# Guide for Buddipole A123 Battery Packs

by Charles Preston KL7OA  Version 1.4  2012-06-01
http://www.charlespreston.net/batteryop/Guide-BP-Battery-Packs.pdf

Buddipole A123 battery packs are different from any other rechargeables you have used before. There are two chargers sold by Buddipole, the Cellpro 10XP (updated 10s) and the Cellpro Multi4, that automate most of the charging details to get the longest life and most stored energy from each battery pack.

The 10XP and Multi4 each have advantages in different situations.

**When to charge**
Any time.

Buddipole A123 batteries can be charged when they are 95% charged or 95% discharged. Unlike lead acid batteries, leaving A123 batteries discharged for a few days won't damage them.

**When to stop discharging a Buddipole A123 battery pack**

Recommended low voltage measured at the battery pack with a current load

| | |
|---|---|
| 4S2P or 4S1P at 1-2 A current load | 12.0 V |
| 4S2P or 4S1P at 20 A current load | 11.0 V |
| 3S1P at 1-2 A current load | 9.0 V |

These voltages can be measured at the battery pack with a Power Analyzer Pro (see photo on page 9) or similar device. When your transceiver is in receive mode, the same voltage will show on an FT-857D display as at the battery pack. But if your transceiver is key down at 100 W, the voltage on the transceiver display will be 1.1 V lower due to voltage drop in the factory-supplied power cable.

These voltages mean that about 90% of the battery pack energy has been used, and allow a margin for some cells being slightly lower voltage than others while discharging. Discharging below the recommended voltages may mean that the lowest voltage cell will drop below 2.0 V and damage the multi-cell battery pack, or shorten its life.

While these voltages may seem too high to set as a cutoff point, take a look at the discharge curves for A123 ANR26650M1-B cells, at A123 Systems or the chart at the Buddipole web site.

Unlike some other common battery chemistries or types, the A123 has a flat discharge curve. This means that the voltage doesn't drop very much until most of the stored power has been used, and then the voltage drops very rapidly. There is a only a short time (approximately 12 minutes at 2 A, or 1 minute at 20 A) between a 90% discharged condition and potential cell damage from over-discharge.

http://info.a123systems.com/data-sheet-26650-cylindrical-cell

http://www.buddipole.com/portablepower.html

Buddipole now has a Low Voltage Alarm with an adjustable low voltage point from 8 VDC to 12 VDC. This is very small and light, and has a flashing red LED and short tone to indicate when it has reached its setpoint.

**How long will my transceiver operate on a 4S2P battery pack?**

If you are buying a transceiver primarily to operate portable with a lightweight battery pack, you should know that not all transceivers operate equally efficiently on batteries. For example: one popular HF/VHF/UHF transceiver uses 8.5 A DC when set to transmit at 20 W, and another one uses 6.7 A. Efficiency and mode of operation will make a big difference in battery life.

| Transceiver | Mode | RF Power Out | Approximate Time |
|---|---|---|---|
| FT-857 | SSB - talk 2 min., listen 2 min | 100 W | 1.5 hours |
| FT-857 | CW - xmit 5 min., rcv 5 min. | 100 W | 0.5 hours |
| FT-857 | CW - xmit 5 min., rcv 5 min. | 20 W | 1 hour |
| FT-817ND | SSB - talk 2 min., listen 2 min | 5 W | 7.5 hours, no speech compression |

## Charging with the Multi4

Information for charging with the **10s** can be found at the link below.

http://www.charlespreston.net/batteryop/Charging-BP-10s.pdf

### Power source

10 Volts to 16 Volts DC, at least 5 Ampere rating

Examples
1. 12 V battery. If it is a lead acid battery, 12 Ah or larger is recommended.


2. 12 V (13.8VDC) power supply suitable for powering a 100 W transceiver. Examples include: Alnico DM-330MV; Astron RS-35A; or Samlex SEC-1235M. Because the charger comes with an Anderson PowerPole to banana plug short cable, and spring clamps, the power supply doesn't need to have Anderson PowerPoles installed.

