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TEST REPORT

Applicant:	Neat-Oh! International, LLC 790 Frontage Road, 2nd Floor, Suite 303 Northfield, Illinois 60093 U.S.A	Report No.: Date:	16121251HKG-001 27 January 2017

Sample Description

Product	:	Lithium Battery for Zipes™ Speed Pipes RC Toy
Model No.	:	A2280XX, A2281XX, A2282XX, A2283XX (XX can be any alphabet A to Z or number 1-9, where electrical and mechanical properties of the battery pack would not be affected)
Rating	:	3.7Vdc, 250 mAh
Qty of Sample	:	Battery Pack – Eighteen (18) Cell – Twenty-Five (25)
Category	:	Single Cell Rechargeable Small Battery
Date Received	:	29 December 2016
Date Test Conducted	:	30 December 2016 to 25 January 2017
Factory	:	CHENER BATTERY WROKS(CHINA)LIMITED
Test Requested	:	Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria ST/SG/AC.10/11/Rev.6 - Section 38.3 Lithium Metal and Lithium Ion Batteries
Test Method	:	Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria ST/SG/AC.10/11/Rev.6 with Corrigendum February 2016 - Section 38.3 Lithium Metal and Lithium Ion Batteries
Test Results	:	See details attached
Conclusion	:	The submitted samples were **COMPLIED** with the test requested.
Remark	:	1. When determining the test conclusion, the Measurement Uncertainty of test has been considered. 2. Evaluation was conducted on battery pack only, cell inside the battery pack was not separately evaluated. Compliance of cells against UN 38.3 should be referred to the cell report.

********** End of Page **********

Reviewed by

Digitally signed by Derek Leung
Location: Intertek Testing Services Hong Kong Ltd.

Leung Chi Shing, Derek
Manager

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Test Summary:

Test No.	Description	Test Item	Result
Test T.1	Altitude simulation	Battery	Pass
Test T.2	Thermal test	Battery	Pass
Test T.3	Vibration	Battery	Pass
Test T.4	Shock	Battery	Pass
Test T.5	External short circuit	Battery	Pass
Test T.6:	Impact / Crush	Component Cell	Pass
Test T.7	Overcharge	Battery	Pass
Test T.8	Forced discharge	Component Cell	Pass

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Test T.1: Altitude simulation

Purpose:

This test simulates air transport under low-pressure conditions.

Test procedure:

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

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.

Test Result:

Test item: Single Cell Battery								
Test Sample	Conditions	Before Test		After Test		Mass Loss (%), <0.2%	Residual OCV (%), >90%	Observations
		Weight (g)	OCV (V)	Weight (g)	OCV (V)			
B1	First cycle, fully charged	5.02	4.11	5.03	4.10	-0.20	100.00	No leakage, no venting, no disassembly, no rupture and no fire
B2		5.15	4.10	5.16	4.10	-0.19	99.98	
B3		5.21	4.12	5.21	4.12	0.00	99.98	
B4		5.12	4.12	5.11	4.12	0.20	99.98	
B5		5.23	4.12	5.22	4.11	0.19	99.97	
B6		5.29	4.11	5.28	4.11	0.19	99.97	
B7		5.11	4.11	5.10	4.11	0.20	100.00	
B8		5.16	4.12	5.16	4.11	0.00	99.98	
B9		5.18	4.11	5.18	4.11	0.00	99.97	
B10		5.12	4.11	5.12	4.11	0.00	99.98	

All samples were complied with this clause.

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Test T.2: Thermal test

Purpose:

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

Test procedure:

Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72 ± 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 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.

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.

Test Result:

Test item: Single Cell Battery								
Test Sample	Conditions	Before Test		After Test		Mass Loss (%), <0.2%	Residual OCV (%), >90%	Observations
		Weight (g)	OCV (V)	Weight (g)	OCV (V)			
B1	First cycle, fully charged	5.03	4.10	5.04	4.08	-0.20	99.43	No leakage, no venting, no disassembly, no rupture and no fire
B2		5.16	4.10	5.15	4.08	0.19	99.45	
B3		5.21	4.12	5.21	4.09	0.00	99.34	
B4		5.11	4.12	5.12	4.09	-0.20	99.33	
B5		5.22	4.11	5.22	4.09	0.00	99.33	
B6		5.28	4.11	5.27	4.09	0.19	99.35	
B7		5.10	4.11	5.11	4.08	-0.20	99.42	
B8		5.16	4.11	5.17	4.09	-0.19	99.33	
B9		5.18	4.11	5.19	4.09	-0.19	99.37	
B10		5.12	4.11	5.12	4.09	0.00	99.38	

All samples were complied with this clause.

