U-Match Modbus

Modbus Protocol

For All DC Inverter U-Match

GREE ELECTRIC APPLIANCES, INC.OF ZHUHAI

Thanks for choosing the long-distance monitoring communication module of GREE central air conditioners. In order to use the building management system properly, please read this manual carefully before operation and keep it for future reference.

Contents

Preface

U-Match Modbus: This protocol specifies the communication format and data format for the Modbus communication of All DC Inverter U-Match. This protocol is applicable to All DC Inverter U-Match.

BMS: Please pay attention to the following 3 points before developing the BMS software:

1. MODBUS Controllers for the IDUs of this series have been integrated with MODBUS interface, so there is no need to connect communication modules. In this context, communication module indicates the module that is integrated by the controllers. Please be noted.
2. BMS 5.1.2 U-Match BMS Make sure you have read the precautions before developing the BMS interface of each unit, e.g. section 5.1.2 Precautions before the Development of the BMS Interface for All DC Inverter U-Match.
3. BMS Please contact GREE to confirm the compatibility of the BMS system.

Notice: This product is subject to change without prior notice.

I. Terms and Definitions

1.1 Modbus communication

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

1.2 ASCII Mode

Modbus 8 2 ASCII: Under this mode, as for the communication via the Modbus, eight bits in one piece of information can be transimitted as two ASCII characters.

1.3 RTU Mode 8 2 4 16 ASCII: Under this mode, eight bits can be divided into two 4-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 tramsmitted continuously.

1.4 Master Unit

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

1.5 Slave Unit Modbus

It indicates the device which needs Modbus communication interface and 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.

1.6 Coil

1 Bit Modbus 1 Bit Bool It is expressed by one bit, like the switch bit, failure bit, etc. The coil is a universal expression of the Modbus protocol and actually it is a one-bit data value, namely Boolean, switching value.

1.7 Register 2 Byte (16 Bit) Modbus Word 16 Bit It is expressed by two bytes (16 bits), like temperature, mode, etc. The register is a universal expression of the Modbus protocol and actually it is a word (16 bits), or an analog value.

1.8 Device Address Modbus 1 255 0

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

1.9 Broadcast

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

1.10 Function Code

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

Table 1 Function Code

Description	Function Code
(Bit) Read coils (read bit)	0x01
(Word) Read registers (read word)	0x03
(Bit) Write coils (write bit)	0x0f
(Word) Write registers (write word)	0x10

1.11 Starting Address
3 28 Bit Word 8 8
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.
1.12 Data Size
Bit Word 8 8 It indicates the counting number of to-be-operated data starting from the starting address (coil: bit count; register: word count). The data translation starts from the high-order eigth bits to the low-order eight bits.
1.13 Byte Count
It indicates the count number of effective bytes during the data transmission.
1.14 Effective Data
It indicates the control data, statuss data, etc.
1.15 Aalrm Code
It indicates the error type which is detected by the communication module when the master unit is sending the request frame.
1.16 CRC
2 8, 8 A It indicates the cyclic redundancy code consisting of two bytes. The data translation starts from the low-order eight bits to the high-order eight bits. See Annex A for more detaila about its calculation.
1.17 Request Frame
It is the request sent by the master unit to the communication module.
1.18 Response Frame
It is the response replied by the communication module to the request frame sent by the master unit.
1.19 Communicaiton Frame
It is the collection of continuosly transmitted bytes during the communication.
1.20 BMS
Building management system

II. Brief Introduction of the BMS System

U-Match MODBUS 255

The Modbus monitoring system of All DC Inverter U-Match is capable of controlling up to 255 sets of units at the same time.

Modbus RS485 255

The interface RS485 of Modbus communication protocal, provided by the long-distance monitoring system, can de directly connected with the BMS or Gree monitoring system, that is, can control up to 255 units and display their running statuss at the same time. The control function of the BMS/PC is equal to that of the unit itself. In other words, BMS/PC and units can both control the functions of units at them same time. However, the command sent later takes the priority.

III. Network Topology

3.1. General

Modbus: As shown in Fig.1, the whole network consists of two parts: units' network and Modbus network. The IDUs are with MODBUS interface and have to be selected by setting address mode through the wired controller so that the communication data of the two networks can be interchanged. See the corresponding section in unit's service manual for the detailed setting method.

255: There are at most 255 comunication modules in one monitoring system, that is, only 255 indoor units can be connected.

255 BMS 255: When there are more than 255 units, 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. 255 Opological Structure Consisting of Max. 255 Communication Modules

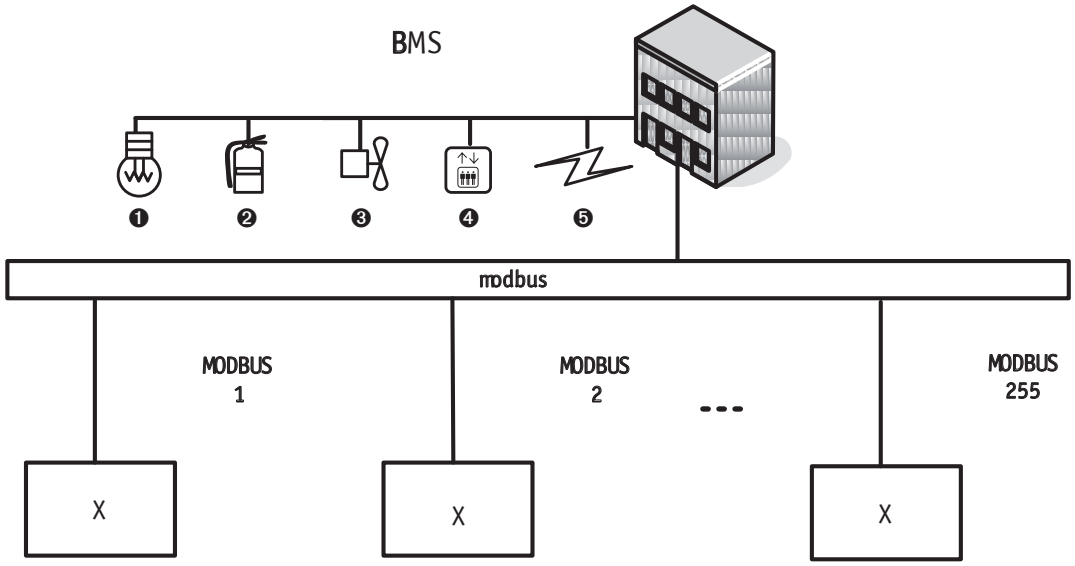

Fig.1 Topological Structure

BMS System
❶ Lighting
❷ Fire
❸ Vent
❹ Elevator
❺ Electricity

Modbus Protocol
1 Device Addr. 1
2 Device Addr. 2
255 Device Addr. 255
X Unit

3.2.2. 255 Topological Structure Consisting of Min. 255 Communication Modules

BMS System
❶ Lighting
❷ Fire
❸ Vent
❹ Elevator
❺ Electricity

1 Port 1
2 Port 2
N Port N

Modbus Protocal
1 Network 1
2 Network 2
N Network N
1 Device Addr. 1
255 Device Addr. 255
X Unit

