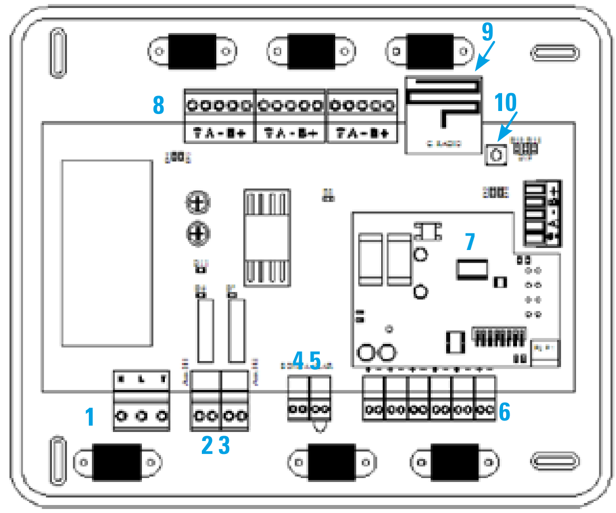
NOTE:

- If the indoor unit AirNet Address shows (---) the system has yet to be set up
- This set up is not required on a Heat Recovery system, when the DZK is being served by its own branch selector box or port

Zone Control Box Connections

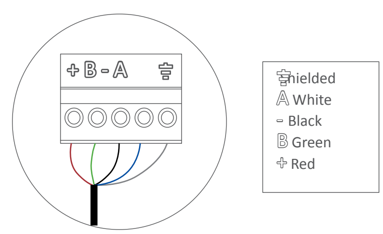
The Zoning Box is fitted with a control and power wiring enclosure.

Listed here are the various connections and features available for both standard and optional applications.



1. **Power Supply**
   Power supply 120/240 VAC line.
   The Zoning box control board is protected by a self-resettable fuse.
2. **Heating Stage 1 Output**
   If the system includes Auxiliary Heat, when required by the heat demand, this output enables the first stage of auxiliary heat. The technical specifications for the 1st Stage auxiliary heat relay are: Imax: = 1 A @ 24V, dry contacts (If higher power is required for control, use external contactors with appropriate capabilities).
3. **Heating Stage 2 Output**
   This output enables a second stage of Auxiliary Heat, if a system features. The technical specifications for the 2nd stage auxiliary heat relay are:
   Imax: = 1 A @ 24V, dry contacts (If higher power is required for control, use external contactors with appropriate capabilities).
4. **Protection Probe Input**
   This input is used to connect the supply temperature sensor.
5. **Alarm Input (NC)**
   When this input is open it will stop the AC unit, and close all dampers. This input is shipped with a jumper in the connector that should be left in place unless an alarm input is connected.
6. **Actuator Control Outputs**
   These outputs are used to drive the damper actuators with 12VDC control for each zone.
7. **Daikin Interface Board**
   This Interface provides the communication between Zoning box control board and Daikin indoor unit (via the Nav Controller).
8. **Expansion Bus**
   The expansion bus allows the connection of the Main Thermostat (5 contacts).

   NOTE: 3 connectors allow for up to 6 main thermostats to be used (as an alternative to the wireless thermostats). Connect the cables to the connector contacts as per these color codes:

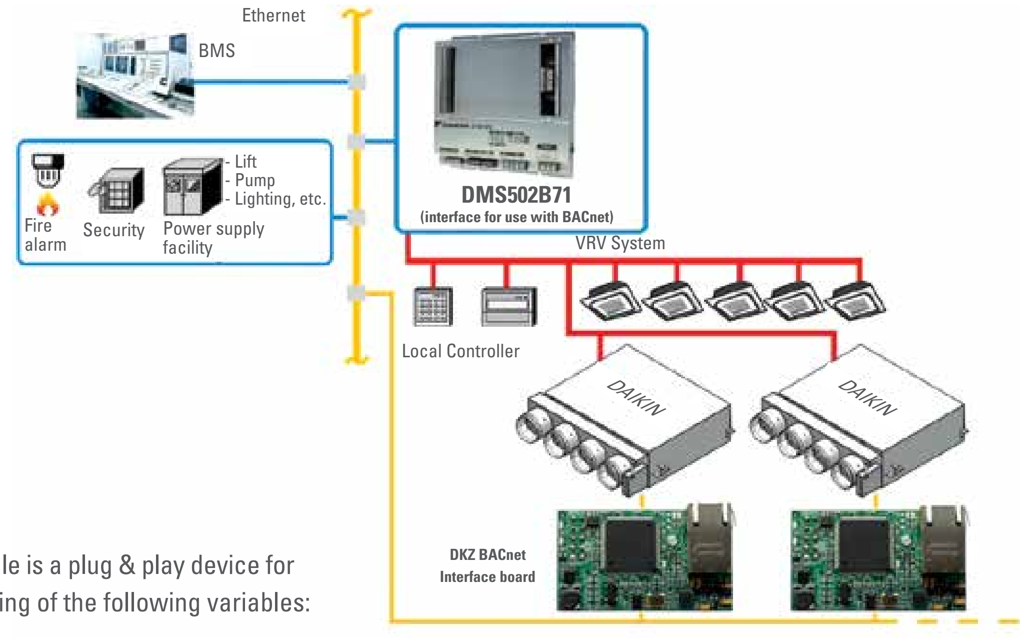


9. **Wireless Interface**
   This device provides the communication between the Zoning box control board and the Wireless thermostats connected to this bus.
10. **Reset System Button**
    If the whole system needs to be reset (e.g. replacement board or as a last resource to fix a problem) press and hold SW1 until the LED 19 stops flashing. A system reset will return all configurations to default values and conditions.

Central Control Application

Central control of all individual zones is possible via a DZK BACnet® Interface Board

The interface allows both BMS & Daikin iTM to control all variables of the DZK systems. The DZK BACnet interface board uses a standard open protocol based on ASHRAE Standard 135.



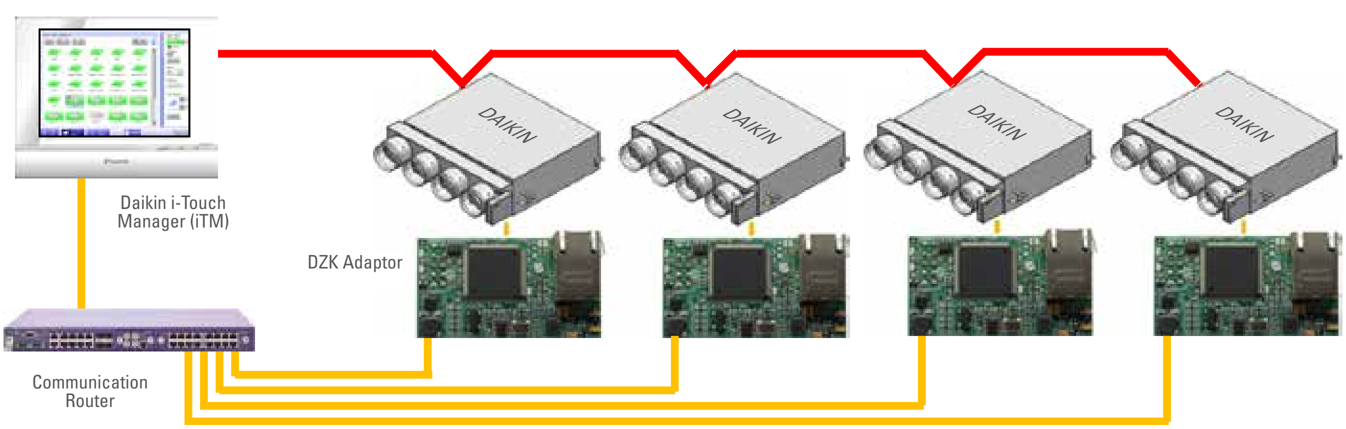
DZK controlled via BMS

The DZK BACnet® Interface module is a plug & play device for DZK - It allows control & monitoring of the following variables:

