APPENIDIX : BMS SMBus Communication Protocol

1. Instruction

The Battery Management System (BMS) platform supports System Management Bus (SMBus) Specification version 2.0 (http://smbus.org/specs/smbus20.pdf) and Smart Battery Data Specification, version 1.1 command (http://smartbattery.org/specs/sbdat110.pdf), which defines the data message that flows across the SMBus between the Smart Battery and the SMBus Host.

The electrical and mechanical specifications of SMBus are covered by other specifications (refer to the References section). This specification is generic and disregard to the type of battery chemistry, battery pack voltage, battery pack capacity and as well as the battery pack's physical packaging .

2. Commond list –Sbdata:

Temperature	
Command	0x08
Protocol	Read Word
Functional Requirements	Read the temperature value of the battery Detail refer <<Smart Battery Data Specification, Revision 1.1>>
Design Performance	The read data is unsigned integer value, the accuracy value is 0.1°K ; Celsius degree can be calculated as: (Reading data -2731)/10 ie: Reading data = 0xb90=2960(0.1°K), Degree Celsius = (2960-2731)/10 = 22.9℃ Reading data = 0xa74 = 2631, Degree Celsius = (2631-2731) /10 =-10℃

Voltage	
Command	0x09
Protocol	Read Word
Functional Requirements	Read the pack voltage value (mV)
Design Performance	The Reading data is unsigned integer value

Current	
Command	0x2a
Protocol	Read Block
Functional Requirements	Read the current value during the charging and discharging (mA)
Design Performance	The reading value is signed integer value, represented by 4bytes, lower bytes is first. Read Block: 0x16 command 0x17 length d0 d1 ..... PEC i.e.: Read Block Data: 0x16 2a 17 04 10 30 ff ff PEC = - 53232mA (discharging)

RelativeStateOfCharge	
Command	0x0d
Protocol	Read Word
Functional Requirements	Read the predicted value (%) of RemainingCapacity/FullChargeCapacity. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	Reading value is unsigned integer value; unit is % (Granularity: 1%) The value = (RemainingCapacity/FullChargeCapacity)%。

AbsoluteStateOfCharge

Command	0x0e
Protocol	Read Word
Functional Requirements	Read the predicted value (%) of RemainingCapacity/DesignCapacity. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	Reading value is unsigned integer value; unit is % (Granularity: 1%) The value = (RemainingCapacity/DesignCapacity)%。

RemainingCapacity

Command	0x0f
Protocol	Read Word
Functional Requirements	Read the predicted remaining capacity value (mAh) For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	Reading value is unsigned integer value;

FullChargeCapacity

Command	0x10
Protocol	Read Word
Functional Requirements	Read the predicted pack capacity value (mAh) when it is fully charged. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>。
Design Performance	Reading value is unsigned integer value;

BatteryStatus

Command	0x16
Protocol	Read Word
Functional Requirements	Read the current status of battery pack For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer Two byte data is defined:

Bit4	Full Discharged
Bit5	Full Charged
Bit6	Discharging
Bit7	Initialized
Bit11	Terminate Discharge Alarm
Bit12	Terminate Charge

CycleCount

Command	0x17
Protocol	Read Word
Functional Requirements	Read the number of cycles the battery pack has experienced. A cycle is defined as: An amount of discharge approximately equal to the value of DesignCapacity. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer

DesignCapacity	
Command	0x18
Protocol	Read Word
Functional Requirements	Read the design capacity value (mAh) of the battery pack. For detail refer to << *Smart Battery Data Specification Revision 1.1* >
Design Performance	The reading value is unsigned integer

DesignVoltage	
Command	0x19
Protocol	Read Word
Functional Requirements	Read the design voltage value of a series (mV), design voltage of pack can be derived as return value times number of series. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer

SpacifacitionInfo	
Command	0x1a
Protocol	Read Word
Functional Requirements	Read the unsigned integer data, indicating whether to use PEC bytes For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	Data is 0x0031. The communication data of MA03 must include the PEC byte

ManufactureDate	
Command	0x1b
Protocol	Read Word
Functional Requirements	Read the manufacturing date of battery pack in a packed integer. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer value, The date is used 16bit to define (Year, Month, Day), and it is packed in the following fashion: (year-1980) * 512 + month * 32 + day

Bit0-Bit4	5 bit binary value	corresponds to date
Bit5-Bit8	4 bit binary value	corresponds to month number
Bit9-Bit15	7 bit binary value	corresponds to year biased by 1980

SerialNumber	
Command	0x1c
Protocol	Read Word
Functional Requirements	Read a serial number, when combined with ManufacturerName, DeviceName, and ManufactureDate will uniquely identify the battery For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer value

