锂离子电芯规格书

Lithium ion battery specification

型号: TB-40138-HE-20Ah-LFP

Model:TB-40138-HE-20Ah-LFP

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修订履历

Revision of resume

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1.基本信息 Basic Information

1.1 术语定义 Definition of terms

术语	定义
产品 Products	本规格书中的“产品”是指拓邦锂电生产的 20Ah 3.2V 可充电磷酸铁锂圆柱型电池。 The "product" in this specification refers to the 20Ah 3.2V rechargeable lithium iron phosphate cylindrical battery produced by Topband Battery.
周围环境温度 Ambient temperature	电池所处的周围环境温度。 The ambient temperature to which the battery is exposed.
电池管理系统（BMS） Battery Management System (BMS)	客户用于监测和记录产品在整个服务期限内的运行参数的一种有效的追踪和控制系统。其追踪和记录的参数包括但不限于电压、电流、温度等，以控制产品的运行并确保产品运行环境及运行条件符合本规格书的规定。 An effective tracking and control system used by the customer to monitor and record the operating parameters of the product throughout the service period. The parameters tracked and recorded include, but are not limited to, voltage, current, temperature, etc., to control the operation of the product and to ensure that the operating environment and operating conditions of the product are in accordance the provisions of this specification.
电芯温度 Cell temperature	由接入电池的温度传感器测量的电芯的温度，温度传感器和测量线路的选择由拓邦锂电和客户共同商定。 The temperature of the cell measured by the temperature sensor plugged into the battery, the selection of the temperature sensor and the measurement line is mutually agreed by Topband Battery and the customer.
新电池状态 New Battery Status	是指电池自产品的制造下线日期算起 7 天以内的状态。 It is the condition of the battery within 7 days from the date of manufacture of the product off the production line.
充电倍率 Charging multiplier	充电电流与电池管理系统多次测量的电池的容量值的比率。例如：电池容量为 20Ah，充电电流为 4A 时,则充电倍率为 0.2C；当电池容量跌落为 16Ah，充电电流为 3.2A 时，则充电倍率为 0.2C The ratio of charging current to the capacity value of the battery measured by the battery management system several times. For example, if the battery capacity is 20Ah and the charging current is 4A, the charging multiplier is 0.2C; when the battery capacity drops to 16Ah and the charging current is 3.2A, the charging multiplier is 0.2C.
循环	电池按规定的充放标准充放一次为一个循环。循环包括短时的正常

Cycle	充电或者再生充电和放电过程的组合，在充电过程中有时只有正常充电而无再生充电的情况。放电可以由一些部分放电组合在一起形成。 The battery is charged and discharged once for one cycle according to the specified charging and discharging standards. The cycle includes short periods of normal charging or a combination of regenerative charging and discharging processes, and sometimes only normal charging without regenerative charging during the charging process. Discharge can be formed by a combination of some partial discharges together.
生产日期 **Production date**	电池的制造日期，可通过电芯包膜上的标识码进行追溯。 The date of manufacture of the battery can be traced by the identification code on the core wrap.
开路电压 **Open circuit voltage**	没有接入任何负载和电路时测得的电池的电压 The voltage of the battery measured when no load or circuit is connected.
标准充电 **Standard charging**	本规格书第 3.2 条所述的充电模式。 The charging mode described in clause 3.2 of this specification.
标准放电 **Standard discharge**	符合本规格书第 3.3 条所述的 0.5C 的放电电流以及本规格书第 2.3.1 条所述的最小 2.5V 电压的放电模式。 Discharge mode conforming to a discharge current of 0.5C as described in clause 3.3 of this specification and a minimum voltage of 2.5V as described in clause 2.3.1 of this specification.
充电状态(SOC) **State of Charge (SOC)**	在无负载的情况下，以安培小时或者以瓦特小时为单位计量的电池充电容量状态的所有的线性关系。如：若将容量为 20Ah 的状态视为 100%SOC，则容量为 0Ah 时，SOC 为 0%。 All linear relationships for battery charge capacity states measured in ampere-hours or in watt-hours without load. For example, if the state with a capacity of 20Ah is considered 100% SOC, then the SOC is 0% for a capacity of 0 Ah.
温度上升 **Temperature rise**	在本规格书规定的条件如充电过程或者放电过程中电芯温度的升高。 The temperature of the cell increases during the conditions specified in this specification such as the charging process or the discharging process.
测量单位 **Measurement units**	“V” (Volt)伏特(V)，电压单位 “A” (Ampere)安培(A)，电流单位 “Ah” (Ampere-Hour)安培-小时(Ah)，负荷单位 “Wh” (Watt-Hour)瓦特-小时(Wh)，能量单位 “mΩ” (MilliOhm) 毫欧姆(mΩ)，电阻单位 “℃” (degree Celsius) 摄氏度(℃)，温度单位

