# Bon Chef ,Inc..

# TEST REPORT

**SCOPE OF WORK**
TYPE TEST OF UL 62133-2:2020 ED.1+R:31MAY2024, FOR RECHARGEABLE LI-ION BATTERY PACK, MODEL: CA402S50-IH-H

**REPORT NUMBER**
260500075TPE-001

**ISSUE DATE**
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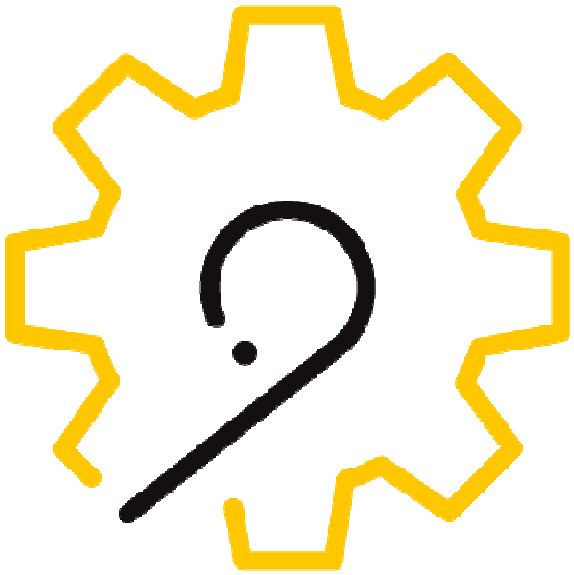

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# TEST REPORT

Issued:2026-06-26

Intertek Report No. 260500075TPE-001
Intertek Project No. TWJ26050119

Bon Chef ,Inc.
205 Route 94 Lafayette, NJ 07848 U.S.A

**Subject:** UL 62133-2:2020 test result of the Li-ion rechargeable battery, model: CA402S50-IH-H

To Bon Chef ,Inc.

This test report represents the results of the above referenced product(s) to the requirements contained in the following testing method (Not applicable to Intertek certification process):

**METHODS PER ISO/IEC 17025:2017 7.8.2.1f**

| DESCRIPTION OF TEST METHODS AND STANDARDS |
|---|
| UL 62133-2:2020 ED.1+R:31MAY2024 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 |

Tested Location:
No. 17, Ln. 246, Niupu S. Rd., Xiangshan Dist.TW-300075 Hsinchu City, Taiwan, Chinese Taipe

**SAMPLES PROVIDED PER ISO/IEC 17025:2017 7.8.2.1h & i**

| SAMPLE # | SAMPLE RECEIVED | SERIEL # | DATE | CONDITION |
|---|---|---|---|---|
| P250400164 | CA402S50-IH-H | 15 | 2025-04-25 | -- |

Test date: 2025-05-23 to 2025-07-16

## TEST REPORT

**SCOPE OF RESULTS PER ISO/IEC 17025:2017 7.8.2.1l**

The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

**RESULTS PER ISO/IEC 17025:2017 7.8.2.1m**

The results are recorded in this report.

**REPORTING STATEMENTS OF CONFORMITY REQUIRED PER ISO/IEC 17025:2017 7.8.6**

Please note that the test results with statement of conformity, the decision rules which are based on:
the specification, standard and not taking into account the measurement uncertainty.

**REPORT AUTHORIZED PER ISO/IEC 17025:2017 7.8.2.1o**

When signed with physical or electronic signature, the contents of this report have been prepared and approved per Intertek's quality process in accordance with ISO 17025.

Aslan Chen

Aslan Chen
Project Engineer

Dan Chen
Reviewer

**TEST REPORT**

**REPORT REVISIONS**

| Date/ Proj# | Project Handler/ Reviewer | Description of Change |
|---|---|---|
| 2026-05-xx TWJ26050119 | Aslan Chen/ Dan Chen | Original Issued |
| | | |
| | | |

**TEST REPORT**

| Test Summary Report | |
|---|---|
| Applicant | Bon Chef ,Inc. |
| | 205 Route 94 Lafayette, NJ 07848 U.S.A |
| | info@bonchef.com |
| Manufacturer (Factory) | SEGL ENERGY CO., LTD. |
| | No. 55, Wuxun St., Anie Dist., Keelung City 204, Taiwan |
| | sales@seglenergy.com |

| | |
|---|---|
| Test Laboratory | Intertek Testing Services Taiwan Ltd |
| | 5F, No. 423, Ruiguang Rd., Neihu District TW-114 Taipei City, Chinese Taipei |
| | 02-6602-2888#762 / aslan.chen@intertek.com |

| | |
|---|---|
| Test report identification number | 250400280TPE-001 |
| Date of test report | 2026-06-26 |

| Description of cell or battery to include at a minimum | | | |
|---|---|---|---|
| Product Type | Rechargeable Li-Ion Battery Pack | Model | CA402S50-IH-H |
| Rating | 50.82V, 9.8 Ah | Mass | Approx. 2.7 kg |
| Physical description of the ~~cell~~/battery | | A module composed of cylindrical battery cells, covered by plastic enclosure, 14S2P | |
| Maximum Continue Charging Voltage/ Current | | 58.8V / 5 A (@0~45°C) | |
| Cell manufacture | | SAMSUNG SDI Co., Ltd.<br>Model: INR21700-50G++, 3.63 Vdc, Rated capacity: 4900mAh | |

| List of tests conducted and results | | | |
|---|---|---|---|
| List of Tests Conducted | Result | Test record reference | Test location |
| 5.2 Insulation Resistance | N/A | -- | -- |
| 7.2.1 Continuous charging at constant voltage (cells) | N/A | -- | -- |
| 7.2.2 Case stress at high ambient temperature (battery) | PASS | Page.222 | 1) |
| 7.2.2A Temperature cycle | N/A | -- | -- |
| 7.3.1 External short-circuit (cells) | N/A | -- | -- |
| 7.3.2 External short-circuit (battery) | PASS | Page.23-24 | 1) |
| 7.3.3 Free fall | PASS | Page.25 | 1) |
| 7.3.4 Thermal abuse (cells) | N/A | -- | -- |
| 7.3.5 Crush (cells) | N/A | -- | -- |
| 7.3.6 Over-charging of battery | PASS | Page.26 | 1) |
| 7.3.7 Forced discharge (cells) | N/A | -- | -- |
| 7.3.8.1 Vibration | PASS | Page.27 | 1) |
| 7.3.8.2 Mechanical shock | PASS | Page.28 | 1) |
| 7.3.9 Forced internal short-circuit (cells) | N/A | -- | -- |
| D.2 Measurement of The Internal Ac Resistance For Coin Cells | N/A | -- | -- |

