Approaching the Final Frontier

Near Space

Adapting Cell Phone Battery Cells for Near Space Use

Due to the extreme cold of near space (NS), hobbyists must be careful when selecting power sources for their NS craft. On one or two occasions, I have lost track of a NS craft, apparently due to cold batteries. To reduce this risk, most of us involved in amateur NS use lithium cells, which can be rated to -60° F.

My source of these cells is S & G Photographics or Fair Radio Sales. These cells come from surplus military battery packs. Each package contains either five or 10 cells that are either D cells or a slightly shortened version thereof. The only risk I face using these surplus cells is that they are 10 years beyond their expiration date. Since the cells are based on a lithium sulfate chemistry, they self-discharge very slowly and still retain most of their original capacity, but — every once in a while — I'll find a bad cell.

If I discover a bad cell before I assemble the battery pack, that's fine. It's the possibility of discovering a bad cell during a mission that has me worried, so I've kept my eye open for an alternative. One alternative is using rechargeable cells that aren't sensitive to cold temperatures. NSTAR's Mark Conner has had success with NiHM cells, for example. However, I hesitate to use NiCds and NiMHs because of their memory effect.

Recently, hobbyists have been able to purchase cell phone batteries through surplus electronics dealers. These batteries use a lithium-ion chemistry, so they're reasonably energy dense (high capacity for their size and weight) and rechargeable. Batteries this good are usually expensive (just wait until you have to replace your cell phone battery), but now that they can be purchased surplus, their cost has become very reasonable.

I purchased several 7.2 V 1,200 mAH batteries from All Electronics for $6.50 each (part number LBAT-35) and the charger for $4.50 (part number BC-9). Being lithium-ion batteries, they don't suffer from the memory effect found in NiCds and they are less susceptible to failure due to cold temperatures. On the negative side, however, is the fact that they are designed for cell phone battery compartments. The battery connector found in a cell phone is not very friendly for use in NS or robotics projects.

In this month's column, I'll describe how you can adapt these inexpensive batteries for your projects. The modification is simple and — when you're done — you'll have a great rechargeable battery to use in your robotic or NS projects.

Figure 1. The cell phone battery in its native state.

Battery Mod

The cells for this battery are sealed in a hard plastic case. Two "springy" metal pins in the cell phone battery case make contact with the metal tabs molded into the battery case. Since I couldn't find a battery holder for cell phone batteries at my local RadioShack, I decided to modify the electrical connection to the battery to suit my needs. Figure 1 shows what the battery looked like before the modification. The cap covering the battery's tabs prevents short circuits when carrying a charged battery in your pocket.

Materials

- Two lengths of 12 gauge, stranded wire (use red and black)
  Note: I used the silicon rubber insulated wire available at R/C car stores
- 2" diameter heat shrink tubing and heat gun
- Two connectors suitable for your projects *Note:* I used a pair of Anderson Power Pole connectors
- Solder and soldering iron
- Wire cutters and strippers
- Electrician's tape
- Masking tape

Procedure

First, a few words of warning. Do not charge your battery before making this modification. Also, watch that you do not accidentally short the battery while modifying it. The modification is safe, but you

need to watch what you are doing.

This modification involves soldering two #12 AWG gauge wires to the battery's tabs and then covering the exposed connection with tape and heat shrink.

So, begin by firing up your soldering iron. After it warms up, apply a thin coat of solder to the entire exposed surface of the electrical contacts of the lithium-ion battery. Do this quickly, as you don't want to heat the metal contacts any longer than necessary. The battery chemistry may not respond favorably to high heat and you certainly do not want to melt the plastic case. I found that the gold-colored contacts soldered very easily.

Cut a red and a black wire to the same length. These wires will become the battery's new power cable, so select the power connectors you plan to use and crimp and/or solder them to one end of each wire. It's easier to terminate your wires now than later, when the battery is hanging from the other end. In my example, I cut my wires 4" long and crimped Anderson Power Poles on the ends.

Strip between 1/8" and 1/4" of insulation from the other ends of the two wires. Bend the ends of the exposed wires at right angles where the insulation ends and tin the exposed ends with solder. Watch out — the wires will stay hot for a while, so be careful when you handle them.

Look at the front of the battery and beneath the tinned electrical contacts. There, you'll see a small positive and a small negative mark imprinted on the plastic battery case. These represent the polarization of the electrical contacts. After determining the polarization of the tinned contacts, solder the wires onto the battery contact. Be sure you solder the red wire to the positive contact and the black wire to the negative contact.

To solder the wires to the battery, I recommend laying a 12 gauge wire on the front of the battery case with its tinned end touching a tinned battery contact. Wrap a strip of masking tape around the battery and wire to hold them together while you solder the wire to the battery contact. When soldering the wire to the contact, quickly apply a well-tinned soldering iron to the wire and battery contact. The solder in the tinned wire and battery contact will melt and fuse together. Remove the soldering iron as soon as the connection is made. Repeat the process on the other wire.