	“mm” (millimetre) 毫米(mm)，长度单位 “s” (second) 秒(s)，时间单位 “Hz” (Hertz)赫兹(Hz)，频率单位 "V" (Volt) Volt (V), unit of voltage "A" (Ampere), unit of current "Ah" (Ampere-Hour) Ampere-Hour (Ah), unit of load "Wh" (Watt-Hour), unit of energy "mΩ" (MilliOhm) milliohm (mΩ), unit of resistance "°C" (degree Celsius) Celsius, unit of temperature "mm" (millimetre) Millimeter (mm), unit of length "s" (second) seconds(s), unit of time "Hz" (Hertz) Hertz (Hz), unit of frequency

1.2 适用范围 Scope of application

本规格书规定了圆柱型锂离子电芯的技术要求，测试方法及注意事项。

This specification specifies the technical requirements, test methods and precautions for cylindrical Lithium-ion battery cells.

1.3 产品分类 Product Classification

本圆柱型可充电锂离子电芯。

This is cylindrical rechargeable lithium-ion battery cell.

1.4 型号名称 Model Name

TB-40138-HE-20Ah-LFP

1.5 电池组装 Battery Assembly

单个电池：根据具体应用组装成一定规格的电池组，由电池组与电子系统共同参与完成电池组的性能管理、热管理和安全管理。

Individual battery: assembled into a certain size battery pack according to the specific application, by the battery pack and electronic system together battery pack performance management, thermal management and safety management.

组装系统：连接前确保电极面干净、无油污、无灰尘，不然可能导致接触不良，影响电池性能，确保电池电极与线路连接紧固，否则会影响电池使用性能。

Assembly system: ensure that the electrode surface is clean, free of oil and dust before connection, otherwise it may lead to poor contact and affect the electrical battery performance, ensure that the battery electrode and line connection is tight, otherwise it will affect the battery

performance.

2.产品电性能指标 Product electrical performance index

2.1 概要 Overview

序号 Serial number	项目 Projects	标准 Standard	备注 Remarks
2.1.1	标称容量 Normal capacity	20Ah	25±3℃，0.5C DC 3.65V to 2.5V
2.1.2	标称电压 Normal voltage	3.2V	
2.1.3	工作电压 Operation voltage	2.5V~3.65V 2.0V~3.65V	Temperature 温度 T>0℃ Temperature 温度 T≤0℃
2.1.4	电芯直径 Cell diameter	封口处 40.9±0.1mm Seal 40.9±0.1mm 中间 40.7±0.1mm Middle 40.7±0.1mm	图形结构详细信息，请参阅附图 1 For details of the graphic structure, see Figure 1.
	电芯高度 Cell height	140±0.5mm	
2.1.5	电池内阻(1KHz) Battery internal resistance(1KHz)	≤2.0mΩ	新电池状态 New Battery Status
2.1.6	电芯重量 Weight	420g±10 g	N.A.
2.1.7	出货电压 Shipping voltage	≥3.2V（≥15%SOC）	出货收到电池七天内测试开路电压，新电池状态 Shipment received within seven days of the battery test open circuit voltage, new battery status
2.1.8	工作温度(充电) Operating temperature (charging)	0~60℃	参考第 2.2 节 Refer to Section 2.3
2.1.9	工作温度(放电) Operating temperature (discharge)	-20~65℃	参考第 2.4 节 Refer to Section 2.3
2.1.10	常温循环（25±2℃） Normal temperature cycle	≥2000cycles	0.5C 充/0.5C 放，衰减至额定容量 80% 0.5C charge/0.5C discharge, decay to 80% of rated capacity
		≥1500cycles	1.0C 充/1.5C 放，衰减至额定容量 70%

	(25±2℃)		1.0C charge / 1.5C discharge, decay to 70% of rated capacity

2.2 充电模式/参数 Charging mode/parameters

序号 Serial number	项目 Projects	标准 Standard	备注 Remarks
2.2.1	标准充电电流 Standard charging current	0.5C	25±2℃
2.2.2	最大可持续充电电流 Maximum sustainable charging current	1.33C	25±2℃
2.2.3	标准充电电压 Standard charging voltage	3.65V	25±2℃
2.2.4	充电截止电流 Charge cut-off current	1A	恒压充电截止电流 0.05C Constant voltage charging cut-off current 0.05C
2.2.5	标准充电温度 Standard charging temperature	25±2℃	
2.2.6	绝对充电温度（电芯温度） Absolute charging temperature (Cell temperature)	0~60℃	无论电芯处在何种充电模式，一旦发现电芯温度超过绝对充电温度范围即停止充电 No matter what charging mode the battery is in, once the battery temperature is found to exceed the absolute charging temperature range, charging will be stopped
2.2.7	绝对充电电压 Absolute charging voltage	最大 3.65V Maximum 3.65V	无论电芯处在何种充电模式，一旦发现电芯电压超过绝对充电电压范围即停止充电 No matter what charging mode the battery is in, once the battery voltage is found to exceed the absolute charging voltage range, charging will be stopped

