

Usage and Safety Guidelines: Internal Battery Pack Modification for KX3 Radio developed by Howard Zehr and James Richards

The modifications to the internal battery holders of the KX3 radio provide for specific physical and wiring modifications based on a presumed KX3 usage pattern, a proven battery summing method developed by [mediadogg Software LLC](#) (Jim Richards) for use in its eTopper™ line of battery pack solutions, and specific battery management and usage guidelines that must be followed by the KX3 operator to insure safety.

In summary, the modifications entail:

- (1) Rewiring of the 8 bay battery compartment of the KX3 to go from a series connection of 8 “AA” style batteries, to a 4S2P configuration where the outputs of two 4 bay battery holders are connected via Schottky diodes, literally summing their output currents.
- (2) Replacing the metal battery holder screws with nylon screws to prevent the wear and tear of battery insertion and removal to inflict damage to the battery cell covers.
- (3) Replacing the 8 series connected “AA” 1.2V NiMH batteries with 8 “AA” 3.2V LiFePO4 batteries connected as 2 parallel sets of 4 cells wired in series.

The complete specifications and details for the mod are available as a [blog article written by Howard Zehr](#).

The following usage and safety guidelines must be followed:

- All battery cells must be charged to full capacity prior to each use in a specific charger designed for the voltage and chemistry, and immediately following each use. Any battery showing indications of improper charging, damage, heat, gas emissions or physical distress must be discarded following recommended procedures.
- At full charge, 3.2V LiFePO4 batteries may read 3.6V, resulting in an internal supply capable of delivering 14.4V at over 2A initially, tapering to a nominal voltage of 12.8V for most of the useful discharge cycle. As the batteries near their discharge limit (2.5V per cell), the voltage will quickly drop. Lithium cells have a rapid recovery chemistry which is perfectly matched for the intermittent keying operations supported by the KX3. You will find that the voltage will “bounce back” while listening, and drop while keying.
- It should be noted that no testing has been done with the modified power pack using the KX3 in continuous data transmission mode. If this is attempted, it is recommended that even more careful attention be given to battery discharge status and battery temperature. Perhaps use a

10.5V cutoff instead of 10V, as an additional safety margin, especially if transmitting at 10W or more.

- Care must be taken when dislodging and inserting batteries into their holders. Do not use metallic implements to pry them up. Use wooden or plastic (e.g. a “popsicle stick”, toothpick, plastic guitar pick, or wooden clothespin) to gently lift them up at the positive or button end.
- Care should be taken to exactly match the indicated polarity of the inserted batteries, per the molded outline picture in the case.
- Ideally, all 8 batteries must be matched in terms of chemistry, voltage, manufacturer, age in service and state of charge. If necessary, measure the voltage of each cell, and ensure that they are within 0.1 volt of each other, especially immediately after full charging. If this cannot be accomplished, then the matching can be within each 4 cell holder, so long as the total voltage of each 4 cell string is charged to within 0.1V of the other 4 cell string.
- Maximum continuous power dissipation allowed is 30W at 2.4A, or higher if less than 100% keying duty cycle at no more than 2.4A average current. The batteries may be individually protected, but the mod has no provision for a BMS, hence the battery level must be checked periodically, and power pack use discontinued immediately upon reaching 10V and the batteries recharged promptly. It is recommended that the KX3 lower battery voltage cutoff setting be used as a further safety measure. Set cutoff to 10V for keying operations, or to 10.5V for continuous data transmissions (not tested).
- Operators with KX3 configured for external charging MUST NOT USE EXTERNAL CHARGING OF THE MODIFIED INTERNAL BATTERY PACK. The 3.2V LiFePO4 “AA” batteries used in this mod, must be removed and charged individually in a charger specifically designed for them. This will ensure the health and safety of the cells. It is recommended that all the cells within a 4-cell string be used and charged as a group. This author employs an indelible marker to label each battery, e.g. as “1” or “2”, to indicate to which group the cell belongs.

The final section of this document, in the spirit of maximum transparency, borrows from a fairly typical industry standard set of disclaimers for the use and handling of Lithium based battery products. It is provided for your general information.

