

HITACHI INVERTER-DRIVEN SPLIT SYSTEM HEAT PUMP AIR CONDITIONERS

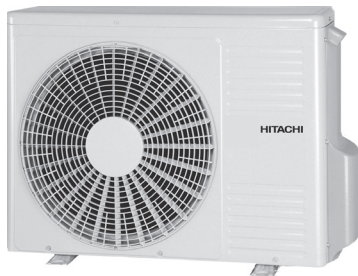
- UTOPIA IVX Premium / IVX Standard -

Technical Catalog

Models

< Outdoor Units >

RAS-2HVNP
RAS-2.5HVNP
RAS-3HVNC



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1. General information

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1.1 General information

1.1.1 General notes

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1.1.2 Introduction

Hitachi UTOPIA series is an outdoor unit series designed with the goal to cover the requirements of the split and multisplit systems, for installations where from one indoor unit (single system) to up to 2 indoor units, are connected to the same IVX Premium outdoor unit (depending on model).

UTOPIA series incorporate the Hitachi inverter technology, which makes possible to adapt automatically and without the user operation the capacity of the unit, so the power input, to the real demand of the installation, increasing the system efficiency to unattainable levels with other technologies. All UTOPIA units are equipped with a heat pump, resulting in an air conditioning system valid for the whole year, in which the installation of additional and specific systems a not necessary.

IVX Premium

Nominal capacity from 5 kW to 5.6 kW (cooling mode). Connectable indoor units up to 2 units (depending on model) and total combination power from 90% up to 110%.

IVX Standard

Nominal capacity 7.1 kW (cooling mode). Connectable indoor units up to 2 units and total combination power from 90% up to 110%.

Indoor Units

One of the main merits of Hitachi units range is the combinability and flexibility of its indoor units SYSTEM FREE. This outstanding technology makes possible to use the same indoor units with both UTOPIA and SET FREE outdoor units, making easier the design, installation and control of the air conditioning installations.

1.1.3 Environment-friendly units

This range of HITACHI outdoor units uses environmentally-friendly R410A gas refrigerant, and the RoHS and Green Dot regulations are applied throughout the manufacturing and installation process to reflect HITACHI's awareness of environmental respect and commitment.

R410A is totally environmentally-friendly since it does not contain any substances that damage the ozone layer:

ODP (ozone depleting product) =0.

HITACHI's UTOPIA series are very efficient and allow significant energy savings compared with conventional systems.

This energy efficiency means less production of CO₂, which causes the greenhouse effect.



1.2 Safety

1.2.1 Applied symbols

During normal air conditioning system design work or unit installation, greater attention must be paid in certain situations requiring particular care in order to avoid damage to the unit, the installation or the building or property.

Situations that jeopardise the safety of those in the surrounding area or that put the unit itself at risk will be clearly indicated in this manual.

To indicate these situations, a series of special symbols will be used to clearly identify these situations.

Pay close attention to these symbols and to the messages following them, as your safety and that of others depends on it.



DANGER

- *The text following this symbol contains information and instructions relating directly to your safety and physical wellbeing.*
- *Not taking these instructions into account could lead to serious, very serious or even fatal injuries to you and others in the proximities of the unit.*

In the texts following the danger symbol you can also find information on safe procedures during unit installation.



CAUTION

- *The text following this symbol contains information and instructions relating directly to your safety and physical wellbeing.*
- *Not taking these instructions into account could lead to minor injuries to you and others in the proximities of the unit.*
- *Not taking these instructions into account could lead to unit damage.*

In the texts following the caution symbol you can also find information on safe procedures during unit installation.



NOTE

- *The text following this symbol contains information or instructions that may be of use or that require a more thorough explanation.*
- *Instructions regarding inspections to be made on unit parts or systems may also be included.*

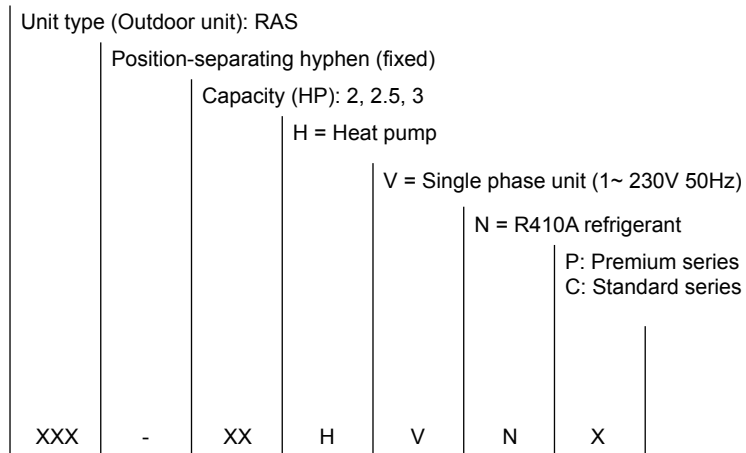
1.2.2 Norms and regulations

Do not vent R410A/R407C into the atmosphere. R410A & R407C are fluorinated greenhouse gases covered by the Kyoto protocol global warming potential (GWP) R410A/R407C: = 1975/1652.5.

1.3 Product guide



1.3.1 Classification of outdoor unit models

◆ IVX series





1.3.2 Product guide: Outdoor units

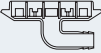
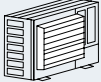
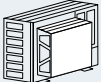
◆ IVX Premium

	
1~ 230V 50Hz	
	
Unit	Code
RAS-2HVNP	60288631
RAS-2.5HVNP	60288632

◆ IVX Standard

	
1~ 230V 50Hz	
	
Unit	Code
RAS-3HVNC	60288633

1.3.3 Outdoor unit accessory code list

Name	Description	Code	Figure
DBS-12L	Drain discharge connection	60291491	
AG-264	Air flow guide	-	
WSP-264	Wind guard	60291831	

**NOTE**

HITACHI has a range of accessories and remote control systems that can be used with the UTOPIA outdoor units.

2. Features and benefits

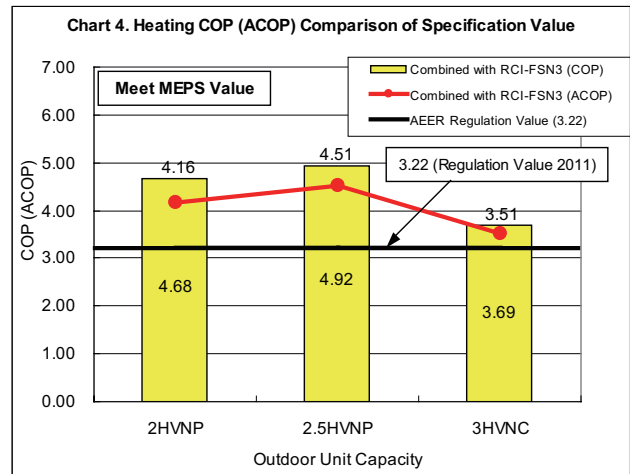
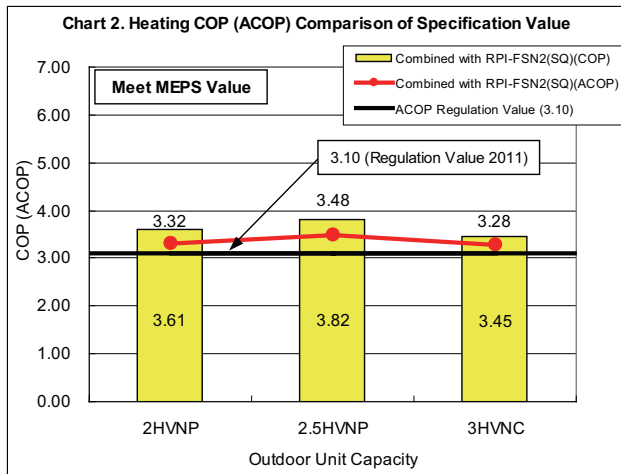
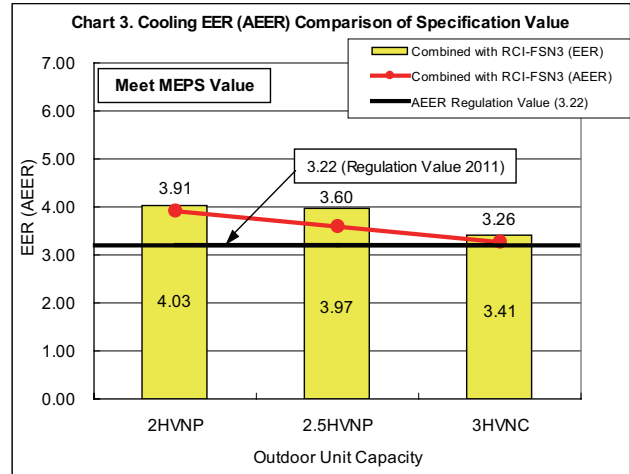
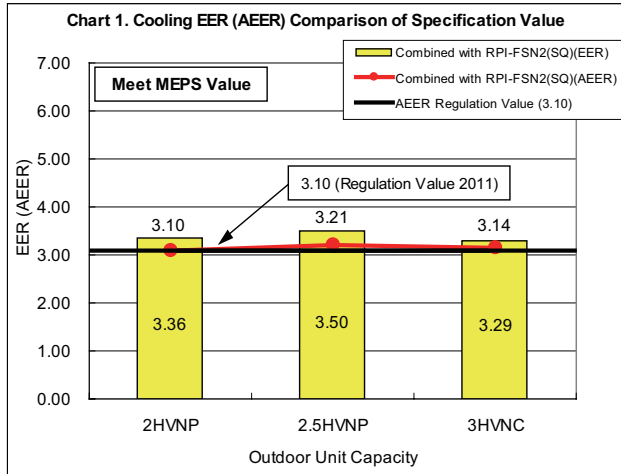
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2.1 Features

2.1.1 Energy-saving

- a. High energy-saving is realized by the improving of intermediate capacity for the new compressors.
- b. The slitless fin type of the heat exchanger is adopted to improve the heating performance.



2.1.2 Individual operation

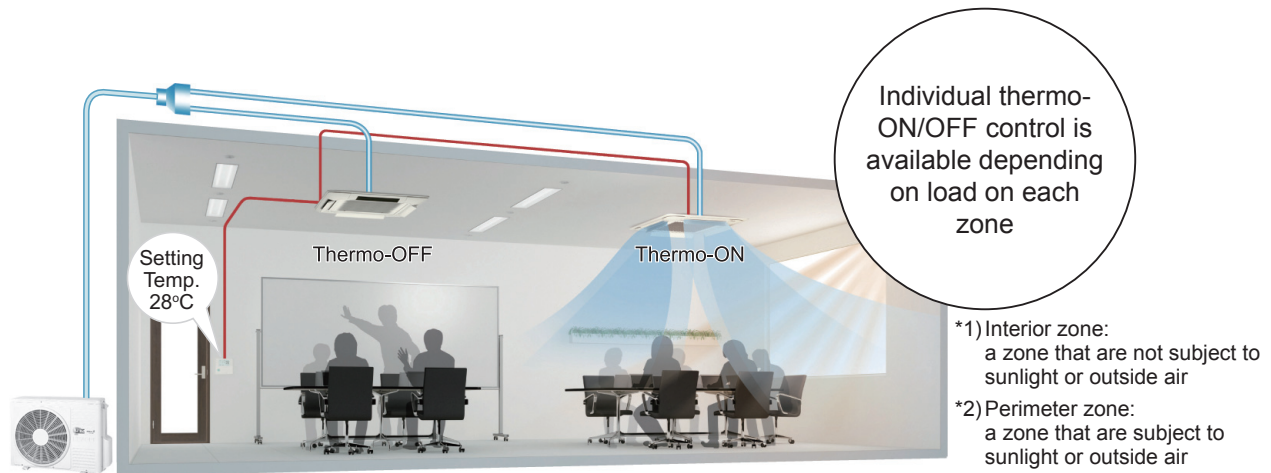
Individual operation makes it possible to keep one room / multiple rooms comfortably and efficiently air-conditioned.

(1) Keeping one room / multiple rooms comfortably and efficiently air-conditioned

< One room >

Individual thermo-ON/OFF control achieves uniform temperature

For multiple indoor units installed in one room, thermo-ON/OFF can individually be controlled with one remote control switch depending on the load on each zone in the room (interior zone *1) / perimeter zone *2)).



< Multiple room >

Individual operation / temperature setting for each room save energy

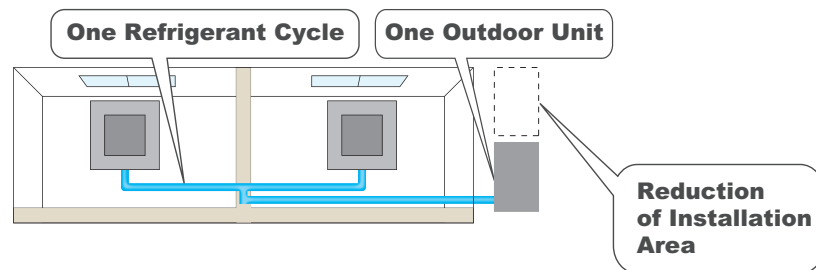
For multiple indoor units installed in different rooms, operation and temperature setting can individually be controlled depending on conditions of each room, by installing one remote control switch to each room. This will save the units of a lot of energy.



(2) Easier installation work

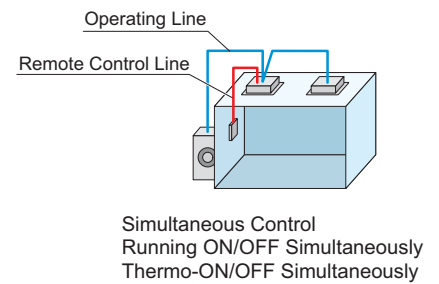
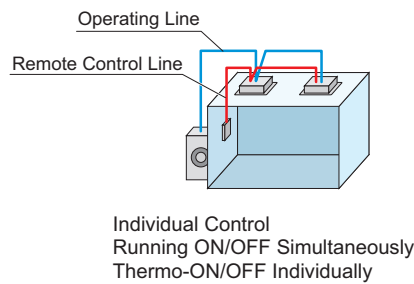
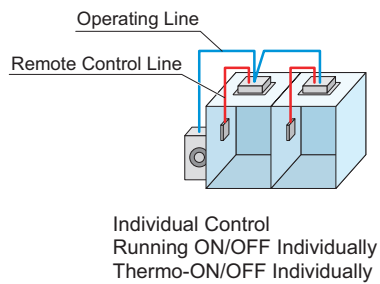
Multiple indoor units can be connected to one outdoor unit, which is why fewer outdoor units are required. This helps to save more installation space and so increases flexibility in installation location. Piping and wiring work for only one refrigerant cycle is required, which makes easier installation possible and makes the work period shortened.

Installation of multiple indoor units to one refrigerant cycle makes installation easier.



< Wiring Example >

Basic Combinations
(In the case of Twin Combination)

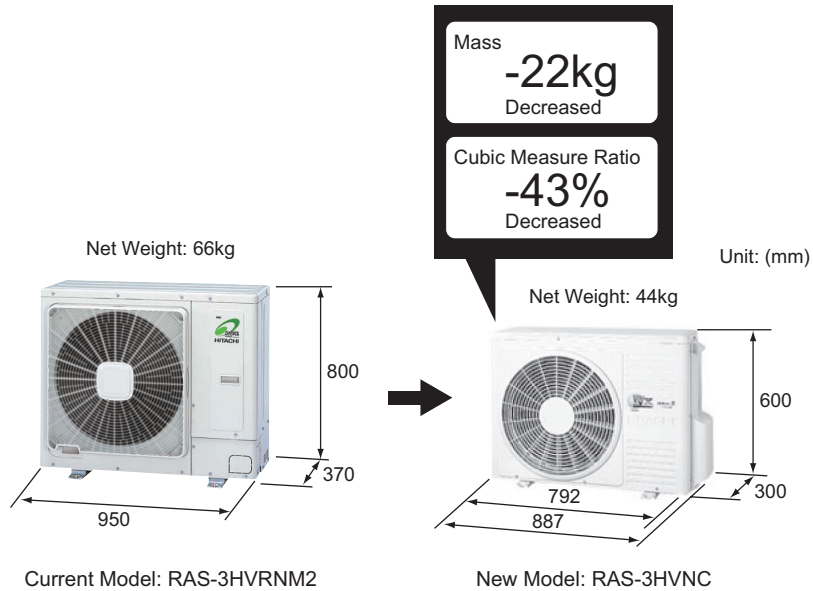


2.1.3 Compact size

The new DC Inverter HVNC series outdoor units are lighter and more compact. Their lightness and smaller volume allow them to be transported more easily. They also take up less room and can be installed more quickly.

◆ **Lighter and smaller**

Since it is lighter and smaller less installation space is required, making it easier to access the machine for installation and subsequent maintenance.

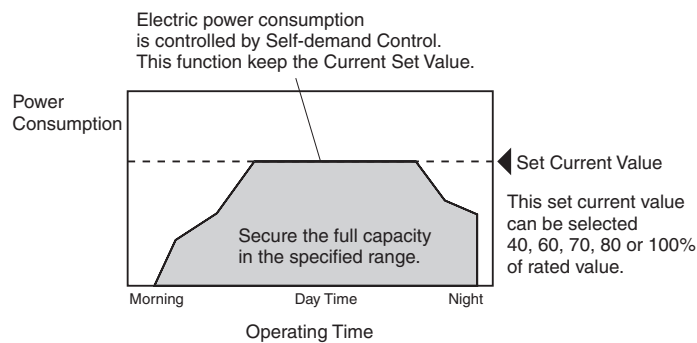


2.1.4 Demand control

(1) Self-demand control

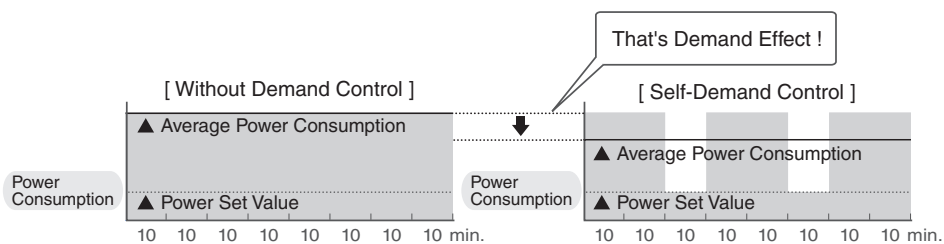
Standard equipment of power-saving technology.

Other facility/multiple air conditioners are not limited to use during on-peak energy hours thanks to demand control function (2 patterns).



(2) Wave mode

Equipped wave mode function to minimize temperature change and electricity.



2.1.5 H-LINK II system

The total number of the indoor units to be controlled is increased from 128 to 160, and the total number of the refrigerant cycles to be controlled is increased from 16 to 64 by combination with the equipment supporting the transmission system H-LINK II.

◆ Comparison with H-LINK system

Item	H-LINK	H-LINK II
Number of max. ref. groups / systems	16	64
Address setting range of indoor units / ref. groups	0 to 15	0 to 63
Number of max. indoor units / systems	128	160
Total device q'ty in same H-LINK	145	200
Max. wiring length	Total 1,000m (5,000m*)	
Recommended cable	Twist pair cable with shield, Over 0.75mm ² (equivalent to KPEV-S)	

*: In case 4 (four) H-LINK relays (PSC-5HR, optional) are used.

