



# U-Match 第四代直流变频机型 Modbus 通讯协议

**Modbus Protocol**

**For All DC Inverter U-Match**

**珠海格力电器股份有限公司**

**GREE ELECTRIC APPLIANCES, INC.OF ZHUHAI**

非常感谢您选用格力中央空调远程监控，为了您正常使用楼宇监控集成功能，请在使用前仔细阅读本通讯协议书，并妥善保存以供今后参考

**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.**

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# 前言 Preface

本协议规定了 U-Match 第四代直流变频机型 Modbus 通讯时的通讯格式和数据格式。This protocol specifies the communication format and data format for the Modbus communication of All DC Inverter U-Match.

本协议适用于 U-Match 第四代直流变频机型。This protocol is applicable to All DC Inverter U-Match.

✚ 您在进行 BMS 软件开发前，需注意如下三点：Please pay attention to the following 3 points before developing the BMS software:

1. 该系列机组内机控制器已集成 MODBUS 接口，不需要再外接通讯模块，文档中涉及到通讯模块字眼的地方均代表机组内机控制器集成的通讯模块，请注意；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. 请务必认真阅读各机型 BMS 接口开发前注意事项，如 5.1.2 U-Match 第四代直流变频机型 BMS 接口开发前注意事项。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. 请务必与格力联系以确定与 BMS 系统的兼容性。Please contact GREE to confirm the compatibility of the BMS system.

✚ 注意：Notice:

产品规格如有变更，恕不另行通知。This product is subject to change without prior notice.

## 一. 术语和定义 I. Terms and Definitions

### 1.1 Modbus 通讯 Modbus communication

Modbus 协议是一种工业通讯和分布式控制系统协议。Modbus 网络属于一种主从网络，允许一个主机与一个或多个从机通讯，来完成数据交互。它采用请求/响应方式，每一种请求消息都对应着一种响应消息。请求消息由上位机发出，当下位机收到发给自己的请求消息后，就发送响应消息进行应答。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 模式 ASCII Mode

在 Modbus 总线上进行通讯时，一个信息中的每 8 位字节作为 2 个 ASCII 字符进行传输。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 模式 RTU Mode

信息中的每 8 位字节分成 2 个 4 位 16 进制的字符，该模式的主要优点是在相同波特率下其传输的字符的密度高于 ASCII 模式，每个信息必须连续传输。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 transimitted continuously.

### 1.4 上位机 Master Unit

发起通讯，发出 Modbus 请求帧的设备，如 PC 机等。It indicates the device which sends out the request to

Modbus, like a PC.

### 1.5 下位机 Slave Unit

需要提供 Modbus 通讯接口，能够响应上位机的查询请求的设备，如通讯模块等。为表述方便，本标准中，以“通讯模块”为例。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 线圈 Coil

用 1 个 Bit 表达的量。如开关位、故障位等。线圈是 Modbus 协议的通用表达方式，其实它就是用 1 个 Bit 来表达的数据量，即布尔型 Bool、开关量。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 寄存器 Register

用 2 个 Byte 表达的量（16 Bit）。如温度、模式等。寄存器是 Modbus 协议的通用表达方式，其实它就是一个数据 Word（16 个 Bit）、模拟量。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 设备地址 Device Address

Modbus 通讯模块地址，上位机通过此地址来识别网络中的各个通讯模块，地址范围：1~255，0 地址表示广播（所有通讯模块都能接收）。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. Address 0 is the address of broadcast (it can be received by all communication modules).

### 1.9 广播 Broadcast

上位机下发控制帧（仅指控制帧），网络中所有的下位机都能接收到，并执行这个控制动作（下位机不作回复），广播帧的设备地址值为 0。When the master unit sends out a control frame, then all slave 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 功能码 Function Code

用于标识通讯帧的功能。本标准用到的功能码如下表所示：It is used to identify the function of the communication frame. See the following table for the function codes covered in this protocol.

表 1 功能码 Table 1 Function Code

名称 Description	功能码 Function Code
读线圈（读 Bit） Read coils (read bit)	0x01
读寄存器（读 Word） Read registers (read word)	0x03
写线圈（写 Bit） Write coils (write bit)	0x0f
写寄存器（写 Word） Write registers (write word)	0x10

### 1.11 起始地址 Starting Address

设备数据寄存器块的起始地址（线圈：Bit 地址；寄存器：Word 地址）。先传高 8 位，后传低 8 位。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 数据数量 Data Size

从起始地址开始的一系列要操作的数据个数（线圈：Bit 个数；寄存器：Word 个数）。先传高 8 位，后传低 8 位。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 eighth bits to the low-order eight bits.

#### 1.13 字节个数 Byte Count

数据传输中，有效数据字节的个数。It indicates the count number of effective bytes during the data transmission.

#### 1.14 有效数据 Effective Data

空调的控制数据和状态数据等。It indicates the control data, status data, etc.

#### 1.15 异常码 Alarm Code

上位机向通讯模块发请求帧，通讯模块检测到错误，返回的错误类型。It indicates the error type which is detected by the communication module when the master unit is sending the request frame.

#### 1.16 CRC 校验码 CRC

指冗余循环码，占 2 个字节。先传低 8 位，后传高 8 位。此码的计算方法见附录 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 details about its calculation.

#### 1.17 请求帧 Request Frame

上位机向通讯模块发起的通讯帧。It is the request sent by the master unit to the communication module.

#### 1.18 响应帧 Response Frame

通讯模块对上位机请求帧的回复。It is the response replied by the communication module to the request frame sent by the master unit.

#### 1.19 通讯帧 Communication Frame

网络通讯中的连续传输的字节集合。It is the collection of continuously transmitted bytes during the communication.

#### 1.20 BMS

楼宇管理系统 Building management system

## 二. BMS 系统概述 II. Brief Introduction of the BMS System

U-Match 第四代直流变频机型 MODBUS 监控系统,具备统一监控 255 个机组的功能。The Modbus monitoring system of All DC Inverter U-Match is capable of controlling up to 255 sets of units at the same time.

远程监控网络提供 Modbus 通讯协议的 RS485 接口,可以直接接入楼宇自控系统或者是格力的监控系统,即可完成对 255 个机组的控制和运行状态的显示。楼宇自控系统/电脑在机组控制的功能上,跟机组是同等地位的。也即是楼宇自控系统/电脑和机组可以同时控制机组,谁最后下发控制命令,机组就执行谁的控制命令。The interface RS485 of Modbus communication protocol, provided by the long-distance monitoring system, can be directly connected with the BMS or Gree monitoring system, that is, can control up to 255 units and display their running status 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 the same time. However, the command sent later takes the priority.

## 三. 系统网络拓扑结构 III. Network Topology

### 3.1. 网络拓扑结构概述 General

网络拓扑结构见下图一。整个监控系统由两部分的通讯网络构成: 机组内部网络和监控网络 (Modbus)。该内机带有 MODBUS 接口, 使用时需要使用机组的线控器来设置地址模式来选择, 具体设置方法见该机组服务手册对应说明, 使两个网络的通讯数据可以互相交换。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.

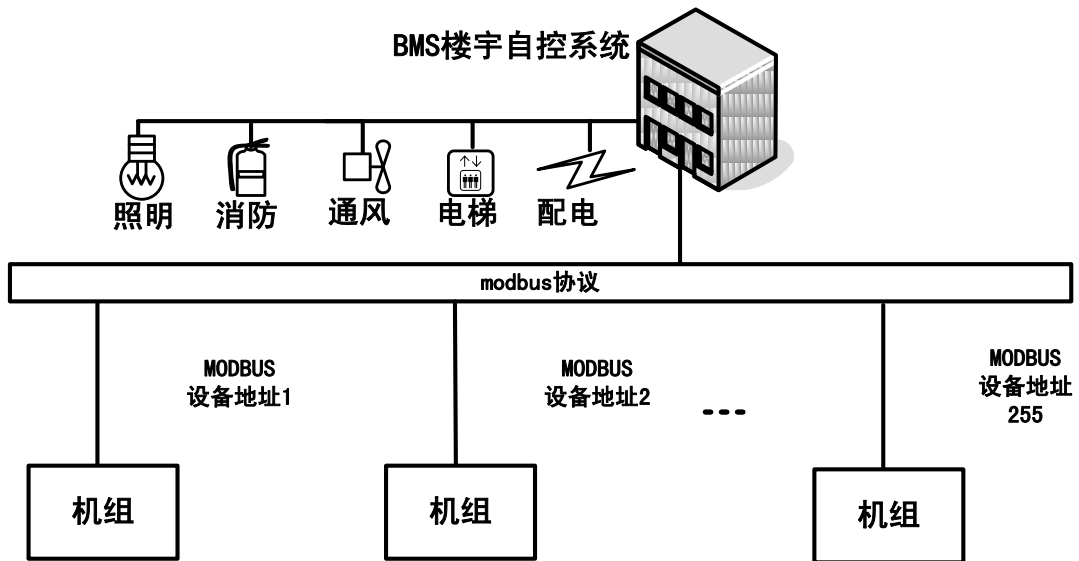
一个监控网络只能接 255 个通讯模块, 也就是只能接 255 台内机机型。There are at most 255 communication modules in one monitoring system, that is, only 255 indoor units can be connected.

