BMS16T

for 2S-16S LiPo/Li-ion, LiFe & LiTO

Low power consumption
High accuracy
2.8" TFT LCD display
Programmable

Thanks for your purchasing the BMS16T for your vehicle.

Read 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

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

Jason Wang

Thanks to Steve_S from https://diysolarforum.com , he rewrite the manual and make it easy to understand.

Revised : 3/15/2020

Chargery BMS16T is designed especial for LiPo,LiFe and LiTo battery packs applied to storage energy systems and Electrical Vehicles 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), the information is displayed with TFT color LCD screen.

Safety Notes

Please read the entire manual completely before using, to ensure safe and efficient use.

1. Ensure the BMS program and settings match your battery pack, otherwise the battery may be damaged and a dangerous situation may arise, especially for Lithium based batteries, which may catch fire.
2. Use the Battery Cell Manufacturers specifications and information when configuring your BMS.
3. For Energy Storage System and Electric Vehicle applications, there are many different requirements, please adjust those key parameters carefully for your application, or contact us for more details.
4. Do not allow water, moisture, metal wires or other conductive materials to come in contact the device.
5. Never charge or discharge any battery having evidence of leaking, expansion/swelling, damaged outer cover or case, color-change or distortion.
6. Do not try to charge "non-rechargeable" dry cells.
7. Do not mix batteries of different types, different capacities or from different manufacturers, all cells used should be of matching specifications.
8. Do not exceed the battery manufacturer's suggested maximum charge and discharge rates.
9. Carefully follow the battery pack manufacturer's recommendations and safety advice.

Warning

1. The Current shunt must not make contact with any metal including the BMS case
2. The BMS case should not be in direct contact to any metal
3. Current shunt must connected to the Battery Pack Negative !
4. Prevent BMS from vibrations and shaking
5. Ensure the BMS case does not make contact with battery wiring in any way.

Copyright

Special update

1. Added RS232 port, allowing for external devices to read out the data from the BMS. Additional Information on the data is located here: http://chargery.com/uploadFiles/bms24_additional_protocol%20V1.22.pdf
2. Improved cell voltage detection accuracy
3. Added over current protection during balancing
4. Added low temperature protection(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. Added 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 8S battery pack. It can drive larger current mechanical and state solid relays.
8. If using external adapter, the BMS can support 2S-7S battery, the external voltage range is 13-60V.
9. The BMS uses one Current Shunt to detect Charge & Discharge current per battery pack. The BMS controls Charge & Discharge relays separately.

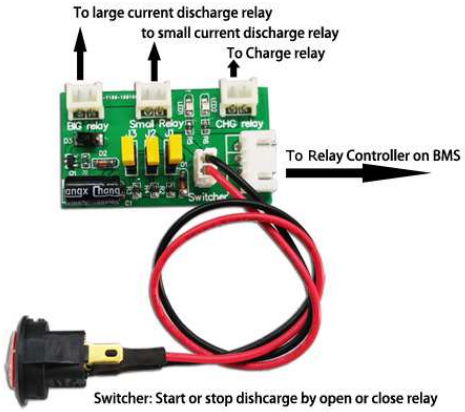
Order information

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 31,

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

Notes:

BMS16T includes Main Unit and Display Module, after powering on the BMS16T finish setting up all of the parameters using the Display Module. The BMS16T will use those settings even if the Display Module is disconnected from the Main Unit. This disables the data display, beeper and warning LED but the BMS will still function properly and can cut off charge / discharge when any set condition requires it. You can connect an external device to the COM3 port on Main Unit to receive all data. More information on this is located here: http://chargery.com/uploadFiles/bms24_additional_protocol%20V1.22.pdf To modify the parameters in setup, please reconnect the Display Module, no data can be written to the BMS from an external application at this time. The BMS16T can be used with any lithium battery charger, when any cell is over charged, the BMS16T will open the charge relay to cut off charge, if used with a CHARGERY charger, the charge control is handled by connecting the CHARGERY charger to the BMS16T on COM1, when any cell reach OVP, the charge current will decrease automatically to prevent any cell damage. 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 (34V)
2. Supports regenerative braking, during braking operation it can charge the battery pack and the discharge power (Wh) will decrease in response to the braking power.
3. Charge/discharge current up to **600A**. Larger current support can be custom ordered.
4. **1.2A** per cell balance current is very useful for large capacity battery pack, this feature can restore all cell voltage balance in the shortest time. Over temperature protection ensures the system safety during balancing.
5. BMS16T calculates and displays the charge and discharge power (Wh), generally the battery rated power is rated voltage multiplied by 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 maximum safety protections, within the range parameters that can be setup, BMS16T will alarm and cutoff charge or discharge according to users' setup, out of range parameters and triggered absolute maximum settings BMS16T will force cutoff charge / discharge to protect the battery.
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 the cells or an external power supply.
10. Detect cell count at any time, and compare with the count detected when switched on first time. If inconsistent, the device will alarm and cutoff charge or discharge according to user setup, this is a safety feature is if a cell becomes loose.
11. Sound alarm and LED alarm will be triggered if any warning events occur, it will wait several seconds, then disconnect charge / discharge if required. The delay time can be programmed.
12. The Charge and Discharge relays are controlled independently.
13. Two temperature sensors monitor battery temperature for different positions on the pack.
14. Supports upgrading the firmware program by USB port.
15. BMS16T provide users the maximum flexibility, key parameters can be programmed.
16. BMS16T displays battery SOC as a dial gauge. Cell count, battery pack voltage and battery gauge (%) temperature is displayed simultaneously.
17. In case the battery pack is not to be charged / discharged and put into **storage mode**, Press STOP button enter into Sleep Mode to save energy consumption, Charge / Discharge are disabled and the LCD back light is turned 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 activate.

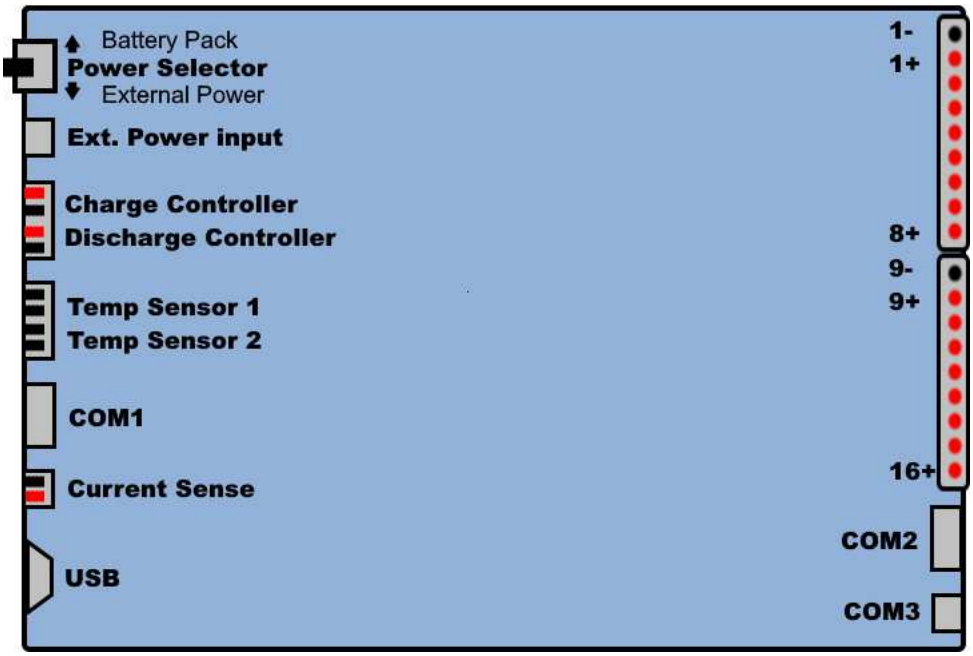
Protection functions

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)

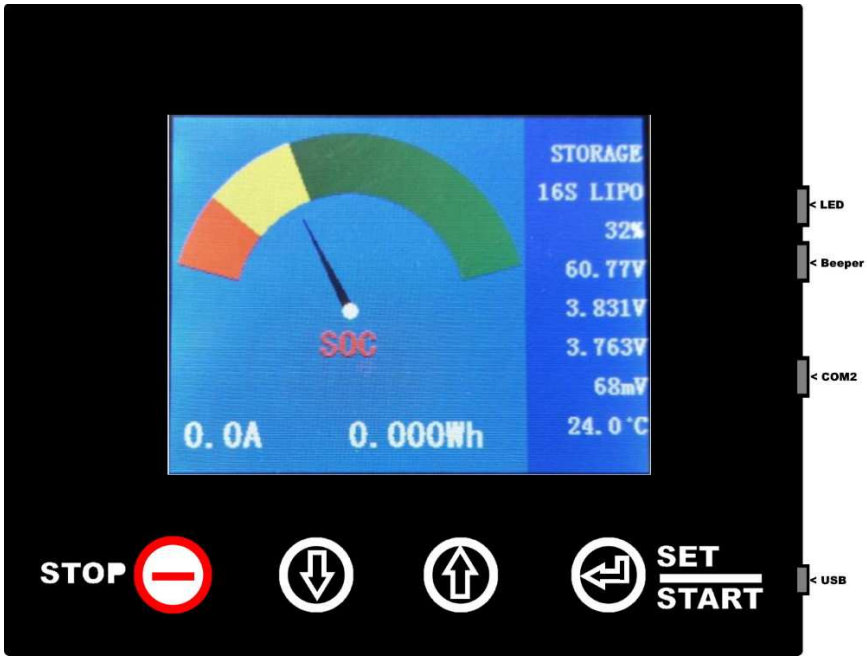
7. Over differential cell voltage protection in discharge
8. Over differential battery temperature protection
9. Under SOC protection

Interface

BMS16T Main Module



BMS16T Display Module



Power Selector	**Battery pack** to power the BMS. the battery pack must be 8S to 16S LiFe or LiPo or LiTO. **External power** supply, BMS16T supports 2S to 16S LiPo, LiFe or LiTo battery pack. The external input supply Voltage range is 13V to 60V @ 3A.
External power port	External power input, the voltage should be 15V to 60V, 3A minimum, the current depends on the relay, the connector is 5.5*2.1 DC jack.
Charge controller	Charge controller, connected to relay / DC contactor. will "OPEN" the relay by releasing the coil power when any cell voltage is OVER setup values. Otherwise the BMS16T will output 12V power the coil to close the relay when everything is within programmed settings. The relay must be a "Normally Open" type.
Discharge controller	Discharge controller, connected to relay / DC contactor. will "OPEN" the relay by releasing the coil power when any cell voltage is UNDER setup values. Otherwise the BMS16T will output 12V power the coil to close the relay when everything is within programmed settings. The relay must be a "Normally Open" type.
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

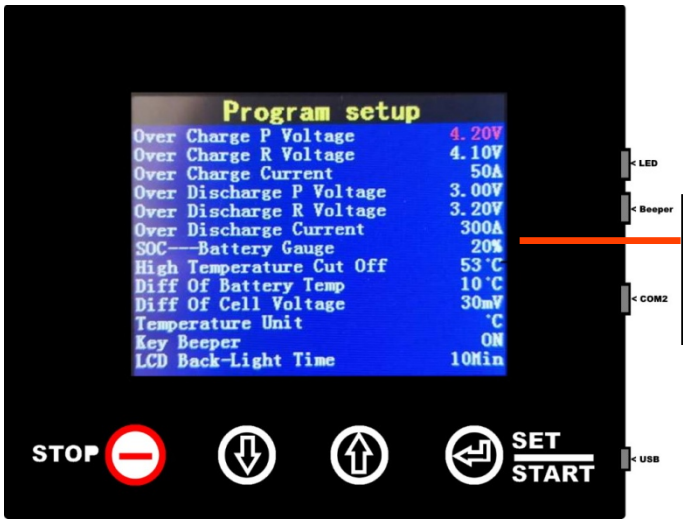
Note:

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	1-80℃	Over the temperature, BMS16T will force to cutoff the charge and discharge

Program Setup



Setup the High Temp Cut Off to the highest battery temperature acceptable. When over temp, the 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, STOP charge

Under the lowest temperature, STOP 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 values unless your application requires special settings.

