

# **Modbus Protocol for export residential air conditioners**

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# Preface

This protocol specifies the communication format and data format for the Modbus communication of export residential air conditioners.

This protocol is applicable to Export Residential Air Conditioners.

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

1. Controllers or wired 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 and the wired controllers.

2. 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 Export Residential Air Conditioners.

3. Please contact ARGO 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 master 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 slave unit.

### 1.2 ASCII Mode

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

### 1.3 RTU Mode

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 transmitted continuously.

### 1.4 Master Unit

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

## 1.5 Slave Unit

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

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

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

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 Broadcast

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 Function Code

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

Table 1 Function Code

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

## 1.11 Starting Address

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

### 1.12 Data Size

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 Byte Count

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

### 1.14 Effective Data

It indicates the control data, status data, etc.

### 1.15 Alarm 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

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 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 Communication Frame

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

### 1.20 BMS

Building management system

## **II. Brief Introduction of the BMS System**

The Modbus monitoring system of export residential air conditioners is capable of controlling up to 255 sets of units at the same time.

The interface RS485 of Modbus communication protocol, provided by the long-distance monitoring system, can be directly connected with the BMS or ARGO 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.

## **III. Network Topology**

### 3.1 General

The network topology is as shown in Fig.1. The whole monitoring system consists of two communication networks: unit's internal network and Modbus network. The IDU or the wired controller is with MODBUS interface. It needs to set the address for each indoor unit or wired controller to make the communication data of these two networks interchangeable.

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

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 Topological Structure Consisting of Max. 255