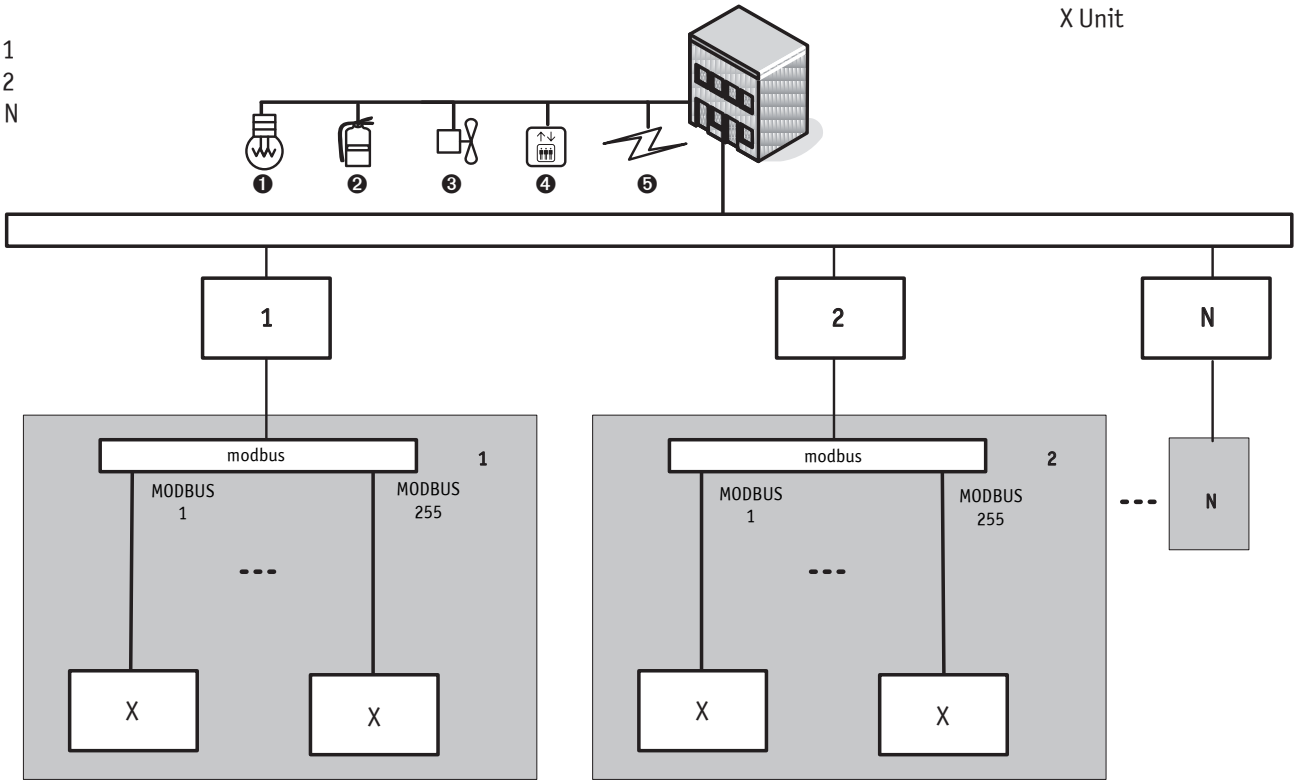

Fig.2 Topological Structure Consisting of Min. 255 Communication Modules

IV. Modbus Protocal Format

4.1. General

Modbus RTU ASCII BMS:Modbus has actually become an 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, Modbus can be developed fast and also can be conveniently connected with devices which support this protocal. There are two communication modes: RTU and ASCII. The former one is asopted for the BMS interface.

4.2 Protocal Interface

Modbus RTU: The protocal interface is the Modbus RTU protocal.

4.3. Hardware Interface

1) RS485 Communication Interface: RS485
2) 9600 bit/s Communication Mode: baud rate: 9600 bit/s (In some special case, other baud rate can be selected but the communication mechanism should be in accord with this protocal.)
Start Bit 1
Data Bit 8
Check Bit

4.4. Modbus RTU Universal Communication

Frame Format of Modbus under RTU Mode

Start Time Interval	Addr. 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

RTU 3.5 ms (T1-T2-T3-T4) 3.5ms
Under the RTU mode, there ia at least 3.5ms dead time before the data transmission, which can be figured throught the adopted baud rate (like T1-T2-T3-T4 in the table above) and there is another 3.5ms dead time after the transmission of the last character. After that, another set of data can be transimitted.

1.5 ms
The whole set of data should be transmitted continuously. If there is a pause more than 1.5ms during the transmission, the receiver will jump to the transmission of the next set of data.
3.5 ms CRC
If the dead time is less than 3.5ms, the transmission would fail as the CRC for the information combination is ineffective.

4.5. MODBUS Standard Protocal Format
4.5.1. Bit Coil (Bit)

Table 2: Coil Data

Addr.	Corresponding Byte	Values
Bit 0	Byte 0.0	1
Bit 1	Byte 0.1	0
Bit 2	Byte 0.2	1
Bit 3	Byte 0.3	0
Bit 4	Byte 0.4	1
Bit 5	Byte 0.5	0
Bit 6	Byte 0.6	1
Bit 7	Byte 0.7	0
Bit 8	Byte 1.0	1
Bit 9	Byte 1.1	0
Bit 10	Byte 1.2	1
Bit 11	Byte 1.3	0
Bit 12	Byte 1.4	1
Bit 13	Byte 1.5	0
Bit 14	Byte 1.6	1
Bit 15	Byte 1.7	0
.....	.....	.....

