# BMS16T

## for 2S-16S LiPo/Li-ion, LiFe & LiTO
Low power consumption
High accuracy
2.8" TFT LCD display
Programmable



**T**hanks for your purchasing the BMS16T for your vehicle.

**R**ead the ENTIRE instruction manual to become familiar with the features/functions of the device before operating. Down load the BMS installation video on http://www.chargery.com/Video/BMS24T_C10325_operation_instructions.mp4 or https://www.youtube.com/watch?v=39lYl3h1kOU with Nissan Leaf battery

**F**eel free to send an email to jasonwang3a@163.com  or call at 86 755 2643 6165 should you have any questions and suggestions.

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Revised : 3/15/2020

Chargery BMS16T is designed special for LiPo, LiFe and LiTo battery pack applied to storage energy system and Electrical Vehicle including E-Motorcycle, E-Scooter and so on. The unit can measure or detect the battery voltage, cell voltage, charge & discharge current, battery temperature, and battery SOC (State of Charge) , displayed with TFT color LCD.

## Safety Notes

Please read the entire manual completely before using, to make sure you can use this device better and more safely.

1. Ensure the BMS program and settings match your battery pack, otherwise the battery will be damaged and a dangerous situation may arise, especially for Lithium batteries, which may cause fire.
2. For storage energy system application and for Electrical vehicle application will have many differences, please adjust those key parameters carefully, or contact us for more details.
3. Do not allow water, moisture, metal wires or other conductive material into the device.
4. Never charge or discharge any battery having evidence of leaking, expansion/swelling, damaged outer cover or case, color-change or distortion.
5. Do not try to charge "non-rechargeable" dry cells.
6. Do not mix batteries of different types, different capacities or from different manufacturers.
7. Do not exceed the battery manufacturer's suggested maximum charge and discharge rates.
8. Carefully follow the battery pack manufacturer's recommendations and safety advice.



# Warning

1. Current shunt don't contact to any mental including BMS mental case
2. BMS case don't contact to any mental panel.
3. Current shunt must connected to Battery pack negative
4. Prevent BMS from vibrating violently to make sure BMS case don't contact to battery pack negative.

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# Special update

1.  Add RS232 port, external device can read out all data from BMS16T
2.  Improve cell voltage detection accuracy
3.  Add over current protection during balancing
4.  Add low temperature cutoff (on LCD unit V3.03)
5.  Optimized SOC accuracy, new approaches are voltage based and coulomb counting, consideration the cell impedance at the same time. Please setup accurate battery capacity on Program setup menu before using the BMS.
6.  Add current, AH and WH, SOC interface, it is easy to read charge or discharge current, capacity, power and state of Capacity of battery pack on one interface.
7.  Relay controller use 12V 3A large current regulator from 16S battery pack. it can drive larger current mechanical and state solid relay.
8.  If use external adaptor, the BMS can do 2S -16S battery,   and the external voltage range is 13-60V.
9.  For same Battery positive and negative terminal when charge and discharge, BMS24T can control charge and discharge separately. And detect charge and discharge current with one current shunt.

# Order information

| Model | Description | Accessories |
|---|---|---|
| BMS16T(BMS16Pro)-100 | 100A charge and discharge | 100A shunt, and standard accessories |
| BMS16T(BMS16Pro)-300 | 300A charge and discharge | 300A shunt, and standard accessories |
| BMS16T(BMS16Pro)-600 | 600A charge and discharge | 600A shunt, and standard accessories |

All standard accessories are listed on page 22,

includes:

1. Battery balance wire, 2pcs
2. Relay controller wire, 1pcs
3. Temperature wire, 1pcs
4. Current sensor wire, 1pcs
5. Current shunt, 1pcs
6. USB data cable, 1pcs
7. Communication wire on COM2, connect main unit to display module, 1pcs
8. Communication wire on COM3, connect BMS to external device, 1pcs
9. Warning LED, 1pcs
10. Warning beeper, 1pcs

Optional accessories

1. 12V 100A relay
2. 12V 200A relay
3. 12V 400A relay
4. 12V 600A relay
5. 12V 800A relay
6. Relay delay time board



To large current discharge relay
to small current discharge relay
To Charge relay

To Relay Controller on BMS

Switcher: Start or stop dishcarge by open or close relay

**Notes:**

**Notes:**

BMS16T includes main unit and display module, after power on the BMS16T and finish all parameters setup on display module, the BMS16T will work according to these parameters even disconnect the display module to the main unit, all data don't be displayed and no beeper and LED warning, but BMS24T can cut off charge or discharge when any cell over charged or over discharged. You can connect the external device to the COM3 on main unit to receive all data, and display these data. if need modify the parameters setup, please connect the display module again.

Disconnect and connect LCD unit to main unit when it is turned on frequently is not suggested, because it maybe damage main unit.

The BMS16T can fit with any lithium battery charger, when any cell over charged, the BMS16T will disconnect charge relay to cut off charge, if fit with CHARGERY charger, need not the charge relay. Only connect CHARGERY charger to BMS16T on COM1, when any cell reach OVP, the charge current will decrease automatically prevent any cell damaged. This feature can save charge relay cost and shorten charge time.
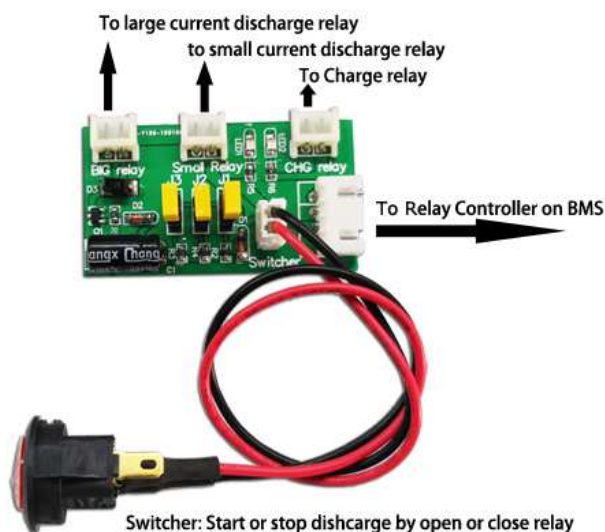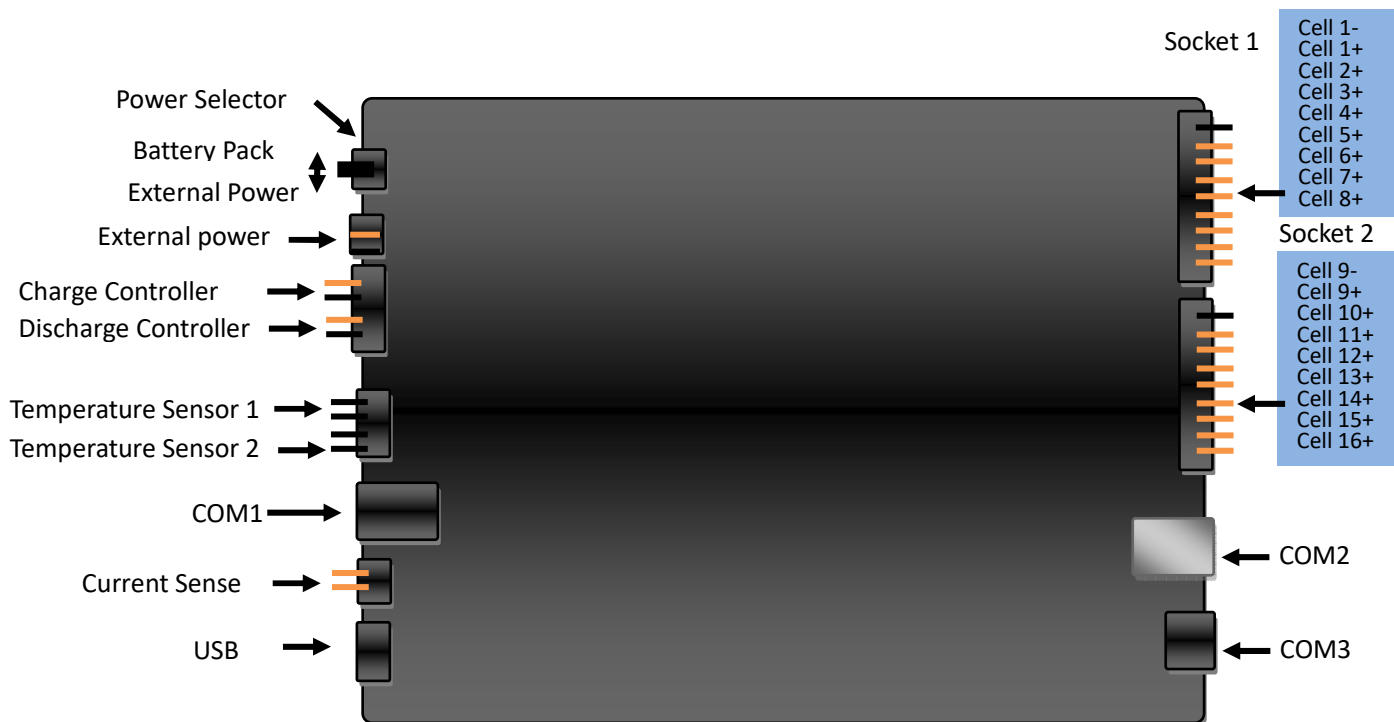
# Special Features

1. The BMS16T uses advanced ADC measurement technology, high accuracy, high voltage and high current detection circuit. The maximum voltage measurements tolerance is within 5mV at up to 16S LiPo battery (68V)

2. Support regenerative braking, during braking operation can charge the batter pack and the discharge power (Wh) will decrease to response to the braking power.

3. Charge/discharge current up to **600A**. Bigger current can be customized.

4. **1.2A** per cell balance current is very useful for large capacity battery pack, the feature can resume all cell voltage balance status at the shortest time. Over temperature protection make sure the system safety during balance.

5. BMS16T calculate and display the charge and discharge power (Wh), generally the battery rated power is rated voltage multiply rated battery capacity.

6. TFT LCD screen provides rich information including current, voltage, power, capacity, battery status, SOC and temperature and so on.

7. BMS16T features a maximal safety protection, within the range parameters can be setup, BMS16T will alarm and cutoff charge or discharge according to users' setup, out of range of parameters, and trigged absolute maximum ratings BMS16T will force to cutoff charge or discharge to prevent the battery from fire.

8. Minimize the power consumption by draw current from all cells or external power supply.

9. Dual power design, the unit can be powered by all cells or external power supply.

10. Detect cell count at any time, and compare with the count detected when switch on first time. If it is not uniformity, the device will alarm and cutoff charge or discharge according to users' setup, the feature can prevent any cell connection from loosing.

11. Sound alarm and LED alarm will be triggered when any warning events happened, and then wait several seconds cut off or Don't cut off charge or discharge. The delay time can be programmed.

12. Charge relay and discharge relay are controlled independently.

13. Two temperature sensors monitor battery temperature on different position.

14. Supports upgrading the firmware program by USB port.

15. BMS16T provide users the maximal flexibility, key parameters can be programmed.

16. BMS16T display battery SOC or called battery gauge similar with car dashboard. Cell count, battery pack voltage and battery gauge (%) is displayed simultaneously.

17. In case that the battery pack need not be charged and discharged, Press STOP button enter into sleep mode to save energy consumption, at this mode, Charge and Discharge is forbidden, and LCD back light is off. Press any key to resume normal work mode.

