



USER MANUAL

SR5K-UL Battery Module

Rack-Mount Battery Module



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1. Introduction

The StackRack SR5K-UL battery modules are specifically designed for low-voltage, small to medium-sized energy storage systems. They utilize high-safety lithium iron phosphate (LiFePO₄) cells and are equipped with an advanced battery management system (BMS). This BMS is capable of real-time monitoring of voltage, current, and temperature for each cell within the battery. Additionally, it features a passive balancing function and an enhanced battery control strategy, significantly boosting the overall performance of the battery pack.

Comprising LiFePO₄ cells, BMS, enclosure, and wiring, each module is engineered with a comprehensive protection function. These modules are designed for easy installation on a rack system and can communicate with external devices via CAN/RS485 interfaces, while also supporting interaction between batteries through RS485 communication.

Disclaimer

StackRack retains the authority to modify the contents of this document at any moment without prior notification. For access to the most recent version of our manual, please visit the StackRack website at stackrackbattery.com/documents.

Contact Information

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2. Safety

Prior to initiating any work, thoroughly review all safety instructions and adhere to them while working on or with the battery. Installation procedures must comply with all relevant national or local standards and regulations. It is essential to consult with your Authority Having Jurisdiction (AHJ) to secure the necessary permits and permissions before proceeding with the installation.

Improper installation could lead to injury or death of the installer, operator, or any third party, as well as damage to the battery and any equipment connected to it.

Important Safety Notifications

Before, during, and after installation, as well as throughout the future operation and maintenance of this product, there are critical safety considerations that must be meticulously followed. The following points serve as vital safety notices for both installers and end users under normal operating conditions:

General Caution

1. ****Utility Grid Connection Authorization****: Before connecting the system and battery to the utility grid, obtain approval from the utility provider. Consult your local Authority Having Jurisdiction (AHJ) for additional local guidelines and requirements.
2. ****Child Safety Measures****: Ensure children are kept away from the battery and its systems to prevent misuse or accidental harm.
3. ****Qualified Personnel Requirement****: Only qualified individuals should perform any work on this product. Adhere strictly to the servicing guidelines provided in the operating instructions to minimize electric shock risks.
4. ****Label and Nameplate Visibility****: It's crucial to keep all warning labels and nameplates on the battery visible and intact, without them being covered or removed.
5. ****Charging Temperature Compliance****: Avoid charging the battery below its specified minimum temperature to avert potential damage. Refer to the manual or specification sheet for precise charging instructions.
6. ****Installation Safety Considerations****: Select the battery's installation location with future user safety in mind, following the recommendations in this manual.
7. ****Comprehensive Instruction Review****: Thoroughly read and understand all instructions before beginning the installation, ensuring compliance with local and national wiring standards and the National Electrical Code (NEC), ANSI/NFPA 70.

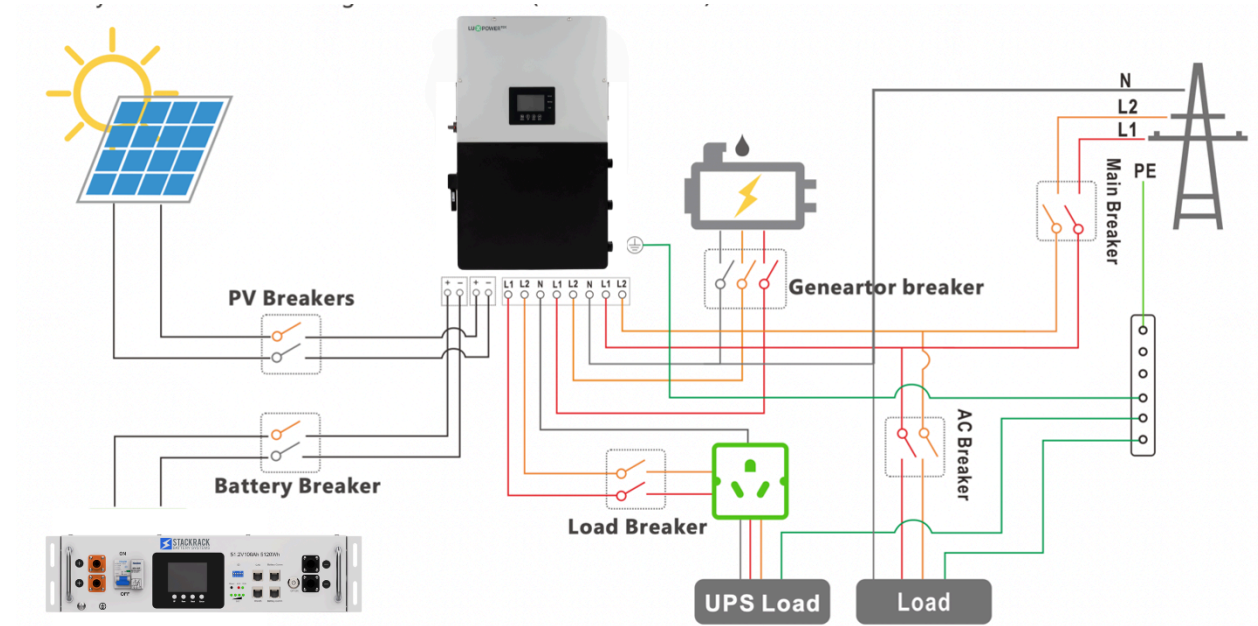
Warning: High Current & Voltage:

1. ****Secure Connections****: Ensure all connections between the battery and system components are tight and comply with technical standards to prevent malfunctions or hazards.
2. ****Battery Disassembly Prohibition****: Do not disassemble the battery. For repairs or issues, contact your distributor for proper guidance. Unauthorized servicing or re-assembly increases the risk of electric shock, fire, and may invalidate the warranty.
3. ****Safe Use of Metal Tools****: Exercise caution when using metal tools near batteries and systems, as they can cause electrical arcs or short circuits, leading to serious injury, death, or damage to equipment.
4. ****Handling Energized Batteries****: Avoid connecting or disconnecting system components while batteries are active to prevent component damage or electric shock.
5. ****System Grounding****: Confirm that the battery and rack are correctly grounded for safety.
6. ****High Battery Current Precautions****: Ensure battery module breakers and/or switches are in the "off" position before installation or maintenance to prevent electric shock. Verify absence of voltage with a voltmeter.
7. ****Installer Protection****: Installers must use appropriate personal protective equipment (PPE) to safeguard against potential hazards during installation or maintenance.
8. ****Wiring Inspection****: Prior to system installation, operation, or maintenance, inspect all existing wiring for compliance with specifications and suitability for use.
9. ****Short-Circuit Hazard****: Avoid short-circuiting DC inputs at all costs. Short-circuiting the battery can cause electric shock or fire, resulting in serious injury, death, or irreversible damage to the battery and any connected devices.

3. Product Overview

3.1 System Overview

This is an example of a typical system using SR5K-UL battery modules and Luxpower 12K hybrid inverter.




3.2 Battery Diagram



Item	Comments
Run LED	Remains on while system is running
SOC LED	4 lights = 100% Full Charge
On/Off Button	Turns BMS On / Off

5. Installation

5.1 Packing List

	Item	Quantity
	SR5K-UL Battery Module	1

5.1 Storage

5.1.1 Battery State of Charge (SOC)

The initial state of the battery prior to storage significantly impacts its storage longevity and condition upon retrieval. StackRack advises charging each battery to a 100% State of Charge (SOC) before storage. Lithium iron phosphate batteries will undergo a reduction in their total charge during storage, with the extent of loss varying based on the storage duration and environmental conditions. It is recommended to recharge the batteries if they are stored for an extended period, specifically after 8 to 9 months.

5.1.2 Other Factors

The storage environment for your StackRack battery significantly influences its health and longevity. For optimal results, maintain a moderate temperature range between 41°F and 68°F (5°C and 20°C). Ensure the battery is positioned away from areas prone to moisture or high humidity levels (greater than 55%). Additionally, it is crucial to store the batteries in a location distanced from any combustible materials.

