



# LITHIUM-POLYMER BATTERY INSTRUCTIONS



DTXC2005



**IMPORTANT!! Great care should be observed when handling lithium-polymer (LiPo) batteries as they are entirely different than NiCd or NiMH batteries!!**

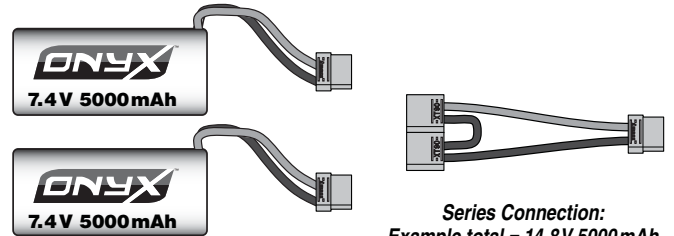
**Read all included instructions to ensure the proper operation, and avoid all possible causes of failure!**

These batteries are intended for use with radio controlled models only. R/C applications vary too greatly to cover every possible use in these instructions. The user must accept the responsibility to make smart and safe decisions about their desired application to avoid possible abuse and misuse. Non-R/C uses are not intended nor approved.

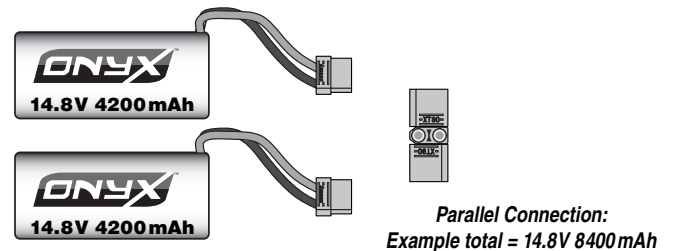
By purchasing this product you agree that you have read and understood the safety precautions printed here and on each product, and agree to bear full responsibility for any injury, loss or damage resulting from all circumstances surrounding your use or misuse of this product. You agree not to hold DuraTrax, its distributors (owners and employees) and/or retailers responsible for any accidents, injury to persons, or property damage. You accept the responsibility for inspecting and detecting any signs of damage or defect before and after use and prior to charging and to discontinue use immediately if any such issue arises. If you do not agree to these terms of use, return the item in its original condition to the place of purchase.

**CAPACITY:** A way to rate a battery's maximum energy *storage limit*, typically listed in "mAh" (milliamp-hours) and being the amount of energy the battery can deliver constantly over a period of one hour. Capacity rating is typically a way to gauge how much run time a battery can provide. The greater the rated capacity, the longer the run time.

**C-RATING:** A multiple of the battery's capacity rating, calculated as the battery's rated milliamp-hours (mAh) divided by 1000. C-ratings are used to establish various limits for a LiPo battery, such as a battery's maximum charge and discharge current values. A battery rated at 2100mAh (1C = 2.1A) with a maximum charge rating of 3C could be charged at (2.1A x 3) 6.3 amps. A battery rated at 3200mAh with a maximum discharge rating of "25C" should be able to deliver (3.2A x 25) 80 amps of current during discharge.



**SERIES PACK CONFIGURATIONS "S":** Electrically connecting multiple cells *end-to-end* places cells in "series", with the resulting total pack voltage being the SUM of all cell voltages. Connecting packs in series is usually done to deliver more power (torque and/or speed) to the motor. A 3-series LiPo pack (3S) would have a total nominal voltage of (3 x 3.7V) 11.1V. A 4S pack has a total nominal voltage of (4 x 3.7V) 14.8V, etc. Connecting two 7.4V batteries in series will result in an overall voltage of 14.8V. Do not connect multiple packs together in series unless each has the same rated capacity (regardless of the rated voltage of each pack).



