AA Portable Power Corp
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Report ID: 2014-002

Lithium Battery UN38.3 Test Report

AA Portable Power Corp

Sample Name: CU-J744

Client: AA Portable Power Corp.

Manufacture: AA Portable Power Corp.

Edited by:	Date:
Checked by:	Date:
Approved by:	Date:

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1 SAMPLE DESCRIPTION:

Sample name	CU-J744		Battery type	Rechargeable package	
Client	AA Portable Power Corp				
Manufactory	AA Portable Power Corp				
Nominal Voltage	12.8V	Rated capacity (Ah)	6Ah	Max Charge Voltage	14.6
Recommended Charge current	1.5A	Maximum Continuous Charge Current	2A (PCB)	End Charge Current	300mA
Cut-off Voltage	15.6V/9.2V (PCB)	Maximum Discharge Current	2A (PCB)	Typical weight	650g
Customer other requirement					
Manufacture of cell	AA Portable Power Corp.		Cell Part No.	LFP-18650-1500	
Client Date	1/21/2014		Finished Date	3/22/2014	

2 STANDARD

Recommendations on transport of dangerous goods，manual of test and criteria，section 38.3 lithium .

3 TEST ITEMS

1. Altitude Simulation
2. Thermal test
3. Vibration
4. Shock
5. External Short circuit
6. Impact (for component cell)
7. Overcharge
8. Forced discharge

4 CONCLUSION

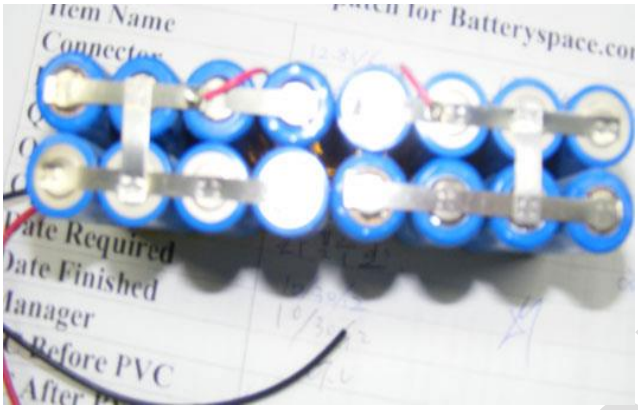
ITEM	SAMPLE NUMBER	STANDARD	CONCLUSION
Altitude simulation	**N1~N4**	**UN38.3**	**Pass**
Thermal test			**Pass**
Vibration	**C1-C4**		**Pass**
Shock			**Pass**
External short circuit			**Pass**
Impact (for component cell)	**N9~N18**		**N/A**
Overcharge	**N5~N8 C5-C8**		**Pass**
Forced discharge	**---**		**N/A**

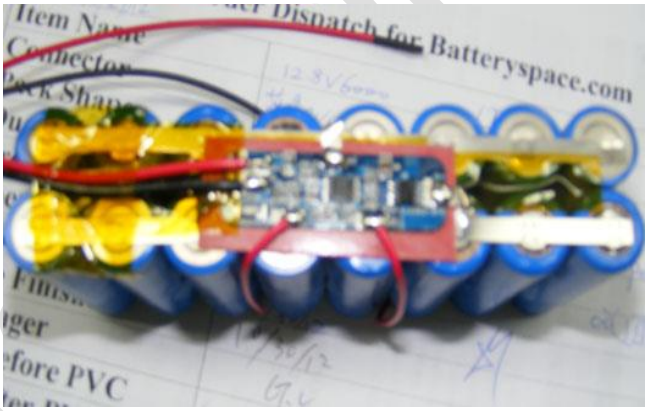
The submitted battery and component cells were complied with the stated requirement of UN38.3.

