Specification Approval Sheet

产品规格书

Battery Type: GRPA770175-15C-44.4V 16000mAh

电池型号: GRPA770175-15C-44.4V 16000mAh

Supplier 供应商	Prepared By 编制	Linli	2021-10-08
	Checked By（RD） 审核（研发）	Yangdan	2021-10-08
	Checked By (QC) 审核（品质）	Weina	2021-10-08
	Approved By 批准	Zhaoshixing	2021-10-08

Customer Approval （客户批准）	Company Name（公司名称）
	Signature/Date（签名/日期）
	Company Stamp（公司印章）

Amendment Records

（修正记录）

Edition （版 本）	Description （记 述）	Prepared by （编 制）	Checked （审 核）	Date （日 期）
A	First publish（首次编写）	ZengHuiMin	ChenFuJin	2020-09-17
B	The weight of laser welding changed from 4200g to 4250g （由于激光焊重量由 4200g 变更为 4250g）	ZengHuiMin	ChenFuJin	2021-01-05
C	Add smart storage capabilities （增加智能存储功能）	ZengHuiMin	ChenFuJin	2021-03-24
D	Update parameters 更新参数	Linli	Zhaoshixing	2021-10-08

Appendix

附

Customer's Checking Criterion

（customer required）

客户验收标准（客户必填）：

√ By Grepow's Testing Criterion for Lithium Polymer Battery。

按格瑞普电池有限公司电池检验标准

□ By Customer's Testing Request and Criterion（Customer must supply the checking criterion）

按客户要求检验（需附验货标准）

Content
目录

1. Scope 适用范围

This document describes the Product Specification of the Lithium-Polymer (LIP) rechargeable battery cell supplied by Grepow Battery Corporation Limited.

本规格说明书描述了深圳市格瑞普电池有限公司生产的可充电聚合物锂离子电池的产品性能指标

2. Specification 产品规格

NO.	Items	Specifications
1	Connecting mode（组合方式）	12 S 1 P （十二串一并）
2	Nominal capacity（标称容量）	16000mAh @ 0.2C Discharge（放电）
3	Minimum capacity（最小容量）	15500mAh @ 0.2C Discharge（放电）
4	Nominal voltage（标称电压）	44.4V（Cell 3.7V）
5	PACK Voltage(As of shipment) 电池电压（出货状态）	45~46.2V（Cell 3.75~3.85V）
6	Internal Impedance（内阻）	≤20mΩ
7	Dimensions（尺寸）	MAX（T*W*H）： 151.5* 81.5 * 219.5mm
8	Pack weight（电池重量）	4250g (APPROX)
9	Standard Charge 标准充电	3.2A CC（constant current）charge to 50.4V,then CV(constant voltage 50.4V)charge till charge current decline to ≤0.02C； 3.2A CC（恒流）充电至 50.4V，再 CV（恒压 50.4V）充电直至充电电流≤0.02C；
10	Rapid Charge 快速充电	Constant Current：16A，Constant Voltage：50.4V，0.02C cut-off； 持续电流：16A，持续电压：50.4V 截止电流：0.02C；
11	Charging time 充电时间	Standard Charging：7.5 hours(Ref.) 标准充电：7.5 小时（参考值） Rapid charge：1.5 hours(Ref.) 快速充电：1.5 小时（参考值）
12	Standard Discharge current 标准放电电流	Standard current：3.2A，end voltage：42.6V； 标准电流：3.2A，截止电压：42.6V；
13	Max Constant Discharge current 最大持续放电电流	Max Constant current：60A(Limited by overcurrent of connector) end voltage：42.6V； 最大持续电流：60A（受插头过流限制）截止电压：42.6V；
14	High Rate Discharge 倍率放电性能	≥12.5min Standard Charge/rest 5min discharge at 60A to 42.6V； 标准充电/静置 5 分钟用 60A 放电至 42.6V；

Notice: Please do not assemble the battery privately，Parallel charging for two packs of batteries maybe lead to short circuit or ignition。

If no otherwise specified, an interval rest time is 30min between charging and discharging。

注意：请勿私自组装电池，将两组电池并联在一起进行充电，此有可能造成短路或燃烧。

如果没有特别说明，电池充放电间隔时间为 30 分钟

3. Protection Circuit Characteristics (at 25℃)保护板特性

3.1 保护板参数

类别 Category	项目 Item	规格（典型值）Specification (typical value)	备注 (Remarks)
充电参数 Charging parameters	最大充电电压 Maximum charging voltage	50.4V	
	最大充电电流 Maximum charging current	25.0A	
	工作温度（充电） Working temperature (charging)	+5℃－+45℃	
放电参数 Discharge parameters	可持续工作电流 Continuous working current	60A	
	峰值电流 Peak current	< 150A	3 秒
	工作温度(放电） Working temperature (discharge)	+10℃－+60℃	
采集误差 Acquisition tolerance	采集串数 Acquisition of Serials battery	12S	
	单体电压采集误差 Acquisition tolerance of single cell voltage	± 5mV	25℃
	电流采集误差 Acquisition tolerance of current	<5%	25℃
	温度采集误差 Acquisition tolerance of temperature	± 2℃	
均衡功能 Balancing function	均衡方式 Balancing method	内置被动均衡 Built-in passive balancing	
	单体电压均衡启动门限 Activation of single cell voltage balancing	3950mV	
	均衡电流 Balancing current	30-50mA	
	单体电压差均衡启动门限 Activation of single cell voltage tolerance balancing	>40mV	
	单体电压差均衡关闭门限 Inactivation of single cell voltage tolerance balancing	< 20mV	
电量管理 Capacity management	SOC 容量统计误差 SOC capacity statistics tolerance	< 5%	
	SOC 过低告警值 Low SOC alarm value	< 5%	
功耗参数 Power consumption	运行状态功耗 Working power consumption	< 10mA	

parameters	休眠静态功耗 Sleeping mode power consumption	< 500uA	
保护参数 Protection parameters	单体电池过充告警值 Overcharge alarm value of single cell	> 4.250±0.05V	指示灯指示告警 LED Indicator Alarm
	单体电池过充告警延时值 Overcharge alarm latency value of single cell	2-5 秒 2-5(S)	
	单体电池过充告警恢复值 Overcharge alarm release value of single cell	< 4.180±0.05V	
	单体电池过放告警值 Over-discharge alarm value of single cell	< 3.30±0.10V	
	单体电池过放告警延时值 Over-discharge alarm latency value of single cell	2~5 秒 2-5(S)	
	单体电池过放告警恢复值 Over-discharge alarm release value of single cell	> 3.65±0.10V	
	低温警告值(放电/待机) Low temperature alarm value (discharge/standby)	＜10℃	指示灯指示告警 LED Indicator Alarm
	高温告警值 High temperature alarm value	> 50℃	指示灯指示告警 LED Indicator Alarm
	充电高温告警值延时值 Latency value of high temperature alarm when charging	2~5 秒 2-5(S)	
	充电高温告警恢复值 Release value of high temperature alarm when charging	< 45℃	
	充电低温告警值 Low temperature alarm value when charging	< 4 ℃	指示灯指示告警 LED Indicator Alarm
	充电低温告警值延时值 Latency value of low temperature alarm value when charging	2~5 秒 2-5(S)	
	充电低温告警恢复值 Release value of low temperature alarm when charging	> 15℃	
	充电过流告警值 Over-current alarm value when charging	> 50A	指示灯指示告警 LED Indicator Alarm
	充电过流告警延时值 Latency value of over-current alarm when charging	2~5 秒 2-5(S)	
	充电过流告警恢复 Release value of over-current alarm when charging	断开电源 Disconnect the power	
	短路保护 Short-circuit protection	/	
	短路保护延时 Latency value of short circuit protection	/	

	短路保护恢复 Release value of short circuit protection	/	
	电池组反充电保护 Battery pack anti-charging protection	/	
通信 Communication	CAN	支持 Support	

注：以上参数为推荐参考值,如有细微修订，恕不另行通知。

Note: The above parameters are recommended values for reference, which is subject to minor revision without notice.

