MITSUBISHI ELECTRIC
Heating and Cooling

QAHV Hot Water Heat Pump
High Temperature Application

THE CITY MULTI QAHV HOT WATER HEAT PUMP

CITY MULTI®

MitsubishiElectricQAHV.ca

QAHV Hot Water Heat Pump

As a leading manufacturer of air-to-water heat pumps, Mitsubishi Electric has developed QAHV; the latest innovation in their comprehensive lineup of Hot Water Heat Pump products. QAHV has been specifically designed to produce hot water of up to 80°C** and is suitable for commercial and industrial applications where hot water demand is high. By adopting Mitsubishi Electric's unique technology, the QAHV ensures highly reliable performance as well as high heating capacity even at low outdoor temperatures.

Main Features of QAHV

- Utilizes natural refrigerant (CO_2)
- High efficiency (Achieved COP 4.11*)
- Supplies high temperature hot water of up to 80ºC**
- Operable even at low outdoor temperature of -25ºC

Ideal Applications:

- ✓ Healthcare
- ✓ Hospitality
- ✓ Education Institutions
- ✓ Residential Buildings
- ✓ Commercial Buildings
- ✓ Aged Care Facilities
- ✓ Fitness Centres
- ✓ Spas

Why is CO_2 Refrigerant Used?

The QAHV adopts CO_2 (R744) as it is an environmentally-friendly, natural refrigerant which has zero Ozone Depletion Potential (ODP) and has a Global Warming Potential (GWP) of 1.

Increased Energy Savings

Unique to Mitsubishi Electric, the QAHV utilizes a twisted and spiral gas cooler. Using twisted pipes as water pipes and running the refrigerant pipes along their grooves helps to increase the heat-conductive area; allowing for better heat transfer and an impressive COP of 4.11*. The continuous spiral groove design accelerates the turbulence effect of water and helps to reduce pressure loss within the heat exchanger, enhancing efficiency. Equipped with the latest inverter scroll compressor, QAHV offers unparalleled efficiency when compared to fixed speed systems.

Superior Heating Performance in Low Temperatures

The unit operates to supply up to 80°C** hot water and can operate at low outdoor temperatures of -25°C. This superior level of performance is achieved using Mitsubishi Electric's industry-first Flash Injection Circuit which provides the optimum amount of refrigerant to the system via a compressor through a specially designed injection port, ensuring highly stable operation.

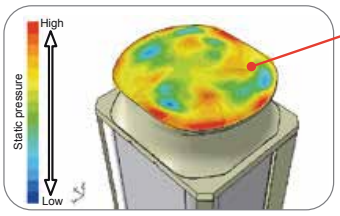
*Under normal heating conditions at outdoor temp: 27°C DB/21.8°C WB, inlet water temp 21.1°C, and outlet water temp 48.9°C.

** Maximum outlet hot water temp on secondary side is 70°C.

Names and Parts Features

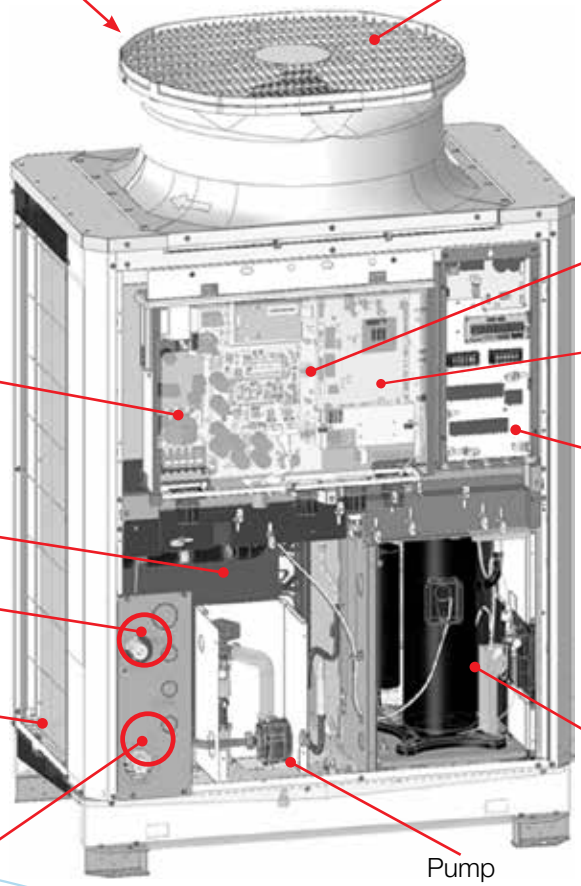
New bellmouth-shaped hood

The bellmouth-shaped hood achieves reduction in fan rotation and increases the pressure at the hood outlet compared to that of the old one, resulting in reduced input power to the fan.



QAHV STRUCTURE

Components such as the pump, compressor and Control box are located in accessible positions, reducing the workers' burden.