当机组数量大于 255 个时, BMS 系统可以采用第二个串口组建一个新的网络, 每个串口可以接 255 个通讯模块。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. 网络拓扑结构图 Topological Structure

#### 3.2.1. 通讯模块数量在 255 以内的网络拓扑图 Topological Structure

##### Consisting of Max. 255 Communication Modules



图一：拓扑图 Fig.1 Topological Structure

BMS 楼宇自控系统 BMS System

照明 Lighting

消防 Fire

通风 Vent

电梯 Elevator

配电 Electricity

Modbus 协议 Modbus Protocol

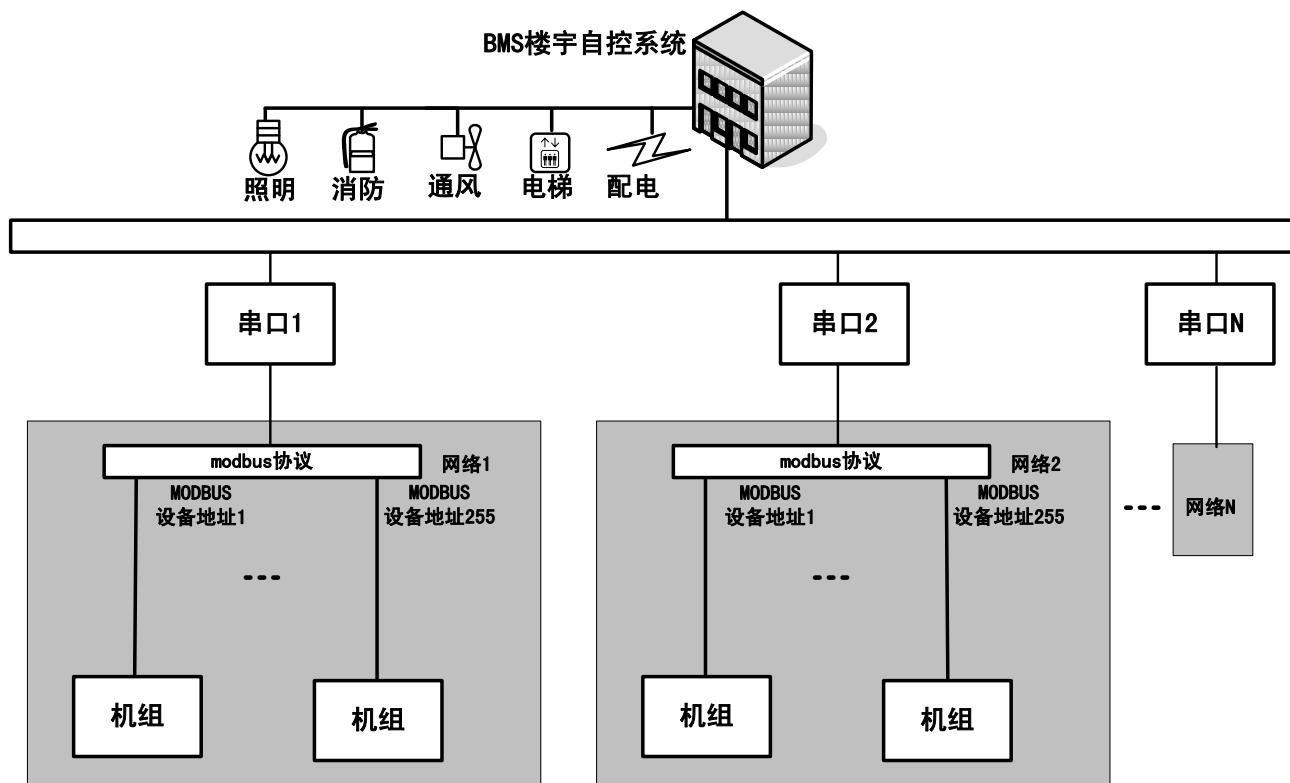
设备地址 1 Device Addr. 1

设备地址 2 Device Addr. 2

设备地址 255 Device Addr. 255

机组 Unit

### 3.2.2. 通讯模块数量超过 255 个的网络拓扑图 Topological Structure Consisting of Min. 255 Communication Modules



图二：通讯模块数量超过 255 个拓扑图

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

BMS 楼宇自控系统 BMS System

照明 Lighting

消防 Fire

通风 Vent

电梯 Elevator

配电 Electricity

串口 1 Port 1

串口 2 Port 2

串口 N Port N

Modbus 协议 Modbus Protocol

网络 1 Network 1

网络 2 Network 2

网络 N Network N

设备地址 1 Device Addr. 1

设备地址 255 Device Addr. 255

机组 Unit



## 四. MODBUS 协议格式 IV. Modbus Protocol Format

### 4.1. 概述 General

由于 Modbus 协议完全开放、应用广泛，而且协议简单、调试手段丰富，在多机通讯的场合很容易提高开发速度，还可以很方便地与市场上已有支持 Modbus 协议的设备连接，实现数据通讯，从而成为一种事实上的工业通讯标准。Modbus 通讯协议有两种传输模式，分为 RTU 模式和 ASCII 模式。本 BMS 接口采用 Modbus RTU 通讯模式。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 protocol. There are two communication modes: RTU and ASCII. The former one is adopted for the BMS interface.

### 4.2. 协议接口 Protocol Interface

协议接口为 Modbus RTU 协议。The protocol interface is the Modbus RTU protocol.

### 4.3. 硬件接口 Hardware Interface

- 1) 通讯接口: RS485 Communication Interface: RS485
- 2) 通讯方式: 波特率: 9600 bit/s(特殊情况可选择其它波特率,但通讯机制要与本规范一致)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 protocol.)
  - 起始位 Start Bit: 1
  - 数据位 Data Bit: 8
  - 校验位 Check Bit: 无 None
  - 停止位 Stop Bit: 1

### 4.4. Modbus 的 RTU 模式的通用通讯帧格式 Universal Communication

#### Frame Format of Modbus under RTU Mode

起始时间间隔 Start Time Interval	地址码 Addr. Code	功能码 Function Code	数据区 Data Area	CRC 校验码 CRC	结束时间间隔 Stop Time Interval
T1-T2-T3-T4	1 Byte	1 Byte	n Bytes	2 Bytes	T1-T2-T3-T4

RTU 模式中，信息开始至少需要有 3.5ms 的静止时间，依据使用的波特率，很容易计算这个静止的时间(如上图中的 T1-T2-T3-T4)。发送完最后一个字符后，也有一个 3.5ms 的静止时间，然后才能发送一个新的信息。Under the RTU mode, there is at least 3.5ms dead time before the data transmission, which can be figured through 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 transmitted.

整个信息必须连续发送。如果在发送帧信息期间，出现大于 1.5ms 的静止时间时，则接收设备刷新不完整的消息，并接收下一个地址数据。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.