2.3 充电 mapping 单位：C-Rate Charging mapping unit: C-Rate

SOC		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
温度 1 temperature 1	0~10℃	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

温度 2 temperature 2	10~20℃	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
温度 3 temperature 3	20~45℃	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
温度 4 temperature 4	45~60℃	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

2.4 放电模式 Discharge mode

序号 Serial number	项目 Project	标准 Standard	备注 Remarks
2.3.1	标准放电电流 Standard discharge current	0.5C	25±2℃
2.3.2	最大可持续放电电流 Maximum sustainable discharge current	3C	25±2℃，SOC＞30%
2.3.3	放电截止电压 Discharge cut-off voltage	2.5V 2.0V	温度 T>0℃ 温度 T≤0℃ Temperature T>0℃ Temperature T≤0℃
2.3.4	标准放电温度 Standard discharge temperature	25±2℃	
2.3.5	峰值放电电流 Peak discharge current	4C	25±2℃，放电时间＜5S， SOC>30% 25±2℃, discharge time＜5S, SOC>30%
2.3.6	绝对放电温度 Absolute discharge temperature	-20~65℃	无论电芯处在持续放电模式或脉冲放电模式，若电芯温度超过绝对放电温度，则停止放电 No matter in continuous discharge mode or pulse discharge mode, if the temperature of the core exceeds the absolute discharge temperature, the discharge will be stopped.

3. 测试条件 Test conditions

3.1 标准测试条件 Standard test conditions

若无特别要求，此规格书上的室温为 25±2℃，产品测试条件为：温度 25±2℃，湿度 15～90 %RH，大气压力 86kPa～106kPa。

If there is no special requirement, the room temperature on this specification is 25±2°C. The product test conditions are: temperature 25±2°C, humidity 15~ 90 %RH, atmospheric pressure 86kPa~106kPa.

3.2 标准充电 Standard charging

“标准充电”即在标准测试条件下，电芯先以恒定电流 0.5C 充电至 3.65V，再以 3.65V 的恒定电压充电至截止电流 0.05C。

"Standard charge" means that under standard test conditions, the cell is charged to 3.65V at a constant current of 0.5C and then to a cut-off current of 0.05C at a constant voltage of 3.65V.

3.3 标准放电 Standard discharge

“标准放电”即在标准测试条件下，电芯以恒定电流 0.5C 放电至 2.5V。

The "standard discharge" means that the cell is discharged to 2.5V at a constant current of 0.5C under standard test conditions

4. 电性能测试 Electrical performance test

序号 Serial number	项目 Project	标准 Standard	测试方法 Test method
4.1	交流内阻 AC internal resistance	≤2.0mΩ	25±2℃，新电池状态，交流频率在 1000 Hz 下测量。 New battery state, AC frequency is measured at 1000 Hz
4.2	初始容量（25℃） Initial Capacity (25℃)	≥20Ah	a) 电芯按标准充电方法充电，静置 30min； b) 以 0.5C 电流放电至 2.5V 容量，静置 30min； c) 重复步骤 a)~c) 3 次，当连续 2 次试验结果的容量变化小于 1%，可提前结束测试，取最后 1 次测试结果。 a) Charging the battery cells according to the standard charging method and leave them for 30min. b) Discharge to 2.5V capacity with 0.5C current and leave for 30min. c) Repeat steps a) ~ c) 3 times, when the capacity change of 2 consecutive test results is less than 1%,the test can be ended early and the last test result is taken.
4.3	3C 室温倍率放电（25℃） 3C room temperature	≥90%*初始容量 ≥90%*initial capacity	a) 电芯按标准充电方法充电，静置 30min； b) 以 3C 电流放电至 2.5V 容量，静置 30min； a) Charging the battery cells according to the standard charging method and leaving them for 30min.