- Indoor unit status
- Fan status and fan speed
- Auxiliary heat stages status
- Global ventilation status
- Operation mode
- On/Off for each zone
- Set point setting for cooling & heating in each zone
- Room temperature in each zone
- Local fan activated/deactivated for each zone
- Auto (scheduling) activated/deactivated
- Unoccupied mode status
- Vacation mode activated/deactivated
- Opening damper status for each zone
- Indoor unit and DZK errors

DZK controlled via Daikin iTM

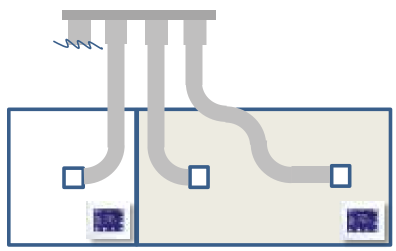
- All control & monitoring functions listed above are available via iTM control
- Purchase of "BACnet Client" software (DCM009A51) is required for download to activate the feature in the iTM



Ductwork Design

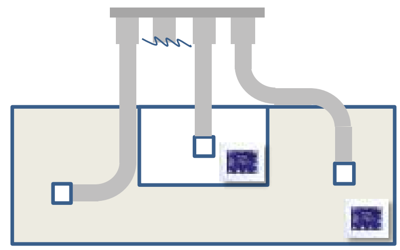
Application Examples

More than one damper outlet in a single space



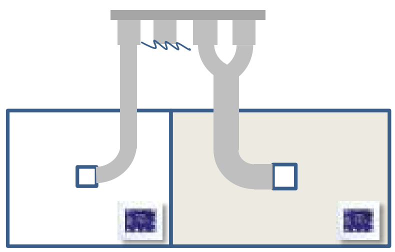
It is possible to supply a space from more than one damper outlet. All dampers serving the area can be linked to a single thermostat for simultaneous damper control.

Damper outlets not in sequence



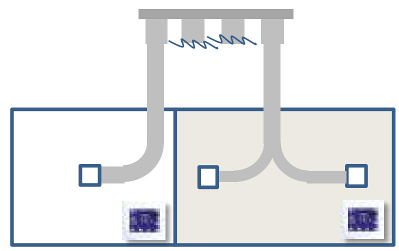
It is also possible to serve a single space when the damper outlets are out of sequence. Again a single controller will provide unified damper control.

Two dampers serving a single duct



Where a large load is required, it is acceptable to link two damper outlets to a single duct/grille outlet. As with all duct design, correct balancing of air flow would be required.

Single damper serving two grilles

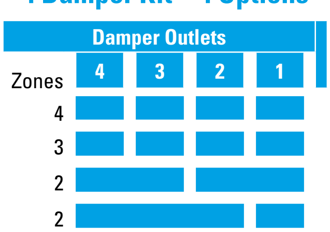


Conversely, with good duct design, an area with a relatively small load that benefits from more than one outlet grille can be served by a single damper outlet.

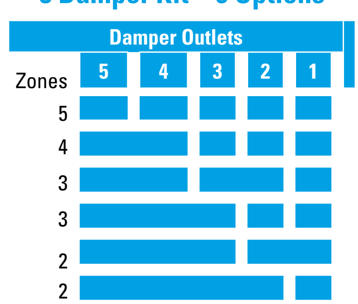
Outlet Combinations

- Each DZK kit has a number of damper outlet combinations.
- The combinations shown can be attached in any order.
- Only two damper outlets need to be used in a project.
- The installer is free to choose which dampers to use and those to remain redundant.
- Damper No.1 is always the outlet next to the control box.

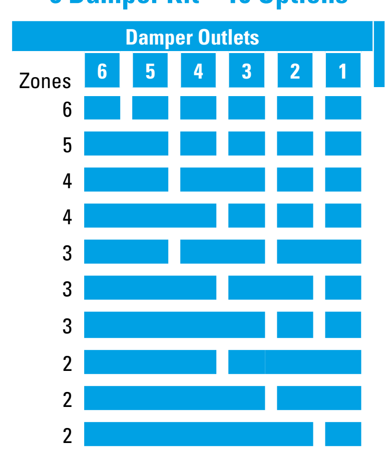
4 Damper Kit – 4 Options



5 Damper Kit – 6 Options



6 Damper Kit – 10 Options



DZK System Air Balancing

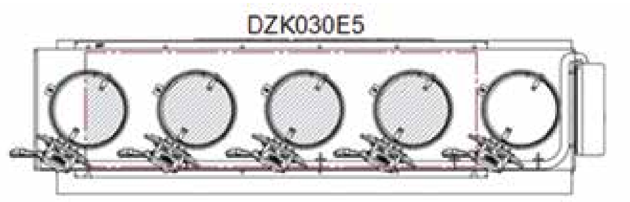
An essential part of good application is correct and balanced air distribution for each space. In addition to duct type, length and grille design, the average flow of each damper outlet should also be taken into consideration and included in any pressure loss calculation.

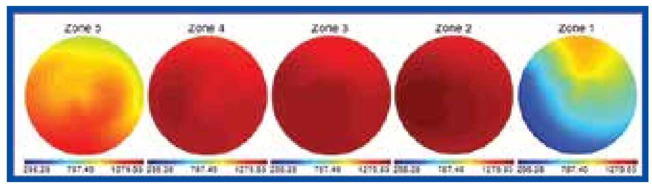
The position of the indoor unit supply port is offset from center of the DZK box (specifically with the smaller DZK030E4 & E5 models). Therefore air velocity is not uniform and the central dampers receive more air flow.

As demonstrated in this example, damper #1 on a DZK030E5 receives a smaller proportion of the air supplied by the unit.

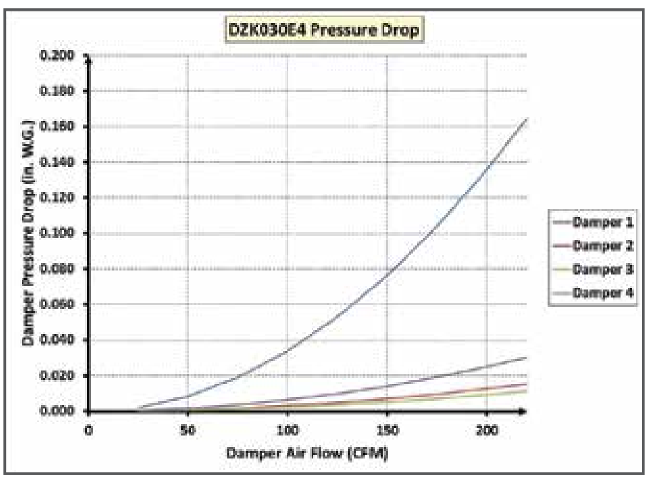
NOTE:

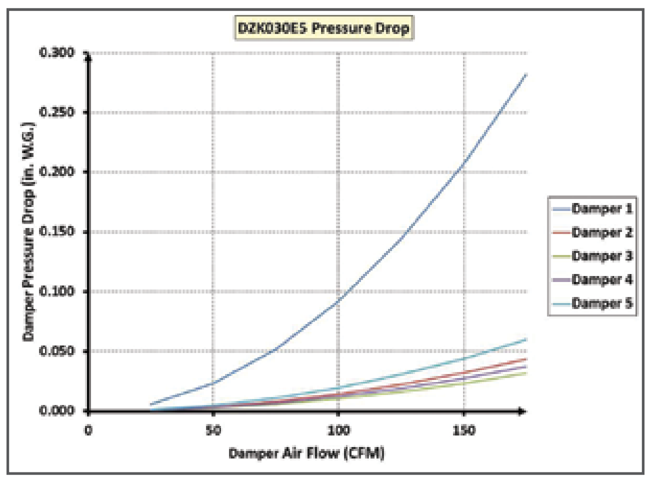
- With all models, damper #1 is the damper closest to the control box and so forth.
- When projects don't require all dampers to be utilized, any damper outlet(s) can be omitted (a minimum of only two outlets is acceptable).

