

**SPLIT TYPE
ROOM AIR CONDITIONER
WALL MOUNTED^{type}
INVERTER**

SERVICE INSTRUCTION

Models	Indoor unit	Outdoor unit
AS*9LSACW AS*12LSACW		AO*9LSAC AO*12LSAC
AS*9LSBCW AS*12LSBCW AS*14LSBCW AS*18LSBCW		AO*9LFBC AO*12LFBC AOY14LFBC AO*18LFBC

Refrigerant
R410A

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WALL MOUNTED type INVERTER

1 . SPECIFICATIONS

SPECIFICATIONS

TYPE	(COOL&HEAT INVERTER)	(COOL&HEAT INVERTER)
INDOOR UNIT	AS*9LSACW	AS*12LSACW
OUTDOOR UNIT	AO*9LSAC	AO*12LSAC
COOLING CAPACITY() : Range (kW)	2.6 (0.5~3.6)	3.5 (0.9~4.2)
HEATING CAPACITY() : Range (kW)	3.6 (0.5~6.0)	4.8 (0.9~6.6)

ELECTRICAL DATA

POWER SOURCE		(V)	230	
FREQUENCY		(Hz)	50	
RUNNING CURRENT	(A)	COOLING	3.0	4.6
		HEATING	3.6	5.8
INPUT WATTS	(kW)	COOLING	0.68 (0.25~1.38)	1.03 (0.25~1.61)
		HEATING	0.91 (0.25~1.96)	1.33 (0.25~2.30)
EER	(kW/kW)	COOLING	3.82	3.40
		HEATING	3.96	3.61
MOISTURE REMOVAL		(ℓ /hr)	1.3	1.8
AIR CIRCULATION-Hi		(m³/hr)	C 630 H665	C 630 H700

COMPRESSOR

TYPE			Hermetic type,4 pole, 3 phase , DC brushles motor	
DISCRIMINATION			80206680	80206680
REFRIGERANT	R410A	(g)	950	1100

Note : Always use a vacuum pump to purge the air.

Refrigerant for purging the air is not charged in the outdoor unit at the factory.

FAN MOTOR

POWER SOURCE (V)		230	
INDOOR UNIT (r.p.m.)	HI-SPEED	C 1,350 H 1,420	C 1,400 H 1,470
	MED-SPEED	C 1,150 H 1,200	C 1,200 H 1,290
	LO-SPEED	C 950 H 1,000	C 1,000 H 1,110
	QUIET	C 740 H 900	C 820 H 980
OUTDOOR UNIT (r.p.m.)		830	

DIMENSIONS

INDOOR UNIT	H x W x D	(mm)	280 x 790 x 230
OUTDOOR UNIT	H x W x D	(mm)	535 x 780 x 250

WEIGHTS

INDOOR UNIT	GROSS / NET (kg)	12 / 9	
OUTDOOR UNIT	GROSS / NET (kg)	35 / 33	37 / 34

NOISE LEVEL

INDOOR UNIT	(dB)	HI-SPEED	C 42 H 42	C 43 H 43
		MED-SPEED	C 37 H 36	C 39 H 38
		LO-SPEED	C 31 H 30	C 32 H 33
		QUIET	C 23 H 26	C 26 H 29
OUTDOOR UNIT	(dB)	C 47 H 49		

Note : Noise was measured in accordance with JIS standards, Japan.

MAX PIPE LENGTH	15 m
ADDITIONAL REFRIGERANT	None

THICKNESSES OF ANNEALED COPPER PIPES

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref.] R22
1/4	6.35	0.80	0.80
3/8	9.52	0.80	0.80

SPECIFICATIONS

TYPE	COOL & HEAT INVERTER	
INDOOR UNIT	AS*9LSBCW	AS*12LSBCW
OUTDOOR UNIT	AO*9LFBC	AO*12LFBC
COOLING CAPACITY (kW)	2.60	3.50
HEATING CAPACITY (kW)	3.60	4.80

ELECTRICAL DATA

POWER SOURCE (V)		230	
FREQUENCY (Hz)		50	
RUNNING CURRENT (A)	COOLING	3.0	4.3
	HEATING	3.8	5.6
INPUT WATTS (kW)	COOLING	0.62	0.92
	HEATING	0.82	1.23
E.E.R. (kW/kW)	COOLING	4.19	3.80
COP (kW/kW)	HEATING	4.39	3.90
MOISTURE REMOVAL (ℓ/hr)		1.3	1.8
AIR CIRCULATION-Hi (m³/hr)		C 595 H 645	C 635 H 670

COMPRESSOR

TYPE	Hermetic type, 4 pole, 3 phase, DC inverter motor, Rotary		
DISCRIMINATION	DA 89 X 1F - 20F		
REFRIGERANT R410A (g)	950	1,050	

FAN MOTOR

POWER SOURCE (V)	230		
INDOOR UNIT	HI-SPEED (r.p.m.)	C 1,300 H 1,390	C 1,370 H 1,440
	MED-SPEED (r.p.m.)	C 1,120 H 1,200	C 1,150 H 1,200
	LO-SPEED (r.p.m.)	C 950 H 1,000	C 950 H 1,000
	QUIET (r.p.m.)	C 700 H 760	C 700 H 760
OUTDOOR UNIT (r.p.m.)	C 840 H 840	C 830 H 830	

DIMENSIONS

INDOOR UNIT	H x W x D (mm)	275 x 790 x 215
OUTDOOR UNIT	H x W x D (mm)	540 x 790 x 290

WEIGHT

INDOOR UNIT	GROSS / NET (kg)	12 / 9
OUTDOOR UNIT	GROSS / NET (kg)	39 / 35 42 / 38

NOISE LEVEL

INDOOR UNIT (dB)	C 42 H 42	C 43 H 43
OUTDOOR UNIT (dB)	C 47 H 48	C 47 H 49

REFRIGERANT (R410A)

FULL CHARGE AMOUNT	Pipe Length 15 m	950 g	1,050 g
	20 m	1,050 g	1,150 g
ADDITIONAL REFRIGERANT		20 g / m	

THICKNESSES OF ANNEALED COPPER PIPES

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref.] R22
1/4	6.35	0.80	0.80
3/8	9.52	0.80	0.80

SPECIFICATIONS

TYPE	COOL & HEAT INVERTER	
INDOOR UNIT	AS*14LSBCW	AS*18LSBCW
OUTDOOR UNIT	AO*14LFBC	AO*18LFBC
COOLING CAPACITY (kW)	4.20	5.20
HEATING CAPACITY (kW)	5.60	6.25

ELECTRICAL DATA

POWER SOURCE (V)		230	
FREQUENCY (Hz)		50	
RUNNING CURRENT (A)	COOLING	4.9	7.6
	HEATING	6.4	7.6
INPUT WATTS (kW)	COOLING	1.11	1.72
	HEATING	1.45	1.73
E.E.R. (kW/kW)	COOLING	3.78	3.02
COP (kW/kW)	HEATING	3.86	3.61
MOISTURE REMOVAL (ℓ/hr)		2.1	2.8
AIR CIRCULATION-Hi (m³/hr)		C 700 H700	C 700 H700

COMPRESSOR

TYPE	Hermetic type, 4 pole, 3 phase, DC inverter motor, Rotary		
DISCRIMINATION	DA / 30A / F-25F		
REFRIGERANT R410A (g)	1,150		

FAN MOTOR

POWER SOURCE (V)	230		
INDOOR UNIT	HI-SPEED (r.p.m.)	C 1,480 H 1,480	
	MED-SPEED (r.p.m.)	C 1,260 H 1,300	
	LO-SPEED (r.p.m.)	C 1,040 H 1,110	
	QUIET (r.p.m.)	C 850 H 950	
OUTDOOR UNIT (r.p.m.)	C 820 H 750	C 860 H 820	

DIMENSIONS

INDOOR UNIT	H x W x D (mm)	275 x 790 x 215
OUTDOOR UNIT	H x W x D (mm)	578 x 790 x 300

WEIGHT

INDOOR UNIT	GROSS / NET (kg)	12 / 9
OUTDOOR UNIT	GROSS / NET (kg)	40 / 38

NOISE LEVEL

INDOOR UNIT (dB)	C 44 H 43	C 45 H 43
OUTDOOR UNIT (dB)	C 48 H 48	C 49 H 49

REFRIGERANT (R410A)

FULL CHARGE AMOUNT	PIPE LENGTH 15 m	1,150 g
	20 m	1,250 g
ADDITIONAL REFRIGERANT		20 g / m

THICKNESSES OF ANNEALED COPPER PIPES

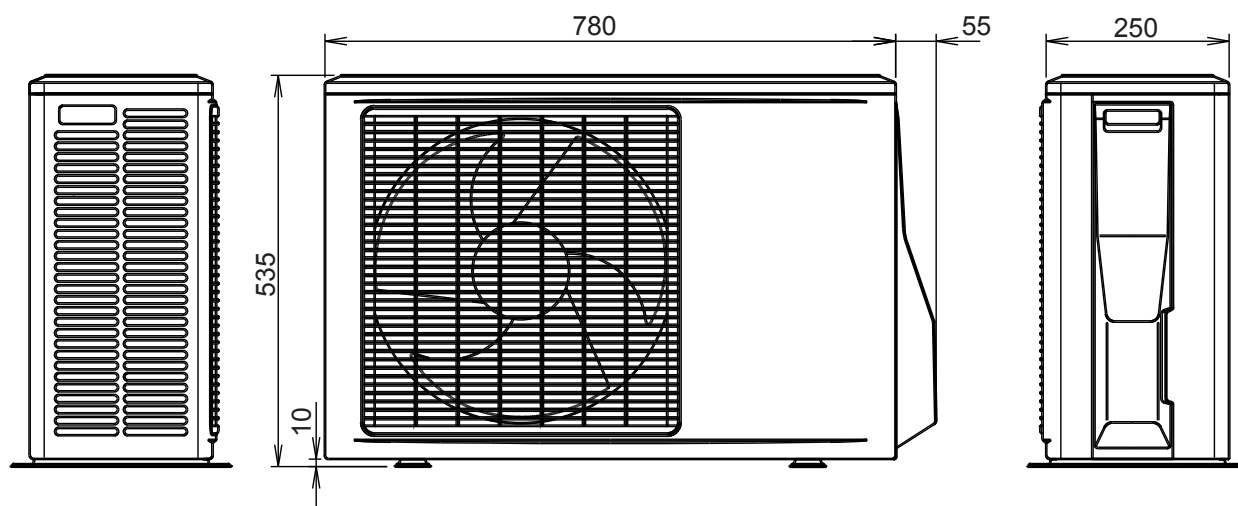
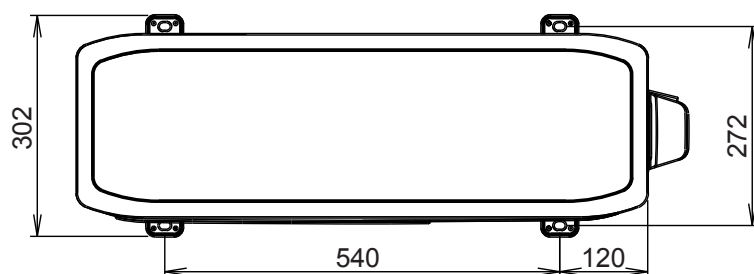
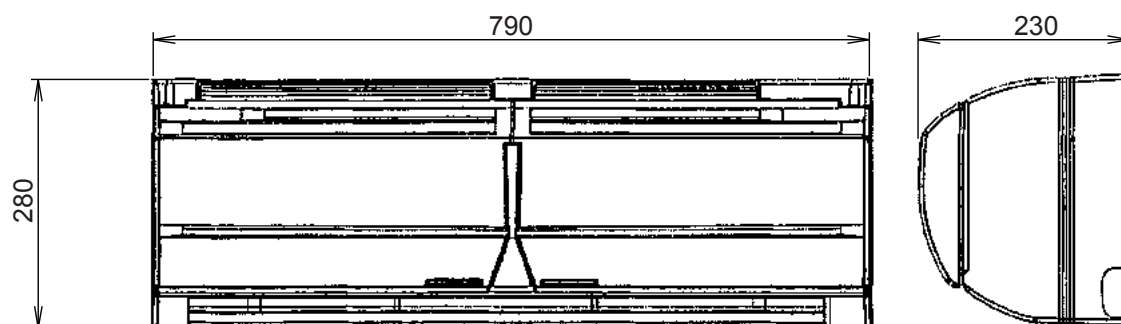
		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref,] R22
1/4	6.35	0.80	0.80
1/2	12.7	0.80	0.80

WALL MOUNTED type INVERTER

2 . DIMENSIONS

DIMENSIONS

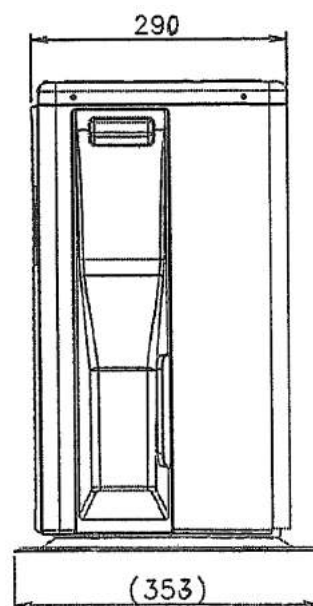
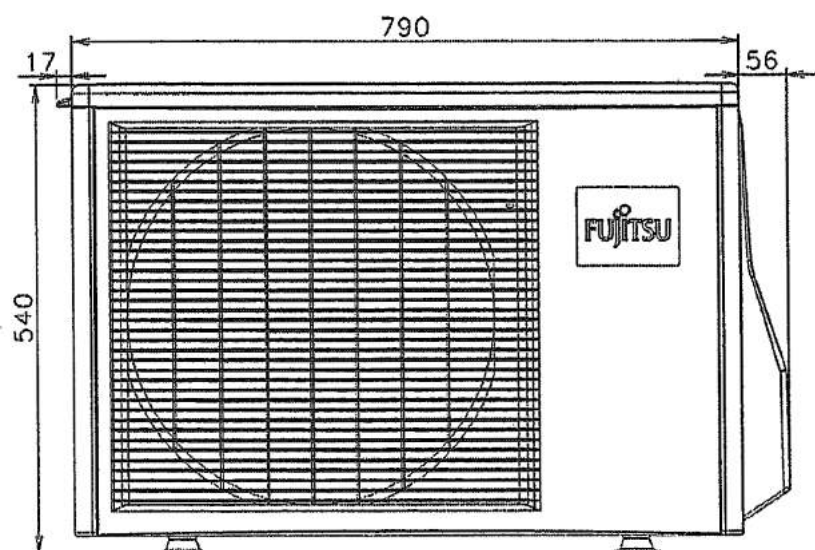
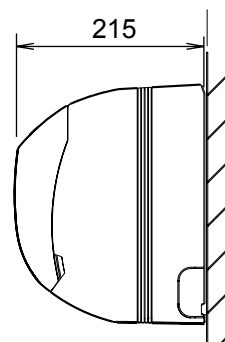
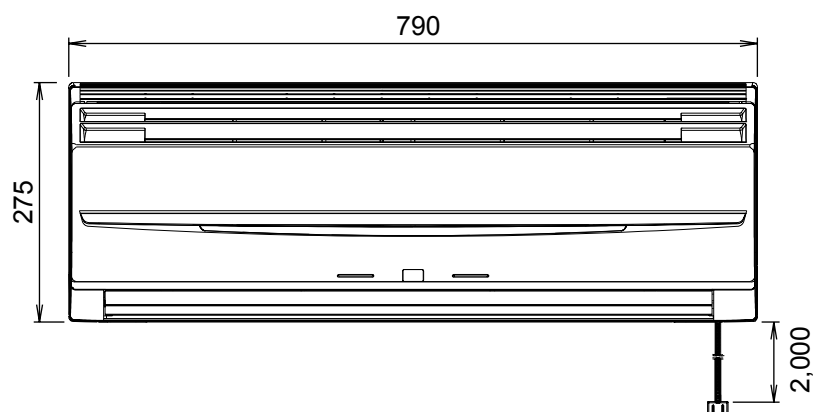
Models : AS*9LSACW / AO*9LSAC
AS*12LSACW / AO*12LSAC



DIMENSIONS

Models : AS*9LSBCW / AO*9LFBC
AS*12LSBCW / AO*12LFBC

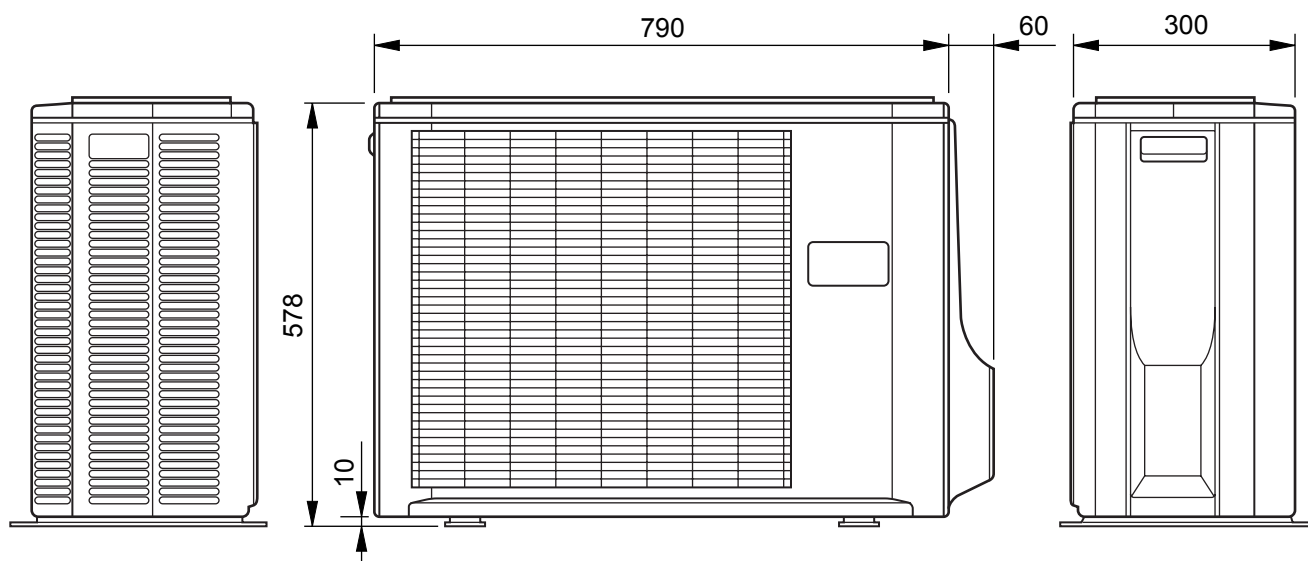
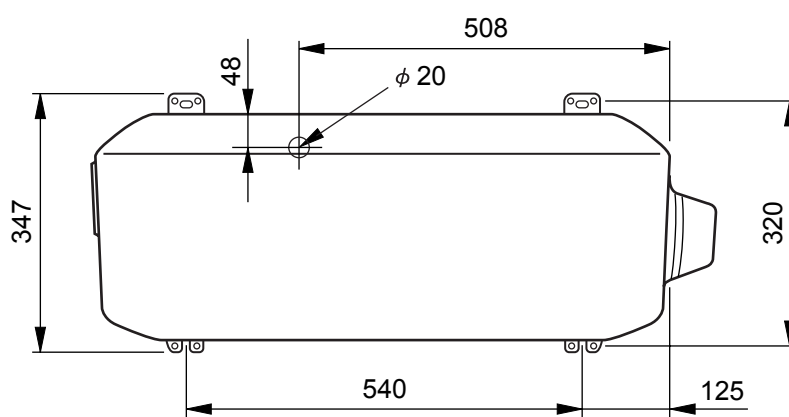
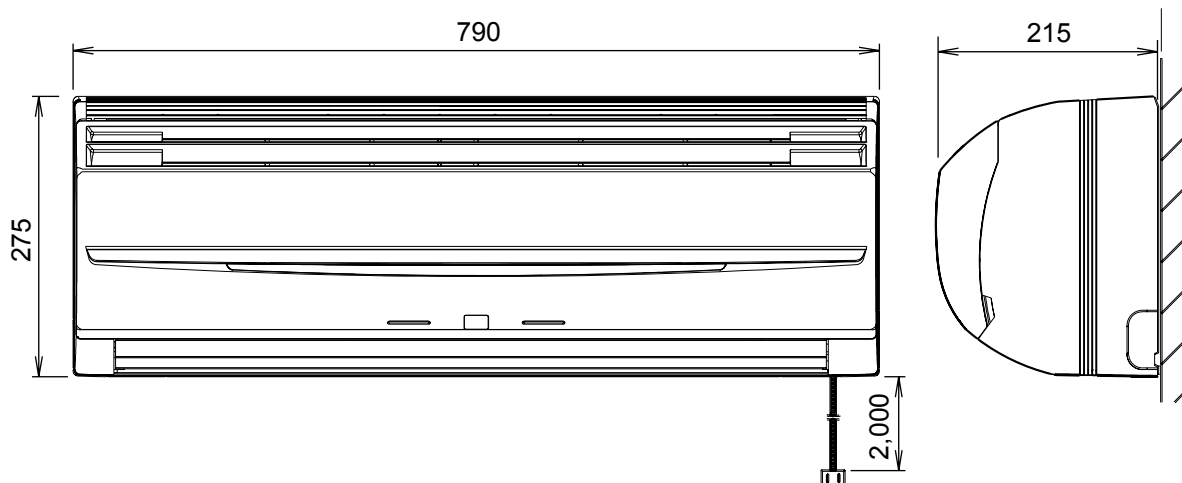
(unit : mm)



DIMENSIONS

Models : AS*14LSBCW / AO*14LFBC
AS*18LSBCW / AO*18LFBC

(unit : mm)

