

# Astro Flight #109 Lithium-Polymer Digital Charger/Discharger Software Version v2.0



We believe that the Astro 109 is one of the finest Lithium Polymer Digital **Charger/Dischargers** available on the market. We have been making quality products since 1972, right here in California, and continue making awesome items for the Radio Control enthusiast!!! With proper care and understanding, this Li-Po charger should give you many years of service and happiness. **Before using this product, please read and re-read these instructions carefully. Should you have any questions, please email us to our address on the last page.** The Astro Model 109 Lithium Charger is specially designed to charge and discharge Lithium Polymer battery packs. This charger can handle any pack containing from one cell up to nine cells in series (4.2 volts to 37.2 volts). Cell capacity can range from 140 mahr to 8000 mahr. Cells may be arranged in parallel to increase the battery pack capacity. For example a 3s4p pack of 2000 mahr cells will have a voltage of 12.6 volts but a capacity of 8000 mahr. **Caution!!! All cells in a single battery pack must be of the same capacity and in the same state of charge.** If you are not certain, please use a Battery Balancer like our Astro Blinky #106 to check your pack before charging.

The Model #109 Lithium charger uses a proprietary 8 bit microprocessor to perform all of the necessary mathematical computations required to insure foolproof charging and discharging Lithium Polymer battery packs. **A two line digital display indicates Charger type, Software version and source voltage, number of Cells in the Battery Pack that the Software has detected, charge mode, discharge mode, charging current, battery voltage, duration of the charge and the actual number of amp hours of charge delivered in the battery pack.** A built in voltage converter boosts the input from 12 volts to 40 volts so that battery packs containing one to nine cells can be charged. **This charger is designed to be powered from a 12 to 15 volt 150 watt regulated power source. We recommend using our Astro Model Power Supply #120 or**

**your 12 volt automobile battery. Never use an automotive type of battery charger as a power source. These are unregulated and could damage your new Model #109 Lithium Charger.**

There are two power cords on the #109 charger/discharger. The four foot long cord with the alligator clips is the **input cord** and should be connected to the 12 volt power source. The short cord is the **output cord** and is fitted with either an Astro Flight Connector or a Deans Ultra plug. The **output cord is** to be connected to the Lithium Polymer battery being charged or discharged. In our opinion these are the two best battery connectors on the market! We strongly urge you to consider using either Deans or Astro connectors. They are both polarized for positive and negative and input and output. They will prevent you from making costly mistakes. The charger has a current adjust knob on the front panel. Charging current can then be adjusted between fifty milliamps and eight amps. Discharging current is electronically limited to 1.25 amps.

### **Charging Your Battery Pack**

Connect your Astro 109 Lithium Polymer Charger to a source of 12 volts DC power. You can use a 12 to 15 volt regulated power supply like our Astro Model **120** or a **12 volt Automobile or Truck Battery. Do not use an unregulated source like an Auto Battery Charger.** When first connected to 12 volts the display should look like this for about 5 seconds:

**Astro Flight Inc  
Lithium V2.0**

Then the display will change to **“waiting for battery”** and will indicate the voltage of the power supply or 12 volt battery that is powering the charger. The display will remain as long as the 12 volt power is connected and should look like this:

**Waiting for Battery  
Source 12.6 Volts**

You may now connect the short output cord on the charger to the Lithium Polymer battery you wish to charge. If the battery voltage is 2 volts or more, the software in the charger will detect the presence of the Lithium battery and will determine the number of cells it assumes is in the pack based strictly on the voltage of the battery pack. **This cell count is locked in and will not change for the remainder of the charging sequence.** The cell count will be displayed for about five seconds. If you battery does not have the same number of cells as is being displayed **STOP!!! SOMETHING IS WRONG!!! Please refer to the “When Things Go Wrong” section of this document.** Your display should look like this for about 5 seconds:

**3 Cells Detected  
Charge**

After about five seconds, the charging sequence will begin and the display will look like this for a 3 cell battery pack:

**0.00A 3C1 10.00V  
00:00:15 0.00 AH**

The Display indicates the charging current, the cell count and charging mode, the battery voltage, the duration of the charge in hours, minutes and seconds and the Amp hours of charge delivered to the battery. The mode and cell count is shown in the middle of the top line, for example 1C1 for a 1 cell pack, 2C1 for a two cell pack, 3C1 for a 3 cell pack, and 4C1 for a four cell pack and so on. **Always start charging with the current adjust at zero amps and slowly increase the charging rate until the rate equals the capacity of the battery pack. We recommend charging Lithium Polymer batteries at a 1C rate (a rate equal to the mahr. rating of the cells).** For example, we

