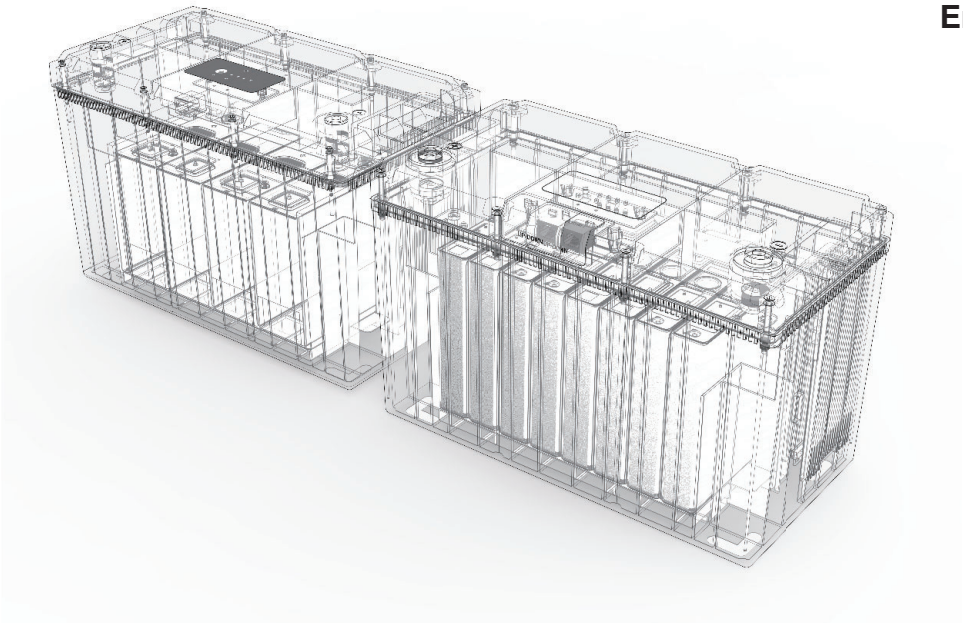
# New Generation 12.8V Li-ionnBattery

# User's Guide

**Ended User Documentation**

Rev 1.0

2023-Aug-30



# CONTENT

## WARNING:

### Explosion, Electrocution, Or Fire Hazard

- **A battery can present a risk of electric shock, burns from high short circuit current, fire, or explosion. Observe proper precautions.**
- **Ensure the cables are properly sized.**
- **Ensure clearance requirements are strictly enforced around the batteries.**
- **Ensure the area around the batteries is well ventilated and clean of debris.**
- **Ensure no heat source near the battery.**
- **Ensure the battery terminal screws are tightened, (M8 screw torque: 18 N.m).**
- **Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts.**
- **Never charge a frozen battery unless optional heater parts inside.**
- **If a battery must be removed, always remove the grounded terminal from the battery first. Make sure all devices are disconnected.**

## IMPORTANT

- **When installing batteries, leave adequate clearance between batteries.**
- **When replacing batteries, use the same number and type of batteries.**
- **Avoid any fall or collision during the installation process.**
- **Do not remove the battery components. The maintenance of the battery should be carried out by a professional engineer.**
- **Do not expose the Li-ion battery to heat in excess of 58°C during operation, 60°C in storage.**
- **Do not incinerate or expose to open ames.**
- **Do not connect over 4 sets Li-ion batteries in series. Wrong operation will damage the BMS.**
- **Before series connection, it's better to make sure fully charge or discharge single battery. The different SOC between batteries may cause the whole group to fail to charge and discharge normally (Reduce the usable capacity of the battery group.**
- **Before parallel connection, it's better to make sure the voltage difference less than 0.1V to avoid large current impact .**
- **Do not connecte in series at the same time connect in parallel.**

Ritar new generation 12.8V100Ah Li-ion battery is intended as a replacement for the common 12V100Ah lead acid battery and traditional case Li-ion battery. The new generation 12.8V100Ah Li-ion battery adopt  removable enclosure and modular design which support to assembly in local.

The new generation 12.8V100Ah Li-ion battery adopt Iron Phosphate (LiFePO4) cells and unique BMS to provide safety, high current and prominent long life performance, with 20 times longer cyclic life than SLA battery to save cost and energy, up to 70% lighter than SLA battery to save logistic cost. Diverse accessories which include Bluetooth modules, heater components, LED display units and communication ports.

This document is intended for use by anyone required to install and operate new generation 12.8V100Ah Li-ion batteries. Be sure to review this manual carefully to identify any potential safety risks before proceeding.

The owner must be familiar with all the features of this product before proceeding.

Failure to install or use this product as instructed can result in damage to the product that may not be covered under the limited warranty.

Ritar new generation 12.8V100Ah Li-ion battery include 3 different type:

**R-LFP12.8V100Ah G1**: IP65 waterproof,

- Optional parts: Built-in Bluetooth module.

