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1. 简介 Introduction (information)

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 4 颗 18650 电芯，1 块保护板（PCM）,输出连接器，塑料外壳等组成。电池包采用 4 串 1 并（4S1P）的方式成组。电池包采用 SMBUS 通讯方式，充电器可以通过 SMBUS 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，具有过压、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。

The specification describes the mechanical and electrical characteristics of the Supra Compact battery pack. The battery pack consists of 4 18650 cells (4 in series and 1 in parallel), one protection circuit module (PCM), an output connector, and plastic case.

The battery pack features SMBUS communications, thus an SMBUS enabled charger can get the real-time parameters of charging voltage and charging current, or a host can read the information of battery capacity, voltage, temperature, and current via SMBUS.

The PCM adopts an intelligent battery management system solution, including primary and secondary safety protection functions including over-voltage, over-current, high temperature, low temperature, low voltage, etc., which can effectively improve the cycle life of cells and ensure the safe and reliable charging and discharging of the battery pack.

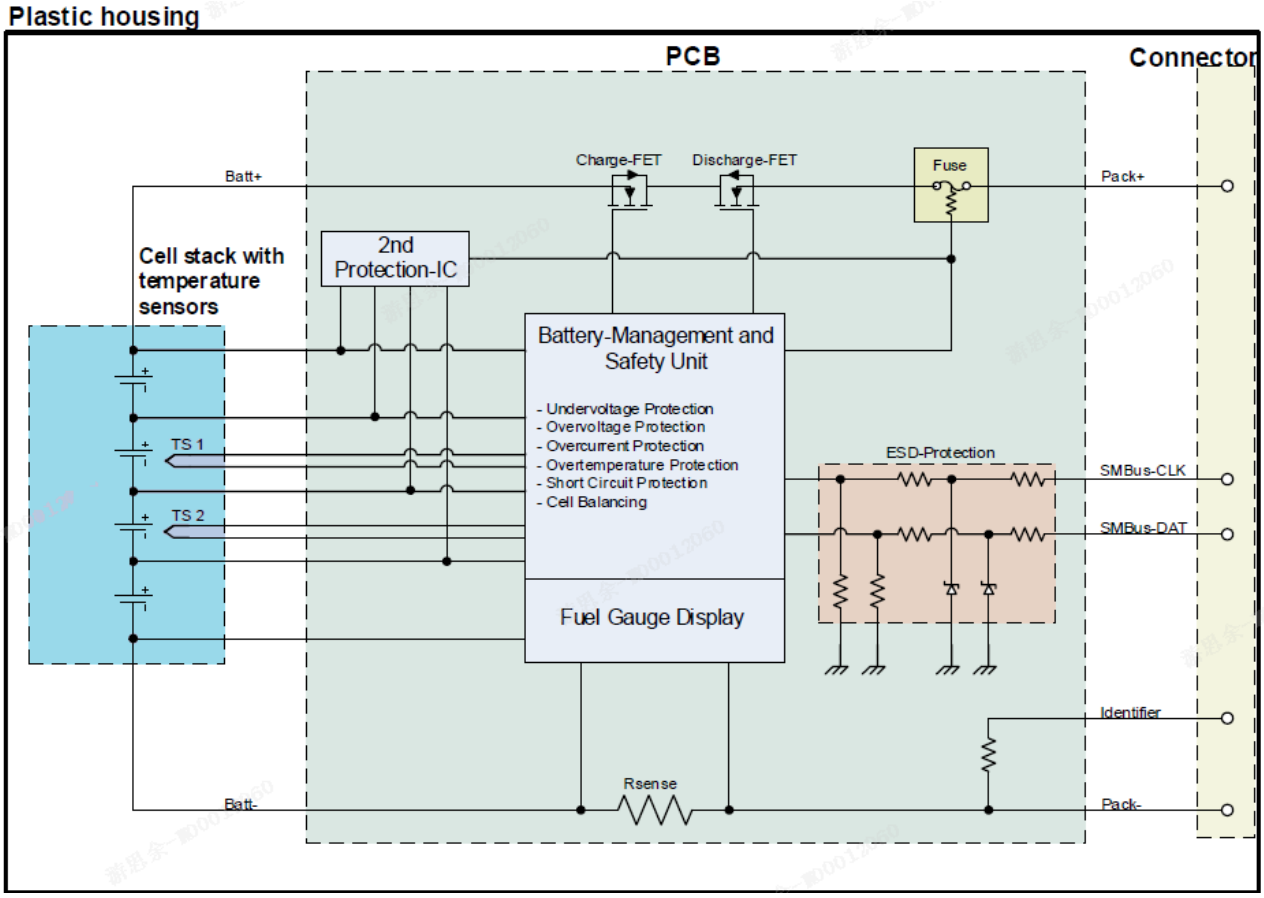
电池包由以下几个部分组成 Each battery pack consists of the following parts：

- 18650 电芯 18650 battery cell
- 机械结构 Internal mechanical frame
- 电量计 Fuel gauge
- 保护电路 Protection circuit
- 塑胶外壳 Plastic case/housing

2. 系统框图 System Block Diagram(information)

下图是电池包的系统框图，包含 4 节电芯，智能电池管理 IC (BQ40z50-R2)，二次保护 IC (BQ294700)，充放电保护 MOSFET，Fuse,温度探头，电流采样电阻等。

The following figure is the system block diagram of the battery pack, including 4 cells, intelligent battery management IC (BQ40Z50-R2), secondary protection IC (BQ294700), charge and discharge protection MOSFETs, Fuse, temper thermistor, current sampling resistor, etc.



3. 主要参数介绍 Main Pack Characteristics

3.1 关键元器件参数 Parameters of Critical Components

关键元器件 Critical component	项目 Item	规格参数 Parameter	备注 Remark
电芯厂家：三星 型号：INR18650-35E Cell Manufacturer: SDI Cell Part#: INR18650-35E	额定电压 Nominal voltage	3.6V	参考电芯参数 Refer to clause 3.2 ,cell parameter
	正常容量 Nominal capacity	3.4Ah	/
	最大充电电流 Max charge current	2A	/
	最大放电电流 Max discharge current	8A	/
保险厂家：迪睿合 型号：SFJ-1415U	额定电压 Rated voltage	36V	/
	额定电流 Rated current	15A	/