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						
Battery Temperature		30	50	80	1	℃
Difference(Diff) of battery Temperature(Temp)		5	10	30	1	℃
Voltage balance Protection						
Difference(Diff) of cell voltage		5	30	1000	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	Sec's
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 restores factory defaults				
Balance Parameter setup: Press SET/START to setup and press for 3 seconds to 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:BMS8C3_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 different for different battery capacities and applications, please carefully verify and use proper settings for your application. For EV's, you can select **NO** to control the EV manually, **NOT** controlled by the BMS16T, but when the cell voltage and/or temperature trigger the absolute maximum or minimum settings, the BMS16T will force the cut off to Charge / Discharge to protect the battery and prevent damage and the possibility of fire or explosion.

3. **Current Calibration** is not recommended unless you are using a different shunt than supplied. Voltage and current is calibrated before delivery for the supplied shunt.
4. Temperature Alarm OFF means Battery and Difference of battery Temperature is disabled.
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 starting voltage, when minimum cell voltage over the setup value, the balancing will start automatically
7. Setup the minimum cell difference, when the difference of the cell voltage under setup value is reached, balancing is stopped automatically
8. Balance switcher, default Balance is OFF,
   a) If balance "in storage" setup is 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. For EV's, balance "in storage" OFF is suggested. For storage systems, ON is recommended.
   b) If balance "in charge" setup is ON, balance will start during charge
   c) If balance "in discharge" setup is ON, balance will start during discharge
   d) Balance current is 1.2A max. per cell,

9. Setup accurate battery capacity, then charge or discharge 25% of the battery capacity, the BMS will calibrate SOC automatically,
10. Main Unit software version

Balancer

The BMS16T can restore balanced cell voltage status in the shortest time, it is based on a 1.2A balancing current per cell, with balancing accuracy of 8mV. Balancing can be operated in Storage, Charge, Discharge or in ALL modes, the feature can be configured in the program setup menu. The balance function is disabled by default. After the BMS display is connected and configured with the cell voltages, reenter into program setup menu to enable balance.

Although the balancing current per cell is larger than some other brand BMS', the Chargery BMS16T uses temperature protection prevent the BMS from overheating and has over current protection for each cell.

In certain conditions, cell voltage difference drop is very slow, it seems that it won'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 the BMS is balancing cell voltage, the balance current is 1.2A max. meaning the high voltage cell discharge will be 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 until the difference reaches the "balance stop diff voltage" setting.

The higher the battery capacity and the more cell difference voltage there is, the balancing time will be longer. The battery discharge platform voltage is storage voltage, so when the average cell voltage is just cell storage voltage, the difference drops very slow, and the balance time seems longer, or looks like the BMS won't balance or stop balancing.

Compare balance and cell capacity/impedance, the cell capacity/impedance is more important. With battery discharge and charge cycle increasing, the cell capacity and impedance will worsen slowly. Take a 100Ah battery for example, 5% difference on capacity, means 5Ah is needed to be balanced, if 1A balancing, it will 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 even 10h.

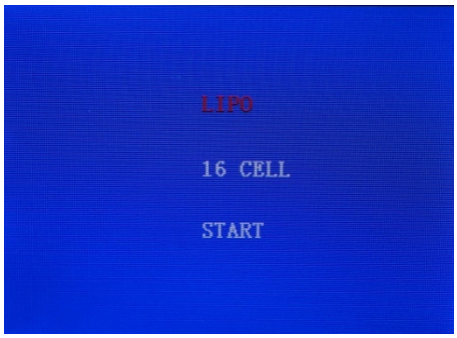
If we think the battery life cycle has ended or battery has to stop service when the battery capacity is degraded to 70%, it means when the lowest cell capacity is 70Ah (for 100AH battery at the beginning), even though other cell capacities are over 70Ah, the battery pack has to stop service. If some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

After 50 or 100 cycles, it is essential to test battery capacity, and measure each cell impedance to identify which cell is has the highest impedance. A High Impedance cell has a lower capacity and will determine the total battery capacity and battery life and even driving distance, if used in an EV application.

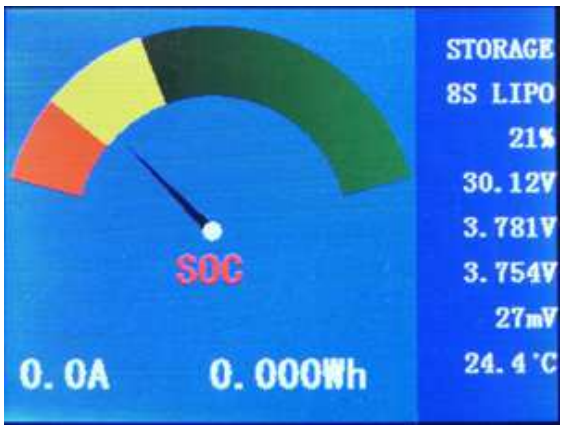
Operating guideline

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

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



1. Connect Beeper, LED, to the Display Module.
2. Connect the shunt, current sensor wire, relays, relay controller wires and Temperature Sensors to BMS16T Main Module.
3. Connect battery wires to BMS16T, **ensure correct cell polarity**. See the "Typical Connections" diagrams starting on page 33.
4. Connect the Main Module to Display Module using the COM2 port
5. Move the power selector to turn on the device.
6. BMS16T will initialize the beeper and LED, beeper will sound one time, then displays BMS16T and version, the battery type and cell count interface is displayed. Three battery types LiPo, LiFe and LTO can be selected. Cell count range is 2S to 16S, the cell count will be identified automatically when the battery pack connect to the BMS16T. Press DOWN / UP button to choose the item and press SET/START until the selection blinks, then press DOWN / UP button to modify, finally press SET/START button to run the BMS16T or wait for 8 seconds start automatically. After started, battery type and cell count will not be changed unless the BMS is powered off. Each cell voltage and other data are displayed correctly. If the cell voltage is not displayed correctly, please check the battery connections.
7. Press SET/START button for 3 seconds enter into Program Setup interface, modify **Over Charge Current (50A default)** and **Over Discharge Current (300A default)** according to your application. If Balancing is needed during Charge or Discharge, please modify the Balance settings in the Program Menu. The balance function is disabled by default.
8. SOC—battery gauge dashboard will be displayed first, as following. Press UP/DOWN button alter other interface.



Status: STORAGE or CHARGE or DISCHARGE (1)

Cell count and battery type

SOC—battery gauge, and 00% display

Battery pack voltage

Highest cell voltage

Lowest cell voltage

Difference between cell voltage

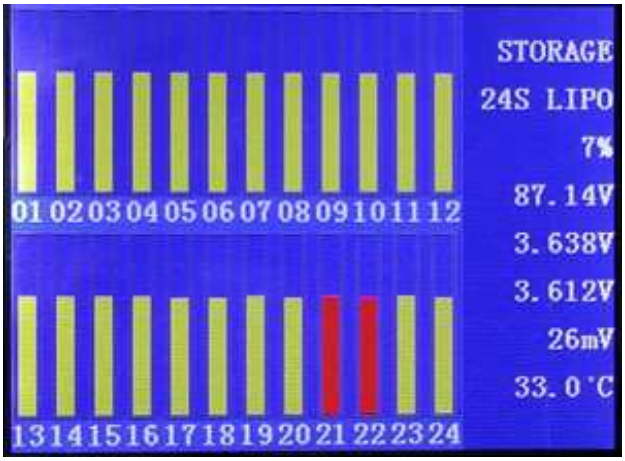
Battery temperature

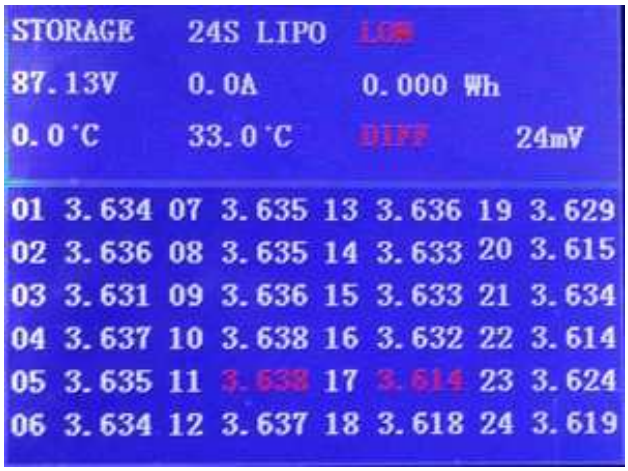
Charge or discharge current	Charge or discharge power

Notes

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

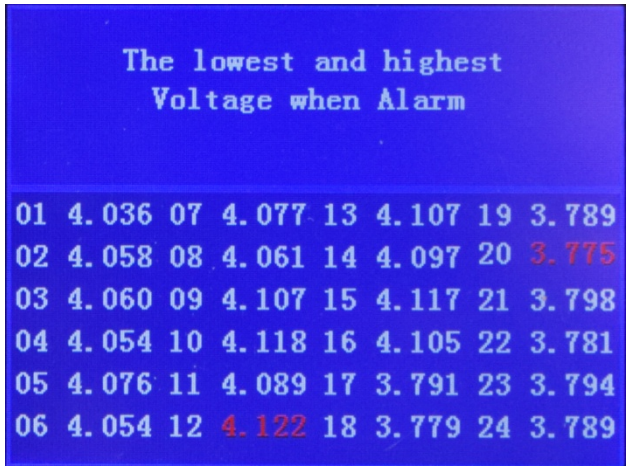
9. The following interface is the cell voltage bar graph, the highest and the lowest cell voltage is displayed in RED column. The images below are taken from a BMS24T as an example.



