MODBUS-ASCII Communication Protocol

RS232 and RS485 Interface

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CONTENT

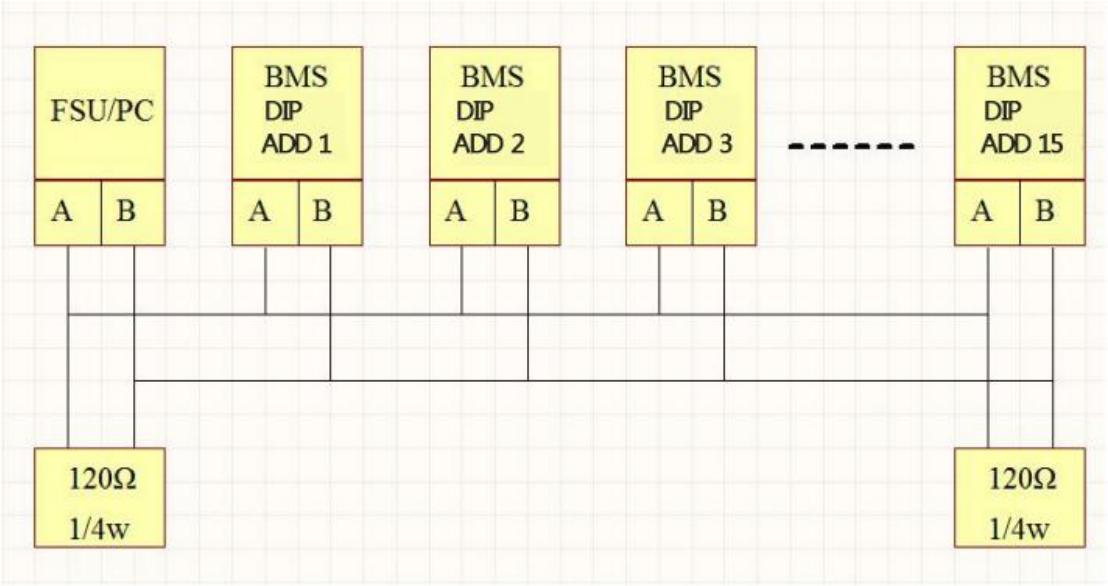
1. Communication

EMU10XX series BMS, applying MODBUS ASCII mode as communication protocol, and creating information frame in accordance with YD/T1363.3 standards, communicate and monitor the battery pack FSU, PC or other controllers via RS232 or RS485.

1.1 Interface

With 1 start bit, eight data bits, 1 stop bit and no parity bit, EMU10XX series BMS applies asynchronous serial communication interface.

1.2 Diagram



1.3 Data transmission

The communication between monitoring unit (SU) and monitoring module is point-to-multipoint master-slave communication. SU send control message to SM through broadcast addresses. And SM send feedback information to SU. If SU didn’ t receive any feedback information SM, the communication between them is failure.

2. Data structure

To enables precision data transmission between SU and SM, the data will be organized and managed in a certain format. Table 1 shows the data structure. Data is composed of bytes, one or several bytes form a unit, with a name and a definite meaning. Table 2 is a note of Table 1, Table 3 shows the details of CID1 in Table 2, Table 4 and Table 5 show the details of CID2 in Table 2.

Table 1 List of data structure

Item	SOI	VER	ADR	CID1	CID2	LENGTH	INFO	CHKSUM	EOI
ASCII	1	2	2	2	2	4	LENID	4	1

Table 2 Data structure reference

Item	Reference	Remark
Start bits	Start bits SOI: The beginning of a frame	SOI =7EH(~)

Version code high bit	Version code VER: Communication protocol version, two ASCII codes	protocol version V2.0=32H 30H
Version code low bit		
Address code high bit	Address code ADR: address code recognizing, two ASCII codes	00-15 available, Address 1=30H 31H
Address code low bit		
Device code high bit	Device code CID1: Device recognizing: two ASCII codes	Battery recognizing code =34H 36H
Device code low bit		
Function code high bit	Function code CID2: The CMD code that SU send to SM, or the RTN code that SM send to SU, 2 ASCII codes	CMD refers to Table 4 RTN refers to Table 5
Function code low bit		
Length code MSB	Length code: LENGTH The byte length of of INFO, including LENID and LCHKSUM, 4 ASCII codes	Refer to 3.2
Length code 3		
Length code 2		
Length code LSB		

Data code Data*LENID	Data code INFO: Includes, the command information (COMMAND INFO) that SU send to SM, the feedback information (RTNDATA INFO) that SU send back to SU Consist of LENID and ASCII codes	
Parity code MSB	Parity code CHKSUM: Consist of 4 ASCII codes	
Parity code 3		
Parity code 2		
Parity code LSB		
Stop bits	Stop bits EOI: the stop of a frame	Refer to 3.3

Table 3

Item	CID1: device code	
1	46H	LiFePO4 Battery BMS
...	...	...

