Test Report issued under the responsibility of:

Prodigy Technology Consultant Co., Ltd.

Test Report No.: T160725-P02	Page 1 of 20
Client	
Name :	Visions TEK Inc.
Address :	Rm. 6D10, 6F, No. 5, Sec. 5, Xinyi Rd., Taipei City 110, Taiwan
Product Name :	LITHIUM ION BATTERY PACK
Model Name :	BP-VT-321B0UF10340S
Testing laboratory	
Name :	Prodigy Technology Consultant Co., Ltd.
Address :	No.181, Sec. 2, Wunhua 1st Rd., Linkou District, New Taipei City 244, Taiwan CHINESE TAIPEI
Test specification Standard :	UN Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.6) Section 38.3
Test Result :	The sample has passed the test items of UN38.3.
Test Report Form No:	DTL-077-A9
Test Report Form Originator:	Prodigy Technology Consultant Co., Ltd.
Master TRF:	Dated 2016-08-11
Approved By :	Andy Yang Signature Senior Engineer 2016-08-29 Date
Reviewed By :	Lk Chang Signature Senior Engineer 2016-08-29 Date
Other Aspects:	
The completed test report includes the following documents:	
■ 20 pages	

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TEST REPORT UN38.3	
Date of sample accepted ..... :	2016-07-22
Date of test ..... :	2016-07-26 to 2016-08-26
Date of issue ..... :	2016-08-29
Battery Information：	
Battery Model ..... :	BP-VT-321B0UF10340S
Composing Mode ..... :	8 Cells, 2 Series, 4 Parallel
Electrochemistry System ..... :	Lithium Ion
Manufacturer of Cell ..... :	SANYO Electric Co., Ltd.
Cell Model ..... :	UF553450Z
Cell Capacity (mAh) ..... :	1150
Use ..... :	--
Contained in equipment during transportation (Yes or No) ..... :	☐ Yes ☒ No
Transportation Mode	By Air
Inner package ..... :	Carton + Paper boxs + Plastic bags
Outer package ..... :	Carton
Interleave material ..... :	EPE
Cross weight (Kg) ..... :	9.71
Dimensions (mm^3) ..... :	380mm by 380mm by 190mm
Battery number ..... :	40
Sample Parameter：	
Nominal Voltage (V) ..... :	7.4
Rated Capacity (mAh) ..... :	4600
Rated Power (Wh) ..... :	34.04
Max. Charging Voltage (V) ..... :	8.43
Max. Charging Current (mA) ..... :	2000
Charging Current (mA) ..... :	2000
Discharge Cut-off Voltage (V) ..... :	4.8
Max. Discharging Current (mA) ..... :	2300
Charge Cut-off Current (mA) ..... :	230
Possible test case verdicts:	
test case does not apply to the test object .....:	N/A
test object does meet the requirement .....:	Pass
test object does not meet the requirement .....:	Fail

38.3.4 Procedure

Tests T.1 to T.5 shall be conducted in sequence on the same cell or battery. Tests T.6 and T.8 shall be conducted using not otherwise tested cells or batteries. Test T.7 may be conducted using undamaged batteries previously used in tests T.1 toT.5 for purposes of testing on cycled batteries.

38.3.4.1 Test T.1: Altitude simulation

38.3.4.1.1 Purpose

This test simulates air transport under low-pressure conditions.

38.3.4.1.2 Test procedure

Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

38.3.4.1.3 Requirement

Cells and batteries meet this requirement if there is 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 90% 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.

38.3.4.2 Test T.2: Thermal test

38.3.4.2.1 Purpose

This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.

38.3.4.2.2 Test procedure

Test cells and batteries are to be stored for at least six hours at a test temperature equal to72 ± 2 °C, followed by storage for at least six hours at a test temperature equal to - 40 ± 2 °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5 °C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.

38.3.4.2.3 Requirement

Cells and batteries meet this requirement if there is 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 90% 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.

38.3.4.3 Test T.3: Vibration

38.3.4.3.1 Purpose

This test simulates vibration during transport.

38.3.4.3.2 Test procedure

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 between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.

The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries).

