MITSUBISHI ELECTRIC

INTERFACE

Modbus manual

January 2016

[Model Name]

PAC-IF013B-E
PAC-SIF013B-E

Related document:
Refer to the following manual
• PAC-IF013B-E/PAC-SIF013B-E INSTALLATION MANUAL

Revision
• Added
0-100% capacity request in "6-3. Holding Register".

This manual describes the Modbus communication only. For safety precautions, make sure to read installation manual of PAC-IF013B-E/PAC-SIF013B-E.

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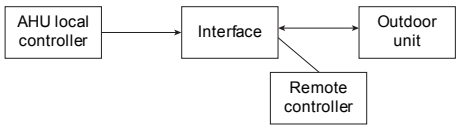
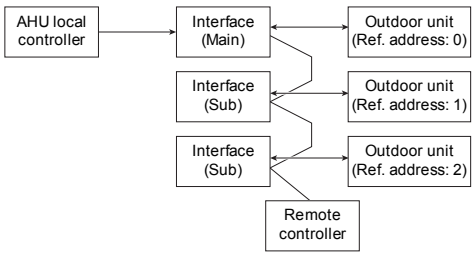
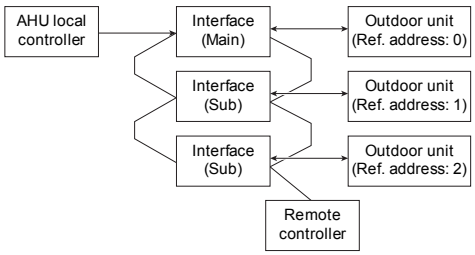
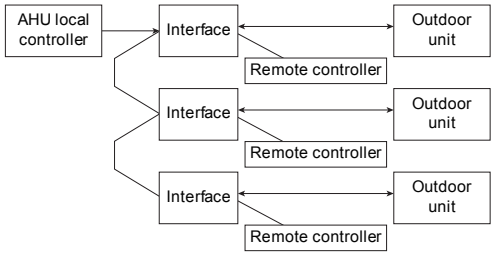
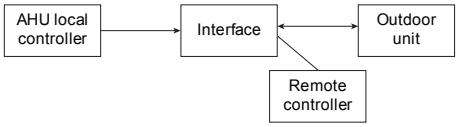
1 System

No.	Using function by Modbus	Step mode	Input type	Number of outdoor unit	Intelligent multiple outdoor unit control	System *3
1	**Writing and Reading (Input and monitoring)**	Manual *1	Modbus	1	N/A	
2				2-6	Apply *4	■When not monitoring sub interfaces 
3						■When monitoring sub interfaces (Wiring among interface units with Modbus cable) 
4					Not apply *5	Input all interfaces separately. 
5		Auto *2	No input (Auto step mode)	1-5	N/A	
6	**Only Reading (Only monitoring)**	Manual	"Analog" or "Remote switch"	1-6	Refer to the installation manual.	
7		Auto	No input (Auto step mode)	1-5		

*1. Manual step mode by Modbus:
- AHU local controller can send " capacity steps" and "operation mode" by Modbus communication to the interface unit.
- Do NOT send " temperature set point" or "Drive ON/ OFF".
- DIP SW 1-1 to 1-3, and SW6 are as follows. Regarding other settings, refer to the section 2 and the installation manual.

Input type	SW1-1	SW1-2	SW1-3	SW6-1	SW6-2
Modbus	ON	ON	ON	OFF	OFF

*2. Auto step mode by Modbus:
- AHU local controller can send " Drive ON/ OFF", "operation mode", and "temperature set point" by Modbus communication to the interface unit.
- Do NOT send " capacity request".
- DIP SW 1-1 to 1-3, and SW6 are as follows. Regarding other settings, refer to the section 2 and the installation manual.

Input type	SW1-1	SW1-2	SW1-3	SW6-1	SW6-2
No input (Auto step mode)	OFF	ON	ON	OFF	OFF

*3. Regarding thermistor positions, refer to the installation manual.