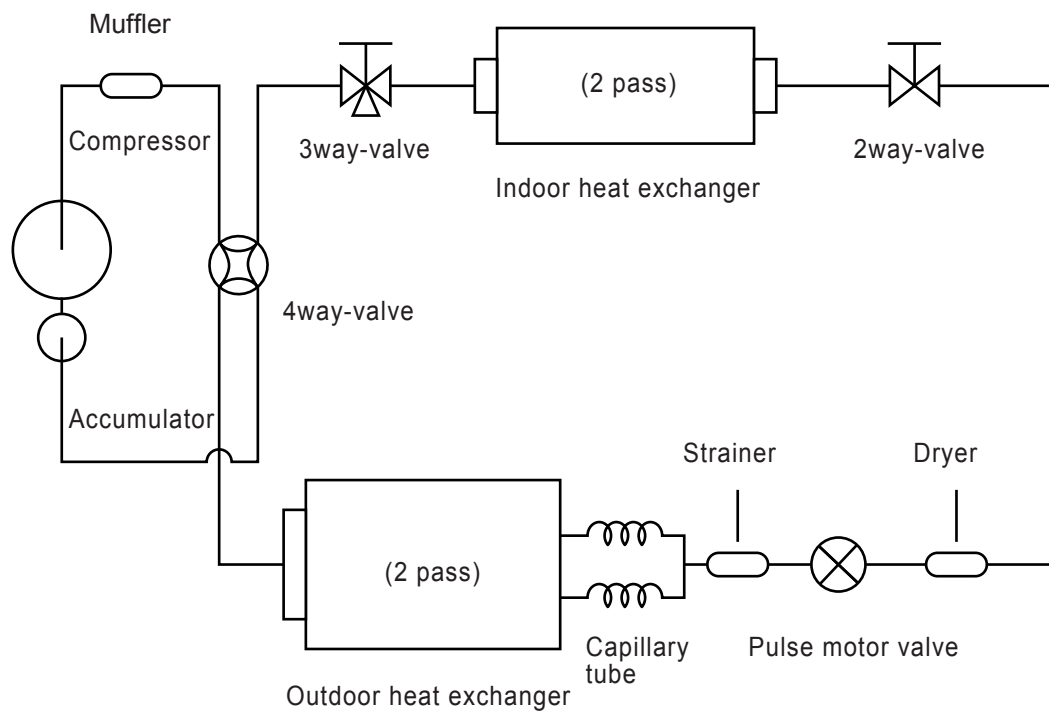


WALL MOUNTED type INVERTER

3 . REFRIGERANT SYSTEM DIAGRAM

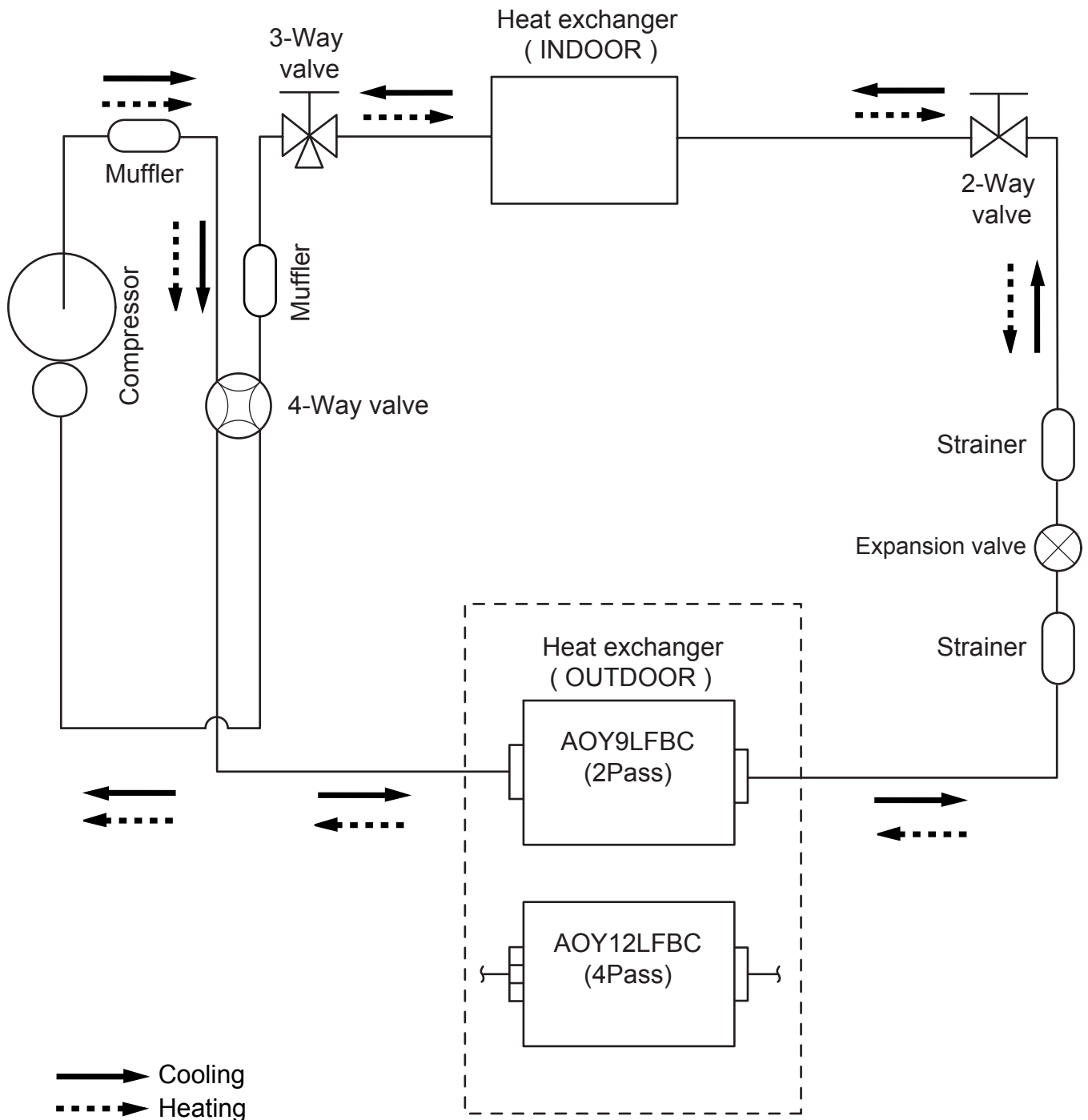
REFRIGERANT SYSTEM DIAGRAM

**Models : AS*9LSACW / AO*9LSACW
AS*12LSACW / AO*12LSACW**



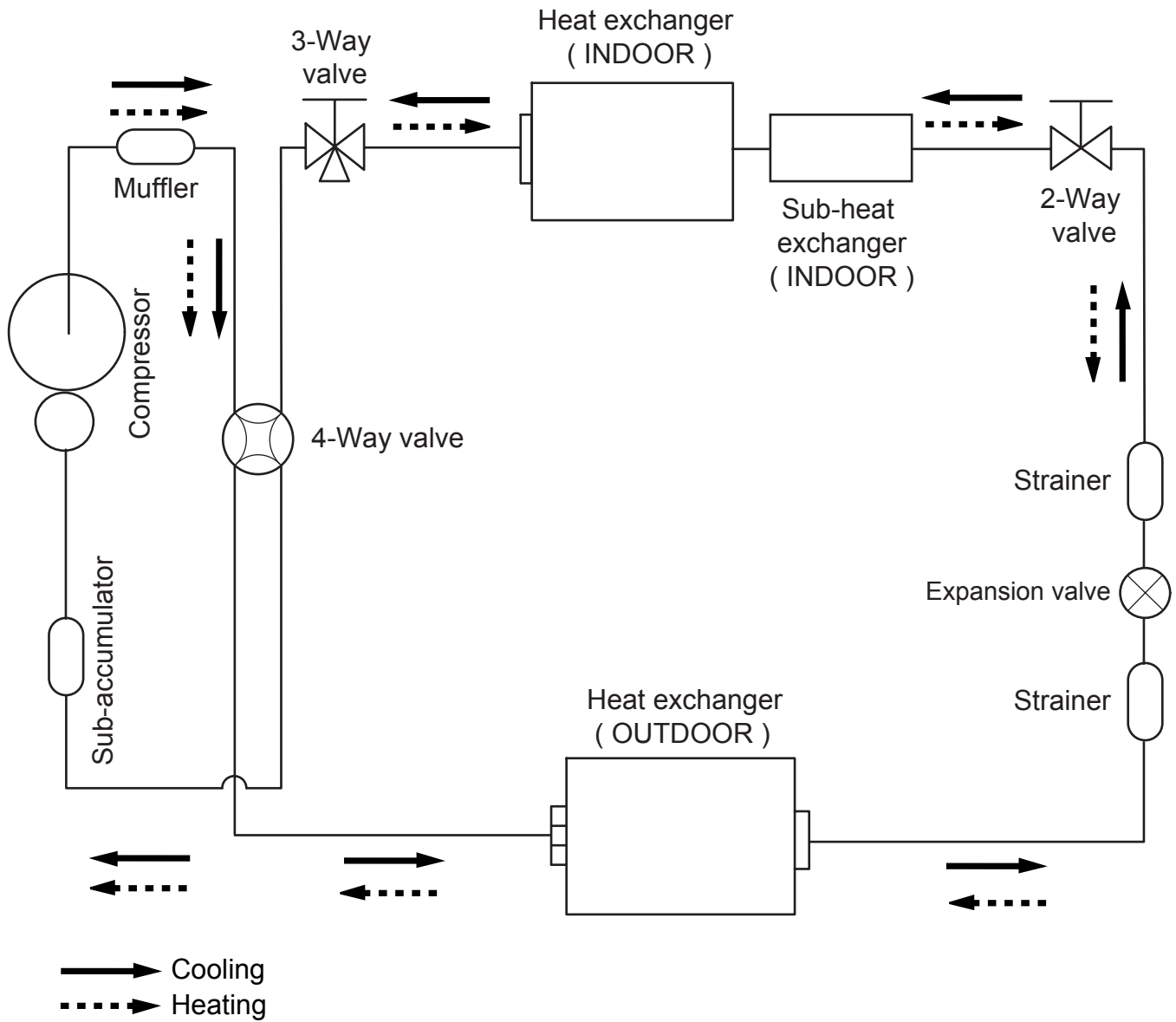
REFRIGERANT SYSTEM DIAGRAM

Models : AS*9LSBCW / AO*9LFBC
AS*12LSBCW / AO*12LFBC



REFRIGERANT SYSTEM DIAGRAM

Models : AS*14LSBCW / AO*14LFBC
AS*18LSBCW / AO*18LFBC



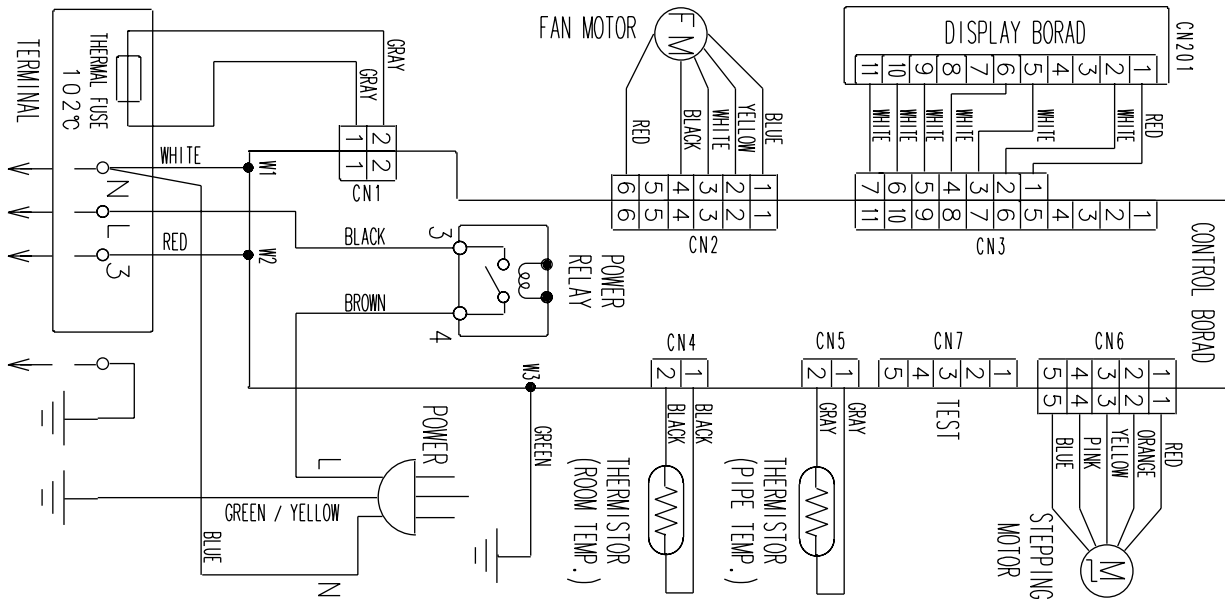
WALL MOUNTED type INVERTER

4 . CIRCUIT DIAGRAM

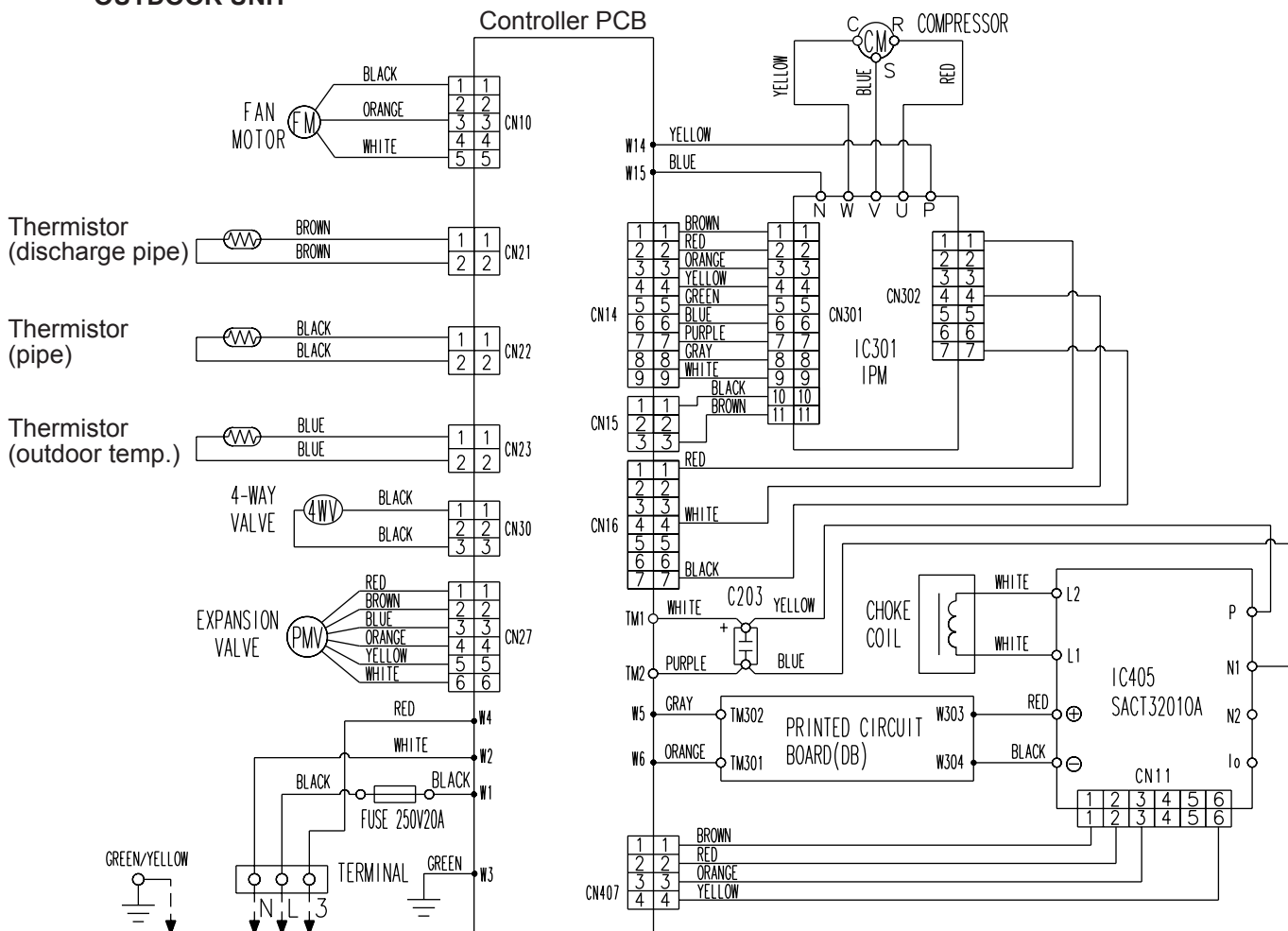
CIRCUIT DIAGRAM

Models : AS*9LSACW / AO*9LSAC
AS*12LSACW / AO*12LSAC

INDOOR UNIT



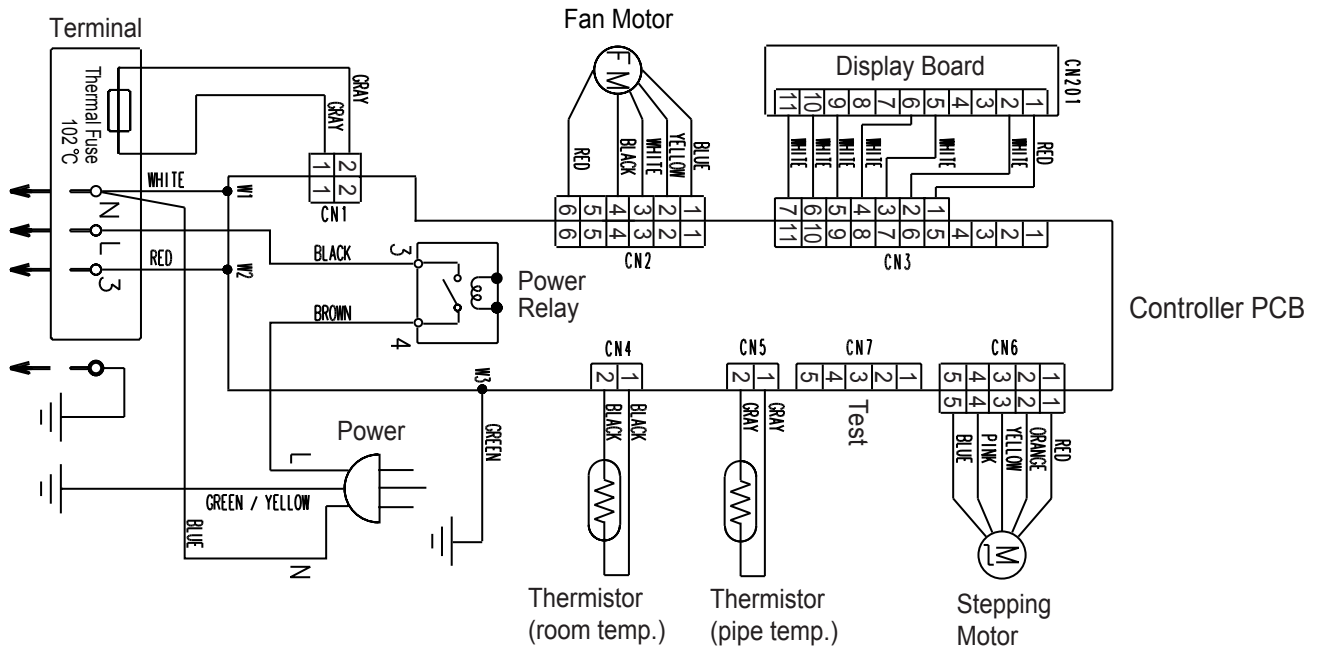
OUTDOOR UNIT



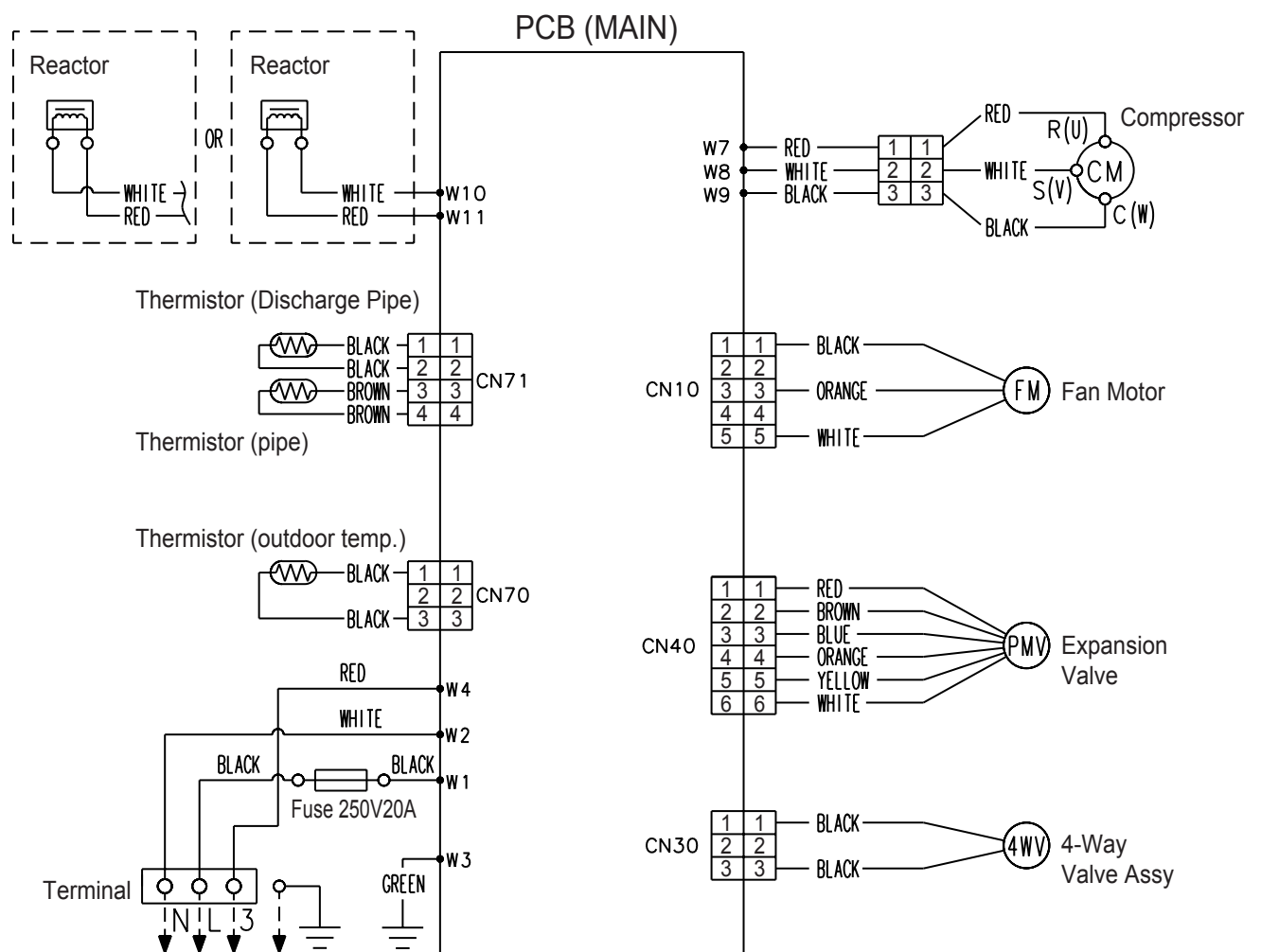
CIRCUIT DIAGRAM

Models : AS*9LSBCW / AO*9LFBC
AS*12LSBCW / AO*12LFBC

INDOOR UNIT



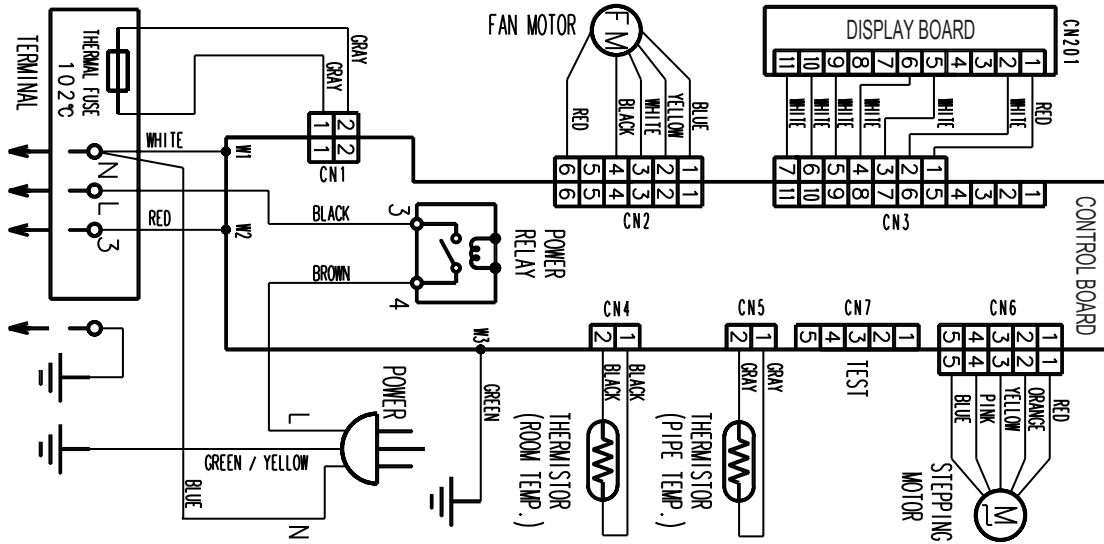
OUTDOOR UNIT



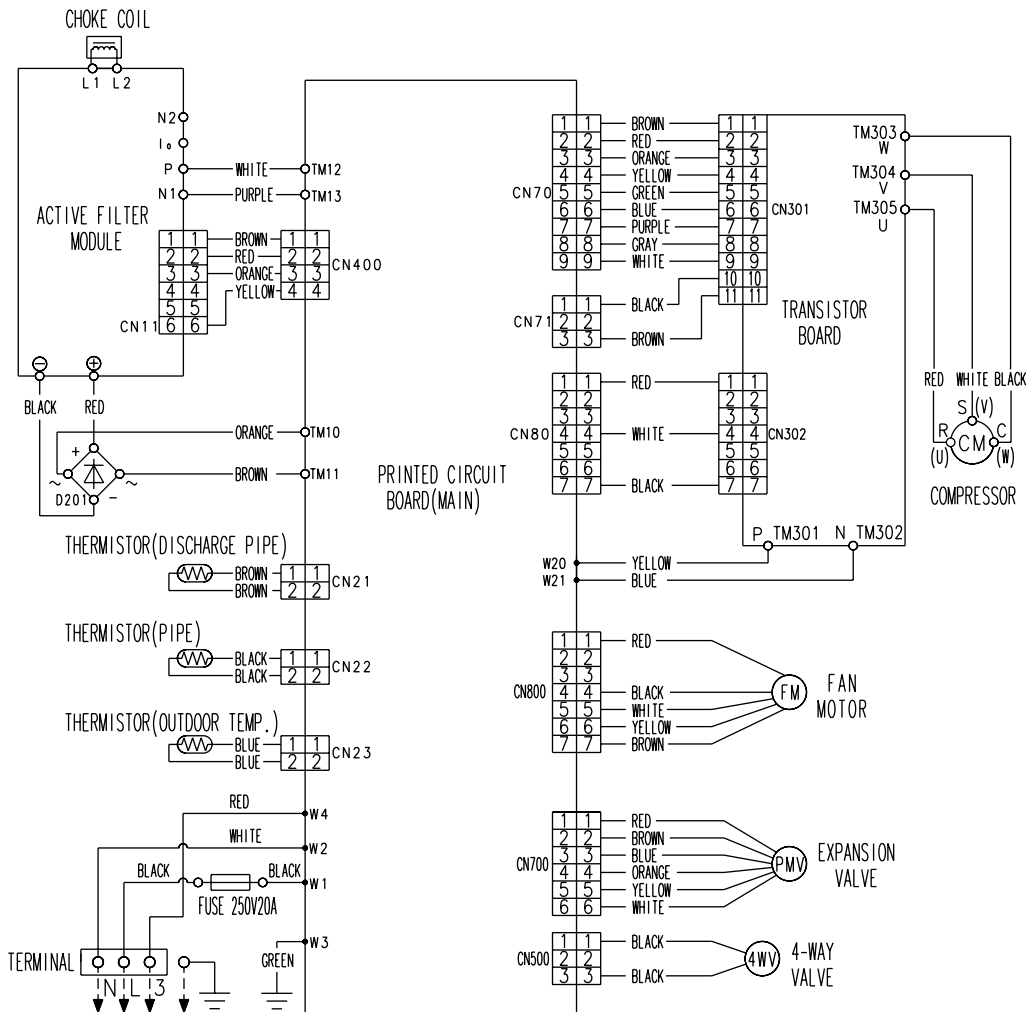
CIRCUIT DIAGRAM

Models : AS*14LSBCW / AO*14LFBC
AS*18LSBCW / AO*18LFBC

INDOOR UNIT



OUTDOOR UNIT



WALL MOUNTED type INVERTER

5 . DESCRIPTION OF EACH CONTROL OPERATION

1. COOLING OPERATION

1-1 COOLING CAPACITY CONTROL

A sensor (room temperature thermistor) built in the indoor unit body will usually perceive difference or variation between a set temperature and present room temperature, and controls the operation frequency of the compressor.

* If the room temperature is 2°C higher than a set temperature, the compressor operation frequency will attain to maximum performance.

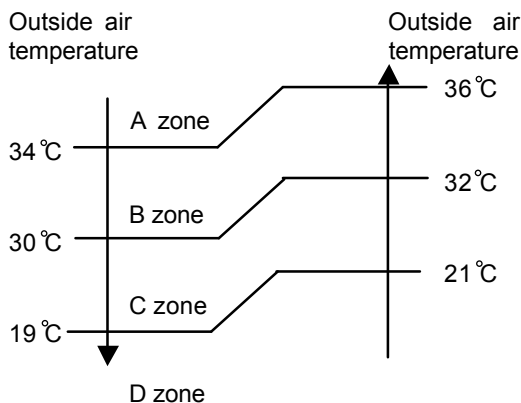
* If the room temperature is 2.5°C lower than a set temperature, the compressor will be stopped.

* When the room temperature is between +2°C to -2.5°C of the setting temperature, the compressor frequency is controlled within the range shown in Table1. However, the maximum frequency is limited in the range shown in Figure 1 based on the fan speed mode and the outdoor temperature.

(Table 1 : Compressor Frequency Range)

	minimum frequency	maximum frequency II	maximum frequency I
AS*9LSACW	18Hz	60Hz	80Hz
AS*12LSACW	18Hz	80Hz	96Hz
AS*9LSBCW	18Hz	61Hz	80Hz
AS*12LSBCW	18Hz	80Hz	96Hz
AS*14LSBCW	18Hz	70Hz	90Hz
AS*18LSBCW	18Hz	70Hz	90Hz

(Fig. 1 : Limit of Maximum Frequency based on Outdoor Temperature)



		Hi	Me	Lo	Quiet
9LSACW	A zone	80Hz	51Hz	45Hz	33Hz
	B zone	80Hz	51Hz	45Hz	33Hz
	C zone	80Hz	51Hz	45Hz	33Hz
	D zone	51Hz	39Hz	33Hz	27Hz
12LSACW	A zone	96Hz	60Hz	51Hz	33Hz
	B zone	96Hz	60Hz	51Hz	33Hz
	C zone	80Hz	60Hz	51Hz	33Hz
	D zone	51Hz	42Hz	36Hz	27Hz
9LSBCW	A zone	80Hz	61Hz	51Hz	33Hz
	B zone	80Hz	61Hz	51Hz	33Hz
	C zone	80Hz	61Hz	51Hz	33Hz
	D zone	51Hz	42Hz	36Hz	22Hz
12LSBCW	A zone	96Hz	61Hz	51Hz	33Hz
	B zone	96Hz	61Hz	51Hz	33Hz
	C zone	96Hz	61Hz	51Hz	33Hz
	D zone	51Hz	42Hz	36Hz	22Hz
14LSBCW	A zone	90Hz	45Hz	42Hz	30Hz
	B zone	90Hz	45Hz	42Hz	30Hz
	C zone	90Hz	45Hz	42Hz	30Hz
	D zone	49Hz	38Hz	34Hz	24Hz
18LSBCW	A zone	90Hz	45Hz	42Hz	30Hz
	B zone	90Hz	45Hz	42Hz	30Hz
	C zone	90Hz	45Hz	42Hz	30Hz
	D zone	49Hz	38Hz	34Hz	24Hz

When the compressor operates for 30 minutes continuously at over the maximum frequency II, the maximum frequency is changed from Maximum Frequency I to Maximum Frequency II.

The room temperature is controlled 1°C lower than the setting temperature for 40 minutes after starting the operation.

After 40 minutes, it is controlled based on the normal setting temperature.

2. HEATING OPERATION

2-1 HEATING CAPACITY CONTROL

A sensor (room temperature thermistor) built in the indoor unit body will usually perceive difference or variation between a set temperature and present room temperature, and controls the operation frequency of the compressor.

* If the room temperature is lower by 3°C than a set temperature, the compressor operation frequency will attain to maximum performance.

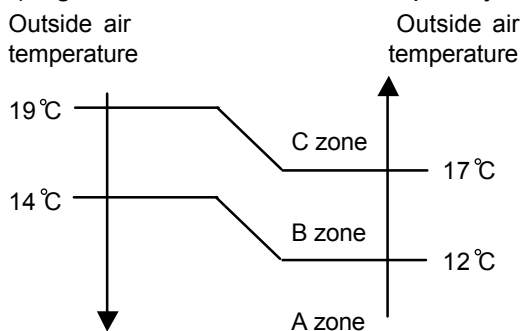
* If the room temperature is higher 2.5°C than a set temperature, the compressor will be stopped.

* When the room temperature is between +2°C to -3°C of the setting temperature, the compressor frequency is controlled within the range shown in Table2.
However, the maximum frequency is limited in the range shown in Figure 2 based on the fan speed mode and the outdoor temperature.

(Table 2 : Compressor Frequency Range)

	minimum frequency	maximum frequency
AS*9LSACW	18Hz	130Hz
AS*12LSACW	18Hz	130Hz
AS*9LSBCW	18Hz	130Hz
AS*12LSBCW	18Hz	130Hz
AS*14LSBCW	18Hz	119Hz
AS*18LSBCW	18Hz	119Hz

(Fig.2 : Limit of Maximum Frequency based on Outdoor Temperature)



		Hi	Me	Lo	Quiet
9LSACW	A zone	130Hz	92Hz	80Hz	68Hz
	B zone	130Hz	80Hz	60Hz	54Hz
	C zone	96Hz	68Hz	54Hz	51Hz
12LSACW	A zone	130Hz	96Hz	80Hz	68Hz
	B zone	130Hz	96Hz	64Hz	57Hz
	C zone	96Hz	96Hz	64Hz	54Hz
9LSBCW	A zone	130Hz	96Hz	80Hz	68Hz
	B zone	130Hz	96Hz	80Hz	54Hz
	C zone	130Hz	96Hz	80Hz	45Hz
12LSBCW	A zone	130Hz	96Hz	80Hz	68Hz
	B zone	130Hz	96Hz	80Hz	54Hz
	C zone	130Hz	96Hz	80Hz	45Hz
14LSBCW	A zone	119Hz	90Hz	70Hz	58Hz
	B zone	119Hz	90Hz	70Hz	58Hz
	C zone	119Hz	90Hz	70Hz	58Hz
18LSBCW	A zone	119Hz	90Hz	70Hz	58Hz
	B zone	119Hz	90Hz	70Hz	58Hz
	C zone	119Hz	90Hz	70Hz	58Hz

* The room temperature is controlled 2°C higher than the setting temperature for 60 minutes after starting the operation.

After 60 minutes, it is controlled based on the normal setting temperature.

3. DRY OPERATION

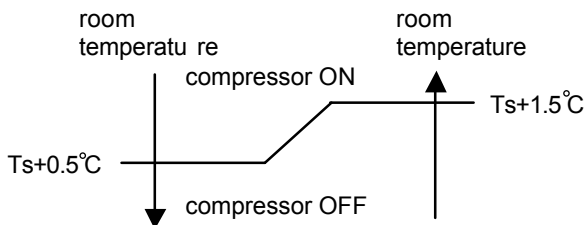
3-1 INDOOR UNIT CONTROL

The compressor rotation frequency shall change according to the temperature, set temperature, and room temperature variation which the room temperature sensor of the indoor unit body has detected as shown in the Table 3. However, after the compressor is driven, the indoor unit shall run at operation frequency of 58Hz, for a minute.

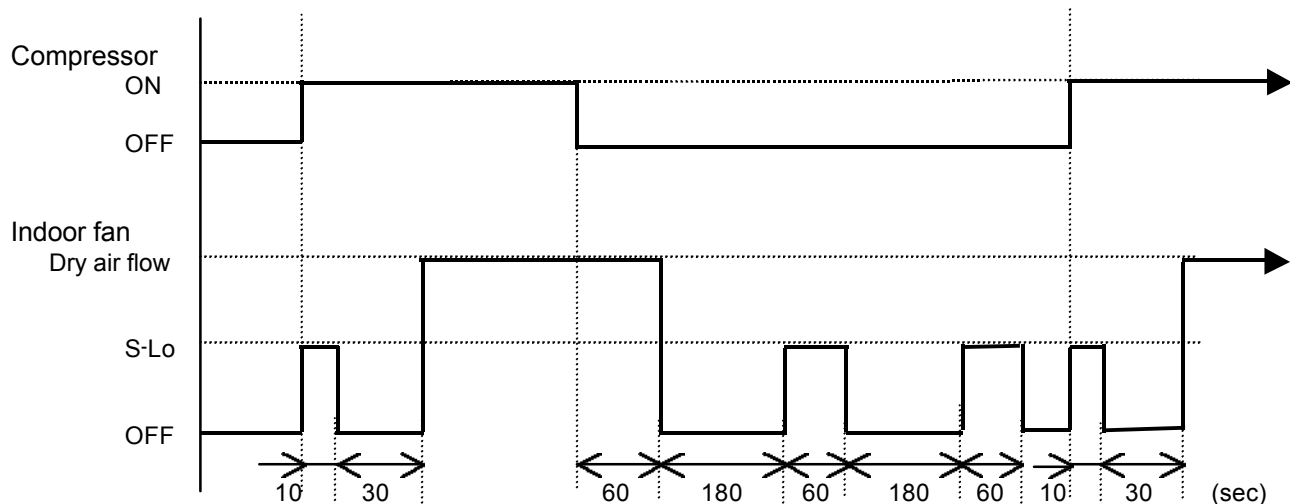
(Table 3 : Compressor frequency)

	Operating frequency
AS*9LSACW	33Hz
AS*12LSACW	33Hz
AS*9LSBCW	33Hz
AS*12LSBCW	33Hz
AS*14LSBCW	24Hz
AS*18LSBCW	24Hz

(Fig.3 : Compressor Control based on Room Temperature)



(Fig.4 : Indoor Fan Control)

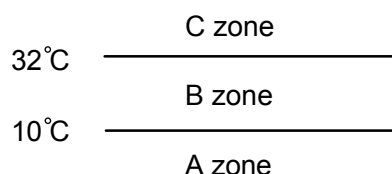


4. AUTO CHANGEOVER OPERATION

When the air conditioner is set to the AUTO mode by remote control, operation starts in the optimum mode from among the HEATING, COOLING, DRY and MONITORING modes. During operation, the optimum mode is automatically switched in accordance with temperature changes. The temperature can be set between 18°C and 30°C in 1°C steps.

- ①. When operation starts, only the indoor and outdoor fans are operated for 1 minute. After 1 minute, the room temperature and outside air temperature are sensed and the operation mode is selected in accordance with the table below.

(Fig.5 : Outside air temperature zone selection)



(Table.4 Operation mode selection table)

Outside air temperature (TO) Room temperature(TB)	A zone	B zone	C zone
$TB > TS + 2^{\circ}\text{C}$	Monitoring	Cooling (automatic dry)	Cooling (automatic dry)
$TS + 2^{\circ}\text{C} \geq TB \geq TS - 2^{\circ}\text{C}$	Monitoring	Monitoring	Monitoring
$TB < TS - 2^{\circ}\text{C}$	Heating	Heating	Monitoring

- ②. When COOLING was selected at ①, the air conditioner operates as follows:
- The same operation as COOLING OPERATION of item 1 above is performed.
 - When the room temperature has remained at (set temperature -1°C) for 8 minutes, operation is automatically switched to DRY and the same operation as DRY OPERATION of item 3 above is performed.
 - If the room temperature reaches (set temperature +2°C) during DRY operation, operation returns to COOLING operation.
- ③. When HEATING was selected at ①, the same operation as HEATING OPERATION of item 2 above is performed.
- ④. When the compressor was stopped for 6 consecutive minutes by the temperature control function after the COOLING or HEATING operation mode was selected at ① above, operation is switched to MONITORING and the operation mode is selected again.

5. INDOOR FAN CONTROL

(1).Fan speed

(Table 5 : Indoor Fan Speed)

AS*9LSACW			AS*12LSACW		
Operation mode	Air flow mode	Speed (rpm)	Operation mode	Air flow mode	Speed (rpm)
Heating	Hi	1420	Heating	Hi	1470
	Me+	1370		Me+	1420
	Me	1200		Me	1290
	Lo	1000		Lo	1110
	Quiet	900		Quiet	980
	Cool air prevention	850		Cool air prevention	850
	S-Lo	480		S-Lo	480
Cooling Fan	Hi	1350	Cooling Fan	Hi	1400
	Me	1150		Me	1200
	Lo	950		Lo	1000
	Quiet	740		Quiet	820
Dry		740	Dry		820

AS*9LSBCW			AS*12LSBCW		
Operation mode	Air flow mode	Speed (rpm)	Operation mode	Air flow mode	Speed (rpm)
Heating	Hi	1390	Heating	Hi	1440
	Me+	1350		Me+	1350
	Me	1200		Me	1200
	Lo	1000		Lo	1000
	Quiet	760		Quiet	760
	Cool air prevention	760		Cool air prevention	760
	S-Lo	480		S-Lo	480
Cooling Fan	Hi	1300	Cooling Fan	Hi	1370
	Me	1120		Me	1150
	Lo	950		Lo	950
	Quiet	700		Quiet	700
Dry		700	Dry		700

AS*14LSBCW			AS*18LSBCW		
Operation mode	Air flow mode	Speed (rpm)	Operation mode	Air flow mode	Speed (rpm)
Heating	Hi	1480	Heating	Hi	1480
	Me+	1420		Me+	1420
	Me	1300		Me	1300
	Lo	1110		Lo	1110
	Quiet	950		Quiet	950
	Cool air prevention	850		Cool air prevention	850
	S-Lo	480		S-Lo	480
Cooling Fan	Hi	1480	Cooling Fan	Hi	1480
	Me	1260		Me	1260
	Lo	1040		Lo	1040
	Quiet	850		Quiet	850
Dry		850	Dry		850

(2).FAN OPERATION

The airflow can be switched in 5 steps such as AUTO, QUIET, LOW, MED, HIGH, while the indoor fan only runs.

When Fan mode is set at (Auto), it operates on (MED) Fan Speed.

(3).COOLING OPERATION

Switch the airflow [AUTO], and the indoor fan motor will run according to a room temperature, as shown in Figure 6.

On the other hand, if switched in [HIGH] ~ [QUIET], the indoor motor will run at a constant airflow of [COOL] operation modes QUIET, LOW, MED, HIGH, as shown in Table 5.

(4).DRY OPERATION

Refer to the table 4.

During the dry mode operation, the fan speed setting can not be changed.

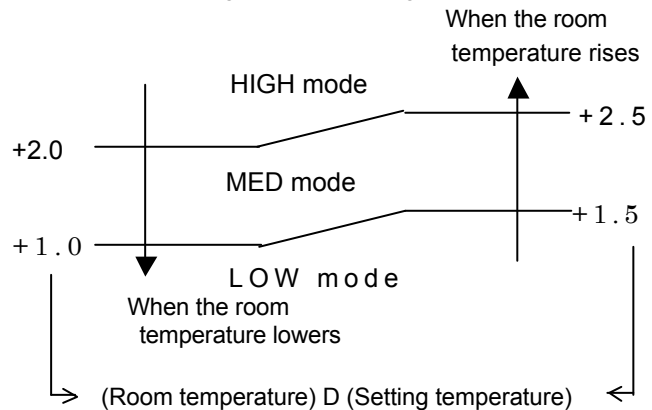
(5).HEATING OPERATION

Switch the airflow [AUTO], and the indoor fan motor will run according to a room temperature, as shown in Figure 7.

On the other hand, if switched [HIGH] ~ [QUIET], the indoor motor will run at a constant airflow of [HEAT] operation modes QUIET, LOW, MED, HIGH, as shown in Table 5.

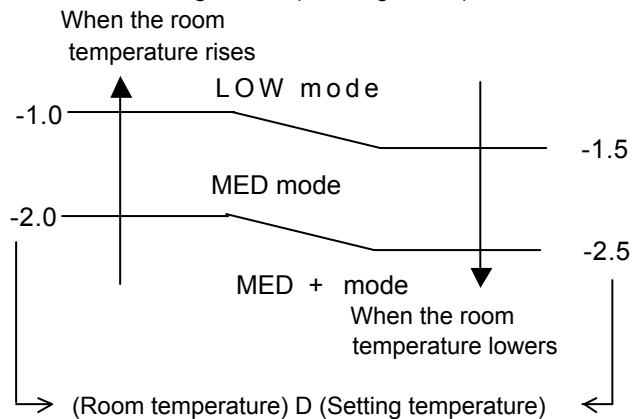
(Fig.6)

airflow change - over (Cooling:AUTO)



(Fig.7)

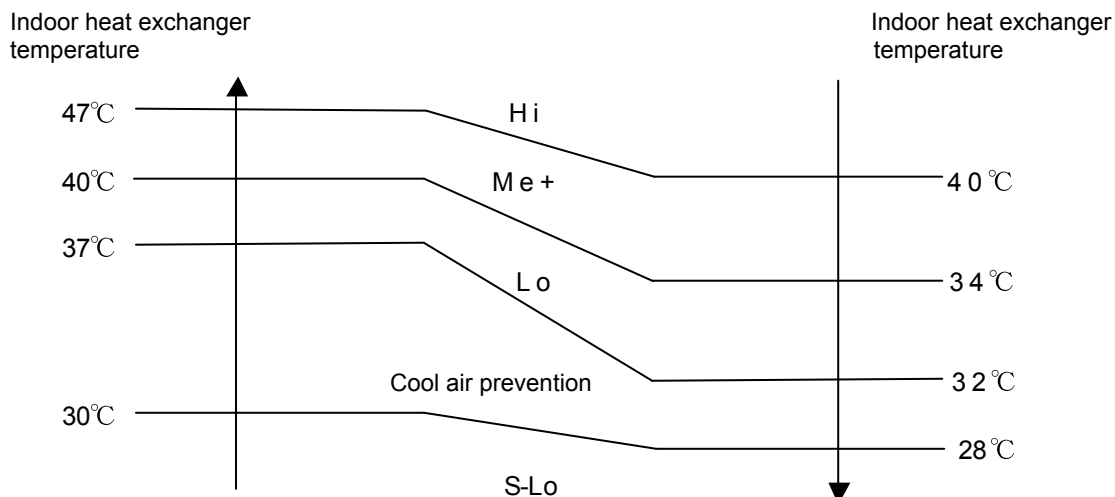
airflow change - over (Heating:AUTO)



(6).COOL AIR PREVENTION CONTROL (Heating mode)

The maximum value of the indoor fan speed is set as shown in Figure 8, based on the detected temperature by the indoor heat exchanger sensor on heating mode.

(Fig.8 : Cool Air Prevention Control)



6. OUTDOOR FAN CONTROL

(1). Outdoor Fan Motor

Following table shows the type of the outdoor fan motor. The control method is different between AC motor and DC motor.

(Table 6 : Type of Motor)

	AC Motor	DC Motor
AS*9/12LSACW	○	
AS*9/12LSBCW	○	
AS*14/18LSBCW		○

(2). Fan Speed

(Table 7 : AC Motor)

	Cooling	Dry	Heating
AS*9LSACW	830rpm	830rpm	830rpm
AS*12LSACW	820rpm	820rpm	820rpm
AS*9LSBCW	840rpm	840rpm	840rpm
AS*12LSBCW	830rpm	830rpm	830rpm

* In conjunction with the compressor ON/OFF, the fan speed operates at around the speed shown above.

(Table 8 : DC Motor)

	Cooling	Dry	Heating
AS*14LSBCW	860/820/670/500rpm	500rpm	820/750/670/550/450rpm
AS*18LSBCW	860/820/670/500rpm	500rpm	820/750/670/550/450rpm

* The outdoor fan speed changed in the range mentioned above depending on the compressor frequency.
(When the compressor frequency increases, the outdoor fan speed also changes to the higher speed. When the compressor frequency decreases, the outdoor fan speed also changes to the lower speed.)

* It runs at 500rpm for 20 seconds after starting up the outdoor fan.

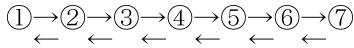
* After the defrost control is operated on the heating mode, the fan speed keeps at 950rpm without relating to the compressor frequency.

7. LOUVER CONTROL

(1). VERTICAL LOUVER CONTROL

(Function Range)

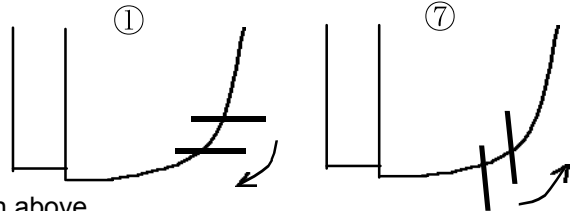
Each time the button is pressed, the air direction range will change as follow:



(Fig 9: Air Direction Range)

(Operation Range)

Cooling / Dry mode : ①—②—③
 Heating mode : ④—⑤—⑥—⑦
 Fan mode : ①—②—③—④—⑤—⑥—⑦



Use the air direction adjustments within the ranges shown above.

- The vertical airflow direction is set automatically as shown, in accordance with the type of operation selected.
 - Cooling / Dry mode : Horizontal flow ①
 - Heating mode : Downward flow ⑦
- When the temperature of the air being blown out is low at the start of heating operation or during defrosting, the airflow direction temporarily becomes ⑦ to prevent cold air being blown onto the body.
- During use of the Cooling and Dry modes, do not set the Air Flow Direction Louver in the Heating range (④~⑦) for long period of time, since water vapor may condense near the outlet louvers and drop of water may drip from the air conditioner. During the Cooling and Dry modes, if the Air Flow Direction Louvers are left in the heating range for more than 30minutes, they will automatically return to position ③.
- During Monitor operation in AUTO CHANGEOVER mode, the airflow direction automatically becomes ①, and it cannot be adjusted.

(2). SWING OPERATION

When the swing signal is received from the remote controller, the vertical louver starts to swing.

(Swinging Range)

Cooling mode / Dry mode / Fan mode(①~③) : ① ⇔ ③
 Heating mode / Fan mode(④~⑦) : ③ ⇔ ⑦

- When the indoor fan is either at S-lo or Stop mode, the swinging operation is interrupted and the louver stops at the memorized position.

8. COMPRESSOR CONTROL

(1). OPEARTION FREQUENCY RANGE

The operation frequency of the compressor is different based on the operation mode as shown in the table 9.

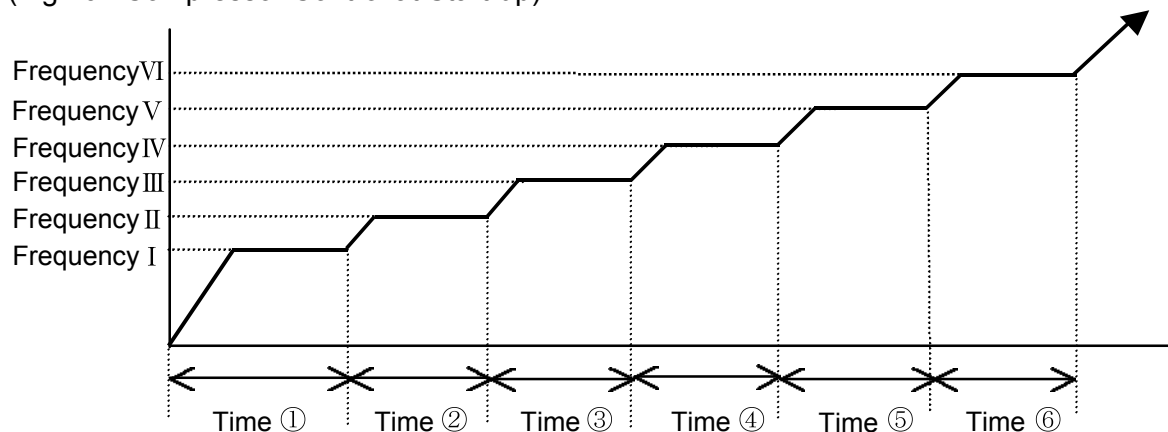
(Table 9 : Compressor Operation Frequency Range)

	Cooling		Heating		Dry
	Min	Max	Min	Max	
AS*9LSACW	18Hz	80Hz	18Hz	130Hz	33Hz
AS*12LSACW	18Hz	96Hz	18Hz	130Hz	33Hz
AS*9LSBCW	18Hz	80Hz	18Hz	130Hz	33Hz
AS*12LSBCW	18Hz	96Hz	18Hz	130Hz	33Hz
AS*14LSBCW	18Hz	90Hz	18Hz	119Hz	24Hz
AS*18LSBCW	18Hz	90Hz	18Hz	119Hz	24Hz

(2). OPEARTION FREQUENCY CONTROL AT START UP

The compressor frequency soon after the start-up is controlled as shown in the figure 10.

(Fig.10 : Compressor Control at Start-up)



(Frequency)

	Frequency I	Frequency II	Frequency III	Frequency IV	Frequency V	Frequency VI
AS*9LSACW	56Hz	64Hz	74Hz	87Hz	108Hz	120Hz
AS*12LSACW	56Hz	64Hz	74Hz	87Hz	108Hz	120Hz
AS*9LSBCW	56Hz	74Hz	87Hz	97Hz	108Hz	119Hz
AS*12LSBCW	56Hz	74Hz	87Hz	97Hz	108Hz	119Hz
AS*14LSBCW	40Hz	59Hz	72Hz	80Hz	101Hz	110Hz
AS*18LSBCW	40Hz	59Hz	72Hz	80Hz	101Hz	110Hz

(Time)

	Time ①	Time ②	Time ③	Time ④	Time ⑤	Time ⑥
AS*9LSACW	80sec	30sec	30sec	30sec	50sec	60sec
AS*12LSACW	80sec	30sec	30sec	30sec	50sec	60sec
AS*9LSBCW	80sec	60sec	60sec	180sec	60sec	60sec
AS*12LSBCW	80sec	60sec	60sec	180sec	60sec	60sec
AS*14LSBCW	60sec	40sec	40sec	60sec	150sec	60sec
AS*18LSBCW	60sec	40sec	40sec	60sec	150sec	60sec

9. TIMER OPEARTION CONTROL

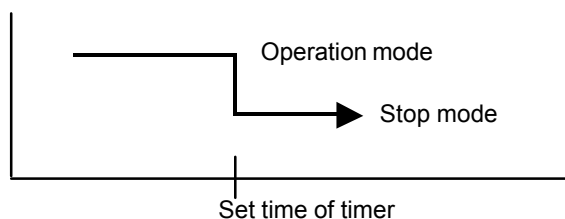
The table 10 shows the available timer setting based on the product model.

