



TEST REPORT UN38.3 TRANSPORT OF DANGEROUS GOODS - Lithium metal and lithium ion batteries		
Report Number	BATT-4789624706-1-UN38.3	
Date of issue	2020-09-	
Total number of pages	26	
Applicant's name	ORIENT TECHNOLOGY (S) PTE LTD	
Address	178 PAYA LEBAR ROAD, #07-06, 409030, SINGAPORE	
Test specification:		
Standard	ST/SG/AC.10/11/Rev.7	
Test procedure	Type test	
Non-standard test method	N/A	
Test item description:		
Trade Mark	Code	
Manufacturer	Same as applicant	
Model/Type reference	CRA-B27, 1ICP7/34/50	
Ratings	3.7V, 4.9Wh	
Testing procedure and testing location:		
Testing Laboratory:	Underwriters Laboratories Taiwan Co., Ltd.	
Address	260 Da-Yeh Road, Peitou, Taipei City, Taiwan 112	
Tested by (name + title + signature)	/ Project Handler	
Approved by (name + title + signature) ...:	Richard Lin / Reviewer	

Summary of testing:**Tests conducted and results:**

☒ T.1 Altitude simulation	☒ Pass; ☐ Fail;
☒ T.2 Thermal test	☒ Pass; ☐ Fail;
☒ T.3 Vibration	☒ Pass; ☐ Fail;
☒ T.4 Shock	☒ Pass; ☐ Fail;
☒ T.5 External short circuit	☒ Pass; ☐ Fail;
☐ T.6 Impact	☐ Pass; ☐ Fail;
☒ T.7 Overcharge	☒ Pass; ☐ Fail;
☐ T.8 Forced discharge	☐ Pass; ☐ Fail;

Test item particulars:	
Chemistry	: ☐ lithium metal / ☒ lithium ion
Mass	: 0.048 kg
Lithium content (for lithium metal)	: N/A
Wh capacity (for lithium ion)	: 4.9Wh
Battery connection configuration (X-S/Y-P)	: 1S-1P
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	: 2020-07-03
Date (s) of performance of tests	: 2020-07-14 to 2020-07-29; 2020-09-14 to 2020-09-22
General remarks:	
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(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.	
Name and address of factory (ies)	ORIENT TECHNOLOGY (S) PTE LTD 178 PAYA LEBAR ROAD,#07-06, 409030,SINGAPORE
General product information:	
Product Description:	
Electronic components mounted on PWB, 1S/1P cells in cell holder, secured together by plastic enclosure, secured together by snap fit.	