1 1. Bit Coil indicates the data of some flag bit or failure bit, etc.

2. Bit The unit of data is bit and each bit has a corresponding address.

3. Bit Byte Byte 8 Bit Byte Bit Bit 2 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 whereas the low-order byte is corresponding to the low-order bit. See table 2 for more details.

4. Bit Bit The master unit can operate one bit among the communication data or multiple bits at the same time.

5. Bit Bit Byte×8 Byte 9 Bit Bit 1, 2 Bytes, Byte „1111 1111“ Byte „0000 0001“ 1 The bit count which the 9 28 master unit can read or transmit is less than Byte×8. The ineffective data bit of the last byte should be cleared when the effective data of the communication frame is transmitted or read. For instance, when nine bits (the vaule of each is 1) are read or transmitted, then two bytes are needed. The first one is „1111 1111“ and the second one is „0000 0001“. For the last byte, the ineffective bits 0 should be cleared.

4.5.2. Word 16 Bit Register (Word, 16 bit)

Table 3: Registers Data

Addr.	Corresponding Byte	Values
Word 0	Byte 0 Byte 1	AA 55
Word 1	Byte 2 Byte 3	AA 55
Word 2	Byte 4 Byte 5	55 AA
.....	....	.....

4. Word:The unit of the register is „word“ which has a corresponding address starting from 0.
5. Word 2 Byte 8 8: 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.
6. Word: When the master unit transmits or reads the request frame, it can transmit or read one or multiple continuous words in the data list.

4.5.3. Bit Read Coils (Read bit)

Note: It can read the coil data but not support the broadcast.

Function Code: 0x01

Table 4: Request Frame

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

Table 5: Corresponding Frame

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

Starting Address: It is the starting place where to read a series of bits.

Bit Data Size: It indicates the count number of bits.

For example: Read ten bits from the coil 5 of the device 10 (see table 2 for the coil data), as follows:

0A 01 00 05 00 0AAD 77 CRC

Request frame: 0A (device address) 01 (function code) 00 05 (starting address) 00 0A (data size) AD 77 (CRC)

0A 01 02 AA 02E3 5C CRC Response Frame: 0A (device address) 01 (function code) 02 (byte count) AA 02 (effective data) E3 5C (CRC)

1 Byte „0000 0010“ 10. The last byte is „0000 0010“, among which the ineffective bits „0“ should be cleared.

4.5.4. Write Coils (Write bit)

Note: The master unit writes coil data into the communication module and also supports the broadcast.

Function Code: 0x0F

Table 6: Request Frame

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

Table 7: Response Frame

Device Addr.	Function Code	Starting Addr.	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.				

For example: Set eleven consecutive bits to „1“ from the device 10 and starting at the address 6, as follows:
0A 0F 00 06 00 0B 02 FF 07 97 A0 (CRC)
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
0A 0F 00 06 00 0B F5 76 (CRC)
Response Frame: 0A device address 0F function code 00 06 (starting address) 00 0B (data size) F5 76 (CRC)
1 Byte „0000 0111“.
The last byte is „0000 0111“, among which the ineffective bits „0“ should be cleared.

4.5.5. Read Registers (Read word)

Note: Read the register data but do not support the broadcast.

Table 8: Request Frame

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

Table 9: Response Frame

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

Starting address: It indicates the starting address to read the data block.
Word 127 Word Data size: It indicates the count number of words with the maximum of 127 each time.
10 1 2 Word 3
For example: Read two continuous words (see table 3 for the registers data) from the device 10 and starting at the address 1, as follow:
0A 03 00 01 00 02 94 B0 (CRC)
Request Frame: 0A device address 03 function code 00 01 starting address 00 02 data size 94 B0 (CRC)
0A 03 04 AA 55 55 AA CE 14 (CRC)
Response Frame: 0A device address 03 function code 04 byte count AA 55 55 AA effective data CE 14 (CRC)

4.5.5. Write Coils (Write bit)

Note: Write control data from the master unit into the register and support broadcast.

Function Code: 0x10

Table 10: Request Frame

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

Table 11: Response Frame

Device Addr.	Function Code	Starting Addr.	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.				

For example: write three words0x12, 0x23, 0x34 from the device 10 and starting at the address 2, as follow:
0A 10 00 02 00 03 06 00 12 00 23 00 34 15 DF (CRC)
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)
0A 10 00 02 00 03 20 B3 (CRC
Response Frame: 0A device address 10 function code 00 02 starting address 00 03 data size 20 B3 (CRC)

4.5.75. Alarm Response

Note: The master unit sends out a request frame in order to receive a normal response, but when the communication module detects a failure, an alarm response will be sent back.

Function code: Set the hightest-order bit to „1“, which is the value figured through the operation of the request frame’s function code and 0x80 (The function code of normal response will be back as it is).

Communication format of the alarm response frame:

Table 12: Request Frame

Device Addr.	**Function Code**	**Alarm Code**	**CRC**
1 Byte	**1 Byte**	**1 Byte**	**2 Bytes**

Table 13: Response Frame

Alarm Code	**Name**	**Description**
0x03	Illegal data	The transmitted data is incorrect or beyond the data range.
0x04	Salve device failure	There is communication failure between the communication module and the air conditioning unit.

10 0 128 Word Modbus For example: The master unit is to read 128 words from the device 10 and starting at the address 0. If it is out of the readable range of Modbus, alarm frame will be sent back as follows:

0A 03 00 00 00 80 45 11 (CRC)

Request frame: 0A device address 03 function code 00 00 starting address 00 80 data size 45 11 (CRC)

0A 83 03 70 F3 (CRC)

Response frame: 0A device address 83 device address 03 alarm code 70 F3 (CRC)

V. Communication Protocal for All DC Inverter U-Match

5.1. U-Match General

All DC Inverter U-Match has integrated BMS interface into the indoor units. As Modbus protocal interface is provided, there is no need to connect communication modules. However, it's necessary to do some settings through wired controllers. Please refer to the relevant service manual for the setting methods. The long-distance monitoring system for All DC Inverter U-Match can be used to monitor Gree's All DC Inverter U-Match or be incorporated into user's BMS system. By monitoring the PC or BMS system, user can realize a centralized management and control on up to 255 sets of All DC Inverter U-Match. It is a highly efficient tool for the management of an intelligent air conditioning system in modern buildings.