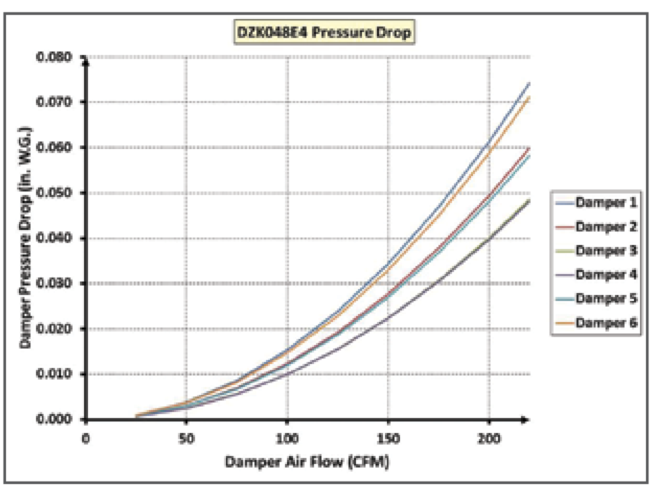


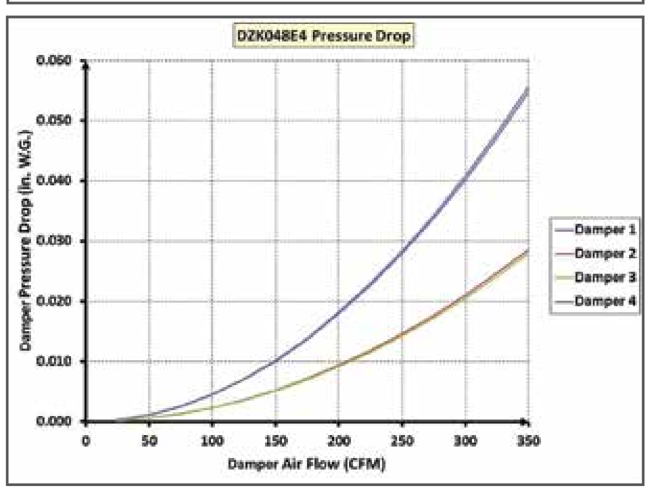


The engineering data book provides comprehensive information to guide the installer through this process. This includes pressure drop charts (as below) and step by step guides to motor adaptor adjustment









Ductwork Design

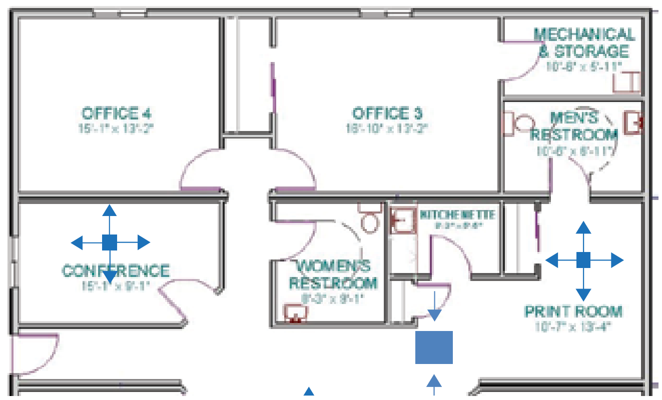
Unit Location & Return Air

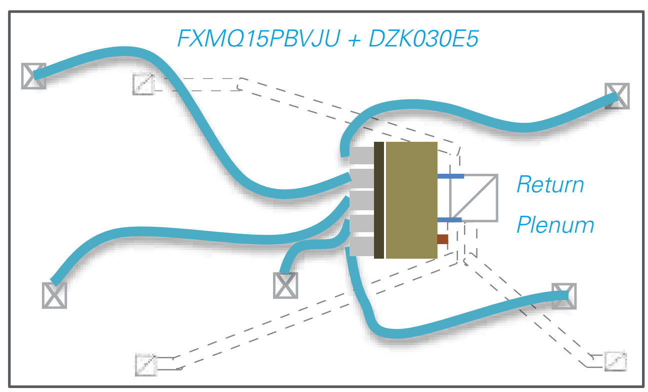
As long as static **pressure limitations** and **air balancing** requirements are met, the exact location of the VRV indoor unit is not critical.

However, due to these two demands, finding a void or plenum space in a central location for the unit is always advantageous and can also reduce installation costs.

Several basic design considerations affect DZK air distribution systems:

- Central return duct systems can reduce overall cost of installing sealed ducts, making them the popular choice. A distributed return duct system can be used if static pressure limitations allow.
- As with standard VRV ducted installations, if fresh air is being supplied to the unit, a remote sensor (KRCS01-4B) should replace the default return air sensor. It should typically be located by, or close to, the return air grille.





Guideline to Duct Sizing

Correct duct design and 'air balancing' are an essential part of the installation process to ensure optimum performance. Under sizing can result in higher noise levels, higher operating cost, and reduced comfort. Oversizing can result in system imbalance and higher installation cost

Guidelines for determining the maximum air velocity to use in various applications is provided as well as a quick sizing chart with instruction. It should be noted the sizing table should be used as a guide only. In practice, once the average velocity of the air moving in the duct is set and air volume is known, the individual duct section is determined from a device commonly known as "Duct Calculator".

Recommended velocities, FPM			
Designation	Residences, Theaters, Churches	School, Offices, public buildings	Industrial buildings
Trunk ducts	700-900	1000-1300	1200-1800
Branch ducts	600	600-900	800-1000

Flex duct				
Duct Size (Diameter)	**0.06" Friction Rate**		**0.10" Friction Rate**	
	CFM	**Velocity (FPM)**	**CFM**	**Velocity (FPM)**
5"	30	220	35	255
6"	50	255	65	330
7"	75	280	100	370
8"	120	345	155	445
9"	160	360	220	500
10"	225	410	295	540
12"	385	490	470	600
14"	610	570	640	750
16"	850	600	1100	790

Metal duct				
Duct Size (Diameter)	**0.06" Friction Rate**		**0.10" Friction Rate**	
	CFM	**Velocity (FPM)**	**CFM**	**Velocity (FPM)**
5"	50	380	70	500
6"	85	400	115	540
7"	130	420	160	600
8"	180	500	240	625
9"	260	520	320	700
10"	320	600	430	800
12"	510	700	700	900
14"	640	750	1000	950
16"	1100	725	1500	1100

How to use sizing charts:

- Identify the volume of air that will pass through the duct.
- Select duct size based on the friction rate.
- Increase duct size if velocity exceeds maximum limits.

