

DAKOTA LITHIUM

DASHBOARD

USER MANUAL

CE, Rohs, ISO9001:2015



RENEWABLE POWER

support@dakotalithium.com

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Thanks for selecting the Dakota Lithium Dashboard solar charge controller. Please take the time to read this user manual, as it will help you to take full advantage of the controller when combined with your solar charging system. This manual gives important recommendations for installing, use, and so on. Please read carefully and pay attention to all safety recommendations.

1, Safety instructions and waiver of liability

1.1 Safety Instructions

The following symbols are used throughout this manual to indicate potentially dangerous conditions or mark important safety instructions. Please take care you see these symbols.



WARNING: Indicates a potentially dangerous condition. Use extreme caution when performing this task.



CAUTION: Indicates a critical procedure for safe and proper operation of the controller.



CAUTION:

- 1) There are no user serviceable parts inside the controller. Do not disassemble or attempt to repair the controller.
- 2) Keep children away from batteries and the charge controller.

1.2 Liability Exclusion

The manufacturer shall not be liable for damages, especially on the battery, caused by use other than as intended or as mentioned in this manual or if the recommendations of the battery manufacturer are neglected. The manufacturer shall not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation, or bad system design.

2, Overview

The Dakota Lithium Dashboard is a fully automatic battery charger which converts power from photovoltaic(PV) array to a regulated battery voltage, widely used in yacht, RV household solar energy system and other fields.

It comes with a number of outstanding features, such as:

- Smart PWM technology, high efficiency
- Backlit LCD displaying system operating information and error codes
- LCD display design, read operating data and working condition easily.
- LED Bar for easy to read charge state and battery information
- 7 Battery Type Compatible Lithium-ion, LiFePO4, LTO, Gel, AGM, WET, and Calcium
- Waterproof design, suitable for indoor or outdoor use
- Support Android mobile phone APP, realize wireless monitoring function of solar controller
- Use high performance, ultra-low power consumption Bluetooth dedicated chip
- Adopt Bluetooth 4.2 and BLE technology, communication distance up to 10m
- Real-time automatic fault alarm
- External temperature sensor optional, automatic temperature compensation
- Built-in temperature sensor, when the temperature exceeds the set value, the charging current will lower down followed by the decrease of temperature, so as to control the controller's temperature rise
- Four stages charge way: Fast, boost, equalization, float
- With current-limiting charging mode, when the power of solar panel is over-sized and charging current exceeds the rated current($\leq 60\%$ of rated current), the controller will lower the charging power, which enables the system to work under the rated charging current
- Perfect EMC & thermal design
- Full automatic electronic protect function

3, PWM Technology

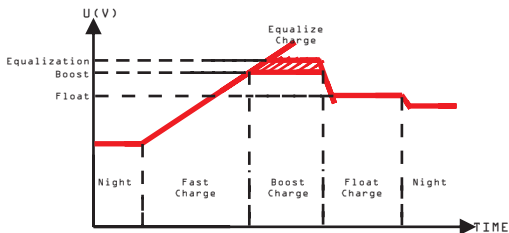
3.1 PWM Introduction

The Dakota Lithium Dashboard utilizes pulse width modulation (PWM) technology for battery charging. The characteristic of solar controller is to adjust the working voltage of solar panels intelligently, so that solar panels always work at the maximum power point of V-A characteristic curve. Battery charging is based on the current process, so controlling the current will control the battery voltage. The charging mode of PWM solar controller has three stages: boost, equalization and float charging, the battery is required to be controlled by specified voltage regulation set points for boost, Float, and Equalization charging stages.

The charge controller uses automatic duty cycle conversion, creating pulses of current to charge the battery. The duty cycle is proportional to the difference between the sensed battery voltage and the specified voltage regulation set point. Once the battery reached the specified voltage range, pulse current charging mode allows the battery to react and allows for an acceptable rate of charge for the battery level.

3.2 Four Charging Stages

The Dashboard has a 4-stage battery charging algorithm for rapid, efficient, and safe battery



Fast Charge

In this stage, the battery voltage has not yet reached boost voltage and 100% of available solar power is used to recharge the battery.