3.2 工作状态说明

3.2.1 Working status description 通常状态

通常状态保护板正确连接上电后，在没有过压、欠压、过流、短路以及过温等告警状态发生时，可以进行正常充放电。

After the BMS is correctly connected and powered on, normal charging and discharging can be performed when no warning circumstance such as over-voltage, under-voltage, over-current, short circuit, and over-temperature occur.

3.2.2 Overcharge alarm and release 过充告警和恢复

当任意一电芯电压 VCELL 大于过充电保护电压且持续时间超过延时时间，BMS 判定为过充，白色状态灯与红色状态灯会同时亮起发出告警，当电芯电压恢复到过充电恢复电压时，状态解除。

When the voltages of any single cells are beyond the overcharge limit and the duration exceeds the latency time, the BMS will define it as overcharged, in this case, the white and red LEDs will be light up at the same time to give an alarm.

3.2.3 Over discharge and recovery 过放电和恢复

当任意一电芯电压 VCELL 小于过放电保护电压且持续时间超过延时时间，BMS 判定为过放，当电芯电压恢复到过放电恢复电压时，状态解除。

When the voltage of single cells are lower than over discharge limit and the duration is longer than the latency time, the BMS will define it as over discharged. The white and red LEDs will be off and the alarm will be released until the cell voltages are back to normal status.

3.2.4 Over temperature alarm and recovery 过温告警和恢复

当 BMS 监测到温度上升或下降到告警值且持续时间超过延时告警时间时过温保护，当温度下降或上升到温度恢复值，状态解除。

The over-temperature protection will be activated when the BMS detects the temperature rises or falls to the alarm value and the duration exceeds the latency time, until the temperature falls or rises to the temperature recovery value.

静止或放电过程中：

During standstill or discharge

1：10℃＜T＜50℃时，所有状态灯不亮；

1: When 10℃＜T＜50℃, all indicator lights are off;

2：50℃≤T≤85℃时，只闪白灯报警并记录；

2: When 50℃≤T≤85℃, only the white light flash as alarm and record.

3：T＞85℃时，只闪红灯报警并记录，T≤80℃后，红灯报警取消，变更为只闪白灯。

3: When T>85℃, only red light flash as alarm and record, after T≤80℃, the red light alarm will release and change to

white light flash only.

4：T≤10℃时，只闪白灯并记录，T≥15℃后恢复，取消报警，白灯熄灭。

4: When T≤10℃, only the white light flash as alarm and record, when T≥15℃, the alarm release and the white light is off.

充电过程中：

During charging:

1：4℃＜T＜50℃，所有状态灯不亮

4℃＜T＜50℃, all indictor lights are off;

2：50℃≤T≤75℃时，只闪白灯报警并记录。

When 50℃≤T≤75℃, only the white light flash as alarm and record.

3：T＞75℃时只闪红灯报警并记录，T≤70℃后，红灯报警取消，变更为只闪白灯。

When T>75℃, only the red light flash to alarm and record, when T≤70℃, the red light alarm release and change to the white light flash only.

4：T≤4℃时，只闪白灯报警并记录，T≥15℃后恢复，取消报警，白灯熄灭

When T≤4℃, only the white light flash as alarm and record, when T≥15℃, the alarm release and the white light is off.

3.2.5 Over-current and recovery 过流和恢复

当充电或放电电流超过充电／放电电流值且持续时间超过延时时间，保护板过流告警，达到恢复时间时，状态解除。放电过流时,不会有指示灯警告.充电过流时,白色灯亮表示警告.

When charging or discharging current is over the limit and the duration is longer than the latency time, the BMS will define it as over current. The alarm will be released until the current is back to normal status. No indicators will alarm when the discharge current exceeds the limit, but the white light will be on as an alarm when the charging current is over limit.

3.2.6 Voltage difference alarm of single cell 单节压差大报警

1.任何电压下，压差≥300mV 时，只亮红灯报警并记录。

When the voltage difference is ≥300mV under any status, the red light is on as alarm and record.

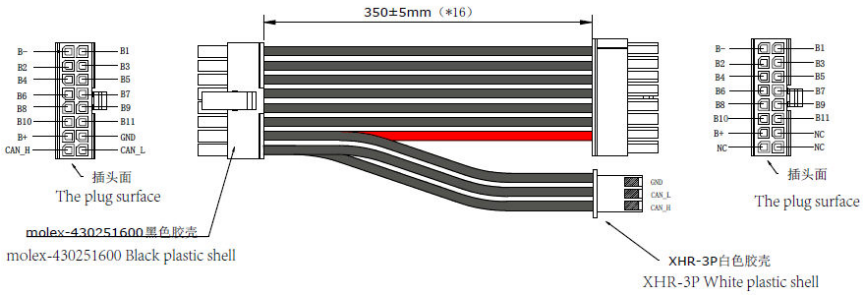
2.＜3.7V 时，压差恢复到＜280mV，取消报警，红灯熄灭.

When Voltage <3.7V, and the voltage difference returns to <280mV, the alarm will release and the red light is off.

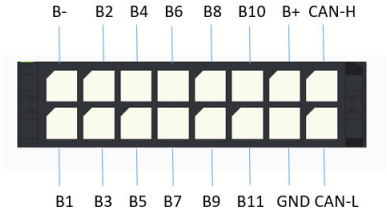
3.≥3.7V，≥100mV，只亮白灯报警并记录，恢复到＜80mV 后，白灯熄灭。

When Voltage ≥3.7V, and the voltage difference≥100mV, the white light is on as alarm and record. When it returns to <80mV, the white light will be off.

4. Battery wiring definition diagram 电池配线定义图



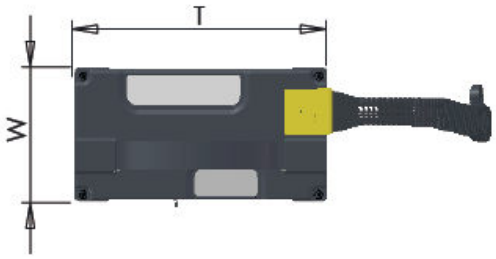
5. Pack Drawing 组装示意图

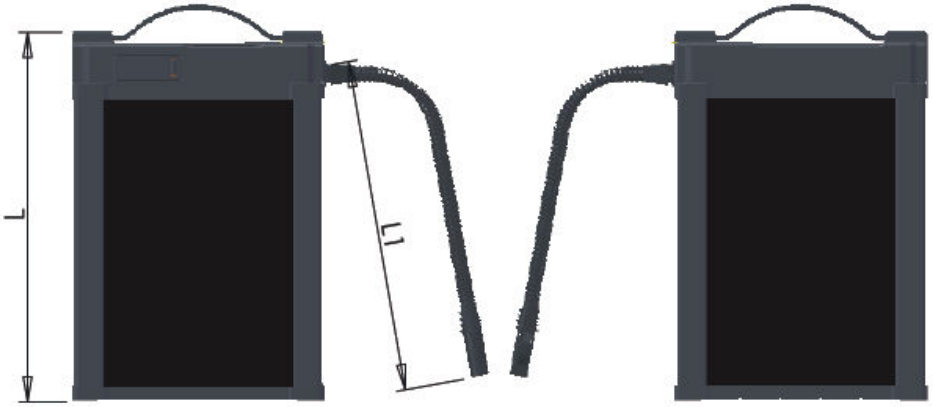


产品参数 Product parameters：

项目 Items	标准 Standard
厚度 Thickness(T)	150±1.5mm
宽度 Width(W)	80±1.5mm
长度 Length(L)	217±2.5mm
放电线出线长（含插头）L1	230±10mm

