Modbus Protocol (V1.0) for the UNITERM 3 Air-to-Water Heat Pump Water Heater

Thank you for choosing air-to-water het pump Cooper and Hunter. In order to ensure the BMS integrated with the monitoring system of the UNITERM 3 Water Heater, please read this manual carefully before installation and use and keep it propely for future reference.

CONTENTS

Modbus Protocol (V1.0) for UNITERM 3 Air-to-Water Heat Pump Water Heater

Preface

This protocol specifies the communication format and also the data format for the Modbus communication of the

UNITERM 3 air-to-water heat pump water heater.

This protocol is applicable to the UNITERM 3 air-to-water heat pump water heater.

1. Terms and Definitions

1) Modbus Communication

Modbus protocol is such a protocol used for industrial communication and distributed control system. Modbus network is a master-slave network, allowable for the communication between one master unit and multiple slave units through data interchange. The Modbus communication is realized in the request-response way, that is, each request sent by the master unit is corresponding to a response replied by the slave unit.

2) ASCII Mode

Under this mode, as for the communication via the Modbus, eight bits in one piece of information can be transmitted as two ASCII characters.

3) RTU Mode

Under this mode, eight bits can be divided into two four-bit hexadecimal characters. The advantage of the RTU mode is that with the same baud rate the transmitted character density is higher than that in the ASCII mode. Each piece of information should be transmitted continuously.

4) Master Unit

It indicates the device which sends out the request to Modbus, like a PC.

5) Slave Unit

It indicates such a device as is capable of responding to the request sent by the master unit, like a communication module which is taken as an example in this protocol.

6) Coil

It is expressed by one bit, like the switch bit, failure bit etc. The coil is a universal express way of the Modbus protocol and actually it is a one-bit data value, namely Boolean, switching value.

7) Register

It is expressed by two bytes (16 bits), like temperature, mode etc. The register is a universal express way of the Modbus protocol and actually it is a word (16 bits), or an analog value.

8) Device Address

It indicates the address of the Modbus communication module, through which the master unit can identify each communication module in the network. Address range: 1~255. “0” is the address of the broadcast (it can be received by all communication modules).

9) Broadcast

When the master unit sends out a control frame, all slave units in the network can receive it and then all perform this control action (but no reply is given). The device address for the broadcast frame is 0

10)Function Code

It is used to identify the function of the communication frame. See the following table for the function codes covered in this protocol.

Table 1 Function Code

Description	Function Code
Read Multiple Coils	0x01
Read Multiple Registers	0x03
Write Multiple Coils	0x0f
Write Multiple Registers	0x10

11)Starting Address

It indicates the starting address of the register (coil: bit address; register: word address). The data translation starts from the high-order eight bits to the low-order eight bits.

12)Data Size

It indicates the operated data count starting from the starting address (coil: bit count, register: word count). The data translation starts from the high-order eight bits to the low-order eight bits.

13)Byte Count

It indicates the count of the effective bytes during the data transmission.

14)Effective Data

It indicates the control data, status data etc.

15)Alarm Code

It indicates the error type which is detected by the communication module when the master unit is sending the request frame.

16)CRC

It indicates the cyclic redundancy code consisting of two bytes. The data translation starts from the low eight bits to the high-order eight bits. See Annex A for more details of its calculation.

17)Request Frame

It is the request sent by the master unit to the communication module.

18)Response Frame

It is the response replied by the communication module to the request frame sent by the master unit.

19)Communication Frame

It is the collection of continuously transmitted bytes during the communication.

20)BMS

Its full name is building management system

2. Brief Introduction to the BMS System

The interface RS485 of Modbus communication protocol, provided by the long-distance monitoring system, can be directly connected with the BMS system or C&H long-distance monitoring system, that is, control up to 255 units and display their running status at the same time. The control function of the BMS system is equal to that of the long-distance monitoring system. However, the command sent later takes the priority.

3. Network Topology

3.1 General

As shown in Fig. 1, it can be seen that the whole network consists of two parts: units network and Modbus network

There are at most 255 communication modules in one monitoring network, that is, only 255 units can be connected.

When the quantity of the units is larger than 255, a new network can be established through another port which is also capable of connecting 255 communication modules.

3.2 Topological Structure

3.2.1 Topological Strcutre (＜255)

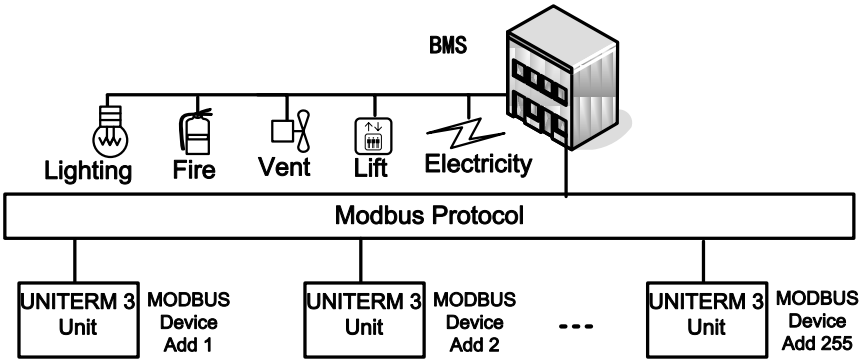


Figure 1: Topological Strucure (＜255)

3.2.2 Topological Strucuture (＞255)

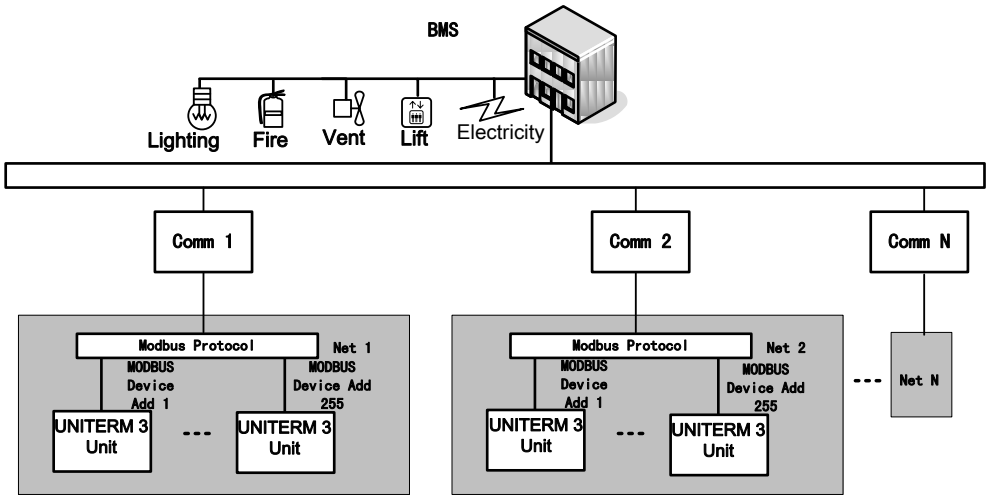


Figure 2: Topological Structure (255)

4. MODBUS Protocol Format

4.1 General

Modbus actually has become the industrial communication standard because it is not only fully opened and used widely but also simple and can be debugged flexibly. Besides, as for the communication of multiple units, it can be developed fast and also can be conveniently connected with the devices which support this protocol. There are two communication modes, RTU and ASCII. The former one is adopted for the BMS interface.

