

TEST REPORT

UL 2054

Household and Commercial Batteries

Report Number..... : CMC211013016

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Applicant's name : KHADAS TECHNOLOGY CO., LTD.

Address..... : D#2101A, Caifugang Building, Baoyuan Road, Xixiang Street,
Bao'an District Shenzhen City, China

Manufacturer's name..... : GUANGDONG ZHAONENG TECHNOLOGY CO., LTD.

Address..... : No.8, Nanda Road, Jinsha Chengnan Industrial Zone, Danzao,
Nanhai District, Foshan City, Guangdong, P.R. China

Test specification:

Standard : UL 2054: 2004 R9.11

Test procedure..... : Type approved

Non-standard test method : N/A

Test result..... : Pass

Test item description..... : Lithium-ion Polymer Rechargeable Battery

Trade Mark..... : 

Model/Type reference : ZN-285565

Ratings..... : 3.8V, 1160mAh, 4.41Wh

General disclaimer:

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 CMC. The authenticity
of this Test Report and its contents can be verified by contacting the CMC, responsible for this Test Report.

List of Attachments (including a total number of pages in each attachment):
Attachment 1: Photo documentation (33 to 35 pages).
Test item particulars:

Information about the product needed to establish a correct test program, such as product mobility, type of power connections and similar. (Test item particulars are selected by the TRF Originator base on the requirements in the standard)

Designation : ZN-285565

Nominal voltage : 3.8V

Rated capacity..... : 1160mAh

Maximum charge voltage..... : 4.35V

Maximum charge current : 580mA

Final voltage..... : 3.0V

Max Ambient Temperature : 45°C max (charge), 60°C max (discharge)

Manufacturer's charge method : Charging the battery with 232mA constant current and 4.35V constant voltage until the current less than 11.6mA.

Sample No. : SN211013016B001-SN211013016B039

Possible test case verdicts:

Test case does not apply to the test object..... : N(/A)

Test object does meet the requirement : P(ass)

Test object does not meet the requirement : F(ail)

Testing:

Date of receipt of test item : 2021-10-13

Date(s) of performance of tests : 2021-10-13 to 2021-11-26

Test Environment Condition..... : Ambient temperature: 20°C±5°C

General remarks:

The test results presented in this report relate only to the object tested.

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"(BXXX)" refers to sample number of batteries, "X" is 0~9;

"(See Enclosure)" refers to additional information appended to the report.

"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Copy of marking plate

The artwork below may be only a draft.



Rema XXXX 株式会社: Here represents the Japanese Notifying Supplier.

Remark:

Code of YYMMDD:

YY: Year, MM: Month, DD: Day.

Summary of testing:

The component cell (model: ZN-285565) has been approved according to UL 1642 by CMC Testing International (Shenzhen) Co., Ltd. With report No.: CMC211013015

Test items:

- cl. 9 Short-Circuit Test;
- cl.10 Abnormal Charging Test;
- cl.11 Abusive Overcharge Test;
- cl.12 Forced-Discharged Test;
- cl.13 Limited Power Source test;
- cl.13A Battery Pack Component Temperature Test;

Description of the product:

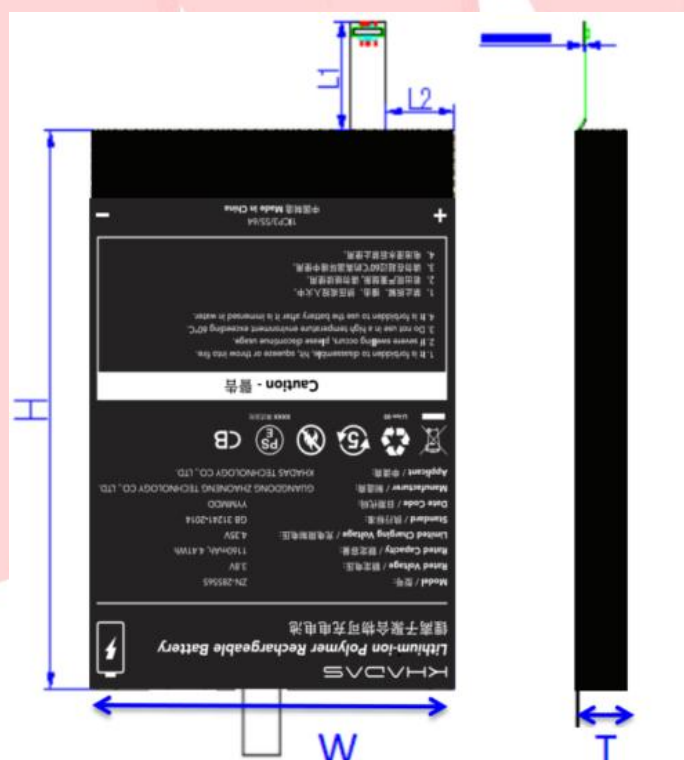
This Rechargeable Li-ion battery is constructed with single Li-ion cells(1S1P), and has overcharge, over-discharge, over current and short-circuits proof circuit.

- 1) The battery has not been evaluated in combination with charger(s) or host product(s). Additional evaluation to determine compliance may be required on the combination(s) in the end product evaluation.
- 2) The battery was evaluated for a maximum charge current and maximum voltage limit outlined in the Table above. The end product evaluation shall ensure that current and voltage limits noted are maintained
- 3) The battery has no enclosure and for built-in only.
- 4) The battery is evaluated for maximum ambient temperature of charge: 10~45°C, discharge: -10~60°C.

Table 1: The battery electrical character profile:

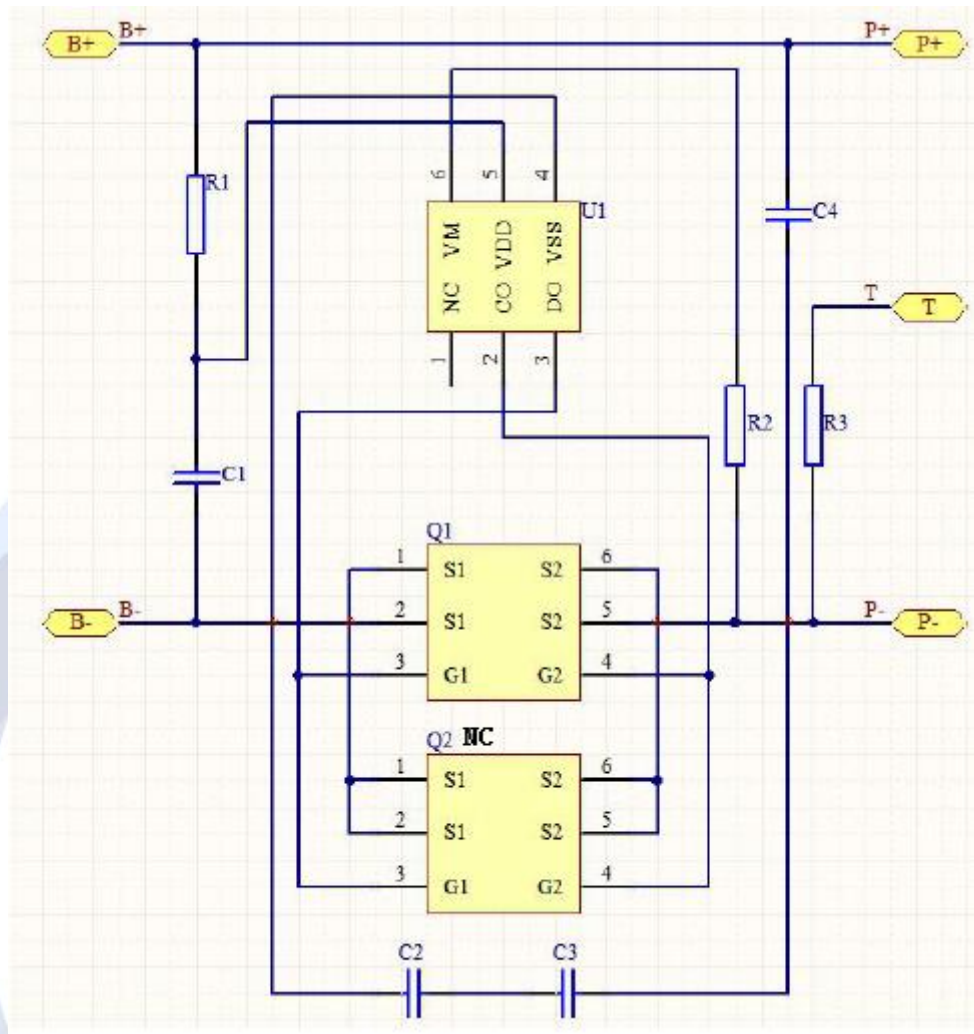
Model	Nominal capacity	Nominal voltage	Nominal Charge Current	Nominal Discharge Current	Max. Charge Current	Max. Discharge Current	Max. Charge Voltage	Cut-off Voltage
ZN-285565	1160mAh	3.8V	232mA	232mA	580mA	1160mA	4.35V	3.0V