3. The Revolectrix PS-12V5A-BJ power supply, with a 5 A rating, weighs 15 oz. and packs into a 6” x 5” x 3” space with cables, to charge from 100-240 VAC.
http://www.store.revolectrix.com/Products/Cellpro-Multi4


**The Multi4 mode switch.**

There is a small pushbutton switch on the right hand end of the Multi4. There are two ways you can push it.

*Press-release* ● quickly, for less than 1 second

*Hold* ▬ for more than 1 second before releasing.

*Press-release* ● is to show alternate menu choices that make sense depending on what stage of operation the charger is in.

Example

When the Multi4 is first powered up -

*Press-release* ● will step through the menu choices for the type of battery pack to charge. Keep going (about 25 menu choices) to get back to #1, Buddipole 2.3Ah Accurate charge .

*Hold* ▬ will pick the choice that is in the display.

*Hold* ▬ to answer yes and start charging the type of battery shown.

**Charging a Buddipole A123 battery pack with the Multi4**

Step 1. The Buddipole battery to be charged should **not** be connected to the charger.

Connect the Multi4 to the DC power source. It will start its power-up process, and in 3 seconds, it will be ready to use. If you last used it with the built-in recommended settings for a Buddipole battery pack , the display will look like the examples, below. It will alternate between


and


Step 2. At this point you should connect the battery pack. Plug the small, white, multi-wire connector into the matching connector labeled “Output” on the right hand end of the Multi4. It will only fit one way. It has a latch, and if it is in all the way you should hear a tiny click.

Step 3. In order to start charging, using the “2.3Ah Accurate” setting shown in the display -

*hold* the mode button in for at least one second.
The display will show


*Press-release* the mode button

The display will show

At this point you can press-release the mode button several times to see information about the charging process in several separate display screens.

Note: On the elapsed time screen it shows A123 FAST CHARGE. This is normal.
Ignore the value given for Start Fuel = XX%.
Cap = XXX mAh should be increasing as the charging process continues.

If you *hold* the button instead of *press-release* while the charger is still charging, it is programmed to ask if you want to stop charging with a question in the display.

Stop charging? No

If you **don't** want to stop charging, *hold* the button for 1 second, to select "No". The Multi4 will continue the already started charge cycle.

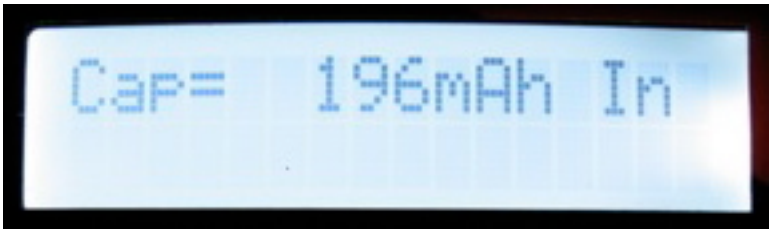
If you **do** want to stop charging, *press-release* to step to the next menu choice, and the display will now show

Stop charging? Yes

Hold the button to select yes.

After a few minutes to about 90 minutes, the charger will beep 3 times in a row to let you know it is done.


If you want to find out how much current had to be replaced to charge the battery pack, press-release the mode switch several times, until you see the display screen below.



Once the battery pack is charged, and you disconnect it (remember, the connector has a latch on top to push down), an easy way to reset the Multi4 is to unplug it for several seconds from its power source and plug it back in.

### Charging a Buddipole A123 battery pack with the radio connected and working

The design engineer for the Multi4 and 10s chargers says there isn't a problem with the possible exception of the charger not being able to determine the correct end-of-charge point. I haven't tried this yet, so I can't recommend it.

### Charging with a solar panel

A Buddipole battery pack can be charged directly from a solar panel. The charge controller must be one made for lithium batteries.

