VRV_Xpress
User's Manual
V7.6.1

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What's New

- Replaced the explanation about the calculation of the discharge temperature (see section 9.2)
- Replaced all figures showing the advanced preferences tab (sections 9.1 to 9.6)

1 Understanding the Basics of VRV_Xpress

This chapter describes general selection principles used in VRV_Xpress and the devices you can select with VRV_Xpress. Several terms used in the sub sections of this chapter will also be explained again in the next chapters, but in terms of how to perform a selection.

1.1 Air Conditioning Systems

An air conditioning system provides cooling, heating and ventilation into rooms of a building. Such a system consists of an outdoor unit connected to mainly indoor units but also to air curtains, ventilation devices and hydro-boxes. One outdoor unit provides the cooling or heating capacity for several rooms. So, a small sized building may need only one outdoor unit, as shown in Figure 1:

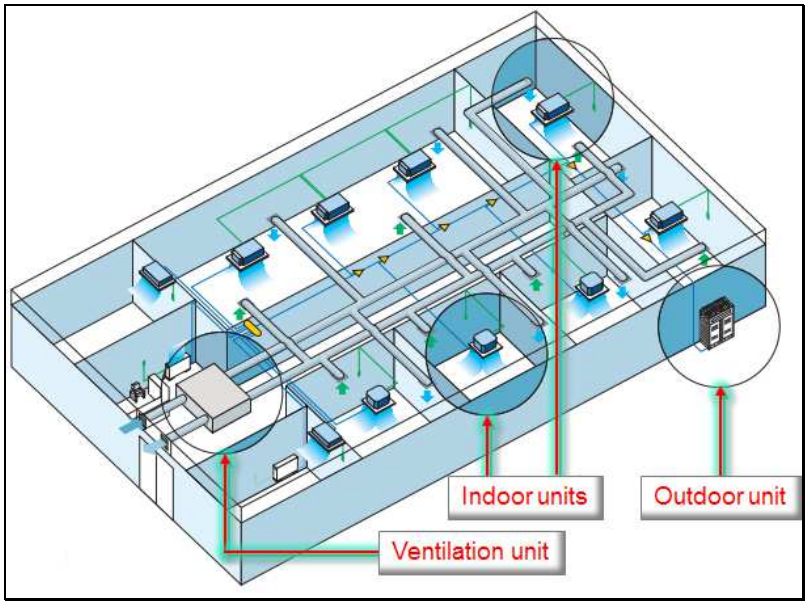


Figure 1: A building equipped with an outdoor unit, several indoor units and a ventilation unit

The outdoor unit connects to the devices it controls through piping. A more effective way to represent a system is a piping diagram, showing the outdoor units and the devices it connects to, as shown in Figure 2:
The outdoor unit in Figure 2 is a ***heat pump***, which operates either in cooling or in heating. All indoor units connected to it are either heating or cooling. A more sophisticated outdoor unit is a ***heat recovery***, as shown in Figure 3:

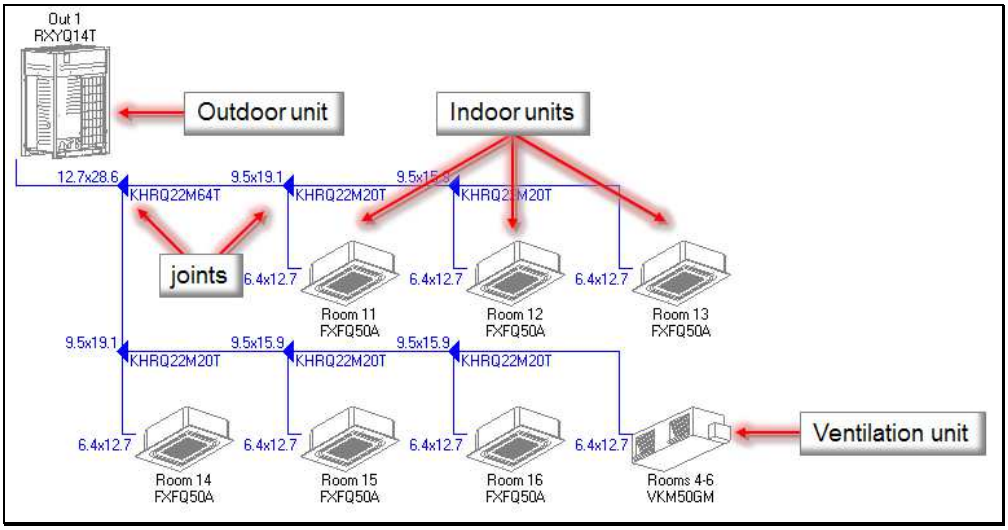


Figure 2: A heat pump system shown in a piping diagram

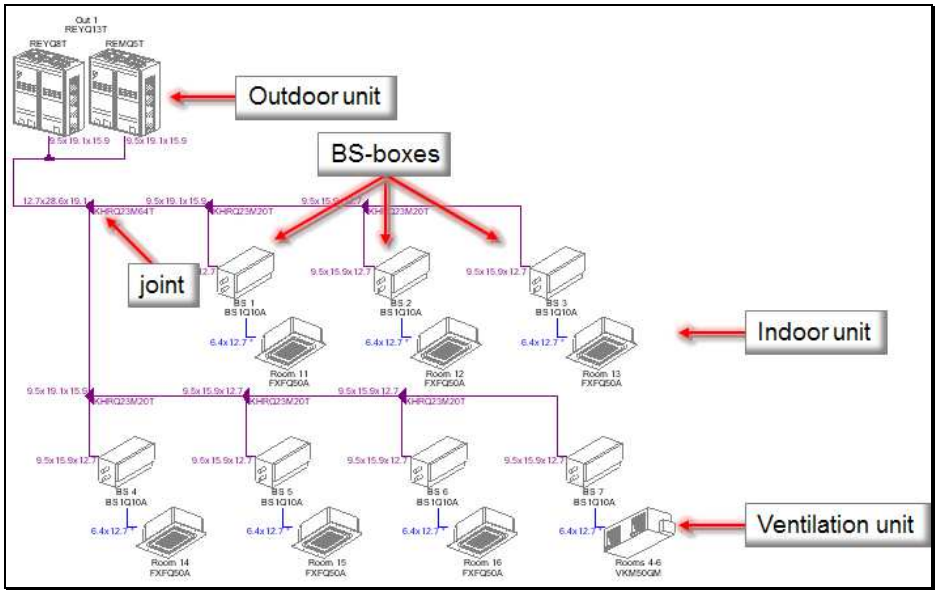


Figure 3: A heat recovery system shown in a piping diagram

In such a system, each indoor unit operates individually in heating or cooling. To allow this, the indoor units must connect to BS-boxes, which in turn connects to the outdoor unit. By cooling a room, a BS-box recuperates its heat and provides it to a room needing heating through its outdoor unit.

The next sub sections shortly describe the different devices that may be used in a system.

1.1.1 Outdoor Unit

Figure 4 shows different kinds of outdoor units:

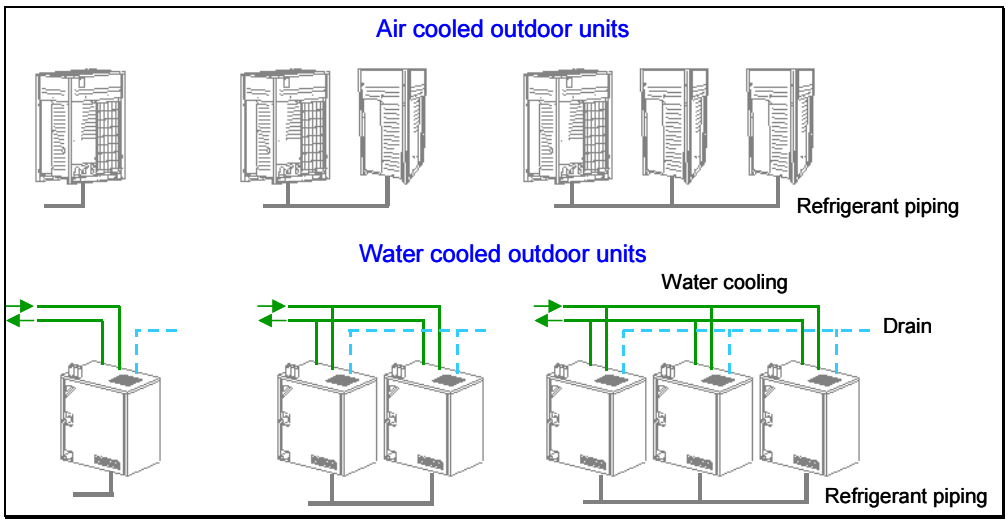


Figure 4: Outdoor units

- An air cooled outdoor unit (Figure 4 at the top) uses the ambient air to cool down or heat up the refrigerant that goes to the devices it is connected to. Depending on the number and size of the devices it is connected to, an outdoor unit consists of one, two or three interconnected outdoor unit modules.
- A water cooled outdoor unit (Figure 4 at the bottom) uses the water to cool down or heat up the refrigerant that goes to the devices it is connected to. In contrast to air cooled outdoor units, a water cooled outdoor unit can be installed inside a building. As for the air cooled outdoor units, a water cooled outdoor unit consists of one, two or three interconnected outdoor unit modules.

1.1.2 Indoor unit

An indoor unit has a family defining the location of its installation in a room: it may be build into the ceiling, mounted on the ceiling or on the wall, may stand on the floor or build into the floor, etc. Per indoor unit family, there are different sizes allowing to provide cooling or heating capacity to small, medium or large rooms. Figure 5 gives a few examples of indoor units from different families:

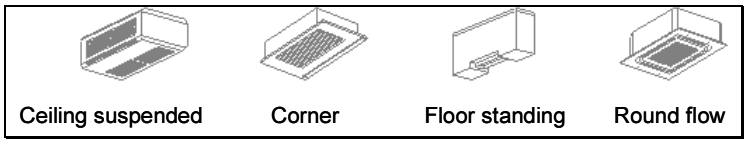


Figure 5: Indoor units

1.1.3 Refnet Piping Connections (Joint / Header)

The piping connects indoor units to their outdoor unit with refnet connections in between. An indoor unit connects two pipes to its outdoor unit: a liquid and a pipe. In cooling mode, the liquid refrigerant enters the indoor unit, where it expands while extracting heat from the room and exits the indoor unit as a gas. Figure 6 at the top left shows a part of a piping diagram connecting the gas and liquid pipes of two indoor units through a joint connection. For large systems drawing those two pipes would make the diagram difficult to read. So, a simplification is drawing both pipes as one connection, as shown in Figure 6 at the top right.

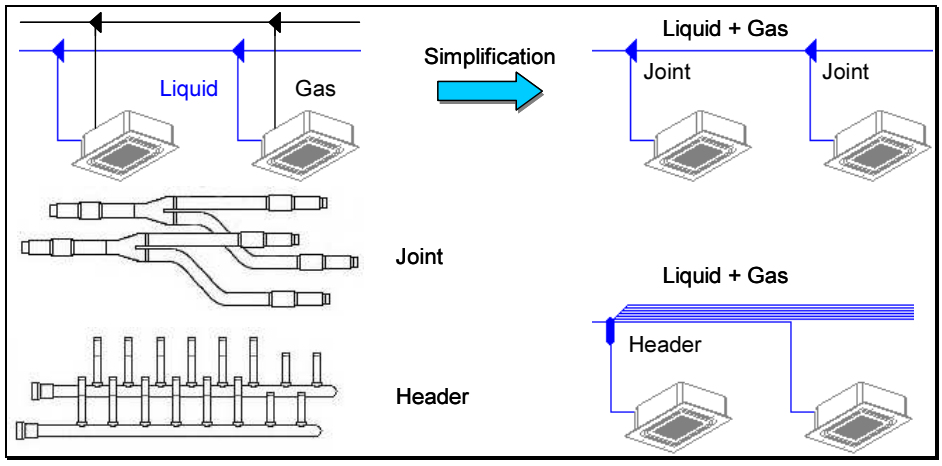


Figure 6: Joint and header piping connections

There are two kinds of refnet connections:

1. Joints (see Figure 6 in the middle left), having two inputs connecting two devices or two piping pieces and one output.
2. Headers (see Figure 6 at the bottom), having several inputs (typically 8) and one output.

In one system (outdoor unit and its connecting devices) you may mix both joints and headers, but there are some limitations, explained in section 4.3.5).

1.1.4 BS-Boxes

A BS-box is a device allowing recuperating heat extracted from one room and delivering it to another room. To perform this action, a BS-box connects to its heat recovery outdoor unit using ***three*** pipes, while the connections to its indoor unit(s) consists of ***two*** pipes. VRV_Xpress shows the difference between two and three pipes through different colors, as shown in Figure 7:

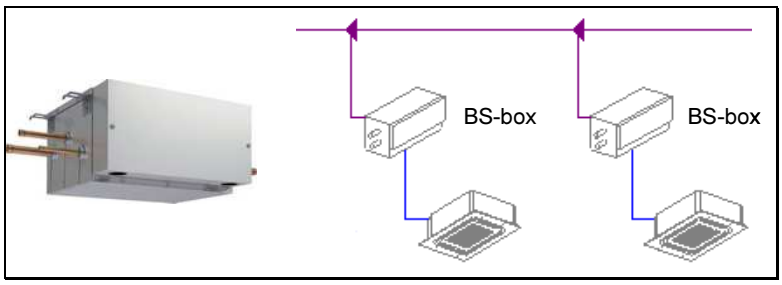


Figure 7: A BS-box and its piping

1.1.5 Other Devices

In addition to the indoor units, VRV_Xpress allows connecting different other devices to an outdoor units, as shown in Figure 8:

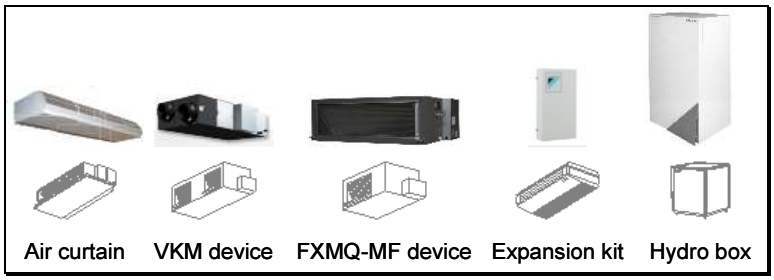


Figure 8: Other devices, which connect to outdoor units

- An air curtain is a ventilation device, mounted at the entrance of shops and public buildings. It creates a warm air jet direct downwards preventing cold ambient air to come in through an open entrance.
- A VKM device is a ventilation device, providing treated ambient air to one or more rooms through ducting. Figure 1 shows a ventilation unit and its ducting, comparable to a VKM device. VRV_Xpress uses required cooling or heating capacity of the VKM device to dimension the outdoor units it connects to. To make a full selection of a VKM device, using airflow and ducting resistance, together with the cooling and heating capacities and possibly electric heaters, you must use the VentilationXpress selection program.
- A FXMQ-MF device is also a ventilation device, providing treated ambient air to one or more rooms through ducting. As for a VKM device, VRV_Xpress only uses the required capacities to dimension the outdoor unit the FXMQ-MF device connects to. For a full selection, you must use VentilationXpress as well.
- A EKEXV device or expansion kit is an interface to connect external devices to a VRV outdoor unit. Each EKEXV device has a maximum (cooling and heating) capacity it can handle. Given required cooling and heating capacities, VRV_Xpress selects the device covering these capacities.
- A hydro box is a device that transforms the heating capacity the refrigerant delivers to it into warm water allowing to connect it to radiators and a boiler (high water temperature) or to floor heating (low water temperature).

These devices all have limitations about their use within a system. VRV_Xpress makes sure you can only make valid selections. It will explain what to do in case you attempt making an invalid selection.

1.2 Selecting a System

When making a selection, the most important criterion is, of course, making sure to cover the required cooling and heating capacities in each room. So, a selection starts with defining the

indoor units in the rooms. You may need some other devices as well, for example a few ventilation devices or a hydro box to provide warm water.

The next step is deciding what kind of outdoor unit you will use: an air-cooled or a water-cooled outdoor unit, a heat pump or a heat recovery system. In case you select a heat recovery system, you must add BS-boxes (see section 4.3.2). The selected outdoor unit compensates for capacity losses due to piping length or heat losses in pipes or extra capacity needed for defrost.

To connect indoor units and other devices, you only have to drag them to the required outdoor unit or BS-box. VRV_Xpress will automatically use joints to interconnect the piping. It also automatically dimensions the different indoor units, BS-boxes and outdoor unit to make sure the indoor units cover their required cooling and heating capacities. VRV_Xpress also calculates an initial wiring diagram showing the control wiring between the indoor units, possibly the BS-boxes and the outdoor unit. This completes an initial selection.

However, you may want to enter more detailed information about the selected system:
- You can enter the piping length of each piping piece and define the number of bends in these pieces. VRV_Xpress then applies all piping rules to dimension the required pipe diameters and to correct refnet joints or headers. If necessary, VRV_Xpress also performs a size up of some diameters to comply with piping rule limitations.
- You can define extra wiring options, such as connecting two indoor units to a single remote controller allowing their concurrent operation.
- You can define a complete central control diagram allowing the management of several systems by a central control system. This is useful in hotels, where rooms are managed from the reception desk, or in large buildings, where a building management system controls the systems remotely from a central location.
- In addition, you may also fine tune the selection itself, by downsizing an indoor unit, although the smaller model does not cover the required capacities, but it comes close enough. This may lead to a smaller or more competing system.

1.3 Using Databases

VRV_Xpress consists of a single file and does not need any installation. To be able to perform its functions, it contains a device database, as shown in Figure 9:

Figure 9: The device database in VRV_Xpress

This database stores the definitions of all devices used in VRV_Xpress. A definition contains families, capacities, correction factors, physical dimensions and limits, …etc. This database also contains options and piping rules.

Having these definitions stored into an integrated database offers several advantages:
- VRV_Xpress is independent from other files, making sure you cannot accidentally move or delete them. All data are available and accessible at any time.

- The device database has an expiration date, as Daikin may decide to launch new devices, abolish existing ones or offer extra options. When the device database becomes outdated, so is VRV_Xpress. A newer VRV_Xpress version automatically contains an updated device database.
- The device database data are read-only, making sure you get the same results, even across different projects.
- It is possible to have a VRV_Xpress version, which is specific for a given region, making sure you only create projects using devices that are available in your region.

2 Initial Setup

This chapter is valid for all Daikin selection programs (VRV_Xpress, VRV_Pro, RefrigXpress, VentilationXpress, Daikin Altherma, etc). In fact, these programs share some settings and at the first you start one of them, it will fill in these settings and store them on a place accessible to the other selection programs. In addition, all selection program perform an automatic version check, allow you to read the release notes and download an user manual. So, the text of this chapter is very similar in the different user manuals, but the figures are specific for the selection program described in the corresponding manual.

2.1 Welcome Window

After having downloaded VRV_Xpress (from Extranet, from a Daikin partner portal, etc), move it to a folder on your computer. You can then keep all project related data in this folder. VRV_Xpress does not need an explicit installation. In fact, it detects its status and performs automatic adjustments, depending on the situation.

A downloaded VRV_Xpress is an English version and does not contain a database (see section 1.3). When you start it the first time, it will look for two global selection program settings:

1. The country you live in. The selection programs use this information to look up the server for program versions available for the program (VRV_Xpress). The functionality of VRV_Xpress is the same for each country, but the database content may differ. In fact, some Daikin devices may or may not be available in some countries.
2. The language version of the program (VRV_Xpress). Each selection program is available in a large set of languages. Note that the language you select is independent of the country you selected. In fact, it is perfectly possible to select a language not spoken at all in the country you selected.

If VRV_Xpress does not find these global settings, it will display a ***Welcome*** window, as shown in Figure 10 at the left. At the right, you find the selections you can choose from. The lists shown here are much larger than the countries or languages supported by Daikin. However, when checking for new versions (see section 2.2), there are two possibilities:

1. Daikin supports the country and language you selected. When new versions are available for that country and in that language, you will get a list of these versions, from which you can select the required one.
2. Daikin does not support either the country or language you selected. When you check for new versions, you will get the default version, which is always a version in English.

For some languages, Daikin offers variant versions. So, these languages appear as sub versions of that language, as for instance English (Australia) in Figure 10.

Once you have selected the country and language, the other Daikin selection programs can get that information and so, you do not have to enter it again. However, you can change this setting at any time, in the window to download new versions (see section 2.2) and in the About window (see section 2.6).

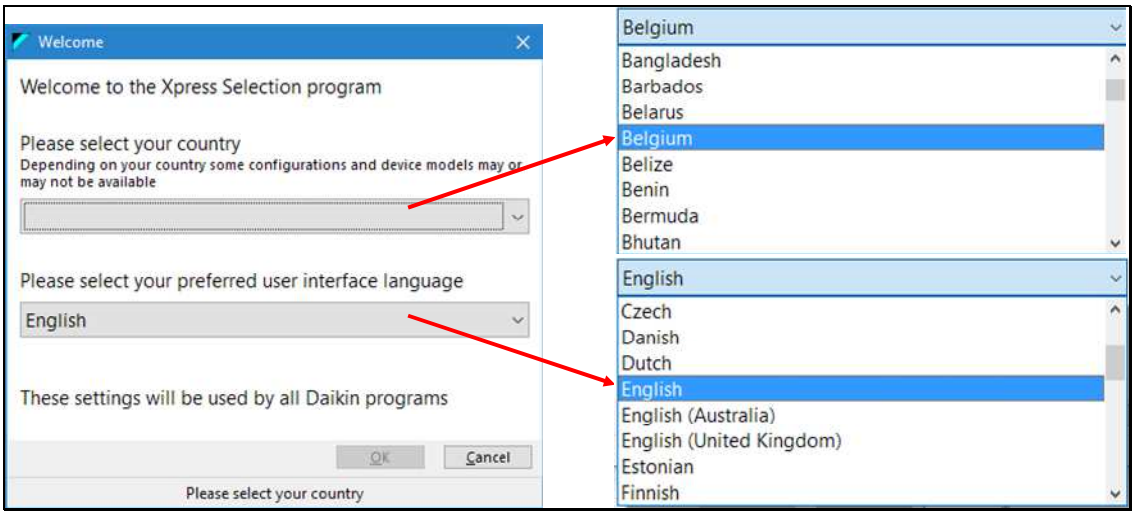


Figure 10: Selecting the country and the language

2.2 Getting the First New Version

As explained in the previous section, a downloaded program (VRV_Xpress) does not contain a device database (see section 1.3) and it is an English version. When you start VRV_Xpress it notices it needs a database and connects to a central server, called DENV. So, your computer needs an Internet connection and ***it is not possible to get any version without it***.

Important note: ***Make absolutely sure the selection program you are using has the correct name. For VRV_Xpress, the name must be "VRV_Xpress.exe". When connecting to the central server, VRV_Xpress must send its executable name. If that central server does not recognize the name it receives, it refuses to proceed.***

The central server will look up the available versions for the given country and language. A version consists of five parts:

1. The program name. In fact, the central server uses this name lookup its database for versions for the given selection program (VRV_Xpress).
2. The program version. A program version defines the available functionality.
3. The program language. VRV_Xpress comes in different language versions (English, French, …etc). The central server will look for the language you selected (see section 2.1)
4. The configuration used for filtering of the devices. Depending on the region or country, Daikin may decide whether or not to offer specific devices. For example, Daikin equips some devices for extreme cold or extreme hot regions. It makes no sense to sell devices for extreme cold regions in extreme hot regions. A configuration defines the set of available devices and the default configuration contains all devices.
5. The version number of the central database.

Using this information, the central server looks up the available versions and sends it to VRV_Xpress, which brings up a window as shown in Figure 11:

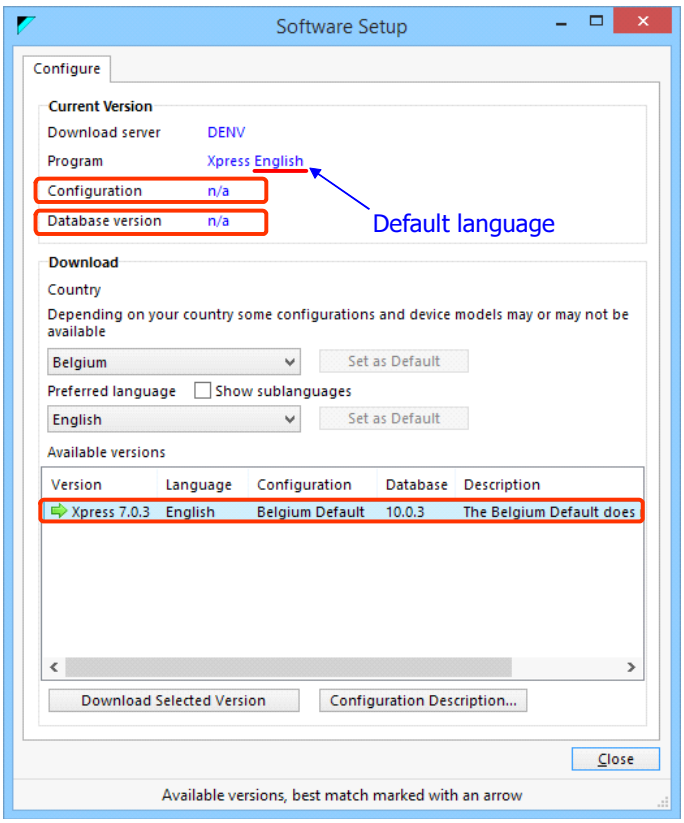


Figure 11: Looking up the available versions

- The top of this window shows that this is the initial VRV_Xpress version, as there is no version information yet.
- The middle part shows the country and language information, you filled in (see section 2.1).
- The bottom part shows the list of available versions: the list here contains only one version, which is the default version for Belgium. It contains a configuration name and description, which may consist of several lines of text. Click on the "***Configuration Description***" command button to display this text in a window, as shown in Figure 12:

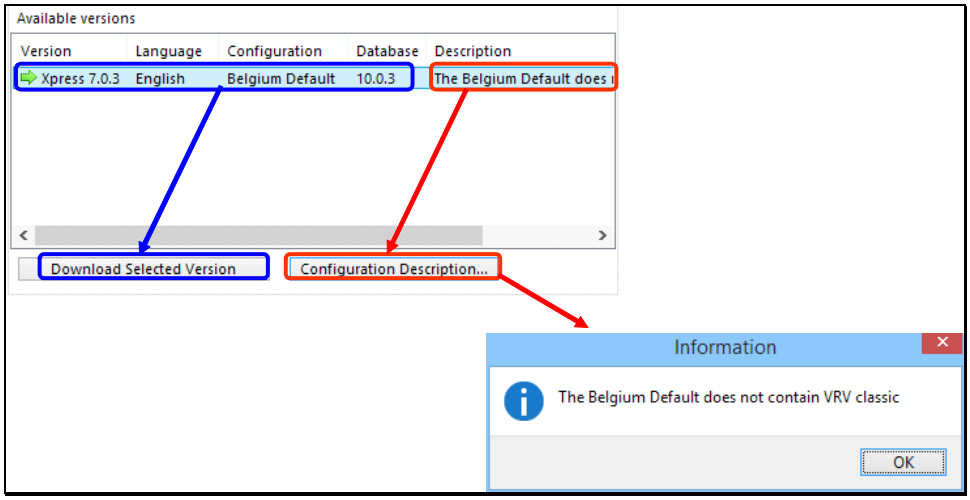


Figure 12: Getting information about a specific configuration

Click the "***Download Selected Version***" command button to download and install the version. Before starting this download, VRV_Xpress brings up a Notice window as shown in Figure 13:

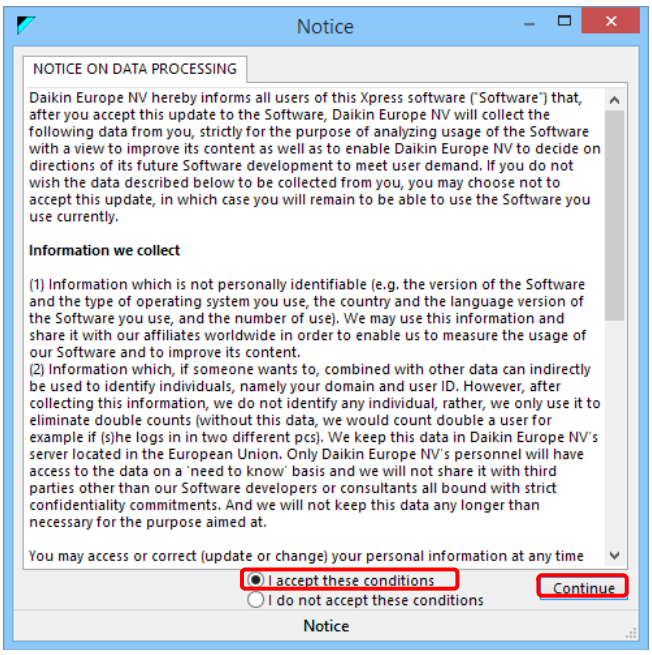


Figure 13: Notice about collecting statistics data

It explains that VRV_Xpress is collecting statistics data during its execution. It sends these to the central server, together with the version, the configuration, the language, …etc. These data are used to perform an analysis about the use of VRV_Xpress, the kind of projects developed, …etc.

To continue, you first have to select "***I accept these conditions***" and click the "***Continue***" button. VRV_Xpress stops without downloading a new version if you select "***I do not accept these conditions***", and click the "***Continue***" button.

After having accepted these conditions VRV_Xpress starts the download. The bottom of the software setup window of Figure 11 changes into a progress bar. On a normal Internet connection, this downloading process takes less than one minute. At the end of the download, VRV_Xpress displays a window to restart it, as shown in Figure 14:

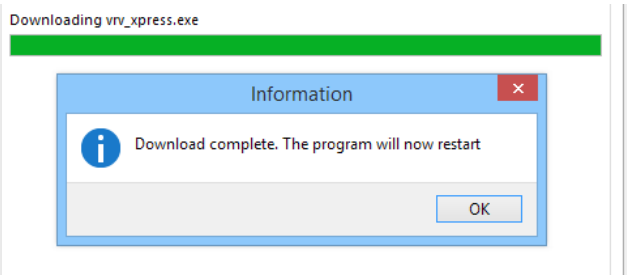


Figure 14: Version download is completed

This completes the initial setup of VRV_Xpress.

2.3 Disclaimer Window

After having completed the initial setup of VRV_Xpress, it restarts as a new version.

Each time you start a new version, VRV_Xpress displays a disclaimer window, as shown in Figure 15. This window explains the general conditions of using this VRV_Xpress software.

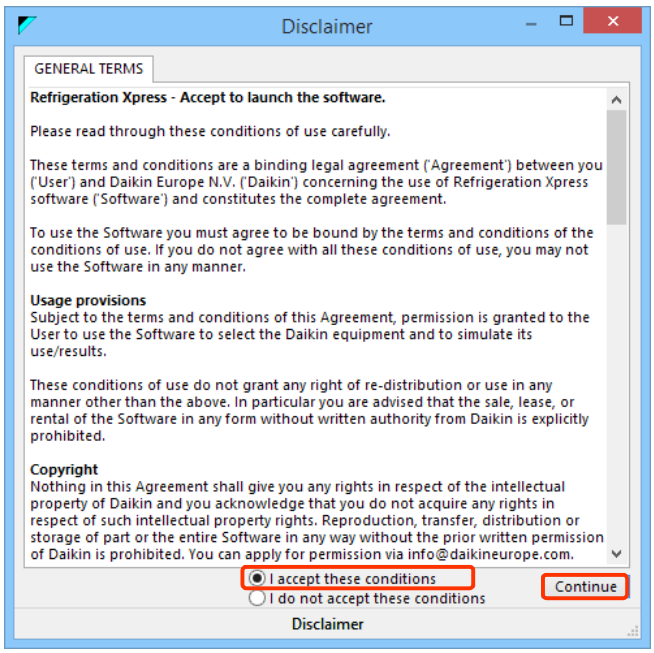


Figure 15: The disclaimer window

To continue, you first have to select "***I accept these conditions***" and click the "***Continue***" button. VRV_Xpress stops if you select "***I do not accept these conditions***", and click the "***Continue***" button.

2.4 Registering

Before being able to use VRV_Xpress, you need to register it. This action is only needed the first time you use VRV_Xpress. Registering is a two step process:

1. First you have to fill in registration data, as shown in Figure 16

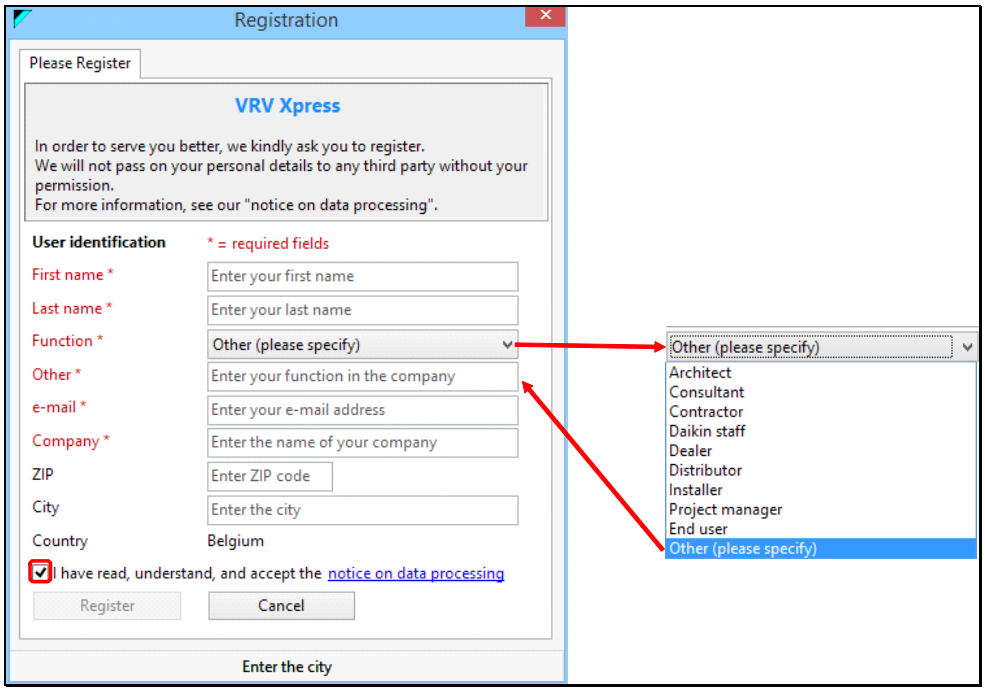


Figure 16: The registration form

This form contains a required fields and a few optional fields. The most important required field is the e-mail address. ***This must be a correct and existing e-mail***. In fact, to finish the registration, the Daikin server will send you a registration code (see step 2) to this e-mail

address. If this address doesn't exist or contains an (typographical) error, you will not receive an e-mail, preventing you to complete the registration process.
After you filled in the required fields, make sure to check the checkmark at the bottom: you can first read the notice on data processing, which will check the checkmark automatically or you have to do this manually. This will make the "***Register***" command available. Click it to send the information to the Daikin server.

2. VRV_Xpress now extends the registration window to allow you entering a confirmation code and after a short moment, the Daikin server will send you a mail with that confirmation code. Figure 17 shows the window after having clicked the "***Register***" command button, and waiting for the mail. The registration code is a large numeric code, e.g. 2131974122.

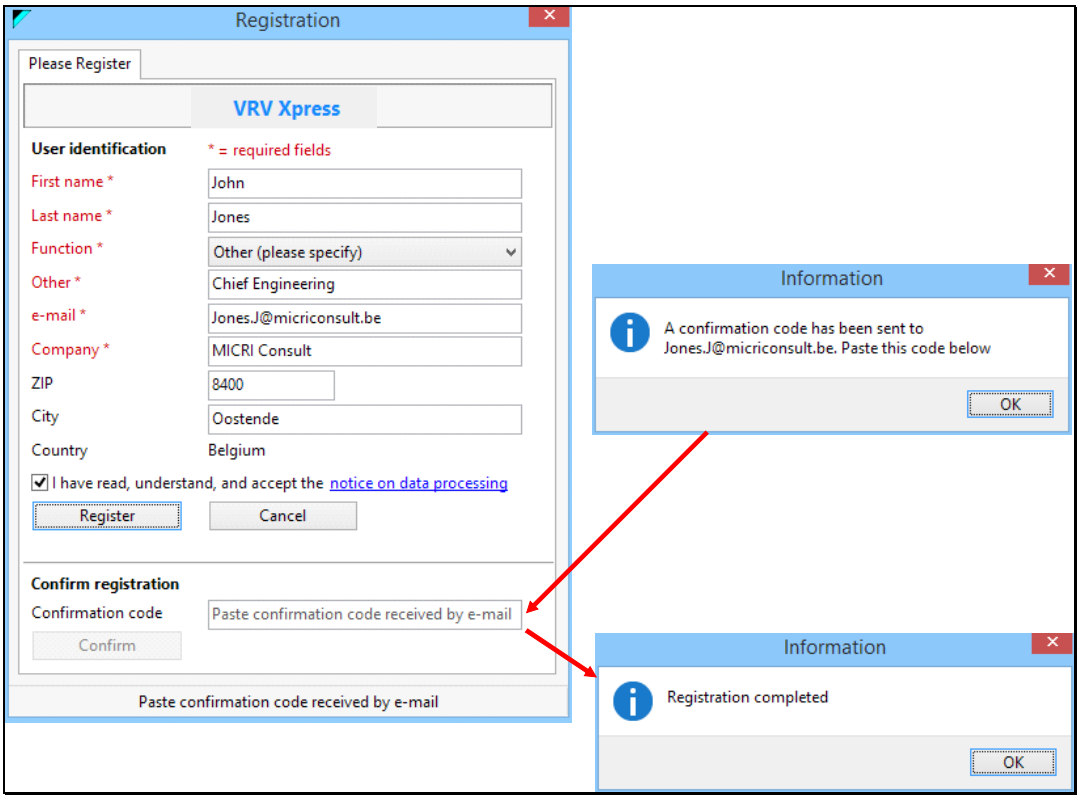


Figure 17: The final registration

When you enter that code, you receive a message that the registration was completed successfully.

This is the final window before showing the main window, as explained in section 2.7

2.5 *Automatic Version Checking*

Each time you start VRV_Xpress and after having displayed the disclaimer window (if any), VRV_Xpress connects to the central server to look for possible new versions:

- There may be a new program version offering new functionality.
- There may be a new device database, offering new devices or containing additions to existing devices.
- There may be a new language version.

A connection to a central server is only possible with an operational Internet connection.

When the central server finds new versions, VRV_Xpress displays the Upgrade window, as shown in Figure 18:

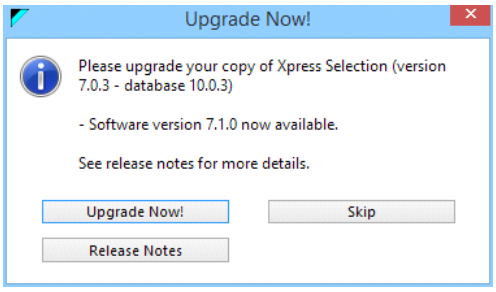


Figure 18: The new version window

This window gives some information about the available version. In Figure 18 there is a new program version available. It is up to you to decide what to do now:

- Click the "***Upgrade Now!***" command button, to bring up the same software setup window of Figure 11, allowing to download the new version in the same way as the very first version (see section 2.2).
- Click the "***Skip***" command button to ignore the new version and to proceed with VRV_Xpress still using the current version.
- Click the "***Release Notes***" command button to display the release notes about the new version, from the current version up to the latest version on the central server (see Figure 19):

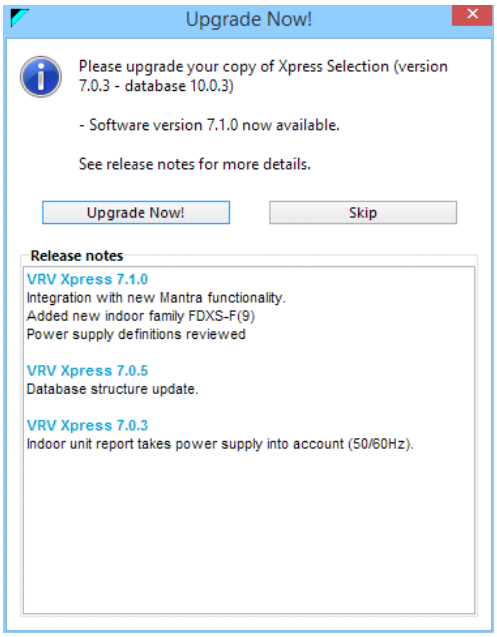


Figure 19: Showing release notes

Release notes refer to the program version and to the database version. When the central server contains a new device database, this window still shows the release notes of the program version followed by the release notes of the new device database.

After reading the release notes you may still decide to install the new version or proceed with the current version.

2.6 About Commands

The main VRV_Xpress window (see section 2.7) has a command toolbar containing an ***About*** command, as shown in Figure 20 at the top (see section 6.1 for the other commands):

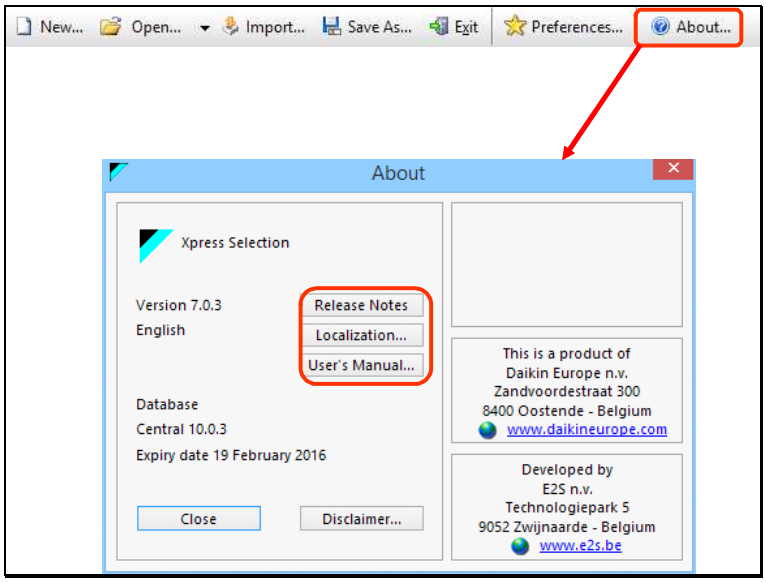


Figure 20: The About window with its version related commands

Clicking this command brings up the About window. contains three version related command buttons:

1. The "***Release Notes***" command button shows the release notes in the same way as in the upgrade window (see Figure 19). The only difference is that they now appear below the About window, as shown in Figure 21:

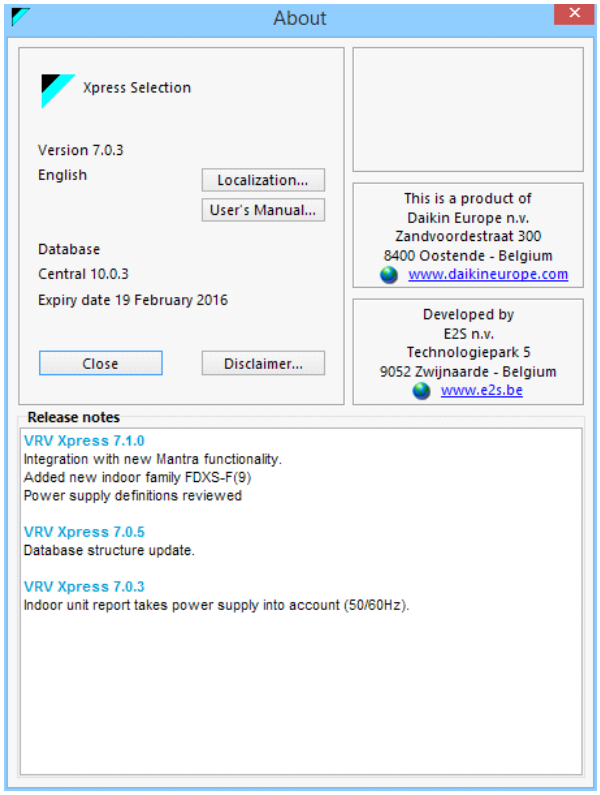


Figure 21: The release notes in the About Window

If you do not upgrade the version, you get all release notes from your current VRV_Xpress

version to the latest version available on the central server, for a maximum of 5 versions.

2. The "***Localization***" command button brings up a window similar to the Welcome window in Figure 10, in which you can change the selected country and language (see section 2.1). Changing the country may lead to different configurations than in the current country and changing the language obviously may lead to a different language version. When closing this window, VRV_Xpress notices the changes and displays one of the question windows from Figure 22:

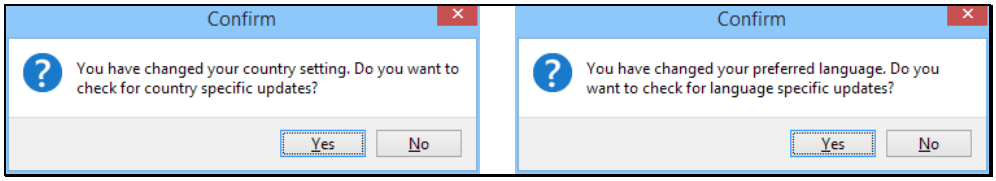


Figure 22: Confirming a lookup for new versions

Answering "Yes" to these questions starts a communication with the central server to look for a new version. As a result, VRV_Xpress brings up the version overview window as shown in Figure 11 (see section 2.2), from which you can download the required version.

3. The "***User's Manual***" command button downloads this user manual as pdf file and allows you to save it locally on your computer. This command only appears if there is a manual available.

2.7 The Main Window

After the initial windows, the main VRV_Xpress window comes up, containing several tabs, as shown in Figure 23:

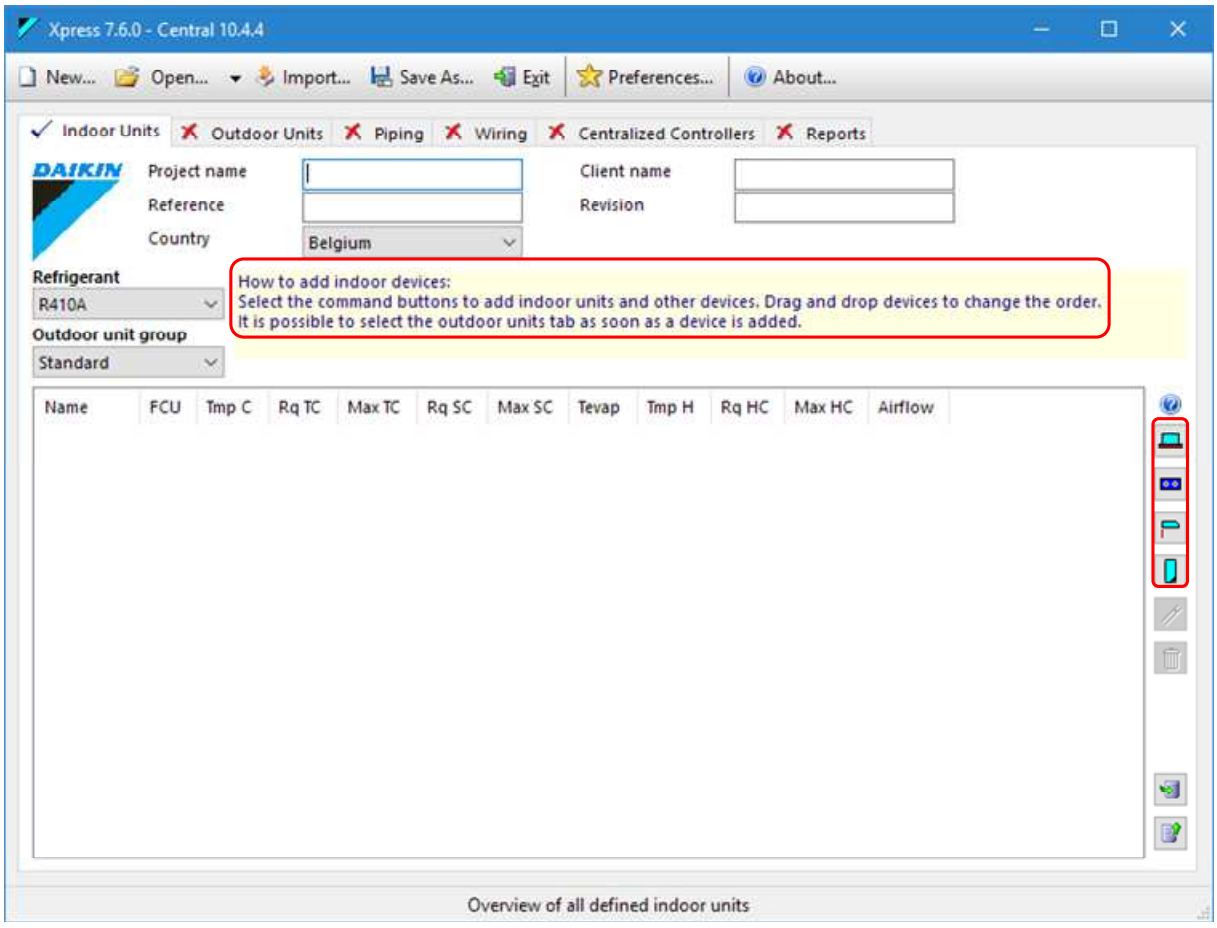


Figure 23: The VRV_Xpress start up window

It shows the "***Indoor Units***" tab to enter indoor units and other devices. At the top is shortly explains how to enter these devices, by clicking on the of icon commands at the right.

The other tabs are not selectable yet, as you first need to enter indoor units and other devices. However, these tabs are:

- Outdoor units: in this tab, you select an outdoor unit and connect the indoor units and other devices to it.
- Piping: this tab shows the piping diagram, which you can refine by rearranging it or by entering the piping lengths.
- Wiring: this tab shows the wiring diagram, which you can refine by defining remote controllers, for example.
- Centralized Controllers: in this tab you define central controller systems managing several systems in a hotel or building.
- Reports: allows you selecting the different parts you want to get in a report.

The next chapters will explain these tabs in much more detail, while making and refining a selection.

3 Making a Selection

This chapter explains the different steps to follow to make a first and simple selection, which only uses indoor units and an outdoor unit. Next chapters refine this selection and combine other devices as well.

