Greenway

CAN BUS
Communication protocol

Version 1.5

No.	Description	Date	Version	Author
1.	Initial release	2013.10.22	V1.0	Felix Wu
2.	增加消息校验 Add CheckSum information	2016.08.05	V1.1	Felix Wu
3.	1. 增加充电器 ID. Add CAN ID for charger.	2017.09.26	V1.2	Felix Wu
4.	增加电池器件 ID 分配及 MD5 算法内容	2017.11.8	V1.4	Felix Wu
5.	修订了几处实际未使用寄存器位的描述	2017.12.20	V1.5	Chenzhijun

1. 基本信息 GENERAL INFORMATION

1.1 术语 Terminology

简写 Item	全称 Description
MC	电机控制器 Motor Controller
BMS	电池管理系统 Battery Management System
HMI	显示单元 Human Machine Interface
BTM	蓝牙模块 Bluetooth Module
DGL	通讯适配器 Communication Dongle
CGR	充电器 Charger

1.2 参考 Reference

CAN Specification Version 2.0
(http://www.kvaser.com/software/7330130980914/V1/can2spec.pdf)

2. 界定 SCOPE

本协议所提供的基本信息描述如何使用 CAN BUS 将电机控制器、电池管理系统、显示器以及服务模块连接起来。

Information in this specification provides general information on how CAN BUS fits among MC,BMS, Display and Service Module.

3. 功能协议 FUNCTION SPECIFICATION

3.1 界定 Scope

本段描述可供外部设备通过 CAN BUS 模块读取的 BMS 内部数据结构。

This document provides information on BMS internal data structure to allow external device to access various pieces of data via CAN BUS.

3.2 数据类型定义 Data type definitions

数据类型 Data Type	描述 Description	长度（字节） Length (bytes)	最小值 Minimum Value	最大值 Maximum Value
uint4	Unsigned long integer	4	0	4294967295
sint4	Signed long integer	4	-2147483648	2147483647
uint2	Unsigned integer	2	0	65535
sint2	Signed integer	2	-32768	32767
uint1	Unsigned char	1	0	255
sint1	Signed char	1	-128	127
bool1	Boolean	1	0	1
textn	Text string or byte string	n	n/a	n/a

3.4 使用权定义 Access

数据使用权限定义如下 The Access of an entry can be as follows:

- ro (只读 Read only)
- rw (可读可写 Read Write)
- wo (只写 Write Only)
- const 常量

4. 物理层 PHYSICAL LAYER

1. 物理接口 Physical layer	Isolated CAN Bus, 2 Pins
2. 通讯格式 Format	CAN 2.0A, 250kbps, Data Frame