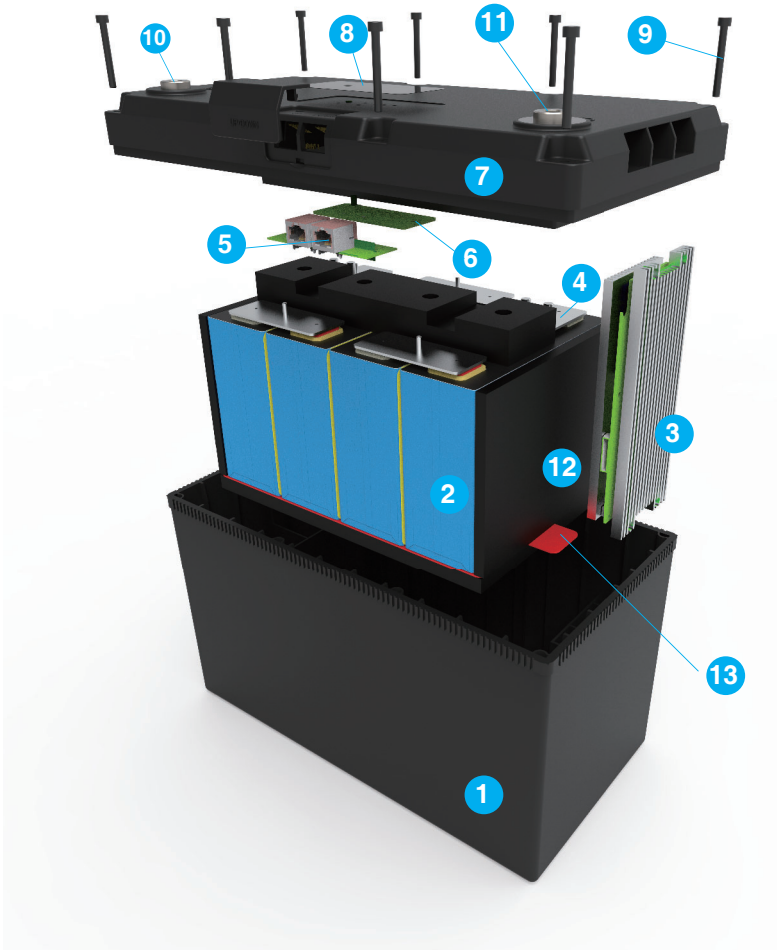
**R-LFP12.8V100Ah G2**: IP65 waterproof,  LED indicator (SOC, RUN, ALARM) and ON/OFF button.

- Optional parts: Built-in Bluetooth module, Heater,

**R-LFP12.8V100Ah G3**:  LED indicator (SOC, RUN, ALARM) and ON/OFF button. Communication port (RS485, CAN).

- Optional parts: Built-in Bluetooth module, Heater, External bluetooth module(RS485), External display module (RS485)

## Explode Diagram




1. Battery enclosure - ABS+PC
2. Prismatic LiFePO4 Cell
   4000 cycles-3.2V104Ah, 1P4S
3. BMS- 4S100A
4. Aluminub Bar -AL1060
5. Communication Port (RS485, CAN),
   Only for G3
6. LED display board for G2, G3
   Optional Built-in Blutooth module for G1 G2,G3
7. Battery cover- ABS+PC
8. Film -PC ,
   No silkscreen for G1
   SOC/RUN/ALM and ON/OFF for G2, G3
9. Fixing screws, M3*25,
10. Battery Positive, Nickel plated brass
    M8 internal thread
11. Battery Negative, Nickel plated brass
    M8 internal thread
12. EVA foam
13. Optional Heater Part for G2, G3

## Specification

| Model | LFP12.8V100AH G1 | LFP12.8V100AH G2 | LFP12.8V100AH G3 |
|---|---|---|---|
| Cell and Connection | CB56-104Ah, 1P4S | | |
| Nominal Voltage [V] | 12.8 | | |
| Nominal Capacity [Ah] | 100 | | |
| Total Energy [Wh] | 1280 | | |
| Max. Charging Current [A] | 100 | | |
| Recommended Charging Current [A] | 50 | | |
| Charging Voltage [V] | 14.2~14.6 | | |
| Max. Discharging Current [A] | 100 | | |
| End of Dicharge Voltage [V] | 11.2 | | |
| Operating Temperature Range | Charge: 0 ~ +50°C;<br>Discharge: -20 ~ +55°C | Charge: 0 ~ +50°C; Discharge: -20 ~ +55°C<br>With Heater: Charge/Discharge -20~+55°C | |
| Protection | Over charge, Over discharge, Over temperature, Low Temperature, Over Current, Short circuit | | |
| Cycle Life | >3000 cycles | | |
| Designed Calendar Life | 10 Years | | |
| Communication Port | / | | RS485; CAN |
| LED Indicator and Button | /、 | SOC, ALM, RUN, ON/OFF | |
| Dimension (W*D*H, mm) | 330*172*214 | | |
| Weight [Kg] | 10.5 | | |
| Operation Humidity | 0~95% RH (No condensing) | | |
| IP Class | IP65 | | IP30 |
| Parallel Support | Yes, Max, 4Sets | | |
| Series Support | Yes, Max. 4 Sets | | |
| Certification-Cell | UN38.3; ROHS; IEC62619; UL1973; UL9540A | | |
| Certification-Battery | UN38.3; MSDS; CE | | |
| Optional Parts | Internal Bluetooth Module | Internal Bluetooth Module<br>Heater | Internal Bluetooth Module<br>Heater<br>External Bluetooth Module<br>External Display Module<br>RS485-USB Device |