Boost Charge

When the battery has recharged to the Boost voltage setpoint, constant-voltage regulation is used to prevent heating and excessive battery gassing. The Boost stage remains 120 minutes and then goes to Float Charge. Every time when the controller is powered on, if it detects neither over discharged nor overvoltage, the charging will enter into boost charging stage.

Float Charge

After the Boost voltage stage, the controller will reduce the battery voltage to Float voltage setpoint. When the battery is fully recharged, there will be no more chemical reactions and all the charge current transmits into heat and gas at this time. Then the controller reduces the voltage to the floating stage, charging with a smaller voltage and current. It will reduce the temperature of battery and prevent the gassing, also charging the battery slightly at the same time. The purpose of Float stage is to offset the power consumption caused by self consumption and small loads in the whole system, while maintaining full battery storage capacity.

Equalization Charge

Certain types of batteries benefit from periodic equalizing charge, which can stir the electrolyte, balance battery voltage and complete chemical reaction. Equalizing charge increases the battery voltage, higher than the standard complement voltage, which gasifies the battery electrolyte. If it detects that the battery is being over discharged, the solar controller will automatically turn the battery to equalization charging stage, and the equalization charging will be 120minutes. Equalizing charge and boost charge are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of battery.



Only for WET or Calcium batteries drained below 12.1V will automatically run this stage and bring the internal cells as an equal state and fully complement the loss of capacity. Lithium-ion, LiFePO4, LTO, Gel and AGM do not undergo this stage.



WARNING: Risk of explosion!

Equalizing flooded battery can produce explosive gases, so well ventilation of battery box is necessary.



WARNING: Incorrect battery type setting may damage your battery.

3.3 Charging Voltage

| Battery Type | AGM | GEL | WET | Calcium | LiFePO4 | Li-ion | LTO |
|--------------------------|--|-------|-------|---------|---------|--------|-------|
| Fast Voltage | 9.0V~14.0V, Current = Rated Charge Current | | | | | | |
| Boost Voltage *1 | 14.4V | 14.1V | 14.7V | 14.9V | 14.4V | 12.6V | 14.0V |
| Equalization Voltage *2 | N/A | N/A | 15.0V | 15.0V | N/A | N/A | N/A |
| Float Voltage | 13.6V | 13.6V | 13.6V | 13.6V | N/A | N/A | N/A |
| Under Voltage Recharging | 12.5V | 12.5V | 12.5V | 12.5V | 14.2V | 12.4V | 13.8V |
| Low Voltage Disconnect | 11.0V | 10.8V | 11.0V | 11.0V | 10.4V | 9.0V | 10.0V |
| Over Voltage Protection | 15.8V | 15.8V | 15.8V | 15.8V | 14.6V | 12.8V | 14.2V |

*1. For LiFePO4, Li-ion and LTO battery, the constant voltage time is 1 Hour.

For AGM, GEL, WET and Calcium battery, the maximum constant voltage time is 2 Hours, If charging current < 0.5A and holds for 1min, the charging state will end.

*2. Only WET and Calcium batteries have equalization charging stage, 2 hours maximum.

Conditions for entering the equalization charging stage: If the battery voltage discharge below 12.1V or without equalization charging stage for 30 days.

4, Optional Component

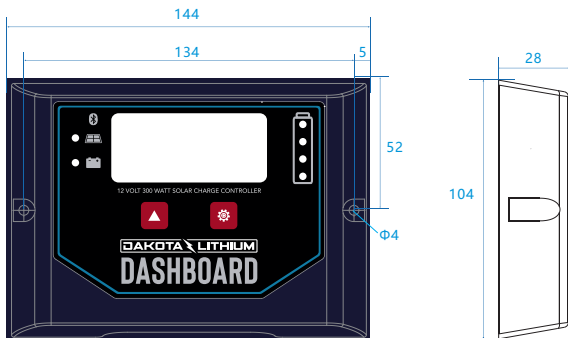
The Dakota Lithium Dashboard is shipped with a temperature sensor of length 80mm. If you need other components you need to purchase separately.

