

Communication protocol for BMS and PCS

Version	Description	Date	Author
V2.0	Init	2017-02-25	
V3.0	Add insulation value register; Separate Temperature Fault From Charge State and Discharge State; Add Slave Unit Functional Fault Warning and Error;	2017-04-25	
V3.1	Increase alarm informations	20190705	

1. Brief introduction:

1. This document is designed for the communication between Battery Management System(BMS) and PCS in the Energy Storage System;
2. The protocol is based on standard Modbus communication protocol, and defines the register address and specific meaning;
3. For the method and sequenceto read/write one or more register values, you can get detail information from the standard Modbus protocol;
4. Physical Layer: RS485/MODBUS-RTU;
5. Default Communication port baud rates 57600 bit/s
6. The communication port link is eight data bits, 1 stop bit, no parity bit;
7. BMS works as the slave device, while the PCS is the master device;
8. BMS has a default address for this protocol, which is 0x01, you can contact us if there is a conflict in the address distribution;
9. The interval time between two different read/write operation cannot be less than 300ms;

2. Message Format

Modbus protocol message format:

Device Address	Function Code	Data	CRC
1B	1B	NB	2B

Device Address:

In the communication net, devices cannot share a same address. Each device must have its unique device address in the network, and the value must be between 0 to 255;

Function Code:

Function code describes the method of each operation. Part of the function codes and methods are listed below:

Function code	Method	Description
03H	Read registers	Read values from registers
06H	Write single register	Write single value to the specific register
10H	Write multi registers	Write multi values to corresponding registers

CRC

polynomial :CRC-16/MODBUS $x^{16}+x^{15}+x^2+1$;

3. Register read/write method:

Read register(03H)

Request:

Address	1B	0x01 (default)
Function code	1B	0x03
Starting address Hi.	1B	0x0000 to 0xFFFF
Starting address Lo.	1B	
Register Quantity Hi.	1B	1 to 127
Register Quantity Lo.	1B	2 bytes per register
CRC	2B	Low byte first

Normal respond:

Address	1B	0x01 (default)
Function code	1B	0x03
Byte count	1B	2 to 254
Register value	2*nB	n = register quantity
CRC	2B	Low byte first

Exception respond:

Address	1B	0x01 (default)
Error code	1B	0x83
Exception type	1B	See table 3.0 for detail
CRC	2B	Low byte first

Single register write(06H)

Request:

Address	1B	0x01 (default)
Function code	1B	0x06
Starting address Hi.	1B	0x0000 to 0xFFFF
Starting address Lo.	1B	
Register value Hi.	1B	
Register value Lo.	1B	
CRC	2B	Low byte first

Normal respond:

Address	1B	0x01 (default)
Function code	1B	0x06
Starting address Hi.	1B	0x0000 to 0xFFFF
Starting address Lo.	1B	
Register value Hi.	1B	
Register value Lo.	1B	
CRC	2B	Low byte first

Exceptionrespond:

Address	1B	0x01 (default)
Error code	1B	0x86
Exception type	1B	Seetable3.0 for detail
CRC	2B	Low byte first

Multi register write(10H)

Request:

Address	1B	0x01(default)
Function code	1B	0x10
Starting address Hi.	1B	0x0000 to 0xFFFF
Starting address Lo.	1B	
Register quantity Hi.	1B	1 to 127
Register quantity Lo.	1B	2 bytes per register
Byte count	1B	2 to 254
Register value	2*nB	n = register quantity
CRC	2B	Low byte first

Respond:

Address	1B	0x01(default)
Function code	1B	0x10
Starting address Hi.	1B	0x0000 to 0xFFFF
Starting address Lo.	1B	
Register quantity Hi.	1B	0 to 127
Register quantity Lo.	1B	2 bytes per register
CRC	2B	Low byte first

Exception respond:

Address	1B	0x01(default)
Error code	1B	0x90
Exception type	1B	See table 3.0 for detail
CRC	2B	Low byte first

Exception code and type

Table3.0 Exception code

Exception code	Description
01	Invalid function code
02	Illegal register address
03	Invalid register quantity
04	Error during operation

3. Register definition:

Register address = base address + offset address

Each battery cluster base address is listed below:

Cluster number	Base address
Cluster 1	0x2000

We only list one cluster information in the further document, you can get access to any cluster information by changing the base address, if there are more than one cluster.