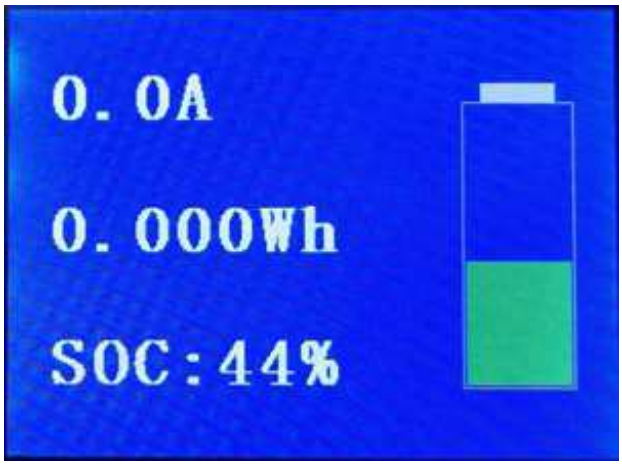


10. The right corner interface displays all of the information including all cell voltage. The highest and the lowest cell voltage is displayed in RED text. The difference of cell voltage and the difference of battery temperature is also displayed.

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



11. When any warning events are triggered, Press UP or DOWN, you can check which cell triggered the warning events (over charge or over discharge), the voltage will be recorded till next warning. See image on the right.



12. This screen displays charge or discharge current, charged or discharged power in Wh and SoC. When the SoC less than 30%, it is displayed in yellow. When under setup values, 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

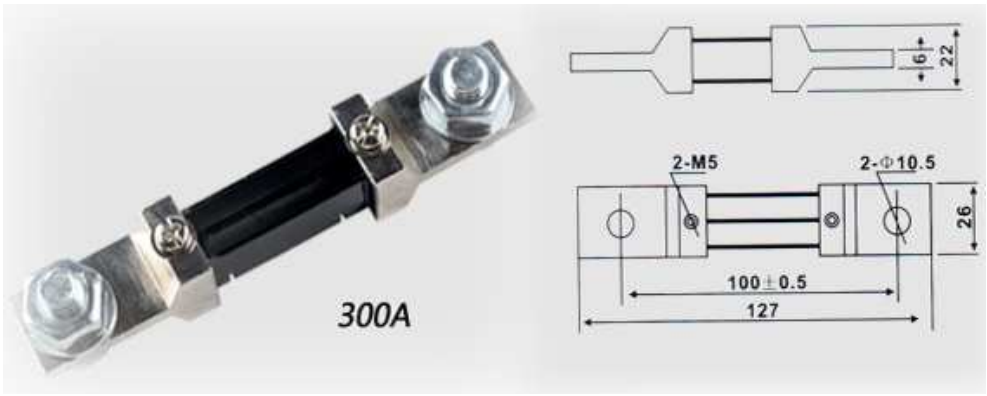
1. Battery range: 2S-16S LiPo & LiFe, LTO battery pack on BMS16T
2. Accurate scope of the cell voltage: -5mV/+5mV on BMS16T
3. Cell Voltage display range: 0.10~4.99V
4. The voltage of external power：13-60V, 3A
5. Balance current:1.2A per cell
6. Temperature display range:-20℃~150℃,
7. SOC indicator:
   - 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

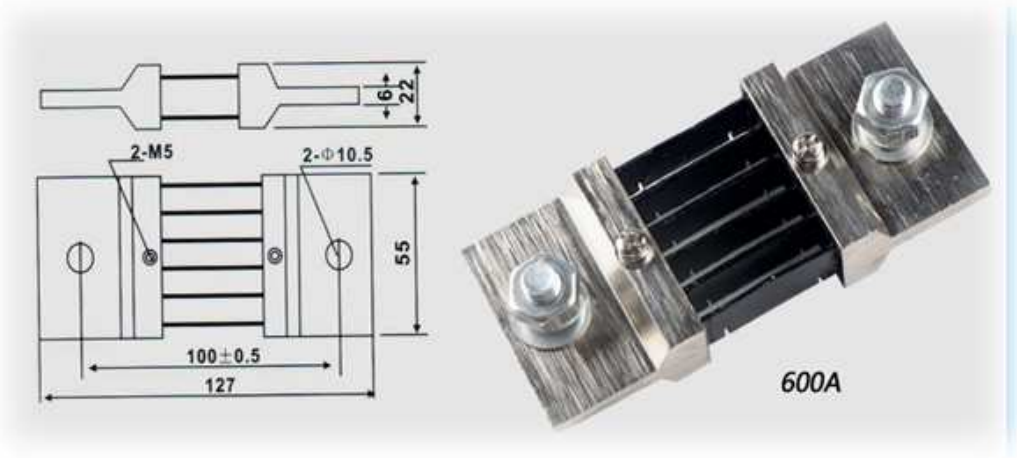
Please use the correct current shunt according to actual maximum charge / discharge current your system will use. A single shunt is used for the BMS16T, 75mV or less is recommended. The BMS16T detects the charge and discharge currents using the same shunt.

All supplied shunts are voltage and current calibrated prior to delivery.

The 300A and 600A 75mV specification is as below.



300A shunt weight: 230g

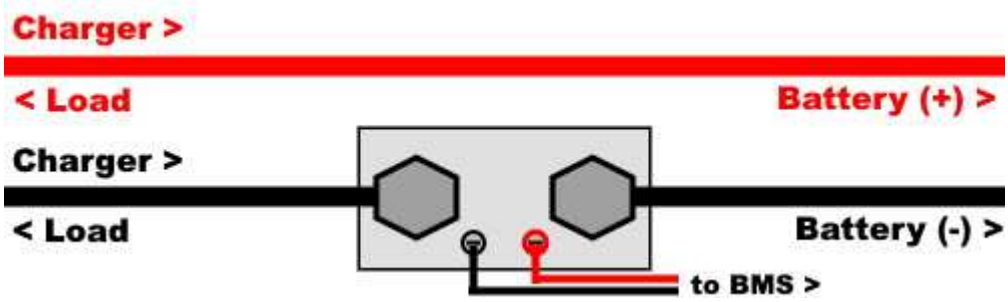


600A shunt weight: 530g

Current sensor wire

Current Calibration

Press SET/START for 3 seconds to enter into Program Setup and find the Current Calibration, you can calibrate the current to improve the measurement accuracy. If using a new current shunt, the current must be calibrated again to ensure accuracy. Use shunts which are 75mv or lower only. The current shunt should be installed as as shown below.



1. **ZERO the shunt:** Turn off charge and discharge, make "current" blink, press UP/DOWN to modify the value to zero, quickly press SET/START button to finish 0A calibration.

2. **CALIBRATE Charge Current:** Quickly press SET/START to make "current" blink and increase the current to the new value (up to 125A, it must be less than current shunt, it is better to make it equal to your charging 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 value.

3. 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 demand current (load), the key is the current must be accurate) turn on the load and discharge battery at the current, 3 seconds later, press SET/START/ save the discharge calibration value.

4. Turn off the load, Press SET/START for 3 seconds quit Program Setup and current calibration is finished.

Youtube video: How to calibrate Chargery BMS Shunt (BMS8T, BMS16T, BMS24T)

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 be installed. NOTE: Always use the most recent update tool version for your BMS model. Download the latest files here http://chargery.com/update.asp

NOTE: BMS Main Unit and LCD Display Module have different firmware files.

1. Connect the BMS Main Unit or Display Module, and power on the BMS, the USB driver will be installed on your computer automatically.
2. Connect PC to BMS with provided USB data cable and power on BMS, if update Main Unit, the LCD Display Module need not be 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.

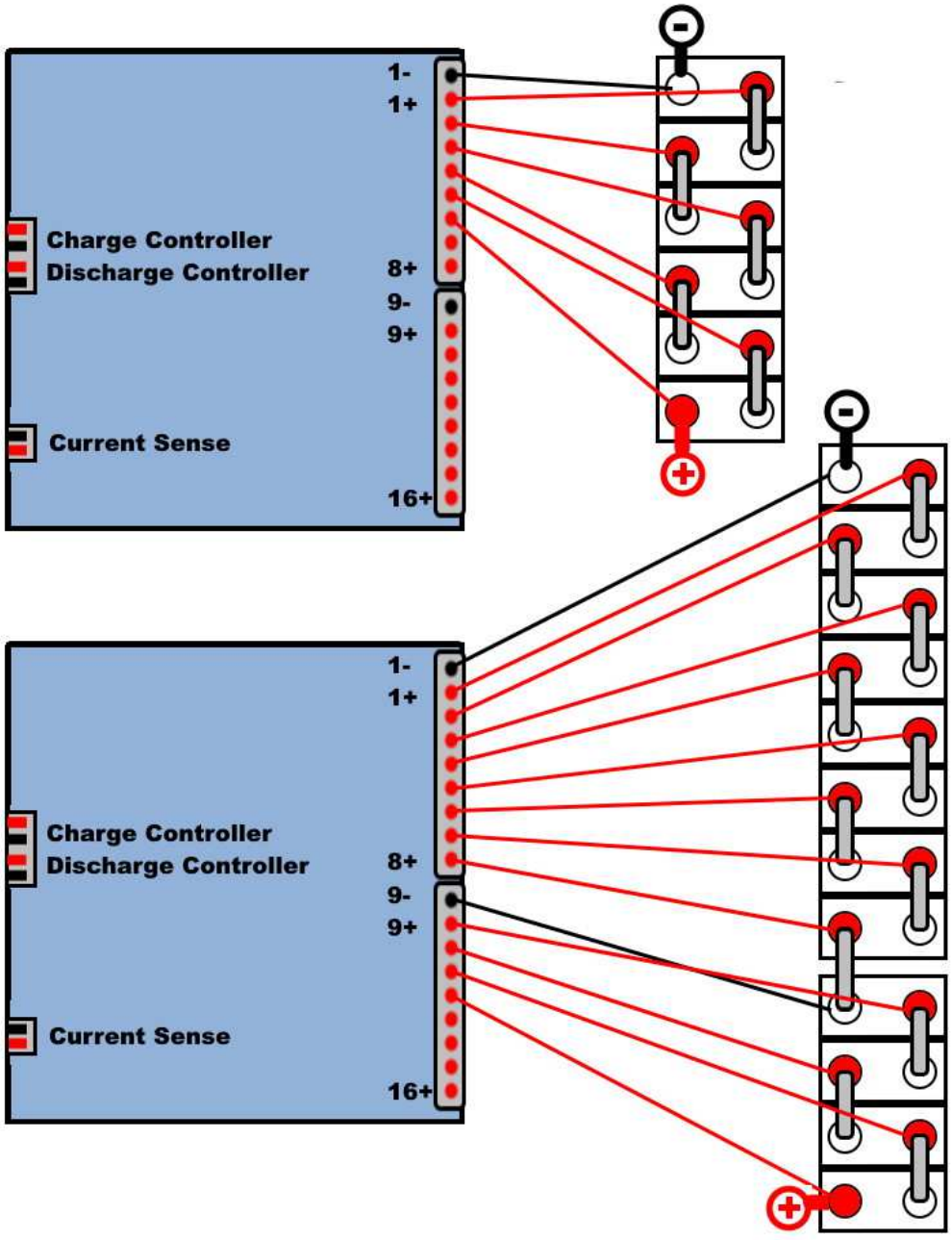
4. Click Open File button load the firmware file. The file should be .hex file.
5. Click Update button to start update, an update progress bar will appear, when the update is complete information will be displayed on the PC, the BMS will also display the progress bar simultaneously
6. When the update is Finished, the BMS will restart automatically.

NOTE: The update tools current only supports Windows.