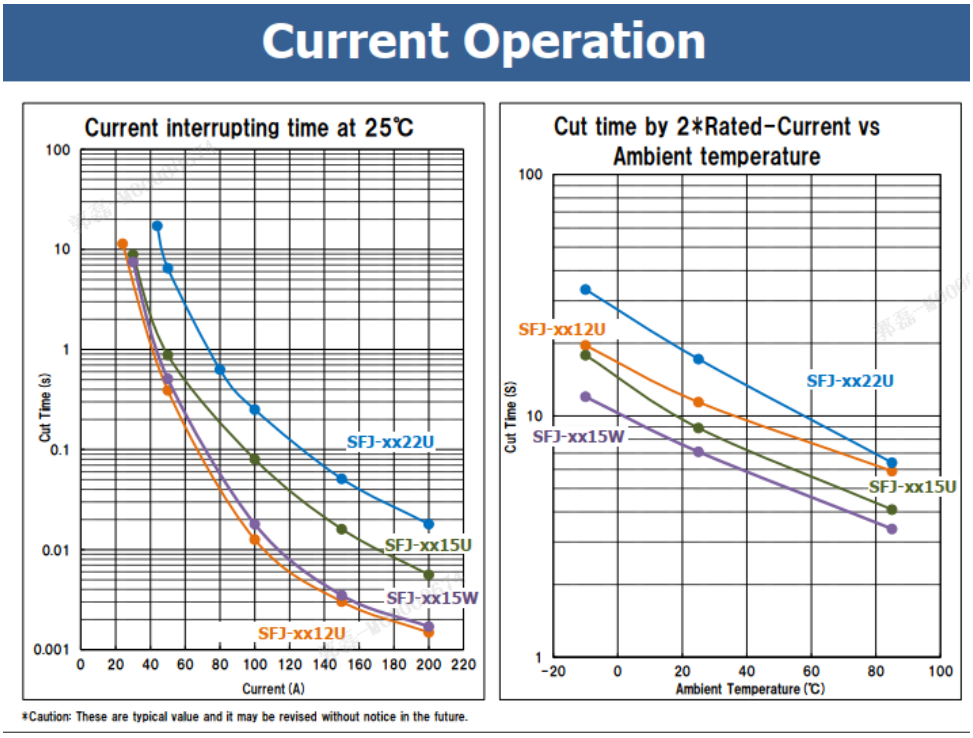
Fuse Manufacturer: Dexerials Fuse Part#: SFJ-1415U	直流内阻 DC internal resistor	1.5mΩ	/
	熔断电流 Fusing current	24A (≤60S)	/
热敏电阻厂家：为勤 型号：NTSE0103FZ083HC Thermistor Manufacturer: WELKIN ELECTRONIC INDUSTRIAL CO., LTD Thermistor Part#: NTSE0103FZ083HC		R=10KΩ（25˚C）	/
一级保护芯片 Primary Protective MCU		TI#BQ40z50-R2	
二级保护芯片 Secondary Protective MCU		TI#BQ294700	

3.2 电芯基本参数 Parameters of Battery Cell (information)

Item	Specification
Standard discharge capacity	Min 3,350mAh - Charge : 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @RT - Discharge : 0.2C(680mA), 2.50V cut-off @RT *1C=3,400mA
Rated discharge capacity	Min. 3,250mAh - Charge: 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @ RT - 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 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) 13,000mA (not for continuous discharge)
Discharge Cut-off Voltage	2.5V (End of discharge)
Cycle life	Capacity ≥ 2,275mAh @ after 500cycles (70% of the Rated Capacity @ RT)

	- Charge : 0.3C(1,020mA), 4.2V, CCCV 170mA cut-off @ RT - Discharge: 1C(3,400mA) , 2.50V cut-off @ RT
Storage characteristics	Capacity recovery(after the storage) ≥ 3,015mAh (90% of the Standard capacity @ RT) - Charge : 0.5C(1,700mA), 4.2V, 0.02C(68mA) cut-off @ RT - Storage : 20 days (@ 60℃) - Discharge : 0.2C(680mA) , 2.50V cut-off @ RT
Cell Weight	50 g max
Cell Dimension	Height : Max. 65.25 mm Diameter: Max. Φ 18.50 mm

3.3 保险熔断电流与熔断时间曲线图 Fuse Breaking Current and Interrupt Time (information)



3.4 电池包的基本规格参数 Battery Pack Specifications

项目 Item	规格参数 Parameter		备注 Remark
额定电压 Nominal voltage	14.4V		参考标准充放电 Refer to rated charge and rated discharge
额定容量 Nominal capacity	3.3Ah		23±2℃，CC-CV 16.8V/0.66A，68mA 截止充电后，以 0.66A 放电至欠压所测容量。23±2℃, CC-CV 16.8V/ 0.66 A, 68mA cut-off charge, 0.66A discharge to the measured capacity under voltage.
充电电压 Charging voltage	16.8V		Charger 充电电压 Max charging voltage of charger
最大充电电流 Max charging current	1.6A		Charger 最大充电电流 Max charging current of charger
满充截止电流 Battery Pack Term Taper Current	66mA		Charger 充电截止电流应≤66mA Charger: cutoff current during charging should be less than or equal to 66mA
标准充放电 Standard charging and discharging	23±2℃环境温度，0.2C 恒流充电至 16.8V，再恒压充电至电流小于 0.02C 截止；0.2C 放电至截止电压。23±2℃ ambient temperature, 0.2C constant current charging to 16.8V, then constant voltage charging to current less than 0.02C cut-off; 0.2C discharge to cut-off voltage.		
预充电流 Precharge current	<1A		当电芯电压为 1.8V 至 2.5V when the cell voltage is 1.8V to 2.5V.
最大放电电流 Max discharging current	5A		持续电流 Constant current
充/放电保护电压 Charge/discharge protection voltage	4.25V/2.6V		任意一节电芯 Any one of the cells
放电截止电压 Cut-off voltage	10.4V		
电池包内阻 Internal resistor of battery pack	＜140mΩ		1kHz，50mA 交流测试 1kHz, 50mA AC test
电池模式功耗 Power consumption	正常 Normal operation	440uA	--
	休眠 Sleeping mode	270uA	
	关机 Shutdown mode	10uA	

电池使用寿命 (information) Life cycle	300 次充放电后电量不低于初始容量 80% The capacity should not be less than 80% of the initial capacity after 300 times life cycle	a cycle consists of one standard charge and one standard discharge.

Notes：

1、除规定温度外，所有测试温度条件应在 23±2˚C。

All test temperature conditions shall be 23±2˚C except specified temperature.

2、电池包满充条件([FC] bit set): 4 节电芯中最大电芯电压+ Charge Term Voltage＞16.8V/4，且充电电流小于 Battery Pack Term Taper Current，并保持 80s。

Full Charge condition of battery pack ([FC] bit set) : the maximum cell Voltage of 4 cells+ Charge Term Voltage was > 16.4V/4, and the charging Current was lower than the Battery Pack Term Taper Current, and maintain 80 seconds.

4. 保护参数设置 Protection Parameters

电池在检测到以下情况时会启动保护，防止电池处于危险工作状态。充放电 MOSFET 和 BQ40z50-R2 触发的保护是可恢复，保险丝触发的保护是不可恢复的。

When the battery detects the following conditions, the protection will be activated to prevent the battery from working in a dangerous state. The protection triggered by charging and discharge MOSFETs and BQ40Z50-R2 is recoverable. Protection by single activation fuses is not.

