

CANBAT TECHNOLOGIES INC.

CANBAT



Lithium Iron Phosphate (LiFePO₄)
USER MANUAL

TABLE OF **CONTENTS**

Safety	4
Equipment	5
LiFePO4 Battery Basics	5
Battery Installation	6
Wire Gauge Table	7
Battery Storage	9
Battery Discharging	10
Battery Charging	11
BMS Operations	12
Battery Recycling	13

CANBAT LITHIUM BATTERY USER MANUAL

This user manual was created by Canbat Technologies Inc. and contains important information relating to the proper care and maintenance of your lithium battery. This manual only applies to Canbat lithium battery products. It does not apply to other lithium batteries or chemistries. Please read through the guide in detail before installing and using your new lithium battery. Reading this guide in its entirety will help you achieve high performance and a longer life from your lithium batteries. Should you have any questions concerning safety precautions, installation or the use of your Canbat lithium battery, please contact us:

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This manual only applies to Canbat Lithium Batteries.
It does not apply to other lithium battery brands.



1. SAFETY

Lithium Iron Phosphate (LiFePO_4) batteries are safe to use indoors and outdoors. However, as with any electronics, safety measures must always be taken. Please follow the instructions within this user manual for safe handling and operation of your Canbat lithium batteries.

- Always wear protective gear when handling batteries
- Use a wrench with a rubber coated handle
- Do not place any objects on top of batteries
- Do not place batteries on a metallic surface
- Check that all cables are in good condition
- Make sure all cable connections are properly tightened
- Install and remove batteries using the lifting handles provided
- Keep sparks, flames and metal objects away from batteries
- Have Canbat MSDS on the premises
- Have a fire extinguisher of the following type: a foam extinguisher, CO_2 , ABC dry chemical, powdered graphite, copper powder or soda (sodium carbonate) on the premises



2. EQUIPMENT

The following equipment may be required to install your battery:

- Protective Gear; gloves and eye protection
- Wrench with insulated/rubber coated handle
- Voltmeter



3. LiFePO₄ BATTERY BASICS

3.1. Basic Construction

Canbat LiFePO₄ battery packs include two main components:

1. Grade A individual cells assembled inside an ABS plastic or a steel case. Depending on the battery's model, the cells are either cylinder or prismatic. Cylinder cells are used in smaller battery packs while prismatic cells are used in larger battery packs.
2. An internal BMS (Battery Management System) to protect the battery from misuse. The BMS protects against over-charge, over-discharge, low-temperatures, high-temperatures, short-circuits, high-voltage and low-voltage. The BMS also helps in balancing the individual cells.

3.2. Battery Pack Voltages

Lithium Iron Phosphate (LiFePO₄) Nominal Voltage

Cell = 3.2V

12.8V – 4 cells in series

25.6V – 8 cells in series

38.4V – 12 cells in series

51.2V – 16 cells in series



4. BATTERY INSTALLATION

4.1. Battery Connections

To maximize battery performance and ensure safe operation of your battery, use the appropriate cable size and tighten connections using the proper torque value. It is recommended to use a washer. Canbat lithium batteries include free bolts and washers. Refer to the data sheet for your particular battery's torque value and the size of the included bolts.

4.2. Cable Size

Choose the appropriate cable size based on the expected load of your system and the length of the cable (refer to the table on the next page). Allowable Ampacities for copper cables rated at 167°F (75°C) operating at an ambient temperature of 86°F (30°C).

4.3. Torque Values

Terminal connections should adhere to the appropriate torque values for the specified terminal type to provide optimum electrical conductivity. Refer to the data sheet for your particular battery's torque value. Over- or under-tightening the connections can result in terminal breakage, overheating and/or terminal melting. Use a rubber handled or insulated wrench when making terminal connections to avoid an external short circuit.

4.4. Terminal Protection

Battery terminals may be covered with a plastic cap to prevent an external short circuit. You can also install a piece of plywood on top of the battery. This is important if your batteries are exposed, as opposed to being in a battery box or a compartment. Terminal protection is also important when recycling your battery. Please always cover the terminals prior to disposing your battery to a lithium recycler.

CURRENT (A)	0-5	16 AWG	16 AWG	16 AWG	16 AWG	14 AWG	12 AWG	12 AWG
	5-10	16 AWG	16 AWG	16 AWG	12 AWG	10 AWG	10 AWG	10 AWG
	10-15	14 AWG	14 AWG	12 AWG	10 AWG	10 AWG	8 AWG	8 AWG
	15-20	14 AWG	12 AWG	12 AWG	10 AWG	8 AWG	6 AWG	6 AWG
	20-25	12 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	6 AWG
	25-30	10 AWG	10 AWG	10 AWG	8 AWG	6 AWG	6 AWG	4 AWG
	30-40	8 AWG	8 AWG	8 AWG	6 AWG	6 AWG	4 AWG	4 AWG
	40-50	8 AWG	8 AWG	8 AWG	6 AWG	4 AWG	4 AWG	2 AWG
	50-60	6 AWG	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG
	60-70	6 AWG	6 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0AWG
	70-80	4 AWG	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0 AWG
	80-90	4 AWG	4 AWG	4 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG
	90-100	2 AWG	2 AWG	2 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG
	100-120	2 AWG	2 AWG	2 AWG	2 AWG	1/0 AWG	1/0 AWG	2/0 AWG
	120-150	1/0 AWG	1/0 AWG	1/0 AWG	1/0 AWG	1/0 AWG	2/0 AWG	4/0 AWG
	150-200	2/0 AWG	2/0 AWG	2/0 AWG	2/0 AWG	2/0 AWG	4/0 AWG	4/0 AWG
		0-4	4-7	7-10	10-15	15-20	20-25	25-30
LENGTH IN FEET								

