Application guide

Daikin VRV Solutions for Hotels

ECPEN 19-292-1

What is in this booklet?

The information in this booklet is the summary of DENV Consulting Sales team experience with discussing and developing hotel HVAC solutions for different customers.

Here you will find the some solutions used and accepted by hotel designers and owners in real life, explanation of their working principle and some features as well as the answers to most common questions posed from customers' side.

We hope you will find this information useful.

Sincerely yours,

Consulting Sales Daikin Europe

01. Why use VRV for hotel?

Answers and explanations

01 WHY USE VRV FOR HOTEL?

VRV are highly versatile DX (direct expansion) systems, which can easily be the reply to all hotel HVAC needs at once.

Not only for air conditioning – cooling – but also for:

- Monovalent (single source) heating
- Fresh air treatment through air handling units
- Air curtains
- Warm water preparation for heating or sanitary purpose (DHW)

Can be easily integrated in various control configurations:

- Individual control of every indoor unit
- Centralized control and remote monitoring

...and yet easy to install:

- Outdoor units are light and compact – can fit in an elevator and moved around with a manually operated lifting fork
- Small diameter of piping resulting in small installation space
- Plug & play solution: simple wiring and control set-up

Based on the study made by consultant Domoserve from Portugal, in many cases VRV has the lowest running costs compared to other solutions

Case 1.

Domoserve has completed energy audit of 2 hotels in Portugal in 2017

- **Hotel 'Pestana Citadela (HPC, 5*)'** using 2-pipe VRV for cooling and heating of guest rooms and common areas.
- **Hotel 'Pestana Sintra Golfe Resort e Spa (HPSG, 4*)'** using 4-pipe water based system.
- The hotels are on close distance to each other

	HPC 5*		HPSG 4*	
Total Floor Area	**10.890**	-----	**12.690**	-----
Total Accommodation Area	5.599	51%	8.550	67%
Total Climatized Area	7.497	69%	7.104	56%
Area indicated by map "FEI" (from Hotel Company)	10.605	97%	8.940	70%
Total Area considered in the Energy Certificate	10.156	93%	10.535	83%

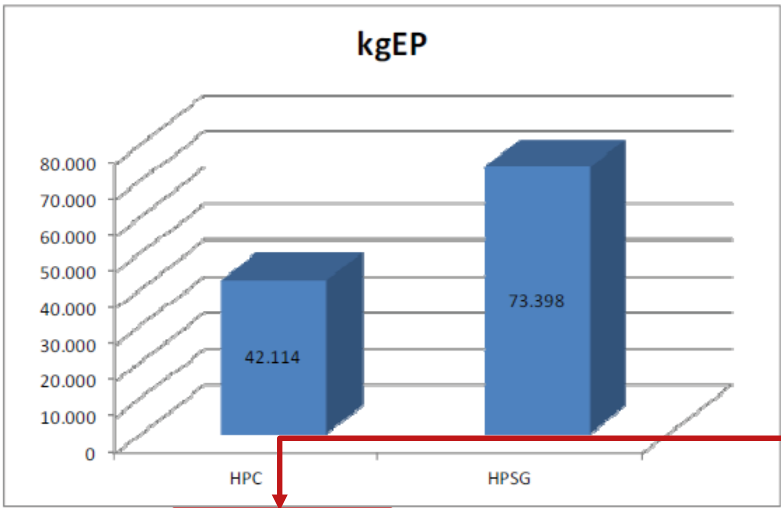
- Climatised area is +/- the same in both cases, so **these hotels are comparable**.

01 WHY USE VRV FOR A HOTEL?

Case 1 (continued)

Domoserve VRV vs water based system study

The results?



- Difference in power consumption (= running costs) per m2 is 1,74 times less in favor of VRV
- 1,22 less energy per room occupied

HVAC	kgEP *	Climat.Area[m²]	kgep/m²
HPC	42.114	7.497	5,62
HPSG	73.398	7.104	10,33

HVAC energy consumption in kgEP for the air conditioned area.

*kgEP = kilogram oil equivalent, energy measurement unit.
1 kgEP = 11,63 kW*h

Case 2

Domoserve "VRV vs water based system" study (measurements in 14 hotels in different regions of Portugal).

HVAC/SHW System	[illegible]	[illegible]	[illegible]	VRV	[illegible]	VRV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nº C	55	52	164	170	232	24	344	155	153	24	100	147	331	171
Occ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nº pers	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
epkg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
epkg/pers	30,82	11,36	4,59	[illegible]	17,2	[illegible]	[illegible]	[illegible]	[illegible]	6,84	[illegible]	[illegible]	12,76	[illegible]
kgep/m² const	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71,40	[illegible]	[illegible]	[illegible]	[illegible]
m² const	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
epkg/m² use	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cont El Power (kW)	[illegible]	3,68	1,73	[illegible]	[illegible]	4,84	3,38	[illegible]	[illegible]	2,36	2,30	[illegible]	[illegible]	[illegible]
Inst El Power (kW)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Annual Energy Cost €	[illegible]	[illegible]	[illegible]	[illegible]	221914	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
€/person	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,6	[illegible]	[illegible]	[illegible]
Nº Tec (maintenance)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The measurements show that "VRV-based" hotels have the lowest running costs per person and per area.

01 WHY USE VRV FOR HOTEL?

Domoserve "VRV vs water based system" studies summarized

Why these results?

- **High load diversity factor** in the hotels -> **partial load** is the most frequent case. VRV/VRF can deliver the capacity where needed instantly without additional effort, while water based system has to run pumps continuously to be able to do that.

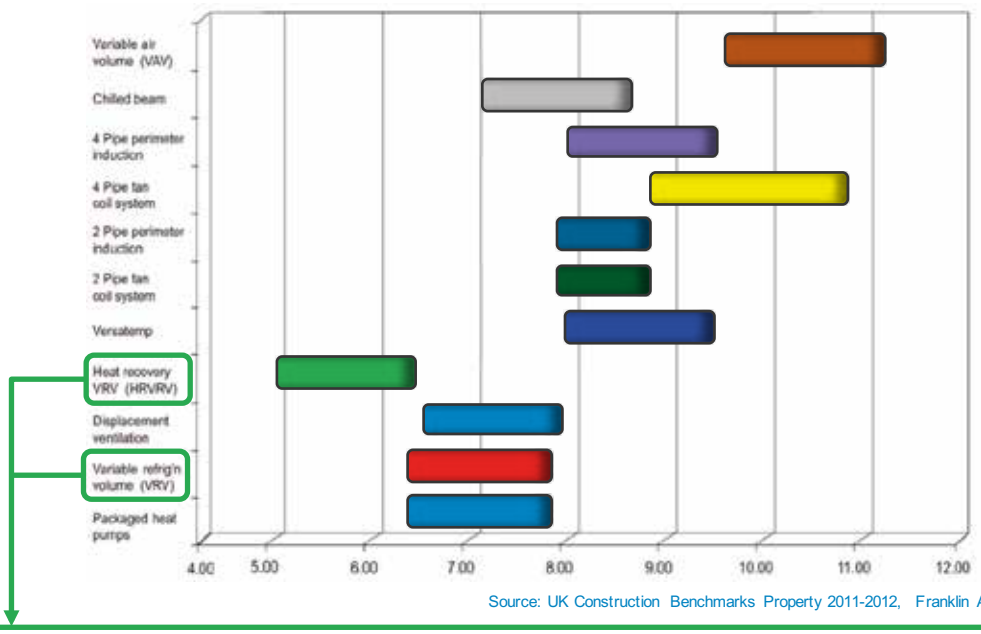
For HPSG (4* hotel), the yearly pump consumption alone is estimated to be up to €6600/year

- **Heating and cooling load are often present simultaneously** in the hotel (e.g. cooling for guestrooms, heating for swimming pool or DHW). This requirement can be easily fulfilled with VRV/VRF, while a water based system has to use different devices/options for cooling and heating or to use multipurpose chillers, still rare and expensive.

Other considerations

The results of Franklin Andrews running cost study on HVAC system.

This study refers to building systems running costs in general.



£/total building surface per year

Source: UK Construction Benchmarks Property 2011-2012, Franklin Andrews

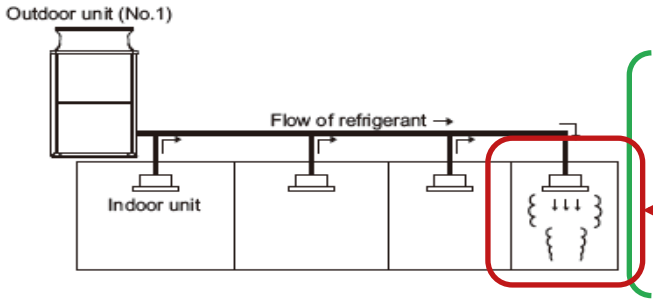
VRV solutions show lower running costs compared to equivalents used for commercial HVAC applications.

01 WHY USE VRV FOR HOTEL?

Why then not all the hotels in the world are using VRV/VRF solutions? In 2 words: size and legislation

1. EN 378 regulation

According to EN378 (Refrigerating systems and heat pumps – safety and environmental requirements) hotels are classified as **Type A occupancy buildings** and hence require that maximum refrigerant concentration in case of leakage is kept under certain critical level determined by refrigerant type **at all times** and in **all of the rooms**. Alternatively refrigerant leak detection and alarm system has to be foreseen.



How to calculate (example for R410A)?

EN 378-1 *Rmax of R410A → 440g/m³*
(European Standard for Refrigerating systems and heat pumps)
Rmax = Wmax / Vmin (g/m³)

Rmax : Critical condition of R410A
Wmax : Total refrigerant amount in system (O/U + pipes)
Vmin : minimum room volume connected to O/U

- Although this is rarely the case, for hotels with **small rooms served by big VRV/F systems**, EN378 can bring restrictions
- Refrigerant charge **may vary a lot in case of different VRV/F manufacturers**, so each case has to be estimated individually.

2. Applicability of VRV/F solution

- To provide air conditioning for big open spaces where big airflows/capacities are required, VRV/F is not the ideal solution.
- The capacity of VRV/F indoor units is limited, which sometimes makes the installation for common spaces complicated and expensive
- Common spaces can have sometimes specific requirements (e.g. humidity conditions) not easy to satisfy by VRV.
- Physical conditions:
  - Refrigerant piping length limitations are another factor to be considered when using VRV for large size buildings
  - Too low/too high ambient temperatures -> **special versions of VRV can sometimes be a solution**

Today it is more common to see the combination of different solutions (DX + applied+...) in the hotel projects.

02. System configuration

Understanding the principle

Selecting components

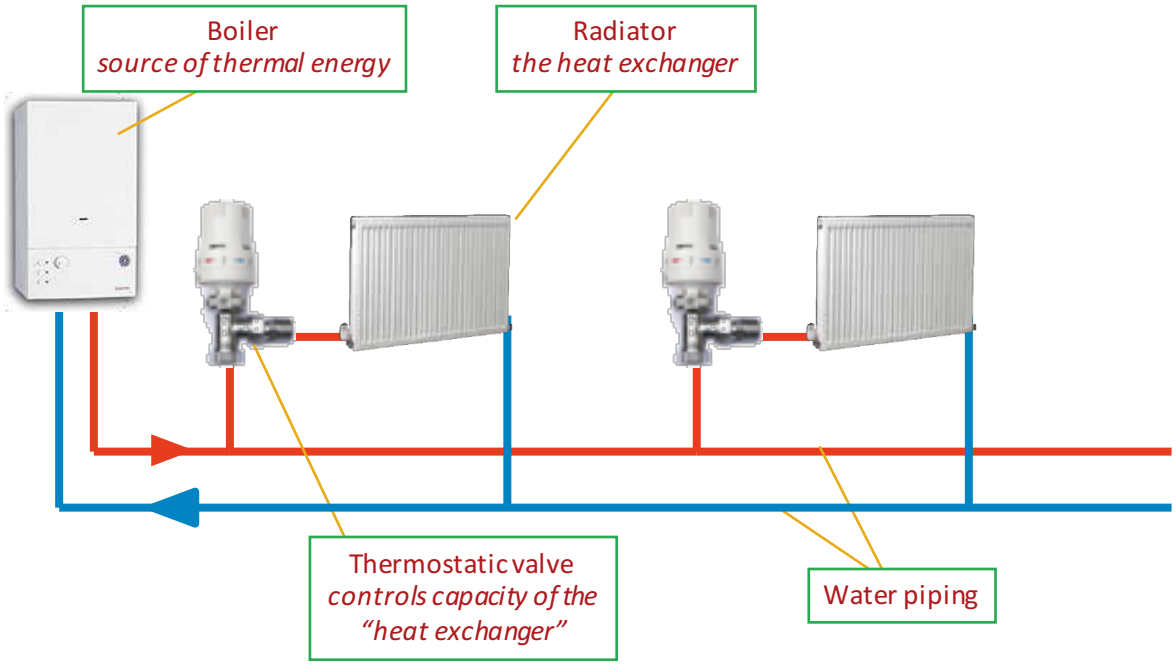
02 SYSTEM CONFIGURATION

Understanding the principle

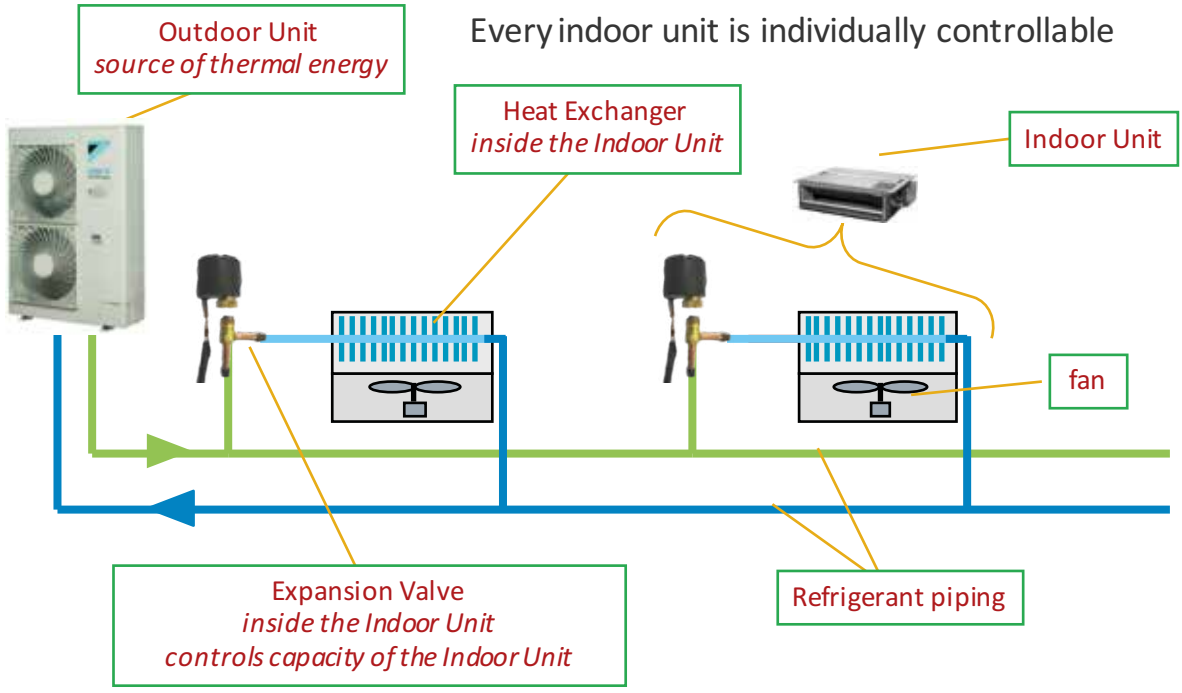
Analogy to a common heating system...