## BMS Information

| Model | LFP12.8V100AH G1 | LFP12.8V100AH G2 | LFP12.8V100AH G3 |
|---|---|---|---|
| **Over-Charge Alarm & Protection /Over-Discharge Alarm & Protection** | | | |
| Over-Charge Alarm | 3.55V (For cell) 14.0V (For pack) | | |
| Over-Charge Protection | 3.7V (For cell) 14.8V (For pack) | | |
| Over-Charge Protection Delay | 1000 ms | | |
| Over-Charge Release | 3.45V (For cell) 13.8V (For pack) | | |
| Over-Discharge Alarm | 2.8V (For cell) 11.2V (For pack) | | |
| Over-Discharge Protection | 2.5V (For cell) 10V (For pack) | | |
| Over-Discharge Protection Delay | 1000 ms | | |
| Over-Discharge Release | 2.8V (For cell) 11.2V (For pack) | | |
| **Over Current Alarm & Protection** | | | |
| Charge Over Current Alarm | 60A | | |
| Charge Over Current Protection | 110A | | |
| Charge Over-Current Protection Delay | 15S | | |
| Charge Over Current Protection Release | Automatic release after 1min and up to 3 times or Discharge | | |
| Discharge Over Current Alarm | 110A | | |
| Discharge Over Current Protection-1 | 115A | | |
| Discharge Over Current Protection-1 Delay | 15S | | |
| Discharge Over Current Protection-2 | 120A | | |
| Discharge Over Current Protection-2 Delay | 200ms | | |
| Discharge Over Current Protection Release | Automatic release after 1min and up to 3 times or Charge | | |
| **Over Temperature Alarm & Protection** | | | |
| Charge Low Temperature Alarm | 7°C | | |
| Charge Low Temperature Protection | 0°C | | |
| Charge Low Temperature Protection Release | 5°C | | |
| Charge High Temperature Alarm | 50°C | | |
| Charge High Temperature Protection | 55°C | | |
| Charge High Temperature ProtectionRelease | 45°C | | |
| Discharge Low Temperature Alarm | -10°C | | |
| Discharge Low Temperature Protection | -20°C | | |
| Discharge Low Temperature Protection Release | -17°C | | |
| Discharge High Temperature Alarm | 55°C | | |
| Discharge High Temperature Protection | 60°C | | |
| Discharge High Temperature Protection Release | 50°C | | |
| **Short Circuit Protection** | | | |
| Short Current Protection Delay Time | 1500 uS | | |
| Short Current Release Method | Release load | | |
| **Heater Control (Optional)** | | | |
| Heater ON | / | Cell temperature < 0°C and charger | |
| Heater OFF | / | Cell temperature >10°C | |

## Storage

The 12.8V100Ah Li-ion battery can be stored in an environment with temperatures between -20°C and +55°C and between 10% and 90% relative humidity, non-condensing.
For long storage periods at 25°C, charge the battery every half years.
For temperatures above 40°C, charge the battery quarterly.
Do not store the Li-ion battery at temperatures above 60°C.

## Relationship Between Charge Limits and Temperature

Due to the chemistry of Lithium Ion cells, the cells cannot accept as much charge current at lower temperatures without risking permanent loss of capacity. As the cells' temperature rises during the charging process, they can gradually accept higher currents.
To maintain optimum performance and durability of Li-ion battery, the following charge limits based on ambient temperature is recommended.

| Temperature (℃ ) | Max Charge Current |
|---|---|
| -20 | Prohibit charging |
| -10 | Prohibit charging |
| 0 | 0.1C |
| 10 | Recommended charge current |
| 20 | Max continuous charge current |
| 35 | Recommended charge current |
| 45 | 0.2C |
| >55 | Prohibit charging |

Table 1 Charge rate by temperature

## Series Strings

The batteries can be combined together in series strings to achieve higher operating voltages by connecting the positive terminal of one battery to the negative terminal of the next battery. The maximum number of 12.8V Li-ion battery that you can connect in a series is four (4).
Below figure 2 illustrates four 12.8V Li-ion batteries connected in series, for a 4S1P configuration.

4pcs 12.8v100ah in series

Figure 2. Connecting Batteries in Series (4S1P Configuration)

Two batteries in series: 2 x 12.8V = 25.6V (nominal) for 24V applications
Three batteries in series: 3 x 12.8V = 38.4V (nominal) for 36V applications
Four batteries in series: 4 x 12.8V = 51.2V (nominal) for 48V applications

## CAUTION

- Failure to follow the following safety instructions may result in personal injuries or damage to the equipment!
- Do not connect more than four batteries in series. Connecting more than four batteries in series exceeds the voltage limit of the BMS.
- Do not short circuit the Li-ion battery
- Do not connect different batches, different types, old and new batteries in series.
- Ensure the batteries consistency before connecting in series.
- For series connection, if one of batteries is charged fully (100% SOC), the other batteries will not be charged anymore, this may casue some batteris SOC won't show 100%, it don't effect the performance of battery.

## Parallel Strings

You can combine batteries together in parallel strings to achieve higher operating energy by connecting like-polarity terminals of adjacent batteries. To combine batteries in parallel strings, connect all like-polarity wires on adjacent batteries to an appropriately sized terminal block for your application.
Refer to Figure 3 for an example of four 12.8V Li-ion batteries connected together in a 4P configuration. The maximum number of 12V series strings that you can connect in parallel is four.

