

OPERATION AND MAINTENANCE MANUAL

<https://www.kon-tec.eu/>

LITHIUM IRON PHOSPHATE LiFePO₄ BATTERY

12,8 V

Very durable LiFePO₄ batteries with A+ category cells. Equipped with an intelligent BMS system, wireless communication and the ability to check battery parameters using the application for mobile devices (iOS and Android)

KT-LFP1250 - 50Ah / KT-LFP1275 - 75 Ah / KT-LFP12100 - 100Ah
KT-LFP12150 - 150Ah / KT-LFP12200 - 200Ah



LEGAL PROVISIONS

This manual describes in detail the requirements and procedures for safe installation and operation of Kon-TEC lithium battery pack. Please read this manual carefully, only qualified persons are allowed to install, operate and maintain the system, otherwise it may cause product damage or personal safety risks. Any actions against safety operation, or do not follow rules of this manual and limited warranty letter, will void warranty and qualification of this product. Meanwhile, the manufacturer will be not responsible for the product damage, property damage, personal injury or even death. The information contained in this manual is accurate when it's issued. Kon-TEC reserve right to change specification (such as optimization, upgrade or other operations) without prior notice, please always view the latest document via QR code. In addition, please noted that the diagrams/schematics in this document are used to help understand system configuration and installation instructions, which may be different from the actual items at the installation.

LEGAL TERMS

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QR-CODE TO DOWNLOAD Android AND iOS APLICATION

Kon-TEC batteries are equipped with wireless communication. Special application allows to monitor state of charge and efficiency of the batteries. Download the APP "Kon-TEC" from Apple Store or Google Play or scan the QR code below to download it.








CONTENT







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1. SAFETY PRECAUTIONS

1.1. SAFETY INSTRUCTIONS


|  NOTICE | |
|--|---|
|  | Before use, read this manual carefully. NON-COMPLIANCE WITH THE INSTRUCTIONS, ANY REPAIRS MADE USING NON-ORIGINAL PARTS OR UNAUTHORIZED REPAIRS RENDER THE WARRANTY VOID. |
|  | Wear safety glasses and protective clothing while using the lithium-ion battery. |

|  WARNING | |
|---|---|
|  | Any exposed battery material such as electrolyte or dust that contacts with the skin should be rinsed off immediately with clean water, then consult a doctor. Contaminated clothes should be also rinsed off with clean water. |
|  | Overdischarge is very dangerous situation and can damage the battery. It is necessary to use internal battery protection (standard equipment of each Kon-TEC battery). |

|  DANGER | |
|--|--|
|  | Explosion or fire risk. The battery terminals are always live, so it is forbidden to place any objects or tools directly on the battery. |
|  | In case of overdischarge, overcharge or damage, the lithium-ion battery may emit dangerous and harmful gas mixtures. |
|  | It is forbidden to try to open or disassemble the battery. The electrolyte contained inside is very corrosive. Under normal operating conditions, contact with the electrolyte is impossible. If the battery case is damaged, do not touch visible electrolyte or dust as these substances are corrosive. |
|  | Never short-circuit positive and negative terminal of the battery! |
|  | The battery is heavy. In case of damage or drop from a height, the battery can become explosive! While transport or installation be especially careful and provide necessary equipment. |

1.2. TRANSPORT



|  WARNING | |
|--|--|
| Lithium-ion battery must be transported in original case, in vertical position. If the batteries are transported on pallets, it is required to use soft transport belts to avoid damage. It is forbidden to stand under the battery when it is lifted. | |

|  DANGER | |
|--|--|
| Always lift the battery by the handles, never by the terminals! | |

1.3. DISPOSAL OF BATTERY

Batteries marked with the recycling symbol must be disposed of a recognized recycling agency. With consent, the battery may be returned to the manufacturer. Used batteries must not be mixed with domestic or industrial waste.



2. INFORMATION

2.1. GENERAL INFORMATION

Lithium-ion batteries have no memory effect and provide higher energy density than lead-acid batteries, GEL or AGM.

