Variable Refrigerant Flow (VRF)

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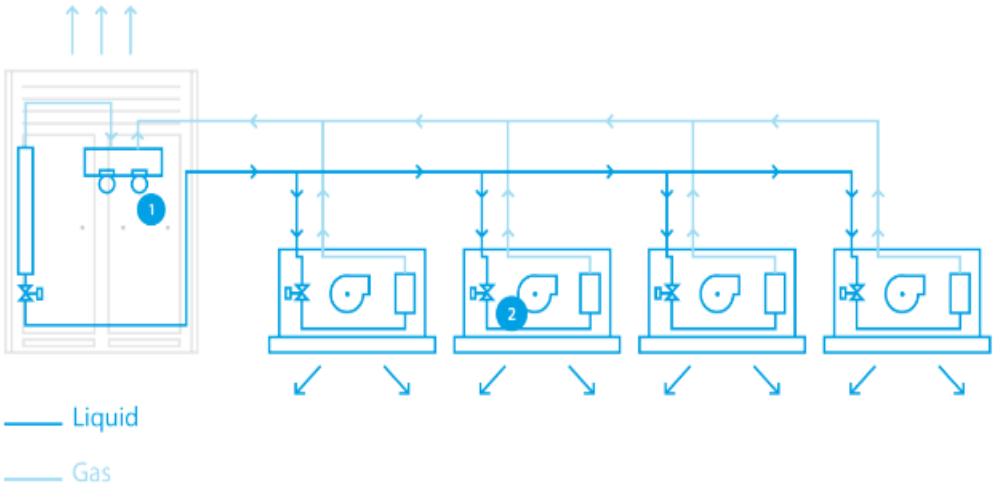
INTRODUCTION

Variable refrigerant flow (VRF) systems vary the flow of refrigerant to indoor units based on demand. This ability to control the amount of refrigerant that is provided to fan coil units located throughout a building makes the VRF technology ideal for applications with varying loads or where zoning is required. VRF systems are available either as heat pump systems or as heat recovery systems for those applications where simultaneous heating and cooling is required. In addition to providing superior comfort, VRF systems offer design flexibility, energy savings, and cost-effective installation. This paper will outline the benefits of a typical VRF system, describe the advantages offered by the most advanced outdoor units available, and provide general guidelines for selecting a heat pump system versus a heat recovery system.



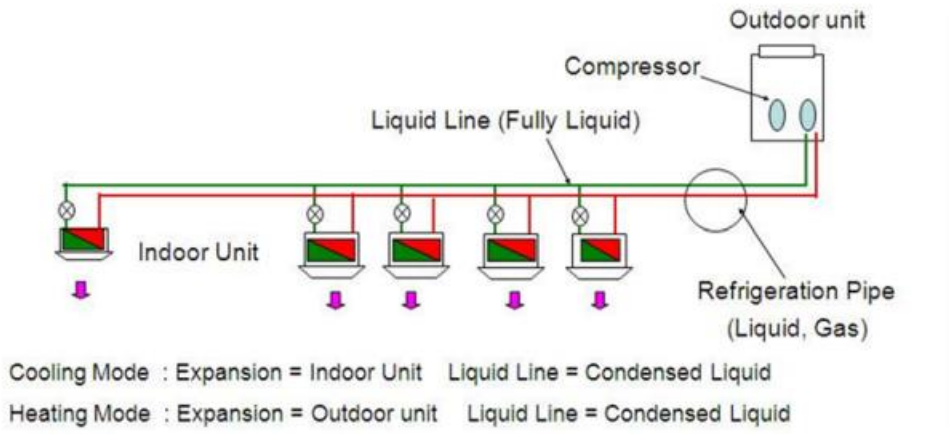
With up to 64 indoor air conditioning units connected to one outdoor unit, the VRF system operates similar to a Multi-Split system. Each individual indoor unit determines the capacity it needs based on the current indoor temperature and requested temperature from the remote control (set point).

