Manual No.'22・AHU-T-428

MITSUBISHI HEAVY INDUSTRIES

TECHNICAL MANUAL

AIR HANDLING UNIT INTERFACE

AHU-KIT-SP2

MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS, LTD.

CONTENTS

1. AHU-KIT-SP2 - Overall composition

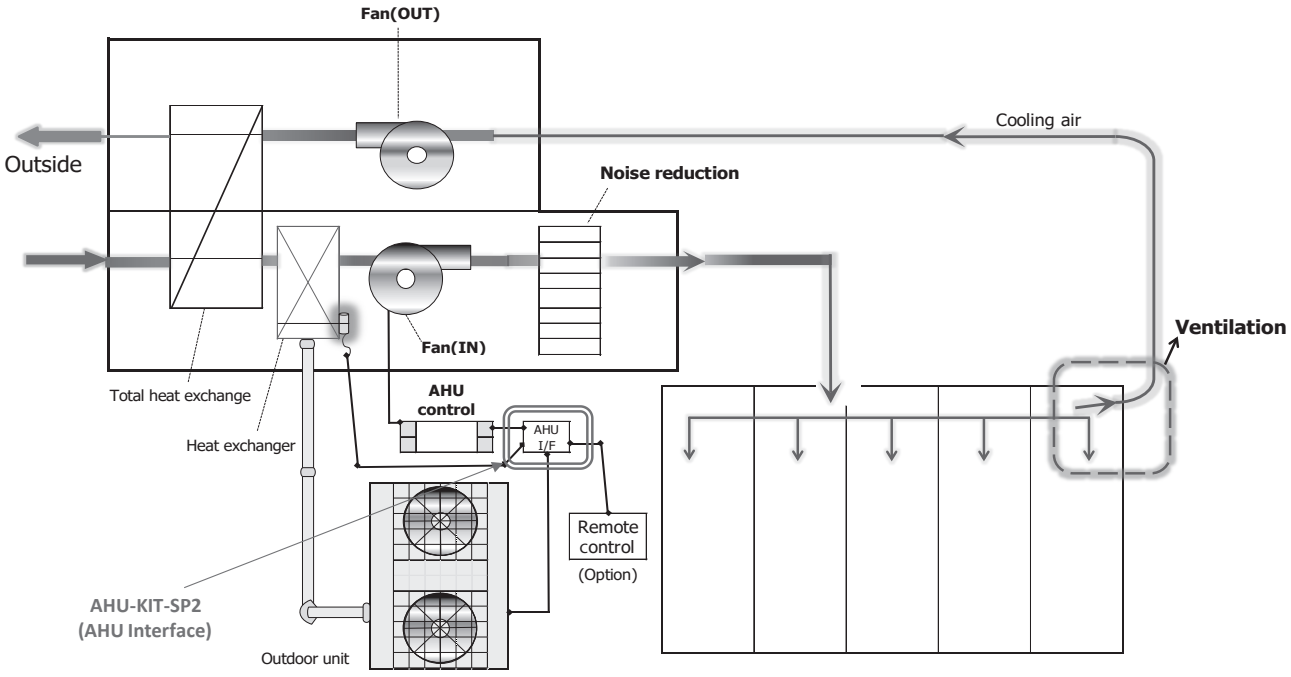
1.1 Product description

(1) What is Air Handling Unit?

This system controls air-conditioning by means of a direct expansion air-heat exchanger, which uses the same refrigerant as for air-conditioning as the heat transferring media.

<MHI AHU system (example)>

Example of cooling



(2) What is AHU-KIT-SP2?

AHU-KIT-SP2 is the control kit (hereafter AHU Interface), which provides a refrigerant control for Air Handling Unit (hereafter AHU) equipped with a direct expansion heat exchanger to be connected to an outdoor unit for use at a shop.

Item	Air Handling Unit Interface (AHU Interface)
Type	AHU-KIT-SP2
Connectable outdoor unit	See list below. (*1)
Environment for use	Temperature: -20 to 60°C, RH: 85% or less (Dewing not allowed)
Environment for storage	Temperature: -20 to 70°C, RH: 40 to 90% (Dewing not allowed)
Power source	Single phase 220 to 240V +10%/-15%, 50Hz, single phase 220V +10%/-15%, 60Hz
Power consumption	5W
Dimensions (HxWxD)	109.5mm x 290mm x 57mm
Weight	0.55kg
Installed on	DIN rail TS 35 mm x 7.5 mm (DIN rail to be provided)
Cascade connection	Max. 16 outdoor units can be combined by cascade control. (16 interface units are required.)
Power failure compensation	This interface has no battery circuit for recovery after power failure. Condition to continue operation: Power-out duration – Less than 30 msec.
Accessory	Heat exchanger temperature sensor (Thi-R1, Thi-R2, Thi-R3) x 1 Return air temperature sensor (Thi-A) x 1 Supply air temperature sensor (Thi-AF) x 1 : only monitoring
	Heat exchanger spring leaf x 3
	Ferrite core x 1 (for function earth connection)
	Installation manual
	Caution label

(*1) Connectable outdoor units

Model capacity	Outdoor unit	
	R410A	R32
40/50/60	SRC40/50/60ZSX-S, -SA	SRC40/50/60ZSX-W1, -W2, -WA
71	FDC71VNX	FDC71VNX-W
100/125/140	FDC100/125/140VN(S)A	FDC100/125/140VN(S)A-W
	FDC100/125/140VN(S)X	FDC100/125/140VN(S)X-W
200/250	FDC200/250VSA	FDC200/250VSA-W
280		FDC280VSA-W

AHU Interface has an analog input circuit for 0 – 10V, 4 – 20mA as the basic capacity control means for connected outdoor unit. Air conditioning control by remote control may be used as other control method.

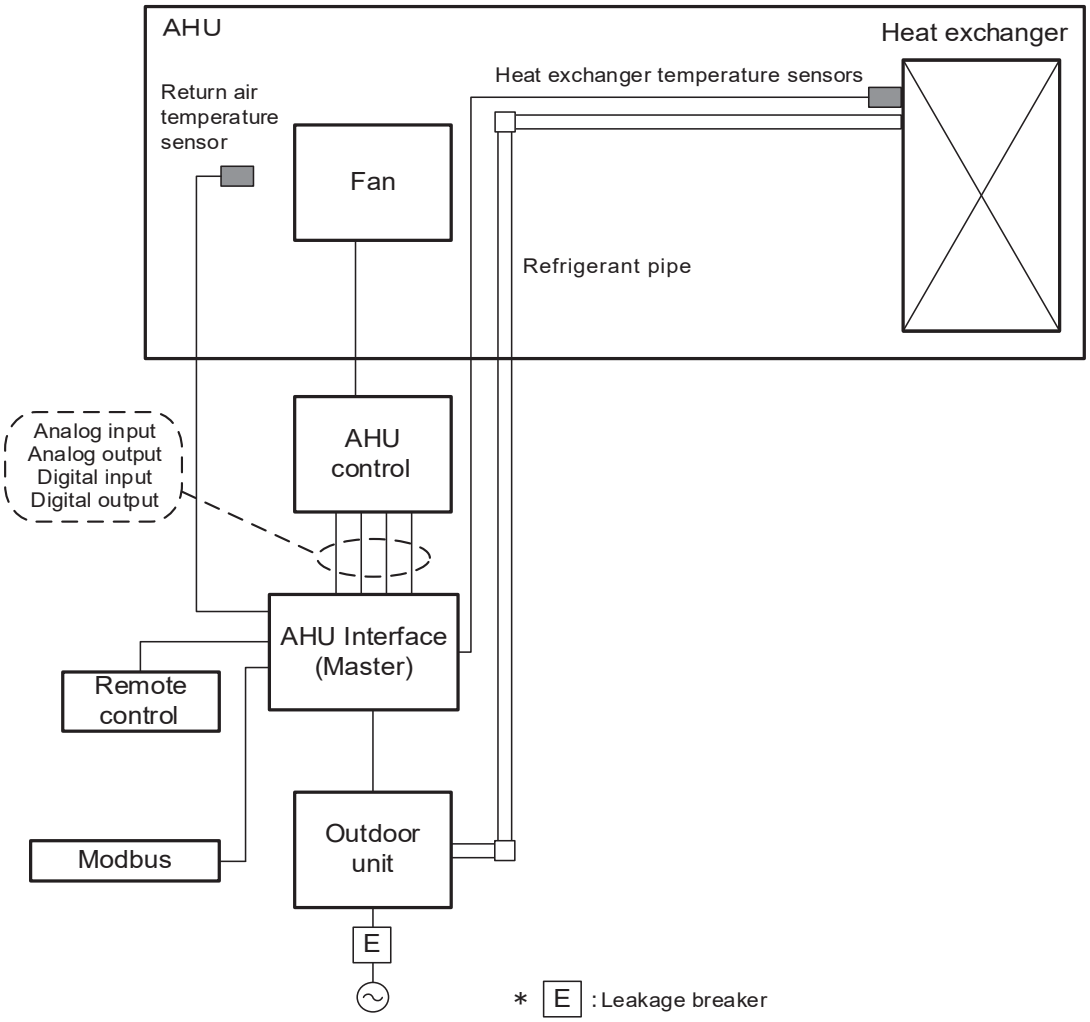
AHU Interface can communicate also on Modbus protocol and control the capacity (0 – 100%) and setting temperature, if necessary. For details, refer to related sections.

AHU Interface outline

(3) Systems based on AHU Interface

(a) Single refrigerant line system

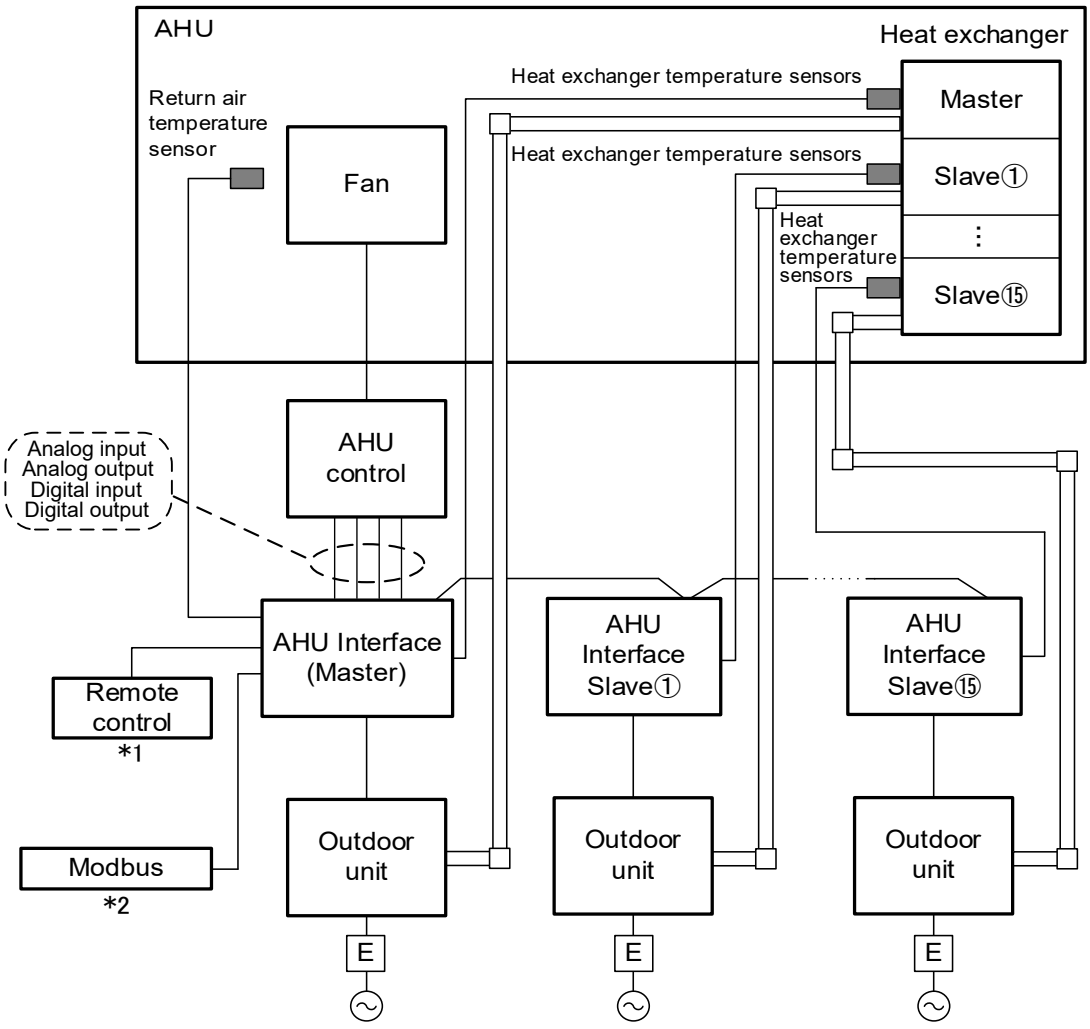
・Single refrigerant line system is a system composed of single refrigerant line, which is controlled with one unit of AHU Interface (Master).



* Leakage breaker of the leakage category Ⅲ must be used.

(b) Multiple refrigerant line system (Cascade control)

- Multiple refrigerant line system is a system which installs multiple refrigerant lines on AHU.
- Since multiple outdoor units can be connected in a system, it is adaptable to a large capacity.
- To this control, a combination of Master and Slave, a combination of maximum 16 units of AHU Interface and outdoor units, including Master, can be connected.
- Number of units can be controlled from AHU Interface (Master) according to the air-conditioning load.



*1 Remote control cannot be connected to Slave.

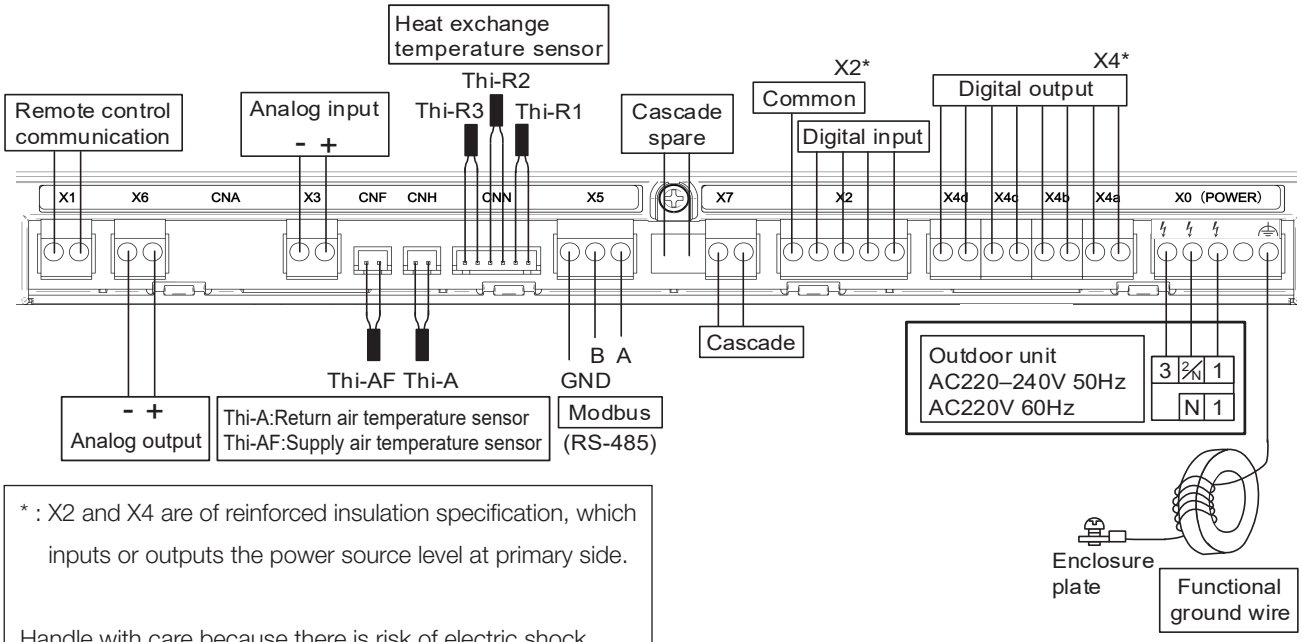
*2 Modbus cannot be connected to Slave.

*3 Leakage breaker of the leakage category Ⅲ must be connected.

*3 E : Leakage breaker

(c) AHU Interface input/output/in-output circuit

In-/output function of each connector is as follows.



* : X2 and X4 are of reinforced insulation specification, which inputs or outputs the power source level at primary side.

Handle with care because there is risk of electric shock.

(4) AHU Interface check sheet

- Although the heat exchanger is designed according to users' requirements, it needs to be used within the range of use for MHI outdoor unit at the same time.
- In order to check if the heat exchanger designed according the users' requirements falls within the range of use for air-conditioner, including air condition, utilize the check sheet referred to in 1.2.
- To design a heat exchanger, it is necessary to use the technical data for the outdoor unit to be connected. Design and select the heat exchanger according to the check sheet in 1.2 and the technical data of outdoor unit.
- AHU Interface is one of components for the air handling system, and the product assurance responsibility for entire air handling system is not covered by the assurance by MHI.

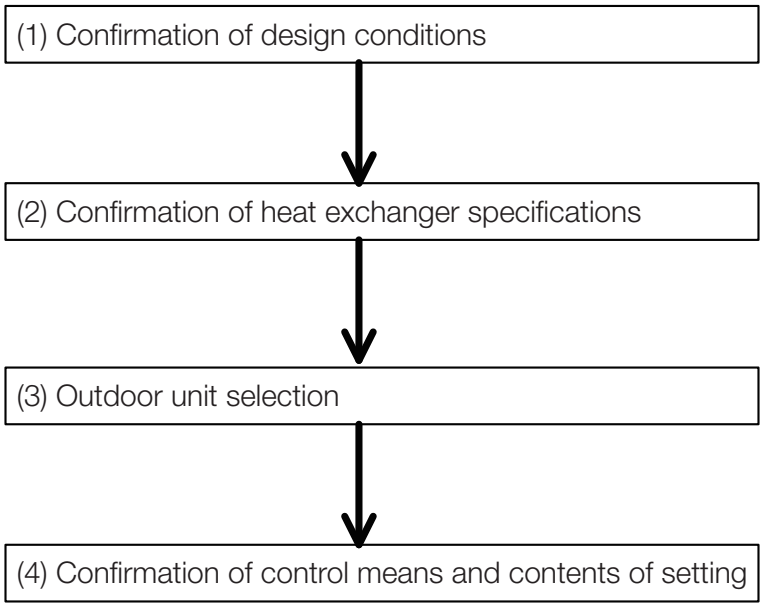
(5) Range of use

Confirm that the air condition, limitation of pipe length, or other, fall within the range of use for the air-conditioner. For practical range of use, refer to the technical data for the outdoor unit to be connected.

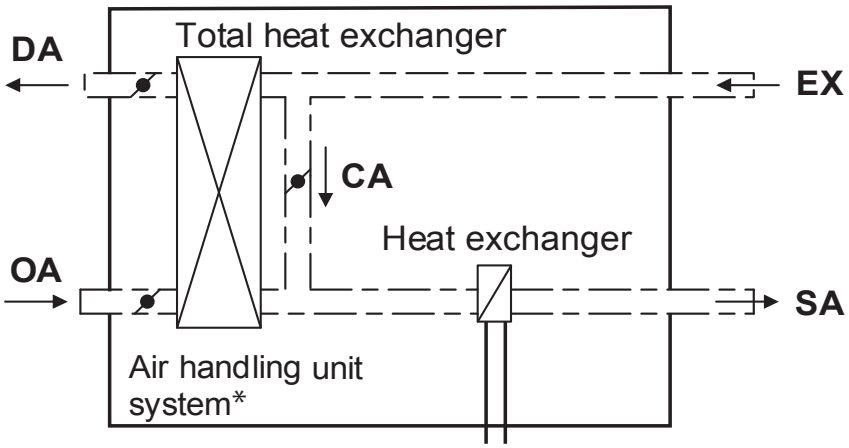
1.2 How to use

1.2.1 AIR HANDLING UNIT INTERFACE check sheet

Flow to select the outdoor unit and design the heat exchanger is as shown below.