recommend charging a 1200 mahr pack at 1.2 amps. Notice and remember the voltage of the battery before increasing the amps. Then compare the voltage of the battery after setting the current to the 1C rate. A battery in good condition will show a very small increase in voltage usually less than 0.1 volt for a 3 cell pack. **If your battery voltage jumps up 0.5 to 1 volt, STOP!!! Something is wrong with your battery!!! Please refer to the “When things go wrong section of this document.** After three minutes the charger will switch to Mode 2 and beep once. During Mode 1 the charger will continue to charge your battery for three minutes regardless of the battery voltage. It acts like a dumb charger during this first phase. This is necessary in order to be able to charge packs that have been discharged to a very low voltage. For this reason it is not recommended that you charge a pack that is already full charged. If you do this your charger will charge for about 3 ½ minutes before turning off and you will slightly over charge your cells. If your pack voltage is over 4.15 volts per cell it is almost full, there is no need to charge it further. The resting voltage of lithium polymer cells is a very accurate indication of their state of charge. A cell voltage of 3.7 volts indicates that the cell is almost empty. A cell voltage of 4.0 volts indicates that the cell is a little more than half charged. A cell voltage of 4.2 volts indicates that the cell is fully charged.

**Warning! If your battery is already fully charged do not try over charge it.**

A fully charged single cell will have a voltage of 4.15 to 4.20 volts

A fully charged 2 cell pack will have a voltage of 8.30 to 8.40 volts.

A fully charged 3 cell pack will have a voltage of 12.45 to 12.60 volts.

A fully charged 4 cell pack will have a voltage of 16.60 to 16.80 volts.

A fully charged 5 cell pack will have a voltage of 20.75 to 21.00 volts.

A fully charged 6 cell pack will have a voltage of 24.90 to 25.20 volts.

A fully charged 7 cell pack will have a voltage of 29.05 to 29.40 volts

A fully charged 8 cell pack will have a voltage of 33.20 to 33.60 volts

A fully charged 9 cell pack will have a voltage of 37.35 to 37.80 volts.

**After Charging for 3 minutes in mode 1 the charger will beep once and enter into Mode 2.**

The display will show 1C2 for a 1 cell pack, 2C2 for a 2 cell pack, 3C2 for a 3 cell pack and so on. The display will look like this:

**1.20A 3C2 10.2V  
0:03:15 0.06AH**

During mode 2 the charging will continue until the battery voltage reaches 4.2 volts per cell. If you are charging a 1C rate and your battery was more or less empty at the start, mode 2 will take about 45 minutes. At the end of mode 2 the battery should be about 90% full and the Model 109 Lithium charger will then switch to Mode 3 to finish the charge cycle. The Charger will beep twice and the display will alternately look like this:

**1.20A 3C3 12.7V or 0.00A 3C3 12.5V  
0:48:25 1.10AH 0:48:30 1.11AH**

In Mode 3 the charging current is turned on and off periodically. You will notice that the battery voltage goes slightly above 4.2 volts per cell when the charging current is on and slightly below 4.2 volts per cell when the charging current is off. The micro processor slowly decreases the charging duty cycle as the resting cell voltage approaches 4.2 volts per cell. This charging sequence is depicted on the drawing on page 5. When the resting battery voltage reaches 4.2 volts per cell, the battery is declared charged and charging stops.

**After charging is complete,** the digital display will indicate that the battery charging is complete. The display will show the highest resting voltage reached and the number of milliamp hours of charge put into the battery.

**CHGR Done 12.60V**

## **How to Charge a Li-Po Battery that has been discharged so far that the Charger Detects a Lower Cell Count**

Always read the battery voltage when it is first connected to determine its state of charge. If the pack has been discharged too far, the cell voltage may be too low for a fast charge. We strongly recommend using a balancer like our Astro Blinky Battery Balancer #106 to check you pack before and during charge. If any cell is discharged below 3.2 volts, this will be detected by the circuit in the Blinky. If this happens, charge you pack at a low current of 0.1C for 10 minutes to see if the pack recovers and all cells are above 3.2 volts. Wait a few minutes to see if the voltage is stable and does not drop back down. **A pack that does not hold its voltage has a damaged cell and is not SAFE. It should be discarded.**