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
38.3.3	Assembled battery testing requirements		P
38.3.3 (f)	The battery assembly has aggregate lithium content of not more than 500 g (lithium metal type) or with a Watt-hour rating of not more than 6 200 Wh (lithium ion type), and is assembled from batteries that have passed all applicable tests. One assembled battery in a fully charged state is tested under tests T.3, T.4 and T.5, and, in addition, test T.7 in the case of rechargeable battery.		P
38.3.3 (g)	Batteries that have passed all applicable tests are electrically connected to form a battery in which the aggregate lithium content is more than 500 g (lithium metal type) or with a Watt-hour rating of more than 6 200 Wh (lithium ion type). The assembled battery is not tested if the assembled battery is of a type that has been verified as preventing: (i) Overcharge; (ii) Short circuits; and (iii) Over discharge between the batteries.		N/A
38.3.4	Transport tests		P
38.3.4.1	Test T-1: Altitude simulation		P
	Cells or batteries are stored at a pressure of 11.6 kPa or less for at least 6 h at ambient temperature.		P
	Results: no leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.	See appended Table 38.3.4.1	P
38.3.4.2	Test T-2: Thermal test		P
	Cells or batteries previously subjected to altitude simulation test.		P
	Cells or batteries are stored for at least 6 h at a test temperature of 72 ± 2 °C, followed by storage for at least 6 h at a test temperature of -40 ± 2 °C. Maximum time for transfer is 30 minutes. This procedure is repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature.		P
	For large cells or batteries the duration of exposure to the test temperatures is at least 12 h instead of 6 h.	Not large batteries.	N/A
	Storage for at least 24 h at ambient temperature.		P
	Results: no leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.	See appended Table 38.3.4.2	P
38.3.4.3	Test T-3: Vibration		P
	Cells or batteries previously subjected to thermal test		P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	Cells or batteries are subjected to the following sinusoidal vibration with a logarithmic sweep: 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 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.		P
	Large batteries are subjected to the following sinusoidal vibration with a logarithmic sweep: 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 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.	Not large batteries.	N/A
	Cycle is repeated 12 times for a total of 3 h for each of three mutually perpendicular mounting positions. One of the directions is perpendicular to the terminal face.		P
	Results: no leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.	See appended Table 38.3.4.3	P
38.3.4.4	Test T-4: Shock		P
	Cells or batteries previously subjected to vibration test.		P
	Cells or batteries are subjected to three shocks in each direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.		P
	Cells are subjected to half-sine shock of peak acceleration of 150 g _n and pulse duration of 6 ms.	Not cells	N/A
	As an alternative, large cells are subjected to a half-sine shock of peak acceleration of 50 g _n and pulse duration of 11 ms.	Not large cells.	N/A
	Small batteries are subjected to half-sine shock of peak acceleration of the smaller of the following and pulse duration of 6 ms: - 150 g_n; or - $\sqrt{(100850 / \text{mass in kg})}$ g_n		P
	Large batteries are subjected to half-sine shock of peak acceleration of the smaller of the following and pulse duration of 11 ms: - 50 g_n; or - $\sqrt{(30000 / \text{mass in kg})}$ g_n	Not large batteries.	N/A
	Results: no leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.	See appended Table 38.3.4.4	P
38.3.4.5	Test T-5: External short-circuit		P

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	Cells or batteries previously subjected to shock test.		P
	Cells or batteries are heated for a period of time necessary to reach a homogeneous stabilized temperature of 57 ± 4 °C, measured on the external case.		P
	Cells or batteries are subjected to a short-circuit condition with a total external resistance of less than 0.1 ohm at 57 ± 4 °C. Short-circuit condition is continued for at least 1 h 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.		P
	The test sample is observed for a further 6 h.		P
	Results: no excessive temperature rise, no rupture, no explosion and no fire during this test and within the 6 h of observation.	See appended Table 38.3.4.5	P
38.3.4.6	Test T-6: Impact / crush	Not cells	N/A
	The test is conducted using test cells or component cells that have not been previously subjected to other transport tests.		N/A
	Each test cell or component cell shall be subjected to one impact / crush only.		N/A
	Cylindrical cells not less than 18.0 mm in diameter are tested with impact test procedure.		N/A
	The cell is placed on a flat smooth surface. A stainless steel bar with a diameter of 15.8 ± 0.1 mm and a length of at least 60 mm or of the longest dimension of the cell, whichever is greater, is placed across the centre of the test sample. A mass of 9.1 ± 0.1 kg is dropped from a height of 61 ± 2.5 cm at the intersection of the bar and the test sample using a vertical sliding track or channel. The vertical track is oriented 90 degrees from the horizontal supporting surface.		N/A
	The test sample is impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the steel bar lying across the centre of the test sample.		N/A
	Prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter are tested with crush test procedure.		N/A
	The cell is 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.		N/A

