User Manual

LiFePO4 Batteries

If you do not follow the Instructions for Use for LiFePO4 batteries, make repairs or perform prohibited activities, the warranty will be lost.

1. Safety

The manufacturer's recommendations and occupational health and safety instructions must be strictly followed. Only persons with appropriate authorizations should work on the battery.

● It is forbidden to smoke in the room where the battery (cells) is installed and to use fire or a fire source because there is a risk of explosion or fire.

● Appropriate air exchange should be ensured (natural ventilation - gravity or forced) in the place where the battery pack (cells) is used.

● The metal parts of the battery are always under voltage, so do not place any instruments or tools on them.

● There is a risk of electric shock. Batteries (cells) accumulate a large amount of electrical energy and even when discharged, they can force a short-circuit current to flow. It is essential to prevent the possibility of short-circuiting the positive (+) and negative (-) terminals (poles) of a single battery (cell) or the entire battery bank (batteries consisting of many cells may have a voltage dangerous to life). Before working with batteries, remove all jewelry and metal decorations and use only insulated tools.

2. Recycling

Appropriate regulations on the disposal of hazardous waste must be observed. Batteries (cells) marked with the disposal symbol should be delivered to a recycling plant or, if agreed, returned to the manufacturer. Used batteries must not be mixed with chemical or household waste.

3. Exploatational parameters

3.1 Charging

LiFePO4 batteries should be charged with a dedicated charger, using the CC-CV method, at constant voltage with a limitation of the initial charging current. It should be less than the maximum charging current specified in the product specifications, otherwise it may damage the battery.

The charging voltage during **buffer** working (emergency power supply) should be in the range from **3.375** to **3.45 [V/cell]** , i.e. from **13.50** to **13.80 [V]** for a battery with a voltage of **12.8 [V] (4 cells).**

In the case of a 25.6V battery (8 cells), the charging voltage for **buffer** working should be in the range from **27.00 to 27.60 [V]**

The charging voltage during **cyclic** working (discharge/charge cycles) should be in the range from **3.60** to **3.65 [V/cell]** , i.e. from **14.40** to **14.60 [V]** for a battery with a voltage of **12.8 [V] (4 cells).**

In the case of a 25.6V battery (8 cells), the charging voltage for **cyclic** working should be in the range from **28.80 to 29.20 [V]**

CC phase charges the battery with constant current, the charger output voltage is higher than the nominal battery voltage. When the battery reaches its maximum safe voltage, the CC phase ends and the CV phase begins.

CV phase charges the battery with a constant voltage until the current drops to close to zero. Then the battery cells are balanced. During balancing, cells that have reached too high a voltage are discharged through a special resistor. Thanks to this, these cells are protected against overcharging and give the remaining cells time to fully charge.

When the difference in cell balanced voltages is small enough and reaches the value allowed by the charger and BMS, the CV phase ends and goes into the charged battery phase.

Cykl naładowanej baterii rozpoczyna się zaraz po zakończeniu balansowania i kończy proces ładowania. Podczas tego cyklu ładowarka jest odłączona od akumulatora poprzez otwarcie stycznika ładowania.

CAUTION: Do not charge the battery at temperatures below 0[°C]

3.2 Temperature

LiFePO4 batteries are characterized by high thermal tolerance, but in order to maintain their rated parameters as long as possible, you must:

● place the battery away from devices that are a source of heat (e.g. transformer, radiator),

● use effective natural or forced ventilation or air conditioning,

Working at high temperatures, above 60℃, in addition to significantly shortening the life of the batteries, may also damage them.

Charging temperature is 0℃~50℃. The number of battery life cycles may vary depending on the operating temperature. When exceeding 40℃, ventilation and heat dissipation are required.

The discharge temperature is -20℃~60℃. The number of battery life cycles may vary depending on the operating temperature. When exceeding 40℃, ventilation and heat dissipation are required.

The ambient humidity cannot exceed RH≤85%. The IP tightness level is IP54.

3.3 Depth of Discharge

Excessive discharge of the battery limits its energy storage capacity, reduces its capacity and shortens its service life. LiFePO4 batteries have protection against deep discharge, but leaving a discharged battery for a long time without charging contributes to a partial, irreversible loss of available capacity. Shallow discharge of a lithium-ion battery is beneficial to improve its service life. The discharge current should be less than the maximum discharge current specified in the data sheet. Discharging with a current higher than recommended may damage the battery and the BMS protection.

A battery in which the BMS protection against too deep discharge is activated, the voltage drops significantly below the rated voltage and if it does not automatically return to the voltage before the protection was activated after a short while, the battery should be recharged.