18. LCD back light ON time can be programmed to save energy, when it is OFF, press any key to resume "ON".

# Protection functions

1. Cell count error protection

2. Over charge protection

3. Under voltage protection

4. Over current protection when charge or discharge

5. High temperature protection

6. Low temperature protection (on LCD unit V3.03)

7. Over differential cell voltage protection in discharge

8. Over differential battery temperature protection

9. Under SOC protection

LiPo & LiFe, LiTo Battery Management System    BMS16T(BMS16Pro) V3.03

# Interface



Power Selector
Battery Pack
External Power
External power
Charge Controller
Discharge Controller
Temperature Sensor 1
Temperature Sensor 2
COM1
Current Sense
USB

Socket 1
Cell 1-
Cell 1+
Cell 2+
Cell 3+
Cell 4+
Cell 5+
Cell 6+
Cell 7+
Cell 8+

Socket 2
Cell 9-
Cell 9+
Cell 10+
Cell 11+
Cell 12+
Cell 13+
Cell 14+
Cell 15+
Cell 16+

COM2
COM3

BMS16T main module



STORAGE
16S LIPO
32%
60.77V
3.831V
3.763V
68mV
24.0℃

SOC

0.0A        0.000Wh

STOP        DOWN        UP        SET/START

LED
Beeper
COM2
USB

BMS16T display module

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| | |
|---|---|
| Power Selector | Alternate External power supply or battery pack to power BMS16T. If select battery, the battery pack must be 8S to 16S LiFe or LiPo or LiTO. But if power by external power supply, BMS16T can do 2S-16S LiPo, LiFe or LiTo battery pack. The external input supply Vin voltage range is 15V to 60V |
| External power port | External power input, the voltage should be 13V to 60V, 3A minimum, the current depends on the relay, the connector is 5.5*2.1 DC jack. |
| Charge controller | Charge controller, connect or disconnect charge circuit, generally connect to relay or DC contactor. When any cell voltage is over setup, it will make relay "OPEN(disconnect)" to turn off the charger, otherwise BMS16T will output 12V power the coil to close (connect) the relay. The relay must be Normal Open (NO). |
| Discharge controller | Discharge controller, connect or disconnect discharge circuit, generally connect to relay or DC contactor. When any cell voltage is under setup, it will make the relay "OPEN" to turn off the motor or other load, otherwise BMS16T will output 12V power the coil to close the relay. The relay must be Normal Open (NO). |
| COM1 | The COM1 port (black connector) is connected to external device such as Charger. If connect to Chargery charger, BMS16T can control charge current to shorten charge time |
| COM2 | The COM2 (gray connector) port is connected BMS main unit to display module by gray spring wire |
| COM3 | Output RS232 level on the port, any external device can read out all data from BMS16T |
| Temperature sensor | Two temperature sensors monitor the battery temperature, the sensor must tie to battery surface or gap of cells where the temperature should be the highest during charge or discharge. The temperature range is -20 to 150℃ |
| LED[1] | Connect to high light LED, the LED will flash when any warning event happened |
| Beeper[1] | Connect to beeper or others to alarm. It will output 12V 25mA max. |
| Current sense | Connect to single current shunt. Charge current and discharge current can be measured simultaneously. |
| USB | Connect to PC update the firmware by Chargery UpdateTool.exe |
| Socket 1 | Connect to 2S to 8S battery, |
| Socket 2 | Connect to 9S to 16S battery. for over 8S battery, please connect 8S battery to socket 1 and then connect other cells to socket 2, such as 8S + 2S for 10S and 8S +5S for 13S |

Note:

**1)** On the BMS display module

# Absolute maximum or Minimum ratings

| | | | |
|---|---|---|---|
| Maximal cell voltage | LiPo | 4.35V | Larger than the absolute maximum voltage, BMS16T will force to cut off charge |
| | LiFe | 3.90V | |
| | LiTO | 2.80V | |
| Minimum cell voltage | LiPo | 2.50V | Less than the absolute minimum voltage, BMS16T will force to cut off discharge |
| | LiFe | 2.00V | |
| | LiTO | 1.50V | |
| Battery temperature | LiPo& LiFe&LiTO | 80℃ | Over the temperature, BMS16T will force to cutoff the charge and discharge |

# Program Setup
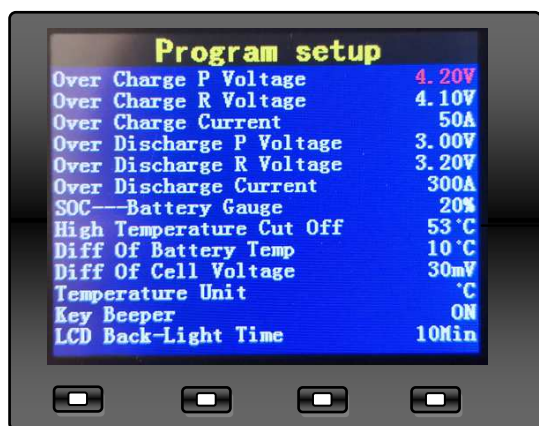


Setup the highest battery temperature, when over the temperature, BMS will cut off charge or discharge
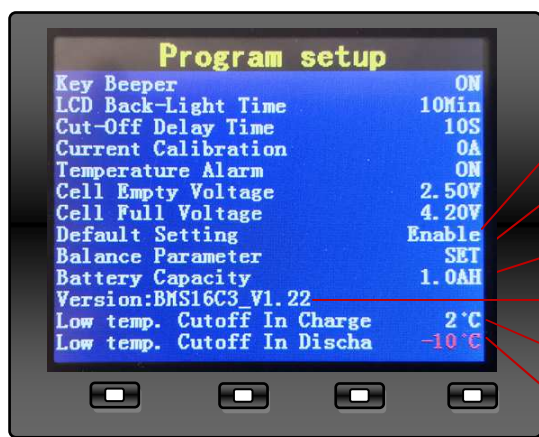


Resume default value in factory

Balance setup

Setup battery pack capacity, 1000AH max. it is as a reference when calibrate battery SoC.

Main unit Software version

Under the lowest temperature, forbid to charge

Under the lowest temperature, forbid to discharge

1.  Press SET/START button for 3 seconds enter into Program Setup interface.
2.  Press UP or DOWN button select the item, press SET/START shortly make the value flash, and press UP or DOWN change the value.   Press SET/START button shortly confirm the change. After finish all setup, press SET/START for 3 seconds quit the setup menu.
3.  When quit setup mode, BMS16T will record all parameters till next change.

**NOTE: Please keep the default setup unless for special purpose.**

| Parameters | | Min. | Type | Max. | Step | unit |
|---|---|---|---|---|---|---|
| **Charge Protection** | | | | | | |
| Over Charge Protection(P) Voltage | LiPo | 3.90 | 4.20 | 4.35 | 0.01 | V |
| | LiFe | 3.40 | 3.65 | 3.90 | 0.01 | V |
| | LiTO | 2.50 | 2.75 | 2.80 | 0.01 | V |
| Over Charge Release(R) Voltage | LiPo | 3.80 | 4.10 | 4.25 | 0.01 | V |
| | LiFe | 3.30 | 3.55 | 3.80 | 0.01 | V |
| | LiTO | 2.40 | 2.65 | 2.70 | 0.01 | V |
| Over Charge current | | 0 | **50** | 600 | 1 | A |
| **Discharge Protection** | | | | | | |
| Over Discharge Protection(P) Voltage | LiPo | 2.75 | 3.00 | 4.00 | 0.01 | V |
| | LiFe | 2.00 | 3.00 | 3.50 | 0.01 | V |
| | LiTO | 1.50 | 1.85 | 2.40 | 0.01 | V |
| Over discharge Release(R) Voltage | LiPo | 2.75 | 3.20 | 4.00 | 0.01 | V |
| | LiFe | 2.00 | 3.10 | 3.50 | 0.01 | V |
| | LiTO | 1.60 | 1.95 | 2.50 | 0.01 | V |
| Over Discharge current | | 0 | **300** | 600 | 1 | A |
| SOC--- Battery gauge | | 5 | 20 | 90 | 1 | % |
| **Temperature Protection** | | | | | | |
| High Temperature cut off | | 30 | 50 | 80 | 1 | ℃ |
| Difference(Diff) of battery Temperature(Temp) | | 5 | 10 | 30 | 1 | ℃ |
| **Voltage balance Protection** | | | | | | |
| Difference(Diff) of cell voltage | | 5 | 30 | 300 | 1 | mV |
| **Others** | | | | | | |
| Temperature Unit | | | ℃ | ℉ | | |
| Key Beeper | | | ON | OFF | | |
| LCD Back-Light time[1] | | 1 | 10 | 999 | 1 | min |
| Cut-Off Delay Time[2] | | 0 | 10 | 60 | 1 | Second |
| Current Calibration[3] | | 0 | 0 | 255 | 5 | A |
| Temperature Alarm[4] | | ON | | OFF | | |
| Cell Empty Voltage [5] | | 1.50 | 2.50 | 4.34 | 0.01 | V |
| Cell Full Voltage[5] | | 1.51 | 4.20 | 4.35 | 0.01 | V |
| Default settings | | Press SET/START restore all parameters to default value before delivery | | | | |
| | | | | | | |
| **Balance Parameter setup:    Press SET/START to setup and press for 3 seconds quit setup** | | | | | | |
| Balance Start Voltage[6] | LiPo | 3.3 | 3.6 | 4.1 | 0.01 | V |
| | LiFe | 3.0 | 3.2 | 3.4 | 0.01 | V |
| | LiTO | 1.75 | 2.20 | 2.6 | 0.01 | V |
| Balance Stop Diff Voltage[7] | | | 5 | 12 | 200 | mV |
| Balance in Charge | | ON means Balance start during charge, OFF disable. | | | | |
| Balance in Discharge | | ON means Balance start during discharge, OFF disable. | | | | |
| Balance[8] in Storage | | ON means Balance start during storage, OFF disable. | | | | |

| Parameters | Min. | Type | Max. | Step | unit |
|---|---|---|---|---|---|
| Battery capacity[9] | 0.1 | 1 | 1000 | 0.1 | AH |
| Version:BMS16C3_v1.22[10] | | | | | |
| Low temp. cutoff in charge | -20 | 2 | 20 | 1 | ℃ |
| Low temp. cutoff in discharge | -20 | -10 | 20 | 1 | ℃ |

**NOTES:**

1. **Always on** means the LCD back-light will be ON forever.
2. **NO** means BMS16T will not cut off charge or discharge but alarm by LED flash and Beeper Sound.

**Cut-Off Delay Time** is very important and difference for different battery capacity and application, please carefully test and make a correct decision, for EV, you can select **NO** to control the EV car by manual **NOT** controlled by BMS16T, but when cell voltage and temperature trigger the absolute maximum or minimum ratings, the BMS16T will force to cut off charge or discharge to make sure the battery safety, and prevent battery pack from explode or fire.

3. **Current Calibration** is not recommended to modify unless use new current shunt. Voltage and current is calibrated before delivery.
4. Temperature Alarm OFF means battery temperature and Difference of battery Temperature is unable.
5. Cell Empty Voltage and Cell Full Voltage is to set up cell voltage bar graph, the value should be as same as Over Charge Protection(P) Voltage and Over Discharge Protection(P) Voltage
6. Setup the battery start voltage, when minimum cell voltage over the setup, balance will start automatically
7. Setup the minimum cell difference, when difference of cell voltage under setup, stop balance automatically
8. Balance switcher, default Balance is OFF,
   a) If balance in storage setup ON, balance will start in storage status, STORAGE means charge or discharge current under 1A. So the current shunt and current sensor wire must be connected to BMS. When driving the car, balance in storage OFF is suggested. For storage system, ON is better.

   

   b) If balance in charge setup ON, balance will start in charge
   c) If balance in discharge setup ON, balance will start in discharge
   d) Balance current is 1.2A max. per cell,
9. Setup accurate battery capacity, then charge or discharge 25% of battery capacity, BMS will calibrate SOC automatically,
10. main unit software version

# Balancer

BMS16T can resume cell voltage balanced status at the shortest time, it is based on 1.2A balance current per cell, balance accuracy is 8mV. Balance can be operated in Storage, in charge or in discharge or in all status, the feature can be setup on program setup menu. The balance function is disable before delivery, after the BMS display each cell voltage, please enter into program setup menu to enable balance.

Although balance current per cell is larger than other brand BMS, Chargery BMS16T use temperature protection prevent BMS from overheating, and has an over current protection for each cell.

In some conditions, cell voltage difference drop very slow, it seems don't balance, such as **battery capacity is over 100AH; cell voltage difference over 0.2V; or average cell actual voltage is just cell storage voltage**.

When BMS balance cell voltage, the balance current is 1.2A max. means the high voltage cell discharge 1.2AH per hour at most, with the difference drop between the high cell voltage and the lowest cell voltage, the balance current will drop, till the difference reach "balance stop diff voltage" setting.