BMScontrol register:

Offset address	Name	r/w	Description
0x0010	主回路接触器控制 Power circuit control	读写 R/W	0x1:0n, 0x0:0ff

Main status information of a single battery cluster(Only Read)

Offset	Name	Description
0x0100	电池总电压 Battery stack Voltage	例: VOL =6912, 对应电压为 691.2V Unit:0.1V which 6912 means 691.2V
0x0101	电池主回路电流 Battery circuit Current	16 位有符号整型 范围: -500A~ 500A Unit: 0.1A signed value Scale: -500A to 500A 例: CUR=1234:123.4A CUR=-1234:-123.4A
0x0102	充放电指示 Battery work State	0x0:standby; 0x1:discharge; 0x2:charge
0x0103	Battery stack SOC	scale: 0%~100% unit 1%
0x0104	Battery stack SOH	scale: 0%~100% unit 1%
0x0105	单体电压最高节电池序号 Position of Maximum cell voltage	范围: 1#~224# 1 to 224
0x0106	单体最高电压值 Maximum cell voltage	例: VOL=3201, 对应电压为 3.201v Unit: 1mV, 3201 = 3201mV
0x0107	单体最低电压值电池序号 Position of Minimum cell voltage	范围: 1#~224# 1 to 224

0x0108	单体最低电压值 Minimum cell voltage	例：VOL=3201，对应电压为 3.201v Unit: 1mV, 3201 = 3201mV
0x0109	最高电池温度采样点序号 Maximum temperature position	范围：1#~224# 1 to 224
0x010A	最高电池温度值 Maximum temperature value	16 位有符号整型 范围：-40~ 150℃ Unit: 0.1℃signed value
0x010B	最低电池温度采样点序号 Minimum temperature position	范围：1#~224# 1 to 224
0x010C	最低电池温度值 Minimum temperature value	16 位有符号整型 范围：-40~ 150℃ Unit: 0.1℃signed value
0x0116	系统绝缘 System Insulation value	Unit:1K/bit
0x011D	电池补电状态 Battery Charge State	0x1:Need Charge; other:Useless

Warning and error alarm information registers

Offset address	Name	description
0x0140	电池系统一级报警信息 1 Alarm level 1_1	Bit11:: 充电电流过高报警 Charge Current High Alarm Bit10: 放电电流过高报警 Discharge Current High Alarm Bit9: 极耳温度过高报警 Pole Temperature Over High Alarm Bit8: 备用 Bit7: 电池温度差过大报警 Temperature Diff Over High Alarm Bit6: 充电: 电池温度过低报警 Under Temperature Alarm (charge); Bit5: 充电: 电池温度过高报警 Over Temperature Alarm(charge); Bit4: 电池温度过低报警 Under Temperature Alarm(discharge); bit3: 电池温度过高报警 Over Temperature Alarm (discharge); bit2: 单体压差过大报警 Battery cells unbalance alarm bit1: 单体电压过低报警 Battery Cell Under Voltage Alarm bit0: 单体过压报警 Battery Cell Over Voltage Alarm 其中:0-正常(no alarm),1-报警有效(valid alarm)
0x0141	电池系统二级报警信息 1 Alarm level 2_1	Bit11:: 充电电流过高报警 Charge Current High Alarm Bit10: 放电电流过高报警 Discharge Current High Alarm Bit9: 极耳温度过高报警 Pole Temperature Over High Alarm Bit8: 备用 Bit7: 电池温度差过大报警 Temperature Diff Over High Alarm Bit6: 充电电池温度过低报警 Under Temperature Alarm (charge); Bit5: 充电电池温度过高报警 Over Temperature Alarm(charge); Bit4: 电池温度过低报警 Under Temperature Alarm(discharge); bit3: 电池温度过高报警 Over Temperature Alarm (discharge); bit2: 单体压差过大报警 Battery cells unbalance alarm bit1: 单体电压过低报警 Battery Cell Under Voltage Alarm bit0: 单体过压报警 Battery Cell Over Voltage Alarm 其中:0-正常(no alarm),1-报警有效(valid alarm)