Self-discharge effect of lithium-ion batteries is negligible and they have very long lifetime. The lithium-ion battery, in which the cathode is made of lithium compounds (LiFePO₄), has the safest cells available on the market. The nominal voltage of one cell is 3,2V. Therefore the 12,8V LiFePO₄ battery consists of 4 cells connected in series. The nominal capacity of the battery is:

- 50 Ah – KT-LFP1250
- 75 Ah – KT-LFP1275
- 100 Ah – KT-LFP12100
- 150 Ah – KT-LFP12150
- 200 Ah – KT-LFP12200

2.2. EFFICIENCY

The energy efficiency of the entire operating cycle of lithium-ion battery (100% discharge and 100% charge) is 98%. By comparison, in a lead-acid battery, the energy efficiency is only 80%. The LiFePO₄ battery can be charged and discharged at high current levels without loss of capacity and has a very high durability. The number of cycles (lifetime), after the battery maintains up to 80% of nominal capacity, depends on depth of discharge (DoD). It is no less than 3,000 with 100% DoD (fully charged and fully discharged battery). The lower DoD cycles, the longer the battery life. Accordingly for 80% DoD cycles (discharge to the level of 20% of nominal capacity), the battery lifetime is 4,500 cycles. For 60% DoD cycles (discharge to the level of 40% of nominal capacity), the battery lifetime is 6,000. The energy density of the battery reaches over 120Wh/kg, which is desirable and energy efficient.

2.3. DIMENSIONS AND WEIGHT

| Capacity [Ah] | Weight [kg] | Dimensions [mm] |
|---------------|-------------|-----------------|
| 50 | 6,6 | 197x166x174 |
| 75 | 10 | 260x167x212 |
| 100 | 11,2 | 307x168x210 |
| 150 | 17,8 | 485x170x240 |
| 200 | 23,7 | 485x170x240 |

2.4. APPLICATION

- Replacement for SLA batteries (lead-acid and gel),
- Caravans and camper vans
- Specialized electric vehicles
- Electric drives
- Yachts, catamarans, houseboats
- Wheelchairs and carriages for disabled
- Hybrid photovoltaic systems
- Wind turbines
- Emergency lighting
- Appliances and toys 12V
- Power source for inverters 12V~/230V~
- and more

3. INSTALLATION



BE CAREFUL

With each type of connection, the batteries must be protected with a fuse in the circuit.

- When connecting the batteries, remember to use the correct cross-section and the same length of wires, to avoid unnecessary energy losses.
- In case of series connection, the individual batteries in the series must not be loaded unevenly. It is allowed to charge individual batteries separately if the series connection is disconnected during charging.
- When connecting the batteries, make sure that their state of charge is identical and the type of batteries is the same. Otherwise, very high equalizing currents may flow while connecting the batteries, which may result in damage of batteries or incorrect operation of the system.

To ensure that the batteries are at the same state of charge:

1. Fully charge each battery separately or as in point 2.
2. Connect the batteries in PARALLEL and charge again until fully charged.
3. Leave the batteries connected to the charger for 12 to 24 hours.

After this process, you can connect the prepared batteries into the systems described below.

3.1. SINGLE BATTERY INSTALLATION

Fig. 1. represents single battery instalation to load.