4pcs x 12.8v100ah in Parallel

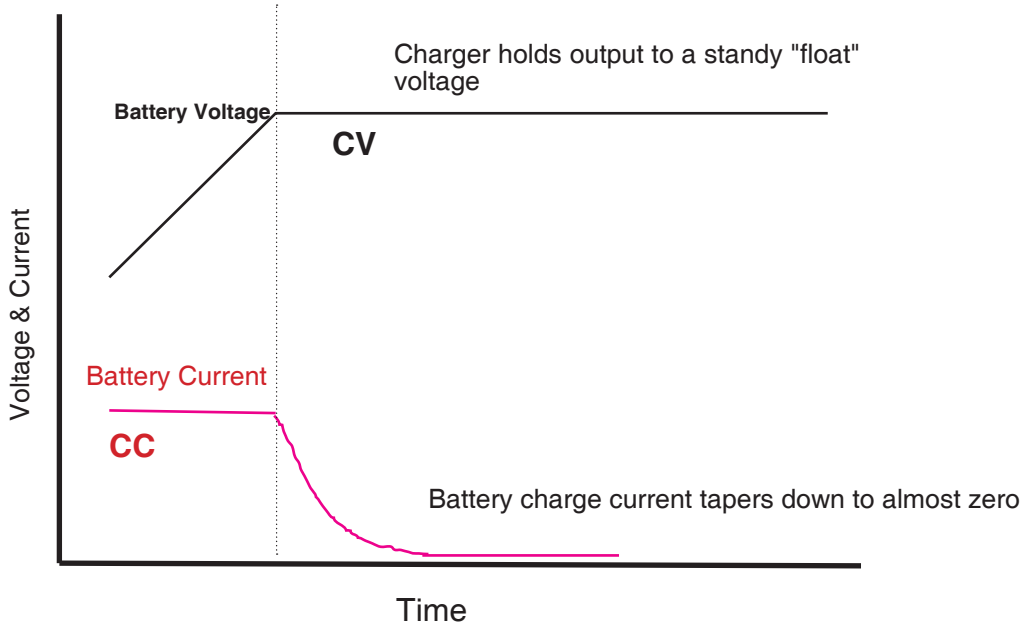
Figure 3 Example of a 4S2P Configuration

### CAUTION

- Do not connect different batches, different types, old and new batteries in parallel.
- Ensure the battery voltage difference is below 100mV before parallel connection to avoid high pulse current.
- Ensure every battery have 3A charge/discharge current.
- **The parallel application can only extend the working time, and cannot increase the charging or discharging current.**

## Charging Batteries

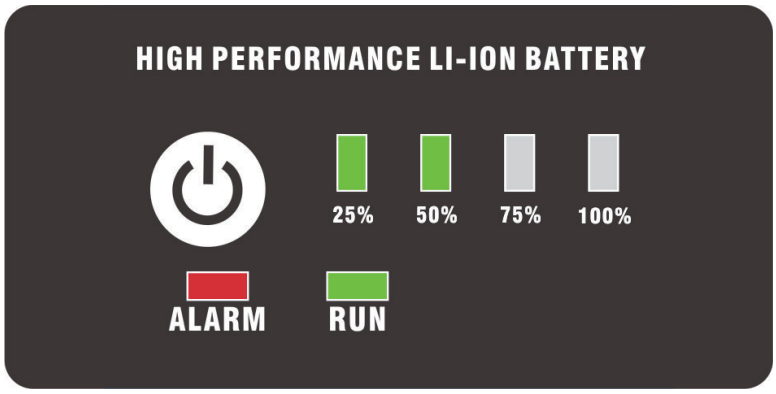
The 12.8V Li-ion is compatible with common 12V Lead-acid battery chargers.
Chargers that require the detection of voltage at the battery terminals to charge may fail to wake the Li-ion battery from a state of under-voltage protection. Constant Voltage (CV) chargers may result in an inrush of current due to the low impedance of the cells, interrupting the charge. Reset the charger and continue charging normally if the charger trips.
The constant current (CC) chargers is recommended strongly.
To charge a single 12.8V battery, the maximum charge voltage is 14.6V and the maximum charge current is refer to Table 1. Any inrush current may cause over current or short circuit protection.
Once you reach end-of-charge voltage, apply a constant voltage hold at this voltage until the current decays to almost zero. This charges the cells to 100% state of charge (SOC). Refer to below figure for an illustration.




Battery voltage and current during recharge

## Week up or Switch Off

For 12.8V100Ah Li-ion battery, if there are no charge or discharge for 24 hours, the battery will enter into sleep mode to save energy and it can still be measured a OCV (>10V), any charge or discharge operation will active the battery.
If the battery was over-dicharged protection, the BMS will enter into sleep mode after 5 min. there are no OCV at this status. only charge operation can active the battery.
For G2 and G3 series. it can also support to press ON/OFF button 6 seconds to active or switch off a battery.



