

Messrs.:

Specification No. KU\*\*\*\*\*

## Product Specification

Issued Date : Dec.2018

Part Description : Cylindrical Lithium-ion Battery US18650VTC5D

Customer Part No. :

MURATA Part No. : US18650VTC5D

Acknowledgement of receipt	
We have accepted and received the attached specification	
Date:	
Company:	
Dept.:	
Representative	Received by
_____	_____
(Signature)	(Signature)
(Type)	(Type)

Person responsible

Technical Dept.

Prepared by

\_\_\_\_\_  
(Signature)  
(Type)  
Product Engineering Sect.  
Product Dept.2, Energy Device Div.  
Tohoku Murata Manufacturing Co., Ltd  
\_\_\_\_\_  
(Company name/Dept.)  
(Type)

\_\_\_\_\_  
(Signature)  
(Type)

Representative

\_\_\_\_\_  
(Signature)  
(Type)  
Product Design Sect.5  
Product Dept.2, Energy Device Div.  
Tohoku Murata Manufacturing Co., Ltd  
\_\_\_\_\_  
(Company name/Dept.)  
(Type)

CUSTOMER SIGNATURE ON TOP PAGE OF THE OFFICIAL PRODUCT SPECIFICATION IS NECESSARY FOR THE SHIPMENT OF THIS BATTERY PRODUCT. PLEASE NOTE THAT CUSTOMER AGREES BY SUCH SIGNATURE THAT IN NO EVENT SHALL WE BE LIABLE TO CUSTOMER AND ANY THIRD PARTY FOR ANY DAMAGES OR LOSSES, INCLUDING BUT NOT LIMITED TO, ANY SPECIAL INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES OR LOSSES, COMPENSATION, REIMBURSEMENT, WHICH MAY BE CAUSED BY CUSTOMER'S NON-OBSERVANCE HEREOF.



## Lithium-Ion Battery Specifications

### 1 General

#### 1.1 Scope

This product specification is applied to “Lithium-Ion Rechargeable Batteries” used for “xxxxxxxxxx”.

Please contact us when using this product for any other applications than described in the above.

#### 1.2 Product Category

Lithium-Ion Rechargeable Battery

#### 1.3 Cell Type

US18650VTC5D

#### 1.4 Cell Designation based on IEC61960.

INR19/66

#### 1.5 Acquired Safety Standard (Registration name : US18650VTC5D)

UL1642 : File No.MH12566

UL62133 : File No.MH61426

IEC62133 2nd Edition

Taiwan Commodity Inspection Act (CNS 15364)

Indian Compulsory Registration Order, IS 16046:2015

(Murata Energy Device Singapore Pte. Ltd. Product Only)

#### 1.6 Applicable Safety Standard

United Nations, Recommendations on the Transport of Dangerous Goods (UN38.3)

Japan, Electrical Appliance and Material Safety Law

#### Reference

In case of the energy density is more than 400Wh/l (see 3.4 Energy Density), it is possibility to be subject to regulation by object country. It is recommend to confirm the contents of regulation.

As of April 2018 Japan, Electrical Appliance and Material Safety Law

“<http://www.meti.go.jp/policy/consumer/seian/denan/index.htm>” (Japanese)

“<http://www.meti.go.jp/english/policy/economy/consumer/pse/index.html>” (English)

### 2 Cell Rating

Item	Rating	Note
2.1 Rated Capacity	2700mAh	Discharge at 0.2ItA, 2.0V cut-off 23±2deg.C, after Standard Charging.
2.2 Maximum Charging Voltage	4.25V	
2.3 Discharging Cut-off Voltage	2.5V	Recommended Voltage
	2.0V	Lower limited Voltage
2.4 Continuous Maximum Charging Current	6.0A	
2.5 Continuous Maximum Discharging Current	35A	(With 90deg.C temperature cut)
2.6 Allowable Environment Temperature	Charging	0~+60deg.C
	Discharging	-20~+60deg.C
2.7 Weight	46.7 ±1.5g	With tube

※ Cell condition at shipment SOC (State Of Charge ) not exceed 30% of rated capacity.

