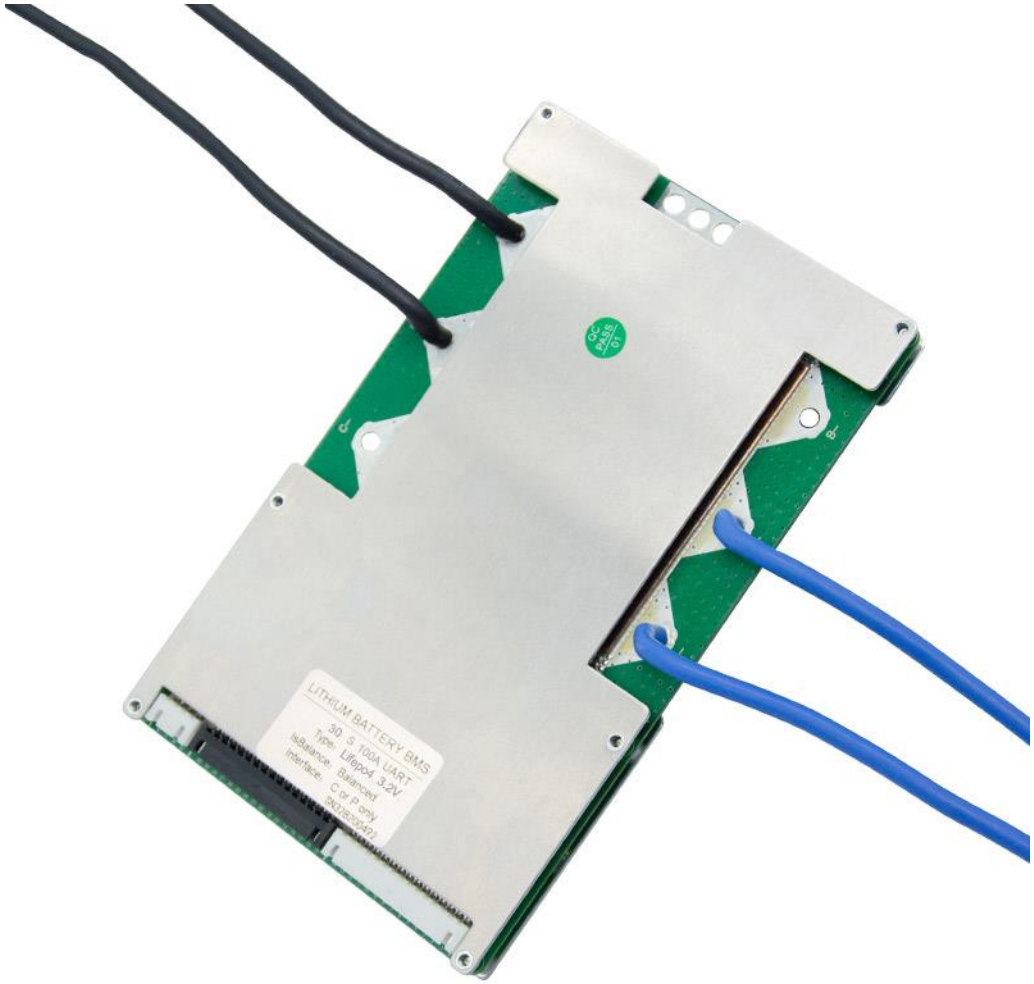
JBD BMS Instruction Manual



Version: 0.2.5

Supported BMS Models:

- JBD-SP04S020 (120A 4s 12V)
- JBD-SP10S009 (100A 8s 24V)
- JBD-SP25S003 (100A 16s 48V) **Date:** June 16, 2021

1.1.1 Discharge over current 21

1.1.2 Charge over temperature 21

Contents

1. Introduction 3
1.1 What is a BMS 3
2. BMS Parameters 3
2.1 Protection Parameters 3
2.1.1 Cell over voltage 3
2.1.2 Cell under voltage 4
2.1.3 Battery over voltage 4
2.1.4 Battery under voltage 5
2.1.5 Charge over current 5
2.1.6 Discharge over current 6
2.1.7 Charge over temperature 6
2.1.8 Charge under temperature 6
2.1.9 Discharge over temperature 6
2.1.10 Discharge under temperature 6
2.1.10 Hardware Protection Parameters 6
2.2 Capacity Parameters 7
2.2.1 Designed Capacity 7
2.2.2 Cycle Capacity 8
2.2.3 Full Charge Voltage 8
2.2.4 End of Discharge Voltage 8
2.2.6 80%, 60%, 40%, 20% Capacity Voltage Levels 8
2.3 Balance Parameters 9
2.3.1 Start Voltage 9
2.3.2 Delta to balance 9
2.3.3 Balancer Enabled 9
2.3.4 Balance only when Charging 9
2.4 Other Parameters / Features 9
2.4.1 Switch 9
2.4.2 Load Detect 9
2.4.4 LED Capacity 9
2.4.5 BMS Name 10
2.4.7 NTC Settings 10
2.4.8 Galvanometer resistance 11
BMS Application Usage 11
XiaoxiangBMS (iPhone) 11
Xiaoxiang (Android) 13
Glossary 16