Product Features / Benefits

The QAHV is a hot water heat pump unit which uses CO_2 as refrigerant and can provide hot water of up to 80°C** and operate at low outdoor temperatures of -25°C.

Nominal Capacity 40 kW

- Utilizes Natural refrigerant (CO_2)
- High efficiency (Achieved COP 4.11*)
- Supply High Temp Hot water (up to 80°C**)
  Operable at low outdoor temp (AT -25°C)
- Connection to Open Network (Modbus)

TABLE 1: Properties of several refrigerants compared to CO_2

NUMERICAL ASSIGNMENT	ODP/GWP
R-134a	0/1,300
R-290	0/3
R-744 (CO2)	0/1
R-22	0.05/1,700
R-717	0/0
R-407C	0/1,610

*Under normal heating conditions at outdoor temp: 27°C DB/21.8°C WB, inlet water temp 21.1°C, outlet water temp 48.9°C

**Maximum outlet hot water temp on secondary side is 70°C.

Product Features / Benefits

High Energy Savings

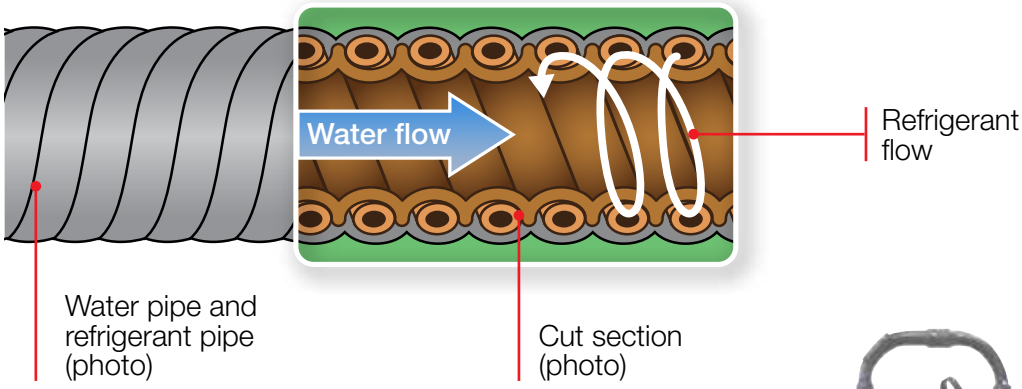
By adopting highly efficient key devises, the QAHV can achieve a high COP of 4.11*. The QAHV utilizes a twisted & spiral gas cooler which is Mitsubishi Electric's unique technology. The 3 connected refrigerant pipes are wound around the twisted water pipe, which maximizes heat transfer. The continuous spiral grooves in the twisted pipe accelerates the turbulence effect of water and also helps to reduce pressure loss within the heat exchanger which contributes to enhance efficiency. Equipped with the latest inverter scroll compressor, the QAHV can significantly increase the annual efficiency which fixed speed systems can not match.

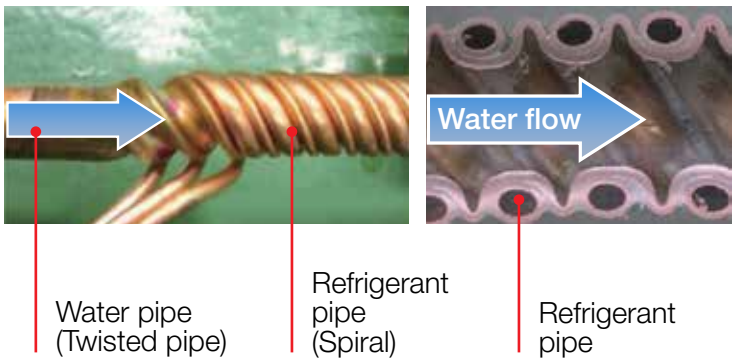
*Under normal heating conditions at outdoor temp: 27°C DB/21.8°C WB, inlet water temp 21.1°C, and outlet water temp 48.9°C.

Twisted & spiral gas cooler

Patented technology

Using twist pipes as water pipes and running the refrigerant pipes along their grooves help increasing the heat-conductive area, allowing for better heat transfer.





Inverter scroll compressor

Mitsubishi Electric's CO_2 inverter compressor

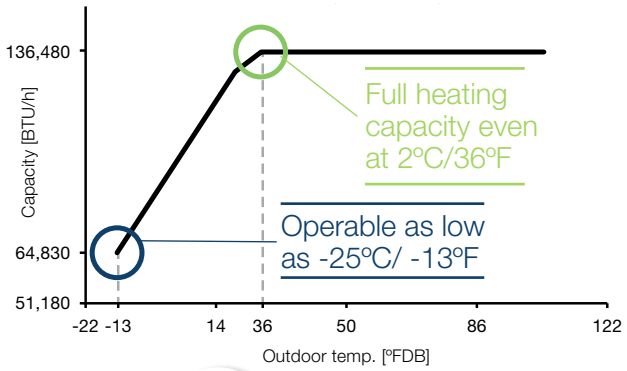
Product Features / Benefits

Maximum hot water supply temperature of up to 80°C** / Supports minimum outdoor temperature of -25°C.

