DAKOTA LITHIUM

General Battery User Manual

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IMPORTANT INFORMATION

Manual Scope

This manual provides general guidance for Dakota Lithium batteries. Product specifications, protection features, operating limits, terminal hardware, environmental ratings, and approved applications vary by battery model. Always confirm the current specifications for the specific battery before installation or use. Do not assume that batteries with the same nominal voltage, chemistry, physical size, or capacity have the same operating limits or approved applications.

Warranty Coverage

Damage resulting from improper installation, incompatible equipment, use outside published operating limits, physical damage, unauthorized modification, or other misuse may not be covered under the applicable product warranty. Refer to the current Dakota Lithium warranty terms for coverage, exclusions, and other applicable conditions.

1 | SAFETY INFORMATION

Read this manual before using or installing your battery. Batteries and electrical systems can present risks of electric shock, serious injury or death, equipment or property damage, and fire if installed or used improperly. Dakota Lithium is not liable for injury resulting from the use or installation of a Dakota Lithium battery or from actions taken based on the recommendations in this document.

Battery installation should be performed by personnel qualified to work on the applicable electrical system. For complex or permanently installed systems, professional installation by a qualified electrician, marine electrician, or other trained technician is strongly recommended and may be required by applicable codes or regulations. If you are uncertain about the installation requirements, consult a qualified professional before proceeding.

GENERAL SAFETY REQUIREMENTS

WARNING: Battery terminals may be electrically live. Avoid short circuits and contact between terminals and conductive tools or materials.

- Do not reverse polarity.
- Do not place tools or other conductive objects on the battery.
- Use insulated tools when working around battery terminals. Remove watches, jewelry, and other conductive items that could accidentally contact the terminals.
- Do not charge or operate a battery that is visibly damaged, dented, swollen, punctured, leaking, or otherwise compromised. If the case or lid becomes damaged or loose, discontinue use.
- Do not puncture, open, crush, incinerate, or disassemble the battery.
- If the battery case is damaged and internal components or material are exposed, discontinue use and avoid contact with the exposed material.
- Do not exceed the battery's published charge or discharge limits.
- Use only charging equipment compatible with the battery chemistry, voltage, and charging requirements.
- Do not immerse the battery in water or expose it to liquids, chemicals, or other potentially damaging substances. Keep the battery case, terminals, and electrical connections dry and protected. Follow the environmental protection requirements published for the specific battery model.
- Store batteries in a dry, protected location away from excessive heat, open flame, direct sunlight, combustible materials, and other sources of ignition.
- Use appropriately sized cables and circuit protection for the expected current and cable length.
- Ensure terminal connections are clean, fully seated, and securely tightened before operation. Do not operate with loose connections.
- Do not mix battery types, chemistries, voltages, capacities, or significantly different ages in the same series or parallel bank unless specifically approved for that configuration.

If a battery is damaged or operates abnormally, stop using it and contact Dakota Lithium support before charging or operating it again.

SHIPPING AND TRANSPORT: Lithium batteries are subject to transportation requirements that vary by battery type, size, carrier, and method of transport. Before shipping a battery, confirm the applicable carrier and dangerous-goods requirements. Protect exposed terminals from short circuit and package the battery securely to prevent movement, impact, or damage during transport.

1 | SAFETY INFORMATION - CONTINUED

BATTERY MANAGEMENT SYSTEM (BMS)

Most Dakota Lithium batteries include an integrated Battery Management System (BMS) that monitors battery operation and provides protective functions such as overvoltage, undervoltage, overcurrent, short-circuit, and temperature protection.

Protection features and operating limits vary by model. If the BMS detects a condition outside the battery's allowable range, it may limit or shut down charging or discharging until the condition is corrected.

The Battery Management System (BMS) is a protective feature and is not a substitute for proper system design, appropriately sized wiring, external overcurrent protection, compatible charging equipment, or correct installation.

BMS PROTECTION AND RESET

If a battery unexpectedly stops charging or supplying power, the BMS may have entered a protective state in response to a condition such as low voltage, high current, short circuit, or temperature. Correct the condition before attempting to restore operation. Depending on the battery model and type of protection event, normal operation may resume automatically, after the load is disconnected, or when a compatible charger is connected. See the Troubleshooting section if the battery does not resume normal operation.

WARNING: Do not repeatedly attempt to charge, discharge, or reset a battery while the condition causing BMS protection remains unresolved. Repeated attempts may damage the battery or connected equipment. Identify and correct the underlying condition before attempting recovery. Follow only recovery procedures approved for the specific battery model.

LITHIUM BATTERY CHEMISTRIES

Dakota Lithium batteries may use different lithium-based chemistries depending on the application, including Lithium Iron Phosphate (LiFePO4) and Lithium Titanate (LTO).

LiFePO4 is commonly used in deep-cycle and Dual Purpose applications because of its cycle life, thermal stability, and durability. LTO may be used in selected starting applications where high power output and rapid charge acceptance are important.

THERMAL SAFETY

Lithium battery chemistries differ in their thermal characteristics and response to abuse or failure conditions. LiFePO4 is generally considered more thermally stable than many other lithium-ion chemistries. However, any battery may present a risk of heat, fire, or other damage if it is physically damaged, improperly installed, short-circuited, overcharged, exposed to excessive temperatures, or used outside its published operating limits.

BATTERY LIFE & GENERAL CARE

Battery life depends on chemistry, model, depth of discharge, charge rate, temperature, storage conditions, and application. To help maximize service life, use the battery within its operating limits, keep connections clean and secure, and follow the charging and storage guidance in this manual.

Exact limits for voltage, current, temperature, terminal torque, environmental conditions, and installation vary by model. Confirm the applicable limits on the battery label, product page, or specification sheet before installation or charging.

2 | INSTALLATION

Before installation, confirm that the battery is suitable for the intended application, system voltage, expected current, charging method, and installation environment. Install the battery and associated electrical system in accordance with applicable codes and equipment requirements.

BEFORE INSTALLATION

1. Confirm the battery terminal type, terminal hardware, and required torque.
2. Confirm the battery's charge and discharge limits for the application.
3. Confirm that the battery is approved for any required series or parallel configuration.
4. Confirm that the battery's environmental or ingress-protection rating is suitable for the installation location.
5. Select cable, overcurrent protection, and connectors sized for the expected current and cable length.

TERMINAL HARDWARE

Use terminal hardware that matches the specified size and thread for your battery. Fasteners must be long enough to engage securely without bottoming out before the cable lug is fully clamped. If the supplied hardware is not appropriate for your installation, use correctly sized replacement hardware. Do not force an incorrect-size or incorrect-thread fastener into the terminal.

