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VTC5A BATTERY PACK INSPECTION

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Product: Electric Skateboard

Company: Globe Brand

1 CONTENTS

2 INTRODUCTION

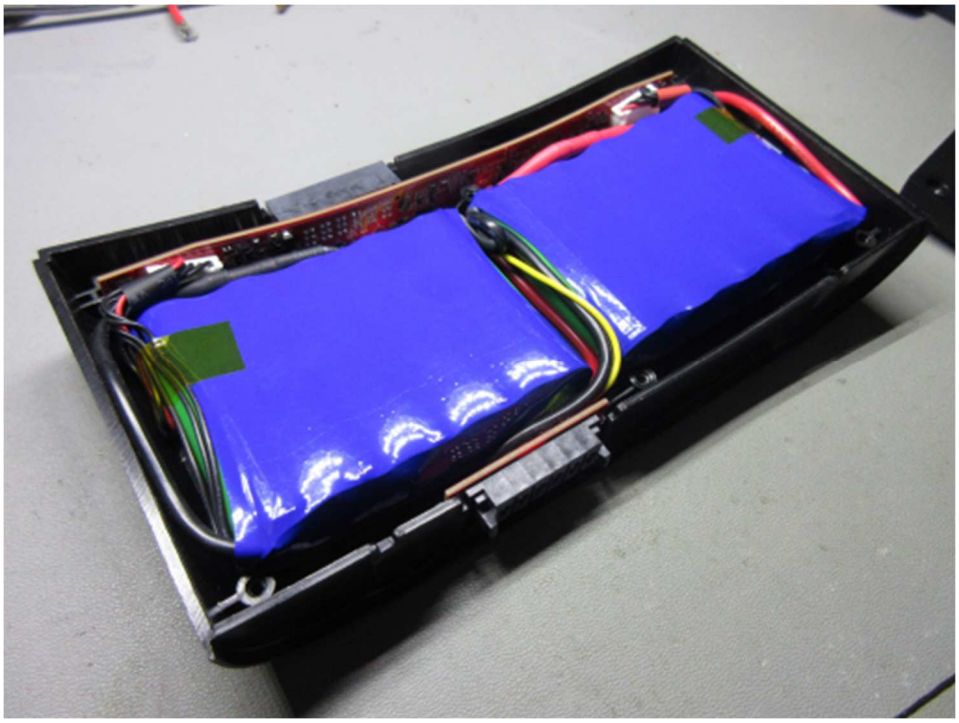
New production Murata VTC5A cell packs inspected.

Of particular interest is to gain confidence the cells are genuine Murata VTC5A. Not fakes.

3 BATTERY PACK ASSEMBLY

Three VTC5A battery packs were available for testing. One was examined in detail.

The battery pack fits neatly within an enclosure fitted with foam padding.



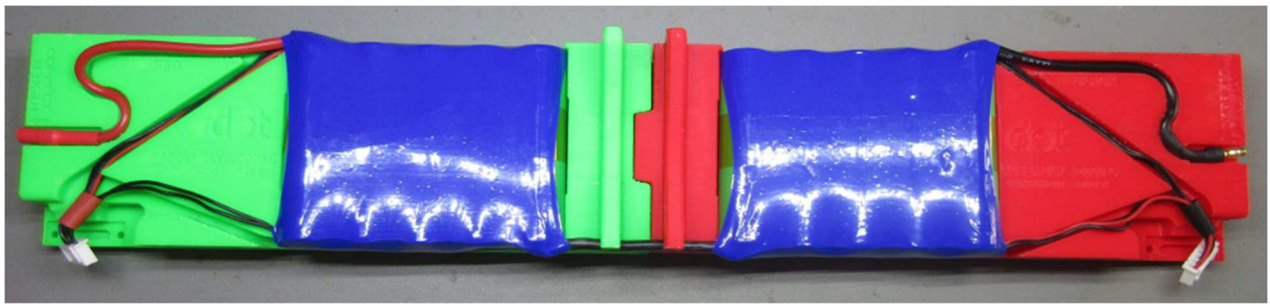
There was no difficulty assembling the enclosure with a perfect flush mounting plate fitment.

