CANBAT TECHNOLOGIES INC.

CANBAT

Lithium Iron Phosphate (LiFePO4)

CHARGING INSTRUCTIONS

CANBAT LITHIUM IRON PHOSPHATE (LiFePO4) BATTERIES

To ensure your Canbat Lithium Iron Phosphate (LiFePO4) battery provide its maximum life, follow these charging instructions. When charging LiFePO4, make sure that you are not using a charger meant for other lithium ion chemistries, which are typically set to a higher voltage than what is suitable for LiFePO4 batteries. Some lead-acid battery chargers could be used if the voltage parameters are within the ranges of LiFePO4 batteries.

Charger Inspection

Check that your charger's cables are insulated and free of breakage. Charger terminal connectors should be clean and properly mate with the battery terminals to ensure a good connection and optimum conductivity. Please refer to Canbat's user manual, or your specific battery's data sheet, for appropriate torque settings.

Charging Guidelines

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% DOD (20% SOC). If the Battery Management System (BMS) disconnects the battery due to low voltage (voltage will be<10V), remove the load and charge immediately using a LiFePO4 battery charger. You will not be able to use a lead-acid charger while the BMS is in protection mode. A LiFePO4 battery charger is required to "wake up" the BMS.

Charging Temperature

LiFePO4 batteries can be safely charged between 0°C to 45°C (-32°F to 113°F). LiFePO4 batteries do not require temperature compensation for voltage when charging at hot or cold temperatures. All Canbat LiFePO4 batteries come with an internal 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 and accept the charging current. If the BMS disconnects because of high temperature, the battery will need to cool down before the BMS will accept charging the battery. Please refer to your specific battery's data sheet for the BMS low temperature and high temperature cut-off and reconnect values.The charging and discharging temperature for lithium batteries from our LT series is -20°C to 60°C. Canbat Low Temperature (LT) Lithium Batteries are cold-weather rated, designed for Canada's cold climates. These batteries have a built-in heating system featuring proprietary technology that draws power from the charger. No additional components required. The entire process ofheating and charging is completely seamless. The heating system automatically activates once charging below 0°C is attempted, and it automatically deactivates when it's no longer needed. The heating system does not take power from the battery, but rather from the charger, ensuring the lithium battery is not discharging itself and using up its cycle life. Simply plug the LT lithium battery into the charger and the internal heating and monitoring systems take care of the rest.

Charging Source: Lead-Acid Battery Chargers

Most lead-acid battery chargers can be used to charge lithium iron phosphate batteries (LiFePO4) as long as they are within the appropriate voltage guidelines. AGM and Gel algorithms typically fall within the LiFePO4 voltage requirements. The voltage for flooded battery charging algorithms are often higher than LiFePO4 requirements, which will result in the BMS disconnecting. If this happens, it is generally good practice to replace your charger for one with a LiFePO4 charge profile. Since the BMS protects the battery, using lead-acid chargers will typically not damage the battery. Nevertheless, a battery's BMS should be the last layer of defence, not the first. You should use a charger that cuts off before the BMS does. Note that if the BMS disconnects due to low voltage, a lead-acid battery charger may not be able to reconnect the BMS, even if the charger has the acceptable charging parameters to charge LiFePO4. This is because when the BMS disconnects, the lithium battery will not have a voltage and it will read 0V on a voltmeter, while lead-acid chargers require the battery to read out a voltage to start charging. If the battery is reading 0V, the lead-acid battery charger will not be able to understand that a battery is connected and that it should start charging. This is also true for some low-quality lithium battery chargers. It is always recommended that you invest in a high quality LiFePO4 battery charger to ensure high performance and longevity. Feel free to contact Canbat should you have any questions.

Charge Profiles

LiFePO4 batteries can be charged with either a 1-stage profile (constant current (CC) aka Bulk Stage) or a 2-stage profile (constant current, constant voltage (CC-CV) profile aka Bulk and Absorption Stages). The 1-stage profile will charge the battery ~97% and the 2-stage profile will charge the battery 100%. The 1-stage profile is sufficient, since LiFePO4 batteries do not need to be fully charged; this will not reduce life as it does with lead-acid batteries.