Duct Sizing Procedure

How to size an air distribution system

There are 6 main steps required to size an air distribution system

They follow a logical path of reviewing the requirements of the application and then choosing the proper equipment and ends with creating a duct system that is specific to the building.

1. Perform load calculation for each zone.
2. Using the peak load calculation information to select an Indoor fan coil unit.
3. Calculate Required Airflow per room. Apply the following formula: (Indoor unit CFM is obtained when the Indoor unit is selected in Step 2)
4. Room CFM= **Indoor Unit CFM × Room Load** / **Total load for the entire space served by Indoor unit**
5. Calculate effective length of the critical circulation path. -Total effective length (TEL) is the sum of the actual measured length of the duct plus all the equivalent lengths of the various fittings. Sometimes the longest runs can be identified by inspection, but depending on the equivalent length of the fittings, the run that has the longest effective length may not be the run that has the longest measured length. If there is any doubt about which run is the longest, check the effective length of each likely candidate.
6. Calculate friction rate design value (IWC per 100 feet of length) – Friction rate value is determined by the effective length of the critical circulation path and available static pressure (ASP). First, determine how much external static pressure (ESP) is available from the Indoor unit. Next, deduct pressure loss for external air-side items that will be installed in the air distribution system to find the available static pressure (ASP) or net pressure available to move the air through the critical circulation path.

   To get the friction rate value apply the following formula:
   Friction Rate= **Available Static ×100** / **Total Effective Length (TEF)**
7. The friction rate value is applied to duct sizing chart to size the duct sections, based on the volume of air they will pass through the duct. Increase duct size if the local velocity exceeds maximum limit.

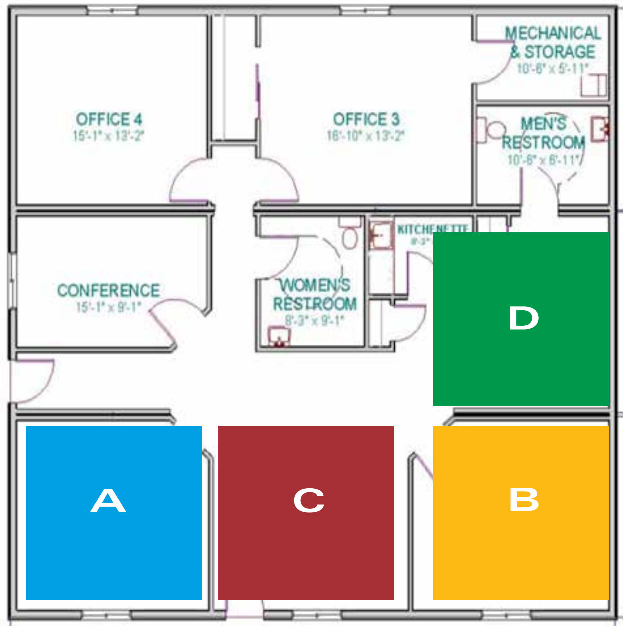
NOTE: This procedures calculates the friction rate based on the worst case or critical path friction that has the longest TEL. The critical path friction rate is then used for the design for all other duct runs. This method slightly oversize ducts with shorter runs and so balancing dampers are required in every branch runout ducts to adjust the airflow to every room.

The next few pages demonstrates these steps using an example.

Ductwork Design

Duct Sizing Example

The example used is an office building. A Daikin VRV IV heat pump system and various Daikin indoor fan coil units were used to provide heating and cooling to the building. A Daikin zoning kit is used to serve several small zones, allowing for less units, yet still providing individual temperature control to each zone. The figure (right) shows the building layout and where the DZK zoning kit is used.



The The Load Analysis worksheet is the summary of calculations for the example used here. It shows the cooling and heating load for each zone (a, b, c and d). Each zone must have the heating and cooling load calculated separately. Once each room has been calculated, add them together to get a load total, and select the indoor unit that will meet the load total. Indoor unit should be selected to meet the total load at the actual outdoor and indoor design conditions using Daikin Xpress software. The figure below shows an indoor fan coil unit performance which is selected to meet the load of the total area served.

Load Analysis worksheet			
Zone	**Room**	**Peak Cooling Load (Indoor temp =75°F)**	**Peak Heating (Indoor temp =72°F)**
A	Office 1	7,500	9,150
B	Office 2	7,500	9,150
C	Reception	8,000	9,760
D	Print room	6,500	7,940
Totals		**29,500**	**36,000**

Name	FCU	Tmp C	Rq TC	Max TC	Rq SC	Max SC	Tevap	Tmp H	Rq HC	Max HC	Airflow
FCU 1	FXMQ36PBVJU	75.0°F / 50%	29500BTU/h	30234BTU/h		24939BTU/h	42.8°F	72.0°F	36000BTU/h	38520BTU/h	1130cfm

Product Reference	Compatible Ducted Unit	No. of Air Duct Outlets	Number of Zones
DZK030E4	FXMQ15PB	4 x Ø8"	2 to 4
DZK030E5	FXMQ18PB FXMQ24PB	5 x Ø8"	2 to 5
DZK048E4	FXMQ30PB FXMQ36PB	4 x Ø8"	2 to 4
DZK048E6	FXMQ48PB FXMQ54PB	6 x Ø8"	2 to 6

As well as selecting an indoor unit, you must also select a zoning kit that is compatible with the unit, and is based on the amount of outlets required. In this example, we selected a DZK048E4 zoning kit which has 4 duct outlets(one for each room).

Duct Sizing Example (cont.)

Once the indoor unit has been selected and the load for each room is known, the cfm for each room can be calculated. The example below is the zone A cooling cfm calculation.

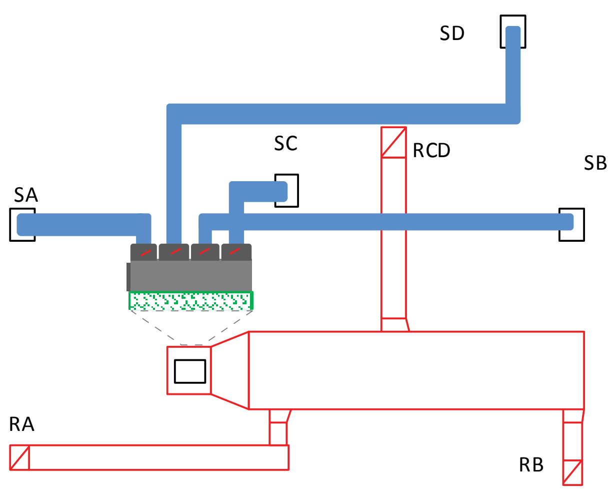
$$\text{Cooling Room CFM} = \frac{\text{Indoor Unit CFM} \times \text{Room Load}}{\text{Total load for the entire space served by Indoor unit}}$$

$$= \frac{1130 \times 7{,}500}{29{,}500} = 287 \text{ CFM}$$

The worksheet below is the summary of calculations for the example used here. The worksheet shows a cooling CFM and a heating CFM. The supply and return duct is sized using the larger of the two values (design CFM).