Constuction:



T: 3.0mm Max W: 54.8mm Max H: 66.0mm Max
Battery

Circuit diagram:



UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict

INTRODUCTION

1	Scope	P
1.1	These requirements cover portable primary (non-rechargeable) and secondary (rechargeable) batteries for use as power sources in products. These batteries consist of either a single electrochemical cell or two or more cells connected in series, parallel, or both, that convert chemical energy into electrical energy by chemical reaction.	P
1.2	These requirements are intended to reduce the risk of fire or explosion when batteries are used in a product. The proper use of these batteries in a particular application is dependent on their use in a complete product that complies with the requirements applicable to such a product.	P
1.3	These requirements are intended to cover batteries for general use and do not include the combination of the battery and the host product which are covered by requirements in the host product standard.	P
1.4	These requirements are also intended to reduce the risk of injury to persons due to fire or explosion when batteries are removed from a product to be transported, stored, or discarded.	P
1.5	These requirements do not cover the toxicity risk that results from the ingestion of a battery or its contents, nor the risk of injury to persons that occurs if a battery is cut open to provide access to its contents.	P
2	General	P
2.1	Lithium cells	P
2.1.1	In lieu of the requirements outlined in Table 6.1 cells constructed of lithium metal, lithium alloy or lithium ion, that are used in batteries, shall meet the requirements in the Standard for Lithium Batteries, UL 1642.	P
2.1.2	Deleted, effective November 11, 2011	N/A
2.1.3	Deleted, effective November 11, 2011	N/A
2.2	Units of measurement	P
2.3	Terminology	P
2.4	Components	P
2.4.1	Except as indicated in 2.4.2, a component of a product covered by this standard shall comply with the requirements for the component. See Appendix A for a list of standards covering components used in the products covered by this standard.	P
2.4.2	A component is not required to comply with a specific requirement that: a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or b) Is superseded by a requirement in this standard.	P
2.4.3	A component shall be used in accordance with its rating established for the intended conditions of use.	P
2.4.4	Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.	P
3	Glossary	P
CONSTRUCTION		

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
4	General		P
4.1	Casing		N/A
4.1.1	The casing of a cell or single cell battery, or the enclosure of a battery pack shall have the strength and rigidity required to resist the possible abuses, that it is exposed to during its intended use, in order to reduce the risk of fire or injury to persons.	No enclosure exists.	N/A
4.1.2	The casing of a battery pack shall be rigid enough to prevent flexing. A tool providing the mechanical advantage of a pliers, screwdriver, hacksaw, or similar tool, shall be the minimum mechanical capability required to open the casing.		N/A
4.1.3	For battery packs with plastic outer enclosures, the outer enclosure of the battery shall be designed such that it is not capable of being opened using simple tools, such as a screwdriver. The enclosure shall be ultrasonically welded, or secured by equivalent means. Adhesives complying with the adhesive requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, single use or tamper-proof screws are considered equivalent means.		N/A
4.1.4	The outer case material of the battery shall be classed as V-1 or less flammable in the minimum part thickness in accordance with the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C. Exception: Materials are not required to be classed as V-1 or less flammable when they comply with the Enclosure Flammability – 20 mm (3/4 inch) Flame test described in the Standard for Polymeric Materials— Use in Electrical Equipment Evaluations, UL 746C.		N/A
4.1.5	Openings in battery pack enclosures shall be minimized to prevent damage to cells, connections, and internal circuitry and shorting of electrical spacings within the pack. Enclosure openings shall not be located over cells that do not comply with the rigid casing requirements of 4.1.2 or over protective circuitry and connections where damage or shorting from debris entering the enclosure could result in a hazard.	No opening exists.	N/A
4.2	Electrolyte		P
4.2.1	A cell shall not contain pressurized vapor or liquid that expels materials forcibly when the battery casing is punctured with a grinding wheel under laboratory conditions at a temperature of 23 ±2°C (73±3.6°F).	The component cell (model: ZN-285565) has approved according to UL 1642.	P
4.3	External battery pack connectors		P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
4.3.1	An external battery pack connector shall be constructed to prevent inadvertent short circuiting of its terminals unless the pack meets the limited power source requirements of the Limited Power Source Test, Section 13. Examples of methods to prevent inadvertent short-circuiting include recessing the terminals, providing circuitry that prevents inadvertent short circuiting, providing covers over the terminals, use of keyed connectors, and the like.	Battery meet the limited power source requirements	P
4.3.2	Insulating material for external battery pack connectors, outside the enclosure, shall have a V-2 minimum flame rating unless the pack meets the limited power source requirements of the Limited Power Source Test, Section 13. External connectors forming part of the fire enclosure shall be V-1 minimum.		N/A
4.4	Printed wiring boards		P
4.4.1	Printed wiring boards mounting battery circuit components shall be rated V-1 minimum	Rated V-0, See Critical Component Table.	P
4.5	Lithium ion systems only		P
4.5.1	The voltage of each cell or each cellblock consisting of parallel-connected plural cells should not exceed the upper limit of the charging voltage specified by the cell manufacturer.	Single cell battery	N/A
4.5.2	For the battery consisting of a single cell or a single cellblock, it should be confirmed that the charging voltage of the cell does not exceed the upper limit of the charging voltage specified by the cell manufacturer.	Complied.	P
4.5.3	For the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it should be confirmed that the voltages of any one of the single cells or single cellblocks does not exceed the upper limit of the charging voltage, specified by the cell manufacturer, by monitoring the voltage of every single cell or the single cellblocks.		N/A
4.5.4	Compliance for 4.5.1 – 4.5.3 can be achieved through analysis of the battery protection circuit or if unable to determine through analysis, than through monitoring values during the test of Section 13A.		P
PERFORMANCE			
5	General		P
5.1	Batteries are to be tested as described in Sections 9 through 24. Section 12, Forced-Discharge Test, is applicable only to cells intended to be used in multicell series applications, such as battery packs. The Battery Enclosure Tests, Sections 18 — 21 (including the 250 N Steady Force, Mold Stress Relief, and Drop Impact Tests) are intended only for batteries that have a plastic outer enclosure.	Tested as required.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
5.2	With the exception of the Projectile Test of Section 22, cells and/or batteries shall not explode or catch fire as a result of the tests in this standard. For the Shock Test, Section 16, Vibration Test, Section 17, 250 N Steady Force Test, Section 19, Mold Stress Relief Test, Section 20, Drop Impact Test, Section 21, and the Temperature Cycling Test, Section 24 the samples shall also not vent or leak. For these tests unacceptable leakage is deemed to have occurred when the resulting mass loss exceeds the values shown in Table 5.1, Venting and Leakage Mass Loss Criteria.	No enclosure exists.	N/A
5.3	Deleted August 12, 2008		N/A
5.4	Certain end product devices require that the power output of a battery be limited. The Limited Power Source Test described in Section 13 is to be used to determine whether a cell or battery is suitable in such applications where fire hazards may otherwise exist.	Test complied. See clause 13.	P
6	Samples		P
6.1	Unless otherwise indicated, fresh cells or batteries in the fully charged state are to be used for the tests described in Sections 9 – 24. The test program and number of samples to be used in each test is shown in Tables 6.1 and 6.2, for cell testing and battery pack testing, respectively.	Tested as required.	P
6.2	When a battery pack is tested in accordance with Table 6.2, the cells comprising that battery pack shall also be tested in accordance with Table 6.1 if they have not already been.	The component cell (model: ZN-285565) has approved according to UL 1642.	N/A
6.3	All batteries shall be fully charged in accordance with the manufacturer's specifications prior to testing except for the samples to be subjected to the Abnormal Charging and Abusive Overcharge Tests, which shall be discharged to the manufacturer specified end point voltage using the manufacturer specified current prior to testing.	Suitable samples prepared according to each test clause requirement.	P
7	Important test considerations		P
7.1	As some batteries explode in the tests described in Sections 9 — 24, it is important that personnel be protected from the flying fragments, explosive force, sudden release of heat, chemical burns, and noise results from such explosions. The test area is to be well ventilated to protect personnel from possible harmful fumes or gases.	Test facilities checked and complied.	P
7.2	The temperatures on the surface of the battery casings shall be monitored during the tests described in Sections 9, 10, 11, 14, and 15. All personnel involved in the testing of batteries are to be instructed never to approach a battery until the surface temperature returns to ambient temperature.	Temperature on battery case recorded for so requested clauses, also see appended tables.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
7.3	The tests described in Section 22, Projectile Test, shall be conducted in a separate room or room equipped with an adequate safety barrier separating the test area from the observer.		N/A
8	Temperature measurements		P
8.1	Temperatures are to be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm ²) and not smaller than 30 AWG (0.05 mm ²) and a potentiometer-type instrument.	Suitable thermocouples used during the test.	P
8.2	The temperature measurements on the batteries are to be made with the measuring junction of the thermocouple held tightly against the outer casing of the battery.	Fulfilled.	P
ELECTRICAL TESTS			
9	Short-Circuit Test		P
9.1	Cells shall comply with 9.1 — 9.6.		N/A
9.2	Each fully charged test sample cell, in turn, is to be short-circuited by connecting the positive and negative terminals of the battery with a circuit load having a resistance load of 80 ± 20 mohm. The temperature of the battery case is to be recorded during the test. The battery is to discharge until a fire or explosion is obtained, or until it has reached a discharged state of less than 0.2 volts and/or the case temperature has returned to $\pm 10^{\circ}\text{C}$ ($\pm 18^{\circ}\text{F}$) of ambient temperature.		N/A
9.3	Tests are to be conducted at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$), and at $55 \pm 2^{\circ}\text{C}$ ($131 \pm 4^{\circ}\text{F}$). The cells are to reach equilibrium at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) or $55 \pm 2^{\circ}\text{C}$ ($131 \pm 4^{\circ}\text{F}$) as applicable, before the terminals are connected.		N/A
9.4	A cell is to be tested individually unless the cell manufacturer indicates that it is intended for use in series or parallel. For series or parallel use, additional tests on five sets of batteries are to be conducted using the maximum number of cells to be covered for each configuration as specified by the manufacturer.		N/A
9.5	A cell is to be tested without the assistance of protective devices unless such protective devices are integral to the cell construction. When a protective device actuates during the test, the test shall be repeated with the cell connected to the maximum load that does not cause the protective device to open.		N/A
9.6	The samples shall not explode or catch fire. The temperature of the exterior cell or battery casing shall not exceed 150°C (302°F) for lithium chemistries.		N/A