(Table 10 : Timer Setting)

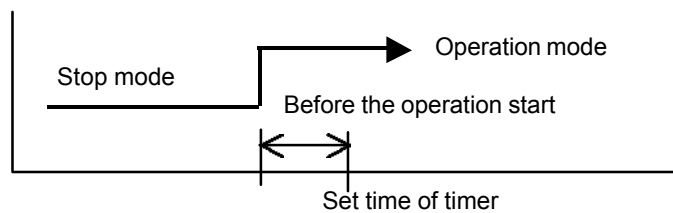
	ON TIMER / OFF TIMER	PROGRAM TIMER	SLEEP TIMER
AS*9LSACW	○	×	○
AS*12LSACW	○	×	○
AS*9LSBCW	○	○	○
AS*12LSBCW	○	○	○
AS*14LSBCW	○	○	○
AS*18LSBCW	○	○	○

(1). OPEARTION FREQUENCY RANGE

- OFF timer : When the clock reaches the set time, the air conditioner will be turned off.



- ON timer : Depending on the difference between the actual room temperature and the set temperature value, the unit will start operation automatically in order to bring the room temperature to the desired set temperature value by the timer previously set.



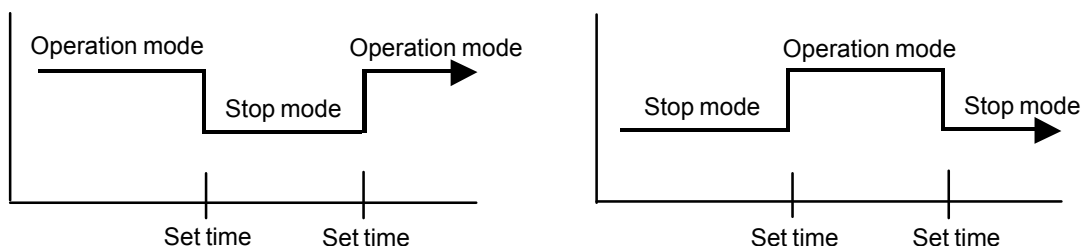
At the ON timer when [Heating/Auto time:45 min] [Cooling/dry time:20 min] are reduced, the indoor fan motor runs with S-Lo for 1 minute, and detects the room temperature. The [Operation start time] is determined according to the Table 11 as shown below, and the operation is started.

(Table 11)

Operation Start Time	Differential of set temperature and room temperature		
	Heating	Cooling	Dry
Before 44 minutes	20°C or larger	—	—
Before 30 minutes	15°C ~ 20 °C	—	—
Before 19 minutes	10°C ~ 15 °C	10°C or larger	10°C or larger
Before 15 minutes	—	5°C ~ 10 °C	5°C ~ 10 °C
Before 10 minutes	Less than 10 °C	Less than 5 °C	Less than 5 °C

(2). PROGRAM TIMER

- The program timer allows the OFF timer and ON timer to be used in combination one time.



- Operation will start from the timer setting (either OFF timer or ON timer) whichever is closest to the clock's current timer setting. The order of operations is indicated by the arrow in the remote control unit's display.
- SLEEP timer operation cannot be combined with ON timer operation.

(3). SLEEP TIMER

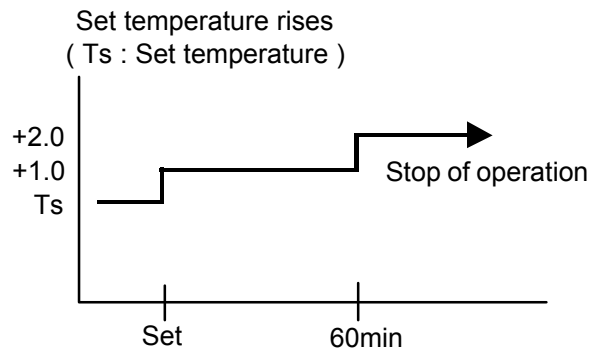
If the sleep is set, the room temperature is monitored and the operation is stopped automatically. If the operation mode or the set temperature is change after the sleep timer is set, the operation is continued according to the changed setting of the sleep timer from that time ON.

In the cooling operation mode

When the sleep timer is set, the setting temperature is increased 1 degC.

It increases the setting temperature another 1degC after 1 hour.

After that, the setting temperature is not changed and the operation is stopped at the time of timer setting.

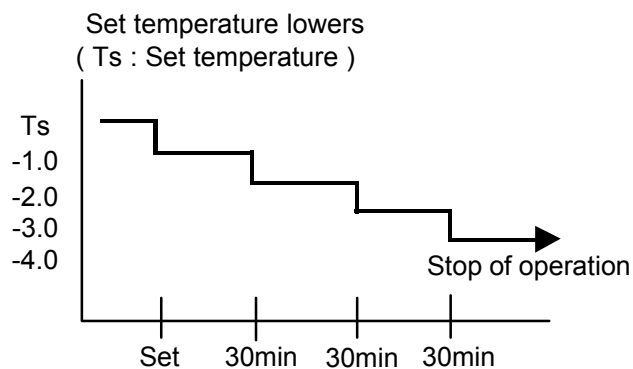


In the heating operation mode

When the sleep timer is set, the setting temperature is decreased 1 degC.

It decreases the setting temperature another 1degC every 30 minutes.

Upon lowering 4degC, the setting temperature is not changed and the operation stops at the time of timer setting.



10. ELECTRONIC EXPANSION VALVE CONTROL

The most proper opening of the electronic expansion valve is calculated and controlled under the present operating condition based on the following values.

The compressor frequency, the temperatures detected by the discharge temperature sensor, the indoor heat exchanger sensor, the outdoor heat exchanger sensor, and the outdoor temperature sensor.

- * The pulse range of the electronic expansion valve control is between 60 to 480 pulses.
- * The expansion valve is set at 480 pulses after 110 seconds of stopping compressor.
- * At the time of supplying the power to the outdoor unit, the initialization of the electronic expansion valve is operated (528 pulses are input to the closing direction).

11. TEST OPERATION CONTROL

Under the condition where the air conditioner runs, press the test operation button of the remote control, and the test operation control mode will appear. During test running, the operation lamp and timer lamp of the air conditioner body twinkle simultaneously. Set the test operation mode, and the compressor will continue to run regardless of whether the room temperature sensor detects. The test operation mode is released if 60 minutes have passed after setting up the test operation.

12. PREVENT TO RESTART FOR 3 MINUTES (3 MINUTES ST)

The compressor won't enter operation status for 2 minutes and 20 seconds after the compressor is stopped, even if any operation is given.

13. FOUR-WAY VALVE EXTENSION SELECT

At the time when the air conditioner is switched from the cooling mode to heating mode, the compressor is stopped, and the four-way valve is switched in 2 minutes and 20 seconds later after the compressor stopped.

14. AUTO RESTART

When the power was interrupted by a power failure, etc. during operation, the operation contents at that time are memorized and when power is recovered, operation is automatically started with the memorized operation contents.

When the power is interrupted and recovered during timer operation, since the timer operation time is shifted by the time the power was interrupted, an alarm is given by blinking (7 sec ON/2 sec OFF) the indoor unit body timer lamp.

[Operation contents memorized when the power is interrupted]

- Operation mode
- Set temperature
- Set air flow
- Timer mode and timer time
- Set air flow Direction
- Swing

15. MANUAL AUTO OPERATION (Indoor unit body operation)

If MANUAL AUTO Button is set, the operation is controlled as shown in Table 12.

If the remote control is lost or battery power dissipated, this function will work without the remote control.

(Table 12)

OPERATION MODE	Auto changeover
FAN CONT. MODE	Auto
TIMER MODE	Continuous (No timer setting available)
SETTING TEMP.	24 °C
SETTING LOUVER	Standard
SWING	OFF

16. COMPRESSOR PREHEATING

When the outdoor heat exchanger temperature is lower than temperature and the heating operation has been stopped for 30 minutes, power is applied to the compressor and the compressor is heated.

(By heating the compressor, warm air is quickly discharged when operation is started.)

When operation was started, and when the outdoor temperature rises to temperature or greater, preheating is ended.

(Table 13 : Preheating Operation / Release Temperature)

	Temperature I	Temperature II
AS*9LSACW	5°C	7°C
AS*12LSACW	5°C	7°C
AS*9LSBCW	5°C	7°C
AS*12LSBCW	5°C	7°C
AS*14LSBCW	5°C	7°C
AS*18LSBCW	5°C	7°C

17. COIL DRY OPERATION CONTROL

The coil-dry operation functions by pressing Coil Dry operation button on the remote controller.

The coil-dry operation is consisted of 3 cycles of [Fan operation 3 minutes / Heating operation 2 minutes], and Fan operates for 3 minutes at last before ending the air conditioner operation.

(It takes 18 minutes to complete the coil-dry operation.)

Following table indicates the indoor unit setting on the coil-dry operation.

(Table 14 : Coil-dry Operating Functions)

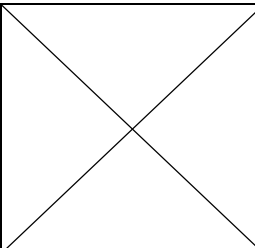
	Indoor Fan Speed	Compressor Frequency	Louver Position	Main Unit Indocation
AS*9LSACW	900rpm	36Hz	①	Coil-dry indication : ON Other indication : OFF
AS*12LSACW	900rpm	36Hz	①	
AS*9LSBCW	900rpm	36Hz	①	
AS*12LSBCW	900rpm	36Hz	①	
AS*14LSBCW	900rpm	24Hz	①	
AS*18LSBCW	900rpm	24Hz	①	

18. DEFROST OPERATION CONTROL

(1). CONDITION OF STARTING THE DEFROST OPERATION

The defrost operation starts when the outdoor heat exchanger temperature sensor detects the temperature lower than the values shown in Table 15.

(Table 15 : Condition of starting Defrost Operation)

1 ST time defrosting after starting operation		Compressor operating time			
		Less than 20 minutes	20 to 60 minutes	60 minutes to 4 hours	After 4 hours
	AS*9LSACW	Does not operate	- 9℃	- 5℃	- 3℃
	AS*12LSACW		- 9℃	- 5℃	- 3℃
	AS*9LSBCW		- 9℃	- 5℃	- 3℃
	AS*12LSBCW		- 9℃	- 5℃	- 3℃
	AS*14LSBCW		- 9℃	- 5℃	- 3℃
	AS*18LSBCW		- 9℃	- 5℃	- 3℃
Defrosting after 2 ST time upon starting operation		Compressor operating time			
		Less than 35 minutes	35 minutes to 4 hours		After 4 hours
	AS*9LSACW	Does not operate	- 6℃		- 3℃
	AS*12LSACW		- 6℃		- 3℃
	AS*9LSBCW		- 6℃		- 3℃
	AS*12LSBCW		- 6℃		- 3℃
	AS*14LSBCW		- 6℃		- 3℃
	AS*18LSBCW		- 6℃		- 3℃

(2). CONDITION OF THE DEFROST OPERATION COMPLETION

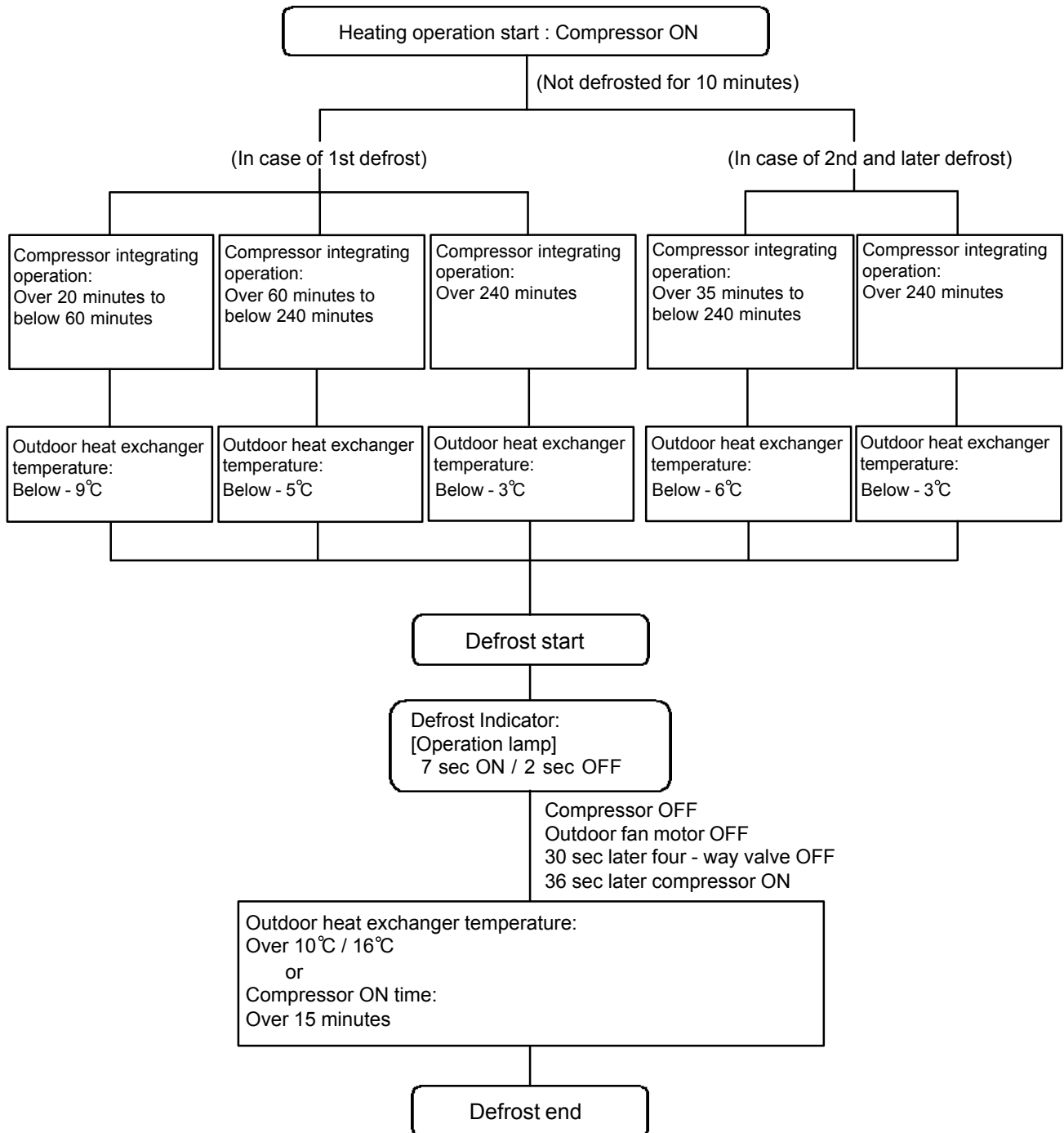
Defrost operation is released when the conditions become as shown in Table 16.

(Table 16 : Defrost Release Condition)

	Release Condition
AS*9LSACW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*12LSACW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*9LSBCW	Outdoor heat exchanger temperature sensor value is higher than 16degC or Compressor operation time has passed 15 minutes.
AS*12LSBCW	Outdoor heat exchanger temperature sensor value is higher than 16degC or Compressor operation time has passed 15 minutes.
AS*14LSBCW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*18LSBCW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.

Defrost Flow Chart

The defrosting shall proceed by the integrating operation time and outdoor heat exchanger temperature as follows.



19. OFF DEFROST OPEARTION CONTROL

When operation stops in the [Heating operation] mode, if frost is adhered to the outdoor unit heat exchanger, the defrost operation will proceed automatically. In this time, if indoor unit operation lamp flashes slowly (7 sec ON / 2 sec OFF), the outdoor unit will allow the heat exchanger to defrost, and then stop.

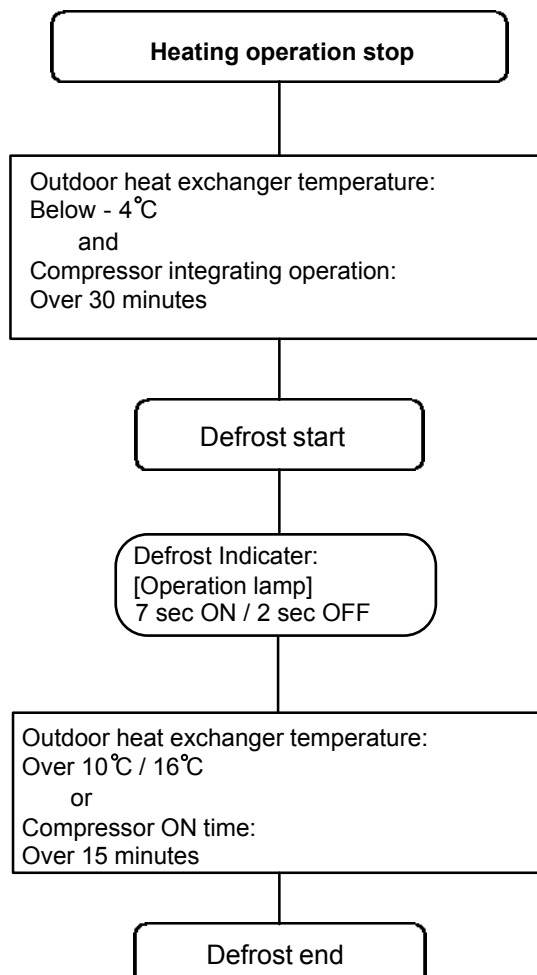
(1). OFF DEFROST OPERATION CONDITION

In heating operation, the outdoor heat exchanger temperature is less than - 4°C, and compressor operation integrating time lasts for more than 30 minutes.

(2). OFF DEFROST END CONDITION

	Release Condition
AS*9LSACW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*12LSACW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*9LSBCW	Outdoor heat exchanger temperature sensor value is higher than 16degC or Compressor operation time has passed 15 minutes.
AS*12LSBCW	Outdoor heat exchanger temperature sensor value is higher than 16degC or Compressor operation time has passed 15 minutes.
AS*14LSBCW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.
AS*18LSBCW	Outdoor heat exchanger temperature sensor value is higher than 10degC or Compressor operation time has passed 15 minutes.

OFF Defrost Flow Chart



20. VARIOUS PROTECTIONS

(1). DISCHARGE GAS TEMPERATURE OVERRISE PREVENION CONTROL

The discharge gas thermosensor (discharge thermistor : Outdoor side) will detect discharge gas temperature.

When the discharge temperature becomes higher than Temperature I ,the compressor frequency is decreased 20 Hz, and it continues to decrease the frequency for 20 Hz every 120 seconds until the temperature becomes lower than Temperature I.

When the discharge temperature becomes lower than Temperature II,the control of the control of the compressor frequency is released.

When the discharge temperature becomes higher than Temperature III ,the compressor is stopped and the indoor unit LED starts blinking.

(Table 17 : Discharge Temperature Over Rise Prevension Control / Release Temperature)

	Temperature I	Temperature II	Temperature III
AS*9LSACW	104°C	101°C	110°C
AS*12LSACW	104°C	101°C	110°C
AS*9LSBCW	104°C	101°C	110°C
AS*12LSBCW	104°C	101°C	110°C
AS*14LSBCW	104°C	101°C	110°C
AS*18LSBCW	104°C	101°C	110°C

(2). CURRENT RELEASE CONTROL

The compressor frequency is controlled so that the outdoor unit input current does not exceeds the current limit value that was set up with the outdoor temperature.

The compressor frequency returns to the designated frequency of the indoor unit at the time when the frequency becomes lower than the release value.

(Table 18 : Current Release Operation Value / Release Value)

[Heating] OT : Outdoor Temperature

AS*9LSACW	AS*12LSACW	AS*9LSBC W	AS*12LSBCW	AS*14LSBCW	AS*18LSBCW
OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)
17°C $\frac{6.5A}{6.0A}$	17°C $\frac{6.5A}{6.0A}$	17°C $\frac{6.5A}{6.0A}$	17°C $\frac{6.5A}{6.0A}$	17°C $\frac{7.0A}{6.5A}$	17°C $\frac{7.0A}{6.5A}$
12°C $\frac{8.0A}{7.5A}$	12°C $\frac{8.0A}{7.5A}$	12°C $\frac{8.0A}{7.5A}$	12°C $\frac{8.0A}{7.5A}$	12°C $\frac{9.0A}{8.5A}$	12°C $\frac{9.0A}{8.5A}$
5°C $\frac{8.0A}{7.5A}$	5°C $\frac{8.5A}{8.0A}$	5°C $\frac{8.0A}{7.5A}$	5°C $\frac{8.5A}{8.0A}$	5°C $\frac{10.5A}{10.0A}$	5°C $\frac{10.5A}{10.0A}$
	9.5A / 9.0A	8.0A / 7.5A	9.5A / 9.0A	12.0A / 11.5A	12.0A / 11.5A

[Cooling / Dry] OT : Outdoor Temperature

AS*9LSACW	AS*12LSACW	AS*9LSBCW	AS*12LSBCW	AS*14LSBCW	AS*18LSBCW
OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)	OT (Control / Release)
46°C $\frac{3.5A}{3.0A}$	46°C $\frac{4.0A}{3.5A}$	46°C $\frac{3.5A}{3.0A}$	46°C $\frac{4.0A}{3.5A}$	46°C $\frac{4.5A}{4.0A}$	46°C $\frac{4.5A}{4.0A}$
40°C $\frac{4.0A}{3.5A}$	40°C $\frac{5.0A}{4.5A}$	40°C $\frac{4.0A}{3.5A}$	40°C $\frac{5.0A}{4.5A}$	40°C $\frac{6.0A}{5.5A}$	40°C $\frac{6.0A}{5.5A}$
	6.5A / 6.0A	5.5A / 5.0A	6.5A / 6.0A	8.5A / 8.0A	8.5A / 8.0A

(3). ANTIFREEZING CONTROL (Cooling and Dry mode)

The compressor frequency is decrease on cooling & dry mode when the indoor heat exchanger temperature sensor detects the temperature lower than Temperature I.
Then, the anti-freezing control is released when it becomes higher than Temperature II .

(Table 19 : Anti-freezing Protection Operation / Release Temperature)

	Temperature I	Temperature II
AS*9LSACW	4℃	7℃
AS*12LSACW	4℃	7℃
AS*9LSBCW	4℃	7℃
AS*12LSBCW	4℃	7℃
AS*14LSBCW	4℃	7℃
AS*18LSBCW	4℃	7℃

(4). COOLING PRESSURE OVERRISE PROTECTION

When the outdoor unit heat exchange sensor temperature rises to temperature I or greater, the compressor is stopped and trouble display is performed.

(Table 20 : Cooling Pressure Over Rise Protection Function Temperature)

	Temperature I
AS*9LSACW	65℃
AS*12LSACW	65℃
AS*9LSBCW	67℃
AS*12LSBCW	67℃
AS*14LSBCW	65℃
AS*18LSBCW	65℃

(5). HIGH TEMPERATURE RELEASE CONTROL (HEATING MODE)

On heating mode, the compressor frequency is controlled as following based on the detection value of the indoor heat exchanger temperature sensor.

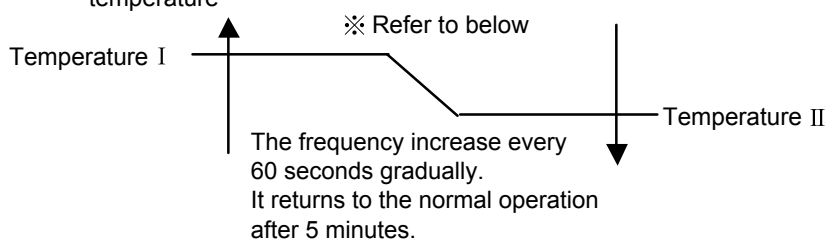
(The control system is different depending on the product model)

	Control system
AS*9LSACW	I
AS*12LSACW	I
AS*9LSBCW	II
AS*12LSBCW	II
AS*14LSBCW	II
AS*18LSBCW	II

(Fig 11 : Heating Overload Protection Control)

[Control System I]

Indoor heat exchange
temperature



※ Compressor Operation

[AS*9/12LSBCW]

52Hz or greater → 51Hz

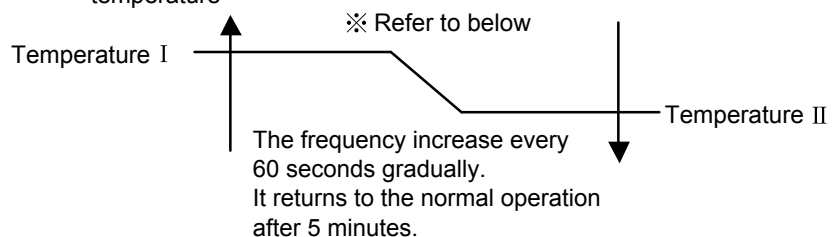
26~51Hz → Frequency down evry 60 seconds

18~25Hz → OFF

	Fan Hi		Other than Hi	
	Temp I	Temp II	Temp I	Temp II
AS*9LSACW	52℃	48℃	54℃	50℃
AS*12LSACW	52℃	48℃	54℃	50℃

[Control System I]

Indoor heat exchange temperature



	Fan Hi		Other than Hi	
	Temp I	Temp II	Temp I	Temp II
AS*9LSACW	52°C	48°C	54°C	50°C
AS*12LSACW	52°C	48°C	54°C	50°C

※ Compressor Operation

[AS*9/12LSBCW]

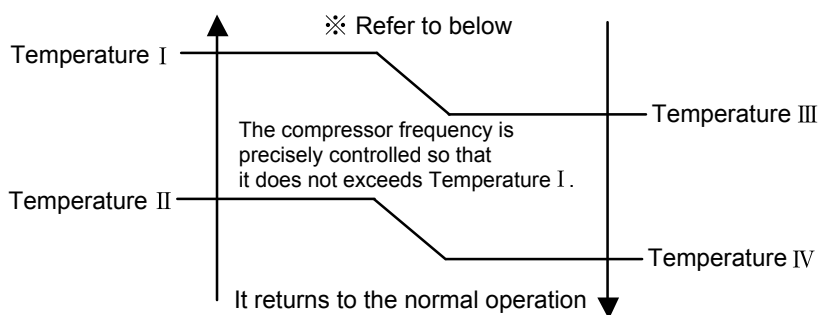
52Hz or greater → 51Hz

26~51Hz → Frequency down evry 60 seconds

18~25Hz → OFF

[Control System II]

Indoor heat exchange temperature



	Temp I	Temp II	Temp III	Temp IV
AS*9LSBCW	55°C	53°C	52°C	50°C
AS*12LSBCW	55°C	53°C	52°C	50°C
AS*14LSBCW	55°C	53°C	52°C	50°C
AS*18LSBCW	55°C	53°C	52°C	50°C

※ Compressor Operation

[AS*9/12LSBCW]

46Hz or greater → 45Hz

39~45Hz → Frequency down every 120 seconds

26~38Hz → 25Hz

18~25Hz → OFF

[AS*14/18LSBCW]

39Hz or greater → 38Hz

30 ~38Hz → Frequency down every 120 seconds

19~29Hz → 18Hz

18Hz → OFF

WALL MOUNTED type INVERTER

6 . REFRIGERANT CAUTION -R410A-

1. R410A TOOLS

This air conditioner used R410A.

For installation and servicing, it is necessary to prepare the tools and machines that are different from the previous refrigerant.

◎ **Mark shows the exclusive use for R410A.**

◎ **Gauge manifold** (Fig.4-1)

The specification of the gauge is different due to higher pressure.

The size of connection pipe is also different to prevent mis-use.

◎ **Charge hose** (Fig.4-2)

Since the normal pressure is high, the connection pipe size is also different.

◎ **Refrigerant cylinder** (Fig.4-3)

Confirm the refrigerant type before charging. Always charge liquid-phase refrigerant.

Electronic balance for refrigerant charging (Fig.4-4)

Electronic balance is recommended as in the case of R410A.

◎ **Vacuum pump with adapter to prevent reverse flow** (Fig.4-5)

Conventional pump can be used.

Vacuum holder (Fig.4-6)

Conventional pump can be used if adapter for preventing vacuum pump oil from flowing back is used.

◎ **Gas leakage tester** (Fig.4-7)

Exclusive for HFC

Refrigerant cleaner (Fig.4-8)

Brown paint as designated by the ARI, USA

◎ **Flare tool** (Fig.4-9)

The shape of flare is different for high pressure condition.

◎ **Torque wrench** (Fig.4-10)

◎ **Refrigerant recovering equipment (Collector)** (Fig.4-11)

The type which can be used for any refrigerant is available

Nitrogen cylinder (Fig.4-12)

This prevents an oxide film from forming in the pipe silver-alloy brazing work by turning the air out of the pipe and preventing the inside combustion.

◎ **Safety charger** (Fig.4-13)

It is always compulsory to change the liquid, because R410A is a mixed refrigerant and there is some fear that a mixing ratio changes. In order to avoid the refrigerant from returning to the compressor in a liquid state, the refrigerant can be charged instead of giving a load to the compressor with a safety charger.

Control valve (Fig.4-14)

The control valve prevents the refrigerant from spouting when it is removed, as the charging hose side and the service port side are possible to open and close at the same time.

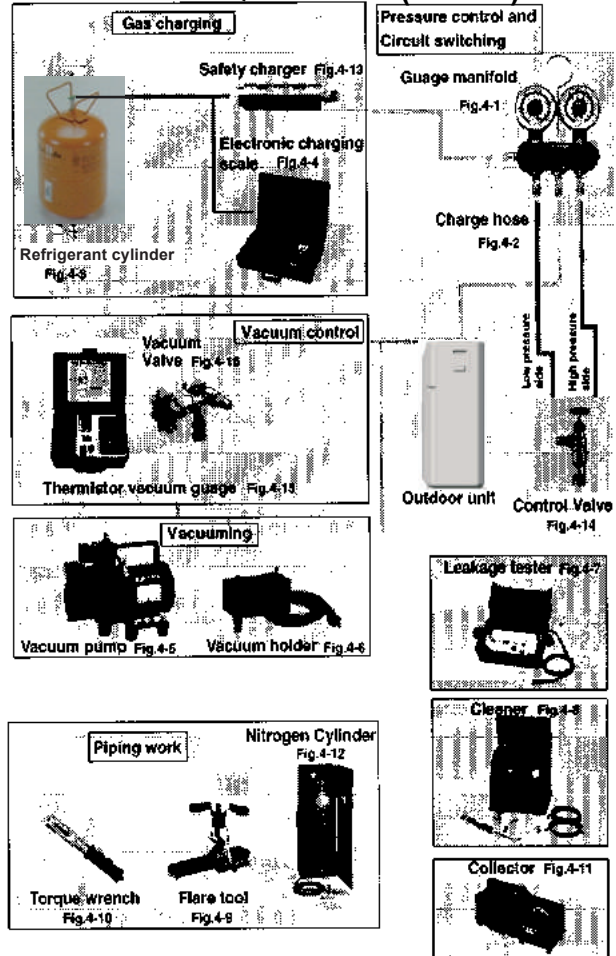
Thermistor vacuum gauge (Fig.4-15)

To remove moisture from the refrigerating cycle completely, it is necessary to perform appropriate vacuum drying. For that reason, vacuum conditions can be confirmed certainly.

Vacuum valve (Fig.4-16)

This valve builds in a check valve, and it is easily possible to vacuum a refrigerating cycle or check for degree of vacuum with it.

TOOLS AND EQUIPMENT (R410A)



* 1 Gauge Manifold

	R410A	R22, R407C
High pressure gauge	-0.1~5.3 Mpa	-0.1~3.5 Mpa
Compound gauge	-0.1~3.8 Mpa	-0.1~1.7 Mpa
Port size	1/2UNF 5/16"	7/16UNF 1/4"

* 2 Charge hose

	R410A	R22, R407C
Normal pressure	5.1 Mpa	3.4 Mpa
Breaking pressure	27.4 Mpa	17.2 Mpa
Port size	1/2UNF	7/16UNF

2. PRECAUTION FOR INSTALLATION

Precaution for installation

Selection of pipe

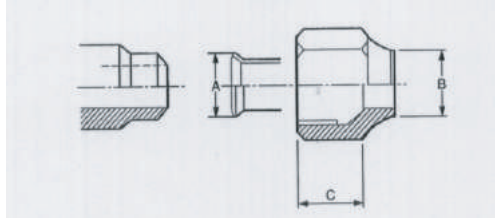
Pipe thickness

Outer diameter	Thickness
1/4" (6.35mm)	0.8 mm
3/8" (9.52mm)	0.8 mm
1/2" (12.7mm)	0.8 mm

Be sure to use this pipe thickness and over for countermeasure against higher pressure.

Flare and flare nuts

Diameter	1/4" (6.35mm)		3/8" (9.52mm)		1/2" (12.7mm)	
Refrigerant	R410A	R22 /R407C	R410A	R22 /R407C	R410A	R22 /R407C
A	9.1	9.0	13.2	13.0	16.6	16.2
B	13	12	20	15	13	20
C	12	11	16	12.5	19	16
Nut width	17		22		26	24

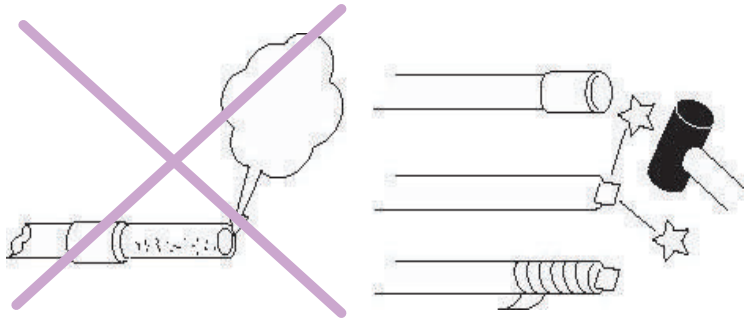


Always use the flare nut that is packed with the product.

Do not use existing (for R22) pipes

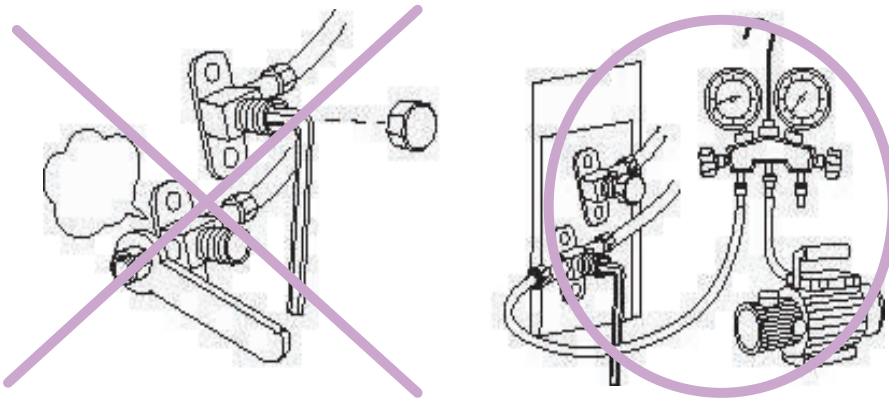
- Be sure to use new pipes when replacing conventional (R22) model with **HFC (R407C, R410A)** model.
- If you use existing pipes, it may cause resolution of compressor oil by remaining mineral oil.

Be careful not to mix moisture and contamination into the pipe



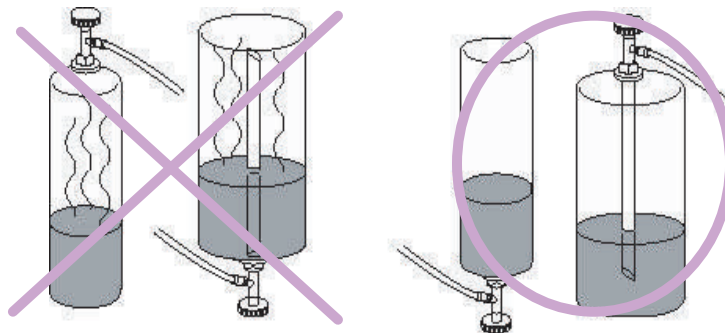
Moisture and **contamination**
in the pipe is a cause of
trouble.

Air purge



Always use a **vacuum pump** to purge air.

Refrigerant charge



Don't charge from the **gas** phase side.

Do it always from the **liquid** phase
side.

Compressor oil is changed

- We developed new synthetic oil, since HFC refrigerant doesn't dissolve in mineral (for R22)oil.
- Be careful to handle synthetic oil, since it resolves easily by moisture and contamination.
- Don't mix new synthetic oil and mineral oil. It may cause trouble.

3. PRECAUTION FOR SERVICING

Feature 1 Refrigerant oil is different from before.

Refrigerant oil for
New Refrigerant

Synthetic oil
Ether
Esther

※ Previously it was
mineral oil.

Different point from
previous one

- Absorbent character is high.
- Contamination occurs when mixed with the other kind of oil.

Precaution on Tools

- Use the gauge manifold and charge hose for New Refrigerant(HFC), which shall be segregated from those of R22.
- Attach the stop valve on the vacuum pump and avoid the oil from reverse flow.
- It is necessary to use the vacuum pump which can obtain the high vacuum condition.

Feature 2 New Refrigerant has Approx 1.6 times higher pressure than previous refrigerant.

R410A

High Pressure

※ 1.6 times of R22.

