天 溯 Tian Su

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TESTING
CNAS L5138

# TEST REPORT
# IEC 62619
# Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications

| | |
|---|---|
| **Report Number.....:** | TSZ22020059-P01-R01 |
| **Date of issue.....:** | 2022-04-08 |
| **Total number of pages.....** | 18 |

| | |
|---|---|
| **Name of Testing Laboratory preparing the Report.....:** | Shenzhen Tiansu Calibration and Testing Co., Ltd. |
| **Applicant's name.....:** | MUST ENERGY (GUANGDONG) TECHNOLOGY CO.,LTD |
| **Address.....:** | 1-5F, 7F, 9F, 10F of No.8 building, No.115, Zhangcha Road 1, Chancheng district, Foshan city, Guangdong Province, P.R. China |
| **Test specification:** | |
| **Standard.....:** | IEC 62619: 2017 |
| **Non-standard test method.....:** | N/A |

**General disclaimer:**

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

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| | |
|---|---|
| **Test item description.....:** | LiFePo4 BATTERY PACK |
| **Trade Mark.....:** | MUST |
| **Manufacturer.....:** | Same as Applicant' s |
| **Model/Type reference.....:** | LP18-48100 |
| **Ratings.....:** | 51.2V, 100Ah, 5.12kWh |

**Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):**

| | | |
|---|---|---|
| ☒ | **Testing Laboratory:** | Shenzhen Tiansu Calibration and Testing Co.,Ltd. |
| **Testing location/ address.....:** | | B/1,4, NO.2 Jinlong Road, Longgang District, Shenzhen, China |
| **Tested by (name, function, signature).....:** | | Dove Fan<br>\Test Engineer |
| **Approved by (name, function, signature)...:** | | Duan Jiangtao<br>\Technology supervisor |

SHENZHEN TIANSU CALIBRATION AND TESTING CO.,LTD. Report Seal (01-01)

| **Summary of testing:** | |
|---|---|
| **Tests performed (name of test and test clause):**<br>7.2.1 External short-circuit test (cell or cell block)<br>7.2.2 Impact test (cell or cell block)<br>7.2.3 Drop test (cell or cell block, and battery system)<br>7.2.6 Forced discharge test (cell or cell block)<br>7.3.2 Internal short-circuit test (cell)<br>8.2.2 Overcharge control of voltage (battery system)<br>8.2.3 Overcharge control of current (battery system)<br>8.2.4 Overheating control (battery system) | **Testing location:**<br>Shenzhen Tiansu Calibration and Testing Co.,Ltd<br>B/1,4, NO.2 Jinlong Road, Longgang District, Shenzhen, China |

**Copy of marking plate:**

**The artwork below may be only a draft.**


Battery Pack label

| | |
|---|---|
| **Test item particulars..... :** | |
| **Classification of installation and use.....:** | -- |
| **Supply Connection.....:** | Specified connector |
| **Possible test case verdicts:** | |
| **- test case does not apply to the test object.....:** | N/A |
| **- test object does meet the requirement.....:** | P (Pass) |
| **- test object does not meet the requirement.....:** | F (Fail) |
| **Testing..... :** | |
| **Date of receipt of test item.....:** | 2022-03-02 |
| **Date (s) of performance of tests.....:** | 2022-03-04 to 2022-03-24 |

**General remarks:**

"(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.**

**Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:**

| | |
|---|---|
| The application includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... : | ☐ **Yes**<br>☒ **Not applicable** |

**When differences exist; they shall be identified in the General product information section.**

**Name and address of factory (ies).....:** Same as applicant

**General product information and other remarks:**

The battery pack consists of 16 battery module in series, and has overcharge, over-discharge, over current, short-circuit and over temperature proof circuit.