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict
	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.		N/A
	The crushing is to be continued until one of the three conditions below is reached: - The applied force reaches 13 ± 0.78 kN; - The voltage of the cell drops by at least 100 mV; or - The cell is deformed by 50 % or more of its original thickness. As soon as one of the above conditions has been obtained, the pressure shall be released.		N/A
	The test sample is observed for a further 6 h.		N/A
	Results: no excessive temperature rise, no explosion and no fire during this test and within the 6 h of observation.	See appended Table 38.3.4.6	N/A
38.3.4.7	Test T-7: Overcharge		P
	The charge current of the battery is twice the manufacturer's recommended maximum continuous charge current.	Tested with 2.6A (manufacturer's recommended maximum continuous charge current: 1.3A)	P
	The manufacturer's recommended charge voltage is not more than 18 V. The minimum voltage of the test is the lesser of two times the maximum charge voltage of the battery or 22 V.	Tested with 8.4Vdc (manufacturer's recommended maximum continuous charge voltage: 4.2Vdc)	P
	The manufacturer's recommended charge voltage is more than 18 V. The voltage of the test is not less than 1.2 times the maximum charge voltage.		N/A
	The test is conducted at ambient temperature. The charging condition is maintained for at least 24 h.		P
	The test sample is observed for a further 7 days.		P
	Results: no explosion and no fire during this test and within the 7 days of observation.		P
38.3.4.8	Test T-8: Forced discharge	Not cells	N/A
	Each cell is forced discharged at ambient temperature by connecting it in series with a 12 V direct current power supply at an initial current equal to the maximum continuous discharge current specified by the manufacturer. Time interval for discharging equals to rated capacity divided by the initial test current.		N/A
	The test sample is observed for a further 7 days.		N/A
	Results: no explosion and no fire during this test, nor within the 7 days of observation.		N/A

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.1	TABLE: Altitude							Pass
Sample No.	Pre-condition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Voltage remain (%)	Results
3184394-1	C	4.168	46.67	4.168	46.65	0.04	100.00	A
3184394-2	C	4.167	46.76	4.167	46.74	0.04	100.00	A
3184394-3	C	4.170	46.71	4.170	46.71	0.00	100.00	A
3184394-4	C	4.086	46.83	4.086	46.81	0.04	100.00	A
3184394-5	D	4.163	46.77	4.163	46.76	0.02	100.00	A
3184394-6	D	4.169	46.78	4.168	46.76	0.04	99.98	A
3184394-7	D	4.129	46.81	4.129	46.79	0.04	100.00	A
3184394-8	D	4.165	46.86	4.165	46.85	0.02	100.00	A
Supplementary information: Precondition: A: Fully discharged state. B: Undischarged state. C: First cycle in fully charged state. D: After 25 cycles ending in fully charged state. Results: A: No leakage, no venting, no short-circuit (voltage not remain 90%), no rupture, no disassembly (explosion), and no fire. B: Other (please explain)								

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.2	TABLE: Thermal Test							Pass
Sample No.	Pre-condition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Voltage remain (%)	Results
3184394-1	C	4.168	46.65	4.142	46.62	0.06	99.38	A
3184394-2	C	4.167	46.74	4.133	46.72	0.04	99.18	A
3184394-3	C	4.170	46.71	4.141	46.67	0.09	99.30	A
3184394-4	C	4.086	46.81	4.076	46.79	0.04	99.76	A
3184394-5	D	4.163	46.76	4.139	46.73	0.06	99.42	A
3184394-6	D	4.168	46.76	4.139	46.73	0.06	99.30	A
3184394-7	D	4.129	46.79	4.109	46.76	0.06	99.52	A
3184394-8	D	4.165	46.85	4.141	46.82	0.06	99.42	A
Supplementary information: Precondition: A: Fully discharged state. B: Undischarged state. C: First cycle in fully charged state. D: After 25 cycles ending in fully charged state. Results: A: No leakage, no venting, no short-circuit (voltage not remain 90%), no rupture, no disassembly (explosion), and no fire. B: Other (please explain)								

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.3	TABLE: Vibration							Pass
Sample No.	Pre-condition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Voltage remain (%)	Results
3184394-1	C	4.142	46.62	4.125	46.62	0.00	99.59	A
3184394-2	C	4.133	46.72	4.122	46.72	0.00	99.73	A
3184394-3	C	4.141	46.67	4.124	46.65	0.04	99.59	A
3184394-4	C	4.076	46.79	4.059	46.77	0.04	99.58	A
3184394-5	D	4.139	46.73	4.122	46.73	0.00	99.59	A
3184394-6	D	4.139	46.73	4.122	46.73	0.00	99.59	A
3184394-7	D	4.109	46.76	4.092	46.76	0.00	99.59	A
3184394-8	D	4.141	46.82	4.124	46.82	0.00	99.59	A
Supplementary information: Precondition: A: Fully discharged state. B: Undischarged state. C: First cycle in fully charged state. D: After 25 cycles ending in fully charged state. Results: A: No leakage, no venting, no short-circuit (voltage not remain 90%), no rupture, no disassembly (explosion), and no fire. B: Other (please explain)								