Buddipole has a Solar Battery Charge Controller that will charge a Buddipole 4S1P, 4S2P, or 4S4P battery pack, as well as lead acid batteries. This is a very small and light controller, especially since it already has Powerpole connectors on each end, requiring no extra cables. This controller is less than half the size of the Genasun GV-5-Li (see below). It was tested in Anchorage, where solar panel output is often very low (5%-10% of rated output) due to overcast. The controller was used first to charge a BP 4S2P battery pack until the controller indicator LED was mainly green with brief flashing red, and charge current was 0.02 A. The battery pack was then connected to a Cellpro 10s, which showed 100% fuel level, and beeped to indicate end of charge in 1 minute or less, indicating a successful full charge from the solar charge controller. The folding solar panels were two PowerFilm F15-1200 units connected in parallel.

Or you may want to try a Genasun GV-4 Li 14.2 V MPPT controller. A maximum power point tracking controller (MPPT) is designed to adapt to changing light conditions and use its DC/DC converter to get more usable power from the solar panel at the voltage and current you need to recharge a particular type of battery. See the GV-5 Li 14.2 also, at the Genasun site. It is a later and somewhat more advanced model at a higher price.

http://www.genasun.com/gv-5.shtml

The GV-4 controller was tested with 2 PowerFilm F15-1200 folding solar panels connected in parallel. During the test, this controller could charge each battery pack, one at a time, at a maximum rate of 1.85 A (bright sun but not directly overhead). The charger finished charging at 14.2 VDC.

A Genasun GV-5 Li 14.2 V MPPT controller was used to finish charging two 4S2P battery packs, one at a time.(2011-05-21) The voltage at the finish was 14.23 VDC, as specified for this controller, and under the 14.4 V that would provide 3.6 V for each cell if

they were perfectly balanced. Since the GV-5 doesn't balance cell voltages while charging, 14.2 V provides very nearly 100% charge with a small safety margin for different cell charging voltages.

The charged cell voltages were all just under 3.6 VDC, the A123 specified fully charged voltage.
Cell 1 3.562
Cell 2 3.569
Cell 3 3.566
Cell 4 3.532

A spokesperson for Genasun says there is no problem connecting the solar panel **only** to the charge controller**,** and then connecting the output of the charge controller to the battery pack or to the battery pack and radio at the same time, even if the transmitter is in use. I haven't tried this yet, so I can't recommend it.

Battery pack balancing
Since solar panel charging through the main Powerpole connector doesn't balance the voltages cell voltages, balancing can be accomplished using a Blinky cell balancer circuit, with an adapter to connect it to the Buddipole 5 pin charging/balancing connector. Sources for the parts used for the adapter can be found in the link below.

http://www.charlespreston.net/batteryop/Cell-Balance-BP-4S2P.pdf

## How to tell the current state of charge

Unlike familiar lead acid batteries, the no-load voltage of a Buddipole A123 battery pack is not an accurate indicator of the percentage of charge.

Since Buddipole battery packs charge quickly, and the Multi4 and 10s and 10XP chargers won't overcharge them, start with a charged battery when possible.

The easiest way to know how much charge is left is to monitor how much has been used since it was fully charged. A Medusa Power Analyzer Pro or similar device will track the total cumulative Ah (Ampere hours ) used or Wh (Watt hours) used, until it is disconnected from the battery pack.


## Storage for more than a week

**Don't leave anything attached to your Buddipole battery pack for storage**, since even a small current drain will eventually completely discharge it below the damage point.

It is slightly better for the battery pack to store it 50% charged than to store it 100% charged, for weeks to months of storage. The Multi4 charger has a Buddipole A123 Storage Charge setting for that purpose. Once the battery is discharged below 50%, use *press-release* ● with the mode button to choose the Storage Charge setting instead of the 2.3Ah Accurate setting before charging.

**This guide is not a publication of Buddipole, Inc., and does not represent their views or opinions in any respect. The use of the Buddipole brand is to designate a specific type of battery pack sold only by Buddipole, Inc.**