同样一个信息后，立即发送的一个新信息，（若无 3.5 ms 的静止时间）这将会产生一个错误。是因为合并信息的 CRC 校验码无效而产生的错误。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 标准协议格式 MODBUS Standard Protocol Format

### 4.5.1. 线圈 (Bit) Coil (Bit)

表 2 线圈数据 Table 2: Coil Data

地址 Addr.	对应 Byte Corresponding Byte	数据 (实例) 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. 线圈是空调的一些标志位、故障位等数据, 即用一个 Bit 表达的数据。“Coil”indicates the data of some flag bit or failure bit, etc.
2. 数据以 Bit 为单位, 每个 Bit 对应一个地址。The unit of data is bit and each bit has a corresponding address.
3. 数据 Bit 存在通讯帧 Byte 中, 每个 Byte 有 8 个 Bit。Byte 低位对应低地址 Bit, 高位对应高地址 Bit, 详情见表 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. 上位机能够操作通讯模块数据中的一个 Bit, 或同时操作多个连续 Bit。The master unit can operate one bit among the communication data or multiple bits at the same time.
5. 上位机读取 Bit 或下发 Bit 的个数小于  $\text{Byte} \times 8$ , 下发或读取通讯帧中“有效数据”的最后 Byte 无效数据位需清零。例如: 读取或下发 9 个 Bit, 每个 Bit 值都为 1, 则需要 2 Bytes, 第一个 Byte 为“1111 1111”, 第二个 Byte 为“0000 0001”, 其中有效数据“1”前面的部份为无效数据, 需清零。The bit count which the

master unit can read or transmit is less than Byte $\times$ 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 value 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. 寄存器（Word, 16 Bit） Register (Word, 16 bit)

表 3 寄存器数据 Table 3: Registers Data

地址 Addr.	对应 Byte 地址 Corresponding Byte	数据（实例）Values
Word 0	Byte 0	AA 55
	Byte 1	
Word 1	Byte 2	AA 55
	Byte 3	
Word 2	Byte 4	55 AA
	Byte 5	
.....	.....	.....

- 寄存器即数据 Word，数据以 Word 为单位，每个 Word 对应一个地址，地址从 0 开始。The unit of the register is “word” which has a corresponding address starting from 0.
- 上位机如果要读取一个 Word 的数据，则要读取 2 个 Byte，先传高 8 位，再传低 8 位。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.
- 上位机下发读取请求帧，可同时读取或下发数据列表中的一个 Word 或多个连续 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. 读线圈（读 Bit） Read Coils (Read bit)

说明：读取线圈数据，不支持广播。Note: It can read the coil data but not support the broadcast.

功能码：0x01 Function Code: 0x01

表 4 请求帧 Table 4: Request Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

表 5 响应帧 Table 5: Corresponding Frame

设备地址 Device Addr.	功能码 Function Code	字节个数 Byte Count	有效数据 Effective Data	CRC 校验码 CRC
1 Byte	1 Byte	1 Byte	n Bytes	2 Bytes

起始地址：要读取的一系列 Bit 的开始地址。Starting Address: It is the starting place where to read a series of bits.

数据数量：要读取 Bit 的个数。Data Size: it indicates the count number of bits.

实例：从设备 10 中的线圈地址 5 开始连续读取 10 个 Bit(线圈数据见表 2)，如下：For example: Read ten bits from the coil 5 of the device 10 (see table 2 for the coil data), as follows:

请求帧：0A（设备地址）01（功能码）00 05（起始地址）00 0A（数据数量）AD 77（CRC 校验码） Request frame: 0A (device address) 01 (function code) 00 05 (starting address) 00 0A (data size) AD 77 (CRC)

响应帧：0A（设备地址）01（功能码）02（字节个数）AA 02（有效数据）E3 5C（CRC 校验码） Response Frame: 0A (device address) 01 (function code) 02 (byte count) AA 02 (effective data) E3 5C (CRC)

返回数据最后为 1 个 Byte 的数据“0000 0010”，其中有效数据“10”前面的部分为无效数据，需清零。The last byte is “0000 0010”, among which the ineffective bits “0” should be cleared.

#### 4.5.4. 写线圈（写 Bit）Write Coils (Write bit)

说明：上位机对通讯模块写入线圈数据，支持广播。 Note: The master unit writes coil data into the communication module and also supports the broadcast.

功能码：0x0F Function Code: 0x0F

表6 请求帧 Table 6: Request Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	字节个数 Byte Count	有效数据 Effective Data	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	1 Byte	n Bytes	2 Bytes

表7 响应帧 Table 7: Response Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

注：响应帧的设备地址、功能码、起始地址、数据数量都与请求帧的相同。 Note: The response frame has the same device address, function code, starting address and data size as the request frame.

实例：将设备为10，地址从6开始的连续11个Bit置1，如下：For example: Set eleven consecutive bits to “1” from the device 10 and starting at the address 6, as follows:

请求帧：0A（设备地址）0F（功能码）00 06（起始地址）00 0B（数据数量）02（字节个数）FF 07（有效数据）97 A0（CRC校验码）

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）

响应帧：0A（设备地址）0F（功能码）00 06（起始地址）00 0B（数据数量）F5 76（CRC校验码）

Response Frame: 0A（device address）0F（function code）00 06（starting address）00 0B（data size）F5 76（CRC）

下发数据最后为1个Byte的数据“0000 0111”，其中有效数据“111”前面的部分为无效数据，需清零。

The last byte is “0000 0111”, among which the ineffective bits “0” should be cleared.

#### 4.5.5. 读寄存器（读 Word）Read Registers (Read word)

说明：读取通讯模块寄存器数据，不支持广播。 Note: Read the register data but do not support the broadcast.

功能码: 0x03    Function Code: 0x03

表8 请求帧 Table 8: Request Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

表9 响应帧 Table 9: Response Frame

设备地址 Device Addr.	功能码 Function Code	字节个数 Byte Count	有效数据 Effective Data	CRC 校验码 CRC
1 Byte	1 Byte	1 Byte	n Bytes	2 Bytes

起始地址: 要读取 Word 数据块的开始地址。Starting address: It indicates the starting address to read the data block.  
数据数量: Word 的个数, 每次最多能读取 127 个 Word。Data size: It indicates the count number of words with the maximum of 127 each time.

实例: 从设备10中, 地址为1开始连续读取2个Word(寄存器数据见表3), 如下: 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:

请求帧: 0A (设备地址) 03 (功能码) 00 01 (起始地址) 00 02 (数据数量) 94 B0 (CRC 校验码)

Request Frame: 0A (device address) 03 (function code) 00 01 (starting address) 00 02 (data size) 94 B0 (CRC)

响应帧: 0A (设备地址) 03 (功能码) 04 (字节个数) AA 55 55 AA (有效数据) CE 14 (CRC 校验码)

Response Frame: 0A (device address) 03 (function code) 04 (byte count) AA 55 55 AA (effective data) CE 14 (CRC)

#### 4.5.6. 写寄存器 (写 Word) Write Registers (Write word)

说明: 将上位机控制数据写入寄存器 (Word), 支持广播。Note: Write control data from the master unit into the register and support broadcast.

功能码: 0x10    Function Code: 0x10

表10 请求帧 Table 10: Request Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	字节个数 Byte Count	有效数据 Effective Data	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	1 Byte	n Bytes	2 Bytes

表11 响应帧 Table 11: Response Frame

设备地址 Device Addr.	功能码 Function Code	起始地址 Starting Addr.	数据数量 Data Size	CRC 校验码 CRC
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

注: 响应帧的设备地址、功能码、起始地址、数据数量都与请求帧的相同。Note: The response frame has the same device address, function code, starting address and data size as the request frame.

实例: 在设备 10 中, 地址为 2 开始写入 3 个 Word(0x12、0x23、0x34), 如下: For example: write three words (0x12,

0x23, 0x34) from the device 10 and starting at the address 2, as follow:

请求帧: 0A (设备地址) 10 (功能码) 00 02 (起始地址) 00 03 (数据数量) 06 (字节个数) 00 12 00 23 00 34  
(有效数据) 15 DF (CRC 校验码)

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)

响应帧: 0A (设备地址) 10 (功能码) 00 02 (起始地址) 00 03 (数据数量) 20 B3 (CRC 校验码)

Response Frame: 0A (device address) 10 (function code) 00 02 (starting address) 00 03 (data size) 20 B3 (CRC)

### 4.5.7. 异常响应 Alarm Response

说明: 上位机对通讯模块发送请求帧, 希望得到一个正常的响应, 但通讯模块检测到异常, 回复异常响应帧。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.

功能码: 请求帧的功能码的最高 Bit 置 1, 即请求帧的功能码与 0x80 进行或运算后得到的值 (而正常响应的功能码原样返回)。Function code: Set the highest-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).