1 Stage Charge Profile - CC

1-STEP CHARGE DESCRIPTION	STEPS	DESCRIPTION	CHARGE PARAMETERS			
Step 1 - Charge at a constant current until the battery reaches termination voltage.	1	Recommended Charge Current	≤0.5C (C = Capacity of battery system)			
		*Maximum Charge Current	1C (refer to the datasheet of your battery's model)			
	SYSTEM VOLTAGE		12V	24V	36V	48V
	Stop	Termination Voltage	14V – 14.6V	28V - 29.2V	42V - 43.8V	56V - 58.4V

2 Stage Charge Profile - CC-CV

2-STEP CHARGE DESCRIPTION	STEPS	DESCRIPTION	CHARGE PARAMETERS			
Step 1 - Charge at a constant current until the battery reaches absorption voltage.	1	Recommended Charge Current	≤0.5C (C = Capacity of battery system)			
		Maximum Charge Current	1C (refer to the datasheet of your battery's model)			
	SYSTEM VOLTAGE		12V	24V	36V	48V
Step 2 - Hold absorption voltage until charge reduces to termination current.	2	Absorption Voltage	14V – 14.6V	28V - 29.2V	42V - 43.8V	56V - 58.4V
	Stop	Termination Current	≤0.05C (C = Capacity of battery system)			

*For optimum life, charge at recommended rate.

Charging Parallel Systems

When connecting batteries in parallel, please make sure each battery is within 0.1V of each other before putting them in service. This will minimize the chance of imbalance between batteries.

1 Stage Charge Profile - CC

1-STEP CHARGE DESCRIPTION	STEPS	DESCRIPTION	CHARGE PARAMETERS			
Step 1 - Charge at a constant current until the battery reaches termination voltage.	1	*Recommended Charge Current	≤0.5C (C = Capacity of battery system)			
		Maximum Charge Current	0.6C (C = Capacity of battery system)			
	SYSTEM VOLTAGE		12V	24V	36V	48V
	Stop	Termination Voltage	14V – 14.2V	28V – 28.4V	42V – 42.6V	56V – 56.8V

2 Stage Charge Profile - CC-CV

1-STEP CHARGE DESCRIPTION	STEPS	DESCRIPTION	CHARGE PARAMETERS			
Step 1 - Charge at a constant current until the battery reaches absorption voltage. Step 2 - Hold absorption voltage until charge reduces to termination current.	1	*Recommended Charge Current	≤0.5C (C = Capacity of battery system)			
		Maximum Charge Current	0.6C (C = Capacity of battery system)			
	SYSTEM VOLTAGE		12V	24V	36V	48V
	2	Absorption Voltage	14V - 14.2V	28V - 28.4V	42V - 42.6V	56V - 56.8V
	Stop	Termination Current	≤0.05C (C = Capacity of battery system)			

* For optimum life, charge at recommended rate.

If your charger's voltage is lower than those listed in the tables, it will not damage your battery, but it will be undercharged, and it will not provide the full rated capacity of the battery. If your charger's voltages are higher than those listed in the tables above, the BMS may disconnect the battery and you may have to remove the load to reconnect. If this happens, we recommend you replace the charger to avoid this inconvenience, and to invest in a high-quality LiFePO4 battery charger.

Charging Series Systems

When connecting batteries in series, please 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. For charging batteries in series, you can either use a multi-bank charger that charges each battery individually or simply charge the batteries in series as a single battery bank.

Charging Source: Inverter/Charger and/or Charge Controller

Below are the key, typical charger inputs when using an inverter/charger or charge controller with LiFePO4 batteries. Many inverter/chargers require additional parameters, please contact Canbat technical support for assistance. LiFePO4 batteries do not require equalizing. LiFePO4 batteries do not require temperature compensation for voltage when charging at hot or cold temperatures.

