

Lithium-ion Rechargeable Specification

Product name: Lithium-ion batteryProduct Item: Lithium-ion 18650 43.2V9Ah

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Revised List

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1. Scope

This product specification describes HIMAX's LiFePO4 battery. Please using the test methods that recommend in this specification. If you have any opinions or advices about the test items and methods, please contact us.

2. Model

Model: Lithium-ion 18650 43.2V9Ah

3. Reference standard

The standard reference GB/T18287-2013, UL1642 and CE61960 technology standards compiled.

4. Specification

	Item	Rating	Note
Cell	Type	Lithium-ion Battery	
	Cell Model	INR18650-30Q	
	Nominal Capacity	3000mAh	Discharge: 0.2C Cut-off Voltage:2.5V
	Minimum Capacity	2900mAh	Discharge: 0.2C Cut-off Voltage:2.5V
	Nominal voltage	3.6V	
	Internal Impedance	≤26mΩ	
	Dimension	Max. 18.4x65.5mm	
	Weight	Approx.48g	
Battery pack	Pack Method	12S3P	
	Nominal Capacity	9Ah	
	Minimum Capacity	8.55Ah	
	Nominal Voltage	43.2V	
	Energy	388.8Wh	
	Charge Voltage	49.8V	
	Discharge cut-off voltage	33.6V	
	Charge Method	CC/CV	
	Standard Charge Current	1.8A	
	Max. Charge Current	5A	
	Standard Discharge Current	1.8A	
	Max. Continues Discharge current	20A	

Cycle Life	250 times	60% SOC at3C
Internal Impedance	≤160mΩ	
Dimension	Max.D59.5*L415mm	
Output Wire	To be determined	
Output Connector	XT-60 / Molex Micro-Fit 3.0-2P	
Weight	Approx.2100g	
Working Temperature Range	Charge: 10°C~45°C Discharge: -20°C~60°C	
Storage Temperature	-10°C~45°C	

5. BMS Parameter

Contents	Min.	Type	Max.	Tolerance	Unit
Absolute Maximum Rating					
Input charging voltage		49.8		±1%	V
Continuous charging current	≤5				A
Output discharging voltage	33.6	43.2	49.8		V
Continuous output discharging current	≤20.0				A
Ambient Condition					
Operating temperature	-20		60		°C
Humidity (No Water-Drop)	0%		90%		RH
Atmospheric pressure	86		106		KPa
Storage Condition					
Storage temperature	-5		30		°C
Humidity (No Water-Drop)	40%		60%		RH
Atmospheric pressure	86		106		KPa
Protection Parameters (for Single Cell)					
Over-Charge voltage protection					
Over-Charge voltage alert	Cell voltage ≥ 4210mV & 1Sec additional delay				
Over-Charge voltage protection 1		4240		±40	mV
Over-Charge voltage protection 2		4275		±40	mV
Over-Charge voltage protection 3		4350		±35	mV
Over-Charge voltage protection 1/2 release		4000		±40	mV
Over-Charge voltage protection 3 release		4050		±35	mV
Over-Charge voltage protection 1 delay time	500	1000	2000		mS

Over-Charge voltage protection 2 delay time	700	1000	1750		mS
Over-Charge voltage protection 3 delay time	3000	4000	5000		mS
Over-Charge voltage alert/protection1/2 release delay time	2000	3000	4000		mS
Over-Charge voltage protection 3 release delay time	10	16.5	25		mS
Cell Voltage Imbalance charge protection					
Cell Voltage Imbalance charge protection	Cell Voltage Imbalance \geq 0.4V & Cell voltage(Min) \geq 3400mV & 2Minutes additional delay				
Over-Discharge voltage protection					
Over-Discharge voltage alert	Cell voltage \leq 3200mV & 3Sec additional delay				
Over-Discharge voltage alert release	Cell voltage \geq 3400mV & 3Sec additional delay				
Over-Discharge voltage protection		2800		\pm 100	mV
Over-Discharge voltage protection		2600		\pm 100	mV
Over-Discharge voltage protection release		3200		\pm 100	mV
Over-Discharge voltage protection release current (Charging state)	Charge current \geq 200mA				mA
Over-Discharge voltage protection 1 delay time	500	1000	2000		mS
Over-Discharge voltage protection 2 delay time	700	1000	1750		mS
Over-Discharge voltage alert/protection release delay time	2000	3000	4000		mS
Into Shutdown mode		2800		\pm 100	mV
Into Shutdown mode delay time		1800		\pm 60	S
Battery pack Over-Charge voltage protection					
Battery pack Over-Charge voltage alert	Total voltage \geq 50.52V & 1Sec additional delay				
Battery pack Over-Charge voltage protection		50.88		\pm 0.4	V
Battery pack Over-Charge voltage protection release		18.0		\pm 0.4	V
Battery pack Over-Charge voltage protection delay time	500	1000	2000		mS
Battery pack Over-Charge voltage alert/protection release delay time	2000	3000	4000		mS
Battery pack Over-Discharge voltage protection					
Battery pack Over-Discharge voltage alert	Total voltage \leq 36.0V & 3Sec additional delay				
Battery pack Over- Discharge voltage protection		33.6		\pm 0.5	V
Battery pack Over-Discharge voltage protection release		38.4		\pm 0.5	V