Through this interface, it can not only realize the long-distance monitoring to units, including units' running temperature, compressor statuss and error statuss, but also can enable units' settings remotely, like temperature setting, mode setting, on/off setting, mode shield setting, on/off shield setting, etc.

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

5.2. U-Match BMS

Precautions before the Development of the BMS Interface for All DC Inverter U-Match

(1) Cooling Only Unit: Heating instruction is invalid. It is recommended that the monitoring software can tell this operation is invalid.

(2)BMS 0x04: When the format of the alarm response frame received by the BMS system is 0x04, it indicates that there is communication failure between units and the communication module.

(3) Energy Saving Solution: BMS Cooling mode: When the setting for energy saving under cooling is active, the temperature set by long-distance monitoring must be higher than the temperature lower limit for energy saving, otherwise units will not response to the command. It is suggested that the BMS software can tell the setting fails.

Heating mode: When the setting for energy saving under heating is active, the temperature set by long-distance monitoring must be lower than the temperature upper limit for energy saving, otherwise units will not response to the command. It is suggested that the BMS software can tell the setting fails.

(4) BMS: When the BMS system needs to cancel or set one of the two flag bits of energy saving, When the BMS system needs to cancel or set one of the two flag bits of energy saving, the two flag bits need to be cancelled or set simultaneously.

(5) When unit is in fan mode or auto mode, sleep setting will be invalid.

(6) When unit is in auto mode, the setting of long-distance temperature shield will be invalid.

(7 Under power-off statuss, when X-fan function is energized, fan motor will run for 2min.

(8) BMS:All data sent by the BMS system to the communication module should be verified if it is effective.

(9) After the communication module is powered on again and before receiving any effective data, the alarm code 04 will be reported.

5.3. U-Match Definition of Effective Data

Modbus:The data for the Modbus communication protocal can be divided into two types: switching value and register. The register indicates the values of temperature, valves and other continuous or multi-mode values. Switching value indicates the value which has only two status, like the temperature sensor error (with only two status: abnormal or normal).

1. Word 0 ~ Word X

Data and Address Distribution of the Analog Values: (Word 0 ~ Word X)

Addr.	(R - W/R) Acess Type (R-read only, W/R-write/read)	Data Meaning	Range	Accuracy	Unit	Data Type (actual value)	Pay special attention before development (to the data marked with ✯)	Remarks
Word 0	R	Reserved	/	/	/	/		
Word 1	R	Reserved	/	/	/	/		Broadcast data
Word 2	W/R	Unit On/Off	0xAA: Unit on 0x55: Unit off	/	/	Unsigned, integer type		
Word 3	R	Reserved	/	/	/	/		
Word 4	R	Ambient temp	Transmission value = actual value, actual value: transmission value = temp value x 10	0.1	°C	Signed, integer type		
Word 5	R	IDU Address	Transmission value = actual value, actual value: If connected with central controller, address range is 1-16;	1	/	Unsigned, integer type		

			if connected with PC address mode, address range is 1-255					
Word 6	R	Reserved	/	/	/	/		
Word 7	R	Reserved	/	/	/	/		
Word 8	R	Reserved	/	/	/	/		
Word 9	R	Reserved	/	/	/	/		
Word 10	R	Reserved	/	/	/	/		
Word 11	R	Reserved	/	/	/	/		
Word 12	R	Reserved	/	/	/	/		
Word 13	R	Reserved	/	/	/	/		
Word 14	R	Reserved	/	/	/	/		
Word 15	R	Reserved	/	/	/	/		
Word 16	R	Reserved	/	/	/	/		
Word 17	W/R	Set mode	Transmission value = actual value, actual value: 001: cooling; 010: heating; 011: drying; 100: fan only; 101: auto mode	/	/	Unsigned, integer type	✯ (1)	
Word 18	R	Reserved	/	/	/	/		
Word 19	W/R	Set fan speed	Transmission value = actual value,	/	/	Unsigned, integer type		

			if connected with PC address mode, address range is 1-255					
Word 20	W/R	Set temp	Transmission value = actual value, actual value:16-30, under low-temp drying, it is 12°C, under absence mode, it is 8°C.	1	°C	Unsigned, integer type		
Word 21	R	Reserved	/		/	/		
Word 22	W/R	Up & down swing	Transmission value = actual value, actual value: 0000---off, 0001---15 air swing, 0010--- 1 position, 0011--- 2 position, 0100--- 3 position, 0101---4 position, 0110---5 position, 0111---35 air swing, 1000---25 air swing, 1001---24 air swing,	/	/	Unsigned, interger type		

			1010---14 air swing 1011---13 air swing					
Word 23	W/R	Left & right swing	Transmission value = actual value, actual value: 0000---off (default value after power on), 0001---air swing at same direction 0010---1 position, 0011---2 position, 0100---3 position, 0101---4 position, 0110---5 position, 1100---15 position, 1101---air swing at opposite direction	/	/	Unsigned, integer type		
Word 24	W/R	Fresh air valve status	Transmission value = actual value, actual value: 0~10, 0: indicates fresh air valve, 10 modes of fresh air	/	/	Unsigned, interger type		
Word 25	W/R	Sleep mode		/	/	Unsigned, interger type	✯ (1)	

			value=actual value, actual value: 0: no sleep mode; 1: sleep mode 1; 2: sleep mode 2; 3: sleep mode 3					
Word 26	W/R	Reserved	/	/	/	/		
Word 27	W/R	Reserved	/	/	/	/		
Word 28	W/R	Reserved	/	/	/	/		
Word 29	W/R	Reserved	/	/	/	/		
Word 30	W/R	Reserved	/	/	/	/		
Word 31	W/R	Reserved	/	/	/	/		
Word 32	W/R	Reserved	/	/	/	/		
Word 33	W/R	Reserved	/	/	/	/		
Word 34	W/R	Clean function	Transmission value = actual value, actual value: 00: no clean function; 10-39; contamination grade	/	/	Unsigned, interger type		
Word 35	W/R	Temp lower limit for energy saving under cooling	Transmission value = actual value, actual value: 16~30	1	°C	Unsigned, interger type	✯ (3)	
Word 36	W/R	Sleep mode	Transmission value = actual value, actual value: 0~10, 0: indicates fresh air valve, 10 modes of fresh air	1	°C	Unsigned, interger type	✯ (3)	