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Test T.3: Vibration

Purpose:

This test simulates vibration during transport.

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 g_n 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 g_n occurs (approximately 50 Hz). A peak acceleration of 8 g_n is then maintained until the frequency is increased to 200 Hz.

For large batteries: from 7 Hz to a peak acceleration of 1 g_n 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 g_n occurs (approximately 25 Hz). A peak acceleration of 2 g_n is then maintained until the frequency is increased to 200 Hz.

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.

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Test T.3: Vibration (Cont')

Test Result:

Test item: Single Cell Battery								
Test Sample	Conditions	Before Test		After Test		Mass Loss (%), <0.2%	Residual OCV (%), >90%	Observations
		Weight (g)	OCV (V)	Weight (g)	OCV (V)			
B1	First cycle, fully charged	5.04	4.08	5.05	4.08	-0.20	99.97	No leakage, no venting, no disassembly, no rupture and no fire
B2		5.15	4.08	5.14	4.08	0.19	99.96	
B3		5.21	4.09	5.21	4.09	0.00	99.97	
B4		5.12	4.09	5.11	4.09	0.20	99.97	
B5		5.22	4.09	5.21	4.09	0.19	99.98	
B6		5.27	4.09	5.28	4.09	-0.19	99.99	
B7		5.11	4.08	5.10	4.08	0.20	99.98	
B8		5.17	4.09	5.18	4.09	-0.19	100.00	
B9		5.19	4.09	5.20	4.08	-0.19	99.96	
B10		5.12	4.09	5.12	4.08	0.00	99.98	

All samples were complied with this clause.

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Test T.4: Shock

Purpose:

This test assesses the robustness of cells and batteries against cumulative shocks.

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 shall be subjected to a half-sine shock of peak acceleration of 150 g_n and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 g_n and pulse duration of 11 milliseconds.

Each cell 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.

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.

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.

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Test Result:

Test item: Single Cell Battery								
Test Sample	Conditions	Before Test		After Test		Mass Loss (%), <0.2%	Residual OCV (%), >90%	Observations
		Weight (g)	OCV (V)	Weight (g)	OCV (V)			
B1	First cycle, fully charged	5.05	4.08	5.05	4.08	0.00	100.00	No leakage, no venting, no disassembly, no rupture and no fire
B2		5.14	4.08	5.15	4.08	-0.10	100.00	
B3		5.21	4.09	5.21	4.09	-0.05	100.00	
B4		5.11	4.09	5.10	4.08	0.16	99.96	
B5		5.21	4.09	5.21	4.09	0.02	99.99	
B6		5.28	4.09	5.29	4.08	-0.26	99.99	
B7		5.10	4.08	5.11	4.08	-0.28	99.99	
B8		5.18	4.09	5.17	4.09	0.19	99.98	
B9		5.20	4.08	5.19	4.08	0.17	99.99	
B10		5.12	4.08	5.12	4.08	-0.07	99.99	

All samples were complied with this clause.

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Test T.5: External short circuit

Purpose:

This test simulates an external short circuit.

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 accessed 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.

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 of this test.

Test Result:

Test item: Single Cell Battery				
Test Sample	Conditions	Before test OCV (V)	Maximum Surface Temperature (°C)	Observations
B1	First cycle, fully charged	4.08	55.28	The external temperature did not exceed 170 °C, no disassembly, no rupture and no fire during the test and within six hours of this test
B2		4.08	55.32	
B3		4.09	55.87	
B4		4.08	55.24	
B5		4.09	55.18	
B6		4.08	55.29	
B7		4.08	55.42	
B8		4.09	55.41	
B9		4.08	55.34	
B10		4.08	55.19	

All samples were complied with this clause.

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Test T.6: Impact / Crush

Purpose:

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

Test procedure (1) – 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.

Test Procedure (2) – Crush (applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18 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.

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.

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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 of this test.

Test Result:

Test procedure (2) was followed for cylindrical cells.

Test item: Component Cell				
Test Sample	Conditions	Before test OCV (V)	Maximum Surface Temperature (°C)	Observations
C1	First cycle, 50% of the design rated capacity	3.83	22.90	The external temperature did not exceed 170 °C, no disassembly and no fire during the test and within six hours of this test
C2		3.79	23.70	
C3		3.83	24.60	
C4		3.52	24.40	
C5		3.78	24.80	

All samples were complied with this clause.

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Test T.7: Overcharge

Purpose:

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

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.

Requirement:

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

Test Result:

Test item: Single Cell Battery			
Test Sample	Conditions	Before test OCV (V)	Observations
B11	First cycle, fully charged	4.12	No disassembly and no fire during the test and within seven days of the test
B12		4.15	
B13		4.16	
B14		4.16	
B15	After 50 cycles, Fully charged	4.18	
B16		4.18	
B17		4.15	
B18		4.18	

All samples were complied with this clause.

