

# DAKOTA LITHIUM

## USER MANUAL

VERSION 1.1

## TABLE OF CONTENTS

<b>SAFETY INFORMATION</b>	4 - 5
<b>HELPFUL LINKS</b>	5
<b>HOW LONG WILL MY BATTERY LAST?</b>	5
<b>ARE LITHIUM BATTERIES SAFE?</b>	5
<b>HOW TO CONNECT TO THE BATTERY TERMINALS</b>	6
WHAT IF MY TERMINAL BOLTS / SCREWS ARE TOO LONG / TOO SHORT?	6
PROTECT AGAINST RESISTANCE	6
PROTECT AGAINST WATER DAMAGE	6
PROTECT AGAINST CORROSION	6
<b>CHOOSING THE CORRECT WIRE GAUGE</b>	7
<b>INTERNAL BATTERY MANAGEMENT SYSTEM (BMS)</b>	7
<b>CHARGING YOUR BATTERY</b>	8
WHAT VOLTAGE IS REQUIRED TO CHARGE MY LITHIUM BATTERIES?	8
HOW FAST CAN I CHARGE MY BATTERY?	8 - 9
WHICH LITHIUM CHARGER BRAND CAN I USE FOR LIFEPO4 BATTERIES?	9
CAN I CHARGE MY BATTERIES WITH SOLAR PANELS VIA A SOLAR CHARGER?	10
CAN I USE AN ONBOARD CHARGER TO CHARGE LITHIUM BATTERIES?	11
CAN I CHARGE A LITHIUM BATTERY USING MY CAR, VAN, OR BOAT'S ALTERNATOR?	11
WHY IS A DC-DC CHARGER NEEDED TO CHARGE A LITHIUM BATTERY FROM A CAR'S ALTERNATOR?	11
SHOULD I USE FLOAT CHARGERS OR BATTERY MAINTAINERS FOR MY LITHIUM BATTERY?	11
HOW DO I KNOW MY CHARGER IS WORKING?	11
WHY WON'T MY LITHIUM BATTERY CHARGE?	11
WHAT IS THE BATTERY VOLTAGE WHEN MY BATTERY IS FULL OR DEPLETED?	12
CAN I CALCULATE THE BATTERY'S RUN TIME?	12
WHAT HAPPENS INSIDE MY BATTERY WHEN CHARGING OR DISCHARGING?	12
WHAT TEMPERATURES CAN I CHARGE AND OPERATE MY BATTERIES?	12
HOW SHOULD I STORE MY BATTERY? DOES IT SELF-DISCHARGE?	12
ARE DAKOTA LITHIUM BATTERIES DESIGNED TO WORK IN LEAD ACID BATTERY SYSTEMS?	12
WHAT IF ONE BATTERY LOSES CHARGE FASTER IN A CIRCUIT?	12
<b>LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERY DISCHARGE CURVE</b>	13
<b>USING A VOLTMETER</b>	13

## **TABLE OF CONTENTS**

<b>WIRING YOUR BATTERIES IN SERIES</b>	14
<b>CHARGING YOUR BATTERIES IN SERIES</b>	14
<b>WIRING YOUR BATTERIES IN PARALLEL</b>	15
<b>TROUBLESHOOTING</b>	16
<b>MOST COMMON ISSUES AND SOLUTIONS</b>	16
MY BATTERY ISN'T CHARGING/WORKING	16
THE CHARGER LIGHT IS NOT TURNING ON	16
THE CHARGER LIGHT DOES NOT TURN RED WHEN CONNECTED TO THE BATTERY	16
THE TERMINAL BOLTS ARE TOO SHORT OR TOO LONG	17
OOPS... I SHORT CIRCUITED MY CHARGER	17
OOPS... I SHORT CIRCUITED MY BATTERY	17
I HAVE THREE BATTERIES LINKED IN SERIES TO MAKE 36 VOLTS AND THE SYSTEM HAS STOPPED	17
MY OUTBOARD MOTOR ON MY BOAT STOPPED	17
THE BATTERY IN MY TRUCK STOPPED WORKING	17
MY TROLLING MOTOR TURNS OFF WHEN I AM ON THE MAXIMUM POWER SETTINGS	17
MY OLD LEAD ACID BATTERY CHARGER ISN'T FULLY CHARGING MY BATTERY	17
<b>BATTERY DISPOSAL &amp; RECYCLING</b>	18
<b>WARRANTY AND RETURN POLICY</b>	18

## SAFETY INFORMATION - INSTALLATION & USE

Please read through this manual prior to use or installation of your battery. Use of electricity and the installation of electrical systems present a risk of electrocution, injury or death. Dakota Lithium is not liable for injury that results from the use or installation of a Dakota Lithium battery or from the safety of the actions recommended in this document. If you do not feel safe to perform these actions you must consult a professional electrician.

Explosion and fire hazard.

- Terminals of the Li-ion Battery are always live;
- Do not place items or tools on the Battery.
- Avoid short circuits
- Avoid too deep discharges, and too high charge currents (too high/deep is defined as discharge or charge that exceeds the battery's specifications).
- Use insulated tools.
- Do not wear any metallic items such as watches, bracelets, et cetera.
- In case of fire you must use a type D, foam or CO2 fire extinguisher.
- Make sure that the wire gauge size is correct for the application and the length of the wire (see choosing the right wire gauge section)
- Make sure the terminal bolts are tight and the wiring has adequate surface area on the terminals (see how to connect the batteries to the terminals section)

Do not charge or operate any visibly damaged, dented, bulging, or punctured batteries. If the battery lid comes loose, cease operations immediately.

Do not short circuit lithium batteries. Doing so may damage your battery and the high current and high temperature may cause personal injury or fire.

Do not heat over 140°F. Doing so may cause the plastic housing to warp and damage the internal components.

Do not exceed the max discharge specifications of the battery (for example, if the battery has a max discharge of 10 amps do not try to run a trolling motor off of it that pulls 20 amps).

Do not charge above 15 Volts for 12V batteries, 30V for 24V batteries, 45V for 36V batteries, or 60V for 48V batteries. The BMS will turn the battery off in case of overcharging, but repeated over charging will damage the battery.

Use compatible chargers and charging components (See charging your battery section).

Do not puncture the outer case or disassemble the battery. Never try to open or dismantle the battery. Electrolyte is very corrosive. In normal working conditions contact with the electrolyte is impossible. If the battery casing is damaged do not touch the exposed electrolyte or powder because it is corrosive.

Do not immerse the batteries in water. Keep the batteries in a dry environment. Use of a battery box in marine environments is recommended (please note, even DL's waterproof marine batteries with an IP 67 rating benefit from remaining dry – it extends the battery lifespan). For fishing kayaks consider the Dakota Lithium Powerbox+ 60 or 135 which include a fully waterproof and submersible pelican style case.

Do not store the battery near heat, high temperature sources, or gas emitters, such as in direct sunlight, fires, heaters, propane tanks, generators, etc.

Batteries over 300Wh are subject to hazmat regulations when shipping.

When shipping a battery, plenty of anti static bubble wrap should be used to protect it from blunt damage. The terminal posts should be removed, if possible, and covered with electrical tape to prevent accidental shorting.

## SAFETY INFORMATION - DAKOTA LITHIUM BATTERIES

Here at Dakota Lithium we build batteries that last a long, long time. Safety is a core value of our engineering team and informs how DL designs and builds our batteries. Here's how Dakota Lithium stand above the competition when it comes to reliability and safety:

**BATTERY MANAGEMENT SYSTEM (BMS)** - Ensures safety and long battery lifespan

All Dakota Lithium batteries include an active BMS protection circuit that handles cell balancing, low voltage cutoff, high voltage cutoff, short circuit protection and temperature protection for increased performance and longer life. Safety measures provided by the BMS prevent overheating. All Dakota Lithium batteries have a BMS that can support linking batteries in series or parallel.

### LITHIUM IRON PHOSPHATE

Different Li-ion batteries use different chemistries. Dakota Lithium exclusively engineers our batteries using lithium iron phosphate or LiFePO4 for short. Lithium Iron Phosphate batteries are the safest lithium battery chemistry. Unlike the cell phone battery in your pocket, or the laptop battery on your desk, the structural stability of LiFePO4 results in significantly less heat generation compared to other lithium chemistries.