◇ Refer to the following figure for the definition of design air condition and air capacity.



List of abbreviations	
EX	Exhaust air
OA	Outdoor air
DA	Discharge air
CA	Circulating air
SA	Supply air

* Due to the system's complexity, the illustration schematic and simplified.

(1) Confirmation of design conditions (Air capacity, suction air temperature/humidity, target temperature/ humidity)

(a) Design air condition

Exhaust air (EX)	Cooling	°CDB	°CWB
	Heating	°CDB	°CWB
Outdoor air (OA)	Cooling	°CDB	°CWB
	Heating	°CDB	°CWB

(b) Air capacity condition

Supply air(SA)	m^3/h
Circulating air(CA)	m^3/h
Outdoor air(OA)	m^3/h

(c) Total heat exchanger

Total heat exchanger	with( )	without( )
	If with, fill in following items	
	Exchange efficiency	
	Outdoor air volume	m^3/h
	Discharge air volume	m^3/h

(d) Humidifier, Heater

Humidifier	Humidifying volume	kg/h
Heater	Heater capacity	kW

(e) Design requirement capacity condition

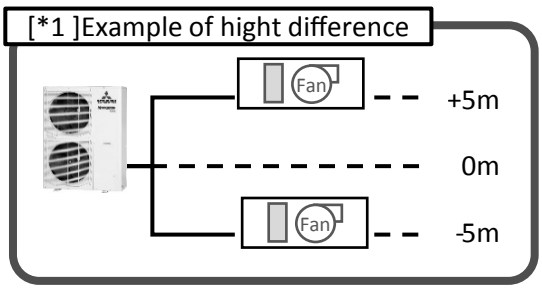
Requirement capacity	Cooling		kW
	Heating		kW
Heat exchanger inlet air condition	Cooling	°CDB	°CWB
	Heating	°CDB	°CWB

(f) Piping length

Piping length	m

(g) Height difference between in-/outdoor units [*1]

Hight difference	m



(2) Confirmation of heat exchanger specifications

Design the heat exchangers according to following conditions.

(a) Heat exchanger calculating conditions

Cooling evaporator outlet superheat degree	3degC
Heating condenser outlet subcool degree	1degC

Target evaporation temperature	5 — 12degC
Target condensation temperature	30 — 47degC

Calculate the heat exchanger capacity based on the design conditions of (1) and the above temperature condition.

(b) Connecting pipe size

Refer to the technical data of connected outdoor unit.

(c) Recommended number of heat exchanger circuits

When the pipe size of heat exchanger is ϕ 9.52, following number of circuits is recommended.

Recommended circuit number for ϕ 9.52 tube

Outdoor unit model capacity	40	50	60	71	100	125	140	200	250	280
Recommended circuit	2 — 4				4 — 6			6 — 10		

(d) Recommended number of heat exchanger columns

Maximum 3 columns is the standard design for heat exchanger.

If it has 4 or more columns, the heat exchanger efficiency will not be good.

Larger number of columns for heat exchanger increases its volume so that it becomes impossible to accommodate in the standard.

(e) Design pressure of heat exchanger

Limit the design pressure at $\geqq$ 4.15 MPa. This is common to R32 and R410A refrigerants.

(f) Allowable volume and minimum air capacity standard for heat exchanger

Limit the volume of heat exchanger within the range listed below for the volume of each outdoor unit.

Air capacity for heat exchanger must be larger than the minimum air capacity in the following list.

Outdoor unit model capacity	Allowable heat exchanger volume [L]		Minimum air volume	
	Min.	Max.	[m^3/h]	[m^3/min]
SRC40	0.3	0.8	420	7
SRC50	0.3	0.9	420	7
SRC60	0.5	1.1	480	8
FDC71	0.7	1.6	600	10
FDC100	0.7	2.1	840	14
FDC125	1.0	2.2	960	16
FDC140	1.0	2.8	1080	18
FDC200	1.2	4.2	1680	28
FDC250	2.0	4.4	1920	32
FDC280	2.0	4.4	2160	36

(3) Outdoor unit selection

Select correct outdoor unit by applying the correction value adequate for the condition of use.

Select the outdoor unit according to the following flow.

(a) Confirmation of the range of use

Confirm that the air condition, limit of pipe length, or other, fall within the range of use for air-conditioner.

(b) Correction coefficient A

Capacity correction according to air condition

Calculate the capacity correction coefficient according to the operation mode.

(c) Correction coefficient B

Correction for pipe length

Calculate the capacity correction coefficient.

(d) Correction coefficient C

Correction for height difference between in-/outdoor units

Calculate the capacity correction coefficient.

Make this correction only when the outdoor unit is positioned at the bottom during cooling and at the top during heating.

(e) Correction coefficient D

Calculate the correction coefficient for frosting on outdoor heat exchanger during heating (heating only)

Some models may have no correction coefficient D.

For the confirmation of the range of use and calculation of correction coefficients A to D, refer to the technical data of outdoor unit.

(f) Calculation of total correction coefficient

Calculate total correction coefficient by multiplying coefficient A to D.

Correction coefficient	Cooling	Heating
A		
B		
C		
D		
Total	α	β

Operation mode	Total correction coefficient
Cooling	Correction coefficient α = A x B x C
Heating	Correction coefficient β = A x B x C x D

(g) Calculation of rated capacity of outdoor unit

Confirm that the result of multiplying the rated capacity of selected outdoor unit by the total correction coefficient is larger than the required capacity.

Calculate for the heating and the cooling respectively.

When the capacity is insufficient, reselect the outdoor unit.

Outdoor unit model	Cooling(rated)	Heating(rated)	Number of units
	kW	kW	pcs.

Operation mode	① Rated capacity of selected outdoor unit	② ① x Number of outdoor units x Total correction coefficient		③ Required capacity (Necessary capacity)	Judgment ②≧③ :OK
Cooling	kW	pcs.	kW	kW	
Heating	kW	pcs.	kW	kW	

(h) Confirmation of volume of internal heat exchanger

Check **(f) Allowable volume for heat exchanger of (2) Heat exchanger calculating conditions** to see if the internal volume of AHU heat exchange is adequate for the selected outdoor unit.

Outdoor unit model	Number of units	AHU heat exchanger volume to be used(per outdoor unit)
	pcs.	

If it does not satisfy the conditions, set conditions once more.

(Resetting of indoor heat exchanger volume, resetting of outdoor unit volume, etc.)

(4) Select control method and settings

The outdoor units can be controlled by one of two methods (Capacity Control or Temperature Control).

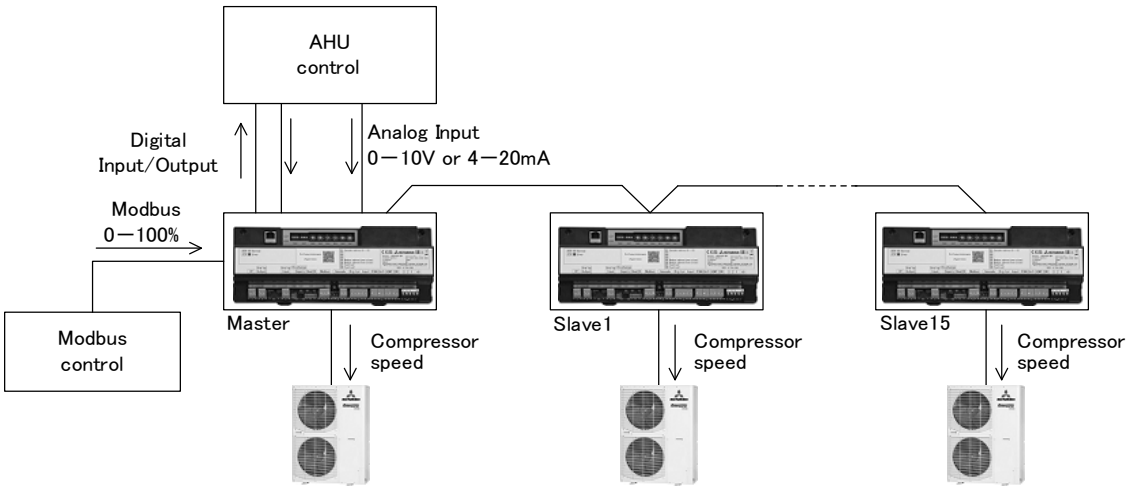
Select the suitable control combination (No.1 — No.4) based on the equipment to be installed.

Correct Master/Slave settings are required when using cascading control.

Check each setting by referring to table 1-1, 1-2 in this section.

(a) Capacity Control SW7-4：OFF (External input:0—10V / 4—20mA / 0—100%)

System diagram



The following control combinations are to be used for Capacity Control.

Table 1-1

No.	Analog input (0 — 10V/4 — 20mA)	Modbus (0 — 100%)	Remote control (Include SL adaptor)	AHU system How to Run/Stop
1	★	△ (*1)	Monitoring only(*2)	Digital input or Modbus(*3)
2	×	★	Monitoring only(*2)	Digital input or Modbus(*3)

★ : Main control for Capacity Control

△ : Option control

× : Not available

(*1) Analog input will be invalidated once 0 — 100% command is sent from the Modbus control.
Power reset is required to restore analog input function.

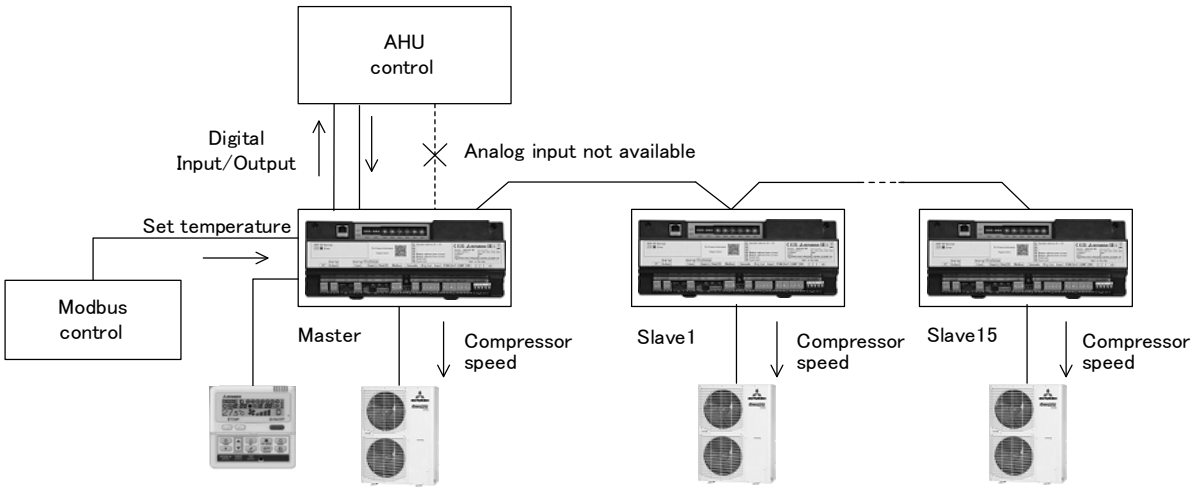
(*2) Monitoring purpose only. Operation from remote control is not possible.

(*3) Select either of the following ways to Run/Stop the AHU system:

- Digital input (ON/OFF)
- Modbus command (Run/Stop)

(b) Temperature Control SW7-4：ON (Set temperature control:16°C—30°C)

System diagram



The following control system can be used for Temperature Control.

Table 1-2

No.	Analog input (0 — 10V/4 — 20mA)	Modbus	Remote control (Include SL adaptor)	AHU system How to Run/Stop
3	×	★ (*4)	○ (*4)	Digital input, RC or Modbus(*5)
4	×	○ (*4)	★ (*4)	Digital input, RC or Modbus(*5)

★ : Main control

△ : Option control

× : Not available

(*4) Last received operation command has priority.

(*5) Select one of the following ways to Run/Stop the AHU system:

- Digital input (ON/OFF)
- Modbus command (Run/Stop)
- Remote control command (Run/Stop)

<Confirmation of peripheral equipment and setting contents>

① Selected control system

No. [ ]

② Confirmation of peripheral equipment to be connected to AHU Interface

Item	Model
AHU control	
Remote control	
Modbus	
Option	

③ Input/Output setting on AHU Interface

Check functions to use.

Connector	Input setting	Check
X2-1	Run/Stop	
X2-2	Cooling/Heating	
X2-3	Emergency stop	
X2-4	Reserve	-

Connector	Output setting	Check
X4a	Outdoor unit error interface error	
X4b	Compressor ON	
X4c	Defrost ON	
X4d	Run/Stop, Cooling / Heating, Fan ON / OFF	
X6	Analog output	

④ AHU Interface Master setting

Item	Setting
SW1(Interface address)	
SW2(Reserve)	-
SW3(Reserve)	-
SW4(Reserve)	-
SW5(Modbus address：ones)	
SW6(Modbus address：tens)	
SW7-1(Analog input switching)	
SW7-2(Modbus bps)	
SW7-3(Modbus parity setting)	
SW7-4(Compressor control)	
SW8-1(Digital output:X4d)	
SW8-2(Capacity step up control)	
SW8-3(Reserve)	-
SW8-4(Reserve)	-
JX1(Termination of Modbus)	
JX2(Analog input switching)	

⑤ AHU Interface slave setting

Only SW1 and JX1 setting is required for the Slave Interface.

AHU Interface No.	SW1(Interface address)	JX1(Termination of Modbus)
Slave1		
Slave2		
Slave3		
Slave4		
Slave5		
Slave6		
Slave7		
Slave8		
Slave9		
Slave10		
Slave11		
Slave12		
Slave13		
Slave14		
Slave15		

1.2.2 Sensor installation guidelines

● Install all sensors correctly.

Each sensor has particular function so that it must be installed correctly. Otherwise, the system will not function correctly.

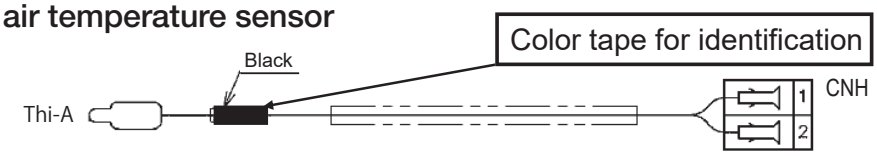
● Correct method for installation of temperature sensor (Example)

When installing the temperature sensor, confirm that it optimally touches the face to measure.

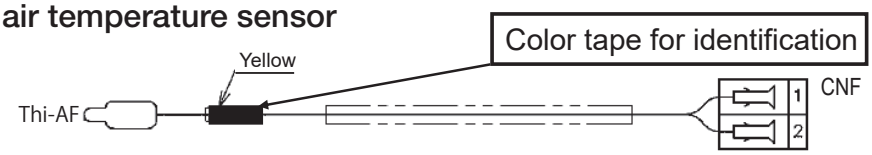
Fix it with a wide hose clamp.

If a cable tie is used, it may break down or crush the temperature sensor. Fix it with a wide hose clamp.

Return air temperature sensor



Supply air temperature sensor

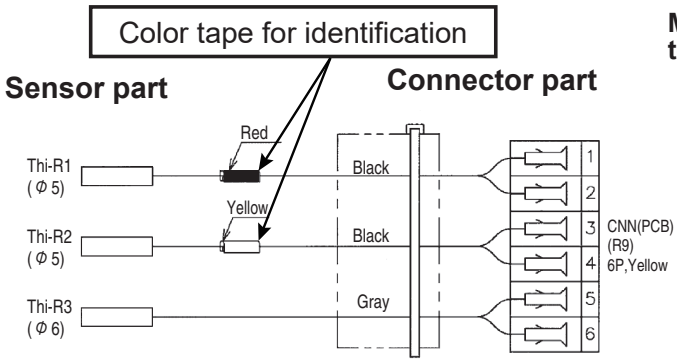


Temperature detection range

● Return air temperature sensor (Thi-A) and supply air temperature sensor (Thi-AF) can detect temperatures accurately in the range of 14 – 33 (±1.2)°C.

● Range of use for return air temperature sensor and supply air temperature sensor are -10 to 50°C.

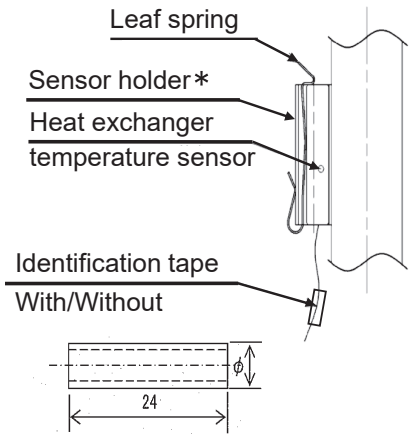
Heat exchanger temperature sensor



* Sensor holder : Provided locally

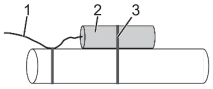
Sensor	ϕ	Material
For Thi-R3	ϕ 9.52 x t 0.6	Copper tube
For Thi-R1 and -R2	ϕ 8.0 x t 0.6	

Mounting method of heat exchanger temperature sensor (example 1)



Mounting method of heat exchanger temperature sensor (example 2)

No.	Designation
1	Temperature sensor cable
2	Temperature sensor
3	Fastener



• Installation locations of the heat exchanger sensor

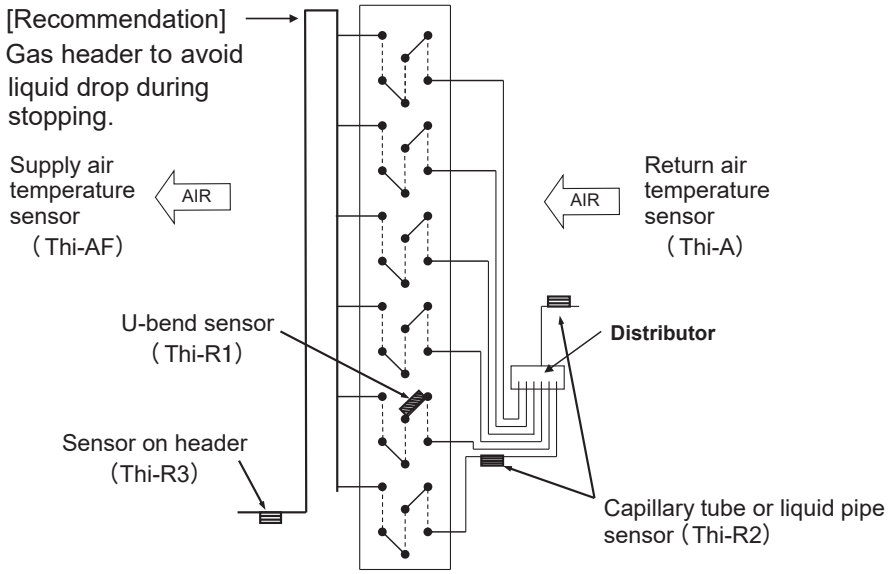
- Each heat exchanger requires 3 pieces of heat exchanger sensor.
- Connect heat exchanger sensor connectors to AHU Interface.
- Install each heat exchanger sensor correctly according to the following table.

