

Battery Management System (BMS) for Communication MODBUS-ASCII Communication Protocol

Applicable interfaces	RS485
Applicable models	EMU11XX Series

Date	Version	Revision Notes
20191015	V2.0	First version

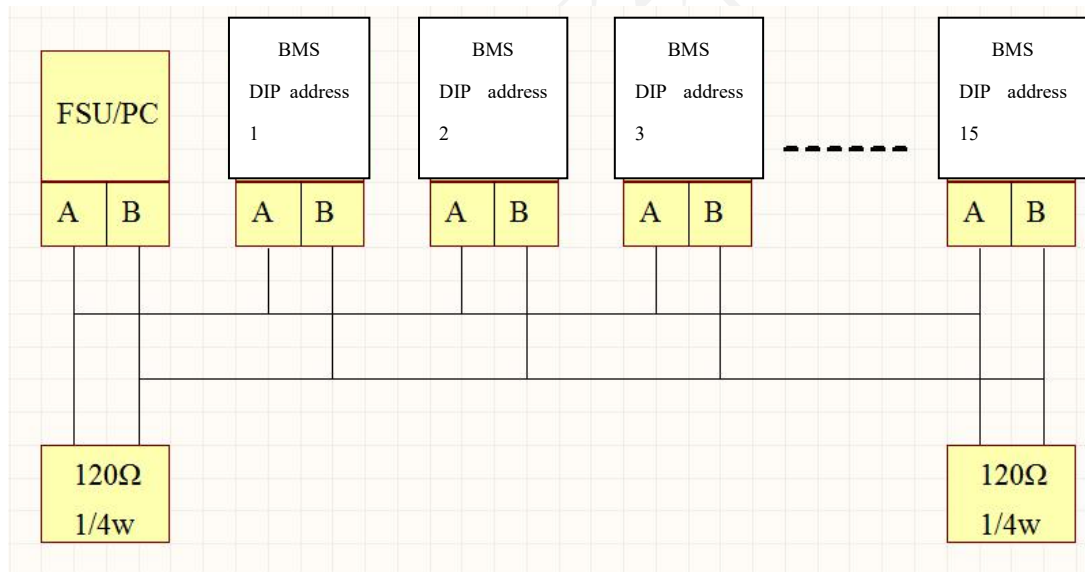
I. Communication instructions

EMU11XX series of BMS products communicate with FSU, PC or other upper controllers via RS485, for which MODBUS ASCII communication protocol is adopted, and information frames are established according to YD/T1363.3 specification.

1.1 Interface setting

EMU11XX series of BMS products adopt asynchronous serial communication interfaces. Start bit: 1; data bit: 8; stop bit: 1; check bit: none; default data transmission rate: 19200BPS.

1.2 Interface connection



Note: A 120Ω terminal matching resistor shall be added to the starting and final points of the communication connection respectively

1.3 Connection mode

The communication between the supervision unit (SU) and the supervision module (SM) is a point-to-multipoint master-slave mode. SU

calls SM through the broadcast address and issues a command. The called SM at the corresponding address receives the command and returns the response information. If SU does not receive the response information of SM in 500ms or receives the wrong response information, the communication process is considered to have failed.

II. Information structure

Information is organized according to a certain structure as a way to ensure that it can be transmitted correctly between SU and SM. See Table 1 for information structure. Information is composed of many bytes. One or more bytes make up a unit, and each unit has a name, expressing the defined meaning. Table 2 contains comments on the units in Table 1, Table 3 contains a further comments on CID1 in Table 2, and Table 4 and Table 5 contain further comments on CID2 in Table 2.

Table 1 List of information structures

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

Table 2 Comments no information structures

Items	Meaning	Remarks
Start code	Start code SOI: Starting of a data frame	SOI=7EH(~)
Version code (high)	Version code VER: A communication protocol version code is composed	Protocol version
Version code (low)	of 2 ASCII codes	V2.0=32H 30H
Address code (high)	Address code ADR: A device address identification code is composed of 2	00-15 valid, Address 1=30H
Address code (low)	ASCII codes	31H