Temperature Sensor

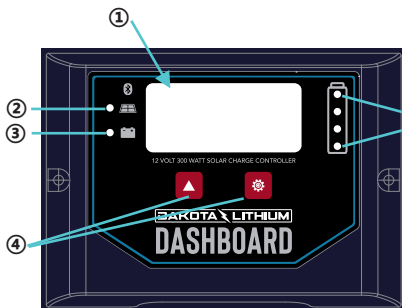
Measures the temperature at the battery and uses this data for very accurate temperature compensation. The sensor is supplied with a 3m cable length that connects to the charge controller. The temperature sensor connected via interface 6.

If the external temperature sensor is not connected or damaged, the internal temperature will be used for temperature compensation during charging.

5, Dimensions(mm)



6, Structure



- ① Backlit LCD
—Display system operating information
- ② Solar panel indicator
—Indicating the working state of solar panel
- ③ Battery indicator
—Indicating the working state of battery

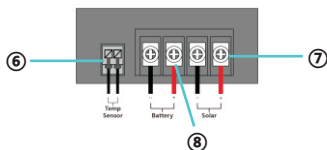
④ Key: ▲ ⚙
Set and view the operating parameters

⑤ Battery capacity indicator
—Display current capacity of battery

⑥ Temperature Sensor Port
—Collect temperature information, Temperature compensation. To connect -press down the top square and insert wire. Repeat for the second.

⑦ Solar module terminals
—Connected solar modules.

⑧ Battery terminals
—Connect the battery.



7, Installation



CAUTION: Please read all instructions and precautions in the manual before installing! It is recommended to remove the acrylic protective film covering the LCD screen before installation.

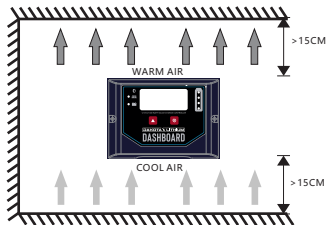
7.1 Installation Notes

- (1)The solar charge controller may only be used in PV systems in accordance with this user manual and the specifications of other modules manufacturers. No energy source other than a solar generator may be connected to the solar charge controller.
- (2)Before wiring installation and adjustment of controller, Always disconnect the solar modules and insurance or circuit breaker of battery terminal.
- (3)Only to comply with the range of the battery charge controller.
- (4)Batteries store a large amount of energy, never short circuit a battery under all circumstances. We strongly recommend connecting a fuse directly to the battery to avoid any short circuit at the battery wiring.
- (5)Batteries can produce flammable gases. Avoid making sparks, using fire or any naked flame. Make sure that the battery room is ventilated.
- (6)Uses insulated tools and avoid placing metal objects near the batteries.
- (7)Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.
- (8)Avoid touching or short circuiting wires or terminals. Be aware that the voltages on special terminals or wires can be as much as twice the battery voltage. Use isolated tools, stand on dry ground, and keep your hands dry.
- (9)Refer to the technical specifications for max wire sizes on the controller and for the maximum amperage going through wires.
- (10)After installation check that all connections are tight line, avoid heat accumulation caused by virtual access danger.

7.2 Mounting Location Requirements

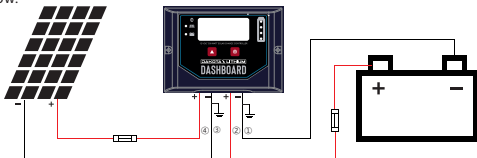
Do not subject the solar charge controller to direct sunshine or other sources of heat. Protect the solar charge controller from dirt and moisture. Mount upright on the wall on a non-flammable substrate. Maintain a minimum clearance of 15cm below and around the device to ensure unhindered air circulation. Mount the solar charge controller as close as possible to the batteries.

Mark the position of the solar charge controller fastening holes on the wall, drill 2 holes and insert dowels, fasten the solar charge controller to the wall with the cable openings facing downwards.



7.3 Connection

Solar PV modules create current whenever light strikes them. The current created varies with the light intensity, but even in the case of low levels of light, full voltage is given by the modules. So, protect the solar modules from incident light during installation. Never touch uninsulated cable ends, use only insulated tools, and make sure that the wire diameter is in accordance with the expected currents of solar charge controller. Connections must always be made in the sequence described below.



WARNING: Risk of electric shock! Exercise caution when handling solar wiring. The solar PV array can produce open-circuit voltages in excess of 100V when in sunlight. Pay more attention to it.