For cells and small batteries: from 7 Hz a peak acceleration of 1 gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1 6 mm total excursion) and the frequency increased until a peak acceleration of 8 gn occurs (approximately 50 Hz). A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2 gn occurs (approximately 25 Hz). A peak acceleration of 2 gn is then maintained until the frequency is increased to 200 Hz.

38.3.4.3.3 Requirement

Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% 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.

38.3.4.4 Test T.4: Shock

38.3.4.4.1 Purpose

This test simulates possible impacts during transport.

38.3.4.4.2 Test procedure

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery. Each cell or battery shall be subjected to a half-sine shock of peak acceleration of 150 gn and pulse duration of 6 milliseconds. Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.
However, large cells and large batteries shall be subjected to a half-sine shock of peak acceleration of 50 gn and pulse duration of 11 milliseconds. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.

Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery.
Each cell shall be subjected to a half-sine shock of peak acceleration of 150 gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 gn and pulse duration of 11 milliseconds. Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations.

Battery	Minimum peak acceleration	Pulse duration
Small batteries	150 g_n or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{100850}{mass*}\right)}$ whichever is smaller	6 ms
Large batteries	50 g_n or result of formula $Acceleration(g_n) = \sqrt{\left(\frac{30000}{mass*}\right)}$ whichever is smaller	11 ms

* Mass is expressed in kilograms.

NOTE: IEC Standard 60068-2-27 (Fourth Edition 2008-02): Environmental testing-Part 2-27: Tests – Test Ea and guidance: Shock provides guidance on tolerance for acceleration and pulse duration.

The relationship between minimum peak acceleration and mass is illustrated in Figure 38.3.4.1 for small batteries and Figure 38.3.4.2 for large batteries.

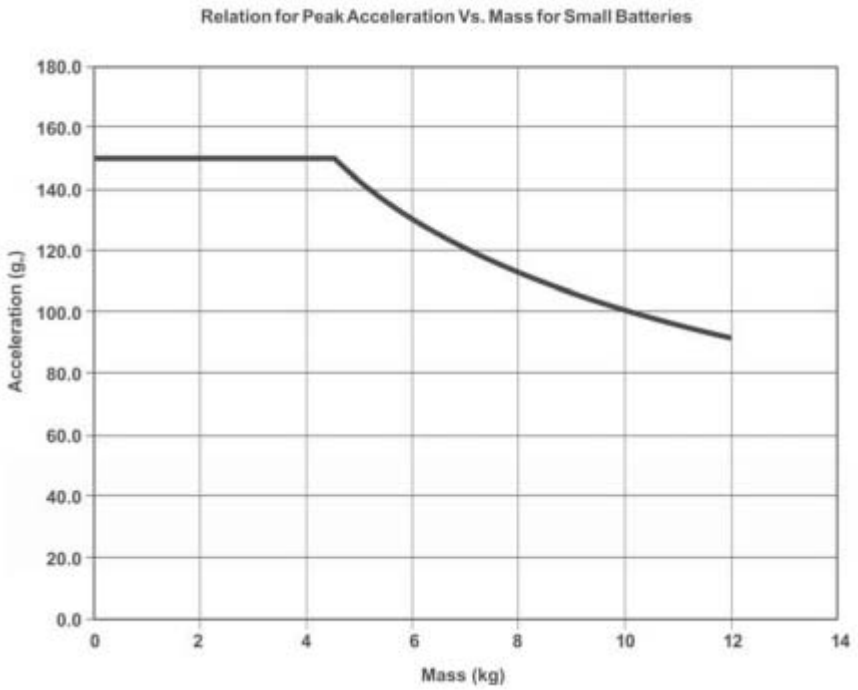


Figure 38.3.4.1: Relation between the Peak Acceleration and the Mass for samll batteries (below 12.0kg).