设备回复异常帧的通讯格式: Communication format of the alarm response frame:

表 12 异常响应帧 Table12: Alarm Response Frame

设备地址 Device Addr.	功能码 Function Code	异常码 Alarm Code	CRC 校验码 CRC
1 Byte	1 Byte	1 Bytes	2 Bytes

异常码详细描述见下表: Description of the alarm codes:

表 13 异常码列表 Table 13: Alarm Codes

异常码 Alarm Code	名称 Name	说明 Description
0x03	非法数据值 Illegal data	下发数据错误或读取数据范围越界 The transmitted data is incorrect or beyond the data range.
0x04	从机设备故障 Salve device failure	通讯模块与空调机组发生通讯故障 There is communication failure between the communication module and the air conditioning unit.

实例: 上位机从设备 10, 地址为 0 开始读取 128 个 Word, 超过 Modbus 可读范围有效长度, 则回复异常帧, 如下: 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:

请求帧: 0A (设备地址) 03 (功能码) 00 00 (起始地址) 00 80 (数据数量) 45 11 (CRC 校验码)

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

响应帧: 0A (设备地址) 83 (功能码) 03 (异常码) 70 F3 (CRC 校验码)

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

## 五. U-Match 第四代直流变频机型通讯协议

# V. Communication Protocol for All DC Inverter U-Match

### 5.1. U-Match 第四代直流变频机型通讯协议概述 General

U-Match 第四代直流变频机型内机自带 BMS 接口，提供 MODBUS 协议接口，不需要外接通讯模块，但需要使用线控器设置，具体设置方法请查阅该系列机组的服务手册。U-Match 第四代直流变频机组远程监控能够对目前格力电器的 U-Match 第四代直流变频机型进行远程监控或接入用户的 BMS 系统，用户通过监控电脑或 BMS 系统就可对最多 255 套 U-Match 第四代直流变频机组进行集中管理和控制，是现代楼宇智能空调系统管理的高效工具。All DC Inverter U-Match has integrated BMS interface into the indoor units. As Modbus protocol 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.

通过该接口，可以实现对机组的远程监控。可以实时监测机组的运行温度、压缩机状态、故障状态。同时也可以对机组进行远程温度设置、模式设置、开关机设置、屏蔽模式设置、屏蔽开关机设置等等。Through this interface, it can not only realize the long-distance monitoring to units, including units' running temperature, compressor status and error status, but also can enable units' settings remotely, like temperature setting, mode setting, on/off setting, mode shield setting, on/off shield setting, etc.

协议中读写标志为：R 表示只允许读。W/R 表示可读可写。 In the protocol, "R" indicates "read only" and "W/R" indicates "write and read".

### 5.2. U-Match 第四代直流变频机型 BMS 接口开发前注意事项

#### Precautions before the Development of the BMS Interface for All DC

#### Inverter U-Match

★(1): 单冷机型，下发制热无效，建议监控软件提示该操作无效。Cooling Only Unit: Heating instruction is invalid. It is recommended that the monitoring software can tell this operation is invalid.

★(2): BMS 系统软件收到的异常响应帧类型为 0x04 时候，表示机组与通讯模块通讯故障。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): 节能处理: Energy Saving Solution:

制冷模式: 当远程设置“制冷节能起作用”置位时，若远程设置“设定温度”值小于“制冷节能温度下限”值时，空调机组将不响应该命令，建议 BMS 系统软件提示该操作不能成功；只有当远程监控设置的“设定温度”值大于“制冷节能温度下限”值时，控制命令才有效。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.

制热模式：当远程设置“制热节能起作用”置位时，若远程设置“设定温度”值大于“制热节能温度上限”值时，空调机组将不响应该命令，建议 BMS 系统软件提示该操作不能成功；只有当远程监控设置的“设定温度”值小于“制热节能温度上限”值时，控制命令才有效。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): 当 BMS 系统软件需要取消或者设置两个节能起作用标志位的其中一个，需同时绑定取消或者设置。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): 当机组模式为送风或自动模式时，睡眠设置无效。When unit is in fan mode or auto mode, sleep setting will be invalid.

★(6): 当机组模式为自动模式时，远程屏蔽温度设定无效。When unit is in auto mode, the setting of long-distance temperature shield will be invalid.

★(7): 关机状态下，开启干燥功能会使风机运转 2 分钟。Under power-off status, when X-fan function is energized, fan motor will run for 2min.

★(8): BMS 系统软件下发给通讯模块的所有数据需要进行有效范围判断。All data sent by the BMS system to the communication module should be verified if it is effective.

★(9): 通讯模块在掉电上电后，在没有收到一帧机组有效数据之前，报异常响应 04。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 第四代直流变频机型有效数据定义 Definition of Effective

#### Data

远程监控 Modbus 通讯协议的数据空间分为两类：开关量和寄存器。寄存器值为空调的温度值、阀门值、档位等连续值或多状态值。开关量为空调的各种只有两种状态的量，如感温包故障，只有两种状态，分别为有故障和无故障。The data for the Modbus communication protocol 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. 模拟量的数据和地址分布: (Word 0~Word X)

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

寻址地址 Addr.	访问类型(R-只读 W/R-可读可写) Access Type (R-read only, W/R-write/read)	数据含义 Data Meaning	范围值(十进制显示) Range	精度 Accuracy	单位 Unit	数据类型 (实际值) Data Type (actual value)	开发前需注意(带★的数据) Pay special attention before development (to the data marked with ★)	备注 Remarks
Word 0	R	预留 Reserved	/	/	/	/		
Word 1	R	预留 Reserved	/	/	/	/		
Word 2	W/R	开关机 Unit On/Off	0xAA: 开机 Unit on; 0x55: 关机 Unit off	/	/	无符号整型 Unsigned, integer type		
Word 3	R	预留 Reserved	/	/	/	/		
Word 4	R	环境温度 Ambient temp	传输值=实际值,实际 值:传输值=温度值 ×10 Transmission value=actual value, actual value: transmission value=temp value×10	0.1	℃	有符号整型 Signed, interger type		广播数据 Broadcast data
Word 5	R	内机地址 IDU Addr.	传输值=实际值,实际 值: 如接集中控制器 时, 地址范围为: 1-16; 如果接 PC 地址 模式时, 地址范围为 1-255 Transmission value=actual value, actual value: If connected with central controller, address range is 1-16;	1	/	无符号整型 Unsigned, integer type		

			if connected with PC address mode, address range is 1-255				
Word 6	R	预留 Reserved	/	/	/	/	
Word 7	R	预留 Reserved	/	/		/	
Word 8	R	预留 Reserved	/	/	/	/	
Word 9	R	预留 Reserved	/	/	/	/	
Word 10	R	预留 Reserved	/	/	/	/	
Word 11	R	预留 Reserved	/	/	/	/	
Word 12	R	预留 Reserved	/	/	/	/	
Word 13	R	预留 Reserved	/	/	/	/	
Word 14	R	预留 Reserved	/	/	/	/	
Word 15	R	预留 Reserved	/	/	/	/	
Word 16	R	预留 Reserved	/	/	/	/	
Word 17	W/R	设定模式 Set mode	传输值=实际值,实际值:001:制冷;010:制热;011:除湿;100:送风;101:自动模式 Transmission value=actual value, actual value: 001: cooling; 010: heating; 011: drying; 100: fan only; 101: auto mode	/	/	无符号整型 Unsigned, integer type	★ (1)
Word 18	R	预留 Reserved	/	/	/		
Word 19	W/R	设定风速 Set fan speed	传输值=实际值,实际值:0:自动;1:1档;2:2档;3:3档;4:4档;5:5档;6:超强档; Transmission value=actual value,	/	/	无符号整型 Unsigned, integer type	

			actual value: 0: auto 1: speed 1; 2: speed 2; 3: speed 3; 4: speed 4; 5: speed 5; 6: turbo				
Word 20	W/R	设定温度 Set temp	传输值=实际值,实际 值:16-30,低温除湿下 为 12 度, 外出模式下 为 8 度 Transmission value=actual value, actual value:16-30, under low-temp drying, it is 12℃, under absence mode, it is 8℃.	1	℃	无符号整型 Unsigned, integer type	
Word 21	R	预留 Reserved	/	/	/		
Word 22	W/R	上下扫风 Up & down swing	传输值=实际值,实际 值:0000---关, 0001---15 扫风, 0010---1 位置, 0011---2 位置, 0100---3 位置, 0101---4 位置, 0110---5 位置, 0111---35 扫风, 1000---25 扫风, 1001---24 扫风, 1010---14 扫风, 1011---13 扫风。 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,	/	/	无符号整型 Unsigned, integer type	

