CHARGERY

BMS8P

for 2S-8S LiPo/Li-ion, LiFe & LiTO
Low power consumption
High accuracy
2.8” TFT LCD display
Programmable

Chargery BMS8P

Battery Management System for 2S-8S LiPo/Li-ion, LiFe & LiTO

Low power consumption, High accuracy, 2.8” TFT LCD display, Programmable

Owners Manual

V 4.3

Main Unit Software Version 4.05
LCD Unit Software Version 4.03

Revised : 28/2/2020

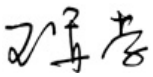
Thank you for choosing the Chargery BMS8P as your Battery Management System. This versatile BMS is designed to be suitable for Electric Vehicles and mobile / fixed Energy Storage Systems providing extensive flexibility for your specific application.

Please read the ENTIRE instruction manual to become familiar with the features and functions and capabilities of the device before operating. Please see Video References for additional installation & operational tips.

Overview:

The Chargery BMS8P is designed especially for LiPo, LiFe and LiTo battery packs applied to Energy Storage 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), with the information displayed on the TFT color LCD screen. It has an Internal balancing function to balance cells to maintain optimal operations of the battery pack being managed.

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

Table of Contents

Safety Notes 5
Warning 5
Copyright 5
Specifications 6
Protection functions 6
Over current protection 6
Version History 7
Update / Change log 8
Order information 9
Standard accessories (included in BMS unit) 9
Current Shunt 10
DC Contactor 11
DCC main Specification 12
ISO board 13
Chargery DC Contactor (DCC) configuration in Common and Separate Port 14
Alternator Saver 16
Operational Description 19
Special Features 20
Interface 21
Hardware Setup 23
Absolute maximum or Minimum ratings *(Always refer to Manufacturer specifications)* 23
Software Configuration 24
Parameters Setting----Configuration Values 25
Operating guideline 28
SOC Calibration 31
Balancer 33
Balancing Indicator 34
Cell internal resistance (Impedance) test 35
Charge and discharge relay lectotype for BMS8P 37
Current Calibration (Shunt) 38
Firmware Upgrades via USB Port 40
Update BMS main unit 41
Continue to update LCD unit 41
Typical Cell Connections 43
2S-4S configuration and 8S configuration 43
4s & 4s with single BMS8P configuration example. 44
6P4S 24 cells with single BMS8P configuration example. 45
Nissan Leaf battery 6P8S with BMS8P configuration example 45
Separate Port Configuration example—with Mechanical relay or DCC. 46
Common Port Configuration example—with two Mechanical relay or one CHARGERY DCC. 47
4p4s Cell configuration with BMS8P-600 example 48
Related parts 49
Total solution on E-Vehicle application—1500W 60A 8S battery charger 50
Supplemental: Solid State Relay supplemental information 51
Supplemental: Single Relay with 2 channel Opti-Coupler 52

Supplemental：Equipment Voltage Calibration....53
Supplemental: Reference Documents & Video links....55
Supplemental: BMS power consumption....56
Frequent questions....57
Improve cell voltage accuracy....59
Improve current reading fluctuation from Steve....60
Over Current protection resume operation....61
Warranty and Service....62

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. **External power supply ground don't connect to battery negative (cell 1 negative) directly**
4. Current shunt must connected to the Battery Pack Negative !
5. Prevent BMS from vibrations and shaking
6. Ensure the BMS case does not make contact with battery wiring in any way.

Copyright

Specifications

1. Battery range: 2S-8S LiPo & LiFe, LTO battery pack
2. Accurate scope of the cell voltage: -5mV/+5mV
3. Cell Voltage display range: 0.10~4.99V
4. The voltage of external power：15-60V, 3A.
5. Balance current:**1.2A per cell continuously**
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. Built-in cooling fan, start automatically upon internal temperature
9. Main module Size: 122×88×38 (L×W×T, mm) or 4.8×3.5×1.5 (L×W×T, inch)
10. Main module weight: 270g excluding accessories
11. Display module size:96×80×24 (L×W×T, mm) or 3.8×3.2×0.95 (L×W×T, inch)
12. Display module weight:130g
13. Warning LED: 11000mCd, @ 2.0V, 20mA
14. Warning beeper: 85dB @ 12V, 25mA
15. Package: AL alloy case

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 and higher version)
7. Over differential cell voltage protection in discharge
8. Over differential battery temperature protection
9. Under SOC protection

Over current protection

When charge or discharge current reach over charge current setting or over discharge current setting, BMS will cut off charge or discharge, to resume charge or discharge, please press SET/START button shortly. But the over current reason should be removed first.

Version History

Software Version of LCD unit	**Description**
V4.03	Released first time
Software Version of main unit	**Description**
V4.05	first released
Hardware Description	
Black mental case with cooling fan	

Update / Change log

BMS8P v4.05 has the following changes that is compared with BMS8T,

- Add intelligent cooling fan, start automatically and speed is controlled by internal temperature, so BMS8T cannot update to BMS8P only by update software. And the BMS can balance cell voltage continuously, to save balance time by speed up balancing even at 1.2A per cell.
- Minimum current 0.5A measurement capacity on 300A / 600A shunt
- Minimum current 0.3A measurement on 100A shunt
- Improve cell voltage detection accuracy
- Improve AH reading accuracy
- Add Discharge End voltage of cell, and charge, discharge status send out ----- Protocol v1.26

Order information

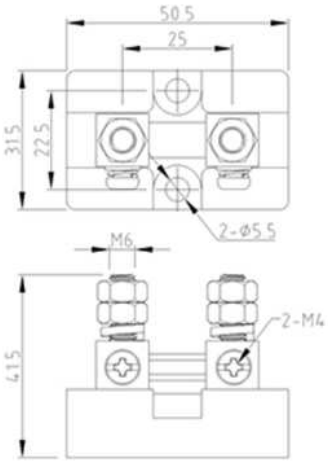
Model	Description	Accessories
BMS8P-100	100A charge and discharge	100A shunt, and standard accessories
BMS8P-300	300A charge and discharge	300A shunt, and standard accessories
BMS8P-600	600A charge and discharge	600A shunt, and standard accessories

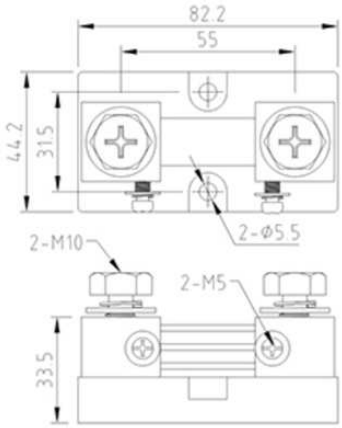
Standard accessories (included in BMS unit)

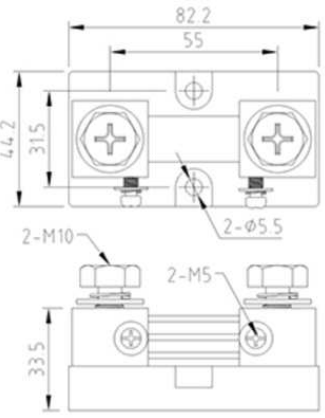
USB data cable: Update main unit and LCD unit	Cell Balance wire: connect cell to BMS balance port, 600mm	DCC/Relay controller wire: cut off charge /discharge，600mm.
		
Temperature sensor: 600mm, monitor battery temperature.	Warning LED, 300mm	Warning Beeper, 300mm
		
Current sensor wire, 600mm, monitor charge /discharge current	Communication wire (4.5 meters), connect main unit to LCD unit	COM3 Data line: connect to external device, send out all data
		

Current Shunt

A single shunt is used for the BMS8P, it is delivered with BMS and other standard accessories. The BMS8P detects the charge and discharge currents using the same shunt. All supplied shunts are voltage and current calibrated prior to delivery. If you exchange the shunt, 75mV or less is recommended, and need calibrate again.







DC Contactor

CHARGERY designed the special DC contactor or named as SSR to fit with all BMS, DCC is used for cut off charge or discharge when any cell voltage reach settings to prevent any cell from damage and possibly fire. The DCC must be installed on battery positive with ISO board, the board will be ship with DCC, on next generation DCC, the board will be built-in DCC.
Before using DCC, please note the charge and discharge is on common port or separate port. The DCC has different hardware on both type port.

Notes

- If without DCC, BMS will only warn by Beeper sound and LED flash.
- **One** DCC can be used in a Common port such as a Solar system, instead of **two** SSR's or relays.
- The Relay Delay Time board (op is to avoid a surge current when start to charge or discharge. If using a CHARGERY DCC, the delay board is not required, because it has a Built-in the surge suppressing circuit. For other SSR or mechanical relay, please consider the surge current seriously and make a suitable plan.

For more detailes please download and read DCC manual V1.2 carefully
http://chargery.com/doc/Chargery_DC_contactor_manual_V1.2.pdf

DCC main Specification

DC Contactor (DCC) model	DCC-100HB	DCC-200HB	DCC-300HB	DCC-600HB
Driving voltage	12V			
Holding current (Avg.) at 12V	9mA	11mA	11mA	11mA
Rated Operating Voltage	100V			
Continuous (Carry) Current, Typical	100A	200A	300A	600A
Maximum current, at 85°C for 2 seconds	200A	300A	500A	1000A
Maximum Contact voltage drop at 100A	200mV	136mV	80mV	40mV
Fan start Temperature		>42°C	>42°C	>42°C
Over temperature protection---- Turn off temperature		>90°C	>90°C	>90°C
Turn on temperature automatically		<80°C	<80°C	<80°C
Current mode	bi-directional			
Size(L*W*H, mm)	105*55*40	105*64*55	105*90*55	142*105*55
Weight(Kg)	0.3	0.45	0.7	1.2
Operating Ambient Temperature	-40 to +85 °C			
Cold pressing copper tube terminal	10-6	25-6	50-8	
Screws	M6*16		M8*20	
Wire Area(mm^2) requirements	18	30	50	70
Ambient Temperature	-10--45℃			
Ambient Humidity	5%--95%			
Storage Temp.	-20℃--70℃			
Storage Humidity	30%--90%			

Status Indicator	Red LED is ON at DCC closed, and OFF at DCC open.
Power Indicator	Red LED is ON, The unit is ON. Red LED is OFF, means BMS cut off charge and/or discharge, or if High/Low temperature protection has been triggered, or Temperature sensor is disconnected from the BMS.

ISO board

The board is designed special for DCC, as we know the DCC install on the positive side is better and safer than install on negative, so we designed the board.

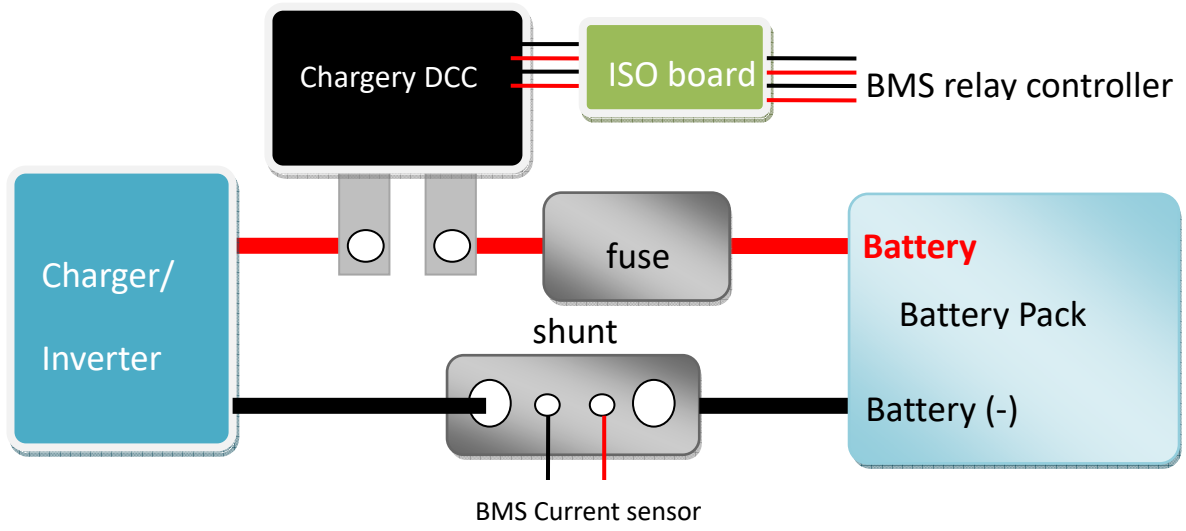
The board should connect between BMS relay controller port and DCC. There is two LEDs, One indicate charge control signal, another indicate discharge control signal. As below.

When over charge triggered, BMS cut off charging, the charge LED on ISO board and Status LED on DCC will be off.

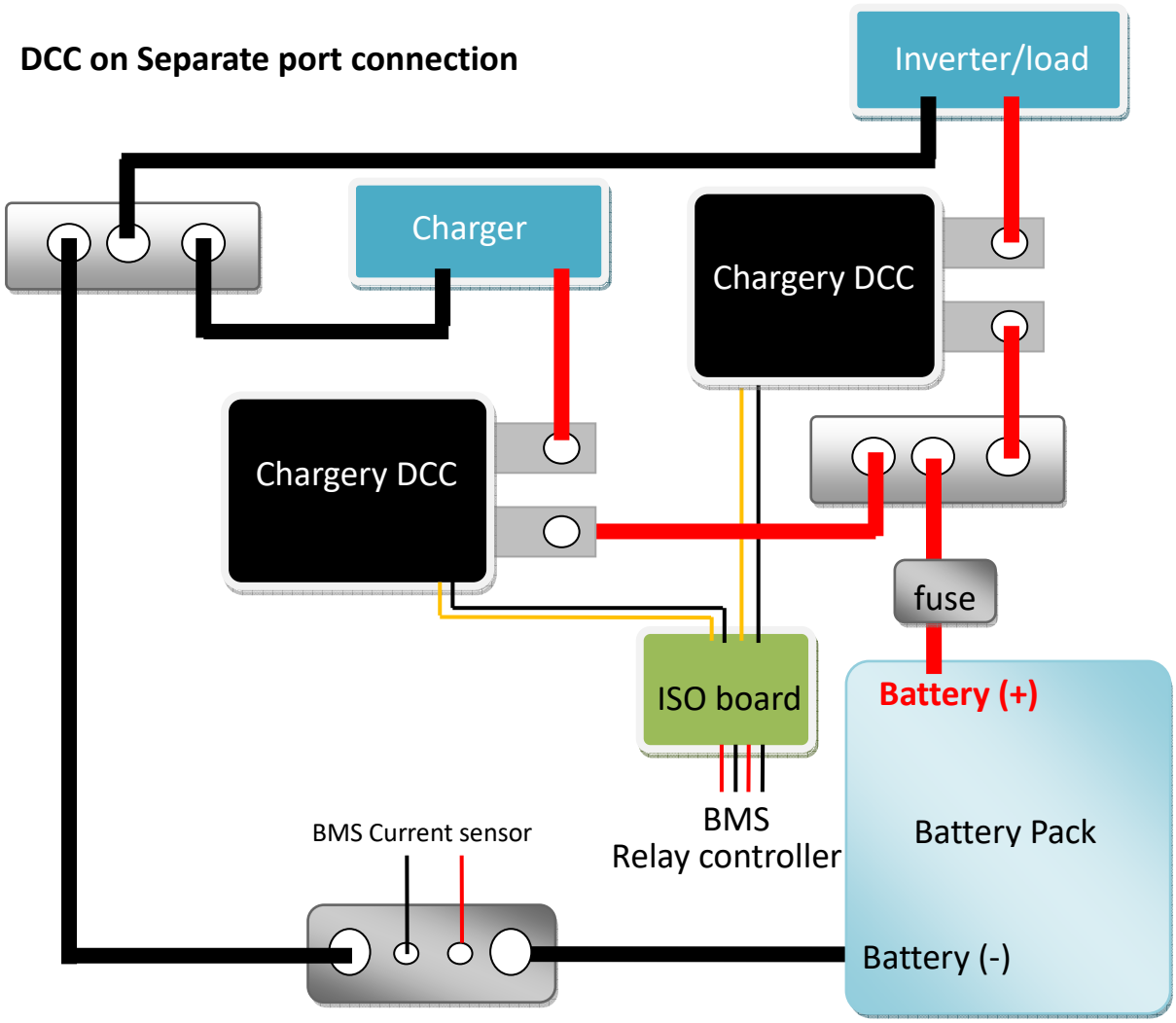
When over discharge triggered, BMS cut off discharging, the discharge LED on ISO board and Status LED on DCC will be off.