	multiplier discharge (25℃)		b) Discharge to 2.5V capacity with 3C current and leave for 30min.
4.4	室温倍率充电（25℃）Room temperature multiplier charging (25℃)	≥97%*初始容量 ≥97%*initial capacity	a)以 0.5C 电流放电至 2.5V，静置 30min； b)以 0.5C 电流仅恒流充电至 3.65V，静置 30min； c)以 1C 电流放电至 2.5V 容量； a)Discharge to 2.5V with 0.5C current and leave for 30min. b)Charge to 3.65V with 0.5C current at constant current only and leave for 30min. c)Discharge to 2.5V capacity with 1C current.
		≥94%*初始容量 ≥94%*initial capacity	a)以 0.5C 电流放电至 2.5V，静置 30min； b)以 1C 电流仅恒流充电至 3.65V，静置 30min； c)以 1C 电流放电至 2.5V 容量； a)Discharge to 2.5V with 0.5C current and leave for 30min. b)Charge to 3.65V with 1C current at constant current only and leave for 30min. c)Discharge to 2.5V capacity with 1C current
4.5	-10℃放电 -10℃ discharge	≥70%*初始容量 ≥70%*initial capacity	a)电芯按标准充电方法充电，静置 30min； b)在-10±2℃下搁置 12h，在-10±2℃下以 1IC 电流放电至 1.8V（结果值取放电至 2.0V 容量）； a)Charging the battery cells according to the standard charging method and leave them for 30min. b)Set aside for 12h at -10±2°C and discharged to 1.8V at -10±2°C with 1C current (the resultant value is taken to be discharged to 2.0V capacity)
4.6	-20℃放电 -20℃ discharge	≥60%*初始容量 ≥60%*initial capacity	a)电芯按标准充电方法充电，静置 30min； b)在-20±2℃下搁置 12h，在-20±2℃下以 1C 电流放电至 1.8V（结果值取放电至 2.0V 容量）； a) Charging the battery cells according to the standard charging method and leave them for 30min. b) Set aside for 12h at -20±2°C and discharged to 1.8V at -20±2°C with 1C current (the resultant value is taken to be discharged to 2.0V capacity)
4.7	65℃高温放电 65℃ high temperature discharge	≥98%*初始容量 ≥98%*initial capacity	a)电芯按标准充电方法充电，静置 30min； b)在 65±2℃下搁置 5h，在 65±2℃下，以 0.5C 电流放电至 2.5V 容量； a)Charging the battery cells according to the standard charging method and leave them for 30min. b)Set aside at 65±2°C for 5h and discharged to 2.5V capacity at 65±2°C with 0.5C current.
4.8	荷电保持与容量恢复能	荷电保持容量≥92%*初始容量	a)电芯按标准充电方法充电，静置 30min； b)在 55±2℃环境下搁置 7 天，然后在 25±2℃下搁置 5h，

	力 Charge retention and capacity recovery capability	恢复容量≥95%*初始容量 Charge retention capacity ≥92%* initial capacity Recovery capacity ≥95%* initial capacity	以 0.5C 电流放电至 2.5V 容量，计量荷电保持容量； c)静置 30min，电芯再按标准充电方法充电，静置 30min； d)25±2℃下，以 0.5C 电流放电至 2.5V 容量，计量恢复容量； a)Charging the battery cells according to the standard charging method and leave them for 30min. b) Shelved at 55±2°C for 7 days, then shelved at 25±2°C for 5h and discharged to 2.5V capacity with 0.5C current to measure the charge retention capacity. c)Leave it for 30min, and the battery cell is then charged according to the standard charging method and left for 30min. d)Discharge to 2.5V capacity with 0.5C current at 25±2°C and measure the recovery capacity.
		荷电保持容量≥95%*初始容量 恢复容量≥97%*初始容量 Capacity retention rate after 1500 cycles ≥ 80% of rated capacity	a)电芯按标准充电方法充电，静置 30min； b)在 25±2℃下储存 28 天后，在 25±2℃下 0.5C 电流放电至 2.5V 容量，计量荷电保持容量； c)静置 30min，电芯再按标准充电方法充电，静置 30min； d)25±2℃下，以 0.5C 电流放电至 2.5V 容量，计量恢复容量。 a)Charging the battery cells according to the standard charging method and leave them for 30min. b)After storage at 25±2°C for 28 days, the charge retention capacity is measured by discharging 0.5C current at 25±2°C to 2.5V capacity. c)Leave it for 30min, and the battery cell is then charged according to the standard charging method and left for 30min. d)Discharge to 2.5V capacity with 0.5C current at 25±2°C and measure the recovery capacity.
4.9	常温循环寿命（25±2℃） Normal temperature cycle life (25±2℃	2000 次后容量保持率≥80%额定容量 Capacity retention rate after 2000 cycles ≥ 80% of rated capacity	a)以 0.5C 的电流放电至 2.5V，搁置 30min； b)电芯按标准充电方法充电，静置 30min； c)0.5C 的电流放电至 2.5V，记录放电容量，搁置 30min； d)重复 b）～c）工步； e)直至连续三次容量保持率低于 80%额定容量停止； a)Discharge to 2.5V with a current of 0.5C and set aside for 30min. b)The battery cell is charged according to the standard charging method and left to stand for 30min. c)0.5C current discharge to 2.5V, record the discharge capacity and set aside for 30min. d)Repeat b) to c) work steps. e) until the capacity retention rate falls below 80% of rated

