

LITHIUM BLUE

Premium Series Lithium Battery

APPLICATION NOTE

Operation of LITHIUM BLUE Batteries Installed in Series

Introduction	2
Operation for Lithium Batteries Installed in Series	2
Charging	2
Example of Lithium Batteries Installed in Series	3
Example of Lithium Batteries Installed in Parallel	3
Summary	4

INTRODUCTION

The installation of batteries in series is standard with lead-acid batteries to raise system voltage. Lead-acid batteries are nominally available in 2V, 6V, 8V, and 12-Volt mono-blocks therefore, installing in series is necessary to achieve a higher system voltage such as 24V, 36V, 48-Volt.

Lithium battery mono-blocks are commonly available in 12V, 24V, 36V, and 48-Volt models, and therefore, installation in series is used only for exceptional circumstances.

Each lithium battery in the series string must share the burden of discharge equally. Use a multi-channel charger to independently charge each lithium battery to the same equal level to avoid one battery stopping the charging process.

Installation of lithium batteries in series requires precise battery balancing and voltage control to avoid premature battery failure and system performance issues.

OPERATION FOR LITHIUM BATTERIES INSTALLED IN SERIES DISCHARGING

All lithium batteries in a series configuration must equally share the same load, do not connect a load to just one battery in the string. For example, do not connect a 12-Volt auxiliary load to only the first battery in the series.

CHARGING

The Battery Management System (BMS) of each lithium battery prevents the internal cells from being over-charged by opening its internal relay. If a single channel charger is used to charge all the batteries in series as a group, the battery that first arrives at this state is fully charged, but not the others. The remaining batteries will be unable to continue charging due to the single battery having gone open circuit, removing the path for current to flow and bringing charging to a stop.

Therefore, a multi-channel charger must charge each battery individually in the series string to the same equal level to avoid one battery stopping the charging process. Each battery can be charged simultaneously but by a channel that is independent of the others.

Retrofitting lithium batteries into a formerly lead-acid battery system is possible with a multi-channel charger that features a compatible lithium charging profile. However, in most applications, it is not practical nor recommended to use multi-channel chargers.

Lithium batteries at the nominal system voltage, and if necessary in parallel for more capacity, charged by a single channel charger are a more practical and reliable solution. Lithium batteries are available from Discover Battery in 12V, 24V, 36V, and 48-Volts nominal.

EXAMPLE OF LITHIUM BATTERIES INSTALLED IN SERIES

Series Installation

- One 36-Volt load (Electric Trolling Motor)
- Lithium battery charger with three independent 12-Volt channels
- Three 12.8-Volt 100 Ah 1.28 kWh lithium batteries in series delivering 38.4-Volt 100 Ah (3.84 kWh).

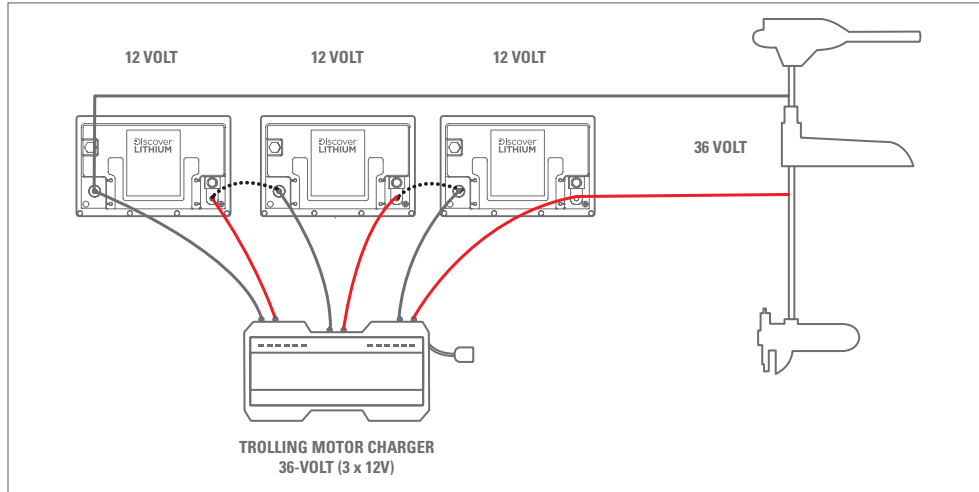


Figure 1. 36-Volt system with a multi-channel charger and three 12-Volt batteries in series.