4.1 充电保护 Charge Protection

4.1.1 充电过压保护 Cell Over Voltage (COV)

通过监控每一节电芯电压来保护电池不过充。 任何一节电芯电压超过设定的过压值，第一级保护将中断充电电流。

Protects the battery from overcharging by monitoring the voltage of each cell. If any cell exceeds the set over-voltage value, protection will interrupt the charging current.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 Unit	动作器件 Action Device
BQ40z50-R2	一次过压保护 Primary protection of over-voltage	4225	4250	4275	mV	充电 MOSFET Charge MOSFET
BQ40z50-R2	一级充电过压保护延时 Primary protection of over-voltage delay	/	1	3	S	/
BQ40z50-R2	一次过压恢复 Recovery value of primary	3975	4000	4025	mV	充电 MOSFET Charge MOSFET

	protection of over-voltage					
BQ40z50-R2	PF 保护 PF protection	4270	4320	4370	mV	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时 PF protection of over-voltage delay	18	20	22	S	

任何一节电芯电压超过设定的二次过压值，将会触发二次过压保护，二次过压保护会熔断保险丝，不可恢复。

If any cell exceeds the set secondary overvoltage value, the secondary overvoltage protection will be triggered. The secondary overvoltage protection will open the fuse and cannot be recovered.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action Device
BQ294700	二次过压保护 secondary protection of over-voltage	4325	4350	4375	mV	保险丝 Fuse
BQ294700	二级充电过压保护延时 Secondary protection of over-voltage delay	/	2	4	S	/
BQ294700	二次过压恢复 Recovery value of secondary protection of over-voltage	/	/	/	/	不可恢复 unrecoverable

4.1.2 充电过流 Charging Over-current Protection(OCC)

保护电路将提供充电过流保护，防止电池包充电电流过大。

The protection circuit will provide charging over-current protection to prevent the battery pack from a high charging current.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	一级充电过流保护 Primary protection of overcurrent	2250	2500	2750	mA	充电 MOSFET Charging MOSFET
BQ40z50-R2	一级充电过流延时	/	3	6	S	/

	Primary protection of overcurrent delay					
BQ40z50-R2	一级充电恢复延时 Primary protection of recoveryt delay	4	5	8	S	/
BQ40z50-R2	一级充电过流恢复 recovery value of primary protection of overcurrent	/	≤100		mA	/
BQ40z50-R2	二级充电过流保护 Secondary protection of overcurrent	3750	4000	4250	mA	充电 MOSFET Charging MOSFET
BQ40z50-R2	二级充电过流延时 Secondary protection of overcurrent delay	/	1	4	S	/
BQ40z50-R2	二级充电恢复延时 Secondary protection of recoveryt delay	4	5	8	S	
BQ40z50-R2	二级充电过流恢复 Recovery value of secondary protection of overcurrent	/	≤100	/	mA	
BQ40z50-R2	PF 保护 PF protection	6975	7000	7025	mA	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时 PF protection of overcurrent delay	4	5	7	S	

4.1.3 充电过温保护 Over Temperature (OTC)

保护电路检测电芯温度，当温度超过电芯允许的最高充电温度时切断充电回路。防止电芯在高温下充电。

The temperature of cells is detected by the protection circuit. Charging circuit will be cut-off when the temperature exceeds the maximum allowable charging temperature of the cell to prevent it from charging at high temperature.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	充电过温保护 Charging over temperature protection	43	45	47	˚C	充电 MOSFET Charging MOSFET

BQ40z50-R2	充电过温延时 Charge over temperature delay	/	2	5	S	/
BQ40z50-R2	充电过温恢复 Overheating recovery	38	40	42	˚C	/
BQ40z50-R2	PF 保护 PF protection	83	85	87	˚C	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时 PF protection of overtemperature delay	/	5	10	S	/

4.1.4 充电低温保护 Under Temperature (UTC)

保护电路检测电芯温度，当温度低于电芯允许的最低充电温度时切断充电回路。防止电芯在低温下充电。

The temperature of cells is detected by the protection circuit. Charging circuit will be cut-off when the temperature lower than minimum allowable charging temperature of the cell to prevent it from charging at low temperature.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	充电低温保护 Charging under temperature protection	-2	0	2	˚C	充电 MOSFET Charging MOSFET
BQ40z50-R2	充电低温延时 Charge under temperature delay	/	2	5	S	/
BQ40z50-R2	充电低温恢复 Underheating recovery	3	5	7	˚C	/

4.2 放电保护 Discharge Protection

4.2.1 放电过流保护 Over Current (OCD)

保护电路提供放电过流保护检测，防止电池包超规格放电损坏电芯。

The protection circuit provides detection of overcurrent during discharging to prevent the battery pack from overcurrent cell damage.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	一级放电过流保护 Primary discharge overcurrent protection	6900	7000	7100	mA	放电 MOSFET Discharging MOSFET
BQ40z50-R2	一级放电过流延时 Primary discharge overcurrent delay	/	3	5.5	S	/
BQ40z50-R2	一级放电恢复延时 Primary discharge recovery delay	/	5	8	S	/
BQ40z50-R2	二级放电过流保护 Secondary discharge overcurrent protection	7900	8000	8100	mA	放电 MOSFET Discharging MOSFET
BQ40z50-R2	二级放电过流延时 Secondary discharge overcurrent delay	/	1	3.5	S	/
BQ40z50-R2	二级放电恢复延时 Secondary discharge recovery delay	/	5	8	S	/
BQ40z50-R2	放电过流恢复 Discharge overcurrent recovery	/	≤100	/	mA	/
BQ40z50-R2	PF 保护 PF protection	8900	9000	9100	mA	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时 PF protection of overcurrent delay	4	5	7	S	

4.2.2 放电过载保护 Over Load (OL)

保护电路提供过负载保护，与放电过流保护相比，具有更高的电流阈值和更快的反应时间。

The protection circuit provides overload protection with a higher current threshold and faster reaction time than the discharge overcurrent protection

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	放电过载保护 Discharge overload protection	16500	17500	18500	mA	放电 MOSFET Discharging MOSFET
BQ40z50-R2	放电过载延时 Discharge overload delay	/	31	33	ms	/
BQ40z50-R2	放电过载恢复延时 Discharge overload recovery delay	/	10	12.5	S	/

4.2.3 放电短路保护 Short Circuit (SCD)

在放电过程中如果检测到短路，放电回路将会立即被切断。

When a short circuit is detected during discharging, the discharge circuit will be cut off quickly.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action device
BQ40z50-R2	放电短路保护 Discharge short circuit protection	27000	29000	30000	mA	放电 MOSFET Discharging MOSFET
BQ40z50-R2	放电短路延时 Discharge short-circuit delay			800	uS	/
BQ40z50-R2	放电短路恢复延时 Discharge short circuit recovery delay	/	30	32	S	/

4.2.4 放电欠压保护 Cell Under Voltage（CUV）

当检测到任何一节电芯电压低于 2.6V 时，将断开放电回路。

The voltage of each cell is detected during discharging. The discharge circuit will be disconnected when the voltage of any one cell is below 2.6V

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action Device
BQ40z50-R2	放电欠压保护 Discharge	2550	2600	2650	mV	放电 MOSFET

	undervoltage protection					Discharging MOSFET
BQ40z50-R2	放电欠压延时 Discharge undervoltage delay	/	2	4	S	/
BQ40z50-R2	放电欠压恢复 Discharge undervoltage recovery	3050	3100	3150	mV	/
BQ40z50-R2	PF 保护 PF protection	1750	1800	1850	mA	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时 PF protection of undervoltage delay	4	5	7	S	

4.2.5 放电过温保护 Over Temperature (OT)

保护电路检测电芯温度，当温度超过电芯允许的最高放电温度时切断放电回路。防止电芯在高温下放电。

The temperature of cells is detected and the discharging circuit will be cut-off when the temperature exceeds the maximum allowable discharging temperature to prevent discharge at high temperature.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action Device
BQ40z50-R2	放电过温保护 Discharge over temperature protection	58	60	62	˚C	放电 MOSFET Discharging MOSFET
BQ40z50-R2	放电过温延时 Discharge over-temperature delay	/	2	4	S	/
BQ40z50-R2	放电过温恢复 Discharge over-temperature recovery	53	55	57	˚C	/
BQ40z50-R2	PF 保护 PF protection	83	85	87	˚C	不可恢复 unrecoverable
BQ40z50-R2	PF 保护延时	/	5	10	S	/

	PF protection of overtemperature delay					

4.2.6 放电低温保护 Under Temperature (UT)

保护电路检测电芯温度，当温度低于电芯允许的最低放电温度时切断放电回路。防止电芯在低温下放电。

The temperature of cells is detected and the discharging circuit will be cut-off when the temperature lower than minimum allowable discharging temperature to prevent discharge at high temperature.

