Order Nr. A2W-SPX-130305-012

Panasonic
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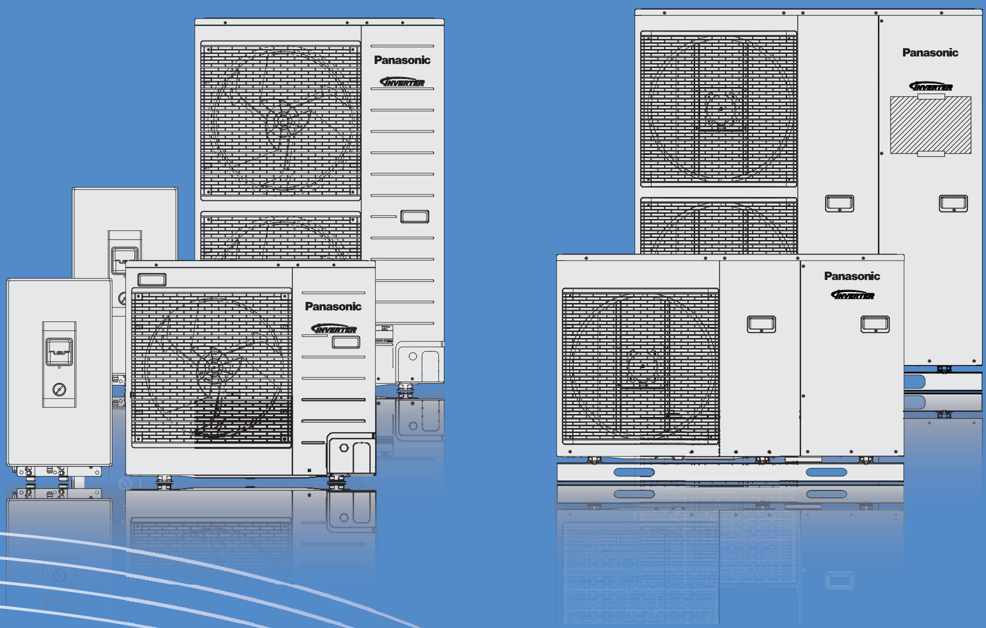
Aquarea Air/water-heatpump – heating and cooling systems

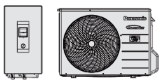
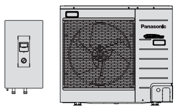
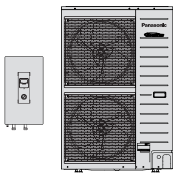
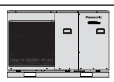
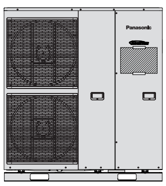
2013



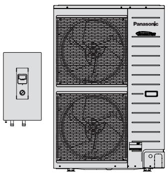
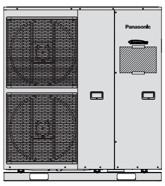
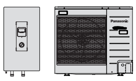
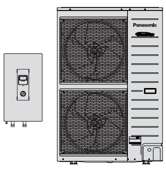
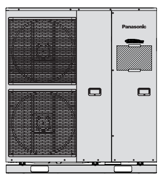
DESIGN HANDBOOK

for split and compact systems

Overview of units

Series	Units	Hydromodule	Outdoor unit/ compact unit	Operating mode	Nominal heating capacity	Capacity of additional electric heater	Electrical connection
Aquarea LT		WH-SDF03E3E5*	WH-UD03EE5	Heating	3	3	single phase
		WH-SDC03E3E5*	WH-UD03EE5	Heating + cooling	3	3	single phase
		WH-SDF05E3E5*	WH-UD05EE5	Heating	5	3	single phase
		WH-SDC05E3E5*	WH-UD05EE5	Heating + cooling	5	3	single phase
		WH-SDF07C3E5	WH-UD07CE5	Heating	7	3	single phase
		WH-SDF07C3E5	WH-UD07CE5	Heating + cooling	7	3	single phase
		WH-SDF09C3E5	WH-UD09CE5	Heating	9	3	single phase
		WH-SDC09C3E5	WH-UD09CE5	Heating + cooling	9	3	single phase
		WH-SDF09C3E8	WH-UD09CE8	Heating	9	3	three phase
		WH-SDC09C3E8	WH-UD09CE8	Heating + cooling	9	3	three phase
		WH-SDF12C6E5	WH-UD12CE5	Heating	12	6	single phase
		WH-SDC12C6E5	WH-UD12CE5	Heating + cooling	12	6	single phase
		WH-SDF12C9E8	WH-UD12CE8	Heating	12	9	three phase
		WH-SDC12C9E8	WH-UD12CE8	Heating + cooling	12	9	three phase
		WH-SDF14C6E5	WH-UD14CE5	Heating	14	6	single phase
		WH-SDC14C6E5	WH-UD14CE5	Heating + cooling	14	6	single phase
		WH-SDF14C9E8	WH-UD14CE8	Heating	14	9	three phase
		WH-SDC14C9E8	WH-UD14CE8	Heating + cooling	14	9	three phase
		WH-SDF16C6E5	WH-UD16CE5	Heating	16	6	single phase
		WH-SDC16C6E5	WH-UD16CE5	Heating + cooling	16	6	single phase
		WH-SDF16C9E8	WH-UD16CE8	Heating	16	9	three phase
		WH-SDC16C9E8	WH-UD16CE8	Heating + cooling	16	9	three phase
			WH-MDF06E3E5*	Heating	6	3	single phase
			WH-MDF09E3E5*	Heating	9	3	single phase
			WH-MDF09C3E5	Heating	9	3	single phase
			WH-MDC09C3E5	Heating + cooling	9	3	single phase
			WH-MDF09C3E8	Heating	9	3	three phase
			WH-MDC09C3E8	Heating + cooling	9	3	three phase
			WH-MDF12C6E5	Heating	12	6	single phase
			WH-MDC12C6E5	Heating + cooling	12	6	single phase
			WH-MDF12C9E8	Heating	12	9	three phase
			WH-MDC12C9E8	Heating + cooling	12	9	three phase
			WH-MDF14C6E5	Heating	14	6	single phase
			WH-MDC14C6E5	Heating + cooling	14	6	single phase
			WH-MDF14C9E8	Heating	14	9	three phase
			WH-MDC14C9E8	Heating + cooling	14	9	three phase
			WH-MDF16C6E5	Heating	16	6	single phase
			WH-MDC16C6E5	Heating + cooling	16	6	single phase
			WH-MDF16C9E8	Heating	16	9	three phase
			WH-MDC16C9E8	Heating + cooling	16	9	three phase

* Devices have a high efficiency pump and fulfil the criteria of the Ecodesign Directive valid from 2015 for energy-related products (ErP)

Series	Units	Hydromodule	Outdoor unit/ compact unit	Operating mode	Nominal heating capacity	Capacity of additional electric heater	Electrical connection
Aquarea T-CAP		WH-SXF09D3E5	WH-UX09DE5	Heating	9	3	single phase
		WH-SXC09D3E5	WH-UX09DE5	Heating + cooling	9	3	single phase
		WH-SXF09D3E8*	WH-UX09DE8	Heating	9	3	three phase
		WH-SXC09D3E8	WH-UX09DE8	Heating + cooling	9	3	three phase
		WH-SXF12D6E5	WH-UX12DE5	Heating	12	6	single phase
		WH-SXC12D6E5	WH-UX12DE5	Heating + cooling	12	6	single phase
		WH-SXF12D9E8*	WH-UX12DE8	Heating	12	9	three phase
		WH-SXC12D9E8	WH-UX12DE8	Heating + cooling	12	9	three phase
			WH-MXF09D3E5	Heating	9	3	single phase
			WH-MXC09D3E5	Heating + cooling	9	3	single phase
			WH-MXF09D3E8	Heating	9	3	three phase
			WH-MXC09D3E8	Heating + cooling	9	3	three phase
			WH-MXF12D6E5	Heating	12	6	single phase
			WH-MXC12D6E5	Heating + cooling	12	6	single phase
			WH-MXF12D9E8	Heating	12	9	three phase
			WH-MXC12D9E8	Heating + cooling	12	9	three phase
Aquarea HT		WH-SHF09D3E5	WH-UH09DE5	Heating	9	3	single phase
		WH-SHF09D3E8	WH-UH09DE8	Heating	9	3	three phase
		WH-SHF12D6E5	WH-UH12DE5	Heating	12	6	single phase
		WH-SHF12D9E8	WH-UH12DE8	Heating	12	9	three phase
			WH-MHF09D3E5	Heating	9	3	single phase
			WH-MHF09D3E8	Heating	9	3	three phase
			WH-MHF12D6E5	Heating	12	6	single phase
			WH-MHF12D9E8	Heating	12	9	three phase

Overview of all available models and their properties (for explanation of unit names, refer to the “Systematics” section)

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Table of contents

1 Introduction ... 7
1.1 Functional principles of the air / water heat pump ... 7
1.2 Coefficient of performance and performance factor ... 8
1.3 Economical and environmentally friendly ... 9

2 Heat pump system ... 11
2.1 Heat source ... 11
2.2 Heat pump ... 12
2.2.1 Function and properties ... 12
2.2.2 Operating mode ... 12
2.3 Heat utilisation ... 13
2.3.1 Heating ... 13
2.3.2 Water heating ... 14
2.3.3 Cooling ... 15
2.4 Systematics and overview ... 16
2.4.1 Systematics ... 16
Hydromodule ... 16
Outdoor unit ... 17
Compact unit ... 17
2.4.2 Overview ... 18
Series ... 19
Split system and compact system ... 20

3 Products, functions and technical data ... 21
3.1 Split system ... 21
3.1.1 Product features ... 21
Hydromodule ... 23
Outdoor unit ... 25
Technical data ... 28
3.2 Compact system ... 32
3.2.1 Compact unit ... 34
Technical data ... 36
3.3 Accessories ... 38
3.3.1 Hot water tank ... 38
3.3.2 Extras ... 42

4 Closed-loop control ... 43
4.1 Design ... 43
4.2 Functions ... 43
4.2.1 Basic functions ... 43
4.2.2 Further functions ... 45
4.2.3 Safety functions ... 46
4.3 Extensions and external interfaces ... 46
4.3.1 External room thermostat ... 46
4.3.2 Deactivation of heating circuits in cooling mode ... 47
4.3.3 External control of the Aquarea heat pump ... 47
4.3.4 External solar thermal installation ... 48

5 Planning 49
5.1 Planning steps 49
5.2 Panasonic Aquarea Designer 49
5.3 Establishing the heating load and outside design temperature 50
5.4 Establishing hot water demand 52
5.5 Establishing the heat emitter temperatures 53
5.6 Operating mode and bivalence point 54
5.7 Heat pump selection 55
5.7.1 General criteria 55
5.7.2 What capacity is needed? 55
5.8 Planning the installation room 58
5.8.1 Room volume for split system 59
5.8.2 Assembly conditions and minimum distances from hydromodule 59
5.9 Planning heat source - air 61
5.9.1 Split system 61
Capacity decrease in long refrigeration piping 62
Assembly conditions and minimum distances from outdoor units 62
5.9.2 Compact system 63
Assembly conditions and minimum distances from compact unit 64
Fastening of the compact unit 65
5.10 Acoustics 65
5.10.1 Sound pressure level 65
5.10.2 Sound pressure level for estimate calculation 66
5.11 Cooling 69
5.11.1 Cooling with underfloor heating system 69
5.11.2 Cooling with fan convectors 69
5.12 Electrical connection 70
5.12.1 Power supply 70
5.12.2 Connections to the inputs and outputs 72
5.12.3 Current meter and tariffs 73
5.13 Hydraulics 73
5.13.1 Hydraulic integration 73
Hydraulic decoupling for standard and high efficiency pumps 74
Dirt filter 75
System volume 75
5.13.2 Pumping height and pipe network resistance 75
5.13.3 Pumping height 77
5.13.4 Hydraulic balancing 79
5.13.5 Peculiarities during cooling 79
5.13.6 Expansion vessel 80
5.13.7 Heating water quality 81
5.13.8 Use of storage tanks 81

6 Examples 82
6.1 Legend 82
Examples 1 to 10 83–92

7 Appendix 93

1 Introduction

1.1 Functional principles of the air / water heat pump

For comfortable living to be achieved, room temperatures should be slightly above 20 °C. This temperature deviates only slightly from the outside temperature during most of the year.

In contrast to heating systems that utilise a boiler, which generates temperatures of several hundred degrees during the combustion process, a heat pump generates only the temperature that is needed. In doing so, the Aquarea air / water heat pump utilises the heat energy in the surrounding air to heat buildings and provide hot water. In other words, the system utilises the freely available environmental air. Electricity is needed only to operate the compressor, electronics, pumps and to operate the additional electric heater in the event of extremely low outside temperatures.

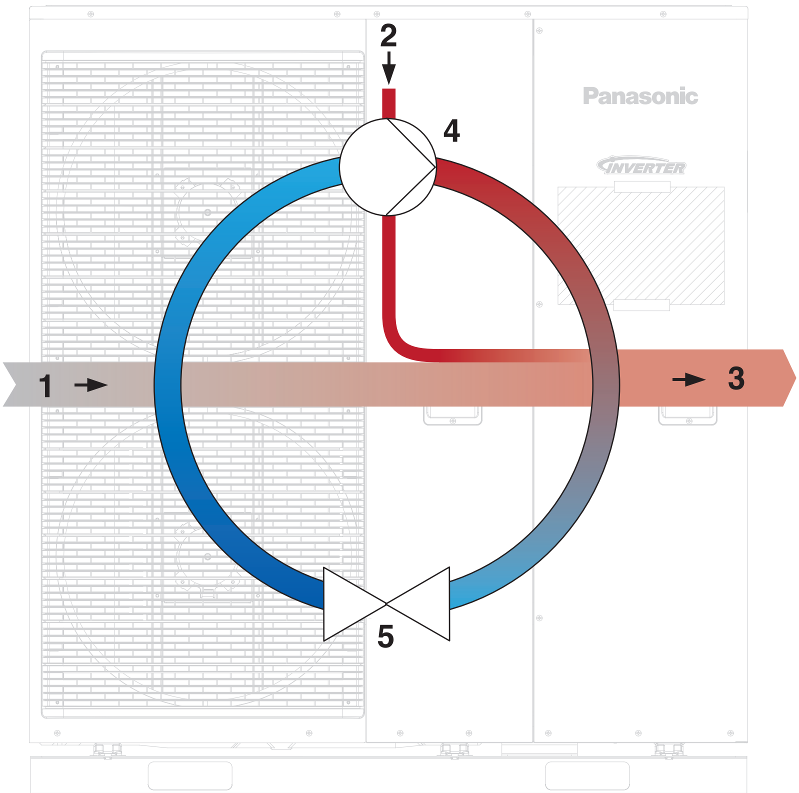
1 Heat energy content in ambient air (Evaporator)

2 Electrical input

3 Available heat energy (Condenser)

4 Compressor

5 Expansion valve



Functional principles of an air / water heat pump

Ambient heat is brought up to a higher temperature level in a cyclical process. To do this, an environmentally compatible refrigerant undergoes four steps:

- The refrigerant boils inside the evaporator where it is transformed from the liquid into the gas state. During this step, heat is extracted from the surrounding air (left side of figure).
- Inside the compressor the pressure of the gaseous refrigerant is greatly increased. The temperature increases accordingly. This step occurs with the supply of electric energy (top of figure).
- In the condenser, the gaseous refrigerant condenses and dissipates the latent heat of condensation to the heating water, whereby it cools down at the same time (right side of figure).
- When passing the expansion valve, the pressure of the liquid refrigerant reduces substantially. Its temperature decreases significantly and it can absorb ambient heat anew (bottom of figure).

This process continues cyclically and can be controlled by the inverter-plus technology of the Aquarea heat pump so that the current heat requirement is catered for.

Reversing the cyclical processes causes the unit to act like a refrigerator. This allows Aquarea heat pumps to be used also for air conditioning.

1.2 Coefficient of performance and performance factor

The coefficient of performance (COP) of a heat pump is defined as the ratio of heat power output to the electrical power input and says something about the efficiency of the heat pump at a certain moment. Depending upon the outside temperature and the temperature of the generated heat, the COP of heat pumps will differ. It is generally the case that the coefficient of performance decreases in proportion with an increasing temperature difference between the outside temperature and the temperature of the heat generated. A comparison of the efficiency of different heat pumps is only possible at the same temperatures. COPs for air/water heat pumps are normally measured at the following temperatures:

Outside temperature	Generated heat
A-15	W35
A-7	W35
A7	W35
A2	W55

(**A** stands for Air, **W** stands for Water)

Example

Coefficient of performance = 4.74 (A7/W35)

For an outside temperature of 7 °C the air/water heat pump produces hot water at 35 °C at a COP of 4.74. Thus, 4.74 kilowatt-hours of heat energy can be generated from one kilowatt-hour of electrical energy.

Performance factor is more meaningful than the COP, which represents the ratio of heat energy output to the electrical energy input over a certain period. The seasonal performance factor (SPF) is the ratio of heat energy output to the electrical enegy input over a one year period. It is obtained from heat and electricity meters and includes all aspects of the heat pump system.

Similar to the coefficient of performance for the heating operation, the coefficient of performance for the cooling operation is defined as the ratio of heat power removed to the electrical power input. In contrast to COP, it is abbreviated with EER = energy efficiency ratio.

1.3 Economical and environmentally friendly

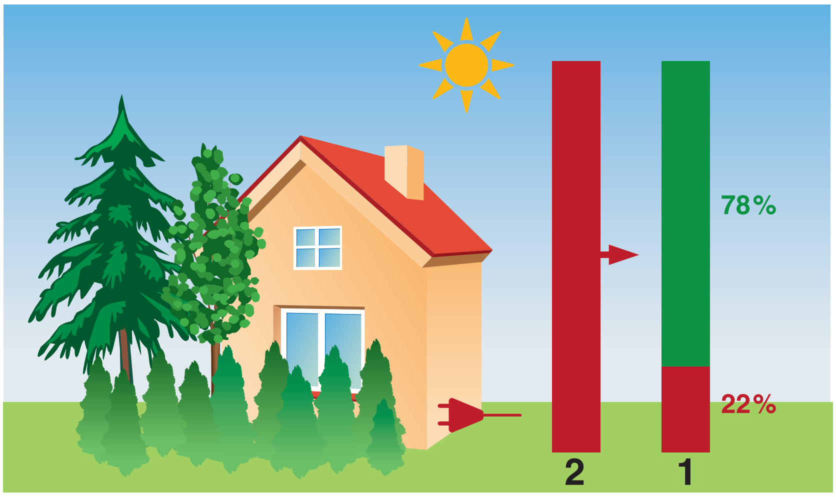
More than 75 % of energy use in the household is used for heating and hot water. At the same time fuel prices (oil, gas, wood pellets) are subject to strong price fluctuations and are becoming increasingly more expensive.

In contrast, an Aquarea heat pump utilises up to 75 % free ambient heat can be used. Electrical energy must be used only for the remaining 25 % of the heat pump operation. In comparison with a direct electric heater, the amount of electrical energy used for the same heat production is reduced down to a quarter.

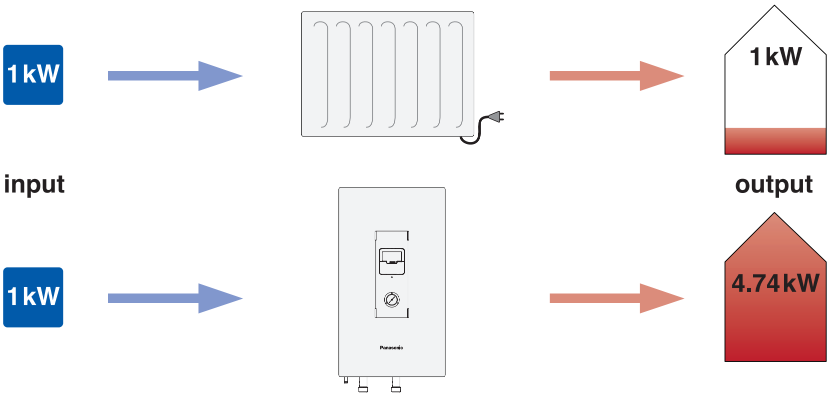
In comparison with fuel based heating systems, the dependence on oil price and risky energy imports is therefore reduced. In addition, the share of renewable energy in electricity production today is already about 25 % in the UK and expected to rise. Besides the ambient heat, the electric energy used for heat pumps is increasingly derived from renewable energy sources.

Besides low electricity use, a yearly oil or gas service is no longer required. Additionally, the investment costs for an Aquarea air/water heat pump are proportionally lower in comparison to other heating systems with natural gas connection, chimney, oil tank or boreholes.

Aquarea heat pumps can optionally be operated also with cooling function and supplemented with a solar thermal system. This allows comfort and efficiency to be increased further.



1 Aquarea heat pump **2** Conventional electric heating



Comparison of power consumption of an Aquarea heat pump to a direct electric heater for the same electricity input.

In the UK, it is proposed to support air-source heat pumps with funding but not until 2013. It will be a condition of this funding that the equipment and installer are certified under the Microgeneration Certification Scheme (MCS) MIS 3005 document. For latest information on this, the website of the Department of Energy and Climate Change (DECC) should be visited.

Note

Panasonic offers a free program for sizing heat pumps with which the seasonal performance factor can be calculated according to VDI 4650, the Aquarea Designer (see the “Panasonic Aquarea Designer” section in the planning chapter).

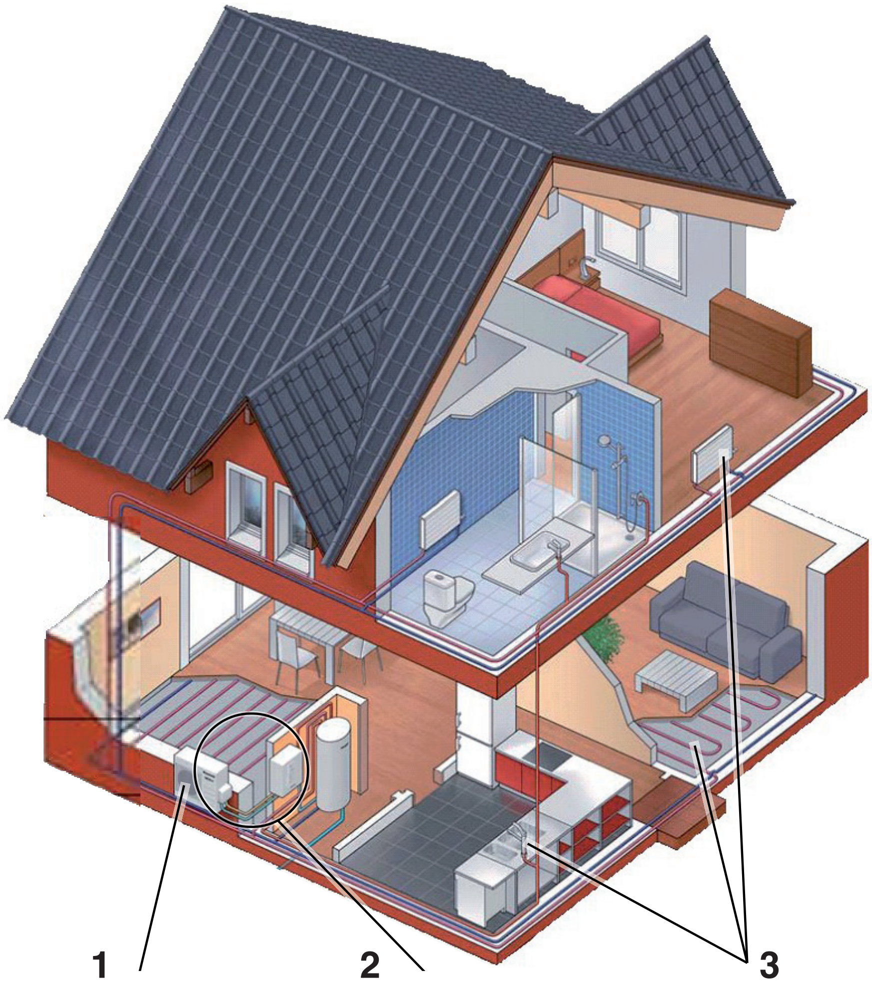
Please see www.microgenerationcertification.org for details of how to apply for MCS accreditation.

2 Heat pump system

1 **Heat source**
ambient air

2 **Heat pump**
split unit or compact unit

3 **Heat utilisation**
Water heating
Heating
Cooling



Smooth and efficient operation of the heat pump system requires careful design and consideration of all aspects of the system from the heat source up to the heat utilisation.

2.1 Heat source

Air as a heat source is available everywhere and can be utilised without limit by means of an air-heat exchanger in combination with fans at very low expense. However, the outside temperature fluctuates significantly in the course of the year and is inversely proportional to the heat requirement. This means that the most heat must be generated when the heat source is at its coldest state. This must be accounted for during the planning phase so that the required internal temperatures are always achieved.

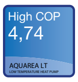
Likewise the noise of the fans and air flow must be considered by ensuring minimum distances from neighbouring plots as well as by selecting a suitable installation location.

2.2 Heat pump

2.2.1 Function and properties

The heat pump as the core piece of the heat pump system was developed by Panasonic in three different series. In this manner, individual requirements for the heat supply of buildings should be considered with each series' properties in mind:

Aquarea LT

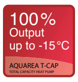


Ideal for low-temperature heat emitters or underfloor heating systems; also for radiators.

Aquarea HT

For high temperature radiators (e.g. radiators in the refurbishment context), Aquarea HT can supply a water temperature of 65 °C without assistance even at outside temperatures of -15 °C.

Aquarea T-CAP



For applications at which the nominal capacity should be kept constant even at outside temperatures of -7 or -15 °C. It is ensured that even under extremely low outside temperatures sufficient capacity is always at disposal for heating the house without assistance from other heat generators.

With the exception of the HT series, all series are available with and without cooling mode. Furthermore, Aquarea heat pumps are available for all series as a compact system in one unit or as split system in two units (outdoor unit and hydromodule) (for details see the chapter 3).

2.2.2 Operating mode

It is generally true that the larger the difference between outside temperature and the temperature of the generated heat, the lower the performance factor of the heat pump. Since high temperature differences occur extremely rarely with correctly designed heat pump systems in the course of the year, temporary heating with an additional electric heater is often accepted. Alternatively to an additional electric heater, it is possible to work with an alternative heat generator like a condensing boiler or a stove with a back boiler. The four different operating modes are:

1. **Monovalent operating mode**
   Heat pump serves as the sole heat generator.

2. **Mono-energetic operating mode**
   Electricity is used to operate a heat pump and additional electrical heater (electric heat pump + additional electric heater for peak load).

3. **Bivalent alternative operating mode**
   A second heat generator supplies the property using a further energy source, under certain conditions (e.g. stove with back boiler instead of heat pump for outside temperatures < -5 °C).

4. **Bivalent parallel operating mode**
   Besides the heat pump, a second heat generator is used using a further energy source. Both heat generators are operated simultaneously (e.g. heat pump + condensing boiler for outside temperatures < 0 °C).

Note

When the heat pump is operated in connection with an additional electric heater in mono-energetic mode, the additional electric heater should cover a maximum of 15 % of the heat requirement.

2.3 Heat utilisation

2.3.1 Heating

In contrast to heat generators such as boilers that produce water supply temperatures of over 80 °C, the maximum water supply temperature of the Aquarea heat pump is limited at 55 °C or 65 °C for Aquarea HT. This must be accounted for during the planning of heat emitter circuits. Radiant panels and underfloor heating systems which have water supply temperatures of up to 35 °C and a range of 5 K are recommended. An advantage of underfloor heating systems is their large storage capacity that dispenses with a storage tank for bridging power outages from the power supply company.

Fan convectors have the advantage of good heat dissipation to the indoor air and are easily controllable. At the same time they can be used for either heating or cooling operation.

When radiators are used, they should be planned likewise with a low design temperature of e.g. 45 °C in order to ensure a high efficiency of the heat pump system. An additional electric heater of 3 to 9 kW caters for sustained heating comfort even under very low outside temperatures, due to the mono-energetic mode. A bivalent operation in combination with an external heater is a possible alternative.

The Aquarea heat pump is provided with an outside temperature dependent control of the supply water temperature and can activate a heating circuit in connection with a room thermostat. The control of further heating circuits can occur via an additional heating circuit controller or an overriding system controller on site.

2.3.2 Water heating

The Aquarea heat pump has a water heating operation integrated within the control system. Upon demand, the water heating operation is switched on and heats the hot water tank via a 3-way directional valve.

Since the required temperature for water heating in general lies above the temperature of the heating operation over the year, the coefficient of performance (COP) is low in the water heating mode in comparison to the heating mode. For efficiency reasons, the hot water storage temperature is therefore set below 60 °C. A hot water temperature of 45 °C is sufficient for normal applications and is not at all connected with reduced comfort. However, at very low hot water temperatures, attention must be paid to the danger of legionella which especially thrive within the range 30 to 50 °C.

The Panasonic hot water tanks are equipped with an electric immersion heater for comfortable hot water supply, which is only switched on upon demand or for legionella control.

Aquarea heat pumps can be combined easily with solar thermal installations, which can largely take over water heating in the summer months.

Note

The requirments for the control of legionella propagation in the workplace are described in HSE guide L8

Attention

When using the Panasonic hot water tank, the quality of water must comply with the portable water directive 98/83/EC. When the chloride and sulphate content exceeds 250 mg / l, water treatment is required. For values above 250 mg / l the guarantee expires.

Water regulations must be considered at all times when installing an Aquarea heat pump.

2.3.3 Cooling

For all Aquarea series, models with cooling mode are available through active cooling. The cooling mode is switched on manually via the remote controller and/or wired remote control and interrupts the heating operation. The switch-over to heating mode occurs likewise again manually at the end of the cooling period.

Room cooling is possible by means of radiant panels such as underfloor, wall or ceiling cooling systems or particularly via fan convectors. Individual heating circuits that are not suitable for the cooling operation can be deactivated by a control system via a 2-way directional valve. For all transfer systems, it is possible for the temperature to fall below the dew point, which can result in condensation in the cooling mode, with high relative humidity. This must be ruled out particularly with radiant panels, via a dew-point sensor, the supply water temperature must be raised through mixing with the return flow, or the cooling mode must be switched off in an emergency. Fan convectors can be operated with much lower supply water temperatures in comparison to radiant panels in the cooling mode and therefore have greater cooling capacities. However, fan convectors for the cooling mode must always be provided with a condensate drain and piping with closed-cell insulation.

Attention

In the cooling mode, condensation of moisture in the air can occur on the surface of the heat transfer systems when the temperature falls below the dew point. This can lead to damage to the building or to the danger of slipping on floor surfaces.

The temperature falling below the dew point must therefore be avoided by means of suitably placed dew point sensors or the condensate occurring must be drained safely. The affected piping must be insulated tightly against this condensation risk.

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2.4 Systematics and overview

2.4.1 Systematics

For easy and clear categorisation of different Aquarea models, a key is used, from which the models with their respective specific properties and functions can be read.

Example

WH-MXC12D6E5 is a heat pump compact unit (M) of series T-CAP (X) with cooling mode (C), of nominal capacity 12 kW (12) of series D (D) for the European market (E) with a single phase voltage supply (5).

Systematics of hydromodule

WH	-	S	D	F	07	C	3	E	5

WH: air/water heat pump

S: Split unit

D: Aquarea LT,
X: Aquarea T-CAP[1], **H:** Aquarea HT[1]

F: Only heating, **C:** Heating and cooling[2]

Nominal heating capacity (**03:** 3 kW[1], **05:** 5 kW[1], **07:** 7 kW[1], **09:** 9 kW, **12:** 12 kW, **14:** 14 kW[1], **16:** 16 kW[1])

C, D, E: Series

Capacity of the additional electric heater (**3:** 3 kW, **6:** 6 kW, **9:** 9 kW)

Market (**E:** Europe)

Electricity supply (**5:** single phase, **8:** three phase)

[1] The units with 3, 5, 6, 7, 14 and 16 kW capacity are available only for the Aquarea LT series and not for the Aquarea T-CAP and Aquarea HT series

[2] The units of the Aquarea HT series can only be used for heating mode and do not have a cooling mode.

Systematics of outdoor unit

WH - U D 07 C E 5

- **WH:** Air/water heat pump
- **U:** Split unit
- **D:** Aquarea LT, **X:** Aquarea T-CAP[1], **H:** Aquarea HT[1]
- Nominal heating capacity (**03:** 3 kW[1], **05:** 5 kW[1], **07:** 7 kW[1], **09:** 9 kW, **12:** 12 kW, **14:** 14 kW[1], **16:** 16 kW[1])
- **C, D, E:** Series
- Market (**E:** Europe)
- Voltage supply (**5:** single phase, **8:** three phase)

Systematics of compact unit

WH - M D F 09 C 3 E 5

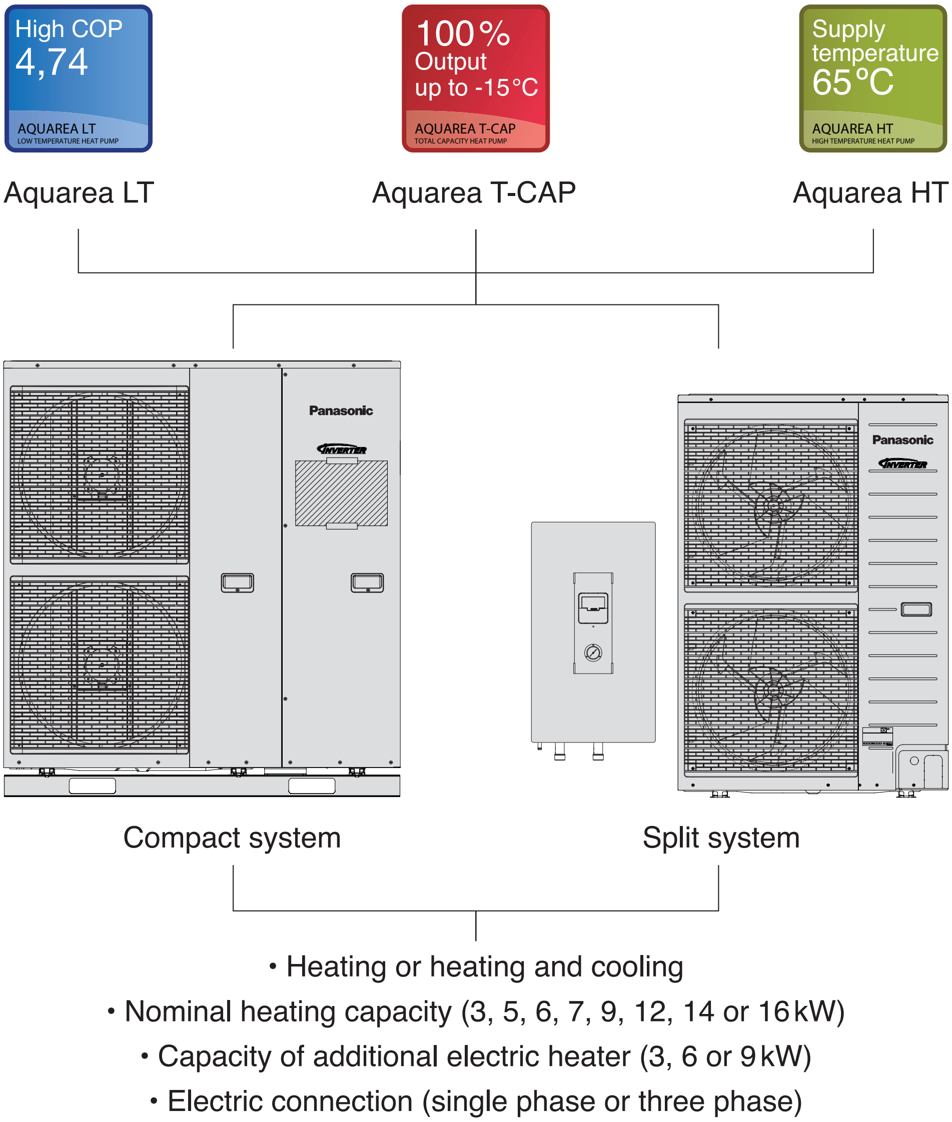
- **WH:** Air/water heat pump
- **M:** Compact unit
- **D:** Aquarea LT, **X:** Aquarea T-CAP[1], **H:** Aquarea HT[1]
- **F:** Only heating, **C:** Heating and cooling[2]
- Nominal heating capacity (**06:** 6 kW[1], **09:** 9 kW, **12:** 12 kW, **14:** 14 kW[1], **16:** 16 kW[1])
- **C, D, E:** Series
- Capacity of the additional electric heater (**3:** 3 kW, **6:** 6 kW, **9:** 9 kW)
- Market (**E:** Europe)
- Electricity supply (**5:** single phase, **8:** three phase)

[1] The units with 3, 5, 6, 7, 14 and 16 kW capacity are available only for the Aquarea LT series and not for the Aquarea T-CAP and Aquarea HT series

[2] The units of the Aquarea HT series can only be used for heating mode and do not have a cooling mode.