EXAMPLE OF LITHIUM BATTERIES INSTALLED IN PARALLEL

Parallel Installation

- One 36-Volt load (Electric Trolling Motor)
- Lithium battery charger with a single 36-Volt channel
- Three 38.4-Volt 30 Ah 1.17 kWh lithium batteries in parallel delivering 38.4-Volt 90 Ah (3.51 kWh)

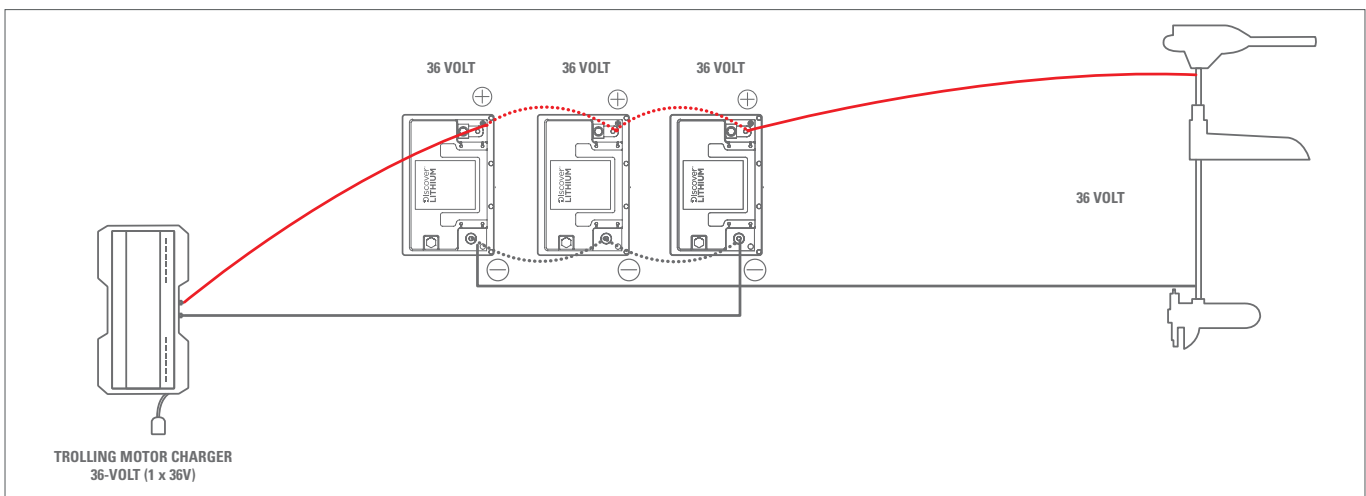


Figure 2. 36-Volt system with a single-channel charger and three 36-Volt batteries in parallel.

SUMMARY

Series installations require each lithium battery to remain perfectly balanced by sharing the discharge burden equally and receiving a full charge independently.

If one battery becomes stronger or weaker than the others, the battery system will become unbalanced, and one battery will open its relay before the others, removing the path for the system current to flow.

Use only batteries of equal:

- Model
- Voltage
- Capacity (Ah)
- Age

Install using the same:

- Home run lengths and cable gauge
- Interconnect lengths and cable gauge

Charge:

- Each battery independently at mono block voltage

Discharge:

- At system voltage
- Each battery equally

Do Not:

- Install auxiliary loads off one battery
- Replace only a single battery (replace all)

Notes:

Lithium batteries at the nominal system voltage, and if necessary in parallel for more capacity, charged by a single channel charger are the optimal and most reliable solution.

Lithium batteries are available from Discover Battery in 12V, 24V, 36V and 48-Volts nominal.