**NO THERMAL RUNAWAY** - Dakota Lithium cells do not produce oxygen

The main cause of fire or explosion of a lithium ion battery is due to the cells being compromised or ruptured, which causes thermal runaway. Without proper management, thermal runaway may result in fire. Dakota LiFePO4 is extremely stable and does not produce the oxygen needed to aid thermal runaway and unlike other lithium battery chemistries will not result in a catastrophic meltdown.

**100% COBALT FREE** - No rare earth elements

NCM and other lithium ion chemistries that contain rare earth elements such as Colton or Cobalt produce oxygen and toxic fumes when ruptured, leading to fire. Dakota Lithium does not contain rare earth elements, and does not produce oxygen or a fire.

## **CERTIFICATIONS** - Tested and certified for safety and reliability

Dakota Lithium batteries are UN 38 certified and built from grade A cells. Dakota Lithium's cells are UL1642 certified and have been tested per IEC62133 standards. UN Manual of Tests and Criteria certified, and meets all US & International regulations for air, ground, marine, and train transport. Select battery models are ISO Certified ISO 9001:2008 Quality Management System & ISO 14001:2004 Environmental Management System for use in industry applications. IEC62133 certifications and additional laboratory services are available as required by our OEM clients.

## **INSTALLATION & CARE** - Treat your batteries right

When proper installation and battery care is followed, your LiFePO<sub>4</sub> battery will be safe and reliable for many years. This includes making sure all connections are tight and proper wiring sizes are used, compatible chargers and charging components are used, and the batteries are used for purposes that they are designed for.

## **HELPFUL LINKS**

- [How to Wire Batteries in Parallel or Series](#)
- [Click here for our Golf Cart Installation Guide](#)
- [Twice the Battery Life with Adjusting Lowrance Screen Brightness?](#)
- [What Size Lithium \(LiFePO<sub>4</sub>\) Battery Do I Really Need on My Boat?](#)
- [How to Balance Batteries in Series – Charge Each Battery Individually for Greater Performance & Lifespan](#)
- [Jim's User Manual for Dakota Lithium Golf Cart Batteries](#)
- [Trolling Motors: how does the power setting impact run time?](#)
- [How To Choose a Lithium Battery for RVs, Campers & Vans](#)
- [Solar Panel Size Chart for RVs, Vans, Campers](#)
- [What Are the Best Batteries for Cold Weather Fishing?](#)
- [How to Install Lithium Batteries on a Sailboat](#)
- [What is the difference between starter batteries and deep cycle batteries?](#)
- [How To Choose A Lithium Battery For Trolling Motors](#)

## **HOW LONG WILL MY BATTERY LAST?**

The average lifespan of a Dakota Lithium Iron Phosphate battery depends on use. If the battery is used at maximum discharge (typically 1C) then the lifespan is typically 2,000 recharge cycles or roughly 5 – 10 years with regular use. When used at <0.2C discharge the lifespan increases, up to 6,000 recharge cycles. Here's a few ways to increase the lifespan of your battery:

- Make sure your application (how you are using the battery) matches the uses that the battery is designed for. The battery size and specifications should match the application.
- Avoid charging the battery when it is freezing (unless the battery has internal heating, such as the DL+ 12V 135Ah or DL+ 12V 280Ah batteries).
- Use dielectric grease and/or terminal covers on terminals to protect from corrosion.
- Use a battery box or battery tray that protects the battery from water (DL batteries are water resistant at an IP 65 to IP 67 rating depending on the battery, but terminals may corrode if repeatedly exposed to salt water, and sitting in standing water for extended periods is not recommended for batteries).
- For high discharge applications use higher capacity batteries. For example, air conditioning in an RV uses 70+ amps continuous. A 100Ah battery could work, but the high amp draw would reduce the lifespan over time. A 280Ah battery would provide a longer run time while also having a longer battery life.

## **ARE LITHIUM BATTERIES SAFE?**

Dakota Lithium batteries are 100% safe & reliable. Our signature chemistry, Lithium Iron Phosphate (LiFePO<sub>4</sub>), does not contain rare earth elements (like Cobalt) or heavy metals, is non-toxic, including no lead or acid, is non-corrosive, does not off gas, requires no watering or maintenance, can be placed in any orientation, and unlike other lithium batteries is not prone to exploding or catching fire due to the lack of oxide / oxygen in the LiFePO<sub>4</sub> chemistry.

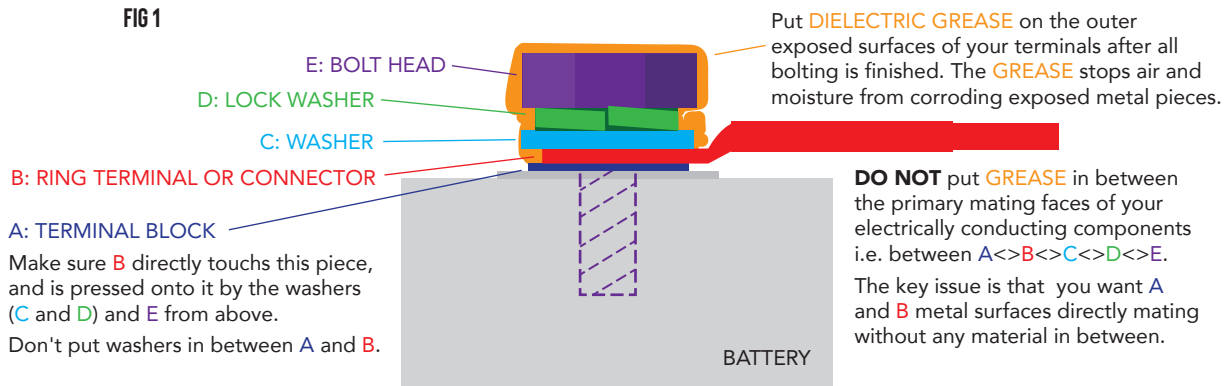
## HOW TO CONNECT TO THE BATTERY TERMINALS

Make sure the device you want to connect has compatible connections for the battery's terminal. The specific terminal and size can be found on the battery's product page on our website. [Our full list of batteries may be found here.](#)

Connect the positive lead to the positive terminal (+) and the negative lead to the negative terminal (-). **Warning: Incorrect installation of leads may lead to shorting the battery.**

Double check to make sure all of the leads are in full contact with the terminals and the correct torque force is applied. The recommended torque for each battery may be found on their specific product page on the Dakota Lithium website.

Dakota Lithium batteries may be installed regardless of orientation, unlike traditional SLA batteries.



TO REDUCE TERMINAL HEATING AND CORROSION ISSUES PLEASE USE PROPER TERMINAL INSTALLATION PRACTICES

### WHAT IF MY TERMINAL BOLTS / SCREWS ARE TOO LONG / TOO SHORT?

The terminals on Dakota Lithium batteries are designed to be universally compatible and terminal bolts are included with your battery. Longer or shorter terminal bolts are likely available at your local hardware store – look at the specifications for the battery and see if the terminal bolt size is M6 or M8 and then ask for those size bolts at the hardware store. If you need a shorter bolt one option is to add additional washers on top of what you are connecting to the terminals.

### PROTECT AGAINST RESISTANCE

Your terminal connection should be secured properly to avoid heating from resistance. This can and will damage your battery permanently. Be sure to use new connectors and have them secure to the terminal.

Your battery connection should be snug and secure with no loose/moving connectors. FIG 2 is an example of a properly connected and secured terminal. Use a max of 10ft-lbs when securing. If exceeded, this can damage the terminal.



**FIG 2**

### PROTECT AGAINST WATER DAMAGE

Our batteries themselves are rated to a specific water resistance - many DL batteries are IP 65 which means they are water resistant to light splashing, but are not waterproof / submersible. IP 66 (DL+ line of batteries) is waterproof but not submersible (cannot go under water), IP 67 is submersible (Powerbox 60 and 135 are so waterproof they can float in water and still work after as long as the box and pressure valves are closed). Please be sure to protect your battery from direct exposure to water/submersion. Water damage is not covered under warranty. [More on our warranty policy can be found here](#) or at the end of this manual.