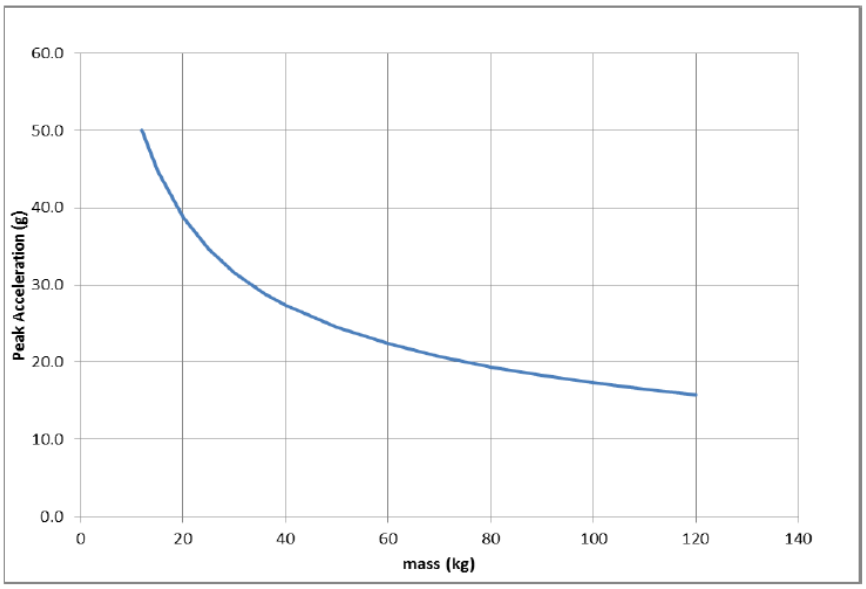


Figure 38.3.4.2: Relation between the Peak Acceleration and the Mass for large batteries (equal or above 12.0 kg).

Each cell or battery shall be subjected to three shocks in the positive direction and to three shocks in the negative direction in each of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

38.3.4.4.3 Requirement

Cells and batteries meet this requirement if there is 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 90% 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.

38.3.4.5 Test T.5: External short circuit

38.3.4.5.1 Purpose

This test simulates an external short circuit.

38.3.4.5.2 Test procedure

The cell or battery to be tested shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 ± 4 °C, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at 57 ± 4 °C shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.
This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 57 ± 4 °C, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.
The short circuit and cooling down phases shall be conducted at least at ambient temperature.

38.3.4.5.3 Requirement

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

38.3.4.6 Test T.6: Impact / Crush

38.3.4.6.1 Purpose

These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.

38.3.4.6.2 Test procedure – Impact (applicable to cylindrical cells not less than 18.0 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.

38.3.4.6.3 Test Procedure – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 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 100mV; or

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

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.

38.3.4.6.3 Requirement

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.

38.3.4.7 Test T.7: Overcharge

38.3.4.7.1 Purpose

This test evaluates the ability of a rechargeable battery or a single cell rechargeable battery to withstand an overcharge condition.

38.3.4.7.2 Test procedure

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 manufacturer'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 voltage of the battery or 22V.

(b) when the manufacturer'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.

38.3.4.7.3 Requirement

Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.

38.3.4.8 Test T.8: Forced discharge

38.3.4.8.1 Purpose

This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition.