By utilizing the advanced technology;
Flash injection circuit and high-efficiency **inverter driven scroll compressor**, QAHV can provide up to 80°C** hot water and can operate at low outdoor temperatures of -25°C.

**Maximum outlet hot water temp on secondary side is 70ºC.

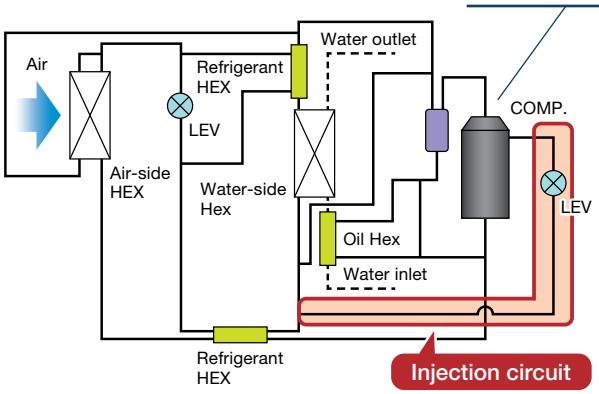
Stable Heating Capacity even at low temperature



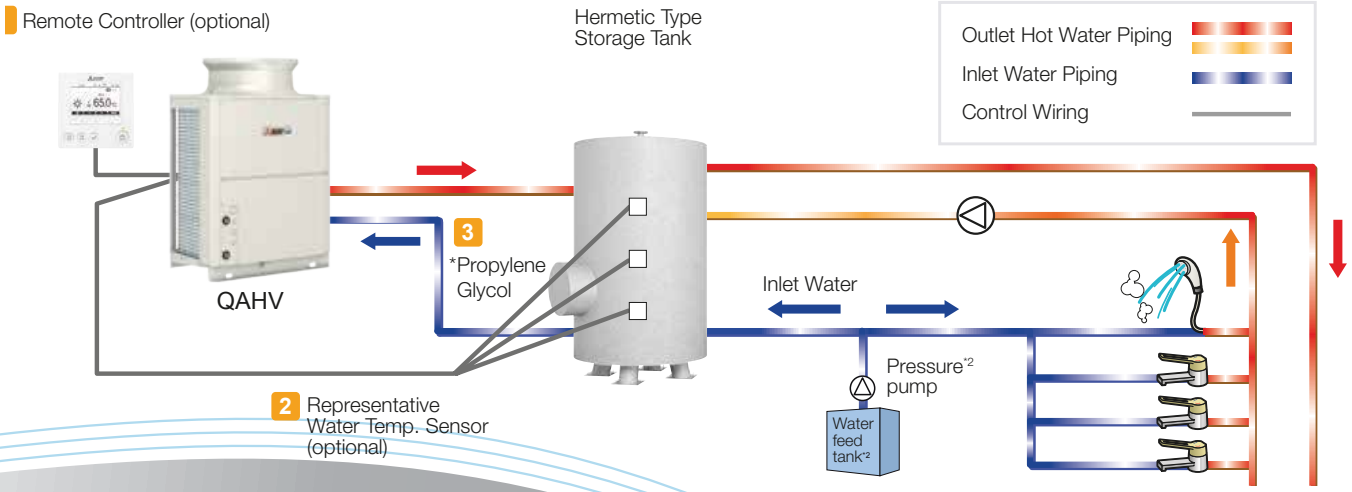
Operable as low as -25°C

High performance even at low outdoor temp.

Highly efficient inverter-driven CO_2 scroll compressor



QAHV System Schematic image*1



*1. If the system does not meet the water quality standard, malfunctions such as scale formation or corrosion may occur. Such water cannot be used in a system in which water is directly supplied to the unit.
*2. Must be procured locally.

Control Options

3 different methods on how to control water temperature in the QAHV system.