5.数据封装 PACKAGE

5.1 消息 ID 分配 ID assignment （Hex 数据）

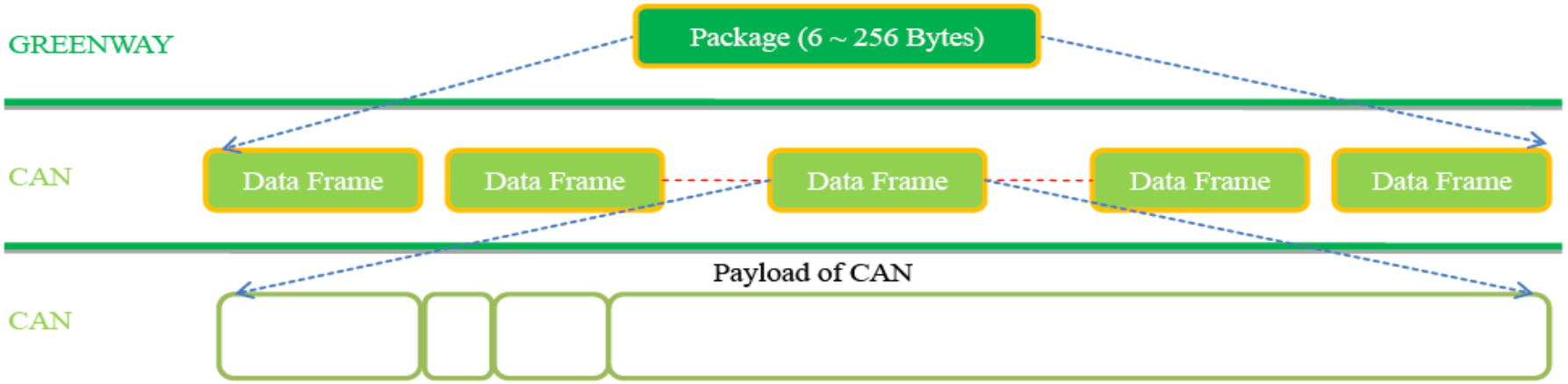
System	Packet Name	NMT	Sync	Emcy	Emcy			
	CAN ID	000	080	08A	091			
CAN Open	Packet Name							
	CAN ID	18C	28C	38C	48C	440	441	442
	Packet Name							
	CAN ID	443	444	445	446	447	448	449
	Packet Name							
	CAN ID	44A	44B	44C	44D	44E	44F	589
	Packet Name							
	CAN ID	58A	58B	58C	591	609	60A	60B
	Packet Name							
	CAN ID	60C	611	70A	711			
MC (Message From)	Target Device		HMI	DGL	BTM	BMS	CGR	Brodcast
	CAN ID		502	504	506	508	50A	501
HMI (Message From)	Target Device	MC		DGL	BTM	BMS	CGR	Brodcast
	CAN ID	510		514	516	518	51A	511
DGL (Message From)	Target Device	MC	HMI		BTM	BMS	CGR	Brodcast
	CAN ID	520	522		526	528	52A	521
BTM (Message From)	Target Device	MC	HMI	DGL		BMS	CGR	Brodcast
	CAN ID	530	532	534		538	53A	531
BMS (Message From)	Target Device	MC	HMI	DGL	BTM		CGR	Brodcast
	CAN ID	540	542	544	546		54A	541
CGR (Message From)	Target Device	MC	HMI	DGL	BTM	BMS		Brodcast
	CAN ID	550	552	554	556	558		551

5.2 数据封装 Package

5.2.1 每帧最大有效数据个数为 8 字节。Maximum effective data for each frame is 8 bytes.

5.2.2 一个包可以 1~32 帧组成，每包最长长度为 256byte。Maximum length for each package is 256 bytes, and a package could be made up by 1-32frames.

5.2.3 包组成示意图 Package layered architecture



5.2.4 基本时序 General Timing

消息类型分为两类：广播型及被动型，广播型在广播允许条件下以固定频率（见后文定义）发送数据，而被动型则只有在接收到外部设备数据请求指令后才回复数据。

There are two types of message, broadcast type and negative type.Broadcast message will send automatically, but negative message will only send after request conform.

5.2.5 包格式 Format of Package

5.2.5.1 主机发送 Host Send (电池的从机地址固定为 0x16 Battery Add fixed to be 0x16)

帧头低字节 Head Low Byte	帧头高字节 Head High Byte	读写标志 Read/Write	数据地址 Data Add	数据长度 Data Length	数据内容 Data	校验 Check Sum
0x46	0x16	R = 1 W = 0	参考第 6 节 See Section 6	不超过 250 字节 (Limited to 250 Byte)	当数据长度为 0 或发送读命令时,此项不存在 When data length is 0 or in read mode, this item is not exist	

Note:

1. 对于每一个数据,都有固定的数据长度,一次不能读取两个数据 To a Data-Add, the Data-Length is fixed, User cannot read two data in one time.
2. 由于存在总线优先级仲裁，无法保证数据帧的连续性，编程时应考虑开辟多个接收 buff，以避免接收出错或遗漏信息，通常情况下 4 个接收缓冲区足够使用。Because of the arbitration of CAN bus, it's recommend to operate several receive buff to avoid communication error or message losing. Normally 4 buff will be enough.
3. 检验为之前所有数据之和(只取低字节) The checksum is the arithmetic sum of all the preceding bytes (lower byte).