※ In the case of air transportation, it corresponds to dangerous goods according to IATA's Dangerous Goods Regulations. Depending on the rated value of the products (pack) set by the customer, there would be possibility to interfere with the Air Transport Prohibited items in case of SOC ≥ 30%.

## 2.8 Cell Temperature Specification

2.8.1 Charging Conditions						
Temperature Range / Cell Surface Temperature Range				Upper Limited Charging Voltage	Maximum Charging Current	Recommended Charging Current
1	Low Charging Temperature Range	$0\text{deg.C} \leq T < 10\text{deg.C}$	A	4.25V	2.00A	1.00A
			B	4.15V	4.00A	2.00A
2	Standard Charging Temperature Range	$10\text{deg.C} \leq T \leq 45\text{deg.C}$		4.25V	6.00A	2.70A
3	High Charging Temperature Range	$45\text{deg.C} < T \leq 60\text{deg.C}$		4.20V	6.00A	2.00A

At Low Charging Temperature range, condition A and B are both available.  
Recommended condition is B.

2.8.2 Discharging Conditions						
Discharge at cell surface temperature below 90deg.C.						

## 3 Cell Nominal Value

Item	Nominal	Note
3.1 Nominal Capacity	2800mAh	Discharge at 0.2ItA, 2.0V cut-off after Standard Charging.
3.2 Nominal Voltage	3.6V	
3.3 Charging Voltage	4.20V	
3.4 Energy Density	567Wh/l	

## 4 Performance

### 4.1 Standard Test Conditions

Test condition shall be at  $23 \pm 2\text{deg.C}$  and  $(65 \pm 20)\%RH$ . However, temperature range of  $15 \sim 30\text{deg.C}$ , humidity  $25 \sim 85\%RH$  is acceptable as far as the test reliability is assured.

### 4.2 Testing Instrument or Apparatus

#### 4.2.1 Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm specified by JIS B 7502(outside micrometer) or JIS B 7503(dial gauge).

#### 4.2.2 Voltmeter and Ammeter

Voltmeters and ammeters shall be equal or more precision instruments specified by JIS C 1102 (Indication Electric Instrument Level 0.5).

### 4.3 Standard Charging definition

Charge at a constant voltage of 4.2V and a constant current of 2.7A for 2.5 hours in  $23 \pm 2\text{deg.C}$  atmosphere.

### 4.4 Standard Discharging definition

Discharge at a constant current of 2.7A down to 2.5V in  $23 \pm 2\text{deg.C}$  atmosphere.

