



RITAR 12.8V / 25.6V Li-ion Battery User's Guide

End User Documentation

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12.8V / 25.6V Li-ion Battery

Ritar 12V / 24V Li-ion batteries are intended as a replacement for the common 12v lead acid battery. Ritar Lithium Iron Phosphate LiFePO_4 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 12V/24V 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.

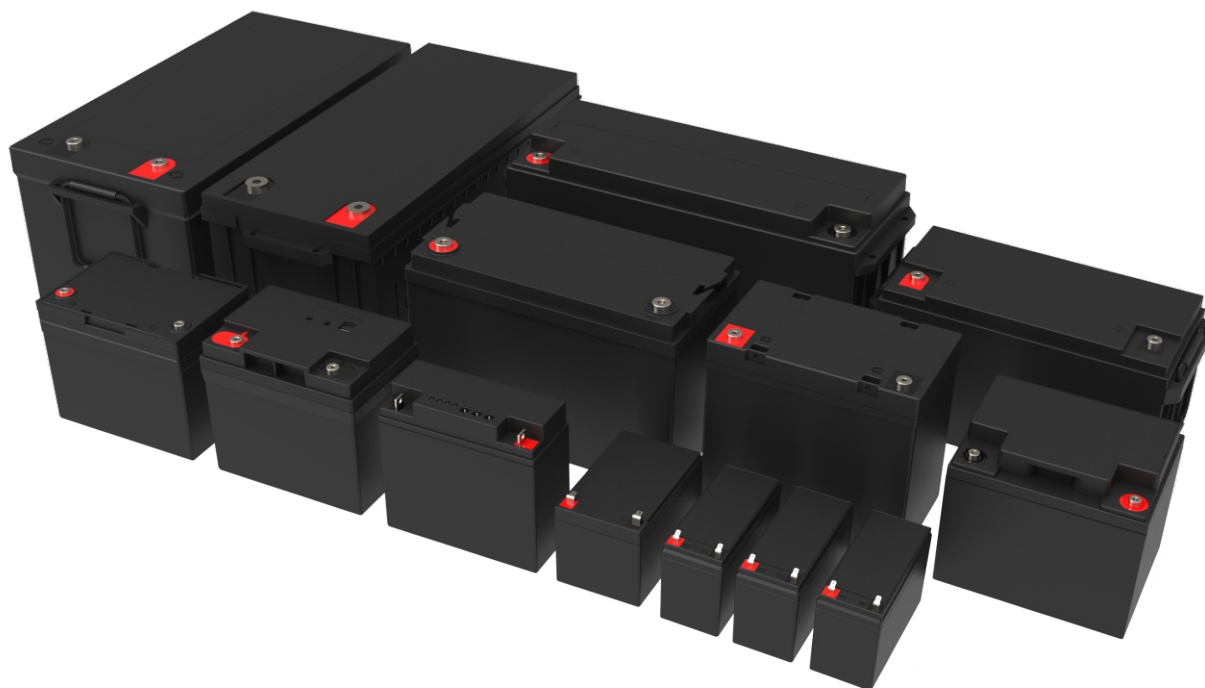


Figure 1. Ritar 12V / 24V Li-ion batteries



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.

Before Jun-01-2020, the Ritar 12V/24V Li-ion battery only support single application. Do not connect in series or parallel. Wrong operation will damage the BMS. The products that delivered after Jun-01-2020, 12V Li-ion battery support 4 sets connected in series.

Storage

The 12V / 24V 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 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 (°C)	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 3 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 12V Li-ion battery that you can connect in a series is four.

Below figure 2 illustrates four 12V Li-ion batteries connected in series, for a 4S1P configuration.

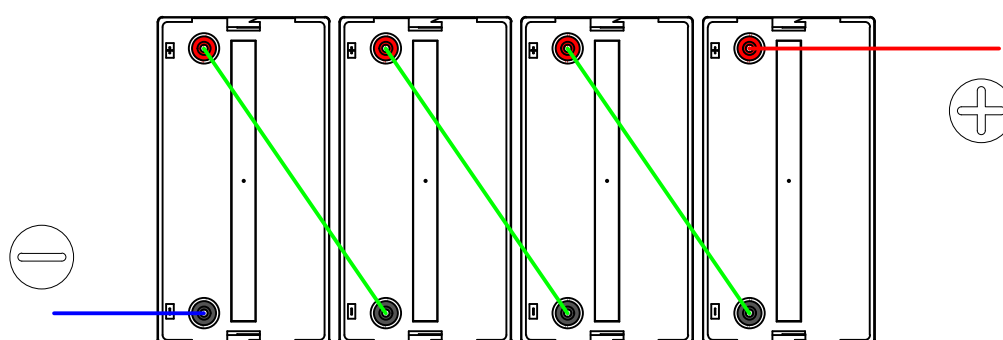


Figure 2. Connecting Batteries in Series (4S1P Configuration)

Two batteries in series: $2 \times 13.2\text{V} = 26.4\text{V}$ (nominal) for 24V applications

Three batteries in series: $3 \times 13.2\text{V} = 39.6\text{V}$ (nominal) for 36V applications

Four batteries in series: $4 \times 13.2\text{V} = 52.8\text{V}$ (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.