均衡口定义 Definition of balancing port



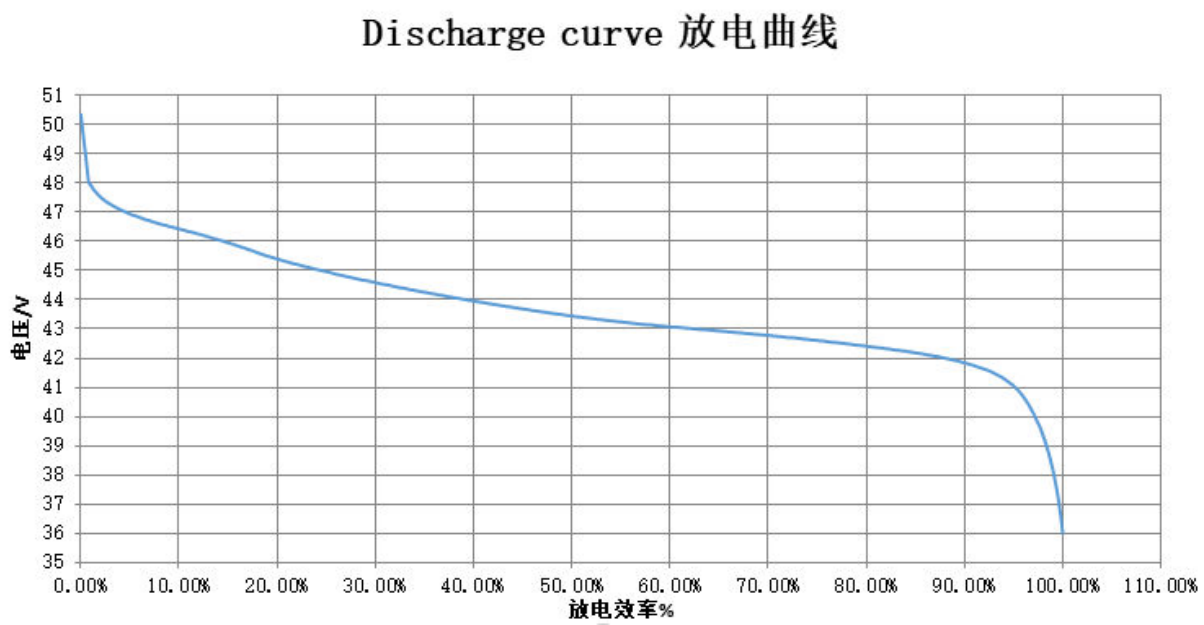


Product BOM 产品 BOM

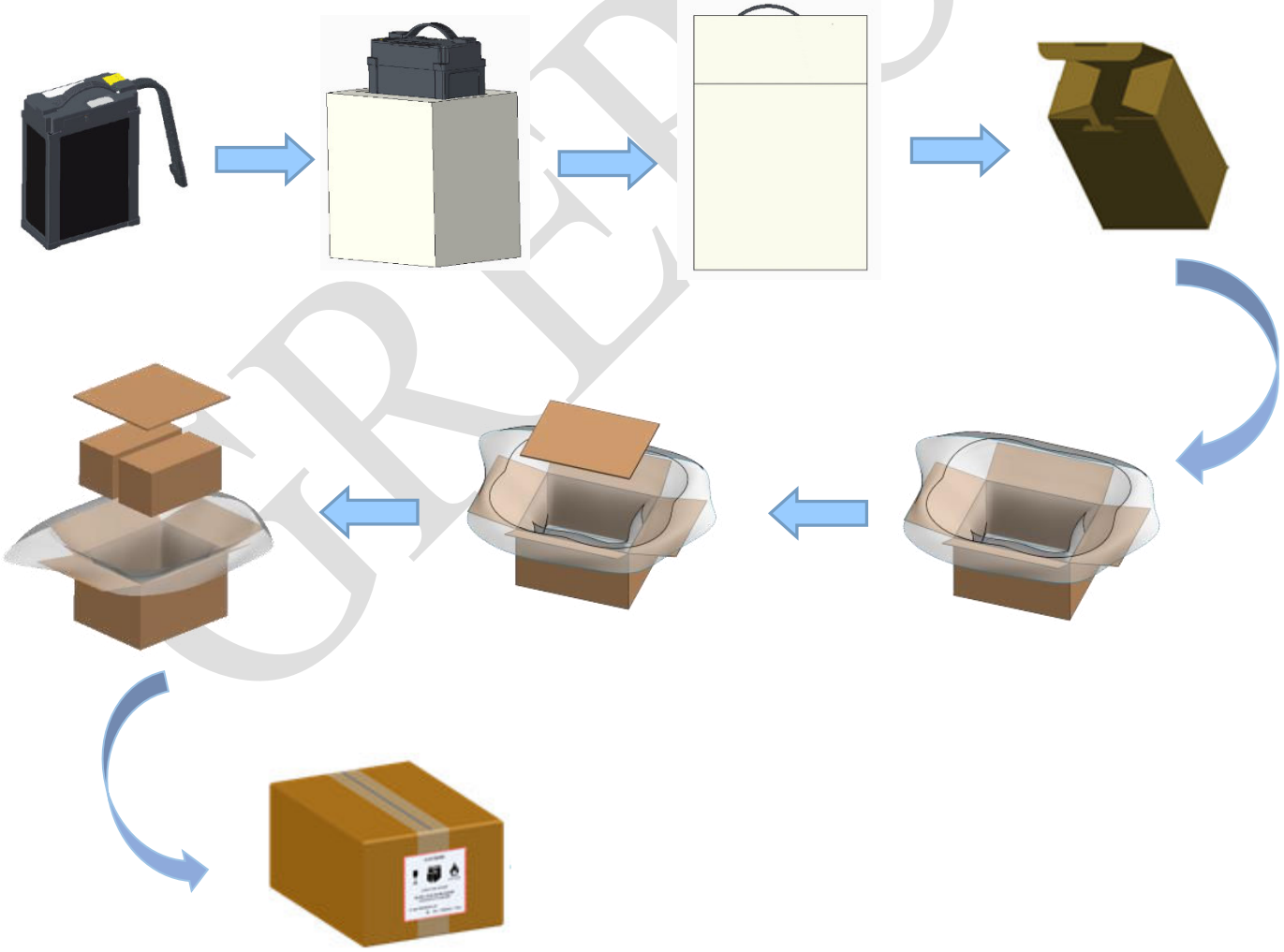
No.	名称	规格型号	用量	单位	备注
01	电芯	GRPA770175 -16000mAh	12	Pcs	A 品
02	放电线	XT90S 防打火公头，8 包胶#线	1	Pcs	出 230mm
03	均衡口	Molex-430251600 卧式，反向	1	Pcs	
04	外壳	铝合金-黑色	1	Pcs	

