

USER MANUAL

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

LITHIUM NICKEL MANGANESE COBALT OXIDE LINIMNCOO₂ BATTERY

48,1V



1. SAFETY NOTES

1.1. GENERAL RULES

| | | | |
|--|---|--|---|
| | Read this manual before use. | | Wear protective eye-glasses and clothing during using the li-ion battery. |
| | Explosion or fire hazard. Lithium-ion battery terminals are always live. Therefore, it is forbidden to place items or tools directly on the li-ion battery. | | Any uncovered battery parts or material such as electrolyte or powder on skin, or eyes must be flushed with plenty of clean water immediately. Then consult with a doctor. Spillages on clothing should be flushed with water |
| | Too deep discharge is very dangerous and may damage the battery. Therefore, it is obligated to use internal safety relay. | | In case of overcharge, over discharge or any damage to the battery there may be released dangerous gas compounds. |
| | It is forbidden to open or disassemble li-ion battery. The battery contains electrolyte that is very corrosive. In normal operating conditions contact with electrolyte is impossible. If the battery case is damaged, it is forbidden to touch exposed electrolyte due to corrosive effects. | | The battery is heavy. In case of damage or an accident it can become explosive. During montage or transport ensure proper protection and use suitable equipment. Li-ion battery is sensitive to shock. Handle with care |
| | Never short circuit positive (+) and negative (-) pole of the battery! | | |

CAUTION!
NON-COMPLIANCE WITH MANUAL, REPAIRS MADE WITH OTHER THAN ORIGINAL PARTS OR UNAUTHORISED REPAIRS RENDER THE WARRANTY VOID.

1.2. TRANSPORTATION

CAUTION!

The li-ion battery must be transported in its original case in upright position.
If the battery is in its case use soft slings to avoid damage.
It is forbidden to stand below the battery when it is hoisted.

Always handle the battery with handles, never the terminals!

1.3. UTILIZATION OF LI-ION BATTERIES

Batteries marked with the recycling symbol must be disposed via recognized recycling agency. Batteries may be returned to the manufacturer by agreement. Used batteries must not be mixed with domestic or industrial waste.



2. GENERAL INFORMATION

Lithium-ion batteries have no memory effect and provide the highest energy density. The self-discharge effect is negligible and they have long lifetime. The li-ion battery with nickel, manganese and cobalt oxide admixtures has the lightest cells available on the market. The nominal voltage of cell is 3,7V. Therefore the 48,1V NMC battery consists of 13 cells connected in series.

The nominal capacity of the battery is:

- 130 Ah - 195 Ah

2.1. EFFICIENCY

Efficient energy use of the NMC battery operating cycle (discharge from 100% to 0% and charging from 0% to 100% capacity) is at 92%. For comparison lead-acid battery energy efficiency use is at only 80%. The energy density released by NMC battery is at 270 Wh/kg which is at very high level. Number of full cycles charge-discharge with 80% DoD is 1,000. It is a kind of compromise between lifetime and the possibility of power release. The LiNiMnCoO₂ battery has the highest maximum capacity regarding weight and volume.

The nominal voltage of the cell is 3,7V that is relatively high value.

Therefore, this results in a beneficial battery size. The higher cell nominal voltage, the less single cells is needed to reach the required

voltage. That directly affects to battery dimensions and weight. The NMC batteries have high operating temperature ranges (-20 C to 50 C) which corresponds with temperature range in Europe.

2.2 DIMENSIONS AND WEIGHT

The 48,1V NMC battery weight and dimensions:

- 130 Ah: 35 kg, 500x400x190 mm,
- 195 Ah: 45 kg, 500x400x200 mm

2.3. APPLICATION

- Electric vehicles (EV),
- Outboard motors,
- 48V devices.

3. INSTALLATION

Caution!

The battery must always be installed in upright position.

During connection, the batteries must be the same type and must have similar charge state. In other case, during battery connection, very high equalization current would flow and it could damage the batteries.

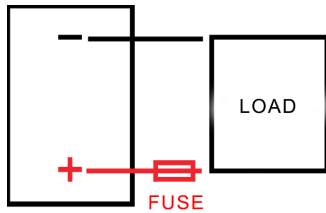
At any type of connection, the batteries must have fuse in circuit.

During connection always pay attention to use proper diameter and length of wires, to avoid energy losses.

It is forbidden to charge each battery in circuit.

3.1 SINGLE BATTERY INSTALLATION

Picture 1 shows wiring diagram for one battery with load.