Chargery DC Contactor (DCC) configuration in Common and Separate Port

DCC on Common port connection

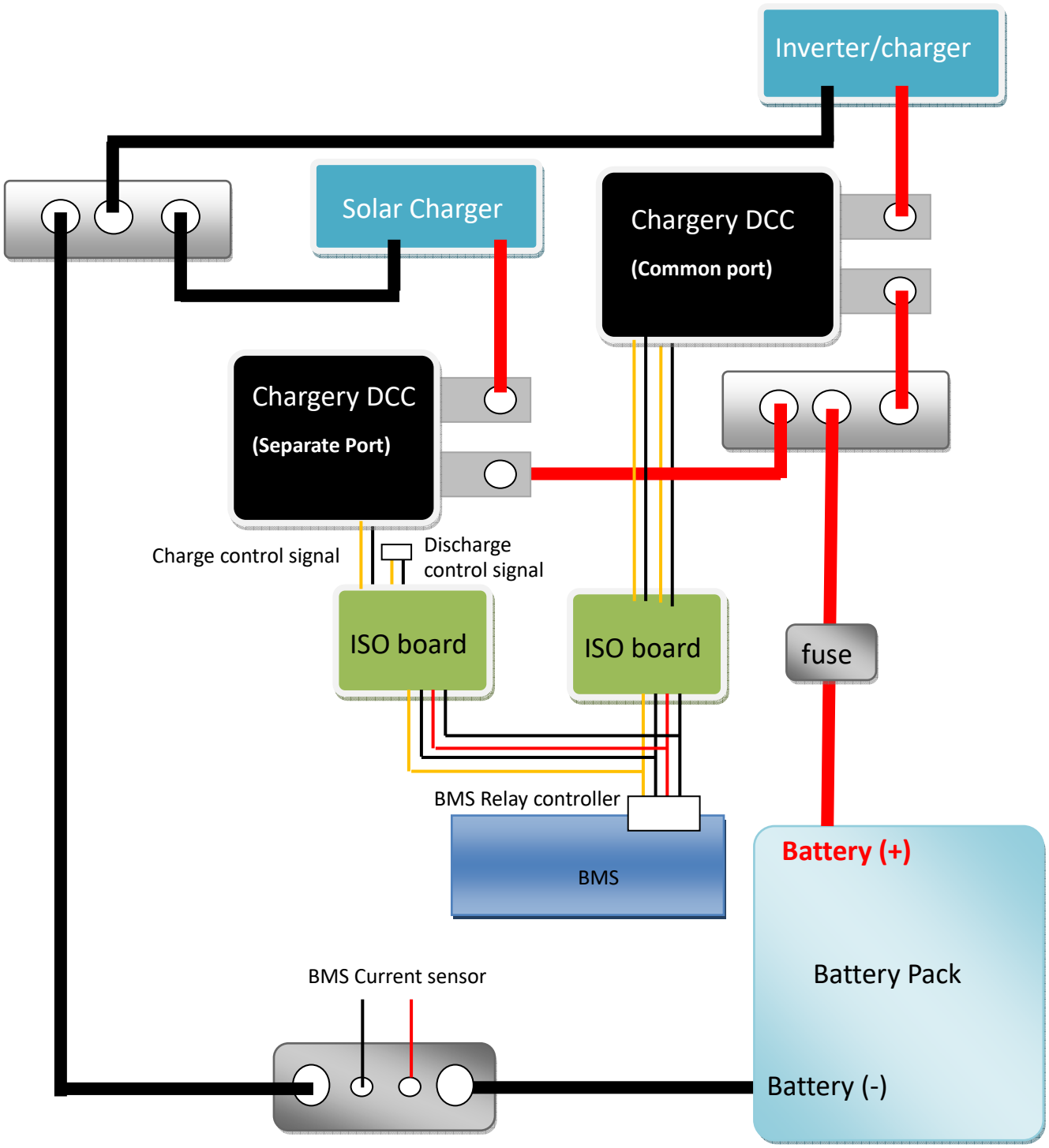


DCC on Separate port connection



DCC on Separate and common port connection

Inverter as load and charger, Solar panel charge battery too

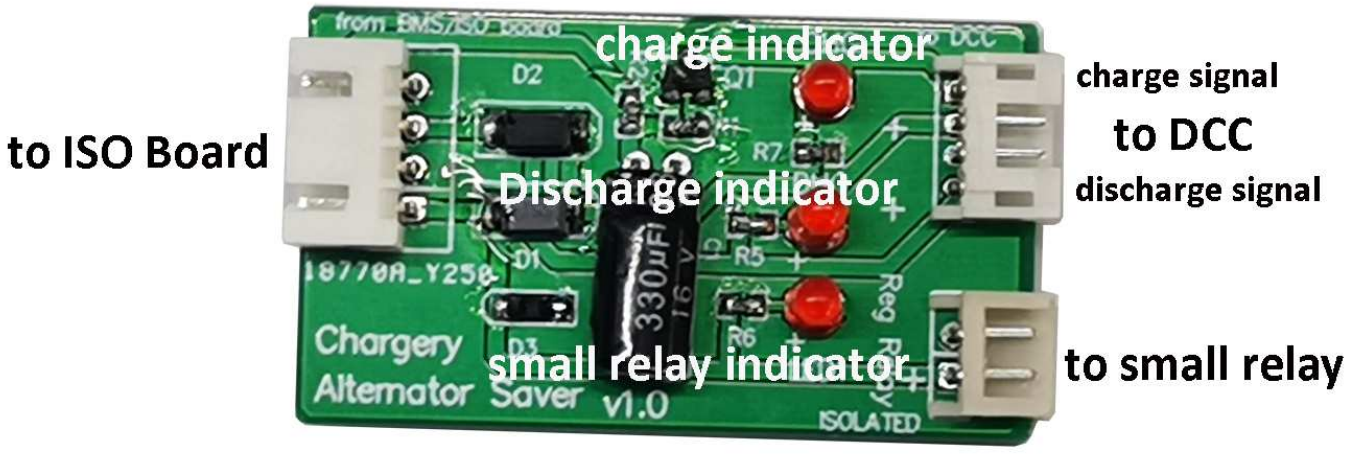


Alternator Saver

The alternator on a car or boat needs 12V or 24V in order to magnetise the field on the alternator. Without that it will produce no current at all. Regulating this current is used in the internal regulation on an alternator to regulate the output of the alternator. The same capability is used on external regulators as Balmar or Grassder Smart Charge one or Sterling ProReg-D. When the batteries have reached floating level they will send less current through the magnetising field of the alternator in order to limit the output.
When BMS cut off charging by "open" DCC or relay directly, this will burn the diodes in the alternator.
The Alternator saver can switch off the magnetising current to the field of the alternator just 3 seconds before the contactor switch off, so protect the diodes of the alternator.

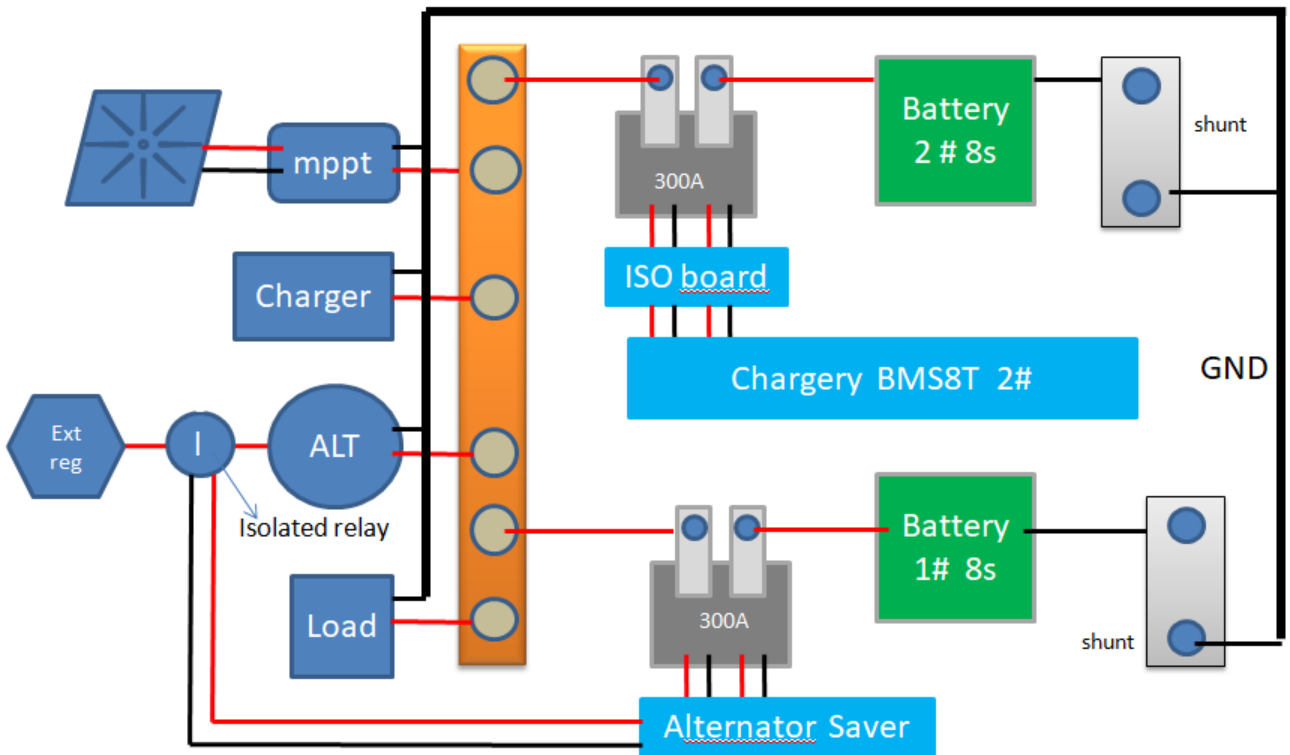
A small isolated relay cutting the power to the magnetising field could do the trick, the relay will be "open" first by the Saver board before DCC cut off charging.

The feature could be useful for many boaters and others who charges with alternators.



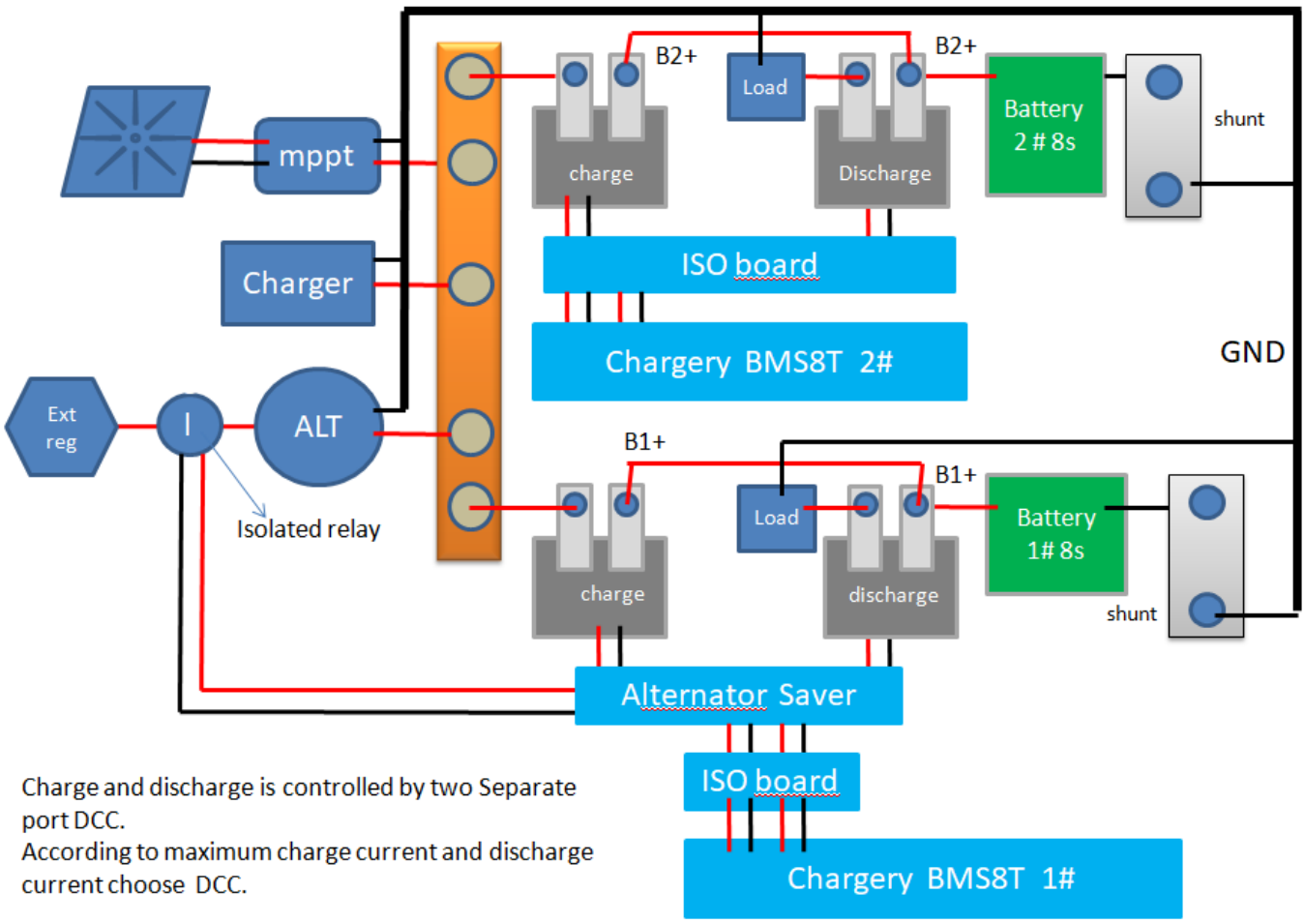
when any cell voltage reach OVP setting, BMS signal cut off small relay (cut off magnetising current to the field of the alternator)
3 seconds later, cut off DCC (disconnet charging current from Alternator)

Common port DCC connection diagram with 2 8S batteries.



1. All DCC is on common port
2. Two bms control two battery charge and discharge, high voltage battery will be discharged first
3. One load is drain power from two battery
4. When all chargers turned on, higher output voltage charger will charge battery till its current is not enough. The charger will power load at the same time

Separate port DCC connection diagram with 2 8S batteries.



Charge and discharge is controlled by two Separate port DCC.
According to maximum charge current and discharge current choose DCC.

Operational Description

The BMS8P includes a Main Unit and a Display Module. Once the hardware installation is completed and ready, power on the BMS8P to finish setting up all of the parameters using the Display Module. The BMS8P will use the saved settings even if the Display Module is disconnected from the Main Unit. Removing the Display Module 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 such as a computer to the COM3 port on the Main Unit to receive all RS232 data. 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 BMS8P can be used with any lithium battery charger, when any cell is over charged, the BMS8P 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 BMS8P 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.

More information on the RS232 Data Interface can be found in Supplemental: Reference Documents & Video links

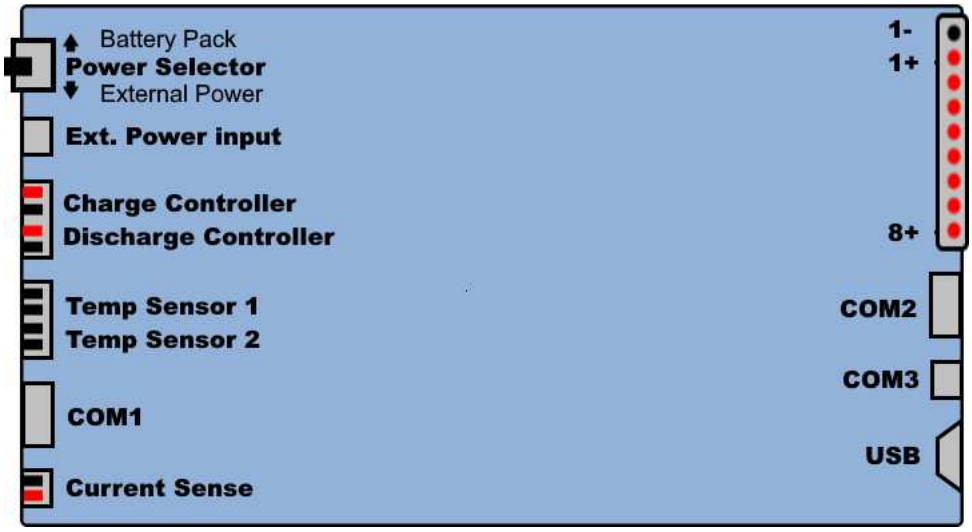
Special NOTE: The RS232 output is wired in a Cross Over fashion. Refer to RS232 Document for pin out. This can be wired to any type of adapter being used, such as RS232, RJ-11, RJ-45. Pin outs must be observed accordingly.