WARNING: Risk of explosion! Once the battery's positive and negative terminals or leads that connect to the two terminals get short-circuited, a fire or explosion will occur. Always be careful in operation.



Fusing is a recommendation in PV systems to provide a safety measure for connections going from panel to controller and controller to battery. Remember to always use the recommended wire gauge sized based on the PV system and the controller.

| | | |
|-------------------------------------|----------|----------|
| Cable total length one-way distance | <3m | 3m~6m |
| Cable wires(AWG) | 14~12AWG | 12~10AWG |

The wire size is only for reference. If there is a long distance between the PV array and the controller or between the controller and the battery, larger wires can be used to reduce the voltage drop and improve performance.

1st step: Connect the battery

Connect the battery connection cable with the correct polarity to the battery terminals on the solar charge controller (with the battery symbol). If the polarity is correct, the LCD on the controller will begin to show.

2nd step: Connect the solar module

Ensure that the solar module is protected from incident light. Ensure that the solar module does not exceed the maximum permissible input current. Connect the solar module connection cable to the correct polarity of the solar terminals on the solar charge controller (with the solar module symbol).


3rd step: Final work

Tighten all cables connected to the controller and remove all the debris around the controller (leaving a space of approx. 15 cm).

7.4 Grounding

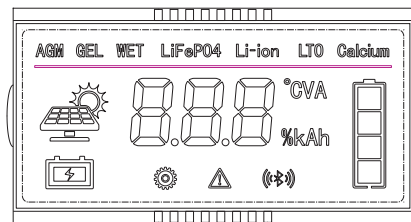
Be aware that the negative terminals of controller are connected together and therefore have the same electrical potential. If any grounding is required, always do this on the negative wires.



CAUTION: For common-negative system, such as motorhome, it is recommended to use a common-negative controller; but if in the common-negative system, some common-positive equipment are used, and the positive electrode is grounded, the controller may be damaged. 

8, Operation

8.1 LCD Display









8.1.1 Status Description

| Icon | Status |
|--|-------------------------------|
| | Daytime |
| | Battery connected |
| | Battery capacity |
| 12.8 V | Battery voltage |
| 10.0 A | Charging current |
| 25 °C | Temperature |
| 99 % | Battery state of charge(in %) |
| 200 Ah | The total charge ampere hours |
| AGM GEL WET LiFePO4 Li-ion LTO Calcium | Battery type |
| | Bluetooth function |
| | Bluetooth connected |
| | Setting icon(Not used) |
| | Fault indication, see 8.1.2 |

The total charge ampere hours are off after power failure.

8.1.2 Fault indication

| Status | Icon | Description |
|------------------|--|--|
| Low voltage |  E1  | Battery level shows empty, fault icon display, battery frame flashes, the LCD screen displays E1 |
| Over voltage |  E2  | Battery level shows full, fault icon display, battery frame flashes, the LCD screen displays E2 |
| Over temperature |  E3  | fault icon display, icon °C flashing, the LCD screen displays E3 |

8.2 Key function



8.2.1 Browse interface

Short press the ▲ key will browse in sequence through the following display parameters: Battery Voltage, Charging Current, Battery Temperature, Battery Capacity and Charged Capacity (Amp-hour).

Normal Sequencing Display



8.2.2 Static display

Press the ▲ key for 1s, the LCD screen will lock the interface. Press the ▲ key again for 1s, the LCD interface will unlock and start scrolling.

8.2.3 Selecting battery type



The Dakota Lithium Dashboard provides 7 battery types for selection: Lithium-ion, LiFePO4, LTO, Gel, AGM, WET, and Calcium Battery.

Short press the ⚙ key to go into battery selection mode. Press the ▲ key until the desired battery is displayed. Short press the ▲ key again the battery type will be saved. If the ▲ key is not pressed during the battery type flashing, the selected battery type will not be saved.



WARNING: Incorrect battery type setting may damage your battery. Please check your battery manufacturer's specifications to when selecting battery type.

8.3 Bluetooth

If the solar charge controller has this icon , it means that the controller has Bluetooth communication function. If the Android phone is connected successfully, this icon  will be displayed.

AGM, GEL, Liquid and Lithium four battery types can be set via Bluetooth mobile phone APP, and the charge voltage can be set.