Battery pack Over-Discharge voltage protection delay time	500	1000	2000		mS
Battery pack Over-Charge voltage alert/protection release delay time	2000	3000	4000		mS
Charge Over-Current/Discharge Over-Current/Short circuit protection					
Over-Current charge alert	Charge current $\geq 4.5A$ & 3Sec additional delay				
Over-Current charge alert release	Charge current $\leq 4A$ & 3Sec additional delay				
Over-Current charge protection		5		± 0.5	A
Over-Current charge protection delay time	2000	3000	4000		mS
Over-Current charge protection release	10 Sec additional delay				
Over-Current charge protection release current (Discharge state)	Discharge current $\geq 200mA$				mA
Over-Current discharge alert	Discharge current $\geq 20A$ & 3Sec additional delay				
Over-Current discharge alert release	Discharge current $\leq 18A$ & 3Sec additional delay				
Over-Current discharge protection 1 (Only in normal mode)		30		± 3	A
Over-Current discharge protection 2 (Only in normal mode)		45		± 5	A
Over-Current discharge protection 3		78		± 12	A
Over-Current protection 1 delay time	55	60	65		S
Over-Current protection 2 delay time	500	1000	2000		mS
Over-Current protection 3 delay time		80		± 16	mS
Over-Current protection 1/2/3 release	15Sec				
Short circuit discharge protection		222		± 34	A
Short circuit protection delay time		400		± 150	uS
Over-Current 3 and Short circuit protection release	15Sec				
Temperature protection					
Charge over temperature alert	Temperature $\geq 40^{\circ}C$ & 3Sec additional delay				
Charge low temperature alert	Temperature $\leq 5^{\circ}C$ & 3Sec additional delay				
Discharging over temperature alert	Temperature $\geq 60^{\circ}C$ & 3Sec additional delay				
Discharging low temperature alert	Temperature $\leq -10^{\circ}C$ & 3Sec additional delay				
Mosfet over temperature alert Mosfet	Temperature $\geq 80^{\circ}C$ & 3Sec additional delay				
Temperature alert release	Hysteresis $5^{\circ}C$ & 3Sec additional delay				
Charge over temperature protection		48		± 5	$^{\circ}C$
Charge over temperature protection release		43		± 5	$^{\circ}C$
Charge low temperature protection		0		± 5	$^{\circ}C$
Charge low temperature protection release		5		± 5	$^{\circ}C$

Discharging over temperature protection		68		±5	°C
Discharging over temperature protection release		60		±5	°C
Discharging low temperature protection		-20		±5	°C
Discharging low temperature protection release		-15		±5	°C
Mosfet over temperature protection Mosfet		85		±5	°C
Mosfet over temperature protection release Mosfet		60		±5	°C
<i>Pre-Discharge</i> Resistor over temperature protection		/		±5	°C
Temperature protection delay time	2000	3000	6000		mS
Temperature protection release delay time	2000	3000	6000		mS
Cell balance					
Balance start voltage		3800mV OR 3400mV		±50	mV
Balance start difference voltage between cells		≥50			mV
Balance cut-off voltage Δcell voltage		≤30			mV
Balance current		<88			mA
Balance condition	Balance on charging mode or idle mode				
Current consumption					
Normal mode		8	15		mA
Idle mode		500	700		uA
Shut down mode ($V_{cell} \leq 2.8V$)		70	100		uA
Idle mode from Normal mode	2Minutes				
Wake up way(Shut down mode)					
Wake up (Shut down mode)	Charge (Minimum Gap Between PACK- and BAT- for Charger wake up: 2 ~ 3V)				
Internal resistance PCB					
main discharging circuit internal resistance of the protection board BMS	≤20mΩ				
main charging circuit internal resistance of the protection board BMS	≤50mΩ				
Communication					
Communication	RS-485				