4 BATTERY PACK CONSTRUCTION

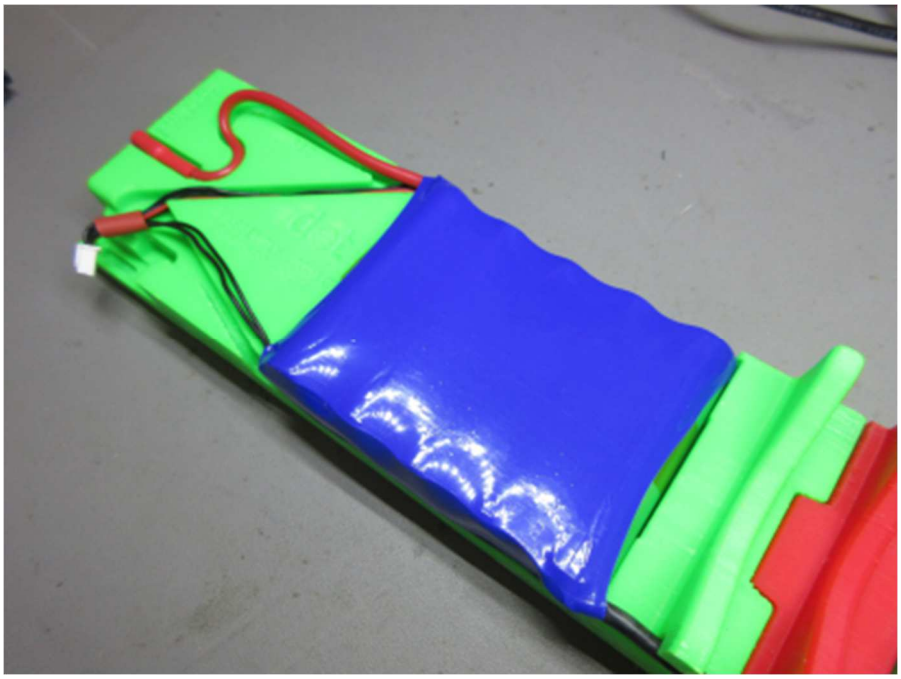
This section examines Ctechi's battery pack construction.

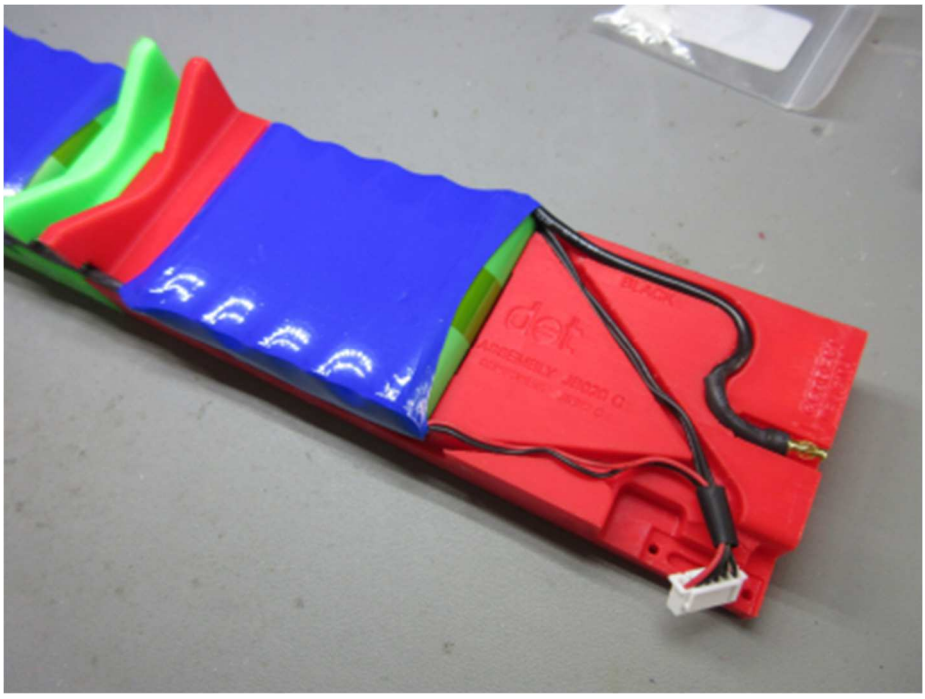
Negative terminal fitted with insulation boot, easily removed. Each half in separate bubble wrap bag.

The pack fits the assembly jig as expected. 5S cell curve as expected. The balance wiring length is good.



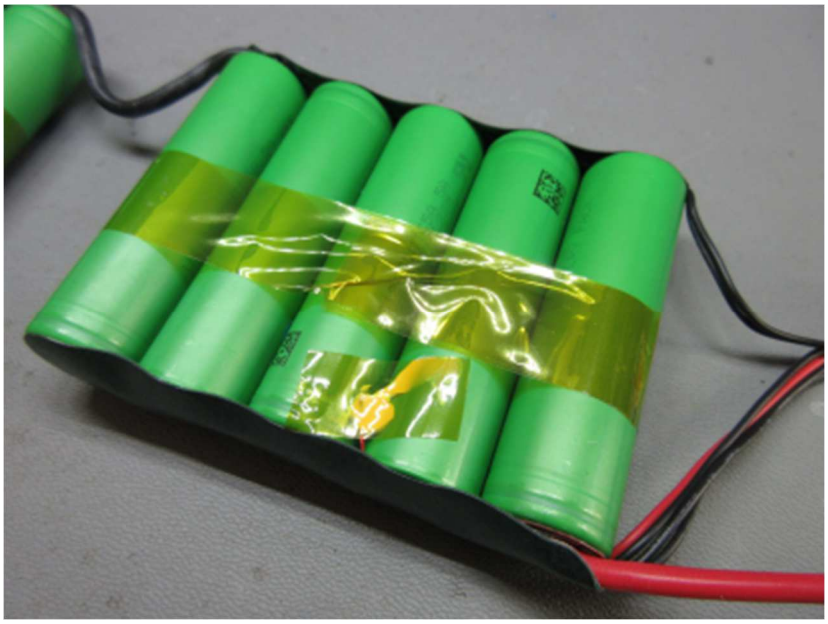
Jig was not fitted with balance connectors sockets, however the battery pack plugs reach the target location with required orientation.