5.2.5.2 从机响应主机写命令 Slave Answer Host write

帧头低字节 Head Low Byte	帧头高字节 Head High Byte	读写标志 Read/Write	数据地址 Data Add	数据长度 Data Length	校验 Check Sum
0x47	0x16	0	参考第 6 节 See Section 6	0	

5.2.5.3 从机响应主机写命令 Slave Answer Host Read

帧头低字节 Head Low Byte	帧头高字节 Head High Byte	读写标志 Read/Write	数据地址 Data Add	数据长度 Data Length	数据内容 Data	校验 Check Sum
0x47	0x16	1	参考第 6 节 See Section 6	不超过 250 字节 (Limited to 250 Byte)	如果返回的数据长度为零,则无此项 When data length is 0, this item is not exist	

6. UART MESSAGE INFORMATION

6.2 Data address description for the third generation BMS.

数据 Message	数据地址 Message Add	数据类型 DataType	单位 Unit	描述 Description
综合信息 MfrAccess	0x00	uint4	/	Fixed 0x46
电池温度 Battery Temperature	0x08	Sint1 * 32	1℃	预留32个温度传感器 32 temperature sensor were reserved. Byte 0: Cell Temp 1# Byte 1: Cell Temp 2# Byte 2: Reserved Byte 3: Reserved Byte 4: DSG Mos Temp 1# Byte 5: CHG Mos Temp 1# Byte 6: Pre-Start Temp 1# Byte 7: Reserved Byte 8~Byte31: Reserved
电池包总电压 Pack Voltage	0x09	uint4	1mV	
实时电流 Real time Current	0x0A	sint4	1mA	
电池剩余容量百分比 Battery SOC	0x0D	uint4	1%	
电池健康状态百分比 Battery SOH	0x0E	uint4	1%	
剩余容量 Remaining Capacity	0x0F	uint4	1mAh	
满充容量	0x10	uint4	1mAh	

Full charge Capacity					
其它电流信息 Other current information	0x14	4bytes	mA	Byte0 ~ Byte1 (sint2，小端)	Reserved
				Byte2 ~ Byte3 (uint2,小端)	Reserved
电池状态 Battery Status	0x16	16 bytes	Byte0	内部状态 Inner status. 读将返回相应状态 Read returns the status, and write can control charging only,not Discharging 0 → OFF, 1 →ON Bit7: 充电MOS(RW). Charge Mosfet Bit6: 放电MOS (R). Discharge Mosfet Bit5: Reserved Bit4: Reserved Bit3: 充电器连接状态(RO). Charger Connection Bit2: Reserved Bit1: Reserved Bit0: 二次保护动作状态.Secondary Protection Status	
			Byte1	内部状态 Inner status. 0 → OFF, 1 →ON Bit7 ~ Bit0: Reserved	
			Byte2 (Errors)	0 -> No error 1 -> Error Bit 0: 保护IC出错 Protection Chip Error Bit 1: 电芯掉线 Cell Drop Error Bit 2: 电芯不平衡Imbanlance Bit 3: 计量出错 Estimate Error Bit 4: 记录出错 Record Error Bit 5: 时钟出错 RTC Error Bit 6: 放电MOS损坏 Discharging Mosfet Error Bit 7: 充电MOS损坏 Charging Mosfet Error	