Different point from
previous one

- Diameter of Service port has been changed from 1/4 Flare to 5/16 Flare.
- JIS standard of flare process It became larger
- To keep the thickness of copper tube.
(1/4, 3/8 = more than 0.8mm)

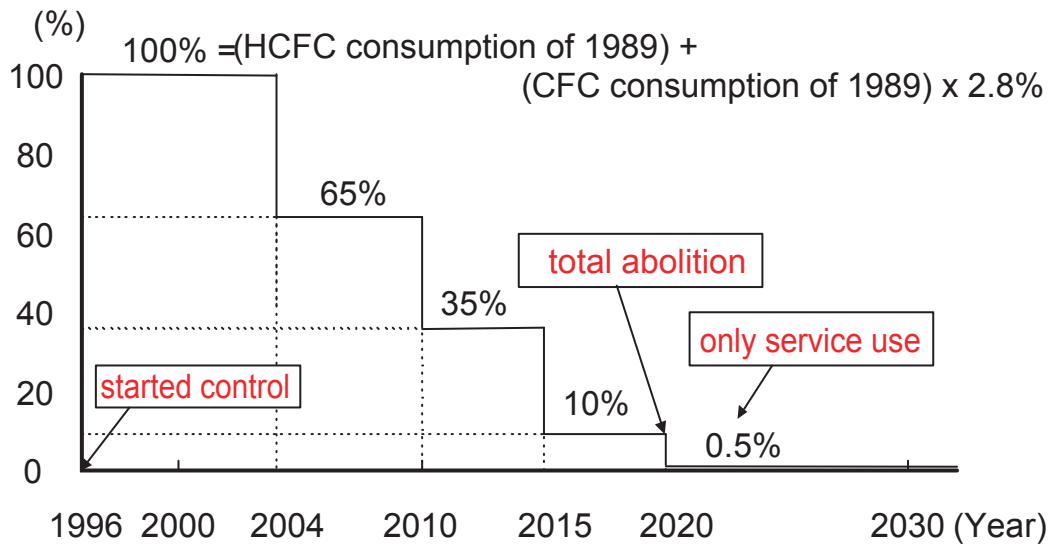
Precaution on Tools

- It requires the gauge manifold and charge hose exclusively for R410A.
 - It requires the flare tool and torque wrench that satisfies New JIS standard.
- ※ Previous flare tool + flare adapter can be used as well.

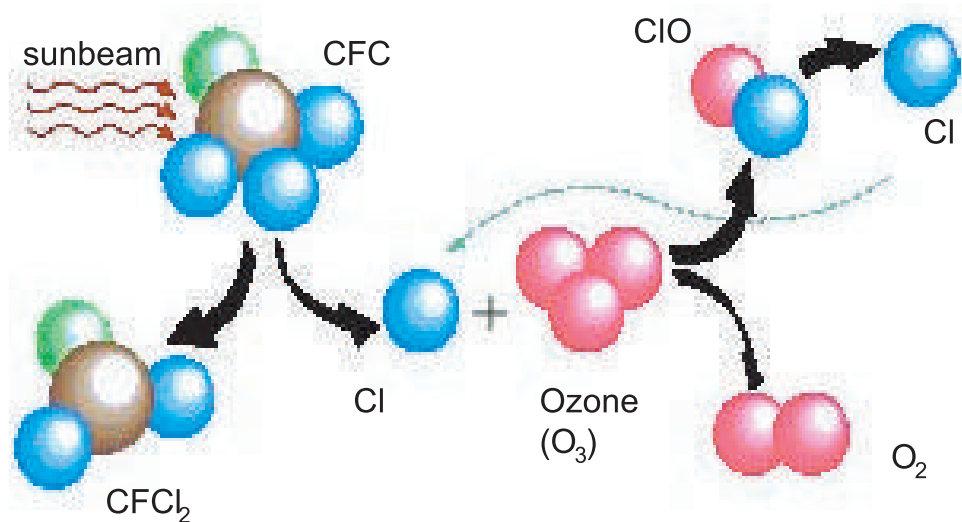
4. NEW REFRIGERANT R410A

* What is HFC ?

Phase-out schedule of HCFC according to Montreal protocol



Ozone Layer depleting mechanism



What is CFC and HCFC?

CFC : Chloro-Fluoro-Carbon

High ODP(ozone depletion potential) chemical compound, including chlorine. (ODP:0.6-1.0)
For example : R12 (for refrigerator and car air-conditioner)

HCFC : Hydro-Chloro-Fluoro-Carbon

Low ODP chemical compound, including chlorine and hydrogen. (ODP:0.02-01)
For example : R22 (for air-conditioner)

HFC₃ : Hydro-Fluoro-Carbon

R134a (for Car air conditioner)
R407C (for air conditioner)

Refrigerant characteristics

	R410A	R407C	R22
Composition (wt%)	R32/R125 (50/50)	R32/R125/R134a (23/25/52)	R22 (100)
Boiling Point	- 51.4	- 43.6	- 40.8
Behavior	near azeotrope	zeotrope	---
Pressure at 54.5 °C (kPa)	3,406	2,262	2,151
Temperature Glide (deg)	0.11	5.4	0
ODP	0	0	0.055

Summary of R407C and R410A characteristics

	R410A	R407C
Advantage	<ul style="list-style-type: none"> • higher system performance • Near-Azeotropic refrigerant 	<ul style="list-style-type: none"> • similar pressure as R22 (possible to design large equipment)
Disadvantage	<ul style="list-style-type: none"> • 1.6 times higher pressure than R22 (difficult to design against pressure resistance) 	<ul style="list-style-type: none"> • Zeotropic refrigerant (handle with care)
Suitable for	<ul style="list-style-type: none"> • Small Air-Conditioners 	<ul style="list-style-type: none"> • Large Air-Conditioners

* Designed pressure of R410A refrigerant

Relation between R410A condensing temperature and saturated pressure.

< Pressure → Temp >

Pressure (Mpa)	Temp (°C)
2.20	37.9
2.25	38.7
2.30	39.6
2.35	40.5
2.40	41.3
2.45	42.1
2.55	43.8
2.60	44.6
2.65	45.3
2.70	46.1
2.75	46.8
2.80	47.6
2.85	48.3
2.90	49.0
2.95	49.8
3.00	50.5
3.05	51.2
3.10	51.9
3.15	52.6
3.20	53.2
3.25	53.9
3.30	54.6
3.35	55.3
3.40	55.9
3.45	56.5
3.50	57.1
2.55	57.8
3.60	58.4
3.65	59.0
3.70	59.6
3.75	60.2
3.80	60.8
3.85	61.4
3.90	62.0
3.95	62.5
4.00	63.1
4.05	63.6
4.10	64.2
4.15	64.8

< Temp → Pressure >

Temp (°C)	Pressure (Mpa)
39	2.27
40	2.32
41	2.38
42	2.44
44	2.57
45	2.63
46	2.69
47	2.76
48	2.83
49	2.90
51	3.04
52	3.11
53	3.18
54	3.26
56	3.41
57	3.49
58	3.57
59	3.65
61	3.82
62	3.90
63	3.99
64	4.08

5. DEFFERENCE FROM CONVENTIONAL MODEL (R22) AND PRECAUTIONS

OIL

- Use new synthetic oils such as ester because HFC series refrigerant has less solubility with mineral oils conventionally used for R22.
- As these new synthetic oils are easily influenced by moisture and dusts, they must be treated more carefully than the conventional lubricating oils.

CAUTION

For installation/servicing, take more precautions than the case of conventional refrigerants to avoid moisture and dusts entering the refrigerant circuit. Also, for storing parts, more precautions must be taken.

COMPRESSOR

- Use better grade of material for sliding parts for securing good lubrication of sliding part as HFC refrigerant does not contain chloride.
- Review insulating materials
- Increase pressure resistance strength

CAUTION

Check if the compressor is suitable for the refrigerant (model) when replacing. Complete welding within 15 minutes after opening the cap when replacing.

HEAT EXCHANGER

- Review the water, contaminants controlling level
- Use thinner tube to increase pressure Increase capacity for resistance strength (only outdoor unit) improving performance

CAUTION

During storage, due care must be taken so that foreign matters such as dust and water do not enter.

4-WAY VALVE

- Review materials

CAUTION

Check if the valve is suitable for the refrigerant (model) when replacing.

2, 3-WAY VALVE

- Review material O-ring, valve core seal for securing suitability with oil.

CAUTION

Check if the valve is suitable for the refrigerant (model) when replacing.

WALL MOUNTED type INVERTER

7 . TROUBLE SHOOTING

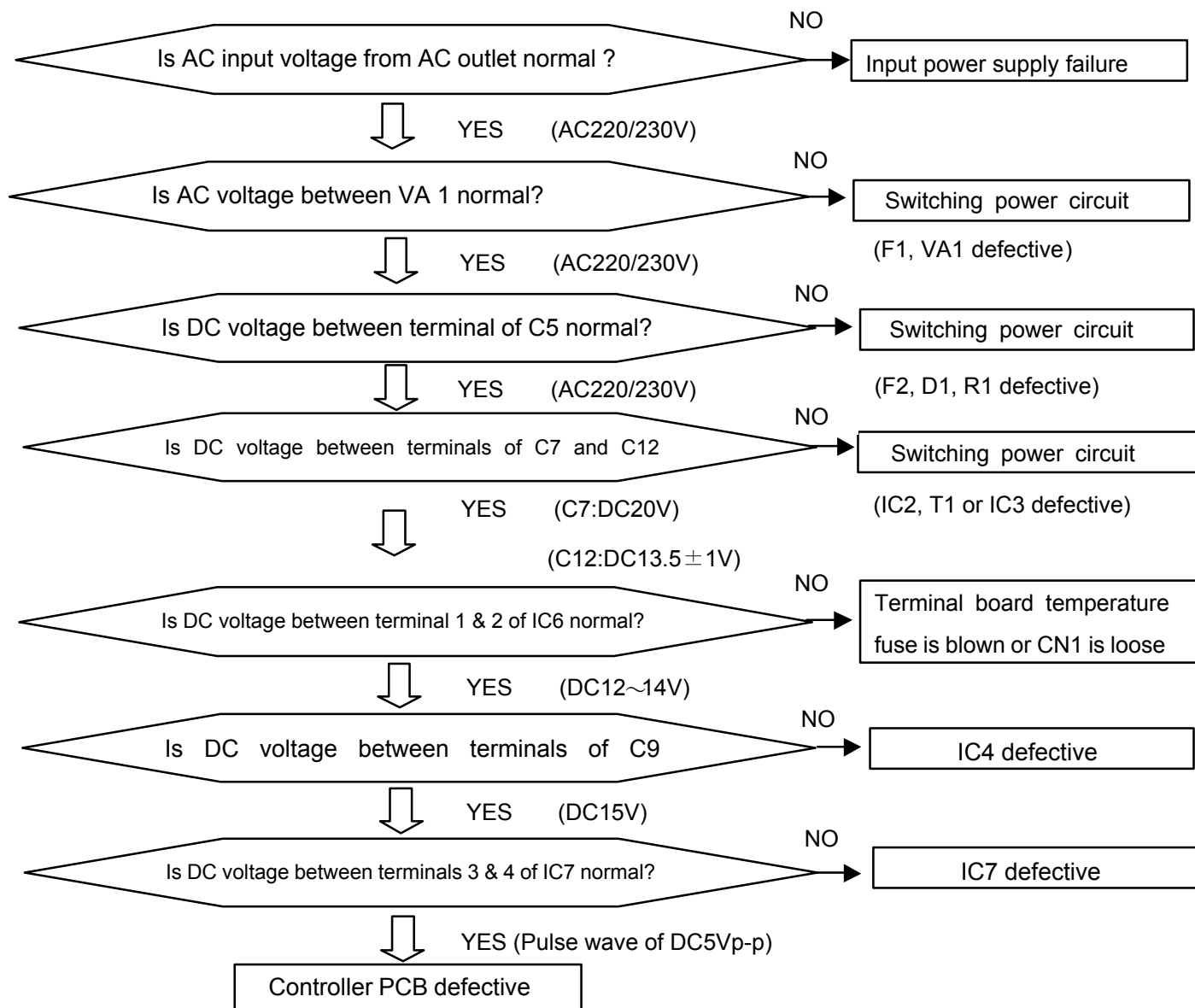
1. When the unit does not operate at all (Operation lamp and Timer lamp do not light up)
2. Self Diagnosis Function (Either Operation lamp or Timer lamp is blinking)
 - * How to operate the self-diagnosis function
 - * Self- diagnosis table and Check points
3. Trouble shooting method
 - * Serial signal check
 - * IPM protection check
 - * Active filter error check
 - * Refrigeration cycle diagnosis

Does not operate at all (Operation Lamp and Timer Lamp do not light up)

[Check Point]

- (1) Is the input power voltage from the exclusive circuit AC outlet normal?
- (2) Is the AC plug inserted to the AC outlet securely and not loose?
- (3) Check if each connector is inserted securely.

[Checking Flow Chart]



SELF-DIAGNOSIS FUNCTION

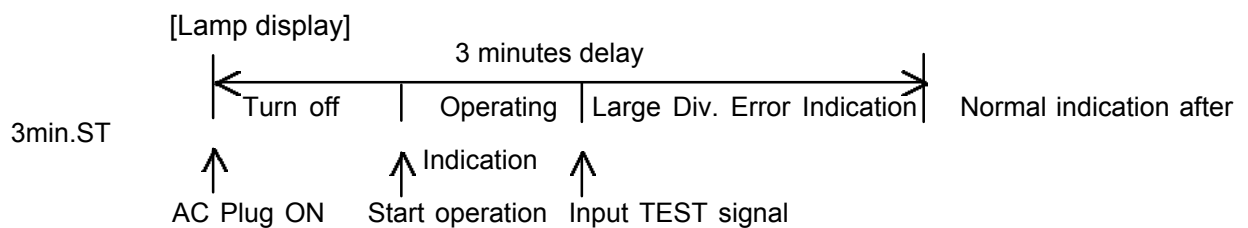
This function memorizes the self-diagnosis function (lamp display) in the indoor control P.C.Board when trouble occurs.

(The memory contents are not destroyed even when the power cord is unplugged from the AC outlet.)

The self-diagnosis function (lamp display) can also be switched between major classification display and minor classification display and precise diagnosis can be made.

Self-diagnosis function [lamp display] (memory reading)

- (1) When error occurs, it is indicated by blinking [Operation lamp (Red)] and [Timer lamp (Green)].
- (2) Upon pulling out and inserting the AC plug, the starts to operates from remote control.
(At this state, a normal operation indication is performed.)
- (3) By pressing [TEST] button of remote control, [Large Division Error Indication] is indicated only during
[3 minutes ST].
(3 minutes ST : 2 minutes 20 seconds from the timing AC plug is ON)



- (4) By pressing [TEST] button of remote control while [Large Division Error Indication], it switches to [Small Division Error Indication].
- (5) Every time [TEST] button of remote control is pressed, it switches between [Large Division Error Indication] and [Small Division Error Indication] alternately.

How to erase Memory

- (1) While [Large Division Error Indication] or [Small Division Error Indication] is ON by the self-diagnosis function, the memorized contents can be erased by pressing [Forced Auto Button] on the main unit.
(Indoor unit buzzer beeps 3 seconds.)

Self - diagnosis function and Checking points

Large Division Error Indication		Large Div. Contents	Small Division Error Indication		Small Div. Contents (Protection)	Diagnosis Method
Operation	Timer		Operation	Timer		
ON	1 sec. blinking	Transmission Error	0.1 sec. blinking	0.5 sec 2 times	Serial reverse transfer error at starting up operation	At the start up, the indoor unit does not receive the signal for 10 consecutive seconds from the time when the power relay was ON. > Permanent stop after 30 seconds. [Diagnosis Point] - Check the indoor/outdoor cable connection (in order). If the cable wiring is not abnormal, measure the voltage of the outdoor unit terminals and diagnose the defective location. (Refer to the after mentioned [Serial Signal Diagnosis] for the voltage measuring method and diagnosis method.)
			0.1 sec. blinking	0.5 sec 3 times	Serial reverse transfer error during the operation	When the indoor unit does not receive the signal for 10 consecutive seconds during the operation > Permanent stop after 30 seconds. [Diagnosis Point] - Check the indoor/outdoor cable connection (in order). If the cable wiring is not abnormal, measure the voltage of the outdoor unit terminals and diagnose the defective location. (Refer to the after mentioned [Serial Signal Diagnosis] for the voltage measuring method and diagnosis method.)
			0.1 sec. blinking	0.5 sec 4 times	Serial forward transfer error at starting up operation	The outdoor unit does not receive the signal for 10 consecutive seconds from the time when the power relay was ON. > Outdoor unit stops. [Diagnosis Point] - Check the indoor/outdoor cable connection (in order). If the cable wiring is not abnormal, measure the voltage of the outdoor unit terminals and diagnose the defective location. (Refer to the after mentioned [Serial Signal Diagnosis] for the voltage measuring method and diagnosis method.)
			0.1 sec. blinking	0.5 sec 5 times	Serial forward transfer error during the operation	When the outdoor unit does not receive the signal for 10 consecutive seconds during the operation > Outdoor unit stops. [Diagnosis Point] - Check the indoor/outdoor cable connection (in order). If the cable wiring is not abnormal, measure the voltage of the outdoor unit terminals and diagnose the defective location. (Refer to the after mentioned [Serial Signal Diagnosis] for the voltage measuring method and diagnosis method.)

0.5 sec 2 times	0.1 sec. blinking	Indoor Unit Thermistor Error	0.1 sec. blink ing	0.5 sec 2 times	Room temperature thermistor defective	The room temperature thermistor detected a abnormal temperature when the power was turned on. > Remote control does not operate. [Diagnosis Point] - Check Thermistor resistance value (Refer to "Thermistor characteristics table"). - Controller PCB defective.
			0.1 sec. blink ing	0.5 sec 3 times	Indoor Heat Exchanger Thermistor Error	The detection value of the indoor heat exchanger thermistor is either open or shorted when the power is ON. > Remote control does not operate. [Diagnosis Point] - Check Thermistor resistance value (Refer to "Thermistor characteristics table"). - Controller PCB defective.
0.5 sec 3 times	0.1 sec. blinking	Outdoor Unit Thermistor Error	0.1 sec. blink ing	0.5 sec 2 times	Discharge Thermistor Error	The detection value of the discharge thermistor is either open or shorted > Compressor, Outdoor Fan : OFF (It automatically releases when the normal value is detected.) [Diagnosis Point] - Check Thermistor resistance value (Refer to "Thermistor characteristics table"). - Controller PCB defective.
			0.1 sec. blink ing	0.5 sec 3 times	Outdoor Heat Exchanger Thermistor Error	The detection value of the outdoor heat exchanger thermistor is open. > Compressor, Outdoor Fan : OFF (It automatically releases when the normal value is detected.) [Diagnosis Point] - Check Thermistor resistance value (Refer to "Thermistor characteristics table"). - Controller PCB defective
			0.1 sec. blink ing	0.5 sec 4 times	Outdoor Temperature Thermistor Error	The detection value of the outdoor temperature thermistor is either open or shorted > Compressor, Outdoor Fan : OFF (It automatically releases when the normal value is detected.) [Diagnosis Point] - Check Thermistor resistance value (Refer to "Thermistor characteristics table"). - Controller PCB defective.
0.5 sec 4 times	0.1 sec. blinking	Indoor Unit Controller Error	0.1 sec. blink ing	0.5 sec 2 times	Forced Auto Switch Error	Forced Auto Switch becomes ON for 10 consecutive seconds. > It indicates the error but the operation continues. [Diagnosis Point] - Check if Forced Auto Switch is kept pressed. - Forced Auto Switch defective. - Controller PCB defective.

0.5 sec 5 times	0.1 sec. blinking	Outdoor Unit Controller Error	0.1 sec. blinking	0.5 sec 3 times	Main Relay Error	After 2 minutes 20 seconds of stopping operation, the signal from outdoor unit is received even though the main relay is OFF. > Main Relay OFF continues (Outdoor Unit OFF Command) [Diagnosis Point] - Main Relay defective - Controller PCB defective.
			0.1 sec. blinking	0.5 sec 4 times	Power Supply Frequency Detection Error	The power supply frequency can not be recognized after 4 seconds of power ON. > Permanent stop. [Diagnosis Point] - Controller PCB defective.
			0.1 sec. blinking	0.5 sec 2 times	IPM Protection	Abnormal current value of IPM is detected > Permanent stop. [Diagnosis Point] - Heat radiation is blocked (Inlet/Outlet) - Check if Outdoor Fan is defective (does not rotate). - Controller PCB defective (Refer to after mentioned "IPM diagnosis") - Refrigeration cycle defective (Refer to after mentioned "Refrigeration cycle diagnosis").
			0.1 sec. blinking	0.5 sec 3 times	CT Error	The current value during the operation after 1 minute from starting up the compressor is 0 A. > Permanent stop. [Diagnosis Point] - Check if CT wire is open. - Controller PCB defective.
			0.1 sec. blinking	0.5 sec 5 times	Compressor Location Error	The compressor speed does not synchronize with the control signal. (Including start up failure of the compressor) > Permanent stop. [Diagnosis Point] - Check if 2 way valve or 3 way valve is left open. - Check the compressor (Winding resistance value, Loose lead wire). - Refrigeration cycle defective (Refer to after mentioned "Refrigerant cycle diagnosis").
			0.1 sec. blinking	0.5 sec 6 times	Outdoor Fan Error (DC Motor)	Either the outdoor fan motor abnormal current or location error was detected. > Permanent stop. [Diagnosis Point] - Fan motor connector loose/ defective contact. - Fan motor defective. - Controller PCB defective.

0.5 sec 6 times	0.1 sec. blinking	Indoor Fan Motor Error	0.1 sec. blink ing	0.5 sec 2 times	Indoor Fan Lock Error	The indoor fan speed is 0 rpm after 56 seconds from starting operation or from the time the fan mode was changed. > Operation stops. (It releases by sending the operation stop signal from the remote controller.) [Diagnosis Point] - Fan motor connector loose/ defective contact. - Fan motor defective. - Controller PCB defective.
			0.1 sec. blink ing	0.5 sec 3 times	Indoor Fan Speed Error	The indoor fan speed is 1/3 of the target frequency after 56 seconds from starting operation or from the time the fan mode was changed. > Operation stops. (It releases by sending the operation stop signal from the remote controller.) [Diagnosis Point] - Fan motor connector loose/ defective contact. - Fan motor defective. - Controller PCB defective.
	0.1 sec. blinking	Refrigerant Cycle Error	0.1 sec. blink ing	0.5 sec 2 times	Discharge Temperature Error	The discharge temperature error is activated. > Permanent stop. [Diagnosis Point] - Check if 2 way valve or 3 way valve is left open. - Heat radiation is blocked (Inlet/Outlet) - Check if Outdoor Fan is defective (does not rotate). - Refrigeration cycle defective (Refer to after mentioned "Refrigerant cycle diagnosis").
			0.1 sec. blink ing	0.5 sec 3 times	Excessive High Pressure Protection on Cooling	Excessive high pressure protection on cooling mode has been activated. > Compressor, Outdoor Fan : OFF (It releases after 3 minute ST) [Diagnosis Point] - Heat radiation is blocked (Inlet/Outlet) - Check if Outdoor Fan is defective (does not rotate). - Refrigeration cycle defective (Refer to after mentioned "Refrigerant cycle diagnosis").
	0.1 sec. blinking	Other Error	0.1 sec. blink ing	0.5 sec 2 times	Active Filter Error (Permanent Stop)	Output voltage error of Active filter is detected. > Permanent stop. [Diagnosis Point] - Check the wiring connection (Connector is loose/open, Choke coil) - Controller PCB defective (Refer to after mentioned "Active Filter diagnosis")
			0.1 sec. blink ing	0.5 sec 3 times	Active Filter Error	Active filter error or instantaneous cut off error is detected. > Compressor, Outdoor Fan : OFF [Diagnosis Point] - Check the wiring connection (Connector is loose/open, Choke coil) - Controller PCB defective (Refer to after mentioned "Active Filter diagnosis") <CAUTION> Even if the unit is normal, it may detect error depending on the power supply voltage condition.

			0.1 sec. blink ing	4 times	PFC Circuit Error	Excessive voltage of DC voltage on PFC circuit in Inverter PCB is detected, or the excessive current in the circuit is detected. > Permanent stop. [Diagnosis Point] - Controller PCB defective (Refer to after mentioned "PFC circuit diagnosis").
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Serial Signal Diagnosis

[Check Point] Check and find out if the cause is at Indoor unit or Outdoor unit.

- * Remove the side cover of Outdoor unit for testing the Outdoor unit connection terminals with a meter.
- * Turn on the power and press [TEST] button of Remote control.

[Checking Flow Chart]

CAUTION: Do not touch the terminals or electrical components to avoid electric shock.

[Check Indoor Unit]

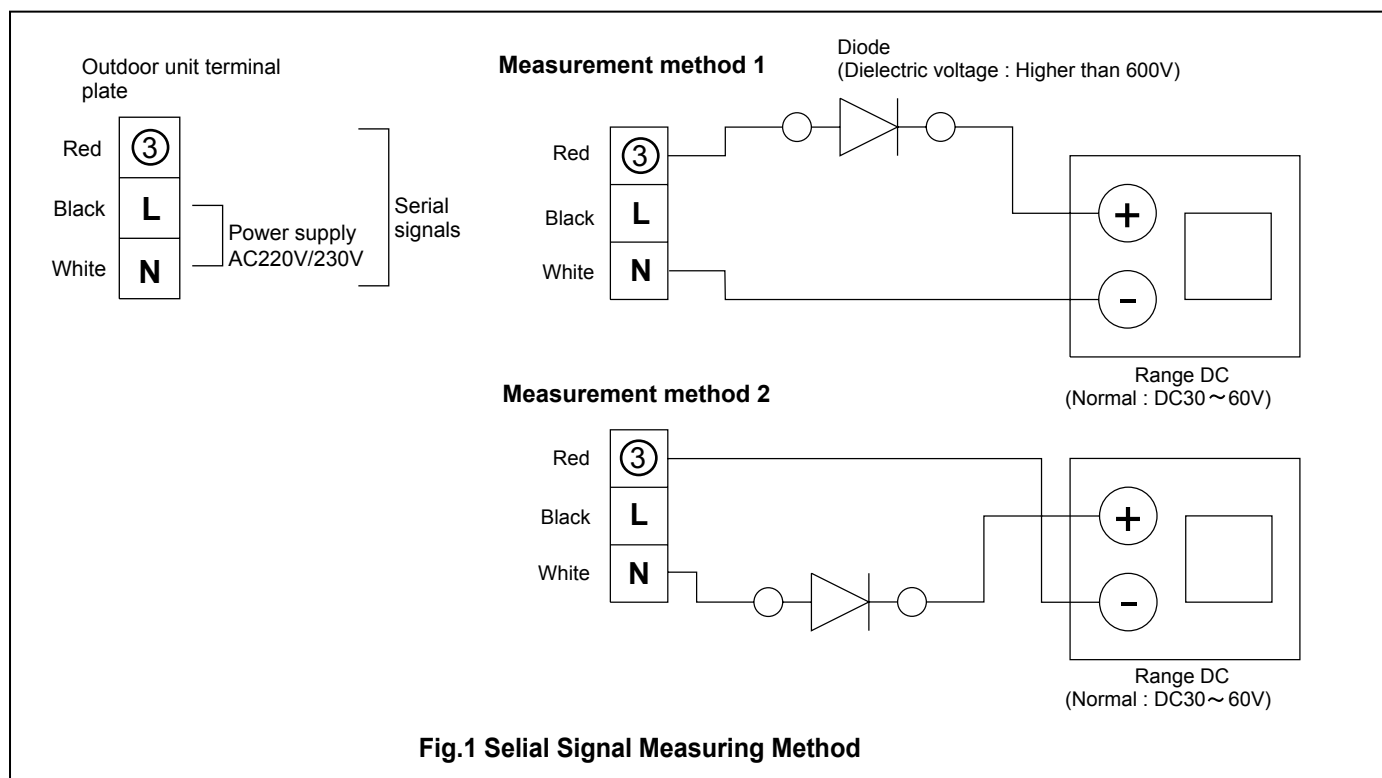
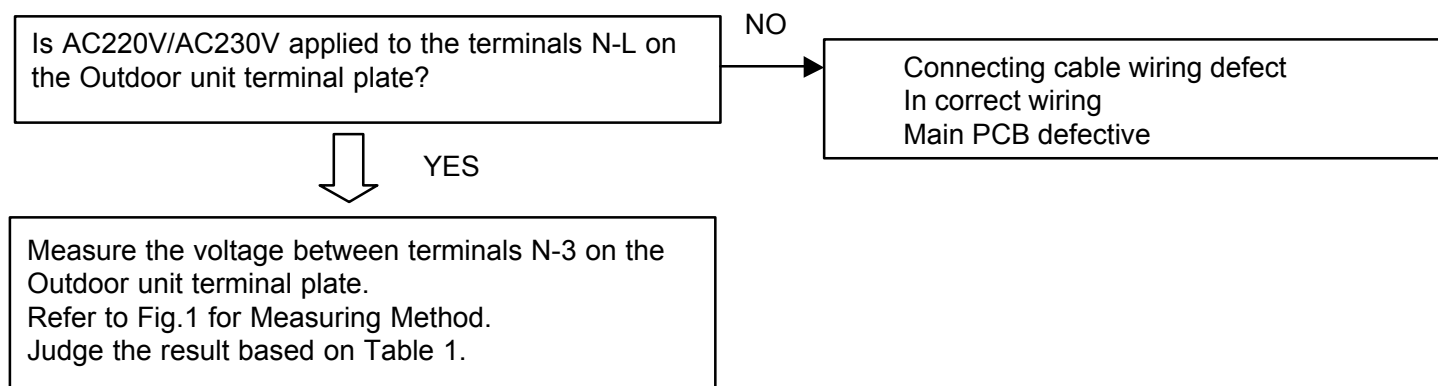


Table 1: Judgement table

Measurement 1 voltage value	Measurement 2 voltage value	Indoor unit trouble display	Outdoor unit operation	Defective point
0 ~ 5V	30 ~ 60 V	Display	No operation	Indoor unit control PCB defective
30 ~ 60V	0 ~ 5V	Display	No operation	Outdoor unit fuse open (input) Inverter defective

IPM Protection

[Checking Points]

Check the following points and locate the cause in the outdoor unit.

[Cause]

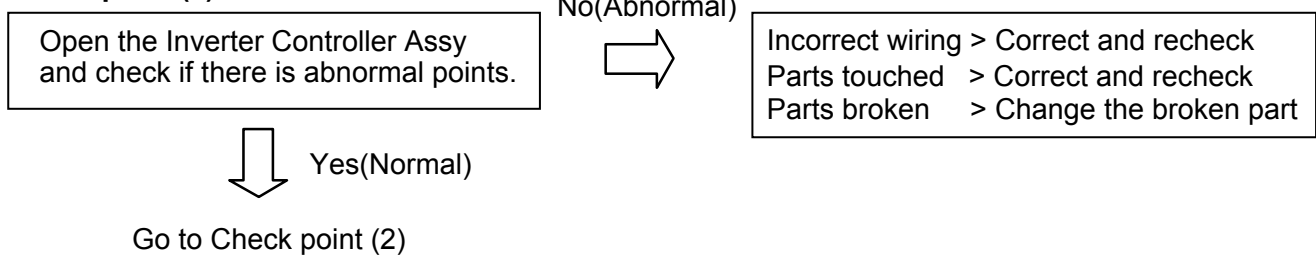
- (1) Compressor failure
- (2) Refrigeration cycle failure
- (3) PC Board defective
- (4) IPM defective
- (5) Incorrect wiring

[First step]

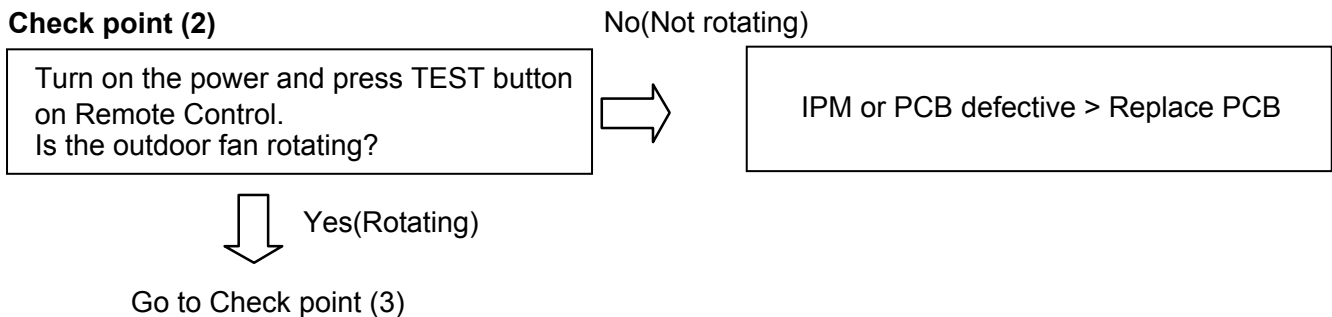
Measure the DC voltage at terminals (between Electrolytic Capacitor and discharge resistance) in the Inverter Controller Assy, and make sure it is lower than DC5V.

If it is higher than 5V, wait until the discharging is over.

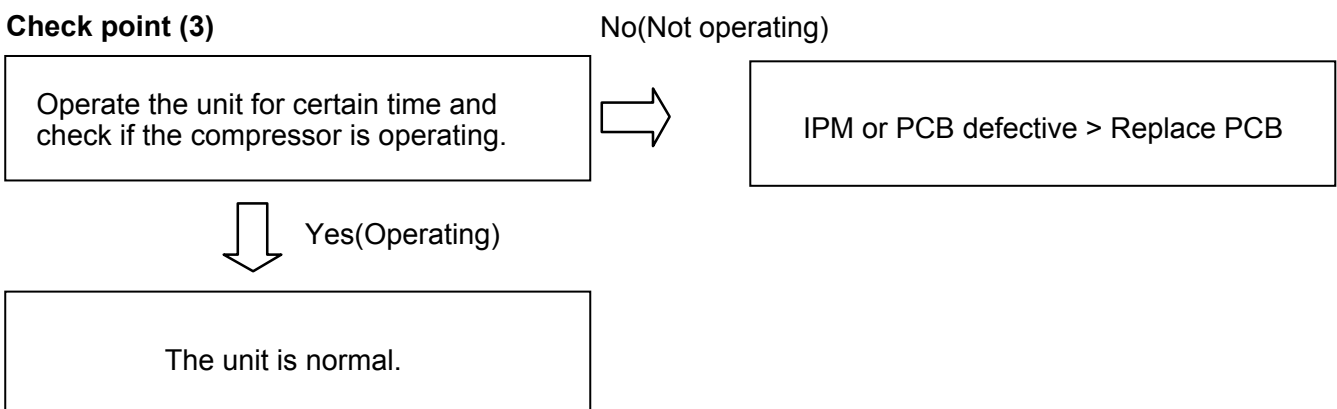
Check point (1)



Check point (2)



Check point (3)



Recheck

Operate the unit for certain time and check if the compressor is operating.

Yes(Operating) > Check completed
No(Not operating) > Return to the start

Active Filter Failure

[Checking points]

Check the following points and locate the cause in the outdoor unit.

[Cause]

- (1) Incorrect wiring
- (2) Active Filter Module defective
- (3) PC Board defective
- (4) DC voltage detection circuit defective

[First Step]

Measure the DC voltage at terminals (between Electrolytic Capacitor and discharge resistance) in the Inverter Controller Assy, and make sure it is lower than DC5V.
If it is higher than 5V, wait until the discharging is over.

Check point (1)

Open the Inverter Controller Assy and check if there is abnormal points.
(Incorrect wiring, Parts touched, Parts broken)

No(Abnormal)



Incorrect wiring > Correct and recheck
Parts touched > Correct and recheck
Parts broken > Change the broken part



Yes(Normal)

Go to Check point (2)

Check point (2)

Turn on the power and press TEST button on Remote Control.
Is the outdoor fan rotating?

No(Not rotating)



ACTPM or PCB defective > Replace Main PCB



Yes(Rotating)

Go to Check point (3)

Check point (3)

Operate the unit for certain time and measure the terminal voltage of the discharge resistance.
Is the DC voltage between 350 to 425V?

No(Out of range)



ACTPM or PCB defective > Replace ACTPM or Main PCB.
(Replace only ACTPM if Main PCB was replaced at Check point (2).)



Yes(Within range)

The unit is normal.

Recheck

Operate the unit for certain time and check if the compressor is operating.

Yes(Operating) > Check completed
No(Not operating) > Return to the start

Trouble Shooting of Refrigerant Cycle

[Diagnosis Table for Defective Component]

○: Item of most possible cause

	IPM Protection	Compressor Location error	Discharge Temperature Error	Cooling High Pressure Protection
Refrigerant leak			○	
Compressor failure(*)	○	○		
EEV failure (*)	○	○	○	○
Thermistor failure (*)	○	○	○	○

(*) Trouble Shooting Method

(1) Checking method of the compressor failure

Insert the AC plug and start up the cooling operation. Input Test operation signal and check if the compressor operates.

If it does not operate, measure the resistance value of compressor windings between U-V, V-W, W-U.

If any of the resistance value between U-V, V-W, W-U is not same as others, the compressor is defective.

Compressor Failure

	NORMAL
ASY9/12LSACW	Compressor Case Temperature at 25degC: 0.512 ohm
ASY9/12LSBCW	Compressor Case Temperature at 20degC: 0.701 ohm
ASY14/18LSBCW	Compressor Case Temperature at 25degC: 0.730 ohm

(The above resistance value is a typical value. There is some distribution. As it also changes by the compressor temperature, the measured value may be much different from the above table when measured right after stopping operation.)

(2) Checking method of EEV failure

- Insert the AC plug and start up the operation. Check if the EEV operates just before compressor is turned on. (Touch EEV by hand and check it.)

If it does not operate, check if the coil or connector of EEV is removed or loose.

If it operates, check the discharge thermistor / outdoor heat exchanger thermistor / indoor heat exchanger thermistor. (Refer to (3) for checking method.)

(3) Checking method of Thermistor

- Check each thermistor if it is removed or the connector is loose.

If there is no problem, remove the connector of the thermistor from the PCB and check the resistance value (refer to the thermistor characteristics table).

WALL MOUNTED type INVERTER

8 . APPENDING DATA

1. Jumper setting of Indoor unit and Outdoor unit
2. Outdoor unit Pressure Value and Total Electric Current Curve
3. Thermistor Resistance Values

JP (Jumper) Setting

[Indoor Unit]

AS*9/12LSACW

AS*9/12LSBCW

AS*14/18LSBCW

* Remote control custom code

When multiple number of indoor units are installed in the same room, erroneous receipt of the signal can be avoided by setting up the remote control custom code separately.

To set up the remote control custom code, always set up the same code on both indoor unit PCB and remote control PCB.

(When the indoor unit PCB is changed to Code B, it can not receive the signal unless remote control PCB is also changed to Code B.)