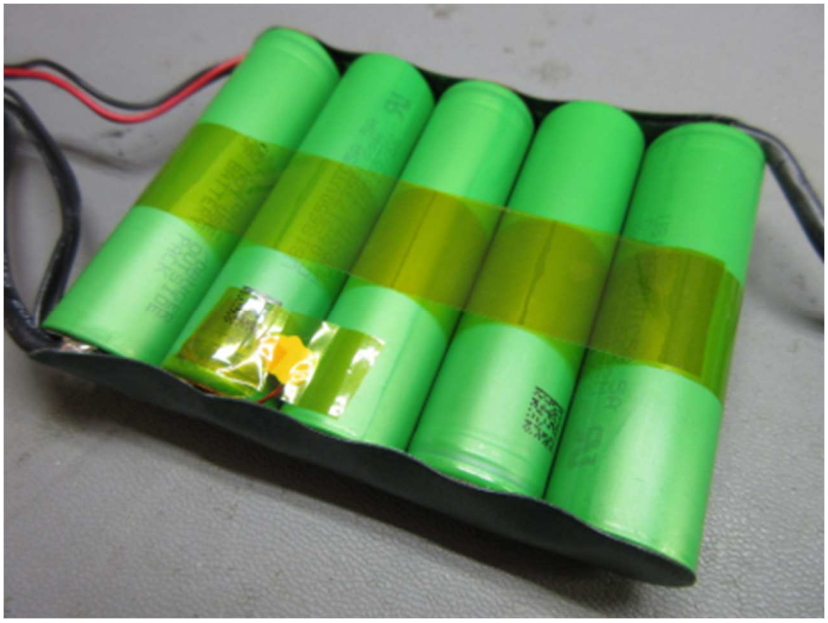




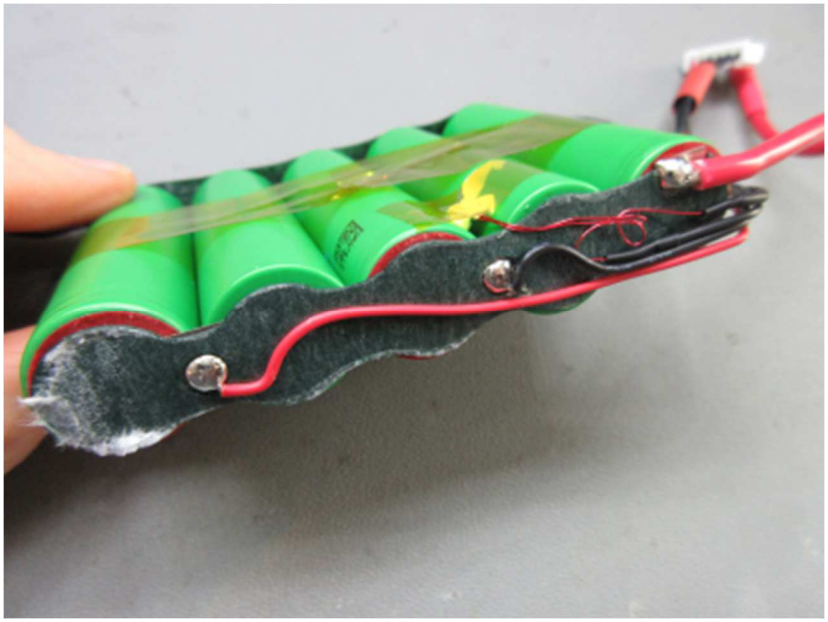
Cell packs have the expected kapton tape fitted.

Both temperature sensors fitted as required.