Fig. 2-1 shows an example of a properly secured terminal connection. Terminal designs and hardware requirements vary by battery model.



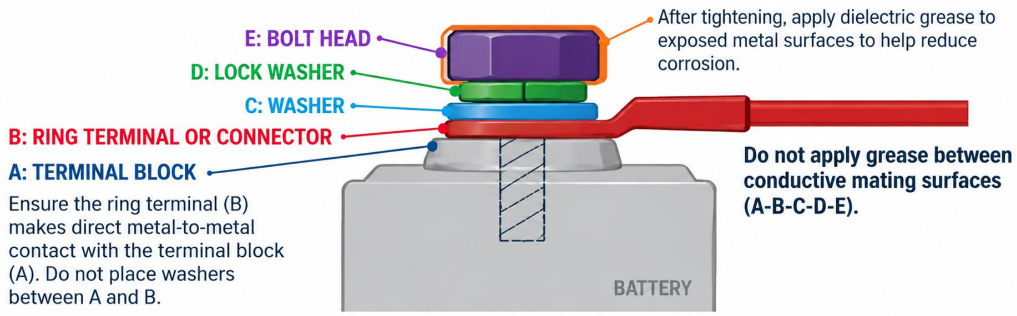
FIG. 2-1 | Example Terminal Connection

TERMINAL CONNECTION PROCEDURE (THREADED TERMINALS)

1. Confirm that cable lugs, connectors, and terminal hardware are compatible with the battery terminals.
2. Connect the positive lead to the positive terminal (+).
3. Connect the negative lead to the negative terminal (-).

   Warning: Incorrectly connecting battery leads may cause a short circuit, resulting in battery damage, equipment damage, or personal injury.
4. Ensure that electrical contact surfaces are clean and connections are properly seated for the applicable terminal design. See Fig. 2-2 for an example of a threaded terminal connection.
5. Where terminal fasteners are used, tighten them to the torque specified for the battery model. Do not overtighten. Verify that the connection is secure before operating the battery.
6. Where appropriate for the terminal design, apply suitable corrosion protection to exposed external metal surfaces after securing the connection. Do not apply insulating compounds between electrical contact surfaces unless specifically directed by the terminal manufacturer.

FIG. 2-2 | Example Threaded Terminal Hardware Arrangement



PROPER TERMINAL INSTALLATION HELPS REDUCE RESISTANCE, HEAT, AND CORROSION.

Terminal connection example. *Always use the hardware and torque specified for your battery model.*

2 | INSTALLATION - CONTINUED

ENVIRONMENTAL PROTECTION

Environmental and ingress-protection ratings vary by model. Check the battery label or current product specifications for the applicable IP rating. Protect the battery, terminals, and electrical connections from unnecessary exposure to water, salt, and corrosive environments. Do not immerse a battery unless the specific model is expressly rated for submersion. In marine, outdoor, or other wet environments, install the battery in a protected location or suitable enclosure when appropriate.

OVERCURRENT PROTECTION

Use appropriately rated fuses or circuit breakers to protect wiring and connected equipment from excessive current and short circuits. Overcurrent protection should be selected and installed based on the system voltage, expected current, conductor size, and applicable electrical requirements.

WIRE GAUGE AND CABLE SIZING

Correct wire sizing is important for system performance and safety. Wire size depends on current, cable length, insulation temperature rating, installation method, and applicable electrical standards.

WARNING: Do not use wire that is undersized for the expected current and cable length. Undersized wire can overheat and may create a fire hazard. This chart is a general reference only. Verify conductor sizing for your specific installation.

RECOMMENDED CABLE GAUGE BY CURRENT & DISTANCE

	CABLE LENGTH (FT)						
CURRENT (A)	0–4	4–7	7–10	10–15	15–20	20–25	25–30
0–5	16 AWG	16 AWG	16 AWG	16 AWG	14 AWG	12 AWG	12 AWG
5–10	16 AWG	16 AWG	14 AWG	12 AWG	10 AWG	10 AWG	10 AWG
10–15	14 AWG	14 AWG	12 AWG	10 AWG	10 AWG	8 AWG	8 AWG
15–20	14 AWG	12 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG
20–25	12 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG
25–30	10 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG
30–40	8 AWG	8 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG
40–50	8 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG
50–60	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG
60–70	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0 AWG
70–80	4 AWG	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0 AWG
80–90	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG
90–100	2 AWG	2 AWG	2 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG
100–120	2 AWG	2 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG	2/0 AWG
120–150	1/0 AWG	1/0 AWG	1/0 AWG	1/0 AWG	1/0 AWG	2/0 AWG	4/0 AWG
150–200	2/0 AWG	2/0 AWG	2/0 AWG	2/0 AWG	2/0 AWG	4/0 AWG	4/0 AWG

This chart is a general reference. Verify conductor sizing for your specific installation, including current, cable length, insulation temperature rating, installation method, voltage drop, and applicable electrical requirements.

3 | CHARGING

Use charging equipment that matches your battery's chemistry and nominal voltage. Charging voltage and maximum charging current vary by model, and those limits must not be exceeded.

CHARGING REQUIREMENTS

Do not assume a charger is compatible based on nominal voltage alone. Some lead-acid chargers may be able to charge a LiFePO4 battery to some degree, but they may not reach a full charge and may use equalization, desulfation, or maintenance modes that are not appropriate for lithium batteries. Use a charger intended for the battery chemistry, or a programmable charger configured to the correct lithium profile.

CHARGE VOLTAGE AND CURRENT

Charging voltage must match the battery chemistry and system voltage. Maximum charging current also varies by model. If the charger is programmable, select the appropriate lithium profile and make sure its voltage and current settings remain within the battery's limits. For batteries connected in series, the charger must match the total voltage of the battery bank as well as the charging requirements of the individual batteries.

WARNING: Do not exceed the battery's published charging voltage or maximum charging current. When multiple charging sources can operate simultaneously, their combined charging current must remain within the applicable battery or bank's published charging limits. This includes AC chargers, solar controllers, alternators, and DC-DC chargers. Configure charging equipment or use appropriate current-limiting controls to prevent exceeding these limits.

CHARGE RATE

Charge rate is often expressed as a C-rate, which compares charging current to battery capacity. For example, charging a 100Ah battery at 10A is a 0.1C charge rate.

