

# **Ductless Split System Technology From Bonus Rooms to Commercial Buildings**

If I was writing this article ten years ago, I would have had to spend several paragraphs explaining what split ductless (mini-split) systems were and how they are applied. Over the past twenty plus years, this primarily Japanese technology has become a very popular solution for American HVAC contractors challenged by specific applications.

Today, split ductless systems remain one of the fastest growing HVAC segments in this, the most mature market in the world. But over the past several years, the primary providers of ductless systems in the U.S. have introduced a technology that is predicted to eclipse even the growth of conventional ductless systems.

This technology is called VRF (Variable Refrigerant Flow) and is world proven over the past twenty years. Introduced into the U.S. to extend the primary benefits of the ductless systems into larger applications, the acceptance level by all constituents in our industry has been phenomenal.

## **Benefits for the Contracting Community**

HVAC contractors appreciate the simple installation, low labor content, low callback and failure rates and automatic zoning that VRF systems provide. They also enjoy a high customer satisfaction rate which typically leads to referral business. But the primary benefit for today's contractor is the ability to offer turnkey solutions to their clients and, many times, bid on jobs that are larger than their typical 25 ton threshold of comfort.

Having the ability to control and complete all aspects of design, bid and installation of these systems allows today's contractor to keep all of the job "in house". Even the controls architecture of these systems is very user friendly with a simple two wire communication cable "daisy-chained" from unit to unit.

With today's renovation market surging, VRF systems offer a very sound solution to updating an existing structure with an extremely high efficiency system that offers automatic zoning, long life cycles (average 20+ years), extremely low failure rates and high tenant comfort levels. But most importantly, the modular design of these systems allows for it to grow and adapt to a building as it changes over the years.

## **Our Buildings Are Not Static Structures Anymore**

All of us in this industry have seen the trend over the past decade or so....buildings that evolve as office landscapes are changed, technology equipment is added, additions are built, etc. A commercial building today is a living, breathing thing...certainly not a static structure by any means. From multiple use and partial use needs, to varied traffic patterns and flex-time employees...the heating and air conditioning requirements of today's buildings is all over the board throughout the day.

And, as hospitals add high-heat producing diagnostic equipment, schools convert gymnasiums to cafeterias or classrooms, office buildings steal closet and hallway space to create more room for workers, the need exists for the building's HVAC system to be adaptable and able to grow with the client's needs.

This is where the inherent design of the VRF modular solutions appears to be a best in class technology. By adding outdoor footprints from 8 tons to 25 tons to an existing piping and controls network, these systems can fluidly grow and adapt with a building. A building owner can even install a larger system today (with only the required number of indoor units) and have built in reserve capacity as the building grows. This is possible due to the inverter technology incorporated by the primary providers of these systems.

### **Inverter Control and the VRF System**

The success of the VRF systems worldwide over the past twenty years is due to the high energy savings these systems were designed to deliver. Remember, necessity is the mother of invention. And with electricity costing up to four times as much as we pay here in the U.S., the leading Japanese HVAC manufacturers had to come up with a better mousetrap. The inverter controlled compressor and its' application into a VRF system was that mousetrap.

Simply put, the inverter control applied to the compressors in these systems is a variable frequency drive...much like what you see on today's chiller pumps. By varying the frequency to the compressor, the inverter control varies its rotational speed from well below 60 hertz to well above. In other words, the compressor only produces and delivers the exact capacity required to satisfy the load it is asked to satisfy at any given time during the day.

In application, this is a very simple process. Imagine a 25 ton outdoor system with multiple compressors connected to 25 or so indoor fan coil units. All of these indoor units have an electronic expansion valve with over 400 steps of capacity. As these indoor units begin calling for heating or cooling, they communicate their requirements (remember the two wire communication cable) to the outdoor unit.

The outdoor unit simultaneously speeds up the rotation of the compressor and opens the EEVs on each indoor unit to the position that will allow them to specifically target their set point. As each indoor zone begins approaching its own set point, the logic on the outdoor unit tells it's compressor to begin slowing down and start closing down the indoor unit's EEV. Once set point is achieved (not over-shot or under-shot), the system is now in "temperature maintenance mode". Quite simply, this means that as the zone experiences any thermal loading such as solar gain, more people coming into a room etc., the systems will automatically respond to the current capacity needs.

This eliminates the wide temperature swings that most people experience in today's buildings. And, with each zone having its own controller, each occupant gets to select their own comfort range. Imagine having an intelligent HVAC system that "lives" within a building with the occupants. These systems basically know what is happening throughout the building all day and automatically respond to the changing loads that are typical. But most importantly, the VRF system only gives you exactly what you need, when you need it. Thus, the ultra high efficiency levels that can only be provided by a system that enjoys part-load performance.

