Record number：EK-16S4EB-S-010

Latest version：V1.01

# Smart Active Balancer

# （EK-16S4EB）

# Operation Instruction

Shenzhen Enerkey BMS Power Technology Co., LTD

# Product warranty terms

**Product model:** Smart Active Balancer

**Warranty period :** One year

Firstly, thank you for purchasing the Smart Active Balance from Jingwei Power Technology Co., LTD. Our company provides quality warranty for hardware products and accessories sold by our company,

with the warranty period as shown above. If there is a malfunction due to quality reasons during the warranty period, the company has the right to choose to repair or replace the entire product after receiving notification of the product malfunction and conducting inspection and verification. The complete replacement product can be new or nearly new.

1. Shenzhen Jingwei power technology Co.,Ltd. guarantees that the products have been fully tested.
2. Jinwei Power does not guarantee uninterrupted use of the product during the repair process.But the company should ensure that the faulty product is repaired within a reasonable period of time.
3. The product warranty period starts from the date of shipment or the date of installation by Shenzhen Jinwei Power Technology Co., Ltd. If the installation of the company's products is not started within 30 days after the date of shipment due to user schedule or delay, the product warranty period shall be calculated from the 31st day after the date of shipment.
4. Shenzhen Jinwei Power Technology Co., Ltd. does not provide free warranty for product failures and damages caused by any of the following situations:

(1) Improper use or improper maintenance;
(2) Software, accessories, components, or other items not provided by Shenzhen Jinwei Power Technology Co., Ltd;
(3) Unauthorized disassembly, modification and misuse;
(4) Use beyond the scope specified in the product technical specifications;
(5) Improper transportation, handling and storage;
(6) Failure or damage caused by other non-quality reasons (such as earthquake,war,traffic accident,etc.).

Within the scope permitted by law, the above warranty terms are the only and explicit, and there are no other warranty terms, whether written or oral. Explicitly refuse to acknowledge any implied warranty and commercial terms.

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# 1.Description

The Smart Active Balancer is a balancing management system tailored for large capacity series connected battery packs.

This balancer uses super capacitors as a medium to achieve active energy transfer balancing.

The APP sets the balancing current to the actual working balancing current value, which is independent of the voltage difference between the series connected battery cells in the battery pack.

The voltage collection range is 1.5V～4.5V, with an accuracy of 1mV. Suitable for mainstream ternary lithium, lithium iron phosphate batteries on the market. Supports 2 to 16 battery strings, supports cascading use, and supports disorderly power on.

This balancer has Bluetooth communication function and is equipped with a mobile app software. Single battery voltage, maximum voltage, minimum voltage, average voltage, maximum voltage difference, total voltage of the battery pack, real-time balancing current, operating time, balancing status, and device temperature can be viewed through Bluetooth connection to the balancer. The device balancing parameters can be modified online.

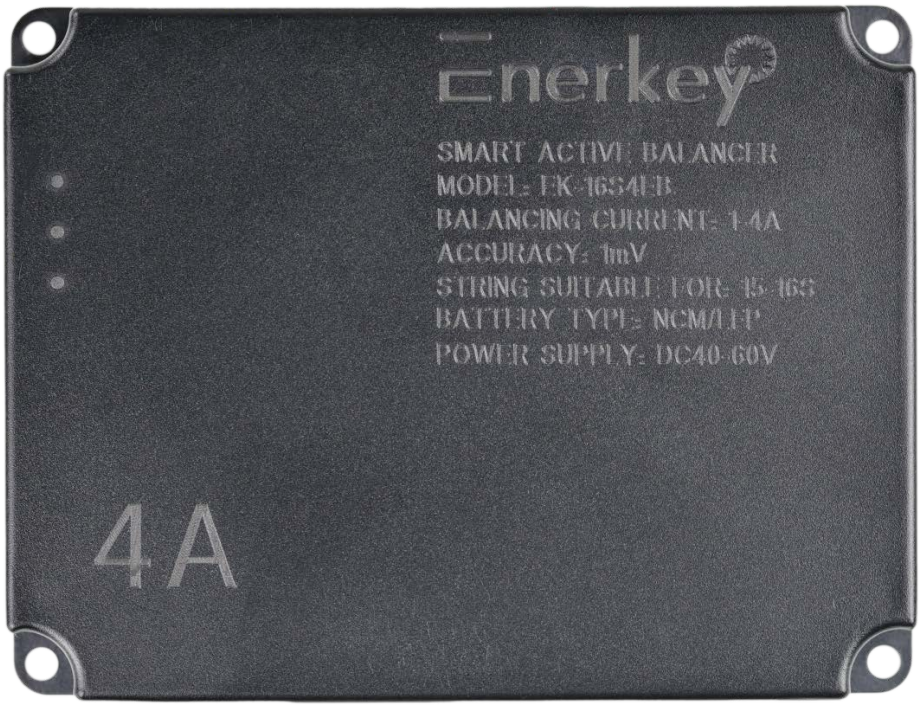
It is commonly used in battery packs for small sightseeing vehicles, commuters, shared cars, high-power energy storage, backup power sources for base stations, solar power stations, and other products. It can also be used for battery balancing maintenance, repair, and other occasions.

# 2.Specifications

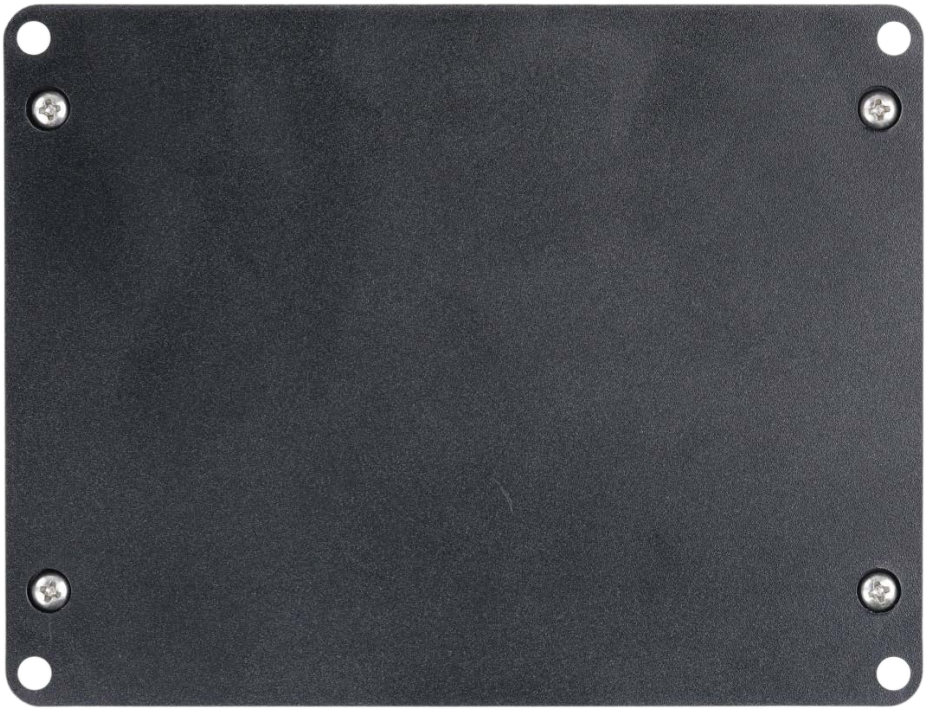
| | |
|---|---|
| **Product model** | EK-16S4EB |
| **Unit quantity (S)** | 2S～16S |
| **Cascading** | √ |
| **Product size** | L123 x W94 x T20（mm） |
| **Weight (package concluded)** | 310g |
| **Supported battery type** | NCM / LFP |
| **Single cell voltage collection range** | 1.5V～4.5V |
| **Undervoltage protects sleep voltage** | APP can be customized Settings：1.5～4.2V |
| **Equilibrium method** | Time-sharing single channel transfer, point-to-point energy transfer. |
| **Equilibrium current** | APP can be customized Settings：1A～4A |
| **Voltage equalization accuracy** | APP can be customized Settings：1mV（TYP） |
| **Whether an external power supply is required** | When the total battery system voltage is below 24V,<br>An external booster module or an external power supply is required. |
| **Power failure detection function** | √ |
| **Wrong wire protection function** | √ |
| **Reverse protection** | √ |
| **Fault alarm function** | √ |
| **Buzzer** | APP can be customized Settings |
| **Power dissipation** | At equilibrium≈1W，Stop equilibrium≈0.5W |
| **Operating ambient temperature** | -20℃ ～ +55℃ |