**TEST REPORT**

| | | | |
|---|---|---|---|
| Handler | Aslan Chen, Project Engineer  | Reviewer | Dan Chen, Reviewer  |

**TEST REPORT**

**General product information and other remarks:**

1. The product (EUT) is a Rechargeable Lithium-Ion Battery Pack, consisting of 28 cells and PCB, , then covered with Plastic enclosure and connect with wiring and DC connector.
2. The EUT is equipped with 28 cells (14S2P) and "14INR22/71-2" is the pack designation.
3. Otherwise specified, all tests have been carried out under temperature of 20 ± 5°C.
4. Approximately weight of EUT: Approx. 2.7 kg
5. Overall dimensions of EUT (mm): 295±3 by 95±3 by 80±3 measured.
6. The CoA to end product evaluated, PCB flammability, Enclosure flammability, Wirings.
7. Battery pack specification is as follows:

| Li-cell used in Li-battery | | Li-battery | |
|---|---|---|---|
| Model | INR21700-50G++ | Model | CA402S50-IH-H |
| Manufacturer | Samsung SDI Co Ltd | Manufacturer | SEGL ENERGY CO., LTD. |
| Cell designation | Cylindrical | Cell Configuration | 14S2P |
| Cell Shape | INR22/71 | Battery designation | 14INR22/71-2 |
| Nominal Voltage | 3.63 V | Normal Voltage | 50.82 Vdc |
| Rated Capacity | 4900mAh | Rated Capacity | 9.8Ah (9800mAh) |
| Charging specification of Li-cell | | Charging specification of Li-Batt | |
| Upper limited charging voltage | 4.25 Vdc | Maximum charging voltage | 58.8 Vdc |
| Maximum charging current | 4900 mA | Maximum charging current | 5 A |
| End of Charging Current | 98 mA | End of Charging Current | 0.5 A (1A±0.5A) |
| Charging Temperature Range | 0~45℃ | Charging Temperature Range | 0~45℃ |
| Discharging specification of Li-cell | | Discharging specification of Li-Batt | |
| 0.2 It | 980 mA | 0.2 It | 1.96A (1960mA) |
| Maximum Discharge Current | 14700 mA | Maximum Discharge Current/Load | 25 A |
| End Point Voltage | 2.5 V | End Point Voltage | 42 V |
| Discharging Temperature Range | -20~60℃ | Discharging Temperature Range | 0~60℃ |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | | | |
|---|---|---|---|
| **4** | **PARAMETER MEASUREMENT TOLERANCES** | | P |
| | Parameter measurement tolerances | Both normal and foreseeable misuses are evaluated in the report. All control and measure values were within the 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** | | N/A |
| | 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 externally exposed metal surface of the battery | N/A |
| | Insulation resistance (MΩ) .....: | N/A | — |
| | Internal wiring and insulation are sufficient to withstand maximum anticipated current, voltage and temperature requirements | | N/A |
| | Orientation of wiring maintains adequate clearance and creepage distances between conductors | | N/A |
| | Mechanical integrity of internal connections accommodates reasonably foreseeable misuse | | N/A |
| **5.3** | **Venting** | Checked | 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 | | P |
| | Encapsulation used to support cells within an outer casing does not cause the battery to overheat during normal operation nor inhibit pressure relief | | P |
| **5.4** | **Temperature, voltage and current management** | | P |
| | Batteries are designed such that abnormal temperature rise conditions are prevented | | P |
| | Batteries are designed to be within temperature, voltage and current limits specified by the cell manufacturer | | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | 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 | | P |
| **5.5** | **Terminal contacts** | | P |
| | The size and shape of the terminal contacts ensure that they can carry the maximum anticipated current | Compliance checked. | 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** | See below. | 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 | The protective circuit monitor and manage the charging voltage. | P |
| | This protection may be provided external to the battery such as within the charger or the end devices | Evaluated in end device. | 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 | | P |
| | 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 | | 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 | | N/A |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | 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 | | N/A |
| 5.6.1DV.1 D1 | For products where no end-product standard requirements exist, printed wiring boards and outer moulded battery cases shall be flammability rated a minimum of V-1 in accordance with CAN/CSA-C22.2 No. 0.17 or UL 94. | | P |
| 5.6.1DV.2 DC | Batteries shall be constructed of:<br>a) Cells meeting the requirements of this standard; or<br>b) Cells in compliance with the requirements of UL 1642. | a) CN63658 (CB by CQC)<br>b) MH21015 | P |
| 5.6.2 | Design recommendation | See below. | 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 | | N/A |
| | 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 | Charging voltage of each cell does not exceed the upper limit of the charging voltage 4.25 V/cell | P |
| | 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 | | P |
| | 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 | | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | It is recommended that the cells and cell blocks not discharged beyond the cell manufacturer's specified final voltage | | P |
| | For batteries consisting of series-connected cells or cell blocks, cell balancing circuitry incorporated into the battery management system | | P |
| 5.6.3 | Mechanical protection for cells and components of batteries | See below. | 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 | | 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 | | P |
| | The battery case and compartments housing cells designed to accommodate cell dimensional tolerances during charging and discharging as recommended by the cell manufacturer | | P |
| | For batteries intended for building into a portable end product, testing with the battery installed within the end product considered when conducting mechanical tests | To be evaluated in final system. | N/A |
| **5.7** | **Quality plan** | | P |
| | 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 | The manufacturer provides an ISO 9001 Certificate for battery. | P |
| **5.8** | **Battery safety components** | | 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 ≤ 3 Ω (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 °C ± 5 °C | | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | 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** | See below. | P |
| 7.1.1 | First procedure | Considered. | P |
| | This charging procedure applies to subclauses other than those specified in 7.1.2 | The batteries are charged in the ambient temp (20°C ± 5°C) and charging procedure according to manufacturer's spec | P |
| | Unless otherwise stated in this document, the charging procedure for test purposes is carried out in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer | | P |
| | Prior to charging, the battery have been discharged at 20 °C ± 5 °C at a constant current of 0,2 It A down to a specified final voltage | | P |
| 7.1.2 | Second procedure | | N/A |
| | This charging procedure applies only to 7.3.1, 7.3.4, 7.3.5, and 7.3.9 | | N/A |
| | 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 | | N/A |
| **7.2** | **Intended use** | See below. | P |
| 7.2.1 | Continuous charging at constant voltage (cells) | | N/A |
| | 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 | | N/A |
| | Results: No fire. No explosion. No leakage..... : | | N/A |