Here's a few ways to protect your batteries against water damage:

- Use dielectric grease on terminals and/or terminal covers to prevent corrosion.
- Use a battery box or a battery tray in a protected space (like a bass boat battery space).

### PROTECT AGAINST CORROSION

Your battery comes with dielectric grease to help protect your terminals from moisture/corrosion. Before connecting your battery, thoroughly clean your connectors. Once the mating surfaces are clean and the terminal bolt is tightened down, apply a thin layer of dielectric grease over the terminal connection.

## CHOOSING THE CORRECT WIRE GAUGE

Choosing the right size gauge wire is crucial to powering your devices.

**Warning:** Choosing too small of a gauge for your system may lead to heat resistance and subsequent fires.

Please refer to the simple, non-exhaustive table below. These are the recommended gauge sizes:

### MAXIMUM AMP FLOW

	5	10	15	20	25	30	40	50	60	70	80	90	100	120	150	200	250	300	
LENGTH OF CABLE	0-5ft	16 AWG	16 AWG	14 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG
	10ft	16 AWG	14 AWG	12 AWG	12 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	1 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG
	15ft	16 AWG	12 AWG	10 AWG	10 AWG	8 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	1 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG
	20ft	14 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG
	25ft	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	2 AWG	1 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	
	30ft	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	1 AWG	0 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG		
	40ft	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	0 AWG	00 (2/0) AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG		
	50ft	10 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	000 (3/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG			
	60ft	10 AWG	6 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG				
	70ft	8 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG						
	80ft	8 AWG	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG							
	90ft	8 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG	0000 (4/0) AWG								
100ft	6 AWG	4 AWG	2 AWG	2 AWG	1 AWG	0 AWG	00 (2/0) AWG	000 (3/0) AWG	0000 (4/0) AWG										

## INTERNAL BATTERY MANAGEMENT SYSTEM (BMS)

Every Dakota Lithium battery has an internal Battery Management System (BMS). A BMS is an integrated electronics board that monitors the battery and its cells, providing overcharge protection, overcurrent protection, regulating operating and charging temperature, and other protective functions to ensure a long and productive life from every Dakota Lithium battery. In short, a BMS is a backup safety system that makes sure your lithium battery is 100% safe and reliable.

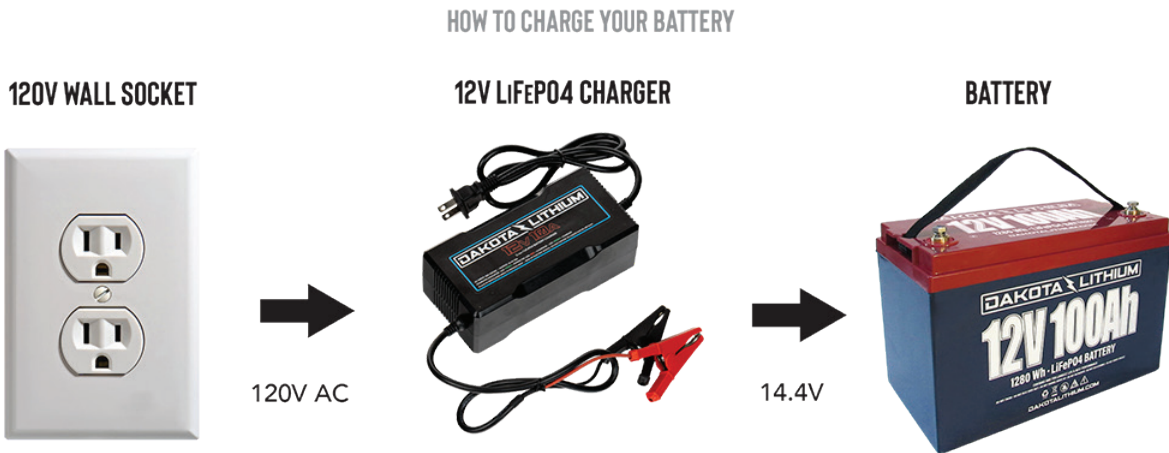
If your battery suddenly "stops working" it is likely the BMS has been tripped. Connecting the battery to a lithium ion charger with the correct output voltage (as listed below) should reset the BMS. If it does not, please refer to the "Troubleshooting" section

## CHARGING YOUR BATTERY

All Dakota Lithium and most lithium-ion batteries require a higher voltage than lead acid batteries to fully charge and perform best when charged with a lithium specific battery charger that charges at 14.4 – 14.8 Volts. This includes Dakota Lithium Iron Phosphate (LiFePO4) and Lithium Nickel Manganese Cobalt (NMC) batteries. A battery charger for a lead acid battery will work to partially charge a lithium battery, but only to a maximum of 60-80% of the lithium battery's capacity. The voltage level of a full lead acid battery is about a volt lower than the voltage of a full lithium battery. As a result, the lead acid charger will think the battery is "full" once it reaches the lower voltage that is associated with a full lead acid battery. The result is lead acid battery chargers work, but only charge to 60-80% of the lithium battery's capacity. Please note that lead acid chargers do not damage the battery, they just prevent the battery from reaching its full capacity and performance potential. The performance limitations of lead acid chargers being used for lithium batteries is significant enough that most lithium battery owners prefer to use lithium specific chargers. Lithium specific chargers maximize the performance and value of a lithium battery.

One exception is solar charge controllers. A solar charge controller transforms the energy produced by a solar panel to the ideal voltage to charge your battery. Solar charge controllers always perform better when they are lithium battery specific or have a lithium setting. Enough solar power is lost due to the inefficiency of a lead acid solar charge controller attached to a lithium battery that the solar panels may fail to adequately charge the battery. An example of a lithium specific solar charge controller would be the Victron SmartSolar MPPT 75/15 Solar Charge Controller.

For more see the "How to charge my battery from Solar Panels" section on page 10.



## WHAT VOLTAGE IS REQUIRED TO CHARGE MY LITHIUM BATTERIES?

Dakota Lithium Iron Phosphate (LiFePO4) 12V batteries should be charged at 14.4 Volts (V). For batteries wired in series, multiply 14.4V by the number of batteries. For example, a 24V battery bank requires a charger voltage of 28.8V, 36V requires 43.2V, etc.

DAKOTA LITHIUM BATTERY VOLTAGE	RECOMMENDED CHARGING VOLTAGE	RECOMMENDED CHARGING SPEED (C)
12 Volts	14.4 Volts	<0.3C (3 hours or more)
24 Volts	28.8 Volts	<0.3C (3 hours or more)
36 Volts	43.2 Volts	<0.3C (3 hours or more)
48 Volts	57.6 Volts	<0.3C (3 hours or more)

## HOW FAST CAN I CHARGE MY BATTERY?

Calculate the charge time by dividing the capacity of the battery (Ah for Amp Hours) by the charger output (A for Amps). For example, a 12V 100Ah Dakota Lithium battery includes a free 12V 10A LiFePO4 battery charger that charges the battery from empty to full in 10 hours (100 Ah divided by 10 A = 10 hours).



## HOW FAST CAN I CHARGE MY BATTERY? (CONT)

For the longest lifespan LiFePO<sub>4</sub> batteries should be charged at less than .3C, or 3 hours or more of charging time. But all Dakota Lithium batteries can be charged at a rate of up to 1C and a charging time as low as 1 hour. For other brands, confirm that max charging amps in the battery's specifications. 0.5C (2 hours) is a common max charging speed for lithium batteries.

**Charging time does impact lifespan.** Charging at 1C / 1 hr regularly will reduce the lifespan of lithium batteries. The Lithium Iron Phosphate (LiFePO<sub>4</sub>) molecules that make up a Dakota Lithium, or any LiFePO<sub>4</sub> battery, are stressed each time you charge a battery. Over time those molecules fracture, break apart, and lose their ability to hold a charge. This is why after 2,000 to 4,000 recharge cycles at <0.3C a LiFePO<sub>4</sub> battery will have <70-80% of the original capacity, and why Dakota Lithium batteries reach their half-life (<50% of capacity) at around 6,000 recharge cycles. A higher charge rate will increase the stress on the molecules, leading to a shorter battery lifespan. Therefore, Dakota Lithium recommends using a DC-DC charger like the Victron Orion-Tr Smart 12/12-18A Isolated DC-DC charger when charging your battery from the alternator in the engine of a car, van, or boat. This is because alternators commonly charge batteries at 1C or higher (to learn more see section Can I charge using my engine's alternator).