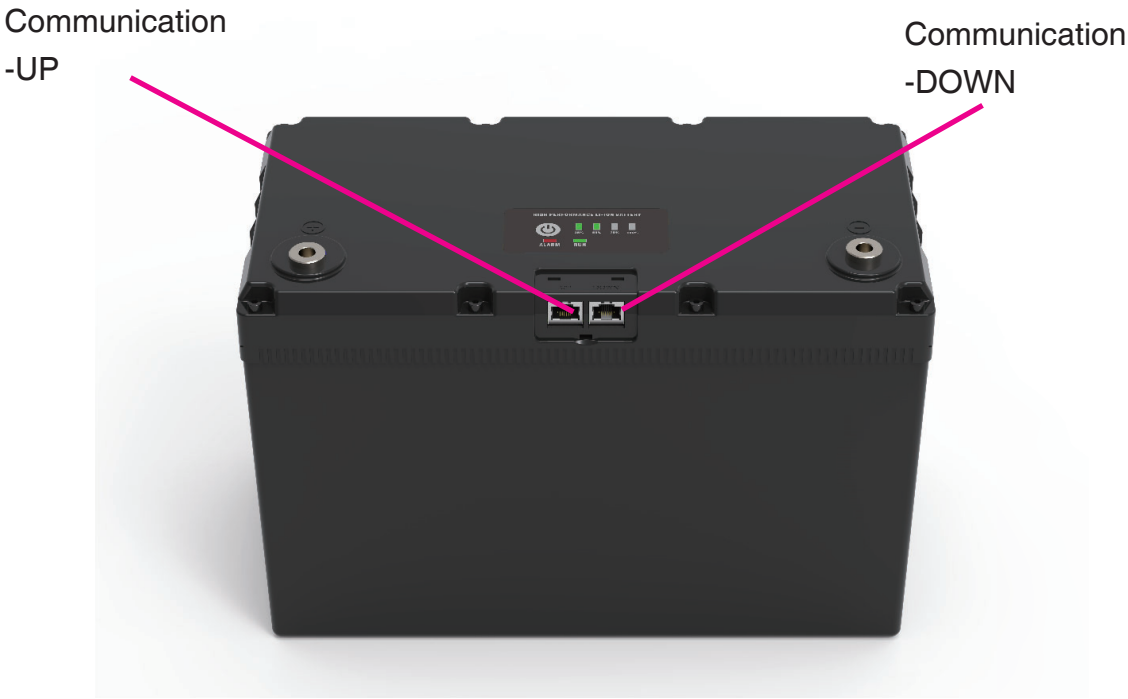
# LED Indicator for G2 & G3

| Status | Nominal Warning Protection | RUN | ALM | SOC | | | | Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Shut down | Dormancy | OFF | OFF | OFF | OFF | OFF | OFF | |
| Standby | Nominal | Flash 1 | OFF | Follow module capacity | | | | Standby |
| | Warning | Flash 1 | Flash 3 | | | | | Module at low voltage |
| Charge | Nominal | ON | OFF | Follow module capacity | | | | |
| | Warning | ON | Flash 3 | | | | | |
| | Over-charge Protection | ON | OFF | ON | ON | ON | ON | LED turn to standby if no power supply |
| | Temperature, over-current, Failure protection | OFF | OFF | OFF | OFF | OFF | OFF | Stop charging |
| Discharge | Nominal | ON | OFF | Follow module capacity | | | | |
| | Warning | ON | Flash 3 | | | | | |
| | Under voltage Protection | OFF | OFF | OFF | OFF | OFF | OFF | Stop discharging |
| | Temperature, over-current, short circuit, failure protection | OFF | ON | OFF | OFF | OFF | OFF | Stop discharging |
| Failure | | OFF | ON | OFF | OFF | OFF | OFF | Stop charging and discharging |

Note:
Flash 1: light 0.25s/off 3.75s
Flash 2: light 0.5s/ off 0.5s
Flash 3: light 0.5s / off 1.5s

## Communication for G3

This chapter mainly introduce the communication function for R-LFP12.8V100Ah G3.




| UP | |
|---|---|
| PIN | Description |
| 1 | LED - |
| 2 | O/F/LED+ |
| 3 | O/F |
| 4 | CAN H |
| 5 | CAN L |
| 6 | COMG |
| 7 | RS485-A |
| 8 | RS485-B |

| DOWN | |
|---|---|
| PIN | Description |
| 1 | / |
| 2 | SWB |
| 3 | SWA |
| 4 | CAN H |
| 5 | CAN L |
| 6 | COMG |
| 7 | RS485-A |
| 8 | RS485-B |

the battery  BMS default ADD is 0, if there are 2 or more batteies connect in series or parallel. It needs change BMS ADD by following steps:

Step 1: Ensure all batteries are on sleep mode. Measure every battery open circuit voltage ( >10V).