Device code (high)	Device code CID1: A device type identification code is composed of 2 ASCII codes	Battery ID=34H 36H
Device code (low)		
Function code (high)	Function code CID2: The command code CMD sent by SU to SM or the return code RTN returned by SM to SU is composed of 2 ASCII codes	See CMD in “Table 4” for details See RTN in “Table 5” for details
Function code (low)		
Length code MSB	Length code LENGTH: Data information INFO length, including LENID and LCHKSUM It is composed of 4 ASCII codes	See “3.2” for details
Length code 3		
Length code 2		
Length code LSB		
Data code Data*LENID	Data code INFO: Including Command data information COMMAND INFO sent by SU to SM Response data information RTNDATA INFO returned by SM to SU It is composed of “LENID” ASCII codes	
Check code MSB	Check code CHKSUM: It is composed of 4 ASCII codes	See “3.3” for details
Check code 3		
Check code 2		
Check code LSB		
End code	End code EOI: Ending of a data frame	EOI =0DH(CR)

Table 3 Device code CID1

S/N	CID1 (HEX): Device code	Meaning
1	46H	Lithium iron phosphate battery BMS
...

Table 4 Command code CID2

S/N	CID2 (HEX): Command code	Meaning
1	42H	Acquisition of telemetering information
2	44H	Acquisition of telecommand information

3	45H	Telecontrol command
4	47H	Acquisition of teleregulation information
5	49H	Setting of teleregulation information
6	4FH	Acquisition of the communication protocol version number
7	51H	Acquisition of device vendor information
8	4BH	Acquisition of historical data
9	4DH	Acquisition time
10	4EH	Synchronization time
11	A0H	Production calibration
12	A1H	Production setting
13	A2H	Regular recording

Table 5 Return code CID2

S/N	CID2 (HEX): Command code	Meaning
1	00H	Normal
2	01H	VER error
3	02H	CHKSUM error
4	03H	LCHKSUM error
5	04H	CID2 invalid
6	05H	Command format error
7	06H	Data invalid (parameter setting)
8	07H	No data (history)
9	E1H	CID1 invalid
10	E2H	Command execution failure
11	E3H	Device fault
12	E4H	Invalid permissions

III. Data format

3.1 Data transmission format

SOI and EOI are explained and transmitted in HEX. Other items are explained in HEX, transmitted in HEX-ASCII code, and each byte contains 2 ASCII codes. E.g. CID2=4BH, transmit in 2 bytes, 34H ('4' in ASCII code) and 42H ('B' in ASCII code).

3.2 LENGTH format

Table 6 LENGTH format

Length check code LCHKSUM	LENID (number of bytes of ASCII code in INFO)
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D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
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3.2.1 LENID represents the number of bytes of ASCII code in INFO. When LENID is equal to 0, the INFO is null, that is, this item does not exist. LENID has only 12 bits, so the data package cannot exceed 4,095 bytes.

3.2.2 To calculate **LCHKSUM**: $D_{11}D_{10}D_9D_8+D_7D_6D_5D_4+D_3D_2D_1D_0$, sum them up, mod 16, take the remainder, do a bitwise invert and then plus 1.

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

$D_{11}D_{10}D_9D_8+D_7D_6D_5D_4+D_3D_2D_1D_0=0000B+0001B+0010B=0011B$, mod 16, remainder=0011B, do a bitwise invert and plus 1=1101B, then $LCHKSUM=1101B$.

3.2.3 LENGTH (in 3.2.2): $1101\ 0000\ 0001\ 0010B=D012H$.

For LENGTH transmission, HIGH byte first, then LOW byte, and it is divided into 4 ASCII codes.

3.3 CHKSUM format

To calculate CHKSUM, except for SOI, EOI and CHKSUM, add values to get the sum of other characters in ASCII code, then mod 65536, take the remainder, do a bitwise invert and then plus 1.

E.g. information frame “~1203400456ABCEFEFC72CR”,
 $CHKSUM='1'+‘2’+‘0’+…+‘F’+‘E’=31H+32H+30H+…+46H+45H=038EH$, mod 65536, remainder=038EH, do a bitwise invert and plus 1= FC72H.

For CHKSUM transmission, HIGH byte first, then LOW byte, and it is divided into 4 ASCII codes.

IV. Communication commands

4.1 Telemetry commands

4.1.1 Telemetry command frame

$CID_2=42H$, INFO is 1 byte `COMMAND_GROUP`.

`COMMAND_GROUP=0x01`, acquire data of battery group 1;

COMMAND_GROUP=0x02, acquire data of battery group 2;

.....