METHOD ONE

Local Control

Controlling target outlet water temp of the QAHV

METHOD TWO

3 Sensor Control

Controlling the water temp in the storage tank by using three water temp sensors. **(TW-TH16E)**

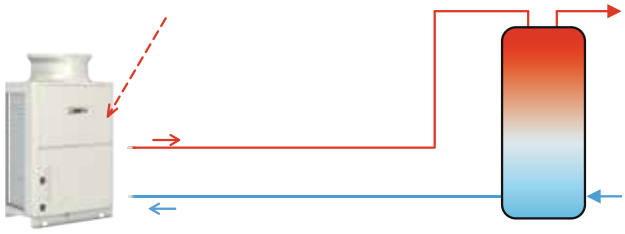
METHOD THREE

6 Sensor Control*

Controlling the water temp in the storage tank by using six water temp sensors **(TW-TH16E)**

Local Control

IT terminal input or no-voltage contact input
On signal: Start operation
Off signal: Stop

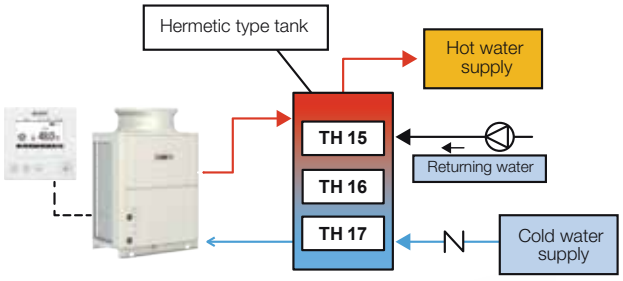


Controlling QAHV's outlet hot water temperature by Analog signal input or dip switches (Control board on the unit)

Advantages:

Using the QAHV input and output contacts, hot water supply system can be freely configured on-site. This system is suitable if you want to configure a system freely by yourself.

3 Sensor Control



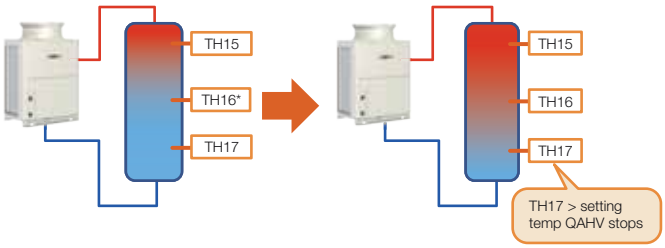
Controlling the water temp in the storage tank by using three water temp sensors **(TW-TH16E)**

Advantages:

The use of three sensors facilitates the control of hot water conditions in the storage tank. This control is suited for systems consisting of a small system, and for controlling the amount of hot water supply easily.

Control Options

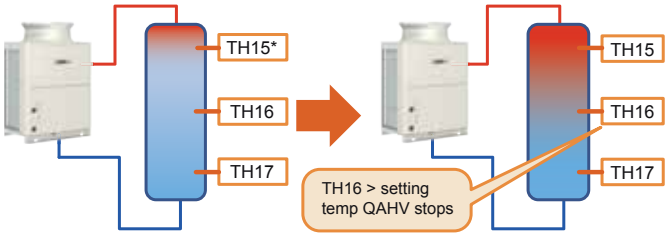
DHW storage volume is large
Thermo-ON = TH16, Thermo-OFF = TH17



* TH16 temperature < (Set water temperature - Mode 2 Thermo differential value [Code: 1509]). Unit operation start.

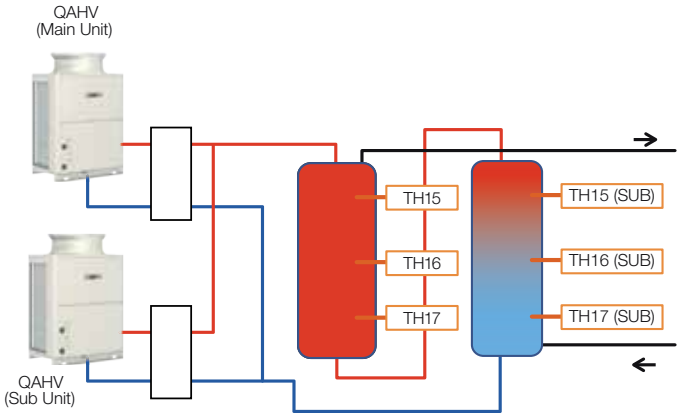
DHW heat storage volume is small
Thermo-ON = TH15, Thermo-OFF = TH16

* To be set on the circuit board for each operation mode/Default value is differential 10°C.



* TH15 temperature < (Set water temperature - Mode 1 Thermo differential value [Code: 1508]). Unit operation start.