Every radiator is individually controllable

More radiators can be connected by simply using a bigger boiler



Every indoor unit is individually controllable



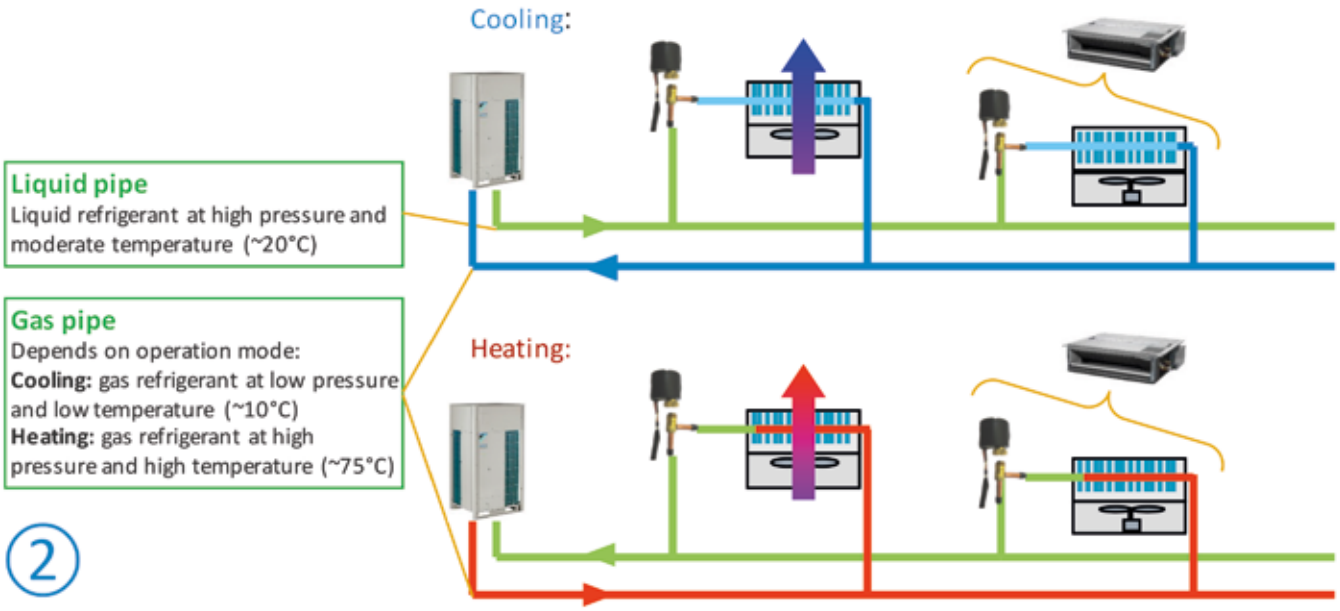
VRV provides precise *control of refrigerant flow in every zone=room* for tight temperature control

02 SYSTEM CONFIGURATION

Understanding the principle
Types of VRV/F systems which can be encountered

① Heat Pump

- Cooling or heating
- Within 1 system all indoor units connected to it can either cool, or heat



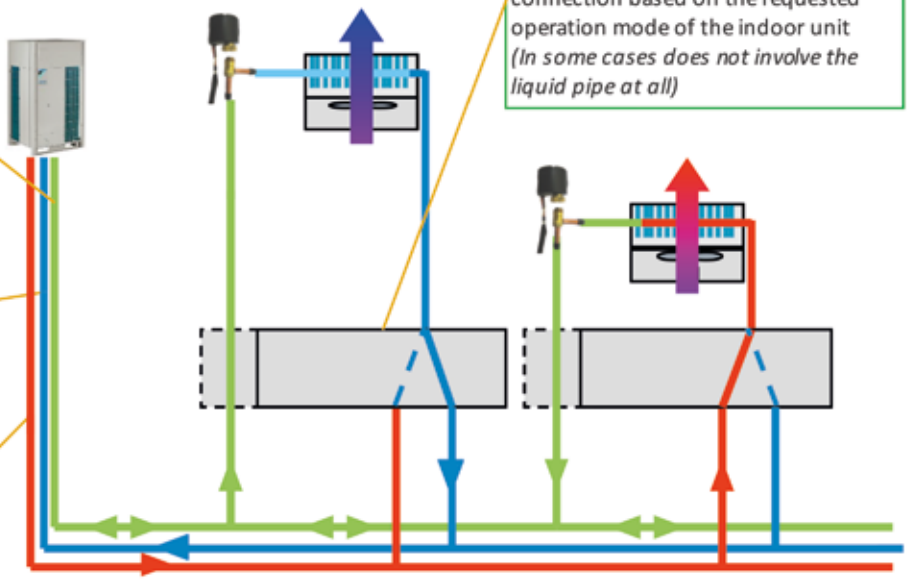
Liquid pipe
Liquid refrigerant at high pressure and moderate temperature (~20°C)

Gas pipe
Depends on operation mode:
Cooling: gas refrigerant at low pressure and low temperature (~10°C)
Heating: gas refrigerant at high pressure and high temperature (~75°C)

② 3 pipe Heat Recovery

- Cooling and heating
- Within 1 system some indoor units can cool, some heat, simultaneously.

Branch Selector / Flow Selector / Branch Controller
Alternates refrigerant piping connection based on the requested operation mode of the indoor unit
(In some cases does not involve the liquid pipe at all)



Liquid pipe
Liquid refrigerant at high pressure and moderate temperature (~20°C); Depending on cooling / heating ratio, the refrigerant either flows from or to the outdoor unit

Suction pipe
Gas refrigerant at low pressure and low temperature (~10°C); Always flows towards the outdoor unit

Discharge pipe
Gas refrigerant at high pressure and high temperature (~75°C); Always flows from the outdoor unit

02 SYSTEM CONFIGURATION

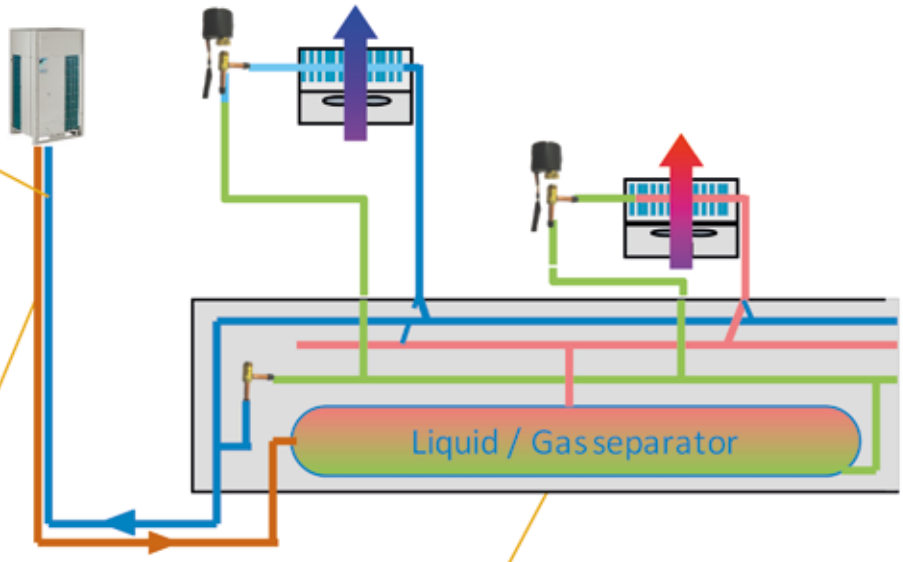
Understanding the principle
Types of VRV/F systems which can be encountered

③ 2-pipe Heat Recovery

- Only two pipes run from the outdoor unit to a central Branch Controller

Suction pipe
Gas refrigerant at low pressure and low temperature (~10°C); Always flows towards the outdoor unit

Mixture pipe
Refrigerant liquid-gas mixture at high pressure and condensation temperature (~45°C). The ratio of liquid to gas depends on the ratio of cooling to heating units.



Central Branch Controller
Separates refrigerant liquid-gas mixture and sends gas to units which are heating and liquid to units which are cooling. If not enough units are cooling, expands liquid and sends it to outdoor unit

Things to know about 2-pipe heat recovery VRF

- Usually promoted as 15-20% cheaper in installation than 3-pipe heat recovery systems, requiring less communications hence less labor;
- Use 20 – 50% more refrigerant charge compared to 3-pipe heat recovery systems -> potential problems with EN378-1 compliancy
- Branch controllers require a lot of space inside the building

02 SYSTEM CONFIGURATION

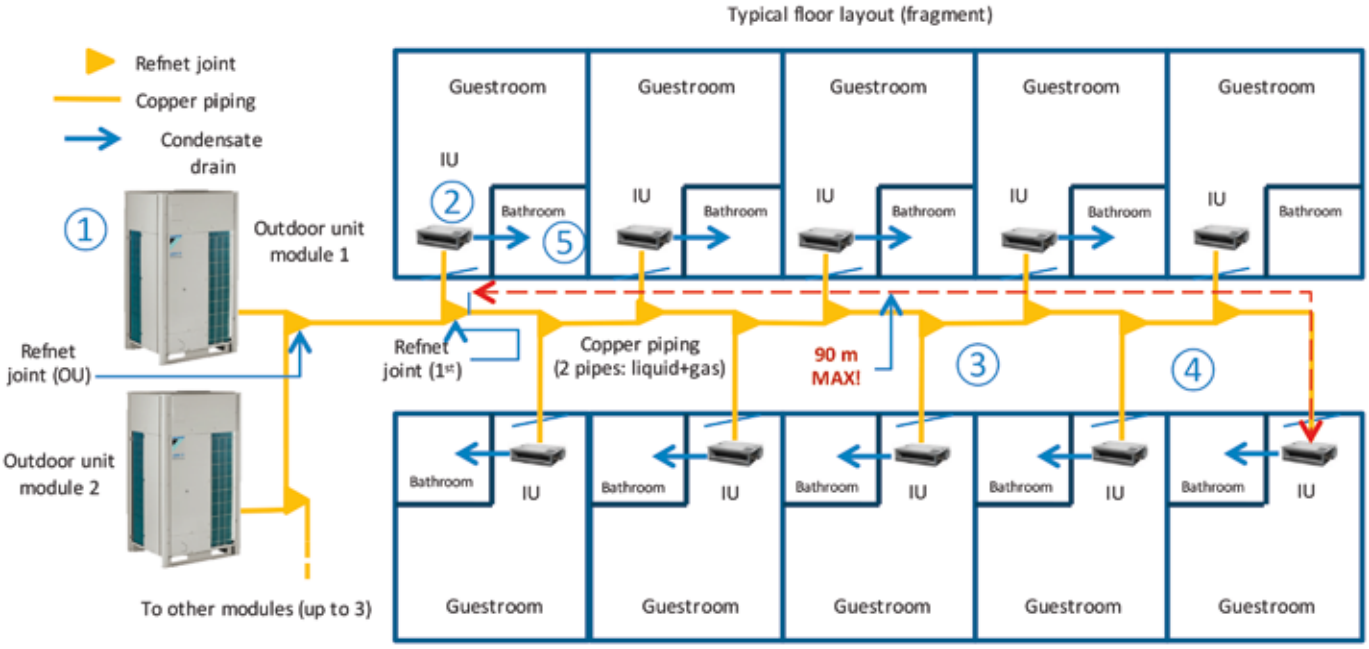
Components and layout advices

① A Heat pump VRV system

Standard layout , using refnet joints.

Easy to install, cost – effective.

Problem: distance from 1st refnet joint to last indoor unit limitation (90 m max) → **NG for lengthy buildings.**



Used components (controls are not in scope of this schematic and will be explained later):

1) Outdoor unit (1 or more modules, depends on capacity required);
2) Indoor units (see guest room suggestions chapter for the recommended types);
3) Refnet joints (selection done via selection software);
4) Connecting copper piping (sizing done via selection software);
5) Condensate drain piping

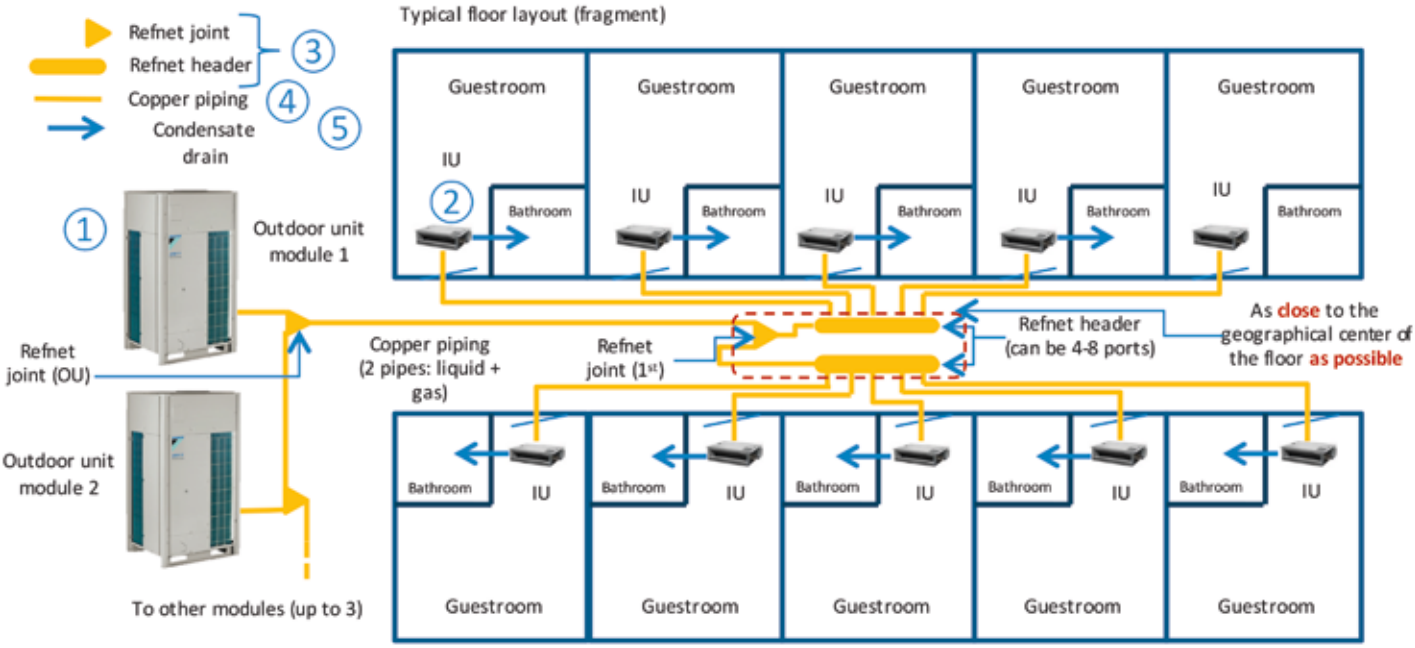
02 SYSTEM CONFIGURATION

Components and layout advices

① B Heat pump VRV system

Layout using refnet headers

Difficult to install, more expensive.
Has no problem with 1st refnet ↔ last IU distance limitation. **Better suitable for lengthy buildings.**



Used components (controls are not in scope of this schematic and will be explained later):

1) Outdoor unit (1 or more modules, depends on capacity required);
2) Indoor units (see guest room suggestions chapter for the recommended types);
3) Refnet joints and headers (selection done via selection software);
4) Connecting copper piping (sizing done via selection software);
5) Condensate drain piping

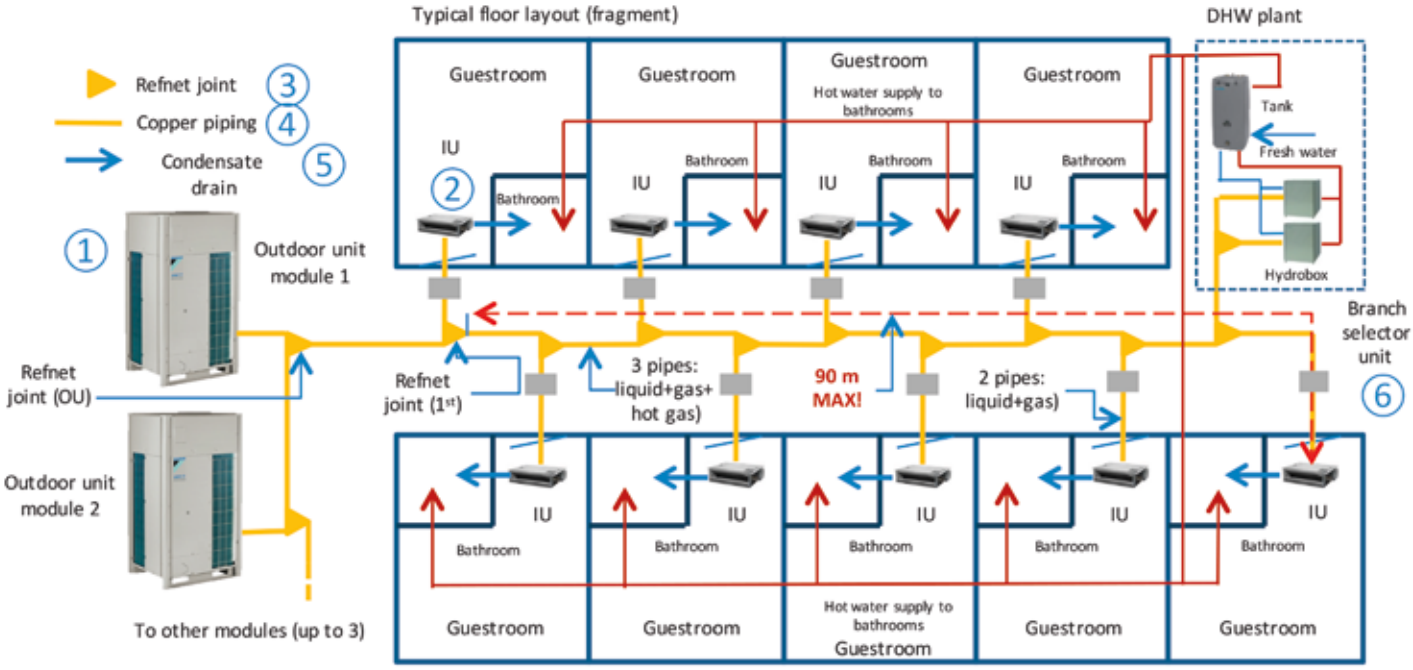
02 SYSTEM CONFIGURATION

② A Components and layout advices
Heat recovery VRV system (3-pipe system)

Single branch selector units (BS-boxes) layout.

Very flexible indoor units placement.

- distance from 1st refnet joint to last indoor unit limitation (90 m max) → **NG for lengthy buildings.**
- **higher equipment and installation cost.**
+ **Good flexibility, does not require a lot of additional space**



Used components (controls and DHW production are not in scope of this schematic and will be explained later):

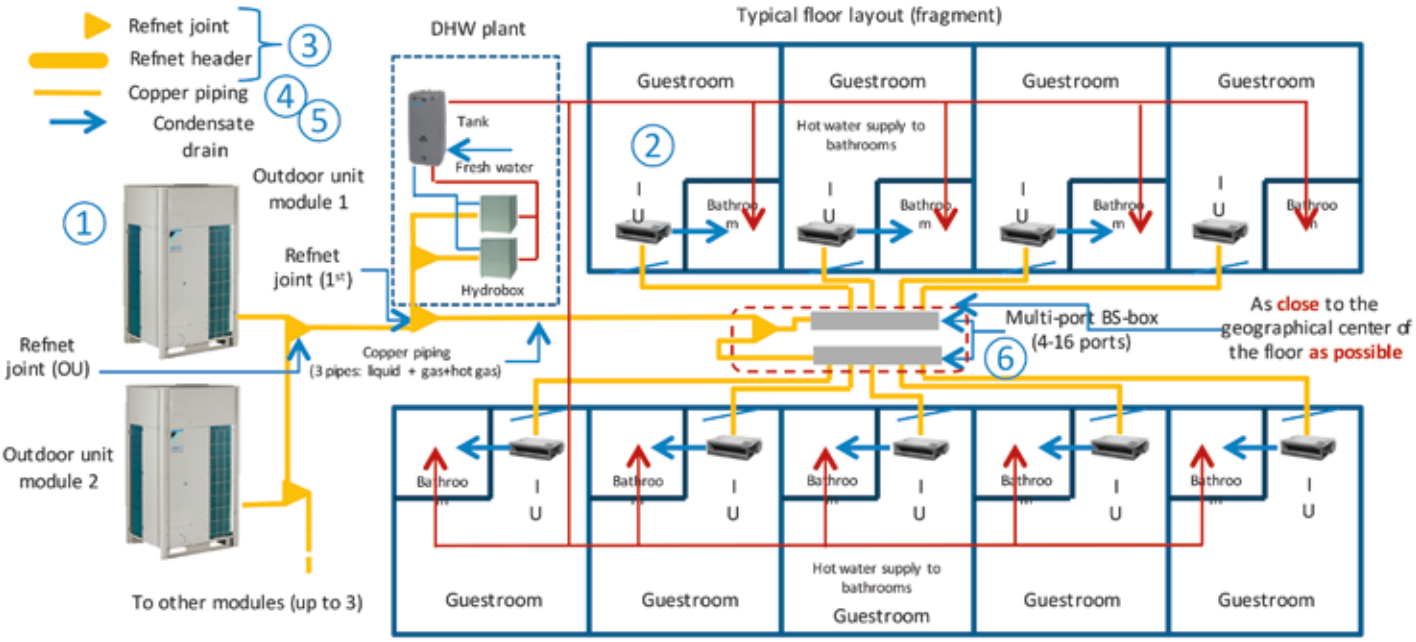
1) Outdoor unit (1 or more modules);
2) Indoor units (see gues troom suggestions chapter for the recommended types);
3) Refnet joints (selection done via selection software);
4) Connecting copper piping (sizing done via selection software);
5) Condensate drain piping
6) Branch selector units (single-port)

02 SYSTEM CONFIGURATION

② B Components and layout advices
Heat recovery VRV system (3-pipe system)

Multi-port branch selector units (BS-boxes) layout.