2.4.2 Overview

The Aquarea heat pump system has three different series which are again available in several model variants. In this manner, individual requirements for the heat supply of buildings with Aquarea heat pumps should be considered with each series' properties in mind:



Overview of series and model variants

The variety of properties and functions of the Aquarea heat pumps leads to a large number of different model variants, which often only differ from one another through small differences like the capacity of the additional electric heater. Externally viewed, the units are nearly similar apart from distinctive differences like the compact or split system and they can therefore be described together with regard to many properties. Relevant differences are pinpointed at an appropriate point.

The Aquarea heat pump models are configured so that a suitable model is available for all typical applications. All models are listed with their properties and functions in the table at the beginning of the Design Handbook.

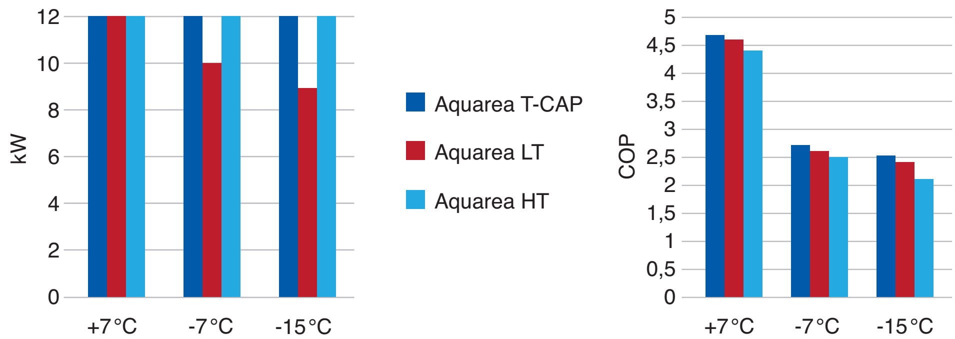
As the overview table shows, the available models differ externally in the first place between the compact and and split systems, whereby the Aquarea LT series is also available as mini-compact unit with 6 and 9 kW nominal capacity.

In contrast to the Aquarea T-CAP series, the outdoor unit of the split system of Aquarea LT and Aquarea HT series is equipped with only one fan.

Series

The Aquarea series differ through their maximum supply water temperature and capacity stability at very low outside temperatures as follows:

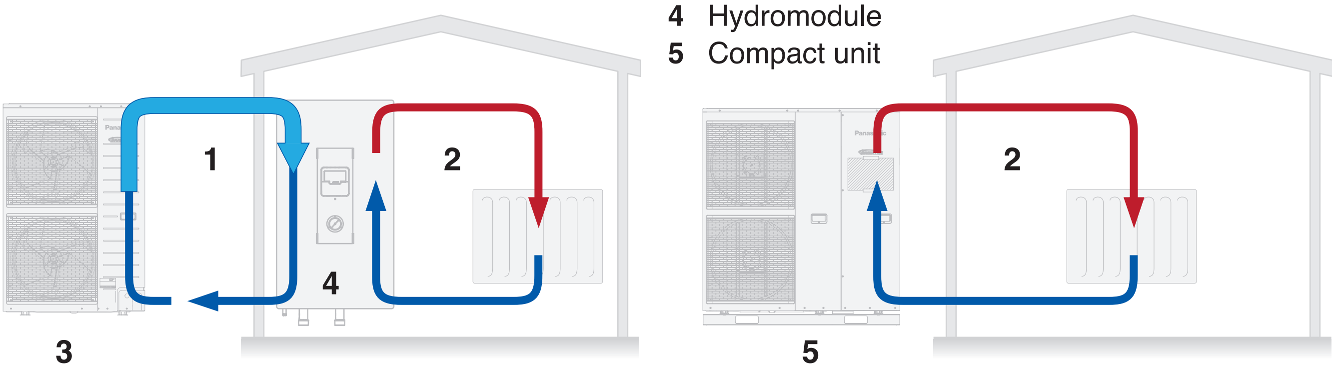
Aquarea LT	Maximum supply water temperature: Capacity at very low outside temperatures:	55 °C Heating capacity decreases
Aquarea T-CAP	Maximum supply water temperature: Capacity at very low outside temperatures:	55 °C Heating capacity is constant up to -15 °C at 35 °C supply water temperature
Aquarea HT	Maximum supply water temperature: Capacity at very low outside temperatures:	65 °C Heating capacity is constant up to -15 °C at 35 °C supply water temperature



Heating capacity and coefficient of performance (COP) of the Aquarea LT Aquarea T-CAP and Aquarea HT series with 12 kW at different outside temperatures and a supply water temperature of 35 °C and a return water temperature of 30 °C.

Split system and compact system

1 Refrigerant circuit
2 Heating circuit (water)
3 Outdoor unit
4 Hydromodule
5 Compact unit



Difference between split system (left) and compact system (right)

Split system

The split system consists of a freely installed outdoor unit and a hydromodule that is normally installed in the installation room or in a different frost-free room. In the case of this design, the two units are connected by means of refrigerant piping, in which there is no danger of freezing. The heat pump is controlled by means of the remote controller on the hydromodule.

Compact system

The compact system consists of only one unit that is installed outdoors. Refrigerant piping is not required for the installation, it is connected directly to the heating system. Compact systems are easy to install, but need more space. Moreover, the water within the heating system is in danger of freezing due to power failure or when the power supplier cuts off the supply.

The heat pump is operated via wired remote control that is mounted inside the building and is connected to the compact unit by means of a 15-metre long cable.

Attention

The compact system is in danger of freezing when the heating circuit is filled with water and the outside temperature decreases below 0 °C! This can lead to substantial damage to the unit.

Freedom from frost must be ensured within the heating system through one of the following options:

1. The heating circuit is operated with a foodgrade frost protection mixture (propylene glycol).
2. An auxiliary electric heater inside the compact unit prevents the heating circuit from freezing.
3. The heating circuit is emptied via an owner-provided device (manually or automatically).

3 Products, functions and technical data

3.1 Split system

Specific hydromodules and outdoor units are supplied together as a set, as each set is fine tuned to work together. Different hydromodules and outdoor units can not thus be combined arbitrarily. The Aquarea split system consists of the hydromodule (indoor) and an outdoor unit. For all typical applications a suitable Aquarea split system model consisting of hydro-module and outdoor unit is available.

3.1.1 Product features

Energy efficiency and environmental friendliness

- up to 78 % energy extraction from ambient air for a greater energy efficiency
- maximum COP of 4.74 for three phase 9 kW model for A7 / W35
- inverter technology allows controllable output of the unit and contributes to energy saving
- environmentally compatible refrigerant (R410A with Aquarea LT and T-CAP and R407C with Aquarea HT), does no damage to the ozone layer
- individual devices also available with a high efficiency pump

High level of comfort

- optimum control by means of room thermostats (room thermostats not supplied)
- models for heating mode as well as heating and cooling mode are available
- optimised capacity depending on the return water temperature
- integrated control of the hot water tank and heating system
- 24-hour timer with operating mode control

Easy operation

- operation and control on the hydromodule
- simple programming via the remote controller
- Aquarea hydromodule is equipped for safety reasons with:
  - 2 FI RCD circuit breakers for 3, 5, 7 and 9 kW units
  - 3 FI RCD circuit breakers for 12, 14 and 16 kW units

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Easy maintenance and assembly

- compact design
- easy control of the water pressure through a manometer in the front casing
- easy to open - hydromodule and outdoor unit
- flexible assembly due to long piping
- piping up to 30 metres with a height difference up to 20 metres (for models up to 9 kW)
- piping up to 40 metres with a height difference of up to 30 metres (for models with 12 to 16 kW)
- the piping connection to the outdoor units can occur in four directions (front, rear, side, bottom)

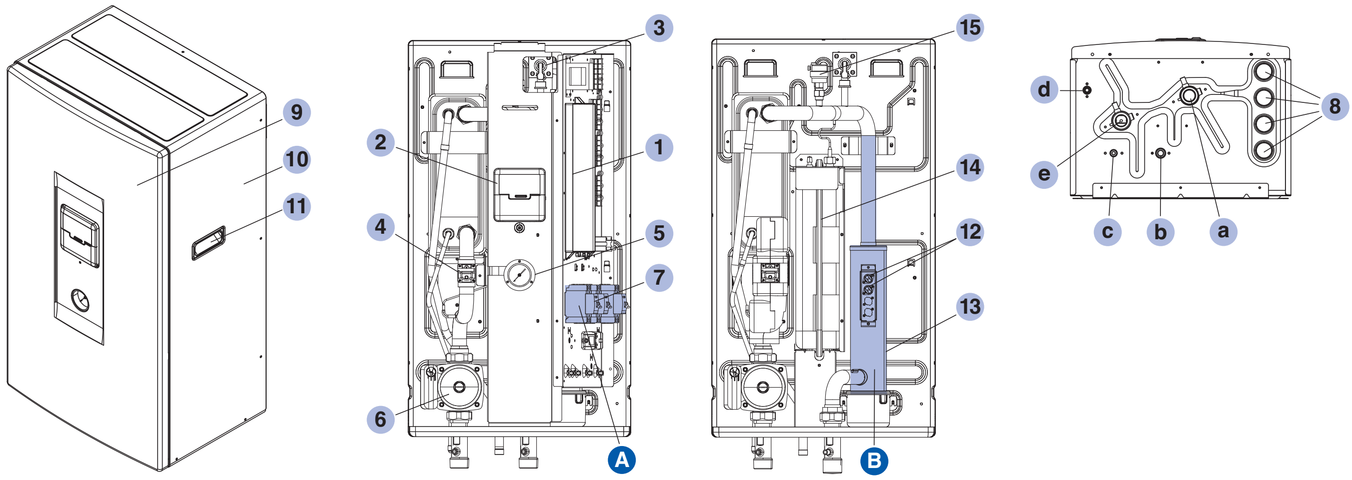
		Supply water temperature (°C)	Outside temperature (°C)
Cooling mode[1]	Maximum	20	43
	Minimum	5	16
Heating mode	Maximum	55/65[2]	35
	Minimum	20	-20[3]

[1] valid for models with cooling mode
[2] valid for Aquarea HT

[3] If the outside temperatures drop below the specified value, the heating capacity decreases significantly. This can lead to the shutdown of the unit due to internal safety functions.

Hydromodule

Components



Component name

1. Electronic printed circuit board
2. Remote controller
3. Safety valve
4. Flow rate cut-out
5. Manometer
6. 3-stage water circulation pump (Figure shows standard pump)
7. FI RCD circuit breakers (differs from one model to the other, see Detail **A**)
8. Cable passage
9. Chamber front plate
10. Chamber
11. Handle
12. Overload protection (differs from one model to the other, see Detail **B**)
13. Additional electric heater (3, 6 and/or 9 kW)
14. 10 l Expansion vessel
15. Deaeration

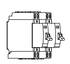
Connection name

a. Supply water Ø R 1¼
b. Gas side refrigerant connection (19.1 mm)
c. Liquid side refrigerant connection (6.4 to 9.5 mm)
d. Water drain
e. Supply water Ø R 1¼

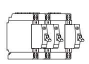
A Different FI RCD circuit breakers

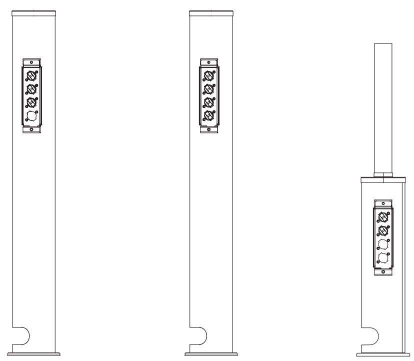
B Different electric heating and overload protection elements

single and three phase, 3 to 9 kW



single and three phase, 12 to 16 kW



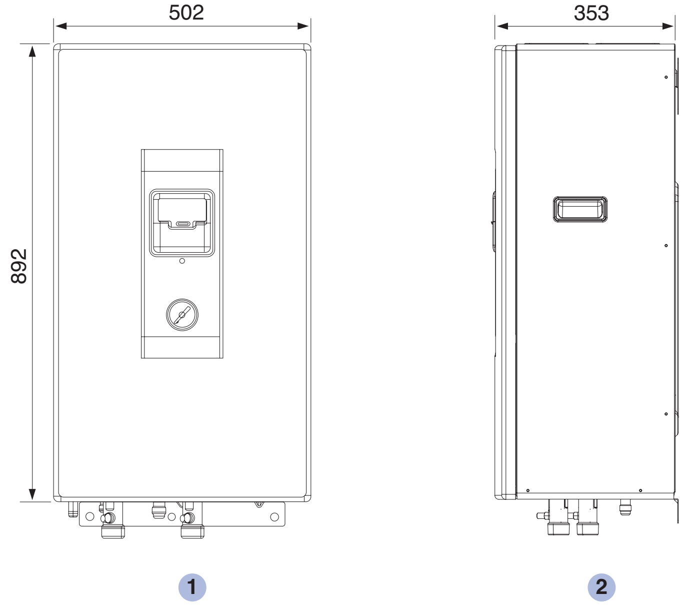


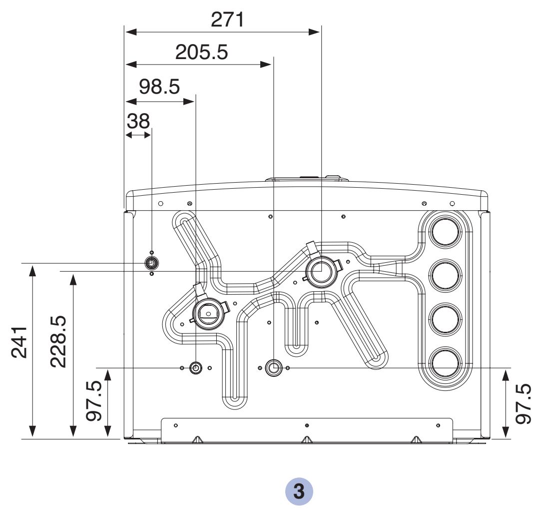
single phase, 7 to 9 kW | single phase, 12 to 16 kW | three phase, 12 to 16 kW and single phase 3 to 5 kW

Detail **A** (left) and **B** (right) of the components of hydromodule

Dimensional drawing for hydromodule

1. Front view
2. Side view
3. Bottom view



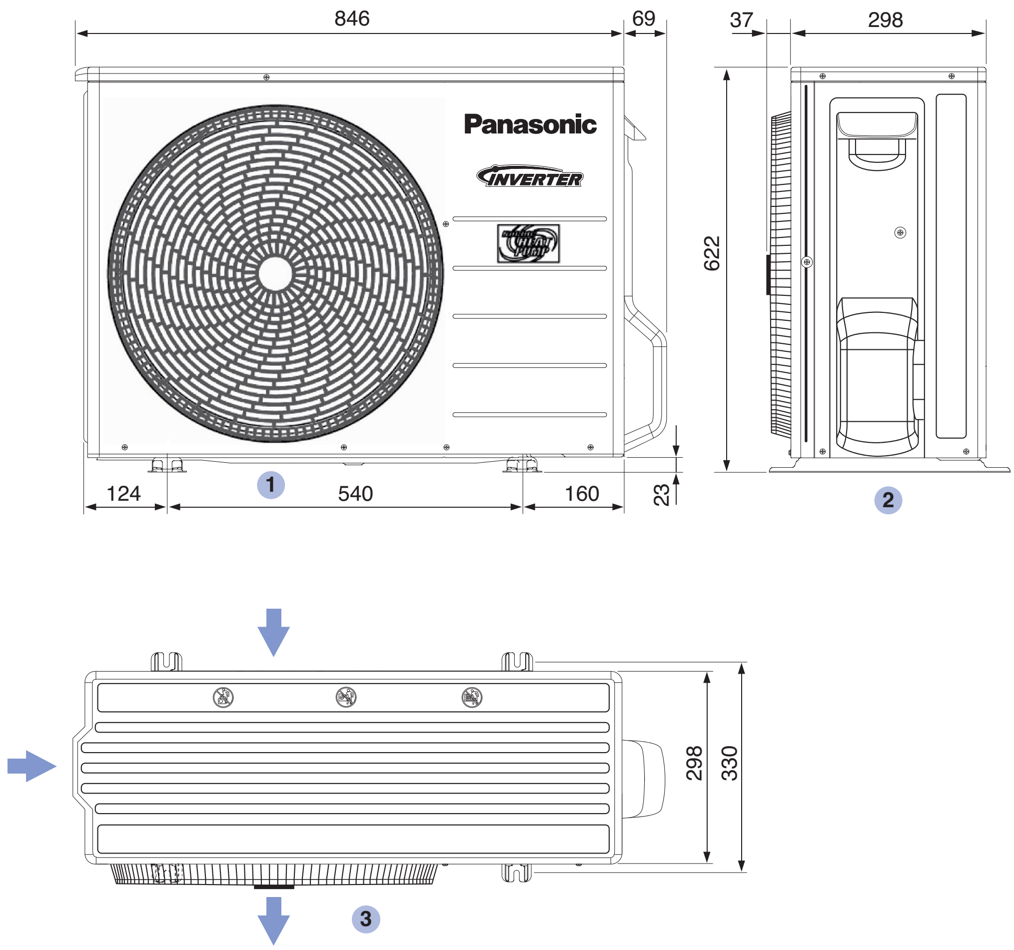


Dimensions of hydromodule in mm

Outdoor unit

Dimensional drawing for outdoor unit with one fan (3 and 5 kW)

1 Front view
2 Side view
3 Bottom view

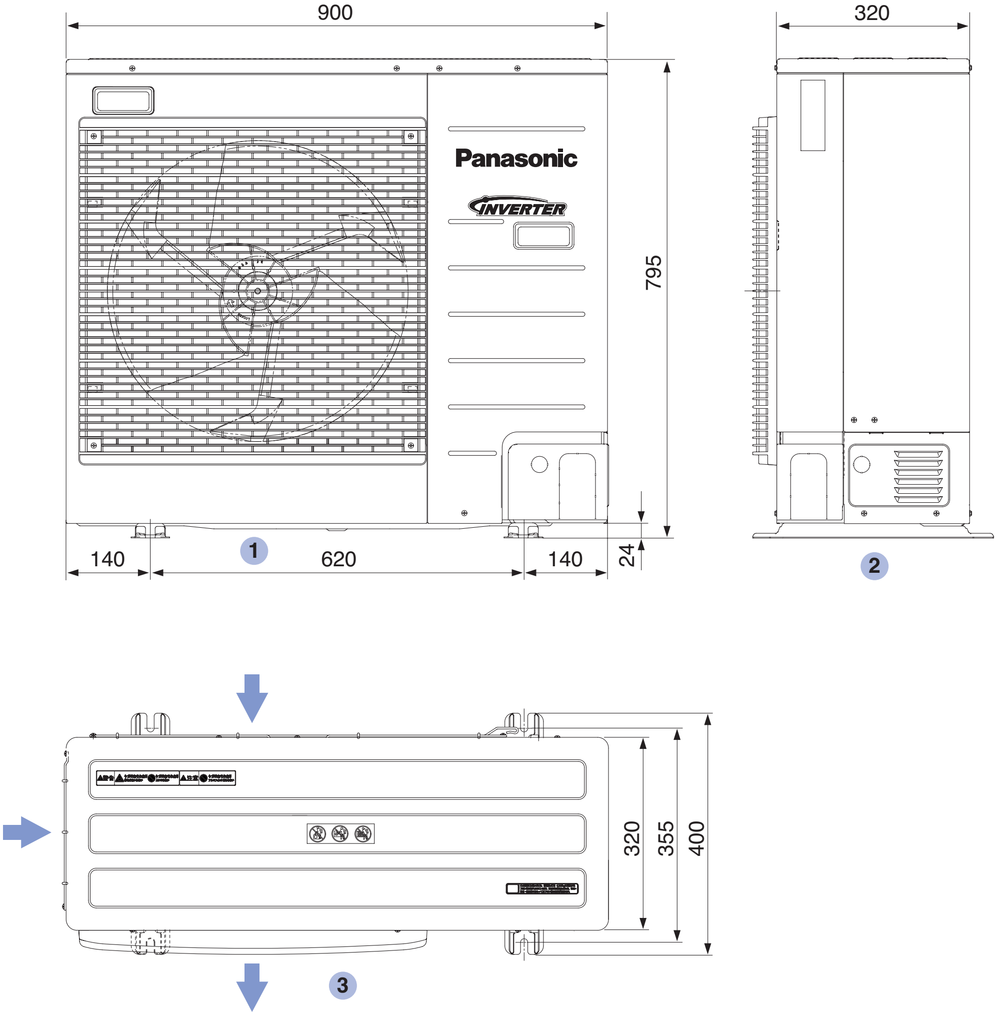


Dimensions of outdoor unit with one fan (3 and 5 kW) in mm.
The air flow is depicted by arrows.

Outdoor unit

Dimensional drawing for outdoor unit with one fan (7 and 9 kW)

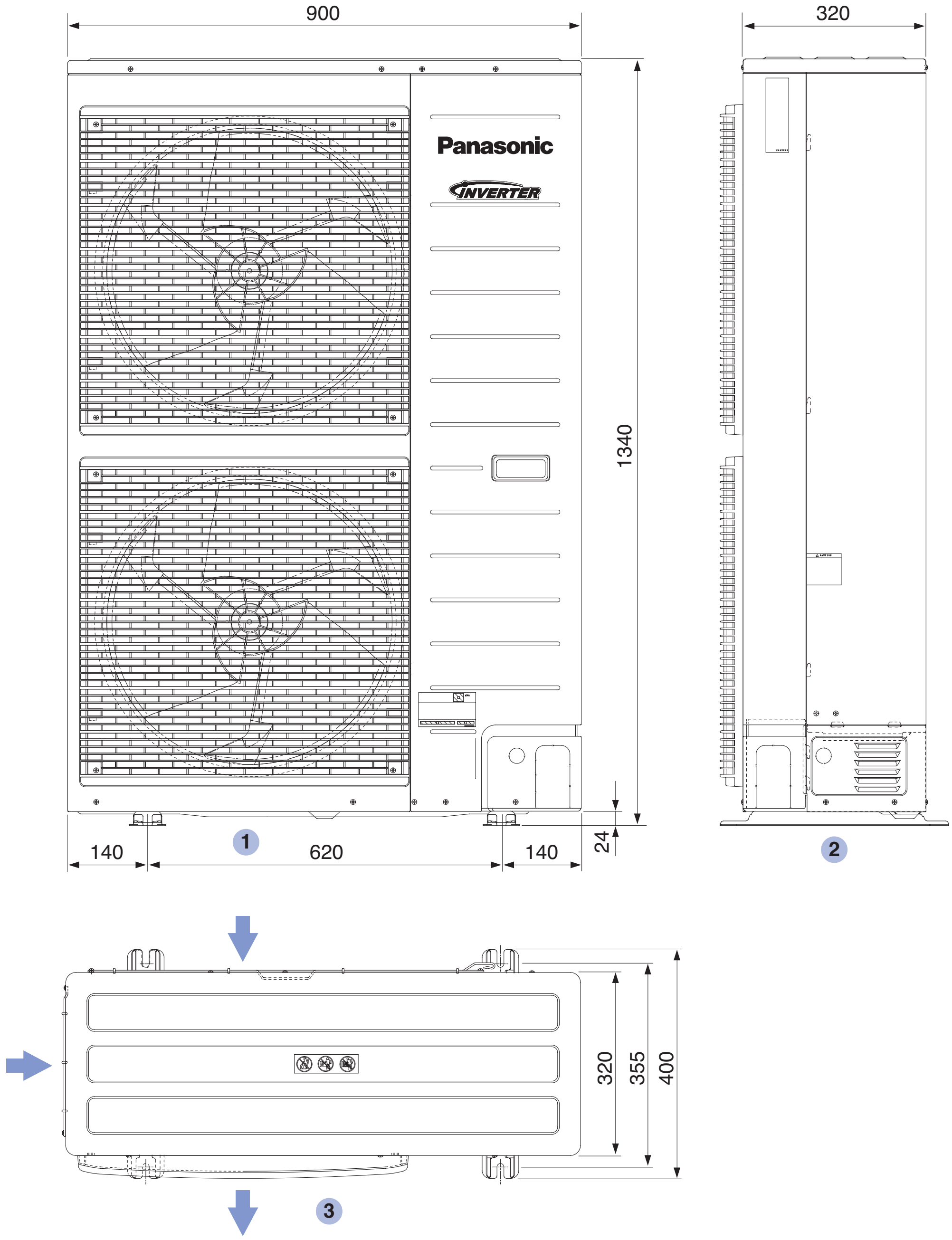
1. Front view
2. Side view
3. Top view



Dimensions of outdoor unit with one fan (7 and 9 kW) in mm.
The air flow is depicted by arrows.

Dimensional drawing for outdoor unit with two fans

1. Front view
2. Side view
3. Top view



Dimensions of outdoor unit with two fans in mm. The air flow is depicted by arrows.

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Split system		Series	Aquarea LT													
		Phases	single phase													
Hydromodule		Model	WH-SDF03E3E5*	WH-SDC03E3E5*	WH-SDF05E3E5*	WH-SDC05E3E5*	WH-SDF07C3E5	WH-SDC07C3E5	WH-SDF09C3E5	WH-SDC09C3E5	WH-SDF12C6E5	WH-SDC12C6E5	WH-SDF14C6E5	WH-SDC14C6E5	WH-SDF16C6E5	WH-SDC16C6E5
Output capacity	Heating capacity A-15/W35	kW	3.2		4.2		4.6		5.9		8.9		9.5		10.3	
	Power consumption A-15/W35	kW	1.39		1.94		2		2.68		3.66		4.05		4.42	
	Coefficient of performance A-15/W35	-	2.30		2.16		2.3		2.2		2.43		2.35		2.33	
	Heating capacity A-7/W35	kW	3.2		4.2		5.15		5.9		10		10.7		11.4	
	Power consumption A-7/W35	kW	1.19		1.62		1.94		2.36		3.7		4.08		4.47	
	Coefficient of performance A-7/W35	-	2.69		2.59		2.65		2.5		2.7		2.62		2.55	
	Heating capacity A2/W35	kW	3.2		4.52		6.64		7.07		11.97		12.72		13.38	
	Power consumption A2/W35	kW	0.9		1.35		1.98		2.03		3.35		3.67		3.97	
	Coefficient of performance A2/W35	-	3.56		3.35		3.35		3.48		3.57		3.47		3.37	
	Heating capacity A7/W35	kW	3.2		5		7		9		12		14		16	
	Power consumption A7/W35	kW	0.64		1.08		1.59		2.2		2.57		3.11		3.78	
	Coefficient of performance A7/W35	-	5.00		4.63		4.4		4.09		4.67		4.5		4.23	
	Heating capacity A2/W55	kW	3.2		4.1		6				9.1		9.5		9.8	
	Power consumption A2/W55	kW	1.49		2.07		3.16				4.18		4.4		4.55	
	Coefficient of performance A2/W55	-	2.15		1.98		1.90				2.18		2.16		2.15	
	Cooling capacity A35/W7	kW	-	3.2	-	4.5	-	6	-	7	-	10	-	11.5	-	12.2
	Power consumption A35/W7	kW	-	1.04	-	1.67	-	2.73	-	3.33	-	4.18	-	5.13	-	5.57
	Coefficient of performance (EER) A35/W7	-	-	3.08	-	2.69	-	2.2	-	2.1	-	2.39	-	2.24	-	2.19
Unit data	Dimensions (H×W×D)	mm	892×502×353													
	Weight	kg	43	44	43	44	43	45	43	45	49	51	49	51	49	51
	Water-side connection	inch AG	R 1 1/4													
	Pump – speed stepping		3													
	Pump – power consumption (max.)	W	25		29		100	75	100	75	190					
	Volumetric flow rate of heating circuit for A7/W35/30	l/min	9.2		14.3		20.1		25.8		34.4		40.1		45.9	
	Minimum circulation	l/min	5				10				19					
	Safety valve (open/closed)	bar	3/≤2.65				1.9/≤1.83									
Electric	Capacity of the additional electric heater	kW	3								6					
	Power consumption (heating/cooling)	kW	0.9/1.04		1.35/1.67		1.59/2.30		2.2/2.9		2.57/3.6		3.11/4.4		3.78/4.8	
	Operation and starting current (heating/cooling)	A	4.2/4.8		6.2/7.6		7.30/10.40		10.1/13.1		11.7/16.1		14.1/19.7		17.1/21.5	
	Maximum current rating	A	11		12		21		22.9		24		25		26	
	Power supply 1 (frequency/voltage)	Hz/V	50/230													
	Power supply 1 (connections)	mm²	3×4													
	Power supply 2 (frequency/voltage)	Hz/V	50/230													
	Power supply 2 (connections)	mm²	3×4													
	Power supply 3 (frequency/voltage)	Hz/V	-								50/230					
	Power supply 3 (connections) (min.)	mm²	-								3×1.5					

Panasonic measurement data in accordance with EN 14511-2. The data is to be considered as guidance values and not as a performance guarantee.
* Devices have a high efficiency pump and fulfil the criteria of the Ecodesign Directive valid from 2015 for energy-related products (ErP)

Aquarea LT								Aquarea T-CAP								Aquarea HT			
three phase								single phase				three phase				single phase		three phase[1]	
WH-SDF09C3E8	WH-SDC09C3E8	WH-SDF12C9E8	WH-SDC12C9E8	WH-SDF14C9E8	WH-SDC14C9E8	WH-SDF16C9E8	WH-SDC16C9E8	WH-SXF09D3E5	WH-SXC09D3E5	WH-SXF12D6E5	WH-SXC12D6E5	WH-SXF09D3E8*	WH-SXC09D3E8	WH-SXF12D9E8*	WH-SXC12D6E8	WH-SHF09D3E5	WH-SHF12D6E5	WH-SHF09D3E8	WH-SHF12D9E8
8.3		8.9		9.5		10.3		9		12		9		12		9	12	9	12
3.25		3.66		4.05		4.42		3.5		5		3.5		5		3.75	5.57	3.75	5.58
2.55		2.43		2.35		2.33		2.54		2.4		2.54		2.4		2.4	2.15	2.4	2.15
9		10		10.7		11.4		9		12		9		12		9	12	9	12
3.2		3.7		4.08		4.47		3.2		4.45		3.2		4.45		3.33	4.8	3.33	4.80
2.81		2.7		2.62		2.55		2.81		2.7		2.81		2.7		2.7	2.5	2.7	2.5
8.8		11.4		12.07		13.26		9.16		11.73		8.59		11.51		8.9	11.48	9	12
2.36		3.31		3.70		4.09		2.50		3.42		2.39		3.35		2.52	3.51	2.65	3.72
3.73		3.44		3.26		3.24		3.67		3.43		3.59		3.44		3.53	3.27	3.4	3.23
9		12		14		16		9		12		9		12		9	12	9	12
1.9		2.57		3.11		3.78		1.9		2.57		1.9		2.57		1.98	2.73	1.98	2.73
4.74		4.67		4.5		4.23		4.74		4.67		4.74		4.67		4.55	4.4	4.55	4.4
8.8		9.1		9.5		9.8		9		12		9		12		9	10.8	9	10.8
3.98		4.18		4.4		4.55		4.11		5.51		4.11		5.51		3.92	4.9	3.91	4.70
2.21		2.18		2.16		2.15		2.19		2.18		2.19		2.18		2.3	2.2	2.3	2.3
-	7	-	10	-	11.5	-	12.2	-	7	-	10	-	7	-	10	-	-	-	-
-	2.61	-	4.13	-	5.11	-	5.57	-	2.25	-	3.6	-	2.25	-	3.6	-	-	-	-
-	2.68	-	2.42	-	2.25	-	2.19	-	3.11	-	2.78	-	3.11	-	2.78	-	-	-	-
892 × 502 × 353																			
50	51	51	52	51	52	51	52	47	48	49	51	50	51	51	52	50	52	50	52
R 1 1/4																			
3																			
190								190	180	190	180	190	180	190	180	180		180	
25.8		34.4		40.1		45.9		25.8		34.4		25.8		34.4		25.8	34.4	25.8	34.4
10		19						10		19		10		19		10	19	10	19
1.9/≤1.83																3.0/≤2.65		3.0/≤2.65	
3		9						3		6		3		6		3	6	3	9
1.9/2.25		2.57/3.55		3.11/4.4		3.78/4.8		1.9		2.57		1.9		2.57		1.98	2.73	1.98	2.73
2.9/3.4		3.9/5.3		4.7/6.6		5.7/7.2		8.8	10.4	11.9	16.7	2.9	3.5	3.9	5.6	9.5	13	n. v.	n. v.
7.5		8.8		9.4		9.9		25		29		10.4		11.9		28.5	29	n. v.	n. v.
50/400								50/230				50/400				50/230		50/400	
5×1.5								3×4				5×1.5				3×4		5×1.5	
50/230								50/230				50/230				50/230		50/230	
3×1.5								3×4				3×1.5				3×4		3×1.5	
-		50/400						-		50/230		-		50/400		-	50/230	-	50/400
-		5×1.5						-		3×1.5		-		5×1.5		-	3×1.5	-	5×1.5

[1] Preliminary data

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Split system	Series	Aquarea LT							
	Phases	single phase							
Outdoor unit	Model	WH-UD03EE5	WH-UD05EE5	WH-UD07CE5-A	WH-UD09CE5-A	WH-UD12CE5-A	WH-UD14CE5-A	WH-UD16CE5-A	
Acoustics	Sound pressure level[1]	dB(A)	47	48	48	49	50	51	53
	Sound power level	dB(A)	65	66	66	67	67	68	70
	Fan speed, top (heating/cooling)	1/min	800/950	860/980	580/670	640/700	510/600	540/630	580/630
	Fan speed, bottom (heating/cooling)	1/min	-	-	-	-	550/640	580/670	620/670
	Air flow rate (heating/cooling)	m^3/min	31.9/38.1	34.4/39.3	46/56.3	51/56.3	80/93.3	84/97.8	90/97.8
Unit data	Dimensions (H×W×D)	mm	622×824×298		795×900×320		1340×900×320		
	Weight	kg	39		66		106		
	Pipe diameter (liquid)	mm (inch)	6.35 (1/4")				9.52 (3/8")		
	Pipe diameter (gas)	mm (inch)	12.70 (1/2")		15.88 (5/8")				
	Refrigerant	kg	1.2 (R410A)		1.45 (R410A)		2.75 (R410A)		
	Pipe length	m	3 up to 15		3 up to 30		3 up to 40		
	Nominal pipe length	m	7						
	Pre-filled pipe length	m	10				30		
	Additional refrigerant filling	g/m	20		30		50		
	Max. height difference IG/AG	m	5		20		30		
Temperature ranges	Operating range (outside temperature)	°C	-20 up to 35						
	Operating range (supply water temp. (H/C)	°C	25 to 55 / 5 to 20						

[1]Measured value in 1 m distance and in 1.5 m height; [2]Preliminary data

Technical data of the split system units

	Aquarea LT				Aquarea T-CAP				Aquarea HT			
	three phase				single phase		three phase		single phase		three phase [2]	
	WH-UD09CE8	WH-UD12CE8	WH-UD14CE8	WH-UD16CE8	WH-UX09DE5	WH-UX12DE5	WH-UX09DE8	WH-UX12DE8	WH-UH09DE5	WH-UH12DE5	WH-UH09DE8	WH-UH12DE8
	49	50	51	53	49	50	49	50	49	50	49	50
	65	67	68	70	66	67	66	67	66	67	66	67
	490/550	510/600	540/630	580/630	490/550	520/600	490/550	520/600	490	520	490	520
	530/590	550/640	580/670	620/670	530/590	560/640	530/590	560/640	530	560	530	560
	76,8/89,5	80/93.3	84/97.8	90/97.8	76.8/89.5	80/93.3	76.8/89.5	80/93.3	76.8	80	76.8	80
	1340 × 900 × 320											
	109				107		109 110	109 110	105		105	
	9.52 (3/8")								9.52 (30/8")		9.52 (30/8")	
	15.88 (5/8”)								15.88 (5/8")		15.88 (5/8")	
	2.75 (R410A)			2.95 (R410A)	3.1 (R410A)				2.99 (R407C)		2.99 (R407C)	
	3 up to 40				3 up to 30				3 up to 30		3 up to 30	
	7								7		7	
	30				15				15		15	
	50				50				70		70	
	30				20				20		20	
	-20 up to 35								-20 up to 35		-20 up to 35	
	25 to 55 / 5 to 20								25 to 65		25 to 65	

3.2 Compact system

The compact system consists of one unit that is installed outdoors and can be connected directly to the heating circuit. Control is by means of a wired remote controller inside the building.