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|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 7.2.2 | Case stress at high ambient temperature (battery) | Batteries were paced at 70°C ± 2°C for 7 hours. | P |
| | Oven temperature (°C)..... : | 70 ˚C | — |
| | Results: No physical distortion of the battery case resulting in exposure of internal protective components and cells | Compliance checked. | P |
| **7.3** | **Reasonably foreseeable misuse** | | P |
| 7.3.1 | External short-circuit (cell) | | N/A |
| | The cells were tested until one of the following occurred: | | N/A |
| | - 24 hours elapsed; or | | N/A |
| | - The case temperature declined by 20 % of the maximum temperature rise | | N/A |
| | Results: No fire. No explosion..... : | | N/A |
| 7.3.2 | External short-circuit (battery) | See below. | P |
| | The batteries were tested until one of the following occurred: | | P |
| | - 24 hours elapsed; or | | P |
| | - The case temperature declined by 20 % of the maximum temperature rise | | N/A |
| | 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 | | N/A |
| | 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 | | 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 (DQ1~DQ7), RS1~RS10 | P |
| | Results: No fire. No explosion..... : | (See appended table 7.3.2) | P |
| 7.3.3 | Free fall | Comply with dropped three times from a height of 1.0 m onto a concrete floor | P |
| | Results: No fire. No explosion | After testing, no fire or explosion occurred. | P |
| 7.3.4 | Thermal abuse (cells) | | N/A |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Oven temperature (°C) ..... : | N/A | — |
| | Results: No fire. No explosion | | N/A |
| 7.3.5 | Crush (cells) | | N/A |
| | The crushing force was released upon: | | N/A |
| | - The maximum force of 13 kN ± 0,78 kN has been applied; or | | N/A |
| | - An abrupt voltage drop of one-third of the original voltage has been obtained | | N/A |
| | Results: No fire. No explosion ..... : | | N/A |
| 7.3.6 | Over-charging of battery | See below. | 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 | | N/A |
| | - 1,2 times the upper limit charging voltage resented in Table A.1 per cell for series connected multi-cell batteries, and | | P |
| | - 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 | | N/A |
| | - Returned to ambient | | P |
| | Results: No fire. No explosion ..... : | (See appended table 7.3.6) | P |
| 7.3.7 | Forced discharge (cells) | | N/A |
| | If 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 |
| | If 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 | | N/A |
| | Results: No fire. No explosion ..... : | | N/A |
| 7.3.8 | Mechanical tests (batteries) | | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 7.3.8.1 | Vibration | | 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 | | 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) | The EUT is battery type. | N/A |
| | The cells complied with national requirement for..... : | | — |
| | The pressing was stopped upon: | | N/A |
| | - A voltage drop of 50 mV has been detected; or | | — |
| | - The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) has been reached | | N/A |
| | Results: No fire ..... : | | N/A |
| **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 | | 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 | | 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 | | P |
| | Do not allow children to replace batteries without adult supervision | | N/A |
| **8.2** | **Small cell and battery safety information** | Not small battery. | 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 |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - Keep small cells and batteries which are considered swallowable out of the reach of children | | N/A |
| | - 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 EUT is battery pack | 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** | See below | P |
| | Batteries marked as specified in IEC 61960, except for coin batteries | | P |
| | Coin batteries whose external surface area is too small to accommodate the markings on the batteries show the designation and polarity. Batteries also marked with an appropriate caution statement | | N/A |
| | A symbol may be used in place of the appropriate caution statement if the significance of the symbol is explained in the instructions. | A symbol caution on label, and the symbol is explained in the instructions. | P |
| | If the appropriate caution statement is provided in text, it shall be in both English and French. | See instructions | P |
| | Terminals have clear polarity marking on the external surface of the battery | | N/A |
| | Batteries with keyed external connectors designed for connection to specific end products need not be marked with polarity markings if the design of the external connector prevents reverse polarity connections | | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **DV.1 DR** | A symbol may be used in place of the appropriate caution statement if the significance of the symbol is explained in the instructions. | | N/A |
| **DV.2 DR** | If the appropriate caution statement is provided in text, it shall be in both English and French. | | P |
| **9.3** | **Caution for ingestion of small cells and batteries** | No small cell and battery. | N/A |
| | Coin cells and batteries identified as small batteries according to 8.2 include a caution statement regarding the hazards of ingestion in accordance with 8.2 | | N/A |
| | When small cells and batteries are intended for direct sale in consumer-replaceable applications, caution for ingestion given on the immediate package | | N/A |
| **9.4** | **Other information** | | P |
| | Storage and disposal instructions | | P |
| | Recommended charging instructions | | P |
| **10** | **PACKAGING AND TRANSPORT** | | N/A |
| | Packaging for coin cells not small enough to fit within the limits of the ingestion gauge of Figure 3 | | N/A |
| | The materials and packaging design are chosen so as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants | | 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** | | P |
| **A.3** | **Consideration on charging voltage** | | P |
| A.3.1 | General | | P |
| A.3.2 | Upper limit charging voltage | | P |
| A.3.2.1 | General | | P |
| A.3.2.2 | Explanation of safety viewpoint | | N/A |
| A.3.2.3 | Safety requirements, when different upper limit charging voltage is applied | The upper limit charging voltage of the EUT did not exceed 4.25 V / cell | P |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **A.4** | **Consideration of temperature and charging current** | | P |
| A.4.1 | General | | P |
| A.4.2 | Recommended temperature range | | P |
| A.4.2.1 | General | | N/A |
| A.4.2.2 | Safety consideration when a different recommended temperature range is applied | | N/A |
| 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 |
| 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 | | 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** | | N/A |
| A.5.1 | General | | N/A |
| A.5.2 | Insertion procedure for nickel particle to generate internal short | | N/A |
| A.5.3 | Disassembly of charged cell | | N/A |
| A.5.4 | Shape of nickel particle | | N/A |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 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 | | N/A |
| **A.6** | **Experimental procedure of the forced internal short-circuit test** | | N/A |
| A.6.1 | Material and tools for preparation of nickel particle | | N/A |
| A.6.2 | Example of a nickel particle preparation procedure | | N/A |
| A.6.3 | Positioning (or placement) of a nickel particle | | N/A |
| A.6.4 | Damaged separator precaution | | N/A |
| A.6.5 | Caution for rewinding separator and electrode | | N/A |
| A.6.6 | Insulation film for preventing short-circuit | | N/A |
| A.6.7 | Caution when disassembling a cell | | N/A |
| A.6.8 | Protective equipment for safety | | N/A |
| A.6.9 | Caution in the case of fire during disassembling | | N/A |
| A.6.10 | Caution for the disassembling process and pressing the electrode core | | N/A |
| A.6.11 | Recommended specifications for the pressing device | | N/A |