3.1 Selecting the Indoor Units

As explained in Figure 23, you bring up the indoor unit edit window by clicking the indoor unit icon at the right. This edit window allows you filling in a few fields to get a complying indoor unit, as shown in Figure 24:

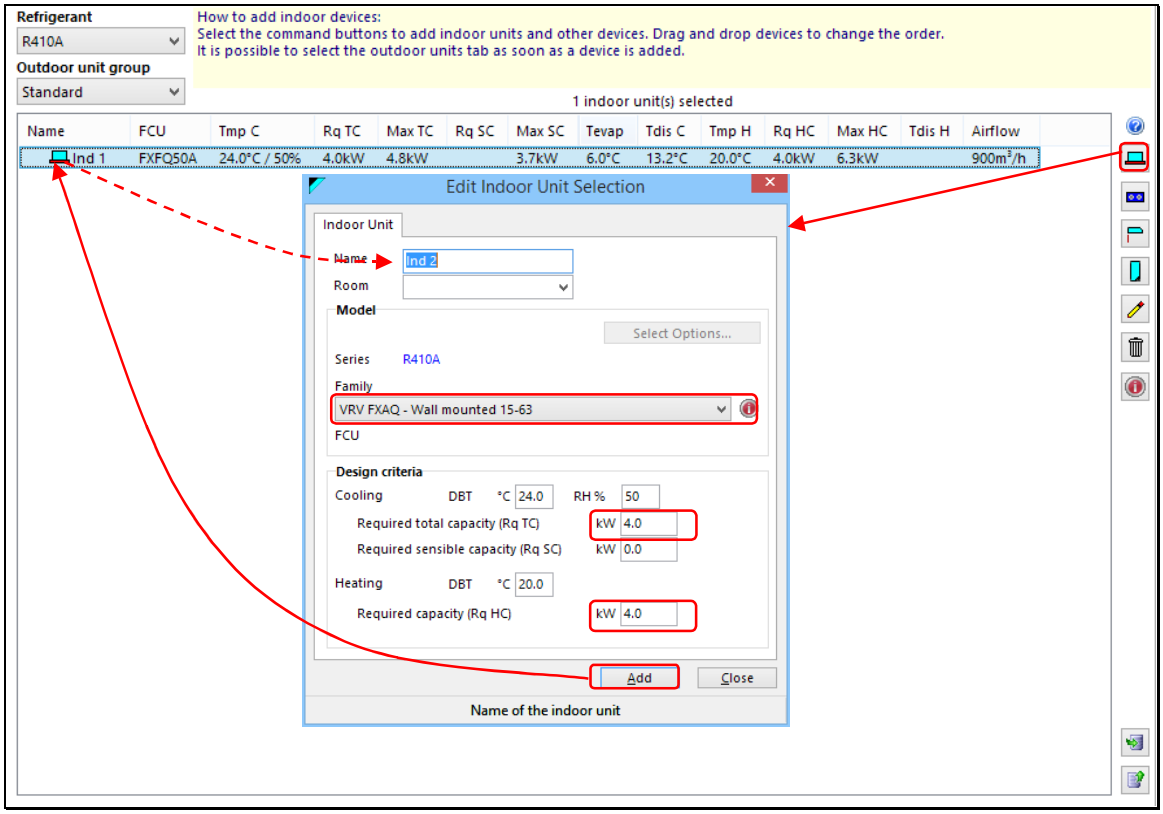


Figure 24: Selecting indoor units

- VRV_Xpress automatically fills in a name for the indoor unit. By default, this name starts with "***Ind***", followed by a number. You can change this name by typing the name you had in mind. You can also change the default in the Preferences window, as explained in section 0. For the moment, just accept the default generated names.
- A more important field is the family, as it defines the kind of indoor unit: wall mounted, ceiling mounted, floor standing, etc. The combo box contains all families available in the database. For this selection example, you select the wall mounted cassette. The family name also contains the indoor unit range, as shown in Figure 25. This gives an first idea about the possible choices. You do not have to select a size. VRV_Xpress does this, based on the required capacities.

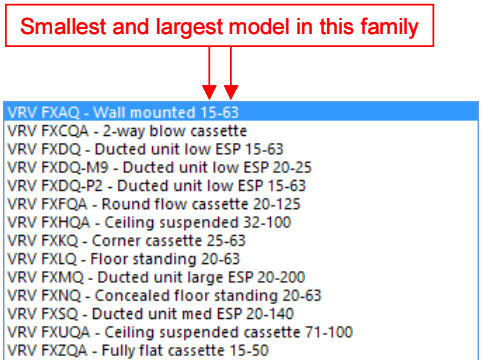


Figure 25: Selecting the indoor unit family

- VRV_Xpress fills in the cooling condition for the room. By default, it shows the room temperature of 24^{0}C with a 50% relative humidity. When you change this condition, VRV_Xpress remembers it and uses this new condition for the next indoor unit

selections.

- VRV_Xpress uses the required total capacity you enter to look up all indoor unit sizes for the selected family and selects the one that covers the closest the required total capacity. If you leave this field zero, VRV_Xpress does not consider it for the indoor unit selection.
- You can also enter the required sensible capacity to add an extra criterion that VRV_Xpress must cover. If you leave this field zero, VRV_Xpress does not consider it for the indoor unit selection.

  Entering a value for the required sensible capacity requires careful consideration. In fact, when cooling down the air in a room, the ***total*** capacity of an indoor unit produces two effects:

  a. The absolute humidity in the air reduces by producing condensate. The part of the total capacity responsible for this effect is the ***latent capacity***.
  b. The temperature drops. The part of the total capacity responsible for this effect is the ***sensible capacity***. As a rule of thumb, the sensible capacity of an indoor unit is about 75% to 80% of the total capacity.

  The total capacity is the sum of these latent and sensible capacities. So, be careful to enter a figure that is ***lower than the total capacity***. In addition, when you enter a sensible capacity, you also should enter total capacity. However, if you leave the total capacity field zero, VRV_Xpress assumes a total capacity for which the given sensible capacity is 75% of that value, as shown in Figure 26:

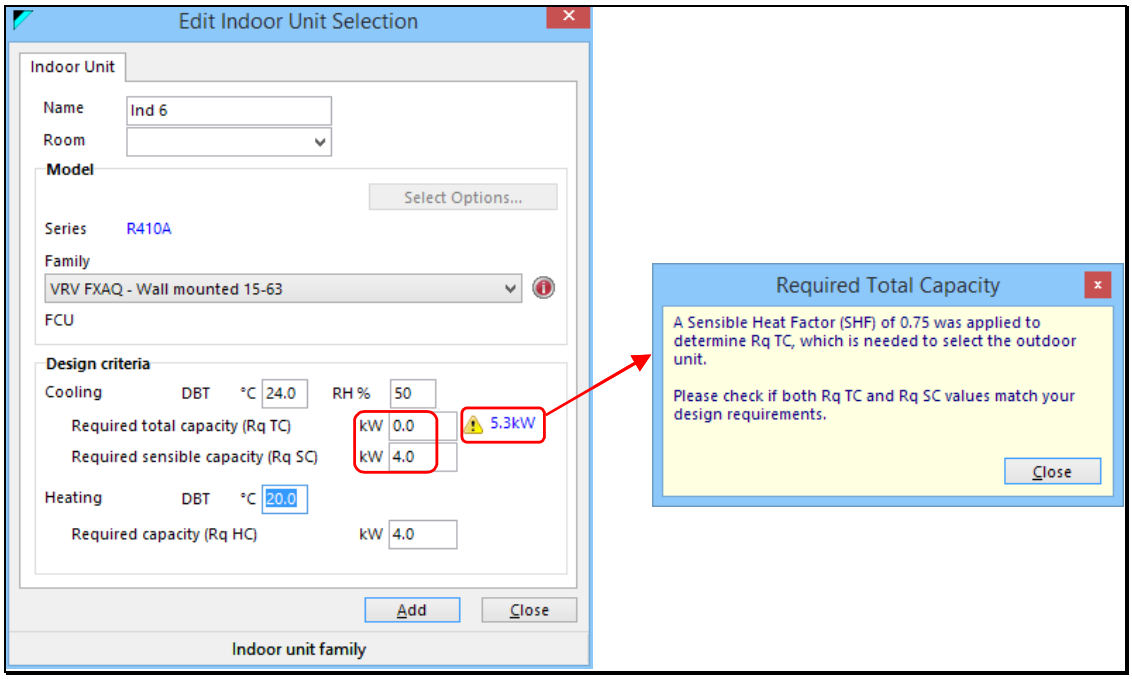


Figure 26: Entering a sensible capacity without total capacity

- As for cooling, VRV_Xpress also fills in the heating condition for the room. By default, it shows the room temperature of 20^0C. However, when you change this condition, VRV_Xpress remembers it and uses this new condition for the next indoor unit selections.
- VRV_Xpress uses the required capacity you enter to look up all indoor unit sizes for the selected family and selects the one that covers the closest the required capacity. If you leave field zero, VRV_Xpress does not consider it for the indoor unit selection.

After filling in these data you can now click the "***Add***" command button to add the indoor unit to the list, as shown Figure 24. VRV_Xpress selects an indoor unit from the selected family covering the closes the required capacities. It then changes the sequence number in the indoor unit name in its edit window. In Figure 24, that name is now "***Ind 2***", making the window ready

for the next indoor unit. If the next room in the building has the same requirements, all fields can remain the same. Just click the "***Add***" command button again to add the next indoor unit.

Figure 27 shows the result of selecting a few indoor units that way. All indoor units, except the last one have, the same model FXFQ50A. Note that for a given maximum total cooling capacity of 4.8kW the indoor unit provides a sensible cooling capacity of 3.8kW, which is about 80% of the total capacity. It also provides a much larger heating capacity of 6.3kW.

You can configure the overview by clicking the question mark icon at the right of it. This brings up a window explaining the titles used in the overview. It also contains checkmarks in front of each column item. Unchecking these checkmarks removes the column from the overview. In Figure 27 at the bottom, the columns about the sensible capacity have been removed from the overview.

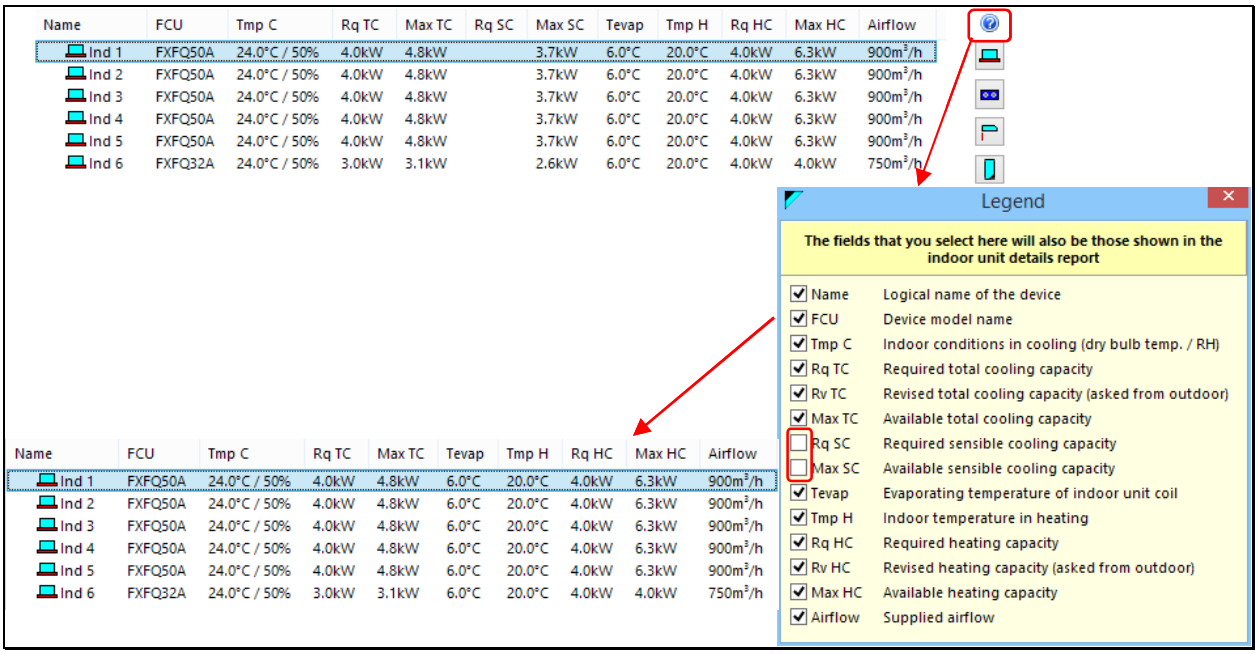


Figure 27: Adding a few indoor units

One final word about the selected indoor units. When clicking on one of them, you select it and at the right border a small red icon appears. Clicking it brings up a window allowing you connecting to Internet or Extranet to get more information about the selected indoor unit or any other device you want to connect to an outdoor unit. Figure 28 gives a schematic overview of how to get this information.

This red icon appears everywhere in VRV_Xpress where you can select a device. So, anywhere you see a red icon appearing you can connect to Internet or Extranet.

> ***Important note***: the red icon only appears if there is information available on Internet or Extranet about the selected device.
> ***Note***: Extranet information if only accessible if you have the permission for it. This means that you will have to enter a user name and password.

Having selected these indoor units, the next step is connecting them to an outdoor unit.

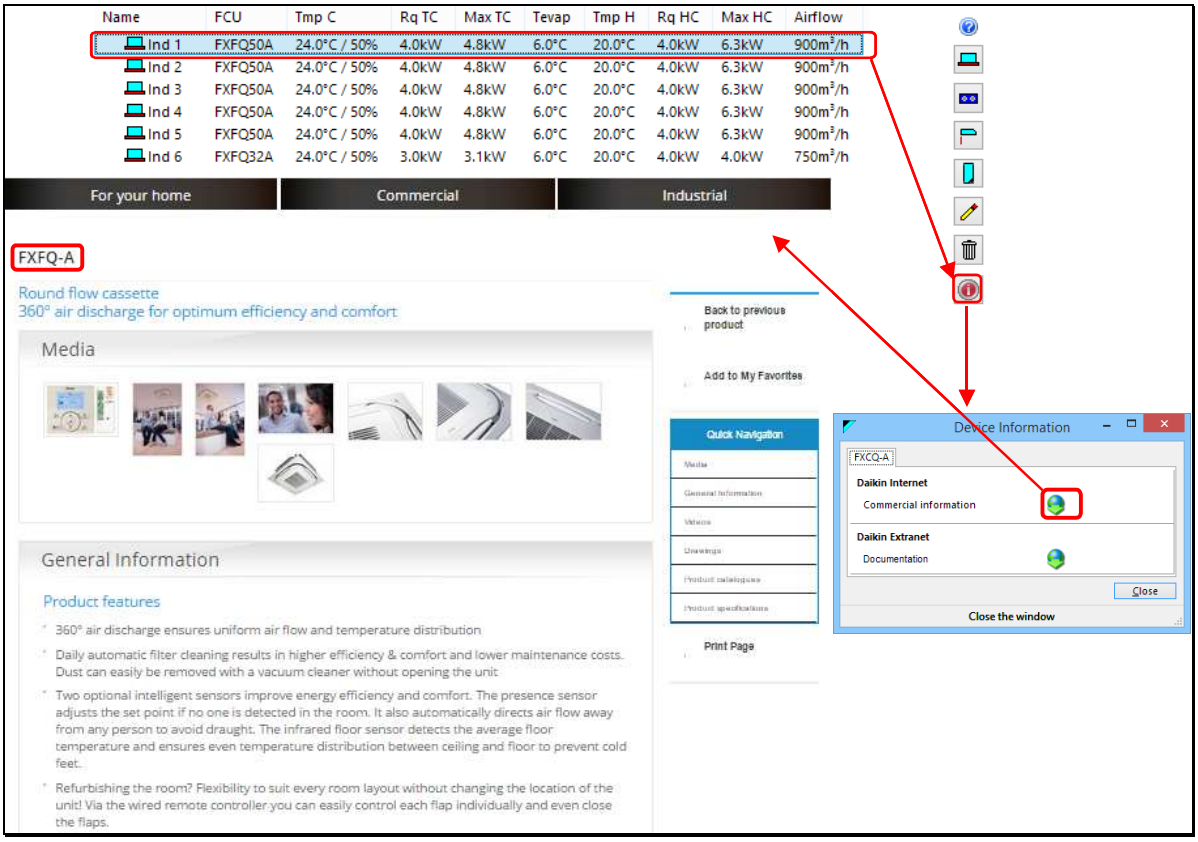


Figure 28: Getting information from Internet or Extranet

3.2 *Selecting the Outdoor Unit*

Once you close the "***Edit Indoor Unit Selection***" window, after having entered at least one indoor unit, the "***Outdoor Units***" tab becomes available. Click on that tab to get a window, as shown in Figure 29. As there no outdoor units yet, this tab is empty. However, at the bottom right, you see the list of indoor units to connect to an outdoor unit. This list contains the six indoor units you defined in the previous section.

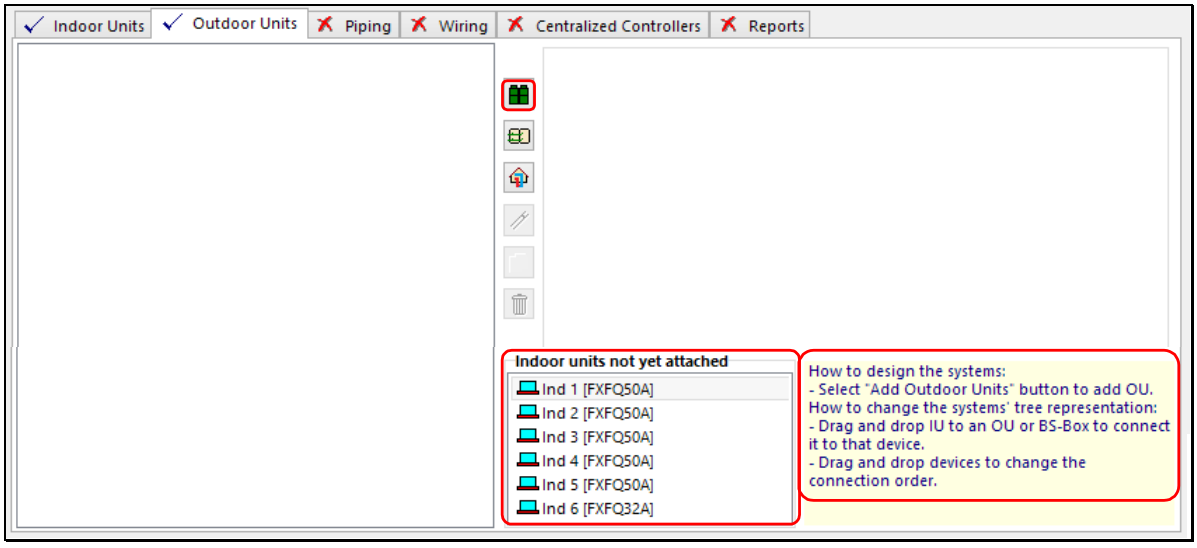


Figure 29: The outdoor units tab

Clicking the green icon at the top in the middle of the tab, brings up the (air-cooled) outdoor unit edit windows as shown in Figure 30:

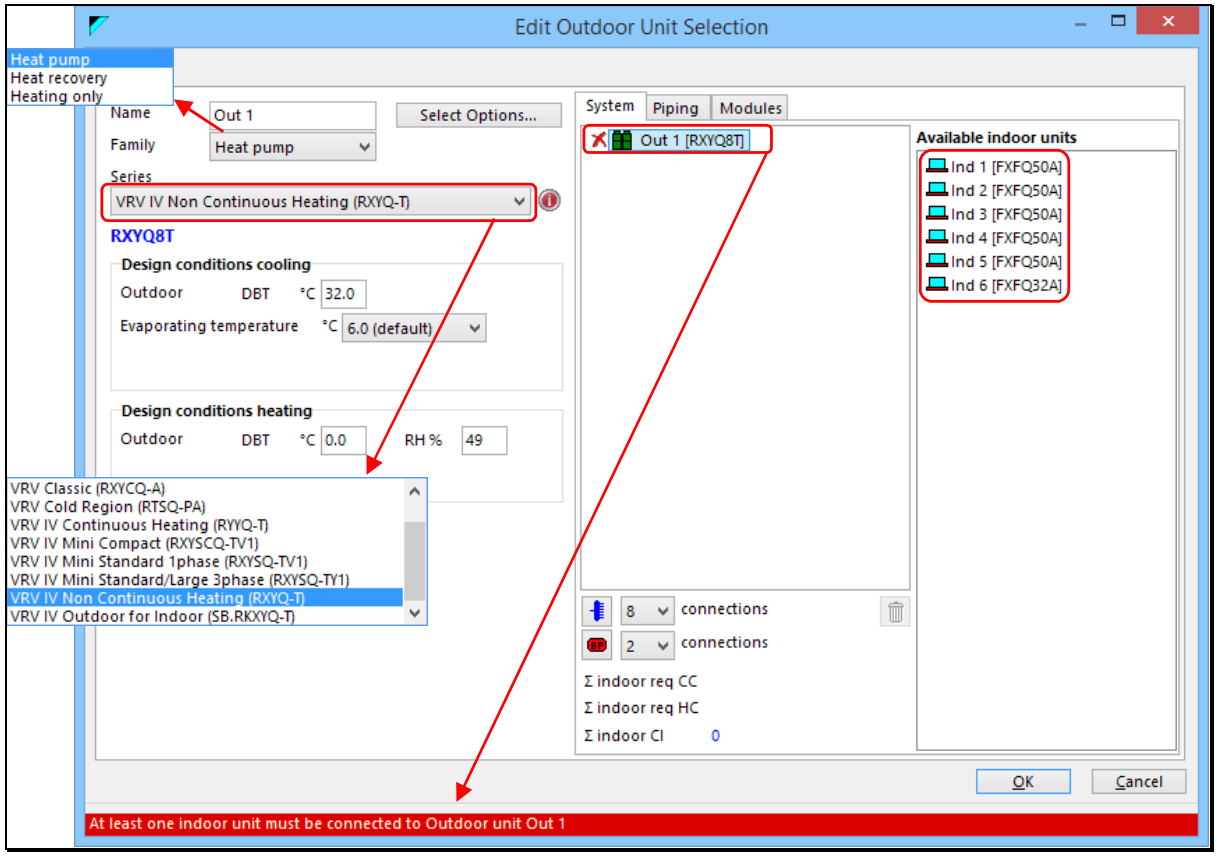


Figure 30: The outdoor edit window

- As for the indoor units, VRV_Xpress automatically fills in a name for the outdoor unit. By default, this name starts with "***Out***", followed by a number. You can change this name by typing the name you had in mind. You can also change the default in the Preferences window, as explained in section 0. For the moment, just accept the default generated names.
- As for indoor units, outdoor units also have a family. For outdoor units, the family stands for what kind of operation the outdoor supports. An outdoor unit can be a heat recovery (see Figure 3), a heat pump (see Figure 2), heating only or cooling only. Heating only and cooling only are specialized heat pump outdoor units.
- Within the selected family, several series may be available. In Figure 30, the heat pump family has eight series: VRV Classic (RXYCQ-A), VRV Cold Region (RTSQ-PA), VRV IV Continuous Heating (RYYQ-T) and so on. A series has a number of models, allowing you defining a small system containing a few indoor units or a considerable system with up to 64 indoor units of different sizes.
- There are no indoor units connected yet to the outdoor unit. VRV_Xpress finds the smallest available outdoor unit in the selected family and series (RYYQ8T), but also marks it with a red cross to indicate a problem. Selecting the outdoor unit will show a message at the bottom of the window explaining the problem, as shown in Figure 30.
- At the right of the outdoor unit, the list of available indoor units appear. You can select and drag them to the outdoor unit. You can do this one indoor unit at a time or select them first and drag them all at once.

Figure 31 shows the result after having connected the indoor units to the outdoor unit:

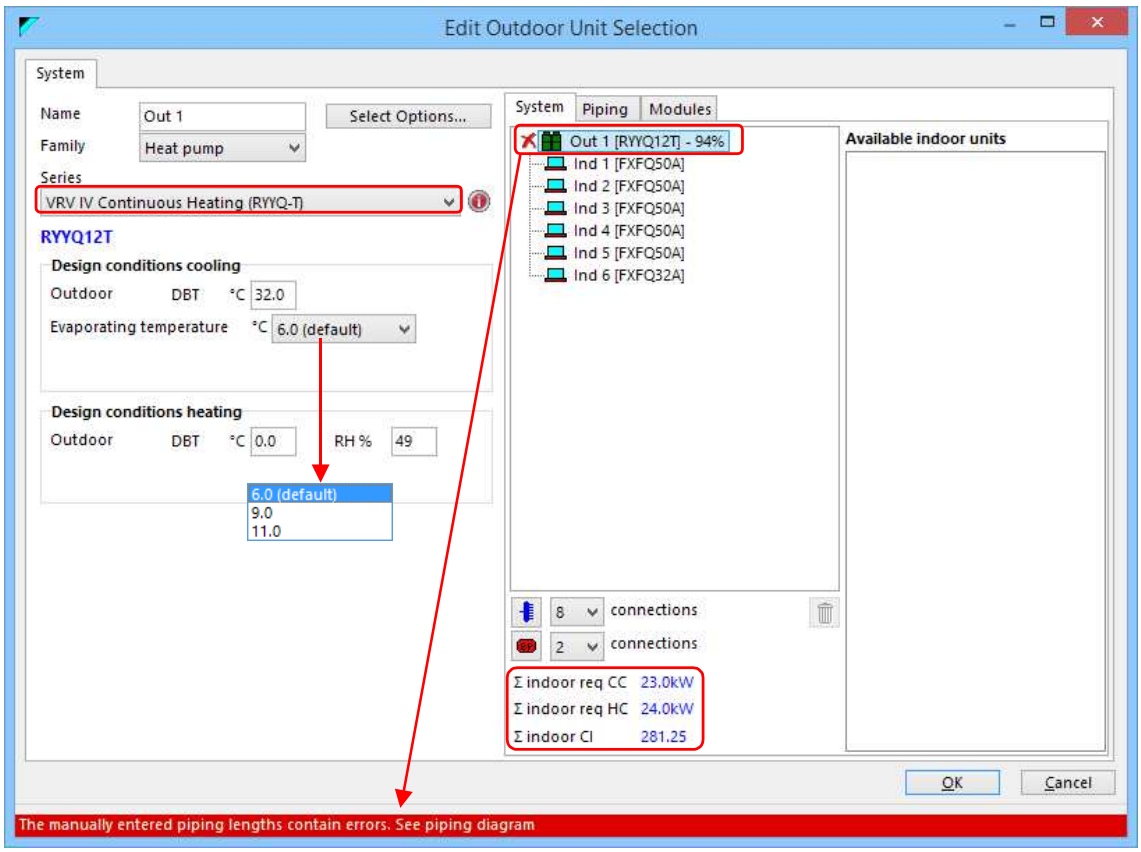


Figure 31: Connecting the indoor units

The outdoor unit now gets a larger model (RYYQ12T) and at the bottom. VRV_Xpress gives an overview of the required capacities for the connected indoor units (see also Figure 27):

- The total required cooling capacity, which is 5 x 4.0kW + 1 x 3.0kW = 23.0kW
- The total required heating capacity, which is 6 x 4.0kW = 24.0kW
- The total connection index for the indoor units, which is 5 x 50 + 1 x 31.25 = 281.25. A connection index is a dimensionless number related to the maximum capacity an indoor can deliver.

In a regular cooling cycle, the sizes of the condenser (= the outdoor unit) and the evaporator (= the indoor units) match, which corresponds with a connection ratio of 100%. The indoor units maximally get the capacity that the outdoor unit can provide. The connection ratio is the ratio between the connection index of the connected indoor units and the connection index of the outdoor unit.

However, ***increasing*** the size of the evaporator by ***30%*** (by connecting more indoor units to the outdoor unit) increases the available capacity of that outdoor unit by ***7%*** for only a fraction of the required power input. The optimum configuration of an outdoor unit with its indoor units is when the connection ratio is close to 130%. Increasing the ratio to larger values no longer increases the available capacity.

Starting from the smallest outdoor unit in the family and connection ratios from 100% to 130%, VRV_Xpress now looks up the outdoor units covering the total required cooling and heating capacities and the total required connection index from the indoor units. In Figure 31, the connection ratio of the selected outdoor unit model (RYYQ12T) is 94%. This figure is explained in Figure 32 showing an overview of the selected outdoor unit data:

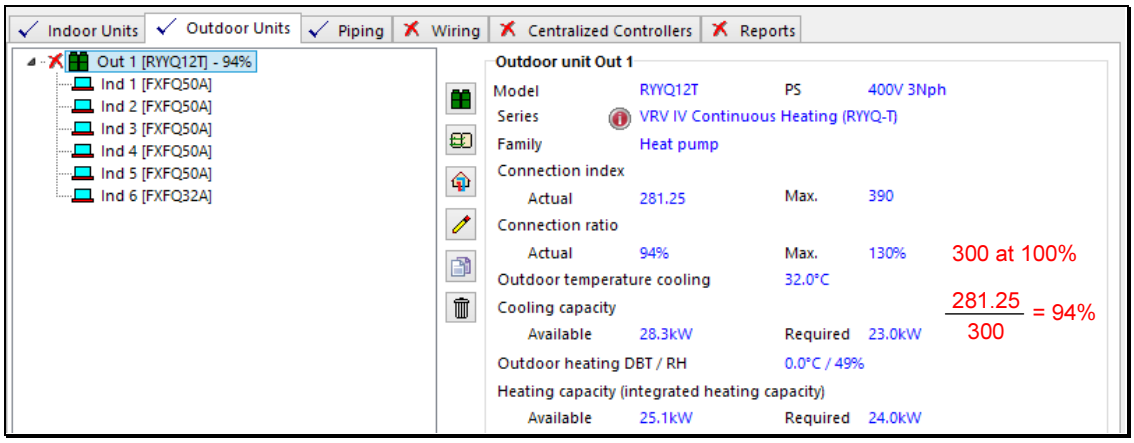


Figure 32: Overview of the selected outdoor unit data

- The actual connection index is 281.25, whereas the outdoor unit has a maximum connection index of 390 at a connection ratio of 130%. At 100%, the connection index is 300 (from the data book), which still covers the required 281.25. The actual connection ratio is then 281.25 / 300 = 93.75%, rounded to 94%.
- The available cooling capacity (28.3kW) covers the total required cooling capacity (23.0kW).
- The available heating capacity (25.2kW), covers the total required heating capacity (24.0kW).

However, the outdoor unit in Figure 31 still gives an error message. In fact, although the indoor units are connected now, VRV_Xpress cannot calculate corrections for the piping, as you still have to fill in piping lengths. Before getting into piping lengths, consider the information at the left side of the window of Figure 31 and also given at the right side in Figure 32 containing the design cooling and heating conditions for an air cooled outdoor unit:

- The design cooling conditions shows the following data:
  - The outdoor dry bulb temperature is the design ambient temperature for which the outdoor unit has been selected for cooling. The higher this temperature, the less efficient the outdoor unit becomes. Its best performance is in the range from 15^0C to 35^0C. VRV_Xpress uses a default value of 32^0C.
  - The evaporating temperature is the temperature of the liquid refrigerant at the moment it evaporates in the indoor units to extract heat from the room. The lower this temperature, the faster the indoor unit cools down but it also extracts more moist from the air. A higher temperature results in indoor units cooling down more gentle, but it may require a larger model to cover the required capacity.
- The design heating conditions show the following data:
  - The outdoor dry bulb temperature is the design ambient temperature for which the outdoor unit has been selected for heating. The lower this temperature, the less efficient the outdoor unit becomes. Its best performance is in the range from 0^0C to 15^0C. VRV_Xpress uses a default value of 0^0C.
  - The outdoor relative humidity is the ambient relative humidity. VRV_Xpress uses a default value of 50%. For locations with high humidity, up to 80% would be a more appropriate value.
- The cooling capacity shows the following data:
  - The available cooling capacity is the cooling capacity the outdoor unit delivers at a connection ratio of 94%. The outdoor unit takes losses into account due to piping lengths. So, this capacity may change when you enter the actual piping lengths (see section 3.3).
  - The required indoor unit cooling capacity is the sum of the required cooling capacities of the connected indoor units. In this example project, there are 5 indoor units requiring 4.0kW and 1 requiring 3.0kW, giving a total of 23.0kW.

- The heating capacity shows the following data:
  - The available integrated heating capacity is the heating capacity the outdoor unit delivers at a connection ratio of 94%, but which is less than the published heating capacity. Indeed, integrated heating capacity is the published capacity minus the capacity the outdoor unit uses for ice defrosting. As the outdoor unit takes the losses into account due to the piping lengths, this capacity may change when you enter the actual piping lengths.
  - The required indoor unit heating capacity and the operational load have the same meaning as for cooling.

When selecting a water cooled outdoor unit, the outdoor unit edit window looks slightly different. In fact, there is no point in defining ambient air conditions. Instead, you must define the design water conditions, as shown in Figure 33:

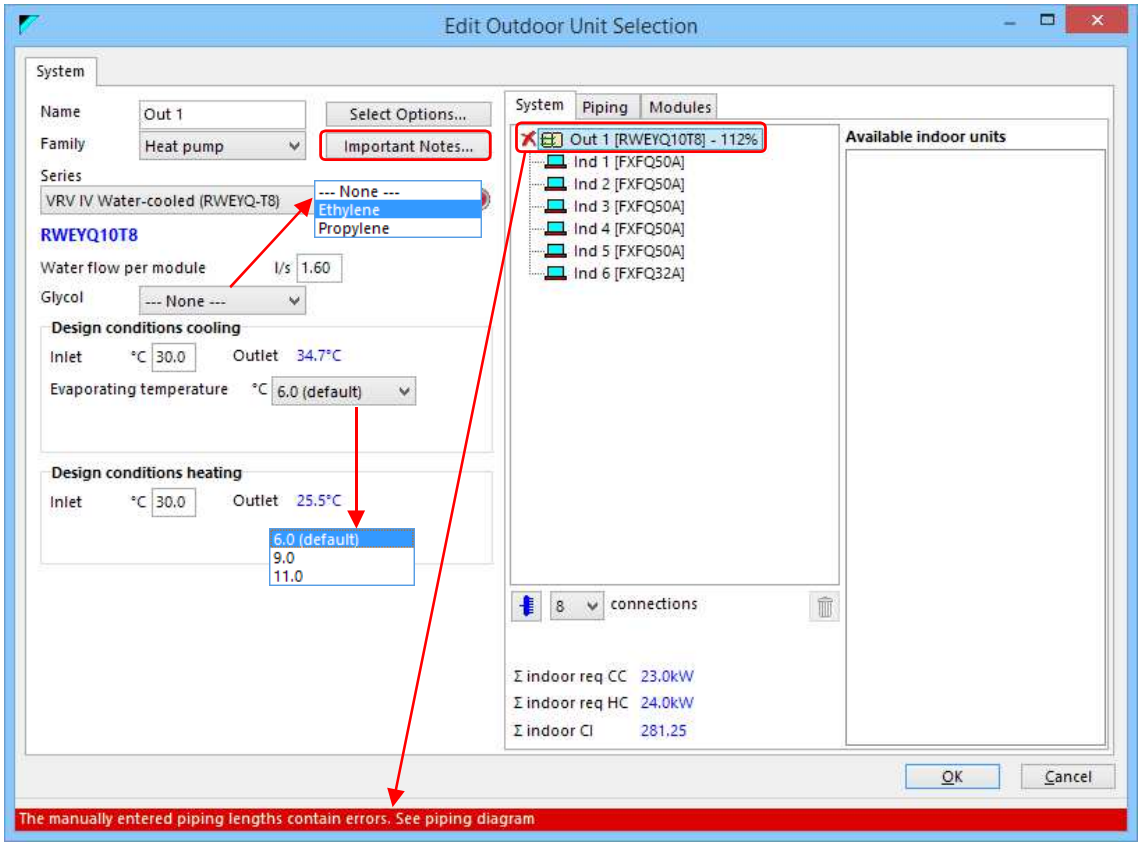


Figure 33: Defining a water cooled outdoor unit

- The water flow per (outdoor unit) module is the water flow used to provide the required capacity. A low water flow value requires more power input to provide the required cooling or heating capacity.
- If you select glycol, you will need to enter a percentage, up to a maximum of 40%. Glycol prevents the water to freeze, but also lowers the available capacity, as glycol does not transport heat as well as water.
- The cooling inlet temperature defines the water temperature for cooling. The lower this temperature, the less power input (electricity) the outdoor unit needs to provide the required cooling capacity. However, the water treating system (a cooling tower or boiler plant) then requires more power input to provide the water at the required temperature. VRV_Xpress uses 15^0C as a default value.
- The heating inlet temperature defines the water temperature for heating. The higher this temperature, the less power input (electricity) the outdoor unit needs to provide the required heating capacity. However, the water treating system then requires more power input to provide the water at the required temperature. VRV_Xpress uses 30^0C as a default value.

In addition to these data to enter, you can also click the "***Important Notes***" command button to display a window enumerating important requirements for water-cooled systems, as shown in Figure 34:

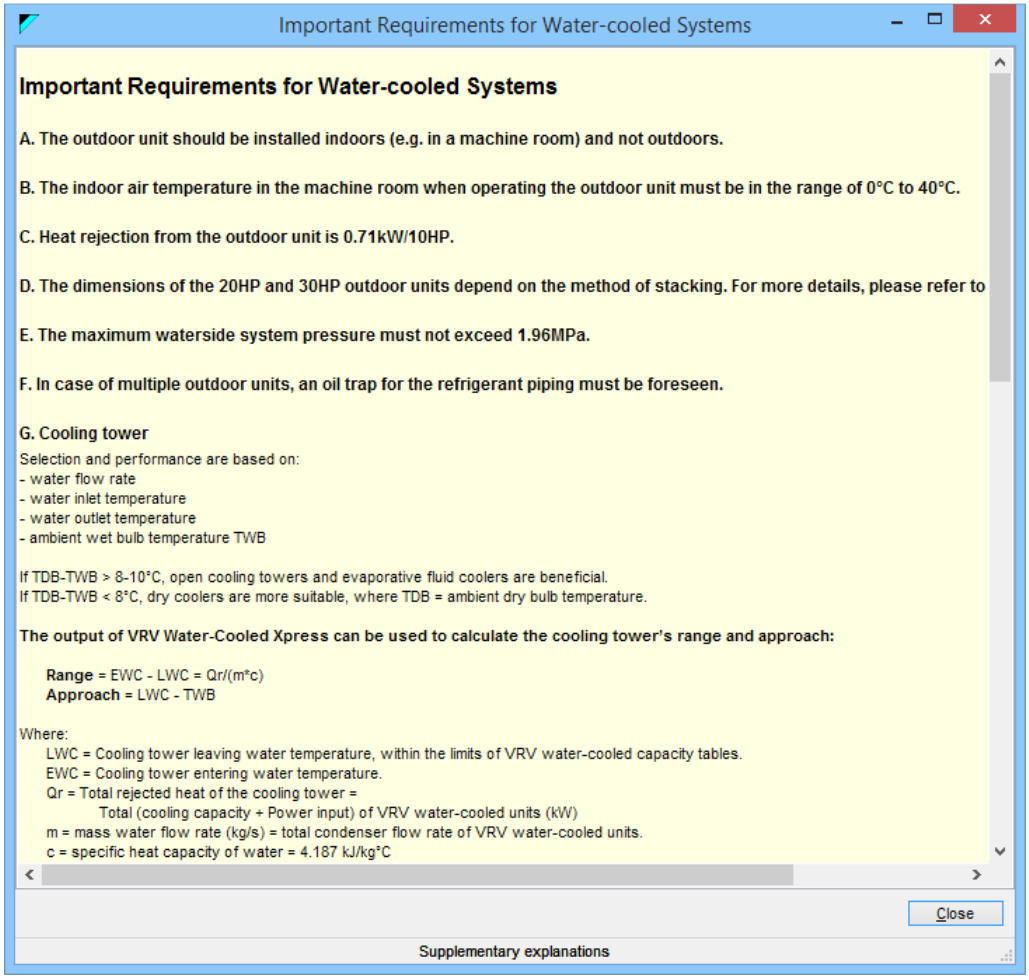


Figure 34: Important requirements for water-cooled systems

The overview of the water-cooled outdoor unit shown in Figure 35 is similar to the overview in Figure 32. However, as the conditions of the water circuit affect both the capacity and the power input (electricity) of the outdoor unit, VRV_Xpress displays both values in cooling as well as in heating.

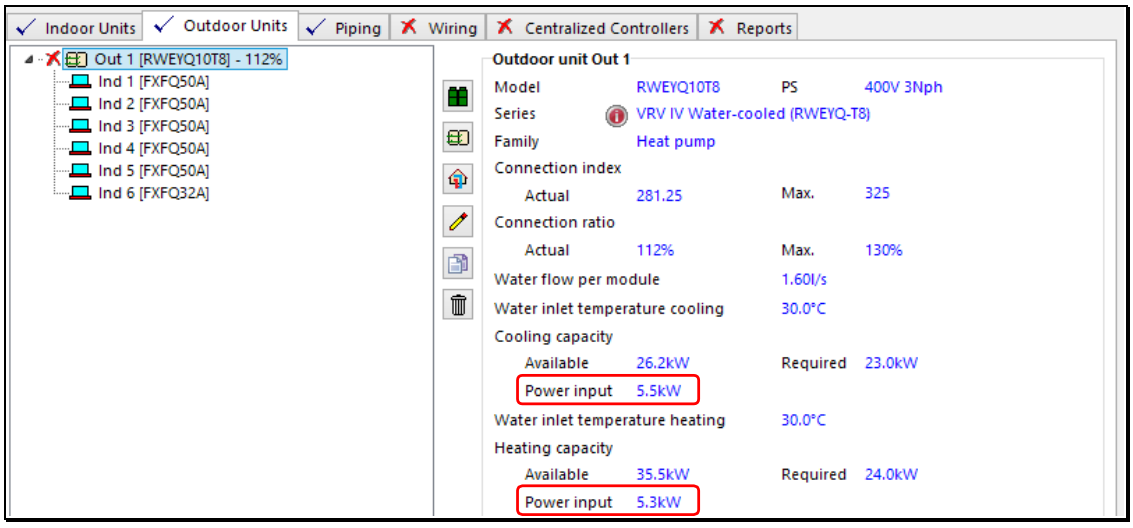


Figure 35: Overview of the selected water cooled outdoor unit data

Before explaining the settings in the piping and modules tab in the previous figures, the next sections describe the functions of the piping diagram. Section 3.6 explains these piping and modules tabs. Closing the outdoor unit edit window will show the outdoor unit in the upper left part of the outdoor units tab (see Figure 35, but also Figure 32).

3.3 Completing the Piping Diagram

Once you have entered the outdoor unit by closing the "***Edit Outdoor Unit Selection***" window by clicking the OK button, the "***Piping***" tab becomes available. Click on that tab to get a window, in which you will need a few clicks to get it exactly as shown in Figure 36:

- Click on the "▶" sign at the left of the outdoor unit to show a tree containing the outdoor unit and its connected indoor units.
- The initial piping diagram shows all indoor units placed vertically below the outdoor unit. Uncheck the "***Vertical***" checkmark to place the indoor units horizontally.
- By default, VRV_Xpress uses a scale of 100%. This scale may be too large to make the whole diagram fit in the window. Click the "***Fit Windows***" command button to make the diagram fit into the window.
- The "***Reset***" command button resets the piping diagram to its original state. Click this button it you want to restart the process described in the previous steps.

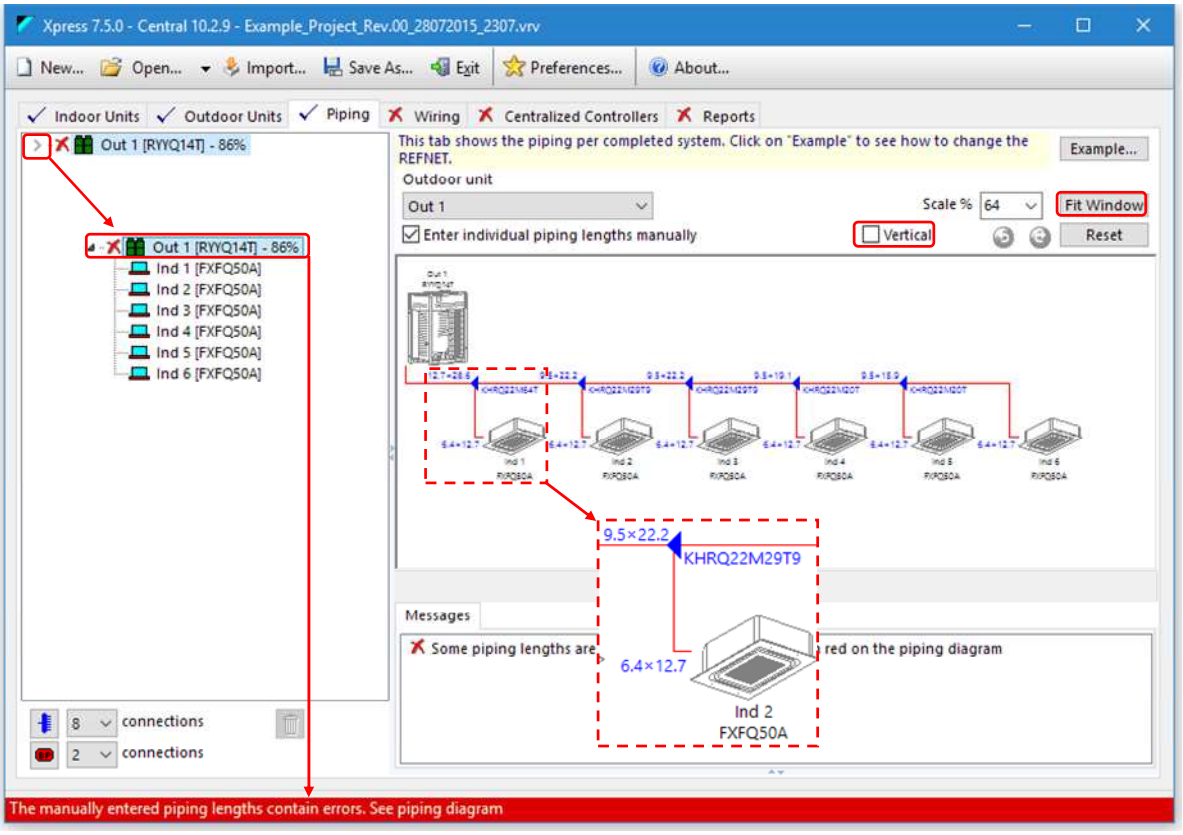


Figure 36: The initial piping diagram

The red pipes in the diagram have a zero length, which of course is not possible in a real installation. However, VRV_Xpress filled in some pipe diameter and REFNET data:

- Close to the indoor unit, it shows the connection diameters: 6.4mm (liquid) x 12.7mm (gas). These diameter depend on the selected indoor unit.
- A small triangle represents a REFNET joint, as explained in section 1.1.3 and Figure 6. VRV_Xpress adds the model number at its right. In Figure 36, there are three models used: KHRQ22M20T (the ones at the right in the diagram), KHRQ22M29T9 (the one zoomed in) and KHRQ22M64T (closest to the outdoor unit).
- To the left of a REFNET joint, VRV_Xpress shows the REFNET output diameters: 9.5mm

(liquid) x 22.2mm (gas).

VRV_Xpress calculates the REFNET models and the intermediate pipe diameters using the connection ratio of the indoor sub system connected up to the point of the REFNET joint. You can get this information by moving the mouse over the piping diagram. VRV_Xpress indicates the device (indoor unit or outdoor unit) or the REFNET joint, together with the corresponding piping piece for which it calculates a diameter, as shown in Figure 37. Below the diagram, VRV_Xpress also displays more information about the marked element:

- The marked indoor unit is Ind3, having the model FXFQ50A and a connection index 50.
- The marked REFNET joint has the model KHRQ22M20T and the combined connection to its right results in a connection index of 181.25.

When you right click the marked element, a menu comes up containing the "***Enter piping length***" command. Selecting this command, brings up a window in which you can enter the piping length and the number of bends in that piping piece.

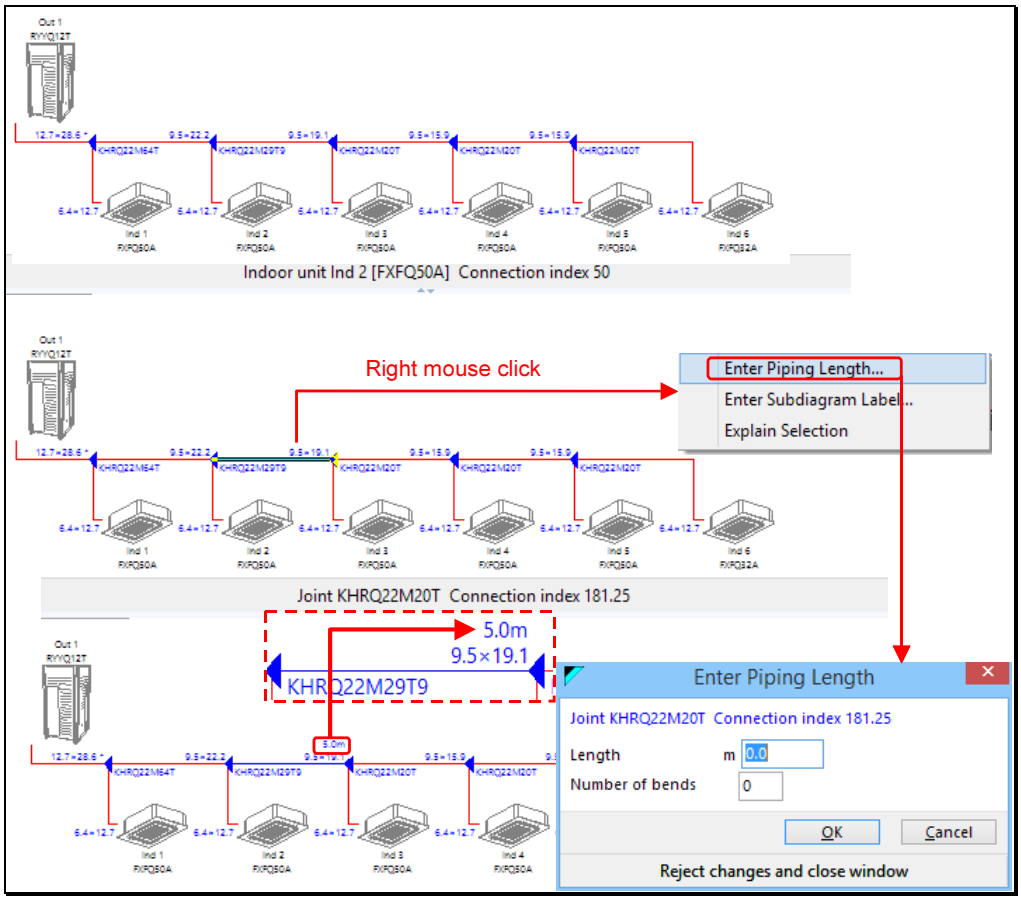


Figure 37: Moving the mouse in a piping diagram and entering a piping length

Closing the window then shows this piping piece in blue and VRV_Xpress now displays the piping length above the diameters. You can repeat this process for all piping pieces to get a result as shown in Figure 38:

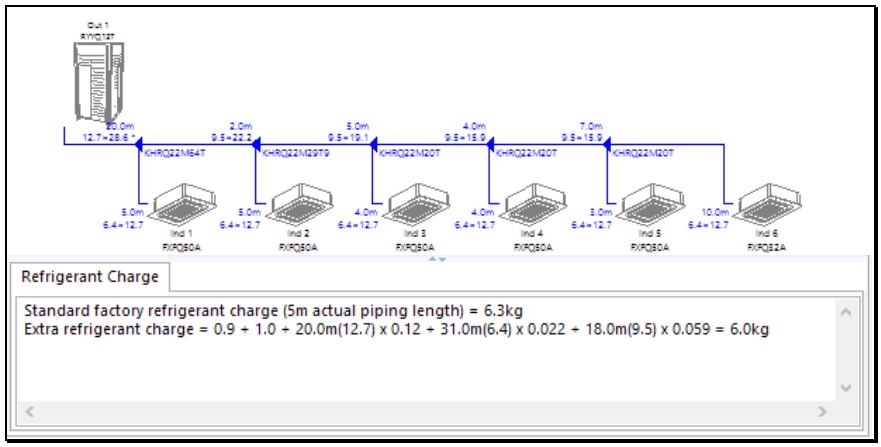


Figure 38: The diagram with the completed piping

When the diagram is completed, VRV_Xpress displays the standard factory refrigerant charge of the outdoor unit (6.3kg) and calculates the extra refrigerant needed in the pipes (5.1kg).