1. Introduction

1.1 What is a BMS

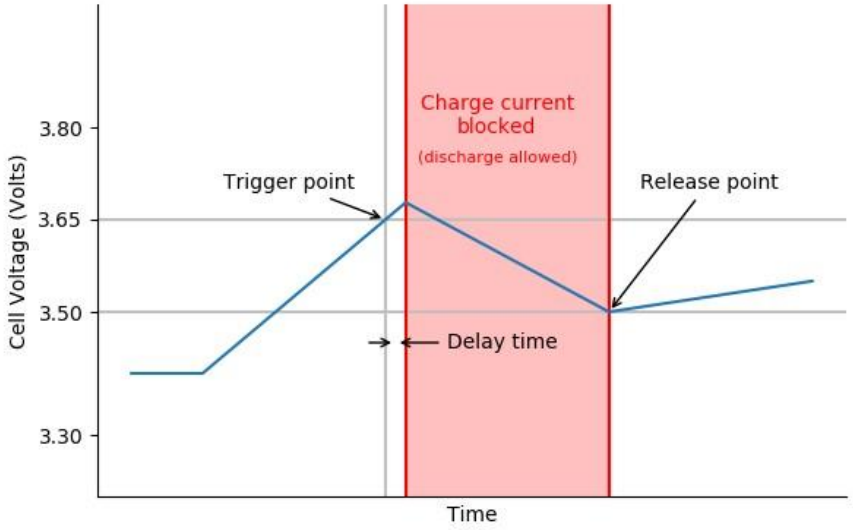
A battery management system, or BMS, is an electronic device that protects and manages rechargeable battery cells.

2. BMS Parameters

2.1 Protection Parameters

2.1.1 Cell over voltage

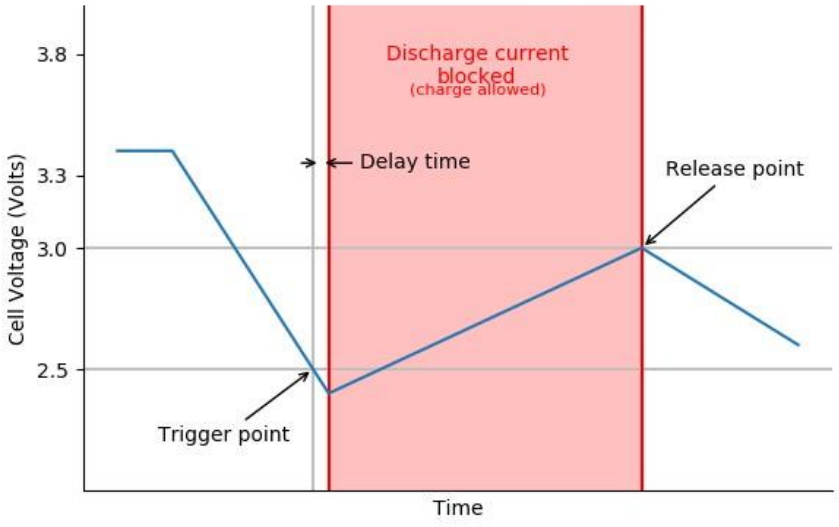
Disconnects charging current if any cell voltage goes over the Trigger value.
Reconnects when all cells drop below the Release value.



Cell Over-Voltage Protection

2.1.2 Cell under voltage

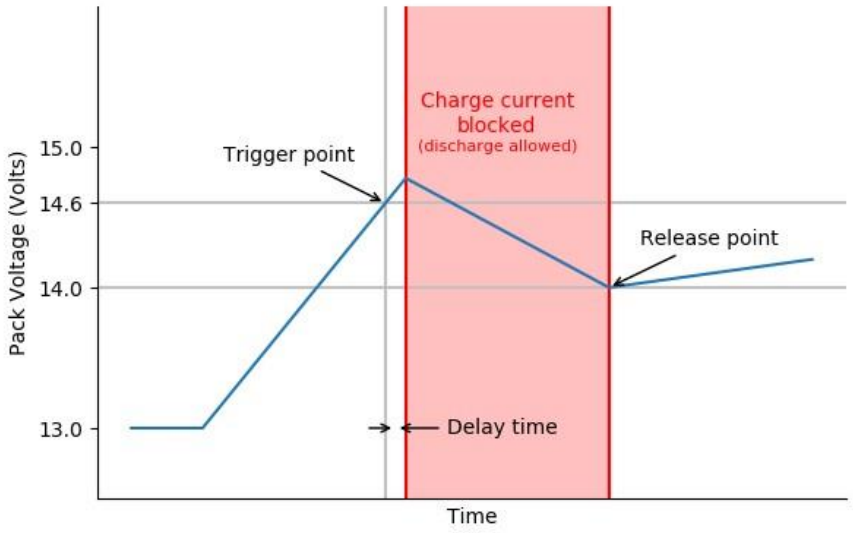
Cuts off discharging current if any cell voltage goes under the Trigger value.
Reconnects when all cells rise above the Release value.