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Test T.8: Forced discharge

Purpose:

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

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).

Requirement:

Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days of the test.

Test Result:

Test item: Component Cell			
Test Sample	Conditions	OCV (V)	Observations
C6	First cycle, fully discharged	3.43	No disassembly and no fire during the test and within seven days of the test
C7		3.43	
C8		3.43	
C9		3.42	
C10		3.25	
C11		3.63	
C12		3.42	
C13		3.42	
C14		3.43	
C15		3.42	
C16	After 50 cycles, fully discharged	3.23	
C17		3.35	
C18		3.35	
C19		3.36	
C20		3.32	
C21		3.39	
C22		3.38	
C23		3.34	
C24		3.36	
C25		3.34	

All samples were complied with this clause.

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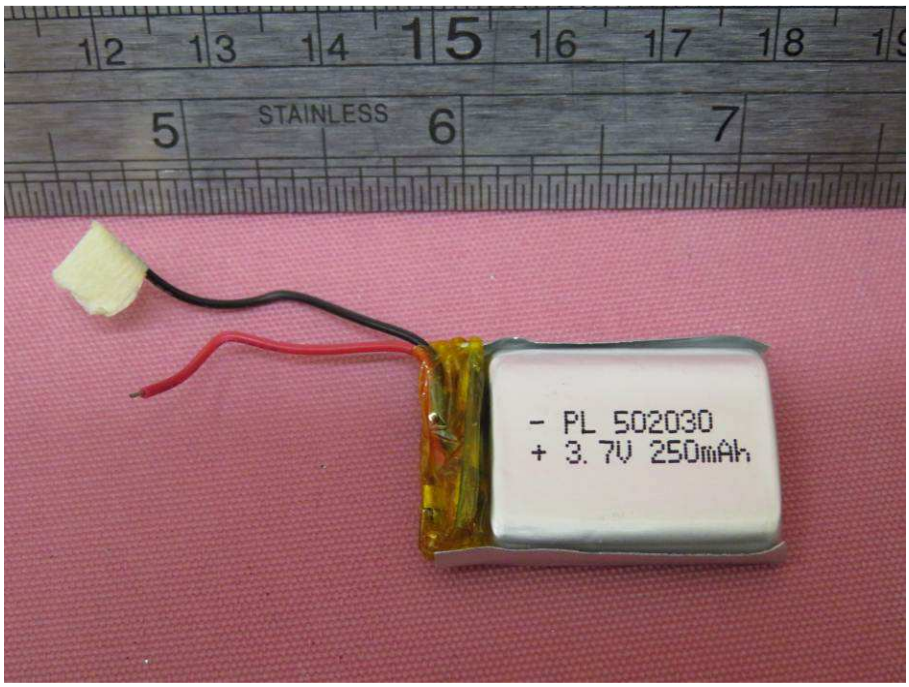
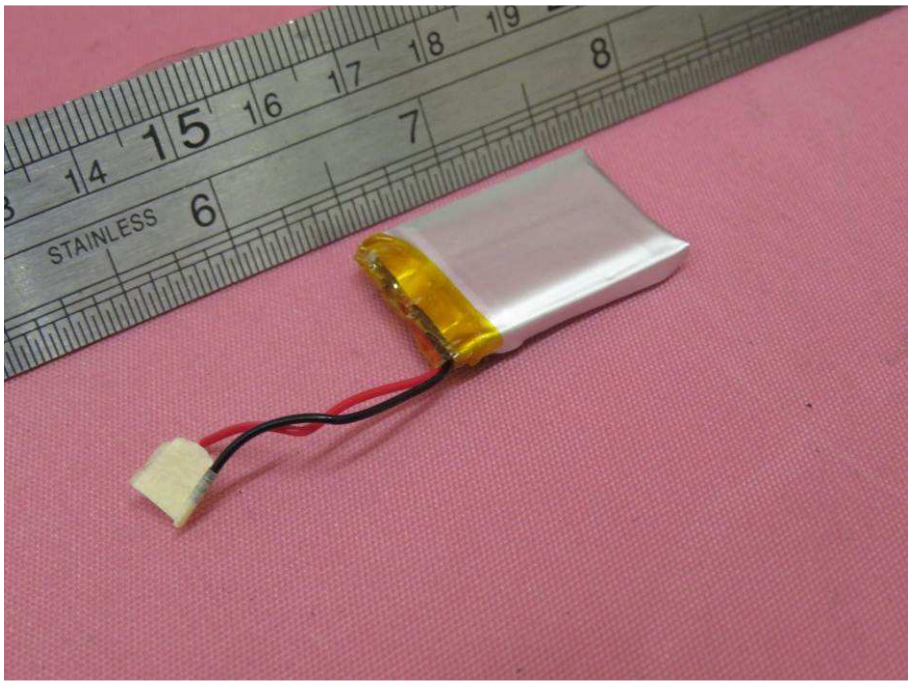
Battery Pack Photo:





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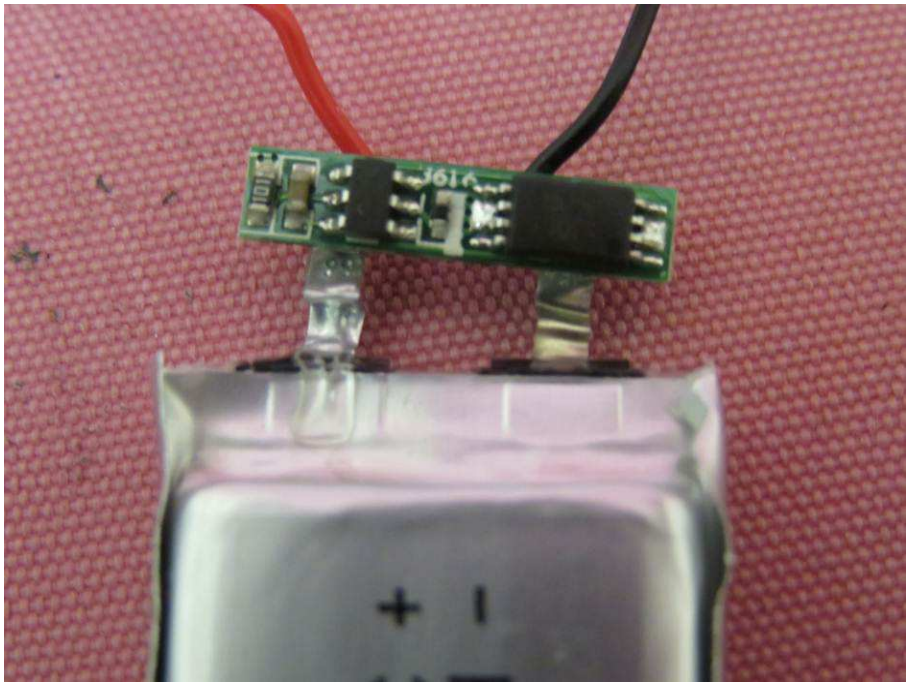
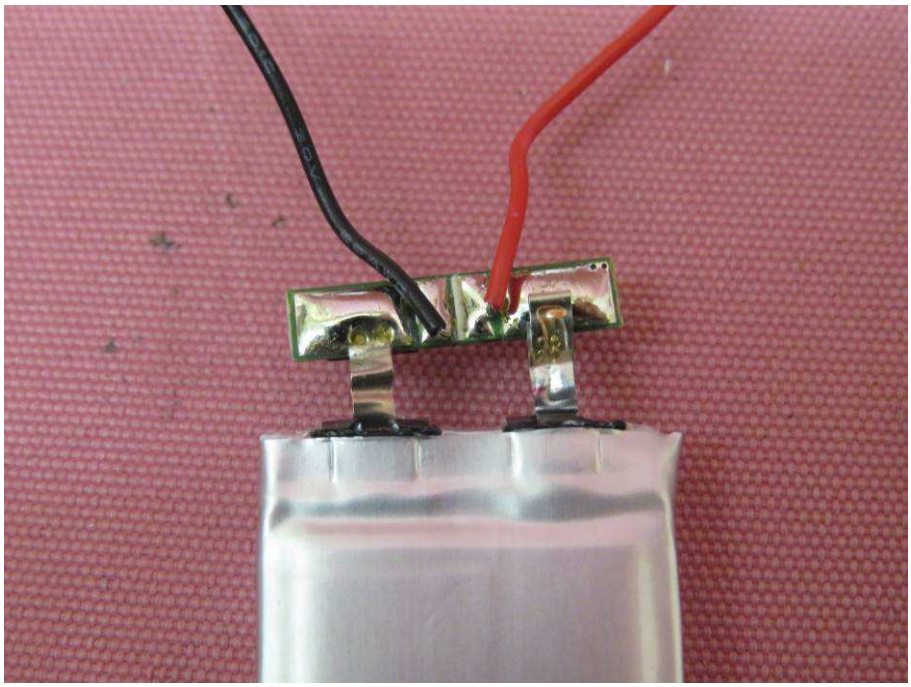
Battery Pack Protection Circuit Photo:





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