38.3.4.8.2 Test procedure

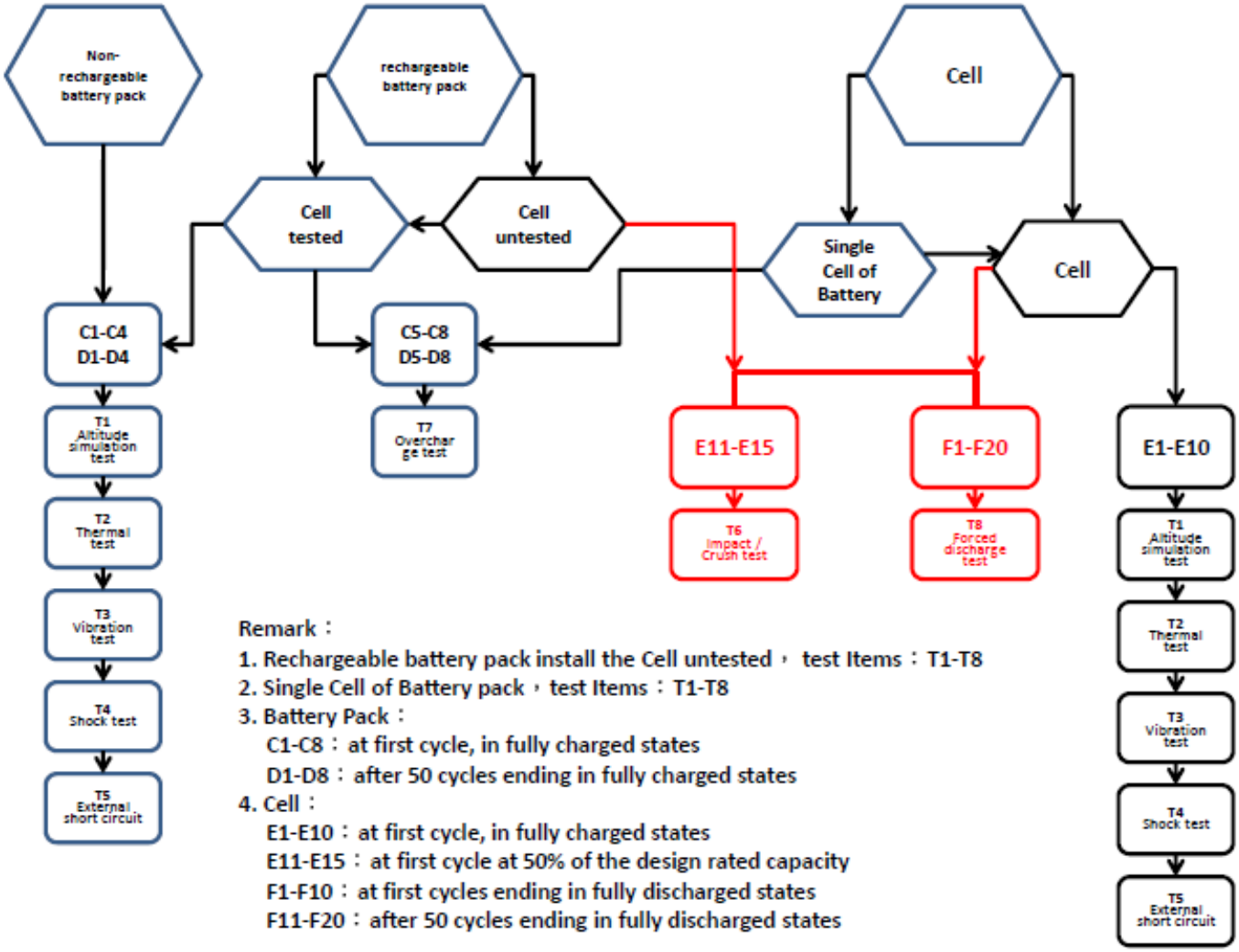
Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer.

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).

38.3.4.8.3 Requirement

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..

Test sequence



Remark：

1. Rechargeable battery pack install the Cell untested， test Items：T1-T8
2. Single Cell of Battery pack，test Items：T1-T8
3. Battery Pack：
   C1-C8：at first cycle, in fully charged states
   D1-D8：after 50 cycles ending in fully charged states
4. Cell：
   E1-E10：at first cycle, in fully charged states
   E11-E15：at first cycle at 50% of the design rated capacity
   F1-F10：at first cycles ending in fully discharged states
   F11-F20：after 50 cycles ending in fully discharged states

Test Results:

Test item No.	Name of Test items	Sample No	Test Result	Conclusion	Remark
T1	Altitude simulation	C1-C4, D1-D4	See Appendix 1	Pass	--
T2	Thermal test	C1-C4, D1-D4	See Appendix 2	Pass	--
T3	Vibration	C1-C4, D1-D4	See Appendix 3	Pass	--
T4	Shock	C1-C4, D1-D4	See Appendix 4	Pass	--
T5	External short circuit	C1-C4, D1-D4	See Appendix 5	Pass	--
T7	Overcharge	C5-C8, D5-D8	See Appendix 7	Pass	--

Altitude simulation test (Appendix 1)

Test item No.	T1	Name of Test items		Altitude simulation Test			
Sample No.	Before Test	After Test	Residual OCV	Before Test (M1)	After Test (M2)	Mass loss	Result after test
	OCV (V)	OCV (V)	(V) (%)	Mass (g)	Mass (g)	(g) (%)	
C1	8.43	8.42	99.9	198.4	198.4	0.00	P
C2	8.43	8.42	99.9	198.9	198.9	0.00	P
C3	8.43	8.42	99.9	198.1	198.1	0.00	P
C4	8.43	8.42	99.9	198.4	198.4	0.00	P
D1	8.43	8.42	99.9	198.4	198.4	0.00	P
D2	8.43	8.42	99.9	198.5	198.5	0.00	P
D3	8.43	8.42	99.9	198.0	198.0	0.00	P
D4	8.43	8.42	99.9	198.1	198.1	0.00	P

Note 1:
L-Leakage,
V-Venting,
D-Disassembly,
R-Rupture,
F-Fire,
P-No Leakage, No Venting, No Disassembly, No Rupture, No Fire.

