UN 38.3 Test Report

Battery Pack

Customer: WU'S TECH CO., LTD.

Model: T4Q-2403GA

Nominal Voltage: 25.2Vdc

Nominal Capacity: 10.35Ah, 260.82Wh

Configuration: 7S-3P

Cell Type: NCR18650GA

Date of issue: 2022-01-25

Reviewed by Rex Ni

Prepared by Paul Chang

1. UN 38.3 Test Report					
Test Period	2021-11-23~2021-12-24		Test Spec.	Manual of Tests and Criteria ST/SG/AC.10/11/ Rev.7/ Section 38.3	
Parts Name	Rechargeable Lithium-Ion Battery Pack	Application	Portable unit	Quantity	16 pieces (Sample No.001~008 reused)

1.1 Test Summary

Item	Test Item	Test Result	Details
T.1	Altitude simulation test (UN 38.3.4.1)	Pass	Page 04
T.2	Thermal test (UN 38.3.4.2)	Pass	Page 05
T.3	Vibration test (UN 38.3.4.3)	Pass	Page 06
T.4	Shock test (UN 38.3.4.4)	Pass	Page 07
T.5	Short Circuit test (UN 38.3.4.5)	Pass	Page 08
T.6	Impact / Crush test (UN 38.3.4.6)	N/A	--
T.7	Overcharge test (UN 38.3.4.7)	Pass	Page 09
T.8	Forced discharge test (UN 38.3.4.8)	N/A	--

Note:

1. This is a new project.
2. The sample is a Li-ion battery.
3. The battery pack passed the UN38.3 test.

1.2 Test sample list

Sample No. for ~~cell /~~ pack	Test Item
001~004	T.1~T.5 first cycle, fully charged state
005~008	T.1~T.5 25th cycle, fully charged state
--	T.6 first cycle, 50% charged state
--	T.6 25th cycle, 50% charged state
009~012	T.7 first cycle, fully charged state
013~016	T.7 25th cycle, fully charged state
--	T.8 first cycle, fully discharged state
--	T.8 25th cycle, fully discharged state

Table 38.3.1: Mass loss limit

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

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

$$\text{Mass loss (\%)} = \frac{(M_1 - M_2)}{M_1} \times 100$$

1.3 Test result

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.1	Altitude Simulation Test (UN 38.3.4.1)	1-1. All batteries weight is measured. The charged batteries voltage are measured and recorded. 1-2. Batteries shall be stored at a pressure of 11.6Kpa or less for at least six hours at ambient temperature 20±5°C. 1-3. Vacuum is released. All batteries weight is measured. The charged batteries voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 small batteries at first cycle, in fully charged states. (Battery #001~004) 4 small batteries after 25 cycles ending in fully charged states. (Battery #005~008)
Test Period		Start: 2021-12-07 / 09:30 End: 2021-12-07 / 15:30		
Test Equipment		I00305, I00722, I00723, I00724, I00725, I00749, I00686, I00644, I00707		
Major Problem		N/A		
Warning Point		N/A		
Recommendation		The battery packs passed the test.		

Raw Data :

T1: Altitude Simulation Test

Sample No.	Before Test		After Test		Difference		Result
	Open-circuit voltage (V)	Weight (g)	Open-circuit voltage (V)	Weight (g)	Voltage (%)	Weight (%)	
001	29.20	1977.5	29.20	1977.0	0.00%	0.03%	Pass
002	29.20	1981.5	29.19	1980.5	0.03%	0.05%	Pass
003	29.18	1977.5	29.17	1976.5	0.03%	0.05%	Pass
004	29.17	1981.0	29.17	1980.0	0.00%	0.05%	Pass
005	29.20	1975.5	29.19	1975.0	0.03%	0.03%	Pass
006	29.20	1980.5	29.19	1980.0	0.03%	0.03%	Pass
007	29.23	1985.5	29.22	1985.0	0.03%	0.03%	Pass
008	29.12	1972.5	29.12	1972.0	0.00%	0.03%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.2	Thermal Test (UN 38.3.4.2)	2-1. Batteries are stored for 6 hours at 72±2°C, followed by storage for 6 hours at -40±2°C. The maximum time interval between test temperature extremes is 3 minutes. 2-2. Repeat 2-1 for 10 times. Then store the batteries at ambient for 24 hours. All batteries weight are measured. The charged batteries voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 small batteries at first cycle, in fully charged states. (Battery #001~004) 4 small batteries after 25 cycles ending in fully charged states. (Battery #005~008)

Test Period	Start: 2021-12-07 End: 2021-12-14
Test Equipment	I00644, I00705, I00686, I00749
Major Problem	N/A
Warning Point	N/A
Recommendation	The battery packs passed the test.