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
9.7	Battery packs shall comply with 9.8 — 9.12. Exception: Battery packs consisting of a single cell, in which the cell has already been subjected to the tests in 9.1 – 9.6 need not be subjected to the tests in 9.8 – 9.12		P
9.8	Each fully charged test sample battery pack, in turn, is to be short-circuited by connecting the positive and negative terminals of the battery with a circuit load having a resistance load of 80 ± 20 m ohm. The temperature of the battery case is to be recorded during the test. The battery is to discharge until a fire or explosion is obtained, or until it is completely discharged and/or the cell case temperature has returned to $\pm 10^{\circ}\text{C}$ ($\pm 18^{\circ}\text{F}$) of ambient temperature.	Tested complied.	P
9.9	Tests are to be conducted at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) and at $55 \pm 5^{\circ}\text{C}$ ($131 \pm 4^{\circ}\text{F}$). The batteries are to reach equilibrium at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) or $55 \pm 5^{\circ}\text{C}$ ($131 \pm 4^{\circ}\text{F}$), as applicable, before the terminals are connected.	Tested complied.	P
9.10	Battery pack constructions are to be subjected to a single fault across any protective device in the load circuit of the battery under test. When protective devices actuate during the test, the test shall be repeated with the battery pack connected to the maximum load that does not cause the protective devices to open. Exception: A positive temperature coefficient device which complies with the tests specified in Standard for Thermistor-Type Devices, UL 1434, the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1A, or other protective devices determined to be reliable, may remain in the circuit without being faulted. See Appendix A for additional component standards.	A single fault applied. MOSFET (U2) pin1-pin3 was short circuited. The test was continued until the battery was completely discharged.	P
9.11	One of the above five test sample battery packs, tested at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) shall be evaluated with the following additional conditions in place. The terminals are to be subjected to a short circuit condition with a minimum length of 16 AWG (1.3 mm ²) bare copper wire. The test is to be conducted on a tissue paper covered soft wood surface and the sample battery pack and bare conductor is to be covered with a single layer of cheesecloth.	One sample additionally tested with 1.3mm ² bare copper wire.	P
9.12	For all samples tested, the samples shall not explode or catch fire and the tests shall not result in chemical leaks caused by cracking, rupturing or bursting of the cell casing. The temperature of the internal cell casings shall not exceed 150°C (302°F) for lithium chemistries. For battery pack samples tested in accordance with 9.11, the cheesecloth and tissue paper shall not catch fire.	No explosion, no fire, chemical leakage, the measured temperature not exceeding 150°C , also see appended table.	P
10	Abnormal Charging Test		P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
10.1	Primary batteries (for example: cells, single cell batteries, or battery packs) shall comply with 10.2 –10.5 (Secondary battery pack)		N/A
10.2	Batteries discharged to the manufacturer's rated capacity are to be used for this test. The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$).		N/A
10.3	Each fully discharged test sample battery is to be subjected to a charging current of three times the current I_c , specified by the manufacturer by connecting it in opposition to a dc-power supply. The test time is to be calculated using the formula: $t_c = \frac{2.5C}{3(I_c)}$, in which t_c is the charging time in hour C is the capacity of the cell/batteiy in ampere-hours, and I_c is the maximum charging current, in amperes, specified by the manufacturer. The minimum charging time is to be 7 hours. Exception: At the manufacturer's discretion, test currents greater than the specified three times rated I_c can be applied to expedite the test timeframe, with the minimum charging times as 7 hours.		N/A
10.4	When a protective device that has been investigated for the purpose, actuates during the test, the test shall be repeated with the battery supply connected to the maximum load that does not cause the protective device to open. A protective device that has not been investigated for the purpose shall be short-circuited.		N/A
10.5	The samples shall not explode or catch fire. For battery pack samples, tests shall not result in chemical leaks caused by cracking, rupturing or bursting of the battery casing.		N/A
10.6	Secondary cells shall comply with 10.7 – 10.9		N/A
10.7	The cells are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$). Each battery shall be discharged at a constant current of 0.2 C/1 hour, to a manufacturer specified discharge endpoint voltage		N/A
10.8	The cells are to be charged with a constant maximum specified charger output voltage and a current limit of three times the maximum current I_c , specified by the manufacturer. Charging duration is the time required to reach the manufacturer's specified end-of-charge condition plus seven additional hours.		N/A

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
10.9	A cell is to be tested without the assistance of protective devices, unless such protective devices are either integral to the cell constructions or have been investigated for the purpose. A re-settable protective device that actuates during the test shall be allowed to reset and the test shall be resumed, cycling as often as necessary to complete the test. When a protective device operates during the test (whether re-settable or not) the test is repeated with the same charging time, but with the cell connected to the maximum load that does not cause the protective devices to operate. A protective device that is not integral to the cell and that has not been investigated for the purpose is to be short-circuited.		N/A
10.9.1	The samples shall not explode or catch fire		N/A
10.10	Secondary battery packs shall comply with 10.11 — 10.13.		P
10.11	The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$). A thermocouple is to be attached to the cells of each test sample battery. Each battery shall be discharged at a constant current of 0.2C/1 hour, to a manufacturer specified discharge endpoint voltage.	Discharge with 232mA to endpoint voltage 3.0V.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
10.12	<p>Each of the test sample batteries are to be subjected to the following overcharge conditions, in sequential order.</p> <p>a) The battery is to be initially charged using a constant current charging mode with a current limit of three times the maximum current I_c, specified by the manufacturer until the maximum specified charger output voltage is reached. At that point, the battery is to be charged with a constant maximum specified charger output voltage and a current limit of three times the maximum current I_c. Charging duration is the time required to reach the manufacturer's specified end-of-charge condition plus seven additional hours. The temperature on the cell casing shall be monitored. A re-settable protective device such as a PTC that actuates during the test shall be allowed to reset and the test shall be resumed, cycling as often as necessary, but no less than 10 times, to complete the test. Automatic reset devices are allowed to cycle during the test. When an overcurrent protective device operates during the test, the test is repeated with the same charging time, but with the battery connected to the maximum load that does not cause the protective devices to operate.</p> <p>b) The charge condition in accordance with (a) shall be conducted with each single component fault that is likely to occur in the charging circuit and which would result in overcharging of the battery.</p> <p>Exception No. 1: A protective device determined to be reliable may remain in the circuit without being faulted. See 2.4 and Appendix A.</p> <p>Exception No. 2: For batteries without protective devices, the overcharge condition(s) in (b) do not apply.</p>	<p>Max. constant charge voltage 4.35V.</p> <p>Charging current: 3 x 580mAh = 1740mA single fault applied.</p> <p>MOSFET (U2) pin1-pin3 was short circuited.</p> <p>The test was continued until the battery charged with additionally charge 7 hours.</p>	P
10.13	The samples shall not explode or catch fire. For battery pack samples, tests shall not result in chemical leaks caused by cracking, rupturing or bursting of the internal cell casing.	No explosion, fire or chemical leak, also see appended table.	P
11	Abusive Overcharge Test		P
11.1	The batteries are to be tested in an ambient temperature of $20 \pm 5^\circ\text{C}$ ($68 \pm 9^\circ\text{F}$).		P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
11.2	Sample batteries are to be subjected to a constant charging current at 10 times the C5 amp rate, using a supply voltage sufficient to maintain the 10 times C5 amp rate throughout the duration of the test. During the test, the temperature is to be measured on the internal cell casing of each sample. The test is to continue until the cell or battery explodes, vents, or a single operation protective device operates, and the temperature of the internal cell casing reaches steady state conditions or returns to ambient. If a PTC or other re-settable protection device operates during the test, it is to be reset a minimum of 10 times during the test. An automatic reset device is allowed to cycle during the test	Tested with constant current 2320mA (4 samples), and 1160mA (1 sample). After short circuit the MOSFET (U2) pin1-pin3 short circuited. The test was continued until battery vents and the temperature of the internal cell casing reaches steady state conditions or returns to ambient.	P
11.3	During the tests, batteries supplied with protective devices shall be subjected to a single component fault using any single fault condition which is likely to occur in the charging circuit and which would result in overcharging of the battery Exception: Protective devices determined to be reliable, may remain in the circuit without being faulted. See Appendix A.		P
11.4	The samples shall not explode or catch fire.	No explosion or fire, also see appended table.	P
11.5	At least one of the five samples shall be subjected to the test outlined in 11.2 and 11.3 with a constant current charge 5 times the C5 rate (for example: at the C rate) with a supply voltage sufficient to maintain that rate throughout the duration of the test	Tested with constant current 1160mA.	P
12	Forced-Discharged Test		N/A
12.1	This test is intended for cells that are to be used in multicell applications, such as battery packs. The batteries are to be tested in an ambient temperature of 20 ±5°C (68 ±9°F).		N/A
12.2	For multi-cell series configurations without parallel strings a fully discharged cell is to be force-discharged by connecting it in series with fully charged cells of the same kind. The number of fully charged cells to be connected in series with the discharged cell is to equal the total number of cells in the pack less one		N/A
12.3	For multi-cell series configurations with parallel strings, a fully discharged parallel string is to be force-discharged by connecting it in series with fully charged cells of the same kind. The number of fully charged cells to be connected in series with the discharged parallel string is to equal the total number of cells in the pack less the number of cells in the discharged parallel string		N/A
12.4	Each of the five battery packs shall be prepared as described in 12.2 or 12.3, as applicable.		N/A