6 Sensor Control



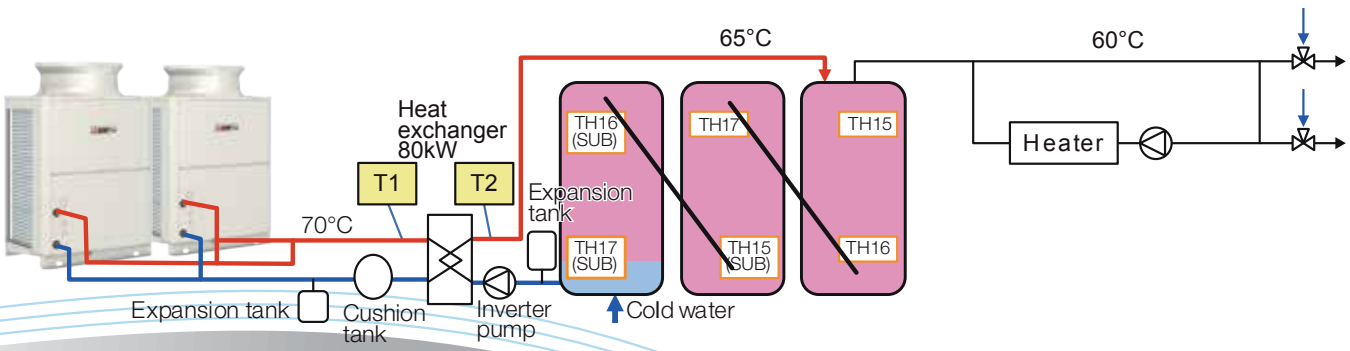
Controlling the water temp in the storage tank by using six water temp sensors (TW-TH16E)

* Requires 2 or more QAHVs to use the 6 sensors

Advantages:

Using six sensors, the hot water conditions in the storage tank can be controlled precisely. This control is suited for cases where multiple tanks are connected to store hot water, and the amount of hot water supply needs to be precisely controlled, depending on the hour of the day in systems with two or more QAHVs.

EXAMPLE OF PUMP CONTROL ON THE SECONDARY SIDE OF HEAT EXCHANGER AND COMPRESSOR OPERATION FOR SPONTANEOUS FREEZE PREVENTIVE OPERATION



Control Options

1. Secondary pump control (on-site work)

This function controls the amount of flow on secondary side to adjust the heat exchanger secondary side outlet water temperature “T2” to the following target value.
Target value = Lower value out of either "secondary side outlet water temp. " or " primary side inlet water temp. “T1” - predefined temp. difference"
If the latest value < target value, it reduces the flow rate, and if the latest value > target value, increases the flow rate. However, if the target value is equal to or less than "predefined temp. 1", it does not operate the secondary pump.

Example: Secondary side outlet water temp. set value = 65°C, predefined temp. difference = 3K, predefined temp. 1 = 40°C

2. Spontaneous freezing prevention for heat pump unit

Prevents spontaneous freezing by operating the compressor (PCB DIP SW2-5: ON)
(Secondary side pump is never operated for freeze prevention)
The above mentioned secondary pump control takes into account that some or all of the compressor and internal pumps for the heat pump unit may stop their operations.

3. Primary side minimum amount of retained water

40 L/unit

Anti-freezing operation

Running the pump will prevent it from freezing

Pump ON: Outdoor temp.	≤ 1°C
and Inlet water temp.	≤ 3°C
Pump OFF: Outdoor temp.	≥ 3°C
or Inlet water temp.	≥ 5°C, 3 minutes continue

Anti-short-cycling protection

To prevent the frequent start-stops of the compressor, the compressor activation is restricted.

(1) Compressor is not to be activated within three minutes of deactivation. (motor protection)

(2) Maximum activation count per day is set to 36, and the time between activations is restricted by the following formula: Note that the minimum is 10 minutes. (Pressure fatigue destruction prevention) Time from the previous activation = remaining time for one day/(36 - activation count on that day) A day starts at the night time thermal storage start time (On-board item code 6: default value is 22:00).

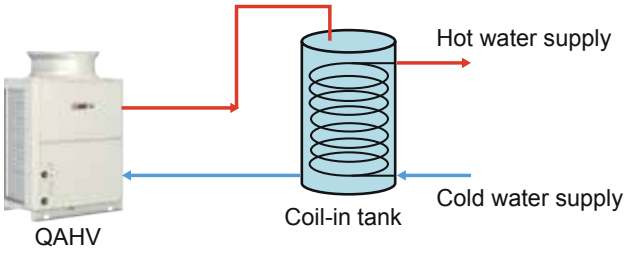
Case study

Our QAHV system has multiple application possibilities

Fitness Center

QAHV + Sealed hot water storage tank with coil
Schedule: Dec 2014 started
Usage QAHV to be used for gym, sanitary hot water usage (shower)
System: QAHV 56 kW × 1 + Hot water tank 400 L×10
Sealed hot water storage tank with coil × 2

