

TEST REPORT

IEC 62133-2

Secondary cells and batteries containing alkaline or other non-acid electrolytes Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications

Part 2: Lithium systems

Report Number: TCT240327B013

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Tested by (name + signature): May Hou

Inspected by (name + signature): Aiden Liu

Approved by (name + signature): Tomsin



May Hou

Aiden Liu

Tomsin

Testing laboratory: Shenzhen TCT Testing Technology Co., Ltd.

Address: 2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

Testing location: As above

Applicant's name: Shenzhen Huafurui Technology Co., Ltd.

Address: Unit 601-03, 6/F, Block A, Building 1, Ganfeng Technology Building, No. 993 Jiaxian Road, Xiangjiaotang Community, Bantian Street, Longgang District, Shenzhen.

Manufacturer's name: Shenzhenshi Jiuliyuan electronic technology co., LTD

Address: 201, Jiuli Yuan Factory, Building A, No.470, Pingshan Jinbi Road, Biling Community, Biling Street, Pingshan District, Shenzhen

Test specification:

Standard: IEC 62133-2:2017, IEC 62133-2:2017/AMD1:2021

Test procedure: Type approved

Test result: Pass

Non-standard test method: N/A

The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing Shenzhen TCT Testing Technology Co., Ltd.

Test item description: Rechargeable Li-polymer battery

Trade Mark: N/A

Model/type reference: C49

Ratings: 3.87V, 5100mAh, 19.737Wh

List of Attachments (including a total number of pages in each attachment):

Attachment 1: Critical components information (page 22)

Attachment 2: Photo documentation (page 23-26)

Summary of testing:

Tests performed (name of test and test clause):

cl.5.6.2 Design recommendation;
cl.7.1 Charging procedure for test purposes (for Cells and Batteries);
cl.7.2.1 Continuous charging at constant voltage (Cells);
cl.7.3.1 External short circuit (Cells);
cl.7.3.2 External short circuit (Batteries);
cl.7.3.3 Free fall (Cells and Batteries);
cl.7.3.4 Thermal abuse (Cells);
cl.7.3.5 Crush (Cells);
cl.7.3.6 Over-charging of battery;
cl.7.3.7 Forced discharge (Cells);
cl.7.3.8 Mechanical tests (Batteries);
cl.7.3.9 Design evaluation – Forced internal short circuit (Cells)

The electrolyte type of this cell doesn't belong to polymer, and the addition test cl.7.3.9 was carried out to evaluate the cell.

Tests are made with the number of cells and batteries specified in IEC 62133-2:2017, IEC 62133-2:2017/AMD1:2021 Table 1.

Testing location:

Shenzhen TCT Testing Technology Co., Ltd.

2101 & 2201, Zhenchang Factory, Renshan Industrial Zone, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

☒ **The product fulfils the requirements of EN 62133-2:2017, EN 62133-2:2017/A1:2021**

Use of uncertainty of measurement for decisions on conformity (decision rule) :

☒ No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other: N/A (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

Information on uncertainty of measurement:

The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.

IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.

Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

Copy of marking plate:

The artwork below may be only a draft

- Rechargeable Li-polymer battery
Model: C49 1ICP5/64/88
3.87V, 5100mAh, 19.737Wh
Shenzhen Shi Jiuliyuan electronic technology co., LTD
+ Date: YYYYMMDD Made in China
WARNING: Risk of Fire and Burns. Do Not Open, Crush, Heat Above 60°C/140°F or Incinerate. Do not short circuit. If bulges severely, discontinue use. Follow Manufacturer's Instructions.

Date code: YYYYMMDD

YYYY=Year, MM= Month, DD=Day.

| | |
|---|--|
| Test item particulars..... : | |
| Classification of installation and use..... : | To be defined in final product |
| Supply Connection | DC Connector |
| Recommend charging method declared by the manufacturer | Charging the battery with 1020mA constant current and 4.45V constant voltage until the current reduces to 102mA at ambient 20°C±5°C. |
| Discharge current (0,2 It A) | 1020mA |
| Specified final voltage..... : | 3.0V |
| Upper limit charging voltage per cell..... : | 4.45V |
| Maximum charging current | 6000mA |
| Charging temperature upper limit | 45°C |
| Charging temperature lower limit..... : | 0°C |
| Polymer cell electrolyte type..... : | <input type="checkbox"/> gel polymer <input type="checkbox"/> solid polymer <input checked="" type="checkbox"/> N/A |
| Possible test case verdicts: | |
| - test case does not apply to the test object..... : N/A | |
| - test object does meet the requirement..... : P (Pass) | |
| - test object does not meet the requirement..... : F (Fail) | |
| Testing..... : | |
| Date of receipt of test item | 2024-03-27 |
| Date (s) of performance of tests | 2024-03-27 to 2024-04-10 |
| General remarks: | |
| <p>The test results presented in this report relate only to the object tested, This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory, "(Cell #XX)" refers to sample number of cells, "X" is 0~9; "(Battery #XX)" refers to sample number of batteries, "X" is 0~9; "(see below table)" refers to a table appended to the report.</p> <p>Throughout this report a point is used as the decimal separator.</p> | |
| When differences exist; they shall be identified in the General product information section. | |
| Name and address of factory (ies) | Same as manufacturer. |

General product information and other remarks:

This battery is constructed with single lithium-ion cell, and has overcharge, over-discharge, over current and short-circuits proof circuit.

The main features of the battery are shown as below (clause 7.1.1):

| Model (Battery) | Nominal capacity | Nominal voltage | Nominal Charge Current | Nominal Discharge Current | Maximum Charge Current | Maximum Discharge Current | Maximum Charge Voltage | Final Voltage |
|-----------------|------------------|-----------------|------------------------|---------------------------|------------------------|---------------------------|------------------------|---------------|
| C49 | 5100mAh | 3.87V | 1020mA | 1020mA | 6000mA | 6000mA | 4.45V | 3.0V |

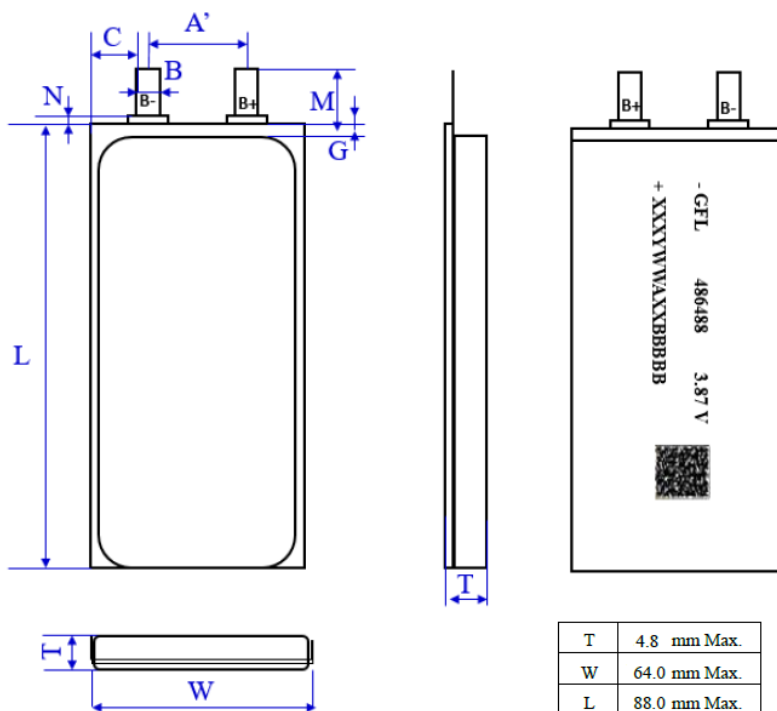
The main features of the cell in the battery are shown as below (clause 7.1.1):

| Model (Cell) | Nominal capacity | Nominal voltage | Nominal Charge Current | Nominal Discharge Current | Maximum Charge Current | Maximum Discharge Current | Maximum Charge Voltage | Final Voltage |
|--------------|------------------|-----------------|------------------------|---------------------------|------------------------|---------------------------|------------------------|---------------|
| 486488 | 5100mAh | 3.87V | 1020mA | 1020mA | 6000mA | 6000mA | 4.45V | 3.0V |