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
12.5	Once the completely discharged cells (or string of cells) are connected in series with the specified number of fully charged cells, the resultant battery pack is to be short circuited.		N/A
12.6	The positive and negative terminals of the sample are to be connected with a copper wire with a resistance load of 80 ± 20 m ohms. The battery is to discharge until a fire or explosion is obtained, or until it has reached a completely discharged state and the cell case temperature has returned to $\pm 10^{\circ}\text{C}$ ($\pm 18^{\circ}\text{F}$) of ambient temperature		N/A
12.7	During the tests, batteries supplied with protective devices shall be subjected to a single component fault using any single fault condition which is likely to occur in the discharge circuit and which would result in excessive discharge of the battery. Exception: A positive temperature coefficient device which complies with the applicable tests specified in the Standard for Thermistor-Type Devices, UL 1434 and the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1A, or other protective devices determined to be reliable, may remain in the circuit without being faulted. See Appendix A for additional component standards.		N/A
12.8	The samples shall not explode or catch fire.		N/A
13	Limited Power Source Test		P
13.1	The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$).	Tested as required.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
13.2	<p>A battery intended to be a limited power source shall comply with one of the following:</p> <p>a) The output is inherently limited in compliance with Table 13.1; or</p> <p>b) A linear or nonlinear impedance limits the output in compliance with Table 13.1. If a positive temperature coefficient device is used, it shall:</p> <p>1) Comply with the Standard for Thermistor-Type Devices, UL 1434, or</p> <p>2) Pass the tests specified in the Manufacturing Deviation and Drift Section, the Endurance Section, and the Manufacturing Deviation and Drift Section and the Endurance Section in the Annex for Requirements for Controls Using Thermistors of the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1; or</p> <p>3) Meet the requirements in the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1 for a device for Type 2.AL Action;</p> <p>c) A regulating network or an integrated circuit (IC) current limiter, limits the output in compliance with Table 13.1, both under normal operating conditions and after any simulated single fault in the regulating network or IC current limiter (open circuit or short circuit); or</p> <p>d) An overcurrent protective device is used and the output is limited in compliance with Table 13.2.</p>	Tested as required, a).	P
13.3	Where an overcurrent protective device is used, it shall be a fuse or a non-adjustable, nonautoreset, electromechanical device.	No overcurrent protective device.	N/A
13.4	Batteries shall be fully charged when conducting the measurements for U_{oc} , I_{sc} , and S according to Tables 13.1 and 13.2.	Tested as required	P
13.5	The non-capacitive load referenced in Tables 13.1 and 13.2 shall be adjusted to develop maximum measured values of current (I_{sc}) and power (S) that can be obtained over the time limits noted in Tables 13.1 and 13.2. Simulated faults in a regulating network required according to 13.2 item (c) above are applied under these load conditions.	Tested as required	P
13.6	Batteries that meet the limited power source requirements may be marked "Limited Power Source" "LPS" to indicate that they are considered to be a limited power source. Batteries that do not meet these requirements, regardless of terminal design, shall not be marked to indicate that they are a limited power source and are restricted to applications where a limited power source is not required	"LPS" marked on the label.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
13A	Battery Pack Component Temperature Test		P
13A.1	A battery pack with enclosure shall be subjected to a normal temperature test under both input (charging) and output (discharging) conditions. As a result of this testing, temperatures on temperature sensitive components shall not exceed the limits outlined in Table 13A.1		P
13A.2	For the output loading temperature test, a fully charged battery pack shall be subjected to a constant resistive loading across the output terminals of the pack with the output load current set to just below the operating limit of the discharging protection circuit. Temperatures are monitored until thermal stabilization or until the pack is at its specified endpoint voltage, whichever comes first.	The output load current is 3050mA.	P
13A.3	The input loading temperature test shall be conducted on a fully discharged battery pack, discharged at a constant current of 0.2C/1 hour to a manufacturer specified discharge endpoint voltage.	Discharge with 232mA to 3.0V.	P
13A.4	For the input loading temperature test, a fully discharged sample shall be subjected to a CCCV charging method with the maximum charging voltage not to exceed the manufacturer's recommended maximum charging voltage limits. During the test, the charging current shall not exceed three times the maximum charge current or the operating limit of the charging protection circuit, whichever is less, during the test. Temperatures are monitored until thermal stabilization or until the pack is at its fully charged state, whichever comes first.	CC=1210mA, CV=4.35V.	P
13A.5	Temperatures are considered to be stabilized when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 15 minutes, indicate no further increase.	Tested as required.	P
13A.6	Protective devices within the pack shall not operate during the test.	Tested as required.	P
13A.7	Temperatures are monitored on surfaces of components using thermocouples. Thermocouples are to consist of 30 AWG wires. Larger size wires may be used, but they shall not exceed 24 AWG and shall not be large enough to result in a heat sink condition on the part under test.	Tested as required.	P
13A.8	During the normal temperature test, temperature measurement T shall not exceed $(T_{max} + T_{amb} - T_{ma})$	See appended table.	P
13B	Battery Pack Surface Temperature Test		N/A
13B.1	A battery pack with enclosure shall be subjected to a normal temperature test under both input (charging) and output (discharging) conditions.	No case exists.	N/A

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
13B.2	For the output loading temperature test, a fully charged battery pack shall be subjected to a constant resistive loading across the output terminals of the pack with the output load current set to just below the operating limit of the discharging protection circuit. Temperatures are monitored until thermal stabilization or until the pack is at its specified endpoint voltage, whichever comes first.		N/A
13B.3	The input loading temperature test shall be conducted on a fully discharged battery pack, discharged at a constant current of 0.2C/1 hour to a manufacturer specified discharge endpoint voltage.		N/A
13B.4	For the input loading temperature test, a fully discharged sample shall be subjected to a CCCV charging method with the maximum charging voltage not to exceed the manufacturer's recommended maximum charging voltage limits. During the test, the charging current shall not exceed three times the maximum charge current or the operating limit of the charging protection circuit, whichever is less, during the test. Temperatures are monitored until thermal stabilization or until the pack is at its fully charged state, whichever comes first.		N/A
13B.5	Temperatures are considered to be stabilized when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 15 minutes, indicate no further increase.		N/A
13B.6	Protective devices within the pack shall not operate during the test.		N/A
13B.7	Temperatures are monitored on the accessible surfaces of the pack enclosure using thermocouples. Thermocouples are to consists of 30 AWG wires. Larger size wires may be used, but they shall not exceed 24 AWG.		N/A
13B.8	During the normal temperature test, temperature measurement T shall not exceed ($T_{max} + T_{amb} - T_{ma}$)		N/A
MECHANICAL TESTS			
14	Crush Test		N/A
14.1	The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$).		N/A
14.2	A battery is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram or similar force mechanism. The flat surfaces are to be brought in contact with the cells and the crushing is to be continued until an applied force of $13 \pm 1.0 \text{ KN}$ ($3000 \pm 224 \text{ pounds}$) is reached. Once the maximum force has been obtained, it is to be released		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
14.3	A cylindrical or prismatic battery is to be crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus. A prismatic battery is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the crushing force. Each sample battery is to be subjected to a crushing force in only one direction. Separate samples are to be used for each test.		N/A
14.4	A coin or button battery is to be crushed with the flat surface of the battery parallel with the flat surfaces of the crushing apparatus.		N/A
14.5	The samples shall not explode or catch fire.		N/A
15	Impact Test		N/A
15.1	The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$).		N/A
15.2	A test sample battery is to be placed on a flat surface. A 15.8 mm (5/8 inch) diameter bar is to be placed across the center of the sample. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 ± 25 mm (24 ± 1 inch) onto the sample.		N/A
15.3	A cylindrical or prismatic battery is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of a 15.8 mm (5/8 inch) diameter curved surface lying across the center of the test sample. A prismatic battery is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the impact. Each sample battery is to be subjected to only a single impact. Separate samples are to be used for each test.		N/A
15.4	A coin or button battery is to be impacted with the fiat surface of the test sample parallel to the flat surface and the 15.8 mm (5/8 inch) diameter curved surface lying across its center.		N/A
15.5	The samples shall not explode or catch fire.		N/A
16	Shock Test		N/A