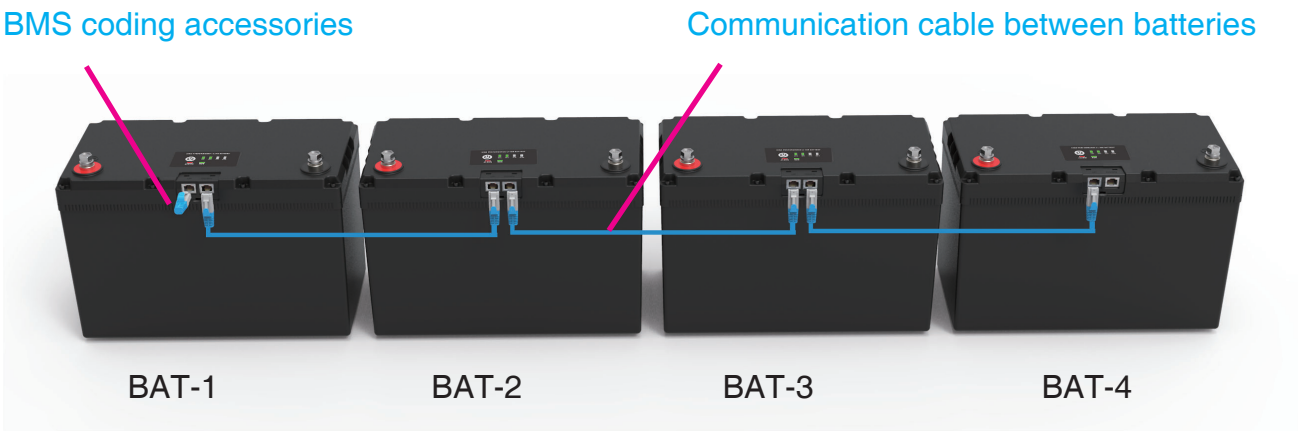
Step 2: Connect power cable for series or parallel.

Step 3: Connect communication cable between batteries.

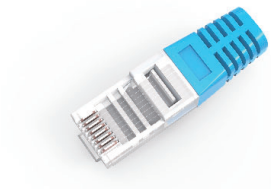
Step 4: Active all batteries by press ON/OFF button 6s, the battery SOC indicator will on.

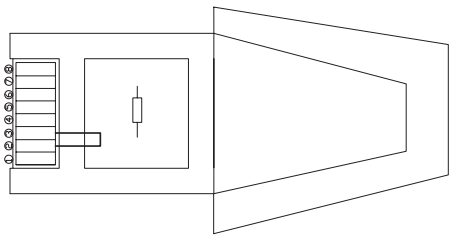
Setp 5: Insert BMS coding accessories to BAT-1 UP port. the BAT-1 RUN & ALARM LED will start to flash, and then BAT-1 and BAT-2 RUN & ALARM LED will flash, finally, all LED indicator will become normal which means the BMS ADD coding process is complete.

Setp 6:  Remove  BMS coding accessories and connect RS485-USB cable to PC, it can monitor every battery information by BMS PC software.




**BMS coding accessories**





**Communication cable**

The communication cable between Battery and Victron inverter  is Customization required，

Cannot be used standard network cable.

## BMS PC software operation

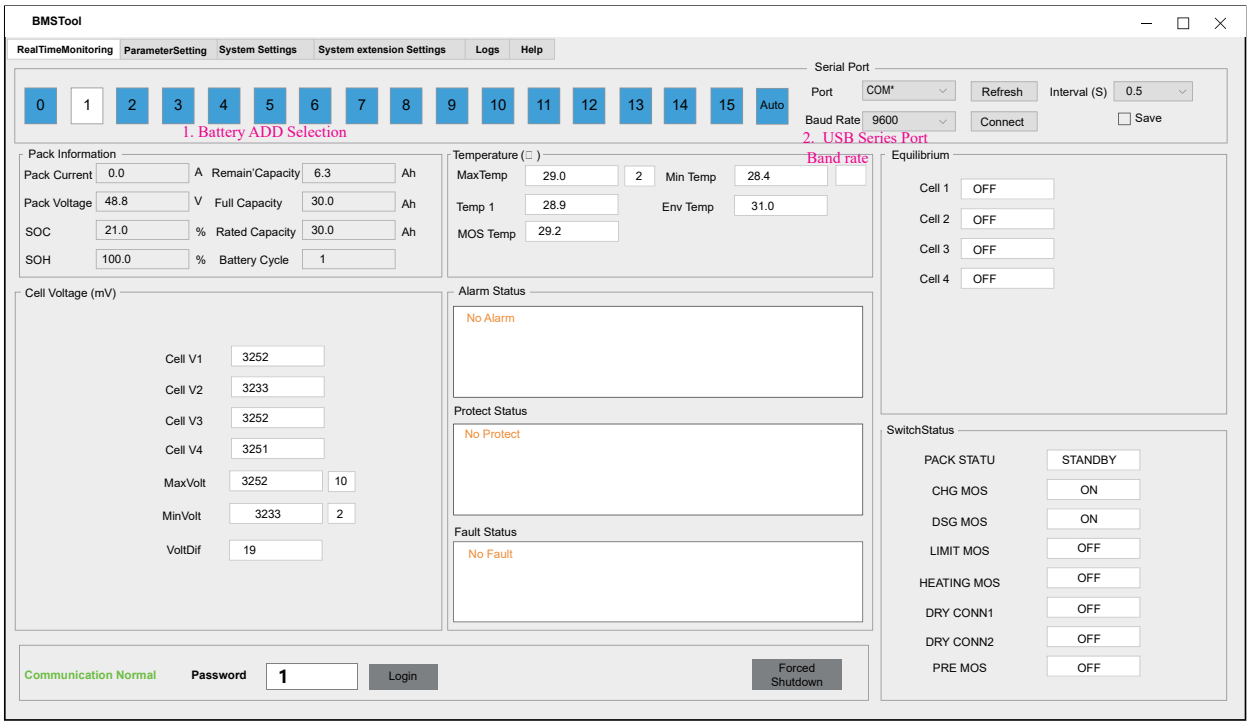
This chapter mainly introduce the BMS PC software operation for R-LFP12.8V100Ah G3.