*4. Intelligent multiple outdoor unit control by Modbus:
- Input "capacity steps" signal and "operation mode" signal to the main interface unit (which connects to the ref. address 0 outdoor unit)
- Monitoring operation status of all interfaces is available. In this case, connecting to all interface units with Modbus cable is needed.
- Setting DIP SW3-6 to SW3-8, and SW4 of sub interfaces is necessary when monitoring sub interfaces.
- Regarding intelligent multiple outdoor unit control, refer to the installation manual.

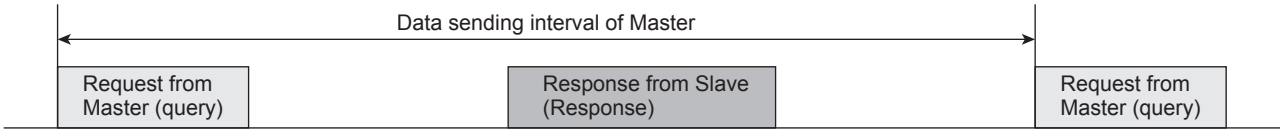
*5. It is recommended to select Intelligent multiple outdoor unit control.
Design local AHU controller to make sure the following points.
- Minimum capacity request should be 20% or more of total capacity.
- Operate all outdoor units when outdoor temperature is below -15 °C.

2 Communication specification

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Interface</td><td>RS-485</td></tr>
<tr><td>Communication method</td><td>Half-duplex</td></tr>
<tr><td>Connectable units</td><td>Max.:31
Slave address can be set by DIP SW on the interface controller board.
<table>
<tr><th>SW 4-1</th><th>SW 4-2</th><th>SW 4-3</th><th>SW 4-4</th><th>SW 4-5</th><th>Slave address</th></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>1</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>1</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>2</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>3</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>4</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>5</td></tr>
<tr><td colspan="5">•••</td><td>•••</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>31</td></tr>
</table></td></tr>
<tr><td>Baud rate</td><td>Selectable from: 1200/2400/4800/9600/19200/38400/57600
Baud rate can be set by DIP SW on the interface controller board.
<table>
<tr><th>SW 3-6</th><th>SW 3-7</th><th>SW 3-8</th><th>Details</th></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>1200bps</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>2400bps</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>4800bps</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>9600bps</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>19200bps</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>38400bps</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>57600bps</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>Transmission mode</td><td>RTU mode</td></tr>
<tr><td>Data length</td><td>8bit</td></tr>
<tr><td>Parity type</td><td>Selectable from: odd/even/none
Set by DIP SW on the interface controller board.
<table>
<tr><th>SW4-6</th><th>SW4-7</th><th>Details</th></tr>
<tr><td>OFF</td><td>OFF</td><td>Odd</td></tr>
<tr><td>ON</td><td>OFF</td><td>Even</td></tr>
<tr><td>OFF</td><td>ON</td><td>None</td></tr>
<tr><td>ON</td><td>ON</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>Stop bit</td><td>Selectable from: 1bit/2bit
<table>
<tr><td></td><td>OFF</td><td>ON</td></tr>
<tr><td>SW 4-8</td><td>1 bit</td><td>2 bit</td></tr>
</table></td></tr>
</table>

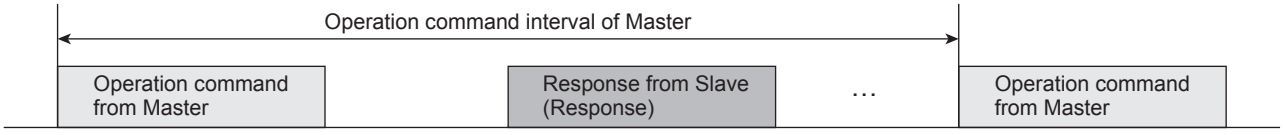
3 Communication timing

3.1 Message sending interval



Note:
- Please send a query (or a operation command) every certain period. [10 seconds is recommended, but it´s acceptable that interval is 10 seconds or more and less than 10 minutes.]
- "Drive ON/OFF" becomes available by remote controller when no query is received for more than 10 minutes, in order to be able to turn on and off in the case of Modbus communication failure.

