



ECO-WORTHY
Make Rural Life Better



LIFEPO4

Lithium Iron Phosphate

User Manual >>>>>>>>

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1.Introduction

1.1Product Overview

ECO-WORTHY 10AH 20AH 30AH 50AH 100AH 150AH lithium iron phosphate batteries can realize automatic balance connection between parallels and provide greater flexibility for battery pack configuration to meet the power and energy requirements of different system settings. The use of the most advanced battery cells ensures an excellent service life of more than 3000 cycles, which can ensure that the battery has a long life (10-year lifespan) and excellent discharge performance. Lithium batteries weigh less than half of similar lead-acid batteries. It is easy to carry and install. It is an ideal choice for powering outdoor campsites and for easy indoor installation. The damage to the environment is less than other types of batteries, and it is more environmentally friendly to use.

The integrated battery management system (BMS) not only protects the battery from various abnormal conditions, but also monitors and manages the charging and discharging process to provide comprehensive protection for the battery.

1.2Advantage

[3000+ Cycle]:

ECO-WORTHY lithium iron phosphate battery can be recycled for more than 3000 times, and can still maintain 80% of the capacity after 3000 deep cycles. The normal service life can reach 10 years, which is more than eight times that of lead-acid batteries.

[Lighter and more portable]:

The weight of lithium batteries is 1/3 of the weight of lead-acid batteries, which is easy to carry and install, and is an ideal choice for outdoor camping and indoor installation.

[BMS protection]:

ECO-WORTHY battery integrates BMS (battery management system), low self-discharge, can prevent overcharge, deep discharge, overload, short circuit.

[Wide application]:

Lithium iron phosphate battery is safe, efficient and portable, suitable for RVs, caravans, electric boats, golf carts, trolling motor, fishfinder, ham radio, tool trailers, solar panels, children's vehicles or can be used as emergency power supplies.

[Extension and support]:

Lithium batteries support series and parallel connections. Supports up to 4 batteries in series or parallel

1.3 Specifications

1.3.1 Battery parameters

Battery Capacity:	10Ah	20Ah	30Ah	50Ah	100Ah	150Ah
Battery Power:	128W·h	225W·h	384W·h	640W·h	1280W·h	1920W·h
Battery Voltage:	12.8V	12.8V	12.8V	12.8V	12.8V	12.8V
Maximum Charge/ Discharge Current:	10A	30A	30A	40A/60A	80A/100A	80A/100A
Charge Temperature Range	0-55 °C					
Discharge Temperature Range	- 20 – 55 °C					
Maximum Charge Voltage:	14.5V					
Discharge Cut-Off Voltage:	10V					
Battery Size: (inch)	5.9*3.7*2.6	7.1*6.3*3	7.1*6.3*3	8.8*5.3*7	13*6.6*8.2	13*6.9*8.5
Battery Weight:	2.43 lbs	4.85 lbs	7.2 lbs	10.8 lbs	22.4 lbs	35.1 lbs
Screw Size:	F2	M5	M5	M6	M8	M8

1.3.2 Battery Management System (BMS)

Warning and Protection

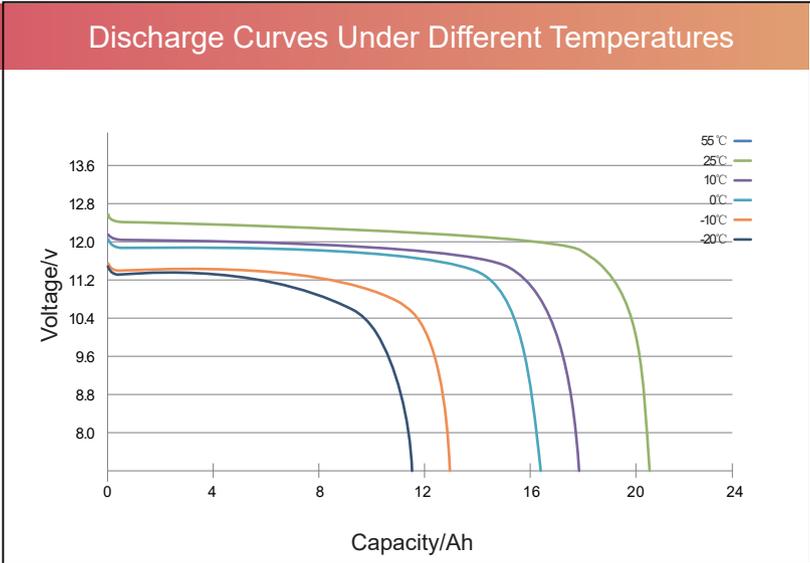
The battery contains a battery management system (BMS) that warns you and protects the battery from over-voltage, under-voltage, short circuit, . Please refer to the following table for the triggering and recovery condition of each