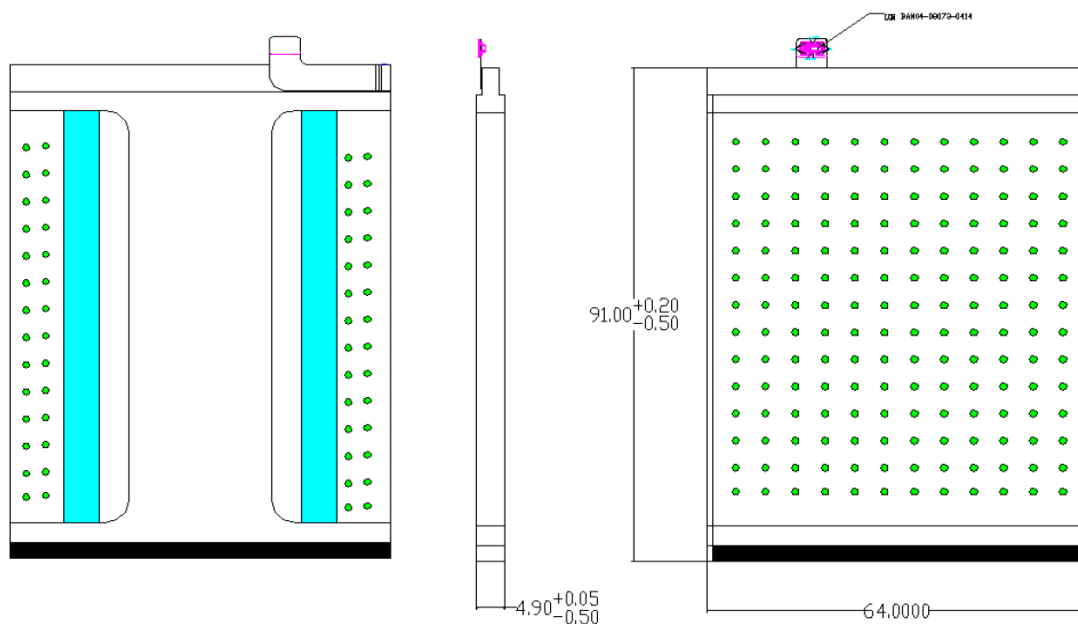
The main features of the cell in the battery are shown as below (clause 7.1.2):

| Model (Cell) | Upper limit charge voltage | Taper-off current (0.05 It A) | Lower charge temperature | Upper charge temperature |
|--------------|----------------------------|-------------------------------|--------------------------|--------------------------|
| 486488 | 4.45V | 255mA | 0°C | 45°C |

Construction:

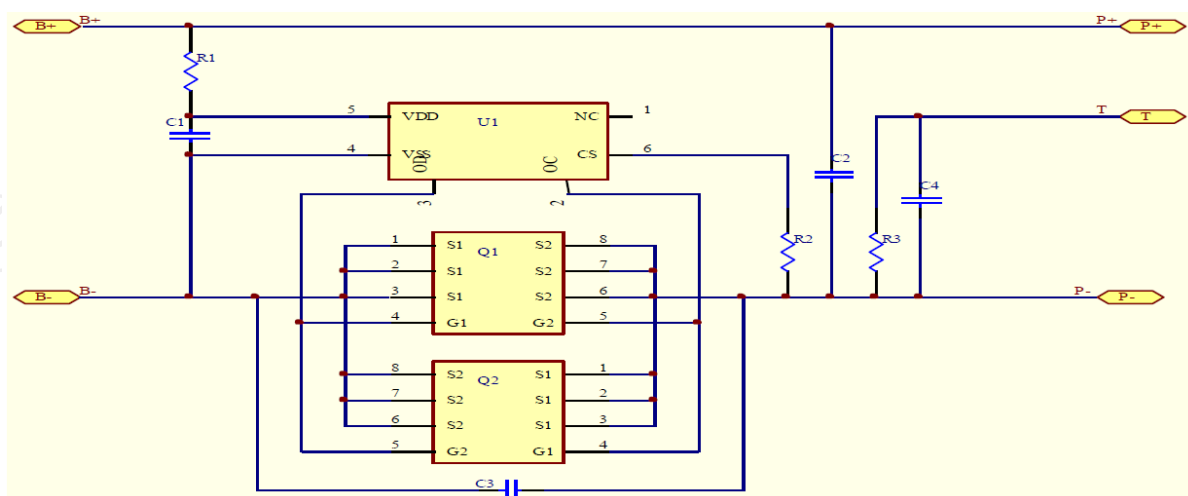


Cell



Battery (Unit: mm)

Circuit diagram:



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|-------------|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 4 | PARAMETER MEASUREMENT TOLERANCES | | P |
| | Parameter measurement tolerances | | P |
| 5 | GENERAL SAFETY CONSIDERATIONS | | P |
| 5.1 | General | | P |
| | Cells and batteries so designed and constructed that they are safe under conditions of both intended use and reasonably foreseeable misuse | | P |
| 5.2 | Insulation and wiring | | P |
| | The insulation resistance between the positive terminal and externally exposed metal surfaces of the battery (excluding electrical contact surfaces) is not less than 5 MΩ | No metal surface exists. | N/A |
| | Insulation resistance (MΩ) : | | — |
| | Internal wiring and insulation are sufficient to withstand maximum anticipated current, voltage and temperature requirements | | P |
| | Orientation of wiring maintains adequate clearance and creepage distances between conductors | | P |
| | Mechanical integrity of internal connections accommodates reasonably foreseeable misuse | | P |
| 5.3 | Venting | | P |
| | Battery cases and cells incorporate a pressure relief mechanism or are constructed so that they relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition | Venting mechanism exists on the narrow side of pouch cell. | P |
| | Encapsulation used to support cells within an outer casing does not cause the battery to overheat during normal operation nor inhibit pressure relief | | N/A |
| 5.4 | Temperature, voltage and current management | | P |
| | Batteries are designed such that abnormal temperature rise conditions are prevented | Overcharge, over discharge, over current and short-circuit proof circuit used in this battery. See tests of clause 7. | P |
| | Batteries are designed to be within temperature, voltage and current limits specified by the cell manufacturer | See above. | P |
| | Batteries are provided with specifications and charging instructions for equipment manufacturers so that specified chargers are designed to maintain charging within the temperature, voltage and current limits specified | The charging limits specified in the manufacturer's specification. | P |
| 5.5 | Terminal contacts | | P |