In addition, VRV_Xpress is now able to give extensive information about any element in the piping diagram: move the mouse over the element, right click it and select the "***Explain Selection***" command. At the bottom of the window appears a "***Calculation Details***" tab explaining why the element was selected from list of possible candidates, as shown in Figure 39:

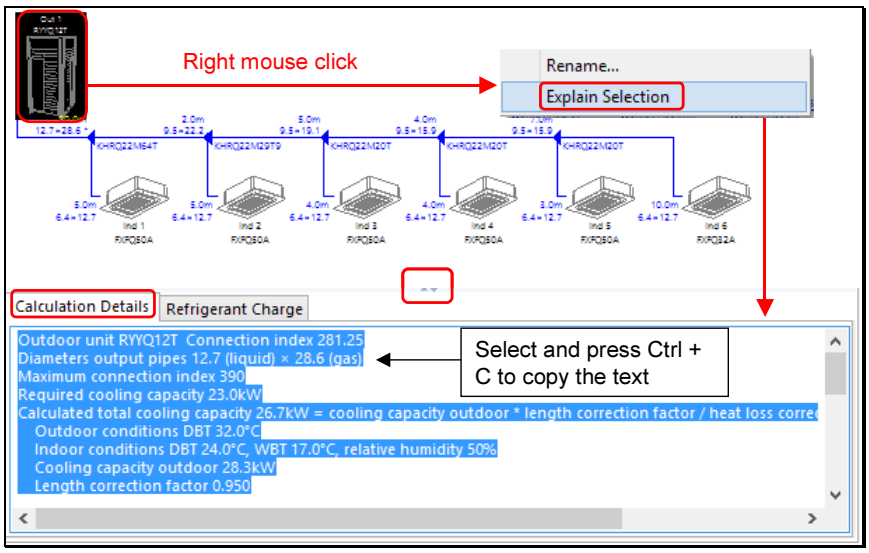


Figure 39: Explaining the selection of a device

Note that the text is larger than the window can hold and VRV_Xpress displays a vertical scroll bar. However, it also shows small arrows at the top of the text. Press the left mouse button and keep it pressed while moving the mouse. This will enlarge or reduce the size of this window. In addition to resizing this window, you can also select the text in it. By pressing the combination of the control key and the letter "C" (Ctrl + C), you copy the selected text in a windows buffer to paste in any other application. The text box below shows the complete text for an outdoor unit.

Outdoor unit RYYQ12T Connection index 281.25 (outdoor unit tab and outdoor unit edit window)
Diameter output pipes 12.7 (liquid) x 28.6 (gas)
Maximum connection index 300 (outdoor unit tab and outdoor unit edit window)
Required cooling capacity 23.0kW (outdoor unit tab and outdoor unit edit window)
Calculated total cooling capacity 26.7kW = cooling capacity outdoor x length correction factor / heat loss correction factor
Outdoor conditions DBT 32.0°C, relative humidity 50%
Indoor conditions DBT 20.0°C, relative humidity 50%
Cooling capacity outdoor 28.3kW (initial data before entering piping lengths)
Length correction factor 0.950
Heat loss correction factor 1.010
Required heating capacity 23.0kW (outdoor unit tab and outdoor unit edit window)
Calculated heating capacity 24.4kW = heating capacity outdoor x freeze up correction x length correction factor / heat loss correction factor
Outdoor conditions DBT 0.0°C, relative humidity 50%
Indoor conditions DBT 24.0°C, relative humidity 50%
Heating capacity outdoor 31.1kW
Freeze up correction 0.810
Length correction factor 1.000
Heat loss correction factor 1.033
Minimum number of indoor units 1
Maximum number of indoor units 64
Maximum height difference between indoor units 30.0m
Total extension length of all pipes 69.0m
Longest equivalent length in the system 50.5m, indoor unit Ind6
Longest actual length in the system 48.0m, indoor unit Ind6
Longest actual from indoor unit to first branch 28.0m, indoor unit Ind6
Largest difference in length 23.0m, between indoor unit Ind6 and indoor unit Ind1
Outdoor unit placed at the same level as the indoor units

What follows is a more detailed explanation of the text in italics:

- The total extension length of all pipes is the sum of the lengths of all piping pieces in the diagram.
- The equivalent length between the outdoor unit and an indoor unit is the sum of the piping pieces between them and the sum of the equivalent length of the REFNET joints between them. A typical equivalent length of a joint is 0.5m. The equivalent length between the outdoor unit and indoor unit Ind 6 is:
  - Piping pieces (starting from the outdoor unit and see Figure 38): 20m + 2m + 5m + 4m + 7m + 10m = 48m.
  - Between the outdoor unit and indoor unit Ind6, there are 5 REFNET joints, giving an extra length of 5 x 0.5m = 2.5m
  - The equivalent length between the outdoor unit and indoor unit Ind6 is 48m + 2.5m.

  This length is the longest equivalent length found in the piping diagram of Figure 38.
- The actual length between the outdoor unit and an indoor unit is the sum of the piping pieces between them. So, an actual length is shorter or equal an equivalent length. The longest actual length found in the piping diagram of Figure 38 is the one between the outdoor unit and indoor unit Ind6.
- The first branch is the first REFNET joint starting from the outdoor unit. The length from the first branch to indoor unit Ind6 is (see Figure 38): 2m + 5m + 4m + 7m + 10m = 28m. This the longest of those actual lengths.
- To get the length difference between two indoor units, calculate the first branch length for both and subtract both distances. The distance difference between indoor unit Ind1 and indoor unit Ind6 is (see Figure 38):
  - First branch length to Ind1 is: 5m.
  - First branch length to Ind6 is 28m (see above).

- Length difference between Ind6 and Ind1 is 28m – 5m.

- If both the outdoor and its indoor units are on the same floor, there is no height difference between them. However, when installing indoor units on a different floor, the outdoor unit may be placed below its indoor units (on the ground) or above them (on the roof). In both cases, there is a vertical pipe connecting the floors. This pipe contributes to the piping length (see section 3.6).

VRV_Xpress displays these piping length data, as there are several limits that you must respect. For some of these limits, the solution to circumvent them is upsizing the pipe diameters. Other limits are absolute and the piping has to stay within these limits to have a valid system selection.

Before getting deeper into the piping rules, you may have to refine the piping diagram to make it consistent with the actual piping on a floor plan.

3.4 Making the Piping Consistent with the Floor Plan

Figure 40 at the left shows the same floor plan twice, but with two different piping schemes. At the right, it shows the corresponding piping diagram.

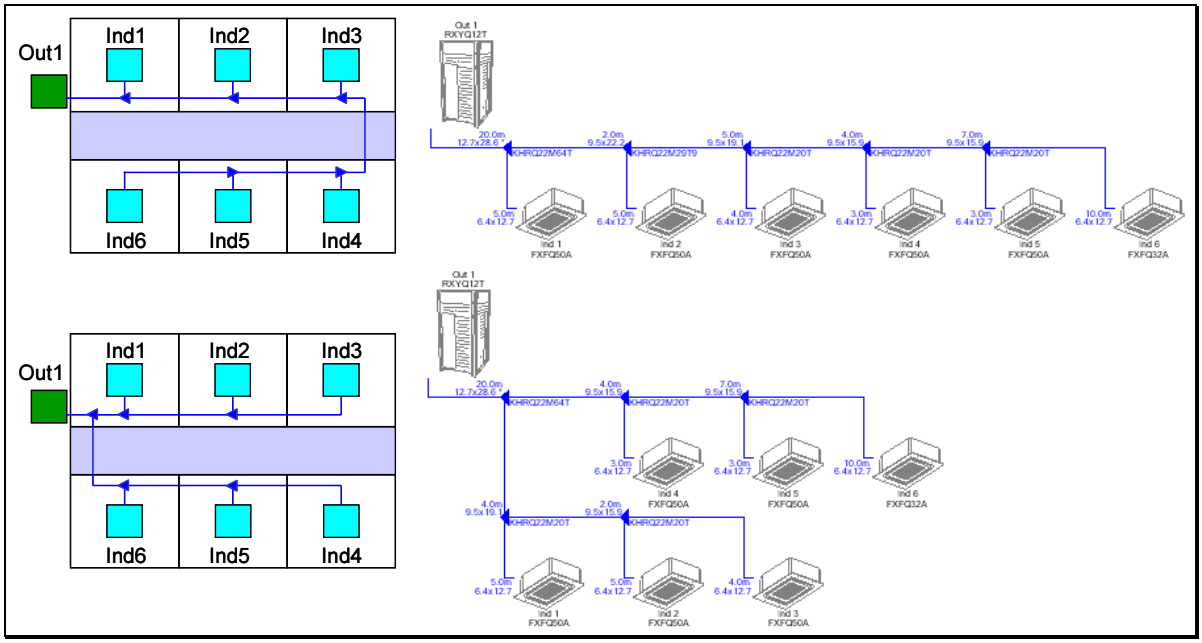


Figure 40: Floor plans and their corresponding piping diagrams

- The first example is a linear connection scheme, which is simple to follow, both on the floor plan and on the piping diagram. However, this scheme has a few considerable draw-backs:
  - The distance between the outdoor unit and the last indoor unit becomes long and to compensate this, larger piping diameters are necessary. Otherwise the last indoor unit will not get enough refrigerant to provide the required capacity. Larger diameters also mean more cupper material, making the installation more expensive.
  - The length difference between the first and the last indoor unit also becomes long. The absolute limit on this length difference is 40m. Keeping a linear connection may not give a solution for that problem.
- The second solution connects the upper (Ind3, Ind2 and Ind1) and lower (Ind4, Ind5 and Ind6) indoor units separately and then connects both groups before going to the outdoor unit. This is a more tree-like system and the diagram at the right reflects this. What is important in this connection scheme is the drastic reduction in piping diameters and much shorter longest lengths.

To adapt the first piping diagram into the second one, the last three indoor units (Ind4, Ind5 and Ind6) must move to the front and must connect closer to the outdoor unit, as shown in Figure 41 at the top. VRV_Xpress offers an editing function, which allows you doing this using the mouse as follows:

- Move the mouse to the REFNET joint you want to move. VRV_Xpress highlights it when the mouse cursor is over it.
- Press the left mouse button and keep it pressed while you move the mouse. A dotted line appears together with a large cross, as shown in Figure 41 in the middle.
- Move the cross to the position you want. VRV_Xpress will highlight the position if it is possible. In this example, VRV_Xpress highlights the piping piece between the outdoor unit and the first branch (REFNET joint).
- Release the mouse button. This gives the diagram as shown in Figure 41 at the bottom. VRV_Xpress has removed a REFNET joint and added a new one, thereby adding an new piping piece.

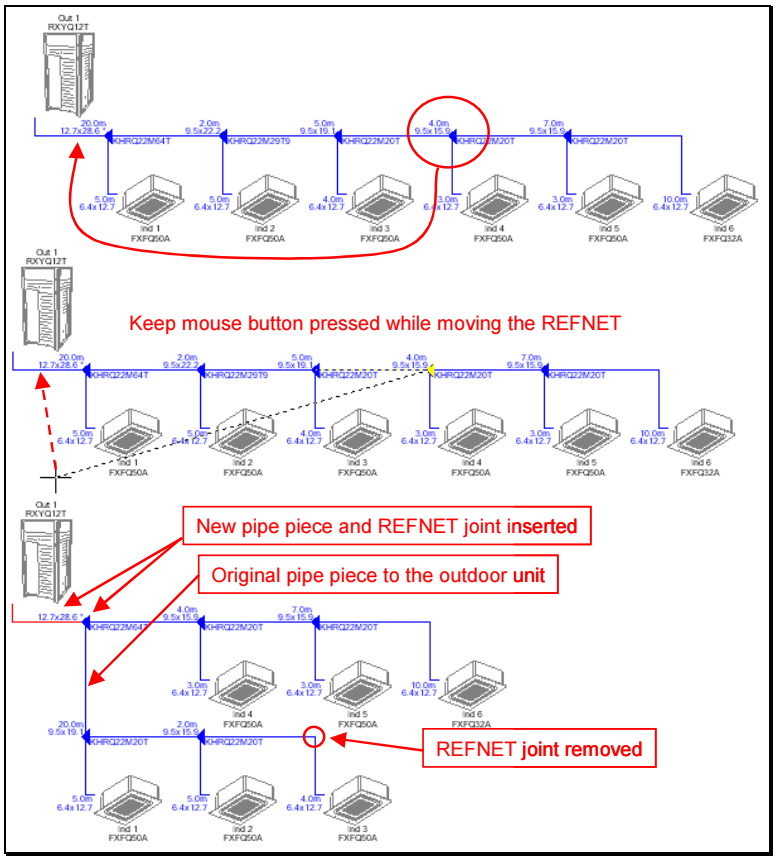


Figure 41: Editing the piping diagram

After this editing action, the piping diagram shows the required sub groups, comparable to the ones in Figure 40. However, the sub groups are swapped: Ind4, Ind5 and Ind6 are at the top, where it supposed to appear at the bottom. To swap the two sub groups, select the REFNET joint at the beginning of the group and move it in front of the REFNET joint at the beginning of the other sub group, as shown in Figure 42:

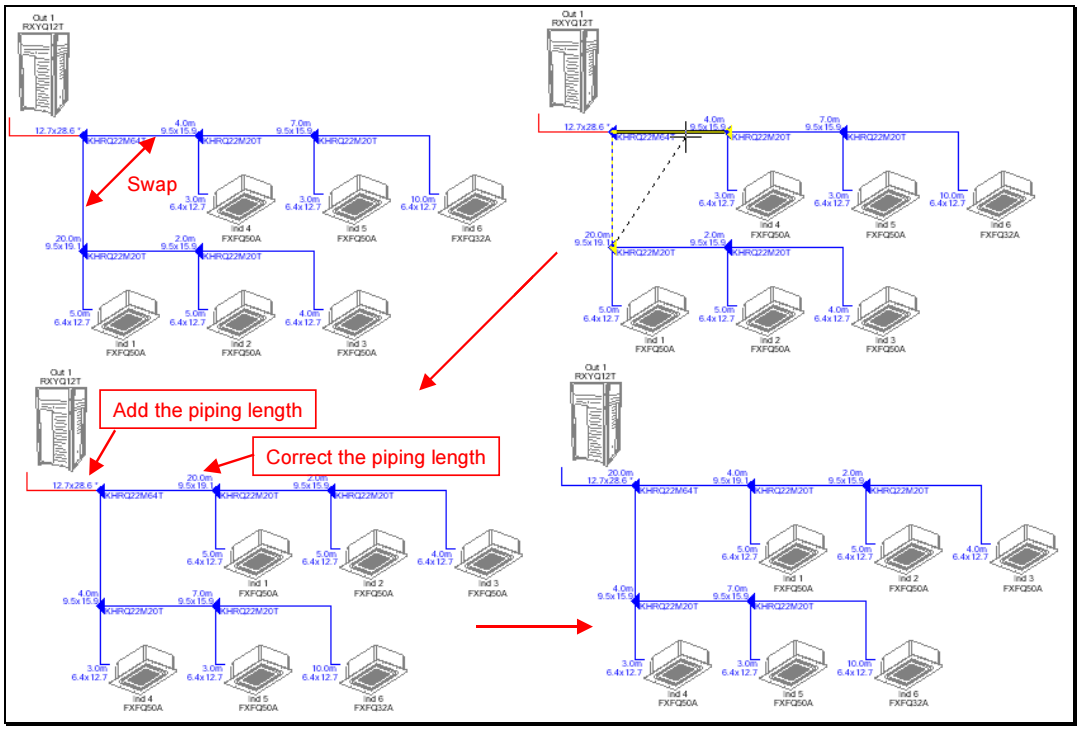


Figure 42: Swapping two sub groups

After this swapping, you still need to enter the piping length from the outdoor unit to its first branch (REFNET joint) and correct the piping length from the REFNET joint connected to indoor unit Ind1, as indicated in Figure 42 at the bottom.

When checking the explain selection for the outdoor unit now, you can find several improvements in addition to the smaller diameter sizes. The table below shows the information, which has been changed. The data between parentheses are the original values. The outdoor unit now can provide more capacity and the longest lengths and length differences are considerably shorter. This piping diagram is a good start to demonstrate a few important piping limits.

Calculated total cooling capacity 27.0kW = cooling capacity outdoor x length correction factor / heat loss correction factor (26.7kW)
Length correction factor 0.959 (0.950)
Heat loss correction factor 1.009 (1.010)
Calculated heating capacity 24.5kW = heating capacity outdoor x freeze up correction x length correction factor / heat loss correction factor (24.4kW)
Freeze up correction 0.810
Length correction factor 1.000
Heat loss correction factor 1.027 (1.033)
Total extension length of all pipes 68.0m (69.0m)
Longest equivalent length in the system 42.5m, indoor unit Ind6 (50.5m)
Longest actual length in the system 41.0m, indoor unit Ind6 (48.0m)
Longest actual from indoor unit to first branch 21.0m, indoor unit Ind6 (28.0m)
Largest difference in length 13.0m, between indoor unit Ind6 and indoor unit Ind1 (23.0m)

3.5 Piping Limits

There are two piping length limits that can be extended by sizing up the pipe diameters. VRV_Xpress performs this sizing up automatically. Figure 43 illustrates both cases:

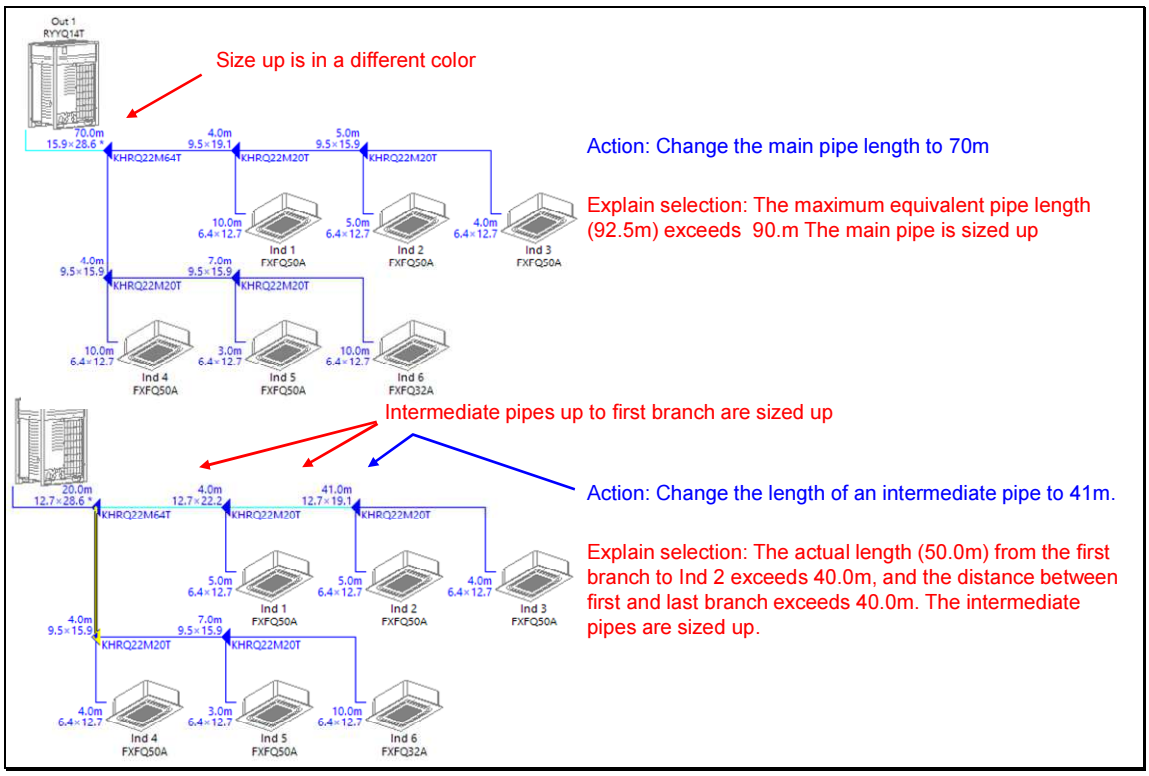


Figure 43: Extending piping limits through sizing up pipe diameters

- It is quite possible that an outdoor unit must be installed at a distance from the building containing the indoor units it controls. This results in a longer main pipe. The maximum equivalent length, including the main pipe is 90m (this limit depends on the outdoor unit and may vary per series). By sizing up the main pipe, the maximum equivalent length is extended to 165m (in this example for this outdoor unit). Note that VRV_Xpress displays the sized up pipe in a different color.

- Another limit is actually the combination of two limits:
  a. The distance between the first and last branches (both REFNET joint) must be less than or equal to 40m.
  b. The distance between the ***first*** branch and an indoor unit also must be less than 40m. The distance between the ***last*** branch and the indoor unit may never exceed 40m.

  There is only a size-up if both limits are exceeded. So, if the distance between the first and last branch is 40m, the distance from the first branch to the indoor unit may be larger than 40m, as long as the distance between the last branch and the indoor unit remains below 40m. So, the maximum distance between the first branch and an indoor unit is 79m.
  When both limits are exceeded, the distance between the first and last branches is extended to 90m after upsizing all intermediate pipes between this first and last branches. However, if the upsized section of pipe is not commercially available in the projects country, extending the piping rule over the 40m limit is ***not allowed***. It is equally not possible to have two size ups. E.g. if you need to upsize a pipe of 7/8" the next diameter would be 1". In many countries this 1" pipe is not available and so, you cannot use the next available diameter.
- Of course, it is possible to get both situations into one piping diagram.

There are also limits, which you cannot extend through sizing up. Figure 44 illustrates the most common situation:

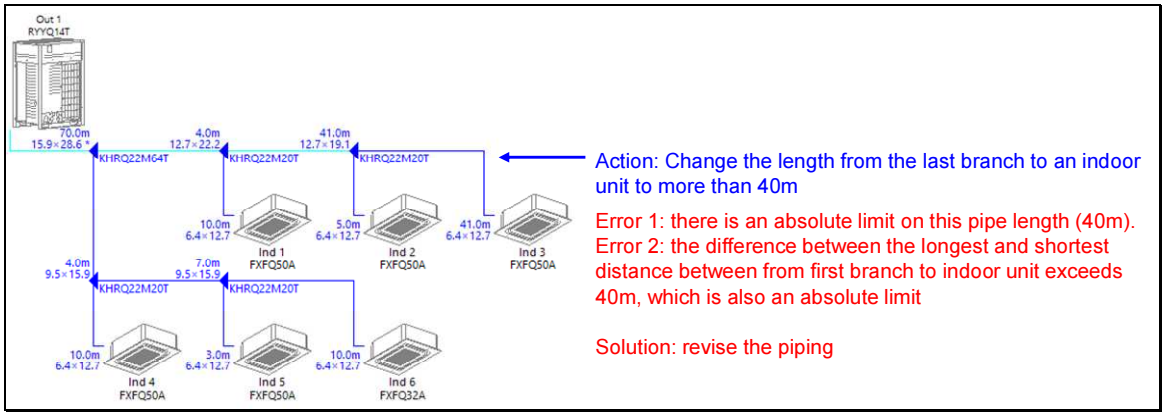


Figure 44: Example of absolute piping limits

The piping length from an indoor unit to its branch (REFNET joint) it connects to can never exceed 40m (this limit depends on the outdoor unit and may vary per series). If you have such a case, you will have to revise the piping diagram.

In a linear connection scheme as for example in Figure 38 it happens frequently that you exceed the maximum length difference between indoor units (see section 3.3: the length difference between the longest and shortest distance from first branch to indoor unit cannot exceed 40m). The only solution in such a case is equally (partially) revising the piping diagram, by splitting up the piping into two sections, as shown in Figure 44.

3.6 Revisiting the Outdoor Unit Tab

The piping diagram as shown in Figure 42, at the bottom right, is the completed one. There is still one definition missing: the height difference between the outdoor unit and its indoor units. To define that, click back on the outdoor unit tab and select the outdoor unit. You can also edit it, by clicking the edit icon, as indicated in Figure 45.

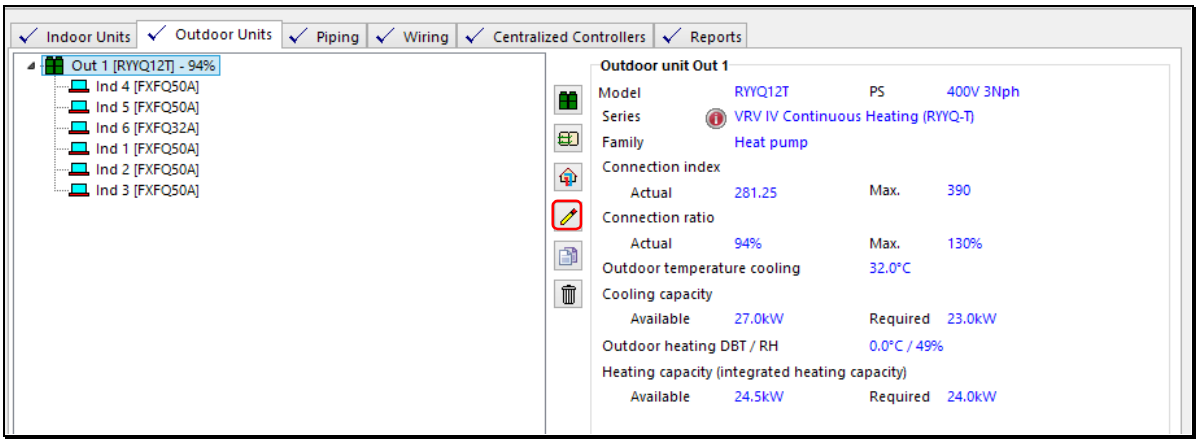


Figure 45: Editing an outdoor unit

This brings up the outdoor edit window again. At the right there are three tabs: the "***System***" tab, explained in section 3.3, the "***Piping***" tab and the "***Modules***" tab.

1. Clicking on the "***Piping***" tab displays the data as shown in Figure 46:
   - By default, the outdoor unit is considered at the same height as its indoor units connected to it and VRV_Xpress does not adapt the piping length correction for height differences.
   - If you define the outdoor unit to be lower than its indoor units, VRV_Xpress displays a

field to enter the height difference. In the example, all indoor units are mounted on the wall and the outdoor unit is standing on the floor. So, the height difference is 2m more or less. This small height difference does not have a large impact on the length correction. It becomes more important in larger buildings, where the height difference may include several floors.

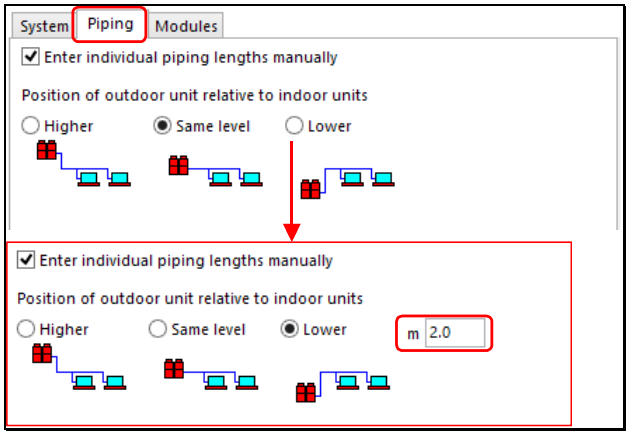


Figure 46: Defining the height difference between outdoor unit and indoor units

Note that there are also limits on height differences (see section 4.3.6). In many cases this will be 40m, possibly extended to 90m, but depends again on the outdoor unit or the outdoor unit series.

2. Clicking on the "***Modules***" tab displays the data as shown in Figure 46:

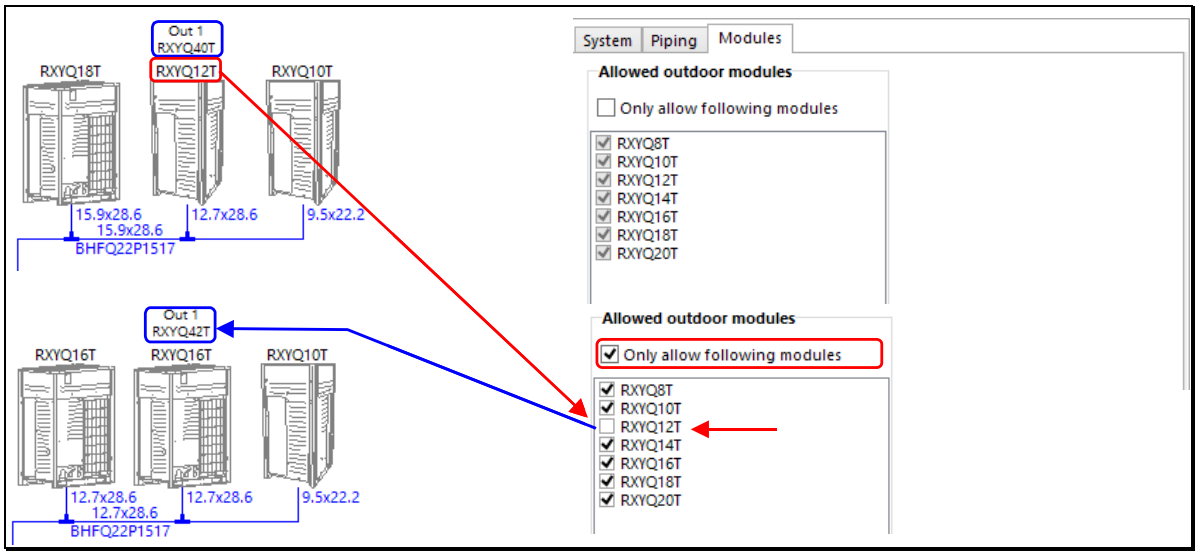


Figure 47: Constraining the outdoor unit modules

Small systems have outdoor units consisting of a single module, where larger systems combine modules. The top left of Figure 46 shows an outdoor unit model 40 consisting of three modules: a model 18, a model 12 and a model 10. If for some reason, you decide not to allow a model 12 module, you uncheck it. VRV_Xpress will then look for outdoor units using a different kind of module combinations. This may lead to larger outdoor unit, as shown at the bottom left of Figure 46.

Note however that a large outdoor unit may have several different module combinations. So, removing a module from the list may also result in a same outdoor unit model, using a different set of modules.

3.7 Saving the Results

Before you can save a project, VRV_Xpress requires that you enter project data. You enter those data in the "***Indoor Units***" tab, as shown in Figure 48:

- A project has a name and should follow the internal company conventions.
- A project also has a unique reference, which also is subject to internal company conventions.
- Of course, you create a project for a customer. So, you need to enter the client name.
- In some cases, a project may need a few revisions, e.g. after a presentation to the client and a discussion afterwards about an alternate solution.
- The selection of the country is important to pre-select language dependent options. By selecting a country, you guide VRV_Xpress to select the option with the correct language interface. By default, VRV_Xpress uses the country you filled in the Welcome window (see section 2.1, Figure 10).

The first three data are obligatory, while the last one is optional. When clicking the "***Save As***" command on the tool bar, VRV_Xpress proposes a file name consisting of the project name, the revision number (if any), the date and time of saving. You can change this proposed filename by a filename of your choice. However, the method VRV_Xpress proposes offers an easy way to create versions of a project, without losing any information or variants of the same project.

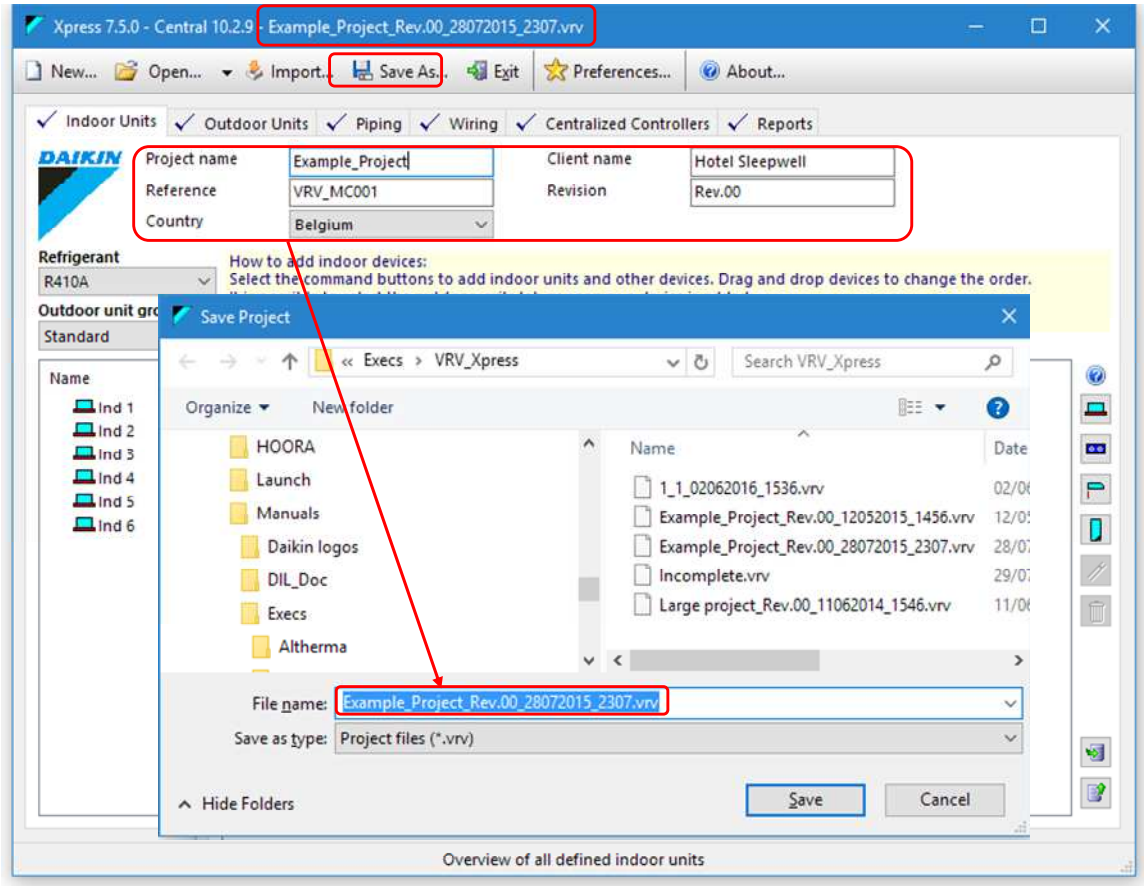


Figure 48: Saving the project

After having saved the project, VRV_Xpress displays the filename in the window title bar, as shown in Figure 48.

4 Refining the Selection

The project explained in the previous chapter has a few simplifications, which this chapter refines and extends. It describes different ways to select an indoor unit, explains how to select other devices to connect to outdoor units, shows how to refine an outdoor unit selection or to use alternatives, such as heat pump or heat recovery systems.

4.1 Indoor Unit Selection Revisited

4.1.1 Defining Rooms

Up to now, each indoor unit serves one room. So, you can give the indoor units a name to reflect the room they serve. However, rooms can become large (e.g. a landscape space) and it may not be possible to cover the required capacities by a single indoor unit.

Suppose the indoor units Ind1 and Ind2 belong to a room Reception. Edit the first indoor unit Ind1 and type the name Reception in the corresponding room field. Closing the edit window, you see the name appearing at the right in the overview, as shown in Figure 49, in the middle:

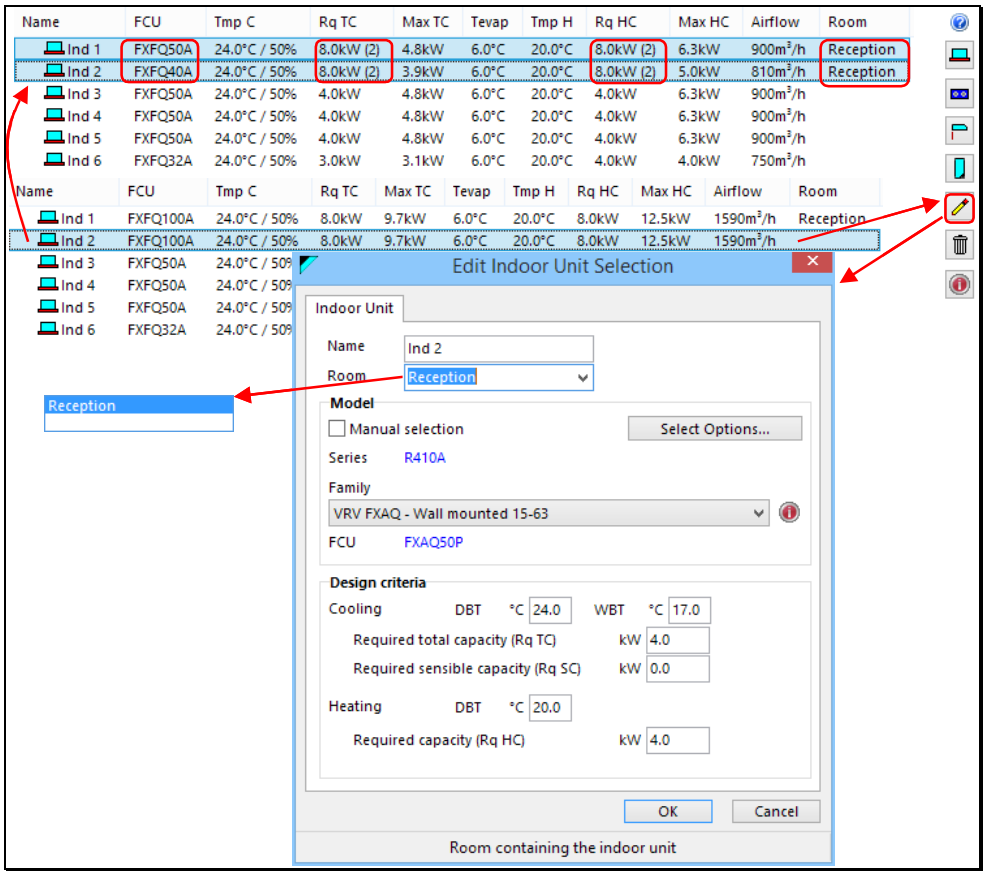


Figure 49: Placing two indoor units in a single room

Then you edit the second indoor unit Ind2 and now you can select Reception, as VRV_Xpress has the name from the first edit action. Select the name Reception and close the edit window.

As VRV_Xpress notices that two indoor unit have the same room name, it assumes those indoor units belong to the same room. This triggers a few actions:

- As the individual indoor unit both required 4.0kW in cooling and 4.0kW in heating, VRV_Xpress assumes that the room requires the sum of these capacities. In the overview (see Figure 49, at the top), it displays 8.0kW and also adds the number of indoor units to cover these capacities.

- To select the indoor units, VRV_Xpress now uses a few steps:
  - Divide the required capacities of the room by the number of indoor units in the room. So, each indoor unit still has 4.0kW as a required cooling and heating capacity.
  - Select the first indoor unit Ind1 that covers these divided capacity values. The resulting indoor unit is still a model FXFQ50A.
  - The required capacities of the room are now ***reduced*** by the capacities covered by this first indoor unit Ind1 and divided by the number of indoor units less 1 in the room. Indoor unit Ind2 now has to cover 8.0kW – 4.8kW = 3.2kW for cooling and 8.0kW – 6.3kW = 1.5kW for heating. The result is that indoor unit Ind2 now has a model FXFQ***40***A.
  - The process now repeats for the next indoor unit, until all indoor units in the room have been selected. This results in a selection of indoor units that covers the required capacities in a closest possible way.

Note:

When selecting indoor units on total ***and*** sensible capacities, this method may lead to a non-selection of the last indoor unit. In fact,. after the selection (total and sensible) of the first indoor unit, the next indoor units must provide the capacities (total and sensible) for the remaining capacities. If the difference between the provided total and sensible capacities of this first indoor unit is large, the remaining indoor units must provide more sensible capacity. The last indoor unit may then indeed have to cope with a large sensible load, possible as large as the total load, resulting in a non-selection. Currently, there is no solution for that situation.

The situation becomes a bit more complicated if a room contains indoor units served by different outdoor units. Suppose the two indoor units in room reception are connected to two different outdoor units. VRV_Xpress then uses slightly different steps:

- Divide the required capacities of the room by the number of indoor units in the room. So, each indoor unit still has 4.0kW as a required cooling and heating capacity.
- Create two groups of indoor units: the group connected to the first outdoor unit and another group connected to the second.
- Treat each group as a room and select the indoor units in these rooms as described as above.
- Note that the extra capacities that would be available in the first group have no influence on the selection in the second group and vice versa. In the example, each group contains one indoor unit. So, the selection results in a model FXFQ50A for both indoor units Ind1 and Ind2. This is the same result as when having individual indoor units.

Note:

When using groups of indoor units in a room and connected to different outdoor units, you will need to make sure that all indoor units operate in the same mode (cooling or heating) or at least make sure the indoor units do not operate in different modes (a group in cooling and another in heating). You can do this using a centralized control system, explained in section 5.2.

4.1.2 Indoor Unit Options

All devices (indoor units, outdoor units, BS-boxes, centralized controllers, etc) have options. These are extra printed circuit boards, sensors, covers, adaptors, etc. When editing an indoor unit, the "***Select Options***" command at the top brings up a option window, as shown in Figure 50:

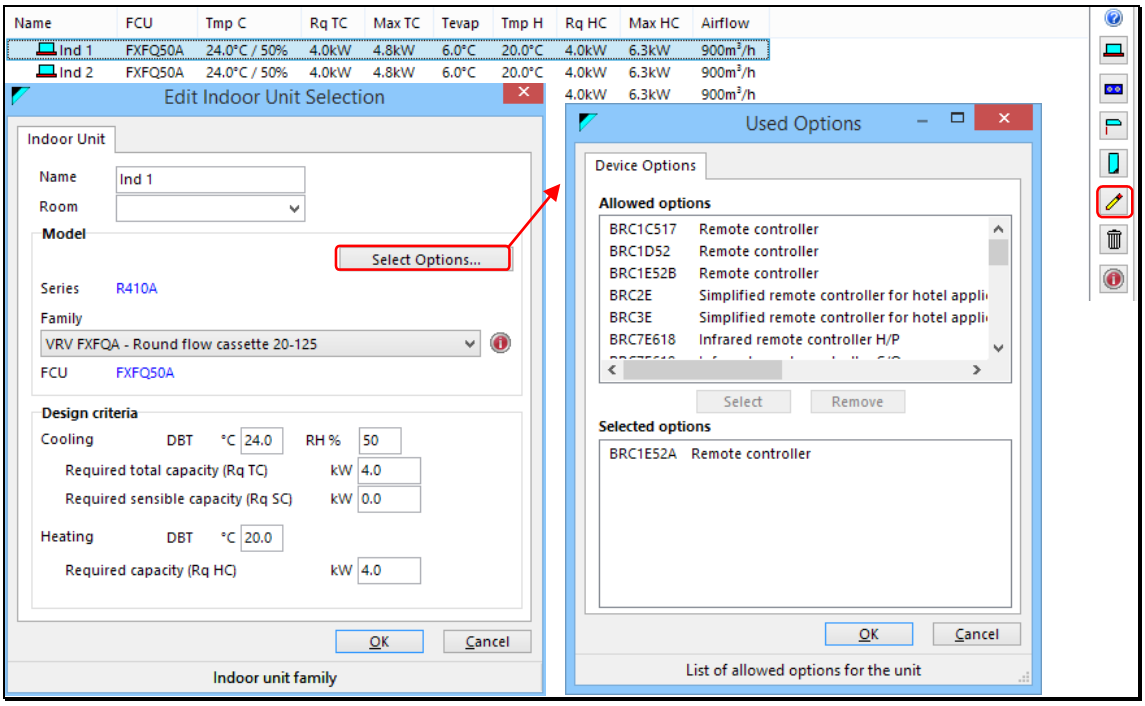


Figure 50: Selecting options

To add an option, select it from the list above and click the "***Select***" command button. To remove an option, select it from the list below and click the "***Remove***" command button.

The option window in Figure 50 already contains two options: a remote controller and a decoration panel. Both were selected automatically. In fact, the Daikin device database contains three kinds of options:

1. Regular options appear in the list at the top of the option window. They are not selected automatically and only you decide whether or not you need that option.
2. Preferred options appear in the list at the bottom of the option window. VRV_Xpress selects them automatically. However, you can remove or replace them. For example, the remote controller option in Figure 50 could be replaced by another one from the list above.
3. Standard options appear in the list at the bottom of the option window, but you cannot remove them. They remain selected. Some of these options are standard accessories and are part of the delivery of the indoor unit (you find them in the box). So, you do not have to order them and they don't appear in the equipment list (see Chapter 7). If the standard option is not a standard accessory, it will appear in the equipment list and you will still have to order it.

4.1.3 Editing and Moving Indoor Units

The order of indoor units in the indoor unit overview is the order you defined them. However, you may want to reorder this list by moving the indoor units. Figure 51,a the top shows how to select and move an indoor unit in front of the selected final position. Note that it is not possible to move an indoor unit beyond the last one. You do this in two steps: first move the indoor unit before the last one and then move the last indoor unit before the moved one.

Figure 51 also shows two ways to select more than one indoor unit: a consecutive and a non-consecutive one.

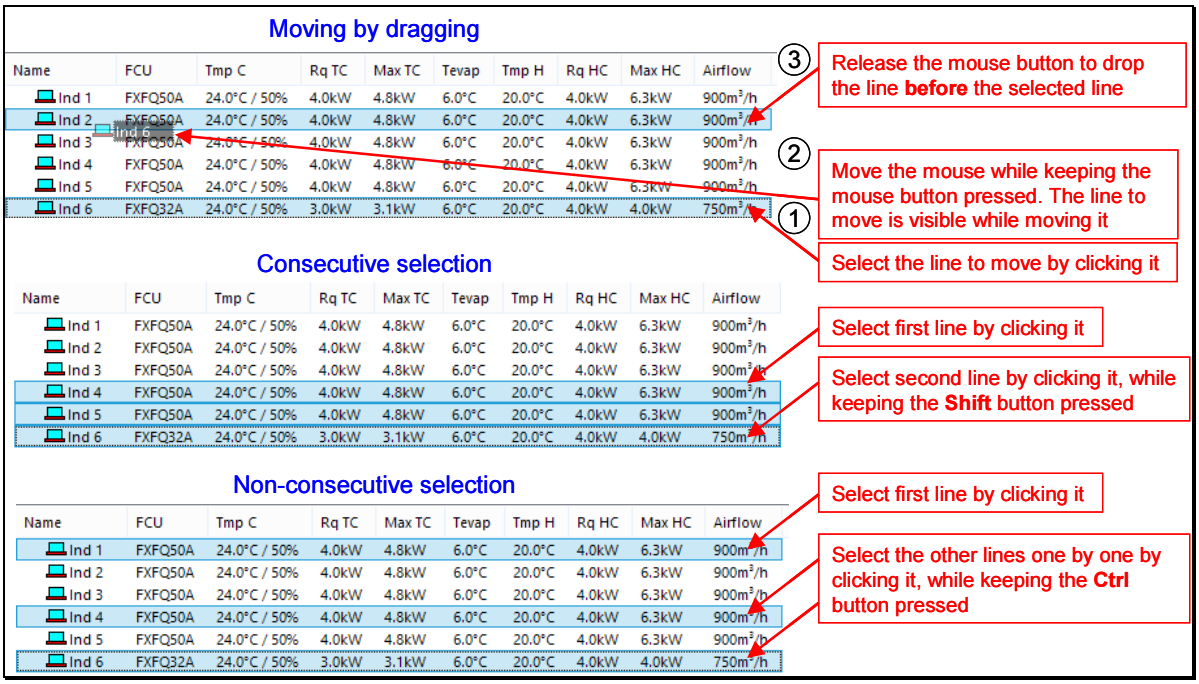


Figure 51: Moving and (multiple) selecting indoor units

You can edit multiple selected indoor units. If the selected indoor units differ from each other, VRV_Xpress shows the data of the first indoor and marks the fields that differ between the selected indoor units in a brown color. Adapting these fields will force all indoor units to get these updated data. Keeping these fields untouched will not update them.

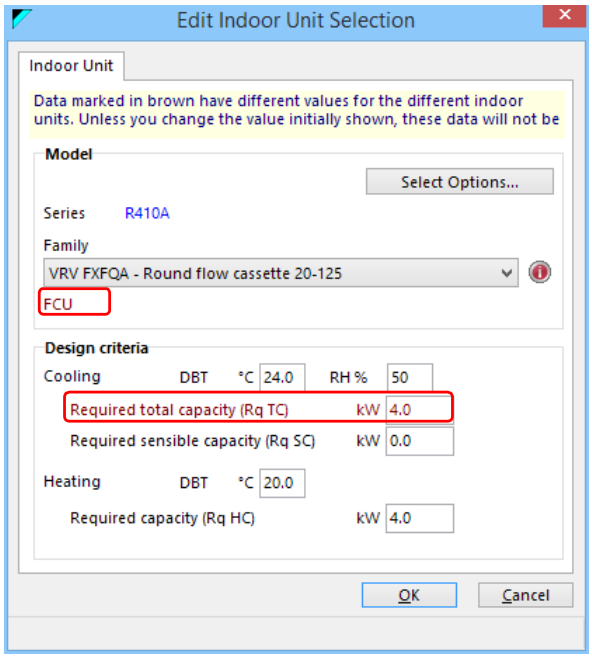
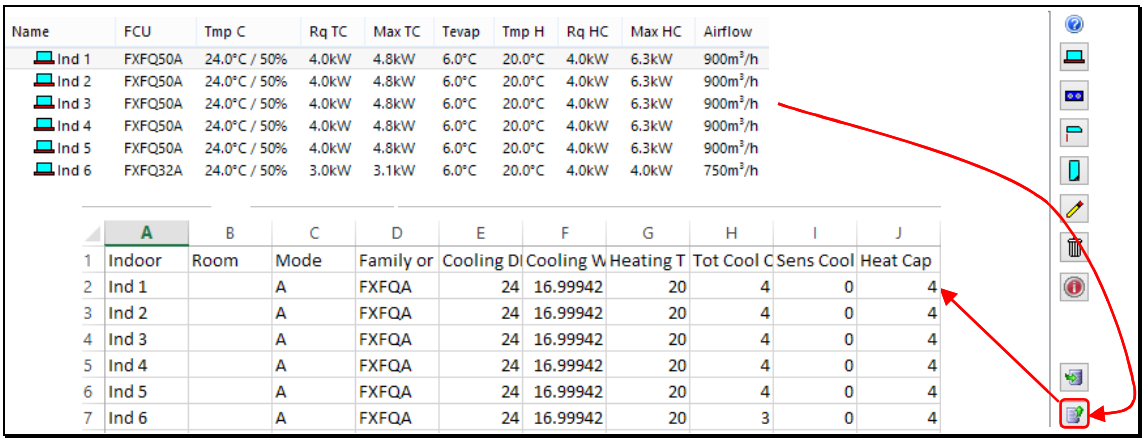


Figure 52: A multiple select edit window

4.1.4 Exporting and Importing Indoor Units

At the bottom of the "***Indoor Units***" tab, there are two command buttons to export and import indoor units. When clicking the "***Export***" command button as shown in Figure 53, VRV_Xpress displays a save dialog in which it proposes a filename in the same way as for saving the project (see section 3.7). This file is a csv-file, which you can open with Excel, as shown in Figure 53 at the bottom.



Name	FCU	Tmp C	Rq TC	Max TC	Tevap	Tmp H	Rq HC	Max HC	Airflow
Ind 1	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	20.0°C	4.0kW	6.3kW	900m³/h
Ind 2	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	20.0°C	4.0kW	6.3kW	900m³/h
Ind 3	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	20.0°C	4.0kW	6.3kW	900m³/h
Ind 4	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	20.0°C	4.0kW	6.3kW	900m³/h
Ind 5	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	20.0°C	4.0kW	6.3kW	900m³/h
Ind 6	FXFQ32A	24.0°C / 50%	3.0kW	3.1kW	6.0°C	20.0°C	4.0kW	4.0kW	750m³/h

	A	B	C	D	E	F	G	H	I	J
1	Indoor	Room	Mode	Family or	Cooling DI	Cooling W	Heating T	Tot Cool C	Sens Cool	Heat Cap
2	Ind 1		A	FXFQA	24	16.99942	20	4	0	4
3	Ind 2		A	FXFQA	24	16.99942	20	4	0	4
4	Ind 3		A	FXFQA	24	16.99942	20	4	0	4
5	Ind 4		A	FXFQA	24	16.99942	20	4	0	4
6	Ind 5		A	FXFQA	24	16.99942	20	4	0	4
7	Ind 6		A	FXFQA	24	16.99942	20	3	0	4

Figure 53: Exporting indoor units to open them in Excel

Note that the combination of dry bulb temperature with relative humidity (24^0C/50%) is replaced by the columns dry bulb temperature (24^0C) and wet bulb temperature (16.999424^0C), as this is more common for cooling selection.

