

SPECIFICATION

产品规格书

Revision: 1.2

Model No.:M4S2P14466-MM

Description: Rechargeable Battery Pack

|                |            |               |            |                |            |
|----------------|------------|---------------|------------|----------------|------------|
| PREPARED<br>编写 | Date<br>日期 | CHECKED<br>审核 | Date<br>日期 | APPROVED<br>批准 | Date<br>日期 |
| 肖晓娟            | 2023-5-30  |               |            |                |            |

Approved BY Valued Customer

|               |            |                  |            |                  |            |
|---------------|------------|------------------|------------|------------------|------------|
| CHECKED<br>审核 | Date<br>日期 | APPROVED<br>批准 1 | Date<br>日期 | APPROVED<br>批准 2 | Date<br>日期 |
|               |            |                  |            |                  |            |

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| 序号<br>No. | 日期<br>Date | 版本<br>Revision | 变更记录<br>Changes                                    |
|-----------|------------|----------------|----------------------------------------------------|
| 1         | 2022.10.28 | 1.0            | 初版                                                 |
| 2         | 2023.2.7   | 1.1            | 短路保护电流由 42A 改为 41A,延时由 500uS 改为 700uS,<br>更新电池循环寿命 |
| 3         | 2023.5.30  | 1.2            | 更新功能框图，指示灯部分内容                                     |
|           |            |                |                                                    |

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## 1 部件总述

### 1.1 简介

本文描述了电池包的结构尺寸，外观，功能参数和电性能方面的参数，电池包由 8 节 18650 电芯，保护板（PCM），输出连接器，外壳等组成。电芯成组方式采用 4 串 2 并方式（4S2P），单个电芯的额定电压 3.6V，额定容量 3.4Ah，电池包的额定电压为 14.4V，额定容量 6.6Ah。电池包采用 SMB 通讯方式，充电器可以通过 SMB 获取当前的充电电压，充电电流参数，主机可以读取电池的电量、电压、温度、电流等信息。PCM 采用智能电池管理芯片方案，包含一级保护和二级保护功能，可以提供过压、过流、高温、低温、低压等保护功能，有效提高电芯的循环寿命，确保电芯的充放电安全可靠。

### 1.2 专用术语及缩写

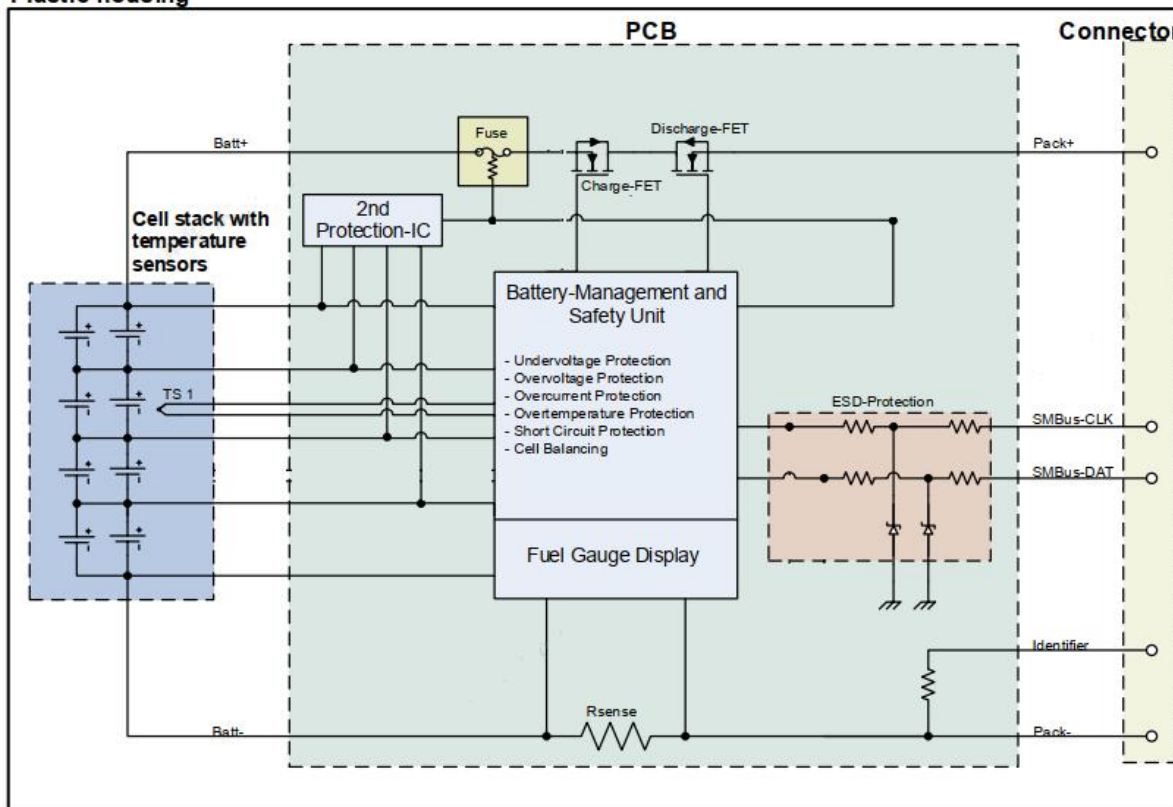
如下的表格为文中使用的专用术语的缩写方式

| 序号 | 缩写  | 专用术语   |
|----|-----|--------|
| 1  | PCM | 电池保护板  |
| 2  | CC  | 恒流     |
| 3  | CV  | 恒压     |
| 4  | FG  | 电量计    |
| 5  | PF  | 永久失效保护 |

