

<b>Dazzle Robotics Private Limited</b>	
<b>GenX Pro+ Solid-State Lithium-ion Battery Product Specification</b>	<b>Product: Genx Pro+ 14S1P 27000mah</b>
	<b>Release Date: 21-07-2022</b>

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## 1. Scope Application

This product specification describes the performances and indicators of Solid-State Lithium- ion Batteries produced by **Dazzle Robotics Private Limited**.

Note: The solid-state lithium-ion batteries described in this specification refers to a lithium- ion battery with solid-state technology (based on mixed solid liquid electrolyte).

## 2. Product Model

GenX Pro+ 51.8V 14S1P 27000Mah

## 3. Product Details

<b>Item</b>	<b>Specs</b>
Length	205mm
Width	88mm
Height	148mm
Connector Cable	UL3135 8AWG
Balance Connector Cable	UL3239 22AWG
Balance Connector	JST-XH-15P
Discharge Connector	XT90-S
Cell Specs	3.7V 27Ah Solid State Li-Ion
Cell Configuration	14S1P
External Metal Protection	Optional Not standard
Packing	Heat Shrink Sleeve

**\*Customization services available for connectors, cables and external packaging in different sizes.**

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### 4. Product Specification

NO.	Items	Specifications
1	Nominal Capacity	27Ah (0.5C)
2	Nominal Voltage	51.8V
3	Charging Voltage	58.8V
4	Cut-Off Voltage	39.2V
5	Charging Method	Ultrafast 2C(54A) constant current (CC) charge to 58.8V, then constant voltage (CV) charge till charge current decline to $\leq 0.02C(0.6A)$ .
		Fast 1C(27A) constant current (CC) charge to 58.8V, then constant voltage (CV) charge till charge current decline to $\leq 0.02C(0.6A)$ .
		Standard 0.5C(13.5A) constant current (CC) charge to 58.8V, then constant voltage (CV) charge till charge current decline to $\leq 0.02C(0.6A)$ .
6	Discharging Method	Pulse 10C (270A, duration $\leq 10s$ )
		High Rate 5C-7C (135A-189A)
		Fast 3C (81A)
		Standard 0.5C (13.5A)
7	Cycle Life	800 Cycles (0.5C/0.5C; 100%DOD)
		500 Cycles (0.5C/3C; 100%DOD)
		300 Cycles (0.5C/5C; 80%DOD)
8	Operating Temperature	Charge: 0°C~45°C Discharge: -20°C~55°C
9	Storage Temperature	Short-term(one month): -20°C~45°C Long-term(six months): -10°C~35°C
10	Store Humidity	<75%RH
11	Energy Density Cell	Weight Specific Energy:>270Wh/Kg(0.5C/0.5C) Volume Specific Energy:>560Wh/L (0.5C/0.5C)
12	Internal Resistance Cell	1±0.4mΩ
13	Weight	5.36kg±100g

### 5. Battery Performance

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### 5.1 Electrochemical Characteristics of cell level

NO.	Items	Criteria	Test Methods
1	Discharge Performance at Room Temperature	Discharge Capacity/ Nominal Capacity $\times 100\%$ $0.5C \geq 100\%$  $3C \geq 95\%$ $5C \geq 90\%$	Standard charge (0.5C) under the condition of 1 atm, $20 \pm 5^\circ\text{C}$ and $\leq 75\%$ RH, discharge at 0.5C/3C/5C to 2.75V; Charge/discharge can be cycled for 3 times before meeting the standards.
2	Capacity Retention	Residual Capacity $\geq$ Nominal Capacity $\times 90\%$ Restore Capacity $\geq$ Nominal Capacity $\times 95\%$	Standard charge (0.5C, CC-CV) and store for 28 days, then discharge to 2.75V at 0.5C, then measure residual capacity. 0.5C/0.5C measure restore capacity. Charge/discharge cycle can be conducted for 3 times before meeting the standards.
3	Cycle Life	Capacity $\geq$ Initial Capacity $\times 80\%$	Conduct 0.5C/0.5C cycle for 800 times. The discharge capacity shall be measured after 800 cycles. Conduct 0.5C/3C cycle for 500 times. The discharge capacity shall be measured after 500 cycles. Conduct 0.5C/5C cycle for 300 times. The discharge capacity shall be measured after 300 cycles.
4	Discharge Performance at Low Temperature	Capacity $\geq$ Nominal Capacity $\times 80\%$	Standard charge (0.5C, CC-CV) and rest for 8h at $-20^\circ\text{C}$ , then discharge to 2.75V at 0.5C, measure the final capacity.
5	Discharge Performance at High Temperature	Capacity $\geq$ Nominal Capacity $\times 98\%$	Standard charge (0.5C, CC-CV) and rest for 4h at $55^\circ\text{C}$ , then discharge to 2.75V at 0.5C, measure the final capacity.
6	Storage Performance	Capacity $\geq$ Nominal Capacity $\times 100\%$ ; $3\text{ months} \geq 90\%$ ; $6\text{ months} \geq 85\%$ ; $12\text{ months} \geq 80\%$	Measure initial status and initial capacity. Standard charge and store for 3 months, 6 months and 1 year respectively. Measure the final capacity, then charge and discharge at 0.5C for 3 cycles, and measure the discharge capacity.

