LITHIUM BATTERY 100Ah

CAN specification

Lithium Battery:
Hardware Rev: 001
Software version: 2:00:23

Contents

Rev No.	Description	Int:	Date
001	Initial release	MBN	15-02-2013

1 CAN Communication

1.1 Standard CAN communication

Standard CAN communication is used to broadcast most important data on the CAN bus
128bit 125kbps ->976msg/s

Source	ID- start	ID- end	Message	Rate (Msg/s)	Bus %
	0x18FF00xx		SOC	10	1.02
	0x18FF01xx		Pack Voltage and Current	1	0.102
	0x18FF03xx		Battery Alarm and status bitmaps	1	0.102
	0x18FF04xx		Battery Operating state and failure level	1	0.102
	0x18FF05xx		Fault and Status	1	0.102
	0x18FF06xx		BMS Internal and Cell Temperature	1	0.102
	0x18FF07xx		BMS Serial number and Manufacture Date	1	0.102
	0x18FF08xx		BMS Firmware and Hardware Revision	1	0.102
	0x18FF10xx	0x18FF11xx	Cell voltage	2	0.205
	0x18FF18xx	0x18FF19xx	Cell SOC	2	0.205
Total				21	2.1%

The maximum amount of units connected in one network is: 40pcs

1.1.1 0x18FF00xx – SOC Message

The BMS calculates SOC and measure current and cell voltages and transmits them over CAN.
The SOC Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF00xx	SOC		Current		Vmin		Vmax	

a. SOC is the pack state of charge. It shall be unsigned 16-bits, with a resolution of 1/65535 (%) per bit, and a range of 0% to 100%.
b. Current – battery current. Resolution is 100mA Signed integer
c. Vmin is defined as the minimum of the cell-voltages. It shall be unsigned 16-bits, MSB first, with a resolution of 1/8192 volts (i.e. 122 µV) per bit.
d. Vmax is defined as the maximum of the cell-voltages. It shall be unsigned 16-bits, MSB first, with a resolution of 1/8192 volts (i.e. 122 µV) per bit.
e. Transmit period: 100 milliseconds

1.1.2 0x18FF01xx – Pack Voltage and Current

The BMS measures Pack Current and calculates current limits, and transmits them over CAN.
The Pack Current & Voltage Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF01xx	Battery Voltage		Total voltage		Output Voltage		Battery Ah	

a. Battery Voltage is input voltage measured with small micro. Resolution is 10mV
b. Total Voltage is voltage of battery pack calculated as sum of all cells. Resolution is 10mV
c. Output Voltage is voltage on BMS output. Resolution is 10mV
d. Battery Ah is the amount of Ah available in the battery. Resolution is 0.1A
e. Transmit period: 1 second

1.1.3 0x18FF03xx – Battery Alarms and status bitmaps

The BMU reports the BMS software revision over CAN. The BMS Software Revision Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF08xx	Voltage Alarms	Temperature alarms	BMS Inputs	BMS Outputs	Voltage Emergency alarms	Temperature Emergency alarms	Cell Count	Temperature Sensor Count

a. Voltage Alarms: The voltage alarms is activated by cell voltages

Bit #	Bit Name	Trigger level	Reset level	Action	Description
0	Voltage Alarm 1	2,700V	2,800V	Warning	Under cell voltage alarm
1	Voltage Alarm 2	2,300V	2,800V	Disconnect	Under cell voltage alarm
2	Voltage Alarm 3	4,100V	3,800V	Warning	Over cell voltage alarm
3	Voltage Alarm 4	4,200V	3,800V	Disconnect	Over cell voltage alarm
4	Voltage Alarm 5			Not configured	
5	Voltage Alarm 6			Not configured	
6	Voltage Alarm 7			Not configured	
7	Voltage Alarm 8			Not configured	