保护芯片 MCU	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action Device
BQ40z50-R2	放电低温保护 Discharge under temperature protection	-22	-20	-18	˚C	放电 MOSFET Discharging MOSFET
BQ40z50-R2	放电低温延时 Discharge under-temperature delay	/	2	4	S	/
BQ40z50-R2	放电低温恢复 Discharge under-temperature recovery	-17	-15	-13	˚C	/

4.3 保险丝独立二级保护功能 Independent Secondary Protection of Fuse

保护器件	项目 Item	最小值 Min.	额定值 Rated	最大值 Max.	单位 unit	动作器件 Action Device
保险丝 Fuse	过流/短路 Overcurrent/Short Circuit	/	24000		mA	保险丝 Fuse

Note：此功能不受外部控制，保险丝自身功能，具体参考第 3.3 节。

Function depends on fuse rating and is not subject to external control. Refer to Section 3.3.

5. LED 显示 LED display

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。

The battery pack has 4 LED status lights which can display the battery capacity (or gas gauge) information by pressing the button. The details are shown in the following table.

Capacity	LED Indicators				Notes
0—25%	X				常亮时间 4sLight on time 4s
26—50%	X	X			
51—75%	X	X	X		
76—100%	X	X	X	X	

6. 寄存器 Register(information)

电池包支持 SMBUS 通讯，部分通讯指令如下：

The battery pack supports SMBUS communication. Some communication commands are shown as follows

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

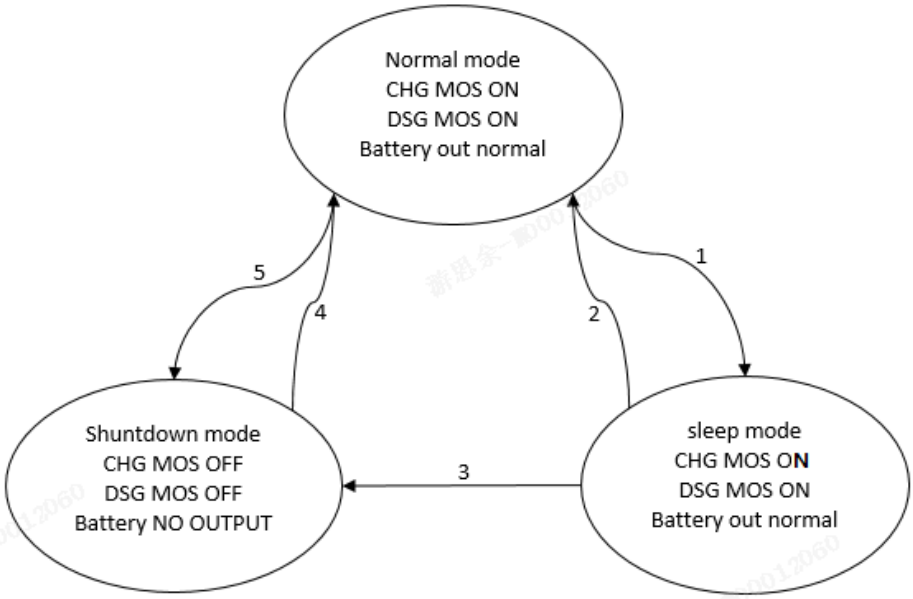
0x15	ChargingVoltage()	R	mV
0x16	BatteryStatus()	R	/
0x17	CycleCount()	R/W	cycles
0x18	DesignCapacity()	R/W	mAh
0x19	DesignVoltage()	R/W	mV
0x1A	SpecificationInfo()	R/W	/
0x1B	ManufacturerDate()	R/W	/
0x1C	SerialNumber()	R/W	/
0x20	ManufacturerName()	R	ASCII
0x21	DeviceName()	R	ASCII
0x22	DeviceChemistry()	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	/

7. 功能描述 Functional Description

7.1 工作模式 Operation Modes

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。每种模式的工作状态及切换关系如下图，不同的工作模式用于不同的场景。

The battery pack has three operating modes: normal, sleep mode, and shutdown. The following figure shows the working status and relationship of each mode. Different working modes are used in different conditions.



1. 电池电流<|10mA|，未检测到充电机连接，无通讯；

The battery current is <|10mA|, the charger connection is not detected, and there is no communication;

2. 有通讯或者放电电流大于 10mA，或检测到充电机连接；

Communication exists or the discharge current is greater than 10mA or the connection of the charger is detected;

3. 电池包任一节电芯电压低于 2300mV；

The voltage of any one cell is less than 2300mV, then the battery pack automatic turn into shutdown mode

4. 检测到充电机连接到接口充电；

If the battery pack is connected to charger, then it will recover to normal operation mode;

5. 通讯下发 Shutdown command.

The battery pack will be shut down when a command is received.;

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。电池需充电激活后使用。

The power consumption of these three modes is normal mode > Sleep mode > Shutdown mode. During transportation, the battery is in shutdown mode by default, which has minimum power consumption. The battery pack need to be charged to activate before use.

8. 环境条件 Environmental Requirements

8.1 温度 Temperature(运行存储温度)

充电:0°C to +45°C

Charging: 0°C to +45°C

放电:0°C to +60°C

Discharge: 0°C to +60°C

8.2 存储条件 Storage Requirements (information)

1. 默认出厂容量在 20%~30%之间，在 -10˚C to +23˚C 环境温度，湿度小于 65%条件下可存储 6 个月。如果长时间存储，建议充电到 50%~70%容量。

2. 20%~30%容量，在 -10˚C to +45˚C 环境温度，湿度小于 65%条件下可存储 3 个月.

3. 20%~30%容量，在 -10˚C to +60˚C 环境温度，湿度小于 65%条件下可存储 1 个月.

4. 50%~70%容量，在 -10˚C to +23˚C 环境温度，湿度小于 65%条件下可存储 1 年。

如果超出以上条件存储，电池包电量可能耗尽。当电池包单节电芯电压低于 2V 时，不建议再使用。

1. Manufactured default charge state ranges from 20% to 30%. The device can be stored for six months at an ambient temperature of -10˚C to +23˚C and humidity less than 65%. It is recommended to charge to 50%~70% capacity for Long-term storage .

2. 20%-30% capacity, can be stored for 3 months at -10˚C to +45˚C and humidity less than 65%.

3. 20%-30% capacity, can be stored for 1 month at -10˚C to +60˚C and humidity less than 65%.

4. 50%-70% capacity, can be stored for 1 year at -10˚C to +23˚C and humidity less than 65%.

If the storage exceeds the above conditions the battery pack may run out of power. When the voltage of a single cell of a battery pack is lower than 2V it is not recommended for use again.

Note：

1. 如果要长期存放，请将电池存放在 <23˚C、无腐蚀性气体环境下。

2. 存储时间超过 1 年时，请至少一年充电一次。建议充电至 50%~70%容量。

3 电池长期存储时性能衰减。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。满充容量电芯在 60˚C 环境温度下存储 28 天，电芯容量降低到 89%。充电后恢复到初始容量的 94%。

Note:

1. For long-term storage, please store the battery in a no corrosive gas environment. which is less than 23˚C.

2. If the storage time is more than one year, please charge it at least once a year. It is recommended to charge the battery as 50-70% capacity.