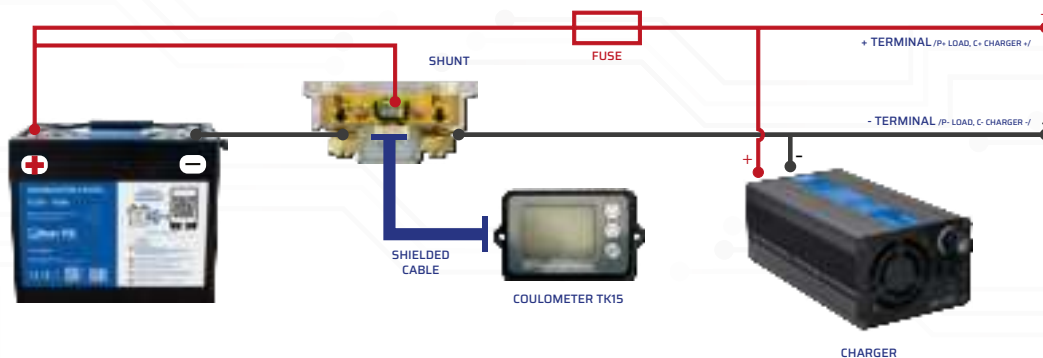


Fig. 1. Single battery installation



NOTICE

The batteries are equipped with wireless parameters monitor. The reading of parameters is ensured by the application dedicated to mobile devices with Android or iOS.

The parameters of the batteries can also be monitored by the TK15 coulometer connected directly to the battery or batteries.

Whenever it is not possible or advisable to use the application, we recommend using the TK15 coulometer.

3.2. SERIES AND PARALLEL CONECTION OF BATTERIES



DANGER

Before connecting in series, the batteries MUST have the same state of charge (not to be confused with the same voltage, as LiFePO₄ batteries may have the same voltages, but their state of charge may differ). Batteries balancing instructions can be found below. It is forbidden to connect the balancer to the batteries of different capacity or state of charge.

Non-compliance to the above recommendations may cause damage to the balancer, battery or charger or even cause a fire.

3.2.1. BATTERY BALANCING MANUAL (THE SAME STATE OF CHARGE OF BATTERIES IN SERIES)

Obtaining identical battery state of charge can be achieved by:

Method 1: Charge each battery separately/individually with a dedicated charger until the charger indicates a fully charged battery.

Method 2: (in order not to charge the batteries separately/individually): Connect the batteries in PARALLEL (Fig.2), and then connect the LiFePO₄ Kon-TEC 12V charger (accurate 14.6V) to the batteries as follows:

1. Connect the positive cable of the charger to the positive terminal of the first battery.
2. Connect the negative cable to the negative terminal of the last battery.

After charging (green LED on the charger), leave the batteries for about 12 hours with the charger still connected. After approx. 12 hours, you can connect the batteries in series and connect the balancer to them. In this way, several batteries can be charged with one 12V LiFePO₄ charger (only when batteries are connected PARALLEL!)

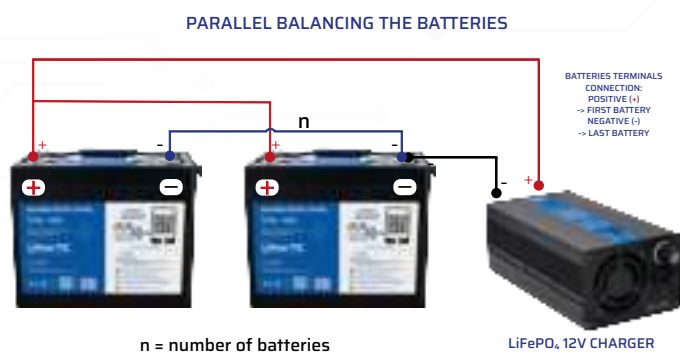


Fig.2 Parallel balancing of batteries

Example: Connect 2 Kon-TEC 12V batteries (accurate 12.8V) in series to obtain a 24V system (accurate 25.6V).

Method 1: Fully charge each battery separately with a LiFePO₄ Kon-TEC 12V charger (accurate 14.6V). After charging, you can connect the batteries in series and connect the balancer to them.

Method 2: Connect the batteries in parallel, and then connect the LiFePO₄ Kon-TEC 12V charger (accurate 14.6V) to them as follows:

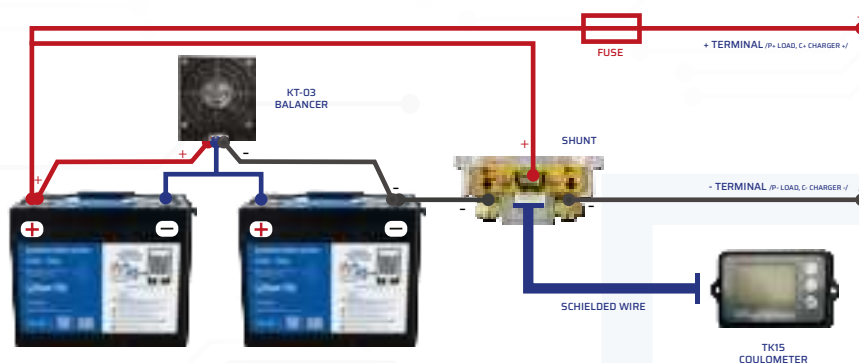
1. Connect the positive cable of the charger to the positive (+) terminal of the first battery.
2. Connect the negative cable to the negative (-) terminal of the last battery.

After charging (signal on the charger), leave the batteries for about 12 hours with the charger still connected. After approx. 12 hours, you can connect the batteries in series and connect the balancer to them.

3.2.2. SERIES CONNECTION OF BATTERIES

The batteries can be connected in series (increase the output voltage) up to a maximum of 4 batteries.

Figure 3 represents the serial connection of batteries.



NOTICE

The parameters can be read using wireless monitoring of parameters via the application or using the TK15 coulometer connected directly to the battery or batteries. Whenever it is not possible or advisable to use the application, we recommend using the TK15 coulometer.

3.2.3. PARALLEL CONNECTION OF BATTERIES

Batteries can be connected in parallel (capacity increase) and in this case there is no limit to the number of batteries connected. When connecting batteries in parallel, remember that the wires coming from the negative and positive terminals should not be led out from the first or last battery. Properly it should be: Positive wire from first battery and negative from last battery OR negative wire from first battery and positive cable from last battery. This is the correct battery connection. Leading out the wires in such a way takes into account the compensation of the wire resistance. The batteries then work evenly loaded, as well as have extended service life.

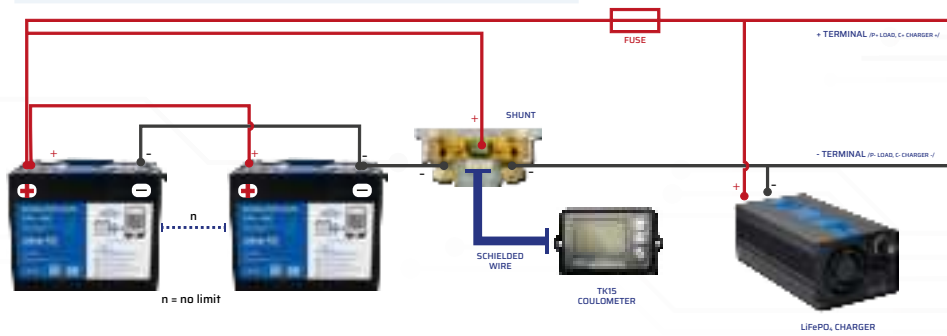


Fig.4. Parallel connection of batteries

NOTICE

The parameters can be read using wireless monitoring of parameters via the application or using the TK15 coulometer connected directly to the battery or batteries. Whenever it is not possible or advisable to use the application, we recommend using the TK15 coulometer

3.2.4. SERIES-PARALLEL BATTERY CONNECTION

The batteries can also be connected in series-parallel (the sum of 2 single voltages and the sum of 2 single capacities). A diagram of such a connection is shown in Fig. 5

