12.8V Li-ion Battery
User's Guide

Ended User Documentation

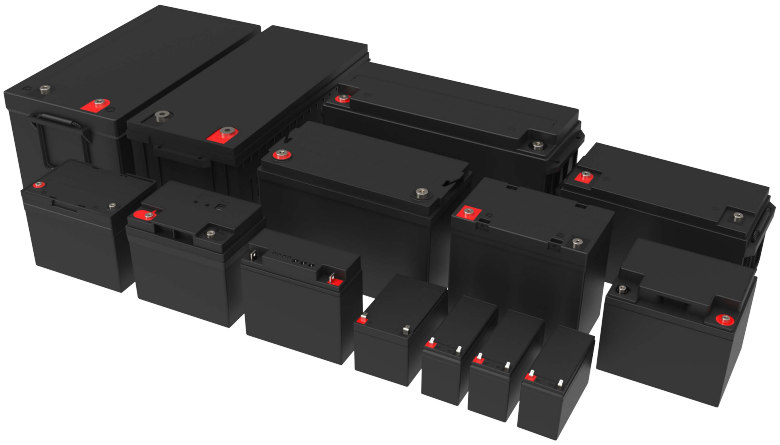
Rev 1.2

2021-Oct-08

DOCUMENT NOTICE: The information contained in this manual is the property of Hengyang Rich Power Co., Ltd. ("Ritar") and is subject to change without notice. Ritar eserves the right to make changes in the design of its products or components as progress in engineering and manufacturing may warrant.
It is the customer's responsibility to satisfy itself as to whether the information contained herein is adequate and suffcient for a user's particular use.
It is the further responsibility of each user to ensure that all applications ' of Ritar products are appropriate and safe based on conditions anticipated or encountered during use.
This document does not create any additional obligation for Ritar and does not constitute additional warranties and representations.

CONTENTS

Ritar 12.8V Li-ion batteries are intended as a replacement for the common 12v lead acid battery. Ritar Lithium Iron Phosphate (LiFePO4) Battery pack with Ritar unique triple safety protection with high performance and prominent long life, with 20 times longer cyclic life than SLA battery to save cost and energy, up to 50% lighter than SLA battery to save logistic cost.
This document is intended for use by anyone required to install and operate Ritar 12.8V 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.



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.
Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts.
Never charge a frozen battery.
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 flames.
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 .

Storage

The 12.8V Li-ion battery can be stored in an environment with temperatures between -40° C and +60° C and between 10% and 90% relative humidity, non-condensing. For long storage periods at 25° C, charge the battery every 6 months. 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.

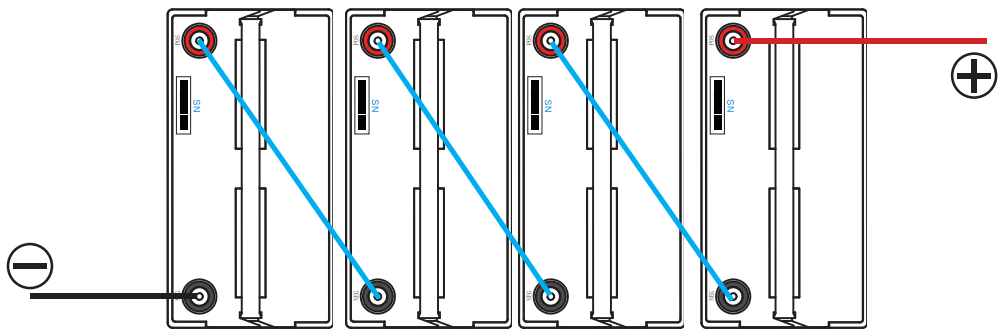


Figure 2. Connecting Batteries in Series (4S1P Configuration)