BMS PC software download: http://120.27.63.138:8181/attach_files/new_vrla_replacement/5


Double click BMSTools.exe to open the software.

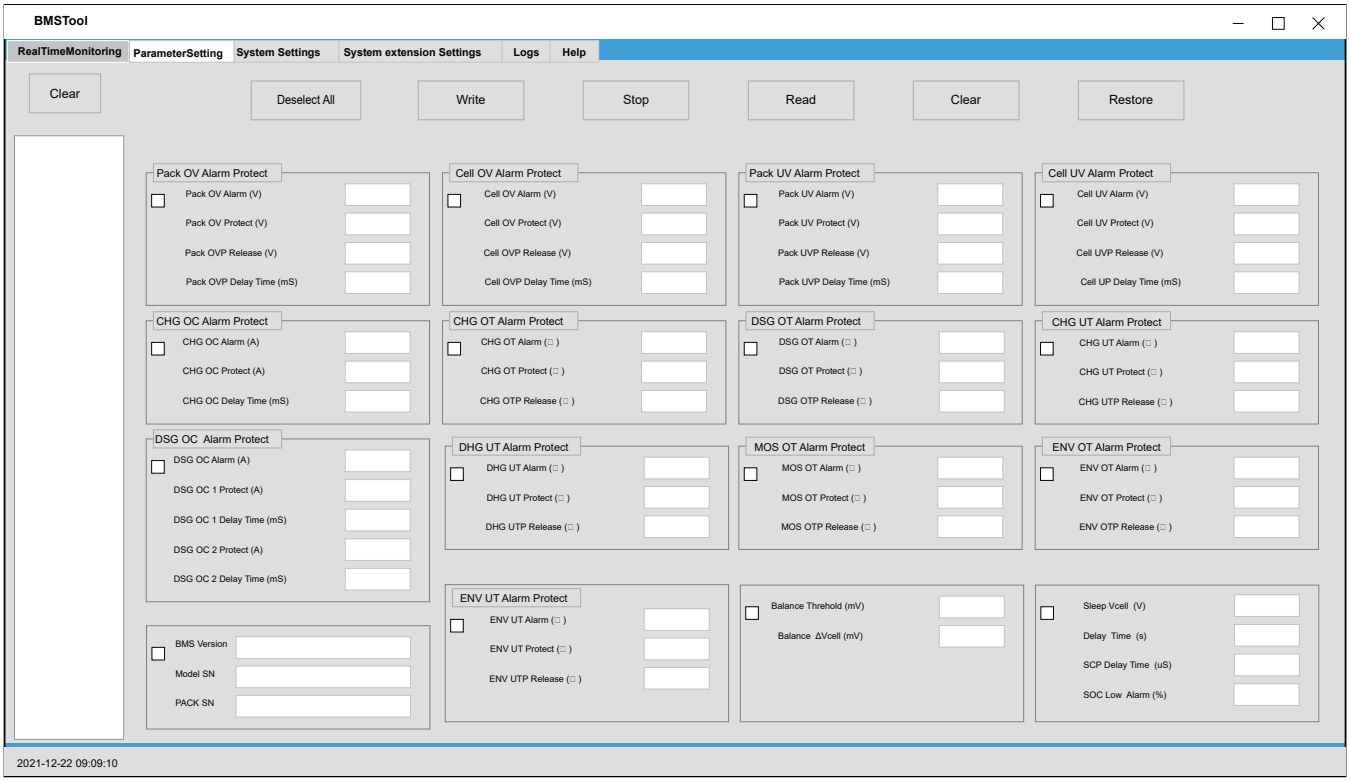
Check the battery ADD, USB series Port and band rate-9600, click “connect”.

If the communication is normal,  the battery realtime information will be listed.



Click “ Read”, the BMS default parameter will be list.  any modify about BMS parameters should be carried out by a professional engineer.

Wrong parameters setting will cause the damage about BMS or battery.



## Bluetooth battery APP introduction

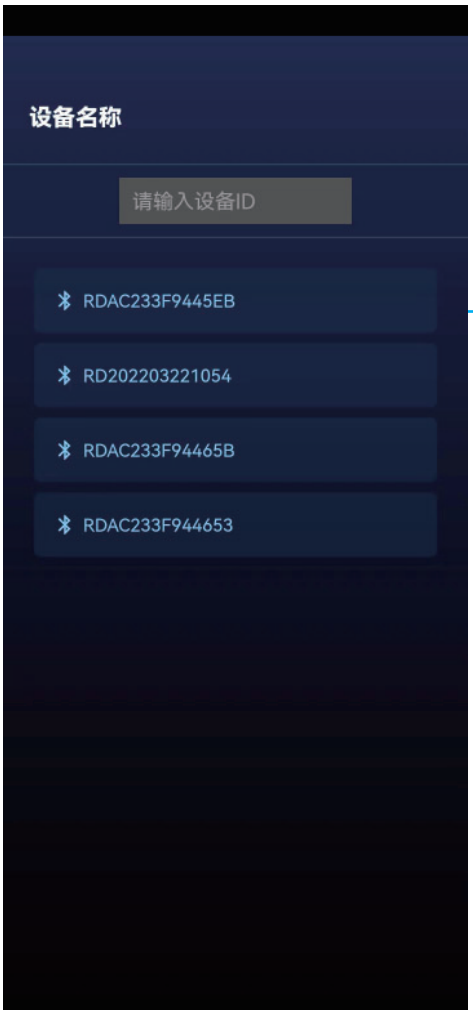
This chapter manily introduce the bluetooth battery APP.