The product covered by this report is Rechargeable LiFePo4 BATTERY PACK mainly composed of:

-Battery Modules (consists of 16 cells in 16S1P)
-Metal Shell
-Fixed Bead
-BMS PWB
-Wire
-Charge and Discharge Connector

The main features of the battery pack are shown as below:

| Model | Nominal capacity | Nominal voltage | Nominal Charge Current | Nominal Discharge Current | Maximum Charge Current | Maximum Discharge Current | Maximum Charge Voltage | Final Voltage |
|---|---|---|---|---|---|---|---|---|
| LP18-48100 | 100Ah | 51.2V | 20A | 50A | 50A | 100A | 57.6V | 44.0V |

The main features of the cell are shown as below:

| Model | Nominal capacity | Nominal voltage | Nominal Charge Current | Nominal Discharge Current | Maximum Charge Current | Maximum Discharge Current | Maximum Charge Voltage | Final Voltage |
|---|---|---|---|---|---|---|---|---|
| IFP48173115 | 100Ah | 3.2V | 20A | 50A | 50A | 100A | 3.65V | 2.0V |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **4** | **PARAMETER MEASUREMENT TOLERANCES** | | P |
| | Parameter measurement tolerances | | P |
| **5** | **GENERAL SAFETY CONSIDERATIONS** | | P |
| **5.1** | **General** | | P |
| | Cells and batteries are safe under conditions of both intended use and reasonably foreseeable misuse.. : | | P |
| **5.2** | **Insulation and wiring** | | P |
| | Voltage, current, altitude, and humidity requirements | | P |
| | Adequate clearances and creepage distances between connectors | | P |
| | The mechanical integrity of internal connections | | P |
| **5.3** | **Venting** | | P |
| | Pressure relief function | Vent design in cell. | P |
| | Encapsulation used to support cells within an outer casing | | P |
| **5.4** | **Temperature/voltage/current management** | | P |
| | The design prevents abnormal temperature-rise | Overcharge, over discharge, over current and short-circuit proof circuit used in this battery. See tests of clause 8 | P |
| | Voltage, current, and temperature limits of the cells | See above. | P |
| | Specifications and charging instructions for equipment manufacturers | The charging limits specified in the manufacturer's specification. | P |
| **5.5** | **Terminal contacts of the battery pack and/or battery system** | | P |
| | Polarity marking(s) | | N/A |
| | Capability to carry the maximum anticipated current | Complied, DC Connector | P |
| | External terminal contact surfaces | See above. | P |
| | Terminal contacts are arranged to minimize the risk of short circuits | | P |
| **5.6** | **Assembly of cells, modules, or battery packs into battery systems** | | P |
| 5.6.1 | General | | P |
| | Independent control and protection method(s) | | P |
| | Recommendations of cell operating limits by the cell manufacturer | | P |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Batteries designed for the selective discharge of a portion of their series connected cells | | N/A |
| | Protective circuit component(s) and consideration to the end-device application | | N/A |
| 5.6.2 | Battery system design | | P |
| | The voltage control function | | P |
| | The voltage control for series-connected batteries | | P |
| **5.7** | **Operating region of lithium cells and battery systems for safe use** | | P |
| | The cell operating region.....: | -10°C to 60°C | P |
| | Designation of battery system to comply with the cell operating region | 0°C to 50°C | P |
| **5.8** | **Quality plan** | | N/A |
| | Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented..... : | Relevant document did not provided. | N/A |
| | The process capabilities and the process controls | | N/A |
| **6** | **TYPE TEST CONDITIONS** | | P |
| **6.1** | **General** | | P |
| **6.2** | **Test items** | | P |
| | Cells or batteries that are not more than six months old (See Table 1 of IEC62619) | | P |
| | Capacity confirmation of the cells or batteries | | P |
| | Default ambient temperature of test, 25 °C ± 5 °C | | P |
| **7** | **SPECIFIC REQUIREMENTS AND TESTS** | | P |
| **7.1** | **Charging procedure for test purposes** | | P |
| | The battery discharged to a specified final voltage prior to charging | | P |
| | The cells or batteries charged using the method specified by the manufacturer.....: | Charging the battery with 20A constant current and 57.6V constant voltage until the current reduces to 2A at ambient 25 °C ± 5 °C. | P |
| **7.2** | **Reasonably foreseeable misuse** | | P |
| 7.2.1 | External short-circuit test (cell or cell block) | | P |
| | Short circuit with total resistance of 30 mΩ ± 10 mΩ at 25 °C ± 5 °C | | P |
| | Results: no fire, no explosion | | P |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 7.2.2 | Impact test (cell or cell block) | | P |
| | Cylindrical cell, longitudinal axis impact | | P |
| | Prismatic cell, longitudinal axis and lateral axis impact | | P |
| | Results: no fire, no explosion. | | P |
| 7.2.3 | Drop test (cell or cell block, and battery system) | Cell tested.<br>Battery Pack tested. | P |
| 7.2.3.1 | General | | P |
| 7.2.3.2 | Whole drop test (cell or cell block, and battery system) | | P |
| | Description of the Test Unit.....: | Cell | — |
| | Mass of the test unit (kg)..... : | 2.03kg for cell | — |
| | Height of drop (m)..... : | 1.0 | — |
| | Results: no fire, no explosion | | P |
| 7.2.3.3 | Edge and corner drop test (cell or cell block, and battery system) | Battery Pack tested. | P |