Typical Connections

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

1. 2S-8S battery connected to the socket 1 directly, but external power supply is required.
2. For 7S or less configuration allows for external to power the BMS. The BMS requires 13-60 VDC @ 3A.
3. Connect 8S to socket 1 and remaining cells connect to socket 2 separately. See the 12S battery example shown below:



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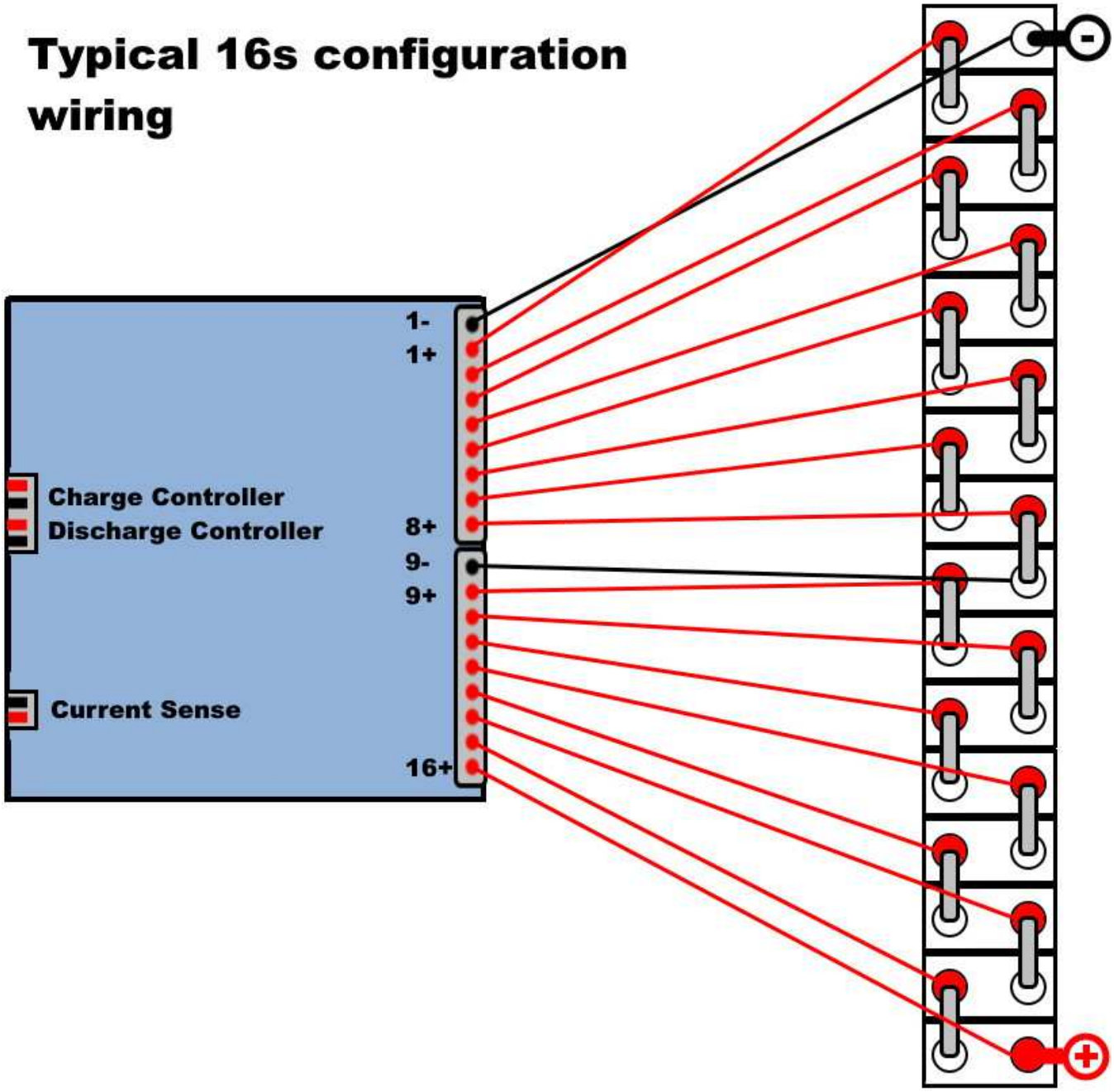
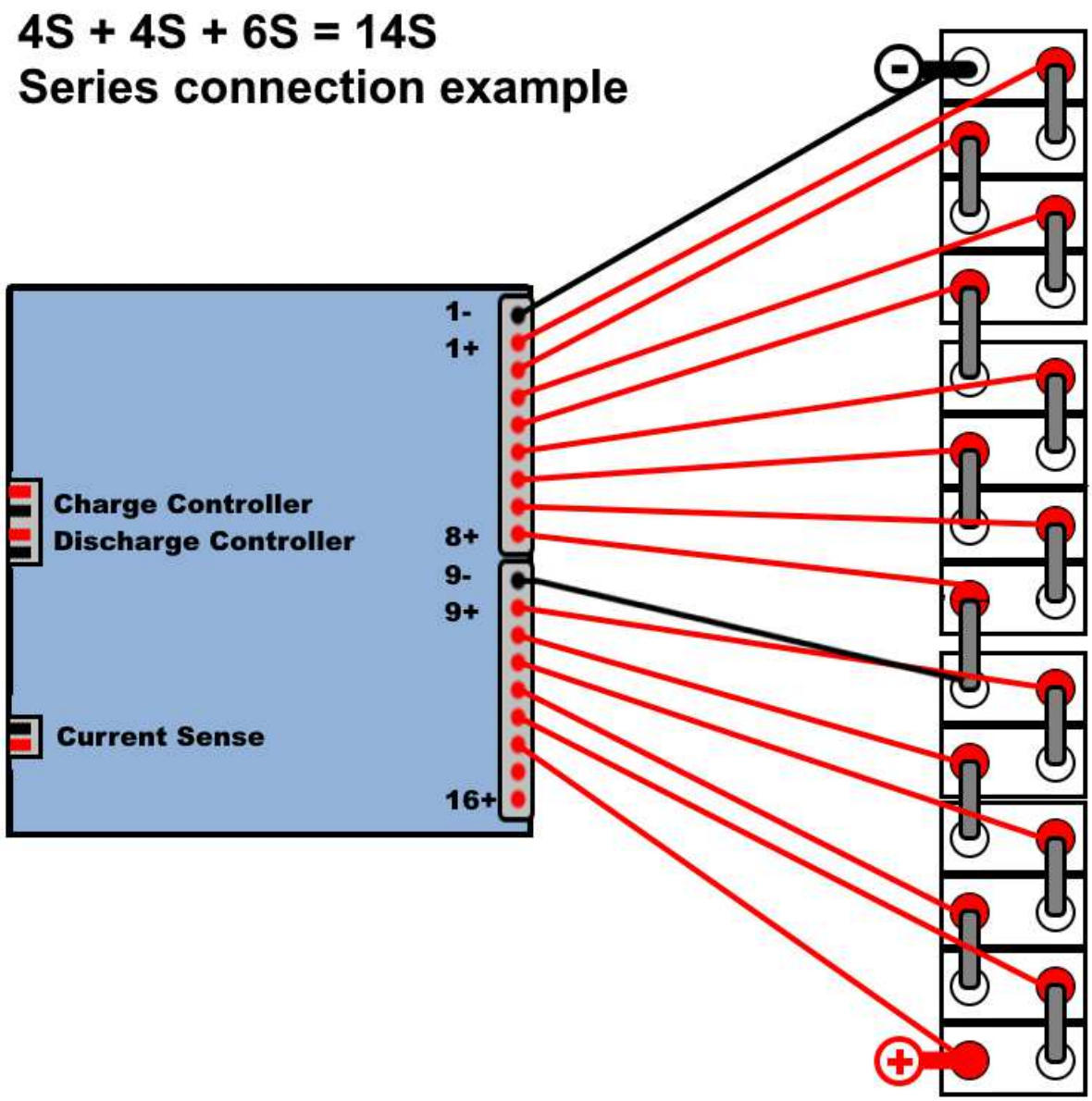
Typical Connection con't.



Typical Connection con't.