Note 2: Mass loss limit

Mass *M* of cell or battery	Mass loss limit
$M < 1$ g	0.5%
1 g $\leq M \leq$ 75 g	0.2%
$M >$ 75 g	0.1%

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

Thermal test (Appendix 2)

Test item No.	T2	Name of Test items	Thermal test				
Sample No.	Before Test	After Test	Residual OCV	Before Test (M1)	After Test (M2)	Mass loss	Result after test
	OCV (V)	OCV (V)	(V) (%)	Mass (g)	Mass (g)	(g) (%)	
C1	8.42	8.31	98.7	198.4	198.3	0.05	P
C2	8.42	8.31	98.7	198.9	198.8	0.05	P
C3	8.42	8.31	98.7	198.1	198.0	0.05	P
C4	8.42	8.31	98.7	198.4	198.3	0.05	P
D1	8.42	8.31	98.7	198.4	198.3	0.05	P
D2	8.42	8.31	98.7	198.5	198.4	0.05	P
D3	8.42	8.31	98.7	198.0	197.9	0.05	P
D4	8.42	8.31	98.7	198.1	198.0	0.05	P

Note 1:
L-Leakage,
V-Venting,
D-Disassembly,
R-Rupture,
F-Fire,
P-No Leakage, No Venting, No Disassembly, No Rupture, No Fire.

Note 2: Mass loss limit

Mass *M* of cell or battery	Mass loss limit
$M < 1$ g	0.5%
1 g $\leq M \leq$ 75 g	0.2%
$M >$ 75 g	0.1%

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

Vibration test (Appendix 3)

Test item No.	T3	Name of Test items		Vibration Test			
Sample No.	Before Test	After Test	Residual OCV	Before Test (M1)	After Test (M2)	Mass loss	Result after test
	OCV (V)	OCV (V)	(V) (%)	Mass (g)	Mass (g)	(g) (%)	
C1	8.31	8.31	100.0	198.3	198.3	0.00	P
C2	8.31	8.31	100.0	198.8	198.8	0.00	P
C3	8.31	8.31	100.0	198.0	198.0	0.00	P
C4	8.31	8.31	100.0	198.3	198.3	0.00	P
D1	8.31	8.31	100.0	198.3	198.3	0.00	P
D2	8.31	8.31	100.0	198.4	198.4	0.00	P
D3	8.31	8.31	100.0	197.9	197.9	0.00	P
D4	8.31	8.31	100.0	198.0	198.0	0.00	P

Note 1:
L-Leakage,
V-Venting,
D-Disassembly,
R-Rupture,
F-Fire,
P-No Leakage, No Venting, No Disassembly, No Rupture, No Fire.

Note 2: Mass loss limit

Mass *M* of cell or battery	Mass loss limit
$M < 1$ g	0.5%
1 g $\leq M \leq$ 75 g	0.2%
$M >$ 75 g	0.1%

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

Shock test (Appendix 4)

Test item No.	T4	Name of Test items		Shock Test			
Sample No.	Before Test	After Test	Residual OCV	Before Test (M1)	After Test (M2)	Mass loss	Result after test
	OCV (V)	OCV (V)	(V) (%)	Mass (g)	Mass (g)	(g) (%)	
C1	8.31	8.31	100.0	198.3	198.3	0.00	P
C2	8.31	8.31	100.0	198.8	198.8	0.00	P
C3	8.31	8.31	100.0	198.0	198.0	0.00	P
C4	8.31	8.31	100.0	198.3	198.3	0.00	P
D1	8.31	8.31	100.0	198.3	198.3	0.00	P
D2	8.31	8.31	100.0	198.4	198.4	0.00	P
D3	8.31	8.31	100.0	197.9	197.9	0.00	P
D4	8.31	8.31	100.0	198.0	198.0	0.00	P

Note 1:
L-Leakage,
V-Venting,
D-Disassembly,
R-Rupture,
F-Fire,
P-No Leakage, No Venting, No Disassembly, No Rupture, No Fire.