6. Product Circuit diagram

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7. Electrical Performance & test condition

7.1 Standard Test Condition

The battery shall be evaluated within 1 month from the arrival date.

Unless otherwise stated in these specifications, the following test shall be carried out in an ambient temperature of $20\pm 5^{\circ}\text{C}$, relative humidity of $65\pm 20\%$,

Discharge capacity when the battery is discharged at 1.8A to 33.6V after being standard charged. Five cycles are permitted for this test. The test shall be terminated at the end of the first cycle which meets the requirement.

7.2 Testing Instrument or Apparatus

7.2.1 Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm specified.

7.2.2 Voltmeter and Ammeter

Voltmeters and ammeters shall be equal or more precision instruments of $10\text{K}\Omega/\text{V}$ and 0.01Ω .

7.2.3 Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method (1kHz LCR meter).

7.3 Standard Charge

Standard charge means charging for 6hours using 49.8V/1.8A charger.

7.4 Standard Discharge

Standard discharge means discharging at 1.8A down to 33.6V.

7.5 Electrical Performance

Item	Condition	Specification
Open-Circuit Voltage	The open-circuit voltage shall be measured within 24hours after standard charge.	$\geq 49.2\text{V}$
Battery Capacity	The discharge time at 1.8A shall be measured after standard charge at $20\pm 5^{\circ}\text{C}$ and rest 1hour.	$\geq 95\%$
Cycle Life	The discharge time on standard discharge shall be measured after 250 cycles of standard charge and 3C discharge at $20\pm 5^{\circ}\text{C}$.	$\geq 60\%$

Charge(capacity) retention	The discharge time at 1.8A shall be measured after standard charge and then storage at 20±5°C for 28days.	≥85%
Temperature Characteristic1	After standard charging at 20±5°C, laying the battery at 55°C for 2hours, then discharge at 1.8A to 33.6V, record the discharge time .	≥95%
Temperature Characteristic2	After standard charging at 20±5°C, laying the battery at -10°C for 4hour, then discharge at 1.8A to 33.6V, record the discharge time .	≥75%

8. Mechanical Performance

Item	Condition	Specification
Crush Test	A battery is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram with a 32mm diameter piston. The crushing is to be continued until a pressure reading of 17.2mmPa is reached on the hydraulic ram, applied force of 13kN. Once the maximum pressure has been obtained it is to be released.	No fire, No explosion
Drop Test	The battery has only two axes of symmetry in which case only two directions shall be tested. The battery is to be dropped from a height of 1 meter twice onto concrete ground.	No explosion, No fire, No smoke
Vibration	A full-charged battery is to be subjected to simple harmonic motion with an amplitude of 1.6mm total maximum excursion. The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz. The cell shall be vibrated for 30 minutes per axis o XYZ axes.	No leakage No Fire No explosion

9. Cell Safety Performance

Item	Condition	Specification
Over charge	At 20±5°C, Cells are discharged per 4.1.2, then charged at constant current of 3 times the max. charge condition and constant voltage of 49.8V while tapering the charge current. Charging is continued for 7 hours .	No explosion, No fire
Over discharge	At 20±5°C, the cell are fully charged with standard charging method and standby at least 1 hour. The cell should be discharged at a current of 1C for 2.5h.	No explosion, No fire

Short-circuit	At 20±5°C, The cells are fully charged with standard charging method and standby at least 1hour. Positive and negative terminal connect with wire (maximum load of 50mΩ) to cause short circuit until its voltage is lower than 0.1V or cell temperature on the surface is back to room temperature ±10°C.	150°C No explosion, No fire The temperature of the surface of the cell are lower than 150°C
Heating	Battery is heated in a circulating air oven at a rate of 5±2°C per min to 130°C, an then placed 30 mins at 130°C.	No explosion, no fire

10. Delivery/Packing/Storage and Shipment

10.1 Approx. 30-70% charged before delivery, Shipment voltage: 42-43.8V.

10.2 Pre shipment inspection

The battery should be checked the voltage, resistance and the function of protective circuit before shipment.