			saving under heating					
Word 37	R	Reserved	/	/	/	/		
Word 38	R	Reserved	/	/	/	/		
Word 39	R	Selection of ambient temp sensor	Transmission value = actual value, actual value: 01: air return temp sensor for indoor ambient temp 10: wired controller temp sensor for indoor ambient temp 11: air return temp sensor for cooling, drying and fan mode, select wired controller temp sensor for heating and auto mode	/	/	Unsigned, interger type		
Word 40	W/R	Reserved	/	/	/	/		
Word 41	W/R	Reserved	/	/	/	/		
Word 42	W/R	Reserved	/	/	/	/		
Word 43	W/R	Reserved	/	/	/	/		
Word 44	W/R	Reserved	/	/	/	/		
Word 45	W/R	Reserved	/	/	/	/		

Word 46	R	Reserved	/	/	/	/		
Word 47	R	Reserved	/	/	/	/		
Word 48	R	Reserved	/	/	/	/		
Word 49	R	Outdoor ambient temp	Transmission value = actual value, actual value: -100--155			Unsigned, interger type		
Word 50	R	Reserved	/	/	/	/		
Word 51	R	Reserved	/	/	/	/		
Word 52	R	Reserved	/	/	/	/		
Word 53	R	Reserved	/	/	/	/		
Word 54	R	Reserved	/	/	/	/		
Word 55	R	Reserved	/	/	/	/		ODU response data
Word 56	R	Reserved	/	/	/	/		
Word 57	R	Reserved	/	/	/	/		
Word 58	R	Reserved	/	/	/	/		
Word 59	R	Reserved	/	/	/	/		
Word 60	R	Reserved	/	/	/	/		
Word 61	R	Reserved	/	/	/	/		
Word 62	R	Reserved	/	/	/	/		
Word 63	R	Reserved	/	/	/	/		
Word 64	R	Reserved	/	/	/	/		
Word 65	R	Reserved	/	/	/	/		

Word 66	R	Reserved	/	/	/	/		
Word 67	R	Reserved	/	/	/	/		
Word 68	R	Reserved	/	/	/	/		
Word 69	R	Reserved	/	/	/	/		
Word 70	R	Reserved	/	/	/	/		
Word 71	R	Reserved	/	/	/	/		
Word 72	R	Reserved	/	/	/	/		
Word 73	R	Reserved	/	/	/	/		
Word 74	R	Reserved	/	/	/	/		
Word 75	R	Reserved	/	/	/	/		
Word 76	R	Reserved	/	/	/	/		
Word 77	R	DRED function	0: no DRED function; 1: DRED1 mode; 2: DRED2 mode; 3: DRED3 mode.	/	/	Unsigned, interger type		
Word 78	R	Reserved	/	/	/	/		
Word 79	R	Reserved	/	/	/	/		
Word 80	R	Reserved	/	/	/	/		
Word 81	R	Reserved	/	/	/	/		
Word 82	R	Ambient temp at the port of air return	Transmission value = actual value, actual value: transmission = (temp value) × 10	0.1	°C	Signed, interger type		IDU identification data

Word 83	R	Ambient temp of light board	Transmission value = actual value, actual value: transmission = (temp value) × 10	0.1	°C	Signed, interger type		
Word 84	R	Reserved	/	/	/	/		
Word 85	R	Reserved	/	/	/	/		
Word 86	R	Reserved	/	/	/	/		
Word 87	R	Reserved	/	/	/	/		
Word 88	R	Reserved	/	/	/	/		
Word 89	R	Reserved	/	/	/	/		
Word 90	R	Reserved	/	/	/	/		
Word 91	R	Reserved	/	/	/	/		
Word 92	R	Reserved	/	/	/	/		

2. Data and Address Distribution of Switching Values: (Bit 0 - Bit 1495)

Addr.	Access Type (R-read only, W/R-write/read)	Addr. Bit	Data Meaning	Range	Parameter type	Pay special attention before development (to the data marked with ✯)	Remarks
Byte 0	R	Bit 0	Reserved	/	/		
	R	Bit 1	Reserved	/	/		
	R	Bit 2	Reserved	/	/		

	R	Bit 3	Reserved	/	/		
	R	Bit 4	Reserved	/	/		
	R	Bit 5	Reserved	/	/		
	R	Bit 6	Reserved	/	/		
	R	Bit 7	Reserved	/	/		
Byte 1	R	Bit 8	Whether or not ODU has flag bit?	0: no, 1: yes	Status parameter		Broadcast data
	R	Bit 9	Whether or not the master wired controller has flag bit?	0: no, 1: yes	Status parameter		
	R	Bit 10	Reserved	0: no, 1: yes	Status parameter		
	R	Bit 11	Reserved	0: no, 1: yes	Status parameter		
	R	Bit 12	Reserved	0: no, 1: yes	Status parameter		
	R	Bit 13	Whether or not the slave wired controller has flag bit?	0: no, 1: yes	Status parameter		
	R	Bit 14	Reserved	/	/		
	R	Bit 15	Reserved	/	/		
Byte 2	R	Bit 16	Reserved	/	/		
	W/R	Bit 17	Remote lock	1: (current status is locked by long-distance monitoring or the household charging system), 0: (no above lock or it is unlocked)	Status parameter		
	W/R	Bit 18	Remote temp shield	1: with shield, 0: without shield	Status parameter	✯ (6)	