**TEST REPORT**

| UL 62133-2:2020 Ed.1 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **ANNEX B** | **RECOMMENDATIONS TO EQUIPMENT MANUFACTURERS AND BATTERY ASSEMBLERS** | | N/A |
| **ANNEX C** | **RECOMMENDATIONS TO THE END-USERS** | | N/A |
| **ANNEX D** | **MEASUREMENT OF THE INTERNAL AC RESISTANCE FOR COIN CELLS** | | N/A |
| **D.1** | **General** | | N/A |
| **D.2** | **Method** | | N/A |
| | A sample size of three coin cells is required for this measurement..... : | | 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 |

**TEST REPORT**

## Moulded case stress at high ambient temperature (battery) (7.2.2)

**Requirement**

Internal components of batteries shall not be exposed during use at high temperature.
This requirement only applies to batteries with a moulded case.

**METHOD**

Fully charged batteries, according to the first procedure in 7.1.1, are exposed to a moderately high temperature to evaluate case integrity. The battery is placed in an air circulating oven at a temperature of 70 °C ± 2 °C. The batteries remain in the oven for 7 h, after which they are removed and allowed to return to room temperature.

**Result**

| Sample No. | OCV at start of test, (Vdc) | Results |
|---|---|---|
| S250401222 | 57.79 | A |
| S250401223 | 57.55 | A |
| S250401224 | 57.63 | A |

**Supplementary information:**

Results:

A – No warping or physical distortion to the battery case that resulted in exposure of internal components of the battery
B – Warping and/or other physical distortion of the battery case that exposed internal components

**TEST REPORT**

## External short circuit (battery) (7.3.2) (AT 20 °C ± 5 °C)

**Requirement**

Short-circuiting of the positive and negative terminals of the battery pack shall not cause fire or explosion.

**METHOD**

A fully charged battery according to the procedure in 7.1.1 is stored in an ambient temperature of 20 °C ± 5 °C. The battery is then short-circuited by connecting the positive and negative terminals with a total external resistance of 80 mΩ ± 20 mΩ. The battery remains on test for 24 h or until the case temperature of battery declines by 20 % of the maximum temperature rise, whichever is the sooner. However, in case of a rapid decline in the short-circuit current, the battery should remain on test for an additional one hour after the current reaches a low end steady state condition. This typically refers to a condition where the per cell voltage (series cells only) of the battery is below 0,8 V and is decreasing by less than 0,1 V in a 30-min period.

A single fault in the discharge protection circuit should be conducted on one to four (depending upon the protection circuit) of the five samples before conducting the shortcircuit test. A single fault applies to protective component parts such as MOSFET (metal oxide semiconductor field-effect transistor), fuse, thermostat or positive temperature coefficient (PTC) thermistor.

NOTE Examples of single fault conditions in the discharge protection circuit can include shorting over a discharge MOSFET or over a fuse or other protection device. Protection devices found to meet the requirements of applicable component standards such as those outlined in Annex F or electronics circuits evaluated for functional safety are not subject to single fault conditions.

**Result**

| 7.3.2 | TABLE: External short circuit (battery) | | | | | P |
|---|---|---|---|---|---|---|
| **Sample No.** | **Ambient, (°C) 20 °C ± 5 °C** | **OCV at start of test, (Vdc)** | **Resistance of circuit, (Ω)** 80 mΩ ± 20 mΩ | **Maximum case temperature rise ΔT, (°C)** | **Component single fault condition** | **Results** |
| S250401225 | 22.8 | 57.70 | 94.38 | 0.8 | Normal | NF, NE, NL |
| S250401226 | 22.2 | 57.61 | 95.64 | 0.7 | SC RS1~RS10 | NF, NE, NL |
| S250401227 | 22.2 | 57.58 | 94.89 | 0.7 | SC RS1~RS10 | NF, NE, NL |
| S250401228 | 22.9 | 57.72 | 94.34 | 0.7 | SC DQ1~DQ7 | NF, NE, NL |
| S250401229 | 22.9 | 57.71 | 95.68 | 1.2 | SC DQ1~DQ7 | NF, NE, NL |

## TEST REPORT

**Supplementary information:**

- No fire (NF) - No explosion (NE) - No leakage (NL)
- Leakage - Fire - Explosion - Bulge
- Others (please explain): “SC” means short circuit.

Stop condition:

[X] A:The test was completed after 24 h

[ ] B:The test was completed after the cell casing cooled to 20% of the maximum temperature rise (Test time by hour)

**TEST REPORT**

## Free fall (7.3.3)

**Requirement**

Dropping a cell or battery (for example, from a bench top) shall not cause fire or explosion.

**METHOD**

Free fall test is conducted at an ambient temperature of 20 °C ± 5 °C, by using cells or batteries that are charged to a fully charged state, in accordance with the first procedure in 7.1.1.

Each cell or battery is dropped three times from a height of 1,0 m onto a flat concrete floor or metal floor.

The cells or batteries are dropped so as to obtain impacts in random orientations.

After the test, the cell or battery shall be put on rest for a minimum of 1 h and then a visual inspection shall be performed.

**Result**

| Sample No. | OCV at start of test, (Vdc) | Results |
|---|---|---|
| S250401222 | 57.78 | NF, NE, NL |
| S250401223 | 57.55 | NF, NE, NL |
| S250401224 | 57.62 | NF, NE, NL |

**Supplementary information:**

- No fire (NF) - No explosion (NE) - No leakage (NL)
- Leakage - Fire - Explosion - Bulge
- Others (please explain)

**TEST REPORT**

## Over-charging of battery (7.3.6)

**Requirement**

Charging for longer periods than specified by the manufacturer shall not cause fire or explosion

**METHOD**

shall be discharged at a constant current of 0,2 It A, to a final discharge voltage specified by the manufacturer. Sample batteries shall then be charged at a constant current of 2,0 It A, using a supply voltage which is:
• **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
• **1.2 times** the upper limit charging voltage presented in Table A.1 per cell for series connected multi-cell batteries, and
• sufficient to maintain a current of **2,0 It A** throughout the duration of the test or until the supply voltage is reached.
A thermocouple shall be attached to each test battery.
For batteries with a case, the temperature shall be measured on the battery case. The test shall be continued until the temperature of the outer case reaches steady state conditions (less than 10 °C change in a 30-min period) or returns to ambient.