# 3.Product photos

## 3.1. Product Appearance




**Front side**



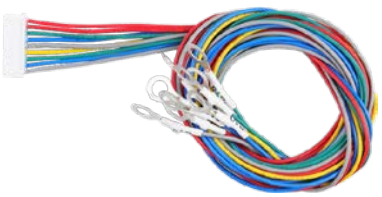
**Back side**

## 3.2. Packaging Picture


## 3.3. Product Accessories

**10 Pin Wire**

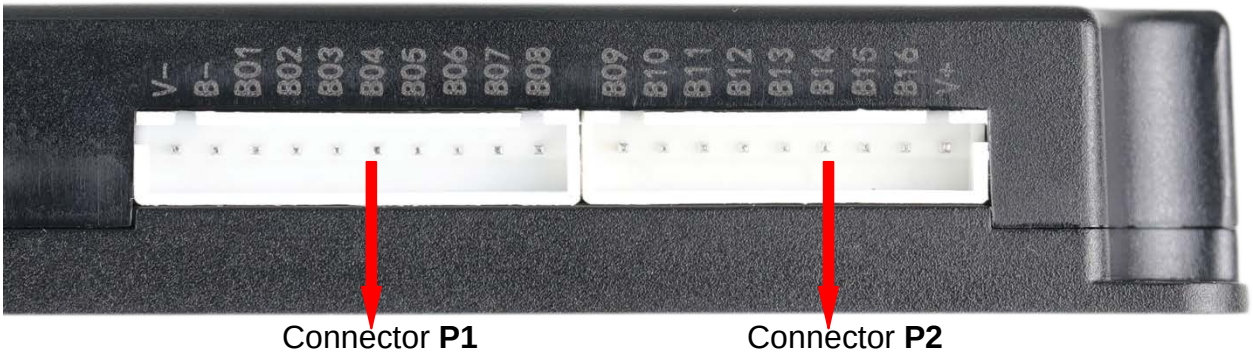
**9 Pin Wire**



| Parts name | Part specification | | | PCS | Notes |
|---|---|---|---|---|---|
| | Wire gauge | Wire length | Peeled tin plated | | |
| 10 Pin | 22AWG | 80cm | 3mm | 1 | |
| 9 Pin | 22AWG | 80cm | 3mm | 1 | |
| DC adapter | 18V or 24V (Random)<br>VDE or UL CSA | | | 1 | |

# 4. Connector terminal

## 4.1. Connector picture

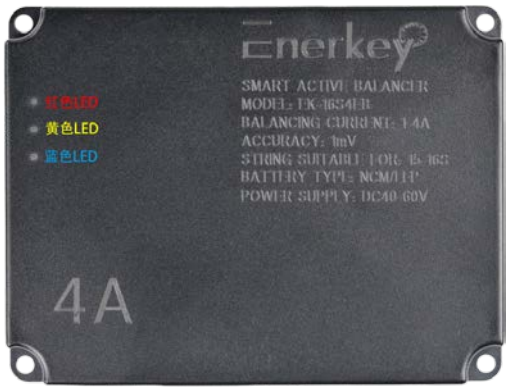



Connector **P1** Connector **P2**

## 4.2. Connector pin description

| Connector | Pin | Pin name | Description |
|---|---|---|---|
| P1 | 1 | V- | Negative pole of power supply /total negative pole of battery pack |
| | 2 | B- | Negative pole of the first battery string/total negative pole of the battery pack |
| | 3 | B01 | The positive electrode of the 1th battery |
| | 4 | B02 | The positive electrode of the 2th battery |
| | 5 | B03 | The positive electrode of the 3th battery |
| | 6 | B04 | The positive electrode of the 4th battery |
| | 7 | B05 | The positive electrode of the 5th battery |
| | 8 | B06 | The positive electrode of the 6th battery |
| | 9 | B07 | The positive electrode of the 7th battery |
| | 10 | B08 | The positive electrode of the 8th battery |
| P2 | 1 | B09 | The positive electrode of the 9th battery |
| | 2 | B10 | The positive electrode of the 10th battery |
| | 3 | B11 | The positive electrode of the 11th battery |
| | 4 | B12 | The positive electrode of the 12th battery |
| | 5 | B13 | The positive electrode of the 13th battery |
| | 6 | B14 | The positive electrode of the 14th battery |
| | 7 | B15 | The positive electrode of the 15th battery |
| | 8 | B16 | Positive electrode of the 16th battery string/total positive electrode of the battery pack |
| | 9 | V+ | Power supply positive pole/battery pack total positive pole |