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.4	TABLE: Shock							Pass
Sample No.	Pre-condition	Open circuit voltage before test (V)	Mass before test (g)	Open circuit voltage after test (V)	Mass after test (g)	Mass loss (%)	Voltage remain (%)	Results
3184394-1	C	4.125	46.62	4.125	46.62	0.00	100.00	A
3184394-2	C	4.122	46.72	4.122	46.72	0.00	100.00	A
3184394-3	C	4.124	46.65	4.124	46.65	0.00	100.00	A
3184394-4	C	4.059	46.77	4.059	46.77	0.00	100.00	A
3184394-5	D	4.122	46.73	4.122	46.73	0.00	100.00	A
3184394-6	D	4.122	46.73	4.122	46.73	0.00	100.00	A
3184394-7	D	4.092	46.76	4.092	46.76	0.00	100.00	A
3184394-8	D	4.124	46.82	4.124	46.82	0.00	100.00	A
Supplementary information: Precondition: A: Fully discharged state. B: Undischarged state. C: First cycle in fully charged state. D: After 25 cycles ending in fully charged state. Results: A: No leakage, no venting, no short-circuit (voltage not remain 90%), no rupture, no disassembly (explosion), and no fire. B: Other (please explain)								

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.5	TABLE: External short-circuit					Pass
Sample No.	Pre-condition	Open circuit voltage before test (V)	Open circuit voltage after test (V)	Maximum case temperature (°C)	Total external resistance (Ω)	Results
3184394-1	C	4.125	--	55.1	0.06543	A
3184394-2	C	4.122	--	55.9	0.06557	A
3184394-3	C	4.124	--	55.7	0.06939	A
3184394-4	C	4.059	--	57.0	0.06951	A
3184394-5	D	4.122	--	56.6	0.06543	A
3184394-6	D	4.122	--	55.0	0.06557	A
3184394-7	D	4.092	--	54.2	0.06939	A
3184394-8	D	4.124	--	54.9	0.06951	A
Supplementary information: Precondition: A: Fully discharged state. B: Undischarged state. C: First cycle in fully charged state. D: After 25 cycles ending in fully charged state. Results: A: No excessive temperature rise (above 170°C), no rupture, no disassembly (explosion), and no fire. B: Other (please explain)						

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.6a	TABLE: Impact			N/A
Sample No.	Precondition	Open circuit voltage before test (V)	Maximum case temperature (°C)	Results
Supplementary information: Precondition: A: Undischarged. B: Fully discharged. C: First cycle in one-half discharged state. D: After 25 cycles in one-half discharged state. Results: A: No excessive temperature rise (above 170°C), no disassembly (explosion), and no fire. B: Other (please explain)				

38.3.4.6b	TABLE: Crush						N/A
Sample No.	Open circuit voltage before test (V)	Voltage drop of the cell (mV)	Applied force (kN)	Thickness before test (mm)	Thickness after test (mm)	Maximum case temperature (°C)	Results
Supplementary information: Precondition: A: Undischarged. B: Fully discharged. C: First cycle in one-half discharged state. D: After 25 cycles in one-half discharged state. Results: A: No excessive temperature rise (above 170°C), no disassembly (explosion), and no fire. B: Other (please explain)							

UN 38.3			
Clause	Requirement + Test	Result - Remark	Verdict

38.3.4.7	TABLE: Overcharge					Pass
Sample No.	Precondition	Open circuit voltage before test (V)	Maximum charging current (mA)	Maximum charging voltage (V)	Total charging time (h)	Results
3169370-1-S1	A	4.156	2600	8.4	24	A
3169370-1-S2	A	4.153	2600	8.4	24	A
3169370-1-S3	A	4.149	2600	8.4	24	A
3169370-1-S4	A	4.152	2600	8.4	24	A
3169370-1-S5	B	4.163	2600	8.4	24	A
3169370-1-S6	B	4.155	2600	8.4	24	A
3169370-1-S7	B	4.158	2600	8.4	24	A
3169370-1-S8	B	4.152	2600	8.4	24	A
Supplementary information: Precondition: A: First cycle in fully charged state. B: After 25 cycles ending in fully charged state. Results: A: No disassembly (explosion), and no fire. B: Other (please explain)						