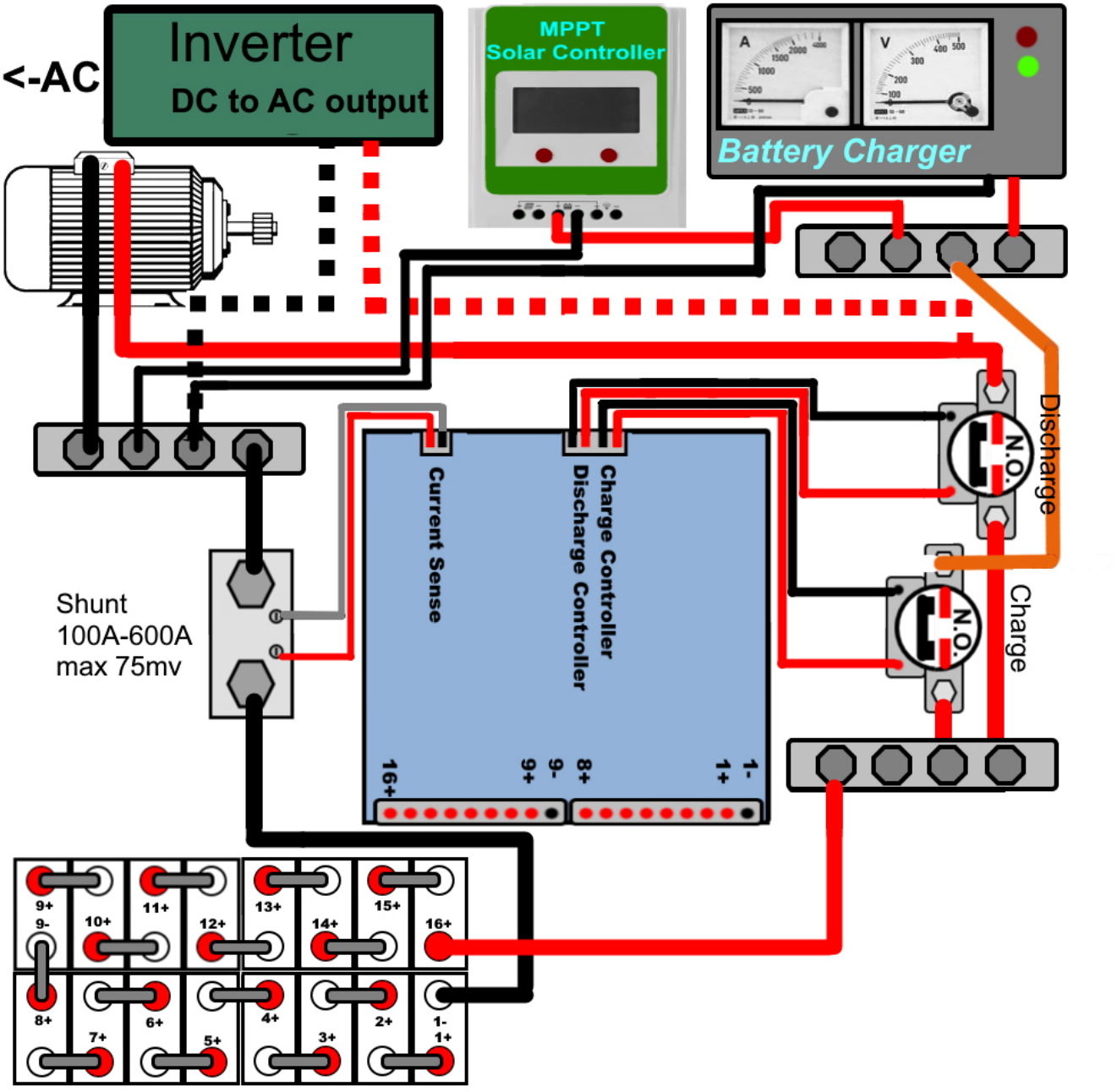


Separate Port Configuration example

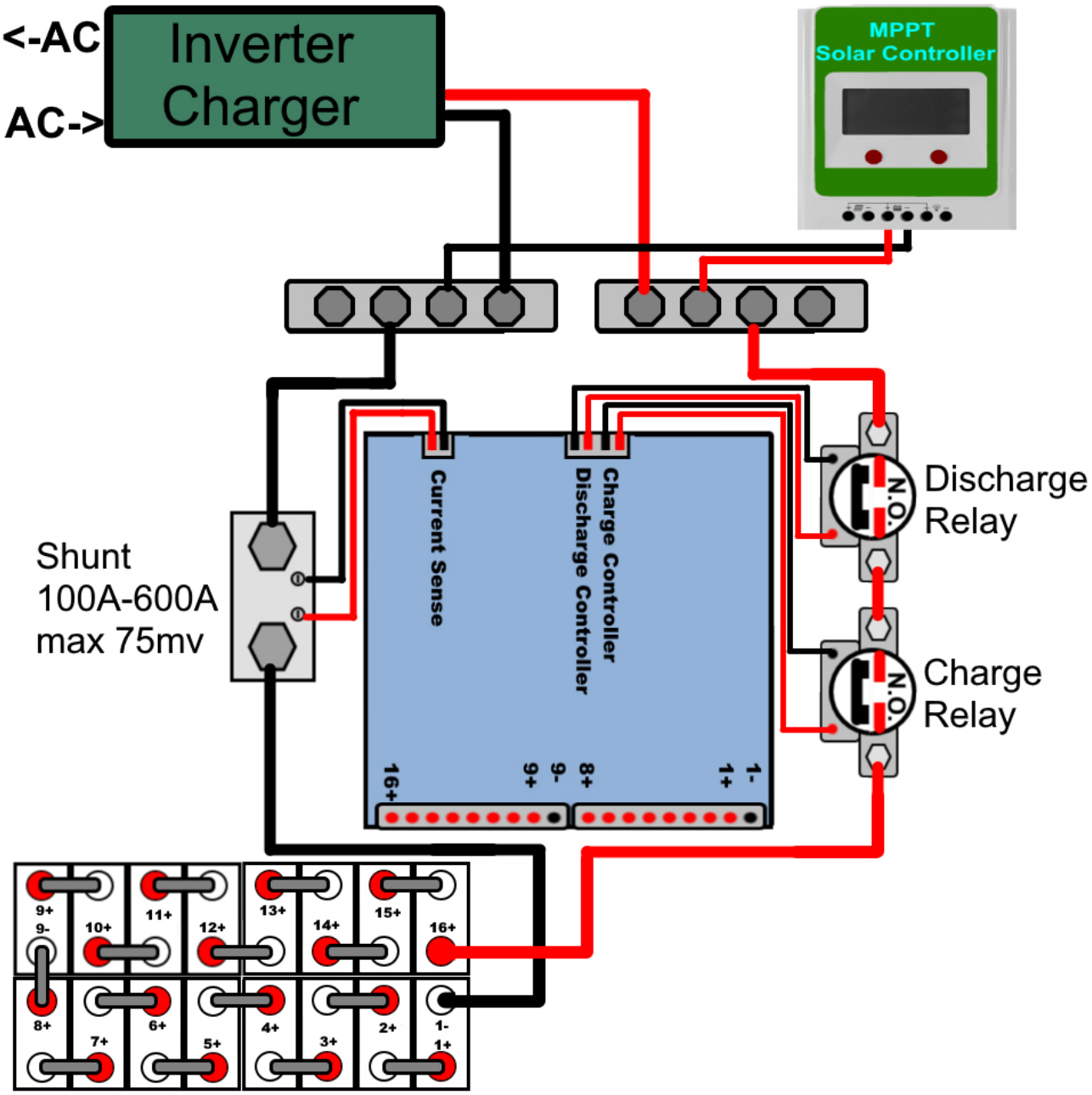
Before connecting the relay's for charge or discharge control, please confirm the coil relay voltage is correct for the voltage being used. The BMS16T controller outputs 12V to power the coil and the total current for charge and discharge relay's cannot be larger than 2.5A. In this configuration, the Charge Relay should be 1.25 times the maximum amperage provided by the charging devices. The Discharge Relay should be 1.25 times the maximum amperage draw expected.

Example: (2000W ÷ 12V = 166A X 1.25 = 208A) (2000W ÷ 24V = 83.3A X 1.25 = 105A)

NOTE ! Fuses, DC Breakers are not shown. Please use Best Practices and install appropriate fuses and breakers according to local codes and other guidelines.



Common Port Configuration example



This configuration requires that both Charge & Discharge Relay's are capable of handling equal amperage.
Example: (2000W ÷ 12V = 166A X 1.25 = 208A) (2000W ÷ 24V = 83.3A X 1.25 = 105A)

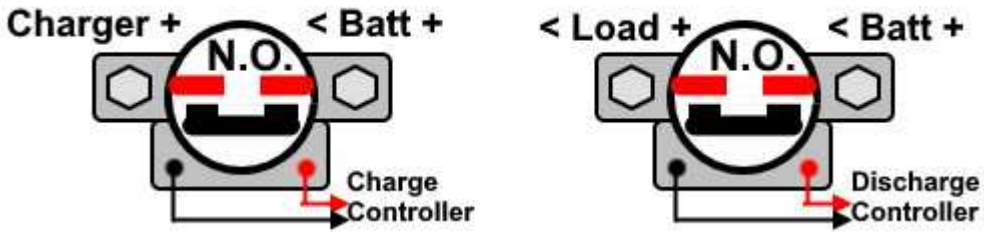
NOTE ! Fuses, DC Breakers are not shown. Please use Best Practices and install appropriate fuses and breakers according to local codes and other guidelines.

Charge relay and discharge relay lectotype for BMS16T

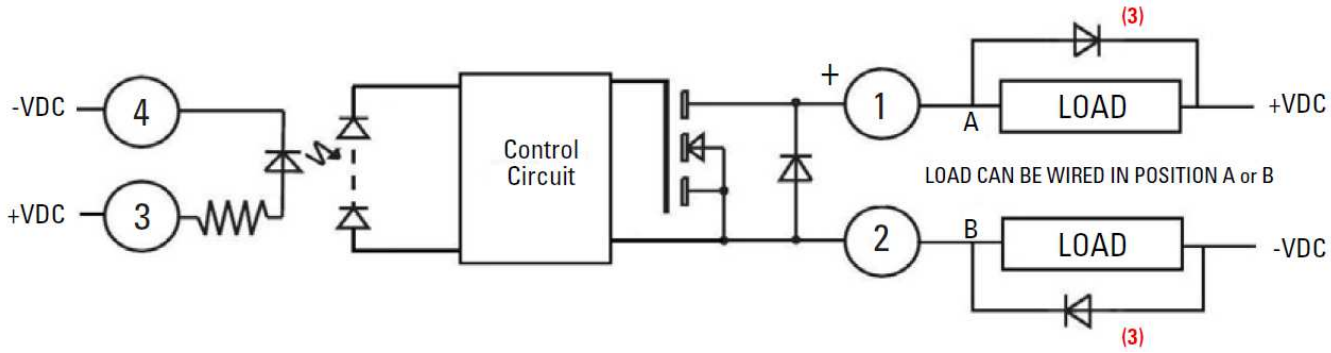
The BMS16T can output 12V/3A to power the charge and discharge relay. The relay coil drive voltage must be 12V and the total current for charge and discharge relays cannot exceed 2.5A.

1. Relay DC rated current (Amp Capacity) should be **1.2 times over** the actual charge / discharge current. If the discharge current is 100A, a 120A relay for discharge is suitable.

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

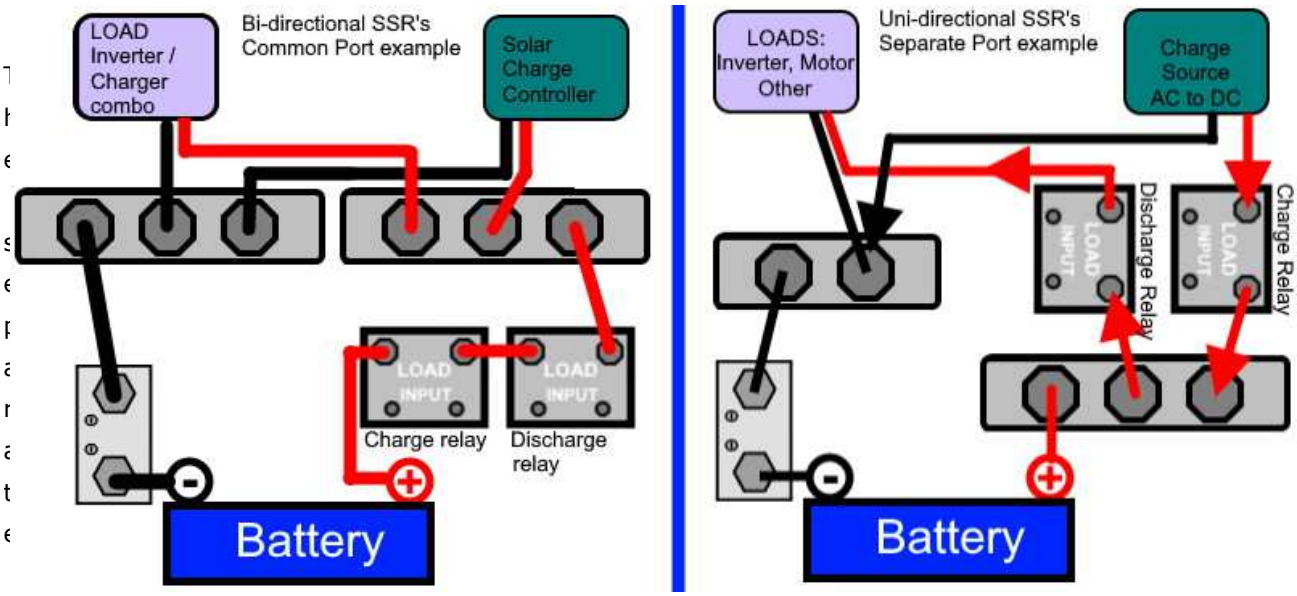


3. For Solid State Relays, the driven voltage (+VDC, -VDC), installing adequate Heats Sinks for the rated load current is very important, please pay close attention to the wiring connections. Special Note: Some SSR's (Solid State Relays) are Uni-directional, others are Bi-directional, be aware of these differences plan and purchase accordingly.