◆ H-LINK II system

The provided H-LINK II wiring system requires only two transmission wires to connect each indoor unit and outdoor unit of up to 64 refrigerant cycles, and to connect wires for all indoor units and outdoor units.

<Specifications>

- * Transmission wire: 2-wire
- * Polarity of transmission wire: Non-polar wire
- * Maximum outdoor units to be connected: 64 units per system
- * Maximum indoor units to be connected: 160 units per H-LINK II system
- * Maximum wiring length: Total 1,000m (including CS-NET)
- * Recommended cable: Twist-pair cable with shield, over 0.75mm² (equivalent to KPEV-S)
- * Voltage: DC5V

NOTE:

H-LINK II system requires the setting of dip switch for outdoor unit. If the dip switches are not set or the setting is incorrect, the alarm will occur due to transmission failure.

2.1.6 Working range

This heat pump air conditioner has been designed for the following temperatures.

Temperature		(°C)	
		Maximum	Minimum
Cooling operation	Indoor	32 DB/23 WB	21 DB/15 WB
	Outdoor	46 DB	-5 DB
Heating operation	Indoor	27 DB	15 DB
	Outdoor	15 WB	-20 WB

DB: Dry bulb, WB: Wet bulb

2.2 Combination of indoor unit and outdoor unit

◆ Standard combination of outdoor unit and indoor unit

Outdoor unit	Indoor unit (type)	Single combination	Twin combination
RAS-2HVNP	4-way cassette (RCI-*FSN3)	RCI-2.0FSN3	-
	4-way cassette (compact) (RCIM-*FSN3)	-	RCIM-1.0FSN3 x 2
	In-the-ceiling (RPI-*FSN2)	RPI-2.0FSN2	RPI-1.0FSN2 x 2
	2-way cassette (RCD-*FSN2)	-	RCD-1.0FSN2 x 2
	Wall (RPK-*FSNSM3)	-	RPK-1.0FSNSM3 x 2
RAS-2.5HVNP	4-way cassette (RCI-*FSN3)	RCI-2.5FSN3	-
	4-way cassette (compact) (RCIM-*FSN3)	-	-
	In-the-ceiling (RPI-*FSN2)	RPI-2.5FSN2	-
	2-way cassette (RCD-*FSN2)	-	-
	Wall (RPK-*FSNSM3)	-	-
RAS-3HVNC	In-the-ceiling (RPI-*FSN2SQ)	RPI-3.0FSN2SQ	-
	4-way cassette (RCI-*FSN3)	RCI-3.0FSN3	-
	4-way cassette (compact) (RCIM-*FSN3)	-	RCIM-1.5FSN3 x 2
	In-the-ceiling (RPI-*FSN2)	-	RPI-1.5FSN2 x 2
	2-way cassette (RCD-*FSN2)	-	RCD-1.5FSN2 x 2
	Wall (RPK-*FSNSM3)	-	RPK-1.5FSNSM3 x 2

* The single connection is subject to MEPS. Other connections are NOT acceptable.

◆ Enhanced combination of outdoor unit and indoor unit

The combination of outdoor units is available in the following conditions. For simultaneous operation of all multiple indoor units, it is recommended to connect less indoor units than is recommended, in order to prevent a cold draft during heating operation.

Outdoor unit capacity		2HP	2.5HP	3HP
Recommended number of connectable indoor unit		1 unit		
Maximum number of connectable indoor unit		2 units		
Minimum indoor unit capacity		0.8HP		
Ratio of total indoor unit capacity to outdoor unit capacity		90-110%		
Minimum indoor unit capacity	In-the-ceiling type (RPI-*FSN2SQ)	-	-	Only 3.0HP
	4-way cassette type (RCI-*FSN3)	2.0HP		
	4-way cassette (compact) type (RCIM-*FSN3)	0.8HP		
	In-the-ceiling type (RPI-*FSN2)	0.8HP		
	2-way cassette type (RCD-*FSN2)	1.0HP		
	Wall type (RPK-*FSNSM3)	1.0HP		

- (1) (Total indoor unit capacity / Total outdoor unit capacity) should be within the value shown in the "Ratio of total indoor unit capacity to outdoor unit capacity" in the table above. If the ratio exceeds 100%, adjust it according to the outdoor unit capacity.
- (2) In the following cases, it is recommended to connect less indoor units than is recommended, and it is also recommended that "Ratio of total indoor unit capacity to outdoor unit capacity" be less than 100%.
 - 4-way cassette type or ceiling type indoor unit is connected to the outdoor unit
 - The unit is installed in cold areas (areas where outside temperature drops to -5°C)
 - The unit is installed in cold areas under high heating load conditions.
- (3) For operation of multiple indoor units, the minimum indoor unit capacity against the maximum indoor unit capacity in the same refrigerant cycle should be as follows.

Max. indoor unit capacity	0.8 - 1.5HP	2.0HP	2.5 - 3.0HP
Min. indoor unit capacity	≥ 0.8HP	≥ 1.0HP	≥ 1.5HP

- (4) The air flow volume for indoor unit of 0.8 and 1.0HP is higher than that for indoor units of 1.5HP or more. Do not install the unit where users are subject to cold draft during heating operation.

3. General data

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3.1 General specifications

3.1.1 IVX Premium series

Outdoor units		RAS-2HVNP	RAS-2.5HVNP
Power supply	-	1~ 230V 50Hz	1~ 230V 50Hz
Nominal cooling capacity (min-max)	kW	5.0 (2.2-5.6)	5.6 (2.2-6.3)
Nominal heating capacity (min-max)	kW	5.6 (2.2-7.1)	6.3 (2.2-8.0)
EER (*)		4.03	3.97
COP (*)		4.68	4.92
Minimum - Maximum indoor units connectable	-	1 - 2	1 - 2
Minimum - Maximum connected capacity	%	90 - 110	90 - 110
Noise level cooling (sound pressure) (night mode)	dB(A)	44 (42)	45 (43)
Noise level heating (sound pressure)	dB(A)	46	47
Noise level (sound power)	dB(A)	62	63
Air flow	m ³ /min	40.6	40.6
Dimensions (H x W x D)	mm	600 x 792 x 300	600 x 792 x 300
Net weight	kg	41	41
Recommended circuit breaker	A	16	20
Starting current	A	Less than maximum current	Less than maximum current
Maximum current	A	12.0	14.0
Running current cooling	A	5.3	5.9
Running current heating	A	5.2	5.4
Power cable size (according to EN 60335-1)	quantity x mm ²	3 x 2.5	3 x 4.0
Transmitting cable size between indoor unit and outdoor unit	quantity x mm ²	2 x 0.75	2 x 0.75
Piping diameter (liquid / gas)	mm (inch)	Ø6.35 (1/4) / Ø12.7 (1/2)	Ø6.35 (1/4) / Ø12.7 (1/2)
Minimum piping length	m	5	5
Maximum piping length chargeless	m	30 (0 m for 2 indoor units system)	30 (0 m for 2 indoor units system)
Maximum piping length (additional refrigerant charge needed)	m (g/m)	50 (30)	50 (30(1))
Height difference (OU higher / OU lower)	m	30 / 20	30 / 20
Working range (cooling // heating)	°C	-5 / +46 (DB) // -20 / +15 (WB)	-5 / +46 (DB) // -20 / +15 (WB)
Refrigerant	-	R410A	R410A
Refrigerant charge before shipment	kg	1.6	1.6
Compressor type	-	Scroll DC Inverter driven	Scroll DC Inverter driven
Remote control model (Optional)		PC-ART / PC-ARF	PC-ART / PC-ARF

(*) COP and EER data are specified for RCI-FSN3 indoor units combination.

(1) For 2 indoor units system the additional refrigerant charge needed is 24 g/m.

3.1.2 IVX Standard series

Outdoor units		RAS-3HVNC
Power supply	-	1~ 230V 50Hz
Nominal cooling capacity (min-max)	kW	7.1 (3.2-8.0)
Nominal heating capacity (min-max)	kW	8.0 (3.5-10.6)
EER (*)		3.41
COP (*)		3.69
Minimum - Maximum indoor units connectable	-	1 - 2
Minimum - Maximum connected capacity	%	90 - 110
Noise level cooling (sound pressure) (night mode)	dB(A)	48 (46)
Noise level heating (sound pressure)	dB(A)	50
Noise level (sound power)	dB(A)	66
Air flow	m ³ /min	44.7
Dimensions (H x W x D)	mm	600 x 792 x 300
Net weight	kg	44
Recommended circuit breaker	A	20
Starting current	A	Less than maximum current
Maximum current	A	16.0
Running current cooling	A	9.0
Running current heating	A	9.3
Power cable size (according to EN 60335-1)	quantity x mm ²	3 x 4.0
Transmitting cable size between indoor unit and outdoor unit	quantity x mm ²	2 x 0.75
Piping diameter (liquid / gas)	mm (inch)	Ø9.52 (3/8) / Ø15.88 (5/8)
Minimum piping length	m	5
Maximum piping length chargeless	m	20
Maximum piping length (additional refrigerant charge needed)	m (g/m)	50 (40)
Height difference (O.U. higher / O.U. lower)	m	30 / 20
Working range (cooling // heating)	°C	-5 / +46 (DB) // -20 / +15 (WB)
Refrigerant	-	R410A
Refrigerant charge before shipment	kg	1.9
Compressor type	-	Scroll DC Inverter driven
Remote control model (Optional)		PC-ART / PC-ARF

(*) COP and EER data are specified for RCI-FSN3 indoor units combination

3.2 Component data

3.2.1 IVX Premium series

MODEL		RAS-2HVNP	RAS-2.5HVNP
Heat exchanger	Type	Multi-pass cross-finned tube	
	Pipe material	Copper	
	Outer diameter	mm	8
	Rows	2	
	Number of tubes in the heat exchanger	44	
	Fin material	Aluminium	
	Fin pitch	1.45	
	Maximum operating pressure	MPa	4.15
	Total front area	m ²	0.47
	Number of heat exchanger per unit	1	
Fan	Fan type	Direct drive propeller fan	
	Fans per unit	1	
	Outer diameter	mm	449
	Revolutions	rpm	770
	Nominal air flow	m ³ /min	41
Motor	Shell	Drip-proof type enclosure	
	Starting	Direct current control	
	Power	W	40
	Quantity	1	
	Insulation class	E	
Compressor		EU1114D9	EU140XA2

3.2.2 IVX Standard series

MODEL		RAS-3HVNC	
Heat exchanger	Type	Multi-pass cross-finned tube	
	Pipe material	Copper	
	Outer diameter	mm	8
	Rows	2	
	Number of tubes in the heat exchanger	44	
	Fin material	Aluminium	
	Fin pitch	1.45	
	Maximum operating pressure	MPa	4.15
	Total front area	m ²	0.47
	Number of heat exchanger per unit	1	
Fan	Fan type	Direct drive propeller fan	
	Fans per unit	1	
	Outer diameter	mm	449
	Revolutions	rpm	850
	Nominal air flow	m ³ /min	45
Motor	Shell	Drip-proof type enclosure	
	Starting	Direct current control	
	Power	W	40
	Quantity	1	
	Insulation class	E	
Compressor		EU180XA1	

3.3 Electrical data

3.3.1 Considerations

Keywords:

- U: Power supply.
- PH: Phase.
- f: Frequency.
- STC: Starting current: Less than maximum current.
- IPT: Total input power.
- RNC: Running current.
- MC: Maximum current.
- CB: Circuit breaker (A)
- ELB: Earth leakage breaker (Number of poles/A/mA)



NOTE

- Specifications in these tables are subject to change without notice in order that HITACHI may bring the latest innovations to their customers.
- Cooling conditions: Indoor air inlet: 20 °C DB; Outdoor air inlet: 7/6 °C (DB/WB).
- Heating conditions: Indoor air inlet: 27/19 °C (DB/WB); Outdoor air inlet: 35 °C DB.

3.3.2 IVX Premium series

Outdoor unit	Main unit power			Applicable voltage		Compressor and fan motor						CB (A)	ELB	
	U (V)	PH	f (Hz)	U max (V)	U min (V)	STC (A)	Cooling		Heating		Max. IPT (kW)			MC (A)
							IPT (kW)	RNC (A)	IPT (kW)	RNC (A)				
RAS-2HVNP	230	1	50	253	207	-	1.20	5.3	1.16	5.2	2.70	12.0	16	2/40/30
RAS-2.5HVNP							1.34	5.9	1.21	5.4	3.16	14.0		

3.3.3 IVX Standard series

Outdoor unit	Main unit power			Applicable voltage		Compressor and fan motor						CB (A)	ELB	
	U (V)	PH	f (Hz)	U max (V)	U min (V)	STC (A)	Cooling		Heating		Max. IPT (kW)			MC (A)
							IPT (kW)	RNC (A)	IPT (kW)	RNC (A)				
RAS-3HVNC	230	1	50	253	207	-	2.02	9.0	2.11	9.3	3.64	16.0	20	2/40/30

4 . Capacities and selection data

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4.1 Combinability range

◆ IVX Premium series

Range of operation capacity control from 90% up to 110%.

Outdoor unit	Minimum combination capacity (HP)	Maximum combination capacity (HP)	Maximum Combination quantity	Minimum indoor unit capacity (HP)
RAS-2HVNP	1.8	2.2	2	0.8
RAS-2.5HVNP	2.25	2.75	2	0.8

◆ IVX Standard series

Range of operation capacity control from 90% up to 110%.

Outdoor unit	Minimum combination capacity (HP)	Maximum combination capacity (HP)	Maximum Combination quantity	Minimum indoor unit capacity (HP)
RAS-3HVNC	2.7	3.3	2	0.8



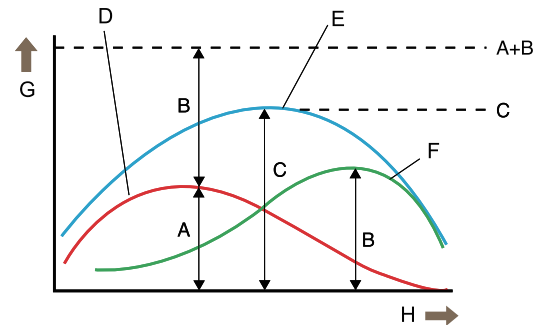
NOTE

- In case of installation in cold territories (where Outdoor Temperature may fall below -10°C for Utopia IVX Premium and -5°C for Utopia IVX Standard) or in places where Heating load is large, install a number of units not bigger than suggested number of connected units, with a connected capacity ratio under 100%.
- Please check the piping chapter for other restrictions and limitations to adequate the combinability and the number of indoor units installed.
- See [Piping work and refrigerant charge](#) for detailed information and additional remarks about combinability.

4.2 System selection procedure

This combinability allows the outdoor unit to be smaller capacity when compared with other air conditioning systems, in case of the total combination horsepower, but considering that maximum load demands can not be simultaneous.

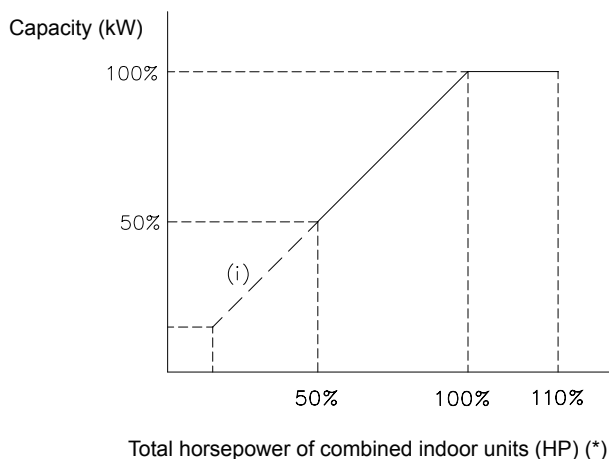
- A: morning peak heat load in the eastern area.
- B: evening peak heat load in the western area.
- C: maximum simultaneous load for the entire building.
- D: eastern area load.
- E: total load.
- F: western area load.
- G: load.
- H: time.



The diagram shows a typical building with a morning peak heat load on the east zone equivalent to a 1.2 HP unit. In the afternoon a peak occurs on the west zone equivalent to a 1.4 HP unit.

Therefore, a conventional system would require total installed plant of 1.2 HP + 1.4 HP = 2.6 HP (next capacity available is 3 HP). The maximum simultaneous load on the whole building occurs at noon and is equivalent to a 2.4 HP capacity. A RAS-2.5HVNP unit can be selected, and this capacity can be directed either to the east or west zone as dictated by the systems controls. Then the IVX Premium series 2.5 HP outdoor unit can be selected, against the 3 HP required in a typical system (16% reduction).

The following figure shows the capacity curve depending on the combined indoor units.



i NOTE

(*) This range can be different depending the outdoor and indoor unit model.

(i) Capacity when some indoor units are off

4.2.1 Selection procedure (step 1)

Considering the layout of the building, the possible position of the indoor units and the air flow distribution, select the unit features that provide the greatest efficiency and comfort. Decide a position for the outdoor unit that facilitates service and maintenance tasks.

- 1 Determine the total load required for each room.
- 2 Select, per each room, the appropriate Indoor Unit according to the required load and the installation characteristics.

In some, situations, it should be useful to adjust the capacity of the indoor units in order to adapt the unit to the actual installation requirements. This function is performed by dip switch setting and it's possible in some HP indoor unit models.

In case of an installation with ducts (outdoor unit with RPI indoor unit) the fan performance for duct calculations should be considered. The RPI units are designed with different static pressure ranges in order to fulfil all installation necessities.

3 Pre-select the outdoor units that covers the installation's cooling load requirements.

If the required loads will not be simultaneous (for example: the maximum required loads of room 1 (east zone) occurs at the morning and the maximum required loads of room 2 (west zone) occurs at the afternoon.), select the outdoor unit that cover the maximum simultaneous load on the installation and check that the total combination horsepower must not be higher than the limits, using the following:

$$\text{Total combination horsepower} = (\text{Total indoor unit horsepower} / \text{Outdoor unit horsepower}) \times 100$$

4 Calculation of f_{LC} (Cooling piping length correction factor)

The length of the refrigerant piping used and the height difference between the outdoor unit and the indoor units directly affect the performance of the unit. This concept is quantified in the piping length correction factor.

To determine this value it is necessary refer to the piping length correction factor tables that are based on the equivalent piping length in meter and height between outdoor and indoor units. For the equivalent one-way piping length between indoor unit and outdoor unit (m) consider the following:

One 90° elbow is 0.5 m.

One 180° bend is 1.5 m.

One Multi-kit is 0.5 m.

5 Cooling capacity correction (Q_c) due to the piping length

The actual cooling capacity of the pre-selected unit must be calculated applying the necessary correction factors:

$$Q_c = Q_{MC} \times f_{LC}$$

Q_c : Actual cooling capacity of the outdoor unit (kW).

Q_{MC} : Maximum cooling capacity of the outdoor unit (kW).

f_{LC} : Cooling piping length correction factor.