3. Long-term storage will affect the performance of battery pack, full capacity decreases and internal resistance increases and this change is irreversible. The battery performance deteriorates more seriously at high temperature.

8.3 湿度 Humidity

60%±25%RH 无凝露

60%±25%RH without condensation

8.4 海拔高度（气压）Altitude (Barometric Pressure)

500 hPa to 1060 hPa

9. 电池寿命 Life Cycle (information)

9.1 电池存储寿命 Battery shelf life

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，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。

When the battery is stored in shutdown mode, it needs to do a full discharge/charge operation once a year to extend the storage time. The default factory charge state is 20% to 30%. The battery can be stored for only 6 months when the factory capacity is less than this at 23˚C and the humidity is less than 65%. For longer storage time, it is recommended to charge and discharge to 50% to 70% of capacity within 6 months.

9.2 电池循环寿命 Battery cycle life

恒流 0.99A 充电到 16.8V，再恒压充电到电流小于到 170mA 截止。以 3.3A 恒流放电到 10.4V。电池在 500 次上述充放电循环后，其初始容量应至少达到电池规格规定的 70%。

The battery pack is charged to 16.8V at constant current 0.99A, and then it is charged by constant voltage until the charging current is less than 260mA. Discharge the battery pack to 10.4V with 3.3A constant current. The initial capacity of the battery should reach at least 70% of the battery specification after 500 cycles of the above-mentioned charging and discharge process.

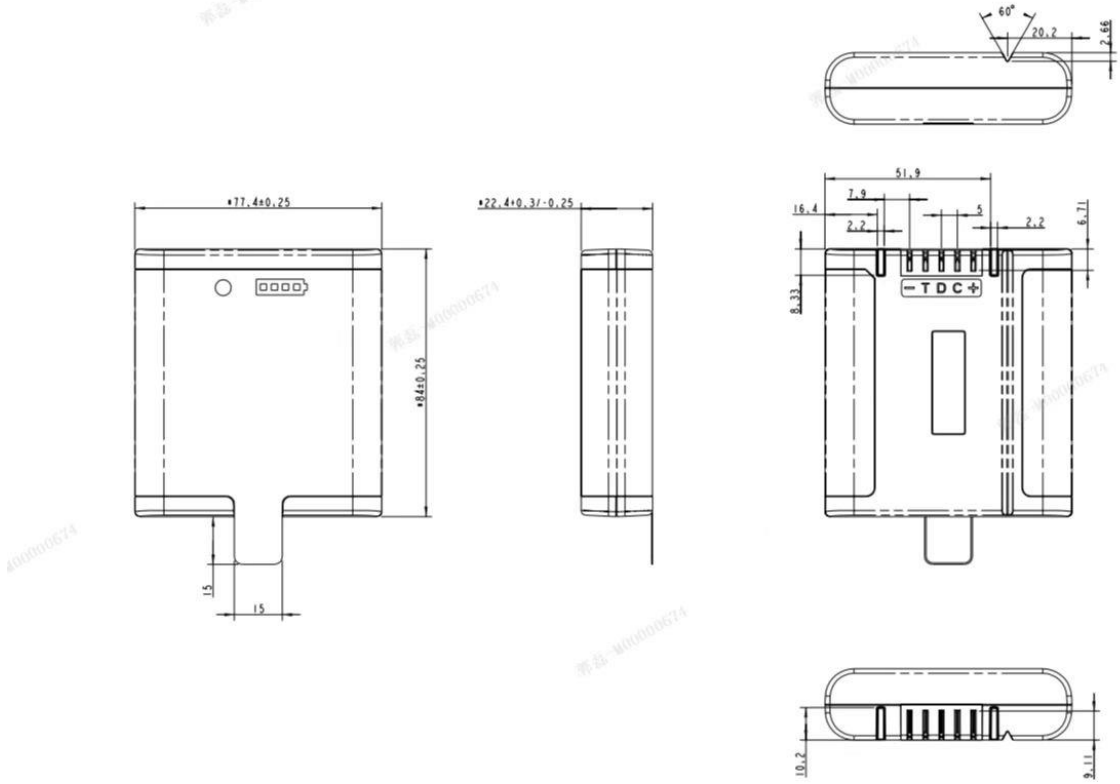
10. 法规 Compliance

The battery complies with

- UN38.3
- IEC 62133-2

11. 结构图 Structure Diagram

11.1 尺寸图 Dimensions



11.2 输出接口定义 Pinout Definition

电池包采用 TE：146845-1 连接器。

The battery pack adopts TE：146845-1 connector.

Table 6-1. Pin Assignments		
Pin	**Signal**	**Description**
1	PACK-	电池输出负极 Battery Output Negative
2	TEMP	温度检测 Temperature Detection
3	SMB Data	SMBUS SDA
4	SMB Clock	SMBUS SCL
5	PACK+	电池输出正极 Battery Output Positive

11.3 适配器连接器 Suggested Battery Mating Connectors

可根据结构需求选用其中任意一款适配。

Any one of them can be selected according to the structural requirements.

制造商 Manufacturer		泰科 TE Connectivity		
制造商零件编号 Mfr. Part	5787430-1	5787446-1	5787441-1	5787422-1
描述 Description	直脚防呆插件 Straight pin anti-dazzle	直脚插件 Straight pin plug-in	弯脚插件 Bending pin plug-in	弯脚防呆插件 Bending pin anti-dazzle

12. 机械结构 Mechanical Structure

12.1 跌落测试 Drop test

电池包需要通过以下结构测试试验。

Battery packs are required to pass the following mechanical tests.

(1) 试验目的：模拟使用者在放置和搬运电池的过程中意外跌落，测试电池的可靠性。

Test Purpose: Simulate drop by accident in the process of placing or handling the battery to ensure the safety and reliability of the battery.

(2) 试验样品及设备：电池 3 个，卷尺。

Test samples and equipment: 3 pieces batteries, tape measure.

(3) 试验方法：测试者手持电池距离水泥地面 1m 的高度，放手跌落，让电池分别以 6 面跌落于地面共 6 次。

Test Method: Hold the battery at a height of 1m from the concrete floor and drop the battery on six sides for a total of six times.

(4) 检查内容及方法 Check Contents and Method:

- 外观无开裂和破损，允许油漆脱落。
  The appearance is free of cracking and breakage, some scratches and plastic deformation is allowed.
- 粘合处没有开裂。
  The bond does not crack.
- 内部零件无松动, 电池应能正常工作。
  No loose internal components, the battery should work properly.

(5) 作测试记录并得出结论：Make test records and draw conclusions

以上试验项目中，有任何一项未通过则说明试验失败。

The test failed if any of the above test phenomenon occurs.

12.2 冲击和震动 Shock and Vibration

(1) 试验目的:模拟实际使用环境,试验电池在运输过程中的可靠性。

Test purpose: Simulate the actual operating environment to ensure the safety and reliability of batteries during transportation.

(2) 试验样品数量: 电池包 3 个

Number of test samples: 3 batteries

(3) 试验设备和条件:振动试验机，冲击试验机。

Test equipment and conditions: vibration testing machine, Shock testing machine.