4.5 Electrical Performance

Item	Condition	Specification										
4.5.1 Open-Circuit Voltage	Shipping condition Measuring condition Temperature : 27 ±3deg.C Accuracy : Within ±1mV	3.250~3.530V and the OCV shall be within 0.100V in the same cell lot.										
4.5.2 AC Impedance	After Standard Charging within 3 days.(1kHz)	7mΩ~17mΩ										
	Shipping Condition.(1kHz)	7mΩ~17mΩ										
4.5.3 Capacity	1 After Standard Charging. Discharge at 0.2ItA(540mA), Cut-off Voltage 2.0V.	2700mAh or more										
	2 After Standard Charging, Standard Discharging.	2565mAh or more										
	3 After Standard Charging. Discharge at 10A(10000mA), Cut-off Voltage 2.5V.	2430mAh or more										
	4 After Standard Charging. Discharge at 20A(20000mA), Cut-off Voltage 2.5V.	2160mAh or more										
4.5.4 Charge/Discharge Cycle	Charge at 4.2V, 4.0A, cut-off current 100mA ⇔Discharge at 10A, 2.5V cut-off after 500cycles.	1620mAh or more										
4.5.5 Storage Characteristic	After Standard Charging, stored at 23deg.C for 28 days. Discharge at 10A, 2.5V cut-off as Remaining Capacity.	2185mAh or more										
	After above measurement, Discharge at 10A, 2.5V cut-off after Standard Charging. Take this value as Recovery Capacity.	2305mAh or more										
	After Standard Charging, stored at 45deg.C for 28 days. Discharge at 10A, 2.5V cut-off as Remaining Capacity.	2065mAh or more										
	After above measurement, Discharge at 10A, 2.5V cut-off after Standard Charging. Take this value as Recovery Capacity.	2185mAh or more										
4.5.6 Long term Storage Characteristic	After Standard Charging, store at 23deg.C, 365days. Discharge at 10A, 2.5V cut-off after Standard Charging. Take this value as Recovery Capacity.	2185mAh or more										
4.5.7 Shipping state Storage Characteristic	After store shipping state sample under the following table conditions, Standard Discharge. And then Discharge at 0.2ItA, 2.0V cut-off, 23±2deg.C, after Standard Charging. Take this value as Recovery Capacity. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Storage Period</th> <th>Storage Temperature</th> </tr> </thead> <tbody> <tr> <td>365days</td> <td>-20deg.C ≤ T ≤ 25deg.C</td> </tr> <tr> <td>90days</td> <td>-20deg.C ≤ T ≤ 45deg.C</td> </tr> <tr> <td>28days</td> <td>-20deg.C ≤ T ≤ 60deg.C</td> </tr> </tbody> </table> <p style="text-align: center;">T: ambient temperature</p>	Storage Period	Storage Temperature	365days	-20deg.C ≤ T ≤ 25deg.C	90days	-20deg.C ≤ T ≤ 45deg.C	28days	-20deg.C ≤ T ≤ 60deg.C	2160mAh or more		
Storage Period	Storage Temperature											
365days	-20deg.C ≤ T ≤ 25deg.C											
90days	-20deg.C ≤ T ≤ 45deg.C											
28days	-20deg.C ≤ T ≤ 60deg.C											
4.5.7 Discharging Temperature Characteristic	Discharge at 10A, 2.5V cut-off below temperature after Standard Charging. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Discharging Temperature</th> <th>Capacity</th> </tr> </thead> <tbody> <tr> <td>-10deg.C</td> <td>1700mAh or more</td> </tr> <tr> <td>0deg.C</td> <td>1940mAh or more</td> </tr> <tr> <td>23deg.C</td> <td>2430mAh or more</td> </tr> <tr> <td>45deg.C</td> <td>2430mAh or more</td> </tr> </tbody> </table>	Discharging Temperature	Capacity	-10deg.C	1700mAh or more	0deg.C	1940mAh or more	23deg.C	2430mAh or more	45deg.C	2430mAh or more	Refer to the left table
Discharging Temperature	Capacity											
-10deg.C	1700mAh or more											
0deg.C	1940mAh or more											
23deg.C	2430mAh or more											
45deg.C	2430mAh or more											
4.5.8 Charging Temperature Characteristic	After Standard Discharge, Charge at 4.20V, 2.7A, 2.5h below temperature, and then Standard Discharging. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Charging Temperature</th> <th>Capacity</th> </tr> </thead> <tbody> <tr> <td>0deg.C</td> <td>2180mAh or more</td> </tr> <tr> <td>23deg.C</td> <td>2565mAh or more</td> </tr> <tr> <td>45deg.C</td> <td>2565mAh or more</td> </tr> </tbody> </table>	Charging Temperature	Capacity	0deg.C	2180mAh or more	23deg.C	2565mAh or more	45deg.C	2565mAh or more	Refer to the left table		
Charging Temperature	Capacity											
0deg.C	2180mAh or more											
23deg.C	2565mAh or more											
45deg.C	2565mAh or more											

