

ModBus Protocol

LPG series

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Preface

This protocol specifies the communication format and data format for the Modbus communication of LPG series.

This protocol is applicable to LPG series.

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

1. 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. Make sure you have read the precautions before developing the BMS interface of each unit, g. section 5.1.2 —Precautions before the Development of the BMS Interface for LPG series”.
3. Please contact Aermec to confirm the compatibility of the BMS system.

Notice:



This product is subject to change without prior notice.

I. Terms and Definitions

1.1 Modbus communication

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

1.2 ASCII Mode

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

1.3 RTU Mode

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

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.

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. 255 Topological Structure

Consisting of Max. 255 Communication Modules

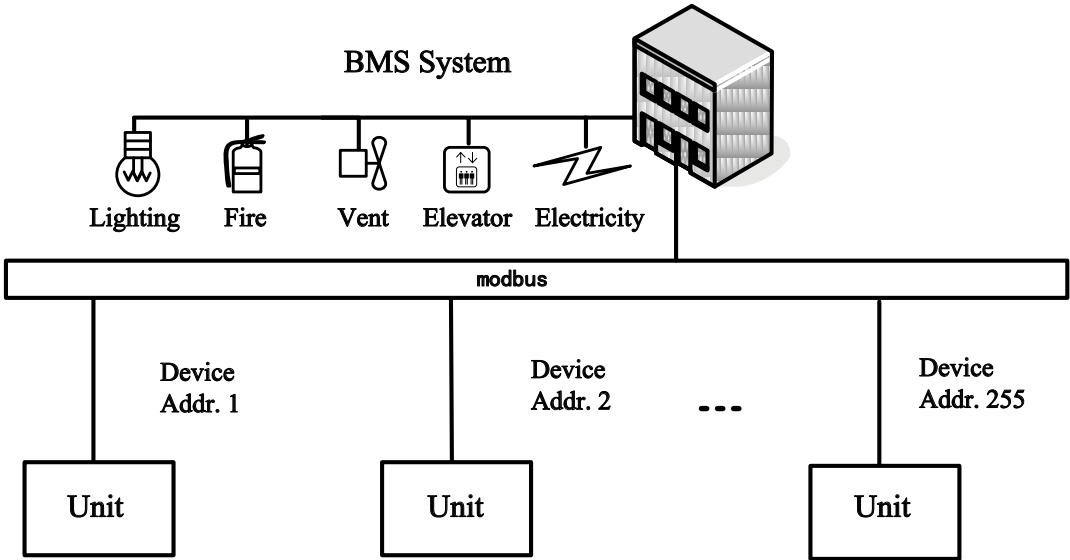


Fig.1 Topological Structure

3.2.2. 255 Topological Structure

Consisting of Min. 255 Communication Modules

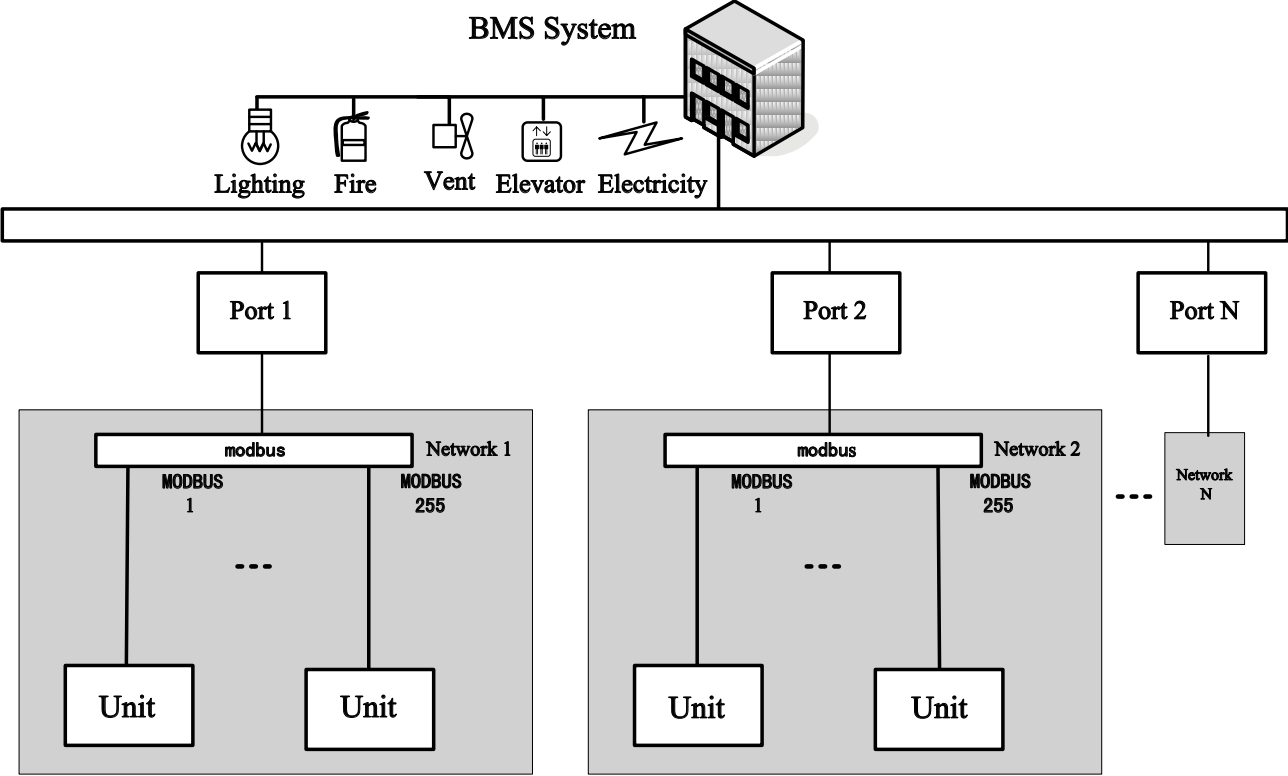


Fig.2 Topological Structure Consisting of Min. 255 Communication Modules

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
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	
.....		
		

4. The unit of the register is “word” which has a corresponding address starting from 0.
5. When the master unit reads a word, it needs to read two bytes from the high-order eight bits to the low-order eight bits.
6. 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 the 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

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

	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.
0x04	Salve device failure	There is communication failure between the communication module and the air conditioning unit.

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 LPG series

5.1. General

All DC Inverter 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 LPG series can be used to monitor Aermec's LPG series 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 LPG series. 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 LPG series

★(1): Cooling Only Unit: Heating instruction is

invalid. It is recommended that the monitoring software can tell this operation is invalid.

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

★(3): Energy Saving Solution:

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

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

-
- ★(4): When the BMS system needs to cancel or set one of the two flag bits of energy saving, When the BMS system needs to cancel or set one of the two flag bits of energy saving, the two flag bits need to be cancelled or set simultaneously.
 - ★(5): When unit is in fan mode or auto mode, sleep setting will be invalid.
 - ★(6): When unit is in auto mode, the setting of long-distance temperature shield will be invalid.
 - ★(7): Under power-off status, when X-fan function is energized, fan motor will run for 2min.
 - ★(8): All data sent by the BMS system to the communication module should be verified if it is effective.
 - ★(9): After the communication module is powered on again and before receiving any effective data, the alarm code 04 will be reported.