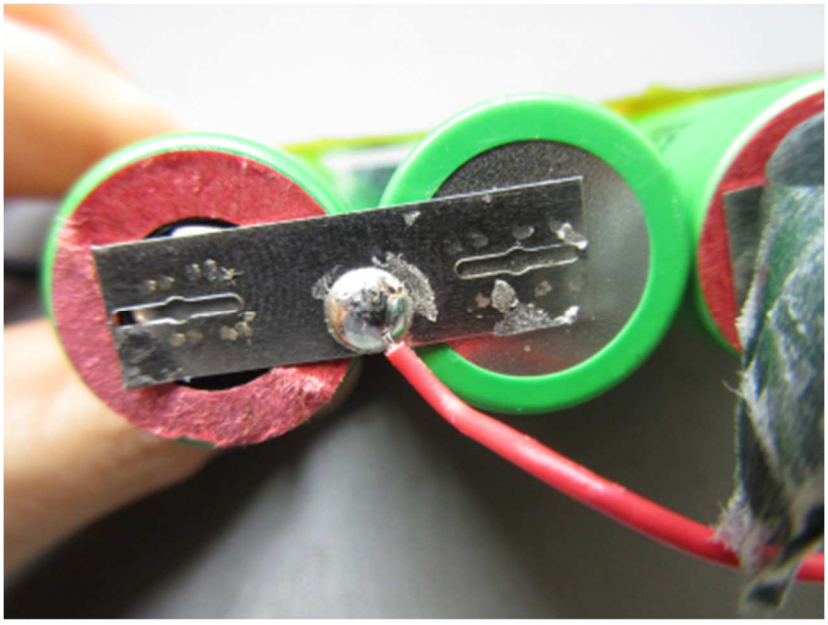




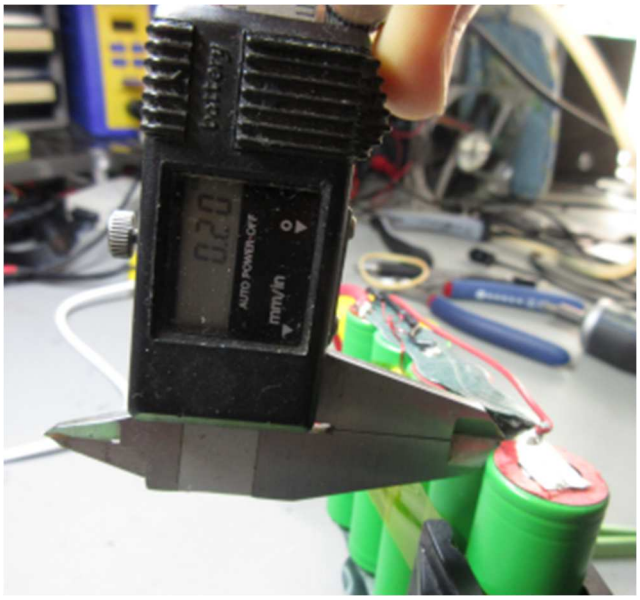
Cell end insulation is very good.



Battery tab geometry revised slightly. Slots have closed end. This change is good, as it likely gives a slightly more consistent weld series end to end. Spot welds secure, not popping off with reasonable leverage.



Tab thickness to 0.2mm spec.



Tab width to 8mm spec.

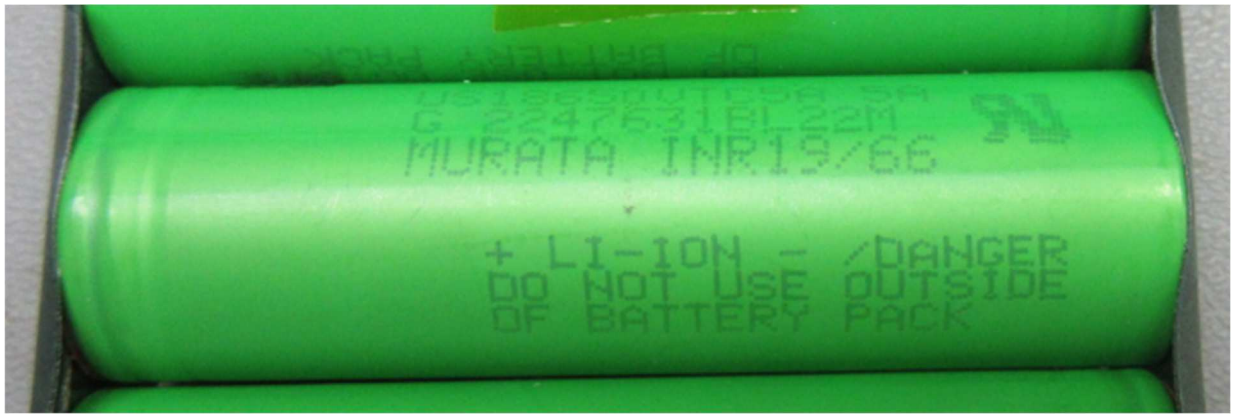
The battery pack assembly is as per design expectation. Considered good quality construction.

5 US18650VTC5A CELL INSPECTION

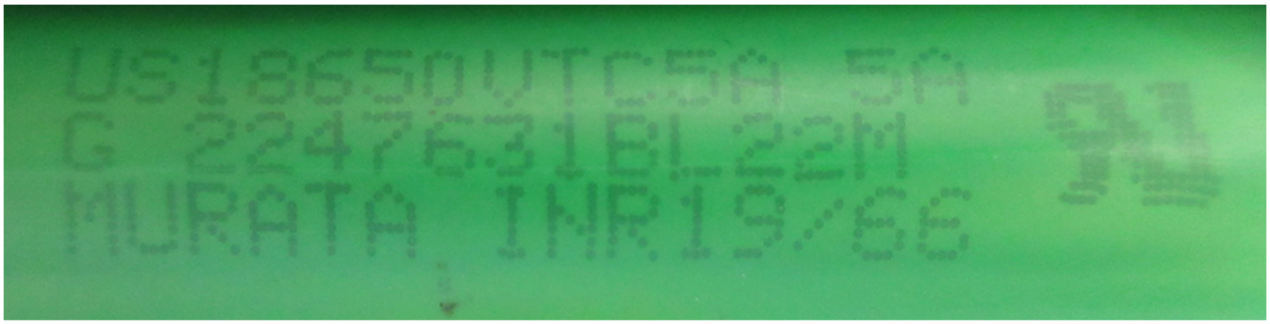
A primary objective is to analyse the cells to determine if they are fake and/or not performing as expected. Confidence they are geninue is based on the accummulation and compliance to all areas examined.