(4) 试验条件 Test Conditions:

振动试验 Vibration test	15min内从7Hz至200Hz完成一次往复对数扫频正弦振动，3h内完成三维方向振动12次。 Complete a reciprocating logarithmic sine sweeping-frequency vibration from 7 Hz to 200 Hz within 15 min, and complete 12 vibrations in three-dimensional direction within 3 h.	无渗漏、无排气、无解体、无燃烧、无爆炸、无破损，开路电压不小于试验前的90%，失重要求见说明 There shall be no leakage, exhaust, disintegration, combustion, explosion and damage. The open-circuit voltage shall not be less than 90% of that before the test. See the instructions for weight loss requirements.
冲击试验 Impact test	加速度150gn、6ms或加速度50gn、11ms半正弦冲击，每个安装方向进行3次，总共18次。 Semi-sinusoidal impact with acceleration of 150 gn, 6 ms or acceleration of 50 gn, 11 ms shall be carried out for 3 times in each installation direction, totaling 18 times.	无渗漏、无排气、无解体、无燃烧、无爆炸、无破损，开路电压不小于试验前的90%，失重要求见说明 There shall be no leakage, exhaust, disintegration, combustion, explosion and damage. The open-circuit voltage shall not be less than 90% of that before the test. See the instructions for weight loss requirements.

失重要求参考 UN38.3。

For weightlessness requirements, refer to UN38.3.

(5) 检查点及检验方法 Check points and inspection methods

- 外观无明显机械损伤，无油漆脱落。
  Appearance without obvious mechanical damage.
- 粘合处没有开裂。
  The bonded/welded area does not crack.
- 内部零件无松动, 电池应能正常工作。
  No loose internal components, the battery should work properly.

(6) 作试验记录并得出结论。Record the test and draw conclusions.

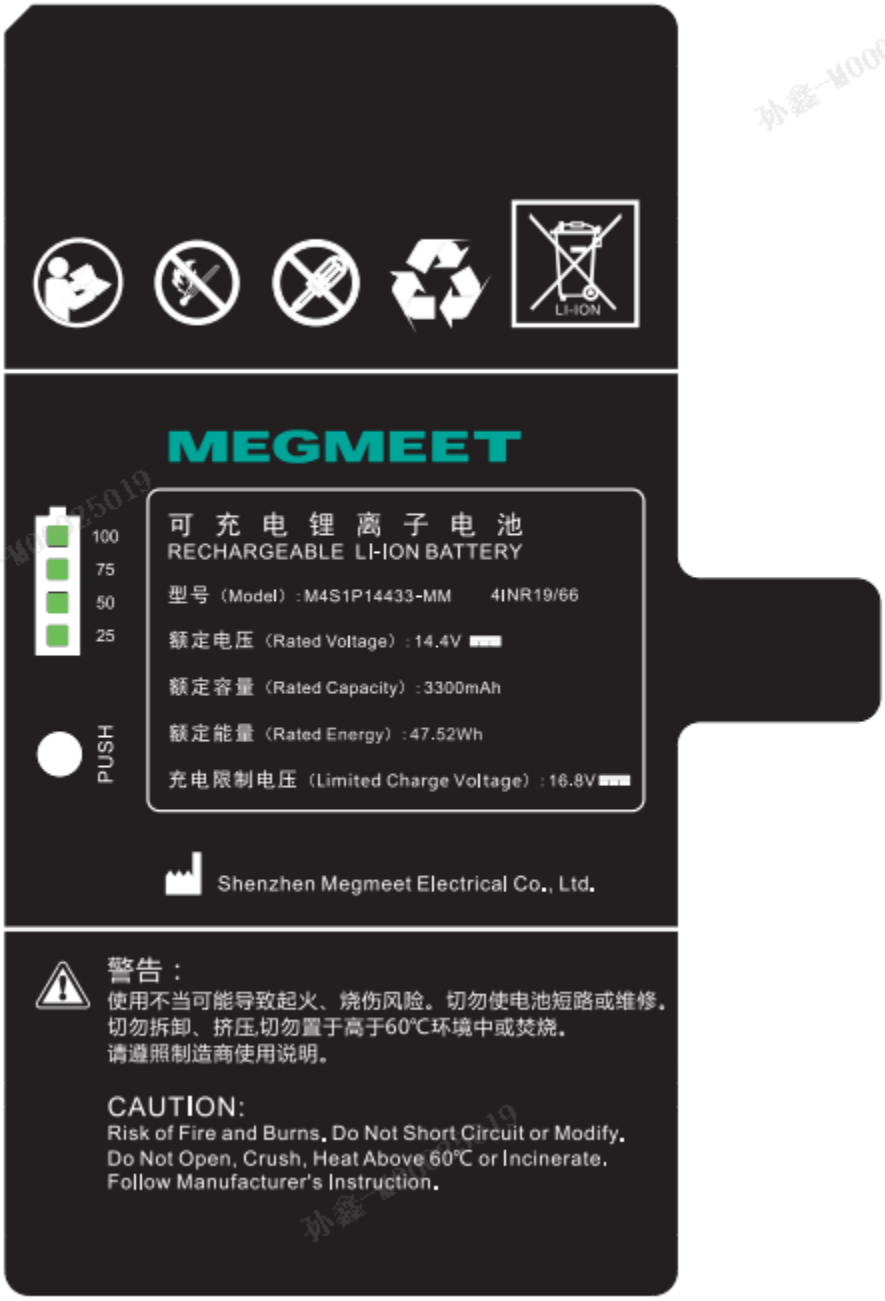
以上试验项目中，有任何一项未通过则说明试验失败。

The test failed if any of above test phenomenon occurs.