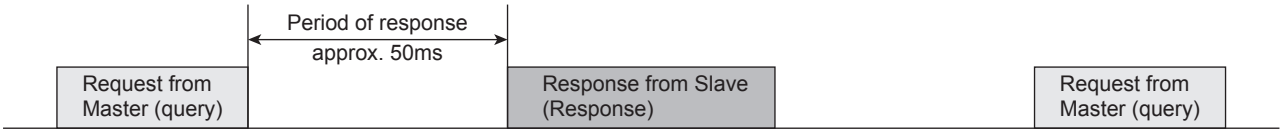
3.2 Operation command interval



Note:
- Please send next operation command **Min. 1 minute after** previous command regardless of the baud rate.

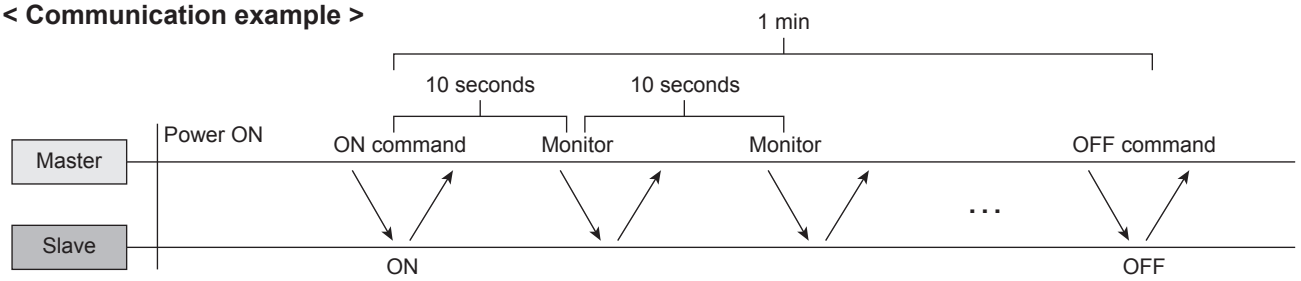
3 Communication timing

3.3 Response interval of Slave



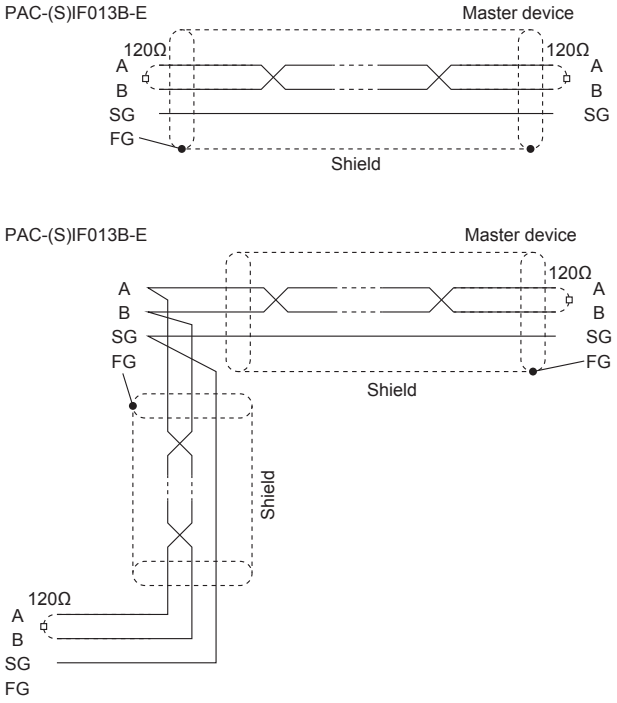
Note:
• Slave will reply approx. 50ms after receiving data from Master regardless of the baud rate.