Heat exchanger temperature sensor	Mounting position	Detected temperature		Purpose
		Cooling	Heating	
Thi-R1	U-bend	Evaporating temperature	Condensing temperature	Anti-freezing protection
Thi-R2	Capillary	Evaporating temperature	Outlet temperature	Anti-freezing protection
Thi-R3	Header	Outlet temperature	Inlet gas temperature	EEV-control

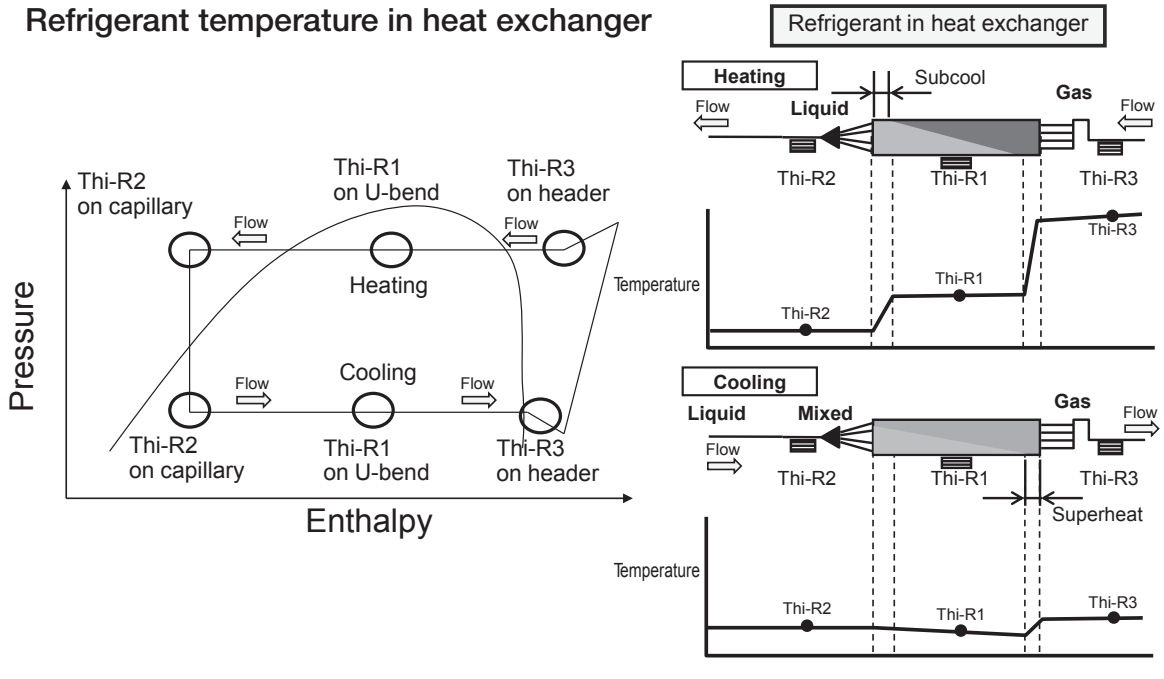
Temperature detection range

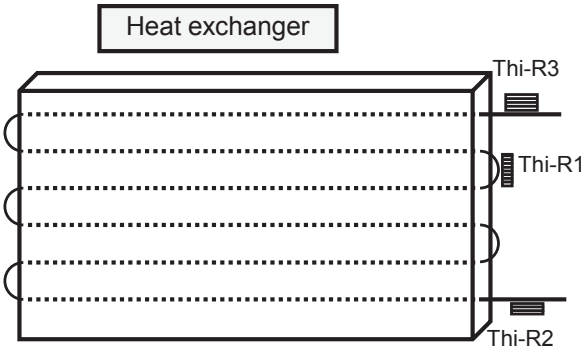
- Heat exchanger temperature sensors (Thi-R1, -R2, -R3) can detect temperatures accurately in the range of 0 – 63 (±2)°C.
- Range of use for heat exchanger temperature sensor is -30 to 72°C.

Mounting position of temperature sensors (example)



Refrigerant temperature in heat exchanger





Each sensor has unique function, Important to fix to correct location.
If fixed to incorrect location, the system will not be controlled correctly, double check during commissioning.
The Thi-R3 sensor diameter is larger than the others to avoid mistakes.

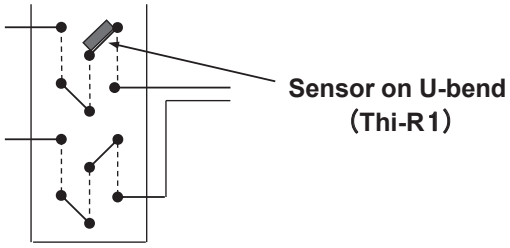
• Items to be checked

1. Thi-R1 : On U-bend section (with RED tape)

a) Considering the frost of the heat exchanger in cooling, mount the sensor on the circuit with the lowest temperature among all circuits (Avoid mounting on the lowest position of the circuit). However the circuit in which the liquid refrigerant is not held in heating operation is better.

b) Mounting the sensor at the middle point of the circuit pass is recommended. If it is mounted near to the header side or the distributor side, it will detect the temperature at the superheat or subcool area, so it cannot detect the actual condensing/evaporating temperature correctly.

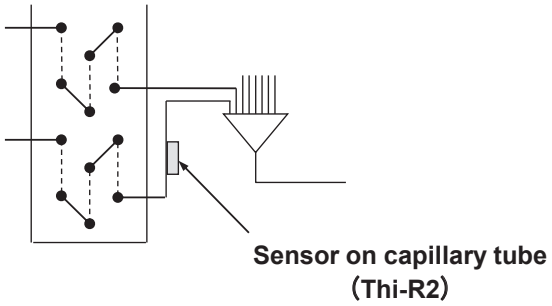
Be sure to check whether the refrigerant is in 2-phase flow in the circuit by testing the actual unit.



2. Thi-R2 : on capillary tube section of distributor (with YELLOW tape)

a) It should be mounted on the capillary tube section to detect the evaporating temperature under conditions enabling a good response.

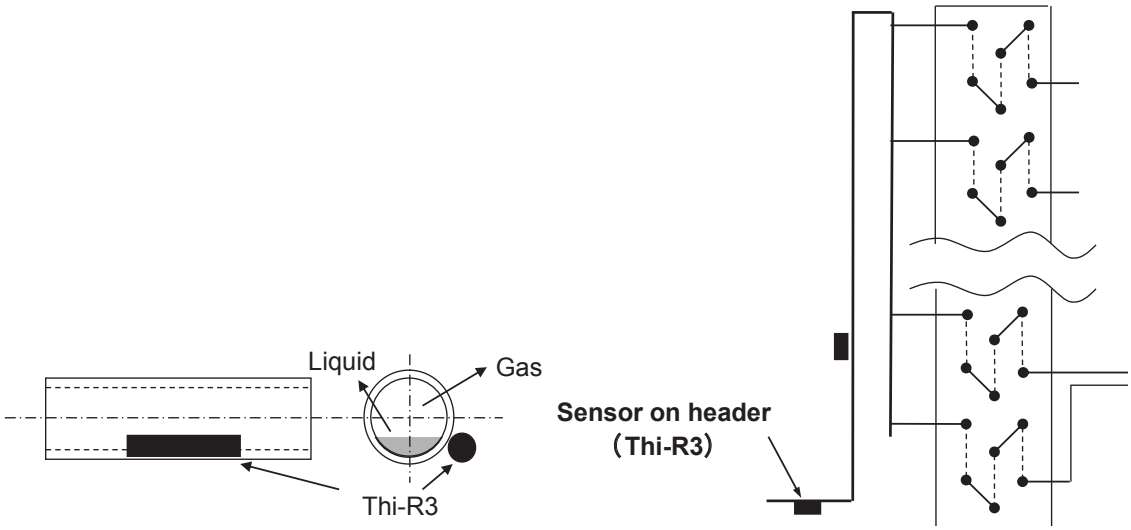
b) It should be mounted in a position that detects the average outlet temperature and not to hold the liquid refrigerant during heating.



3. Thi-R3 : On header section (without tape)

a) It should be mounted on the header main pipe after collecting refrigerant during cooling.

b) If the header main pipe runs horizontally, be sure to mount the sensor on the side part of the pipe to prevent from evaporating liquid refrigerant.



4. Thi-A : Return air temperature sensor (with BLACK tape)

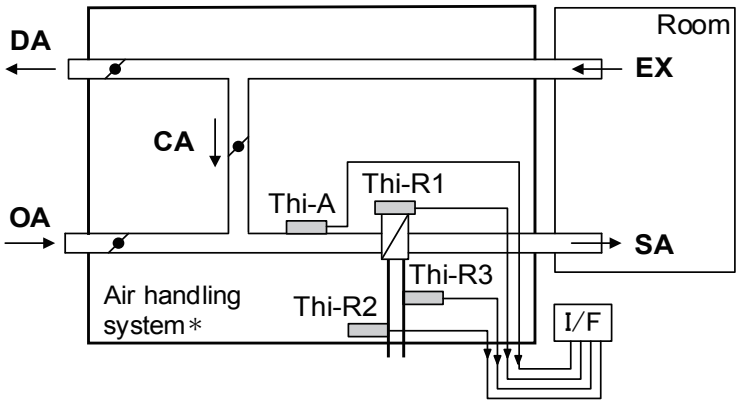
Fixed location

a) Install the suction temperature sensor at the suction side of heat exchanger.

b) Position where the air flow does not stagnate.

c) Position not to be affected by other heat source. (heat exchanger etc.)

List of abbreviations	
EX	Exhaust air
OA	Outdoor air
DA	Discharge air
CA	Circulating air
SA	Supply air



*Due to the system's complexity, the illustration schematic and simplified.

5. Be careful to mount the sensors in the correct position and by identifying the attached colour tape of each sensor.

6. Be sure to confirm whether the temperature of each sensor is correct by actual operation testing at commissioning.

• Other items to be checked

1. The indoor heat exchangers should have pockets for installing sensors.

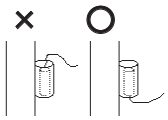
2. The indoor heat exchanger temperature sensors should not be affected by other heat sources.

- Avoid installing the sensors near any electrical devices that generate heat.
- Wrap the sensors with insulation and check for any temperature or air flow changes.
- Confirm that the sensors do not touch incorrect piping.
- The sensors must be installed where the temperature can be measured accurately.
- The sensors must have a good response and vary correctly.

3. The sensor should be inserted into the holder from the bottom side and the wiring should have a trap.

This is to prevent drain water from intruding into the sensor through the gap between the lead wire and the resin at the connecting part of the sensor.

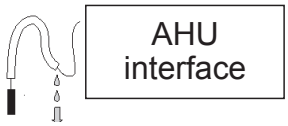
To avoid water intrusion from molding part



To have a trap

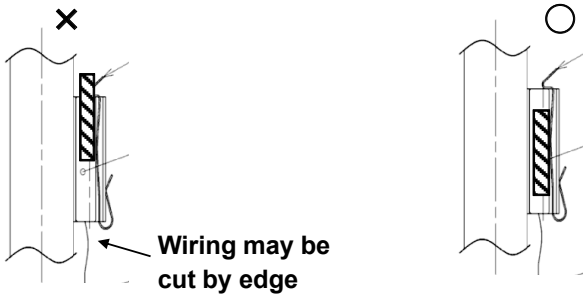
4. The drain water does not intrude into the connection part of the control box through the sensor wire (protective tube).

The wiring route must have a trap so that the drain water drops down just before the control box.



5. The sensor wiring should be loose and not tight.

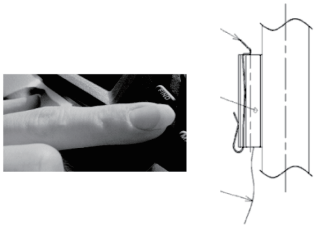
6. The sensors should not be inserted too far into the holder in order to prevent the sensor wire from being damaged.



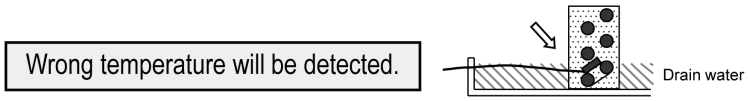
7. The sensors should not make contact with other parts.

8. The sensor wiring should not be located where a person can touch it.

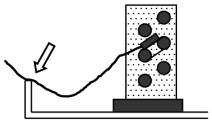
If it can be touched, ensure it is covered by a protective tube with a thickness of 1 mm or more. (for safety reasons)



9. The sensors should not be mounted in a position where the drain water accumulates.



10. The sensor wiring should be covered by a protective tube or rerouted to prevent it from being cut by metal edges.



2. Single cooling line system

2.1 Single cooling line system – Outline

This is a system composed of single refrigerant line (1 outdoor unit), and is controlled with one unit of AHU Interface.

- Since it is necessary to adjust PCB to Master setting, SW1 (Address) must be set at 0.
- Make sure to connect attached suction air temperature sensor and heat exchanger temperature sensor.
- For specifications of combination outdoor unit, refer to the instruction manual of the outdoor unit.
- AHU Interface outputs externally information on the connected outdoor unit.
  It also transmits the compressor speed command to the outdoor unit in response to external input.

<Roles of AHU Interface>

Operation command input
Suction air temperature measurement
Heat exchanger temperature measurement
Operation command to outdoor unit
Outdoor unit status output

2.2 Specifications

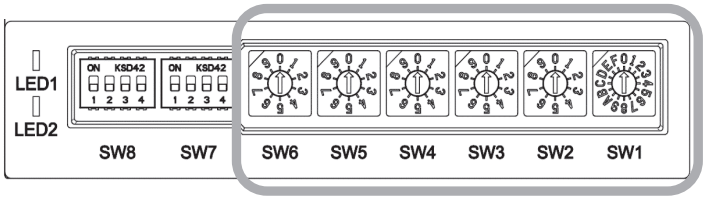
(1) AHU Interface Master input switch

Switch setting

Item	Switch			Item	Remark	Default setting
Rotary switch	SW1		Yellow	Interface address	0-F (Master : 0)	0
	SW2		Yellow	Spare	0, fixed	0
	SW3		Red	Spare	0, fixed	0
	SW4		Red	Spare	0, fixed	0
	SW5		Yellow	Modbus address (Ones)	0-9	0
	SW6		Yellow	Modbus address (Tens)	0-9	0
DIP switch	SW7	Black	-1	Analog input selection	ON : 4 – 20 mA OFF : 0 – 10 V	OFF
			-2	Modbus baud rate (bps)	ON : 9600 bps OFF : 19200 bps	OFF
			-3	Modbus parity	ON: NON parity +2 stop bit OFF: Even parity +1 stop bit	OFF
			-4	Compressor control	ON: Temperature control OFF: Capacity control	OFF
	SW8	Black	-1	Digital output:X4d switching	ON: Cooling/Heating OFF: Setting via Modbus	OFF
			-2	Capacity step up control	ON: Valid OFF: Invalid	OFF
			-3	Spare	OFF, fixed	OFF
			-4	Spare	OFF, fixed	OFF
Shorting PIN	JX1		3P	Modbus terminal selection	1-2 short: No terminal resistor 2-3 short: With terminal resistor, 100Ω	1-2 short
	JX2		3P	Analog input selection	1-2 short: 0 – 10V 2-3 short: 4 – 20mA	1-2 short
	JX3		3P	Spare	2-3 short	2-3 short

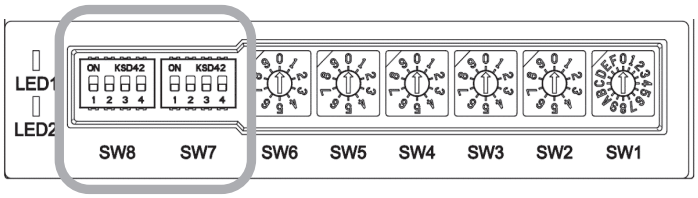
On switches designated as Spare, do not change from the state of 0 or OFF.

● **Rotary switch function**



- Set Master or Slave with SW1.
- On the single refrigerant line system, make sure to set the interface address at 0.
- SW2 – SW4 are spare switches.
- SW5 and SW6 set Modbus communication addresses.
  SW5 is for ones place. SW6 is for tens place
  This interface becomes Slave on Modbus communication.
  Set Modbus addresses in the range of 1 – 99. (Initial address setting: 01)
  * Slave address cannot be set at 0 on Modbus communication.

● **DIP switch function (only Master Unit)**



- SW8-3 to SW8-4 are spares, which must be set at OFF.
- SW7-4 allows selecting methods to control compressor speed rps.
  OFF: Commands the required capacity to the outdoor unit (compressor).
  ON: Controls the outdoor unit with the air-conditioning control.

[SW7-4: OFF] Capacity Control

- The volume control commands the required capacity to the outdoor unit.
- 0 – 100% can be commanded as the required capacity with following methods.
  1) Based on the input voltage (0 – 10V) or input current (4 – 20mA) from Analog Input, a value in % corresponding to the voltage or current is commanded to the outdoor unit.
  2) The required capacity in 0 – 100% is commanded to the outdoor unit by Modbus communication.

[Supplementary]

Priority is given to Modbus command between Analog Input and Modbus.
If Modbus control transmits a 0 – 100% command, the Analog Input is invalidated.
It is necessary to reset the power source to revitalize the disabled analog input.

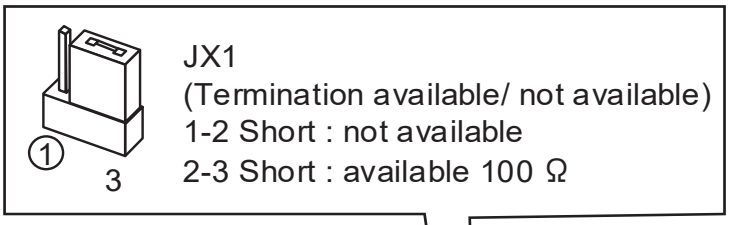
[SW7-4: ON] Temperature Control

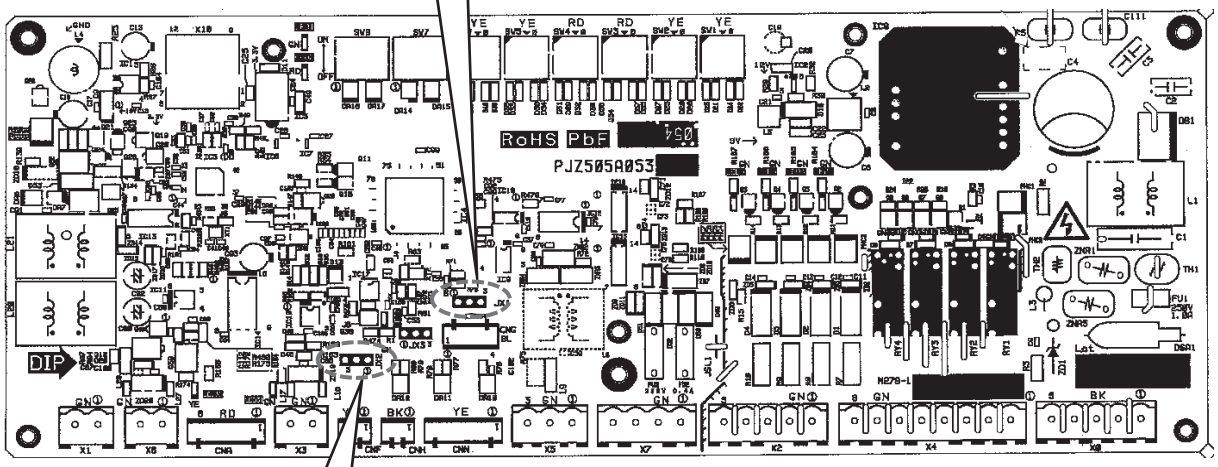
- The air-conditioning control controls the outdoor unit by the difference between the temperature sensor value and setting temperature of AHU Interface.
- It controls the outdoor unit so as to bring the suction temperature sensor value to the setting temperature.
- Setting value of AHU Interface can be changed as follows.
  1) By changing the setting temperature with remote control.
  2) By changing the setting temperature with Modbus communication.