DAKOTA LITHIUM BATTERY	RECOMMENDED LIFEPO4 CHARGER & CHARGE TIME	FASTER CHARGER OPTION
12V 10Ah Battery	12V 3A LiFePO <sub>4</sub> charger (3 hrs)	12V 10A LiFePO <sub>4</sub> charger (1 hr)
12V 18Ah Battery	12V 3A LiFePO <sub>4</sub> charger (6 hrs)	12V 10A LiFePO <sub>4</sub> charger (1.8 hrs)
12V 23Ah Battery	12V 3A LiFePO <sub>4</sub> charger (8 hrs)	12V 10A LiFePO <sub>4</sub> charger (2.3 hrs)
12V 54Ah Battery	12V 10A LiFePO <sub>4</sub> charger (5.4 hrs)	12V 20A LiFePO <sub>4</sub> charger (2.5 hrs)
DL+ 12V 60Ah Battery	12V 10A LiFePO <sub>4</sub> charger (6 hrs)	12V 20A LiFePO <sub>4</sub> charger (3 hrs)
12V 100Ah Battery	12V 10A LiFePO <sub>4</sub> charger (10 hrs)	12V 20A LiFePO <sub>4</sub> charger (5 hrs)
DL+ 12V 135Ah Battery	12V 10A LiFePO <sub>4</sub> charger (13.5 hrs)	12V 20A LiFePO <sub>4</sub> charger (6.75 hrs)
12V 200Ah Battery	12V 10A LiFePO <sub>4</sub> charger (20 hrs)	12V 20A LiFePO <sub>4</sub> charger (10 hrs)
DL+ 12V 280Ah Battery	12V 10A LiFePO <sub>4</sub> charger (28 hrs)	12V 20A LiFePO <sub>4</sub> charger (14 hrs)
24V 60Ah Battery	24V 5A LiFePO <sub>4</sub> charger (10 hrs)	24V 20A LiFePO <sub>4</sub> charger (2.5 hrs)
24V 100Ah Battery System	24V 5A LiFePO <sub>4</sub> charger (20 hrs)	24V 20A LiFePO <sub>4</sub> charger (5 hrs)
36V 60Ah Battery	36V 8A LiFePO <sub>4</sub> charger (8 hrs)	36V 18A LiFePO <sub>4</sub> charger (3.5 hrs)
36V 100Ah Battery System	36V 8A LiFePO <sub>4</sub> charger (12 hrs)	36V 18A LiFePO <sub>4</sub> charger (5.4 hrs)
48V 96Ah Battery	48V 8A LiFePO <sub>4</sub> charger (12 hrs)	48V 15A LiFePO <sub>4</sub> charger (6 hrs)

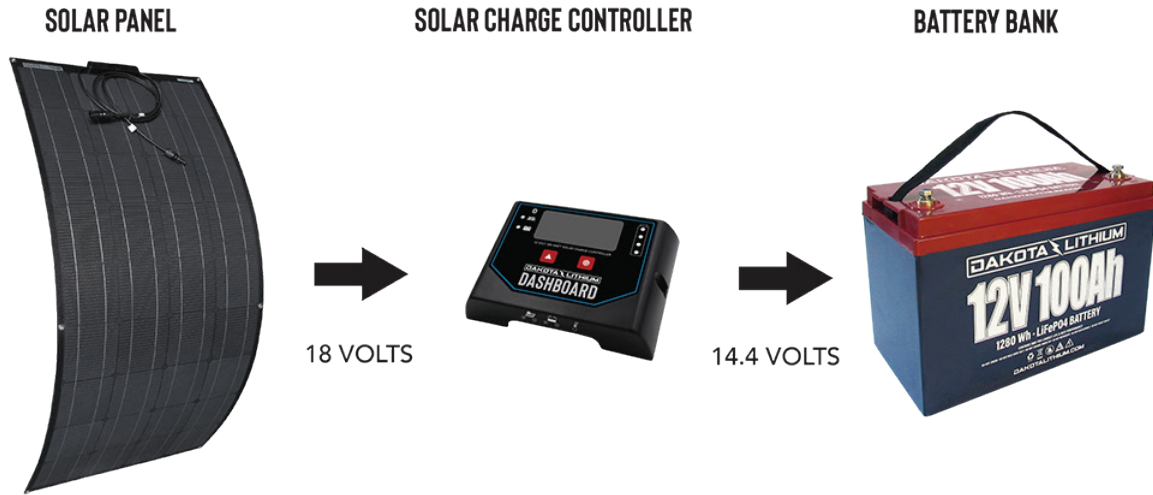
## WHICH LITHIUM CHARGER BRAND CAN I USE FOR LIFEPO4 BATTERIES?

Most LiFePO<sub>4</sub> chargers have an output of 14.6V – 14.8V which will charge Dakota Lithium batteries, and any LiFePO<sub>4</sub> fully. Here at Dakota Lithium, we recommend using Dakota Lithium LiFePO<sub>4</sub> chargers because they provide an optimal voltage of 14.4V, which slightly increases the battery's lifespan by stressing the battery chemistry less during charging. Dakota Lithium LiFePO<sub>4</sub> chargers also undergo our company's redundant quality control process, ensuring every charger is optimized and safe to use with all our LiFePO<sub>4</sub> batteries. Other programmable chargers can also be used if needed and should be set to output 14.4V and disconnected after charging. VRLA chargers and other lithium-ion batteries' chargers do not output the correct voltage for charging the battery fully.

**CAN I CHARGE MY BATTERIES WITH SOLAR PANELS VIA A SOLAR CHARGER?**

Yes, for smaller solar panels that are less than <60 watts you can connect the panel directly to the battery with little loss in efficiency or performance. The battery management system (BMS) in the Dakota Lithium will prevent over charging and stop charging from the panel once the battery is full. When using a solar panel that is 100 watts or larger to charge a battery then a LiFePO4 or lithium compatible solar charge controller is strongly recommended. For system with more than 200 watts of solar energy a solar charge controller is required for efficiency and safety. A solar charge controller takes the energy from the solar panels and turns it into the optimal voltage for charging your battery. For example, if you had installed a 100-Watt Solar Panel on the roof of your van or RV you would then need a [Victron SmartSolar MPPT 75/15 Solar Charge Controller](#) or similar sized solar charge controller to take the energy from the panel that is at 18 Volts (V) and transform it into 14.4 Volts, the optimal voltage for a Dakota Lithium or any LiFePO4 battery. The solar charge controller also increases the efficiency of the transfer of energy from the solar panels to the battery, increasing charge time and overall system efficiency. Approximately 100 – 200 Watts of solar power charges 100Ah of battery capacity depending on use and on climate and latitude. For example, if you use your boat or RV mostly on weekends you need less, if living on it full time you will need more. And if you are living in Canada, you will need more solar panels than someone living in Arizona.

**HOW TO CHARGE YOUR BATTERY BANK USING SOLAR PANELS**



Here’s a size chart for what size of solar panels is needed to fully charge one lithium battery.

DAKOTA LITHIUM BATTERY	RECOMMENDED SOLAR PANEL CAPACITY	SOLAR CHARGE CONTROLLER
12V 7Ah Battery	<a href="#">20-Watt Flexible Solar Panel</a>	None
12V 10Ah Battery, Powerbox 10	<a href="#">50-Watt Folding Solar Panel</a>	None
12V 23Ah Battery	<a href="#">50-Watt Folding Solar Panel</a>	None
12V 54Ah Battery	<a href="#">100-200-Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
DL+ 12V 60Ah Battery	<a href="#">100-200-Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
12V 100Ah Battery	<a href="#">100-200 Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
DL+ 12V 135Ah Battery	<a href="#">100-200 Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
12V 200Ah Battery	<a href="#">200-Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
DL+ 12V 280Ah Battery	<a href="#">200-Watt Rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>
12V 400Ah Off-Grid Power System	<a href="#">300-Watt rooftop Solar Panels</a>	<a href="#">15 Amp MPPT Victron or Similar</a>

## CAN I USE AN ONBOARD CHARGER TO CHARGE LITHIUM BATTERIES?

Yes, Dakota Lithium and all LiFePO<sub>4</sub> batteries can be charged with onboard chargers. Pre-assembled wiring kits for connecting your batteries to onboard chargers are available [here](#). If the onboard charger has a lithium setting, or can be set to 14.4V it will fully charge the battery. Chargers that do not go as high as 14.4V, such as onboard chargers for marine AGM or lead acid batteries that do not have a lithium setting will not be able to charge the battery fully. If possible, disconnect the batteries when they are completely charged.