	W/R	Bit 19	Remote temp shield	1: with shield, 0: without shield	Status parameter		
	W/R	Bit 20	Remote On/Off shield	1: with shield, 0: without shield	Status parameter		
	W/R	Bit 21	Remote energy saving shield	1: with shield, 0: without shield	Status parameter		
	R	Bit 22	Reserved	/	/		
	R	Bit 23	Reserved	/	/		
Byte 3	W/R	Bit 24	Absence mode	0: no, 1: yes	Status parameter		
	W/R	Bit 25	Healthy function	0: no, 1: yes	Status parameter		
	W/R	Bit 26	Comfortable and energy saving: I-Demand	0: no, 1: yes	Status parameter		
	W/R	Bit 27	Turbo	0: no, 1: yes	Status parameter		
	W/R	Bit 28	E-heating permission mark	0: permit e-heating on; 1: not permit e-heating on	Status parameter		
	W/R	Bit 29	X-fan	0: no, 1: yes	Status parameter	✯ (7)	
	W/R	Bit 30	Silent	0: no, 1: yes	Status parameter		
	W/R	Bit 31	Low temp drying mode	0: no, 1: yes	Status parameter		
Byte 4	W/R	Bit 32	Energy saving under cooling is active	0: no, 1: yes	Status parameter	✯ (4)	

	W/R	Bit 33	Energy saving under heating is active	0: off, 1: on	Status parameter	✯ (4)	
	W/R	Bit 34	Buttons lock (childlock status)	0: off, 1: on	Status parameter		
	W/R	Bit 35	On/Off memoring status	0: memorize 1: not memorize	Status parameter		
	W/R	Bit 36	°C / °F flag bit	1: °F 0: °C	Status parameter		
	R	Bit 37	Reserved	/	/		
	R	Bit 38	Reserved	/	/		
	R	Bit 39	Reserved	/	/		
Byte 5	R	Bit 40	Timer status	1: with timer 0: without timer	Status parameter		
	R	Bit 41	Reserved	/	/		
	R	Bit 42	Reserved	/	/		
	R	Bit 43	Reserved	/	/		
	R	Bit 44	Reserved	/	/		
	R	Bit 45	Reserved	/	/		
	R	Bit 46	Gate control system is provided or not?	0: no, 1: yes	Status parameter		
	R	Bit 47	Human body sensing check module is provided or not?	0: no, 1: yes	Status parameter		

	R	Bit 48	Reserved			
	R	Bit 49	Timer On flag	1: active; 0: not active	Status parameter	
	R	Bit 50	Timer Off flag	1: active; 0: not active	Status parameter	
Byte 6	R	Bit 51	Indoor ambient temperature in current mode	0: indoor ambient temperature is the air return ambient temperature 1: indoor ambient temperature is the temperature at wired controller	Status parameter	
	R	Bit 52	Reserved	/	/	
	R	Bit 53	Reserved	/	/	
	R	Bit 54	Reserved	/	/	
	R	Bit 55	Low standby power consumption control function (1W standby)	1: mode 2 0: mode1	Status parameter	
Byte 7	R	Bit 56	Reserved	/	/	
	R	Bit 57	Reserved	/	/	
	R	Bit 58	Reserved	/	/	
	R	Bit 59	Reserved	/	/	
	R	Bit 60	Reserved	/	/	
	R	Bit 61	Reserved	/	/	
	R	Bit 62	Reserved	/	/	
	R	Bit 63	Reserved	/	/	
Byte 8	R	Bit 64	Reserved	/	/	
	R	Bit 65	Wired controller temp sensor error	0: no, 1: yes	Failure parameter	
	R	Bit 66	Reserved	/	/	

	R	Bit 67	Reserved	/	/		
	R	Bit 68	Reserved	/	/		
	R	Bit 69	Reserved	/	/		
	R	Bit 70	Wired controller memory chip error	1: yes; 0: no	Failure parameter		
	R	Bit 71	Reserved	/	/		
Byte 9	W/R	Bit 72	Cancel timer	0: do not cancel, 1: cancel	Status parameter		
	R	Bit 73	Reserved	/	/		
	W/R	Bit 74	Up & down swing mode	0: mode 1-simple air swing; 1: mode 2-fixed angle air swing and small area air swing	Status parameter		
	R	Bit 75	Reserved	/	/		
	R	Bit 76	Reserved	/	/		
	R	Bit 77	Reserved	/	/		
	R	Bit78	Reserved	/	/		
	R	Bit 79	Reserved	/	/		
Byte 10	R	Bit 80	Reserved	/	/		
	R	Bit 81	Reserved	/	/		
	R	Bit 82	Reserved	/	/		
	R	Bit 83	Reserved	/	/		
	R	Bit 84	Reserved	/	/		
	R	Bit 85	Reserved	/	/		
	R	Bit 86	Reserved	/	/		
	R	Bit 87	Reserved	/	/		
Byte 11	R	Bit 88	Reserved	/	/		IDU board identification
	R	Bit 89	Reserved	/	/		
	R	Bit 90	Reserved	/	/		
	R	Bit 91	Electric heating	0: no, 1: yes	Status parameter		
	R	Bit 92	Water pump	1: on, 2: off	Status parameter		
	R	Bit 93	Fresh air valve switch	1: turn on, 2: turn off	Status parameter		

	R	Bit 94	Cold plasma generator	1: turn on; 0: turn off	Status parameter	
	R	Bit 95	Error output status	1: yes; 0: no	Status parameter	
Byte 12	R	Bit 96	Reserved	/	/	
	R	Bit 97	Indoor evaporator temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 98	Indoor air return temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 99	Light board ambient temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 100	Reserved	1: yes, 0: no	Failure parameter	
	R	Bit 101	Water overflow protection	1: yes, 0: no	Failure parameter	
	R	Bit 102	Flag bit of IDU memory ship error	1: yes, 0: no	Failure parameter	
	R	Bit 103	Reserved	/	/	
Byte 13	R	Bit 104	Jumper cap error	1: error, 0: normal	Failure parameter	
	R	Bit 105	Indoor fan error	1: yes, 0: no	Failure parameter	
	R	Bit 106	Reserved	/	/	
	R	Bit 107	Reserved	/	/	