			1010---14 air swing, 1011---13 air swing				
Word 23	W/R	左右扫风 Left & right swing	传输值=实际值,实际 值:0000---关(上电默 认), 0001---同向扫 风, 0010---1 位置, 0011---2 位置, 0100---3 位置, 0101---4 位置, 0110---5 位置, 1100---15 位置, 1101---相向扫风。 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	/	/	无符号整型 Unsigned, integer type	
Word 24	W/R	新风风阀 状态 Fresh air valve status	传输值=实际值,实际 值:0~10, 0:表示新风 阀关,10 种新风模式 Transmission value=actual value, actual value: 0~10, 0: indicates fresh air valve, 10 modes of fresh air	/	/	无符号整型 Unsigned, integer type	
Word 25	W/R	睡眠模式 Sleep mode	传输值=实际值,实际 值:0: 无睡眠; 1: 睡 眠 1; 2: 睡眠 2; 3: 睡眠 3 Transmission	/	/	无符号整型 Unsigned, integer type	★ (5)

			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	预留 Reserved	/	/	/	/	
Word 27	W/R	预留 Reserved	/	/	/	/	
Word 28	W/R	预留 Reserved	/	/	/	/	
Word 29	W/R	预留 Reserved	/	/	/	/	
Word 30	W/R	预留 Reserved	/	/	/	/	
Word 31	W/R	预留 Reserved	/	/	/	/	
Word 32	W/R	预留 Reserved	/	/	/	/	
Word 33	W/R	预留 Reserved	/	/	/	/	
Word 34	W/R	清洗功能 Clean function	传输值=实际值,实际 值:00: 无清洗功能; 10-39: 污染等级 Transmission value=actual value, actual value: 00: no clean function; 10-39: contamination grade	/	/	无符号整型 Unsigned, integer type	
Word 35	W/R	制冷节能 下限温度 Temp lower limit for energy saving under cooling	传输值=实际值, 实际 值: 16~30 Transmission value=actual value, actual value: 16~30	1	℃	无符号整型 Unsigned, integer type	★(3)
Word 36	W/R	制热节能 上限温度 Temp upper limit for energy	传输值=实际值, 实际 值: 16~30 Transmission value=actual value, actual value: 16~30	1	℃	无符号整型 Unsigned, integer type	★(3)

		saving under heating					
Word 37	R	预留 Reserved	/	/	/	/	
Word 38	R	预留 Reserved	/	/	/	/	
Word 39	R	环境感温 包选择 Selection of ambient temp sensor	传输值=实际值, 实际 值: 01: 室内环境温度 为回风处环境感温 包 10: 室内环境温度 为线控器处感温包 11: 制冷、除湿、 送风选择回风口 感温包, 制热、 自动模式选择线 控器处感温包 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	/	/	无符号整型 Unsigned, integer type	
Word 40	R	预留 Reserved	/	/	/	/	
Word 41	R	预留 Reserved	/	/	/	/	
Word 42	R	预留 Reserved	/	/	/	/	
Word 43	R	预留 Reserved	/	/	/	/	
Word 44	R	预留 Reserved	/	/	/	/	
Word 45	R	预留 Reserved	/	/	/	/	

Word 46	R	预留 Reserved	/	/	/	/		
Word 47	R	预留 Reserved	/	/	/	/		
Word 48	R	预留 Reserved	/	/	/	/		
Word 49	R	室外环境温度 Outdoor ambient temp	传输值=实际值, 实际值: -100—155 Transmission value=actual value, actual value: -100--155	1	℃	有符号整型 Signed, interger type		
Word 50	R	预留 Reserved	/	/	/	/		
Word 51	R	预留 Reserved	/	/	/	/		
Word 52	R	预留 Reserved	/	/	/	/		
Word 53	R	预留 Reserved	/	/	/	/		
Word 54	R	预留 Reserved	/	/	/	/		
Word 55	R	预留 Reserved	/	/	/	/		
Word 56	R	预留 Reserved	/	/	/	/		
Word 57	R	预留 Reserved	/	/	/	/		
Word 58	R	预留 Reserved	/	/	/	/		
Word 59	R	预留 Reserved	/	/	/	/		
Word 60	R	预留 Reserved	/	/	/	/		
Word 61	R	预留 Reserved	/	/	/	/		
Word 62	R	预留 Reserved	/	/	/	/		
Word 63	R	预留 Reserved	/	/	/	/		
Word 64	R	预留 Reserved	/	/	/	/		
Word 65	R	预留 Reserved	/	/	/	/		

外机应答  
数据  
ODU  
response  
data

Word 66	R	预留 Reserved	/	/	/	/	
Word 67	R	预留 Reserved	/	/	/	/	
Word 68	R	预留 Reserved	/	/	/	/	
Word 69	R	预留 Reserved	/	/	/	/	
Word 70	R	预留 Reserved	/	/	/	/	
Word 71	R	预留 Reserved	/	/	/	/	
Word 72	R	预留 Reserved	/	/	/	/	
Word 73	R	预留 Reserved	/	/	/	/	
Word 74	R	预留 Reserved	/	/	/	/	
Word 75	R	预留 Reserved	/	/	/	/	
Word 76	R	预留 Reserved	/	/	/	/	
Word 77	R	DRED 功能 DRED function	0: 无 DRED 功能; 1: DRED1 模式; 2: DRED2 模式; 3: DRED3 模式。 0: no DRED function; 1:DRED1 mode; 2:DRED2 mode; 3:DRED3 mode.	/	/	无符号整型 Unsigned, integer type	
Word 78	R	预留 Reserved	/	/	/	/	
Word 79	R	预留 Reserved	/	/	/	/	
Word 80	R	预留 Reserved	/	/	/	/	
Word 81	R	预留 Reserved	/	/	/	/	
Word 82	R	回风处环境温度 Ambient temp at the port of air return	传输值=实际值, 实际值: 传输值=(温度值)×10 Transmission value=actual value, actual value:	0.1	℃	有符号整型 Signed, interger type	内机点名 数据 IDU identification data



			transmission=(temp value)×10				
Word 83	R	灯板环境温度 Ambient temp of light board	传输值=实际值, 实际值: 传输值=(温度值)×10 Transmission value=actual value, actual value: transmission=(temp value)×10	0.1	°C	有符号整型 Signed, interger type	
Word 84	R	预留 Reserved	/	/	/	/	
Word 85	R	预留 Reserved	/	/	/	/	
Word 86	R	预留 Reserved	/	/	/	/	
Word 87	R	预留 Reserved	/	/	/	/	
Word 88	R	预留 Reserved	/	/	/	/	
Word 89	R	预留 Reserved	/	/	/	/	
Word 90	R	预留 Reserved	/	/	/	/	
Word 91	R	预留 Reserved	/	/	/	/	
Word 92	R	预留 Reserved	/	/	/	/	

## 2. 数据状态量的数据和地址分布: (Bit 0~Bit 1495)

### Data and Address Distribution of Switching Values: (Bit 0~Bit 1495)

地址 Addr.	访问类型(R-只读 W/R-可读可写) Access Type (R-read only, W/R-write/read)	位地址 Addr. Bit	数据含义 Data Meaning	范围值 Range	参数类别 Parameter Type	开发前需注意(带★的数据) Pay special attention before development (to the data marked with ★)	备注 Remarks
Byte0	R	Bit0	预留 Reserved	/	/		
	R	Bit1	预留 Reserved	/	/		
	R	Bit2	预留 Reserved	/	/		

