12,8 Volt lithium iron phosphate batteries and BMS 12/200

Especially designed for vehicles and boats

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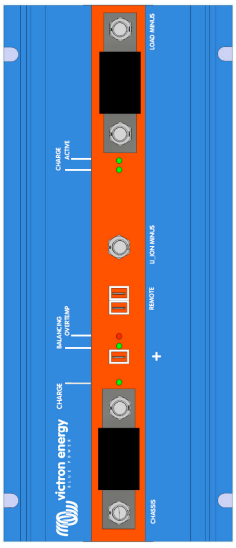
12,8V 90Ah LiFePO4 battery

12,8V 60Ah LiFePO4 battery



BMS 12/200 with:

- **12V 200A load output, short-circuit proof**
- **Li-ion battery over-discharge protection**
- **starter battery discharge protection**
- **adjustable alternator current limit**
- **remote on-off switch**

Why lithium-iron phosphate?

Lithium-iron-phosphate ($LiFePO_4$ or LFP) is the safest of the mainstream li-ion battery types. The nominal voltage of a LFP cell is 3,2V (lead-acid: 2V/cell). A 12,8V LFP battery therefore consists of 4 cells connected in series; and a 25,6V battery consists of 8 cells connected in series.

Why a Battery Management System (BMS) is needed:

1. A LFP cell will be destroyed immediately if the voltage over the cell falls to less than 2,5V.
2. A LFP cell will be destroyed immediately if the voltage over the cell increases to more than 4,2V.

Lead-acid batteries will eventually also be damaged when discharged too deeply or overcharged, but not immediately. A lead-acid battery will recover from total discharge even after it has been left in discharged state during days or weeks (depending on battery type and brand).

3. The cells of a LFP battery do not auto-balance at the end of the charge cycle.

The cells in a battery are not 100% identical. Therefore, when cycled, some cells will be fully charged or discharged earlier than others. The differences will increase if the cells are not balanced/equalized from time to time.
In a lead-acid battery a small current will continue to flow even after one or more cells are fully charged (the main effect of this current is decomposition of water into hydrogen and oxygen). This current helps to fully charge other cells that are lagging behind, thus equalizing the charge state of all cells.
The current through a LFP cell however, when fully charged, is nearly zero, and lagging cells will therefore not be fully charged. The differences between cells may become some so extreme over time that, even though the overall battery voltage is within limits, some cells will be destroyed due to over- or under-voltage.

A LFP battery therefore must be protected by a BMS that actively balances the individual cells and prevents under- and over-voltage.

Rugged

A lead-acid battery will fail prematurely due to sulfation if:

- If it operates in deficit mode during long periods of time (the battery is rarely, or never at all, fully charged).
- If it is left partially charged or worse, fully discharged (yacht or mobile home during winter time).

A LFP battery does not need to be fully charged. Service life even slightly improves in case of partial charge instead of a full charge. This is a major advantage of LFP compared to lead-acid.
Other advantages are the wide operating temperature range, excellent cycling performance, low internal resistance and high efficiency (see below).

LFP is therefore the chemistry of choice for very demanding applications.

Efficient

In several applications (especially off-grid solar and/or wind), energy efficiency can be of crucial importance.
The round trip energy efficiency (discharge from 100% to 0% and back to 100% charged) of the average lead-acid battery is 80%.
The round trip energy efficiency of a LFP battery is 92%.
The charge process of lead-acid batteries becomes particularly inefficient when the 80% state of charge has been reached, resulting in efficiencies of 50% or even less in solar systems where several days of reserve energy is required (battery operating in 70% to 100% charged state).
In contrast, a LFP battery will still achieve 90% efficiency under shallow discharge conditions.

Size and weight

Saves up to 70% in space
Saves up to 70% in weight

Expensive?

LFP batteries are expensive when compared to lead-acid. But in demanding applications, the high initial cost will be more than compensated by longer service life, superior reliability and excellent efficiency.

Endless flexibility

LFP batteries are easier to charge than lead-acid batteries. The charge voltage may vary from 14V to 16V (as long as no cell is subjected to more than 4,2V), and they do not need to be fully charged. Therefore several batteries can be connected in parallel and no damage will occur if some batteries are less charged than others.
We therefore designed two 12,8V batteries with integrated Balancing, Temperature and Voltage control (BTV), of respectively 60Ah and 90Ah. Our 12V BMS will support up to 10 batteries in parallel (BTV's are simply daisy-chained) so that a 12V battery bank of up to 900Ah can be assembled.

A 12V BMS that protects the alternator (and wiring), and supplies up to 200A in any DC load (including inverters and inverter/chargers)

Alternator/battery charger input (Power Port AB)

1. The first function of Power Port AB is to prevent the load connected to the LFP battery from discharging the starter battery. This function is similar to that of a Cyrix battery combiner or Argo FET battery isolator. Current can flow to the LFP battery only if the input voltage (= voltage on the starter battery) exceeds 13V.
2. Current cannot flow back from the LFP battery to the starter battery, thus preventing eventual damage to the LFP battery due to excessive discharge.
3. Excessive input voltage and transients are regulated down to a safe level.
4. Charge current is reduced to a safe level in case of cell unbalance or over temperature.
5. The input current is electronically limited to approximately 80% of the AB fuse rating. A 50A fuse, for example, will therefore limit the input current to 40A. Choosing the right fuse will therefore:
   a. Protect the LFP battery against excessive charge current (important in case of a low capacity LFP battery).
   b. Protect the alternator against overload in case of a high capacity LFP battery bank (most 12V alternators will overheat and fail if running at maximum output during more than 15 minutes).
   c. Limit charge current in order not to exceed the current handling capability of the wiring.