Battery Operation Status	Condition	
Operating temperature	Detection voltage	Lithium Iron 3.75V±0.03V
	Release voltage	Lithium Iron 3.6V±0.05V
Over discharge voltage protection	Detection voltage	Lithium Iron 2.1V±0.08V
	Release voltage	Lithium Iron 2.3V±0.1V
Battery Operation Status	Detection voltage	Lithium Iron ≥3.60V
	Release voltage	Lithium Iron < 3.60V
	Balance current	20-30mA
Short circuit protection	Detection voltage	Short circuit of external load
	Release voltage	Disconnect load/charge activation
Operating temperature	/	Working power consumption: <50uA
Self-consumption	/	Temperature range: -20 °C / +80 °C

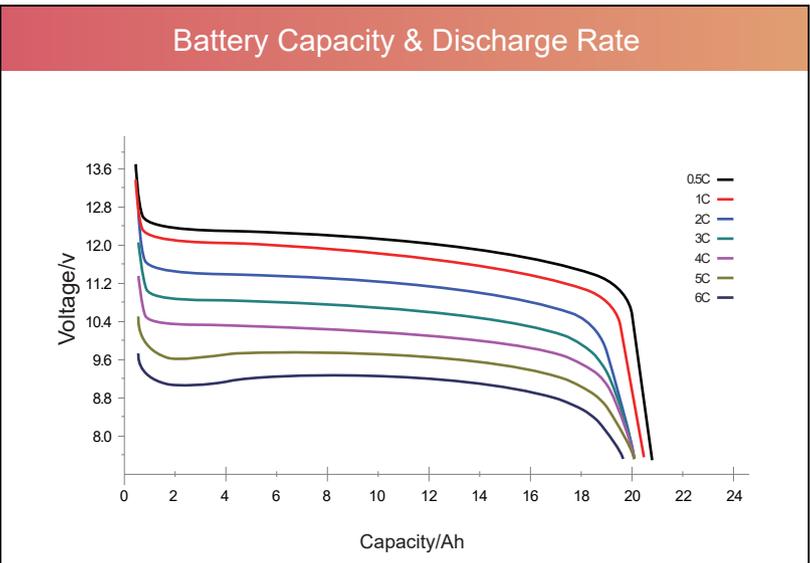
1.4 Technical requirements

1.4.1 Battery test environment (Take 20AH as the reference object)

Unless otherwise specified, the environmental conditions required for all tests: $20 \pm 5^\circ\text{C}$