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|-------------|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | The size and shape of the terminal contacts ensure that they can carry the maximum anticipated current | DC Connector contacts complied with the requirements. | P |
| | External terminal contact surfaces are formed from conductive materials with good mechanical strength and corrosion resistance | | P |
| | Terminal contacts are arranged to minimize the risk of short-circuit | | P |
| 5.6 | Assembly of cells into batteries | | P |
| 5.6.1 | General | | P |
| | Each battery have an independent control and protection for current, voltage, temperature and any other parameter required for safety and to maintain the cells within their operating region | Protective circuit equipped on battery. | P |
| | This protection may be provided external to the battery such as within the charger or the end devices | | N/A |
| | If protection is external to the battery, the manufacturer of the battery provide this safety relevant information to the external device manufacturer for implementation | | N/A |
| | If there is more than one battery housed in a single battery case, each battery have protective circuitry that can maintain the cells within their operating regions | | N/A |
| | Manufacturers of cells specify current, voltage and temperature limits so that the battery manufacturer/designer may ensure proper design and assembly | Current, voltage and temperature limits specified by cell manufacturer. | P |
| | Batteries that are designed for the selective discharge of a portion of their series connected cells incorporate circuitry to prevent operation of cells outside the limits specified by the cell manufacturer | | N/A |
| | Protective circuit components added as appropriate and consideration given to the end-device application | | P |
| | The manufacturer of the battery provide a safety analysis of the battery safety circuitry with a test report including a fault analysis of the protection circuit under both charging and discharging conditions confirming the compliance | Safety analysis report provided by manufacturer. | P |
| 5.6.2 | Design recommendation | | P |
| | For the battery consisting of a single cell or a single cellblock, it is recommended that the charging voltage of the cell does not exceed the upper limit of the charging voltage specified in Table 2 | Single cell battery, Max. Charging voltage of cell: 4.45V. | P |

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|-------------|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | For the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that the voltages of any one of the single cells or single cellblocks does not exceed the upper limit of the charging voltage, specified in Table 2, by monitoring the voltage of every single cell or the single cellblocks | | N/A |
| | For the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that charging is stopped when the upper limit of the charging voltage is exceeded for any one of the single cells or single cellblocks by measuring the voltage of every single cell or the single cellblocks | | N/A |
| | For batteries consisting of series-connected cells or cell blocks, nominal charge voltage not be counted as an overcharge protection | | N/A |
| | For batteries consisting of series-connected cells or cell blocks, cells have closely matched capacities, be of the same design, be of the same chemistry and be from the same manufacturer | | N/A |
| | It is recommended that the cells and cell blocks not discharged beyond the cell manufacturer's specified final voltage | Final voltage of cell: 3.0V, not exceed the final voltage specified by cell manufacturer. | P |
| | For batteries consisting of series-connected cells or cell blocks, cell balancing circuitry incorporated into the battery management system | | N/A |
| 5.6.3 | Mechanical protection for cells and components of batteries | | P |
| | Mechanical protection for cells, cell connections and control circuits within the battery provided to prevent damage as a result of intended use and reasonably foreseeable misuse | Mechanical protection for cell connections and control circuits provided. | P |
| | The mechanical protection can be provided by the battery case or it can be provided by the end product enclosure for those batteries intended for building into an end product | Build-in batteries, mechanical protection for cells should be provided by end product. | N/A |
| | The battery case and compartments housing cells designed to accommodate cell dimensional tolerances during charging and discharging as recommended by the cell manufacturer | To be evaluated in final system. | N/A |
| | For batteries intended for building into a portable end product, testing with the battery installed within the end product considered when conducting mechanical tests | | N/A |
| 5.7 | Quality plan | | P |

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|-------------|---|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | The manufacturer prepares and implements a quality plan that defines procedures for the inspection of materials, components, cells and batteries and which covers the whole process of producing each type of cell or battery | Complied. Quality plan provided. | P |
| 5.8 | Battery safety components | | N/A |
| | According annex F | See TABLE: Critical components information | N/A |

| | | | |
|----------|--|-------------------|-----|
| 6 | TYPE TEST AND SAMPLE SIZE | | P |
| | Tests are made with the number of cells or batteries specified in Table 1 using cells or batteries that are not more than six months old | | P |
| | Coin cells with resistance $\leq 3 \Omega$ (measured according annex D) are tested according table 1 | Not coin cells | N/A |
| | Unless otherwise specified, tests are carried out in an ambient temperature of $20^\circ\text{C} \pm 5^\circ\text{C}$ | | P |
| | The safety analysis of 5.6.1 identify those components of the protection circuit that are critical for short-circuit, overcharge and overdischarge protection | | P |
| | When conducting the short-circuit test, consideration given to the simulation of any single fault condition that is likely to occur in the protecting circuit that would affect the short-circuit test | See clause 7.3.2. | P |

| | | | |
|------------|---|-------------|---|
| 7 | SPECIFIC REQUIREMENTS AND TESTS | | P |
| 7.1 | Charging procedure for test purposes | | P |
| 7.1.1 | First procedure | | P |
| | This charging procedure applies to subclauses other than those specified in 7.1.2 | | P |
| | Unless otherwise stated in this document, the charging procedure for test purposes is carried out in an ambient temperature of $20^\circ\text{C} \pm 5^\circ\text{C}$, using the method declared by the manufacturer | See page 4. | P |
| | Prior to charging, the battery have been discharged at $20^\circ\text{C} \pm 5^\circ\text{C}$ at a constant current of 0,2 It A down to a specified final voltage | See page 4. | P |
| 7.1.2 | Second procedure | | P |
| | This charging procedure applies only to 7.3.1, 7.3.4, 7.3.5, and 7.3.9 | | P |

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|-------------|--|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | After stabilization for 1 h and 4 h, respectively, at ambient temperature of highest test temperature and lowest test temperature, as specified in Table 2, cells are charged by using the upper limit charging voltage and maximum charging current, until the charging current is reduced to 0,05 It A, using a constant voltage charging method | Charge temperature specified by manufacturer: 0-45°C. 0°C used for lower limit tests. 45°C used for upper limit tests. | P |
| 7.2 | Intended use | | P |
| 7.2.1 | Continuous charging at constant voltage (cells) | | P |
| | Fully charged cells are subjected for 7 days to a charge using the charging method for current and standard voltage specified by the cell manufacturer | Charging for 7days with 1020mA. | P |
| | Results: No fire. No explosion. No leakage | (See appended table 7.2.1) | P |
| 7.2.2 | Case stress at high ambient temperature (battery) | | N/A |
| | Oven temperature (°C) | | — |
| | Results: No physical distortion of the battery case resulting in exposure of internal protective components and cells | | N/A |
| 7.3 | Reasonably foreseeable misuse | | P |
| 7.3.1 | External short-circuit (cell) | Tested complied. | P |
| | The cells were tested until one of the following occurred: | | P |
| | - 24 hours elapsed; or | | N/A |
| | - The case temperature declined by 20 % of the maximum temperature rise | | P |
| | Results: No fire. No explosion..... | (See appended table 7.3.1) | P |
| 7.3.2 | External short-circuit (battery) | Tested complied. | P |
| | The batteries were tested until one of the following occurred: | | P |
| | - 24 hours elapsed; or | | N/A |
| | - The case temperature declined by 20 % of the maximum temperature rise | | P |
| | In case of rapid decline in short circuit current, the battery pack remained on test for an additional one hour after the current reached a low end steady state condition | | P |
| | A single fault in the discharge protection circuit conducted on one to four (depending upon the protection circuit) of the five samples before conducting the short-circuit test | Single fault conducted on three samples. | P |
| | A single fault applies to protective component parts such as MOSFET, fuse, thermostat or positive temperature coefficient (PTC) thermistor | Single fault applies on MOSFET Q1. | P |
| | Results: No fire. No explosion..... | (See appended table 7.3.2) | P |