[Supplementary]

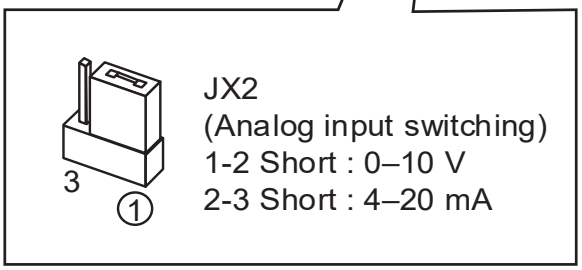
In the operation to change the setting temperature by remote control and Modbus, the latter takes priority over former.

● **Shorting plug function**





PCB of AHU Interface



- Functions can be changed by switching shorting plugs on PCB.
- JX1: Select With/No for terminal resister on Modbus communication circuit.
- JX2: Switches the analog input circuit function.
- JX3 is spare. Do not change from the initial setting: 2-3P.
- When setting these, check the numbers on PCB carefully.

(2) External in-/output terminals

Connector LED

Item	Connector LED		Housing	Color	Function	Remark
Analog input	CNH		2P	Black	Return air temperature	Thi-A
	CNF		2P	Yellow	Supply air temperature	Thi-AF
	CNN		6P	Yellow	Heat exchanger (U bend)	Thi-R1
					Heat exchanger (capillary)	Thi-R2
					Heat exchanger (Header)	Thi-R3
	X3		2P	Green	Capacity Control	0 – 10V/4 – 20mA can be selected by JX2 setting.
Digital input	X2		5P	Green	X2-1: Run/Stop	Power source: AC24 — 240V/DC20 — 130V, 0.5A
					X2-2: Cooling/heating	Power source: AC24 — 240V/DC20 — 130V, 0.5A
					X2-3: Emergency stop	Power source: AC24 — 240V/DC20 — 130V, 0.5A
					X2-4: Spare	Power source: AC24 — 240V/DC20 — 130V, 0.5A
					X2-5: Common	Common terminal
Analog output	X6		2P	Green	Analog output:0—10V	Maximum tolerable load 1kΩ (10mA)
Digital output	X4a		2P	Green	Outdoor unit, interface error	No voltage, a-contact output
	X4b		2P		Compressor ON	No voltage, a-contact output
	X4c		2P		Defrost ON	No voltage, a-contact output
	X4d		2P		[SW8-1:ON] Cooling/Heating (Fixed) [SW8-1:OFF] Function selectable via Modbus; ① Run/Stop [Initial] ② Cooling/heating ③ Fan ON/OFF	No voltage, a-contact output X4d can be selected with Modbus communication.(SW8-1:OFF) or SW8-1 ON:Coolin/Heating
	LED 1			Green	Normal	
	LED 2			Red	Error	
In-/ output	X1		2P	Green	Remote control	Remote control can be connected to SC-ADNA-E.
	X5		3P	Green	Modbus	RS-485 communication circuit
	X7	1	2P	Green	Cascade	Cascade control connector
		2				
		3	2P		Cascade spare	Spare cascade control connector
		4				
	X0	1	5P	Green	X0-1: Function earth	
		2			X0-2: Open port	For reinforced insulation
		3			X0-3: Power, L	AC 220 — 240 V
		4			X0-4: Power, N	AC 220 — 240 V
		5			X0-5: Communication terminal	

(3) Analog input circuit: X3 connector (only Master Unit)

Compressor speed can be controlled with analog input signal (0 – 10V/4 – 20mA).

AHU Interface converts 0 – 10V/4 – 20mA signals within the rage of 0 – 100% to grasp the capacity necessary for AHU System.

If the outdoor unit uses 100% of necessary capacity, it operates at the maximum speed of outdoor unit.

To use the analog input function, set the DIP switch SW7-4 to “OFF” to enable the capacity control.

1) 0 – 10V capacity control (SW7-1: OFF and JX2: 1-2 Short)

0 – 10V signals are converted to 0 – 100% necessary capacity.

Take note that there is an insensitive zone (dead band) in certain range.

Example) If 0.5V is input, the necessary capacity becomes 0%.

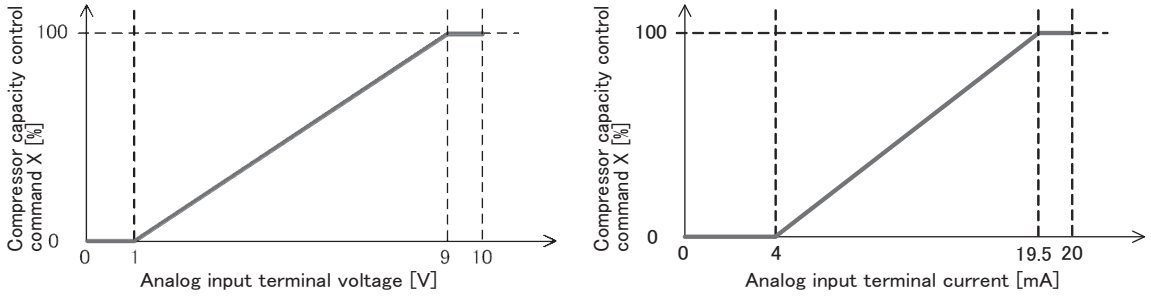
2) 4 – 20mA capacity control (SW7-1: ON and JX2: 2-3 Short)

4 – 20mA signals are converted to the necessary capacity of 0 – 100%.

Take note that there is an insensitive zone (dead band) in certain range.

Example) If 0.7V is input, the necessary capacity becomes 0%

It controls necessary capacity of outdoor unit with Analog input signal: 0 – 10 [V]/4 – 20 [mA] in the following range.



Capacity control command X [%] x Analog input conversion table

Capacity control command [%]	0	10	20	30	40	50	60	70	80	90	100
Analog input voltage [V]	1.0	1.8	2.6	3.4	4.2	5.0	5.8	6.6	7.4	8.2	9.0
Analog input current [mA]	4.0	4.8	7.1	8.6	10.2	11.8	13.3	14.9	16.4	18.0	19.5

(4) Digital input circuit: X2 connector (only Master Unit)

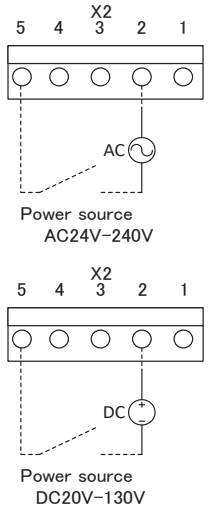
- ON/OFF can be recognized with the change edge of voltage input in the digital input terminal: X2.
- Digital input terminal: X2-5 is Common terminal.
  To use X2-1 - X2-4, wire it as a set with X2-5.
- Functions of digital input terminals are as follows.

Digital input terminal function list

Terminal	Function	ON (Shorted)	OFF (OPEN)
X2-1	Run/Stop	Run	Stop
X2-2	Cooling/Heating	Heating	Cooling
X2-3	Emergency stop	Emergency stop	Emergency stop release
X2-4	Reserve	-	-
X2-5	Common		

- When operations compete with that of remote control or Modbus after switching Run/Stop or heating/cooling, latter operation takes the priority.
- When the emergency stop is overlapped with inputs from Modbus, it cannot reset unless both of them are turned OFF.

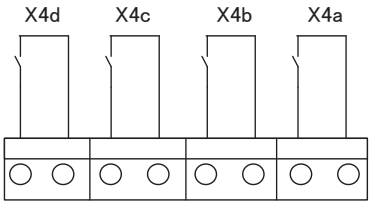
Digital input：Example X2-2



(5) Digital output circuit: X4 connector

- Digital output terminal outputs ON/OFF status with voltage.
- Functions of each digital terminal are as follows.

Digital output
Voltage free a contact output



1) X4a-X4d

Terminal	Function	ON (Shorted)	OFF (OPEN)
X4a	Outdoor Unit/Interface error	Error	Normal
X4b	Compressor ON	Compressor ON	Compressor OFF
X4c	Defrost ON	Defrost ON	Defrost OFF
X4d	Function selectable*	Run	Stop

* X4d can be changed with SW8-1 and Modbus communiscation.

SW8-1	Digital Output : X4d		
	Function	ON	OFF
ON	Operation mode output	Heating	Cooling
OFF	Modbus communication*		
	①Run/Stop	Run	Stop
	②Operation mode	Heating	Cooling
	③Fan ON/OFF	Fan ON	Fan OFF

*Initial : ①Run/Stop

[Digital Output of Master unit]

All slave units are the subjects to Master's signal output X4 (from a to d).

If either master or slave meets the required output condition, the signal X4 will be sent out ("OR" condition).

[Digital Output of Slave unit]

Digital output of Slave unit are separately outputted according to its system's status.

<Delay time setting for Fan On/Off output > (only valid for Master Unit)

This control can be used only when you select "Fan ON/OFF" as X4d setting.

According to the delay time configured by Modbus communication, the fan output will be kept "ON" even after stopping a Cooling/ Heating operation.

The fan output will be also kept "ON" in the case when an emergency stop enters while the unit's operation is stopping.

・It can be set by Modbus Communication.

Emergency stop

	0	1	2	3
Cooling	Invalid	5 minutes	15 minutes	48 hours
Heating	Invalid	5 minutes	15 minutes	48 hours

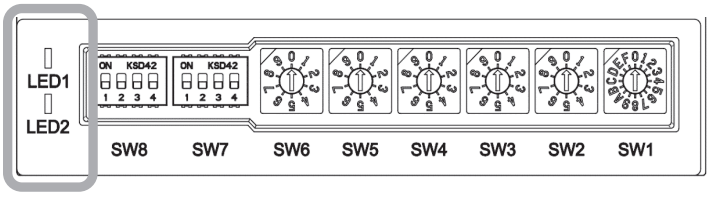
【Initial】

System stop

	0	1	2	3
Cooling	Invalid	30 minutes	60 minutes	6 hours
Heating	Invalid	30 minutes	60 minutes	6 hours

【Initial】

2) LED output



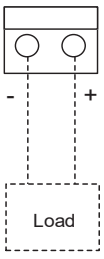
- Normal/error status of the system can be confirmed with LED output.
- LED1 (G): Flickers at 0.5 sec cycle normally.
- LED2 (R): Flicker if any error occurs. (Normally OFF) For details, refer to 6. Error display

(6) Analog output circuit: X6 connector (only Master Unit)

- The analog output terminal output 0—10V status.
- Output by setting the air volume from the remote control during system operation.
- Any voltage can be set 0—10V by Modbus communication (In increments of 0.1V).
- The analog output is 0V during the system is stop.

Air volume	Analog output
AUTO	8.0V
1 Speed	3.0V
2 Speed	5.0V
3 Speed	8.0V
4 Speed	10.0V

Analog output:X6
DC 0—10V



(7) In-/output circuits

• There are following input functions.

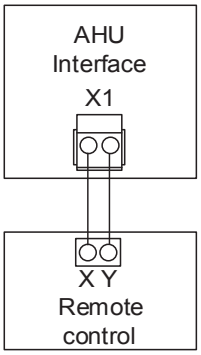
Item	Connector		Housing	Function
Input/ Output	X1		2P	Remote control
	X5		3P	Modbus (RS-485)
	X7	-1	2P	Cascade control
		-2		
		-3	2P	Cascade control (Reserve)
		-4		
	X0		5P	Power (X0-2 is an empty port)

1) Remote control communication circuit (only Master Unit)

• X1 connector: Remote control communication terminal (There is no polarity.)

• Remote control can be installed if necessary.

• When connecting the remote control, connect it to Master (SW1 = 0).



X1 connector is effective at Master setting (SW1: Address 0) only.

2) Modbus communication circuit (RS-485) (only Master Unit)

• X5 connector: Modbus communication circuit terminal

• Also when connecting Modbus communication, connect it to Master.

X5-1	A polor
X5-2	B polor
X5-3	GND
JX-1 (Termination)	1-2:Not available 2-3:Available 100Ω

X5 connector is effective at Master setting (SW1: Address 0) only.

3) Cascade communication circuit

• X7 connector: Cascade connection circuit terminal

• This is not used on single refrigerant line systems.

2.3 Basic control

(1) Operation stop command to AHU system

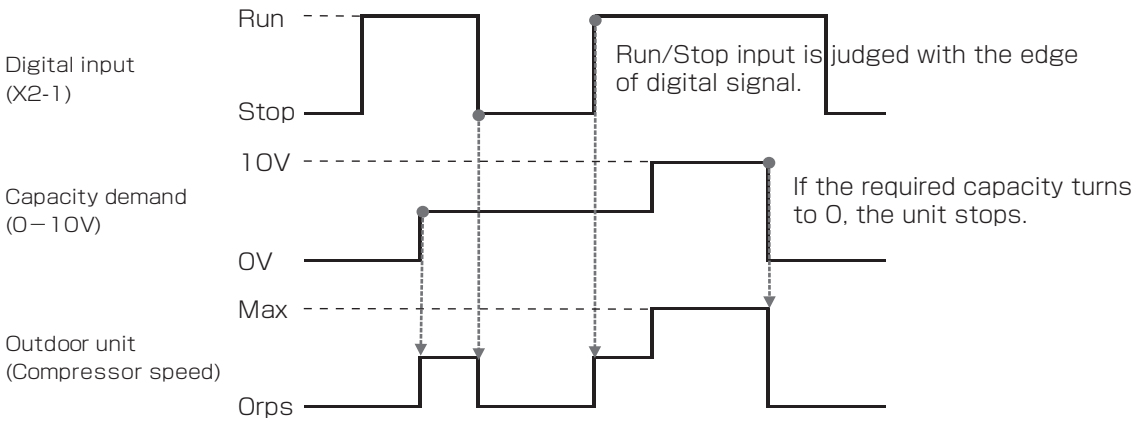
Run/Stop means to the system vary depending on the setting of SW7-4. Either one of Run/Stop means must be provided.

1) Capacity Control (SW7-4 : OFF)

AHU system How to Run/Stop
Digital input or Modbus (*1)

(*1) Select either of the following ways to Run/Stop the AHU system:
- Digital input (Run/Stop)
- Modbus command (Run/Stop)

Samples of system Run/Stop are as shown below. Although the compressor speed is shown as if it adapts immediately, it has a time lag actually.

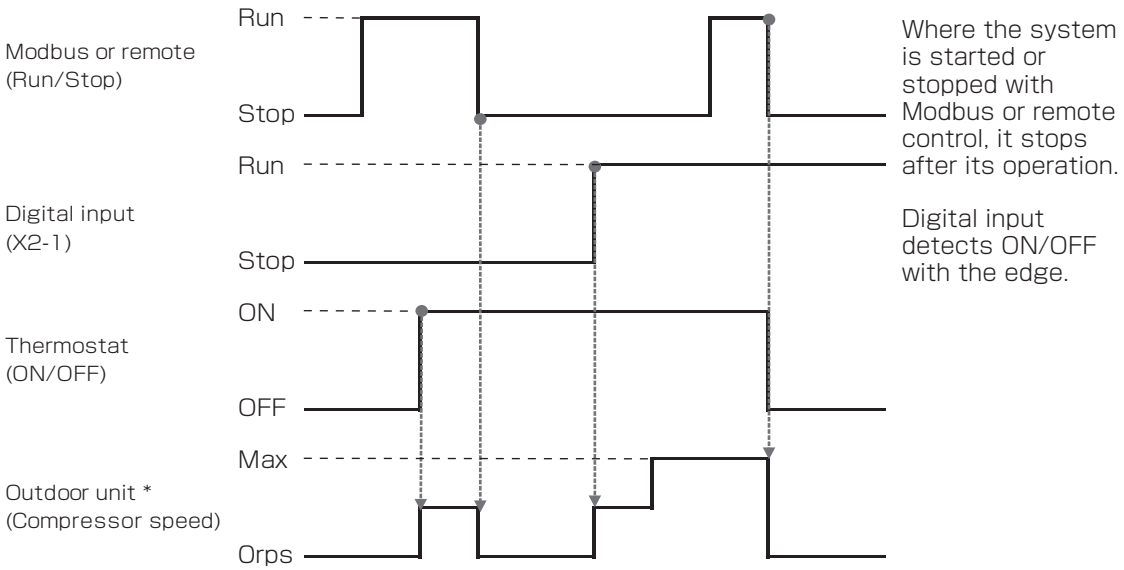


2) Temperature Control (SW7-4 : ON)

AHU system How to Run/Stop
Digital input, RC or Modbus(*2)

(*2) Select one of the following ways to Run/Stop the AHU system:
- Digital input (Run/Stop)
- Modbus command (Run/Stop)
- Remote control command (Run/Stop)

Samples of system Run/Stop are as shown below. Although the compressor Speed is shown as if it adapts immediately, it has a time lag actually.



* By the air-conditioning control (See page 32.)
(Temperature Control)

(2) Operation mode selection

AHU Interface allows selecting two operation modes.

- Cooling mode
- Heating mode

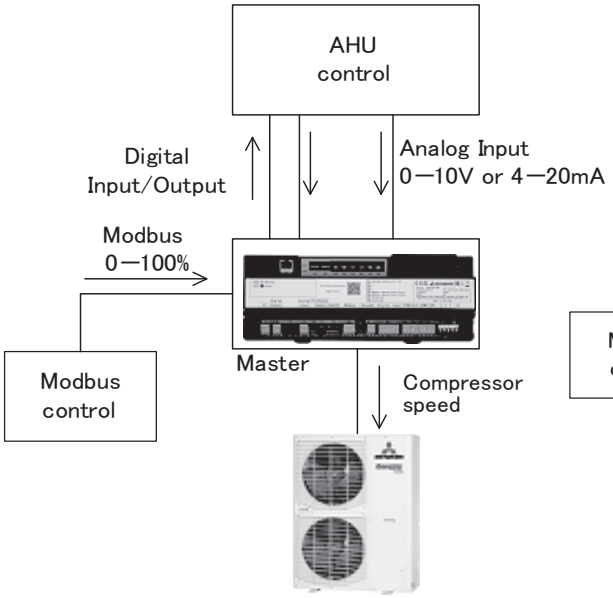
Operation mode can be changed in three ways.

- Operation mode switching by external input
- Operation mode switching by remote control operation
- Operation mode switching with Modbus communication

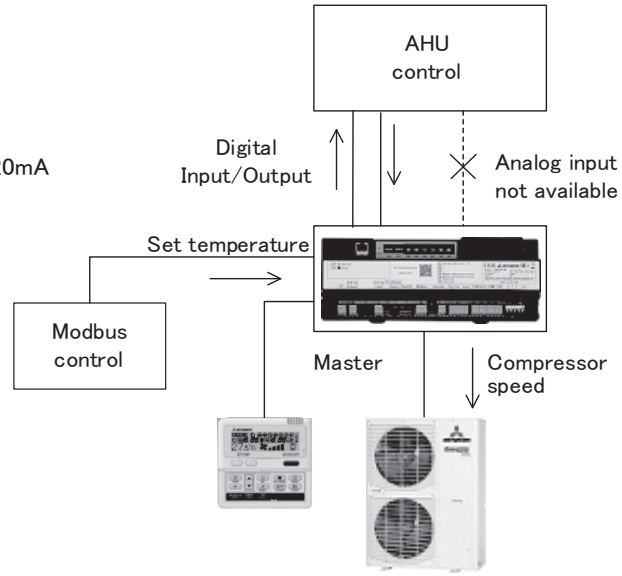
(3) Outdoor unit control means selection

Outdoor unit control means can be changed with SW7-4.