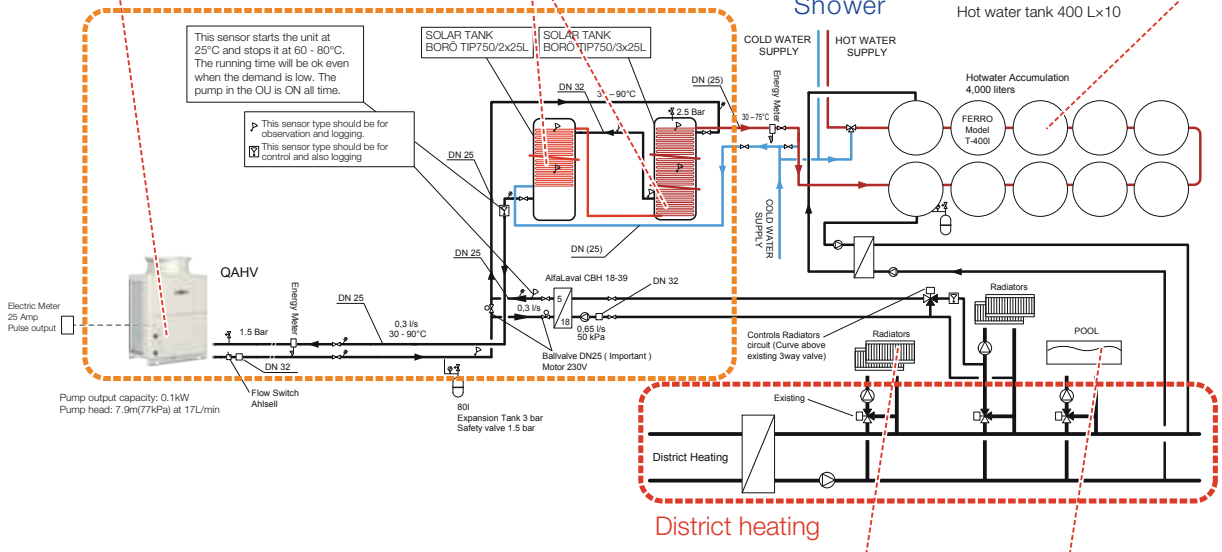
Coil-in tank Heating System



QAHV unit
(Prototype with snow hood)

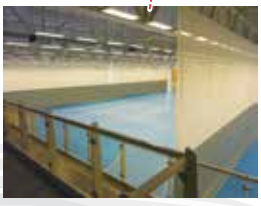
Hot water tank (2qty)

Hot water tank 400 L×10



Municipal Fitness Center

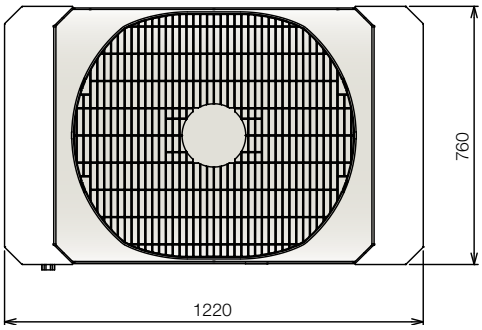
Commissioning completed Dec 2014
QAHV used for showers and as back up for gym/pool (basically by district heating).



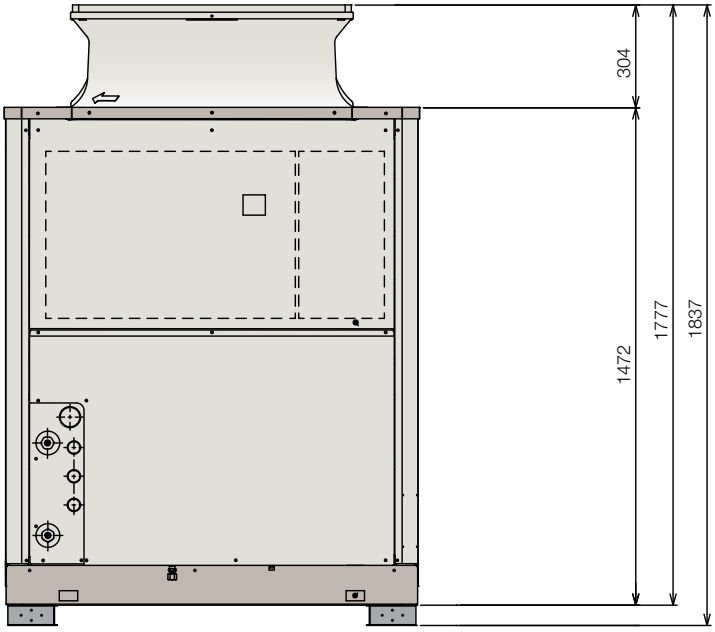
Floor/Pool (heating) is managed by district heating circuit.

Dimensions

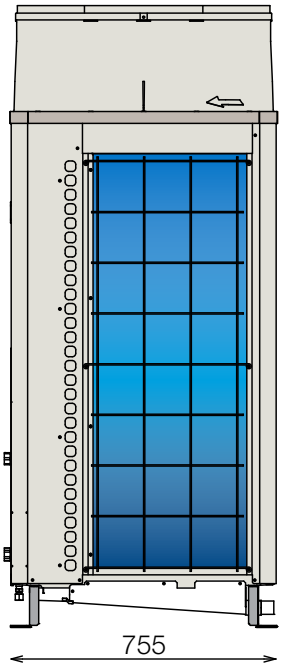
Top Elevation

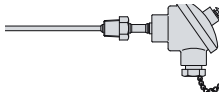
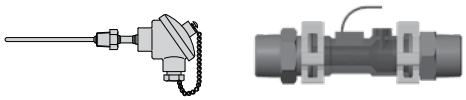


Front Elevation



Side Elevation



DESCRIPTION	IMAGE	MODEL NAME
1 **Remote controller**		PAR-W31MAA-J
2 **Representative water temperature sensor**		TW-TH16-E
3 **Secondary circuit kit* (Temperature sensor, Flow sensor)**		Q-1SCK

*This kit is required when performing secondary control between QAHV and the hot water storage tank.