Solid State Relay supplemental information

Because SSR's vary by manufacturer, carefully plan your configuration to accommodate your "specific application" and how to best implement the relays for your needs. Bi-directional relays are the most flexible and the least complicated to work with. Uni-directional relays can be used within a common-port configuration as well. Simple examples shown below.



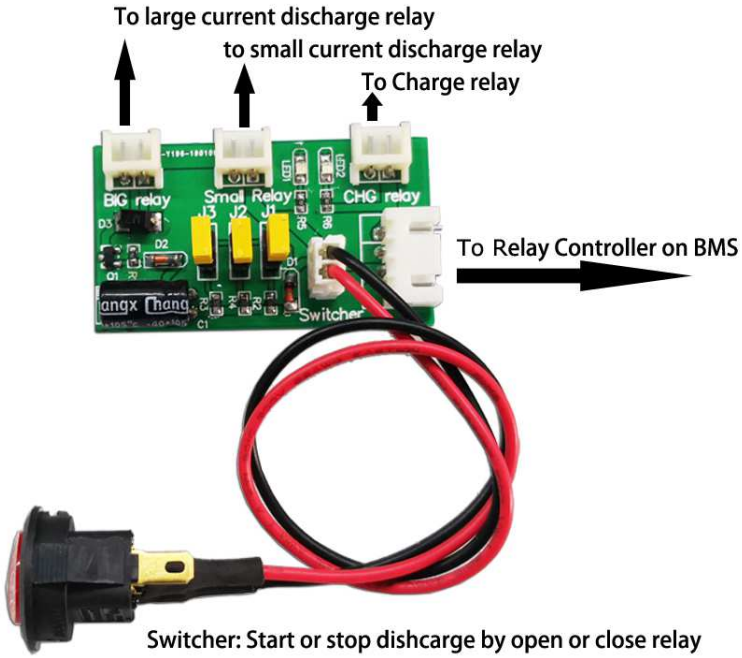
Port example shown, could also use a busbar between the Charge Relay and Charge Source if there is more than one charge source available.

If more than one Battery Pack, each with their own BMS exists, the current sensing Shunt must be on the battery side of the Shunt, as each separate BMS will read the current to and from that particular battery pack. Remember that these relays must be sized at least 1.20 to 1.25 times the maximum anticipated Amperage throughput that is expected. Relays capable f handling more amperage than expected will not cause any issues. Example: If you know you will never exceed 100A Load Draw or Charge then you can safely use 120A to 125A rated relays, you may chose to use 200A relays without concern.

If you wish to monitor the "complete battery bank" consisting of multiple battery packs, then a shunt will be required between the NEG busbar and the actual Load such as an Inverter / Charger.

CAUTION NOTE: If your using a Common Port configuration, ensure that "both" relays are equally matched, as the highest throughput current is the determining factor and if a relay is installed that cannot handle the maximum Amperage that could pass through it, it will fail and possibly result in damage.

Relay Delay Time Board



When a Motor and many Inverters are started, the initial surge is very large. In order to restrict the current surge, CHARGERY designed this special delay board, it can work with CHARGERY BMS8T, BMS16, BMS16T and BMS24T and so on.

The board receives the relay signal from the BMS, the Charge Relay and Small Current Discharge Relay will be closed without a delay. But the Large Current Discharge Relay will be closed after a delay time. When the Large Current Relay is closed, the Small Current Relay will open automatically according to the below jumper connections diagram below:

The delay time can be adjusted by changing the jumpers J1, J2 and J3.

1. Short circuit ALL jumpers: J1, J2 and J3, the delay time = 2 seconds,
2. Short circuit ONE of 3 jumpers": J1, or J2 or J3, the delay time = 6 seconds.
3. Short circuit TWO of 3 jumpers: J1 and J2, or J2 and J3, or J1 and J3, the delay time = 3 seconds.

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

Before completing connections: please power off the switcher (LED 1 is off). On the board, there are two BLUE LED indicators, when the Charge relay is closed, LED 2 is ON, otherwise it is OFF, when Discharge relay closed, the LED 1 is ON.

Finish all connection and setup, when ready to go, please close all other switchers on other device first, finally power on the switcher on the board, LED 1 is ON, small current relay closed immediately, after setup delay time, the large current relay closed. The battery will discharge normally.

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.

The large NTC Power Resistors must be chosen by delay time and load current.

Surge Power Rating: During start up, certain loads require a considerably higher surge of power for a short duration (lasting from tens of milliseconds to few seconds) as compared to their Maximum Continuous Running Power Rating. The inverter Continuous Power Rating should be higher than the surge power rating of these devices. 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 winding's draw a very heavy surge of starting current (Amperes) called "Locked Rotor Amperes"(LRA) due to low DC resistance of the winding's. For example, in motor driven loads like Air-conditioning and Refrigeration Compressors and 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 winding's and the current draw reduces proportionately till it draws the running FLA/ Maximum Continuous Running Power Rating at the rated RPM.

Example: If the motor's rated current is 100A, the surge current may be up to 1000A, it is over the maximum Discharge Current of Battery, so a power resistor is needed to restrict the current to 100A for example, therefore you will 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 depends on delay time desired. 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. It is recommended to consult your Inverter or Motor documents and supplier information before testing the Small Relay and Power Resistor.

Complete all connections and configuration setup, check and confirm all settings are ok, when ready to go. Please close all other switcher's on other devices, finally turn on the switcher on the board and the battery will start to charge or discharge.

12V: The resistor value should be over 0.24 OHM

24V: The resistor value should be over 0.24 OHM

48V: The resistor value should be over 0.48 OHM

Delay Board Implementation Examples:

Shown with BMS8T, the configuration is the same between BMS8T, BMS16T & BMS24T

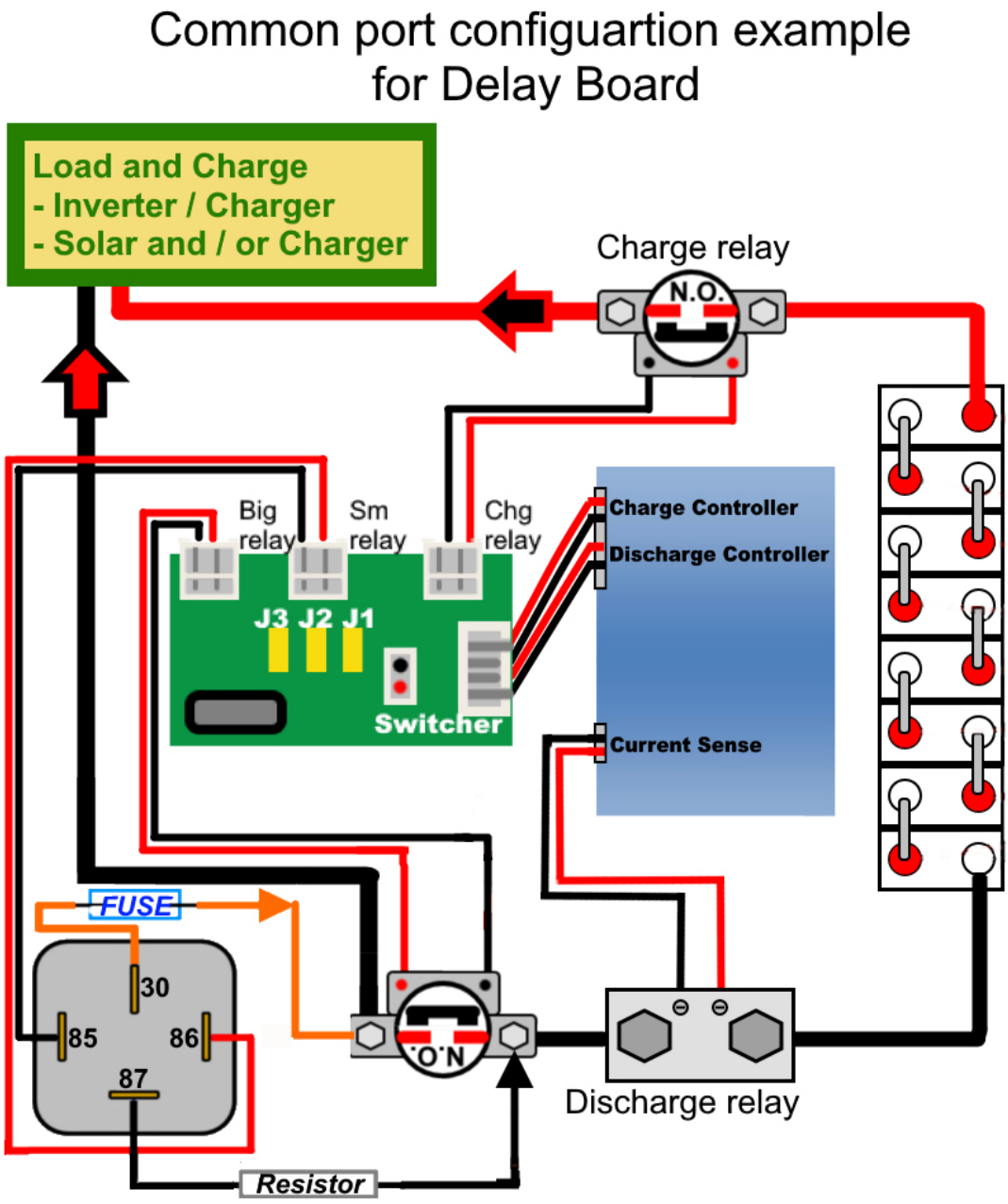
The Small Relay in this example is a simple automotive "Make & Break relay". The simplest and most common form of relay. The circuit between terminals 30 and 87 is Closed "on" when energized and Open "off" when de-energized, this is known as NO (Normally Open). Terminals 85 and 86 actuate the relay. Suggested to use a 12VDC / 10A or greater relay.

In this configuration, both the Charge and Discharge relays must be of equal Amperage rating as they share the common lines between the Motor / Inverter and battery.