- **Occupies more space compared to single box layout**
+ **Has no problem with 1st refnet ↔ last IU distance limitation. Suitable for lengthy buildings.**
+ **Lower investment and installation cost**



Used components (controls and DHW production are not in scope of this schematic and will be explained later):

1) Outdoor unit (1 or more modules);
2) Indoor units (see guest room suggestions chapter for the recommended types);
3) Refnet joints (selection done via selection software);
4) Connecting copper piping (sizing done via selection software);
5) Condensate drain piping
6) Branch selector units – BS-boxes (multi-port)

03. System configuration

Understanding the outdoor units

02 SYSTEM CONFIGURATION

Understanding the main components

Outdoor units

Outdoor units determine the system type. It is necessary to understand when to use what.

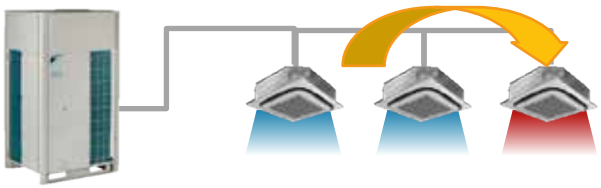
	System type	Outdoor unit model name	When to use?
VRV IV	Heat Pump with continuous heating during defrost	**RYYQ-U** **RYMQ-U**	When **HEATING** is the predominant mode
	Heat Pump without continuous heating during defrost	**RXYQ-U**	When **COOLING** is the predominant mode
	Heat Recovery	**REYQ-U** **REMQ-U**	When **cooling and heating requirements can happen at the same time.** When there is a potential of **HEAT RECOVERY**
	Cold Region Heat Pump	**RXYLQ-U**	For heating in cold regions (design winter ambient temperature lower than -20^{0}C)
VRV IV S-series	Mini VRV	**RXYS(C)Q-T**	For **small projects** (~100-400 m^2)
VRV IV W-series	Water-cooled Heat Pump / Heat Recovery	**RWEYQ-T**	**High-rise buildings or specific applications** (low noise, geothermal,…)
VRV IV Q-series	Replacement VRV Heat Pump	**RXYQQ-U**	For **refurbishment projects and replacement of old VRF systems while keeping the piping**
	Replacement VRV Heat Recovery	**RQCEQ-P**	

02 SYSTEM CONFIGURATION

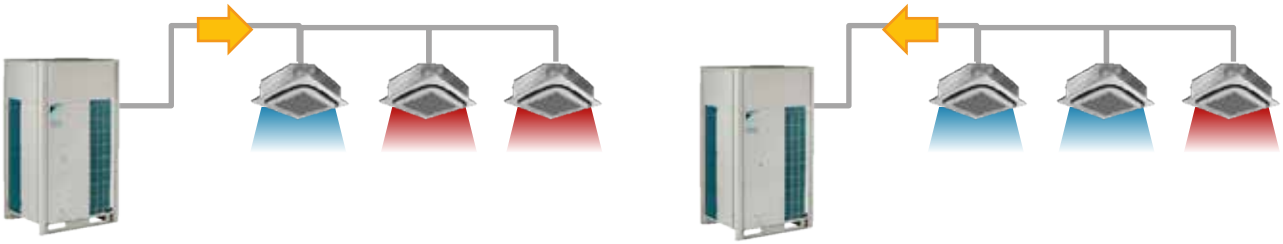
Understanding the main components

Outdoor units
Understanding heat recovery

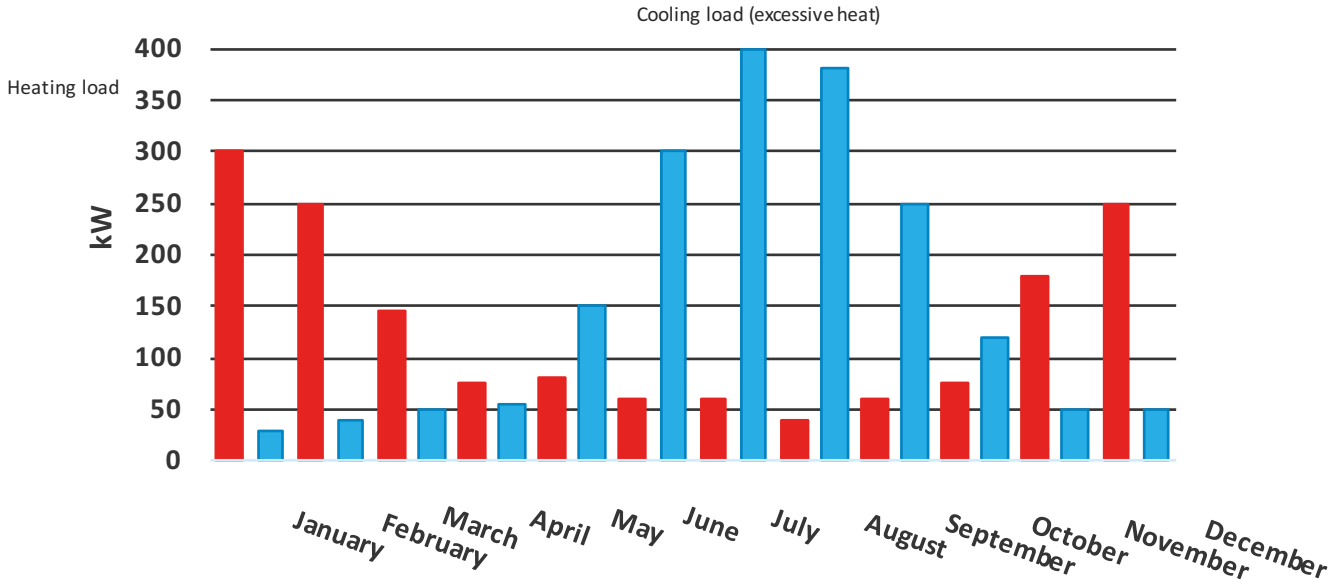
- From rooms that are being cooled, heat energy is transferred to rooms being heated – like a refrigerator transfers heat energy from its inside out



- The outdoor unit exchanges heat energy with the outdoor air,



Heat recovery brings maximum benefit if the load profile is like this (example)



Any case of simultaneous cooling and heating load = heat recovery

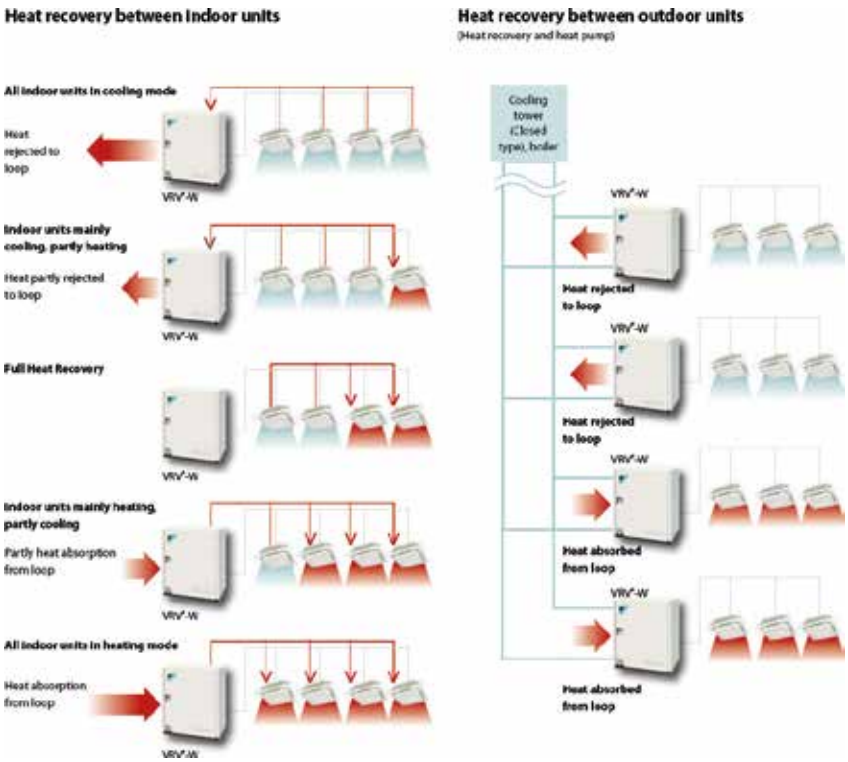
02 SYSTEM CONFIGURATION

Understanding the main components

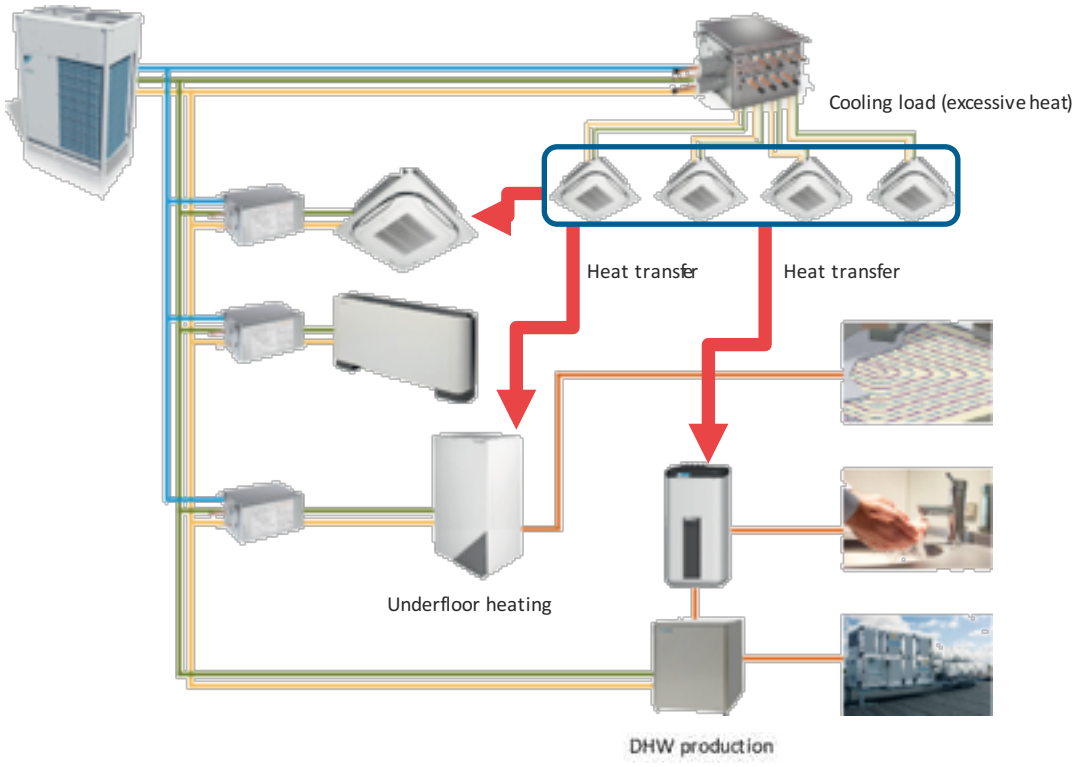
Outdoor units
Understanding heat recovery

Water cooled VRV and double heat recovery principle

- If several water-cooled VRVs work with the same water loop, it gives the opportunity to recover energy not just within one VRV system in heat recovery mode, but also in between several separate systems via the water loop
- In this case if the overall system is designed correctly then throughout most of the year the temperature in the water loop is kept on the necessary level without external cooling/heating devices.



Example of heat recovery utilization

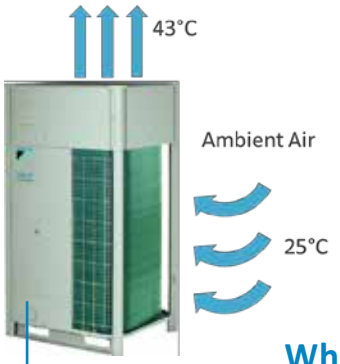


02 SYSTEM CONFIGURATION

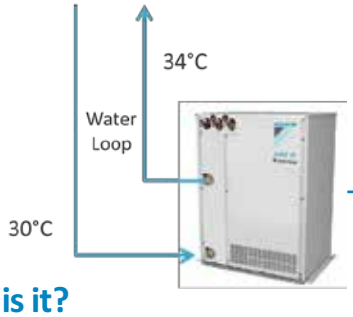
Understanding the main components

Air cooled vs water cooled outdoor units

Air cooled
(stands outside the building)



Water cooled
(placed inside the building)



What is it?

- "Packaged" solution, for standard conditions and applications
- No additional equipment required
- **Efficiency depends on working conditions**

What is a water cooled VRV?

"Engineered" solution, suitable for non-standard conditions and applications.
Additional equipment is required to keep the temperature in the water loop within acceptable limits (normally 10-45^{0}C).

Efficiency depends on application

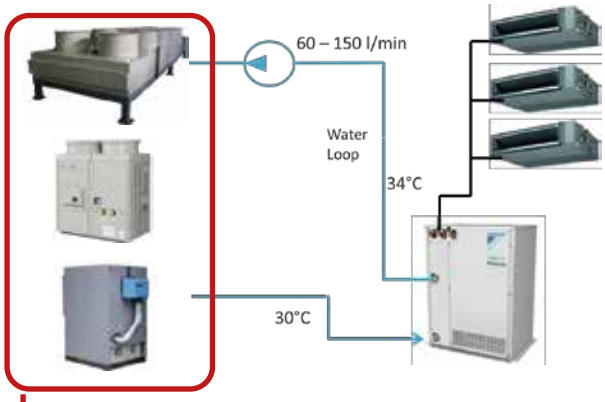
- High-rise buildings
- Places with very strict noise requirements
- Very corrosive environments
- Protected buildings or when there is no space for outdoor units
- Extremely high ambient temperatures
- Refurbishment projects with existing water loop
- Where very high efficiency is needed

Understanding water cooling

Means to keep the temperature in the water loop within the operation range (10-45 deg.C)

Closed loop type

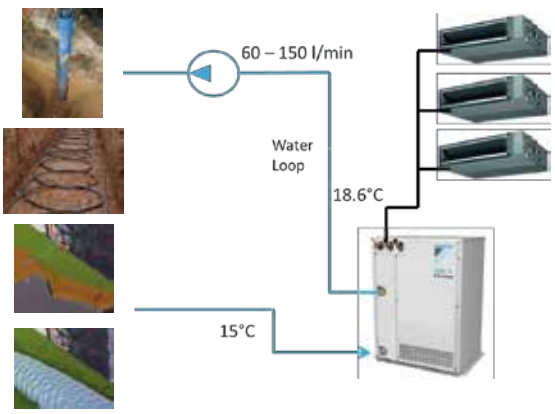
Cheaper to install, can use existing water loop of the building. There is no efficiency benefit VS air cooled in this case, but in some cases it is the only solution due to space and noise restrictions.



- Drycoolers
- Heat pump chillers
- Boilers

Geothermal type

Can be very efficient, but expensive to install, expertise and special permissions are required



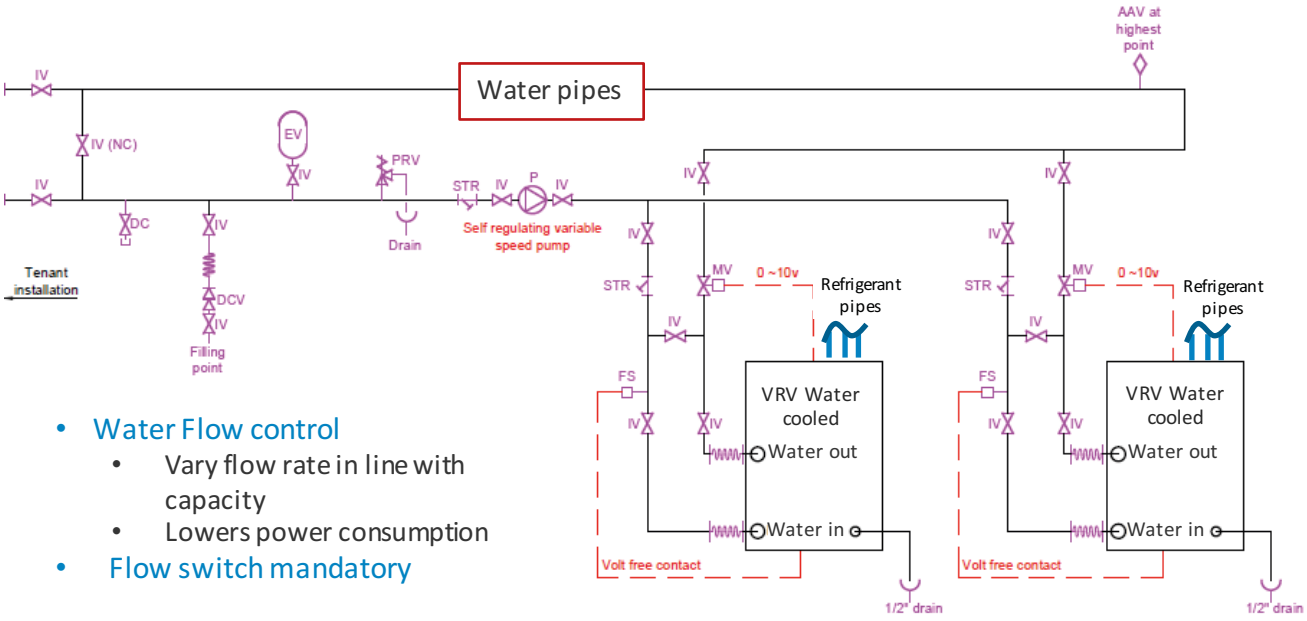
- Geothermal loops
- Loops to underground water
- Open loops to river, lake, sea, etc.