UNDERSTANDING CHARGE RATE

Charge Rate	Example for a 100Ah Battery	Approximate Ideal Charge Time*
0.1C	10A	10 hours
0.2C	20A	5 hours
0.3C	30A	3.3 hours
0.5C	50A	2 hours

*Approximate only. Actual charge time may be longer as charger output tapers and will vary with battery state of charge, temperature, and charging system.

CHARGE RATE AND BATTERY LIFE

Charging rate can affect battery service life. For LiFePO4 batteries, lower charge rates are generally easier on the cells and can help support longer cycle life over time.

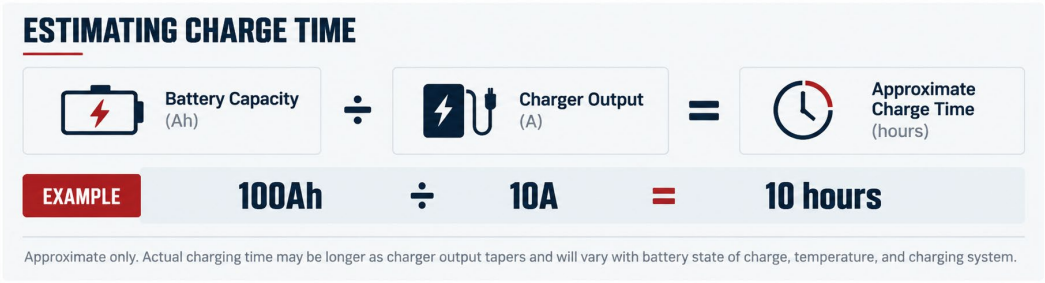
When practical, a charge rate of 0.5C or less is a conservative general guideline for LiFePO4 batteries. Slower charging, such as 0.1C to 0.3C, may further reduce stress on the battery during charging.

Higher charge rates may be supported by some battery models and chemistries, but the maximum allowable charge current varies by battery.

3 | CHARGING - CONTINUED

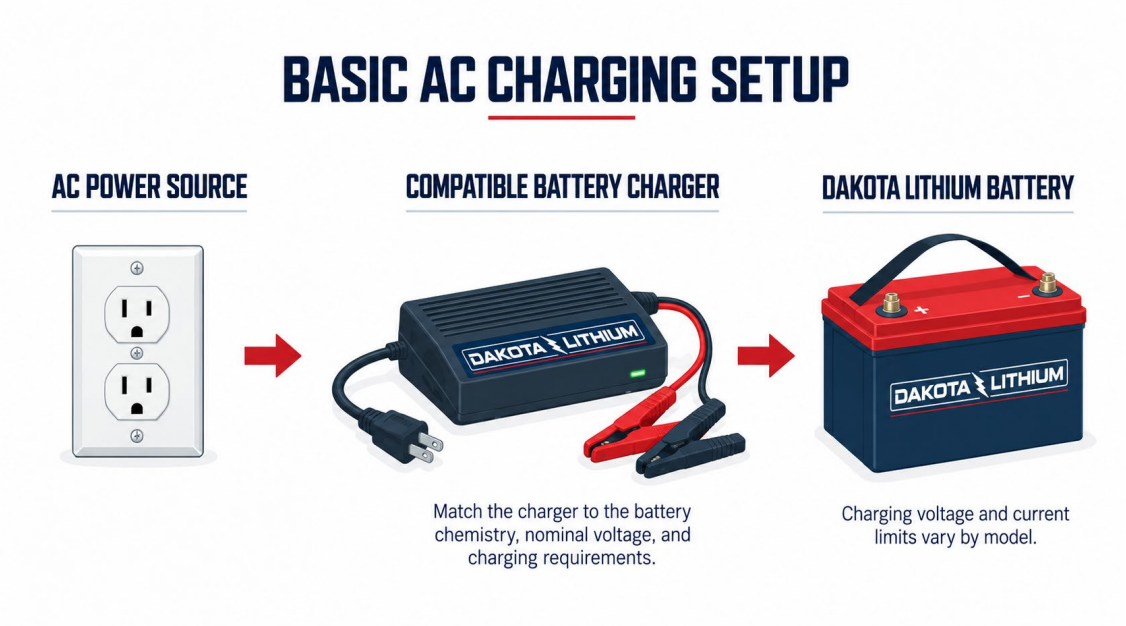
ESTIMATING CHARGE TIME

A simple charge-time estimate can be made by dividing battery capacity in amp-hours (Ah) by charger output in amps (A). For example, a 100Ah battery charged at 10A would require approximately 10 hours from empty under ideal conditions. Actual charging time may vary because charger output can taper and battery state of charge, temperature, and system losses affect charging.



GENERAL CHARGING PRACTICES

- Use only compatible charging equipment.
- Inspect cables and connectors before charging.
- Do not charge a visibly damaged battery.
- Charge only within the temperature limits specified for your battery.
- Do not exceed the battery's published voltage or current limits.
- Follow the instructions provided by both the charger and battery manufacturers.



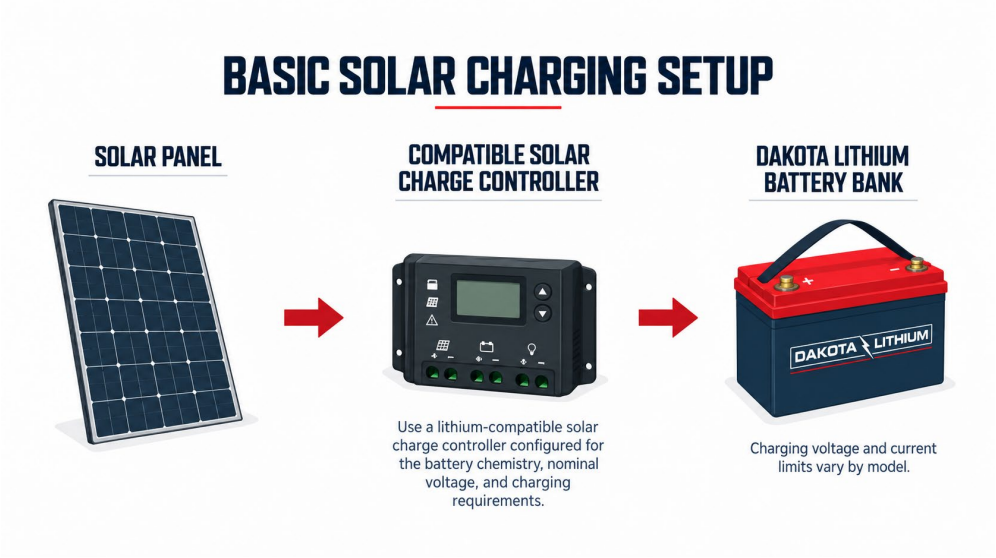
3 | CHARGING - CONTINUED

ONBOARD CHARGING

A lithium-compatible onboard charger can be used when its output profile matches the battery chemistry and system voltage. If the charger offers selectable profiles, choose the setting intended for the battery chemistry and avoid equalization or desulfation modes unless specifically allowed.