38.3.4.8	TABLE: Forced discharge				N/A
Sample No.	Precondition	Open circuit voltage before test (V)	Measured reverse charging current (mA)	Total time for reversed charging application (min)	Results
Supplementary information: Precondition: A: Fully discharged state. B: First cycle in fully discharged state. C: After 25 cycles ending in fully discharged state. Results: A: No disassembly (explosion), and no fire. B: Other (please explain)					

ENCLOSURE

Supplement Id	Description
01-01~01-02	Overall view
02-01~02-02	Internal view
03	Battery assembly Layout
04	PWB layout
05	Specification
06	Date code information
07	Pack Dimension Drawing
08	Packaging Method
09	Safety Instruction

ID 01-01



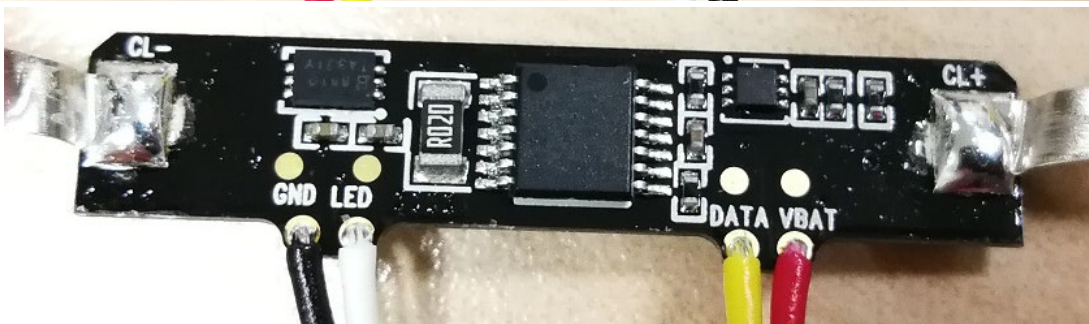
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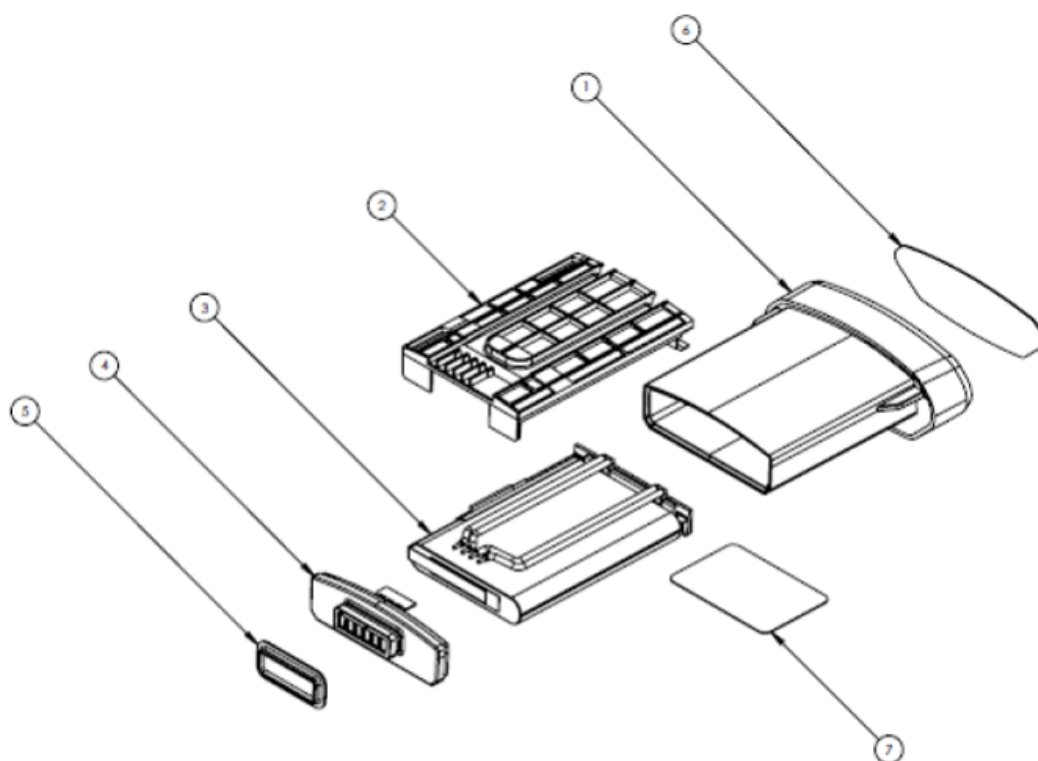
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ID 02-02