The applied charging voltage must be appropriate depending on the type of battery, i.e. for a 12.8V battery the excitation voltage is in the range of ~10V-14.6V, for a 25.6V battery the excitation voltage is in the range of ~20V-29.2V.

After the BMS protection against too deep discharge, i.e. below 10V, is activated, it is recommended to charge the battery after waiting at least 10 minutes. Charge no later than 12 hours after discharge.

In the BMS system, despite the safeguards used, it is possible to damage the battery through incorrect use. Leaving the battery discharged for longer than 72 hours will result in permanent damage to the battery.

4. Precautions and use.

In order to maintain the battery in the best possible performance and to protect against destruction, fire and other forms of damage to the battery, it is absolutely necessary to follow the following rules:

● Do not immerse the battery in water.

● Keep away from fire, radiator and other heat sources.

● Keep the battery away from children and animals.

● Do not short-circuit the battery.

● Do not connect more than 4 batteries of 12.8V in series and not more than 2 batteries of 25.6V.

● Do not store or transport together with metal objects.

● Do not hit, throw or drop the battery.

● Do not disassemble/open the battery.

● Do not solder anything directly to the battery.

● Do not pierce the case with any objects.

● Do not use in environments with strong electrostatic or magnetic fields.

● Before connecting the module in parallel, make sure there is a voltage discrepancy between the battery packs

less than 100mV, old and new batteries cannot be mixed.

● If the battery leaks, the liquid gets into the eye or skin, do not rub it, wash the area

contact with clean water and call for medical help immediately.

● If the battery emits a strange odor, excessive heat, discoloration, deformation or any other

abnormalities from the norm during use, storage or charging, unplug it immediately

from load. Then put the battery in a safe place and contact your supplier.

● Do not carry metal objects when handling or using the battery

● Before recycling the used battery, insulate the terminals of the scrapped battery

battery to reduce the potential for danger.

● Contaminated battery terminals should be wiped with a dry cloth to maintain proper

conduction and connection to the battery.

● If the battery is over-discharged after a long period of storage, perform the cycle the battery at least once a month and maintain the voltage range (13.32-13.6V)

● Do not wash metal parts with an organic solvent.

● Do not connect the battery directly to electrical outlets

● Use a dedicated charger.

● Do not charge below 0℃

● Charge the battery only under supervision

● Charge the battery in accordance with the instructions for the charger and the data sheet.

● Do not reverse the charging polarity.

● Do not charge the battery for a long time, disconnect the charger after it is fully charged. Act accordingly with charger instructions.

● Do not charge, discharge or store the battery at temperatures above 60 ℃.

● Do not overload the battery with excessive charging and discharging current.

● Do not connect the battery plus (+) and minus (-) terminals reversely, as this will result in damage to the battery and the internal BMS system.

● After cutting off the BMS during discharging, please charge the battery within 12 hours.

● Recharge the battery within 12 hours after discharge.

5. BMS battery management system

Cells in lithium-ion batteries, despite almost identical parameters, can be charged and discharged to varying degrees and times. Each lithium-ion cell is very sensitive to overcharging and over-discharging. For this reason, it is necessary for each battery to have protection against the above-mentioned threats.

The battery management system (BMS) fulfills specific tasks by measuring and controlling battery parameters:

● protects the battery cells against too deep discharge, i.e. exceeding the minimum discharge level safe voltage (for LiFePO4 batteries it is 2.5V/cell),

● protects battery cells against overcharging, i.e. exceeding the maximum safe limit voltage (for LiFePO4 batteries it is 3.65V/cell),

● thermal protection against too high battery operating temperature, they are activated above 65℃.

● protection against overload, too high current.

● Additionally, the BMS has a balancing system that equalizes the voltages on all cells in the last phase charging, which extends the life and reliability of the battery.

6. Storage

Batteries should be stored under the following conditions:

- Ambient temperature 0℃~40℃ (best storage temperature is 15℃~25℃)

- Store in a cool and dry place.

- In a ventilated room, away from sunlight.

- To maintain their service life, batteries left for a long time should be left at 50%-70% charge.

- After a storage period of 6 months, it is recommended to perform at least one charging cycle (even more often for batteries with communication) to reduce the cell degradation process.

- Store with clamps covered.

7. Transport

The lithium-ion battery must be transported in its original housing, in a vertical position.

If the battery is transported in packages on pallets and the use of straps is required, use soft straps to support the load to avoid damage. Do not stand under the battery when it is raised. Always lift the battery by the handles, never by the clamps!