The maximum fuse rating is 100A (limiting charge current to approximately 80A).

Load/battery charger output/input (Power Port LB)

1. Maximum current in both directions: 200A continuous.
2. Peak discharge current electronically limited to 400A.
3. Battery discharge cut-off whenever the weakest cell falls below 3V.
4. Charge current is reduced to a safe level in case of cell unbalance or over temperature.

Battery specification

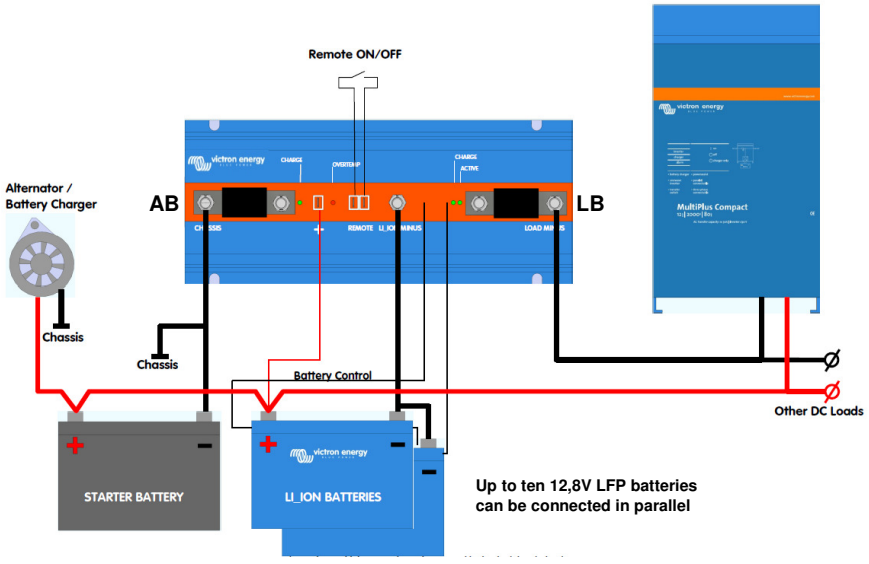
VOLTAGE AND CAPACITY	LFP 12,8/60	LFP 12,8/90
Nominal voltage	12,8V	12,8V
Nominal capacity @ 25°C*	60Ah	90Ah
Nominal capacity @ 0°C*	48Ah	72Ah
Nominal capacity @ -20°C*	30Ah	45Ah
Nominal energy @ 25°C*	768Wh	1152Wh
Cycle life		
80% DoD	2000 cycles	
70% DoD	3000 cycles	
50% DoD	5000 cycles	
*Discharge current ≤1C		

DISCHARGE	LFP 12,8/60	LFP 12,8/90
Maximum continuous discharge current	180A	270A
Recommended continuous discharge current	≤60A	≤90A
Maximum 10 s pulse current	600A	900A
End of discharge voltage	11V	11V
Operating conditions		
Operating temperature	-20 - 50°C	
Storage temperature	-45 - 70°C	
Humidity (non condensing)	Max. 95%	
Protection class	IP 54	

CHARGE	LFP 12,8/60	LFP 12,8/90
Charge voltage	14,4V	14,4V
Float voltage	13,6V	13,6V
Maximum charge current	180A	270A
Recommended charge current	≤30A	≤45A
Other		
Max storage time @ 25 °C*	1 year	
Dimensions (hxwxd) mm	230x282x125	250x282x155
Weight	12kg	16kg
*When fully charged		

BMS 12/200 specification

Maximum number of 12,8V batteries	10
Maximum charge current, Power Port AB	80A
Maximum charge current, Power Port LB	200A
Maximum continuous discharge current, LB	200A
Peak discharge current, LB (short circuit proof)	400A
Cut-off voltage	11V
GENERAL	
No load current when operating	10mA
Current consumption when switched off	5mA
Current consumption after battery discharge cut-off due to low cell voltage	3mA
Operating temperature range	-40 to +50°C
Humidity, maximum	100%
Humidity, average	95%
Protection, electronics	IP65
DC connection AB, LB and battery minus	M8
DC connection battery plus	Faston female 6.3 mm
LED's	
Battery being charged through Power Port AB	green
Battery being charged through Power Port LB	green
Power port LB active	green
Over temperature	red
ENCLOSURE	
Weight (kg)	1,8
Dimensions (hxwxd in mm)	65 x 120 x 260
STANDARDS	
Emission	EN 50081-1
Immunity	EN 50082-1
Automotive Directive	2004/104/EC



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