LowestVoltage	
Command	0x1D
Protocol	Read Word
Functional Requirements	Read the lowest voltage in all cells voltage (mV)
Design Performance	Reading value is unsigned integer value;

ManufacturerName	
Command	0x20
Protocol	Read Block
Functional Requirements	Returns a character string containing the battery manufacturer's name. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is string, maximum 15 characters

DeviceName	
Command	0x21
Protocol	Read Block
Functional Requirements	Read a character string containing the battery pack's part number. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is string, maximum 15 characters

DeviceChemistry	
Command	0x22
Protocol	Read Block
Functional Requirements	Read a character string containing the battery pack's chemistry. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is string, maximum 15 characters

ManufacturerData	
Command	0x23
Protocol	Read Block
Functional Requirements	Read the data containing the battery pack's manfacture data. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>
Design Performance	The reading value is unsigned integer value,

Byte	Definition	Description
Byte0	Length = 6	Data length
Byte1	Bit0	1: Temperature alarm in discharging
	Bit1	1: Current alarm in discharging
	Bit2	1: Under Cell voltage alarm
	Bit3	1: Under Pack voltage alarm
By	bit0	1: In the Factory Mode
e2	Bit1	1: Reach to EDV2 during discharging, making the

				learning process
			Bit2	1: Support Pec
			Bit3	1: Press the button
			Bit5	1: effective charging
			Bit6	1: effective discharging
		Byte3	N/A	
		Byte4	N/A	
		Byte5	N/A	
		Byte6	N/A	

ManufactureINfo

Command	0x25			
Protocol	Read Block			
Functional Requirements	Read the data containing the battery pack's manufacture data. For detail refer to << *Smart Battery Data Specification Revision 1.1* >>			
Design Performance		Byte	Definition	Description
		Byte0	Length	Block datal length
		Bye1	Firmware version	
			0x10	Version 1.0
		Byte 2	Status	
			Bit7	
			Bit6	Cell Temperature over
			Bit 5	ShortCircuit
			Bit 4	Over Current in Discharging
			Bit 3	Over Current in Charging
			Bit 2	Under Voltage
			Bit 1	Over Pack Voltage
			Bit 0	Over Cell Voltage
		Byte 3		

			Bit 0,1	Cell Number 00: 3cell 01: 4cell 10: 2cell
		Byte 4	Bit 3	DFET control 0: OFF 1: ON
			Bit 2	CFET control 0: OFF 1:ON
		Byte 5,6	The voltage of Cell 4	LSB first
		Byte 7,8	The voltage of Cell 3	LSB first
		Byte 9,10	The voltage of Cell 2	LSB first
		Byte 11, 12	The voltage of Cell 1	LSB first
		Byte 13	Project No	0xa5
		Byte 14	Project style	0x03
		Byte15 (is same as command 0x23 byte2)	bit0	1: In the Factory Mode
			Bit1	1: Reach to EDV2 during discharging, making the learning process
			Bit2	1: Support Pec
			Bit3	1: Press the button
			Bit5	1: effective charging
			Bit6	1: effective discharging

CellVoltage	
Command	0x28
Protocol	Read Block
Functional Requirements	Read each cell voltage (mV)。

Design Performance	Read the unsigned integer data, lower byte is first. ie. For 4 Cell, data length = 0x08 The Block Data: 16 28 17 08 V1L V1H V2L V2H V3L V3H V4L V4H PEC ie. For 6 Cell, data length = 0x0C The Block Dat: 16 28 17 0C V1L V1H V2L V2H V3L V3H V4L V4H V5L V5H V6L V6H PEC

3. Data format

Pack address 0x16

Word Write: 0x16 command d0 d1 PEC

Word Read: 0x16 command 0x17 d0 d1 PEC

Block Write: 0x16 command length d0 d1 …… PEC

Block Read: 0x16 command 0x17 length d0 d1 ……. PEC

4. PEC Calculated

PEC byte is a sum of all CRC byte of communication data package, the calculation as:

```
#define POLYNOME                0x07                    // Polynome for CRC generation

unsigned char GetCrc8(unsigned char chkSum, unsigned char crcData)
{
    unsigned char j = 8;            // Counter for 8 shifts

    chkSum ^= crcData;                  // Initial XOR
    do
    {
        if (!(chkSum & 0x80))           // Check MSB
        {
            chkSum = chkSum << 1;     // If MSB = 0, shift left
        }
        else
        {
            chkSum = (chkSum << 1) ^ POLYNOME;   // If MSB = 1, shift and XOR
        }
    } while (--j);                                  // Continue for 8 bits
    return chkSum;                                  // Return final value
}
```

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