## 2 系统框图

下图是电池包的系统框图，包含 8 个电芯，智能电池管理 IC，二次保护 IC，充放电保护 MOSFET, fuse, 温度探头，电流采样电阻等。

## Plastic housing



### 3 主要参数介绍

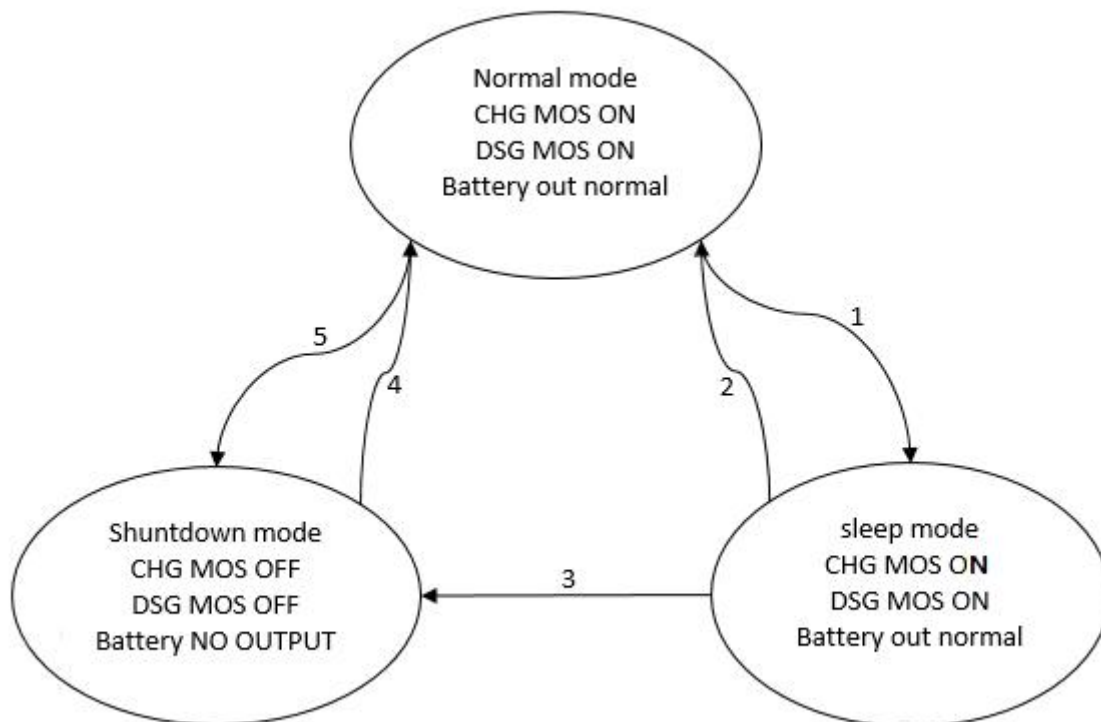
电池包基本参数（除非有特殊说明，否则所有测试要求为：温度在  $23\pm2^{\circ}\text{C}$  条件下）

| 类型       | 参数数值                     | 备注                                                                           |
|----------|--------------------------|------------------------------------------------------------------------------|
| 电芯型号     | INR18650-35E             | 三星                                                                           |
| 额定电压     | 14.4V                    |                                                                              |
| 电池包额定容量  | 6.6Ah                    | $23\pm2^{\circ}\text{C}$ , CC-CV 16.8V/1.32A, 132mA 截止充电后, 以 1.32A 放电至欠压所测容量 |
| 标准充电     | 16.8V/1.32A, 132mA 截止充电  |                                                                              |
| 标准放电     | 1.32A 放电, 放电截止电压 10.4V   |                                                                              |
| 最大充电电压   | 16.8V                    | 16.8V 为推荐的充电电压                                                               |
| 最大充电电流   | 3A                       |                                                                              |
| 预充电电流    | <1A                      | 当电芯电压为 1.8V 至 2.5V                                                           |
| 最大放电电流   | 8.5A                     |                                                                              |
| 充/放电保护电压 | 4.25V/2.6V               | 单个电芯最大/最小电压值                                                                 |
| 循环寿命     | 500cycles 后电量不低于 70%初始容量 | 16.8V/0.3C 充 340mA 截止, 1C 放                                                  |
| 通讯方式     | SMB                      | 请参考 TI BQ40Z50-R2 手册                                                         |

## 4 电池包功能描述

### 4.1 电池工作模式

电池包包含三种工作模式，分别为正常模式，休眠模式，关机模式。每个模式的工作状态及切换关系如下图，在不同的工作模式用于不同的场景。

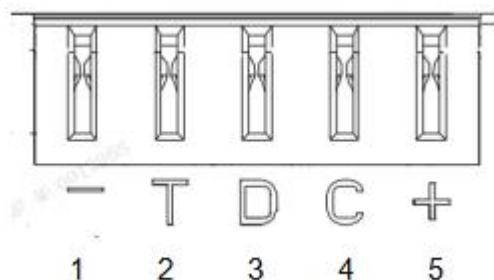


不同工作模式切换说明：

- 1) 电池电流绝对值小于 10mA，未检测到充电机连接，无通讯；
- 2) 有通讯, 或电流绝对值大于 10mA , 或接充电机；
- 3) 电芯电压低于 2300mV；
- 4) 检测到充电机连接到接口；
- 5) 发送 Shutdown command.

三种模式的功耗依次为正常模式>休眠模式>关机模式。在运输过程中电池默认处于关机模式，功耗最低。新出厂电池需充电激活后使用。

## 4.2 输出接口定义



|          |                                                                              |                 |
|----------|------------------------------------------------------------------------------|-----------------|
| 连接器型号    | TE: 146845-1                                                                 |                 |
| 推荐适配对接型号 | TE: 5787422-1 弯角防呆插件<br>5787430-1 直角防呆插件<br>5787446-1 直角插件<br>5787441-1 弯角插件 |                 |
| 孔位       | 标示符                                                                          | 描述              |
| 1        | PACK-                                                                        | 电池输出负极          |
| 2        | TEMP                                                                         | 内部 NTC (阻抗表如附件) |
| 3        | SMB Data                                                                     | SMBUS SDA       |
| 4        | SMB Clock                                                                    | SMBUS SCL       |
| 5        | PACK+                                                                        | 电池输出正极          |