SOLAR CHARGING

Dakota Lithium batteries may be charged using a compatible solar charge controller configured for the battery's chemistry, nominal voltage, and published charging limits. Follow the controller manufacturer's installation instructions and account for other charging sources that may operate simultaneously.



BEFORE CONNECTING A SOLAR SYSTEM

- Confirm that the controller supports your battery chemistry and system voltage.
- Confirm that the controller's charging voltage and maximum output current remain within the battery's charging limits.
- Use conductors, fuses or other circuit protection, and connectors sized for the installation.
- Observe correct polarity.
- Follow the solar charge controller manufacturer's installation instructions.

SOLAR SYSTEM SIZING

Solar array and controller size depend on battery capacity, expected daily energy use, available sunlight, climate, installation location, and desired recharge time. Size the array to replace the energy you expect to use, and choose a controller rated for the solar array voltage and current as well as the battery-bank voltage.

3 | CHARGING - CONTINUED

ALTERNATOR CHARGING

Lithium batteries are not all designed to charge directly from an engine alternator. Many deep-cycle lithium batteries require a DC-DC charger to regulate charging voltage and current and to help protect both the battery and alternator.

Selected Dakota Lithium DL+ Dual Purpose batteries may be designed for applications where the battery supports both engine-starting loads and direct charging from a vehicle or marine alternator. Direct alternator compatibility is model-specific and should not be assumed for all Dakota Lithium batteries.

Before connecting a battery directly to an alternator, confirm that:

- the battery model is approved for direct alternator charging;
- the alternator charging voltage is within the battery's allowable range; and
- the charging current supplied to the battery does not exceed the battery's published charging limit.

Engine-starting capability and direct alternator-charging capability are separate specifications. A battery may be capable of starting an engine without necessarily being approved for direct alternator charging.

IMPORTANT: Direct alternator charging systems must also account for the possibility of a battery BMS disconnect during operation, which may cause voltage transients that could damage the alternator or connected equipment. Confirm whether alternator protection or other system-specific safeguards are required before installation.

DIRECT ALTERNATOR CHARGING WITH DL+ DUAL PURPOSE BATTERIES

Certain DL+ Dual Purpose batteries may support direct alternator charging without a separate DC-DC charger, depending on the specific battery model and charging-system configuration.

This capability can simplify installations where the same battery is used for starting and auxiliary power, including selected automotive and marine applications.

Direct alternator compatibility varies by model. Always confirm the allowable charging voltage and maximum charging current for the specific battery before installation.

IMPORTANT: ALTERNATOR OUTPUT

Alternator output can vary with engine speed, electrical load, and charging-system design. Both charging voltage and current must remain within the battery's approved limits.

For 12V LiFePO4 batteries, charging voltage above approximately 14.8V may cause the BMS to enter high-voltage protection. Confirm the allowable charging-voltage range for the specific battery before connecting it directly to an alternator.

An alternator may also supply charging current at a rate that exceeds the battery's allowable charge rate. Uncontrolled alternator charging can exceed 1C and may trigger BMS protection or damage the battery. A 1C charge rate means charging current equal to the battery's rated amp-hour capacity, such as 100A into a 100Ah battery.

A deeply discharged lithium battery or large battery bank can also place a significant continuous load on an alternator. Excessive alternator loading may result in overheating or reduced alternator life.

If alternator voltage or charging current cannot be kept within the battery's approved limits, use a properly sized DC-DC charger.

IF THE BATTERY SHUTS DOWN DURING ALTERNATOR CHARGING

If the battery stops charging or supplying power while connected to an alternator, the BMS may have entered a protective state.

Disconnect the charging source and load, then verify:

- alternator charging voltage;
- maximum charging current available to the battery;
- the battery's allowable charging limits; and
- wiring, connections, and polarity.

Do not repeatedly reconnect the battery until the cause of the protective shutdown has been identified.

3 | CHARGING - CONTINUED

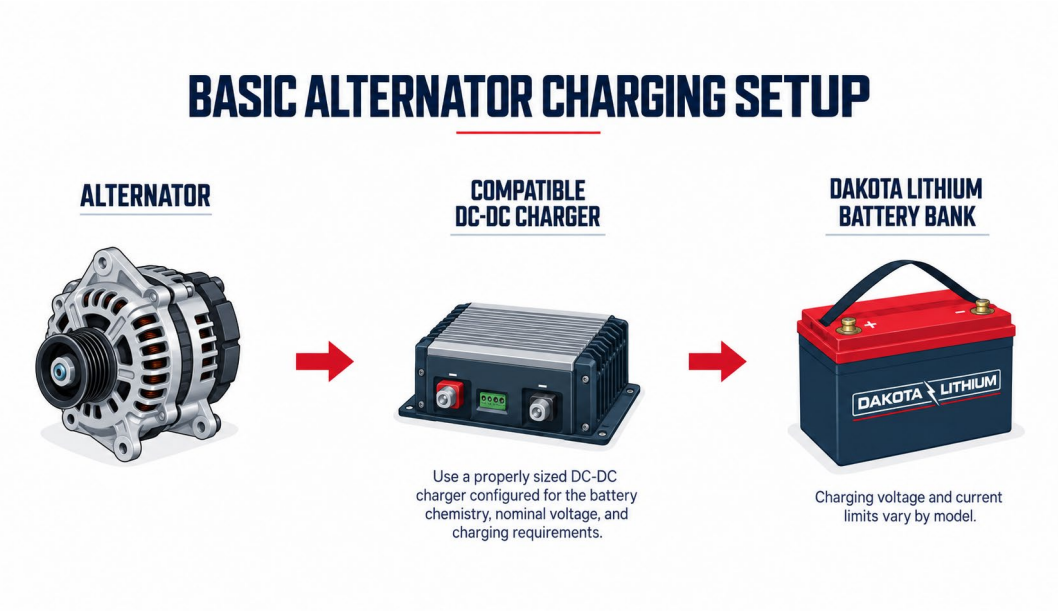
DC-DC CHARGING

A DC-DC charger regulates the power supplied by the alternator and provides a controlled charging profile to the battery.