4.2 Protocol Interface

The protocol interface supports the Modbus RTU protocol.

4.3 Hardware Interface

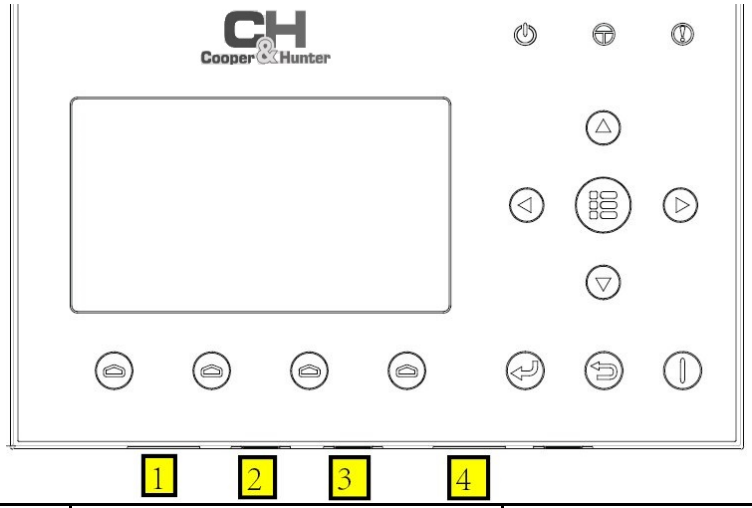
1) Communication Interface: RS485

2) Baud Rate: 9600 bit/s(In some special event, other baud rate also can be selected but the communication mode should be compatible with this protocol)

- Start Bit:1
- Data Bit：8

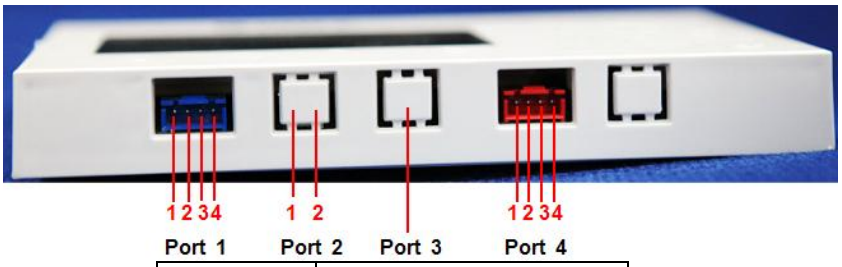
◆ Check Bit：None ◆
Stop Bit：1

3） Hardware interface of Wired Controller：



No.	Interface	Specifications	Instructions
1	BMS communication interface	Four-wire communication line, Class V twisted pairs, AWG24, non-standard	To be integrated into the BMS system
2	Equipment communication interface	Two-wire communication line	To be integrated with the equipment communication line
3	+12VDC interface	Input voltage:+12VDC， Input ampere: 800~1000mA	To provide power for the control. Note that the correct adapter is required.
4	+12VDC interface+ Communication interface	Four-wire communication line, Class V twisted pairs, AWG24, 8m, standard.	To be integrated with the equipment communication line. +12VDC interface is powered through the equipment.

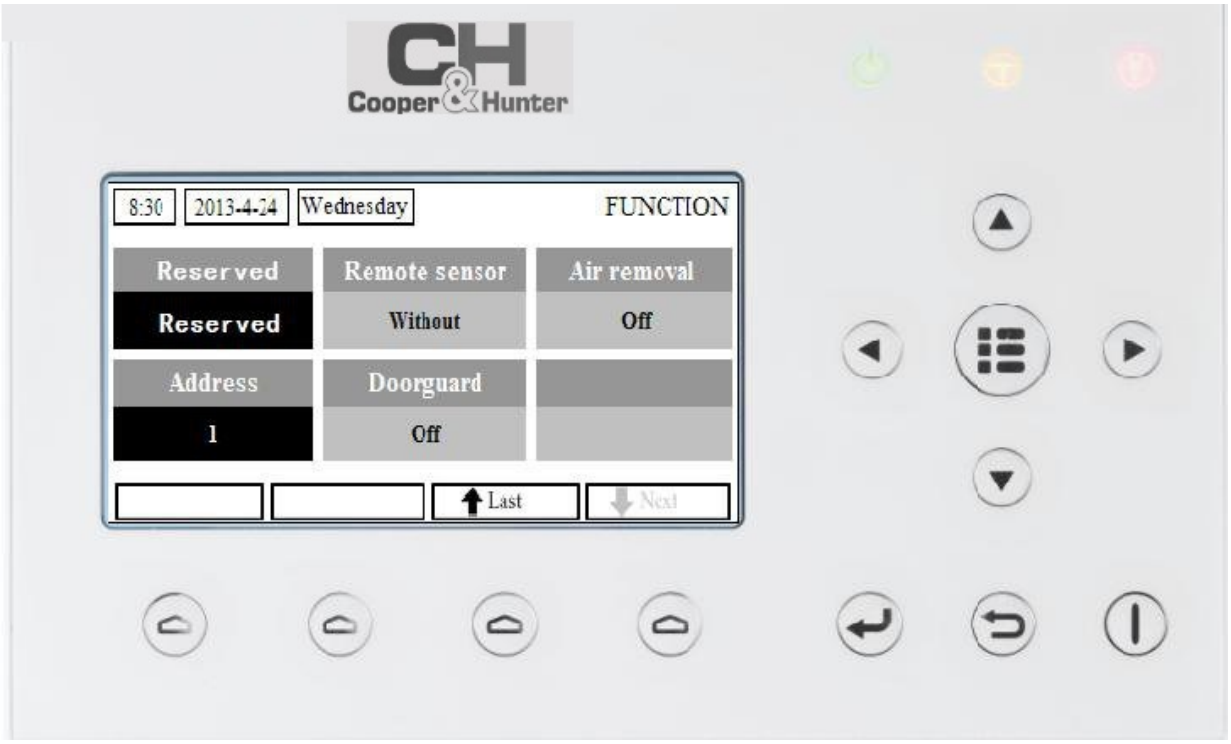
Note：Interface 1 inputs/outputs RS-485 signals, please connect interface 1 into a RS-232 to RS-485 converter, and then integrate into the BMS system.



No.	Interfaces
Port 1	1——Not Used 2——B 3——A 4——Not Used
Port 2	1——B 2——A
Port 3	+12VDC interface
Port 4	1——+12VDC 2——B 3——A

	4——GND

4) How to Set the BMS Address of the Controller:



Step 1: power the controller on, press "" to access to the homepage, and then press "" (the 1st from the left side)to go to the "Function Setting" page.