#### Communication Modules

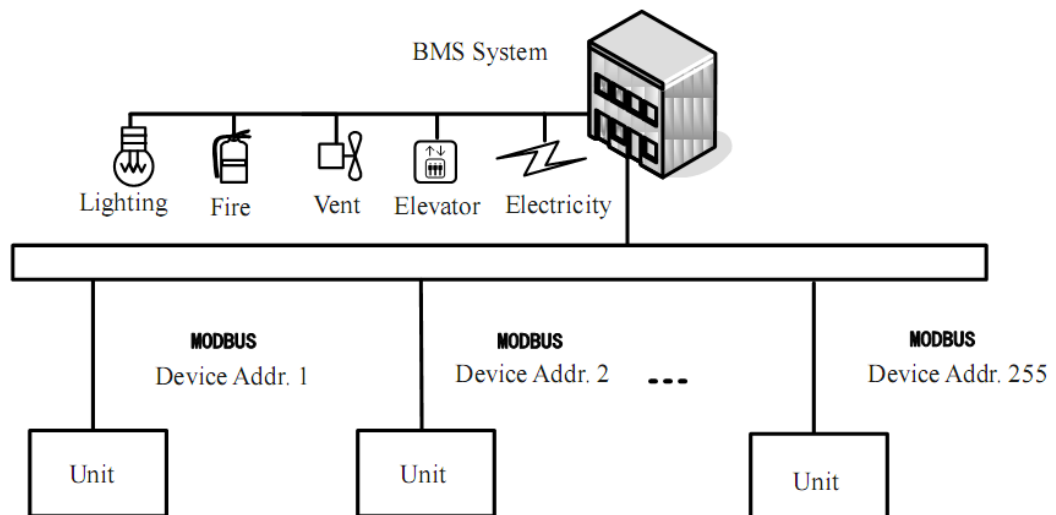


Fig.1 Topological Structure

#### 3.2.2 Topological Structure Consisting of Min. 255

#### Communication Modules

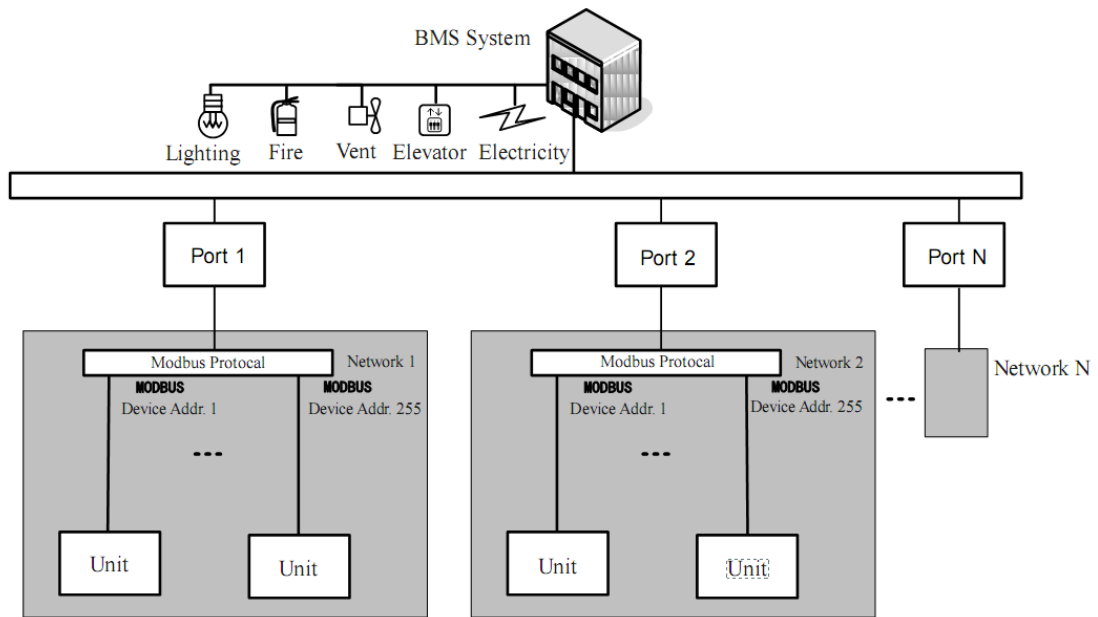


Fig.2 Topological Structure Consisting of Min. 255 Communication Modules

## IV. Modbus Protocol Format

### 4.1 General

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 Protocol Interface

The protocol interface is the Modbus RTU protocol.

### 4.3 Hardware Interface

(1)Communication Interface: RS485

(2)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.)

Start Bit: 1

Data Bit: 8

Check Bit: None

Stop Bit: 1

## 4.4 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

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.

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.

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 Protocol Format

### 4.5.1 Coil (Bit)

Table 2: Coil Data

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

1. “Coil” indicates the data of some flag bit or failure bit, etc.
2. The unit of data is bit and each bit has a corresponding address.
3. The data bit exists in the byte of the communication frame and each byte is composed of eight bits. The high-order byte is corresponding to the high-order bit

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

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

5. The bit count which the master unit can read or transmit is less than  $\text{Byte} \times 8$ . 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 Register (Word, 16 bit)

Table 3: Registers Data

Addr.	Corresponding Byte	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	
.....	.....	.....
	.....	

1. The unit of the register is “word” which has a corresponding address starting from 0.

2. When the master unit reads a word, it needs to read two bytes from the high-order eight bits to the low-order eight bits.

3. When the master unit transmits or reads the request frame, it can transmit or read one or multiple continuous words in the data list.

### 4.5.3 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	1 Byte	n Bytes	2 Bytes

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

Data Size: it indicates the 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:

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

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

The last byte is “0000 0010”, among which 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	n 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 device 10 and starting at the address 6, as follows:

Request Frame: 0A (device address) 0F (function code) 00 06 (starting address) 00 0B (data size) 02 (byte count) FF 07 (effective data) 97 A0 (CRC)

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

The last byte is “0000 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.

Function Code: 0x03

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	1 Byte	n Bytes	2 Bytes

Starting address: It indicates the starting address to read the data block.

Data size: It indicates the count number of words with the maximum of 127 each time.

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:

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

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

## 4.5.6 Write Registers (Write word)

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 words (0x12, 0x23, 0x34) from the device 10 and starting at the address 2, as follow:

Request Frame: 0A (device address) 10 (function code) 00 02 (starting address) 00 03 (data size) 06 (byte count) 00 12 00 23 00 34 (effective data) 15 DF (CRC)

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

### 4.5.7 Alarm Response

Note: The master unit sends out a request frame 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 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).

Communication format of the alarm response frame:

Table12: Alarm Response Frame

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

Description of the alarm codes:

Table 13: Alarm Codes

Alarm Code	Name	Description
0x03	Illegal data	The transmitted data is incorrect or beyond the data range.