CFM per Room calculation worksheet						
Zone	**Room**	**Peak Cooling Load**	**Cooling Room CFM**	**Peak Heating Load**	**Heating Room CFM**	**Design CFM**
A	Office 1	7,500	287	9,150	287	287
B	Office 2	7,500	287	9,150	287	287
C	Reception	8,000	306	9,760	306	306
D	Print room	6,500	250	7,940	250	250
	Totals	**29,500**	**1,130**	**36,000**	**1,130**	**1,130**

The duct system geometry for zones a, b, c, and d, are shown below. The blue represents the supply duct run, and the red represents the return duct run. Each section of duct work is given an identification number (see table below). Each zone has its own return duct, except for c and d which have been combined.

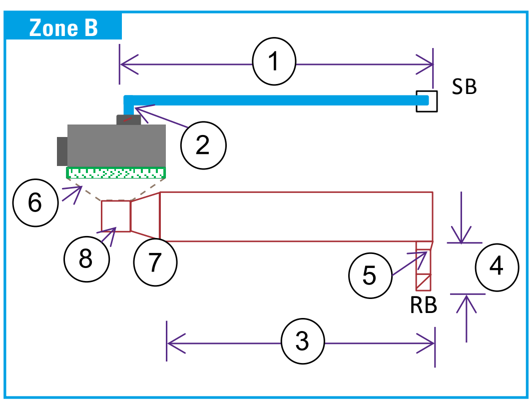


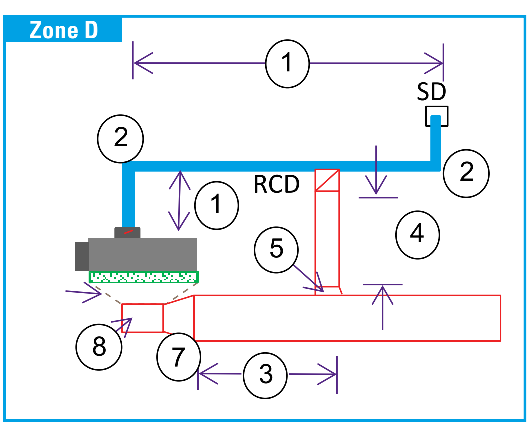
Zone	**Room**	**Supply Duct**		**Return Duct**		
		Supply Run ID Number	CFM	Return Run ID Number		CFM
A	Office 1	SA	287	RT	RA	287
B	Office 2	SB	287		RB	287
C	Reception	SC	306		RCD	556
D	Print Room	SD	250			
Totals			**1,130**			**1,130**

Duct Sizing Example (cont.)

Next, calculate the effective length for the critical circulation path. The effective length is the sum of the supply and return duct length plus all the equivalent lengths of the various fittings. When there are multiple candidates then each one must be calculated. In this example zones b, and d are potential candidates, so they must be calculated to determine which one is the longest. The effective length worksheet below provides the calculations for these runs. Each element is given an identification number and each circulation path is illustrated under its respective zone column. The equivalent length for each element is added together to produce a total effective length, this is done for each potential critical circulation path and the results are compared. The longest of the two will become the critical circulation path which is then used to size the duct system.

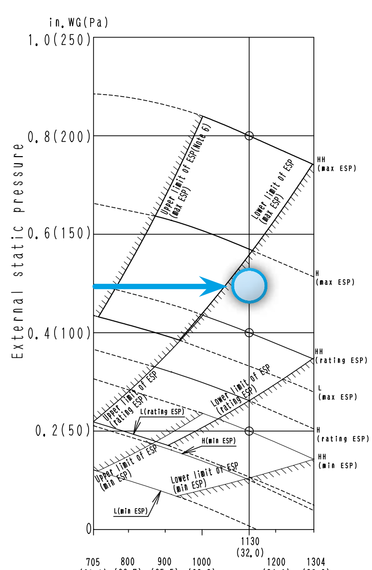
Effective Length worksheet			
		Zone B	Zone D
Element	**ID**	**Supply duct SB**	**Supply duct SD**
Runout Length	①	25	25
Elbow(s)	②	25	50
Element	**ID**	**Return duct RB**	**Return duct RCD**
Trunk Length	③	15	10
Branch Runout Length	④	2	6
Branch Return Air fittings	⑤	30	30
Return Air fitting at the IDU	⑥	40	40
Transitions	⑦	30	30
Junction Box	⑧	30	30
Total Equivalent Length (TEL)		197	221





After the effective length calculation has been done, the design friction rate needs to be determined. To determine the design friction rate value (" WC per 100 feet of length) for duct sizing, we will need to know how much external static pressure is available from the indoor unit. Determine the

Friction Rate worksheet	
External Static pressure (ESP)	0.45" WC, CFM = 1,130
External Device	
Zone Damper	0.05"
Supply Register	0.03"
Return Grille	0.03"
Return Filter	0.15"
Total	0.23"
Available Static Pressure (ASP)	=0.45"-0.23" = 0.22"
Total Effective Length	221 (See effective length worksheet)
Friction Rate Design Value	= 0.22" × 100 = 0.10 221



Duct Sizing Example (cont.)

external static pressure of the fan by using the engineering data book. The FXMQ36PBVJU indoor unit fan data indicates the fan can deliver 1,130 Cfm when operating against external resistance as high as 0.8“ WC, this is the maximum external static pressure the fan can handle. Once we add all the external devices (0.23” WC) and deduct it from the maximum external pressure it gives you the net pressure available for the duct system. In this case, the available static pressure is much greater than needed, thus we can set the maximum external pressure of the indoor unit to 0.45” (using the manual external static-airflow adjustment function), which then gives us an available static pressure of 0.22” WC. Finally, apply the formula shown in step 5 of the duct sizing procedure to calculate the friction rate design value, based on 0.22“ WC of pressure and 221 feet of effective length. These calculations are summarized by the Friction rate worksheet.

On a side note, when selecting which zone damper to connect the longest duct run , it is not a good idea to connect it to the two outside dampers due to them having a higher pressure drop than the inside zone dampers, resulting in less available static pressure. To determine the pressure drop for the zone damper refer to the pressure drop charts provided on page 12. After looking at the table below it is evident that in our example, dampers 1 and 4 have a significantly higher pressure loss than that of 2, and 3, thus we didn't connect the two potential critical runs to damper 1 and 4.

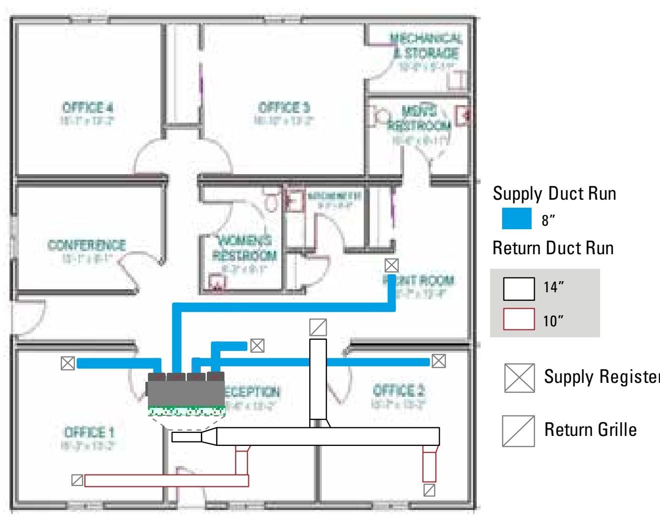
	SA	SB	SC	SD
CFM	287	287	306	250
Damper Number	1	3	4	2
Pressure Drop	0.035"	0.018"	0.04"	0.016"

Finally, the friction rate value is applied to the duct sizing chart (Pg. 14) to size the duct sections, based on the volume of air that will pass through them. The following summarizes the duct size calculations for this example. The worksheet uses the friction rate values from the friction rate worksheet (Pg. 18) and design CFM values (Pg. 17) to determine duct size. All of the values in the round size column were read from the metal duct scale on the duct calculator. The supply side branch ducts are based on a maximum velocity limit of 900 fpm.