5.3. 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 developmen t (to the data marked with ★)	Remarks
Word 0	R	Reserved	/	/	/	/		
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	°C	Signed, integer type		Broadcast data
Word 5	R	IDU Addr.	Transmission value=actual value, actual value: If connected with central controller, address range is 1-16; if connected with PC address mode, 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 (1): cooling 010 (2): heating 011 (3): drying 100 (4): fan only 101 (5): auto mode	/	/	Unsigned, integer type	★ (1)
Word 18	R	Reserved	/	/	/		
Word 19	W/R	Set fan speed	Transmission value=actual value,	/	/	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	Set temp	Transmission value=actual value, actual value:16-30, under low-temp drying, it is 12℃, under absence mode, it is 8℃.	1	℃	Unsigned, integer type	
Word 21	R	Reserved	/	/	/		
Word 22	W/R	Up & down swing	Transmission value=actual value, actual value: 0000---off, 0001---15 air swing, 0010--- 1 position, 0011--- 2 position, 0100--- 3 position, 0101---4 position, 0110---5 position, 0111---35 air swing, 1000---25 air swing, 1001---24 air swing, 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,	/	/	Unsigned, integer type	★ (5)

			actual value:0: no sleep mode; 1: sleep mode 1; 2: sleep mode 2; 3: sleep mode 3				
Word 26	W/R	Reserved	/	/	/	/	
Word 27	W/R	Reserved	/	/	/	/	
Word 28	W/R	Reserved	/	/	/	/	
Word 29	W/R	Reserved	/	/	/	/	
Word 30	W/R	Reserved	/	/	/	/	
Word 31	W/R	Reserved	/	/	/	/	
Word 32	W/R	Reserved	/	/	/	/	
Word 33	W/R	Reserved	/	/	/	/	
Word 34	W/R	Clean function	Transmission value=actual value, actual value: 00: no clean function; 10-39: contamination grade	/	/	Unsigned, integer type	
Word 35	W/R	Temp lower limit for energy saving under cooling	Transmission value=actual value, actual value: 16~30	1	℃	Unsigned, integer type	★(3)
Word 36	W/R	Temp upper limit for energy	Transmission value=actual value, actual value: 16~30	1	℃	Unsigned, integer type	★(3)

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

Word 46	R	Reserved	/	/	/	/		
Word 47	R	Reserved	/	/	/	/		
Word 48	R	Reserved	/	/	/	/		
Word 49	R	Outdoor ambient temp	Transmission value=actual value, actual value: -100--155	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	/	/	/	/		

ODU
response
data

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	1:DRED1 mode; 2:DRED2 mode; 3:DRED3 mode. 0: no DRED function;	/	/	Unsigned, integer type		
Word 78	R	Reserved	/	/	/	/		
Word 79	R	Reserved	/	/	/	/		
Word 80	R	Reserved	/	/	/	/		
Word 81	R	Reserved	/	/	/	/		
Word 82	R	Ambient temp at the port of air return	Transmission value=actual value, actual value:	0.1	°C	Signed, interger type		IDU identification data

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

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

Addr.	Access Type (R-read only, W/R-write/read)	Addr. Bit	Data Meaning	Range	Parameter Type	Pay special attention before development (to the data marked with ★)	Remarks
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	Whether or not ODU has flag bit?	0: no, 1: yes	Status parameter		Broadcast data
	R	Bit9	Whether or not the master wired controller has flag bit?	0: no, 1: yes	Status parameter		
	R	Bit10	Reserved	0: no, 1: yes	Status parameter		
	R	Bit11	Reserved	0: no, 1: yes	Status parameter		
	R	Bit12	Reserved	0: no, 1: yes	Status parameter		
	R	Bit13	Whether or not the slave wired controller has flag bit?	0: no, 1: yes	Status parameter		
	R	Bit14	Reserved	/	/		
	R	Bit15	Reserved	/	/		
	R	Bit16	Reserved				
Byte2	W/R	Bit17	Remote lock	1 (current status is locked by long-distance monitoring or the household charging system), 0 (no above lock or it is unlocked)	Status parameter		
	W/R	Bit18				★ (6)	