## 5 PCM 保护板参数设置

| 序号 | 项目            | 保护等级       | 参数范围                                          | 保护动作    |         |
|----|---------------|------------|-----------------------------------------------|---------|---------|
|    |               |            |                                               | CHG FET | DSG FET |
| 1  | 过压保护<br>COV   | 一级保护       | 保护电压 : $4.25 \pm 0.025V$                      | OFF     | ON      |
|    |               |            | 保护延迟时间 : $1 + 2.5s / -0.5s$                   | /       | /       |
|    |               |            | 保护解除电压: $4.00 \pm 0.025V$                     | /       | /       |
|    |               | PF保护       | 保护电压: $4.30V$ 延时 $20s + 2.5s / -0.5s$         | OFF     | OFF     |
|    |               | 二次过压<br>IC | 保护电压: $4.35 \pm 0.025V$ 延时 $3.5s \pm 1.5s$    | OFF     | OFF     |
| 2  | 欠压保护<br>CUV   | 一级保护       | 保护电压 : $2.6 \pm 0.025V$                       | ON      | OFF     |
|    |               |            | 保护延迟时间 : $1 + 2.5s / -0.5s$                   | /       | /       |
|    |               |            | 保护解除 : 电芯电压大于 $3.1V \pm 0.025V$               | /       | /       |
|    |               | PF保护       | 保护电压: $1.8 \pm 0.025V$ 延时 $5s + 2.5s / -0.5s$ | OFF     | OFF     |
| 3  | 充电过流保护<br>OCC | 一级保护       | 保护电流 : $3.5 \pm 0.25A$                        | OFF     | ON      |
|    |               |            | 保护延迟时间 : $3 + 2.5s / -0.5s$                   | /       | /       |
|    |               |            | 保护解除条件 : 等待 $5s + 2.5s / -0.5s$ 自恢复           | /       | /       |
|    |               | 二级保护       | 保护电流: $5 \pm 0.25A$                           | OFF     | ON      |
|    |               |            | 保护延迟时间: $1 + 2.5s / -0.5s$                    | /       | /       |
|    |               |            | 保护解除条件 : 等待 $5s + 2.5s / -0.5s$ 自恢复           | /       | /       |
|    |               | PF保护       | 保护电流: $7 \pm 0.25A$ 延时 $5s + 2.5s / -0.5s$    | OFF     | OFF     |

|    |               |            |                                |     |     |
|----|---------------|------------|--------------------------------|-----|-----|
|    |               | 预充电流<br>保护 | 保护电流: 1.05A±0.05A (1.8V-2.5V)  | OFF | ON  |
|    |               |            | 保护延迟时间: 2+2.5s/-0.5s           | /   | /   |
|    |               |            | 保护解除条件 : 等待5+2.5s/-0.5s        | /   | /   |
| 4  | 放电过流保护<br>OCD | 一级保护       | 保护电流1 : 11±0.25A               | ON  | OFF |
|    |               |            | 保护延迟时间1: 5+2.5s/-0.5s          | /   | /   |
|    |               |            | 保护解除条件 : 等待5s+2.5s/-1s自恢复      | /   | /   |
|    |               | 二级保护       | 保护电流2 : 14±0.25A               | ON  | OFF |
|    |               |            | 保护延迟时间2 : 1+2.5s/-0.5s         | /   | /   |
|    |               |            | 保护解除条件 : 等待5s+2.5s/-0.5s自恢复    | /   | /   |
|    |               | PF保护       | 保护电流: 15A 延时5s+2.5s/-0.5s      | OFF | OFF |
| 5  | 短路保护<br>SCD   | 一级保护       | 保护条件: 41±1.5A                  | OFF | OFF |
|    |               |            | 保护延迟时间: Max 700us              | /   | /   |
|    |               |            | 保护解除条件 : 等待10s+2.5s/-0.5s自恢复   | /   | /   |
| 6  | 过载保护<br>AOLD  | 一级保护       | 保护条件: 17.5±1A                  | OFF | OFF |
|    |               |            | 保护延迟时间: 31±2ms                 | /   | /   |
|    |               |            | 保护解除条件 : 等待10s+2.5s/-0.5s自恢复   | /   | /   |
| 8  | 充电过温保护<br>OTC | 一级保护       | 保护温度 : 45±2°C                  | OFF | ON  |
|    |               |            | 保护延迟时间 : 2+2.5s/-0.5s          | /   | /   |
|    |               |            | 保护解除条件 : 40±2°C                | /   | /   |
|    |               | PF保护       | 保护温度 : 85±2°C 延时10s+2.5s/-0.5s | OFF | OFF |
| 7  | 放电过温保护<br>OTD | 一级保护       | 保护温度 : 60±2°C                  | ON  | OFF |
|    |               |            | 保护延迟时间 : 2+2.5s/-0.5s          | /   | /   |
|    |               |            | 保护解除条件 : 55±2°C                | /   | /   |
|    |               | PF保护       | 保护温度 : 85±2°C 延时10s+2.5s/-0.5s | OFF | OFF |
| 8  | FET过温保护       | 一级保护       | 保护温度: 85±2°C                   | OFF | OFF |
|    |               |            | 保护延迟时间 : 5+2.5s/-0.5s          | /   | /   |
|    |               |            | 保护解除条件 : 65±2°C                | /   | /   |
| 9  | FET故障         | FUSE保护     | 保护电流: 500mA 延时5s+2.5s/-0.5s    | OFF | OFF |
| 10 | 充电低温保护<br>UTC | 一级保护       | 保护温度 : 0±2°C                   | OFF | ON  |
|    |               |            | 保护延迟时间 : 2+2.5s/-0.5s          | /   | /   |
|    |               |            | 保护解除条件 : 5±2°C                 | /   | /   |

|    |               |      |                     |    |     |
|----|---------------|------|---------------------|----|-----|
| 11 | 放电低温保护<br>UTD | 一级保护 | 保护温度：-20±3℃         | ON | OFF |
|    |               |      | 保护延迟时间：2+2.5s/-0.5s | /  | /   |
|    |               |      | 保护解除条件：-15±2℃       | /  | /   |

## 6 LED 指示灯

电池包有 4 个 LED 状态灯，通过按键来显示电池的电量信息，具体定义如下表，当电池包没有 CUV、PF 和 shutdown 的非充电状态时：

| Capacity | LED Indicators |   |   |   | Notes                       |
|----------|----------------|---|---|---|-----------------------------|
| 0—10%    | Blink          |   |   |   | 亮灯时间 4s<br>Light on time 4s |
| 11—25%   | X              |   |   |   |                             |
| 26—50%   | X              | X |   |   |                             |
| 51—75%   | X              | X | X |   |                             |
| 76—100%  | X              | X | X | X |                             |