Step 2: press "" (the 4th from the left side) to go to the page where "Address" is.

Step 3: press "" or "" to select the option "Address", and then this option box will turn black with white fonts.

Step 3:After that, press "" or "" to increase or decrease the "Address" value.

Note: the "Address" can't be 0 or 126. When the setting is finished, the address in the control command sent by the BMS software should be same as this setting value by the controller.

4.4 Universal Communication Frame Format of Modbus under RTU Mode

Start Time Interval	Add. Code	Function Code	Data Area	CRC	Stop Time Interval
T1-T2-T3-T4	1 Byte	1 Byte	n Bytes	2 Bytes	T1-T2-T3-T4

Under the RTU mode, there is at least 3.5minutes dead time before the data transmission, which can be figured out through the adopted baud rate (like T1-T2-T3-T4 listed in the table above) and there is another 3.5 minutes dead time after the transmission of the last character. After that, another set of data can be transmitted. The whole set of data should be transmitted continuously, if there is a pause more than 1.5 minutes, the receiver will jump to the transmission of next set of data.

If the dead time is less than 3.5 minutes, the transmission would fail as the CRC for the information combination is ineffective.

4.5 ModBus Standard Protocol Format

4.5.1. Coil (Bit)

Table 2 Coil Data

Add	Corresponding Byte	Values
Bit 0	Byte0.0	1
Bit 1	Byte0.1	0
Bit 2	Byte0.2	1
Bit 3	Byte0.3	0
Bit 4	Byte0.4	1
Bit 5	Byte0.5	0
Bit 6	Byte0.6	1
Bit 7	Byte0.7	0
Bit 8	Byte1.0	1
Bit 9	Byte1.1	0
Bit 10	Byte1.2	1
Bit 11	Byte1.3	0
Bit 12	Byte1.4	1
Bit 13	Byte1.5	0
Bit 14	Byte1.6	1
Bit 15	Byte1.7	0
……	……	……

1）“Coil” indicates the data of some flag bit or failure bit etc.
2）The unit of date is bit and each bit has a corresponding address.
3）The data bit exists in the byte of the communication frame and each byte is composed of eight bits. The high-order byte is corresponding to the high-order bit, so is the low-order byte and bit. See Table 2 for more details.
4）The master unit can operate one bit among the communication data or multiple continuous bits at the same time.
5）The bit count which the master unit can read or transmit is less than Byte×8. The ineffective data bit of the last byte should be cleared when transmit or read the effective data of the communication frame. For instance, when nine “1” bits are read or transmitted, then two bytes are need, “1111 1111” and “0000 0001”. For the later byte, the ineffective bits “0” should be cleared.

4.5.2 **Register (Word, 16 Bit)**

Table 3 Register Data

Add	Corresponding Byte	Value
Word 0	Byte 0	AA 55
	Byte 1	
Word 1	Byte 2	AA 55
	Byte 3	
Word 2	Byte 4	55 AA
	Byte 5	
……	……	……

	.....	

1) ..The unit of the register is “word” which has a corresponding address starting from 0
2) ..When the master unit reads a word, it needs to read two bytes from the high-order eight bits to the low-order eight bits.
3) ..When the master unit transmits or read the request frame, it can transmit or read one or multiple continuous words in the data list.

4.5.3 **Read Multiple Coils**

Note: It can read the coil data but not support the broadcast.
Function Code: 0x01

Table 4: Request Frame

Device Add.	Function Code	Starting Add.	Data Size	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

Table 5: Response Frame

Device Add.	Function Code	Byte Count	Effective Data	CRC
1 Byte	1 Byte	1 Byte	n Bytes	2 Bytes

Starting Address: it is the starting place where to read a series of bits.
Data size: It indicates the bit count.
Case: Read ten bits from the coil 5 of the device 10(see Table 2 for the coil data), as follows:
Request Frame: 0A(device address)01(function code)00 05(starting address)00 0A(data size)AD 77(CRC)
Response Frame: 0A(device address)01(function code)02(byte count)AA 02(effective data)E3 5C(CRC)
The last byte is “0000 0010”, among which six insignificant bits “0” before the bit "1"should be cleared

4.5.4 **Write Multiple Coils**

Note: The master writes coil data to the communication module and also supports the broadcast.
Function Code: 0x0F

Table 6: Request Frame

Device Add.	Function Code	Starting Add.	Data Size	Byte Count	Effective Data	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	1 Byte	n Bytes	2 Bytes

Table 7: Response Frame

Device Add.	Function Code	Starting Add.	Data Size	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
Note: The response frame has the same device address, function code, starting address and data size as the request frame.				

Case: set eleven consecutive bits to “1” for the device 10 and start at the address 6, as follows:
Request Frame:0A(device address)0F(function code)00 06 (starting address)00 0B(data size)02(byte count) FF 07 (effective data)97 A0(CRC)
Response Frame: 0A (device address) 0F (function code) 00 06(starting address) 00 0B (data size) F5 76(CRC)
The last byte is “0000 0010”, among which the insignificant bits “0” before the bit "1" should be cleared.

4.5.5 **Read Multiple Registers**

Note: Read the register data but do not support the broadcast.
Function Code: 0x03

Table 8: Request Frame

Device Add.	Function Code	Starting Add.	Data Size	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

Table 9: Response Frame

Device Add.	Function Code	Byte Count	Effective Date	CRC
1 Byte	1 Byte	1 Byte	n Bytes	2 Bytes

Starting Add.: It indicates the starting address to read the block data.
Data Size: It indicates the word count with the maximum of 127 each time.
Case: read two continuous words (see Table 3) from the device 10 starting at the address 1, as follows:
Request Frame: 0A (device address) 03 (function code) 00 01(starting address) 00 02(data size)94 B0 (CRC)
Response Frame: 0A (device address) 03 (function code) 04(byte count) AA 55 55 AA (effective data) CE 14(CRC)

4.5.6 **Write Multiple Registers (Word)**

Note: Write control data from the master unit to the register and support the broadcast
Function Code: 0x10

Table 10: Request Frame

Device Add.	Function Code	Starting Add.	Data Size	Byte Count	Effective Date	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	1 Byte	n Bytes	2 Bytes

Table 11: Response Frame

Device Add.	Function Code	Starting Add.	Data Size	CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
Note: The response frame has the same device address, function code, starting address and data size as the request frame.				

Case: Write three words (0x12, 0x23, 0x34) from the device 10 starting at the address 2, as follows:
Request Frame: 0A (device address) 10 (function code) 00 02(starting address) 00 03(data size) 06 (byte count) 00 12 00 23 00 34(effective data) 15 DF (CRC)
Response Frame: 0A (device address) 10 (function code) 00 02 (starting address) 00 03 (data size) 20 B3 (CRC)

4.5.7 **Alarm Response**

Note: The master unit sends out a request frame, but the communication module detects that there is some fault, so an alarm response is replied.
Function Code: Set the highest-order bit to “1”, which is value figured out through the OR operation of the request frame’s function code and 0x80.