	Indoor Unit	Remote Control	
		AR-JE (LSAC)	AR-NJ (LSBC)
	JM1 (JP)	D4 (Diode)	D3 (Diode)
Code A (Default)	○	○	○
Code B	X	X	X

* Auto Restart

It is possible to disengage Auto Restart function if it is not needed.

	Indoor Unit
	JM2 (JP)
With Auto Restart function (Default)	YES
Without Auto Restart function	NO

[Outdoor Unit]

AO*9/12LSAC

		JP						
		JM101	JM102	JM103	JM104	JM105	JM106	JM107
9LSAC	Normal Preheat	NO	NO	NO	NO	NO	YES	NO
	Higher Preheat	NO	NO	NO	YES	NO	NO	NO
12LSAC	Normal Preheat	NO	YES	NO	NO	NO	NO	NO
	Higher Preheat	NO	NO	NO	NO	NO	NO	NO

AO*9/12LFBC

	JP
	JM500
Normal Preheat	YES
Higher Preheat	NO

AO*14/18LFBC

		JP						
		JM101	JM102	JM103	JM104	JM105	JM106	JM107
14LSBC	Normal Preheat	NO	YES	NO	NO	NO	NO	NO
	Higher Preheat	NO	NO	NO	NO	NO	NO	NO
18LSBC	Normal Preheat	NO	NO	NO	NO	NO	YES	NO
	Higher Preheat	NO	NO	NO	YES	NO	NO	NO

- it is possible to select the higher or standard level of preheating function.

- When it is set up at the higher level of preheat, the magnetic noise of the compressor becomes higher.

Outdoor Unit Low Pressure Value and Outdoor Total Electric Current Curve (Cooling)

Model Name : AS*9LSACW, AS*12LSACW

[Condition]

Ambient Indoor / Outdoor - Same temperature
temperature

Refrigerant Standard amount
amount

Piping 7.5m (Height difference 1m)
length

Power 50Hz - 230V
voltage

Operation TEST mode (Cooling), Hi Fan, Horizontal direction, Front air flow
condition

Measuring Measure the low pressure with the pressure meter at the service valve. Measure the outdoor
method unit overall current with the current clamp meter at Power Cable.

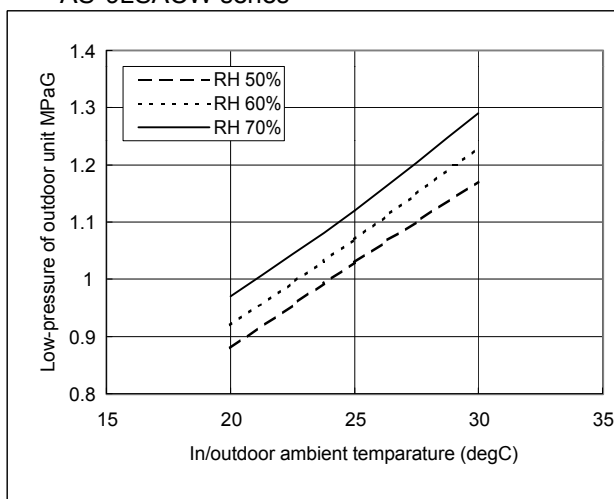
Caution Start operation with the condition of the Indoor Unit air filter clean.

[Constant Frequency Operation Method (Test mode)]

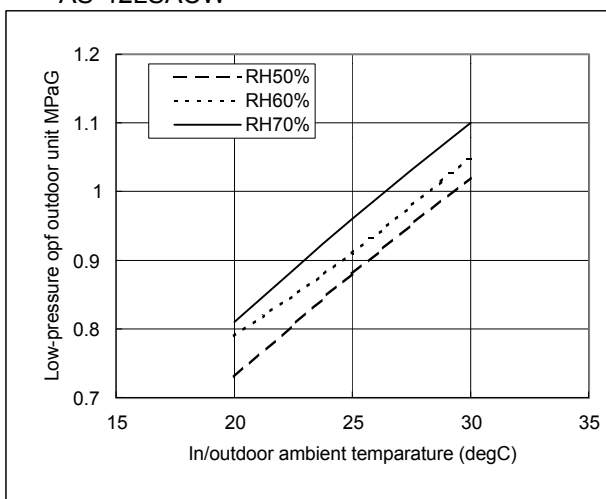
1. Operate on Colling mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automatically.)

(1) Indoor/Outdoor Temperature - Outdoor Low Pressure Curve

AS*9LSACW series

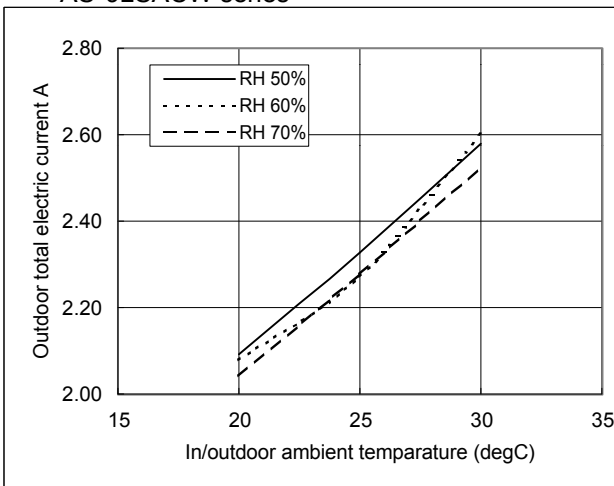


AS*12LSACW

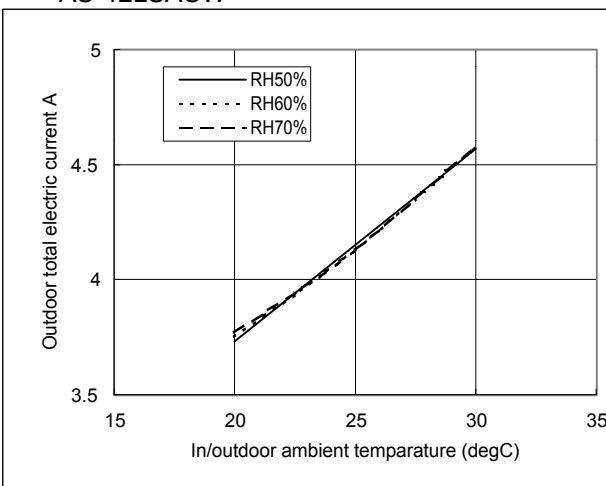


(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*9LSACW series



AS*12LSACW



Outdoor Unit High Pressure Value and Outdoor Total Electric Current Curve (Heating)

Model Name : AS*9LSACW, AS*12LSACW

[Condition]

Ambient temperature Indoor 15 - 23degC, Outdoor 2 - 12degC

Refrigerant amount Standard amount

Piping length 7.5m (Height difference 1m)

Power voltage 50Hz - 230V

Operation condition TEST mode (Heating), Hi Fan, Lower direction, Front air flow

Measuring method outdoor unit overall current with the current clamp meter at Power Cable.

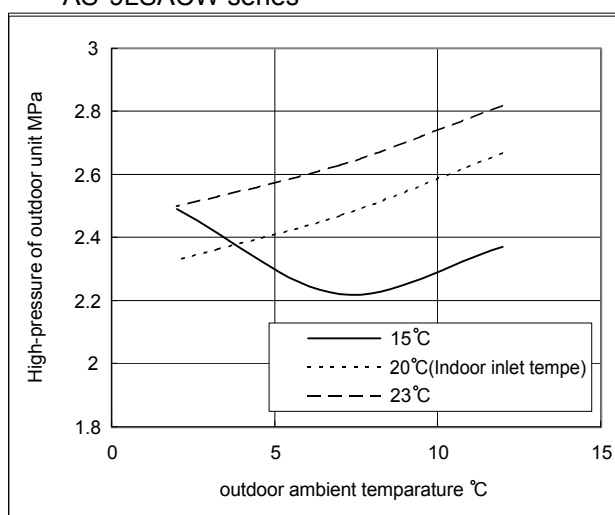
Caution Start operation with the condition of the Indoor Unit air filter clean.

[Constant Frequency Operation Method (Test mode)]

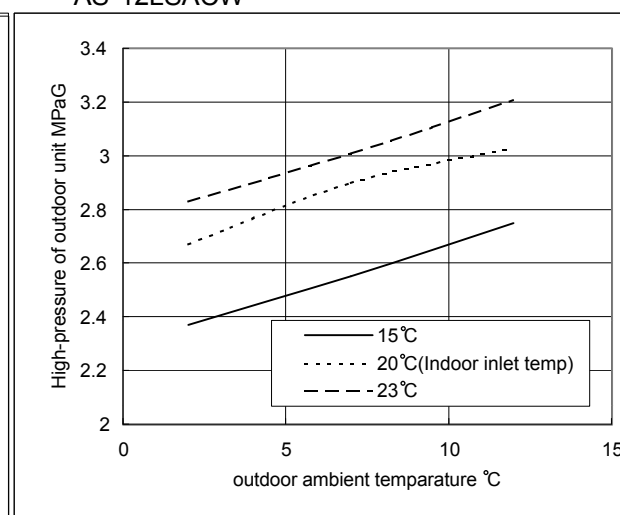
1. Operate on Heating mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automatically.)

(1) Indoor/Outdoor Temperature - Outdoor High Pressure Curve

AS*9LSACW series

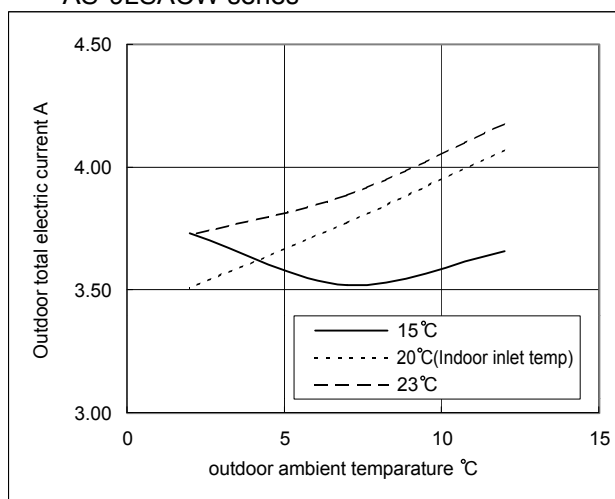


AS*12LSACW

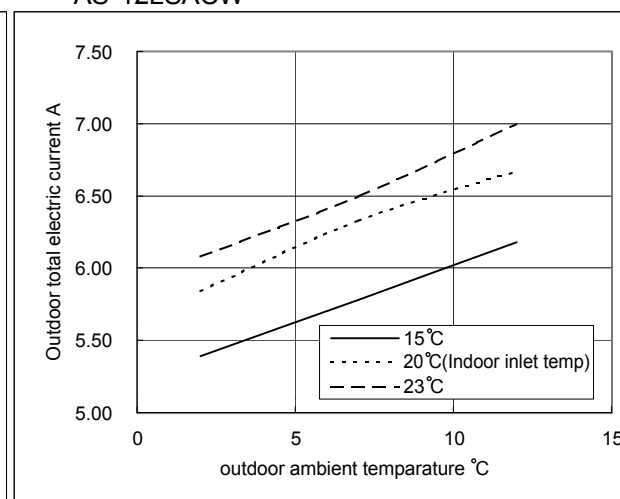


(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*9LSACW series



AS*12LSACW



Outdoor Unit Low Pressure Value and Outdoor Total Electric Current Curve (Cooling)

Model Name : AS*9LSBCW, AS*12LSBCW

[Condition]

Ambient temperature Indoor / Outdoor - Same temperature

Refrigerant amount Standard amount

Piping length 7.5m (Height difference 1m)

Power voltage 50Hz - 230V

Operation condition TEST mode (Cooling), Hi Fan, Horizontal direction, Front air flow

Measuring method Measure the low pressure with the pressure meter at the service valve. Measure the outdoor unit overall current with the current clamp meter at Power Cable.

Caution Start operation with the condition of the Indoor Unit air filter clean.

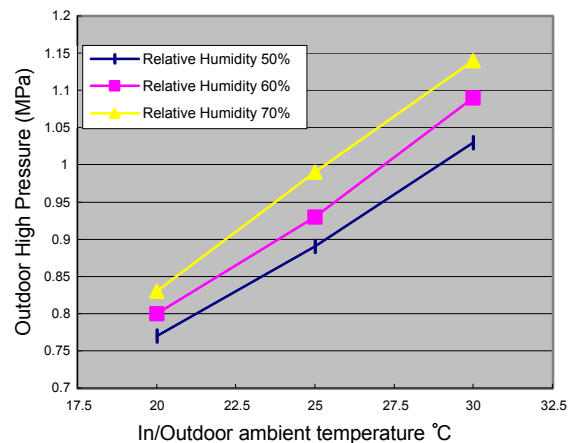
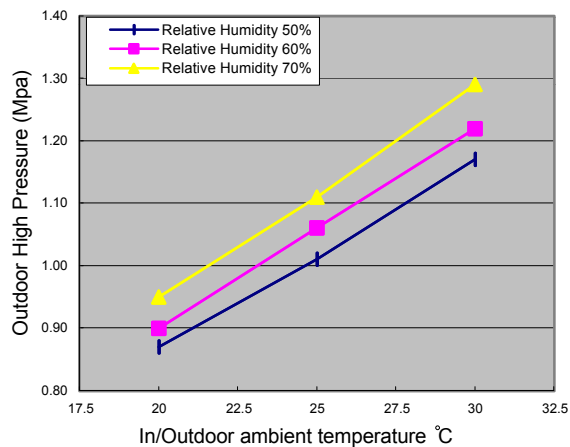
[Constant Frequency Operation Method (Test mode)]

1. Operate on Colling mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automatica

(1) Indoor/Outdoor Temperature - Outdoor Low Pressure Curve

AS*9LSBCW series

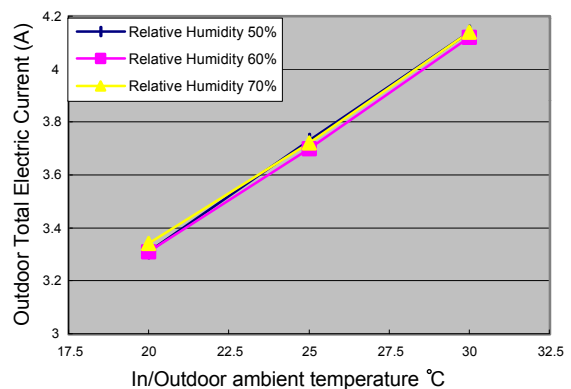
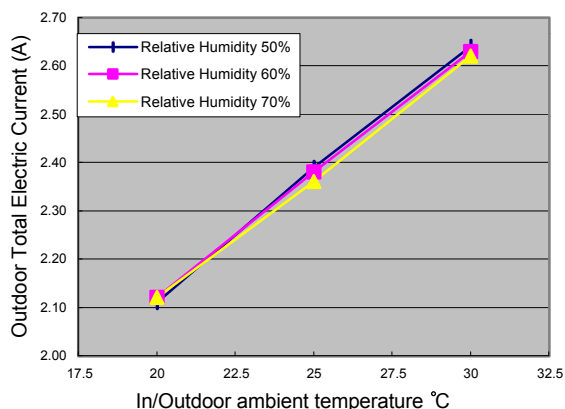
AS*12LSBCW



(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*9LSBCW series

AS*12LSBCW



Outdoor Unit High Pressure Value and Outdoor Total Electric Current Curve (Heating)

Model Name : AS*9LSBCW, AS*12LSBCW

[Condition]

Ambient temperature Indoor 15 - 23degC, Outdoor 2 - 12degC

Refrigerant amount Standard amount

Piping length 7.5m (Height difference 1m)

Power voltage 50Hz - 230V

Operation condition TEST mode (Heating), Hi Fan, Lower direction, Front air flow

Measuring method Measure the high pressure with the pressure meter at the service valve. Measure the outdoor unit overall current with the current clamp meter at Power Cable.

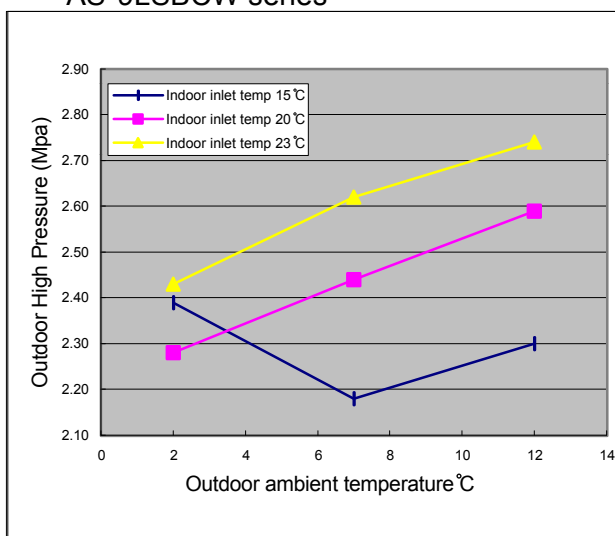
Caution Start operation with the condition of the Indoor Unit air filter clean.

[Constant Frequency Operation Method (Test mode)]

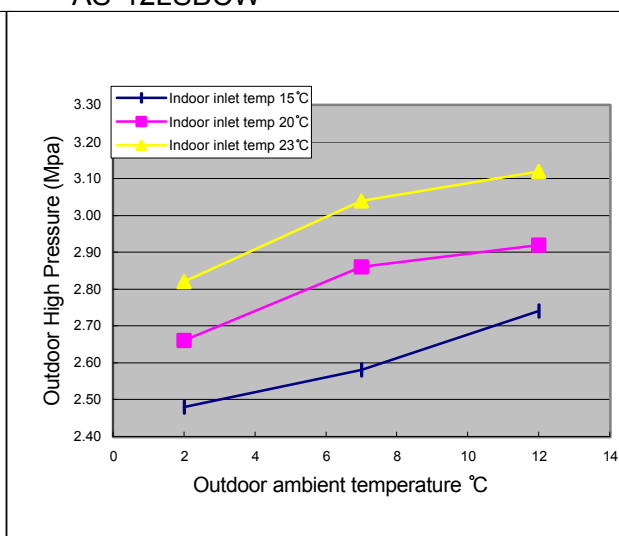
1. Operate on Heating mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automat

(1) Indoor/Outdoor Temperature - Outdoor High Pressure Curve

AS*9LSBCW series

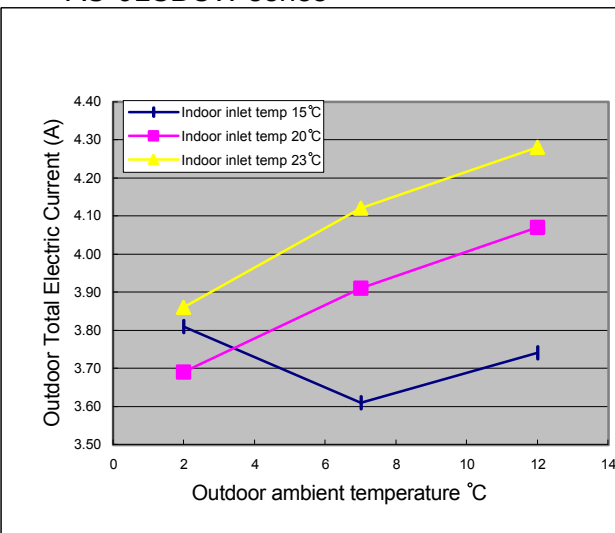


AS*12LSBCW

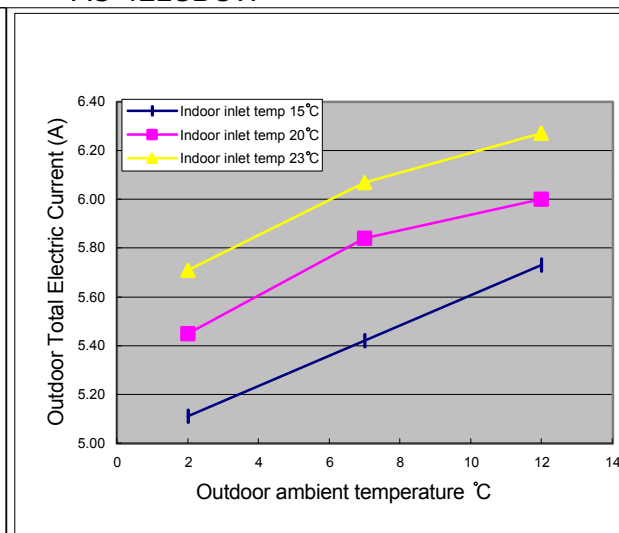


(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*9LSBCW series



AS*12LSBCW



Outdoor Unit Low Pressure Value and Outdoor Total Electric Current Curve (Cooling)

Model Name : AS*14LSBCW, AS*18LSBCW

[Condition]

Ambient Indoor / Outdoor - Same temperature temperature

Refrigerant amount Standard amount

Piping length 7.5m (Height difference 1m)

Power voltage 50Hz - 230V

Operation condition TEST mode (Cooling), Hi Fan, Horizontal direction, Front air flow

Measuring method Measure the low pressure with the pressure meter at the service valve. Measure the outdoor unit overall current with the current clamp meter at Power Cable.

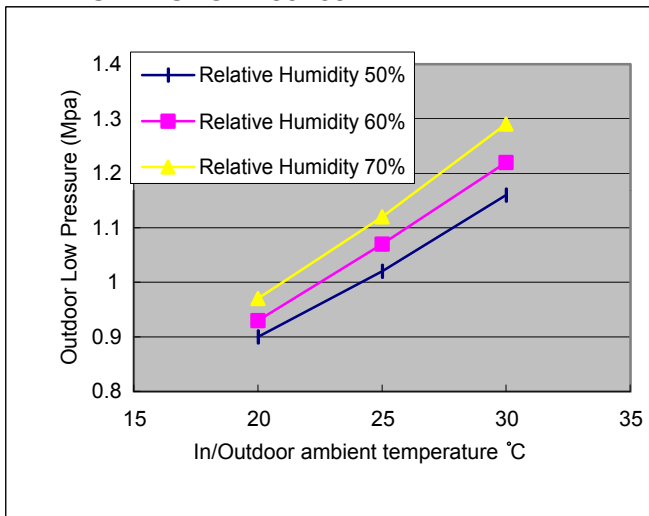
Caution Start operation with the condition of the Indoor Unit air filter clean.

[Constant Frequency Operation Method (Test mode)]

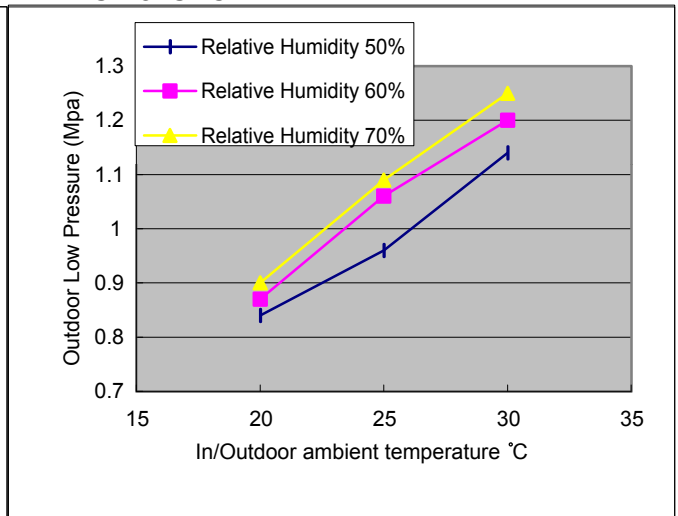
1. Operate on Colling mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automatically.)

(1) Indoor/Outdoor Temperature - Outdoor Low Pressure Curve

AS*14LSBC W series

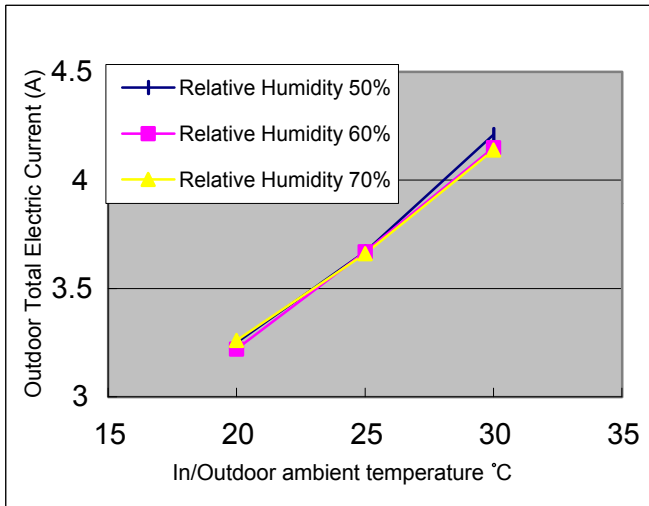


AS*18LSBCW

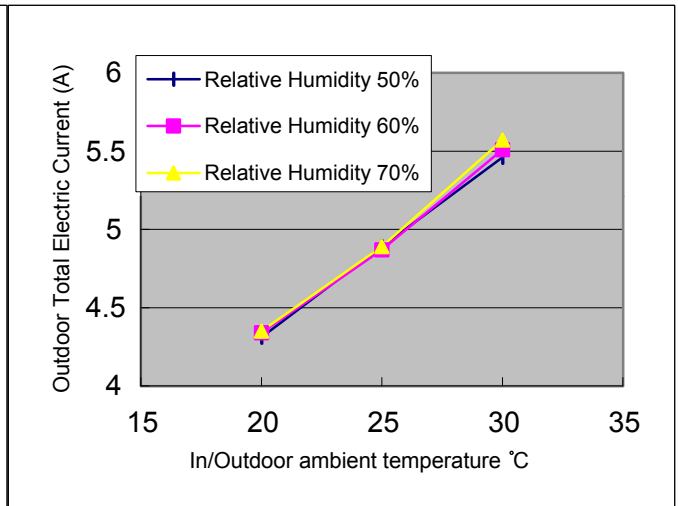


(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*14LSBC W series



AS*18LSBCW



Outdoor Unit High Pressure Value and Outdoor Total Electric Current Curve (Heating)

Model Name : AS*14LSBCW, AS*18LSBCW

[Condition]

Ambient temperature Indoor 15 - 23degC, Outdoor 2 - 12degC

Refrigerant amount Standard amount

Piping length 7.5m (Height difference 1m)

Power voltage 50Hz - 230V

Operation condition TEST mode (Heating), Hi Fan, Lower direction, Front air flow

Measuring method Measure the high pressure with the pressure meter at the service valve. Measure the outdoor unit overall current with the current clamp meter at Power Cable.

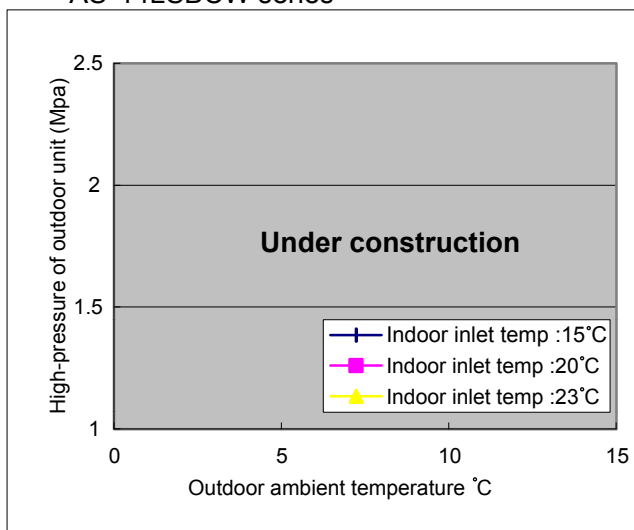
Caution Start operation with the condition of the Indoor Unit air filter clean.

[Constant Frequency Operation Method (Test mode)]

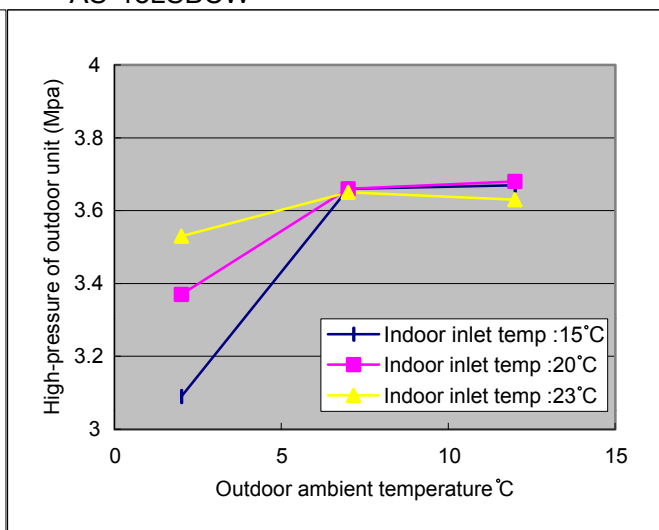
1. Operate on Heating mode, and press TEST button of remote control.
2. Operate continuously for 30 minutes. (After 60 minutes of operation, Test mode is released automatically.)

(1) Indoor/Outdoor Temperature - Outdoor High Pressure Curve

AS*14LSBCW series

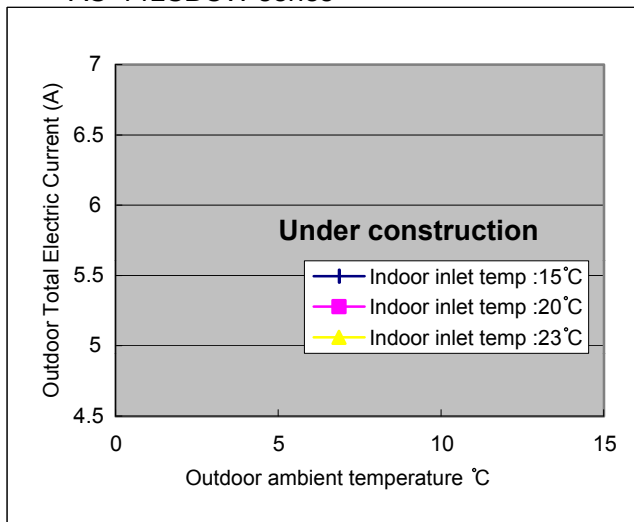


AS*18LSBCW

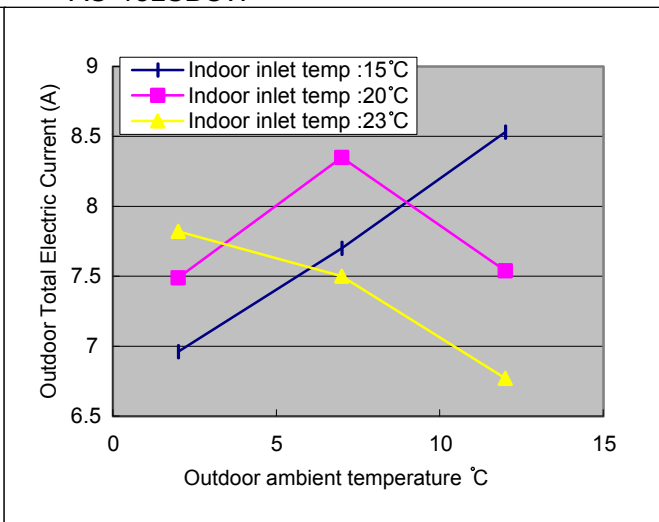


(2) Indoor/Outdoor Temperature - Outdoor Total Electric Current Curve

AS*14LSBCW series



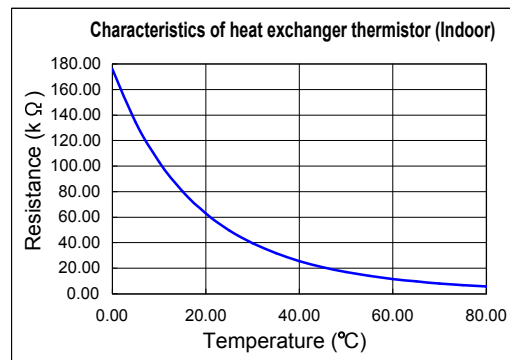
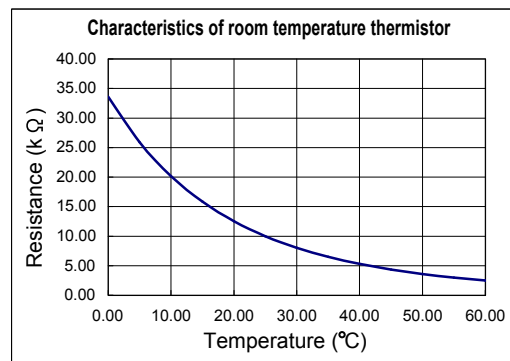
AS*18LSBCW



Thermistor resistance values

Room temperature thermistor		
Temp (°C)	Resistance(k Ω)	Voltage(V)
0.00	33.62	1.15
5.00	25.93	1.39
10.00	20.18	1.66
15.00	15.84	1.94
20.00	12.54	2.22
25.00	10.00	2.50
30.00	8.04	2.77
35.00	6.51	3.03
40.00	5.30	3.27
45.00	4.35	3.48
50.00	3.59	3.68
55.00	2.98	3.85
60.00	2.47	4.00
65.00	2.09	4.14
70.00	1.76	4.25
75.00	1.49	4.35
80.00	1.27	4.44
85.00	1.09	4.51
90.00	0.93	4.57
95.00	0.81	4.63
100.00	0.70	4.67

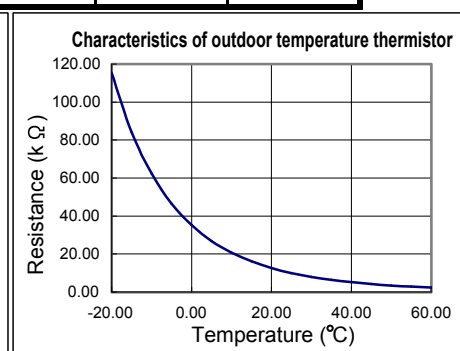
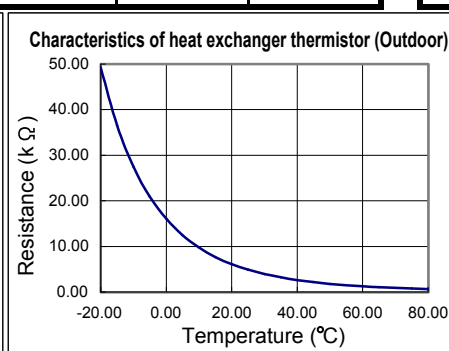
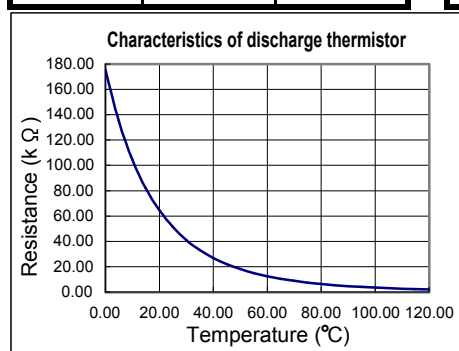
Indoor heat exchanger thermistor		
Temp (°C)	Resistance(k Ω)	Voltage(V)
0.00	176.03	1.10
5.00	134.23	1.36
10.00	103.34	1.63
15.00	80.28	1.92
20.00	62.91	2.21
25.00	49.70	2.51
30.00	39.57	2.79
35.00	31.74	3.06
40.00	25.64	3.30
45.00	20.85	3.53
50.00	17.06	3.73
55.00	14.10	3.90
60.00	11.64	4.55
65.00	9.69	4.19
70.00	8.12	4.30
75.00	6.83	4.40
80.00	5.78	4.48
85.00	4.91	4.55
90.00	4.19	4.61
95.00	3.59	4.66
100.00	3.09	4.71



Discharge thermistor		
Temp (°C)	Resistance(k Ω)	Voltage(V)
0.00	175.70	0.18
5.00	134.93	0.24
10.00	104.59	0.30
15.00	81.79	0.31
20.00	64.50	0.38
25.00	51.27	0.47
30.00	41.07	0.70
35.00	33.13	0.84
40.00	26.91	0.99
45.00	22.01	1.16
50.00	18.10	1.34
55.00	14.98	1.54
60.00	12.47	1.74
65.00	10.44	1.95
70.00	8.78	2.16
75.00	7.42	2.36
80.00	6.31	2.57
85.00	5.38	2.76
90.00	4.61	2.95
95.00	3.97	3.13
100.00	3.43	3.30
105.00	2.98	3.45
110.00	2.59	3.60
115.00	2.26	3.73
120.00	1.99	3.85

Outdoor heat exchanger thermistor		
Temp (°C)	Resistance(k Ω)	Voltage(V)
-20.00	49.20	2.66
-15.00	36.58	3.02
-10.00	27.51	3.35
-5.00	20.91	3.64
0.00	16.05	3.89
5.00	12.44	4.09
10.00	9.73	4.26
15.00	7.67	4.40
20.00	6.10	4.51
25.00	4.89	4.60
30.00	3.95	4.67
35.00	3.21	4.73
40.00	2.62	4.78
45.00	2.16	4.81
50.00	1.79	4.85
55.00	1.49	4.87
60.00	1.25	4.89
65.00	1.05	4.91
70.00	0.89	4.92
75.00	0.76	4.93
80.00	0.65	4.94
85.00	0.56	4.95
90.00	0.48	4.96
95.00	0.41	4.96
100.00	0.36	4.97

Outdoor temperature thermistor		
Temp (°C)	Resistance(k Ω)	Voltage(V)
-20.00	115.24	1.25
-15.00	84.21	1.56
-10.00	62.28	1.90
-5.00	46.58	2.26
0.00	35.21	2.61
5.00	26.88	2.94
10.00	20.72	3.25
15.00	16.12	3.52
20.00	12.64	3.76
25.00	10.00	3.97
30.00	7.97	4.14
35.00	6.40	4.28
40.00	5.18	4.41
45.00	4.21	4.51
50.00	3.45	4.59
55.00	2.85	4.65
60.00	2.36	4.71
65.00	1.97	4.76
70.00	1.65	4.79
75.00	1.39	4.83
80.00	1.18	4.85
85.00	1.00	4.87
90.00	0.85	4.89
95.00	0.73	4.91
100.00	0.63	4.92



WALL MOUNTED type INVERTER

9 . INSTALLATION MANUAL

SPLIT TYPE ROOM AIR CONDITIONER

INSTALLATION MANUAL

(PART NO. 9312557011-01) AS*9/12LSAC

This air conditioner uses new refrigerant HFC (R410A).