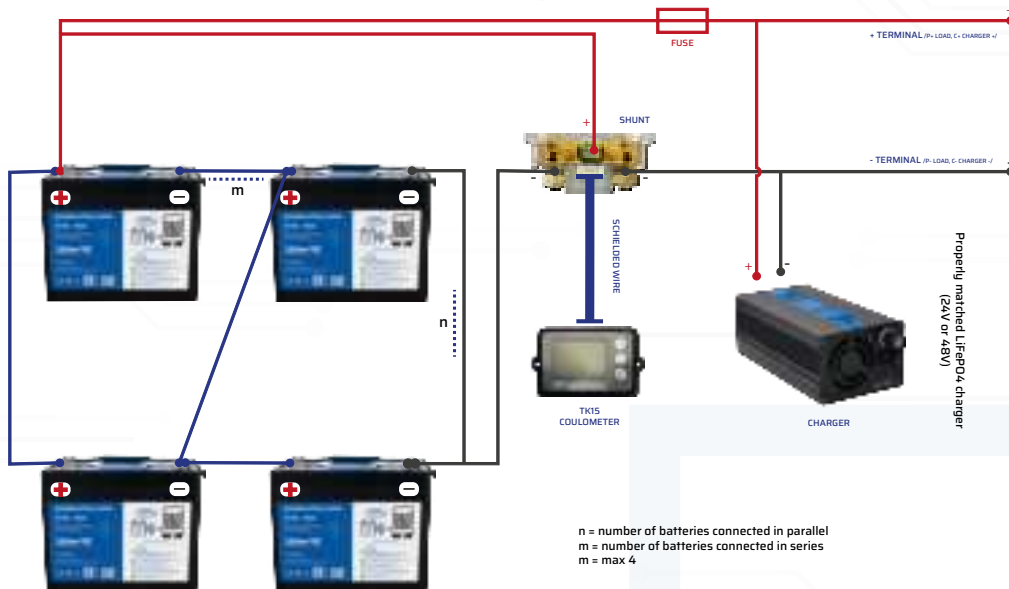


Fig.5. Series-parallel connection of batteries

NOTICE

The parameters can be read using wireless monitoring of parameters via the application or using the TK15 coulometer connected directly to the battery or batteries. Whenever it is not possible or advisable to use the application, we recommend using the TK15 coulometer.

4. OPERATION

4.1. CHARGE



WARNING

It is recommended to use a dedicated charger from the manufacturer for the charging process. It is allowed to use chargers from other manufacturers, however, the user must be sure of the compatibility of the equipment that is about to work with the batteries. Non-compliance with the instructions may cause damage to the device, as well as danger to health and life.



DANGER

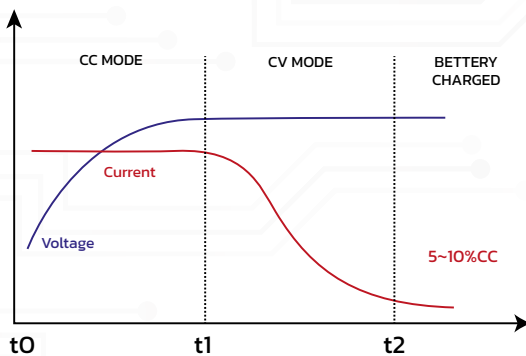
Do not charge the battery in temperatures below 0°C.
The battery has a protection that disconnects the charging process when the battery temperature drops below 0°C.

4.2. FIRST CHARGE

For safety reasons, batteries are shipped in a low state of charge. Charge the battery before using it for the first time.

4.3. CHARGING PROCESS - GENERAL INFORMATION

The process of charging a lithium-ion battery can be divided into 3 cycles:



t0 – constant current CC;
t1 – constant voltage CV;
t2 – battery charged

Fig. 6 Charging cycles of LiFePO₄ batteries

The CC mode – cycle charges the battery with a constant current, while the output voltage of the charger is higher than the nominal battery charging voltage. That condition is necessary, because there is a need for such a difference in potential to pass the charging current. While the battery reaches its maximum safe voltage, the CC cycle ends and the CV cycle begins.

The CV mode – cycle charges the battery with a constant voltage until the current drops to close to 0 A. Then the balancing of the battery cells takes place. During balancing, the cells that have reached too high voltage are discharged through a special resistor.

There are two reasons for this:

- first, not to overcharge the cells;
- second, remaining cells with too low voltage have time to charge.

When the voltage difference of balanced cells is small enough for charger and BMS, the cycle CV ends and passes to the charged battery cycle.

The charged battery cycle begins immediately after balancing and ends the charging process. During this cycle the charger is disconnected from the battery by opening the charging contactor.