Communication Format of the Response Frame

Table12: Alarm Response Frame

Device Add.	Function Code	Alarm Code	CRC
1 Byte	1 Byte	1 Bytes	2 Bytes

Description to the Alarm Codes:

Table13: Alarm Codes

Alarm Code	Name	Description
0x03	Illegal data	The transmitted data is incorrect or beyond the data area.
0x04	Slave device failure	There is communicating failure between the communication module and the unit.

Case: Read two words from the device 10 starting at the address 1, but the address 2 does not exist in the communication address, so the replay of the alarm response frame is as follows:
Request Frame: 0A (device address) 03(function code) 00 01(starting address) 00 02(data size) 94 B0 (CRC)
Reponses Frame: 0A (device address) 83(function code) 03(alarm code) 70 F3 (CRC)

5. Communication Protocol for the UNITERM 3 Air-to-water Heat Pump Water Heater

5.1. General

Through this interface, it can not only realize the long-distance monitoring to the unit, including the running temperature of the unit, the status of the compressor, and the failure status but also set the unit long distantly, like temperature, running mode, on/off etc.

In the protocol, "R" indicates "only read" and "W/R" indicates "write and read".

5.2. Precautions before Designing the BMS Interface

Before designing the BMS interface, please make sure the setting of the Address(do not set 0) and the wiring are correct and
read *Installation and Operation Instructions of the Wired Controller of the UNITERM 3 air-to-water heat pump water heater.*

Please pay attention to the statements below.

★(1) Modes are allowed to be changed only when the unit is off, or this operation is ineffective. When the unit is off, "On/off" and "Mode" settings both are effective. However, when the unit is on, "On/off" and "Mode" settings both are effective and the monitoring software is suggested to tell this operation is invalid.

★(2): For the heating only unit, the "Cool" and "Cool+ Hot water" settings are ineffective and the monitoring software is suggested to tell this operation is invalid.

★(3): When the water tank is unavailable, the following points should be paid much attention.

a: "Cool+ Hot water" or "Heat+Hot water" or "Hot water" settings are ineffective and the monitoring software is suggested to tell this operation is invalid.

b:"Sanitze", "Fast hot water", "Cool+Hot water Priority", "Heat+ Hot water Priority", or "Water Tank Temp Sensor" settings are ineffective and the monitoring software is suggested to tell this operation is invalid.

★(4): Only when "Sanitization" is deactivated, "Sanitizing Temp" setting is effective. Similarly, only when the "Floor Debug" is deactivated, "Floor Debug Sections", "First Floor Debug Section Temp", 'Each Floor Debug Section Temp" or "Each Floor Debug Section Interval" settings are effective, or the monitoring software is suggested to tell this operation is invalid.

★(5): Sanitize: please read the *Installation and Operation Instructions of the Wired Controller of the UNITERM 3 air-to-water heat pump water heater* for details about the "Sanitize" function. When the command "Sanitize" is sent out, it is required to detect the "Sanitize" state (Word62) of the unit. If it is detected that "Sanitize" failed, then confirm this fact and it is suggested to let the monitoring software tell and confirm it, which should be done together with Bit36 (1: Clear the "Sanitize" failed state; 0: Do not clear "Sanitize" failed state). Next "Sanitize" is allowed only when the first option (1: Clear the "Sanitize" failed state) is performed.

★(6): Floor Debug: please read the *Installation and Operation Instructions of the Wired Controller of the UNITERM 3 air-to-water heat pump water heater* for details about the "Floor Debug" function. When the command "Floor Debug" is sent out, it is required to detect the "Floor Debug" state (Word64) of the unit. If it is detected that "Floor Debug" failed, it is suggested to let the monitoring software to give out some alarm or warning. Meanwhile, it is available to check the real-time "Floor Debug Target Temperature", "Floor Debug Total Runtime", and "Floor Debug Error Time".

5.3. Valid Data for Modbus Communication

The data for the Modbus communication protocol can be divided into two types: register and switching value. The former indicates the values of temperature, valves and other continuous, multi-mode values, while the later indicates the value which only has two status, like the temperature sensor failure (with only two options: “Yes” or “No”).

1. Definition and Address of the Analog Variables (Word 0-Word 63)

Register (Read 03, Write 10)						
Add	**Visit Type**	**Data**	**Range**	**Accuracy**	**Data Type**	**Note**
Word 0	/	Reserved	/	/	/	Wired Controller
Word 1	R/W	On/Off	Actual value: 0xAA:On/ 0x55:Off Default: Off Transmission value=Actual value	/	Unsigned Integer	
Word 2	R/W	Mode Setting	Actual value: 1:Heat/ 2:Hot water/ 3:Cool+Heat water/ 4:Heat +Hot water/ 5:Cool/ Default: Heat Transmission value=Actual value	/	Unsigned Integer	
Word 3	R/W	IDO E-heater Control	Actual value: 1:1 set/ 2:2 sets/ 3: Off/ Default: 1 set Transmission value=Actual value	/	Unsigned Integer	
Word 4	R/W	Sanitizing Temp	Actual value:40～70℃, Default: 70℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 5	R/W	Floor Debug Section	Actual value: 1-10 sections Default : 1 section Transmission value＝Actual value	1 Section	Unsigned Integer	
Word 6	R/W	First Floor Debug Section Temp	Actual value:25～35℃, Default: 25℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 7	R/W	Each Floor Debug Temp	Actual value:2～10℃, Default: 5℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 8	R/W	Interval of Each Floor Debug Section	Actual value: 0～72Hours, Default: 0 Hour Transmission value＝Actual value	12 Hours	Unsigned Integer	
Word 9	R/W	Leaving Water Temp Set Point for Cooling	Actual value: 7~25℃[with FCU]/ 18~25℃[without FCU] Default： 7℃[with FCU]/18℃[without FCU] Transmission value＝Actual value	1℃	Unsigned Integer	
Word 10	R/W	Leaving Water Temp Set Point for Heating	Actual value: 25~63℃ [High-temp] / 25~55℃[low-temp] Default： 45℃[High-temp]/35℃[Low-temp] Transmission value＝Actual value	1℃	Unsigned Integer	