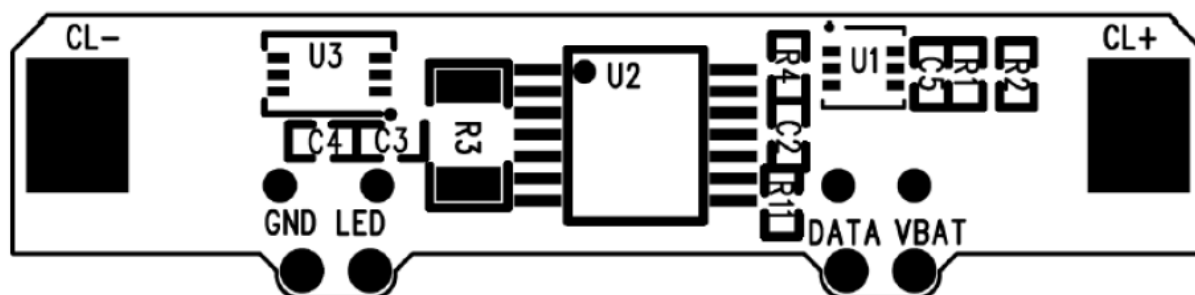


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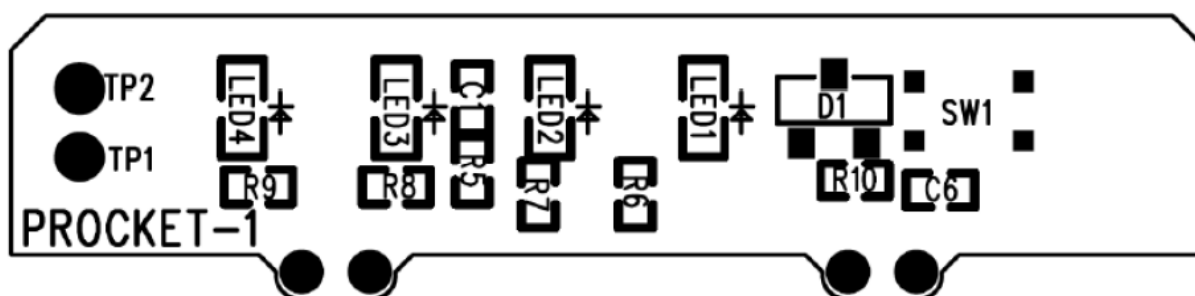


DESCRIPTION	PART NO.	ITEM NO.	QTY.
Battery Housing With Overmold, B27	C011522	1	1
Battery Cell Holder, B27	C011530	2	1
Core Pack Assembly, B27	C011730	3	1
Battery End Cap, 4 Contacts, B27	C011524-001	4	1
Battery Contact Seal, B27	C011519	5	1
Battery Status Overlay, B27	C011525	6	1
Label, Serial Product, B27	C011529	7	1