Attention

the compact system is in danger of freezing when the heating circuit is filled with water and the outside temperature decreases below 0 °C! This can lead to substantial damage to the unit.

Freedom from frost must be ensured within the heating system through one of the following options:

1. The heating circuit is operated with a foodgrade frost protection mixture (propylene glycol).
2. An auxiliary electric heater inside the compact unit prevents the heating circuit from freezing.
3. The heating circuit is emptied via an owner-provided device (manually or automatically).

Energy efficiency and environmental friendliness

- up to 78 % energy extraction from ambient air for a greater energy efficiency
- maximum COP of 4.74 for three phase 9 kW model for A7 / W35
- inverter technology allows controllable output of the unit and contributes to energy saving
- environmentally compatible refrigerant (R410A with Aquarea LT and T-CAP and R407C with Aquarea HT), does no damage to the ozone layer
- individual devices also available with a high efficiency pump

High level of comfort

- optimum control by means of room thermostats (room thermostats not supplied)
- models for heating mode as well as heating and cooling mode are available (Aquarea HT series is only available for heating mode)
- optimised capacity depending on the return water temperature
- integrated control of the hot water tank and heating system
- 24-hour timer with operating mode control

Easy operation

- control is by means of a wired remote controller inside the building (15 m cable)
- simple programming via the remote controller
- Aquarea compact unit is equipped for safety reasons with FI-circuit breakers:
  - 2 FI RCD circuit breakers for 6 and 9 kW units
  - 3 FI RCD circuit breakers for 12, 14 and 16 kW units

Easy maintenance and assembly

- compact system, no special space requirement inside the building, no refrigerant connections
- easy opening of the unit for maintenance work

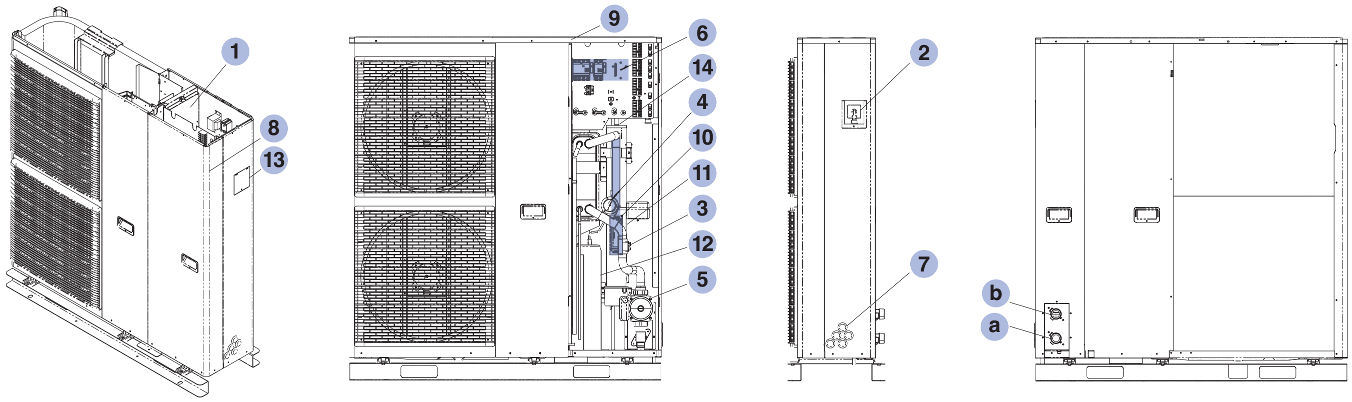
		Supply water temperature (°C)	Outside temperature (°C)
Cooling mode[1]	Maximum	20	43
	Minimum	5	16
Heating mode	Maximum	55/65[2]	35
	Minimum	20	-20[3]

[1] valid for models with cooling mode [2] valid for Aquarea HT

[3] If the outside temperatures drop below the specified value, the heating capacity decreases significantly. This can lead to the shutdown of the unit due to internal safety functions.

3.2.1 Compact unit

Components



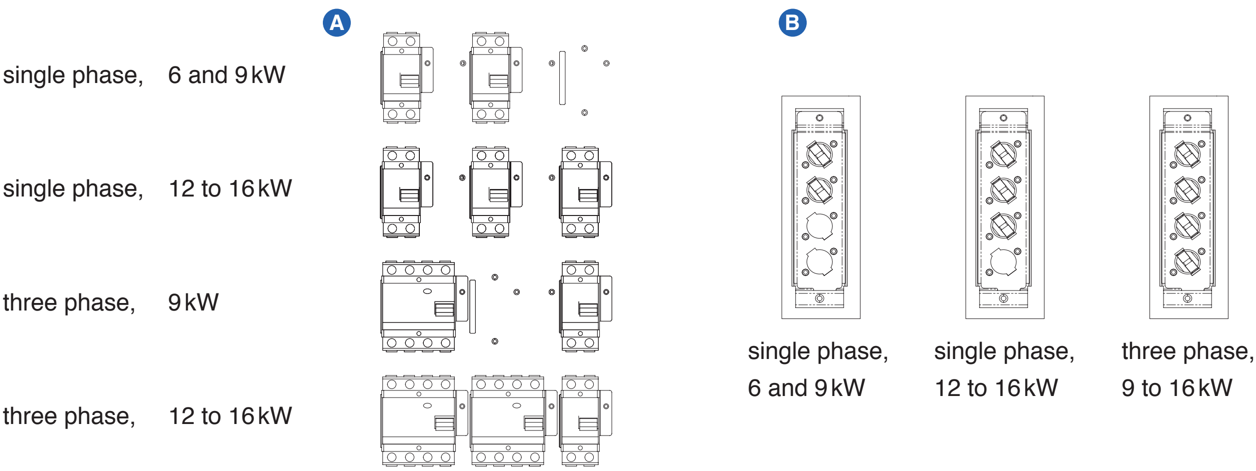
Component name

1 Electronic printed circuit board (view without top cabinet plate)
2 Safety valve (view without cover)
3 Flow rate cut-out
4 Manometer
5 3-stage water circulation pump (Figure shows standard pump)
6 FI RCD breakers (differs from one model to the other, see Detail **A**)
7 Cable passage
8 Front plate
9 Top cabinet plate
10 Overload protection (differs from one model to the other, see Detail **B**)
11 Additional electric heater (3, 6 and / or 9 kW)
12 Expansion vessel
13 Cover
14 Deaeration

Connection name

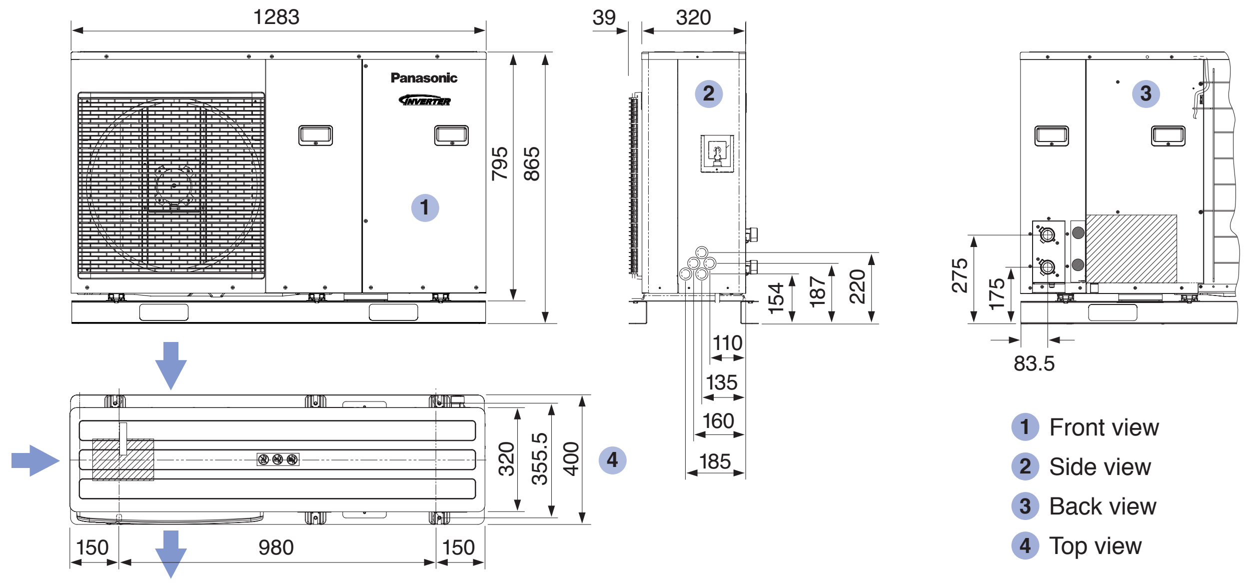
a Return water pipe Ø R 1¼
b Supply water pipe Ø R 1¼

Components of the compact unit with two fans



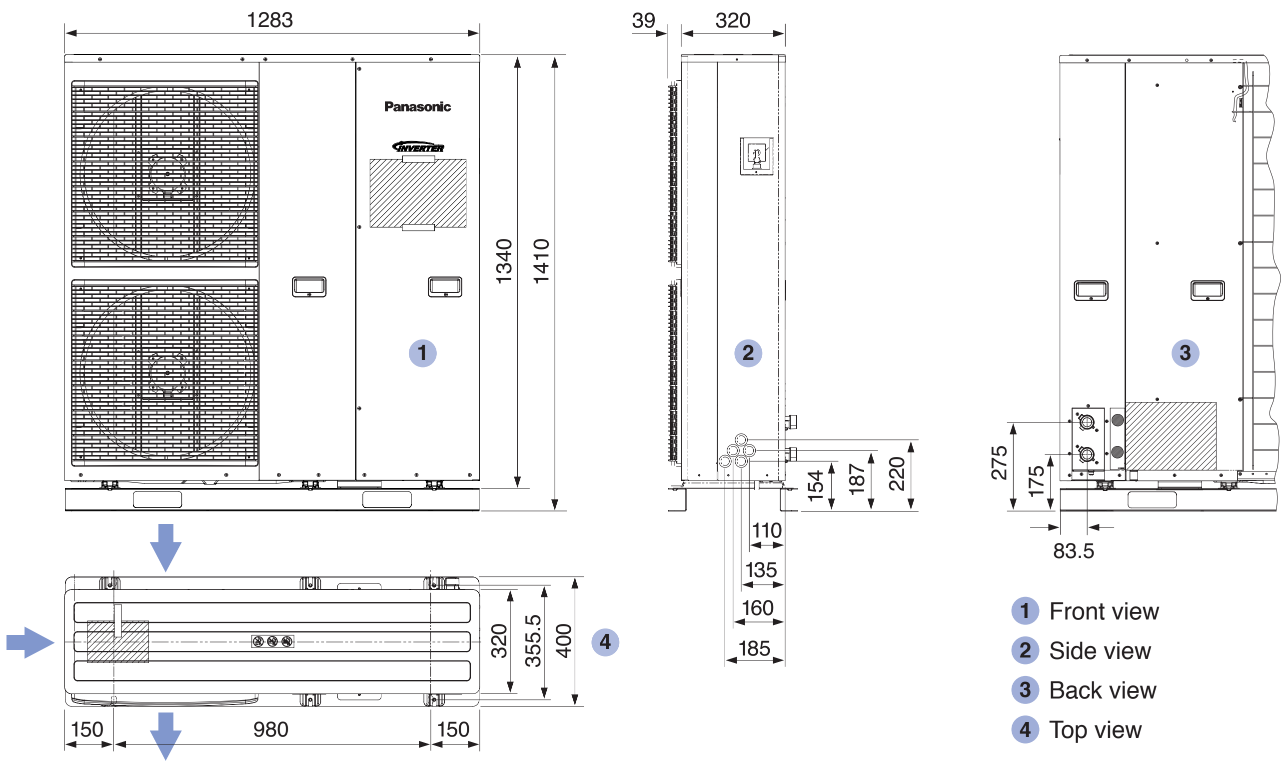
Detail **A** (left) and **B** (right) of the components of the compact unit with two fans

Dimensional drawing for mini compact unit with 6 to 9 kW nominal capacity



Dimensions of compact unit with one fan in mm. The air flow is depicted by arrows.

Dimensional drawing for compact unit with 9 to 16 kW nominal capacity



Dimensions of compact unit with two fans in mm. The air flow is depicted by arrows.

Panasonic ideas for life

Compact system		Series	Aquarea LT									
		Phases	single phase									
Compact unit		Model	WH-MDF06E3E5*	WH-MDF09E3E5*	WH-MDF09C3E5	WH-MDC09C3E5	WH-MDF12C6E5	WH-MDC12C6E5	WH-MDF14C6E5	WH-MDC14C6E5	WH-MDF16C6E5	WH-MDC16C6E5
Output capacity	Heating capacity A-15/W35	kW	5.9	7.6	8.3		8.9		9.5		10.3	
	Power consumption A-15/W35	kW	2.68	3.80	3.25		3.66		4.05		4.42	
	Coefficient of performance A-15/W35	-	2.2	2	2.55		2.43		2.35		2.33	
	Heating capacity A-7/W35	kW	5.15	7.7	9		10		10.7		11.4	
	Power consumption A-7/W35	kW	1.94	3.67	3.20		3.70		4.00		4.47	
	Coefficient of performance A-7/W35	-	2.65	2.1	2.81		2.7		2.62		2.55	
	Heating capacity A2/W35	kW	5,23	7,51	8,85		11,88		12,66		12,83	
	Power consumption A2/W35	kW	1,48	2,38	2,47		3,45		3,90		3,96	
	Coefficient of performance A2/W35	-	3,54	3,15	3,58		3,44		3,25		3,24	
	Heating capacity A7/W35	kW	6	9	9		12		14		16	
	Power consumption A7/W35	kW	1.36	2.20	1.90		2.57		3.11		3.78	
	Coefficient of performance A7/W35	-	4.41	4.1	4.74		4.67		4.5		4.23	
	Heating capacity A2/W55	kW	5.0	7.0	8.8		9.1		9.5		9.8	
	Power consumption A2/W55	kW	2.50	3.88	3.98		4.18		4.40		4.55	
	Coefficient of performance A2/W55	-	2.0	1.8	2.21		2.18		2.16		2.15	
	Cooling capacity A35/W7	kW	-		-	7	-	10	-	11.5	-	12.2
	Power consumption A35/W7	kW	-		-	2.61	-	4.18	-	5.11	-	5.57
	Coefficient of performance (EER) A35/W7	-	-		-	2.68	-	2.39	-	2.25	-	2.19
Acoustics	Sound pressure level [1]	dB(A)	47	49	49		50		51		53	
	Sound power level	dB(A)	65	67	66		67		68		70	
	Fan speed, top (heating/cooling)	1/min	580	640	490/540		510/600		540/630		580/630	
	Fan speed, bottom (heating/cooling)	1/min			530/580		550/640		580/670		620/670	
	Air flow rate (heating/cooling)	m³/min	46,7	51,6	76.8/89.5		80/93.3		84/97.8		90/97.8	
Unit data	Dimensions (H×W×D)	mm	865×1283×320		1410×1283×320							
	Weight	kg	112		153							
	Water-side connection	inch AG	R 1 1/4									
	Pump – speed stepping		3									
	Pump – power consumption (max.)	W	75		190							
	Volumetric flow rate of heating circuit for A7/W35/30	l/min	17.2	25.8	25.8		34.4		40.1		45.9	
	Minimum circulation	l/min	10				19					
	Safety valve (open/closed)	bar	3/≤1,86		1.9/≤1.83							
Electric	Capacity of the additional electric heater	kW	3				6					
	Power consumption (heating/cooling)	kW	1.36	2.2	1.9/2.25		2.57/3.6		3.11/4.4		3.78/4.8	
	Operation and starting current (heating/cooling)	A	6.2	10.1	8.7/10.2		11.6/16.1		14.1/19.7		17.1/21.5	
	Maximum current rating	A	20.5	22.9	22.9		24		25		26	
	Power supply 1 (frequency/voltage)	Hz/V	50/230									
	Power supply 1 (connections)	mm²	3×4									
	Power supply 2 (frequency/voltage)	Hz/V	50/230									
	Power supply 2 (connections)	mm²	3×4									
	Power supply 3 (frequency/voltage)	Hz/V	-		-		50/230					
	Power supply 3 (connections) (min.)	mm²	-		-		3×1.5					
Temp.-ranges	Operating range (outside temperature)	°C	-20 up to 35									
	Operating range (supply water temp. (H/C)	°C	22 to 55/5 to 20									

[1] Measured value in 1 m distance and in 1.5 m height; [2] Preliminary data Panasonic measurement data in accordance with EN 14511-2.
* Devices have a high efficiency pump and fulfil the criteria of the Ecodesign Directive valid from 2015 for energy-related products (ErP)

Technical data of the compact units

Aquarea LT								Aquarea T-CAP								Aquarea HT			
three phase								single phase				three phase				single phase		three phase[2]	
WH-MDF09C3E8	WH-MDC09C3E8	WH-MDF12C9E8	WH-MDC12C9E8	WH-MDF14C9E8	WH-MDC14C9E8	WH-MDF16C9E8	WH-MDC16C9E8	WH-MXF09D3E5	WH-MXC09D3E5	WH-MXF12D6E5	WH-MXC12D6E5	WH-MXF09D3E8	WH-MXC09D3E8	WH-MXF12D9E8	WH-MXC12D9E8	WH-MHF09D3E5	WH-MHF12D6E5	WH-MHF09D3E8	WH-MHF12D9E8
8.3		8.9		9.5		10.3		9		12		9		12		9	12	9	12
3.25		3.66		4.04		4.42		3.54		5.00		3.54		5.00		3,75	5,57	3,75	5,58
2.55		2.43		2.35		2.33		2.54		2.4		2.54		2.4		2,4	2,15	2,4	2,15
9		10		10.7		11.4		9		12		9		12		9	12	9	12
3.20		3.70		4.08		4.47		3.20		4.44		3.20		4.44		3,33	4,8	3,33	4,80
2.81		2.7		2.62		2.55		2.81		2.7		2.81		2.7		2,7	2,5	2,7	2,5
9,01		11,92		12,68		12,65		9,22		11,76		9		12		9	12	9	12
2,40		3,33		3,65		3,78		2,52		3,54		2,55		3,53		2,65	3,61	2,65	3,61
3,75		3,58		3,47		3,35		3,66		3,32		3,53		3,4		3,4	3,32	3,4	3,32
9		12		14		16		9		12		9		12		9	12	9	12
1.90		2.57		3.11		3.78		1.90		2.57		1.90		2.57		1,98	2,73	1,98	2,73
4.74		4.67		4.5		4.23		4.74		4.67		4.74		4.67		4,55	4,4	4,55	4,4
8.8		9.1		9.5		9.8		9		12		9		12		9	10,8	9	10,8
3.98		4.18		4.40		4.55		4.11		5.51		4.11		5.51		3,92	4,9	3,91	4,91
2.21		2.18		2.16		2.15		2.19		2.18		2.19		2.18		2,3	2,2	2,3	2,2
-	7	-	10	-	11.5	-	12.2	-	7	-	10	-	7	-	10	-	-	-	-
-	2.61	-	4.18	-	5.11	-	5.57	-	2.25	-	3.6	-	2.25	-	3.6	-	-	-	-
-	2.68	-	2.39	-	2.25	-	2.19	-	3.11	-	2.78	-	3.11	-	2.78	-	-	-	-
49		50		51		53		49		50		49		50		49	50	49	50
66		67		68		70		66		67		66		67		66	67	66	67
490/540		510/600		540/630		580/630		490/540		510/600		490/540		510/600		490	520	490	520
530/580		550/640		580/670		620/670		530/580		550/640		530/580		550/640		530	560	530	560
76.8/89.5		80/93.3		84/97.8		90/97.8		76.8/89.5		80/93.3		76.8/89.5		80/93.3		76,8	80	76,8	80
1410 × 1283 × 320																			
157								155				158				n. v.		n. v.	
R 1 1/4																			
3																			
190																			
25.8		34.4		40.1		45.9		25.8		34.4		25.8		34.4		25,8	34,4	25,8	34,4
10		19						10		19		10		19		10	19	10	19
1.9/≤1.83																3,0/≤2,65		25,8	
3		9						3		6		3		9		3	6	3	6
1.9/2.25		2.57/3.6		3.11/4.4		3.78/4.8		1.9		2.57		1.9		2.57		1,98	2,73	1,98	2,73
2.9/3.4		3.9/5.3		4.7/6.6		5.7/7.2		8.8	10.4	11.9	16.7	2.9		3.9		9,5	13	n. v.	n. v.
7.5		8.8		9.4		9.9		25		29		10.4		11.9		28,5	29	n. v.	n. v.
50/400								50/230				50/400				50/230		50/400	
5 × 1.5								3 × 4				5 × 1.5				3 × 4		5 × 1,5	
50/230								50/230				50/230				50/230		50/230	
3 × 1.5								3 × 4				3 × 1.5				3 × 4		3 × 1,5	
-		50/400						-		50/230		-		50/400		-	50/230	-	50/400
-		5 × 1.5						-		3 × 1.5		-		5 × 1.5		-	3 × 1,5	-	5 × 1,5
-20 up to 35																-20 up to 35		-20 up to 35	
22 to 55/5 to 20																25 to 65		25 to 65	

The datas are to be considered as guidance values and not as a performance guarantee.

3.3 Accessories

3.3.1 Hot water tank

The hot water tank is used for the storage of hot water before use. In addition to the heat from the Aquarea heat pump, it is also possible to utilise solar heat from a connected solar thermal installation. Furthermore, an electric immersion heater with a capacity of 3 kW ensures hot water supply at very low outside temperatures and can also be used for Legionella control.

Panasonic offers a total of three different tank models in different sizes (200 to 500 l) for easy water heating for different requirements:

Hot water tank WH-TD20E3E5 and WH-TD30E3E5

Compact tank made of stainless steel and thus long service life. Electric immersion heater in the top or middle section. For more information, see table.

Hot water tank HR

High-performance hot water tank (enamelled) with generously dimensioned heat exchanger surfaces to increase the transfer efficiency for ideal combination with Aquarea heat pumps. Use of an electric immersion heater as a flange heater in the bottom tank section. Other properties (see table):

- Operating temperature: Max. 95 °C
- Energy-saving 50 mm PU thermal insulation.
- Connection for circulation pipe
- Variable sensor position (sensor channel)
- high-quality dial thermometer

Hot water tank HRS

High-performance hot water tank (enamelled) with extremely large heat exchanger surfaces and a very high transfer efficiency for ideal combination with Aquarea heat pumps in situations with a high demand for hot water. Use of an electric immersion heater in the top tank section or a flange heater in the bottom tank section. Other properties (see table):

- Operating temperature: Max. 95 °C
- Energy-saving 50 mm PU thermal insulation.
- Connection for circulation pipe
- Variable sensor position (sensor channel)
- high-quality dial thermometer

For easy installation and integration of all three tank models into the heat pump system, the following components are included:

- Pressure relief valve, included separately
- 3-way directional valve, included separately
- Tank temperature sensor
- Galvanic anode
- thermostatic overload protection
- 3 machine mounts

Note

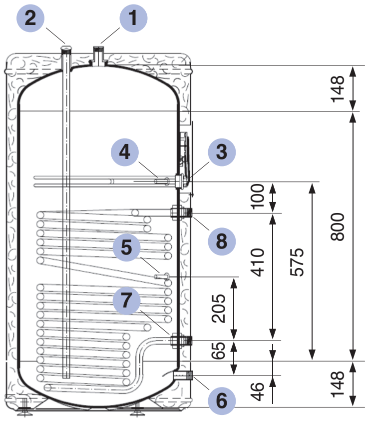
The hot water circulation pipe can only be integrated into the hot water tank with the tank models HR and HRS.

If a hot water circulation pipe is to be installed, the tank models WH-TD20E3E5 and WH-TD30E3E5 are not suitable.

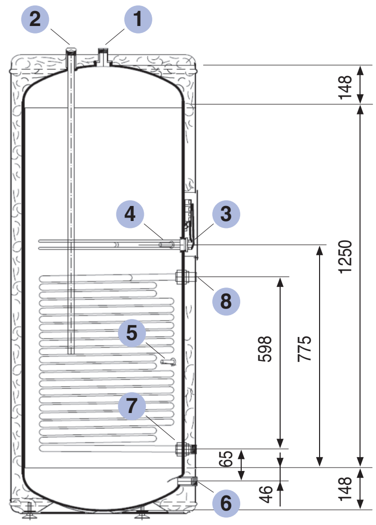
Hot water tank			WH-TD 20E3E5	WH-TD 30E3E5	HR 200	HR 300	HRS 300	HRS 500
Storage volume		l	200	300	200	300	300	500
Max. water temperature		°C	85	85	95	95	95	95
Dimensions including insulation	**Height**	mm	1230	1700	1340	1797	1435	1806
	Diameter	mm	580	580	600	600	680	760
	Overall height	mm	n. v.	n. v.	1440	1870	1595	1970
Weight		kg	42	54	108	140	170	254
Electric immer-sion heater	**Output capacity**	kW	3	3	3	3	3	3
	Position		top	middle	bottom[1]	bottom[1]	top	top
	Electrical supply		single phase					
Material in the interior of tank			stainless steel		enamelled according to DIN 4753			
Heat exchanger	**Surface area**	m²	1.4	1.8	1.8	2.6	3.5	6.0
	Capacity	l	n. v.	n. v.	11.8	17.0	22.6	39.6
Thermal insulation		mm	40	40	50	50	50	50
Energy loss at 65 °C (according to EN 12897)		kWh/24h	1.7	2.0	1.8	2.2	2.2	2.7
[1]Flange heater								

Technical data of hot water tank

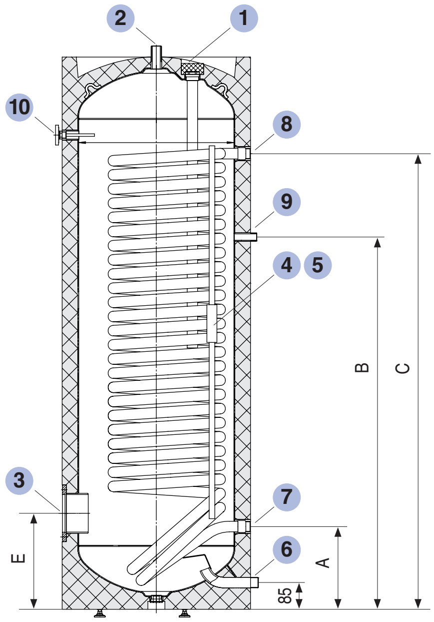
Dimensional drawings for hot water tank



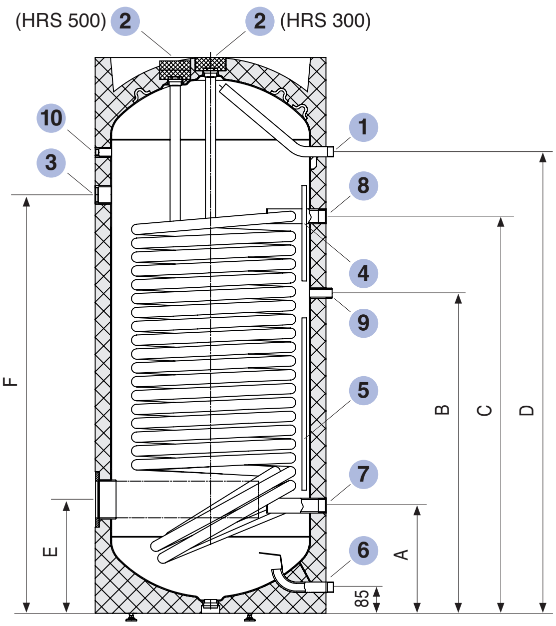
WH-TD20E3E5 – 200 l



WH-TD30E3E5 – 300 l



HR 200, 300



HRS 300, 500

	Tank connections	WH-TD 20E3E5	WH-TD 30E3E5	HR 200	HR 300	HRS 300	HRS 500
1	Hot water outlet	G 3/4“	G 3/4“	G 1“	G 1“	G 1“	G 1“
2	Galvanic anode	n. a.	n. v.	G 5/4“	G 5/4“	n. a	n. a.
3	Electric immersion heater	n. a.	n. v.	Flange ø 180 mm		G 6/4“	G 6/4“
4	Hot water sensor position	G 1/2“	G 1/2“	variable (sensor channel)			
5	Solar sensor	G 1/2“	G 1/2“	variable (sensor channel)			
6	Cold water connection	G 3/4“	G 3/4“	G 1“	G 1“	G 1“	G 1“
7	Return flow heat pump	G 3/4“	G 3/4“	G 1“	G 1“	G 1“	G 1“
8	Supply water heat pump	G 3/4“	G 3/4“	G 1“	G 1“	G 1“	G 1“
9	Circulation	-	-	G 3/4“	G 3/4“	G 3/4“	G 1“
10	Thermometer	-	-	G 1/2“	G 1/2“	G 1/2“	G 1/2“

Connections of the hot water tank

	HR 200	HR 300	HRS 300	HRS 500
A	263	263	320	320
B	803	983	840	1040
C	998	1313	990	1290
D	-	-	1160	1500
E	305	305	345	370
F	-	-	1050	1360

Dimensions of the hot water tanks HR and HRS

3.3.2 Extras

Panasonic offers special accessories for easy combination of Aquarea heat pumps with tanks or solar thermal systems already existing in the building. Likewise an auxiliary heater unit is available, which prevents the formation of ice on either the outdoor or compact units, which blocks air movement.

Model	Description	Function
CZ-NE1P	Additional casing heater for the series Aquarea T-CAP and Aquarea HT as well as mini compact unit of the series Aquarea LT.	Heating band attached on the floor plate inside the unit's casing (outdoor unit or compact unit) to prevent the water incurred during defrosting from freezing.
CZ-NS1P	Additional PCB for solar thermal connection – (split systems)	The circuit board is used for communication between solar thermal system and Aquarea control system
CZ-NS2P	Additional PCB for solar thermal connection – (compact systems)	
CZ-NS3P	Additional PCB for solar thermal connection – (mini compact systems)	
CZ-TK1	Temperature sensor installation kit for third-party tanks	Sensor with cable and immersion sleeve for installation in tanks from third-party manufacturers

Note

The additional PCB for the solar thermal connection does not replace the solar controller, but rather serves as a means of communication and optimisation. To combine Aquarea heat pumps with a solar thermal installation, a separate solar controller (to be provided by the customer) is required in addition to the additional PCB.

4 Closed-loop control

4.1 Design

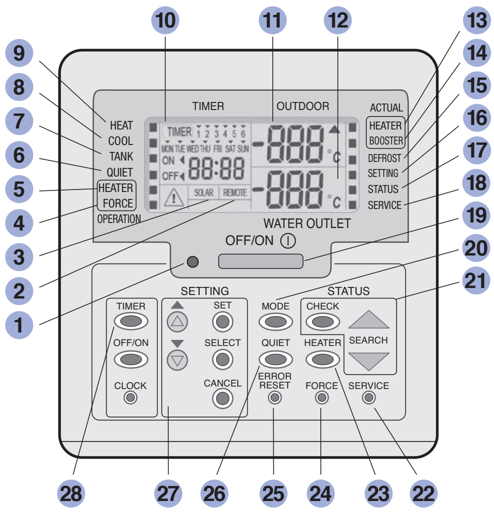
The operation and programming of the Aquarea heat pump takes place in a simple manner by means of the remote controller on the hydromodule (split system) and / or by means of the wired remote control (compact system) within the building. The remote controller and wired remote control are similar in design and are provided with an LCD-display for the indication of essential operating parameters. Clearly arranged keys are used for the operation of these controllers.

4.2 Functions

All basic functions for the operation of the Aquarea heat pump are included in the internal controller. Furthermore, the controller is provided with other functions that can be activated upon demand. For the combination of the Aquarea heat pump with external devices, e.g. a solar thermal installation or a room thermostat, the controller offers the required interfaces which if necessary can be used in combination with other accessories.

4.2.1 Basic functions

- Automatic control of supply water temperature for the operating modes heating, heating + water heating, water heating, cooling + water heating or cooling depending on the outside temperature, the preset values and the current operating conditions.
- At the same time, the valves are switched from heating and / or cooling to water heating and thus deactivating the heating circuits in cooling mode.
- Electric immersion heater and additional electric heater – when activated – are automatically switched on e.g. for quick heat-up of the hot water tank or for supporting the heat pump during extremely low outside temperatures.



1 OFF/ON LED ⓘ
Illuminates during operation and flashes upon occurrence of an error

2 REMOTE display
Symbol is displayed when an external room thermostat is connected and activated

3 SOLAR display
Symbol is displayed when an external solar thermal installation is connected and activated

4 FORCE display
Symbol is displayed when the FORCE mode is activated (additional electric heater can heat)

5 HEATER display
Symbol is displayed when the additional electric heater is activated (additional electric heater can heat)

6 QUIET display
Symbol will be shown when the quiet mode is activated

7 TANK display
Symbol will be shown during the hot water mode (Aquarea heat pump heating the tank)

8 COOL display
Symbol will be shown during the cooling mode (Aquarea heat pump cooling)

9 HEAT display
Symbol will be shown during the heating mode (Aquarea heat pump heating)

10 TIMER display
Shows the setting of the 24-hour timer for each weekday with clock

11 OUTDOOR display
Shows the current outside temperature

12 WATER OUTLET display
Shows the current supply water temperature of the Aquarea heat pump

13 HEATER display
Symbol is displayed when the additional electric heater is in operation

14 BOOSTER display
Symbol is displayed when the electric immersion heater in the hot water tank is in operation

15 DEFROST display
Symbol is displayed when defrosting

16 SETTING display
Symbol will be displayed when parameters in the settings are set

17 STATUS display
Symbol will be displayed when values are depicted in the status menu

18 SERVICE display
Symbol is displayed in service mode

19 OFF/ON key ⓘ
Starts or stops the operation of the unit

20 MODE key
Serves for setting the operation mode: Heating, Heating + Hot water, Hot water, Cooling + Hot water or Cooling

21 STATUS keys
For checking the system status (compressor frequency, fault history, return water temperature, tank temperature)

22 SERVICE key
For the activation of the circulation pump and the pump down operation

23 HEATER key
For activating the additional electric heater

24 FORCE key
For the activation of additional electric heater (emergency operation)

25 ERROR RESET key
For the reset of the remote controller or wired remote control and for acknowledging the error code

26 QUIET key
For the activation of quiet mode with reduced noise production

27 SETTING key
For setting the heating curve, the heating limit temperature, the cooling temperature as well as the hot water temperature and functions

28 TIMER keys
For setting the system time

Display and operating keys for easy operation and programming of the Aquarea control via the remote controller or wired remote control (split system or compact system)

Note

The same control panel is used for various devices. It is possible that some functions may not apply to your device.