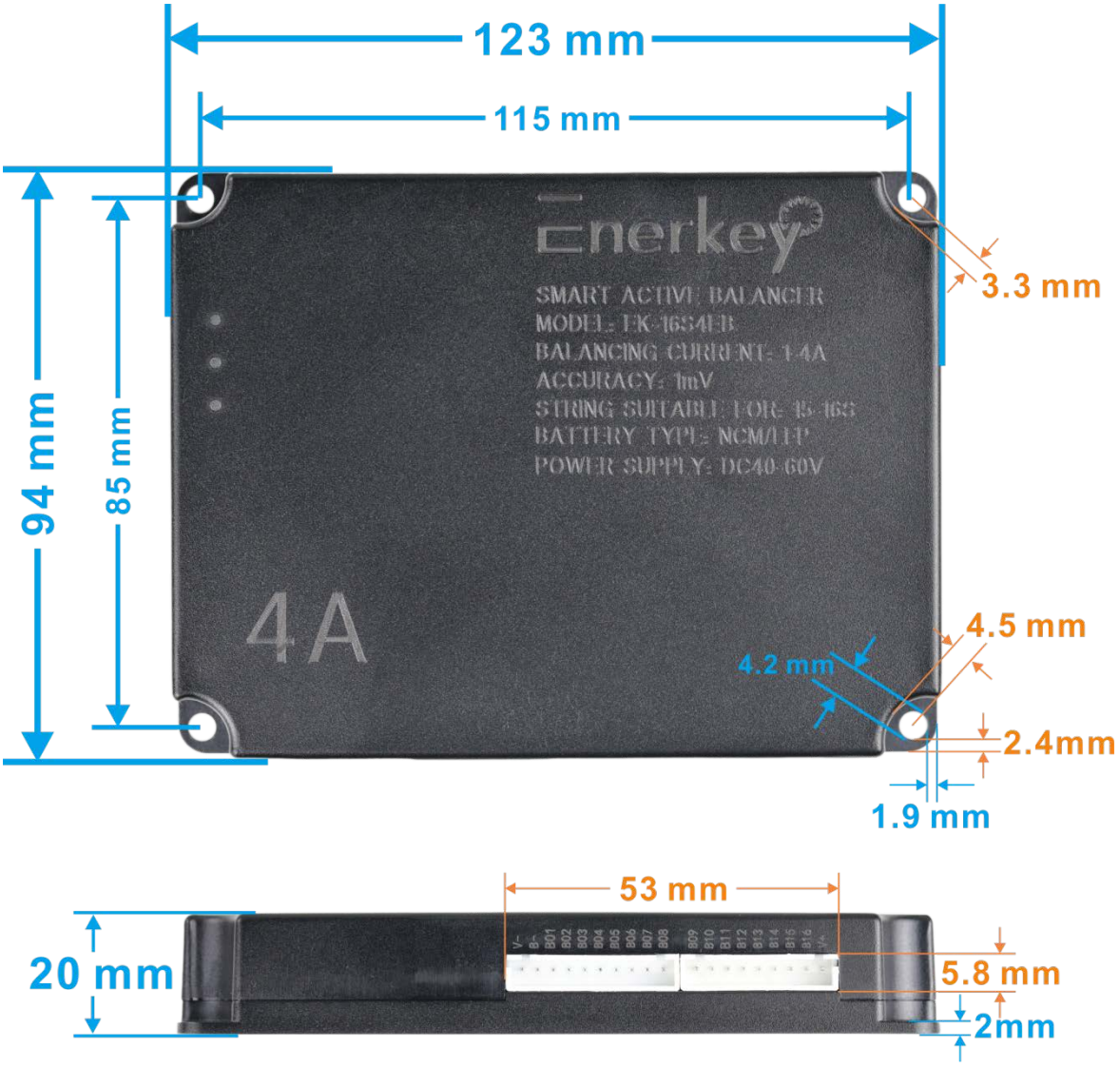
# 5.Indicator description




| Indicator | Indicator color | Indicator Steady on | Indicator Flashed |
|---|---|---|---|
| Bluetooth | Blue | Connection successful | Connection break |
| Fault | Red | internal fault | Battery detection Not go |
| Balance | Yellow | Balanced completion | In balance |

# 6.Product Size

**Notes： Unit is mm, the error is ±0.5mm**



# 7. Introduction to Balance

## 7.1. Balance principle

The equalization process of the active equalizer consists of the following three steps, which are cycled in turn until the maximum pressure difference is within the set range:

1. The largest monomer and the smallest monomer were detected;
2. The maximum unit charges the ultra capacitor in the equalizer. The charging current is the set current, and the maximum is 4A;
3. The ultra capacitor in the equalizer discharges the minimum monomer, and the discharge current is the set current, and the maximum is 4A;
4. Cycle 1 to 3 steps successively until the pressure difference is within the set range.

## 7.2. Single moving capacity

The formula for calculating the capacity of an equalizer is balancing current /3600* Duration (2-5S) For example, if the balanced current is 4A, the single transfer capacity ranges from 0.0022Ah to 0.0056Ah.

If the capacity of the balanced battery is relatively small or the capacity difference is relatively small, there will be too much capacity transfer, such as the capacity difference between the largest monomer and the smallest monomer is 0.1AH, and at this time the balance current is set to 4A, there will be too much capacity transfer, the smallest monomer becomes the largest monomer after the end of the current balance cycle, and the largest monomer becomes the smallest monomer. The simplest solution to this is to turn down the equilibrium current.

## 7.3. Small-capacity balancing policy

In response to the situation of excessive energy transfer caused by small capacity differences, the 4A equalizer has designed a balancing strategy to cope with this situation. When the balance cycle ends, the original smallest monomer becomes the largest monomer, the largest monomer becomes the smallest monomer, the equalizer waits for 3 minutes, so that the battery voltage has a recovery time, if 3 minutes later or the maximum becomes the minimum, the minimum becomes the maximum, it indicates that the balance is indeed overdone, at this time the equalizer automatically reduces the balance current by half. For example, the original 4A current balance is now reduced to 2A current balance. If there is still an overbalance situation, continue to reduce the balance current until the pressure difference is within the set range.

# 8. Installation method and precautions

## 8.1. Unpacking check and precautions

1. Handle the packing boxes and equalizers gently and do not turn them upside down;
2. Before unpacking, pay attention to whether the package is intact, such as whether there are impact marks, whether there is damage, etc.

## 8.2. Instructions for installing the equalizer

1. A single balancer can connect up to 16 battery packs in series. As shown in 8.2.1.

2. When used for battery packs with less than 16 battery packs in series, the remaining pins are left floating. As shown in 8.2.2.

3. When used for battery packs with a total voltage lower than 24V, an external 24V-60V DC power supply is required., As shown in 8.2.3 and 8.2.4

4. When used in cascade, at least one battery between every two balancers is the common end for energy exchange. As shown in 8.2.5

### 8.2.1. 16S Wiring Diagram

A single equalizer supports 2S-16S.