| | Description of the Test Unit.....: | Battery Pack | — |
| | Mass of the test unit (kg)..... : | 44.3kg for battery module | — |
| | Height of drop (m)..... : | 0.1 | — |
| | Results: no fire, no explosion | | P |
| 7.2.4 | Thermal abuse test (cell or cell block) | | P |
| | Results: no fire, no explosion | | P |
| 7.2.5 | Overcharge test (cell or cell block) | | P |
| | For those battery systems that are provided with only a single protection for the charging voltage control | | — |
| | Results: no fire, no explosion.....: | | P |
| 7.2.6 | Forced discharge test (cell or cell block) | | P |
| | Upper limit charge voltage of the cell.....: | 3.65V | P |
| | Cells connected in series in the battery system..... : | | N/A |
| | Redundant or single protection for discharge voltage control provided in battery system..... : | | N/A |
| | Target Voltage..... : | -3.65V | P |
| | Maximum discharge current of the cell, $I_m$..... : | 100A | P |
| | Discharge current for forced discharge, 1.0 It.....: | 100A | P |
| | Discharging time, t = (1 It / $I_m$ ) x 90 (min.)..... : | 90min | P |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Results: no fire, no explosion.....: | | P |
| **7.3** | **Considerations for internal short-circuit – Design evaluation** | | P |
| 7.3.1 | General | | P |
| 7.3.2 | Internal short-circuit test (cell) | | P |
| | Samples preparation procedure:<br>a), in accordance with 8.3.9 of IEC62133:2012; or<br>b), the nickel particle inserted before charging, or<br>c), the nickel particle was inserted before electrolyte filling.....: | | P |
| | Tested according to Cl. 8.3.9 of IEC 62133:2012 test method, except all tests were carried out in an ambient temperature of 25 °C ± 5 °C. | | P |
| | The appearance of the short-circuit location recorded by photograph or other means..... : | | — |
| | The pressing was stopped<br>- When a voltage drop of 50 mV was detected; or | | N/A |
| | - The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) was reached | 400N for prismatic cells. | P |
| | Results: no fire, no explosion.....: | | P |
| **7.3.3** | **Propagation test (battery system)** | | N/A |
| | Method to create a thermal runaway in one cell .... : | | N/A |
| | Results: No external fire from the battery system or no battery case rupture.....: | | N/A |
| **8** | **BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)** | | P |
| **8.1** | **General requirements** | | N/A |
| | Functional safety analysis for critical controls | | N/A |
| | Conduct of a process hazard, risk assessment and mitigation of the battery system | | N/A |
| **8.2** | **Battery management system (or battery management unit)** | | P |
| 8.2.1 | Requirements for the BMS | | P |
| | The safety integrity level (SIL) target of the BMS | | N/A |
| | The charge control evaluated by tests in clauses 8.2.2 to 8.2.4 | | P |
| 8.2.2 | Overcharge control of voltage (battery system) | | P |
| | The exceeded charging voltage applied to the whole battery system | | P |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | The exceeded charging voltage applied to only a part of the battery system, such as the cell(s)..... : | | P |
| | Results: no fire, no explosion.....: | See Table 8.2.2. | P |
| | The BMS interrupted the overcharging before reaching 110% of the upper limit charging voltage | | P |
| 8.2.3 | Overcharge control of current (battery system) | | P |
| | Results: no fire, no explosion.....: | See Table 8.2.3 | P |
| | The BMS detected the overcharging current and controlled the charging to a level below the maximum charging current | | P |
| 8.2.4 | Overheating control (battery system) | | P |
| | The cooling system, if provided, was disconnected | | P |
| | Elevated temperature for charging, 5 °C above maximum operating temperature..... : | Maximum operating temperature is 50°C. | P |
| | Results: no fire, no explosion.....: | See Table 8.2.4 | P |
| | The BMS detected the overheat temperature and terminated charging | | P |
| | The battery system operated as designed during test | | P |
| **9** | **INFORMATION FOR SAFETY** | | P |
| | The cell manufacturer provides information about current, voltage and temperature limits of their products | Information for safety mentioned in manufacturer's specifications. | P |
| | The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users. | Information is given in manufacturer's specifications. | P |
| **10** | **MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)** | | N/A |
| | The marking items shown in Table 1 in IEC 62620 indicated on the cell, battery system or instruction manual. | | N/A |
| | Cell or battery system has clear and durable markings | | N/A |
| | Cell designation | | N/A |
| | Battery designation | | N/A |
| | Battery structure formulation | | N/A |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | | | |
|---|---|---|---|
| **ANNEX A** | **OPERATING REGION OF CELLS FOR SAFE USE** | | P |
| A.1 | General | | P |
| A.2 | Charging conditions for safe use | Cell charge temperature range: 0~50°C,<br>Battery pack charge temperature range: 0~50°C | P |
| A.3 | Consideration on charging voltage | | P |
| A.4 | Consideration on temperature | | P |
| A.5 | High temperature range | 50°C | P |
| A.6 | Low temperature range | 0°C | P |
| A.7 | Discharging conditions for safe use | | P |
| A.8 | Example of operating region | | P |