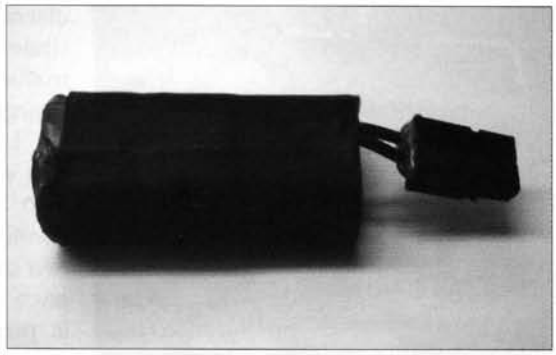

Figure 2. The modified lithium-ion cell phone battery. Now you can use these great and inexpensive batteries in your hobbies.

Once the solder has cooled, cut two pieces of electrician's tape and cover the exposed solder joints on the top of the battery. Cut the tape long enough to not only cover the top of the battery, but also to partially cover the sides of the battery. For good measure, wrap a strip of electrician's tape around the top of the battery and cover the ends of the first two strips.

Finish the battery modification by cutting a 2-1/2" length of 2" diameter heat shrink tubing. Slide the tubing over the battery and fully cover both the body of the battery and the ends of the electrician's tape that was used to cover the solder on the battery. Shrink the tubing down. When completed, your battery should look like the one in Figure 2. Repeat this modification for the rest of your cell phone batteries.

Charger Mod

Once a battery has been modified, it can no longer charge on its original charger, so let's modify that, too.

Materials

- Small Phillips screwdriver
- 22 gauge stranded wire (in red and black)
- 3/16" heat shrink tubing
- Power connectors to mate to the

Figure 3. This is what the inside of my charger looks like.

power connectors in the modified battery
- Wire cutters and strippers
- Solder and a soldering iron
- Heatsink clip or other small clamp

Procedure

It shouldn't be necessary to say this, but please make this modification while the charger's wall wart is disconnected from the charger base. Under no circumstances should you make this modification while the charger is plugged into the wall.

Look at the pocket of the charger. You will see two pairs of metal pins. Two metal pins make an electrical connection with the battery and the two other metal pins detect the presence of the battery. Unless a battery is pressed into the charger pocket, the charging pins are not pressed into contact with the charge circuit. In this way, there is no voltage present at the charging pins when the battery is not located in the pocket. It's been a while since I modified my charger, but this is how I made it.

The case of the charger is held together with two Phillips screws located in the bottom of the charger case. Remove these two screws and the case should pop open. The two bottom pins (the battery detecting pins) pull right through the holes in the case. The charging pins also pulled out of the case when I opened it.

Now, look inside the charger and identify the two pairs of leaf springs containing the two battery detecting pins and the two charging pins. The top leaf spring contains the battery detecting pins that protrude from the bottom two holes of the charger pocket. The bottom leaf spring is connected to the two charging pins that protrude from the top two holes of the charger pocket. Notice that the two leaf springs form the switch inside the plastic case that lets current flow into the cell phone battery when it is dropped into the charger pocket.

The first modification to make involves soldering the two leaf springs together so there's always power from the recharge circuit. Use a heatsink clamp and clamp the top and bottom leaves together on the side of the springs where the battery sensing

pins are closed to the leaf contacts (in my charger, this is on the left side of the leaves). Now, solder the leaves together (the leaves appear to be made of brass). After the solder cools, remove the heatsink clamp. The leaves will remain in contact if the soldered connection is good.

The next step is to connect wires and connectors to the charger that can interface with the modified cell phone battery. Cut two lengths of wire (red and black) about 8" long. For my charger, I used #22 AWG stranded wire. We can get by with thinner gauge wire on the charger unit than on the battery because the charger recharges the battery at a low current, whereas the battery may be discharged at a high current.

Crimp and/or solder the same type of connectors used in the battery mod to one end of both wires. Now strip about 1/4" of insulation from the other ends of each wire and tin them. Slide a short length of heat shrink tubing over the wires and push them away from the bare ends of the wires and close to the crimped connectors on the other end (you want to keep the heat shrink away from where you will be soldering). Thoroughly tin the battery charging pins.

If the front of the charger is pointed at you (the front of the charger has the two LED indicators), then the right charging pin is negative and the left charging pin is positive. You can verify this by looking at the charging circuit's PCB silk screening.

Pass the two #22 AWG gauge wires through the two charging pin holes in the pocket of the charger case. Be sure to pass the black wire through the right hole and the red wire through the left hole. Press one of the tinned ends of wire into contact with a tinned charging pin and heat both of them with a well-tinned soldering iron. Hold the wire in place until the solder cools. Repeat the same thing with the other pin. Once the solder cools, slide the heat shrink over the soldered connection and shrink.

Figure 4. With the case closed, the charger "almost" looks normal.

Now, you can close the charger case. Be sure a wire doesn't get pinched in the case.

I have used my new batteries twice on NS missions and, so far, I'm pleased with the results. **NV**