4.5. Battery Orientation

Canbat LiFePO₄ batteries can be installed upright or on their sides. Please ensure the battery is fastened if installed in a moving vehicle, such as in an RV or a boat.

4.6. Series or Parallel Connections

When connecting batteries in series or parallel, please follow these guidelines:

(1) Make sure each battery is within 50mV (0.05V) of each other before putting them in service. This will minimize the chance of imbalance between batteries. If your batteries get out of balance, the voltage of any battery is >50mV (0.05V) from another battery in the set, you should charge each battery individually to rebalance. Canbat 12V LiFePO₄ batteries support series connections up to 4 units. 24V, 36V and 48V lithium batteries do not support series connections.

(2) Size batteries in parallel accordingly: The capacity of batteries (rated in amp hours) when connected in parallel is increased by the multiple of the batteries connected (2x, 3x, 4x, etc). However, the current ratings (discharge and charge) for parallel batteries is only increased by 75% of the multiple of the batteries connected (1.5x, 2.25x, 3x, etc). For example, the CLI100-12 is a 12.8V 100Ah LiFePO₄ battery. The battery is capable of discharging 100A continuously. When connecting two in parallel, the maximum continuous discharge increases to 150A. Canbat 12V, 24V and 36V LiFePO₄ batteries support parallel connections of up to 4 units. Canbat 48V LiFePO₄ batteries support up to 14 to 20 units in parallel, depending on the model of the battery. Always refer to the battery's data sheet of your specific battery model.

(3) Please reference Canbat LiFePO₄ Charging Instructions document for series and parallel charging.

Specifications for CLI100-12 Batteries in Parallel

Battery Quantity	1	2	3	4
Voltage	12.8	12.8	12.8	12.8
Capacity (Ah)	100	200	300	400
Max Continuous Discharge Current	100	150	225	300
Peak Discharge Current	200	300	450	600
Rec'd Charge Current	50	75	113	150
Max Charge Current	100	150	225	300



5. BATTERY STORAGE

Some people use their LiFePO₄ batteries seasonally such as while camping in the summer or while ice fishing in the winter. It is common for some people to store lithium batteries during the off-season. When storing LiFePO₄ batteries, it is important to store them properly to ensure they do not get damaged and to keep them at peak performance for many years ahead. Based on the temperature and length of time, here's a summary of how to store your LiFePO₄ battery:

- Recommended storage temperature: -5 to +35°C (23 to 95 °F)
- Storage up to 1 month: -20 to +60°C (4 to 140 °F)
- Storage up to 3 month: -10 to +35°C (14 to 95 °F)
- Extended storage time: +15 to +35°C (59 to 95 °F)

It is highly recommended to store lithium batteries indoor during the off season.

LiFePO₄ batteries have a low self-discharge rate of 2% a month. This means that when a lithium battery is stored, it'll lose 2% of its charge capacity every month. In order to prevent a higher rate of discharge, we recommend disconnecting all power draw from your batteries. When you store LiFePO₄ batteries, it is important that you store them with a state of charge (SOC) of 50% or higher. A higher state of charge is recommended when storing for an extended period of time. If you want the battery to retain a good level of charge after the storage period is over, you should charge them to 100% and store them in that fully charged state.

There are major consequences if you store your LiFePO₄ battery without a charge. Because of the 2% self-discharge rate, the battery can become over-discharged. The level of discharge can potentially go below what the BMS can protect. This is why it is very important to charge your lithium battery before you store it. It is highly recommended that you also store the lithium battery at room temperature, especially when storing them for an extended period of time. Refer back to the above information to see how long you can store LiFePO₄ at various temperature ranges. Over-discharging the cells due to storage without a charge can cause permanent damage and void your 10-year battery warranty. The Canbat built-in BMS logs all activities performed on the battery including storage. Every charge and every discharge is recorded, along with various other factors, such as temperature.



6. BATTERY DISCHARGING

6.1. Discharge Temperature

LiFePO₄ batteries generate a fraction of the heat of other lithium chemistries when discharging, making them very safe. LiFePO₄ batteries can safely discharge between -20°C to 60°C (-4°F to 140°F). All Canbat LiFePO₄ come with a BMS that protects the battery from low and high temperatures. If the BMS disconnects due to low temperature, the battery must warm up for the BMS to reconnect. If the battery disconnects due to high temperature, wait until the temperature reduces. Please refer to your particular battery's data sheet for BMS low temperature and high temperature cut-off values.