## 7 SBS 指令

部分指令列表：

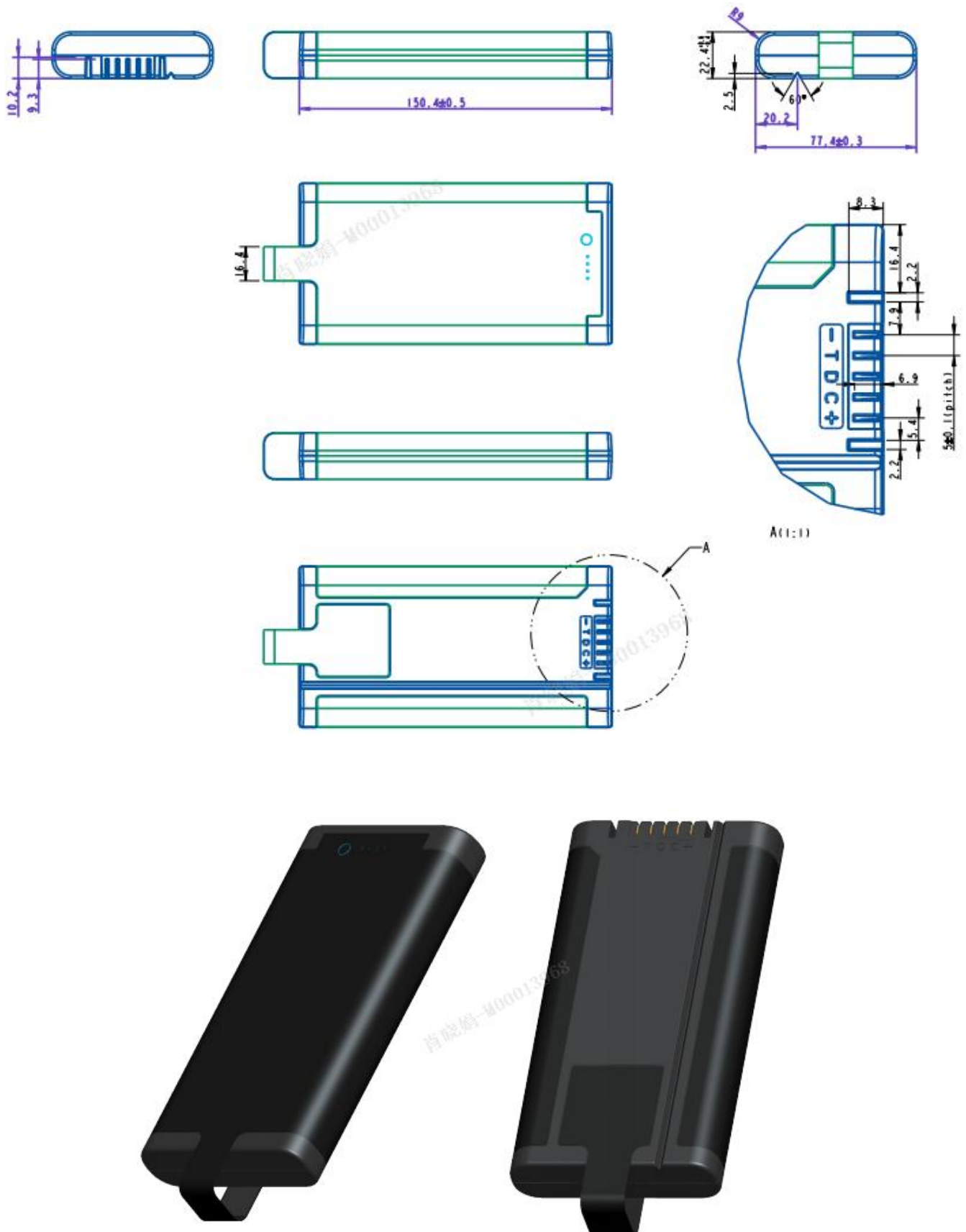
| SBS Cmd | Name                     | Access | Unit  |
|---------|--------------------------|--------|-------|
| 0x00    | ManufacturerAccess()     | R/W    | word  |
| 0x01    | RemainingCapacityAlarm() | R/W    | mAh   |
| 0x02    | RemainingTimeAlarm()     | R/W    | min   |
| 0x03    | BatteryMode()            | R/W    | /     |
| 0x04    | AtRate()                 | R/W    | mA    |
| 0x05    | AtRateTimeToFull()       | R      | min   |
| 0x06    | AtRateTimeToEmpty()      | R      | min   |
| 0x07    | AtRateOK()               | R      | /     |
| 0x08    | Temperature()            | R      | 0.1°K |
| 0x09    | Voltage()                | R      | mV    |
| 0x0A    | Current()                | R      | mA    |
| 0x0B    | AverageCurrent()         | R      | mA    |
| 0x0C    | MaxError()               | R      | %     |
| 0x0D    | RelativeStateOfCharge()  | R      | %     |
| 0x0E    | AbsoluteStateOfCharge()  | R      | %     |
| 0x0F    | RemainingCapacity()      | R      | mAh   |
| 0x10    | FullChargeCapacity()     | R      | mAh   |
| 0x11    | RunTimeToEmpty()         | R      | min   |
| 0x12    | AverageTimeToEmpty()     | R      | min   |
| 0x13    | AverageTimeToFull()      | R      | min   |

|      |                      |     |        |
|------|----------------------|-----|--------|
| 0x14 | ChargingCurrent()    | R   | mA     |
| 0x15 | ChargingVoltage()    | R   | mV     |
| 0x16 | BatteryStatus()      | R   | /      |
| 0x17 | CycleCount()         | R/W | cycles |
| 0x18 | DesignCapacity()     | R/W | mAh    |
| 0x19 | DesignVoltage()      | R/W | mV     |
| 0x1A | SpecificationInfo()  | R/W | /      |
| 0x1B | ManufacturerDate()   | R/W | /      |
| 0x1C | SerialNumber()       | R/W | /      |
| 0x20 | ManufacturerName()   | R   | ASCII  |
| 0x21 | DeviceName()         | R   | ASCII  |
| 0x22 | DeviceChemistry()    | R   | ASCII  |
| 0x23 | ManufacturerData()   | R   | /      |
| 0x3C | CellVoltage4()       | R   | mV     |
| 0x3D | CellVoltage3()       | R   | mV     |
| 0x3E | CellVoltage2()       | R   | mV     |
| 0x3F | CellVoltage1()       | R   | mV     |
| 0x4F | State-of-Health(SOH) | R   | %      |
| 0x51 | SafetyStatus         | R   | /      |
| 0x53 | PFStatus             | R   | /      |

