

# Bestgo Power Battery Maintenance Manual

## Overview

This document describes the detailed maintenance operations for the Li-ion Battery packs supplied by BESTGO POWER COMPANY LIMITED, the products mentioned in the document accord with GB/T18333.1-2001 Standard.

## Transportation

- Can be transported via Truck, train, airplane and vessel, but to keep out of the sun & raining during transportation.
- To handle the battery pack with care during assembling or dis-assembling, do not arbitrarily throw to avoid collision.
- Do not place any heavy objects on the battery pack during transportation, to avoid crushing or damage caused.
- Do not mix Battery with flammable, explosive, and sharp metal objects in transportation.
- Make sure that the Packaging marked with moisture-proof & waterproof sticker, anti-fire stickers, to avoid dangerous in transportation.
- Battery should be kept under dry and ventilation condition. Do not put the battery close to fire and explosive products.

## Storage

- When a battery has not be used for more than 3 months, please discharge and charge it to reactive the electricity, so that the battery cycle life will be well kept. We require every 3~6 months battery should be cycled 3~5 times (discharge and charge) then discharge the electricity to 40~60% SOC for long time storage again. If those operations can not be done batteries may lose capacity permanently.
- The cycle life of li-ion battery would be shorted if the battery always be kept as fully charged state. For long time storage, keep the battery as 40 ~ 60% state of charge (SOC) and discharge & charge the battery 3~5 times for every 3 to 6 months.
- Cells in battery pack will have its own self-discharge rate, after long term storage, the SOC of cells may not became so identical, the capacity of battery pack may became less. For this case, people can discharge and charge battery packs for several cycles, cycling the battery pack will contain some balancing activities (if BMS support) which will eliminate the SOC difference of Cells in battery pack, the "lost capacity" will come back.
- If battery pack is used for a back up type UPS system, it can be stored as 95% SOC.

## Operation

- When battery pack is fully discharged and turned off automatically, please do not use it any more until it is recharged. Over discharge the battery pack means battery life will be shortened and the battery may become permanently damaged.
- When battery pack is fully discharged and turned off automatically, please recharge it in time (Within 12 hours), even charge 2~5% electricity to the pack will protect the cycle life well.
- We suggest charge no more than 95% SOC and discharge no less than 10% SOC when using to prolong the cycle life. When the voltage of single cell drop down to 3.0V or the actual capacity is lower than 20%, please recharge the battery promptly.
- If the battery pack will not be used for a long time (several days or weeks), please disconnect the Anderson connector from the load. (When battery pack connected to the load, the pack is always "waiting for" running, which will consume the electricity and make battery fully discharged and damaged.)

- Some battery packs are equipped with BMS which support balancing function, those packs can be charged over 95%SOC like to 98%SOC or more to start the balancing function. For the cycle life consideration, when a battery pack is well balanced (be fully charged) then the pack should be discharged in a short time (like within 24 hours). Keep Li-ion batteries not in a full SOC state will be helpful for cycle life.
- The battery pack can be used at  $-15\sim 50^{\circ}\text{C}$  for discharge,  $0\sim 45^{\circ}\text{C}$  for charge, while the best working temperature for this battery pack is  $15\sim 40^{\circ}\text{C}$ . Please take some necessary procedures, like heating & cooling methods, or use heat insulation materials to stop cold effect battery pack in winter.
- When the temperature is more than  $75^{\circ}\text{C}$  (Internal temperature of the battery), the battery cycle life would be shorted or got explosion. So do not exposure the battery under the sun during summer.
- When the temperature is under  $-15^{\circ}\text{C}$  or lower, the battery performance would be effect and the cycle life might be shorted.
- Battery packs equipped with "D-Type" BMS do not support charging and discharging at the same time. When charging the battery, please cut of the load. Or using "S-Type " BMS for battery pack.
- Do not wash the battery shell with organic solvent. If there's fire accident, please do not use CO2 to extinguish the fire but use CCl4 or sand soil.
- Please handle the pack with care and gently to avoid severe vibration, throw or drop.

## After-sale Service

In the period of warranty, there is any problem as the following description, we will take responsible for the replacement and repair.