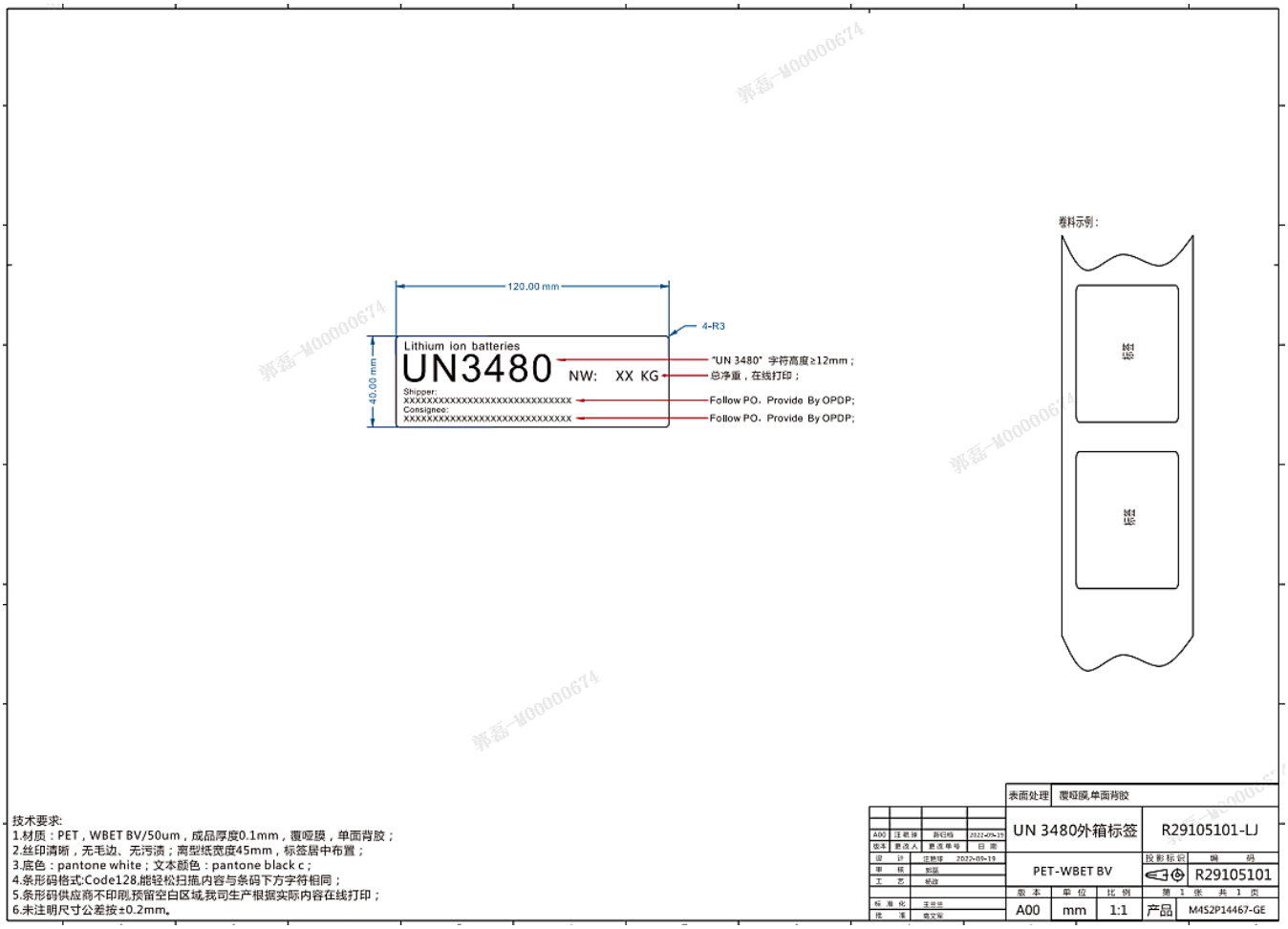
13. 包装和标签 Packaging and Labeling

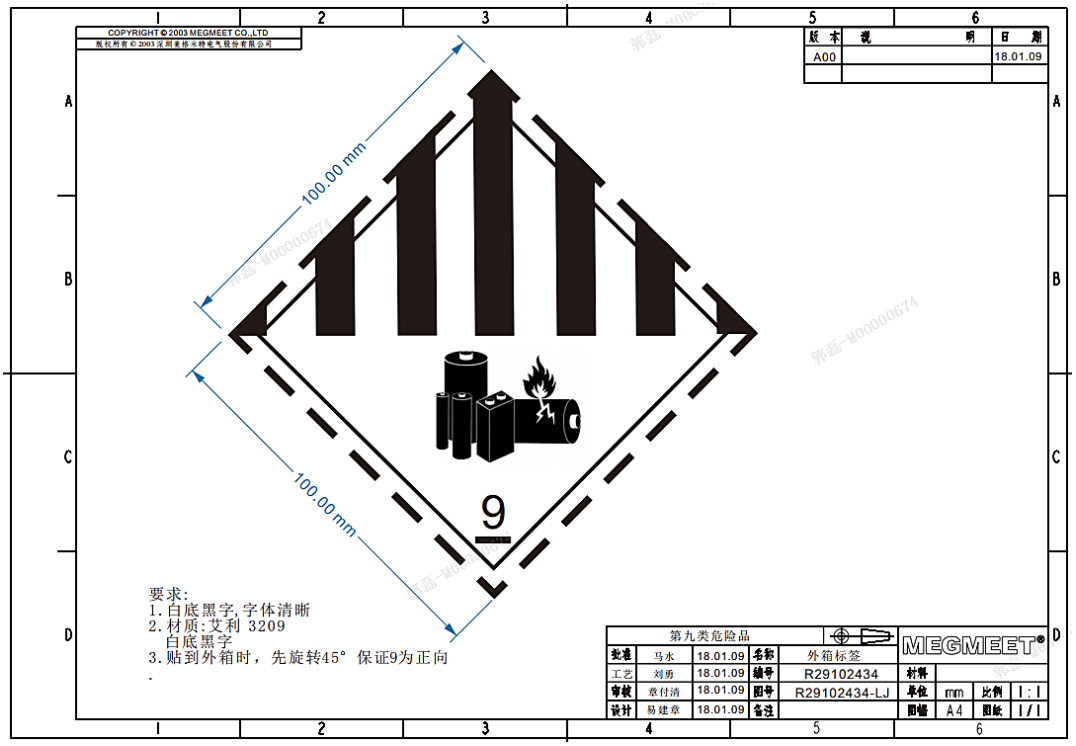
13.1 产品包装 Product Package

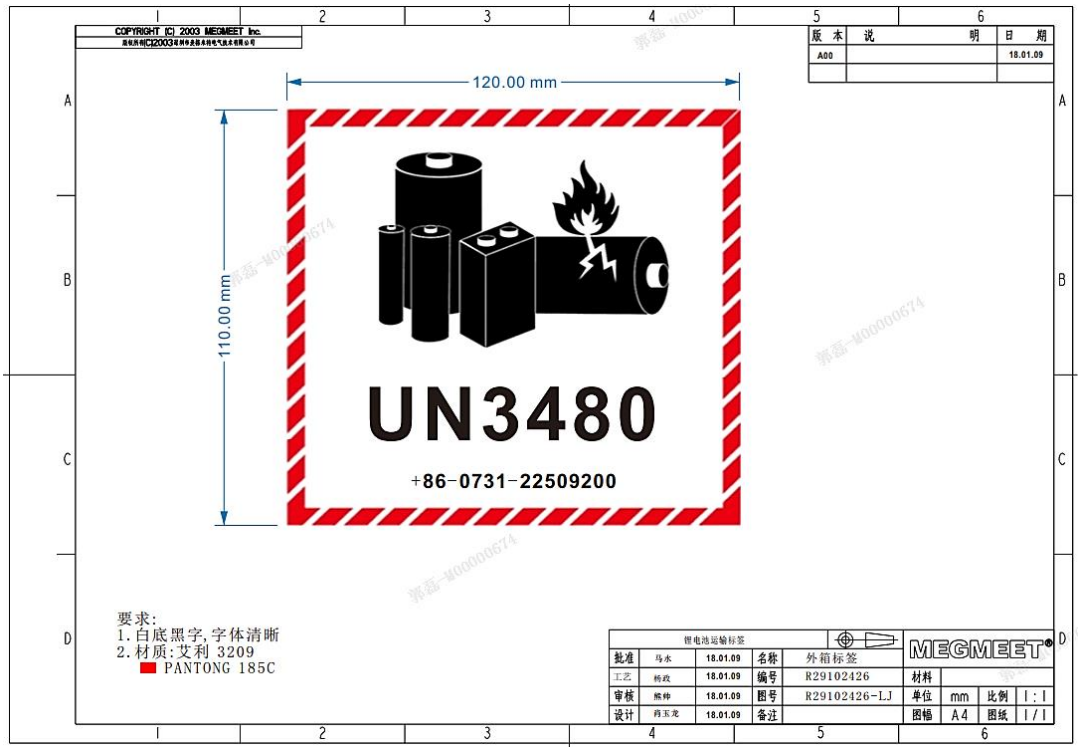
13.2 产品标签 **Label of Battery Pack**



13.3 **UN38.3 标签 Label of UN38.3**







14. 包装和运输 Package and Transportation

14.1 跌落试验 Drop Test:

(1) 试验目的：对带包装的电池可靠性进行试验。

Test purpose: To test the reliability of batteries with packaging.