4.2.2 Further functions

- **Pump control:** Monitoring of the operating condition upon switching on the heat pump – only when all the required criteria were positively checked does the heat pump transform into the normal mode. Should one criterion not correspond to the expected value, the heat pump goes into the error state.
- **Service mode:** Is used for the activation of the circulation pump and the pump down operation.
- **Flow rate cut-out:** Monitors the water flow rate and switches the heat pump off, when the minimum flow rate is not attained.
- **Additional electric heater mode:** The additional electric heater can be operated as backup when the fan malfunctions. For this purpose, the additional electric heater must be switched on manually.
- **Monitoring the maximum return water temperature:** The return water temperature is checked during the start of operation, should this temperature exceed 80 °C, the pump will be switched off.
- **Defrosting function:** By taking into account the outdoor temperature and supply water temperature as well as their fluctuations, this function ensures that ice that forms on the air-to-water heat exchanger of the outdoor unit or compact unit is defrosted.
- **Auto-restart check:** For controlled start after abrupt interruption of the power supply.
- **Sterilization mode:** Weekly thermal sterilization of the hot water tank by means of the electric immersion heater. Adjustable using the 24-hour timer.
- **Quiet mode:** Reduces the compressor operating frequency as well as the fan speed of the outdoor or compact unit by 80 rpm to at least 200 rpm, thus reducing the noise level.
- **Solar mode:** Expands the system by integrating an external solar thermal control system into the heat pump controller. For the solar operation, a tank as well as the additional PCB for solar thermal connection must be available. The solar thermal installation itself is controlled by an external solar thermal controller (to be provided by the customer).
- **Operation with an external room thermostat:** Without an external room thermostat, the Aquarea heat pump works via an internal thermostat function that monitors supply water and return water temperature and compares it with the heating curve. Upon exceeding the nominal supply water temperature by 2 K the compressor switches off. The operation with external room thermostat can prevent frequent switch on-and-off, in that the room temperature is additionally considered for control of the heat pump.

4.2.3 Safety functions

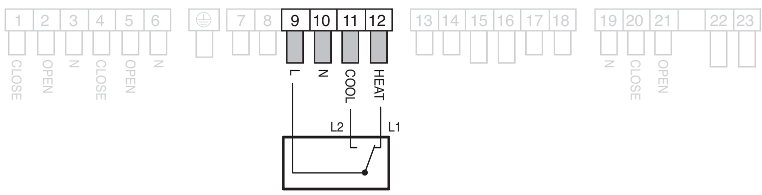
Besides the listed functions, the control system also contains a series of further internal functions that ensure minimum compressor operation time, total current limitation, overheating protection for the compressor and protection functions for extreme operating conditions as well as other safety features.

4.3 Extensions and external interfaces

4.3.1 External room thermostat

Operation with external room thermostat can prevent frequent switch on-and-off, in that the room temperature is additionally considered for control of the heat pump. For this purpose, a room thermostat with two-step controller is needed. Depending on the current room temperature and adjustable required temperature, either the circuit L/L1 or the circuit L/L2 will be switched on via a potential-free switch-over contact.

Depending on which operating mode of the Aquarea heat pump is activated (Heating or Cooling), the heat pump will be activated or deactivated via the two-step controller. The operating mode of the heat pump (Heating or Cooling) acts like an internal release. For example, if the heat pump is in the heating mode, then closing the circuit L/L2 deactivates the heat pump. Only when an internal release exists by switching over into the Cooling mode, closing the circuit L/L2 actually leads to activation of the cooling mode.



Condition	L/L1	L/L2
Required temperature < room temperature	Circuit is open (Heating off)	Circuit is closed (Cooling on)
Required temperature > room temperature	Circuit is closed (Heating on)	Circuit is open (Cooling off)
Operating mode - heat pump	Heating	Cooling

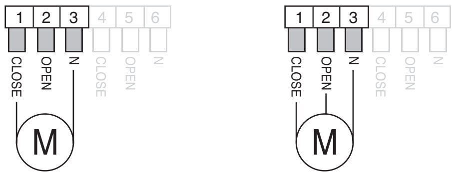
Connection diagram for the control of Aquarea heat pump via an external room thermostat. The room thermostat is connected to the terminals 9 to 12 of the terminal strip.

Note

For exclusive control of the heating mode via the external room thermostat, only the phases L and L1 are connected to the terminal strip. This also effects the Aquarea heat pump series without the cooling mode.

4.3.2 Deactivation of heating circuits in cooling mode

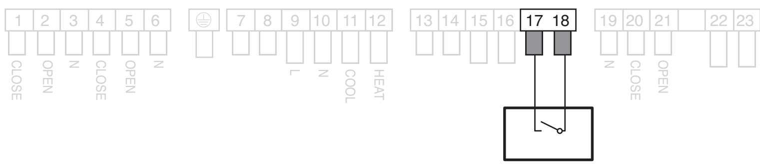
Heating circuits that can be used exclusively for the heating mode and not for the cooling mode (e.g. radiators), can be deactivated automatically by means of an external 2-way directional valve on the control system of the Aquarea heat pump in the cooling mode (see e.g. Hydraulic Diagrams 3 and 6).



Connection diagram for the automatic deactivation of heating circuits in cooling mode via 2-way directional valves to the connections 1 to 3 of the terminal strip.
Left: Spring loaded 2-way directional valve, open without current,
right: Motor-driven 2-way directional valve with single-pole change-over switch.

4.3.3 External control of the Aquarea heat pump

To be able to control the Aquarea heat pump by means of an external controller, the latter can be activated and deactivated by means of its own interface. The interface consists of a 2-position contact, which in the closed state activates the heat pump. An external, overriding control system can control several heat generators in paralell or in cascade sequence via the interface (see e.g. Hydraulics 9 and 10).



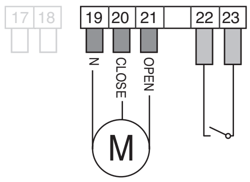
Connection of the external control to the terminals 17 and 18 of the terminal strip

Note

In the delivery state, the terminals 17 and 18 are bridged.
The Aquarea heat pump is thereby activated.

4.3.4 External solar thermal installation

This interface serves for the combination of Aquarea heat pump with a solar thermal installation for water heating via the Panasonic hot water tank. Operation of the heat pump is adapted based on an additional PCB that is available as an accessory for solar thermal connection for operation of the solar thermal installation. In addition, via an inherent input one can check whether the solar pump is running or not. As soon as a 230 V (AC) voltage is availible at the respective input (solar pump running), the externally connected 3-way directional valve will be opened via the control system of the Aquarea heat pump, so that heat from the solar circuit can be output directly to the hot water tank. When the external solar controller switches on the solar pump, the external 3-way directional valve will be connected again (see also Hydraulic Diagram 4) via the control system of the Aquarea heat pump.



Connection of the external 3-way directional valve and the input signal of the solar pump to the terminals 19 to 21 or 22 and 23 of the terminal strip. The 3-way directional valve has to be connected such that in that it prevents the passage from solar circuit and heat exchanger of the hot water tank.

Note

For the combination of the Aquarea heat pump with a solar thermal installation, a solar pump must be used with a heat exchanger. Through this, the solar heat is first transferred from the solar circuit to the heating system water and subsequently to the hot water in the hot water tank.

The additional PCB for the solar connection does not replace the solar controller, but rather serves as a means of communication and optimisation. To combine Aquarea heat pumps with a solar thermal installation, a separate solar controller (to be provided by the customer) is required in addition to the additional PCB.

5 Planning

5.1 Planning steps

The heat pump system is planned step by step. The overview of individual steps below refers to the respective sections in which each planning step is clearly described.

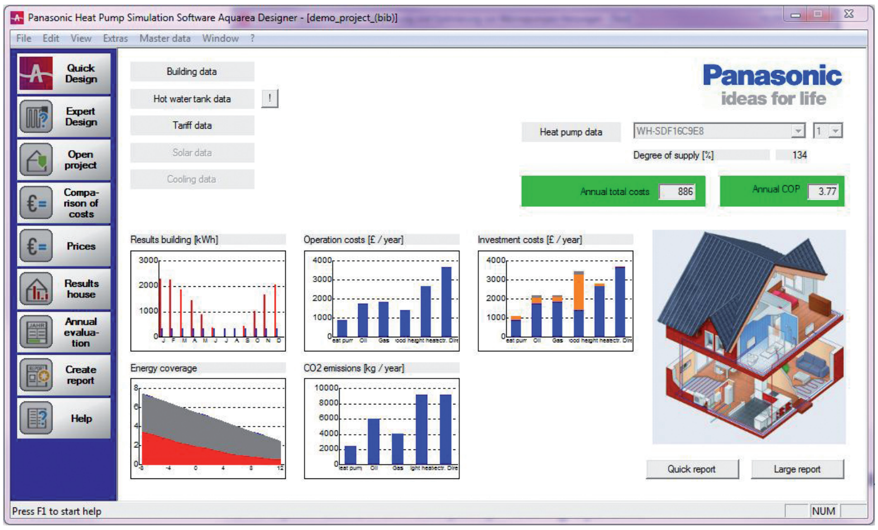
Planning steps		Page
1.	Establishing the outside design temperature θe	50
2.	Establishing the heating load	51
3.	Establishing hot water demand	52
4.	Establishing the heat emitter temperature	53
5.	Heat pump selection and determination of the bivalence point	54 and 55
6.	Installation room and acoustics	58 and 65
7.	Integration of hydraulics and control engineering	73

5.2 Panasonic Aquarea Designer

Panasonic offers the Aquarea Designer for free download at www.PanasonicProClub.com, for easy and quick modelling and optimisation of the heat pump heating systems.

The program offers the following functions:

- Sizing of heat pumps based on building and consumption data
- Comprises in-house air-conditioning and weather databases for sizing calculation
- Quick selection of the suitable heat pump
- Calculation of the bivalence point
- Calculation of coefficient of performance and seasonal performance factor according to VDI 4650
- Costs comparison
- Quick design or expert design as well as either a short or long report



View of the Start user interface of the Panasonic Aquarea Designer for calculation and optimisation of heat pump heating systems

5.3 Establishing the heating load and outside design temperature

The heating load of a building is determined according to EN 12831 “Method for calculation of the design heat load”. For new buildings design heat loads are derived from the planning documents. The heating load is calculated assuming an outside design temperature θe. This value can be derived from CIBSE Guide A: ‘Environmental Design’, table 2.4. In the UK, this typically varies beween -1 ˚C and - 5 ˚C at sea level. This temperature is equal to or is exceeded for 99 % of the hours in a year. A selection is reproduced in the table below. Please note: If using the closest location to your site in the table, you must decrease the temperature by 0.6 ˚C for every additional 100 metres above sea level.

Location	Altitude (metres)	Temperature (˚C)
Belfast	68	-1.2
Birmingham	96	-3.4
Cardiff	67	-1.6
Edinburgh	35	-3.4
Glasgow	5	-3.9
London	25	-1.8
Manchester	75	-2.2
Plymouth	27	-1.2

Determination of standard outside temperature θe according to CIBSE Guide A: Environmental Design

For existing buildings, the rough calculation method described below can also be used for establishing the heating load. It should only be used as an estimate because a variety of factors like house type, insulation and the ventilation rate play a role in the calculation. Over the years, the specific heat requirement of buildings has constantly decreased owing to increasingly stringent thermal insulation requirements. Owing to this fact, the following rates per square metre living-space are used as approximation:

Existing buildings before 1977	163 to 250 W/m²
Buildings as from 1977	88 to 163 W/m²
Buildings as from 1982	75 to 125 W/m²
Buildings as from 1995	50 to 75 W/m²
Buildings as from 2002	38 to 63 W/m²
Low energy building	31 to 50 W/m²
Ultra-low energy building	19 to 38 W/m²
Passive house	13 W/m²

Typical values for the specific heat requirement of residential buildings for rough calculation of heating load

Example

For a 1992 residential house in London, UK with a living space of 120 m², has a required heating load of 12 kW (100 W/m²). The standard outside design temperature for the residential house can be read from the table for the considered location with θe = -1.8 °C.

The heat pump should therefore approximatley provide the determined heating capacity of 12 kW for an outside temperature of -1.8 °C.

Note

The above calculation method provides only rough estimated values for the heating load. For correct dimensioning, precise calculation of the required heating capacity must be carried out by a heating system specialist. Under no circumstances can Panasonic be made responsible for any miscalculations.

Panasonic ideas for life

5.4 Establishing hot water demand

The hot water demand can be estimated based on the following table of different comfort levels:

Comfort level	Daily demand per person in litres (45 °C)	kWh per person per day
Low	15 to 30	0.6 to 1.2
Normal	30 to 60	1.2 to 2.4
High	60 to 120	2.4 to 4.8
Washing machine or dishwasher with warm fill operation	~20 (see Manufacturer's Documents)	0.8

Typical hot water demand per person for one and two family houses for 45 °C tap temperature

Depending on the number of persons and the comfort level required, the hot water demand can vary substantially. It is recommended to select the size of the hot water tank depending on the hot water demand. Attention must be paid so that there is sufficient volume to cover spontaneous demand (e.g. 120 litres for a bath). At the same time, for hygienic reasons, the storage volume should not be unnecessarily large in order to ensure short storage time inside the tank. For single and multiple family buildings, the following tank sizes are recommended:

Persons	Storage volume
2 to 3	200 l
3 to 6	300 l
> 6	> 300 l

Note

The requirements for the control of legionella propagation are described in the HSE Guide L8.

The hot water demand has the greatest influence on the coverage of solar thermal installations for water heating. A proven relationship between tank volume and collector surface lies between 50 to 80 litres per m² of collector surface.

Hot water secondary circulation increases the heat requirement for water heating and for very long piping lengths it can amount up to 100 % of the heat requirement for water heating. Hot water circulation pumps should always therefore be time-and-temperature controlled.

5.5 Establishing the heat emitter temperatures

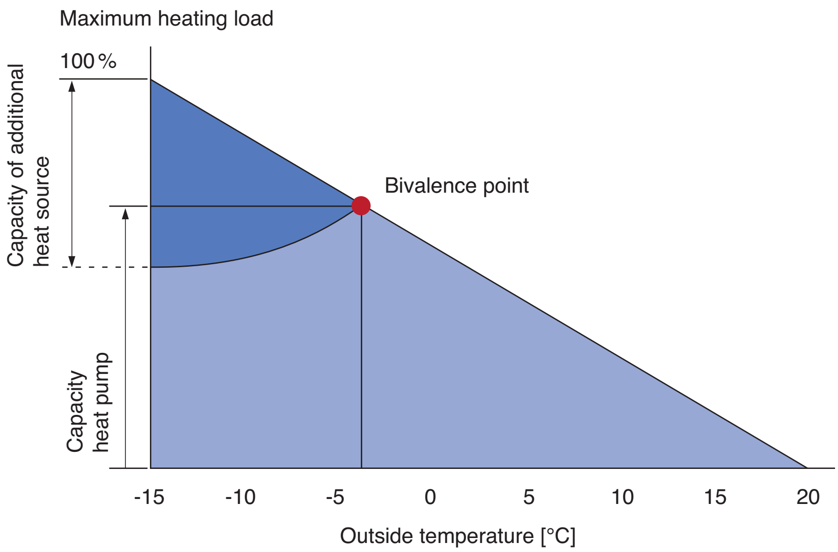
The temperature of the heat emitters at standard outside temperatures should not be higher than 55 °C. Recommended are underfloor systems with supply water temperatures of 35 °C and radiators with a supply water temperature of 45 °C. When replacing a conventional boiler heating system, with an Aquarea heat pump, the supply water temperature should be reduced as much as possible by installing additional thermal insulation and by taking redevelopment measures on the building. Conventional boiler heating systems are operated with supply water temperatures up to 75 °C. Through suitable redevelopment measures, existing radiators can often be operated at lower temperatures and therefore lower heat outputs. For this, refer to manufacturers' guidance for details of the the output of the radiator at lower supply water temperatures.

If it is not possible to reduce the supply water temperature to 55 ˚C, it is also possible to use supply water temperatures of up to 65 °C by using the Aquarea HT series.

5.6 Operating mode and bivalence point

In order to avoid over-sizing and thus reduce investment costs, bivalent operation is generally preferred. In this case, below a defined outside temperature an additional heat source will be switched on. This heat source can be integrated externally (e.g. a gas boiler or stove with back boiler) or internally via the additional electric heater. If a heat source which produces heat from electric power is used, then this is termed (monoenergetic) operating mode.

In this bivalent operation, the air/water heat pump is only supported when the outside temperatures are very low. Because this is the case only for a few days per year, the heat generated by an additional heat source is only a few percentage of the overall generated energy.



Bivalent parallel operating mode via an additional heat source

Note

The bivalence point is determined individually for each building (see for example the following section). By utilising its inverter technology, Aquarea heat pumps can operate efficiently even operating under part load without cycling. Nevertheless, it is recommended to select the bivalence point of the heat pump system above -10 °C.

For an installation to comply with Microgeneration Installation Standard (MIS) 3005, either the heat pump in monovalent mode or heat pump with additional heat source (excluding additional electric heater) integrated into a single control system must meet 100 % of the calculated design space heating requirement.

5.7 Heat pump selection

5.7.1 General criteria

The selection of a suitable heat pump is made via the required heating capacity. In addition, the following decions must be taken:

- Should a split system or a compact system be used?
- Should the heat pump be used just for heating or also for cooling?
- Should the heat pump be powered by a single phase or three phase supply (three phase units have higher coefficients of performance)?

5.7.2 What capacity is needed?

The main requirements on air / water heat pumps are determined using the calculated heating load to EN 12831 and outside design temperature. Furthermore, also the hot water heating and possible outages from the power company must be accounted for. Also the length of pipe between the outdoor unit and hydromodule as well as between the compact unit and building must be considered because long pipe runs lead to loss of some heating capacity. Not only the capacity of the heat pump but also their supply water temperature at design outside temperature is important for correct selection of the heat pump.

Aquarea heat pumps have an additional electric heater which can provide extra heat supply in the event of very low outside temperatures.

All the above points must be considered together for the calculation of required heat pump capacity:

1. Heating load (see section “Establishing the heating load and outside design temperature”)
2. Outside design temperature (see section “Establishing the heating load and outside design temperature”)
3. Hot water tank charging (required time for water heating with the heat pump)
4. The power company's outages (if applicable, e.g. once per day for 2 hours)
5. Pipe correction factor (see section “Planning Heat Source - Air” for consideration of losses through long pipe lengths)

$$\text{Heat pump capacity} \geq \frac{\text{standard heating load} \cdot 24\,h}{(24\,h - \text{tank charging time} - \text{power supplier outage time}) \cdot \text{pipe correction factor}}$$

Note

In a new building, the building fabric generally dries out in the first two years after occupancy, whereby moisture from the construction phase escapes from the building fabric; in this phase, the heat requirement is higher than after the building has dryed. This increase in heat requirement should be offset by the additional electric heater.

Example

- For a residential house in London, UK a required heating load of 9.6 kW and an outside temperature θe = -1.5 °C
- Water heating for four people with a normal comfort level (45 litres per person and day at 45 °C tap temperature or 1.8 kWh): 4 Hence 1.8 = 7.2 kWh per day. A heat pump with a heating power of 9.6 kW would require an operating time of 7.2 kWh / 9.6 kW = 0.75 h. Thus, if rounded up:
  Tank charging = 1 h
- The pipe correction factor, owing to a pipe length of 15 m (one-way length) with means of 1.0 and 0.83 results in
  line correction factor = 0.92

$$\text{Total heating capacity} \geq \frac{9.6 \cdot 24\,h}{(24\,h - 1\,h) \cdot 0.92} = \frac{230.4}{21.16} = 10.89\,kW$$

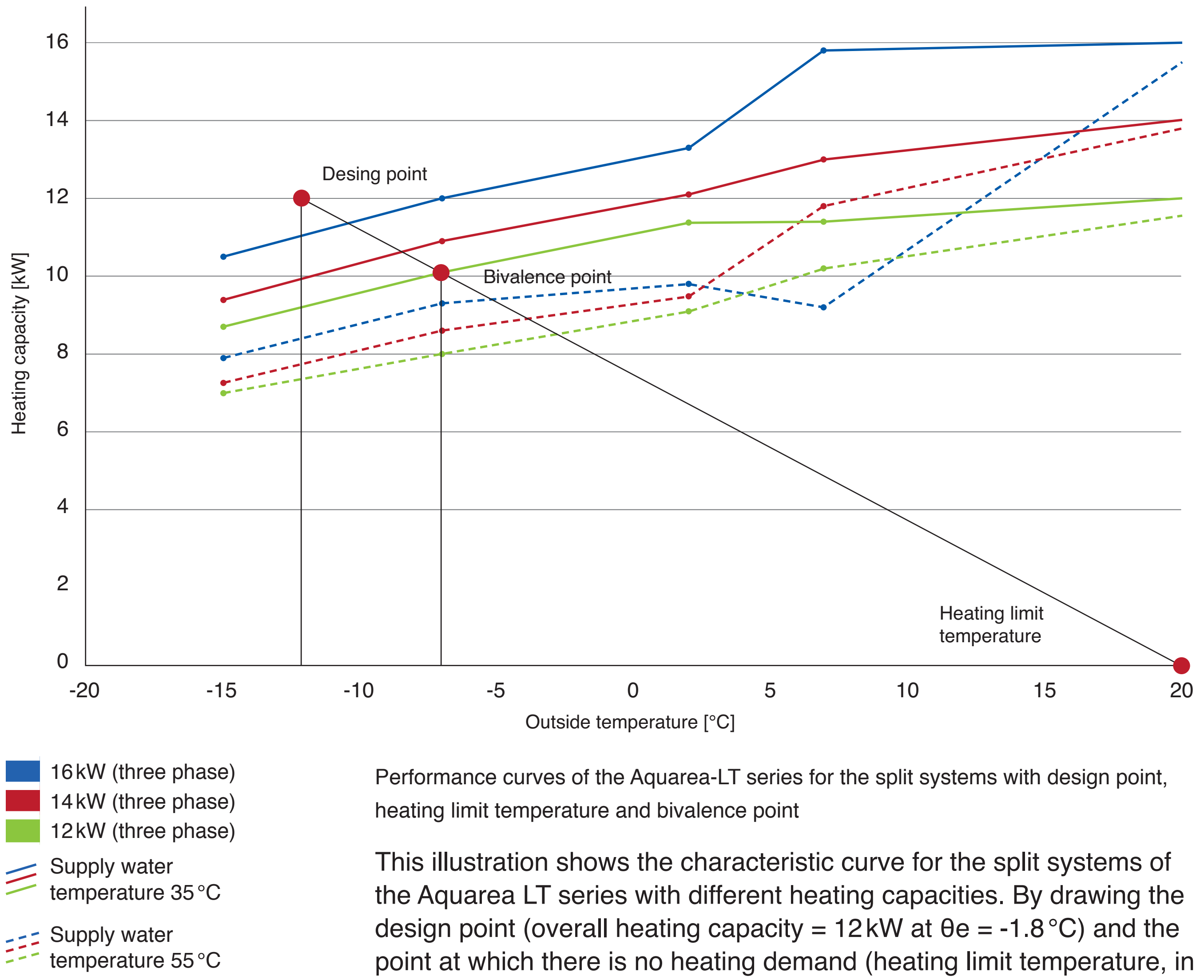
Factoring in power supplier outages of 2 hours per day:

$$\text{Total heating capacity} \geq \frac{9.6 \cdot 24\,h}{(24\,h - 1\,h - 2\,h) \cdot 0.92} = \frac{230.4}{19.32} = 11.93\,kW$$

The calculated overall heating capacity must be calculated using a continuous water supply temperature of 35 °C for a underfloor heating system.

Note

The illustrated calculation of the overall heating load may differ slightly from the detailed calculation of the Aquarea Designer, but can still be used as a rule of thumb for fast calculation without the need of a calculation program.



Performance curves of the Aquarea-LT series for the split systems with design point, heating limit temperature and bivalence point

This illustration shows the characteristic curve for the split systems of the Aquarea LT series with different heating capacities. By drawing the design point (overall heating capacity = 12 kW at θe = -1.8 °C) and the point at which there is no heating demand (heating limit temperature, in this case 20 °C) and the connection of both points, one can determine the bivalence point. If this line crosses the performance curve of the selected heat pump a bivalance point is found.

For monovalent operation of the heat pump, the determined heating capacity of 12 kW can thus be generated with a 16 kW Aquarea heat pump from series LT. The design point (overall heating capacity = 15 kW at θe = -1.8 °C) is below the Aquarea 16 kW performance curve at 35 °C supply water temperature and thus can be supplied.

For reasons of economic viability or practicalities such as an existing heating system, the heat pump can be sized as a bivalent parallel system. Using the 12 kW Aquarea heat pump from series LT, a bivalence point of 0 °C is found. Below this outside temperature the heat pump will need support, whereas above this temperature the heat pump will run unsupported.

The following heat pumps of the Aquarea-LT series, that are split systems, come in question due to the intersection point with the performance curve at 0 °C and at a supply water temperature of 35 °C:

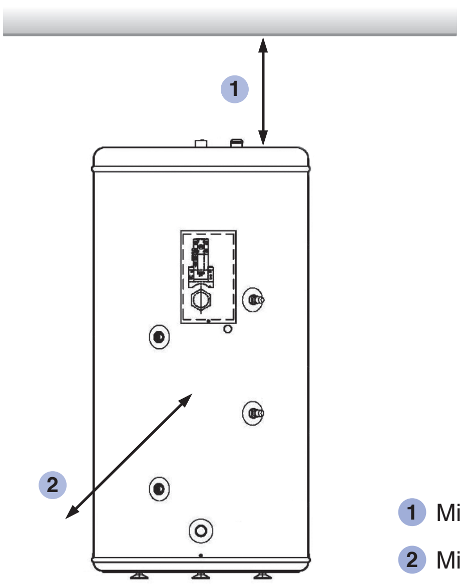
	Heating	Heating and cooling
single phase	WH-SDF16C6E5	WH-SDC16C6E5
three phase	WH-SDF16C9E8	WH-SDC16C9E8

For an installation to comply with Microgeneration Installation Standard (MIS) 3005, the heat pump should be designed to run in monovalent mode or bivalent mode with additional heat source (excluding additional electric heater) integrated into a single control system to meet 100 % of the calculated design space heating requirement.

5.8 Planning of installation room

When planning the installation room, all units and components of the heat pump system that are not installed outside the building must be considered:

- The Hydromodule (for the split system)
- Pipes and wall passages should be thought out and arranged with short runs (electrical, refrigerant and heating pipes)
- Tanks (hot water tank as well as storage tank if applicable)



1 Minimum distance from the ceiling 300 mm
2 Minimum distance from the front 600 mm

Minimum distances from the Panasonic hot water tank

Furthermore, attention must be paid so that the installation room is dry and free from frost and the maintenance work area is easily accessible.

5.8.1 Room volume for split system

With a split system, the refrigerant is partly inside the building, which must be considered with respect to minimum room volume. When no special machine room according to EN 378 T1 is at disposal, the minimum required volume for a heat pump installation room (V_{min}) according to EN 378 T1 is calculated as follows:

$$V_{min} = \frac{G}{c}$$

G = amount of refrigerant in kg
c = practical limit value in kg / m³ (for R410A c = 0.44 kg / m³ and for R407C c = 0,31 kg / m³)

Note

The refrigerant and the amount of refrigerant differs for individual models and is dependent upon additional refrigerant filling that exceeds the pre-filled pipe length. Details on this can be derived from the technical data.

Attention

The refrigerant may not be mixed with or be replaced by a different type of refrigerant. Using a different refrigerant can lead to damage to the unit and also to safety problems.

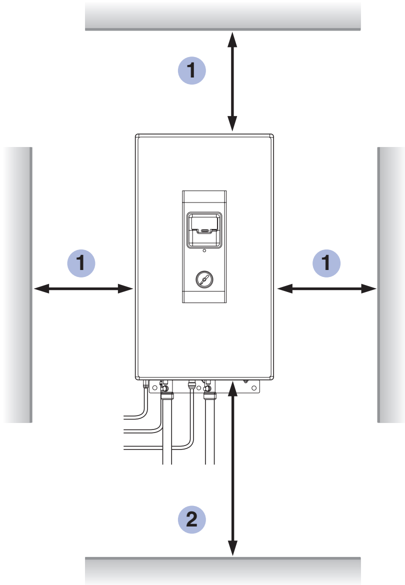
The manufacturer assumes no responsibility and provided no guarantee for the application of refrigerants of a different type apart from R410A for the series Aquarea LT and T-CAP and R407C for the series Aquarea HT.

5.8.2 Assembly conditions and minimum distances from hydromodule

- No heat or steam source can be located near the hydromodule. Also laundry houses or other rooms with higher humidity are unsuitable, since high humidity leads to rust and can damage the unit.
- Adequate circulation of air must be provided inside the room.
- The condensate drained from the hydromodule should be easily channelled out because it can cause damage if not correctly drained.
- Noise inside the room should be considered.
- Do not install the unit near the door.
- The minimum distances (see Figure) must be observed.
- The hydromodule must be installed vertically on the wall, whereby the wall should be thick and dense so that no vibration occurs.
- In case electrical units are installed on wooden buildings with metallic or cable strips in accordance with the corresponding standards for electrical work, no electrical contacts are permitted between the unit and building.
- The hydromodule is only developed for internal installation and may not be installed outside.

Minimum distances from the hydro-module to walls, ceiling and floor

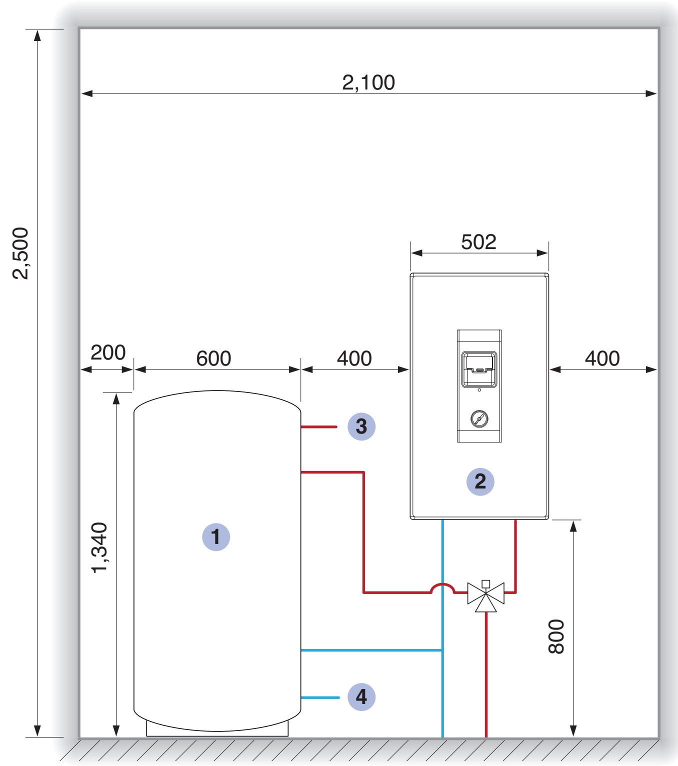
> **Note**
> The compressor is located in the outdoor unit of the split system. The only noise from the hydromodule will solely come from circulation pump operation.



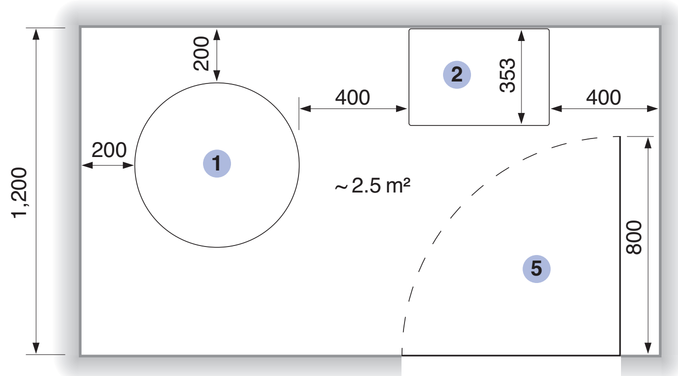
1. Minimum distance 300 mm
2. Minimum distance 600 mm

Example of an installation room with a hydromodule and hot water tank HR 200

> **Note**
> Because of an installation room volume of 6.25 m³ in the example, it is suitable only for Aquarea LT single phase devices up to 9 kW heating capacity. The use of a device with a larger amount of refrigerant would exceed the practical limit value c (for R410A c = 0.44 kg / m³ and for R407C c = 0.31 kg / m³)



Side view

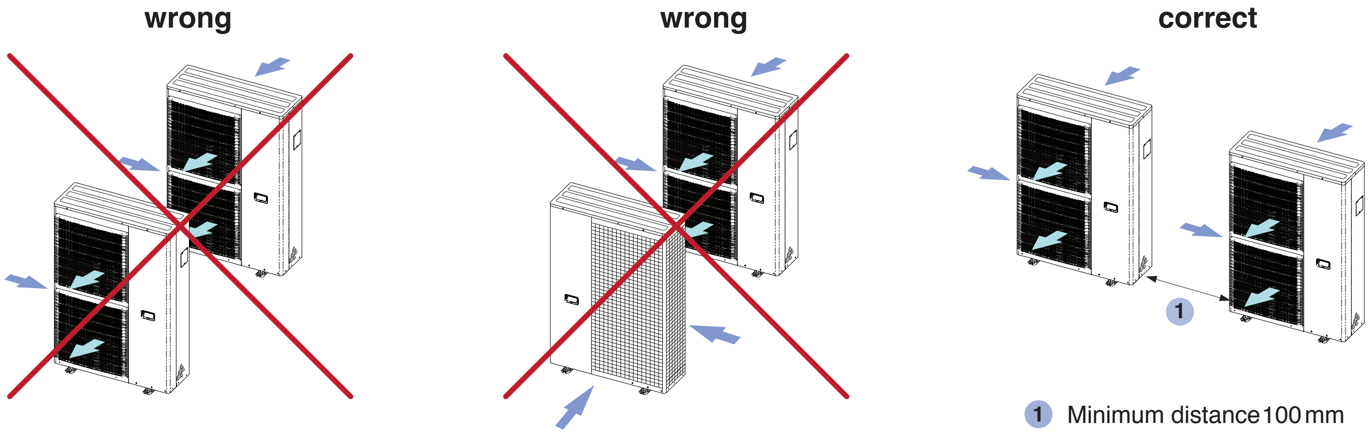


Top view

1. Hot water tank HR 200
2. Hydromodule
3. Hot water
4. Cold water
5. Door

5.9 Planning heat source - air

Air/water heat pumps do not usually require planning permission for installation. However, local authority regulations, in particular in the area of noise must be considered. Furthermore, besides the conditions listed in the following sections, attention must be paid so that when several outdoor or compact units (e.g. for heat pump cascades) are used, no short circuit of the exhaust air occurs (see Figure).



Correct arrangement of several outdoor or compact units

5.9.1 Split system

The split system consists of an outdoor unit and a hydromodule. Depending on the capacity and model, the outdoor unit has one or two fans and differs in size (see Overview on Page 3). Generally, the following points must be observed for the distance between outdoor unit and hydromodule when using the split system:

- In case the length of the refrigerant piping is greater than the pre-filled pipe length of the unit (depending upon model 10, 15 or 30 m, see Technical Data), additional refrigerant quantities specified in the technical data must be added.
- The maximum length of the refrigerant piping between hydromodule and outdoor device depending on model is 30 or 40 m (see Technical Data). This value may not be exceeded.
- The minimum length of the refrigerant piping between hydromodule and outdoor unit is 3 m and the installation may not fall short of this value.
- The maximum height difference between hydromodule and outdoor unit depending on model is 20 or 30 m (see Technical Data). This value may not be exceeded.
- The wall thickness of copper pipes for the refrigerant piping must be more than 0.8 mm.

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Capacity decrease in long refrigerant pipe runs

The capacity of the split systems decreases significantly with increasing length of the refrigerant pipe runs. The capacity reduces depending on the heat pump's nominal capacity, either up to 12 kW nominal capacity or 14 and 16 kW nominal capacity (see Table).