6.2. Discharging your LiFePO₄ Battery

LiFePO₄ batteries can be discharged up to 100% of their capacity. However, to optimize the performance of your LiFePO₄ battery, and to avoid the BMS disconnecting the battery, we recommend limiting the discharge to 80%. Please refer to your battery's data sheet for the maximum rate of discharge for your specific battery model.

6.3. Discharging Rate

Most Canbat LiFePO₄ batteries can be discharged continuously at a rate of 1C. For example, a 12V 100Ah battery can output 100A continuously until it is fully discharged, which would be in one hour. Similarly, a 12V 200Ah Canbat LiFePO₄ battery can discharge 200A continuously until it is fully discharged. Each battery also has a peak discharge rate, which is usually 2 to 3 times the continuous rate. The peak discharge only lasts for 3 seconds. Please consider both the continuous discharge rate and the peak discharge rate of your battery when deciding on the inverter size. Always refer to your battery's datasheet for this information. They are referred to as maximum Continuous Discharge Current and Peak Discharge Current. If you need any help with this, please contact us and one of our experts will be happy to help.



7. BATTERY CHARGING

7.1. When to Charge your LiFePO4 Battery

If LiFePO4 batteries are not fully discharged, they do not need to be charged after each use. LiFePO4 batteries do not get damaged when left in a partial state of charge (PSOC). You can charge your LiFePO4 batteries after each use or when they have been discharged up to 80% (20% SOC). If the BMS disconnects the battery due to low voltage, at 100% depth of discharge, remove the load to reconnect the battery circuit and charge immediately. You must use a LiFePO4 battery charger in order for the BMS to reconnect.

7.2. Charging Temperature

Lithium Iron Phosphate batteries generate a fraction of the heat of other lithium chemistries when charging, making them very safe. LiFePO4 batteries can safely charge between 0°C to 45°C (32°F to 113°F). Canbat Low Temperature series (LT) can be charged between -20°C to 45°C (-4°F to 113°F). The LT series has a built-in heating system which activates when the temperature reaches the freezing point. It works by warming up the lithium cells to above freezing and only then would the BMS allow in the charging current.

LiFePO4 batteries do not require temperature compensation for voltage when charging at hot or cold temperatures. All Canbat LiFePO4 come with a BMS that protects the battery from under-temperature and over-temperature. If the BMS disconnects due to low temperature while charging, the battery must warm up for the BMS to reconnect and continue charging. If the battery disconnects due to high temperature, the BMS will not allow the battery to recharge until the battery's temperature is reduced.

Please refer to your particular battery's data sheet for BMS low temperature and high temperature cut-off values.

7.3. Charging with Lead-Acid Chargers

Most lead-acid battery chargers can be used with LiFePO₄ batteries as long as they are within the appropriate voltage parameters. AGM and Gel algorithms typically fall within the LiFePO₄ voltage requirements, but you are still required to check the charging algorithm of your specific charger. The voltage for flooded battery charging algorithms are often higher than LiFePO₄ requirements, which will result in the BMS disconnecting the battery at the end of the charge cycle and may result in the charger displaying an error code. If this happens, it is generally good practice to replace your charger. Since the BMS protects the battery, using lead-acid chargers will not damage the battery. Please refer to Canbat's Lithium Charging Instruction document for complete charging guidelines. Important: If your battery's BMS disconnects due to low voltage during discharge, the battery's voltage will read 0V. In this case, a lead-acid battery charger may not be able to reconnect the BMS and recharge the battery. This is because a lead-acid battery charger requires a voltage reading to start charging. A LiFePO₄ battery charger is required to reconnect the BMS, as it is designed to charge at 0V. This is why it's always recommended to use a charger designed for LiFePO₄ batteries.



8. BMS OPERATION

All Canbat LiFePO₄ batteries come with a BMS, which protects against:

Under and Over-Voltage/Current - during charging and discharging

Temperature Extremes - low and high temperature cut-off

Protection from Shorts - internal circuit

If the BMS disconnects the battery due to voltage or current limits, you must remove the load to reconnect the battery. If the BMS disconnects the battery due to temperature limits, you must wait for the temperature to adjust to reconnect the battery. While short-circuit protection protects the battery's cells, it still may produce a spark and damage your cable or bolt, so it is best to avoid short circuit conditions.



9. BATTERY RECYCLING

Terminals must be covered with a protective cap or non-conductive tape prior to battery disposal to a lithium recycler. Dispose of LiFePO₄ batteries at an authorized lithium recycling facility or send it to Canbat and we will recycle it for free.



TECHNICAL SUPPORT

If you have technical questions about your Canbat battery, please contact the original place of purchase or Canbat Technologies Inc. directly:



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