Specifications

Model			QAHV-N136TAU-HPB(-BS)
Power Source			3-phase 3-wire 208–230 V 60 Hz
Capacity *1		Btu/h	136,480
		kW	40
		kcal/h	34,400
	Power input	kW	9.73
	Current input	A	30.0 - 27.2
	COP	kW/kW	4.11
Capacity *2		Btu/h	136,480
		kW	40
		kcal/h	34,400
	Power input	kW	10.44
	Current input	A	32.2 - 29.1
	COP	kW/kW	3.83
Allowable external pump head		ftAq (kPa)	22.75 (68)
Temperature range	Inlet water temperature	°C (°F)	5~63 (41~145)
	Outlet water temperature		120-176°F (when the secondary side control is enabled: 120-158°F) 49-80°C (when the secondary side control is enabled: 49-70°C)
	Outdoor temperature	D.B.	-25~43°C (-13~109°F)
Sound pressure level (measured 1 m below the unit in an anechoic room) *1		dB(A)	56
Water pipe diameter and type	Inlet	in. (mm)	Rc 3/4 (19.05), screw pipe *3
	Outlet	in. (mm)	Rc 3/4 (19.05), screw pipe *3
External finish			Acrylic painted steel sheet <Munsell 5Y 8/1 or similar>
External dimensions H x W x D		in. (mm)	69.7 x 48.0 x 29.9 (1777 x 1220 x 760)
Net weight		lbs (kg)	895 (406)
Design pressure	R744	psi (MPa)	2,030 (14)
	Water	psi (MPa)	72.5 (0.5)
Heat exchanger	Water-side		Copper tube coil
	Air-side		Plate fins and cooper tubes
Compressor	Type	cfm	Inverter scroll hermetic compressor
	Manufacturer	m^3/min	MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Motor output	kW	11.0
	Case heater	kW	0.045
	Lubricant		PAG
Fan	Air flow rate	cfm	7,768
		m^3/min	220
		L/s.	3,666
	Type and quantity		Propeller fan x 1
	Control and driving mechanism		Inverter control, direct driven by motor
	Motor output	kW	0.75
HIC (Heat inter-changer) circuit			Copper pipe
Protection devices	High pressure		High-pressure sensor and switch set at 2030 psi (14 MPa)
	Inverter circuit		Overheat and overcurrent protection
	Compressor		Overheat protection
	Fan motor		Thermal switch
Defrosting method			Auto-defrost mode (Hot gas)
Refrigerant	Type and factory charge	lbs (kg)	CO_2 (R744) 14.3 lbs (6.5 kg)
	Flow and temperature control		LEV

*1 Under normal heating conditions at the outdoor temperature of 27.0°CDB/21.8°CWB (80.6°FDB/71.2°FWB), the outlet water temperature of 48.9°C (120°F), and the inlet water temperature of 21.1°C (70°F)
*2 Under normal heating conditions at the outdoor temperature of 27.0°CDB/21.8°CWB (80.6°FDB/71.2°FWB), the outlet water temperature of 65°C (149°F), and the inlet water temperature of 21.1°C (70°F)
*3 PT-NPT reducers are included as accessories.
*Due to continuing improvements, specifications may be subject change without notice.
*Do not use steel pipes as water pipes.
*Keep the water circulated at all times. Blow the water out of the pipes if the unit will not be used for an extended period of time.
*Do not use ground water or well water.
*Do not install the unit in an environment where the wet bulb temperature exceeds 32°C (90°F).
*The water circuit must be a closed circuit.
*There is a possibility that the unit may abnormally stop when it operates outside its operating range. Provide backup (ex. boiler start with error display output signal (blue CN511 1-3)) for abnormal stop.
*In a system in which the ascent rate of inlet water temperature becomes 5°C/min (9°F/min) or above instantly or 1°C/min (1.8°F/min) or above continuously this model of units cannot be used.