	R	Bit3	预留 Reserved	/	/		
	R	Bit4	预留 Reserved	/	/		
	R	Bit5	预留 Reserved	/	/		
	R	Bit6	预留 Reserved	/	/		
	R	Bit7	预留 Reserved	/	/		
Byte1	R	Bit8	外机有无标志位 Whether or not ODU has flag bit?	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit9	主线控制器有无标志位 Whether or not the master wired controller has flag bit?	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit10	预留 Reserved	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit11	预留 Reserved	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit12	预留 Reserved	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit13	副线控制器有无标志位 Whether or not the slave wired controller has flag bit?	0: 无, 1: 有 0: no, 1: yes	状态参数 Status parameter		
	R	Bit14	预留 Reserved	/	/		
	R	Bit15	预留 Reserved	/	/		
Byte2	R	Bit16	预留 Reserved				
	W/R	Bit17	远程锁定 Remote lock	1 (远程监控或分户计费锁定系统当前状态), 0 (无上述锁定或已解除锁定) 1 (current status is locked by long-distance monitoring or the household charging system), 0 (no above lock or it is unlocked)	状态参数 Status parameter		
	W/R	Bit18	远程屏蔽温度	1: 屏蔽, 0: 不屏蔽	状态参数	★ (6)	

广播数据  
Broadcast data

			设定 Remote temp shield	1: with shield, 0: without shield	Status parameter	
	W/R	Bit19	远程屏蔽模式 Remote mode shield	1: 屏蔽, 0: 不屏蔽 1: with shield, 0: without shield	状态参数 Status parameter	
	W/R	Bit20	远程屏蔽开关机 Remote On/Off shield	1: 屏蔽, 0: 不屏蔽 1: with shield, 0: without shield	状态参数 Status parameter	
	W/R	Bit21	远程屏蔽节能设置 Remote energy saving shield	1: 屏蔽, 0: 不屏蔽 1: with shield, 0: without shield	状态参数 Status parameter	
	R	Bit22	预留 Reserved	/	/	
	R	Bit23	预留 Reserved	/	/	
Byte3	W/R	Bit24	外出模式 Absence mode	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
	W/R	Bit25	健康 Healthy function	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
	W/R	Bit26	舒适节能 Comfortable and energy saving: I-Demand	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
	W/R	Bit27	超强 Turbo	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
	W/R	Bit28	辅热禁止标志 E-heating permission mark	0: 允许开; 1: 禁止开 0: permit e-heating on; 1: not permit e-heating on	状态参数 Status parameter	
	W/R	Bit29	干燥 X-fan	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	★ (7)
	W/R	Bit30	静音 Silent	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
	W/R	Bit31	低温除湿模式 Low temp drying mode	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	
Byte4	W/R	Bit32	制冷节能起作用 Energy saving under	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	★(4)

			cooling is active			
	W/R	Bit33	制热节能起作用 Energy saving under heating is active	0: 关闭; 1: 开启 0: off; 1: on	状态参数 Status parameter	★(4)
	W/R	Bit34	按键锁(童锁)状态 Buttons lock (childlock) status	1: 有; 0: 没有 1: on; 0: off	状态参数 Status parameter	
	W/R	Bit35	记忆开关机状态 On/Off memoring status	0: 记忆, 1: 不记忆 0: memorize, 1: not memorize	状态参数 Status parameter	
	W/R	Bit36	摄氏华氏标志位 °C/°F flag bit	1: 华氏; 0: 摄氏 1: °F; 0: °C	状态参数 Status parameter	
	R	Bit37	预留 Reserved	/	/	
	R	Bit38	预留 Reserved	/	/	
	R	Bit39	预留 Reserved	/	/	
Byte5	R	Bit40	定时状态 Timer status	1: 有定时; 0: 无定时 1: with timer; 0: without timer	状态参数 Status parameter	
	R	Bit41	预留 Reserved	/	/	
	R	Bit42	预留 Reserved	/	/	
	R	Bit43	预留 Reserved	/	/	
	R	Bit44	预留 Reserved	/	/	
	R	Bit45	预留 Reserved	/	/	
	R	Bit46	是否带门禁系统 Gate control system is provided or not?	1: 是; 0: 否 1: yes; 0: no	状态参数 Status parameter	
	R	Bit47	是否带人体感应检测模块 Human body sensing check module is provided or not?	1: 是; 0: 否 1: yes; 0: no	状态参数 Status parameter	

Byte6	R	Bit48	预留 Reserved	/	/	
	R	Bit49	定时开标志 Timer On flag	1: 启动; 0: 不启动 1: active; 0: not active	状态参数 Status parameter	
	R	Bit50	定时关标志 Timer Off flag	1: 启动; 0: 不启动 1: active; 0: not active	状态参数 Status parameter	
	R	Bit51	当前模式使用 环境温度 Indoor ambient temperature in current mode	0: 室内环境温度为回风处环 境温度 1: 室内环境温度为线控器处 温度 0: indoor ambient temperature is the air return ambient temperature 1: indoor ambient temperature is the temperature at wired controller	状态参数 Status parameter	
	R	Bit52	预留 Reserved	/	/	
	R	Bit53	预留 Reserved	/	/	
	R	Bit54	预留 Reserved	/	/	
	R	Bit55	低待机能耗控 制功能(1W 待 机) Low standby power consumption control function (1W standby)	1: 模式 2; 0: 模式 1 1: mode 2; 0: mode 1	状态参数 Status parameter	
Byte7	R	Bit56	预留 Reserved	/	/	
	R	Bit57	预留 Reserved	/	/	
	R	Bit58	预留 Reserved	/	/	
	R	Bit59	预留 Reserved	/	/	
	R	Bit60	预留 Reserved	/	/	
	R	Bit61	预留 Reserved	/	/	
	R	Bit62	预留 Reserved	/	/	
	R	Bit63	预留 Reserved	/	/	
Byte8	R	Bit64	预留 Reserved	/	/	
	R	Bit65	线控器感温包 故障 Wired controller temp sensor error	1: 是; 0: 否 1: yes; 0: no	故障参数 Failure parameter	
	R	Bit66	预留 Reserved	/	/	

	R	Bit67	预留 Reserved	/	/	
	R	Bit68	预留 Reserved	/	/	
	R	Bit69	预留 Reserved	/	/	
	R	Bit70	线控器记忆芯片故障 Wired controller memory chip error	1: 是 0: 否 1: yes; 0: no	故障参数 Failure parameter	
	R	Bit71	预留 Reserved	/	/	
Byte9	W/R	Bit72	取消定时 Cancel timer	0: 不取消, 1: 取消 0: do not cancel, 1: cancel	状态参数 Status parameter	
	R	Bit73	预留 Reserved	/	/	
	W/R	Bit74	上下扫风工作模式 Up & down swing mode	0:模式 1-简单扫风,1:模式 2-定格扫风及小区域扫风 0: mode 1-simple air swing; 1: mode 2-fixed angle air swing and small area air swing	状态参数 Status parameter	
	R	Bit75	预留 Reserved	/	/	
	R	Bit76	预留 Reserved	/	/	
	R	Bit77	预留 Reserved	/	/	
	R	Bit78	预留 Reserved	/	/	
Byte10	R	Bit79	预留 Reserved	/	/	
	R	Bit80	预留 Reserved	/	/	
	R	Bit81	预留 Reserved	/	/	
	R	Bit82	预留 Reserved	/	/	
	R	Bit83	预留 Reserved	/	/	
	R	Bit84	预留 Reserved	/	/	
	R	Bit85	预留 Reserved	/	/	
Byte11	R	Bit86	预留 Reserved	/	/	
	R	Bit87	预留 Reserved	/	/	
	R	Bit88	预留 Reserved	/	/	
	R	Bit89	预留 Reserved	/	/	
	R	Bit90	预留 Reserved	/	/	
	R	Bit91	辅助电加热 Electric heating	1: 是 0: 否 1: yes 0: no	状态参数 Status parameter	内机板点名 IDU board identification
R	Bit92	水泵 Water pump	1: 开 0: 关 1: on; 0: off	状态参数 Status parameter		
R	Bit93	新风风阀开关 Fresh air valve switch	1: 是 0: 关 1: turn on; 0: turn off	状态参数 Status parameter		