b. Temperature Alarms: The Temperature alarms is activated by cell temperature

Bit #	Bit Name	Trigger level	Reset level	Action	Description
0	Voltage Alarm 1	2,700V	2,800V	Warning	Under cell voltage alarm
1	Voltage Alarm 2	2,300V	2,800V	Disconnect	Under cell voltage alarm
2	Voltage Alarm 3	4,100V	3,800V	Warning	Over cell voltage alarm
3	Voltage Alarm 4	4,200V	3,800V	Disconnect	Over cell voltage alarm
4	Voltage Alarm 5			Not configured	
5	Voltage Alarm 6			Not configured	
6	Voltage Alarm 7			Not configured	
7	Voltage Alarm 8			Not configured	

c. BMS Inputs:

Bit #	Bit Name	Description
3	CAN Wakeup	Status of CAN wakeup
2	Input 3	Status of input 3
1	Input 2	Status of input 2
0	Input 1	Status of input 1

a. BMS Outputs:

Bit #	Bit Name	Description
2	CAN Wakeup	Status of CAN wakeup
1	Output 2	Status of output 2
0	Output 1	Status of output 1

b. Cell count, is a counter of the number of cells inside the battery
c. Temperature sensor count, is a counter of the number of Cell temperature sensors inside the battery
d. Transmit period: 1 s

1.1.4 0x18FF04xx – Battery Operating state

The battery reports information about operating state and failure levels in the battery.

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF08xx	BMS Operating State	BMS Failure Level	BMS Application State	App Failure Level	App Status	Eeprom Status	System State	App Failure Code

a. BMS Operating State

Value	Bit Name	Description
0	Power Up	
1	Idle	
2	Connecting	
3	Connected	
4	Disconnecting	
5	Prepare For Sleep	
6	Sleep	

b. BMS Failure Level

Value	Bit Name	Description
0	OK	No change
1	Warning	No change
2	Emergency	Battery disconnect

Value	Bit Name	Description
3	Failure	Battery disconnect and goto sleep after 30sec

c. BMS Application state, see BMS Operating State
d. App Failure Level, see BMS Failure level
e. App Status:

Bit #	Bit Name	Description
4	Parallel mode	Battery is in parallel mode

f. EEprom Status, is Checksum failures in listed areas

Bit #	Bit Name	Description
0	Alarms	
1	Interface	
2	SOC	
3	LOG	

g. System State, see BMS Operating State
h. App Failure Code

Code #	Failure Name	Failure Level	System Action
01	Cell Voltage warning	Warning	System runs normally
02	Cell Temperature warning	Warning	System runs normally
03	Contactor Pre-charge failure	Warning	System runs normally
04	Main fuse broken	Warning	System runs normally
05	Internal temperature warning	Warning	System runs normally
20	Cell temperature alarm	Disconnect	Disconnect but stays in Idle
21	Cell voltage too high alarm	Disconnect	Disconnect but stays in Idle
22	Intern temperature failure	Disconnect	Disconnect but stays in Idle
23	Cell Temperature sensor failure	Disconnect	Disconnect but stays in Idle
24	Overload	Disconnect	Disconnect, wait 30 sec and retry (Automatically reset)
25	Short circuit	Disconnect	Disconnect, wait 30 sec and retry (Automatically reset)
26	Current offset too high	Disconnect	Disconnect but stays in Idle
27	Power Communication failure	Disconnect	Disconnect but stays in Idle
28	Current Communication failure	Disconnect	Disconnect but stays in Idle
29	Intern temp sensor failure	Disconnect	Disconnect but stays in Idle
30	Empty battery (<20% SOC)	Empty	Disconnect after 30sec and goes to sleep after additionally 30sec. Stays connected if a charger is detected
31	Cell voltage too low alarm	Critical empty	Disconnect after 5sec and goes to sleep after additionally 30sec. Stays connected if a charger is detected
32	Cell Missing failure	Critical failure	Disconnect and goes to sleep after 30 sec.
33	EEPROM failure	Critical failure	Disconnect and goes to sleep after 30sec