Word 11	R/W	Indoor Temp Set Point for Cooling	Actual value: 18～30℃, Default: 24℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 12	R/W	Indoor Temp Set Point for Heating	Actual value: 18～30℃, Default:20℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 13	R/W	Water Tank Temp Set Point	Actual value: 40～80℃/40~50℃ [Solar power function is unavailable and the electric heater of the water tank is OFF.] Default: 50℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 14	R/W	Ambient Temp for Starting the E-heater	Actual value: -22～18℃, Default: -7℃ Transmission value＝Actual value	1℃	Float Type
Word 15	R/W	Environment temperature for activating the auxiliary heater	Actual value: -22～18℃, Default: -15℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 16	R/W	Max Water Temp for Heat Pump	Actual value: 40～50℃, Default: 50℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 17	R/W	Ambient Temp Upper Limit for Heating	Actual value: 10～37℃, Default: 25℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 18	R/W	Ambient Temp Lower Limit for Heating	Actual value: -22～5℃, Default:-20℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 19	R/W	Indoor Temp Upper Limit for Heating	Actual value: 22～30℃, Default: 24℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 20	R/W	Indoor Temp Lower Limit for Heating	Actual value: 18～21℃, Default: 18℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 21	R/W	Water Temp Upper Limit for Heating	Actual value: 56～60℃[High-temp]/ 35～55℃[Low-temp] Default: 60℃[High-temp]/35℃[Low-temp] Transmission value＝Actual value	1℃	Unsigned Integer
Word 22	R/W	Water Temp Lower Limit for Heating	Actual value: 55～58℃[High-temp]/ 25～29℃[Low-temp] Default: 55℃[High-temp]/29℃[Low-temp] Transmission value＝Actual value	1℃	Unsigned Integer
Word 23	R/W	Ambient Temp Upper Limit for Cooling	Actual value:26～50℃, Default :40℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 24	R/W	Ambient Temp Lower Limit for Cooling	Actual value:8～25℃ Default :25℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 25	R/W	Indoor Temp Upper Limit for Cooling	Actual value:24～30℃, Default : 27℃ Transmission value＝Actual value	1℃	Unsigned Integer
Word 26	R/W	Indoor Temp Lower	Actual value:18～23℃,	1℃	Unsigned

		Limit for Cooling	Default : 22℃ Transmission value＝Actual value		Integer	
Word 27	R/W	Water Temp Upper Limit for Cooling	Actual value: 15~25℃[with FCU]/ 22~25℃[without FCU] Default : 15℃[with FCU]/23℃[without FCU] Transmission value＝Actual value	1℃	Unsigned Integer	
Word 28	R/W	Water Temp Lower Limit for Cooling	Actual value: 7~14℃[with FCU]/ 18~21℃[with FCU] Default : 7℃[with FCU]/18℃[without FCU] Transmission value＝Actual value	1℃	Unsigned Integer	
Word 29	R/W	Temp Deviation for Cooling	Actual value: 2～10℃, Default :5℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 30	R/W	Temp Deviation for Heating	Actual value: 2～10℃, Default :10℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 31	R/W	Temp Deviation for Hot Water	Actual value:2～8℃, Default :5℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 32	R/W	Solar power maximum water temperature setting	Actual value:50～80℃, Default :80℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 33	R/W	Room temperature control deviation setting	Actual value:1～5℃, Default :2℃ Transmission value＝Actual value	1℃	Unsigned Integer	/
Word 34	R/W	Runtime setting	Actual value:1～10min, Default :3min[with FCU]/5min[with FCU] Transmission value＝Actual value	1min	Unsigned Integer	
Word 35	R/W	Solar panel start temperature difference setting	Actual value:10～30℃, Default :15℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 36	R/W	Solar panel maximum temperature	Actual value:90～130℃, Default :110℃ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 37	R/W	Solar panel ON time setting-hour	Actual value:0～24 Default :8 Transmission value＝Actual value	1h	Unsigned Integer	
Word 38	R/W	Solar panel ON time setting-minute	Actual value:0～59 Default :0 Transmission value＝Actual value	1min	Unsigned Integer	
Word 39	R/W	Solar panel OFF time setting-hour	Actual value:0～24 Default :8 Transmission value＝Actual value	1h	Unsigned Integer	
Word 40	R/W	Solar panel OFF time setting-minute	Actual value:0～59 Default :0 Transmission value＝Actual value	1min	Unsigned Integer	
Word 41	R/W	Solar power	Actual value: 1:on/0:off/2:timer Default :0:off Transmission value＝Actual value	1	Unsigned Integer	
Word 42	R/W	Thermostat	Actual value: 1:air/0:without/2:air+hotwater Default :0:without Transmission value＝Actual value	1	Unsigned Integer	

Word 43	/	Reserved	/	/	/	
Word 44	/	Reserved	/	/	/	
Word 45	/	Reserved	/	/	/	
Word 46	/	Reserved	/	/	/	
Word 47	/	Reserved	/	/	/	
Word 48	/	Reserved	/	/	/	
Word 49	/	Reserved	/	/	/	
Word 50	/	Reserved	/	/	/	
Word 51	/	Reserved	/	/	/	
Word 52	/	Reserved	/	/	/	
Word 53	/	Reserved	/	/	/	
Word 54	/	Reserved	/	/	/	
Word 55	/	Reserved	/	/	/	
Word 56	/	Reserved	/	/	/	
Word 57	/	Reserved	/	/	/	
Word 58	/	Reserved	/	/	/	
Word 59	/	Reserved	/	/	/	
Word 60	/	Reserved	/	/	/	
Word 61	/	Reserved	/	/	/	
Word 62	/	Reserved	/	/	/	
Word 63	/	Reserved	/	/	/	
Word 64	/	Reserved	/	/	/	
Word 65	/	Reserved	/	/	/	
Word 66	/	Reserved	/	/	/	
Word 67	/	Reserved	/	/	/	
Word 68	/	Reserved	/	/	/	
Word 69	/	Reserved	/	/	/	
Word 70	/	Reserved	/	/	/	
Word 71	/	Reserved	/	/	/	
Word 72	/	Reserved	/	/	/	
Word 73	/	Reserved	/	/	/	
Word 74	/	Reserved	/	/	/	
Word 75	/	Reserved	/	/	/	
Word 76	/	Reserved	/	/	/	
Word 77	/	Reserved	/	/	/	
Word 78	/	Reserved	/	/	/	
Word 79	/	Reserved	/	/	/	
Word 80	/	Reserved	/	/	/	
Word 81	/	Reserved	/	/	/	
Word 82	/	Reserved	/	/	/	
Word 83	/	Reserved	/	/	/	
Word 84	/	Reserved	/	/	/	
Word 85	/	Reserved	/	/	/	
Word 86	/	Reserved	/	/	/	

Word 87	/	Reserved	/	/	/	
Word 88	/	Reserved	/	/	/	
Word 89	/	Reserved	/	/	/	
Word 90	/	Reserved	/	/	/	
Word 91	/	Reserved	/	/	/	
Word 92	/	Reserved	/	/	/	
Word 93	/	Reserved	/	/	/	
Word 94	/	Reserved	/	/	/	
Word 95	/	Reserved	/	/	/	
Word 96	/	Reserved	/	/	/	
Word 97	/	Reserved	/	/	/	
Word 98	/	Reserved	/	/	/	
Word 99	/	Reserved	/	/	/	
Word 100	/	Reserved	/	/	/	
Word 101	/	Reserved	/	/	/	
Word 102	/	Reserved	/	/	/	
Word 103	/	Reserved	/	/	/	
Word 104	/	Reserved	/	/	/	
Word 105	/	Reserved	/	/	/	
Word 106	/	Reserved	/	/	/	
Word 107	/	Reserved	/	/	/	
Word 108	R	Solor kit-entering water temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 109	R	Solor kit-leaving water temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 110	R	Solar pannel temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 111	R	Swimming pool-water temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 112	R	Swimming pool-entering water temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 113	R	Swimming pool-leaving water temp	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 114	R	Discharge pressure	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 115	R	Enthalpy-enhancing pressure	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 116	R	Suction pressure	Actual value:/ Default :/ Transmission value＝Actual value	1℃	Unsigned Integer	
Word 117	R	ODU Mode	01: Cool/ 02: Heat/ 06: Hot water/ 08: Off/	/	Unsigned Integer	Out d