6 Cooling capacity correction of the outdoor unit (Q_{AC}) depending of the humidity of the indoor unit

The correction ratio due to humidity is the coefficient that corrects the sensible heat capacity of a unit according to the relative humidity of the air entering the indoor unit. The greater the relative humidity the lower will be the sensible heat capacity and vice versa.

The following formula is used to apply an adjustment to the cooling capacity showed in the tables due to the difference between the real indoor air inlet dry bulb temperature vs the one used for calculate the nominal cooling capacity data.

$$Q_{AC} = Q_c + (CR \times (DB_R - DB))$$

Q_{AC} : Actual cooling capacity of the outdoor unit (kW) (at given real % humidity)

Q_c : Corrected cooling capacity of the outdoor unit by piping length (kW) (at given 50 % humidity)

CR : Correction ratio due to humidity.

DB_R : Real Dry Bulb evaporator temperature (°C).

DB : Dry Bulb evaporator temperature (°C) for each wet bulb temperature from the curves (HR = 50 %).

7 Actual indoor units capacity

Once it is known the actual outdoor units cooling capacity, it must be calculated the actual cooling capacity of each indoor unit, according to the following formula:

$$Q_{CI} = Q_{AC} \times (Q_{NCI} / Q_{NCC})$$

Q_{CI} : Actual cooling capacity of the indoor unit (kW).

Q_{AC} : Actual cooling capacity of the outdoor unit (kW).

Q_{NCI} : Nominal cooling capacity of the indoor unit (kW).

Q_{NCC} : Nominal cooling capacity of the combination (kW).

8 Sensible heat capacity (SHC)

Once the calculation of the indoor units cooling capacity has been completed, the sensible heat capacity can be calculated using the following formula:

$$\text{SHC} = Q_{ci} \times \text{SHF}$$

SHC: Sensible heat capacity (kW).

Q_{ci} : Actual cooling capacity of the indoor unit (kW).

SHF: Sensible heat factor.

9 Checks

Check that the total capacity and sensible heat capacity (SHC) are greater than the estimated cooling load by the different rooms to be conditioned. Therefore, it can be said that the selected outdoor unit meets the minimum cooling requirements set for the system.

$$\begin{aligned} \text{Corrected total cooling capacity (kW)}_{\text{TOTAL}} &\geq \text{Estimated total cooling load (kW)}_{\text{TOTAL}} \\ \text{Corrected sensible heat capacity (kW)}_{\text{TOTAL}} &\geq \text{Estimated sensible heat capacity (kW)}_{\text{TOTAL}} \\ \text{Corrected total cooling capacity (kW)}_{\text{ROOMn}} &\geq \text{Estimated total cooling load (kW)}_{\text{ROOMn}} \\ \text{Corrected sensible heat capacity (kW)}_{\text{ROOMn}} &\geq \text{Estimated sensible heat capacity (kW)}_{\text{ROOMn}} \end{aligned}$$

4.2.2 Selection procedure (step 2)

1 Calculate the heating requirements for each room

See if the pre-selected indoor units and outdoor units have the necessary nominal heating capacity for each room.

2 Heating capacity correction (Q_H)

The actual heating capacity of the pre-selected outdoor unit (in cooling mode (step 1)) must be calculated applying the necessary correction factors:

$$Q_H = Q_{MH} \times f_{LH} \times f_D$$

Q_H : Actual heating capacity of the outdoor unit (kW)

Q_{MH} : Maximum heating capacity of the outdoor unit (kW)

f_{LH} : Heating piping length correction factor

f_D : Defrost correction factor

Calculation of f_{LH}

Referring to the diagrams for *Piping length correction factor*.

Calculation of f_D

In situations where the ambient temperature is lower than 7 °C DB, frost may build up on the heat exchanger. In this case, the heating capacity for the unit may be reduced because of the time spent by the unit in removing the frost up.

The defrost correction factor takes this time into account to apply the heating capacity correction.

3 Heating capacity of each indoor unit (Q_{HI})

Once the real heating capacity of the outdoor unit has been determined, its heating capacity in combination with the indoor units, can be calculated.

$$Q_{HI} = Q_H \times (Q_{NHI} / Q_{NHC})$$

Q_{HI} : Actual heating capacity of the indoor unit (kW).

Q_H : Actual heating capacity of the outdoor unit (kW)

Q_{NHI} : Nominal heating capacity of the indoor unit (kW)

Q_{NHC} : Nominal heating capacity of the combination (kW)

If the corrected heating capacity is greater than the estimated heating load by the different rooms to be conditioned, it can be said that the selection is valid for both cooling and heating.

$$\begin{aligned} \text{Actual heating capacity (kW)}_{\text{TOTAL}} &\geq \text{Estimated heating capacity (kW)}_{\text{TOTAL}} \\ \text{Actual heating capacity (kW)}_{\text{ROOMn}} &\geq \text{Estimated heating capacity (kW)}_{\text{ROOMn}} \end{aligned}$$

4.3 Maximum cooling capacity curve

Curves are based on the following conditions:

Piping Length/Height difference: 7.5 m / 0 m

The point “o” on the curves is based on the following conditions:

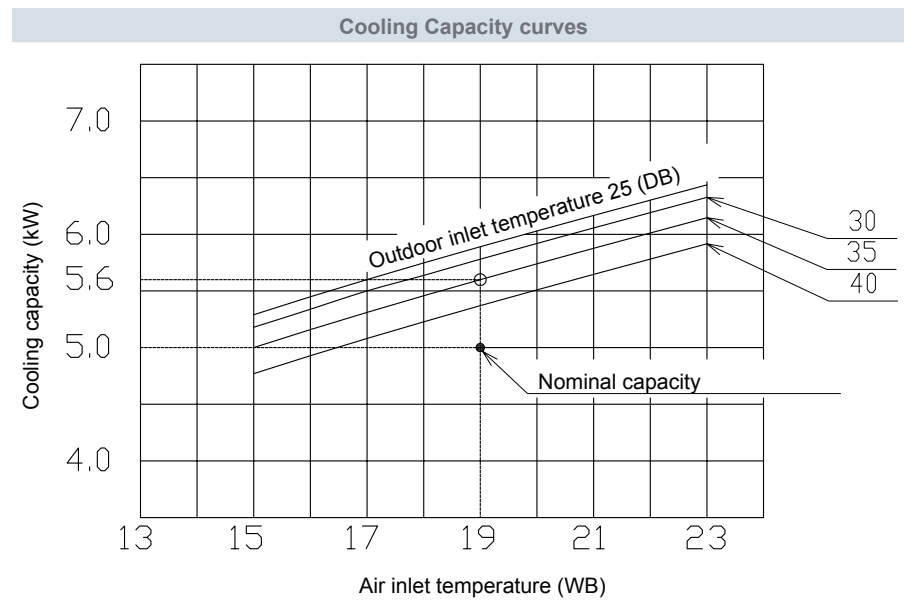
- Indoor air inlet temperature: 27°C (DB) / 19 °C (WB)
- Outdoor air inlet temperature: 35°C (DB)

The curves are based on High speed of indoor fan. To calculate the cooling capacity of medium or low speed of indoor fan, multiply cooling capacity of high speed by Correction Curve Factor (Chapter [Correction curve factor](#)).

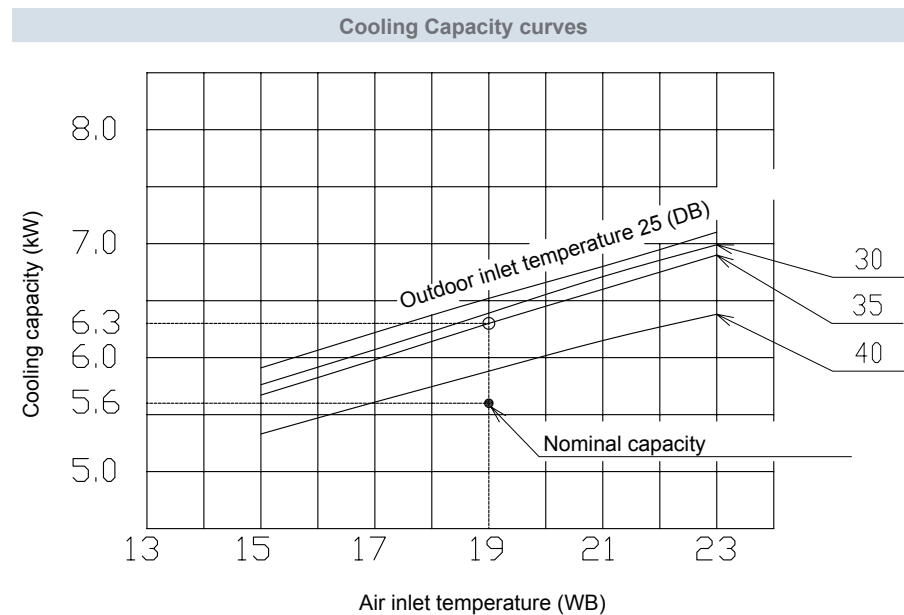
All temperatures in °C.

4.3.1 IVX Premium series

◆ RAS-2HVNP



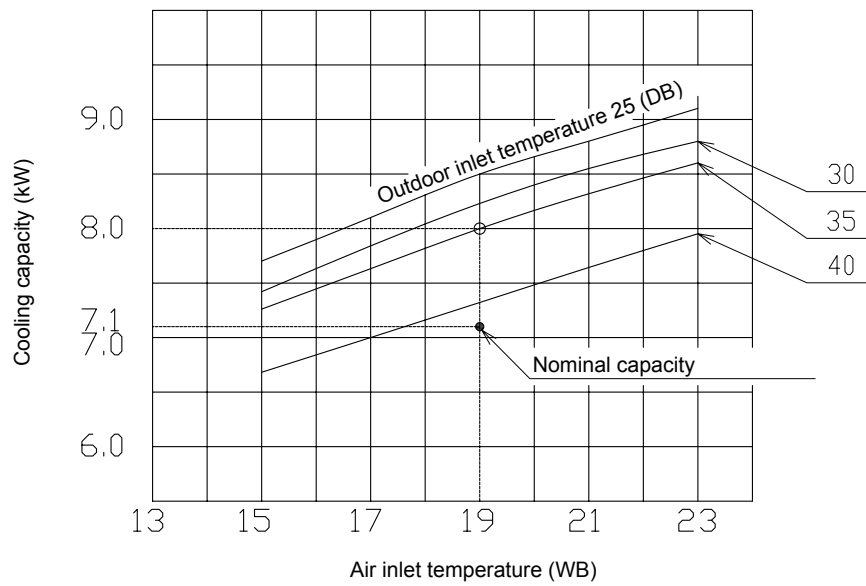
◆ RAS-2.5HVNP



4.3.2 IVX Standard series

◆ RAS-3HVNC

Cooling Capacity curves



7S139311

4.4 Maximum heating capacity curve

Curves are based on the following conditions:

Piping Length/Height difference: 7.5 m / 0 m

The point “o” on the curves is based on the following conditions:

- Indoor air inlet temperature: 20°C (DB)
- Outdoor air inlet temperature: 7°C (DB) / 6°C (WB)

The curves are based on High speed of indoor fan. to calculate the cooling capacity of medium or low speed of indoor fan, multiply cooling capacity of high speed by correction curve factor.

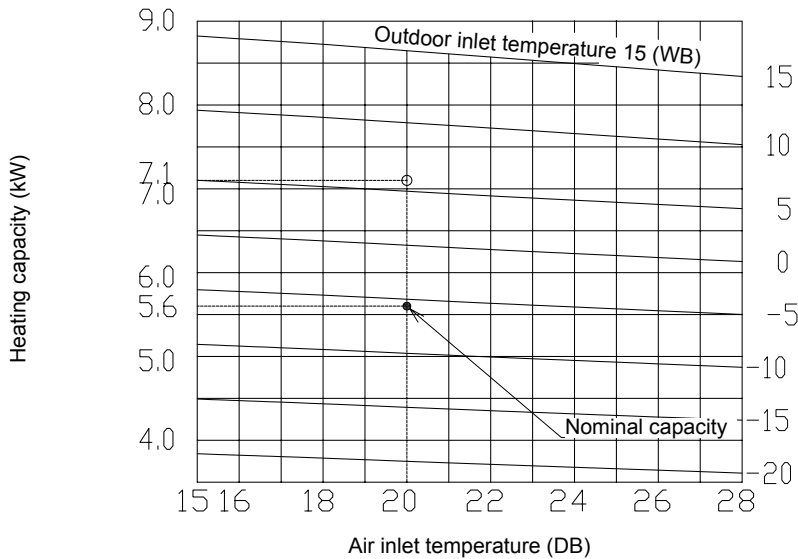
The curve does not include decreasing capacity by defrosting operation.

All temperatures in °C.

4.4.1 IVX Premium series

◆ RAS-2HVNP

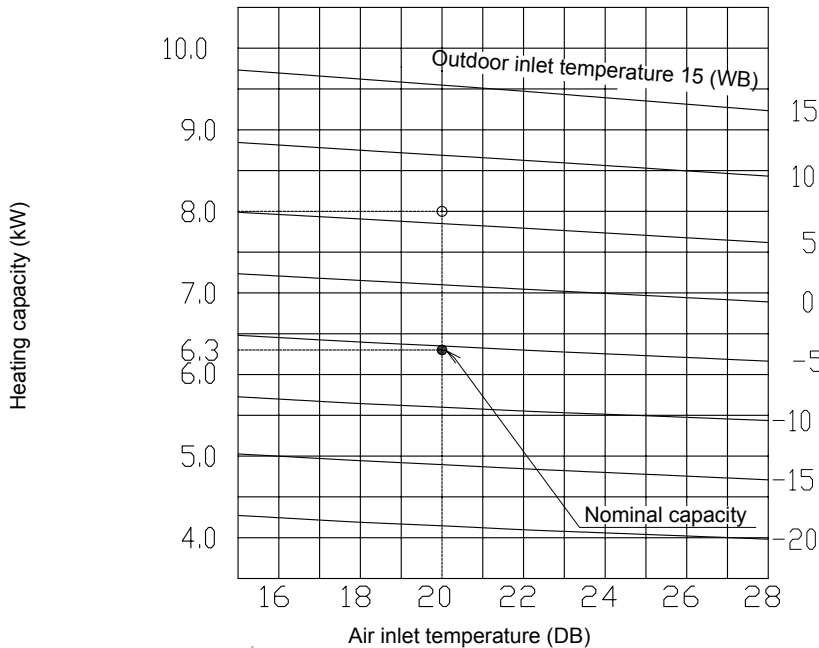
Heating Capacity curves



7S139312

◆ RAS-2.5HVNP

Heating Capacity curves

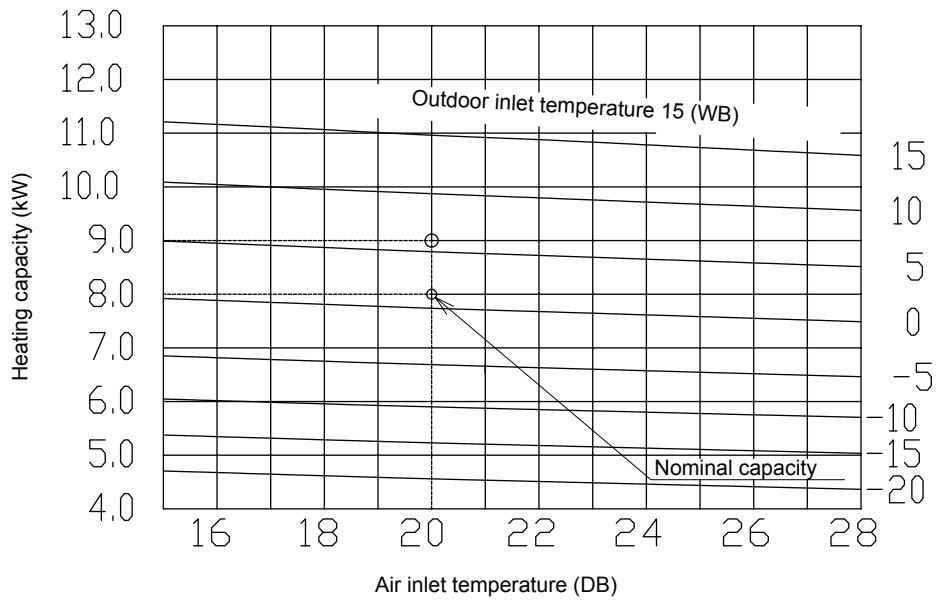


7S138313

4.4.2 IVX Standard series

◆ **RAS-3HVNC**

Heating Capacity curves



7S139316

4.5 Correction curve factor

4.5.1 Cooling

The curves are based on High speed of indoor fan. To calculate the cooling capacity of medium or low speed of indoor fan, multiply cooling capacity of high speed by correction curve factor.

	Outdoor Unit HP
Indoor Unit fan speed	2 - 3
High	1.00
Medium	0.98
Low	0.95

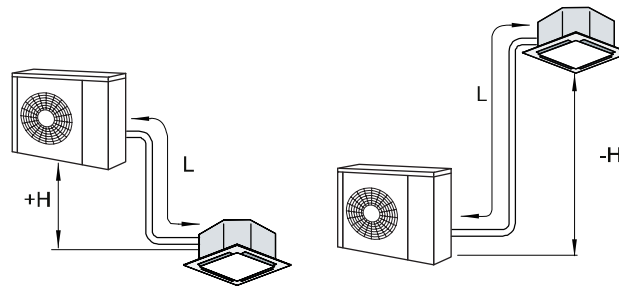
4.5.2 Heating

The curves are based on High speed of indoor fan. to calculate the cooling capacity of medium or low speed of indoor fan, multiply cooling capacity of high speed by correction curve factor.

The curve does not include decreasing capacity by defrosting operation.

	Outdoor Unit HP
Indoor Unit fan speed	2 - 3
High	1.00
Medium	0.98
Low	0.97

4.6 Piping length correction factor



The correction factor is based on the equivalent piping length in meters (EL) and the height between outdoor and indoor units in meters (H).

H:

Height between indoor unit and outdoor unit (m).

- $H > 0$: Position of outdoor unit is higher than position of indoor unit (m).
- $H < 0$: Position of outdoor unit is lower than position of indoor unit (m).

L:

Actual one-way piping length between indoor unit and outdoor unit (m).

EL:

Equivalent one-way piping length between indoor unit and outdoor unit (m).

- One 90° elbow is 0.5 m.
- One 180° bend is 1.5 m.
- One Multi-kit is 0.5 m.

