A Better Bug Swatter

I moved into a house that has high ceilings and getting rid of those occasional flying critters that park themselves on the ceiling is a real pain. Moths like to lay their eggs in the corners where the wall and ceiling join making them really hard to reach. Eradicating *musca domestica* with the ubiquitous fly swatter is very frustrating because they have reflexes that are among the fasted in the animal kingdom. So I decided to create a better “swatter”.

WARNING: This instructable makes use of laser technology and is not a toy. Do not attempt to make the end product described here unless you are thoroughly familiar with safety procedures in working with a laser and are of adult age (over 18). Not doing so could result in injury to yourself, others, and permanent loss of eye-sight! Never operate a laser without proper eye protection. Review of the following safety procedures is highly advisable http://www.laserfx.com/BasicSafety/BasicSafety4.html and

http://www.laserfx.com/BasicSafety/Safety4.html

Disclamer

By constructing this project you are agreeing to the following:

- You are over 18 years of age.

- You understand that the laser component mentioned in the body of this document is dangerous when not properly assembled into the finished product.

- You will use the components and properly incorporate them into the described finished product.

- You will use the assembled end product in a safe and responsible manner and for a legal purpose.

- You are legally responsible for the use and assembly of these components and the improper use of said components or the end product.

- You are legally responsible for any injury to anybody resulting from the use of or assembly of these components or the finished product.

- You accept and agree to be legally responsible for any and all LIABILITIES resulting from and during construction and the end product use. Therefore, this end product is exempt from compliance with the appropriate requirements of FDA 21CFR, section 1040.10 and 1040.11 for complete products.

I wanted to make use of readily available technology to create my new swatter and without breaking the budget. I decided to make a laser-based swatter, or perhaps better put, a “bug-blaster”. Hobbyist lasers are common place these days and not super expensive. Using a laser would allow me to “reach out and touch” these invaders with immediate and devastating affect... at least in theory. If it failed to perform its intended function, the journey of its construction would be a good learning experience and fun nonetheless.

I wanted to satisfy the following requirements… where possible:

- Keep things simple and low cost
- Adapt and apply common house-hold items in uncommon ways
- Must be stable and easy to aim, unlike wand shaped laser pointers
- Laser will be fired in short bursts
- Rechargeable internal battery using high capacity 16650 cells
- Effective range- close, say 1 or 2 meters. I’m not going to hitting something as small as a moth from 10 meters away

It was decided to use and modify the familiar pistol-grip flashlight as the platform for the bug-blaster. That would eliminate having to construct a complicated case to contain all the *stuff* that would have to go inside it. All I needed to do was pull out the guts of the flashlight then customize the cavity to contain batteries and any other supporting electronics needed.

The end result is shown here...

The following steps are *guidelines* used to create your own bug-blaster. Feel free to make changes to personalize it to your liking. A reference list of parts used in this instructable are listed at the end. Everything was obtained from eBay at minimal cost. Miscellaneous resistors, capacitor, diodes, alligator clips, wire etc. used can be obtained from Radio Shack, Fry's, or on-line from eBay or Digi-Key etc.

Skills needed: You need to know some basic electronics. How to identify polarity on a battery and diode. How to read a simple schematic then wire and solder according to it. You also need access to a multimeter and how to use it. I've added a few TECH NOTES to add details for those interested. You'll also need some familiarity with common hand and power tools, drill, dremel tool, hand saw, solder iron etc. If you are patient you will be successful. If you think you can build this in the time it takes to watch a movie you might want to try a different instructable ☺

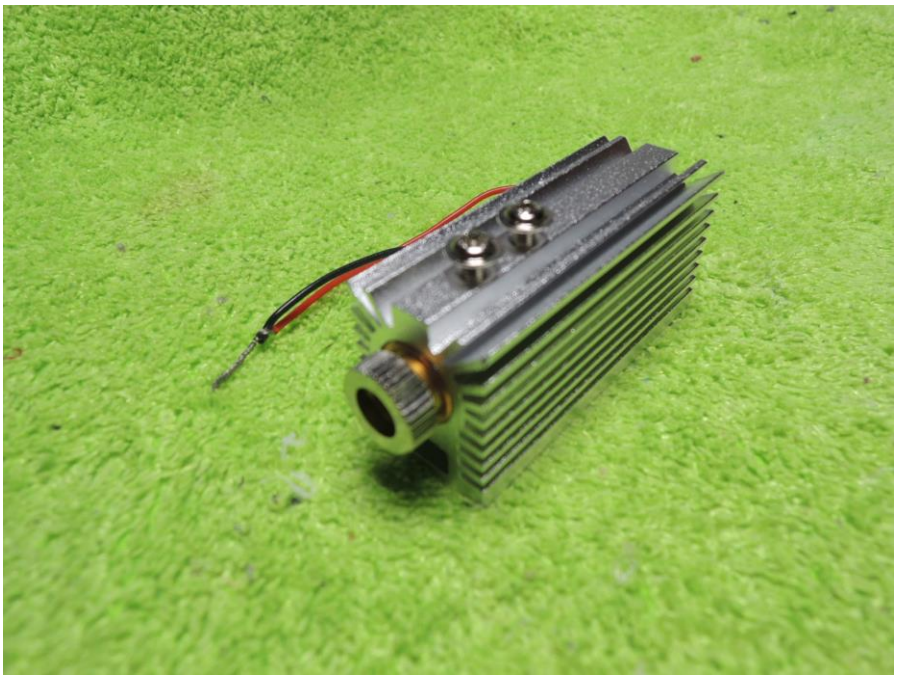
Step #1 Selecting a laser module-

This is the most expensive part of the project. You need something that delivers a devastating punch in a fraction of a second. There are a lot of options here. A laser of only a few hundred mW can burn paper or flame a match but you have to be really close to the target… my adversary will never let me get within that range. I need it to burn from 1-2 meters away and very quickly. I decided on a 2W laser module (item #2). It has everything included (driver and focusable lens), just apply power and it works!

IMPORTANT NOTE- The laser module comes with the black and red wires twisted together, this is to prevent static discharge from killing the laser. To keep the lens dust-free I used a small piece of black electrical tape over the lens cap until mounting and test time.

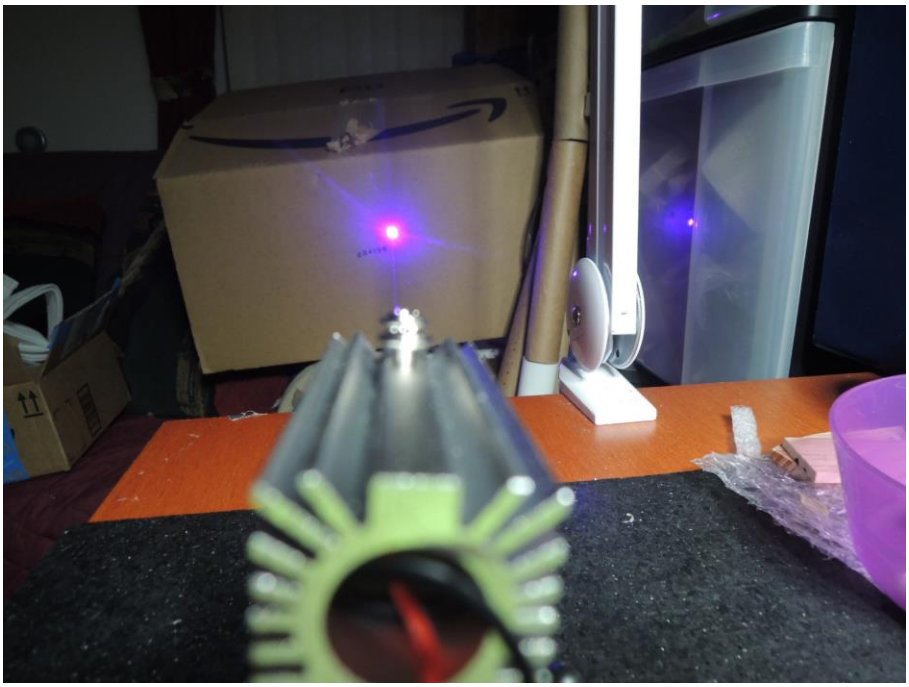
Step #2 Mount the laser module in the heatsink and set focus-

Lasers generate a lot of heat that must be dissipated or you'll kill it dead. I selected item #3 to host the laser module because it's relatively small yet large enough to do the job. Also I will not be firing it in a continuous manner like a flashlight but in short well aimed bursts. Insert the laser module into the heatsink as shown below and just lightly tighten the screws. The lens focus ring is the part just protruding from the heatsink.

