



## Lithium-Polymer Battery Series

### Safety and Handling Instructions

Lithium-polymer batteries offer a variety of significant advantages over NiCd, NiMH and Li-Ion batteries for use in R/C electric devices. It is very important to have a good understanding of the operating characteristics of LiPo batteries - **especially how to charge and care for them safely**. Always read the specifications printed on the battery's label and this instruction sheet in their entirety prior to use. Failure to follow these instructions can quickly result in severe, permanent damage to the batteries and its surroundings and even start a **FIRE!**

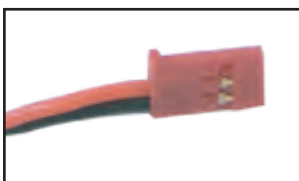
**WARNING!** Lithium-polymer batteries (LiPo) are ENTIRELY DIFFERENT than NiCd and NiMH batteries and must be handled differently as well!! MuchMore Racing will not be held responsible for any and all incidental damages and bodily harm that may result from improper use of MuchMore™ brand lithium-polymer batteries. In purchasing these products, the buyer/user agrees to bear all responsibilities of these risks and not hold MuchMore™, its distributors (owners and employees) and/or retailers responsible for any accidents, injury to persons, or property damage. If you do not agree with these conditions, please return the battery to the place of purchase.

Before and after every use of your LiPo battery, inspect all cells in the pack as much as possible to ensure no physical damage or swelling is evident. Such signs can often indicate a dangerous problem exists with the battery that could lead to failure.

#### LOW-HIGH VOLTAGE PROTECTOR

MuchMore Matched LiPo battery packs include a very small, lightweight built-in "Low-High voltage protector" circuit which constantly monitors the voltage of each cell in the pack during charge-discharge. If any cell in the pack reaches 4.20V (+/- 0.05V), the Low-High voltage protector circuit will automatically stop the charge process for all cells in the pack entirely. The Low-High voltage protector circuit protects every cell in the pack from accidental overcharge, if accidentally connected to a non-compatible charger, and helps to make the pack more sturdy and rigid.

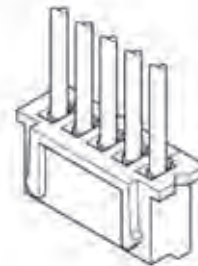
MuchMore LiPo packs which contain the Low-High voltage protector circuitry are easily recognizable as they have a red 2-pin connector which is used for charging the battery. Packs with the Low-High voltage protector circuitry are NOT designed for balancing of the individual cells in the pack.



**WARNING! NEVER** apply a current of greater than 1C or apply a voltage greater than 20V DC to the charge-lead of any MuchMore LiPo battery which contains the built-in Low-High voltage protector circuitry. Otherwise, the Low-High voltage protector circuit can become damaged, preventing the battery from receiving a proper charge and rendering all safety features in operable.

#### BALANCING PLUGS

MuchMore LiPo battery packs are configured for balancing. Such packs do NOT include the SafeCharge protection circuit, and do not include a red 2-pin connector as described earlier. Instead, balancing packs include a unique white connector which includes multiple wires (more than 2) similar to the type of plug shown below.



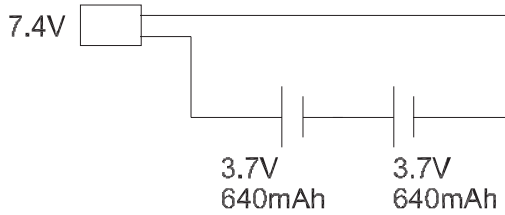
#### WARNING!

Packs with the balancing connector do NOT include the Low-High voltage protector circuit. **NEVER** attempt to charge a pack which has the balancing connector with a charger that is not capable of balance charging! Failure to do so could result in damage to the battery and its surroundings, and result in personal injury.