**PARALLEL PACK CONFIGURATIONS "P":** Electrically connecting multiple cells *side-by-side* places cells in "parallel", with the resulting total pack voltage being identical to the rated voltage of each individual battery (not the sum of all battery voltages). However, the resulting total CAPACITY is the sum of all battery capacities. Connecting two 14.8V 4200mAh packs in parallel would result in a total voltage of 14.8V (same as each pack), but the total capacity would be 8400 mAh (total of both pack capacities). Connecting packs in parallel is usually done to lengthen the run-time of the model. **Do not** connect packs of different voltage ratings together in parallel.

## POTENTIAL HAZARDS When Handling LiPo Batteries



**LiPo batteries can be damaged and CATCH FIRE if overcharged, shorted, damaged physically, or over-discharged!**

- Over-charging, using an incompatible charger, or charging a battery that was *previously damaged* either physically or electrically can result in a catastrophic failure of the battery in the form of swelling, emission of smoke, and **FIRE**.
- Over-discharging a LiPo (to a voltage lower than its rated minimum voltage) can damage a LiPo internally – even without the damage being visible in any way. Yet, a catastrophic failure (FIRE) could occur when attempting to re-charge the battery later.
- LiPo failures are often a result of *human error*. Reading and understanding these instructions is **CRUCIAL** for avoiding problems, and to ensure personal safety and the protection of the surroundings.

## Glossary – Understanding Terms

**PACK:** Multiple battery cells connected together electronically form a pack.

**VOLTAGE:** A way to rate a battery's energy *potential*. Individual LiPo cells have a nominal voltage rating of 3.70V per cell, with a maximum charge voltage of 4.20V per cell. A pack marked "11.1V" has a nominal voltage rating of 11.1V, etc. The more cells wired in series, the higher the voltage. See page 2 for a listing of different size LiPo packs and voltages.

## Charging LiPo Batteries



**WARNING!! Charging LiPo batteries poses a risk of FIRE!** NEVER treat LiPo batteries in the same manner as other battery types. Misuse and overcharge can quickly result in LiPo cells swelling and/or getting hot which could lead to VIOLENT EXPLOSION, FIRE, PERSONAL INJURY, AND/OR PROPERTY DAMAGE! NEVER leave lithium batteries unattended while being charged! It's strongly recommended to have a Class "D" fire extinguisher nearby when charging a LiPo battery. Do NOT use water or fire extinguishers other than a "class D" to put out a burning LiPo battery. Failure to follow all care and handling instructions properly could result in quick, severe, permanent damage to the batteries and all surroundings!! ALWAYS make sure batteries are physically and electrically undamaged before charge or discharge.

**1. IMPORTANT! Choose an isolated, fireproof area to charge the battery. NEVER place the charger or battery on or near flammable or combustible objects during the charge process. Keep away from carpets, wood, paper, plastic, cluttered workbenches, etc. Do NOT charge batteries in the model, nor inside an automobile. Placing batteries inside an army surplus ammunition can, ceramic flower pot, or on a large concrete surface is recommended.**

2. Use a LiPo compatible charger that includes balancing capabilities, or use a LiPo compatible charger in conjunction with a separate LiPo balancer. NEVER use a NiCd or NiMH charger on LiPo batteries!

| Battery | Nominal Voltage | *Maximum Charge Voltage |
|---------|-----------------|-------------------------|
| 2S      | 7.4 V           | 8.4 V                   |
| 3S      | 11.1 V          | 12.6 V                  |
| 4S      | 14.8 V          | 16.8 V                  |
| 5S      | 18.5 V          | 21.0 V                  |
| 6S      | 22.2 V          | 25.2 V                  |

\* Recommended, based on 4.2 V per cell

3. Set the charger's output voltage to EXACTLY match the nominal rated voltage shown on the battery label.

4. Depending on the charger, set the charger's charge current or pack capacity to the appropriate level:

a. Some chargers require the setting of the actual charge current. It's recommended to charge Onyx LiPos at the 1C level as shown below. **WARNING: Make sure to heed all warnings listed in these instructions if charging at currents greater than 1C.**

b. Instead of entering the actual charge current value, some chargers require entering the rated capacity of the battery pack to be charged into the charger's programming, whereby the charger will then automatically set the charge current value.