Special Features

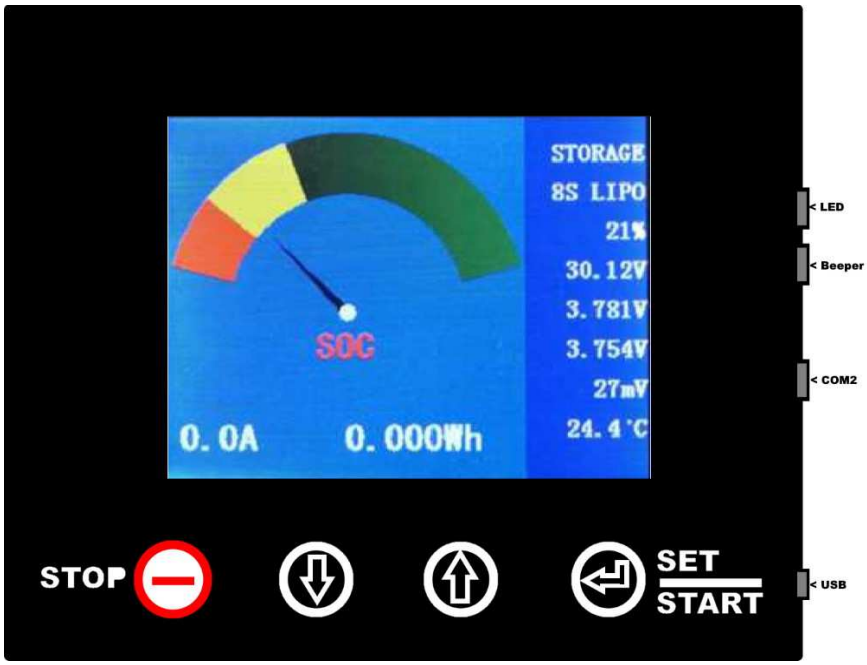
1. The BMS8P uses advanced ADC measurement technology, high accuracy, high voltage and high current detection circuit. The maximum voltage measurements tolerance is within 5mV at up to 8S LiPo battery (34V)
2. Supports regenerative braking, during braking operation it can charge the battery pack and the discharge power (Wh) will increase 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. BMS8P 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. BMS8P features maximum safety protections, within the range parameters that can be setup, BMS8P will alarm and cutoff charge or discharge according to users' setup, out of range parameters and triggered absolute maximum settings BMS8P 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. BMS8P provide users the maximum flexibility, key parameters can be programmed.
16. BMS8P 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.

Interface

BMS8P Main Module



BMS8P Display Module



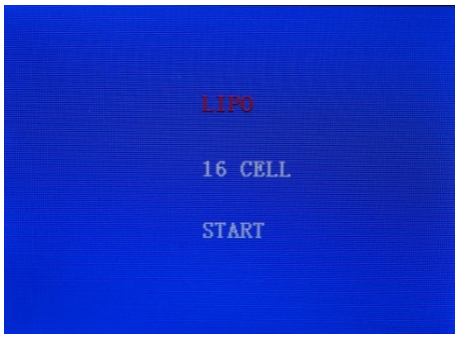
Power Selector	**Battery pack** to power the BMS. the battery pack must be 4S to 8S LiFe or LiPo or LiTO. **External power** supply, BMS8P supports 2S to 8S LiPo, LiFe or LiTo battery pack. The external input supply Voltage range is 15V to 30V, 3A
External power port	External power input, the voltage should be 15V to 30V, 3A minimum, the current depends on the relays used, 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 BMS8P 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 BMS8P 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 connected to Chargery charger, BMS8P can control charge current to shorten charge time
COM2	The COM2 (gray connector) port is connected BMS Main Unit to Display Module with the gray coil wire
COM3	Output RS232 level with the port, any external device can read out all data from BMS8P
Temperature sensor	Two temperature sensors monitor the battery temperature, the sensor must be attached to the battery surface or gap between 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 if any warning event occurred
Beeper[1)]	Connect to beeper or others to alarm. It will output 12V 25mA max.
Current sense	Connect to a single current shunt. Charge/Discharge current is measured simultaneously.
USB	Connect to PC update the firmware by Chargery UpdateTool.exe
Socket	Connect to 2S to 8S battery,

Note:

1) On the BMS display module

Hardware Setup

1. Prepare the BMS wiring harness by attaching ring terminals on the ends. Isolate any leads which will not be used to prevent accidental contact.
2. Attach the leads to the cells and install temperature sensors on pack.
3. Connect Beeper, LED, to the Display Module.
4. Ensure the BMS Main Module power switch is OFF.
5. Connect the shunt, current sensor wire, relays, relay controller wires and Temperature Sensors to BMS8P Main Module.
6. Connect battery wires to BMS8P, **ensure correct cell polarity**. See the "Typical Connections" diagrams starting on page 27.
7. Connect the Main Module to Display Module using the COM2 port
8. Turn on BMS by moving the Power Selector to turn on the device.
9. BMS8P will initialize the beeper and LED, beeper will sound one time, then displays BMS8P 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 8S, the cell count will be identified automatically when the battery pack connect to the BMS8P.



Warning

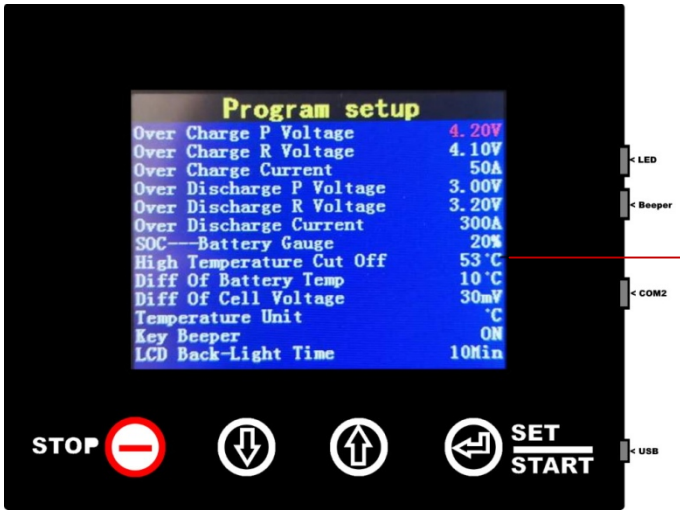
7. The Current shunt must not make contact with any metal including the BMS case
8. The BMS case should not be in direct contact to any metal
9. Current shunt must connected to the Battery Pack Negative !
10. Prevent BMS from vibrations and shaking
11. Ensure the BMS case does not make contact with battery wiring in any way.

Absolute maximum or Minimum ratings *(Always refer to Manufacturer specifications)*

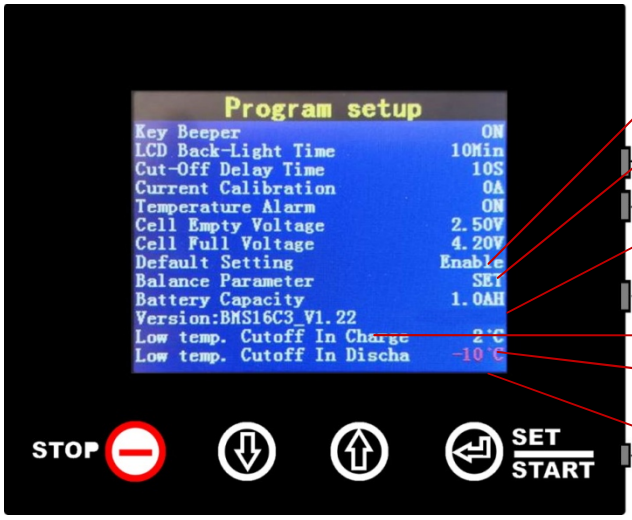
Maximum cell voltage	LiPo	4.35V	Larger than the absolute maximum voltage, BMS8P will force charge cut off
	LiFe	3.90V	
	LiTO	2.80V	
Minimum cell voltage	LiPo	2.50V	Less than the absolute minimum voltage, BMS8P will force discharge to cut off
	LiFe	2.00V	
	LiTO	1.50V	
Battery temperature	LiPo LiFe LiTO	1 ℃ - 80℃	Over / Under temperature, BMS8P will cutoff the charge and discharge

Next Step is to configure the Software.

Software Configuration



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, STOP charge

Under the lowest temperature, STOP discharge

Warning

When setting up parameters, the "current calibration" shouldn't be modified, otherwise the current reading will be wrong.

INSTRUCTIONS on Navigating Menu

1) Press SET/START button for 3 seconds enter into Program Setup interface.
2) Press UP or DOWN button to select the item, press SET/START quickly to make the value flash, and press UP or DOWN to change the value. Press SET/START button quickly to confirm the change. After finishing **all** of the setup, press SET/START **for 3 seconds to save & quit the setup menu.**
3) When you quit setup mode, BMS8P will save all the parameters till next change.

Parameters Setting----Configuration Values

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	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	Sec's
Current Calibration(3)						SET
Current in Storage			0			A
Current in Charge		0	20	100	1	A
Current in Discharge		0	-20	-100	1	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		Choose Enable and 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 AH(9)	1	1	1000	1	AH
Battery Power WH(11)	1	1000	99999	1	WH
Low temp. cutoff in charge	-20	2	20	1	℃
Low temp. cutoff in discharge	-20	-10	20	1	℃
Version:BMS8C3_v4.0(10)					

NOTES:

1. **Always on** means the LCD back-light will be ON forever.
2. **NO** means BMS8P 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 BMS8P, but when the cell voltage and/or temperature trigger the absolute maximum or minimum settings, the BMS8P 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. 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 C**ell 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. **Battery start voltage,** when minimum cell voltage over the setup value, the balancing will start automatically
7. **Balance Stop Diff Voltage,** 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. **Battery Capacity AH**, Setup accurate battery capacity, **See the cell specification / datasheet.** Continuous charge-discharge cycles will decrease capacity over time. Usually once the battery pack reaches 70% of the original capacity, the pack is typically decommissioned and replaced.
10. Main Unit software version
11. **Battery Power WH,** Setup accurate battery power, the measurement unit is in WH (Watt Hours). If you do not have the values on the battery label or data sheet, it can be calculated as shown below.
    WH=Rated battery voltage x battery capacity
    One Li-on (NMC) cell, rated voltage is 3.6V, if capacity is 10AH, battery power is 36WH
    One LiPO cell, rate voltage is 3.7V, if capacity is 10AH, battery power is 37WH
    One LiFe cell, rate voltage is 3.25V, if capacity is 10AH, battery power is 32.5WH

One LiTO cell, rated voltage is 2.3V，if capacity is 10AH, battery power is 23WH

LiFe Example:

If four LiFe cell are connected in series, the rated battery voltage will be 13V with the cells at 3.25V,
If each cell capacity is 280AH, the total battery power is 3640WH @ 3.25V per cell.
4 cells X 3.25 volts = 13.0V. 13.0V x 280AH = 3640WH
4 cells x 3.65 volts = 14.6V 14.6V X 280AH = 4088WH

About AH and WH

AH is rated battery capacity, it is most important parameter and must be written in the battery or cell data or manual. At the same time the AH depends on a special testing conditions, AH is discharge current multiply discharge time. If discharge current is 10A and discharge time is 1 hour, the battery rated capacity is 10AH, during discharging, the discharge current must be constant.
Generally, the testing condition includes discharge current, discharge terminal voltage and ambient temperature.
For 280AH LiFePO4 battery, means the battery can be discharged at 280A, when the battery voltage drop to 2.5V, the discharge time is 60min at least.

As far as WH, it is battery voltage **x** AH, but the battery is not stable during charge or discharge, so the WH is not stable and change with voltage going up or down.

There are four voltage parameters for any chemical battery:
Rated voltage is most stable, and marked with battery label, generally it is the voltage of discharge platform. At this voltage battery has most of capacity, or at this voltage, the discharge time is longer than at other voltage.
Charge terminal voltage, it is the highest voltage, over this voltage, if continue to charge, battery is not safe.
Discharge terminal voltage, it is the lowest voltage, under this voltage, if continue to discharge, battery is no safe too.
OCV is Open Circuit Voltage, measure battery voltage accurate must be done without charge or discharge, otherwise it is not accurate. Because battery impedance affect the voltage measurement.
BMS realize many functions based on accurate cell voltage measurement.

During battery discharge, at rated voltage, the discharge time is longer than at other voltage, so we calculate wh based on rated voltage. If wh calculate based on other voltage, the WH will be lower or higher, it is bad.
Some battery label has WH and AH, if without WH, WH calculation based on AH **x** battery rated voltage is suggested, Ah and rated voltage must be found in battery datasheet.

Operating guideline

Installation video:

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

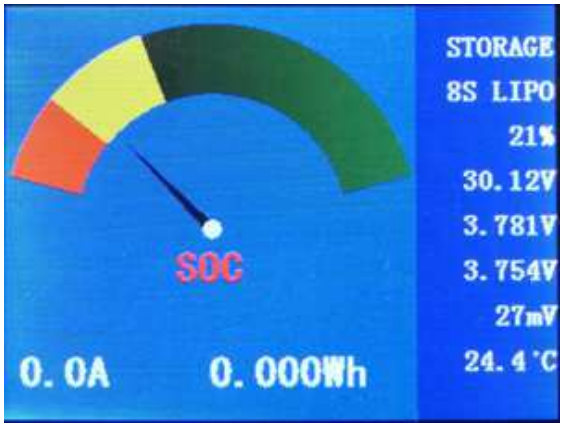
INSTRUCTIONS on Navigating Menu

a) Press SET/START button for 3 seconds enter into Program Setup interface.

b) Press UP/DOWN button to select the item, press SET/START quickly to make the value flash, and press UP/DOWN to change the value. When done, press SET/START **button quickly to confirm the change**. (**stop blinking**). After finishing all of the setup, press SET/START **for 3 seconds to save & quit the setup menu.**

c) When you quit setup mode, BMS8P will save all the parameters until the next change

1. With all the hardware setup completed, Turn on the BMS by moving the power selector Switch
2. BMS8P will initialize the beeper and LED, beeper will sound one time, then displays BMS8P 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 8S, the cell count will be identified automatically when the battery pack connect to the BMS8P. 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 BMS8P 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.
3. 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.
4. SOC—battery gauge dashboard will be displayed first, as following. Press UP/DOWN button alter Configuration Interface. **SOC need to be calibrated first time**, See the "SOC Calibration" on page 25.



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.