- Capacity Control SW7-4 OFF
- Temperature Control SW7-4 ON



Example of Capacity Control: SW7-4 OFF system



Example of Temperature Control: SW7-4 ON system

(3-1) Capacity Control

Required capacity can be commanded to the outdoor system as follows.

1) Command from Analog input – Refer to 2.2 (3) Analog input circuit.
2) Command from Modbus – Modbus communication allows transmitting the capacity command signal of 0 – 100% in the unit of 0.01%.

See **4. Modbus communication.**

(Caution)

When commands from Analog input and Modbus compete each other, command from Modbus takes the priority, invalidating that of Analog input.

(3-2) Temperature Control

Temperatures are set from the remote control or Modbus. It control the outdoor unit with the difference with the suction temperature sensor.

Setting temperatures are determined as follows.

1) From the remote control – Refer to the instruction manual of remote control.
2) From Modbus – Refer to **4. Modbus communication.**
   When the temperature setting from remote control completes with that from Modbus, the latter takes the priority.

In the air-conditioning control, amount of increase or decrease in the compressor speed is determined by the size of difference E between the temperature setting Ts and suction temperature Ta.

In Modbus communication, Gain can be multiplied to this amount of increase or decrease in compressor speed: Δf.

Initial value of Gain is 0.5. Amount of increase or decrease in Δf can be adjusted in the range of 0.1 – 10 by changing the setting of Gain.

Cooling: E = Ta – Ts

Heating: E = Ts – Ta

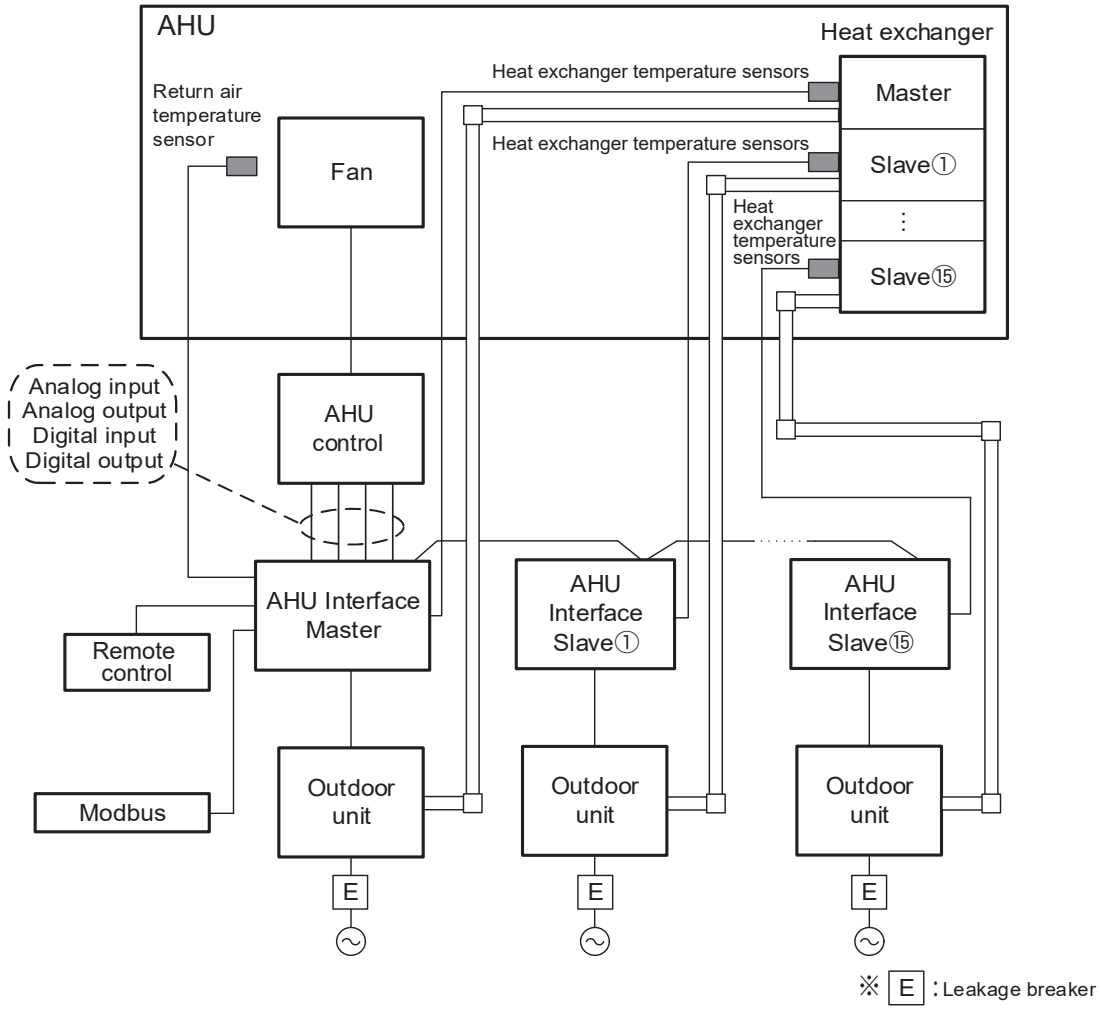
Table: Increase/decrease in compressor speed Δf relative to temperature difference E

E	⊿ f	E	⊿ f	E	⊿ f	E	⊿ f
-8.00	-30	-3.75	-12	0.25	0	4.25	18
-7.75	-28	-3.50	-12	0.50	0	4.50	18
-7.50	-28	-3.25	-10	0.75	2	4.75	20
-7.25	-26	-3.00	-10	1.00	2	5.00	20
-7.00	-26	-2.75	-8	1.25	4	5.25	22
-6.75	-24	-2.50	-8	1.50	4	5.50	22
-6.50	-24	-2.25	-8	1.75	4	5.75	24
-6.25	-22	-2.00	-6	2.00	6	6.00	24
-6.00	-22	-1.75	-6	2.25	6	6.25	24
-5.75	-20	-1.50	-6	2.50	8	6.50	26
-5.50	-20	-1.25	-4	2.75	8	6.75	26
-5.25	-18	-1.00	-4	3.00	10	7.00	26
-5.00	-18	-0.75	-4	3.25	10	7.25	28
-4.75	-16	-0.50	-2	3.50	12	7.50	28
-4.50	-16	-0.25	0	3.75	14	7.75	28
-4.25	-14	0.00	0	4.00	16	8.00	30
-4.00	-14						

3. Multiple refrigerant line system: Cascade control

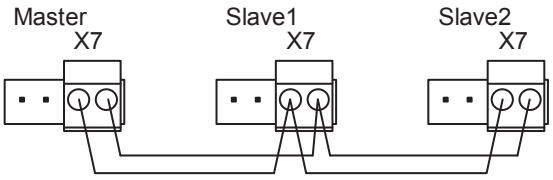
3.1 Cascade control - Outline

● This is a system in which two or more refrigerant lines are used in one AHU system.



● Connecting method

- X7 connector allows connecting and controlling multiple units of AHU Interface and outdoor unit.
- Only one outdoor unit can be connected to AHU Interface.
- Example of connection for each Interface for the cascade control is as shown below.

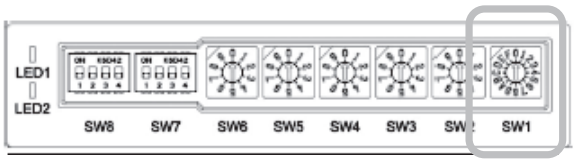


3.2 Difference of specifications/setting with cascade control single refrigerant system

(1) Input switch in cascade control

Switches are same as in the single refrigerant line. Check 2.2.

(a) Address setting: SW1



- · It is necessary to set Master for one unit of AHU Interface. Make sure to set SW1 (Address) of Master at 0.
- · Master setting (SW1=0 setting) is on one unit only.
- · Any of 1 – F can be set for the Slave address, if it is other than 0. Addresses cannot be duplicated.
- · Master judges the number of connected units automatically.
- · Slave unit can be added on the way.

(b) Sensor connection

- · Make sure to connect attached suction air temperature sensor and heat exchanger temperature sensor.
- · Connect the suction air temperature sensor to CNH connecter. Connect the heat exchanger temperature sensor to CNN connector.
- · Connect the suction temperature senor to Master. This is not necessary for Slave.
- · Make sure to connect the heat exchanger temperature sensor to each of Master/Slave of Interface.
- · When connecting each temperature sensor, take care to connect it to correct position.

  If heat exchanger temperature sensors (Thi-R1 – Thi-R3) are misconnected such that those connected to Interfaces of Master and Slave are installed in respective heat exchanger, the protection control cannot function correctly, resulting in trouble or error. (Refer to page 8 and pages 17 – 22).

(2) Master/Slave in-/output functions in cascade control

In-/output functions are controlled by Master unit. Connect all in-/output circuits, other than the temperature sensor, to Master.

Slave unit does not communicate either with the remote control nor Modbus.

Master unit outputs its own status (information) and that of Slave externally.

Master unit controls commands to Slave unit.

It is not necessary to connect external in-/output, other than sensor and cascade connection wires and Digital output, to Slave unit.

Slave unit needs connections to outdoor unit (X0 connector), heat exchanger temperature sensor (CNN connector) and cascade signal wire (X7 connector).

Although Digital output of Slave unit is effective, its connection is option.

3.3 Basic control

· AHU Interface master controls all Slaves.

· All of Run/Stop, operation mode and thermostat ON/OFF are judged by Master.

· Rotation control and fault backup control are enabled automatically.

(1) Capacity distribution control in multiple unit connection

- AHU Interface Master calculates the required capacity from AHU system according to the number of connected outdoor units.
- It calculates necessary capacity for entire system: X_all [%] from the require capacity from AHU system: X = 0 – 100% and the number of connected units.
- Based on the result of X_all [%], Master commands the distributed required capacity Xn [%] to Slave, and control the number of operating units.

• Optimum compressor speed control [Initial : Valid]

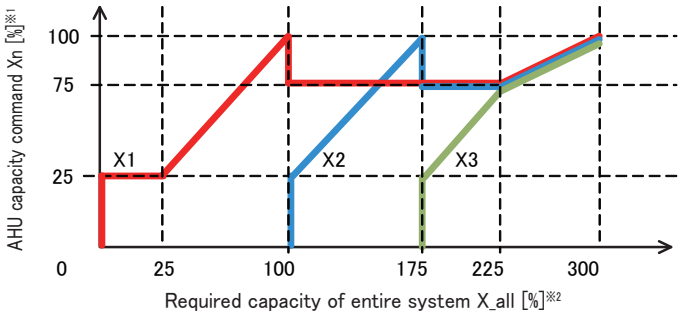
· Restriction applies to the upper limit of compressor speed.

· The upper limit of compressor speed is restricted at 75%.

· Values of the upper limit of compressor speed can be changed with Modbus.
(Initial value: 75%. Range: 40 – 90%.)

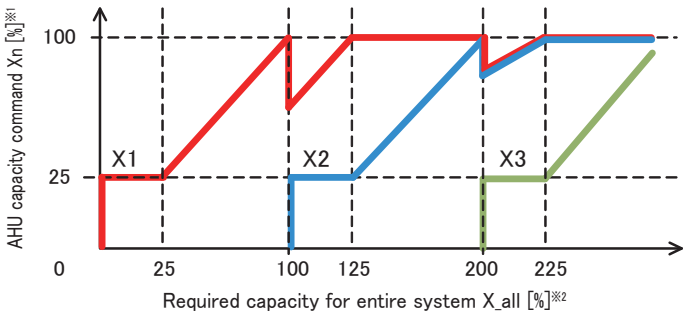
· This control can be changed to Valid/Invalid with Modbus.

· Image of these is as illustrated below.



• Optimum compressor speed control [Invalid]

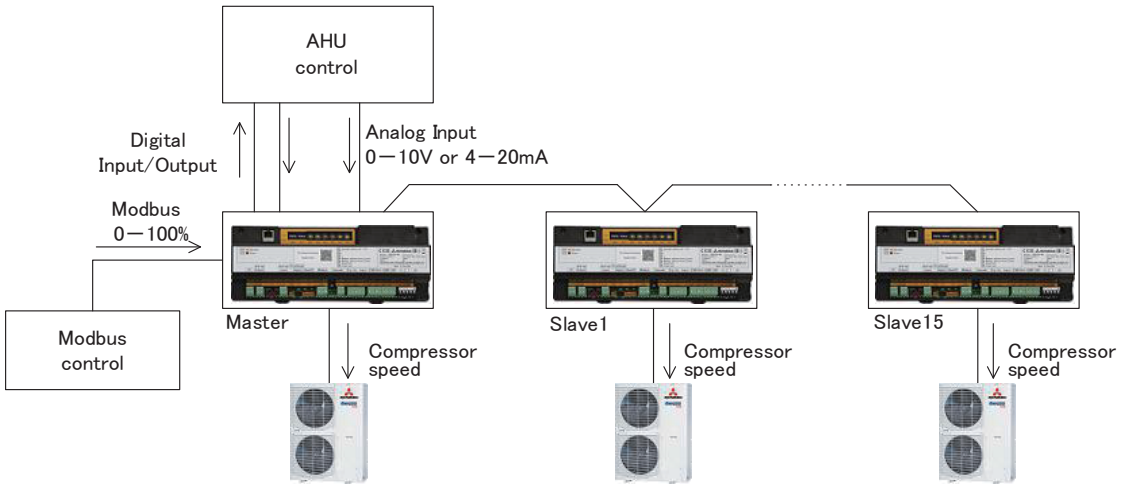
· Restriction does not apply to the upper limit of compressor speed.



※1 The master commands each slave.

※2 The master calculates X_all from the following :
· Analog input or Modbus or remote control (0–10V/4–20mA, 0–100%, set temperature)
· Number of outdoor units

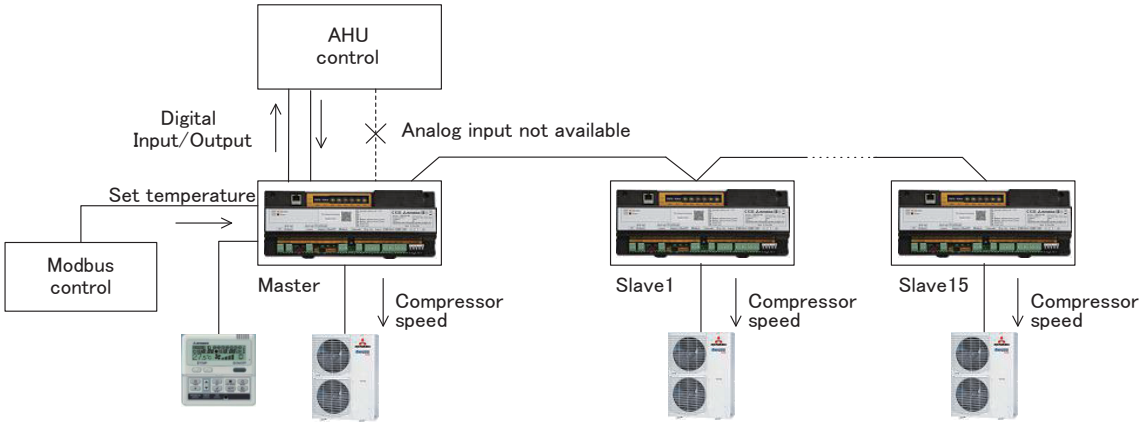
<Cascade control : Capacity Control (SW7-4: OFF)>



Capacity Control under Cascade Control (SW7-4 OFF): Example system

- It calculates necessary capacity for entire system: X_all [%] from the value of required capacity from AHU system: X
- **X_all [%]** = Required capacity X [%] x Number of units connected in the system [Unit]

<Cascade control : Temperature Control (SW7-4: ON)>



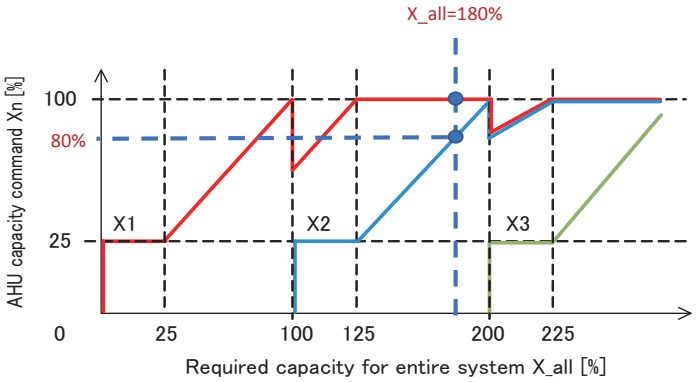
Temperature Control under cascade control (SW7-4 ON): Example system

- AHU Interface Master controls the air-conditioning based on the difference between setting temperature and return air temperature sensor, and calculate the required speed to compressor. For the amount of increase or decrease in compressor speed based on the temperature difference, refer to page 32.
- Master calculates the necessary capacity for entire system: X_all from the rate of required speed and maximum outdoor unit speed.
- **X_all [%]** = (Required speed ÷ Max. outdoor unit speed) × Number of units connected in system [Unit]

- It calculates the command value transmitted to each outdoor unit in the system: Xn [%] from the necessary capacity for entire system: X_all [%].
- AHU Interface Master commands Xn [%] to AHU Interface Slave.
- Each AHU Interface commands Compressor speed to outdoor unit.

Compressor speed [rps] = Max. outdoor unit speed [rps] × Xn [%]

X_all : Example of the capacity distribution at 180% is illustrated below.



(Ex.) When 3 units are connected and X_all = 180%:

X1 outdoor unit: 100% operation

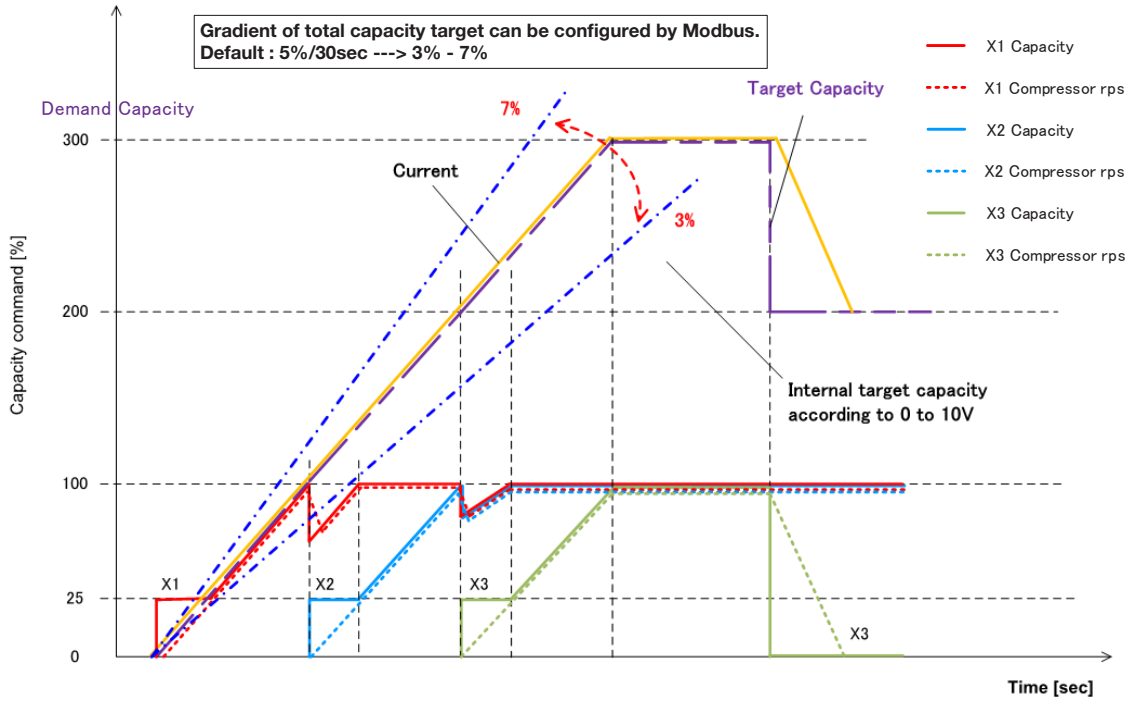
X2 outdoor unit: 80% operation

X3 outdoor unit: 0% (Stop)

(Optimum compressor speed control : Invalid)

<Capacity step up control (SW8-2: ON)>

- When a demand capacity is received from AHU control, this control operates outdoor units step by step or one after another, instead of operating all units simultaneously.
- Although it takes time to raise the speed to the demand capacity, it allows to raise it gradually.
- Use this control in the event that a hunting occurs on PID control at AHU control side because multiple outdoor units are operated simultaneously after receiving a high demand capacity input suddenly.