5.1 MARKINGS

Cell markings below.



Identification marking…

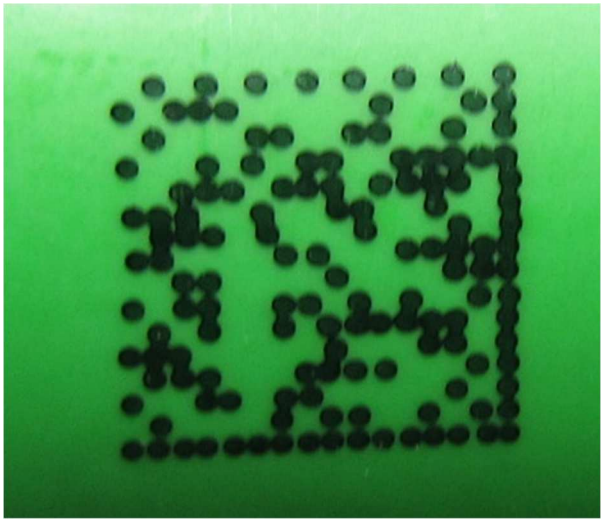


The VTC5A datasheet available shows labeling specifics for Sony Energy Devices Corp., but not Murata labeling. Therefore there is no specific validation source available. Murata website was checked.

The encoded date code reads 22nd December 2019.

This matches the original advisory from Ctechi, "VTC5A 18900 pcs (one pallet) **d/c: 12/2019** $3.58/ea FOB Shenzhen 1 week."

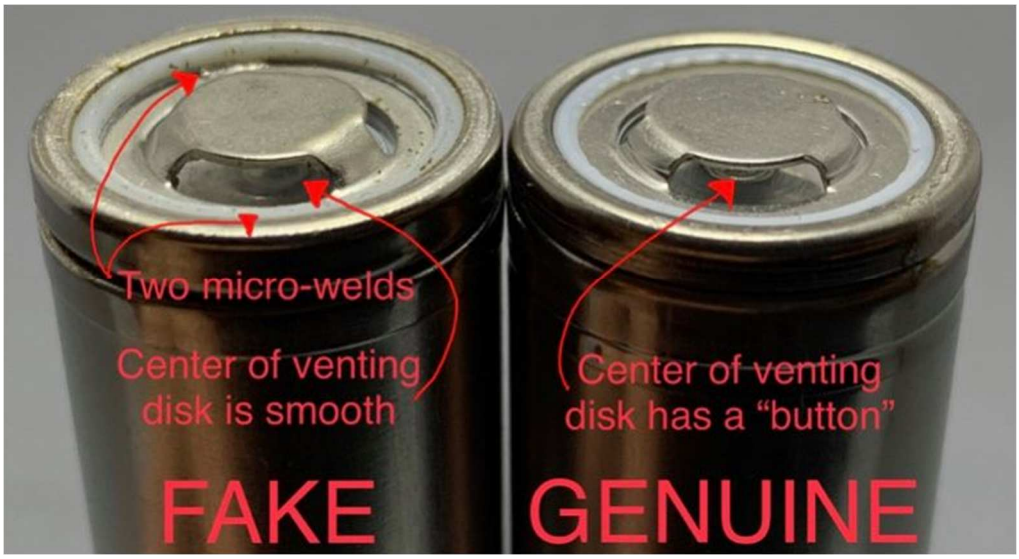
QR code not readable.



5.2 CONSTRUCTION

A known internet source for analyzing cell authenticity, known as Mooch, had available data on cell construction for a known genuine VTC5A and example fake cell construction. Image below shows the comparison.

The supplied VTC5A cell has the expected double ring feature.