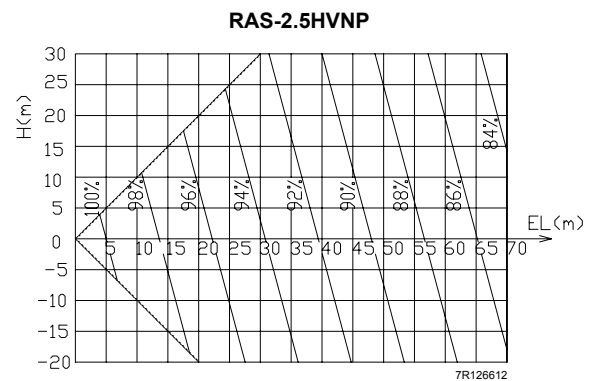
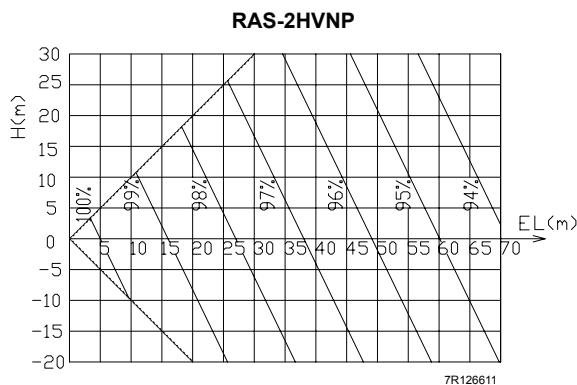


NOTE

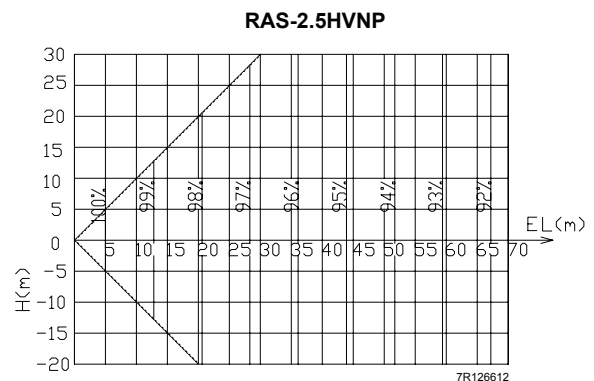
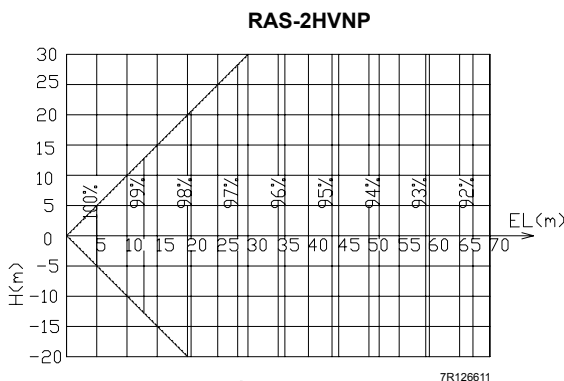
In order to ensure correct unit selection, consider the farthest indoor unit.

4.6.1 IVX Premium series

Cooling

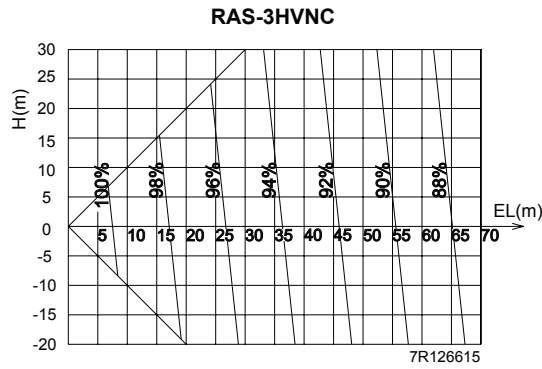


Heating

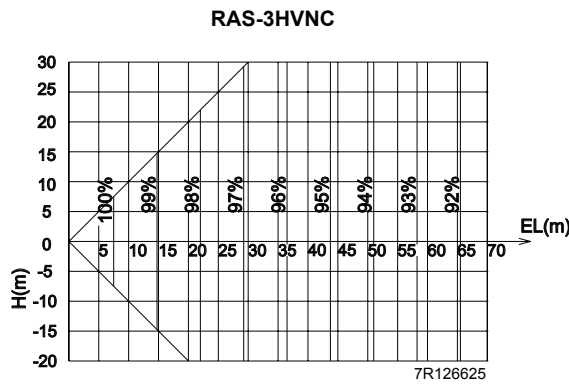


4.6.2 IVX Standard series

Cooling



Heating



4.7 Correction factor / ratio

4.7.1 Defrost operation correction factor

The heating capacity does not include operation during frost or defrosting.

When this type of operation is taken in account, the heating capacity must be corrected according to the following equation:

$$\text{Correction heating capacity} = \text{Correction factor} \times \text{heating capacity}$$



NOTE

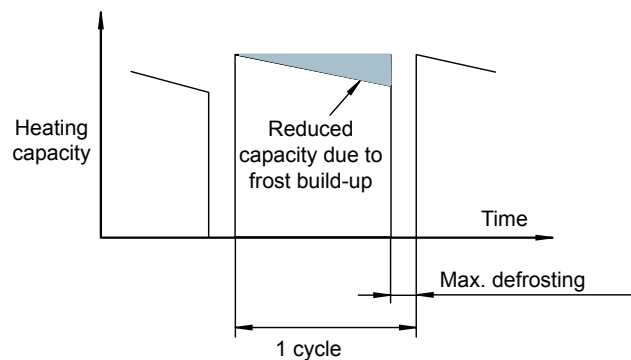
- Defrost correction factor corresponds to a relative humidity of 85%. If the condition changes, the correction factor will be different.
- Defrost correction factor is not valid for special conditions such as during snow or operation in a transitional period.

Outdoor inlet air temperature (°C DB)	-7	-5	-3	0	3	5	7
Correction factor	0.95	0.93	0.88	0.85	0.87	0.90	1.00



NOTE

- Defrost correction factor corresponds to a relative humidity of 85%. If the condition changes, the correction factor will be different.
- Defrost correction factor is not valid for special conditions such as during snow or operation in a transitional period.



4.7.2 Correction ratio due to humidity (CR)

The cooling capacity data for the outdoor units is taken from the cooling capacity curves. The curves are calculated on the basis of a relative humidity of 50%.

In some situations, it's possible that the temperature condition of the ambient to be conditioned, specifies other different relative humidity, which affect at the Dry Bulb temperature. In this cases, it's necessary to calculate the difference between the indoor air inlet dry bulb temperature required by the system and the indoor air inlet dry bulb temperature shown in the cooling capacity data.

This temperature difference requires an adjustment of the cooling capacity of the system.

$$Q_{AC} = Q_C + (CR \times (DB_R - DB))$$

Model	CR
RAS-2HVNP	0.25
RAS-2.5HVNP	0.30
RAS-3HVNC	0.34

5. Acoustic characteristic curves

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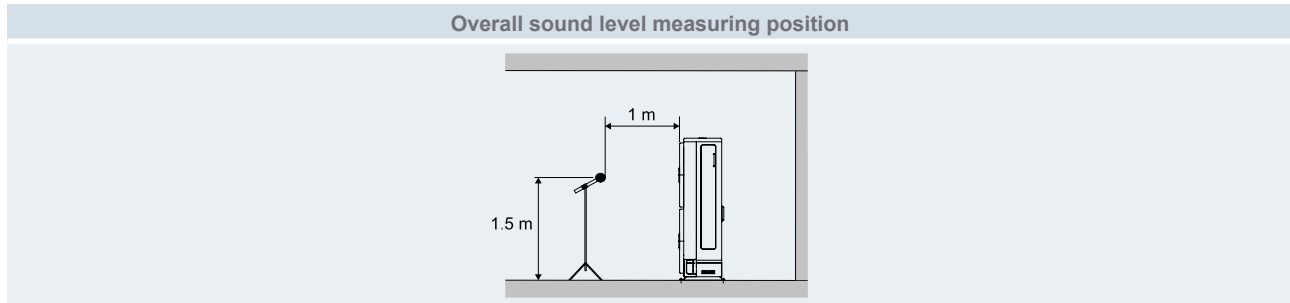
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5.1 Overall sound level

The overall sound level has been measured in an anechoic chamber so reflected sound should be taken into consideration when installing the unit.

Test Conditions:

- 1 Distance of the unit from the measuring point: 1 meter from the unit's front surface; 1.5 meter from floor level:



- 2 Power supply:

Single phase units: 1~ 230V 50Hz.

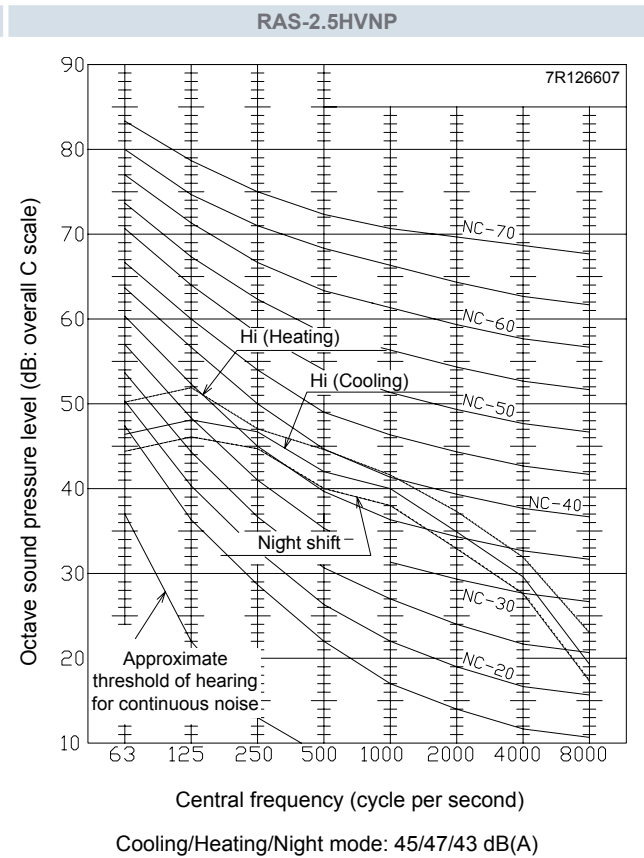
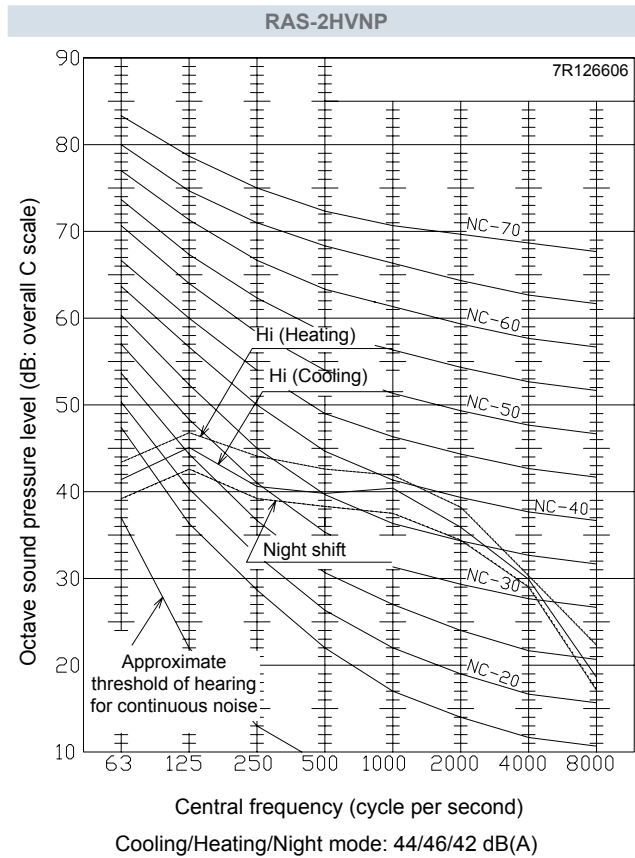


NOTE

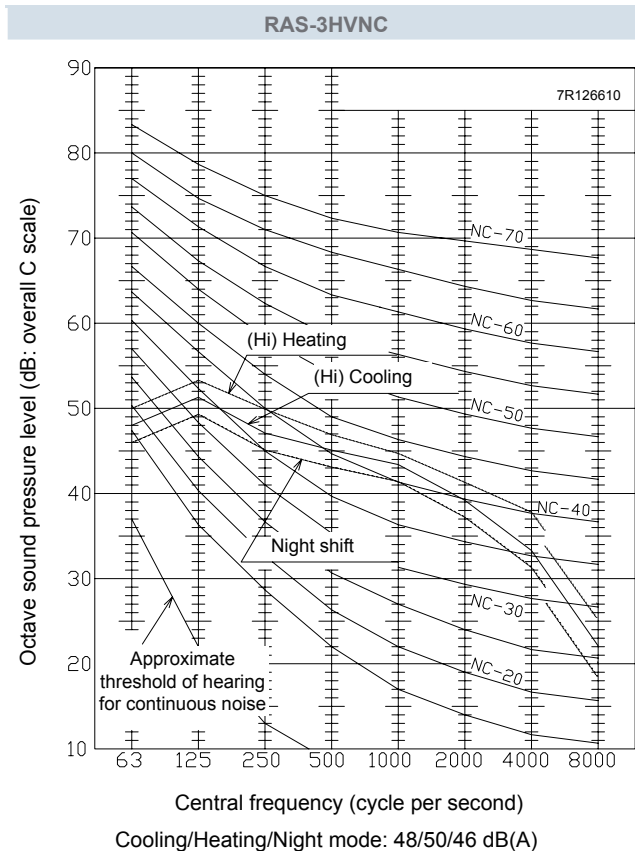
The sound data is measured in an anechoic chamber, so reflected sound should be taken into consideration when installing the unit.

5.2 Sound pressure data

5.2.1 IVX Premium series



5.2.2 IVX Standard series



6 . Working range

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6.1 Working range

6.1.1 Power supply

Nominal power supply:

- Single phase: 1~ 230V 50Hz

Operating voltage

Between 90 and 110% of the nominal voltage.

Starting voltage

Always higher than 85% of the nominal voltage.

6.1.2 Temperature range

The temperature range is indicated in the following table:

		Cooling mode	Heating mode
Indoor side air inlet temperature	Minimum	21 °C DB / 15 °C WB	15 °C DB
	Maximum	32 °C DB / 23 °C WB	27 °C DB
Outdoor side air inlet temperature	Minimum	-5 °C DB	-20 °C WB
	Maximum	46 °C DB	15 °C WB

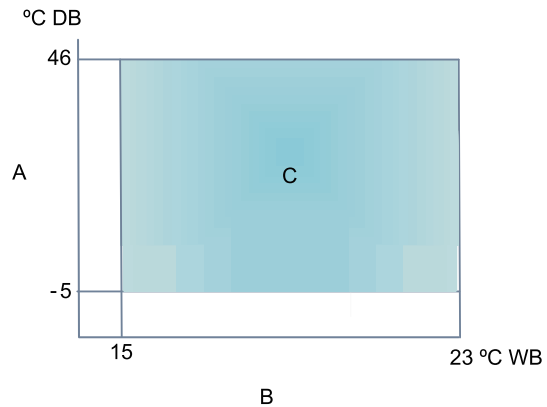


NOTE

DB: Dry Bulb; WB: Wet Bulb.

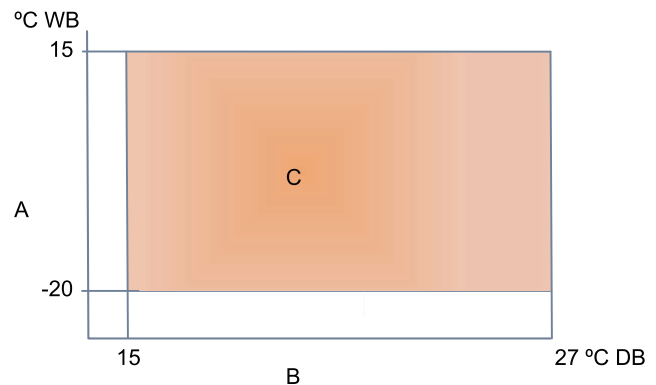
Cooling mode

- A. Outdoor side air inlet temperature.
- B. Indoor side air inlet temperature.
- C. Working range.



Heating mode

- A. Outdoor side air inlet temperature.
- B. Indoor side air inlet temperature.
- C. Working range.



7. General dimensions

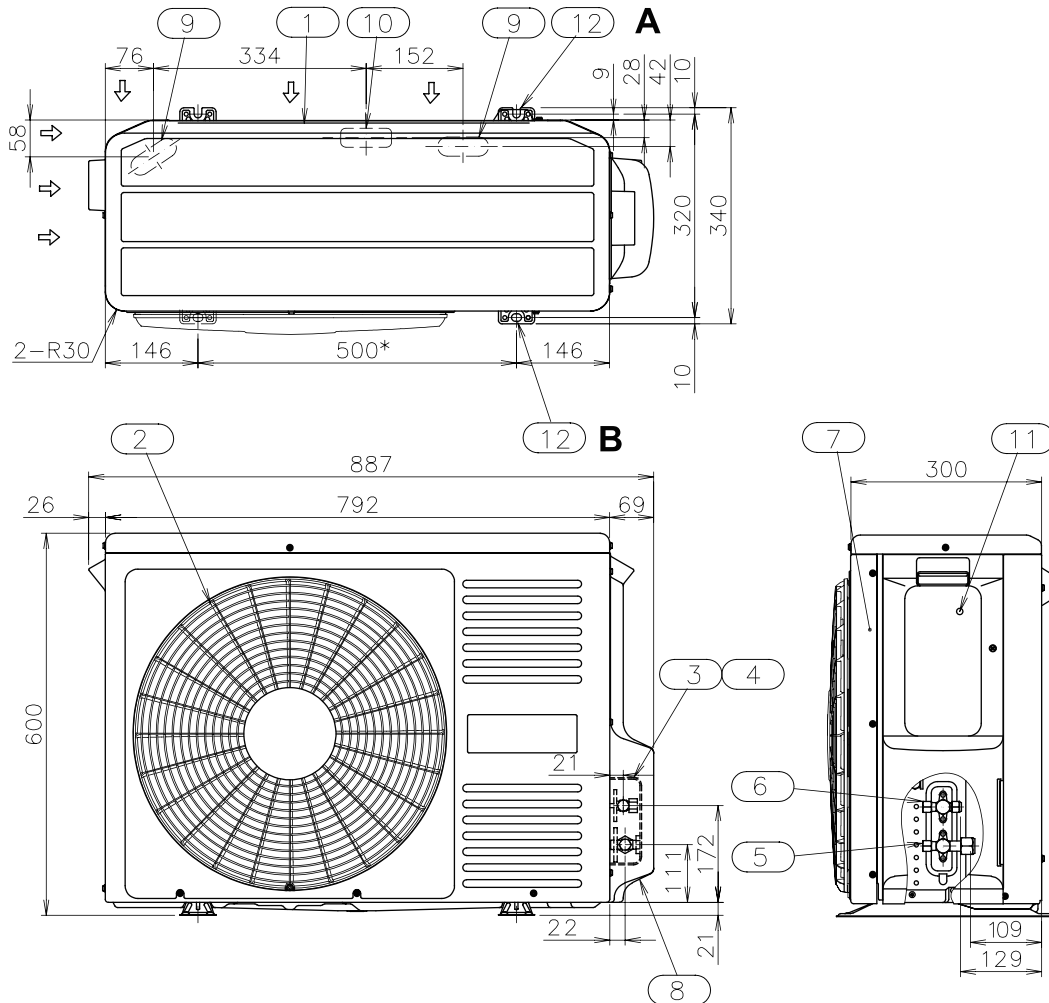
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7.1 Dimensions