Example of Capacity step up control (Outdoor unit: 3 units)
(Optimum compressor speed control : Invalid)

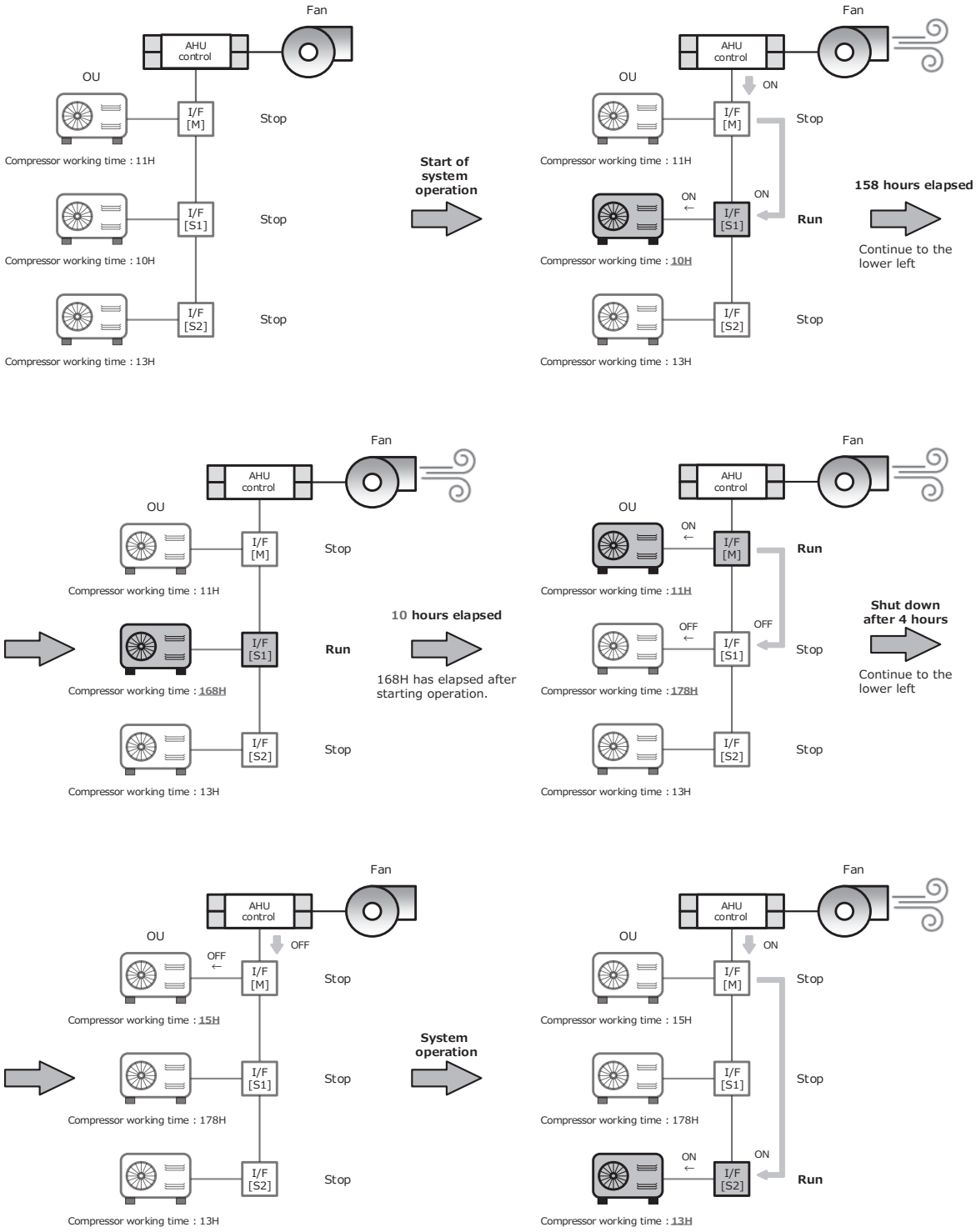
(2) Rotation control

In order to keep the compressor operation time of each unit in the system at a constant level, AHU Interface (Master) controls such that the unit, of which the compressor operation time is the shortest, is operated preferentially.

- This control is enabled automatically.
- Outdoor unit operation is switched at every 168H from the start of operation.

  Operation switching time is rotation selecting time can be changed with Modbus. [1 – 364H].

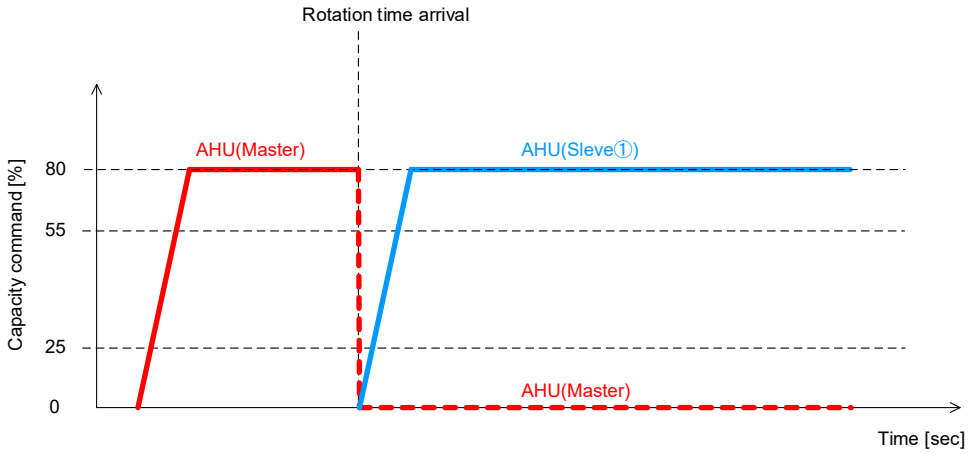
An example of rotation control is shown below.



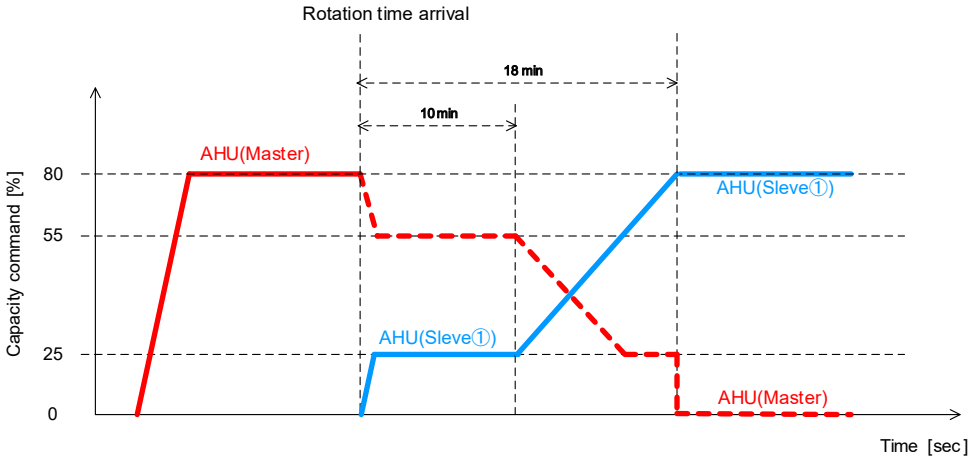
Rotation control example

(2-1) Rotation control_Constant capacity control [Initial : Invalid]

- When the rotation control is selected and constant capacity control is set to “invalid”, the capacity command is controlled as figure (a).
- To minimize a capacity drop, the constant capacity control can be set to “valid”. And then the capacity command is controlled as figure (b).
- Modbus allows selecting Valid/Invalid for this control. Initial value: Invalid.
- Image of these is as illustrated below.



(a) Rotation control_constant capacity control:Invalid



(b) Rotation control_constant capacity control:Valid

(3) Fault backup control

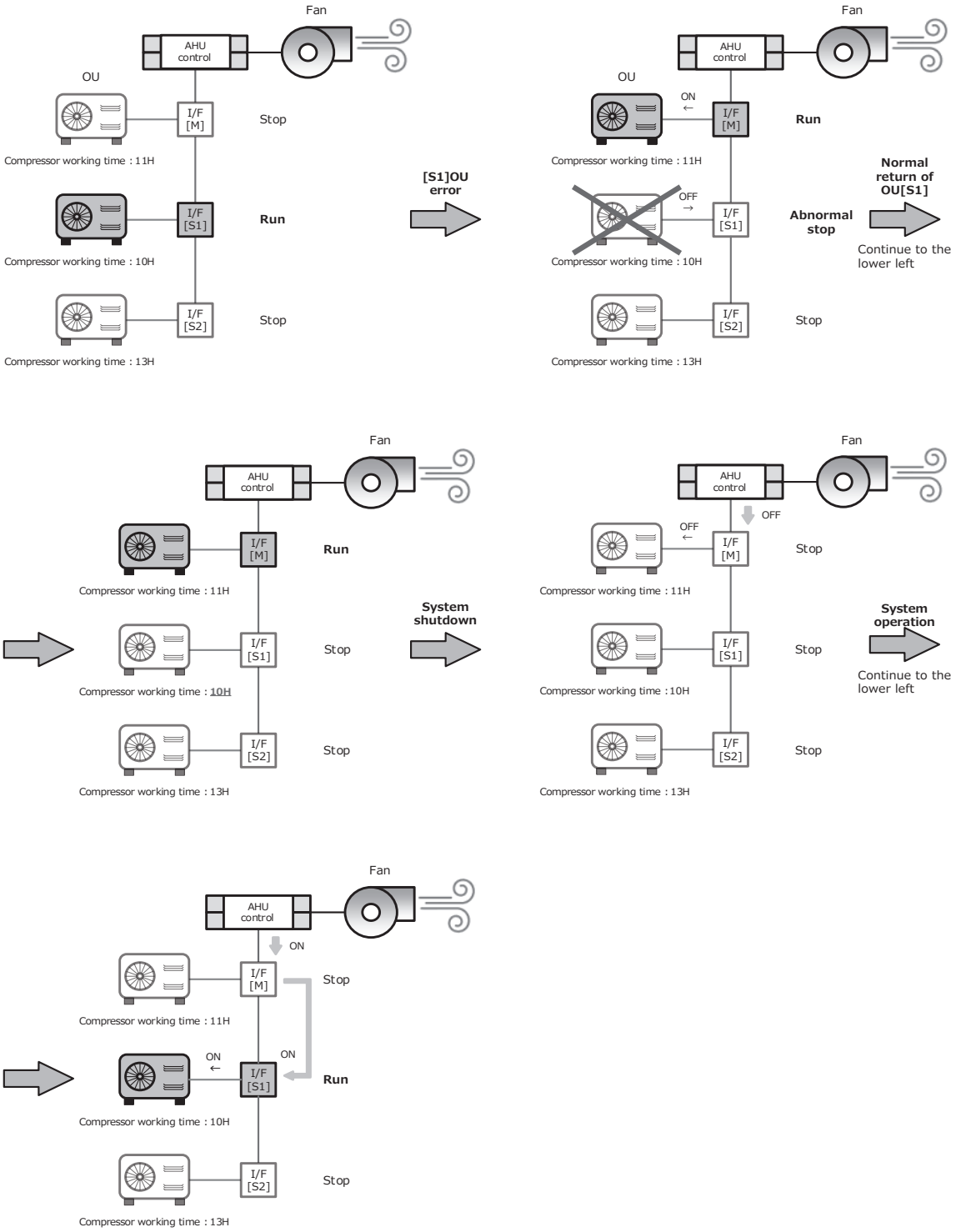
If any operating outdoor unit is stopped by the error stop, AHU Interface (Master) starts the backup operation of other normal outdoor units.

· This control is enabled automatically.

· Even if the unit stopped by error has been restored from the error, operation of the outdoor unit is not switched.

It stands by till next operation in the rotation control.

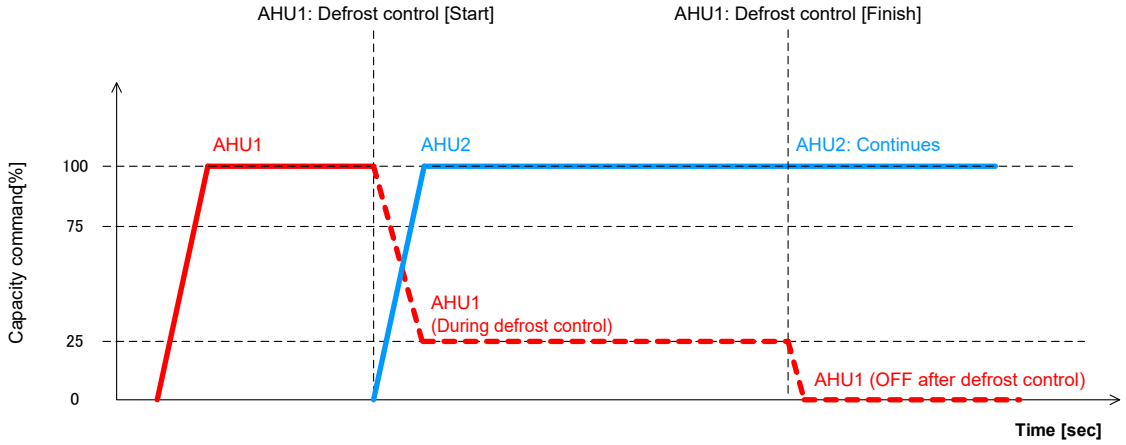
An example of fault backup control is shown below.



Fault backup control example

(4) Defrost control_Constant capacity control [Initial : Invalid]

- This control is designed to restrain the temporary capacity drop during defrost control.
- No sooner than an outdoor unit enters the defrost operation, another outdoor unit starts to run instead.
- Modbus allows selecting Valid/Invalid of this control.



Defrost control_Constant capacity control

4. Modbus communication

4.1 Communication specifications

X5 connector enables Modbus communication. (Modbus communication is effective on Master only.)

Monitoring of AHU Interface and outdoor unit and some of setting contents for AHU Interface can be changed.

Modbus communication specifications are as follows.

Item	Specification	Note
Transmission mode	RTU (Remote Terminal Unit)	
Transmission speed	(1) 19200bps (Initial)	SW7-2：OFF
	(2) 9600bps	SW7-2：ON
Data bit	8	
Parity/Stop bit	(1) Even parity + 1 Stop bit (Initial)	SW7-3：OFF
	(2) Non parity + 2 Stop bits	SW7-3：ON
Node number (Slave address)	01–99(Initial：01)	SW5：Ones SW6：Tens
Connection	RS-485 communication	X5-1：A polar X5-2：B polar X5-3：GND
Combinations	Modbus Master：External control：1unit Modbus Slave：AHU Interface：1unit	

4.2 Function

Modbus function: Function codes are as follows.

Code		Function name	Remark
3	(0×03)	Read holding register	Read the contents of the hold register
4	(0×04)	Read input register	Read the contents of the input register
6	(0×06)	Preset single register	Change the contents of the hold register
16	(0×10)	Preset multiple registers	Change the contents of multiple consecutive hold registers

4.3 Data information

Kind of Modus data, data length and address assignment range are as shown below.

Target register	Data length	Type of Access	Register address range	Register number range
Input register	2 byte	Monitoring only	0—9998	30001—39999
Holding register	2 byte	Monitoring / control	0—9998	40001—49999

4.4 Exception response

In the case query message has a problem, this interface will reply exception response.

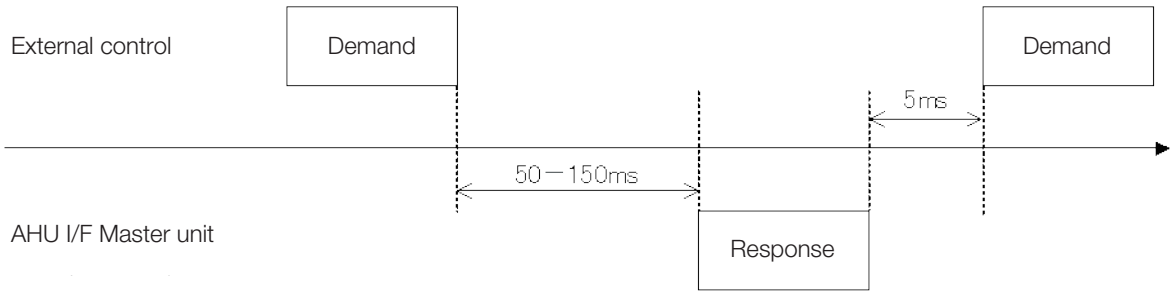
The function code of exception response is added 0x80 to original function code to inform this response is exception response.

And the exception response includes exception code which shows reason of the problem.

Exception code	Name	Meaning
0x01	Illegal function	The function code received in the query is not an allowable action.
0x02	Illegal data address	The data address received in the query is not an allowable address.
0x03	Illegal data value	A value contained in the query data field is not an allowable value.

4.5 Communication - Outline

Intervals between Modbus operating device and AHU-KIT-SP2 are as specified below.



· Data length of demand frame is as shown below.

Field	Detail	Data length
Address	Slave address	8 bit
Function	Function code	8 bit
Data	Request data	Variable
Error check	CRC error check	16 bit

· Data length of response frame is as shown below.

Field	Detail	Data length
Address	Slave address	8 bit
Function	Function code	8 bit
Data	Request data	Variable
Error check	CRC error check	16 bit

4.6 Input register

[Query]

The query message specifies the start address of the register and the number of registers.

The register addressed starting at zero. For example, register number "30001" must be requested by sending an address of "0".

• The following table shows the input registers (read only, 2-byte data).

