Construction Notes for Modification of "Atomic Beam" Flashlights for Optical Communications

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At the end of May 2019 I was introduced to a novel light communications system developed by Rob K0XL and Warren WF0T. The system makes use of a simple yet excellently performing receiver developed by Clint KA7OEI and improved by Ron K7RJ. The system makes use of "page magnifier" flat lenses and 3D printed parts used to mount the components on a simple 1 in square aluminum rail. For transmit the system designed by Rob K0XL makes use of a high intensity LED flashlight. This paper details the steps I went through in making the modifications to the Atomic Beam flashlights.

The original modifications were described in brief by Rob K0XL in a paper called "PWM Optical Transmitter LED Driver" dated 07/01/2018. Diagrams are included that show the basic electrical modifications required (see Appendix). The Flashlights are available from several sources on E bay and claim very high intensity output and feature an adjustable lens that allows focusing into a tight beam or onto a lens surface. The flashlights are packaged as shown in Figure 1.

Figure 1 Flashlight Packaging

Disassembly

-After unpacking the flashlight, unscrew the bottom battery cover and the Lens assembly from the top end (see Figure 2).

-Use a "snap ring" tool to unscrew the 'chrome colored" ring at the lens end (see figure 3), which will free up the LED assembly from the main body.

- Pry out the PCB from the back end of the LED assembly as shown in figure 4.

PCB Modifications

-Remove the 3 leaded SOT-523 surface mount part shown near the middle of the PCB in figure 4 and add solder to 2 of the now empty pads as shown in figure 5.

-Mount a plastic case 2N2222 as shown in figure 6, with the base lead but up behind it for attachment to R3 a 10 k resistor leading to the outside driver.

Figure 2 Initial Disassembly

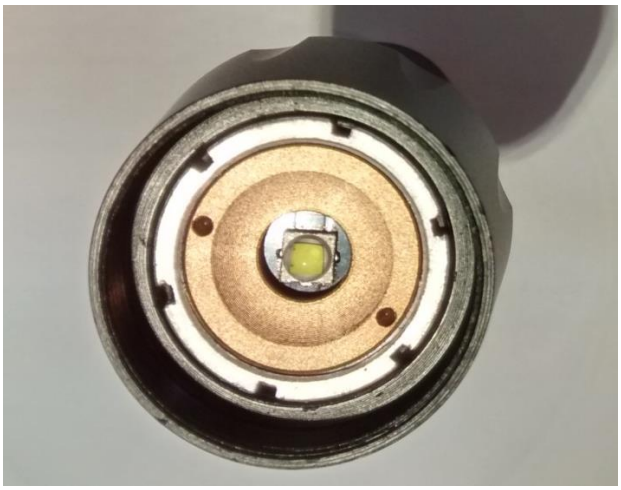


Figure 3 Removal of LED Assembly

The resistor is mounted so that the lead passed through the small notch in the side of the board, and will be attached to a cable coming from the external driver board.

LED Changes

The LED's used in these flashlights are of the LUXEON III or "Star" type (see figure 7). The original LED produces white light. Field tests had shown a significant nuisance factor to shining white lights into the darkness and the preference is to use either or both a Red 630 nm or Infra-Red 850 nm LEDs. The IR light is significantly better as the silicon detector efficiency is better at that wavelength, but the Red LEDs allow visual verification of focusing and pointing. The LEDs are available in 1, 3 and 5 Watt versions in a variety of colors and the style used here are of the . K0XL used 3 W LEDs and the FET switching transistor seems to handle that OK. The current will increase from 600 mA to 1.2 A for the 5 W devices.