			capacity for three consecutive stops
		1500 次后容量保持率≥70%额定容量 Capacity retention rate after 1500 cycles ≥ 70% of rated capacity	a) 以 0.5C 的电流放电至 2.5V，搁置 30min； b) 电芯按照 1.0C 标准制式充满电，搁置 30min； c) 1.5C 的电流放电至 2.5V，记录放电容量，搁置 30min； d) 重复 b）～c）工步； e) 直至连续三次容量保持率低于 80%额定容量停止； a)Discharge to 2.5V with a current of 0.5C and set aside for 30min. b)The batteries are fully charged in accordance withthe standard 1.0C system and set aside for 30min. c)1.5C current discharge to 2.5V, record the discharge capacity and set aside for 30min. d) Repeat b) to c) work steps. e) until the capacity retention rate falls below 80% of rated capacity for three consecutive stops.

5.安全与可靠性 Safety and Reliability

The following safety tests should be conducted under conditions of forced air exhaust and explosion-proof measures, and the battery cells should be fully charged in accordance with the standard charging method, and then the following safety tests should be conducted.

序号 Serial number	项目 Projects	标准 Standard	测试方法 Test method
5.1	短路测试 Short Circuit Test	不起火、不爆炸 No fire, no explosion	a) 将电芯正、负极经外部短路 10min，外部线路总电阻 20±5mΩ，观察 1h。 a)Short circuit the positive and negative electrodes of the core by external for 10min, total external line resistance 20±5mΩ, and observe for 1h.
5.2	过充电 Overcharging	不起火、不爆炸 No fire, no explosion	a) 1C 恒流充电至终止电压的 1.5 倍（5.4V）或充电时间达到 1h 后停止充电，观察 1h。 a)1C constant current charging to 1.5 times of the termination voltage (5.4V) or stop charging after charging time reaches 1h and observe for 1h
5.3	过放电 Over-discharge	不起火、不爆炸 No fire, no explosion	a) 1C 恒流放电至 0V 或放电时间达到 1.5h 后停止放电，观察 1h。 a) 1C constant current discharge to 0V or discharge time up to 1.5h and then stop discharge and observe for 1h.
5.4	跌落 Falling	不起火、不爆炸 No fire, no explosion	a) 将电芯的正极或负极朝下从 1.2m 高度处自由跌落到水泥地面上一次。

			a)Drop the positive or negative electrode of the battery core face down from a height of 1.2m onto the concrete floor once.
5.5	挤压测试 Crush test	不起火、不爆炸 No fire, no explosion	挤压方向：垂直于电芯极板方向施压；挤压面面积大于被挤压电芯的尺寸；当电压达到 0V 或变形量达到 15%或挤压力达到 13kN 保持 1min 之后下载挤压力。每个电芯只接受一次挤压；试验结束后观察 1h。 Extrusion direction: apply pressure perpendicular to the core plate direction; the extrusion surface area is larger than the size of the extruded core; download the extrusion pressure after the voltage reaches 0V or the deformation reaches 15% or the extrusion pressure reaches 13kN for 1min. Each core only receives one extrusion; 1h observation after the test.
5.6	海水浸泡 Sea water immersion	不起火、不爆炸 No fire, no explosion	将电芯浸入 3.5%NaCl 溶液（质量分数，模拟常温下的海水成分）中 2h，水深应完全没过电芯；观察 1h。 Immerse the core in 3.5% NaCl solution (mass fraction, simulating the composition of seawater at room temperature) for 2h, the water depth should be completely submerged in the core; observe for 1h.
5.7	低气压 Low pressure	不起火、不爆炸 No fire, no explosion	电芯按标准充电方法充满电；放入低气压箱中，调节试验箱中气压为 11.6kPa，温度为室温，静置 6h；拿出室温下静止 1h 观察外观变化。 The core is fully charged according to the standard charging method; put it into the low pressure box, adjust the air pressure in the test box to 11.6kPa, the temperature is room temperature, and leave it for 6h; take it out and leave it for 1h at room temperature to observe the appearance change.
5.8	加热测试 Heating test	不起火、不爆炸 No fire, no explosion	将电芯电热古风干燥箱中加热，温度以 5±2℃/min 的加热速率由室温升至 130±2℃并保持 30min，然后关闭加热，并观察 1h。 The electric core was heated in the electric ancient air drying oven, and the temperature was increased from room temperature to 130± 2℃ at a heating rate of 5±2℃/min and kept for 30min, then the heating was turned off and observed for 1h.