标记	处数	变更内容		成品电池组 GRPA770175-12S1P	图纸号：		
					客户名称	比列	
设计		样品确认		深圳市格瑞普电池有限公司 SHENZHEN GREPOW BATTERY CO.,LTD			
绘图		复核			共 页	第 页	
审核		批准					
版本	A	日期	2021-10-08				

6. Discharge curve 放电曲线

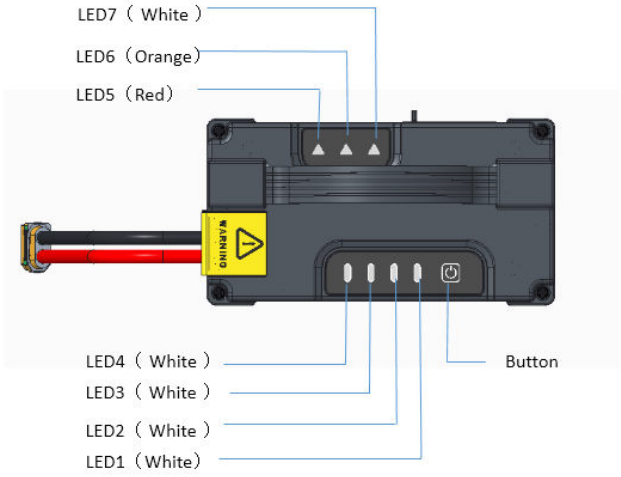


7. Package Schemes 包装示意



8. Operating Instruction 使用说明

8.1 Description of control board and LEDs 控制面板、指示灯说明



8.2 Button function 按键功能

8.2.1 Check: When battery is power-off, press the button shortly, the LED indicates the remaining capacity, then it will be off after 5 seconds;

查看：关机状态，短按按键，LED 指示电量，5S 后熄灭；

8.2.2 Power on: When the battery is power-off, press the button shortly,the LED indicates the remaining capacity, press and hold the button for more than 2 seconds before the LEDs off, the LEDs will light up from the right to the left, then the battery will be power on, remaining capacity will be indicated on LED.

开机：关机状态下，短按按键，LED 指示电量，在灯没有熄灭状态下，再长按按键 2 秒以上，电量指示灯从右到左依次全亮，开机完成，随后 LED 指示当前电量。

8.2.3 Power off: When the battery is power-on, press the button shortly , 4 LEDs are flash, press and hold the button for more than 2 seconds, the LEDs will light off from the left to the right, then the battery will be power off.

关机：电池开机状态下，短按按键，4 个 LED 全闪，再长按按键 2 秒以上，LED 指示灯从左到右依次全灭，电池进入关机状态。

8.2.4 Health indicator: When the battery is power-off, press and hold the button for more than 5 seconds, the LEDs will display the battery's remaning lifetimes.

健康指示：关闭状态下，长按键 5S 以上，电量指示灯显示电池的寿命

8.3 Smart capacity indicator 智能电量指示

There are 4 LEDs on the BMS to indicate battery capacity in 8 levels;

BMS 设计了 4 个 LED，分 8 等级指示电池电量；

Note: ● on ; ○ off; ⊙ flash

说明：●表示常亮；○ 表示熄灭；⊙ 表示闪烁；

8.3.1 Capacity in standby and discharge status

待机与放电状态下的电量指示

容量 Capacity	LED1	LED2	LED3	LED4
0%~12%	⊙	○	○	○
13%~24%	●	○	○	○
25%~37%	●	⊙	○	○
38%~49%	●	●	○	○
50%~62%	●	●	⊙	○
63%~74%	●	●	●	○
75%~94%	●	●	●	⊙
95%~100%	●	●	●	●

8.3.2 Capacity in charging status 充电状态的电量指示

容量 Capacity	LED1	LED2	LED3	LED4
0%~12%	⊙	⊙	⊙	⊙
13%~37%	●	⊙	⊙	⊙
38%~62%	●	●	⊙	⊙
63%~94%	●	●	●	⊙
95%~100%	●	●	●	●

Note: Charging when battery is power-on , battery indicators will be off 10 minutes after fully charged .

注：开机状态下进入充电，充满电后电量指示灯10分钟后全熄灭。

Charging when battery is power-off, battery indicators will be off 10 minutes after fully charged.

关机状态下进入充电，充满电后电量指示灯全熄灭。

8.3.3 Remaining life times 剩余使用寿命指示灯

Press and hold the button for 5 seconds when the battery is power-off, LEDs indicate the current remaining battery life times.

电池关闭状态长按按键 5S , LED 显示电池当前剩余使用寿命。

剩余寿命 Remaining battery life	LED1	LED2	LED3	LED4
88%~100%	●	●	●	●
75%~87%	●	●	●	⊙
63%~74%	●	●	●	○
50%~62%	●	●	⊙	○
38%~49%	●	●	○	○
25%~37%	●	⊙	○	○
13%~24%	●	○	○	○
12%以下 Under 12%	⊙	○	○	○

8.4 Status LEDs indication 状态 LED 指示

①. 红色LED：电池处于二级告警状态，此状态下电池不能继续使用。

Red LED: the battery is in the second alarm state, and the battery can't be used any more in this state.

②. 白色LED：电池处于一级告警状态，此状态下电池不适合使用。

White LED: the battery is in the first-level alarm state, and the battery is not suitable for use in this state.

③. 错误指示：红灯与白灯同时亮起。

Error: The red and white lights are on at the same time.

红色 Red（LED5）	白色 White （LED7）	说明 Description
⊙	○	过温二级告警 Overheating secondary alarm
●	○	压差二级告警 Differential pressure secondary alarm
●	○	电池电量过低 Low battery
○	⊙	过温一级告警 Overheating primary alarm
○	●	压差一级告警 Differential pressure first-level alarm
●	●	电池过放、短路等错误告警 Error alarm such as battery overdischarge and short circuit

8.5 Sleeping mode 休眠功能

When the battery is turned on for 10 minutes, BMS will enter into the sleeping mode to reduce the self-consumption, it can be activated to normal working status with charging or discharging. When the voltage of any single cell is lower than 3.65V, in order to keep the battery in safety, the BMS will enter the secondary power-saving mode. In this mode, the battery pack needs to be charged in time to avoid irreversible damage to the battery; if the battery is damaged, the user must scrap the battery or return it to the original factory for safety inspection!

If the battery enters deep sleeping mode due to extremely low capacity and long-term idle, please power it on manually and charge the battery immediately.

当电池开机10分钟后，BMS进入系统休眠，降低自耗，充电或放电可以激活到正常工作状态。

当任一单节电池电压低于3.65V后，为了保证电池安全，BMS将进入二级节能模式，在此模式下，电池组需要及时充电,避免对电池造成不可逆损坏;若电池损坏，用户必须将电池报废或返回原厂进行安全检查！

若因电池电量严重不足且闲置时间过长导致电池将进入深度睡眠模式后，需要手动开机唤醒，并立即对电池充电。

8.6 Self-balancing mode 自均衡功能

When the battery is left for more than 6 hours, if the BMS detects that the voltage difference of each cell meet the preset value, the self-balancing mode is activated.