< Communication example >

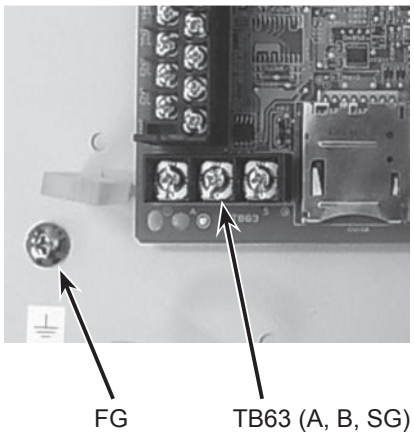


4 Connecting Modbus input

Connect Modbus input to TB63. (See <Fig. 4.1> and <Photo 4.1>)
Besides, See <Table 4.1> regarding RS-485 cable specifications.
Connect only one side of the shield wire to the FG terminal.



< Fig. 4.1 >



< Photo 4.1 >

Note :
•Termination resistor is NOT mounted in the circuit on PAC-IF013B-E/PAC-SIF013B-E. Therefore, if you install PAC-IF013B-E/PAC-SIF013B-E at line end, connect a termination resistor.

< Table 4.1 : Cable specifications >

Item	Description
Cable type	Shielded cable
Number of pairs	2P
Conductor resistance (20°C)	88.0 Ω/km or less
Insulation resistance	10000MΩ · km or more
Dielectric withstand voltage	500VDC, 1 minute
Electrostatic capacitance (1 kHz)	60nF/km or less by an average
Characteristic impedance (100 kHz)	110±10Ω
Recommended conductor size	0.5 to 1.25 mm²
Length	Max. 1200m

5 LED Display detail for Modbus connection

LED	LED display	
LED4	No communication	: Not lighted
	During Communication	: 1 blinking
	Communication error	: Lighted

6 Function code and Data address

6.1 Coils

Read using function code 01 and write using function code 05/15.
Function code 05 is single coil register, and function code 15 is multiple coil register. Broad cast request is available.

Function Code	Address	Modicon Address	Register Name	Details	System No.*1	
					1-4,6	5,7
Read:01 Write:05/15	0	00001	Drive ON/OFF	0=OFF / 1=ON • If the interface unit receives other data, received data will be cancelled.	N/A	✓

*1. Refer to the section 1 "System". "✓" means available, and "N/A" means NOT available.

6.2 Input Register

Read using function code 04. (Response is data in terms of 2 bytes.)

Function Code	Address	Modicon Address	Register Name	Details	
Read:04	0	30001	TH11:HEX inlet air temp.	-39°C-88.5°C (by 0.5°C)	Actual thermistor temp. × 10 = Communication data 0xFC19=-99.9°C ~~~~~ 0xFFFF=-0.1°C 0x0000=0.0°C ~~~~~ 0x0001=0.1°C ~~~~~ 0x012C=30.0°C • When thermistor is open or short, Open:0xFC19/ Short:0x03E7
	1	30002	TH1: Target air temp.	-39°C-88.5°C (by 0.5°C)	
	2	30003	TH5: 2-Phase temp.	-39°C-88.5°C (by 0.5°C)	
	3	30004	TH2: Ref. liquid temp.	-39°C-88.5°C (by 0.5°C)	
	4	30005	TH7: Outdoor temp.	-15°C-46°C (by 1°C)	Actual thermistor temp. × 10 = Communication data 0xFC19=-99.9°C ~~~~~ 0xFFFF=-0.1°C 0x0000=0.0°C ~~~~~ 0x0001=0.1°C ~~~~~ 0x012C=30.0°C
	6	30007	Error Code (hex)	0x8000=No error 0x8000≠Error Code *1	
	7	30008	Error Code (decimal)	8000=No error 8000≠Error Code *1	
	8	30009	External Output OUT1: ON/OFF OUT2: Error OUT3: Compressor OUT4: Defrost OUT5: Cooling mode OUT6: Heating mode OUT7: Self protection OUT8: Predefrost	bit0:OUT1 0=OFF / 1=ON ~~~ bit7:OUT8 e.g.) When only OUT3 is "ON", outputs are as follows. bit 7654 3210 Out 0000 0100 → 0x0004"	
	9	30010	Ref.address	0x0000=address0 0x0001=address1 ~~~~ 0x000F=address15	
	10	30011	Modbus Comms Counter	Value or a counter which increments upon every valid Modbus command received. 0=0count 1=1count ~~ 65535=65535count • When the counter becomes more than 65535, it's cleared.	
	11	30012	Software version	0X0000=Ver00.00 0X0100=Ver01.00	