Cell Under-Voltage Protection

2.1.3 Battery over voltage

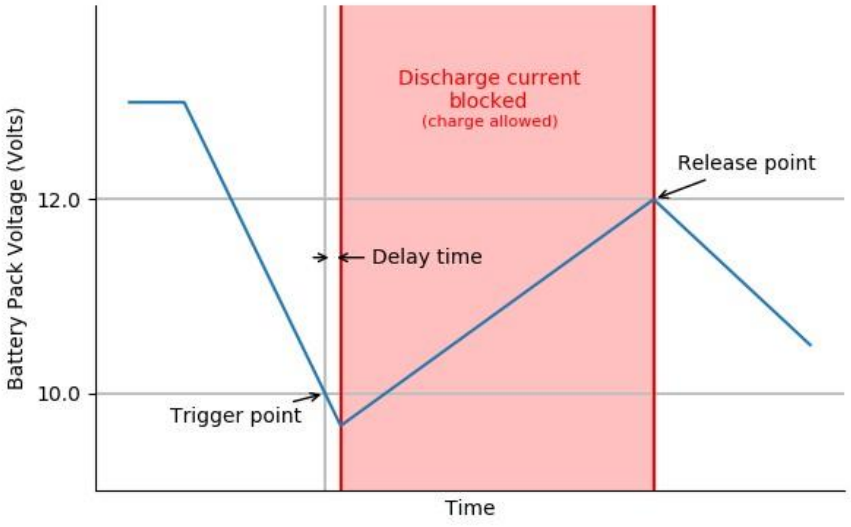
Cuts off charging current if entire pack goes over the Trigger value.
Reconnects when pack drops below the Release value.



Battery Pack Over-Voltage Protection

2.1.4 Battery under voltage

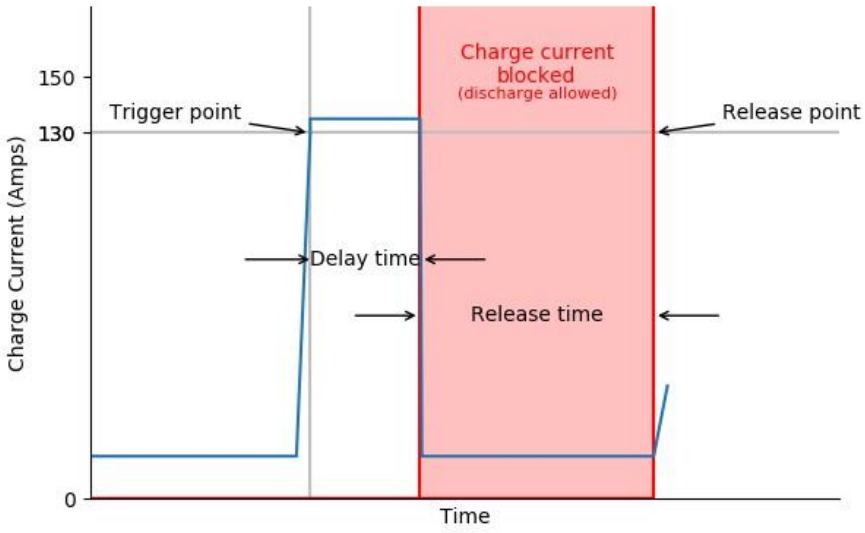
Cuts off discharging current if entire pack falls under the Trigger value.
Reconnects when pack rises above the Release value.



Battery Pack Under-Voltage Protection

2.1.5 Charge over current

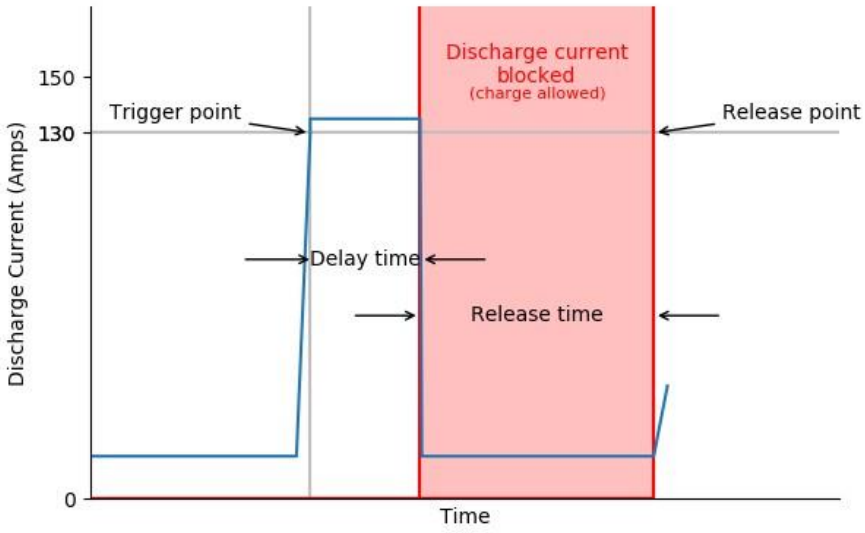
Cuts off charging current if the current exceeds the trigger value, for [delay] seconds.
Reconnects after [release value] seconds.



Charge Over-Current Protection

2.1.6 Discharge over current

Cuts off discharging current if the current exceeds the trigger value, for [delay] seconds.
Reconnects after [release value] seconds.



Discharge Over-Current Protection

2.1.7 Charge over temperature

Cuts off charging current if the probe temperature exceeds the trigger value.
Reconnects after the temp drops below the release value.

2.1.8 Charge under temperature

Cuts off charging current if the probe temp drops below the trigger value.
Reconnects after the probe temp rises above the release value.

2.1.9 Discharge over temperature

Cuts off discharging current if the probe temperature exceeds the trigger value.
Reconnects after the temp drops below the release value.

2.1.10 Discharge under temperature

Cuts off discharging current if the probe temp drops below the trigger value.
Reconnects after the probe temp rises above the release value.

2.1.10 Hardware Protection Parameters

These parameters are the last line of defence between the outside world and your batteries. They will shut off charging and/or discharging if the limits are exceeded. **These settings should never be changed.** Resist the temptation to change them. They were set this way to prevent physical damage to your batteries and BMS.