With battery packs of 4 cells or more, it is possible to get a low cell count detection even if each cell is above 3.2 volts. For example, a four cell pack with four cells at 3.2 volts will have a pack voltage of 12.8 volts. The 109 charger will think that this is a 3 cell pack. The 109 detects the fourth cell at 12.9 volts. To charge this pack, simply charge it normally as if it were a 3 cell pack. During the first three minutes of Mode 1, the pack voltage will rise above 12.9 volts. As soon as the charger enters model 2 it will think that the battery is over charged and will stop charging beep nine times and Display “Bt Vlt Hi”. Remove the battery and disconnect the 12 volt power. Reconnect 12 volt power and when you see “Waiting for Battery” reconnect your battery. The charger will display 4 cell detected and you can charge your pack normally. On a 5 cell pack a fully discharged pack may read as low as 16 volts. The 109 detects 5 cells at 17.2 volts. So you have to put in enough charge to reach 17.2 volts before 5 cells are detected. Again charge your battery as though it were a 5 cell pack. At the end of Mode 1 the voltage may not have reached 17.2 volts so the charger will continue to charge the pack until it reaches 16.8 volts. That is the voltage of a fully charged 4 cell pack. When the charger stops and says done, remove and replace the pack on the charger and charge a second time. This time the voltage should reach 17.2 volts within the first three minutes and the charger will stop and Display “Bt Vlt Hi”. Now you can charge normally because you pack is above 17.2 volts and the 109 charger will detect 5 cells. This over lap in voltage becomes higher and higher for packs with more cells. You may have to repeat the charge sequence one more time before proper cell count is detected. If it is practical for you to do so, do not discharge your packs so far in the future.

## **Discharging Your Battery Pack**

You can use the discharge function to measure the capacity of your battery and to cycle your battery. To enter the discharge mode Connect a battery to your charger before connecting your charger to the 12 volt power source. The charger will enter its discharge mode and begin discharging your battery pack. First the charger software will detect the number of cells it thinks are in the battery pack and it will display this information like this:

**3 Cells Detected  
Discharge**

During Discharge the digital display will indicate battery voltage, duration of discharge in hours, minutes and seconds, and the milliamp hours delivered from the Lithium Polymer battery to the electronic load in the charger. The Charger will discharge your battery to a voltage of 3.15 volts

per cell based on the number of cells originally detected. The discharge rate is 1.25 amps for 1 to 3 cells, above 3 cells the discharge current is limited so that the heat dissipated is limited to 15 watts. During the discharge mode the display will look like this:

**Discharge 10.52V**  
**1:05:22 2.12AH**

**Warning! If your battery is already discharged do not try to over discharge it.**

A fully discharged single cell will have a voltage of 3.15 volts  
A fully discharged 2 cell pack will have a voltage of 6.30 volts.  
A fully discharged 3 cell pack will have a voltage of 9.45 volts.  
A fully discharged 4 cell pack will have a voltage of 12.60 volts.  
A fully discharged 5 cell pack will have a voltage of 15.75 volts.  
A fully discharged 6 cell pack will have a voltage of 18.90 volts.  
A fully discharged 7 cell pack will have a voltage of 22.05 volts  
A fully discharged 8 cell pack will have a voltage of 25.20 volts  
A fully discharged 9 cell pack will have a voltage of 28.35 volts.

**Warning! If the cell count is low the discharge will be too low.**

So a more practical limit for automatic discharge is based on correct cell count detection.

**You can discharge a single cell between 3.15 V and 4.29V**  
**You can discharge a 2 cell pack between 6.30 V and 8.59V**  
**You can discharge a 3 cell pack between 9.45 V and 12.89V**  
**You can discharge a 4 cell pack between 12.90 V and 17.19V**  
**You can discharge a 5 cell pack between 17.20 V and 21.49V**  
**You can discharge a 6 cell pack between 21.50 V and 25.79V**  
**You can discharge a 7 cell pack between 25.80 V and 30.09V**  
**You can discharge a 8 cell pack between 30.10 V and 34.39V**  
**You can discharge a 9 cell pack between 34.40 V and 38.69V**

**During Discharge the display will look like this:**

**Discharge 10.50V**  
**1:22:15 2.02AHR**

When Discharge is complete the discharging will automatically stop. As long as the pack remains connected, the display will be locked with the values of final discharge voltage and the number of milliamp hours taken from the pack. To go back to charging, remove the battery pack, wait for the display to say “waiting for battery” and then connect the next battery.

When Discharge is done the display will look like this:

**Disc done 9.45V**  
**1:25:18 2.12AH**

## **When Things Go Wrong**

**“Over Voltage Error”** If a battery pack with more than 39 volts is connected to the charger, or if the charger is accidentally disconnected during charge, the open circuit voltage will jump above 39 volts and the charger software will detect an over voltage condition. The Charger will stop charging, beep nine times and display **“Over Voltage Error”**. To clear display, disconnect the 12 volt power and reconnect the 12 volt power to continue. If you have modified your charger to use a different connector, please check to make sure that the polarity of your connector is correct and that you have done a good solder job. Wiggle all connections just to be sure.