Pipe length of refrigerant (one-way)	up to 10 m	up to 20 m	up to 30 m
Pipe correction factor	1.0	0.83	0.77

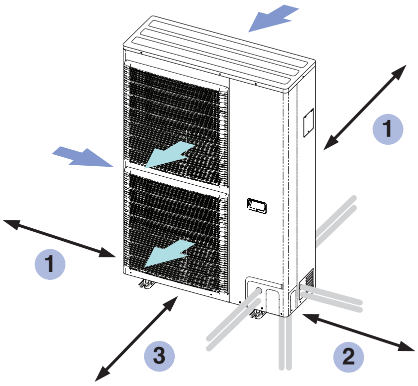
Pipe correction factors for consideration of the reduced heat pump heating capacity during the selection of the heat pump for split systems with **up to 12 kW nominal capacity**

Pipe length of refrigerant (one-way)	up to 7 m	up to 10 m	up to 20 m	up to 30 m	up to 40 m
Pipe correction factor	1.0	0.91	0.87	0.83	0.77

Pipe correction factors for consideration of the reduced heat pump heating capacity during the selection of the heat pump for split systems with **14 and 16 kW nominal capacity**

Assembly conditions and minimum distances around outdoor unit

- The heat output of the outdoor unit may not be prevented by additional protection apparatus like sun blind or similar.
- Locations at which the outside temperature decreases below -20 °C must be avoided.
- The minimum distances (see Figure) must be observed.
- Objects that can lead to short circuit of exhaust air must not be erected.
- The operational noise emission of the outdoor unit should not lead to irritation of the users or neighbours.
- If the outdoor unit is installed near the sea, in regions with a high content of sulphur or at oily locations (e.g. machine oil, etc.), its operational service life will be possibly shortened.
- The outdoor unit is to be installed on a concrete foundation or on a stable base frame e.g. on a building external wall, aligned horizontally, and fastened with bolts (ø 10 mm).
- For installation locations that can be influenced by strong winds e.g. when a wind blows between buildings, including building roofs, the outdoor unit must be secured on the building by means of an additional protection against toppling (e.g. cable).
- The hydromodule is only developed for internal installation and may not be installed outdoors.



1 Minimum distance 100 mm
2 Minimum distance 300 mm
3 Minimum distance 1000 mm

Minimum distances from the outdoor unit to the neighbouring walls and objects with representation of air flow direction. The connection of the refrigerant piping can occur in one of four directions (front, rear, side, down).

5.9.2 Compact system

The compact system consists of a unit that has one or two fans depending on the capacity and model. In this manner the units differ in size (see Overview on Page 3).

The pipes from the compact unit to the building are heat distribution pipes directly exposed to outside air. These pipes must be insulated to a minimum of the TIMSA Guidance to the Building Regulations, however with 40 mm thickness and a thermal conductivity of 0.035 W/(m.K.).

Attention

The compact system is in danger of freezing when the heating circuit is filled with water and the outside temperature decreases below 0 °C!

This can lead to substantial damage to the unit.

Freedom from frost must be ensured through one of the following options:

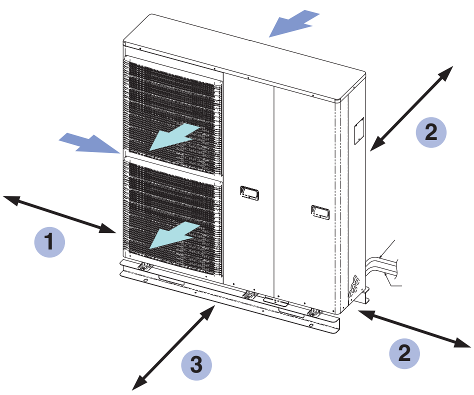
1. The heating circuit is operated with a food grade frost protection mixture (propylene glycol).
2. An auxiliary electric heater inside the compact unit prevents the heating circuit from freezing.
3. The heating circuit is emptied via an owner-provided device (manually or automatically).

Note

Building regulations guidance and WRAS guidance provide details for reducing risks of pipe freezing and the thermal and frost protection regulations.

Assembly conditions and minimum distances from compact unit

- The heat output of the compact unit may not be prevented by additional protection apparatus like sun blind or similar.
- Locations at which the outside temperature decreases below -20 °C must be avoided.
- The minimum distances (see Figure) must be observed.
- Objects that can lead to short circuit of exhaust air must not be erected.
- The operational noise emission of the compact unit should not lead to irritation of the users or neighbours.
- If the compact unit is installed near the sea, in regions with a high content of sulphur or at oily locations (e.g. machine oil, etc.), its operational service life will be possibly shortened.
- For installation locations that can be influenced by strong winds e.g. when a wind blows between buildings, including on building, the compact unit must be secured on the building by means of an additional protection against toppling (e.g. cable).
- The compact unit is only developed for outdoor installation and may not be installed outdoors.
- Condensate should be able to be drained from the unit without difficulty.



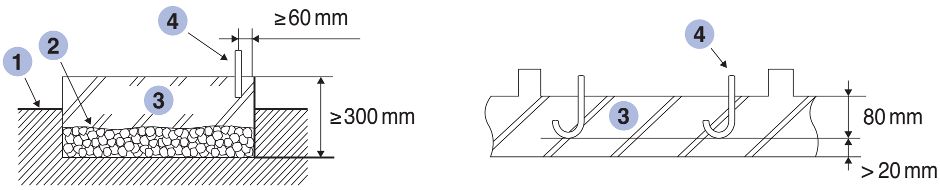
1 Minimum distance 100 mm
2 Minimum distance 300 mm
3 Minimum distance 1000 mm

Minimum distances from the compact unit to the neighbouring walls and objects with representation of air flow direction.

Fastening of the compact unit

The compact unit must be mounted on one level, horizontal and on a solid surface. Besides the weight of unit, also the weight of water must be considered. Four anchoring bolts M12 are needed for fastening, where the tightening force is minimum 15,000 N.

1 Ground
2 Stone quarry
3 Concrete and / or floor slab
4 Anchor bolt



Minimum requirements for anchoring the compact unit on the floor above a foundation (left) or directly in the floor plate (right).

5.10 Acoustics

5.10.1 Sound pressure level

Sound occurs when air vibrates. This vibration propagates in air as pressure waves and reaches the ear drum of the human ear. Independent of the type of noise (speech or motor noise) the sound can be measured as sound pressure. The larger the sound pressure, the louder the noise is perceived. The human ear can perceive a range from 20 × 10-6 Pa (hearing threshold) up to 20 Pa (threshold of pain). This range that corresponds to a ratio of 1:1,000,000 is not perceived by the human ear linearly, but rather logarithmically. For this reason the sound pressure is not specified as pressure, but rather as sound pressure level in decibel (dB). Values of sound pressure level for typical situations are:

Noise	Sound pressure level in dB(A)	Sound pressure in µPa	Perception
Forest	20	100	very quiet
Library	40	1,000	quiet
Speech	55	10,000	normal
Street	80	100,000	loud
Pneumatic hammer	100	1,000,000	very loud

Typical noise situations and occurring sound pressure levels and sound pressures

The non-linear perception of sound pressure leads to a state where two equally loud sound sources are not perceived as double as loud as one sound source but only 3 dB louder. Doubling of the volume of a noise source is associated with a sound pressure level increase by 10 dB.

The effect of other nearby noise influences will alter the perceveid noice limit values. The following table can therfore only act as a guide of noise limits for each type of area:

Industrial areas	Day and night	70 dB(A)
Commercial areas	Day time	65 dB(A)
	Night time	50 dB(A)
Core areas	Day time	60 dB(A)
	Night time	45 dB(A)
General residential areas	Day time	55 dB(A)
	Night time	40 dB(A)
Pure residential areas	Day time	50 dB(A)
	Night time	35 dB(A)
Health resort areas, hospitals	Day time	45 dB(A)
	Night time	35 dB(A)

The values are based on the measurable value 0.5 m in front of the middle of an opened window of the affected room to be protected. They are only valid as mean values and may be exceeded by temporary noise peaks.

The measurable sound pressure level is dependent on the distance to the sound source and decreases with increasing distance.

5.10.2 Sound power levels for estimation of sound pressure level

The sound power level is a quantity for evaluating the sound source independently of distance and direction of sound propagation. It is a calculable quantity that is determined for individual units in laboratory measurements under defined conditions. Based on the sound power level of a specific unit the sound pressure level can be estimated at a certain distance and for corresponding sound propagation conditions for a certain case.

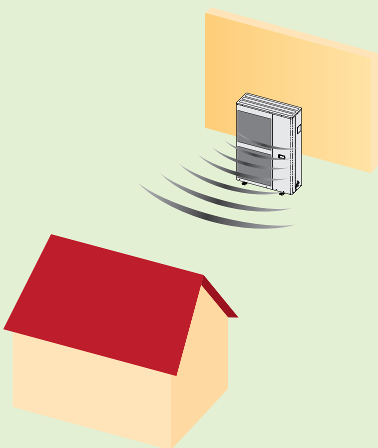
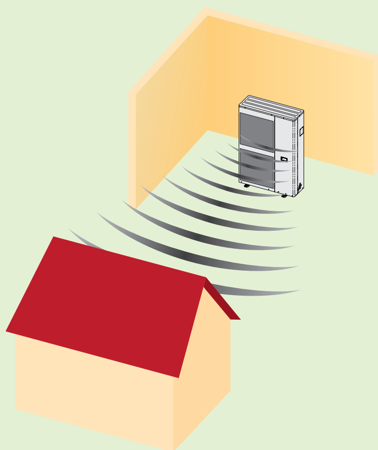
Sound propagates in all directions equally with the sound power from the sound source. With an increasing distance to the sound source, the area through which the sound penetrates expands in proportion to the distance from the sound source. This leads to a continuous decrease of the sound pressure level for a constant sound power. During sound propagation the sound pressure level is moreover influenced by the following factors:

- Interruption by obstructions like buildings, walls or landscape formations
- Reflection from surfaces such as walls, glass facades, buildings or asphalt-covered areas as well as areas made of stone
- Absorption of sound on e.g. grass, bark-chip mulch, leaves or fresh-fallen snow
- Wind can increase or decrease the sound pressure level (depending on wind direction).

An estimation of the sound pressure level L_{Aeq} at a certain place with a distance r from the heat pump can be calculated with the following formula based on the sound power level L_{WAeq}:

$$L_{Aeq} = L_{WAeq} + 10 \times \log \left(\frac{Q}{4 \times \pi \times r^2} \right)$$

For this, one additionally needs the direction factor Q, which considers the spatial radiation conditions of the sound source:

Sound propagation	Half space	Quarter space	Eighth space
Q =	2	4	8
Arrangement			

Directional factor Q for different arrangements of the sound source

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Example

The outdoor unit WH-UD12CE5-A of a split system has a sound power level of 67 dB(A) and is installed such that the sound can propagate into the quarter space (Q = 4). The sound pressure level as 10 m distance results in:

$$L_{Aeq}\,(10\,m) = 67\,dB\,(A) + 10 \times \log\left(\frac{4}{4 \times \pi \times 10^2}\right) = 42\,dB\,(A)$$

For a distance of 20 m the sound pressure level is still:

$$L_{Aeq}\,(20\,m) = 67\,dB\,(A) + 10 \times \log\left(\frac{4}{4 \times \pi \times 20^2}\right) = 36\,dB\,(A)$$

The sound pressure level can be determined roughly from the following table, in that the table value is subtracted from the unit specific sound power level (see technical data).

Directivity factor Q	Distance from the sound source in m								
	1	2	4	5	6	8	10	12	15
2	-8	-14	-20	-22	-23,5	-26	-28	-29,5	-31,5
4	-5	-11	-17	-19	-20,5	-23	-25	-26,5	-28,5
8	-2	-8	-14	-16	-17,5	-20	-22	-23,5	-25,5

Table for rough calculation of the sound pressure level based on the sound power level.

Note

Through the selection of the installation location, the sound pressure level can be increased or decreased. Installation on reflective floor surfaces should be avoided. Sound pressure level can be reduced further by constructing obstructions, whereby the air flow itself should not be obstructed.

The sound output direction of outdoor and / or compact units should be selected if possible towards the street, since neighbouring rooms to be protected are seldom oriented in this direction.

In case of doubt, an acoustic engineer must be consulted.

5.11 Cooling

Aquarea heat pump models with cooling mode are manually switched over from the heating mode into the cooling mode and must be switched over into the heating mode again after the end of the cooling period.

5.11.1 Cooling with underfloor heating

Underfloor heating systems are in principle suitable for the cooling mode, however, they cannot be operated with very low supply water temperatures, because both the comfort decreases as well as the danger of negatively exceeding the dew point. The surface temperature is limited generally to minimum 20 °C. For a delta-T between supply and return water temperatures of 3 to 4 K a specific cooling capacity of maximum 30 to 40 W/m² can be attained. The cooling capacity is essentially influenced by pipe length and pipe diameter in the underfloor heating system as well as the floor covering. For a tile covered floor the thermal transfer is significantly better than e.g. carpeted floor, which negatively influences the cooling capacity.

Due to the limits on cooling capacity of underfloor heating systems, the room cooling cannot be controlled to a fixed room temperature. At least the supply water temperature must be set, which prevents the dew point from being negatively exceeded.

5.11.2 Cooling with fan convectors

Fan convectors can be operated with much lower supply water temperatures than underfloor heating systems. Accordingly, the achievable cooling capacity of fan convectors is greater and a greater level of comfort is achievable than with underfloor heating systems. Owing to low supply water temperatures closed-cell insulation of the piping as well as an integration of the condensate outlet to the building's waste water system or another suitable outlet must be considered with the application of fan convectors for room cooling.

Attention

In the cooling mode, condensation of moisture in the air can occur on the surface of the heat transfer systems when the temperature falls below the dew point. This can lead to damage to the building or also to danger of slipping on the floor surfaces.

The effects of the temperature falling below the dew point must therefore be ruled out by means of suitably placed dew point sensors or the condensate occurring must be drained safely. The affected piping must be insulated tightly against condensation.

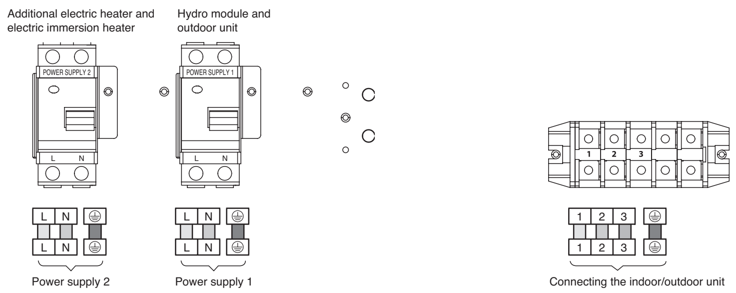
5.12 Electrical connection

5.12.1 Power supply

The Aquarea heat pump range contains models specific to either a single phase of three phase electrical connection. Depending on the nominal heating capacity and the capacity of the additional electric heater, individual models differ in the number of mains connections. Models up to 9 kW nominal capacity are available with two mains connections and models with 12 to 16 kW with three mains connections.

Electrical connections for the split systems

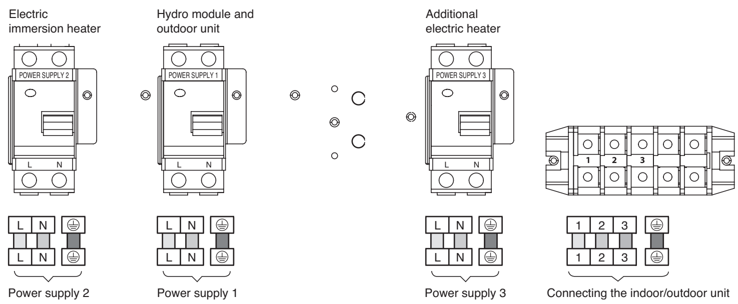
3 to 9 kW (single phase)



Fault-current protective switch

Mains connections

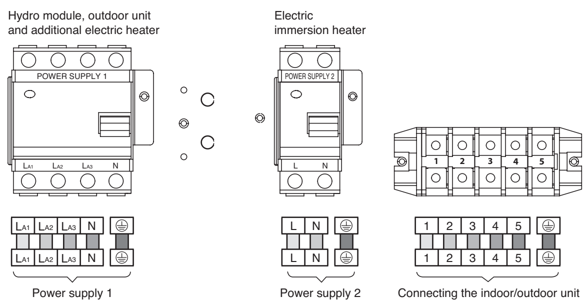
12 to 16 kW (single phase)



Fault-current protective switch

Mains connections

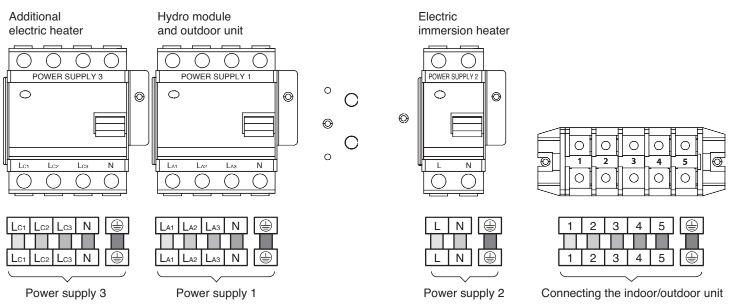
9 kW (three phase)



Fault-current protective switch

Mains connections

12 to 16 kW (three phase)

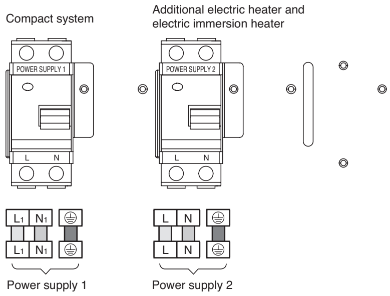
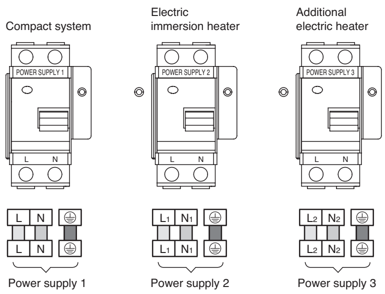
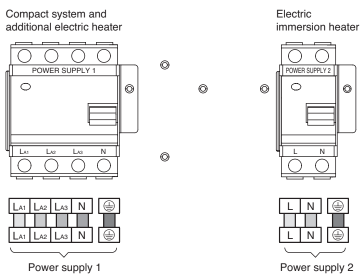
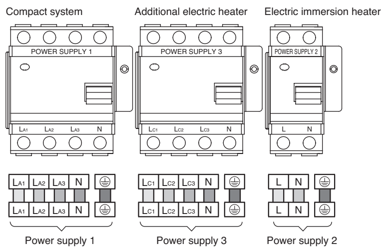


Fault-current protective switch

Mains connections

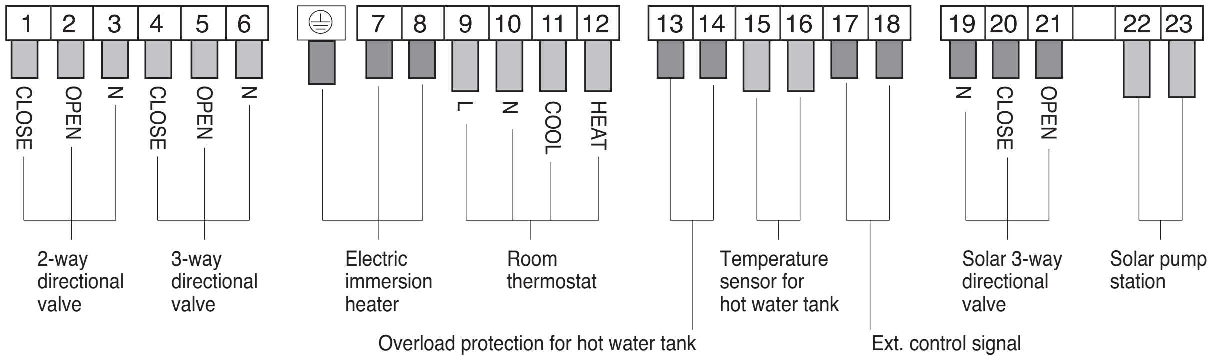
Differences of electrical connections for split systems, different phases and nominal heating capacities.

With the compact system, the mains connection is provided directly on the compact unit. With the split system the mains connection is provided on the hydromodule, whereby the power supply of the outdoor unit is provided via an additional connection between the hydromodule and outdoor unit. An overview of the above-mentioned differences is depicted in the following table. The required cross-sections can be derived from the technical data.

Electrical connections for the compact systems		
6 to 9 kW (single phase)		Fault-current protective switch Mains connections
12 to 16 kW (single phase)		Fault-current protective switch Mains connections
9 kW (three phase)		Fault-current protective switch Mains connections
12 to 16 kW (three phase)		Fault-current protective switch Mains connections

Differences of electrical connections for compact systems, different phases and nominal heating capacities.

5.12.2 Connections to the inputs and outputs



Terminals	Connection	Function	Condition	Cable cross-section
1 to 3	2-way directional valve	Output for the activation of the 2-way directional valves (e.g. for underfloor heating system, cooling)		3 × min. 0.5 mm^2
4 to 6	3-way directional valve	Output for the activation of the 3-way directional valves (e.g. for heating, hot water tank)		3 × min. 0.5 mm^2
Earth to 8	Electric immersion heater	Output for switching on/off the electric immersion heater	The maximum power of the hot water electric immersion heater should be maximum 3 kW	3 × min. 1.5 mm^2
9 to 12	Room thermostat	Input for room thermostat signals		4 and/or 3 × min. 0.5 mm^2
13 to 14	Overload protection for hot water tank	Input for overload protection of the hot water tank	Terminals 13/14 must be bridged when no overload protection is used for the hot water storage	2 × min. 0.5 mm^2
15 to 16	Temperature sensor for hot water tank	Input for temperature sensor of the hot water tank		2 × min. 0.5 mm^2
17 to 18	Ext. control signal	Input for external control signal	These two terminals are bridged during delivery. Connection: 1-pole (min. 3 mm contact gap)	2 × min. 0.5 mm^2
19 to 21	Solar 3-way directional valve	Output for activation of the solar 3-way directional valve		3 × min. 0.5 mm^2
22 to 23	Solar pump station	Input of the ON signal of Solar pump 2 (230 VAC)	Use additional circuit board CZ-NS1P, CZ-NS2P or CZ-NS3P	2 × min. 0.5 mm^2

Terminal strip and table of the input and outputs with function

Note

For easy connection of a hot water tank provided by the customer, Panasonic offers a temperature sensor installation kit for a foreign tank. This article bears the designation CZ-TK1.

Note

The outside temperature sensor is located in the outdoor or compact unit and must not be installed or connected because the measured values are transmitted via an internal BUS line.

5.12.3 Current meter and tariffs

For the connection of the heat pump to the power mains, consideration of the electricity supply company's connection conditions is required. With this connection, data about the heat pump and operating parameters must also be specified. If there is the option of using a cheaper split tariff, this should be carefully considered to take into account the hot water and heating run times and the building heat loss. This should be considered at the planning stage to ensure the appropriateness of using a split tariff.

Attention

If an outage from the power supply company coincides with a frost period, then frost damage can occur if the frost protection measure selected requires electricity. An auxiliary heating unit or other frost protection devices are therefore need to be connected to the power mains such that they are not affected.

5.13 Hydraulics

5.13.1 Hydraulic integration

All Aquarea heat pump systems have an internal water circulation pump which transports the heating water into the heat transfer system. Depending on the series and model version of the Aquarea heat pump, either a standard pump or a high efficiency pump is used. Due to the automatic regulation of the high efficiency pumps, standard and high efficiency pumps must be handled differently for hydraulic decoupling of the heat pump circuit and heat emitter circuit (see sections below).

Attention

Depending on the series and model version, Aquarea heat pumps are delivered with standard or high efficiency pumps.

High efficiency pumps have internal speed control, which can cause the volume flow to drop below the minimum volume flow depending on the setting. If this is not taken into consideration, it can lead to error messages.

Note the explanations on hydraulic decoupling for standard and high efficiency pumps.

Note

Devices with high efficiency pumps are identified specifically in the device overview on pages 2 and 3 and in the technical data.

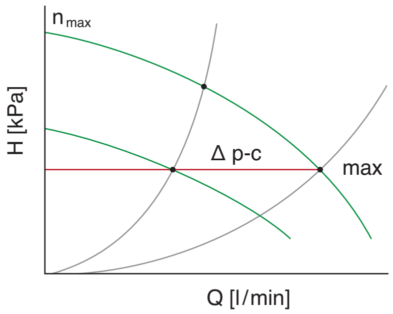
Hydraulic decoupling for standard pumps

In individual cases, one or more water circulation pumps may be needed for the respective heating circuits in addition to the device-internal water circulation pump. If this is the case, the heat pump circuit and the heat emitter circuit must be hydraulically decoupled via a storage tank or a hydraulic switch. If they are integrated without hydraulic decoupling, you must ensure that the minimum flow of the respective heat pump (see technical data) is guaranteed at all times. Automatic mixers or thermostatic valves can restrict the hot water circulation to such an extent that the flow falls below the minimum circulation. To prevent this, Panasonic recommends always combining heat transfer systems without hydraulic decoupling with an overflow valve between the heating supply flow and return flow. The overflow valve must be designed for the nominal volume flow of the respective heat pump.

Hydraulic decoupling for high efficiency pumps

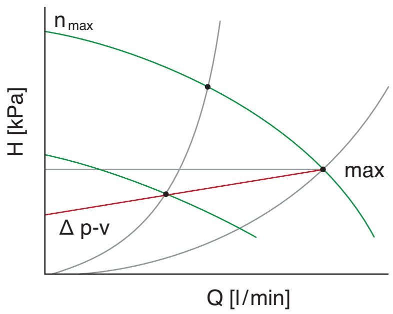
By contrast to standard pumps, high efficiency pumps have automatic regulation. If the resistance in the heating circuit increases, e.g. because thermostatic valves close, the high efficiency pump detects an increased differential pressure and automatically reduces the speed and volume flow. That ensures that the water circulation pump does not consume electricity unnecessarily. The pump supplies the heat transfer system with a lower volume flow until the valves re-open and the speed increases automatically due to the decreasing differential pressure until the nominal volume flow or the target differential pressure is reached.

The high efficiency pumps in Aquarea heat pumps have two control types which can be set on the pump.



Δ p-c – constant differential pressure:

The electronic system **holds** the differential pressure target to be maintained by the pump at the value set (level 1 to 7) up to the maximum point. Panasonic recommends this type of control.



Δ p-v – variable differential pressure:

The electronic system **changes** the differential pressure target to be maintained by the pump (configurable between levels 2 to 6), whereby the differential pressure decreases simultaneously with the volume flow to max. half of the differential pressure target.

Both types of control reduce the pump speed when the differential pressure or resistance in the heating circuit increases. As a result, the volume flow decreases to a far greater extent than with unregulated standard pumps, and can cause the volume flow to drop below the minimum (see technical data) and thus to a fault.

Attention

By contrast to standard pumps, hydraulic decoupling between the heat pump circuit and heat consumer circuit is always required when using Aquarea heat pumps with high efficiency pumps - overflow valves may not be used.

As an alternative to hydraulic decoupling via a hydraulic switch or a storage tank, it can be implemented via a bypass using multiple non-restrictable or permanently open heating circuits.

Rooms with continuous high heating requirements such as bathrooms are suitable for this. When using this option, you must also ensure that the minimum volume flow of the heat pump is always guaranteed.

Dirt filter

Prior to connecting the return pipe to the heat pump, a dirt filter must be installed on the building side to protect the heat pump. The mesh size of the dirt filter must be minimum 500 to 600 µm, whereby the pressure loss though the installation of the dirt filter may not impair the operation of the heat pump.

System volume

Depending on the nominal heating capacity of the heat pump system the following total water volume in the system must be available:

Nominal heating capacity up to incl. 9 kW:	30 litres
Nominal heating capacity 12 kW up to incl. 16 kW:	50 litres

Note

If the total water volume in the system is lower than the specified values, the system water volume must be increased using a storage tank or an additional vessel.

5.13.2 Pumping height and pipe network resistance

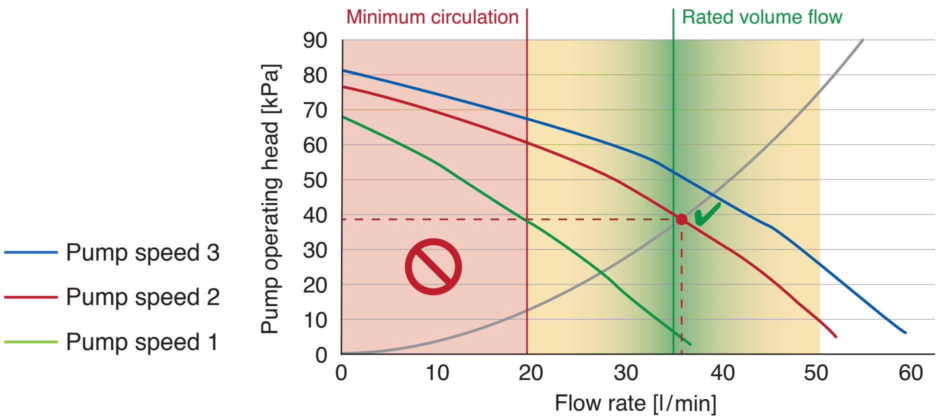
The device-internal water circulation pump of Aquarea heat pumps differs in delivery height and delivery volume according to the series and model version. In addition, standard pumps and high efficiency pumps are also distinguished (identified separately in the device overview on pages 2 and 3 and in the technical data).

While standard pumps have fixed configurable pump levels, high efficiency pumps have automatic speed control with a finer pump level setting option, which results in different pump curve characteristics (see the following sections).

When designing the pump delivery head, all components of the piping network and their individual resistances must be incorporated at their rated volume flow. Components like mixers, valves and heat meters must be selected so that the rated flow matches the rated volume flow of the heat pump system.

Tipp 1: Note the rated volume flow

For efficient heat generation, heat pumps work with a spread between the supply and return flows of approx. 5 K. That distinguishes them from heat generators with burners, which can easily cope with a spread between the supply and return flows of roughly10 or 20 K. The low temperature spread of heat pumps means that the volume flow of heat pumps is generally higher than heat generators with burners for transporting the same heat output. When planning, you must therefore pay particular attention to the rated volume flow and the resulting resistance of the pipe network.



Sample pipe network resistance characteristic curve with a correctly set rated volume flow at pump level 2 (standard pump) for the WH-MXF12D6E5

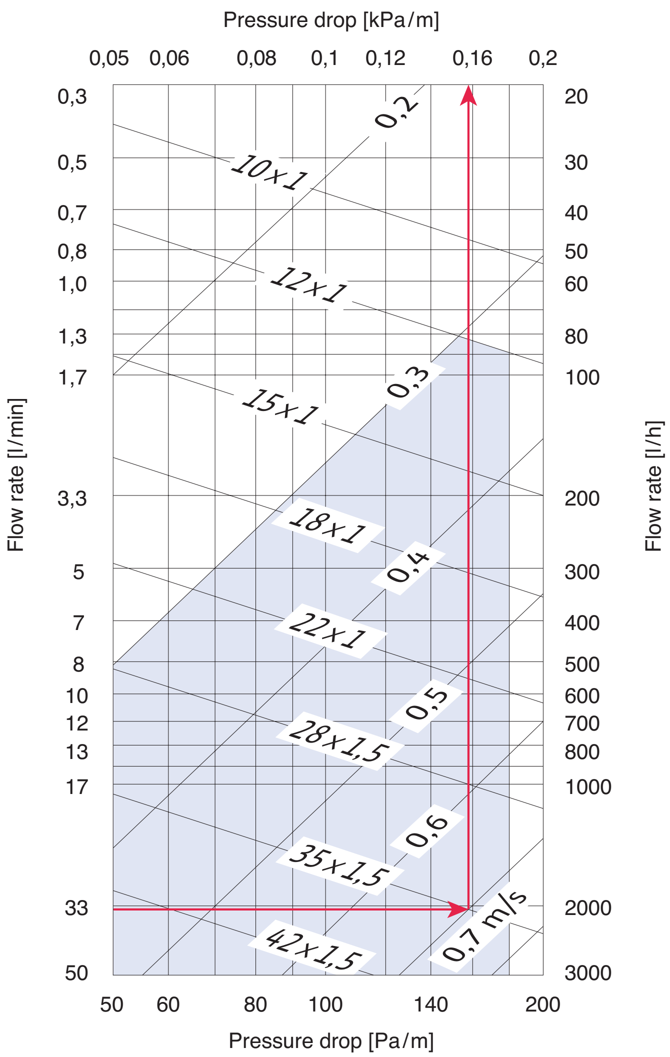
Tipp 2: Note the rated pipe width

The pressure drop in the pipelines increases exponentially with the volume flow. That means that doubling the volume flow increases the pressure drop by a factor of 4! This is due to the flow speed in the pipe, which depends on the volume flow and the internal pipe diameter.

As an alternative to pipe network calculations, the pressure drop in pipe sections can be determined via nomograms. The following applies as a recommendation for designing main distribution lines:

- The flow speed should be between 0.3 to max. 1.5 m/s
- The pressure drop per metre should be roughly 0.1 kPa/m

Based on these criteria, the required rated pipe width can be read from the copper pipe nomogram (see example). The recommended range is highlighted in colour. In order to determine the pipe network resistance of an entire line, the pressure drop per metre must be multiplied by the length of the respective sub-sections, and the pressure drop of the sub-sections must be added. The total resistance of a line is calculated from the total pressure drop of the sub-sections multiplied by an estimated supplementary factor of 1.5.



Copper pipe nomogram
Sample calculation of the rated pipe width for the WH-MXF12D6E5 with a rated volume flow of 34 l/min: This results in a rated copper pipe width of 35 × 1.5 at a pressure drop of 0.16 kPa/m and a flow speed of 0.7 m/s

5.13.3 Pumping height

The device-internal water circulation pump of Aquarea heat pumps differs in delivery height and delivery volume according to the series and model version. In addition, standard pumps and high efficiency pumps are also distinguished (identified separately in the device overview on pages 2 and 3 and in the technical data).

While standard pumps have fixed configurable pump levels, high efficiency pumps have automatic speed control with a finer pump level setting option, which results in different pump curve characteristics (see the following sections).

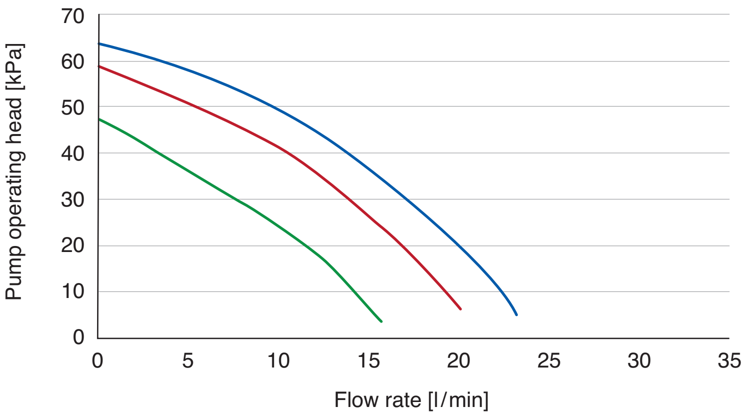
For dimensioning the pump operating head, all components of the piping individual resistances must be considered for nominal flow rate. Components like mixer valves and heat meters must be selected such that the nominal flow rate is matched to the nominal flow rate of the heat pump system.

Attention

The sum of individual resistances of all components of the network of pipes may not exceed the pump head under nominal volumetric flow. If the resistance of the network of pipes is too high, the nominal volumetric flow cannot be attained by the internal water circulation pump. The heat pump control system will register that the minimum circulation quantity is not attained and therefore indicate malfunction.

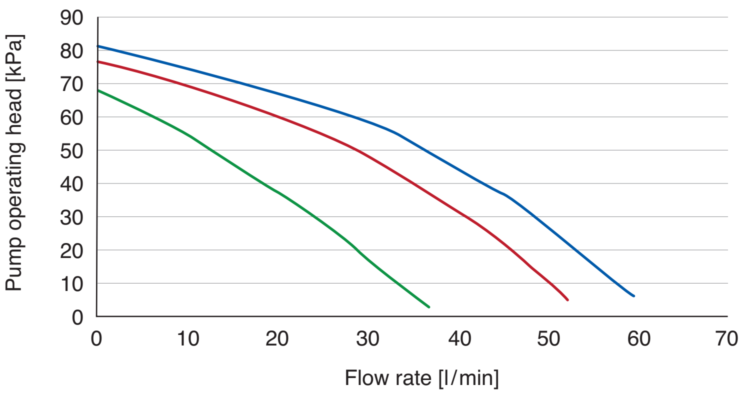
Pumping height standard pumps

- Pump speed 3
- Pump speed 2
- Pump speed 1



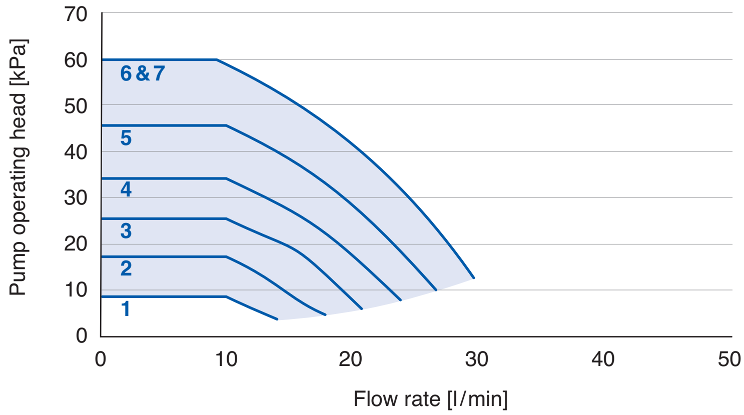
Properties of the standard water circulation pump for the Aquarea heat pumps, 7 and 9 kW single phase.