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
16.1	The cell is to be secured to the testing machine by means of a rigid mount which supports all mounting surfaces of the cell. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions unless it has only two axes of symmetry in which case only two directions shall be tested. Each shock is to be applied in a direction normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g (where g is the local acceleration due to gravity). The peak acceleration shall be between 125 and 175 g Cells shall be tested at a temperature of 20 ±5°C (68 ±9°F).		N/A
16.2	The samples shall not explode or catch fire.		N/A
16.3	The sample shall be examined 6 hours after testing and shall not vent or leak as described in 5.2.		N/A
17	Vibration Test		N/A
17.1	The batteries are to be tested in an ambient temperature of 20 ±5°C (68 ±9°F).		N/A
17.2	A battery is to be subjected to simple harmonic motion with an amplitude of 0.8 mm (0.03 inch) [1.6 mm (0.06 inch) total maximum excursion].		N/A
17.3	The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz and return in not less than 90 nor more than 100 minutes. The battery is to be tested in three mutually perpendicular directions. For a battery that has only two axes of symmetry, the battery is to be tested perpendicular to each axis.		N/A
17.4	The samples shall not explode or catch fire.		N/A
17.5	The sample shall be examined 6 hours after testing and shall not vent or leak as described in 5.2.		N/A
BATTERY ENCLOSURE TESTS			
18	General		N/A
18.1	The batteries are to be tested in an ambient temperature of 20 ±5°C (68 ±9°F).		N/A
18.2	Batteries with outer plastic enclosures shall be subjected to the tests described in Sections 19, 20, and 21. Batteries with outer enclosures made from materials other than plastic, shall be subjected to the tests described in Sections 19 and 21	No outer plastic enclosures exists.	N/A
19	250 N Steady Force Test		N/A
19.1	The batteries are to be tested in an ambient temperature of 20 ±5°C (68 ±9°F).		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
19.2	External enclosures of the battery pack are to be subjected to a steady force of 250 ± 10 N (56 ± 2 pounds force) for a period of 5 seconds, applied in turn to the top, bottom and sides of the battery pack enclosure by means of a suitable test tool providing contact over a circular plane surface 30 mm (1.2 inches) in diameter.		N/A
19.3	The samples shall not explode or catch fire. The outer battery enclosure shall not crack to the extent that the cells or any protective devices are exposed. Openings in the enclosure created as a result of application of the 250 N steady force shall meet the criteria of 4.1.5		N/A
19.4	The sample shall be examined 6 hours after testing and shall not vent or leak as described in 5.2.		N/A
20	Mold Stress Relief Test		N/A
20.1	Each of three samples are to be placed in a full-draft circulating-air oven maintained at a uniform temperature of 70°C (158°F). The samples are to remain in the oven for 7 hours. Exception: If the maximum temperature, T, recorded on the battery pack thermoplastic enclosure parts, obtained during the normal temperature test of Section 13A exceeds 60°C (140°F), then the oven temperature is to be maintained at a temperature equal to $T + 10^{\circ}\text{C}$ (50°F).		N/A
20.2	Deleted effective November 11, 2011		N/A
20.2.1	To prevent hazards from overheating energized cells, samples shall either be fully discharged prior to conditioning or provided with "dummy" cells, which are representative of the actual cells		N/A
20.3	After careful removal from the oven and after returning to room temperature following the conditioning described in 20.3, the samples shall show no evidence of mechanical damage that would result in damage to cells or protective circuitry. In addition, The battery enclosures shall not crack, warp, or melt to the extent that the cells or any protective devices are exposed. Openings in the enclosure created as a result of the conditioning shall meet the criteria of 4.1.5		N/A
21	Drop Impact Test		N/A
21.1	The batteries are to be tested in an ambient temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) Exception: Battery packs employing plastic enclosures that are intended for use in 0°C (32°F) temperatures shall be conditioned for 3 hours at 0°C (or temperature specified if lower than 0°C) prior to conducting the drop test, which shall be conducted immediately after removing the samples from the cold conditioning.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
21.2	Each of three samples is to be dropped from a height of 1 m (3.28 ft) so it strikes a concrete surface in the position that is most likely to produce the adverse results in 21.3. Each sample is to be dropped ,three times		N/A
21.3	The samples shall not explode or catch fire.		N/A
21.4	The sample shall be examined 6 hours after testing and shall not vent or leak as described in 5.2, and the integrity of the protective devices shall be maintained		N/A
21.5	The outer battery enclosure shall not crack to the extent that cells or any protective devices are exposed. Openings in the enclosure created as a result of the drop impact(s) shall meet the criteria of 4.1.5		N/A
FIRE EXPOSURE TESTS			
22	Projectile Test		N/A
22.1	When subjected to the test described in 22.2 — 22.5 no part of an exploding cell or battery shall create a hole in the wire screen cage or penetrate the wire screen cage such that some or all of the cell or battery protrudes through the screen cage.		N/A
22.2	Each test sample cell or battery is to be placed on a screen that covers a 102 mm (4 inch) diameter hole in the center of a platform table. The screen is to be constructed of steel wire mesh having 20 openings per inch (25.4 mm) and a wire diameter of 0.43 mm (0.017 inch).		N/A
22.3	The screen is to be mounted 38 mm (1-1/2 inch) above a burner. The fuel and air flow rates are to be set to provide a bright blue flame that causes the supporting screen to glow a bright red.		N/A
22.4	An eight-sided covered wire cage, 610 mm (2 feet) across and 305 mm (1 foot) high, made from metal screening is to be placed over the test sample. See Figure 22.1. The metal screening is to be constructed from 0.25 mm (0.010 inch) diameter aluminum wire with 16— 18 wires per inch (25.4 mm) in each direction.		N/A
22.5	The sample is to be heated and shall remain on the screen until it explodes or the cell or battery has ignited and burned out. It is not required to secure the sample in place unless it is at risk of falling off the screen before the test is completed. When required, the sample shall be secured to the screen with a single wire tied around the sample.		N/A
ENVIRONMENTAL TESTS			

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
23	Heating Test		N/A
23.1	The sample shall not explode or catch fire when subjected to the test described in 23.2 — 23.4.		N/A
23.2	A battery is to be heated in a gravity convection or circulating air oven with an initial temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$).		N/A
23.3	The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}$ ($9 \pm 3.6^{\circ}\text{F}$) per minute to a temperature of $130 \pm 2^{\circ}\text{C}$ ($266 \pm 3.6^{\circ}\text{F}$) and remain at that temperature for 10 minutes.		N/A
23.4	The sample shall return to room temperature ($20 \pm 5^{\circ}\text{C}$) and then be examined.		N/A
24	Temperature Cycling Test		N/A
24.1	<p>The batteries are to be placed in a test chamber and subjected to the following cycles:</p> <p>a) Raising the chamber-temperature to $70 \pm 3^{\circ}\text{C}$ ($158 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.</p> <p>b) Reducing the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 2 hours.</p> <p>c) Reducing the chamber temperature to minus $40 \pm 3^{\circ}\text{C}$ (minus $40 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.</p> <p>d) Raising the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes.</p> <p>e) Repeating the sequence for a further 9 cycles.</p> <p>f) After the 10th cycle, storing the batteries for a minimum of 24 hours at $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to examination</p>		N/A
24.2	The samples shall not explode or catch fire. In addition, the samples shall not vent or leak as described in 5.2.		N/A
MARKING			
25	General		P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
25.1	<p>A battery shall be legibly and permanently marked with:</p> <ul style="list-style-type: none"> a) The manufacturer's name, trade name, or trademark or other descriptive marking by which the organization responsible for the product may be identified; b) A distinctive (catalog or model) number or the equivalent; c) The electrical rating in Vdc and Ah. (Secondary lithium batteries may be marked in Wh rather than Ah); and d) The date or other dating period of manufacture not exceeding any three consecutive months <p>Exception No. 1: The manufacturer's identification may be in a traceable code if the product is identified by the brand or trademark owned by a private labeler</p> <p>Exception No. 2: The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code:</p> <ul style="list-style-type: none"> a) Does not repeat in less than 10 years, and b) Does not require reference to the production records of the manufacturer to determine when the product was manufactured. 	See marking plate.	P
25.2	When a manufacturer produces the battery at more than one factory, each battery shall have a distinctive marking to identify it as the product of a particular factory.	One factory only.	N/A
25.3	<p>A battery or the smallest unit package or instructions provided with each battery shall include the following statements or equivalent:</p> <ul style="list-style-type: none"> a) An attention word, such as "Caution", "Warning", or "Danger" b) A brief description of possible hazards associated with mishandling of the battery, such as burn hazard, fire hazard, explosion hazard. c) A list of actions to take to avoid possible hazards, such as do not crush, disassemble, dispose of in fire, or similar actions, and for primary batteries, do not charge. d) Instructions regarding replacement batteries if the batteries are replaceable by the user 	See marking plate.	P