The higher the battery capacity and the more the cell difference voltage, the longer the balance time. And the battery discharge platform voltage is storage voltage, so when the average cell voltage is just cell storage voltage, the difference drop very slow, and the balance time seems longer, or looks like the BMS don't balance or stop balance.

Compare balance and cell capacity/impedance accordance, the cell capacity/impedance accordance is more important. With battery discharge and charge cycles increase, the cell capacity and impedance accordance is worse slowly. Take a 100Ah battery as a sample, 5% difference on capacity, means 5Ah need to be balanced, if 1A balance, need 5 hours at least,  consider the 10mV difference as stopping conditions, the balance current will very small at the end of balancing, the total balancing time will be longer than 5h, maybe 10h.

If we think the battery life ended or battery has to stop service when the battery capacity degrade to 70%, it means when the lowest cell capacity is 70Ah (for 100AH battery at the beginning), even other cell capacity is over 70Ah, the battery pack has to stop service. If some cell capacity is 80AH, the balance time will be 20-30 hours.

So after 50 or 100 cycles, it is essential to test battery capacity, and measure each cell impedance to identify which cell is with the highest impedance.  High impedance cell has low capacity and decide total battery capacity and battery life even driving distance.
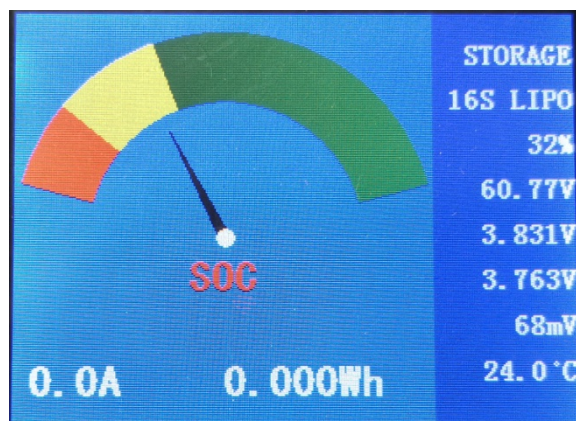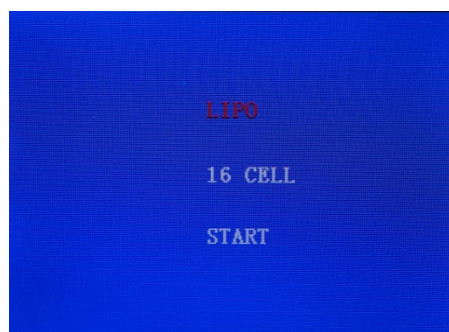
# Operating guideline

**Installation video: https://www.youtube.com/watch?v=39lYl3h1kOU**

**http://chargery.com/Video/BMS24T_C10325_operation_instructions.mp4**

1. Connection balance wire to each battery. Each battery voltage must be around 3.8V for lipo, 3.2V for LiFe or 2.2V for LiTo. Many cells can be connected in parallel but the voltage should be as one battery. The detailed connection diagram is as the following page.

2. Connect main unit to display unit on COM2 port by gray communication wire.

3. Move the power selector to external power supply, don't connect external power to BMS.

4. Connect battery to BMS main unit by 9pin wire. Redundant should be removed or isolated. Move the power selector to battery, turn on BMS.

5. BMS16T LCD unit show model and LCD unit version, then battery type and cell count interface is displayed. Three battery type LiPo, LiFe and LTO can be selected. Cell count range is 2S to 16S, the cell count will be identified automatically. Press DOWN or UP button choose the item and press SET/START blink, then press DOWN or UP button modify, finally press SET/START button to run the BMS16T, or waiting for 8 seconds, the unit will start automatically. After started, battery type and cell count will not be changed unless power off BMS16T.

6. Check if each cell voltage is displayed correctly. If NOT, please check the cell connection.

7. Connect Beeper, LED to LCD unit,

8. Connect current shunt to battery negative and charger / load negative.

9. Connect charge relay to battery positive and charger positive, Connect discharge relay to battery positive and load positive, then connect relay controller to relay coil and then plug into BMS main unit. Redundant controller wire should be removed or isolated, Avoid the controller wire short circuit.

10. Connect temperature sensor, and current sensor to BMS main unit.

11. Press SET/START button for 3 seconds enter into Program Setup interface, modify all related parameters, such as Over Charge Current (50A default) and Over Discharge Current (300A default) according to your application. If need balance in Charge or in Discharge, please modify the Balance set on Program Menu. the balance function is off before delivery

12. SOC—battery gauge dashboard will be displayed first, as following. Press UP/DOWN button alter other interface. If SOC is zero, please turn off then turn on it again. Battery accurate capacity should be setup to get accurate SOC.

STORAGE is battery status, maybe CHARGE or DISCHARGE [1]

Cell count and battery type

SOC—battery gauge, display 0% lose temperature sensor

Battery pack voltage

Highest cell voltage

Lowest cell voltage

Difference of cell voltage

Battery temperature

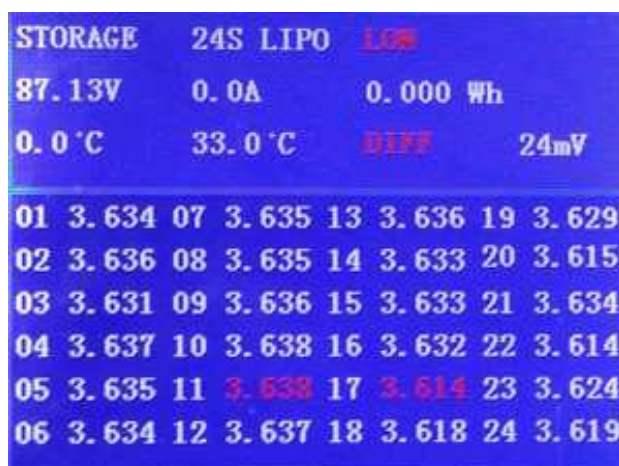Charge or discharge current     Charge or discharge power

13. The following interface is cell voltage bar graph, the highest and the lowest cell voltage is displayed in RED column. The below picture is taken on BMS24T as a sample.

14. The right corner interface display all information including all cell voltage. The highest and the lowest cell voltage is displayed in RED text. Difference of cell voltage and difference of battery temperature is displayed.
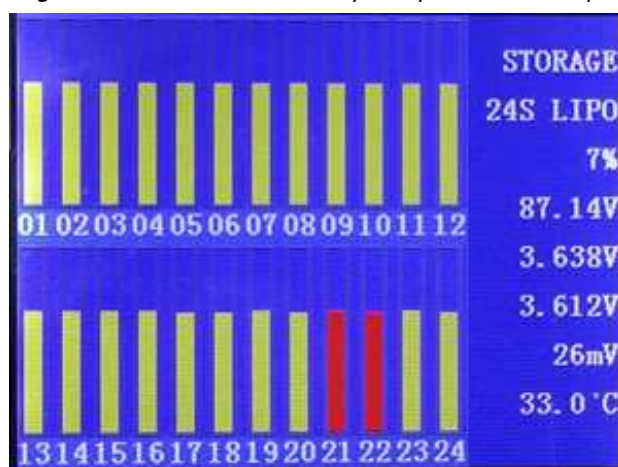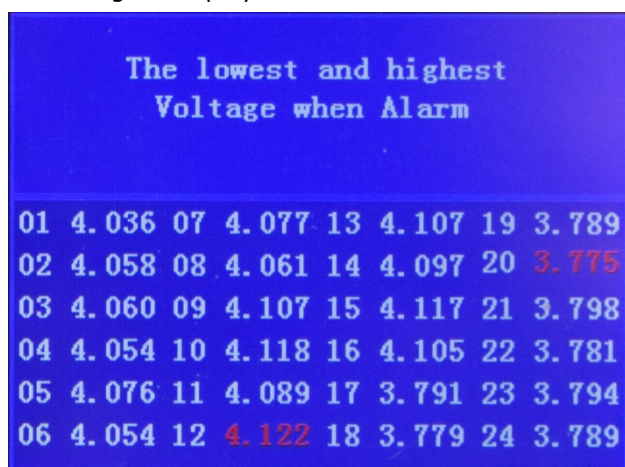




When any warning events triggered, BMS16T will go to the interface and display error information. Such as if the battery connection break down, the cell count and ERROR will be displayed in turn. If the cell voltage over the setup value, the cell voltage and HIGH will be displayed in turn.



15. When any warning events triggered, Press UP or DOWN, you can check which cell triggered the warning events (over charge or over discharge or low SoC), the voltage will be recorded till next warning. See right picture.

16. The right interface display charge or discharge current, charged or discharged power and SoC. When SoC less than 30%, it is displayed in yellow. When under setup, the BMS will cut off discharge.
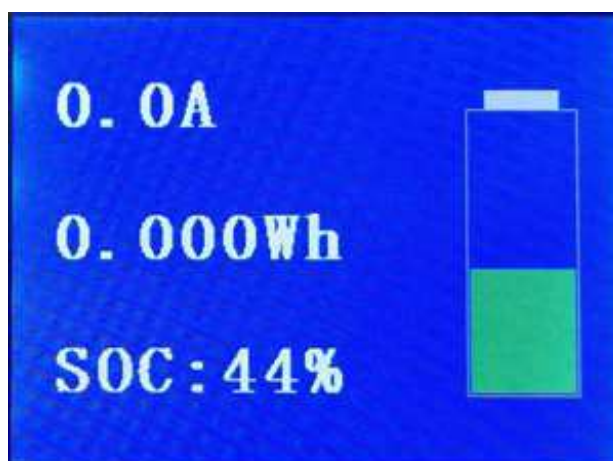


**Notes**

● When charge or discharge current less than 1.0A, battery status will be STORAGE.

● When balance setup is on, Please check if the cell voltage difference is going down, if the difference changes will slow. But the main unit case is warm, means balancing.

● when setup accurate battery capacity, charge or discharge the battery, the charged or discharged capacity is 25% at least, the SOC can be calibrated automatically.

● COM2 is to connect to charger if you have CHARGERY charger, COM3 is to connect to external device.

# Specifications

1. Battery range: 2S-16S LiPo & LiFe, LTO battery pack on BMS16T

2. Accurate scope of the cell voltage: -5mV/+5mV on BMS16T

3. Cell Voltage display range: 0.10~4.99V

4. The voltage of external power：13-60V, 3A

5. Balance current:1.2A per cell

6. Temperature display range:-20℃~150℃,

7. SOC indicator:

   ■ RED area @ 0~15% of SOC

   ■ YELLOW area @ 16~35% of SOC

   ■ GREEN area @ 36~100% of SOC

8. Main module Size: 124×95×30 (L×W×T, mm) or 4.88×3.74×1.18 (L×W×T, inch)

9. Main module weight: 365g excluding accessories

10. Display module size:96×80×24 (L×W×T, mm) or 3.8×3.2×0.95 (L×W×T, inch)

11. Display module weight:130g

12. Warning LED: 11000mCd, @ 2.0V, 20mA

13. Warning beeper: 85dB @ 12V, 25mA

14. Package: AL alloy case

# Current shunt Specifications

Please use correct current shunt according to actual maximal charge and discharge current, singe shunt is enough for BMS16T, 75mV or less shunt is suggested. BMS16T can detect charge and discharge current by same shunt.

All cell voltage and current are calibrated before delivery.