i. Transmit period: 1 s

1.1.5 0x18FF05xx – Fault and Status Message

The MBS transmits fault status in the Fault Message.
The Fault Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF05xx	BMS Status Bitmap				SOC Time		Cell Balancing	

a. BMS Status Bitmap

Bit #	Fault name	Fault description	Accommodation	Reset
31				
30				
29	BMS_AppInitialized		Status	
28	BMS_FanActive		Status	
27	BMS_ContactorPrimaryPreActive		Status	
26	BMS_ContactorPrimaryActive		Status	
25	BMS_Input1 WakeupActive		Status	
24	BMS_Input2 WakeupActive		Status	
23	BMS_Input3 Wakup Active		Status	
22	Test mode Active		Status	
21	BMS_InternTempSensorFailure		Failure	
20	BMS_CAN wakeup Active		Status	
19	BMS_CurrentSenseCommunicationError		Failure	
18	BMS_PowerSupplyCommunicationError		Failure	
17	BMS_CellMissingFailure		Emergency	
16	BMS_TemperatureSensorFailure		Disconnect	
15	BMS_InternTempTooHigh		Disconnect	
14	BMS_InternTempWarningHigh		Warning	
13	BMS_InternTempTooLow		Disconnect	
12	BMS_InternTempWarningLow		Warning	
11	BMS_EEPROMBusy		Failure	
10	BMS_EEPROMOffline		Failure	
9	BMS_EEPROM_CRC16Failure		Failure	
8	BMS_MainFuseBroken		Warning	
7				
6				
5	BMS_PrimaryWelded		Emergency	
4	BMS_PrimaryPreChargeFailure		Warning	
3	BMS_CurrentOffsetTooHigh		Failure	
2	BMS_PrimaryShortCircuit		Emergency	
1	BMS_PrimaryOverloaded2		Emergency	
0	BMS_PrimaryOverloaded1		Emergency	

b. SOC Time is specifying the number of minutes until the battery is fully charged (97%) or empty. if the value is positive is time until fully charged. (MSB)
c. Cell balancing is a bitmap of the cell balancing in the battery. each bit corosto
d. Transmit period: 1 second

1.1.6 0x18FF06xx – Battery Internal and Cell temperature

The BMS report internal temperature of hardware

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF06xx	Internal Temperature 1		Internal Temperature 2		Cell T1		Cell T2	

a. Internal Temperature 1
b. Internal Temperature 2 are temperatures on controls board
c. Resolution of all temperatures is 1/256 ^{o}C/bit
d. Cell T1 is the temperature closest to cell 1 (i.e. closest to the negative battery terminal).
e. Battery temperatures shall be signed 2's complement, 16 bits, MSB first, with a resolution of 0.0039 deg C per bit.
f. If a thermistor input is physically disconnected from the BMS, the BMS shall report a value of 0x7FFE for the corresponding battery temperature.
g. Transmit period: 1s

1.1.7 0x18FF07xx – Battery Serial Number and Manufacture Date

The BMU reports the manufacture date and serial number over CAN. Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF07xx	Year	Month	Day	Batch Number			Serial Number	

a. Year shall be unsigned 8 bits with MSB first with valid values from 0-99 decimal.

b. Month shall be unsigned 8 bits with MSB first with valid values from 0-12 decimal.
c. Day shall be unsigned 8 bits with MSB first with valid values from 0-31 decimal. In cases where Day is not used, this value shall be 0xFF.
d. Batch Number is number of manufacture batch of BMS. Batch number consists from 3 bytes each can have the value 0-99 which gives a batch number of 6 digits.
e. Serial number is the serial number of the BMS. The serial number consists of 2 bytes each can have the value 0-99 which gives a serial number of 4 digits.
f. Transmit period: 1 s.