Please refer to Bluetooth APP instructions for detailed operation of mobile APP.

8.3.1 Charging Voltage Parameters(Liquid, GEL, AGM)

When choosing Liquid, GEL or AGM for battery type, the parameters of boost, equalization and float charge voltage can be set by mobile phone APP. The range of parameters is as follows. The following voltage parameters are 25°C/12V system parameters.

| Charging stage | Boost | Equalization | Float |
|--------------------------|------------|--------------|------------|
| Charging Voltage Range | 14.0~14.8V | 14.0~15.0V | 13.0~14.5V |
| Default charging voltage | 14.5V | 14.8V | 13.7V |

8.3.2 Charging Voltage Parameters(Lithium)

When choosing lithium battery type, the overcharge target and overcharge recovery voltage of lithium battery can be set by mobile phone APP.

Lithium overcharge target(CVT) voltage range: 10.0-17.0V

Lithium overcharge recovery(CVR) voltage setting range: 9.2-16.8V



(Overcharge Recovery Voltage+1.5V) ≥ Lithium Overcharge Protection Voltage ≥ (Overcharge Recovery Voltage+0.2V)
Mobile App does not support parameters beyond this range.



Warning: The required accuracy of BMS shall be at least 0.2V. If the deviation is higher than 0.2V, the manufacturer will assume no liability for any system malfunction caused by this.

8.4 LED Display



| LED | Status | Function |
|---|------------------------------|---|
| Solar LED (Red) | On | Solar panel is correctly connected, but not charged |
| | Flash(0.2/0.2s) | Charging |
| | Off | Night |
| Battery LED (Blue) | On | Battery is normal |
| | Flash(0.2s/0.2s) | Over temperature |
| Battery Capacity LED (Red, Orange, Green, Green) | Soc1 Flash(0.2s/0.2s, Red) | Low voltage protection |
| | Soc4 Flash(0.2s/0.2s, Green) | Over voltage protection |
| | Soc1 On | Battery capacity < 20% |
| | Soc2 On | 20% < Battery capacity < 50% |
| | Soc3 On | 50% < Battery capacity < 90% |
| | Soc4 On | Battery capacity > 90% |

9, Protection, Troubleshooting and maintenance

9.1 Troubleshooting

| Faults | Reason | Troubleshooting |
|---|--------------------------------------|---|
| E1 | Battery voltage is too low | Charging battery. |
| E2 | Battery voltage is too high | Check if other sources overcharge the battery. If not, controller is damaged. |
| E3 | Over temperature | After the temperature decreases, the controller will work normally |
| Battery can't be charged during daytime | PV panel fault or reverse connection | Check panels and connection wires |

9.2 Protection

| Protection | Description |
|-----------------------------|--|
| PV Over Current | When the charging current of the PV array exceeds the controller' s rated current, it will be charged at the rated current. |
| PV Short Circuit | When PV short circuit occurs, the controller will stop charging. Remove it to start normal operation. |
| PV Reverse Polarity | Fully protection against PV reverse polarity, no damage to the controller. Correct the connection to start normal operation. |
| Night Reverse Charging | Prevents the battery from discharging to the PV array at night. |
| Battery Reverse Polarity | Fully protection against battery reverse polarity, no damage to the controller. Correct the connection to start normal operation. |
| Battery Over voltage | If there are other energy sources to charge the battery, the battery voltage may exceeds the rated data, the controller will stop charging to protect the battery from overcharging damage. |
| Battery Over discharge | When battery voltage drops to the setting voltage point of Low Voltage Disconnect ,the controller will alarm. |
| Over Temperature Protection | The controller detects the internal temperature through internal sensor, when the temperature exceeds the setting value, the charging current will lower down followed by the decrease of temperature, so as to control the controller' s temperature rise, when the internal temperature exceeds the setting over temperature protection threshold, the controller stops working and restores after the temperature is lowered. |

9.3 Maintenance

The following inspections and maintenance tasks are recommended at least two times per year for best performance.