Note: Hardware parameters are only accessible from the Android and PC app. They are not available from the iPhone app.

2.1.10.1 Hardware Overcurrent Protection

Provides instantaneous inrush current protection. The delay should be no more than a few hundred milliseconds.

Cuts off charging or discharging current if the current exceeds the trigger value for [delay] seconds.

2.1.10.2 Hardware Short circuit Protection

Provides instantaneous short-circuit current protection. The delay should be no more than a few hundred microseconds.

Cuts off charging or discharging current if the current exceeds the trigger value for [delay] seconds. Reconnects after [release delay] seconds.

2.1.10.3 Hardware Overvoltage Protection

Provides a last line of defence against cell over-voltage. This value is set from the factory to be higher than the user parameter cell overvoltage setting. It will prevent damage if the user parameter is set incorrectly.

Disconnects charging current if any cell voltage goes over the Trigger value for [delay] seconds.

2.1.10.4 Hardware Undervoltage Protection

Provides a last line of defence against cell under-voltage. This value is set from the factory to be lower than the user parameter cell under-voltage setting. It will prevent damage if the user parameter is set incorrectly.
Disconnects discharging current if any cell voltage goes under the Trigger value for [delay] seconds.

2.2 Capacity Parameters

These parameters are used to display the battery capacity and to calculate the state of charge..

2.2.1 Designed Capacity

This should be set to the battery pack's capacity, in amp hours (Ah). It is not used to calculate the state of charge. It's simply used when displaying the intended capacity of the cells. The actual capacity of the pack is defined as the *cycle capacity*, which is described in the next section. Designed capacity can be calculated as follows:

Designed capacity=Cell capacity Parallel cell count of pack

NOTE: This parameter is displayed in milliamp hours in the iPhone app.

2.2.2 Cycle Capacity

This parameter is used to calculate state of charge. In the real world, batteries do not meet the designed capacity printed on the cells. It can be higher, if the cell was underrated, or it can be lower (especially true for used or B- or C-grade cells).

Ideally, the capacity of the battery pack should be measured, and the actual number should be programmed into the BMS. Therefore:

Cycle capacity =Actual measured capacity of the pack

There are several ways to measure the pack's total capacity. The easiest way is to set the cycle capacity to hook a known DC load up to the battery, and measure the amount of time it takes from full charge down to cutoff. Ensure that the protection parameters are set before starting. Charge up to 100% (see the section on top-balancing). Note the start time. Record the pack voltage in 15 minute intervals (this info may be used to set the percent capacity voltages, later in this section). Record the time when the BMS protection circuitry cuts off the discharge current.

Cycle capacity = Test load current (A) Total run time (h)

NOTE: This parameter only affects the state of charge. If it is set too low, the state of charge will hit zero percent before the battery is actually at zero percent. The state of charge percentage will never go negative.

2.2.3 Full Charge Voltage

This should be set to the cell's voltage at full charge. This information typically comes from the battery cell's datasheet, but the recommended values in Appendix A may be used.

2.2.4 End of Discharge Voltage

This should be set to the cell's voltage and end of discharge. This information typically comes from the battery cell's datasheet, but the recommended values in Appendix A may be used.

2.2.5 Discharge Rate

Leave this at the default setting.

2.2.6 80%, 60%, 40%, 20% Capacity Voltage Levels

This should be set to the cell's voltage at each of the four indicated state of charge levels. This information typically comes from the battery cell's datasheet, which may involve interpreting the discharge curve graph. However, the recommended values in Appendix A may be used.

2.3 Balance Parameters

2.3.1 Start Voltage

The BMS will not begin its balancing routine until the cell voltage(s) are above this voltage. Typically this parameter should be set towards the top of the battery's voltage curve.

2.3.2 Delta to balance

The BMS will not balance unless the delta exceeds this level. Setting this value too coarse will result in possible cell damage; setting this value too fine will result in the BMS dissipating considerable heat as it attempts to equalize the cell voltages. Recall that the passive balancing circuit works by routing the excess voltage into resistors within the BMS, which converts into heat. This value must be a compromise between those two extremes. Please see the recommended values in Appendix A.

2.3.3 Balancer Enabled

The BMS will only perform its balancing routine if this option is enabled.
There are very few reasons why this would ever be turned off. We recommend keeping it enabled.

2.3.4 Balance only when Charging

When enabled, the balancing routine will only be performed when charging.
When disabled, the BMS will enter Static Balance mode, where it will balance when both charging and discharging.

NOTE: Charging while balancing is usually more effective, because the cell delta is greatest at the top of the charge. We recommend keeping this setting enabled.

2.4 Other Parameters / Features

2.4.1 Switch

When enabled, the discharge FET will be disabled when the optional external switch contact is open. This external switch, if used, must be wired to the 2-pin JST-XH connector on the BMS (see Appendix D1.3). When disabled, the external switch will not be monitored or read.

2.4.2 Load Detect

When enabled, you will need to disconnect the load after a short-circuit before the battery pack can be used again.

2.4.3 LED Enabled

Not applicable. Our BMS does not have the LED populated.

2.4.4 LED Capacity

Not applicable. Our BMS does not have the LED populated.

On BMS modules that have an LED, this would blink the capacity out (e.g., 5 blinks would mean 100% capacity).