6.产品寿命终止管理 End-of-life management

电池的使用期限是有限的。客户应该建立有效的跟踪系统监测并记录每个使用期限内电池

和容量。当使用中的电池的容量≤70%额定容量时（25℃），应停止使用电池。违反该项要求，将免除拓邦锂电依据产品销售协议以及本规格书所应承担的产品质量保证责任。

Batteries have a limited life span. Customers should establish an effective tracking system to monitor and record the battery and capacity during each service life. When the capacity of the battery in use is ≤ 70% of the rated capacity (25℃), the battery should be discontinued. Violation of this requirement will relieve Topband Battery responsibility of product quality assurance according to the product sales agreement and this specification.

7. 应用条件 Application conditions

客户应当确保严格遵守以下与电池相关的应用条件：

The customer should ensure that the following battery-related application conditions are strictly adhered to.

7.1 客户应配置电池管理系统，严密监控、管理与保护每个电池。

7.1 The customer shall configure a battery management system to closely monitor, manage and protect each battery.

7.2 客户应保存完整的电池运转的监测数据，用作产品质量责任划分的参考。不具备完整的电池系统使用期限内的监测数据的，拓邦锂电不承担产品质量保证责任。

7.2 Customers should keep complete monitoring data of the battery operation, used as a reference for product quality responsibility division. Do not have complete monitoring data of the battery system within the period of use, Topband Battery does not assume responsibility for product quality assurance.

7.3 避免电池到达过放状态。电池电压低于 1.8V 时，电池内部可能会遭到永久性的损坏，此时拓邦锂电的产品质量保证责任失效。根据本规格书放电标准，当放电截止电压低于 2.5V 时，系统内部能耗降低到最小，并在重新充电之前延长休眠时间。客户需要培训使用者在最短的时间内重新充电，防止电池进入过放状态。

7.3 Avoid the battery to reach the over-discharged state. When the battery voltage is below 1.8V, the battery may be permanently damaged internally, at which point Toppan Lithium's product quality warranty liability is voided. According to the discharge standard of this specification, when the discharge cut-off voltage is below 2.5V, the internal energy consumption of the system is reduced to

a minimum and the dormancy time is extended before recharging. Customers need to train users to re-charge in the shortest possible time to prevent the battery from going into over-discharge.

7.4 若预计将电池存放 90 天以上的，应将 SOC 调整为 30%～ 50%左右。

7.4 If the battery is expected to be stored for more than 90 days, the SOC should be adjusted to about 30%~50%.

7.5 电池避免在本规格书禁止的低温条件下充电(包括标准充电，快充，紧急情况充电和再生充电)，否则可能出现意外的容量降低现象。电池管理系统应依照最小的充电和再生充电温度进行控制。禁止在低于本规格书规定的温度条件下充电，否则，拓邦锂电不承担质量保证责任。

7.5 Avoid charging the battery in low temperature conditions prohibited by this specification (including standard charging, fast charging, emergency charging and regenerative charging), otherwise unexpected capacity reduction may occur. The battery management system shall be controlled in accordance with the minimum charging and regenerative charging temperatures. It is prohibited to charge under temperature conditions lower than those specified in this specification, otherwise, Topband Battery will not assume the responsibility of quality assurance.

7.6 电箱设计中应充分考虑电芯的散热问题，由于电箱散热设计问题导致的电芯或电池过热损坏，拓邦锂电不承担质量保证责任。

7.6 The design of the electric box should be fully considered in the heat dissipation of the core, due to the thermal design of the electric box caused by the core or battery overheating damage, Topband Battery does not assume responsibility for quality assurance.

7.7 电箱设计中应充分考虑电芯的防水、防尘问题，电箱必须满足国家有关标准规定的防水、防尘等级。由于防水、防尘问题而导致的电芯或电池的损坏（如腐蚀、生锈等），拓邦锂电不承担质量保证责任。

7.7 The design of the electric box should be fully considered the waterproof and dustproof problems of the battery cells, the electric box must meet the relevant national standards for waterproof and dustproof grade. Waterproof, dustproof problems caused by the core or battery damage (such as corrosion, rust, etc.), Topband Battery does not assume responsibility for quality assurance.