The following figure shows the installation and wiring method for a 16S battery pack:

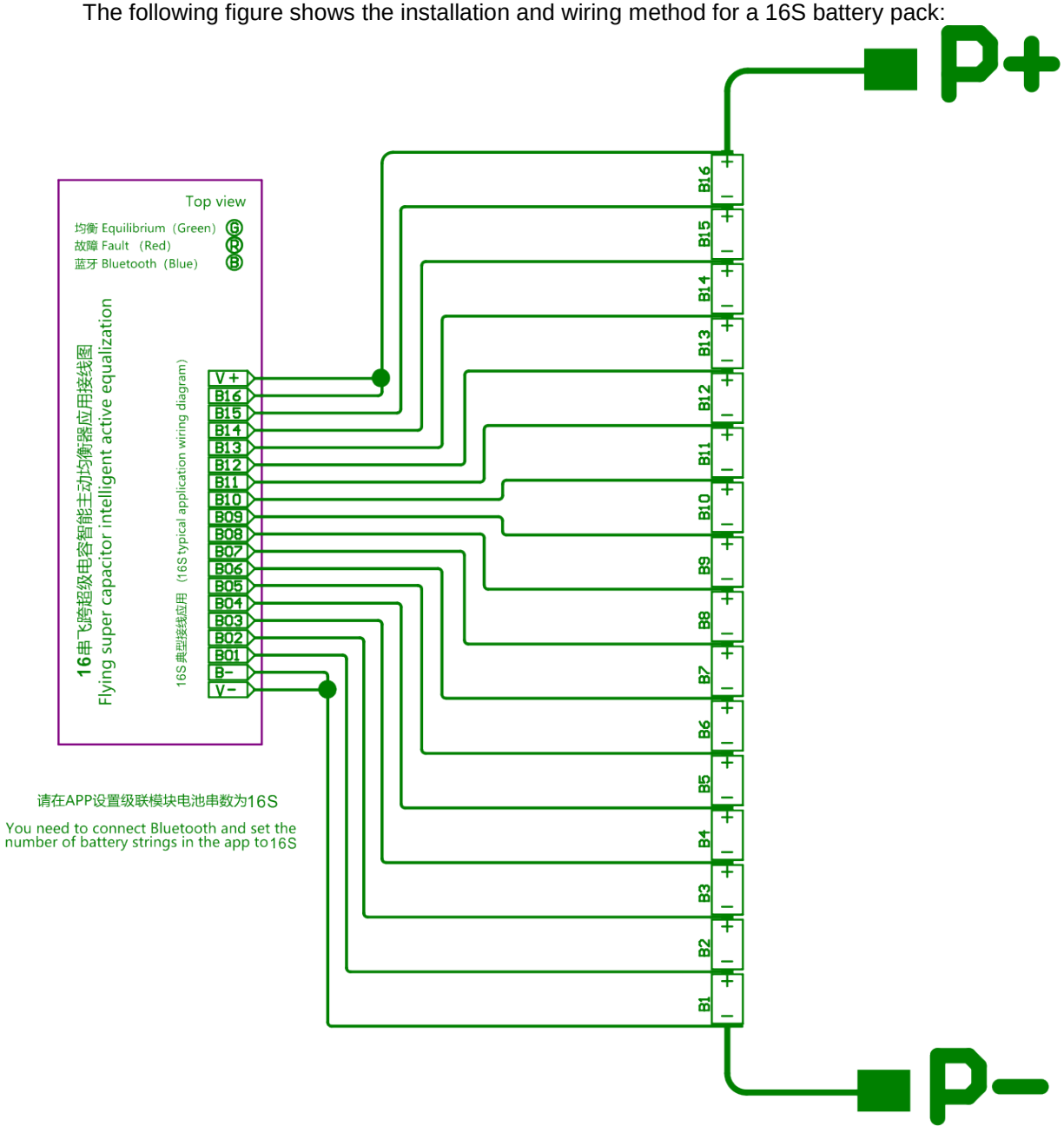



Figure 8.2.1

### 8.2.2. 15S Wiring Diagram

When used in a battery pack with less than 16 batteries in series, the remaining pins are left hanging.

Take 15S as an example, the installation and wiring method is as follows

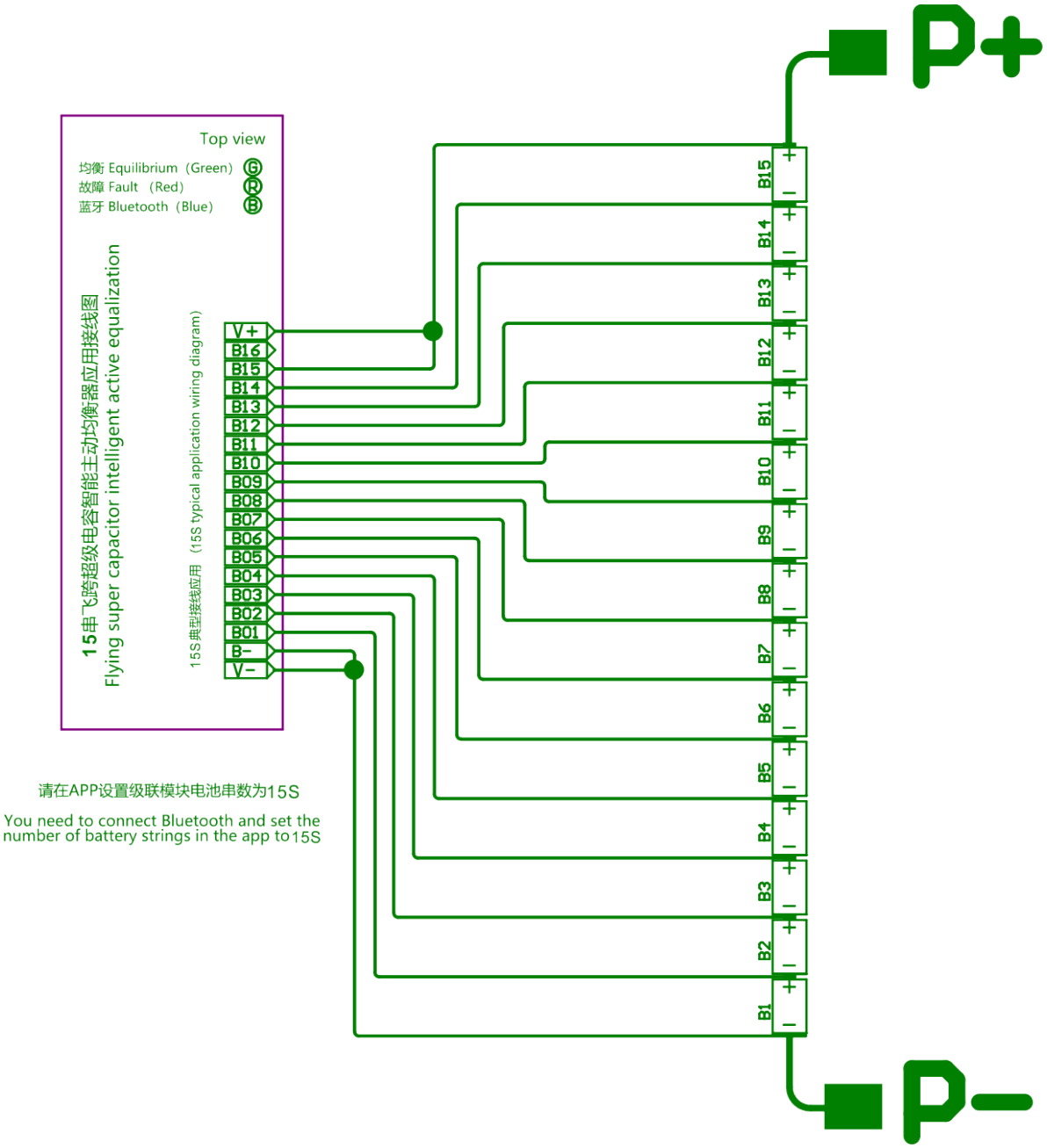



Figure 8.2.2

### 8.2.3. 3S Wiring Diagram

When used for battery packs with a total voltage lower than 24V, an external 24V-60V DC power supply is required.