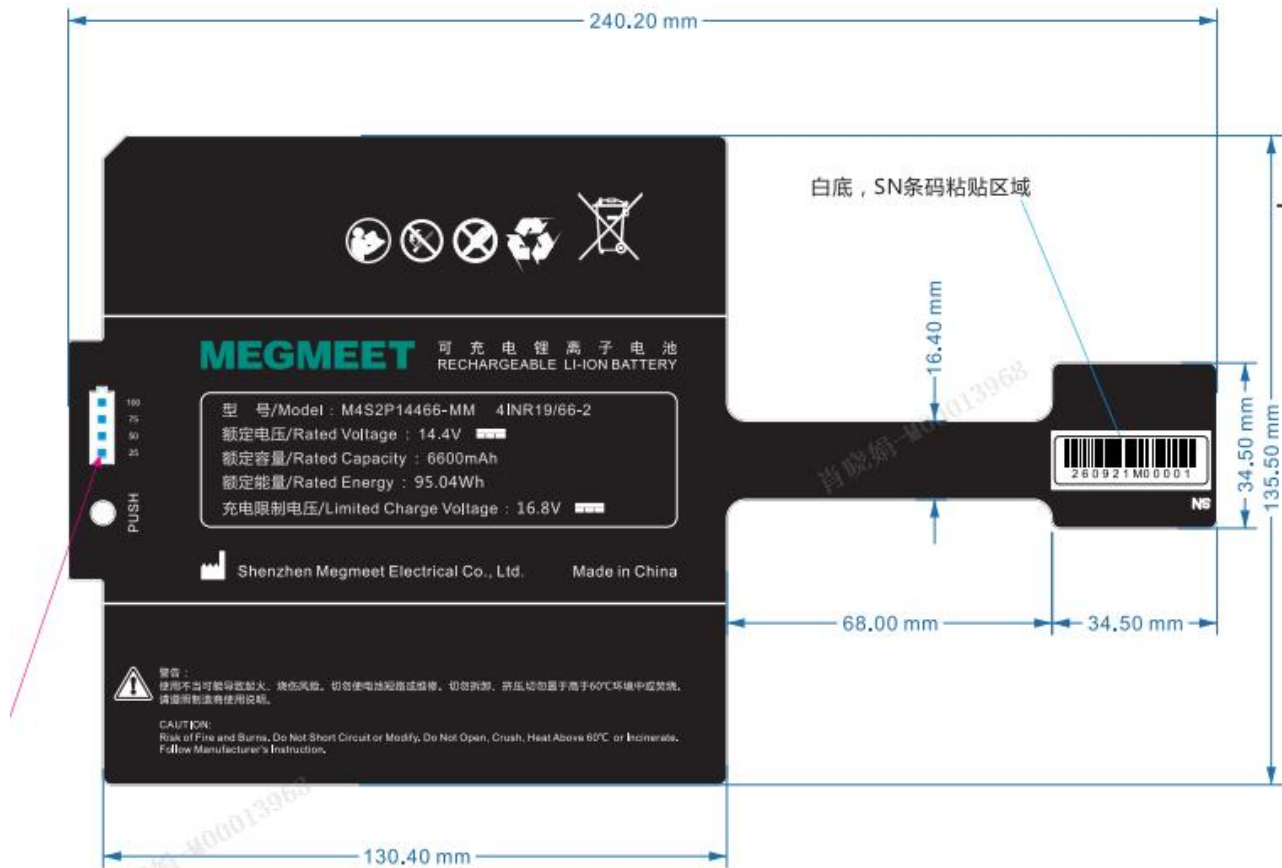
## 8 电池结构尺寸及标签

### 8.1 尺寸参数及尺寸图

| 项目          | 描述                                                                            | 备注 |
|-------------|-------------------------------------------------------------------------------|----|
| 尺寸          | 长 150.4*宽 77.4*高 22.4mm                                                       |    |
| 材料/Material | PC                                                                            |    |
| 电池包颜色       | 黑色                                                                            |    |
| 尺寸公差        | 未注公差：尺寸小于 10mm 时 +/- 0.1mm，尺寸在 10mm 和 25mm 之间 +/- 0.2mm，尺寸大于 25mm 时 +/- 0.25。 |    |
| 重量          | 约 470G                                                                        |    |



## 8.2 标签图



## 9 环境条件

### 9.1 环境温度

- Operating: Charge: 0°C to 45°C , Discharge: -20°C to 60°C
- Storage: -20°C to +60°C, Recommend bellow 23°C.
- 默认出厂容量在20%~30%之间, 按照出厂容量在小于23°C, 湿度小于65%条件下只能存储6个月。如需存储更长时间, 建议在6个月内充放电到50%~70%电量。电池存储时间大于6个月, 建议充电50%~70%电量, 每年需要充电一次到50~70%。电池长期存储时性能会有衰减。满充容量降低, 内阻增加。且此变化是不可逆的。高温下电池性能衰减更严重。

### 9.2 环境湿度

- Operating: Recommend bellow 90%RH,无凝露
- Storage: Recommend bellow 65%RH,无凝露

### 9.3 海拔高度

- Operating: 0 to 10000 feet(3077 meters)
- Storage: 0 to 15000 feet(4615 meters)

## 10 电池寿命

### 10.1 电池存储寿命

当电池在关机模式下储存时，每年需要做一次完整的放电/充电操作，以延长储存时间。默认出厂容量在 20%~30%之间，在小于 23°C，湿度小于 65%条件下只能存储 6 个月。如需存储更长时间，建议在每至少 6 个月充放电到 50%~70%电量。

### 10.2 电池循环寿命

恒流 1.98A 充电到 16.8V，再恒压充电到电流小于 340mA 截止。以 6.6A 恒流放电到欠压（10.4V 左右）。电池在 500 次上述充放电循环后，其放电容量应至少达到电池规格规定的 70%。

## 11 电池使用注意

1. 保持使用环境适宜：不应在高于 75°C 的环境下存储或使用，否则电池内部保险熔断，不可恢复正常使用。切勿将电池放在高温处，火边或置入火中，否则有爆炸危险。不可使电池进水，以免内部短路。

2. 长期不使用电池时，建议电池进入关机模式降低功耗，低温干燥环境存储，每超过 6 个月，充电一次，以保持使用寿命。

3. 避免对电池施加外力或使之从高处落下。

4. 勿将高于 6V 电压施加到正负极以外其他端口

5. 请不要让非专业技术人员拆开电池任何部分

6. 请将电池放置在远离幼儿及小孩的地方

7. 电池外部沾水或弄脏，请用干毛巾擦拭

8. 若闻电池有异味，应立即对电池进行隔离

## Recommendations to equipment manufacturers and battery assemblers

The following represents a typical, but non-exhaustive, list of good advice to be provided by the manufacturer of secondary cells and batteries to equipment manufacturers and battery assemblers.