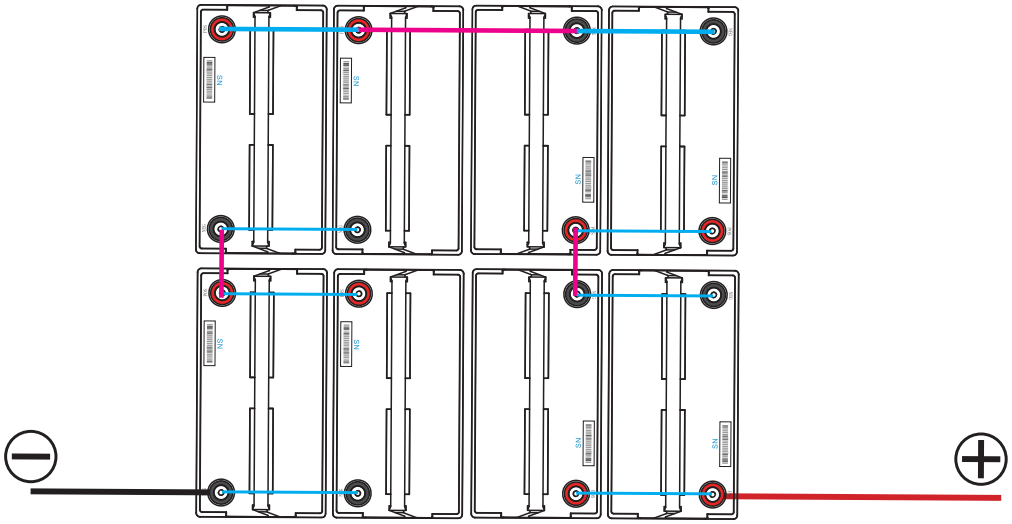
Two batteries in series: 2 x 12.8V = 25.6V (nominal) for 24V applications
Three batteries in series: 3 x 12.8V = 38.4V (nominal) for 36V applications
Four batteries in series: 4 x 12.8V = 51.2V (nominal) for 48V applications

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 more than two battery strings in parallel.
- Do not connect different batches, different types, old and new batteries in series.

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 eight 12.8V Li-ion batteries connected together in a 4S2P configuration. The maximum number of 12.8V series strings that you can connect in parallel is two.
Parallel string configurations greater than 4S2P are not supported at this time.



2pcs x 12v100ah in Parallel

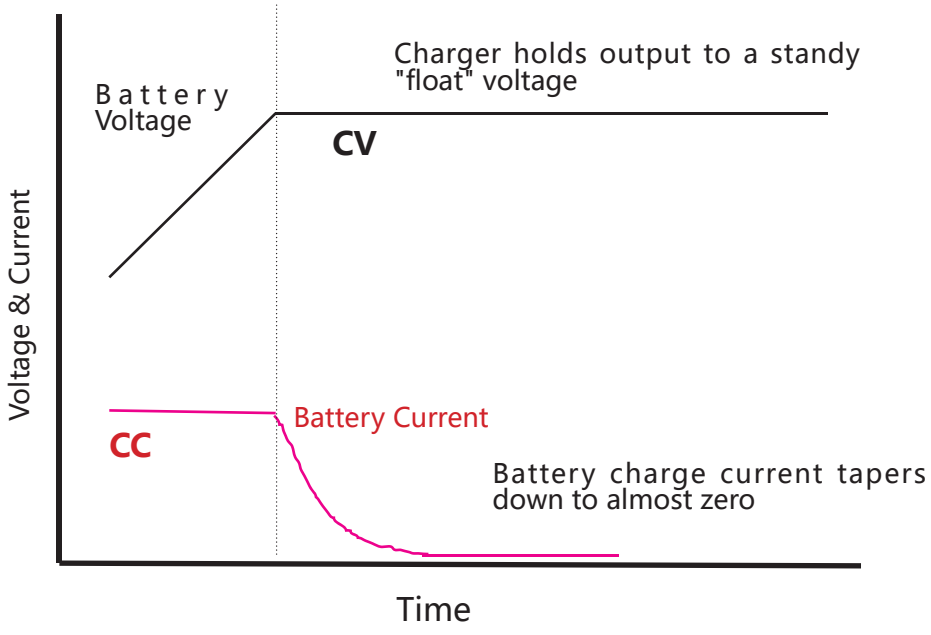
Figure 3 Example of a 4S2P Configuration

CAUTION

- Do not connect different batches, different types, old and new batteries in series.
- It needs to make sure the battery voltage difference is below 100mV before parallel connection.
- Do not connect more than 8 battery strings in parallel and make sure every battery have 3A charge/discharge current.
- Do not connect different batches, different types, old and new batteries in parallel.
- **The parallel application can only extend the working time, and cannot double the charging or discharging current.**

Charging Batteries

The 12.8V Li-ion is compatible with common 12.8V 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

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.
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, 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.
The battery pack is out-of-balance (normally in series application).
Charger voltage is too high.
Solution:
To resolve situations where current disappears when charging:
1.Allow the battery to cool.
2.Apply a 14.0 V charge voltage for 48 hours to balance the battery pack ‘s cells.
3.Reduce charger voltage to 14.4 V or less.

The Bluetooth Li APP can't find battery (No bluetooth ID is listed)

Problem:
The battery is working in sleep mode.
Solution:
If there are no charge and discharge over 1hours, The battery will enter sleep mode. it can recharge or discharge to active the BMS.

The displayed SOC does not match the actual power

Problem:
Due to the current accuracy and the power consumption of the battery itself, the SOC will have an error with the actual power after a period of time, and the error will accumulate.
Solution:
It is recommended that once a month, the battery should be fully charged to the protection or completely vented to the protection according to the current of 0.5c, and the SOC should be corrected.