Note 2: Mass loss limit

Mass *M* of cell or battery	Mass loss limit
$M < 1$ g	0.5%
1 g $\leq M \leq$ 75 g	0.2%
$M >$ 75 g	0.1%

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

External short circuit test (Appendix 5)

Test item No.	T5	Name of Test items	External short circuit Test
Sample No.	Max. External Temperature (℃)		Result after test
C1	56.9		P
C2	56.9		P
C3	56.9		P
C4	56.8		P
D1	56.8		P
D2	56.9		P
D3	56.9		P
D4	56.8		P
Note: D-Disassembly, R-Rupture, F-Fire, P- No Disassembly, No Rupture, No Fire.			

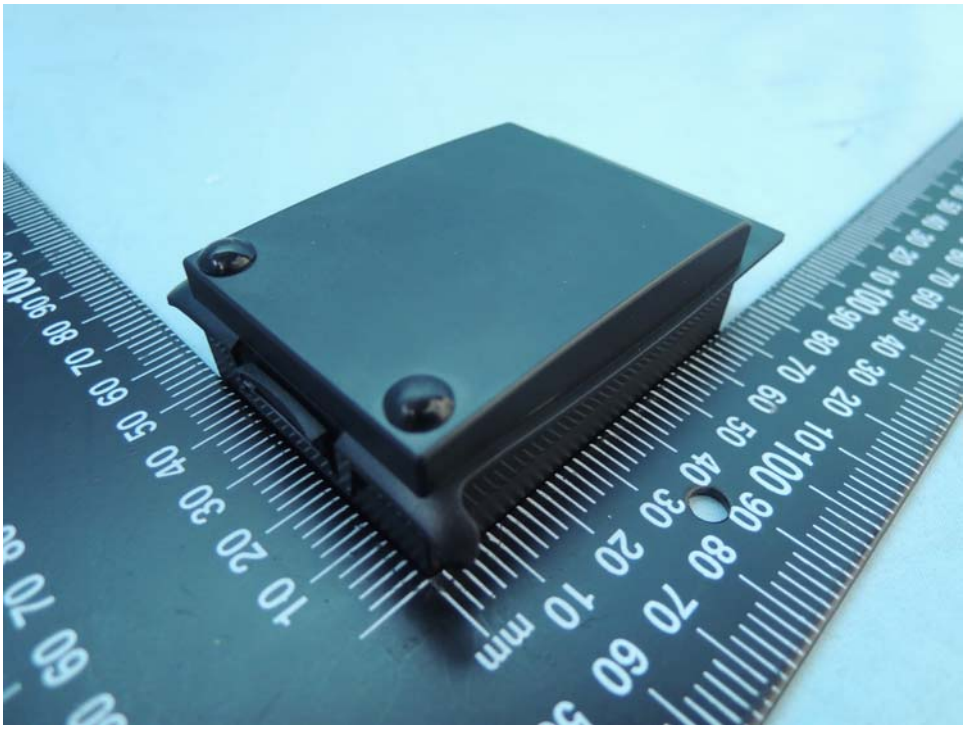
Overcharge test (Appendix 7)

Test item No.	T7	Name of Test items	Overcharge Test
Sample No.	Result after test		
C5	P		
C6	P		
C7	P		
C8	P		
D5	P		
D6	P		
D7	P		
D8	P		
Note: D-Disassembly, F-Fire, P- No Disassembly, No Fire.			