Table 4 CID2 command code

Item	CID2: command code	Reference
1	42H	Obtain telemetry information
2	44H	Obtain remote information
3	45H	Remote command
4	47H	Obtain telemetry information
5	49H	Set remote adjustment information
6	4FH	To get communication protocol version
7	51H	To obtain device details
8	4BH	To obtain historical data
9	4DH	To obtain time
10	4EH	synchronization time
11	A0H	Production calibration
12	A1H	Production settings
13	A2H	Timed recording

Table 5 CID2 FEEDBACK CODE

Item	CID2: feedback code	Reference
1	00H	Normal
2	01H	VER Abnormal
3	02H	CHKSUM Abnormal
4	03H	LCHKSUM Abnormal

5	04H	Invalid CID2 code
6	05H	Invalid command
7	06H	Invalid data
8	07H	No data (Historical record)
9	E1H	Invalid CID1 code
10	E2H	Command execution failed
11	E3H	Equipment failure
12	E4H	Invalid permission

3. Data formats

3.1 Data transmission

Except that SOI and EOI are interpreted in hexadecimal as hexadecimal transmission, the rest of the items are interpreted in hexadecimal and transmitted in hexadecimal-ASCII code, each byte is represented by two ASCII codes, such as when When CID2 = 4BH, two bytes of 34H (ASCII code of '4') and 42H (ASCII code of'B') are transmitted during transmission.

3.2 LENGTH

LCHKSUM				LENID											
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

3.2.1

LENID represents the number of ASCII code bytes of INFO item. When LENID=0, INFO is empty, that is, there is no item. LENID is only 12Bit, so the maximum packet size cannot exceed 4095 bytes.

3.2.2 The calculation of LCHKSUM

After sum up D11D10D9D8+D7D6D5D4+D3D2D1D0, the modulo 16 remainder is inverted and added by 1.

For example, the number of ASCII code bytes in INFO is 18, that is, LENID=0000 0001 0010B.

D11D10D9D8+D7D6D5D4+D3D2D1D0=0000B+0001B+0010B=0011B, modulo 16 remainder is 0011B, 0011B is inverted and 1 is added as 1101B, then LCHKSUM is 1101B.

3.2.3 The LENGTH (listed in example 3.2.2 above) is 1101 0000 0001 0010B=D012H. When transmitting LENGTH, the high byte is transmitted first, and then the low byte is transmitted with four ASCII codes.

3.3 CHKSUM

The calculation of CHKSUM is that except for SOI, EOI and CHKSUM, the other characters are accumulated and summed according to the ASCII code value, and the result is modulo 65536 and the remainder is inverted and increased by 1.

For example: CHKSUM = '1' + '2' + '0' +... +'F' +'E' = 31H + 32H + 30H + ... + 46H + 45H = 038EH 038EH modulo 65536 with the code 038EH and 038EH inverse in the

information frame "~1203400456ABCEFEFC72CR" Add 1 to FC72H. When transmitting CHKSUM, the high byte is transmitted first, and then the low byte is transmitted, which is transmitted with four ASCII codes.

4. Communication

4.1 Telemetry

4.1.1 Telemetry command frame

The telemetry CID2 command code is 42H, and INFO is one byte, which is COMMAND_GROUP.

COMMAND_GROUP=0x01, obtain the data of first cell.

COMMAND_GROUP=0x02, obtain the data of second cell.

COMMAND_GROUP=0xFF, obtain the data of battery pack.

……

Remarks: GROUP=0xFF supports only RS232. RS485 is not supported.

For RS485 communication, SM will check whether the received COMMAND_GROUP is consistent with the dialing address.

For RS232 communication, COMMAND_GROUP identifies the number of groups in which the SU addresses multiple groups of parallel batteries.

For example, when VER=20H and CID1=46H, the telemetry commands of different addresses are shown in Table 7.

Table 7 Example of telemetery command

Address	Telemetry command information frame (ASCII)
00	7E 32 30 30 30 34 36 34 32 45 30 30 32 30 31 46 44 33 35 0D
01	7E 32 30 30 31 34 36 34 32 45 30 30 32 30 31 46 44 33 35 0D
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	7E 32 30 30 43 34 36 34 32 45 30 30 32 30 31 46 44 32 33 0D
13	
14	
15	

4.1.2 Telemetering feedback frame

The telemetering CID2 feedback code is 00H. INFO is 75 bytes.