**Result**

| 7.3.6 | TABLE: Over-charging of battery | | | P |
|---|---|---|---|---|
| Constant charging current (A) .....: | | 19.6 (9800mAh*2) | | — |
| Supply voltage (Vdc).....: | | 71.4 (4.25V*14*1.2) | | — |

| Sample No. | OCV before charging, (Vdc) | Total charging time (minute) | Maximum outer casing temperature, (°C) | Results |
|---|---|---|---|---|
| S250401230 | 46.170 | 105 | 24.6 | NF, NE, NL |
| S250401231 | 44.017 | 105 | 34.4 | NF, NE, NL |
| S250401232 | 44.54 | 105 | 24.8 | NF, NE, NL |
| S250401233 | 45.132 | 105 | 25.5 | NF, NE, NL |
| S250401234 | 45.017 | 105 | 26.2 | NF, NE, NL |

**Supplementary information:**

- No fire (NF) - No explosion (NE) - No leakage (NL)
- Leakage - Fire - Explosion - Bulge
- Others (please explain)

Stop condition:
[ ] A: The test is continued until the temperature of the outer casing reaches steady state conditions (less than 10 °C change in 30-minute period)
[X] B: The test is continued until the temperature of the outer casing returns to ambient

**TEST REPORT**

# *Vibration (7.3.8.1)*

**Requirement**

Vibration encountered during transportation and use shall not cause leakage, fire or explosion.

**METHOD**

Test batteries, fully charged in accordance with the charging procedure of 7.1.1, shall be firmly secured to the platform of the vibration machine without distorting them in such a manner as to faithfully transmit the vibration. Test batteries shall be subjected to sinusoidal vibration according to Table 3. This cycle shall be repeated 12 times for a total of approximately 3 h for each of three mutually perpendicular mounting positions. One of the directions shall be perpendicular to the terminal face.

**Table 3 – Conditions for vibration test**

| Frequency range (Hz) | | Amplitudes | Duration of logarithmic sweep cycle (7 Hz – 200 Hz – 7 Hz) | Axis | Number of cycles |
|---|---|---|---|---|---|
| from | to | | | | |
| $f_1$ = 7 Hz | $f_2$ | A1 = 1 $g_n$ | Approximately 15 min | X | 12 |
| $f_2$ | $f_3$ | S = 0,8 mm | | Y | 12 |
| $f_3$ | $f_4$ = 200 Hz | A2 | | Z | 12 |
| and back to $f_1$ = 7Hz | | | | Total | 36 |

NOTE Vibration amplitude is the maximum absolute value of displacement or acceleration. For example, a displacement amplitude of 0,8 mm corresponds to a peak-to-peak displacement of 1,6 mm.

Key

$f_1$, $f_4$ lower and upper frequency

$f_2$, $f_3$ cross-over frequencies
- $f_2$ = 17,62 Hz
- $f_3$ = 49,84 Hz

A1, A2 acceleration amplitude
- A2 = 8 $g_n$

S displacement amplitude

**Result**

| 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** |
| S250401222 | 57.7 | 57.8 | 2690 | 2690 | NF, NE, NR, NL, NV |
| S250401223 | 57.5 | 57.7 | 2675 | 2675 | NF, NE, NR, NL, NV |
| S250401224 | 57.6 | 57.8 | 2680 | 2680 | NF, NE, NR, NL, NV |

**Supplementary information:**

- No fire (NF) - No explosion (NE) - No rupture (NR) - No leakage (NL) - No venting (NV)
- Fire - Explosion - Rupture - Leakage - Venting
- Others (please explain)

**TEST REPORT**

# *Mechanical shock (7.3.8.2)*

**Requirement**

Shock encountered during transportation and use shall not cause leakage, fire or explosion. This test simulates rough handling during transport and use.

**METHOD**

Test batteries, fully charged in accordance with the charging procedure of 7.1.1, shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery. Each test battery shall be subjected to three shocks in each direction of three mutually perpendicular mounting positions of the battery for a total of 18 shocks. For each shock, the parameters given in Table 4 shall be applied.

**Table 4 – Shock parameters**

| | Waveform | Peak acceleration | Pulse duration | Number of shocks per half axis |
|---|---|---|---|---|
| Batteries | Half sine | 150 $g_n$ | 6 ms | 3 |