The "***Import***" command button allows adding the indoor units to the list of indoor units. Export and import may be interesting if you are designing similar installations using a large diversity of indoor units. An alternative to this is importing a whole project as explained in section 6.1.

4.2 Selecting Other Devices

In addition to indoor units, it is also possible to connect other devices to an outdoor unit. VRV_Xpress only considers their required cooling and heating capacities for their selection and does not offer a way to enter other criteria, such as the amount of airflow or the ducting for ventilation devices. In fact, VentilationXpress offers a complete selection for those devices and also calculates the required capacities, which you can use to enter in VRV_Xpress.

Some of the other devices are specialized ones and there are some rules to follow:
- You may have to connect them to specific outdoor units.
- You may have to connect in combination with a minimum number of regular indoor units.
- You may have to use special devices to connect them to an outdoor unit.
- Etc

Those rules apply at the moment you connect these devices to outdoor units. VRV_Xpress gives error messages when it finds a non-compliance with one of those rules.

Figure 54 shows how to select an other device: click on one of the other command buttons:
1. The command button "***Add ventilation devices***" brings up a window, listing the classes of the ventilation devices. Select one of them to bring up a specific selection window for that device.
2. The command button "***Add air curtains***" brings up a window to manually select air curtains.
3. The command button "***Add hydroboxes***" brings up a window, show the two types of hydoro boxes available. Select a class brings up a specific selection window for that hydro box.

Although you can select any of these device classes, VRV_Xpress will give an error message when you try to connect some of them to an outdoor unit: VKM, Outdoor air processing unit and Biddle air curtains can only be added as a manual selection, which is an advanced selection and explained in chapter 9. Air handling units are specialized devices requiring additional selection details, which are explained in more detail in section 8.2.

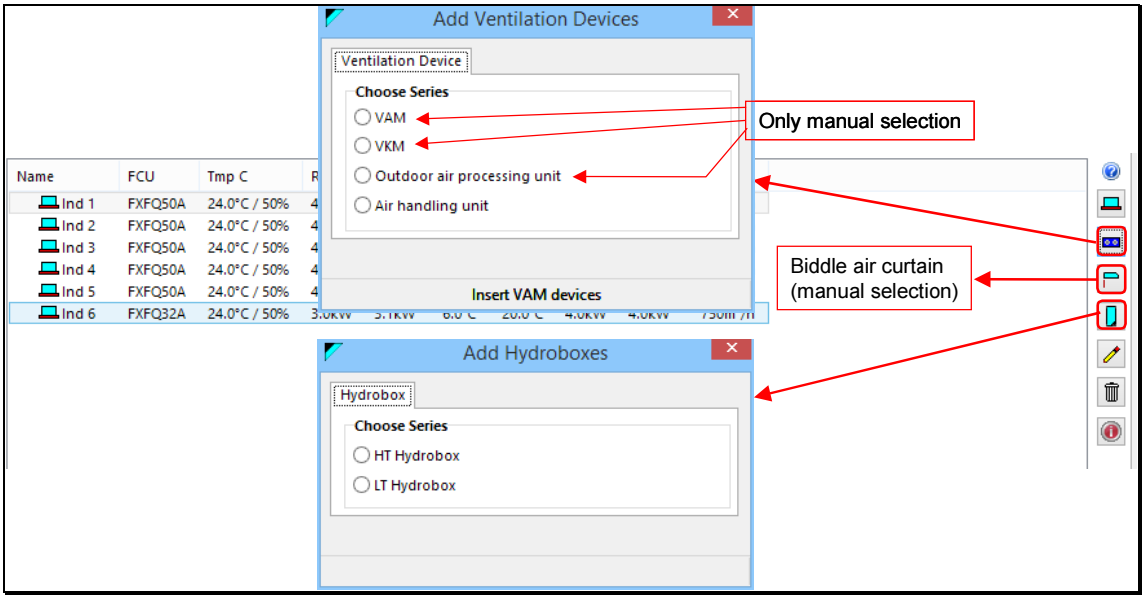


Figure 54: Selecting other devices

4.2.1 VAM Devices

A VAM device is a ventilation device, but has no coil to cool or heat. So, you cannot enter a required cooling or heating capacity. VRV_Xpress only offers a manual selection, as shown in Figure 55:

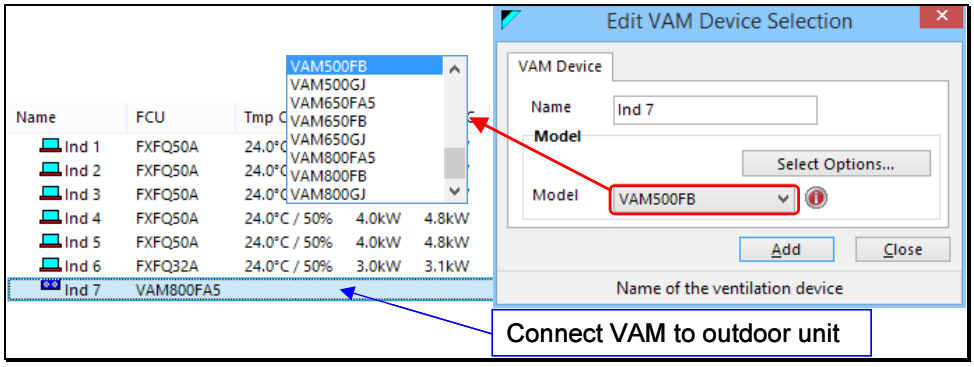


Figure 55: Selecting a VAM device

When appearing in the list of indoor units, there are no other data than the name and the selected model. As a VAM does not have a coil, there should be no need to connect it to an outdoor unit. However, VRV_Xpress supports a "***logical***" connection so that you can keep the indoor units and the VAM ventilation unit into one system. Therefore, you have to connect a VAM device to an outdoor unot. This is similar to the situation as depicted in Figure 1.

4.2.2 Ventilation Devices

An EKEXV device is an expansion valve kit to install in an ventilation device and allowing to connect it to a VRV outdoor unit. As the Daikin database contains maximum capacities for each of those devices, VRV_Xpress supports an automatic selection. Figure 56 shows the selection window and the corresponding line in the indoor unit overview.

The required cooling and heating capacities depend on the ventilation device with the installed expansion valve kit. Please refer to the documentation about these devices together with the company responsible for the ventilation in the building to decide what selection you have to make.

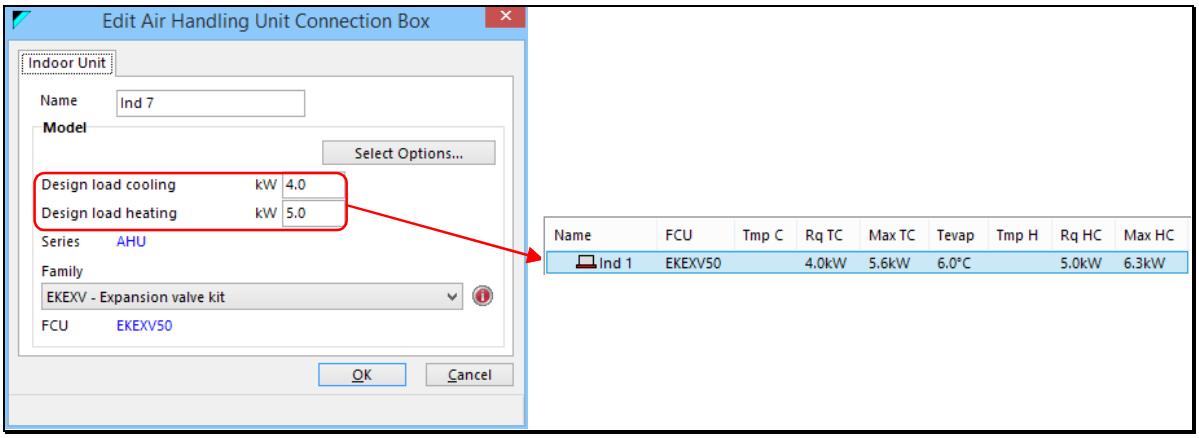


Figure 56: Selecting other ventilation devices

4.2.3 Hydro Boxes

A hydro box is a device that transforms the cooling or heating capacity from the outdoor unit into cool or hot water. This water can then be used for domestic hot water, floor cooling or heating or for radiator heating.

The Daikin database contains two kinds of hydro boxes: the high temperature hydro box used for domestic hot water and radiators and the low temperature hydro box used for floor heating and water indoor units.

High temperature hydro boxes can only be used in heating and must be connected to a heat recovery outdoor unit (see section 4.3.2). Figure 57 shows the window to select a hydro box and the resulting line in the indoor unit overview:

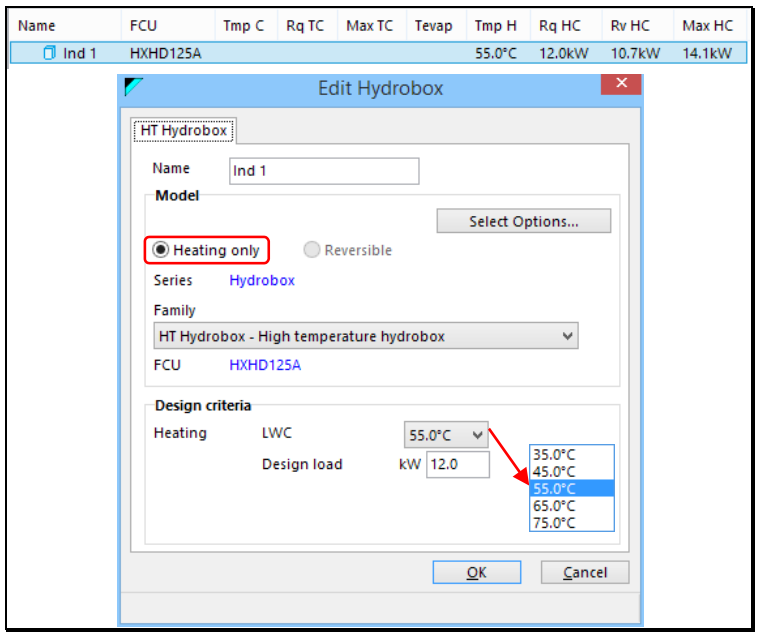


Figure 57: Selecting high temperature hydro boxes

As a hydro box produces hot water, you now have to enter the water temperature. From this information, VRV_Xpress calculates the required heating capacity from the outdoor unit.

The low temperature hydro box can be used for cooling and heating. So, you now can enter water temperature values for heating and cooling. Note that the water temperature in heating is considerably lower than for the high temperature hydro box. Indeed, floor heating only requires

moderately warm water.

The selection of a low temperature hydro box is similar to the selection of high temperature hydro boxes, as shown in Figure 58:

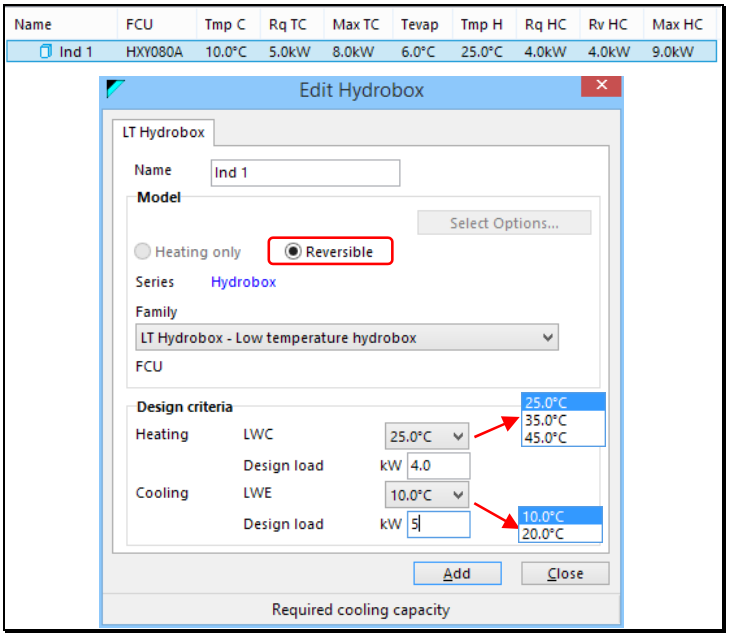


Figure 58: Selecting low temperature hydro boxes

4.3 *Outdoor Unit Tab Revisited*

4.3.1 Disconnecting Indoor Units

Figure 30 and Figure 31 show how to connect indoor units in the outdoor edit window. However, it must also be possible to disconnect indoor units, e.g. to connect them to other outdoor units. Figure 59 shows several ways to do this:

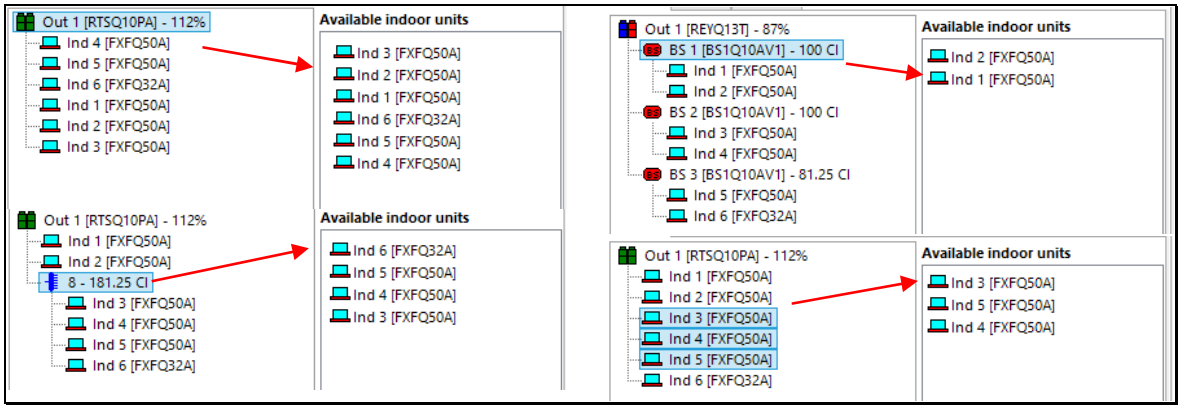


Figure 59: Several ways to disconnect indoor units

- Select the outdoor unit and drag it to the right to disconnect all indoor units connected to that outdoor unit.
- Dragging a header refnet disconnects all indoor units connected to that header refnet.
- Dragging a BS-box disconnects all indoor units connected to that BS-box.
- Selecting several indoor units at the same level and dragging them to the right disconnects them. To deselect a selected indoor unit in the tree, press the Ctrl-key together with the mouse.

4.3.2 Moving Outdoor Units

In large projects containing several outdoor units, you may have to move outdoor units to get a more logical order. Figure 60 shows how to select several outdoor units and to drag them in front of another one to move the selected outdoor units. To deselect a selected outdoor unit in the tree, press the Ctrl-key together with the mouse. Obviously, you can also select and drag one outdoor unit at a time as well.

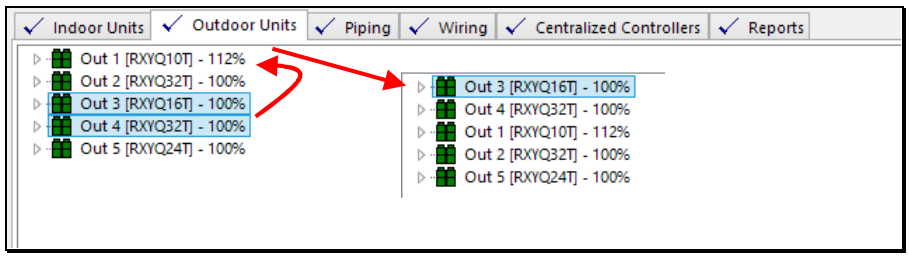


Figure 60: Moving outdoor units in the outdoor unit tab

4.3.3 Heat Recovery Outdoor Units

One way to define a heat recovery system is to remove the indoor units from the existing heat pump (see also Figure 59) and change its family into heat recovery, as shown in Figure 61:

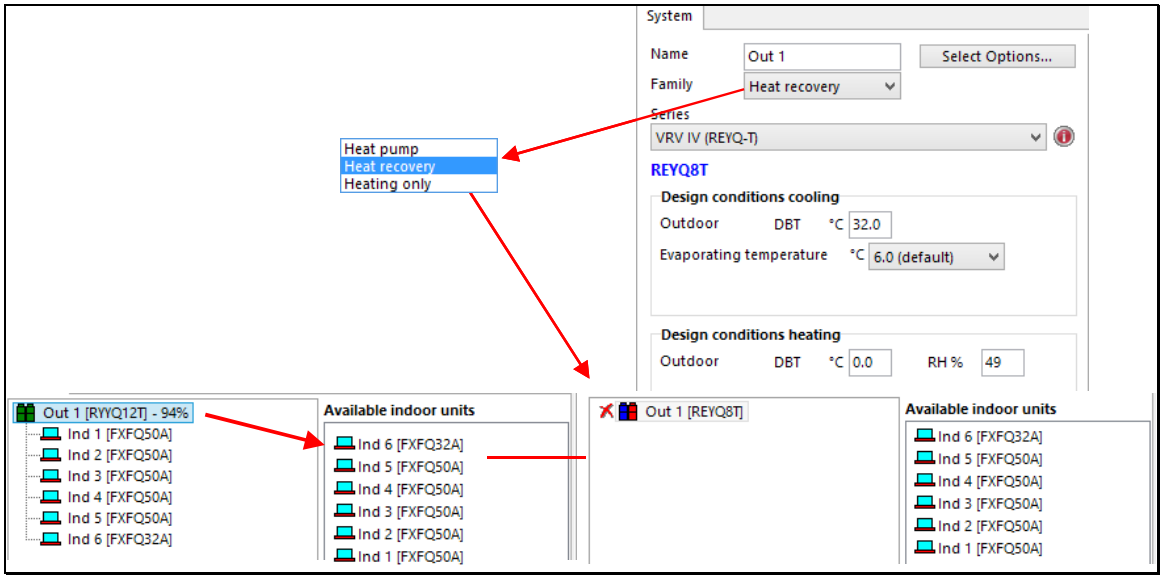


Figure 61: Removing the indoor units and change the outdoor family

In a heat recovery system, indoor units are connected through BS-boxes to the outdoor unit. So, the first step is adding the BS-boxes. Each BS-box will control only one indoor unit. So, in the example with 6 indoor units, you will need 6 BS-boxes. Figure 62 shows how to add the BS-boxes first and then to drag the indoor units to each BS-box. It also shows that BS-boxes automatically get a model (BS1Q10A) when connecting an indoor unit to them:

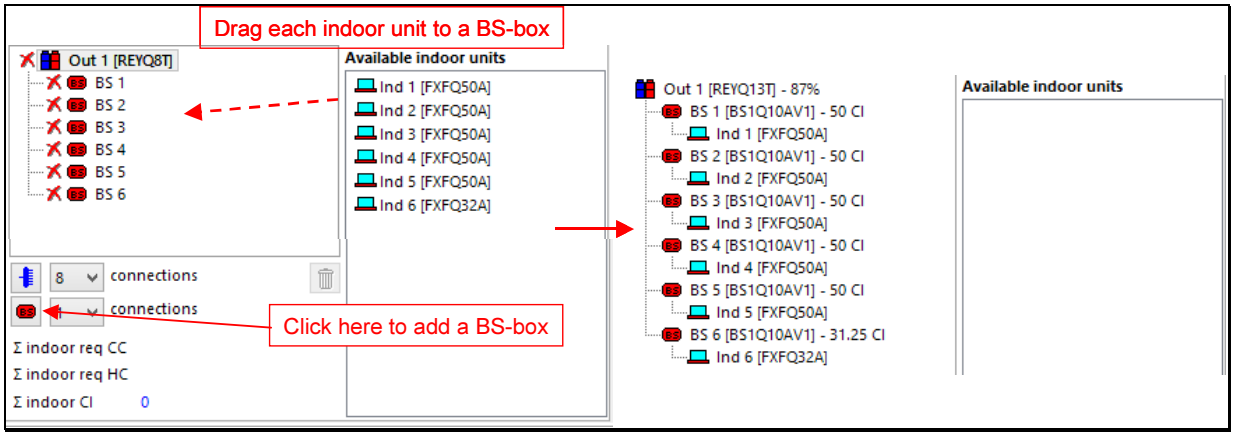


Figure 62: Adding the BS-boxes and indoor units

In the same way as in section 3.2, the outdoor unit indicates an error, because the piping diagram is missing the piping lengths. And indeed, the piping diagram at the top of Figure 63 contains many piping pieces marked in red, meaning that they do not have a length.

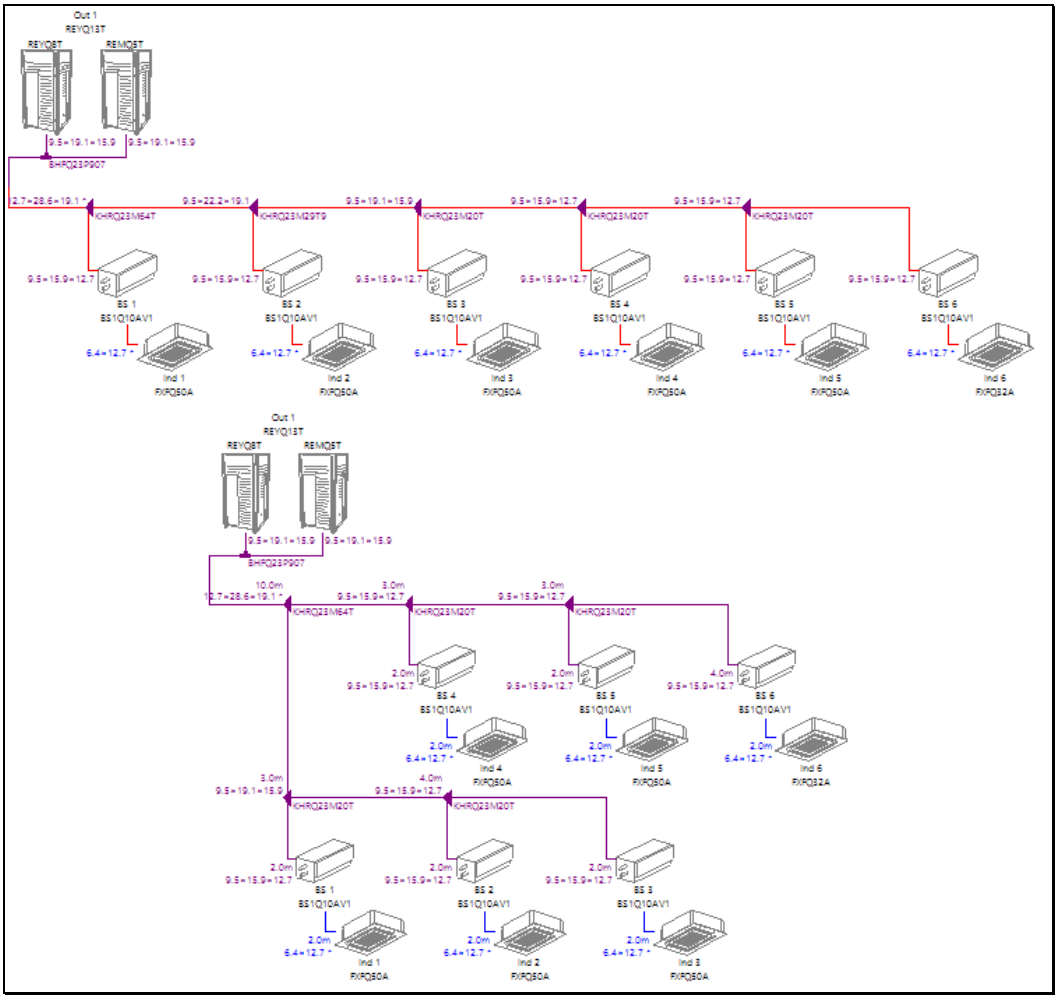


Figure 63: The initial piping diagram and the completed one

Fill in the lengths and rework the piping diagram in similar ways as explained in section 3.3. Note that the piping from indoor units to their BS-box consists of 2 pipes (blue) and from BS-boxes to the outdoor unit consists of 3 pipes (purple) needed to recover heat.

Figure 64 shows how to add a HT hydro box. Select it as explained in section 4.2.3 and connect it to heat recovery system without using a BS-box, as shown at the right. The piping diagram

then shows the hydro box connected to the outdoor unit using a two pipe connection, whereas the BS-boxes use a three pipe connection. Note that adding hydro box to the outdoor unit also increases the size of the outdoor unit: instead of a model REYQ12T, VRV_Xpress now finds a model REYQ18T.

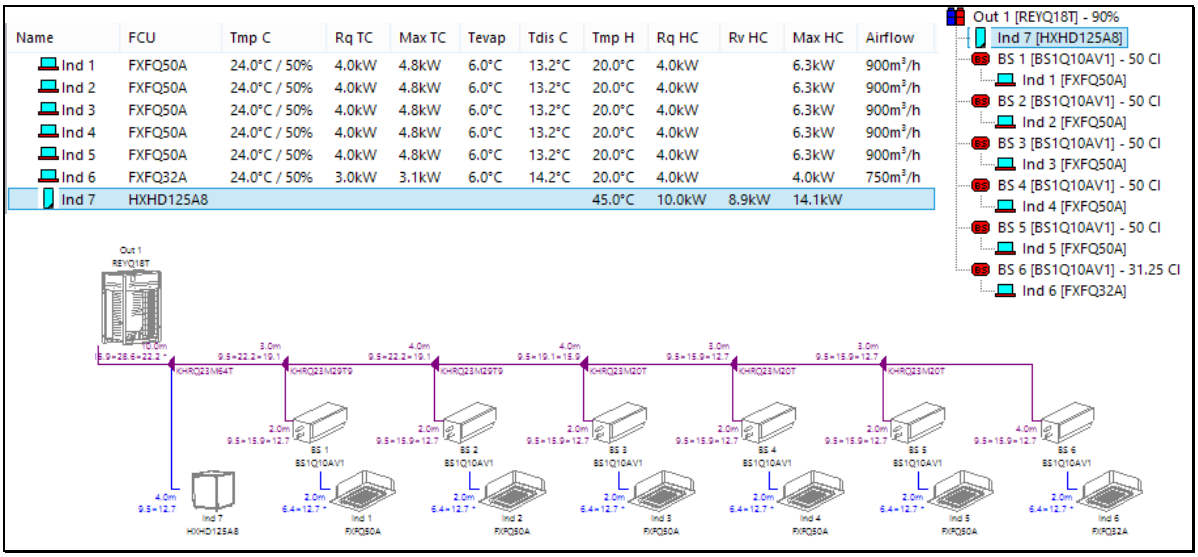


Figure 64: Adding a HT hydro box to a heat recovery system

A second way to have a heat recovery system similar to the original heat pump example is using the intelligent copy function, as shown in Figure 65. This copy function automatically inserts a BS-box per indoor unit, while copying the heat pump system. However, the piping diagram is the same as shown in Figure 63 at the top. So, you will have edit and adapt the piping diagram in the same way.

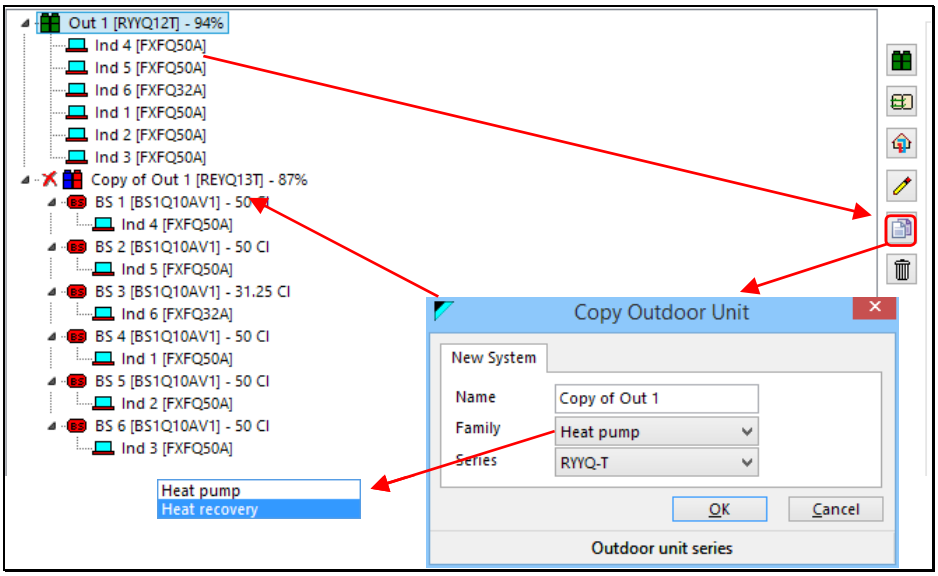


Figure 65: Intelligent copy of a heat pump system into a heat recovery system

A third and last method to define a heat recovery system similar to the original heat pump example is deleting the outdoor unit first, as shown in Figure 66:

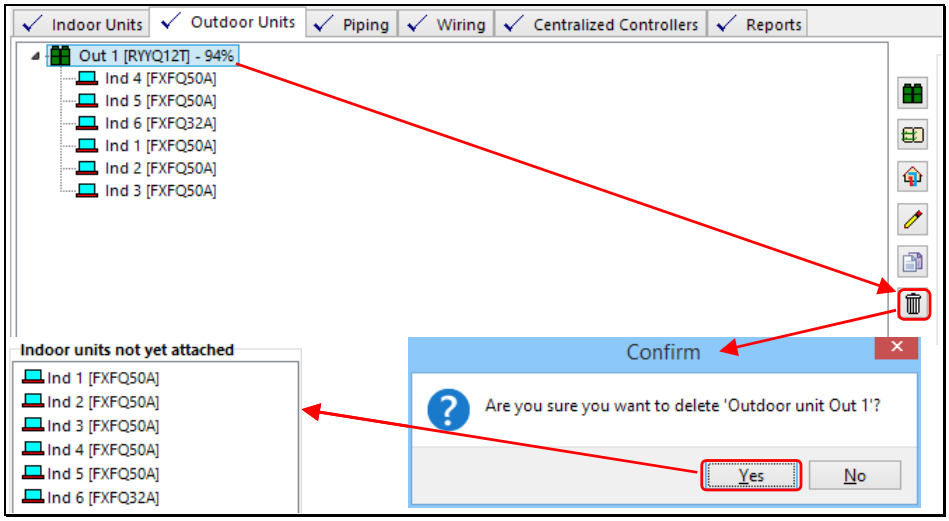


Figure 66: Deleting the heat pump outdoor unit

Deleting the outdoor unit does not remove its indoor units. Instead, VRV_Xpress disconnects them and makes them available to connect to another outdoor unit. You now can define a new outdoor unit and select the family heat recovery. Instead of adding 6 individual BS-boxes, as in Figure 62, you now add a multiple BS-box with six individual BS-boxes, as shown in Figure 67, at the left. Dragging the indoor units is exactly the same as for individual BS-boxes.

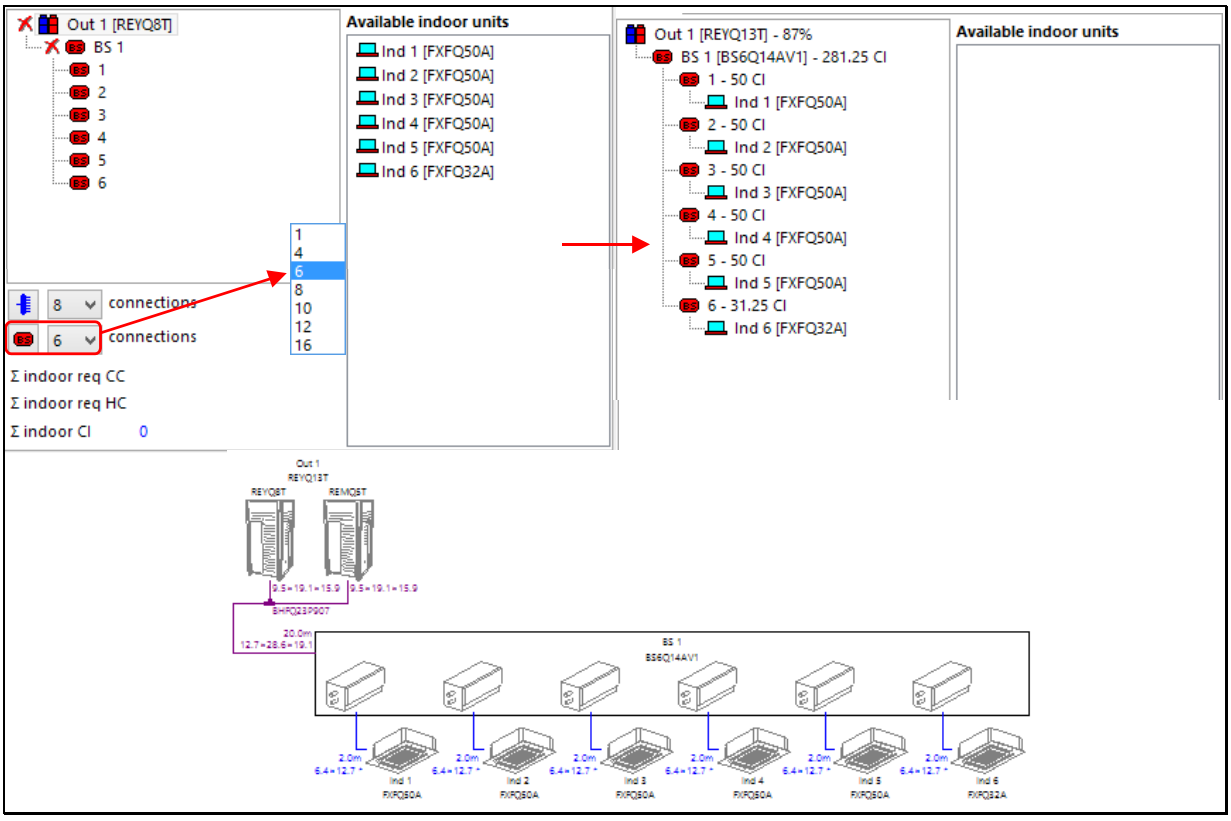


Figure 67: A recovery system using a multiple BS-box

The big difference however is now in the piping diagram: all piping between the BS-boxes has been integrated in the multiple BS-box. The only pipes left are from the indoor units to this BS-box and from the multiple BS-box to the outdoor unit.

Note that a multiple BS-box consists of individual BS-boxes. So, each indoor unit is still controlled in an individual way. There are multiple BS-boxes with up to 16 indoor units.

A single BS-box can control more than one indoor unit. A BS-box can control up to 5 indoor units, but the actual number also depends on the connection index. The smallest BS-box has a maximum connection index of 100, which allows to connect maximally 2 models FXFQ50A to them.

Suppose the indoor units Ind5 and Ind6 in the example project are now installed in a single room. So, one BS-box will control them both. In the outdoor unit definition, you drag Ind5 and Ind6 to the same BS-box.

Figure 68 shows the multiple BS-box solution, in which two indoor units (Ind5 and Ind6) connect to a single BS-box. The multiple BS-box now contains an unused BS-box requiring a closing kit to keep the refrigerant in a closed circuit.

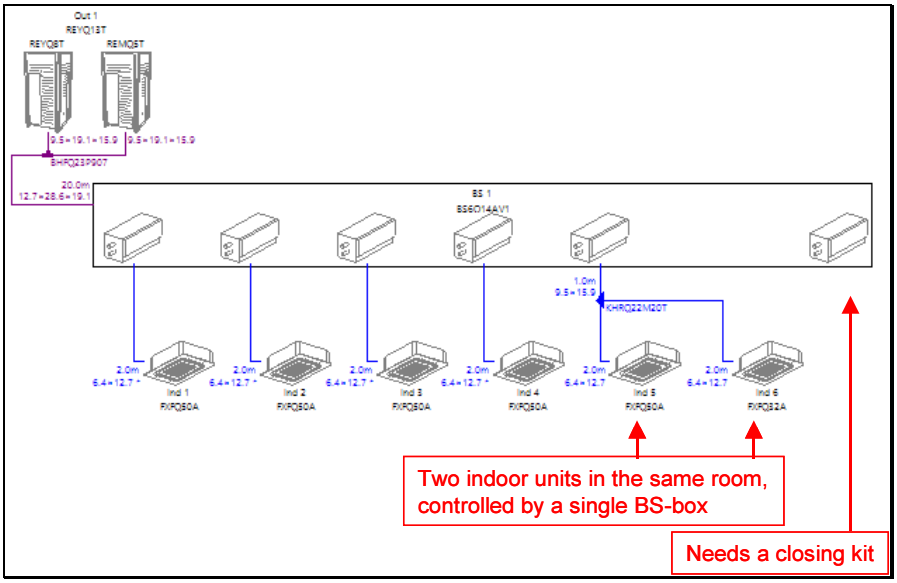


Figure 68: Connecting more than one indoor unit to a BS-box

4.3.4 Residential Application Indoor Units

Residential application indoor units (RA indoor units) are somewhat special, as they impose a few special constraints to the outdoor unit they connect to:

- They can only connect to a heat pump outdoor unit.
- The outdoor unit must operate at an evaporator temperature of 9^0C, instead of the standard 6^0C.
- An outdoor unit connected to RA indoor units must have a minimum connection ratio of 80%.
- The size of outdoor units connected to RA indoor units is limited to single module outdoor units.
- RA indoor units must connect to a BP unit, which in turn connects to the outdoor unit. A BP unit can either control 2 or 3 RA indoor units.

Figure 69 shows the edit indoor unit window, in which you can select RA indoor unit (their family starts with "***Split***").

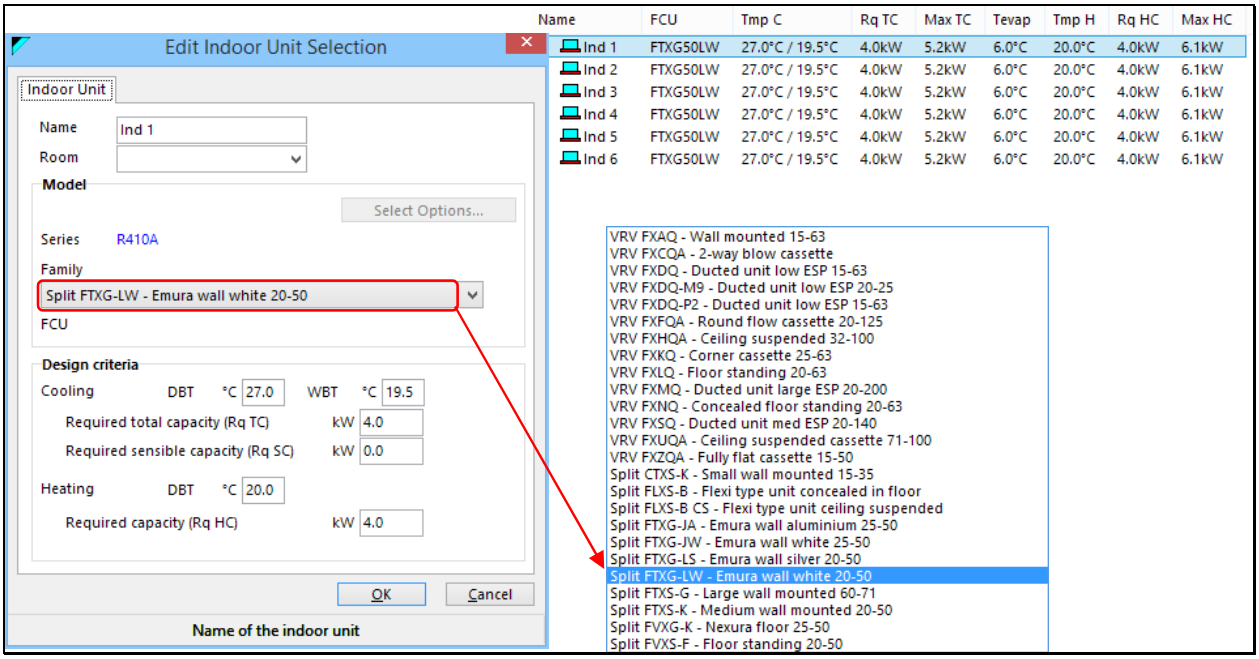


Figure 69: Defining RA indoor units

Figure 70 illustrates how to connect these RA indoor units to an outdoor unit, using BP units. There are two BP unit models: one to connect maximally two indoor units and another to connec maximally three indoor units.

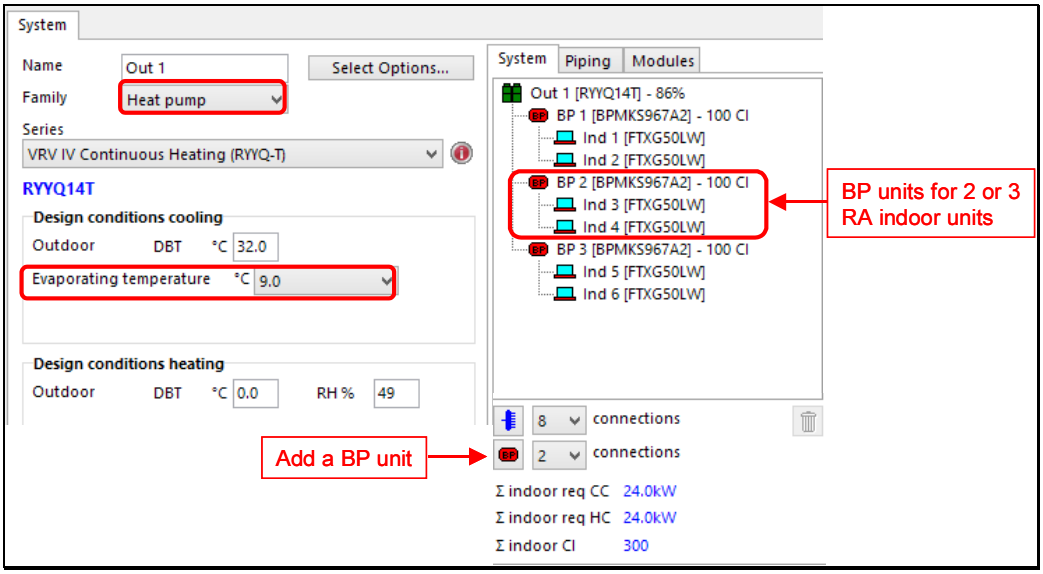


Figure 70: Connecting RA indoor units to an outdoor unit

The piping diagram is not much different from other piping diagrams and you fill in the piping length in the same way as for the other types of piping diagram. Figure 71 shows the diagram for the example given in Figure 69:

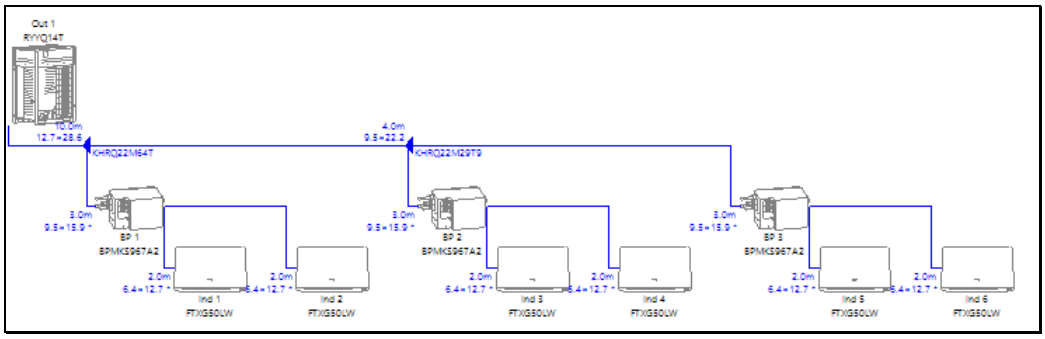


Figure 71: The completed piping diagram for a RA system

4.3.5 Using REFNET Headers

A REFNET header can connect several indoor units instead only two with a REFNET joint. However, there are limits on their use:

- It is not possible to connect a header to a header
- It is not possible to connect joints to a header.
- It is only possible to connect a header to a joint.

Figure 72 shows an outdoor unit containing two headers. This will allow defining two sub groups of indoor units, similar to the piping shown in Figure 40 at the bottom. Each header connects to three indoor units, although it would be possible to connect the 6 indoor units to a single header.

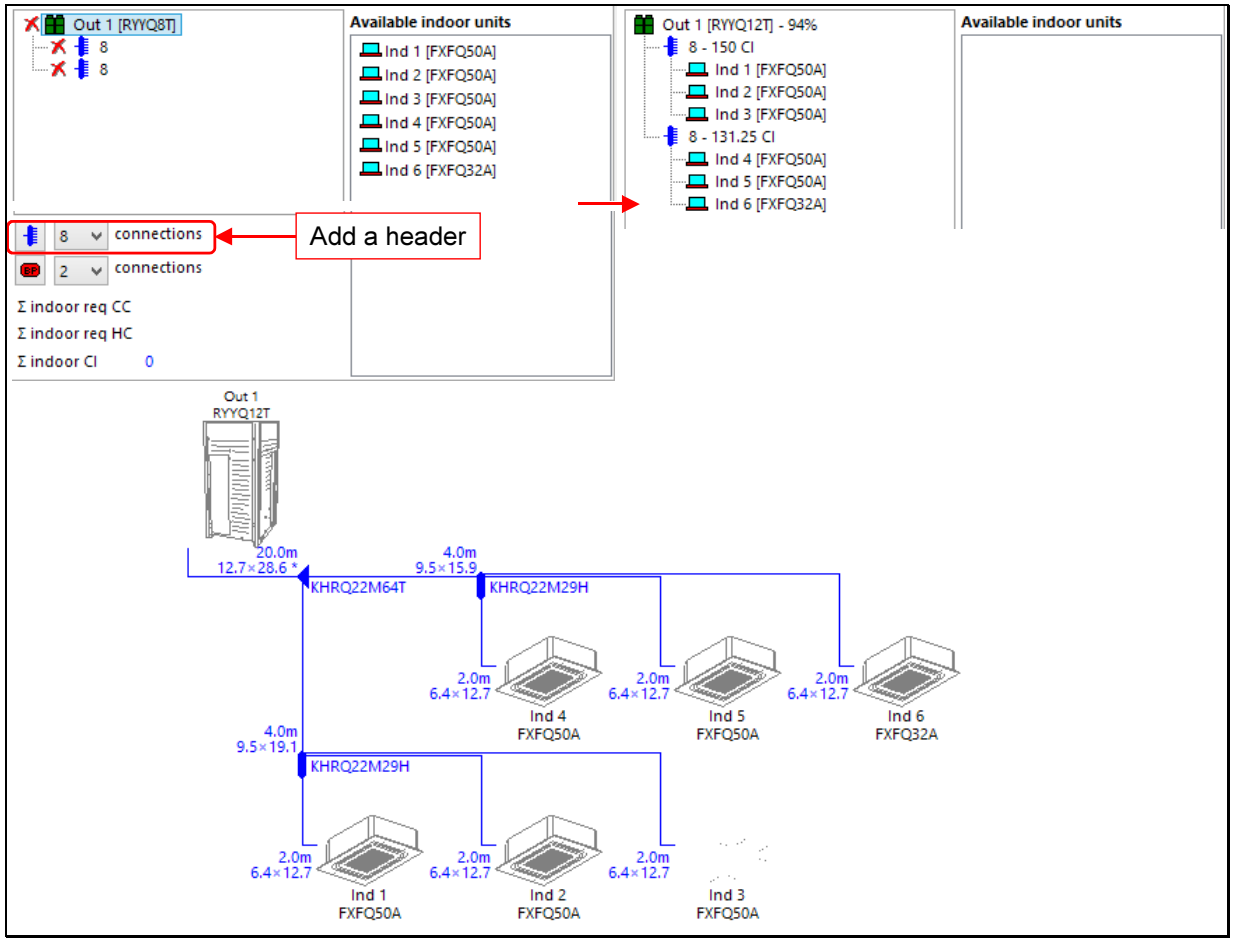


Figure 72: Defining an outdoor unit with REFNET headers

The corresponding piping diagram appears at the bottom of Figure 72. The headers nicely defines indoor unit groups and connect to a joint, which in turn connects to the outdoor unit.

Although a piping diagram with headers looks neat, the amount of piping may become larger and a header adds more resistance to piping than joints.

4.3.6 Simplified Piping

Up to now, all examples had a piping diagram in which you have to fill in the piping lengths. This is the more accurate way of designing a project. However, in some cases you do not have any plan of the building and you will have to make assumptions.

Figure 73 at the left shows the example from chapter 3. Instead of filling in piping lengths and editing the diagram, you uncheck the "***Enter individual piping lengths manually***" checkmark. This changes the "***Piping***" tab at the right. Instead of a single height difference, it now contains 4 extra data to enter:

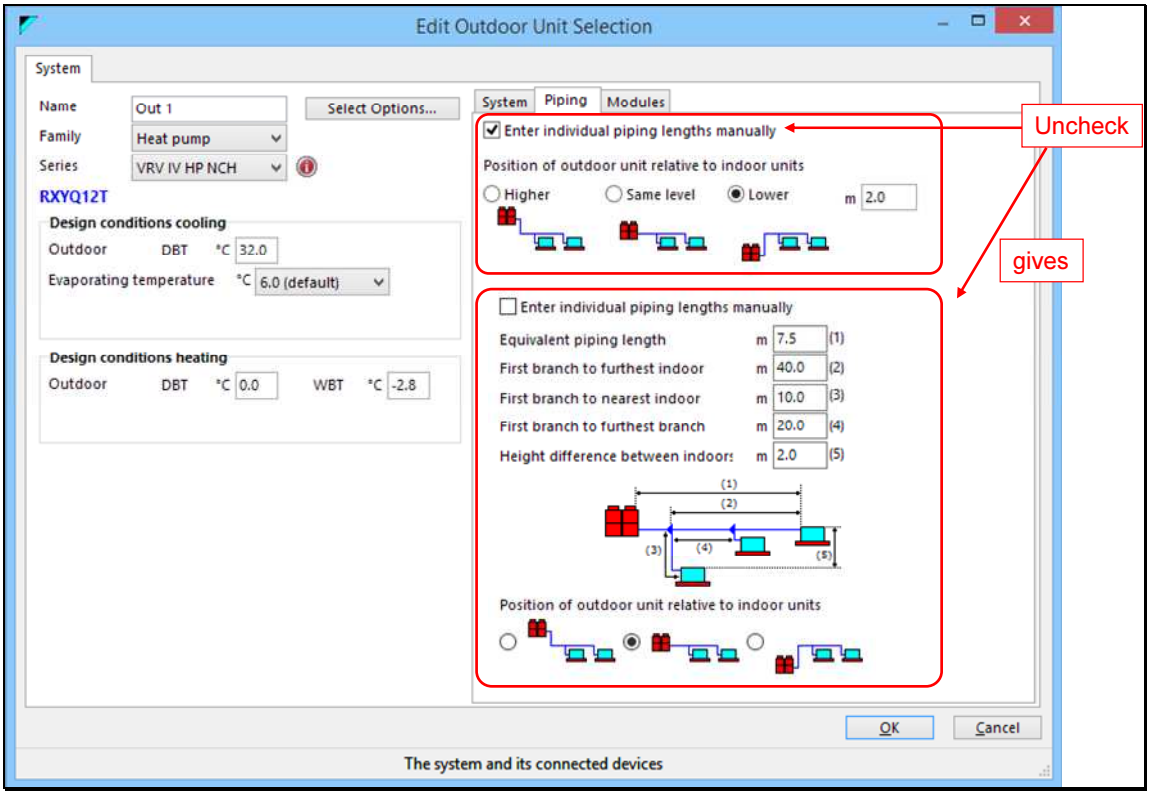


Figure 73: Using automatic piping lengths

1. The equivalent piping length of the installation. As you no longer enter piping lengths this an estimate of the longest equivalent piping length. If this value is longer than 90m, VRV_Xpress will size up the main pipe.
2. A second estimation is the distance from the first branch to the furthest indoor unit. VRV_Xpress combines this value with the distance between the first and last branches (fourth value) to decide for a size-up of intermediate pipes.
3. The third value is the first branch to nearest indoor unit. The difference between the second and this value must remain smaller than 40m.
4. If the distance between the first and the last branch is larger than 40m and the distance between the first branch and the furthest indoor unit (second value) is equally larger than 40m, VRV_Xpress will size up all intermediate piping diameters. This is a worst case action, as VRV_Xpress no longer knows where to find this longest length.
5. The height difference between indoor units is limited to 15m.