5.1.3 Warning

- ****Heat and Sunlight Precautions****: Batteries should not be exposed to direct sunlight or placed on surfaces that may become extremely hot, as it can compromise their performance and safety.
- ****Careful Battery Handling****: When managing batteries and devices powered by them, handle with caution to prevent damage to the battery casing or connections.
- ****Avoidance of Conductive Exposures****: Ensure batteries are not exposed to conductive materials such as water, strong oxidizers, and acids to avoid potential damage and hazardous reactions.
- ****Workspace Safety****: Keep the area free from flammable materials to minimize the risk of fire hazards.
- ****Series Connection Advisory****: Do not connect SR5K-UL batteries in series due to the risk of module failure, as the BMS and internal mechanisms are not designed for such configurations.
- ****Inspection and Damage Protocol****: Before using any battery, inspect it for damage or swelling. Never use batteries that are damaged or appear puffy. Contact the distributor for guidance if any issues are found upon receipt or during use.

5.1.4 Positioning



5.2 General Installation

The provided chart is relevant for a 100A continuous output from a single battery. When the ambient temperature exceeds 86°F (30°C), the cable size needs to be adjusted in line with NEC 310 guidelines. The 4 AWG cable included with the package is specifically designed for connecting the module to a busbar.

Cable Size	Min. Insulator Voltage	Torque Value	Max Rec. Distance
2 AWG	600V	60 in. lbs. (7 Nm)	15 ft

5.2.1 Danger

Before adding or removing a battery from any rack, cabinet, or busbar, ensure that ALL batteries are turned off. Use a voltmeter to verify the absence of voltage. This precaution helps to avoid accidental contact with live (powered) busbars. Ignoring this safety measure could lead to serious injury or even death.

5.2.2 Tools Needed for Installation

The specific tools required for installation can differ based on the chosen method for mounting your battery. Generally, the following tools are essential for installing the battery into a StackRack battery system or any standard racking system:

1. Socket and ratchet set
2. Phillips head screwdriver
3. Torque wrench
4. M6-1.0 terminal bolts (provided with the StackRack battery cabinet packaging).

5.2.3 Connecting cables to the battery terminals and busbars

StackRack advises utilizing a busbar that is correctly sized in terms of amp rating for paralleling batteries. This approach prevents potential issues with inconsistent charging and discharging that might arise when paralleling is done directly through the battery terminals.







- **Identifying Battery Terminals:** Locate the positive and negative terminals on your battery, which are marked and color-coded (red for positive, black for negative).
- **Hardware Verification:** Ensure you have all the necessary hardware for cable attachment. Confirm that the bolt threads completely into the terminal and can be tightened to the correct torque specification.
- **Cable Connection to Battery Terminals:** Remove the M8 terminal bolts, pass them through the eyelet of the appropriate cable, and then reinsert the bolt into the terminal block, tightening it to the specified torque.
- **Connecting to the Busbar:** Attach the positive battery cables to the positive busbar by removing the busbar bolts, inserting them through the eyelets of the correct cable, and

then reseating the bolt in the busbar, adjusting to the correct torque. Follow the same procedure for all negative cables.

- **Proper Torque Required:** Do not merely hand-tighten the battery terminal bolts. A specific torque is necessary to prevent them from loosening during operation. Inadequate tightening of terminal bolts can lead to significant damage and will invalidate your warranty.

5.2.4 Installing Batteries to StackRack Battery Cabinets

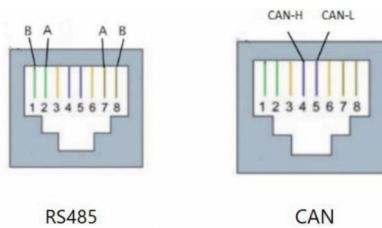
Refer to the following installation guides:

SR BRACKETS	SRB2 Battery Cabinet	SRB4 Battery Cabinet
		
SRB6I Battery Cabinet	SRB6 / Power Station Pro	SRB10 / Power Station Pro XL
		

5.3 Battery Communications

SR5K-UL batteries include the capability to connect to PC software for monitoring the battery's status. This feature enables you to precisely observe and understand the battery's behavior and facilitate troubleshooting in case of issues.