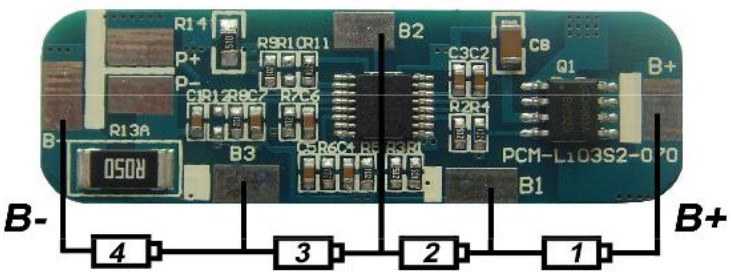
5 PHOTO AND DECRIBTION OF SAMPLE

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Protection Circuit Module Specifications For 12.8V LiFePO4 Battery Packs	
·Model：PCB-LFP12.8V2A（4S） ·Features: Apply for 4 Cells LiFePO4 Battery Pack with discharging current < 2A Adopt seiko S-8254 protection IC Dimension：L50*W16*T3mm Weight：2 grams	Electric performance： * Overcharge protection voltage for single cell：3.900 ± 0.025 V * Overdischarge protection voltage for single cell：2.30 ± 0.080 V * Overcurrent protection： 5～7A * Maximal continuous discharging current：2A * Current consumption for single cell： ≤20uA * Short circuit protection：Automatic recovery * Protection circuitry resistance（B+ TO P+）： ≤100mΩ
Port design： P+ = Charge+/Discharge+ P- = Charge-/Discharge-  	

- The battery pack is made of 16 pcs 1500 mAh cylindrical 18650 cells in 4S4P connection with black thin plastic PVC. 18Awg wire.
- A PCB installed to protect the battery pack
- Pack Size: 150mm (5.91") x 70mm(2.76") x 38mm(1.5")

6 TEST METHOD

Test 1 to 5 must be conducted in sequence on the same battery.

In order to quantify the mass loss, the following procedure is provided;

Mass loss (%) = (M1-M2)/M1*100%.

Where M1 is the mass before the test and M2 is the mass after the test. When mass loss does not exceed the value in table blow, it shall be consider as “not mass loss”.

Mass M of cell or battery	Mass loss limit
M<1g	0.5%
1g≤M≤75g	0.2%
M>75g	0.1%

In test 1 to 4, cells and batteries meet this requirement if three is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 905 of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.

1. Altitude simulation

Test batteries or cells shall be stored at a pressure if 11,6KPa or less for at least six hours at ambient temperature (20±**5**ºC).

2. Thermal test

Test cells and batteries are to be stored for at least six hours at a test temperature equal 75±2ºC, followed by storage for at least six hours at a test temperature equal -40±2ºC. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated 10 times, after which all cells and batteries are to be stored for 24 hours at ambient temperature ((20±**5**ºC). For large cell and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

3. Vibration

Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep 7Hz and 200Hz and back to 7Hz traversed in 15minutes. This cycle shall be repeated 12times for total of 3 hours for each of here mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep is as follows: from 7Hz a peak acceleration of 1g is maintained until 19Hz is reached. The amplitude is then maintained at 0.8mm (1.6mm total

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excursion) and the frequency increased until a peak acceleration of 8g is then maintained until frequency is increased to 200Hz.

4. Shock

Test cells and batteries shall be secured to the testing machine by mean of a rigid mount, which will support all mounting surface of each test battery. Each cell or battery shall be subjected to a half-sine shock of peak acceleration of 150g and pulse duration of 6 milliseconds. Each cell or battery shall be subjected to three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

5. External short circuit

The cell and battery to be tested shall be temperature stabilized so that its external case temperature reaches 55±2ºC and then the cell or battery shall be subjected a short circuit condition with a total external resistance of less than 0.1ohm at 55±2ºC. This short circuit condition is continued for at least one hour after the cell of battery external case temperature has returned to 55±**2**ºC. The cell or battery must be observed for a further six hours for the test to be conclude.

Cells and batteries meet this requirement if this requirement if their temperature does not exceed 170ºC and there is no disassembly, no rupture and no fire within six hours of the test.

6. Impact / Crush
   a. Test procedure – Impact (applicable to cylindrical cells greater than 20 mm in diameter)

The sample cell or component cell is to be placed on a flat smooth surface. A 15.8 mm ±0.1mm diameter, at least 6 cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg ± 0.1 kg mass is to be dropped from a height of 61 ± 2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface. The test sample is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8 mm ± 0.1mm diameter curved surface lying across the centre of the test sample. Each sample is to be subjected to only a single impact.

   b. Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells not more than 20 mm in diameter)

A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5 cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.

(a) The applied force reaches 13 kN ± 0.78 kN; Example: The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 MPa is reached on the hydraulic ram.

(b) The voltage of the cell drops by at least 100 mV; or

(c) The cell is deformed by 50% or more of its original thickness.