			Remote temp shield	1: with shield, 0: without shield	Status parameter	
	W/R	Bit19	Remote mode shield	1: with shield, 0: without shield	Status parameter	
	W/R	Bit20	Remote On/Off shield	1: with shield, 0: without shield	Status parameter	
	W/R	Bit21	Remote energy saving shield	1: with shield, 0: without shield	Status parameter	
	R	Bit22	Reserved	/	/	
	R	Bit23	Reserved	/	/	
Byte3	W/R	Bit24	Absence mode	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	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	★ (7)
	W/R	Bit30	Silent	0: off; 1: on	Status parameter	
	W/R	Bit31	Low temp drying mode	0: off; 1: on	Status parameter	
Byte4	W/R	Bit32	Energy saving under	0: off; 1: on	Status parameter	★(4)

			cooling is active			
	W/R	Bit33	Energy saving under heating is active	0: off; 1: on	Status parameter	★(4)
	W/R	Bit34	Buttons lock (childlock) status	1: on; 0: off	Status parameter	
	W/R	Bit35	On/Off memoring status	0: memorize, 1: not memorize	Status parameter	
	W/R	Bit36	°C/°F flag bit	1: °F; 0: °C	Status parameter	
	R	Bit37	Reserved	/	/	
	R	Bit38	Reserved	/	/	
	R	Bit39	Reserved	/	/	
Byte5	R	Bit40	Timer status	1: with timer; 0: without 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?	1: yes; 0: no	Status parameter	
	R	Bit47	Human body sensing check module is provided or not?	1: yes; 0: no	Status parameter	

Byte6	R	Bit48	Reserved	/	/	
	R	Bit49	Timer On flag	1: active; 0: not active	Status parameter	
	R	Bit50	Timer Off flag	1: active; 0: not 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	Low standby power consumption control function (1W standby)	1: mode 2; 0: mode 1	Status parameter	
Byte7	R	Bit56	Reserved	/	/	
	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	1: yes; 0: no	Failure parameter	
	R	Bit66	Reserved	/	/	

	R	Bit67	Reserved	/	/	
	R	Bit68	Reserved	/	/	
	R	Bit69	Reserved	/	/	
	R	Bit70	Wired controller memory chip error	1: yes; 0: no	Failure parameter	
	R	Bit71	Reserved	/	/	
Byte9	W/R	Bit72	Cancel timer	0: do not cancel, 1: cancel	Status parameter	
	R	Bit73	预留 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	Reserved	/	/	
	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	/	/	
	R	Bit89	Reserved	/	/	
	R	Bit90	Reserved	/	/	
	R	Bit91	Electric heating	1: yes 0: no	Status parameter	
	R	Bit92	Water pump	1: on; 0: off	Status parameter	
	R	Bit93	Fresh air valve switch	1: turn on; 0: turn off	Status parameter	

IDU board
identification

	R	Bit94	Cold plasma generator	1: turn on; 0: turn off	Status parameter	
	R	Bit95	Error output status	1: yes 0: no	Status parameter	
Byte12	R	Bit96	Reserved	/	/	
	R	Bit97	Indoor evaporator temp sensor error	1: yes 0: no	Failure parameter	
	R	Bit98	Indoor air return temp sensor error	1: yes 0: no	Failure parameter	
	R	Bit99	Light board ambient temp sensor error	1: yes 0: no	Failure parameter	
	R	Bit100	Reserved	1: yes 0: no	Failure parameter	
	R	Bit101	Water overflow protection	1: yes 0: no	Failure parameter	
	R	Bit102	Flag bit of IDU memory ship error	1: yes 0: no	Failure parameter	
	R	Bit103	Reserved	/	/	
Byte13	R	Bit104	Jumper cap error	1 error, 0 normal	Failure parameter	
	R	Bit105	Indoor fan error	1: yes 0: no	Failure parameter	
	R	Bit106	Reserved	/	/	
	R	Bit107	Reserved	/	/	