			Byte3 (Errors)	Bit 0: 过充错误 Over Charge Bit 1: 初级过放 Primary Over Discharge Bit 2: 二级过放错误 Secondary Over Discharge Bit 3: 初级过流 Primary Over Current Bit 4: 二级过流 Secondary Over Current Bit 5: 充电过流 Over Charge Current Bit 6: 软启动失败 Pre-Start Fail Bit 7: Reserved
			Byte4 (Errors)	Bit 0: MOS温度传感器故障 MOS Temperature Sensor Error Bit 1: 电芯温度传感器故障 Cell Temperature Sensor Error Bit 2: 放电过温 Over Discharge Temperature Bit 3: 充电过温 Over Charge Temperature Bit 4: 放电欠温 Under Discharge Temperature Bit 5: 充电欠温 Under Charge Temperature Bit 6: 放电MOS过温 Over Temperature of Discharge Mosfet Bit 7: 充电MOS过温 Over temperature of Charge Mosfet
			Byte5 (Errors)	Bit 0: Reserved Bit 1: Reserved Bit 2: Reserved Bit 3: Reserved Bit 4: 三级过流 Third Over Current Bit 5: 四级过流 Four Over Current Bit 6: 配置错误 Config Data Error Bit 7: Reserved
			Byte6 (Warring)	0 -> No Warning 1 ->Warning Bit 0: 保护IC警告 Protection Chip Warning Bit 1: 电芯掉线警告CellDrop Warning Bit 2: 电芯不平衡警告Imbanlance Bit 3: 计量警告 Estimate Warning

				Bit 4: 记录警告 Record Warning Bit 5: 时钟出错警告 RTC Warning Bit 6: Reserved Bit 7: Reserved
			Byte7 (Warring)	Bit 0: 过充警告 Over Charge Bit 1: 初级过放警告 Primary Over Discharge Bit 3: 初级过流警告 Primary Over Current Bit 4: Reserved Bit 5: 充电过流警告 Over Charge Current Bit 6: Reserved Bit 7: Reserved
			Byte8 (Warring)	Bit 0: MOS温度传感器警告 MOS Temperature Sensor Warning Bit 1: 电芯温度传感器警告 Cell Temperature Sensor Warning Bit 2: 放电过温 Over Discharge Temperature Bit 3: 充电过温 Over Charge Temperature Bit 4: 放电欠温 Under Discharge Temperature Bit 5: 充电欠温 Under Charge Temperature Bit 6: 放电MOS过温 Over Temperature of Discharge Mosfet Bit 7: 充电MOS过温 Over temperature of Charge Mosfet
			Byte9 (Warring)	Bit 0: Reserved Bit 1: Reserved Bit 2: Reserved Bit 3: Reserved Bit 4: Reserved Bit 5: Reserved Bit 6: Reserved Bit 7: Reserved
			Byte10	允许最大充电电流 Maximum Charge Current Bit7~Bit6: 数据单位 Unit of the Value 00→0.05A

				01→0.1A 10→1A 11→2A Bit5~Bit0: 允许最大充电电流数值，表示电池当前状态下能接受的最大充电电流，充电器应控制充电电流小于或等于此值 Maximum Charge Current, the charging current should not be higher than this value. 实际值 = 此值*数据单位 Physical Value = Value * Unit. 示例：此byte数据为0x89，则单位为1A，且数值为9，故此状态下允许的最大充电电流为9*1A = 9A。 Example: If the value of this byte is 0x89, which means the unit of the value is 1A, and the value is 9, so the maximum charge current is 9*1A = 9A.
			Byte11	放电信息 Discharging message Bit7 ~ Bit0: Reserved
			Byte12	均衡状态 Balance Status Bit0: Channal 1, 0→No banlance; 1→Banlancing Bit1: … Bit2: …
			Byte13	均衡状态 Balance Status Bit0: Channal 9, 0→No banlance; 1→Banlancing Bit1: … Bit2: …
			Byte14	均衡状态 Balance Status Bit0: Channal 17, 0→No banlance; 1→Banlancing Bit1: … Bit2: …
			Byte15	Reserved
电池循环次数 Cycle Count	0x17	uint4	1 cycle	范围：0 ~ 0xFFFFFFFF次 Range: 0 ~ 0xFFFFFFFF