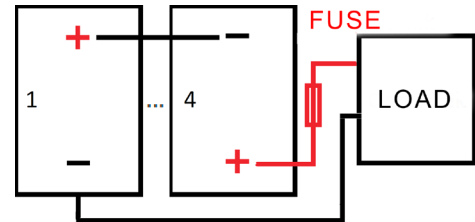


Picture 1. Single battery

3.2 SERIES CONNECTION

Batteries can be connected in series (output voltage increase) in a maximum number of 4 batteries.

Picture 2 shows wiring diagram for series connection batteries with load.

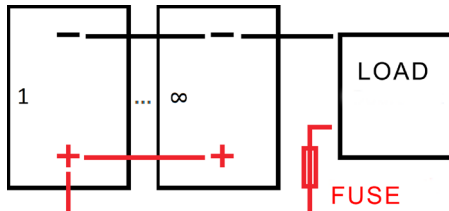


Picture 2. Series connection

3.3 PARALLEL CONNECTION

Batteries can be connected in parallel (capacity increase) and in this case there is no limit in number of batteries.

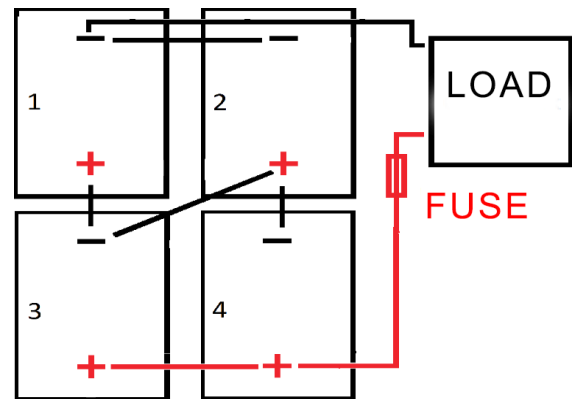
Pay attention the outgoing wires from positive and negative pole are not derived from the last battery. From the first battery should be wired positive (+) and the last battery should be wired negative (-). It is proper connection the battery that takes into account compensation of wire resistance and the batteries operate evenly loaded. Therefore, their lifetime is longer. Picture 3 shows parallel connection.



Picture 3. Parallel connection

3.4 SERIES-PARALLEL CONNECTION

Batteries can be connected in series-parallel (the sum of 2 each voltage and the sum of 2 each capacity). Picture 4 shows wiring diagram for series-parallel connection.



Picture 4. Series-parallel connection

4. OPERATION

4.1. CHARGING

Caution!

For charging process use only dedicated charger by manufacturer. Non-compliance with user manual may cause damage to the battery or danger to health or life.

Charging process needs to be carried out under direct supervision.

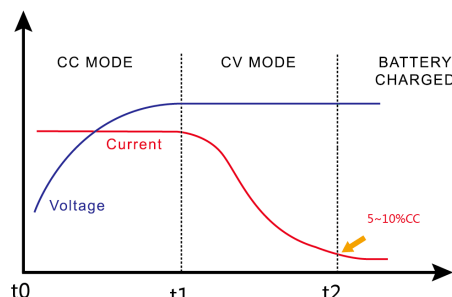
It is not recommended to leave the battery charging without user's supervision. It is not allowed to charge the battery at temperatures below 0 C.

4.2 FIRST CHARGING

For safety reasons during shipping, the batteries are approximately charged at 50%. Therefore, it is recommended to fully charge the battery before use.

4.3 CHARGING PROCESS – GENERAL INFORMATION

The li-ion battery charging process can be divided into 3 cycles:



Picture 5. Charging cycles

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

The CC 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 cycle charges the battery with a constant voltage until the current drops to close to 0. 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.

4.4 BATTERY MANAGEMENT SYSTEM (BMS)

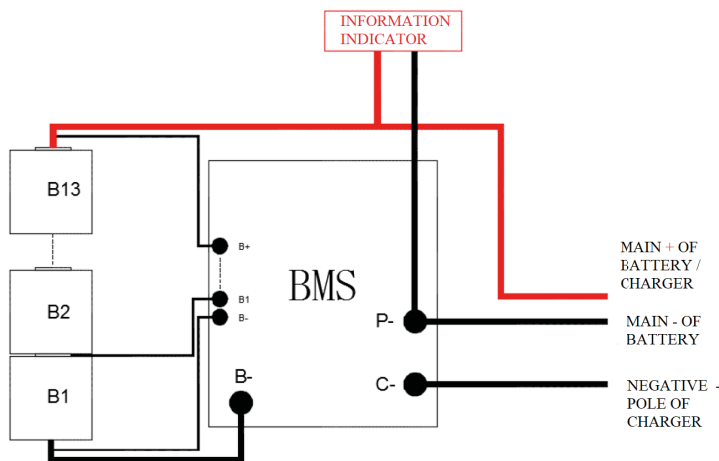
Caution!