	R	Bit108	Unit needs cleaning	1: yes 0: no	Status parameter	
	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	Is there people in the room?	0: no, 1: yes	Status parameter	
	R	Bit114	Static pressure type	0: low static pressure; 1: high static pressure	Status parameters	
	R	Bit115	Reserved	/	/	
	R	Bit116	Reserved	/	/	
	R	Bit117	Reserved	/	/	
	R	Bit118	Reserved	/	/	
	R	Bit119	Reserved	/	/	
Byte15	R	Bit120	Communication failure with master wired controller	1: yes 0: no	Failure parameter	
	R	Bit121	Communication failure with slave wired controller	1: yes 0: no	Failure parameter	
	R	Bit122	Communication failure with ODU	1: yes 0: no	Failure parameter	
	R	Bit123	Reserved	/	/	
	R	Bit124	Reserved	/	/	
	R	Bit125		/	/	
	R	Bit126	Reserved	/	/	
	R	Bit127	Reserved	/	/	
	R	Bit128	Reserved	/	/	
Byte16	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	/	/	
	R	Bit143	Reserved	/	/	
Byte18	R	Bit144	Reserved	/	/	
	R	Bit145	Reserved	/	/	
	R	Bit146	Reserved	/	/	
	R	Bit147	Outdoor fan status	1: on 0: off	Status parameter	
	R	Bit148	Reserved	/	/	
	R	Bit149	Reserved	/	/	
	R	Bit150	4-way valve status	1: on 0: off	Status parameter	
	R	Bit151	Compressor status	1: on 0: off	Status parameter	
Byte19	R	Bit152	Compressor discharge temperature protection	1: yes 0: no	Failure parameter	
	R	Bit153	Fluorine shortage protection	1: yes 0: on	Failure parameter	
	R	Bit154	DC fan motor protection	1: yes 0: on	Failure parameter	
	R	Bit155		1: yes 0: on	Failure	

ODU
response
information

			4-way valve reverse error protection		parameter	
	R	Bit156	Over power protection	1: yes 0: on	Failure parameter	
	R	Bit157	Over load protection	1: yes 0: on	Failure parameter	
	R	Bit158	Low pressure protection	1: yes 0: on	Failure parameter	
	R	Bit159	High pressure protection	1: yes 0: on	Failure parameter Failure parameter	
Byte20	R	Bit160	Evaporator anti-freezing protection	1: yes 0: on	Failure parameter	
	R	Bit161	Outdoor ambient temp sensor error	1: yes 0: on	Failure parameter	
	R	Bit162	Discharge temp sensor error	1: yes 0: on	Failure parameter	
	R	Bit163	Condenser temp sensor error	1: yes 0: on	Failure parameter	
	R	Bit164	Error of copper pipe temp sensor for the outdoor heat exchanger	1: yes 0: on	Failure parameter	

	R	Bit165	Jumper cap error	1: yes 0: on	Failure parameter	
	R	Bit166	ODU memory chip error	1: yes 0: on	Failure parameter	
	R	Bit167	Reserved	/	/	
Byte21	R	Bit168	Reserved	/	/	
	R	Bit169	Reserved	/	/	
	R	Bit170	Reserved	/	/	
	R	Bit171	Reserved	/	/	
	R	Bit172	Reserved	/	/	
	R	Bit173	Reserved	/	/	
	R	Bit174	Drive communication failure	1: yes 0: on	/	
	R	Bit175	Reserved	/	/	
	R	Bit176	SAVE status	1: yes 0: on	Status parameter	
Byte22	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	1: yes 0: on	Status parameter	
	R	Bit180	Reserved	/	/	
	R	Bit181	Reserved	/	/	
	R	Bit182	Low power consumption status	1: ready 0: not	Status parameter	
	R	Bit183	AC input phase sequence protection	1: yes 0: no	Failure parameter	

			(phase loss or reverse)			
Byte23	R	Bit184	Inverter compressor drive DC busbar voltage overflow protection or voltage drop off error	1 failure, 0 normal	Failure parameter	
	R	Bit185	Inverter compressor drive DC busbar voltage overhigh protection	1 failure, 0 normal	Failure parameter	
	R	Bit186	Inverter compressor drive alternate current protection (input side)	1 failure, 0 normal	Failure parameter	
	R	Bit187	Inverter compressor drive IPM protection	1 failure, 0 normal	Failure parameter	
	R	Bit188	Inverter compressor drive PFC protection	1 failure, 0 normal	Failure parameter	