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:

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

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

# **V. Communication protocol for export residential air conditioners**

## **5.1 General**

Export residential air conditioner's indoor unit and wire controller is with BMS interface. As it has Modbus protocol interface, there is no need to connect the external communication modules. However, it's necessary to set the address for each indoor unit or wired controller. The long-distance monitoring system for export residential air conditioners can be used to monitor ARGO export residential air conditioners remotely or be incorporated into user's BMS system. By monitoring the PC or BMS system, users can realize a centralized management and control on up to 255 sets of export residential air conditioners. 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 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.

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

## **5.2 Precautions before the development of the BMS interface for export residential air conditioners**

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

(2)Energy Saving Solution:

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.

(3)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.

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

(5)If the connected unit is not the one whose temperature is adjustable under auto mode, when unit is in auto mode, the setting of long-distance temperature shield will be invalid.

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

(7)If the connected unit is the one whose temperature is adjustable under auto mode, the temperature can be adjusted under the auto mode.

### **5.3 Definition of Effective Data**

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

Addr.	Access 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	/	/	/	/		Broadcast data
Word 1	R	Reserved	/	/	/	/		
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×10	0.1	℃	Signed, interger type		
Word 5	R	IDU Addr.	Transmission value=actual value, address range is 1-255	1	/	Unsigned, integer type		
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, actual value: 0: auto; 1: speed 1; 2: speed 2; 3: speed 3; 4: speed 4; 5: speed 5; 6: turbo.	/	/	Unsigned, integer type		

Addr.	Access 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 20	W/R	Set temp	Transmission value=actual value, actual value:16-30	1	°C	Unsigned, integer type	★(7)	Broadcast data
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; 1010--- 14 air swing; 1011--- 13 air swing.	/	/	Unsigned, integer type		
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, integer type		
Word 25	W/R	Sleep mode	Transmission value=actual value, actual value: 0: no sleep mode; 1: sleep mode 1; 2: sleep mode 2; 3: sleep mode 3	/	/	Unsigned, integer type	★(4)	
Word 26	W/R	Reserved	/	/	/	/		

Addr.	Access 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 27	W/R	Reserved	/	/	/	/		Broadcast data
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	Reserved	/	/	/	/		
Word 35	W/R	Temp lower limit for energy saving under cooling	Transmission value=actual value, actual value: 16~30	1	°C	Unsigned, integer type	★(2)	
Word 36	W/R	Temp upper limit for energy saving under heating	Transmission value=actual value, actual value: 16~30	1	°C	Unsigned, integer type	★(2)	
Word 37	R	Reserved	/	/	/	/		
Word 38	R	Reserved	/	/	/	/		
Word 39	R	Selection of ambient temp sensor	Transmission value=actual value, actual value: 001: air return temp sensor for indoor ambient temp. 010: wired controller temp sensor for indoor ambient temp. 011: air return temp sensor for cooling, drying and fan mode, wired controller temp sensor for heating and auto mode. 100: wired controller temp sensor for cooling, drying and fan mode, air return temp sensor for heating and auto mode.	/	/	Unsigned, integer type		
Word 40	R	Reserved	/	/	/	/		
Word 41	R	Reserved	/	/	/	/		
Word 42	R	Reserved	/	/	/	/		
Word 43	R	Reserved	/	/	/	/		

Addr.	Access 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 44	R	Reserved	/	/	/	/		Broadcast data
Word 45	R	Reserved	/	/	/	/		
Word 46	R	Reserved	/	/	/	/		
Word 47	R	Reserved	/	/	/	/		
Word 48	R	Reserved	/	/	/	/		ODU response data
Word 49	R	Outdoor ambient temp	Transmission value=actual value, actual value: -100--155	1	°C	Signed, 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	/	/	/	/		
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, integer type		

Addr.	Access 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 78	R	Reserved	/	/	/	/		ODU response data
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	Reserved	/	/	/	/		
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 X)