ID 04



2. Bottom



ID 05

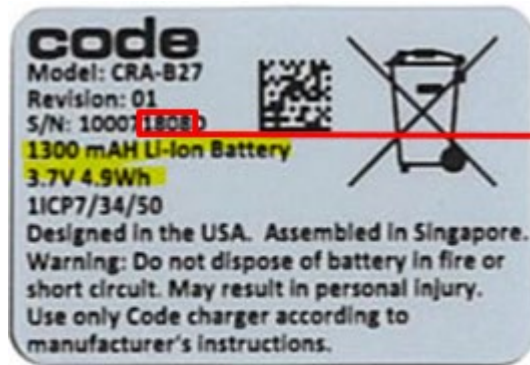
DESCRIPTION AND MODEL

- a. Description : Lithium Ion Battery Pack
- b. Cell : Panasonic UF653450SQ
- c. Configuration : 1 series and 1 parallel (1 cell)
- d. Model Name : CRA-B27

GENERAL SPECIFICATIONS

a.	Rated Capacity	1300mAh
b.	Charging Voltage	4.20V
c.	Nominal Voltage	3.70V
d.	Standard Charge	Constant Current followed by Constant Voltage
		665mA constant charge till pack reaches 4.20V current reduced to keep 4.20V.
e.	Max continuous charge current	1300mA
f.	Standard Discharge	650mA discharge till 3.0V @ 25°C
g.	Max continuous discharge current	1900mA
h.	Operating Temperature (Charging)	0degC to 45degC
i.	Operating Temperature (Discharging)	-20degC to 60degC