10.3 Packing and Shipping

10.3.1 The battery should be transported to the factory assembly, to pay special attention to the packing, in order to avoid transport stress.

10.3.2 The battery should be in a half state of charge packaging boxes for transport, in the transport process, prevent severe vibration, shock, extrusion, prevent the sun and rain, should be in automobile, train, ship, airplane and other forms.

10.4 Abnormal Condition


Do not use the battery when it's smell like abnormal cell electrolyte because of transport stress, sag, short circuit or any other.

10.5 Acceptable level

Normal inspection quality standard AQL (%): 0.65.

11. Drawing

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HMS Model	Lithium-ion 18650 43.2V9Ah			
File No.	HLISS12 0009-1116	Signature	Date	
Revision		Drawn by	Joan Li	2020-06-17

12. Period of Warranty

The period of warranty is one year from the date of shipment. HIMAX guarantees to give a replacement in case of battery with defects proven due to manufacturing process instead of the customer abuse and misuse.

13. Warnings

To prevent the possibility of the battery from leaking, heating, fire, Please READ this specification carefully before usage and observe the following precautions:

- Ⓞ When recharging, use the Li-ion battery charger specifically for that purpose.
- Ⓞ Do not strike battery with any sharp edge parts, such as Ni-tabs, pins and needles.
- Ⓞ Do not immerse the battery in water and seawater.
- Ⓞ Do not use and leave the battery near a heat source as fire or heater.
- Ⓞ Do not reverse the positive and negative terminals.
- Ⓞ Do not connect the battery to an electrical outlet.
- Ⓞ Do not discard the battery in fire or heat it.
- Ⓞ The battery tabs are not so stubborn especially for aluminum tab. Do not bend tab.
- Ⓞ Do not short-circuit the battery by directly connecting the positive and negative terminal with metal object.
- Ⓞ Do not transport and store the battery together with metal objects such as necklaces, hairpins etc.
- Ⓞ Do not knock or throw, trampling battery etc.
- Ⓞ Do not directly solder the battery and pierce the battery with a nail or other sharp object.
- Ⓞ Do not split the battery without permission.

14. Battery operation instruction

14.1 Charging

Charging current: Do not surpass the biggest charging current which in this specification.

Charging voltage: Do not surpass the highest voltage which in this specification.

Charge temperature: The charge temperature is in according to this specification.

14.2 Discharging

Discharge current: Do not surpass the biggest discharge current which in this specification.

Discharging with a higher current may result in the capacity fade and over-heat.

Discharge temperature: The discharge temperature is in according to this specification.

14.3 Over-discharges

After the short time excessively discharges charges immediately cannot affect the use, but the long time excessively discharges can cause the battery the performance, battery function losing. The

battery long-term has not used, has the possibility to be able to be at because of its automatic flashover characteristic certain excessively discharges the condition, for prevented excessively discharges the occurrence, the battery should maintain the certain electric quantity.

14.4 Storing the Batteries

The battery should store in the product specification book stipulation temperature range. If has surpasses above for 3 months the long time storage, suggested you should carry on additional charge to the battery.

14.5 Please do not continuously charge the battery over 8hours(0.2C).

15. Others

- ◎The customer is requested to contact HIMAX in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.
- ◎HIMAX will take no responsibility for any accident when the battery is used under other conditions than those described in this Document.
- ◎HIMAX will inform, in a written form, the customer of improvement(s) regarding proper use and handing of the battery, if it is deemed necessary.

16. Additional information

Controller current limit:

- ◎Maximum continuous discharge current at 35Amp
- ◎Maximum Instantaneous discharge current 50Amp in 400ms
- ◎Maximum protection current 80Amp, (the motor is not completely locked.)