For configurations utilizing a single battery, it will **directly communicate with the system through the RS485 or CAN port using a standard Cat5 cable.**



RS485 (Battery to Battery):

Pin-1, Pin-8 -> RS485 B-(T/R-)

Pin-2, Pin-7 -> RS485 A+(T/R+)

Can (Battery to Inverter):

PIN-4 -> CAN High

PIN 4 -> CAN Low

DIP Switch ID Table to Parallel Multiple Modules:

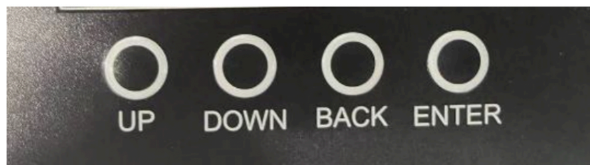
ID:1	ID:2	ID:3	ID:4	ID:5	ID:6	ID:7	ID:8
ID:9	ID:10	ID:11	ID:12	ID:13	ID:14	ID:15	ID:16
ID:17	ID:18	ID:19	ID:20	ID:21	ID:22	ID:23	ID:24
ID:25	ID:26	ID:27	ID:28	ID:29	ID:30	ID:31	ID:32
ID:33	ID:34	ID:35	ID:36	ID:37	ID:38	ID:39	ID:40
ID:41	ID:42	ID:43	ID:44	ID:45	ID:46	ID:47	ID:48
ID:49	ID:50	ID:51	ID:52	ID:53	ID:54	ID:55	ID:56
ID:57	ID:58	ID:59	ID:60	ID:61	ID:62	ID:63	ID:64

6. Battery Operation

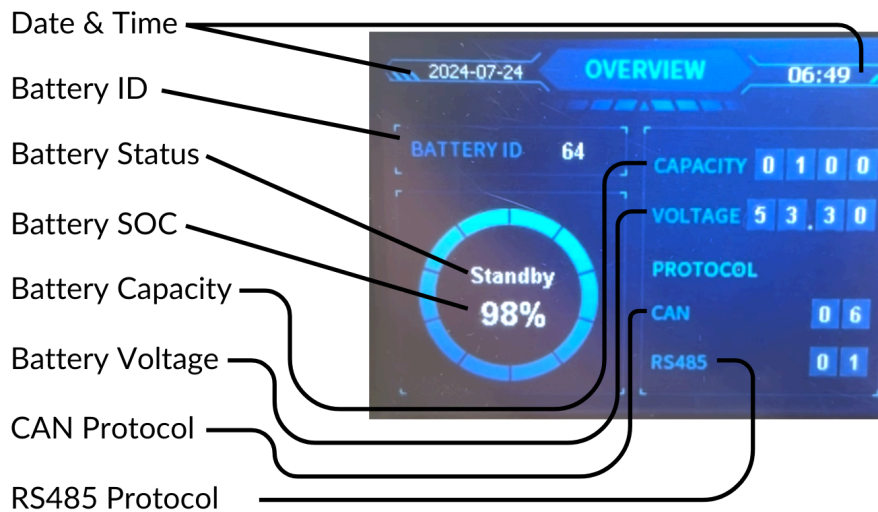
6.1 LCD Screen and Button Use

Each module is equipped with a built-in HD LCD touch screen, which serves to display critical information about the cells. This includes data on voltage, current, temperature, State of Charge (SOC), among other important parameters.

Below the display, there are 4 function buttons, each with specific functions. These buttons allow for intuitive navigation and adjustment within the system's interface, facilitating easy access to and modification of the battery's settings and parameters.

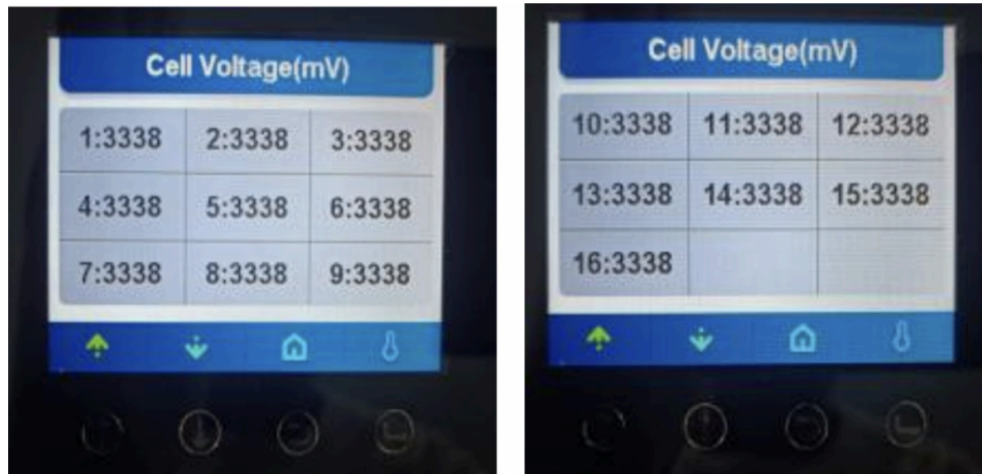


When the power is on, pressing any key will wake up the screen, and the display will show the relevant information.