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
Byte0	R	Bit0	Reserved	/	/		
	R	Bit1	Reserved	/	/		
	R	Bit2	Reserved	/	/		
	R	Bit3	Reserved	/	/		
	R	Bit4	Reserved	/	/		
	R	Bit5	Reserved	/	/		
	R	Bit6	Reserved	/	/		
	R	Bit7	Reserved	/	/		
Byte1	R	Bit8	Reserved	/	/		Broadcast data
	R	Bit9	Reserved	/	/		
	R	Bit10	Reserved	/	/		
	R	Bit11	Reserved	/	/		
	R	Bit12	Reserved	/	/		
	R	Bit13	Reserved	/	/		
	R	Bit14	Reserved	/	/		
	R	Bit15	Reserved	/	/		
Byte2	R	Bit16	Reserved				
	W/R	Bit17	Remote lock	0 (no above lock or it is unlocked) ; 1 (current status is locked by long-distance monitoring or the household charging system);	Status parameter		
	W/R	Bit18	Remote temp shield	0: without shield ; 1: with shield	Status parameter	★ (5)	
	W/R	Bit19	Remote mode shield	0: without shield ; 1: with shield	Status parameter		
	W/R	Bit20	Remote On/Off shield	0: without shield ; 1: with shield	Status parameter		
	W/R	Bit21	Remote energy saving shield	0: without shield ; 1: with shield	Status parameter		
	R	Bit22	Reserved	/	/		
	R	Bit23	Reserved	/	/		
Byte3	W/R	Bit24	Absence mode (8℃ heating)	0: off; 1: on	Status parameter		
	W/R	Bit25	Healthy function	0: off; 1: on	Status parameter		
	W/R	Bit26	Comfortable and energy saving: I-Demand or Energy-saving	0: off; 1: on	Status parameter		
	W/R	Bit27	Turbo	0: off; 1: on	Status parameter		
	W/R	Bit28	E-heating permission mark	0: permit e-heating on 1: not permit e-heating on	Status parameter		
	W/R	Bit29	X-fan	0: off; 1: on	Status parameter		
	W/R	Bit30	Silent	0: off; 1: on	Status parameter		
	W/R	Bit31	Reserved	/	/		

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
Byte4	W/R	Bit32	Energy saving under cooling is active	0: off; 1: on	Status parameter	★(3)	Broadcast data
	W/R	Bit33	Energy saving under heating is active	0: off; 1: on	Status parameter	★(3)	
	W/R	Bit34	Buttons lock (childlock) status	0: off; 1: on	Status parameter		
	W/R	Bit35	On/Off memoring status	0: memorize, 1: not memorize	Status parameter		
	W/R	Bit36	°C/°F flag bit	0: °C; 1: °F	Status parameter		
	R	Bit37	1°F flag bit	0: no; 1: yes	Status parameter		
	R	Bit38	1°F flag bit of temp lower limit for energy saving under cooling	0: no; 1: yes	Status parameter		
	R	Bit39	1°F flag bit of temp upper limit for energy saving under heating	0: no; 1: yes	Status parameter		
Byte5	R	Bit40	Timer status	0: without timer; 1: with timer	Status parameter		
	R	Bit41	Reserved	/	/		
	R	Bit42	Reserved	/	/		
	R	Bit43	Reserved	/	/		
	R	Bit44	Reserved	/	/		
	R	Bit45	Reserved	/	/		
	R	Bit46	Gate control system is provided or not?	0: no; 1: yes	Status parameter		
	R	Bit47	Reserved	/	/		
Byte6	R	Bit48	Reserved	/	/		
	R	Bit49	Timer On flag	0: not active; 1: active	Status parameter		
	R	Bit50	Timer Off flag	0: not active; 1: active	Status parameter		
	R	Bit51	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	Bit52	Reserved	/	/		
	R	Bit53	Reserved	/	/		
	R	Bit54	Reserved	/	/		
	R	Bit55	Reserved	/	/		