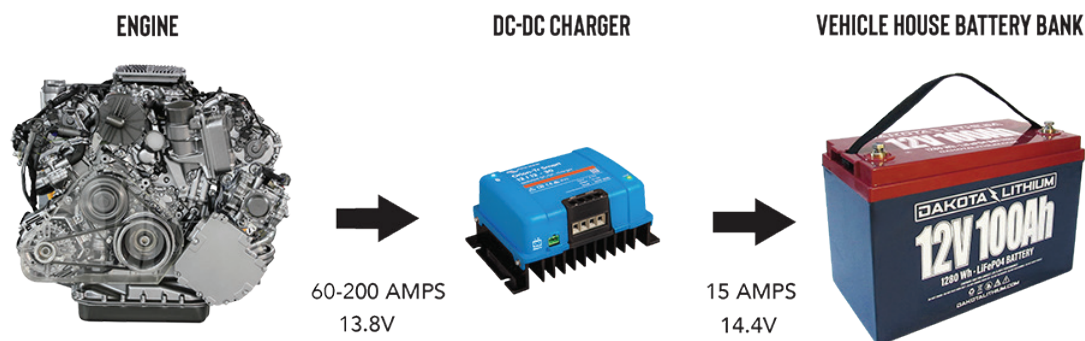
## CAN I CHARGE A LITHIUM BATTERY USING MY CAR, VAN, OR BOAT'S ALTERNATOR?

Yes, but only lithium and LiFePO<sub>4</sub> batteries that are designed for automotive use can be charged directly by the alternator. For automotive or marine cranking applications where you are starting an engine and charging the starter battery from the engine's alternator, we recommend the Dakota Lithium Plus 12V 60Ah Dual Purpose 1000 CCA battery. This battery provides up to 1,000 cold cranking amps to start a vehicle's engine and can charge up to 80 Amps from a vehicle's alternator. For most LiFePO<sub>4</sub> batteries on the market, including all Dakota Lithium deep cycle batteries, a DC-DC charger is required to charge a lithium battery from an engine's alternator.

## WHY IS A DC-DC CHARGER NEEDED TO CHARGE A LITHIUM BATTERY FROM A CAR'S ALTERNATOR?

DC-DC chargers are needed in most cases when using alternators to charge batteries (exception is the Dakota Lithium Plus 12V 60Ah or 135Ah 1000CCA battery which is designed for use in a boat or car's engine). Without a DC-DC charger, an alternator's power output can charge the battery at a rate more than 1C, which causes damage to the battery and may turn the battery off by triggering the overcharging protection in Dakota Lithium's battery management system (BMS). Also, charging a large capacity 'house bank' of batteries via the alternator will cause it to run at full nameplate output power, which may overheat and/or damage the alternator. For alternator charging, a DC-DC charger is recommended, or the user may carefully review and choose a "DL+" model pack from our catalog and use it without a DC-DC charger in circumstances where the alternator output matches the battery charging abilities well.

### HOW TO CHARGE YOUR VEHICLE HOUSE BATTERY BANK FROM YOUR ENGINE ALTERNATOR



## SHOULD I USE FLOAT CHARGERS OR BATTERY MAINTAINERS FOR MY LITHIUM BATTERY?

No, LiFePO<sub>4</sub> batteries should be disconnected from the charger when fully charged. Float charging, or maintainers are not good for lithium batteries. Keeping a constant float charge or topping off charge also can cause metal plating and will reduce the lifespan of lithium batteries. Dakota Lithium batteries also have a low self-discharge rate of <5% a month. This low self-discharge rate makes a battery maintainer for long term storage unnecessary (for more on battery storage see section below).

## HOW DO I KNOW MY CHARGER IS WORKING?

The light on the battery charger turns green when plugged into an outlet. While charging, the light turns red. It turns green again when the battery is fully charged. The charger should be disconnected when the battery is fully charged to prevent over-charging which can cause permanent battery damage.

## WHY WON'T MY LITHIUM BATTERY CHARGE?

Checking the battery and a charger with a voltmeter is a good place to start when experiencing issues. Test the battery before and after attempting a full charge, and when the battery is depleted. Also, test the output on the charger, it should measure 14.4V when working properly. Getting a voltage charge of less than 1V is evidence that the B.M.S. has been triggered on the battery to protect it from a potentially dangerous condition. The B.M.S. can usually be reset by charging the battery with a Dakota Lithium charger. If it does not, please refer to the "Troubleshooting" section

## **WHAT IS THE BATTERY VOLTAGE WHEN MY BATTERY IS FULL OR DEPLETED?**

Batteries measure around 14.4V when they are fully charged and quickly drop to about 13.4V when the charger is removed. They provide consistent power between 13.4 to about 12.8V and quickly deplete to 9.7V at the end of the discharge. Dakota Lithium Iron Phosphate batteries have a flat voltage curve. This means that the voltage will be fairly steady throughout use, and only drop below a useful voltage when the battery is nearly empty. Lead acid batteries have a steep voltage drop and it is common that a lead acid battery's voltage is no longer usable when the battery still has 60% of capacity left. This flat voltage curve is why Dakota Lithium batteries have twice the usable power even though the battery has the same amount of energy inside the battery. A 100Ah Dakota Lithium battery will last twice as long as a 100Ah AGM or lead acid battery even though the name plate or energy rating is the same. Please note: Seeing a low voltage of <1V is evidence that the B.M.S. is triggered.

## **HOW CAN I CALCULATE THE BATTERY'S RUN TIME?**

Calculate the battery run time by dividing the battery capacity (Ah) by the power draw of anything connected to the battery (A). For example, an electric cooler that has a power draw of 1 amp can be powered for 100 hours by a Dakota Lithium or LiFePO4 battery or 40-50 hours by an AGM or lead acid battery.

## **WHAT HAPPENS INSIDE MY BATTERY WHEN CHARGING OR DISCHARGING?**

Dakota Lithium batteries transfer a charge via lithium-ions between lithium iron phosphate in the cathode and graphite in the anode using intercalation. The ions never become lithium metal and stay in the ion state, which makes the batteries rechargeable.

## **AT WHAT TEMPERATURES CAN I CHARGE AND OPERATE MY BATTERIES?**

LiFePO4 batteries can be safely discharged below freezing temperature and provide up to 70% of their power, VRLA batteries do not work at that temperature. Dakota Lithium batteries can also operate safely in temperatures up to 149°F, while VRLA batteries' service life halves every 18°F increase in temperature over 120°F. LiFePO4 batteries can be charged in environments up to 113°F but should not be charged in direct sunlight above 90°F. Charging lithium iron phosphate batteries below 32°F not only makes your batteries unsafe, but it also will drastically and permanently reduce the capacity.

## **HOW SHOULD I STORE MY BATTERY? DOES IT SELF-DISCHARGE?**

LiFePO4 batteries have a low self-discharge rate of 3 – 5% per month, so they can be left in a partially discharged state for over a year without damaging the battery. This is 5X less than the self-discharge rate of VRLA batteries, but it is higher than some other lithium based systems.

L.F.P. batteries should be stored well charged at a temperature between 40 – 95°F, however, they need to be above 32°F to charge. We recommend charging your lithium batteries every two months to ensure they do not completely drain.