Operational Parameters

PARAMETER	12V SYSTEM	24V SYSTEM	36V SYSTEM	48V SYSTEM
Bulk Voltage	14V – 14.6V	28V - 29.2V	42V - 43.8V	56V - 58.4V
Absorption Voltage	14V – 14.6V	28V - 29.2V	42V - 43.8V	56V - 58.4V
Absorption Time	0- 6 min	0- 6 min	0- 6 min	0- 6 min
Float Voltage	13.8V ± 0.2V	27.6V ± 0.2V	41.4V ± 0.2V	55.2V ± 0.2V
Low Voltage Cutoff	11V	22V	33V	44V
High Voltage Cutoff	14.6V	29.2V	43.8V	58.4V

Charging Source: Alternator and DC to DC Chargers

Depending on the quality of the alternator, it may work fine with LiFePO4 batteries without modifications. However, low quality alternators with poor voltage regulation can cause the BMS to disconnect LiFePO4 batteries. If the BMS disconnects the batteries, the alternator may be damaged. To protect your LiFePO4 battery and your alternator, please be sure to use a compatible high-quality alternator or install a voltage regulator. You can also use a DC to DC charger to safely and effectively charge your batteries including house banks. Installing a DC to DC charger is the recommended option. Canbat offers a wide range of DC to DC chargers.

Fuel Gauges

If you are using a voltage-based fuel gauge that is designed for lead-acid batteries, it will not accurately measure the state of charge (SOC) of LiFePO4 batteries. Please replace your fuel gauge with one that measures current rather than voltage to accurately measure the state of charge of lithium iron phosphate batteries. Many of Canbat LiFePO4 batteries have integrated Bluetooth and does not require you to purchase a fuel gauge. The buil-in Bluetooth allows for wireless monitoring with our free Canbat BT apps available for IOS and Android devices. Our exclusive Bluetooth monitoring system is a smart addition built to banish battery anxiety, and it's just one of the many cutting edge upgrades that sets Canbat batteries apart from the pack. Here's what you'll be able to monitor: state of charge in percentage, rate of charge, rate of discharge, cycle life and temperature. The app will also keep a log of all activities so you know how you're using your battery.

Frequently Asked Questions - Charging, Discharging & Installation

Can I charge lithium with solar panels?

Yes, you can charge Canbat lithium batteries with solar panels. In fact, you can charge them with any type of charging equipment,as long as the charging voltage is within the accepted parameters as mentioned in the charging instructions manual. The mostcommon methods of charging is via an AC charger, renewable energy, alternator (DC to DC) and shore power. You can charge witheither one charging source, such as solar only, or multiple charging sources, such as by solar and the alternator simultaneously.

Can I charge lithium with an alternator?

Yes, but it is always recommended to invest in a DC to DC charger to protect your LiFePO4 battery and alternator. Unlike lead-acid batteries, LiFePO4 batteries can charge very fast. They are capable of drawing all the power generated by the alternator, not leaving residual power for the alternator's fan, which helps the alternator from over-heating. To ensure the fan is getting sufficient power and to prevent the alternator from over-heating, please invest in a DC to DC charger.

Can I charge lithium with a lead-acid charger?

Most lead-acid battery chargers can be used with LiFePO4 batteries as long as they are within the appropriate voltage guidelines. AGM and Gel algorithms typically fall within the LiFePO4 voltage requirements. The voltage for wet cell or 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.

Can I charge lithium in cold weather?

LiFePO4 batteries can safely charge between 0°C to 45°C (32°F to 113°F). If your application requires you to recharge in freezing temperatures, Canbat Low Temperature series (LT) can be recharged between -20°C to 45°C (-4°F to 113°F). The LT series has a built-in heating system featuring proprietary technology that draws power from the charger itself. No additional components are required. The entire process of heating and charging is completely seamless. The heating system automatically activates once charging below 0°C is attempted, and it automatically deactivate when it's no longer needed. The heating system does not take power from the battery, but rather from the charger, ensuring the battery is not discharging itself. Simply plug the battery into the lithium charger and the internal heating and monitoring systems take care of the rest.