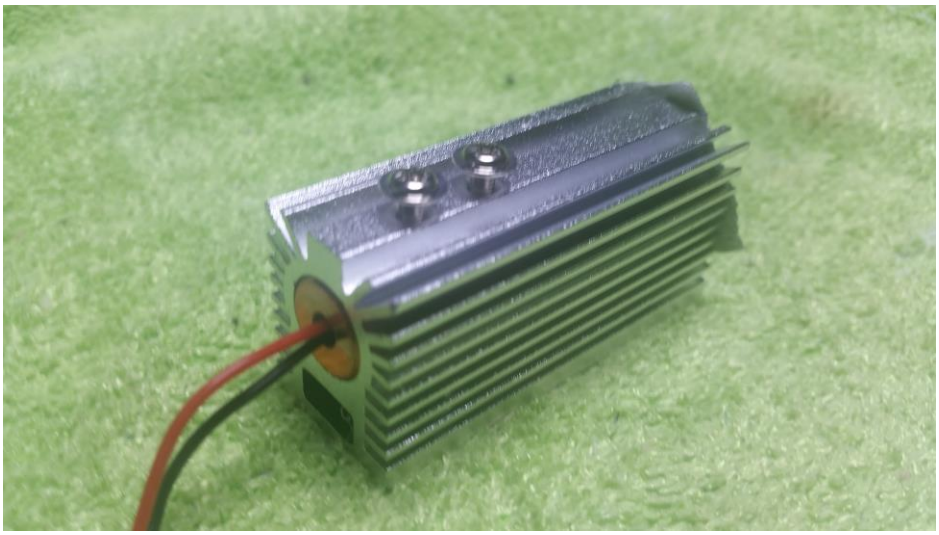


To set the focus use the power supply that comes with the flashlight to power the laser. I made a simple adapter to plug the power supply into then use alligator clips to connect to the laser module.

Position a cardboard target 1 meter or so away from the laser. **Put on your laser safety glasses** then apply power to the laser. Hold the laser heatsink steady then turn the focus ring so the smallest possible dot appears on the target. The smaller the dot the more intense the burn.



Once the focus is set remove power from the laser. Remove the laser module from the heatsink. Apply a very thin coating of heat conductive grease to the module then insert it back into the heatsink as shown below. This is the reverse of that used to adjust the focus pictured above. I chose this orientation because it protects the lens from dust and the focus ring from being bumped and going out of focus. Tighten the screws just firm.



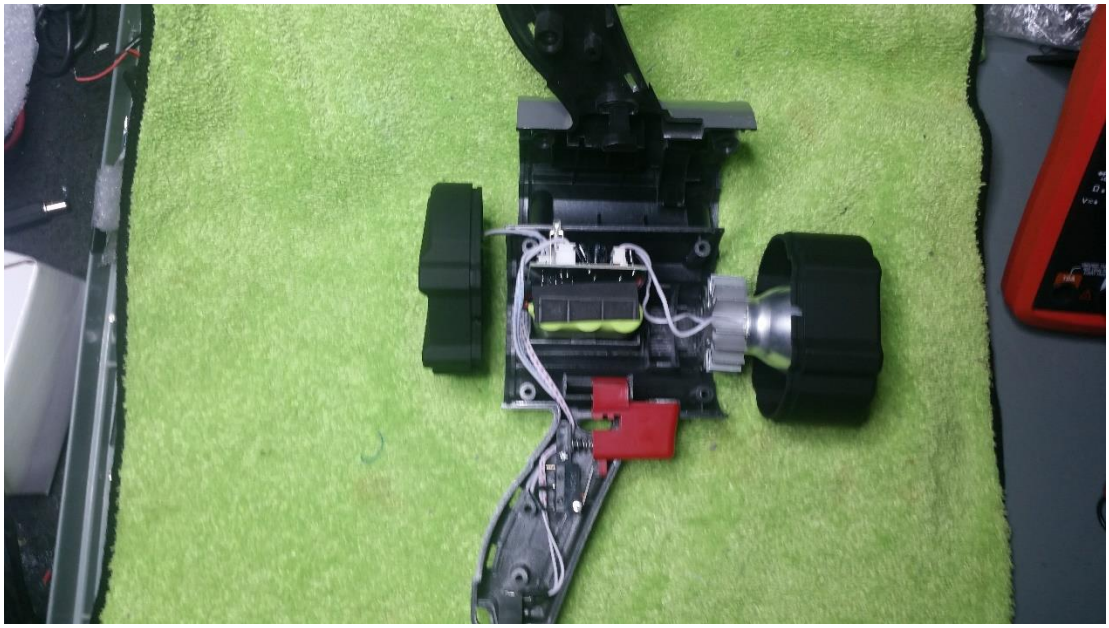
Step #3 Select a pistol-grip flashlight-

I wanted a pistol-grip style because it's much easier to aim and hold steady than the traditional wand pointers. After all this is not a simple pointing device that you wave around like a Star Wars laser sword, we're going after and zapping bugs so a steady aim is essential. The flashlight chosen has to allow disassembly so we can get to the internals. These things are mass produced and often press-fix together so they can't be opened. So I looked for something with screws. Item #1 looked close to what I needed. I would need some luck here since I had no clue as to the insides and how easy it could be to customize.

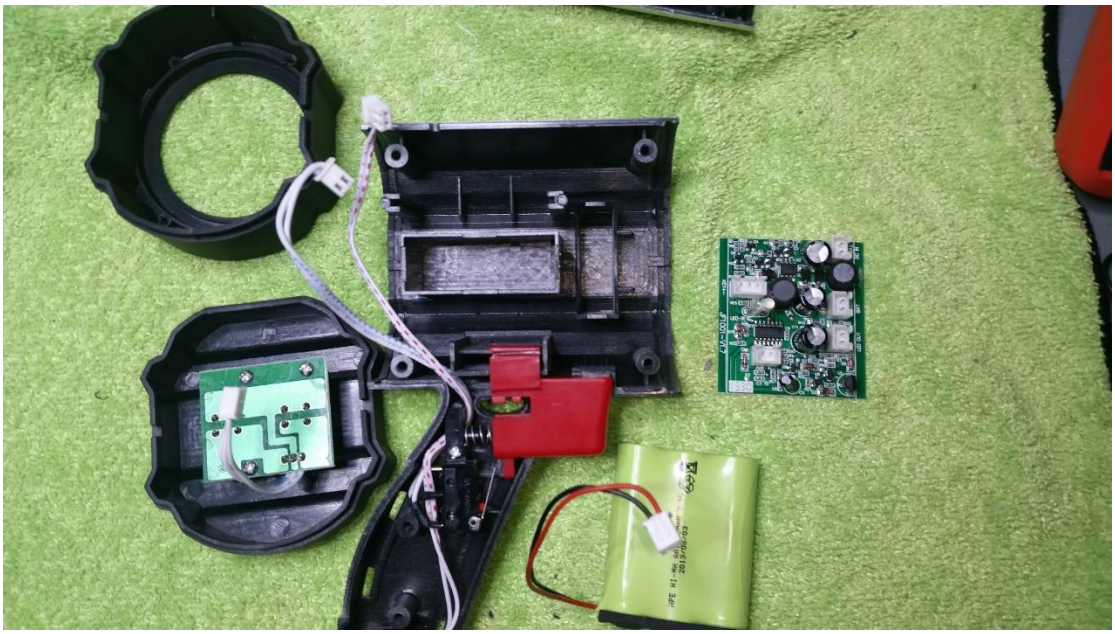
Step #4 Disassemble the flashlight-

This unit *fortunately* disassembles easily with just (2) snap panels in the grip and (6) screws, (2) in the grip and (4) in the head. Remove the snap panels from each side of the grip first. You have to pry them off. Use something made of hard plastic else you'll mar the surface.