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### 5.2 Electrochemical Characteristics

NO.	Items	Criteria	Test Methods
1	Overcharge	No fire No explosion	Charge to 4.6V at 1.5C after standard discharge at 0.5C: stop charging if charging duration $\geq 7$ h or the surface temperature of battery is 20% lower than of the peak value.
2	Forced-Discharge	No fire No explosion No leakage	Reverse charge at 1C for 90min after standard discharge at 0.5C, then observe for at least 1h.
3	Short Circuit	No fire No explosion Temperature $\leq 150^{\circ}\text{C}$	After standard charge (0.5C, CC-CV), put the battery into a ventilation cabinet and connect the positive and negative terminals directly by a $80\pm 20\text{m}\Omega$ wire for 1h at $20\pm 5^{\circ}\text{C}$ , stop testing when the battery temperature is 20% lower than the peak value, or the short-circuit duration $\geq 24$ h.
4	Low Pressure	No fire No explosion No leakage	After 0.5C standard constant current and constant voltage charging, put the battery in a $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ empty chamber. Vacuum until the internal pressure drops to 11.6kPa, then keep for 6h.
5	Temperature Cycling	No fire No explosion No leakage	1. The battery is charged according to the standard charging method: 2. Put the battery in a room temperature box, and do the following steps: ——The temperature box was heated up to $75^{\circ}\text{C}$ within 30 min and kept for 6h; ——Temperature box temperature was cooled down to $-40^{\circ}\text{C}$ within 30min and kept for 6h. ——Repeat the above steps for 10 times.
6	Dropping	No fire No explosion No leakage	After the battery is charged at 0.5C with standard constant current and constant voltage, the battery is dropped onto a concrete slab form 1m height. The battery is dropped for 6 times so as to obtain impacts from every surface/side.

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7	Crushing	No fire No explosion	<p>1. The battery shall be charged according to 0.5C standard charging method</p> <p>2. The crushing method is as follows: The crushing direction is vertical to the plate direction; The size of the plane pressing plate is larger than the battery surface;</p> <p>3. The crushing pressure is <math>13 \pm 0.78 \text{ kN}</math>; Stop crushing when the pressure reaches the specific value.</p>
8	Vibration	No fire No explosion	<p>After standard charging at 0.5C, the battery is set on the vibrating table under the condition of <math>20 \pm 5^\circ \text{C}</math> for 1h. The test equipment is adjusted according to the following vibration frequency and corresponding amplitude. The frequency of vibration in each direction of X.Y and Z is cyclically swept from 10Hz to 55Hz for 30min, and the frequency sweeping rate of 1oct/min:</p> <p>A) Vibration frequency: 10Hz~ 30Hz; Displacement amplitude (single amplitude): 0.38mm;</p> <p>B) Vibration frequency: 30Hz~55Hz; Displacement amplitude (single amplitude): 0.19mm;</p> <p>After frequency scanning, test the final state of the battery and observe the changes of the battery appearance.</p>
9	Thermal Abuse	No fire No explosion	<p>Rest for 1h at <math>20 \pm 5^\circ \text{C}</math> after standard charge (0.5C, CC-CV) of the battery. Then, Put the battery into an oven and heating from room temperature to <math>130 \pm 2^\circ \text{C}</math> at the rate of <math>5 \pm 2^\circ \text{C}/\text{min}</math>. After keeping the temperature for 30 min, the heating was stopped and then observe for 1h.</p>

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## **6. Visual Inspection**

There shall be no such defects as scratch, flaw, crack, and leakage, which may adversely affect the commercial value of the battery.

## **7. Standard Environmental Test Condition**

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

Temperature:  $20 \pm 5^{\circ}\text{C}$

Humidity:  $\leq 75\% \text{RH}$

Atmosphere:  $86\text{KPa} \sim 106\text{KPa}$

## **8. Storage**

### **8.1 Long Time Storage:**

If the battery is to be stored for a long time (over 3 months), the battery should be stored in dry and cool place. The battery should be charged and discharged every six month. The battery's storage voltage should be  $3.6 \sim 3.75\text{V}$  and the battery is to be stored at the condition as NO.7.

### **8.2 Others:**

Any matters which have not been covered in this specification should be conferred between the customer and Others

## **9. Warranty Period and Product Liability**

- (1) Warranty period of this product is 3 months from the production date.
- (2) Dazzle Robotics Private Limited is not responsible for the troubles caused by Mishandling of the battery which is clearly against the instructions in this specification.