Take 5S as an example below, the installation and wiring method is as follows:

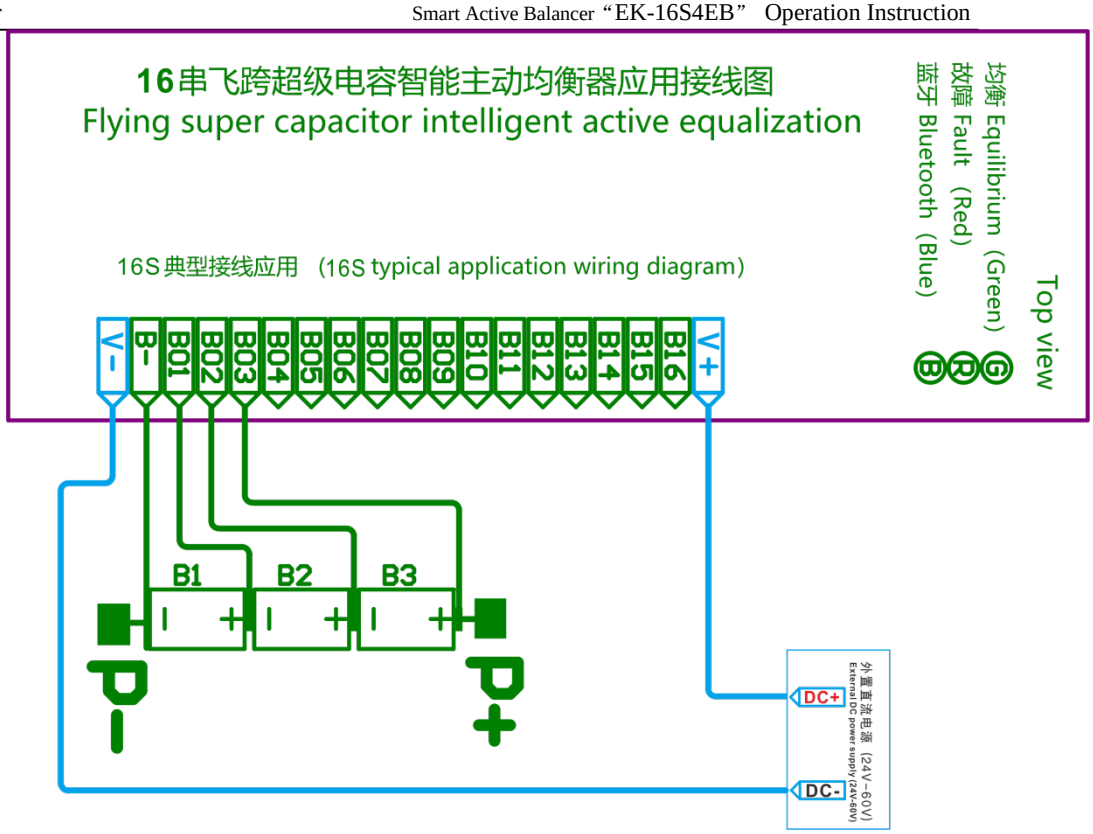



Figure 8.2.3

### 8.2.4. 5S Wiring Diagram

When used for battery packs with a total voltage lower than 24V, an external 24V-60V DC power supply is required.

Take 3S as an example below, the installation and wiring method is as follows:

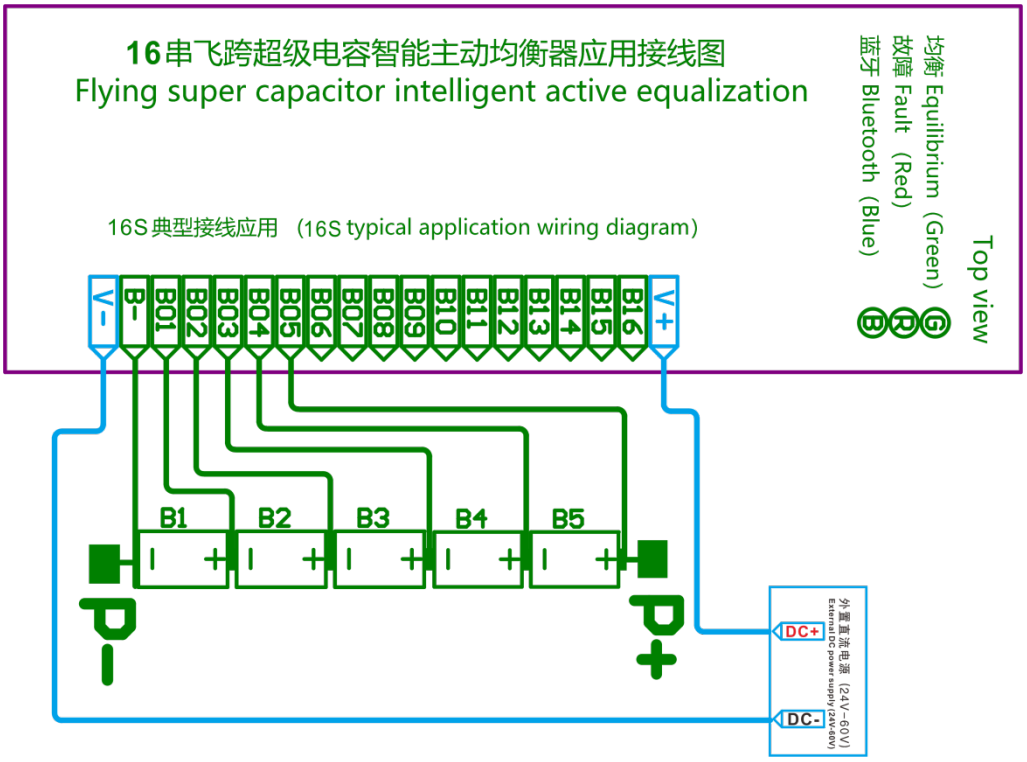



Figure 8.2.4

### 8.2.5.30S Cascade Diagram

EK-16S4EB supports cascading. There is at least one battery between every two equalizers as the common end for energy exchange. Taking 30S as an example, the installation and wiring method is as follows:

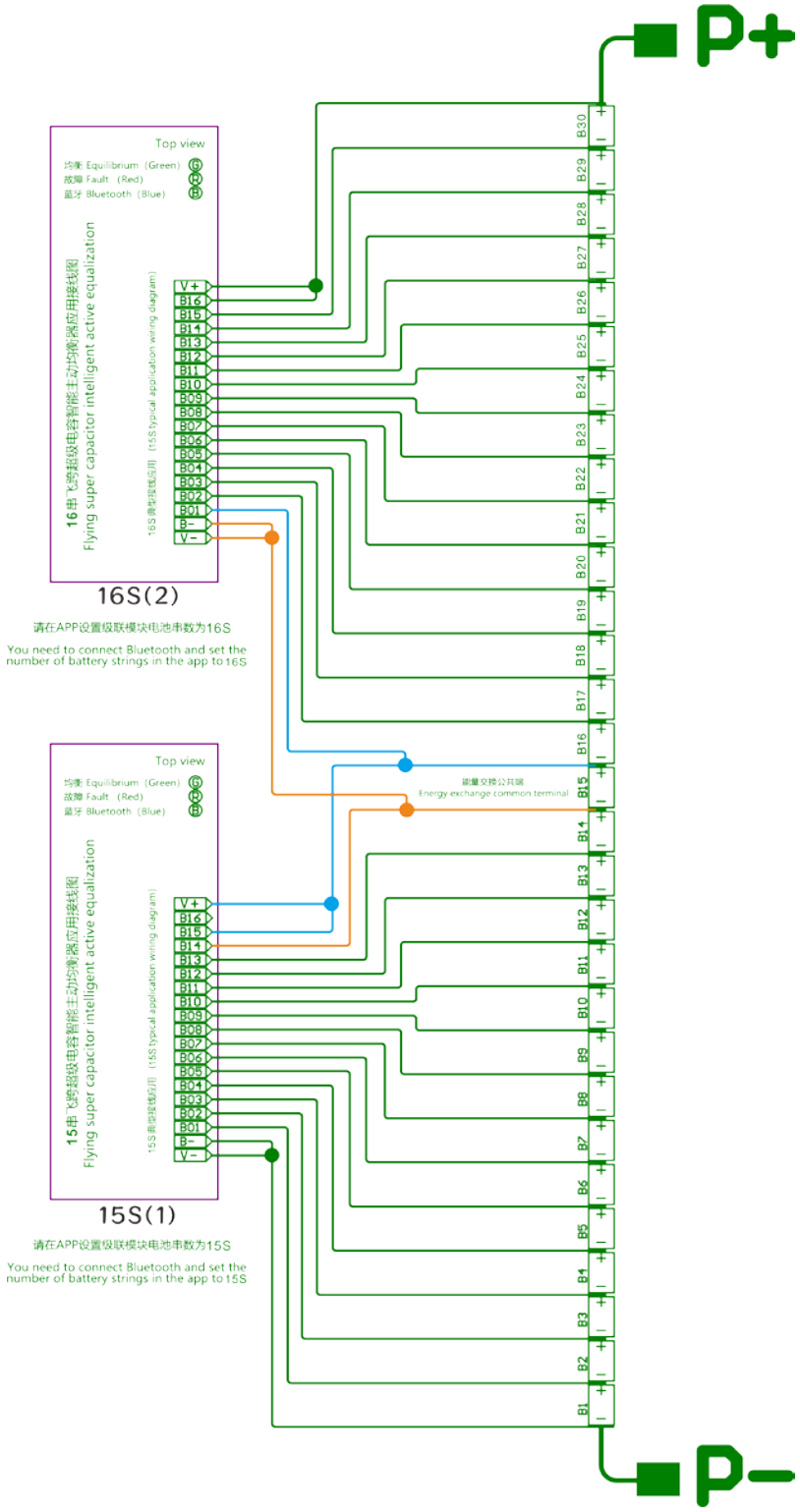



Figure 8.2.5

Wire precautions:

①. Installing an equalizer requires a certain amount of knowledge about electronics.

②. When connecting cables, solder the terminal cable to the battery string, and then insert the equalizer.

③. When cascading is used, there is at least one common end of energy exchange between each two equalizers. During welding, pay attention to whether the connection is correct and whether there is a phenomenon such as false welding.

④. The cascade is used in a high-voltage environment. Please check whether the wiring is incorrect. If it cannot be used after connection, please contact after-sales personnel for the corresponding cascade diagram.

# 9. APP Installation and Use

## 9.1. APP Installation

The APP has two versions of Android system and IOS system, both support Chinese and English bilingual.

IOS users can search in the App Marketplace: Enerkey 


Android users can download it from Baidu web disk; Or go to the official website "Support" to download the installation package.

Baidu web disk link：https://pan.baidu.com/e/1r-HFiB8KfPVy5SplVK1iTA

Official website：http://www.enerkey.cn/

## 9.2. APP Use

### 9.2.1. Pre-use inspection

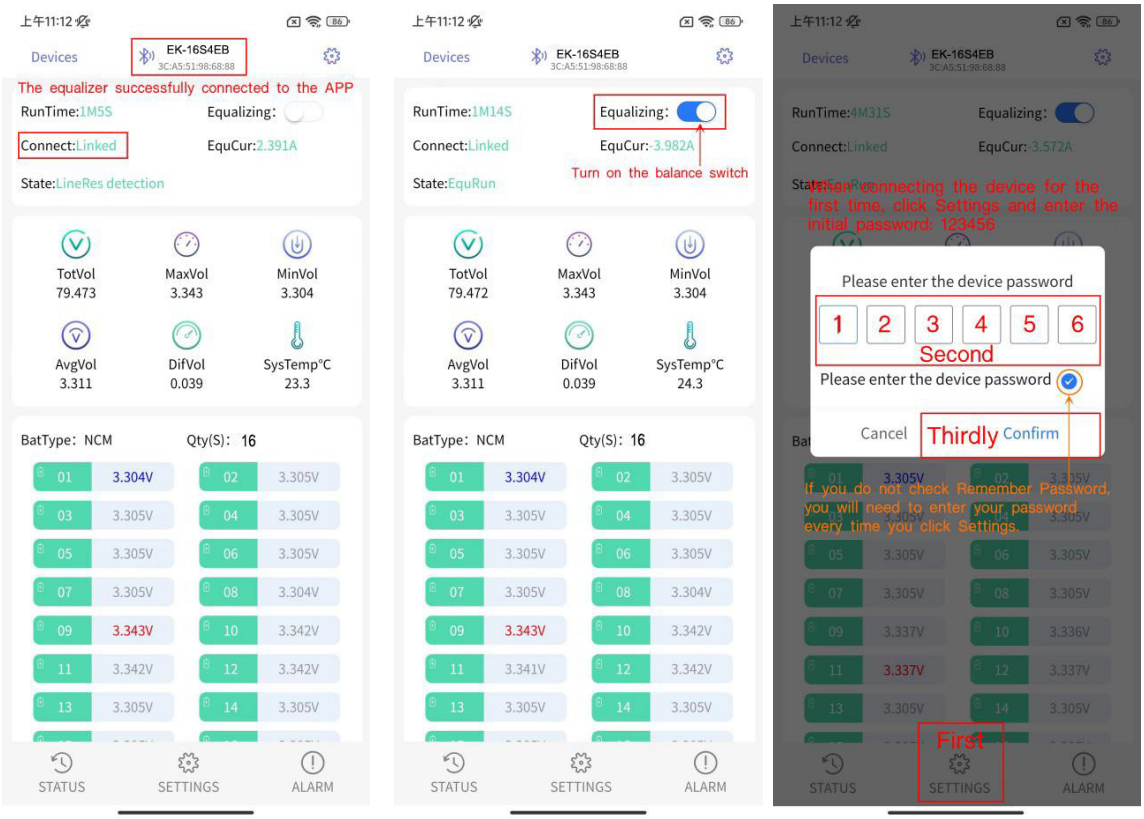
①. After downloading the APP, you must enable the location and location information and allow the APP to use the location information. If the location is not enabled, the equalizer cannot be searched and the device cannot be connected.