当电池静置时间>6小时后，如果BMS检测到各单元电芯的电压差值达到预设值,均衡功能被触发。

8.7 Smart Storage Mode 智能存储功能

If battery will not be used in several days, store the battery at 40~70％ SOC. If store at full SOC,the battery will

trigger smart storage function(self-discharging to 40~70％ SOC, battery temperature will go up during self-discharging). The battery should be put into safety box for long-term storage. Never store the battery at full discharged status, otherwise cell will be damaged and cannot be used anymore.

超过 5 天不使用电池，请将电池放电至 40~70％电量存放，可延长电池的使用寿命。如将电池满电状态存储，电池会自动开启智能存储功能（由满电放电至合适存储的电量，放电过程电池温度可能会升高，这属正常现象）。建议将电池存放在专用电池箱内。切勿将电池彻底放完电后长时间存储，以避免电池进入过放状态，造成电芯损坏，将无法恢复使用。

8.8 Software upgrading function 软件升级功能

The software can be updated. Directly turn the CAN port to USB port, then connect to computer to realize software update.

BMS具有软件升级功能，可通过专用的升级通讯转换模块，将CAN口转为USB口连接电脑后通过上位机进行软件升级，更新电池软件。

8.9 Battery log record function 电池日志记录功能

BMS can record all using data of battery, including cell voltage, current, battery temperature, cycle times and error status times etc.

BMS设计有日志记录功能，能够对电池整个生命过程的数据记录存储。电池日志信息包含单体电压，电流，电池温度，循环次数，异常状态次数等.

9. Performance And Test Conditions 电池性能测试条件

9.1 Standard test condition（标准测试条件）

Before proceed the following tests, the battery should be discharged at 0.2C to 42.6V cutoff. Unless otherwise stated, tests should be done within one month of delivery under the following conditions:

Ambient temperature: 23℃±2℃ Relative Humidity: ≤75%RH

Note Standard Charge/Discharge Conditions:

Charge: The battery will be charged to 50.4V with 0.2C from constant current to constant voltage, when the current is 0.05C, stop to charge.;

Discharge: 0.2C to 42.6V

在进行下例各项测试前电池应用 0.2C 放电至 42.6V。如果没有特别规定，测试应在电池交付 1 个月内按以下各项条件进行：

环境温度：23℃±2℃ 相对湿度：≤75%RH

注意标准充放电为：

充电：以 0.2C 电流恒流充电至限制电压 50.4V 时,改为恒压充电,直到截止电流为 0.05C 时停止充电;

放电：以 0.2C 电流恒流放电至限制电压 42.6V

9.2 Visual inspection 外观检查

There shall be no such defect as scratch, flaw, crack, and leakage, which may adversely affect commercial value of the cell..

不允许有任何影响电池性能的外观缺陷，诸如裂纹、裂缝、泄漏等。

9.3 Measuring Instrument or Apparatus（测量器具及设备）

9.3.1 Dimension Measuring Instrument（尺寸测量器具）

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.

尺寸测量器具的精度等级应不小于 0.01 mm 。

9.3.2 Voltmeter（伏特计）

Standard class specified in the national standard or more sensitive class having inner impedance more than 10kΩ/V

按照国家标准指定规格等级或采用灵敏度更高的，测量电压时内阻不应小于 10kΩ/V。

9.3.3 Ammeter（安培计）

Standard class specified in the national standard or more sensitive class. Total external resistance including ammeter and wire is less than 0.01Ω.

按照国家标准指定规格等级或采用灵敏度更高的，包括电流表及电线在内的总外阻应小于 0.01Ω。

9.3.4 Impedance Meter（电阻计）

Impedance shall be measured by a sinusoidal alternating current method (1kHz LCR meter).

内阻测试仪测量原理应为交流阻抗法（1kHz LCR）。

9.4 Routine Inspection And Testing Of Battery Performance 电池常规性能检查及测试

NO	Items	Test Method and Condition	Criteria
1	Discharge Performance at different temperature 不同温度下放电特性	High Temperature： Storage 2hrs at 60±2℃ after standard charge,0.2C discharge at 60±2℃ 高温：标准充电后储存在 60±2℃的环境中，2 小时后用 0.2C 放电	≥90%
		Normal Temperature：Standard Charge / Discharge 常温：标准充放电	≥100%
		Low Temperature：Storage 2hrs at 0±2℃ after standard charge,0.2C discharge at 0±2℃ 低温：标准充电后储存在 0±2℃ ，2 小时后用 0.2C 放电	≥90%
		Low Temperature： Storage 4hrs at -20±2℃ after standard charge,0.2C discharge at -20±2℃ 低温：标准充电后储存在-20±2℃ ，4 小时后用 0.2C 放电	≥70%
2	Cycle Life 循环寿命	Test condition： Step1：Charge: 8A to 50.4V , end current 0.05C Step2：Rest :30min Step3：Discharge: 60A to 42.6V Step4：cycle from step 1 to step 3 More than 80% first capacity at 60A discharging 测试条件： 1）恒流恒压充电：8A 充电到 50.4V 限流 0.05C 2）静置：30min 3）恒流放电：60A 放电到 42.6V 4）循环 1）至 3）工步 当以 60A 放电容量小于初始容量 80%时，所完成的循环次数定义为该电芯的循环寿命	≥300 Circle

3	Charge retention 荷电保持	20 ℃ for 28days 常温 28 天	Standard charge，storage：28days at 20±2℃ 0.2C discharge at 20±2℃to test residual capacity 标准充满电后 20±2℃贮藏 28 天。 然后常温下 0.2C 放电, 所得容量为剩余容量	Residual capacity ≥90% （First Capacity） 剩余容量≥90%初始容量
			Standard charge/discharge for 3 cycles，to test recovery capacity 按标准充放电制式循环 3 次，取最大值为恢复容量	Recovery Capacity ≥95%（First Capacity） 恢复容量≥95%初始容量
	High Temperature storage Characteristics 高温储存特性		Residual capacity≥95%,容量保持率≥ 95 %， Recovery Capacity≥95%,容量恢复率≥ 95 %， Thickness Variation≤ 5%,厚度增加≤ 5 %， Impedance Variation≤ 10%,内阻增加≤ 10 %	60℃ for 4 hours 60℃ 4 小时

Appendix 1

附录 1

Handling Precautions and Guideline For LIP(Lithium-Ion Polymer)Rechargeable Batteries 聚合物锂离子充电电池操作指示及注意事项

Preface

This document of' Handling Precautions and Guideline for LIP Rechargeable Batteries shall be applied to the battery cells manufactured by GREPOW.

前言

本文件“聚合物锂离子充电电池操作指示及注意事项”仅适用于深圳市格瑞普电池有限公司生产的电池。

Note(1):

The customer is requested to contact GREPOW in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.

声明一：

客户若需要将电池用于超出文件规定以外的设备，或在文件规定以外的使用条件下使用电池，应事先联系格瑞普，因为需要进行特定的实验测试以核实电池在该使用条件下的性能及安全性。

Note(2):

GREPOW will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

声明二：

对于在超出文件规定以外的条件下使用电池而造成的任何意外事故，格瑞普概不负责。

Note(3):

GREPOW will inform, in a written form, the customer of improvement(s) regarding proper use and handing of the cell, if it is deemed necessary.