Bluetooth battery APP introduction

This chapter manily introduce the bluetooth battery APP.

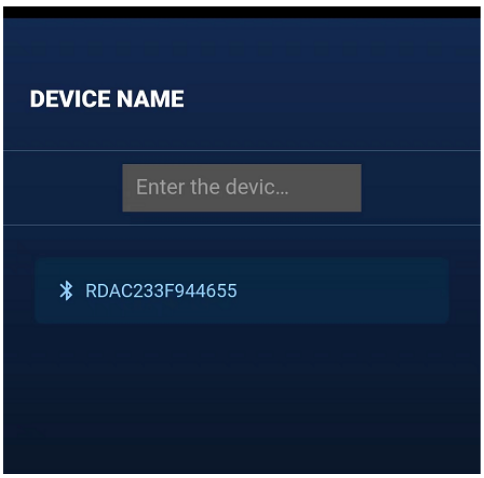
The end user can download APP by searching " Bluetooth Li"

the download link refer to below:

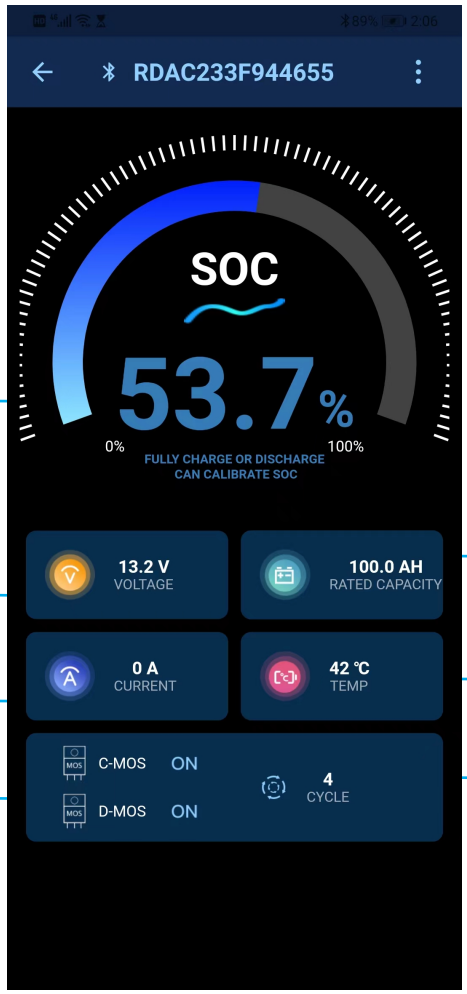
App Store Link

Android App Download Link

http://120.27.63.138:8181/attach_files/vrla_case_12/102



Bluetooth ID



State of charge

Battery Voltage

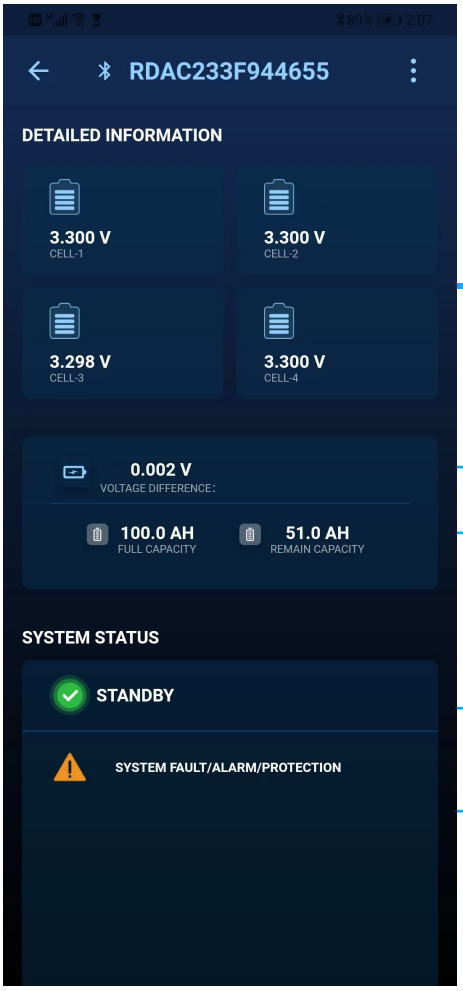
Battery Current

Charge control MOS & Discharge control MOS status

Battery Rated Capacity

Battery Temperature

Cycle times



Cells Voltage

Cells Voltage Difference

Remain Capacity

Status:
Standby,
Charge
Discharge

Alarm &Protection:
Low temperature alarm;
High temperature alarm;
Over current alarm;
Low voltage alarm;
Low temperature protection;
High temperature protection;
Over current protection;
Short current protection.
Low voltage protection;