设计容量 Design Capacity	0x18	uint4	1mAh	
设计电压 Design Voltage	0x19	uint4	1mV	
电池版本信息 Version Information	0x1A	Uint1 * 8	Byte 0	软件版本低8位 Lower bits of software. Representing in {Byte1}.{Byte0}
			Byte 1	软件版本高8位 Higher bits of software
			Byte 2	硬件版本低8位 Lower bits of Hardware Representing in {Byte3}.{Byte2}
			Byte 3	硬件版本高8位 Higher bits of Hardware
			Byte 4 ~ Byte 7	固件索引码（ASC II * 4） Index Code for Firmware
生产日期 Manufacture Date	0x1B	4bytes	/	Byte0: Year Byte1: Month Byte2: Day Byte3: Reserved
电池内部实时时钟 Battery RTC	0x1D	6 bytes	/	Byte0: Year Byte1: Month Byte2: Day Byte3: Hour Byte4: Min Byte5: Sec
充电时间 Time to Full	0x1E	6 bytes	分钟 Min	充满时间 Time to full (Stop Using) Range: 0 ~ 65535 minutes
			小时 Hour	最长未充电时间 Longest Uncharged Time Range: 0 ~ 65535 hours.
			/	充电次数 Charge Counter Range: 0 ~ 65535 times

电池制造商名称 Manufacturer Name	0x20	16bytes	ASCII	16 bytes
电池型号 Battery Name	0x21	32 bytes	ASCII	32 bytes
电芯型号 Battery ChemID	0x22	16 bytes	ASCII	16 bytes
电池条码 Battery Barcode Number	0x23	32 bytes	ASCII	预留32字节数据来存储条形码，且放弃使用序列号 32 bytes were reserved for battery barcode number. And “Battery Serial Num” will not been used.
低 16 节电压数据 Single cell voltage of low 16 cells	0x24	32 bytes	uint2	Byte0 ~ Byte1: Voltage of cell 1 Byte2 ~ Byte3: Voltage of cell 2 … Byte30 ~ Byte31: Voltage of cell 16
高 16 节电压数据 Single cell voltage of high 16 cells	0x25	32 bytes	uint2	Byte0 ~ Byte1: Voltage of cell 17 Byte2 ~ Byte3: Voltage of cell 18 … Byte30 ~ Byte31: Voltage of cell 32
电池最值记录 Extremely value of battery	0x26	14 bytes	/	Byte0 ~ byte3: Max DSG Current(sint4) Byte4 ~ byte7: Max CHG Current(sint4) Byte8 ~ byte9: Max Cell Voltage(uint2) Byte10~Byte11: Min Cell Voltage(uint2) Byte12: Max Pack Temperature(sint1) Byte13: Min Pack Temperature(sint1)
错误计数 Error Counter	0x27	64 bytes	Uint2	参考电池状态中错误bits，依次增加 Byte0 ~ Byte1: Error counter of “Protection Chip Error” Byte2 ~ Byte3: Error counter of “Cell Drop Error” Byte4 ~ Byte5: Error counter of “Imbanlance Error” … Byte62 ~ Byte 63: Error counter of “Reserved” (Bit7 of byte5 from

				address 0x16)
电池单命令信息 Information summarize	0xA0	26bytes	Byte0	内部状态 Inner status. 读将返回相应状态 Read returns the status, and write can control charging only,not Discharging 0 → OFF, 1 →ON Bit7: 充电MOS(RW). Charge Mosfet Bit6: 放电MOS (R). Discharge Mosfet Bit5: Reserved Bit4: Reserved Bit3: 充电器连接状态(RO). Charger Connection Bit2: Reserved Bit1: Reserved Bit0: 二次保护动作状态.Secondary Protection Status.
			Byte1	内部状态 Inner status. 0 → OFF, 1 →ON Bit7 ~ Bit0: Reserved
			Byte2	0 -> No error 1 -> Error Bit 0: 保护IC出错 Protection Chip Error Bit 1: 电芯掉线 Cell Drop Error Bit 2: 电芯不平衡Imbanlance Bit 3: 计量出错 Estimate Error Bit 4: 记录出错 Record Error Bit 5: 时钟出错 RTC Error Bit 6: 放电MOS损坏 Discharging Mosfet Error Bit 7: 充电MOS损坏 Charging Mosfet Error
			Byte3	Bit 0: 过充错误 Over Charge Bit 1: 初级过放 Primary Over Discharge Bit 2: 二级过放错误 Secondary Over Discharge Bit 3: 初级过流 Primary Over Current