These figures are such that they take the most important piping limitations into account and at the same the worst case is taken into account. Figure 74 shows the (edited) piping diagram with the worst case diameter size up. In this diagram no piping lengths have been filled in and VRV_Xpress does not show any length, only the diameters.

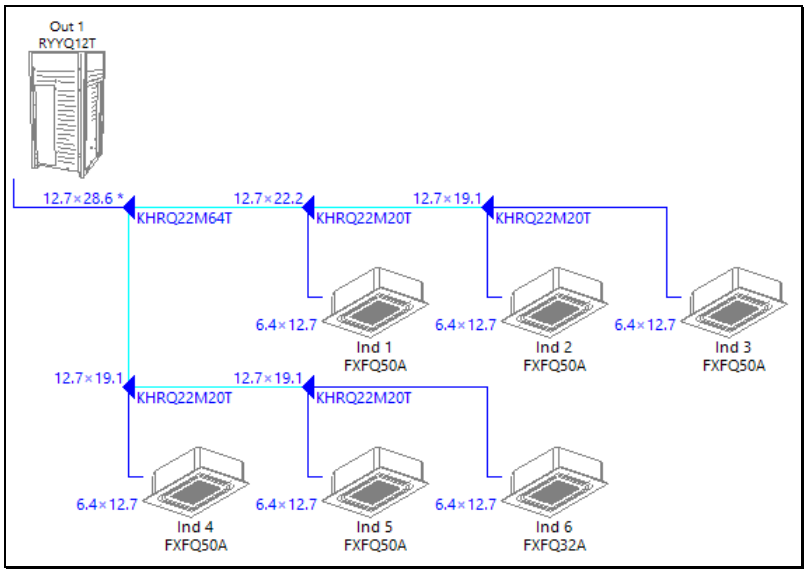


Figure 74: The piping with worst case diameter size up

5 Wiring Diagrams

VRV_Xpress offers two kind of diagrams: a system wiring diagram and a centralized controller diagram, meant to control a group of systems. This chapter explains the first one using the simple example of Chapter 3. For the second uses a much larger project containing a few systems allowing to illustrate a centralized control.

5.1 *Wiring Diagram*

Figure 75 shows the wiring diagram for the example system as explained in Chapter 3:

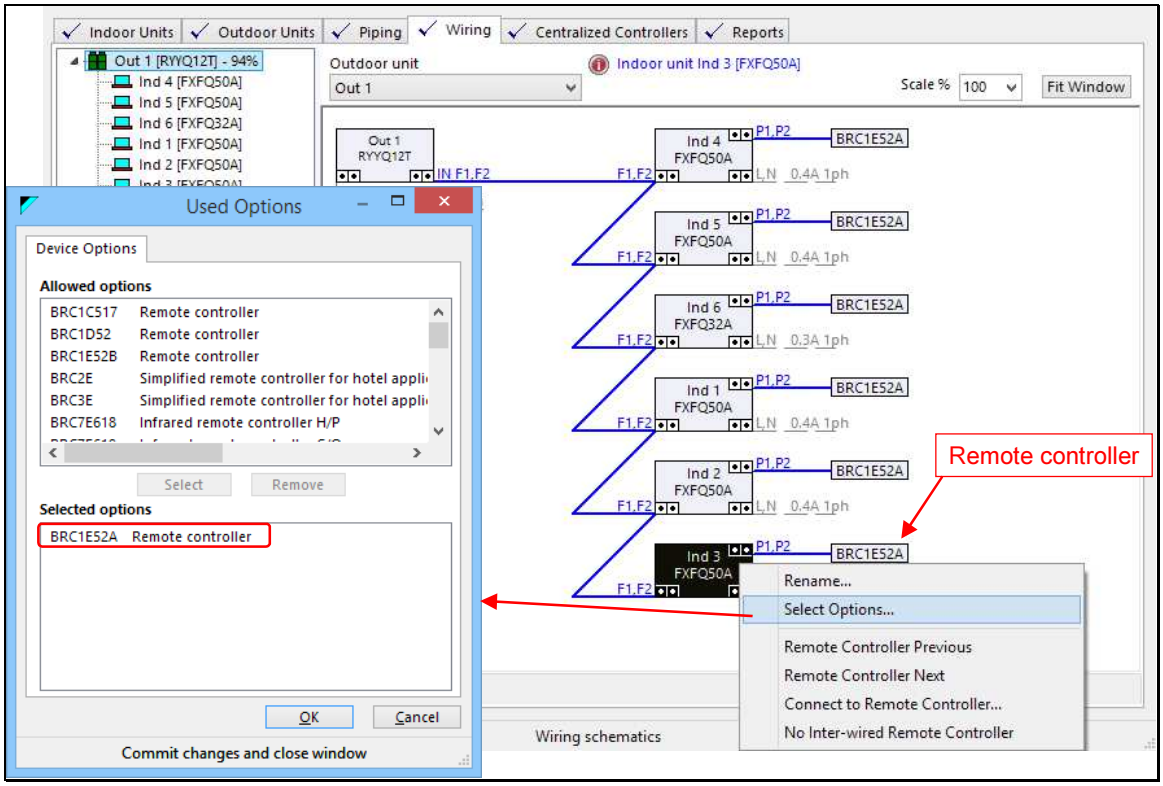


Figure 75: The wiring diagram for the system with 6 indoor units

It consists of a F1/F2 wiring between the outdoor unit and its indoor units. The indoor units communicate through this wiring with their outdoor unit.

As a remote controller is a preferred option (see section 4.1.2), each indoor unit has a remote controller. This device allows a customer switching the indoor unit on and off, changing its set temperature, setting its fan speed, etc. A remote controller connects to its indoor unit through the P1,P2 wiring. To see the options associated to an indoor unit, select it and click the right mouse button. This displays up a pop up menu, containing the "***Select Options***" command. Select this command to bring up the indoor options window.

The wiring diagram also shows the power lines, the current through those power lines and the number of phases.

Suppose now that indoor unit Ind4 needs a remote sensor, as the sensor build in the indoor unit gets too many influences from drafts. In addition, the indoor units Ind5 and Ind6 belong to one room as well as indoor units Ind1 and Ind3. Finally, indoor unit Ind2 needs to have a wireless remote controller.

A remote controller can control two indoor units in one room and make sure they operate simultaneously. So, you can remove one of the remote controllers in those rooms (Ind5 or Ind6 and Ind1 or Ind3). Using the option window (right click the indoor unit and select the "***Select options***" command), add a remote sensor to indoor unit Ind4, remove the remote controller from indoor units Ind5, Ind2 and Ind3 and a wireless remote controller to Ind2. This gives a results as shown in Figure 76:

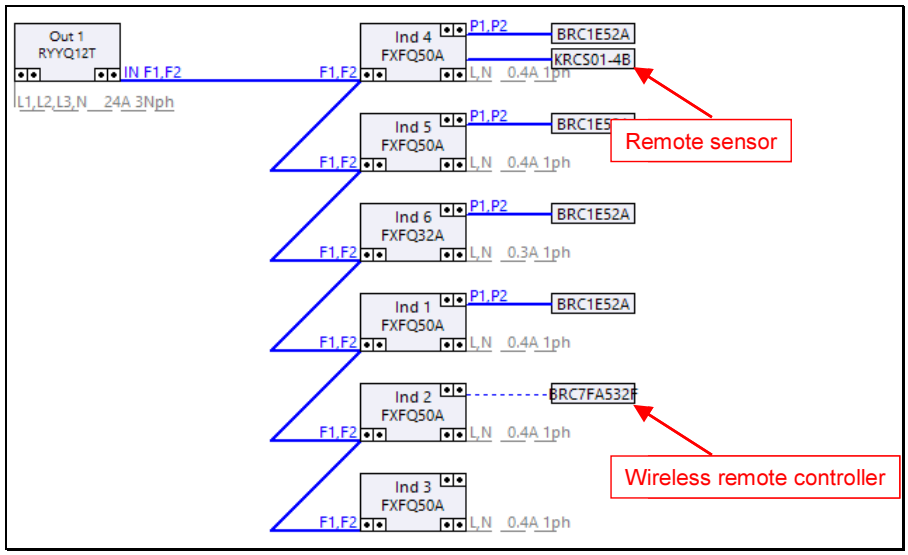


Figure 76: Adapted options in the wiring diagram

The indoor unit Ind5 now needs to share the remote controller of indoor unit Ind6. Right click Ind5 and select the "***Remote Controller Next***" command. This connects the indoor units Ind5 and Ind6 to the same remote controller, as shown in Figure 77:

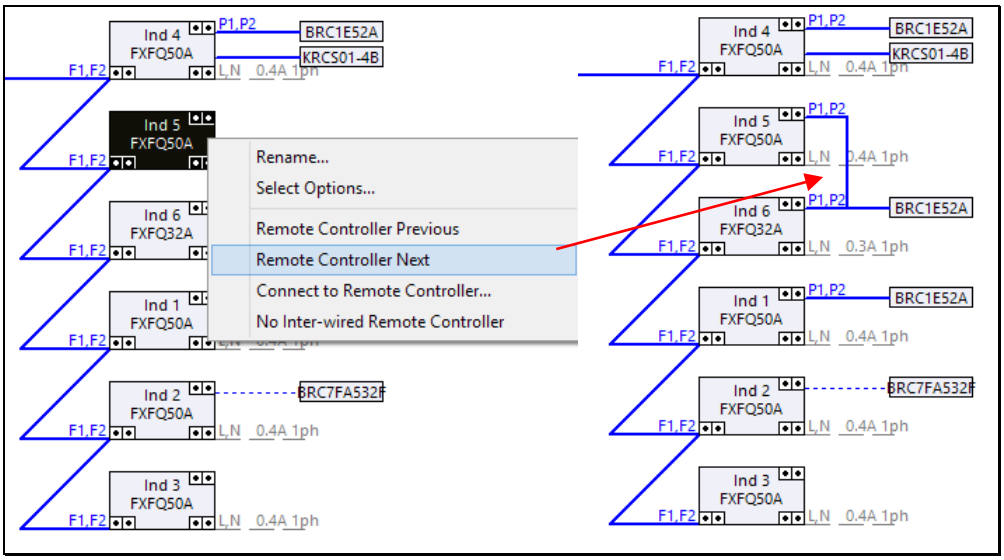


Figure 77: Sharing a remote controller between two consecutive indoor units

The "***Remote Controller Previous***" command would connect indoor unit Ind5 to the previous indoor unit in the wiring diagram, i.e. Ind4.

You cannot use these commands to connect indoor unit Ind3 to indoor unit Ind1, as indoor unit Ind2 is located between them. Use the "***Connect to Remote Controller***" command instead, as this the general command to connect any indoor unit to the remote controller of any other. Right click indoor unit Ind3 and select indoor unit Ind1 from the window coming up when selecting

the "***Connect to Remote Controller***" command. Now VRV_Xpress does not draw an actual connection but a reference to the indoor unit it shares the remote controller with. Drawing the connections would make the diagram much harder to read and may confuse you about what indoor units are sharing.

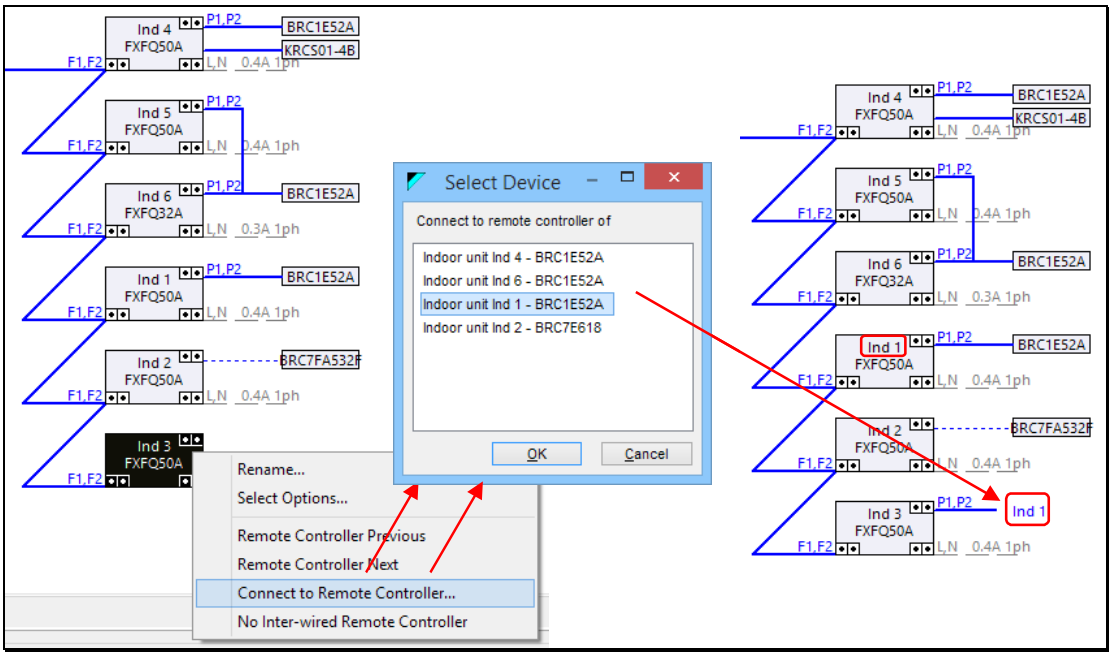


Figure 78: Sharing a remote controller between any indoor units

5.2 Centralized Controller Wiring

You need centralized controllers to control the systems in large buildings. In the same way an outdoor unit connects to its indoor units, a centralized controller connects to its outdoor units, but they also control the indoor units (through the communication wiring of the outdoor units). Figure 79 shows the outdoor units to be controlled and at the bottom the available list of centralized controllers:

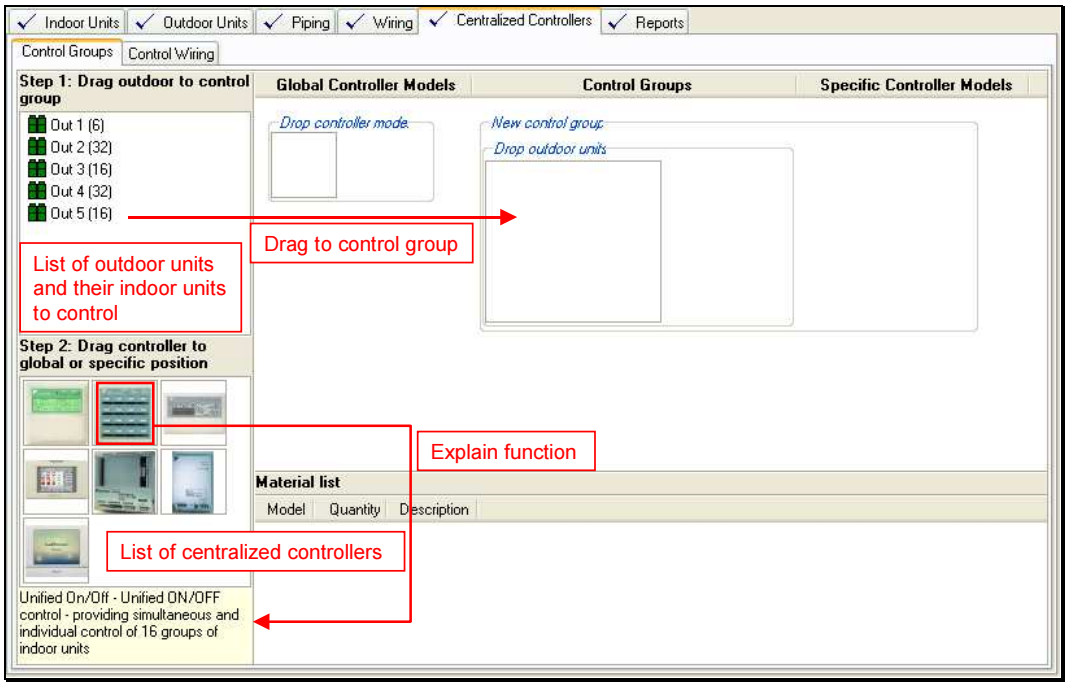


Figure 79: Initial window to define centralized controllers

Centralized controllers have a maximum number of indoor units they can control, typically 64, 128 or 256. If there are more indoor units, you need to add another centralized controller. However, as a centralized controller only connects to outdoor units, you need to group outdoor units so that they form clusters of indoor units containing their maximum number as close as possible. This is the purpose of having control groups.

First, you have to drag outdoor units to a control group. A control group is a logical entity defining groups of outdoor units (and consequently indoor units) that must be controlled in a similar way. Figure 80 shows two control groups: one containing four outdoor units and a total of 86 indoor units and a second control group contains one outdoor unit. This outdoor unit has 24 indoor units, 8 of which have no group address. These indoor units connect as slave indoor units to their master (see also section 9.3).

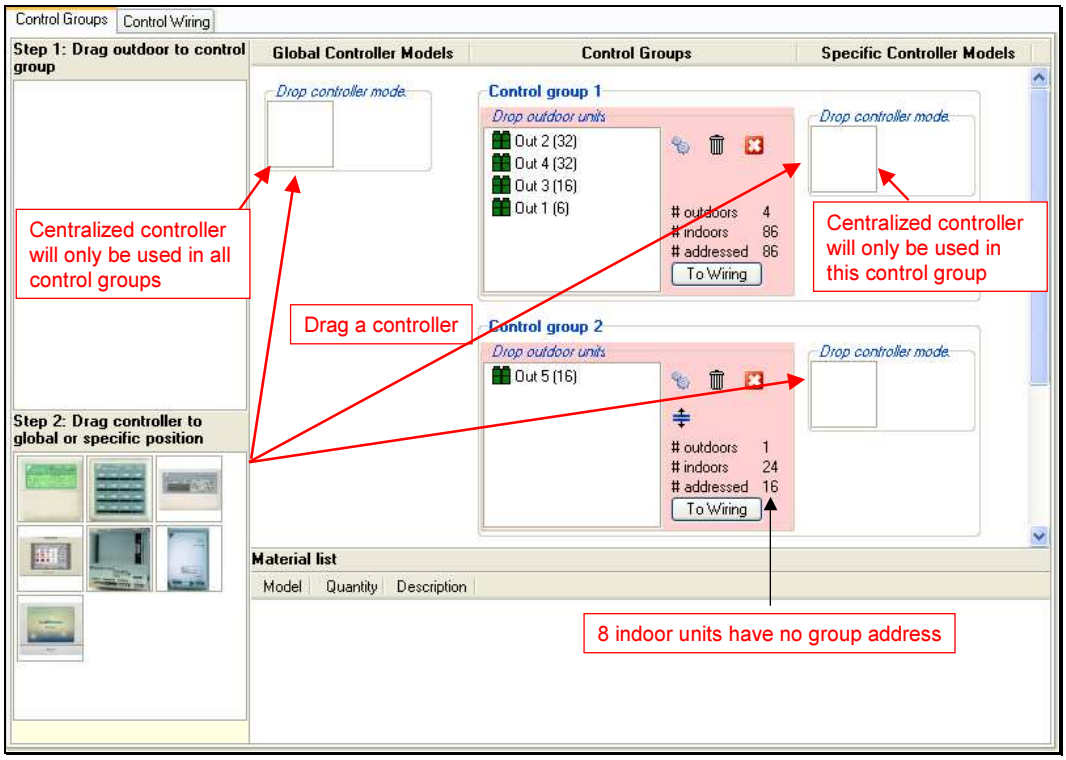


Figure 80: Defining control groups by dragging the outdoor units

You can now start dragging the centralized controllers. There are two possible places:

1. At the left: each centralized controller dragged to the left will be used in ***all*** control groups.
2. At the right and within a control group: each centralized controller dragged to the right will only be used in the control group it has been dragged to.

While dragging the centralized controllers, VRV_Xpress will check if the intended combination is compatible. If not, it gives an error message as shown e.g. in Figure 81:

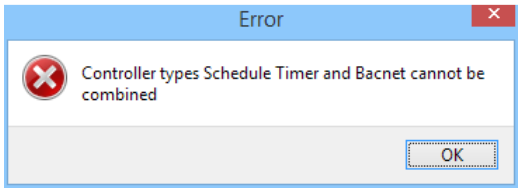


Figure 81: Some centralized controllers are incompatible

Figure 82 shows the result after having added an unified ON/OFF controller, a centralized remote controller and a Bacnet controller (only for control group 1).

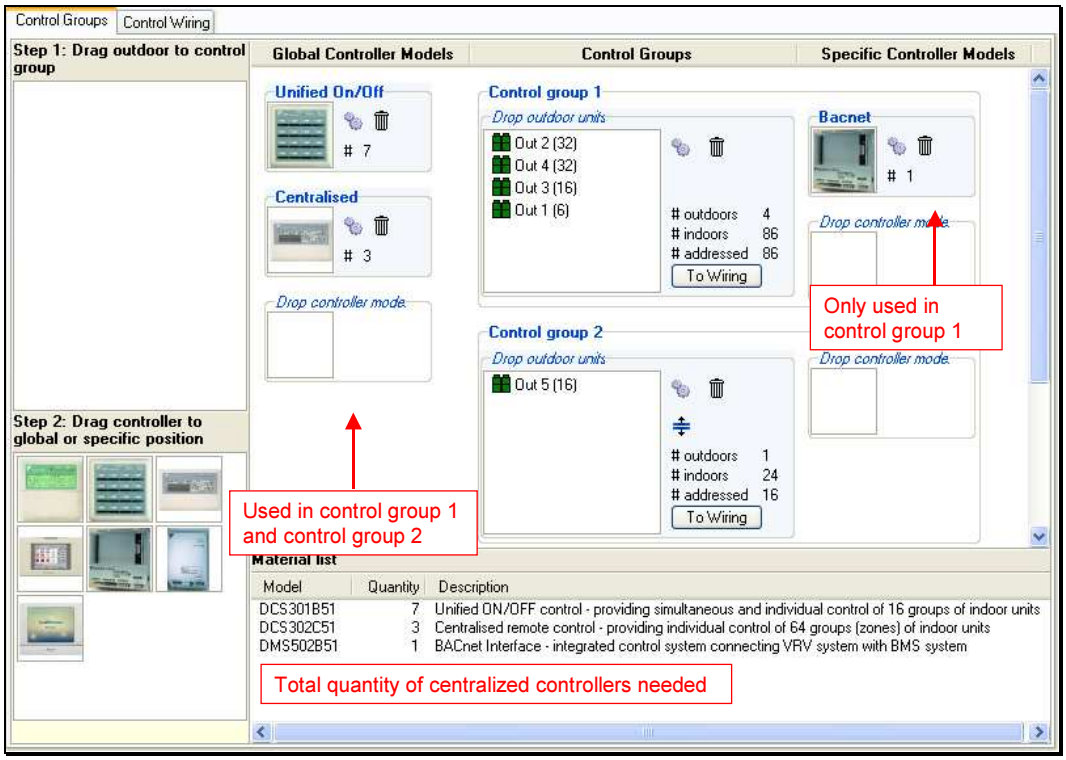


Figure 82: Completing the control groups

This completes the definition of the control groups. The next step is refining the actual wiring diagrams. Click the "***Control Wiring***" tab and select a control group or click the "***To Wiring***" command button in the control group to display the required wiring diagram.

Figure 83 shows the wiring diagram for control group 1:

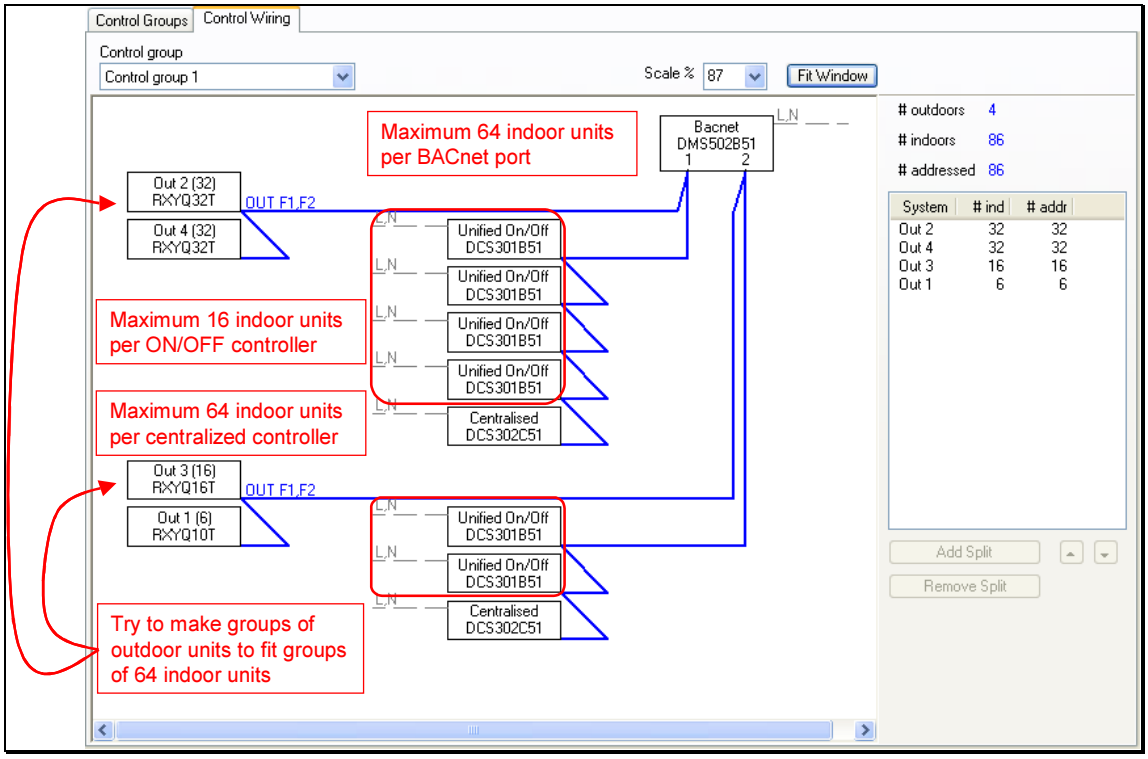


Figure 83: The wiring diagram for control group 1

VRV_Xpress automatically groups the outdoor units to make clusters of 64 indoor units or as

close as possible to 64. In Figure 83, outdoor units 2 and 4 have been combined into one cluster and outdoor units 3 and 1 into another. It then assigns the different centralized controllers to these clusters and draws the wiring.

However, this automatic clustering may not be what a customer would like. In fact, outdoor unit 1 and 2 may cover a single floor and outdoor unit 3 and 4 another. So, the VRV_Xpress sorting must be overruled.

At the right of the wiring diagram, VRV_Xpress shows the sorted outdoor units. The bottom of this list contains commands to edit this list. Figure 84 shows how to reorganize the original order by adding splits and moving outdoor units:

1. Select outdoor unit Out4 and click the "***Add Split***" command button. This creates two clusters: one only containing outdoor unit Out2 and the other containing outdoor units Out4, Out3 and Out1.
2. Select outdoor unit Out1 and click the "▲" command button to move it to the other cluster. This gives the expected clusters Out1 and Out2, Out 3 and Out4.
3. While performing those command, VRV_Xpress automatically recalculates the wiring diagram, creating new diagrams after each step. Figure 84, at the bottom right shows the final diagram.

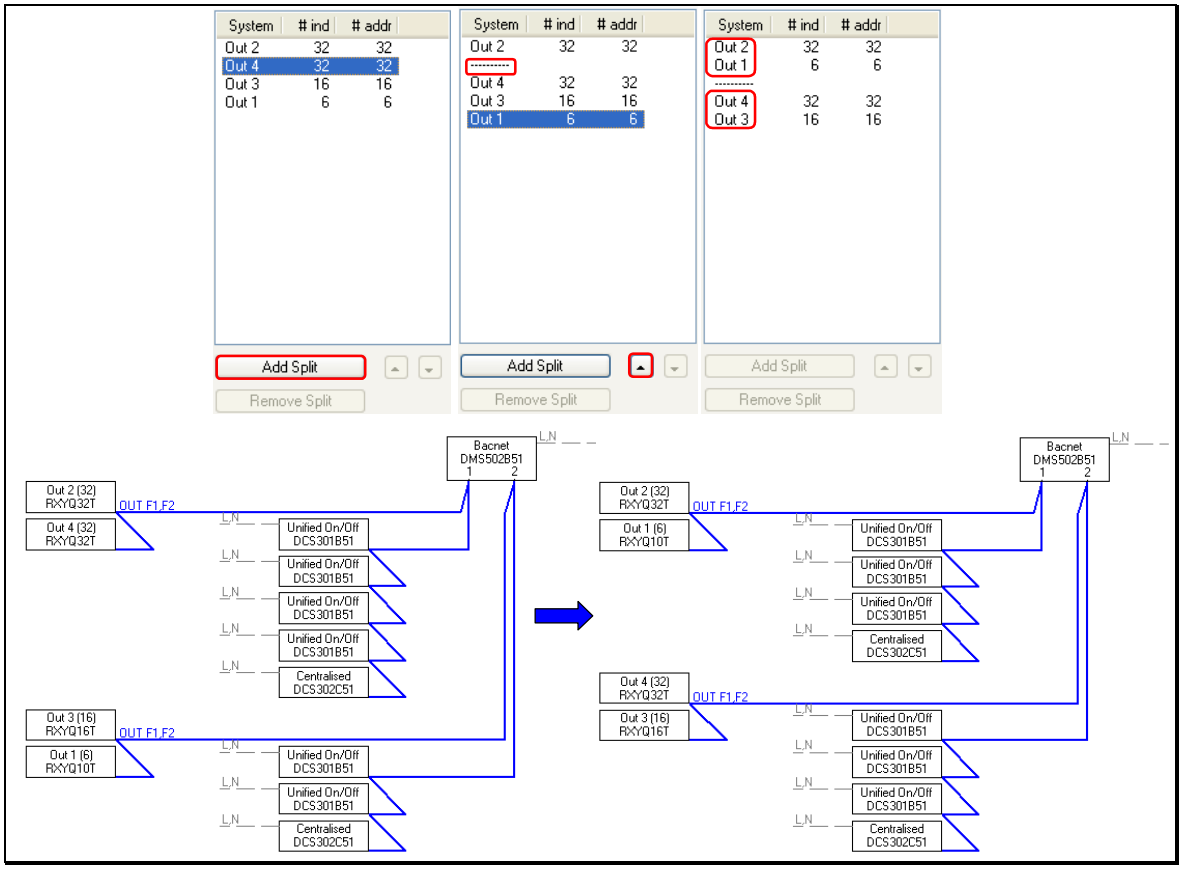


Figure 84: Overruling the default wiring diagram (making other clusters)

6 The Preferences Window

This chapter explains the command toolbar and more specifically the preferences window, which contains many settings and options that have an important influence on the VRV_Xpress operation.

6.1 The Command ToolBar

Figure 85 shows the command toolbar appearing at the top of the VRV_Xpress main window, together with two settings in the "***Indoor Units***" tab:

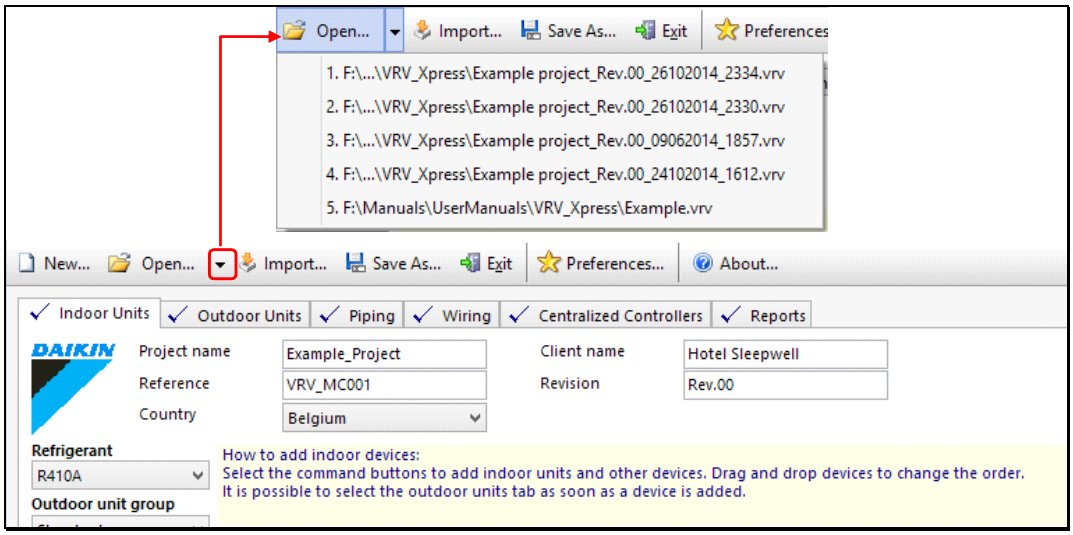


Figure 85: The command toolbar

The following commands are common to many programs:

- New: starts a new project, if necessary after clearing the list of indoor units and outdoor units.
- Open: opens a project file, fills in the indoor units in the "***Indoor Units***" tab, the outdoor units in the "***Outdoor Units***" tab and creates the diagrams for piping, wiring and centralized controllers. Next to the open command, a small icon appears, showing a down arrow. Clicking this icon, brings up a menu with the most recently used project files. Select one of these files to open the project immediately.
- Import: when starting a new project, importing a VRV_Xpress project is identical to opening that project. However, importing a project while another project is still active, adds its contents to the current project. This allows combining several projects into a single large project.
  You cannot import an incomplete project, as for example a project containing indoor units only and not yet connected to an outdoor unit. Attempting to import an incomplete project results in an error message as shown in Figure 86:

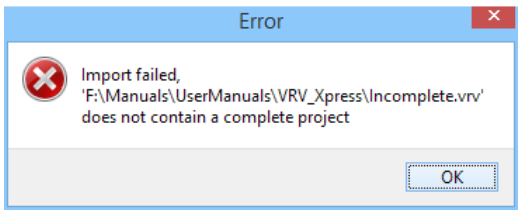


Figure 86: Importing an incomplete project

- Save As: saves the project in a file.
- Exit: exits VRV_Xpress, possibly after a project save confirmation, shown in Figure 87:

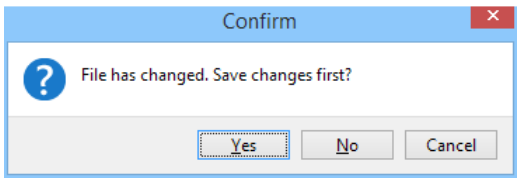


Figure 87: Confirm exiting without saving

- Preferences: the next section explains this command, bringing up a window with several tabs.
- About: this command brings up a window containing extra commands and explained in section 2.6.

Below the project information (see Figure 85) in the "***Indoor Units***" tab, you find two more settings:

- The "***Refrigerant***" list box, where you can select the refrigerant to use in the project. Currently, there is only one refrigerant available (R410A).
- The "***Outdoor unit group***" is an additional grouping of outdoor units, that are not compatible with each other. For example, High Ambient outdoor units connect to a complete different set of indoor units. So, it is not possible to make a project combining two outdoor unit groups. Note that the outdoor unit group list may vary per region or per country, depending on the available configurations (see section 2.2).

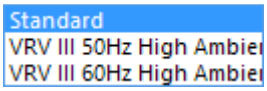


Figure 88: Outdoor unit groups

6.2 The Preferences Command

The Preferences window consists of several tabs, each defining specific settings. A very special tab is the one marked "***Advanced***", mainly containing settings for advanced selections. It is described in chapter 8, together with these advanced selections. The next sub sections describe the other settings, together with the influences they have on the VRV_Xpress operation.

6.2.1 Units Tab

By default, VRV_Xpress uses the SI units to express temperature values, capacities, etc. However, the "***Units***" tab allows you using other units, as shown in Figure 89.

- The preferences window displays dimensions for several units: weight, dimensions, piping, capacity, temperature, airflow and indoor cooling/ambient heating. The current dimension is the selected one. For example, the selected dimension for temperature in Figure 89 is ^{0}C.
- You can now select another dimension, such as ^{0}F for the temperature and close the window. VRV_Xpress immediately replaces all occurrences of ^{0}C by ^{0}F and also converts the data to the new dimension, as shown in Figure 89 at the right.

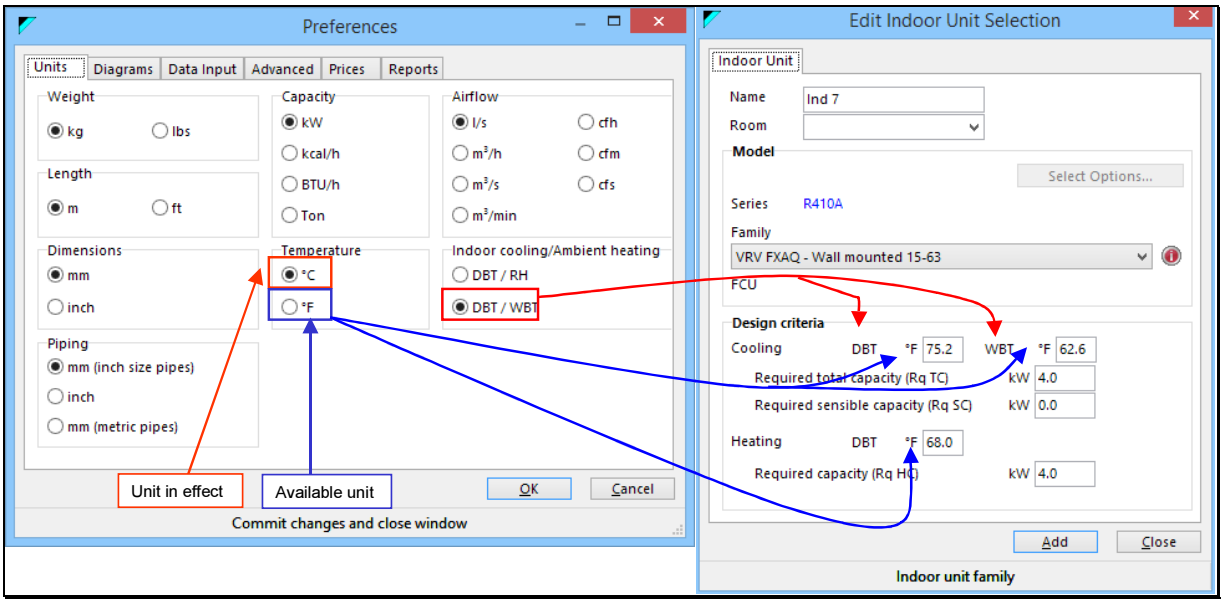


Figure 89: Changing the dimension of an unit

A special case is the "***indoor cooling/ambient heating***" setting. When defining a cooling condition, you need to define the dry bulb temperature as well as a measurement defining the humidity. This can be a relative humidity or a wet bulb temperature. Depending on the region or country, users prefer the one or the other setting, but both are equivalent. Figure 90 shows a single condition (25^0C/50%) on a psychrometric diagram and other measurements that are equivalent. The wet bulb temperature is the easiest to measure.

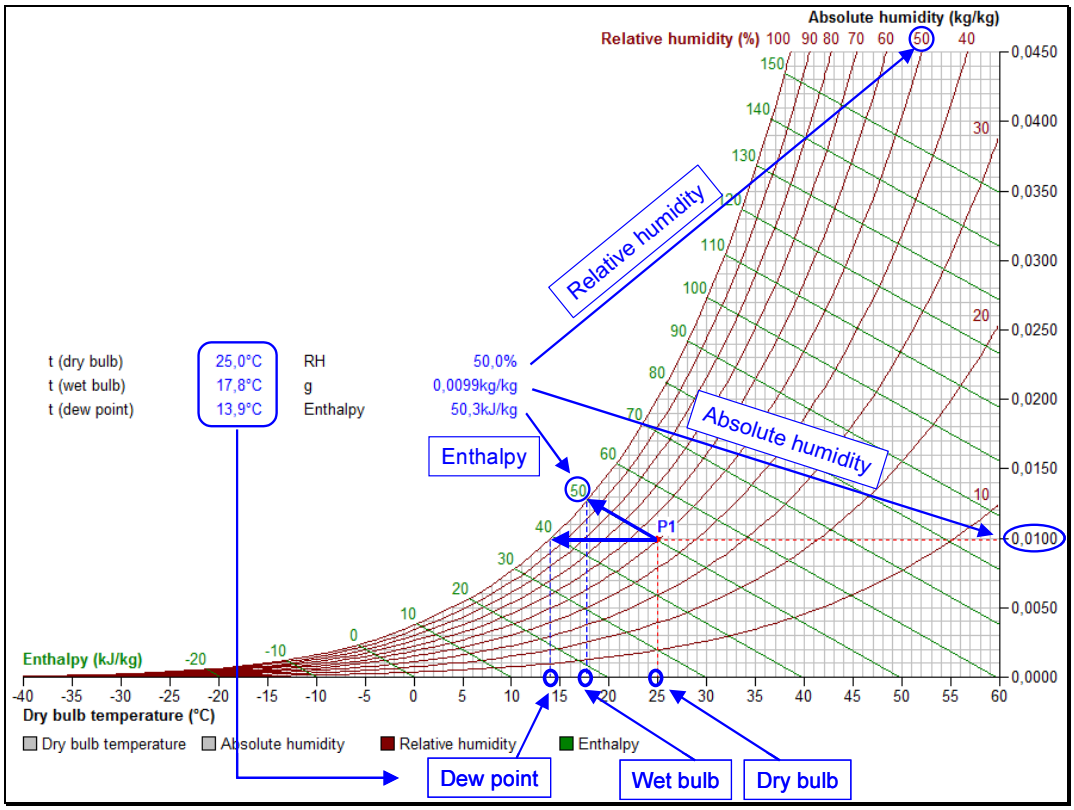


Figure 90: A psychrometric diagram with the measurements of a single condition

The defaults used for the units depend on the region: in Europe and Japan VRV_Xpress uses SI units and in the United States it uses Imperial units.

6.2.2 Diagrams Tab

The "***Diagrams***" tab allows you defining other colors and line styles for the different diagrams, as shown in Figure 91:

- When clicking on a colored square, a window comes up in which you can select the required color. If you still want another color, click the "***Define custom colors***" command button (at the bottom of the color window). This window may differ, depending on the Windows version you use.
- You can change the line styles by selecting one from the combo box. The default VRV_Xpress selections are such that results are clear both on the screen and in reports (on color or on black/white printer).

The color define to draw and fill devices is used for rectangles representing devices schematically, mainly in wiring diagrams.

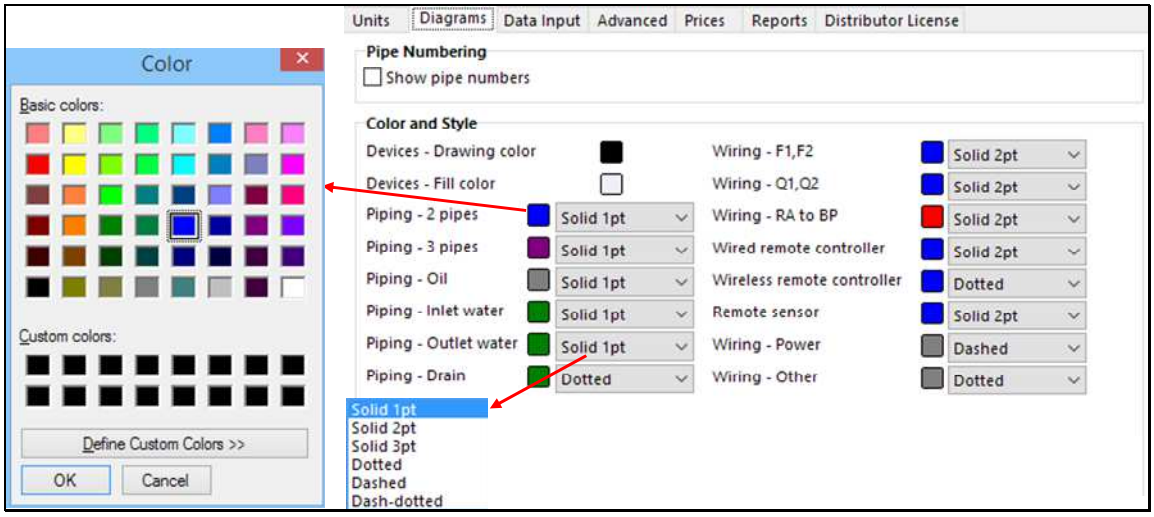


Figure 91: Defining colors and line styles for diagrams

At the top of this "***Diagrams***" tab, there is also a "***Pipe Numbering***" checkmark. When checking it VRV_Xpress numbers all piping pieces in the piping diagram, as shown in Figure 92:

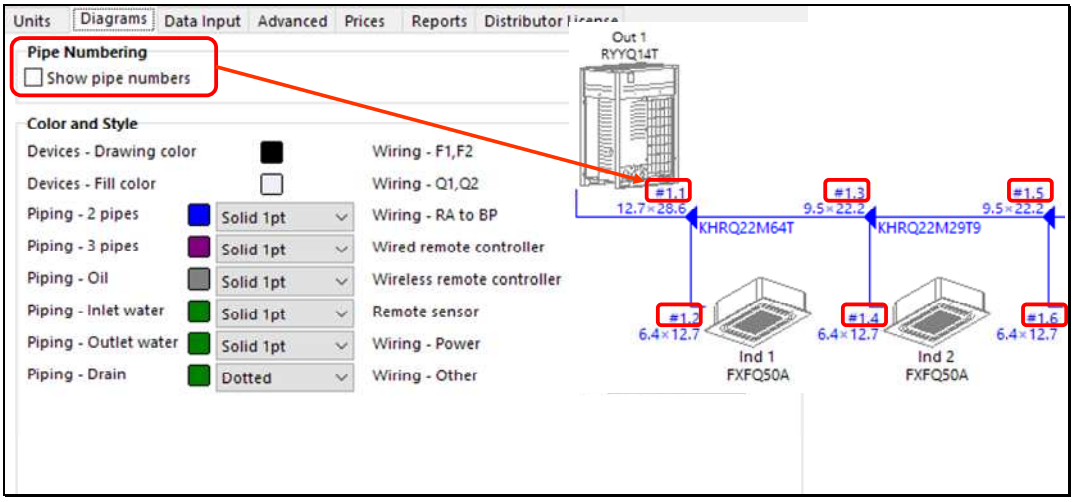


Figure 92: Numbering piping pieces

Each number consists of two parts, separated by a dot: the outdoor unit number and a pipe piece number. The right part of Figure 92 shows a part of piping diagram with the numbered piping pieces.

6.2.3 Data Input Tab

When defining a new device (indoor unit, outdoor unit, BS-box, etc), VRV_Xpress creates a name for it, consisting of a prefix and a sequence number. Figure 93 shows the default prefixes used in the "***Data Input***" tab and a new prefix for the indoor units:

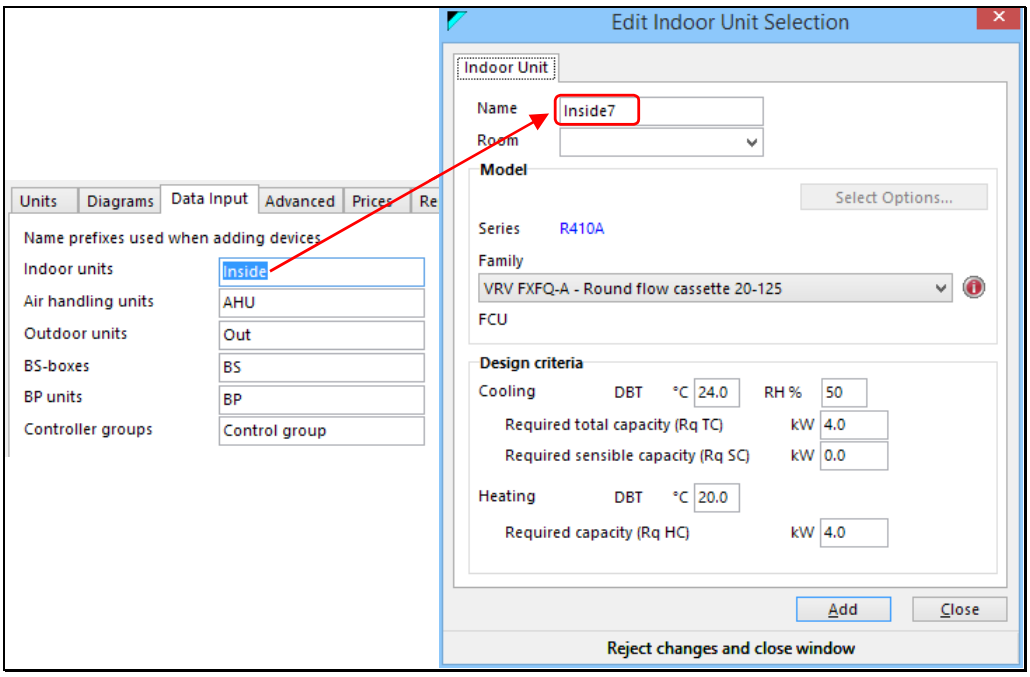


Figure 93: Defining the device prefixes

When you change them, only new devices will get the adapted prefix. VRV_Xpress does not change the names of the existing devices.

6.2.4 Prices Tab

For all devices in the device database, it is possible to define prices using the "***Price Editor***" program. This program saves the prices in a price file, which you can load in the "***Prices***" tab, as shown in Figure 94:

Figure 94: Loading a price file

When having loaded a price file, VRV_Xpress will mention the prices in the equipment list part of the report (see chapter 7). To learn more about this program, please contact us through the helpdesk: http//marketing.daikineurope.com.