Another benefit of the VRF operational characteristics is better dehumidification. The VRF system basically wants to continue to run the indoor unit for as long as possible (don't worry, most of these indoor fan coils use less than 1 amp of electricity). But, when the indoor unit is in the aforementioned "temperature maintenance mode", you will still have air moving across a coil with a small amount of refrigerant in it. So you continue to address the latent load in the space even when set point has been achieved. This feature alone has tremendous opportunities in the more humid climate regions of the U.S.

One other benefit of inverter technology that should be mentioned here is the heating performance of these systems. We all know that conventional heat pumps need supplemental electric heat when outdoor ambients start approaching the freezing point. Having the ability to "over speed" the compressor to well over 100 hertz allows these systems to develop an adequate amount of heat to provide primary heating without the electric strip heat down to as low as -4 degrees F. By eliminating the need for the electric heat you don't forfeit the energy saving benefits inherent in the heat pump technology.

## **Mythbusters**

At this point, it is important to dispel some of the common myths associated with VRF systems. The most common myth that I have come across over the years is with regard to refrigerant leaks. I have had numerous contractors voice concerns about installing a network of refrigerant piping into a building and the near impossibility of detecting the leaks that are bound to occur over the years.

Obviously, if proper R410A protocols are not followed during the installation of these systems, you most likely WILL have leaks in the system. And it most likely won't be over the years...but will manifest very early on. So, as with ANY new system utilizing

the higher pressure refrigerants, proper installation, brazing, evacuation and pressure testing is MANDATORY. Making sure you have a clean, dry and tight refrigerant loop is critical.

But, here is where the final benefit of the inverter controlled compressor comes in. These units always start at their lowest speed. In the industry this is simply referred to as “soft start” technology. By starting the compressor at it’s slowest speed, not only do you use less than 10 amps to start the system (you read that right), but you also eliminate the common torque stress on the refrigerant pipes that the traditional compressor creates by “kicking on” at full load. Without the starting torque and subsequent “pipe chatter” seen in traditional systems, a piping network that is tight on commissioning day will still be just as tight over the life cycle of the equipment. Let’s face it, if this were a problem, this would not be the number one growing technology in the rest of the world for the past twenty years.

Another myth I hear quite often is with regard to availability of equipment, parts, service and technical support, etc. Being in this segment for 12 years, I can personally attest to the huge investment the leading providers of this technology have made in setting up a world class infrastructure to support this product family. From tens of millions of dollars in equipment and parts inventories strategically placed around the U.S. to training centers with hands-on labs and installed systems for troubleshooting, to highly trained technical support staff and regional service managers, the leaders in this segment have shown a long term commitment to our market.

### **“Boxes On The Wall”**

When most people think about the Japanese ductless split systems, they immediately envision the all too familiar high-wall mounted indoor unit. The acceptance of these wall mount units has always been an interesting phenomenon. Everyone has always commented that homeowners or architects do not want to give up wall space to an air conditioner (they would rather have paintings and such). But, when these systems solve a problem or take a window unit out of a bedroom, the customer always raves about the technology.

The good news is that the VRF systems of today now offer multiple styles of indoor units that will fit almost any application. From low and medium static concealed ducted units, to one-way and four-way ceiling cassettes, to the ever so maligned traditional wall mount units, ductless technology has certainly come a long way. With indoor unit capacities ranging from 7,500 btu to 48,000 btu there is now something for everyone in this product portfolio.

### **Don’t Be Afraid of the Future**

In closing, I would like to offer this simple suggestion. If you have not started to learn about this technology, do so as soon as you can. Chances are your competitors are already doing so. With low labor content, high reliability factors, ultra high efficiencies

and the ability to control more of the job, the VRF systems are what the HVAC contracting community has been looking for to maintain a competitive edge and profitability. When the application is right, your company will look like a hero to your client, you will make more profit on the job and transfer more gross profit to your net profit column. Most importantly, you will be part of a segment that is growing faster than most anything else in our industry. And the best news of all...you will become less dependent on hot summers and cold winters to have a good year. By beginning to raise the bar on how you do business and how you serve your clients, you just may remember why you got into this business in the first place.

*Davis Watkins is Vice President – Applied Products for Sanyo HVAC Solutions, a division of Sanyo Commercial Solutions. Sanyo Electric Co. is a world leader in sustainable energy technologies, with over 24 years supporting the HVAC market in the U.S. Davis can be reached at [dwatkins@sss.sanyo.com](mailto:dwatkins@sss.sanyo.com).*