Specifications

Model			QAHV-N136YAU-HPB (-BS)
Power Source			3-phase 3-wire 460 V 60 Hz
Capacity *1		Btu/h	136,480
		kW	40
	Power input	kW	9.73
	Current input	A	13.6
	COP	kW/kW	4.11
Capacity *2		Btu/h	136,480
		kW	40
	Power input	kW	10.44
	Current input	A	14.6
	COP	kW/kW	3.83
Allowable external pump head		ftAq (kPa)	22.75 (68)
Temperature range*3	Inlet water temperature	°C (°F)	41-145 (5-63)
	Outlet water temperature		120-176°F (when the secondary side control is enabled: 120-158°F) 49-80°C (when the secondary side control is enabled: 49-70°C)
	Outdoor temperature	D.B.	-13-109°F (-25-43°C)
Sound pressure level (measured 1 m below the unit in an anechoic room) *1 *4		dB(A)	56
Water pipe diameter and type	Inlet	in. (mm)	Rc 3/4 (19.05), screw pipe *5
	Outlet	in. (mm)	Rc 3/4 (19.05), screw pipe *5
External finish			Acrylic painted steel plate <MUNSELL 5Y 8/1 or similar>
External dimensions H x W x D		in. (mm)	70 x 48-1/16 x 29-15/16 (1,777 x 1,220 x 760)
Net weight		lbs (kg)	934 (424)
Design pressure	R744	psi (MPa)	2,030 (14)
	Water	psi (MPa)	72.5 (0.5)
Heat exchanger	Water-side		Copper tube coil
	Air-side		Plate fins and copper tubes
Compressor	Type		Inverter scroll hermetic compressor
	Manufacturer		MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Motor output	kW	11.0
	Case heater	kW	0.045
	Lubricant		PAG
Fan	Air flow rate	cfm	7,768
		m^3/min	220
		L/s.	3,666
	Type and quantity		Propeller fan x 1
	Control and driving mechanism		Inverter control, direct driven by motor
	Motor output	kW	0.92
HIC (Heat inter-changer) circuit			Copper pipe
Protection devices	High pressure		High-pressure sensor and switch set at 2,030psi (14 MPa)
	Inverter circuit		Overheat and overcurrent protection
	Compressor		Overheat protection
	Fan motor		Thermal switch
Defrosting method			Auto-defrost mode (Hot gas)
Refrigerant	Type and factory charge	lbs (kg)	CO_2 (R744) 14.3 lbs (6.5 kg)
	Flow and temperature control		LEV

NOTES:
*1.Under normal heating conditions at the outdoor temperature of 80.6°FDB/71.2°FWB (27.0°CDB/21.8°CWB), the outlet water temperature of 120°F (49°C), and the inlet water temperature of 70°F (21°C)
*2.Under normal heating conditions at the outdoor temperature of 80.6°FDB/71.2°FWB (27.0°CDB/21.8°CWB), the outlet water temperature of 149°F (65°C), and the inlet water temperature of 70°F (21°C)
*3.The temperature difference between inlet water and outlet water must be kept above the following values.
Energy saving operation 1 mode ••• ΔT=50°F (28°C) Energy saving operation 2 mode ••• ΔT=50°F (28°C) Max capacity operation ••• ΔT=67°F (37°C)
If the unit is operated with the inlet-outlet water temperature difference at or below the ΔT listed above, the flow rate will reach its maximum, which can adversely affect the normal operation of the unit and shorten product life. Note that, regardless of the inlet-outlet water temperature difference (even during operation within the range with the minimum water inlet-outlet temperature difference), the higher the inlet temperature, the lower the COP. Keep the inlet water temperature as low as possible to ensure efficient operation.
*4.The sound pressure level is a value measured in an anechoic room in accordance with the conventional method in JRA4060.
*5.PT-NPT reducers are included as accessories.
*Due to continuing improvements, specifications may be subject to change without notice.
*Do not use steel pipes as water pipes.
*Keep the water circulated at all times. Blow the water out of the pipes if the unit will not be used for an extended period of time.
*Do not use ground water or well water.
*Do not install the unit in an environment where the wet bulb temperature exceeds 90°F (32°C).
*The water circuit must be a closed circuit.
*There is a possibility that the unit may abnormally stop when it operates outside its operating range. Provide backup (ex.boiler start with error display output signal (blue CN511 1-3)) for abnormal stop.
*In a system in which the ascent rate of inlet water temperature becomes 5 K/min (9°F/min) or above instantly or 1 K/min (1.8°F/min) or above continuously, this model of units cannot be used.

UNIT CONVERTER
BTU/h = kW x 3,412
cfm = m^3/min x 35.31
lbs = kg/0.4536

Environmental Sustainability Vision 2050

Protect the air, land, and water with our hearts and technologies to sustain a better future for all.

To solve various factors that lead to environment issues, the Mitsubishi Electric Group shall unite the wishes of each and every person, and strive to create new value for a sustainable future.

Certificate Number 79222 Certificate Number 78649

Mitsubishi Electric Consumer Products has acquired ISO 9001 certification under Series 9000 of the International Standard Organization (ISO). The plant has also acquired environmental management system standard ISO 14001 certification.

VCSi TECHNOLOGY

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