5. The following interface figure 1 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.

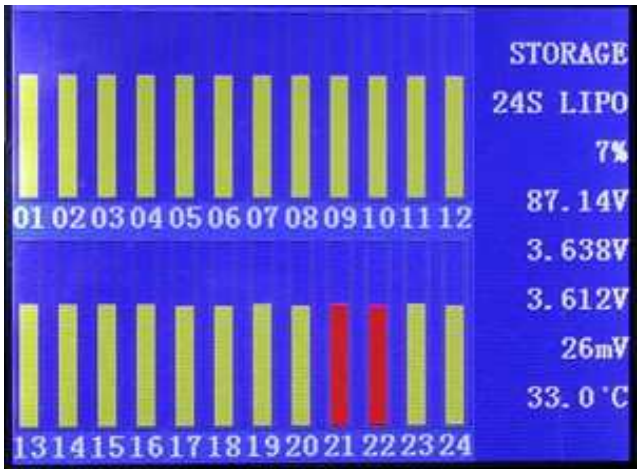


figure 1

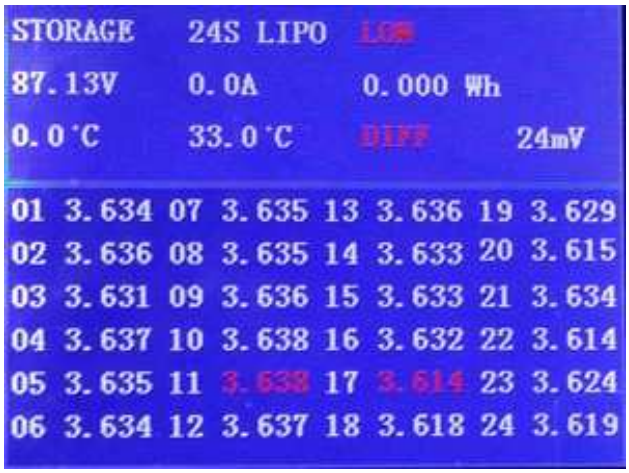


figure 2

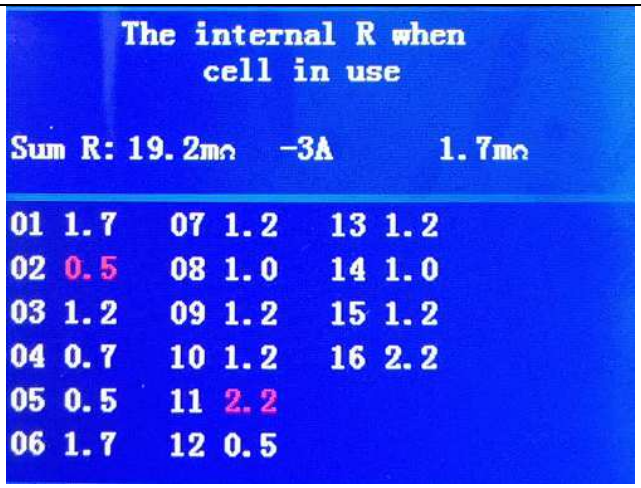


figure 3

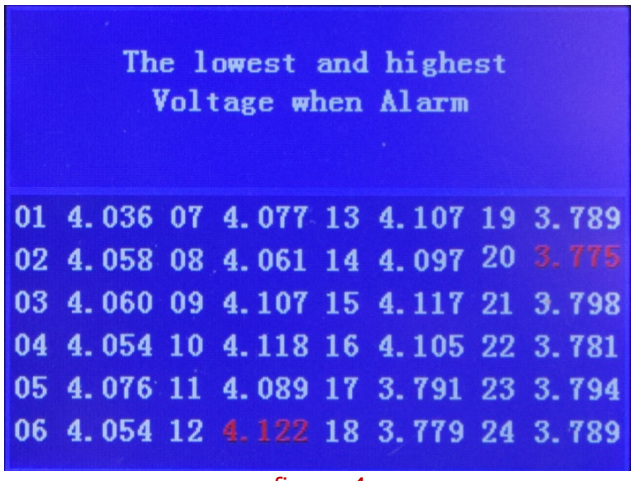
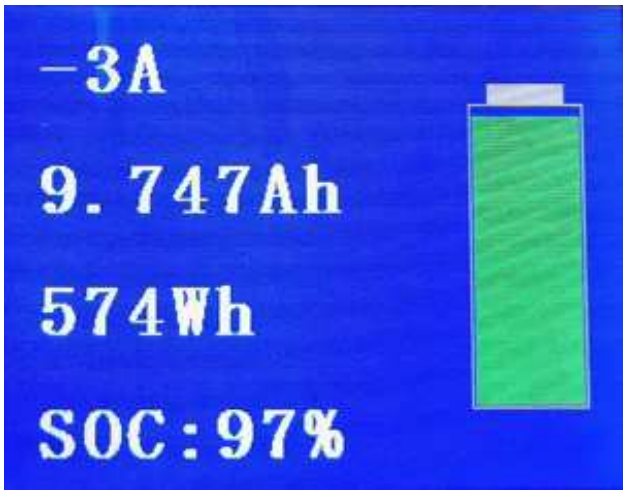


figure 4

6. The right corner interface figure 2 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 BMS8P 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.



7. When charge or discharge, BMS will measure each cell internal resistance. See above figure 3.
8. This right figure displays charge or discharge current, charged or discharged power in Wh, Capacity in AH and SoC. When the SoC less than 30%, it is displayed in yellow. When under setup values, the BMS will cut off discharge.
9. 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 figure 4.

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 yellow bar is displayed means the cell is in balancing. See "Balancing Indicator" on page 28.
- COM2 is to connect to charger if you have CHARGERY charger, COM3 is to connect to external device.

SOC Calibration

The program calculates SOC according to the power charged or discharged from battery. Users need to setup **battery power (WH)** and **battery capacity (AH)** when turning on the BMS for the first time. After charging to Maximum voltage or discharge to minimum voltage, BMS will complete the SOC calibration and display accurate SOC. The details are as below.

WH = (Cell Voltage X AH rating) IE: 4 cells X 3.25 volts = 13.0V. 13.0V x 280AH = 3640WH

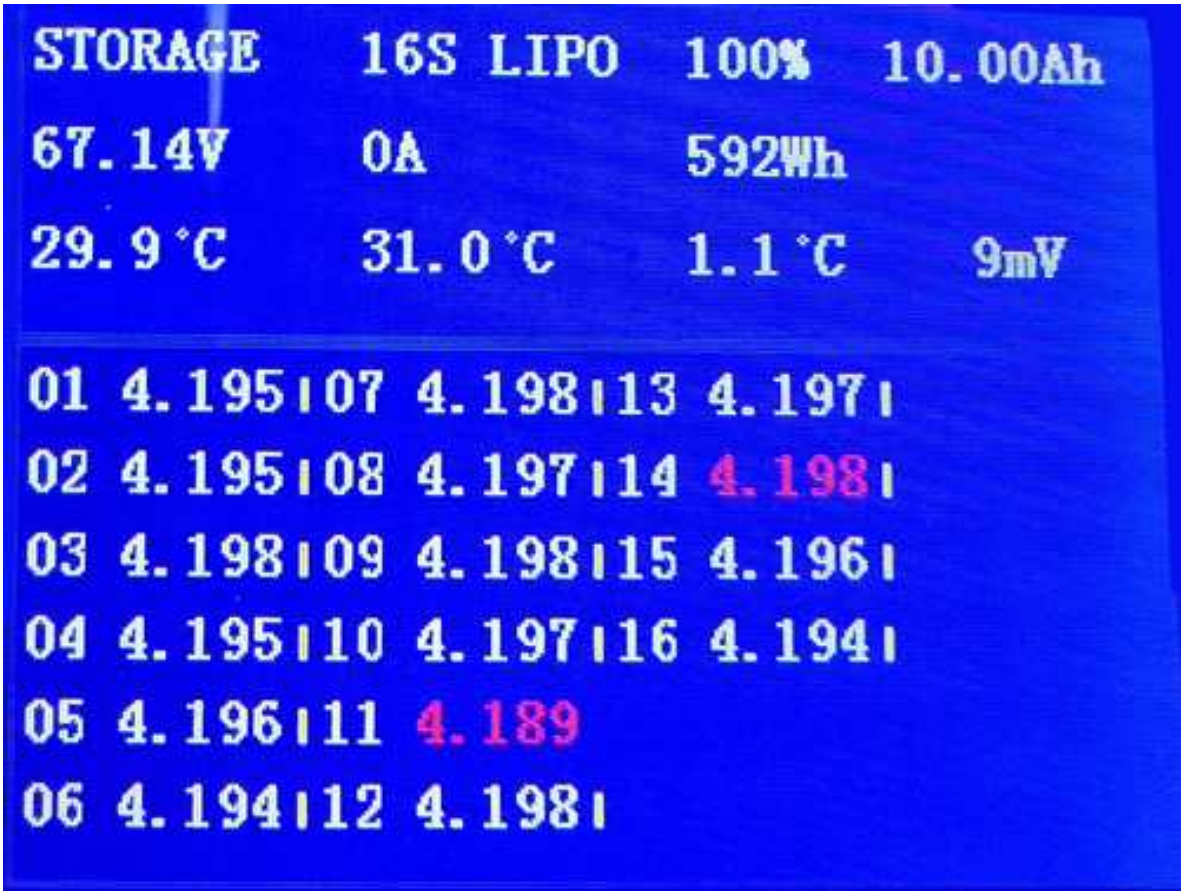
1. Connect all cells and accessories.
2. Turn on BMS, choose battery type, cell count is automatically identified by the BMS, press START or waiting for 8 seconds, BMS will start and display all cell voltages.
3. Press START **for 3 seconds** to enter setup configuration screen.
4. Continue to setup **"over charge protection(P) voltage"** to Maximum value according to cell datasheet. Generally it is 4.20V for LiPo, 4.15V for Li-ion, 3.65V for LiFe, 2.70V for LiTo battery.
5. Continue to setup **"over discharge protection (P) voltage"** to minimum value according to cell datasheet. Generally it is 2.75V for LiPo, 2.50V for Li-ion, 2.5V for LiFe, 1.50V for LiTo battery.
6. Continue to setup **battery AH and WH** according to battery datasheet. WH can be calculated based on the formula above or setup according to cell datasheet.
7. Continue to setup **"Low SOC cut off"** to 0. The setting is used for SOC calibration while discharging.
8. Continue to setup **"over charge current**" and **"over discharge current"** according to your particular application requirements.
9. Others can be setup later, but make sure battery can be charged or discharged normally.
10. Press START for 3 seconds, quit Program Setup, LCD display SOC, WH and AH, SOC is estimated based on battery voltage. WH and AH is calculated according to WH and AH settings. Take a 16S 10AH LiPo battery as a sample, If SOC estimated is 20%, AH setting is 10AH, WH setting is 592WH (**3.7v x 16 x 10AH=592WH)**, the WH reading will be 118.4WH, and AH reading will be 2 AH.
11. Start to charge, with the charging time increased, the SOC, AH and WH will increase, till the cell average voltage reach 4.2V (it is over charge protection voltage setting), the SOC will display 100%, AH reading is 10AH, WH reading is 592WH. Actual power charged may be not 592WH, it is normal, the power (WH) difference is caused by SOC tolerance based on voltage. The BMS calibrated the difference and display accurate SOC.
12. Or start to discharge, with the discharging time increased, the SOC, AH and WH will decrease, till the cell average voltage reach 2.75V (it is over discharge protection voltage setting), the SOC will display 0%, AH reading is 0AH, WH reading is 0WH. Actual power discharged may be not 0WH, it is normal, the power (WH) difference is caused by SOC tolerance based on voltage. The BMS calibrated the difference and display accurate SOC.
13. Stop charging or discharging, the BMS will display accurate WH, AH and SOC, when starting to discharge or charge again, the BMS will display actual power charged or discharged. It will be very accurate.

Notes:

1. In SOC calibration, or in first charging or discharging, **"over charge protection(P) voltage"** and **"over discharge protection(P) voltage"** setting are very important, it must be **maximum cell voltage and minimum cell voltage** separately. The voltage setting can make sure the WH and AH reading after calibration are accurate.
2. When you turn off BMS, the actual SOC, WH and AH will be saved, and displayed when you turn on BMS. This feature avoids re-calibrating SOC.
3. As Charge and Discharge cycles increase, the battery capacity will be decreased, that is to say, the actual

battery capacity will reduce over time. You may find that the SOC is not 100% when the battery is fully charged (each cell voltage reaches maximum value), such as 90%. This means battery WH or AH is only 90% of the original setting. When this occurs, you can setup new WH and AH, if the original is 100wh, you can change it to 90WH, then the BMS will update SOC display to 100%.

4. After SOC calibration, the voltage can be set again according to your specific application. Such as you can set the "over charge protection (P) voltage" to 4.0V (LiPo), and "over discharge protection (P) voltage" (LiPo) to 3.3V, means the battery SOC will be used from 10% to 90%. This will extended the battery pack life-cycle and make the system safer in general.



Balancer

The BMS8P 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 BMS8P uses temperature protection prevent the BMS from overheating and has over current protection for each cell.

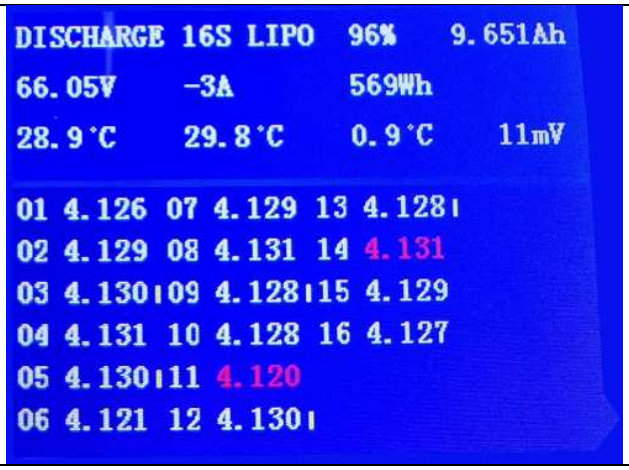
In certain conditions, cell voltage difference drop is very slow, it seems that it won't balance, such as **battery capacity is over 100AH; cell voltage difference over 0.2V; or average cell actual voltage is just cell storage voltage**.
When the BMS is balancing cell voltage, the balance current is 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.

Comparing 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.

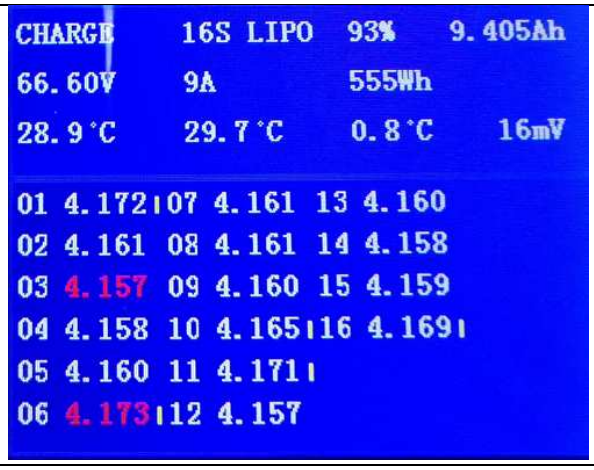
RECOMMENDATION: After 50 or 100 cycles, it is essential to test battery capacity, and measure each cell impedance to identify which cell is has the highest impedance. A High Impedance cell has a lower capacity and will determine the total battery capacity and battery life and even driving distance, if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

Balancing Indicator

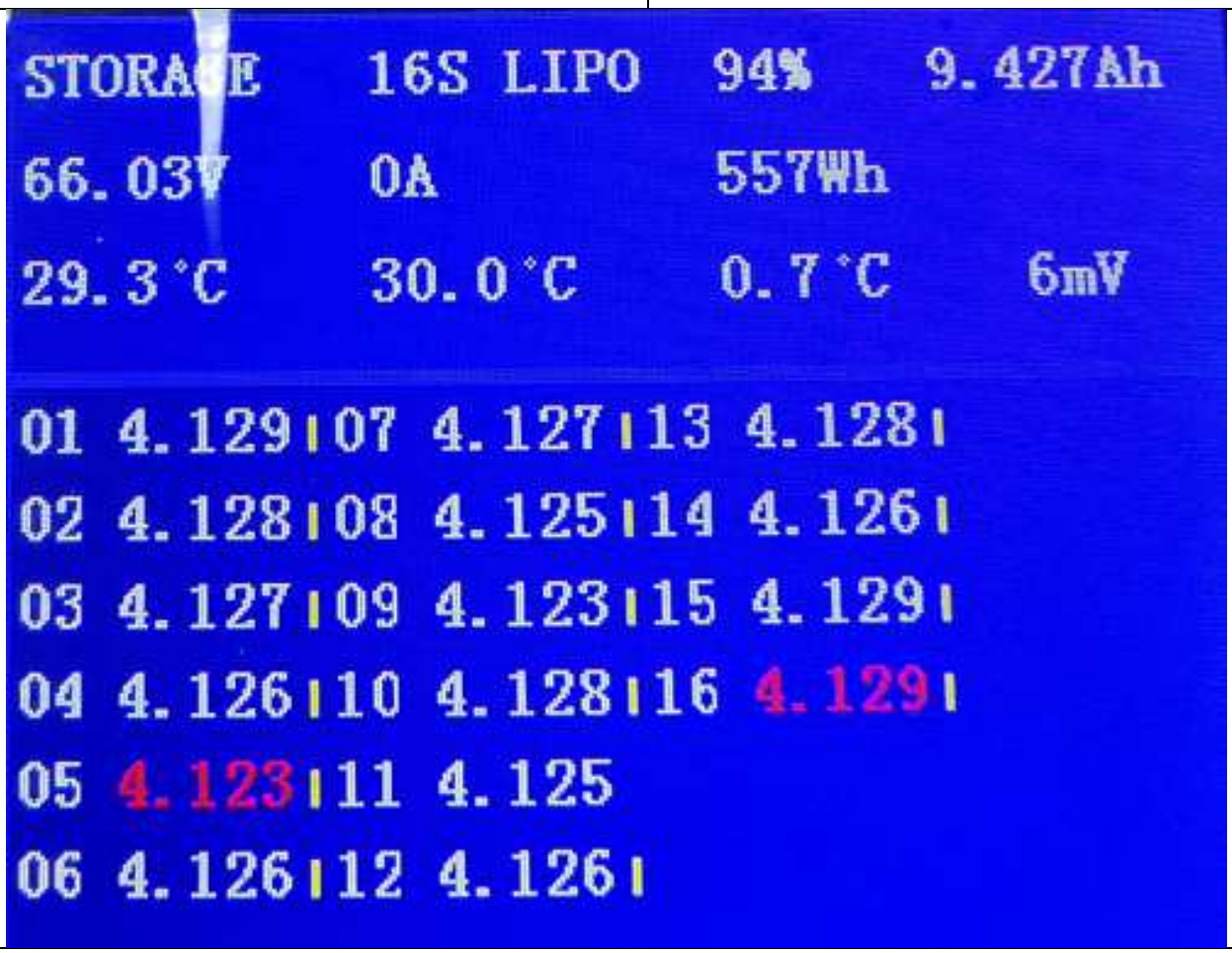
From firmware v4.0, the BMS has a yellow indicator, when the BMS is balancing cell voltage in Storage, Charging or Discharging. The "yellow bar" will be displayed after cell voltage reading, when cell are not in balancing mode, the yellow bar will be not displayed. Example below.