| | | | |
|---|---|---|---|
| **ANNEX B** | **PROCEDURE OF 7.3.3 PROPAGATION TEST** | | N/A |
| B.1 | General | | N/A |
| B.2 | Test conditions: | | N/A |
| | – The battery fully charged according to the manufacturer recommended conditions.....: | | — |
| | – Target cell forced into thermal runaway.....: | | — |
| | – A specially prepared sample (e.g. a heater or a hole for nail penetration provided) used for ease of testing..... : | | — |
| B.3 | Method used for initiating the thermal runaway.<br>1) Heater (Heater, Burner, Laser, Inductive heating<br>2) Overcharge<br>3) Nail penetration of the cell<br>4) Combination of above methods<br>5) Other methods..... : | | — |

| | | | |
|---|---|---|---|
| **ANNEX C** | **PACKAGING** | | P |
| | The materials and pack design chosen in such a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants | | |

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| 5.1 | TABLE: Critical components information | | | | P |
|---|---|---|---|---|---|
| **Object/part no.** | **Manufacturer/ trademark** | **Type/model** | **Technical data** | **Standard** | **Mark(s) of conformity [1)]** |
| Cell | JIANGXI ANCHI NEW ENERGY TECHNOLO CO., LTD | IFP48173115-100Ah | 3.2V, 100Ah, 320Wh | IEC 62619: 2017 | Tested with appliance |
| PCB | GLOBAL SUCCESS CIRCUITS CO LTD | SCS-M | V-0, 130°C | -- | Tested with appliance |
| IC (UM1) | HUADA SEMICONDUCTOR Co., Ltd | HC32F460PETB | $V_{CU}$: 3.60±0.08V, $V_{DL}$: 1.65±0.02V | -- | Tested with appliance |
| MOSFET (QP1 to QP24) | MAGNACHIP Co., Ltd | MDE10N026 | $V_{DS}$: 100V, $V_{GS}$: 1.65±0.02V, $T_{opr}$: -40°C to 85°C | -- | Tested with appliance |
| PTC (R308) | ShenZhen JinRui Electronic Material Co.,Ltd | JK-nSMD005 | $I_h$: 0.05A, $I_t$: 0.15A, $V_{max}$: 60V, Operating Temperature: -40°C to 85°C | -- | Tested with appliance |
| Fuse (R253) | Shenzhen liangsheng electronics Co., LTD | 12h1400C | Rated voltage: 63V, Rated current: 4A, Off current: 50A | -- | Tested with appliance |
| NTC (RT2) | Shenzhen Sunlord Electronics Co., Ltd. | SDNT1608X103F 3435FTF | 10KΩ±1% at 25°C, B25/85=3435K±1% | -- | Tested with appliance |