The data content and conversion are shown in Table 8 and Table 9.

Table 8 Telemetering feedback frame

Item	Content	Hexadecimal bytes
1	DATA FLAG	1
2	COMMAND GROUP	1
3	Cell quantity M=16	1
4	Voltage of cell 1 (mv)	2
	Voltage of cell 2 (mv)	2
	...	
	Voltage of cell M (mv)	1
5	Temperature sensing points N=6	1
6	Temperature of cell 1 (0.1℃)	2
	Temperature of cell 2 (0.1℃)	2
	Temperature of cell 3 (0.1℃)	2
	Temperature of cell 4 (0.1℃)	2
	Ambient temperature (0.1℃)	2
	Components temperature (℃)	2
7	Charge and discharge current (0.01A)	2
8	Pack voltage (0.01V)	2
9	Remaining capacity (0.01Ah)	2
10	Customize info P=10	1
11	Battery capacity (Ah)	2
12	SOC (1‰)	2
13	Rated capacity (0.01Ah)	2

14	Cycle life	2
15	SOH (1‰)	2
16	Port voltage (0.01V)	2
17	Reserved	2
18	Reserved	2
19	Reserved	2
20	Reserved	2

Table 9 Data conversion method

Temperature	Unsigned integer number (0.1K), Actual value=(transmitted value-2731)/10(℃). For example: 3032 means (3032-2731)/10(℃)=30.1℃
Pack current	Signed integer number, unit A, actual value = value/100(A). For example: 4500 means 45.00A
Pack voltage	Unsigned integer number, unit V, actual value = transmission value/100(V). For example: 5400 means 54.00V
Capacity	Unsigned integer number (Ah), actual value = transmission value/100(Ah). For example: 4830 means 48.30Ah

4.2 Telesignalization command

4.2.1 Telesignalization Command Frame

The telesignalization CID2 command code is 44H, and INFO is one byte, which is COMMAND_GROUP.

COMMAND_GROUP=0x01, obtain the data of the first cell.

COMMAND_GROUP=0x02, obtain the data of the second cell.

.....

COMMAND_GROUP=0xFF, obtain the data of the battery pack.

Remarks: GROUP=0xFF support RS232 only. RS485 is not supported.

For RS485 communication, SM will check whether the received COMMAND_GROUP is consistent with the dialing address.

For RS232 communication, COMMAND_GROUP identifies the number of groups in which the SU addresses multiple groups of parallel batteries.

For example: When VER=20H and CID1=46H, the remote signaling commands of different addresses are shown in Table 10.

Table 10 Example of remote command

Address	Telemetry command information frame (ASCII)
00	7E 32 30 30 30 34 36 34 34 45 30 30 32 30 31 46 44 32 45 0D
01	7E 32 30 30 31 34 36 34 34 45 30 30 32 30 31 46 44 33 35 0D
02	
03	
04	
05	
06	

07	
08	
09	
10	
11	
12	7E 32 30 30 43 34 36 34 34 45 30 30 32 30 31 46 44 32 31 0D
13	
14	
15	

4.2.2 Telesignalization feedback frame

The feedback code of remote CID2 is 00H. INFO comes with 49 bytes.

Table 11 shows the details of INFO data.

Table 12 shows the reference of 24-bytes-warnings.

And Table 13 is the reference of 20-bits-warnings.

Table 11

Item	Reference	Hexadecimal bytes
1	DATA FLAG	1
2	COMMAND GROUP	1
Bytes warnings		
3	Cell quantity M=16	1

4	Warnings of cell 1	1
	Warnings of cell 2	1
	...	
	Warnings of cell M	1
5	Temperature sensing points	1
6	Cell temperature warnings 1	1
	Cell temperature warnings 2	1
	Cell temperature warnings 3	1
	Cell temperature warnings 4	1
	Ambient temperature warnings	1
	Component temperature warnings	1
7	Charging and discharging current warnings	1
8	Pack voltage warnings	1
Bits warnings		
9	Customize warnings P=20	1
10	Warning 1	1
	Warning 2	1
	Warning 3	1
	Warning 4	1
	Warning 5	1
	Warning 6	1
	Power status	1