#### BATTERY VOLTAGES, RATINGS & APPLICATIONS

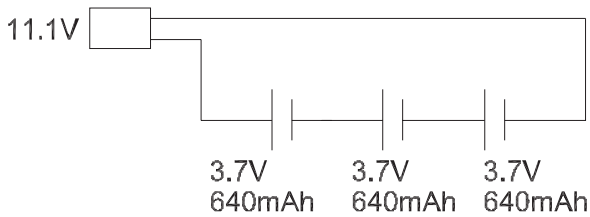
LiPo batteries can be assembled in many configurations. Packs are most commonly found with cells assembled in series, normally denoted with an "S". For example, 3 cells in series are often denoted as "3S". Each LiPo cell has a nominal voltage rating of 3.7V (with a minimum recommended discharge voltage of 2.8V, and a maximum charge voltage of 4.20V). The more cells assembled in series, the higher the total voltage of the pack. But assembling in series does not affect the overall rated capacity of the pack as shown in the diagram on page 2.

### 2-Series Pack (2S)



$3.7V + 3.7V = 7.4V$   
640mAh total capacity  
5.6V minimum discharge volts  
8.4V maximum charge volts

### 3-Series Pack (3S)



$3.7V + 3.7V + 3.7V = 11.1V$   
640mAh total capacity  
8.4V minimum discharge volts  
12.6V maximum charge volts

## CHARGING THE BATTERY

**IMPORTANT WARNINGS:** Be sure to follow these important warning statements regarding the charging of LiPo batteries:

- **NEVER LEAVE A LIPO BATTERY UNATTENDED AT ANY TIME WHILE BEING CHARGED!!**
- **NEVER** charge a LiPo battery while it's inside the model. A hot pack could ignite wood, foam, plastic, etc.
- **NEVER** charge LiPo batteries with a NiCd or NiMH peak charger!  
**ONLY** use a charger specifically designed for LiPo batteries which can apply the "constant current / constant voltage" charge technique (cc/cv). MuchMore offers several LiPo compatible chargers ([www.much-more.co.kr](http://www.much-more.co.kr)) which can be found at your local retailer.
- **NEVER** charge LiPo batteries at currents greater than the "1C" rating of the battery ("C" equals the rated capacity of the battery).
- **NEVER** allow LiPo cells to overheat at any time! Cells which exceed 140°F (60°C) during charge can and USUALLY WILL become damaged physically and possibly catch **FIRE!!** Always inspect a battery which has previously overheated and do not re-use if you suspect it has been damaged in any way.

- **ALWAYS** discontinue charging a LiPo immediately if at any time you witness smoke or see the battery starting to swell up. This may cause the battery to rupture and/or leak, and the reaction with air may cause the chemicals to ignite, resulting in fire. Disconnect the battery and leave it in a safe fireproof location for approximately 15 minutes.

- **ALWAYS** charge a LiPo battery in a fireproof location, which could be a container made of metal (such as an ammunition box), ceramic tile, or a bucket of sand. ALWAYS have an "ABC type" fire extinguisher available at all times.

Charging LiPo batteries:

1. Use a charge lead that directly mates to the connector on the LiPo battery. It is strongly recommended to use pre-assembled charge leads which can be found at most hobby retailers. Hand made connectors can be unreliable and hazardous, providing poor physical and/or electrical connections. Muchmore's "Docking Station" (#MR-SDS) is directly compatible with MuchMore LiPo batteries which have the 2-pin charge connector (non-balanced packs).

2. Connect the charge lead to the charger first. Then connect the battery to the charge lead. **NEVER** connect the battery to the charge lead if the charge lead is not connected to the charger! **WARNING! Never allow a battery's positive and negative leads to accidentally touch each other. This will result in a short circuit and cause permanent damage to your battery and or charger.**

**a. For batteries having the RED 2-PIN CHARGE CONNECTOR:** Connect the red positive (+) lead to the charger's red positive (+) output jack, and the black negative (-) lead to the charger's black negative (-) jack. **ALWAYS** charge the battery through the connector. **NEVER** charge the battery through the connector which goes to the ESC. For safety purposes, do not cut or modify wires on the battery in any way.

**b. For batteries having the BALANCING CONNECTOR:** You must know **how many cells** are in the battery pack, and then choose an adapter lead which matches your pack. For example, a 3-cell LiPo configured for balancing **MUST** use a charge adapter which has enough wires to monitor the voltage of all 3 cells in the pack (an adapter designed for 2 or 4 cells will **NOT** work properly). A 2-cell LiPo configured for balancing must use a balancing charge adapter that is designed for 2-cell packs only, and so on. Failure to choose the proper balancing adapter could result in improperly charged and improperly balanced packs.  
MuchMore "Cell Balancer" (#MR-SBL) is directly compatible with batteries having the balancing connector.