| Rated Capacity | 1C Charge Current |
|----------------|-------------------|
| 4200 mAh       | 4.2 amps          |
| 5000 mAh       | 5.0 amps          |
| 5600 mAh       | 5.6 amps          |
| 5800 mAh       | 5.8 amps          |

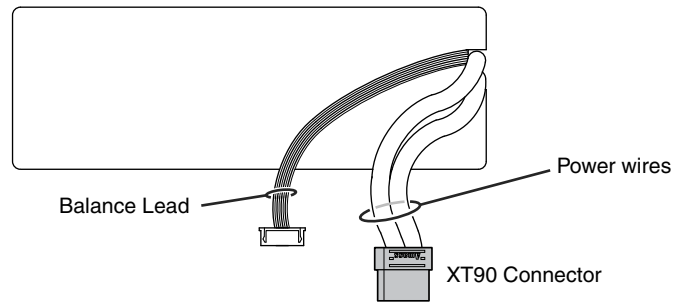


**WARNING!!** NEVER enter a capacity or voltage value into the charger that is higher than the value specified for the battery! Failure to follow this warning can cause permanent damage to the battery, charger, and the surroundings as a result of FIRE, and cause personal injury!!!

5. If possible, as another extra safety measure, use a charger that also includes a temperature monitoring function that can stop charge if the battery exceeds a specified temperature. Set the charger's maximum temperature to 115°F (46°C).

6. Connect the battery's main lead and balancing lead to the charger as described in the charger's instructions. ALWAYS connect a charge adapter lead to the charger BEFORE connecting the battery to the charger.

## ONYX 2S-4S Hardwired LiPo Packs



**2S-4S Hardwired LiPo Packs:** For charging 2S-4S hardwired LiPo batteries, the balance lead will need to be connected to the proper balance adapter and the power wires will need to be connected to the charger. It is imperative that the proper balance adapter is chosen for charging.

7. **NEVER** leave the room where the battery is until charge has finished.



**IMPORTANT:** NEVER allow a battery's positive and negative leads to accidentally touch each other as a short-circuit condition will result and permanently damage the battery and/or charger. Disconnect the battery and remove input power from the charger immediately if the battery begins to swell or becomes hot!! Be sure to wear protective gloves when moving the battery in case it has become hot.

### IMPORTANT WARNINGS FOR CHARGING LIPO BATTERIES:

- NEVER allow a LiPo cell to exceed 4.20V maximum at any time.
- NEVER allow LiPo cells to exceed 140°F (60°C) during charge, as they can and USUALLY WILL become damaged and possibly catch FIRE!!
- NEVER allow a LiPo to continue charging if the battery begins to swell or smoke begins to emit from the pack, as this is an indication the pack is damaged and a catastrophic failure could occur soon. Disconnect the battery and leave it in a safe, fireproof location for approximately 1 hour.
- NEVER allow a LiPo to continue with the charge process if the charger fails to recognize full charge. Disconnect the battery immediately, as pack failure could result.
- NEVER attempt to charge a battery that has previously overheated, discharged below 2.50V, or which has been damaged in any other way. Dispose of the battery.
- LiPo cells should be charged about once per year at a minimum to prevent over-discharge.
- LiPo batteries should be stored with about 30%-50% of capacity.
- ALWAYS keep out of reach of children.

## Discharging LiPo Batteries



**WARNING!!** NEVER allow Onyx LiPo cells to discharge below 2.5V per cell as permanent cell damage could result. This can also result in some chargers not recognizing the battery upon recharge, preventing the battery from being charged again. ALWAYS make sure batteries are physically and electrically undamaged before charge or discharge.