Do I need a special charger for lithium?

The short answer is no. In order to fully charge a 12V LiFePO4 battery, a charger with a voltage of 14V to 14.6V is required. MostAGM battery chargers are within that range and they would be compatible with Canbat lithium batteries. If you have a charger with a lower voltage, it may still charge the battery, but it won't charge it to 100%. A charger with a higher voltage would not charge the battery and the BMS would enter protection mode due to it's high voltage disconnect feature. Although many AGM battery chargers are compatible with LiFePO4, wet cell or flooded battery chargers are not compatible as they typically charge at a higher voltage.

Can I fully discharge a lithium battery?

Canbat LiFePO4 batteries can be discharged up to 100% of their capacity. However, to optimize the performance of your LiFePO4 battery, to achieve a higher cycle life, and to avoid the BMS disconnecting the battery, we recommend limiting the discharge to 80%. If the BMS disconnects the battery due to low voltage, at 100% depth of discharge, remove the load and recharge using a LiFePO4 charger reactivate the BMS.

Can lithium discharge in cold temperatures?

LiFePO4 batteries can safely discharge between -4°F to 140°F (-20°C to 60°C). All Canbat LiFePO4 batteries come with a built-in BMS that protects the battery from low-temperatures and high-temperatures. If the BMS disconnects due to cold or high temperature, wait until the temperature is more suitable and the BMS will reconnect automatically.

How do I store lithium batteries?

It is highly recommended to store lithium batteries indoors during the off-season. It is also recommended to store LiFePO4 batteries at about a 50% state of charge (SOC) or higher. If the batteries are stored for long periods of time, store them at 100% SOC and cycle the batteries at least once every 6 months. Do not store batteries that are discharged. A trickle charger is not required.

· 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)

Can I connect 12V lithium in series?

Yes, you can connect up to four 12V batteries of the same model in series to obtain a higher voltage. Do not connect lithium batteries in both parallel and series simultaneously. It is either series or parallel. Please note that only our 12V lithium batteries support series connections. Canbat 24V, 36V and 48V lithium batteries do not support series connections, but they support parallel connections.

Can I connect 12V lithium in parallel?

Yes, you can connect up to four 12V batteries of the same model in parallel to obtain a higher capacity. Do not connect lithiumbatteries in both parallel and series simultaneously. It is either parallel or series. Canbat 24V and 36V lithium batteries also support up to 4 units in parallel. Canbat 48V LiFePO4 batteries support a much larger number of batteries in parallel. Please refer to the datasheet of the specific model for more information.

Can I install a lithium battery on its side?

Yes, Canbat LiFePO4 batteries can be installed upright or on their sides. Please fasten the battery if installed in a moving vehicle, such as in an RV or a boat. Please also avoid placing anything over the battery, and it's recommended to cover the terminals with a plastic cap to prevent an external short circuit.

Are LiFePO4 batteries safe?

Yes, LiFePO4 is an inherently safe chemistry and the most stable lithium-type battery on the market. Canbat lithium is UL 1642 certified, which means they have been tested for short-circuit, abnormal charging, crush, impact, shock, vibration, heating, temperature cycling and pressure . All Canbat LiFePO4 batteries come with an internal Battery Management System.

The BMS protects against:
1. Under-Voltage - during discharge
2. Over-Voltage - during charge or regen conditions
3. Over-Current - during discharge
4. Low-Temperature - during charge and discharge
5. High-temperature - during charge and discharge
6. Short-Circuit Protection - protects battery cells from damage
7. Single Cell Equalization and balancing

If you have any additional questions, please feel free to contact us and we are always happy to help!

CANBAT

CANADIAN BATTERY MANUFACTURER