## **HOW ARE DAKOTA LITHIUM BATTERIES DESIGNED TO WORK IN LEAD ACID BATTERY SYSTEMS?**

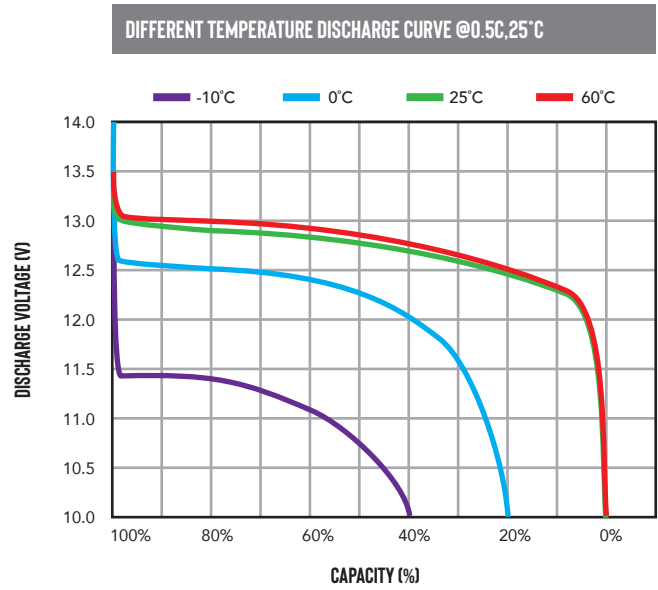
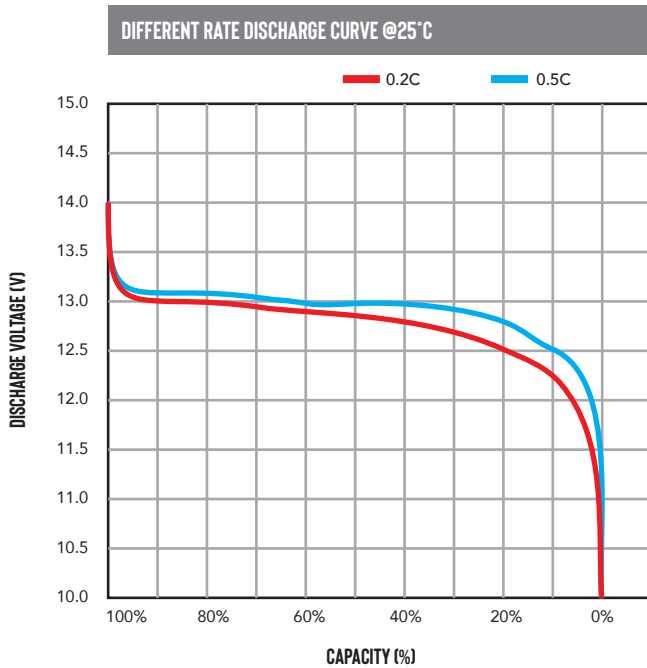
LiFePO4 batteries are one-third the size of VRLA batteries of the same capacity, but they are designed to be "drop-in replacements" for 12V, 24V, 36V and 48V systems designed around lead-acid batteries. For example, four LiFePO4 cells in series can provide 12.8V, which can be used to replace systems made around traditional 6 2V cell batteries.

## **WHAT IF ONE BATTERY LOSES CHARGE FASTER IN A CIRCUIT?**

When batteries are connected in a series, they can become unbalanced, this can be detected by testing each battery with a voltmeter. Separately charging each battery can fix this issue.

## LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERY DISCHARGE CURVE

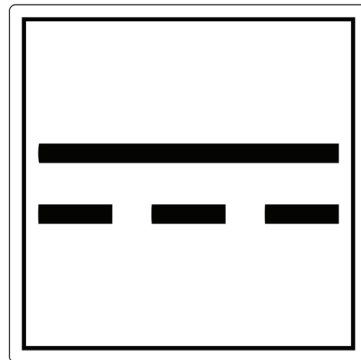
Unlike the steep voltage drop that lead acid/SLA and AGM batteries have, Dakota Lithium LiFePo4 batteries have a strong flat curve. This means that the voltage will be fairly steady throughout use, and only drop below a useful voltage when the battery is nearly empty.



You will not see the voltage drop in the same way that you would see a drop in SLA/lead acid batteries. The best way to track how much charge is left in the battery is to attach a monitor that records the amount of amps discharged from the battery.

## USING A VOLTMETER

When taking a reading of your Dakota Lithium Battery or Charger, you'll want to get a DC voltage reading. Be sure your voltmeter/multimeter is set to the DC symbol:



The red lead should touch the positive connection and the black lead should touch the negative end. If you receive a negative reading that means the polarity has been reversed. Double check to make sure you have the leads in the correct place.

## WIRING YOUR BATTERIES IN SERIES

CHARGE EACH BATTERY FULLY BEFORE WIRING INTO SERIES

**WARNING:** Only wire matching batteries in series. Never wire batteries with a different voltage or amp hour rating in series. For example, do not wire a 24V 50Ah battery with a 12V 54Ah battery, do not wire a 12V 10Ah in series with a 12V 23Ah, etc.

Wiring a battery in series is a way to increase the voltage of a battery. For example if you connect two of our 12 Volt, 100 Ah batteries in series you will create one battery that has 24 Volts and 100 Amp-hours. All it requires is a specific connection across the terminals.

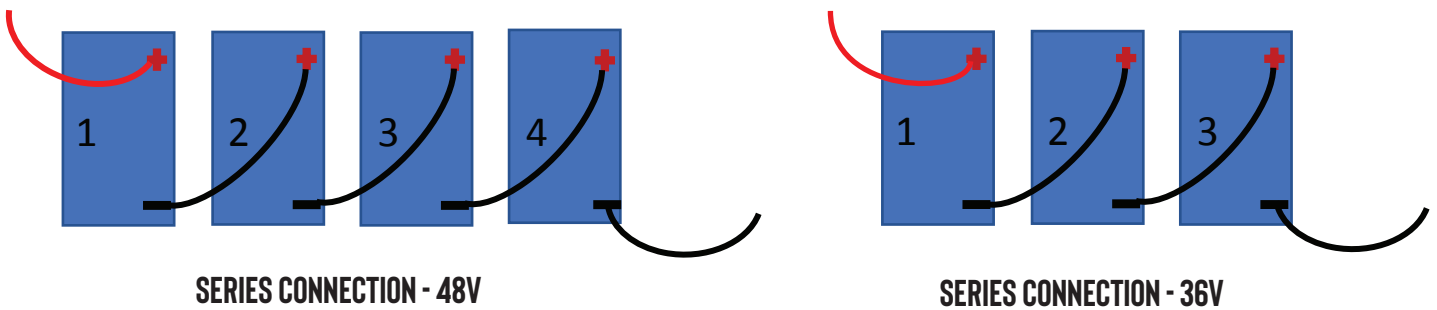
- Connect the positive (+) of Battery 1 to the negative (-) of Battery 2. Continue this pattern for each battery in the bank. See FIG 1 for details.
- **WARNING:** Only a maximum of four 12V Dakota Lithium batteries should be wired in series (48V max).
- The remaining open negative and positive terminals will be the battery bank's main terminals as shown in the following diagram. More information on wiring in series may be found by [clicking this link](#).

FIG 1

48V Series Connection example:

1. Connect the RED 18 inch wire to the POSITIVE TERMINAL on battery 1. NOTE: Be sure to secure the other end of the RED wire to prevent shorting.
2. Connect a BLACK 18 inch wire to the NEGATIVE TERMINAL on battery 1 and connect the other end to the POSITIVE TERMINAL on battery 2.
3. Connect a BLACK 18 inch wire to the NEGATIVE TERMINAL on battery 2 and connect the other end to the POSITIVE TERMINAL on battery 3.
4. Connect a BLACK 18 inch wire to the NEGATIVE TERMINAL on battery 3 and connect the other end to the POSITIVE TERMINAL on battery 4.
5. On battery 4 connect the last BLACK 18 inch wire to the NEGATIVE TERMINAL and the other end to the negative side of your device.

For a 36V Series connection skip step 4 and use step 5 on the last battery in the chain.