UL 2054:2004 R9.11			
Clause	Requirement + Test	Result - Remark	Verdict
25.3.1	A lithium ion battery pack shall be marked with the following or equivalent: "CAUTION: Risk of Fire and Burns. Do Not Open, Crush, Heat Above (manufacturer's specified maximum temperature) or Incinerate. Follow Manufacturer's Instructions" This wording or equivalent shall also be included in the instructions packaged with the battery pack Exception No. 1: A lithium ion battery pack not provided with an enclosure, need not be marked, but shall include the above wording or equivalent in the instructions provided with the pack Exception No. 2: If space does not permit marking on the battery, the marking may be on the smallest unit package.	See marking plate.	P
25.4	The manufacturer's specified charging instructions shall be included for secondary batteries. Primary batteries shall include instructions indicating that the batteries shall not be charged	See marking plate.	P
25.5	A cell or battery that is less than 32 mm (1.25 inches) in diameter by 3.8 mm (0.15 in) thick shall include the following marking or equivalent on the smallest unit package or instructions provided with each cell or battery: "Caution — Never put batteries in mouth. If swallowed, contact your physician or local poison control center."		N/A
25.6	Batteries which meet the requirements of the Limited Power Source Test, Paragraph 13.4, may include the Marking "Limited Power Source" or "LPS"	"LPS" mark on the label.	P

Critical Components Material: e.g. external enclosure, PCB, closed-end connector, sleeves, cord anchorage etc Components with winding: e.g. motor, transformer, magnetic coil etc. Other components: e.g. switch, thermostat, heater, plug, internal wire, capacitor, relay, varistor etc.					
Object/part No.	Manufacturer/ trademark	Type/ model	Technical data	Standard	Mark(s) of conformity
PCB	XIAMEN G&P ELECTRONICS CO., LTD	2C	V-0, 130°C	UL 796 UL 94	UL E230743
PCB (Alt.)	Interchangeable	Interchangeable	V-0, 130°C	UL 94 UL 796	UL approved
IC (U1)	HYCON Technology Corp.	3OBH0A	Over-charge Threshold Voltage: 4.40V±0.025V@Topt=25°C; Over-discharge Threshold Voltage: 2.80V±0.05V; Topt: -40°C ~ 85°C	--	Tested with appliance
MOSFET (Q1)	SHENZHEN TUOFENG SEMICONDUCTOR TECHNOLOGY CO., LTD	2009 TFX80C	V _{DS} :20V, V _{GS} : ±12V I _D (at Ta=25°C): 9A T _{STG} : -55°C ~ 150°C	--	Tested with appliance
DC Connector	JAPAN AVIATION ELECTRONICS INDUSTRY., LTD	WP10-P004VA	SJ116135	--	Tested with appliance
NTC	Shenzhen Sunlord Electronics Co., Ltd.	SDNT1005 Series	Resistance at 25°C (K ohm): 10K, T _{moa} (°C): 125°C	--	Tested with appliance
Cell	Guangdong Zhaoneng Technologies Co., Ltd.	ZN-285565	3.8V, 1160mAh, 4.41Wh	UL 1642	CMC Report No. : CMC211013015
- Electrolyte	Anhui Xingli New Energy Co., Ltd.	ZN-82	LiPF ₆ +EC+DEC	--	--
- Separator	ShenZhen Xuran Electronic Co., Ltd.	60.0mm*14um	PE+AL ₂ O ₃ , Shutdown temperature: 135~140°C	--	--
-Negative electrode	Long Time Technology Co., Ltd.	16HY	Graphite, CMC, SBR, Distilled Water, Conductive Additive	--	--
-Positive electrode	Jiangmen KanHoo Industry Co., Ltd.	LCO-4	LiCoO ₂ , Carbon black, NMP, PVDF, Conductive Additive	--	--

9	TABLE: Short-Circuit Test					P
Ambient temperature: 23.8°C						
Sample No.	SN211013016 B001	SN211013016 B002	SN211013016 B003	SN211013016 B004	SN211013016 (16AWG)	
Cell case temp. (°C)	103.6	106.8	102.7	108.1	24.1	
Battery surface temp. (°C)	--	--	--	--	--	
Failure Mode	Yes	Yes	Yes	Yes	No	
Faulted Protective Device	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	--	
Ambient temperature: 55.6°C						
Sample No.	SN211013016 B006	SN211013016 B007	SN211013016 B008	SN211013016 B009	SN211013016 B010	
Cell case temp. (°C)	105.4	101.7	102.3	104.4	106.8	
Battery surface temp. (°C)	--	--	--	--	--	
Failure Mode	Yes	Yes	Yes	Yes	Yes	
Faulted Protective Device	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	
Supplementary information:						
No explosion or fire, or chemical leak;						
Tmax was recorded on the centre of the cell case;						
The temperature of the internal cell casings does not exceed 150°C (302°F);						
Faulted Protective Device*: The MOSFET (U2) pin1-pin3 is bypassed during the test;						

10	TABLE: Abnormal Charging Test					P
Ambient temperature: 23.9°C						
Id	232 mA					
Ue	3.0 V					
Ic	580 mA					
Uc	4.35 V					
Sample No.	SN21101301 6B011	SN21101301 6B012	SN21101301 6B013	SN21101301 6B014	SN211013016 B015	
Cell case temp. (°C)	35.8	37.4	36.1	33.1	34.2	
Battery surface temp. (°C)	--	--	--	--	--	
Failure Mode	Yes	Yes	Yes	Yes	Yes	
Faulted Protective Device	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	
Supplementary information: No explosion or fire, or chemical leak; Tmax was recorded on the centre of the cell case; Faulted Protective Device*: The MOSFET (U2) pin1-pin3 is bypassed during the test; The charging current is 580mA×3=1740mA; The battery doesn't have metal or plastic enclosure.						

11	TABLE: Abusive Overcharge Test					P
Ambient temperature: 23.2°C						
Sample No.	SN211013016 B016	SN211013016 B017	SN211013016 B018	SN211013016 B019	SN211013016 B020	
Ic (mA)	2320	2320	2320	2320	1160	
Cell Case temp. (°C)	108.4	112.3	107.5	110.2	98.7	
Battery surface temp. (°C)	--	--	--	--	--	
Failure Mode	Yes	Yes	Yes	Yes	Yes	
Faulted Protective Device	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	
Supplementary information: No explosion or fire; T _{max} was recorded on the centre of the cell case; Faulted Protective Device*: The MOSFET (U2) pin1-pin3 is bypassed during the test; Cell vented finally; The battery doesn't have metal or plastic enclosure.						

12	TABLE: Forced-Discharged Test					N/A
Ambient temperature: °C						
Sample No.	--	--	--	--	--	
Cell Case temp. (°C)	--	--	--	--	--	
Battery surface temp. (°C)	--	--	--	--	--	
Failure Mode	--	--	--	--	--	
Faulted Protective Device	--	--	--	--	--	
Supplementary information: No explosion or fire.						

13	TABLE: Limited Power Source					P
Ambient temperature: 23.5°C						
Normal condition						
Sample No.	SN211013 016B026	SN21101301 6B027	SN21101301 6B028	SN21101301 6B029	SN21101301 6B030	SN2110130 16B031
Uoc	4.29	4.30	4.31	4.30	4.29	4.30
Isc (A)	4.45	6.54	6.45	4.38	6.38	6.42
S (VA)	13.80	19.62	19.34	13.72	18.88	19.25
Faulted Protective Device	Normal	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited	Normal	MOSFET (U2) pin1-pin3 short circuited	MOSFET (U2) pin1-pin3 short circuited
Supplementary information: No explosion or fire.						