4.6 Mechanical Performance

Item	Condition	Specification										
4.6.1 Shock Test	After Standard Charging, P-tile from height of 1.2m. Dropped in Each X, Y and Z for 3 time, with guide like as tube. Discharging 10A, Cut-off Voltage 2.5V Capacity of the 2nd time.	No leakage 2305mAh or more										
4.6.2 Vibration Test	After Standard Charging, vibration is to be applied. Discharging at 10A, Cut-off Voltage 2.5V Capacity of the 2nd time. Sinusoidal Oscillation	No leakage 2305mAh or more										
	<table border="1"> <tr> <td>Frequency(Hz)</td> <td>10~60</td> <td>60~80</td> <td>80~100</td> <td>100~125</td> </tr> <tr> <td>Acceleration(m/s<sup>2</sup>)</td> <td>20.6</td> <td>13.7</td> <td>6.9</td> <td>3.9</td> </tr> </table>		Frequency(Hz)	10~60	60~80	80~100	100~125	Acceleration(m/s <sup>2</sup> )	20.6	13.7	6.9	3.9
	Frequency(Hz)		10~60	60~80	80~100	100~125						
Acceleration(m/s <sup>2</sup> )	20.6	13.7	6.9	3.9								
5 min. Sweep Each XYZ for 1h.												

5 Identification and Marking (Lot Number Definition : Manufacturing Date of Cells)

The code is printed on a surface of the can, under the tube, at six lines.

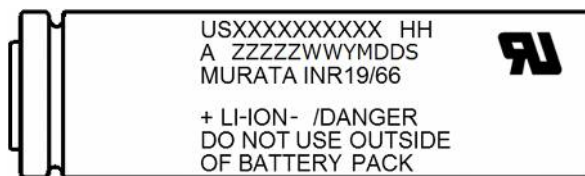


Fig.1

5.1 Manufacturer Name (Trade name for UL standard)

MURATA (Trade name for Tohoku Murata Manufacturing Co., Ltd.)

5.2 Model Name(Fig.1 : USXXXXXXXXXX)

US18650VTC5D

5.3 Factory(Fig.1 : A for factory code)

SG or G : Murata Energy Device Singapore Pte. Ltd.

5.4 Specification(Fig.1 : HH for Cell Type)

5D : US18650VTC5D

5.5 Lot Number(Fig.1: YMDDS for Manufacturing Date of Cells)

ZZZZZ : Serial No.

Y : Year      Supposing the year '15 as X, the year '16 as Y, the year '17 as Z, the year '18 as A, Every next year is counted as B, C, ... (Using an Alphabet letter)

M : Month    January as A, the consecutive month as B, C, ... (Using an Alphabet letter)

D : Day      01, 02, ... 29, 30, 31      (Using figures)

S : Identification Code    A, B, C, ... (Using an Alphabet letter)

5.6 Warning Message

DANGER DO NOT USE OUTSIDE OF BATTERY PACK

5.7 Cell Designation based on IEC61960

INR19/66

5.8 Battery Type

LI-ION (Lithium-ion Battery)



Fig.2

5.9 Polarity

+ , -

5.10 UL Recognition Mark (Fig.2)



Fig.3

5.11 2Dimensional Code (Fig.3)