Most of us have dozens of lithium based battery products in our homes: in computer products, phones, vehicles and appliances, but it is important be informed and not cavalier in their handling.

Li-ion Battery Safety (Credit: Orbitronic.com)

WARNING + Li-ion BATTERY SAFETY INSTRUCTIONS:

IMPORTANT BATTERY SAFETY INSTRUCTIONS AND WARNINGS | ALL LI-ION BATTERY USERS MUST READ BEFORE USING LITHIUM-ION BATTERIES.

Failure to read, and follow Li-ion safety instructions, and warnings may result in fire, personal injury, and property damages if the battery is charged and/or used improperly.

- **DO NOT SHORT CIRCUIT. Short circuits may cause a fire and injury!**
- Charge battery fully to 4.2V before first use.
- Use high-quality charger specifically designed to charge Li-ion batteries.
- Do not charge unattended.
- Always keep your battery that is not in use inside the plastic battery holder(container).
- Do not keep a bare battery in your pocket, purse, or anywhere together with other metal (conductive) objects.
- Never attach any metal moving part [magnet] to the top positive or the bottom negative battery contact.
- **DO NOT USE WITH E-CIGARETTE, VAPORIZER, (E-cig, vape, mod) OR SIMILAR DEVICE**
- Stop using the battery with damaged PVC tube (wrap) or terminal insulator immediately.
- If the battery is damaged in any way stop using it immediately.
- Never discharge a Li-ion battery at a rate exceeding the maximum discharge current specified for that battery.
- Never use force to install (insert) Li-ion battery.
- Do not use old, and new batteries together.
- Do not solder directly onto the battery.
- Do not immerse in any liquid.
- Do not drop the battery. Always keep it in a plastic protective holder.
- Do not place the battery in high-pressure containers, microwave ovens, or on induction cookware.
- Immediately discontinue use of the battery if, while using, charging or storing the battery, the battery emits an unusual smell, feels hot, changes color or shape, or appears abnormal in any other way.
- Do not carry, or store the batteries together with hairpins, necklaces, or other conductive metal objects.
- Use only high-quality battery Li-ion charger (CC/CV 4.2V max).
- Do not expose to heat.
- Do not disassemble, or modify the battery.
- Keep the battery away from children, and pets.
- Never charge, or store the batteries inside your car in extreme temperature. Extreme temperatures (low or high) might ignite the battery, and cause a fire.
- Do not short (connect) positive, and negative battery terminals (contacts) intentionally, or unintentionally.
- Never charge the battery over 4.25V (properly charged li-ion battery is 4.2 Volts / full charge).
- Do not reverse the positive (+) and negative (-) terminals when charging, or using the battery.
- Never charge the battery at a current exceeding manufacturer-specified charging current.
- Do not expose the battery to water or salt water, or allow the battery to get wet.
- You must verify polarity before connecting the battery to the host device (or charger).
- Never completely discharge the Li-ion battery (below 2.5V under load).

- After the battery is discharged-don't leave it discharged-charge battery as soon as possible (10 min. rest time).
- It is your responsibility to determine that your charger and host device works properly.
- On (battery electrolytes) exposure to skin, flush with water immediately.
- If eye exposure occurs, flush with water for 15 minutes, and seek emergency care immediately.
- Always keep metal objects or other materials that can short circuit battery terminals away from the batteries

What is short circuit?

The situation when battery positive (+) and negative (-) connect. The current will become extremely high because there is no resistance in the path to limit current flow. This Short circuit will result in dangerously high temperature which may cause a fire.

Warning:

The use of any unprotected li-ion cylindrical battery as a stand-alone device, including with e-cigarettes, vaporizer mods or other products, constitutes a **DANGEROUS** misuse of the battery cells that poses a **SERIOUS RISK** of personal injury or property damage. These cells are only for prototyping with proper electronic protection circuits, and not for stand-alone use.

Warning:

These are high discharge current & high capacity Li-ion batteries. If mishandled or mistreated, these batteries can cause you **SERIOUS INJURY. USE AT YOUR OWN RISK.**