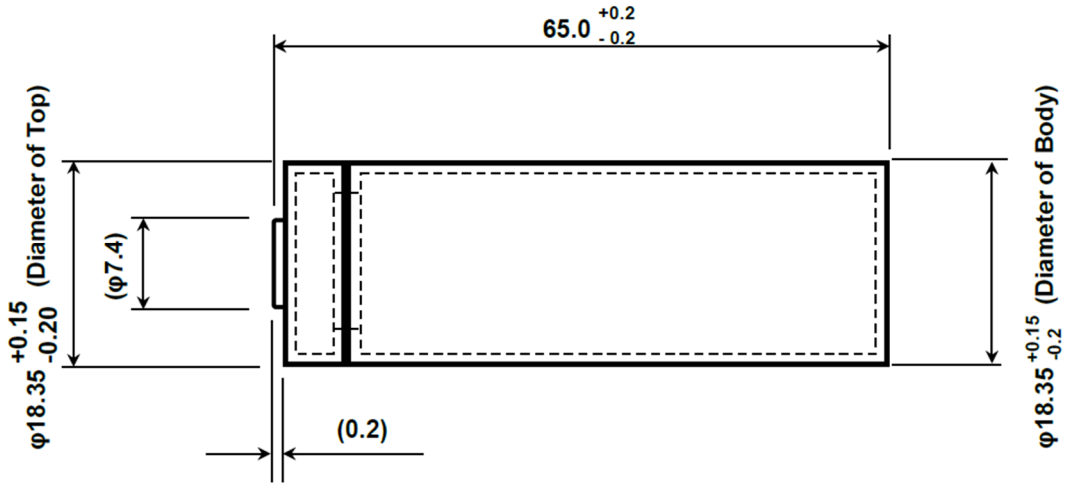
The supplied VTC5A cell features the expected single "button" shaped vent, congreant with the genuine reference. This is more evident on close inspection than the image captured.

The cell dimensions were checked against the technical Information data on the VTC5A.

Technical information…

1.2 Cell Shape and Weight

1.2.1 Cell Shape	: Cylindrical	
*1.2.2 Size (*with plastic tube)	: Diameter	18.50mm max
	Length	65.20mm max
1.2.3 Weight	: 47.1g Average	



Measured 64.91mm length with kapton tape either end and insulation ring on positive.

Diameter 18.26mm, 18.25mm, measured at ~1/3 length interval.

Dimensions are considered consistent with the technical information.

6 PERFORMANCE

6.1 VOLTAGE MEASUREMENTS

Measurements from a battery module.

```
Measurements
- Battery                : 34238mV       --

Cell Voltages
- Cell 0                 : 3418mV        --
- Cell 1                 : 3422mV        --
- Cell 2                 : 3409mV        --
- Cell 3                 : 3428mV        --
- Cell 4                 : 3422mV        --
- Cell 5                 : 3422mV        --
- Cell 6                 : 3422mV        --
- Cell 7                 : 3422mV        --
- Cell 8                 : 3426mV        --
- Cell 9                 : 3423mV        --

Temperature Sensors
- PCB                    : 25.3'C        --
- Cells 0-4              : 25.5'C        --
- Cells 5-9              : 25.6'C        --

Battery Metrics
- State of Charge        : 0.0%
- Current Capacity       : 0.00Wh
```

Bench Measurement

- Battery : 34402mV

```
Cell Voltages
- Cell 0                 : 3444mV
- Cell 1                 : 3440mV
- Cell 2                 : 3441mV
- Cell 3                 : 3443mV
- Cell 4                 : 3442mV
- Cell 5                 : 3440mV
- Cell 6                 : 3441mV
- Cell 7                 : 3440mV
- Cell 8                 : 3440mV
- Cell 9                 : 3441mV
```

6.2 CELL CAPACITY REFERENCE DATA

Technical Information

US18650VTC5A

Nominal Capacity at 0.2ItA	**2600mAh 9.36Wh**	**discharge 2.0V cut off at 23℃**
Rated Capacity at 0.2ItA	**2500mAh 9.0Wh**	**discharge 2.0V cut off at 23℃**
Capacity at 1ItA (typ.)	**2524mAh 9.05Wh**	**discharge 2.5V cut off at 23℃**
Capacity at 10A (typ.)	**2516mAh 8.66Wh**	**discharge 2.5V cut off at 23℃**
Nominal Voltage	**3.6V**	
Internal Impedance	**10mΩ Typ.**	**measured by AC1kHz**
Cycle Performance	**70% Min. of Initial capacity at 500 cycles**	**10A discharge**

For future reference, Murata's UN38.3 battery transport information states 9.0Wh.

Description of cell or battery to include at a minimum: Lithium ion or Lithium metal cell or battery; Mass; Watt-hour rating, or lithium content; Physical description of the cell/battery; and Model