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|-------------|---|------------------------------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 7.3.3 | Free fall | Tested complied. | P |
| | Results: No fire. No explosion | No fire. No explosion | P |
| 7.3.4 | Thermal abuse (cells) | Tested complied. | P |
| | Oven temperature (°C): 130°C | | — |
| | Results: No fire. No explosion | No fire. No explosion | P |
| 7.3.5 | Crush (cells) | Tested complied. | P |
| | The crushing force was released upon: | | P |
| | - The maximum force of 13 kN ± 0,78 kN has been applied; or | | P |
| | - An abrupt voltage drop of one-third of the original voltage has been obtained | | N/A |
| | Results: No fire. No explosion.....: (See appended table 7.3.5) | | P |
| 7.3.6 | Over-charging of battery | Tested complied. | P |
| | The supply voltage which is: | | P |
| | - 1,4 times the upper limit charging voltage presented in Table A.1 (but not to exceed 6,0 V) for single cell/cell block batteries or | 6.0V applied. | P |
| | - 1,2 times the upper limit charging voltage resented in Table A.1 per cell for series connected multi-cell batteries, and | | N/A |
| | - Sufficient to maintain a current of 2,0 It A throughout the duration of the test or until the supply voltage is reached | | P |
| | Test was continued until the temperature of the outer casing: | | P |
| | - Reached steady state conditions (less than 10 °C change in 30-minute period); or | | P |
| | - Returned to ambient | | N/A |
| | Results: No fire. No explosion.....: (See appended table 7.3.6) | | P |
| 7.3.7 | Forced discharge (cells) | Tested complied. | P |
| | Discharge a single cell to the lower limit discharge voltage specified by the cell manufacturer | Lower limit discharge voltage 3.0V | P |
| | The discharged cell is then subjected to a forced discharge at 1 It A to the negative value of the upper limit charging voltage | | P |
| | - The discharge voltage reaches the negative value of upper limit charging voltage within the testing duration. The voltage is maintained at the negative value of the upper limit charging voltage by reducing the current for the remainder of the testing duration | | N/A |

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|-------------|--|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - The discharge voltage does not reach the negative value of upper limit charging voltage within the testing duration. The test is terminated at the end of the testing duration | | P |
| | Results: no fire, no explosion | (See appended table 7.3.7) | P |
| 7.3.8 | Mechanical tests (batteries) | | P |
| 7.3.8.1 | Vibration | Tested complied. | P |
| | Results: No fire, no explosion, no rupture, no leakage or venting. | (See appended table 7.3.8.1) | P |
| 7.3.8.2 | Mechanical shock | Tested complied. | P |
| | Results: No leakage, no venting, no rupture, no explosion and no fire | (See appended table 7.3.8.2) | P |
| 7.3.9 | Design evaluation – Forced internal short-circuit (cells) | Tested complied. | P |
| | The cells complied with national requirement for | France, Japan, Republic of Korea and Switzerland. | — |
| | The pressing was stopped upon: | | P |
| | - A voltage drop of 50 mV has been detected; or | | N/A |
| | - The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) has been reached | 400N for prismatic cell. | P |
| | Results: No fire | (See appended table 7.3.9) | P |
| 8 | INFORMATION FOR SAFETY | | P |
| 8.1 | General | | P |
| | Manufacturers of secondary cells ensure that information is provided about current, voltage and temperature limits of their products | Information for safety mentioned in manufacturer's specifications. | P |
| | Manufacturers of batteries ensure that equipment manufacturers and, in the case of direct sales, end-users are provided with information to minimize and mitigate hazards | Information for safety mentioned in manufacturer's specifications. | P |
| | Systems analyses performed by device manufacturers to ensure that a particular battery design prevents hazards from occurring during use of a product | | N/A |
| | As appropriate, any information relating to hazard avoidance resulting from a system analysis provided to the end user | | N/A |
| 8.2 | Small cell and battery safety information | Not small cells and batteries. | N/A |
| | The following warning language is to be provided with the information packaged with the small cells and batteries or equipment using them: | | N/A |
| | - Keep small cells and batteries which are considered swallowable out of the reach of children | | N/A |

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|-------------|---|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - Swallowing may lead to burns, perforation of soft tissue, and death. Severe burns can occur within 2 h of ingestion | | N/A |
| | - In case of ingestion of a cell or battery, seek medical assistance promptly | | N/A |
| 9 | MARKING | | P |
| 9.1 | Cell marking | The final product is battery | N/A |
| | Cells marked as specified in IEC 61960, except coin cells | | N/A |
| | Coin cells whose external surface area is too small to accommodate the markings on the cells show the designation and polarity | | N/A |
| | By agreement between the cell manufacturer and the battery and/or end product manufacturer, component cells used in the manufacture of a battery need not be marked | | N/A |
| 9.2 | Battery marking | | P |
| | Batteries are marked as specified in IEC 61960, except for coin batteries | See marking plate on page 3. | P |
| | Coin batteries whose external surface area is too small to accommodate the markings on the batteries show the designation and polarity | Not coin batteries. | N/A |
| | Batteries are marked with an appropriate caution statement | | P |
| | - Terminals have clear polarity marking on the external surface of the battery, or | The “-” and “+” polarity explicitly marked on surface of the battery. | P |
| | - Not be marked with polarity markings if the design of the external connector prevents reverse polarity connections | DC Connector used. | P |
| 9.3 | Caution for ingestion of small cells and batteries | Not small cells. Not small batteries. | N/A |
| | Coin cells and batteries identified as small batteries include a caution statement regarding the hazards of ingestion in accordance with 8.2 | | N/A |
| | Small cells and batteries are intended for direct sale in consumer-replaceable applications, caution for ingestion is given on the immediate package | Not intended for direct sale. | N/A |
| 9.4 | Other information | | P |
| | The following information are marked on or supplied with the battery: | | P |
| | - Storage and disposal instructions | Information for storage and disposal instructions mentioned in manufacturer's specifications. | P |