COMMAND_GROUP=0xFF, acquire data of all battery groups;

Note: GROUP=0xFF only for RS232, but not for RS485;

When RS485 is used for communication, SM checks whether the received COMMAND_GROUP matches the DIP address;

When RS232 is used for communication, COMMAND_GROUP is used to identify the number of SU addressing multi-group parallel batteries.

E.g. VER=20H and CID1=46H, the telemetry commands for different addresses are shown in Table 7

Table 7 Telemetry command examples

Address	Telemetry Command Info Frame (ASCII)																			
00	7E	32	30	30	30	34	36	34	32	45	30	30	32	30	30	46	44	33	37	0D
01	7E	32	30	30	31	34	36	34	32	45	30	30	32	30	31	46	44	33	35	0D
02	7E	32	30	30	32	34	36	34	32	45	30	30	32	30	32	46	44	33	33	0D
03	7E	32	30	30	33	34	36	34	32	45	30	30	32	30	33	46	44	33	31	0D
04	7E	32	30	30	34	34	36	34	32	45	30	30	32	30	34	46	44	32	46	0D
05	7E	32	30	30	35	34	36	34	32	45	30	30	32	30	35	46	44	32	44	0D
06	7E	32	30	30	36	34	36	34	32	45	30	30	32	30	36	46	44	32	42	0D
07	7E	32	30	30	37	34	36	34	32	45	30	30	32	30	37	46	44	32	39	0D
08	7E	32	30	30	38	34	36	34	32	45	30	30	32	30	38	46	44	32	37	0D
09	7E	32	30	30	39	34	36	34	32	45	30	30	32	30	39	46	44	32	35	0D
10	7E	32	30	30	41	34	36	34	32	45	30	30	32	30	41	46	44	31	35	0D
11	7E	32	30	30	42	34	36	34	32	45	30	30	32	30	42	46	44	31	33	0D
12	7E	32	30	30	43	34	36	34	32	45	30	30	32	30	43	46	44	31	31	0D
13	7E	32	30	30	44	34	36	34	32	45	30	30	32	30	44	46	44	30	46	0D
14	7E	32	30	30	45	34	36	34	32	45	30	30	32	30	45	46	44	30	44	0D
15	7E	32	30	30	46	34	36	34	32	45	30	30	32	30	46	46	44	30	42	0D

4.1.2 Telemetry return frame

CID2=00H, INFO is 75 bytes. See Table 8 and Table 9 for data content and conversion respectively.

Table 8 Comments on telemetry return

S/N	Content	Number of bytes
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		(HEX)
1	DATA FLAG	1
2	COMMAND GROUP	1
3	Number of cells M=16	1
4	Voltage of Cell 1 (mV)	2
	Voltage of Cell 2 (mV)	2
	...	
	Voltage of Cell M (mV)	2
5	Number of temperatures N=6	1
6	Cell temperature 1 (0.1°C)	2
	Cell temperature 2 (0.1°C)	2
	Cell temperature 3 (0.1°C)	2
	Cell temperature 4 (0.1°C)	2
	Environment temperature (0.1°C)	2
	Power temperature (0.1°C)	2
7	Charge/discharge current (0.01A)	2
8	Total battery voltage (0.01V)	2
9	Residual capacity (0.01Ah)	2
10	Custom number P=10	1
11	Battery capacity (0.01Ah)	2
12	SOC (1‰)	2
13	Rated capacity (0.01Ah)	2
14	Number of cycles	2
15	SOH (1‰)	2
16	Port voltage (0.01V)	2
17	Reservation	2
18	Reservation	2
19	Reservation	2
20	Reservation	2

Table 9 Methods of data conversion

Temperature	Unsigned integer, in 0.1K, actual value=(transmission value-2731)/10(°C). E.g. 3032 means (3032-2731)/10(°C) =30.1°C
Total current	Signed integer, in A, actual value=transmission value/100(A). E.g. 4500 means 45.00 A
Total voltage	Unsigned integer, in V, actual value=transmission value/100(V). E.g. 5400 means 54.00 V
Capacity	Unsigned integer, in Ah, actual value=transmission value/100(Ah). E.g. 4830 means 48.30Ah

4.2 Telecommands

4.2.1 Telecommand frame

CID2=44H, INFO is 1 byte COMMAND_GROUP.