Balancing in Discharge, cell 5 and cell 12 are in balancing.



Balancing in Charge, cell 1,6,10,11 and cell 16 are in balancing.



Balancing in Storage, except cell 11, other cells are in balancing.

Cell internal resistance (Impedance) test

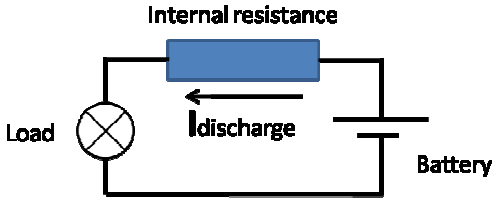
Internal resistance of an energy storage device, such as a battery, is an importance parameter that determines their power performance. For commercial products, the manufacturers usually provide two types of internal resistance, i.e. dc internal resistance and ac internal resistance. For ac resistance, typically the parameter is measured at 1 kHz frequency, namely Rs at 1 kHz. For dc resistance, there has been no standard regarding the method of measurement.

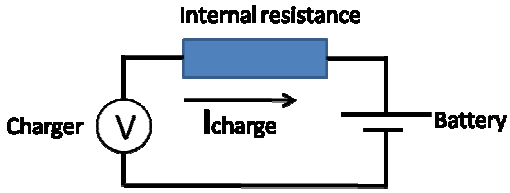
For a battery the internal resistance is dependent on many factors, such as conductivity of electrolyte, electrode material, and current collectors. The Ohmic internal resistance should be distinguished from the influence of electrode processes, such as voltage changes due to electrochemical double layer charge/discharge and faradaic reactions (polarization in the battery). Ideally internal resistance should be measured by instantaneous voltage change after a current pulse or interruption. However when it comes to practical measurements, time resolution regarding to how the dc resistance from iR drop is determined has become an issue.

With firmware v4.0, the BMS features a cell internal resistance measurement. When battery start to charge or start to discharge, the BMS measures each cell internal resistance within 1 second, the total battery resistance and difference of cell resistance are being displayed on one interface.

The measurement time and charge or discharge current affects the resistance. The shorter the time and the higher current, results in higher accuracy, so the internal resistance will be updated when charging or discharging occurs again.

Generally, the new cell internal resistance is lower than the same cell that has been used for several cycles. With the internal resistance increased, the battery power/capacity will decrease.



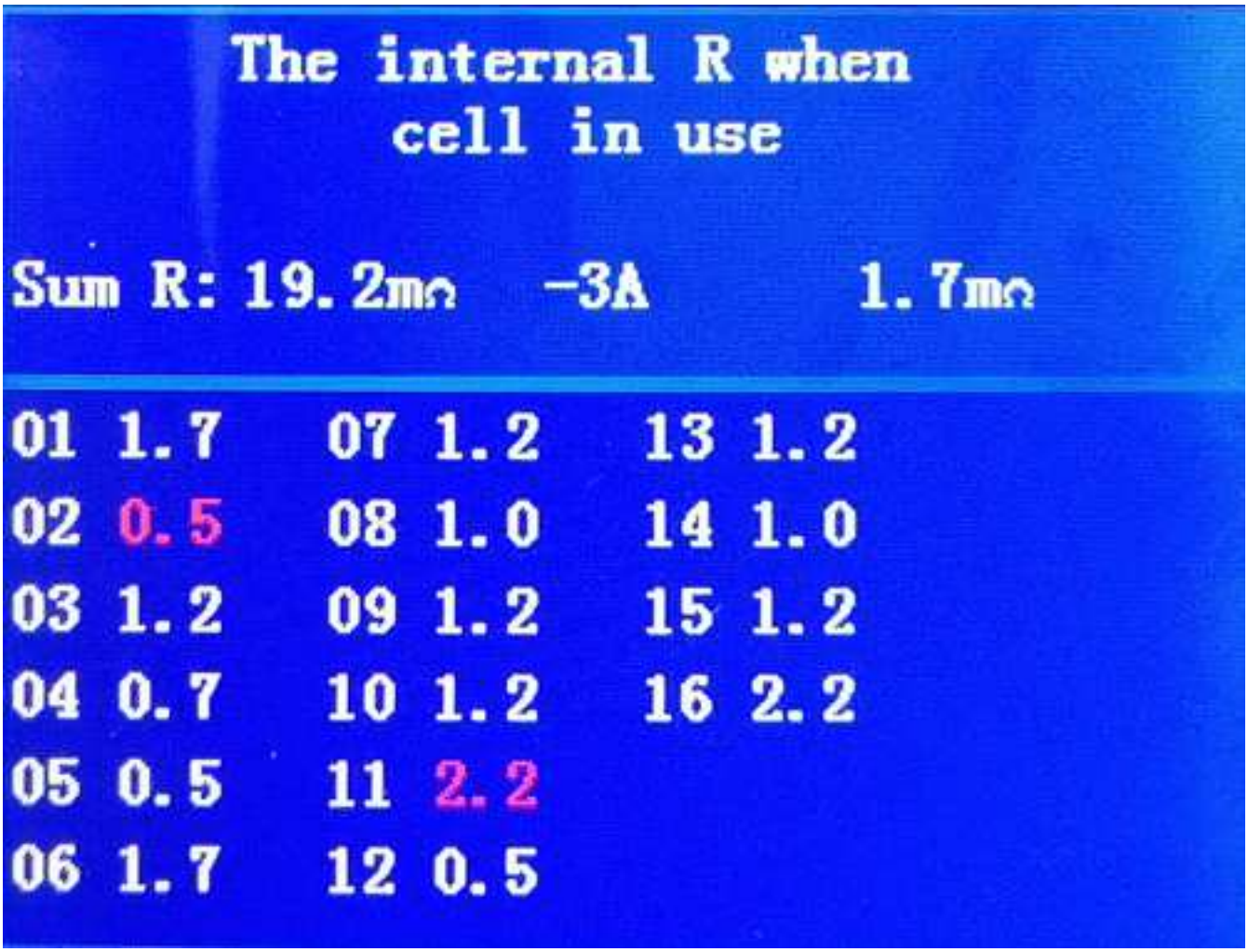


When battery is in discharging, the voltage of load is battery voltage minus discharge current x cell internal resistance, **Vload=Vbattery – Idischarge x R, R is battery internal resistance**

If R is 10mohm, when Idischarge is 100A, the IR drop will be 1V. for any cell in series, if the cell voltage is 4.0V, means the cell voltage is only 3.0V when discharge at 100A. the cell have to be exchanged or abandoned.

When battery is in charging, the formula is **Vcharger=Vbattery + Icharge x R, R is battery internal resistance,** for any cells in series, all cells have same charge current, so the cell with higher R will be charged fully first. and will cause imbalanced cell voltage.

Although cell internal resistance measured by BMS may be not accurate, it is still very useful to sort out all cells and then find "good" or "bad" cell. Ideally, each cell in series should have same internal resistance, if the difference of cell internal resistance is very large, the higher resistance cell must be "bad", and caused large cell voltage difference, then shorten the total battery life.



EXAMPLE:

One 16S LiPo battery pack is in discharging at 3A, BMS measured all cell internal resistance. The total battery resistance is 19.2mohm, and the difference of each cell resistance is 1.7mohm.

All cell internal resistance, total battery internal resistance, cell internal resistance difference and the current when measure internal resistance are sent out.

You can record the cell internal resistance, and compare new cell internal resistance with the cell used for several months, then you can find which cell has the highest internal resistance.

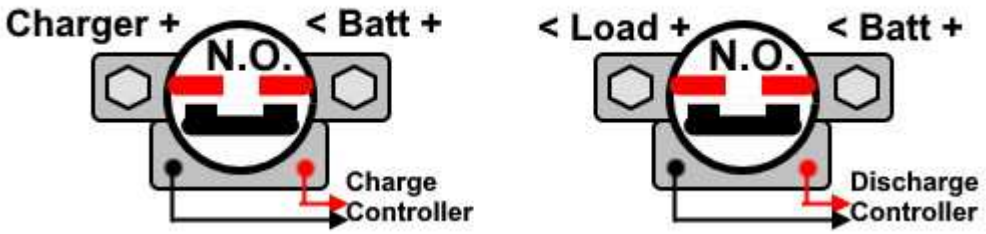
Charge and discharge relay lectotype for BMS8P

The BMS8P can output 12V/3A to power the charge and discharge DCC/relay/SSR that is used for cut off charge or discharge when any cell voltage reach settings. 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 BMS8P is powered by external power supply, the external voltage should be 15-30V which can output at least 3A to drive the relay and power the BMS8P.

3. Generally the mechanical relay is bi-directional, can be installed on the battery positive or negative, the driven coil is isolated with large current terminal (main contactor). Connection is as below picture.

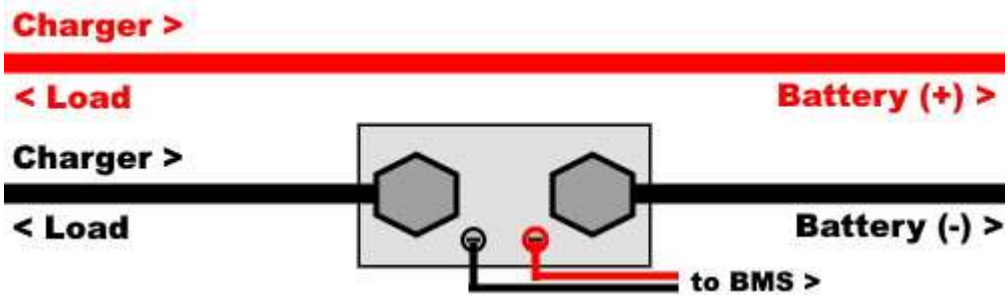


4. Chargery DCC (DC contactor) can be fit with Chargery BMS, it is designed special for the BMS. Detailed connection diagram on page 14

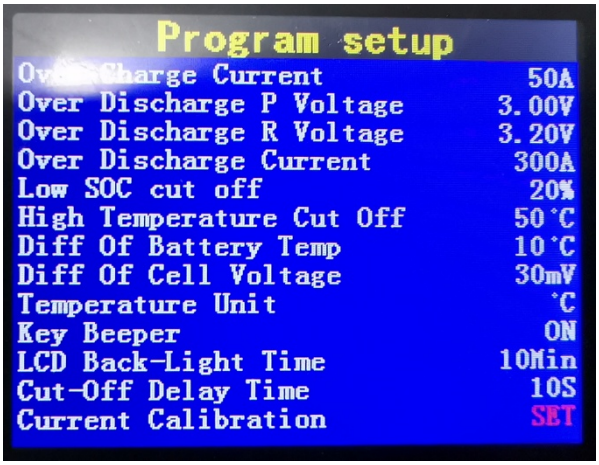
Current Calibration (Shunt)

Current calibration is only required if you change the Shunt from the one supplied by Chargery which are calibrated at the factory. Use shunts which are 75mv or lower only.

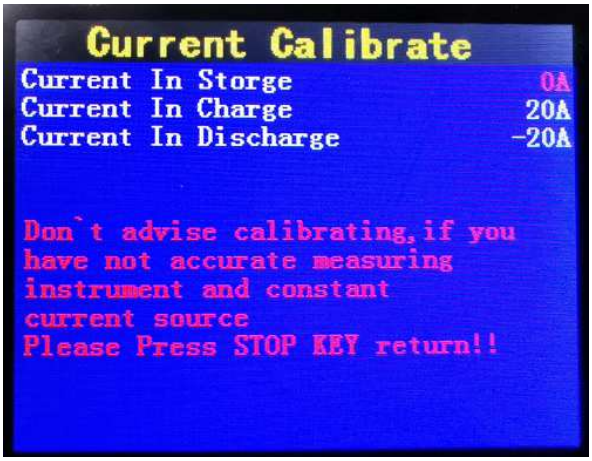
Press SET/START for 3 seconds to enter into Program Setup and find the Current Calibration, you can calibrate the current to improve the measurement accuracy. If using a new current shunt, the current must be calibrated again to ensure accuracy. The current shunt should be installed as shown below.



Turn off charge and discharge, choose "Current Calibration SET" and press START enter into Calibration submenu as right picture,



1. **ZERO the shunt:** choose first line " Current In Storage" press SET/START button make the 0A blink, quickly press SET/START button to finish 0A calibration.
2. **CALIBRATE Charge Current:** choose second line "Current In Charge", Press SET/START make the current blink, Quickly press UP/DOWN increase the current to the new value (up to 100A, 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. **CALIBRATE Discharge Current:** choose third line "Current In Discharge", Press SET/START make the current blink, Quickly press UP/DOWN decrease the calibration current to new value (up to -100A, 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, quickly press STOP quit calibration, and press SET/START button for 3 seconds quit Program Setup and current calibration is finished.

If calibration is not needed, please press STOP button quit directly.

During calibrating, the charge current and discharge current must be stable and accurate, and must be as same as current calibration setting. If charge current setting is 30A (on Program setup, current calibration submenu, the setting is 30A, as right picture), the actual charge current must be 30A that must be measured by high accuracy current meter and confirm it is 30A NOT 29.8A or 30.1A. if it is 30.1A, BMS will make the 30.1A as 30A reference, so the current reading will not be accurate.

When calibrating **charge current**, the charger must work on CC (constant current) mode. So the current can keeps stable basically.

When calibrating **discharge current**, the load must be drawn at a constant current from battery, but this is very difficult to do, because discharge current depend on the load applied. If using an electric load, and set the discharge current such as 30A on CC mode, the electric load can make the discharge current at 30A and keep it there so it won't change.

If you cannot make the battery discharge at a constant current, but you can charge the battery at constant current, when calibrating **discharge current**, you can swap current sensor wire (slim red and black wire) on the shunt, then turn on charger, and charge the battery at "Current In discharge" settings, Such as -20A or -30A. Don't forget switch the wires back on the shunt after finishing the discharge current calibration. Remember, RED wire toward the Battery Pack terminal.

Current calibration is not suggested. We calibrate shunt and current before delivery. You only need to re-calibrate if you change shunts from the ones supplied by Chargery.

If the current is not accurate, the WH and AH will not be accurate. SOC reading will also be wrong.