**Result**

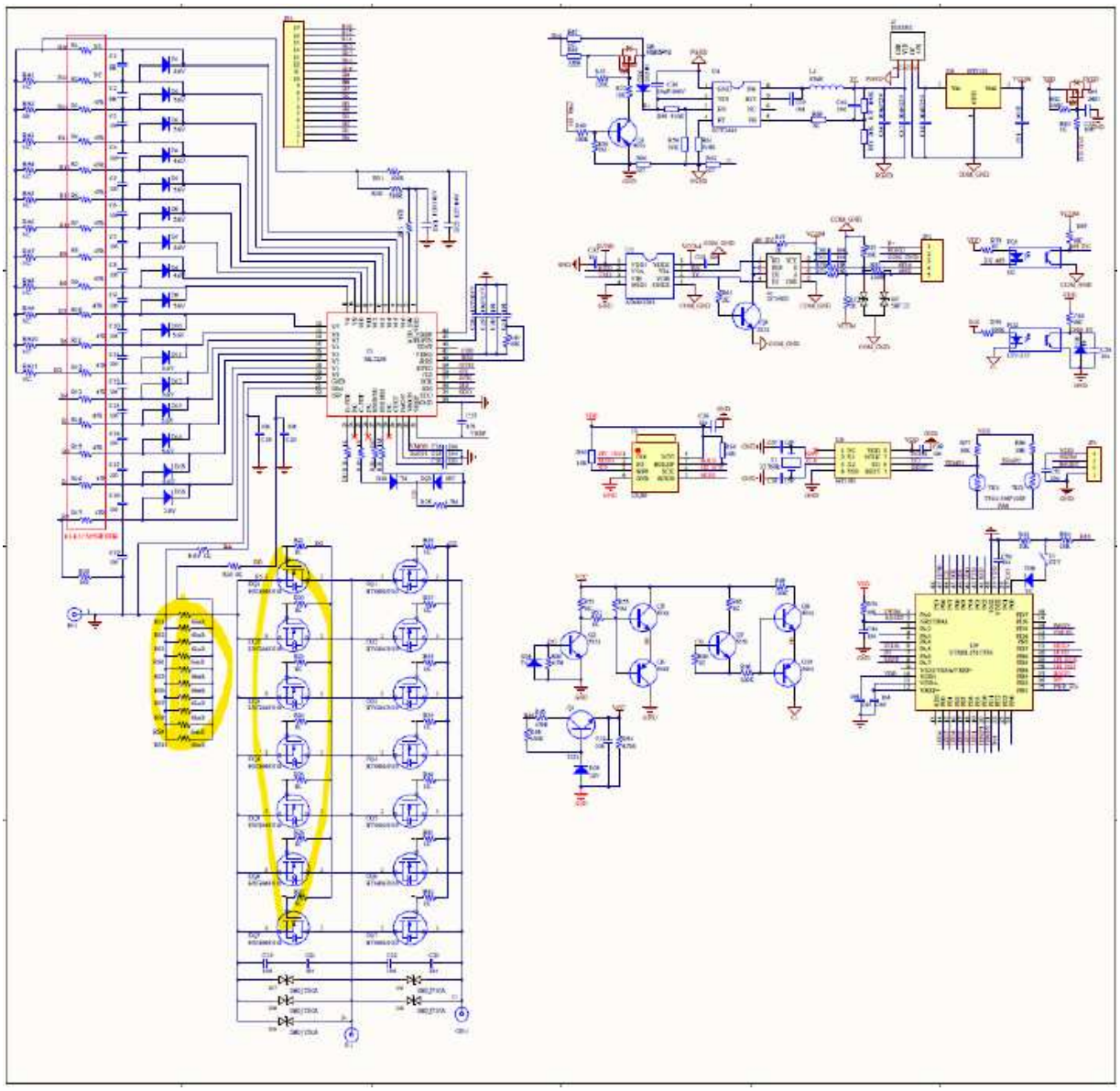
| 7.3.8.2 | TABLE: Mechanical shock | | | | P |
|---|---|---|---|---|---|
| **Sample no.** | **OCV before test (Vdc)** | **OCV after test (Vdc)** | **Mass before test (g)** | **Mass after test (g)** | **Results** |
| S250401222 | 57.81 | 57.79 | 2695 | 2695 | NF, NE, NR, NL, NV |
| S250401223 | 57.71 | 57.55 | 2675 | 2675 | NF, NE, NR, NL, NV |
| S250401224 | 57.89 | 57.63 | 2680 | 2680 | NF, NE, NR, NL, NV |

**Supplementary information:**

- No fire (NF) - No explosion (NE) - No rupture (NR) - No leakage (NL) - No venting (NV)
- Fire - Explosion - Rupture - Leakage - Venting
- Others (please explain)