Use a DC-DC charger when:

- the battery is not approved for direct alternator charging;
- alternator voltage or current may exceed the battery's charging limits;
- charging a large or deeply discharged battery bank may place excessive load on the alternator; or
- controlled charging is otherwise required by the system design.

The DC-DC charger should be sized appropriately for the battery, alternator, and electrical system.



FLOAT CHARGING AND BATTERY MAINTAINERS

For LiFePO4 batteries, continuous float or maintenance charging is generally unnecessary because self-discharge is low.

Do not leave a battery connected indefinitely to a charger that continuously tops it off or uses maintenance, equalization, or desulfation modes unless that charging method is specifically supported by the battery model. Where a programmable charger includes a float stage, confirm that its settings are compatible with the battery's published charging requirements.

For storage, disconnect loads that may slowly discharge the battery and check its charge periodically.

CHARGING A BATTERY BANK

When charging batteries connected in series or parallel, make sure the battery model supports the configuration and use a charger that matches the resulting bank voltage, battery chemistry, and allowable charging current. Use matching batteries of the same model, voltage, and capacity, with a similar state of charge.

CHARGING AFTER A PROTECTIVE SHUTDOWN

If the BMS has disabled battery output, remove the load and inspect the installation before attempting a reset. A compatible charger may restore operation on some models. If the battery does not recover, stop troubleshooting and contact Dakota Lithium support.

4 | BATTERY OPERATION & CARE

SERVICE LIFE & GENERAL CARE

Battery service life is affected by operating temperature, depth of discharge, charge rate, storage conditions, and application. Operating the battery within its specified limits, using an appropriate charging system, and keeping electrical connections clean and secure can help maximize service life.

BATTERY MANAGEMENT SYSTEM

A Battery Management System (BMS) monitors battery operation and may provide protection against conditions such as overvoltage, undervoltage, overcurrent, short circuit, and excessive temperature. Available protection features vary by model.

If a battery unexpectedly stops providing power, the BMS may have entered a protective state. Remove the load and inspect the system for a short circuit, overload, low-voltage condition, or temperature outside the battery's allowable range. Correct the cause before attempting to restore operation.

Depending on the battery model and type of protection event, operation may resume automatically, after the load is disconnected, or when a compatible charger is connected.

BATTERY VOLTAGE

Battery voltage varies with chemistry, nominal voltage, state of charge, load, and whether the battery is actively charging. A typical 12V LiFePO4 battery may measure approximately 14.4V while charging and settle to around 13.4V after charging.

LiFePO4 batteries maintain a relatively flat voltage through much of the discharge cycle, so voltage alone is not a precise state-of-charge indicator. These example values do not apply to LTO or higher-voltage batteries.

ESTIMATING RUNTIME

To estimate runtime, divide usable battery capacity in amp-hours (Ah) by the average current draw in amps (A). For example, a 100Ah battery supplying an average 5A load would provide approximately 20 hours of runtime under ideal conditions. Actual runtime varies with load, temperature, system efficiency, and battery limits.

OPERATING AND CHARGING TEMPERATURE

Operating, charging, and storage temperature limits vary by model. For LiFePO4 batteries, do not charge below 32°F (0°C) unless the battery specifically supports low-temperature charging or includes an approved heating function. LiFePO4 batteries can often discharge below freezing, but available performance may be reduced. LTO batteries and some specialized models may have different temperature limits.

BATTERY STORAGE

Store the battery in a dry, protected location away from excessive heat, open flame, and conductive materials. Disconnect loads and charging sources that could slowly discharge the battery during storage.

Dakota Lithium LiFePO4 batteries have a low self-discharge rate, typically around 3–5% per month under normal storage conditions. Even so, do not store the battery in a deeply discharged state.

As a general guideline for LiFePO4 batteries, maintain approximately 50% or greater state of charge during extended storage unless the specific battery model has different published recommendations. Because battery voltage alone is not a precise state-of-charge indicator, refer to model-specific information for additional guidance.

Long-Term & Winter Storage Checklist: For additional storage instructions and a printable maintenance record, visit the Guides section of the Dakota Lithium Academy at https://www.dakotalithium.com/blogs/academy

Do not use a continuous float charger or battery maintainer unless specifically approved for the battery.

REPLACING A LEAD-ACID BATTERY

Many Dakota Lithium batteries are designed for applications traditionally served by lead-acid batteries, but compatibility is not automatic. Before installation, confirm system voltage, charging profile, current requirements, physical fit, terminal configuration, and any application-specific requirements.

4 | BATTERY OPERATION & CARE - CONTINUED

DUAL PURPOSE & STARTING APPLICATIONS

Dakota Lithium Dual Purpose batteries are designed to support both high-current starting loads and deep-cycle use when the specific battery model is approved for the application. This allows a single battery to support engine starting while also supplying power to onboard electrical loads.

Not every Dakota Lithium battery is designed for engine starting. Do not use a deep-cycle-only battery as a starting battery unless the specific model is approved for that application. Always confirm that the battery's published starting or cranking rating meets the requirements of the vehicle, engine, or equipment manufacturer.

UNDERSTANDING STARTING AND DISCHARGE RATINGS

Battery current ratings describe different types of performance and should not be used interchangeably.

- **Cold Cranking Amps (CCA)** indicate a battery's ability to crank an engine under standardized cold-temperature conditions.
- **Continuous discharge current** is the amount of current the battery can supply continuously within its operating limits.
- **Peak discharge current** is a higher current the battery can supply only for a specified short duration. Peak discharge capability is useful for loads with brief current surges, but it is not the same as a CCA rating.

For engine starting, use the published CCA or starting rating. For electrical loads, use the published continuous and peak discharge ratings.

TYPICAL CCA REFERENCE

CCA (Cold Cranking Amps) is a standardized measure of cold-weather engine-starting performance. Larger engines, colder temperatures, higher compression, and diesel applications may require greater starting capability.

CCA RANGE	TYPICAL APPLICATIONS
Under 300 CCA	Smaller powersports, lawn & garden, and other small-engine starting applications.
300–500 CCA	Some compact automotive, utility, and smaller marine starting applications.
500–700 CCA	Many passenger-vehicle and moderate-demand starting applications.
700–900 CCA	Higher-demand automotive and marine starting applications.



IMPORTANT: This chart is a general educational reference only and does not indicate that any specific Dakota Lithium battery is suitable for the applications shown. Always confirm the required CCA and battery specifications provided by the vehicle, engine, or equipment manufacturer.