	R	Bit 108	Unit needs cleaning	1: yes; 0: no	Status parameter		
	R	Bit 109	Reserved	/	/		
	R	Bit 110	Reserved	/	/		
	R	Bit 111	Reserved	/	/		
Byte 14	R	Bit 112	Card in/out status	0: card out, 1: card in	Status parameter		
	R	Bit 113	Indoor evaporator temp sensor error	1: yes, 0: no	Status parameter		
	R	Bit 114	Static pressure type	0: low static pressure; 1: high static pressure	Status parameter		
	R	Bit 115	Reserved	/	/		
	R	Bit 116	Reserved	/	/		
	R	Bit 117	Reserved	/	/		
	R	Bit 118	Reserved	/	/		
	R	Bit 119	Reserved	/	/		
Byte 15	R	Bit 120	Communication failure with master wired controller	1: yes, 0: no	Failure parameter		
	R	Bit 121	Communication failure with slave wired controller	1: yes, 0: no	Failure parameter		
	R	Bit 122	Communication failure with ODU	1: yes, 0: no	Failure parameter		
	R	Bit 123	Reserved	/	/		
		Bit 124	Reserved	/	/		
		Bit 125	Reserved	/	/		
		Bit 126	Reserved	/	/		
		Bit 127	Reserved	/	/		
Byte 16		Bit 128	Reserved	/	/		
	R	Bit 129	Reserved	/	/		

	R	Bit 130	Reserved	/	/		
	R	Bit 131	Reserved	/	/		
	R	Bit 132	Reserved	/	/		
	R	Bit 133	Reserved	/	/		
	R	Bit 134	Reserved	/	/		
	R	Bit 135	Reserved	/	/		
Byte 17	R	Bit 136	Reserved	/	/		
	R	Bit 137	Reserved	/	/		
	R	Bit 138	Reserved	/	/		
	R	Bit 139	Reserved	/	/		
	R	Bit 140	Reserved	/	/		
	R	Bit 141	Reserved	/	/		
	R	Bit 142	Reserved	/	/		
	R	Bit 143	Reserved	/	/		
Byte 18	R	Bit 144	Reserved	/	/		ODU response information
	R	Bit 145	Reserved	/	/		
	R	Bit 146	Reserved	/	/		
	R	Bit 147	Ourdoor fan status	1: on, 0: off	Status parameter		
	R	Bit 148	Reserved	/	/		
	R	Bit 149	Reserved	/	/		
	R	Bit 150	4-way valve status	1: on, 0: off	Status parameter		
	R	Bit 151	Compressor status	1: on, 0: off	Status parameter		
Byte 19	R	Bit 152	Compressor discharge temperature protection	1: yes, 0: no	Failure parameter		
	R	Bit 153	Fluorine shortage protection	1: yes, 0: no	Failure parameter		
	R	Bit 154	DC fan motor protection	1: yes, 0: no	Failure parameter		
	R	Bit 155	4-way valve reverse error protection	1: yes, 0: no	Failure parameter		

	R	Bit 156	Over power protection	1: yes, 0: no	Failure parameter	
	R	Bit 157	Over load protection	1: yes, 0: no	Failure parameter	
	R	Bit 158	Low pressure protection	1: yes, 0: no	Failure parameter	
	R	Bit 159	High pressure protection	1: yes, 0: no	Failure parameter	
Byte 20	R	Bit 160	Evaporator anti-freezing protection	1: yes, 0: no	Failure parameter	
	R	Bit 161	Outdoor ambient temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 162	Discharge temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 163	Condenser temp sensor error	1: yes, 0: no	Failure parameter	
	R	Bit 164	Error of copper pipe temp sensor for the outdoor heat exchanger	1: yes, 0: no	Failure parameter	

	R	Bit 165	Jumper cap error	1: yes, 0: no	Failure parameter		
	R	Bit 166	ODU memory chip error	1: yes, 0: no	Failure parameter		
	R	Bit 167	Reserved	/	/		
Byte 21	R	Bit 168	Reserved	/	/		
	R	Bit 169	Reserved	/	/		
	R	Bit 170	Reserved	/	/		
	R	Bit 171	Reserved	/	/		
	R	Bit 172	Reserved	/	/		
	R	Bit 173	Reserved	/	/		
	R	Bit 174	Drive communication failure	1: yes, 0: no	/		
	R	Bit 175	Reserved	/	/		
Byte 22	R	Bit 176	SAVE status	1: yes, 0: no	Status parameter		
	R	Bit 177	Cooling only heat pump flag bit	0: cool and heat 1: cool only	Status parameter	✯ (1)	
	R	Bit 178	Reserved	/	/		
	R	Bit 179	System defrosting	1: yes, 0: no	Status parameter		
	R	Bit 180	Reserved	/	/		
	R	Bit 181	Reserved	/	/		
	R	Bit 182	Low power consumption status	1: ready, 0: not	Status parameter		
	R	Bit 183	AC input phase sequence protection (phase loss or reverse)	1: yes, 0: no	Failure parameter		

Byte 23	R	Bit 184	Inverter compressor drive DC busbar voltage overlow protection or voltage drop off error	1 failure, 0 normal	Failure parameter		
	R	Bit 185	Inverter compressor drive DC busbar voltage overhigh protection	1 failure, 0 normal	Failure parameter		
	R	Bit 186	Inverter compressor drive alternate current protection (input side)	1 failure, 0 normal	Failure parameter		
	R	Bit 187	Inverter compressor drive IPM protection	1 failure, 0 normal	Failure parameter		
	R	Bit 188	Inverter compressor drive PFC protection	1 failure, 0 normal	Failure parameter		

	R	Bit 189	Inverter compressor startup failure	1 failure, 0 normal	Failure parameter		
	R	Bit 190	Inverter compressor phase loss protection	1 failure, 0 normal	Failure parameter		
	R	Bit 191	Inverter compressor drive module reset	1 failure, 0 normal	Failure parameter		
Byte 24	R	Bit 192	Inverter compressor over-current protection	1 failure, 0 normal	Failure parameter		
	R	Bit 193	Inverter compressor power protection	1 failure, 0 normal	Failure parameter		
	R	Bit 194	Inverter compressor drive current check circuit failure	1 failure, 0 normal	Failure parameter		
	R	Bit 195	Inverter compressor out-of-step protection	1 failure, 0 normal	Failure parameter		
	R	Bit 196	Compressor stalling	1 failure, 0 normal	Failure parameter		