6.2 Battery Cell

To check the voltage of individual cells, press the “Enter” button on the main page of the LCD screen, where the voltage is displayed in millivolts (mV). The information is spread across 2 pages. Use the “Up” and “Down” buttons to navigate between these pages.



6.3 Temperature Information

On the Cell Voltage page, press "Enter" to access the temperature information for both the PCB (Printed Circuit Board) and the cells. This temperature data is displayed in degrees Celsius (°C).

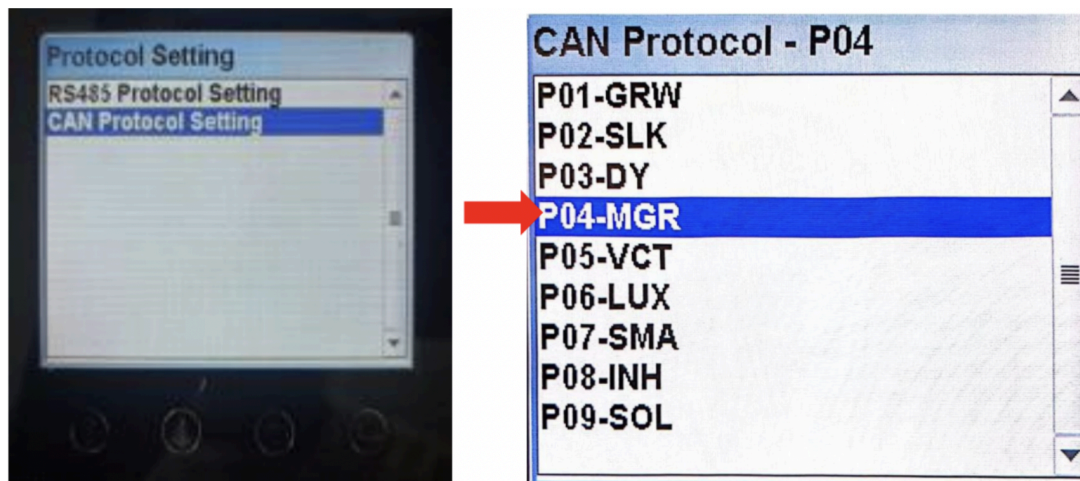
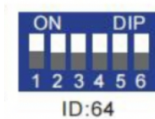


6.4 Communication Protocol Selection

In a multi-battery setup, only the host battery, designated as Address 1, requires setting to the specific inverter protocol. All other batteries in the system must be assigned unique addresses, beginning with Address 2 and increasing sequentially. The CAN/RS485 port of the host battery should be connected to the inverter's BMS communication port to ensure proper communication across the system.

6.4.1 Selecting BMS Protocol

1. Before making any changes, turn off all DC breakers and BMS power buttons for each battery in the system. Verify that the voltage between the positive and negative busbars reads 0V to ensure safety and prevent any electrical issues.
2. To change the inverter protocol, **the master battery must temporarily be set to address 64**. Once the address dial is adjusted, restart the battery using only the BMS power button to apply the new settings.
3. To access the "Protocol Setting" on the host battery, press and hold the "Return" key for 5 seconds. This action allows you to adjust the communication protocol settings according to the requirements of your inverter or communication device.



4. Select the corresponding RS485 program or CAN program, and press Enter.
5. Press the "Return" key to return to the main interface.
6. Change the master DIP switch address back to address 1.
7. Turn the Master battery off and then on for BMS protocol to initiate.

6.5 Battery Charging

6.5.1 Charge Settings

It's important to configure the correct settings on the charge controller and/or inverter to prevent overcharging or causing damage to the module. Make sure to consult the device's manual for the appropriate settings that match the specifications of your battery module.