**Supplementary information:**

[1)] Provided evidence ensures the agreed level of compliance. See OD-2039.

Some of the above component information cannot be provided due to the customer's commercial secrets.

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| 7.2.1 | TABLE: External short-circuit test (cell or cell block) | | | | P |
|---|---|---|---|---|---|
| **Sample No.** | **Ambient (at 25°C ± 5ºC)** | **OCV at start of test (V dc)** | **Resistance of Circuit (mΩ)** | **Maximum Case Temperature Rise ΔT (°C)** | **Results** |
| C01# | 23.4 | 3.467 | 35 | 37.9 | A, E |
| C02# | 23.4 | 3.462 | 37 | 39.0 | A, E |

**Supplementary information:**

A - No fire or Explosion
B - Fire
C - Explosion
D - The test was completed after 6 h
E - The test was completed after the cell casing cooled to 20% of the maximum temperature rise
F - Other (Please explain):___

| 7.2.6 | TABLE: Forced discharge test (cell or cell block) | | | | P |
|---|---|---|---|---|---|
| **Sample No.** | **OCV before applying reverse charge, (V dc)** | **Target Voltage (V dc)** | **Measured Reverse Charge Current It, (A)** | **Total Time for Reversed Charge Application (min)** | **Results** |
| C11# | 3.021 | 3.65 | 100 | 90 | A |
| C12# | 3.027 | 3.65 | 100 | 90 | A |

**Supplementary information:**

Results:
A - No fire or Explosion
B - Fire
C - Explosion
D - Other (Please explain): ___

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| 7.3.2 | TABLE: Internal short-circuit test (cell) | | | P |
|---|---|---|---|---|
| **Sample No.** | **OCV at start of test, (V dc)** | **Particle location [1)]** | **Maximum applied pressure, (N)** | **Results** |
| C13# | 3.462 | 1 | 400 | A, E |
| C14# | 3.467 | 1 | 400 | A, E |
| C15# | 3.466 | 1 | 400 | A, E |
| C16# | 3.469 | 1 | 400 | A, E |
| C17# | 3.461 | 1 | 400 | A, E |
| C18# | 3.346 | 1 | 400 | A, E |
| C19# | 3.349 | 1 | 400 | A, E |
| C20# | 3.348 | 1 | 400 | A, E |
| C21# | 3.351 | 1 | 400 | A, E |
| C22# | 3.341 | 1 | 400 | A, E |

**Supplementary information:**
[1)] Identify one of the following**:**
1: Nickel particle inserted between positive and negative (active material) coated area.
2: Nickel particle inserted between positive aluminium foil and negative active material coated area.
**No location 2 exists.**
**Results:**
A - No fire or explosion
B – Fire
C - Explosion
D – Test concluded when 50 mV voltage drop occurred prior to reaching force limit
E – Test concluded when 400 N pressure was reached and 50 mV voltage drop was not achieved
F – Test was concluded when fire or explosion occurred
G - Other (Please explain): __