Firmware Upgrades via USB Port

Warning:

1. BMS main unit and LCD display module have **different firmware file**, and must be updated separately.
2. There is a USB port on the Main unit and LCD unit separately for updating.
3. Don't turn off BMS during updating
4. If loading the wrong firmware, the BMS may be damaged and won't resume operations.
5. Generally the USB driver is not needed for the BMS8P, 16T and 24T. If it is needed, please install USB driver on PC from the Chargery downloads.
6. Main unit V4.0 cannot communicate with a lower version LCD, such as V3.03, it means, when press START button on LCD unit, the BMS WON'T start.

Update operations

Before update, please down load update tool software, new firmware for BMS main unit and LCD unit. Generally windows PC can identify BMS and communicate with BMS successfully as right image (COM3)
If the below image or others with yellow mark is showed up in device manager, please install USB driver on pc.

1. Please down load BMS8P, 16T and 24T USB driver for window PC
2. Please down load update tool on http://www.chargery.com/uploadFiles/Update_Tool_V1.03.zip, it is for BMS8P v3.0, BMS16T v3.0 and BMS24T v3.0 (new hardware with COM3 communication port),
3. Please down load the latest firmware according to your BMS model, including main unit firmware and LCD unit firmware, take as BMS16T-300 as sample, the correct link is BMS16T-300 main unit v4.0 and BMS16T LCD module V4.0
   All files are here http://chargery.com/update.asp,
4. Install USB driver if need,
   a) Turn on BMS, connect BMS to PC,
   b) If above image with yellow mark is showed in device manager, please run the USB driver. If don't

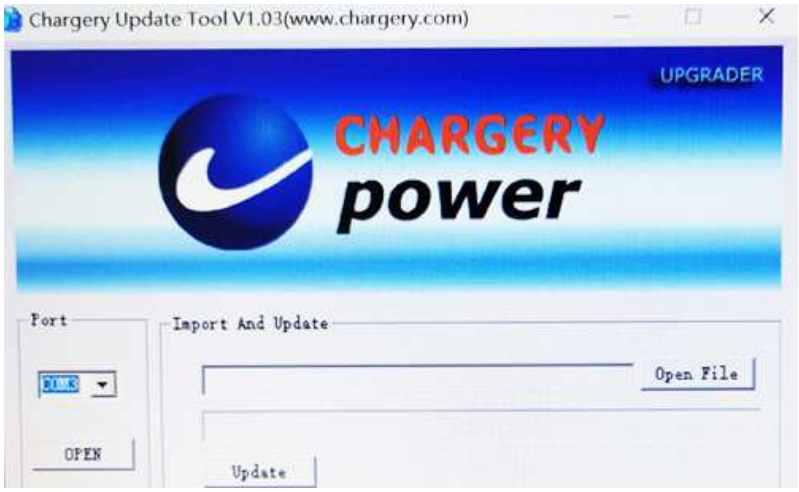
show it, please check the USB data cable and BMS turned on or not.

c) After running USB driver, when right image showed, please press INSTALL button, continue to install the driver.

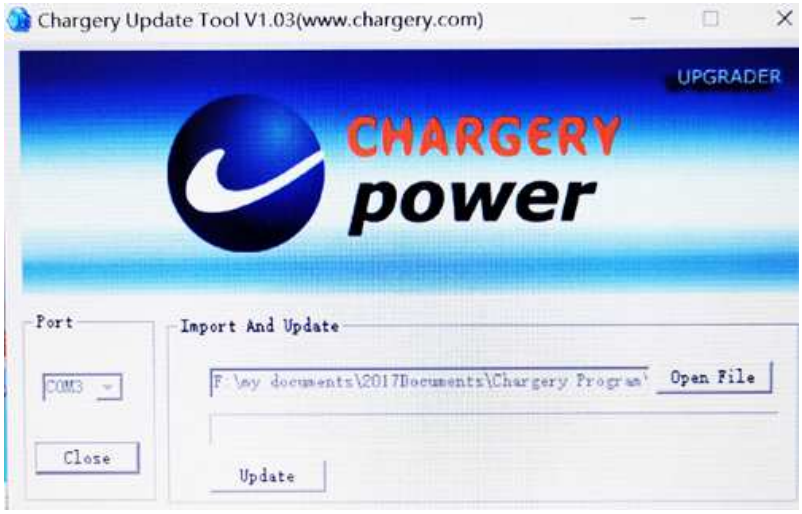
d) When Installation finished, installation finished menu will be pop up.

e) Check the device manager, USB-SERIAL CH340 (COMx) will be listed in Ports(COM&LPT) list.

Update BMS main unit



1. Connect PC to BMS by USB data cable and turn on BMS, the LCD display module do not need connect to main unit. If connect LCD to main unit, the update information will not be showed on LCD.
2. On PC "device manager" find the correct COM port, as above image, it is COM3.
3. Unzip the update tool software, and run the software, choose correct COM port, See right image, choose COM3
4. Click OPEN button lock the port please.
5. Click Open File button load the firmware file. The file should be .hex file. Such as BMS16C3_V4.00_APP.hex. "C3" means 300A model. See right image.
6. Click Update button start to update, the update progress bar will be showed on PC,
7. Finish installation, the complete information will be displayed on PC.



Continue to update LCD unit

1. Connect LCD unit to main unit and connect LCD unit to PC by usb data cable.
2. Click Close button unlock the port, then click Open button lock the port on update tool software
3. Click Open File button load the firmware file. The file should be .hex file. Such as BMS16T_V4.00_APP.hex, it is for BMS16T LCD model.
4. Click Update button start to update, the update progress bar will be on PC and LCD, update complete information will be displayed on PC.

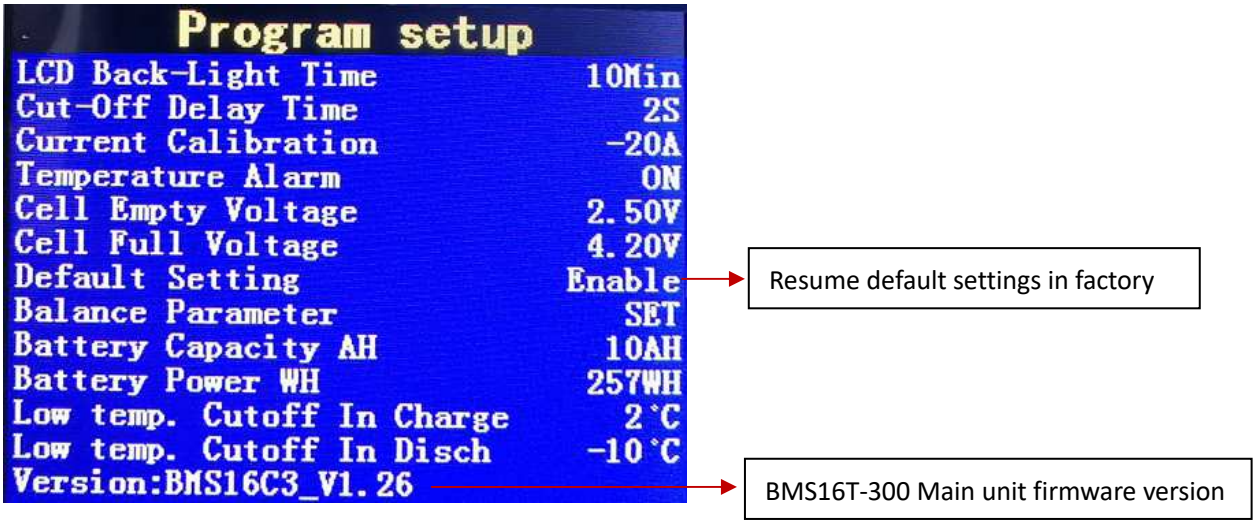
Finish update, the BMS will start automatically. You can find the main unit version on the bottom line of program setup interface, when power on BMS, you can find the LCD module version on the first interface.

NOTES:

a) If display "update time over", or don't display any COM port, please run update tool software again, the software version must be V1.03.

b) The update tools current only supports Windows.

c) After BMS main unit and LCD unit updated to V4.0, please enter into program setup interface and press UP or DOWN **choose Default Settings, then choose Enable press START button, resume all parameters settings as default**. As below.

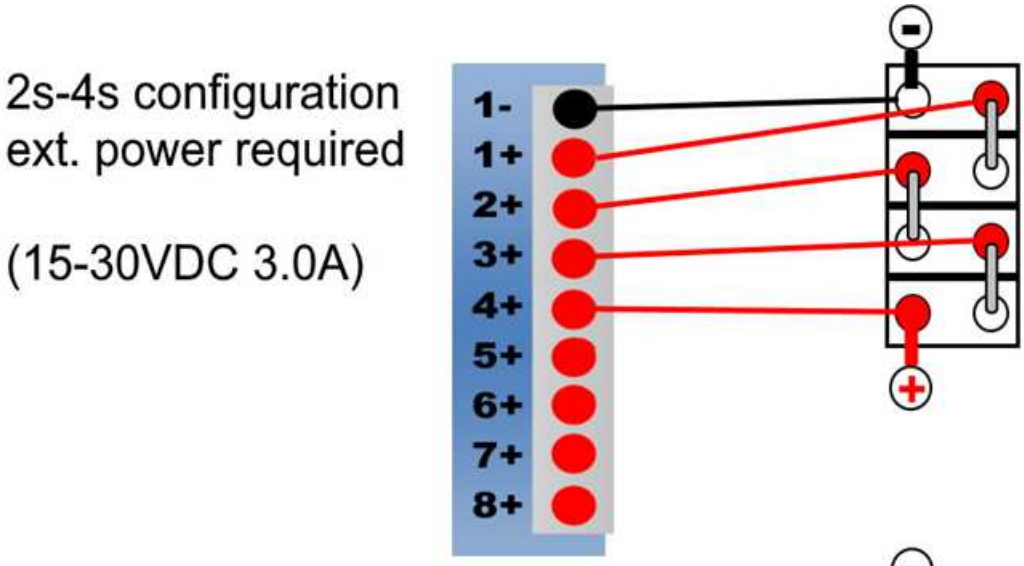


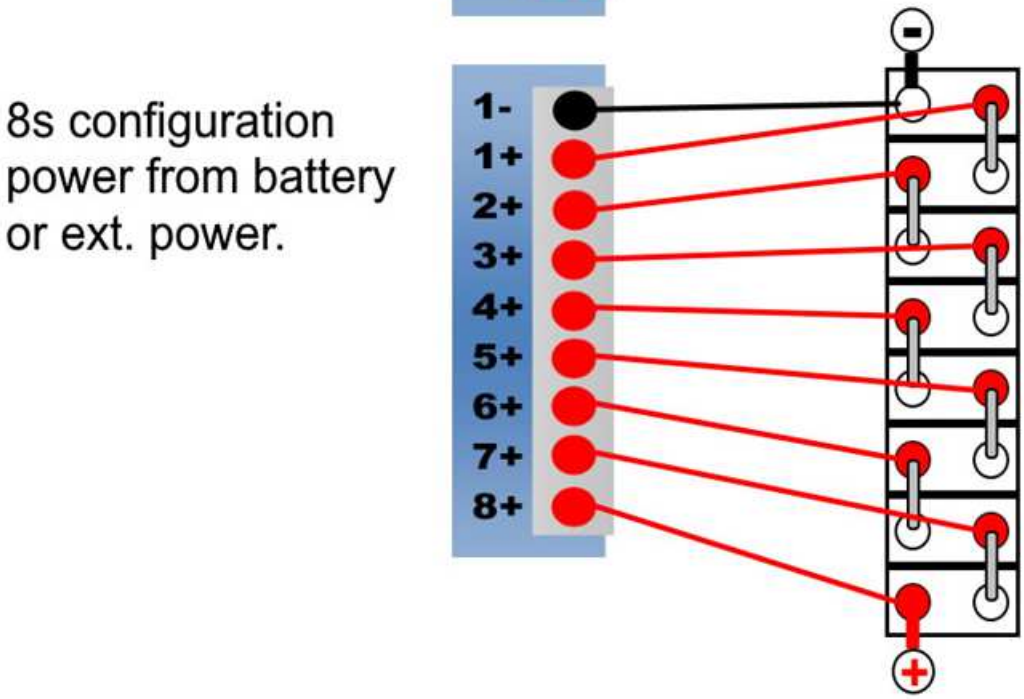
Typical Cell Connections

There are 1 socket connecting to 2S-8S battery pack,

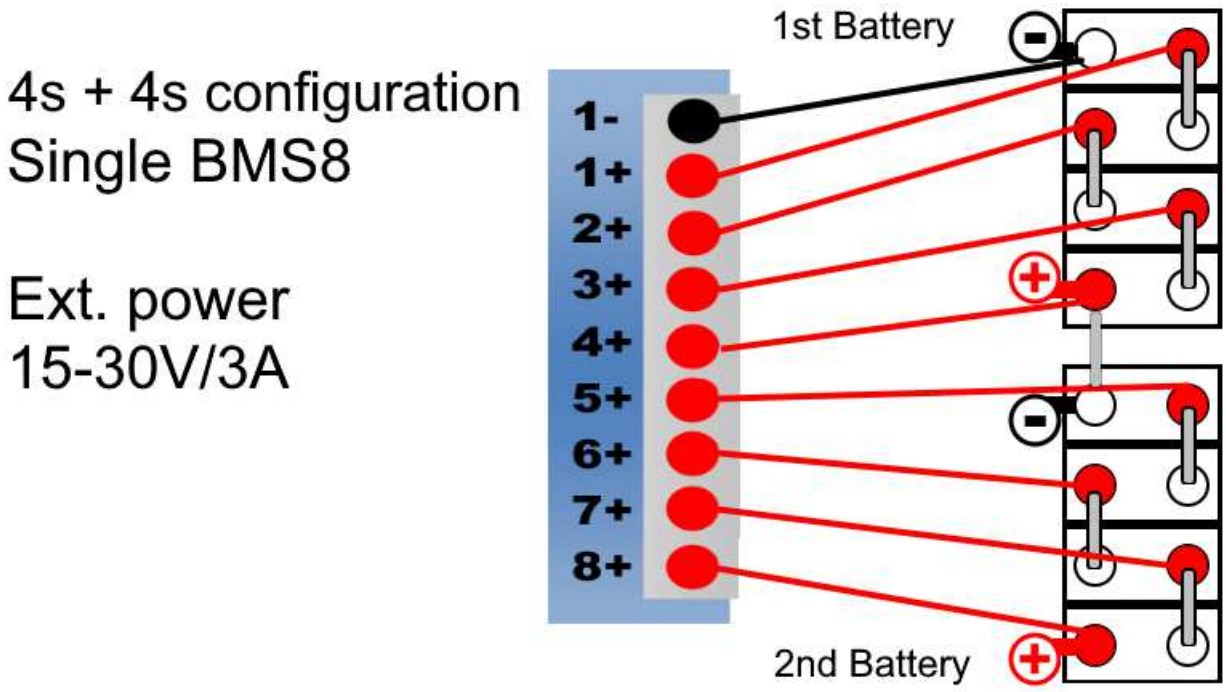
1. There is 1 socket connecting to 2S-8S battery pack,
2. 2S-3S battery connected to the socket 1 directly, but an external power supply is required.
3. 8S configuration allows for battery / external to power the BMS. The BMS requires 15-30 VDC @ 3A.