*1. Meanings of error codes, please see Table 6.

< Continued to next page. >

6 Function code and Data address

< Continued from the previous page. >

< Table 6 : Error codes >

Error code (Modbus)	Error code (Remote controller)	Discription
5101	P1	Refer to the installation manual.
5102	P2	
1503	P6 (Freezing)	
1504	P6 (Overheating)	
5103	P9	
6831 6834	"E0" or "E4"	
6201	E1	
6202	E2	

Error code (Modbus)	Error code (Remote controller)	Description
6832 6833	"E3" or "E5"	Refer to the installation manual.
6840 6843	E6	
6842	E7	
0404	Fb	
1514	PL	
5111	PU	
7130	EE	

6.3 Holding Register

Read using function code 03 and write using function code 06/ 16.
Function code 06 is single holding register, and function code 16 is multiple holding register.
Broadcast request is available ONLY when function code is 06/16.

Function Code	Address	Modicon Address	Register Name	Details		System No.*1 1-4,6	System No.*1 5,7
Read:03 Write: 06/ 16	0	40001	Capacity request (from Local controller)	OFF, Step1-Step11, Auto step mode • In Auto step mode, only READ is available.	0(0x0000)=OFF 1(0x0001)=Step1 (Min.) 2(0x0002)=Step2 ~~~~ 11(0x000B)=Step11 (Max.) 12(0x000C)=Auto step mode (Auto) • If the interface unit receives other data, received data will be cancelled. • OFF=DriveOFF / Others=DriveON • When reading and the intelligent multiple outdoor unit control is used, response of the sub interface unit becomes "12 (0x000C)", because capacity request is only for the main interface unit.	✓	N/A
	1	40002	Drive Mode	1 (0x0001) = Heating mode, 3 (0x0003) = Cooling mode, 7(0x0007) = Fan mode, 8 (0x0008) = Auto change over • If the interface unit receives other data, received data will be cancelled.		✓	✓
	2	40003	Temperature Setpoint	Cooling: 12~30°C Heating: 17~28°C Auto change over: 17~28°C (by 1°C)	0(0x0000)=0°C 10(0x000A)=1.0°C 20(0x0014)=2.0°C Actual set point × 10 = Communication data ~~~~ 300(0x012C)=30.0°C • If the interface unit receives other data, received data will be cancelled. • When the interface unit receives decimal value, value will be round down.	N/A	✓
	3	40004	Drive ON/OFF	0=OFF / 1=ON • If the interface unit receives other data, received data will be cancelled.		N/A	✓
	4	40005	Error Code (hex) [READ ONLY]	0x8000=No error 0x8000≠Error Code *2		✓	✓
	5	40006	Error Code (decimal) [READ ONLY]	8000=No error 8000≠Error Code *2		✓	✓
	6	40007	Step status [READ ONLY]	OFF,Step1-Step11,Auto step mode	0(0x0000)=OFF 1(0x0001)=Step1 (Min.) 2(0x0002)=Step2 ~~~~ 11(0x000B)=Step11 (Max.) 12(0x000C)=Auto step mode (Auto) • When the intelligent multiple outdoor unit control is used, step status shows divided capacity step of each interface unit.	✓	✓
	7	40008	Ref.address [READ ONLY]	0x0000=address0 0x0001=address1 ~~~~ 0x000F=address15		✓	✓
	8	40009	Modbus Comms Counter [READ ONLY]	Value or a counter which increments upon every valid Modbus command received. 0=0count 1=1count ~~ 65535=65535count • When the counter becomes more than 65535, it´s cleared.		✓	✓

*1. Refer to the section 1 "System". "✓" means available, and "N/A" means NOT available.
*2. Meanings of error codes, please see Table 6.