	R	Bit94	冷等离子发生器 Cold plasma generator	1: 是 0: 关 1: turn on; 0: turn off	状态参数 Status parameter	
	R	Bit95	故障输出状态 Error output status	1: 有 0: 无 1: yes 0: no	状态参数 Status parameter	
Byte12	R	Bit96	预留 Reserved	/	/	
	R	Bit97	室内蒸发器感温包故障 Indoor evaporator temp sensor error	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit98	室内回风处环境温度感温包故障 Indoor air return temp sensor error	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit99	灯板处环境温度感温包故障 Light board ambient temp sensor error	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit100	预留 Reserved	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit101	水满保护 Water overflow protection	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit102	内机记忆芯片故障标志位 Flag bit of IDU memory ship error	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit103	预留 Reserved	/	/	
Byte13	R	Bit104	跳线帽故障 Jumper cap error	1: 故障; 0: 正常 1 error, 0 normal	故障参数 Failure parameter	
	R	Bit105	内风机故障 Indoor fan error	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit106	预留 Reserved	/	/	
	R	Bit107	预留 Reserved	/	/	

	R	Bit108	机组需要清洗 Unit needs cleaning	1: 是 0: 否 1: yes 0: no	状态参数 Status parameter	
	R	Bit109	预留 Reserved	/	/	
	R	Bit110	预留 Reserved	/	/	
	R	Bit111	预留 Reserved	/	/	
Byte14	R	Bit112	插拔卡状态 Card in/out status	0: 拔卡, 1: 插卡 0: card out, 1: card in	状态参数 Status parameter	
	R	Bit113	室内人员状态 Is there people in the room?	0: 无人, 1: 有人 0: no, 1: yes	状态参数 Status parameter	
	R	Bit114	静压类型 Static pressure type	0: 低静压; 1: 高静压 0: low static pressure; 1: high static pressure	状态参数 Status parameters	
	R	Bit115	预留 Reserved	/	/	
	R	Bit116	预留 Reserved	/	/	
	R	Bit117	预留 Reserved	/	/	
	R	Bit118	预留 Reserved	/	/	
	R	Bit119	预留 Reserved	/	/	
Byte15	R	Bit120	与主线控器通 讯故障 Communication failure with master wired controller	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit121	与副线控器通 讯故障 Communication failure with slave wired controller	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit122	与外机通讯故 障 Communication failure with ODU	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit123	预留 Reserved	/	/	
	R	Bit124	预留 Reserved	/	/	
	R	Bit125	预留	/	/	
	R	Bit126	预留 Reserved	/	/	
	R	Bit127	预留 Reserved	/	/	
Byte16	R	Bit128	预留 Reserved	/	/	
	R	Bit129	预留 Reserved	/	/	



	R	Bit130	预留 Reserved	/	/	
	R	Bit131	预留 Reserved	/	/	
	R	Bit132	预留 Reserved	/	/	
	R	Bit133	预留 Reserved	/	/	
	R	Bit134	预留 Reserved	/	/	
	R	Bit135	预留 Reserved	/	/	
Byte17	R	Bit136	预留 Reserved	/	/	
	R	Bit137	预留 Reserved	/	/	
	R	Bit138	预留 Reserved	/	/	
	R	Bit139	预留 Reserved	/	/	
	R	Bit140	预留 Reserved	/	/	
	R	Bit141	预留 Reserved	/	/	
	R	Bit142	预留 Reserved	/	/	
Byte18	R	Bit143	预留 Reserved	/	/	
	R	Bit144	预留 Reserved	/	/	
	R	Bit145	预留 Reserved	/	/	
	R	Bit146	预留 Reserved	/	/	
	R	Bit147	外风机状态 Outdoor fan status	1: 开 0: 关 1: on 0: off	状态参数 Status parameter	
	R	Bit148	预留 Reserved	/	/	
	R	Bit149	预留 Reserved	/	/	
Byte19	R	Bit150	四通阀状态 4-way valve status	1: 开 0: 关 1: on 0: off	状态参数 Status parameter	
	R	Bit151	压缩机状态 Compressor status	1: 开 0: 关 1: on 0: off	状态参数 Status parameter	
	R	Bit152	压缩机排气温度保护 Compressor discharge temperature protection	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit153	缺氟保护 Fluorine shortage protection	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit154	直流风机保护 DC fan motor protection	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	
	R	Bit155	四通阀换向异常保护	1: 是 0: 否 1: yes 0: no	故障参数 Failure	

外机应答信息 ODU response information

			4-way valve reverse error protection		parameter	
R	Bit156	过负荷保护 Over power protection	1: 是 0: 否 1: yes 0: on		故障参数 Failure parameter	
R	Bit157	过载保护 Over load protection	1: 是 0: 否 1: yes 0: on		故障参数 Failure parameter	
R	Bit158	低压保护 Low pressure protection	1: 是 0: 否 1: yes 0: on		故障参数 Failure parameter	
R	Bit159	高压保护 High pressure protection	1: 是 0: 否 1: yes 0: on		故障参数 Failure parameter Failure parameter	
Byte20	R	Bit160	蒸发器防冻结保护 Evaporator anti-freezing protection	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit161	室外环境感温包故障 Outdoor ambient temp sensor error	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit162	排气感温包故障 Discharge temp sensor error	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit163	冷凝器感温包故障 Condenser temp sensor error	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit164	室外换热器流程中间铜管表面感温包故障 Error of copper pipe temp sensor for the outdoor heat exchanger	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	

	R	Bit165	跳线帽故障 Jumper cap error	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit166	外机记忆芯片故障 ODU memory chip error	1: 是 0: 否 1: yes 0: on	故障参数 Failure parameter	
	R	Bit167	预留 Reserved	/	/	
Byte21	R	Bit168	预留 Reserved	/	/	
	R	Bit169	预留 Reserved	/	/	
	R	Bit170	预留 Reserved	/	/	
	R	Bit171	预留 Reserved	/	/	
	R	Bit172	预留 Reserved	/	/	
	R	Bit173	预留 Reserved	/	/	
	R	Bit174	与驱动通讯故障 Drive communication failure	1: 是 0: 否 1: yes 0: on	/	
	R	Bit175	预留 Reserved	/	/	
Byte22	R	Bit176	SAVE 状态 SAVE status	1: 是 0: 否 1: yes 0: on	状态参数 Status parameter	
	R	Bit177	单冷热泵标志位 Cooling only heat pump flag bit	0: 冷暖 1: 单冷 0: cool and heat 1: cool only	状态参数 Status parameter	★(1)
	R	Bit178	预留 Reserved	/	/	
	R	Bit179	系统化霜 System defrosting	1: 是 0: 否 1: yes 0: on	状态参数 Status parameter	
	R	Bit180	预留 Reserved	/	/	
	R	Bit181	预留 Reserved	/	/	
	R	Bit182	低功耗状态 Low power consumption status	1: 准备就绪 0: 否 1: ready 0: not	状态参数 Status parameter	
	R	Bit183	交流输入相序保护（缺相或逆相） AC input phase sequence protection	1: 是 0: 否 1: yes 0: no	故障参数 Failure parameter	

			(phase loss or reverse)			
Byte23	R	Bit184	变频压缩机驱动直流母线电压过低保护或电压跌落故障 Inverter compressor drive DC busbar voltage overlow protection or voltage drop off error	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit185	变频压缩机驱动直流母线电压过高保护 Inverter compressor drive DC busbar voltage overhigh protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit186	变频压缩机驱动交流电流保护 (输入侧) Inverter compressor drive alternate current protection (input side)	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit187	变频压缩机驱动 IPM 模块保护 Inverter compressor drive IPM protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit188	变频压缩机驱动 PFC 保护 Inverter compressor drive PFC protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	

	R	Bit189	变频压缩机启动失败 Inverter compressor startup failure	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit190	变频压缩机缺相保护 Inverter compressor phase loss protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit191	变频压缩机驱动模块复位 Inverter compressor drive module reset	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
Byte24	R	Bit192	变频压缩机过流保护 Inverter compressor over-current protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit193	变频压缩机功率保护 Inverter compressor power protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit194	变频压缩机驱动电流检测电路故障 Inverter compressor drive current check circuit failure	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit195	变频压缩机失步保护 Inverter compressor out-of-step protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit196	压缩机堵转	1 故障, 0 正常	故障参数	