CCA is measured at 0°F (-18°C). Marine applications may also use CA or MCA ratings.

4 | BATTERY OPERATION & CARE - CONTINUED

HIGH-CURRENT LOADS

Starting motors, winches, hydraulic pumps, trolling motors, inverters, and other high-current equipment can place very different demands on a battery.

Confirm that both the expected continuous current and any short-duration peak current remain within the battery's published discharge limits. If the load exceeds those limits, the BMS may enter overcurrent protection or the battery may be damaged.

Cable size, cable length, terminal connections, and circuit protection must also be appropriate for the expected current.

TEMPERATURE AND STARTING PERFORMANCE

Battery performance changes with temperature. Cold temperatures can reduce available power and cranking performance even when the battery remains within its allowable operating range.

For LiFePO4 batteries, discharging below freezing may be permitted on some models, but available performance may be reduced. Operating and storage temperature limits vary by battery model. Always use the battery within its published temperature limits.

ENGINE-COMPARTMENT / UNDER-HOOD INSTALLATION

Selected Dual Purpose batteries may be suitable for engine-starting applications, but suitability for starting does not automatically establish approval for installation in an engine compartment. Always confirm that the specific battery model and intended mounting location are approved for the applicable environmental and operating conditions.

Engine compartments can experience temperatures significantly higher than outside ambient temperature, especially near the engine, exhaust components, turbochargers, radiators, and other heat sources. Battery temperature may also continue to rise after the engine is shut off due to heat soak.

Before installing a battery in an engine compartment:

- Confirm that the specific battery model is approved for the application.
- Confirm the battery's published operating-temperature range.
- Secure the battery against movement and vibration.
- Keep cables and terminals protected from abrasion and accidental short circuits.
- Choose a mounting location away from exhaust components and other concentrated heat sources.
- Avoid locations exposed to excessive radiant heat or restricted airflow.
- Consider operating conditions such as high ambient temperature, towing, extended idling, heavy engine loads, and post-shutdown heat soak.
- If expected battery temperature may approach or exceed the battery's published operating limit, use a cooler mounting location or another approved installation method.

IMPORTANT: High-temperature BMS protection is a safety feature, not a normal operating target. Do not rely on the BMS high-temperature cutoff as an acceptable continuous operating temperature.

INVERTER CONNECTIONS

Some inverters contain large input capacitors that may draw a brief, high inrush current when first connected to a battery. A Current Surge Limiter (CSL) or other approved pre-charge solution can help limit this initial surge and prevent unintended BMS protection or system interruptions.

As a general best practice, a CSL or equivalent pre-charge solution is recommended for inverter systems rated at 3,500W or higher. Requirements may vary by inverter, battery model, and system configuration. Always follow the inverter manufacturer's installation requirements and confirm compatibility with the specific battery system.

5 | SERIES & PARALLEL CONNECTIONS

SERIES CONNECTIONS

Connecting batteries in series increases the total system voltage while the amp-hour capacity remains the same. For example, two 12V 100Ah batteries connected in series create a 24V 100Ah battery bank.

Before connecting batteries in series, fully charge each battery individually with a compatible charger. Batteries in a series bank should begin at the same or very similar state of charge. Connecting batteries at significantly different states of charge can cause imbalance, reduced usable capacity, or premature BMS protection.

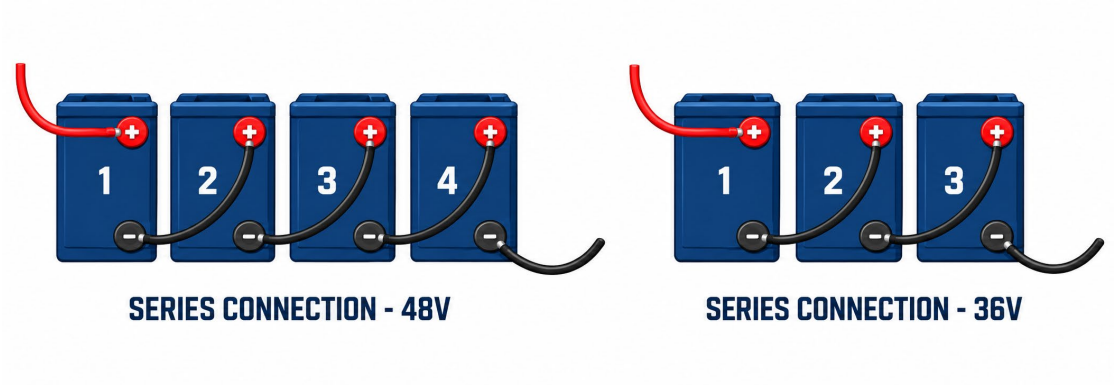
WARNING: Only connect batteries in series when the specific battery model is approved for series operation. Do not exceed the maximum series configuration permitted for that model.

BEFORE CONNECTING

- Confirm that the battery model is approved for series operation.
- Use matching batteries of the same model, chemistry, nominal voltage, and capacity.
- Do not mix batteries of significantly different age, condition, or state of charge in the same series bank.
- Fully charge each battery individually before making the series connections.
- Confirm that all cables, terminal hardware, and circuit protection are appropriately sized for the system.
- Do not exceed the maximum series configuration approved for the battery model.

SERIES CONNECTION PROCEDURE

1. Confirm that every battery in the bank is approved for series operation and that all batteries are at a similar state of charge.
2. Connect the positive (+) terminal of Battery 1 to the negative (-) terminal of Battery 2.
3. Continue the same positive-to-negative pattern for each additional battery in the bank.
4. Use the remaining open negative and positive terminals as the main bank terminals.
5. Before energizing the system, verify correct polarity, secure cable connections, and the permitted maximum series configuration for the battery model.



Maximum series configuration varies by battery model. Confirm the permitted series configuration before installation.