- a) Do not dismantle, open or shred cells. Batteries should be dismantled only by trained personnel. Multi-cell battery cases should be designed so that they can be opened only with the aid of a tool.
- b) Compartments should be designed to prevent easy access to the batteries by young children.
- c) Do not short-circuit a cell or battery. Do not store cells or batteries haphazardly in a box or drawer where they may short-circuit each other or be short-circuited by conductive materials.
- d) Do not remove a cell or battery from its original packaging until required for use.
- e) Do not expose cells or batteries to heat or fire. Avoid storage in direct sunlight.
- f) Do not subject cells or batteries to mechanical shock.
- g) In the event of a cell leaking, do not allow the liquid to come into contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.
- h) Equipment should be designed to prohibit the incorrect insertion of cells or batteries and should have clear polarity marks. Always observe the polarity marks on the cell, battery and equipment and ensure correct use.
- i) Do not mix cells of different manufacture, capacity, size or type within a battery.
- j) Seek medical advice immediately if a cell or battery has been swallowed.
- k) Consult the cell or battery manufacturer on the maximum number of cells which may be assembled in a battery and on the safest way in which cells may be connected.
- l) A dedicated charger should be provided for each equipment. Complete charging instructions should be provided for all secondary cells and batteries offered for sale.
- m) Keep cells and batteries clean and dry.

- n) Wipe the cell or battery terminals with a clean dry cloth if they become dirty.
- o) Secondary cells and batteries need to be charged before use. Always refer to the cell or battery manufacturer's instructions and use the correct charging procedure.
- p) Do not maintain secondary cells and batteries on charge when not in use.
- q) After extended periods of storage, it may be necessary to charge and discharge the cells or batteries several times to obtain maximum performance.
- r) Retain the original cell and battery literature for future reference.
- s) When disposing of secondary cells or batteries, keep cells or batteries of different electrochemical systems separate from each other.

### **Recommendations to the end-users**

The following represents a typical, but non-exhaustive, list of good advice to be provided by the equipment manufacturer to the end-user.

- a) Do not dismantle, open or shred secondary cells or batteries.
- b) Keep batteries out of the reach of children  
Battery usage by children should be supervised. Especially keep small batteries out of reach of small children.
- c) Seek medical advice immediately if a cell or a battery has been swallowed.
- d) Do not expose cells or batteries to heat or fire. Avoid storage in direct sunlight.
- e) Do not short-circuit a cell or a battery. Do not store cells or batteries haphazardly in a box or drawer where they may short-circuit each other or be short-circuited by other metal objects.
- f) Do not remove a cell or battery from its original packaging until required for use.
- g) Do not subject cells or batteries to mechanical shock.
- h) In the event of a cell leaking, do not allow the liquid to come in contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.
- i) Do not use any charger other than that specifically provided for use with the equipment.
- j) Observe the plus (+) and minus (–) marks on the cell, battery and equipment and ensure correct use.
- k) Do not use any cell or battery which is not designed for use with the equipment.
- l) Do not mix cells of different manufacture, capacity, size or type within a device.
- m) Always purchase the battery recommended by the device manufacturer for the equipment.
- n) Keep cells and batteries clean and dry.
- o) Wipe the cell or battery terminals with a clean dry cloth if they become dirty.
- p) Secondary cells and batteries need to be charged before use. Always use the correct charger and refer to the manufacturer's instructions or equipment manual for proper charging instructions.
- q) Do not leave a battery on prolonged charge when not in use.
- r) After extended periods of storage, it may be necessary to charge and discharge the cells or batteries several times to obtain maximum performance.
- s) Retain the original product literature for future reference.
- t) Use the cell or battery only in the application for which it was intended.
- u) When possible, remove the battery from the equipment when not in use.
- v) Dispose of properly.