Now remove the (6) screws, with a little giggling the housing separates into four pieces. Be careful here because the trigger is spring loaded and it needs to be kept intact with the housing.

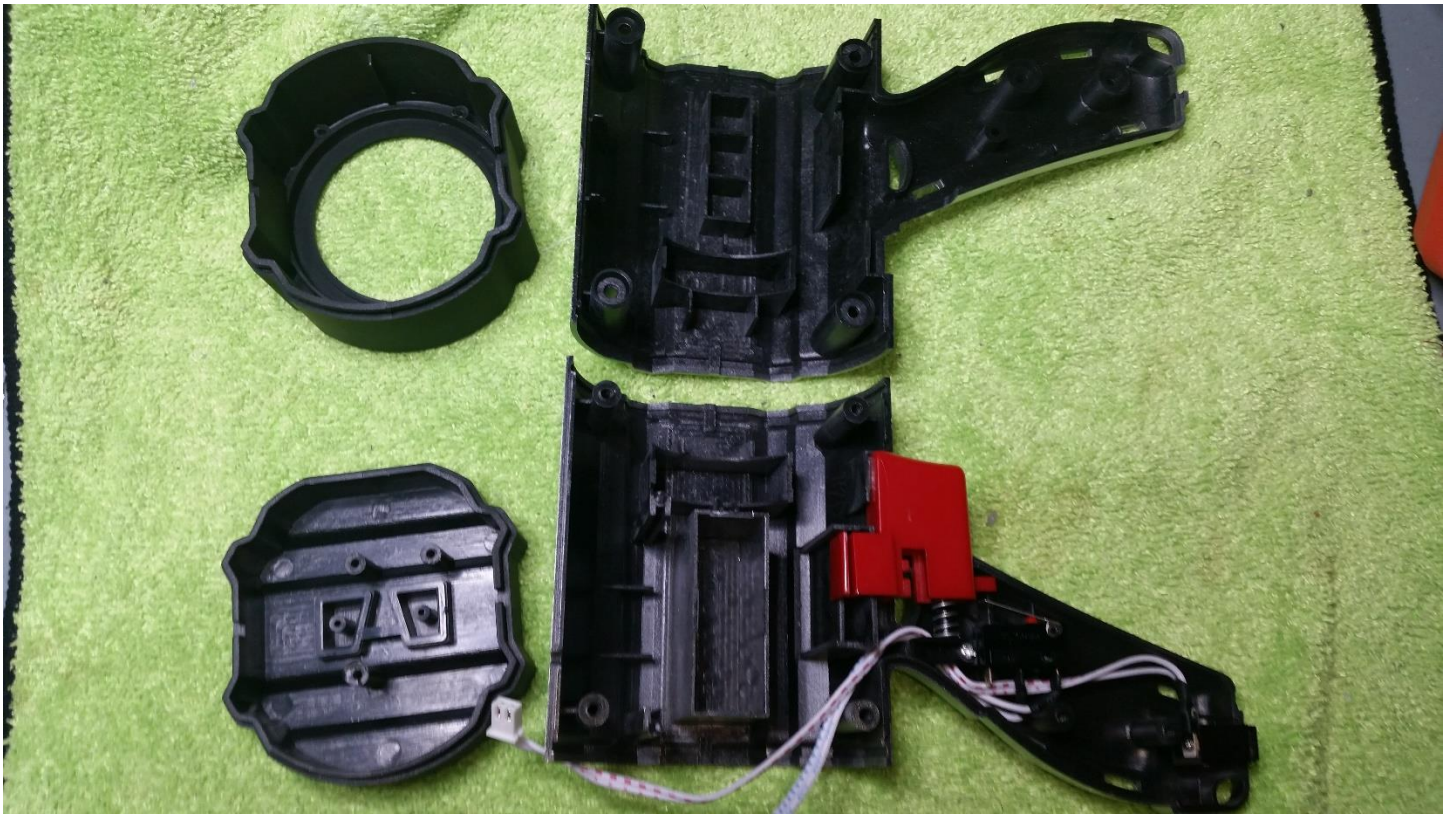


Remove the circuit board and unplug all connecting wires. Unscrew and remove the circuit board located in the end cap. Remove the (4) small screws from the lens head to remove the LED housing, washer and glass lens. Set aside the (4) small screws and washer for reuse later. Only the trigger, and power jack in the handle will remain. This flashlight includes a power supply that will be used to charge the internal battery. Keep the other internals for your next DIY project!



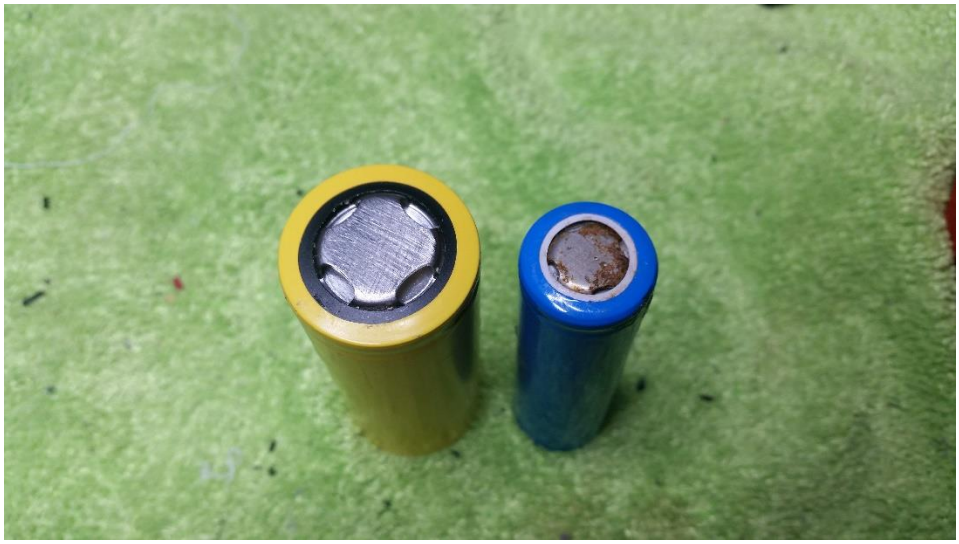
Make sure to remove the trigger-hold piece shown below. Just wiggle it out. It will not be included in the final assembly.

These are the pieces from which the bug-blaster will be constructed. There is also a lens washer and (4) small screws that will be reused but not shown here.



Step #5 Creating a cavity for the batteries-

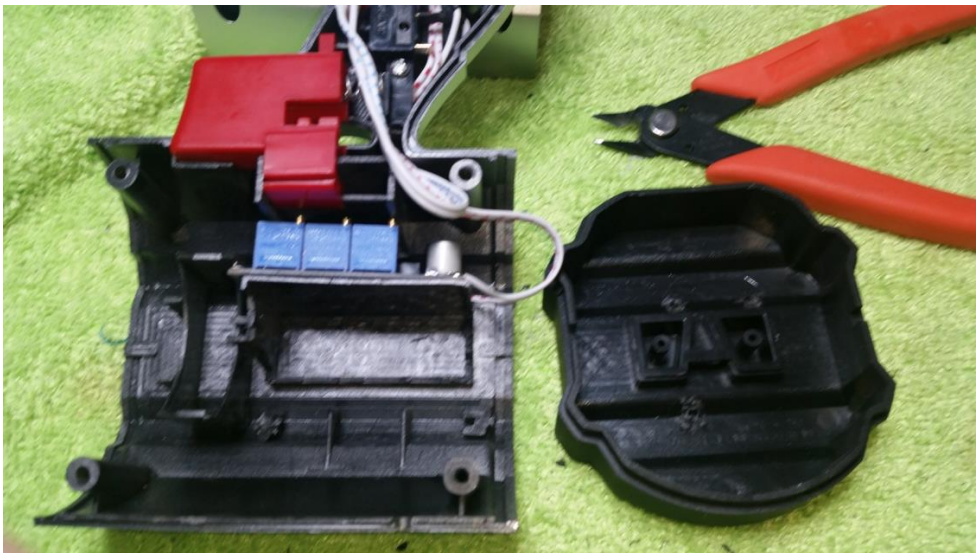
This step takes a little time and patience and a decision on your part. The internal cavity has to be customized to hold two batteries. While I was originally going to use (2) 18650's I decided to use the higher capacity 26650 batteries instead. Here's a size comparison.