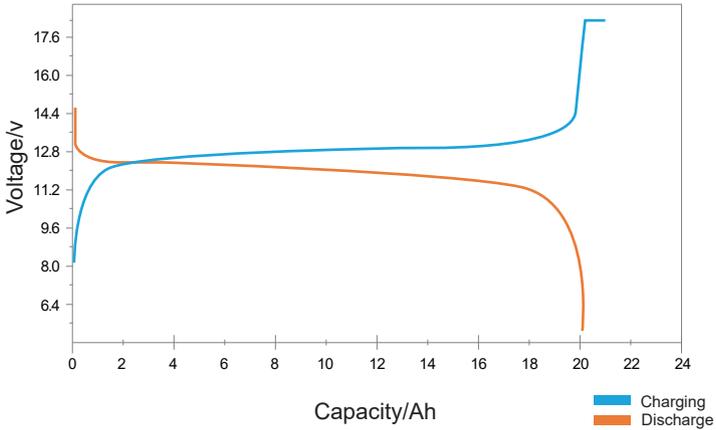


1.4.1.1



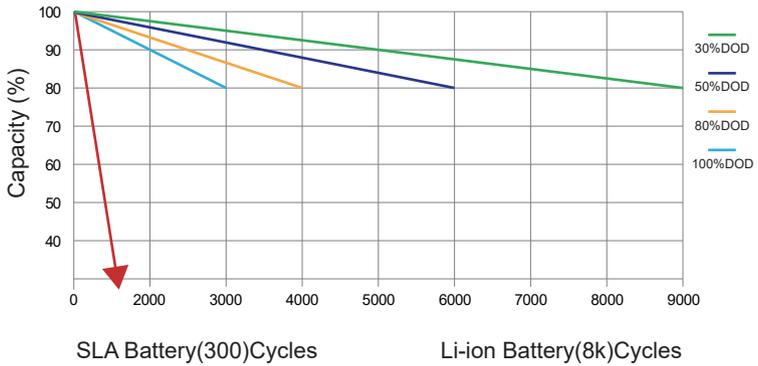
1.4.1.2

0.2C CC-Cv Charge Characteristics



1.4.1.3

Cycle Life & Capacity @ Li-ion Battery(8k)Cycles



1.4.1.4

2. General Safety

- Please keep the battery away from water, heat sources, sparks, and hazardous chemicals.
- Please keep the battery out of the reach of young children.
- Please wear proper protective equipment when working on the battery.
- Please make sure any battery charger or charge controller has been disconnected before working on the battery.
- Please use insulated tools when working on the battery.
- Please use recycling
- DO NOT puncture, drop, crush, burn, penetrate, shake, or strike the battery.
- DO NOT open, dismantle, or modify the battery.
- DO NOT touch any terminals or connectors.
- DO NOT connect or disconnect terminals from the battery without first disconnecting loads.
- DO NOT place tools on top of the battery.
- DO NOT wear jewelry or other metal objects when working on or around the battery.
- DO NOT dispose of the battery as household waste.
- DO NOT touch the exposed electrolyte or powder if the battery casing is damaged.

3. General Installation Guide

3.1 Installation Environment

The battery should be installed in a clean, cool, and dry place, keeping water, oil, and dirt away from the battery. The accumulation of these materials on the battery can cause current leakage, resulting in self-discharge and a possible short-circuit. Sufficient air flow must be provided to prevent excessive heat build-up and to minimize temperature variation between the batteries.

3.2 Preparation

Before the installation and operation of the battery, it is recommended to have the following equipment or tools available:

Proper Protective Equipment

Insulated Tool(s)

Multimeter

Battery Cable

Battery Charger / Charge Controller

3.3 Inspection

Please check for visible damage including cracks, dents, deformation, and other visible abnormalities. The top of the battery and terminal connections should be clean, free of dirt and corrosion, and dry. If any problems are detected with the battery, please contact us for assistance.

DO NOT short-circuit the battery terminals. Doing so can cause current bursts and lead to irreversible damage to the system and the battery.

Please verify the polarity before connecting wiring. Reversing polarity can and will destroy the battery.

Please use circuit breakers, fuses, or disconnects appropriately sized by a certified electrician, licensed installers, or regional code authorities to protect all electrical equipment.

3.4 Cable Sizing

Battery cables should be appropriately sized to handle the expected load. Please refer to the following table for the ampacities of copper cables with different gauge sizes.

Copper Cable Gauge Size (AWG/mm ²)	Ampacity (A)
14 (2.08)	20
12 (3.31)	25
10 (5.25)	35
8 (8.36)	50
6 (13.3)	65
4 (21.1)	85
2 (33.6)	115
1 (42.4)	130
1/0 (53.5)	150
2/0 (67.4)	175
4/0 (107)	230

3.5 Connecting Batteries

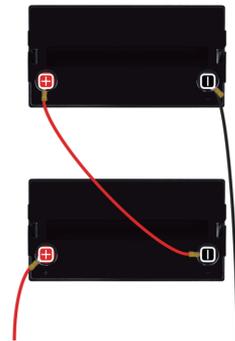
DO NOT string batteries with different chemistries, brands, models, rated capacities, or nominal voltages in parallel.

Please avoid too high a voltage difference between paralleled batteries, despite the auto-balancing function, to avoid triggering the over-current protection.

In parallel battery banks, the cables between each battery should be of equal length to ensure that all batteries in the system can work equally together.

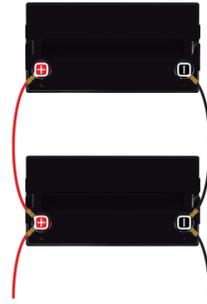
It is not recommended to connect more than 4 batteries in parallel if taking advantages of the auto-balancing function.