6.2.5 Reports Tab

The "***Reports***" tab, shown in Figure 95, contains a few optional data that you may decide to show in reports:

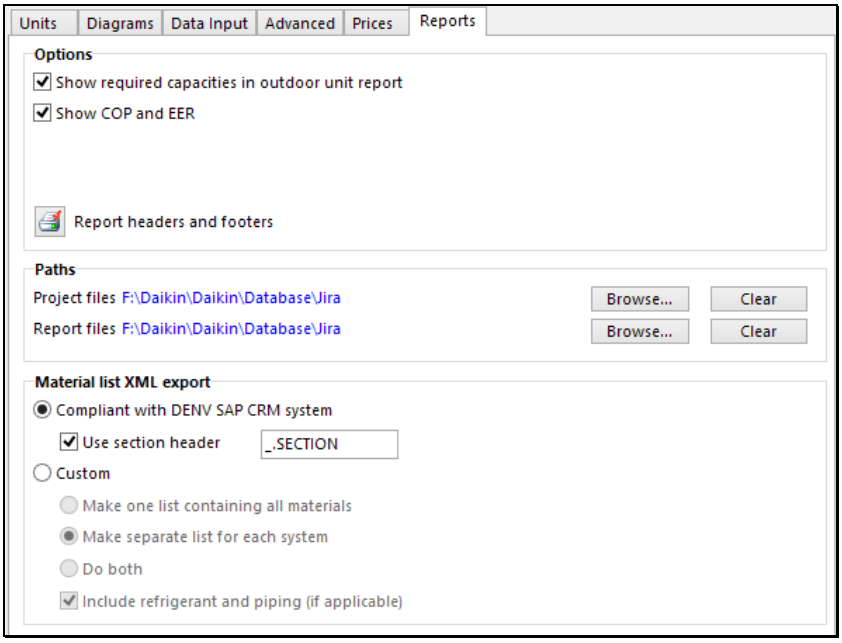


Figure 95: Defining extra data in the reports

- When checking the "***Show required capacities in outdoor unit report***" checkmark, VRV_Xpress will add the required capacities you entered to the report. When unchecked, only the provided capacities will appear.
- When checking "***Show COP and EER***" checkmark, VRV_Xpress will add the COP and EER at a connection ratio of 100% to the report. The COP and EER are both ratios of the capacity over the power input. As VRV_Xpress only stores the power input data for a connection ratio of 100% it can only calculate these values and not the COP and EER for the actual connection ratio of the outdoor units.
- The "***Report headers and footers***" command button, brings up a window to define the headers and footers in a report, containing distributor or installer coordinates and logo, as shown in Figure 96. When creating a report, VRV_Xpress fills in headers and footers, which by default only contain a Daikin logo in the header. Figure 96 at the right shows the corresponding page layout when defining the distributor or installer data.

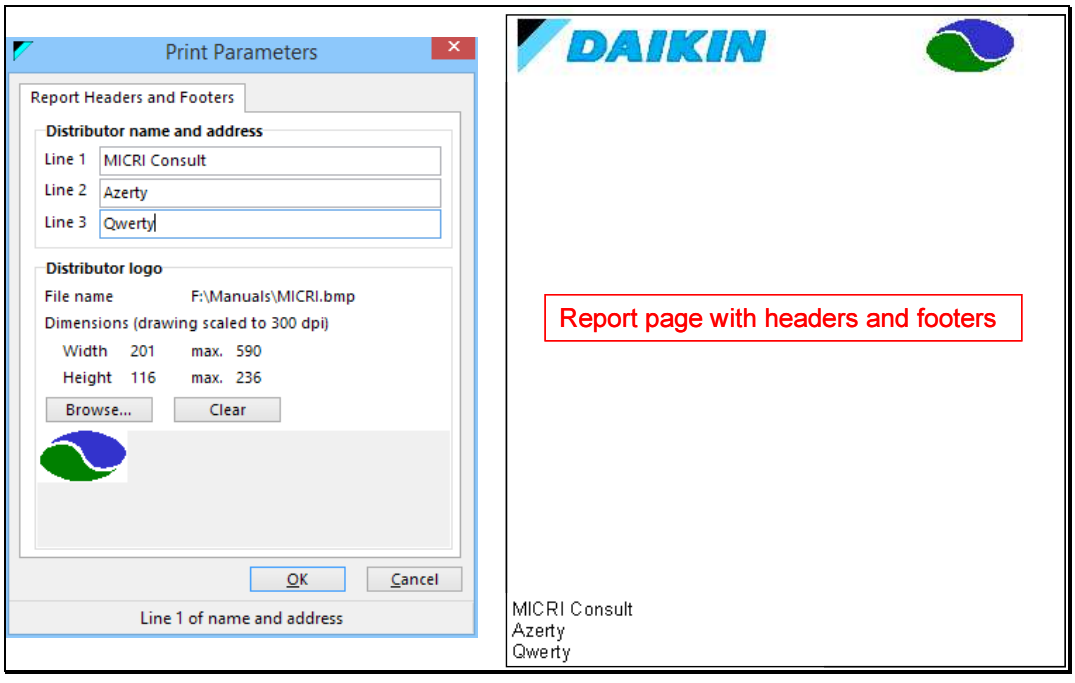


Figure 96: Defining distributor data and the corresponding header and footer in the report

- The Paths section allows you defining the path on the hard disk, where you want to store projects and reports. Clicking the "***Browse***" command button next to project files, brings up a window to select a folder. VRV_Xpress will then position on this folder by default, when you open, import or save a project. Clicking the "***Clear***" command button will clear the path. VRV_Xpress will then use the latest folder used to open, import or save a project. VRV_Xpress uses similar actions for the report files.
- The Material list XML export section defines settings for the content of the "***Material list XML export***" report, described in chapter 7, containing examples of this report in Figure 100. There are two choices:
  a. Compliant with DENV SAP CRM system. This choice is only available for VRV_Xpress versions in Europe and is selected by default. It creates an XML file with one sheet per system. Each sheet contains the selected outdoor unit, possibly its modules, the indoor units connected to it, the REFNETS used and the options. This file may contain an additional section header. The DENV SAP CRM system puts all sheets into one list when reading this file. This section header allows showing the individual system structure again.
  b. Custom. This choice is selected by default for VRV_Xpress versions outside Europe. It equally creates an XML file with either one sheet containing all systems or several sheets with one sheet per system or a sheet with all systems following by sheets for the individual systems. When checking the "***Include refrigerant and piping***" checkmark, the sheets also contain the extra refrigerant needed for each system and an overview of the piping diameters used, together with their lengths. Obviously, this is only possible for systems where you entered the individual piping lengths. For simplified piping (see section 4.3.6), VRV_Xpress cannot provide these data, even if requested.

7 Reporting

The "***Reports***" tab becomes available when the project contains completed systems: that is, indoor units connect to outdoor units and all piping diagrams are completed.

The reports tab in Figure 97 contains four parts:

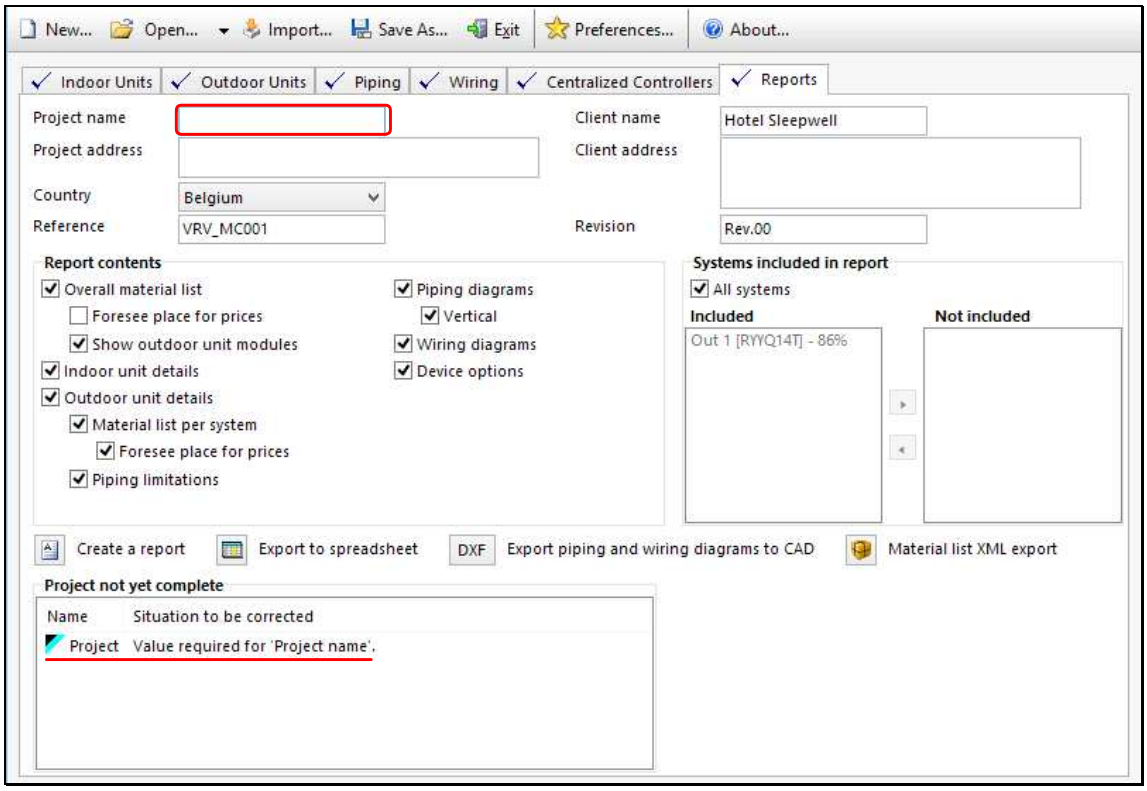


Figure 97: The report tab showing the different reporting sections

1. At the top, it repeats four fields that also appear in the "***Indoor Units***" tab. The Project name has been removed to trigger an error message appearing in the fourth part. For the example project, that field contains the value "Example project", as shown in Figure 48.
2. The report contents shows several checkmarks standing for several sections of the report. Unchecking a checkmark will suppress that section from the report.
3. Three command buttons allow creating the actual reports:
   - "***Create a report***" command button creates a rtf-file, which you can open with MSWord.
   - "***Export to spreadsheet***" command button creates a csv-file, which you can open with Excel.
   - "***Export piping and wiring diagrams to CAD***" command button creates one dxf-file per diagram. You can open dxf-file with Autocad or with an Autocad viewer.
   - "***Material list XML export***" command button creates an xml-file containing the material list, which you can open in Excel 2003 and higher (see further).
4. An optional part that only appears if the project cannot be saved, due to important errors or missing information about the project data in part 1. Figure 97 shows this part at the bottom, because the project does not have a name. This "***Project not yet complete***" part of the window only appears if the project cannot be saved.
   However, VRV_Xpress may also replace this fourth part by another one, in case there are files to download available on the server. In that case, VRV_Xpress shows the list of files that you can download. Click on a file to display a save dialog to save the file on your local hard disk

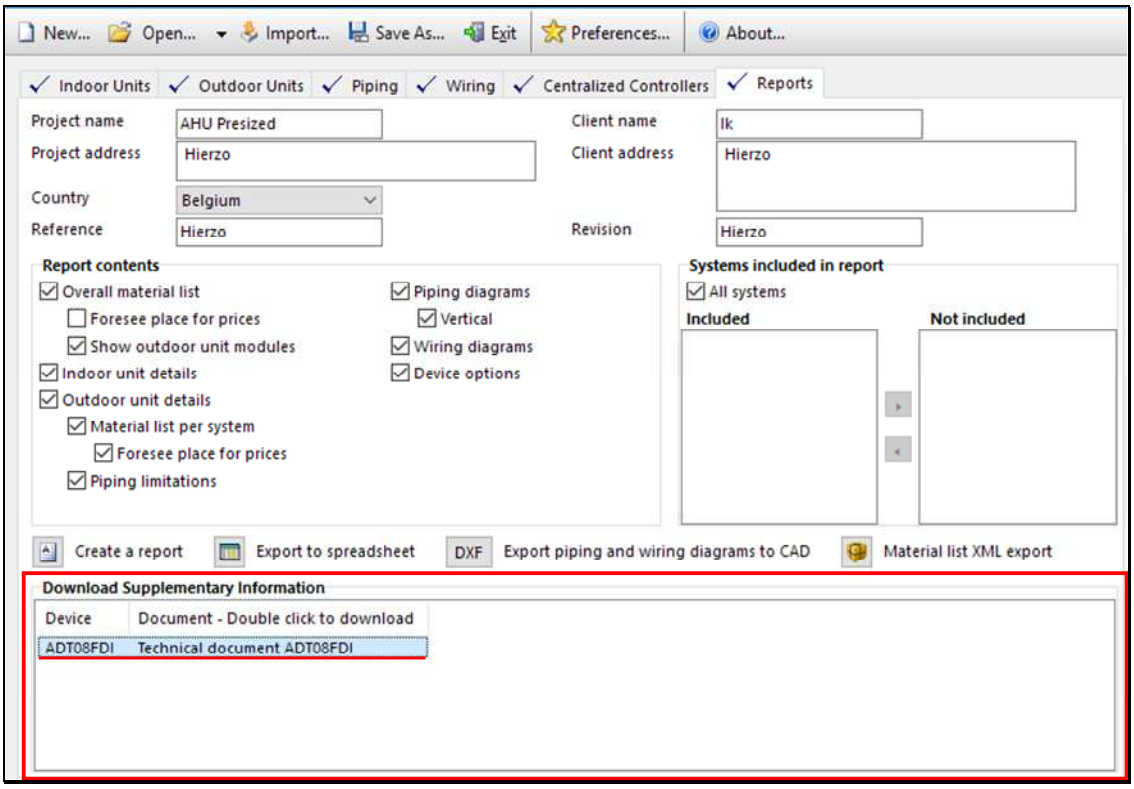


Figure 98: The server contains files to download

The most important of these reports is the MSWord report. This report contains the data that you also find in the different VRV_Xpress tabs. However, it also contains extra information as requested in the Preferences window (see section 6.2.5) and several remarks and warnings, some of them depending on the selected devices.

Figure 99 shows a page from the MSWord report with the details about the indoor units of the example project. Similar pages give the details about the outdoor unit and the diagrams.

Some tables may be larger than the page. To make them fit, right click the table to select it and use the upper left icon or the menu command to "***fit to content***". The report is also saved as an rtf-file. To reduce its size, you can save it in MSWord as a .doc or .docx file.

2. Indoor Unit Details

2.1. Table of Abbreviations

Name	Logical name of the device
FCU	Device model name
Tmp C	Indoor conditions in cooling (dry bulb temp. / RH)
Rq TC	Required total cooling capacity
Max TC	Available total cooling capacity
Tevap	Evaporating temperature of indoor unit coil
Tmp H	Indoor temperature in heating
Rq HC	Required heating capacity
Max HC	Available heating capacity
Airflow	Supplied airflow
Sound	Sound pressure low and high
PS	Power supply (voltage and phases)
MCA	Minimum Circuit Amps
Fuses	Fuses
WxHxD	WidthxHeightxDepth
Wght	Weight of the device
PI-C 50Hz	Power input in cooling at 50Hz
PI-C 60Hz	Power input in cooling at 60Hz
PI-H 50Hz	Power input in heating at 50Hz
PI-H 60Hz	Power input in heating at 60Hz

2.2. Out 1 - RYYQ12T

Capacity data at conditions and connection ratio (94%) as entered

Name	FCU	Tmp C	Rq TC	Max TC	Tevap	Tmp H	Rq HC	Max HC	Airflow
		°C	kW	kW	°C	°C	kW	kW	m³/h
Ind 1	FXFQ50A	24.0 / 50%	4.0	4.8	6.0	20.0	4.0	6.3	900
Ind 2	FXFQ50A	24.0 / 50%	4.0	4.8	6.0	20.0	4.0	6.3	900
Ind 3	FXFQ50A	24.0 / 50%	4.0	4.8	6.0	20.0	4.0	6.3	900
Ind 4	FXFQ50A	24.0 / 50%	4.0	4.8	6.0	20.0	4.0	6.3	900
Ind 5	FXFQ50A	24.0 / 50%	4.0	4.8	6.0	20.0	4.0	6.3	900
Ind 6	FXFQ32A	24.0 / 50%	3.0	3.1	6.0	20.0	4.0	4.0	750
Σ			23.0				24.0		

Name	Sound	PS	MCA	Fuses	WxHxD	Wght	PI-C 50Hz	PI-C 60Hz	PI-H 50Hz	PI-H 60Hz
	dBA		A		mm	kg	kW	kW	kW	kW
Ind 1	28-33	220V 1ph	0.4	Factory Std	840x204x840	21	0.053	0.053	0.053	0.053
Ind 2	28-33	220V 1ph	0.4	Factory Std	840x204x840	21	0.053	0.053	0.053	0.053
Ind 3	28-33	220V 1ph	0.4	Factory Std	840x204x840	21	0.053	0.053	0.053	0.053
Ind 4	28-33	220V 1ph	0.4	Factory Std	840x204x840	21	0.053	0.053	0.053	0.053
Ind 5	28-33	220V 1ph	0.4	Factory Std	840x204x840	21	0.053	0.053	0.053	0.053
Ind 6	28-31	220V 1ph	0.3	Factory Std	840x204x840	19	0.038	0.038	0.038	0.038

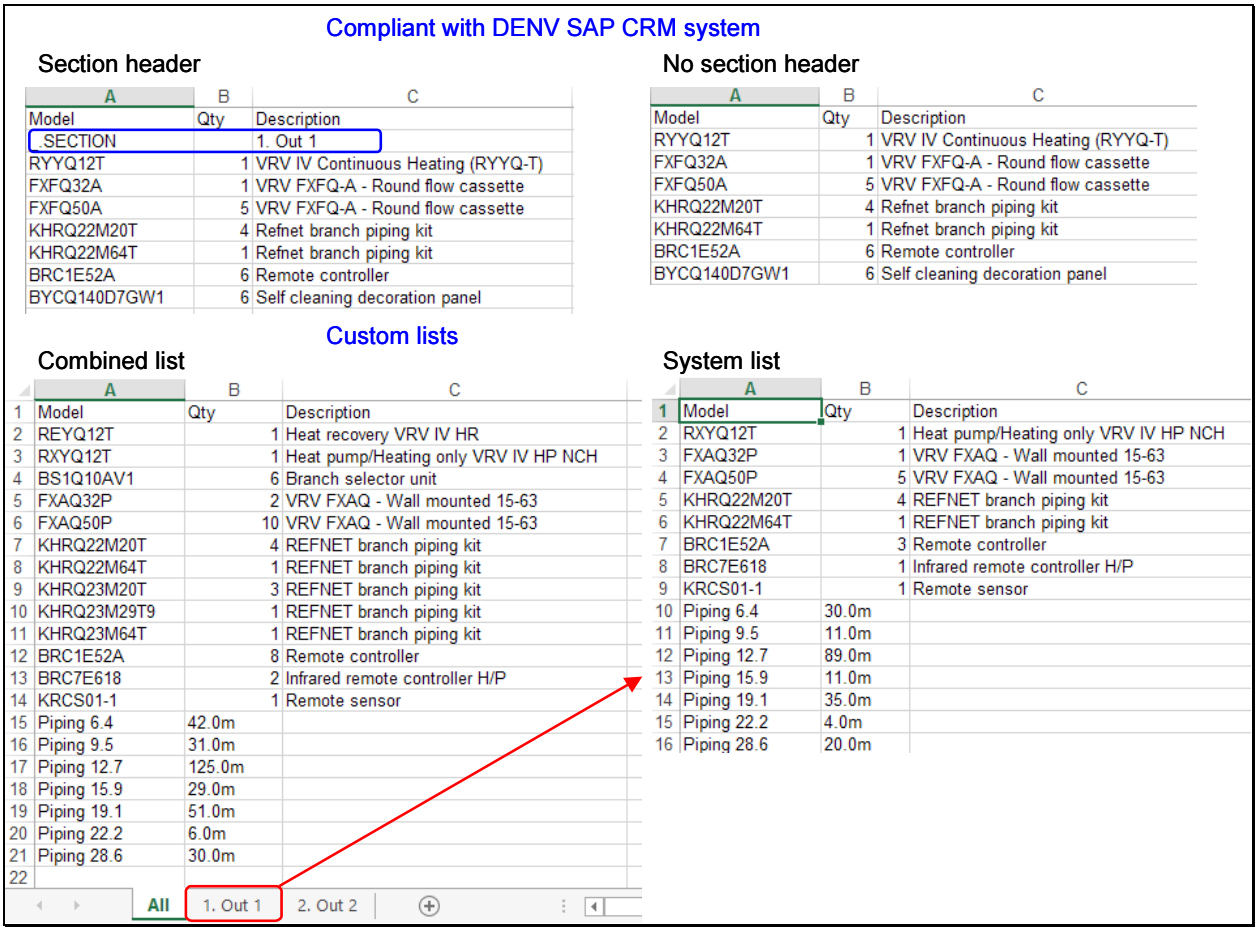
Outdoor unit placed 5.0m below the indoor units.
The minimum connection ratio for this height difference is 50%.

Figure 99: An example page from the MSWord report

The "***Material list XML export***" command produces an xml-file, which you can open with Excel, version 2003 or higher. Its contents depends on your settings in the preferences window (see section 6.2.5). Figure 100 shows four different examples:

1. The list in the upper left corner is compliant with the DENV SAP system and contains a line with a section header. You define this header in the Preferences window. This content is only available for VRV_Xpress versions in Europe and is the default setting for this file.
2. The list in the upper right corner is equally compliant with the DENV SAP system, but does not contain a section header. This content is only available for VRV_Xpress versions in Europe.
3. The list at the bottom left combines the equipment of all systems in the VRV_Xpress project file. However, the Excel sheet contains additional tabs for each system.
4. The list at the bottom right contains the material list for a single system. VRV_Xpress creates a separate tab for each system.

For VRV_Xpress versions outside Europe, the default setting is a separate tab for each system, without a combined list.



Section header

Model	Qty	Description
_SECTION		1. Out 1
RYYQ12T	1	VRV IV Continuous Heating (RYYQ-T)
FXFQ32A	1	VRV FXFQ-A - Round flow cassette
FXFQ50A	5	VRV FXFQ-A - Round flow cassette
KHRQ22M20T	4	Refnet branch piping kit
KHRQ22M64T	1	Refnet branch piping kit
BRC1E52A	6	Remote controller
BYCQ140D7GW1	6	Self cleaning decoration panel

No section header

Model	Qty	Description
RYYQ12T	1	VRV IV Continuous Heating (RYYQ-T)
FXFQ32A	1	VRV FXFQ-A - Round flow cassette
FXFQ50A	5	VRV FXFQ-A - Round flow cassette
KHRQ22M20T	4	Refnet branch piping kit
KHRQ22M64T	1	Refnet branch piping kit
BRC1E52A	6	Remote controller
BYCQ140D7GW1	6	Self cleaning decoration panel

Combined list

	Model	Qty	Description
2	REYQ12T	1	Heat recovery VRV IV HR
3	RXYQ12T	1	Heat pump/Heating only VRV IV HP NCH
4	BS1Q10AV1	6	Branch selector unit
5	FXAQ32P	2	VRV FXAQ - Wall mounted 15-63
6	FXAQ50P	10	VRV FXAQ - Wall mounted 15-63
7	KHRQ22M20T	4	REFNET branch piping kit
8	KHRQ22M64T	1	REFNET branch piping kit
9	KHRQ23M20T	3	REFNET branch piping kit
10	KHRQ23M29T9	1	REFNET branch piping kit
11	KHRQ23M64T	1	REFNET branch piping kit
12	BRC1E52A	8	Remote controller
13	BRC7E618	2	Infrared remote controller H/P
14	KRCS01-1	1	Remote sensor
15	Piping 6.4	42.0m	
16	Piping 9.5	31.0m	
17	Piping 12.7	125.0m	
18	Piping 15.9	29.0m	
19	Piping 19.1	51.0m	
20	Piping 22.2	6.0m	
21	Piping 28.6	30.0m	
22			

System list

	Model	Qty	Description
2	RXYQ12T	1	Heat pump/Heating only VRV IV HP NCH
3	FXAQ32P	1	VRV FXAQ - Wall mounted 15-63
4	FXAQ50P	5	VRV FXAQ - Wall mounted 15-63
5	KHRQ22M20T	4	REFNET branch piping kit
6	KHRQ22M64T	1	REFNET branch piping kit
7	BRC1E52A	3	Remote controller
8	BRC7E618	1	Infrared remote controller H/P
9	KRCS01-1	1	Remote sensor
10	Piping 6.4	30.0m	
11	Piping 9.5	11.0m	
12	Piping 12.7	89.0m	
13	Piping 15.9	11.0m	
14	Piping 19.1	35.0m	
15	Piping 22.2	4.0m	
16	Piping 28.6	20.0m	

Figure 100: The results of executing a material list XML export command

8 Special Systems

8.1 Outdoor for Indoor

An outdoor for indoor is a special air-cooled outdoor unit consisting of a separate condenser and compressor. Both are installed indoors and the condenser is connected to the ambient air through ducting. Figure 101 shows the conceptual scheme.

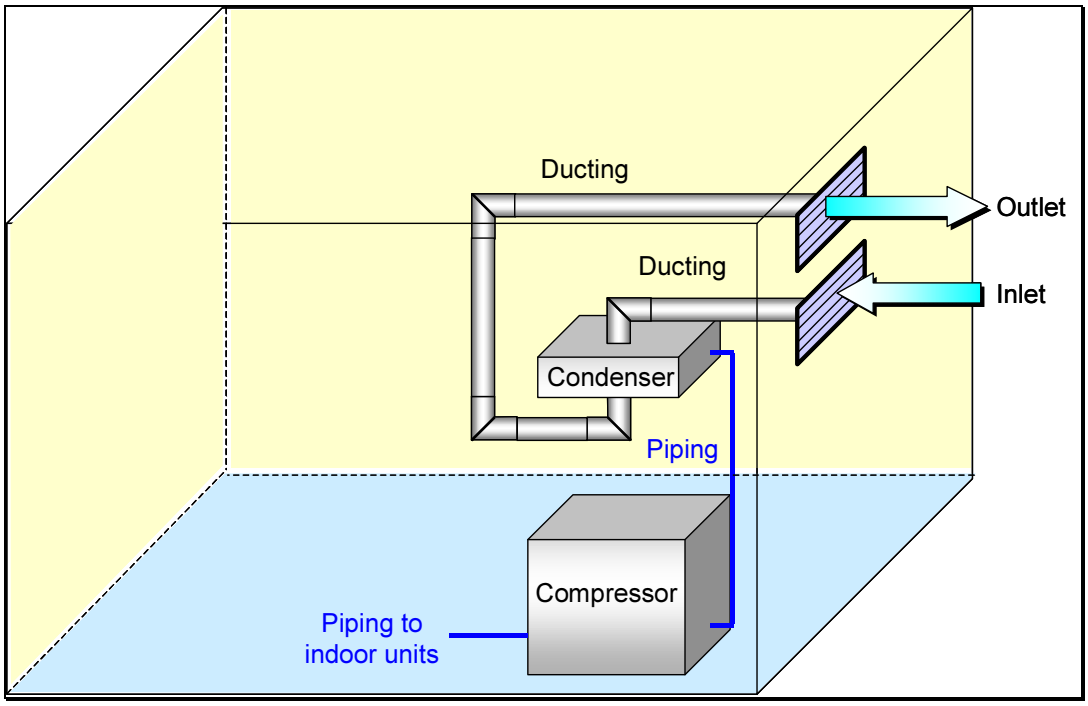


Figure 101: The conceptual scheme of an outdoor for indoor system

The compressor connects to indoor units in the same way as a regular outdoor unit. So, using an outdoor for indoor installation does not make any difference in the selection of indoor units. As these outdoor units are small, there is only a more stringent limit on the number of indoor units you can connect to them.

Figure 102 shows the differences in the piping and wiring diagrams, when selecting an outdoor for indoor system:

1. The piping diagram shows the two separate parts (compressor and condenser) of the outdoor unit, together with the piping between those parts. The compressor connects to the indoor units and to the condenser. Note that VRV_Xpress does not show the ducting to (inlet ducting) and from (exhaust ducting) the condenser.
   The piping tab in the outdoor editing window now shows an extra field to enter the piping distance between the compressor and the condenser (see Figure 102 at the top middle and right). You can enter this distance ("***condenser to compressor***") whether or not you decide to enter the piping lengths manually.

2. The wiring also shows the two parts of the outdoor unit separately. The compressor connects its F1/F2 wiring to the indoor units and to the condenser. In case you connected the outdoor unit to a centralized controller, you have to connect the condenser to the it, as shown at the bottom right in Figure 102.

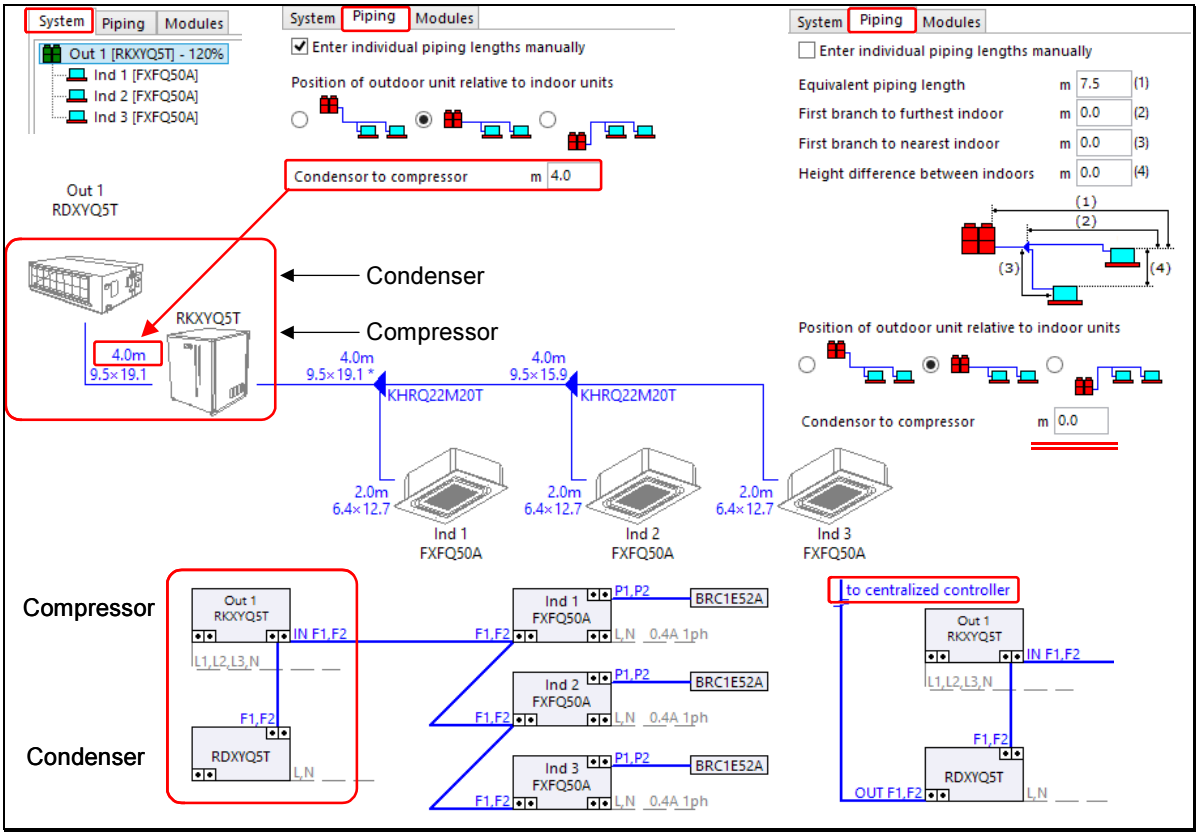


Figure 102: An outdoor for indoor system with its piping and wiring diagrams

8.2 *Air Handling Units (AHU)*

An air handling configuration consists of a an outdoor unit, an expansion kit (EKEXV device) and an air handling unit coil. Figure 103 shows that there are five kinds of configurations:

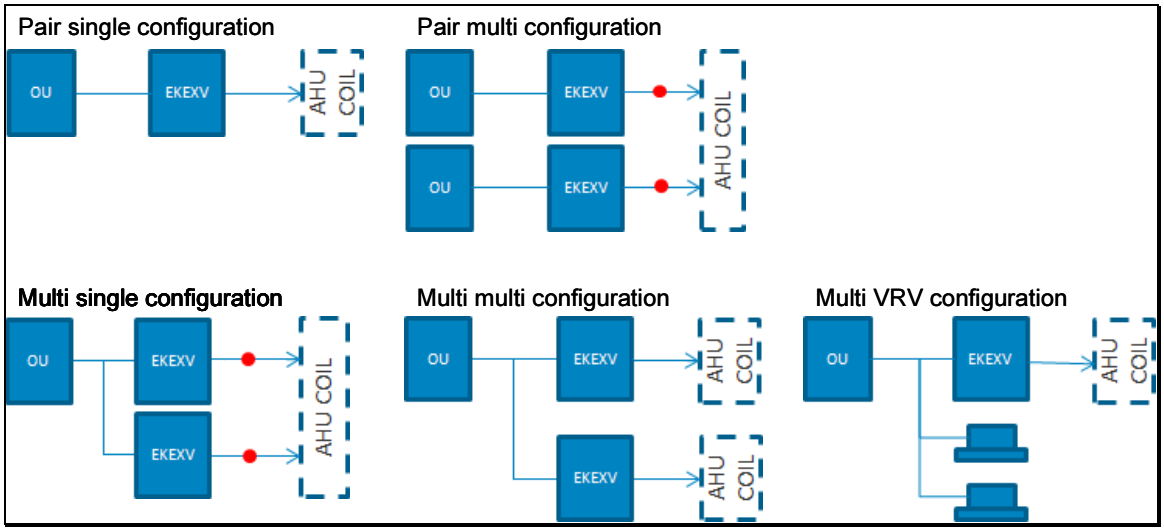


Figure 103: Air handling unit configurations

1. ***Pair single configuration***. In this configuration, an outdoor unit connects to a single EKEXV device, which in turn connects to an air handling unit coil. This configuration is used for smaller installations and the outdoor unit is mainly a ERQ series outdoor unit. It is not possible to connect indoor units or any other device to an ERQ outdoor unit.
2. ***Pair multi configuration***. Larger air handling units need more cooling or heating capacity than a single (ERQ) outdoor unit can deliver. In such cases, you need several combinations of a single (ERQ) outdoor unit with a single EKEXV device, called a ***circuit***. You can connect

up to four circuits to a single air handling unit coil.

3. ***Multi single configuration***. This configuration consist of a single (larger VRV) outdoor unit connected to several EKEXV devices, which in turn connect to a single air handling coil. You can connect up to three circuits to a singe air handling coil. When connecting EKEXV devices to a VRV outdoor unit, the minimum connection ratio is 90% and the maximum 110%.
4. ***Multi multi configuration***. The VRV outdoor unit can also connect to EKEXV devices, each of which connect to a single air handling unit coil. Here also, there is a maximum of three circuits and the same range of connection ratios (90% - 110%).
5. ***Multi VRV configuration***. The last configuration is a combination of an air handling unit and regular indoor units. In this case the minimum connection ratio of the connected indoor units must be 50%.

To control an air handling unit, you need a control box. Depending on the configuration, you may choose a control box type (X, Y, Z or W) or you have to use a specific one (e.g. Z control for multi VRV configuration). The help icon next to an air handling unit selection (see next sections) explains the different control boxes and their specificities, as shown in Figure 104:

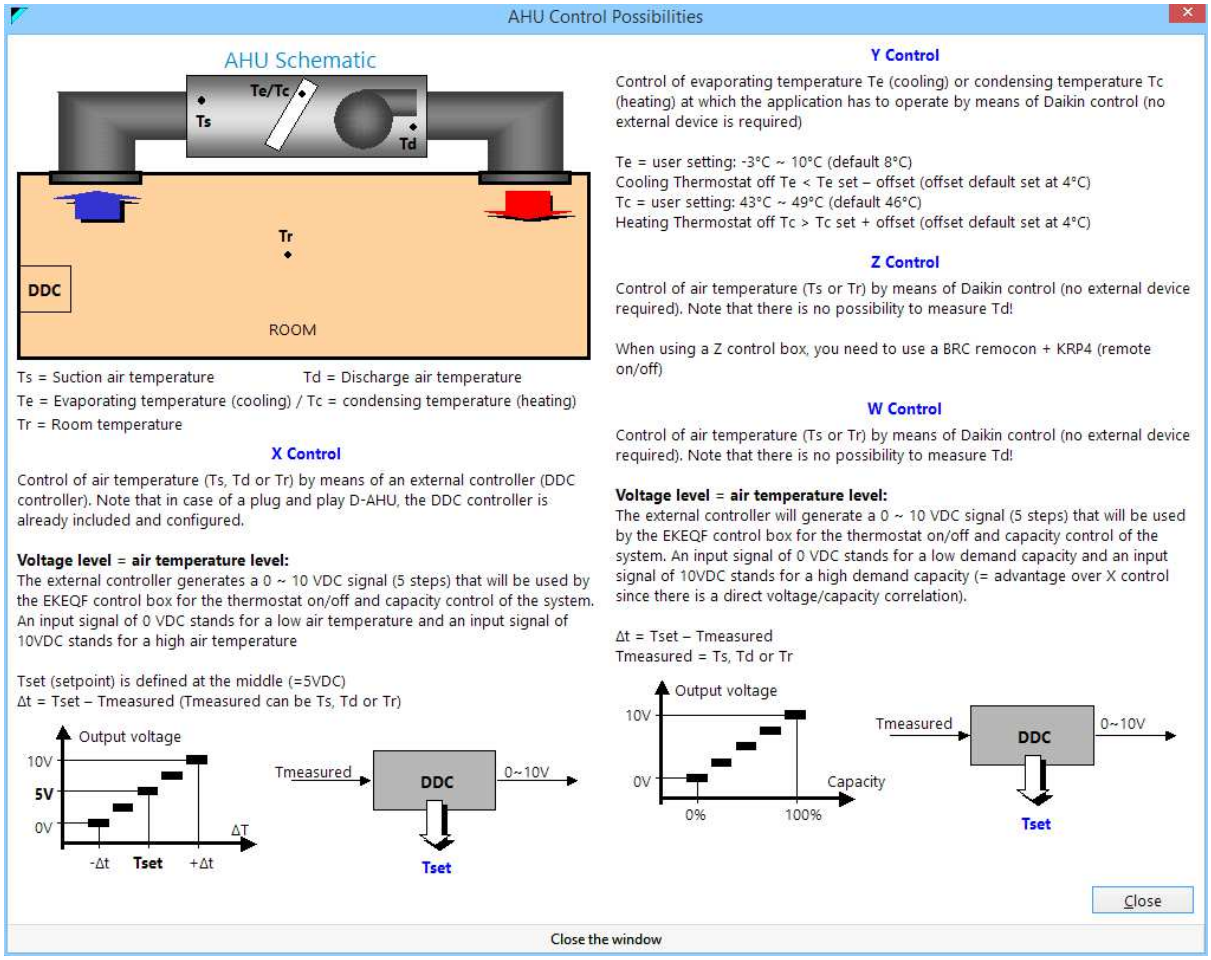


Figure 104: Schematic overview of an air handling unit and the control boxes (X, Y, Z and W)

The next two sections explain how to select air handling unit configurations using a DX-kit and plug and play.

8.2.1 AHU with DX-kit

An EKEXV device has three cooling and heating capacities: minimum, standard and maximum. To correctly select one of the available EKEXV devices, you have to enter capacities between minimum and maximum.

Figure 105 shows how to select a single EKEXV as a DX-kit for AHU. The used capacities are the standard values for a model EKEXV63.

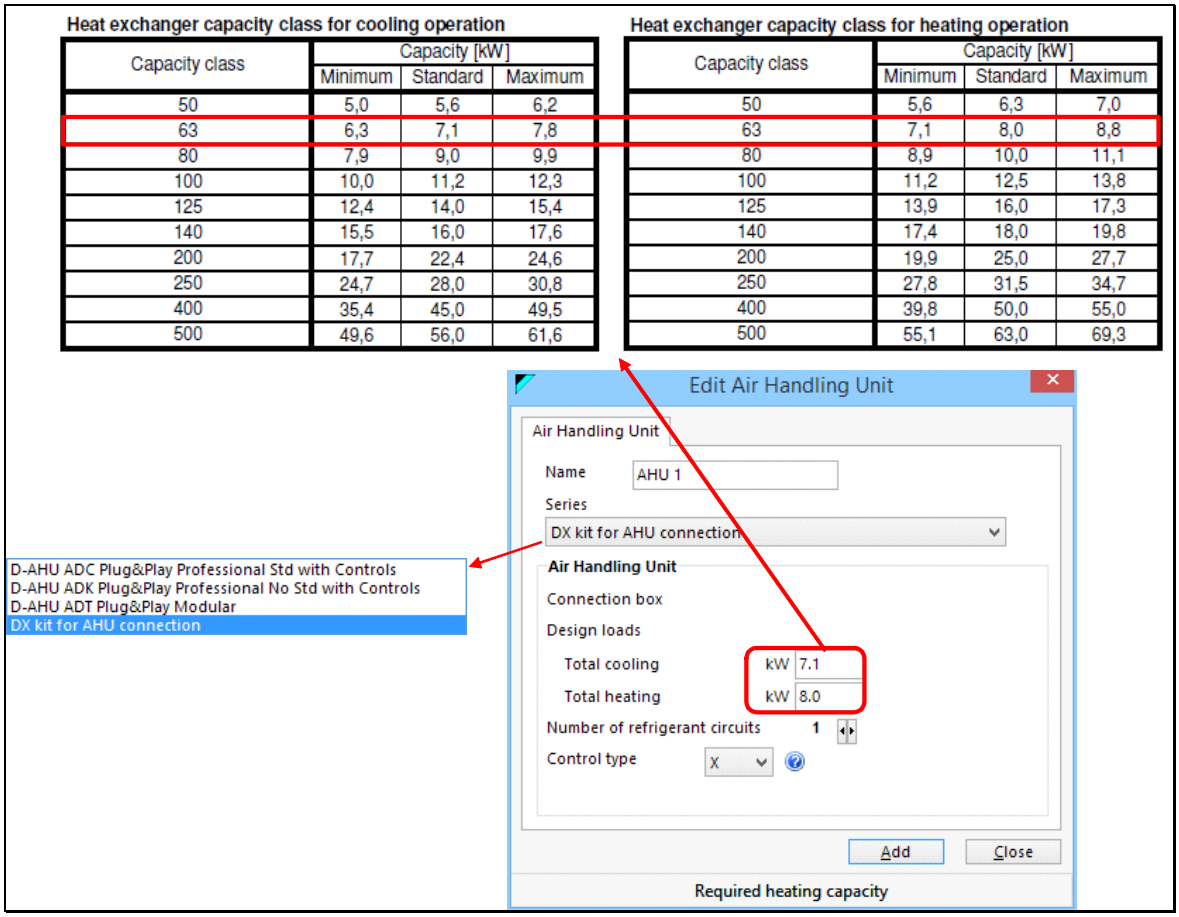


Figure 105: Selecting an EKEXV device

Figure 106 shows the result when connecting this EKEXV device to an ERQ outdoor unit to become a pair configuration:

- The piping diagram shows the outdoor unit and the EKEXV device as a pair configuration.
- The wiring diagram shows the control box used in this configuration. VRV_Xpress considers a control box as a (special) option and inserts it between the ERQ outdoor unit and the EKEXV device. This EKEQFCBA option is an X control box, as required in the selection window (see Figure 105).
- When selecting an EKEXV device, using standard capacities, its capacity index is the same as for indoor units. In this example, the selected EKEXV device is a model EKEXV63 with a capacity index of 62.5. However, in contrast to regular indoor units, the capacity index of an EKEXV device changes, depending on the capacities entered:
  - Calculate the correction factor for cooling by dividing the actual capacity by the standard capacity.
  - Calculate the correction factor for heating in the same way and use the largest of both correction factors.
  - Multiply the capacity index by the largest correction factor to get the actual capacity index.

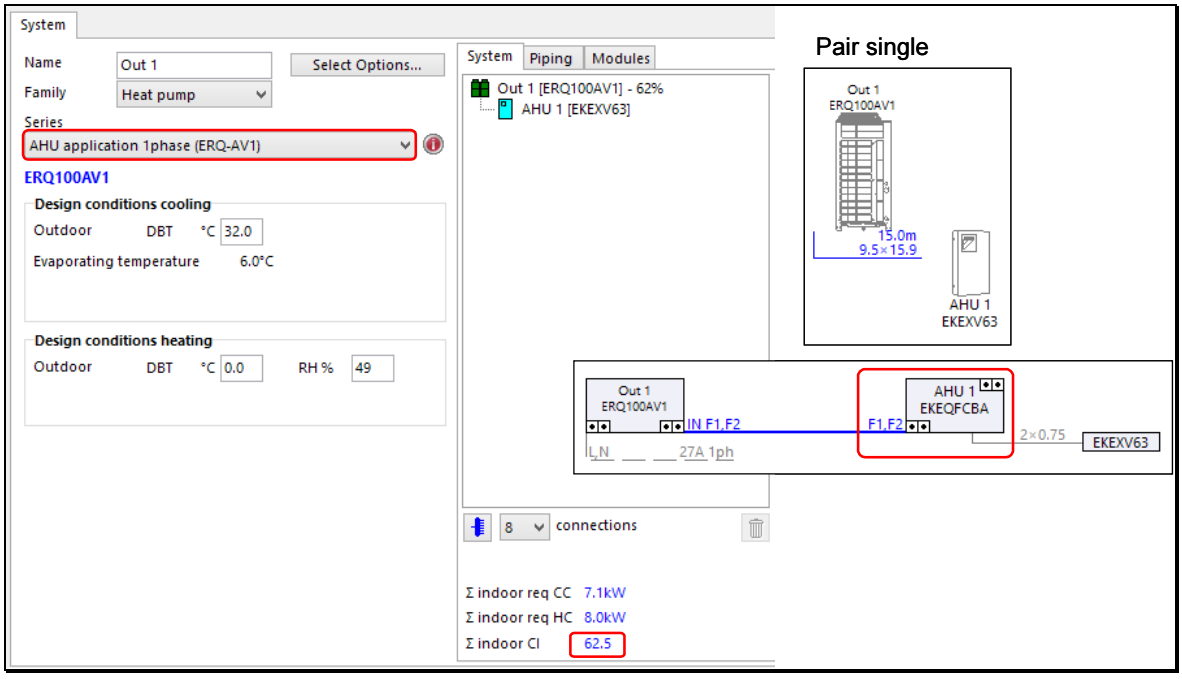


Figure 106: A pair single configuration

Suppose you would change the capacity data in Figure 105 to a cooling capacity of 6.5kW and heating capacity of 7.5kW. Both capacities are still larger than the minimum capacity of an EKEXV63. So, VRV_Xpress still selects the same model, but the capacity index would change (see also Figure 105 for the standard capacities), as shown in Figure 107:

- Correction factor for cooling: 6.5 / 7.1 = 0.9154.
- Correction factor for heating: 7.5 / 8.0 = 0.9375
- The largest correction factor is 0.9375 and the capacity index now becomes: 6.25 x 0.9375 = 58.59

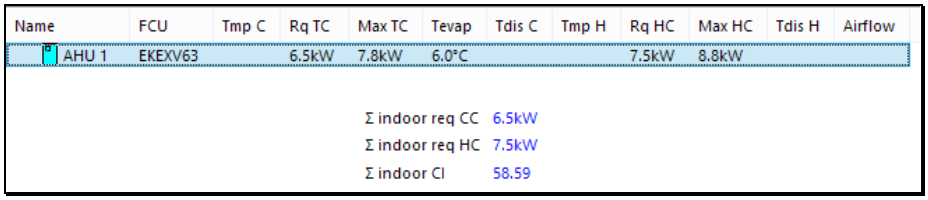


Figure 107: Adapted capacity index of EKEXV devices

The next example consists of a number of circuits connected to a single air handling coil, which is a pair multi configuration, as shown in Figure 108:

- Both for cooling and heating, you need to enter the ***total required*** capacity for the whole installation.
- You also have to select the number of circuits. VRV_Xpress then divides the total required capacities by the number of circuits to find the required EKEXV devices covering these capacities.
- The maximum number of circuits depends on the AHU configuration and the control box used. With an X control box, you can have up to 4 circuits. However, you can change this number, which result in larger EKEXV devices:
  - In Figure 108 at the left, the number of circuits is 4. So, VRV_Xpress divides the required capacities (28kW cooling and 32kW heating) by 4 to dimension the EKEXV devices. This results in four EKEXV63 models.
  - In Figure 108 at the right, the number of circuits has been lowered to 2, resulting in larger EKEXV125 models to cover the same capacities, now using 2 circuits.

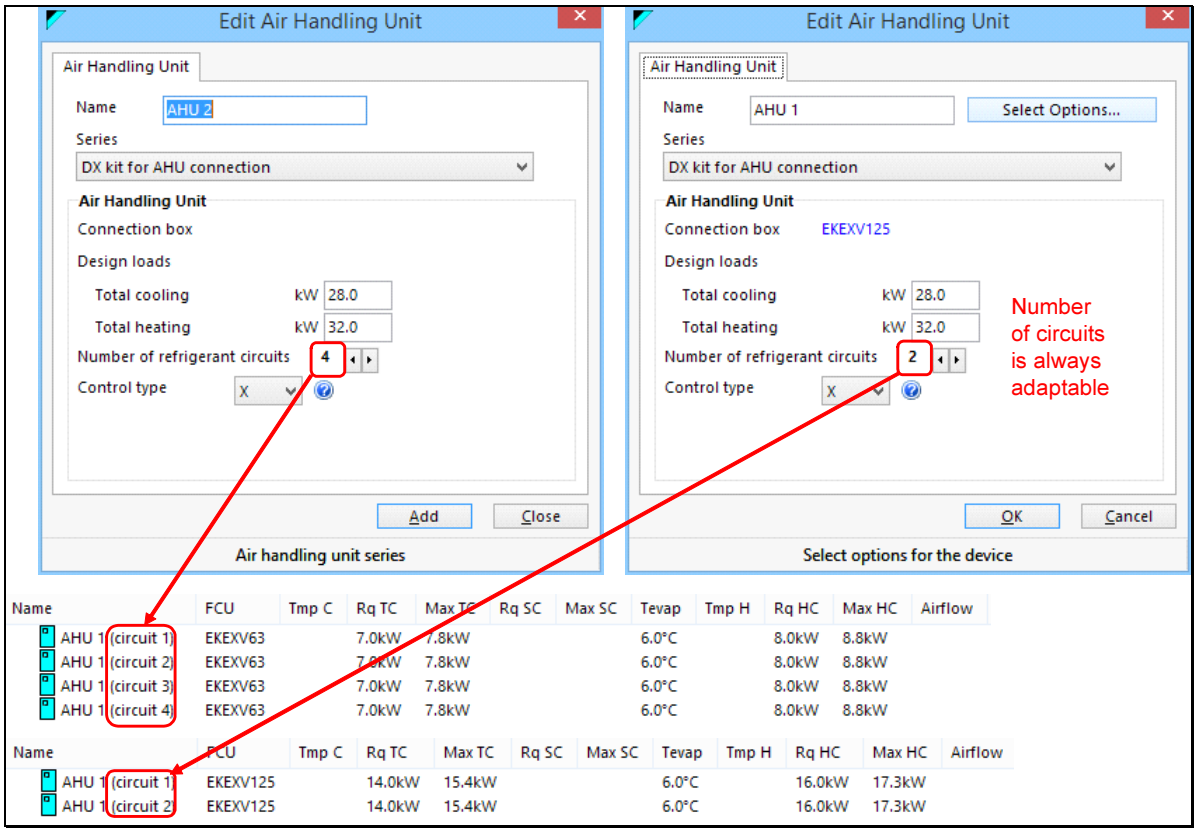


Figure 108: Defining a pair multi configuration

To change the (total) capacities or the circuits, you can edit any of the EKEXV devices.

Figure 109 shows four outdoor units, each of them connected to a single circuit. The piping and wiring diagrams of these outdoor units are similar, but not necessarily identical. In fact, you must enter the piping lengths for each outdoor unit individually and these length may (slightly) differ for each outdoor unit.