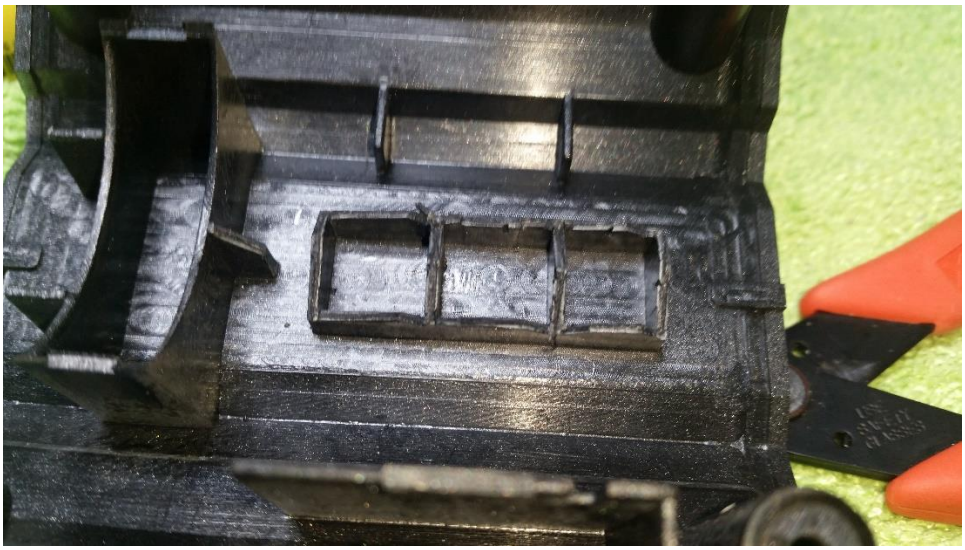
Fitting (2) 18650 is very easy and does not require much cavity customizing. I choose instead to use the much larger 26650's because of their capacity, but I wasn't sure they would actually fit until I tried it. Turns out they will, just barely. Customizing the

cavity to accommodate these monsters takes more time but not that difficult and the payoff is much better. Just follow the pictures and take your time.

I use wire clippers like those shown to snip away at the internal plastic structure to make room for the batteries. Avoid removing too much material as this will reduce housing stiffness.



After some work this is what’s left from each half of the housing and end-cap. Compare your work with these pictures. Remember less is better.



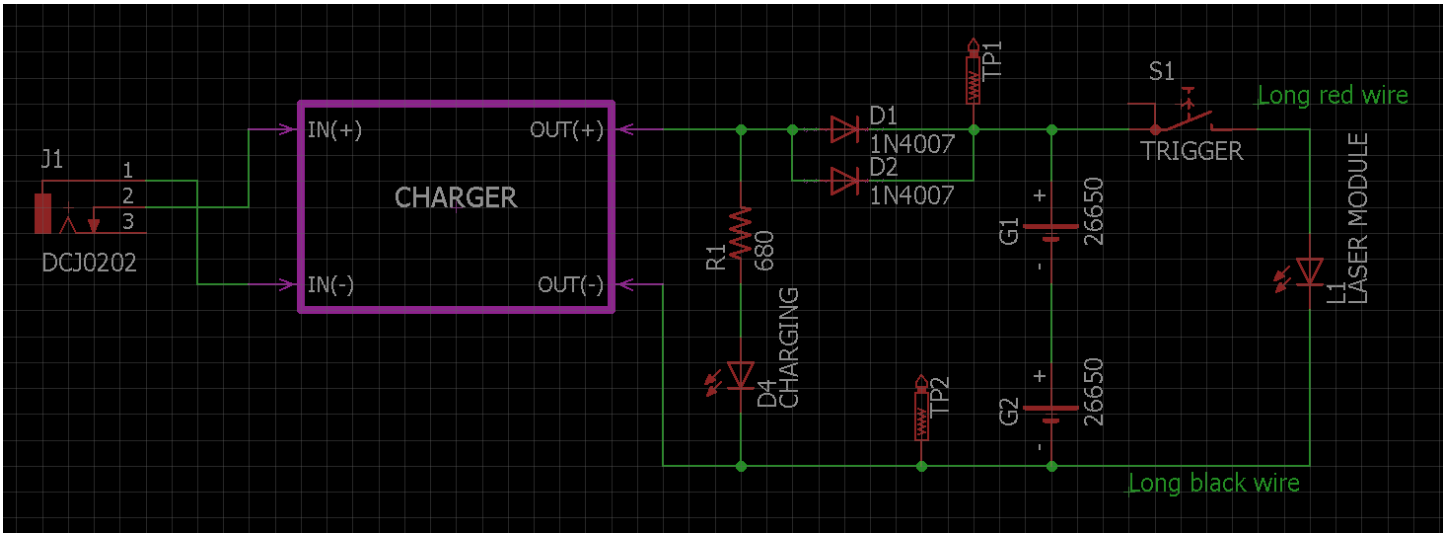
Step #6 Fit the batteries to the cavity-

As you incrementally remove material to make room for the batteries constantly check how well they are fitting so you don’t remove more than is necessary. Notice the gap on the left side of the battery. I used a piece of ¼” thick bubble foam cut to the size of the gap to keep the batteries from moving around.

Test for clearance by snapping together both halves of the housing and the end cap.

Step #7 Wiring the battery charger board-

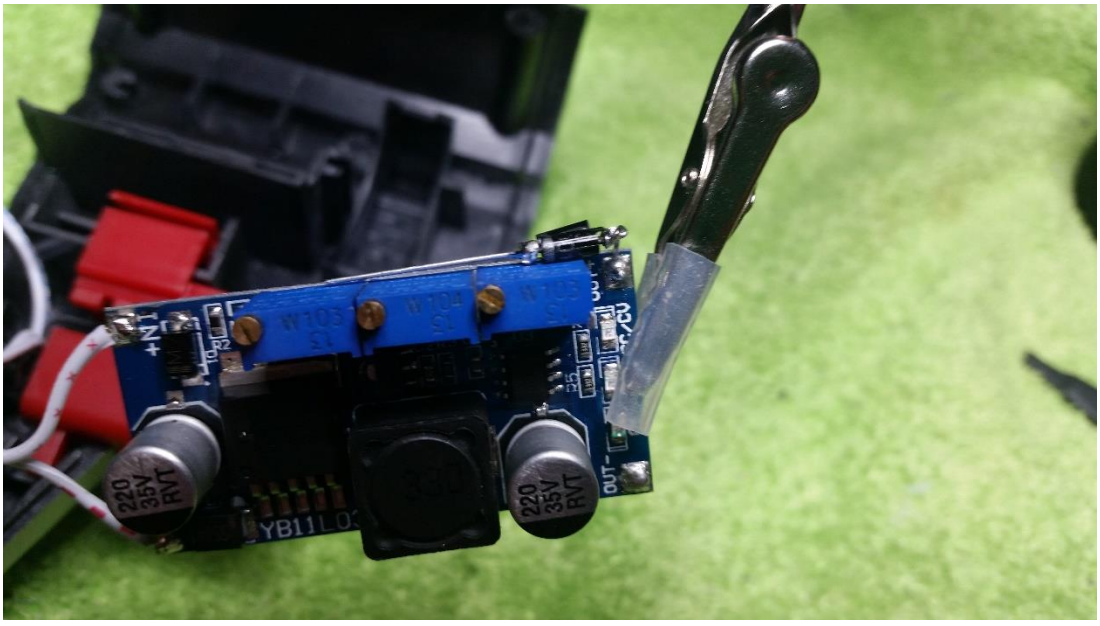
The bug-blaster will be wired using this ultra-simple schematic. The battery charger is driven from the power jack located in the base of the handle. I utilized the existing wire associated with the power jack and the trigger. All other wire is red and black 26 gauge.