5 | SERIES & PARALLEL CONNECTIONS - CONTINUED

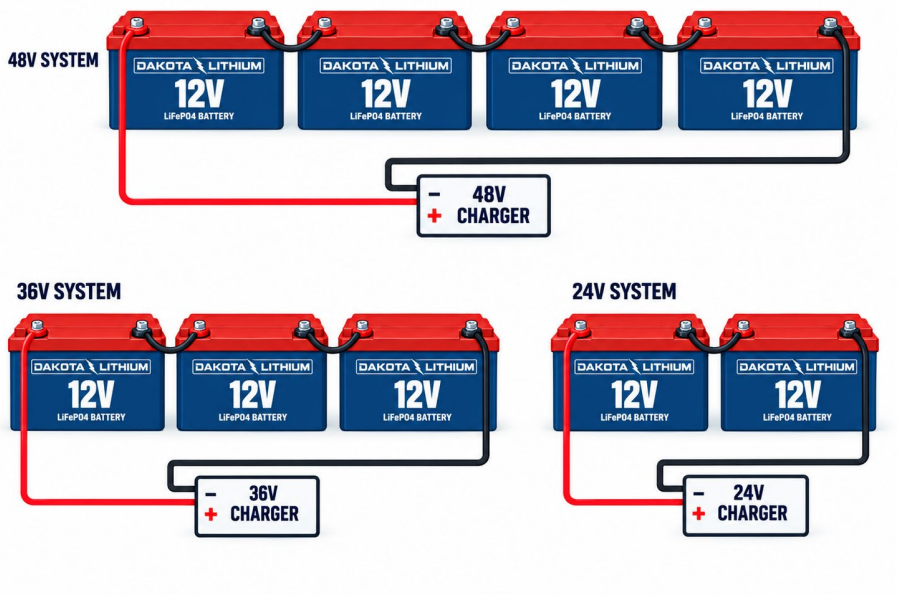
CHARGING A SERIES BANK

Use a charger designed for the total voltage of the completed battery bank and compatible with the battery chemistry and charging requirements.

Connect the charger positive lead to the bank's main positive terminal and the charger negative lead to the bank's main negative terminal, as shown in Fig. 5-1.

Do not connect a charger intended for a single battery across the entire series bank unless its output voltage is appropriate for the total bank voltage.

FIG 5-1: CHARGER LAYOUTS



MAINTAINING BALANCE IN A SERIES BANK

Over time, batteries connected in series may become unbalanced. If one battery reaches a BMS protection limit before the others, the entire bank may stop supplying or accepting power.

If a series bank shows signs of imbalance:

- disconnect the bank from loads and charging sources;
- measure each battery individually;
- check all terminal and cable connections; and
- if one battery differs noticeably from the others, charge the batteries individually with compatible chargers before reconnecting the bank.

Periodically check the condition and individual battery voltages in a series bank, particularly following extended storage, unusual performance, or a protective shutdown. Where compatible with the battery model, a properly configured multi-bank charger may be used to help maintain or restore balance.

IMPORTANT SERIES-BANK WARNINGS

Do not mix different battery models, voltages, capacities, or chemistries in the same series bank.

Do not connect 12V accessories or other loads across only one battery in a higher-voltage series bank. Doing so can discharge one battery faster than the others and create an imbalanced bank.

Do not assume every Dakota Lithium battery can be connected in series. Series capability and the maximum allowable bank voltage vary by model.

5 | SERIES & PARALLEL CONNECTIONS - CONTINUED

PARALLEL CONNECTIONS

Connecting batteries in parallel increases available amp-hour capacity while nominal system voltage remains the same. For example, two matching 12V 100Ah batteries connected in parallel create a 12V 200Ah battery bank.

WARNING: Only connect batteries in parallel when the specific battery model is approved for parallel operation. Do not exceed the maximum parallel configuration permitted for that model.

BEFORE CONNECTING A PARALLEL BANK

Fully charge each battery individually before connecting the batteries in parallel. Batteries should be at the same or very similar voltage and state of charge before the final connection is made.

Connecting batteries with a significant voltage difference can cause a high equalization current to flow immediately between the batteries.

Before making the connections:

- Use matching batteries of the same model, chemistry, nominal voltage, and capacity.
- Avoid mixing batteries of significantly different age or condition.
- Confirm that battery voltages and states of charge are closely matched.
- Use appropriately sized conductors and arrange equivalent battery connections with matching cable gauge and length to support balanced current sharing, unless an approved system design specifies otherwise.
- Use appropriately sized overcurrent protection for the battery bank and connected equipment.
- Confirm that the battery model is approved for the intended number of batteries in parallel.

MAKING A PARALLEL CONNECTION

Connect positive (+) terminals together and negative (–) terminals together.

The battery bank's main positive and negative connections should be arranged to promote balanced current sharing across all batteries. Follow an approved wiring arrangement for the specific battery-bank configuration.

Balanced cabling helps prevent one battery from supplying or receiving significantly more current than the others.

For larger or higher-current battery banks, appropriately rated positive and negative bus bars may provide a more balanced connection method.

Use appropriately rated fuses or circuit breakers for each battery branch as required by the system design and applicable electrical standards. Locate overcurrent protection as close to the positive battery connection as practical.



PARALLEL CONNECTION - 12V

**Illustration shows basic electrical connections only. Required circuit protection and installation details are not shown.*

CURRENT SHARING

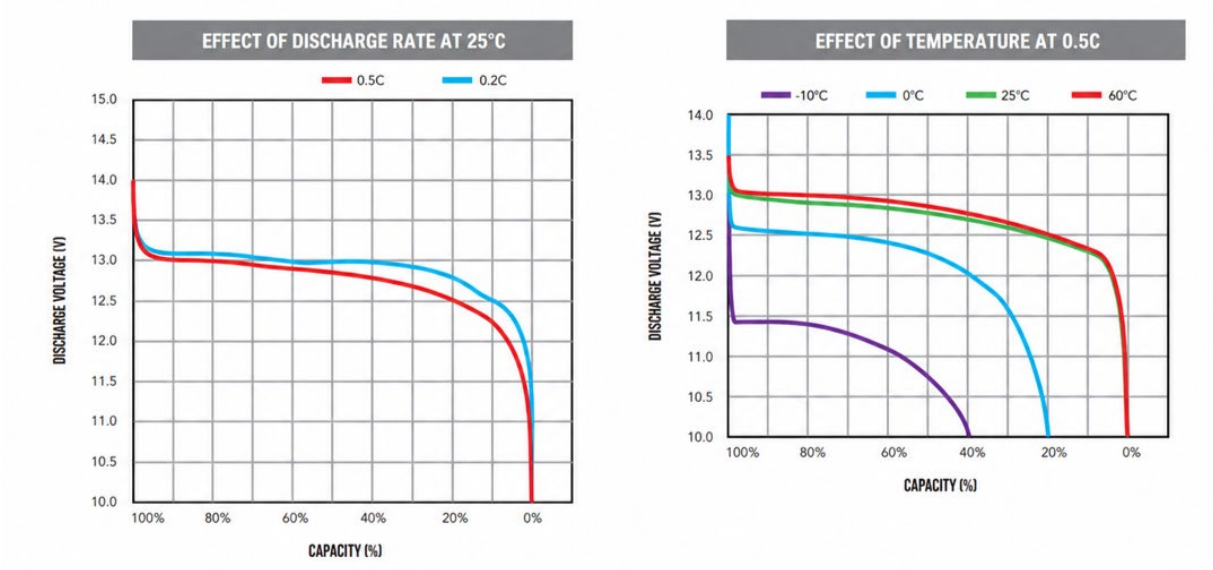
Cable resistance affects how current is distributed within a parallel battery bank. Using equal or similar cable lengths and conductor sizes helps the batteries share charging and discharging current more evenly.