- The whole battery pack can not be charged or discharged.
- Under the standard condition for testing, capacity is less than 80% of rated capacity in the first year. Or less than 70% of rated capacity in second year. (For some kinds of batteries which we offer 2 years warranty)
- There is liquid leakage.
- There is some damage on battery pack's case and accessory because it is caused by the battery.

There is any situation like the following description, we will not take responsible for the warranty and after-sale service.

- Expired warranty period.
- Customer didn't follow the manual instruction, which is resulted in battery damage.
- Customer dismantles and convert the battery pack, which is not guided by the professional people.
- There is some apparent scratches and trace on the case of BMS and charger.
- Customer use a wrong charger, or a low quality charger, or a defective charger damaged the battery pack. (Some chargers are not able to offer very stable DC output so that may damage the DC circuits of BMS in battery pack)

## Requirements in operation of Li-ion battery pack (General purpose)

Before operation, please carefully read the data sheet provided by the manufacturer. This is benefit to understand better of the charge and discharge characteristics of lithium ion battery, and the battery management system (or the lithium battery protection board) and the use of lithium battery charger.

Unless otherwise specified, our Li-NCM batteries charge and discharge parameters are:

Charging state:

- When single cell reaches 4.25V, BMS would cut-off the charging circuit;
- Or when battery pack reaches the volt of  $4.2*N$ , charging state is finished.

(PS: N is the number of 3.7V parallel units in series config of battery pack)

**Discharge state:**

When single cell reaches 3.3V, BMS should alarm (if BMS support this function), it is not suitable for use now;  
 When Single cell reaches 3.0V, BMS should cut-off the discharging circuit.

For our LiFePO4 batteries charge and discharge parameters are:

**Charging state:**

When single cell reaches 3.85V, BMS would cut-off the charging circuit;  
 Or when battery pack reaches the volt of  $3.65 * N$ , charging state is finished.

(PS: N is the number of 3.2V parallel units in series config of battery pack)

**Discharge state:**

When single cell reaches 2.8V, BMS should alarm (if BMS support this function), it is not suitable for use now;  
 When Single cell reaches 2.5V, BMS should cut-off the discharging circuit.

To make sure our customer can use our battery effectively, we suggest our customer choose the specialized Li-ion charger in CC/CV mode. Please do not charge and discharge the battery without BMS in case the battery pack be over-charged and over-discharged.

**Battery Pack Installation & Maintenance (For Technical Reference only)**

- Please study the related datasheet and user manual before the installation of battery pack, BMS and Charger.
- Fix the battery installation location and install the battery pack under ventilation cooling environment.
- Please be careful and prevent the battery from short circuit.
- All the cables should be the standard match that can resist the related temperature and voltage.
- Please install/change the BMS under the instructions of operation manuals and make sure every part is rightly and tightly connected. BMS install requires the right sequence of parts, please be aware.
- If the battery pack is separated, please pay attention to the connecting steps and composition way.

Failure	Cause Analysis	Corrective Action	
The Battery pack can not work properly	1. Incorrect Wire connection	Make Sure the connection is right	
	2. Energy has exhausted	Please use the charger for charging	
	3. BMS is not working	Replace the BMS	
	4. Some single cell is damaged.	Replace the damaged cell	
Battery pack is overheated while working	1. The continuous discharging current is too large.	Do some cooling method, make sure battery pack is not over-discharged.	
BMS (Only for Advanced BMS type, for LiFePO4 battery type)	Cannot working	1. No power supply	Make sure the DC power supply for BMS is 12V or 24V
		2. Incorrect connection	Make sure the wire connection is right.
	Buzzing Alarm	1. Battery pack is in overcharge or over discharge state.	Please check the volt too low ( $\leq 3.0V$ ) or too high ( $\geq 4.2V$ )
		2. CAN communication is stopped	Check the communication port.
	No display on Screen	No power supply.	Please check the line of power is connected to screen or is loosed?
The volt is 0 V on CCM	CAN communication is stopped	Please check the communication port is loosed or not?	
When discharge, it shows as "charge"	The direction of current sensor is opposite.	Please refer to the current sensor installation manual	