NOTICE

The parameters can be read using wireless monitoring of parameters via the application or using the TK15 coulometer connected directly to the battery or batteries. Whenever it is not possible or advisable to use the application, we recommend using the TK15 coulometer.

4.4. BATTERY MANAGEMENT SYSTEM (BMS)

The cells in a lithium-ion battery are not completely identical and may charge and discharge at different rates and discharge differently. Each lithium-ion cell is very sensitive to overcharging and overdischarge. For this reason, it is essential that each battery pack has protection against these hazards.

The Battery Management System (BMS) performs specific tasks by measuring and controlling battery parameters:

- protects the battery cells from exceeding the minimum safe voltage (for LiFePO₄ cells it is 2.5V),
- protects the battery cells from exceeding the maximum safe voltage (for LiFePO₄ cells it is 3.65V),
- during charging, balances and equalizes voltages of all cells, which extends battery life and reliability.
- In addition, the BMS protects against short-circuits and battery overloads.

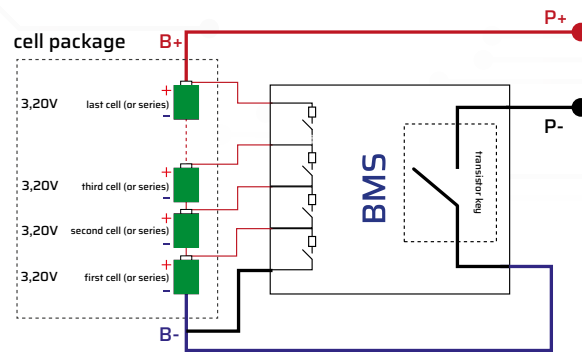


Fig.7. General diagram of the BMS system installed in the battery

WARNING

In the BMS system, despite the protections used, it is possible to damage the battery through incorrect use. Examples may be: leaving the discharged battery for a period longer than 72 hours (permanent damage to the battery) or leaving the fully charged battery for MORE than 6 months (partial loss of capacity) without use. It is necessary to discharge and recharge the battery once every 6 months, so that it does not lose its capacity.

WARNING

In case of a deep discharge of the Kon-TEC LiFePO₄, 12V battery, the BMS system will disconnect the battery from further use. In this case, the BMS works to avoid excessive discharge of cells, dangerous for the battery. The voltage of the battery terminals can be ~ 0 V. In order to reactivate such a battery for further operation, it should be connected to the terminals with a voltage close to its rated voltage (approx. 12.8 V), or higher, close to the charging voltage (max. 14.6 V). For this purpose, use a dedicated charger Kon-TEC LiFePO₄, 12V or a suitable power supply/charger. The process of "awakening" the battery lasts a few/several seconds. After the above operation, the battery should have a voltage at the terminals of ≥10 V and will be ready to be charged and to continue the work.

NOTICE

Not all processor chargers are suitable for the process of "awakening" of such a battery, because some of them do not have constant voltage on terminals. Therefore, use only a dedicated Kon-TEC LiFePO₄, 12V charger or a suitable power supply/charger.

NOTICE

In the event of disconnection (by BMS) of any of the batteries connected in series 24V / 36V / 48V, the entire block will turn off, because deeply discharged, disconnected battery will create an open circuit. In order to "awake" such battery, it must be disconnected from the series and also be "awaken" by dedicated Kon-TEC LiFePO₄, 12V charger or appropriate power supply/charger. You cannot "awake" a single battery connected in series with a charger matched to charge 24 V / 36 V / 48 V batteries in series!

4.5. WIRELESS COMMUNICATION - PARAMETERS CONTROL IN MOBILE APP

The app connects with the battery via wireless communication to monitor the parameters and status of the battery in real time with mobile device. The connection provides great flexibility and ease of use for Kon-TEC batteries. Multiple batteries can be connected to the application simultaneously and the user is able to monitor the status of each battery.

The app displays:

- Battery State of Charge (%)
- Battery temperature (°C / F)
- Discharge current (A)
- Load current (A)
- Battery life (number of cycles)

Advantages of using the application:

- + No need to use separate monitoring device
- + No wires - no need to connect the battery monitor with wires to the battery
- + Ability to connect multiple Kon-TEC batteries to one application.