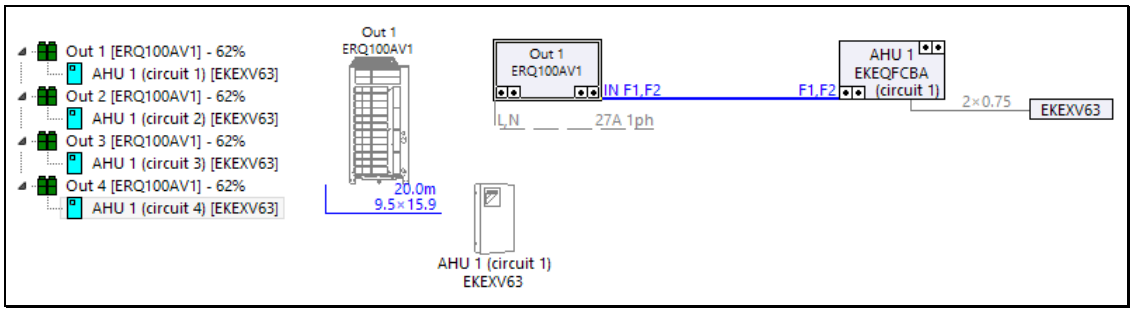


Figure 109: The outdoor units in a pair multi configuration

Note that you cannot easily change this pair multi configuration into a multi single configuration and vice versa:

- When connecting EKEXV devices to a VRV outdoor unit, the minimum connection ratio is 90% and the maximum is 110%. This is a narrow range to work in, especially because a multi circuit solution always uses EKEXV devices of the same size.
- You have to detach the circuits from the individual ERQ outdoor units and connect them to a VRV outdoor unit.
- You may have to change the control box type: some configurations restrict the allowed control boxes to use or the maximum number of circuits.

8.2.2 Plug and Play AHU

A plug and play configuration is an integrated solution containing one or more EKEXV devices, control boxes and an air handling coil into one casing. Its dimensions are calculated using a different program (Astra software) and the selection of the AHU device is now manual. VRV_Xpress only checks if the capacities of the EKEXV devices in the configuration are within their ranges (minimum - maximum).

A plug and play AHU selection is not possible without having set manual settings in the preferences window, as explained in section 9.1.1 and shown in Figure 115.

To dimension a plug and play AHU, you need to use the Astra selection software. This software will calculate the required capacities and number of circuits. You can then use these results to complete the selection in VRV_Xpress, as shown in Figure 110:

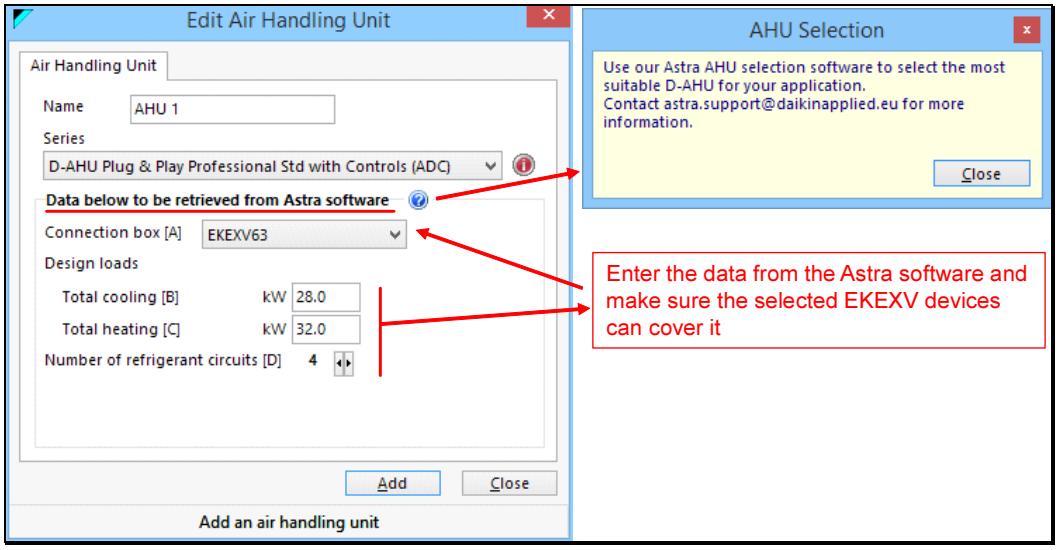


Figure 110: Selection of a plug and play air handling unit

- Enter the data from the Astra selection software.
- Divide the capacities by the number of circuits and select an EKEXV device that covers them. The selected EKEXV device must have capacities within its minimum - maximum range, shown in Figure 105.

Plug and play air handling units can only be connected in pair single or pair multi configurations and mainly using ERQ outdoor units, though larger EKEXV devices may need a VRV outdoor unit, which must be a single module outdoor unit.

The selection of outdoor units is similar to the one for an AHU with DX-kit (see section 8.2.1). Only the symbol used in the piping diagram is different, as shown in Figure 111:

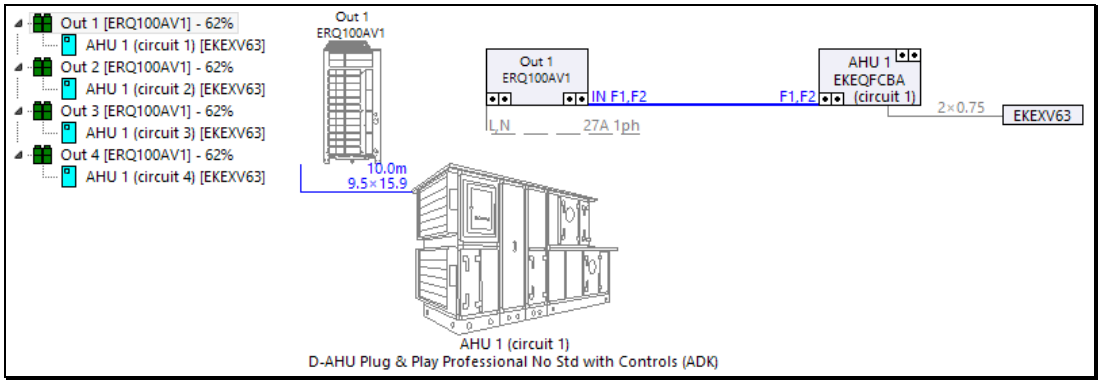


Figure 111: The outdoor unit selection in a plug and play pair multi configuration

8.2.3 Pre-Sized Plug and Play AHU

A pre-sized plug and play AHU is a combination of a plug and play AHU with its EKEXV device and connected to an associated outdoor unit.

In contrast to a regular plug and play AHU (see section 8.2.2), a pre-sized plug and play AHU can be selected automatically. As the combination AHU-Outdoor unit is fixed, you now enter the required airflow limit at a given ambient temperature, as shown in Figure 112:

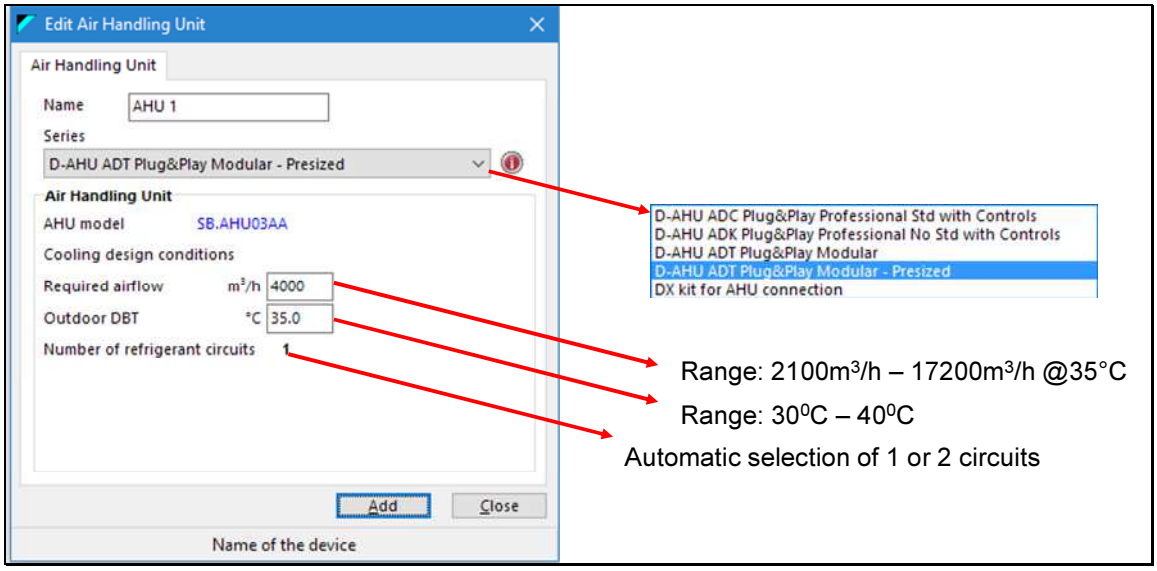


Figure 112: Selecting a pre-sized plug and play AHU

The actual airflow range depends on the ambient temperature you select. At the highest ambient (40°C) temperature, the airflow range is smaller (1700m^3/h - 13200m^3/h) than at the lowest ambient temperature (30°C) with a range of 2500 m^3/h – 17800m^3/h.

Depending on the airflow you enter, VRV_Xpress selects an AHU with 1 or 2 circuits, connected to the predefined outdoor unit(s), as shown in Figure 113:

- The first AHU device at the top is a single circuit pre-sized plug and play AHU, requiring an airflow of 4000m^3/h. VRV_Xpress selects the model SB.AHU03AA with the corresponding outdoor unit ERQ125AV1.
- To cover a required airflow of 10000m^3/h, the second AHU device consists of 2 circuits and each circuit is served by an outdoor unit ERQ200AW1

Figure 113 at the bottom shows the piping of the first circuit. This piping is similar to regular plug and play AHU devices. The only difference is that you cannot select the outdoor unit.

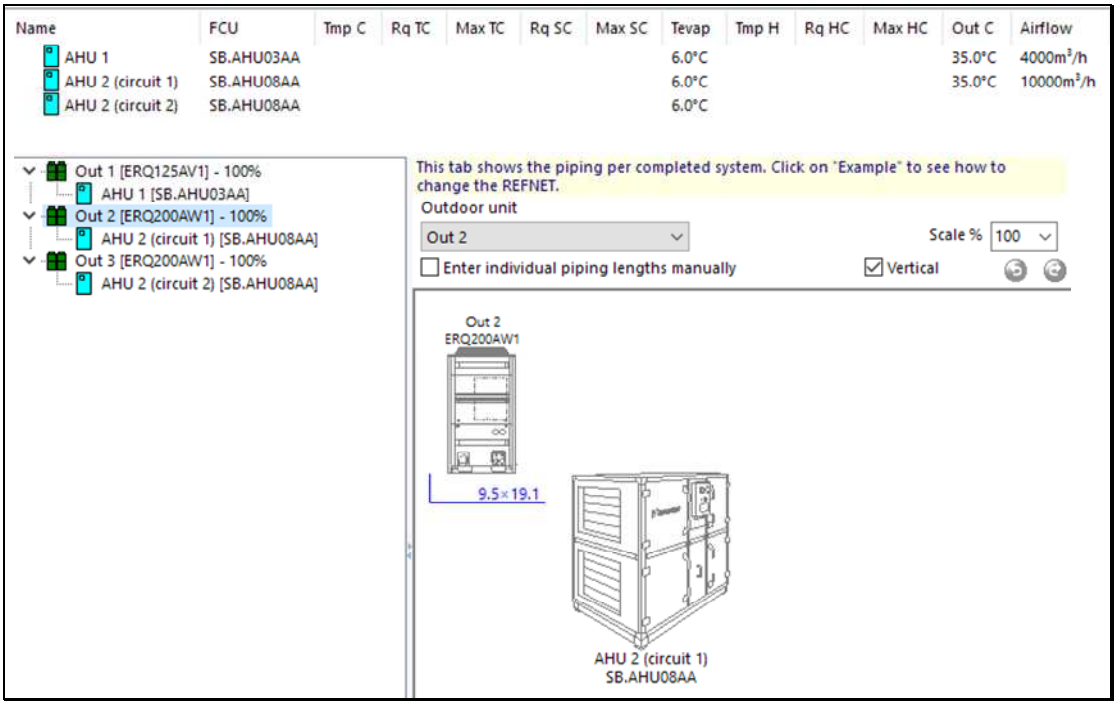


Figure 113: Selecting pre-sized plug and play AHU devices

VRV_Xpress automatically inserts the same number of outdoor units as the required number of circuits. As the selected outdoor unit(s) are part of a pre-sized configuration, it is not possible to delete them or replace them by another model. To remove the outdoor unit(s), remove the AHU device instead.

9 Advanced Selections

This chapter explains several advanced selections. With the exception of the last section, all of them are driven by advanced settings in the Preferences window. To have the influence of these preferences settings as close as possible to the effects on the selection, each section in the chapter starts with specific settings in the Preferences window, followed by the explanations about the effect on the selection.

Warning: All settings in this tab require an in-depth knowledge of a VRV system. Some setting may result in an under dimensioned system causing discomfort to the customers and maybe incapable to reach the required conditions in the rooms.

9.1 Manual Selections

As the advanced options may have a considerable impact on the selections, VRV_Xpress does not save them automatically in the Windows registry. Instead, you have to perform this action manually by clicking the "***Save as Defaults***" command button at the bottom of the "***Advanced***" tab of the Preferences window, as shown in Figure 114

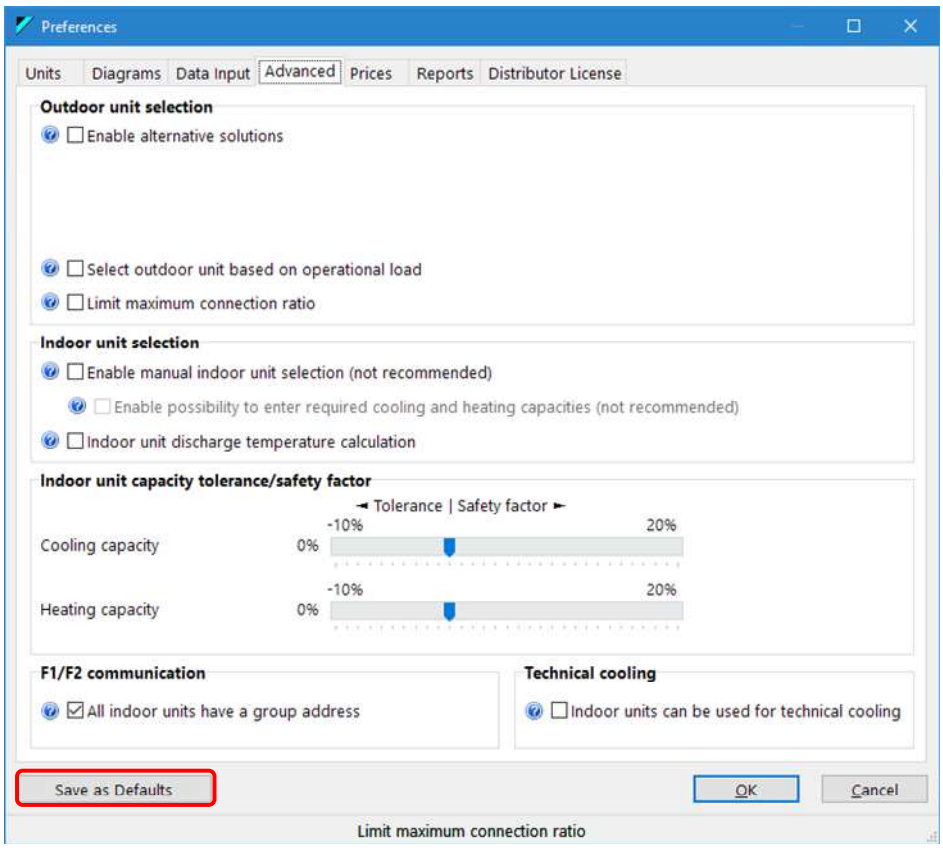


Figure 114: Possibility to save the advanced options as defaults

9.1.1 Setting the Manual Selections

Figure 115 shows the two checkmarks that you can set for manual selections. By default, these checkmarks are unchecked. Although not recommended to use a manual selection of indoor units, you have to check these settings for the selection of VKM devices, Outdoor Air Processing Units and Biddle Air Curtains.

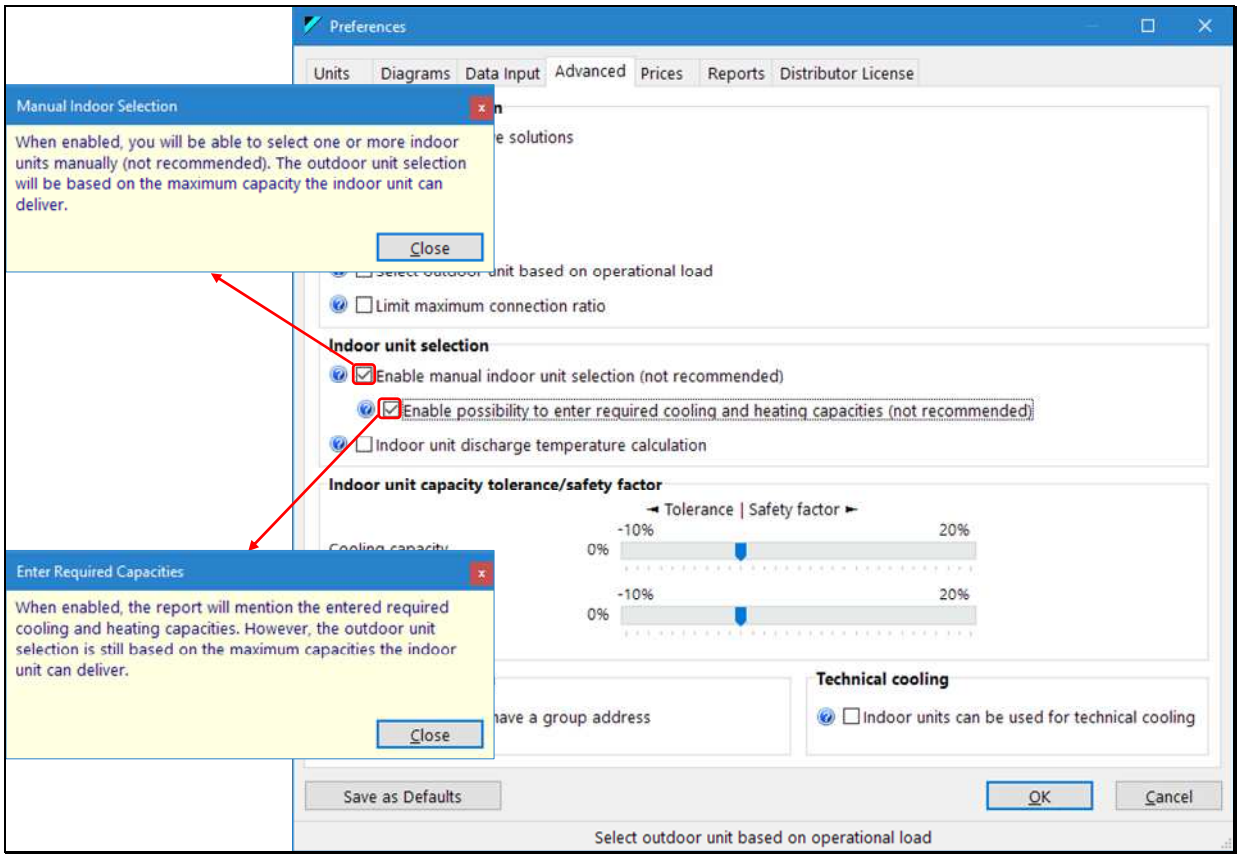


Figure 115: Allowing the manual selections

9.1.2 Manually Selected Indoor Units

The project from previous chapters contains 6 indoor units, 5 of which are a model FXFQ50A. VRV_Xpress selected this model based on the required cooling and heating capacities entered (see Figure 24). Although that model can deliver more than required (see Figure 27), VRV_Xpress only uses the ***required capacities*** when dimensioning the outdoor unit.

When you change the required cooling or heating capacities, VRV_Xpress recalculates what model fits the best the requirements and then uses this updated information to recalculate the selected outdoor unit and dimension the piping diameters for the selected outdoor unit.
However, when setting the manual selection in the Preferences window, VRV_Xpress also supports a manual selection, which is really very simple: select an indoor unit from the list of available indoor units, as shown in Figure 116:

- The window at the right is the simple one that appear when you only check the first of the two manual selection checkmarks in Figure 115. You just select an indoor unit from the list of available models. Suppose you want to replace the automatically calculated model FXFQ50A of indoor unit Ind1 by the same model, but now manually selected. As VRV_Xpress has no clue about the required cooling and heating capacities now, it takes the ***maximum available*** capacities for that indoor unit.
- The window at the left appears when you check both manual selection checkmarks in Figure 115. As for the simple window, you also select an indoor unit from the list, but now you can also enter the ***estimated*** capacities for cooling and heating. Those capacities only serve as a documentation and do not influence the selection. In fact, VRV_Xpress will equally use the maximum available capacities from the indoor units.

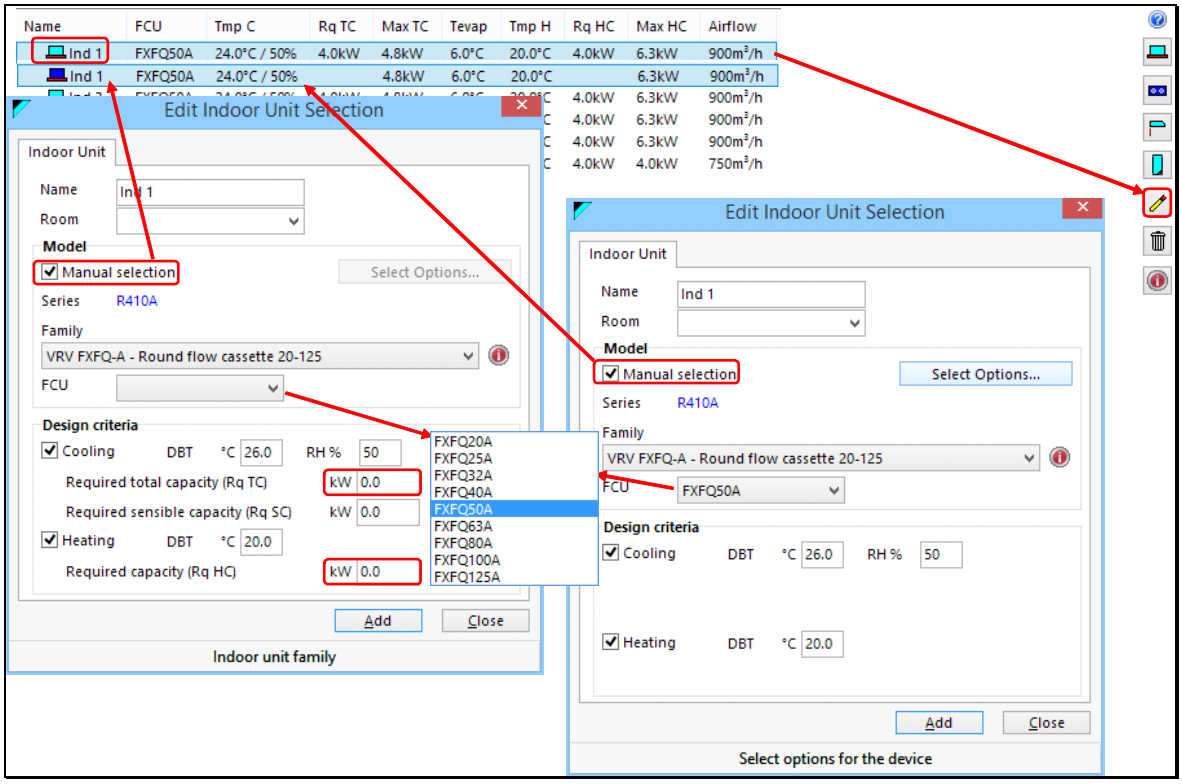


Figure 116: Manually selecting an indoor unit

For Ind1, the cooling capacity is now 4.8kW (instead of 4.0kW when selected automatically) and the heating capacity 6.3kW (instead of 4.0kW when selected automatically). ***If all indoor units would have been selected manually, this would lead to a much larger outdoor unit***, as the sum of the required capacities now becomes larger (respectively 27.4kW for cooling and 35.5kW for heating instead of the 23.0kW when selected automatically, as explained in Figure 32). This results in an outdoor unit model RYYQ18T instead of the model RYYQ12T found in the previous chapter, making the installation considerably more expensive.

By default, VRV_Xpress requires the maximum cooling ***and*** heating capacity of the indoor unit from the outdoor unit. However, you can uncheck one of the checkmarks in front of "Cooling" or "Heating" to make a cooling only or heating only selection. If you try to uncheck both checkmarks, you get an error message as shown in Figure 117:

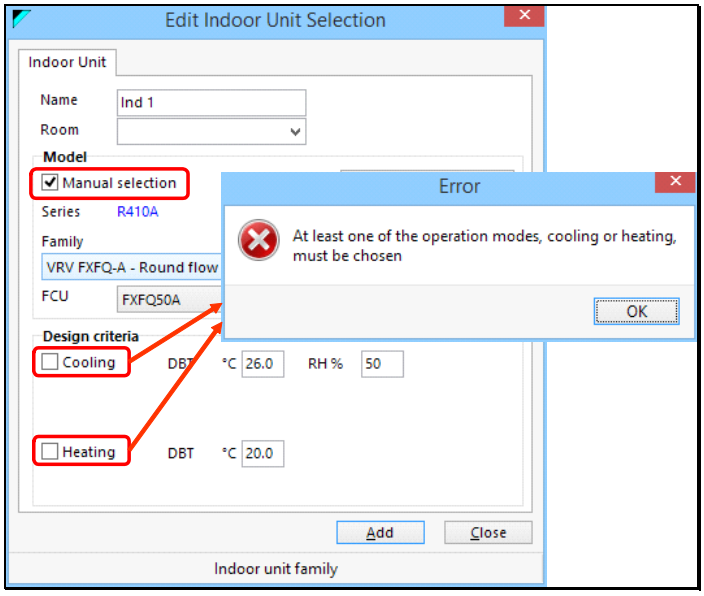


Figure 117: VRV_Xpress needs at least one capacity

A good reason to select an indoor unit manually is in case the required capacities in a room are slightly higher than what an indoor unit model can provide. Suppose the capacities you need for Ind1 would have been 5.0kW for cooling and 6.0kW for heating. With its maximum capacities of 4.8kW for cooling and 6.3kW for heating, a model FXFQ50A does not cover the required cooling load, but covers the requirement for heating. For an automatic selection, VRV_Xpress will take the next larger model FXFQ63A, delivering maximally 6.1kW for cooling and 8.0kW for heating.

So, in this case, you may decide to use the model FXFQ50A anyway.

It is clear that you must make such decisions very carefully to avoid possible discomfort for the customers. If an indoor unit cannot deliver the required capacity, it will last longer or forever to cool down or heat up the room.

9.1.3 Manually Selected VKM Devices

A VKM is a ventilation device and has a coil to cool down or heat up the ambient air before delivering it to the room. Before that ambient air reaches the coil, it already passed a heat exchanger, such that the original ambient air already has been cooled down or heated up. The temperature and humidity of the air at the coil must be calculated in function of the airflow through the VKM device. This also results in the required cooling and heating capacity.

VRV_Xpress does not perform these calculations. Instead, you can use the results from VentilationXpress to define a VKM device in VRV_Xpress, as shown in Figure 118:

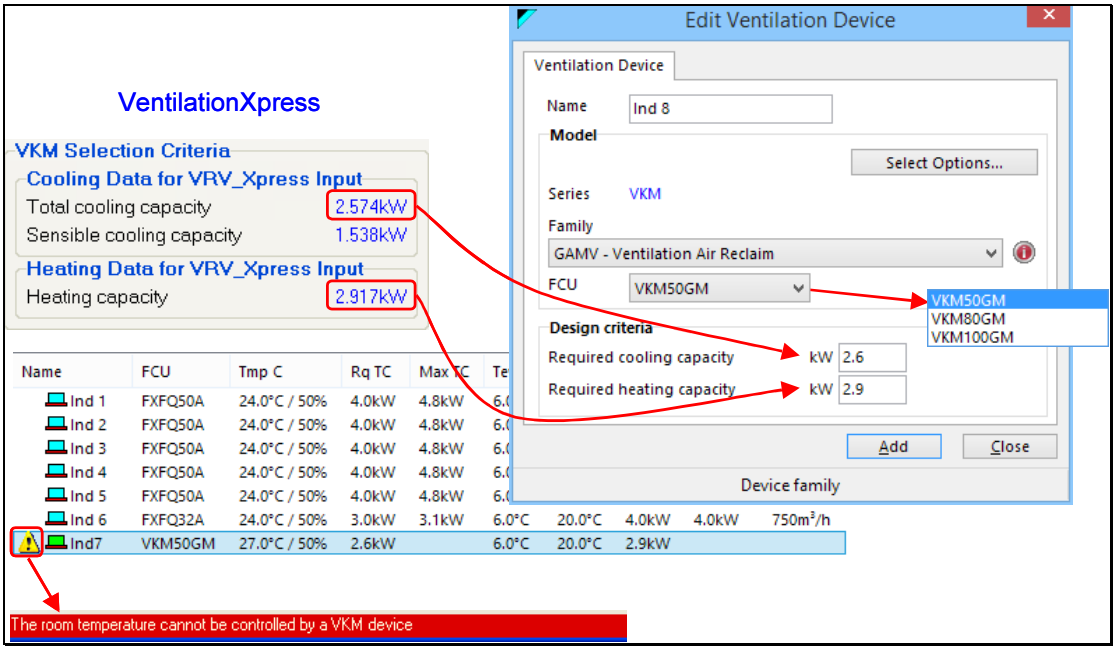


Figure 118: Selecting a VKM device

From the VRV_Xpress point of view, you select a VKM device in the same way as a manually selected indoor unit, but you have to enter required cooling and heating capacities. Note that these may be too high for the VKM device you select. It is your responsibility to select the same VKM device as the one used in VentilationXpress to calculate the capacities.

As a VKM device has a coil, connecting it to an outdoor unit will increase the size of the outdoor unit. In addition, VRV_Xpress adds a warning triangle to next to the definition. Selecting the definition shows the message at the bottom of Figure 118. In fact, a VKM device provides treated air to one or several rooms. This may result in smaller indoor units in those rooms. However, it cannot replace the indoor units.

9.1.4 Manually Selected Outdoor Air Processing Units (FXMQ-MF)

In VRV_Xpress, the selection of an outdoor air processing unit (or FXMQ-MF device is completely similar to the selection of a VKM device, as shown in Figure 119.

In the same way as for a VKM device, you make a selection in VentilationXpress, copy the calculated capacities into VRV_Xpress and select the required device from the list of available devices.

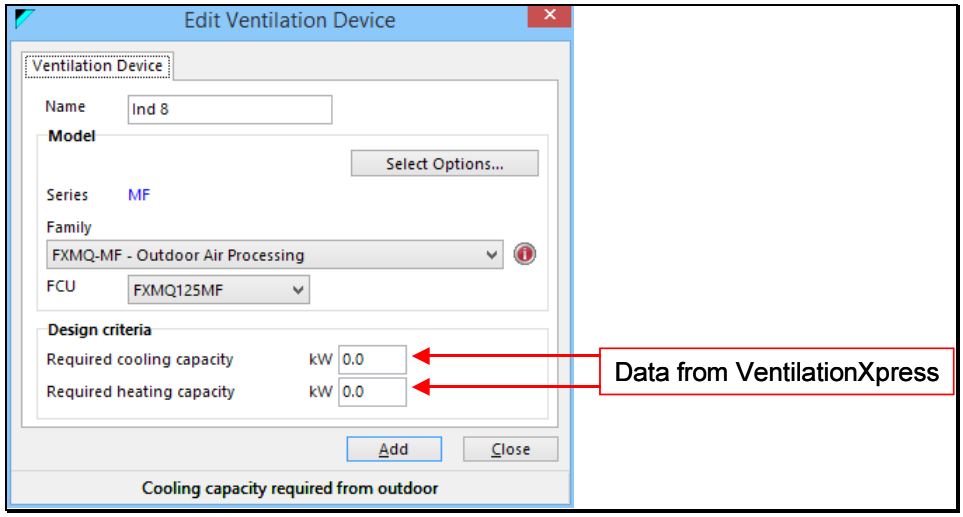


Figure 119: Selecting an outdoor air processing unit.

9.1.5 Manually Selected Biddle Air Curtains

Air curtains are devices installed in shops and public buildings with open entrance doors. They create a vertical airflow of warm air to keep the cold ambient air out. So, air curtains need heating capacity. Figure 120 shows the selection of a Biddle air curtain:

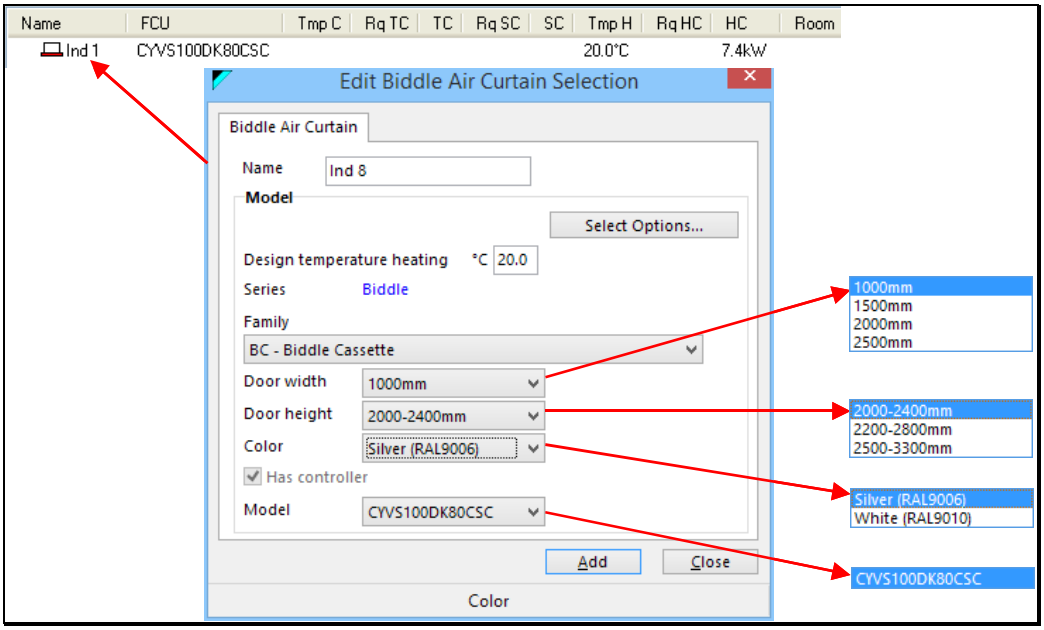


Figure 120: Selecting a Biddle air curtain

As for ventilation devices, VRV_Xpress only support a manual selection. However, air curtains have extra selection criteria: the door width, the door height and the color. After having selected this criteria, only a short list of possible air curtains are available in the model list box.

Figure 120, at the top shows the required heating capacity for the selected Biddle air curtain. You will have to connect an air curtain to an outdoor unit providing heat capacity. Although not available in Europe, cooling only outdoor unit are available in other regions. You cannot connect an air curtain to a cooling only outdoor unit.

9.1.6 Manually Selected AHU Devices

Plug and play AHU devices (see section 8.2.2) are selected manually, but use the entered capacities when you select the outdoor units. When you select an AHU device with DX-kit (see

section 8.2.1) manually, VRV_XPress always uses the maximum capacities for it.

Figure 121 shows the manual selection of an AHU device with DX-kit. In addition to the EKEXV device, you also have to select the number of circuits and the control box to use, much in the same way as shown in Figure 105. The selection in Figure 121 only uses one circuit, which defines a single pair configuration.

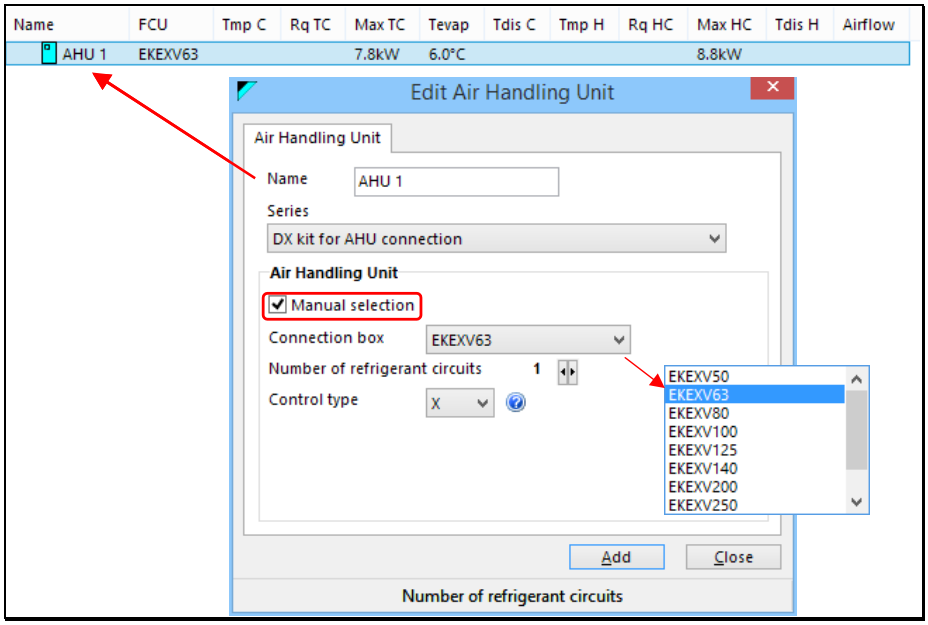


Figure 121: Manually selected AHU device with DX-kit

It is also possible to perform a manual selection of a pre-sized plug and play AHU device, as shown in Figure 122. Depending on the selected AHU, there will be 1 or 2 circuits and their corresponding outdoor units, similar to the selection shown in Figure 113.

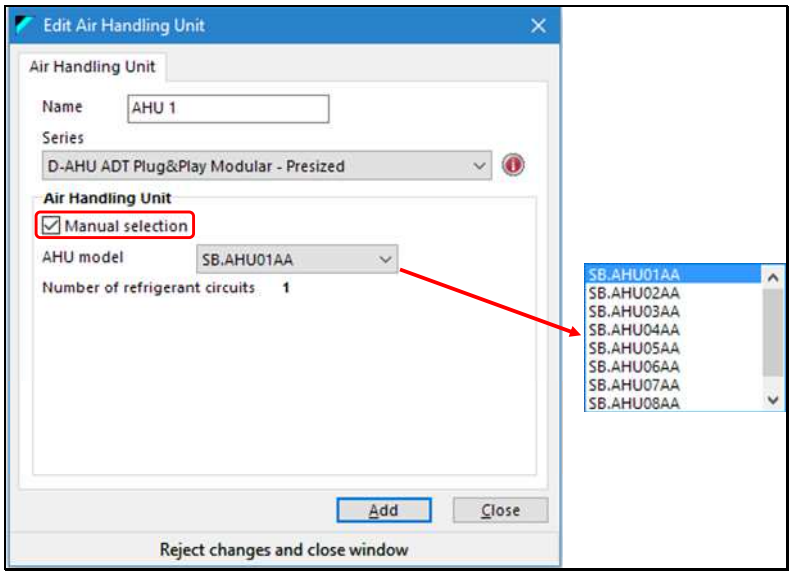


Figure 122: Manually selecting a pre-sized plug and play AHU

9.1.7 Manually Selected Hydro Boxes

When manually selecting a hydro box, VRV_Xpress always uses the maximum capacities for it, , in the same way as for the indoor units. Figure 123 shows the windows when manually selecting a air handling device and a low temperature hydro box.

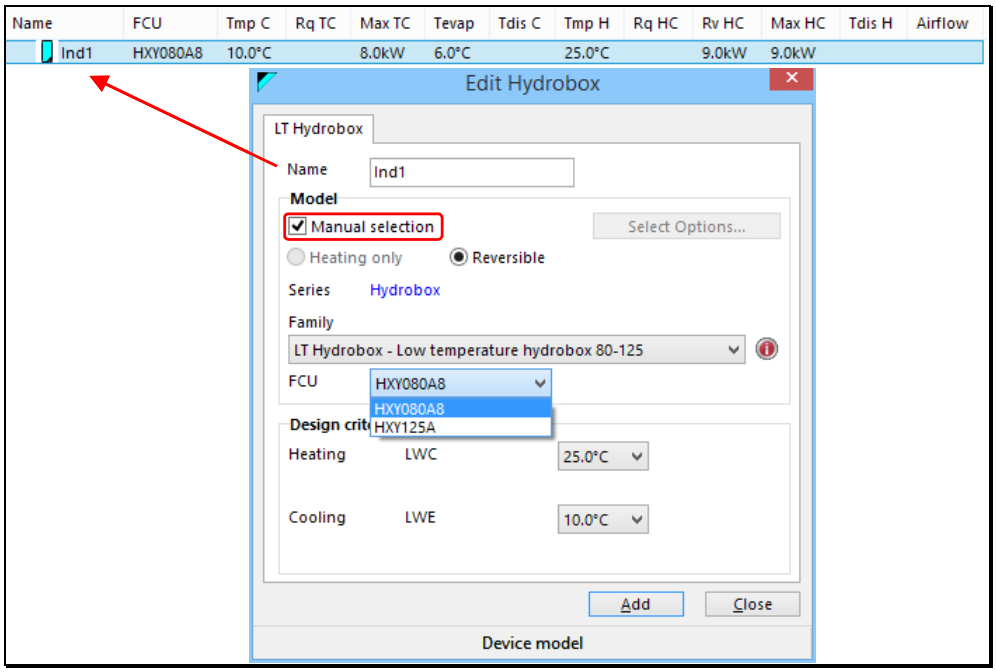


Figure 123: Manual selection of hydro boxes

9.2 *Discharge Temperature Values*

Figure 124 shows the discharge temperature settings in the ***Advanced*** tab of the Preferences window. When checking it, VRV_Xpress calculates the discharge temperature (= the air temperature an indoor unit blows into the room) and shows the cooling and heating discharge temperature values in the indoor unit overview and in the report.

A low discharge temperature will not allow heating up the room in a reasonable time and create a cold draft. VRV_Xpress uses an inlet temperature instead of the ambient temperature when using water-cooled outdoor units.

VRV_Xpress calculates the following discharge temperature values:

- Cooling mode:
  Indoor unit design temperature – Maximum sensible cooling capacity / (1.23 x airflow)
  As an example, consider an FXFQ125A with a design temperature of 27^0CDB/19^0CWB, a maximum sensible cooling capacity of 9.8kW for these conditions and an airflow of $0.55m^3/s$. This gives an discharge temperature of 27 – 9.8 / (1.23 x 0.55) = 12.5^0C
- Heating mode:
  Indoor unit design temperature + Maximum heating capacity / (1.23 x airflow)
  Using the same indoor unit with a design temperature of 20^0C and a maximum heating capacity of 16kW, gives a discharge temperature of 20 + 16 / (1.23 x 0.55) = 43.7^0C

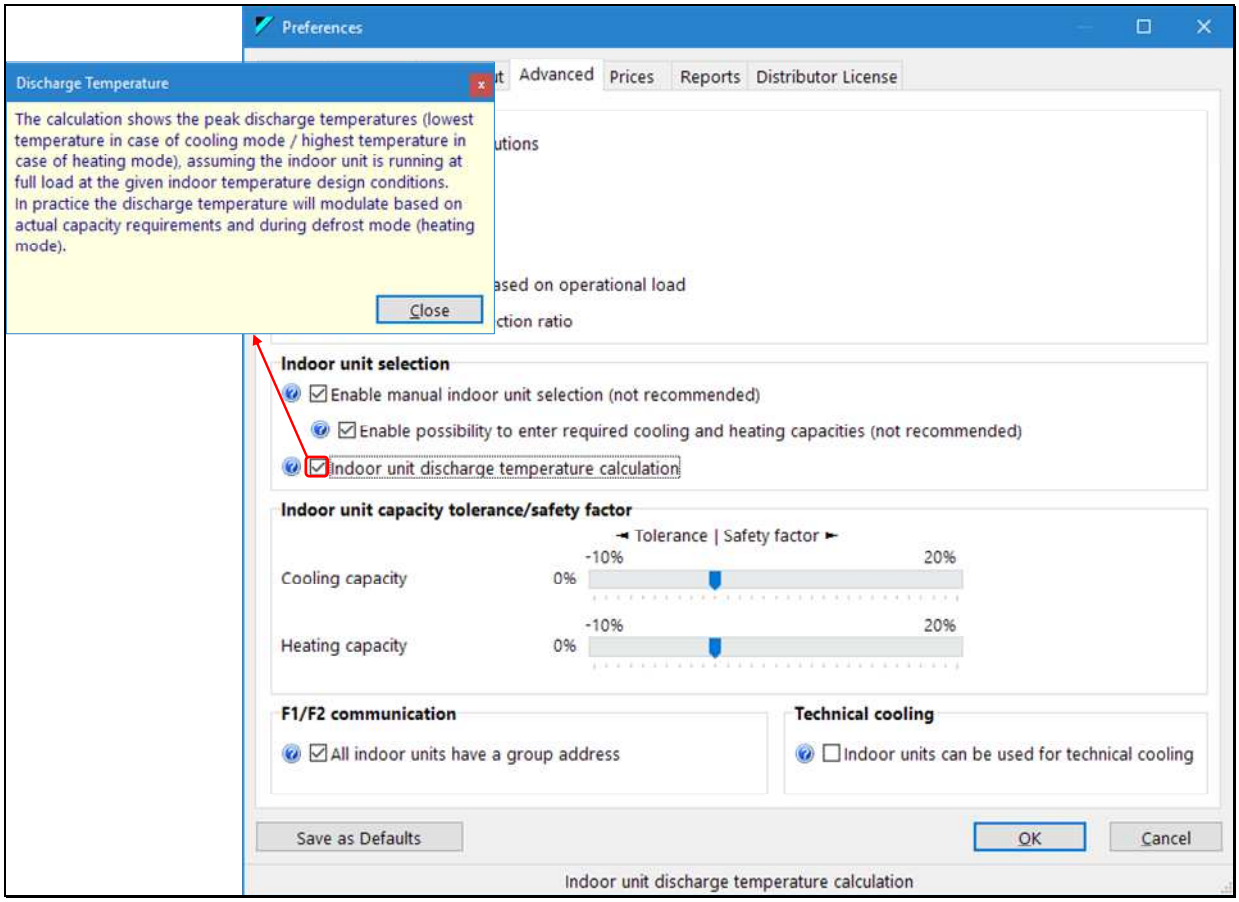
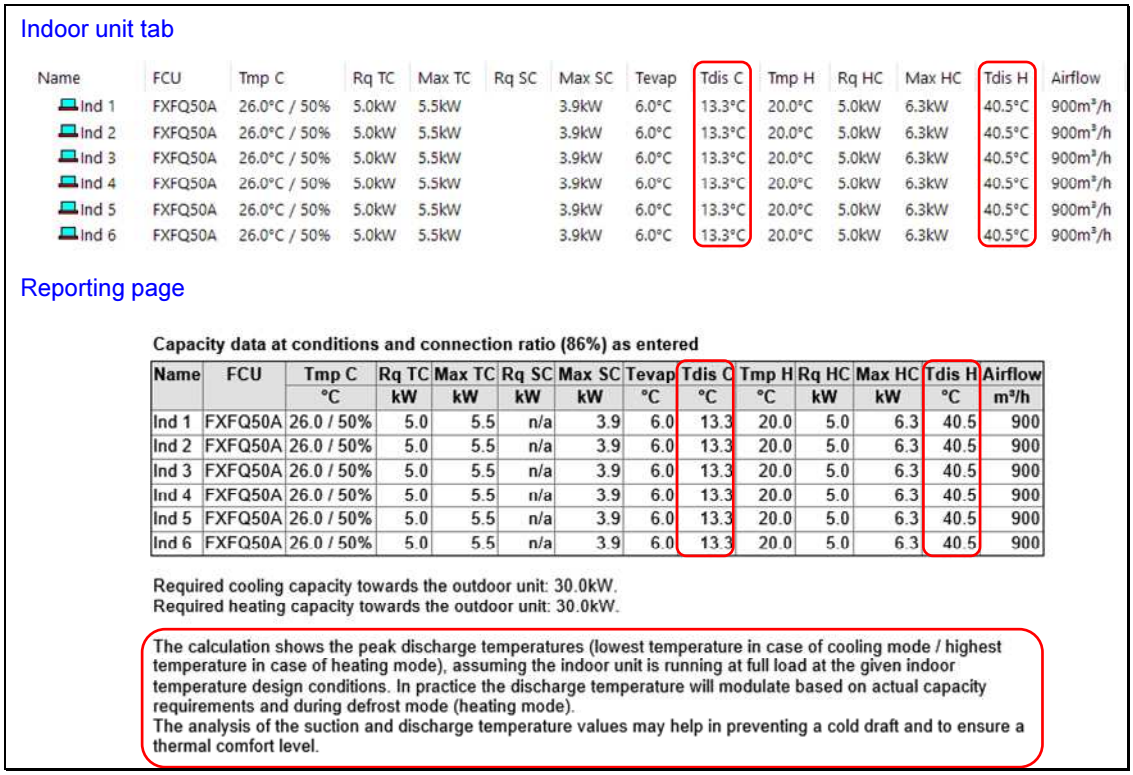


Figure 124: Setting the discharge temperature calculation

Figure 125 shows the indoor unit overview, now containing extra columns with the discharge temperature values for cooling and heating. The heating discharge temperature is the most important one, as a low discharge temperature may cause discomfort to the users.

Figure 125 also shows the report parts with the same extra columns for the discharge temperature values. The report also contains extra information about the calculation used. Compare this report extract with the one shown in Figure 99.

Trained Daikin staff can get an unlocking password, allowing them to make selections of outdoor units for you up to a connection ratio of 200%, while still making sure the operational connection ratio does not exceed 130%. In such selections, the indoor units cannot deliver their full capacity and automatically switch to a low fan speed. This, in turn can lead to a low discharge temperature, especially in the morning when all indoor units more or less start up at the same time.



Indoor unit tab

Name	FCU	Tmp C	Rq TC	Max TC	Rq SC	Max SC	Tevap	Tdis C	Tmp H	Rq HC	Max HC	Tdis H	Airflow
Ind 1	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h
Ind 2	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h
Ind 3	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h
Ind 4	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h
Ind 5	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h
Ind 6	FXFQ50A	26.0°C / 50%	5.0kW	5.5kW		3.9kW	6.0°C	13.3°C	20.0°C	5.0kW	6.3kW	40.5°C	900m³/h

Reporting page

Capacity data at conditions and connection ratio (86%) as entered

Name	FCU	Tmp C	Rq TC	Max TC	Rq SC	Max SC	Tevap	Tdis C	Tmp H	Rq HC	Max HC	Tdis H	Airflow
		°C	kW	kW	kW	kW	°C	°C	°C	kW	kW	°C	m³/h
Ind 1	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900
Ind 2	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900
Ind 3	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900
Ind 4	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900
Ind 5	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900
Ind 6	FXFQ50A	26.0 / 50%	5.0	5.5	n/a	3.9	6.0	13.3	20.0	5.0	6.3	40.5	900

Required cooling capacity towards the outdoor unit: 30.0kW.
Required heating capacity towards the outdoor unit: 30.0kW.

The calculation shows the peak discharge temperatures (lowest temperature in case of cooling mode / highest temperature in case of heating mode), assuming the indoor unit is running at full load at the given indoor temperature design conditions. In practice the discharge temperature will modulate based on actual capacity requirements and during defrost mode (heating mode).
The analysis of the suction and discharge temperature values may help in preventing a cold draft and to ensure a thermal comfort level.