Raw Data :

T2: Thermal Test

Sample No.	Before Test		After Test		Difference		Result
	Open-circuit voltage (V)	Weight (g)	Open-circuit voltage (V)	Weight (g)	Voltage (%)	Weight (%)	
001	29.20	1977.0	28.85	1975.5	1.20%	0.08%	Pass
002	29.19	1980.5	28.84	1979.0	1.20%	0.08%	Pass
003	29.17	1976.5	28.84	1975.0	1.13%	0.08%	Pass
004	29.17	1979.0	28.83	1978.0	1.17%	0.05%	Pass
005	29.19	1975.0	28.84	1973.5	1.20%	0.08%	Pass
006	29.19	1980.0	28.84	1978.5	1.20%	0.08%	Pass
007	29.22	1985.0	28.85	1983.5	1.27%	0.08%	Pass
008	29.12	1972.0	28.80	1971.0	1.10%	0.05%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.3	Vibration Test (UN 38.3.4.3)	3-1. Batteries are firmly secured to the platform of the vibration machine without distorting the packs in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 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 3 mutually perpendicular to the terminal face. 3-2. The logarithmic frequency sweep is as follows: For small batteries: 7-18 Hz ➔ 1gn 18-50 Hz ➔ 0.8mm amplitude 50-200 Hz ➔ 8gn For large batteries: 7-18 Hz ➔ 1gn 18-25 Hz ➔ 0.8mm amplitude 25-200 Hz ➔ 2gn 3-3. All batteries weight are measured. The charged batteries voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%	4 small batteries at first cycle, in fully charged states. (Battery #001~004) 4 small batteries after 25 cycles ending in fully charged states. (Battery #005~008)

Test Period	Start: 2021-12-14 End: 2021-12-16
Test Equipment	I00644, I00708, I00686, I00749
Major Problem	N/A
Warning Point	N/A
Recommendation	The battery packs passed the test.

Raw Data :

T3: Vibration Test

Sample No.	Before Test		After Test		Difference		Result
	Open-circuit voltage (V)	Weight (g)	Open-circuit voltage (V)	Weight (g)	Voltage (%)	Weight (%)	
001	28.85	1975.5	28.85	1975.5	0.00%	0.00%	Pass
002	28.84	1979.0	28.84	1979.0	0.00%	0.00%	Pass
003	28.84	1975.0	28.83	1975.0	0.03%	0.00%	Pass
004	28.83	1978.0	28.83	1978.0	0.00%	0.00%	Pass
005	28.84	1973.5	28.84	1973.5	0.00%	0.00%	Pass
006	28.84	1978.5	28.84	1978.5	0.00%	0.00%	Pass
007	28.85	1983.5	28.84	1983.5	0.03%	0.00%	Pass
008	28.80	1971.0	28.80	1971.0	0.00%	0.00%	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.4	Shock Test (UN 38.3.4.4)	4-1. Batteries shall be secured to the testing machine by means of a rigid mount, which will support all mounting surfaces. 4-2. Batteries shall be subjected to a half-sine shock of cell acceleration 150gn and pulse duration of 6 milliseconds. Each batteries shall be subjected to 3 shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicularly mounting positions of the batteries for a total of 18 shocks. 4-3. All batteries weight are measured. The charged batteries voltage are measured and recorded.	No mass loss (<0.1%), no leakage, no venting, no disassembly, no rupture and no fire. Battery voltage drop < 10%.	4 small batteries at first cycle, in fully charged states. (Battery #001~004) 4 small batteries after 25 cycles ending in fully charged states. (Battery #005~008)

Test Period	Start: 2021-12-16 End: 2021-12-16
Test Equipment	I00644, I00706, I00686, I00749
Major Problem	N/A
Warning Point	N/A
Recommendation	The battery packs passed the test.