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
Byte7	R	Bit56	Reserved	/	/		Broadcast data
	R	Bit57	Reserved	/	/		
	R	Bit58	Reserved	/	/		
	R	Bit59	Reserved	/	/		
	R	Bit60	Reserved	/	/		
	R	Bit61	Reserved	/	/		
	R	Bit62	Reserved	/	/		
	R	Bit63	Reserved	/	/		
Byte8	R	Bit64	Reserved	/	/		
	R	Bit65	Wired controller temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit66	Reserved	/	/		
	R	Bit67	Reserved	/	/		
	R	Bit68	Reserved	/	/		
	R	Bit69	Reserved	/	/		
	R	Bit70	Reserved	/	/		
	R	Bit71	Reserved	/	/		
Byte9	W/R	Bit72	Reserved	/	/		
	R	Bit73	Reserved	/	/		
	W/R	Bit74	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	Bit75	Adjustable temperature mark under auto mode	0: no; 1: yes	Status parameter	★(7)	
	R	Bit76	Reserved	/	/		
	R	Bit77	Reserved	/	/		
	R	Bit78	Reserved	/	/		
	R	Bit79	Reserved	/	/		
Byte10	R	Bit80	Reserved	/	/		
	R	Bit81	Reserved	/	/		
	R	Bit82	Reserved	/	/		
	R	Bit83	Reserved	/	/		
	R	Bit84	Reserved	/	/		
	R	Bit85	Reserved	/	/		
	R	Bit86	Reserved	/	/		
	R	Bit87	Reserved	/	/		
Byte11	R	Bit88	Reserved	/	/		IDU board identification
	R	Bit89	Reserved	/	/		
	R	Bit90	Reserved	/	/		
	R	Bit91	Reserved	/	/		
	R	Bit92	Reserved	/	/		
	R	Bit93	Reserved	/	/		
	R	Bit94	Reserved	/	/		
	R	Bit95	Reserved	/	/		

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
Byte12	R	Bit96	Reserved	/	/		IDU board identification
	R	Bit97	Indoor evaporator temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit98	Indoor air return temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit99	Reserved	/	/		
	R	Bit100	Reserved	/	/		
	R	Bit101	Water overflow protection	0: normal; 1: error	Failure parameter		
	R	Bit102	Reserved	/	/		
	R	Bit103	Reserved	/	/		
Byte13	R	Bit104	Jumper cap error	0: normal; 1: error	Failure parameter		
	R	Bit105	Indoor fan error	0: normal; 1: error	Failure parameter		
	R	Bit106	Reserved	/	/		
	R	Bit107	Reserved	/	/		
	R	Bit108	Reserved	/	/		
	R	Bit109	Reserved	/	/		
	R	Bit110	Reserved	/	/		
	R	Bit111	Reserved	/	/		
Byte14	R	Bit112	Card in/out status	0: card out; 1: card in	Status parameter		
	R	Bit113	Reserved	/	/		
	R	Bit114	Reserved	/	/		
	R	Bit115	Reserved	/	/		
	R	Bit116	Reserved	/	/		
	R	Bit117	Reserved	/	/		
	R	Bit118	Reserved	/	/		
	R	Bit119	Reserved	/	/		
Byte15	R	Bit120	Communication failure with master wired controller	0: normal; 1: error	Failure parameter		
	R	Bit121	Reserved	/	/		
	R	Bit122	Communication failure with ODU	0: normal; 1: error	Failure parameter		
	R	Bit123	Reserved	/	/		
	R	Bit124	Reserved	/	/		
	R	Bit125	Reserved	/	/		
	R	Bit126	Reserved	/	/		
	R	Bit127	Reserved	/	/		