The 300A and 600A 75mV specification is as below.
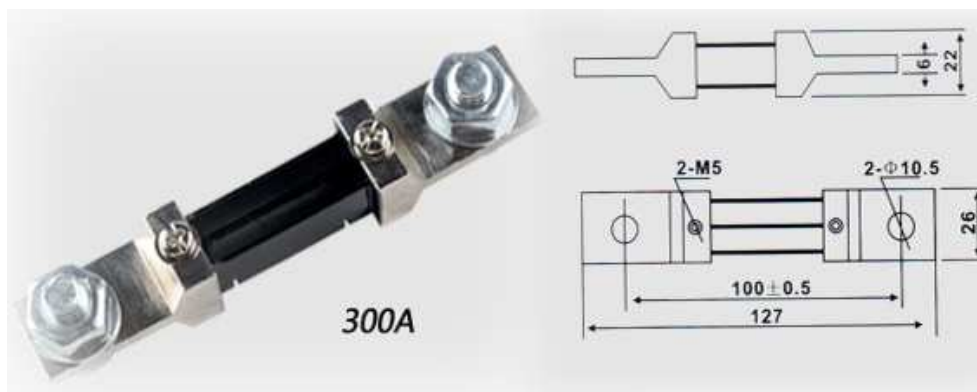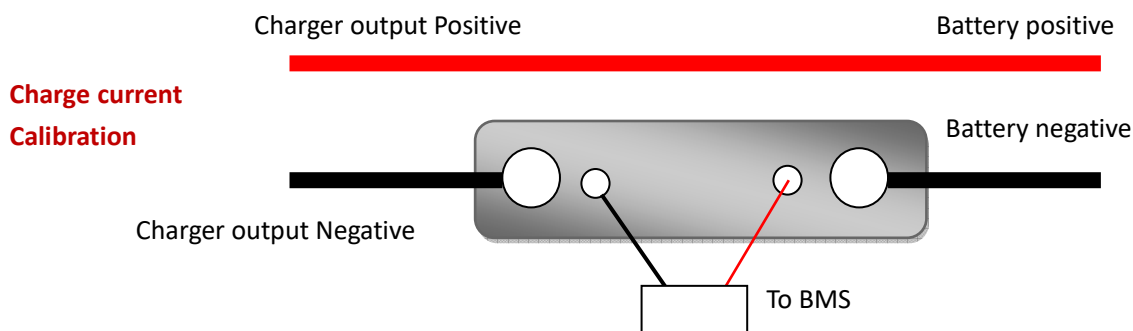
300A shunt weight: 230g
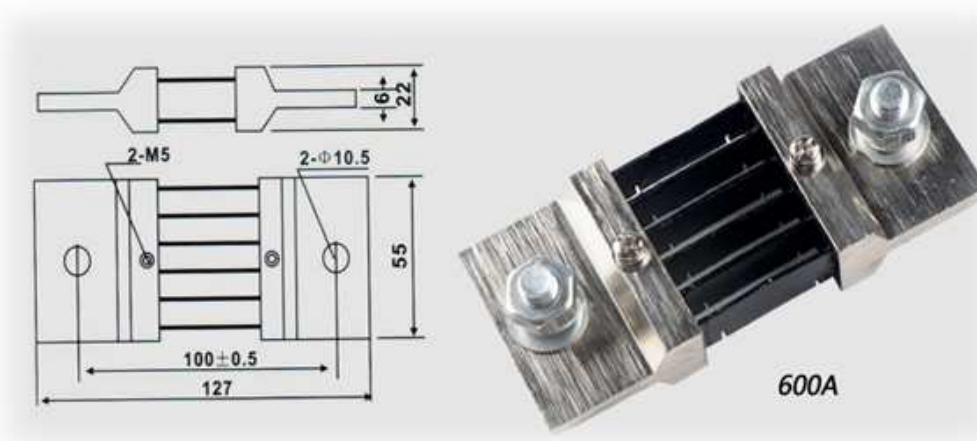
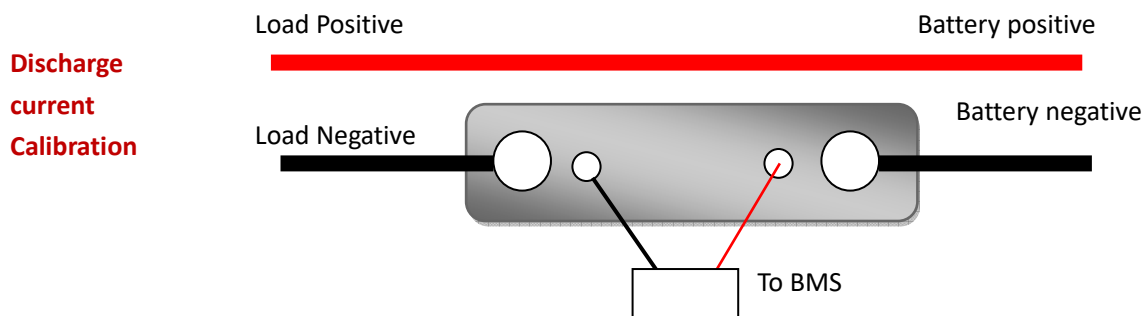600A shunt weight: 530g

# Current sensor wire

# Current Calibration

Press SET/START 3 seconds enter into Program Setup and find the Current Calibration, you can calibrate the current to improve the measure accuracy. If use new current shunt, the current must be calibrated again.

1. Turn off charge and discharge, make the current blink, press UP/DOWN modify the value to zero, shortly press SET/START button finish 0A calibration.
2. Connect the current shunt as following calibrate charge current

Charger output Positive                                                    Battery positive

**Charge current**
**Calibration**
                                                                            Battery negative

Charger output Negative
                                                        To BMS

3. Shortly press SET/START make the current blink and increase the current to new value (up to 125A, it must be less than current shunt, it is better to make it equal to your charge current, the key is the current must be accurate), turn on charger and charge battery at the current, 3 seconds later, press SET/START save the charge current calibration.

4. Connect the current shunt as following calibrate discharge current

Load Positive                                                          Battery positive

**Discharge**
**current**
**Calibration**                                                           Battery negative
Load Negative

                                                        To BMS

5. Press SET/START again and decrease the calibration current to new value (up to -125A, it must be less than current shunt, it is better to make it equal to your motor current, the key is the current must be accurate) turn on motor and discharge battery at the current, 3 seconds later, press SET/START/ save the discharge calibration.
6. Turn off motor, Press SET/START for 3 seconds quit Program Setup, current calibration is finished.

**Here is a Current calibration video: https://www.youtube.com/watch?v=_LOJw83s18M**
**Thanks Jimmy in USA.**

# Firmware Upgrades via USB Port

Please down load the update tool on http://chargery.com/uploadFiles/Update_Tool_V1.03.zip , the USB driver need not installed.

1. Connect the BMS main unit or display module, and power on BMS, the USB driver will be installed on your computer automatically

2. Connect PC to BMS by USB data cable and power on BMS, if update main unit, the LCD display module need not connect to main unit.

NOTE: BMS main unit and LCD display module must be updated separately

3. Execute Chargery update tool software, When the port number (such as com5) appears, this shows the update tool identified the BMS. Click OPEN button lock the port please.

4. Click Open File button load the firmware file. The file should be .hex file. You can down load the latest file here http://chargery.com/update.asp

NOTE: BMS main unit and LCD display module have different firmware file.

5. Click Update button start to update, the update progress bar will appear, update complete information will be displayed on PC. BMS also display the progress bar simultaneously

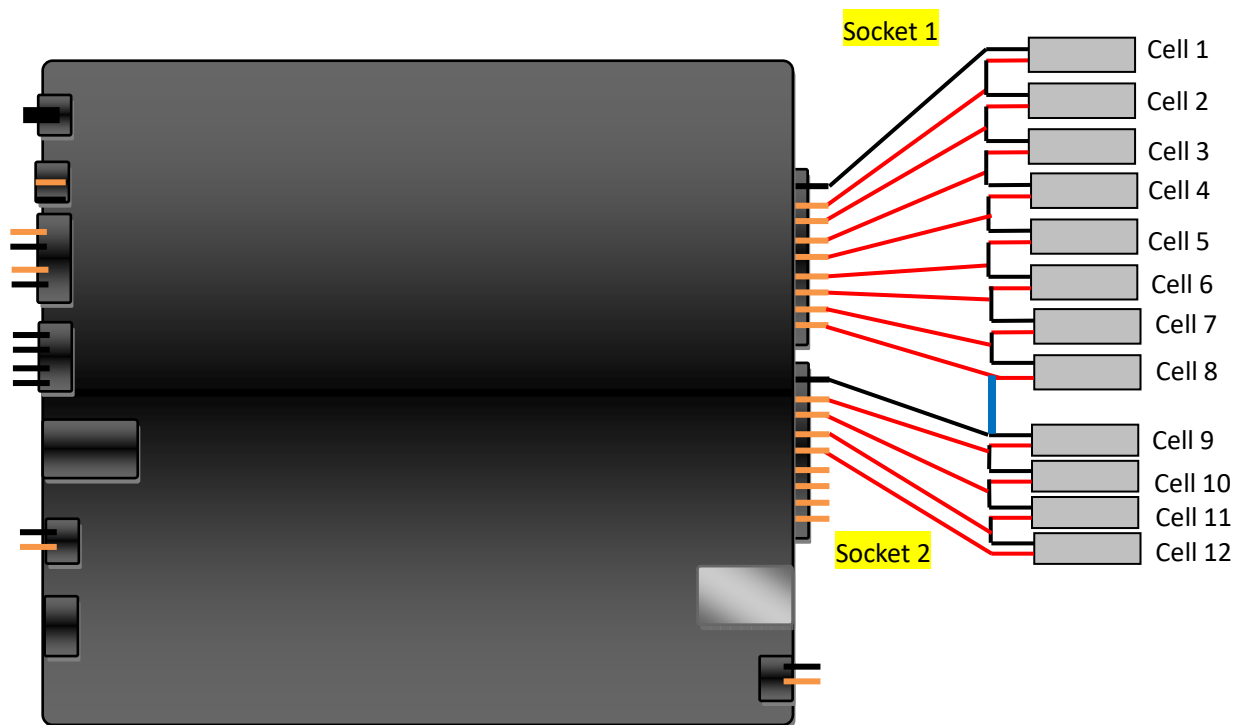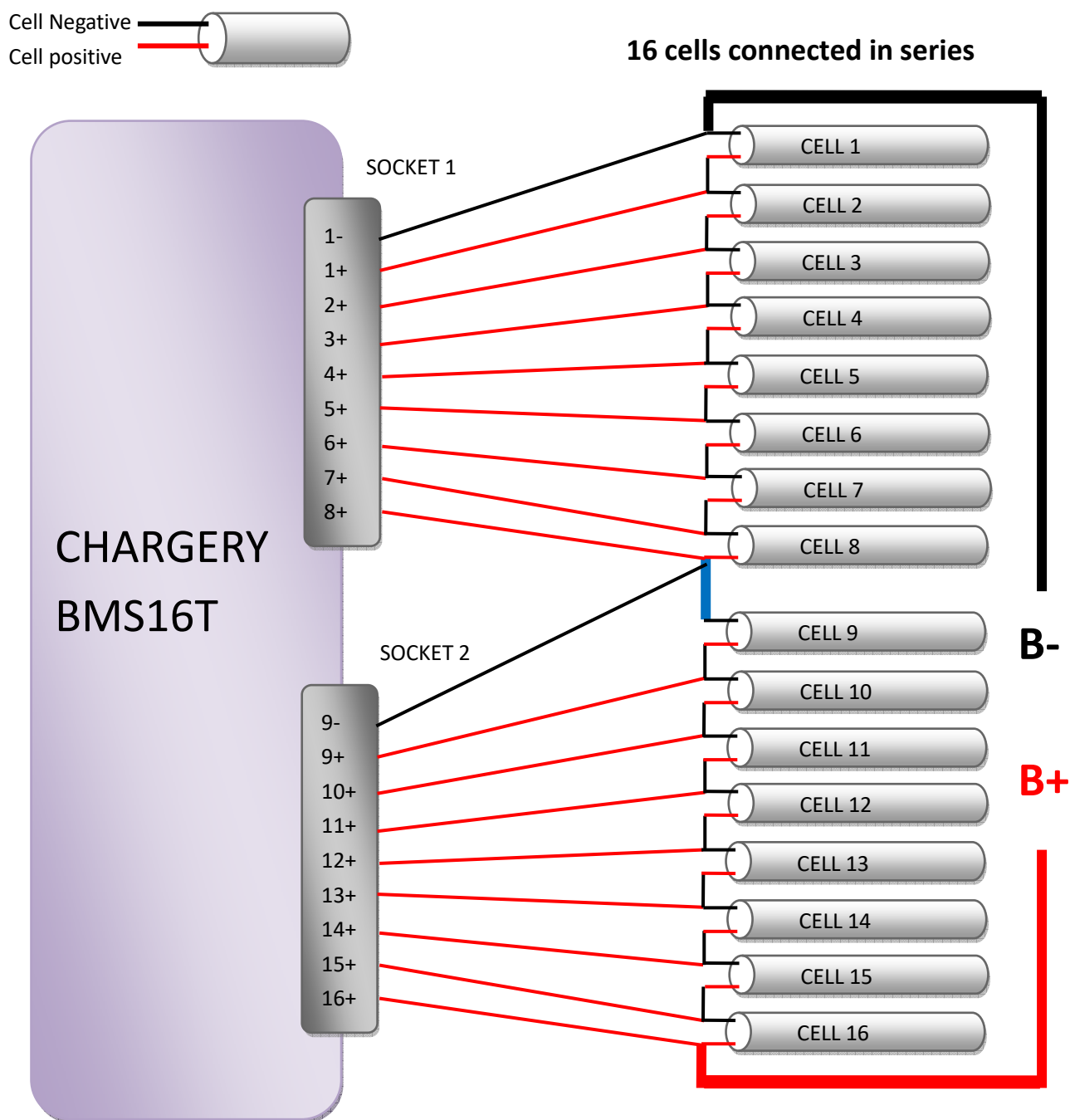6. Finish update, the BMS will start automatically.