## **12 安规认证**

电池包可选择安规认证如下：

- 1) IEC 62133-2:2017+A1:2021
- 2) UN 38.3
- 3) 其他

## **13 环境关注**

全部机械零部件、PCB 板卡及电缆的设计需符合 RoHS&Reach 标准。

## 14 附录

A-输出 NTC R-T table

| Temperature<br>(°C) | Rmax.<br>(KΩ) | Rnor.<br>(KΩ) | Rmin.<br>(KΩ) | Temperature Tol.<br>(°C) |      | Resistance Tol.<br>(%) |       |
|---------------------|---------------|---------------|---------------|--------------------------|------|------------------------|-------|
| -21                 | 76.506        | 74.245        | 72.044        | -0.59                    | 0.60 | 3.0%                   | -3.0% |
| -20                 | 72.717        | 70.603        | 68.544        | -0.58                    | 0.60 | 3.0%                   | -2.9% |
| -19                 | 69.138        | 67.163        | 65.237        | -0.57                    | 0.59 | 2.9%                   | -2.9% |
| -18                 | 65.759        | 63.911        | 62.109        | -0.57                    | 0.59 | 2.9%                   | -2.8% |
| -17                 | 62.565        | 60.838        | 59.151        | -0.56                    | 0.58 | 2.8%                   | -2.8% |
| -16                 | 59.548        | 57.932        | 56.354        | -0.56                    | 0.57 | 2.8%                   | -2.7% |
| -15                 | 56.695        | 55.183        | 53.706        | -0.55                    | 0.57 | 2.7%                   | -2.7% |
| -14                 | 53.998        | 52.583        | 51.201        | -0.54                    | 0.56 | 2.7%                   | -2.6% |
| -13                 | 51.447        | 50.123        | 48.828        | -0.54                    | 0.56 | 2.6%                   | -2.6% |
| -12                 | 49.033        | 47.794        | 46.581        | -0.53                    | 0.55 | 2.6%                   | -2.5% |
| -11                 | 46.748        | 45.588        | 44.453        | -0.53                    | 0.54 | 2.5%                   | -2.5% |
| -10                 | 44.584        | 43.499        | 42.435        | -0.52                    | 0.54 | 2.5%                   | -2.4% |
| -9                  | 42.535        | 41.518        | 40.522        | -0.51                    | 0.53 | 2.4%                   | -2.4% |
| -8                  | 40.593        | 39.641        | 38.708        | -0.51                    | 0.52 | 2.4%                   | -2.4% |
| -7                  | 38.752        | 37.861        | 36.987        | -0.50                    | 0.52 | 2.4%                   | -2.3% |
| -6                  | 37.006        | 36.172        | 35.353        | -0.49                    | 0.51 | 2.3%                   | -2.3% |
| -5                  | 35.350        | 34.569        | 33.801        | -0.49                    | 0.50 | 2.3%                   | -2.2% |
| -4                  | 33.778        | 33.047        | 32.327        | -0.48                    | 0.50 | 2.2%                   | -2.2% |
| -3                  | 32.286        | 31.601        | 30.927        | -0.47                    | 0.49 | 2.2%                   | -2.1% |
| -2                  | 30.869        | 30.227        | 29.596        | -0.47                    | 0.48 | 2.1%                   | -2.1% |
| -1                  | 29.523        | 28.921        | 28.330        | -0.46                    | 0.48 | 2.1%                   | -2.0% |
| 0                   | 28.243        | 27.680        | 27.125        | -0.45                    | 0.47 | 2.0%                   | -2.0% |
| 1                   | 27.026        | 26.499        | 25.979        | -0.45                    | 0.46 | 2.0%                   | -2.0% |
| 2                   | 25.868        | 25.375        | 24.888        | -0.44                    | 0.45 | 1.9%                   | -1.9% |
| 3                   | 24.767        | 24.305        | 23.849        | -0.43                    | 0.45 | 1.9%                   | -1.9% |
| 4                   | 23.719        | 23.286        | 22.859        | -0.42                    | 0.44 | 1.9%                   | -1.8% |
| 5                   | 22.721        | 22.316        | 21.916        | -0.42                    | 0.43 | 1.8%                   | -1.8% |
| 6                   | 21.770        | 21.391        | 21.017        | -0.41                    | 0.42 | 1.8%                   | -1.7% |
| 7                   | 20.865        | 20.510        | 20.160        | -0.40                    | 0.42 | 1.7%                   | -1.7% |
| 8                   | 20.001        | 19.670        | 19.342        | -0.39                    | 0.41 | 1.7%                   | -1.7% |
| 9                   | 19.179        | 18.869        | 18.562        | -0.39                    | 0.40 | 1.6%                   | -1.6% |
| 10                  | 18.394        | 18.104        | 17.817        | -0.38                    | 0.39 | 1.6%                   | -1.6% |
| 11                  | 17.646        | 17.375        | 17.106        | -0.37                    | 0.39 | 1.6%                   | -1.5% |
| 12                  | 16.932        | 16.679        | 16.428        | -0.36                    | 0.38 | 1.5%                   | -1.5% |
| 13                  | 16.250        | 16.014        | 15.779        | -0.36                    | 0.37 | 1.5%                   | -1.5% |
| 14                  | 15.600        | 15.379        | 15.160        | -0.35                    | 0.36 | 1.4%                   | -1.4% |
| 15                  | 14.979        | 14.773        | 14.568        | -0.34                    | 0.35 | 1.4%                   | -1.4% |
| 16                  | 14.386        | 14.194        | 14.003        | -0.33                    | 0.35 | 1.4%                   | -1.3% |

|    |        |        |        |       |      |      |       |
|----|--------|--------|--------|-------|------|------|-------|
| 17 | 13.820 | 13.640 | 13.462 | -0.32 | 0.34 | 1.3% | -1.3% |
| 18 | 13.278 | 13.111 | 12.945 | -0.32 | 0.33 | 1.3% | -1.3% |
| 19 | 12.761 | 12.605 | 12.450 | -0.31 | 0.32 | 1.2% | -1.2% |
| 20 | 12.267 | 12.122 | 11.977 | -0.30 | 0.31 | 1.2% | -1.2% |
| 21 | 11.794 | 11.659 | 11.525 | -0.29 | 0.30 | 1.2% | -1.2% |
| 22 | 11.342 | 11.217 | 11.092 | -0.28 | 0.29 | 1.1% | -1.1% |
| 23 | 10.909 | 10.793 | 10.677 | -0.27 | 0.29 | 1.1% | -1.1% |
| 24 | 10.496 | 10.388 | 10.280 | -0.27 | 0.28 | 1.0% | -1.0% |
| 25 | 10.100 | 10.000 | 9.9000 | -0.26 | 0.27 | 1.0% | -1.0% |
| 26 | 9.7286 | 9.6286 | 9.5287 | -0.27 | 0.28 | 1.0% | -1.0% |
| 27 | 9.3728 | 9.2730 | 9.1734 | -0.28 | 0.29 | 1.1% | -1.1% |
| 28 | 9.0320 | 8.9325 | 8.8332 | -0.29 | 0.30 | 1.1% | -1.1% |
| 29 | 8.7053 | 8.6062 | 8.5074 | -0.30 | 0.32 | 1.2% | -1.1% |
| 30 | 8.3923 | 8.2937 | 8.1954 | -0.32 | 0.33 | 1.2% | -1.2% |
| 31 | 8.0922 | 7.9941 | 7.8965 | -0.33 | 0.34 | 1.2% | -1.2% |
| 32 | 7.8044 | 7.7070 | 7.6101 | -0.34 | 0.35 | 1.3% | -1.3% |
| 33 | 7.5284 | 7.4318 | 7.3357 | -0.35 | 0.36 | 1.3% | -1.3% |
| 34 | 7.2637 | 7.1679 | 7.0726 | -0.36 | 0.38 | 1.3% | -1.3% |
| 35 | 7.0098 | 6.9148 | 6.8205 | -0.38 | 0.39 | 1.4% | -1.4% |
| 36 | 6.7661 | 6.6721 | 6.5787 | -0.39 | 0.40 | 1.4% | -1.4% |
| 37 | 6.5323 | 6.4392 | 6.3468 | -0.40 | 0.41 | 1.4% | -1.4% |
| 38 | 6.3078 | 6.2157 | 6.1244 | -0.41 | 0.43 | 1.5% | -1.5% |
| 39 | 6.0923 | 6.0012 | 5.9110 | -0.42 | 0.44 | 1.5% | -1.5% |
| 40 | 5.8853 | 5.7954 | 5.7062 | -0.44 | 0.45 | 1.6% | -1.5% |
| 41 | 5.6866 | 5.5977 | 5.5097 | -0.45 | 0.46 | 1.6% | -1.6% |
| 42 | 5.4956 | 5.4079 | 5.3210 | -0.46 | 0.48 | 1.6% | -1.6% |
| 43 | 5.3121 | 5.2255 | 5.1398 | -0.48 | 0.49 | 1.7% | -1.6% |
| 44 | 5.1358 | 5.0504 | 4.9658 | -0.49 | 0.50 | 1.7% | -1.7% |
| 45 | 4.9663 | 4.8820 | 4.7987 | -0.50 | 0.52 | 1.7% | -1.7% |
| 46 | 4.8034 | 4.7203 | 4.6381 | -0.51 | 0.53 | 1.8% | -1.7% |
| 47 | 4.6467 | 4.5648 | 4.4838 | -0.53 | 0.54 | 1.8% | -1.8% |
| 48 | 4.4960 | 4.4152 | 4.3355 | -0.54 | 0.55 | 1.8% | -1.8% |
| 49 | 4.3510 | 4.2714 | 4.1929 | -0.55 | 0.57 | 1.9% | -1.8% |
| 50 | 4.2115 | 4.1331 | 4.0558 | -0.57 | 0.58 | 1.9% | -1.9% |
| 51 | 4.0772 | 4.0000 | 3.9239 | -0.58 | 0.59 | 1.9% | -1.9% |
| 52 | 3.9480 | 3.8720 | 3.7971 | -0.59 | 0.61 | 2.0% | -1.9% |
| 53 | 3.8235 | 3.7487 | 3.6750 | -0.61 | 0.62 | 2.0% | -2.0% |
| 54 | 3.7037 | 3.6301 | 3.5575 | -0.62 | 0.63 | 2.0% | -2.0% |
| 55 | 3.5883 | 3.5158 | 3.4444 | -0.63 | 0.65 | 2.1% | -2.0% |
| 56 | 3.4771 | 3.4058 | 3.3356 | -0.65 | 0.66 | 2.1% | -2.1% |
| 57 | 3.3699 | 3.2997 | 3.2307 | -0.66 | 0.68 | 2.1% | -2.1% |
| 58 | 3.2666 | 3.1976 | 3.1297 | -0.68 | 0.69 | 2.2% | -2.1% |