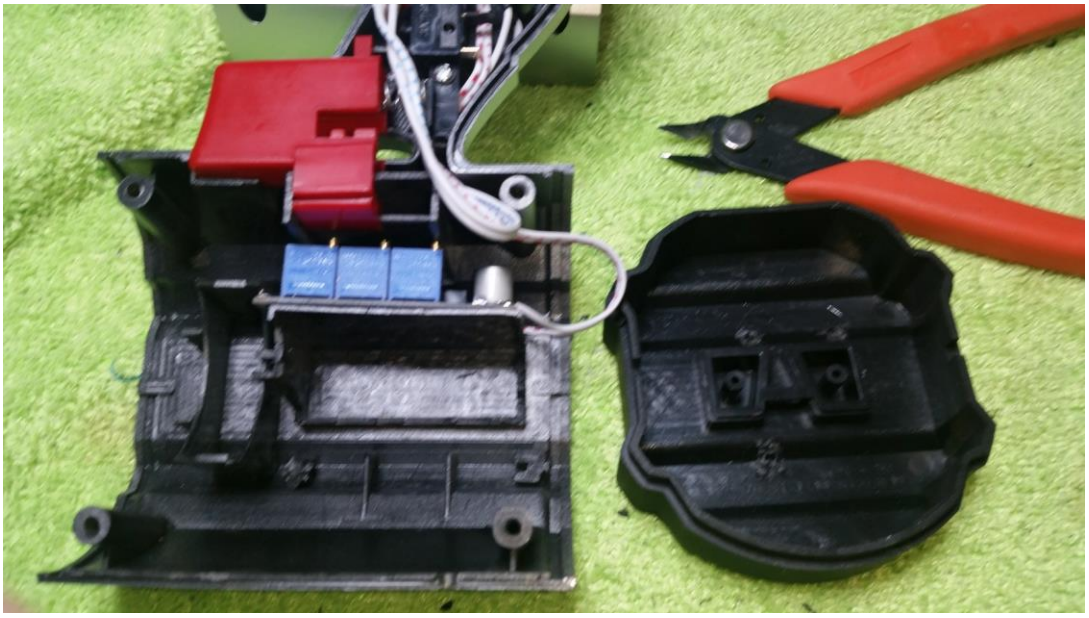
Cut off the white connector leading to the power jack then solder the wires to the IN(+) and IN(-) pads of the charger board as shown below on the left side. The two white wires are labeled with “+” and “-“. Double check to make sure you get this correct.

Solder (2) 1N4007 diodes in parallel then solder the anode to the OUT(+) terminal of the charger board. These can be seen in the photo below next to the alligator clip on the right.

TECH NOTE: the two diodes in parallel prevent the batteries from discharging back through the charger when the batteries are NOT being charged. Two diodes were used to allow up to 2A of charging current.



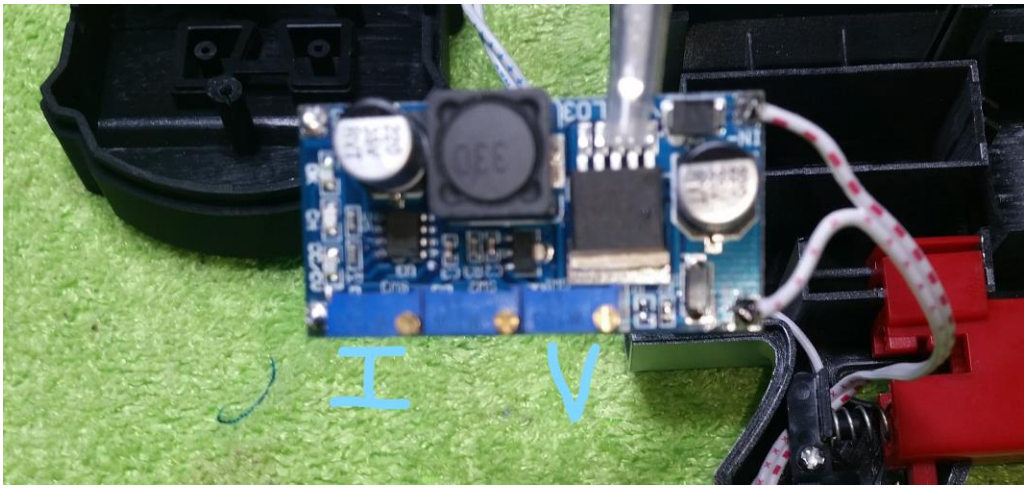
The charger board can be test fitted in the cavity already provided by the existing housing. As it just happens, it fits perfectly without any modifications.



Step #8 Setting the battery charger voltage and current limits-

Once the power jack has been wired to the charger board we need to set the current and voltage output limits to accommodate our batteries.

By default the charger board has been set to limit output current at 1A and is controlled using the blue potentiometer on the left in the photo below. To set a different current limit, place an amp meter across TP1 and TP2 (see schematic). Connect the flashlight power supply to the power connector, now turn potentiometer counter-clockwise to decrease the current to 0.3A or 300mA. This is the rating of the flashlight power supply.



Next adjust the voltage limit by attaching a voltmeter across TP1 and TP2. The potentiometer on the far right (shown above) is use to adjust the voltage. Turn

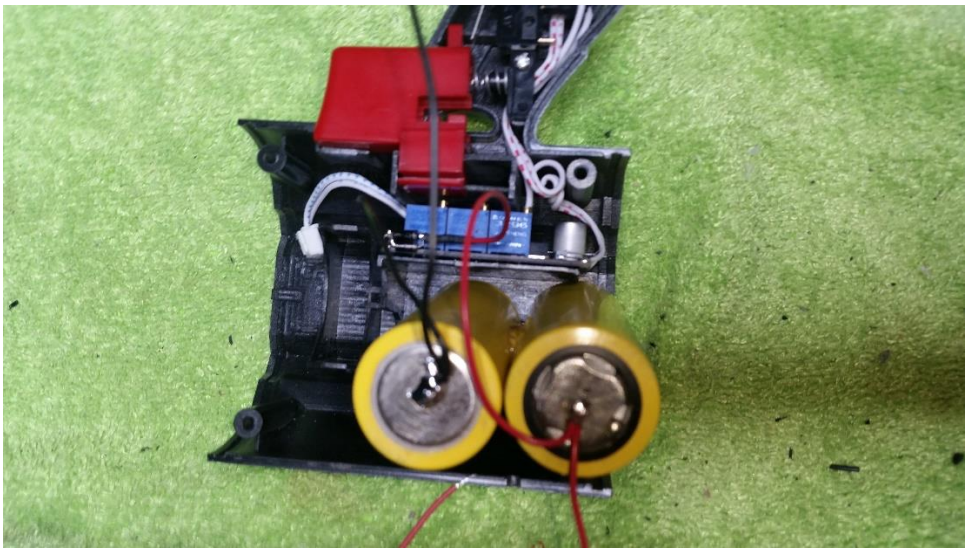
clockwise to increase the voltage to about 8.2 volts.

Unplug the power supply from the flashlight power jack.

TECH NOTE: If you want to upgrade to a power supply with greater current capability you can. They are cheap and plentiful. Just look for something rated 12VDC at 1 to 2 amps. Make sure it has a male 2.1 x 5.5mm plug. Use the same procedure for setting the charger current limit but set it to match your power supply (up to 2 amps). I have even used a Dell laptop power supply with an appropriate connector adaptor to give me 2A of charging current.