# Typical Connection

There are 2 sockets connecting to battery pack, socket 1 is for 2S-8S, and socket 2 for 9S~16S

1.  2S-7S battery connect to the socket 1 directly, but external power supply is essential, it is as following.
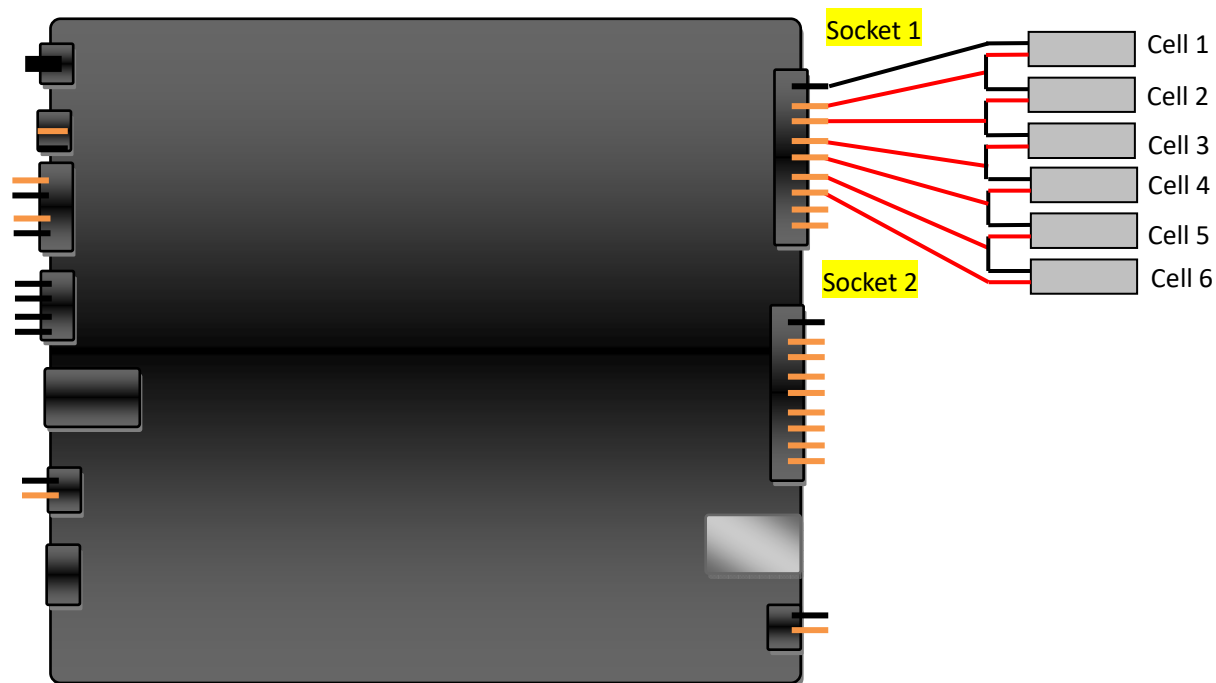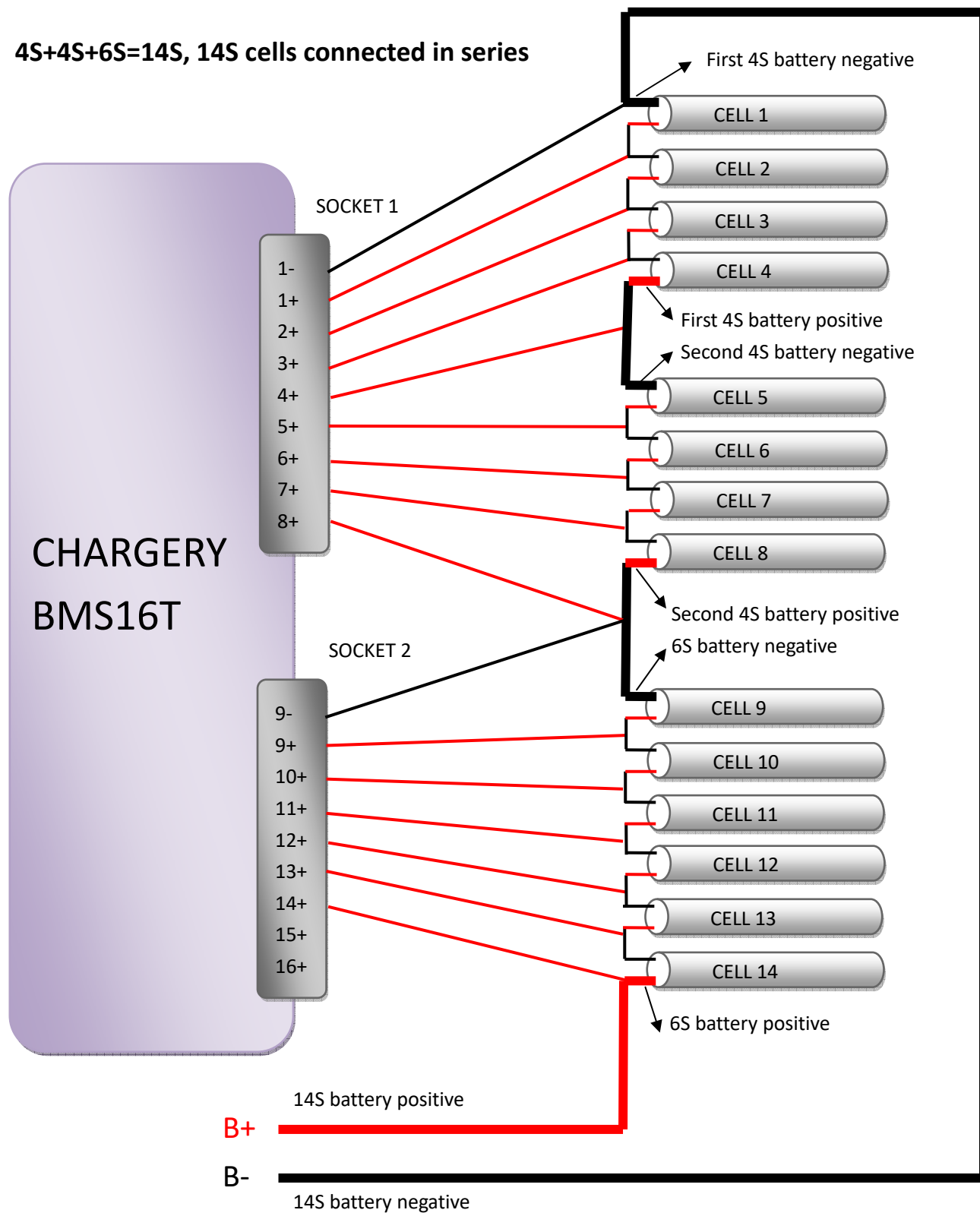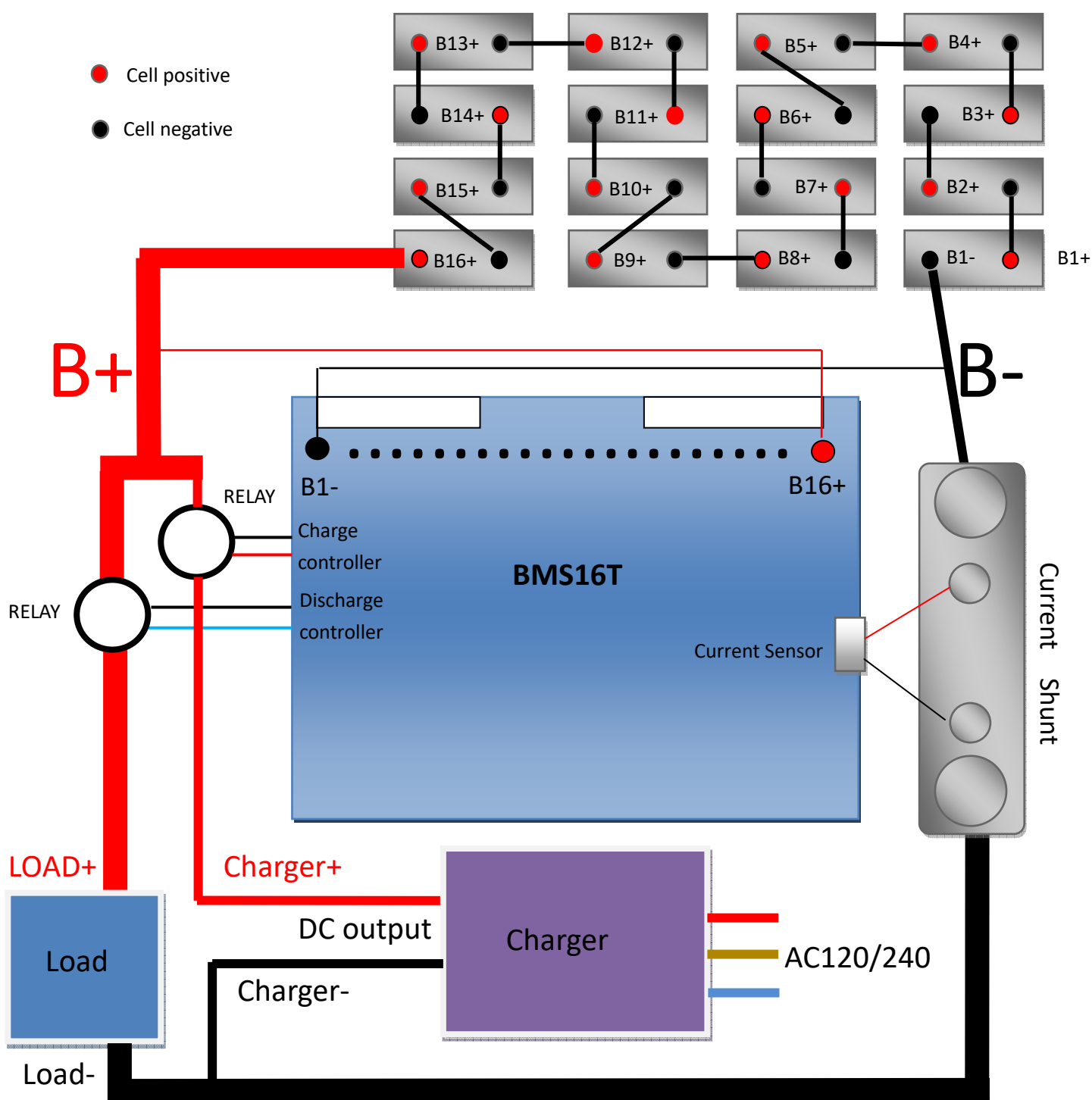


2.  For over 8S battery pack, connect 8S to socket 1 and other cells connect to socket 2 separately. Take 12S battery sample as following:

Cell Negative

Cell positive

**16 cells connected in series**



CHARGERY
BMS16T

SOCKET 1

1-
1+
2+
3+
4+
5+
6+
7+
8+

SOCKET 2

9-
9+
10+
11+
12+
13+
14+
15+
16+

CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14
CELL 15
CELL 16

**B-**

**B+**

**4S+4S+6S=14S, 14S cells connected in series**

First 4S battery negative

CELL 1
CELL 2
CELL 3
CELL 4

First 4S battery positive

Second 4S battery negative

CELL 5
CELL 6
CELL 7
CELL 8

Second 4S battery positive

6S battery negative

CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14

6S battery positive

SOCKET 1

1-
1+
2+
3+
4+
5+
6+
7+
8+

CHARGERY
BMS16T

SOCKET 2

9-
9+
10+
11+
12+
13+
14+
15+
16+

14S battery positive

B+

B-

14S battery negative

Heavy RED wires are positive of battery pack (B+/B16+), charger and load such as motor, and heavy black wire is negative of battery pack(B-/B1-), charger and load.