0x0142	本支路运行状态 ClusterXRun State	0x0: 正常 Normal 0x1: 充满 Full 0x2: 放空 Empty 0x3: 待机 Standby 0x4: 停机 Stop
0x0143	电池系统三级报警信息 1 Alarm level 3_1	Bit11:: 充电电流过高报警 Charge Current High Alarm Bit10: 放电电流过高报警 Discharge Current High Alarm Bit9: 极耳温度过高报警 Pole Temperature Over High Alarm Bit8: 备用 Bit7: 电池温度差过大报警 Temperature Diff Over High Alarm Bit6: 充电: 电池温度过低报警 Under Temperature Alarm (charge); Bit5: 充电: 电池温度过高报警 Over Temperature Alarm(charge); Bit4: 电池温度过低报警 Under Temperature Alarm(discharge); bit3: 电池温度过高报警 Over Temperature Alarm (discharge); bit2: 单体压差过大报警 Battery cells unbalance alarm bit1: 单体电压过低报警 Battery Cell Under Voltage Alarm bit0: 单体过压报警 Battery Cell Over Voltage Alarm 其中: 0-正常 (no alarm), 1-报警有效 (valid alarm)
0x0144	其它报警信息 Other Alarm Info	Bit9: 熔断器故障 Bit9: Fuse Alarm Bit8: 隔离开关状态 Bit8: Shielded Switch State Bit7: BCU 通信故障 Bit7: BCU Communication Fault Bit6: 绝缘检测故障 Bit6: Insulation Check Fault Bit5: 电流传感器故障 Bit5: Current Sensor Fault Bit4: EEPROM 故障 Bit4: EEPROM Fault Bit3: 内网通信故障 Bit3: BCU-BMU Communication Fault Bit2: 接触器粘连状态 Bit2: Contactor Adhesion Fault Bit1: 主控 NTC 故障 Bit1: BCU NTC Fault

		<p>Bit0:从控概要故障 Bit0:SlaveCtrl Summary Fault 其中: 0-正常 (no alarm), 1-报警有效 (valid alarm)</p>
0x0145	<p>电池系统一级报警信息 2 Alarm level 1_2</p>	<p>Bit11: 单体电压极低报警 Battery Cell Very High Alarm Bit10: 单体电压极高报警 Battery Cell Very Low Alarm Bit9: 高压箱温度过高报警 Pack Temperature Over High Alarm Bit8: SOH 过低报警 SOH Lower Alarm Bit7: SOC 过高报警 SOC Over High Alarm Bit6: SOC 过低报警 System SOC Lower Alarm; Bit5: 负端绝缘阻值过低报警 Neg Insulation Resistance Lower Alarm; Bit4: 正端绝缘阻值过低报警 Pos Insulation Resistance Lower Alarm; bit3: 绝缘阻值过低报警 Insulation Resistance Lower Alarm; bit2: 总电压压差过大报警 System Voltage unbalance alarm bit1: 总压过低报警 SystemUnder Voltage Alarm bit0: 总压过高报警 System Over Voltage Alarm 其中:0-正常(no alarm),1-报警有效(valid alarm)</p>
0x0146	<p>电池系统二级报警信息 2 Alarm level 2_2</p>	<p>Bit11: 单体电压极低报警 Battery Cell Very High Alarm Bit10: 单体电压极高报警 Battery Cell Very Low Alarm Bit9: 高压箱温度过高报警 Pack Temperature Over High Alarm Bit8: SOH 过低报警 SOH Lower Alarm Bit7: SOC 过高报警 SOC Over High Alarm Bit6: SOC 过低报警 System SOC Lower Alarm; Bit5: 负端绝缘阻值过低报警 Neg Insulation Resistance Lower Alarm; Bit4: 正端绝缘阻值过低报警 Pos Insulation Resistance Lower Alarm; bit3: 绝缘阻值过低报警 Insulation Resistance Lower Alarm; bit2: 总电压压差过大报警 System Voltage unbalance alarm bit1: 总压过低报警 SystemUnder Voltage Alarm bit0: 总压过高报警 System Over Voltage Alarm</p>