The return side trunk and branch ducts are based on a maximum velocity limit of 600 fpm and 1000 fpm. Return branch ducts were sized for lower velocity to reduce noise generation.

Duct Sizing worksheet					
Design Friction Rate = 0.10”, Construction Material = Metal					
Supply-Side Runout, Max allowable velocity = 900 fpm					
Zone	**Room**	**ID**	**CFM**	**Round Size**	**Velocity Fpm**
A	Office 1	SA	287	8”	822
B	Office 2	SB	287	8”	822
C	Reception	SC	306	8”	876
D	Print Room	SD	250	8”	716
Supply-Side Trunks (No supply trunks for a DZK system)					
Return-Side Branch Runouts, Max allowable velocity = 600 fpm					
A	Office 1	RA	287	10”	526
B	Office 2	RB	287	10”	526
C	Reception	RCD	556	14"	520
D	Print Room				
Return-Side Trunks, Max allowable velocity = 1000 fpm					
		RT	1130	14”	1057

Once all the steps have been completed and the duct sizes have been determined, a duct layout plan can be put together. The duct layout plan will show the location of the indoor unit and the DZK zoning kit as well as all the ducts, registers and grills. To know what size the duct is, refer to the color legend located to the right of the duct plan.



Multi-Space Ventilation rate requirement

The procedure for finding the required outdoor air intake flow varies with the configuration of the ventilation system. The ASHRAE 62.1-2013 defines three configurations: Single zone, 100% OA, and multiple zone recirculating system. In Multiple zone recirculation systems, such as VRV DZK zoning systems, the indoor unit supplies outdoor air and recirculated return air to more than one zone. The required outdoor air intake flow can only be determined by properly accounting for system ventilation efficiency using the multi space calculation. The reason for this is because the intake airflow must be sufficient to ventilate the critical zone, which is the zone that requires the highest fraction of outdoor air in its primary airstream. Since a multiple-zone system delivers the same primary air mixture to each ventilation zone, proper minimum ventilation in the critical zone over ventilates all other zones. As a result, some "unused" outdoor air recirculates while some leaves the building via the relief, exhaust, and exfiltration air streams. ASHRAE 62.1 recognizes this behavior and accounts for it by incorporating system ventilation efficiency in the calculations.

The multi space procedure consist of multiple steps. First, determine the primary outdoor air fraction, Zp, using the following equation: Zp = Voz / Vpz. The zone primary outdoor air fraction is the ratio of zone outdoor air (Voz) to zone primary air (Vpz) for each zone served by the system. Zp must be calculated for each zone and the highest value must be chosen among all zones; this will be the value of Zp that represents the primary outdoor air fraction for the system. Once the zone primary air fraction has been determined for the system, the system ventilation efficiency, Ev, can also be determined using the default maximum value from the ASHRAE table 6.2.5.2 below. If Zp is greater than 0.55,

Table 6.2.5.2 System Ventilation Efficiency

Max Zone Primary Outdoor Air Fraction (Zp)	System Ventilation Efficiency (Ev)
≤0.15	1
≤0.25	0.9
≤0.35	0.8
≤0.45	0.7
≤0.55	0.6
>0.55	Use Appendix A

Ev must be determined/calculated using Appendix A located in the back of the Standard. For multiple-zone systems, it is usually safe to assume that people are not at peak occupancy in every space at the same time. For example, in an office building, if all the occupants were in their offices, the conference rooms would be below design occupancy.
To account for occupant diversity, D, the following equation is used: D = Ps / Pz. Ps is the system population and represents the total population in the area served by the system. Pz is the zone population which is defined as the largest number of people expected to occupy the zone during typical use. Now that diversity has been factored in, the uncorrected outdoor air intake rate can be determined using equation: Vou = D Σall zone (Rp*Pz) + Σall zones (Ra*Az).
The uncorrected outdoor air intake is the minimum outdoor air required by all zones before adjusting for system ventilation efficiency (the ASHRAE tables showing the Rp and Ra can be found on the following page). Finally, the designer can determine the outdoor air intake, Vot, for the multiple-zone recirculated system using the following equation: Vot = Vou / Ev.

Multi-Space Ventilation rate requirement (cont.)

Step by step calculation of Multi-Space recirculation system:

1. Determine Zone Population, Pz
2. Determine Zone Floor Area, Az
3. Calculate Breathing Zone Outdoor Airflow, Vbz = Rp Pz + Ra Az (Use Table 6.2.2.1)
4. Determine Zone Air Distribution Effectiveness, Ez (Use Table 6.2.2.2)
5. Calculate Zone Outdoor Airflow, Voz = Vbz / Ez
6. Calculate Primary Outdoor Air Fraction, Zp = Voz / Vpz
7. Determine System Ventilation Efficiency, Ev (Use Table 6.2.5.2 or Appendix A)
8. Calculate Occupant Diversity, D= Ps / ∑all zones Pz
9. Calculate Uncorrected Outdoor Air Intake; Vou = D ∑all zones Rp Pz + ∑ all zones Ra Az
10. Calculate Outdoor Air Intake Flow, Vot = Vou / Ev

Table 6.2.2.1. Minimum Ventilation Rates in Breathing Zone

Occupancy Category	People Outdoor Air Rate, Rp cfm/person	Area Outdoor Air Rate, Ra cfm/ft2	Occupant Density #/1000 ft2
Classroom (ages 5-8)	10	0.12	25
Classroom (age 9 plus)	10	0.12	35
Lecture Hall (fixed seats)	7.5	0.06	150
Office Space	5	0.06	5
Conference/Meeting rooms	5	0.06	50
Breakrooms	5	0.12	50
Reception areas	5	0.06	30
Retail Sales	7.5	0.12	15
Supermarket	7.5	0.06	8
Hotel Bedrooms	5	0.06	10
Music/Theater/dance	10	0.3	35

Table 6.2.2.2 Zone Air Distribution Effectiveness

Air distribution Configuration	Ez
Ceiling supply of warm air 15F or more above space temperature and ceiling return	0.8
Ceiling supply of warm air and floor return	1.0
Floor supply of warm air and floor return	1.0
Floor supply of warm air and ceiling return	0.7
Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification	1.2
Ceiling supply of cool air	1.0

Applying Fresh Air

Applications Rules

When integrating fresh air into a VRV system the basic rules are:

Cooling: Any percentage of OA can be used as long as the resulting mixed air is between 57 and 77 WB and 80% RH or lower

Heating: Any percentage of OA can be used as long as the resulting mixed air is between 59 and 80 FDB and 80% RH or lower

Application Considerations

- Verify the OA conditions with the higher system level OA requirement and, if necessary, pretreat the OA to meet the desired temperature and humidity range.
- OA has to be pre-filtered.
- The minimum zone supply airflow must exceed the required minimum zone ventilation airflow. This can be achieved by setting the individual dampers to the minimum damper position so the damper never closes completely.
- Consider setting the indoor unit fan speed to maintain high or low speed during thermo off via a field setting service code. This will prevent the indoor unit fan from automatically switching to a reduced fan speed setting during a thermo off condition, which could cause the system fresh air to be below the code required amount.