Raw Data :

T4: Shock Test

Sample No.	Before Test		After Test		Difference		Result
	Open-circuit voltage (V)	Weight (g)	Open-circuit voltage (V)	Weight (g)	Voltage (%)	Weight (%)	
001	28.85	1975.5	28.84	1975.5	0.03%	0.00%	Pass
002	28.84	1979.0	28.83	1979.0	0.03%	0.00%	Pass
003	28.83	1975.0	28.82	1975.0	0.03%	0.00%	Pass
004	28.83	1978.0	28.82	1978.0	0.03%	0.00%	Pass
005	28.84	1973.5	28.83	1973.5	0.03%	0.00%	Pass
006	28.84	1978.5	28.83	1978.5	0.03%	0.00%	Pass
007	28.84	1983.5	28.83	1983.5	0.03%	0.00%	Pass
008	28.80	1971.0	28.79	1971.0	0.03%	0.00%	Pass

Small batteries (150 gn or result of formula whichever is smaller):

Mass: 1.98 (kg)

Acceleration (g_n)= $\sqrt{\frac{100850}{\text{mass}}}$ = 225.69 (g_n)

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.5	Short Circuit Test (UN 38.3.4.5)	5-1. Batteries are placed in to a 57±4°C oven, and exterior packs temperature are monitored 5-2. When batteries exterior reach 57±4°C, they are shorted by connecting terminals with a copper wire of resistance less than 100m Ohm. 5-4. The short was continued for more than 1hour or the batteries temperature return to 57±4°C. The batteries are observed for a further 6 hours.	No rupture, no disassembly, no explosion, no fire, no smoke. Batteries exterior peak temperature <170°C.	4 small batteries at first cycle, in fully charged states. (Battery #001~004) 4 small batteries after 25 cycles ending in fully charged states. (Battery #005~008)
Test Period		Start: 2021-12-16 End: 2021-12-24		
Observed Time		6 Hours		
Test Equipment		I00325, I00312, I00749, I00480, I00644		
Major Problem		N/A		
Warning Point		N/A		
Recommendation		The battery packs passed the test.		

Raw Data :

T5: External Short Circuit Test			
Sample No.	Open circuit voltage (V)	Battery pack case max. temperature (℃)	Result
001	28.84	59	Pass
002	28.83	58.3	Pass
003	28.82	57.3	Pass
004	28.82	58.1	Pass
005	28.83	58.8	Pass
006	28.83	57.3	Pass
007	28.83	57.3	Pass
008	28.79	57	Pass

Item	Test Item	Test specification	Judge criteria	Sample(s)
T.7	Overcharge test (UN 38.3.7)	7-1. The charge current shall be twice the Spec's recommended maximum continuous charge current. 7-2.The minimum voltage of the test shall be as follows: (a) When the Spec'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 Spec's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage. 7-3. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.	No disassembly, no fire within seven days of the test.	4 small batteries at first cycle, in fully charged states. (Battery #009~012) 4 small batteries after 25 cycles ending in fully charged states. (Battery #013~016)

Test Period	Start: 2021-12-09/09:45 End: 2021-12-10/09:45 Start: 2021-12-13/09:19 End: 2021-12-13/09:19
Observed Time	Start: 2021-12-10/09:45 End: 2021-12-17/09:45 Start: 2021-12-13/09:19 End: 2021-12-20/09:19
Test Equipment	I00749, I00263, I00607, I00029, I00030, I00082, I00121
Major Problem	N/A
Warning Point	N/A
Recommendation	The battery packs passed the test.

Raw Data :

T7: Overcharge Test				
Sample No.	Charge voltage (V)	Charge current (A)	Battery pack case max. temperature (°C)	Result
009	35.28	15	18.9	Pass
010	35.28	15	18.8	Pass
011	35.28	15	18.9	Pass
012	35.28	15	18.7	Pass
013	35.28	15	19.5	Pass
014	35.28	15	19.3	Pass
015	35.28	15	19.3	Pass
016	35.28	15	19.2	Pass