### 1. When powering an ESC:

- Do NOT use an ESC unless it's LiPo compatible.
- Follow the ESC's instructions carefully to set the proper low voltage cutoff point for the battery. As an extra measure of safety and to maximize the lifespan of the Onyx battery, it's recommended to not allow the battery to discharge below 3.2V per cell.
- ALWAYS disconnect LiPo batteries completely from electronic speed controls when not in use to prevent accidental over-discharge.

### 2. When using a battery discharger:

- Choose an isolated, fire-proof area to discharge the battery as explained on page 2.
- Choose a LiPo compatible discharger which has balancing capabilities. Or, use a LiPo compatible discharger in conjunction with a separate LiPo balancer.
- Set the discharge cutoff voltage to 3.2V per cell for Onyx LiPo batteries. NEVER discharge a LiPo to 2.5V or below at any time as permanent failure will result.
- Set the discharger's output current to an appropriate value for the battery.
- Connect the battery's main lead and balancing lead to the discharger as described in the discharger's instructions. ALWAYS connect a charge adapter lead to the charger BEFORE connecting the battery to the charger.
- If possible, as another extra safety measure, use a discharger that also includes a temperature monitoring function that can stop charge if the battery exceeds a specified temperature. Set the discharger's maximum temperature to 115°F (46°C).
- NEVER leave the room where the battery is being discharged.

| Battery | Nominal Voltage | *Minimum Discharge Voltage |
|---------|-----------------|----------------------------|
| 2S      | 7.4 V           | 6.4 V                      |
| 3S      | 11.1 V          | 9.6 V                      |
| 4S      | 14.8 V          | 12.8 V                     |
| 5S      | 18.5 V          | 16.0 V                     |
| 6S      | 22.2 V          | 19.2 V                     |

\* Recommended, based on 3.2 V per cell



**WARNING!!** NEVER enter a discharge cutoff voltage value into the discharger or ESC that is lower than the value specified for the battery! Failure to follow this warning can cause permanent damage to the battery and might result in a FIRE when attempting to recharge the battery afterwards!!! Do not discharge LiPo batteries at currents that exceed the maximum rating of the pack, as overheating could occur. Do not allow a LiPo to exceed 140°F (60°C) during discharge.

## Batteries Involved in a Crash

Carefully inspect a LiPo battery which has been involved in a crash to determine that no physical damage has occurred. Look for even the smallest of cracks, splits, punctures, or damage to the wiring

and connectors. Failure to do so could result in a battery failing at some point afterward, resulting in a total loss of power in the battery or even a FIRE. It's possible that sometime after removing it from a crash a LiPo battery might begin to smolder, emit smoke and catch fire even after 30 minutes or an hour. Remove the LiPo battery from the crashed model but DO NOT immediately place it in a model, full size automobile, pocket, pit bag, etc. Place the battery in a fireproof location instead, for up to 24 hours if possible, and observe it for safety reasons.

**CAUTION:** Cells may be hot! Refer to the following section for important handling and first aid instructions.

## Handling & First Aid Instructions



- 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 assembler should assemble or modify LiPo battery packs.
- NEVER allow LiPo cells to become punctured, especially by metallic objects such as screwdrivers, T-pins, or hobby knives.
- 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 an absorbent material 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.
- LiPo 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). Allow batteries to cool before proceeding with disposal instructions.

## Storage and Transportation

- For long term storage it is recommended to charge the cells fully, then discharge them to 50-60% of their capacity.
- Store batteries at room temperature in a cool or shaded area, ideally between 40-80°F.
- 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.

- Transport LiPo batteries in a fireproof container. NEVER leave batteries lying loosely anywhere in the car (in the trunk, backseat, floor, etc.). 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.
- 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.

## Disposal of LiPo Batteries

### 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. For example, a battery rated at 1200mAh has a "C/10" rating of 0.12 amps, or 120mAh....

calculated as  $[(1200 \text{ divided by } 1000) \text{ divided by } 10] = 0.12\text{A}$ . As an alternative, a battery can also be discharged 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.
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.

See <http://www.duratrax.com/techsupport/index.html> for the latest warranty and support information.

### Hobby Services

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