2.4.5 BMS Name

Not applicable; has no effect on the behaviour of the BMS. However, if the PIN protect option is used within the iPhone app, it will use the name as a PIN passcode, which could leave you locked out of your BMS. We recommend to leave this alone, and to not use the iPhone app's PIN protect function.

2.4.6 Barcode

Not applicable. This does not affect the operation of the BMS. We recommend to keep it at its default value.

2.4.7 NTC Settings

Leave these at their default setting.

12V BMS:

NTC1 is the internal temperature sensor
NTC2 is the external temperature sensor that is to be taped to the battery cells

24V BMS:

NTC1 and NTC2 are external temperature sensors that are to be taped to the battery cells. Note that the 24V BMS does not have an internal temperature sensor.

48V BMS:

NTC1 is the internal temperature sensor
NTC2*, NTC4, and NTC5 are external temperature sensors that are to be taped to the battery cells. Note that in the xiaioxangBMS iPhone app they're labeled as NTC1-4. Which is confusing. We didn't write the app, but figured we'd pass this info along.

*Some of the 48v 16s BMSs were built with only 2 temperature probes. In this case NTC1, NTC4, and NTC5 should be enabled.

2.4.8 Galvanometer resistance

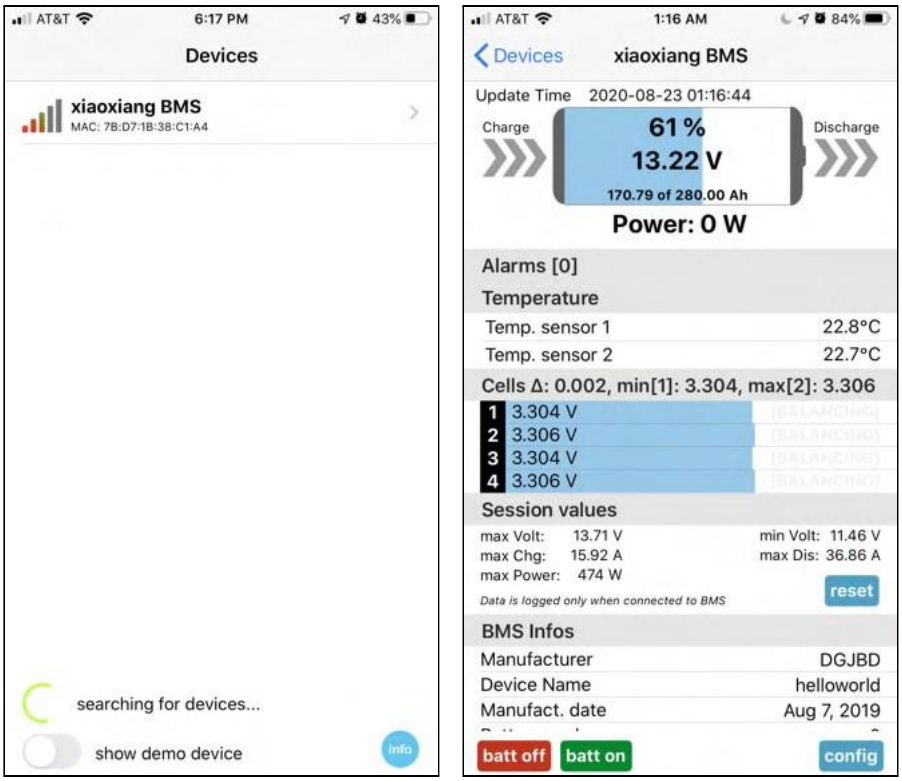
In the context of the BMS, the galvanometer refers to the current sense resistor used to calculate current. A galvanometer is an ammeter that is capable of displaying both the magnitude and direction of measured current. Leave this at its default setting. Do not change. The current sensor resistors used are high-precision, low-tolerance, and therefore will not drift.

Note: This setting is only accessible from the Android and PC app; not the iPhone app.

BMS Application Usage

XiaoxiangBMS (iPhone)

1. Download the iPhone application from the app store. Link: https://apps.apple.com/us/app/xiaoxiang-bms/id1375405426
2. Open the app. Ensure that the phone's Bluetooth has not been disabled (Settings -> Bluetooth -> enable the top Bluetooth radio button)
3. Ensure that your battery pack is fully assembled and operational.
4. The iPhone app communicates via Bluetooth. So ensure that the Bluetooth module is present and plugged in.
5. Open the app. Your BMS should be immediately enumerated in the list of devices found. Click on the device.
6. The basic info for your BMS should now be displayed.



To edit the BMS settings, or to perform BMS calibration, you must purchase the pro version, which at the time of writing, costs £5.99. After purchasing the pro version, the **Config** button can be clicked to bring up the config page.