				Bit 4: 二级过流 Secondary Over Current Bit 5: 充电过流 Over Charge Current Bit 6: 软启动失败 Pre-Start Fail Bit 7: Reserved
			Byte4	Bit 0: MOS温度传感器故障 MOS Temperature Sensor Error Bit 1: 电芯温度传感器故障 Cell Temperature Sensor Error Bit 2: 放电过温 Over Discharge Temperature Bit 3: 充电过温 Over Charge Temperature Bit 4: 放电欠温 Under Discharge Temperature Bit 5: 充电欠温 Under Charge Temperature Bit 6: 放电MOS过温 Over Temperature of Discharge Mosfet Bit 7: 充电MOS过温 Over temperature of Charge Mosfet
			Byte5	Bit 0: 软启动电路过温 Over temperature of Pre-Start circuit Bit 1: Reserved Bit 2: Reserved Bit 3: Reserved Bit 4: 三级过流 Third Over Current Bit 5: 四级过流 Four Over Current Bit 6: 配置错误 Config Data Error Bit 7: Reserved
			Byte6 (Warning)	0 -> No Warning 1 ->Warning Bit 0: 保护IC警告 Protection Chip Warning Bit 1: 电芯掉线警告CellDrop Warning Bit 2: 电芯不平衡警告Imbanlance Bit 3: 计量警告 Estimate Warning Bit 4: 记录警告 Record Warning Bit 5: 时钟出错警告 RTC Warning Bit 6: Reserved Bit 7: Reserved

			Byte7 (Warning)	Bit 0: 过充警告 Over Charge Bit 1: 初级过放警告 Primary Over Discharge Bit 3: 初级过流警告 Primary Over Current Bit 4: Reserved Bit 5: 充电过流警告 Over Charge Current Bit 6: Reserved Bit 7: Reserved
			Byte8	电池剩余容量百分比 Battery soc
			Byte9	电池健康状态百分比 Battery soh
			Byte9~ Byte13	Uint4，电池包总电压，PackVoltage，单位unit:mV
			Byte14~ Byte17	实时电流，Real time current，单位unit：mA
			Byte18	实时电芯最高温度Highest cell temperature(real time),单位unit:℃
			Byte19	实时电芯最低温度Lowest cell temperature(real time),单位unit:℃
			Byte20	实时mos管温度Mosfet temperature，单位unit:℃
			Byte21	其他温度 other temperature，单位unit:℃
			Byte22	允许最大充电电流 Maximum Charge Current Bit7~Bit6: 数据单位 Unit of the Value 00→0.05A 01→0.1A 10→1A 11→2A Bit5~Bit0: 允许最大充电电流数值，表示电池当前状态下能接受的最大充电电流，充电器应控制充电电流小于或等于此值 Maximum Charge Current, the charging current should not be higher than this value. 实际值 = 此值*数据单位 Physical Value = Value * Unit.

				示例：此byte数据为0x89，则单位为1A，且数值为9，故此状态下允许的最大充电电流为9*1A = 9A。 Example: If the value of this byte is 0x89, which means the unit of the value is 1A, and the value is 9, so the maximum charge current is 9*1A = 9A.
			Byte23	放电信息Discharge message Reserved
			Btye24~ Byte25	电池循环次数 Cycle Counter

实例 Example:

控制器读取电池电压 MC Read Battery Voltage (61200mV):

MC Send (ID=0x508, Data Frame, Frame Counter=1, Data Length=6):

46 16 01 09 04 6A （此器件 ID 值必须设定为读到的器件 ID，方可正确回应数据）

BMS Return (ID=0x540, Data Frame, Frame Counter =2, Data Length=10):

47 16 01 09 04 10 EF 00 00 6A

工具盒读取电池电流 DGL Read Battery Current (-26000mA):

DGLSend(ID=0x528, Data Frame, Frame Counter=1, Data Length=6):

46 16 01 0A 04 6B

BMS Return (ID=0x544, Data Frame, Frame Counter =2, Data Length=10):

47 16 01 0A 04 70 9A FF FF74