②. Before powering on the power supply, check whether the equalizer is properly connected, whether the power supply for the equalizer is within the required range, whether the equalizer is properly placed, and whether there is short circuit on the circuit board.

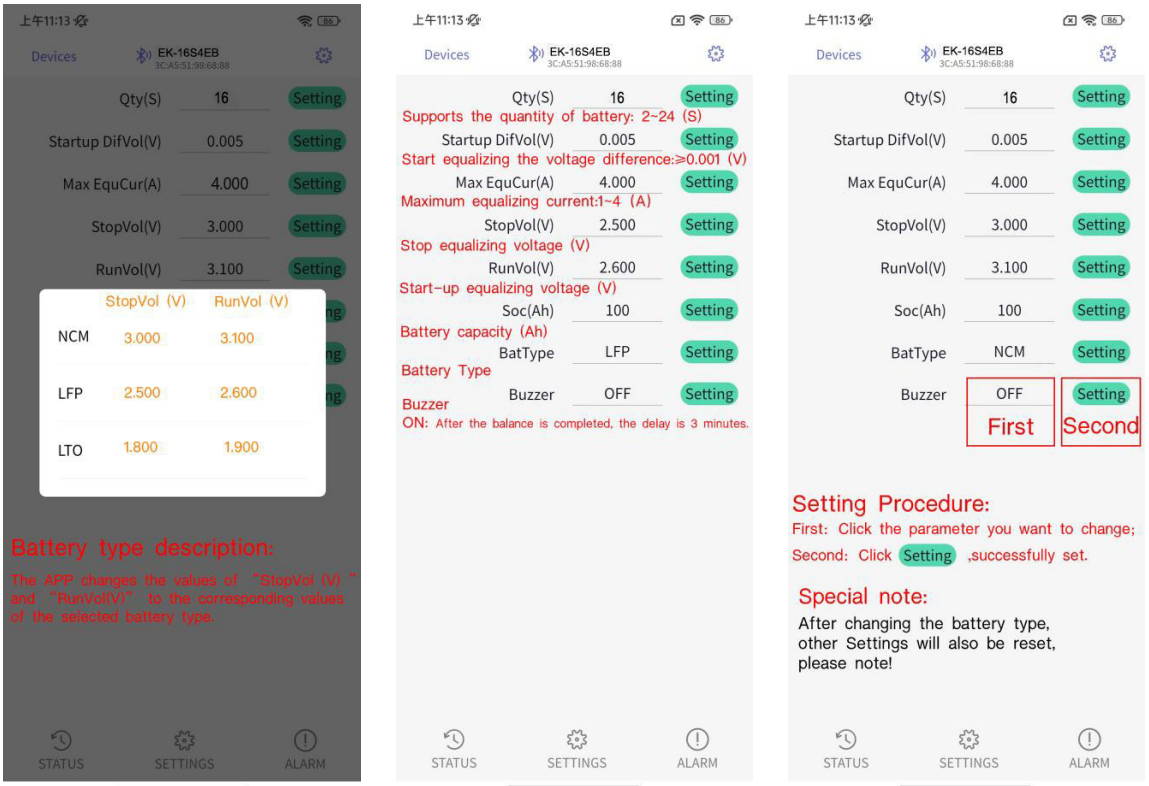
### 9.2.2. APP Connect device procedure

The first step is to connect the device, as shown below; After the unconnected device enters the APP, the system will automatically start scanning the device.

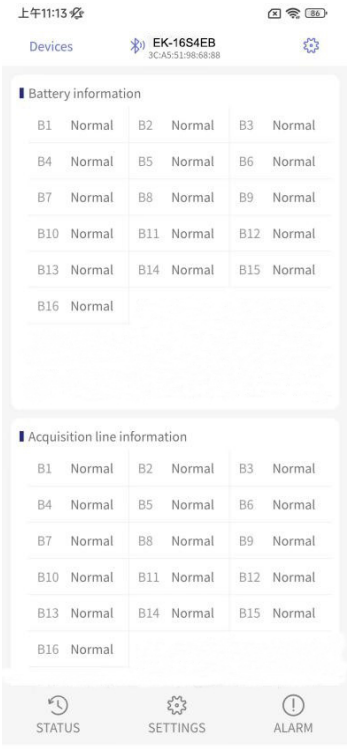

The second step, after the connection is successful, start the balance switch, You can also modify the parameters first (enter the password for the first time)




The third step, according to the battery type and battery string number, change the parameters , as shown in the figure below;



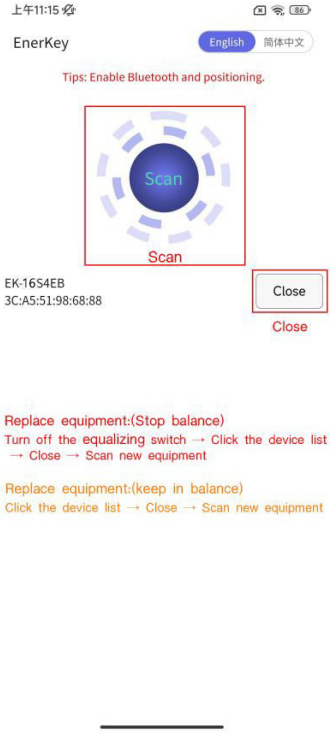
Fourth, after setting the required parameters, you can monitor the parameters of each monomer from the "Status" or "Alarm" page;