There are five configuration pages:

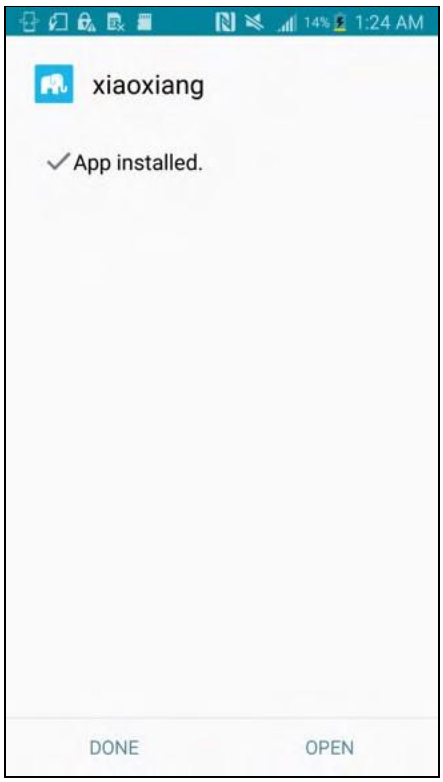
1. **App Settings:** In this screen, you can give each BMS in your system a descriptive name. You can also change the battery temperature display units to Celsius or Fahrenheit.
2. **BMS Settings:** In this screen, you can read and write the BMS settings. To do this, first click the BMS read button. This will populate the page with settings from the BMS. Then, after updating the settings, click BMS write. This will update the BMS. See Appendix A for recommended settings. Settings may also be saved and loaded to a file.
3. **Current Calibration:** In this screen, the charge and discharge current readings can be calibrated.
4. **Voltage Calibration:** In this screen, the idle, charge, and discharge voltage readings can be calibrated.
5. **Notifications:** In this screen, optional notifications may be added. This will send an alert to your phone when something bad happens. However, it will only alert you if the app is running and the BMS is within range of the phone. Which makes it impractical in the real-world.

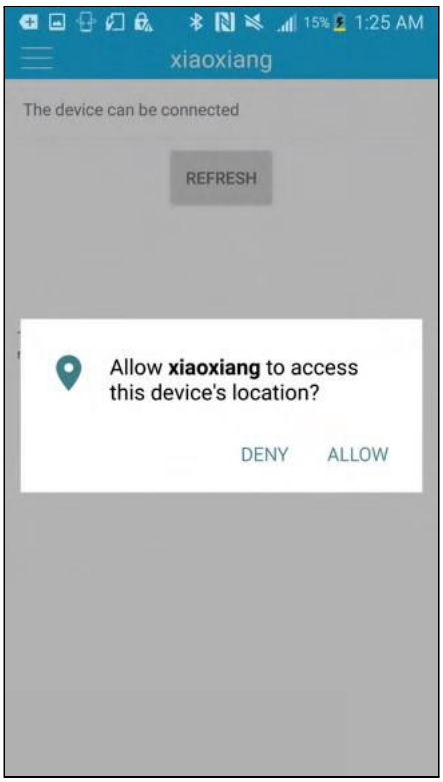
Note that this app supports password protection of parameter settings, even though the actual BMS does not. The app accomplishes this through a clever hack. The password is stored plain-text in the BMS name field, which gets written to the BMS non-volatile memory. The app cross-checks the value stored in the BMS name to the value stored in the app. More information can be found on the app developer's github project.

Xiaoxiang (Android)

This application was provided by the manufacturer of the BMS.

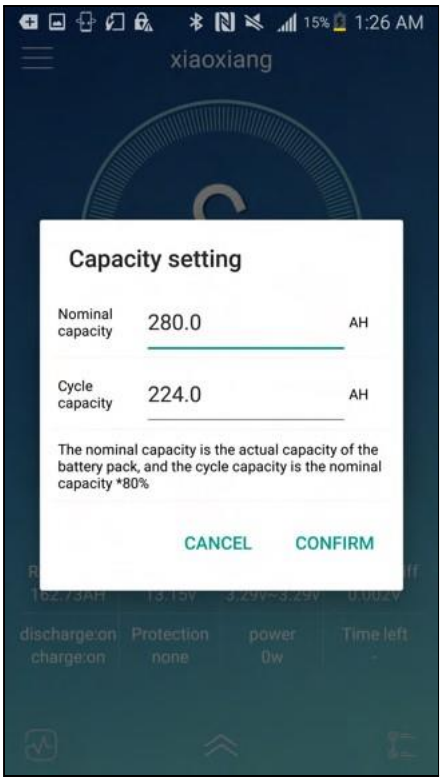
1. Download “Xiaoxiang BMS” from the Google Play Store.
2. Ensure that your battery pack is fully assembled and operational.
3. The Android app communicates via Bluetooth. So ensure that the Bluetooth module is present and plugged in. Note that you must grant the application access to the device’s location. Android requires location access to grant the application access to the Bluetooth device.
4. Your BMS should be immediately enumerated in the list of devices found. Click on the device. Wait momentarily while the app connects to the BMS.
5. The application will display a dialog window that allows the user to set the nominal capacity and the cycle capacity. In the image below, the user customized the capacity to 280 Ah.
6. The application may display another dialog window, asking, “**use GPS to test speed? Yes / No**”. This question is not applicable to JBD BMS (some versions of the BMS from the manufacturer include GPS, as they are intended to be installed in electric scooters). Simply click **No**.
7. The basic info for your BMS should now be displayed.