Step #9 Wiring the batteries-

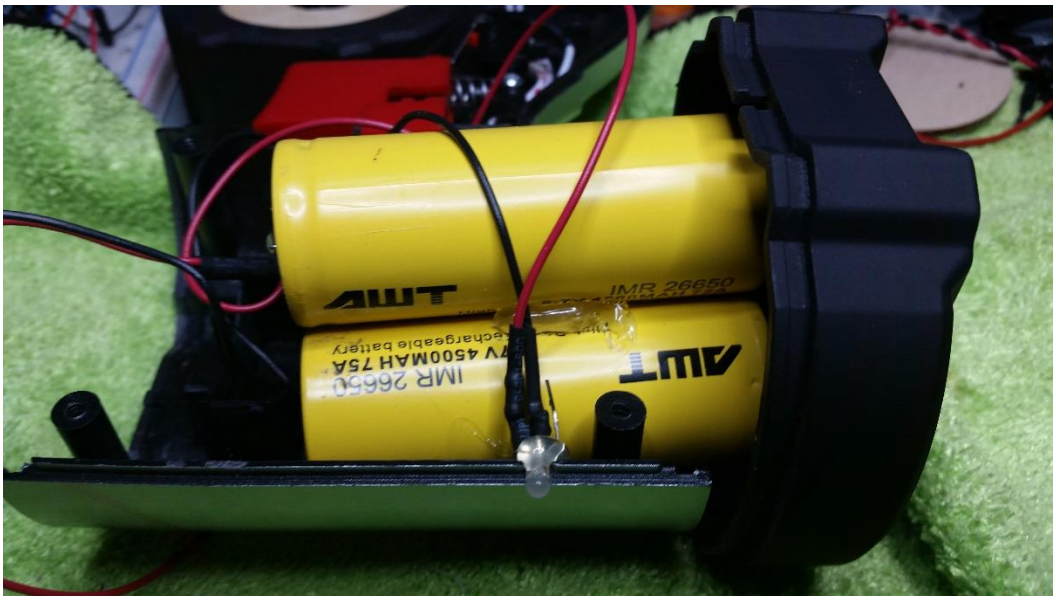
Solder the two batteries in series to give an output voltage of +8 volts. This voltage will power the laser module when the trigger is pulled. I used a small piece of 20 gauge or higher wire to connect the batteries in series. Next, solder the positive battery terminal to the cathode side of the parallel connected diodes (refer to the schematic). Solder the negative side of the battery to the OUT(-) pad of the charger. I added a bead of hot-glue between the two batteries to keep them tied together.



Step #10 Wiring the battery charging LED-

The LED on the original flashlight control board below can be used as a battery charging indicator. Cut out the 3 pin LED. This LED is dual-colored red and green. I will use the red LED as a battery charging indicator. Use a 1.5V battery to determine which outside lead corresponds to the anode of the red LED. The center lead acts as a shared cathode to both LEDs.

Solder a 680-ohm resistor to the anode of the LED then solder connecting red and black wires to the leads corresponding to the anode and cathode respectively. Solder the connecting wires per the schematic. Test fit the LED to the housing as shown below to make sure only the head appears.



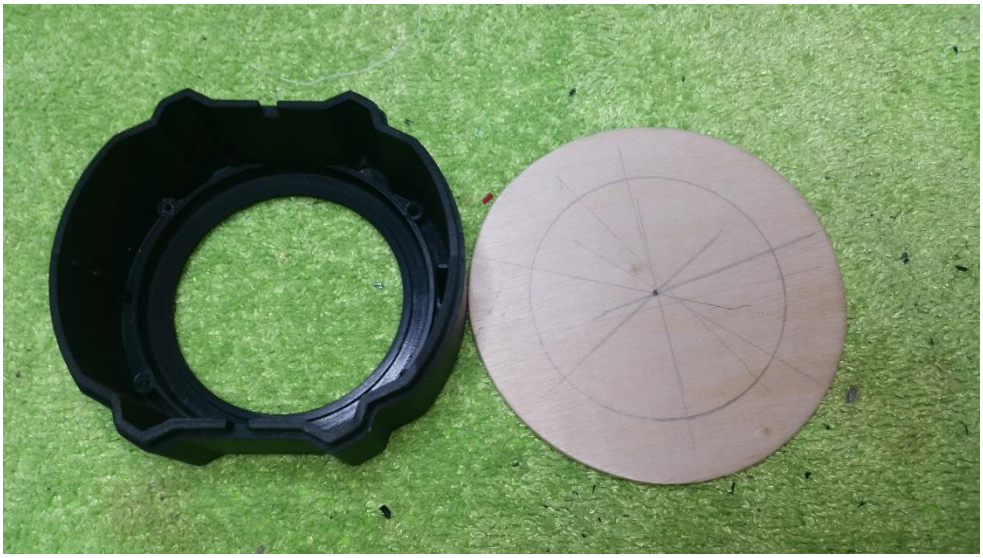
If you need to snap together the other half of the housing to convince yourself the fit is correct then do so. Use some hot glut to secure the LED in place. Once the glue dries insert the power supply plug into the flashlight power jack located in the base of the handle. The LED should turn on. Now unplug power to the power jack so the LED turns off.

Step #11 Plexiglass tube supports-

Cut the plexiglass tube to 400-450mm or about 16-18 inches. Make sure both end surfaces are flat and perpendicular to the tube axis. Sometimes cutting can cause the edge to run askew.

The laser module heatsink will be attached to one end of the plexiglass tube and the other end to the flashlight housing. To do this two wood supports are need to secure the tube to the flashlight housing.

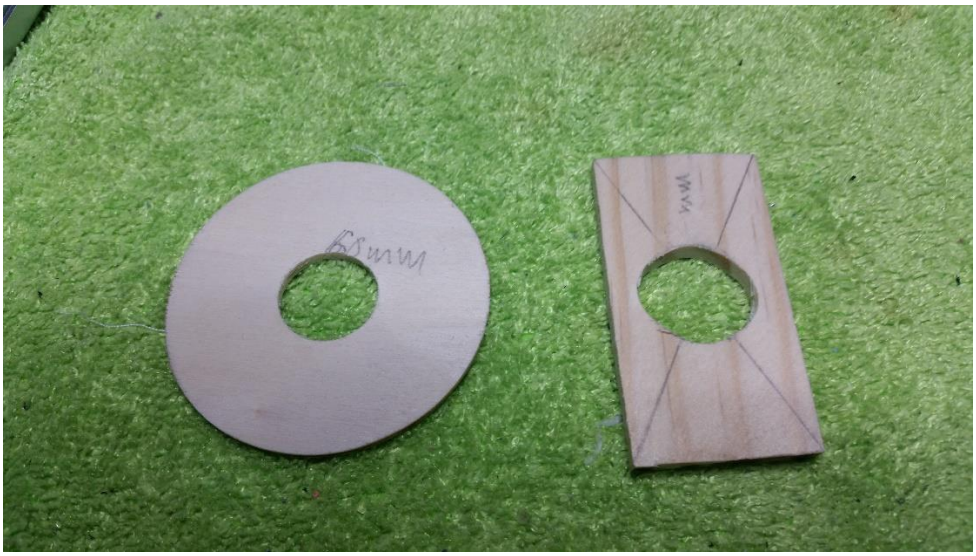
A wood disk replaces the glass lens of the flashlight. A package of 3” wood disks can be found at Walmart in the hobby section. Trim one of the wood disks to 60mm in diameter.



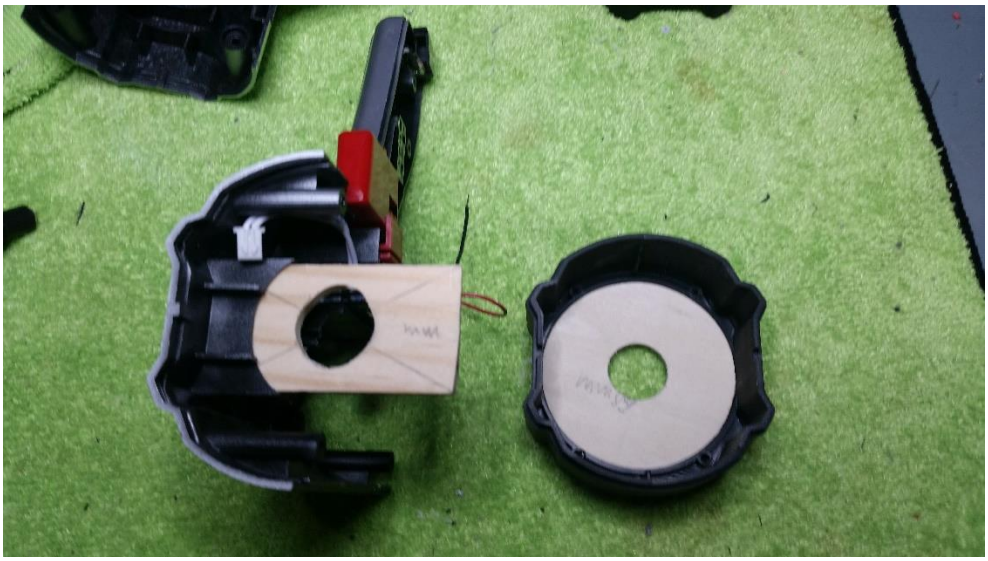
The trimmed disk will be secured into the lens housing using the original washer and (4) screws later in this description. Below is the original housing, lens, washer and screws.