- Pump speed 3
- Pump speed 2
- Pump speed 1

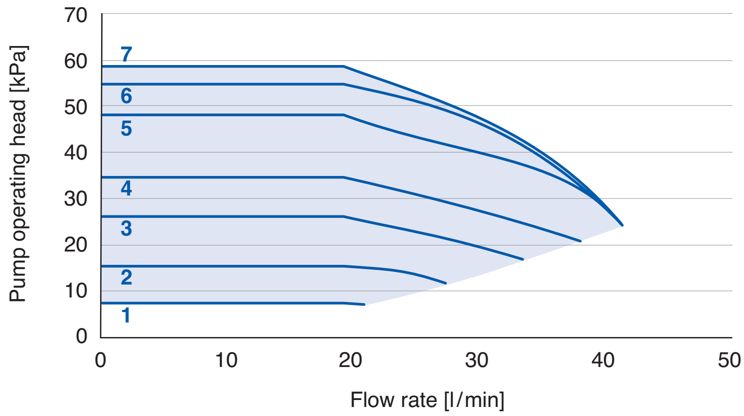


Properties of the standard water circulation pump for the Aquarea heat pumps, 9 kW three phase and 12, 14 and 16 kW single phase and three phase.

Pumping height high efficiency pumps



Pump characteristic curve of the high efficiency water circulation pump for the Aquarea heat pump devices WH-SDF03E3E5, WH-SDF05E3E5, WH-SDC03E3E5 and WH-SDC05E3E5



Pump characteristic curve of the high efficiency water circulation pump for the Aquarea heat pump devices WH-MDF06E3E5, WH-MDF09E3E5, WH-SXF09E3E8 and WH-SXF12D9E8

5.13.4 Hydraulic balancing

The hydraulic balancing of the heat transfer system is achieved from correct setting of the flow rates from regulating valves.In this manner, a situation where individual building areas are excessively heated up whereas other sections remain cold with low flow rates is avoided. The hydraulic balancing is therefore a question of home comfort and at the same time also a prerequisite for efficient operation of air/water heat pump.

5.13.5 Peculiarities when cooling

Hydraulically, a heat pump system with cooling does not differ from a pure heating system. For the calculation of seasonal performance factor, both the heat produced and heat removed via cooling should be measured with a meter.

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5.13.6 Expansion vessel

With the exception of the mini compact unit WH-MDF06E3E5 and WH-MDF09E3E5 with a heating capacity of 6 and 9 kW respectively (see note), the Aquarea heat pumps have an internal expansion vessel with a capacity of 10 litres and an initial pressure of 1 bar.

This expansion vessel can be used for heating systems with an overall quantity of water in the system of under 200 litres and a static head of not more than 7 metres (difference between the highest point of the system to the expansion vessel).

When the overall quantity of water is greater than 200 litres or greater static heads are required, the pressure must be sustained by means of an expansion vessel that is installed in the building itself. In general the pressure limit of the pressure relief valve must be observed. This may be derived from the technical data and is maximum 3 bar.

Note

Unlike the other units, the mini compact units WH-MDF06E3E5 and WH-MDF09E3E5 with a heating capacity of 6 and 9 kW respectively have an expansion vessel with only 6 litres capacity. Accordingly, these units can only be used in heating systems with a total water volume of less than 150 litres. The other conditions correspond to those of the other units.

The required expansion vessel is designed according to the nominal volume VN taking into account:

System volume	V_A	(Total volume of the heating system)
Maximum temperature	T_{max}	(Highest temperature in the system, e.g. 60 °C)
Final pressure of the pressure relief valve	p_e	(Depends on the pressure relief valve, max. 2.5 bar)
Admission pressure expansion vessel	p_0	(Initial pressure 1 bar)

$$V_N = (V_e + V_V)\ \frac{p_e + 1}{p_e - p_0}$$

1. The expansion volume Ve is based on the system volume, the maximum temperature and the expansion coefficient of water according to the following table:

T_{max} [°C]	40	50	60	70	80	90	100
n [%]	0,93	1,29	1,71	2,22	2,81	3,47	4,21

Percentage expansion of water

$$V_e = V_A\ \frac{n}{100}$$

2. The volume of the water header VV can be calculated by a simplified method:

$V_V = 0{,}2 \times V_N$ (with a nominal volume of VN < 15 litres) or
$V_V = 0{,}005 \times V_A$ (with a nominal volume of VN > 15 litres, whereby VV ≥ 3 litres)

3. The final pressure of the pressure relief valve is derived from the opening pressure of the pressure relief valve minus a tolerance of 0.5 bar:

   p_e = opening pressure pressure relief valve minus 0.5 bar

4. The admission pressure p_0 must be such that it corresponds to the static head of the heating system and an additional pressure of max. 0.5 bar. A static head of 10 metres corresponds to 1 bar. The admission pressure of the Aquarea expansion vessel may have to be adjusted.

Note

The calculation of the expansion vessel is done according to EN 12828 Heating systems in buildings – Design for water-based heating systems. For dimensioning with local requirements, design programs from manufacturers for expansion vessels can be used generally. These calculate also the required admission pressure values to be set on the expansion vessel.

Attention

Aquarea heat pumps may only be installed as closed systems without direct contact of the heating water to the ambient air. The oxygen transfer in open systems can lead to excessive corrosion of the piping and thus to problems in operation.

5.13.7 Heating water quality

To avoid damage to the heating system and to the heat pump, limestone formation in drinking water heaters and hot water heating systems must be observed. Furthermore, heating systems must be flushed thoroughly prior to filling them.

5.13.8 Use of storage tanks

Storage tanks can fulfil three functions in connection with heat pumps:

- Bridging outage time by power supply companies,
- hydraulic decoupling of the heat pump circuits from the heat transfer system and
- extension of the heat pump service life by preventing frequent switch on and off (cycling), which reduces the system efficiency.

Owing to the inverter technology of Aquarea heat pumps, the system capacity can be regulated in line with the heat requirement, ensuring efficiency and meaning a storage tank is not needed, thus saving space. To bridge the outage time by the power supply company, heat transfer systems with greater storage capacity like underfloor heating systems can cater for adequate intermediate storage.

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6 Examples

On the following pages there are typical user examples of Aquarea heat pump systems with different applications and properties illustrated. An overview of the examples are shown in following table.

Example	Several heating circuits	Hydraulic decoupling	Hot water tank	Storage	Cooling	Solar Thermal	External heat source	Cascade	Page
1	x	–	x	–	–	–	–	–	81
2	x	–	x	–	x	–	–	–	82
3	x	–	x	–	x	–	–	–	83
4*	–	–	x	–	–	x	–	–	84
5*	–	x	x	x	–	–	–	–	85
6*	x	x	x	–	x	–	–	–	86
7	–	–	x	–	x	–	–	–	87
8	–	–	x	–	x	–	–	–	88
9*	x	x	FWS[1]	x	–	–	x	–	89
10*	x	x	–	x	–	–	–	x	90

Overview of examples on the following pages with illustration of properties and applications. 3 and 8 show the respective previous schemes (2 and 7) in the cooling mode. [1]FWS = Fresh water station *Suitable for devices with high efficiency pumps

Note

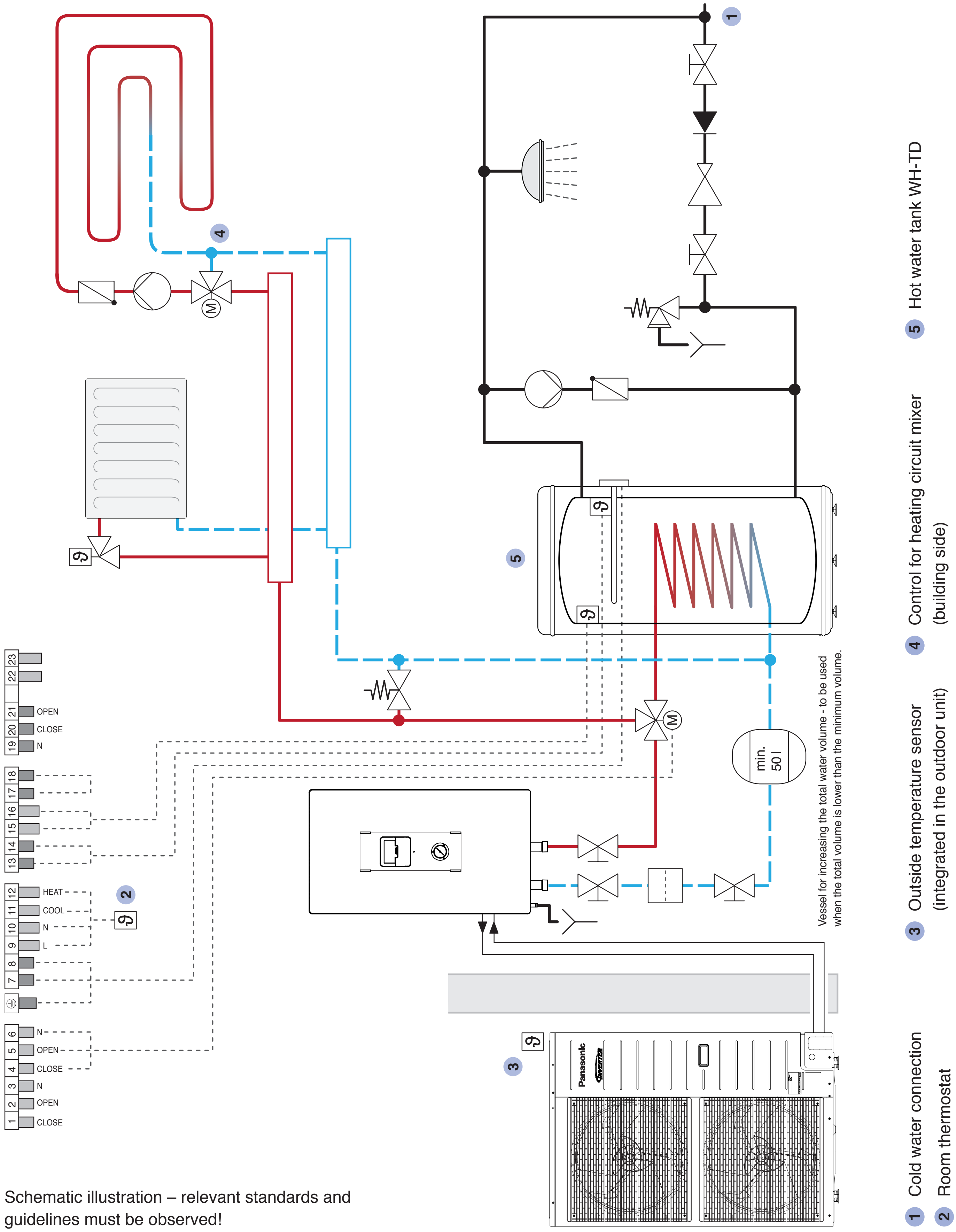
The schematic diagrams show the essential components. They serve as help for the planning of actual systems and do not include all the components and safety devices that are needed according to EN 12828. Relevant standards and guidelines must be observed!

6.1 Legend

2-way directional valve	Valve cap
3-way directional valve / 3-way mixer	Manometer
Drain funnel	Pump
Shutoff valve	Control valve
Expansion vessel	Pipe deaeration
Storage tank for minimum volume (min. 50 l)	Non-return valve
Hydraulic switch	Filter
Pressure-reducing valve	Pressure relief valve

Temperature sensor
Thermostatic valve / valve for individual room control
Bypass valve
Hot water thermostatic mixer
Hot water appliances
Return flow
Supply
Control cable

Example 1
Direct connection of heating circuits with bypass valve

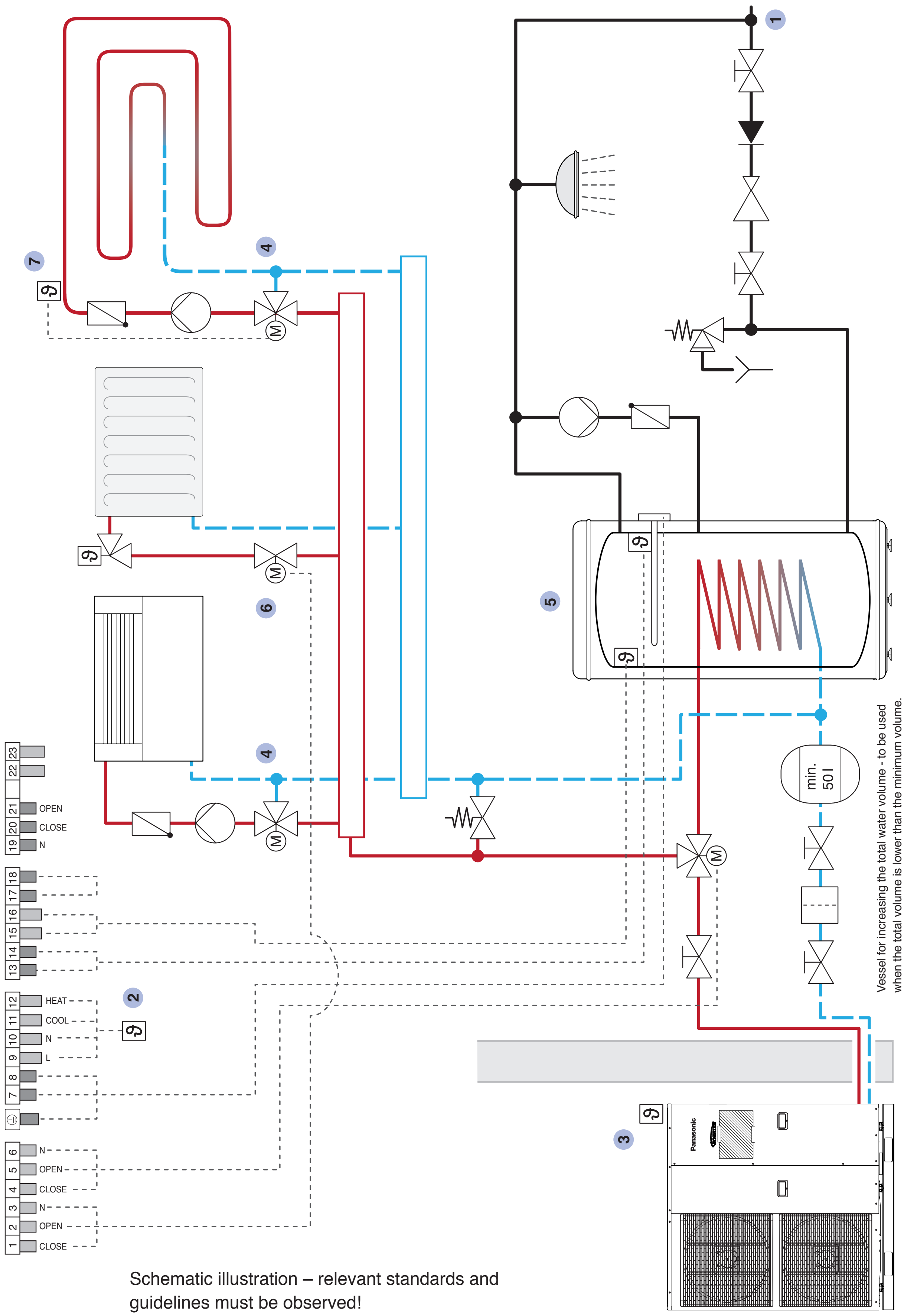


Schematic illustration – relevant standards and guidelines must be observed!

Example 2

Direct connection of heating circuits with bypass valve

Radiators can be switched off for cooling mode via 2-way directional valves (image shows heating mode)



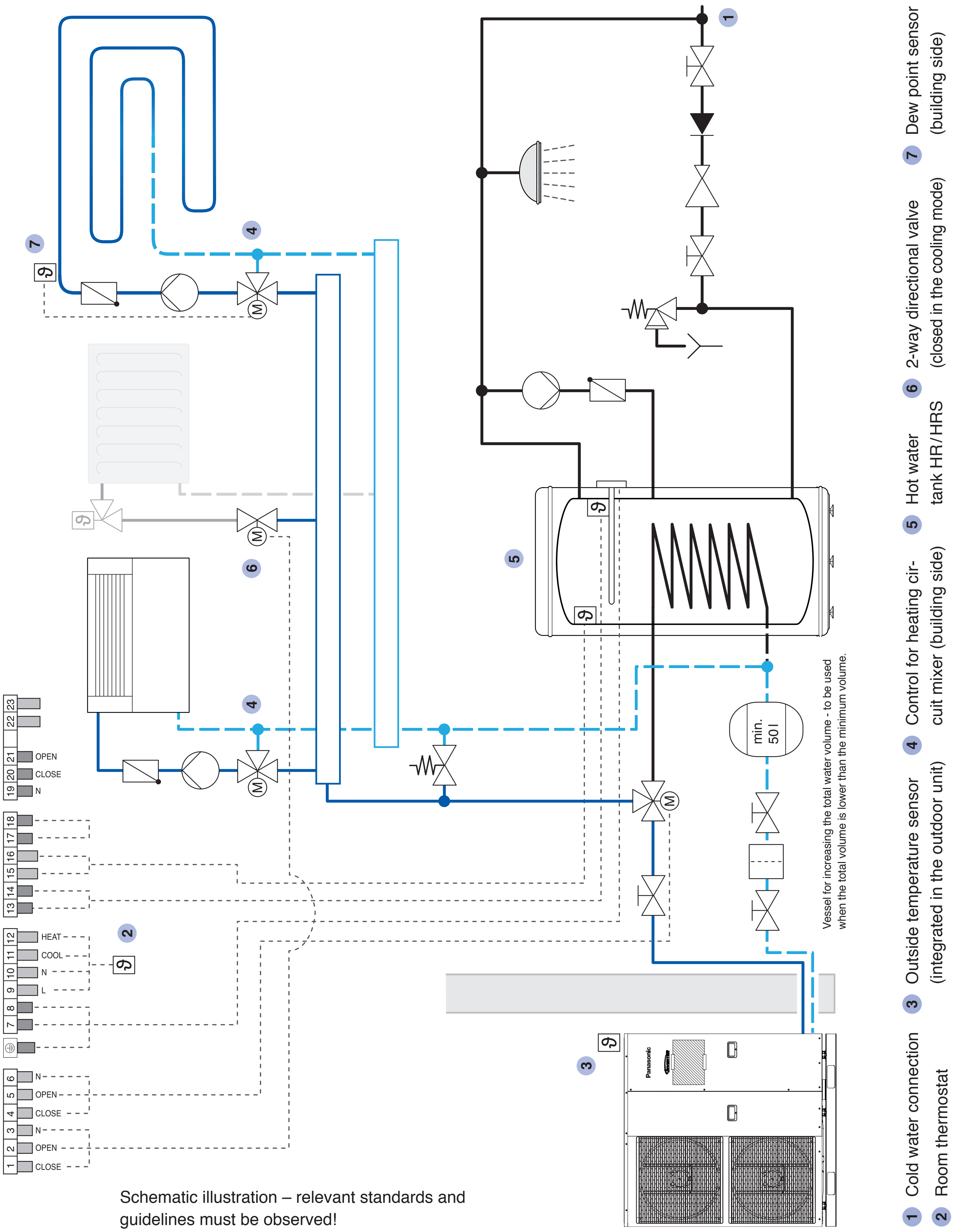
Schematic illustration – relevant standards and guidelines must be observed!

1 Cold water connection
2 Room thermostat
3 Outside temperature sensor (integrated in the outdoor unit)
4 Control for heating circuit mixer (building side)
5 Hot water tank HR/HRS
6 2-way directional valve (open in the heating mode)
7 Dew point sensor (building side)

Example 3

Direct connection of heating circuits with bypass valve

Radiators can be switched off for cooling mode via 2-way directional valves
(image shows cooling mode)

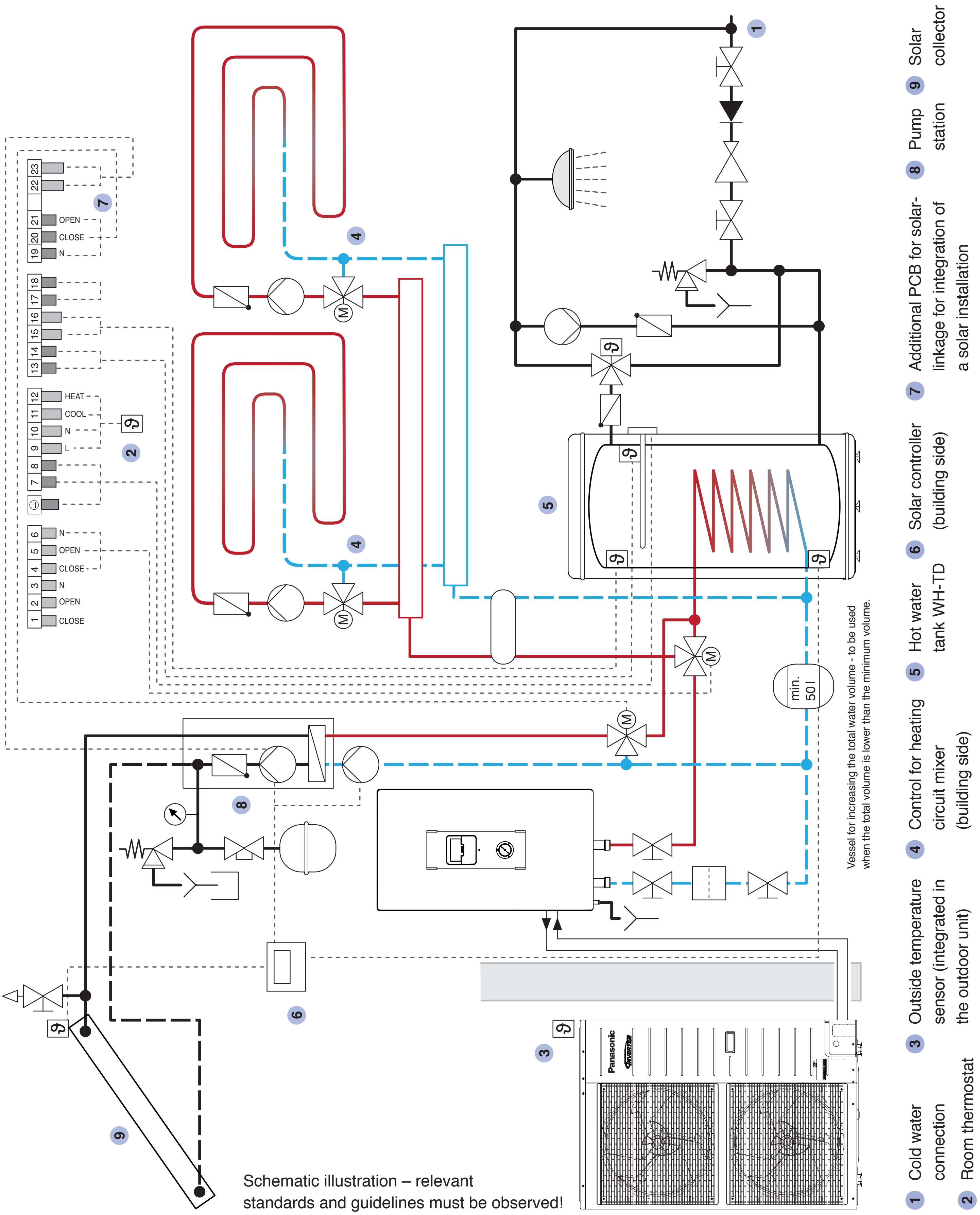


Schematic illustration – relevant standards and guidelines must be observed!

Example 4

Direct connection of heating circuits with bypass valve

Solar thermal water heating by means of a solar collector array with a heat exchanger and thermostatic mixer at the hot water connection to protect against scalding.

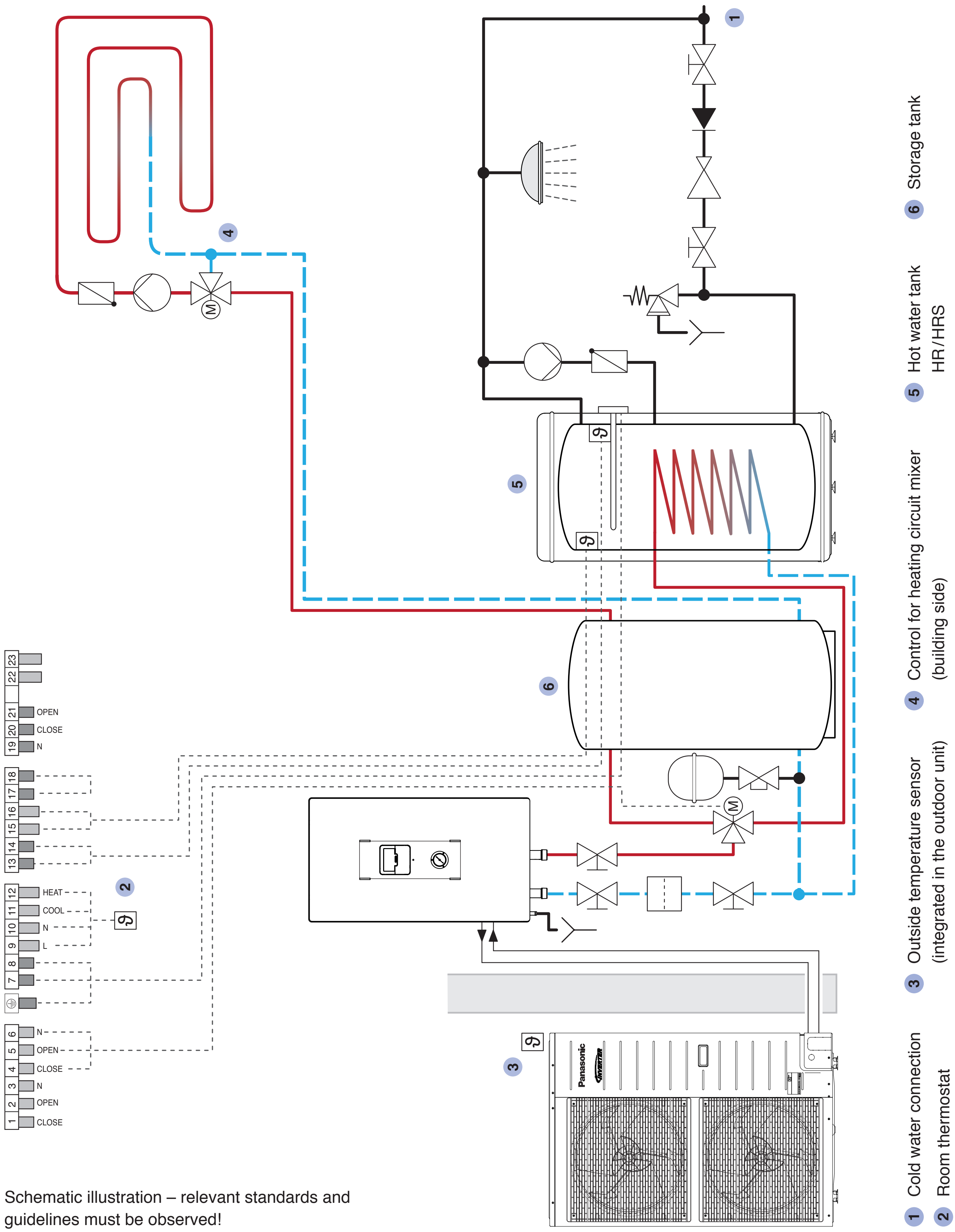


Schematic illustration – relevant standards and guidelines must be observed!

Example 5

Hydraulic isolation of the heating circuits by means of storage tank

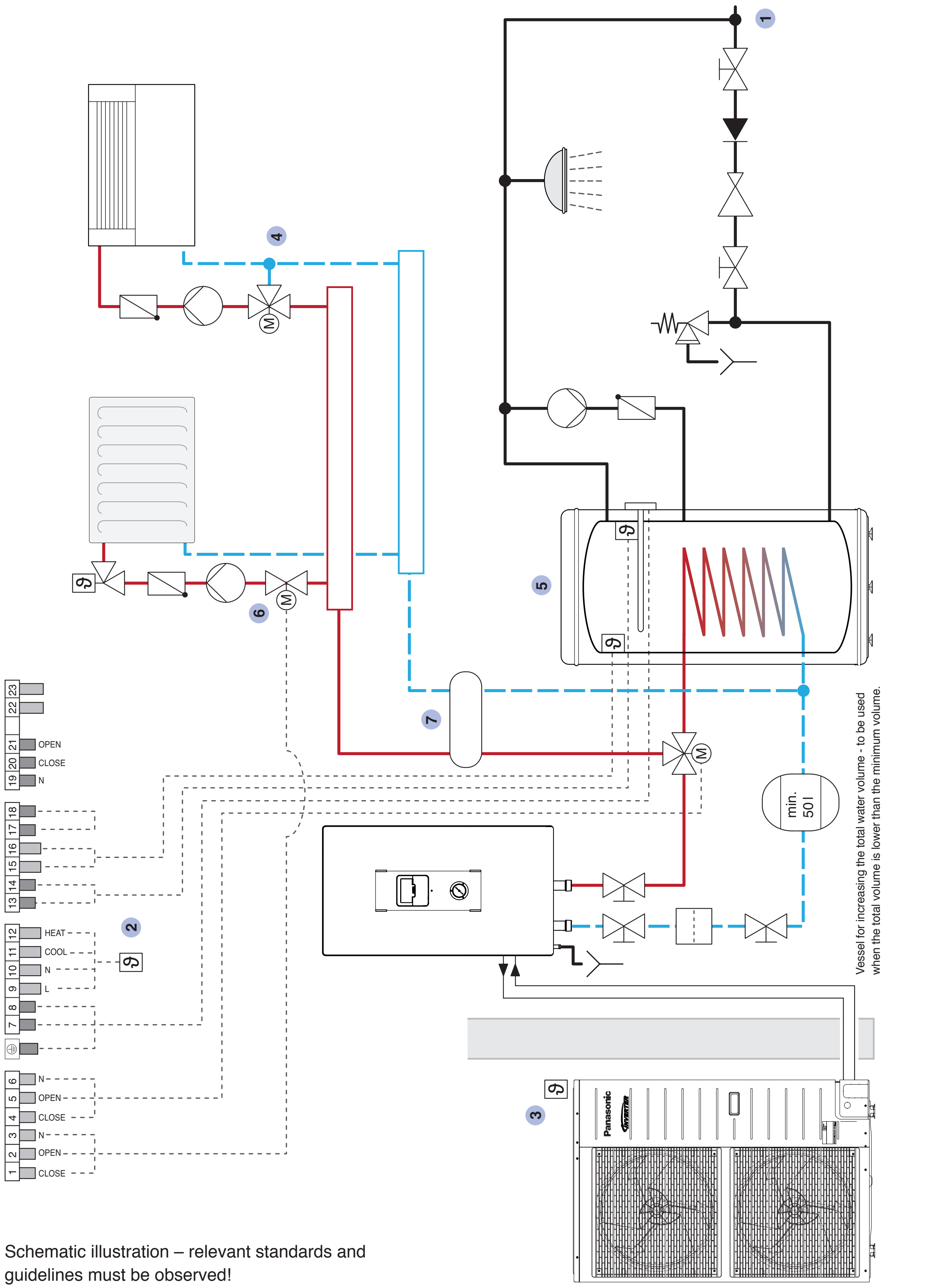
To bridge outage time and extend heat pump operating time.



Schematic illustration – relevant standards and guidelines must be observed!

Example 6

Hydraulic isolation of the heating circuits by means of a heat exchanger



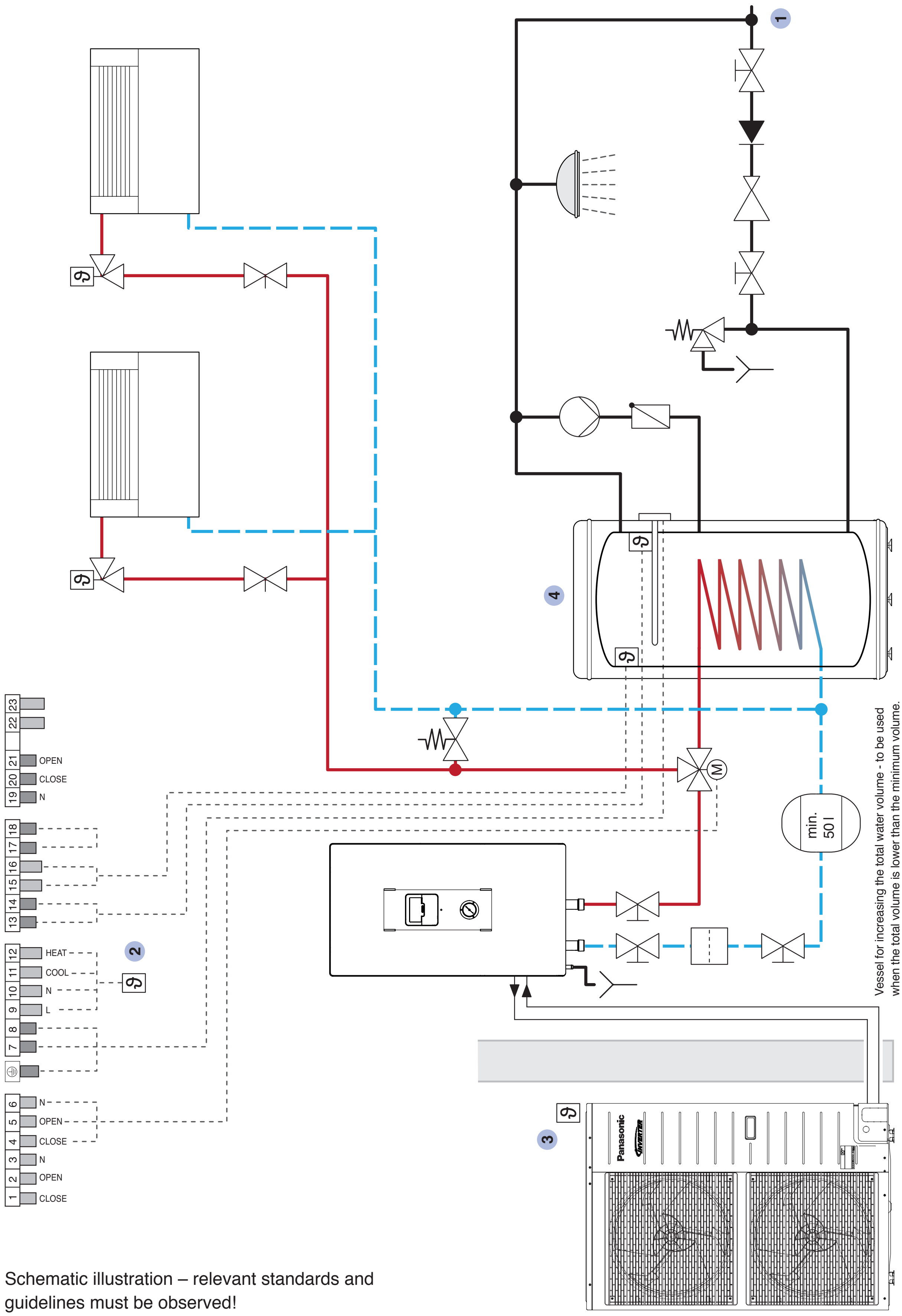
1 Cold water connection
2 Room thermostat
3 Outside temperature sensor (integrated in the outdoor unit)
4 Control for heating circuit mixer (building side)
5 Hot water tank HR/HRS
6 2-way directional valve (heating mode = open, cooling mode = closed)
7 Heat exchanger

Schematic illustration – relevant standards and guidelines must be observed!