The series connection means that the negative electrode of the first lithium battery is connected to the positive electrode of the second lithium battery, and the negative electrode of the second lithium battery is connected to the positive electrode of the third battery, and so on, until the required voltage is reached. The voltage of this connection method is all The total voltage of the cells connected together, and the capacity is the capacity of a single cell.



Load(+) 24V Load(-)

The parallel mode means that the positive pole of the first lithium battery is connected to the positive pole of the second cell, and the negative pole is connected to the negative pole, and so on, to achieve the required capacity. The voltage in this comprehensive mode is unchanged or the voltage of a single cell, and the capacity is It is the sum of all battery capacities.



Load(+) 12V Load(-)

3.6 Securing Cable Connections

Please use an insulated Philips screwdriver to tighten the cable connections.

Please secure all cable connections to the proper specification in order to ensure good contact between the cable lugs and the terminals.

Over-tightening cable connections can cause terminal breakage and loose cable connections can cause terminal meltdown or fire.

To ensure good contact between the cable lugs and the terminals, please use the appropriate number of washers to allow for as much thread engagement as possible without bottoming out the terminal bolt. The correct number of washers can be determined by hand-tightening the terminal bolt with just the cable lug in place and observing the gap that is present. Use the number of washers needed so that the washer stack is slightly larger than the observed gap.

It is important to ensure that the cable lug and the top surface of the terminal are in contact. The washer(s) must be placed on top of the lug. Do not place the washer(s) between the battery terminal and the cable lug as this can cause high resistance and excessive heating

4.Charging Batteries

You can charge your lithium iron phosphate batteries whenever you want just like your cellphone. Unlike lead-acid batteries, lithium iron phosphate batteries do not get damaged if they are left in a partial state of charge, so you don't have to stress about getting them charged immediately after use. They also don't have a memory effect, so you don't have to drain them completely before charging.

4.1 Charging method

4.1.1 Battery charger (mains power)

The most ideal way to charge a LiFePO₄ battery is with a lithium iron phosphate battery charger, as it will be programmed with the appropriate voltage limits. Most lead-acid battery chargers will do the job just fine.

AGM and GEL charge profiles typically fall within the voltage limits of a lithium iron phosphate battery. Wet lead-acid battery chargers tend to have a higher voltage limit, which may cause the Battery Management System (BMS) to go into protection mode. This won't harm the battery; however, it may cause fault codes on the charger display.

Li-ion Battery cell level and pack level control variables are needed to be maintained accurately for safe operation. These control variables are monitored and protected by the battery management system (BMS).

BMS is an electronic device that acts as a brain of a battery pack, monitors the output, and protects the battery from critical damages. This incorporates monitoring of temperature, voltage and current, failure forecast or prevention, and data collection through communication protocol for battery parameter analysis. Battery state of charge (SOC) is the percentage of energy currently stored in the battery to the battery nominal capacity. One of the important key functions of BMS is the cell balancing.

4.1.2 Solar panel (DC power)

You can also use solar panel to charge your ECO WORTHY LiFePO₄ battery, but please make sure to choose a proper controller, both PWM controller and MPPT controller are okay.

And as an SLA targeted 12V panel makes about 18V at full-sun full-load, such a 12v panel will provide more than enough voltage under all practical light conditions.

If you don't have a controller, you can connect the battery to the solar panel, too. The BMS inside will protect the battery in most times. But if there is a defect on the battery BMS, the battery will be damaged.

Lithium batteries are not like lead acid and not all battery chargers are the same. A 12v lithium battery fully charged to 100% will hold voltage around 13.3-13.4v. Its lead acid cousin will be approx 12.6-12.7v.

4.2 Charger selection

A lithium battery at 20% capacity will hold voltage around 13V, its lead acid cousin will be approx 11.8v at the same capacity.

So if you use lead acid charger to charge your lithium battery, it may not be fully charged.