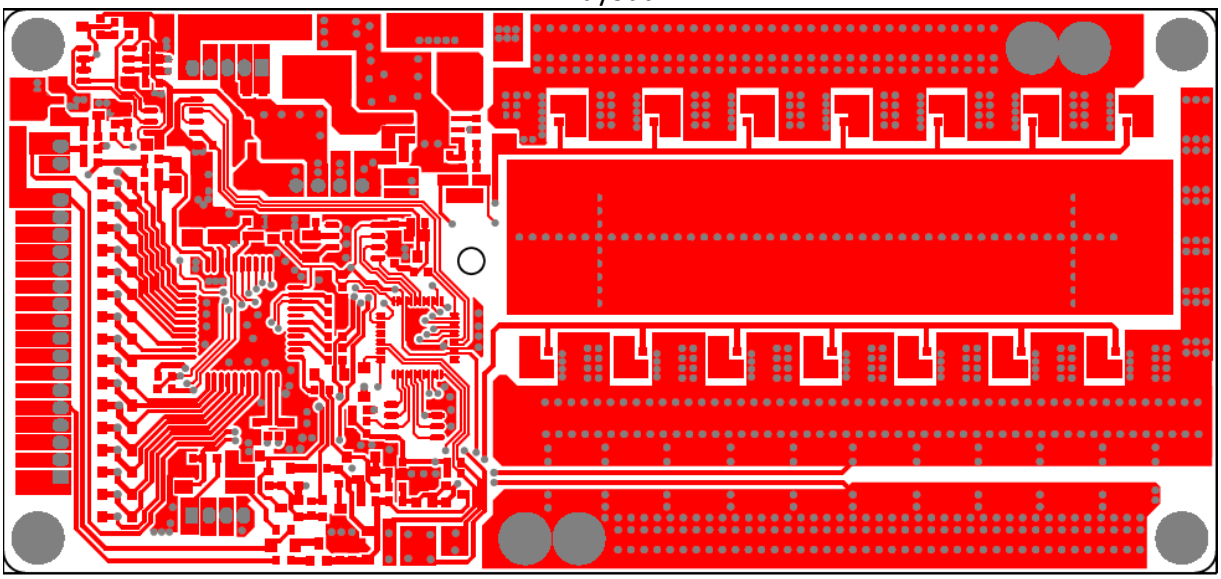
**TEST REPORT**

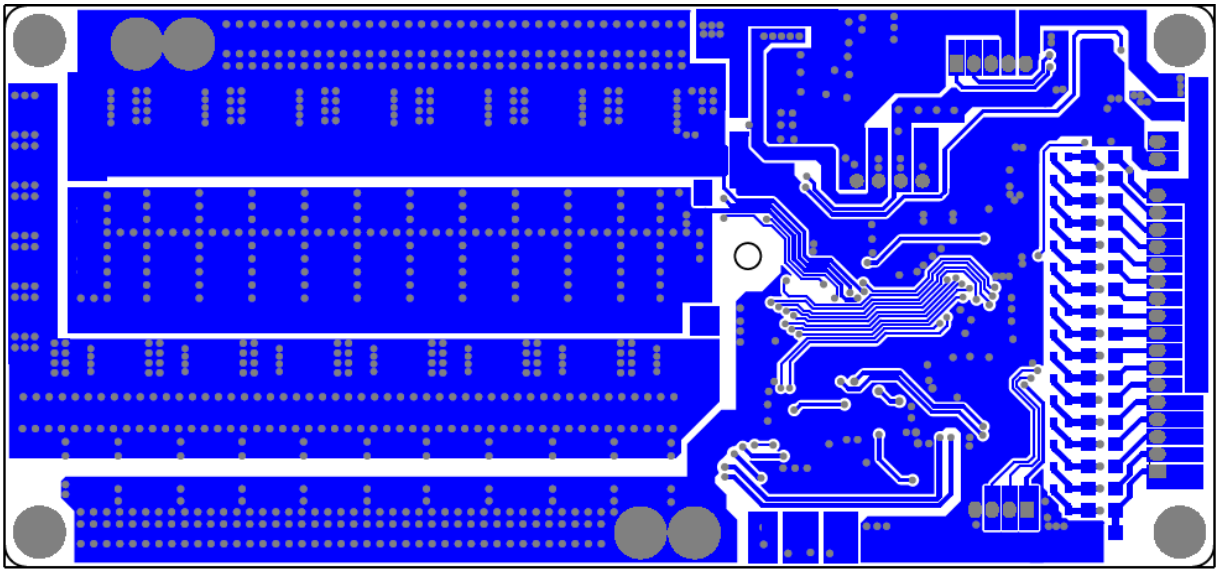
Circuit



**TEST REPORT**

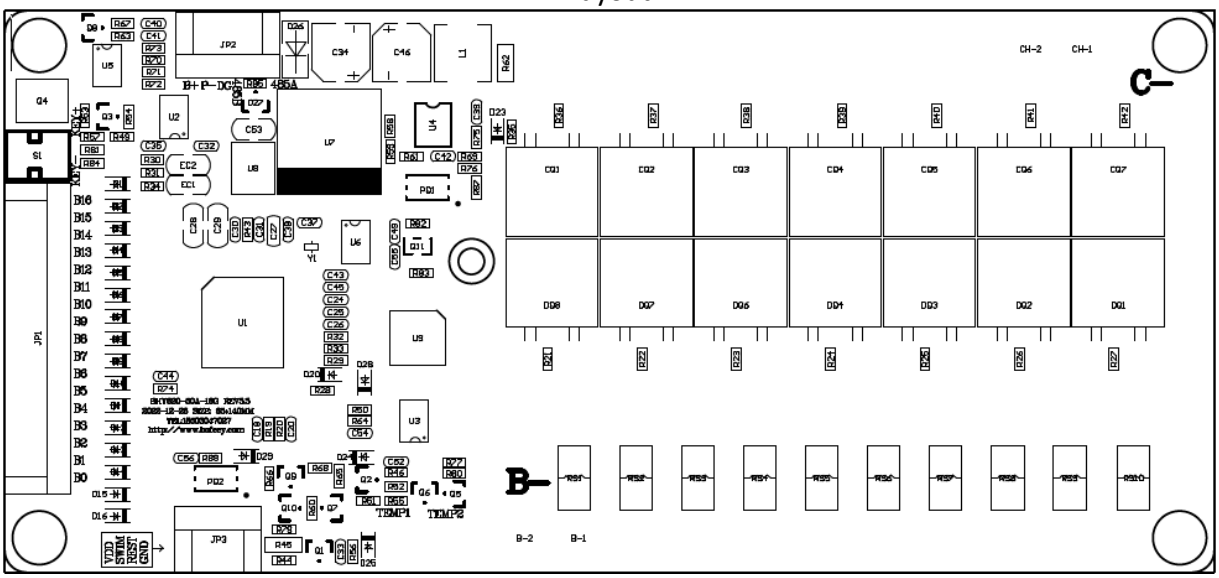
Layout

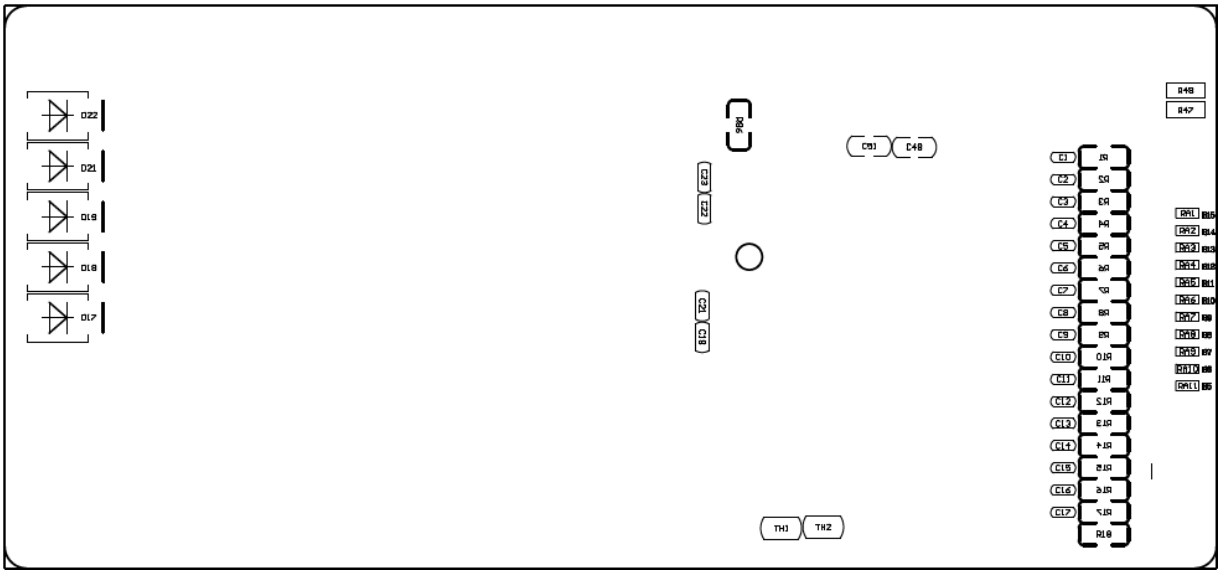




**TEST REPORT**

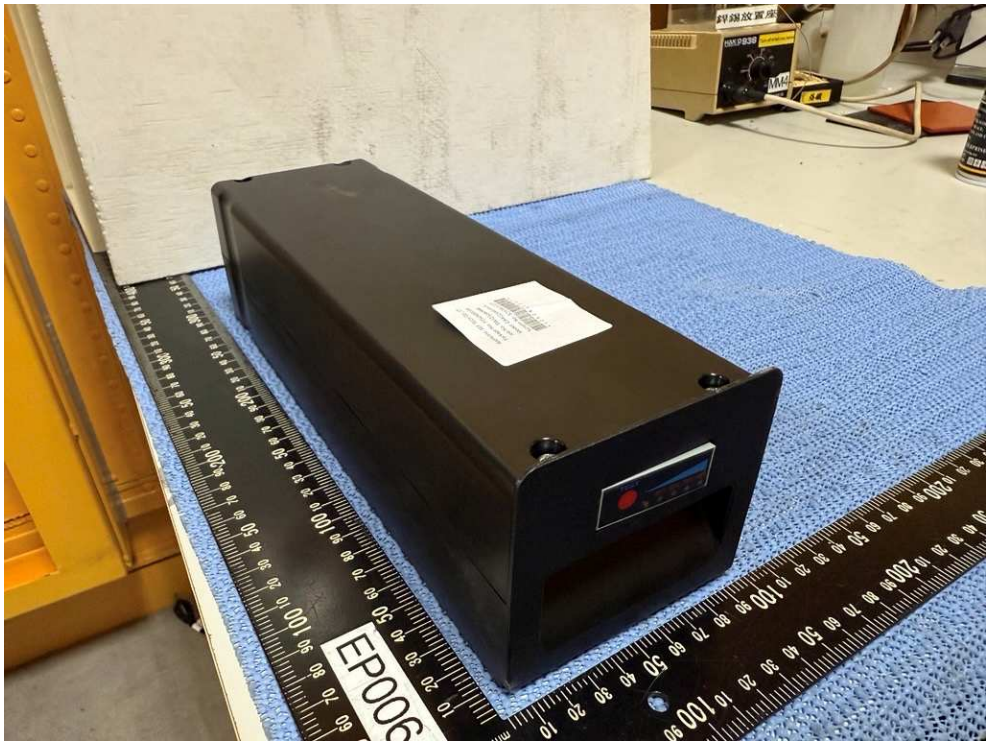