The total demand among all indoor units will determine how the outdoor unit adjusts the refrigerant volume and temperature. By only supplying the cooling or heating that is needed, the inverter compressor continues to save a large amount of energy during VRV operation.

VRF TECHNOLOGY

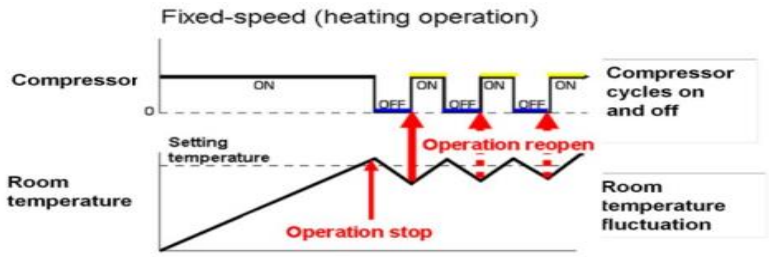
In a VRF system, multiple indoor fan coil units may be connected to one outdoor unit. The outdoor unit has one or more compressors that are inverter driven, so their speed can be varied by changing the frequency of the power supply to the compressor. As the compressor speed changes, so does the amount of refrigerant delivered by the compressor. Each indoor fan coil unit has its own metering device that is controlled by the indoor unit itself, or by the outdoor unit. As each indoor unit sends a demand to the outdoor unit, the outdoor unit delivers the amount of refrigerant needed to meet the individual requirements of each indoor unit (Fig. 1). These features make the VRF system ideally suited for all applications that have part load requirements based on usage or building orientation, as well as applications that require zoning.

VRF is a technology that alternates the refrigerant Flow in a system to match a building's precise requirements. Only a minimum amount of energy is required for a system to maintain set temperatures, and ensure that it automatically shuts off when no occupants are detected in a room. This unique mechanism is more sustainable in the long run, as end users save on energy costs while reducing their system's carbon emissions.

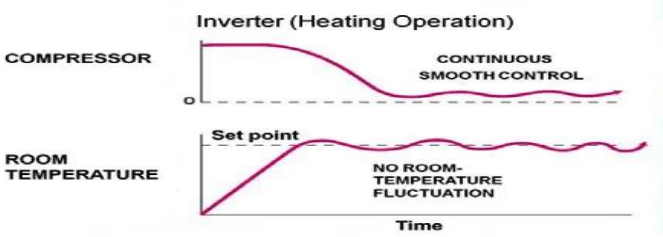


ADVANTAGES OF A VRF SYSTEM

Control Means Comfort The key to providing comfort is to supply heating or cooling when and where it is required without swings in room temperature. In conventional systems, the compressor is either on or off, so even spaces that have individual controls experience fluctuations in room temperature as the compressor stops and then starts again to maintain the thermostat setting



In a VRF system, since the speed of the compressor can be varied, the compressor does not cycle on and off, but operates continuously for longer periods.