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Once the maximum pressure has been obtained, the voltage drops by 100 mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released. A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis. Each test cell or component cell is to be subjected to one crush only. The test sample shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.

Cells and component cells meet this requirement if their external temperature does not exceed 170 °C and there is no disassembly and no fire during the test and within six hours after this test.

7. Overcharge

The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:

(a) When the manufacture's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge of the battery or 22V.
(b) When the manufacture's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.

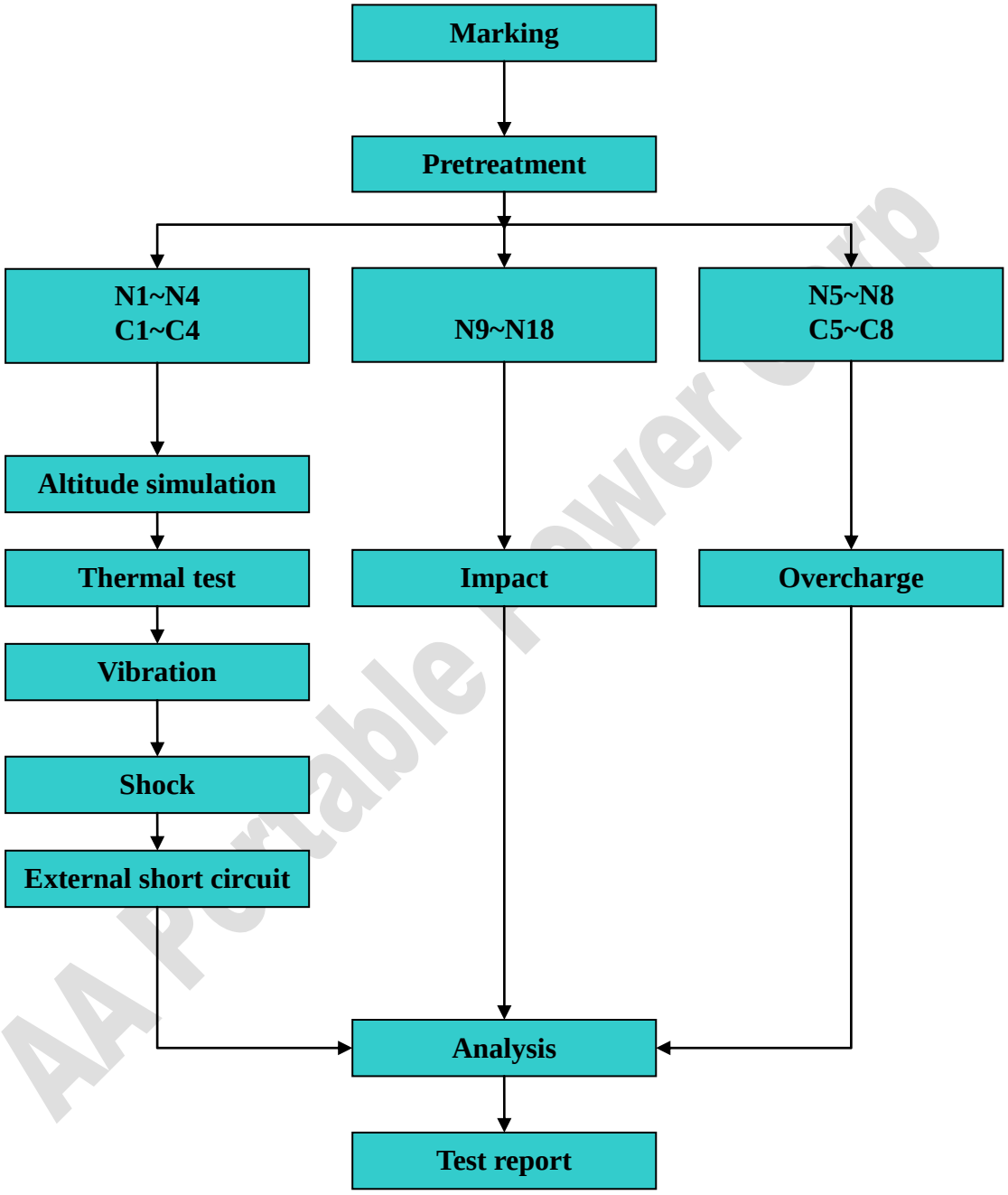
Tests are to be conducted at ambient temperature; the duration of the test shall be 24 hours. Rechargeable batteries meet this requirement if there is no disassembly and no fire within seven days of the test.