8.安全防范 Security Precautions

8.1 禁止将电池浸入水中。

8.1 It is prohibited to immerse the battery in water.

8.2 禁止将电池投入火中或长时间暴露在超过本规格书规定的温度条件的高温环境中,否则可能会导致火灾。在任何正常的使用情况下，电池电芯温度不能超过 65℃，如果电池中电芯温度超过 65℃，电池管理系统需关闭电池，停止电池运行。

8.2 It is prohibited to put the battery into fire or expose it to high temperature environment for a long time which exceeds the temperature condition specified in this specification, otherwise it may lead to fire. Under any normal use, the battery cell temperature should not exceed 65℃. If the cell temperature in the battery exceeds 65℃, the battery management system needs to shut down the battery and stop the battery operation.

8.3 禁止电池正负极短路，否则强电流和高温可能导致人身伤害或者火灾。由于电池的正负极暴露于塑料保护套中，在电池系统组装和连接时，应有足够的安全保护，以避免短路。

8.3 It is prohibited to short-circuit the positive and negative terminals of the battery, otherwise the strong current and high temperature may lead to personal injury or fire. Since the positive and negative terminals of the battery are exposed in the plastic protective sleeve, there should be sufficient safety protection to avoid short circuit when the battery system is assembled and connected.

8.4 严格按照标示和说明连接电池正负极，禁止反向充电。

8.4 Connect the positive and negative terminals of the battery in strict accordance with the label and instructions, and prohibit reverse charging.

8.5 禁止电池过充，否则，可能引起电池过热和火灾事故的发生。在电池安装和使用中，硬件和软件需实行多重过充失效安全保护。

8.5 Prohibit battery overcharging, otherwise, it may cause battery overheating and fire accidents. In the battery installation and use, hardware and software need to implement multiple overcharge failure safety protection.

8.6 根据本规格书充电后，应结束正常充电。当持续充电时间超过合理的时间限制，电池会出现过热现象可能会引起热失控和火灾。应安装上一个定时器加以保护。一旦充电电流达到过冲状态而不能终止，定时器将会起作用从而终止充电。

8.6 After charging according to this specification, normal charging should be ended. When the

continuous charging time exceeds the reasonable time limit, the battery will overheat phenomenon may cause thermal runaway and fire. A timer should be installed to protect it. Once the charging current reaches an overshoot state and cannot be terminated, the timer will act to terminate the charge.

8.7 客户应将电池安全地固定在固体平面上，并将电源线安全地束缚在合适的位置，以避免摩擦而引起电弧和火花。

8.7 The customer shall securely fasten the battery to a solid plane and safely bind the power cord in a suitable location to avoid arcing and sparking due to friction.

8.8 严禁用塑料封装电池或用塑料进行电气连接。不正确的电气连接方式可能会造成电池使用过程中发生过热现象。

8.8 It is strictly forbidden to encase the battery in plastic or make electrical connections with plastic. Incorrect electrical connections may cause the battery to overheat during use.

8.9 当电解液泄露时，应避免皮肤和眼睛接触电解液。如有接触，应使用大量的清水清洗接触到的区域,并向医生寻求帮助。禁止任何人或动物吞食电池的任何部件或电池所含物质。

8.9 Avoid skin and eye contact with the electrolyte when it is leaking. In case of contact, wash the contacted area with plenty of water and seek medical help. It is forbidden for any person or animal to swallow any part of the battery or the substance contained in the battery.

8.10 尽力保护电池，使其免受机械震动、碰撞及压力冲击,否则电池内部可能短路，产生高温和火灾。

8.10 Make every effort to protect the battery from mechanical vibration, collision and pressure shock, otherwise the battery may be short-circuited internally and generate high temperature and fire.

8.11 电池充电过程中可能发生不适当的终止充电现象。如：超出允许的充电时间充电，充电电压过高而终止充电或充电电流过强而终止充电。上述现象被定义为“不适当的终止充电”。当发生以上现象时，可能意味着电池系统出现漏电或某些部件出现故障。在没有找到根本原因并彻底解决之前继续对该电池充电可能会引起电池过热或发生火灾。当发生以上现象时，电池管理系统应该通过自动锁定功能，禁止后续的充电，并提醒使用者将装载有该电池的交通工具退回到经销商处进行系统维护。该电池只有经过有认证资格的技术人员全面检查，确定根本原因并彻底解决、改善后方可恢复充电。

8.11 Improper termination of charging may occur during the battery charging process. For

example, charging beyond the allowed charging time, charging voltage is too high and charging is terminated or charging current is too strong and charging is terminated. The above phenomena are defined as "improper termination of charging". When these phenomena occur, it may mean that the battery system is leaking or some components are malfunctioning. Continuing to charge the battery until the root cause is found and completely resolved may cause the battery to overheat or fire. When these phenomena occur, the battery management system should prohibit subsequent charging through the automatic lockout function and remind the user to return the vehicle with the battery to the dealer for system maintenance. This battery should only be recharged after a thorough inspection by a certified technician to determine the root cause and thoroughly resolve and improve it.