# **W**arning

Before connect the relay to charge or discharge controller, please confirm the coil of relay voltage. The BMS16T controller will output 12V to power the coil, and total current for charge and discharge relay don't be larger than 2.5A.
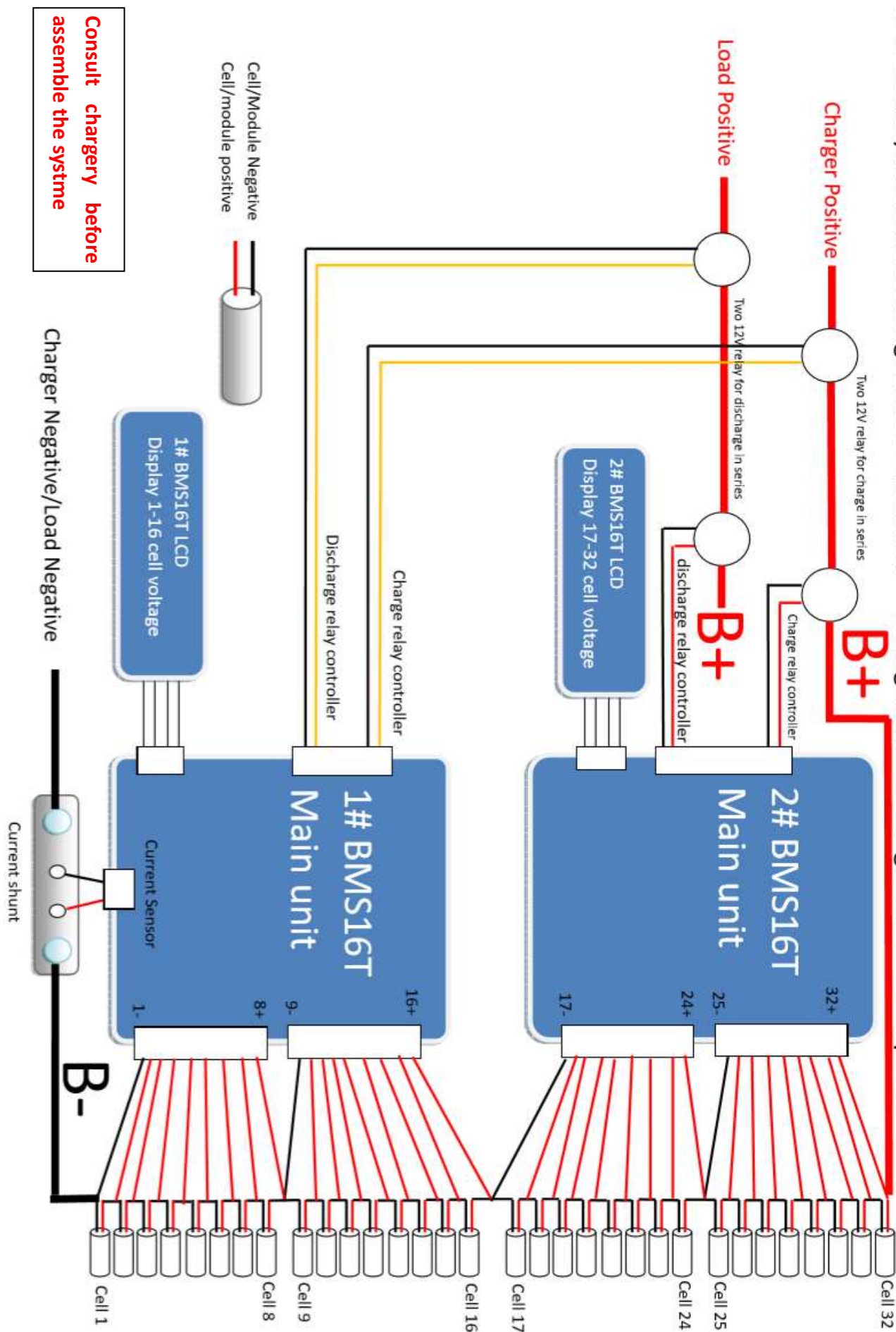
When charge and discharge use one port, the charge relay and discharge relay can be connected in series, but the charge relay must be with enough rated current that is larger than maximal discharge current.
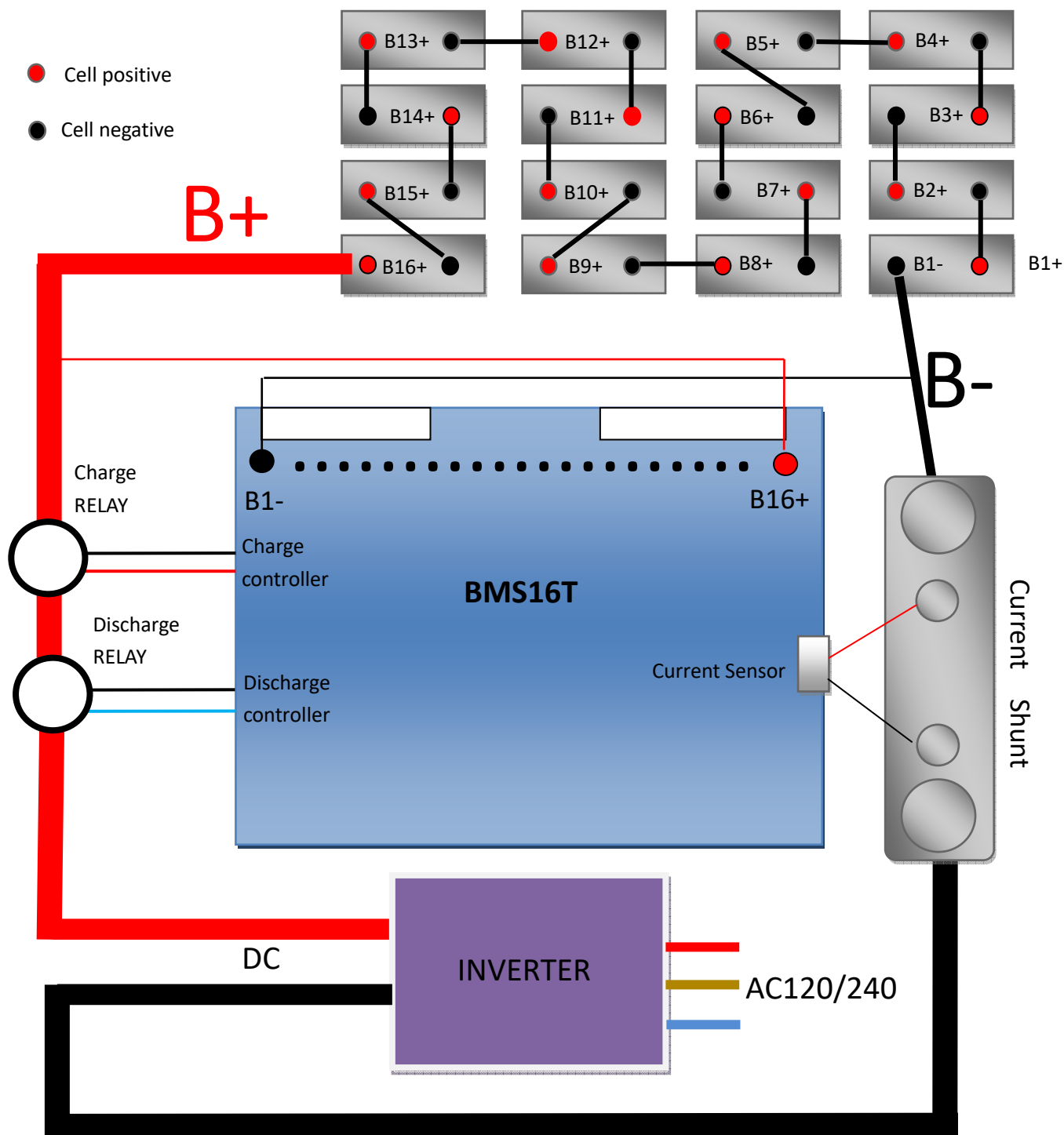


Heavy RED wires are positive of battery pack (B+/B16+), charger and load such as motor, and heavy black wire is negative of battery pack(B-/B1-), charger and load.

# **W**arning

Before connect the relay to charge or discharge controller, please confirm the coil of relay voltage. The BMS16T controller will output 12V to power the coil, and total current for charge and discharge relay don't be larger than 2.5A.
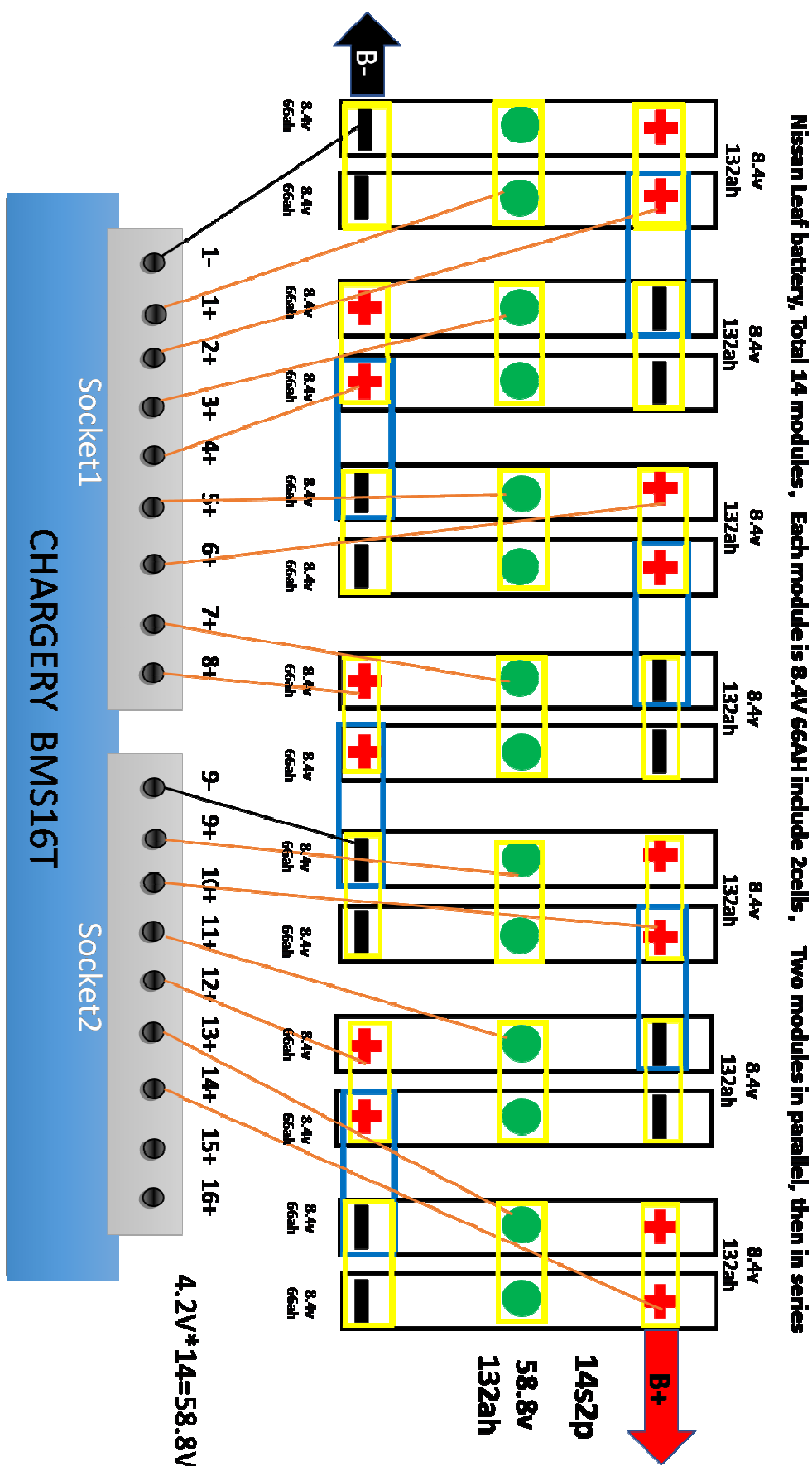
32S battery connection diagram on 2 BMS16T----charge and discharge on different port