Understanding the main components

Outdoor units
Understanding water cooled units

- Variable water flow scheme is recommended
- There are several possibilities of pump speed control in case of VRV-W-T9 lineup

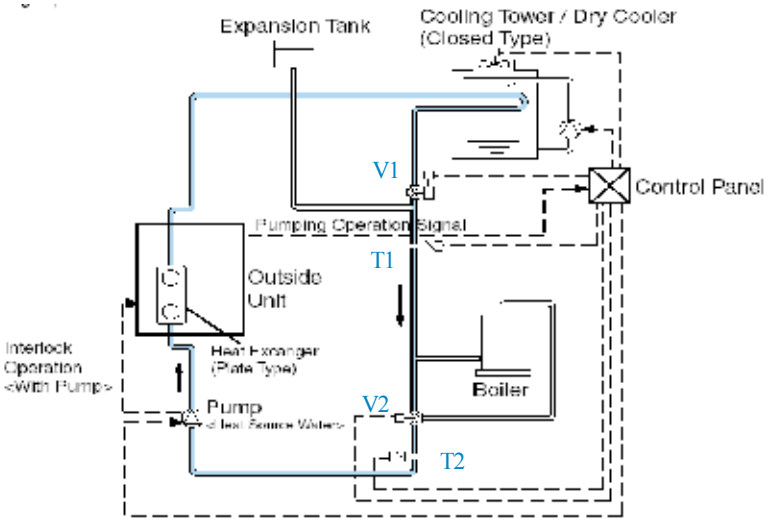
Typical plant layout scheme (water side)



- Water Flow control
  - Vary flow rate in line with capacity
  - Lowers power consumption
- Flow switch mandatory

Typical water loop temperature control schemes

1. Cooling tower + boiler



In summer:

• the bypass of the 3-way valve **V1** will be opened when the cooling water temperature is below the preset temperature value of **T1;**

• the bypass of the 3-way valve **V1** will close when the water temperature exceeds value **T1** and more water will be send to the cooling tower to lower its temperature.

• the start/stop control of the fan and pump of the closed type cooling tower is following the command of **V1.**

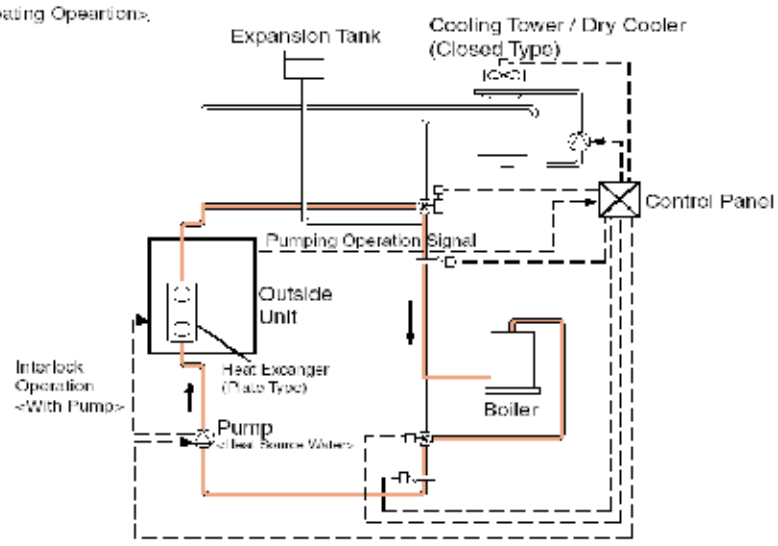
Understanding the main components

Outdoor units

Understanding water cooled units

Typical water loop temperature control schemes

1. Cooling tower + boiler



In winter:

- if the water temperature drops below 15° C, V2 will allow the circulation of water through the boiler to keep the circulation water temperature above the preset value of T2

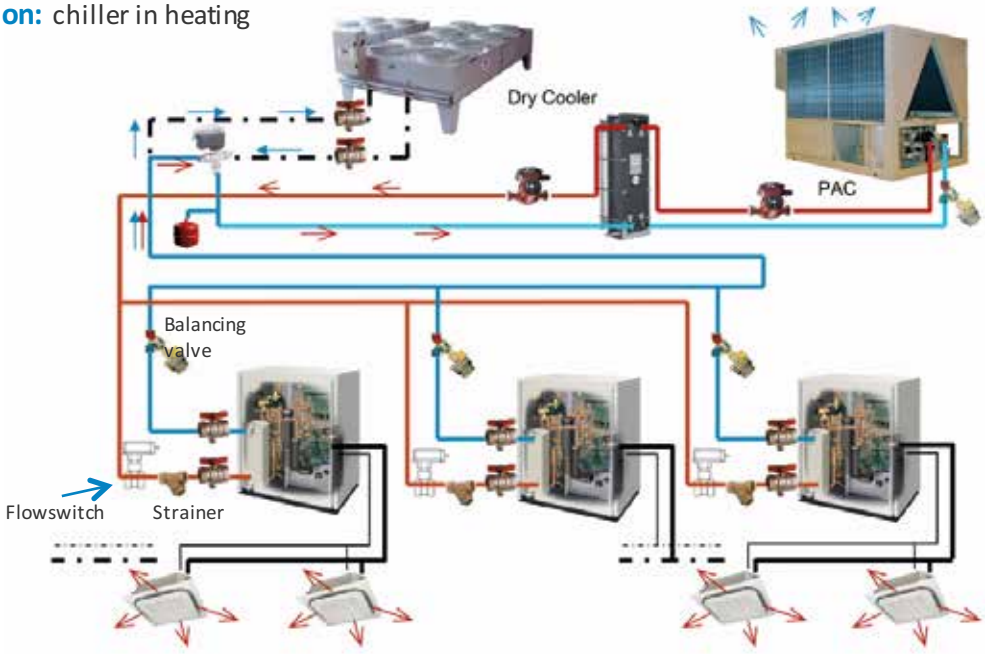
- when the water pump stops, V2 closes automatically the access of water to the boiler

2. Cooling tower + heat pump chiller

Cooling operation:

1. The dry cooler enters in operation
2. If not sufficient, the chiller helps

Heating operation: chiller in heating mode



Understanding the main components

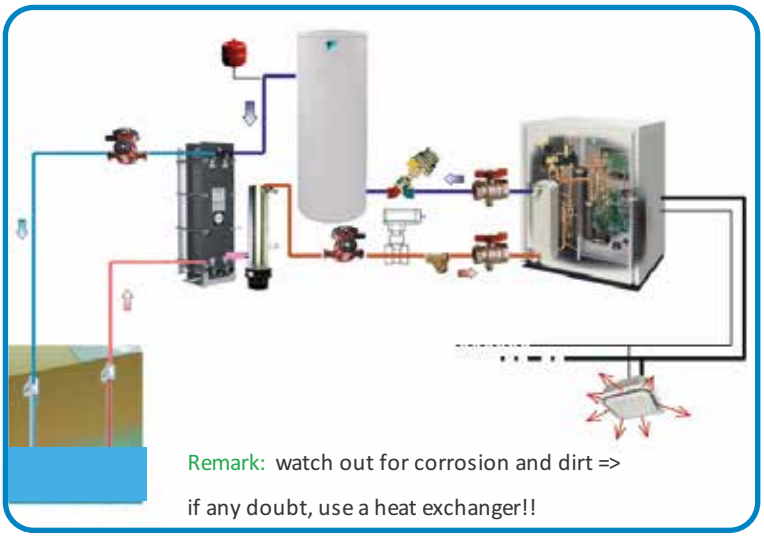
Outdoor units
Understanding water cooled units

The Geothermal systems utilize the heat accumulated in ground (this heat is continually supplied by sun and earth).

At a depth of approximately 10 meters the ground temperature remains fairly constant with an average temperature between 10-20° C year-round (Europe), depending on the region, terrain and soil type.

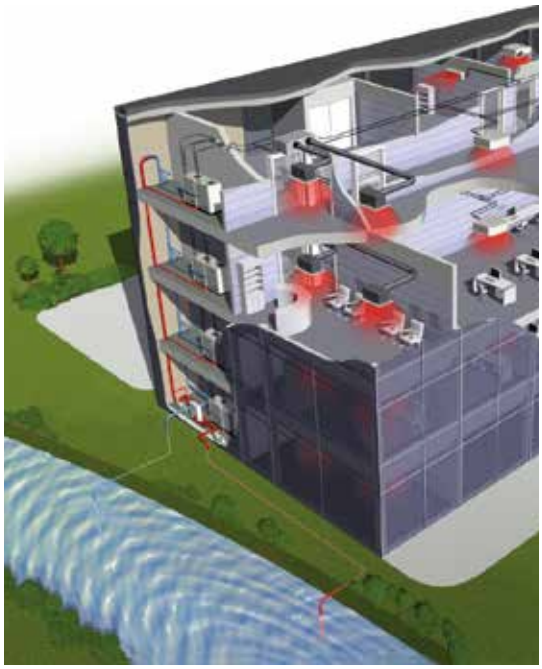
Typical water loop temperature control schemes

3. Geothermal, open loop



Remark: watch out for corrosion and dirt =>
if any doubt, use a heat exchanger!!

Open loop systems draw ground water directly into the building to heat or cool the heat pumps.



4. Geothermal, closed loop

Horizontal loops run piping parallel and close to the surface (1-2 m).
The undisturbed ground temperature naturally change with the seasons.

Vertical loops run perpendicular to the surface and the holes can be several hundred meters deep (80-200 m). At these depths, the undisturbed ground temperature does not change throughout the year.

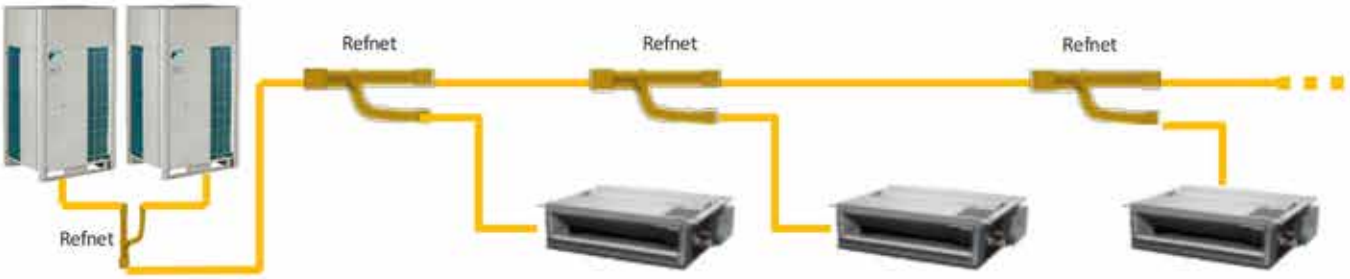
04. System configuration

Understanding auxiliary components

Understanding the main components

What is a refnet joint?

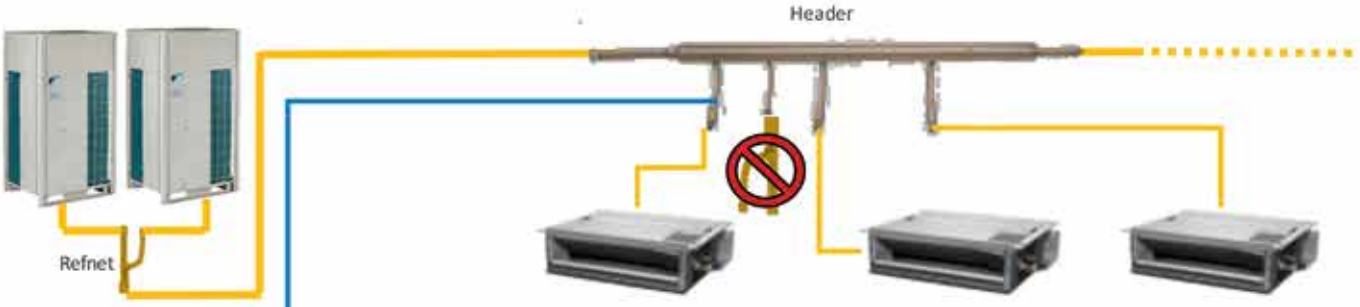
A **Refnet joint** is the Daikin term for refrigerant pipe branches.



Daikin Refnets are sold in kits for all the pipes that you need to connect

- A Daikin Refnet Kit contains:
  - A branch for the liquid/gas/discharge gas* pipe
  - Adaptors to fit various sizes of piping
  - Insulation for all the branches
- Daikin Refnet Kits are available in Metric and Imperial pipe sizes

A **Refnet header** is different kind of joint. Headers are useful when indoor units are located evenly around a central shaft with the main refrigerant piping



Daikin headers are sold in kits for all the pipes that you need to connect

- A Daikin Header Kit contains:
  - A branch for the liquid/gas/discharge gas* pipe
  - Adaptors to fit various sizes of piping
  - Insulation for all the branches
- Daikin Header Kits are available in Metric and Imperial pipe sizes
- Refnet joints **cannot be installed after headers!**

SYSTEM CONFIGURATION

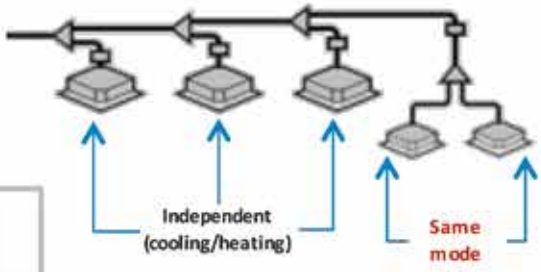
Understanding the main components

Branch selector units ("boxes") used in combination with VRV 3-pipe

These are the units responsible for cooling-heating mode switching of the connected indoor units operation.

1-port units line-up

BS 1 Q 10 A = IU connection index 10x10 = 100
BS 1 Q 16 A = IU connection index 16x10 = 160
BS 1 Q 25 A = IU connection index 25x10 = 250



Multi-port units line-up

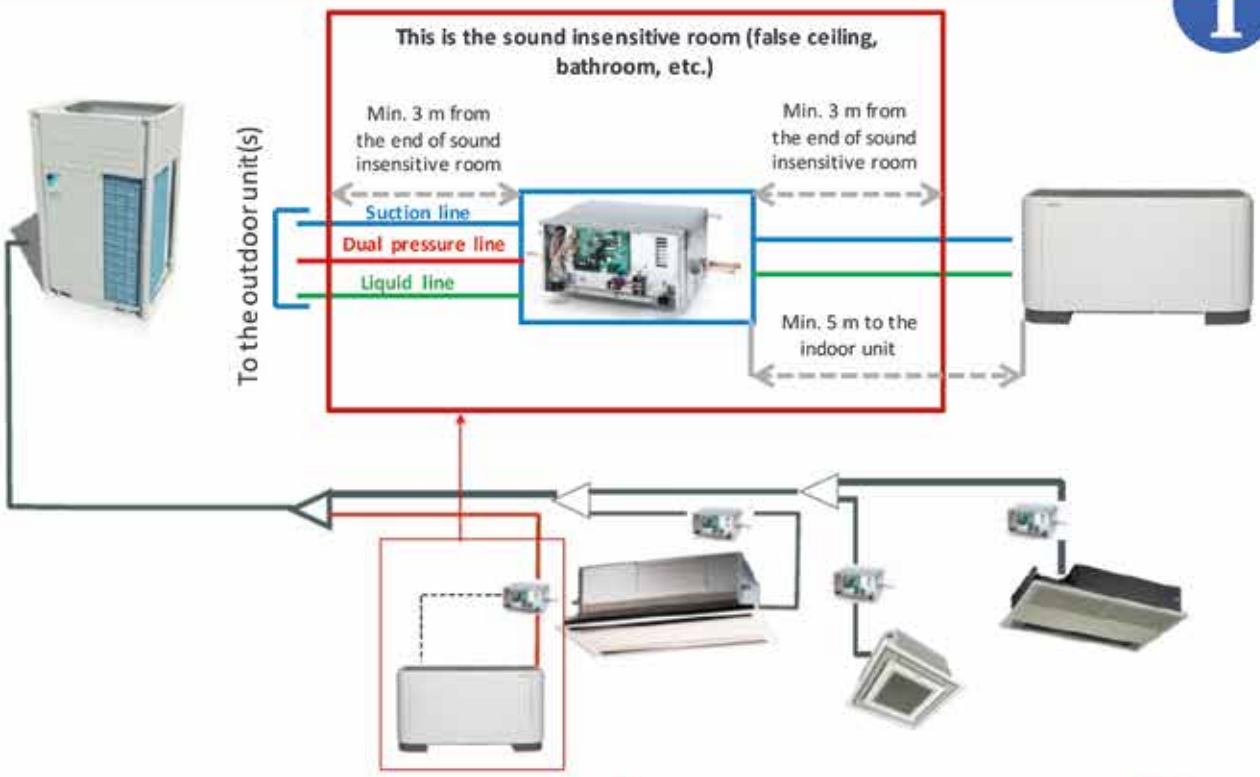
BS 4 Q 14 A = 4xIU of index 14x10 = 4x140
BS 6 Q 14 A = 6xIU of index 14x10 = 6x140
BS 8 Q 14 A = 8xIU of index 14x10 = 8x140
BS 10 Q 14 A = 10xIU of index 14x10 = 10x140
BS 12 Q 14 A = 12xIU of index 14x10 = 12x140
BS 16 Q 14 A = 16xIU of index 14x10 = 16x140

To provide the independent indoor unit operation mode switching:
Connect the unit to single BS-box or to a separate port of multi BS-box

IMPORTANT NOTES:

- At least 50% of the outdoor unit load must be connected via BS-boxes
- Do not place BS-boxes to the area with low background sound level. This is because of changeover noise, when changing from cooling to heating operation. This happens only for 1-2 seconds, but can create discomfort.
- Multi BS-boxes require condensate drain connection!

