

## LiPo Battery Connections, Modifications And Hookup Options

LiPo batteries don't have any kind of standard connector. With more than 16 different types of incompatible connectors, this can become very messy. Let's look at some strategies and tactics to minimize the number of different connectors. Of course if you don't care, you should invest in one of the several "universal" charging cables available from R/C online suppliers.

The one pictured is from a company called Padrasey. It is available from Amazon for about \$16. Search Amazon using this phrase: Padrasey RC Lipo Battery Charger Adapter Connector Splitter Wire.



Padrasey  
16-1 Splitter

**Purchase batteries from the same supplier.** In most cases, the connectors will be the same. If you buy from different vendors, the chances are high the connectors will not be the same.

**Below are some of the more popular power output connectors used on LiPo battery packs.** Learning the names of common connectors helps when shopping. You can quickly verify the type of connector and if it's the one you want. Most battery suppliers offer matching connectors so be sure and get some. They can also be purchased from numerous suppliers found on Amazon.



Standard Tamiya



XT-60

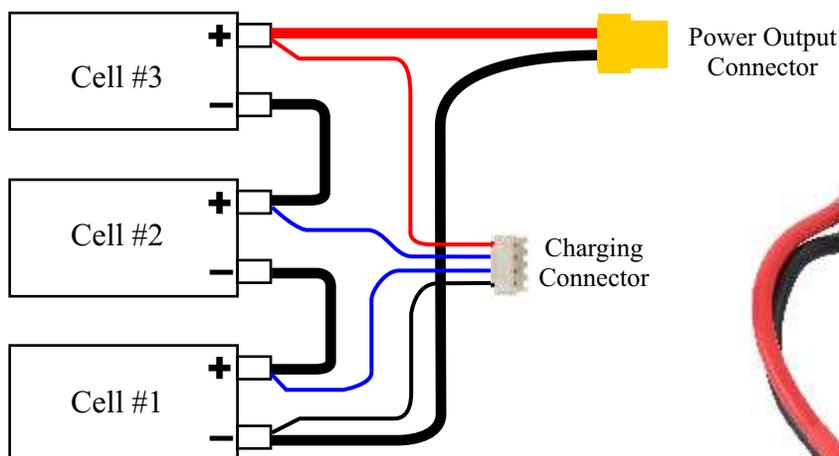


Deans

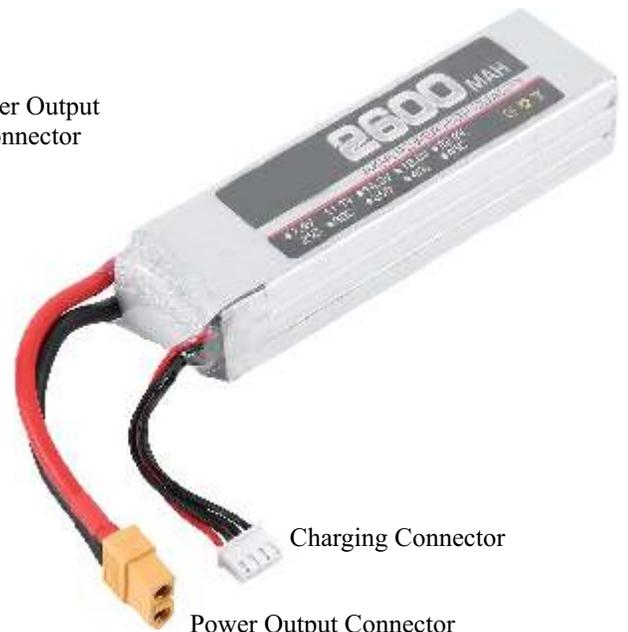


EC3

**Why are there two connectors on a LiPo battery and what do they do?** The heavy duty connector with two wires attached is the primary power output connector. The LiPo battery was designed for the high current demands of drones, planes, cars and boats. This is the reason why the primary power connector has large wire and a relatively large connector. The other smaller connector has several wires. This is the "balance charging connector" used to charge the LiPo battery. The charging connector uses much smaller wire since charging currents are much lower. The pictures below show the LiPo battery and how the connectors are wired. The connections provide for different options to make connections to AirWire components and charge the battery..