7.1.1 IVX Premium series

◆ RAS-(2/2.5)HVNP



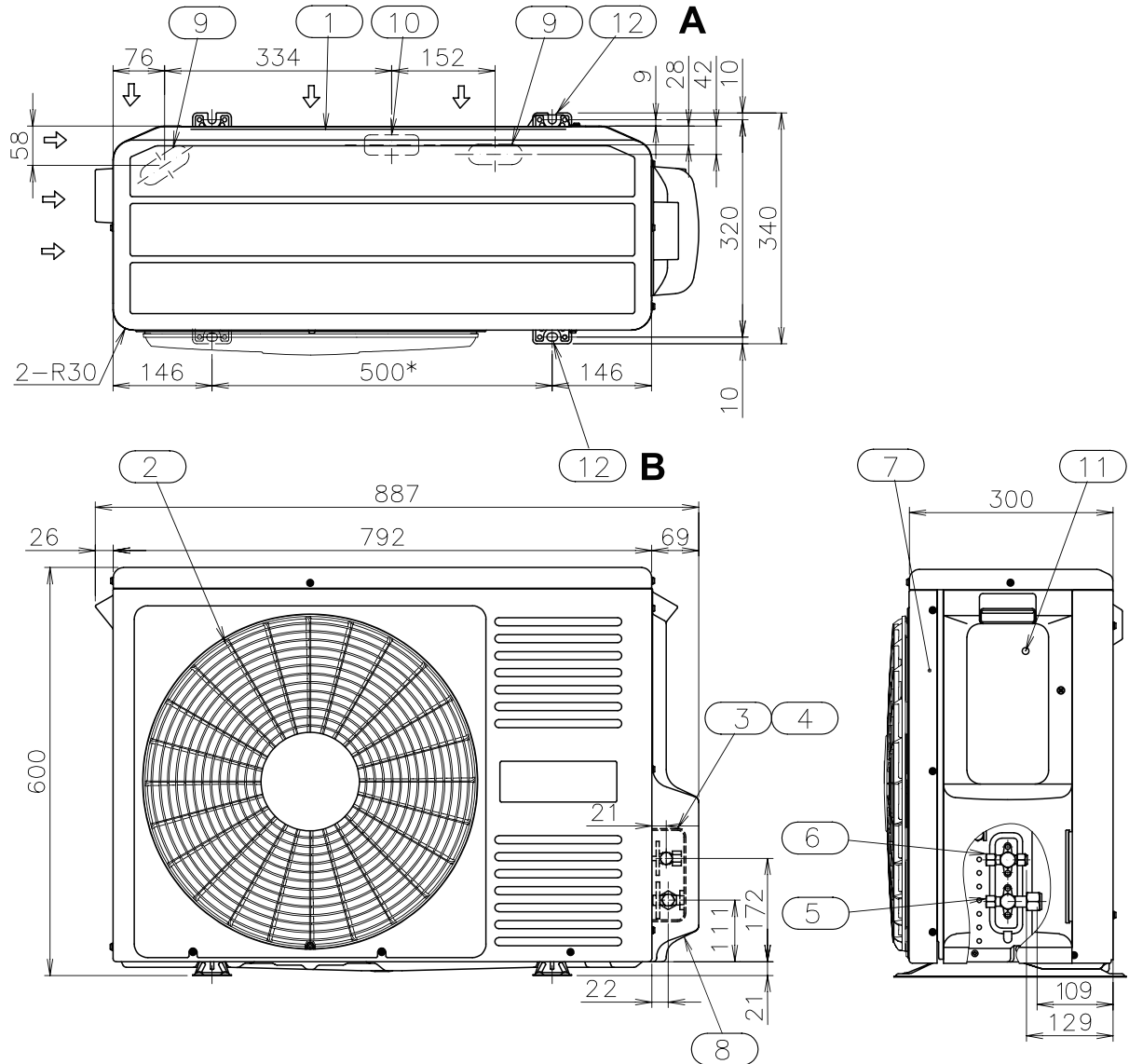
Units in mm.

No.	Description	Remarks
1	Air inlet	—
2	Air outlet	—
3	Hole for power supply wiring	—
4	Hole for control line wiring	—
5	Gas piping connection	—
6	Liquid piping connection	—
7	Service panel	—
8	Refrigerant piping hole	—
9	Drain hole	—
10	Drain hole	—
11	Earth terminal wiring	(M5)
12	Holes for fixing machine to wall	A: 2-U cut holes / B: 2 - holes



7.1.2 IVX Standard series

◆ **RAS-3HVNC**



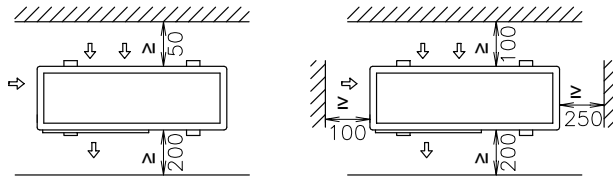
Units in mm.

No.	Description	Remarks
1	Air inlet	—
2	Air outlet	—
3	Hole for power supply wiring	—
4	Hole for control line wiring	—
5	Gas piping connection	—
6	Liquid piping connection	—
7	Service panel	—
8	Refrigerant piping hole	—
9	Drain hole	—
10	Drain hole	—
11	Earth terminal wiring	(M5)
12	Holes for fixing machine to wall	A: 2-U cut holes / B: 2 - holes



7.2 Service space

7.2.1 Basic sizes



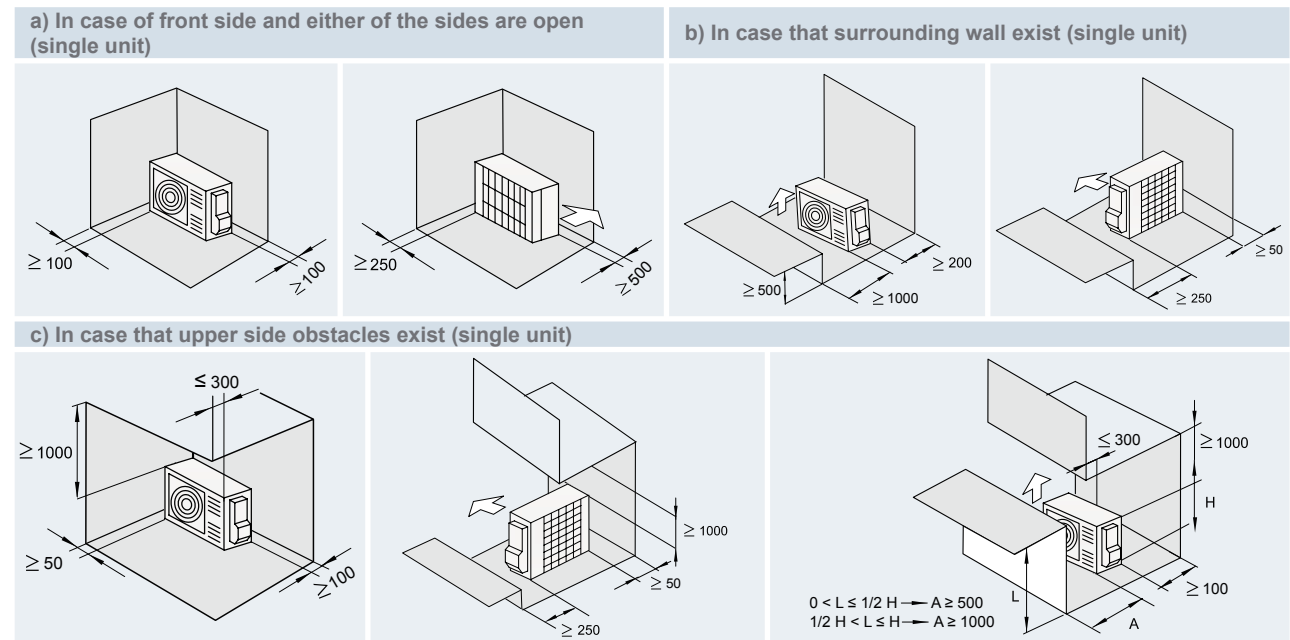
Units in mm.



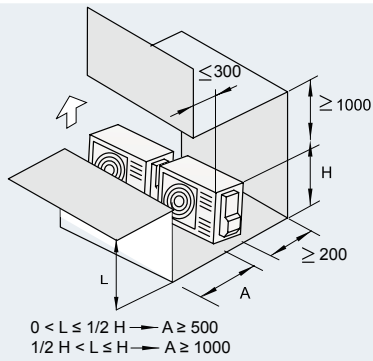
NOTE

For the specific information, please refer to the Service Manual.

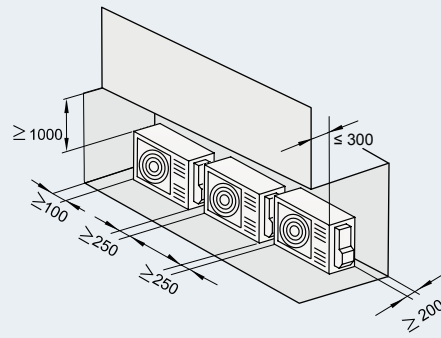
7.2.2 Service space



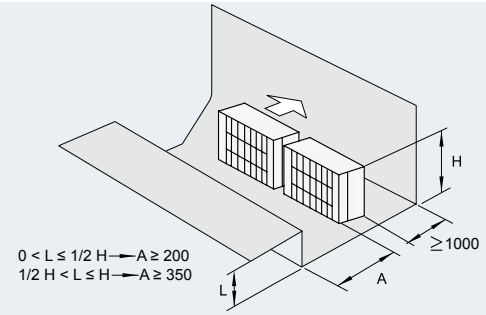
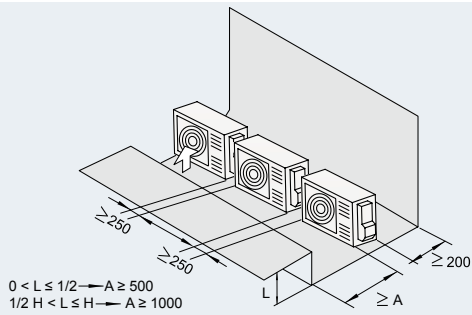
d) In case that upper side obstacles exist (serial units)



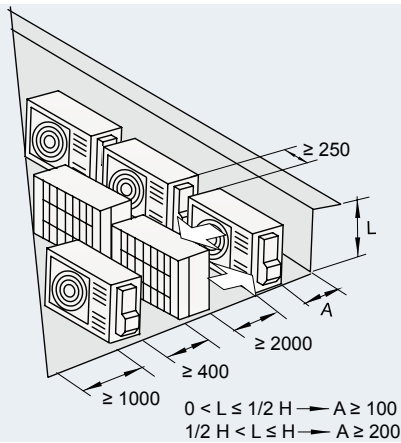
e) In case of front side and either of the sides are open (serial units)



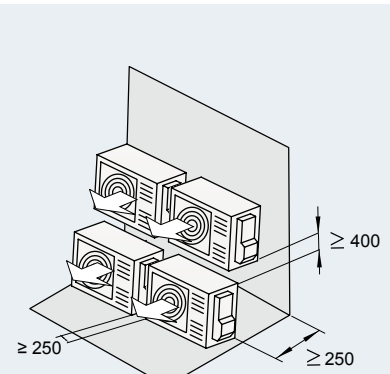
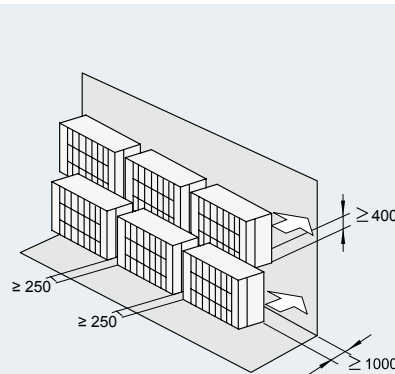
f) In case that surrounding wall exist (serial units)



g) Horizontal (multiple units)



h) Vertical (multiple units)



- Do not stack more than two units in height.
- Close gap (*) to avoid recirculating discharge air flow.





8 . Refrigerant cycle

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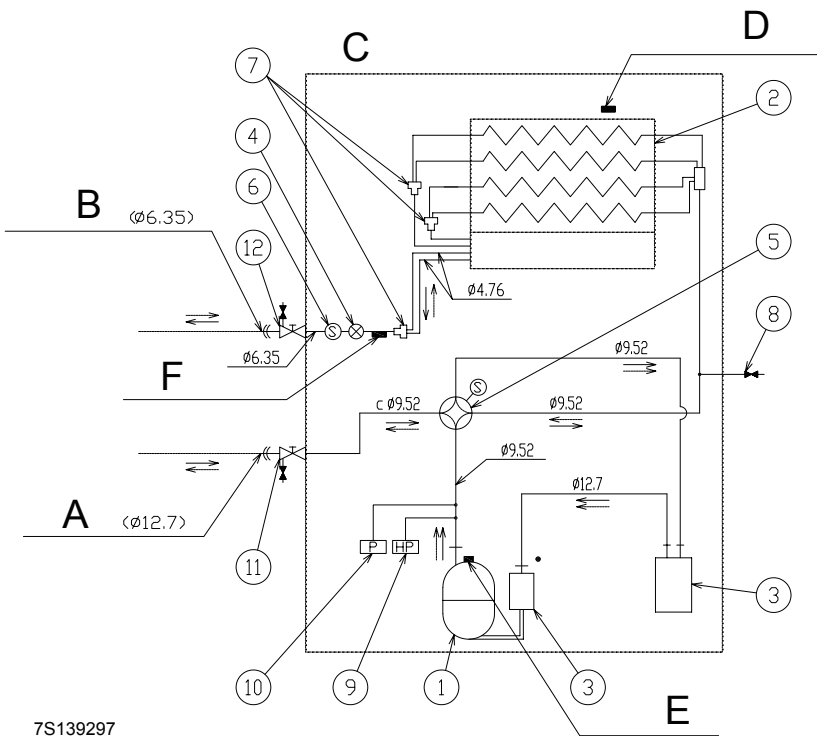
8.1 General notes

Mark	Part name
A	Gas line refrigerant piping connection
B	Liquid line refrigerant piping connection
C	Outdoor unit
D	Ambient thermistor
E	Discharge gas thermistor
F	Pipe thermistor

				R410A	4.15 MPa
Refrigerant flow for cooling	Refrigerant flow for heating	Connection by flare nut	Connection by welding	Gas refrigerant	Leakage test pressure

8.2 IVX Premium series

◆ RAS-(2/2.5)HVNP

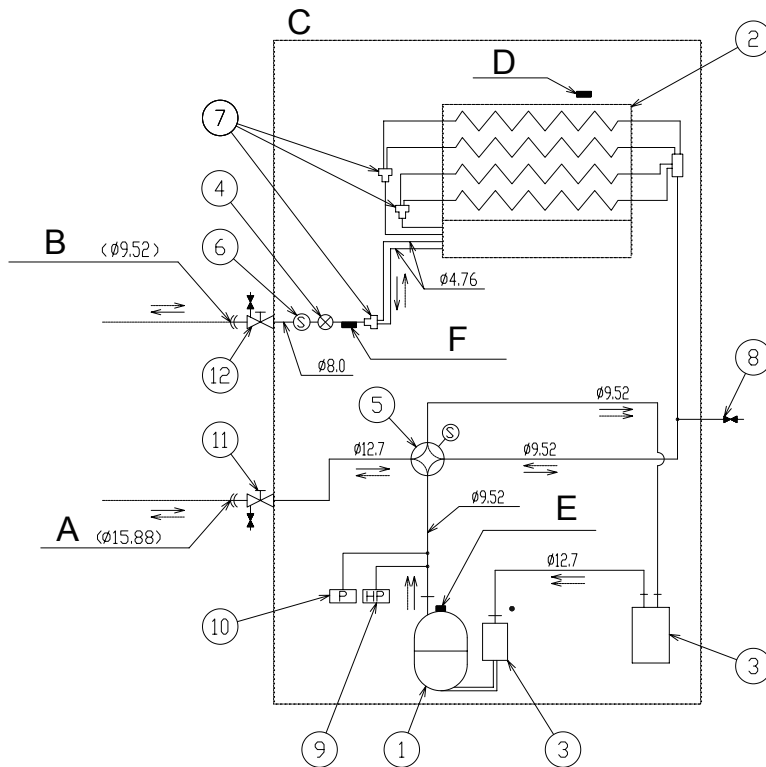


7S139297

Mark	Part name
1	Compressor
2	Heat exchanger
3	Accumulator
4	Micro-computer control expansion valve
5	Reversing valve
6	Strainer
7	Distributor
8	Check joint
9	High pressure switch for protection
10	Pressure switch for control
11	Stop valve for gas line
12	Stop valve for liquid line

8.3 IVX Standard series

◆ **RAS-3HVNC**



Mark	Part name
1	Compressor
2	Heat exchanger
3	Accumulator
4	Micro-computer control expansion valve
5	Reversing valve
6	Strainer
7	Distributor
8	Check joint
9	High pressure switch for protection
10	Pressure switch for control
11	Stop valve for gas line
12	Stop valve for liquid line

7S139296

9. Piping work and refrigerant charge

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9.1 Refrigerant pipe selection

9.1.1 Pipe size selection

Select the pipe size in line with the following instructions:

- 1 Between the outdoor unit and the branch pipe (multikit): select the same pipe connection size as for the outdoor unit.
- 2 Between the branch pipe (multikit) and the indoor unit: select the same pipe connection size as for the indoor unit.
- 3 Between branch pipes (multikits): select the pipe connection size according the equivalent indoor unit size if adding up the units after the branch pipe



CAUTION

- Do not use refrigerant pipe sizes other than those indicated in this Technical Catalogue. The diameter of the refrigerant pipes depends directly on the outdoor unit capacity.
- If larger diameter gas refrigerant pipes are used, the circuit lubrication oil tends to separate from the gas carrying it. The compressor will be seriously damaged due to a lack of lubrication.
- If smaller diameter gas refrigerant pipes are used, the gas or liquid refrigerant will have serious difficulties in circulating. System performance will be affected. The compressor will run under more severe conditions than foreseen and will be damaged in a short space of time.

9.1.2 Multikit or distributor selection

Pipe connection size on outdoor units, indoor units and the multikit or distributor vary according to the system.

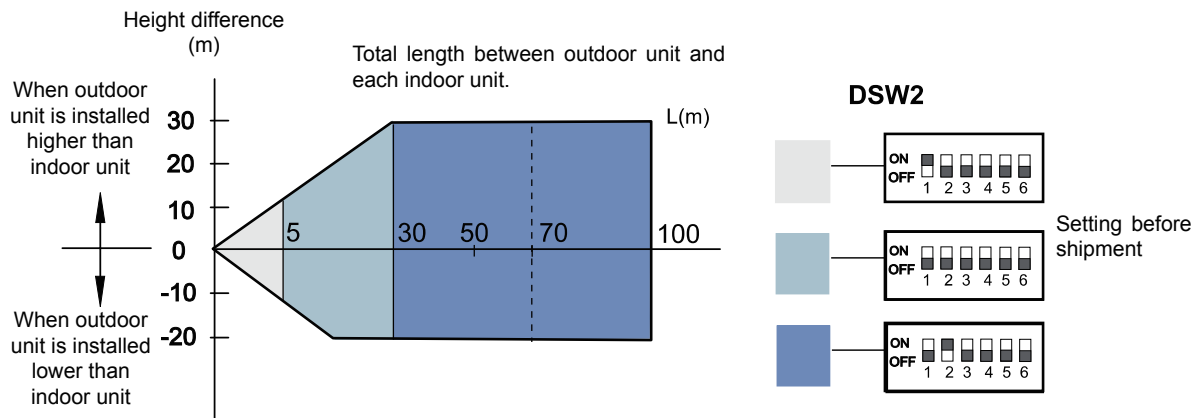
The sizes of the indoor and outdoor units could be different. Adjust the flare adapter (accessory) to the indoor pipe connection in these cases.