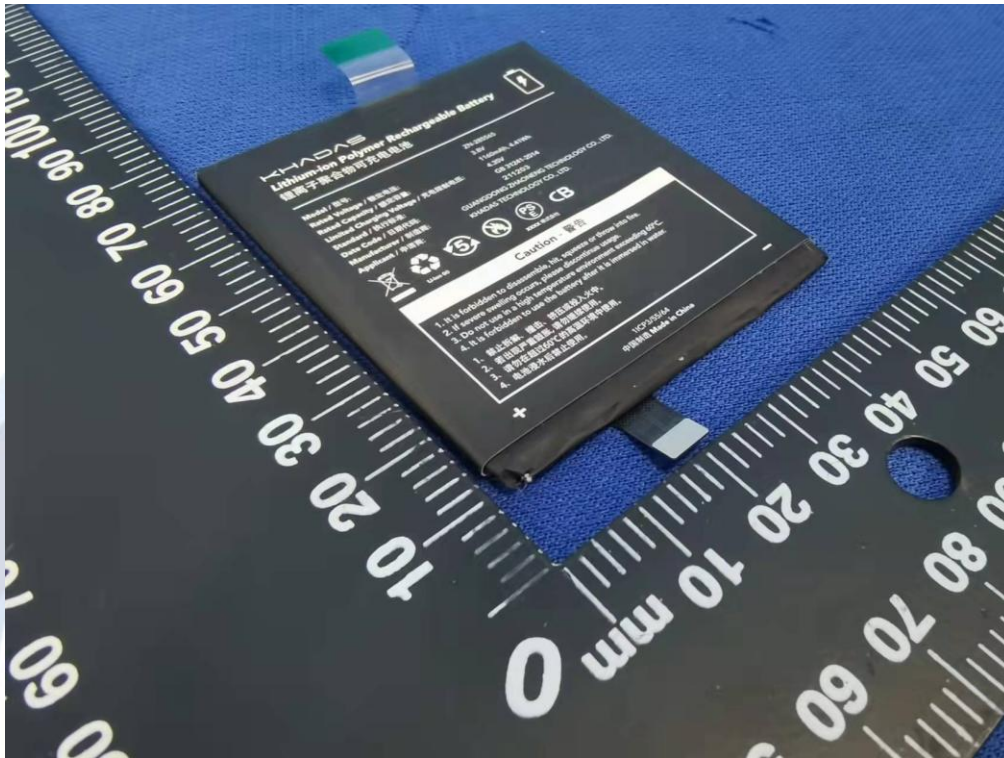
13A/13B	TABLE: Battery Pack Component Temperature Test and Battery Pack Surface Temperature Test					P
Ambient temperature: see below						
13A: Battery Pack Component Temperature Test						
Sample No.	SN211013016B032		SN211013016B033		Limited T	
Testing Process	Charging	Discharging	Charging	Discharging	Charging	Discharging
PCB near U1	51.3	73.1	52.0	74.5	130°C	130°C
PCB near U2	53.7	75.8	54.1	77.4	130°C	130°C
PCB near the positive of battery	48.2	68.2	49.5	71.1	130°C	130°C
Battery body surface	46.5	63.3	46.8	65.0	Ref.	Ref.
Ambient	45.0	60.0	45.0	60.0	--	--
13B: Battery Pack Surface Temperature Test						
Sample No.	--		--		Limited T	
Testing Process	Charging	Discharging	Charging	Discharging	Charging	Discharging
--	--	--	--	--	--	--
Supplementary information:						
Output load temperature test: fully charged battery discharge with 3.05A to endpoint voltage 3.0V						
Input load temperature test: fully discharged battery charge with 1.21A, 4.35V.						
*The test temperature was actual test ambient temperature.						

19	TABLE: 250 N Steady Force Test				N/A
Ambient temperature: °C					
Sample No.	--	--	--	--	
Mass before test (g)	--	--	--	--	
Mass after test (g)	--	--	--	--	
Supplementary information: No vent or leak.					

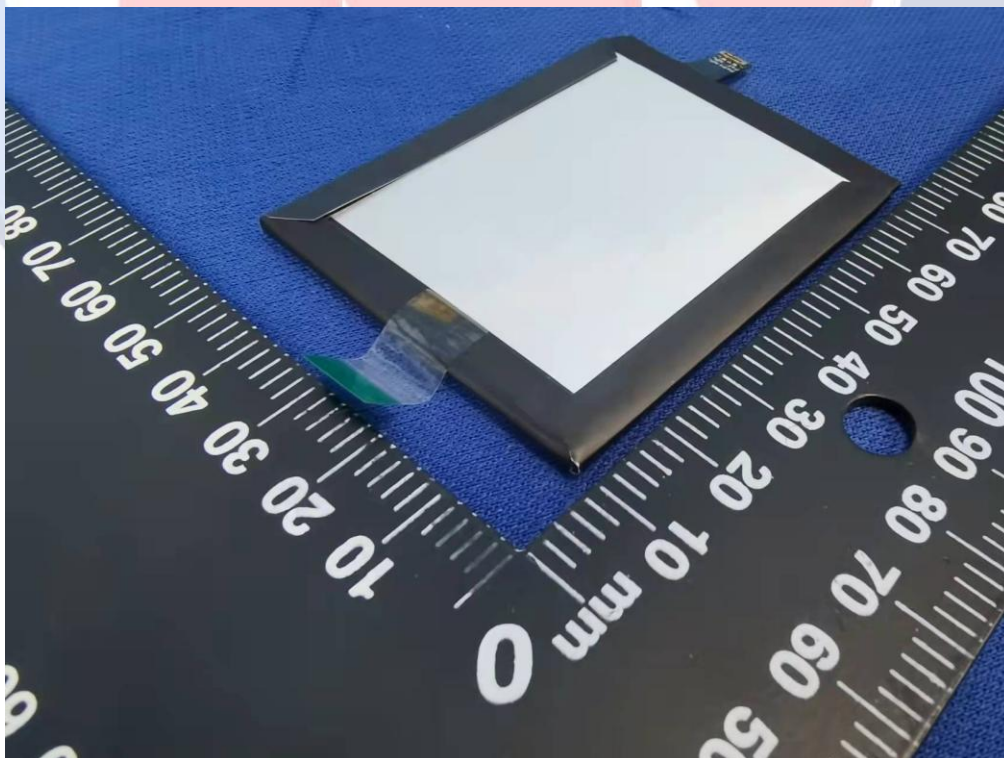
20	TABLE: Mold Stress Relief Test			N/A
Ambient temperature: °C				
Sample No.	--	--	--	
Mass before test (g)	--	--	--	
Mass after test (g)	--	--	--	
Supplementary information:				
The battery enclosures dose not crack, warp, or melt to the extent that the cells or any protective devices are exposed.				

21	TABLE: Drop Impact Test			N/A
Ambient temperature: °C				
Sample No.	--	--	--	--
Mass before test (g)	--	--	--	--
Mass after test (g)	--	--	--	--
Supplementary information: No explosion or fire.				