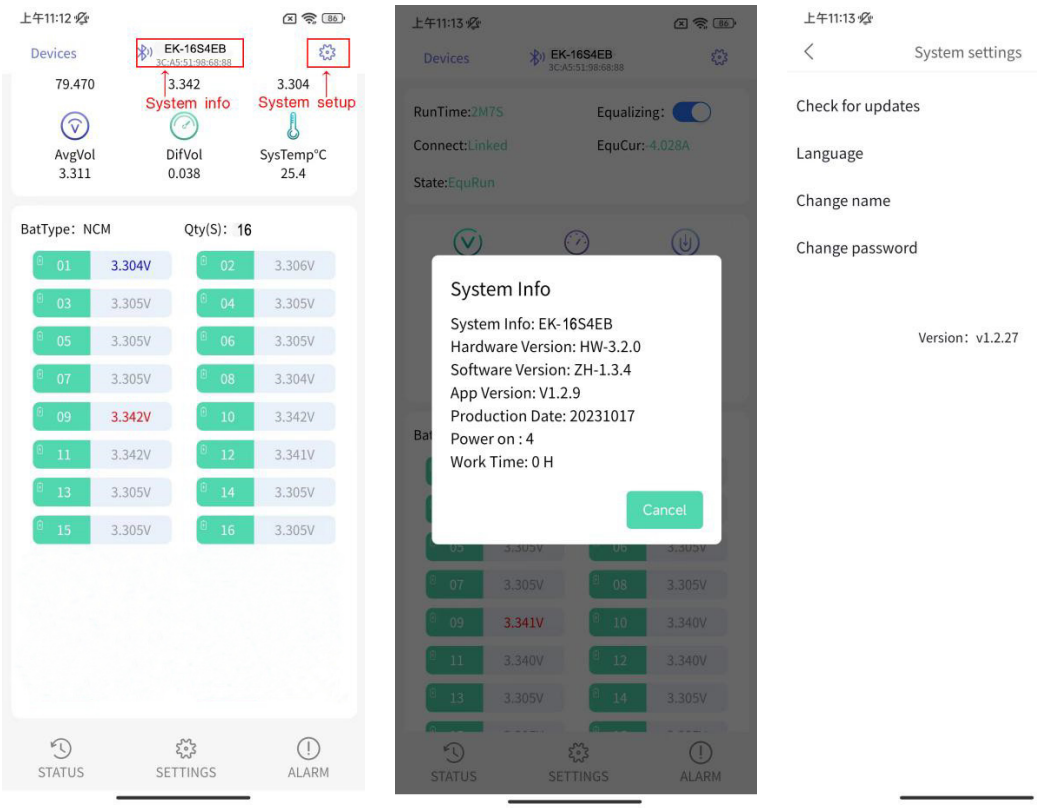

Step 5: Disconnect the device or replace the connected device.

(If you want to maintain equilibrium, do not close the equilibrium)

Special note: Turn off the "balance switch" or remove the power/battery pack, and the equalizer will stop running.

Finally, the steps for viewing device information and changing device password are attached, as shown in the figure below.




## 9.3. Notice

①. The equalizer defaults to 16S for the first time, so when you use it for the first time, the connected battery pack is not 16S, and the fault indicator will light up, which is a normal phenomenon. Because the number of strings set in the APP is inconsistent with the number of battery strings actually connected, in this case, modify the battery parameters after the connection is successful and then enable the balance.

②. When a fault occurs, the balance cannot be enabled.

# 10. Phenomenon description

## 10.1. General fault analysis and elimination

| No. | Fault Phenomenon | Analysis Of Causes | Final Solution |
|---|---|---|---|
| 1 | The power indicator is off | The power supply to the equalizer is abnormal | ①Check whether the electric source pin of the equalizer is connected correctly;<br>②If the battery string is less than 25V, an external 30V to 100V DC power supply is required |
| 2 | Device not found | The APP has no relevant authorization | ①Check whether the Bluetooth is turned on;<br>②Turn on location and location information and allow the APP to use location information. |
| 3 | The equalizer does not start | The equalizer does not meet working conditions | Check whether the first battery voltage is higher than 2.4V, if not meet the conditions,<br>please charge the battery to more than 2.4V, and then the equalizer will automatically start. |
| 4 | The APP prompts that the number of monomer Settings does not match the set value | The number of units set or the balance line is improperly connected | Check whether the number of units configured is the same as the number of connected batteries.<br>If it is different, change the number of battery strings actually connected in the APP. |
| 5 | The APP indicates that the resistance of the balance line is too large | The cable resistance from the battery to the connector is too large | Check whether the cable between the battery unit and the connector is in poor contact. If no, replace the cable. |
| 6 | Inaccurate voltage acquisition | Cables are incorrectly connected or parameters are incorrectly set | Check the connection one by one to eliminate connection errors.<br>Fine-tune through the voltage acquisition reference until the<br>acquisition is accurate. |
| 7 | Cannot be cascaded | There is no energy exchange common end | Contact customer service or after-sales personnel to consult the wiring diagram for your desired cascade. |

Special note: The above are the possible causes of common faults and solutions,
if the fault is still not removed, please contact Jingwei power after-sales.

## 10.2. Buzzer alarm description

| No. | Fault Phenomenon | Analysis Of Causes | Final Solution |
|---|---|---|---|
| 1 | The buzzer goes off twice every one second (Red fault indicator lights up when ringing). | The hardware data store is faulty | contact the manufacturer |
| 2 | The buzzer sounds three times every 0.5 seconds (Red fault indicator light up when ringing). | Bluetooth communication error | contact the manufacturer |
| 3 | The buzzer sounds four times every 0.5 seconds (Red fault indicator light is only on at intervals) | The device hardware is faulty.<br>The supercapacitor voltage overvoltage | contact the manufacturer |

Special note: Hardware problems rarely occur, mostly caused by hardware damage caused by operation errors. You can try to reconnect the device several times.

## 10.3. Buzzer description

| No. | Phenomenon | Notes |
|---|---|---|
| 1 | After the device is powered on, the buzzer rings four times. (The green light is on at this time) | |
| 2 | After the balance is enabled, the buzzer sounds. (The yellow light is blinking at this time) | |
| 3 | After the equalization is complete, delay 3 minutes and beep. (The yellow light is on at this time) | Need in the Settings,<br>Turn on the buzzer function. |

# 11. Safety protection measures and transportation and storage

## 11.1. Safety precautions

①. The equalizer itself does not have high pressure and will not cause electric shock damage to the body.

②. There are no user repairable parts inside the equalizer. All repairs should be performed by qualified maintenance personnel. If the operating voltage set by the factory is changed, the safety certificate is no longer applicable.

③. Before touching the sampling line of the equalizer, discharge the static electricity and take ESD preventive measures.

## 11.2. Transportation

The packaged products can be transported by the usual means of transport without being directly affected by rain and snow and violent collisions.

It is not allowed to be put together with corrosive substances such as acid and alkali during transportation.

## 11.3. Storage

Packaged products should be placed in a permanent warehouse storage, warehouse temperature is 0℃~35℃, relative humidity is not more than 80%,

There should be no acid, alkali and corrosive gases in the warehouse, no strong mechanism vibration and impact, and no strong magnetic field.

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