BS-boxes can produce noise, this is why their correct positioning in the building is important



05. The guestroom

Application advice

WHAT WE SUGGEST FOR THE GUESTROOM

Indoor units to cool and heat the air

Ducted type (hidden installation)

This is most commonly used indoor unit type in hotel rooms.

Daikin name: FXDQ-A

- Horizontal
- Low ESP
- Low noise

Daikin name: FXNQ-A

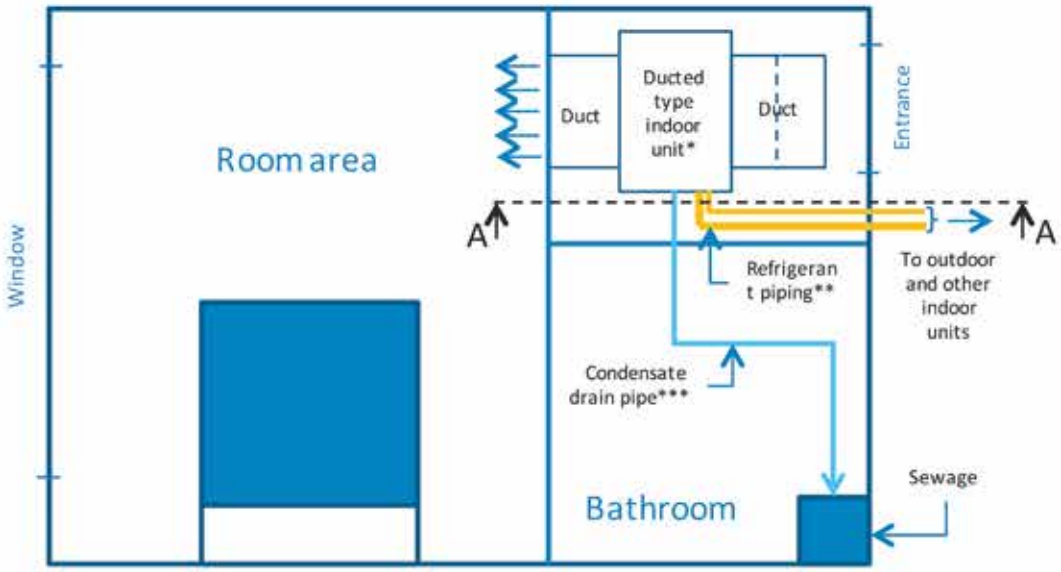
- Vertical
- Low ESP
- Low noise
- For the cases when predominant mode is heating

Ducted type units application

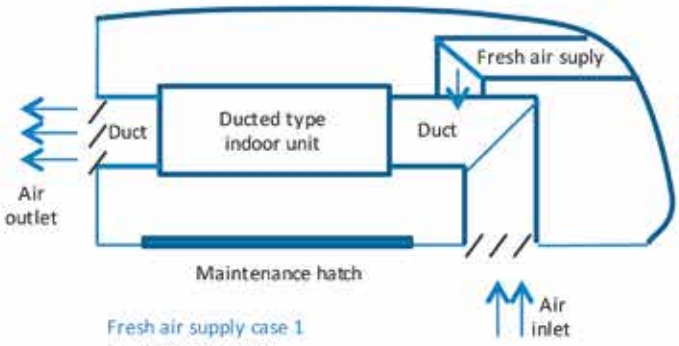
IMPORTANT NOTES:

- *Observe the required service spaces. Service hatch is also necessary (please see the corresponding installation manual).
- **For refrigerant piping requirements please refer to the VRV application manual or use the VRV xPress software.
- *** Observe the drain pipe diameter and slope when laying the pipe (please see the corresponding installation manual)

A most typical guestroom layout



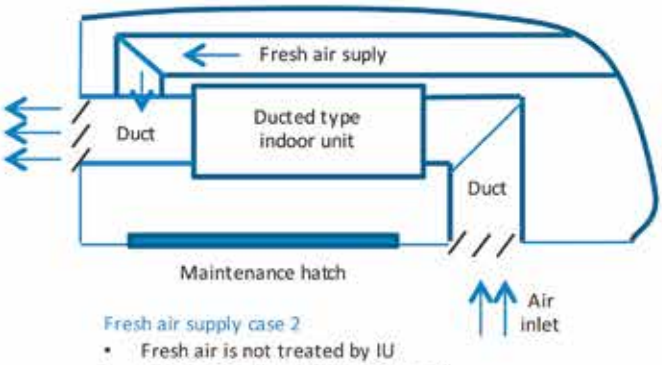
A-A Section (not in scale)
Air distribution



Fresh air supply case 1

- Most common
- Fresh air is treated in the IU
- IU off = no fresh air supply

A-A Section (not in scale)
Air distribution
Fresh air supply case 2



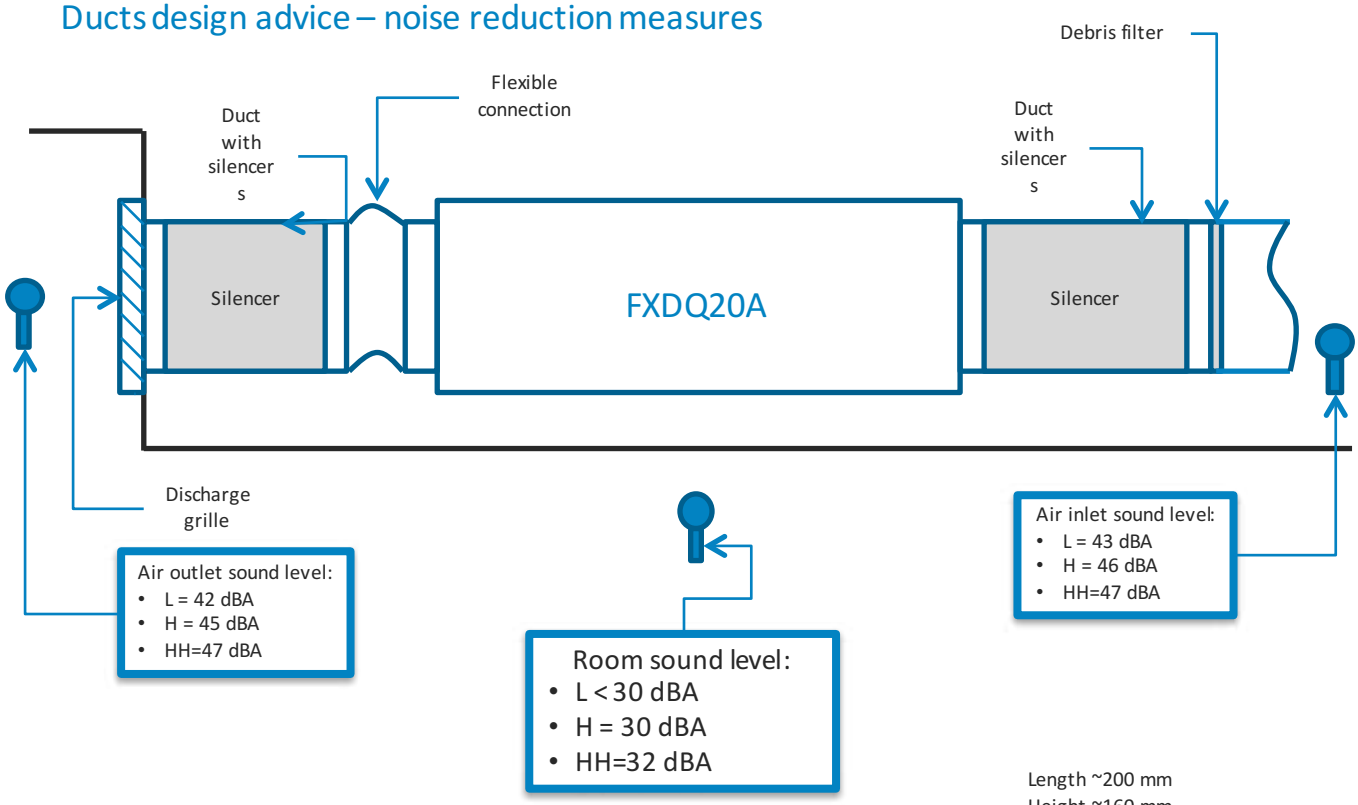
Fresh air supply case 2

- Fresh air is not treated by IU
- Fresh air is supplied even if IU is off

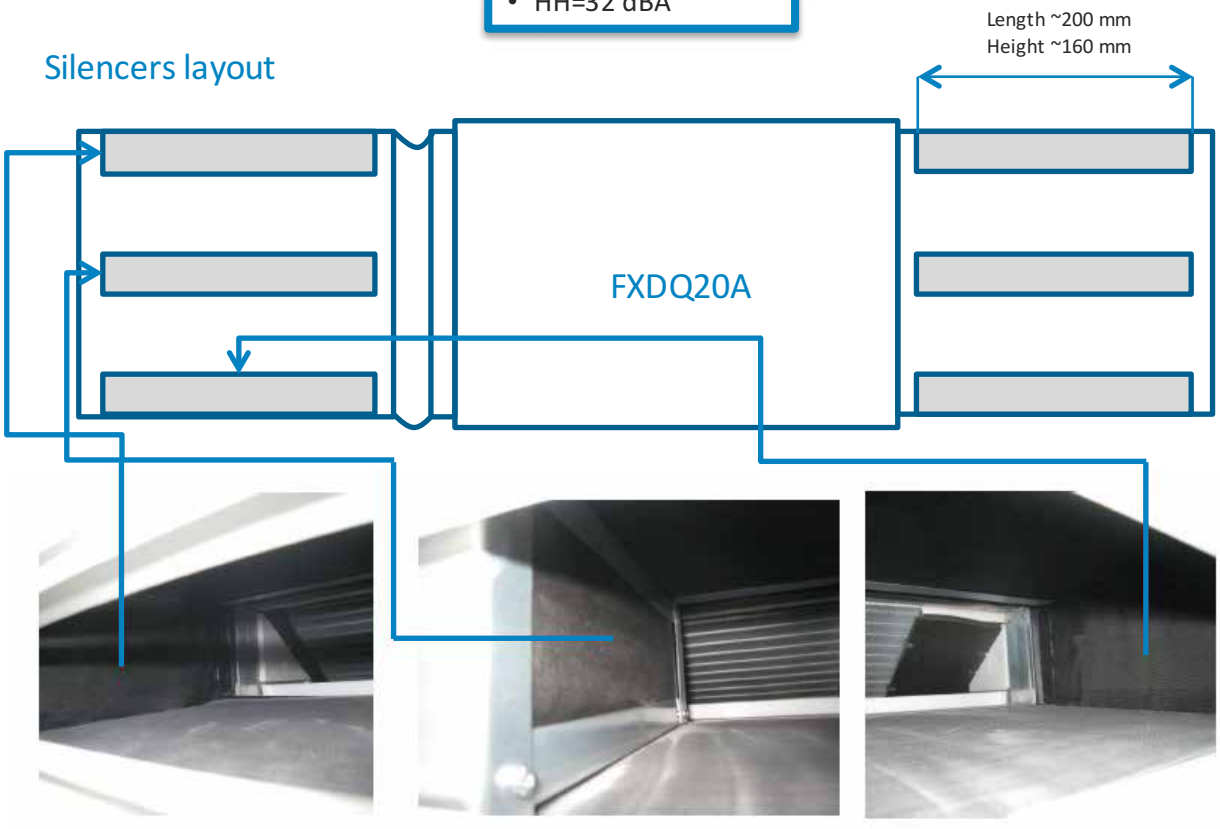
WHAT WE SUGGEST FOR THE GUESTROOM

Ducted type units application advice

Ducts design advice – noise reduction measures



Silencers layout



WHAT WE SUGGEST FOR THE GUESTROOM

Guestroom controls

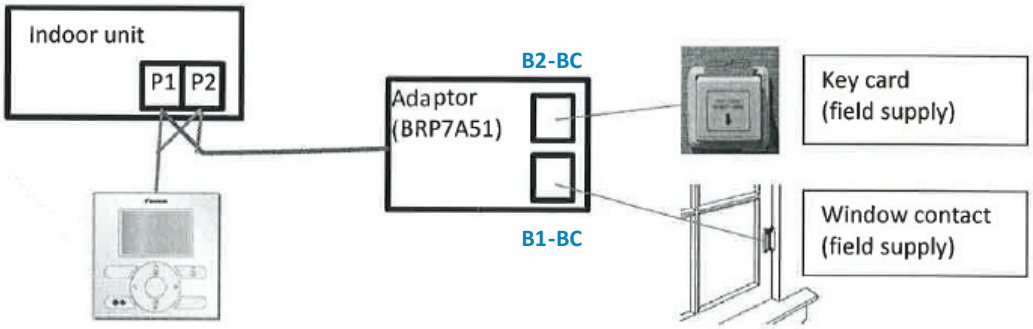
Local hard wired remote controller + door/window and keycard adapter

This is most common control solution at the user side

BRC1H…

- Comes in 3 colors (white, silver, black)
- Simplified GUI
- Can be connected to smartphone via Bluetooth for advanced control

BRP7A51



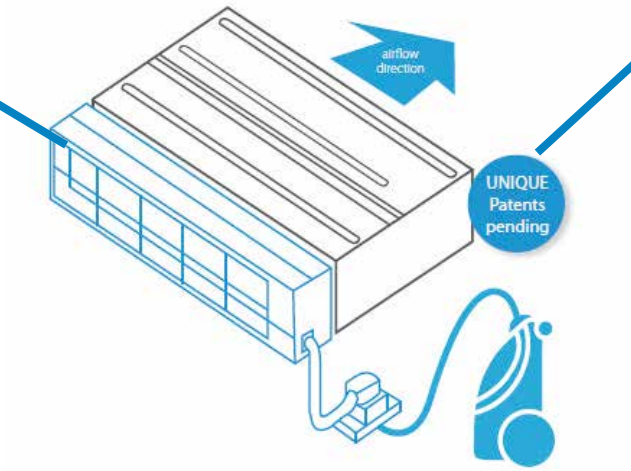
Useful options

Self cleaning filter module for the indoor unit

How does it work?

1) Cleans filter weekly

- Improves reliability
- Improves efficiency
- Improves air quality
- Helps to avoid the dust marks on the walls



2) The dust is removed from the dustbox by vacuum cleaner during room cleaning

The result?

- Better efficiency
- Energy saving up to 20% - no capacity losses because of reduced air flow
- Easy maintenance, no need in specialized staff
- No risk of evaporator freezing

06. Hot water production with VRV

Understanding the possibilities, application hints

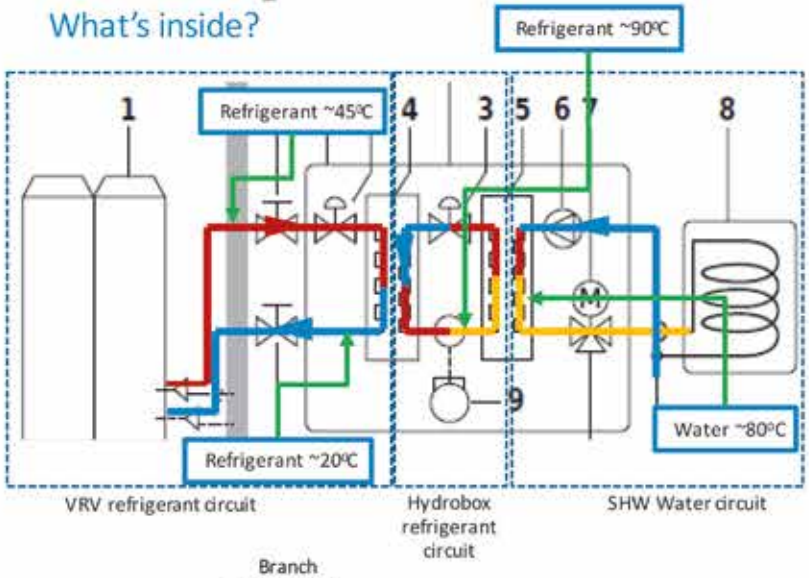
Hot water production using VRV with heat recovery

Understanding the hydrobox

High temperature hydrobox (HXHD-A)

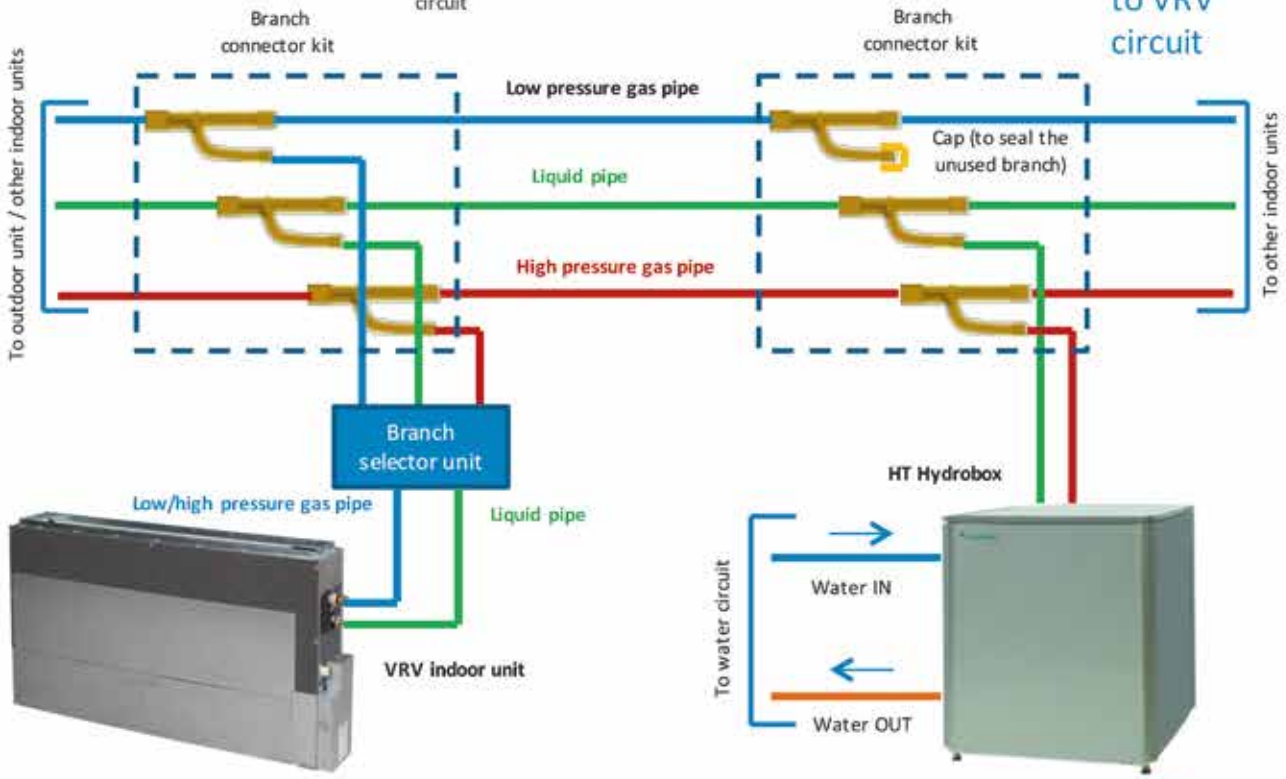
- A device to heat water using VRV refrigerant circuit (only VRV with heat recovery)
- Only heating mode
- Leaving water temperature up to 80°C
- Based on cascade compression cycle
- Stacked installation with buffer tank is possible
- Stacked installation on top of each other is possible
- 2 models, nominal capacity 14 and 22,4 kW, same dimensions

What's inside?