声明三：

如有必要，格瑞普会以书面形式告之客户有关正确操作使用电池的改进措施。

1. Charging 充电

1.1 Charging current 充电电流:

Charging current should be less than maximum charge current specified in the Product Specification. Charging with higher current than recommended value may cause damage to cell electrical, mechanical and safety performance and could lead to heat generation or leakage.

充电电流不得超过本标准书中规定的最大充电电流。使用高于推荐值电流充电将可能引起电池的充放电性能、机械性能和安全性能的问题，并可能会导致发热或泄漏。

1.2 Charging voltage 充电电压:

Charging shall be done by voltage less than that specified in the Product Specification 50.4V. Charging beyond 51V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition.

It is very dangerous that charging with higher voltage than maximum voltage may cause damage to the cell electrical, mechanical safety performance and could lead to heat generation or leakage.

充电电压不得超过本标准书中规定的额定电压 50.4V。51V 为充电电压最高极限，充电器设计应满足此条件。

电芯电压高于额定电压值时，将可能引起电池的充放电性能、机械性能和安全性能的问题，可能会导致发热或泄漏。

1.3 Charging temperature 充电温度:

The battery shall be charged within 10℃~45℃ range in the Product Specification.

电池必须在 10℃~45℃的环境温度范围内进行充电。

1.4 Prohibition of reverse charging 禁止反向充电:

Reverse charging is prohibited. The battery shall be connected correctly. The polarity has to be confirmed before wiring, In case of the battery is connected improperly, the battery cannot be charged. Simultaneously, the reverse charging may cause damaging to the battery which may lead to degradation of battery performance and damage the battery safety, and could cause heat generation or leakage.

正确连接电池的正负极，严禁反向充电。若电池正负极接反，将无法对电池进行充电。同时，反向充电会降低电池的充放电性能、安全性，并会导致发热、泄漏。

2. Discharging 放电

2.1 Discharging current 放电电流

The battery shall be discharged at less than the maximum discharge current specified in the Product Specification.

High discharging current may reduce the discharging capacity significantly or cause over-heat.

放电电流不得超过本标准书规定的最大放电电流，大电流放电会导致电池容量剧减并导致过热。

2.2 Discharging temperature 放电温度

The battery discharge temperature is -20~60℃, 10~45℃ environment suggested when Discharge with large current , small current discharge suggested under ＜10℃ or ＞45℃, Discharged under too low or too high temperature could lead to battery failure or other

conditions.

电池放电环境温度为-20~60℃，大电流放电建议在 10~45℃环境下进行，＜10℃或＞45℃建议用小电流进行放电，过低或过高温度大电流放电将可能导致电池失效或出现其他状况。

2.3 Over-discharging 过放电:

It should be noted that the battery would be at over-discharged state by its self-discharge characteristics in case the cell is not used for long time. In order to prevent over-discharging, the battery shall be charged periodically to maintain between 44.4V and 46.8V.

Over-discharging may causes loss of cell performance, characteristics, or battery functions.

The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voyage specified in the Product Specification. Also the charger shall be equipped with a device to control the recharging procedures as follows:

The battery pack shall start with a low current (0.01C) for 15-30 minutes, i.e.-charging, before rapid charging starts. The rapid charging shall be started after the (individual) cell voltage has been reached above 3.0V within 15-30 minutes that can be determined with the use of an appropriate timer for pre-charging. In case the (individual) cell voltage does not rise to 3.0V within the pre-charging time, then the charger shall have functions to stop further charging and display the cell/pack is at abnormal state.

需要注意的是，在电池长期未使用期间，它可能会用其它自放电特性而处于某种过放电状态。为防止放电的发生，电池应定期充电，将其电压维持在 44.4V 至 46.8V 之间。

过放电会导致电池性能、电池功能的丧失。

充电器应有装置来防止电池放电至低于本标准书规定的截止电压。此外，充电器还应有装置以防止重复充电，步骤如下：

电池在快速充电之前，应先以一小电流（0.01C）预充电 15~30 分钟，以使（每个）电芯的电压达到 3.0V 以上，再进行快速充电。可用一记时器来实现该预充电步骤。如果在预充电规定时间内，（个别）电池的电压仍未升到 3.0V 以上，充电器应能够停止下一步快速充电，并显示该/电池正处于非正常状态。

3. Storage 贮存

3.1 Storage condition 储存条件

When voltage is over 46.8V, battery should be stored in the environment humidity ≤75%RH， temperature -20~35℃. Storage time should be less than 7 days.

When voltage is 44.4V~46.8V, battery could be stored for long term in the environment humidity ≤75%RH, temperature -20~35℃.Need to active the battery once every three month, so as to keep voltage during 44.4V~46.8V;

Storage time ＞7 days, voltage is NOT allowed to be higher than 46.8V.

环境湿度≤75%RH，温度-20~35℃，电压大于 46.8V 时储存时间≤7 天；

环境湿度≤75%RH，温度-20~35℃，电压 44.4V~46.8V 时可长期储存，3 个月需要激活一次。保持电压处于 44.4V~46.8V；

禁止在高电压下（电压＞46.8V）长时间（＞7 天）储存。

3.2 Please activate the battery once every 3 months according to the following method:

Charge at 0.2C to 50.4V, rest 5 min, then discharge with 0.2C to 3.0V/cell,rest 5 min, then charge at 0.2C to 46.8V.

请每隔 3 个月按下面方法激活电池一次:

0.2C 充电至 50.4V，休息 5 分钟，然后用 0.2C 放电至每颗电池 3.0V，休息 5 分钟，0.2C 充电 46.8V。

4. Handling of Cells 电池操作注意事项

Since the battery is packed in soft package, to ensure its better performance, it's very important to carefully handle the battery

由于电池属于软包装，为保证电池的性能不受损害，必须小心对电池进行操作。

4.1 The protection of soft aluminum foil 铝箔包装材料的防护

The soft aluminum packing foil is very easily damaged by sharp edge parts such as Ni-tabs, pins and needles.

·Don't strike battery with any sharp edge parts;

·Trim your nail or wear glove before taking battery;

·Clean worktable to make sure no any sharp particle.

铝箔包装材料易被尖锐部件损伤，诸如镍片，尖针。

·禁止用尖锐部件碰撞电池；

·取放电池时，请修短指甲或戴上手套；

·应清洁工作环境，避免有尖锐物体存在。

4.2 Folding edge 折边

The folding edge is form in battery process and passed all hermetic test

·Don't open or deform folding edge

折边在电池生产过程中已完成，并通过了密封测试。

·禁止打开或破坏折边。

4.3 Mechanical shock 机械撞击

·Don't Fall, hit, bend battery body

· 禁止坠落、冲击、弯折电池。

5. Notice20Designing Battery Pack 电池外壳设计注意事项

5.1 Pack design 外壳设计

·Battery pack should have sufficient strength and battery should be protected from mechanical shock

·No Sharp edge components should be inside the pack containing the battery.

·电池外壳应有足够的机械强度以保证其内部电芯免受机械撞击。

·外壳内安装电芯的部位不应有锋利的边角。

6. Notice20for Assembling Battery Pack 电池与外壳组装注意事项

6.1 Cell fixing 电池的安装

·The battery should be fixed to the battery pack by its large surface area.

·No cell movement in the battery pack should be allowed.