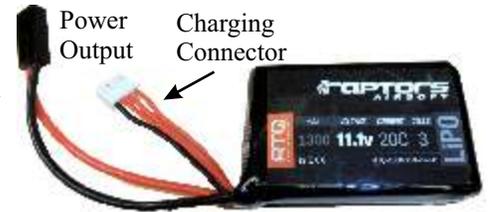
There is no internal protection circuit in a standard LiPo battery pack.



Power Output Connector

**Which LiPo connector is used for AirWire?** If you have the space, get a matching connector and use the power output connector. The disadvantage of this approach is the space taken up by the bulky wire and connector.

**For charging a LiPo battery,** the smaller multi-pin connector is used. As shown on the previous page, there is a connection to each battery in a pack. This allows the charger to monitor individual cells and charge each one up independently of the others. This is called balanced charging and allows each cell to be charged to its peak value. However, this connector is not small or easily lengthened or changed. Instead, the battery is typically removed and plugged into the charger. This may be OK for a boxcar or flatcar type load but not if the battery is embedded into a narrow hood diesel.



Factory Wired LiPo

**Battery modifications might void the warranty.** Beware of the Battery Warranty! Before modifying the battery pack, verify that it actually works and can be charged. It is very likely that modifying the pack in any way will void any factory warranty. Removing any of the factory supplied connectors is considered modifying the pack

**Splicing a smaller connector** onto the original power output connector saves space. To do so requires cutting off one wire at a time from the power output connector and then splicing on the appropriate wire from the new connector. Cover the splice with heatshrink tubing. Do only one wire at a time to avoid accidental shorting of the battery wires. The image to the right shows the CVP standard JST-PLUG connector spliced onto the LiPo power output wires. The charging plug is retained for connection to the balance charger. It is tucked out of the way when not needed. The JST-PLUG is the same type as found on our large scale batteries. Connector type and connector phasing consistency is the secret to trouble-free charging and battery swapping.



JST-Plug Replaces Original Connector

**Even smaller connectors can be used** since a small scale locomotive does not demand high current; certainly far less than a drone or large scale locomotive. Because of this a much smaller connector can be spliced onto the battery. Look at the previous page and the wiring diagram for the battery. Notice the two outside wires of the charging connector connect to the same location as the primary output connector. Therefore, it is OK to use the two outside wires of the charging connector as the primary power output. And the same two wires can be used as the charger input too.



Using Charger Connector Wires To Connect To JST 2.0 Connector

For this example, all of the connectors will be removed. Unused wires will be cut short and covered with either heatshrink tubing or electrical tape. The picture shows the two unused charging wires covered by orange Kapton tape. However any kind of good electrical tape can be used. Just make sure the tape doesn't come off. Notice the two cut wires are of different lengths to help insure they don't touch and short out.



Male



Female

## Correct Names, Colors, and Phasing For AirWire JST PH2.0mm Connectors

## Using The Charging Connector

Make the modification to one wire at a time. This prevents accidental short circuits. For this example, the JST PH-2.0mm series female connector will be used as the power output connector. This connector was used since it matches our 3.7V Li-Ion battery pack.

The first step is to remove the original power output connector. Next shorten the two original power output wires and cover them with heatshrink tubing. Do one wire at a time to prevent accidental short circuits.

*Tip: While the heatshrink is still hot, pinch the end together. This provides further protection for the end of the wire. The picture shows two different colors of tubing were used.*

The next step is to cut the outside red wire from the original charge connector. Next, splice the red wire onto the red wire from the new connector. Insulate the splice with heatshrink tubing.

Next step is to cut the outside black wire from the original charge connector. Splice the black wire onto the black wire of the new connector. Insulate the splice with heatshrink tubing.

The remaining charging connectors can be cut off and the connector discarded. As the picture at the top of the page shows, tape the unused wires down and cover the ends with tape.

## Charging the Modified Battery Pack

The recommended Tenenergy smart Lithium-Ion charger (TLP4000) will charge the battery pack to the proper voltage and then shut off. The red charging light will turn green. This charger automatically detects and sets for the correct battery pack voltage. It can charge 3.7V, 7.4V, 11.1V and 14.8V battery packs. The price is about \$20. Consider getting more than one so multiple batteries can be recharged at the same time.

Notice this charger has a simple pair of alligator clips for making connections. If you have standardized on a specific type of connector, cut off the alligator clips and splice the wires onto the desired connector. The figure shows the JST PH2.0 series male connector. The red wire of the connector attaches to the red wire from the charger.