Consult chargery before assemble the systme

Load Positive

Charger Positive

Cell/Module Negative
Cell/module positive

Two 12V relay for discharge in series

Two 12V relay for charge in series

Charger Negative/Load Negative

1# BMS16T LCD
Display 1-16 cell voltage

2# BMS16T LCD
Display 17-32 cell voltage

Discharge relay controller
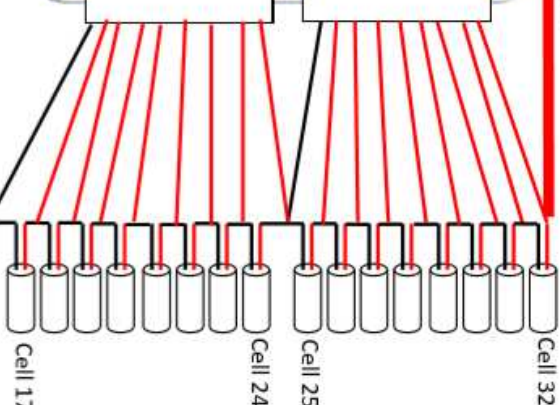
Charge relay controller

discharge relay controller

Charge relay controller

B+

B+

1# BMS16T
Main unit

2# BMS16T
Main unit

Current shunt

Current Sensor

B-

1-

8+

9-

16+

17-

24+

25-

32+

Cell 1

Cell 8

Cell 9

Cell 16

Cell 17

Cell 24

Cell 25

Cell 32

32S battery connection diagram on 2 BMS16T----charge and discharge on same port

four 12V relay for charge and discharge in series

Charger Positive

Load Positive

Consult chargery before assemble the systme

Cell/Module Negative

Cell/module positive

1# BMS16T
Display 1-16 cell voltage

Charger Negative/Load Negative

Discharge relay controller

Charge relay controller

2# BMS16T
Display 17-32 cell voltage

discharge relay controller

Charge relay controller

B+

Current shunt

Current Sensor

1# BMS16T
Main unit

2# BMS16T
Main unit

1-

8+

9-

16+

17-

24+

25-

32+

B-

Cell 1

Cell 8

Cell 9

Cell 16

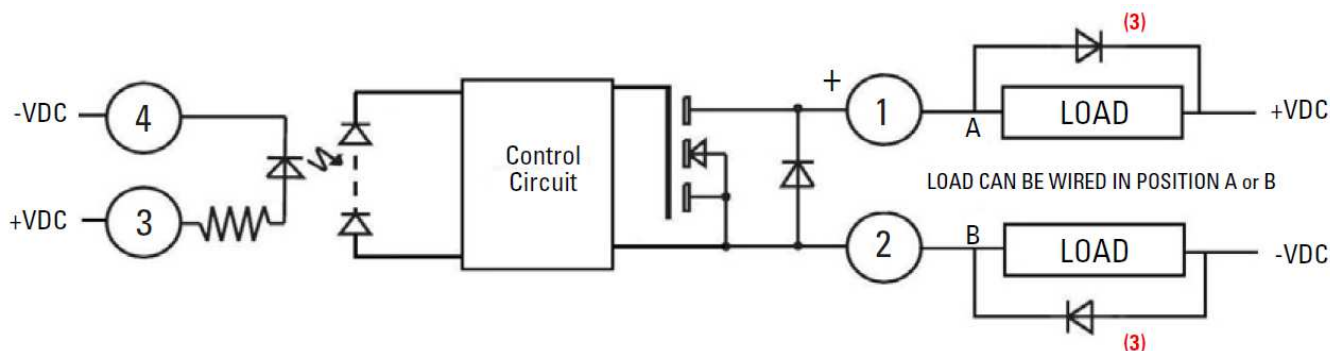Cell 17

Cell 24

Cell 25

Cell 32

# Charge relay and discharge relay lectotype for BMS16T

BMS16T can output 12V 3A to power the charge and discharge relay. So the relay coil driven voltage must be 12V and total current for charge and discharge relay don't be larger than 2.5A.

1. Relay DC rated current should be over 1.2 times of real charge or discharge current. If discharge current is 100A, 120A relay for discharge is suitable.

2. If BMS16T is powered by external power supply, the external voltage should be 15-60V and can output 3A at least to drive the relay and power the BMS16T.
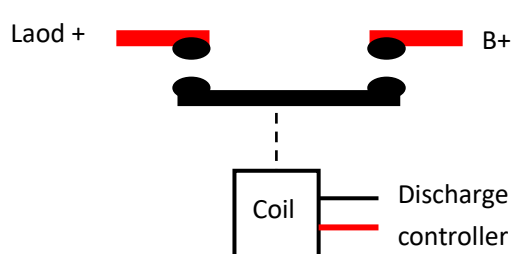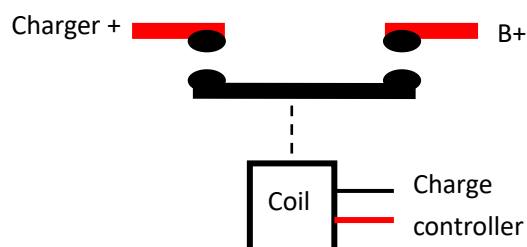


3. For solid state relay, the driven voltage (+VDC, -VDC), adequate Heats Sink and rated load current is very important, please pay attention to its wire connection.

## Standard Accessory

| USB data cable | Battery connection XHR-9PIN, 600mm | |
|---|---|---|
|  |  | |
| Temperature sensor, 600mm | Relay controller wire 600mm | |
|  |  | |
| Warning LED, 300mm | Warning Beeper, 300mm | |
|  |  | |
| Current sensor wire, 600mm | Communication wire (4.5 meters) | COM3 Data line |
|  |  |  |

# Optional accessories

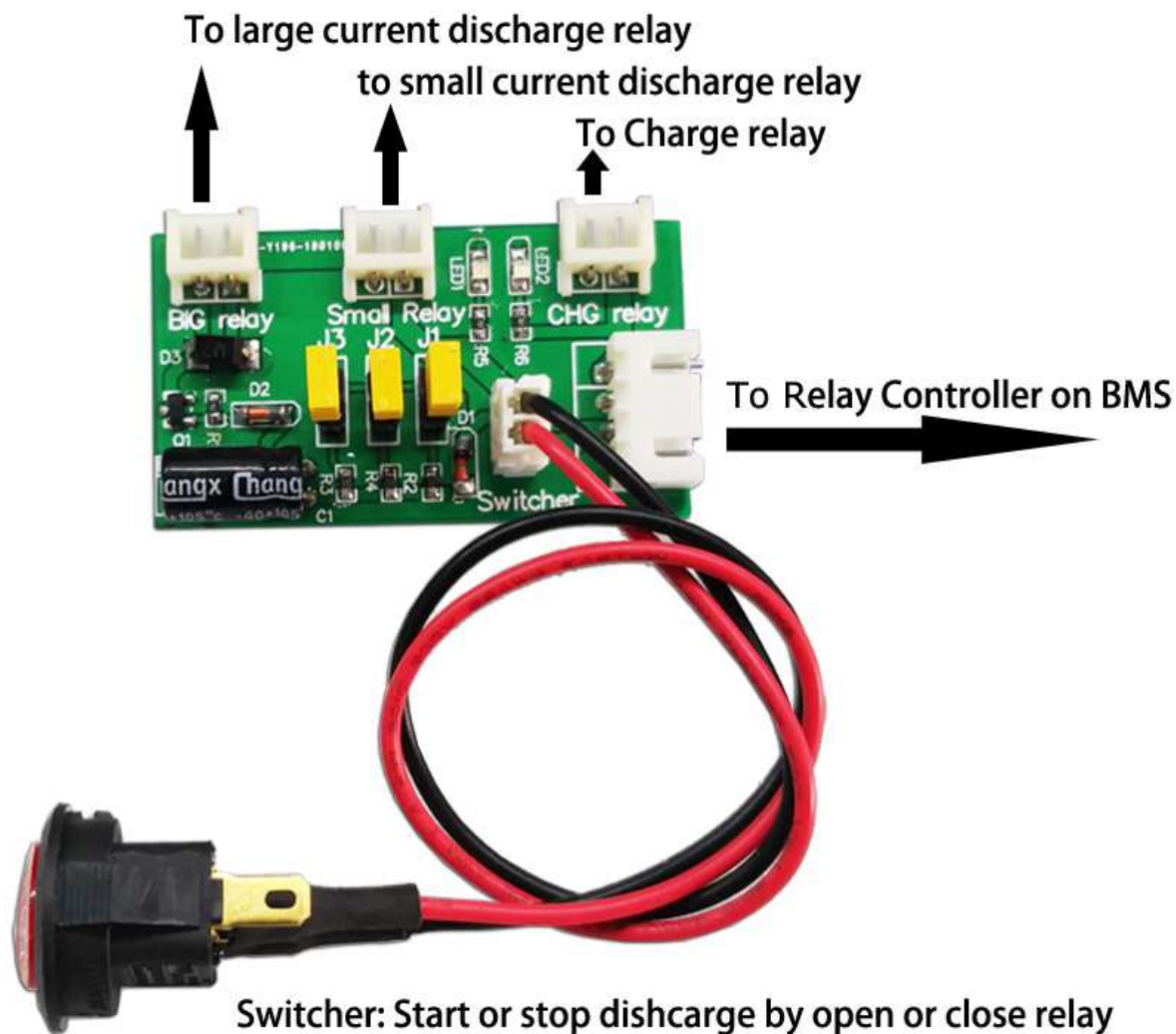1.  12V 100A, 200A 400A, 600A and 800A relay, all is normal open.

| Rated    Operating voltage | 12V – 500V DC | | | | |
|---|---|---|---|---|---|
| Continuous (Carry) Current, Typical | **100A** | **200A** | **400A** | **600A** | **800A** |
| Voltage drop at 100A load | ⚡80mV | ⚡80mV | ⚡80mV | ⚡80mV | ⚡80mV |
| Coil operating voltage range | 12V±20% | 12V±20% | 12V±20% | 12V±20% | 12V±20% |
| Close (includes bounce), Typ. | 10 ms | 10 ms | 10 ms | 10 ms | 10 ms |
| Release (includes arcing), Max | 40 ms | 40 ms | 40 ms | 40 ms | 40 ms |
| Bounce (after close only), Max. | 3 ms | 3 ms | 3 ms | 3 ms | 3 ms |
| Insulation Resistance @ 500VDC | 20MΩ | 20MΩ | 20MΩ | 20MΩ | 20MΩ |
| Coil power | 4-10 w | 4-10 w | 4-10 w | 4-10 w | 4-10 w |
| Load Life | 20000 Cycles | 20000 Cycles | 20000 Cycles | 20000 Cycles | 20000 Cycles |
| Mechanical Life | 1 million | 1 million | 1 million | 1 million | 1 million |
| Operating Ambient Temperature | -40 to +85 ℃ | -40 to +85 ℃ | -40 to +85 ℃ | -40 to +85 ℃ | -40 to +85 ℃ |
| Weight, Nominal | 0.3 Kg | 0.5 Kg | 1.0 Kg | 1.6 Kg | 3 Kg |

2.    Relay delay time board



Switcher: Start or stop dishcarge by open or close relay

When battery start to discharge and power the motor, the surge current is very large, in order to restrain the current, CHARGERY designed the special board, it can fit with CHARGERY BMS8T, BMS16, BMS16T and BMS24T and so on.

The board gets the relay driven signal from BMS, charge relay coil and small current discharge relay will be closed without any delay. But the large current discharge relay will be closed after a delay time. When large current relay closed, the small relay will be open automatically according to the below connection diagram.