Example 7

Direct connection of heating circuits with bypass valve

The circulation in the fan convector heating circuits is balanced.
Suitable for heating and cooling mode (image shows heating mode)



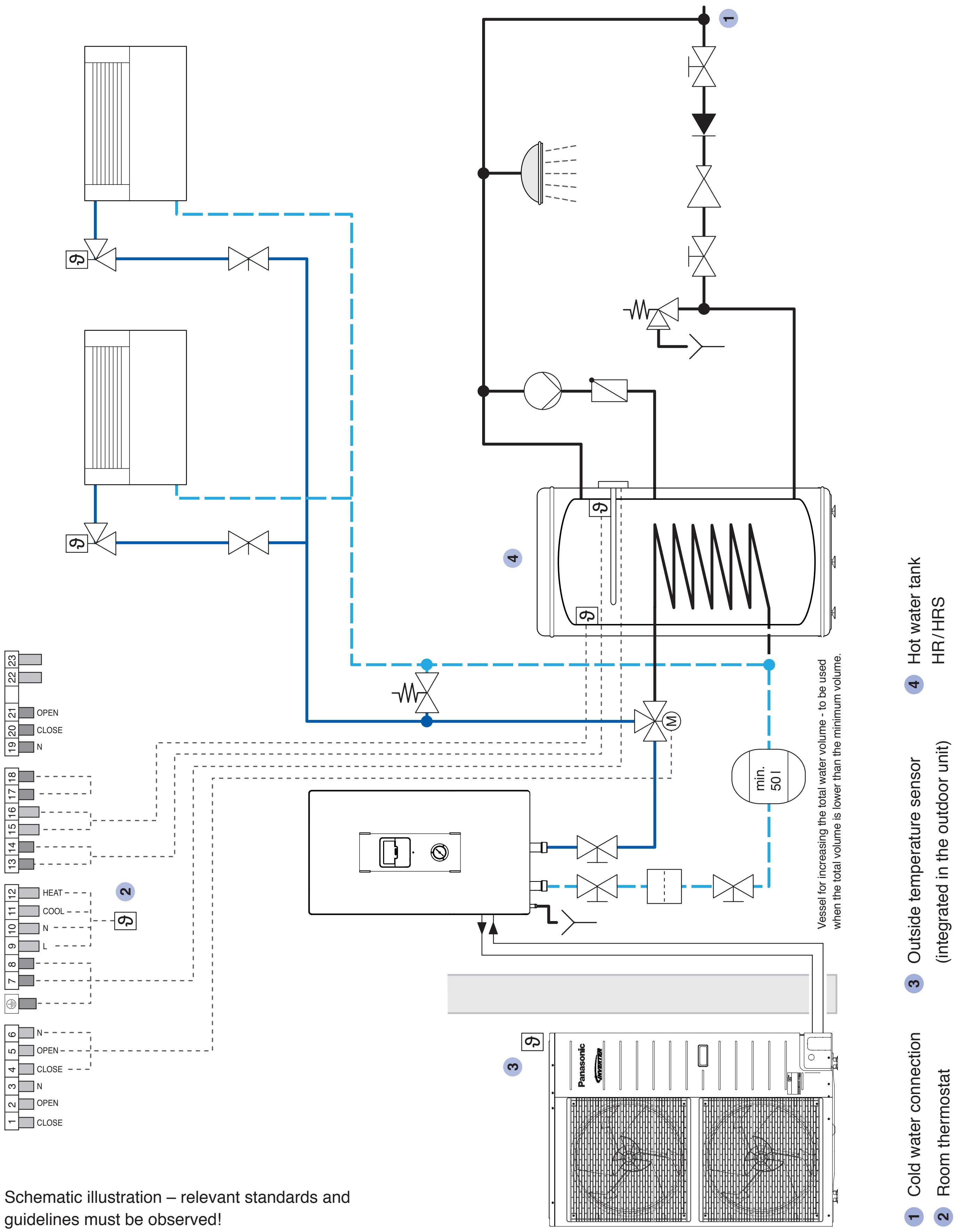
1 Cold water connection
2 Room thermostat
3 Outside temperature sensor (integrated in the outdoor unit)
4 Hot water tank HR/HRS

Schematic illustration – relevant standards and guidelines must be observed!

Example 8

Direct connection of heating circuits with bypass valve

The circulation in the fan convector heating circuits is balanced.
Suitable for heating and cooling mode (image shows cooling mode)

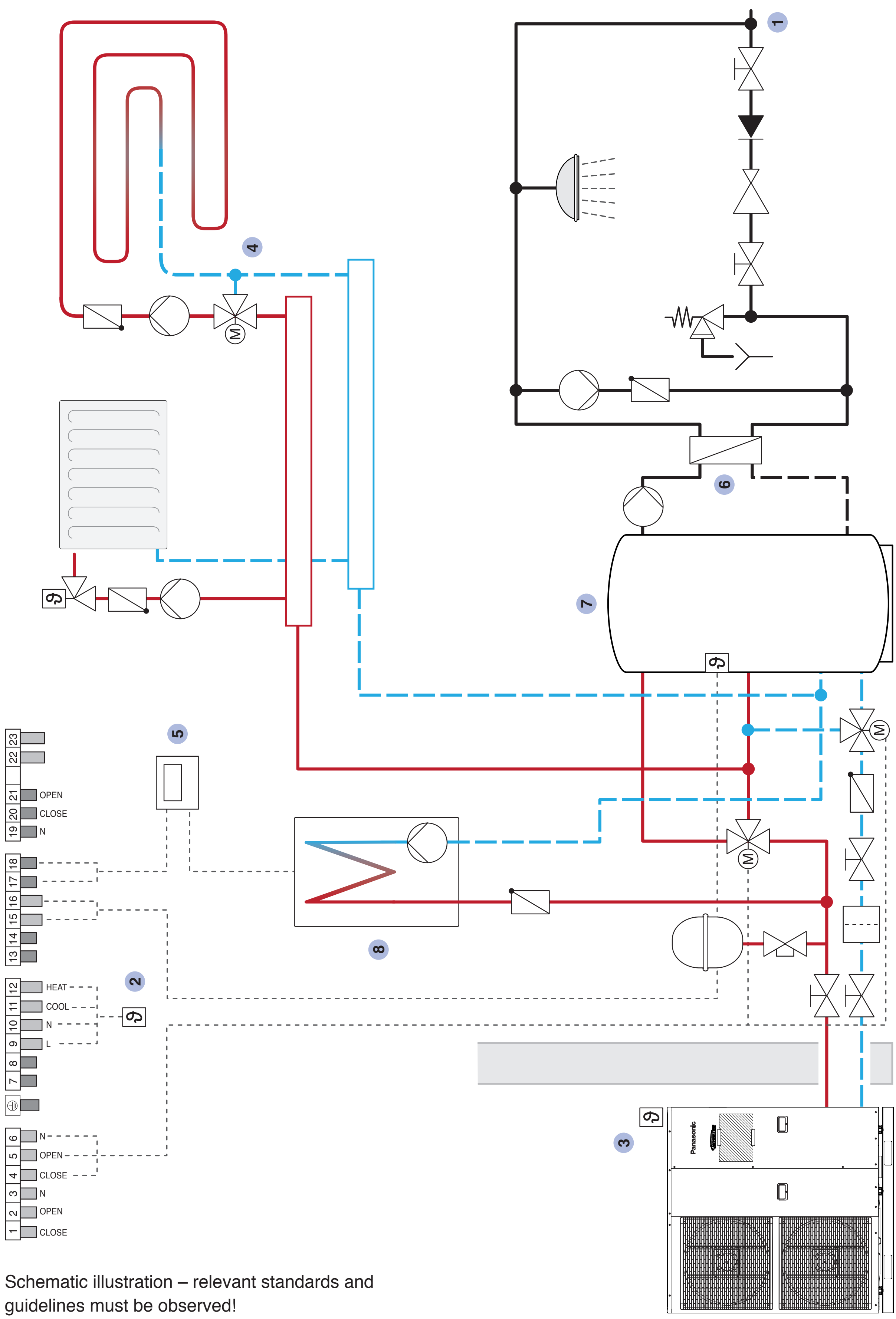


Schematic illustration – relevant standards and guidelines must be observed!

Example 9

Hydraulic isolation of the heating circuits by means of storage tank

Dual-mode operation with additional heater via external system controller.
Water heating via fresh water station



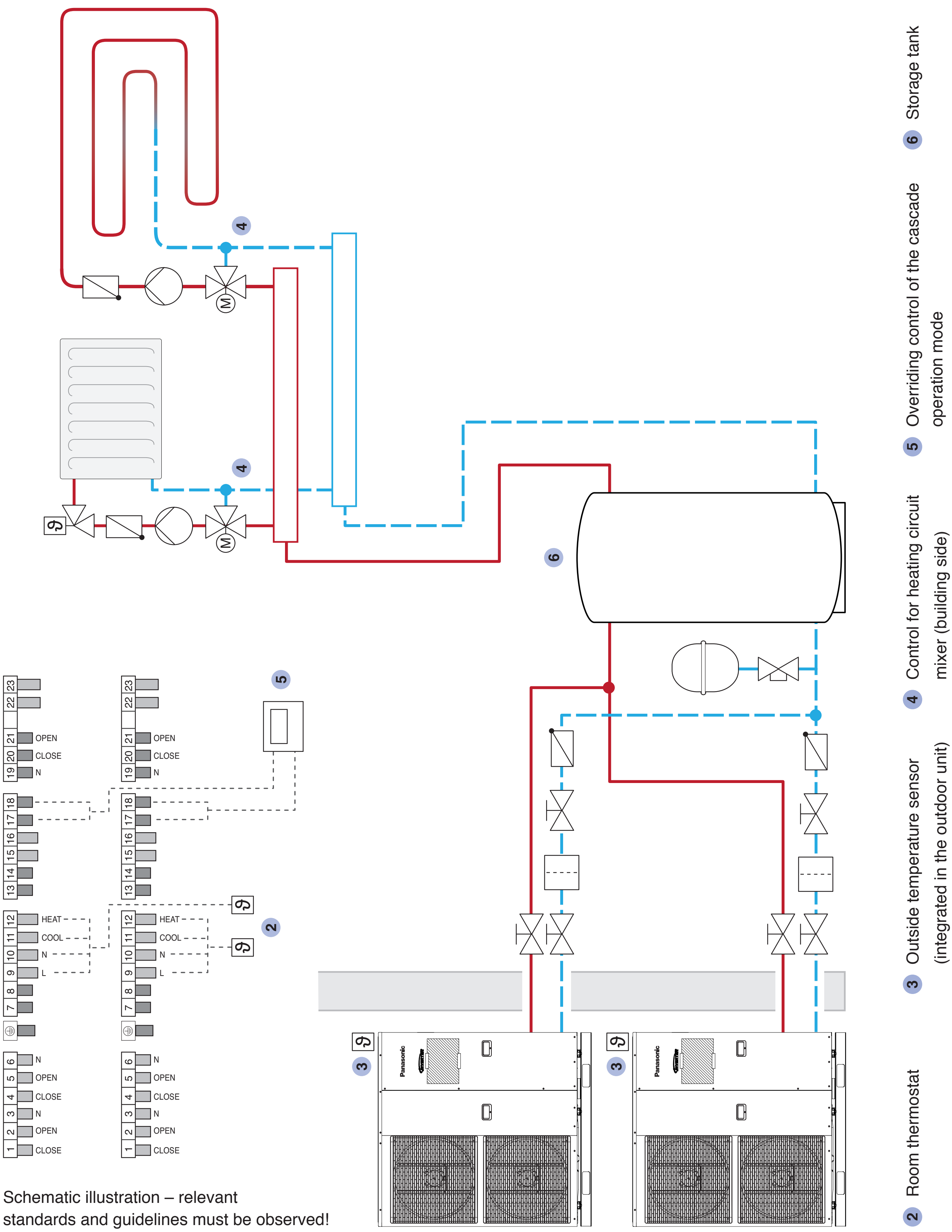
1 Cold water connection
2 Room thermostat
3 Outside temperature sensor (integrated in the outdoor unit)
4 Control for heating circuit mixer (building side)
5 Overriding control of the bivalent operation of heat pump and additional heating
6 Fresh water station
7 Storage tank
8 Heating unit with boiler

Schematic illustration – relevant standards and guidelines must be observed!

Example 10

Heat pump cascade with hydraulic isolation of the heating circuits by means of storage tank

Closed-loop control of cascade operation by means of an external controller, taking into account operating time, redundancy and peak load.

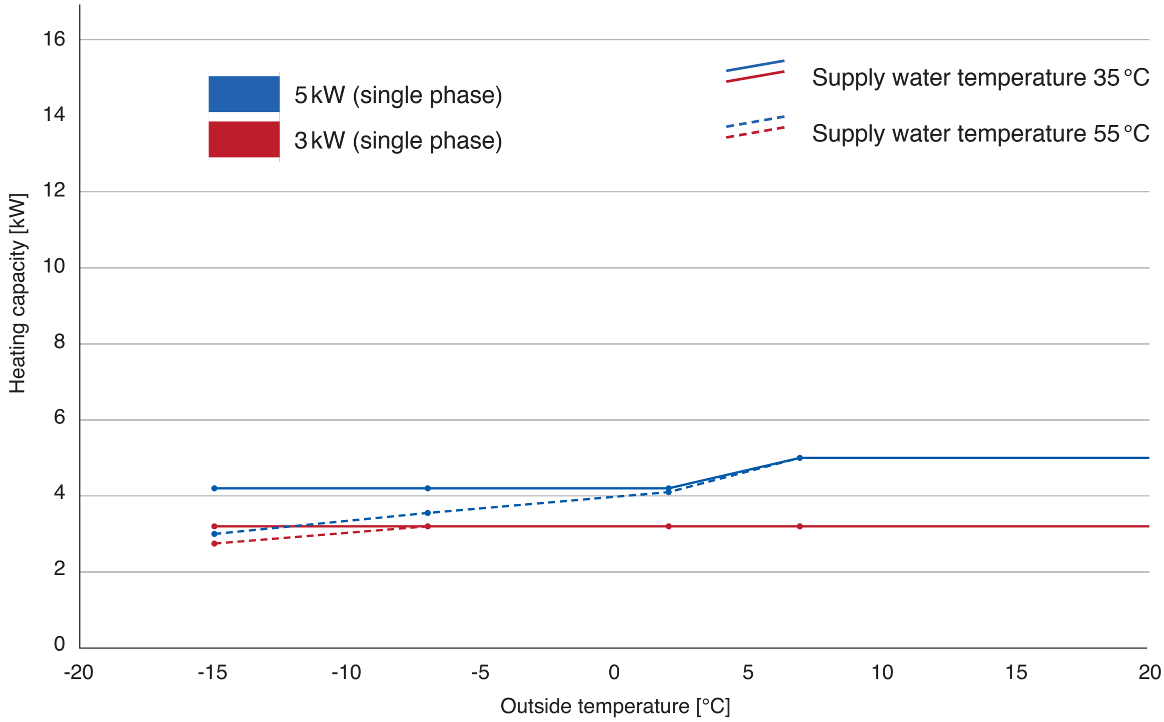


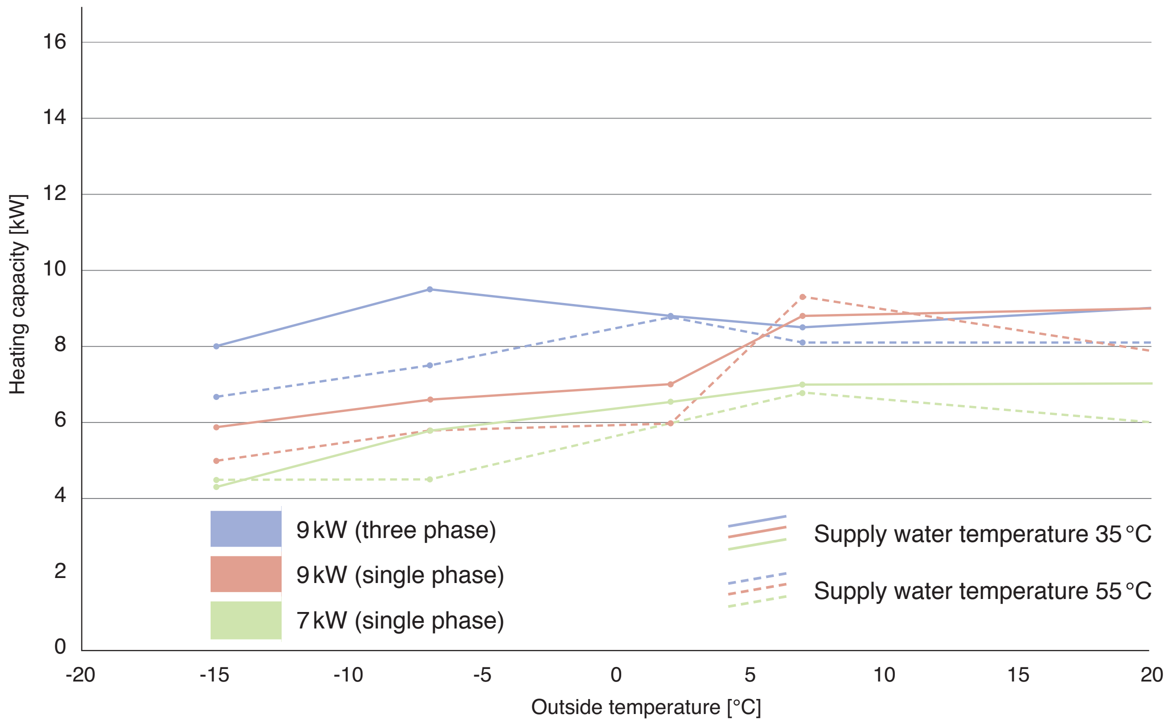
Schematic illustration – relevant standards and guidelines must be observed!

7 Appendix

Heating capacity in relation to supply water and outside temperature

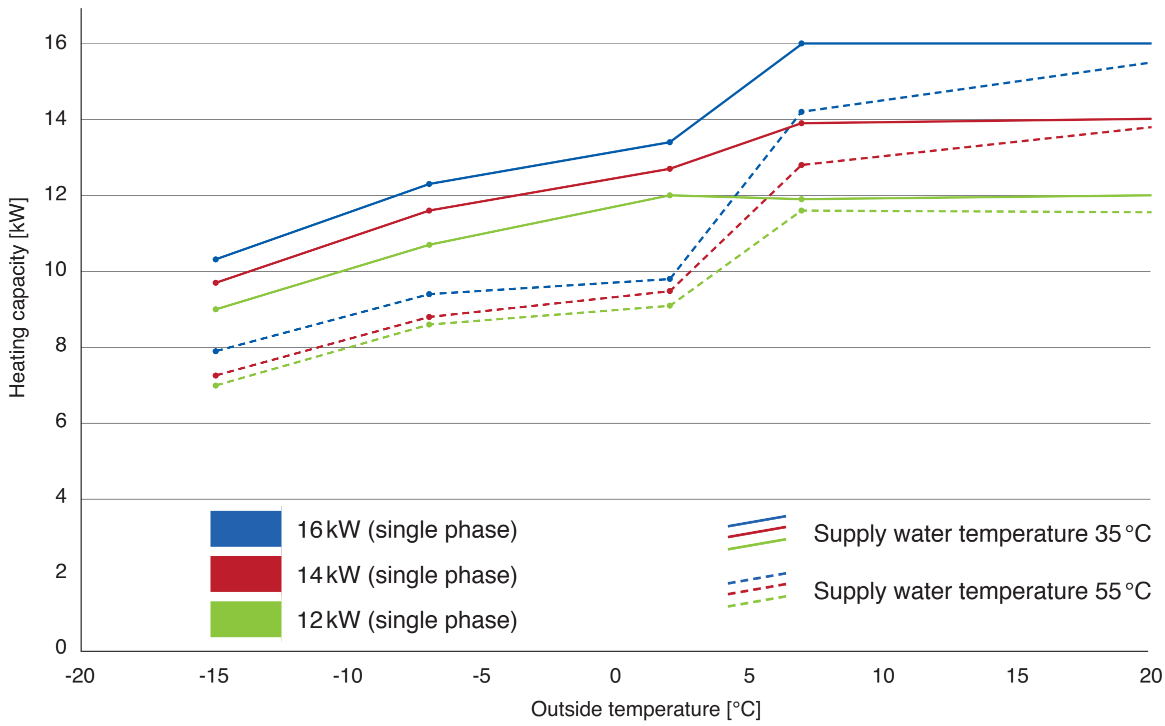
Aquarea LT – split system

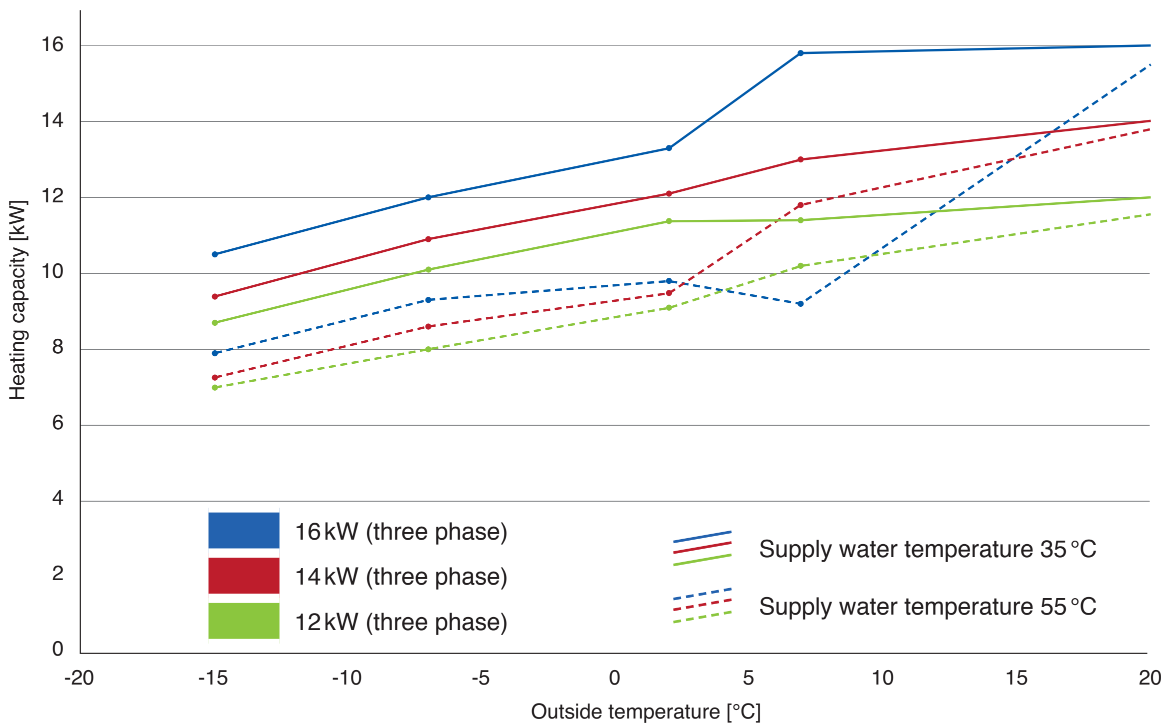




Heating capacity [kW] of individual models of the **split system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

Aquarea LT – split system





Heating capacity [kW] of individual models of the **split system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

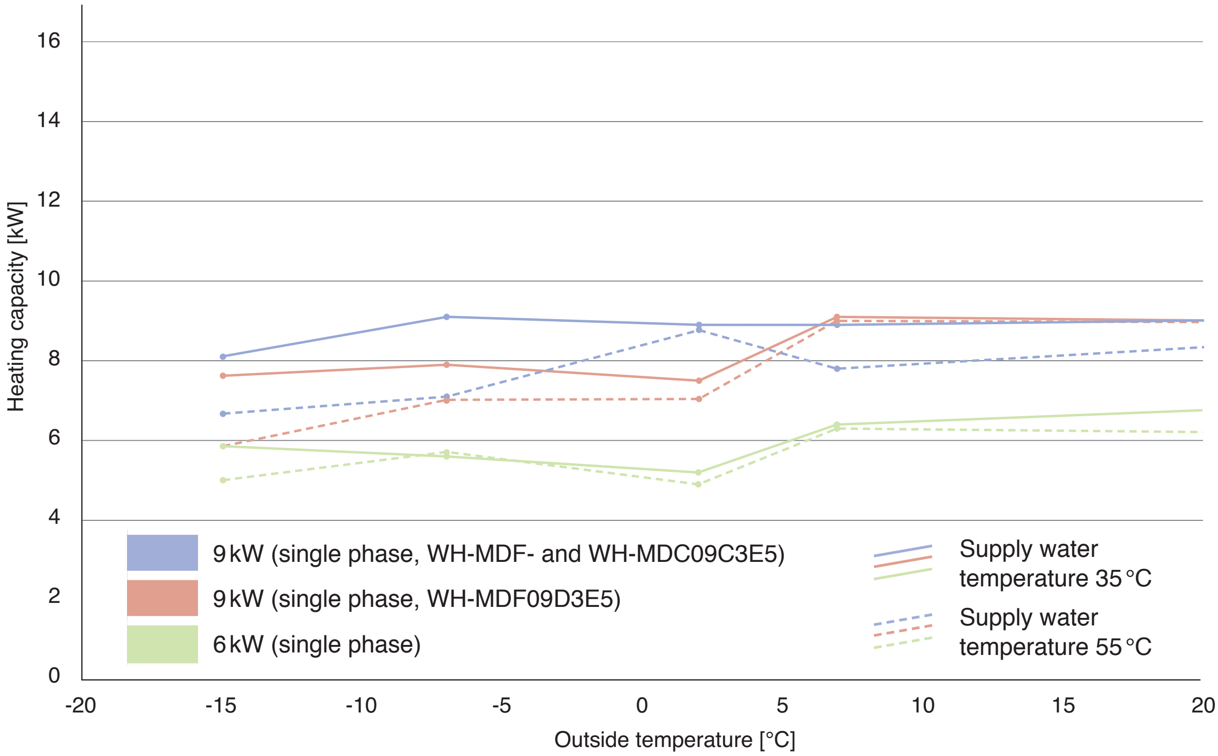
Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**3 kW (single phase)** WH-SDF03E3E5 WH-SDC03E3E5
-15	3,2	3,2	3,1	3,0	2,8	2,75	
-7	3,2	3,2	3,2	3,2	3,2	3,2	
2	3,2	3,2	3,2	3,2	3,2	3,2	
7	3,2	3,2	3,2	3,2	3,2	3,2	
25	3,2	3,2	3,2	3,2	3,2	3,2	
	30	**35**	**40**	**45**	**50**	**55**	**5 kW (single phase)** WH-SDF05E3E5 WH-SDC05E3E5
-15	4,2	4,2	3,8	3,4	3,2	3,0	
-7	4,2	4,2	4,0	3,8	3,7	3,55	
2	4,2	4,2	4,2	4,2	4,15	4,1	
7	5,0	5,0	5,0	5,0	5,0	5,0	
25	5,0	5,0	5,0	5,0	5,0	5,0	
	30	**35**	**40**	**45**	**50**	**55**	**7 kW (single phase)** WH-SDF07C3E5 WH-SDC07C3E5
-15	4,6	4,3	4,6	4,6	4,6	4,5	
-7	5,2	5,8	5,1	5,0	4,9	4,5	
2	6,7	6,6	6,6	6,7	6,3	6,0	
7	7,0	7,0	7,0	7,4	6,9	6,8	
25	7,0	7,0	6,4	6,1	5,9	5,7	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (single phase)** WH-SDF09C3E5 WH-SDC09C3E5
-15	6,0	5,9	5,5	5,4	5,2	5,0	
-7	6,1	6,6	5,9	5,8	5,8	5,6	
2	6,8	7,0	6,7	6,7	6,3	6,0	
7	9,0	8,8	9,0	9,0	9,0	9,3	
25	9,0	9,0	8,4	8,0	7,8	7,5	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (three phase)** WH-SDF09C3E8 WH-SDC09C3E8
-15	8,7	8,0	8,0	7,6	7,2	6,7	
-7	9,4	9,5	8,9	8,7	8,3	7,5	
2	9,3	8,8	9,0	9,0	8,9	8,8	
7	9,0	8,5	9,0	8,5	9,0	8,1	
25	9,0	9,0	8,7	8,5	8,3	8,1	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (single phase)** WH-SDF12C6E5 WH-SDC12C6E5
-15	9,3	9,0	8,5	8,1	7,5	7,0	
-7	10,4	10,7	9,6	9,2	8,7	8,6	
2	11,8	12,0	11,0	10,9	9,8	9,1	
7	12,0	11,9	12,0	11,8	12,0	11,6	
25	12,0	12,0	11,8	11,7	11,5	11,4	
	30	**35**	**40**	**45**	**50**	**55**	**14 kW (single phase)** WH-SDF14C6E5 WH-SDC14C6E5
-15	9,9	9,7	9,0	8,6	7,9	7,3	
-7	11,1	11,6	10,2	9,8	9,1	8,8	
2	12,9	12,7	11,9	11,8	10,4	9,5	
7	14,0	13,9	14,0	14,2	13,6	12,8	
25	14,0	14,0	14,0	14,0	14,0	14,0	
	30	**35**	**40**	**45**	**50**	**55**	**16 kW (single phase)** WH-SDF16C6E5 WH-SDC16C6E5
-15	10,6	10,2	10,0	9,7	8,8	7,9	
-7	11,9	12,3	10,8	10,3	9,6	9,4	
2	13,5	13,4	12,4	12,1	10,8	9,8	
7	16,0	16,0	16,0	15,8	15,2	14,2	
25	16,0	16,0	16,0	16,0	16,0	15,9	

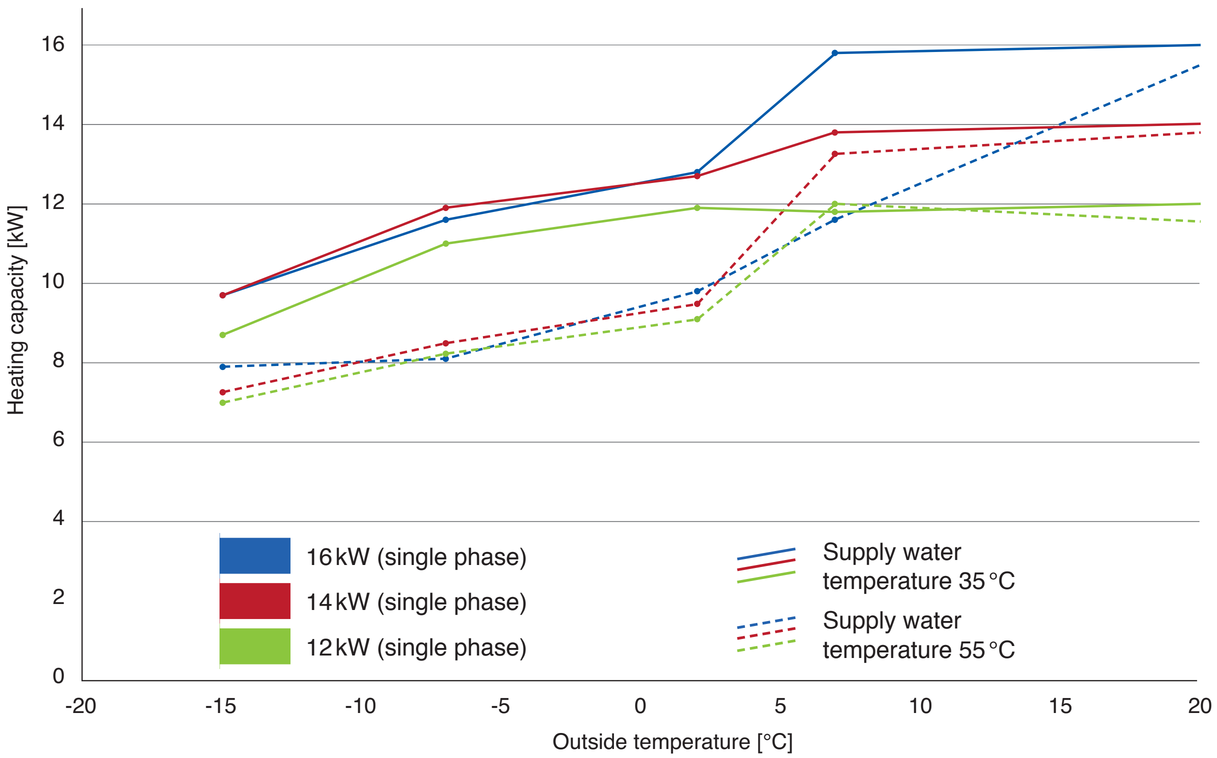
Heating capacity [kW] of individual models of the **split system** for different supply water and outside temperatures [°C].

Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (three phase)** WH-SDF12C9E8 WH-SDC12C9E8
-15	9,3	8,7	8,5	8,1	7,5	7,0	
-7	10,4	10,1	9,6	9,2	8,7	8,0	
2	11,8	11,4	11,0	10,6	9,8	9,1	
7	12,0	11,4	12,0	11,2	12,0	10,2	
25	12,0	12,0	11,8	11,7	11,5	11,4	
	30	**35**	**40**	**45**	**50**	**55**	**14 kW (three phase)** WH-SDF14C9E8 WH-SDC14C9E8
-15	9,9	9,4	9,0	8,6	7,9	7,3	
-7	11,1	10,9	10,2	9,8	9,1	8,6	
2	12,9	12,1	11,9	11,4	10,4	9,5	
7	14,0	13,0	14,0	13,2	13,6	11,8	
25	14,0	14,0	14,0	14,0	14,0	14,0	
	30	**35**	**40**	**45**	**50**	**55**	**16 kW (three phase)** WH-SDF16C9E8 WH-SDC16C9E8
-15	10,6	10,5	10,0	9,7	8,8	7,9	
-7	11,9	12,0	10,8	10,3	9,6	9,3	
2	13,5	13,3	12,4	11,9	10,8	9,8	
7	16,0	15,8	16,0	15,6	15,2	9,2	
25	16,0	16,0	16,0	16,0	16,0	15,9	

Heating capacity [kW] of individual models of the **split system** for different supply water and outside temperatures [°C].