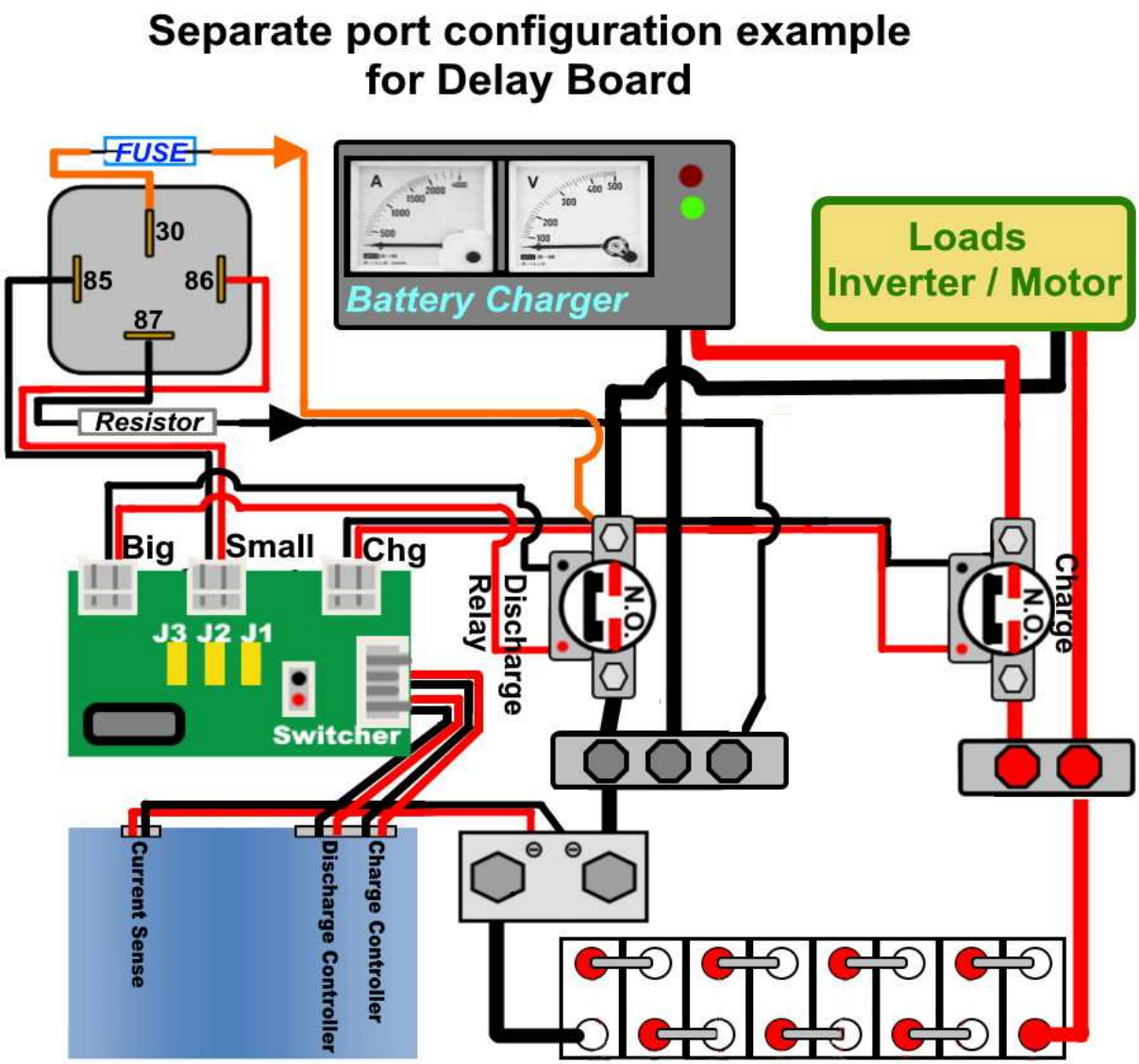
For example: 24V/4000W Inverter will draw (4000W ÷ 24VDC = 166.66A) X 1.25 = 208.3A

Note a Low Frequency Inverter is capable of 3X the wattage (12,000W) for momentary surge.

The relays in this case should be sized 200A or greater



Delay Board Implementation Examples con't.



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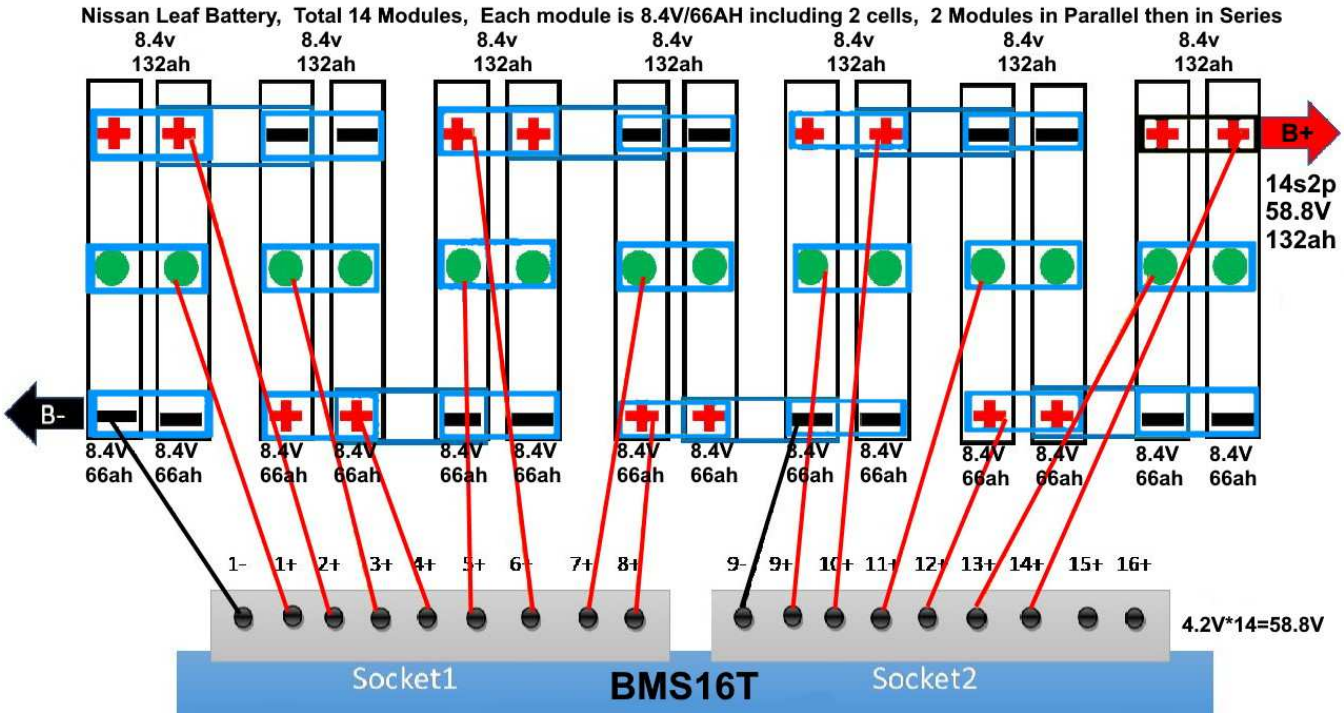
In this configuration, the Discharge relay must be sized to the maximum Amperage anticipated x 1.25.

For example: 24V/4000W Inverter will draw (4000W ÷ 24VDC = 166.66A) X 1.25 = 208.3A

But a Low Frequency Inverter is capable of 3X the wattage (12,000W) for momentary surge. The Charge relay must be rated for the Maximum Amperage that the charge sources (combined if multiple charge sources) can output to the battery. For example a Solar Charge Controller at 75A, and an AC Charger at 50A equals a max input potential of 125A x 1.25 = 156A, so a relay of 150A an up would be suitable.