	Equalization status 1	1
	Equalization status 2	1
	System status	1
	Disconnection status 1	1
	Disconnection status 2	1
	Warning 7	1
	Warning 8	1
	Reserved	1
	Reserved	1
	Reserved	1
	Reserved	1
	Reserved	1
	Reserved	1

Table 12 Bytes warnings reference

Item	Warning value	Reference
1	0x00	Normal, no warnings
2	0x01	Analog value trigger the lowest limits
3	0x02	Analog value trigger the highest limits
4	0xF0	Others

Table 13 Bits warning reference

Warning 1	Bits reference (1: warnings, 0: normal)	
0	Voltage sensing failure	
1	Temperature sensing failure	
2	Current sensing failure	
3	Power switch failure	
4	Cell voltage difference sensing failure	
5	Charging switch failure	
6	Discharging switch failure	
7	Current limit switch failure	
Warning 2	Bits reference (1: warnings, 0: normal)	
0	Cell over voltage warning	
1	Cell over voltage protection	
2	Cell low voltage warnings	
3	Cell low voltage protection	
4	Pack over voltage warnings	
5	Pack over voltage protection	
6	Pack low voltage warnings	
7	Pack low voltage protection	
Warning 3	Bits reference (1: warnings, 0: normal)	
0	Charging high temperature warnings	Cell temperature
1	Charging high temperature protection	
2	Charging low temperature warnings	

3	Charging low temperature protection	
4	Discharging high temperature warnings	
5	Discharging high temperature protection	
6	Discharging low temperature warnings	
7	Discharging low temperature protection	
Warning 4	Bits reference (1: warnings, 0: normal)	
0	Ambient high temperature warnings	Ambient temperature
1	Ambient high temperature protection	
2	Ambient low temperature warnings	
3	Ambient low temperature protection	
4	Component high temperature warnings	Component temperature
5	Component high temperature protection	
6	Heating	Cell temperature
7	Reserved	
Warning 5	Bits reference (1: warnings, 0: normal)	
0	Charging over current warnings	
1	Charging over current protection	
2	Discharging over current warnings	
3	Discharging over current protection	
4	Transient over current protection	
5	Output short circuit protection	

6	Transient over current lock
7	Output short circuit lock
Warning 6	Bits reference (1: warnings, 0: normal)
0	Charging high voltage protection
1	Intermittent power supplement waiting
2	Remaining capacity warning
3	Remaining capacity protection
4	Cell low voltage forbidden charging
5	Output reverse connection protection
6	Output connection failure
7	Internal bit
Power status	Bits reference (1: ON, 0: OFF)
0	Discharge switch status
1	Charge switch status
2	Current limit switch status
3	Heating switch status
4-7	Reserved
Equalization status 1	Bits reference (1: ON, 0: OFF)
0	Equalization of cell 01
1	Equalization of cell 02
2	Equalization of cell 03
3	Equalization of cell 04

4	Equalization of cell 05
5	Equalization of cell 06
6	Equalization of cell 07
7	Equalization of cell 08
Equalization status 2	Bits reference (1: ON, 0: OFF)
0	Equalization of cell 09
1	Equalization of cell 10
2	Equalization of cell 11
3	Equalization of cell 12
4	Equalization of cell 13
5	Equalization of cell 14
6	Equalization of cell 15
7	Equalization of cell 16
System status	Bits reference (1: ON, 0: OFF)
0	Discharge
1	Charge
2	Floating charge
3	Reserved
4	Standby
5	Power off
6	Reserved
7	Reserved

Disconnection 1	Bits reference (1: warnings, 0: normal)
0	Disconnection of cell 01
1	Disconnection of cell 02
2	Disconnection of cell 03
3	Disconnection of cell 04
4	Disconnection of cell 05
5	Disconnection of cell 06
6	Disconnection of cell 07
7	Disconnection of cell 08
Disconnection 2	Bits reference (1: warnings, 0: normal)
0	Disconnection of cell 09
1	Disconnection of cell 10
2	Disconnection of cell 11
3	Disconnection of cell 12
4	Disconnection of cell 13
5	Disconnection of cell 14
6	Disconnection of cell 15
7	Disconnection of cell 16
Warning 7	Bits reference (1: warnings, 0: normal)
0	Internal bits
1	Internal bits
2	Internal bits

3	Internal bits
4	Auto charging wait
5	Manual charging wait
6	Internal bits
7	Internal bits
Warning 8	Bits reference (1: warnings, 0: normal)
0	EEP Storage failure
1	RTC clock failure
2	No calibration of voltage
3	No calibration of current
4	No calibration of null point
5	Internal bits
6	Internal bits
7	Internal bits