·应将电池的宽面安装在外壳内；

·电池不得在壳内活动。

7. Others 其它事项

7.1 Prevention of short circuit within a battery pack 电池短路预防

Enough insulation layers between wiring and the cells shall be used to maintain extra safety

protection.

线与电芯之间需要做充分绝缘，保持电池安全

7.2 Prohibition of disassembling 严禁拆卸电池

1）Never disassemble the cells 在任何情况下不得拆卸电池

The disassembling may generate internal short circuit in the cell, which may cause gassing, firing, or other problems.

拆卸电池可能会导致内部短路，进而引起鼓气、着火及其它问题。

2）Electrolyte is harmful 电解液有害

LIP battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

聚合物锂电池理论上不存在流动的电解液，但万一有电解液泄漏而接触到皮肤、眼睛或身体其它部位，应立即用清水冲洗电解液并就医。

7.3 Prohibition of dumping of cells into fire 严禁将电池投入火中

Never incinerate nor dispose the cells in fire. These may cause firing of the cells, which is very dangerous and is prohibited.

在任何情况下，不得燃烧电池或将电池投入火中，否则会引起电芯燃烧，这是非常危险的，应绝对禁止。

7.4 Prohibition of cells immersion into liquid such as water 严禁将电池浸入液体 ，如水

The cells shall never be soaked with liquids such as water, seawater drinks such as soft drinks, juices coffee or others.

不得将电池浸泡液体，如淡水、海水、饮料（果汁、咖啡等）。

7.5 Battery cells replacement 电芯的更换

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

更换电芯应由电芯供应商或设备供应商完成，用户不得自行更换。

7.6 Prohibition of use of damaged cells 禁止使用已损坏的电池

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of electrolyte, electrolyte leakage and others, the cells shall never be used any more.

The cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing.

电池在运输过程中可能因撞击等原因而损坏，若发现电池有任何异常特征，如电池塑料封边损坏，外壳破损，闻到电解液气体，电解液泄漏等，该电池不得使用。有电解液泄漏或散发电解液气味的电池应远离火源以避免着火。

7.7 Other The Chemical Reaction 其它的化学反应

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even when they are charged correctly, this may indicate it is time to change the battery.

电池是利用化学反应产生电量，电池性能会随时间变差，即使电池长时间储存而不使用。另外，各种各样的使

用方法，像充电、放电及环境温度，等等不能在本规格书规定的范围时的情形，会减小电池的期望寿命，或者会使仪器设备由于电池漏液而损坏。即使充电正确，电池长时间不能再充电，那就要更换电池了。

7.8 Note: Any other items which are not covered in this specification shall be agreed by both parties

注意：任何本产品规格书未包含的其它条款，应由双方协议确定。

Appendix 2

附录 2

1. Term 术语

Document Term 文档术语

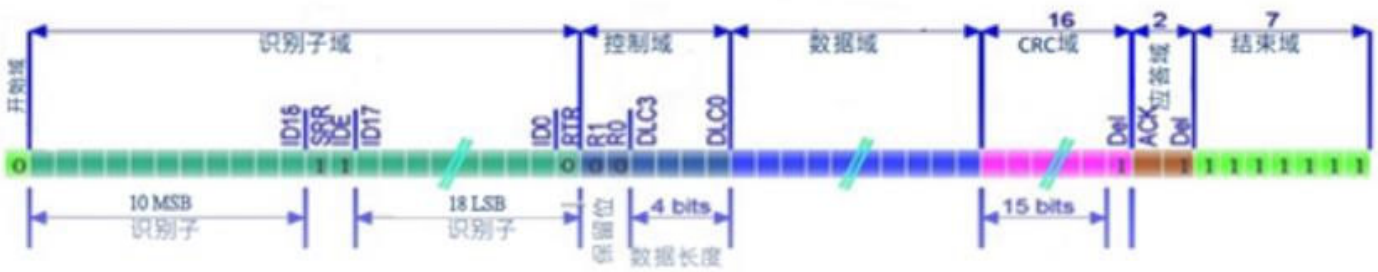
术语	解释说明
BMS	Battery Management System 电池管理系统
CAN	Controller Area Network 控制器局域网络同时是一种通讯协议。

2. Protocol Definition 协议定义

2.1. CAN 协议

CAN 协议基于标准 CANBus 2.0B 协议。基于 29bit 的扩展帧。通讯速率为 1MKbps。

CAN protocol is based on the standard CANBUS 2.0B protocol. Based on 29bit extended frame. The communication rate is 1Mbps.



The format of battery transmission protocol frame is as follows:

电池发送协议帧格式如下：:

2.1.1. ID field

In E -UAVCAN protocol, only the data frame defined in CANBUS be used, and all the data is transmitted through

the data frame. the data frame is defined as follows:

在 E -UAVCAN 协议中，我们只用到了 CANBus 中定义的数据帧，所有的数据通过数据帧来传输。我们将数据帧定义成以下格式：

Message frame

Field name	Priority					Message type ID													Service not message	Source node ID						
CAN ID bits	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Allowed values																						0	1...127						
CAN ID bytes	3					2																1	0						

In the case of a message broadcast transfer, the CAN ID field of every frame of the transfer will contain the following fields:

Field	Bits	Allowed values	Description
Priority	5	0-31	默认填最高优先级:0 Fill the highest priority by default:0
Message type ID	16	0x1092	查询模式 Query mode
Service or message	1	0	0x 1092----此位为 0； 0x 1092----This bit is 0;
Source node ID	7	1…127	0 是保留的，代表一个未知的节点; 自身的节点 Id; 0 is reserved and represents an unknown node; Own node Id;

※ BMS 默认 Source node ID 为 0x16。
BMS default Source node ID is 0x16。

2.1.2. CANBus2.0B 规定 CAN 总线传输每一帧数据位 8Byte。如下图所示：
CANBUS 2.0B specifies that the CAN bus transmits 8 bytes of each frame data. As shown in the figure below:

CAN payload

Field name	Transfer payload	Start of transfer / End of transfer / Toggle / Transfer ID							
Payload byte	Up to 7 bytes	Tail byte							
Bit position		7	6	5	4	3	2	1	0

CAN 协议规定，将 Payload 的 8Byte 划分为两部分：

According to CAN protocol, the 8byte of payload is divided into two parts:

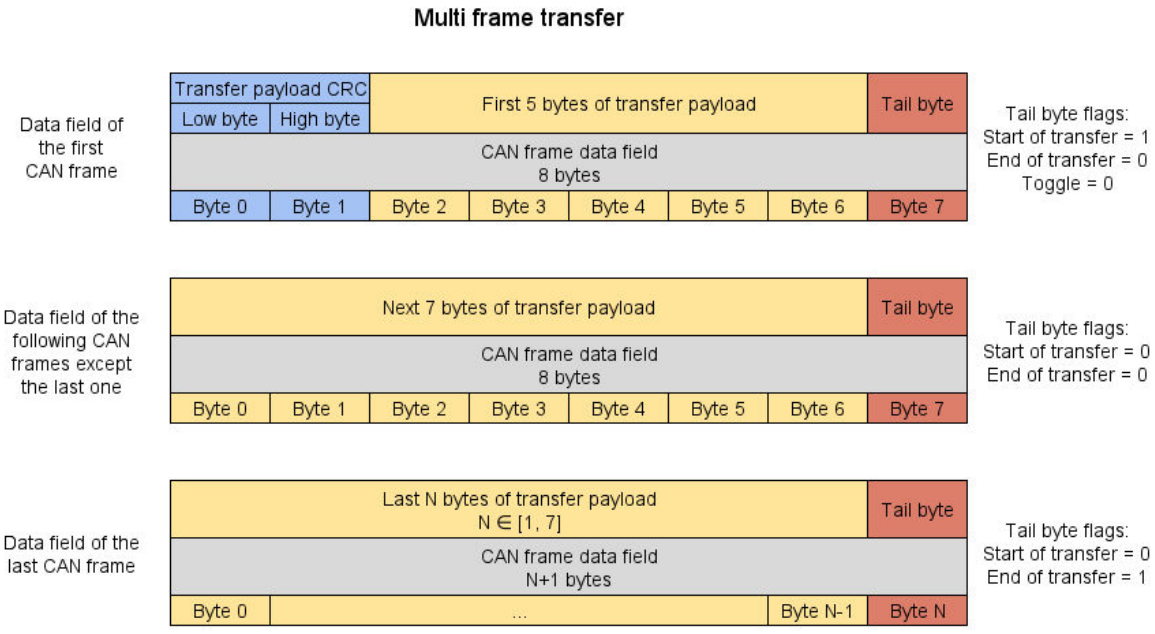
Field	Field Description
Transfer payload	Actual payload of the transfer
Tail byte	The last byte of the CAN frame data field that contains auxiliary fields of the transport layer

Transfer payload is the actual payload data transferred, and Tail byte contains the following information:

其中 Transfer payload 为实际传输的 payload 数据，Tail byte 则包含以下信息：

Field	Bits	Description
Start of transfer	1	See below
End of transfer	1	See below
Toggle bit	1	See below
Transfer ID	5	The transfer ID value

multi-frame transfer 多帧传输:



2.1.2.1. Start of transfer 开始传输

For multi-frame transfers, the value of this field is 1 if the current frame is the first frame of the transfer, and 0 otherwise.

对于多帧传输，如果当前帧是传输的第一帧，则该字段的值为 1，否则为 0。

2.1.2.2. End of transfer 传输结束

For multi-frame transfers, the value of this field is 1 if the current frame is the last frame of the transfer, and 0 otherwise.

对于多帧传输，如果当前帧是传输的最后一帧，则该字段的值为 1，否则为 0。

2.1.2.3. Toggle bit 切换点

For multi-frame transfers, this field contains the value of the toggle bit, which is specified above.

对于多帧传输，该字段包含上面指定的切换位的值

2.1.2.4. Transfer ID 传输 ID

For all kinds of transfers, this field contains the transfer ID value of the current transfer.

The value is 5 bits wide, therefore the allowed values range from 0 to 31, inclusively.

对于所有类型的传输，该字段包含当前传输的传输 ID 值。

该值是 5bits 宽，因此允许的值范围从 0 到 31。

2.2.BMS message BMS 通讯

name	Data Type ID	message type	description	note
info	0x1092	Message	电池主动上报的信息，包括：厂商编号，电池型号编码，电池电压等,具体见表 6.2.1. The information actively reported by the battery includes: manufacturer number, battery model code, battery voltage, etc. see table 6.2.1 for details	4HZ，自主上报

All messages or data are in the data domain of frame format, and 7 valid data are transmitted at a time.

所有的消息或者数据，均处于帧格式中的数据域，一次传送 7 个有效数据。

2.2.1. Info(0x1092)

Data field: 12S 数据域：12S

字段 Field	说明 Description	长度 bytes	备注 Notes
厂商编号 Manufacturer number	类型为 short The type is short	2	*********
电池型号编码 Battery model code	类型为 short The type is short	2	
电池电压 Battery voltage	类型为 unsigned short，单位（mv） The type is short, unit(mv)	2	
充放电电流 Charge and discharge current	类型为 short，单位（10mA） 注：正数充电，负数放电 The type is short, unit(mv) Notes: positive number for charging, negative number for discharging	2	
电池温度 Battery temperature	类型为 short,单位（1℃） The type is short, unit(1℃)	2	
电量百分比 Capacity percentage	类型为 unsigned short, 单位（%） The type is unsigned short, unit (%)	2	
循环计数 Cycle count	类型为 unsigned short 单位（次数） The type is unsigned short, unit (times)	2	

健康状况 Health condition	类型为 short，单位（%） The type is short, unit(%)	2	依照电池化学特性曲线分析生成 According to the chemical characteristic curve of the battery
电池 1 电压 Battery 1 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 2 电压 Battery 2 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 3 电压 Battery 3 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 4 电压 Battery 4 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 5 电压 Battery 5 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 6 电压 Battery 6 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 7 电压 Battery 7 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 8 电压 Battery 8 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 9 电压 Battery 9 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 10 电压 Battery 10 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 11 电压 Battery 11 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池 12 电压 Battery 12 voltage	类型为 unsigned short，单位（mv） The type is unsigned short, unit (mv)	2	
电池设计容量 Battery design capacity	类型为unsigned short，单位（mAh） The type is unsigned short, unit	2	0

	(mAh)		
电池剩余容量 Battery remaining capacity	类型为unsigned short，单位（mAh） The type is unsigned short, unit (mAh)	2	0
错误信息 Error message	Uint32		每位表示一种错误类型的状态 Each bit represents the status of an error type

Notes: All datas are little 注：所有的数据是小端

2.3. List of error messages 错误信息列表

Bit ID	description	Note
Bit0	电池温度过低 Battery low temperature	1---表示错误发生 1 --- indicates that an error has occurred 0---表示没有错误 0 --- indicates that no error
Bit1	电池过温 Battery over temperature	
Bit2	充电过流 Charging over current	
Bit3	放电过流 Discharging over current	
Bit4	总电压欠压 Total-voltage low voltage	
Bit5	总电压过压 Total-voltage over voltage	
Bit6	单节压差过大 Over voltage difference of single cell	
Bit7	单节电压过压 Over voltage of single cell	
Bit8	单节电压欠压 Low voltage difference of single cell	
Bit9	充电短路 Charging short circuit	
Bit10	放电短路 Discharge short circuit	
Bit11	电池剩余容量过低 Low battery remaining capacity	
Bit12	非原装充电器充电 Charging with non original charger	
Bit13….Bit31	保留 reserved	

Notes: All datas are little

注：所有的数据是小端

3.CRC 算法

附 CRC 算法 Attached CRC algorithm

```
#define              CRC_CCITT_INIT                  0xFFFF
#define              CRC_CCITT_POLY                  0x1021U
void CCITT_CRC16Init(uint8_t const * bytes, uint16_t len)
{
CCITT_CRC16 =CRC_CCITT_INIT;
CCITT_CRC_ARRAY(bytes,len);
 }
void CCITT_CRCStep(uint8_t byte)
{
uint32_t j;
CCITT_CRC16 ^= ((uint16_t)byte << 8); for
            (j = 0; j < 8; j++)
{
CCITT_CRC16=(CCITT_CRC16 & 0x8000U)?((CCITT_CRC16 << 1) ^ CRC_CCITT_POLY):(CCITT_CRC16   << 1);
}
}
void CCITT_CRC_ARRAY(uint8_t const * bytes, uint16_tlen)
{
while (len--) CCITT_CRCStep(*bytes++);
```