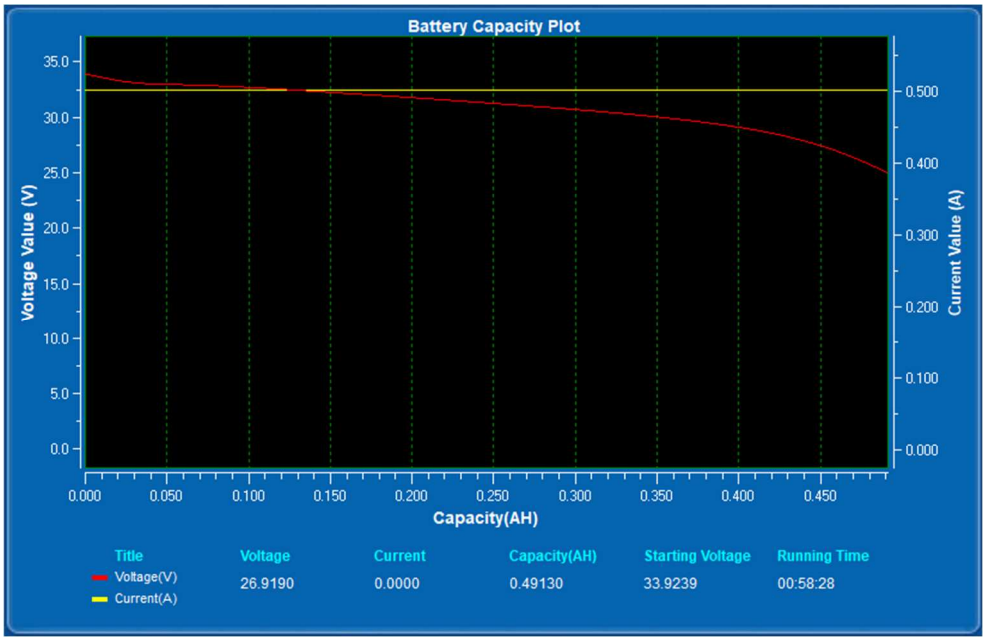
Cell/battery Type : Lithium Ion
Cell or Battery : Cell
Cell or Battery Weight : 16.0 g
LC or W/h rating : 9.0 Wh
Physical description
: Lithium Ion Rechargeable Cells

编号 NO.	开路电压（V） Battery voltage	2A放电带电量（mAh） Charged capacity(Constant current 2A, end voltage 2.5V)	2A充满容量（mAh） capacity--2A CC(constant current)charged to4.2v, then CV(constant voltage 4.2V)charge till charge current decline to≤0.02C;ge Constant current 2A, end voltage 2.5V	2A放电容量（mAh） capacity--2A CC(constant current)charged to4.2V, then CV(constant voltage 4.2V)charge till charge current decline to≤0.02C;ge decline current 0.4A, end voltage 2.5V
1	3.463	493.4	2491.2	2476.9
2	3.461	497.9	2499.9	2486.2
3	3.466	500.7	2500	2485.5
4	3.462	490.2	2488	2473.0
5	3.464	495.6	2495	2479.8

6.3 STOCK CHARGE LEVEL

Battery pack charge measured at 0.49Ah, 15.05Wh. The Ah measurement is consistent with Ctech's measurement.

This represents and estimated 16.7% to 19.6% charge.



The Sony datasheet specifies…

※ Cell condition at the shipment About 55% discharged.

This however is not a specific condition. It has been more common to receive other cells around the 30% charge level. The VTC4 specification uses "Cell condition at the shipment about 70% discharged.". Actual measurements on

a battery pack reviewed 27-8-2019 found they were 15% charged. Therefore, the measured charge level is a realistic expectation and not considered non-conforming.

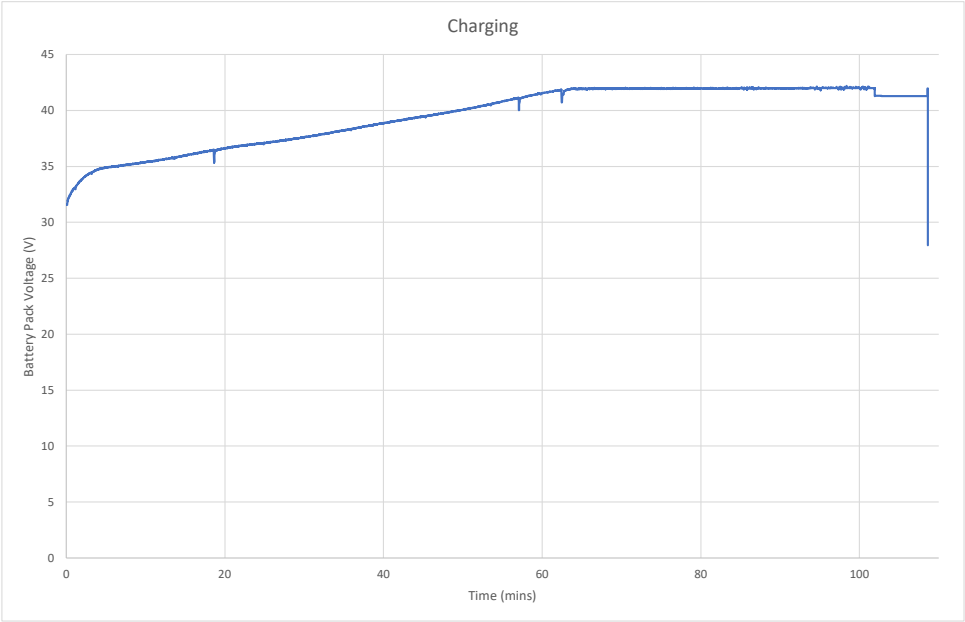
6.4 CHARGING

Charge testing was done with the 10S battery, not a individual cell. This enables 10 cells to be tested simultaneously. It is not considered a significant error given the cells have very well matched rested voltage and the charging system performance is well known.