	R	Bit 197	Reserved	/	/		
	R	Bit 198	Inverter compressor drive module high temperature protection	1 failure, 0 normal	Failure parameter		
	R	Bit 199	Inverter compressor drive module temperature sensor failure	1 failure, 0 normal	Failure parameter		
Byte 25	R	Bit 200	Reserved	/	/		
	R	Bit 201	Inverter compressor low intensity field	1 enters field weakening, 0 does not have field weakening	Status parameter		
	R	Bit202	Inverter compressor drive frequency limit	1 enter frequency limit, 0 normal frequency	Status parameter		
	R	Bit 203	Inverter compressor drive frequency demultiply	1 frequency reduction, 0 normal frequency	Status parameter		
	R	Bit 204	Inverter compressor drive AC input low voltage	1 enter low voltage frequency limit, 0 normal frequency rise and fall	Status parameter		

	R	Bit 205	Inverter compressor drive under charge	1 under charge, 0 charged	Status parameter		
	R	Bit 198	Reserved	/	/		
	R	Bit 207	Power type of inverter compressor drive AC input	1 three-phase, 0 single-phase	Status parameter		
Byte 26	R	Bit 208	Inverter compressor drive storage chip failure	1 failure, 0 normal	Failure parameter	✯ (1)	
	R	Bit 209	Reserved	/	/		
	R	Bit210	Inverter compressor drive charged circuit failure	1 failure, 0 normal	Failure parameter		
	R	Bit 211	Inverter compressor drive AC input voltage abnormal protection	1 failure, 0 normal	Failure parameter		
	R	Bit 212	Inverter compressor drive AC input low voltage drive electric box	1 failure, 0 normal	Failure parameter		

	R	Bit 213	Inverter compressor drive under charge	1 failure, 0 normal	Failure parameter		
	R	Bit 214	Temperature drift protection	1 failure, 0 normal	Failure parameter		
	R	Bit 215	Sensor connection protection (electric current sensor is not connected to the corresponding U phase or V phase)	1 failure, 0 normal	Failure parameter		
Byte 27	R	Bit 216	Reserved	/	/		
	R	Bit 217	Reserved	/	/		
	R	Bit 218	Reserved	/	/		
	R	Bit 219	Reserved	/	/		
	R	Bit 220	Reserved	/	/		
	R	Bit 221	Reserved	/	/		
	R	Bit 222	Reserved	/	/		
	R	Bit 223	Reserved	/	/		
Byte 28	R	Bit 224	Reserved	/	/		
	R	Bit 225	Reserved	/	/		
	R	Bit 226	Reserved	/	/		
	R	Bit 227	Reserved	/	/		
	R	Bit 228	Reserved	/	/		
	R	Bit 229	Reserved	/	/		
	R	Bit 230	Reserved	/	/		
	R	Bit 231	Reserved	/	/		
Byte 29	R	Bit 232	Reserved	/	/		
	R	Bit 233	Reserved	/	/		

	R	Bit 234	Reserved	/	/		
	R	Bit 235	Reserved	/	/		
	R	Bit 236	Reserved	/	/		
	R	Bit 237	Reserved	/	/		
	R	Bit 238	Reserved	/	/		
	R	Bit 239	Reserved	/	/		
Byte 30	R	Bit 240	Reserved	/	/		
	R	Bit 241	Reserved	/	/		
	R	Bit 242	Reserved	/	/		
	R	Bit 243	Reserved	/	/		
	R	Bit 244	Reserved	/	/		
	R	Bit 245	Reserved	/	/		
	R	Bit 246	Reserved	/	/		
	R	Bit 247	Reserved	/	/		

VI. Common Failures of BMS System

Failures	Possible Causes	Corrective Actions
Based on the provided protocol BMS shows there is communication error and it fails to display any operation status for all or some units and fails to control all or some units	Some communication cord is not twisted pair	Replace the cord with the twisted pair.
	The crystal head of the communication cord is not pressed down properly	Press down the crystal head properly
	The communication cord between indoor and outdoor units is disconnected	Solder the disconnected communication cord
	The communication cord is broken	Solder the broken communication cord
	It is not the two cords in the middle of the crystal head that are wired	Wired the two cords in the middle of the crystal head
	The communication cord is short-circuit	Repair the short-circuit communication cord
	The twisted pairs are too close with the power cord (less than 15cm), resulting in too much interference which causes the communication failure	Separate the twisted pairs and the power cord. If impossible, it is recommended to shield them with the steel pipe
	Some communication interfaces are connected improperly	Reconnect the communication interface
The wiring is in good condition, but there is no information displayed for all or some units and the software shows there is communication failure	After the replacement of the chip of the outdoor unit or resetting of the DIP switch, the unit is not re-energized	Re-energize the unit
	The serial port of the communication software fails to match with that of the PC	Replace the serial port or modify the setting of the serial port of the software
	The unit address of the software does not match with the actual unit address	Modify the set unit address of the software
	The unit is not energized	Energize the unit
	No chip is plugged in the indoor or outdoor unit, or it is plugged reversely	Replug the chip and power on the unit again
	The unit address is wrong or repeated	Modify the improperly set unit address
The wiring and other devices are in good condition, but there is no information displayed for some device	A repeater may be is needed or the repeater is connected improperly	Install the repeater correctly
No information is displayed and there is a alarm indicating the communication failure. Besides the TX lamp on the converter lights all the time	The communication A and B are connected reversely or incorrectly	Check the wiring and follow the principle of line A-to-line A and line B-to-line B
Although the communication cord, devices and the installation are in good condition, there is still communication failure on the software	Incompatible display or controller is used	Check the model of the wireless remote controller and the wired controller, If not, make a replacement

ANNEX

A1. 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 calculating 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 is 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 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.

A2. CRC

1) Preload a 16–bit register with FFFF hex (all 1's). 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, putting 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 been processed.
6) Repeat Steps 2 and 5 to process the next 8-bit data.
7) The final obtained CRC register is CRC.

A3. CRC Example (Only for Reference)

Data, DataSize (Byte)
Parameters: Data (Starting address of the block data), Data Size (Byte count of the block data)

Return: CRC Calculating 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);// 0xA001,0xA001 is a preset multinomial, a constant value
                        }
                }
        }
        return CRCode;
}
```

References

1. MODBUS, MODBUS Protocal
2. Operation Instructions of the Long-distance Monitoring System to Gree Central AC
3. 2012, BMS, Gree BMS Interface Service Manual 2012