8. Forced discharge

Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer. The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere). Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

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7 TEST PROCEDURE



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8 MAIN TEST APPARATUS

Items	Apparatus model	Apparatus name	Note
1	BS-001	Vacuum chamber	T1
2	BS-003	Programmable Fast Thermal Test Chamber	T2
3	BS-004	BS-004	T3
4	BS-005	BS-005	T4
5	BS-006	Short Circuit Tester	T5
6	BS-007	Gravity Impact Tester	T6
7	BS-011	Crushing & Nail Penetration Tester	T6
8	BA8-30V10A	Battery analyzer	T7
9	EL-M9717	DC Programmable Electronic load	T8
10	EQ-001-3000 EQ-001-6000 EQ-001-10000	Precision Digital Strain Gauge Balances3000gx1g / 6000gx1g / 10000gx2g	Weight measurement
11	BS-024	Portable Digital Temperature Calibrator	Temperature measurement (T2/T5)
12	BS-008	Dual Explosion-Proof Box	T7/T8

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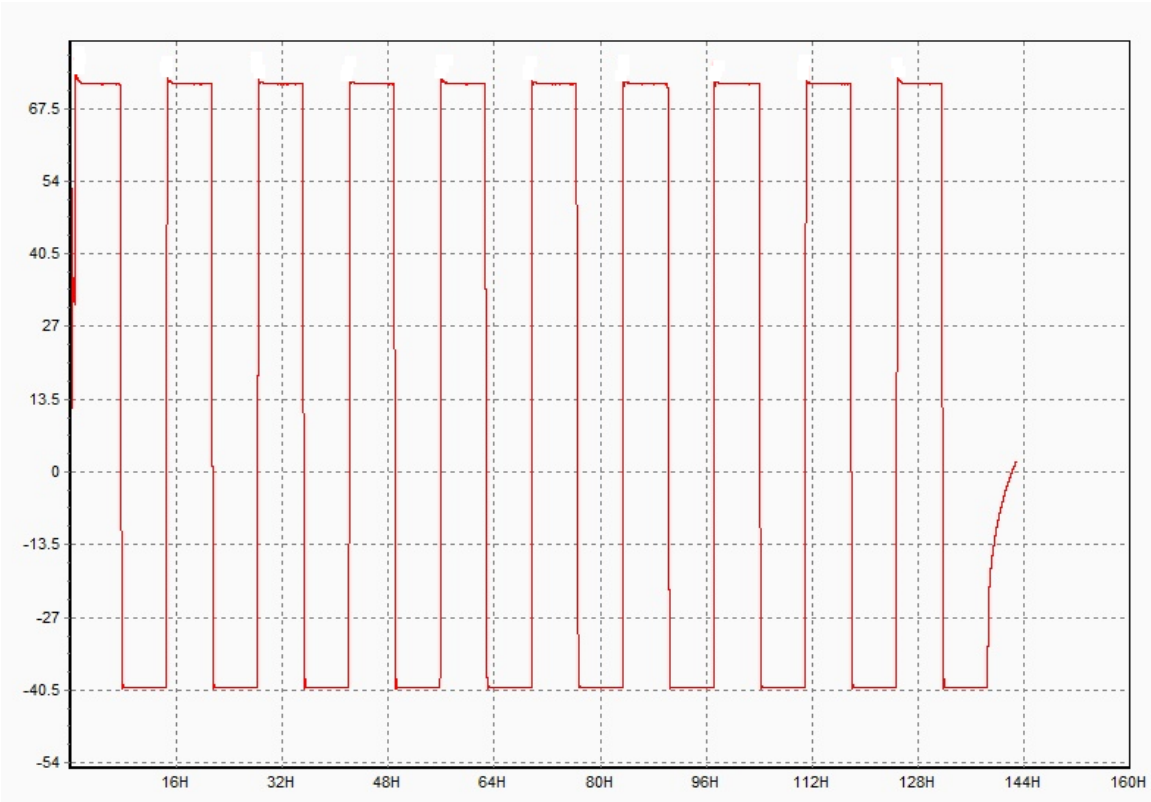
9 DATA