The cells in lithium-ion batteries are not completely identical and may charge and load at different states and time. Each lithium-ion cell is very sensitive to overcharging and over discharge. Therefore, it is necessary that each battery has protection against above-mentioned threats.

Through measuring and checking the battery management system (BMS) performs actions such as:

- Protection the battery cells from exceeding the minimum safe voltage (2,7V for NMC cells),
- Protection the battery cells from exceeding the maximum safe voltage (4,2V for NMC cells),
- Balance and equalization voltage each cell during charging. Therefore, the battery lifetime is longer.
- Additionally, BMS protects from short circuit and the battery overload.

Figure 6 shows a general diagram of the BMS system located in the battery.



Picture 6. Diagram of BMS system

4.5 BATTERY DAMAGE OR FIRE PROCEDURE

Caution!

Incorrectly used or damaged battery can be unstable and very dangerous for the user. If noticed any irregularities, the load should be immediately disconnected from the battery and put in a safe place. Then immediately contact the manufacturer / supplier.

The battery should be placed in a safe place and under supervision. However, there is always a risk of fire, during mechanical damage, electronics failure or any other cause. The user is obligated to have a specialist D category fire extinguisher used to extinguish metals (including burning lithium).

The procedure for lithium-ion battery fire is:

- 1.Alert people in the danger zone immediately and then leave it.
- 2.Call the fire brigade.
- 3.Ventilate the room if possible.
- 4.If possible, use a D category fire extinguisher.
- 5.If possible, cool the burning battery with a continuous stream of water until the fire brigade arrives.

Additional information:

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

General precautions:

- Do not expose the battery to sunlight,
- Do not immerse the battery in water,
- Do not leave the battery near heat sources,
- Charge the battery only under supervision,
- Do not short circuit the + and the - poles with any conductive elements,
- Do not connect the battery directly to electrical sockets,
- Do not put the battery into a fire,
- Do not transport the battery 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 store the battery if it has not been used for a long time,
- Do not leave the battery in high temperature conditions,
- Do not use the battery in a strong electrostatic or magnetic field,
- If the battery emits a strange smell, is noticeably hot, changes colour, deforms or in any other way deviates from standards when using, immediately disconnect it from the load and store it in a safe place. Then contact the supplier / manufacturer,
- If the battery terminals are dirty, clean them with a dry cloth, otherwise connection may be faulty,
- Read the charger manual carefully,
- Store the battery with secured terminals,
- Keep the battery away from children and animals,
- Do not wear metal objects when handling and using the battery,
- Charging time should be no longer than specified in the manual,
- Do not sold anything to the battery,
- Do not expose the battery to microwaves and high pressure,
- Do not use any form of pressure on the battery.

4.6 STORAGE

The battery should be stored in conditions as:

- Dry, ventilated places, avoiding directly sunlight,
- In case of long-time storage, the battery should be stored in low humidity places and temperature range -20 C to + 30 C,
- Store the battery in the state of 50 % charge (longer lifetime),
- If the battery is stored more than 6 months, it is recommended to perform charge cycle to avoid damage to cells through self-discharge.

5. TERMS OF WARRANTY

Kon-TEC will provide the following warranty to the original purchaser subject 48,1V NMC battery, to the terms and conditions stated herein. The customer is guaranteed that this product will be free from defects in materials and production for a period of 2 years. If during the warranty period there are symptoms that may indicate a product defect, the client is obligated to contact the technical support department for further action. Under this warranty, a defective product will be replaced or put back into service.

This warranty does not apply

- In case of modifying, opening, changing or damage of the product due to improper use,
- In case of non-compliance with the following operating manual,
- If the product is sold at a public auction,
- In case of damage to the device during an accident or natural disaster,
- In case of damage to the connection terminals,
- In case of improper connection, use or charging the device,
- In case of damage to the device by fire, freezing or high temperature,
- In case of flooding/crushing by pressure,
- In case of user interference in the device,
- In case of damage to the case.

Caution!

The number of cycles depends on depth of discharge of the battery. The number of cycles is not less than 1,000 while maintaining 80% of the nominal capacity. After exceeding 1,000 cycles, the battery is still in operating state, although its capacity begins to decrease with time. The estimated battery life is assumed to be over 12 years.