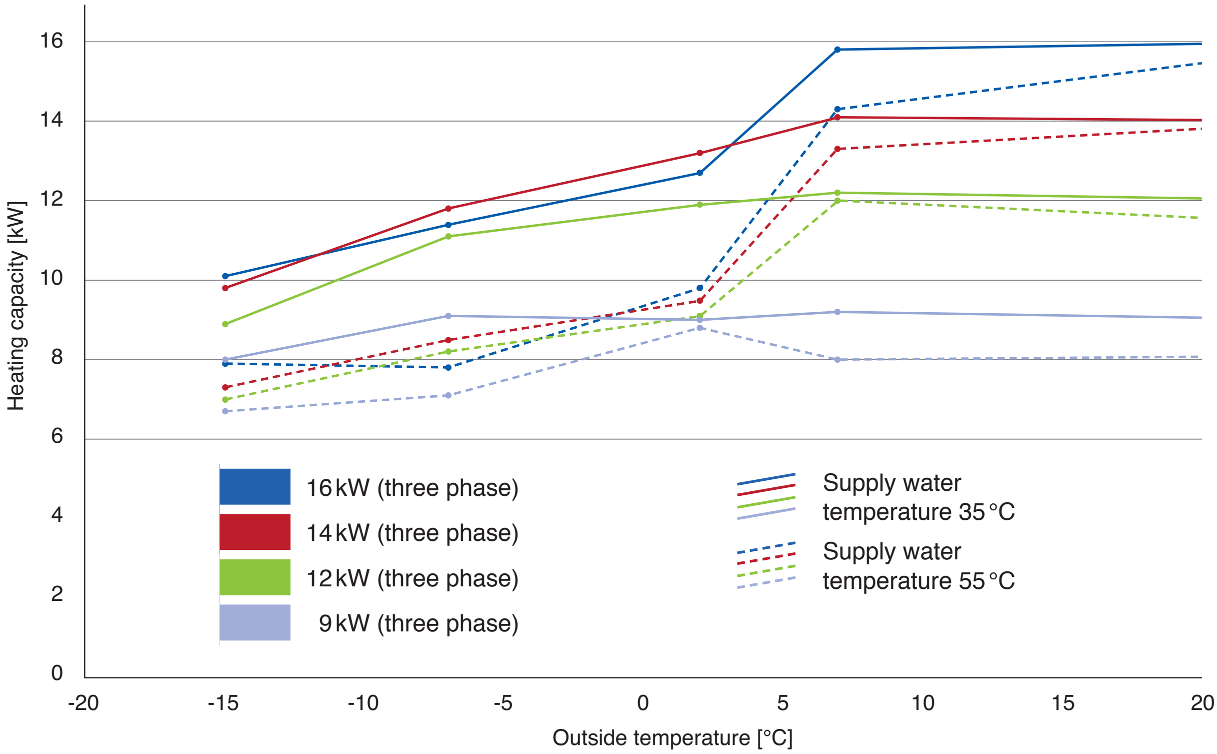
Aquarea LT – compact system





Heating capacity [kW] of individual models of the **compact system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

Aquarea LT – compact system



Heating capacity [kW] of individual models of the **compact system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**6 kW (single phase)** WH-MDF06E3E5
-15	6,2	5,9	5,7	5,4	5,2	5,0	
-7	5,2	5,6	5,1	5,1	5,5	5,7	
2	5,0	5,2	5,0	5,3	5,0	5,0	
7	6,0	6,4	6,0	6,3	6,0	6,3	
25	7,3	7,1	6,9	6,7	6,5	6,3	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (single phase)** WH-MDF09E3E5
-15	7,9	7,6	7,3	7,0	6,5	5,9	
-7	7,8	7,9	7,6	7,5	7,6	7,0	
2	7,0	7,5	7,0	8,0	7,0	7,0	
7	9,0	9,1	9,0	9,5	9,0	9,0	
25	9,0	9,0	9,0	9,0	9,0	9,0	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (single phase)** WH-MDF09C3E5 WH-MDC09C3E5
-15	8,7	8,1	8,0	7,8	7,2	6,7	
-7	9,4	9,1	8,9	8,7	8,0	7,1	
2	9,3	8,9	9,0	9,0	8,3	8,8	
7	9,0	8,9	9,0	8,7	9,0	7,8	
25	9,0	9,0	8,7	8,5	8,3	8,1	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (single phase)** WH-MDF12C6E5 WH-MDC12C6E5
-15	9,3	8,7	8,5	8,1	7,5	7,0	
-7	10,4	11,0	9,6	9,2	8,7	8,2	
2	11,8	11,9	11,0	10,6	9,8	9,1	
7	12,0	11,8	12,0	12,0	12,0	12,0	
25	12,0	12,0	11,8	11,7	11,5	11,4	
	30	**35**	**40**	**45**	**50**	**55**	**14 kW (single phase)** WH-MDF14C6E5 WH-MDC14C6E5
-15	9,9	9,7	9,0	8,6	7,9	7,3	
-7	11,1	11,9	10,2	9,8	9,1	8,5	
2	12,9	12,7	11,9	11,4	10,4	9,5	
7	14,0	13,8	14,0	14,0	13,6	13,3	
25	14,0	14,0	14,0	14,0	14,0	14,0	
	30	**35**	**40**	**45**	**50**	**55**	**16 kW (single phase)** WH-MDF16C6E5 WH-MDC16C6E5
-15	10,6	9,7	10,0	9,7	8,8	7,9	
-7	11,9	11,6	10,8	10,3	9,6	8,1	
2	13,5	12,8	12,4	11,9	10,8	9,8	
7	16,0	15,8	16,0	15,3	15,2	11,6	
25	16,0	16,0	16,0	16,0	16,0	15,9	

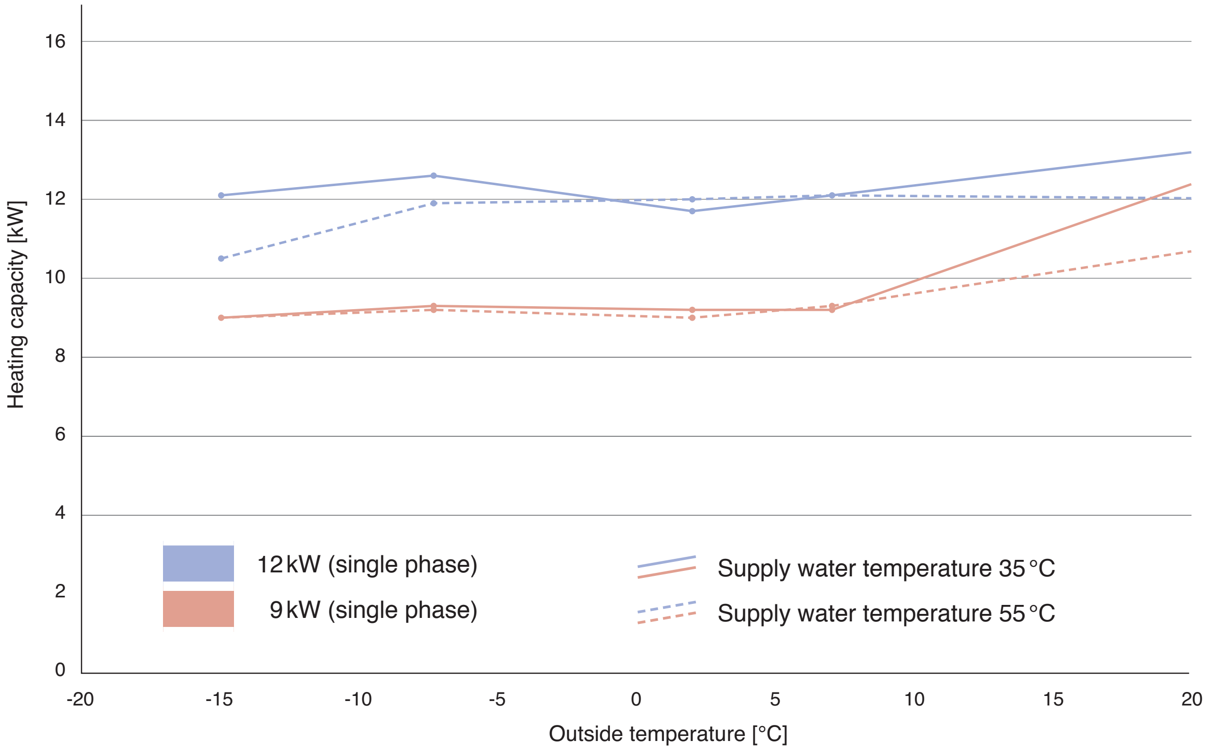
Heating capacity [kW] of individual models of the **compact system** for different supply water and outside temperatures [°C].

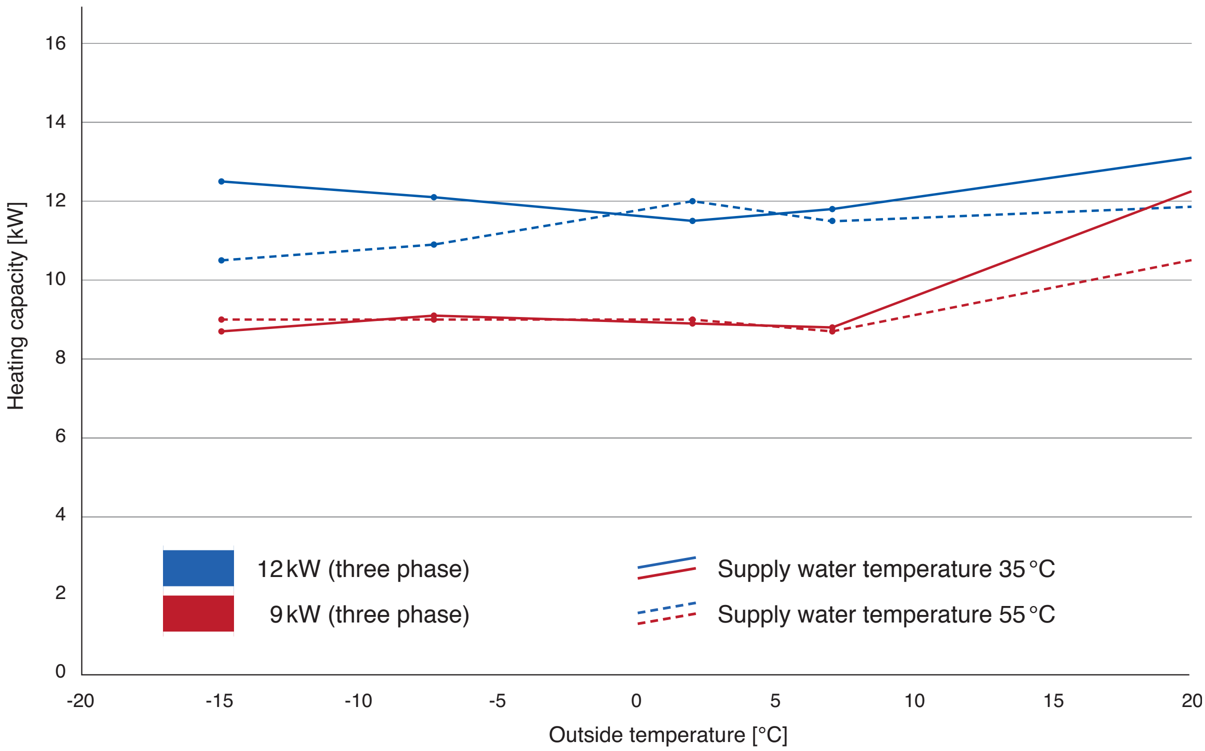
Panasonic ideas for life

Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (three phase)** WH-MDF09C3E8 WH-MDC09C3E8
-15	8,7	8,0	8,0	7,8	7,2	6,7	
-7	9,4	9,1	8,9	8,7	8,0	7,1	
2	9,3	9,0	9,0	9,0	8,3	8,8	
7	9,0	9,2	9,0	9,0	9,0	8,0	
25	9,0	9,0	8,7	8,5	8,3	8,1	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (three phase)** WH-MDF12C9E8 WH-MDC12C9E8
-15	9,3	8,9	8,5	8,1	7,5	7,0	
-7	10,4	11,1	9,6	9,2	8,7	8,2	
2	11,8	11,9	11,0	10,6	9,8	9,1	
7	12,0	12,2	12,0	12,0	12,0	12,0	
25	12,0	12,0	11,8	11,7	11,5	11,4	
	30	**35**	**40**	**45**	**50**	**55**	**14 kW (three phase)** WH-MDF14C9E8 WH-MDC14C9E8
-15	9,9	9,8	9,0	8,6	7,9	7,3	
-7	11,1	11,8	10,2	9,8	9,1	8,5	
2	12,9	12,7	11,9	11,4	10,4	9,5	
7	14,0	14,1	14,0	14,0	13,6	13,3	
25	14,0	14,0	14,0	14,0	14,0	14,0	
	30	**35**	**40**	**45**	**50**	**55**	**16 kW (three phase)** WH-MDF16C9E8 WH-MDC16C9E8
-15	10,6	10,1	10,0	9,7	8,8	7,9	
-7	11,9	11,4	10,8	10,3	9,6	7,8	
2	13,5	12,7	12,4	11,9	10,8	9,8	
7	16,0	15,8	16,0	15,9	15,2	14,3	
25	16,0	16,0	16,0	16,0	16,0	15,9	

Heating capacity [kW] of individual models of the **compact system** for different supply water and outside temperatures [°C].

Aquarea T-CAP – split system





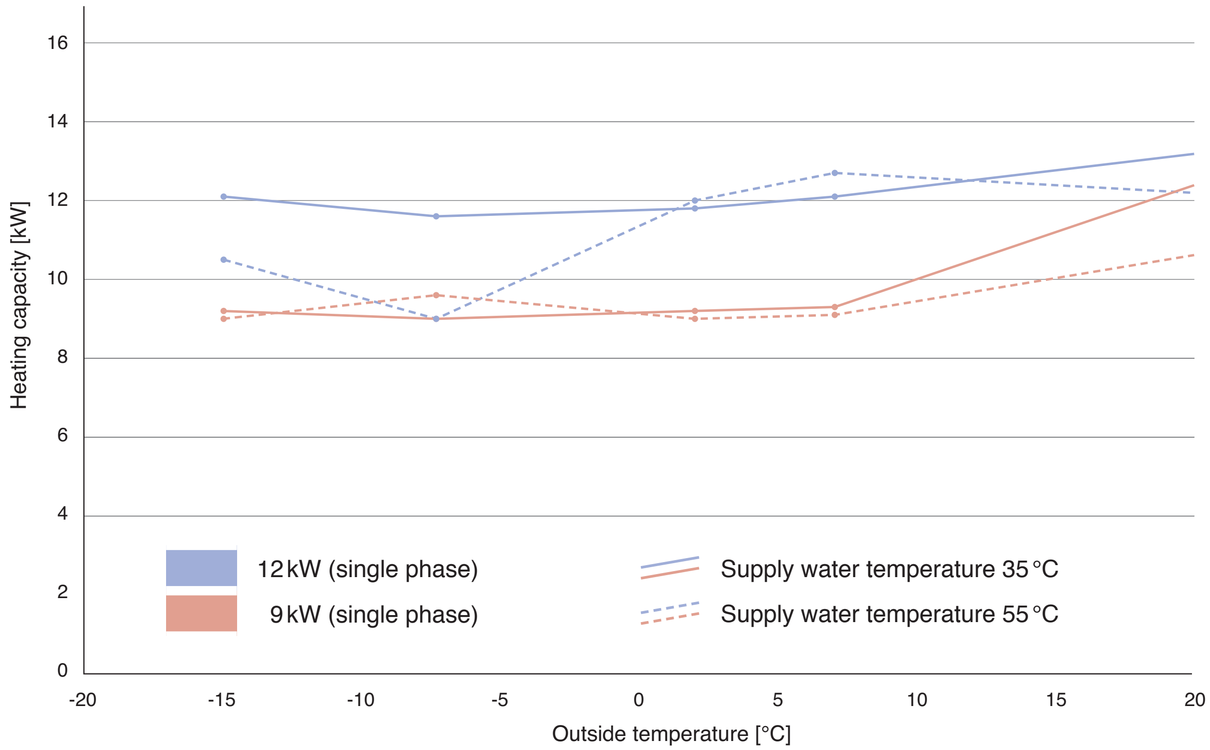
Heating capacity [kW] of individual models of the **split system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

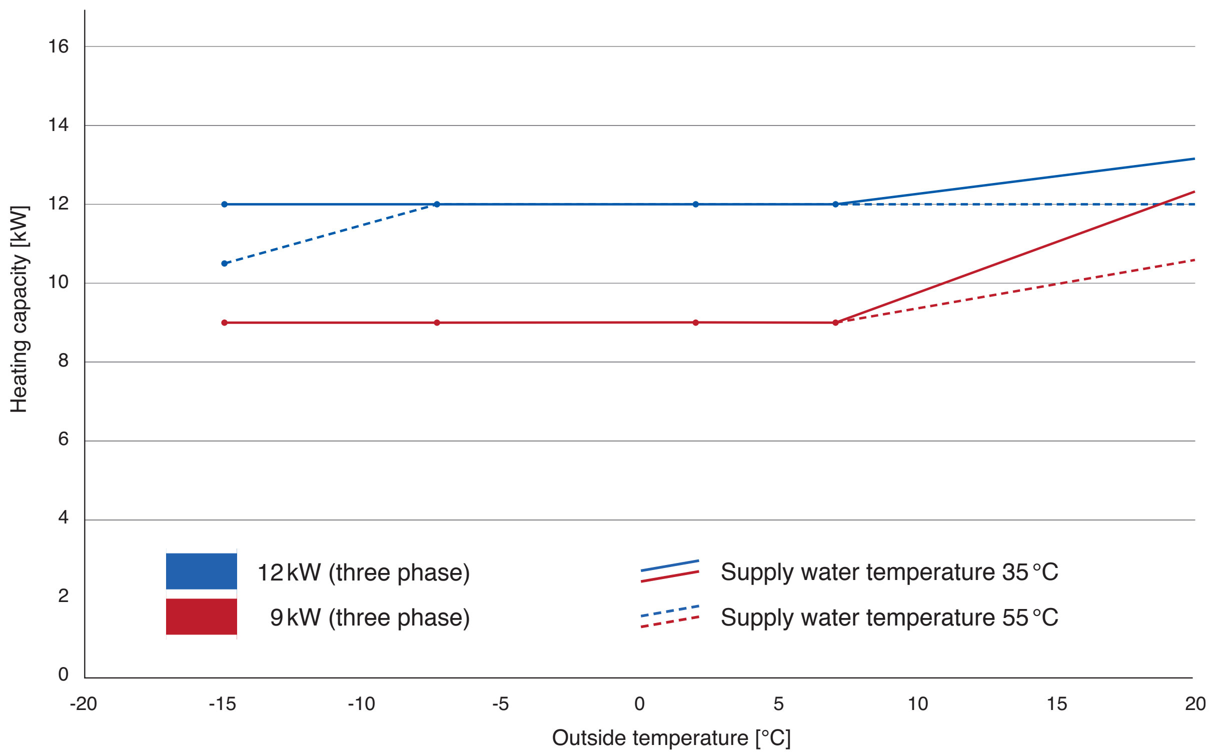
Panasonic
ideas for life

Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (single phase)** WH-SXF09D3E5 WH-SXC09D3E5
-15	9,0	9,0	9,0	9,0	9,0	9,0	
-7	9,0	9,3	9,0	9,0	9,0	9,2	
2	9,0	9,2	9,0	9,2	9,0	9,0	
7	9,0	9,2	9,0	9,3	9,0	9,3	
25	13,6	13,6	13,2	12,8	12,0	11,2	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (single phase)** WH-SXF12D6E5 WH-SXC12D6E5
-15	12,0	12,1	11,5	11,0	10,7	10,5	
-7	12,0	12,6	12,0	12,0	12,0	11,9	
2	12,0	11,7	12,0	12,2	12,0	12,0	
7	12,0	12,1	12,0	12,3	12,0	12,1	
25	13,6	13,6	13,4	13,2	12,6	12,0	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (three phase)** WH-SXF09D3E8 WH-SXC09D3E8
-15	9,0	8,7	9,0	9,0	9,0	9,0	
-7	9,0	9,1	9,0	9,0	9,0	9,0	
2	9,0	8,9	9,0	8,7	9,0	9,0	
7	9,0	8,8	9,0	8,6	9,0	8,7	
25	13,6	13,6	13,2	12,8	12,0	11,2	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (three phase)** WH-SXF12D9E8 WH-SXC12D9E8
-15	12,0	12,5	11,5	11,0	10,7	10,5	
-7	12,0	12,1	12,0	12,0	12,0	10,9	
2	12,0	11,5	12,0	11,7	12,0	12,0	
7	12,0	11,8	12,0	11,8	12,0	11,5	
25	13,6	13,6	13,4	13,2	12,6	12,0	

Heating capacity [kW] of individual models of the **split system** for different supply water and outside temperatures [°C].

Aquarea T-CAP – compact system



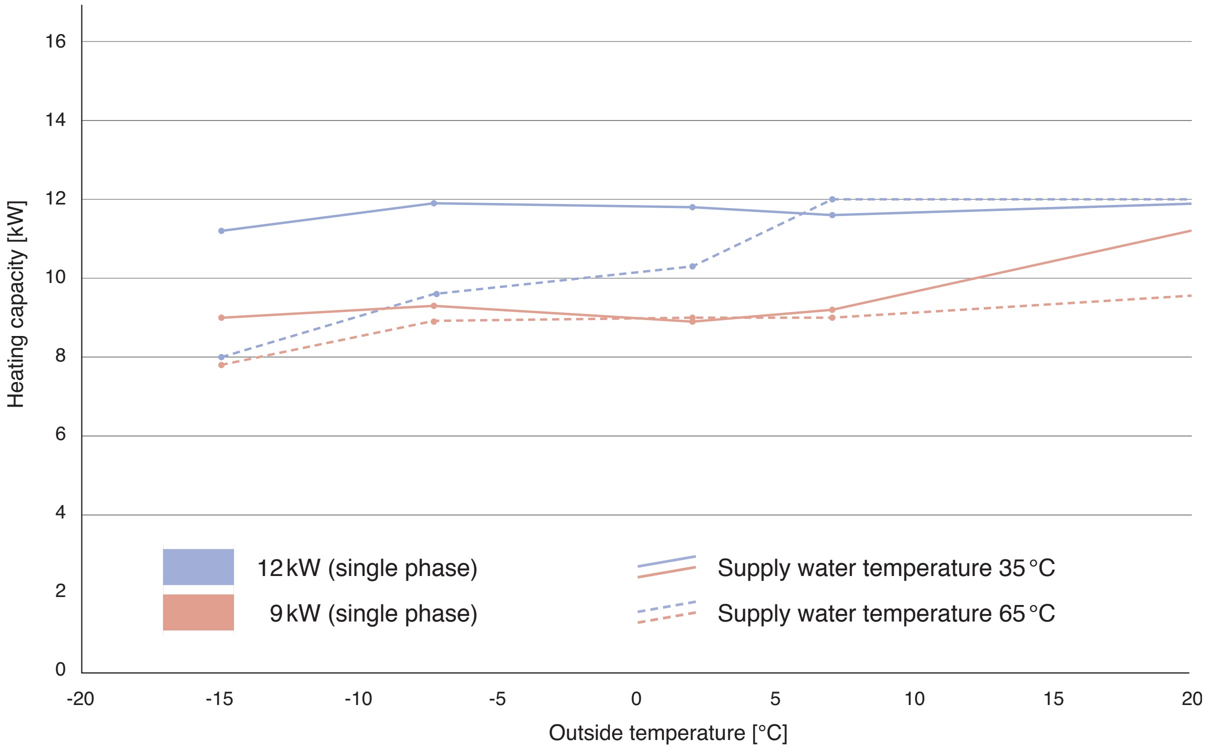


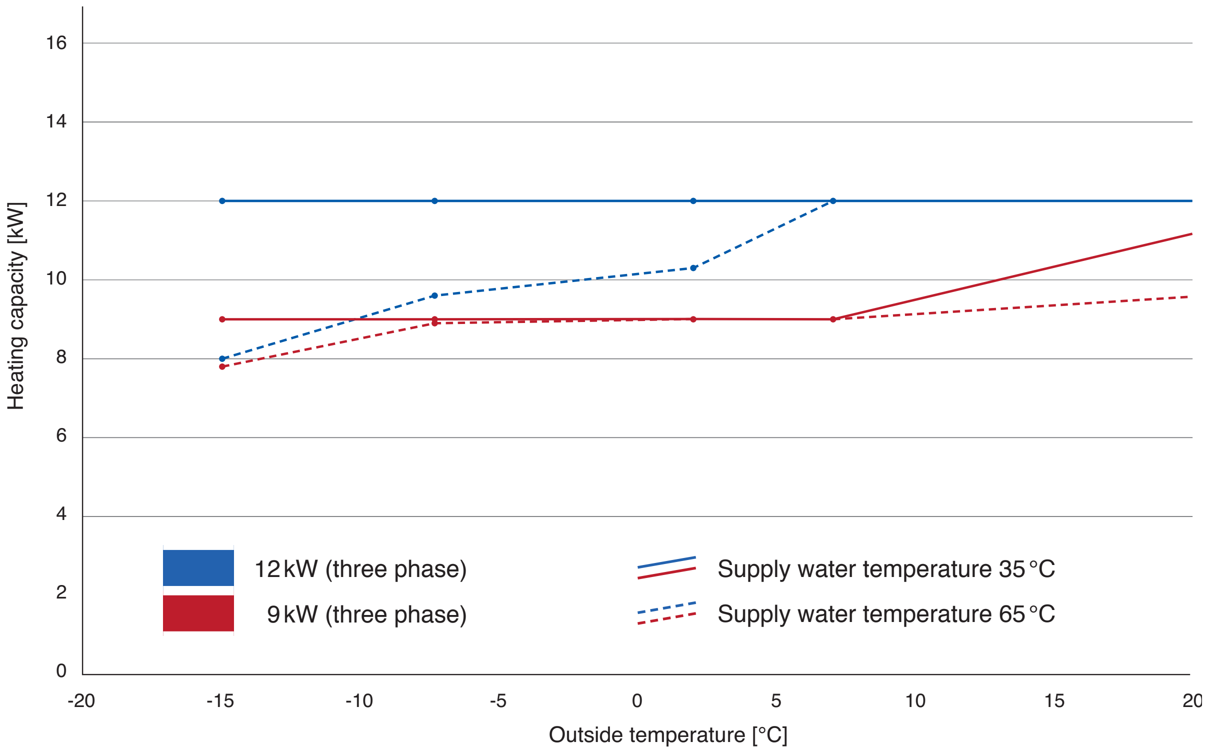
Heating capacity [kW] of individual models of the **compact system** for different outside temperatures and a supply water temperature of 35 or 55 °C.

Outside temperature	Supply water temperature						Models
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (single phase)** WH-MXF09D3E5 WH-MXC09D3E5
-15	9,0	9,2	9,0	9,0	9,0	9,0	
-7	9,0	9,0	9,0	9,0	9,0	9,6	
2	9,0	9,2	9,0	9,0	9,0	9,0	
7	9,0	9,3	9,0	9,2	9,0	9,1	
25	13,6	13,6	13,2	12,8	12,0	11,2	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (single phase)** WH-MXF12D6E5 WH-MXC12D6E5
-15	12,0	12,1	11,5	11,0	10,7	10,5	
-7	12,0	11,6	12,0	12,0	12,0	9,0	
2	12,0	11,8	12,0	12,0	12,0	12,0	
7	12,0	12,1	12,0	12,5	12,0	12,7	
25	13,6	13,6	13,4	13,2	12,6	12,0	
	30	**35**	**40**	**45**	**50**	**55**	**9 kW (three phase)** WH-MXF09D3E8 WH-MXC09D3E8
-15	9,0	9,0	9,0	9,0	9,0	9,0	
-7	9,0	9,0	9,0	9,0	9,0	9,0	
2	9,0	9,0	9,0	9,0	9,0	9,0	
7	9,0	9,0	9,0	9,0	9,0	9,0	
25	13,6	13,6	13,2	12,8	12,0	11,2	
	30	**35**	**40**	**45**	**50**	**55**	**12 kW (three phase)** WH-MXF12D9E8 WH-MXC12D9E8
-15	12,0	12,0	11,5	11,0	10,7	10,5	
-7	12,0	12,0	12,0	12,0	12,0	12,0	
2	12,0	12,0	12,0	12,0	12,0	12,0	
7	12,0	12,0	12,0	12,0	12,0	12,0	
25	13,6	13,6	13,4	13,2	12,6	12,0	

Heating capacity [kW] of individual models of the **compact system** for different supply water and outside temperatures [°C].

Aquarea HT – split system





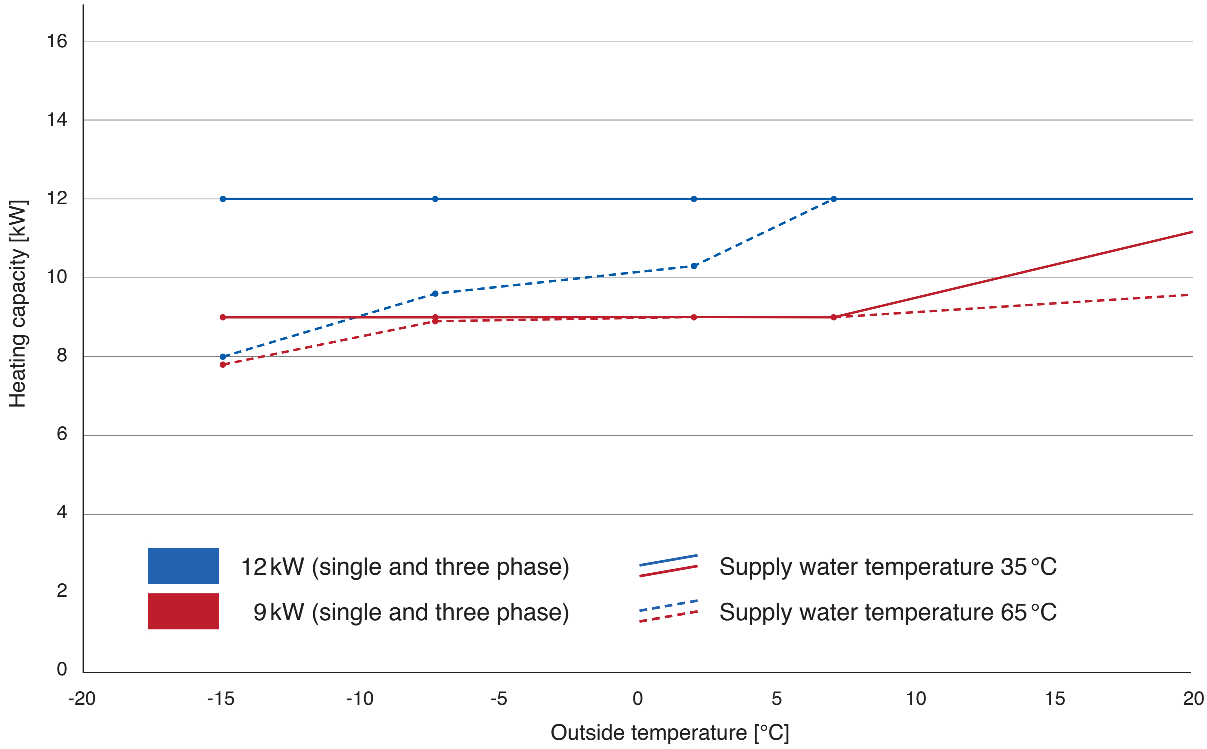
Heating capacity [kW] of individual models of the **split system** for different outside temperatures and a supply water temperature of 35 or 65 °C.

Panasonic ideas for life

Outside temperature	Supply water temperature								Models
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**9 kW (single phase)** WH-SHF09D3E5
-15	9,0	9,0	8,9	8,8	8,5	8,5	8,0	7,8	
-7	9,0	9,3	9,0	8,9	8,9	9,3	8,9	8,9	
2	9,0	8,9	9,0	8,3	9,0	9,0	9,0	9,0	
7	9,0	9,2	9,0	9,2	9,0	8,8	9,0	9,0	
25	12,0	12,0	12,0	10,8	10,2	11,2	10,0	9,8	
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**12 kW (single phase)** WH-SHF12D6E5
-15	12,0	11,2	11,0	10,6	10,3	9,7	9,0	8,0	
-7	12,0	11,9	11,5	11,2	10,8	10,2	9,9	9,6	
2	12,0	11,5	11,5	10,5	11,0	10,8	10,7	10,3	
7	12,0	11,6	12,0	11,5	12,0	11,7	12,0	12,0	
25	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0	
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**9 kW (three phase)** WH-SHF09D3E8
-15	9,0	9,0	8,9	8,8	8,5	8,5	8,0	7,8	
-7	9,0	9,0	9,0	8,9	8,9	8,9	8,9	8,9	
2	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	
7	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	
25	12,0	12,0	12,0	10,8	10,2	11,2	10,0	9,8	
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**12 kW (three phase)** WH-SHF12D9E8
-15	12,0	12,0	11,0	10,6	10,3	9,7	9,0	8,0	
-7	12,0	12,0	11,5	11,2	10,8	10,1	9,9	9,6	
2	12,0	12,0	11,5	11,3	11,0	10,8	10,7	10,3	
7	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0	
25	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0	

Heating capacity [kW] of individual models of the **split system** for different supply water and outside temperatures [°C].

Aquarea HT – compact system



Heating capacity [kW] of individual models of the **compact system** for different outside temperatures and a supply water temperature of 35 or 65 °C.

Outside temperature	Supply water temperature								Models
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**9 kW (single and three phase)** WH-MHF09D3E5 WH-MHF09D3E8
-15	9,0	9,0	8,9	8,8	8,5	8,5	8,0	7,8	
-7	9,0	9,0	9,0	8,9	8,9	8,9	8,9	8,9	
2	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	
7	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	
25	12,0	12,0	12,0	10,8	10,2	11,2	10,0	9,8	
	30	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**12 kW (single and three phase)** WH-MHF12D6E5 WH-MHF12D9E8
-15	12,0	12,0	11,0	10,6	10,3	9,7	9,0	8,0	
-7	12,0	12,0	11,5	11,2	10,8	10,1	9,9	9,6	
2	12,0	12,0	11,5	11,3	11,0	10,8	10,7	10,3	
7	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0	
25	12,0	12,0	12,0	12,0	12,0	12,0	12,0	12,0	

Heating capacity [kW] of individual models of the **compact system** for different supply water and outside temperatures [°C].

Cooling capacity in relation to supply water and and outside temperature

Aquarea LT

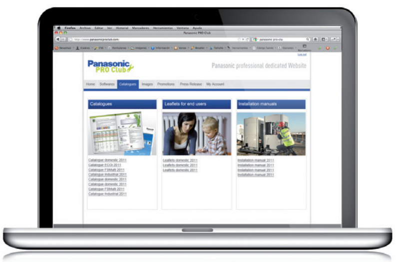
Outside temperature	Supply water temperature			Models
	7	**14**	**18**	**3 kW (single phase)**
18	2,4	4,4	3,7	WH-SDC03E3E5
25	3,2	4,1	3,5	
35	3,2	3,9	3,3	
43	2,9	3,5	3,0	
	7	**14**	**18**	**5 kW (single phase)**
18	4,5	5,0	5,7	WH-SDC05E3E5
25	5,0	6,3	5,4	
35	4,5	5,5	5,0	
43	3,3	4,1	4,4	
	7	**14**	**18**	**7 kW (single phase)**
18	5,1			WH-SDC07C3E5
25	6,6			
35	6,0	7,3	8,0	
43	5,1			
	7	**14**	**18**	**9 kW (single phase)**
18	5,9			WH-SDC09C3E5
25	7,8			
35	7,0	8,3	9,0	
43	6,2			
	7	**14**	**18**	**9 kW (single and three phase)**
18	5,9			WH-MDC09
25	7,5			WH-SDC09C6E8
35	7,0	8,3/8,6	9,0/9,5	
43	5,8			
	7	**14**	**18**	**12 kW (single and three phase)**
18	7,7			WH-MDC12/
25	9,2			WH-SDC12
35	10,0	11,6/11,8	12,5/12,8	
43	7,6			
	7	**14**	**18**	**14 kW (single and three phase)**
18	8,9			WH-MDC14/
25	10,0			WH-SDC14
35	11,5	12,8/13,4	13,5/14,5	
43	9,1			
	7	**14**	**18**	**16 kW (single and three phase)**
18	9,6			WH-MDC16/
25	10,5			WH-SDC16
35	12,2	13,4/14,6	14,1/16,0	
43	10,1			

Cooling capacity [kW] of individual models of the **split and compact systems** for different outside temperatures and a supply water temperature of 7 °C.

Aquarea T-CAP

Outside temperature	Supply water temperature			Models
	7	**14**	**18**	**9 kW (single and three phase)** WH-MXC09 / WH-SXC09
18	7,0			
25	7,7			
35	7,0	8,3 / 9,2	9,0 / 10,5	
43	6,3			
	7	**14**	**18**	**12 kW (single and three phase)** WH-MXC12 / WH-SXC12
18	7,5			
25	8,9			
35	10,0	11,6 / 12,6	12,5 / 14,0	
43	8,0			

Cooling capacity [kW] of individual models of the **split and compact systems** for different outside temperatures and a supply water temperature of 7 °C.



PANASONIC PRO CLUB

Panasonic announces a new initiative for all professionals involved in the heating and cooling business - the Panasonic PRO Club (www.panasonicproclub.com).

This exciting new portal provides distributors, installers, engineers and specifiers with a direct communication channel with one of the industry's major manufacturers.

The website contains a wealth of information from the latest versions of Panasonic's Aquarea and Etherea Design Software, to Technical Documentation, Catalogues and Images for the company's wide range of heating and cooling systems - all in an easy to navigate and use website.

Also, registered users will be able to access news regarding special promotions and take advantage of these offers, as well as access helpful business advice such as ideas and guidelines for showroom decoration or van livery featuring Panasonic logos and display material.

www.panasonicproclub.com

Panasonic

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