1. VRV outdoor unit
2. Hydrobox
4. Refrigerant to refrigerant heat exchanger
5. Refrigerant to water heat exchanger
6. Pump
8. Hot water tank
9. Compressor

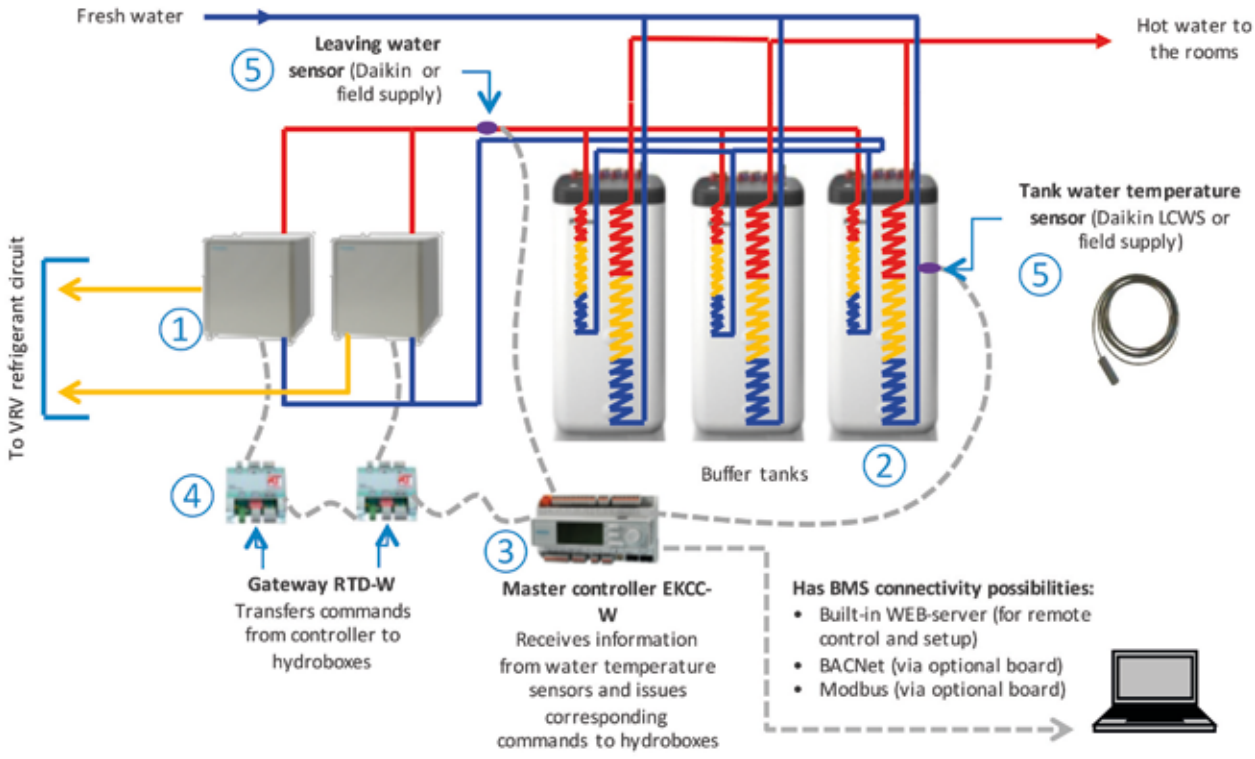
Connection to VRV circuit



Hot water production

Hot water plant possible configuration (when significant quantity of hot water is required)

Example with Daikin buffer tanks used



For such hot water plant configuration you will need:

1) HT Hydrobox HXHD (quantity depends on the demand);
2) Buffer tanks (quantity depends on the demand);
3) Sequencing controller;
4) Connection gateways for hydroboxes;
5) Water temperature sensors

Hot water production

Understanding Daikin buffer tanks

Traditional storage tank Suitable for smaller application

200L – EKHTS200
260L – EKHTS260

- Stainless steel coil
- Can be stacked installed on the hydrobox
- Can be stacked installed one on one (up to 3)

Energy storage tank Suitable for modular installation and bigger applications

300L – EKHWP300
500L – EKHWP500

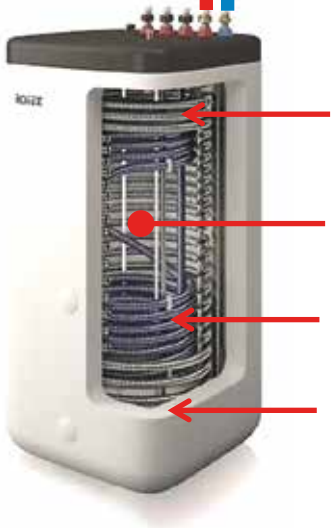
- Stainless steel coil
- Backup heater control possible
- Solar panels connection possible
- Optional pump station
- 500 l tank can also provide space heating

Some examples of modular installation

Understanding Daikin energy storage tanks

Fresh hot water heated „on demand“

Fresh cold water from mains at < 20°C



Stainless steel **domestic hot water heat exchanger** with corrugated pipes to store fresh drinking water

Pressureless hot water inside tank: **Energy storage** – not used for drinking

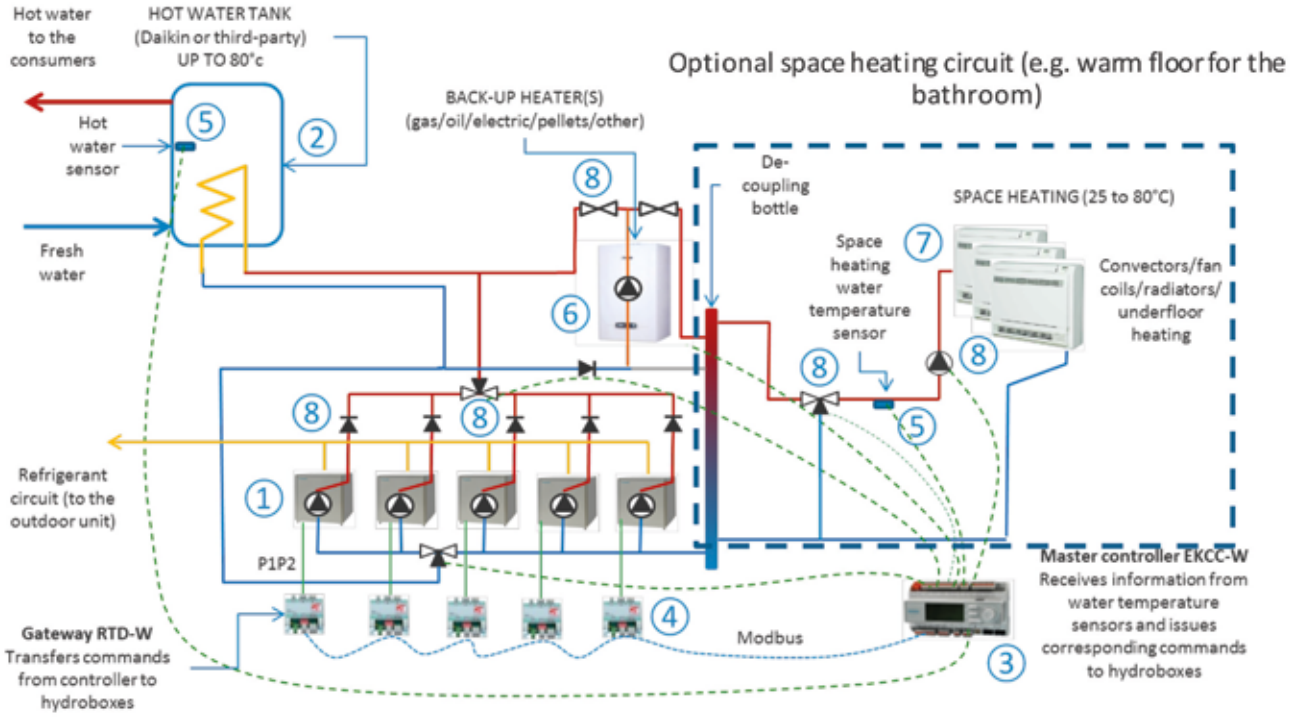
Double stainless steel (Inox) **loading heat exchanger** for the DHW: connection to heat source

High efficiency blow moulded tank: thick PU foam insulation

Hot water production

Hot water plant possible configuration (when significant quantity of hot water is required)

Scheme with non-Daikin large buffer tank and optional space heating circuit



For such hot water plant configuration you will need:

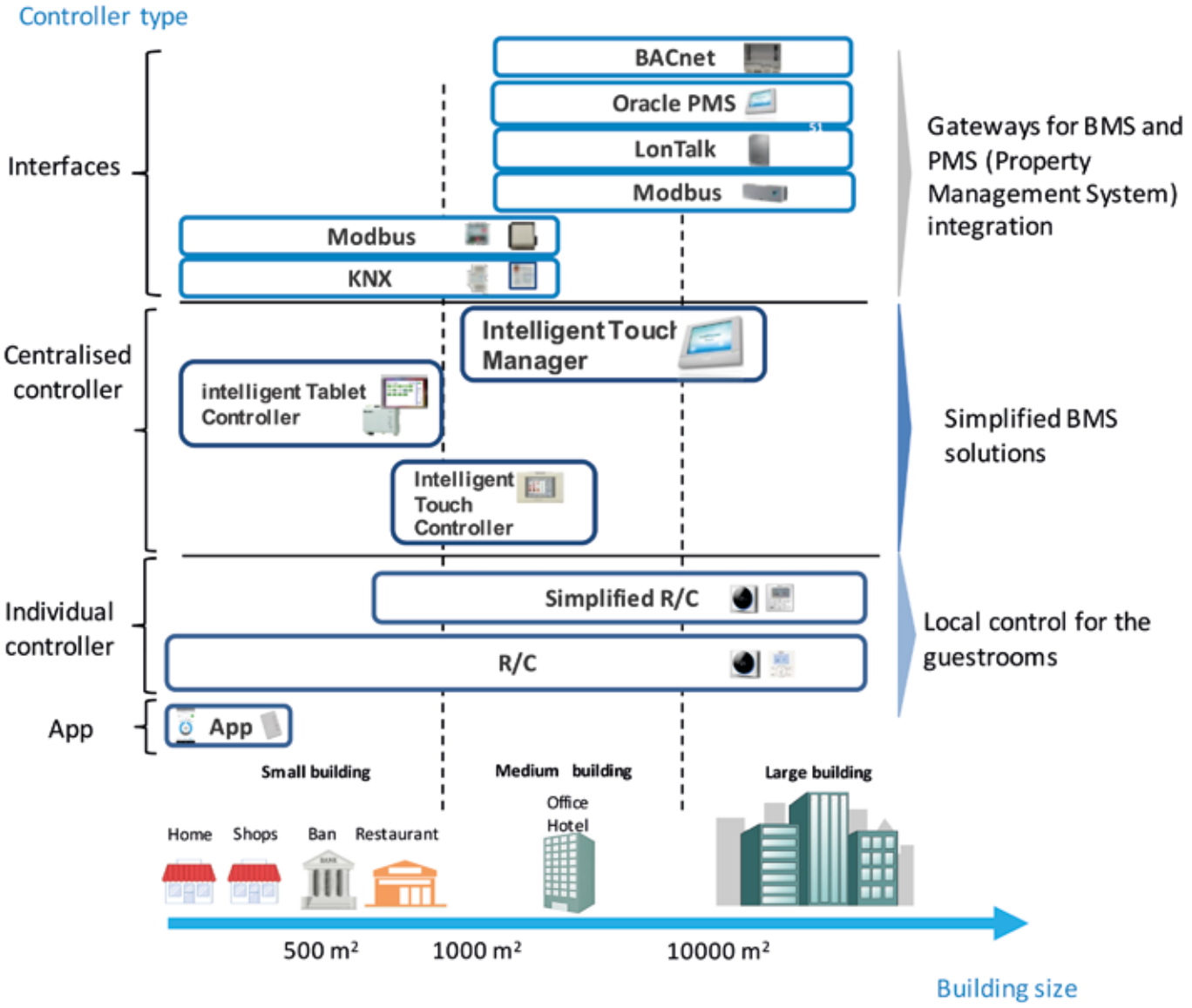
1) HT Hydrobox HXHD (quantity depends on the demand);
2) Water tank(s) (quantity and volume depends on the demand);
3) Sequencing controller;
4) Connection gateways for hydroboxes;
5) Water temperature sensors
6) Back-up heaters (if required)
7) Space heating devices (if required)
8) Hydronic circuit devices (valves, pumps, etc.)

05. Centralized control systems

Understanding, selecting

CENTRALIZED CONTROLS

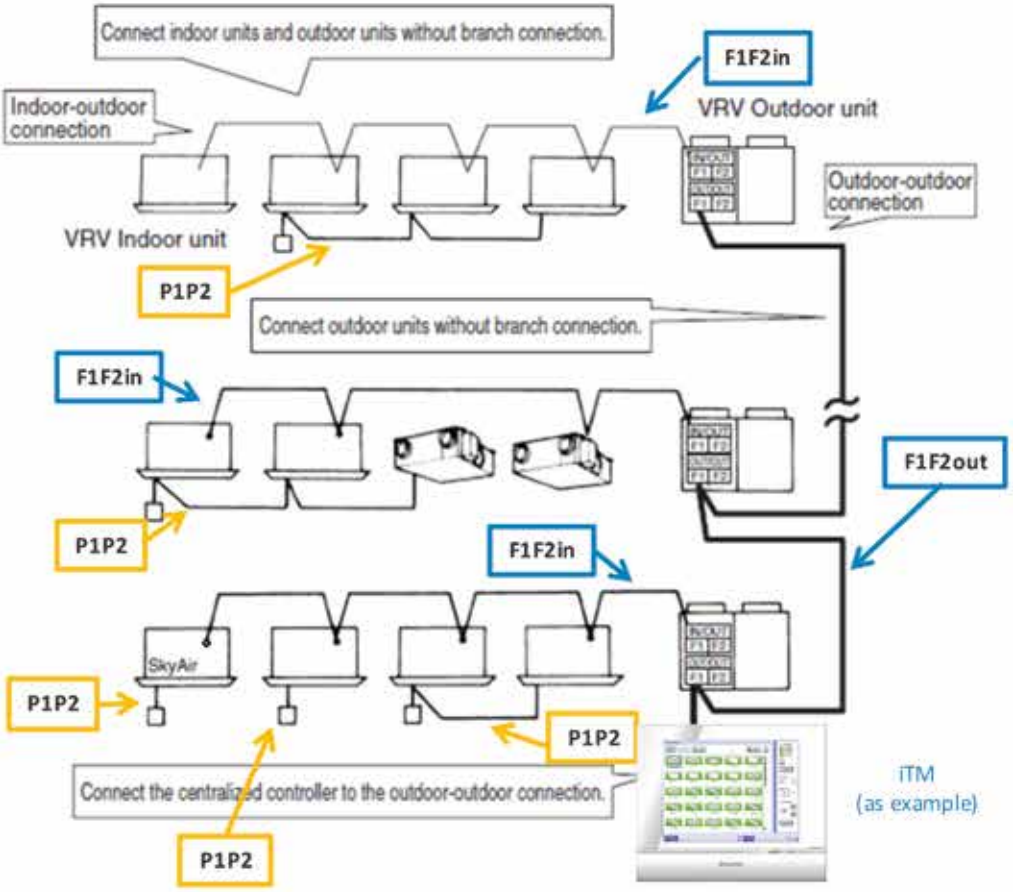
Daikin Control solutions overview
What is available