4.5.1 INSTALLATION AND USE MANUAL

1. Enable wireless communication on your mobile device



2. Download the application "Kon-TEC" from Google Play for Android devices or "Kon-TEC Battery Monitor" from Apple Store for iOS devices. The qr-code can be scanned to download application - please scan the corresponding qr-code for your device.



3. Run the "Kon-TEC Battery Monitor" and allow the app to access your device's location.



WARNING

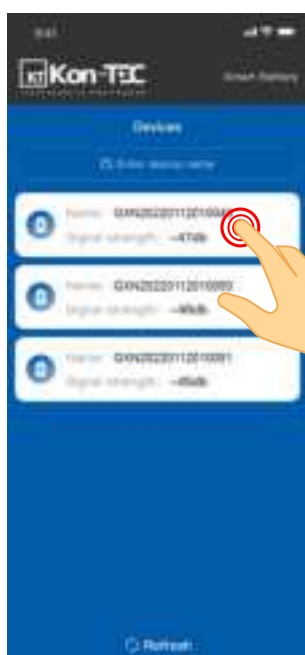
The battery is only connected via the "Kon-TEC Battery Monitor" application. Do not connect the battery directly via wireless communication on your mobile device.


4. After launching, the application will search for the batteries within the working range of wireless communication (about 10m).

5. The distance to the battery can be checked by monitoring "Signal strength" parameter. When approaching the battery or moving away from the battery, select the "Refresh" button, "Signal strength" will increase (e.g. -87dB) or decrease (e.g. -25dB) depending on the distance from the battery or batteries.




6. To check the parameters of the battery, select (press) the desired battery.



7. After selecting the icon  you can check the basic data of the selected battery



8. After selecting the icon  you can check the details of the selected battery



9. After selecting the icon  you can check the manufacturer's basic contact details



5. BATTERY DAMAGE OR FIRE PROCEDURE



DANGER

An incorrectly used or damaged battery can be unstable and very dangerous for the user.

If you notice any irregularities, disconnect the battery from the load and put it in a safe place, then immediately contact the service.

The battery should be placed in a safe place and under supervision. However, there is always a risk of fire, including mechanical damage of battery, electronic failure or any other cause that could cause a fire. Use an extinguishing agent suitable for extinguishing lithium-ion batteries, such as an extinguishing device containing an extinguishing agent in the form of water dispersion of vermiculite.

In the event of a Li-Ion battery fire, follow these steps:

1. Immediately alert people in the danger zone and then leave it.
2. Call the fire brigade.
3. Ventilate the room if possible.
4. If possible, use an extinguishing agent suitable for lithium-ion batteries, such as an extinguishing device containing extinguishing agent in the form of water dispersion of vermiculite.

Additional information:

- wear a gas mask,
- if possible, disconnect the load from the battery,
- continuous cooling of the battery reduces the risk of ignition of the emitted gases.



DANGER

Use an extinguishing agent suitable for lithium-ion batteries, such as an extinguishing device containing extinguishing agent in the form of water dispersion of vermiculite.

6. GENERAL PRECAUTIONS

- do not expose the battery to sunlight,
- do not immerse the battery in water,
- do not place the battery near heat sources,
- charge the battery only under supervision,
- do not short-circuit the + and - terminals with any conductive elements,
- do not connect the battery directly to electrical outlets,
- do not throw the battery into fire,
- do not transport the battery together with other metal objects,
- do not hit, throw or step on the battery,
- do not pierce the battery with any objects,
- do not disassemble/open the battery,
- do not keep the battery unused for a long period of time,
- do not leave the battery in high temperature conditions,
- do not use the battery in the area of strong electrostatic or magnetic field,
- read the charger manual carefully,
- store the battery with secured terminals,
- keep the battery away from children and pets,
- do not wear metal objects during handling and using the battery,
- charging time should not be longer than described in the charger manual,
- do not solder anything to the battery,
- do not expose the battery to microwaves and high pressure,
- do not use any form of pressure on the battery.
- if the battery emits a strange smell, is noticeably hot, changes colour, deforms or otherwise deviates from the standard at use, immediately disconnect it from the load and put it in a safe place, then contact with the supplier/manufacturer,
- if the battery terminals are dirty, clean them with a dry cloth, otherwise connection with the battery may be defective.

