

## SAFETY INFORMATION AND HANDLING PRECAUTIONS

Modern Lithium Polymer batteries (LiPo, Li-Poly) are a preferred source of power for flying models because of their ability to store and deliver large amounts of energy from lightweight packs. Performance wise, these new batteries have much more in common with model aircraft fuel than with any previous battery technology and they deserve similar respect: For safe handling it is useful to **Think of Lithium Polymer Batteries as Fuel.**

Treated with respect in knowledgeable hands, Lithium Polymer batteries have been proven world-wide to be a controllable, practical and enjoyable power source for model aviation.

### WHAT CAN GO WRONG:

- Fire can be caused by: "Overcharging" (wrong charger or charger setting, unbalanced battery load, charger fouled by poor power supply), charging a damaged cell or pack and short circuit (including crash damage).
- Cells or packs can be damaged by: Over discharging (running "too flat" and/or too hot, discharging an unbalanced battery load), short circuit and crash damage.
- The definitions of "overcharging" and "too flat" are detailed in the do's and don'ts section overleaf.

With the exception of a very small number of fires that have resulted directly from crash damage at the flying field, fires have almost always occurred during charging. These fires have been almost exclusively permitted by avoidable human error. Therefore the main purpose of this information is:

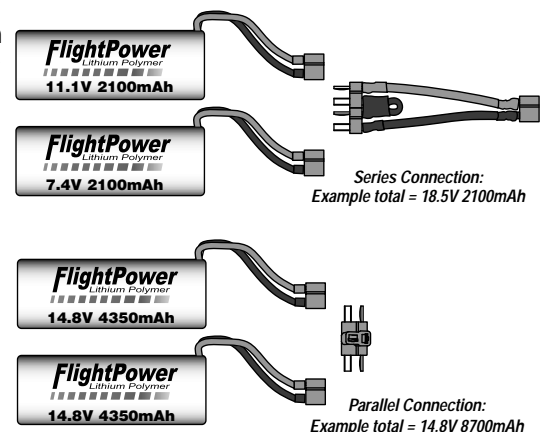
- To provide information that can help you actively avoid a dangerous charging situation.
- To provide some standard precautions to limit loss or injury in case a fire results anyway.

### SOME LITHIUM POLYMER JARGON EXPLAINED:

- LiPo battery packs are typically identified by the pack voltage and capacity. An 11.1V 2100mAh LiPo battery has a total NOMINAL voltage of 11.1 volts and has a current capacity of 2100 milliamp-hours, or 2.1 amp-hours.
- LiPo batteries are made up of individual LiPo cells that are connected together in SERIES inside the battery. Connecting them in series adds the voltage of each cell to total the battery pack voltage. In the example above, the 11.1V 2100mAh is made up of three 3.7V 2100mAh LiPo cells ( $3 \times 3.7V = 11.1V$ ). This is referred to as a "3s" pack, meaning three cells in series. A "4s" pack would have a total pack voltage of 14.8V ( $4 \times 3.7V = 14.8V$ ).
- Each LiPo cell has a NOMINAL voltage of 3.7V. This voltage is an average, partially charged state voltage that the industry uses to designate LiPo batteries. A fully charged LiPo cell is 4.2V, and a fully depleted LiPo cell is 3.0V. Most LiPo chargers and balancing equipment are set up for charging using a battery's nominal voltage rating as a parameter.
- The battery capacity is typically labeled in mAh (milliamp-hours). Although this value is a technical description for the amount of current that the battery can deliver over a certain time period, the actual labeled capacity is more useful in the R/C industry as a relative comparison to other size batteries. The greater the capacity, the longer the flight time you will have.
- In addition to defining the "size" of the battery, this value will also govern the maximum current the battery can deliver at any given moment as well as the maximum charge rate for the battery. The "C" value of a battery is simply a multiplier that is based on the amp-hour capacity of the battery. As an example, a 2100mAh LiPo battery has a C value of 2.1. A 640mAh LiPo battery has a C value of 0.64, and so on. In addition to capacity and voltage, LiPo batteries are also labeled by their maximum discharge capability using the C value. A battery labeled as 25C can deliver a maximum current of 25 times the C value of the battery. As an example, a 2100mAh battery with a 25C discharge rating can deliver a maximum current of 52.5A ( $25 \times C = 25 \times 2.1 = 52.5A$ ).
- LiPo batteries should never be charged at a current rate greater than 1C. As an example, a 2100mAh battery should have a maximum charge rate of 2.1A ( $1 \times C = 1 \times 2.1 = 2.1A$ ). Charging a LiPo battery at a rate greater than 1C will reduce the overall lifespan of the battery. **Note:** *The FlightPower EON-X Lite and FlightPower EON-X 30 packs may be fast charged at a maximum of 3C and 5C respectively in conjunction with a cell balancer with cut-off function. Please see product labels for details of maximum fast charge conditions. Although these batteries are capable of higher charge currents, doing so will reduce the overall lifespan of the battery and is recommended to charge the batteries at a rate of 1C or less to maximize useful life.*
- LiPo battery packs can also be combined in series to increase the total voltage or combined in PARALLEL to increase the total capacity, resulting in an increase in maximum current delivery and flight time. Combining batteries in parallel adds the capacity of each pack together while the voltage remains the same. Following our examples, two 11.1V 2100mAh packs combined in parallel will have a total capacity of 4200mAh; however, the combined packs will still only have a voltage of 11.1V. Since the capacity has doubled, the C value is increased to 4.2. Series and parallel connector leads are available for purchase from your hobby supplier. Only battery packs with the **same capacity** should ever be connected in series or parallel! Only battery packs with the **same capacity and voltage** should be connected in parallel. Battery packs with the **same capacity and different voltage** can be connected in series.
- LiPo batteries should only be charged to 4.2V per cell. A battery with a nominal voltage of 11.1V will have a voltage of 12.6V ( $3 \times 4.2V$ ) when fully charged. LiPo chargers that charge using the constant current/constant voltage method will terminate charge when the pack voltage reaches 4.2V/cell. See your charger manual for details about this process. Attempting to charge LiPo batteries higher than 4.2V/cell will create an over-charge condition that could cause heat, rupturing, or fire!
- LiPo batteries should never be discharged below 3.0V/cell. Discharging a LiPo battery below 3.0V/cell could cause permanent damage to the battery or make the battery non-recognizable by your charger. Most LiPo compatible speed controllers are designed with an internal low-voltage cutoff that safely shuts down the system when the battery voltage reaches this point. See your ESC manual for details.