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|-------------|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - Recommended charging instructions | Information for recommended charging instructions mentioned in manufacturer's specifications. | P |
| 10 | PACKAGING AND TRANSPORT | | N/A |
| | Packaging for coin cells are not be small enough to fit within the limits of the ingestion gauge of Figure 3 | Not coin cells. | N/A |

| | | | |
|----------------|---|--|-----|
| ANNEX A | CHARGING AND DISCHARGING RANGE OF SECONDARY LITHIUM ION CELLS FOR SAFE USE | | P |
| A.1 | General | | P |
| A.2 | Safety of lithium ion secondary battery | Complied. | P |
| A.3 | Consideration on charging voltage | Complied. | P |
| A.3.1 | General | | P |
| A.3.2 | Upper limit charging voltage | 4.45V applied. | P |
| A.3.2.1 | General | | P |
| A.3.2.2 | Explanation of safety viewpoint | | P |
| A.3.2.3 | Safety requirements, when different upper limit charging voltage is applied | 4.45V applied. | P |
| A.4 | Consideration of temperature and charging current | | P |
| A.4.1 | General | | P |
| A.4.2 | Recommended temperature range | See A.4.2.2. | P |
| A.4.2.1 | General | | P |
| A.4.2.2 | Safety consideration when a different recommended temperature range is applied | Charging temperature range declared by client is: 0-45°C | P |
| A.4.3 | High temperature range | | N/A |
| A.4.3.1 | General | | N/A |
| A.4.3.2 | Explanation of safety viewpoint | | N/A |
| A.4.3.3 | Safety considerations when specifying charging conditions in the high temperature range | | N/A |
| A.4.3.4 | Safety considerations when specifying a new upper limit in the high temperature range | | N/A |
| A.4.4 | Low temperature range | | N/A |
| A.4.4.1 | General | | N/A |
| A.4.4.2 | Explanation of safety viewpoint | | N/A |
| A.4.4.3 | Safety considerations, when specifying charging conditions in the low temperature range | | N/A |
| A.4.4.4 | Safety considerations when specifying a new lower limit in the low temperature range | | N/A |

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|----------------|---|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| A.4.5 | Scope of the application of charging current | | P |
| A.4.6 | Consideration of discharge | | P |
| A.4.6.1 | General | | P |
| A.4.6.2 | Final discharge voltage and explanation of safety viewpoint | Cell specified final voltage 3.0V, not exceed 3.0V specified by cell manufacturer. | P |
| A.4.6.3 | Discharge current and temperature range | | P |
| A.4.6.4 | Scope of application of the discharging current | | P |
| A.5 | Sample preparation | | P |
| A.5.1 | General | | P |
| A.5.2 | Insertion procedure for nickel particle to generate internal short | | P |
| A.5.3 | Disassembly of charged cell | | P |
| A.5.4 | Shape of nickel particle | | P |
| A.5.5 | Insertion of nickel particle in cylindrical cell | | N/A |
| A.5.5.1 | Insertion of nickel particle in winding core | | N/A |
| A.5.5.2 | Marking the position of the nickel particle on both ends of the winding core of the separator | | N/A |
| A.5.6 | Insertion of nickel particle in prismatic cell | | P |
| A.6 | Experimental procedure of the forced internal short-circuit test | | P |
| A.6.1 | Material and tools for preparation of nickel particle | | P |
| A.6.2 | Example of a nickel particle preparation procedure | | P |
| A.6.3 | Positioning (or placement) of a nickel particle | | P |
| A.6.4 | Damaged separator precaution | | P |
| A.6.5 | Caution for rewinding separator and electrode | | P |
| A.6.6 | Insulation film for preventing short-circuit | | P |
| A.6.7 | Caution when disassembling a cell | | P |
| A.6.8 | Protective equipment for safety | | P |
| A.6.9 | Caution in the case of fire during disassembling | | P |
| A.6.10 | Caution for the disassembling process and pressing the electrode core | | P |
| A.6.11 | Recommended specifications for the pressing device | | P |
| ANNEX B | RECOMMENDATIONS TO EQUIPMENT MANUFACTURERS AND BATTERY ASSEMBLERS | | N/A |
| ANNEX C | RECOMMENDATIONS TO THE END-USERS | | N/A |

| IEC 62133-2 | | | |
|----------------|---|--------------------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| ANNEX D | MEASUREMENT OF THE INTERNAL AC RESISTANCE FOR COIN CELLS | | N/A |
| D.1 | General | Not coin cells. | N/A |
| D.2 | Method | | N/A |
| | A sample size of three coin cells is required for this measurement..... : | (See appended table D.2) | N/A |
| | Coin cells with an internal resistance of less than or equal to 3 Ω are subjected to the testing according to Clause 6 and Table 1 | | N/A |
| | Coin cells with an internal resistance greater than 3 Ω require no further testing | | N/A |
| ANNEX E | PACKAGING AND TRANSPORT | | N/A |
| ANNEX F | COMPONENT STANDARDS REFERENCES | | N/A |

| 7.2.1 | TABLE: Continuous charging at constant voltage (cells) | | | | P |
|---|--|---|-----------------------|---------|---|
| Sample no. | Recommended charging voltage V _c (Vdc) | Recommended charging current I _{rec} (mA) | OCV before test (Vdc) | Results | |
| Cell #1 | 4.45 | 1020 | 4.42 | P | |
| Cell #2 | 4.45 | 1020 | 4.42 | P | |
| Cell #3 | 4.45 | 1020 | 4.41 | P | |
| Cell #4 | 4.45 | 1020 | 4.41 | P | |
| Cell #5 | 4.45 | 1020 | 4.42 | P | |
| Supplementary information: - No fire or explosion - No leakage | | | | | |

| 7.3.1 | TABLE: External short-circuit (cell) | | | | P |
|---|--------------------------------------|-----------------------|----------------------------|--------------------------------------|---------|
| Sample no. | Ambient T (°C) | OCV before test (Vdc) | Resistance of circuit (mΩ) | Maximum case temperature rise ΔT, °C | Results |
| Samples charged at charging temperature upper limit (45°C) | | | | | |
| Cell #1 | 55.2 | 4.41 | 82 | 117.4 | P |
| Cell #2 | 55.2 | 4.41 | 81 | 118.6 | P |
| Cell #3 | 55.2 | 4.41 | 82 | 118.2 | P |
| Cell #4 | 55.2 | 4.42 | 82 | 118.7 | P |
| Cell #5 | 55.2 | 4.42 | 80 | 116.9 | P |
| Samples charged at charging temperature lower limit (0°C) | | | | | |
| Cell #6 | 55.2 | 4.38 | 82 | 110.2 | P |
| Cell #7 | 55.2 | 4.38 | 84 | 111.5 | P |
| Cell #8 | 55.2 | 4.39 | 83 | 110.8 | P |
| Cell #9 | 55.2 | 4.39 | 82 | 110.9 | P |
| Cell #10 | 55.2 | 4.38 | 85 | 111.1 | P |
| Supplementary information: - No fire or explosion | | | | | |

| 7.3.2 | TABLE: External short-circuit (battery) | | | | | P |
|---|---|-----------------------|----------------------------|---|----------------------------------|---------|
| Sample no. | Ambient T (°C) | OCV before test (Vdc) | Resistance of circuit (mΩ) | Maximum case temperature rise ΔT , °C | Component single fault condition | Results |
| Battery #1 | 23.2 | 4.41 | 83 | 105.2 | Short circuit MOSFET Q1 | P |
| Battery #2 | 23.2 | 4.42 | 84 | 103.9 | Short circuit MOSFET Q1 | P |
| Battery #3 | 23.2 | 4.42 | 83 | 104.5 | Short circuit MOSFET Q1 | P |
| Battery #4 | 23.2 | 4.42 | 84 | 23.3 | -- | P |
| Battery #5 | 23.2 | 4.41 | 83 | 23.4 | -- | P |
| Supplementary information: - No fire or explosion | | | | | | |