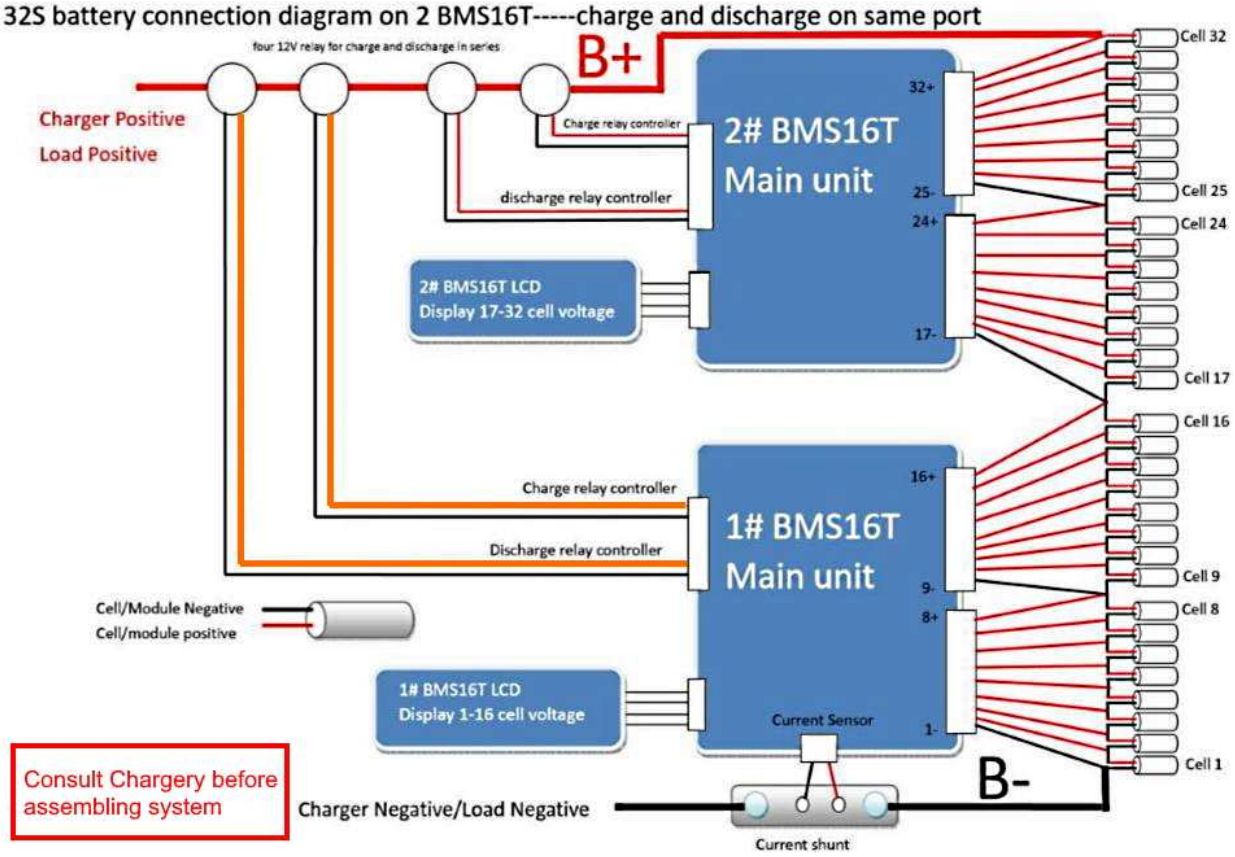
Example Configurations



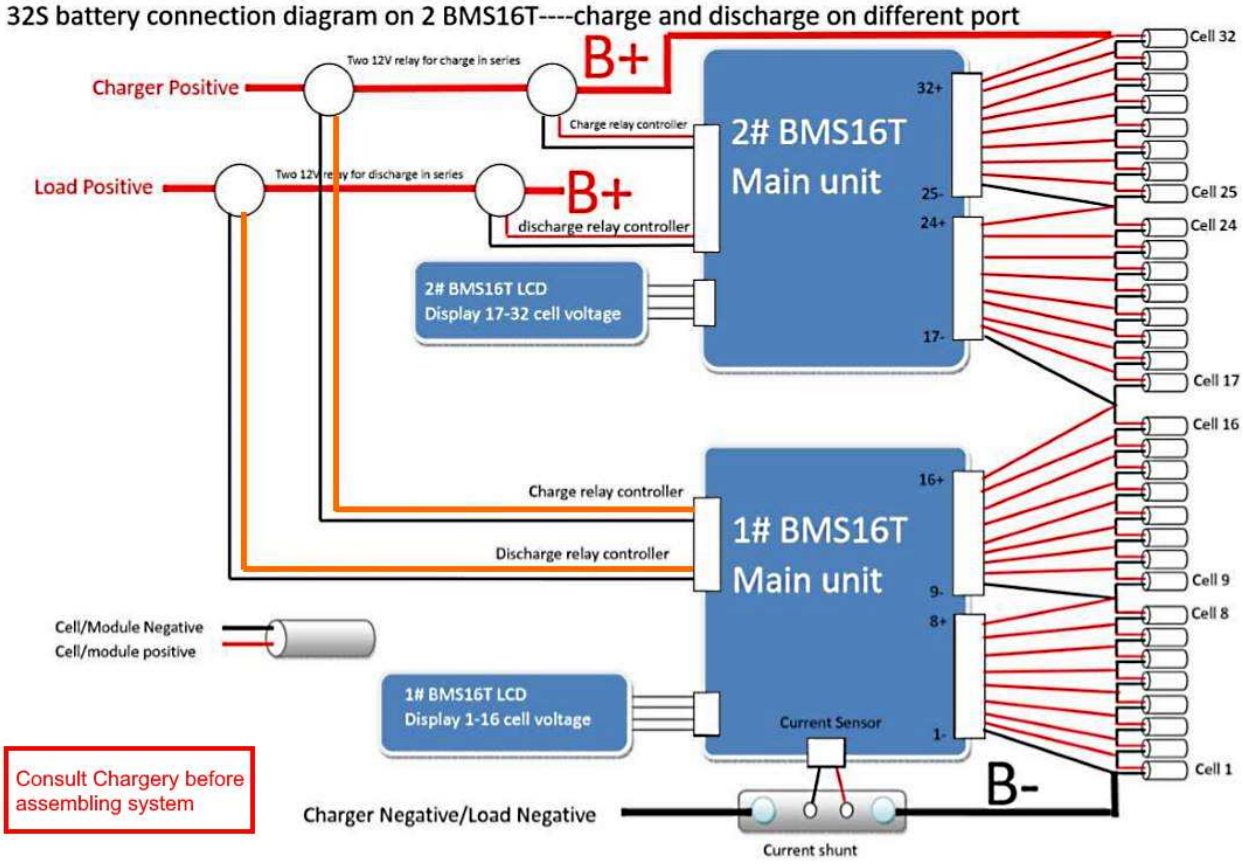
Two BMS16T used for 14 cells to manage a 58.8 Volt Battery Pack.

Example Configurations cont'd.

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



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



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 °C	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Weight, Nominal	0.3 Kg	0.5 Kg	1.0 Kg	1.6 Kg	3 Kg

Related parts

The following device is related with BMS16T

MODEL	DESCRIPTION	COMMENTS
BMS16	For 2S-16S, without cell balancer	300A charge/discharge
BMS16T	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.

Total solution on E-Vehicle application

If using the Chargery charger, the charge relay can be ignored, BMS16T can communicate with charger, when any cell is over charged, BMS will send a signal to charger, the charger will decrease charge current till the cell voltage within safe values. If using another brand of charger, BMS16T only OPEN the Charge relay, if the charge current is too high, such as over 10A, the relay will open and close repeatedly. The relay life cycle will be shortened and charge time will be longer.

The Chargery Charger and BMS can 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.

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

Frequent questions

1. Charge or Discharge relay/DC contactor won't open (disconnect) or close (connect)
   a) Confirm the relay coil driven voltage, it must be 12V.
   b) Confirm relay coil current requirement, it must not be over 1A for each relay or that the total current with two relays won't be over 2.6A
   c) Without alarm the charge and discharge relay controller voltage is 12V,
   d) When any alarm events occurs, 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 9 pin balance wire connections are good and secure.
   b) Measure actual cell voltage on the 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 ohm or so).
   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 an inverter.
   c) Add low-pass filter on current sensor
   d) Update main unit to V1.21, need not calibrate current.
   e) If shunt is replaced, or for other reasons you need to 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, it 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 or so). If only 10 ohm or less, please return back to us for repair.
   f) For over 50Ah battery, the balance time is longer relative to battery size

g) After discharge, check the cell voltage difference on LCD, if over 100mV even 200mV, it 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 is not charging or discharging, press STOP button to make the BMS enter into **sleep mode** to save battery energy.

b) If you need wake up the BMS, please press UP, DOWN or START Button.

c) The STOP button will NOT stop an Inverter while drawing power and will NOT stop charging if there is current from the Charger. Loads & Charger must be OFF to allow the BMS to enter into Sleep Mode.

8. BMS power consumption

Battery voltage	Normal mode without Relay but LCD is on	Sleep mode without relay and LCD is off	Normal mode with 12V mechanical relay with different rated current and LCD is on			
			100A	200A	400A	600A
	BMS drain current from battery (mA)					
16V	120	40	500	850	1150	1425
24V	84.25	35	475	550	725	890
36V	65	50	325	365	485	587.5
48V	55	42.5	247.5	280	370	445
60V	48.75	29	207.5	230	302.5	365
67.2V	46	28.25	187.5	207.5	275	332.5

9. BMS Relay controller output current at 12V when Chargery Mechanical Relay closed.

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 the relay coil current is far more than BMS working current, to avoid any cell being over discharged, please operate as below,

a) if the battery is not in use (exclude charging), please disconnect coil driven wire.

b) If storage for over 1 month, please press STOP button place the BMS into Sleep Mode.

c) If storage for over 3 months, please turn off the BMS directly. You may use the External / Internal power switch if using internal power.

10. Show timeout during updating,

a) Download the correct firmware according to product model and save to your PC, from http://chargery.com/update.asp

b) Update tool software version must be v1.03 or greater. Always use the most current.

c) Connect BMS main unit or LCD unit to the PC by using the provided USB cable.

d) Turn on BMS main unit.

e) Execute update tool software and lock the com port by click OPEN button.

f) Click open file button and upload the correct firmware.

g) Click update button finish update.

11. Charging stops, the possible reasons are as below.

a) Any cell voltage reaches "Over Charge Protection(P) Voltage" setting.

b) The highest cell voltage is over "Over Charge Release(R) Voltage" setting.

c) Charging current is over "Over charge current" setting.

d) Battery temperature is over "high temperature cutoff" setting.

e) Battery temperature is under "low temp cutoff in charge" setting.

f) Battery temperature difference is over "diff of battery temp" setting.

g) Charger stop charging,

12. Discharging stops, the possible reasons are as below.

a) Any cell voltage reaches "Over discharge Protection(P) Voltage " setting

b) The lowest cell voltage is under "Over discharge Release(R) Voltage" setting.

c) Discharging current is over "Over discharge current" setting.

d) SOC under "SOC----battery gauge" setting.

e) Cell voltage difference is over "Difference(Diff) of cell voltage" setting.

f) Battery temperature is over "high temperature cutoff" setting.

g) Battery temperature is under "low temp cutoff in discharge" setting.

h) Battery temperature difference is over "diff of battery temp" setting.

i) Others

Supplemental, equipment voltage calibration

Various components such as Solar Charger Controllers, Inverter/Chargers need to "know" the precise voltages being dealt with in regards to the batteries, with Lithium Based batteries, accurate voltage sensing is essential. This is not a difficult process to do but as equipment varies a great deal on how they are configured and what options they have, you will have to refer to the manuals for your particular equipment.

! **You will require an accurate DVOM (Digital Volt Ohm Meter) or DMM (Digital Multi-Meter) to accomplish this task.**

Simple Steps:

Do this when there is no charging from the Solar Charge Controller, best time to do this is just after sundown, so that there is no solar activity.

1. Ensure your batteries are charged and "at rest", meaning no loads or charging for 1 hour.
2. The Solar Charge Controller, Inverter/Charger must connected and ON. As well, if you have a Buck Converter / Step Down converter have that on BUT WITH NO LOAD being supplied to devices.
3. First, take a Voltage Reading at the Battery Terminal (if only one pack) or at BUS Terminals if multiple packs in parallel. *Test "after" the BMS but before the Relays as the BMS is on the "battery side". NOTE the Voltage as ##.## volts (IE 28.92vdc or 14.86vdc)*
4. Next, measure the Voltage at the Inverter/Charger DC Input Terminals and again note it.
5. Next measure the voltage at the Solar Charge Controller "Battery Terminals" (not the solar input terminals) NB: The Solar Charge Controller should not be getting any sun, no input. NOTE the Voltage seen at the Battery Terminals of the Controller.
6. If you have an external AC to DC charger connected as well, check the voltage at the "terminals" of the charger and note them as well.

You will now see a difference in readings between the Batteries, the Solar Charge Controller & the Inverter Charger. This is the result of "deration", essentially the wire and every single connector in between adds a bit of loss through the whole circuit and this must be addressed. **! ALERT !** *If the discrepancy is more than 1 Volt you may have other problems, such as a loose connection, poor crimps or damaged wire / components. This must be addressed first and once done, redo above readings.* The BATTERY reading (be it a single or a bank of packs) is the one that RULES and the remaining equipment must "match up" to be effective.

Example using basic numbers to Keep It Simple:

Assume the Battery reads 24.0 VDC, the Solar Charge Controller reads 23.75 VDC and the Inverter/Charger reads 23.60 VDC.

EXAMPLE: If the desired CHARGING cutoff is 29.20 VDC, then the SCC would have to be corrected for the 0.25V shortfall in readings, so it would be programmed to cutoff at 29.45 VDC. The Inverter Charger "Charge cutoff" would then also have to be corrected to 29.60 VDC to compensate for the 0.40 VDC difference.

LOW Volt Disconnect !

The Inverter will have it's own LVD (Low Voltage Disconnect) setting and this is extremely important. While 0.40V is not a big difference, it can be if you want to keep within a very specific range and with Lithium based batteries 0.40V at the bottom edge **can be significant !** So you would have to Correct the voltage the Inverter/Charger sees, so that it cuts off exactly at the voltage desired "at the battery terminal end". So IF you want the LVD to kick on when the cells reach 2.75VDC ea / 22.0 VDC for the 24V pack/bank, the LVD setting will have to be adjusted to 22.40. This way when the Inverter/Charger sees 22.40 Volts it cuts off as the actual batteries are at 22.0VDC. 21.60 VDC = 2.70v per cell.(uncorrected) * REMEMBER, that below

2.80V per cell the voltage drops very fast as you in the "bottom 20%" of cell capacity. *Always defer to the particular battery chemistry data sheets from the Manufacturer for the cells you are using, they vary quite a bit.*

Don't make the BMS do the work it shouldn't do.

The BMS of course will cut off for High / Low Volt etc but this is not it's job, those are "safety" features to protect you batteries and are more or less the "fail safe mechanism", as such they should not be doing that work as a matter of normal operations. This is really the task of the Solar Charge Controller and Inverter/Charger to manage on an ongoing basis. Continually using the BMS to do this function can actually affect the BMS negatively and may even result in damage, it is not what they are designed to do.

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 Vendor / 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 are NOT covered by warranty.

Charging Expert

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