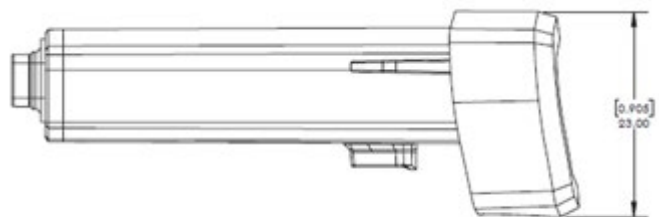
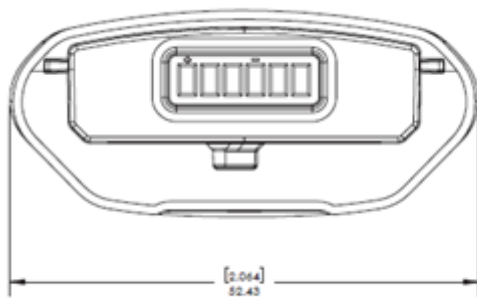
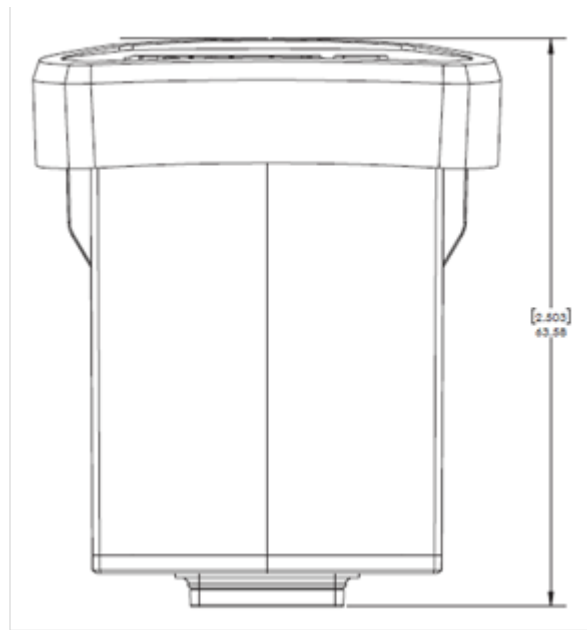
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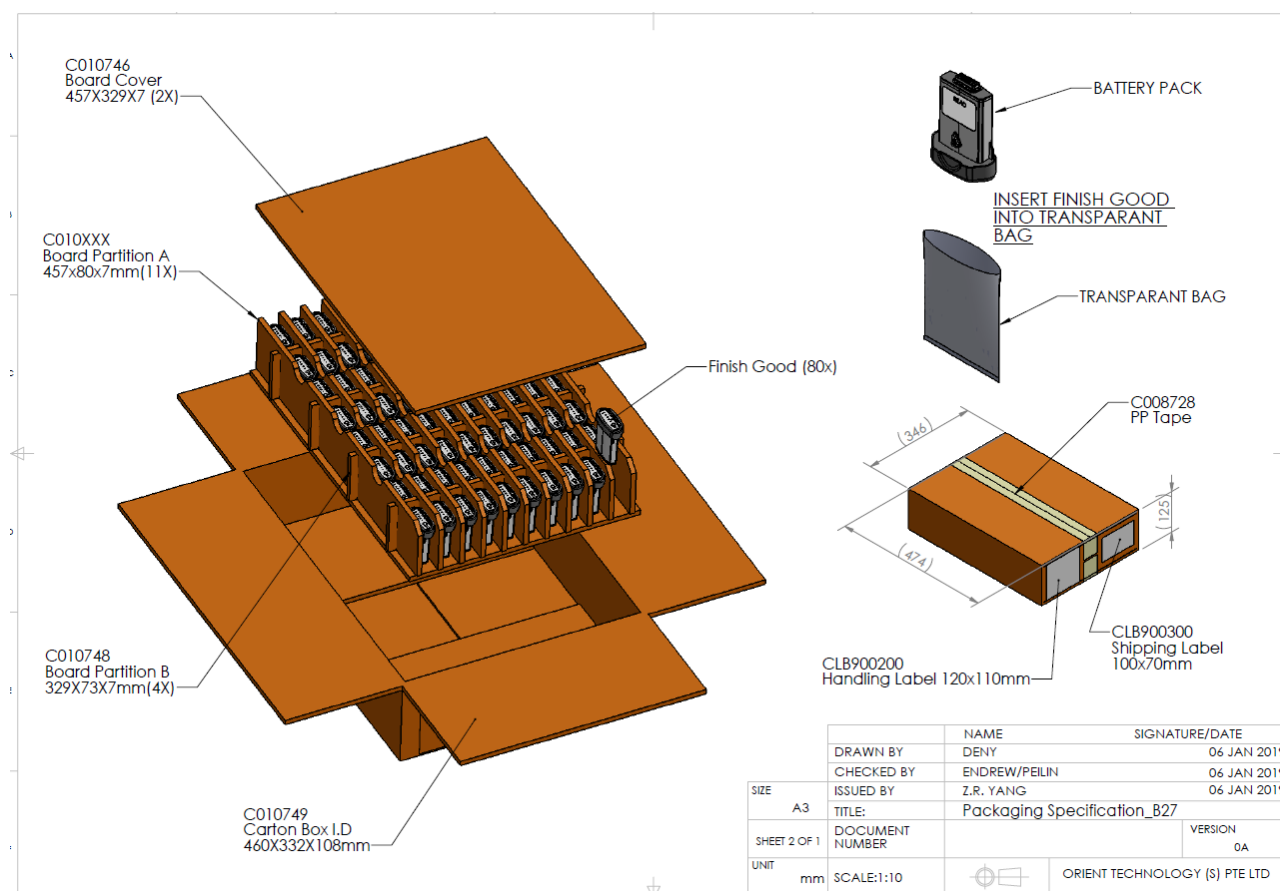
lot number date code is
included in the serial number.
The 4 digits inside the red box is the date code.
YYMM

YY: year
MM: month

ID 07



ID 08



ID 09

USA: Lithium ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream. These batteries, however, do contain recyclable materials and are accepted for recycling by Call2Recycle, Inc. Please go to their website at www.call2recycle.org for additional information.

In the European Union, manufacturing, handling and disposal of batteries is regulated on the basis of the DIRECTIVE 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC. Customers find detailed information on disposal in their specific countries using the web site of the European Portable Batteries Association (http://www.epbaeurope.net/legislation_national.html).

Importers and users outside EU should consider the local law and rules. In order to avoid short circuit and heating, used lithium ion batteries should never be stored or transported in bulk. Proper measures against short circuit are:

- Storage of batteries in original packaging
- Coverage of the terminals
- Embedding in dry sand