(2) 试验样品数量：带包装的电池 1 盒

Number of test samples: 1 box of batteries with packaging

(3) 试验设备及条件：跌落试验机。

跌落面为光滑、平整、坚硬的地面。

Test equipment and conditions: drop testing machine.

The drop surface is smooth, flat and hard ground.

(4) 试验方法 Test method：

根据试验系统选择表中: 重量为 0-10kg，外包装的最大尺寸为 Under 100cm，跌落高度 120cm

跌落次数为 10 次，其中包含包装箱每个面， 棱，角。

试验时应保证系统迅速脱离试验机，并且使包装箱的边或角以垂直于撞击面的方向自由落下。

According to the selection table of the test system, the weight is 0-10kg, the maximum size of the outer package is under 100cm, the drop height is 120cm, drop 10 times, including each face, edge and angle of the packing box.

During the test, it should be ensured that the system is quickly detached from the testing machine, and the edge or angle of the packing box should fall freely in the direction perpendicular to the impact surface.

(5) 检查点及检验方法 Check points and inspection methods:

- 外观无明显机械损伤，无油漆脱落。

  Appearance without obvious mechanical damage and no paint peeling.

- 粘合处没有开裂。

  The bond does not crack.

- 内部零件无松动, 电池应能正常工作。

  Without loose internal components, the battery should work properly.

- 外包装应无损坏导致机器外露。

  The outer packing should be free of damage that causes the machine to be exposed.

(6) 作试验记录并得出结论 Make a record of the test and draw conclusions:

以上试验项目中，有任何一项未通过则说明试验失败

The test failed if any of above test phenomenon occurs.

(7) 运输试验 Transportation test

振动试验 Vibration test	15min内从7Hz至200Hz完成一次往复对数扫频正弦振动，3h内完成三维方向振动12次。 Complete a reciprocating logarithmic sine sweeping-frequency vibration from 7 Hz to 200 Hz within 15 min, and complete 12 vibrations in three-dimensional direction within 3 h.	无渗漏、无排气、无解体、无燃烧、无爆炸、无破损，开路电压不小于试验前的90%，失重要求见说明 There shall be no leakage, exhaust, disintegration, combustion, explosion and damage. The open-circuit voltage shall not be less than 90% of that before the test. See the instructions for weight loss requirements.
冲击试验 Impact test	加速度150gn、6ms或加速度50gn、11ms半正弦冲击，每个安装方向进行3次，总共18次。 Semi-sinusoidal impact with acceleration of 150 gn, 6 ms or acceleration of 50 gn, 11 ms shall be carried out for 3 times in each installation direction, totaling 18 times.	无渗漏、无排气、无解体、无燃烧、无爆炸、无破损，开路电压不小于试验前的90%，失重要求见说明 There shall be no leakage, exhaust, disintegration, combustion, explosion and damage. The open-circuit voltage shall not be less than 90% of that before the test. See the instructions for weight loss requirements.

失重要求参考 UN38.3。

For weightlessness requirements, refer to UN38.3.

15. 建议 Handling Requirements

The following represents a typical, but non-exhaustive, list of guidance 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 End-Users

The following represents a typical, but non-exhaustive, list of guidance 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.

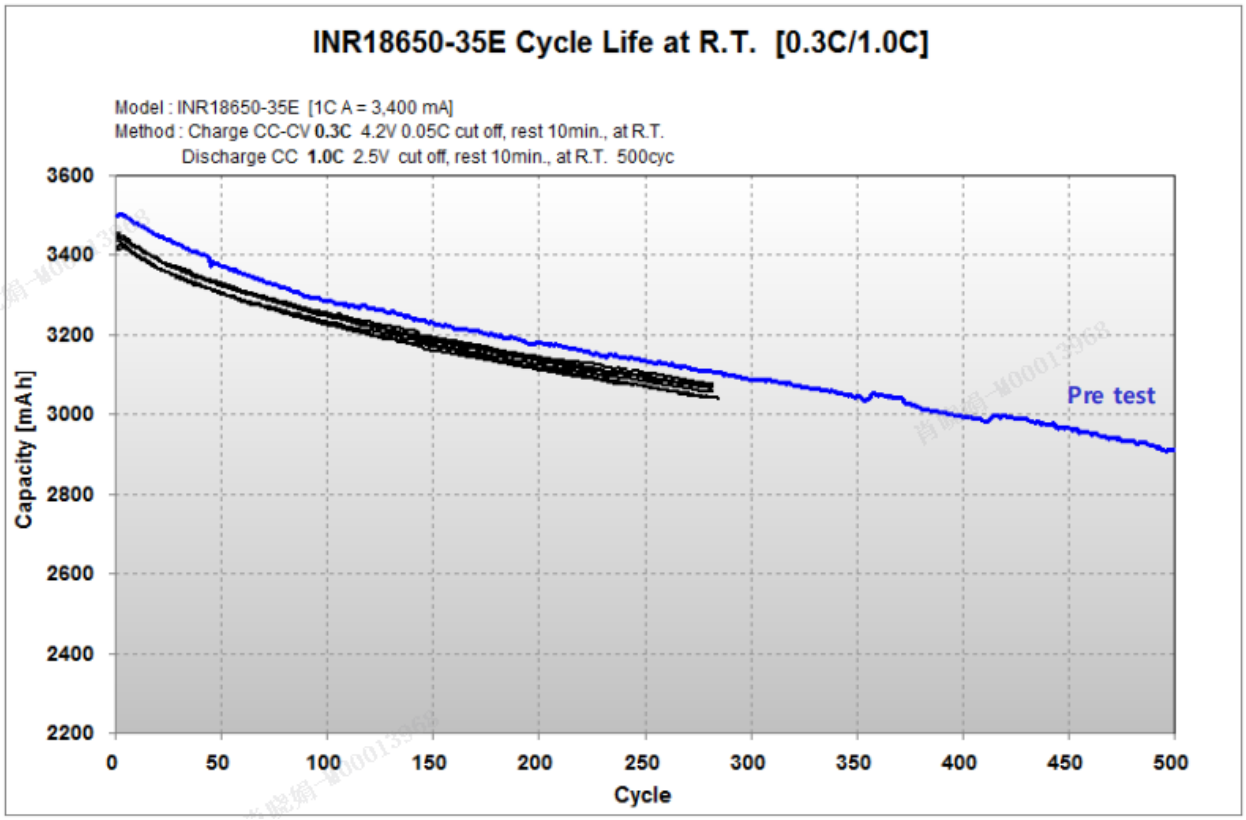
t) Use the cell or battery only in the application for which it was intended.

u) When possible, remove the battery from the equipment when not in use.

v) Dispose of properly.

16. 附录 Appendix

16.1 电芯循环寿命曲线 Curve of Cell cycle life



16.2 热敏电阻温度阻抗表 Thermistor Resistance VS Temperature(R-T Table) (information)

Temperature (℃)	Rmax. (KΩ)	Rnor. (KΩ)	Rmin. (KΩ)	Temperature Tol. (℃)		Resistance Tol. (%)	
-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%