It's normal for Lithium Iron Phosphate (LFP) batteries with internal BMS, wired in parallel, to show SOC variations up to 10% during charge or discharge cycles. These differences, caused by slight variances in wiring resistance, internal resistance, temperature, and cell variations, are not indicative of reduced capacity. Typically, one battery might temporarily bear more load or charge, but over the cycle, imbalances even out, ensuring the pack's full kWh capacity is utilized. Voltage differences that arise will lead to SOC alignment, maintaining the pack's efficiency and capacity.

7. Troubleshooting & Maintenance

The BMS (Battery Management System) protects the battery and battery cells from potential dangerous situations and events. It also helps to maintain the health of the battery cells to improve overall performance and battery lifespan.

7.1 BMS Protection

The BMS (Battery Management System) plays a vital role in battery safety and efficiency through several key protections:

- **Voltage Protection:** Ensures each cell is kept within safe voltage limits to prevent overcharging or undercharging.
- **Environmental Temperature Protection:** Guards against operation in extreme temperatures by shutting down the battery if harmful conditions are detected.
- **PCB Temperature Protection:** Monitors the Printed Circuit Board temperature to prevent overheating and automatically shuts off the battery if necessary.
- **Current Protection:** Monitors charging and discharging currents, implementing safeguards to prevent surpassing set limits. It features quick shut-off timers for scenarios like short circuits or excessively high amperage.
- **Cell Balance Protection:** Automatically balances the charge across all cells to maintain uniform voltage levels, crucial for the battery's optimal performance and longevity.

7.2 Troubleshooting

7.2.1 Alarm Guide

If the ALM (Alarm) light on the battery control panel is on, the battery has been damaged or has been protected from potential damage.

Status	Name	Definition	What to Do
Warning/ Protection	Pack OV	Pack over-voltage	Discharge the module to a lower voltage
Warning/ Protection	Cell OV	Cell over-voltage	Use LCD screen to check cell voltage
Warning/ Protection	Pack UV	Pack under-voltage	Charge the battery
Warning/ Protection	Cell UV	Cell under-voltage	Use LCD screen to check cell voltage
Warning/ Protection	Charge OC	Charge over-current	Reduce current into the battery
Warning/ Protection	Discharge OC	Discharge over-current	Reduce current out of the battery
Warning/ Protection	Temp Anomaly	Temperature anomaly	Check battery and ambient temperature
Warning/ Protection	MOS OT	BMS temperature too high	Shut down battery and cool location
Warning/ Protection	Charge OT	Charge over-temperature	Shut down battery and cool location
Warning/ Protection	Discharge OT	Discharge over-temperature	Shut down battery and cool location
Warning/ Protection	Charge UT	Charge under-temperature	Shut down battery and warm location
Warning/ Protection	Discharge UT	Discharge under-temperature	Shut down battery and warm location
Warning	Low Capacity	Battery low charge	Charge the battery
Warning	Other Error	Unknown error	Contact Distributor/StackRack
Protect	Float Stopped	Float charge stopped	Contact Distributor/StackRack
Protect	Discharge SC	Discharge short current	Discharge current is too high, turn battery and breaker off. Turn battery back on.

7.2.2 Fault Guide

Fault	Definition	What to Do
Communication failure with inverter	Communication port connect error or battery ID setting error	Change DIP setting on master battery and power cycle the battery
No DC output	Low voltage or open battery breaker	Check battery breaker and charge battery
Power supply unstable	Battery capacity not at full power	Check battery cable connections
Battery can't be charged fully	Battery output voltage is below the minimum battery charge voltage	Verify that inverter charge settings match battery charge requirements
ALM LED always on	Short Circuit	Disconnect and check all power cables
Battery output voltage is unstable	BMS is not operating normally	Press the reset button to reset the battery. Then turn on battery
ALM LED flash 20 times and SOC1 LED on	Unbalance voltage with cell	Discharge battery below 20% SOC, then fully charge battery
ALM LED flash 20 times and SOC2 LED on	Unbalanced temperature	Contact Distributor/StackRack
ALM LED flash 20 times and SOC3/4 LED on	BMS damaged	Contact Distributor/StackRack
Different SOC value of batteries in parallel	Normal	Discharge battery below 20% SOC, then fully charge battery
Low voltage protection with no LED on	BMS in protection	Contact Distributor/StackRack
Deep discharge with "run" light on	Battery voltage too low to start BMS	Contact Distributor/StackRack

8. Warranty

StackRack's limited warranty must be registered within the first year of purchase to stay valid. Failure to register will invalidate the warranty. This limited warranty applies only to the original purchaser and is not transferable. The warranty covers all BMS and cell exchanges during its term. For a full replacement, the warranty is prorated at 1/9th per year after the first year, based on current retail pricing.