			Default: / Transmission value＝Actual value			o o r U ni t
Word 118	R	Outdoor Temp	Actual value: -30～100℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 119	R	Defrost temperature	Actual value:-30～100℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 120	R	Outdoor Discharge Temp	Actual value:-30～149℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 121	R	Outdoor Suction Temp	Actual value:-30～149℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 122	R	Plate exchanger water-out temperature	Actual value:-30～100℃ Default: / Transmission value＝Actual value×10	0.5℃	Float Type	
Word 123	R	E-heater Leaving Water Sensor Temp	Actual value:-30～100℃ Default: / Transmission value＝Actual value×10	0.5℃	Float Type	
Word 124	R	Liquid Line Sensor Temp	Actual value:-30～100℃ Default: / Transmission value＝Actual value×10	1℃	Float Type	
Word 125	R	Plate exchanger water-in temperature	Actual value:-30～100℃ Default：/ Transmission value＝Actual value×10	0.5℃	Float Type	
Word 126	R	Water Tank Temp Sensor 1	Actual value :-26～151℃ Default: / Transmission value＝Actual value	1℃	Float Type	I n d o o r U ni t
Word 127	R	Water Tank Temp Sensor 2	Actual value:-26～151℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 128	R	Reserved	/	/	/	
Word 129	R	Reserved	/	/	/	
Word 130	R	Remote Rom Temp Sensor	Actual value : -30～100℃ Default: / Transmission value＝Actual value	1℃	Float Type	
Word 131	R	Auto Mode Target Temp	Actual value: actual calculated value Default: / Transmission value＝Actual value	1℃	Float Type	O u t d o o r U ni t
Word 132	R	Terminal Controller	Actual value: 1: Cool/ 2: Heat/ 3: Off/ Default: / Transmission value＝Actual value	/	Unsigned Integer	I n d o o r U ni

Word 133	R	Floor Debug Target Temp	Actual value: actual calculated value Default: / Transmission value＝Actual value	1℃	Unsigned Integer	Outdoor Unit
Word 134	R	Total Time for Floor Debug	Actual value: actual calculated value Default: / Transmission value＝Actual value	1 Hr	Unsigned Integer	
Word 135	R	Sanitizing State	Actual value: 1: Sanitizing/ 2: Sanitization finished/ 3: Sanitization failed Default: / Transmission value＝Actual value	/	Unsigned Integer	
Word 136	R	Error Time for Floor Debug	Actual value: actual calculated value Default: / Transmission value＝Actual value	1 Sec	Unsigned Integer	
Word 137	R	Floor Debug Running State	Actual value: 0：No Floor Debug/ 1：Normal/ 2：Abnormal/ 3：Failed Transmission value＝Actual value	/	Unsigned Integer	
Word138	/	Indoor unit program version	Decimal digit; E.g. when the version is V1.0, the transmit value =10	/	Unsigned Integer	
Word139	/	Outdoor unit program version	Decimal digit; E.g. when the version is V1.0, the transmit value =10	/	Unsigned Integer	
Word140	/	Control panel program version	Decimal digit; E.g. when the version is V1.0, the transmit value =10	/	Unsigned Integer	
Word141	/	Protocol version	Decimal digit; E.g. when the version is V1.0, the transmit value =10	/	Unsigned Integer	
Word142 ~	/	Reserved	/	/	/	

2. Definition and Address of State Variables (Bit 0-Bit 191)

Byte Add	Visit Type	Bit Add	Data		Data Type	Note
Byte 0	/	Bit 0	Recoverable protection	0:No/1:Yes	State Variable	Wired Controller
	/	Bit 1	Irrecoverable protection	0:No/1:Yes	State Variable	
	/	Bit 2	Reserved	/	/	
	/	Bit 3	Reserved	/	/	
	/	Bit 4	Reserved	/	/	
	/	Bit 5	Reserved	/	/	
	/	Bit 6	Reserved	/	/	
	/	Bit 7	Reserved	/	/	
Byte 1	W/R	Bit 8	Weekly Timer	0:Close/1:Open	State Variable	
	W/R	Bit 9	Clock Timer	0:Close/1:Open	State Variable	
	W/R	Bit 10	Temp Timer	0:Close/1:Open	State Variable	
	W/R	Bit 11	Keycard	0:Close/1:Open	State Variable	
	/	Bit 12	Reserved	/	/	

	/	Bit 13	Reserved	/	/	
	/	Bit 14	Reserved	/	/	
	/	Bit 15	Reserved	/	/	
Byte 2	W/R	Bit 16	Control Mode	0: Leaving water temp; 1: Room temp	State Variable	Wired Controller
	W/R	Bit 17	Fast Hot Water	0:Off/1:On	State Variable	
	R	Bit 18	Hot Water Temp Control	0: High-temp/ 1: Low-temp	State Variable	
	W/R	Bit 19	Cool+Hot Water Priority	0:Cool/1:Hot water	State Variable	
	W/R	Bit 20	Heat+ Hot Water Priority	0:Heat/1:Hot water	State Variable	
	W/R	Bit 21	Quite Mode	0: Off/1: On	State Variable	
	W/R	Bit 22	Auto Mode	0: Off/1: On	State Variable	
	W/R	Bit 23	Sanitization Mode	0: Off/1: On	State Variable	
Byte 3	W/R	Bit 24	Floor Debug Mode	0: Off/1: On	State Variable	Wired Controller
	W/R	Bit 25	Emergency Mode	0: Off/1: On	State Variable	
	W/R	Bit 26	Reserved	0	/	
	W/R	Bit 27	Other Heat Source	0: Without/1: With	State Variable	
	W/R	Bit 28	Underpan Heater	0: Off/1: On	State Variable	
	W/R	Bit 29	Water Tank	0: Without/1: With	State Variable	
	W/R	Bit 30	Water Tank Temp Sensor	0:1/1:2	State Variable	
	W/R	Bit 31	Solar Heater	0: Without/1: With	State Variable	
Byte 4	W/R	Bit 32	FCU	0: Without/1: With	State Variable	Wired Controller Outdoor Unit
	W/R	Bit 33	Remote Room Temp Sensor	0: Without/1: With	State Variable	
	W/R	Bit 34	Holiday Mode	0: Off/1: On	State Variable	
	W/R	Bit 35	Air Removal for Water System	0: Off/1: On	State Variable	
	W/R	Bit 36	Confirm Sanitization Failed	0:Not Confirm / 1:Confirm	State Variable	
	W/R	Bit 37	Floor Debug Mode Failed	0:Not Confirm / 1:Confirm	State Variable	
	R	Bit 38	Reserved	/	/	
	R	Bit 39	Reserved	/	/	
Byte 5	R	Bit 40	Tank heater running	0:with/1:without	State Variable	
	R	Bit 41	Plate heater exchanger heater	0:off/1:on	State Variable	
	R	Bit 42	Solar kit-antifreeze	0:with/1:without	State Variable	
	R	Bit 43	Floor config	0:with/1:without	State Variable	
	R	Bit 44	Radiator config	0:with/1:without	State Variable	
	/	Bit 45	Reserved	/	/	
	/	Bit 46	Reserved	/	/	
	/	Bit 47	Reserved	/	/	
Byte 6	/	Bit 48	Reserved	/	/	
	/	Bit 49	Reserved	/	/	
	/	Bit 50	Reserved	/	/	
	/	Bit 51	Reserved	/	/	
	/	Bit 52	Reserved	/	/	
	/	Bit 53	Reserved	/	/	
	/	Bit 54	Reserved	/	/	
	/	Bit 55	Reserved	/	/	
Byte 7	/	Bit 56	Reserved	/	/	