VRF System Inverter-Driven Compressor Operation

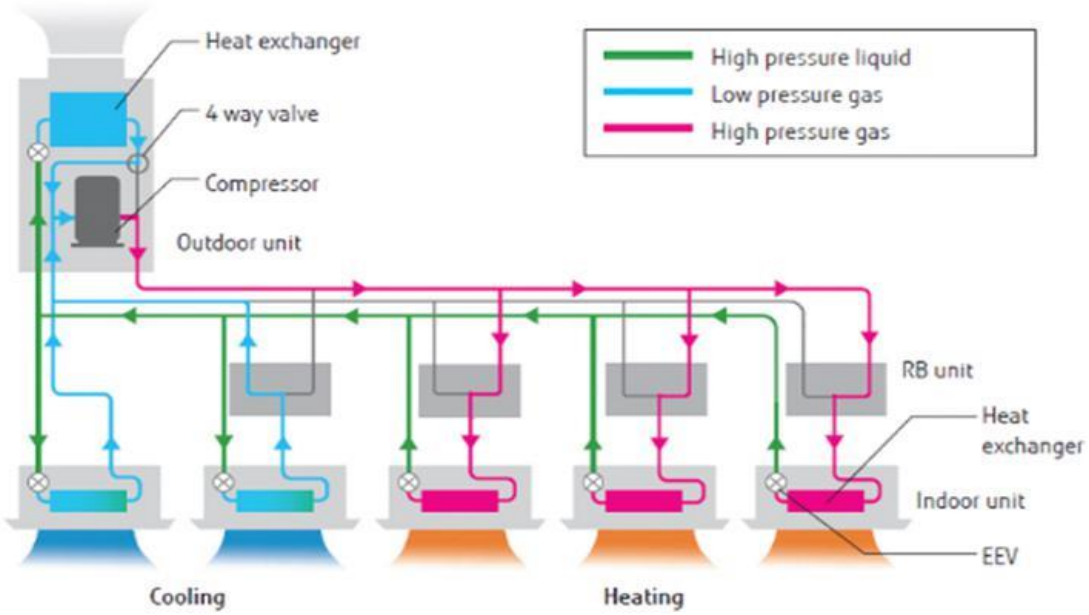
The required refrigerant flow is supplied to the indoor fan coil and once the set point is reached, the refrigerant flow is adjusted to maintain the room temperature smoothly without fluctuation. In addition to having distinct set points, the indoor unit fan speeds and louver positions can be changed to provide additional comfort in the space

DESIGN FLEXIBILITY

One of the major advantages of a VRF system is the flexibility provided by the diversity of the product offering. Multiple types and sizes of fan coils are available to fit any application. Figure 4 shows a sample zoning layout for a VRF system, combining outdoor units, 4-way cassette type fan coils, and hi-wall type fan coils to create comfortable conditions for varying uses of 15 different spaces within the same building. When selecting a VRF system, keep in mind that not all systems have the same piping capabilities. Systems that offer expanded piping capabilities will maximize the application flexibility provided by the VRF technology. Important considerations when reviewing piping capabilities are:

1) the maximum elevation difference allowed between the highest and lowest indoor units on a single system and

2) the distance allowed from the outdoor unit to the farthest fan coil on the system.



COST EFFECTIVE

Installation Depending on the application, the installation of a VRF system can be a cost effective alternative to traditional systems that require ductwork or large pipe sizes, and pumps and boilers in the case of chilled water systems

COMPARISON OF VRF SYSTEMS

The VRF systems available on the market today differ according to the number and type of compressor. The 3 types of units that will be compared here are:

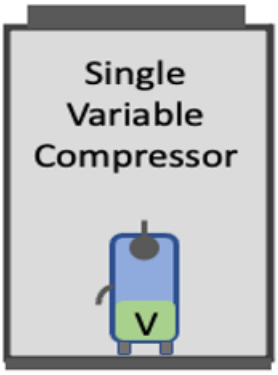
• Single Variable Speed Compressor

• Variable Speed Compressor Plus FixedSpeed Compressor

• Multiple Variable Speed Compressors

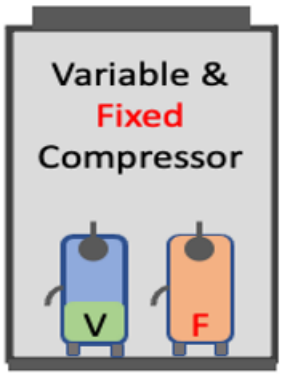
Single Variable Speed Compressor

In this system with a single, large-capacity scroll compressor, the same compressor starts and runs when there is demand and no redundancy is available if the compressor fails.