For full warranty details and to register your product visit stackrackbattery.com/warranty.

8.1 Extended Warranty

StackRack offers 5-year extended warranty options - extending the entire term of the limited warranty up to a maximum of 25 years. Each 5-year extended limited warranty option must be purchased and registered within the first year and purchased for each module to be covered.

For full details regarding the 5-year extended warranty options and to register your product visit stackrackbattery.com/warranty.

8.2 Warranty Exclusions

Under this limited warranty, StackRack Inc. has no obligation to the product if it is subject to the following conditions, including but not limited to:

- Unauthorized modifications, tampering, or dismantling of the product
- Utilizing the product in ways not specified by the manufacturer
- Damage resulting from neglect of regular maintenance
- Exposure to unsuitable environmental conditions
- Damage sustained during the installation or removal process
- Products with altered, defaced, or removed serial numbers
- Damage from natural disasters such as Lightning, Fire, Flood, or other Acts of God
- Mishandling or improper handling of the product

StackRack Inc.'s equipment is intended for installation exclusively by licensed, trained, and insured solar electrical installation experts. We highly recommend engaging a professional for the installation of our products. StackRack Inc. does not guarantee the purchaser's safety, the successful implementation of the equipment, or adherence to local codes and regulations.

StackRack Inc. explicitly excludes all warranties, both expressed and implied, not limited to any implied warranties regarding the precision or completeness of information shared and/or the suitability of the materials sold for a specific purpose. Warranties cannot be created or extended by sales or promotional materials regarding these items. Both parties irrevocably renounce their right to a jury trial in any legal actions or proceedings stemming from this agreement or the transactions it entails. Any installation advice provided by StackRack, whether before, during, or after the purchase of solar equipment, is intended solely for educational purposes on general concepts and should not substitute the expertise of a licensed, trained solar specialist. The Customer commits to fully indemnify StackRack against any legal actions related to, or arising from, losses, whether direct or consequential, associated with the product installation, exceeding the purchase price of the equipment.

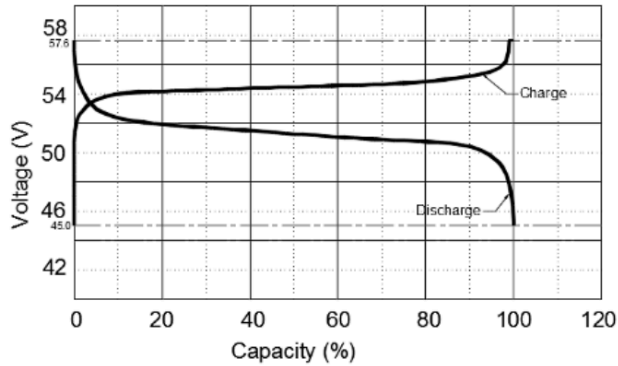
9. Technical Specifications

Battery Operating Specifications		
Specification	BMS	Recommended Setting
Nominal Voltage	51.2V	
Capacity	100aH	
Charge Voltage (Bulk/Absorb)	56.8V	56.2V (+/-0.2V)
Float		54V (+/-0.2V)
Low DC Cutoff	44.8	47-45.6V
Charging Current	100A (max continuous)	30-50A
Discharging Current	100A (max continuous)	90A
Environmental Parameters		
Charging Range	32° – 113°F (0°C to 45°C)	
Discharging Range	-4°F – 122°F (-20°C to 50°C)	
Storage Range	-4°F – 122°F (-20°C to 50°C)	
Charging/ Discharging Parameters		
Charge	Specification	Recovery
Cell Voltage Protection	3.8V	3.45V
Battery Voltage Protection	60.0V	55.2V
Over Charging Current 1	>102A	
Over Charging Current 2	>120A	
Temperature Protection	<23°F or >158°F <-5°C or >70°C	>32°F or <140°F >0°C or 60°C
Discharge	Specification	Recovery
Cell Voltage Protection	2.3V	3.1V
Battery Voltage Protection	44.8V	48V
Over-Charging Current 1	>102A	60 sec
Over-Charging Current 2	>150A	60 sec
Short Circuit	>300A	
Temperature Protection	<-4°F or >167°F <-20°C or >75°C	>14°F or <149°F >-10°C or <65°C