9.2 Refrigerant piping range

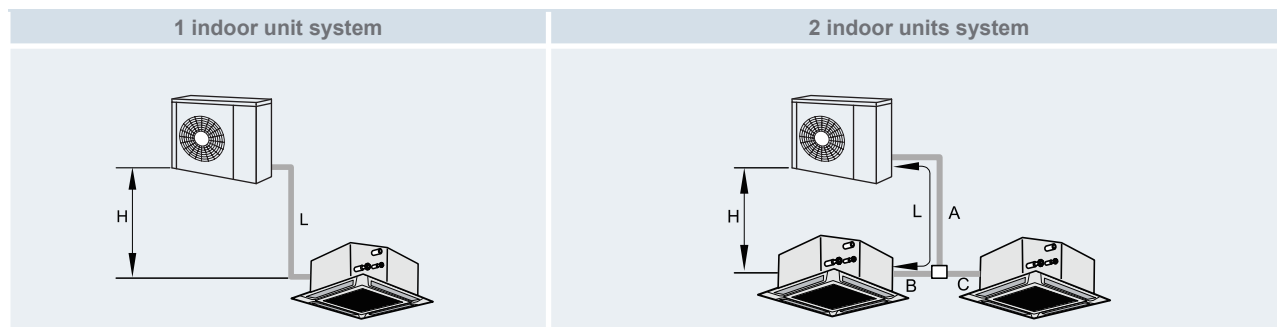
9.2.1 Refrigerant piping length

The refrigerant piping between the indoor unit and the outdoor unit should be designed using the following chart.

Keep the design point within the area of the chart, which is showing the applicable height difference according to piping length.



9.2.2 Piping system for header branch



(pictures are as example)

◆ Maximum refrigerant piping length

IVX Premium series

(m)

Outdoor unit		2 HP	2.5 HP
Maximum piping length between the outdoor unit and the farthest indoor unit	Actual length (L)	50	
	Equivalent length (EL)	70	
Total piping length	2 units (A+B+C)	50	
Maximum piping line after first branch	2 units (B, C)	10	
Main piping length A		A > B, C	
Maximum height difference, Outdoor / Indoor (H) (Outdoor unit is higher / lower)		30 / 20	
Maximum height difference Indoor / Indoor		3	
Maximum height difference: branch pipe/indoor (2 indoor units system)		3	

IVX Standard series

(m)

Outdoor unit		3 HP
Maximum piping length between the outdoor unit and the farthest indoor unit	Actual length (L)	50
	Equivalent length (EL)	70
Total piping length	2 units (A+B+C)	60
Maximum piping line after first branch	2 units (B, C)	10
Main piping length A		A > B, C
Maximum height difference, Outdoor / Indoor (H) (Outdoor unit is higher / lower)		30 / 20
Maximum height difference Indoor / Indoor		3
Maximum height difference: branch pipe/indoor (2 indoor units system)		3



NOTE

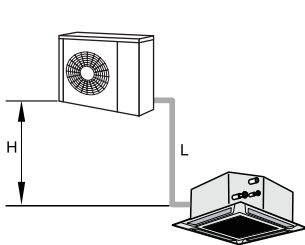
The liquid piping and the gas piping must be of the same piping length and run along the same route.
Install the branch piping as much as possible near the indoor units
Install Multikits at the same horizontal level.

9.2.3 Refrigerant piping size and multikit/distributor

Select the piping connection sizes according to the following procedures

- Between outdoor unit and branch pipe: Select the same pipe connection size as the pipe size of the outdoor unit.
- Between branch pipe and indoor unit: Select the same pipe connection size as the pipe size of the indoor unit.

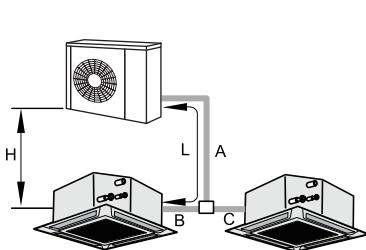
1 indoor unit system



(mm)

Outdoor Unit HP	Pipe Size (L)	
	Gas	Liquid
2 / 2.5	Ø12.70	Ø6.35
3	Ø15.88	Ø9.52

2 indoor units system



(mm)

Outdoor Unit HP	Pipe Size (A)		Multi-kit	
	Gas	Liquid	IVX Premium Series	IVX Standard Series
2 / 2.5	Ø12.70	Ø6.35	TW-22AN	-
3	Ø15.88	Ø9.52	-	TW-52AN

(mm)

Indoor unit capacity	Pipe Size (B, C)	
	Gas	Liquid
≤ 1.5 HP	Ø12.70	Ø6.35
2.0 HP	Ø15.88	Ø6.35
≥ 2.5 HP	Ø15.88	Ø9.52

Connections including Indoor Units 8 and 10 HP are not possible

9.3 Copper pipes, sizes and connection

9.3.1 Copper pipes and sizes

- 1 Prepare locally-supplied copper pipes.
- 2 Select the pipe size of a suitable thickness and material. Use the table below to select the required piping.

Nominal diameter		Thickness (mm)	Copper type
(mm)	(in.)		
Ø6.35	1/4	0.80	Roll
Ø9.52	3/8	0.80	Roll
Ø12.70	1/2	0.80	Pipe/Roll
Ø15.88	5/8	1.00	Roll
Ø19.05	3/4	1.00	Pipe/Roll
Ø22.20	7/8	1.00	Pipe/Roll
Ø25.40	1	1.00	Pipe
Ø28.58	1 1/8	1.25	Pipe



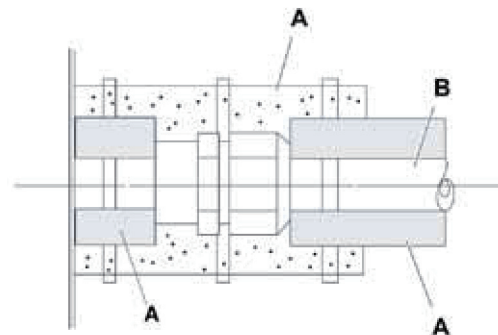
NOTE

If copper pipe is used for piping bigger than Ø19.05, flaring work can not be performed. If necessary, use a joint adapter.

- 3 Select clean copper pipes. Make sure there is no dust and moisture inside. Blow the inside of the pipes through with oxygen-free nitrogen to remove any dust and foreign materials before connecting pipes.
- 4 After connecting the refrigerant piping, seal the open space between the knockout hole and refrigerant pipes by using insulation material as shown below:

A. Insulation.

B. Field-supplied refrigeration piping.



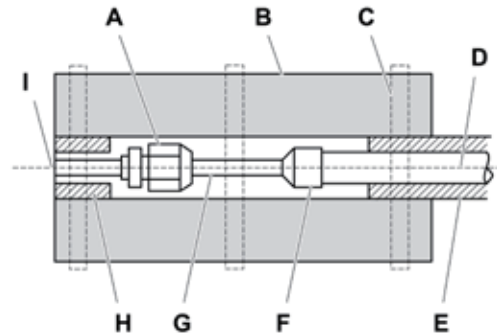
NOTE

- Do not use saws, grindstone or other tools which might create copper dust.
- When cutting pipes, secure the part to be soldered as shown in the Service Manual.
- Strictly follow national or local regulations regarding occupational health and safety.
- Wear appropriate means of protection during cutting or brazing operations and installation (gloves, eye protection, etc).

9.3.2 Pipe connection

Fix the connecting pipe as shown in the figure below. Use the insulation attached to the indoor unit.

- A. Use the flare nut of the indoor unit.
- B. Insulate this part with the insulation material supplied.
- C. Fix this part with the bracket supplied or with tape.
- D. Refrigerant piping in the installation.
- E. Field-supplied insulation.
- F. Brazing.
- G. Make flares after attaching flare nut to the connecting pipe in the Multikit package.
- H. Insulation attached to indoor unit.
- I. Indoor unit.



NOTE

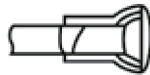
- A system with no moisture or oil contamination will give maximum performance and life-cycle as compared with a poorly prepared system. Take particular care to ensure that all copper piping is clean and dry internally.
- To ensure this, blow oxygen free nitrogen through the pipes.



CAUTION

- Cap the end of the pipe when the pipe is to be inserted through a hole.
- Do not place pipes directly on the ground without a cap or vinyl tape covering the end, as it shown in the figure.

Right



Wrong



- If piping installation cannot be completed until the following day or longer, solder the ends of the piping to close them and load with oxygen-free nitrogen using an access device such as a Schrader valve to avoid moisture and contamination by extraneous particles.
- Do not use insulation material containing NH₃ as it can damage the copper piping material and may be a source of future leakage.

9.3.3 Insulation

Attach insulation package with the Multikit to each branch using vinyl tape. Also attach insulation to field-supplied piping to prevent capacity decrease due to ambient air conditions and dewing on pipe surface caused by low pressure.



NOTE

When polyethylene foam is applied, a thickness of 10 mm for the liquid piping and from 15 mm to 20 mm for the gas piping is recommended.



CAUTION

Perform insulation work after the surface temperature decreases to the room temperature, If not, the insulation material may melt. If the ends of the piping system are open after finishing the installation work, securely attach caps or vinyl bags to the ends of the piping to prevent moisture or dust entering.

9.4 Refrigerant charge amount

Although refrigerant has been charged into this unit, additional refrigerant charge is required according to piping length.

- The additional refrigerant quantity should be determined and charged into the system according to the following procedure.
- Record the additional refrigerant quantity in order to facilitate maintenance and servicing activities.

9.4.1 Refrigerant charge before shipment (W_0 (kg))

W_0 is the outdoor unit refrigerant charge before shipment explained before, and it's shown in the following table:

IVX Premium series

Model	Refrigerant charge before shipment (W_0 (kg))	Additional refrigerant charge (P) (g/m)	Maximum additional charge (kg)
RAS-2HVNP	1.6	30	1.5
RAS-2.5HVNP	1.6	30 (for 2 indoor units system: 24)	1.2

IVX Standard series

Outdoor unit	Refrigerant charge before shipment (W_0 (kg))	Additional refrigerant charge (g/m)	Maximum additional charge (kg)
RAS-3HVNC	1.9	40	1.2



CAUTION

- *When charging refrigerant, measure the amount precisely.*
- *Overloading or underloading of refrigerant may cause compressor problems.*
- *If the actual piping length is less than 5 m consult your dealer.*

9.4.2 Calculation method for the additional refrigerant charge

Calculate the additional refrigerant charge amount according to the following steps:

◆ Step 1: Additional refrigerant charge calculation for liquid piping (W_1 (kg))

Outdoor units has been charged with refrigerant for 30 m (20 m for RAS-3HVNC) of actual piping length, an additional refrigerant charged is required in systems with actual piping length longer.

Use the following formula:

$$W_1 = (L-30) \times P \quad (*)$$



NOTE

(*): In case of RAS-3HVNC units, the unit is charged with refrigerant for 20 m. In these cases, the formula for calculating the additional refrigerant charge is:

$$W_1 = (L-20) \times P$$

L: Total piping length (m)

P: Additional refrigerant charge (kg/m) (Refer to the *Refrigerant charge before shipment* chapter)

◆ Step 2: Additional refrigerant charge calculation for indoor unit (W_2 (kg))

When the outdoor unit is combined with indoor units RPI-(8/10)HP, it's necessary an additional refrigerant charge (W_2) = 1 kg/unit. For indoor units lower than 8 HP, an additional refrigerant charge it's not needed.

Indoor unit capacity	Additional refrigerant charge (W_2 (kg))
≥ 8 HP	1
< 8 HP	0

◆ Step 3: Calculation of total additional refrigerant charge (W (kg))

Put weight W_1 and W_2 calculated in step 1 and step 2 into the following formula:

$$W = W_1 + W_2$$

System example (W) = + = kg



CAUTION

Do not exceed the allowed maximum additional charge.

◆ Step 4: Charging work

Charge refrigerant (R410A) into the system according to the instructions in the Service Manual.

◆ Step 5: Total refrigerant charge of the system (W_{TOT} (kg))

The total refrigerant charge of this system is calculated by the following formula:

$$W_{TOT} = W + W_0$$

System example (W_{TOT}) = + = kg

W_0 is the outdoor unit refrigerant charge before shipment explained before, and it's shown in its specific table.

Finally, record the refrigerant charge quantity in order to facilitate maintenance and servicing activities.

Total additional charge W	<input type="text"/>	kg
Total ref. charge of this system	<input type="text"/>	kg
Date of ref. charge work		
Year	<input type="text"/>	Month <input type="text"/> Day <input type="text"/>

9.5 Caution in case of refrigerant leakage

The installers and those responsible for drafting the specifications are obliged to comply with local safety codes and regulations in the case of refrigerant leakage.

9.5.1 Maximum permitted concentration of hydrofluorocarbon (HFC)

The refrigerant R410A, charged in the UTOPIA series system, is an incombustible and non-toxic gas. However, if leakage occurs and gas fills a room, it may cause suffocation. The maximum permissible concentration of HFC gas, R410A in air is 0.44 kg/m³, according to EN378-1.

Therefore, some effective measure must be taken to lower the R410A concentration in air below 0.44 kg/m³, in case of leakage.

9.5.2 Calculation of refrigerant concentration

The room must have the following characteristics should there be a gas refrigerant leak:

- 1 Calculate the total quantity of refrigerant **R (kg)** charged in the system by connecting all the indoor units in the rooms to be air-conditioned.
- 2 Calculate the room volume **V (m³)** of each room.
- 3 Calculate the refrigerant concentration **C (kg/m³)** of the room according to the following equation:

$$C = R / V$$

R: Total quantity of refrigerant charged (kg).

V: Room volume (m³).

C: Refrigerant concentration (≤ 0.44 kg/m³ for R410A).

9.5.3 Countermeasure for refrigerant leakage

The facility must have the following features in case of a refrigerant leakage occurs:

- 1 Provide a shutterless opening which will allow fresh air to circulate into the room.
- 2 Provide a doorless opening of 0.15% or more size to the floor area.
- 3 There must be a ventilator fan connected to a gas leak detector, with a ventilator capacity of 0.4 m³/min or higher per Japanese refrigeration ton (= compressor displacement volume / 5.7 m³/h) of the air conditioning system using the refrigerant.

IVX Premium series

Model	Tonnes
RAS-2HVNP	0.88
RAS-2.5HVNP	1.14

IVX Standard series

Model	Tonnes
RAS-3HVNC	1.35

- 4 Pay a special attention to the place, such as a basement, etc., where refrigerant can stay, since refrigerant is heavier than air.

10. Electrical wiring

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10.1 General information

10.1.1 General notes



CAUTION

- *Before any electrical wiring work or regular inspections, switch off the main power supply switches of the indoor and outdoor units. Wait three minutes before starting installation or maintenance work.*
- *Make sure that all the units (both indoor and outdoor) are completely stopped before starting work on the electrical wiring or regular inspections.*
- *Protect cables, drain hose, electric parts, etc. from rodents and insects; otherwise these might damage unprotected components and, in the worst case, cause a fire.*
- *Do not allow cables to come into contact with the refrigerant pipes, metal edges, printed circuit boards (PCB) or the electric parts inside the unit; the cables may be damaged and, in the worst case, cause a fire.*
- *Firmly secure the cables inside the indoor unit with plastic flanges.*



DANGER

- *Use an earth leakage breaker with medium sensitivity, and an activation speed of 0.1 sec or less. If this is not fitted, there is a risk of electric shock and/or fire.*
- *Install an earth leakage breaker, fuse and circuit breaker for each outdoor unit power line. Not fitting it may cause an electric shock or fire.*



NOTE

Fix the rubber bushes with adhesive when the outdoor unit ducts are not used.

10.1.2 General verifications

- 1 Make sure the electric components supplied by the installer (main power switches, circuit breakers, wires, connectors and connection terminals) have been selected correctly in line with the electrical data given.
 - a. The electricity supply to the unit should be via an exclusive power control switch and protective circuit breaker, certified and installed in accordance with local or national safety regulations.
 - b. The electricity supply for the outdoor and indoor units should be separate. Connect the voltage supply wiring for each group of indoor units to the same outdoor unit.
- 2 Check that the supply voltage is between 90 and 110% of the rated voltage. Where the voltage capacity is too low, it will not be possible to start the system due to the drop in voltage.
- 3 During the preliminary preparation work of the electricity supply line for the unit, the provisions in local and national legislation must never be violated.
- 4 Check that the earth cable is correctly connected.



DANGER

- *Never connect the earth cable to the refrigerant pipes. The gas in the pipes could cause a fire.*
- *Do not connect the earth cable to the lighting arrest system. The electrical potential of earth would increase abnormally.*

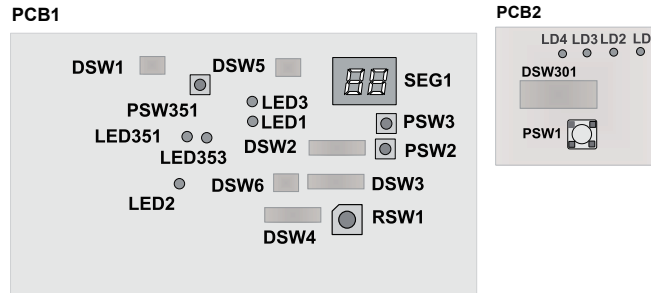
10.2 DIP and RSW switches settings

TURN OFF all power source before setting. Without turning OFF, the switches do not work and the contents of the setting are invalid.

Mark of “n” indicates the position of dip switches. Set the dip switches according to the figure below.

◆ Quantity and Position of DIP Switches

The PCB in the outdoor unit is operating with 7 types of DIP switches, and 4 push switch. The location is as follows:



◆ DSW301: Test run mode

Setting before shipment	
-------------------------	--

◆ DSW1: No setting is required

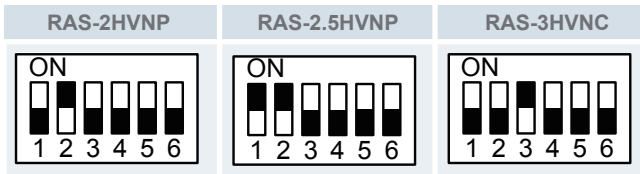
When set pin number 1 to ON, the electric current detection is cancelled. Pin number 1 should be set back to OFF after electrical work	
--	--

◆ DSW2: Pipe length setting (setting is required) / Optional function setting

	Setting before shipment
Pipe length setting should be performed as follows according to the on-site pipe length.	Pipe length (≤5m)
	Pipe length (≥30m)
Optional piping setting	
Optional function setting	
External input/output setting mode	

◆ **DSW3: Capacity setting (no setting is required)**

Factory setting



◆ **DSW4 / RSW1: Refrigerant cycle number setting (Setting is required)**

Setting for the ten digit
(Factory setting)



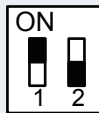
Setting position.