7. STORAGE

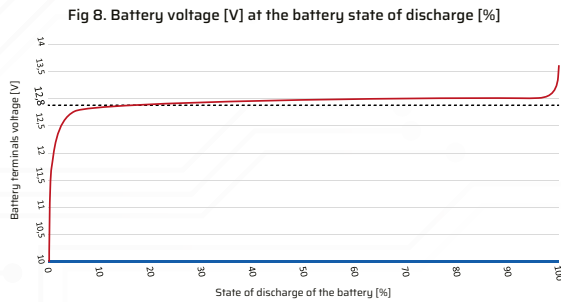
The batteries should be stored under the following conditions:

- In ventilated rooms avoiding direct sunlight.
- For long-term storage, do it in rooms with low air humidity and temperature in the range from -10°C to +45°C.
- Keep the battery fully charged,
- When storing the battery for 6 months or MORE, at least one full discharge and charge cycle is required to avoid damaging the cells by self discharge.

**NOTICE**

Due to the non-linear nature of the LiFePO₄ battery discharge, its voltage ranges maintain an almost constant value through a wide range of its capacity (Fig 8). The nominal voltage of 12.8V (for our batteries) can mean both a charged battery approx. 90% of the nominal capacity, BUT also discharged battery nearly 0% of the nominal capacity. As can be seen from the characteristic, a battery whose quiescent voltage (open circuit, no load) is 12.8V (or less) can be practically fully discharged.

Therefore, in the case of LiFePO₄ batteries, you must not rely on their voltage to determine their actual state of discharge/charge. Despite this, never let the quiescent voltage on the LiFePO₄ battery to be less than 12.8V.



8. WARRANTY INFORMATION

For the above product, which is a 12.8V LiFePO₄ battery, the customer is warranted that this product will be free from material and manufacturing defects for period of 5 years from the date of production, or 3 years from the date of purchase in Poland. If during the warranty period there are symptoms that may indicate a defect in the product, contact the technical support department, which will indicate the further course of action.

Under this warranty, a defective product will be restored to working order or replaced if the defect makes it impossible to repair.

The warranty will be considered within no more than 30 business days from the date of receipt of the complaint.

**WARNING**

Replacement of the device includes the delivery of a new product free of defects, the same or - in the case when it is withdrawn from production with similar parameters, excluding dimensions that may change. After servicing there may be noticeable indicators of repair (traces, gluing marks, small scratches) on the outer packaging of the battery

This warranty does not apply:

- if the product has been modified, opened or damaged due to improper use,
- in case of non-compliance with the instructions of use of the device,
- if the product is sold at a public auction,
- in the event of damage to the device due to an accident or natural disaster,
- in case of destruction of the terminals,
- in case of incorrect connection, use or charging of the device,
- if the device is damaged by fire, freezing or high temperature,
- in case of flooding/crushing by pressure,
- in the event of user interference with the device,
- in case of damage to the casing.

**NOTICE**

The number of cycles (lifetime), after the battery maintains up to 80% of nominal capacity, depends on depth of discharge (DoD). It is no less than 3,000 with 100% DoD (fully charged and fully discharged battery). After exceeding 3000 cycles the battery is still functional and its capacity is at least 80% of the nominal capacity and begins to decrease with time and/or further use. The lower DoD cycles, the longer the service life. Accordingly for 80% DoD cycles (discharge to the level of 20% of nominal capacity), the battery lifetime is 4,500 cycles. For 60% DoD cycles (discharge to the level of 40% of nominal capacity), the battery lifetime is 6,000. The energy density of the battery reaches over 120Wh/kg, which is desirable and energy efficient. The estimated lifetime of the battery electrolyte is approximately 12 years of use.