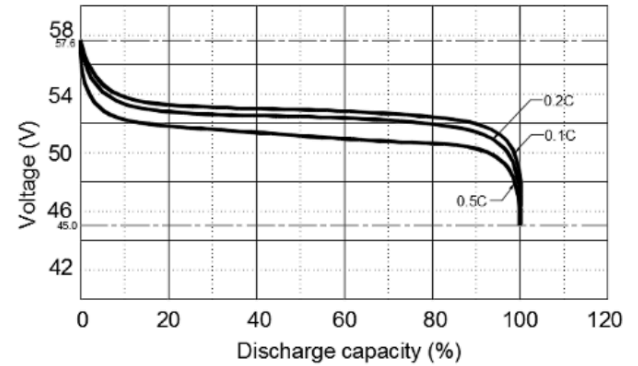
General Specifications			
Parameter	Specifications		Condition
Cell Balance	120mA	Passive Balance	Cell Voltage Difference >40mV
Temperature Accuracy	3%	Cycle Measurement	Measuring Range -40°F – 212°F (-40°C – 100°C)
Voltage Accuracy	0.5%	Cycle Measurement	For Cells & Battery
Current Accuracy	3%	Cycle Measurement	Measuring Range -200A - 200A
SOC	5%		Internal Calculation
Power Consumption	Sleep & Off Mode	<300uA	Storage/Transport/Standby
Power Consumption	Operating Mode	<25mA	Charging/Discharging
Communication Ports	RS485/CAN		
Maximum Batteries in Series	1		
Maximum Batteries in Parallel	64		
Physical Specifications			
Dimensions (H×W×D)	6.1 in.×19 in.×17.4 in. (15.5 cm×48.2 cm×44.2 cm)		
Weight	99.6 lbs. (45.2 kg)		
Standards and Certifications			
Module	ETL Listed to UL Standard 9540A:2019		
Cell	UL:1973		

9. Battery Performance Curves

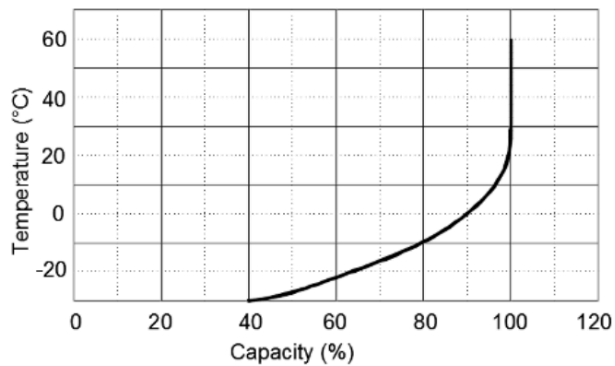
Charge & Discharge curve with 0.5C @ 25°C



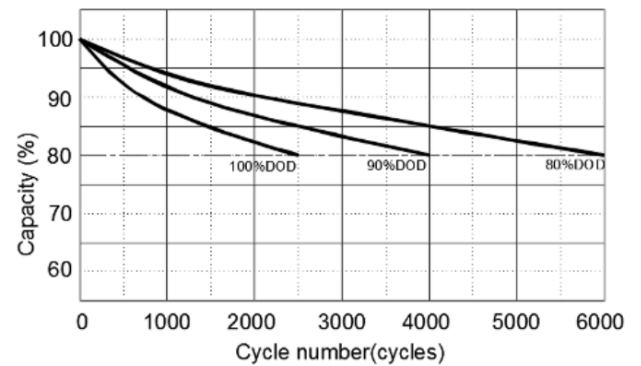
Discharge performance with different rate @ 25°C



Discharge capacity with different temperature @ 0.5C



Cycle life with DOD @ 0.5C, 25°C



Self-discharge @ different temperature