2S-4S configuration and 8S configuration

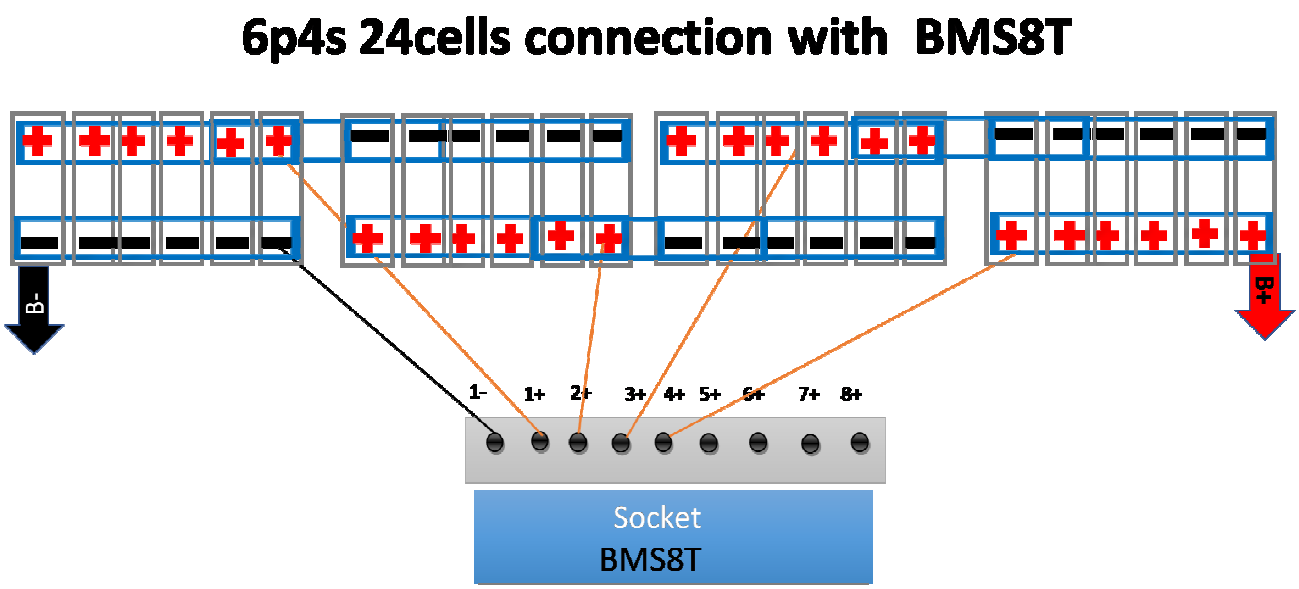




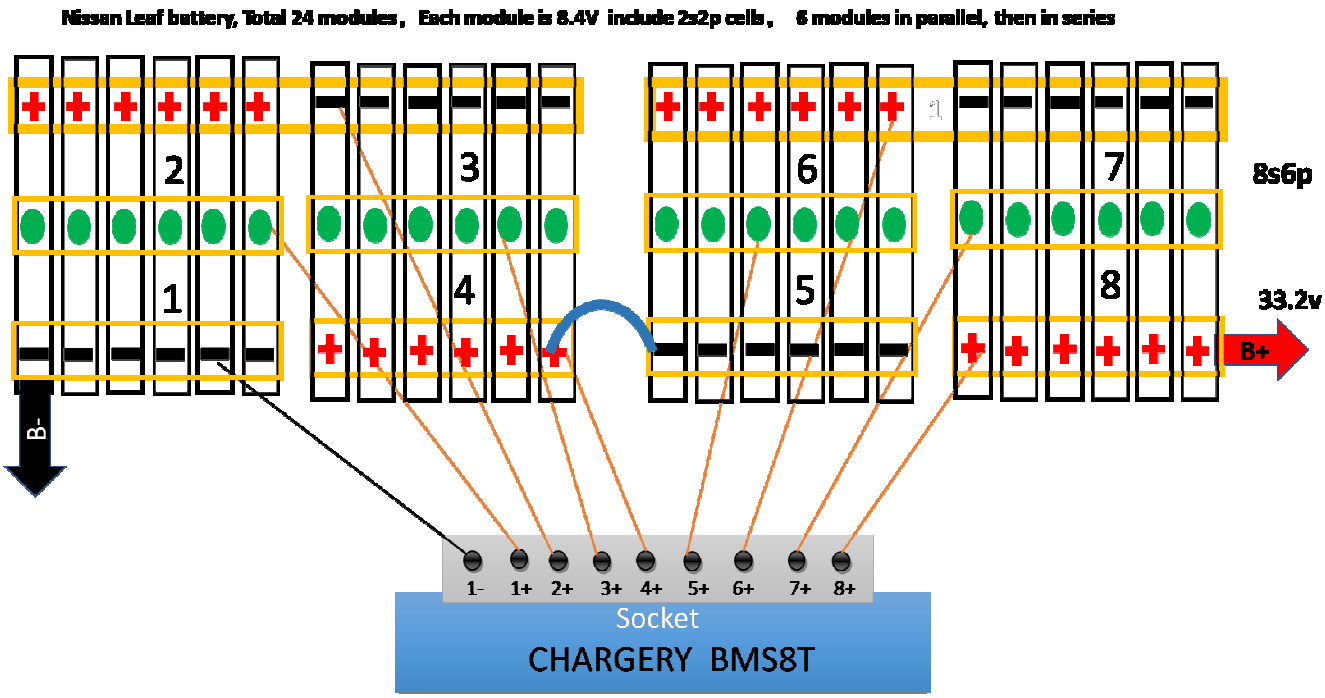
4s & 4s with single BMS8P configuration example.



6P4S 24 cells with single BMS8P configuration example.



Nissan Leaf battery 6P8S with BMS8P configuration example

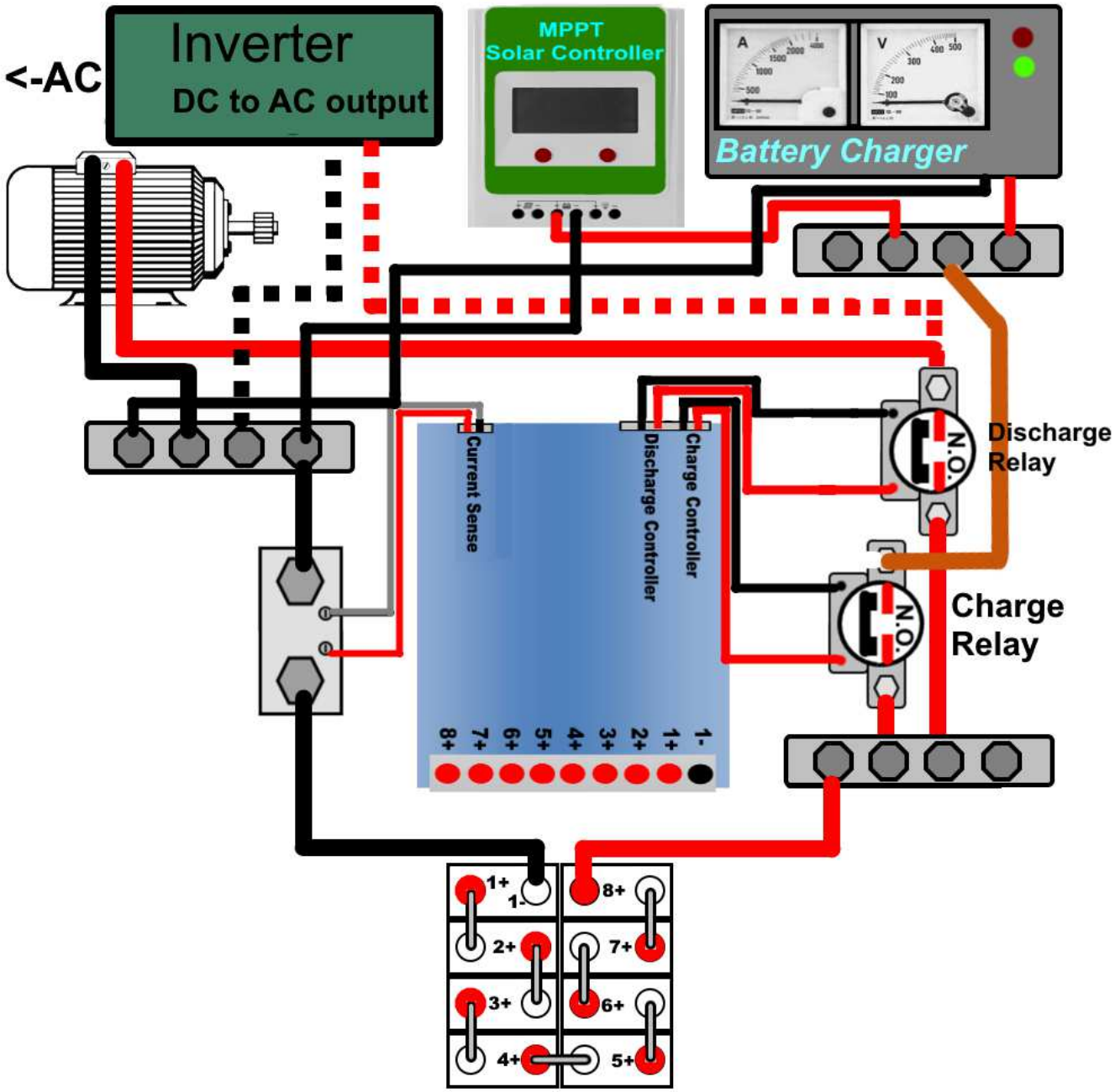


Separate Port Configuration example—with Mechanical relay or DCC.

Before connecting the relay's for charge or discharge control, please confirm the coil relay voltage is correct for the voltage being used. The BMS8P 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)

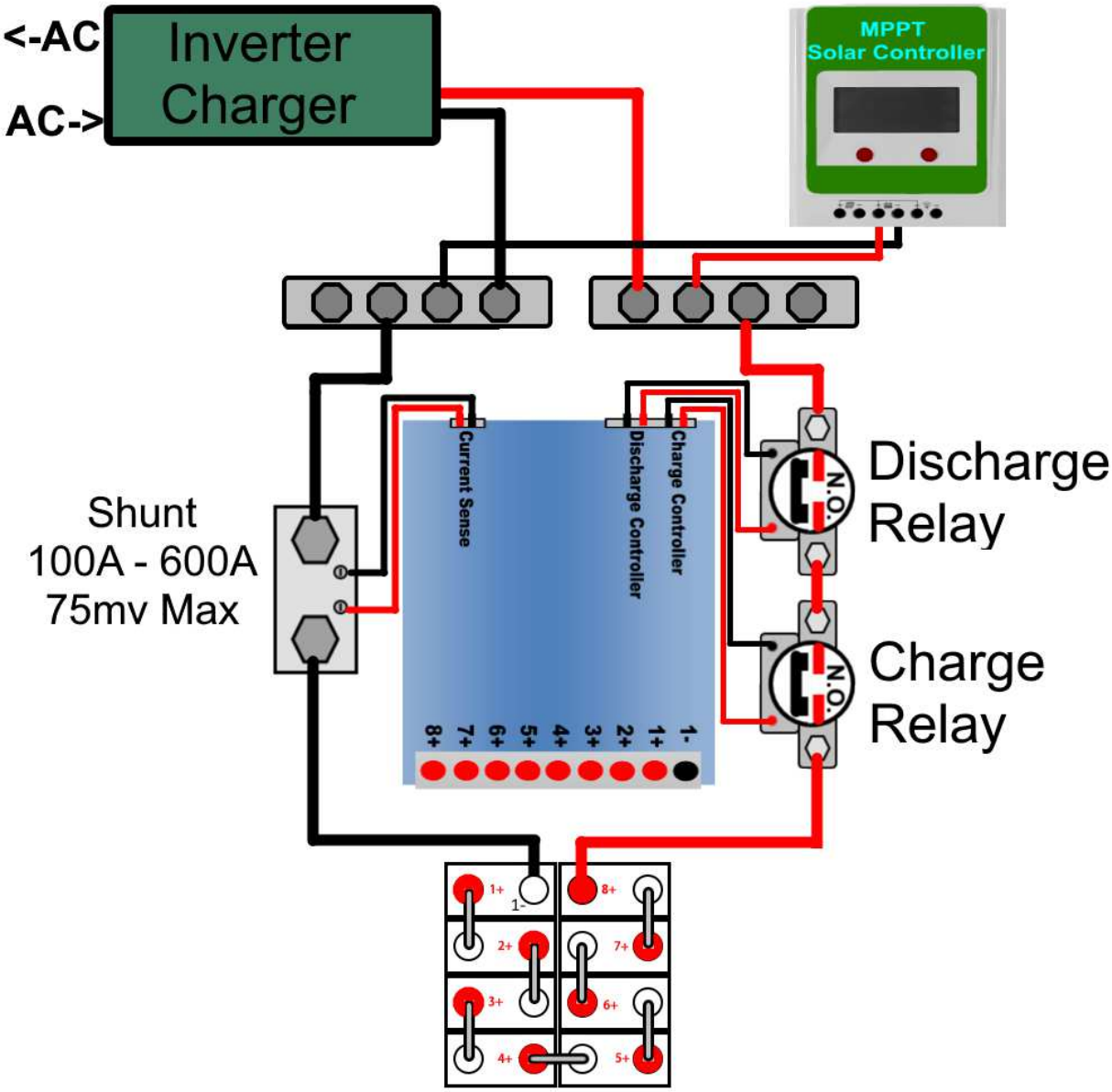
NOTE ! Fuses, DC Breakers are not shown. Please use Best Practices and install appropriate fuses and breakers according to local codes and other guidelines.



ATTENTION !

The relay on above Configuration is bi-directional or uni-directional SSR/mechanical relay. But SSR must be isolated. **Above relay can be replaced with Chargery DCC.**

Common Port Configuration example—with two Mechanical relay or one CHARGERY DCC.

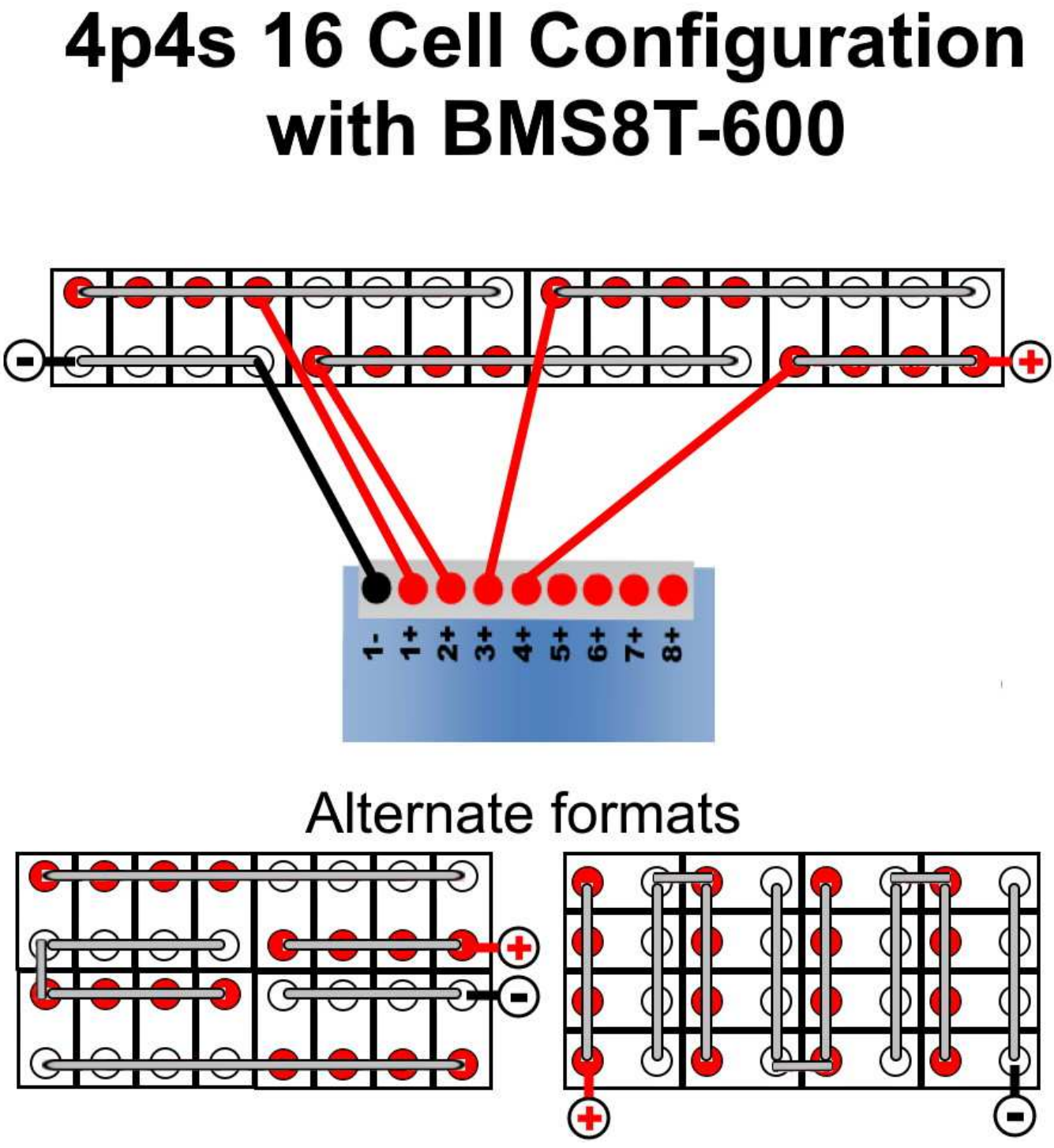


This configuration requires that both Charge & Discharge Relay's are capable of handling equal amperage.
Example: (2000W ÷ 12V = 166A X 1.25 = 208A) (2000W ÷ 24V = 83.3A X 1.25 = 105A)

ATTENTION !