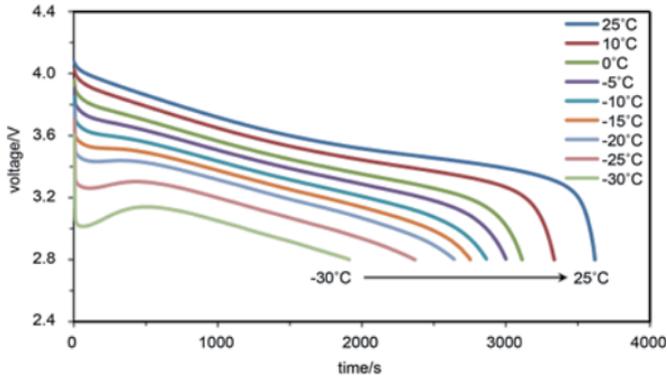
You can use a AC to DC lead acid charger powered from mains power, as charge efficiency and duration are less of a concern, it must not have automatic desulphation or equalization modes. If it does, do not use it as there is a high chance of damage to the cells or battery. This can have significant reduction in battery longevity. If it has a simple bulk/ absorption/ float charge profile, then it can be used to recharge the battery but must be disconnected once charged and not left in trickle charge/maintenance mode. It must also have a maximum output voltage of 13v-14.5V. When it comes to DC- DC chargers and solar controllers, you must change these to LiFePO4 specific models.

5.Q&A

5.1 The role of ECO WORTHY battery management system (BMS)?

- ① It protects the battery pack from being over-charged (cell voltages going too high) or over-discharged (cell voltages going too low) thereby extending the life of the battery pack. It does this by constantly monitoring every cell in the battery pack and calculating exactly how much current can safely go in (source, charge) and come out (load, discharge) of the battery pack without damaging it. These calculated current limits are then sent to the source (typically a battery charger) and load (motor controller, power inverter, etc), which are responsible for respecting these limits.
- ② It calculates the State of Charge (the amount of energy remaining in the battery) by tracking how much energy goes in and out of the battery pack and by monitoring cell voltages. This value can be thought of as a fuel gauge indicating how much battery power is left in the pack.
- ③ It monitors the health and safety of the battery pack by constantly checking for shorts, loose connections, breakdowns in wire insulation, and weak or defective battery cells that need to be replaced.

5.2 Can I charge lithium batteries in the cold?



Lithium batteries rely on chemical reactions to work, and the cold can slow and even stop those reactions from occurring. Unfortunately, charging them in low temperatures is not as effective as doing so under normal weather conditions because the ions that provide the charge do not move properly in the cold weather.

There's one hard and fast rule: to prevent irreversible damage to the battery, don't charge them when the temperature falls below freezing (0°C or 32°F) without reducing the charge current. Because the lithium batteries suffer from a phenomenon of lithium metal plating on the anode if charged at high rates in cold temperatures. This could cause an internal short of the battery and a failure.

5.3 Can I leave ECO WORTHY lithium battery on charging all the time?

For a lithium battery with a low maintenance charging procedure and battery management system, it's perfectly fine and better than leaving them discharged for a long period. Regardless of whether it is a dedicated charger or a general charger, under normal conditions, it has a charging cut-off voltage, which means that it will stop charging at a certain volt. The same is true for the solar panel controller, and the controller can also be configured like this. The solar panel is directly connected for charging. If there is a problem with the BMS, it may be overcharged.

5.4 Can I recharge my lithium battery from my vehicle alternator?

Yes, but not necessarily to full charge, due to the fact that most Alternators are adjusted for the lower voltage requirements of the vehicle Lead/Acid Battery (approximately 13.9-v). Lithium Batteries require 14.4 to 14.6-Volts to fully charge. That being said, you can get up to approximately a 70% charge, depending on the depth of discharge and distance driven while recharging from your vehicle alternator.

6.Maintenance

- To prevent possible leakage, heat generation, and explosion of the battery, please pay attention to the following precautions:
- It is strictly forbidden to immerse the battery in sea water or water.
- When it is not in use, it should be placed in a cool and dry environment.
- It is forbidden to use and leave the battery near a hot and high temperature source; - such as fire, heater, etc.
- It is strictly forbidden to directly plug the positive and negative ends of the battery into a power socket.
- Do not throw the battery into a fire or heater.
- It is forbidden to use metal to directly connect the positive and negative electrodes of the battery to short-circuit.
- It is forbidden to transport or store the battery with conductive materials such as metal and carbon powder.
- Do not knock or throw, step on the battery, etc.
- It is forbidden to weld the battery directly and pierce the battery with nails or other sharp objects.

7.Support

This product is covered by a 3 year warranty provided by ECO-WORTHY . We will refund or a partial refund or replace any products with defects at our discretion. If you are experiencing technical problems and cannot find a solution in this manual, please contact ECO-WORTHY for further assistance.

- **Call: (417) 459-7063**
- **Email: customer.service@eco-worthy.com**