COMMAND_GROUP=0x01, acquire data of battery group 1;

COMMAND_GROUP=0x02, acquire data of battery group 2;

.....

COMMAND_GROUP=0xFF, acquire data of all battery groups;

Note: GROUP=0xFF only for RS232, but not for RS485;

When RS485 is used for communication, SM checks whether the received COMMAND_GROUP matches the DIP address;

When RS232 is used for communication, COMMAND_GROUP is used to identify the number of SU addressing multi-group parallel batteries.

E.g. VER=20H and CID1=46H, the telecommands for different addresses are shown in Table 10

Table 10 Telecommand examples

Address	Telemetry Command Info Frame (ASCII)																			
00	7E	32	30	30	30	34	36	34	34	45	30	30	32	30	30	46	44	33	35	0D
01	7E	32	30	30	31	34	36	34	34	45	30	30	32	30	31	46	44	33	33	0D
02	7E	32	30	30	32	34	36	34	34	45	30	30	32	30	32	46	44	33	31	0D
03	7E	32	30	30	33	34	36	34	34	45	30	30	32	30	33	46	44	32	46	0D
04	7E	32	30	30	34	34	36	34	34	45	30	30	32	30	34	46	44	32	44	0D
05	7E	32	30	30	35	34	36	34	34	45	30	30	32	30	35	46	44	32	42	0D
06	7E	32	30	30	36	34	36	34	34	45	30	30	32	30	36	46	44	32	39	0D
07	7E	32	30	30	37	34	36	34	34	45	30	30	32	30	37	46	44	32	37	0D
08	7E	32	30	30	38	34	36	34	34	45	30	30	32	30	38	46	44	32	35	0D
09	7E	32	30	30	39	34	36	34	34	45	30	30	32	30	39	46	44	32	33	0D
10	7E	32	30	30	41	34	36	34	34	45	30	30	32	30	41	46	44	31	33	0D
11	7E	32	30	30	42	34	36	34	34	45	30	30	32	30	42	46	44	31	31	0D
12	7E	32	30	30	43	34	36	34	34	45	30	30	32	30	43	46	44	30	46	0D
13	7E	32	30	30	44	34	36	34	34	45	30	30	32	30	44	46	44	30	44	0D
14	7E	32	30	30	45	34	36	34	34	45	30	30	32	30	45	46	44	30	42	0D
15	7E	32	30	30	46	34	36	34	34	45	30	30	32	30	46	46	44	30	39	0D

4.2.2 Telecommand return frame

CID2=00H, INFO is 49 bytes. Please refer to Table 11 for INFO data, Table 12 for the

meaning of 24 byte alarms, and Table 13 for the meaning of 20 bit alarms.

Table 11 Comments on telecommand return

S/N	Content	Number of bytes (HEX)
1	DATA FLAG	1
2	COMMAND GROUP	1
The following are 24 byte alarms		
3	Number of cells M=16	1
4	Cell 1 alarm	1
	Cell 2 alarm	1
	...	
	Cell M alarm	1
5	Number of temperatures N=6	1
6	Cell temperature alarm 1	1
	Cell temperature alarm 2	1
	Cell temperature alarm 3	1
	Cell temperature alarm 4	1
	Environment temperature alarm	1
	Power temperature alarm 1	1
7	Charge/discharge current alarm	1
8	Total battery voltage alarm	1
The following are 20 bit alarms		
9	Number of custom alarms P=20	1
10	Alarm event 1	1
	Alarm event 2	1
	Alarm event 3	1
	Alarm event 4	1
	Alarm event 5	1
	Alarm event 6	1
	On-off state	1
	Equilibrium state 1	1
	Equilibrium state 2	1
	System state	1
	Disconnection state 1	1
	Disconnection state 2	1
	Alarm event 7	1
	Alarm event 8	1
	Reservation extension	1
	Reservation extension	1
Reservation extension	1	

	Reservation extension	1
	Reservation extension	1
	Reservation extension	1

Table 12 Comments on byte alarms

S/N	Alarm Value	Meaning
1	0x00	Normal, no alarm
2	0x01	Alarm that analog quantity reaches the lower limit
3	0x02	Alarm that analog quantity reaches the upper limit
4	0xF0	Other alarms