The code is on the surface of the tube

6 Outline

6.1 Shape/Dimension

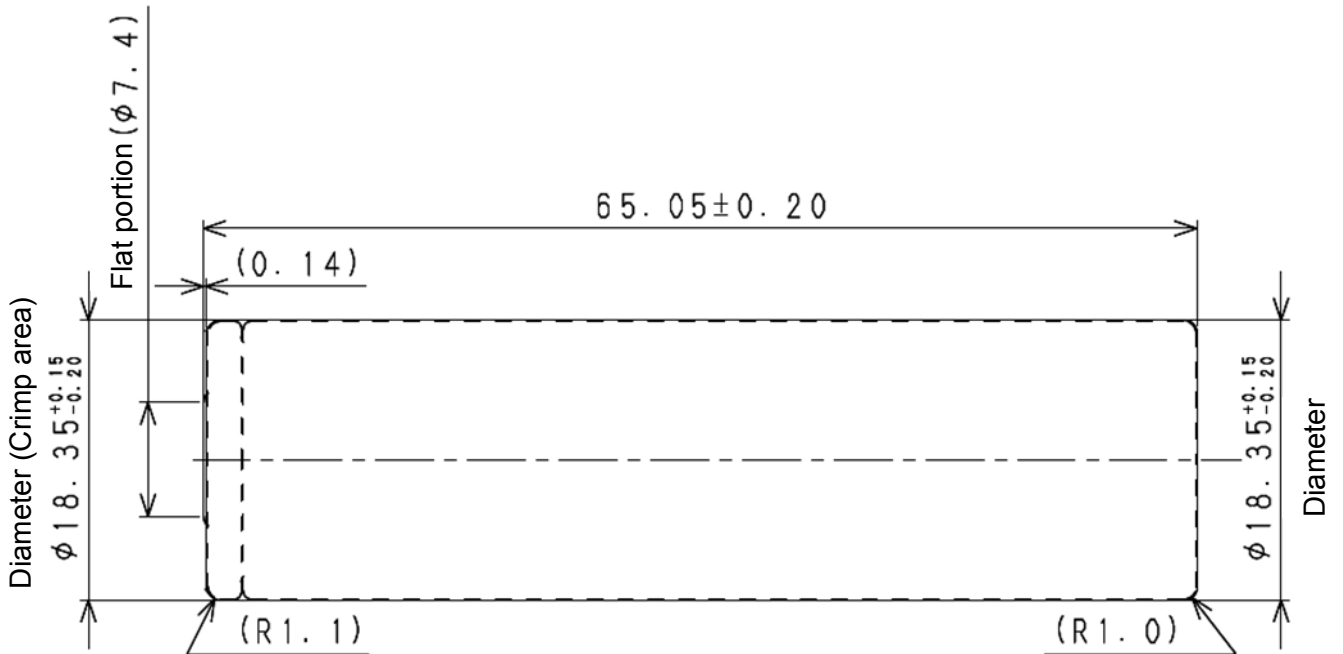
Diameter of crimp :  $18.35 +0.15 / -0.20\text{mm}$  (excluding wrinkle on the tube)

Diameter of trunk :  $18.35 +0.15 / -0.20\text{mm}$  (excluding wrinkle on the tube)

Total Height :  $65.00 \pm 0.20\text{mm}$

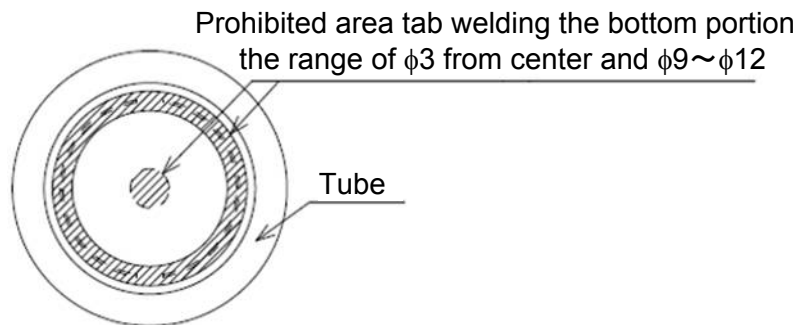
6.2 Appearance

It shall be free from any defects such as remarkable scratches, breaks, cracks, discoloration, leakage, or deformation.



Prohibited area tab welding the bottom portion

As shown in the figure on the right,  
 Don't weld in the range of  $\phi 3$  from center  
 and the range of  $\phi 9 \sim \phi 12$



7 Caution

Caution on usage of Lithium-Ion Rechargeable Battery

 **CAUTION**

7.1 Caution for installing the battery into the pack

\*Do not combine the different Lot Number cell (the Last 5 letters and figure) into the pack.

7.2 Caution for the battery and the pack

7.2.1 Charge

\*It should be Constant Current-Constant Voltage (CC-CV) charging method.

7.2.2 Design of battery pack

\*It shall be the shape which cannot be connected easily to any charger other than the dedicated charger.

\*It shall have the structure which cannot be connected easily for end user to apply for another purpose.

\*It shall have terminals or function which cannot easily cause external short circuit. (such as chain short by necklace).

\*It shall not short easily by effect of vibration or drop due to contact of internal wiring materials to battery.

\*Mounted PWB which is assembled in battery pack shall perform the smoke and fire protection for the electrolyte adhesion.