# FlightPower™

Lithium Polymer



## LITHIUM POLYMER DO'S:

- Do always use a correctly specified Lithium Polymer charger [mandatory].
- Do always use a cell balancer.
- Do always double-check that your multi-function charger is set in LiPo mode [extremely important].
- Do ensure that your charger has a clean power supply, such as a car battery that is not itself on charge.
- Do always set the charger to the total series cell count "s" of your pack.
- Do read the battery label to confirm the cell count for charging shown e.g. "charge as 3 cell".
- Do handle and transport carefully to avoid piercing, deformation or short circuit with other objects.
- Do disconnect batteries fully from ESCs with BEC to prevent slow over-discharge.
- Do ensure connectors are insulated correctly to prevent short circuit in handling or storage.
- Do always check that batteries are physically and electrically undamaged before charge or discharge.

## LITHIUM POLYMER DON'TS:

- Don't ever allow charging to continue above 4.20V per "s" series cell [definition of overcharging].
- Don't set the charge current limit above 1C unless you have special equipment available and supervise the process fully. 1C = 3.2Amps for a 3200mAh pack, 0.83Amps for an 830mAh pack and so on. Choose an available charger setting at or below the 1C value for your pack.
- Don't permit your pack to be discharged below 3.0V per cell. (Hint: Use monitoring and timing or a Lithium-safe ESC, land immediately in case of noticeable power drop, over-discharge = overheating/damage.)
- Don't expose batteries to intense heat or prolonged exposure to elevated temperature.
- Don't charge any pack containing one or more damaged or swollen cell.
- Don't continue charging if any part of the pack is getting warm (LiPo packs should charge cool).
- Don't charge any pack that is under voltage after recovery (under 3.0V per series cell).
- Don't charge batteries unattended. Always remain alert and monitor the charging process.

## TO LIMIT THE CONSEQUENCES OF A POTENTIAL FIRE HAZARD:

Charge in an isolated area away from flammables and valuables and avoid charging batteries in the model. If you decide to charge in the vicinity of other property, equip your charging location with a dry extinguisher or fire blanket. Never charge in a moving vehicle where the dangers of fire and smoke can be compounded by the risk of a road accident. If the battery is crashed in a model, or gets warm during charging place the battery in an open space for observation, never directly into a vehicle, clubhouse, garage or home. If at any time you observe a cell or pack that has started to balloon or swell up, place in a safe area, for observation. If swelling occurs while charging, disconnect immediately and place in a safe place for observation. If the wire leads accidentally short out place battery in a safe place and observe for 15 minutes. If you determine that the battery should be disposed of, discharge it slowly to dead flat before throwing away or recycling so it does not present a short-circuit danger to the waste disposal system. Use a light bulb or immerse in salt water to discharge slowly.

## TERMS OF USE:

The purpose of this document is to warn you of the safety considerations surrounding batteries of this type so that you are better informed when making decisions and taking precautions concerning their use. These batteries are intended for RC flight only. No other use is approved. Because RC modeling invariably requires decisions about preparation and deployment that pass beyond our control (and that of our retailers or agents), your decision to use FlightPower product incorporates your agreement that you have read and understood the safety precautions printed here and on each battery pack, and that you agree to accept full responsibility for any injury, loss or damage resulting from all circumstances surrounding your use or misuse of this product. You are also responsible for inspecting and detecting any signs of damage or defect before and after flight and prior to charging and to discontinue use immediately if any such issue arises. If you do not agree to these terms of use, you are under no obligation to proceed; instead you may contact Hobby Services ([www.hobbyservices.com](http://www.hobbyservices.com) or (217) 398-0007) to arrange for the return of this product to us in its original condition for a full refund.

Product warranty is strictly limited to 3 months from the date of purchase and covers original defects in material and build; it does not cover collateral damage, misuse, abuse, incorrect charging and discharging, modified product and all other unapproved use. Your statutory rights are unaffected.

Issue 8 Revised 20/04/09

Autography Flight Technology Ltd.

Hobby Services, 3002 N. Apollo Dr, Suite 1, Champaign, IL 61822 [[hobbyservices@hobbyservices.com](mailto:hobbyservices@hobbyservices.com)]