9.1 Altitude simulation

No.	Pre-test		After test		Mass loss (%)	Voltage loss (%)	Status
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
N1	651.7	13.5	651.65	13.35	0.01%	1.11%	Pass
N2	649.7	13.4	649.7	13.31	0.00%	0.67%	Pass
N3	651.25	13.5	651.15	13.34	0.02%	1.19%	Pass
N4	650.5	13.4	650.45	13.34	0.01%	0.45%	Pass
C1	650.95	13.45	650.95	13.44	0.00%	0.07%	Pass
C2	651.75	13.31	651.7	13.28	0.01%	0.23%	Pass
C3	649.95	13.45	649.95	13.42	0.00%	0.22%	Pass
C4	652.25	13.35	652.2	13.29	0.01%	0.45%	Pass

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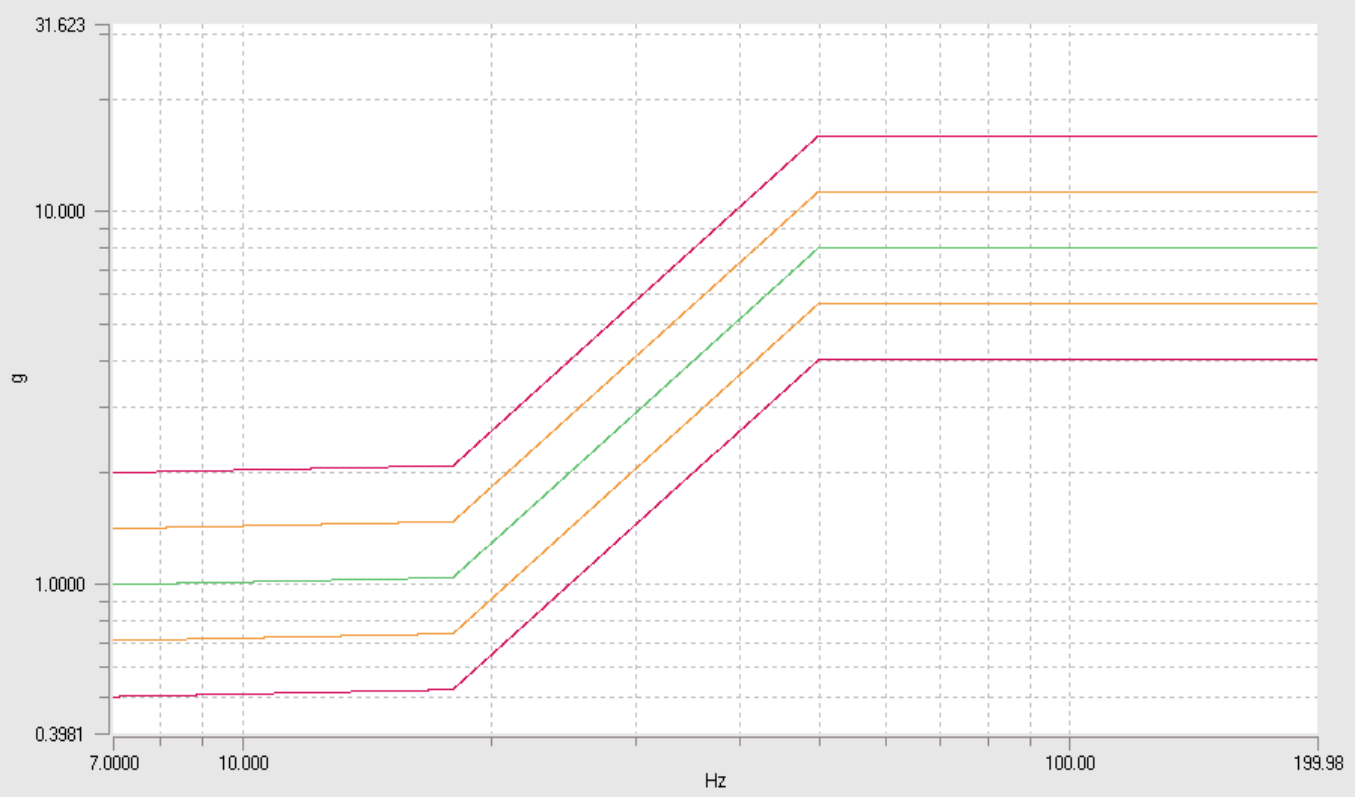
9.2 Thermal test