Table 13 Comments on bit alarms

Alarm event 1	Flag bit information (1: trigger, 0: normal)	
0	Voltage sensor fault	
1	Temperature sensor fault	
2	Current sensor fault	
3	Key switch fault	
4	Cell voltage dropout fault	
5	Charge switch fault	
6	Discharge switch fault	
7	Current limit switch fault	
Alarm event 2	Flag bit information (1: trigger, 0: normal)	
0	Monomer high voltage alarm	
1	Monomer overvoltage protection	
2	Monomer low voltage alarm	
3	Monomer under voltage protection	
4	High voltage alarm for total voltage	
5	Overvoltage protection for total voltage	
6	Low voltage alarm for total voltage	
7	Under voltage protection for total voltage	
Alarm event 3	Flag bit information (1: trigger, 0: normal)	
0	Charge high temperature alarm	Cell temperature
1	Charge over temperature protection	
2	Charge low temperature alarm	
3	Charge under temperature protection	
4	Discharge high temperature alarm	
5	Discharge over temperature protection	
6	Discharge low temperature alarm	
7	Discharge under temperature protection	
Alarm event 4	Flag bit information (1: trigger, 0: normal)	
0	Environment high temperature alarm	Environment

1	Environment over temperature protection	temperature
2	Environment low temperature alarm	
3	Environment under temperature protection	
4	Power over temperature protection	Power temperature
5	Power high temperature alarm	
6	Cell low temperature heating	Cell temperature
7	Reservation bit	
Alarm event 5	Flag bit information (1: trigger, 0: normal)	
0	Charge over current alarm	
1	Charge over current protection	
2	Discharge over current alarm	
3	Discharge over current protection	
4	Transient over current protection	
5	Output short circuit protection	
6	Transient over current lockout	
7	Output short circuit lockout	
Alarm event 6	Flag bit information (1: trigger, 0: normal)	
0	Charge high voltage protection	
1	Intermittent recharge waiting	
2	Residual capacity alarm	
3	Residual capacity protection	
4	Cell low voltage charging prohibition	
5	Output reverse polarity protection	
6	Output connection fault	
7	Inside bit	
On-off state	Flag bit information (1: on, 0: off)	
0	Discharge switch state	
1	Charge switch state	
2	Current limit switch state	
3	Heating switch state	
4-7	Reservation bit	
Equilibrium state 1	Flag bit information (1: on, 0: off)	
0	Cell 01 equilibrium	
1	Cell 02 equilibrium	
2	Cell 03 equilibrium	
3	Cell 04 equilibrium	
4	Cell 05 equilibrium	
5	Cell 06 equilibrium	
6	Cell 07 equilibrium	
7	Cell 08 equilibrium	
Equilibrium state 2	Flag bit information (1: on, 0: off)	

0	Cell 09 equilibrium
1	Cell 10 equilibrium
2	Cell 11 equilibrium
3	Cell 12 equilibrium
4	Cell 13 equilibrium
5	Cell 14 equilibrium
6	Cell 15 equilibrium
7	Cell 16 equilibrium
System state	Flag bit information (1: access, 0: exit)
0	Discharge
1	Charge
2	Floating charge
3	Reservation bit
4	Standby
5	Shutdown
6	Reservation bit
7	Reservation bit
Disconnection state 1	Flag bit information (1: trigger, 0: normal)
0	Cell 01 disconnection
1	Cell 02 disconnection
2	Cell 03 disconnection
3	Cell 04 disconnection
4	Cell 05 disconnection
5	Cell 06 disconnection
6	Cell 07 disconnection
7	Cell 08 disconnection
Disconnection state 2	Flag bit information (1: trigger, 0: normal)
0	Cell 09 disconnection
1	Cell 10 disconnection
2	Cell 11 disconnection
3	Cell 12 disconnection
4	Cell 13 disconnection
5	Cell 14 disconnection
6	Cell 15 disconnection
7	Cell 16 disconnection
Alarm event 7	Flag bit information (1: trigger, 0: normal)
0	Inside bit
1	Inside bit
2	Inside bit
3	Inside bit
4	Automatic charging waiting

5	Manual charging waiting
6	Inside bit
7	Inside bit
Alarm event 8	Flag bit information (1: trigger, 0: normal)
0	EEP storage fault
1	RTC error
2	Voltage calibration not performed
3	Current calibration not performed
4	Zero calibration not performed
5	Inside bit
6	Inside bit
7	Inside bit