

12,8 Volt lithium iron phosphate batteries

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Why lithium-iron phosphate?

Lithium-iron-phosphate (LiFePO₄ 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.



**12,8V 90Ah LiFePO₄ battery
LFP-CB 12,8/90
(cell balancing only)**



**12,8V 90Ah LiFePO₄ battery
LFP-BMS 12,8/90
(cell balancing and BMS interface)**

Rugged

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

- If it operates in deficit mode during long periods of time (i. e. if 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.

With or without Battery Management System (BMS)?

Important facts:

1. A LFP cell will fail if the voltage over the cell falls to less than 2,5V (note: recovery by charging with a low current, less than 0,1C, is sometimes possible).

2. A LFP cell will fail 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. Over time the differences between cells may become some so extreme that, even though the overall battery voltage is within limits, some cells will fail due to over- or under-voltage. Cell balancing is therefore highly recommended.

In addition to cell balancing, a BMS will:

- Prevent cell under voltage by timely disconnecting the load.
- Prevent cell overvoltage by reducing charge current or stopping the charge process.
- Shut down the system in case of over temperature.

A BMS is therefore indispensable to prevent damage to large Li-ion battery banks.

With cell balancing, but without BMS: 12,8V LFP batteries for light duty applications

In applications where excessive discharge (to less than 11V), overcharge (to more than 15V) or excessive charge current will never occur, 12,8V batteries with cell balancing only may be used.

Please note that these batteries are not suitable for series or parallel connection.

Notes:

1. A Battery Protect module (see www.victronenergy.com) may be used to prevent excessive discharge.
2. The current draw of inverters and inverterchargers is often still significant (0,1A or more) after low voltage shutdown. The remaining stand-by current will therefore damage the battery if the inverters or inverterchargers are left connected to the battery after low voltage shutdown during a long period of time.

With cell balancing and interface to connect to a Victron BMS: 12,8V LFP batteries for heavy duty applications and parallel/series connection

These batteries have integrated Cell Balancing, Temperature and Voltage control (BTv). Up to ten batteries can be paralleled and up to four batteries can be series connected (BTv's are simply daisy-chained) so that a 48V battery bank of up to 2000Ah can be assembled. The daisy-chained BTv's must be connected to a battery management system (BMS).

Battery Management System (BMS)

The BMS connects to the BTv's and its essential functions are:

1. Disconnect or shut down the load whenever the voltage of a battery cell falls to less than 2,5V.
2. Stop the charging process whenever the voltage of a battery cell increases to more than 4,2V.
3. Shut down the system whenever the temperature of a cell exceeds 50°C.

More features may be included: see the individual BMS datasheets.

Battery specification								
	Cell balancing only				Cell balancing and BMS interface			
VOLTAGE AND CAPACITY	LFP-CB 12,8/60	LFP-CB 12,8/90	LFP-CB 12,8/160	LFP-CB 12,8/200	LFP-BMS 12,8/60	LFP-BMS 12,8/90	LFP-BMS 12,8/160	LFP-BMS 12,8/200
Nominal voltage	12,8V	12,8V	12,8V	12,8V	12,8V	12,8V	12,8V	12,8V
Nominal capacity @ 25°C*	60Ah	90Ah	160Ah	200Ah	60Ah	90Ah	160Ah	200Ah
Nominal capacity @ 0°C*	48Ah	72Ah	130Ah	160Ah	48Ah	72Ah	130Ah	160Ah
Nominal capacity @ -20°C*	30Ah	45Ah	80Ah	100Ah	30Ah	45Ah	80Ah	100Ah
Nominal energy @ 25°C*	768Wh	1152Wh	2048Wh	2560Wh	768Wh	1152Wh	2048Wh	2560Wh
*Discharge current ≤1C								
CYCLE LIFE								
80% DoD	2500 cycles							
70% DoD	3000 cycles							
50% DoD	5000 cycles							
DISCHARGE								
Maximum continuous discharge current	180A	270A	400A	500A	180A	270A	400A	500A
Recommended continuous discharge current	≤60A	≤90A	≤160A	≤200A	≤60A	≤90A	≤160A	≤200A
Maximum 10 s pulse current	600A	900A	1200A	1500A	600A	900A	1200A	1500A
End of discharge voltage	11V	11V	11V	11V	11V	11V	11V	11V
OPERATING CONDITIONS								
Operating temperature	-20°C to +50°C (maximum charge current when battery temperature < 0°C: 0,05 C, i.e. 1A in case of a 200Ah battery)							
Storage temperature	-45°C to +70°C							
Humidity (non condensing)	Max. 95%							
Protection class	IP 54							
CHARGE								
Charge voltage	Between 14V and 15V (<14,5V recommended)							
Float voltage	13,6V							
Maximum charge current	60A	90A	160A	200A	180A	270A	400A	500A
Recommended charge current	≤20A	≤25A	≤40A	≤50A	≤30A	≤45A	≤80A	≤100A
OTHER								
Max storage time @ 25 °C*	1 year							
BMS connection	n. a.				Male + female cable with M8 circular connector, length 50 cm			
Power connection (threaded inserts)	M8	M8	M10	M10	M8	M8	M10	M10
Dimensions (hwxwd) mm	235x293x139	249x293x168	320x338x233	295x425x274	235x293x139	249x293x168	320x338x233	295x425x274
Weight	12kg	16kg	33kg	42kg	12kg	16kg	33kg	42kg

*When fully charged