Layout





**TEST REPORT**

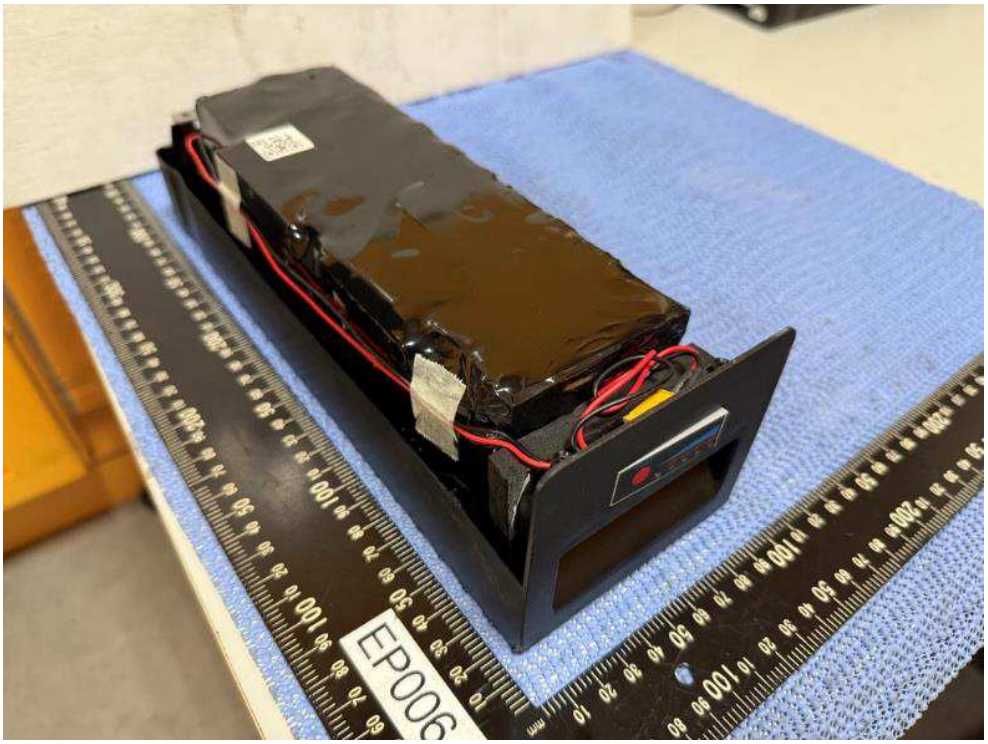
External view of EUT




**TEST REPORT**

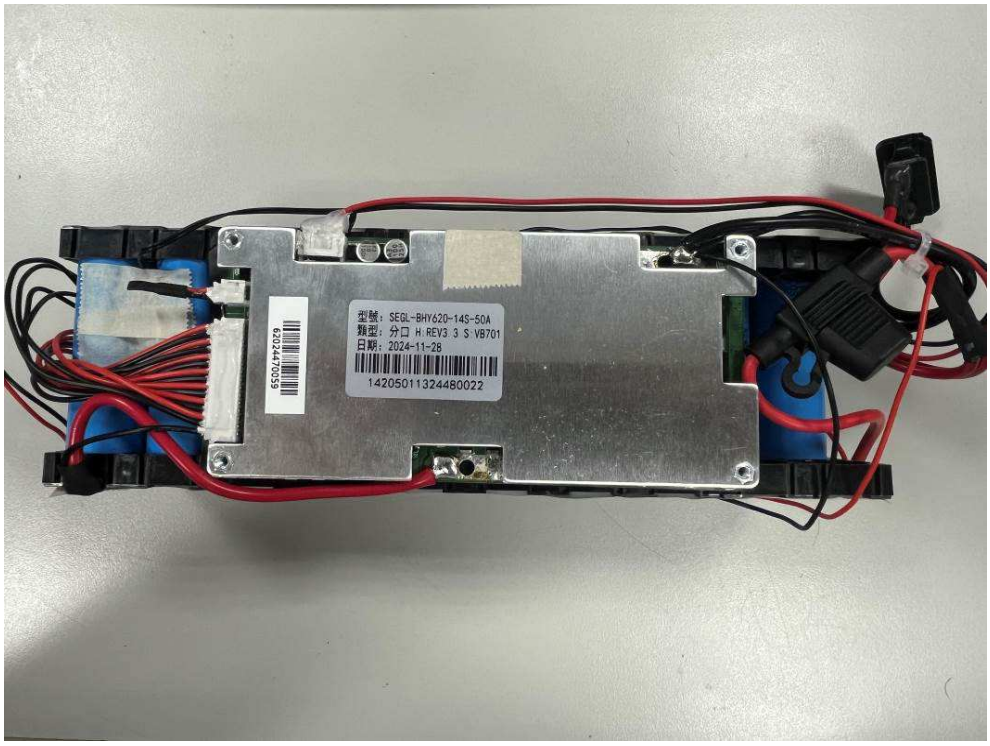
External view of EUT (connector)


Internal view of EUT



**TEST REPORT**

Internal view of EUT




Internal view of EUT