6 Function code and Data address

<table>
<tr><th rowspan="2">Function Code</th><th rowspan="2">Address</th><th rowspan="2">Modicon Address</th><th rowspan="2">Register Name</th><th rowspan="2">Details</th><th colspan="2">System No.*1</th></tr>
<tr><th>1-4,6</th><th>5,7</th></tr>
<tr><td rowspan="3">Read:03
Write: 06/ 16</td><td>9</td><td>40010</td><td>Software version [READ ONLY]</td><td colspan="2">0x0000=Ver00.00
0x0100=Ver01.00</td><td>✓</td><td>✓</td></tr>
<tr><td>10*3</td><td>40011</td><td>Capacity request (0-100%) (from Local controller)</td><td>0-100, Auto step mode (by 1(%))
• In Auto step mode, only READ is available.</td><td>■When Writing
<table>
<tr><th>• When the intelligent multiple outdoor unit control is NOT selected</th><th>• When the intelligent multiple outdoor unit control is selected</th></tr>
<tr><td>0 (0x0000) - 5 (0x0005) = OFF</td><td>0 (0x0000) - 5 (0x0005) = OFF</td></tr>
<tr><td>6 (0x0006) - 40 (0x0028) = Step1</td><td>6 (0x0006) - 20 (0x0014) = Step1</td></tr>
<tr><td>41 (0x0029) - 46 (0x002E) = Step2</td><td>21 (0x0015) - 28 (0x001C) = Step2</td></tr>
<tr><td>47 (0x002F) - 52 (0x0034) = Step3</td><td>29 (0x001D) - 36 (0x0024) = Step3</td></tr>
<tr><td>53 (0x0035) - 58 (0x003A) = Step4</td><td>37 (0x0025) - 44 (0x002C) = Step4</td></tr>
<tr><td>59 (0x003B) - 64 (0x0040) = Step5</td><td>45 (0x002D) - 52 (0x0034) = Step5</td></tr>
<tr><td>65 (0x0041) - 70 (0x0046) = Step6</td><td>53 (0x0035) - 60 (0x003C) = Step6</td></tr>
<tr><td>71 (0x0047) - 76 (0x004C) = Step7</td><td>61 (0x003D) - 68 (0x0044) = Step7</td></tr>
<tr><td>77 (0x004D) - 82 (0x0052) = Step8</td><td>69 (0x0045) - 76 (0x004C) = Step8</td></tr>
<tr><td>83 (0x0053) - 88 (0x0058) = Step9</td><td>77 (0x004D) - 84 (0x0054) = Step9</td></tr>
<tr><td>89 (0x0059) - 94 (0x005E) = Step10</td><td>85 (0x0055) - 92 (0x005C) = Step10</td></tr>
<tr><td>95 (0x005F) - 100 (0x0064) = Step11</td><td>93 (0x005D) - 100 (0x0064) =Step11</td></tr>
</table>
■When Reading
<table>
<tr><th>• When the intelligent multiple outdoor unit control is NOT selected</th><th>• When the intelligent multiple outdoor unit control is selected</th></tr>
<tr><td>0 (0x0000) = OFF</td><td>0 (0x0000) = OFF</td></tr>
<tr><td>40 (0x0028) = Step1</td><td>20 (0x0014) = Step1</td></tr>
<tr><td>46 (0x002E) = Step2</td><td>28 (0x001C) = Step2</td></tr>
<tr><td>52 (0x0034) = Step3</td><td>36 (0x0024) = Step3</td></tr>
<tr><td>58 (0x003A) = Step4</td><td>44 (0x002C) = Step4</td></tr>
<tr><td>64 (0x0040) = Step5</td><td>52 (0x0034) = Step5</td></tr>
<tr><td>70 (0x0046) = Step6</td><td>60 (0x003C) = Step6</td></tr>
<tr><td>76 (0x004C) = Step7</td><td>68 (0x0044) = Step7</td></tr>
<tr><td>82 (0x0052) = Step8</td><td>76 (0x004C) = Step8</td></tr>
<tr><td>88 (0x0058) = Step9</td><td>84 (0x0054) = Step9</td></tr>
<tr><td>94 (0x005E) = Step10</td><td>92 (0x005C) = Step10</td></tr>
<tr><td>100 (0x0064) = Step11</td><td>100 (0x0064) =Step11</td></tr>
<tr><td>65535 (0xFFFF) = Auto step mode</td><td>65535 (0xFFFF) = Auto step mode</td></tr>
</table>
If the interface unit receives other data, received data will be cancelled.