The charging CC limit is 2.2A, CV 4.2V. This is close enough to the 1ItA capacity reference for cell validation.

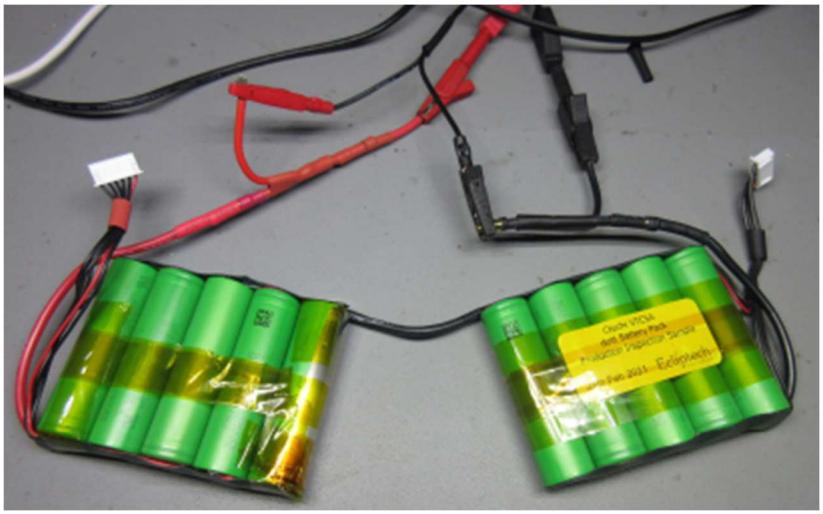
The bulk of the charge finished in ~85 minutes. Charging finished in 102 minutes.

Dips are as per the charging systems automatic zero-current calibration at 36, 41 and 42 volts.

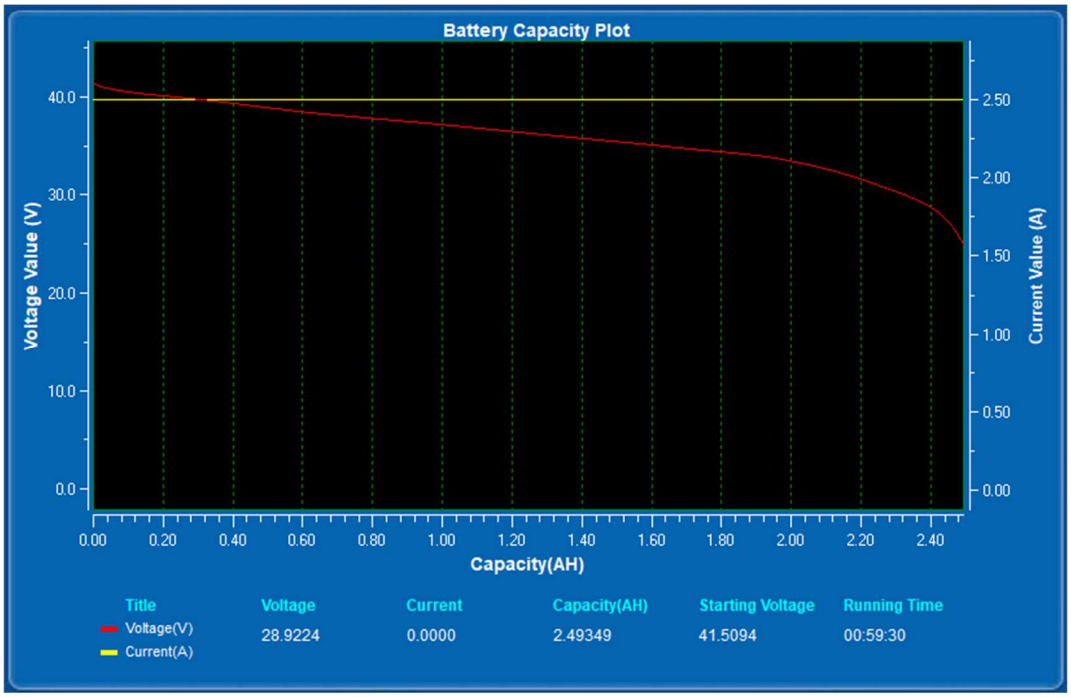


6.5 CAPACITY MEASUREMENTS

Discharge Test.



Discharge at 2.5A. No rest from charging given.



Measured 2493mAh, 10S.

Ctechi's five cell tests averaged 2495mAh, consistent with the test above.

The nominal stated in the datasheet 2524mAh.

Test is deemed congruant with expectations.

Capacity calculated from recorded data, 89.01Wh. This is close to the UN38.3 90Wh classification.

7 CONCLUSION

The battery pack construction is good quality. There are no issues.

The VTC5A cells used in the pack investigated are considered genuine.

Given no concern raised with the pack investigated, the other 2 samples have not been examined in detail.

The battery pack is deemed suitable for production use.

<end of report>