	R	Bit189	Inverter compressor startup failure	1 failure, 0 normal	Failure parameter	
	R	Bit190	Inverter compressor phase loss protection	1 failure, 0 normal	Failure parameter	
	R	Bit191	Inverter compressor drive module reset	1 failure, 0 normal	Failure parameter	
Byte24	R	Bit192	Inverter compressor over-current protection	1 failure, 0 normal	Failure parameter	
	R	Bit193	Inverter compressor power protection	1 failure, 0 normal	Failure parameter	
	R	Bit194	Inverter compressor drive current check circuit failure	1 failure, 0 normal	Failure parameter	
	R	Bit195	Inverter compressor out-of-step protection	1 failure, 0 normal	Failure parameter	
	R	Bit196				

			Compressor stalling	1 failure, 0 normal	Failure parameter	
	R	Bit197	Reserved	/	/	
	R	Bit198	Inverter compressor drive module high temperature protection	1 failure, 0 normal	Failure parameter	
	R	Bit199	Inverter compressor drive module temperature sensor failure	1 failure, 0 normal	Failure parameter	
Byte25	R	Bit200	Reserved	/	/	
	R	Bit201	Inverter compressor low intensity field	1 , 0	Status parameter	
	R	Bit202	Inverter compressor drive frequency limit	1 , 0	Status parameter	
	R	Bit203	Inverter compressor drive frequency demultiply	1 , 0	Status parameter	
	R	Bit204	Inverter compressor drive AC input low voltage	1 , 0	Status parameter	

			frequency limit			
	R	Bit205	Inverter compressor drive under charge	1 under charge, 0 charged	Status parameter	
	R	Bit206	Reserved	/	/	
	R	Bit207	Power type of inverter compressor drive AC input	1, 0	Status parameter	
Byte26	R	Bit208	Inverter compressor drive storage chip failure	1 failure, 0 normal	Failure parameter	★ (1)
	R	Bit209	Reserved	/	/	
	R	Bit210	Inverter compressor drive charged circuit failure	1 failure, 0 normal	Failure parameter	
	R	Bit211	Inverter compressor drive AC input voltage abnormal protection	1 failure, 0 normal	Failure parameter	
	R	Bit212	Temperature sensor failure of inverter compressor	1 failure, 0 normal	Failure parameter	

			drive electric box			
	R	Bit213	Inverter compressor drive AC input zero cross protection	1 failure, 0 normal	Failure parameter	
	R	Bit214	Temperature drift protection	1 failure, 0 normal	Failure parameter	
	R	Bit215	Sensor connection protection (electric current sensor is not connected to the corresponding U phase or V phase)	1 failure, 0 normal	Failure parameter	
Byte27	R	Bit216		/	/	
	R	Bit217		/	/	
	R	Bit218		/	/	
	R	Bit219		/	/	
	R	Bit220		/	/	
	R	Bit221		/	/	
	R	Bit222		/	/	
	R	Bit223		/	/	
Byte28	R	Bit224		/	/	
	R	Bit225		/	/	
	R	Bit226		/	/	
	R	Bit227		/	/	
	R	Bit228		/	/	
	R	Bit229		/	/	
	R	Bit230		/	/	
	R	Bit231		/	/	
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		/	/	

VI. Common Failures of BMS System

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

Annex 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 How to calculate the CRC

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

A.3 CRC Example (Only for Reference)

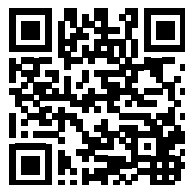
Parameters: Data (Starting address of the block data), Data Size (Byte count of the block data)

Return: CRC Calculating Result

```
uint16 CRC_Calculate(uint8 *data, uint16 dataSize)
{

    uint8 i;
    uint8 temp;
    uint16 j;
    uint16 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 0xA001 is a preset multinomial, a constant value
            }
        }
    }
    return CRCCode;
}
```


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