・OFF = DriveOFF / Others = DriveON
・When reading, Modbus master can receive ONLY the above fixed value.
・When reading and the intelligent multiple outdoor unit control is selected, response of sub interface unit becomes "65535 (0xFFFF)", because capacity request is only for the main interface unit.</td><td>✓</td><td>N/A</td></tr>
<tr><td>11*4</td><td>40012</td><td>Step status (0-100%) [READ ONLY]</td><td>0-100, Auto step mode</td><td>
<table>
<tr><th>• When the intelligent multiple outdoor unit control is NOT selected</th><th>• When the intelligent multiple outdoor unit control is selected</th></tr>
<tr><td>0 (0x0000) = OFF</td><td>0 (0x0000) = OFF</td></tr>
<tr><td>40 (0x0028) = Step1</td><td>20 (0x0014) = Step1</td></tr>
<tr><td>46 (0x002E) = Step2</td><td>28 (0x001C) = Step2</td></tr>
<tr><td>52 (0x0034) = Step3</td><td>36 (0x0024) = Step3</td></tr>
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<tr><td>76 (0x004C) = Step7</td><td>68 (0x0044) = Step7</td></tr>
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<tr><td>88 (0x0058) = Step9</td><td>84 (0x0054) = Step9</td></tr>
<tr><td>94 (0x005E) = Step10</td><td>92 (0x005C) = Step10</td></tr>
<tr><td>100 (0x0064) = Step11</td><td>100 (0x0064) =Step11</td></tr>
<tr><td>65535 (0xFFFF) = Auto step mode</td><td>65535 (0xFFFF) = Auto step mode</td></tr>
</table>
・Modbus master can receive ONLY the above fixed value.
・When the intelligent multiple outdoor unit control is used, step states shows divided capacity step of each interface unit.</td><td>✓</td><td>✓</td></tr>
</table>

*1. Refer to the section 1 "System". "✓" means available, and "N/A" means NOT available.
*3. Both address 0 (OFF, step 1-11) and address 10 (0-100%) are for capacity step request. Select address 0 or address 10. Address 10 is available ONLY since version 07.00 software of interface unit (produced since January 2016).
*4. Both address 6 (OFF, step 1-11) and address 11 (0-100%) are for step status. Select address 6 or address 11. Address 11 is available ONLY since version 07.00 software of interface unit (produced since January 2016).

6 Function code and Data address

6.4 Exception code

When the message from the master device is not valid, the interface unit will discard the message and respond exception code.
The structure of exception response is shown below.

①Slave address
②Function code + 80h
③Exception code
④CRC-16

The description of exception codes in exception response is shown in the table below.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave (the interface unit).
02h	ILLEGAL DATA ADDRESS	The data address received in the query is not allowable address for the slave (the interface unit).
03h	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the slave (the interface unit).

7 System Design Responsibility

● Mitsubishi Electric does not take any responsibility on the local system design of Modbus communication.

8 Laws and Regulations

● Please make sure to comply with laws and regulations in terms of Modbus communication designed locally.

MITSUBISHI ELECTRIC CORPORATION

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