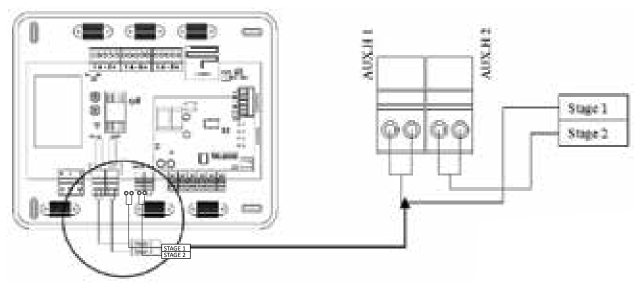
Auxiliary Heating

Applying Secondary Heat Source

The primary use of auxiliary heat is to supplement the system when the outside temperature falls below the balance point (Common practice for building with substantial heat load during winter) or to quickly raise the indoor temperature to recover from a set back.

- The capacity modulation of the Heat pump and aux heating systems is controlled by the DZK zoning box. Staging of auxiliary heat is through dry contact relays. The output stage (up to 2 stage), are energized sequentially, by number as heating demand dictates.
- The two relay contacts should be connected directly to a heater control circuit provided that the circuit is 24 V and the current through the relay contacts does not exceed 1 Amps inductive (see below wiring detail).

DZK Zoning Control Box



Auxiliary Heating Types	
Electric* **(Fan ON)**	Electric Duct Heater
	Ducted Furnace
	Ducted Hot Water Coil
Furnace* **(Fan OFF)**	Baseboard Heater
	Radiant Floor Heating

* Selecting Electric or Furnace in heating device (in control menu) defines whether or not the indoorunit fan must be active during auxiliary heat operation.

Primary or Secondary?

NOTE: In a scenario where a building receives a much lower price in utilities using an alternative heat source, auxiliary heat can be set up to be the primary heat.

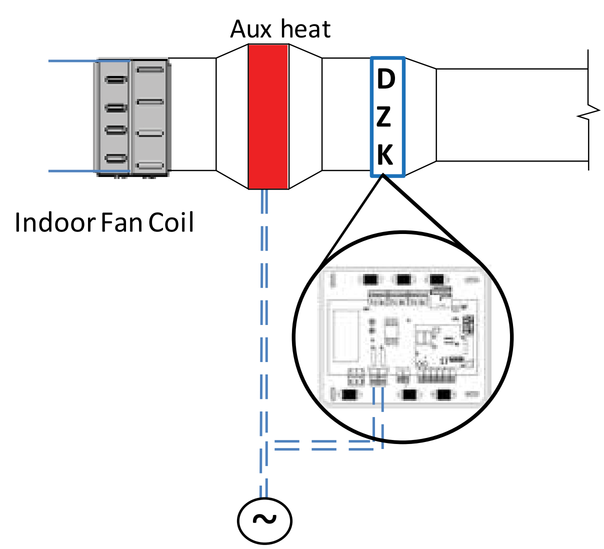
To do this, go into the configuration menu to 'Aux heat' and select Aux heat under 'first supply heat'.

NOTE: Only an auxiliary light source that does not need any ran assitance ffrom the VRV indoor unit can be utilized as the 1st stage of heat.

Aux Heater	Primary Heat	Secondary Heat
No	VRV System	None
Yes	VRV System	Aux Heater
	Aux Heater	VRV System

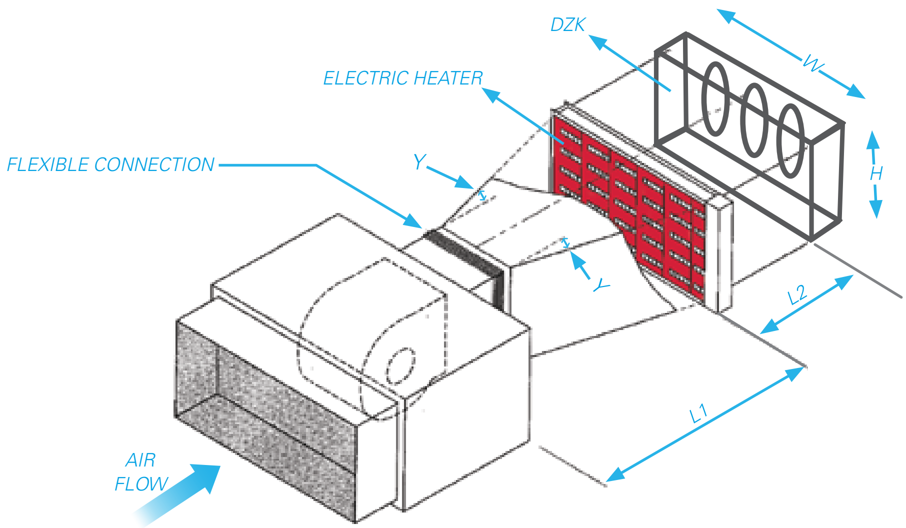
Integration of Duct Heater

- The field provided duct heater should be installed downstream of the indoor fan coil unit.
- The fan in the indoor unit should be set to active, sending hot air to the space during auxiliary heat operation.
- To do this, go into the configuration menu- Aux heat and select Electric (Fan on) under fan configuration.
- A time delay can be set to delay the operation of the fan until heating elements have warmed up to prevent discharge of cold air while the system is operating in the "heating" mode.
- Time delay is configurable between 0, 45, 60 and 120 sec, default to 60 seconds.
- Be sure to follow manufacturer install recommendations.



Auxiliary Heating

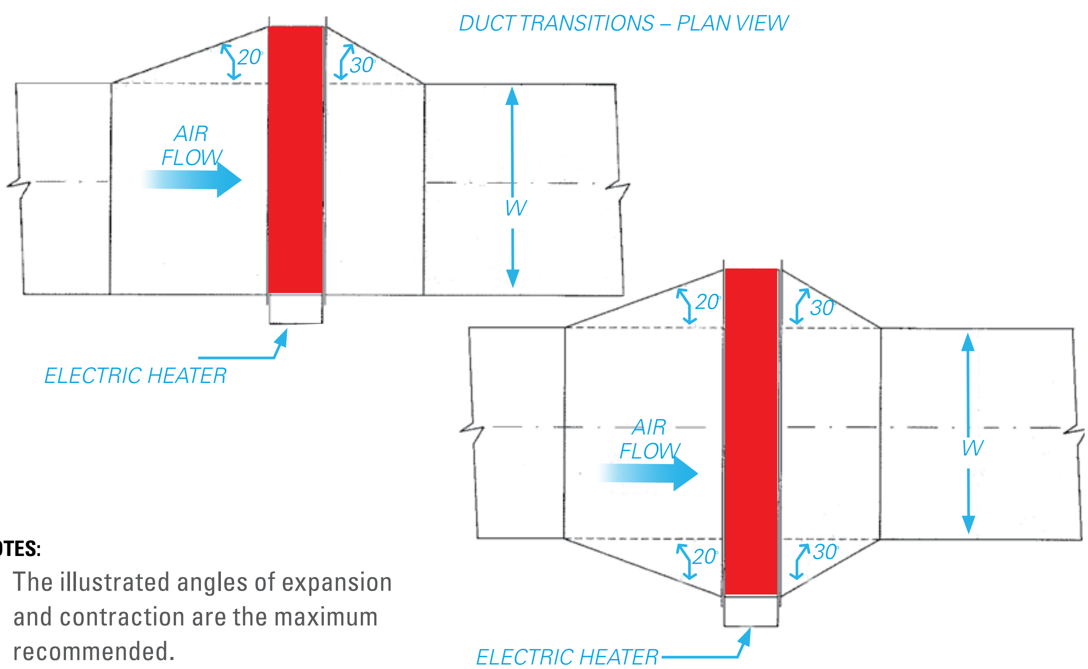
Optimum Installation of Heater



NOTES:

1. L1 = $\frac{H+W}{2}$ with a minimum of 48"
2. Refer to heater manufacture's instructions, and all applicable national, state, 8 local codes.
3. Angles Y are 20°maximum

When transitions are necessary on the inlet or outlet of a heater, the flow must be controlled within the following limits illustrated



NOTES:

1. The illustrated angles of expansion and contraction are the maximum recommended.

Reprint from SMACNA Ducted Electric Heat Guide. For Air Handling Systems, Edition 2

Application Consideration

- The air ducts should be installed in accordance with Standard NFPA90B, Standard for Warm Air Heating and Air Conditioning Systems
- The Heater should be wired in compliance with NEC/CSA and any existing local codes.
- Aux heater has to have an air proven switch – indoor unit fan could stop in defrosting.
- The kW selected must avoid exceeding the maximum UL listed coil temperature. The table below shows the max allowable kW for a different unit size.

Max Allowable KW by Unit Size*							
Inlet Air Temp (°F)	**FXMQ15P**	**FXMQ18P**	**FXMQ24P**	**FXMQ30P**	**FXMQ36P**	**FXMQ48P**	**FXMQ54P**
85	7.5	7.5	10.0	15.0	15.0	20.0	20.0
75	10.0	10.0	10.0	15.0	20.0	20.0	25.0
65	10.0	10.0	15.0	20.0	20.0	25.0	30.0

*Based on H fan speed and max discharge air temp of 129 °F

Note: Discharge Air Temp = KW * 3160 / cfm + Inlet Air Temp

Standards and Documentation

Applying ASHRAE Standards

ASHRAE STD 15/ASHRAE STD 34

These ASHRAE standards define the classification of refrigerants and their use in refrigerating systems in buildings. A key aspect of ASHRAE STD 15 is reviewing a project application relative to refrigerant density.

One of the critical measurements is calculating the size of the smallest room. The advantage of serving several enclosed areas from one ducted unit is that the total space served can be calculated as one area. This can help greatly toward demonstrating conformity to these standards.

As long as the minimum airflow setting to each zone is above 10% of design airflow, the volume of the rooms supplied by the VRV/DZK system can be included in the dilution volume calculation. In other words, the damper serving a space needs to be set so it cannot be shut below 10% of it's maximum with the fan running.

Product Documentation

There is a full compliment of support documentation for the DZK system. This documentation can be downloaded from DaikinCity.com.

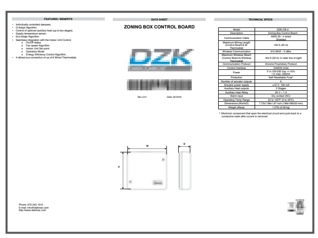
ENG DATA BOOK

INSTALL MANUAL

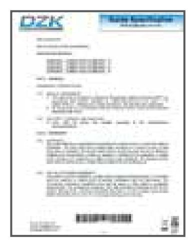
USER'S GUIDE

SALES LEAFLETS

SUBMITTAL SHEET



TECHNICAL SPECS



GUIDE SPECIFICATION

Notes

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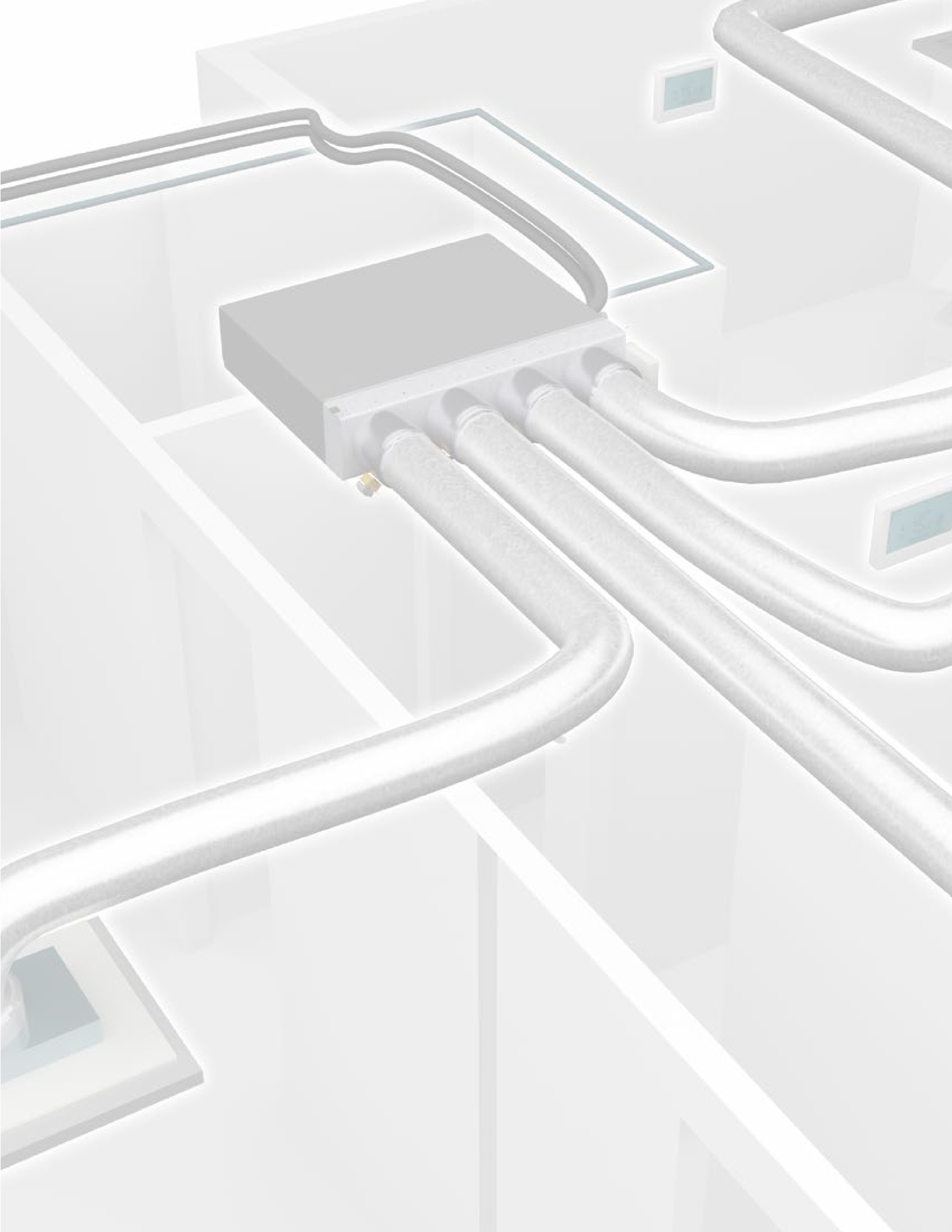

Daikin is one of the largest manufacturers of HVAC products in North America delivering environmentally-friendly conscious, energy-intelligent™ technology solutions for residential, commercial, and industrial applications.