The delay time can be adjusted by J1, J2 and J3. When use 3 jumpers short circuit the 3 sockets (as upper picture), the delay time is 2 seconds, when use any two jumpers such as J1 and J2 or J2 and J3, the time is 3 seconds. When use one of 3 jumpers, the time is 6 seconds.

The small current relay and large current connection is as below,
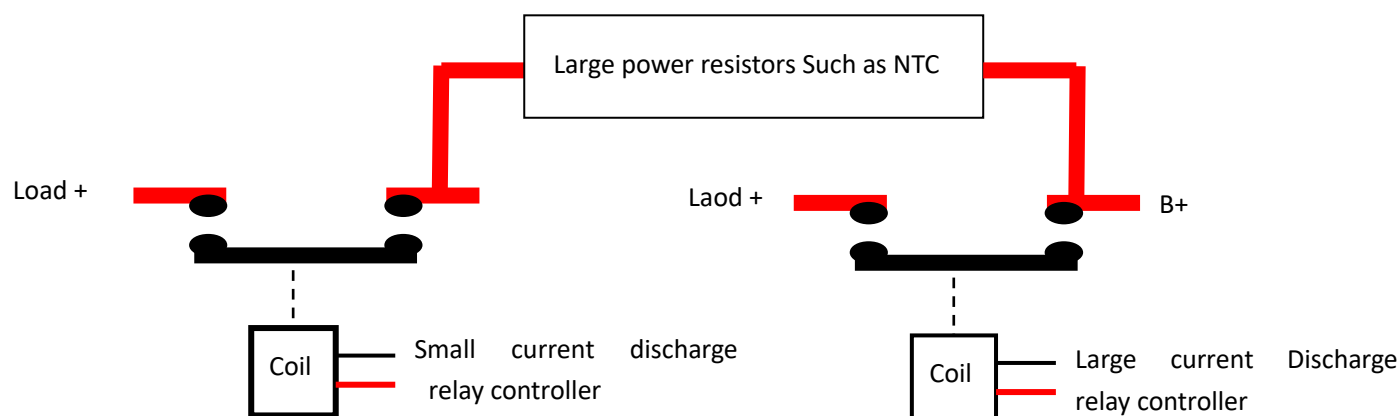


The large power resistors must be chosen by delay time and load current.

Surge Power Rating: During start up, certain loads require considerably higher surge of power for short duration (lasting from tens of milliseconds to few seconds) as compared to their Maximum Continuous Running Power Rating. The inverter continuous powershouldbehigherthanthesurgepowerratingoftheseappliances.Some examples of such loads are given below: Electric Motors:At the moment when an electric motor is powered ON, the rotor is stationary (equivalent to being "Locked"), there is no "Back EMF" and the windings draw a very heavy surge of starting current (Amperes) called "Locked Rotor Amperes"(LRA) due to low DC resistance of the windings. For example, in motor driven loads like Air-conditioning and Refrigeration Compressors and in Well Pumps (using Pressure Tank), the Starting Surge Current / LRA may be as high as 10 times its rated Full Load Amps (FLA) / Maximum Continuous Running Power Rating. The value and duration of the Starting Surge Current / LRA of the motor depends upon the winding design of the motor and the inertia / resistance to movement of mechanical load being driven by the motor. As the motor speed rises to its rated RPM, "Back EMF" proportional to the RPM is generated in the windings and the current draw reduces proportionately till it draws the running FLA/ Maximum Continuous Running Power Rating at the rated RPM.

Take a sample, if motor rated current is 100A, the surge current may be 1000A, it is over the maximal discharge current of battery, so need a power resistor to restrict the current to such as 100A (. so need a 200A small relay and a large power resistor. The resistor value should be over 0.48 OHM (If battery voltage is 48V), and the rated power depend on delay time. The 10pcs 5D-20 (5ohm) in parallel (6 seconds delay time), 5pcs 3D-20 (3ohm) in parallel (3 seconds delay time) or 2pcs 1D-20 (1ohm) in parallel (2 seconds delay time) is suggested.

Anyway, it is better to consult inverter or motor supplier before test the small relay and power resistor.

Finish all connection and setup, check and confirm all is ok, when ready to go, please disconnect all other switchers on other device , finally turn on the switcher on the board, the battery will start to charge or discharge.

| LED 2 ON | all cell voltage is in normal range, No cell voltage over OVP. Charge relay closed. |
|---|---|
| LED 1 ON | all cell voltage is in normal range, No cell voltage under UVP, Small discharge relay closed for a short time that is delay time. |
| LED 3 ON LED 1 OFF | all cell voltage is in normal range, No cell voltage under UVP, Small discharge relay OPEN and large discharge relay closed, motor round at rated RPM |

When the battery is not in use, please power off the switcher to save battery energy. The switcher should be installed on convenient place to be operated.

# Related parts

The following device is related with BMS16T

| MODEL | DESCRIPTION | COMMENTS |
|---|---|---|
| BMS16 | For 2S-16S, without cell balancer | 300A charge/discharge |
| BMS8T | For 2S-8S, 1.2A balance current per cell | 600A max. charge/discharge |
| BMS24T | For 2S-24S, 1.2A balance current per cell | 600A max. charge/discharge |
| C10325 | AC charger for 4S-24S battery pack | 1-25A charge, 1500W max. |



1.2A balance

600A max. charge/discharge

# Total solution on E-Vehicle application

If use Chargery charger, the charge relay can be ignored, BMS16T can communicate with charger, when any cell over charged, BMS will send signal to charger, the charger will decrease charge current till the cell voltage under safe value. If use other brand charger, BMS16T only make the relay OPEN, if charge current is big such as over 10A, the relay will open and close repeatedly. The relay life will be shortened and charge time will be longer.

Chargery charger and BMS save a relay cost and shorten the charge time.



The BMS on above picture is BMS24T, it is as a sample, the connection is as same as BMS8T and BMS16T

**NOTE**

Chargery charger decrease charge current according to "Over Charge Protection(P) Voltage" on BMS setup, so please setup the charge terminal voltage setup in accordance with Over Charge Protection(P) Voltage on BMS.

# Frequent questions

1. **Charge or discharge relay/DC contactor don't be open(disconnect) or closed (connect)**
   a) Confirm relay coil driven voltage, it must be 12V.
   b) Confirm relay coil consume power or current, don't be over 1A for each relay or total current with two relay don't be over 2.6A
   c) Without alarm the charge and discharge relay controller voltage is 12V,
   d) When any alarm events happen, the charge and discharge relay controller voltage is 0V,
   e) Without any warnings, the relay always closed

2. **Cell voltage display is not accordance with actual cell voltage**
   a) Check 9pin balance wire connection is good.
   b) Measure actual cell voltage on BMS balance port.
   c) Disconnect battery, measure resistance on balance port. Such as, if cell 5 voltage is not correct, measure resistance between cell 5- and 5+ on balance port. Generally it is very large ( 100K orso).
   d) Or send back to us and calibrate the cell voltage again.

3. **SOC is zero,**
   a) Restart BMS main unit---power off it and power on again.

4. **SOC is wrong**
   a) Setup accurate battery capacity on program setup interface
   b) Charge or discharge the battery. Charged capacity or discharged capacity is 25% of battery rated capacity at least.
   c) BMS will calibrate the SOC automatically after charge or discharge.

5. **Charge or discharge current display is not stable or wrong**
   a) The wire length from current shunt to battery negative should be as short as possible.
   b) Check charge current or discharge current ripple, especially on inverter.
   c) Add low-pass filter on current sensor, or
   d) Update main unit to V1.21, need not calibrate current.
   e) If exchange shunt, or other reasons need calibrate current, the calibration video is here
   https://www.youtube.com/watch?v=_LOJw83s18M

6. **Cell voltage difference drop slow during balance**
   a) Setup balance in storage is ON
   b) Setup balance in charge is ON
   c) Setup lower balance start voltage
   d) Confirm the BMS main unit blue case is warm, if yes, means the balance is in working.
   e) If a cell voltage is always lower than others, such as cell 5, please disconnect all battery and measure resistance between cell 5- and 5+ on balance port. Generally it is very large (100K ohm orso). If only 10 ohm or less, please return back to us for repair.
   f) For over 50Ah battery, the balance time is longer
   g) After discharge, check the cell voltage difference on LCD, if over 100mV even 200mV, means the cell impedance difference or capacity difference is very large. Exchange lower voltage cell in discharge or higher voltage cell in charge is suggested.

7. **STOP button freeze**
   a) When current displayed is zero, that is to say, the battery don't be in charging or discharging, press STOP button make the BMS enter into sleep mode to save battery energy.
   b) If need wake up BMS, please press UP, DOWN or START Button.

    c) If stop charging or stop discharging, please realize it on charger or load/inverter or other switcher.

8. **BMS power consumption**
    a) At normal work mode, the BMS draw current from 16S battery (60V) is 6.3mA at LCD back light is off, and 10.5mA at LCD back light is ON.
    b) At sleep mode, the BMS draw current from 16S battery (60V) is less than 1mA at LCD back light is off.

9. **Relay closed continuous power consumption.**
    a) 12V 100A relay, coil current is 0.75A at 12V drive voltage.
    b) 12V 200A relay, coil current is 0.96A at 12V drive voltage.
    c) 12V 400A relay, coil current is 1.24A at 12V drive voltage.
    d) 12V 600A relay, coil current is 1.3A at 12V drive voltage.

Because relay coil current is far more than BMS working current, to avoid any cell over discharged, please operate as below,
- if the battery is not in use (exclude charging), please disconnect all relay coil driven wire immediately,
- If storage for over 1 month, please make BMS enter into sleep mode.
- If storage for over 3 months, please turn off BMS directly.

10. Show timeout during updating,
    a) Update tool software version must be v1.03
    b) Connect BMS main unit or LCD unit to PC by USB cable.
    c) Turn on BMS main unit.
    d) Execute update tool software and lock the com port by click OPEN button.
    e) Down load correct firmware according to product model and save your PC.
    f) Click open file button and upload the correct firmware.
    g) Click update button finish update.

11. Charging stop, the possible reasons are as below.
    a) Any cell voltage reach "Over Charge Protection(P) Voltage " setting
    b) The highest cell voltage over "Over Charge Release(R) Voltage" setting.
    c) Charging current over "Over charge current" setting.
    d) Battery temperature over "high temperature cutoff" setting.
    e) Battery temperature under "low temp cutoff in charge" setting.
    f) Battery temperature difference over "diff of battery temp" setting.
    g) Charger stop charging,

12. Discharging stop, the possible reasons are as below.
    a) Any cell voltage reach "Over discharge Protection(P) Voltage " setting
    b) The lowest cell voltage under "Over discharge Release(R) Voltage" setting.
    c) Discharging current over "Over discharge current" setting.
    d) SOC under "SOC----battery gauge" setting.
    e) Cell voltage difference over "Difference(Diff) of cell voltage" setting.
    f) Battery temperature over "high temperature cutoff" setting.
    g) Battery temperature under "low temp cutoff in discharge" setting.
    h) Battery temperature difference over "diff of battery temp" setting.
    i) Others

# Version History

| Software Version of LCD unit | Description |
|---|---|
| V3.0 | Released first time |
| V3.01 | debug a mistake on display |
| V3.02 | adjusted maximal cell difference can be set up to 1000mV |
| V3.03 | Add low temperature cutoff |
|  |  |
|  |  |
|  |  |
|  |  |
| **Software Version of main unit** | **Description** |
| V1.18 | first released |
| V1.19 | optimize over charge protection, don't cut off charge when cell voltage difference over setup. |
| V1.20 | optimize current detection |
| V1.21 | add current mode send out |
| V1.22 | Add SOC send out |
|  |  |
|  |  |
|  |  |

# Warranty and Service

Chargery Power Co., Ltd. as manufacture of power system warrants its BMS16T and current Sensor to be free of defects in material and workmanship. This warranty is effective for 12 months from date of purchase. If within the warranty period the customer is not satisfied with the products performance resulting from a manufacturing defect, the accessory will be replaced or repaired.

Your selling dealer is your first point of contact for warranty issues. Return postage costs are the responsibility of the user in all cases. Please submit copy of original receipt with the return.

Damage due to physical shock (dropping on the floor, etc.), inappropriate power supply (unstable output voltage and insufficient power, etc.), water, moisture, and humidity are specifically NOT covered by warranty.

**Charging Expert**

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