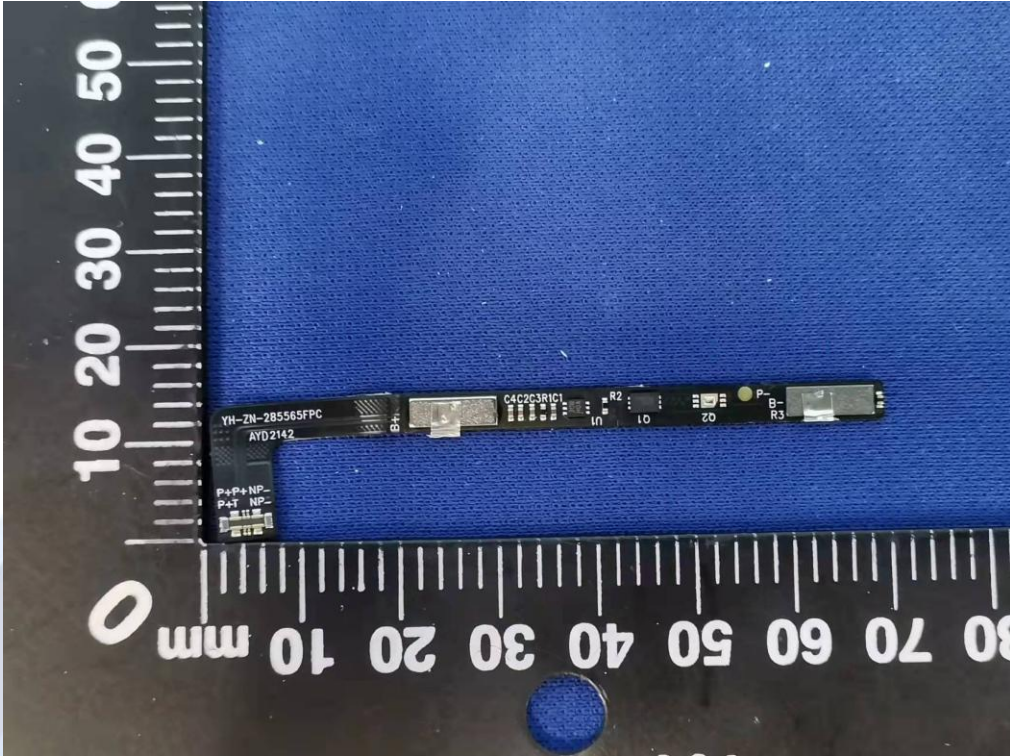
Attachment 1: Photo documentation



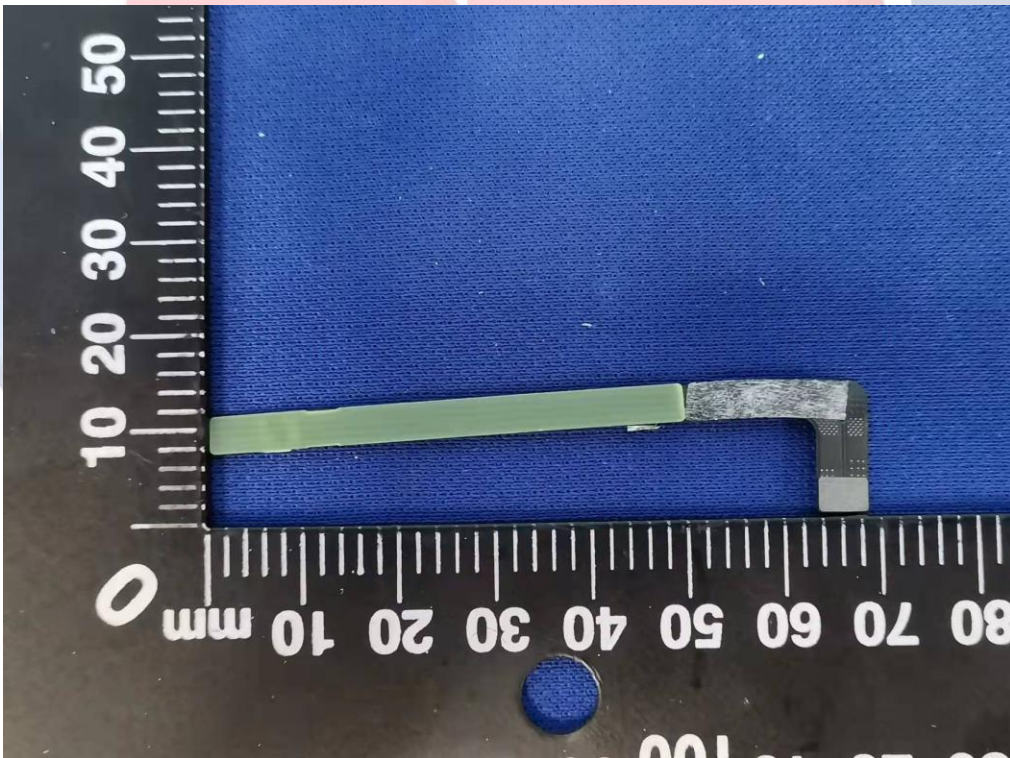
Picture 1. Front view of Battery



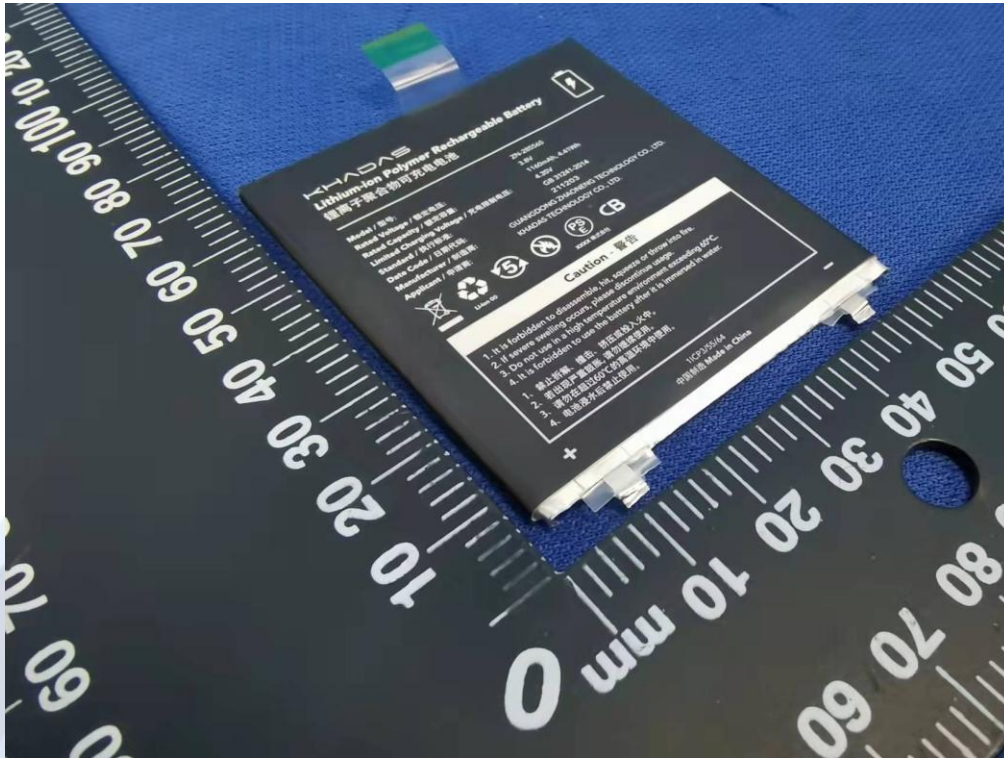
Picture 2. Back view of Battery



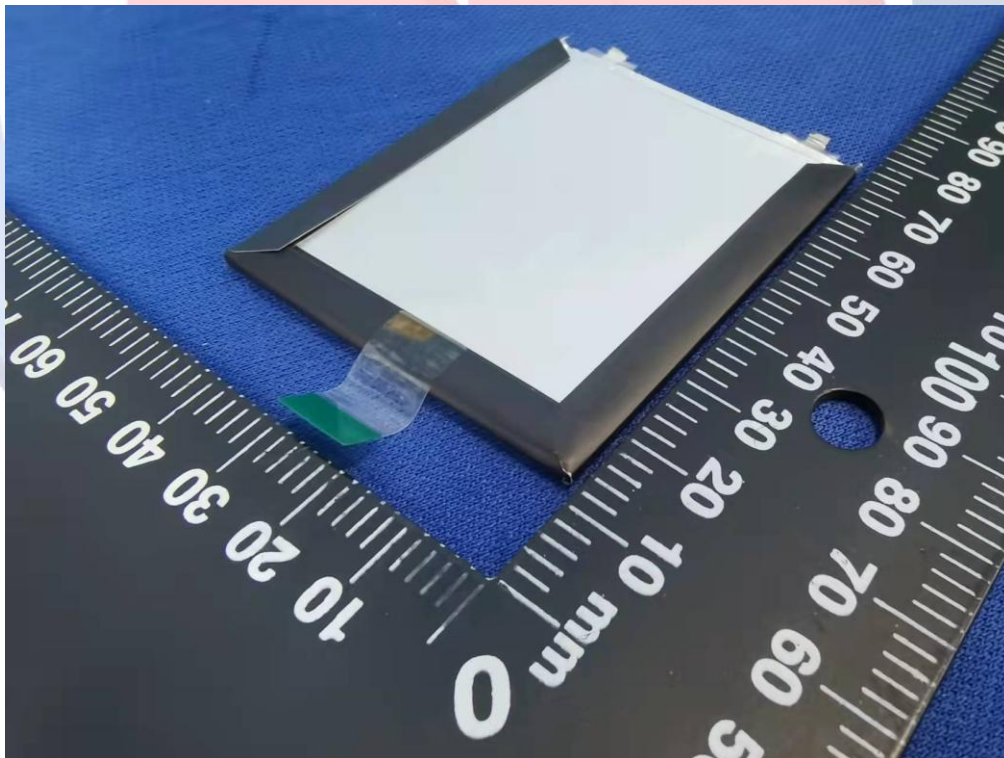
Picture 3. Front view of PCM



Picture 4. Back view of PCM



Picture 5. Front view of cell



Picture 6. Back view of cell

Important

1. The test report is invalid if it is not affixed the official seal of the laboratory to it.
2. Copies of the test report without the official seal of the laboratory are invalid.
3. It is forbidden to copy the test report partially without the written approval of the laboratory.
4. The test report is invalid without the signatures of Approver, Reviewer and Testing engineer.
5. The test report is invalid if it is blotted out.
6. Objections to the test report must be submitted to CMC within 15 days.
7. The test report is valid for the tested samples only.
8. As for the Verdict, “-” means “no need for judgement”, “P” means “pass”, “F” means “fail” and “N/A” means “not applicable”.

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-- End of Report --