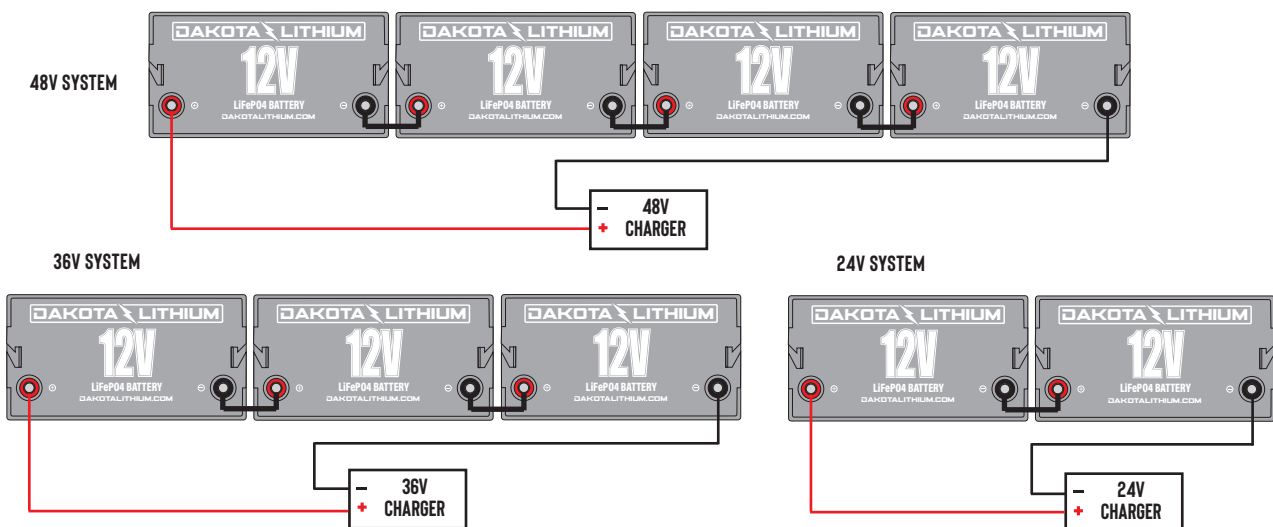


## CHARGING YOUR BATTERIES IN SERIES

To charge the system connect the positive lead of the charger to the positive terminal of the first battery in the series and the negative lead of the charger to the last negative terminal in the series.

Please follow the operating instructions on the charger.

FIG 2: CHARGER LAYOUTS



## WIRING YOUR BATTERIES IN PARALLEL

CHARGE EACH BATTERY FULLY BEFORE WIRING INTO PARALLEL

**WARNING:** Only wire matching batteries in parallel. Never wire batteries with a different voltage or amp hour rating in parallel. For example, do not wire a 24V 50Ah battery with a 12V 54Ah battery, do not wire a 12V 10Ah in parallel with a 12V 23Ah, etc.

Wiring a battery in parallel is a way to increase the amp hours of a battery (i.e. how long the battery will run on a single charge). For example if you connect two of our 12V 100 Ah batteries in parallel you will create one battery that has 12 Volts and 200 Amp-hours. Since many small electric motors, solar panels, RVs, boats, and most household electronics run on 12 volts this is a common way of creating a battery that will last a long time. We always recommend installing a fuse block in between each battery when wiring in parallel.

1. Install the FUSE BLOCK (FIG 2) on each POSITIVE TERMINAL of the batteries you will be setting up in parallel connection.
2. Make sure all the packs have exactly matching voltages. Place the batteries in desired order prior to connecting the provided cables.
3. POSITIVE BATTERY CONNECTION:

- A. Using a RED 18 inch wire, connect one end to the POSITIVE FUSE BLOCK on battery 1 and connect the other end to the POSITIVE FUSE BLOCK on battery 2.
- B. Connect another RED 18 inch wire to POSITIVE FUSE BLOCK on battery 2 and connect the other end to the POSITIVE FUSE BLOCK on battery 3.
- C. Connect another RED 18 inch wire to POSITIVE FUSE BLOCK on battery 3 and connect the other end to the POSITIVE FUSE BLOCK on battery 4.
- D. On battery 4 connect the last RED 18 inch wire to the POSITIVE FUSE BLOCK and the other end to the positive side of your device.

4. NEGATIVE BATTERY CONNECTION:

- A. Using a BLACK 18 inch wire, connect one end to the NEGATIVE TERMINAL on battery 1 and connect the other end to the NEGATIVE TERMINAL on battery 2.
- B. Connect another BLACK 18 inch wire to NEGATIVE TERMINAL on battery 2 and connect the other end to the NEGATIVE TERMINAL on battery 3.
- C. Connect another BLACK 18 inch wire to NEGATIVE TERMINAL on battery 3 and connect the other end to the NEGATIVE TERMINAL on battery 4.
- D. On battery 1 connect the last BLACK 18 inch wire to the NEGATIVE TERMINAL and the other end to the negative side of your device.

FIG 2

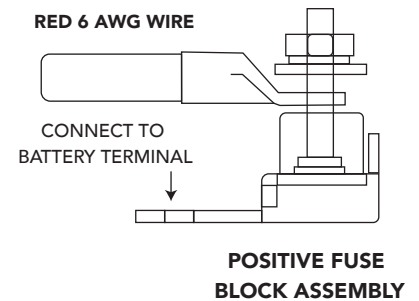
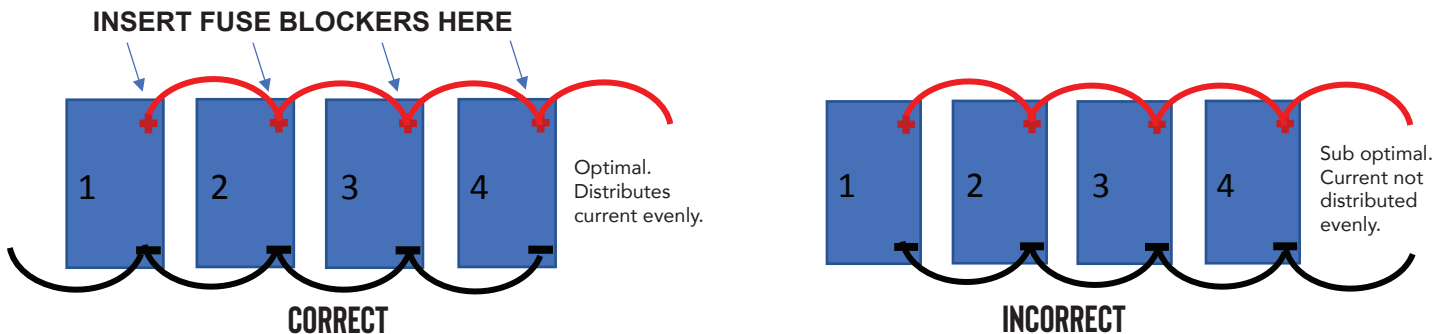


FIG 1



## TROUBLESHOOTING

If you're having an issue with your battery or charger, here are some useful troubleshooting tips. We go by the adage "follow the juice" - meaning start with the wall socket you are charging from and follow the flow of energy from there to your battery then to any devices connected to the battery.

- Make sure the wall socket you are using is in working order.
- Check the DC voltage coming out of your charger while disconnected from the battery. If it is working properly, it should match (+/-1V) the following voltages:

VOLTAGE LISTED ON CHARGER	VOLTAGE THE CHARGER SHOULD OUTPUT
12 Volts	14.4 Volts
24 Volts	28.8 Volts
36 Volts	43.2 Volts
48 Volts	57.6 Volts

- If the charger is reading below or above these readings, please discontinue use and contact [support@dakotadithium.com](mailto:support@dakotadithium.com)
- If the charger is reading a negative voltage, double check to make sure the voltmeter leads are connected to the correct charger leads. If they are, the charger's polarity has been reversed and needs to be replaced.
- If the charger is performing well, check the voltage on the battery after attempting a full charge. A working battery should match the same charger output voltages as above immediately after charging, but will "settle" to approximately the following voltages:

VOLTAGE LISTED ON CHARGER	SETTLING VOLTAGE AFTER FULL CHARGE
12 Volts	~13.4-13.6 Volts
24 Volts	~26.8-27.2 Volts
36 Volts	~40.2-40.8 Volts
48 Volts	~53.6-54.4 Volts

- If the battery is only showing a partial voltage after the charger has indicated a full charge, there is likely an issue with the cells/BMS. Please report all of your voltage readings and test results to [Support@DakotaLithium.com](mailto:Support@DakotaLithium.com)
- If both the battery and charger are performing up to specification, be sure to check any wiring used in your system to make sure you are using the correct gauge, that they aren't damaged, etc., as well as the manufacturing specifications of every device you are using with the battery and their requirements.