**“BT VLT HI”** will be displayed in mode 2 and mode 3 if the battery voltage increases enough so that the software detects a higher cell count than the count detected in mode 1. This can happen if there is something wrong with your battery, if there is a bad connection, if your battery was

already fully charged, or if you are charging a battery of a higher cell count that was previously discharged too far.

1. A good battery will only increase in voltage a small fraction of a volt when charge current is applied. A battery that is has been damaged or that is in poor condition may show an increase of 1 volt or more when charge current is applied. It is not SAFE to charge a damaged battery. You should always monitor the voltage closely for the first minute to be sure that the battery that you are charging is alright.

2. If the battery voltage displayed jumps up many volts, it means that there is a bad connection somewhere. Wiggle all connections to find the bad connection and fix it before trying to charge the battery again.

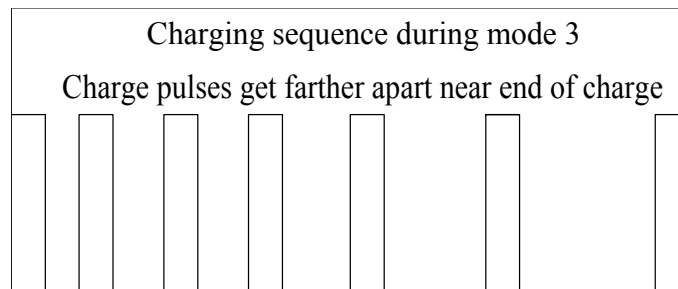
3. If your battery was already fully charged, do not try to over charge it. Read the battery voltage first to confirm that is OK to charge before turning up the amps adjust knob.

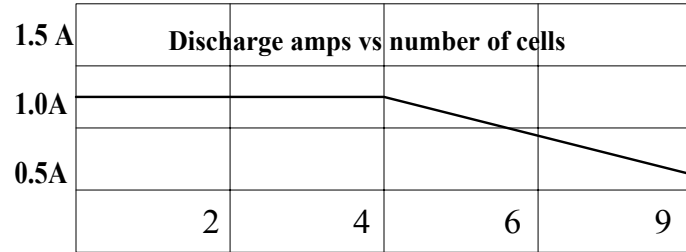
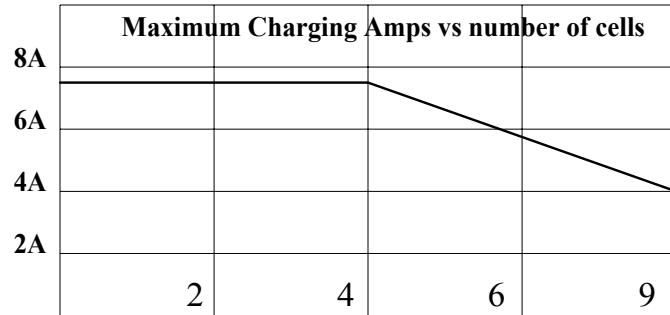
4. If the battery is disconnected from the charger while it is being charged, the charger will attempt to charge an open circuit causing the detected voltage to rise. This may also happen if one tries to charge a high cell count battery that has been discharged below the voltage of a pack with the next lower cell count.

**“Shorted Battery”** will be displayed during mode 2 or mode 3 if the battery voltage decreases enough so that the software detects a lower cell count than the cell count detected in mode 1.

**“Timed Out”** message will be displayed if the charger has not reached Mode 3 within 10 hours. Remove lithium battery then reconnect to continue charging. If the charge is taking that long you may want to increase charge rate a bit.

I hope that you will enjoy our Li-Po Charger #109. With proper care and understanding, it should give you many years of service. Hand made right here in sunny Marina Del Rey, California. Should you have any questions, please email me: [info@astroflight.com](mailto:info@astroflight.com)  
Sincerely, Bob Boucher





### Other Astro Products You May Need

Stock No	Item Description	Price
101n	Whattmeter up to 75 A and 80 V	\$44.95
105	Servo Tester	\$19.95
106	Blinky Balancer	\$24.95
110	Model 110 Deluxe Charger/Discharger	\$129.95
112	Model 112 Deluxe Charger/Discharger	\$139.95
120	Model 120 Power Supply 12.5 Amps, 13 Volts	\$74.95
525	Astro Zero Loss Connectors, 1 pair(for motor&bttty)	\$10.00
526	Astro Zero Loss Connectors , 2 motor sides	\$6.95
527	Astro Zero Loss Connectors, 2 nicad sides	\$12.95
545	Charger patch cord Astro to Deans Ultra Plug	\$7.50
546	Charger patch cord Astro to Deans Micro	\$7.50
549	Adaptor for Blinky to Thunder Power Batteries	\$4.50

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