CENTRALIZED CONTROLS

Understanding Daikin VRV control system topology

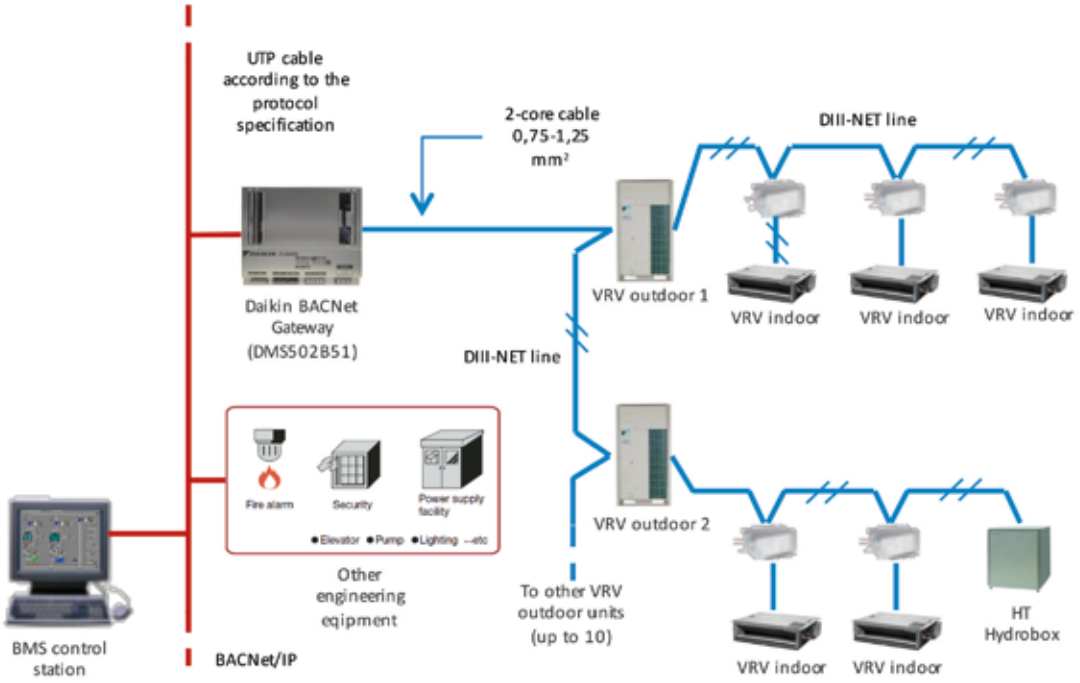
Multiple VRV systems
Centralized control



- Up to **64 Indoor Unit** (groups) controlled from central system
- Up to **10 VRV outdoor** systems
- Individual R/C not required → exceptions!
- Up to total of 2000m of F1F2 control wiring
- Longest branch < 1000m

Centralized control solutions suitable/used in the hotels

BMS (BACNet based)



*Lonworks and Modbus – based BMS will use the same topology

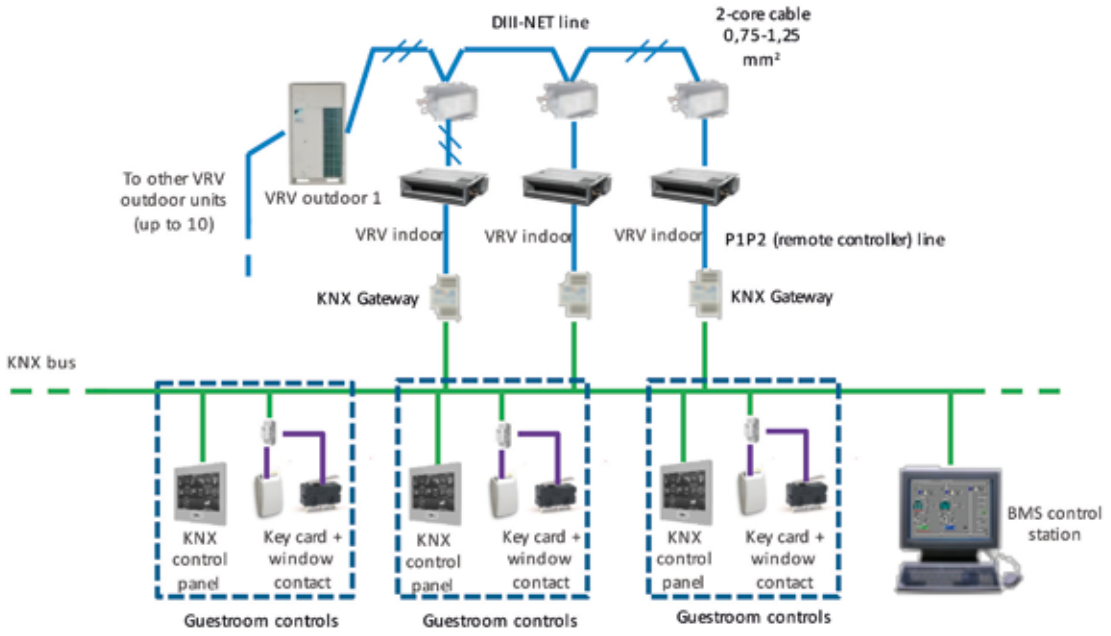
Control system functions:

1) Interlocking of indoor units with key card and window contacts;
2) Individual control of indoor units by means of Daikin remote controller;
3) Control of indoor units from BMS system side;
4) Control of other engineering equipment from BMS system side

See databooks and installation manuals for more details.

Centralized control solutions suitable/used in the hotels

BMS (KNX based)



Control system functions:

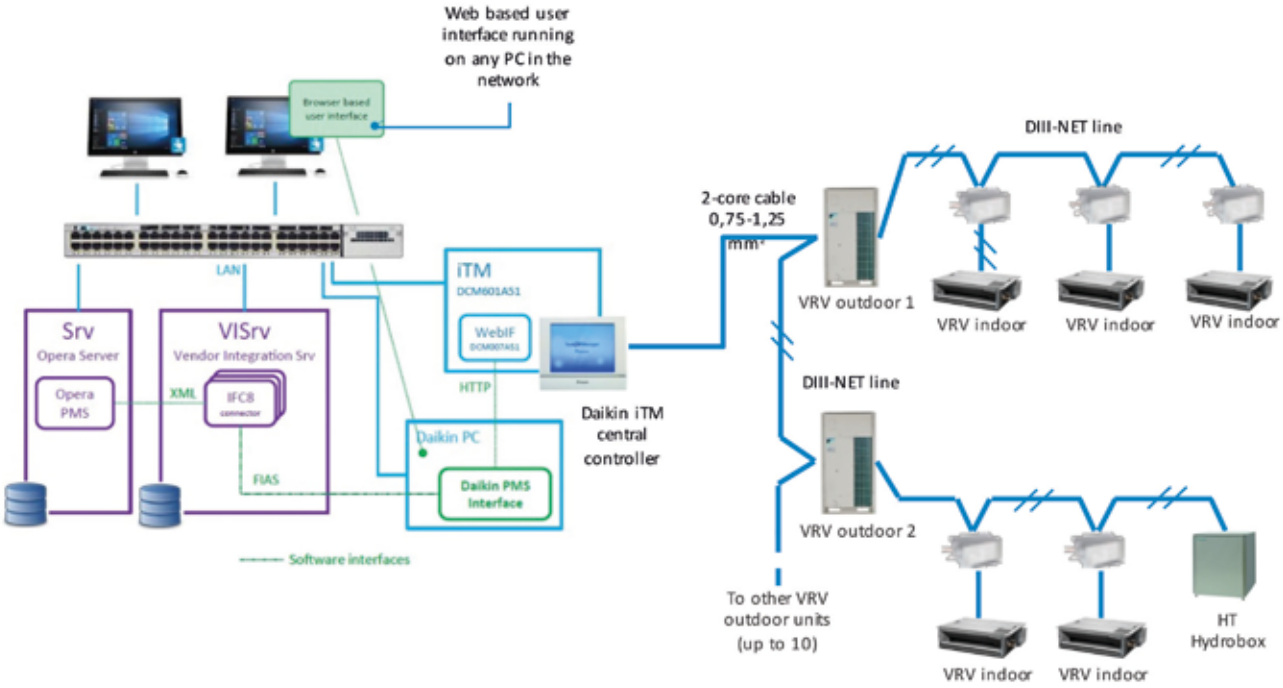
1) Interlocking of indoor units with key card and window contacts;
2) Individual control of indoor units by means of local control panels (using Daikin controllers is not common);
3) Control of indoor units from BMS system side;
4) Control of other engineering equipment from BMS system side

See databooks and installation manuals for more details.

CENTRALIZED CONTROLS

Centralized control solutions suitable/used in the hotels

Opera PMS integration
(Option 1 -> PMS server on dedicated Daikin PC)



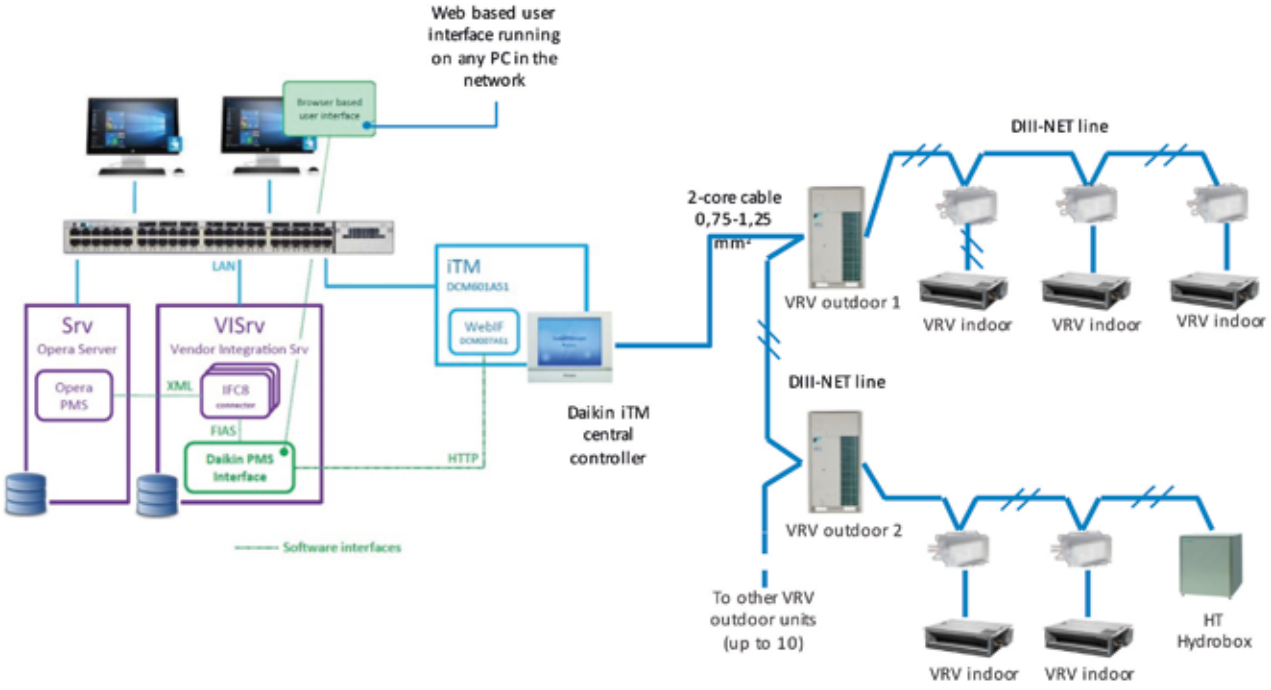
Control system functions:

1) Interface between a Hotel Management System and the Daikin HVAC systems that allows to save energy, automate human actions, and improve the hotel customer experience.
2) Individual control of indoor units by means of Daikin remote controller or from the front desk;
3) Interlocking the guestroom indoor units operation with room occupation status;

See databooks and installation manuals for more details.

Centralized control solutions suitable/used in the hotels

Opera PMS integration
(Option 2 -> Daikin PMS interface on PMS server, no dedicated PC required)



Control system functions:

1) Interface between a Hotel Management System and the Daikin HVAC systems that allows to save energy, automate human actions, and improve the hotel customer experience.
2) Individual control of indoor units by means of Daikin remote controller or from the front desk;
3) Interlocking the guestroom indoor units operation with room occupation status;

See databooks and installation manuals for more details.

07. Application examples

Some examples of VRV Hotel application

NORDPORT PLAZA HAMBURG (NORDERSTEDT)

Facts and figures

- Consists of 2 buildings:
- "The Eye" – guest rooms, 11 floors, 7897 m^2
- "The Brow" – guest rooms, conference facilities, restaurant, 5 floors, 3345 m2.
- 188 guest rooms
- Fitness and spa
- Part of the "FOR F.R.E.E. – Förderprojekt Regenerative Energie-Effizienz" (funded project for regenerative energy efficiency) programme

Customer requirements

- High energy efficiency
- Maximum use of renewable energy
- Reduction of CO2 emissions
- High user comfort
- BMS connection

Equipment installation – what and why

Customer requirements

- High energy efficiency
- Maximum use of renewable energy
- Reduction of CO2 emissions
- High user comfort
- BMS connection

Daikin VRV Water cooled connected to geothermal loops for heating and cooling of guest rooms, common areas and air processing in the AHU

- Using geothermal energy -> energy efficient installation, independent of the ambient
- Heat recovery between different zones -> energy saving and guest comfort
- Variable Refrigerant Temperature technology -> guest comfort and energy saving

+

Daikin AHU with heat recovery and DX coils

- Efficient heat recovery wheels -> energy efficient installation, less cooling/heating load
- No cold/hot drafts due to supply temperature control -> improved guest comfort

BACNet gateway for BMS connection

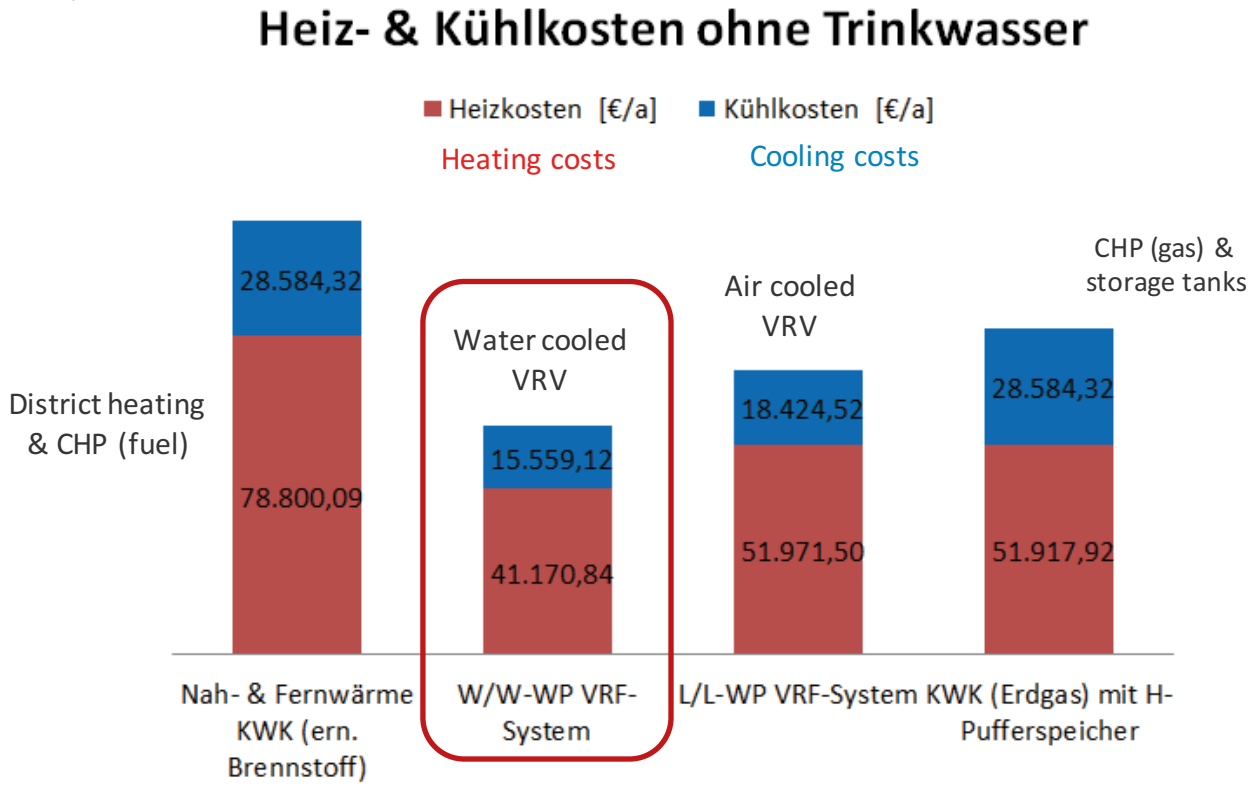
- Interlocking with hotel booking system, guest room temperature protection -> improved guest comfort