	/	Bit 57	Reserved	/	/	
	/	Bit 58	Reserved	/	/	
	/	Bit 59	Reserved	/	/	
	/	Bit 60	Reserved	/	/	
	/	Bit 61	Reserved	/	/	
	/	Bit 62	Reserved	/	/	
	/	Bit 63	Reserved	/	/	
Byte 8	R	Bit 64	Communication Error between the Wired Controller and IDU	1: Error; 0:Normal	Error	Wired Controller
	R	Bit 65	Communication Error between the Wired Controler and ODU	1: Error; 0:Normal	Error	
	R	Bit 66	Communication Error between the Wired Controller and Drive	1: Error; 0:Normal	Error	
	R	Bit 67	Auto Antifreezing	0: Off; 1: On	Error	
	R	Bit 68	Reserved	/	/	
	R	Bit 69	Reserved	/	/	
	R	Bit 70	Reserved	/	/	
	R	Bit 71	Reserved	/	/	
Byte 9	R	Bit 72	Reserved	/	/	
	R	Bit 73	Reserved	/	/	
	R	Bit 74	Reserved	/	/	
	R	Bit 75	Reserved	/	/	
	R	Bit 76	Reserved	/	/	
	R	Bit 77	Reserved	/	/	
	R	Bit 78	Reserved	/	/	
	R	Bit 79	Reserved	/	/	
Byte 10	R	Bit 80	Compressor State	1: On; 0: Off	State Variable	Outdoor Unit
	R	Bit 81	ODU Fan 1 State	1: On; 0: Off	State Variable	
	R	Bit 82	ODU Fan 2 State	1: On; 0: Off	State Variable	
	R	Bit 83	4-way Valve State	1: On; 0: Off	State Variable	
	R	Bit 84	Compressor Crankcase Heater State	1: On; 0: Off	State Variable	
	R	Bit 85	Underpan Heater State	1: On; 0: Off	State Variable	
	R	Bit 86	Defrosting State	0: End; 1: Defrosting;	State Variable	
	R	Bit 87	Oil Return State	0: No oil return; 1: In oil return	State Variable	
Byte 11	R	Bit 88	Ambient Temp Sensor Error	1: Error; 0:Normal	Error	Outdoor Unit
	R	Bit 89	Condenser Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 90	Discharge Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 91	Suction Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 92	ODU Fan Error	1: Error; 0:Normal	Error	
	R	Bit 93	Compressor Over-load Protection	1: Error; 0:Normal	Error	
	R	Bit 94	High Pressure Protection	1: Error; 0:Normal	Error	
	R	Bit 95	Low Pressure Protection	1: Error; 0:Normal	Error	
Byte 12	R	Bit 96	High Discharge Protection	1: Error; 0:Normal	Error	Outdoor Unit
	R	Bit 97	Capacity DIP Setting Error	1: Error; 0:Normal	Error	
	R	Bit 98	Communication Error between IDU and ODU	1: Error; 0:Normal	Error	

	/	Bit 99	Reserved	0	State Variable	
	/	Bit 100	Reserved	0	State Variable	
	R	Bit 101	High-pressure Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 102	System Recoverable Protection	1: Yes, 0: NO	Error	
	R	Bit 103	System Irrecoverable Protection	1: Yes; 0: No	Error	
Byte 13	/	Bit 104	Reserved	0	/	Outdoor Unit
	/	Bit 105	Reserved	0	/	
	R	Bit 106	Reserved	0	/	
	/	Bit 107	Reserved	0	/	
	R	Bit 108	Reserved	0	/	
	/	Bit 109	Reserved	0	/	
	/	Bit 110	Reserved	0	/	
	/	Bit 111	Reserved	0	/	
Byte 14	R	Bit 112	Refrigerant loss protection	1: Error; 0:Normal	Error	
	R	Bit 113	Indoor unit water pump error	1: Error; 0:Normal	Error	
	R	Bit 114	Solar water pump error	1: Error; 0:Normal	Error	
	R	Bit 115	Solar kit-superheating	1: Error; 0:Normal	Error	
	R	Bit 116	Solar kit-water flow switch	1: Error; 0:Normal	Error	
	R	Bit 117	Enthalpy-enhancing sensor error	1: Error; 0:Normal	Error	
	/	Bit 118	Low pressure sensor error	1: Error; 0:Normal	Error	
	/	Bit 119	High pressure sensor error	1: Error; 0:Normal	Error	
Byte 15	/	Bit 120	Reserved	0	/	
	/	Bit 121	Reserved	0	/	
	/	Bit 122	Reserved	0	/	
	/	Bit 123	Reserved	0	/	
	/	Bit 124	Reserved	0	/	
	/	Bit 125	Reserved	0	/	
	/	Bit 126	Reserved	0	/	
	/	Bit 127	Reserved	0	/	
Byte 16	R	Bit 128	DC Bus Low-voltage or Voltage Drop	1: Error; 0:Normal	Error	Outdoor Unit
	R	Bit 129	DC Bus Over-voltage	1: Error; 0:Normal	Error	
	R	Bit 130	AC Current Protection (Input Side)	1: Error; 0:Normal	Error	
	R	Bit 131	IPM Error	1: Error; 0:Normal	Error	
	R	Bit 132	PFC Error	1: Error; 0:Normal	Error	
	R	Bit 133	Startup Error	1: Error; 0:Normal	Error	
	R	Bit 134	Phase Loss	1: Error; 0:Normal	Error	
	R	Bit 135	Drive Module Resetting	1: Error; 0:Normal	Error	
Byte 17	R	Bit 136	Compressor Overcurrent	1: Error; 0:Normal	Error	Outdoor Unit
	R	Bit 137	Over-speed	1: Error; 0:Normal	Error	
	R	Bit 138	Charging Circuit Error or Current Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 139	Desynchronizing	1: Error; 0:Normal	Error	
	R	Bit 140	Compressor Stalling	1: Error; 0:Normal	Error	
	R	Bit 141	Drive Communication Error	1: Error; 0:Normal	Error	