\*It should have the structure which protect electrolyte to outside of battery pack, in case of the electrolyte leakage from battery cell.

7.2.3 Protection Circuit for Safety

\*The protection circuit shall be installed in the battery pack or the charger.

\*The battery system must possess the following four types of protective circuits;

7.2.3.1 Over charging protective circuit by each block cell voltage monitoring

By each block cell voltage monitoring, the overcharging protective circuit shall operate at less than 4.250V/cell.

7.2.3.2 Over discharging protective circuit by each block cell voltage monitoring

By each block cell voltage monitoring, the over discharging protective circuit shall operate at 1.5V/cell to 2.5V/cell.

7.2.3.3 Over current protective circuit

The over current protective circuit shall operate charging at less than 6A.

The over current protective circuit or device shall operate discharging at less than 35A.

If the over 35A discharge occur, the allowable time of operating over current protection comply with the below table.

Discharge current	~40A	~50A	~60A	~80A	~100A
Time	<91sec.	<43sec.	<28sec.	<15sec.	<9sec.
	~120A	~130A	~150A	~200A	
	<6sec.	<4sec.	<3sec.	<1sec.	

7.2.3.4 Temperature protective circuit

The over temperature protective circuit at high temperature side shall operate discharging until 90deg.C on the cell surface. (Including overshoot).

The over temperature protective circuit at high temperature side shall operate charging at until 60deg.C on the cell surface. (Including overshoot).

The over temperature protective circuit at low temperature side shall operate charging below 0degC on the cell surface.



#### 7.2.4 Prohibition of Charging at over discharged state.

\*In the situation that the battery becomes over discharged to the point where it becomes less than or equal to 1.0V, it is prohibited to charge such battery.

#### 7.2.5 Cell Configuration

\* The maximum cell configuration for the battery pack is shown in below table.

Parallels	Series
1P	Up to 32
2P, 3P	Up to 18
4P, 5P	Up to 14

#### 7.3 Storage

\*Keep and Store the same package condition as shipping from Manufacturer.

\*The recommendation is SOC 10~50% for long-term storage.

\*Recommended condition is temperature 0~25deg.C and Humidity 75%RH or less.

\*Do not store the battery near heat sources, nor in a place subject to direct sunlight.

#### 7.4 Prohibition Clause

### **WARNING**

\*Do not use the battery for any purpose other than the application and the battery pack specified in the Pack Check Sheet for Li-ion Cell (Category; Power Technology) of such battery.

\*Do not resell the battery.

### **DANGER**

\*Do not expose the batteries to water or moisture.

\*Do not leave the battery in a place of high temperature (60deg.C or more).

\*Do not use the battery in a place of high temperature (60deg.C or more).

\*Do not throw the battery into fire, nor heat the battery.

\*Do not disassemble nor modify the battery.

\*Do not add strong shock, nor drop the battery.

\*Do not solder leads directly to the battery body.

\*Do not short (+) and (-) terminal of the battery with a kind of metal.

\*Do not reverse charge the battery.

\*Do not penetrate the battery with a nail etc., nor make a hole in the battery.

\*Do not put the battery into a microwave oven or high pressure container.

#### 7.5 Note

If any doubt or inconvenience regards this specification arises, modification and revision shall be only made per mutual agreement.

Depending upon circumstances such as E.O.L of raw material for cell component, we may not be able to keep the supply of the cell. In that case, we will notify you of this announcement by more than 6 months before production stop (before discontinuation).

When production location of the cell is planned to be changed or added, we'll inform and provide of necessary evaluation data beforehand to get customer's approval.

## 8 Packing

### 8.1 Packing Instruction

LBH, Class9 and CAO marks are printed on the surface on carton.  
These marks are compliant with the specified design of ICAO and IATA.

### 8.2 Parts Name Marking

Part name is marked on the bar code label of master carton.  
This bar code label is stuck onto one of the faces of the master carton.

### 8.3 Packing Instruction for Pallet

LBH, Class9 and CAO labels are affixed on the surface of the stretch film.  
These labels are compliant with the specified design of ICAO and IATA.