For 24V Li-ion battery, it's not supported in series at this time.

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 12V Li-ion batteries connected together in a 4S2P configuration. The maximum number of 12V series strings that you can connect in parallel is two.

Parallel string configurations greater than 4S2P are not supported at this time.

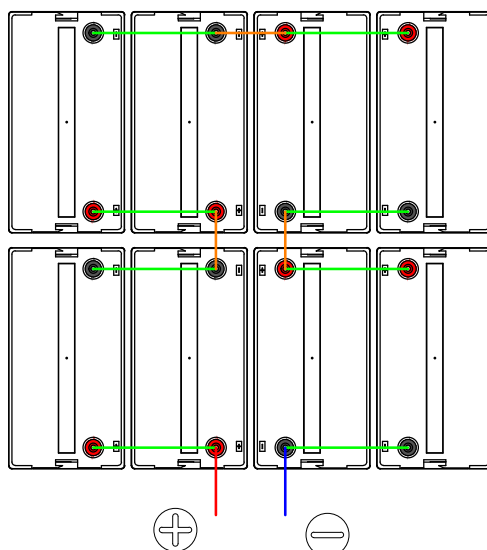


Figure 3 Example of a 4S2P Configuration



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 **30mV** before parallel connection.

Do not connect more than two battery strings in parallel.

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 Ritar 12V/24V Li-ion is compatible with common 12V/24V Lead-acid battery chargers.

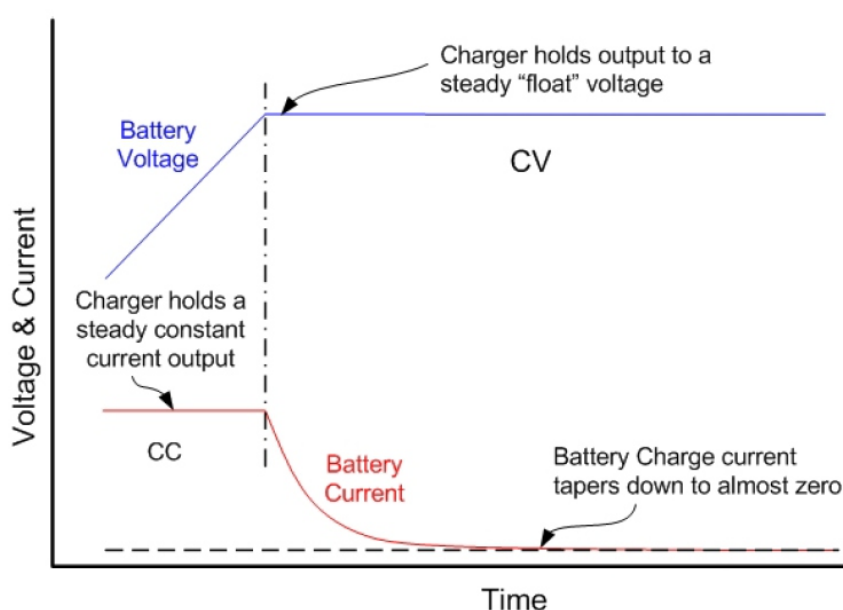
Chargers that require the detection of voltage at the battery terminals to charge may fail to wake the Li-ion battery from a state of under-voltage protection. Constant Voltage (CV) chargers may result in an inrush of current due to the low impedance of the cells, interrupting the charge. Reset the charger and continue charging normally if the charger trips.

The constant current (CC) chargers is recommended strongly.

To charge a single 12V battery, the maximum charge voltage is 14.6V and the maximum charge current is refer to Table 1. Any inrush current may cause the short circuit protection.

To charge a single 24V battery, the maximum charge voltage is 29.2V and the maximum charge current is refer to Table 2.

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 12V / 24V Li-ion batteries are extremely reliable batteries that provide greater useful life than comparable 12V lead-acid batteries. Despite the high reliability of the 12V/24V 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 12V / 24V 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 V, causing the microprocessor to enable under-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. Depending on the battery's voltage and state of balance it may take up to 48 hours to completely charge and balance the battery.

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.

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.