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| 7.3.3 | TABLE: Propagation test (battery system) | | | | N/A |
|---|---|---|---|---|---|
| **Sample No.** | **OCV of Battery System Before Test, (V dc)** | **OCV of Target Cell Before Test, (V dc)** | **Maximum Cell Case Temperature, (°C)** | **Maximum DUT Enclosure Temperature, (°C)** | **Results** |
| | | | | | |
| **Method of cell failure 1)** | | **Location of target cell** | | **Area for fire protection ($m^2$)** | |
| | | | | | |
| **Supplementary information:** | | | | | |

| 8.2.2 | TABLE: Overcharge control of voltage (battery system) | | | | P |
|---|---|---|---|---|---|
| **Sample No.** | **OCV at start of test for Cell/Cell Blocks, (V dc)** | **Maximum Charging Current, (A)** | **Max. Charging Voltage, (V dc)** | **Max. Voltage of Cell/Cell Blocks, (V dc)** | **Results** |
| B03# | 47.226 | 50 | 63.36 | 3.65 | A, D, F |
| B04# | 47.341 | 50 | 63.36 | 3.65 | A, D, F |
| | | | **Charge Voltage Applied Battery System: 1)** | | |
| | | | **Whole** | **Part** | |
| | | | Yes | No | |

**Supplementary information:**

1. The exceeded voltage can be applied to only a part of the system such as the cell(s) in the battery system per Figure 6 of IEC 62619, if it is difficult to do it in using the whole battery system.

Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage
E - The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage
F - All function of battery system did operate as intended during the test.

G - All function of battery system did not operate as intended during the test.

H - Other (Please explain): ___

| IEC 62619 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| 8.2.3 | TABLE: Overcharge control of current (battery system) | | | P |
|---|---|---|---|---|
| **Sample No.** | **OCV at start of test, (V dc)** | **Max. Charging Current, (A)** | **Max. Charging Voltage, (V dc)** | **Results** |
| B05# | 47.221 | 60 | 57.6 | A, D, F |
| B06# | 47.204 | 60 | 57.6 | A, D, F |

**Supplementary information:**

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D - Overcurrent sensing function of BMU did operate and then charging stopped
E - Overcurrent sensing function of BMU did not operate and then charging stopped
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): ____

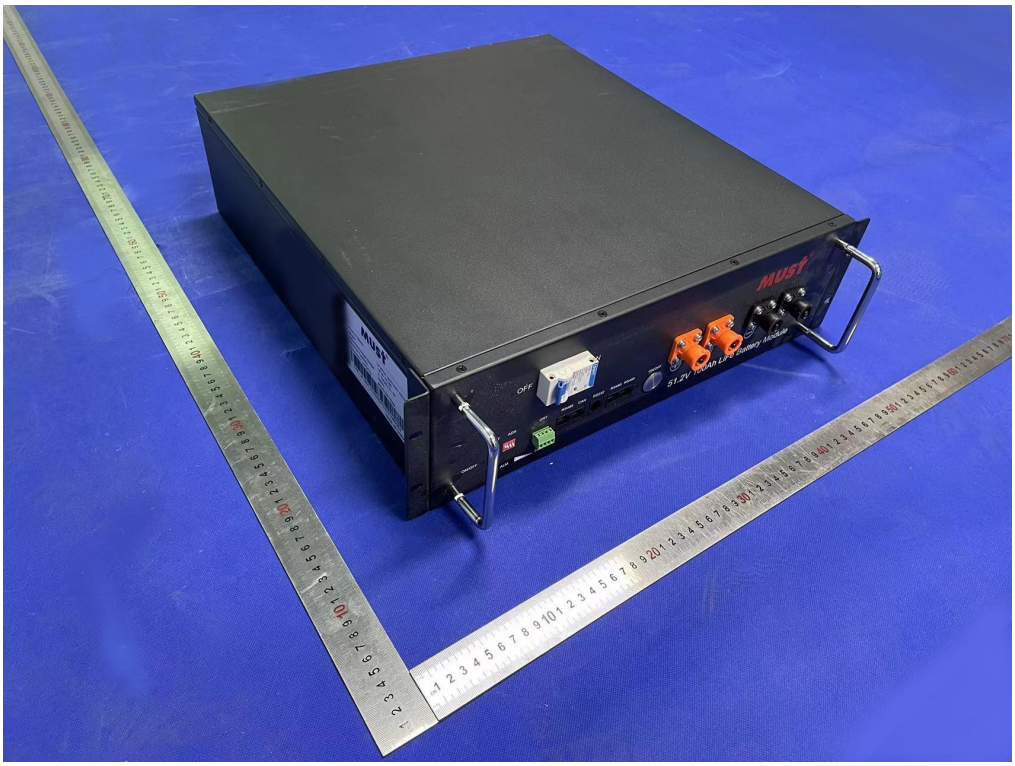
| 8.2.4 | TABLE: Overheating control (battery system) | | P |
|---|---|---|---|
| **Model No.** | **OCV at start(SOC 50%) of test, V dc** | **Maximum Charging Current, A** | **Maximum Charging Voltage, V dc** |
| B07# | 51.334 | 50 | 57.6 |
| B08# | 51.256 | 50 | 57.6 |
| **Maximum Specified Temperature of Battery System, °C** | | **Maximum Measured Cell Case Temperature, °C** | **Results** |
| 55 | | 55.2 | A, D, F |
| 55 | | 55.1 | A, D, F |