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
Byte16	R	Bit128	Reserved	/	/		IDU board identification
	R	Bit129	Reserved	/	/		
	R	Bit130	Reserved	/	/		
	R	Bit131	Reserved	/	/		
	R	Bit132	Reserved	/	/		
	R	Bit133	Reserved	/	/		
	R	Bit134	Reserved	/	/		
	R	Bit135	Reserved	/	/		
Byte17	R	Bit136	Reserved	/	/		
	R	Bit137	Reserved	/	/		
	R	Bit138	Reserved	/	/		
	R	Bit139	Reserved	/	/		
	R	Bit140	Reserved	/	/		
	R	Bit141	Reserved	/	/		
	R	Bit142	Reserved	/	/		
Byte18	R	Bit143	Reserved	/	/		ODU response information
	R	Bit144	Reserved	/	/		
	R	Bit145	Reserved	/	/		
	R	Bit146	Reserved	/	/		
	R	Bit147	Outdoor fan status	0: off; 1: on	Status parameter		
	R	Bit148	Reserved	/	/		
	R	Bit149	Reserved	/	/		
	R	Bit150	4-way valve status	0: off; 1: on	Status parameter		
R	Bit151	Compressor status	0: off; 1: on	Status parameter			
Byte19	R	Bit152	Compressor discharge temperature protection	0: normal; 1: error	Failure parameter		
	R	Bit153	Fluorine shortage protection	0: normal; 1: error	Failure parameter		
	R	Bit154	DC fan motor protection	0: normal; 1: error	Failure parameter		
	R	Bit155	4-way valve reverse error protection	0: normal; 1: error	Failure parameter		
	R	Bit156	Over power protection	0: normal; 1: error	Failure parameter		
	R	Bit157	Over load protection	0: normal; 1: error	Failure parameter		
	R	Bit158	Low pressure protection	0: normal; 1: error	Failure parameter		
	R	Bit159	High pressure protection	0: normal; 1: error	Failure parameter		

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
Byte20	R	Bit160	Evaporator anti-freezing protection	0: normal; 1: error	Failure parameter		ODU response information
	R	Bit161	Outdoor ambient temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit162	Discharge temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit163	Condenser temp sensor error	0: normal; 1: error	Failure parameter		
	R	Bit164	Reserved	/	/		
	R	Bit165	Jumper cap error	0: normal; 1: error	Failure parameter		
	R	Bit166	ODU memory chip error	0: normal; 1: error	Failure parameter		
	R	Bit167	Reserved	/	/		
Byte21	R	Bit168	Reserved	/	/		
	R	Bit169	Reserved	/	/		
	R	Bit170	Reserved	/	/		
	R	Bit171	Reserved	/	/		
	R	Bit172	Reserved	/	/		
	R	Bit173	Indoor and outdoor units unmatched	0: normal; 1: error	Failure parameter		
	R	Bit174	Drive communication failure	0: normal; 1: error	Failure parameter		
R	Bit175	Reserved	/	/			
Byte22	R	Bit176	Reserved	/	/		
	R	Bit177	Cooling only heat pump flag bit	0: cool and heat 1: cool only	Status parameter	★(1)	
	R	Bit178	Reserved	/	/		
	R	Bit179	System defrosting	0: no; 1: yes	Status parameter		
	R	Bit180	Reserved	/	/		
	R	Bit181	Reserved	/	/		
	R	Bit182	Reserved	/	/		
	R	Bit183	Reserved	/	/		
Byte23	R	Bit184	Inverter compressor drive DC busbar voltage overlow protection or voltage drop off error	0: normal; 1: error	Failure parameter		
	R	Bit185	Inverter compressor drive DC busbar voltage overhigh protection	0: normal; 1: error	Failure parameter		
	R	Bit186	Inverter compressor drive alternate current protection (input side)	0: normal; 1: error	Failure parameter		
	R	Bit187	Inverter compressor drive IPM protection	0: normal; 1: error	Failure parameter		
	R	Bit188	Inverter compressor drive PFC protection	0: normal; 1: error	Failure parameter		
	R	Bit189	Inverter compressor startup failure	0: normal; 1: error	Failure parameter		
	R	Bit190	Inverter compressor phase loss protection	0: normal; 1: error	Failure parameter		
	R	Bit191	Inverter compressor drive module reset	0: normal; 1: error	Failure parameter		