| | | | | | |
|---|-----------------------|--|---|---------|---|
| 7.3.5 | TABLE: Crush (cells) | | | | P |
| Sample no. | OCV before test (Vdc) | OCV at removal of crushing force (Vdc) | Maximum force applied to the cell during crush (kN) | Results | |
| Samples charged at charging temperature upper limit (45°C) | | | | | |
| Cell #1 | 4.41 | 4.41 | 13.04 | P | |
| Cell #2 | 4.42 | 4.42 | 13.02 | P | |
| Cell #3 | 4.42 | 4.42 | 13.03 | P | |
| Cell #4 | 4.41 | 4.41 | 13.02 | P | |
| Cell #5 | 4.41 | 4.41 | 13.05 | P | |
| Samples charged at charging temperature lower limit (0°C) | | | | | |
| Cell #6 | 4.38 | 4.38 | 13.03 | P | |
| Cell #7 | 4.39 | 4.39 | 13.04 | P | |
| Cell #8 | 4.39 | 4.39 | 13.02 | P | |
| Cell #9 | 4.38 | 4.38 | 13.05 | P | |
| Cell #10 | 4.39 | 4.39 | 13.03 | P | |
| Note: A 13kN force applied at the wide side of prismatic cells. No voltage abrupt occurred. | | | | | |
| Supplementary information: | | | | | |
| - No fire or explosion | | | | | |

| 7.3.6 | TABLE: Over-charging of battery | | | P |
|---|--|------------------------------|-------------------------------------|----------|
| Constant charging current (A) | | 10.2 | | — |
| Supply voltage (Vdc) | | 6.0 | | — |
| Sample no. | OCV before charging (Vdc) | Total charging time (minute) | Maximum outer case temperature (°C) | Results |
| Battery #1 | 3.38 | 120 | 32.3 | P |
| Battery #2 | 3.39 | 120 | 31.9 | P |
| Battery #3 | 3.38 | 120 | 32.4 | P |
| Battery #4 | 3.39 | 120 | 31.8 | P |
| Battery #5 | 3.39 | 120 | 33.1 | P |
| Supplementary information: - No fire or explosion | | | | |

| 7.3.7 | TABLE: Forced discharge (cells) | | | P |
|---|--|------------------------------------|-------------------------------------|----------|
| Sample no. | OCV before application of reverse charge (Vdc) | Measured reverse charge I_t (mA) | Lower limit discharge voltage (Vdc) | Results |
| Cell #1 | 3.36 | 5100 | 3.0 | P |
| Cell #2 | 3.36 | 5100 | 3.0 | P |
| Cell #3 | 3.37 | 5100 | 3.0 | P |
| Cell #4 | 3.37 | 5100 | 3.0 | P |
| Cell #5 | 3.36 | 5100 | 3.0 | P |
| Supplementary information: - No fire or explosion | | | | |

| 7.3.8.1 | TABLE: Vibration | | | | P |
|---|-------------------------|----------------------|----------------------|---------------------|----------|
| Sample no. | OCV before test (Vdc) | OCV after test (Vdc) | Mass before test (g) | Mass after test (g) | Results |
| Battery #1 | 4.42 | 4.42 | 65.146 | 65.146 | P |
| Battery #2 | 4.42 | 4.42 | 64.928 | 64.928 | P |
| Battery #3 | 4.42 | 4.42 | 65.179 | 65.179 | P |
| Supplementary information: - No fire or explosion - No rupture - No leakage - No venting | | | | | |

| 7.3.8.2 | TABLE: Mechanical shock | | | | | P |
|---|-------------------------|----------------------|----------------------|---------------------|---------|---|
| Sample no. | OCV before test (Vdc) | OCV after test (Vdc) | Mass before test (g) | Mass after test (g) | Results | |
| Battery #1 | 4.41 | 4.41 | 65.200 | 65.200 | P | |
| Battery #2 | 4.41 | 4.41 | 65.188 | 65.188 | P | |
| Battery #3 | 4.42 | 4.42 | 65.145 | 65.145 | P | |
| Supplementary information: - No fire or explosion - No rupture - No leakage - No venting | | | | | | |

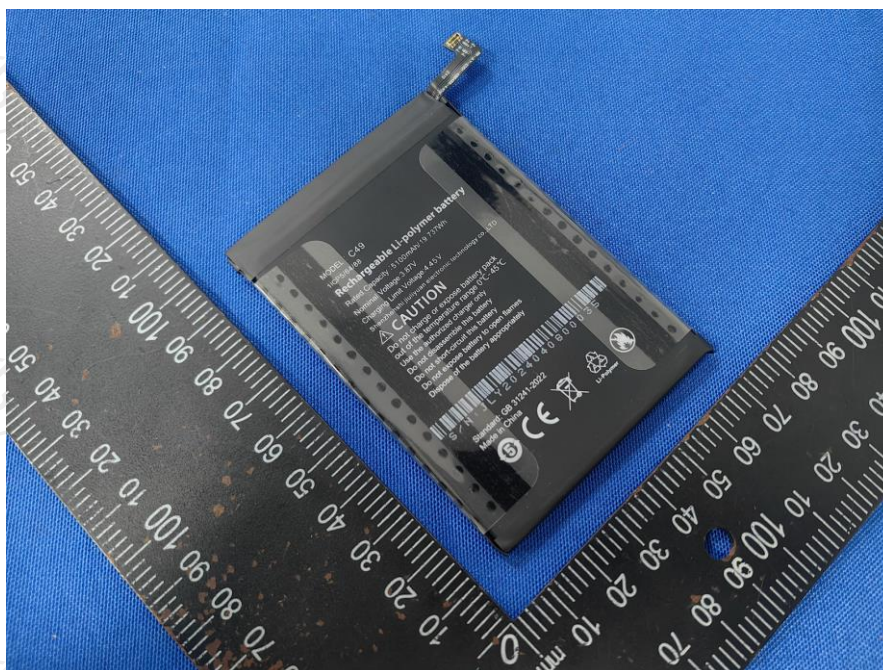
| 7.3.9 | TABLE: Forced internal short circuit (cells) | | | | | P |
|---|--|-----------------------|---------------------------------|------------------------------|---------|---|
| Sample no. | Chamber ambient T (°C) | OCV before test (Vdc) | Particle location ¹⁾ | Maximum applied pressure (N) | Results | |
| Samples charged at charging temperature upper limit (45°C) | | | | | | |
| Cell #1 | 45 | 4.42 | 1 | 400 | P | |
| Cell #2 | 45 | 4.42 | 1 | 400 | P | |
| Cell #3 | 45 | 4.41 | 1 | 400 | P | |
| Cell #4 | 45 | 4.41 | 1 | 400 | P | |
| Cell #5 | 45 | 4.42 | 1 | 400 | P | |
| Samples charged at charging temperature lower limit (0°C) | | | | | | |
| Cell #6 | 0 | 4.38 | 1 | 400 | P | |
| Cell #7 | 0 | 4.38 | 1 | 400 | P | |
| Cell #8 | 0 | 4.39 | 1 | 400 | P | |
| Cell #9 | 0 | 4.39 | 1 | 400 | P | |
| Cell #10 | 0 | 4.38 | 1 | 400 | P | |
| Supplementary information: ¹⁾ Identify one of the following: 1: Nickel particle inserted between positive and negative (active material) coated area. 2: Nickel particle inserted between positive aluminium foil and negative active material coated area. - No fire | | | | | | |

| D.2 | TABLE: Internal AC resistance for coin cells | | | | N/A |
|---|--|----------------|--------------------|-----------------------|-----|
| Sample no. | Ambient T (°C) | Store time (h) | Resistance Rac (Ω) | Results ¹⁾ | |
| | | | | | |
| | | | | | |
| | | | | | |
| Supplementary information: ¹⁾ Coin cells with internal resistance less than or equal to 3 Ω, see test result on corresponding tables | | | | | |