**Supplementary information:**

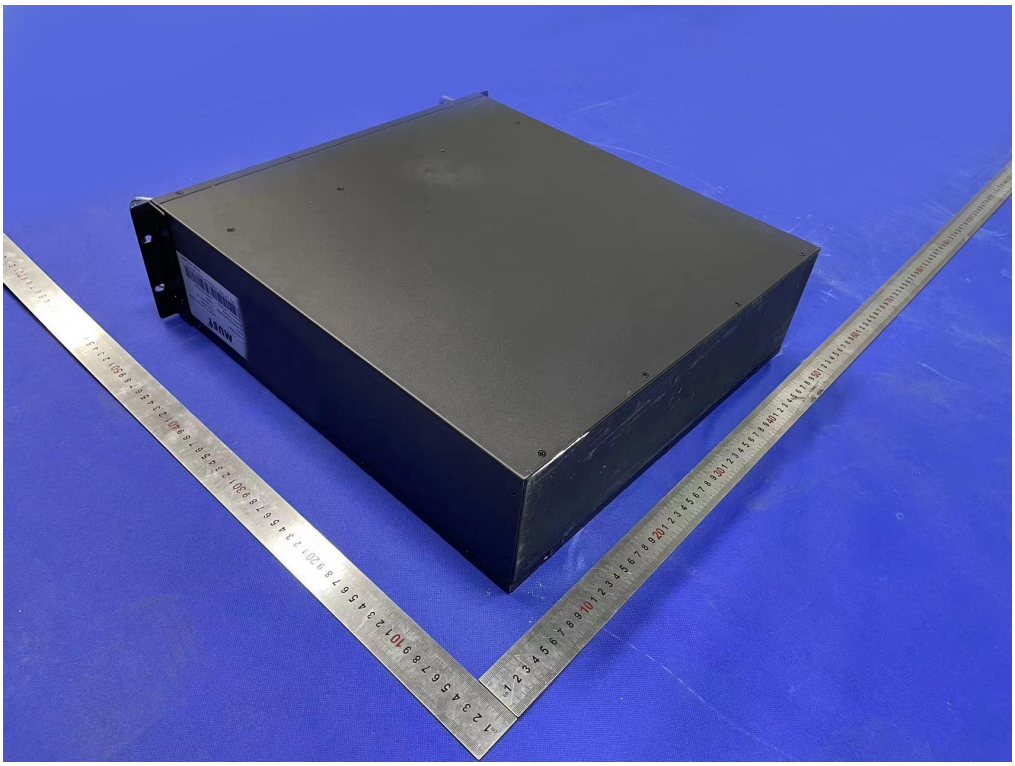
Results:
A – No fire or Explosion
B – Fire
C – Explosion
D - Temperature sensing function of BMU did operate and then charging stopped
E - Temperature sensing function of BMU did not operate and then charging stopped
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): ____

**Product protective circuit module**
The circuit schematic and layout information cannot be reflected due to customer's business secrets.

**Product Photos:**




View of Battery Pack-1



View of Battery Pack-2