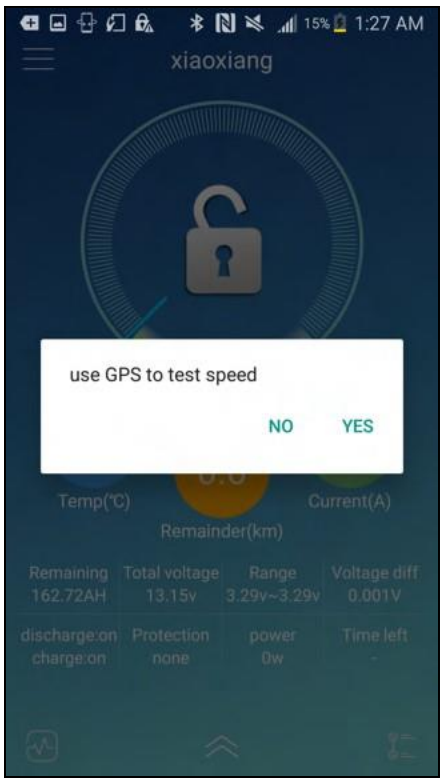


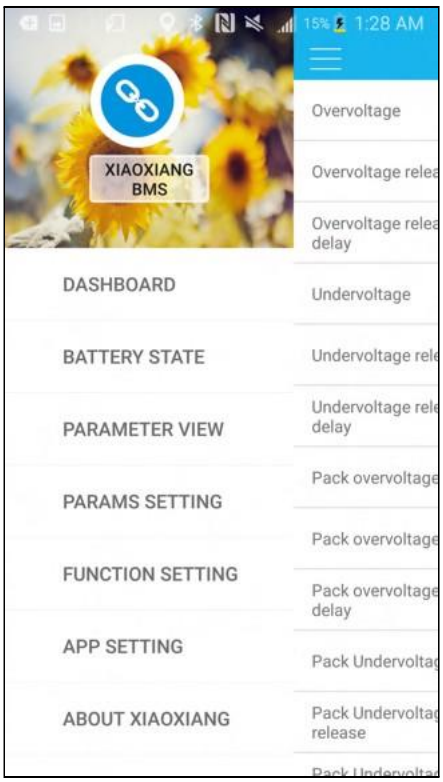


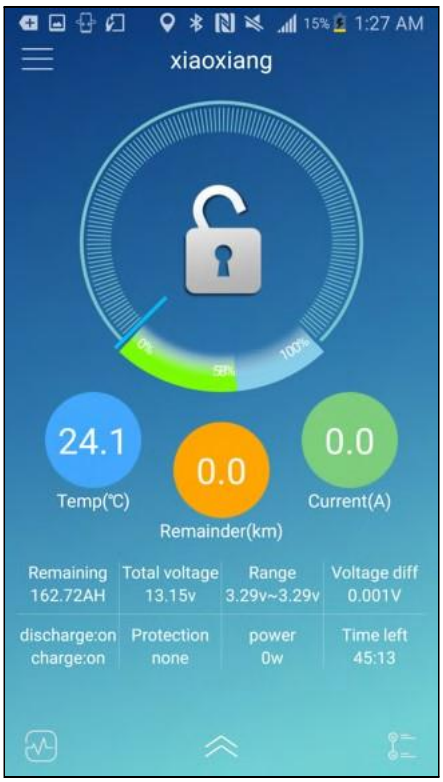
1:26 AM
xiaoxiang
The device can be connected
xiaoxiang BMS
connectable
A4:C1:38:1B:D7:7B
signal:Strong-53
REFRESH
Tip:When close to Bluetooth and refresh many times, but can not be found, you can point the Fix button to reboot bluetooth
FIX

1:26 AM
xiaoxiang
The device can be connected
xiaoxiang BMS
connectable
A4:C1:38:1B:D7:7B
signal:Strong-53
REFRESH
connecting...


1:26 AM
xiaoxiang
Capacity setting
Nominal capacity
280.0
AH
Cycle capacity
224.0
AH
The nominal capacity is the actual capacity of the battery pack, and the cycle capacity is the nominal capacity *80%
CANCEL
CONFIRM

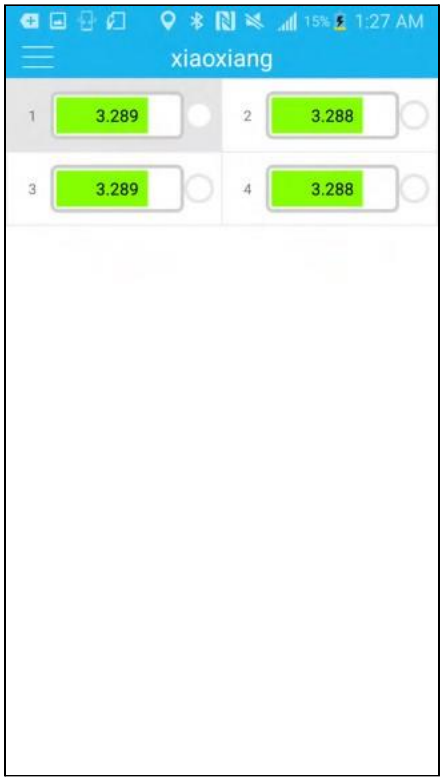

1:27 AM
xiaoxiang
use GPS to test speed
NO
YES
Temp(℃)
Current(A)
Remainder(km)
Remaining
162.72AH
Total voltage
13.15v
Range
3.29v~3.29v
Voltage diff
0.001V
discharge:on
charge:on
Protection
none
power
0w
Time left