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
Byte24	R	Bit192	Inverter compressor over-current protection	0: normal; 1: error	Failure parameter		ODU response information
	R	Bit193	Inverter compressor power protection	0: normal; 1: error	Failure parameter		
	R	Bit194	Inverter compressor drive current check circuit failure	0: normal; 1: error	Failure parameter		
	R	Bit195	Inverter compressor out-of-step protection	0: normal; 1: error	Failure parameter		
	R	Bit196	Compressor stalling	0: normal; 1: error	Failure parameter		
	R	Bit197	Reserved	/	/		
	R	Bit198	Inverter compressor drive module high temperature protection	0: normal; 1: error	Failure parameter		
	R	Bit199	Inverter compressor drive module temperature sensor failure	0: normal; 1: error	Failure parameter		
Byte25	R	Bit200	Reserved	/	/		
	R	Bit201	Reserved	/	/		
	R	Bit202	Reserved	/	/		
	R	Bit203	Reserved	/	/		
	R	Bit204	Reserved	/	/		
	R	Bit205	Reserved	/	/		
	R	Bit206	Reserved	/	/		
	R	Bit207	Reserved	/	/		
Byte26	R	Bit208	Reserved	/	/		
	R	Bit209	Reserved	/	/		
	R	Bit210	Inverter compressor drive charged circuit failure	0: normal; 1: error	Failure parameter		
	R	Bit211	Inverter compressor drive AC input voltage abnormal protection	0: normal; 1: error	Failure parameter		
	R	Bit212	Reserved	/	/		
	R	Bit213	Reserved	/	/		
	R	Bit214	Temperature drift protection	0: normal; 1: error	Failure parameter		
Byte27	R	Bit215	Sensor connection protection (electric current sensor is not connected to the corresponding U phase or V phase)	0: normal; 1: error	Failure parameter		
	R	Bit216	Exit tube temperature sensor error of indoor unit (gas valve)	0: normal; 1: error	Failure parameter		
	R	Bit217	Inlet tube temperature sensor error of indoor unit (liquid valve)	0: normal; 1: error	Failure parameter		
	R	Bit218	Ambient temperature sensor error of drive board	0: normal; 1: error	Failure parameter		
	R	Bit219	Outdoor condenser's inlet tube temperature sensor is open/short-circuited	0: normal; 1: error	Failure parameter		
	R	Bit220	Outdoor condenser's exit tube temperature sensor is open/short-circuited	0: normal; 1: error	Failure parameter		
	R	Bit221	Wrong connection wire connection or expansion valve error	0: normal; 1: error	Failure parameter		
	R	Bit222	Mode conflict protection	0: normal; 1: error	Failure parameter		
R	Bit223	Compressor demagnetization protection	0: normal; 1: error	Failure parameter			

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
Byte28	R	Bit224	Whole unit current detecting error	0: normal; 1: error	Failure parameter		ODU response information
	R	Bit225	AC contactor protection	0: normal; 1: error	Failure parameter		
	R	Bit226	Overspeed	0: normal; 1: error	Failure parameter		
	R	Bit227	Outdoor fan 2 error	0: normal; 1: error	Failure parameter		
	R	Bit228	PG motor zero crossing protection	0: normal; 1: error	Failure parameter		
	R	Bit229	Compressor suction temperature sensor error	0: normal; 1: error	Failure parameter		
	R	Bit230	Indoor fan tripping error	0: normal; 1: error	Failure parameter		
Byte29	R	Bit231	Communication error between IDU and grid	0: normal; 1: error	Failure parameter		
	R	Bit232	Communication error between ODU and grid	0: normal; 1: error	Failure parameter		
	R	Bit233	Main error at grid side	0: normal; 1: error	Failure parameter		
	R	Bit234	IDU network address error	0: normal; 1: error	Failure parameter		
	R	Bit235	IP address allocation overflow	0: normal; 1: error	Failure parameter		
	R	Bit236	Other error and protection	0: normal; 1: error	Failure parameter		
	R	Bit237		/	/		
R	Bit238		/	/			
R	Bit239		/	/			

## 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 connecting indoor unit's controller or wired controller, the unit is not cut off from the power and then 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
	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 wired controller or controller is used	Check the model of the wireless remote controller and the wired controller, If not, make a replacement

# Annex A

(Normative Annex)

CRC Calculation Method

## A.1 CRC Calculation Method

Calculation Method of CRC: The CRC is first preloading a 16-bit register to all 1's. Then successively transact each 8-bit bytes of the message. During 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 Procedure step for calculating CRC code

- 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 Example (Only for Reference)

**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 is a preset multinomial, a constant value
            }
        }
    }
    return CRCode;
}
```

## References

- 1.MODBUS Protocol
- 2.User's Technical Conditions of BMS Communication Protocol for All DC Inverter