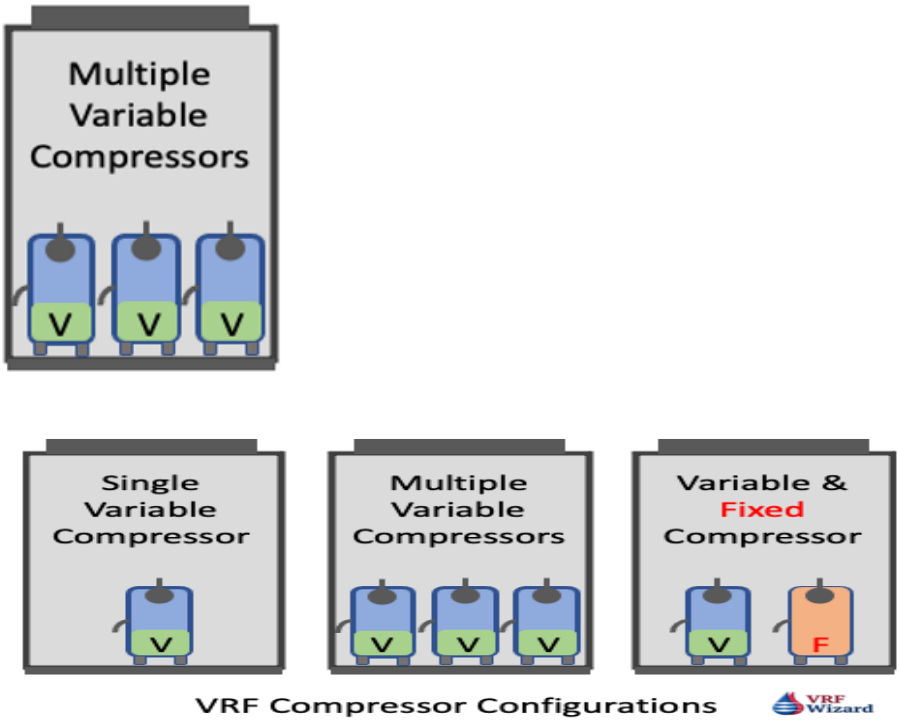
Variable Speed Compressor Plus Fixed-Speed Compressor

In this two-compressor system, the inverter-driven compressor always starts and ramps up until it reaches its maximum capacity at which time the fixed-speed compressor starts and the inverterdriven compressor ramps down. This system provides back-up capability



Multiple Variable Speed Compressors

Outdoor units with multiple inverter-driven twin rotary scroll compressors, as shown in Fig. 5, offer the most complete set of advantages achievable with a VRF system. The system with 3 inverter-driven compressors also provides greater back-up capability. If one of the compressors fails, the system will continue to operate at 67% of its original capacity, and comfort will be maintained in the conditioned space until the faulty compressor can be replaced. The starting sequence of the compressors is rotated, equalizing their operating time and thereby minimizing excess operation of an individual compressor. Multiple inverter-driven compressors allow the unit to provide better part load performance without the need to use hot gas bypass. Under low-load conditions, the system has the advantage of running only as many compressors at whatever speed is required to achieve the capacity necessary to satisfy the load and maintain comfort within the conditioned space.



VRF Compressor Configurations

VRF INDOOR UNIT

with variable refrigerant flow DX coils are used exclusively with variable refrigerant flow (VRF) systems. Indoor units operate to satisfy a heating or cooling load in a zone based on a zone thermostat temperature set point. Direct-expansion (DX) cooling and DX heating coils are specified and used depending on the operating mode required. Although a DX cooling and a DX heating coil are included in the terminal unit, only one may be used at any one time.

TYPE OF INDOOR UNIT

One-way cassette

Two-way cassette

Four-way cassette

Round-way cassette

Slim Duct

Standard static duct 20-200 Pa

High static duct 0-250 Pa

Wall Type

Two-way console

Flex ceiling with Dc fan

Air Handling Unit Dx

VRF OUTDOOR UNIT

Outdoors unit of VRF-systems are core elements of structure, and include compressors, fan, evaporators, valve system, advanced electronic control system, based on latest technology and research of producers. At usually, outdoors units devide by compressor type (DC-inverter or Digital Scroll), Horizontal or vertical air-exhaust arrow for 2-pipe refrigeration system, etc.