The basic installation work procedures are the same as conventional refrigerant (R22) models. However, pay careful attention to the following points:

- (1) Since the working pressure is 1.6 times higher than that of conventional refrigerant(R22) models, some of the piping and installation and service tools are special.(See the table below.) Especially, when replacing a conventional refrigerant(R22) model with a new refrigerant R410A model, always replace the conventional piping and flare nuts with the R410A piping and flare nuts.
- (2) Models that use refrigerant R410A have a different charging port thread diameter to prevent erroneous charging with conventional refrigerant(R22) and for safety. Therefore, check beforehand.[The charging port thread diameter for R410A is 1/2 threads per inch.]
- (3) Be more careful that foreign matter (oil, water, etc.) does not enter the piping than with refrigerant (R22) models. Also, when storing the piping ,securely seal the opening by pinching ,taping, etc.
- (4) When charging the refrigerant, take into account the slight change in the composition of the gas and liquid phases, and always charge from the liquid phase side whose composition is stable.

Special tools for R410A

Tool name	Contents of change
Gauge manifold	Pressure is high and cannot be measured with a conventional gauge. To prevent erroneous mixing of other refrigerants, the diameter of each port has been changed. It is recommended the gauge with seals-0.1 to 5.3 MPa (-1 to 53 bar) for high pressure. -0.1 to 3.8 MPa (-1 to 38 bar) for low pressure.
Charge hose	To increase pressure resistance, the hose material and base size were changed.
Vacuum pump	A conventional vacuum pump can be used by installing a vacuum pump adapter.
Gas leakage detector	Special gas leakage detector for HFC refrigerant R410A.

Copper pipes

It is necessary to use seamless copper pipes and it is desirable that the amount of residual oil is less than 40 mg/10m. Do not use copper pipes having a collapsed, deformed or discolored portion (especially on the interior surface). Otherwise, the expansion valve or capillary tube may become blocked with contaminants.

As an air conditioner using R410A incurs pressure higher than when using R22, it is necessary to choose adequate materials.

Thicknesses of copper pipes used with R410A are as shown in Table1.Never us copper pipes thinner than 0.8mm even when it is available on the market.

Table 1 Thicknesses of Annealed Copper Pipes

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref.] R22
1/4	6.35	0.80	0.80
3/8	9.52	0.80	0.80

⚠ WARNING

- (1) Do not use the existing (for R22) piping and flare nuts.
 - If the existing materials are used, the pressure inside the refrigerant cycle will rise and cause breakage, injury, etc.(Use the special R410A materials.)
- (2) When installing and relocating the air conditioner, do not mix gases other than the specified refrigerant(R410A) to enter the refrigerant cycle.
 - If air or other gas enters the refrigerant cycle, the pressure inside the cycle will rise to an abnormally high value and cause breakage, injury, etc.

SELECTING THE MOUNTING POSITION

Decide the mounting position with the customer as follows:

1. INDOOR UNIT

- (1) Install the indoor unit level on a strong wall which is not subject to vibration.
- (2) The inlet and outlet ports should not be obstructed : the air should be able to blow all over the room.
- (3) Install the unit near an electric outlet or special branch circuit.
- (4) Do not install the unit where it will be exposed to direct sunlight.
- (5) Install the unit where connection to the outdoor unit is easy.
- (6) Install the unit where the drain pipe can be easily installed.
- (7) Take servicing, etc. into consideration and leave the spaces shown in (Fig. 2). Also install the unit where the filter can be removed.

2. OUTDOOR UNIT

- (1) If possible, do not install the unit where it will be exposed to direct sunlight. (If necessary, install a blind that does not interfere with the air flow.)
- (2) Do not install the unit where a strong wind blows or where it is very dusty.
- (3) Do not install the unit where people pass.
- (4) Take you neighbors into consideration so that they are not disturbed by air blowing into their windows or by noise.
- (5) Provide the space shown in Fig. 2 so that the air flow is not blocked. Also for efficient operation, leave open three of the four directions front, rear, and both sides.

⚠ WARNING

Install at a place that can withstand the weight of the indoor and outdoor units and install positively so that the units will not topple or fall.

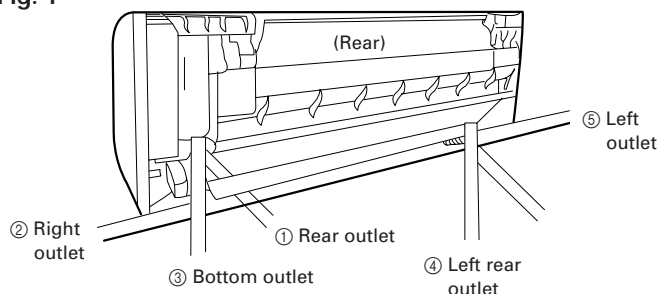
⚠ CAUTION

- (1) Do not install where there is the danger of combustible gas leakage.
- (2) Do not install near heat sources.
- (3) If children under 10 years old may approach the unit, take preventive measures so that they cannot reach the unit.
- (4) Install the indoor unit on the wall where the height from the floors more than 230 cm.

[Indoor unit piping direction]

The piping can be connected in the five directions indicated by ①, ②, ③, ④, and ⑤ in (Fig. 1). When the piping is connected in direction ② or ⑤, cut along the piping groove in the side of the front cover with a hacksaw. When connecting the piping in direction ③, cut a notch in the thin wall at the front bottom of the front cover.

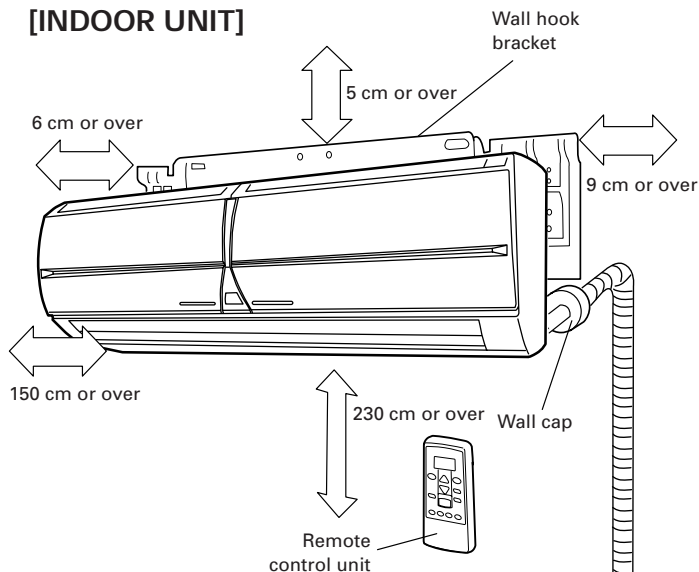
Fig. 1



INSTALLATION DIAGRAM OF INDOOR AND OUTDOOR UNITS

Fig. 2

[INDOOR UNIT]



Connection Cord

Conform to Type245 IEC57

[OUTDOOR UNIT]

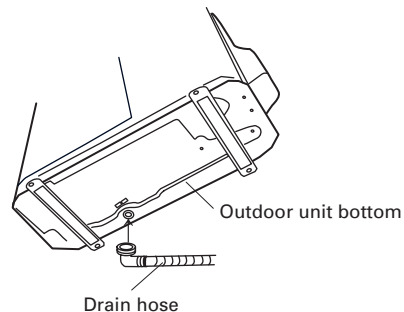
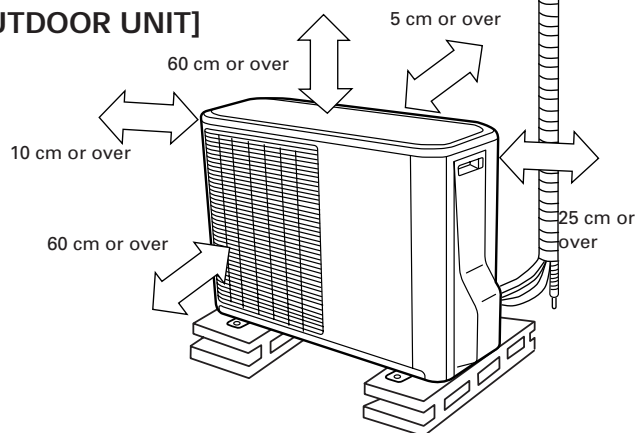
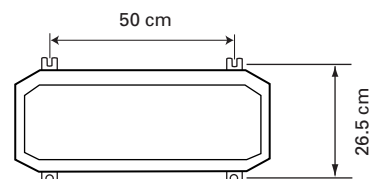


Fig. 3



For authorized service personnel only.

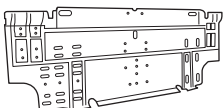
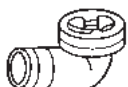
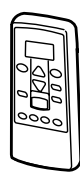
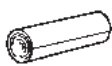
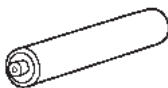

⚠ WARNING

- (1) For the room air conditioner to operate satisfactory, install it as outlined in this installation manual.
- (2) Connect the indoor unit and outdoor unit with the air conditioner piping and cords available standards parts. This installation manual describes the correct connections using the standard accessories and the parts specified in this installation manual.
- (3) Have installation work done by authorized service personnel only.
- (4) Never cut the power cord, lengthen or shorten the cord, or change the plug.
- (5) Also do not use an extension cord.
- (6) Plug in the power cord plug firmly. If the receptacle is loose, repair it before using the room air conditioner.
- (7) Do not turn on the power until all installation work is complete.

- Be careful not to scratch the air conditioner when handling it.
- After installation, explain correct operation to the customer, using the operating manual.
- Let the customer keep this installation manual because it is used when the air conditioner is serviced or moved.
- The maximum length of the piping is 15 m. The maximum height difference of the piping is 8 m, if the units are further apart than these, correct operation can not be guaranteed.

STANDARD ACCESSORIES

The following installation accessories are supplied.
Use them as required.

Name and Shape	Q'ty	Name and Shape	Q'ty
Wall hook bracket 	1	Drain pipe 	1
Remote control unit 	1	Cloth tape 	1
Battery 	2	Tapping screw (big) (ø4 X 20) 	8

One set of following parts are necessary in installation of this product.

Name
Connection pipe assembly
Connection cord
Wall pipe
Decorative tape
Vinyl tape
Wall cap
Saddle
Drain hose
Tapping screws
Sealant

ELECTRICAL REQUIREMENT

Always make the air conditioner power supply a special branch circuit and provide a special switch and receptacle. Do not extend the power cord.

OUTDOOR UNIT

OUTDOOR UNIT INSTALLATION

- Set the unit on a strong stand, such as one made of concrete blocks to minimize shock and vibration.
- Do not set the unit directly on the ground because it will cause trouble.

Connector cover removal

- Remove the two mounting screws.

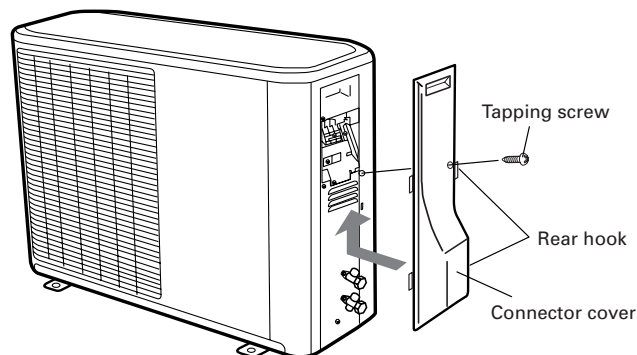
Installing the connector cover

- (1) After inserting the three front hooks, then insert the rear hook.
- (2) Tighten the two mounting screws.

⚠ WARNING

- (1) Install the unit where it will not be tilted by more than 5°.
- (2) When installing the outdoor unit where it may be exposed to strong wind, fasten it securely.

Fig. 10



AIR PURGE

Always use a vacuum pump to purge the air.
Refrigerant for purging the air is not charged in the outdoor unit at the factory.

Close the high pressure side valve of the gauge manifold fully and do not operate it during the following work.

1. Check if the piping connections are secure.
2. Check that the stems of 2-way valve and 3-way valve are closed fully.
3. Connect the gauge manifold charge hose to the charging port of the 3-way valve (side with the projection for pushing in the valve core).
4. Open the low pressure side valve of the gauge manifold fully.
5. Operate the vacuum pump and start pump down.
6. Slowly loosen the flare nut of the 3-way valve and check if air enters, then retighten the flare nut. (When the flare nut is loosened the operating sound of the vacuum pump changes and the reading of the compound pressure gauge goes from minus to zero.)
7. Pump down the system for at least 15 minutes, then check if the compound pressure gauge reads -0.1 MPa (-76 cmHg, -1 bar).
8. At the end of pump down, close the low pressure side gauge of the gauge manifold fully and stop the vacuum pump.
9. Slowly loosen the valve stem of the 3-way valve. When the compound pressure gauge reading reaches 0.1-0.2 MPa, retighten the valve stem and disconnect the charge hose from the 3-way valve charging port. (If the stem of the 3-way valve is opened fully before the charge hose is disconnected, it may be difficult to disconnect the charge hose.)

⚠ CAUTION

- (1) Refrigerant must not be discharged into atmosphere.
- (2) After connecting the piping, check the joints for gas leakage with gas leak detector.

10. Fully open the valve stems of the 2-way valve and 3-way valve using a hexagon wrench. (After the valve stem begins to turn, turn it with a torque of less than 2.9 N·m (30 kgf·cm) until it stops turning.)

11. Firmly tighten the 2-way valve and 3-way valve blank cap and the charging port cap.

Fig. 11

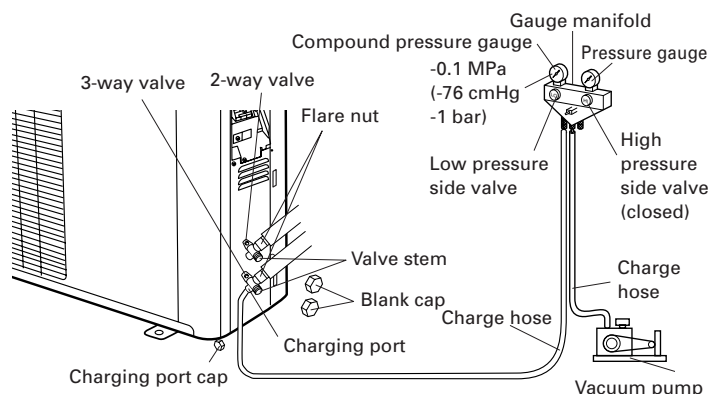


Table 4

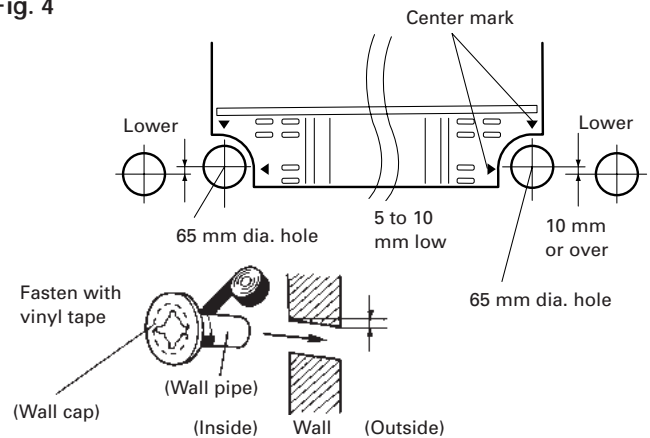
	Tightening torque
Blank cap	19.6 to 24.5 N·m (200 to 250 kgf·cm)
Charging port cap	12.3 to 15.7 N·m (125 to 160 kgf·cm)

INDOOR UNIT

CUTTING THE HOLE IN THE WALL FOR THE CONNECTING PIPING

- (1) Cut a 65 mm diameter hole in the wall at the position shown in (Fig. 4).
- (2) When cutting the wall hole at the inside of the installation frame, cut the hole within the range of the left and right center marks 40 mm below the installation frame.
When cutting the wall hole at the outside of the installation frame, cut the hole at least 10 mm below over.
- (3) Cut the hole so that the outside end is lower (5 to 10 mm) than the inside end.
- (4) Always align the center of the wall hole. If misaligned, water leakage will occur.
- (5) Cut the wall pipe to match the wall thickness, stick it into the wall cap, fasten the cap with vinyl tape, and stick the pipe through the hole. (The connection pipe is supplied in the installation set.) (Fig. 4)
- (6) For left piping and right piping, cut the hole a little lower so that drain water will flow freely. (Fig. 4)

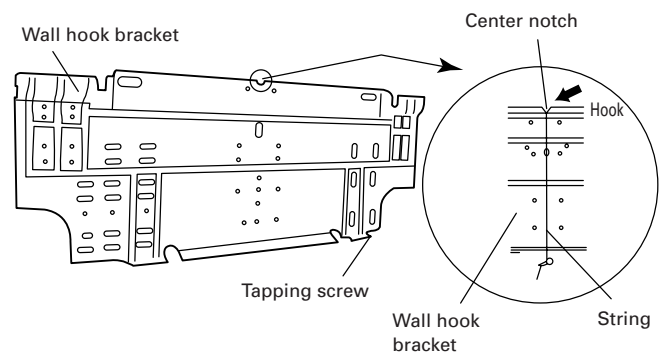
Fig. 4



INSTALLING THE WALL HOOK BRACKET

- (1) Install the wall hook bracket so that it is correctly positioned horizontally and vertically. If the wall hook bracket is tiled, water will drip to the floor.
- (2) Install the wall hook bracket so that it is strong enough to withstand the weight of an adult.
 - Fasten the wall hook bracket to the wall with 6 or more screws through the holes near the outer edge of the bracket.
 - Check that there is no rattle at the wall hook bracket.

Fig. 5



⚠ WARNING

If the wall pipe is not used, the cord interconnecting the indoor and outdoor units may touch metal and cause electric leakage.

⚠ CAUTION

Install the wall hook bracket horizontally and perpendicularly.

FORMING THE DRAIN HOSE AND PIPE

[Rear piping, Right piping, Bottom piping]

- Install the indoor unit piping in the direction of the wall hole and bind the drain hose and pipe together with vinyl tape. (Fig. 6)
- Install the piping so that the drain hose is at the bottom.
- Wrap the pipes of the indoor unit that are visible from the outside with decorative tape.

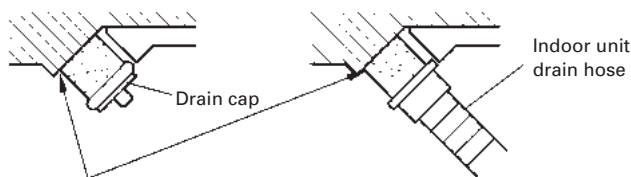
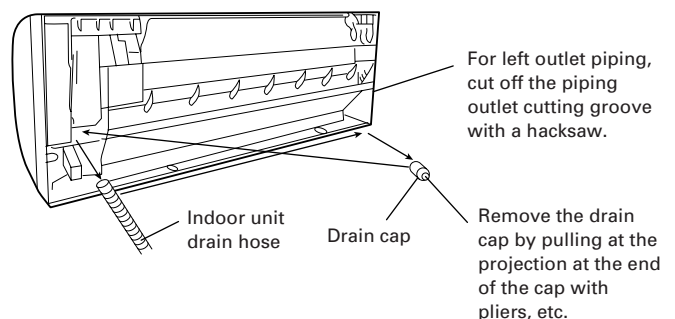
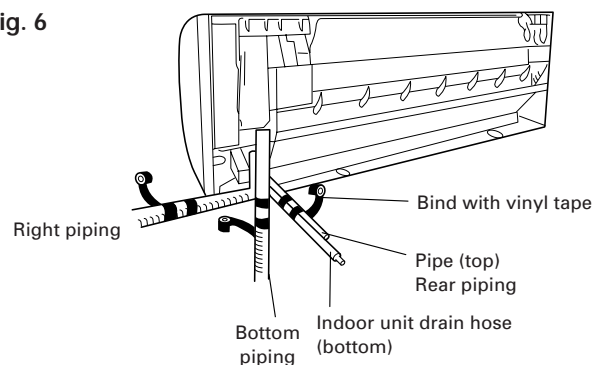
[For Left rear piping, Left piping]

Interchange the drain cap and the drain hose.

⚠ CAUTION

After removing the drain hose, do not forget to install the drain cap.

Fig. 6



Insert the drain cap and drain hose until it butts against the drain port.

- For left piping and left rear piping, align the marks on the wall hook bracket and shape the connection pipe.
- Bend the connection piping at the bend radius of 70 mm or more and install no more than 35 mm from the wall.
- After passing the indoor piping and drain hose through the wall hole, hang the indoor unit on the hooks at the top and bottom of the wall hook bracket.

[Installing the indoor unit]

- Hang the indoor unit from the hooks at the top of the wall hook bracket.
- Insert the spacer, etc. between the indoor unit and the wall hook bracket and separate the bottom of the indoor unit from the wall.

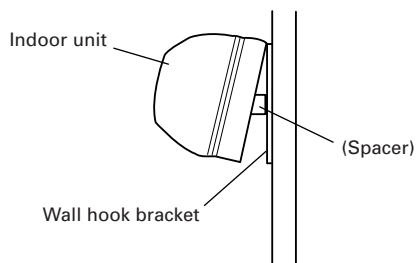
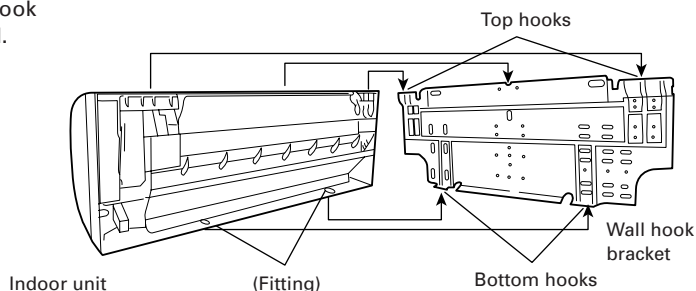
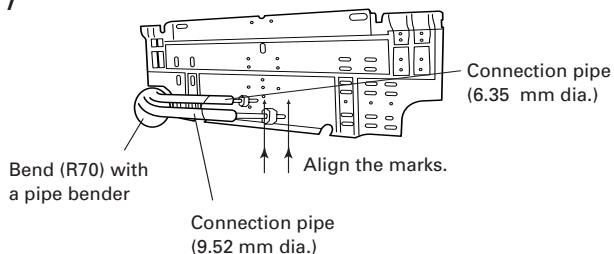


Fig. 7



After hooking the indoor unit to the top hook, hook the fittings of the indoor unit to the two bottom hooks while lowering the unit and pushing it against the wall.

CONNECTING THE PIPING

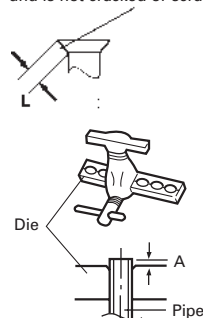
CONNECTION

- (1) Install the outdoor unit wall cap (supplied with the optional installation set or procured at the site) to the wall pipe.
- (2) Connect the outdoor unit and indoor unit piping.
- (3) After matching the center of the flare surface and tightening the nut hand tight, tighten the nut to the specified tightening torque with a torque wrench. (Table 2)

FLARING

- (1) Cut the connection pipe to the necessary length with a pipe cutter.
- (2) Hold the pipe downward so that cuttings will not enter the pipe and remove the burrs.
- (3) Insert the flare nut onto the pipe and flare the pipe with a flaring tool.

Check if [L] is flared uniformly and is not cracked or scratched.



Insert the flare nut (always use the flare nut attached to the indoor and outdoor units respectively) onto the pipe and perform the flare processing with a flare tool. Use the special R410A flare tool, or the conventional (for R22) flare tool.

When using the conventional flare tool, always use an allowance adjustment gauge and secure the A dimension shown in table 3.

Fig. 8

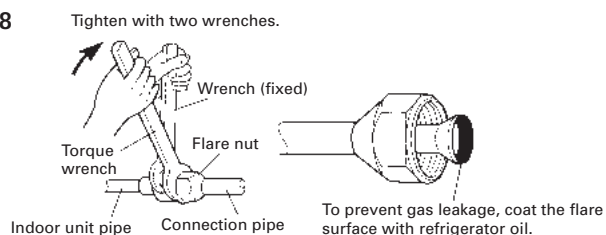


Table 2 Flare nut tightening torque

Flare nut	Tightening torque	Tightening torque standard (using a 20 cm wrench)
6.35 mm dia.	15.7 to 17.6 N·m (160 to 180 kgf·cm)	Wrist strength
9.52 mm dia.	29.4 to 41.1 N·m (300 to 420 kgf·cm)	Arm strength

Table 3 Pipe outside diameter

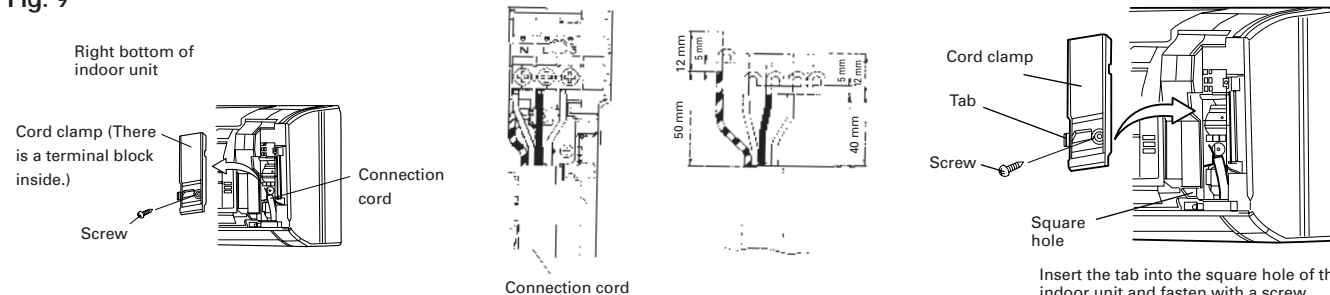
Pipe outside diameter	Flash tool for R410A, clutch type	A (mm)	
		Conventional (R22) flare tool	
		Clutch type	Wing nut type
ø 6.35 mm (1/4")	0 to 0.5	1.0 to 1.5	1.5 to 2.0
ø 9.52 mm (3/8")	0 to 0.5	1.0 to 1.5	1.5 to 2.0

INDOOR UNIT WIRING

- (1) Remove the cord clamp.
- (2) Bend the end of the connection cord as shown in the figure.

- (3) Connect the end of the connection cord fully into the terminal block.
- (4) Fasten the connection cord with a cord clamp.

Fig. 9



CAUTION

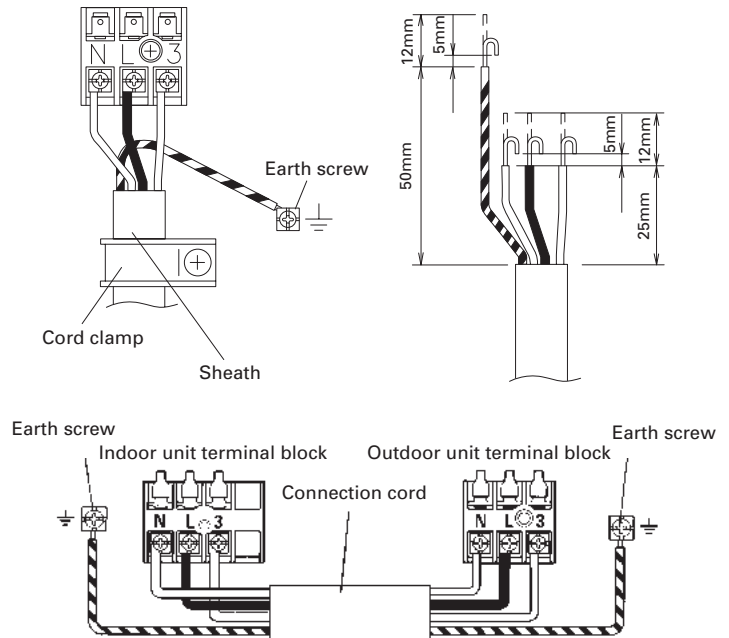
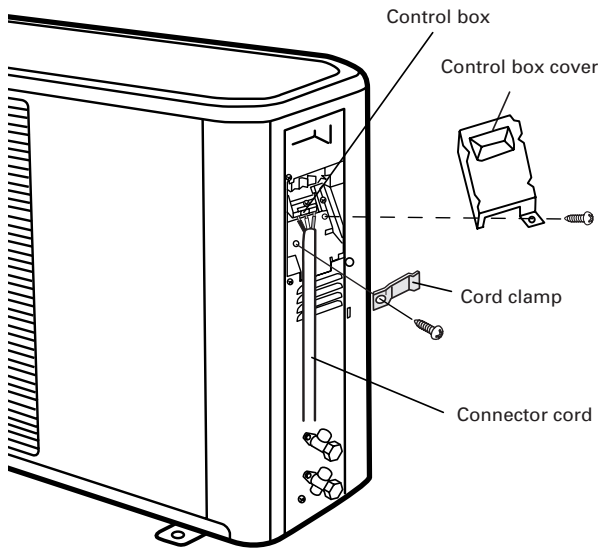
- | | |
|---|--|
| (1) Match the terminal block numbers and connection cord colors with those of the outdoor unit. Erroneous wiring may cause burning of the electric parts. | (3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.) |
| (2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire. | (4) Securely earth the power cord plug. |
| | (5) Do not use the earth screw for an external connector. Only use for interconnection between two units. |

OUTDOOR UNIT WIRING

- (1) Remove the outdoor unit connector cover.
- (2) Remove the control box cover.
- (3) Bend the end of the cord as shown in the figure.
- (4) Connect the end of the connection cord fully into the terminal block.

- (5) Fasten the sheath with a cord clamp.
- (6) Install the control box cover.
- (7) Install the connector cover.

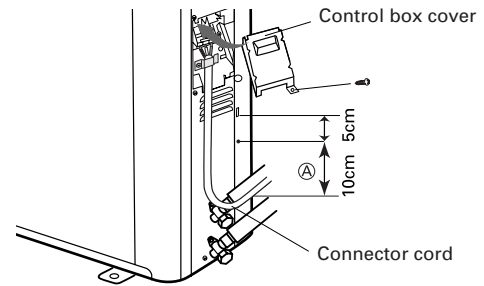
Fig. 12



Connection cord wiring

Run the connection cord to the rear of the outdoor unit within the range of the arrows shown in the figure.
(The connector cover becomes difficult to install.)

Fig. 13



CAUTION

- | | |
|--|---|
| <p>(1) Match the terminal block numbers and connection cord colors with those of the indoor unit. Erroneous wiring may cause burning of the electric parts.</p> <p>(2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire.</p> | <p>(3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.)</p> <p>(4) Securely earth the power cord plug.</p> <p>(5) Do not use the earth screw for an external connector. Only use for interconnection between two units.</p> |
|--|---|

FINISHING

- (1) Insulate between pipes.
 - For rear, right, and bottom piping, overlap the connection pipe heat insulation and indoor unit pipe heat insulation and bind them with vinyl tape so that there is no gap.
 - For left and left rear piping, butt the connection pipe heat insulation and indoor unit pipe heat insulation together and bind them with and vinyl tape so that there is no gap.
 - For left and left rear piping, wrap the area which accommodates the rear piping housing section with cloth tape.
 - For left and left rear piping, bind the connection cord to the top of the pipe with vinyl tape.
 - For left and left rear piping, bundle the piping and drain hose together by wrapping them with cloth tape over the range within which they fit into the rear piping housing section.
- (2) Temporarily fasten the connection cord along the connection pipe with vinyl tape. (Wrap to about 1/3 the width of the tape from the bottom of the pipe so that water does not enter.)
- (3) Fasten the connection pipe to the outside wall with saddles, etc.
- (4) Fill the gap between the outside wall pipe hole and the pipe with sealer so that rain water and wind cannot blow in.
- (5) Fasten the drain hose to the outside wall, etc.

Fig. 15

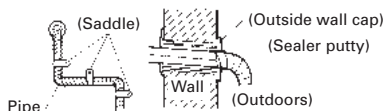
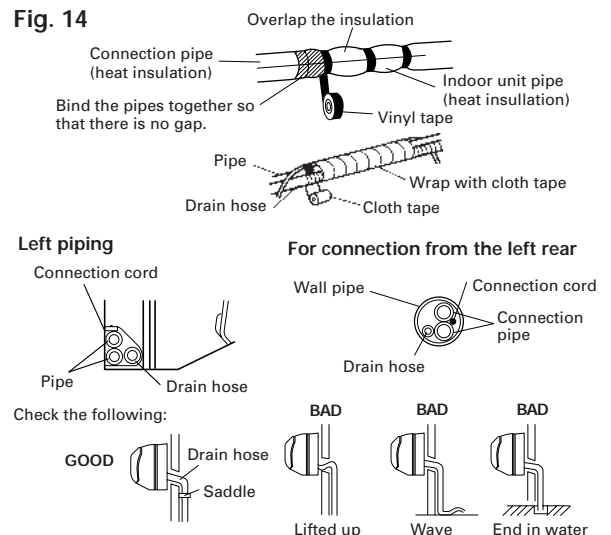


Fig. 14



FRONT PANEL REMOVAL AND INSTALLATION

THE OPEN PANEL

- (1) Pull the Open Panel to 90° ahead of you, then open it.
- (2) Pull down the knob.
- (3) Lift the intake grille upward.

THE OPEN PANEL INSTALLATION

- (1) Pull the Open Panel to 90° ahead of you, insert the mounting shafts into the hole of the hinge and install it.
- (2) Close the Open Panel.

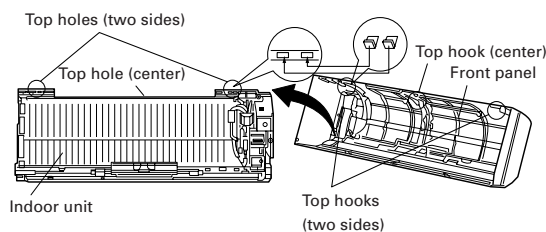
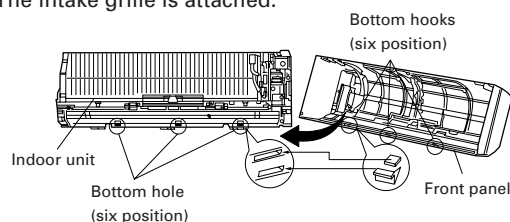
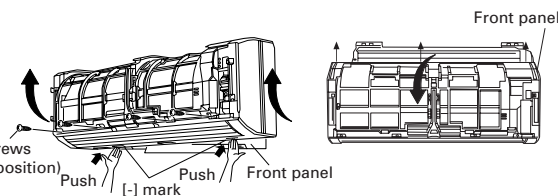
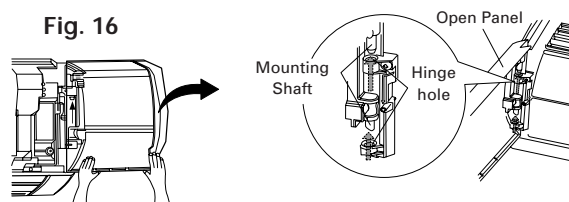
THE FRONT PANEL REMOVAL

- (1) Remove intake grille (Reference the intake grille removal.)
- (2) Remove four screws.
- (3) The thumb is hung on the lower part as shown in the figure, and it pulls to the front, pushing [-] mark, and bottom hooks (two position) is removed from wall hook bracket.
- (4) The front panel bottom is pulled to the front, and bottom hooks is removed indoor unit.
- (5) The front panel is pulled to the front, raising the upper surface, and a front panel is removed.

THE FRONT PANEL INSTALLATION

- (1) Firstly, fit the lower part of the front panel, and insert top and bottom hooks. (Three top sides, six bottom sides)
- (2) Four screws is attached.
- (3) The intake grille is attached.

Fig. 16



CAUTION

Install the front panel and intake grille securely. If installation is imperfect, the front panel or intake grille may fall off and cause injury.

Be sure that the top hole of the front panel is hooked securely to the hook of the base.

CUSTOMER GUIDANCE

Explain the following to the customer in accordance with the operating manual:

- (1) Starting and stopping method, operation switching, temperature adjustment, timer, air flow switching, and other remote control unit operations.
- (2) Air filter removal and cleaning, and how to use the air louvers.
- (3) Give the operating and installation manuals to the customer.

TEST RUNNING

- Perform test operation and check items 1 and 2 below.
- For the test operation method, refer to the operating manual.
- The outdoor unit, may not operate, depending on the room temperature. In this case, press the test run button on the remote control unit while the air conditioner is running. (Point the transmitter section of the remote control unit toward the air conditioner and press the test run button with the tip of a ball-point pen, etc.)
- To end test operation, press the remote control unit START/STOP button. (When the air conditioner is run by pressing the test run button, the OPERATION indicator lamp and TIMER indicator lamp will simultaneously flash slowly.)

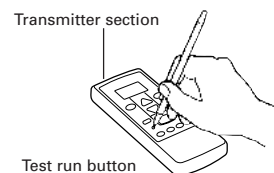
1. INDOOR UNIT

- (1) Is operation of each button on the remote control unit normal?
- (2) Does each lamp light normally?
- (3) Do the air flow-direction louver operate normally?
- (4) Is the drain normal?

2. OUTDOOR UNIT

- (1) Is there any abnormal noise and vibration during operation?
- (2) Will noise, wind, or drain water from the unit disturb the neighbors?
- (3) Is there any gas leakage?

Fig. 17



POWER

WARNING

- (1) The rated voltage of this product is 230 V AC 50 Hz.
- (2) Before turning on the power, check if the voltage is within the 220 V -10 % to 240 V +10 % range.
- (3) Always use a special branch circuit and install a special receptacle to supply power to the room air conditioner.
- (4) Use a circuit breaker and receptacle matched to the capacity of the air conditioner.
- (5) Do not extend the power cord.
- (6) Perform wiring work in accordance with standards so that the air conditioner can be operated safely and positively.
- (7) Install a leakage circuit breaker in accordance with the related laws and regulations and electric company standards.

CAUTION

- (1) The power source capacity must be the sum of the air conditioner current and the current of other electrical appliances. When the current contracted capacity is insufficient, change the contracted capacity.
- (2) When the voltage is low and the air conditioner is difficult to start, contact the power company the voltage raised.