## MOST COMMON ISSUES AND SOLUTIONS

### MY BATTERY ISN'T CHARGING/WORKING

There are a few things that could be causing a failure. Be sure to "follow the juice" and refer to the troubleshooting guide above.

### THE CHARGER LIGHT IS NOT TURNING ON

Check that the cord connecting from the wall to the charger is connected. Check that the wall socket is turned on / working by trying a different wall socket. If the light still does not turn on then the charger may need to be replaced.

### THE CHARGER LIGHT DOES NOT TURN RED WHEN CONNECTED TO THE BATTERY

Unplug the charger from the wall until the green light turns off. Plug the charger back into the wall. Check to see if the battery is already fully charged. Check if the red charger plug is connected to the red terminal, black charger plug to black terminal.



## **THE MOST COMMON ISSUES AND SOLUTIONS (CONT)**

### **THE TERMINAL BOLTS ARE TOO SHORT OR TOO LONG**

Longer or shorter terminal bolts are likely available at your local hardware store – look at the specifications for the battery and see if the terminal bolt size is M6 or M8 and then ask for those size bolts at the hardware store. If you need a shorter bolt one option is to add additional washers on top of what you are connecting to the terminals.

### **OOPS... I SHORT CIRCUITED MY CHARGER**

Chargers can be short circuited by accidentally connecting the black charger terminal to the red battery terminal. The charger is designed to protect the battery and most likely will need to be replaced. You can buy a new charger at [DakotaLithium.com](http://DakotaLithium.com) or contact [sales@dakotalithium.com](mailto:sales@dakotalithium.com)

### **OOPS... I SHORT CIRCUITED MY BATTERY**

All Dakota Lithium batteries have a battery management system that provides short circuit protection. In most cases the BMS will turn the battery off if the short circuit is sustained for more than a few seconds. To restart the battery connect to a LiFePO4 charger to restart the battery. Repeated short circuits or a sustained short circuit will damage the battery and should be avoided.

### **I HAVE THREE BATTERIES LINKED IN SERIES TO MAKE 36 VOLTS AND THE SYSTEM HAS STOPPED**

Charge each battery individually before linking in series. Test each battery with a voltmeter to see if one unit has a lower voltage than the rest of the batteries. Check each terminal to make sure the wiring has equal surface area where it touches each battery terminal. If driving a golf cart check to make sure the amp rating of your motor controller does not exceed the max discharge of the battery (for example, a 250A motor controller needs 250 Amps and would require a DL+ 12V 135Ah battery in series instead of a DL+ 12V 60Ah battery). Check to make sure there are not 12V electronics pulling off of one of the batteries in the 36V series set.

### **MY OUTBOARD MOTOR ON MY BOAT STOPPED**

Check the voltage output of the alternator of your motor. If the output is above 14.8 volts then it may trigger the BMS in the battery to turn off. Please contact [support@dakotalithium.com](mailto:support@dakotalithium.com) for more details. If the voltage is compatible then check the amp output rating of your motor. If it is >70 amps then it needs the DL+ 12V 135Ah battery. If it is 70 Amps or less than the DL+ 12V 60Ah battery should work.

### **THE BATTERY IN MY TRUCK STOPPED WORKING**

Larger passenger vehicles, including most light trucks, have larger alternators. If your battery dies after its first charge it is possible that the alternator is too large for the size of the battery. The solution is to swap for a larger battery. Check the amp output rating of your vehicle's alternator. If the voltage is compatible then check the amp output rating of your motor. If it is >70 amps then it needs the DL+ 12V 135Ah battery. If it is 70 Amps or less than the DL+ 12V 60Ah battery should work.

### **MY TROLLING MOTOR TURNS OFF WHEN I AM ON THE MAXIMUM POWER SETTINGS**

This indicates that the battery is too small for the trolling motor. The maximum amp draw of the motor exceeds the maximum discharge ability of the battery. The solution is to contact the support team and exchange your battery for a larger model. For example, a 12V 23Ah battery may work for a 30 lbs thrust trolling motor on the lowest settings, but it will not work at full power. Whereas a 12V 60 Amp Hour battery would power a 30 lbs trust trolling motor all day.

### **MY OLD LEAD ACID BATTERY CHARGER ISN'T FULLY CHARGING MY BATTERY**

Chargers made for lead acid or SLA batteries charge at a lower voltage than lithium batteries. So a lead acid charger will only charge the battery to 70% of capacity. This does not hurt the battery or lessen the lifespan. But it does result in less usable power. Lead acid chargers may be solar charge controllers without a lithium setting, onboard multi bank chargers made for AGM, or SLA chargers for mobility scooters, golf carts, or other vehicles. The solution is to replace your charger with a lithium compatible charger. See charging your battery section.

## BATTERY DISPOSAL & RECYCLING

LiFePO<sub>4</sub> batteries must be properly recycled to protect the environment, and disposal of LiFePO<sub>4</sub> is regulated by local and federal law:

- Do not throw out batteries in your regular household garbage or recycling bin.
- Do not burn batteries in a fire, they may explode.
- Avoid storing batteries in metal containers.
- Don't keep old batteries close to flammable materials.
- Don't crush or puncture the batteries resulting in leakage or short-circuiting.
- Don't store large quantities of li-ion batteries close together without capping or taping off exposed connectors.

You should contact your local waste management facility and ask for LiFePO<sub>4</sub>/Lithium Ion recycling locations in your area.

Here is a recommended locator for LiFePO<sub>4</sub> recycling: [Call2Recycle Drop-off Locator](#)

## WARRANTY AND RETURN POLICY

In the unlikely event you are having an issue with one of our batteries we have developed a straight forward warranty & return policy:

- For all returns or warranty claims contact [support@dakotalithium.com](mailto:support@dakotalithium.com)
- 30-day money back guarantee. Returns of undamaged batteries may be issued full refunds less a 5% restocking fee.
- World beating / best in class 11 year warranty on all batteries.
  - It's simple. Dakota Lithium batteries are built to last. We stand by our craftsmanship. If we made a mistake in building your battery we'll fix it or replace it.
  - Dakota Lithium offers a 11 year manufacturer's defect warranty from the date of purchase [[fine print available here](#)]. The average lifespan of a Dakota Lithium Iron Phosphate battery is 2,000 recharge cycles, or roughly 5 – 10 years with regular use that is appropriate to what the battery is designed for (see the specifications of the battery). This warranty does not cover negligence or misuse of the battery or normal wear and tear. If it is deemed that the battery was used improperly, you will be subject to a \$150 an hour repair charge plus parts and shipping.
  - Dakota Lithium 12V to 48V batteries are not intended or warrantied for serial wiring applications above 48V.
  - To submit a warranty claim, please contact the original place of purchase. The battery may be required to be shipped back to us (Dakota Lithium) for further inspection.
- 1 year warranty on all accessories & complimentary products (chargers, powerbox cases, volt meter, etc).
- Free lifetime technical support & free battery analysis.
- Warranty only applies to the original owner (non-transferable).
- Warranties can be used for an exchange of a component only once.
- Customer pays return shipping on returns or warrantied component inspections. Shipping costs for qualified returns will be refunded by Dakota Lithium. Please note some battery returns may require special documentation and packaging, and these instances will encounter extra fees. This is in order to correctly comply with lithium battery shipping regulations. For all return shipping we recommend using a local shipping service like FedEx office or the UPS Store.
- If you have a quality issue with a product please contact support to help diagnose the problem. If a product does not meet our high quality standards, then we will issue you a replacement component or fix the original at no additional cost. Replacement components will only be sent after we have received your returned component and finished an inspection to determine the cause of any problems.  
**Dakota Lithium is not responsible for return shipping.**
- Do-It-Yourself modifications or damage due to gross negligence or abuse are not covered by the warranty.



**CONTACT INFORMATION:**

SALES: 1.855.743.327 [sales@dakotalithium.com](mailto:sales@dakotalithium.com)

SUPPORT: [support@dakotalithium.com](mailto:support@dakotalithium.com)

225 SOUTH LUCILE STREET  
SEATTLE WASHINGTON 98108

**DAKOTALITHIUM.COM**



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