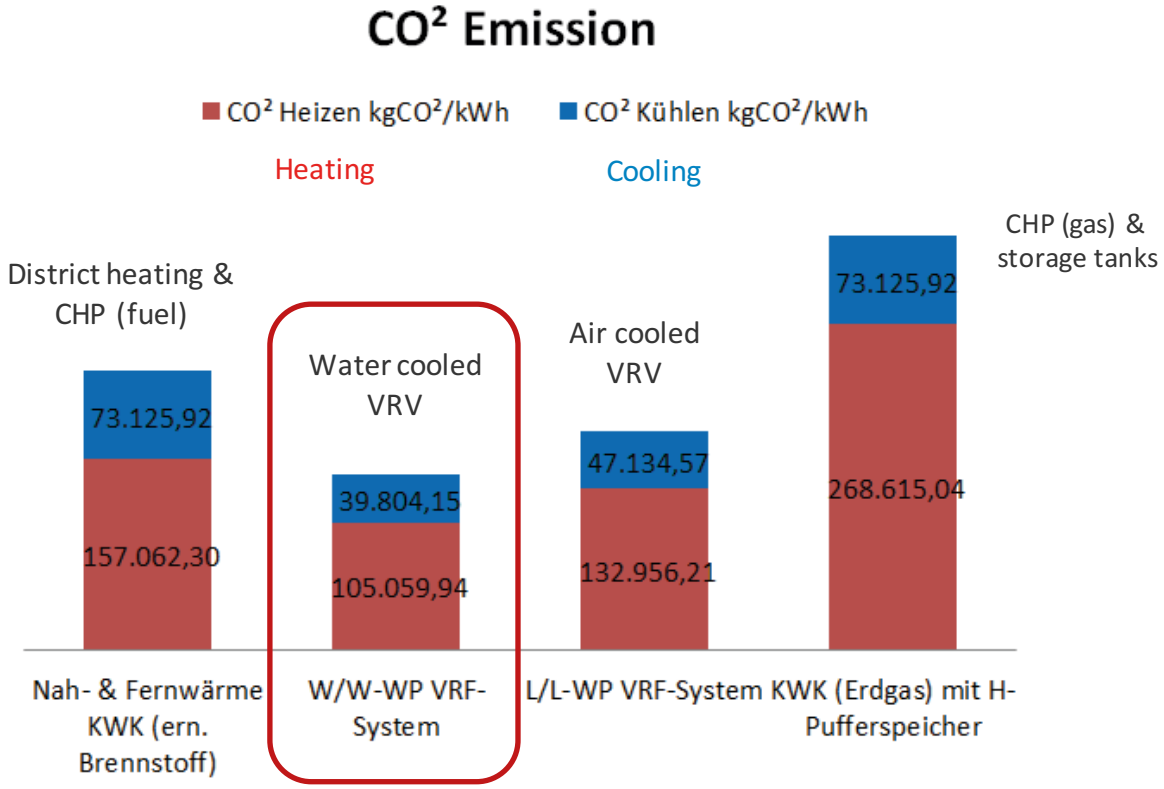
NORDPORT PLAZA

System comparison following EnEV 2016 (Energy Saving Ordinance in Germany)

Estimation of running costs of different solutions was made

- VRV Water Cooled solution proved to be the best both from running cost perspective and CO2 emissions point of view



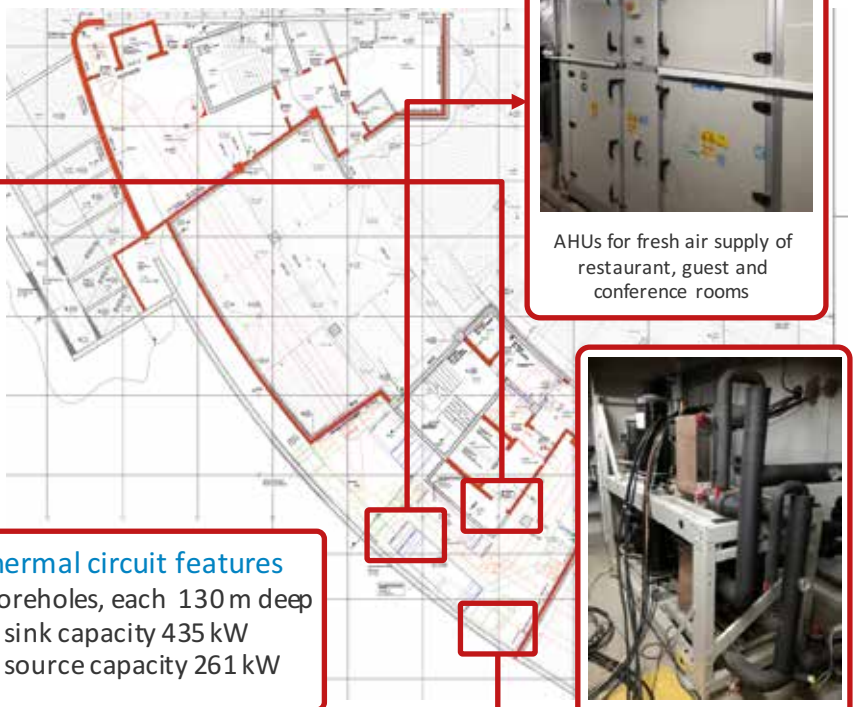


NORDPORT PLAZA

Equipment installation – additional information

Equipment in the technical room of "The Brow"

Water cooled condensers for climatization of all the rooms of "The Brow"



AHUs for fresh air supply of restaurant, guest and conference rooms

All equipment is using geothermal loop (also the one installed in "The Eye" part)

Geothermal circuit features

- 46 boreholes, each 130 m deep
- Heat sink capacity 435 kW
- Heat source capacity 261 kW

Water cooled chiller for air processing in the AHUs

Water cooled condensers

Equipment installation – additional information

Typical guest room floor layout

Guestroom installation (low noise slim ducted unit FXDQ)

Multiport BS-boxes

PUERTO TRIANA SEVILLA

Facts and figures

- High-rise building, 180.5 m high.
- 5* hotel located on floors 25-37
- Business center located on floors 1-24
- Facility spaces on floors 0-2

Customer requirements

- High energy efficiency
- High guest comfort level
- Connection to monitoring system
- Connection to BMS system
- Minimal refrigerant impact

Equipment installation – what and why

Customer requirements

- High energy efficiency
- High guest comfort level
- Minimal refrigerant impact
- Monitoring and control integration

Daikin VRV Water cooled (for cooling, heating and DHW production)

- High energy efficiency due to double heat recovery
- High comfort level due to independent operation of indoor units
- Variable Refrigerant Temperature technology -> guest comfort and energy saving
- Minimized refrigerant quantity due to shorter pipe runs (vs air cooled)

Daikin intelligent Touch Manager

- Mini-BMS system used to control Daikin and 3rd party equipment -> cost efficient solution for 1-point control of the whole installation
- Allows connection to Daikin remote monitoring system -> power consumption monitoring and preventive maintenance

Daikin BACNet gateway

- For integration into building's management system

PUERTO TRIANA SEVILLA

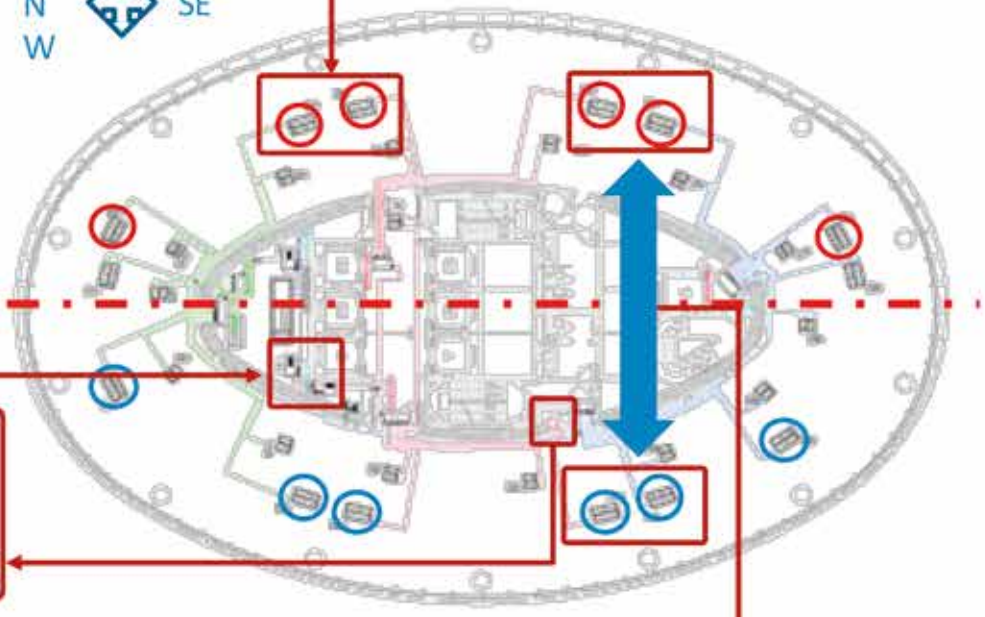
Equipment installation – additional information

Typical floor layout

VRV Water cooled condensers (3 systems per floor)

Medium ESP ducted units

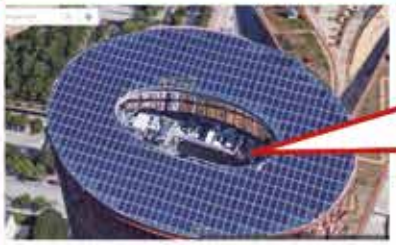
N W SE



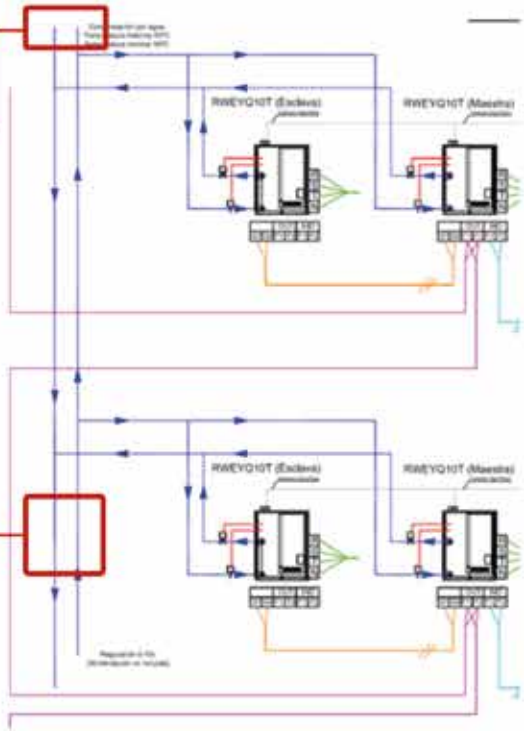
LT Hydrobox for DHW production

Unbalanced load (0 = FXSQ100P, 0=FXSQ80P), creates opportunity for heat recovery

VRV water cooled water loop layout



Cooling towers are used to maintain the water loop temperature. They are installed on the roof.



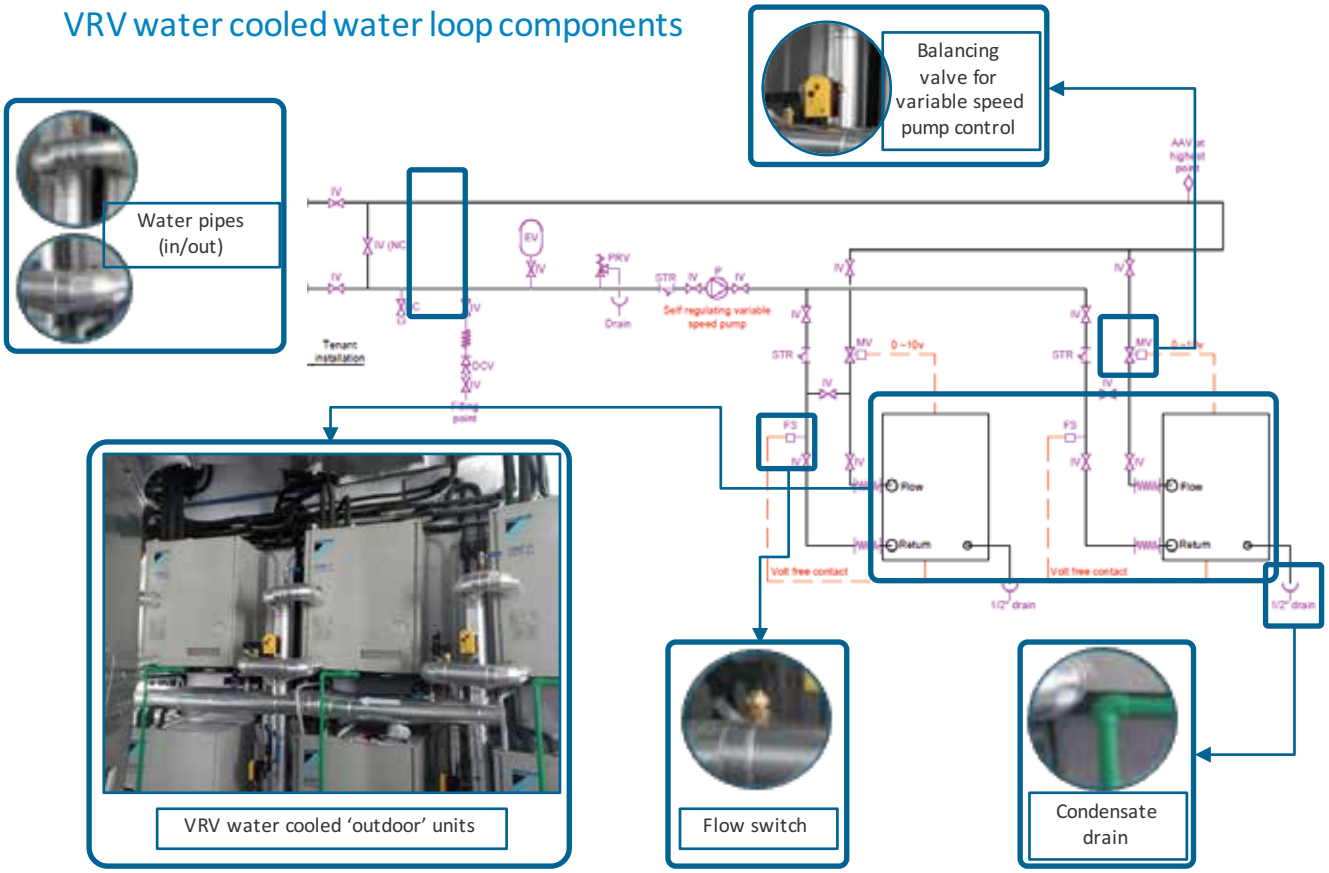
(1) (2)

Variable water flow in the water loop. Using valves (1) and variable speed pumps (2).

PUERTO TRIANA SEVILLA

Equipment installation – additional information

VRV water cooled water loop components



ARBOREA MARINA RESORT - NEUSTADT

Facts and figures

- building surface 8.379 m²
- 124 rooms
- 5 floors + stacked storey
- 2 meeting rooms
- 2 restaurants + kitchen for guests
- amphitheatre
- bar and lounge area
- pool, sauna and spa area

Customer requirements

- High energy efficiency
- Using renewable energies
- Reduction of CO2 emissions
- Centralized control, intelligent energy consumption monitoring
- High user comfort

Equipment installation – what and why

Customer requirements

- High energy efficiency
- Using renewable energies
- Centralized control, intelligent energy consumption monitoring
- High user comfort

Air cooled VRV with heat recovery and hydroboxes

- High energy efficiency
- Waste heat is utilized to heat water for underfloor heating
- High comfort level due to independent operation of indoor units
- Variable Refrigerant Temperature technology -> guest comfort and energy saving

+

Air handling units with heat recovery

- Utilizing waste heat of exhaust air

+

ZEAS and CVP refrigeration units

- Waste heat from refrigeration is used to heat the water for underfloor heating and swimming pool

Intelligent Touch Manager + BMS gateways + WAGO controls

Low noise ducted horizontal and vertical indoor units, cassette units with presence sensors in common areas, underfloor heating

ARBOREA MARINA RESORT - NEUSTADT

Equipment installation – additional information

Public area concept

Cooling and heating with roundflow cassettes
Additional underfloor heating
Heat recovery potential is utilized

Cooling and heating of fresh air
Heat recovery potential is utilized

Underfloor heating

Fresh air supply

Kitchen cold storage supply

- One CVP and one ZEAS unit on the rooftop provide the needed cooling capacity for the whole kitchen
- The waste heat of the CVP is used to obtain the hot water for the underfloor heating system in the public areas

Energy accumulator

Boiler

Underfloor heating

ARBOREA MARINA RESORT - NEUSTADT

Equipment installation – additional information

Guest rooms equipment installation

Low noise slim ducted units in classic rooms

- ducted units in the suspended ceiling in the hallway
- about 60 m^3/h fresh air intake

Low noise slim ducted units in family rooms

- No suspended ceiling
- Floor standing unit invisible behind the wardrobe
- In the small rooms for the kids it was not possible to install VRV because of the refrigerant charge, therefore a split unit has been installed

User interface is “Madoka” remote controller

Power switch (card switch) switches off the indoor unit

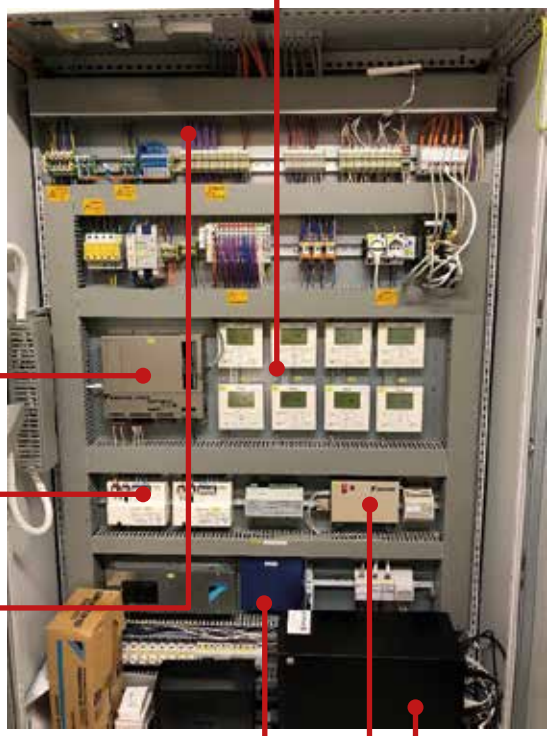
Window contact switches off the indoor unit

ARBOREA MARINA RESORT - NEUSTADT

Equipment installation – additional information

Control systems

R/C for IU in public area



BACnet Gateway
Building BMS integration

iTM Plus Adapters
To expand the number of units controlled by ITM

Modbus Gateway
Refrigeration units BMS integration

WAGO extension modules
To control underfloor heating

Interface to FIAS
Property Management System connection

VRV-Checker
For service monitoring

Power Manager Server
For energy cosumption monitoring
Nearly everything is measured:

- gas consumption
- water consumption
- power consumption
- operating hours of the hydroboxes
- heat meter for measuring the heat recovery amount etc

Notes