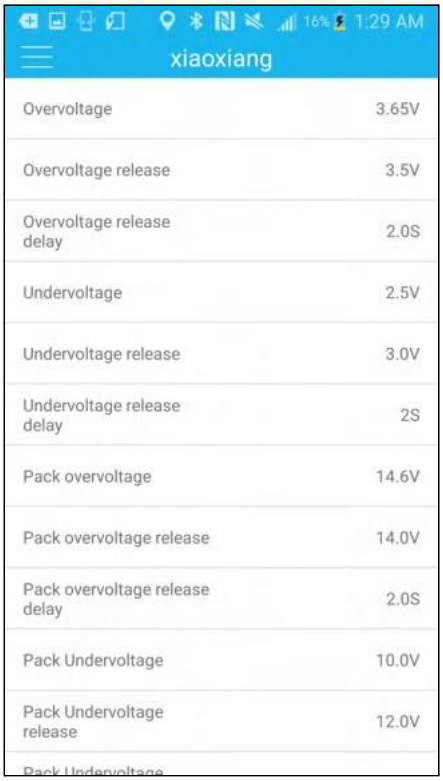

1:28 AM
XIAOXIANG BMS
DASHBOARD
BATTERY STATE
PARAMETER VIEW
PARAMS SETTING
FUNCTION SETTING
APP SETTING
ABOUT XIAOXIANG
Overvoltage
Overvoltage relea
Overvoltage relea delay
Undervoltage
Undervoltage rele
Undervoltage rele delay
Pack overvoltage
Pack overvoltage
Pack overvoltage delay
Pack Undervoltag
Pack Undervoltag release

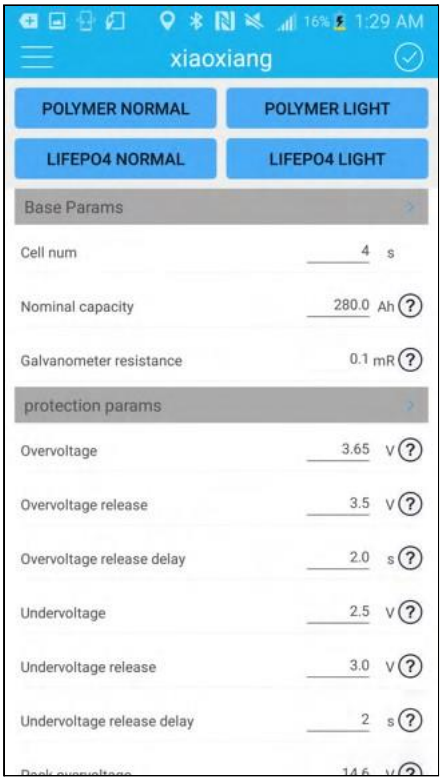

1:27 AM
xiaoxiang
24.1
Temp(℃)
0.0
Remainder(km)
0.0
Current(A)
Remaining
162.72AH
Total voltage
13.15v
Range
3.29v~3.29v
Voltage diff
0.001V
discharge:on
charge:on
Protection
none
power
0w
Time left
45:13

By clicking on the top-right nav icon, you can navigate to the app's sub-pages:

1. **Dashboard:** This navigates back to the main menu
2. **Battery State:** In this screen, you can view individual cell voltages
3. **Parameter View:** In this screen, you can read the BMS settings.
4. **Params Setting:** In this screen, you can read and write the BMS settings.
5. **Function Setting:** In this screen, the general BMS settings, can be set (external switch on/off, load check on/off, balance enable on/off, charge balance on/off, and NTC temp sensors on/off).
6. **App Setting:** asdf
7. **About XiaoXiang:** In this screen, you can view information about the author of this app.







NOTE: Avoid pressing the giant padlock on the main screen. If you touch it, it engages the "mosfet software lock" without confirmation. Then it disappears. To find it again, you must switch the app mode from driving mode to monitor mode and back. Avoid clicking it.

Glossary

AC: Alternating current. In the context of this document, this means wall power (or shore power, in the marine / RV parlance).

Balancing: The process of equalizing the voltages between series cells within a battery pack. This process can be passive (as is the case with our BMS), or active.

BMS: Battery management system.

CC/CV: Constant-current, constant-voltage. This is a topology of power supply with the ability to regulate both current and voltage (though only one of these modes would be activated at a time). The supply will have controls for both, usually knobs, that define the maximum voltage and current. When on, the power supply will be in one of two modes: constant-current, or constant-voltage. Usually the mode will be indicated by LEDs. When in constant-voltage mode, the voltage will be regulated, and the current will vary depending on the load's needs. When in constant-current mode, the current will be regulated, and the voltage may vary depending on the load's needs. These power supplies are typically advertised as lab power supplies, and are typically used during the electronics prototyping process. They're great to have around, and have many uses. Every DIYer should consider having at least one.

Cutoff: A feature of the BMS, which will disconnect the battery from the charger and/or load when an error condition occurs.

Charge: When electric current is flowing into the batteries.

DC: Direct current. Batteries operate on direct current.

Discharge: When electric current is flowing out of the batteries, into the load.

Load: The portion of a circuit which consumes electric power. In this context of this document, a load is typically the items that are being powered by the battery and/or solar panels (e.g. lights, cooking equipment, computers, and phones).

Parallel: In the context of batteries, a parallel circuit is when multiple battery cells are connected with their positive terminals connected together, and their negative terminals connected together. This increases the current capacity of the battery, but not the voltage.

Self discharge: A battery's natural tendency to lose charge over time, even when no load is applied. It is caused by chemical reactions within the positive electrode, negative electrode, and/or the electrolyte.
All rechargeable batteries exhibit this behaviour, although certain chemistries are less susceptible to it. Higher temperatures can accelerate self-discharge.

Series: In the context of batteries, a series circuit is when multiple battery cells are connected in a chain, so each cell's positive terminal is connected to the next cell's negative terminal. This increases the voltage, but not the current capacity.