An 18.7 mm diameter hole is made in the center of each wood piece. This is the diameter of the plexiglass tube that will pass through both pieces. The rectangular piece is 62 x 32mm and was made from a 5 gallon paint stirring stick found at Walmart or paint stores. I used a ½ drill bit to make the initial hole then a dremel tool fitted with a sanding bit to enlarge the hole to the correct size.

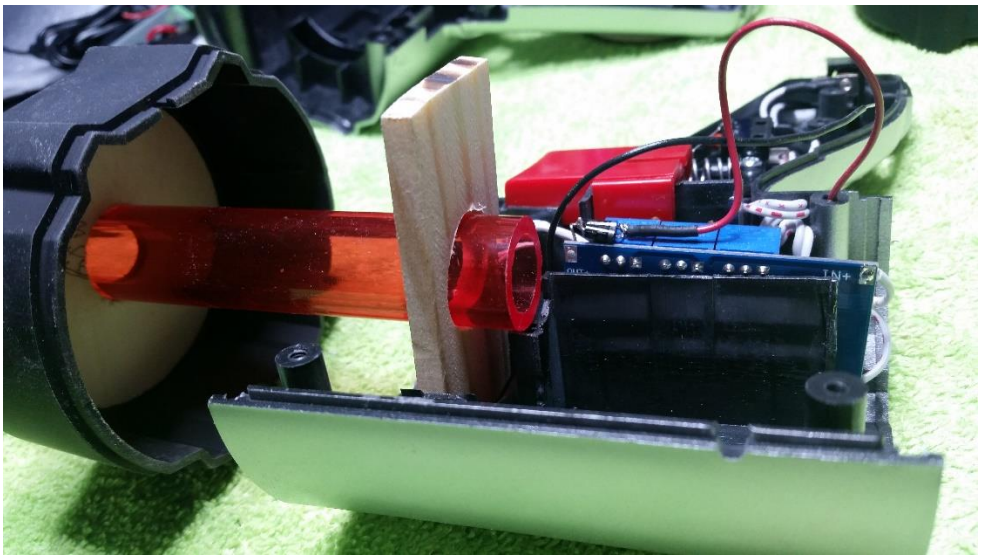
IMPORTANT NOTE: the plexiglass tube needs to fit snug when passing through the two holes to prevent wobble. As you are sanding a hole constantly check by trying to pass the plexiglass tube through the hole.



When creating these parts adhere closely to the outside dimensions so that both pieces fit snug into the flashlight housing.



Test fit the plexiglass tube through both wood supports. There should be no wobble. I also painted the disk side facing outward red to match the plexiglass tube.



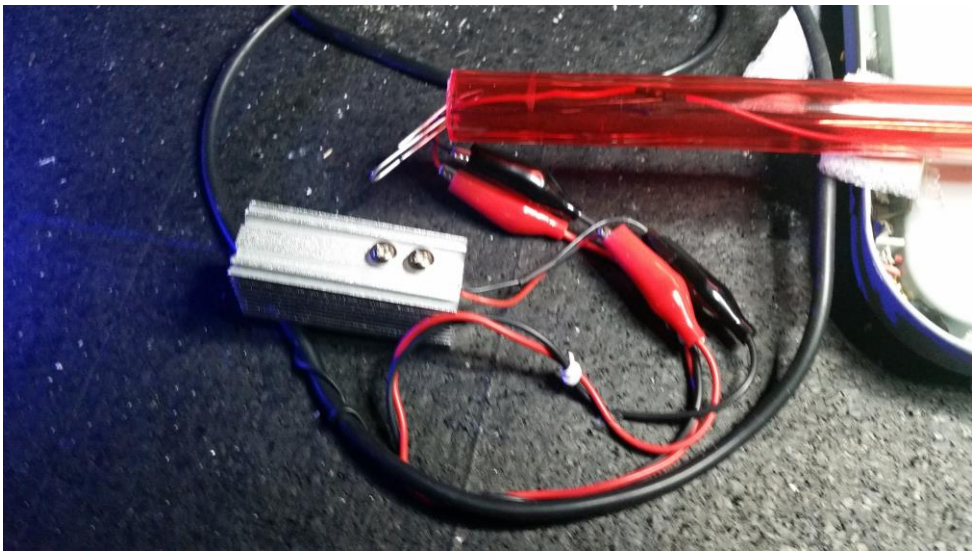
Step #12 Wire the laser module-

Since the laser module heatsink will be mounted to the end of the plexiglass tube it's necessary to provide wire from the housing to the end of the tube. Cut off the white connector leading to the trigger. Solder one end of the white trigger wire to the positive side of the battery. Solder the other end of the trigger wire to a piece of red 26 gauge wire that is as long as your plexiglass tube + 5 or 6cm. Solder another black wire of equal length to the negative side of the battery (see schematic). Lightly twist the red and black wires together and feed them through both holes of the wood supports then down through the end of the tube. Secure the two wires now protruding out the end of the tube with a large paper clip (or some tape). This will prevent them from disappearing back into the tube while you make some final tests.

Step #13 Testing the laser module-

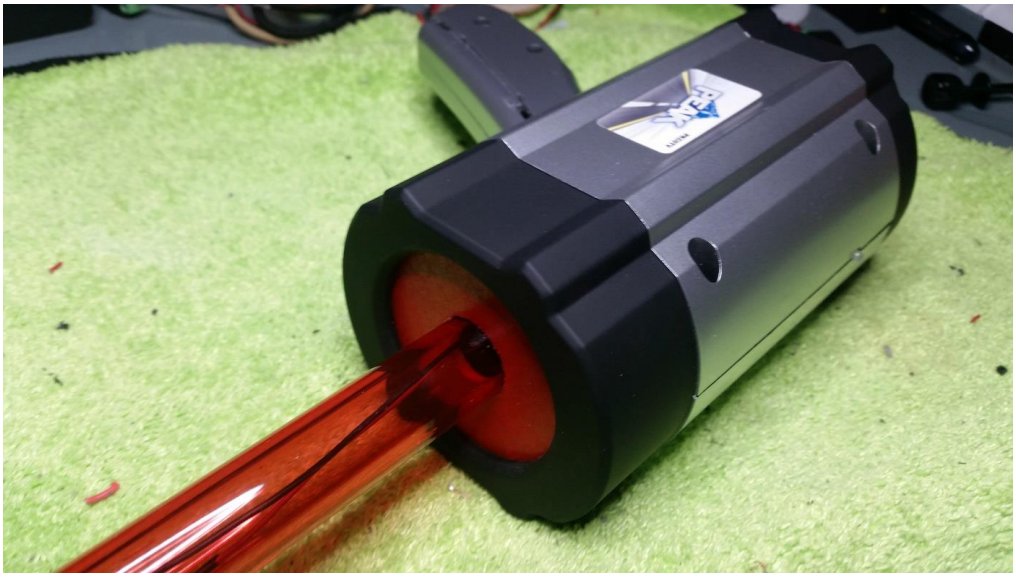
Prepare the red and black wires coming from the end of the tube for soldering. After stripping and tinning, attach a voltmeter to the wires. The reading should be near 0V. Now pull the trigger the voltage should be over 8 volts assuming fully charged batteries. Release the trigger and the voltage should drop to near 0V again. If everything appears OK solder the wires from the plexiglass tube to those of the laser module. Red wire to red wire and black wire to black wire. The polarity must be absolutely correct or you could destroy the laser module.

Set up a cardboard target a few feet away taking proper caution. Aim the laser module at the target. **Put on your laser safety glasses** then pull the trigger. You should see the laser light begin to burn a mark on the target. Release the trigger.



Step #14 Final housing assembly-

Now that everything appears to be working you can snap together the housing with the end cap.



If you were precise in making your wood support pieces the tube should be fairly rigid. I added a bead of hot-glue around the tube where it passes through the rectangular support piece hole. This will prevent the tube from sliding out of the housing. I did not apply glue to the disk because if disassembly is necessary the head piece will slide down the tube away from the housing.