	R	Bit 142	Radiator or IPM or PFC Over-temperature	1: Error; 0:Normal	Error	
	R	Bit 143	Defective Radiator or IPM or PFC	1: Error; 0:Normal	Error	
Byte 18	/	Bit 144	Reserved	0	State Variable	Outdoor Unit
	/	Bit 145	Reserved	0	State Variable	
	R	Bit 146	Charging Circuit Error	1: Error; 0:Normal	Error	
	R	Bit 147	AC Input Voltage Error	1: Error; 0:Normal	Error	
	R	Bit 148	Drive Board Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 149	AC Contactor Protection or Input Cross-zero Error	1: Error; 0:Normal	Error	
	R	Bit 150	Temp Drift Protection	1: Error; 0:Normal	Error	
	R	Bit 151	Sensor Connection Protection (Connection to Phase U or V failed)	1: Error; 0:Normal	Error	
Byte 19	R	Bit 152	Condenser Leaving Water Temp Sensor Error	1: Error; 0:Normal	Error	Indoor Unit
	R	Bit 153	E-heater Leaving Water Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 154	Refrigerant Liquid Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 155	Condenser Entering Water Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 156	Water Tank Temp Sensor 1 Error	1: Error; 0:Normal	Error	
	R	Bit 157	Water Tank Temp Sensor 2 Error	1: Error; 0:Normal	Error	
	R	Bit 158	Refrigerant Vapor Line Temp Sensor Error	1: Error; 0:Normal	Error	
	R	Bit 159	Solar Leaving Water Temp Sensor Error	1: Error; 0:Normal	Error	
Byte 20	R	Bit 160	Remote Room Temp Sensor Error	1: Error; 0:Normal	Error	Indoor Unit
	R	Bit 161	Communication Error between IDU and ODU	1: Error; 0:Normal	Error	
	/	Bit 162	Reserved	0	/	
	/	Bit 163	Reserved	0	/	
	R	Bit 164	Condenser Leaving Water Temp Decimal Part	1:0.5℃, 0:0.0℃	State Variable	
	R	Bit 165	E-heater Leaving Water Temp Decimal Part	1:0.5℃, 0:0.0℃	State Variable	
	R	Bit 166	Entering Water Temp Decimal Part	1:0.5℃, 0:0.0℃	State Variable	
	/	Bit 167	Reserved	0	/	
Byte 21	R	Bit 168	3-way Valve State	1: On, 0: Off	State Variable	Indoor Unit
	R	Bit 169	Other Heat Source State	1: On, 0: Off	State Variable	
	R	Bit 170	Flow Switch State	1: Open, 0: Close	State Variable	
	R	Bit 171	IDU E-heater 1 State	1: On, 0: Off	State Variable	
	R	Bit 172	IDU E-heater 2 State	1: On, 0: Off	State Variable	
	R	Bit 173	Water Tank Heater State	1: On, 0: Off	State Variable	
	R	Bit 174	Solar Water Pump State	1: On, 0: Off	State Variable	
	R	Bit 175	IDU Water Pump State	1: On, 0: Off	State Variable	
Byte 22	R	Bit 176	Circulating 2-way Valve State	1: On, 0: Off	State Variable	Indoor Unit
	/	Bit 177	Reserved	0	/	

	/	Bit 178	Reserved	0	/	
	R	Bit 179	Keycard State	1: Card in; 0: Card out	State Variable	
	R	Bit 180	Running LED State	1: On, 0: Off	State Variable	
	R	Bit 181	Error LED State	1: On, 0: Off	State Variable	
	/	Bit 182	Reserved	0	/	
	/	Bit 183	Photovoltaic water flow switch	1:connect, 0: disconnect	/	
Byte 23	/	Bit 184	Reserved	0	/	Indoor Unit
	R	Bit 185	E-heater 1 Welding Protection	1: protected, 0: Normal	Error	
	R	Bit 186	E-heater 2 Welding Protection	1: protected, 0: Normal	Error	
	R	Bit 187	Water Heater Welding Protection	1: protected, 0: Normal	Error	
	R	Bit 188	Water Flow Protection	1: Yes, 0: No	Error	
	R	Bit 189	Photovoltaic water flow switch Protection	1: protected, 0: Normal	Error	
	R	Bit 190	IDU Recoverable Protection	1: Yes, 0: No	Error	
	R	Bit 191	IDU Irrecoverable Protection	1: Yes, 0: No	Error	
Byte 24	R	Bit 192	Photovoltaic entering water temperature sensor error	1: Error; 0:Normal	Error	
		Bit 193	Reserved	0	/	
		Bit 194	Reserved	0	/	
		Bit 195	Reserved	0	/	
		Bit 196	Reserved	0	/	
		Bit 197	Reserved	0	/	
	/	Bit 198	Reserved	0	/	
	/	Bit 199	Reserved	0	/	

6. Precautions befor the Use

1) Make sure the proper adapter is used; or normal communication would fail.

2) Reinforce the stability of the communication cord through soldering and insulate it with the insulating tape to prevent oxidation and short circuit.

Annex A

CRC Calculation Method

(Normative)

A.1 CRC Calculation Method

Calculation Method of CRC: The CRC is first preloading a 16-bit register to all 1's. Then successively transact each 8–bit bytes of the message. During generation of the CRC, each 8–bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8–bit character is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC value. During transmission and reception of data in CRC, low order byte is in the front.

A.2 **How to Calculate the CRC**

1）Preload a 16–bit register with FFFF hex (all 1's) and Call this the CRC register.
2）Exclusive OR the first 8–bit byte of the message with the low–order byte of the 16–bit CRC register, and put the result in the CRC registers.
3）Shift the CRC register one bit to the right (toward the LSB), zero–filling the MSB. Extract and examine the LSB
4）(If the LSB was 0): Repeat Step 3 (another shift). (If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 (1010 0000 0000 0001).
5）Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8–bit byte will have beenprocessed
6）Repeat Steps 2 and 5 to process the next 8-bit data.
7）The final obtained CRC register is CRC.

A.3 **CRC Example**

Parameters: Data (starting address of the block data), Data Size (Byte count of the block data) **Return:** CRC Calculatin Result

```
uint16 CRC_Calculate(uint8 *data, uint16
dataSize) {
 uint8 i;
  uint8
  temp;
 uint16 j;
  uint16 CRCode;
 CRCode=0xffff;
 for(j=0;j<dataSize;j++)
 {
        CRCode =
        CRCode^data[j]; for( i = 0;
        i < 8; i++ ){
              temp = CRCode &
              0x0001; CRCode =
              (CRCode >> 1); if(temp
              ==1){
                    CRCode = (CRCode^0xA001);// 0xA001 is a preset multinomial, a
              constant. }
        }
 }
return CRCode;
        }
```