Figure 125: The indoor units overview and report with discharge temperature results

9.3 *Tolerances and Safety Factors*

Figure 126 shows the address and technical cooling settings, together with the tolerance and safety settings in the "***Advanced***" tab and the changes they cause in the indoor unit edit window:

- The "***All indoor units have a group address***" checkmark in Figure 126 is checked by default.
  - ° When you uncheck it, the indoor unit edit window shows the "***Has group address***" checkmark, which is checked by default, equally shown in Figure 126.
    In most installations, each indoor unit has its own unique group address to communicate with the outdoor unit: it sends information about its immediate required capacity and gets information about the outdoor unit (e.g. the outdoor unit is in defrost mode). However, it is also possible to define a group of indoor units, connected in a master-slave configuration, in which only the master indoor unit communicates with the outdoor unit. The other indoor units are the slaves and follow the master indoor unit. Slave indoor units do not have a group address. So, if you want to define such a configuration, you have to uncheck the "***Has group address***" checkmark for all slave indoor units.
  - ° When you check it, all VRV indoor units have a group address. In addition, all RA indoor units belonging to a system, which is connected to a centralized controller (see section 5.2) have a group address as well and VRV_Xpress automatically selects a PCB option to support a group address. When connecting a system to a centralized controller, the F1/F2 wiring connects to all its VRV and RA indoor units that have a group address.

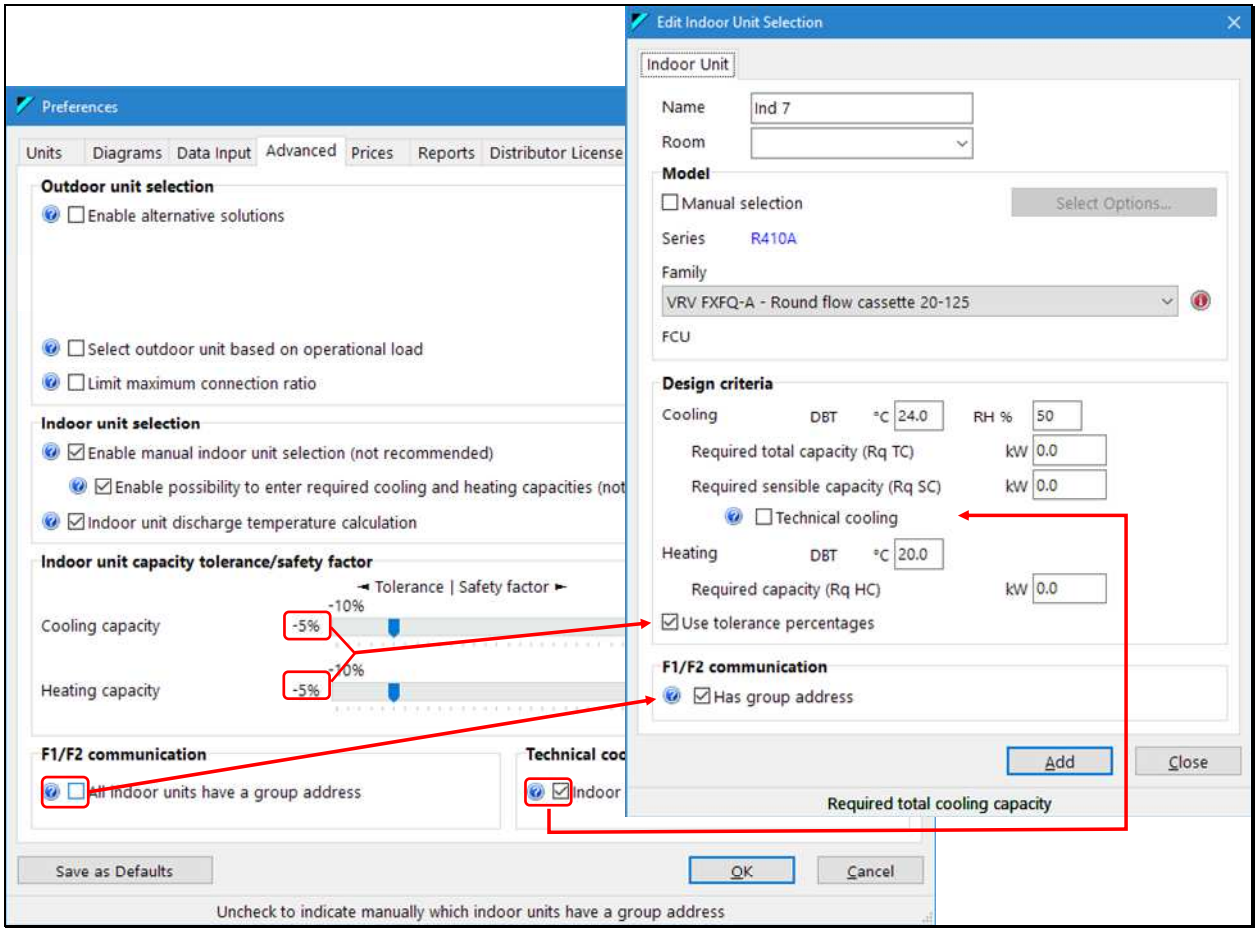


Figure 126: Defining addresses, technical cooling, tolerances and safety factors

- The "***Indoor units can be used for technical cooling***" checkmark allows an indoor unit to be used in a technical space, making sure fragile devices are protected against overheating. This is a very special application, subject to many restrictions. You get an overview of these restrictions when clicking the small blue icon next to checkmark as shown in Figure 127.

  When checking this checkmark, the indoor unit edit window shows a "***Technical cooling***" checkmark, which is unchecked (for obvious reasons) by default. It is a good idea to contact a Daikin responsible to discuss your intentions about using technical cooling.

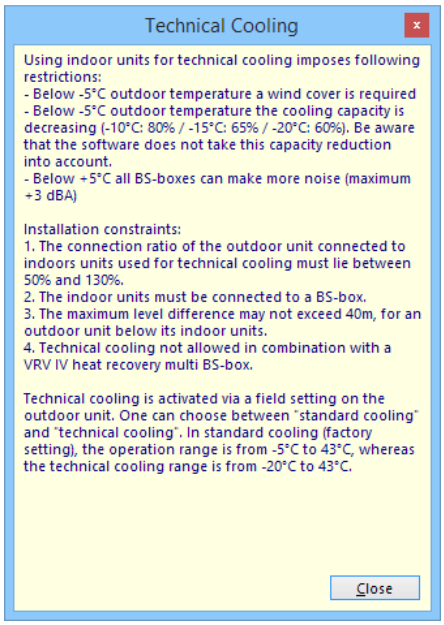


Figure 127: Restrictions on technical cooling

- The indoor unit capacity tolerance/safety factor allows you defining deviations on the selection of indoor units:
  - When defining a tolerance (the setting in Figure 126 shows tolerances of -5%), the indoor unit edit window shows a "***Use tolerance percentages***" checkmark, that is checked by default. This means that VRV_Xpress will reduce the required capacities by 5% and select the indoor unit with these deviated required capacities.
    This may lead to three different situations, as shown in Figure 128:
    1. The reduced capacity is not enough to find a smaller indoor unit. VRV_Xpress does not change the model and the indoor unit selection remains the same. An example is indoor unit Ind6 keeping its model FXFQ32A.
    2. The reduced capacity may result in conditions (e.g. relative humidity that becomes too high at the coil) in the room that makes the indoor unit requiring more capacity from the outdoor unit. VRV_Xpress will then calculate the revised required capacity and will not change the indoor unit model. An example is indoor unit Ind1 keeping its model FXFQ50A.
    3. The reduced capacity results in a smaller indoor unit model. VRV_Xpress then replaces the original model by a smaller one and also indicates why by showing that this was the result of a reduced capacity due to tolerances. An example is indoor unit Ind2, where VRV_Xpress replaced the original model FXFQ50A by a model FXFQ40A. The original required cooling capacity of 4.0kW reduced by 5% gives 3.8kW, which a model FXFQ40A can cover.

Name	FCU	Tmp C	Rq TC	Rv TC	Max TC	Tevap	Tdis C	Tmp H	Rq HC	Max HC	Tdis H	Airflow
Ind 1	FXFQ50A	24.0°C / 50%	4.0kW	4.0kW	4.8kW	6.0°C	12.6°C	20.0°C	4.0kW	6.3kW	36.5°C	900m³/h
Ind 2	FXFQ40A ▼	24.0°C / 50%	4.0kW -5%		3.9kW	6.0°C		20.0°C	4.0kW	5.0kW	34.6°C	810m³/h
Ind 3	FXFQ40A ▼	24.0°C / 50%	4.0kW -5%		3.9kW	6.0°C		20.0°C	4.0kW	5.0kW	34.6°C	810m³/h
Ind 4	FXFQ40A ▼	24.0°C / 50%	4.0kW -5%		3.9kW	6.0°C		20.0°C	4.0kW	5.0kW	34.6°C	810m³/h
Ind 5	FXFQ40A ▼	24.0°C / 50%	4.0kW -5%		3.9kW	6.0°C		20.0°C	4.0kW	5.0kW	34.6°C	810m³/h
Ind 6	FXFQ32A	24.0°C / 50%	3.0kW		3.1kW	6.0°C	14.2°C	20.0°C	4.0kW	4.0kW	32.4°C	750m³/h

Figure 128: Smaller indoor units due to tolerance on cooling

In Figure 128 all indoor units where using these tolerances. However, you can check or uncheck the use of tolerances for each indoor unit individually. Note also that you can get the same results by selecting indoor units manually, as explained in section 9.1.2.

- When defining a safety factor, the indoor unit edit window no longer shows the "***Use tolerance percentages***" checkmark. VRV_Xpress increases the required capacities by the given percentage and selects the indoor unit with these deviated required capacities. If this leads to a larger indoor unit model, VRV_Xpress indicates it in the indoor unit overview, as shown in Figure 129:

Name	FCU	Tmp C	Rq TC	Max TC	Tevap	Tdis C	Tmp H	Rq HC	Max HC	Tdis H	Airflow
Ind 1	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	13.2°C	20.0°C	4.0kW	6.3kW	33.7°C	900m³/h
Ind 2	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	13.2°C	20.0°C	4.0kW	6.3kW	33.7°C	900m³/h
Ind 3	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	13.2°C	20.0°C	4.0kW	6.3kW	33.7°C	900m³/h
Ind 4	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	13.2°C	20.0°C	4.0kW	6.3kW	33.7°C	900m³/h
Ind 5	FXFQ50A	24.0°C / 50%	4.0kW	4.8kW	6.0°C	13.2°C	20.0°C	4.0kW	6.3kW	33.7°C	900m³/h
Ind 6	FXFQ40A ▲	24.0°C / 50%	3.0kW +10%	3.9kW	6.0°C	14.6°C	20.0°C	4.0kW	5.0kW	32.2°C	810m³/h

Figure 129: Larger indoor unit due to safety factor on cooling

A possible reason why you would consider larger indoor units is a room for which the function is not yet determined. For example, a room may be used as an office, but also as a small kitchen. To anticipate this, you may consider providing slightly larger indoor units.

- It is not possible to define a tolerance for cooling and a safety factor for heating or vice versa. Both settings must be in the same direction (tolerance or safety factor) or zero.

9.4 Finding Alternative Outdoor Units

Figure 130 shows the "***Advanced***" tab of the Preferences with the settings to find alternative outdoor units:

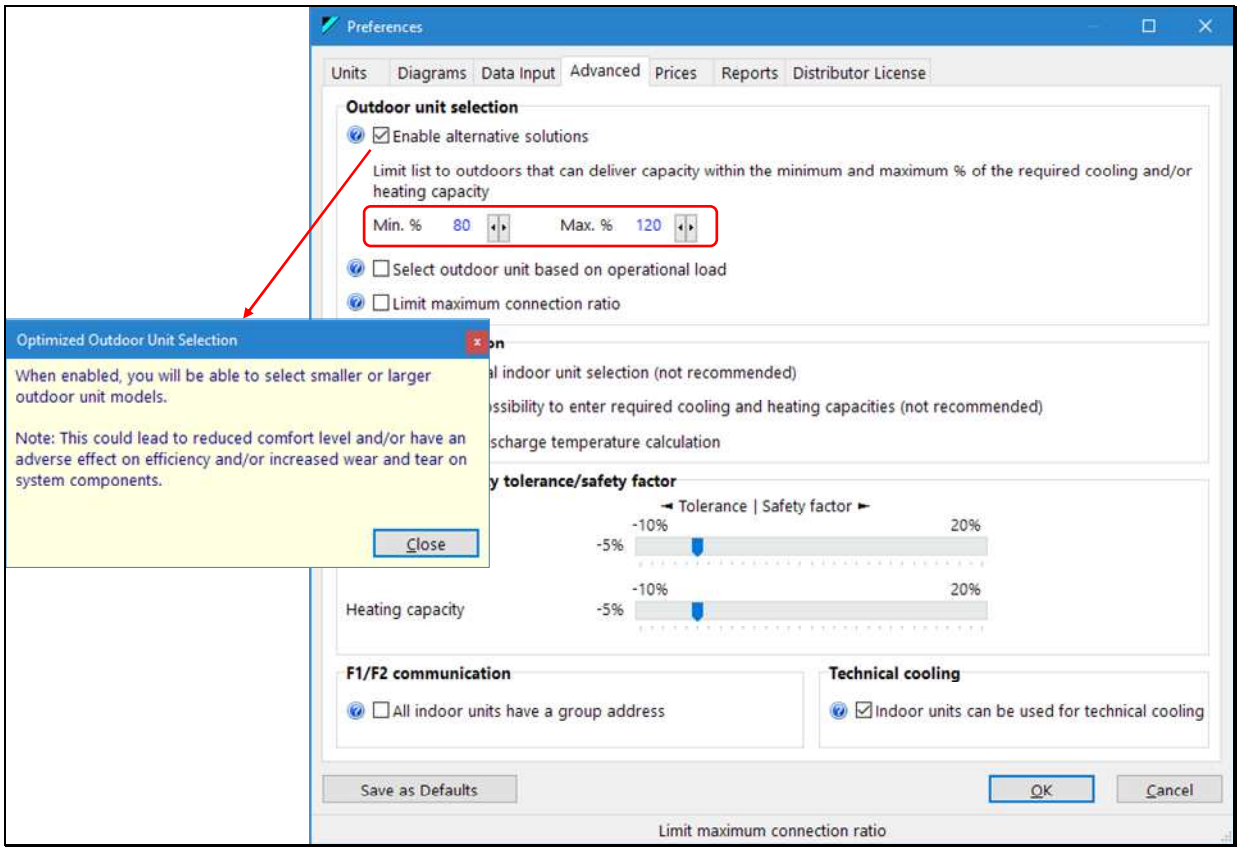


Figure 130: Settings to enable alternative outdoor units

When checked, VRV_Xpress still selects the outdoor unit that optimally covers the required loads. However, it also shows a list of outdoor units that are smaller and larger than the selected one, together with the deviation percentage. Figure 130 shows the maximum deviation allowed

to look for alternatives.

When editing the outdoor unit of the example of section 3.2 and Figure 43, the outdoor unit window now shows the same selection, but also alternatives, as shown in Figure 131.

The selected outdoor unit (model RYYQ12T) has a 14% surplus capacity in cooling and 0% in heating. So, it is sure this outdoor unit covers the required capacities at all times. Within a deviation of 80% (see Figure 130), VRV_Xpress also finds an alternative outdoor unit (model RYYQ10T) with a 2% surplus capacity in cooling, but with a 10% shortage capacity in heating.

If the installation mainly will be used for cooling, the selection of the smaller outdoor unit may perfectly suit the purpose. Selecting the smaller model automatically deselects the original selection and also marks the outdoor unit to show you have selected an alternative solution with deviated capacities.

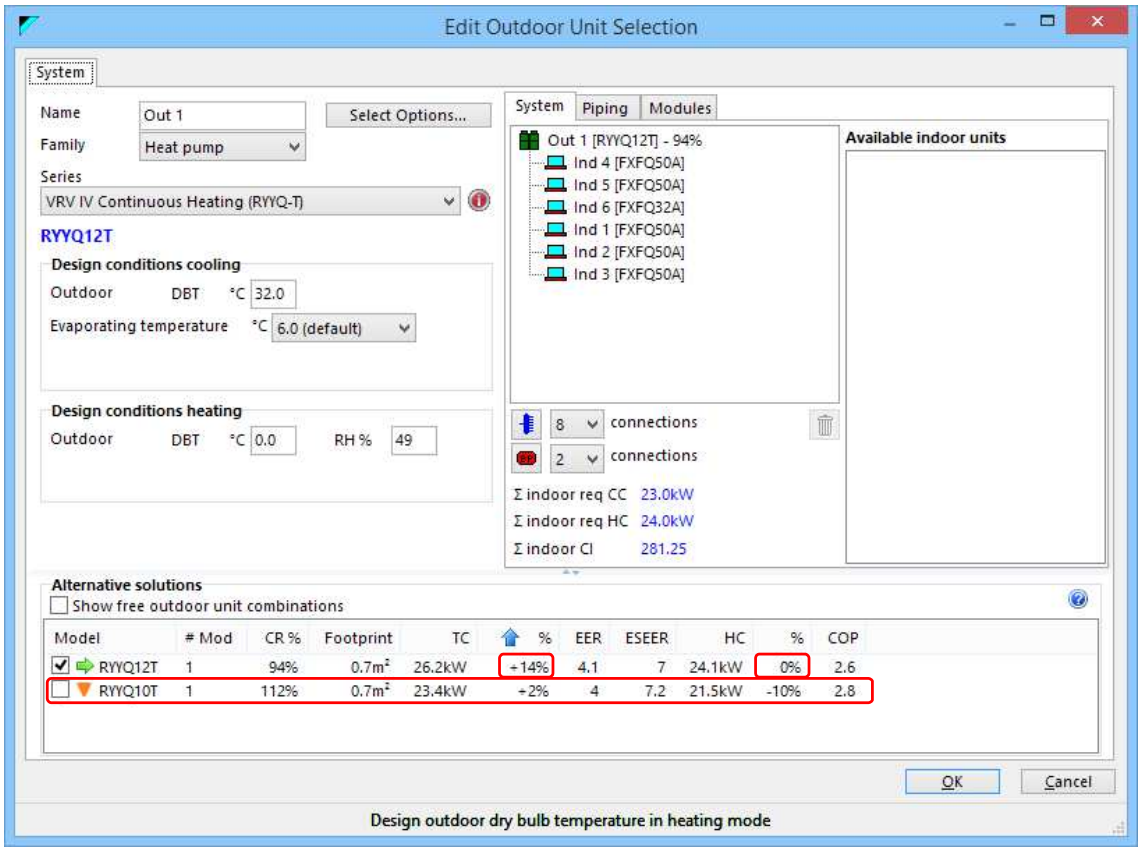


Figure 131: The selected outdoor unit and its alternative(s)

Warning: If you select a smaller outdoor unit, you must do this with good judgment and make sure not to combine reductions. For example, it is surely a bad idea to reduce the size of the indoor units (see section 9.3) and combine this with the selection of a smaller outdoor unit. This may result in under dimensioned devices causing discomfort and the resulting system may also not be capable of reaching the design temperature values in the room.

Figure 132 shows alternative solutions for different outdoor unit selections:

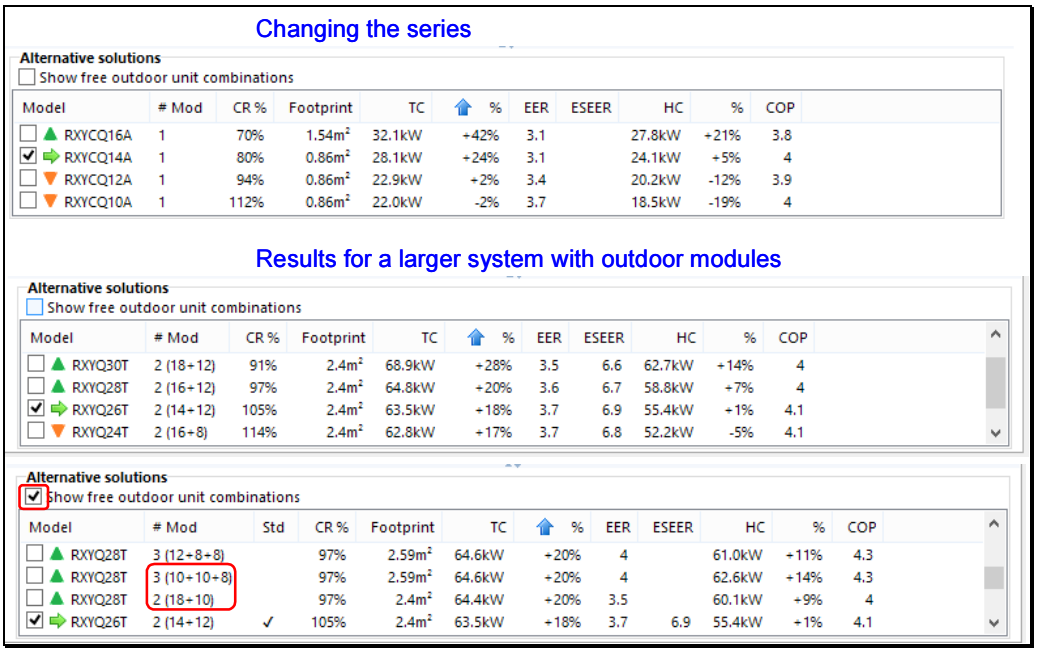


Figure 132: Alternative solutions with larger and smaller outdoor units

- The overview at the top results by changing the series in Figure 131 to VRV Classic. VRV_Xpress proposes a larger and two smaller alternative solutions, within the limits as defined the Preferences window.
- The overview in the middle is from a system with 20 indoor units. VRV_Xpress proposes two larger systems and several smaller systems. Some alternative solutions are not visible, but a scroll bar allows to move them up or down.
- The overview at the bottom is for the same system with 20 indoor units. However, larger outdoor units consists of a combination of modules. Depending on the combination used, the resulting outdoor unit may perform differently. To see the free outdoor unit combinations, check the checkmark above the overview. Figure 132 shows three different outdoor module combinations for the outdoor unit model 28, each having a slightly larger surplus capacity in heating.
  Note that the "***Modules***" tab in the outdoor unit window allows you to remove selections using specific modules from the list of solutions, as explained in section 3.6.

9.5 *Changing the Operational Load*

The checkmark to select an outdoor unit based on operational load basically allows a manual selection of an outdoor unit. Figure 133 shows the setting in the "***Advanced***" tab of the Preferences window and the changes resulting from this settings in the outdoor unit edit window:

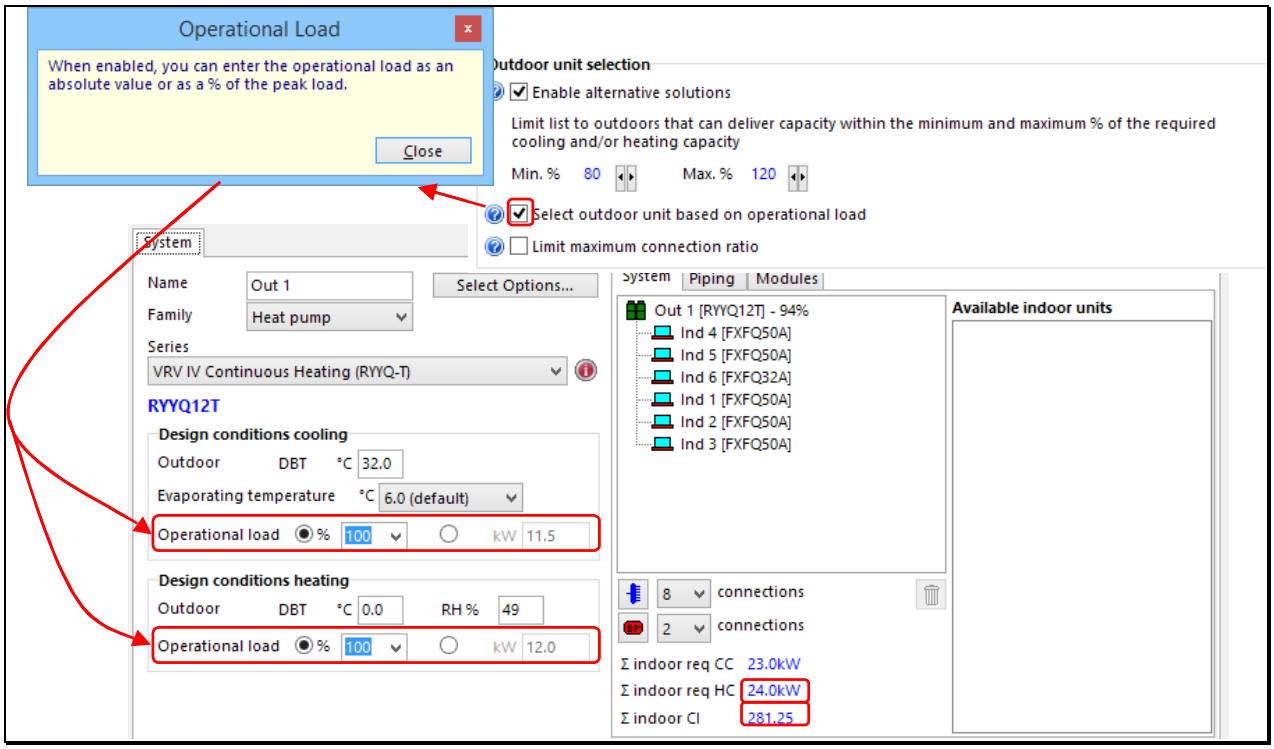


Figure 133: Allowing changing the operational load of outdoor units

The outdoor unit selected in Figure 131 must cover 22.6kW in cooling and 23.0kW in heating. Although it may happen in the morning after a weekend without operation, all indoor units seldom need their full capacity at the same time of the day. Consequently, the outdoor unit seldom has to provide these required capacities. So, a ***small*** deviation would be acceptable.

When reducing the operational load in heating to 90%, the required total indoor unit capacity becomes 21.6kW (24.0kW – 10%) and the selected outdoor unit becomes a model RYYQ10T with a cooling capacity of 24.4kW and an integrated heating capacity of 22.0kW. The cooling capacity still covers the required total indoor unit capacity of 23.0kW and the heating capacity is larger than the reduced required capacity of 21.6kW. Selecting this smaller outdoor unit will only have a small impact, maybe not even noticeable, on the performance of the indoor units.

Figure 134 shows the result of reducing the operational load for heating and the proposed outdoor unit, which now becomes a model RYYQ10T instead of the original model RYYQ12T.

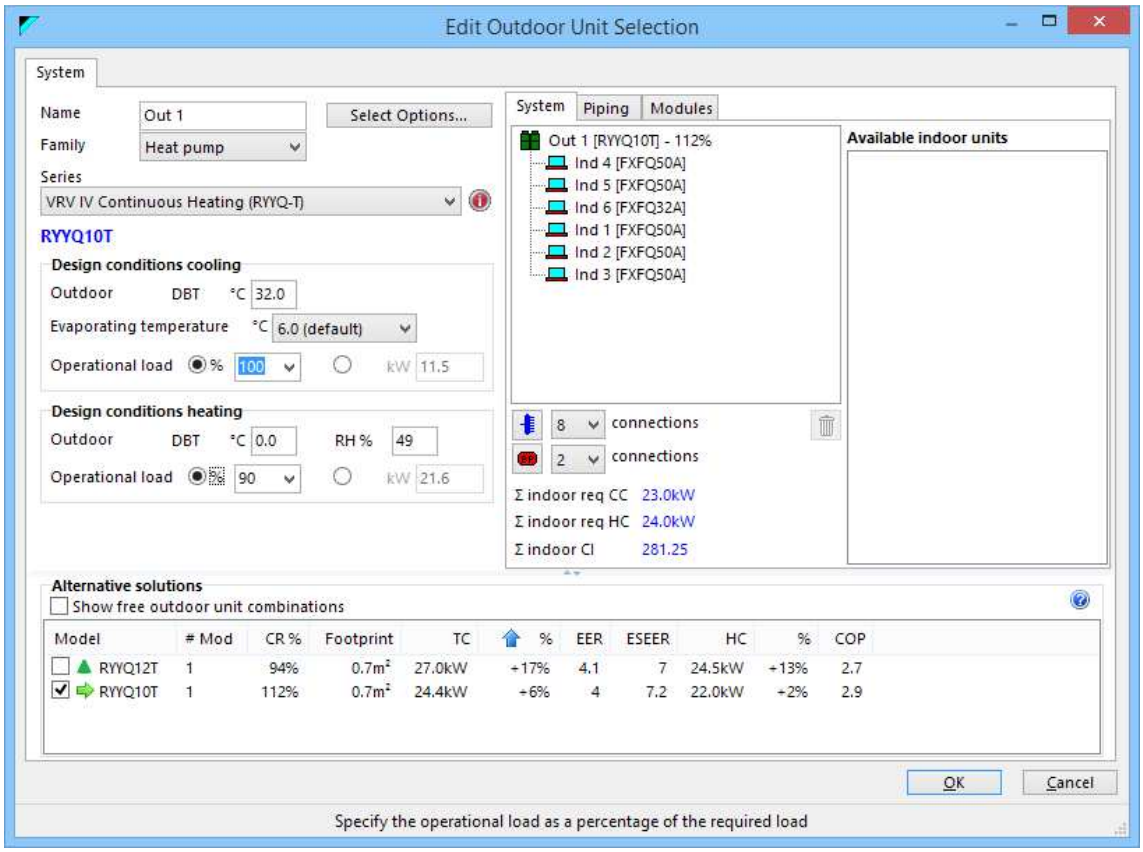


Figure 134: Manually selecting an outdoor unit through operational load changes

VRV_Xpress allows you reducing the operational loads down to 50%. This is ***far too much*** in regular installations and only needed in very specific situations. The rule of thumb is to never reduce the operational load by more than 10%.

Instead of reducing the operational load by a percentage, you can also reduce it by entering a value for the operational load. In the example in Figure 134, you click the radio button next to kW and enter 21.6kW instead of entering a percentage.

You must reduce operational loads with utmost caution and make sure you fully understand the impact. To remind you about the risks, VRV_Xpress gives a message each time you close the outdoor unit edit window, as shown in Figure 135:

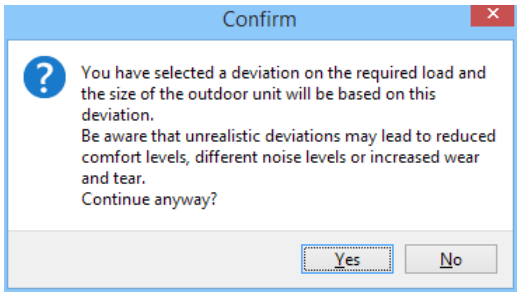


Figure 135: Caution when reducing operational loads

9.6 Changing the Connection Ratio

The final setting in the "***Advanced***" tab of the Preferences window is limiting the connection ratio, as shown in Figure 136. This window contains all the settings explained in the previous sections as well.

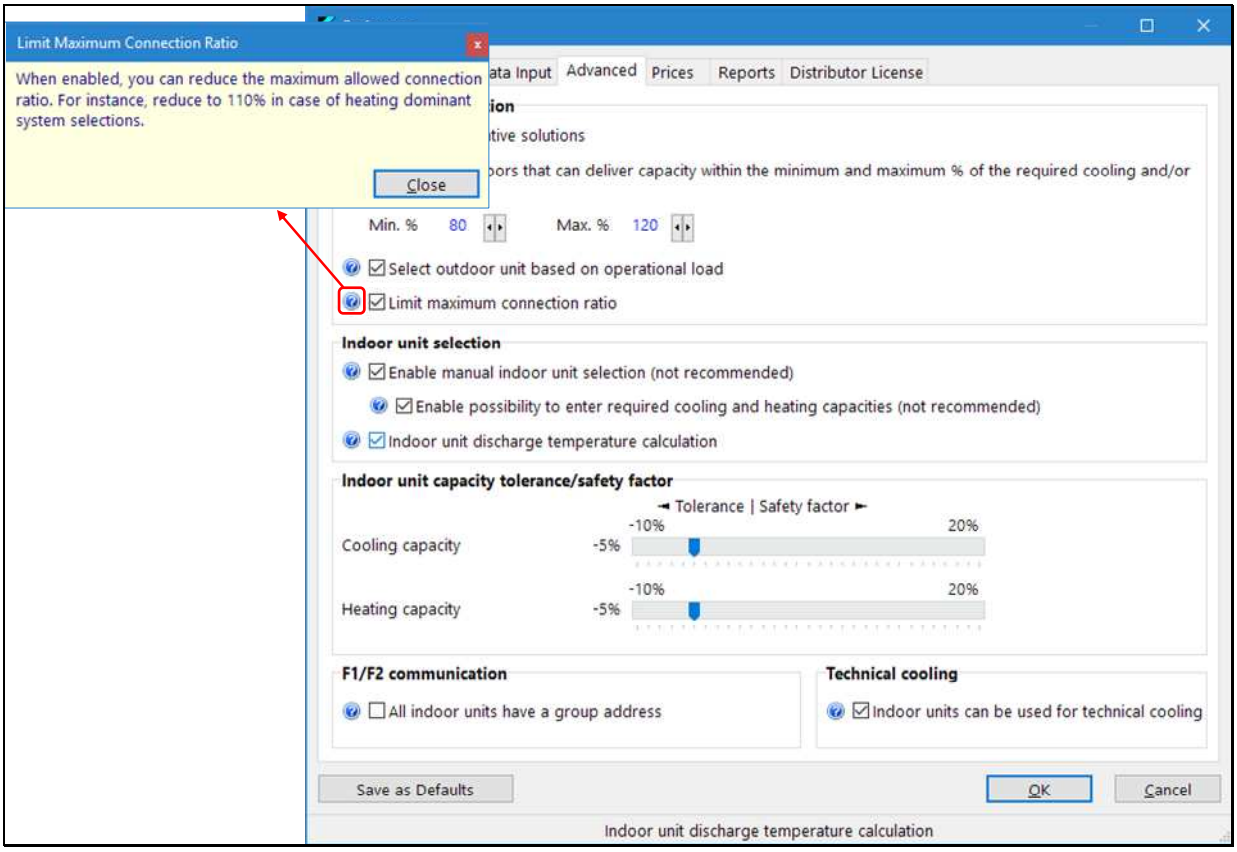


Figure 136: Limiting the maximum connection ratio

By default, VRV_Xpress selects an outdoor unit at a connection ratio of 130% (see section 3.2). However, in some situations it is worthwhile to consider smaller connection ratios:

- When your customer wants an installation in phases. By reducing the connection ratio, you make sure you can still add indoor units in a next phase without having to use another outdoor unit.
- Outdoor units cover larger cooling than heating capacities. If you select an outdoor unit that just covers the required heating capacity, you do not have any spare in case the heating demand would be larger than anticipated. By reducing the connection ratio, you have some extra heating capacity available.

Suppose you reduce the connection ratio to 110%, as shown in Figure 137. This makes VRV_Xpress to look up the outdoor units starting at a connection ratio of 100% up to 110%. The selected outdoor unit in the example used throughout this manual has a connection ratio of 94%. So, VRV_Xpress will find it before reaching the limit of 110%. However, the model RYYQ10T it was showing as an alternative solution no longer appears. In fact, this model was available within the limits given in the Preferences window, but at a connection ratio of 112% (see for instance Figure 131).

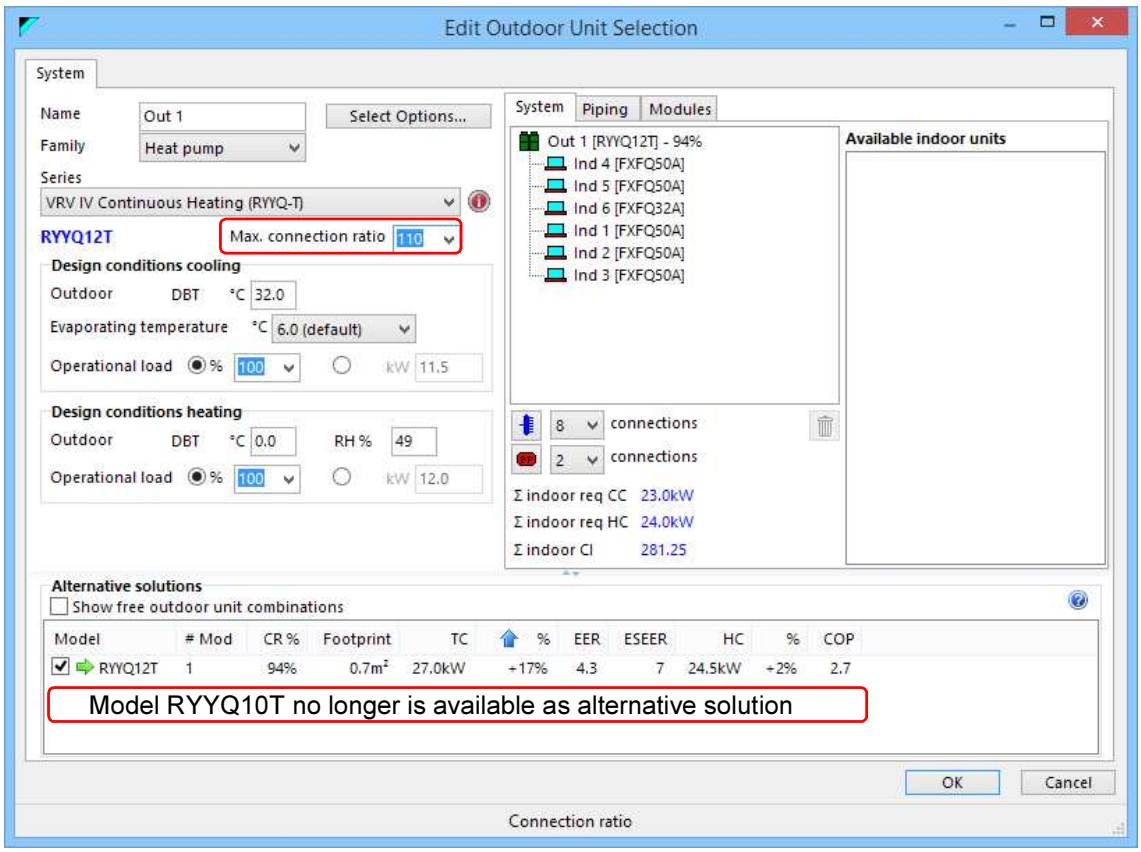


Figure 137: Reducing the connection ratio

When used with caution, the combination of increasing the connection ratio with reducing the operational load (see section 9.5) may give considerable benefits.

9.7 *Selecting Indoor Units on Sensible Cooling*

Selecting an indoor unit both on total and sensible cooling capacities or only on the sensible cooling capacity requires a good understanding of the selection process. Before going deeper into this subject, first consider the capacity tables of a few indoor units, for evaporating temperature values of 6^0C and 9^0C, as shown in Figure 138:

Model	TE	WB/DB	14°C/20°C	16°C/23°C	18°C/26°C	19°C/27°C	20°C/28°C	22°C/30°C	24°C/32°C
FXFQ50A	6°C	TC	3.8	4.5	5.2	5.6	5.9	6.0	6.2
		SC	3.2	3.6	4.0	4.1	4.2	3.7	3.8
		SHF	0.84	0.80	0.77	0.73	0.71	0.62	0.61
	9°C	TC	2.5	3.1	3.9	4.4	4.7	5.0	5.3
		SC	2.5	2.9	3.4	3.5	3.6	3.4	3.6
		SHF	0.99	0.95	0.86	0.80	0.77	0.68	0.68
FXFQ63A	6°C	TC	4.8	5.7	6.6	7.1	7.2	7.4	7.5
		SC	4.0	4.6	5.1	5.2	5.1	4.8	4.6
		SHF	0.83	0.81	0.77	0.73	0.71	0.65	0.61
	9°C	TC	3.2	4.0	5.0	5.5	5.8	6.2	6.4
		SC	3.1	3.8	4.3	4.4	4.4	4.4	4.4
		SHF	0.97	0.95	0.87	0.80	0.76	0.72	0.68
FXFQ80A	6°C	TC	6.1	7.2	8.4	9.0	9.5	9.7	9.9
		SC	5.2	5.8	6.4	6.5	6.6	6.4	6.1
		SHF	0.85	0.81	0.76	0.72	0.69	0.66	0.62
	9°C	TC	4.1	5.0	6.4	7.1	7.7	8.1	8.5
		SC	4.0	4.7	5.4	5.6	5.7	5.6	5.8
		SHF	0.98	0.95	0.85	0.79	0.75	0.70	0.68

Figure 138: Capacity tables for a few indoor units

The total (TC) and sensible (SC) cooling capacities are maximum capacities for the given wet bulb temperature. The total cooling capacity is the sum of the sensible cooling capacity and the latent cooling capacity and the sensible heat factor (SHF) gives the portion of the sensible cooling capacity in the total cooling capacity. Note that this sensible heat factor becomes smaller

for higher wet bulb temperature values. For an evaporating temperature of 6°C and nominal conditions (19°CWB/27°CDB), the SHF of a model FXFQ63A is 0.73 and the maximum capacities are 7.1kW total cooling and 5.2kW sensible cooling.

To calculate the maximum total cooling capacity for temperature conditions not published in the data book, as for instance (17°CWB/24°CDB), you can use simple interpolation. For the model FXFQ63A, this gives:

$$TC = 5.7 + \frac{(18-17)(6.6-5.7)}{(18-16)} = 5.7 + \frac{1\times 0.9}{2} = 5.7 + 0.45 = 6.15kW$$

The calculation of the maximum sensible cooling capacity is completely different and uses the interpolation of bypass factors. Figure 139 shows the definition of the bypass factor for published capacities.

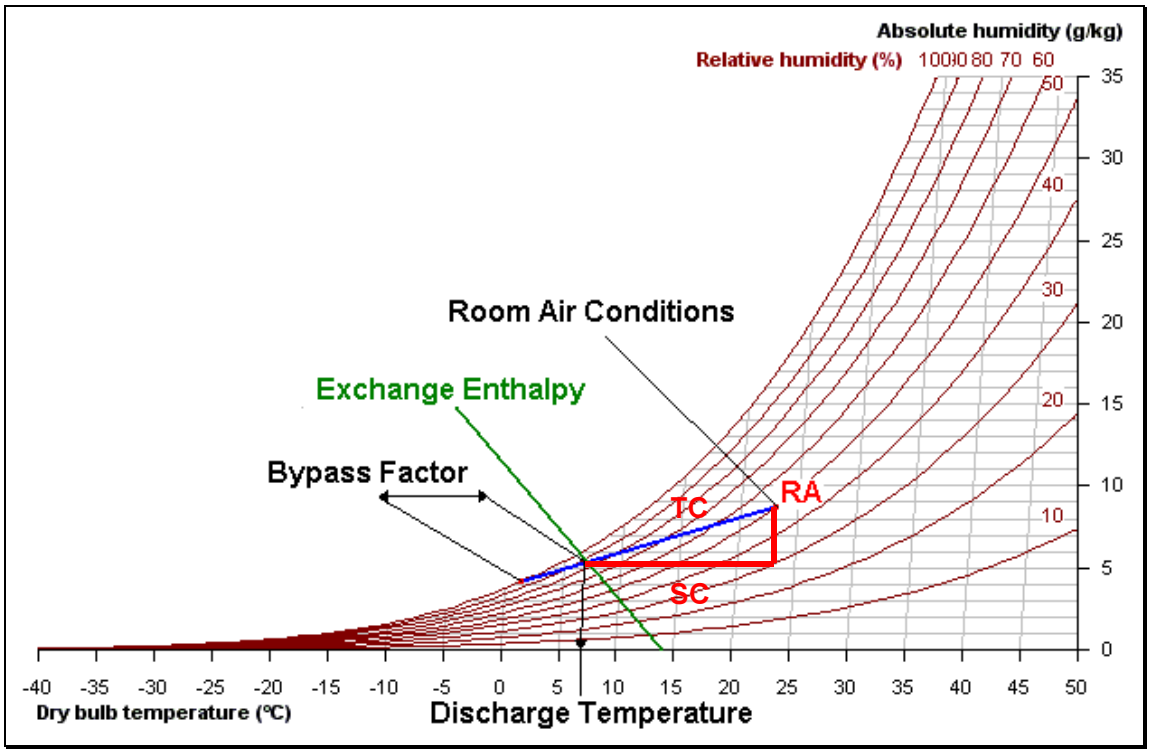


Figure 139: Graphical representation of the bypass factor

Given an room condition and the corresponding total and sensible (published) capacities for that condition:

- Calculate the latent capacity as Total Cooling Capacity - Sensible Cooling Capacity.
- Draw the lines corresponding with the latent and sensible capacities.
- Draw the line corresponding with the total capacity until it reaches a relative humidity of 100%.
- Mark the point where the sensible capacity crosses the line of the total capacity. This gives the discharge temperature.
- Measure the percentage of the total capacity line to the point with relative humidity of 100%. This gives the bypass factor.

It is clear that there is no closed formula to calculate the bypass factors for the published total and sensible capacities. In fact, this is an iterative calculation, which is a function of a published room temperature condition (e.g. 16°CWB/23°CDB), the published total cooling capacity (5.7kW), the published sensible cooling capacity (4.6kW), the airflow (=the fan speed, which is 990m³/h for the model FXFQ63A), the position of the fan motor and its power input.

To know the bypass factor for the temperature condition of 17°CWB/24°CDB, you need to calculate the bypass factors for the conditions 16°CWB/23°CDB and 18°CWB/26°CDB and interpolate those two results.

It is now possible to calculate the sensible capacity, by using this bypass factor, the enthalpy of the room temperature and the enthalpy of the discharge point to find the temperature of the discharge point. This finally gives you the maximum sensible capacity.

Using this bypass factor, you can then calculate the maximum sensible cooling capacity for the condition 17°CWB/24°CDB. For a model FXFQ63A, the ***sensible cooling*** capacity for the 17°CWB/24°CDB is ***4.693kW*** with a corresponding SHF of 4.693/6.15=0.79.

Given total and sensible cooling loads, finding an indoor unit able to cover both becomes a complex matter. Given a room temperature condition (P1). Applying the calculated indoor unit total and sensible cooling capacities to it, gives the condition of the design air (P2). Figure 140 shows both points:

- The room condition defined by a wet bulb and dry bulb temperature (e.g. 17^0CWB/25^0CDB), allows you representing it on a psychrometrics chart and reading the enthalpy and temperature values for that condition. Point P1 shows this room condition.
- The enthalpy of the design air is then given by:

$$Enthalpy(Design) = Enthalpy(RoomCondition) - \frac{TC}{1.2 \times Airflow}$$

  with 1.2 the air density in kg/m^3 and the airflow in m^3/s. The airflow of an indoor unit is its (high) fan speed. So, the design air enthalpy depends on the indoor unit and of course, this has to be an indoor unit able to provide at least the required total cooling capacity.
- The temperature of the design air is given by:

$$Temperature(Design) = Temperature(RoomCondition) - \frac{SC}{1.23 \times Airflow}$$

with 1.23 the air density multiplied by the specific heat of moist air.

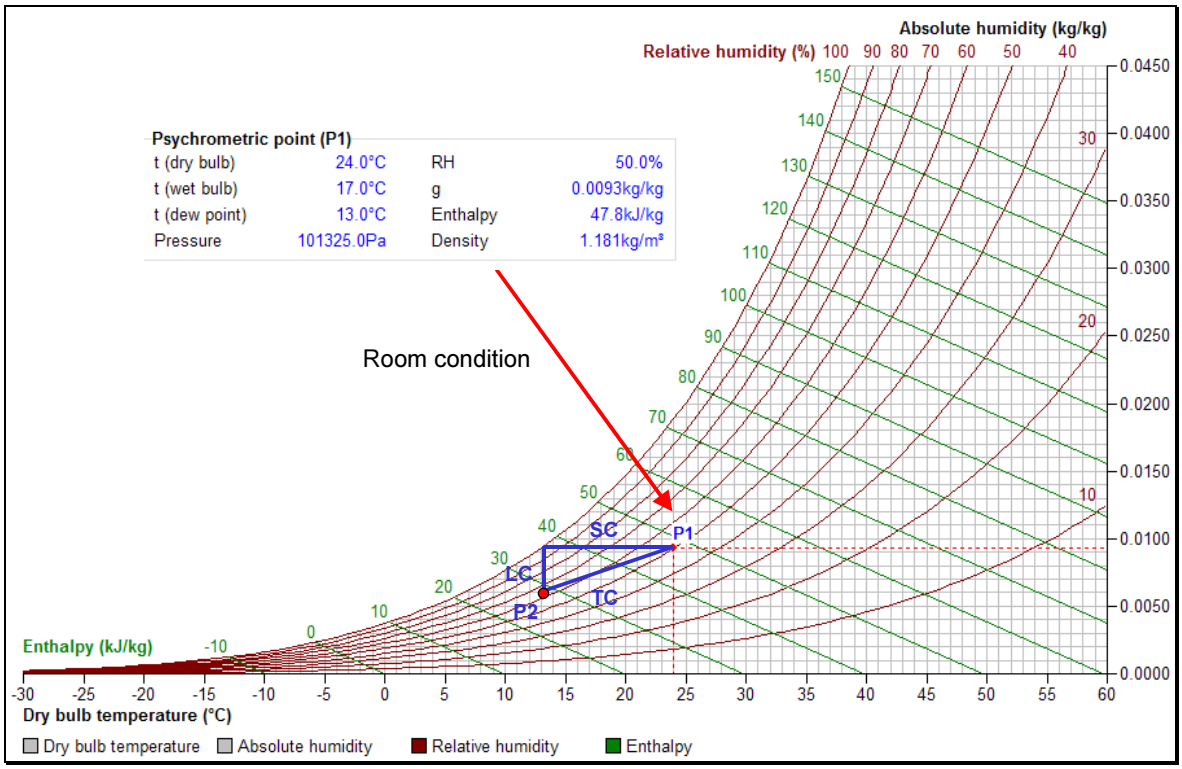


Figure 140: Indicating a room condition on a psychrometrics diagram

The resulting point P2 must comply with two important conditions:

6. The relative humidity must be less than 100%.
7. Using the (published or calculated) maximum sensible capacity of the indoor unit, you can also calculate the temperature that the indoor unit would provide:

   T (incoming air) - maximum sensible cooling capacity / (1.23 x airflow).

   If this temperature is higher than the temperature of the design air (P2), the indoor unit is not capable of producing the required sensible cooling capacity.

Given a total and a sensible cooling load, the selection of an indoor unit now proceeds as follows:

- Find an indoor unit covering the required total cooling load, using the given room conditions.
- Calculate the maximum sensible capacity of the indoor unit for the given room conditions, its maximum total capacity, its airflow and its bypass factor. As explained above, this is an iterative calculation.
- Calculate the sensible capacity of the indoor unit and corresponding with the required total cooling load, using the given room conditions, its airflow and its bypass factor.
- Find the position of point P2 for the required total capacity and the corresponding calculated sensible capacity of the indoor unit.
- Check the conditions 1 and 2 above for this point. If the indoor unit complies, VRV_Xpress selects it. If not, VRV_Xpress takes the next larger model from the indoor unit family.

The resulting indoor unit may be much larger than you expect, especially when the ratio of SC/TC gives a value that is (much) higher than the SHF of the indoor unit. In fact, if the required sensible cooling load is almost equal to the required total cooling load, you should consider using a selection with a higher evaporating temperature. For example at an evaporating temperature of 9^0C, the SHF is more than 0.9 for many room conditions (see Figure 138).

Selecting indoor unit for a total and sensible capacity requires careful considerations. And of course, you cannot renounce selecting indoor units on total and sensible cooling loads because this may lead to larger models. In fact, for some projects may have strict requirements for sensible capacities and you must be able to cope with these requirements.