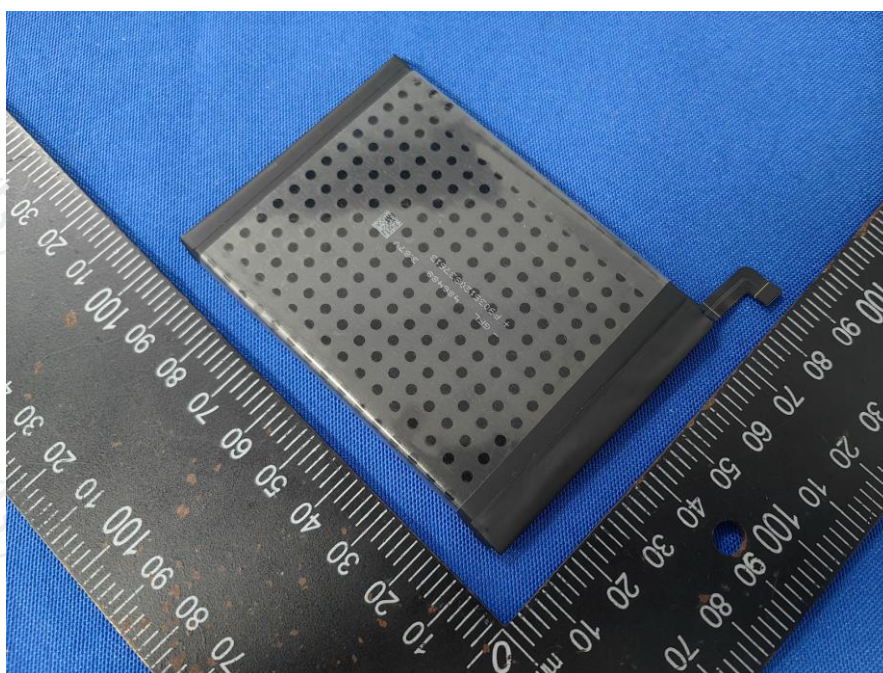
| Attachment 1: Critical components information | | | | | P |
|--|---|-----------------|---|---|-------------------------------------|
| Object / part No. | Manufacturer / trademark | Type / model | Technical data | Standard | Mark(s) of conformity ¹⁾ |
| Cell | GanFeng | 486488 | 3.87V, 5100mAh | IEC 62133-2:2017, IEC 62133-2:2017/AMD 1:2021 | Tested with appliance |
| -Positive electrode | XTC New Energy Materials (Xiamen) LTD | CPC091 | LiCoO ₂ , PVDF, CNT, Conductive | -- | -- |
| -Negative electrode | Jiangxi Zichen Technology CO., LTD | C | Graphite, CMC, SBR, Conductive, Copper Foil | -- | -- |
| -Electrolyte | Zhuhai Saiwei Electronic Materials Co., Ltd | A010 | LiPF ₆ , EMC, EC, DEC, PC | -- | -- |
| -Separator | Advanced Electronic Technology Co., Ltd | 9um | PE+Al ₂ O ₃ +PVDF, Shutdown temperature: 168°C | -- | -- |
| PCB | Interchangeable | Interchangeable | V-0, 130°C | UL 796 | UL approved |
| FPC | Interchangeable | Interchangeable | V-0, 130°C | UL 94 | UL approved |
| Protect IC (U1) | Ricoh Electronic | R5487L123KM | V _{CU} : 4.475±0.003V, V _{DL} : 2.5±0.05V | -- | Tested with appliance |
| MOSFET (Q1, Q2) | ITM | TMM1817E | V _{DS} : 20V, V _{GS} : ±12V, I _D : 6A, T _J : -55~+150°C | -- | Tested with appliance |
| NTC (R3) | Murata Electronics | NCP18XH103F03RB | R020: 10K±1%, B: 3380K, T _{opr} : -40°C~+125°C, 0603 | -- | Tested with appliance |
| Tape | Interchangeable | Interchangeable | 130°C | UL 510 | UL approved |
| Supplementary information: | | | | | |
| ¹⁾ Provided evidence ensures the agreed level of compliance. See OD-CB2039. | | | | | |