The end user can download APP by searching " Bluetooth Li"

the download link refer to below:

IOS App Store Link

Google Play Link

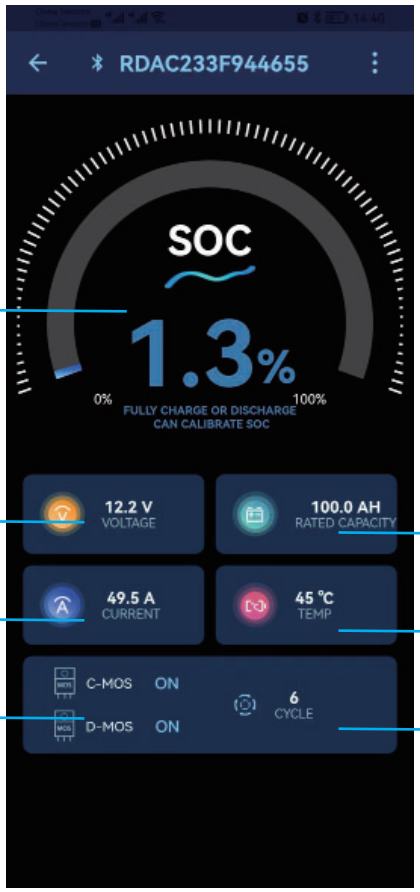


State of charge

Battery Voltage

Battery Current

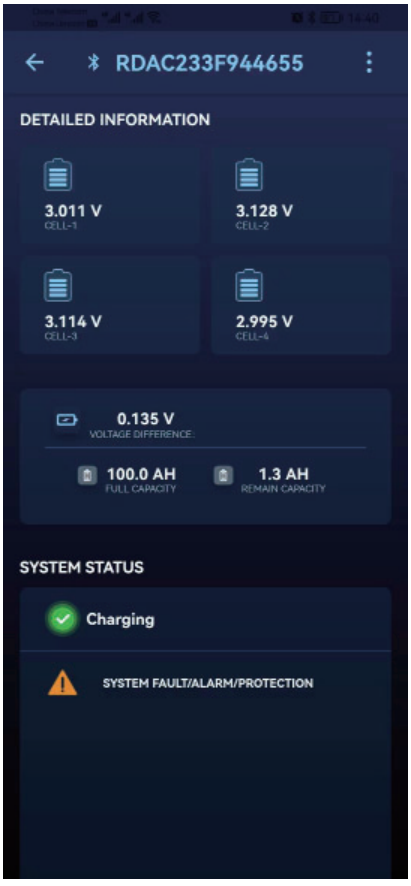
Charge is positive,
Discharge is negative




Battery Rated Capacity

Battery Temperature

Cycle times



## Troubleshooting

The 12.8V Li-ion batteries are extremely reliable batteries that provide greater useful life than comparable 12V lead-acid batteries. Despite the high reliability of the 12.8V Li-ion batteries, you may encounter situations where the battery does not operate as expected. These situations are typically the result of misuse, abuse or a non-optimal operating or storage environment. This part details potential issues you may encounter with the 12.8V Li-ion batteries and the appropriate troubleshooting procedures.

## Charger Trips using Constant Voltage

**Problem:**
CV charger trips when charging the batteries. This is due to the low impedance of the battery creating a current inrush.
**Solution:**
Reset the charger and try again.

## Terminal Voltage Absent or Low

**Problem:**
Using a multimeter to check terminal voltage shows the terminal voltage is low (<10V).
Possible causes for this problem are:
The voltage of a cell within the battery dropped below 2.5 V, causing the microprocessor to enable low-voltage protection.
The battery's SOC dropped below 5% from either an extended idle period or heavy use, enabling under-voltage protection.
The battery overheated (>60°C), causing the microprocessor to enable over-temperature protection.
**Solution:**
To resolve situations where terminal voltage is absent or low:
1.Allow the battery to cool and then recheck terminal voltage.
2. Connect the battery to a charger to wake the battery and recover terminal voltage.
(<=30V PV panel can be used to active a deep discharge battery. )
(A 12V VRLA battery can also be used to active a deep discharge battery. )
3. If the cells pack voltage is below 7V, the BMS will not be actived anymore. So it needs to be charged in time after deep discharge.

## Battery Current Disappears when Charging

**Problem:**

Battery current disappears when charging. Possible causes for this problem are:
The battery overheated, enabling over-temperature protection.
Charger voltage is too high.

**Solution:**

To resolve situations where current disappears when charging:
1.Allow the battery to cool.
2.Reduce charger voltage to 14.2~.14.6 V.