Avoid connecting both the bank's main positive and main negative leads to the same battery when using a simple daisy-chain configuration. This can cause the closest battery to carry more current than the batteries farther away.

6 | TECHNICAL REFERENCE

TYPICAL LIFEPO4 DISCHARGE CURVES

LiFePO4 batteries typically maintain a relatively flat voltage through much of the discharge cycle, then drop more quickly near the end of available capacity. Because of this flat voltage profile, voltage alone is not a precise indicator of remaining state of charge. A battery monitor that tracks amp-hours or energy used can provide a more useful estimate.



Typical LiFePO4 discharge curves are shown for illustration only. Actual performance varies by battery model, cell design, discharge rate, temperature, age, and other conditions. These curves are not specifications or approved operating-temperature limits for every Dakota Lithium battery.

CHECKING BATTERY VOLTAGE

Measuring battery voltage can help confirm that a battery is receiving charge, identify differences between batteries in a series bank, and assist with troubleshooting a possible BMS protective shutdown.

Set the multimeter to DC voltage. Place the red probe on the positive (+) terminal and the black probe on the negative (–) terminal. *A negative reading generally indicates the probes are reversed.*

WARNING: Take care not to allow the meter probes or other conductive tools to bridge the battery terminals, which can create a short circuit.

7 | TROUBLESHOOTING

Many battery issues are caused by wiring, charging equipment, protection devices, or connected loads rather than the battery itself. Start with the simplest checks first and work through the steps below in order.

Before troubleshooting, disconnect unnecessary loads and inspect the battery, charger, wiring, polarity, connectors, fuses or circuit breakers, and connected equipment. Confirm that all components are compatible with the battery and system voltage.

If the battery is visibly damaged, unusually hot, swollen, leaking, or otherwise compromised, stop troubleshooting and discontinue use.

WARNING: Before performing electrical measurements or repairs, safely isolate connected charging sources and electrical loads according to the equipment manufacturers' instructions. This may include disconnecting AC power, disabling inverter/charger equipment, and isolating solar or other charging sources. Batteries may remain electrically energized even when connected equipment is switched off. Electrical troubleshooting and repairs should be performed by qualified personnel using appropriate safety precautions.

BATTERY WILL NOT CHARGE OR PROVIDE OUTPUT

CHECK: Disconnect the load and measure battery voltage. Verify charger output, polarity, connections, fuses or circuit breakers, and wiring. If the battery shows little or no output voltage, the BMS may be in a protective state.

ACTION: Correct any short circuit, overload, low-voltage, or temperature condition before attempting to restore operation. After the cause is corrected, connect a compatible charger. Some BMS protective states may reset when charging begins. If the battery remains unresponsive or shows signs of damage, discontinue use and contact Dakota Lithium support.

CHARGER WILL NOT POWER ON OR BEGIN CHARGING

CHECK: Confirm that the AC power source is working and the charger is connected correctly. Verify charger-to-battery polarity, connector contact, battery voltage, and charger compatibility. Where permitted by the charger manufacturer, verify charger output using the specified testing procedure. Note that some lithium chargers may not begin charging or provide measurable output if the battery voltage is outside their detection range or the BMS is in protection.

ACTION: Correct any polarity or connection issues and reconnect the charger. Confirm that the charger is configured for the correct battery chemistry and system voltage. If the charger appears damaged or still will not begin charging after completing the manufacturer's recommended checks, follow the charger manufacturer's troubleshooting instructions.

BATTERY WAS SHORT-CIRCUITED

CHECK: If it is safe to do so, disconnect the load or source. Inspect the battery, terminals, cables, and connectors for excessive heat, discoloration, melting, or other damage.

ACTION: A short circuit may cause the BMS to enter a protective state. Correct the short before attempting to restore operation. If no damage is present, connecting a compatible charger may restore operation on some battery models. Do not charge or operate a damaged battery.

SERIES-CONNECTED BANK STOPPED WORKING

CHECK: Measure each battery individually and compare their voltages. Inspect every series interconnect and terminal connection. Confirm that the battery model supports the series configuration and that no lower-voltage load is connected across only one battery or part of the series bank.

ACTION: If one battery is at a significantly different state of charge, disconnect the bank and charge each battery individually with a compatible charger until their states of charge are similar. Correct any connection or unequal-load issue before reconnecting the bank. If one battery will not recover, discontinue use of the bank and contact Dakota Lithium support.

BATTERY SHUTS DOWN IN AN ENGINE OR ALTERNATOR APPLICATION

CHECK: Confirm that the battery is approved for the starting application and, when connected directly to an alternator, for direct alternator charging. Check charging-system voltage and determine the maximum charging current available from the alternator.

ACTION: Charging voltage or current outside the battery’s allowable limits may trigger BMS protection or damage the battery. If alternator output cannot be kept within the battery’s charging limits, use an appropriately sized DC-DC charger or another approved battery configuration.

7 | TROUBLESHOOTING - CONTINUED

TROLLING MOTOR SHUTS OFF AT HIGH POWER

CHECK: Compare the trolling motor's maximum current draw with the battery's published continuous and peak discharge limits. Inspect terminals, connectors, and cables for loose connections, undersized conductors, or excessive resistance.

ACTION: Correct any connection or wiring issues. If the motor's current demand exceeds the battery's allowable discharge current, use a battery or battery-bank configuration sized for the required load.

BATTERY DOES NOT FULLY CHARGE WITH AN EXISTING CHARGER

CHECK: Confirm that the charger or charging source is configured for the battery chemistry and nominal voltage. Some charging equipment may indicate that charging is complete while using a voltage profile that does not fully charge the battery.

ACTION: Use a lithium-compatible charging profile that remains within the battery's published voltage and current limits. Disable equalization, desulfation, or other charging modes that are not appropriate for the battery.

If troubleshooting does not resolve the issue, stop using the battery and contact Dakota Lithium support at support@dakotalithium.com

DAKOTA LITHIUM

DakotaLithium.com

support@dakotalithium.com

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