3. Set the charger's output voltage to match the nominal rated voltage of the entire LiPo battery pack. **NEVER set the charger to a voltage which is greater than the nominal voltage rating of the LiPo pack or allow LiPo cells to charge to greater than 4.20V per cell at any time!!** Overcharging LiPo cells usually will result in a permanent, catastrophic failure in the LiPo cells which can result in permanent damage to the battery and its surroundings, and cause personal injury!

4. Set the charger's output current to **NO GREATER** than the "1C" rating of the battery. A battery's "1C" rating equals the amount of current needed to fully charge the battery in one hour. For example, a battery with a capacity rating of 1200mAh has a 1C charge current rating of 1200mA (or 1.2 amps). A battery rated at 640mAh of capacity has a 1C rating of 640mA (or 0.6 amps).

5. Command the charger to start the charge process.

6. **ALWAYS** monitor the battery and charger during the entire charge process! **NEVER** leave the battery and charger unattended during charge!

7. **NEVER** continue to charge LiPo batteries if the charger fails to recognize full charge. Overheating or swelling of the LiPo cells is an indication that a problem exists and the batteries should be disconnected from the charger immediately and placed in a fireproof location!!

8. **NEVER** apply a trickle charge to LiPo batteries.

9. Using a charger which has a battery temperature monitor is very helpful for charging LiPo batteries. This can help to ensure a full charge and also prevent unwanted heating at the same time. Set the charger's maximum battery temperature to approximately 115°F (46°C).

## CONNECTING TO AN ESC & DISCHARGING

**IMPORTANT WARNINGS:** Be sure to follow these important warning statements regarding the discharging of LiPo batteries:

• **NEVER LEAVE A LIPO BATTERY UNATTENDED AT ANY TIME WHILE BEING DISCHARGED!!!**

• **ALWAYS** discharge LiPo batteries in a fireproof location, which could be a container made of metal (such as an ammunition box) or on ceramic tile. Monitor the charge area with a smoke or fire alarm, and have a lithium approved "ABC type" fire extinguisher available at all times.

1. It is strongly recommended to use an ESC which is designed to handle the low voltage cutoff points for LiPo batteries (always follow the instructions provided with the ESC for proper operation). Discharging LiPo batteries below 2.5V per cell can cause permanent damage and limit the number of times the battery can effectively be used again.

2. **NEVER** discharge LiPo batteries at currents which exceed the discharge current rating of the battery as this can often cause a cell to overheat. Do not allow a LiPo cell to exceed 140°F (60°C) during discharge.

## BATTERIES INVOLVED IN A CRASH

It is very important to remember that crash damage to LiPo batteries is much more dangerous than with NiCd or NiMH cells. It might appear that no physical damage occurred to a pack after a crash. However, LiPo batteries can often have a delayed chemical reaction, and while they may appear to be safe immediately after removing them from the crash they can suddenly begin to smolder, emit smoke and catch fire even after 30 minutes or an hour!! After a crash, remove the LiPo battery from the model but **DO NOT** immediately place it in a car, pocket or flight box. Instead, place the battery in a fireproof location and observe it for safety reasons. If possible, leave the battery in the safe location for 24 hours.

**CAUTION!** Cells may be hot! **DO NOT** allow the battery's internal electrolyte to get in the eyes or on skin – wash affected areas with soap and water immediately if they come in contact with the electrolyte. If electrolyte makes contact with the eyes, flush with large amounts of water for 15 minutes and seek medical attention immediately!

Carefully inspect LiPo batteries which have been involved in a crash for even the smallest of cracks, splits, punctures or damage to the wiring and connectors.

## STORAGE & TRANSPORTATION

- For long term storage it is recommended to charge the cells fully, then discharge them to 50-60% of their capacity.
- Store battery at room temperature in cool or shaded area, ideally between 40-80°F. Temperatures exceeding 170°F for greater than 1 hour may cause damage to battery and cause a fire.
- Do not expose battery packs to direct sunlight for extended periods of time, or place in direct contact with any liquids. If batteries come in contact with water, immediately dry the battery with a clean towel.
- When transporting LiPo batteries, store them in a fireproof container. **NEVER** leave batteries lying loosely anywhere in the car (in the trunk, backseat, floor, etc.).
- **ALWAYS** make sure all plugs / connectors on the LiPo battery are covered, to prevent an accidental short. Small sections of fuel tubing make good insulators.
- **NEVER** leave LiPo batteries in the car indefinitely as temperatures inside the vehicle can easily rise far in excess of 120°F which could damage the battery.