|    |        |        |        |       |      |      |       |
|----|--------|--------|--------|-------|------|------|-------|
| 59 | 3.1670 | 3.0991 | 3.0324 | -0.69 | 0.70 | 2.2% | -2.2% |
| 60 | 3.0710 | 3.0043 | 2.9387 | -0.70 | 0.72 | 2.2% | -2.2% |
| 61 | 2.9784 | 2.9128 | 2.8483 | -0.72 | 0.73 | 2.3% | -2.2% |
| 62 | 2.8891 | 2.8245 | 2.7612 | -0.73 | 0.74 | 2.3% | -2.2% |
| 63 | 2.8029 | 2.7394 | 2.6771 | -0.75 | 0.76 | 2.3% | -2.3% |
| 64 | 2.7197 | 2.6573 | 2.5961 | -0.76 | 0.77 | 2.3% | -2.3% |
| 65 | 2.6394 | 2.5781 | 2.5179 | -0.77 | 0.79 | 2.4% | -2.3% |
| 66 | 2.5619 | 2.5016 | 2.4425 | -0.79 | 0.80 | 2.4% | -2.4% |
| 67 | 2.4870 | 2.4278 | 2.3697 | -0.80 | 0.81 | 2.4% | -2.4% |
| 68 | 2.4147 | 2.3565 | 2.2995 | -0.82 | 0.83 | 2.5% | -2.4% |
| 69 | 2.3449 | 2.2877 | 2.2317 | -0.83 | 0.84 | 2.5% | -2.4% |
| 70 | 2.2774 | 2.2212 | 2.1662 | -0.85 | 0.86 | 2.5% | -2.5% |
| 71 | 2.2122 | 2.1570 | 2.1029 | -0.86 | 0.87 | 2.6% | -2.5% |

**B-电芯参数**

| Item                        | Specification                                                                                                                                                                                                                              |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Standard discharge capacity | Min 3,350mAh<br>- Charge : 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @RT<br>- Discharge : 0.2C(680mA), 2.50V cut-off @RT<br>*1C=3,400mA                                                                                                     |
| Rated discharge capacity    | Min. 3,250mAh<br>- Charge: 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @ RT<br>- Discharge: 1C(3,400mA) , 2.50V cut-off @ RT                                                                                                                  |
| Charging Voltage            | 4.2V                                                                                                                                                                                                                                       |
| Nominal Voltage             | 3.60V                                                                                                                                                                                                                                      |
| Charging Method             | CC-CV (constant voltage with limited current)                                                                                                                                                                                              |
| Charging Current            | Standard charge: 1,700mA<br>For cycle life : 1,020mA                                                                                                                                                                                       |
| Charging Time               | Standard charge: 4hours                                                                                                                                                                                                                    |
| Max. Charge Current         | 2,000mA (not for cycle life)                                                                                                                                                                                                               |
| Max. Discharge Current      | 8,000mA (for continuous discharge)<br>13,000mA (not for continuous discharge)                                                                                                                                                              |
| Discharge Cut-off Voltage   | 2.5V (End of discharge)                                                                                                                                                                                                                    |
| Cycle life                  | Capacity $\geq$ 2,275mAh @ after 500cycles<br>(70% of the Rated Capacity @ RT)<br>- Charge : 0.3C(1,020mA), 4.2V, CCCV 170mA cut-off @ RT<br>- Discharge: 1C(3,400mA) , 2.50V cut-off @ RT                                                 |
| Storage characteristics     | Capacity recovery(after the storage) $\geq$ 3,015mAh<br>(90% of the Standard capacity @ RT)<br>- Charge : 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @ RT<br>- Storage : 20 days (@ 60°C )<br>- Discharge : 0.2C(680mA) , 2.50V cut-off @ RT |
| Cell Weight                 | 50 g max                                                                                                                                                                                                                                   |
| Cell Dimension              | Height : Max. 65.25 mm    Diameter: Max. $\Phi$ 18.50 mm                                                                                                                                                                                   |

电芯循环寿命图