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
0	30001	System Run/Stop display	0	0 - 65535	-	0 : Stop 1 : Run
1	30002	Operation mode display	0	0 - 65535	-	0 : Cooling 1 : Heating
2	30003	Set temperature display	46(23℃)	0 - 65535	0.5℃/count	16—30℃
3	30004	Center/Remote display	1	0 - 65535	-	0 : Remote 1 : Center/Remote 2 : Center 3 : Center2 4 : Remote2 5 : Center/Remote2
4	30005	Temperature Control Gain display	0.5	0 - 65535	-	Compressor rps Asjustment Gain : 0.1 - 10
5	30006	Emergency stop display	0	0 - 65535	-	0 : Emergency stop release 1 : Emergency stop
6	30007	Return air temperature (Master)	0	-32768 - 32767	0.1℃/count	
7	30008	External temperature (Master)	-64	-32768 - 32767	0.1℃/count	
8	30009	Request capacity	0	0 - 65535	1 %/count	X_all
9	30010	Analog input voltage [V]	0	0 - 65535	0.1 V/count	0 – 10V
10	30011	Analog input current [mA]	0	0 - 65535	0.1 mA/count	0 – 20mA
11	30012	Digital input X2-1	0	0 - 65535	-	0 : OFF 1 : ON
12	30013	Digital input X2-2	0	0 - 65535	-	0 : OFF 1 : ON
13	30014	Digital input X2-3	0	0 - 65535	-	0 : OFF 1 : ON
14	30015	Digital input X2-4	0	0 - 65535	-	0 : OFF 1 : ON
15	30016	Digital output X4a	0	0 - 65535	-	0 : OFF 1 : ON
16	30017	Digital output X4b	0	0 - 65535	-	0 : OFF 1 : ON
17	30018	Digital output X4c	0	0 - 65535	-	0 : OFF 1 : ON
18	30019	Digital output X4d	0	0 - 65535	-	0 : OFF 1 : ON
19	30020	Analog input switching	0	0 - 65535	-	0 : 0 – 10V 1 : 4 – 20mA
20	30021	Modbus baudrate setting	0	0 - 65535	-	0 : 19200bps 1 : 9600bps
21	30022	Modbus Parity/Stop bit setting	0	0 - 65535	-	0 : Even parity +1Stop bit 1 : Non parity +2Stop bit
22	30023	Compressor Control	0	0 - 65535	-	0 : Capacity Control 1 : Temperature Control
23	30024	Reserve	0	0 - 65535	-	
24	30025	Capacity step up control setting	0	0 - 65535	-	0 : Invalid 1 : Valid
25	30026	SW8-3 Setting display	0	0 - 65535	-	0
26	30027	Reserve	0	0 - 65535	-	Reserve
27	30028	SW7-1 Reading value	0	0 - 65535	-	0 : OFF 1 : ON
28	30029	SW7-2 Reading value	0	0 - 65535	-	0 : OFF 1 : ON
29	30030	SW7-3 Reading value	0	0 - 65535	-	0 : OFF 1 : ON
30	30031	SW7-4 Reading value	0	0 - 65535	-	0 : OFF 1 : ON

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
31	30032	SW8-1 Reading value	0	0 – 65535	–	0 : OFF 1 : ON
32	30033	SW8-2 Reading value	0	0 – 65535	–	0 : OFF 1 : ON
33	30034	SW8-3 Reading value	0	0 – 65535	–	0 : OFF 1 : ON
34	30035	SW8-4 Reading value	0	0 – 65535	–	0 : OFF 1 : ON
35	30036	Modbus capacity control command display	0	0 – 65535	–	0 : No command 1 : Command
36	30037	Modbus capacity control value display	0	0 – 65535	0.01%/count	0 – 100%
37	30038	Capacity step up control – Step-up rate display	50	30 – 70	0.1%/count	3 – 7%
38	30039	Silent mode	0	0 - 65535	–	0 : OFF 1 : ON
39	30040	Analog output	0	0 - 65535	0.1V/count	0—10V
40	30041	Supply air temperature (Master)	–	-32768 - 32767	0.1°C/count	
41	30042	Optimum compressor speed control	1	0 - 65535	–	0 : Invalid 1 : Valid
42	30043	Optimum compressor speed setting	75	0 - 65535	0.1 %/count	40—90%
43	30044	Rotation control - Constant capacity control	0	0 - 65535	–	0 : Invalid 1 : Valid
44	30045	Defrost control - Constant capacity control	0	0 - 65535	–	0 : Invalid 1 : Valid
45	30046	Rotation hour	168	0 - 65535	1 H/count	1—364 hours
46	30047	System stop - Delay time setting for Fan ON/ OFF output (in a cooling mode)	0	0 - 65535	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
47	30048	System stop - Delay time setting for Fan ON/ OFF output (in a heating mode)	0	0 - 65535	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
48	30049	Emergency stop - Fan ON/OFF setting (in a cooling mode)	0	0 - 65535	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
49	30050	Emergency stop - Fan ON/OFF setting (in a heating mode)	0	0 - 65535	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
1000	31001	Connection status : Slave1	0	0 – 65535	–	0 : Unconnected 1 : Connection
1001	31002	Connection status : Slave2	0	0 – 65535	–	0 : Unconnected 1 : Connection
1002	31003	Connection status : Slave3	0	0 – 65535	–	0 : Unconnected 1 : Connection
1003	31004	Connection status : Slave4	0	0 – 65535	–	0 : Unconnected 1 : Connection
1004	31005	Connection status : Slave5	0	0 – 65535	–	0 : Unconnected 1 : Connection
1005	31006	Connection status : Slave6	0	0 – 65535	–	0 : Unconnected 1 : Connection
1006	31007	Connection status : Slave7	0	0 – 65535	–	0 : Unconnected 1 : Connection
1007	31008	Connection status : Slave8	0	0 – 65535	–	0 : Unconnected 1 : Connection
1008	31009	Connection status : Slave9	0	0 – 65535	–	0 : Unconnected 1 : Connection
1009	31010	Connection status : Slave10	0	0 – 65535	–	0 : Unconnected 1 : Connection

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1010	31011	Connection status：Slave11	0	0 - 65535	-	0 : Unconnected 1 : Connection
1011	31012	Connection status：Slave12	0	0 - 65535	-	0 : Unconnected 1 : Connection
1012	31013	Connection status：Slave13	0	0 - 65535	-	0 : Unconnected 1 : Connection
1013	31014	Connection status：Slave14	0	0 - 65535	-	0 : Unconnected 1 : Connection
1014	31015	Connection status：Slave15	0	0 - 65535	-	0 : Unconnected 1 : Connection
1015	31016	Capacity command (Master)	0	0 - 65535	1 %/count	0—100%
1016	31017	Capacity command (Slave1)	0	0 - 65535	1 %/count	0—100%
1017	31018	Capacity command (Slave2)	0	0 - 65535	1 %/count	0—100%
1018	31019	Capacity command (Slave3)	0	0 - 65535	1 %/count	0—100%
1019	31020	Capacity command (Slave4)	0	0 - 65535	1 %/count	0—100%
1020	31021	Capacity command (Slave5)	0	0 - 65535	1 %/count	0—100%
1021	31022	Capacity command (Slave6)	0	0 - 65535	1 %/count	0—100%
1022	31023	Capacity command (Slave7)	0	0 - 65535	1 %/count	0—100%
1023	31024	Capacity command (Slave8)	0	0 - 65535	1 %/count	0—100%
1024	31025	Capacity command (Slave9)	0	0 - 65535	1 %/count	0—100%
1025	31026	Capacity command (Slave10)	0	0 - 65535	1 %/count	0—100%
1026	31027	Capacity command (Slave11)	0	0 - 65535	1 %/count	0—100%
1027	31028	Capacity command (Slave12)	0	0 - 65535	1 %/count	0—100%
1028	31029	Capacity command (Slave13)	0	0 - 65535	1 %/count	0—100%
1029	31030	Capacity command (Slave14)	0	0 - 65535	1 %/count	0—100%
1030	31031	Capacity command (Slave15)	0	0 - 65535	1 %/count	0—100%
1031	31032	Compressor accumulated time (Master)	0	0 - 65535	1H/count	
1032	31033	Compressor accumulated time (Slave1)	0	0 - 65535	1H/count	
1033	31034	Compressor accumulated time (Slave2)	0	0 - 65535	1H/count	
1034	31035	Compressor accumulated time (Slave3)	0	0 - 65535	1H/count	
1035	31036	Compressor accumulated time (Slave4)	0	0 - 65535	1H/count	
1036	31037	Compressor accumulated time (Slave5)	0	0 - 65535	1H/count	
1037	31038	Compressor accumulated time (Slave6)	0	0 - 65535	1H/count	
1038	31039	Compressor accumulated time (Slave7)	0	0 - 65535	1H/count	
1039	31040	Compressor accumulated time (Slave8)	0	0 - 65535	1H/count	
1040	31041	Compressor accumulated time (Slave9)	0	0 - 65535	1H/count	
1041	31042	Compressor accumulated time (Slave10)	0	0 - 65535	1H/count	
1042	31043	Compressor accumulated time (Slave11)	0	0 - 65535	1H/count	
1043	31044	Compressor accumulated time (Slave12)	0	0 - 65535	1H/count	
1044	31045	Compressor accumulated time (Slave13)	0	0 - 65535	1H/count	
1045	31046	Compressor accumulated time (Slave14)	0	0 - 65535	1H/count	
1046	31047	Compressor accumulated time (Slave15)	0	0 - 65535	1H/count	
1047	31048	Error code display (Master)	0	0 - 65535	-	0—99
1048	31049	Error code display (Slave1)	0	0 - 65535	-	0—99

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1049	31050	Error code display (Slave2)	0	0 - 65535	-	0—99
1050	31051	Error code display (Slave3)	0	0 - 65535	-	0—99
1051	31052	Error code display (Slave4)	0	0 - 65535	-	0—99
1052	31053	Error code display (Slave5)	0	0 - 65535	-	0—99
1053	31054	Error code display (Slave6)	0	0 - 65535	-	0—99
1054	31055	Error code display (Slave7)	0	0 - 65535	-	0—99
1055	31056	Error code display (Slave8)	0	0 - 65535	-	0—99
1056	31057	Error code display (Slave9)	0	0 - 65535	-	0—99
1057	31058	Error code display (Slave10)	0	0 - 65535	-	0—99
1058	31059	Error code display (Slave11)	0	0 - 65535	-	0—99
1059	31060	Error code display (Slave12)	0	0 - 65535	-	0—99
1060	31061	Error code display (Slave13)	0	0 - 65535	-	0—99
1061	31062	Error code display (Slave14)	0	0 - 65535	-	0—99
1062	31063	Error code display (Slave15)	0	0 - 65535	-	0—99
1063	31064	Heat exchanger temperature: Thi-R1(Master)	-3276	-32768 - 32767	0.1°C/count	
1064	31065	Heat exchanger temperature: Thi-R1(Slave1)	-3276	-32768 - 32767	0.1°C/count	
1065	31066	Heat exchanger temperature: Thi-R1(Slave2)	-3276	-32768 - 32767	0.1°C/count	
1066	31067	Heat exchanger temperature: Thi-R1(Slave3)	-3276	-32768 - 32767	0.1°C/count	
1067	31068	Heat exchanger temperature: Thi-R1(Slave4)	-3276	-32768 - 32767	0.1°C/count	
1068	31069	Heat exchanger temperature: Thi-R1(Slave5)	-3276	-32768 - 32767	0.1°C/count	
1069	31070	Heat exchanger temperature: Thi-R1(Slave6)	-3276	-32768 - 32767	0.1°C/count	
1070	31071	Heat exchanger temperature: Thi-R1(Slave7)	-3276	-32768 - 32767	0.1°C/count	
1071	31072	Heat exchanger temperature: Thi-R1(Slave8)	-3276	-32768 - 32767	0.1°C/count	
1072	31073	Heat exchanger temperature: Thi-R1(Slave9)	-3276	-32768 - 32767	0.1°C/count	
1073	31074	Heat exchanger temperature: Thi-R1(Slave10)	-3276	-32768 - 32767	0.1°C/count	
1074	31075	Heat exchanger temperature: Thi-R1(Slave11)	-3276	-32768 - 32767	0.1°C/count	
1075	31076	Heat exchanger temperature: Thi-R1(Slave12)	-3276	-32768 - 32767	0.1°C/count	
1076	31077	Heat exchanger temperature: Thi-R1(Slave13)	-3276	-32768 - 32767	0.1°C/count	
1077	31078	Heat exchanger temperature: Thi-R1(Slave14)	-3276	-32768 - 32767	0.1°C/count	
1078	31079	Heat exchanger temperature: Thi-R1(Slave15)	-3276	-32768 - 32767	0.1°C/count	
1079	31080	Heat exchanger temperature: Thi-R2(Master)	-3276	-32768 - 32767	0.1°C/count	
1080	31081	Heat exchanger temperature: Thi-R2(Slave1)	-3276	-32768 - 32767	0.1°C/count	
1081	31082	Heat exchanger temperature: Thi-R2(Slave2)	-3276	-32768 - 32767	0.1°C/count	
1082	31083	Heat exchanger temperature: Thi-R2(Slave3)	-3276	-32768 - 32767	0.1°C/count	
1083	31084	Heat exchanger temperature: Thi-R2(Slave4)	-3276	-32768 - 32767	0.1°C/count	
1084	31085	Heat exchanger temperature: Thi-R2(Slave5)	-3276	-32768 - 32767	0.1°C/count	

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1085	31086	Heat exchanger temperature: Thi-R2(Slave6)	-3276	-32768 - 32767	0.1°C/count	
1086	31087	Heat exchanger temperature: Thi-R2(Slave7)	-3276	-32768 - 32767	0.1°C/count	
1087	31088	Heat exchanger temperature: Thi-R2(Slave8)	-3276	-32768 - 32767	0.1°C/count	
1088	31089	Heat exchanger temperature: Thi-R2(Slave9)	-3276	-32768 - 32767	0.1°C/count	
1089	31090	Heat exchanger temperature: Thi-R2(Slave10)	-3276	-32768 - 32767	0.1°C/count	
1090	31091	Heat exchanger temperature: Thi-R2(Slave11)	-3276	-32768 - 32767	0.1°C/count	
1091	31092	Heat exchanger temperature: Thi-R2(Slave12)	-3276	-32768 - 32767	0.1°C/count	
1092	31093	Heat exchanger temperature: Thi-R2(Slave13)	-3276	-32768 - 32767	0.1°C/count	
1093	31094	Heat exchanger temperature: Thi-R2(Slave14)	-3276	-32768 - 32767	0.1°C/count	
1094	31095	Heat exchanger temperature: Thi-R2(Slave15)	-3276	-32768 - 32767	0.1°C/count	
1095	31096	Heat exchanger temperature: Thi-R3(Master)	-3276	-32768 - 32767	0.1°C/count	
1096	31097	Heat exchanger temperature: Thi-R3(Slave1)	-3276	-32768 - 32767	0.1°C/count	
1097	31098	Heat exchanger temperature: Thi-R3(Slave2)	-3276	-32768 - 32767	0.1°C/count	
1098	31099	Heat exchanger temperature: Thi-R3(Slave3)	-3276	-32768 - 32767	0.1°C/count	
1099	31100	Heat exchanger temperature: Thi-R3(Slave4)	-3276	-32768 - 32767	0.1°C/count	
1100	31101	Heat exchanger temperature: Thi-R3(Slave5)	-3276	-32768 - 32767	0.1°C/count	
1101	31102	Heat exchanger temperature: Thi-R3(Slave6)	-3276	-32768 - 32767	0.1°C/count	
1102	31103	Heat exchanger temperature: Thi-R3(Slave7)	-3276	-32768 - 32767	0.1°C/count	
1103	31104	Heat exchanger temperature: Thi-R3(Slave8)	-3276	-32768 - 32767	0.1°C/count	
1104	31105	Heat exchanger temperature: Thi-R3(Slave9)	-3276	-32768 - 32767	0.1°C/count	
1105	31106	Heat exchanger temperature: Thi-R3(Slave10)	-3276	-32768 - 32767	0.1°C/count	
1106	31107	Heat exchanger temperature: Thi-R3(Slave11)	-3276	-32768 - 32767	0.1°C/count	
1107	31108	Heat exchanger temperature: Thi-R3(Slave12)	-3276	-32768 - 32767	0.1°C/count	
1108	31109	Heat exchanger temperature: Thi-R3(Slave13)	-3276	-32768 - 32767	0.1°C/count	
1109	31110	Heat exchanger temperature: Thi-R3(Slave14)	-3276	-32768 - 32767	0.1°C/count	
1110	31111	Heat exchanger temperature: Thi-R3(Slave15)	-3276	-32768 - 32767	0.1°C/count	
1111	31112	Compressor rps display (Master)	0	0 - 65535	1 rps/count	0—120rps
1112	31113	Compressor rps display (Slave1)	0	0 - 65535	1 rps/count	0—120rps
1113	31114	Compressor rps display (Slave2)	0	0 - 65535	1 rps/count	0—120rps
1114	31115	Compressor rps display (Slave3)	0	0 - 65535	1 rps/count	0—120rps

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1115	31116	Compressor rps display (Slave4)	0	0 - 65535	1 rps/count	0—120rps
1116	31117	Compressor rps display (Slave5)	0	0 - 65535	1 rps/count	0—120rps
1117	31118	Compressor rps display (Slave6)	0	0 - 65535	1 rps/count	0—120rps
1118	31119	Compressor rps display (Slave7)	0	0 - 65535	1 rps/count	0—120rps
1119	31120	Compressor rps display (Slave8)	0	0 - 65535	1 rps/count	0—120rps
1120	31121	Compressor rps display (Slave9)	0	0 - 65535	1 rps/count	0—120rps
1121	31122	Compressor rps display (Slave10)	0	0 - 65535	1 rps/count	0—120rps
1122	31123	Compressor rps display (Slave11)	0	0 - 65535	1 rps/count	0—120rps
1123	31124	Compressor rps display (Slave12)	0	0 - 65535	1 rps/count	0—120rps
1124	31125	Compressor rps display (Slave13)	0	0 - 65535	1 rps/count	0—120rps
1125	31126	Compressor rps display (Slave14)	0	0 - 65535	1 rps/count	0—120rps
1126	31127	Compressor rps display (Slave15)	0	0 - 65535	1 rps/count	0—120rps
1127	31128	Defrost display (Master)	0	0 - 65535	–	0 : Normal 1 : Defrost
1128	31129	Defrost display (Slave1)	0	0 - 65535	–	0 : Normal 1 : Defrost
1129	31130	Defrost display (Slave2)	0	0 - 65535	–	0 : Normal 1 : Defrost
1130	31131	Defrost display (Slave3)	0	0 - 65535	–	0 : Normal 1 : Defrost
1131	31132	Defrost display (Slave4)	0	0 - 65535	–	0 : Normal 1 : Defrost
1132	31133	Defrost display (Slave5)	0	0 - 65535	–	0 : Normal 1 : Defrost
1133	31134	Defrost display (Slave6)	0	0 - 65535	–	0 : Normal 1 : Defrost
1134	31135	Defrost display (Slave7)	0	0 - 65535	–	0 : Normal 1 : Defrost
1135	31136	Defrost display (Slave8)	0	0 - 65535	–	0 : Normal 1 : Defrost
1136	31137	Defrost display (Slave9)	0	0 - 65535	–	0 : Normal 1 : Defrost
1137	31138	Defrost display (Slave10)	0	0 - 65535	–	0 : Normal 1 : Defrost
1138	31139	Defrost display (Slave11)	0	0 - 65535	–	0 : Normal 1 : Defrost
1139	31140	Defrost display (Slave12)	0	0 - 65535	–	0 : Normal 1 : Defrost
1140	31141	Defrost display (Slave13)	0	0 - 65535	–	0 : Normal 1 : Defrost
1141	31142	Defrost display (Slave14)	0	0 - 65535	–	0 : Normal 1 : Defrost
1142	31143	Defrost display (Slave15)	0	0 - 65535	–	0 : Normal 1 : Defrost
1143	31144	Oil return display (Master)	0	0 - 65535	–	0 : Normal 1 : Oil return
1144	31145	Oil return display (Slave1)	0	0 - 65535	–	0 : Normal 1 : Oil return
1145	31146	Oil return display (Slave2)	0	0 - 65535	–	0 : Normal 1 : Oil return
1146	31147	Oil return display (Slave3)	0	0 - 65535	–	0 : Normal 1 : Oil return
1147	31148	Oil return display (Slave4)	0	0 - 65535	–	0 : Normal 1 : Oil return
1148	31149	Oil return display (Slave5)	0	0 - 65535	–	0 : Normal 1 : Oil return
1149	31150	Oil return display (Slave6)	0	0 - 65535	–	0 : Normal 1 : Oil return
1150	31151	Oil return display (Slave7)	0	0 - 65535	–	0 : Normal 1 : Oil return
1151	31152	Oil return display (Slave8)	0	0 - 65535	–	0 : Normal 1 : Oil return
1152	31153	Oil return display (Slave9)	0	0 - 65535	–	0 : Normal 1 : Oil return