NOTE: These equipment shall be connected to a suitable mains network with a main impedance less than the following: 0.424Ω
The product is intended for use only in premises having a service current capacity ≥ 100A per phase, supplied from a distribution network having a nominal voltage of 230 V, and instruct the user to determine in consultation with the supply authority, if necessary, that the service current capacity at the interface point is sufficient for the equipment.

SPLIT TYPE ROOM AIR CONDITIONER

INSTALLATION MANUAL

(PART NO. 9313209018-01) AS*9/12LSBC

This air conditioner uses new refrigerant HFC (R410A).

The basic installation work procedures are the same as conventional refrigerant (R22) models. However, pay careful attention to the following points:

(1) Since the working pressure is 1.6 times higher than that of conventional refrigerant (R22) models, some of the piping and installation and service tools are special.(See the table below.)
Especially, when replacing a conventional refrigerant (R22) model with a new refrigerant R410A model, always replace the conventional piping and flare nuts with the R410A piping and flare nuts.

(2) Models that use refrigerant R410A have a different charging port thread diameter to prevent erroneous charging with conventional refrigerant (R22) and for safety. Therefore, check beforehand.[The charging port thread diameter for R410A is 1/2 threads per inch.]

(3) Be more careful that foreign matter (oil, water, etc.) does not enter the piping than with refrigerant (R22) models. Also, when storing the piping ,securely seal the opening by pinching ,taping, etc.

(4) When charging the refrigerant, take into account the slight change in the composition of the gas and liquid phases, and always charge from the liquid phase side whose composition is stable.

Special tools for R410A

Tool name	Contents of change
Gauge manifold	Pressure is high and cannot be measured with a conventional gauge. To prevent erroneous mixing of other refrigerants, the diameter of each port has been changed. It is recommended the gauge with seals-0.1 to 5.3 MPa (-1 to 53 bar) for high pressure. -0.1 to 3.8 MPa (-1 to 38 bar) for low pressure.
Charge hose	To increase pressure resistance, the hose material and base size were changed.
Vacuum pump	A conventional vacuum pump can be used by installing a vacuum pump adapter.
Gas leakage detector	Special gas leakage detector for HFC refrigerant R410A.

Copper pipes

It is necessary to use seamless copper pipes and it is desirable that the amount of residual oil is less than 40 mg/10m. Do not use copper pipes having a collapsed, deformed or discolored portion (especially on the interior surface). Otherwise, the expansion value or capillary tube may become blocked with contaminants.

As an air conditioner using R410A incurs pressure higher than when using R22, it is necessary to choose adequate materials. Thicknesses of copper pipes used with R410A are as shown in Table1.Never us copper pipes thinner than 0.8mm even when it is available on the market.

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref.] R22
1/4	6.35	0.80	0.80
3/8	9.52	0.80	0.80

⚠ WARNING

(1) Do not use the existing (for R22) piping and flare nuts.

- If the existing materials are used, the pressure inside the refrigerant cycle will rise and cause breakage, injury, etc.(Use the special R410A materials.)

(2) When installing and relocating the air conditioner, do not mix gases other than the specified refrigerant(R410A) to enter the refrigerant cycle.

- If air or other gas enters the refrigerant cycle, the pressure inside the cycle will rise to an abnormally high value and cause breakage, injury, etc.

SELECTING THE MOUNTING POSITION

- Decide the mounting position with the customer as follows:
- ### 1. INDOOR UNIT
- (1) Install the indoor unit level on a strong wall which is not subject to vibration.

(2) The inlet and outlet ports should not be obstructed : the air should be able to blow all over the room.

(3) Install the unit near an electric outlet or special branch circuit.

(4) Do not install the unit where it will be exposed to direct sunlight.

(5) Install the unit where connection to the outdoor unit is easy.

(6) Install the unit where the drain pipe can be easily installed.

(7) Take servicing, etc. into consideration and leave the spaces shown in (Fig. 2). Also install the unit where the filter can be removed.
- ### 2. OUTDOOR UNIT
- (1) If possible, do not install the unit where it will be exposed to direct sunlight. (If necessary, install a blind that does not interfere with the air flow.)

(2) Do not install the unit where a strong wind blows or where it is very dusty.

(3) Do not install the unit where people pass.

(4) Take you neighbors into consideration so that they are not disturbed by air blowing into their windows or by noise.

(5) Provide the space shown in Fig. 2 so that the air flow is not blocked. Also for efficient operation, leave open three of the four directions front, rear, and both sides.

⚠ WARNING

Install at a place that can withstand the weight of the indoor and outdoor units and install positively so that the units will not topple or fall.

⚠ CAUTION

(1) Do not install where there is the danger of combustible gas leakage.

(2) Do not install near heat sources.

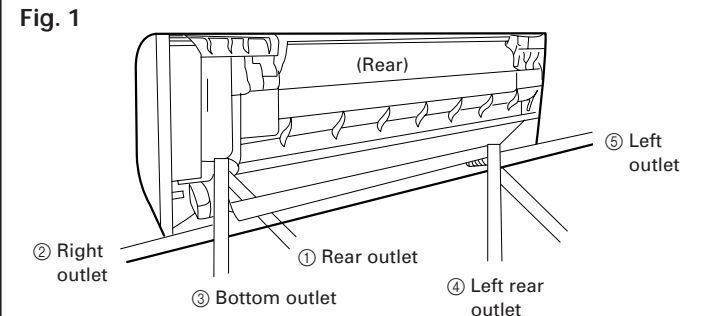
(3) If children under 10 years old may approach the unit, take preventive measures so that they cannot reach the unit.

(4) Install the indoor unit on the wall where the height from the floors more than 230 cm.

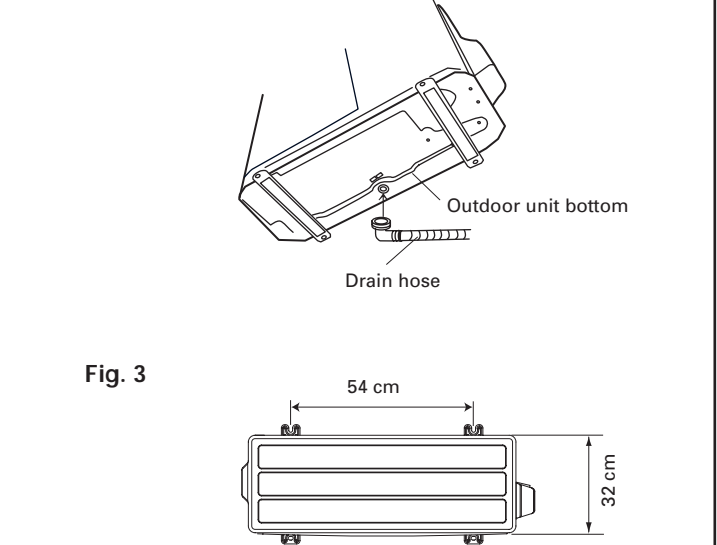
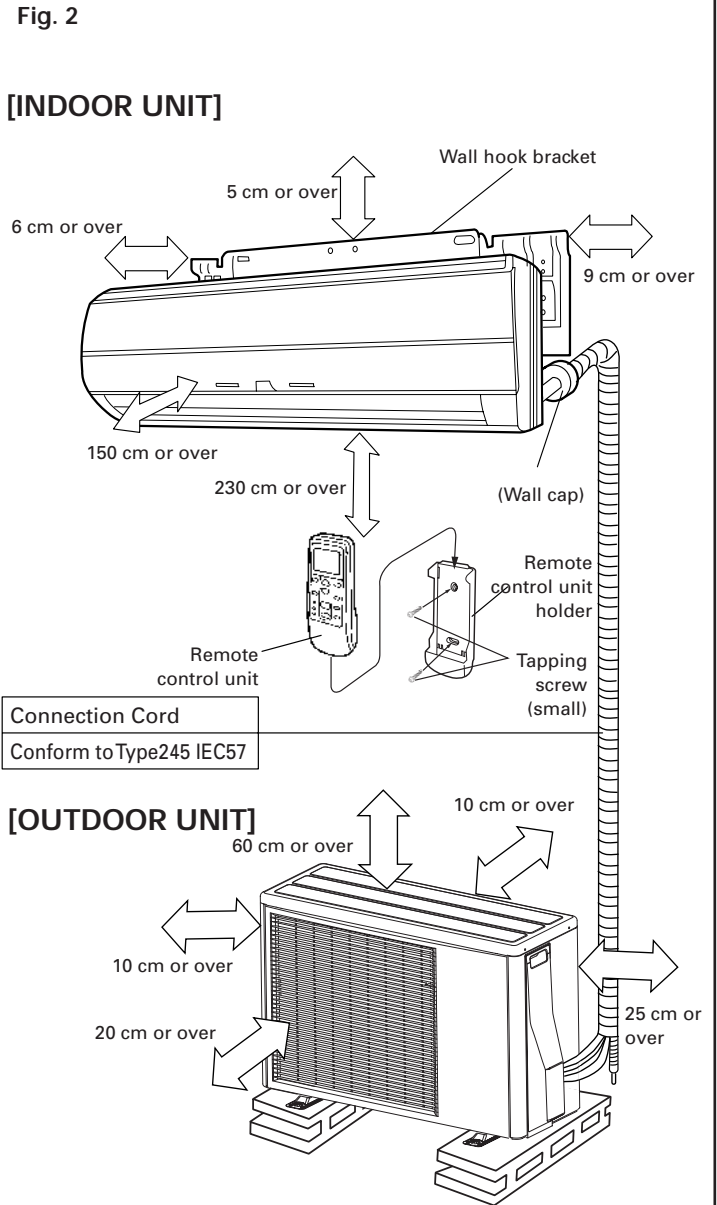
[Indoor unit piping direction]

The piping can be connected in the five directions indicated by ①, ②, ③, ④, and ⑤ in (Fig. 1). When the piping is connected in direction ② or ③, cut along the piping groove in the side of the front cover with a hacksaw.

When connecting the piping in direction ③, cut a notch in the thin wall at the front bottom of the front cover.



INSTALLATION DIAGRAM OF INDOOR AND OUTDOOR UNITS



For authorized service personnel only.

⚠ WARNING

(1) For the room air conditioner to operate satisfactory, install it as outlined in this installation manual.

(2) Connect the indoor unit and outdoor unit with the air conditioner piping and cords available standards parts. This installation manual describes the correct connections using the standard accessories and the parts specified in this installation manual.

(3) Have installation work done by authorized service personnel only.

(4) Never cut the power cord, lengthen or shorten the cord, or change the plug.

(5) Also do not use an extension cord.

(6) Plug in the power cord plug firmly. If the receptacle is loose, repair it before using the room air conditioner.

(7) Do not turn on the power until all installation work is complete.

- Be careful not to scratch the air conditioner when handling it.
- After installation, explain correct operation to the customer, using the operating manual.
- Let the customer keep this installation manual because it is used when the air conditioner is serviced or moved.
- The maximum length of the piping is 20 m. The maximum height difference of the piping is 15 m, if the units are further apart than these, correct operation can not be guaranteed.

STANDARD ACCESSORIES

The following installation accessories are supplied. Use them as required.

Name and Shape	Q'ty	Name and Shape	Q'ty
Wall hook bracket	1	Cloth tape	1
Remote control unit	1	Tapping screw (big)	8
Battery	2	Tapping screw (small)	2
Remote control unit holder	1	Air cleaning filter	2
Drain pipe	1	Air cleaning filter frame	2

One set of following parts are necessary in installation of this product.

Name
Connection pipe assembly
Connection cord
Wall pipe
Decorative tape
Vinyl tape
Wall cap
Saddle
Drain hose
Tapping screws
Sealant

ELECTRICAL REQUIREMENT

Always make the air conditioner power supply a special branch circuit and provide a special switch and receptacle. Do not extend the power cord.

FRONT PANEL REMOVAL AND INSTALLATION

- #### THE INTAKE GRILLE REMOVAL
- (1) Open the intake grille.

(2) Pull down the knob.

(3) Lift the intake grille upward, until the axle at the top of the intake grille is removed.
- #### THE INTAKE GRILLE INSTALLATION
- (1) The fixing axle of the intake grille is installed on the Panel.

(2) Lay down the intake grille.
- #### THE FRONT PANEL REMOVAL
- (1) Remove intake grille (Reference the intake grille removal.)

(2) Remove four screws.

(3) The thumb is hung on the lower part as shown in the figure, and it pulls to the front, pushing [-] mark , and bottom hooks (two position) is removed from wall hook bracket.

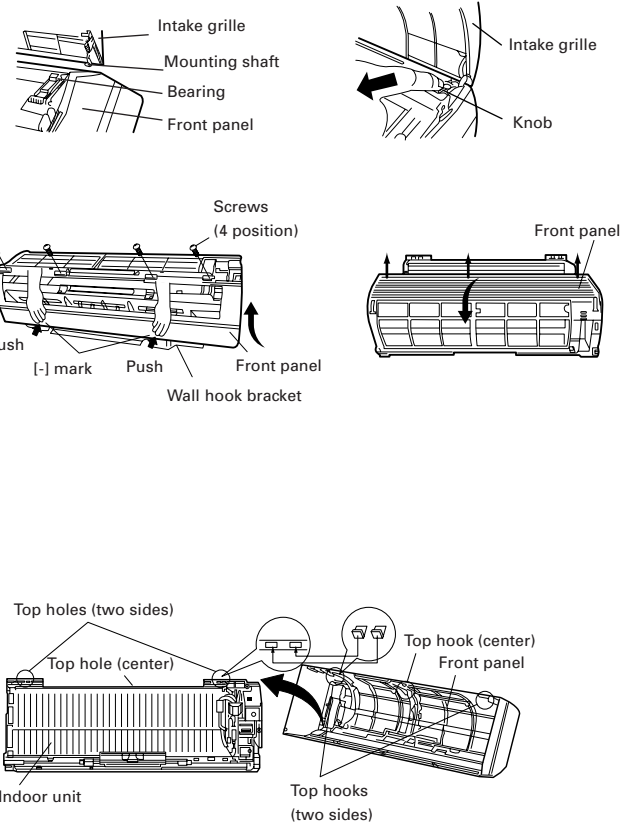
(4) The front panel bottom is pulled to the front, and bottom hooks is removed indoor unit.

(5) The front panel is pulled to the front, raising the upper surface, and a front panel is removed.
- #### THE FRONT PANEL INSTALLATION
- (1) Firstly, fit the lower part of the front panel, and insert top and bottom hooks. (Three top sides, six bottom sides)

(2) Four screws is attached.

(3) The intake grille is attached.

Fig. 4



⚠ CAUTION

Install the front panel and INTAKE GRILLE securely. If installation is imperfect, the front panel or INTAKE GRILLE may fall off and cause injury.

Be sure that the top hole of the front panel is hooked securely to the hook of the base.

CUSTOMER GUIDANCE

Explain the following to the customer in accordance with the operating manual:

(1) Starting and stopping method, operation switching, temperature adjustment, timer, air flow switching, and other remote control unit operations.

(2) Air filter removal and cleaning, and how to use the air louvers.

(3) Give the operating and installation manuals to the customer.

TEST RUNNING

- Perform test operation and check items 1 and 2 below.
 - For the test operation method, refer to the operating manual.
 - The outdoor unit, may not operate, depending on the room temperature. In this case, press the test run button on the remote control unit while the air conditioner is running, (Point the transmitter section of the remote control unit toward the air conditioner and press the test run button with the tip of a ball-point pen, etc.)
 - To end test operation, press the remote control unit START/STOP button. (When the air conditioner is run by pressing the test run button, the OPERATION indicator lamp and TIMER indicator lamp will simultaneously flash slowly.)
1. INDOOR UNIT

(1) Is operation of each button on the remote control unit normal?

(2) Does each lamp light normally?

(3) Do the air flow-direction louver operate normally?

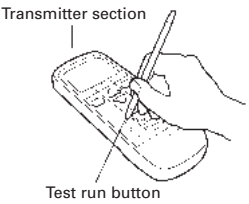
(4) Is the drain normal?

2. OUTDOOR UNIT

(1) Is there any abnormal noise and vibration during operation?

(2) Will noise, wind, or drain water from the unit disturb the neighbors?

(3) Is there any gas leakage?
- Fig. 5



POWER

⚠ WARNING

(1) The rated voltage of this product is 230 V AC 50 Hz.

(2) Before turning on the power, check if the voltage is within the 220 V -10 % to 240 V +10 % range.

(3) Always use a special branch circuit and install a special receptacle to supply power to the room air conditioner.

(4) Use a circuit breaker and receptacle matched to the capacity of the air conditioner.

(5) Do not extend the power cord.

(6) Perform wiring work in accordance with standards so that the air conditioner can be operated safely and positively.

(7) Install a leakage circuit breaker in accordance with the related laws and regulations and electric company standards.

⚠ CAUTION

(1) The power source capacity must be the sum of the air conditioner current and the current of other electrical appliances. When the current contracted capacity is insufficient, change the contracted capacity.

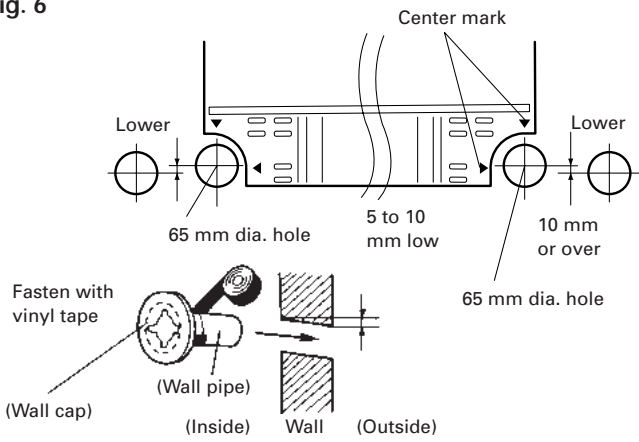
(2) When the voltage is low and the air conditioner is difficult to start, contact the power company the voltage raised.

INDOOR UNIT

CUTTING THE HOLE IN THE WALL FOR THE CONNECTING PIPING

- (1) Cut a 65 mm diameter hole in the wall at the position shown in (Fig. 6).
- (2) When cutting the wall hole at the inside of the installation frame, cut the hole within the range of the left and right center marks 40 mm below the installation frame. When cutting the wall hole at the outside of the installation frame, cut the hole at least 10 mm below over.
- (3) Cut the hole so that the outside end is lower (5 to 10 mm) than the inside end.
- (4) Always align the center of the wall hole. If misaligned, water leakage will occur.
- (5) Cut the wall pipe to match the wall thickness, stick it into the wall cap, fasten the cap with vinyl tape, and stick the pipe through the hole. (The connection pipe is supplied in the installation set.) (Fig. 6)
- (6) For left piping and right piping, cut the hole a little lower so that drain water will flow freely. (Fig. 6)

Fig. 6



INSTALLING THE WALL HOOK BRACKET

- (1) Install the wall hook bracket so that it is correctly positioned horizontally and vertically. If the wall hook bracket is tiled, water will drip to the floor.
- (2) Install the wall hook bracket so that it is strong enough to withstand the weight of an adult.
- Fasten the wall hook bracket to the wall with 6 or more screws through the holes near the outer edge of the bracket.
- Check that there is no rattle at the wall hook bracket.

WARNING

If the wall pipe is not used, the cord interconnecting the indoor and outdoor units may touch metal and cause electric leakage.

CAUTION

Install the wall hook bracket horizontally and perpendicularly.

FORMING THE DRAIN HOSE AND PIPE

[Rear piping, Right piping, Bottom piping]

- Install the indoor unit piping in the direction of the wall hole and bind the drain hose and pipe together with vinyl tape. (Fig. 8)
- Install the piping so that the drain hose is at the bottom.
- Wrap the pipes of the indoor unit that are visible from the outside with decorative tape.

[For Left rear piping, Left piping]

Interchange the drain cap and the drain hose.

CAUTION

After removing the drain hose, do not forget to install the drain cap.

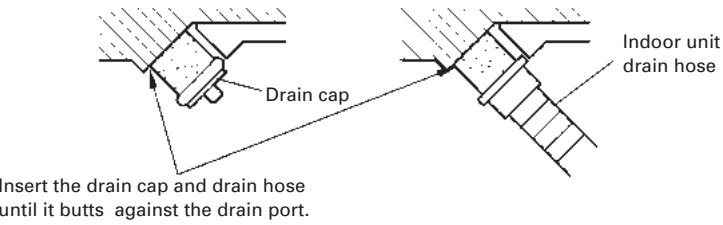
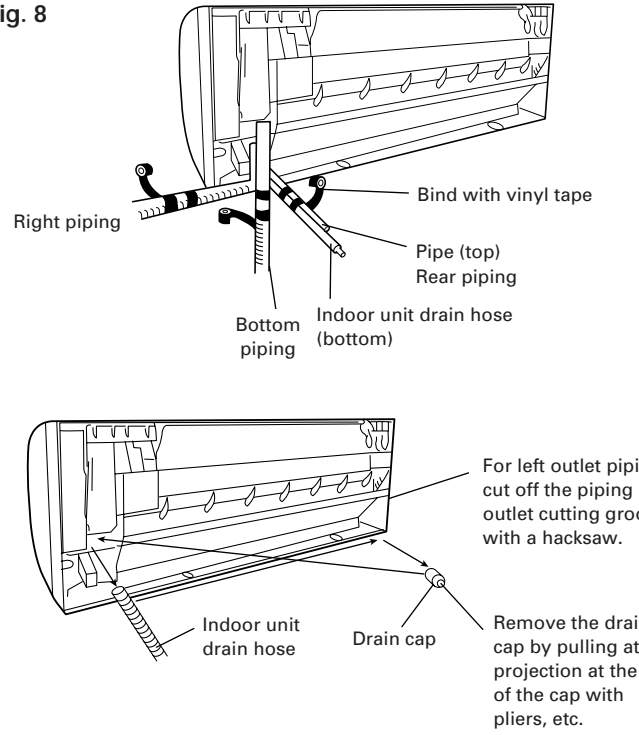


Fig. 8



OUTDOOR UNIT

OUTDOOR UNIT INSTALLATION

- Set the unit on a strong stand, such as one made of concrete blocks to minimize shock and vibration.
- Do not set the unit directly on the ground because it will cause trouble.

Connector cover removal

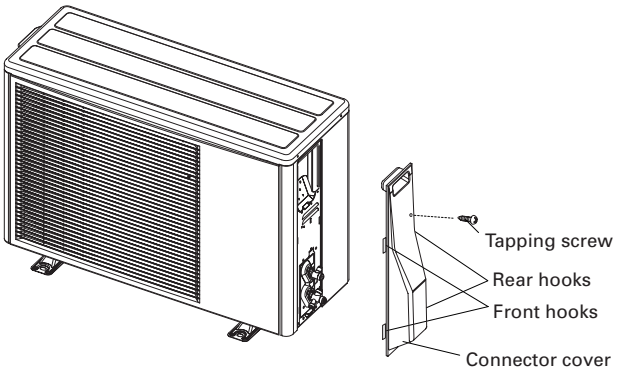
- Remove the tapping screws.

Installing the connector cover

- (1) After inserting the two front hooks, then insert the rear hook.
- (2) Tighten the tapping screws.

- WARNING**
- (1) Install the unit where it will not be tilted by more than 5°.
 - (2) When installing the outdoor unit where it may be exposed to strong wind, fasten it securely.

Fig. 12



AIR PURGE

Always use a vacuum pump to purge the air. Refrigerant for purging the air is not charged in the outdoor unit at the factory.

Close the high pressure side valve of the gauge manifold fully and do not operate it during the following work.

1. Check if the piping connections are secure.
2. Check that the stems of 2-way valve and 3-way valve are closed fully.
3. Connect the gauge manifold charge hose to the charging port of the 3-way valve (side with the projection for pushing in the valve core).
4. Open the low pressure side valve of the gauge manifold fully.
5. Operate the vacuum pump and start pump down.
6. Slowly loosen the flare nut of the 3-way valve and check if air enters, then retighten the flare nut. (When the flare nut is loosened the operating sound of the vacuum pump changes and the reading of the compound pressure gauge goes from minus to zero.)
7. Pump down the system for at least 15 minutes, then check if the compound pressure gauge reads -0.1 MPa (-76 cmHg, -1 bar).
8. At the end of pump down, close the low pressure side gauge of the gauge manifold fully and stop the vacuum pump.
9. Slowly loosen the valve stem of the 3-way valve. When the compound pressure gauge reading reaches 0.1-0.2 MPa, retighten the valve stem and disconnect the charge hose from the 3-way valve charging port. (If the stem of the 3-way valve is opened fully before the charge hose is disconnected, it may be difficult to disconnect the charge hose.)

- CAUTION**
- (1) Refrigerant must not be discharged into atmosphere.
 - (2) After connecting the piping, check the joints for gas leakage with gas leak detector.

10. Fully open the valve stems of the 2-way valve and 3-way valve using a hexagon wrench. (After the valve stem begins to turn, turn it with a torque of less than 2.9 N·m (30 kgf·cm) until it stops turning.)
11. Firmly tighten the 2-way valve and 3-way valve blank cap and the charging port cap.

Fig. 13

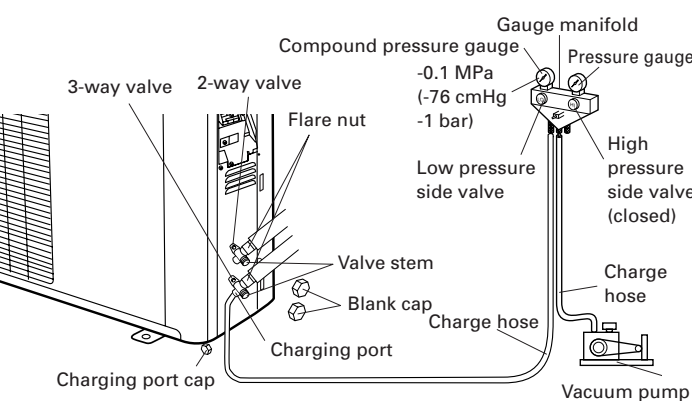


Table 4

	Tightening torque
Blank cap	19.6 to 24.5 N·m (200 to 250 kgf·cm)
Charging port cap	12.3 to 15.7 N·m (125 to 160 kgf·cm)

- For left piping and left rear piping, align the marks on the wall hook bracket and shape the connection pipe.
- Bend the connection piping at the bend radius of 70 mm or more and install no more than 35 mm from the wall.
- After passing the indoor piping and drain hose through the wall hole, hang the indoor unit on the hooks at the top and bottom of the wall hook bracket.

[Installing the indoor unit]

- Hang the indoor unit from the hooks at the top of the wall hook bracket.
- Insert the spacer, etc. between the indoor unit and the wall hook bracket and separate the bottom of the indoor unit from the wall.

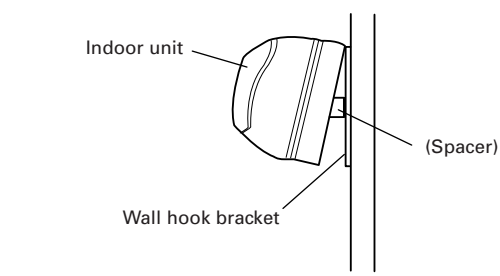
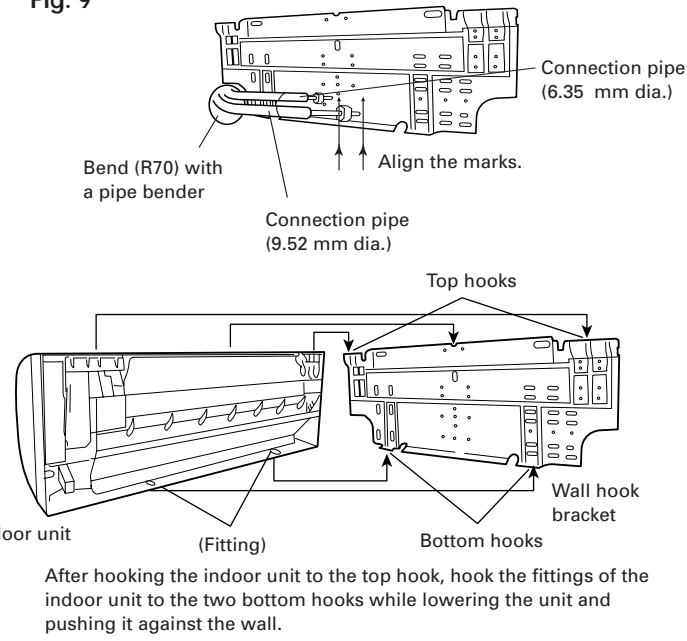


Fig. 9



CONNECTING THE PIPING

CONNECTION

- (1) Install the outdoor unit wall cap (supplied with the optional installation set or procured at the site) to the wall pipe.
- (2) Connect the outdoor unit and indoor unit piping.
- (3) After matching the center of the flare surface and tightening the nut hand tight, tighten the nut to the specified tightening torque with a torque wrench. (Table 2)

FLARING

- (1) Cut the connection pipe to the necessary length with a pipe cutter.
- (2) Hold the pipe downward so that cuttings will not enter the pipe and remove the burrs.
- (3) Insert the flare nut onto the pipe and flare the pipe with a flaring tool.

Insert the flare nut (always use the flare nut attached to the indoor and outdoor units respectively) onto the pipe and perform the flare processing with a flare tool. Use the special R410A flare tool, or the conventional (for R22) flare tool. When using the conventional flare tool, always use an allowance adjustment gauge and secure the A dimension shown in table 3.

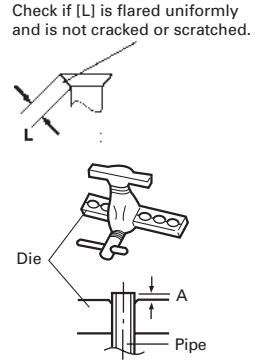


Fig. 10

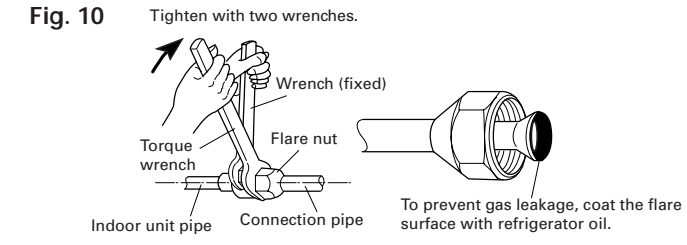


Table 2 Flare nut tightening torque

Flare nut	Tightening torque	Tightening torque standard (using a 20 cm wrench)
6.35 mm dia.	15.7 to 17.6 N·m (160 to 180 kgf·cm)	Wrist strength
9.52 mm dia.	29.4 to 41.1 N·m (300 to 420 kgf·cm)	Arm strength

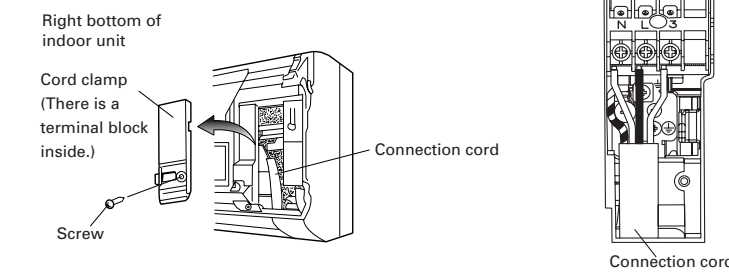
Table 3 Pipe outside diameter

Pipe outside diameter	Flash tool for R410A, clutch type	A (mm)	
		Conventional (R22) flare tool	
ø 6.35 mm (1/4")	0 to 0.5	Clutch type	Wing nut type
ø 9.52 mm (3/8")	0 to 0.5	1.0 to 1.5	1.5 to 2.0

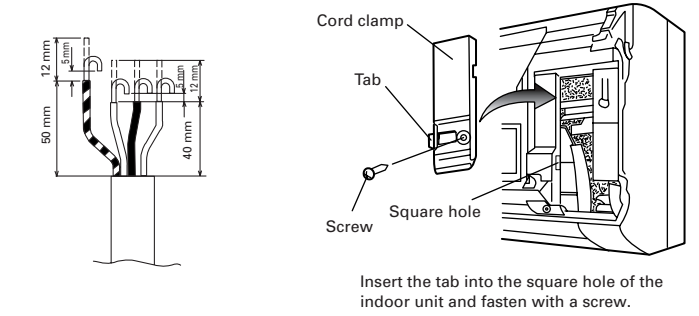
INDOOR UNIT WIRING

- (1) Remove the cord clamp.
- (2) Bend the end of the connection cord as shown in the figure.

Fig. 11



- (3) Connect the end of the connection cord fully into the terminal block.
- (4) Fasten the connection cord with a cord clamp.



- CAUTION**
- (1) Match the terminal block numbers and connection cord colors with those of the outdoor unit. Erroneous wiring may cause burning of the electric parts.
 - (2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire.
 - (3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.)
 - (4) Securely earth the power cord plug.
 - (5) Do not use the earth screw for an external connector. Only use for interconnection between two units.

Additional charge

Refrigerant suitable for a piping length of 15 m is charged in the outdoor unit at the factory. When the piping is longer than 15 m, additional charging is necessary. For the additional amount, see the table below.

Table 5

Pipe length	15 m	20 m
Additional refrigerant	None	100 g

CAUTION

- (1) When adding refrigerant, add the refrigerant from the charging port at the completion of work.
- (2) The maximum length of the piping is 20 m. If the units are further apart than this, correct operation can not be guaranteed.

Between 15 m and 20 m, when using a connection pipe other than that in the table, charge additional refrigerant with 20g/1 m as the criteria.

OUTDOOR UNIT WIRING

- (1) Remove the outdoor unit connector cover.
- (2) Bend the end of the cord as shown in the figure.
- (3) Connect the end of the connection cord fully into the terminal block.
- (4) Fasten the sheath with a cord clamp.
- (5) Install the connector cover.

Fig. 14

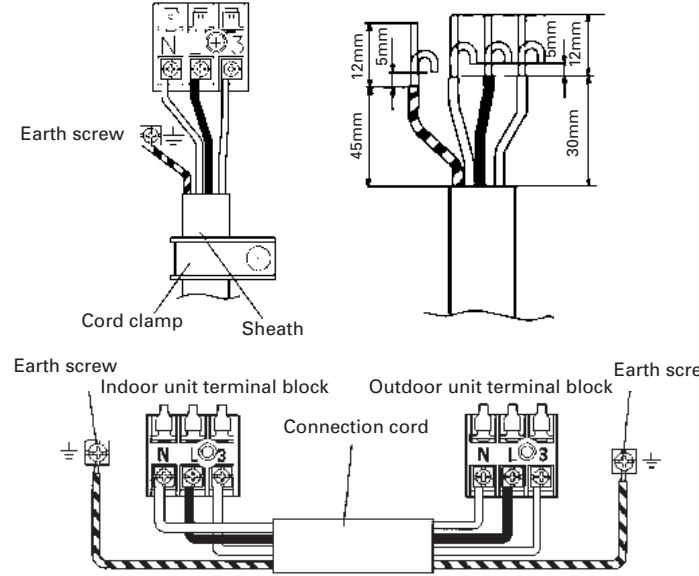
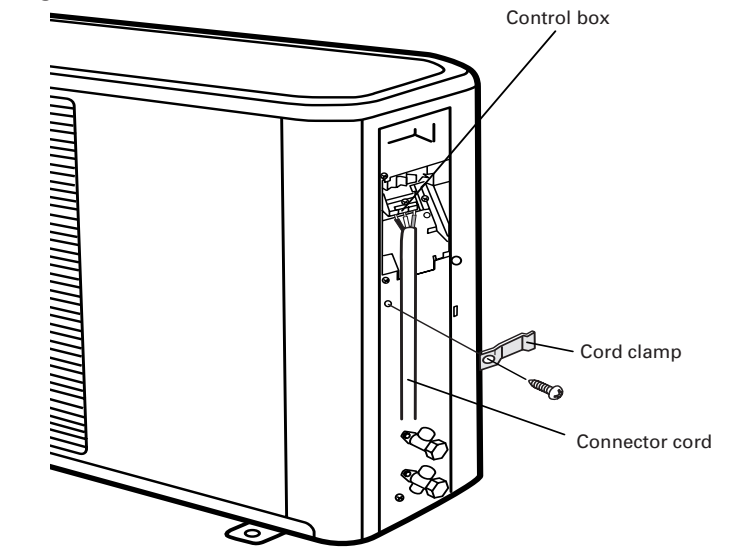
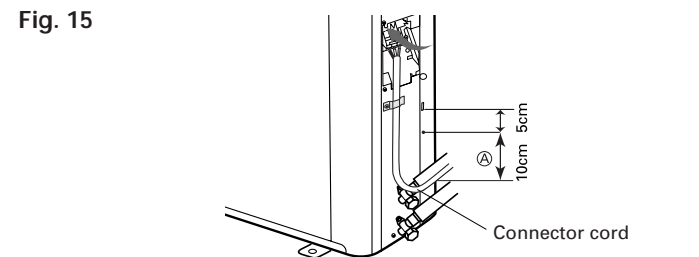


Fig. 15



Connection cord wiring

Run the connection cord to the rear of the outdoor unit within the ④ range of the arrows shown in the figure. (The connector cover becomes difficult to install.)

- CAUTION**
- (1) Match the terminal block numbers and connection cord colors with those of the indoor unit. Erroneous wiring may cause burning of the electric parts.
 - (2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire.
 - (3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.)
 - (4) Securely earth the power cord plug.
 - (5) Do not use the earth screw for an external connector. Only use for interconnection between two units.

FINISHING

- (1) Insulate between pipes.
 - For rear, right, and bottom piping, overlap the connection pipe heat insulation and indoor unit pipe heat insulation and bind them with vinyl tape so that there is no gap.
 - For left and left rear piping, butt the connection pipe heat insulation and indoor unit pipe heat insulation together and bind them with and vinyl tape so that there is no gap.
 - For left and left rear piping, wrap the area which accommodates the rear piping housing section with cloth tape.
 - For left and left rear piping, bind the connection cord to the top of the pipe with vinyl tape.
 - For left and left rear piping, bundle the piping and drain hose together by wrapping them with cloth tape over the range within which they fit into the rear piping housing section.
- (2) Temporarily fasten the connection cord along the connection pipe with vinyl tape. (Wrap to about 1/3 the width of the tape from the bottom of the pipe so that water does not enter.)
- (3) Fasten the connection pipe to the outside wall with saddles, etc.
- (4) Fill the gap between the outside wall pipe hole and the pipe with sealer so that rain water and wind cannot blow in.
- (5) Fasten the drain hose to the outside wall, etc.