			Compressor stalling	1 failure, 0 normal	Failure parameter	
R	Bit197		预留 Reserved	/	/	
R	Bit198		变频压缩机驱动模块温度过高保护 Inverter compressor drive module high temperature protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
R	Bit199		变频压缩机驱动模块温度传感器故障 Inverter compressor drive module temperature sensor failure	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
Byte25	R	Bit200	预留 Reserved	/	/	
	R	Bit201	变频压缩机弱磁 Inverter compressor low intensity field	1 进入弱磁, 0 没有弱磁	状态参数 Status parameter	
	R	Bit202	变频压缩机驱动限频 Inverter compressor drive frequency limit	1 进入限频, 0 正常升降频	状态参数 Status parameter	
	R	Bit203	变频压缩机驱动降频 Inverter compressor drive frequency demultiply	1 进入降频, 0 正常升降频	状态参数 Status parameter	
	R	Bit204	变频压缩机驱动交流输入低电压限频 Inverter compressor drive AC input low voltage	1 进入低电压限频, 0 正常升降频	状态参数 Status parameter	

			frequency limit			
	R	Bit205	变频压缩机驱动充电未完成 Inverter compressor drive under charge	1 未完成, 0 完成 1 under charge, 0 charged	状态参数 Status parameter	
	R	Bit206	预留 Reserved	/	/	
	R	Bit207	变频压缩机驱动交流输入电源类型 Power type of inverter compressor drive AC input	1 三相, 0 单相	状态参数 Status parameter	
Byte26	R	Bit208	变频压缩机驱动存储芯片故障 Inverter compressor drive storage chip failure	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	★ (1)
	R	Bit209	预留 Reserved	/	/	
	R	Bit210	变频压缩机驱动充电回路故障 Inverter compressor drive charged circuit failure	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit211	变频压缩机驱动交流输入电压异常保护 Inverter compressor drive AC input voltage abnormal protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit212	变频压缩机驱动电器盒温度传感器故障 Temperature sensor failure of inverter compressor	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	

			drive electric box			
	R	Bit213	变频压缩机驱动交流输入过零保护 Inverter compressor drive AC input zero cross protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit214	温漂保护 Temperature drift protection	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
	R	Bit215	传感器连接保护 (电流传感器没有接到对应的 U 相或 V 相) Sensor connection protection (electric current sensor is not connected to the corresponding U phase or V phase)	1 故障, 0 正常 1 failure, 0 normal	故障参数 Failure parameter	
Byte27	R	Bit216		/	/	
	R	Bit217		/	/	
	R	Bit218		/	/	
	R	Bit219		/	/	
	R	Bit220		/	/	
	R	Bit221		/	/	
	R	Bit222		/	/	
Byte28	R	Bit224		/	/	
	R	Bit225		/	/	
	R	Bit226		/	/	
	R	Bit227		/	/	
	R	Bit228		/	/	
	R	Bit229		/	/	
	R	Bit230		/	/	
Byte29	R	Bit232		/	/	
	R	Bit233		/	/	



	R	Bit234		/	/	
	R	Bit235		/	/	
	R	Bit236		/	/	
	R	Bit237		/	/	
	R	Bit238		/	/	
	R	Bit239		/	/	
Byte30	R	Bit240		/	/	
	R	Bit241		/	/	
	R	Bit242		/	/	
	R	Bit243		/	/	
	R	Bit244		/	/	
	R	Bit245		/	/	
	R	Bit246		/	/	
	R	Bit247		/	/	

## 六. BMS 系统常见故障排查 VI. Common Failures of BMS System

故障现象	可能原因	排除方法
BMS 系统根据提供的协议显示有通讯故障警告, 某些或所有机组的运行状态显示不出来也无法进行控制	某些通讯线不是用双绞通讯线	换成双绞通讯线
	通讯线的水晶头没压好, 或 AB 相反	根据本指南的说明重新压水晶头
	室外机与室内机通讯线断开	焊接好断开的线路
	通讯线有断线	焊接好断开的线路
	水晶头使用的不是中间 2 根	换用中间的两根
	通讯线短路	维修短路的部分
	双绞线与电源线太靠近 (小于 15CM), 干扰太大造成通讯故障	将两种线分开走线, 如果无法分开大于 15CM 可以考据加屏蔽钢管
有通讯接口接入错误	对照本指南的说明进行接入	
线路检查正常, 但所有机组或某些机组没有信息显示, 软件上仍然有通讯故障	室外机更换芯片或重新拨码后, 没有掉电后再上电	重新上电
	通讯软件使用的串口和计算机连接的串口号不符	换串口或更改软件上的串口设置
	软件上添加的机组地址和实际机组的地址不相符	修改软件机组地址设置
	机组没有上电	给机组上电
	外机或者内机忘记插装芯片, 或者是将芯片插装方向与实际方向相反	重新检查插装芯片, 按照 PCB 上缺口方向插, 并重新上电
	机组地址有错误或重复	修改有误的机组的地址设置
线路检查正常, 其他设备层正常, 唯独某个设备层整体没有信息显示	可能需要装中继器。如果已经安装了中继器, 中继器可能接线错误	正确安装中继器
所有机组没有信息显示, 软件上有通讯故障提示, 且转换器上 TX 灯长亮 (不是闪烁)	通讯线 A,B 方向接反或者是通讯线接错位置	检查线路, 使通讯线按照 A 线接 A 线, B 线接 B 线的原则连接
线路、设备、工程安装检查正常, 软件上仍然有通讯故障	使用了与实际机组不相符的显示器或控制器	检查当前机组的控制器、手操器型号, 如有不符要求客服更换

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	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

all or some units	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

## 附 录 A Annex A

(规范性附录) (Normative Annex)

冗余循环码(CRC)的计算方法 CRC Calculation Method

### A.1 冗余循环码(CRC)的计算方法 CRC Calculation

#### Method

CRC 码的计算方法是：先预置 16 位寄存器全为 1。再逐步把每 8 位数据信息进行处理。在计算 CRC 码时，8 位数据与寄存器的数据相异或，得到的结果向低位移一字节，用 0 填补最高位。再检查最低位，如果最低位

为 1，把寄存器的内容与预置数相异或，如果最低位为 0，不进行异或运算。这个过程一直重复 8 次。第 8 次移位后，下一个 8 位数据再与现在寄存器的内容相异或，这个过程与以上一样重复 8 次。当所有的数据信息处理完后，最后寄存器的内容即为 CRC 码值。CRC 码中的数据发送、接收时低字节在前。

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.

## A.2 计算 CRC 码的程序步骤

- 1) 预置 16 位寄存器为十六进制 FFFF（即全为 1）。称此寄存器为 CRC 寄存器。
  - 2) 把第一个 8 位数据与 16 位 CRC 寄存器的低位相异或，把结果放于 CRC 寄存器。
  - 3) 把寄存器的内容右移一位（朝低位方向），用 0 填补最高位，移位前先检查最低位。
  - 4) 如果最低位为 0 则重复第 3 步(再次移位)；  
如果最低位为 1 则 CRC 寄存器与多项式 A001(1010 0000 0000 0001)进行异或运算。
  - 5) 重复步骤 3 和 4，直到右移 8 次，这样整个 8 位数据全部进行了处理。
  - 6) 重复步骤 2 到步骤 5，进行下一个 8 位数据的处理。
  - 7) 最后得到的 CRC 寄存器即为 CRC 码。
- 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.

## A.3 CRC 实例程序（仅供参考） CRC Example (Only for Reference)

参数：Data（数据块起始地址）、DataSize（数据块 Byte 的个数）

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

返回：CRC 计算结果

**Return:** CRC Calculating Result

```
uint16 CRC_Calculate(uint8 *data, uint16 dataSize)
{
    uint8 i;
    uint8 temp;
    uint16 j;
    uint16 CRCCode;
    CRCCode=0xffff;
    for(j=0;j<dataSize;j++){
        CRCCode = CRCCode^data[j];
        for( i = 0; i < 8; i++){
            temp = CRCCode & 0x0001;
            CRCCode = (CRCCode >> 1);
            if(temp ==1){
                CRCCode = (CRCCode^0xA001);// 0xA001 为预置多项式,常量值 0xA001 is a preset multinomial, a constant value
            }
        }
    }
    return CRCCode;
}
```

## 参考文献 References

1. MODBUS 协议。MODBUS Protocal
2. 格力中央空调远程监控使用说明书。  
Operation Instructions of the Long-distance Monitoring System to Gree Central AC
3. 格力 2012 年 BMS 接口技术服务手册。Gree BMS Interface Service Manual 2012