Set by inserting slotted screwdriver into the groove (setting for the last digit)



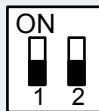
◆ **DSW5: End terminal resistance (No setting is required)**

Factory setting



Cancellation

(Setting of end terminal resistance)



Setting for transmission

It is required to set the outdoor unit number refrigerant cycle and end terminal resistance for the H-LINK.

In the same refrigerant cycle, set the same refrigerant cycle number for the outdoor unit and the indoor units.

Example incase of setting before cycle number 25

DSW4: Turn ON pin number 2

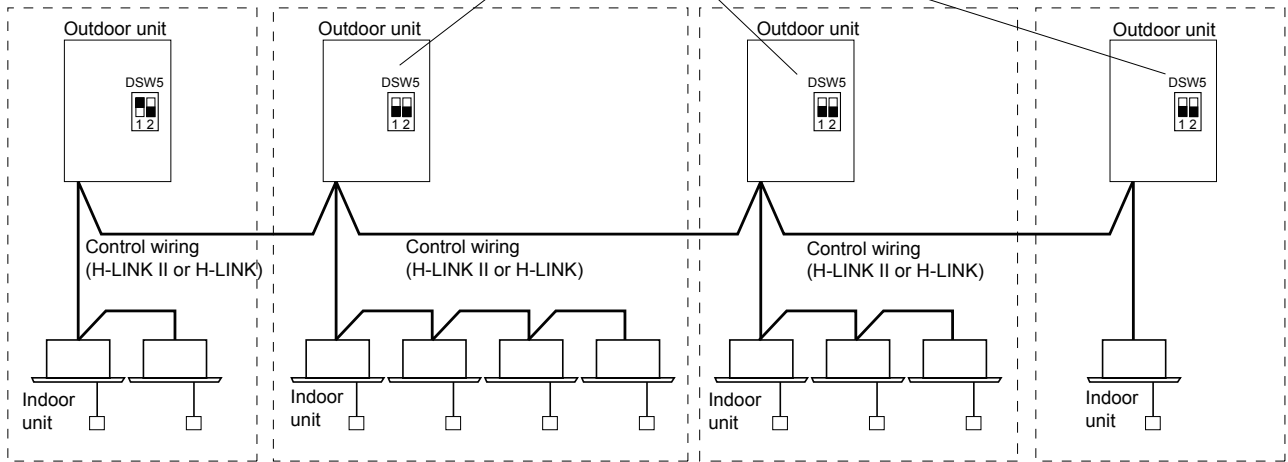


RSW1: set dial number 5



In case that the outdoor units quantity in the same H-LINK II is 2 or more, set in the DSW5 the pin number 1 OFF side from the second refrigerant group outdoor units. If only one outdoor unit is used (in the same H-Link II system), no setting is required.

Turn OFF DSW5 number 1 pin for cancel of end terminal resistance setting



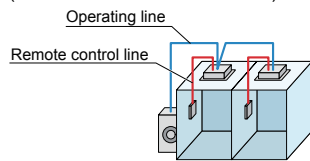
◆ **DSW6: Setting of multiple indoor units operation (setting is required)**

Optional function setting

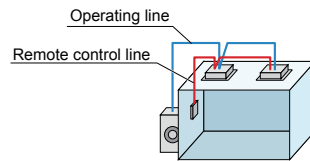
For individual operation (factory setting)
For simultaneous operation
Set pin number 1 at OFF for simultaneous operation

Wiring example

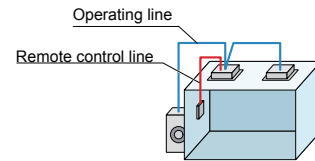
Basic combinations
(In the case of twin combination)



Individual control
Running ON/OFF individually
Thermo-ON/OFF individually



Individual control
Running ON/OFF simultaneously
Thermo-ON/OFF individually



Simultaneous control
Running ON/OFF simultaneously
Thermo-ON/OFF simultaneously



10.3 Common wiring

10.3.1 Electrical wiring between outdoor and indoor unit

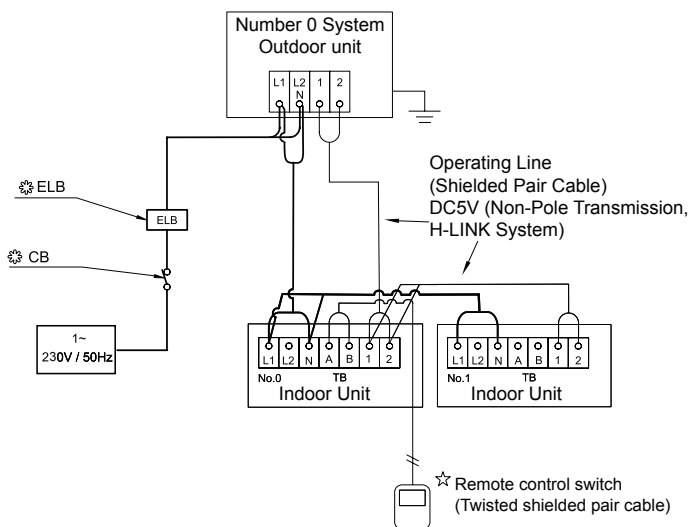
- Connect the electrical wires between the indoor unit and the outdoor unit as show in the figure.
- When installing the electrical wiring, follow local codes and regulations.
- The refrigerant piping and the control wiring are connected to the units in the same refrigerant cycle.
- Use twist pair wire (more than 0.75 mm²) for operation wiring between the outdoor unit and indoor unit, and operation wiring between indoor unit and indoor unit.
- Use a 2-core wire for the operating line (do not use wire with more than 3 cores).
- Use shielded wires for intermediate wiring to protect the units from noise interference at lengths of less than 300 m. The size must comply with local code.
- Open a hole near the connection hole of power source wiring when multiple outdoor units are connected from a single power source line.
- The recommended breaker sizes are detailed in the *Wire size* section.
- In the case that a conduit tube for field-wiring is not used, fix rubber bushes with adhesive on the panel.
- All field wiring and equipment must comply with local and international codes.
- H-LINK twist pair shielded cable must be grounded.



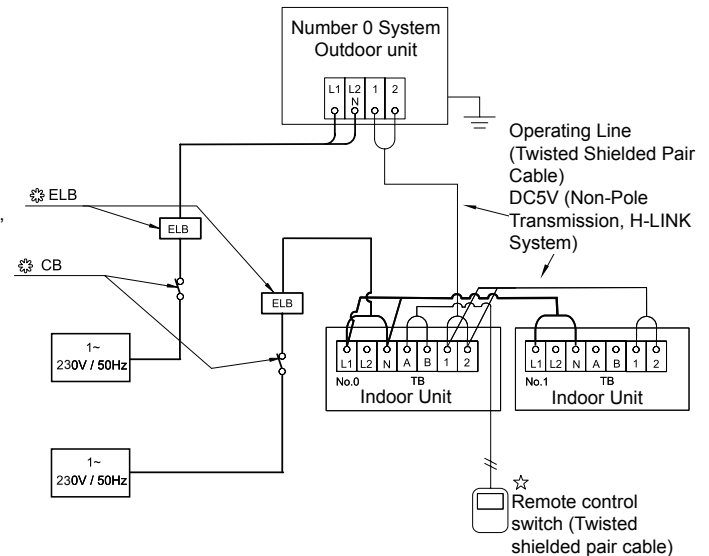
NOTE

Take care with the connection of the operating line. Incorrect connection may cause a failure of the PCB.

Power source from the outdoor unit to the indoor unit



Independent power source of outdoor unit and indoor unit



- TB Terminal board
 CB Circuit Breaker (field supplied)
 ELB Earthleakage Breaker (field supplied)
 A Power source from the outdoor unit to the indoor unit
 — Field Wiring
 Field supplied
 Optional Accessory

10.3.2 Wire size

◆ Connection wiring

Recommended minimum sizes for field provided wires:

Model	Power supply	Power source cable size	Transmitting cable size	
		EN60 335-1	EN60 335-1	
IVX Premium Series				
RAS-2HVNP	1~ 230V 50Hz	2.5 mm ²	0.75 mm ²	
RAS-2.5HVNP		4.0 mm ²		
IVX Standard Series				
RAS-3HVNC	1~ 230V 50Hz	4.0 mm ²		



NOTE

- Follow local codes and regulations when selecting field wires, Circuit breakers and Earth Leakage breakers
- Use the wires which are not lighter than the ordinary polychloroprene sheathed flexible cord (code designation H05RN-F)

10.4 H-LINK II system

The H-LINK II is the wiring connection system between units.

The H-LINK II wiring system only needs:

- Two transmission wires connecting each indoor and outdoor unit for a total of 64 refrigerant cycles.
- Connection wiring for all indoor and outdoor units in series.



CAUTION

The H-LINK II system cannot be applied to the models with the old cycle, nor to units with an old transmission.

10.4.1 Features

- The total wiring length is considerably reduced compared to traditional connections.
- Only one connection is required for the wiring between the indoor and outdoor units.
- The wiring connection of the complementary central control devices is easy.



NOTE

CSNET WEB is centralized control system which allows the installation to be controlled remotely. It can be connected at any point of the local corporate network, or even via the Internet.

10.4.2 Specifications

A: outdoor unit.

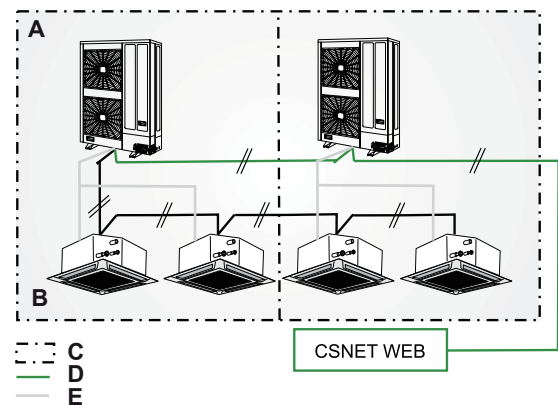
B: indoor unit.

C: a refrigerant cycle.

D: transmission cables.

E: refrigerant piping.

- Transmission cable: 2-wire.
- Polarity of transmission cable: non-polar wire.
- Maximum number of indoor units that can be connected: 4 units per cycle and 160 units per H-LINK II system.
- Maximum wiring length: total 1000 m (including CSNET WEB).
- It is possible to increase the maximum wiring length up to 5000 m by using up to four PSC-5HR units.
- Recommended cable: shielded twisted pair cable, over 0.75 mm² (Equivalent to KPEV-S).
- Voltage: 5 V DC.



CAUTION

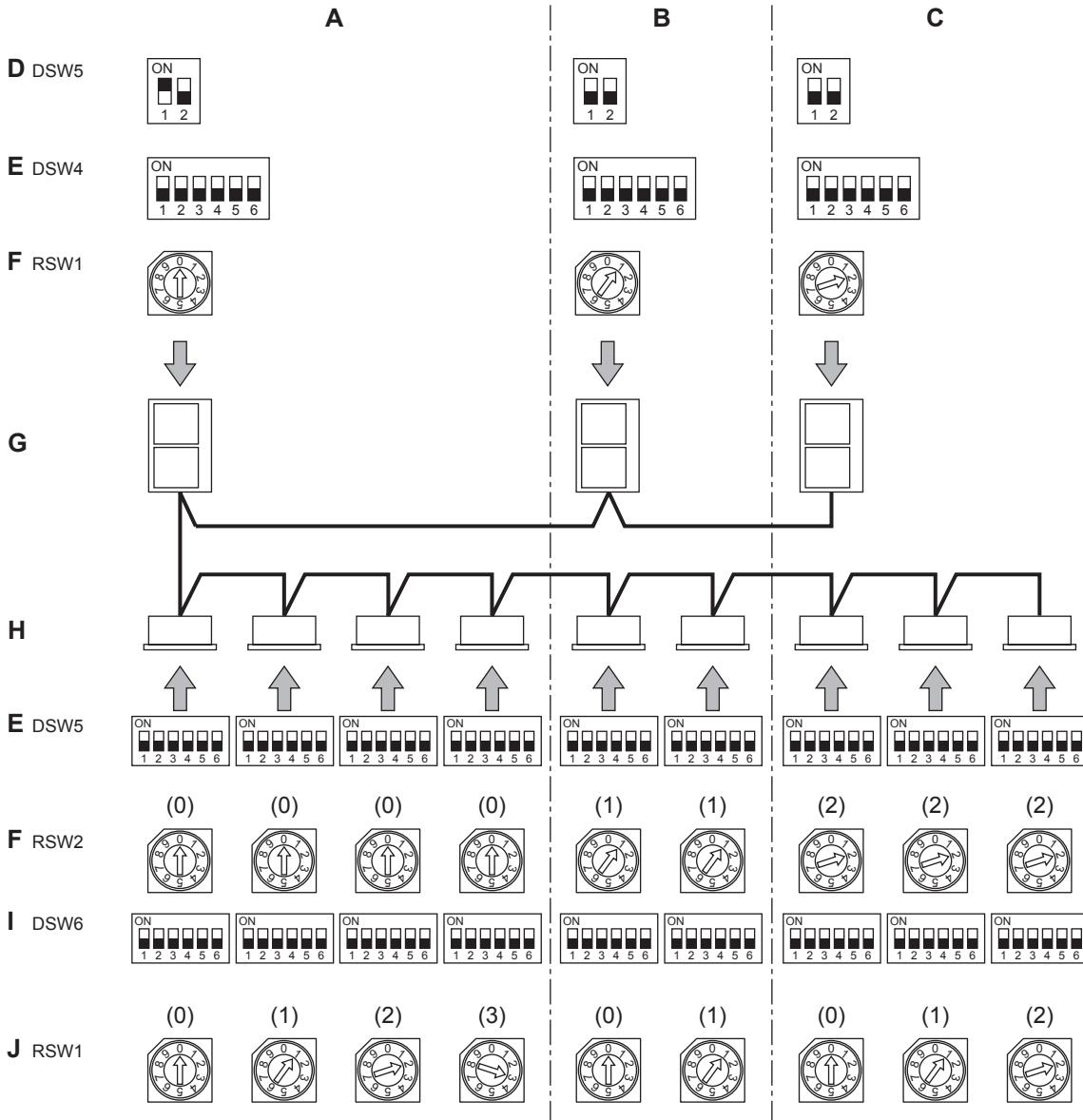
For the H-LINK II system must use twisted shielded pair cable or shielded pair cable.

10.4.3 DIP Switch setting for 2, 3 and 4 indoor units systems

Dip switch of indoor and outdoor unit PCB - H-LINK II

The DIP switches of all the indoor and outdoor units have to be set and the impedance of the transmission circuit adapted.

- Example of the setting of the DIP switches.



A: Cycle number 0.

B: Cycle number 1.

C: Cycle number 2.

D: Terminal resistance.

E: Number of refrigerant cycle (setting for the tens digit).

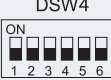
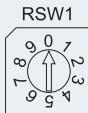

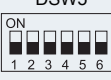
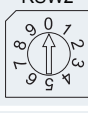

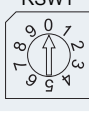
F: Number of refrigerant cycle (setting for the last digit).

G: Outdoor units.

H: Indoor units.

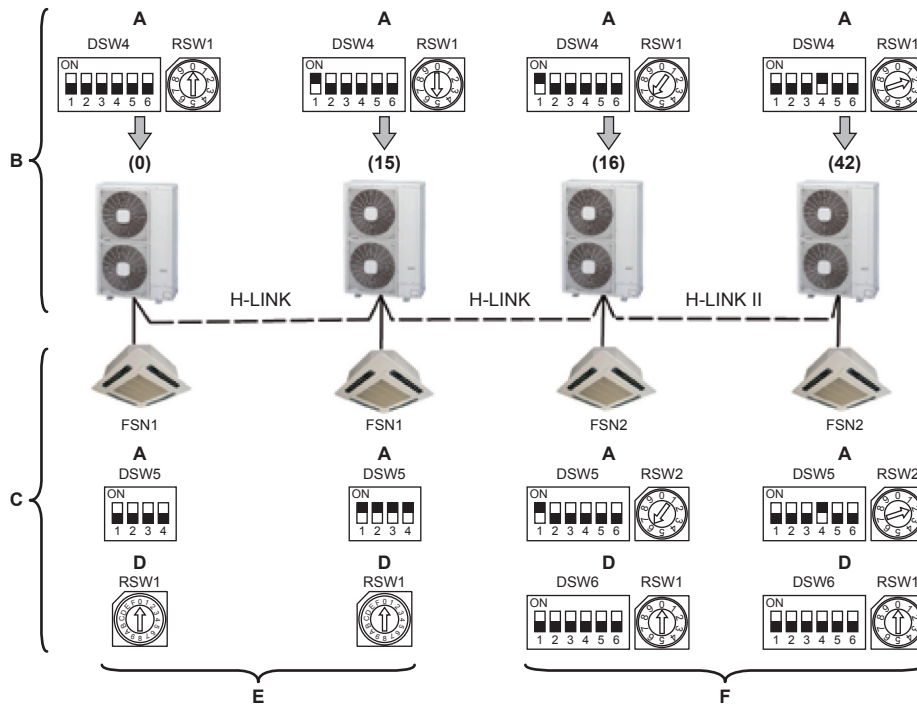
I: Address of the indoor unit (setting for the tens digit).

J: Address of the indoor unit (setting for the tens digit).

Unit	Name of DIP switch	Mark	Setting before the Shipment	Function
Outdoor Unit	Refrigerant cycle	DSW4 RSW1	 	For setting the refrigerant cycle address of the outdoor unit. Set the DSW4 and RSW1 to overlap the setting of other outdoor units in the same H-LINK system.
	Resistance of terminal	DSW5		To adapt the impedance of the transmission circuit, adjust DSW5 according to the number of outdoor units of the H-LINK system.
Indoor Unit	Refrigerant cycle	DSW5 RSW2	 	For setting the refrigerant cycle address of the indoor unit. Set the DSW5 and RSW2 corresponding to the address of outdoor unit in the same refrigerant cycle.
	Address of the indoor unit	DSW6 RSW1	 	Setting indoor unit address. Set the DSW6 and RSW1 not to overlap the setting of other indoor units in the same refrigerant cycle. (If no set, the automatic address function is performed.)

10.4.4 Examples of the system of connection between H-LINK and H-LINK II units

In the case of mixed systems with H-LINK and H-LINK II, set the H-LINK units in the first 16 position of the system, as in the following example where 42 systems are connected, 16 with indoor FSN1 units and 26 with indoor FSN2 units.