## HANDLING & FIRST AID INSTRUCTIONS

- **NEVER** allow LiPo batteries to be charged or discharged on or near combustible materials, including paper, plastic, carpets, vinyl, leather, wood, inside an R/C model or full-sized automobile!
- **NEVER** put loose cells or packs in the pocket of any clothing!
- **NEVER** allow LiPo cells to come in contact with moisture or water at any time.
- **NEVER** store batteries near an open flame or heater.
- **NEVER** assemble LiPo cells or pre-assembled packs together with other LiPo cells/packs. Only a qualified battery assembly company should assemble or modify LiPo batteries.
- **NEVER** allow LiPo cells to become punctured, especially by metallic objects such as screwdrivers, T-pins, or hobby knives.
- **NEVER** charge or discharge a LiPo battery without having an "ABC type" lithium approved fire extinguisher readily available in case of a fire.
- **DO NOT** allow the battery's internal electrolyte to get in the eyes or on skin. Wash affected areas with soap and water immediately if they come in contact with the electrolyte. If electrolyte makes contact with the eyes, flush with large amounts of water for 15 minutes and seek medical attention immediately! If a battery leaks electrolyte or gas vapors, do not inhale leaked material. Leave the area and allow the batteries to cool and the vapors to dissipate. Remove spilled liquid with absorbent and dispose.
- **ALWAYS** provide adequate ventilation around LiPo batteries during charge, discharge, and during storage. If a battery becomes overheated IMMEDIATELY place it in a fire-proof location until it cools.
- **ALWAYS** store LiPo cells/packs in a secure location away from children.
- **ALWAYS** make sure that metallic objects, such as wristwatches, bracelets, or rings are removed from your hands when handling LiPo packs. Accidentally touching battery terminals to any such objects could create a short-circuit condition and possibly cause severe personal injury.

## DISPOSAL OF LIPO BATTERIES

Unlike NiCd batteries, lithium-polymer batteries are environmentally friendly. For safety reasons, it's best that LiPo cells be fully discharged before disposal (however, if physically damaged it is NOT recommended to discharge LiPo cells before disposal - see below for details). The batteries must also be cool before proceeding with disposal instructions. To dispose of LiPo cells and packs:

1. If any LiPo cell in the pack has been physically damaged, resulting in a swollen cell or a split or tear in a cell's foil covering, do NOT discharge the battery. Jump to step 5.
2. Place the LiPo battery in a fireproof container or bucket of sand.
3. Connect the battery to a LiPo discharger. Set the discharge cutoff voltage to the lowest possible value. Set the discharge current to a C/10 value, with "C" being the capacity rating of the pack. For example, the "1C" rating for a 1200mAh battery is 1.2A, and that battery's C/10 current value is (1.2A / 10) 0.12A or 120mA. Or, a simple resistive type of discharge load can be used, such as a power resistor or set of light bulbs **as long as the discharge current doesn't exceed the C/10 value and cause an overheating condition.** For LiPo packs rated at 7.4V and 11.1V, connect a 150 ohm resistor with a power rating of 2 watts (commonly found at Radio Shack) to the pack's positive and negative terminals to safely discharge the battery. It's also possible to discharge the battery by connecting it to an ESC/motor system and allowing the motor to run indefinitely until no power remains to further cause the system to function.
4. Discharge the battery until its voltage reaches 1.0V per cell or lower. For resistive load type discharges, discharge the battery for up to 24 hours.
5. Submerge the battery into bucket or tub of salt water. This container should have a lid, but it does not need to be airtight. Prepare a bucket or tub containing 3 to 5 gallons of cold water, and mix in 1/2 cup of salt per gallon of water. Drop the battery into the salt water. Allow the battery to remain in the tub of salt water for at least 2 weeks.
6. Remove the LiPo battery from the salt water and place it in the normal trash.



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