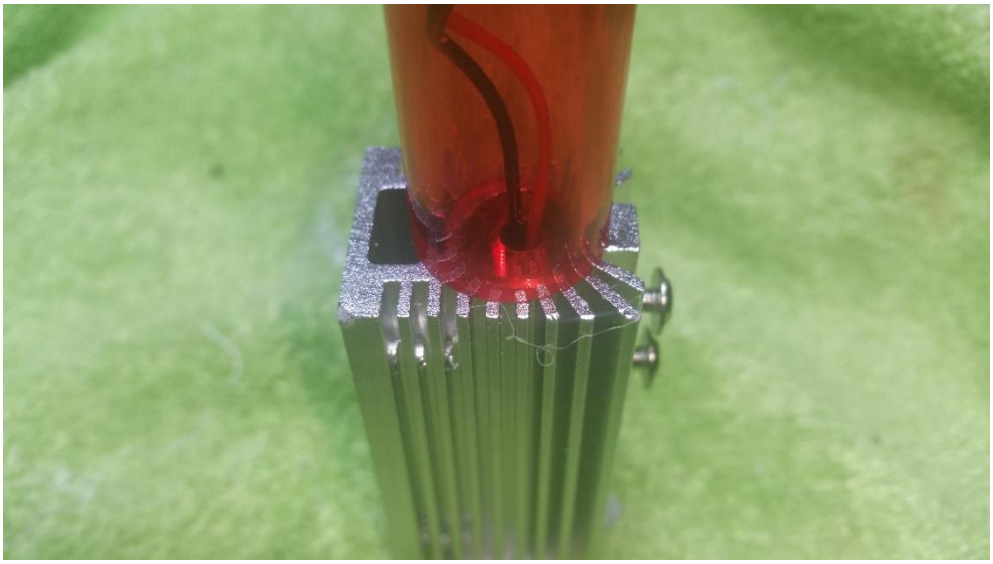
Step #15 Laser module mounting and final test-

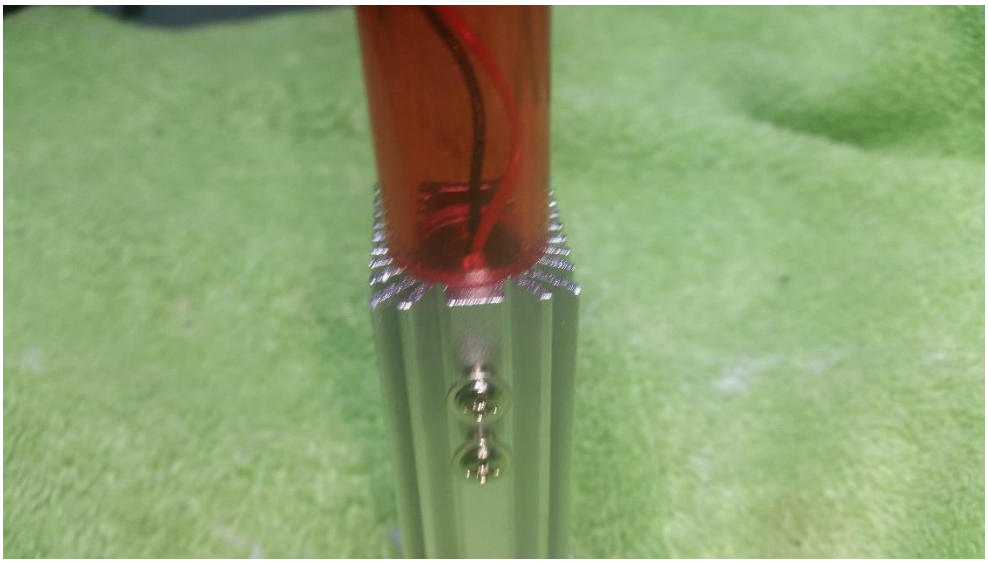
At this point the main housing should be assembled together except for adding back the screws and snap panels to the grip. Making sure all the housing seams are snug fit, add back just **one** screw to the body housing. This will prevent the housing from coming apart as the laser heatsink is attached to the end of the plexiglass tube. If something goes wrong during mounting it will me much easier to disassemble the housing to investigate by removing just the one screw.

Turn on your hot-glue gun and let it get really hot. Also make sure you have at least 3 or 4 cm of glue stick margin. Don’t want to run out of glue at this critical point.

Coil the excess wire into the tube.

It really helps to have an extra pair of hands here to hold the bug-blaster while you align and attached the heatsink. Place the heatsink on a flat surface with the beam end facing down. Hold the bug-blaster so the free end of the tube is pointing down. Center the heatsink to the tube so that the two surfaces are flush with each other.





Now with your glue gun tack two places at the intersection of the tube and heatsink with a small amount of glue. Fine adjust the heatsink to make sure it's centered on the tube, make haste before the glue sets. If you mess up the alignment just remove the two small tacks of glue and start again.

After the tacks dry add a bead of glue around where the tube and heatsink meet. Build up the bead until it reaches the edges of the heatsink. Apply equal portion of glue to both the tube and heatsink. This should be enough to keep it in place. Let the glue dry thoroughly before final assembly and test.

Step #16 Final assembly and test-

Once the glue dries add the remaining screws to the housing body and snap panels to the grip.

Set up a target, **put on your laser safety glasses** and take some shots, practice your aim, you'll need it to hit anything as small as a moth or fly. Enjoy.

IMPORTANT NOTE: Monitor how warm the heatsink is getting during use. If it gets warm let it cool a few minutes. Use short well aimed bursts to prevent rapid buildup.

List of Parts Used

1. Pistol-grip flashlight- http://www.ebay.com/itm/Peak-PKC0TV-Rechargeable-3-Watt-Cordless-LED-Spotlight-w-Wall-Car-Chargers/182320694545?_trksid=p2047675.c100012.m1985&_trkparms=aid%3D777003%26algo%3DDISCL.MBE%26ao%3D2%26asc%3D41375%26meid%3D9a64a73aa43c460392a4a2bc91e9bfca%26pid%3D100012%26rk%3D7%26rkt%3D12%26sd%3D172606830943

2. 2W blue laser module - http://www.ebay.com/itm/Nichia-NDB7875-445nm-9mm-Copper-445nm-Blue-Laser-Module-W-X-Drive-405-G-2-/180981069208?hash=item2a234ff598:g:~MwAAOSwrklVP2EN

3. Laser heat sink - http://www.ebay.com/itm/Silver-Heat-Sink-radiator-Cooling-Holder-Stand-Mount-for-12mm-laser-1-2cm-/311412281079?hash=item48819e4ef7:g:C2cAAOSwjVVVt3xT

4. Battery charger- http://www.ebay.com/itm/171907258940?_trksid=p2057872.m2749.l2649&ssPageName=STRK%3AMEBIDX%3AIT

5. Plexiglass tube- http://www.ebay.com/itm/302202749750?_trksid=p2057872.m2749.l2649&ssPageName=STRK%3AMEBIDX%3AIT

6. 3” wood disks - http://www.ebay.com/itm/10x-Wooden-Plain-Round-Circles-Craft-Shapes-3mm-Plywood-/271928348483?var=&hash=item3f50314f43:m:m7R5M5LgP4xo1TrhgXdMb3Q

7.Blue laser safety glasses - http://www.ebay.com/itm/Eye-Protection-Goggles-Laser-Safety-Glasses-Green-532nm-Blue-445nm-Violet-405nm-/331781646568?hash=item4d3fba28e8:g:rtMAAOSwB4NWxeez

8. 26650 batteries- http://www.ebay.com/itm/2-NEW-AWT-IMR-26650-HIGH-DRAIN-35A-75A-4500mAh-RECHARGEABLE-BATTERY-3-7v-/252942256957?hash=item3ae4888b3d:g:TxkAAOSw4A5YrN8B

9. (2) 1N4007 diodes or other 1 amp rated diode

List of Tool Used

1. Soldering iron

2. Hot glue gun

3. Screw driver, power drill, dremel tool and accessories

4. Xacto knife

5. Wire, heat-shrink tubing, electrical tape, alligator clips

6. Wire cutters and stripper, needle nose pliers

7. Multimeter