1.1.8 0x18FF08xx – Battery Firmware and Hardware Revision

The BMU reports the BMS software revision over CAN. The BMS Software Revision Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF08xx	FW Major Revision	FW Minor Revision	FW Build Revision	HW Major Revision	HW Minor Revision	Parallel Count	Parallel Status	Parallel Failures

a. The FW Major Revision
b. The FW Minor Revision
c. The FW Build Revision
d. The HW Major Revision. It is hardware revision.
e. The HW Minor Revision. It is hardware revision.
f. Parallel Count, is a counter of number of batteries connected to this battery.
g. Parallel Status:

Bit #	Bit Name	Description
7	Master	This battery is selected as master
6	Master Delay	Selected as master but waiting initate delay
5	Not used	
4	Not used	
3	Not used	
2	Not used	
1	G3_Mains_Received	One or more of the connected G3 Combi units has detected 230 vac mains to one of the other batteries
0	G3_Mains_Detected	One or more of the connected G3 Combi units has detected 230 vac mains connected to this battery

h. Parallel Failure:
Bit 0-3: Counter of batteries online, but with main switch disconnected.
Bit 4-7: Counter of batteries offline or missing in the parallel network.
i. Transmit period: 1 s

1.1.9 0x18FF10xx Cell Voltage Message

The BMS shall have the ability to transmit all cell voltages on the CAN bus.
This message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF10xx	Cell 1		Cell 2		Cell 3		Cell 4	
0x18FF11xx	Cell 5		Cell 6		Cell 7		Cell 8	

a. Cell 1 is the voltage of the first cell (at the negative battery terminal).
b. The BMS shall only transmit cell voltage messages for cell group of 4 in the configuration. For example, if the configuration has only 4 cells, the MCU shall transmit only one cell-group voltage message.
c. Cell voltages shall be unsigned 16 bits, MSB first, with a resolution of 1/8192 volts (i.e. 122 μV) per bit.
d. If a cell voltage sense line is physically disconnected from the battery, the MCU shall report a value of 0xFFFE for that cell voltage.
e. Transmit period (12V): 1sec between each message

f. Transmit period (24V): 500ms between each message

1.1.10 0x18FF18xx Cell SOC Message

The BMS shall have the ability to transmit all cell SOC on the CAN bus.
This message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF18xx	Cell 1		Cell 2		Cell 3		Cell 4	
0x18FF19xx	Cell 5		Cell 6		Cell 7		Cell 8	

g. Cell 1 is the SOC of the first cell (at the negative battery terminal).
h. The BMS shall only transmit cell messages for cell-groups in the configuration. For example, if the configuration has only 4 cells, the MCU shall transmit only one cell-group SOC message.
i. Cell SOC shall be unsigned 16 bits, MSB first, with a resolution of 1/65535 % (i.e. 0,00001529%) per bit.
j. Transmit period (12V): 1sec between each message
k. Transmit period (24V): 500ms between each message

1.1.11 0x18FF20xx – Serial information

The BMS serial battery information when connected in serial

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FF06xx	Serial Count	Serial Status	Battery Voltage		Total voltage		Output Voltage	

a. Serial Counter, number of batteries in series.
b. Serial Status

Bit #	Bit Name	Description
1	Serial Battery Disconnected	The battery in serial is detected disconnected
0	Serial Battery Offline	The battery in serial is detected offline

c. Battery Voltage is input voltage measured with small micro. Resolution is 10mV
d. Total Voltage is voltage of battery pack calculated as sum of all cells. Resolution is 10mV
e. Output Voltage is voltage on BMS output. Resolution is 10mV
f. Transmit period: 1sec between each message and onFailureAction

1.1.12 0x18FFFFxx – Master Message

The unit selected as master sends the master message to control the other batteries.
The BMU reports the BMS software revision over CAN. The BMS Software Revision Message is defined as follows:

CAN-ID	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
0x18FFFFxx	Parallel Operating State	LED Flash information						

a.
b. Transmit period: 100msec