- Fuses, DC Breakers are not shown. Please use Best Practices and install appropriate fuses and breakers according to local codes and other guidelines.
- The relay on above Configuration is bi-directional or uni-directional SSR/mechanical relay. But must be isolated. **Above two relay can be replaced with one CHARGERY DCC.**

4p4s Cell configuration with BMS8P-600 example



ATTENTION ! Fuses and Breakers should be installed according to your specific application and usage. Failure to do so may result in Damage or Injury.

Related parts

The following device is related with BMS8P

MODEL	DESCRIPTION	COMMENTS
BMS16	For 2S-16S, without cell balancer	300A charge/discharge
BMS16T	For 2S-16S, 1.2A balance current per cell	600A max. charge/discharge
BMS24T	For 2S-24S, 1.2A balance current per cell	600A max. charge/discharge
C3060	AC charger for 1S-8S battery pack	1-60A charge, 1500W max.
C6830	AC charger for 4S-16S battery pack	1-30A charge, 1500W max.
C10325	AC charger for 4S-24S battery pack	1-25A charge, 1500W max.

Total solution on E-Vehicle application—1500W 60A 8S battery charger

If using the Chargery charger, the charge relay can be ignored, BMS8P 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, BMS8P 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 BMS8P 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.

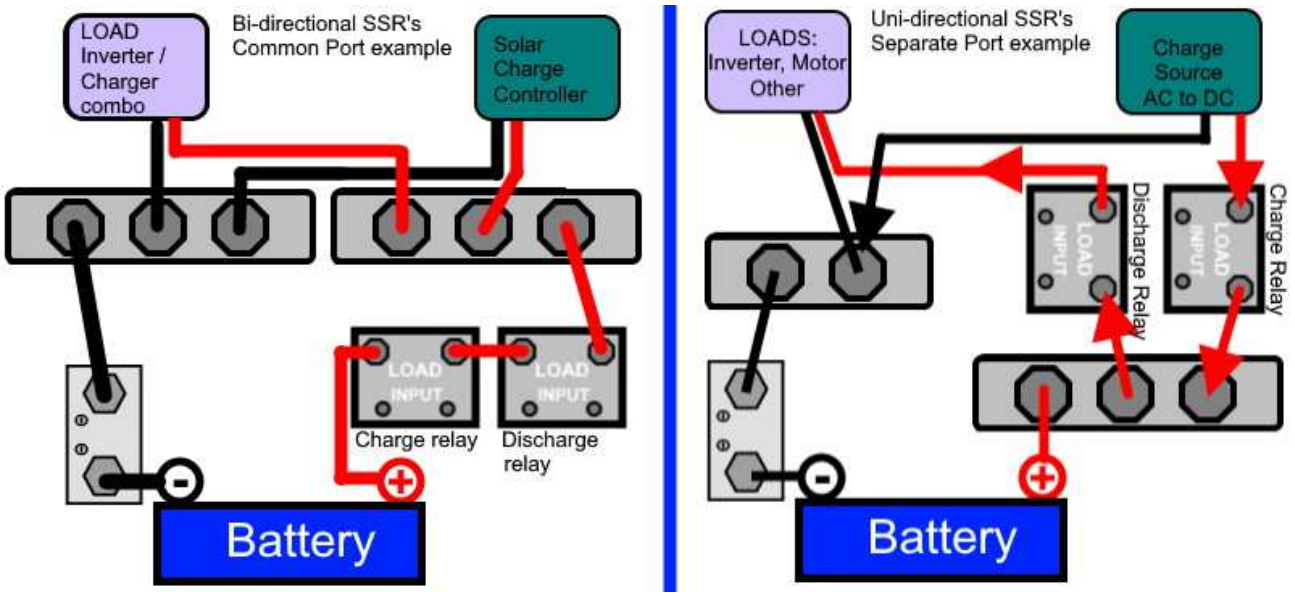
Supplemental: Solid State Relay supplemental information

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 are shown below.

The separate Port example is 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 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 choose 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 you are 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.



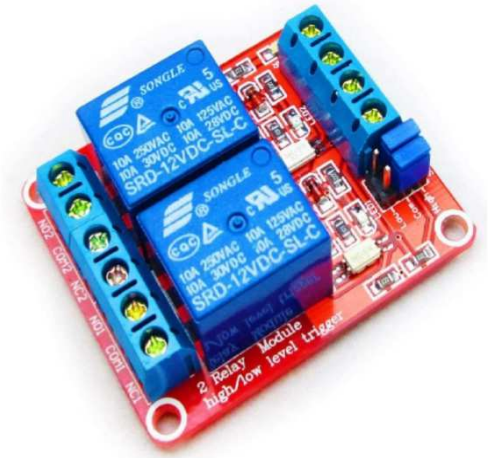
ATTENTION !

- The relay on above Configuration is bi-directional or uni-directional SSR/mechanical relay. But must be isolated. If it is not isolated, please install it on battery negative, connect between Load inverter/charger negative and current shunt.
- If use CHARGERY DCC, one DCC is enough for the Common Port application (connection diagram is on page 14).

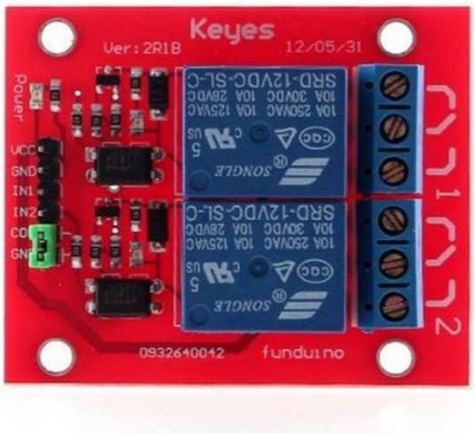
Supplemental: Single Relay with 2 channel Opti-Coupler

Quite often, the "need" for two relays in unnecessary and can use more power than needed. Fortunately by using a 2 Channel Opti-Coupler board, it can accept the two Relay Signals from the BMS but actuate only one Relay. This is often practical in a Common Port configuration where charging & discharging is done through a common DC Bus. Note that the Relay / Contactor chosen MUST be capable of handling the highest Amperage load that will pass through it.

Components Required:
- DC 12V 2 Channel Relay Module with Isolated Optocoupler " Triggered by DC 12V" NOT 5.5V or 3.0V
- Support minimum of 5A, 10A is typical.
- 12VDC Power Source. Can be from Battery or a Step-down converter if battery pack is above 12VDC, Two Example Coupler Boards: (used for Arduino & Raspberry Pi etc, there are many brands / versions)

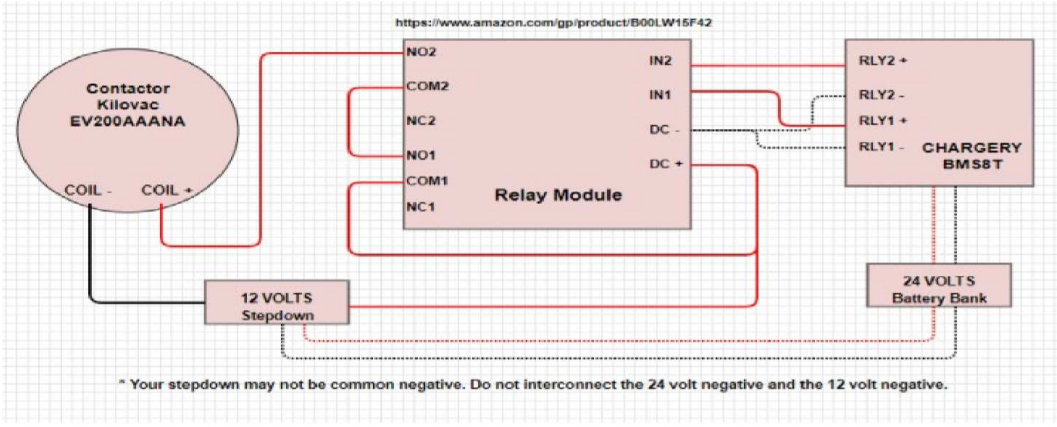


HiLetGo 3-01-0342



Keyes 2R1B

Wiring the board:
For two contactors run 12v+ through NO1/COM1 and NO2/COM2 separately to each coil+. 12V is provided from either 12V battery or Step Down converter. Caution: If using converter, do not connect (-) from the battery but from the converter only.



Thanks to user "Onemorebattery" from Diysolarforum.com.

Chargery DCC solved the problem, one DCC uses in a Common Port configuration, and does not need the relay board. Detailed connection is on page 46.

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.

Supplemental: Reference Documents & Video links

1. **Updated Manuals, Firmware & Drivers:** http://chargery.com/update.asp
2. **Communication Protocol V1.25 for BMS24T, BMS24T and BMS24T**: Protocol 1.25 PDF

Videos:

3. Chargery BMS update Video

https://www.youtube.com/watch?v=zsMADtoNi1c

4. **BMS installation video on installation with Nissan Leaf battery:**
   http://www.chargery.com/Video/BMS24T_C10325_operation_instructions.mp4

5. Current calibration:

How to calibrate Chargery BMS Shunt (BMS24T, BMS24T, BMS24T)

6. BMS current calibration by power supply

https://www.youtube.com/watch?v=bCM_cau0TD0

7. Chargery BMS update firmware on Main & LCD modules to v4.0

https://www.youtube.com/watch?v=4nrYUm1uhAs

8. Chargery BMS. Package and settings walk-trough.

https://www.youtube.com/watch?v=7ggsGRL8VC0

9. Configure 16s LiFePo4 to 48V battery---Connecting balancing leads to battery and Capacity test.

https://www.youtube.com/watch?v=ic_Ulh8DOlk

Supplemental: BMS power consumption

1. BMS power consumption when fit with **Mechanical Relay**

Battery voltage	Normal mode without Relay but LCD is on	Sleep mode without relay and LCD is off	Normal mode with 12V mechanical relay at different rated current and LCD is on			
			100A	200A	400A	600A
	BMS drain current from battery (mA)					
12V	125	31	772.5	875	1170	1375
18V	96.25	25.5	652.5	745	1012.5	1237.5
24V	74.75	21.75	490	555	752.5	917.5
30V	59	17.5	392.5	445	600	730

Mechanical relay power consumption at 12V driven voltage when it is closed.

12V 100A relay	12V 200A relay	12V 400A relay	12V 600A relay
0.75A	0.96A	1.24A	1.3A

Because the mechanical 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.

2. BMS power consumption when fit with **Chargery DC Contactor**

Battery voltage	Normal mode without DCC but LCD is on	Sleep mode without DCC and LCD is off	Normal mode with 12V DCC at different rated current and LCD is on			
			100A	200A	300A	600A
	BMS drain current from battery (mA)					
12V	125	31	129	130	133	135
18V	96.25	25.5	102	103	105	107
24V	74.75	21.75	78	79	80	83
30V	59	17.5	62	62	62	67

Chargery DC Contactor power consumption at 12V driven voltage when it is closed.

DCC-100HB	DCC-200HB	DCC-300HB	DCC-600HB
9mA	11mA	11mA	11mA

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, do not need 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. 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.
9. 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,
10. 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
11. LCD back light is always ON, the possible reasons are as below.

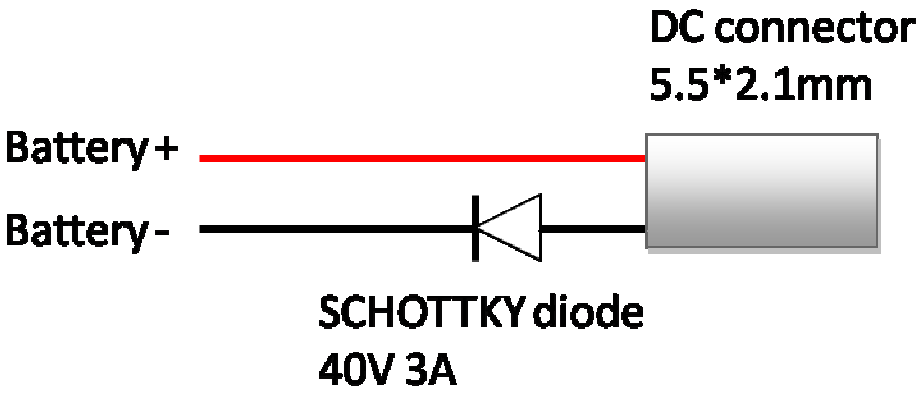
   Within "LCD Back-light time" setting

   a) There are any warning events happened
   b) Do any operations

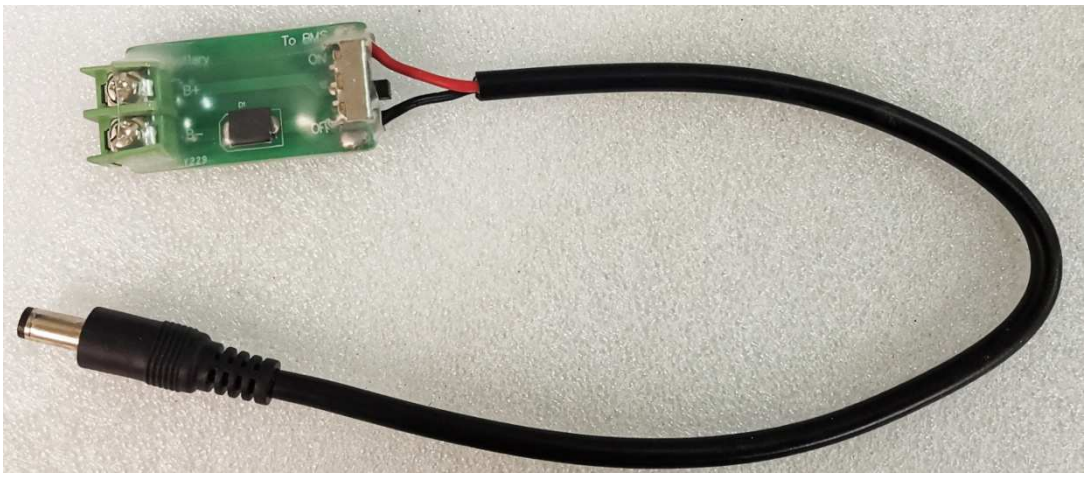
Improve cell voltage accuracy

When 4S battery such as 12V 4S LiFe battery power BMS, the current from battery is around 125mA at LCD is on, the current will affect cell 1 and cell 4 voltage measurement, the cell voltage will be lower 15-25mV than actual cell voltage.

To solve the problem, the battery positive and negative can be connected to external power supply socket, but need a diode on battery negative. The connection diagram is as below,



With BMS8P, BMS16P and BMS24P, the battery in monitoring can be connected to BMS as above, don't need buck or boost converter, The schottky current I(av) depends on relay or SSR driven current, the schottky current must be over the two mechanical relay total driven current. For Chargery DCC, 1A even 0.5A is enough.



Improve current reading fluctuation from Steve

Sometimes the current reading on BMS LCD fluctuate even at a large scope, the main reason is caused by EMI from charger or inverter.

On BMS, there are low pass filter to limit the EMI, but it is not always effective.

EMI due to factors external to the inverter may be reduced as follows:

1. Ensure that the inverter/charger is firmly grounded to the Ground System of the building or the vehicle.
2. Locate the inverter as far away from the EMI receptors like radio, audio and video devices as possible.
3. Keep the DC side wires between the battery and the inverter as short as possible.
4. Do NOT keep the battery wires far apart. Keep them taped together to reduce their inductance and induced voltages. This reduces ripple in the battery wires and improves performance and efficiency.
5. Shield the DC side wires with metal sheathing / copper foil / braiding.
6. Use coaxial shielded cable for all antenna inputs (instead of 300 ohm twin leads).
7. Use high quality shielded cables to attach audio and video devices to one another.
8. Limit operation of other high power loads when operating audio / video equipment.

Over Current protection resume operation

When charge or discharge current is over setting, the BMS will cut off charge or discharge without any delay, the current value and HIGH will be flashed in turn. It is named as over current protection.
When modify current setting, or decrease the charge or discharge current, please press SET/START button to resume charging or discharging.

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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