		其中:0-正常(no alarm),1-报警有效(valid alarm)
0x0147	电池系统三级报警信息 2 Alarm level 3_2	Bit11:: 单体电压极低报警 Battery Cell Very High Alarm Bit10: 单体电压极高报警 Battery Cell Very Low Alarm Bit9: 高压箱温度过高报警 Pack Temperature Over High Alarm Bit8: SOH 过低报警 SOH Lower Alarm Bit7: SOC 过高报警 SOC Over High Alarm Bit6: SOC 过低报警 System SOC Lower Alarm; Bit5: 负端绝缘阻值过低报警 Neg Insulation Resistance Lower Alarm; Bit4: 正端绝缘阻值过低报警 Pos Insulation Resistance Lower Alarm; bit3: 绝缘阻值过低报警 Insulation Resistance Lower Alarm; bit2: 总电压压差过大报警 System Voltage unbalance alarm bit1: 总压过低报警 SystemUnder Voltage Alarm bit0: 总压过高报警 System Over Voltage Alarm 其中:0-正常(no alarm),1-报警有效(valid alarm)
0x016C	最大充电电流 Max Charge Current	Unit: 0.1A signed value
0x016D	最大放电电流 Max Discharge Current	Unit: 0.1A signed value

从控故障信息:

Slave unit fault information

0x0183	主控与从控通信告警 2 Master control and Slave control Communication fault 2	Bit0-Bit15: SlaveCtrl17、...、SlaveCtrl32
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0x0184	主控与从控通信告警 1 Master control and Slave control Communication fault 1	Bit0-Bit15: SlaveCtrl1、…、SlaveCtrl16
0x0185	从控告警设备故障 Slave unit function fault	Bit11:主动均衡故障 Bit11:Active Balance Fault Bit10:被动均衡温度故障 Bit10:Passive Balance Temperature Fault Bit9:被动均衡故障 Bit9:Passive Balance Fault Bit8:EEPROM 故障 Bit8:EEPROM Fault Bit7:接触器故障 Bit7:Contactor Fault Bit6:温度传感器故障 Bit6:Temperature Sensor Fault Bit5: 电池温度采样故障 Bit5: Temperature sampling fault Bit4: 电压采样故障 Bit4:Voltage sampling fault Bit3: 采样芯片故障 Bit3:Sampleing Chip Fault Bit2: 连接线故障 Bit2:Connecting Line Fault Bit1: 采样线故障 Bit1:Voltage sampling Line fault Bit0:从控初始化故障 Bit0:Slave unit initialization fault 其中: 0-正常 (no fault), 1-报警有效(valid alarm)

电压寄存器 cell voltage register

Offset address	Name	description
0x0800	当前组第 1 节电池电压 Battery Voltage: cell 1	例: VOL=3201, 对应电压为 3.201v; Unit:1mV 3201 stands for 3201mV

...	...	
0x08D7	当前组第 216 节电池电压 Battery Voltage: cell 216	
...	...	

We only support 224cells in one cluster for now.

温度寄存器 temperature register

偏移地址	数据名	说明
0x0C00	当前组第 1 个温度测量点温度值 Battery Temperature: 1	16 位有符号整型 范围: -40~ 150°C
...	...	
0x0C6b	当前组第 108 个温度测量点温度值 Battery Temperature: 108	单位 0.1°C
...	...	Unit: 0.1°C, significant value

We only support 224 temperature sensors in one cluster for now.

注: 以上寄存器若未指明数据类型的默认均为无符号整形

Tip: All register values are unsigned numbers, unless otherwise noted.