Photo Documentation

Product: Rechargeable Li-polymer battery
Type Designation: C49

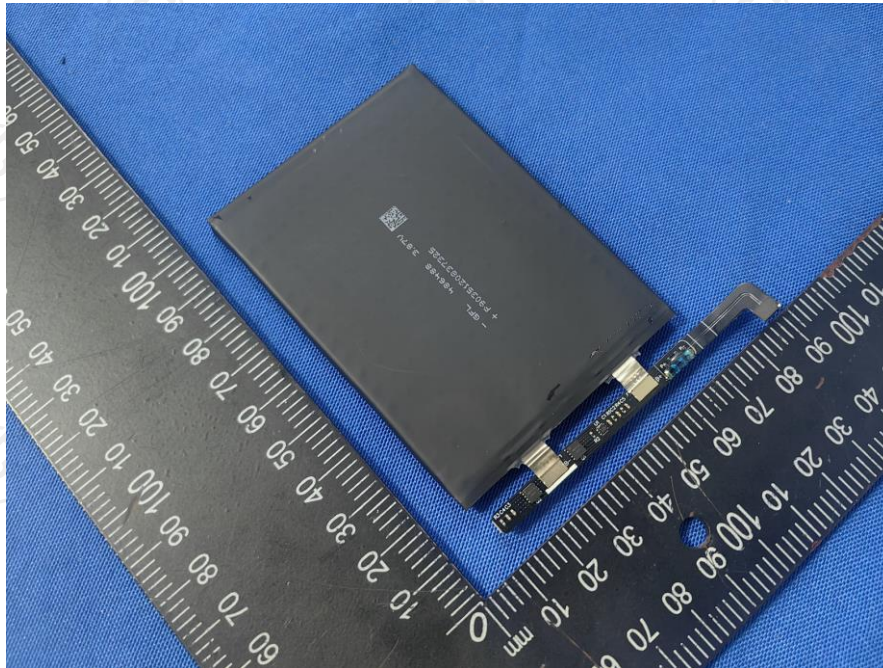


Picture 1. Battery view-1



Picture 2. Battery view-2

Photo Documentation

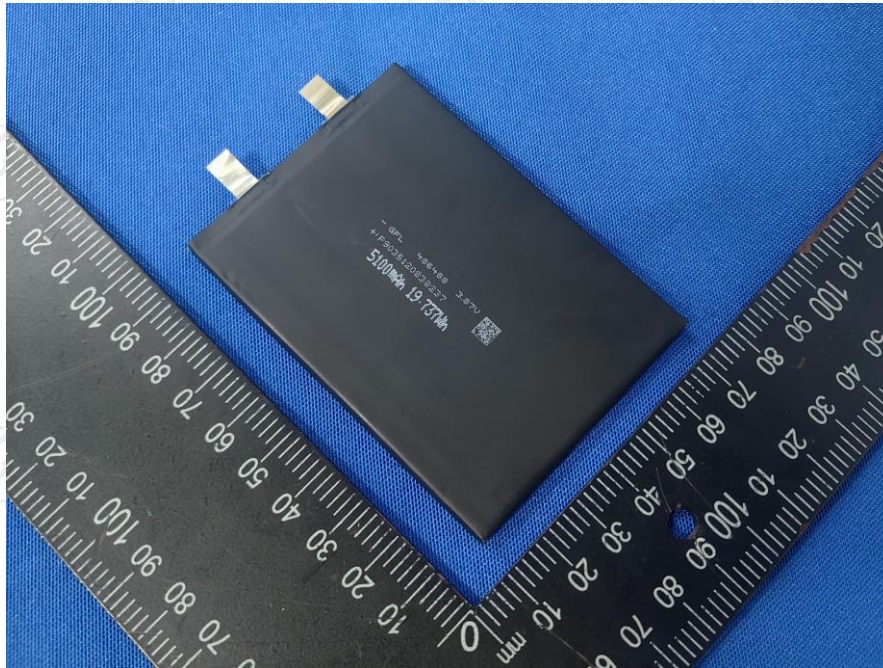


Picture 3. Battery view-3

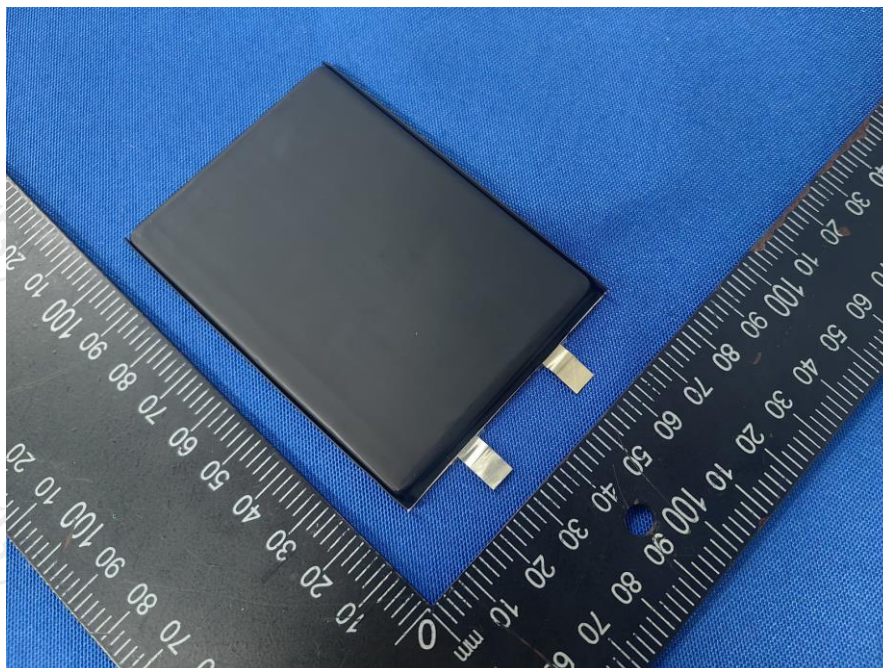


Picture 4. Battery view-4

Photo Documentation

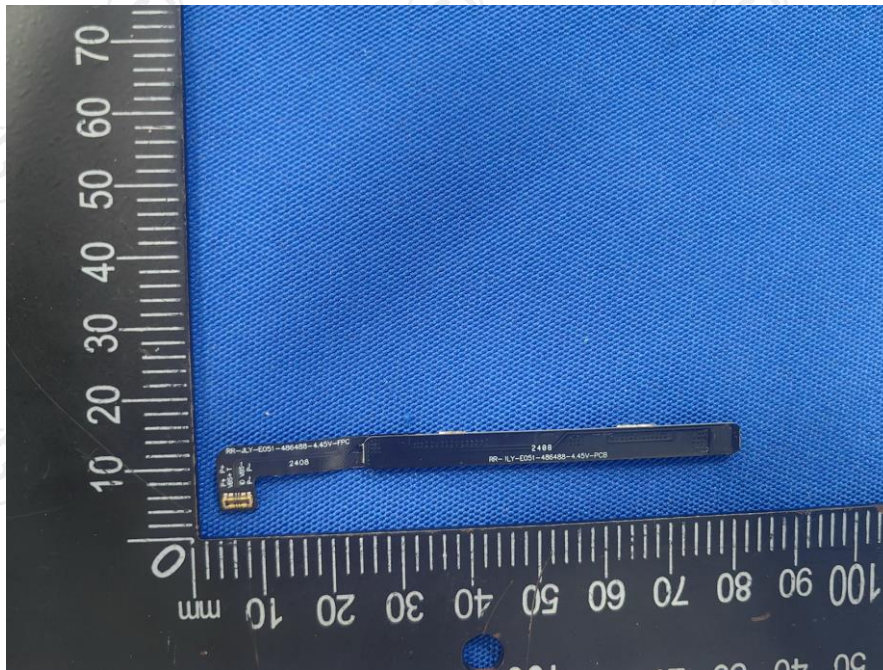


Picture 5. Cell view-1

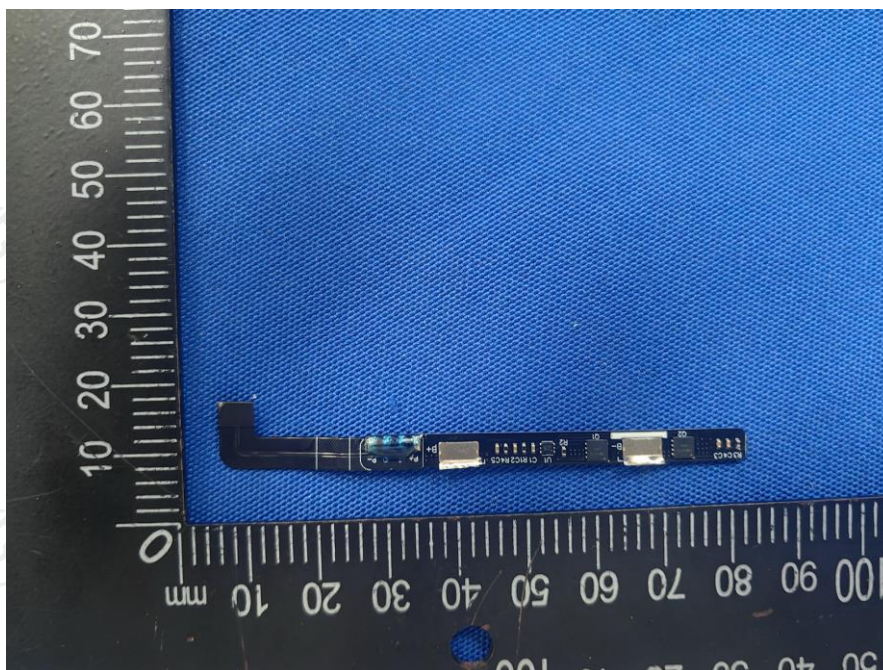


Picture 6. Cell view-2

Photo Documentation



Picture 7. Protection board view-1



Picture 8. Protection board view-2

***** End of Test Report *****