No.	Pre-test		After test		Mass loss	Voltage loss	Status
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)	(%)	(%)	
N1	651.65	13.35	651.45	13.31	0.03%	0.30%	Pass
N2	649.7	13.31	649.4	13.3	0.05%	0.08%	Pass
N3	651.15	13.34	651	13.3	0.02%	0.30%	Pass
N4	650.45	13.34	650	13.3	0.07%	0.30%	Pass
C1	650.95	13.44	650.9	13.44	0.01%	0.00%	Pass
C2	651.7	13.28	651.7	13.28	0.00%	0.00%	Pass
C3	649.95	13.42	649.9	13.42	0.01%	0.00%	Pass
C4	652.2	13.29	652.2	13.29	0.00%	0.00%	Pass

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9.3 Vibration



No.	Pre-test		After test		Mass loss (%)	Voltage loss (%)	Status
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
N1	651.45	13.31	651.3	13.29	0.02%	0.15%	Pass
N2	649.4	13.3	649.25	13.3	0.02%	0.00%	Pass
N3	651	13.3	650.8	13.29	0.03%	0.08%	Pass
N4	650	13.3	650	13.29	0.00%	0.08%	Pass
C1	650.9	13.44	650.85	13.43	0.01%	0.07%	Pass
C2	651.7	13.28	651.7	13.28	0.00%	0.00%	Pass
C3	649.9	13.42	649.9	13.4	0.00%	0.15%	Pass
C4	652.2	13.29	652.2	13.29	0.00%	0.00%	Pass

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9.4 Shock

No= 1,A=145.49g, D=6.35 ms, V=5.20 m/s No= 2,A=151.97g, D=6.33 ms, V=5.19 m/s
No= 3,A=151.97g, D=6.34 ms, V=5.18 m/s No= 4,A=150.97g, D=6.40 ms, V=5.21 m/s
No= 5,A=148.98g, D=6.40 ms, V=5.17 m/s No= 6,A=148.98g, D=6.39 ms, V=5.18 m/s
No= 7,A=151.47g, D=6.43 ms, V=5.23 m/s No= 8,A=149.97g, D=6.39 ms, V=5.22 m/s
No= 9,A=149.47g, D=6.39 ms, V=5.21 m/s No= 10,A=151.97g, D=6.52 ms, V=5.13 m/s
No= 11,A=146.48g, D=6.66 ms, V=5.14 m/s No= 12,A=144.99g, D=6.74 ms, V=5.10 m/s
No= 13,A=152.46g, D=6.53 ms, V=5.23 m/s No= 14,A=150.97g, D=6.53 ms, V=5.23 m/s
No= 15,A=149.97g, D=6.51 ms, V=5.21 m/s No= 16,A=151.97g, D=6.30 ms, V=5.26 m/s
No= 17,A=152.46g, D=6.26 ms, V=5.23 m/s No= 18,A=152.46g, D=6.27 ms, V=5.23 m/s

No.	Pre-test		After test		Mass loss (%)	Voltage loss (%)	Status
	Mass (g)	Voltage (V)	Mass (g)	Voltage (V)			
N1	651.3	13.29	651.3	13.29	0.00%	0.00%	Pass
N2	649.25	13.3	649.25	13.3	0.00%	0.00%	Pass
N3	650.8	13.29	650.8	13.29	0.00%	0.00%	Pass
N4	650	13.29	650	13.29	0.00%	0.00%	Pass
C1	650.85	13.43	650.85	13.43	0.00%	0.00%	Pass
C2	651.7	13.28	651.7	13.28	0.00%	0.00%	Pass
C3	649.9	13.4	649.9	13.4	0.00%	0.00%	Pass
C4	652.2	13.29	652.2	13.29	0.00%	0.00%	Pass

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9.5 External short circuit

No.	Peak temperature (ºC)	Status
N1	56.5	Pass
N2	56	Pass
N3	56	Pass
N4	56	Pass
C1	56	Pass
C2	56	Pass
C3	56.5	Pass
C4	56	Pass

Note: No Short circuit current due to the PCM function..

9.6 Overcharge

No.	Status
N5	Pass
N6	Pass
N7	Pass
N8	Pass
C5	Pass
C6	Pass
C7	Pass
C8	Pass

Note: Charge voltage 29.2V. No current due to PCM function

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