- A: Refrigerant cycle.
- B: Outdoor unit.
- C: Indoor unit.
- D: Indoor unit address.
- E: Either the current remote control switch (H-LINK) or the new one (H-LINK II) can be used.
- F: Only the new remote control switch (H-LINK II) can be used.

i NOTE

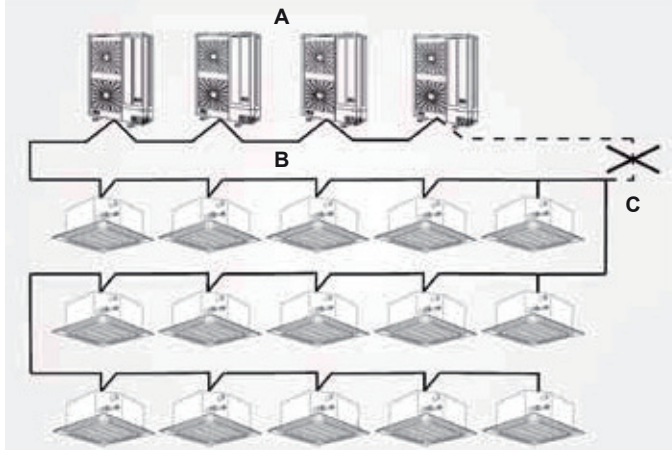
- The maximum number of indoor units than an H-LINK II can control is 160.
- If you use PSC-5S and the CSNET WEB 2.0 (systems only compatible with H-LINK) bear in mind that it will only recognize 16 indoor and 16 outdoor units.

10.4.5 Examples of H-LINK II system

Two cases:

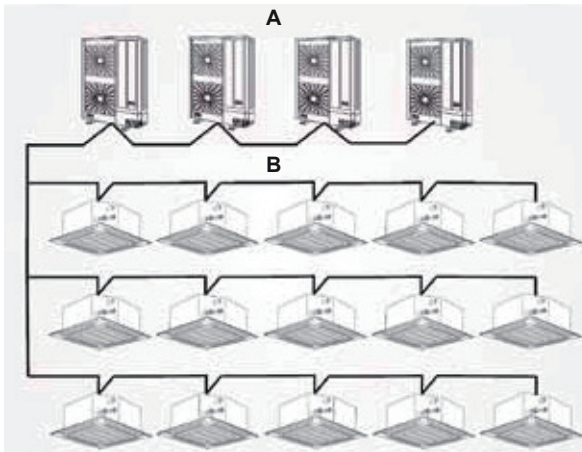
1. Using H-LINK II system for air conditioning systems without a central control device (CSNET WEB or PSC-A64S)

- Line connection with all units (including Utopia and/or Set Free, Mini Set Free and DC Inverter).



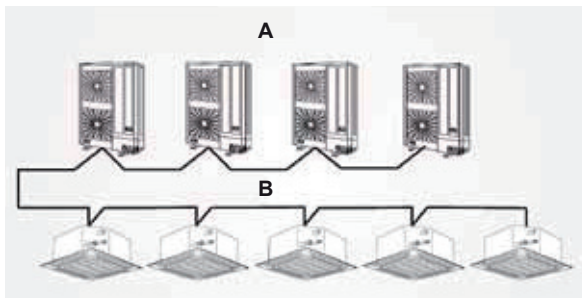
- A: Outdoor units.
- B: Indoor units.
- C: Do not install wiring in a loop.

- Line connection for each floor.



- A: Outdoor units.
- B: Indoor units.

- Connection with one main line and with the branch lines for the units.



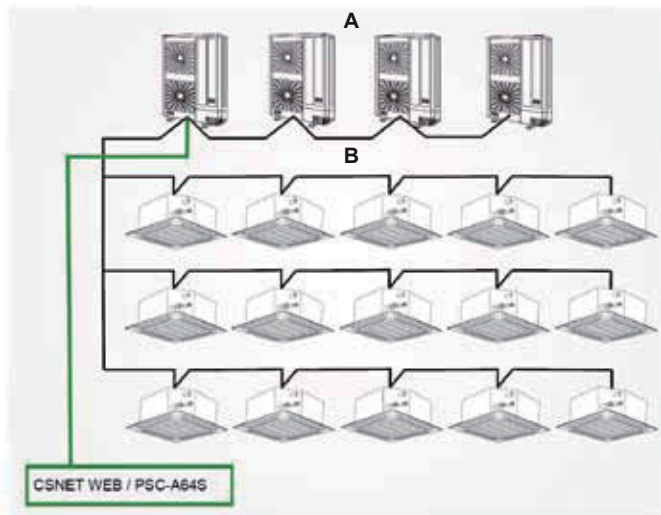
- A: Outdoor units.
- B: Indoor units.

CAUTION

- The maximum number of units that can be connected is 64 outdoor units and 160 indoor units (including Utopia and/or Set Free, Mini Set-free).
- Do not install the wiring in a loop.
- If the H-LINK II system is not used when carrying out the electrical wiring as shown above, it must be used once the wiring of the instrument is completed. The DIP switches must therefore be set as specified in the DIP switches on the PCB.

2. Using the H-LINK II system for air conditioning systems with a central control device (CSNET WEB or PSC-A64S)

- If the central control device is used when carrying out electrical wiring, the CS-NET WEB can be connected at any point of the H-LINK II wiring.



A: Outdoor units.

B: Indoor units.

- If the central control device is not used when electrical wiring is carried out, you must connect the H-LINK II wiring to all the systems. The easiest method is usually to connect the outdoor units.

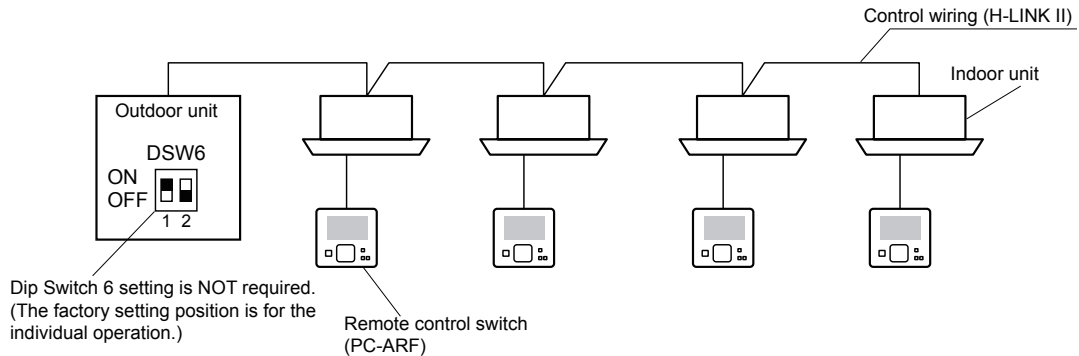


NOTE

For CSNET WEB 2.0 the limitations are those corresponding to H-LINK.

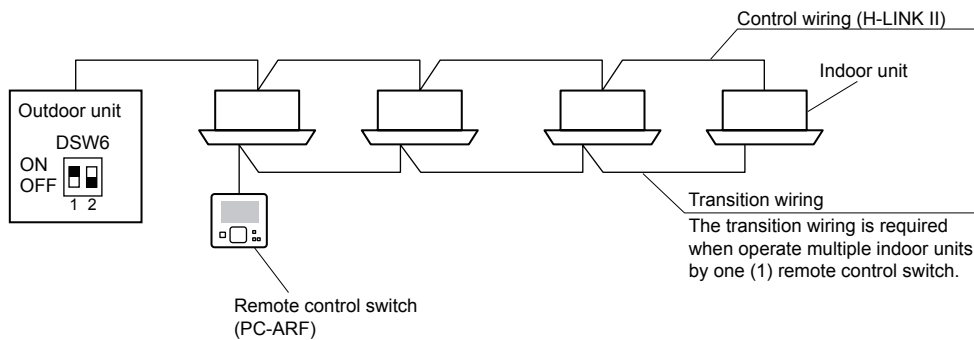
10.5 System control

10.5.1 Individual operation



◆ Individual Thermo ON/OFF Operation

The individual Thermo ON/OFF is available to be controlled each indoor unit even if multiple indoor units are controlled simultaneously by one remote control switch.



Control Method		by each optional remote control switch	
Operation Method		by one group	
(1)	ON/OFF	Yes	
(2)	Setting of Operation Mode	Yes	*1)
(3)	Room Temperature Setting	Yes	
(4)	Fan Speed Setting	Yes	
(5)	Timer Setting	Yes	
(6)	ON/OFF by Timer Control	Yes	
(7)	Operation Indication	Yes	
(8)	Alarm Indication	Yes	
(9)	Self-Checking	Yes	
(10)	Test Mode	Yes	
(11)	Individual Louver Setting	Yes	*2)
(12)	Motion Sensor Setting	Yes	*3)

Yes: Available

*1): Cooling and heating can not be operated simultaneously.

*2): Only for RCI-FSN3 series with PC-ARF

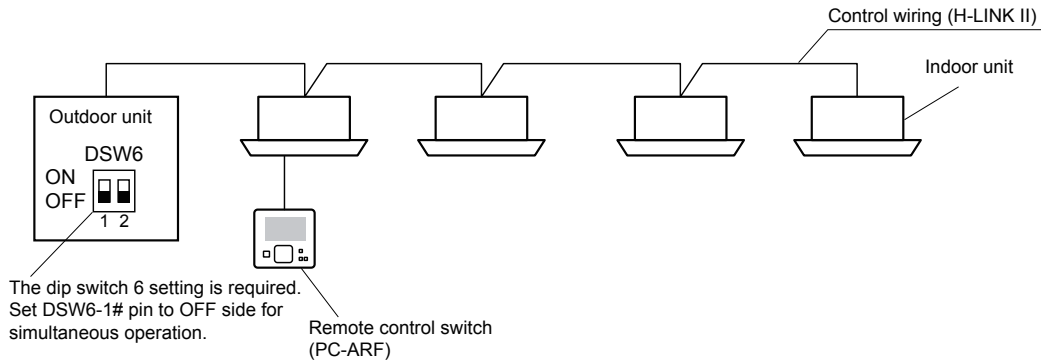
Only for RCI-FSN3 + P-AP160NAE + PC-ARF.

*3): Do not mix other indoor unit, air panel (P-AP160NA1) and remote control switch (PC-ART) if set from one remote control switch

10.5.2 Simultaneous operation

This unit can be operated simultaneously with 2, 3 and 4 indoor units combinations.

One remote control switch (PC-ARF) can control without transition wiring up to 4 units of FSN2 series or later model types (H-LINK II supported models) simultaneously (Available if it is with the transition wiring.)



Control Method	by one optional Remote Control Switch	
	Operation Method	by one group
(1) ON/OFF	Yes	
(2) Setting of Operation Mode	Yes	*1)
(3) Room Temperature Setting	Yes	
(4) Fan Speed Setting	Yes	
(5) Timer Setting	Yes	
(6) ON/OFF by Timer Control	Yes	
(7) Operation Indication	Yes	
(8) Alarm Indication	Yes	
(9) Self-Checking	Yes	
(10) Test Mode	Yes	
(11) Individual Louver Setting	Yes	*2)
(12) Motion Sensor Setting	Yes	*3)

Yes: Available

*1): Only if all units in one group are connected to the same outdoor unit.

*2): Only for RCI-FSN3 series with PC-ARF
Only for RCI-FSN3 + P-AP160NAE + PC-ARF

*3): Do not mix other indoor unit, air panel (P-AP160NA1) and remote control switch (PC-ART) if set from one remote control switch.

11 . Troubleshooting

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11.1 On-screen displays during abnormal operation

Abnormal operation can be produced due to the following reasons:

- Malfunction

The RUN (red) indicator flashes.

The ALARM indicator appears on the liquid crystal display.

The screen also displays the following items:

- A: indoor unit address.
- B: Refrigerant cycle number.
- C: Alarm code.
- D: Model code.
- E: If there are various indoor units connected, the above mentioned information is shown for each one of them.

Write down the indications and contact your HITACHI service supplier.

- Power supply failure.

All displays disappear.

If the unit stops due to a power shortage, it will not start again, even though the power comes back on. Carry out the start-up operations again.

If the power failure lasts less than 2 seconds, the unit will start again automatically.

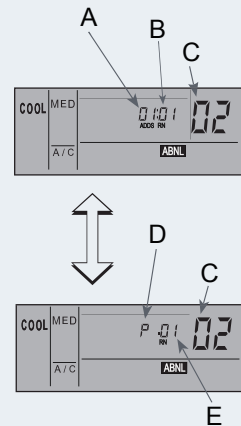
- Electrical noise

The displays can disappear from the screen and the unit can stop. This is because the microcomputer has been activated to protect the unit from electrical noise.



NOTE

If the wireless remote control is used for the wall-type indoor unit, remove the connectors (CN25) that are connected to the indoor PCB. Otherwise the unit will not work. The stored data cannot be erased unless the remote control is initialised.



(PC-ART example)

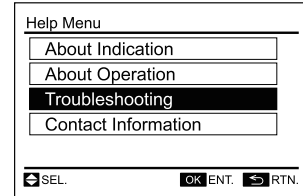
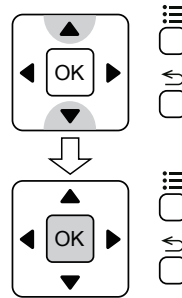
Model code	
Indication	Model
H	Heat pump
P	Inverter
F	Multi (SET-FREE)
C	Cooling only
E	Other
b	IVX, individual operation
L	KPI

11.1.1 PC-ARF Troubleshooting help menu

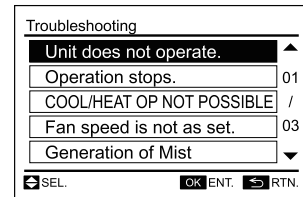
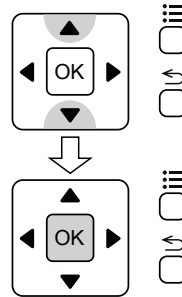
PC-ARF remote controller have a Troubleshooting function in Help Menu.

Make sure that the troubleshooting is read carefully before requesting for repairs.

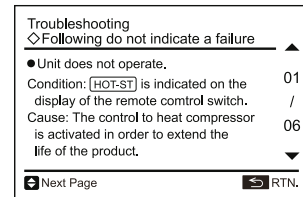
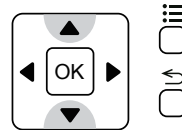
Select "Troubleshooting" from the help menu and press "OK". The list of troubleshooting will be displayed.



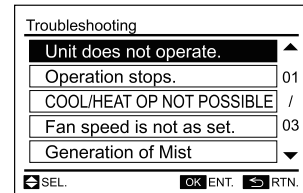
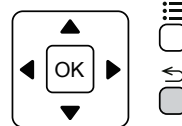
1 Select a problem from the list by pressing "Δ" or "∇" and press "OK". The details of the selected problem will be displayed.



2 Press "Δ" or "∇" to scroll the text up and down.

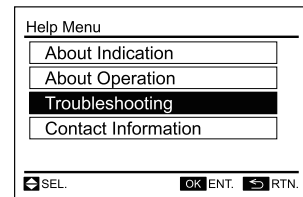
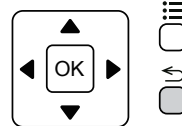


3 Press "↵" (return). The screen will return to the list of troubleshooting.



4 Press "↵" (return). The screen will return to the help menu.

To return to the normal mode, press "↵" (return) again.



11.2 Alarm codes

Code number	Category	Abnormality	Cause
01	Indoor unit	Activation of the safety device	Failure of fan motor, drain discharge, PCB, relay, float switch activated
02	Outdoor unit	Activation of the safety device	Failure of fan motor, drain discharge, PCB, relay, float switch activated
03	Transmission	Abnormal transmission between outdoor and indoor units	Incorrect wiring, failure of PCB, tripping of fuse, power supply OFF
04		Abnormal transmission between inverter PCB (DIP-IPM) and outdoor unit PCB (PCB1)	Abnormal transmission between PCB
05	Power supply	Abnormal operation of picking up phase signal	Main power supply phase is reversely connected or one phase is not connected.
06	Voltage	Excessively low voltage or excessively high voltage for the inverter	Incorrect wiring or insufficient capacity of power supply wiring
07	Cycle	Decrease in discharge gas superheat	Discharge gas superheat less than 10 degrees is maintained for 30 minutes.
08		Excessively high discharge gas temperature at the top of compressor	Temperature of top compressor: Td Td > 132°C over 10 minutes, or Td > 140°C over 5 minutes
11	Sensor on indoor unit	Air inlet thermistor	Failure of thermistor, sensor, connection.
12		Air outlet thermistor	
13		Freeze protection thermistor	
14		Gas piping thermistor	
16	Sensor on indoor unit	Remote thermistor	Failure of thermistor
17		Thermistor of RCS	Failure of thermistor
19		Activation of the protection device for the indoor fan motor	Failure of fan motor
20	Sensor on outdoor unit	Compressor thermistor	Failure of thermistor, sensor, connection.
21		High pressure sensor	Incorrect wiring, disconnected wiring, broken cable, short circuit.
22		Thermistor for outdoor ambient temperature (THM7)	Failure of thermistor, sensor, connection.
23		Thermistor for discharge gas temperature (THM9)	Incorrect wiring, disconnected wiring, broken cable, short circuit.
24		Thermistor for evaporating temperature (THM8)	Failure of thermistor, sensor, connection.
31	System	Incorrect capacity setting or combined capacity between outdoor and indoor units	Incorrect setting of the capacity code.
35		Incorrect indoor unit number setting	Duplication of indoor unit number , number of indoor units over specifications.
38		Abnormality of picking up circuit for protection (Outdoor unit)	Failure of indoor unit PCB, incorrect wiring, connection to PCB in indoor unit.
41	Pressure	Cooling overload (possible activation of high pressure device)	OU pipe thermistor temp. is higher than 55 °C and the compressor top temperature is higher than 95 °C, OU protection device is activated.
42		Heating overload (high-pressure device may be activated)	If IU freeze protection thermistor temperature is higher than 55 °C and compressor top temperature is higher than 95 °C, OU protection device is activated.
45		Activation of the safety device from excessively high discharge pressure	Overload (obstruction of HEX, short circuit) mixture of inert gas
47		Activation of the safety device from excessively low suction pressure (protection from vacuum operation)	Shortage or leakage of refrigerant, piping clogging, expansion valve close-locked, fan motor locked.

Code number	Category	Abnormality	Cause
48	Inverter	Abnormality of current sensor for inverter	Failure of DIP-IPM, heat exchanger clogged, locked compressor, EVI/EVO failure or overcharge.
51		Abnormality of Current Sensor for Inverter	Failure of control PCB, inverter module.
53		Protection activation of inverter module	Inverter module abnormality. Failure of compressor, clogging of heat exchanger.
54		Inverter fin temperature increase	Abnormal inverter fin thermistor, clogging of heat exchanger, abnormal outdoor fan.
55		Inverter Module abnormality	Failure of inverter module.
57	Outdoor fan	Fan Motor abnormality	Disconnected wire of incorrect wiring between control PCB and inverter PCB. Incorrect wiring or fan motor abnormality.
b1	Indoor unit number setting	Incorrect setting of the unit and the refrigerant cycle number.	Over 64 indoor units setting by number or indoor unit address.
b5		Incorrect indoor unit connection number setting	There are more than 17 units not corresponding to H-Link II connected to one system
EE	Compressor	Compressor protection	Failure of compressor.

Specifications in this catalog are subject to change without notice, in order that HITACHI may bring the latest innovations to their customers.

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