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1153	31154	Oil return display (Slave10)	0	0 - 65535	-	0 : Normal 1 : Oil return
1154	31155	Oil return display (Slave11)	0	0 - 65535	-	0 : Normal 1 : Oil return
1155	31156	Oil return display (Slave12)	0	0 - 65535	-	0 : Normal 1 : Oil return
1156	31157	Oil return display (Slave13)	0	0 - 65535	-	0 : Normal 1 : Oil return
1157	31158	Oil return display (Slave14)	0	0 - 65535	-	0 : Normal 1 : Oil return
1158	31159	Oil return display (Slave15)	0	0 - 65535	-	0 : Normal 1 : Oil return
1159	31160	Abnormal stop status display (Master)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1160	31161	Abnormal stop status display (Slave1)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1161	31162	Abnormal stop status display (Slave2)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1162	31163	Abnormal stop status display (Slave3)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1163	31164	Abnormal stop status display (Slave4)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1164	31165	Abnormal stop status display (Slave5)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1165	31166	Abnormal stop status display (Slave6)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1166	31167	Abnormal stop status display (Slave7)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1167	31168	Abnormal stop status display (Slave8)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1168	31169	Abnormal stop status display (Slave9)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1169	31170	Abnormal stop status display (Slave10)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1170	31171	Abnormal stop status display (Slave11)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1171	31172	Abnormal stop status display (Slave12)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1172	31173	Abnormal stop status display (Slave13)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1173	31174	Abnormal stop status display (Slave14)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1174	31175	Abnormal stop status display (Slave15)	0	0 - 65535	-	0 : Normal 1 : Abnormal stop
1175	31176	Digital output (X4d) Function (Master)	0	0 - 65535	-	0 : System run/stop 1 : Heating/Cooling 2 : System fan ON/OFF
1176	31177	Digital output (X4d) Function (Slave1)	0	0 - 65535	-	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1177	31178	Digital output (X4d) Function (Slave2)	0	0 - 65535	-	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1178	31179	Digital output (X4d) Function (Slave3)	0	0 - 65535	-	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1179	31180	Digital output (X4d) Function (Slave4)	0	0 - 65535	-	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1180	31181	Digital output (X4d) Function (Slave5)	0	0 - 65535	-	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1181	31182	Digital output (X4d) Function (Slave6)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1182	31183	Digital output (X4d) Function (Slave7)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1183	31184	Digital output (X4d) Function (Slave8)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1184	31185	Digital output (X4d) Function (Slave9)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1185	31186	Digital output (X4d) Function (Slave10)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1186	31187	Digital output (X4d) Function (Slave11)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1187	31188	Digital output (X4d) Function (Slave12)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1188	31189	Digital output (X4d) Function (Slave13)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1189	31190	Digital output (X4d) Function (Slave14)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1190	31191	Digital output (X4d) Function (Slave15)	0	0 - 65535	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF

[Register address "2" Set temperature display example]
<0.5°C/count>
18=9°C
36=18°C
50=25°C
60=30°C

[Register address "6" Return air temperature display example]
<0.1°C/count>
10=1°C
30=3°C
500=50°C
600=60°C

[Master/Slave1~15]
<SW1 AHU Interface address >
SW1 : 0=Master
SW1 : 1=AHU Interface No.1 (Slave1)
SW1 : 2=AHU Interface No.2 (Slave2)
SW1 : 3=AHU Interface No.3 (Slave3)
SW1 : 4=AHU Interface No.4 (Slave4)
SW1 : 5=AHU Interface No.5 (Slave5)
SW1 : 6=AHU Interface No.6 (Slave6)
SW1 : 7=AHU Interface No.7 (Slave7)
SW1 : 8=AHU Interface No.8 (Slave8)
SW1 : 9=AHU Interface No.9 (Slave9)
SW1 : A=AHU Interface No.10 (Slave10)
SW1 : B=AHU Interface No.11 (Slave11)
SW1 : C=AHU Interface No.12 (Slave12)
SW1 : D=AHU Interface No.13 (Slave13)
SW1 : E=AHU Interface No.14 (Slave14)
SW1 : F=AHU Interface No.15 (Slave15)

[Error code display example]
0 : Normal
1 : E1
7 : E7
99 : E99

[Raw Packet Example (Register address "2")]
Modbus Address (SW5, 6) : 10
Function Code : Read Input Register (0 x 04)
Register Address : 2 (Set temperature display)
⇒ 0a 04 00 02 00 01
→ Count of register number to be read
→ Register Address : 2
→ Function Code : 0 x 04
→ Modbus Address : 10 (0 x 0a)

4.7 Holding register

[Query]

The query message specifies the start address of the register and a value.

The register addressed starting at zero. For example, register number "40001" must be requested by sending an address of "0".

- The holding registers (readable, changeable, 2-byte data) are as follows.
- If data outside the range is received, the data is not accepted and an error is returned

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
0	40001	Run/Stop command	0	0 - 1	–	0 : Stop 1 : Run
1	40002	Operation mode command	0	0 - 1	–	0 : Cooling 1 : Heating
2	40003	Set temperature command	46	32 - 60	0.5℃/count	16—30℃
3	40004	Temperature control Gain command	5	1 - 100	0.1 /count	Compressor speed Adjustment Gain
4	40005	Emergency stop command	0	0 - 1	–	0 : Emergency stop release 1 : Emergency stop
5	40006	CPU reset command	0	0 - 1	–	0 : NOP 1 : Reset
6	40007	Compressor accumulated time all reset command	0	0 - 1	–	0 : NOP 1 : Reset
7	40008	Capacity control command	0	0 - 10000	0.01 /count	0—100%
8	40009	Capacity step up control – Step-up rate command	50	30 - 70	0.1%/count	3—7%
9	40010	Silent mode command	0	0 - 1	–	0 : OFF 1 : ON
10	40011	Analog output command	0	0 - 100	0.1V/count	0-10V
11	40012	Optimum compressor speed control	1	0 - 1	–	0 : Invalid 1 : Valid
12	40013	Optimum compressor speed setting	75	40 - 90	1 %/count	40—90%
13	40014	Rotation control - Constant capacity control	0	0 - 1	–	0 : Invalid 1 : Valid
14	40015	Defrost control - Constant capacity control	0	0 - 1	–	0 : Invalid 1 : Valid
15	40016	Rotation hour	168	1 - 364	1 H/count	1-364hours
16	40017	System stop - Delay time setting for Fan ON/OFF output (in a cooling mode)	0	0 - 3	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
17	40018	System stop - Delay time setting for Fan ON/OFF output (in a heating mode)	0	0 - 3	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
18	40019	Emergency stop - Fan ON/OFF setting (in a cooling mode)	0	0 - 3	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3
19	40020	Emergency stop - Fan ON/OFF setting (in a heating mode)	0	0 - 3	–	0 : Invalid 1 : Setting1 2 : Setting2 3 : Setting3

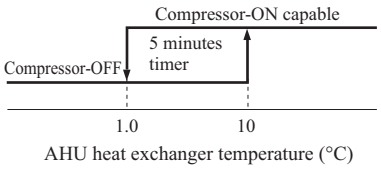
Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1000	41001	Compressor accumulated time reset command (Master)			–	0 : NOP 1 : Reset
1001	41002	Compressor accumulated time reset command (Slave1)	0	0 - 1	–	0 : NOP 1 : Reset
1002	41003	Compressor accumulated time reset command (Slave2)	0	0 - 1	–	0 : NOP 1 : Reset
1003	41004	Compressor accumulated time reset command (Slave3)	0	0 - 1	–	0 : NOP 1 : Reset
1004	41005	Compressor accumulated time reset command (Slave4)	0	0 - 1	–	0 : NOP 1 : Reset
1005	41006	Compressor accumulated time reset command (Slave5)	0	0 - 1	–	0 : NOP 1 : Reset
1006	41007	Compressor accumulated time reset command (Slave6)	0	0 - 1	–	0 : NOP 1 : Reset
1007	41008	Compressor accumulated time reset command (Slave7)	0	0 - 1	–	0 : NOP 1 : Reset
1008	41009	Compressor accumulated time reset command (Slave8)	0	0 - 1	–	0 : NOP 1 : Reset
1009	41010	Compressor accumulated time reset command (Slave9)	0	0 - 1	–	0 : NOP 1 : Reset
1010	41011	Compressor accumulated time reset command (Slave10)	0	0 - 1	–	0 : NOP 1 : Reset
1011	41012	Compressor accumulated time reset command (Slave11)	0	0 - 1	–	0 : NOP 1 : Reset
1012	41013	Compressor accumulated time reset command (Slave12)	0	0 - 1	–	0 : NOP 1 : Reset
1013	41014	Compressor accumulated time reset command (Slave13)	0	0 - 1	–	0 : NOP 1 : Reset
1014	41015	Compressor accumulated time reset command (Slave14)	0	0 - 1	–	0 : NOP 1 : Reset
1015	41016	Compressor accumulated time reset command (Slave15)	0	0 - 1	–	0 : NOP 1 : Reset
1016	41017	Digital output (X4d) Function(Master)	0	0 - 2	–	0 : System run/stop 1 : Heating/Cooling 2 : System fan ON/OFF
1017	41018	Digital output (X4d) Function(Slave1)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1018	41019	Digital output (X4d) Function(Slave2)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1019	41020	Digital output (X4d) Function(Slave3)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1020	41021	Digital output (X4d) Function(Slave4)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1021	41022	Digital output (X4d) Function(Slave5)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1022	41023	Digital output (X4d) Function(Slave6)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1023	41024	Digital output (X4d) Function(Slave7)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF

Register Address	Register Number (For reference)	Item	Initial	Range	Unit	Note
1024	41025	Digital output (X4d) Function(Slave8)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1025	41026	Digital output (X4d) Function(Slave9)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1026	41027	Digital output (X4d) Function(Slave10)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1027	41028	Digital output (X4d) Function(Slave11)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1028	41029	Digital output (X4d) Function(Slave12)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1029	41030	Digital output (X4d) Function(Slave13)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1030	41031	Digital output (X4d) Function(Slave14)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF
1031	41032	Digital output (X4d) Function(Slave15)	0	0 - 2	–	0 : Run/Stop 1 : Heating/Cooling 2 : Fan ON/OFF

5. Protection control

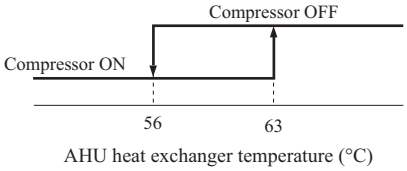
5.1 Cooling frost protection

To prevent frosting during cooling mode operation, the compressor-OFF if the AHU heat exchanger temperature (detected with Thi-R) drops to 1.0 ℃ or lower at 4 minutes after the compressor-ON. If the AHU heat exchanger temperature is 1.0 ℃ or lower after 5 minutes, the AHU Interface is controlled compressor-OFF. If it becomes 10℃ or higher, the control terminates.



5.2 Heating overload protection

If the AHU heat exchanger temperature (detected with Thi-R) at 63℃ or higher is detected for 2 seconds continuously, the compressor stops. When the compressor is restarted after a 3-minute delay, if a temperature at 63℃ or higher is detected for 2 seconds continuously within 60 minutes after initial detection and if this is detected 5 times consecutively, the compressor stops with the anomalous stop (E8). Anomalous stop occurs also when the AHU heat exchanger temperature at 63℃ or higher is detected for 6 minutes continuously.



5.3 Compressor inching prevention control

(a) 3-minute timer

When the compressor has been stopped by the thermostat, remote control operation switch or anomalous condition, its restart will be inhibited for 3 minutes. However, the 3-minute timer is invalidated at the power on the electric power source for the unit.

(b) 3-minute forced operation timer

Compressor will not stop for 3 minutes after the compressor ON. However, it stops immediately when the unit is stopped by means of the ON/OFF switch or when the thermostat is turned OFF by the change of operation mode.

5.4 Fan control during the defrost control and the heating oil return control

It is necessary to stop the fan motor at AHU side during the defrost control (during defrost and heating oil return controls)

When the fan motor cannot be stopped under the conditions for use of AIR HANDLING UNIT, however, it becomes possible to continue the fan control during defrost control and heating oil return controls so far as the following conditions are satisfied.

Unless these conditions are satisfied, stop the fan motor at AHU side while defrost control and oil return control signals are output*.

<Conditions to continue the operation of fan motor at AHU side during defrost control>

It is limited to when the height difference is 20 m or less between the outdoor unit and AHU heat exchanger.

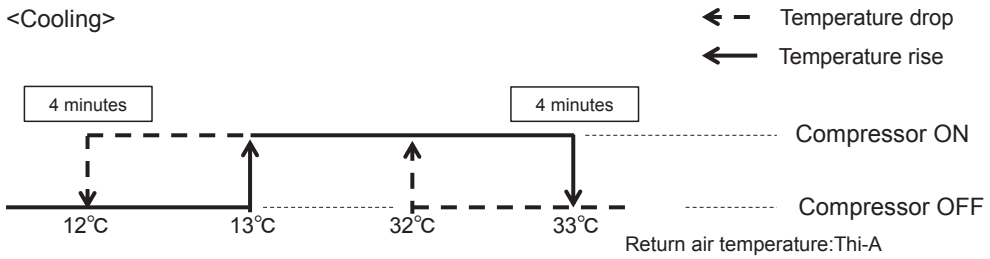
* Confirmation of defrost control and oil return control signals … Signals are output from Digital output: X4c of AHU-KIT-SP2.

If any one of outdoor units enters the defrost control and oil return controls when two or more outdoor units are connected, Digital output: X4c outputs signals.

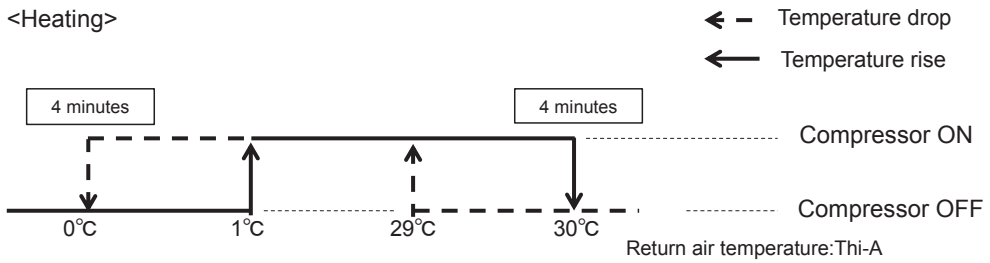
5.5 Forced compressor OFF control by suction temperature

The compressor stops for protection if the air-conditioner is used beyond its range of use.

・If AHU Interface suction temperature (detected with Thi-A) is detected lower than 12.0℃ or higher than 33.0℃ for 4 minutes continuously during cooling mode operation, the compressor is turned OFF.



・If AHU Interface suction temperature (detected with Thi-A) is detected lower than 0.0℃ or higher than 30.0℃ for 4 minutes continuously during the heating mode operation, the compressor is turned OFF.



6. Error display

6.1 Abnormal temperature sensor (return air/heat exchanger) broken wire/short-circuit detection

(a) Broken wire detection

When the return air temperature sensor detects -50°C or lower or the heat exchanger temperature sensor detect -50°C or lower for 5 seconds continuously, the compressor stops. After 3-minute delay, the compressor restarts but, if it is detected again within 60 minutes after the initial detection for 6 minutes continuously, stops again (the return air temperature sensor: E7, the heat exchanger temperature sensor: E6).

(b) Short-circuit detection

If the heat exchanger temperature sensor detects short-circuit for 5 seconds continuously within 2 minutes to 2 minutes 20 seconds after the compressor ON during cooling operation, the compressor stops (E6).

6.2 Trouble/error detection

- ●When it is stopped by the operation of protective device, or other, it stops with “Error stop”.
- ●If any error stop occurs during system operation, following operations occur.
  - ・If any error occurs on Master/Slave and outdoor unit during system operation, it stops only Master/Slave and outdoor unit on which the error occurred.
  - ・In case of a cascade control system, operation continues unless an entire unit error.
  - ・If all Master/Slave units in the system stop by error during system operation, the system error occurs.
- ●Slave stops with the error stop if it becomes unable to communicate with Master.
- ●If Master becomes unable to communicate with Slave, it handles the Slave, which becomes unable to communicate, as an error unit.
  - ・Even if Master becomes unable to communicated with Slave, it acts as normal and continues the system operation.
- ●Once Master restores its communication with remote control, it stops with the error stop if it becomes unable to communicate with the remote control.

Error code list

Error code	Description	Error conditions	System stop*
E1	Remote control communication error	When it cannot communicate with the remote control for 2 minutes while it is recognizing the connection to the remote control.	○
E2	Address duplication	When addresses are duplicated on the communication between Master and Slave.	
E5	Outdoor unit communication error	When it could not communicated with the outdoor unit for 2 minutes continuously during operation.	
E6	Broken heat exchanger temperature sensor wire	When a broken heat exchanger temperature sensor wire is detected.	
E7	Broken return temperature sensor wire	When a broken return temperature sensor wire is detected.	○
E8	Heating overload error	When a heating overload is detected. (See 5. Protection control.)	
E10	Excessive number of units connected to remote control		
E14	Master/Slave communication error	When communication error is detected between Master and Slave.	
E63	Emergency stop	When digital input or emergency stop signal is received from Modbus.	○

* If E1, E7 or E63 is detected, the system stops immediately.

6.3 Trouble/error display

● Error display

If any error occurs, AHU Interface displays the error contents with LED on PCB.

Under the cascade control, the error contents are displayed with each PCB LED.

If two or more errors occur on AHU Interface and outdoor unit, the error display on AHU Interface supersedes.

Error code of smaller number supersedes the others.

● Error confirmation

If any error occurs in the system, Master outputs “Error” from the digital output X4a.

If any error occurred on AHU-KIT-SP2 or outdoor unit, check the error with the following methods.

- Error code display on remote control
- Error code display by Modbus communication
- “Error” output by digital output: X4a
- Flicker of LED on PCB (Red)

● Supplementary for error confirmation

If any error occurs on Slave system during cascade control, the error code is sent to Master.

In such occasion, the remote control does not show “Error”. It is displayed with “Backup”.

The remote control or digital output cannot display any error on Slave.

To check each error on Slave, it is necessary to use Modbus communication.

● LED display on AHU-KIT-SP PCB

· LED1 (Green) flickers continuously normally.

· LED2 (Red) flickers if any error occurs.

· LED2 (Red) flickers indicate following errors.

Error code	Description	LED2 (Red) display*
E1	Remote control communication error	3 times
E2	Address duplication	Once
E5	Outdoor unit communication error	2 times
E6	Broken heat exchanger temperature sensor coil	Once
E7	Broken return temperature sensor coil	Once
E8	Heating overload error	Once
E10	Excess number of units connected to remote control	OFF
E14	Master/slave communication error	3 times
E63	Emergency stop	Continuous

* LED2 (Red): 5-second cycle, flickers for 0.5 sec.

6.4 Error mode reset (Error reset)

Error displays occur in 6.2 can be turned off (reset) with the Run/Stop operation from operating device.

Run/Stop operation: Means operation from system stop to system operation. (Digital input, Modbus, remote control)

If AHU Interface Master recognizes the Run/Stop operation, it turns off the error display in the system (AHU Interface Slave and outdoor unit)

If the Run/Stop is operated while an error is not reset, the error display repeats.

AIR HANDLING UNIT INTERFACE

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