8.12 本规格书安全与可靠性检测描述的测试实验如操作不当可能会引起电池起火或者爆炸。该测试实验只能由配备适当的防护装备的专业人员在专业的实验室进行。否则，可能会导致严重的人身伤害和财产损失。

8.12 The test experiments described in this specification for safety and reliability testing may cause the battery to catch fire or explode if not performed properly. This test should only be performed in a professional laboratory by professionals equipped with appropriate protective equipment. Failure to do so may result in serious personal injury and property damage.

9.存储建议 storage suggestions

9.1 如果要长时间存放（超过 3 个月），电芯应存储在温度范围为 10～30℃，低湿度和不含腐蚀性气体的环境中；

9.1 If it is to be stored for a long period of time (more than 3 months), the cells should be stored in an environment with a temperature range of 10 to 30°C, low humidity and free from corrosive gases.

9.2 建议每 3 个月要充放电一次（2 次循环），6 个月必须充放电一次（2 次循环），充放电方式如下：在 25±3℃环境下，0.5C 恒流放电至 2.5V，静置 30min，0.5C 恒流恒压充电至 3.65V 截止电流 0.05C，静置 30min，0.5C 恒流放电至 2.5V，静置 30min，0.5C 恒流充电至约 30%SOC；

9.2 It is recommended to charge and discharge once every 3 months (2 cycles), and must charge and discharge once every 6 months (2 cycles) in the following manner: 0.5C constant current discharge to 2.5V at 25±3°C environment, rest for 30min, 0.5C constant current and constant voltage charge to 3.65V cut-off current 0.05C, rest for 30min, 0.5C constant current discharge to 2.5V, rest

for 30min, 0.5C constant current charge to ~30% SOC.

9.3 基于对电芯的保护，良好的存储环境是必需的。

9.3 A good storage environment is necessary based on the protection of the battery cells.

10. 危险类型 Hazard type

客户知悉在电池使用和操作过程中存在以下潜在的危险:

The customer is aware of the following potential hazards in the use and operation of the battery:

10.1 操作者在操作时可能会受到化学品、电击或者电弧的伤害。尽管人体对遭受直流电与交流电的反应不同,但是高于 50V 的直流电压与交流电对人体的伤害是同样严重的,因此客户必须在操作中采取保守的姿势以避免电流的伤害。

10.1 Operators may be injured by chemicals, electric shock or arcing while operating. Although the human body reacts differently to exposure to direct current and alternating current, a direct current voltage above 50V is just as serious as an alternating current, so the customer must adopt a conservative posture during operation to avoid injury from the current.

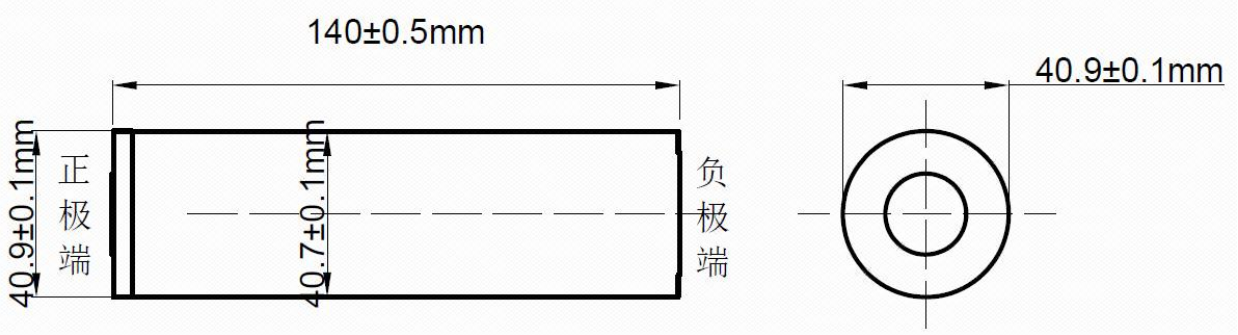
10.2 存在来自电池中的电解液的化学风险。

10.2 There is a chemical risk from the electrolyte in the battery.

10.3 在操作电池和选择个人防护装备时，客户及其雇员必须考虑到以上潜在的风险；防止发生意外短路，造成电弧、爆炸或热失控。

10.3 When operating batteries and selecting personal protective equipment, customers and their employees must take into account the above potential risks; preventing accidental short circuits that could cause arcing, explosions or thermal runaway.

附件 Annex
附图 1/
电池图片和外形尺寸
Attachment Annex
Attachment 1/
Battery picture and external dimensions



包膜示图如下：The envelope is shown below.

正极端	电池壳体	负极端
positive extreme	Battery casing	Negative extreme