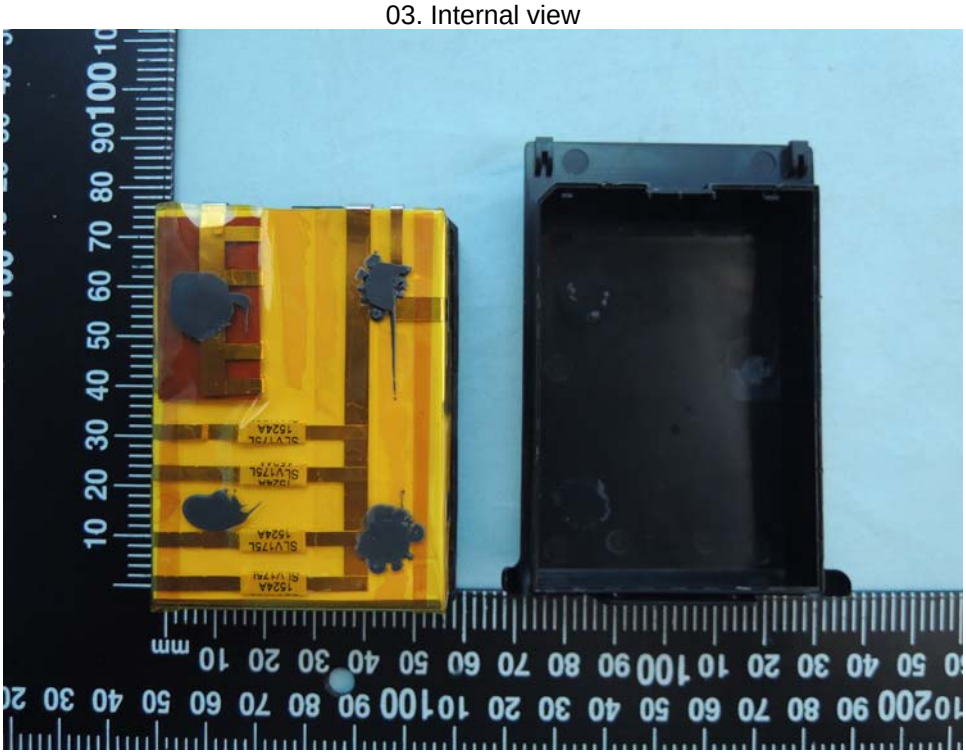
Photo:

01. Overall view 1

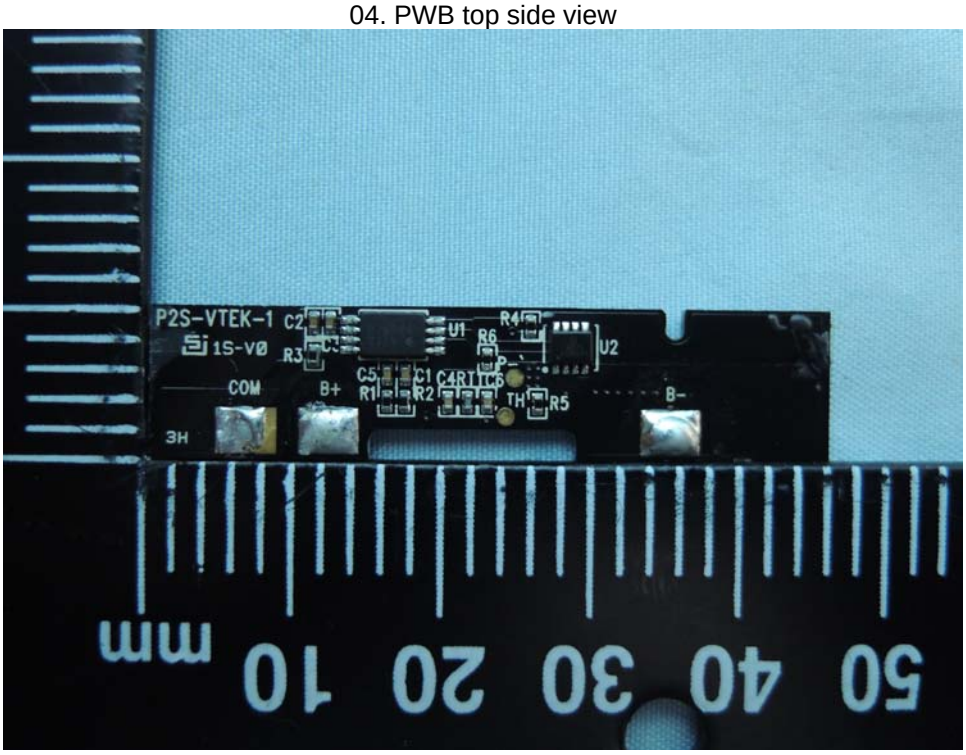
02. Overall view 2



03. Internal view



04. PWB top side view



05. PWB bottom side view