Fig. 16

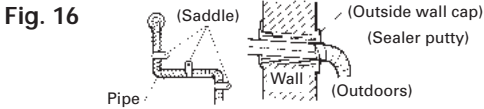
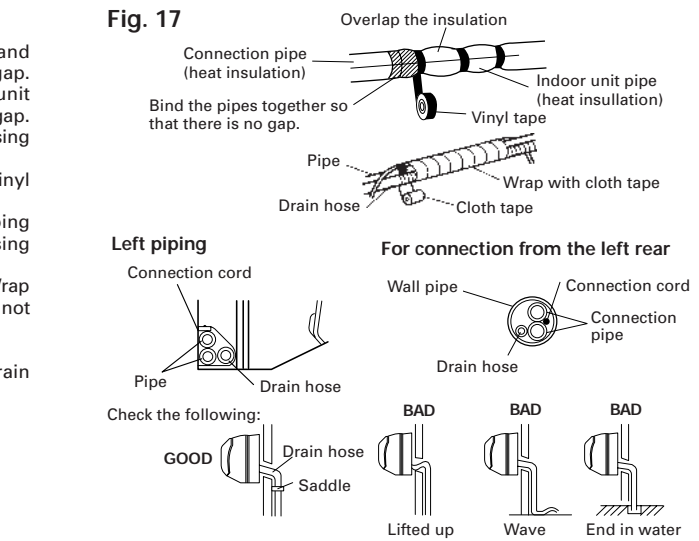


Fig. 17



SPLIT TYPE ROOM AIR CONDITIONER

INSTALLATION MANUAL

(PART NO. 9313802028-01) AS*14/18LSBC

This air conditioner uses new refrigerant HFC (R410A).

The basic installation work procedures are the same as conventional refrigerant (R22) models. However, pay careful attention to the following points:

(1) Since the working pressure is 1.6 times higher than that of conventional refrigerant (R22) models, some of the piping and installation and service tools are special.(See the table below.)
Especially, when replacing a conventional refrigerant (R22) model with a new refrigerant R410A model, always replace the conventional piping and flare nuts with the R410A piping and flare nuts.

(2) Models that use refrigerant R410A have a different charging port thread diameter to prevent erroneous charging with conventional refrigerant (R22) and for safety. Therefore, check beforehand.[The charging port thread diameter for R410A is 1/2 threads per inch.]

(3) Be more careful that foreign matter (oil, water, etc.) does not enter the piping than with refrigerant (R22) models. Also, when storing the piping ,securely seal the opening by pinching ,taping, etc.

(4) When charging the refrigerant, take into account the slight change in the composition of the gas and liquid phases, and always charge from the liquid phase side whose composition is stable.

Special tools for R410A

Tool name	Contents of change
Gauge manifold	Pressure is high and cannot be measured with a conventional gauge. To prevent erroneous mixing of other refrigerants, the diameter of each port has been changed. It is recommended the gauge with seals-0.1 to 5.3 MPa (-1 to 53 bar) for high pressure. -0.1 to 3.8 MPa (-1 to 38 bar) for low pressure.
Charge hose	To increase pressure resistance, the hose material and base size were changed.
Vacuum pump	A conventional vacuum pump can be used by installing a vacuum pump adapter.
Gas leakage detector	Special gas leakage detector for HFC refrigerant R410A.

Copper pipes

It is necessary to use seamless copper pipes and it is desirable that the amount of residual oil is less than 40 mg/10m. Do not use copper pipes having a collapsed, deformed or discolored portion (especially on the interior surface). Otherwise, the expansion value or capillary tube may become blocked with contaminants.

As an air conditioner using R410A incurs pressure higher than when using R22, it is necessary to choose adequate materials. Thicknesses of copper pipes used with R410A are as shown in Table1.Never us copper pipes thinner than 0.8mm even when it is available on the market.

		Thickness (mm)	
Nominal diameter	Outer diameter (mm)	R410A	[ref.] R22
1/4	6.35	0.80	0.80
1/2	12.7	0.80	0.80

⚠ WARNING

(1) Do not use the existing (for R22) piping and flare nuts.

- If the existing materials are used, the pressure inside the refrigerant cycle will rise and cause breakage, injury, etc.(Use the special R410A materials.)

(2) When installing and relocating the air conditioner, do not mix gases other than the specified refrigerant(R410A) to enter the refrigerant cycle.

- If air or other gas enters the refrigerant cycle, the pressure inside the cycle will rise to an abnormally high value and cause breakage, injury, etc.

For authorized service personnel only.

⚠ WARNING

(1) For the room air conditioner to operate satisfactory, install it as outlined in this installation manual.

(2) Connect the indoor unit and outdoor unit with the air conditioner piping and cords available standards parts. This installation manual describes the correct connections using the standard accessories and the parts specified in this installation manual.

(3) Have installation work done by authorized service personnel only.

(4) Never cut the power cord, lengthen or shorten the cord, or change the plug.

(5) Also do not use an extension cord.

(6) Plug in the power cord plug firmly. If the receptacle is loose, repair it before using the room air conditioner.

(7) Do not turn on the power until all installation work is complete.

- Be careful not to scratch the air conditioner when handling it.
- After installation, explain correct operation to the customer, using the operating manual.
- Let the customer keep this installation manual because it is used when the air conditioner is serviced or moved.
- The maximum length of the piping is 20 m. The maximum height difference of the piping is 10 m, if the units are further apart than these, correct operation can not be guaranteed.

STANDARD ACCESSORIES

The following installation accessories are supplied. Use them as required.

Name and Shape	Q'ty	Name and Shape	Q'ty
Wall hook bracket	1	Cloth tape	1
Remote control unit	1	Tapping screw (big)	8
Battery	2	Tapping screw (small)	2
Remote control unit holder	1	Air cleaning filter	2
Drain pipe	1	Air cleaning filter frame	2
		Seal A	1

One set of following parts are necessary in installation of this product.

Name
Connection pipe assembly
Connection cord
Wall pipe
Decorative tape
Vinyl tape
Wall cap
Saddle
Drain hose
Tapping screws
Sealant

ELECTRICAL REQUIREMENT

Always make the air conditioner power supply a special branch circuit and provide a special switch and receptacle. Do not extend the power cord.

SELECTING THE MOUNTING POSITION

Decide the mounting position with the customer as follows:

1. INDOOR UNIT

- (1) Install the indoor unit level on a strong wall which is not subject to vibration.
- (2) The inlet and outlet ports should not be obstructed : the air should be able to blow all over the room.
- (3) Install the unit near an electric outlet or special branch circuit.
- (4) Do not install the unit where it will be exposed to direct sunlight.
- (5) Install the unit where connection to the outdoor unit is easy.
- (6) Install the unit where the drain pipe can be easily installed.
- (7) Take servicing, etc. into consideration and leave the spaces shown in (Fig. 2). Also install the unit where the filter can be removed.

2. OUTDOOR UNIT

- (1) If possible, do not install the unit where it will be exposed to direct sunlight. (If necessary, install a blind that does not interfere with the air flow.)
- (2) Do not install the unit where a strong wind blows or where it is very dusty.
- (3) Do not install the unit where people pass.
- (4) Take you neighbors into consideration so that they are not disturbed by air blowing into their windows or by noise.
- (5) Provide the space shown in Fig. 2 so that the air flow is not blocked. Also for efficient operation, leave open three of the four directions front, rear, and both sides.

⚠ WARNING

Install at a place that can withstand the weight of the indoor and outdoor units and install positively so that the units will not topple or fall.

⚠ CAUTION

(1) Do not install where there is the danger of combustible gas leakage.

(2) Do not install near heat sources.

(3) If children under 10 years old may approach the unit, take preventive measures so that they cannot reach the unit.

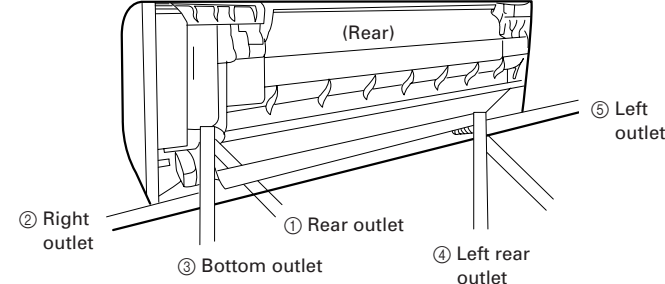
(4) Install the indoor unit on the wall where the height from the floors more than 230 cm.

[Indoor unit piping direction]

The piping can be connected in the five directions indicated by ①, ②, ③, ④, and ⑤ in (Fig. 1). When the piping is connected in direction ② or ③, cut along the piping groove in the side of the front cover with a hacksaw.

When connecting the piping in direction ③, cut a notch in the thin wall at the front bottom of the front cover.

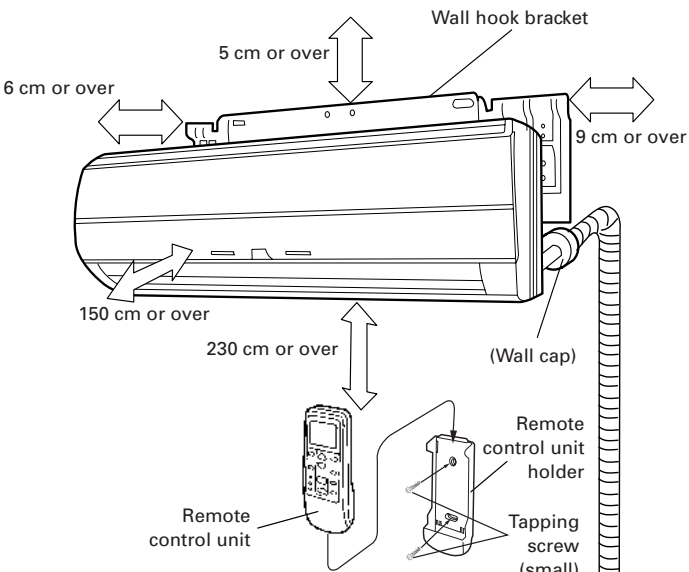
Fig. 1



INSTALLATION DIAGRAM OF INDOOR AND OUTDOOR UNITS

Fig. 2

[INDOOR UNIT]



[OUTDOOR UNIT]

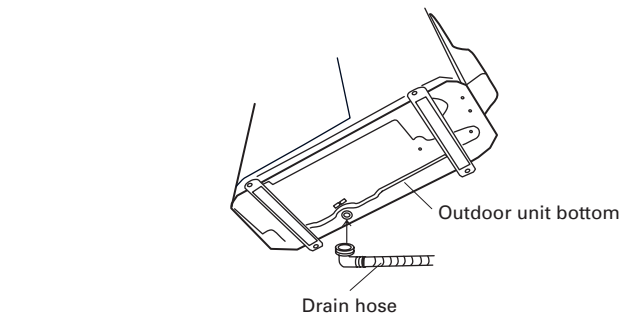
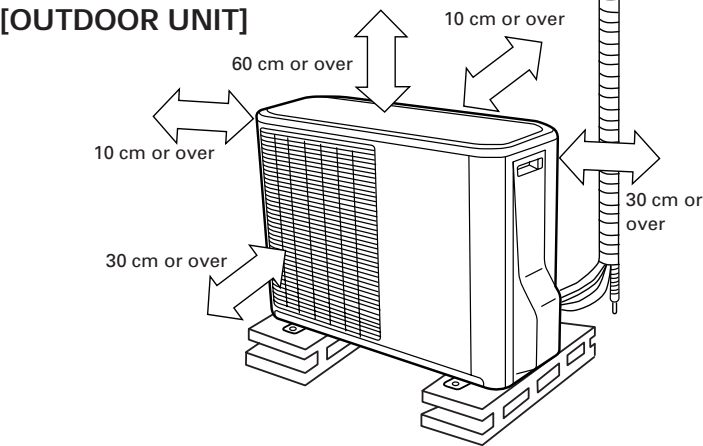
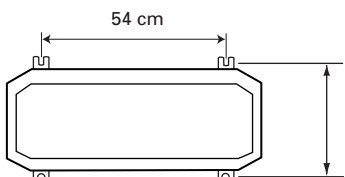


Fig. 3



FRONT PANEL REMOVAL AND INSTALLATION

THE INTAKE GRILLE REMOVAL

- (1) Open the intake grille.
- (2) Pull down the knob.
- (3) Lift the intake grille upward, until the axle at the top of the intake grille is removed.

THE INTAKE GRILLE INSTALLATION

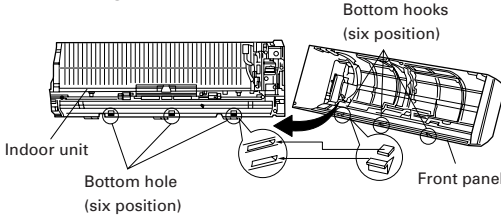
- (1) The fixing axle of the intake grille is installed on the Panel.
- (2) Lay down the intake grille.

THE FRONT PANEL REMOVAL

- (1) Remove intake grille (Reference the intake grille removal.)
- (2) Remove four screws.
- (3) The thumb is hung on the lower part as shown in the figure, and it pulls to the front, pushing [-] mark , and bottom hooks (two position) is removed from wall hook bracket.
- (4) The front panel bottom is pulled to the front, and bottom hooks is removed indoor unit.
- (5) The front panel is pulled to the front, raising the upper surface, and a front panel is removed.

THE FRONT PANEL INSTALLATION

- (1) Firstly, fit the lower part of the front panel, and insert top and bottom hooks. (Three top sides, six bottom sides)
- (2) Four screws is attached.
- (3) The intake grille is attached.



⚠ CAUTION

Install the front panel and INTAKE GRILLE securely. If installation is imperfect, the front panel or INTAKE GRILLE may fall off and cause injury.

Be sure that the top hole of the front panel is hooked securely to the hook of the base.

CUSTOMER GUIDANCE

Explain the following to the customer in accordance with the operating manual:

(1) Starting and stopping method, operation switching, temperature adjustment, timer, air flow switching, and other remote control unit operations.

(2) Air filter removal and cleaning, and how to use the air louvers.

(3) Give the operating and installation manuals to the customer.

POWER

⚠ WARNING

(1) The rated voltage of this product is 230 V AC 50 Hz.

(2) Before turning on the power, check if the voltage is within the 220 V -10 % to 240 V +10 % range.

(3) Always use a special branch circuit and install a special receptacle to supply power to the room air conditioner.

(4) Use a circuit breaker and receptacle matched to the capacity of the air conditioner.

(5) Do not extend the power cord.

(6) Perform wiring work in accordance with standards so that the air conditioner can be operated safely and positively.

(7) Install a leakage circuit breaker in accordance with the related laws and regulations and electric company standards.

⚠ CAUTION

(1) The power source capacity must be the sum of the air conditioner current and the current of other electrical appliances. When the current contracted capacity is insufficient, change the contracted capacity.

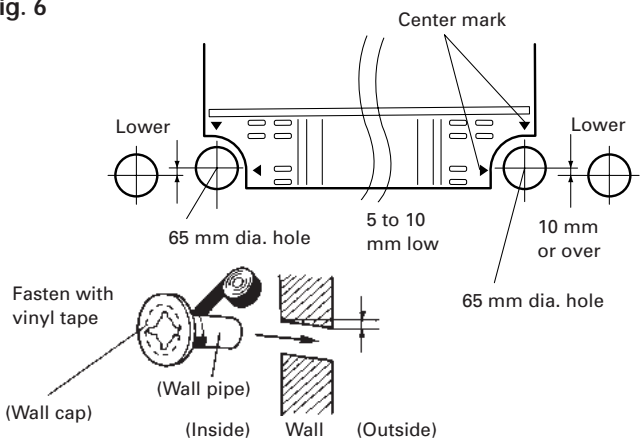
(2) When the voltage is low and the air conditioner is difficult to start, contact the power company the voltage raised.

INDOOR UNIT

CUTTING THE HOLE IN THE WALL FOR THE CONNECTING PIPING

- (1) Cut a 65 mm diameter hole in the wall at the position shown in (Fig. 6).
- (2) When cutting the wall hole at the inside of the installation frame, cut the hole within the range of the left and right center marks 40 mm below the installation frame. When cutting the wall hole at the outside of the installation frame, cut the hole at least 10 mm below over.
- (3) Cut the hole so that the outside end is lower (5 to 10 mm) than the inside end.
- (4) Always align the center of the wall hole. If misaligned, water leakage will occur.
- (5) Cut the wall pipe to match the wall thickness, stick it into the wall cap, fasten the cap with vinyl tape, and stick the pipe through the hole. (The connection pipe is supplied in the installation set.) (Fig. 6)
- (6) For left piping and right piping, cut the hole a little lower so that drain water will flow freely. (Fig. 6)

Fig. 6



INSTALLING THE WALL HOOK BRACKET

- (1) Install the wall hook bracket so that it is correctly positioned horizontally and vertically. If the wall hook bracket is tiled, water will drip to the floor.
- (2) Install the wall hook bracket so that it is strong enough to withstand the weight of an adult.
- Fasten the wall hook bracket to the wall with 6 or more screws through the holes near the outer edge of the bracket.
- Check that there is no rattle at the wall hook bracket.

WARNING

If the wall pipe is not used, the cord interconnecting the indoor and outdoor units may touch metal and cause electric leakage.

CAUTION

Install the wall hook bracket horizontally and perpendicularly.

FORMING THE DRAIN HOSE AND PIPE

[Rear piping, Right piping, Bottom piping]

- Install the indoor unit piping in the direction of the wall hole and bind the drain hose and pipe together with vinyl tape. (Fig. 8)
- Install the piping so that the drain hose is at the bottom.
- Wrap the pipes of the indoor unit that are visible from the outside with decorative tape.

[For Left rear piping, Left piping]

Interchange the drain cap and the drain hose.

CAUTION

After removing the drain hose, do not forget to install the drain cap.

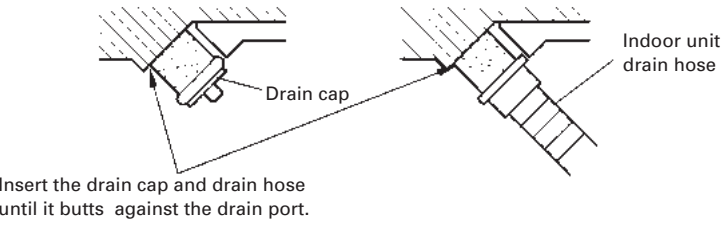


Fig. 7

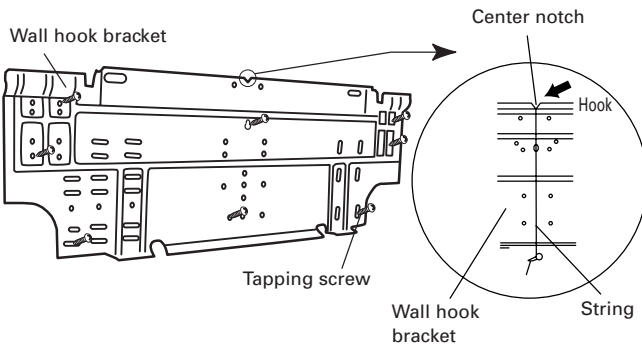
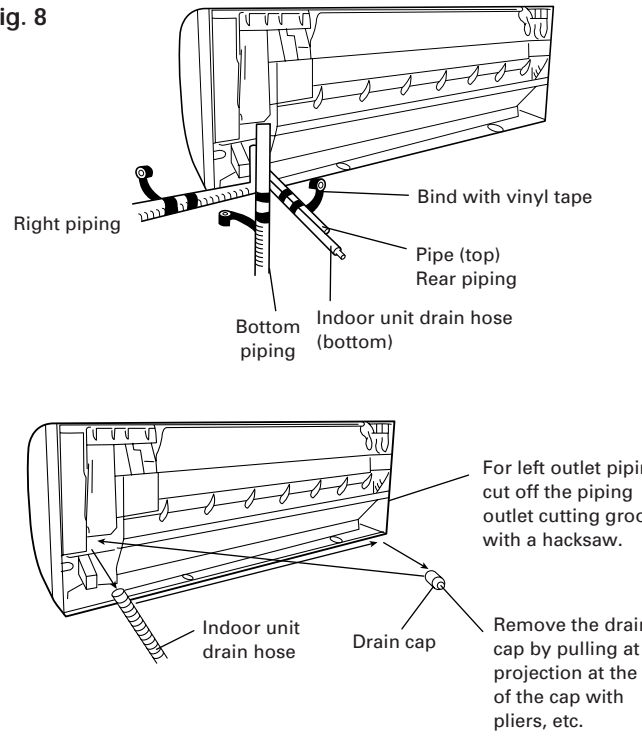


Fig. 8



OUTDOOR UNIT

OUTDOOR UNIT INSTALLATION

- Set the unit on a strong stand, such as one made of concrete blocks to minimize shock and vibration.
- Do not set the unit directly on the ground because it will cause trouble.

Connector cover removal

- Remove the tapping screws.

Installing the connector cover

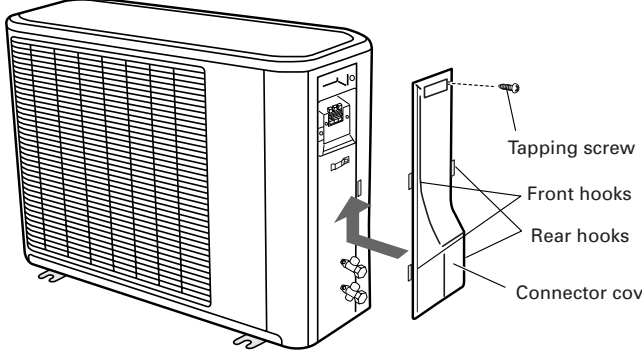
- (1) After inserting the two front hooks, then insert the rear hook.
- (2) Tighten the tapping screws.

WARNING

(1) Install the unit where it will not be tilted by more than 5°.

(2) When installing the outdoor unit where it may be exposed to strong wind, fasten it securely.

Fig. 12



AIR PURGE

Always use a vacuum pump to purge the air. Refrigerant for purging the air is not charged in the outdoor unit at the factory.

Close the high pressure side valve of the gauge manifold fully and do not operate it during the following work.

1. Check if the piping connections are secure.
2. Check that the stems of 2-way valve and 3-way valve are closed fully.
3. Connect the gauge manifold charge hose to the charging port of the 3-way valve (side with the projection for pushing in the valve core).
4. Open the low pressure side valve of the gauge manifold fully.
5. Operate the vacuum pump and start pump down.
6. Slowly loosen the flare nut of the 3-way valve and check if air enters, then retighten the flare nut. (When the flare nut is loosened the operating sound of the vacuum pump changes and the reading of the compound pressure gauge goes from minus to zero.)
7. Pump down the system for at least 15 minutes, then check if the compound pressure gauge reads -0.1 MPa (-76 cmHg, -1 bar).
8. At the end of pump down, close the low pressure side gauge of the gauge manifold fully and stop the vacuum pump.
9. Slowly loosen the valve stem of the 3-way valve. When the compound pressure gauge reading reaches 0.1-0.2 MPa, retighten the valve stem and disconnect the charge hose from the 3-way valve charging port. (If the stem of the 3-way valve is opened fully before the charge hose is disconnected, it may be difficult to disconnect the charge hose.)

CAUTION

(1) Refrigerant must not be discharged into atmosphere.

(2) After connecting the piping, check the joints for gas leakage with gas leak detector.

10. Fully open the valve stems of the 2-way valve and 3-way valve using a hexagon wrench. (After the valve stem begins to turn, turn it with a torque of less than 2.9 N·m (30 kgf·cm) until it stops turning.)
11. Firmly tighten the 2-way valve and 3-way valve blank cap and the charging port cap.

Fig. 13

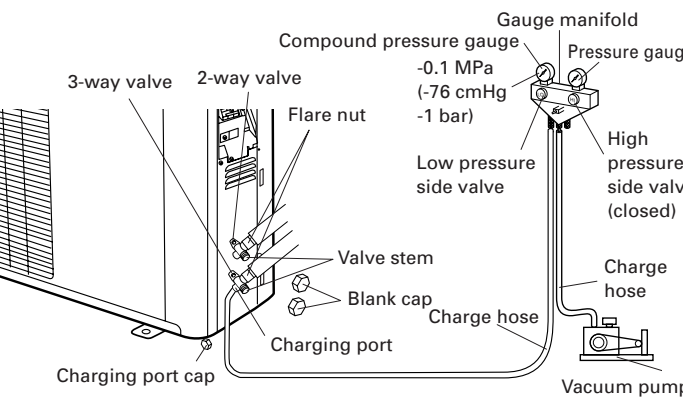


Table 4

	Tightening torque
Blank cap (2-way valve)	19.6 to 24.5 N·m (200 to 250 kgf·cm)
Blank cap (3-way valve)	27.4 to 31.4 N·m (280 to 320 kgf·cm)
Charging port cap	12.3 to 15.7 N·m (125 to 160 kgf·cm)

- For left piping and left rear piping, align the marks on the wall hook bracket and shape the connection pipe.
- Bend the connection piping at the bend radius of 70 mm or more and install no more than 35 mm from the wall.
- After passing the indoor piping and drain hose through the wall hole, hang the indoor unit on the hooks at the top and bottom of the wall hook bracket.

[Installing the indoor unit]

- Hang the indoor unit from the hooks at the top of the wall hook bracket.
- Insert the spacer, etc. between the indoor unit and the wall hook bracket and separate the bottom of the indoor unit from the wall.

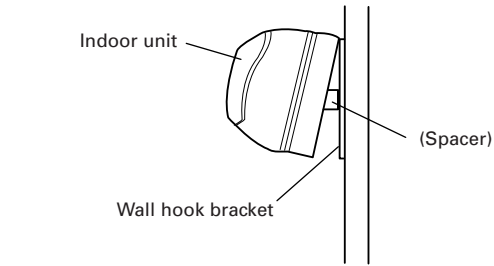
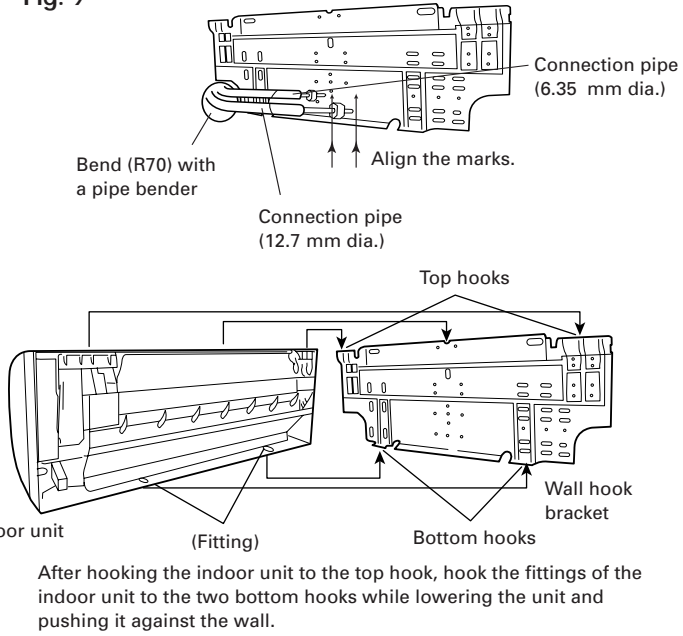


Fig. 9



CONNECTING THE PIPING

CONNECTION

- (1) Install the outdoor unit wall cap (supplied with the optional installation set or procured at the site) to the wall pipe.
- (2) Connect the outdoor unit and indoor unit piping.
- (3) After matching the center of the flare surface and tightening the nut hand tight, tighten the nut to the specified tightening torque with a torque wrench. (Table 2)

FLARING

- (1) Cut the connection pipe to the necessary length with a pipe cutter.
- (2) Hold the pipe downward so that cuttings will not enter the pipe and remove the burrs.
- (3) Insert the flare nut onto the pipe and flare the pipe with a flaring tool.

Insert the flare nut (always use the flare nut attached to the indoor and outdoor units respectively) onto the pipe and perform the flare processing with a flare tool. Use the special R410A flare tool, or the conventional (for R22) flare tool. When using the conventional flare tool, always use an allowance adjustment gauge and secure the A dimension shown in table 3.

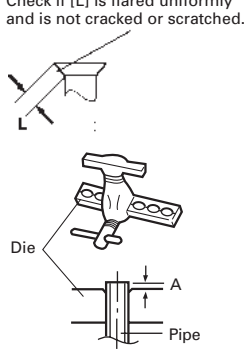


Fig. 10

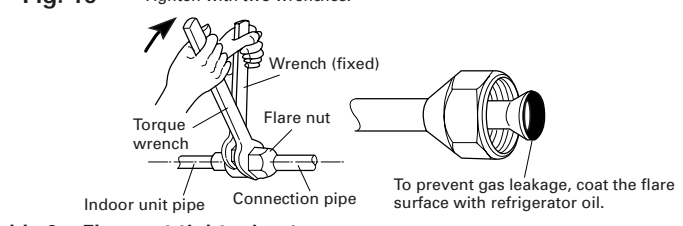


Table 2 Flare nut tightening torque

Flare nut	Tightening torque	Tightening torque standard (using a 20 cm wrench)
6.35 mm dia.	15.7 to 17.6 N·m (160 to 180 kgf·cm)	Wrist strength
12.7 mm dia.	49.0 to 53.9 N·m (500 to 550 kgf·cm)	Arm strength

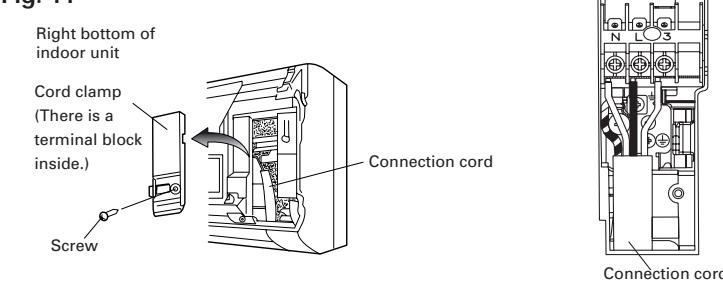
Table 3 Pipe outside diameter

Pipe outside diameter	Flash tool for R410A, clutch type	A (mm)	
		Conventional (R22) flare tool	
φ 6.35 mm (1/4")	0 to 0.5	Clutch type	Wing nut type
φ 12.7 mm (3/8")	0 to 0.5	1.0 to 1.5	1.5 to 2.0

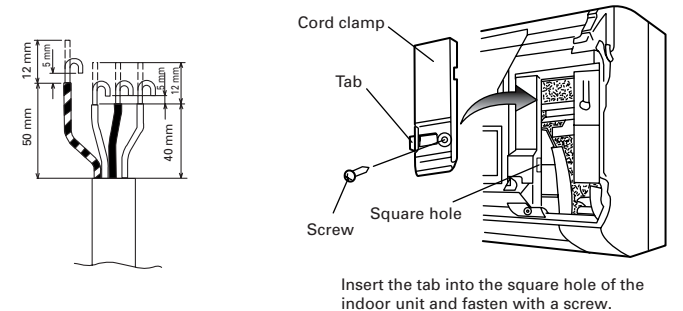
INDOOR UNIT WIRING

- (1) Remove the cord clamp.
- (2) Bend the end of the connection cord as shown in the figure.

Fig. 11



- (3) Connect the end of the connection cord fully into the terminal block.
- (4) Fasten the connection cord with a cord clamp.



CAUTION

(1) Match the terminal block numbers and connection cord colors with those of the outdoor unit. Erroneous wiring may cause burning of the electric parts.

(2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire.

(3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.)

(4) Securely earth the power cord plug.

(5) Do not use the earth screw for an external connector. Only use for interconnection between two units.

OUTDOOR UNIT

Additional charge

Refrigerant suitable for a piping length of 15 m is charged in the outdoor unit at the factory. When the piping is longer than 15 m, additional charging is necessary. For the additional amount, see the table below.

Table 5

Pipe length	15 m	20 m
Additional refrigerant	None	100 g

CAUTION

- (1) When adding refrigerant, add the refrigerant from the charging port at the completion of work.
- (2) The maximum length of the piping is 20 m. If the units are further apart than this, correct operation can not be guaranteed.

Between 15 m and 20 m, when using a connection pipe other than that in the table, charge additional refrigerant with 20g/1 m as the criteria.

OUTDOOR UNIT WIRING

- (1) Remove the outdoor unit connector cover.
- (2) Bend the end of the cord as shown in the figure.
- (3) Connect the end of the connection cord fully into the terminal block.
- (4) Fasten the sheath with a cord clamp.
- (5) Install the connector cover.

Fig. 14

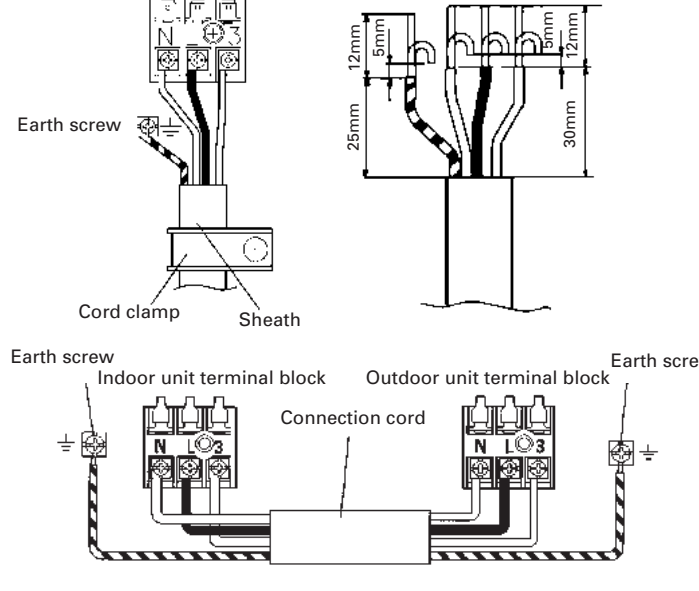
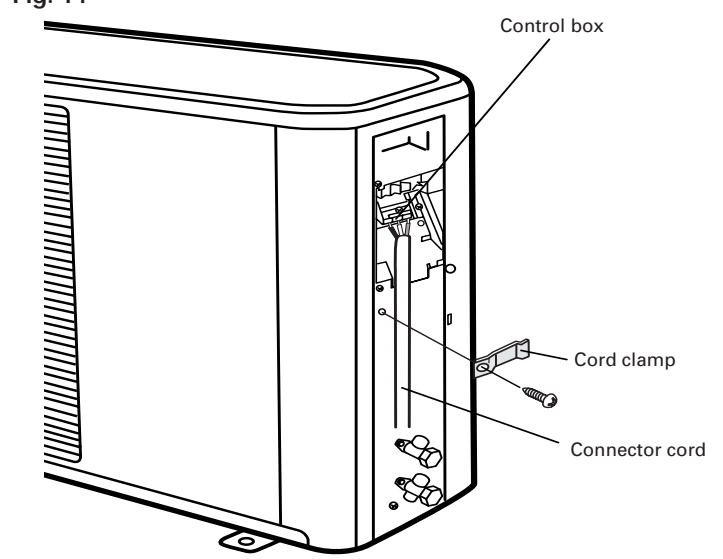
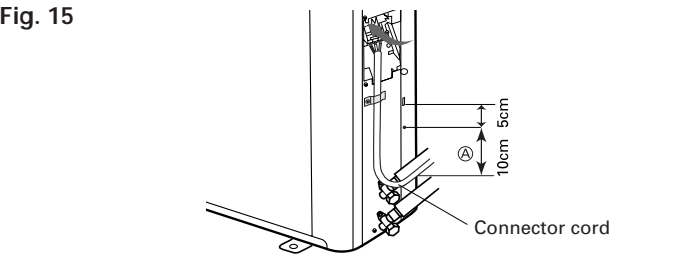


Fig. 15



Connection cord wiring

Run the connection cord to the rear of the outdoor unit within the ④ range of the arrows shown in the figure. (The connector cover becomes difficult to install.)

CAUTION

(1) Match the terminal block numbers and connection cord colors with those of the indoor unit. Erroneous wiring may cause burning of the electric parts.

(2) Connect the connection cords firmly to the terminal block. Imperfect installation may cause a fire.

(3) Always fasten the outside covering of the connection cord with the cord clamp. (If the insulator is chafed, electric leakage may occur.)

(4) Securely earth the power cord plug.

(5) Do not use the earth screw for an external connector. Only use for interconnection between two units.

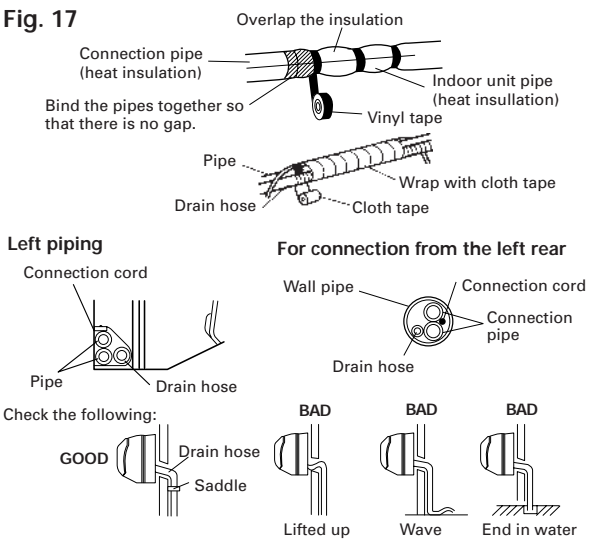
FINISHING

- (1) Insulate between pipes.
- For rear, right, and bottom piping, overlap the connection pipe heat insulation and indoor unit pipe heat insulation and bind them with vinyl tape so that there is no gap.
- For left and left rear piping, butt the connection pipe heat insulation and indoor unit pipe heat insulation together and bind them with and vinyl tape so that there is no gap.
- For left and left rear piping, wrap the area which accommodates the rear piping housing section with cloth tape.
- For left and left rear piping, bind the connection cord to the top of the pipe with vinyl tape.
- For left and left rear piping, bundle the piping and drain hose together by wrapping them with cloth tape over the range within which they fit into the rear piping housing section.
- (2) Temporarily fasten the connection cord along the connection pipe with vinyl tape. (Wrap to about 1/3 the width of the tape from the bottom of the pipe so that water does not enter.)
- (3) Fasten the connection pipe to the outside wall with saddles, etc.
- (4) Fill the gap between the outside wall pipe hole and the pipe with sealer so that rain water and wind cannot blow in.
- (5) Fasten the drain hose to the outside wall, etc.

Fig. 16



Fig. 17



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