- Make sure no block on air-flow around the controller. Clear up any dirt and fragments on radiator.
- Check all the naked wires to make sure insulation is not damaged. Repair or replace some wires if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Check and confirm that LCD is consistent with required. Pay attention to any troubleshooting or error indication .Take corrective action if necessary.
- Confirm that all the system components are ground connected tightly and correctly.
- Confirm that all the terminals have no corrosion, insulation damaged, high temperature or burnt/discolored sign, tighten terminal screws to the suggested torque.
- Check for dirt, nesting insects and corrosion. If so, clear up in time.

10, Technical Data

10.1 Electrical Parameters

| Item | Dakota Lithium Dashboard |
|-----------------------------------|--|
| System Voltage | 12V |
| Max Charging Power | 300W |
| Max volt on Bat. Terminal | 25V |
| Max volt on PV Terminal | 40V |
| Temp. Compensation | -4.17mV/K per cell (Boost, Equalization), -3.33mV/K per cell (Float) |
| Self consumption | <10mA |
| Communication | Bluetooth |
| Grounding | Common Negative |
| Dimensions | 144 * 104 * 28mm |
| Weight | 180g |
| Mounting | Vertical Wall Mounting |
| Mounting dimensions | 134 * 52mm |
| Mounting hole size | φ4mm |
| Maximum Terminals Wire Size | 10AWG(4mm ²) |
| Ambient temperature | -20 ~ +55°C |
| Storage temperature | -25 ~ +80°C |
| Ambient humidity | 0 ~ 100%RH |
| Protection degree | IP65 |
| Max Altitude | 4000m |
| Electrical Protection and Feature | Spark-free Protection. Reverse polarity solar and battery connection. Reverse current from battery to solar panel protection at night Over temperature protection with derating charging current Transient overvoltage protection at solar input and battery output protects against surge voltage |

10.2 Charging Parameters

10.2.1 Default battery Parameters

| Battery Type | AGM | GEL | WET | Calcium | LiFePO4 | Li-ion | LTO |
|--------------------------|--|-------|-------|---------|---------|--------|-------|
| Fast Voltage | 9.0V~14.0V, Current = Rated Charge Current | | | | | | |
| Boost Voltage *1 | 14.4V | 14.1V | 14.7V | 14.9V | 14.4V | 12.6V | 14.0V |
| Equalization Voltage *2 | N/A | N/A | 15.0V | 15.0V | N/A | N/A | N/A |
| Float Voltage | 13.6V | 13.6V | 13.6V | 13.6V | N/A | N/A | N/A |
| Under Voltage Recharging | 12.5V | 12.5V | 12.5V | 12.5V | 14.2V | 12.4V | 13.8V |
| Low Voltage Disconnect | 11.0V | 10.8V | 11.0V | 11.0V | 10.4V | 9.0V | 10.0V |
| Over Voltage Protection | 15.8V | 15.8V | 15.8V | 15.8V | 14.6V | 12.8V | 14.2V |

10.2.2 Battery Parameters can be set

| Battery Type | AGM | GEL | Liquid | Lithium |
|--------------------------|--|------------|------------|------------|
| Fast Voltage | 9.0V~14.0V, Current = Rated Charge Current | | | |
| Boost Voltage *1 | 14.0~14.8V | 14.0~14.8V | 14.0~14.8V | 10.0~17.0V |
| Equalization Voltage *2 | N/A | N/A | 14.0~15.0V | N/A |
| Float Voltage | 13.0~14.5V | 13.0~14.5V | 13.0~14.5V | N/A |
| Under Voltage Recharging | 12.5V | 12.5V | 12.5V | 9.2~16.8V |
| Low Voltage Disconnect | 10.8~11.8V | 10.8~11.8V | 10.8~11.8V | 8.0~15.0V |
| Over Voltage Protection | 15.8V | 15.8V | 15.8V | 10.2~17.2V |

*1. For LiFePO4, Li-ion, LTO and Lithium battery, the constant voltage time is 1 Hour.
For Liquid, AGM, GEL, WET and Calcium battery, the maximum constant voltage time is 2 Hours,
If charging current < 0.5A and holds for 1min, the charging state will end.

*2. Only Liquid, WET and Calcium batteries have equalization charging stage, 2 hours maximum.
Conditions for entering the equalization charging stage: If the battery voltage discharge below 12.1V or without equalization charging stage for 30 days.

*3. This parameters are in the 12V system at 25°C.