## Beware of Connector Phasing

All of the various connectors discussed in this app note can be purchased from local R/C shops or the numerous online suppliers. However, you must be very careful to check for proper phasing of the connectors. Phasing is nothing more than which color hooks to which pin of the connector. Most of the low cost connectors use the opposite phasing compared to AirWire. If you are not aware of this you can accidentally apply reverse polarity to an AirWire decoder or CONVRTR which will either damage or destroy it. Use the drawing on page 2 double check before you buy. But if you can't locate



Finished LiPo battery pack with charging connector and power connector removed. Unused wires have been shortened. The power output wires are covered by heatshrink tubing. The two unused charging wires were covered the orange Kapton tape and stuck to the bottom of the battery.



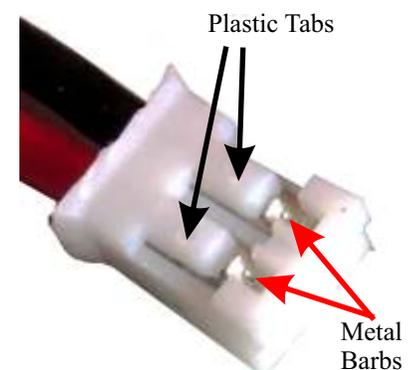
Charging wires connected to JST PH2.0 female connector. Splices are covered with heatshrink tubing.



Tenergy TLP4000 Charger



JST PH2 Male Connector



Swapping Pins

properly phased connectors, the pins can be easily swapped. No special tools are needed.

Turn the connector so the two slots are face up. Look closely and note the plastic tab (black arrows) and the pin's metal barb (red arrows) preventing the pin from being pulled out. holding the pin. Use the point of an X-acto blade and push down the barb and lift up the plastic tab to release the pin. Before putting the pin back into the socket, raise the metal tab to insure it engages the plastic tab. After insertion, pull on the wire to verify it can't be pulled out.

### **Verify Polarity**

One guaranteed way to destroy an AirWire decoder or CONVRTR is to connect the battery power backwards. Incorrect polarity is never a good idea even if it is just for a fraction of a second. Connector wire colors must be consistent. Always use the color we recommend.

Red is the standard color for positive polarity. Positive polarity is indicated with the plus symbol: +

Black is the standard color for negative polarity. Negative polarity is indicated with the minus symbol: -

Use a test meter to check polarity. Verify the two probes are in the correct position. The red probe must be in the positive or plus labeled jack. The black probe must be in the minus labeled jack. Touch the black probe to battery minus. Touch the red probe to battery plus. The meter will show the measured positive voltage without any polarity sign. If the probes are reversed, the minus sign will proceed the measured negative voltage.

### **Sources For Items Mentioned In This Appnote**

As of the revision date of this appnote, these are online sources when some of the items mentioned in this appnote can be found. If the link no longer works, use the words in a search engine. There will usually be an exact match in the search engine results. Don't forget that some of the larger batteries and matching connectors can be found at local stores specializing in radio-control drones, airplanes, helicopters, boats, and cars.

<b><u>Vendor</u></b>	<b><u>Cat #</u></b>	<b><u>Description</u></b>	<b><u>CVP Phase Match</u></b>
AdaFruit	261	JST PH 2-Pin Cable - Female Connector 100mm	Yes
AdaFruit	3814	JST PH 2-Pin Cable – Male Connector 200mm	Yes
AdaFruit	1131	JST-PH Extension Cable 500mm Male-Female	Yes
CVP	JST-SKT	Female Socket 2.54mm with 18 inches wire	Yes
CVP	JST-PLUG	Male Plug 2.54mm with 18 inches wire	Yes

### **Vendor Links**

AdaFruit	<a href="https://www.adafruit.com">https://www.adafruit.com</a>
CVP Products	<a href="https://www.cvpusa.com/airwire_accessory.php">https://www.cvpusa.com/airwire_accessory.php</a>

### **Companion AppNotes From The AirWire Document Center**

[http://www.cvpusa.com/doc\\_center/Battery\\_Oper\\_In\\_Small\\_Scales.pdf](http://www.cvpusa.com/doc_center/Battery_Oper_In_Small_Scales.pdf)

Batteries for HO Locomotive Operation

Useful Soldering Tools, Tips and Information

Flow Chart Of Tasks When Considering Battery Power