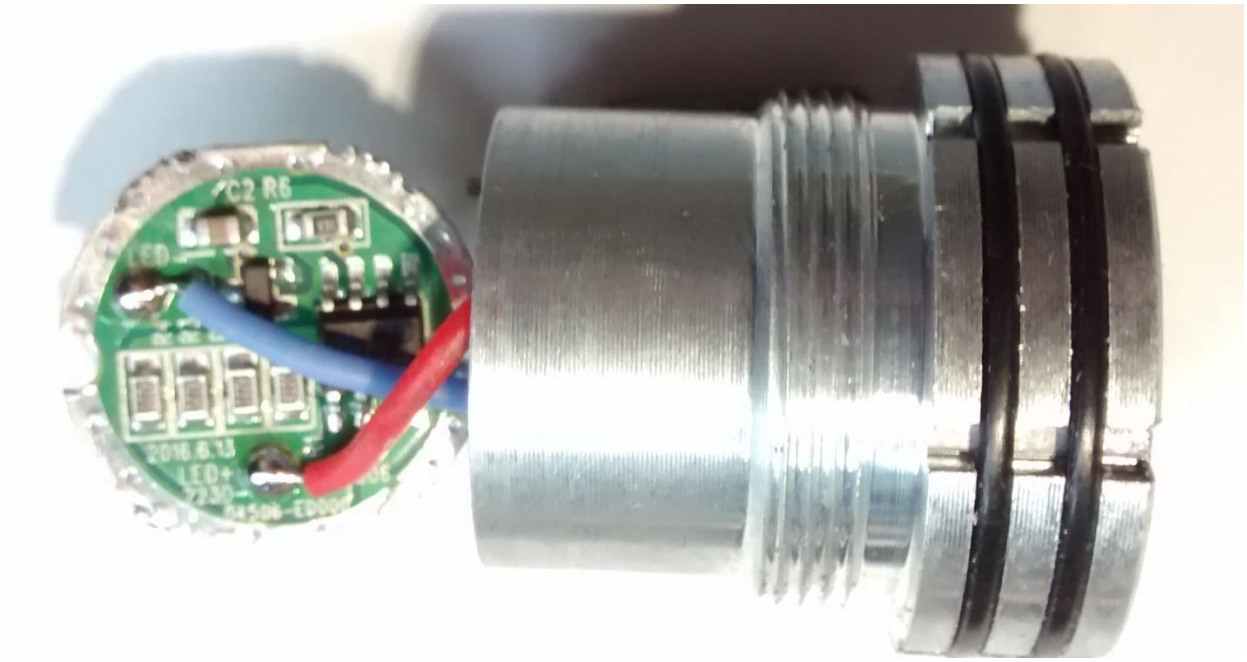


Figure 4 PCB Removed from LED Assembly

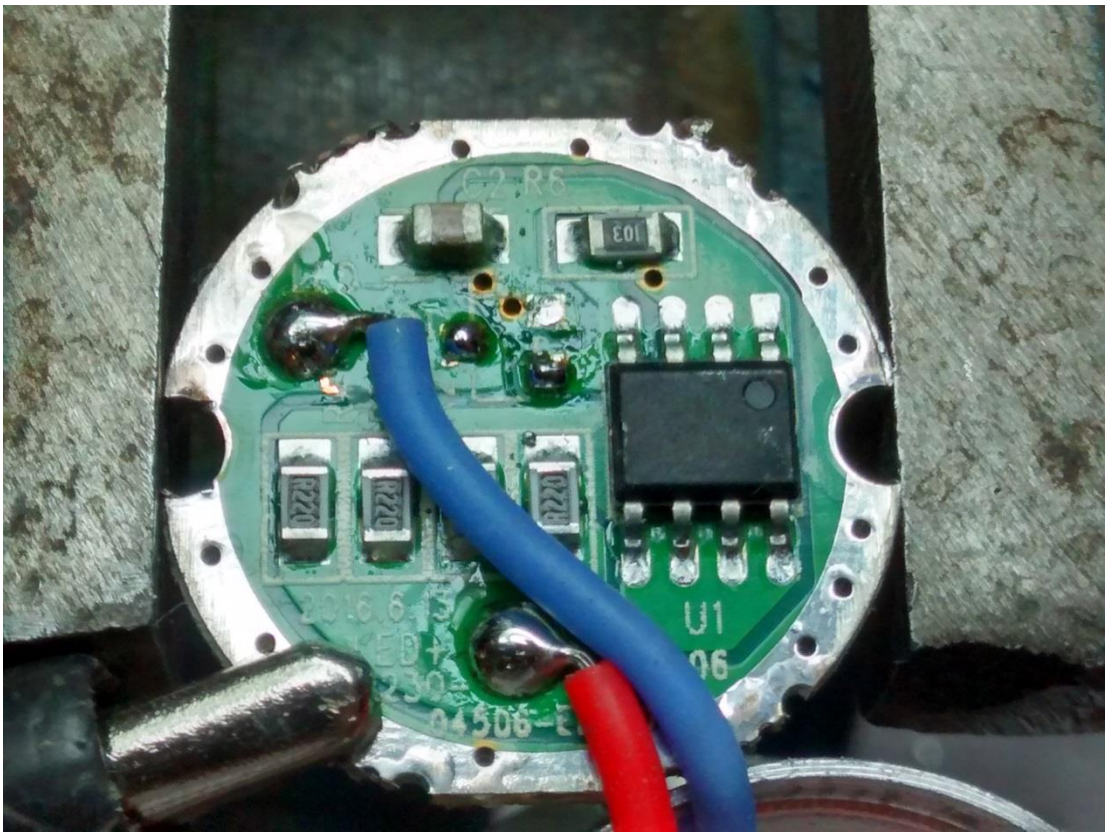


Figure 5 PCB with Surface Mount Part Removed

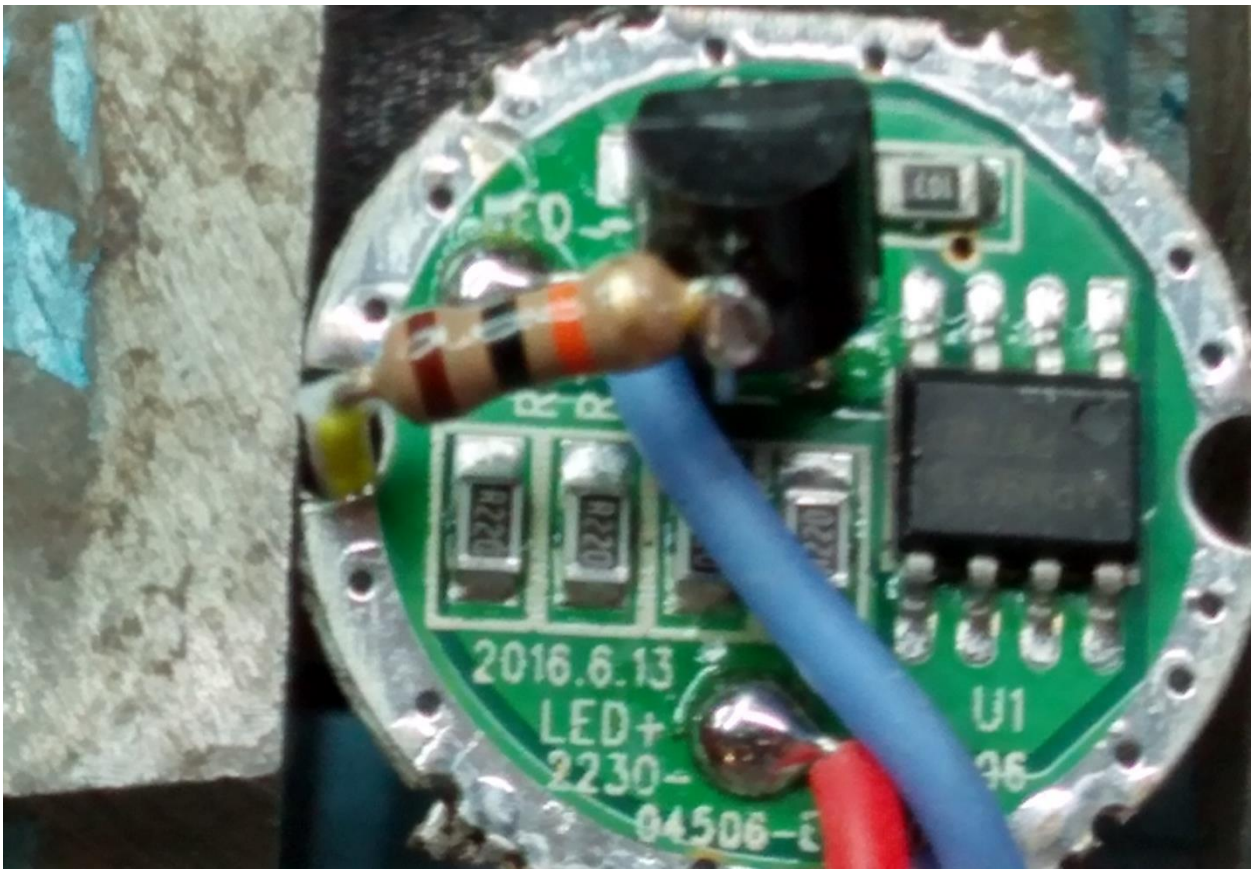


Figure 6 2N2222 & 10 k Resistor Added

LED Changes Continued

In order to change the LED here are the steps I used:

-Unscrew the bronze/ copper colored ring shown in figure 3 using the “snap ring” tool. You will find a clear plastic insulation disc underneath that must be reused later.

-You can now extract the LED PCB, although it may stick down with the heat sink compound on the underside.

-Remove the Red and Blue wires going to the LED and reinstall on the new LED. Add heatsink compound to the new LED, and using the clear insulation disk and the bronze/copper colored ring, secure the new LED into the assembly.

NOTE: You may need to drill out the retaining ring to avoid shorting out the diode if the insulating disk does not cover the LED contacts

-Remove the Red wire from the PCB and install a fixed resistor used to limit the LED current. I used a single 4.7 ohm 2 Watt resistor, which is marginal dissipation wise when used continuously at full duty cycle. K0XL originally used 3 smaller value resistors to accomplish this.

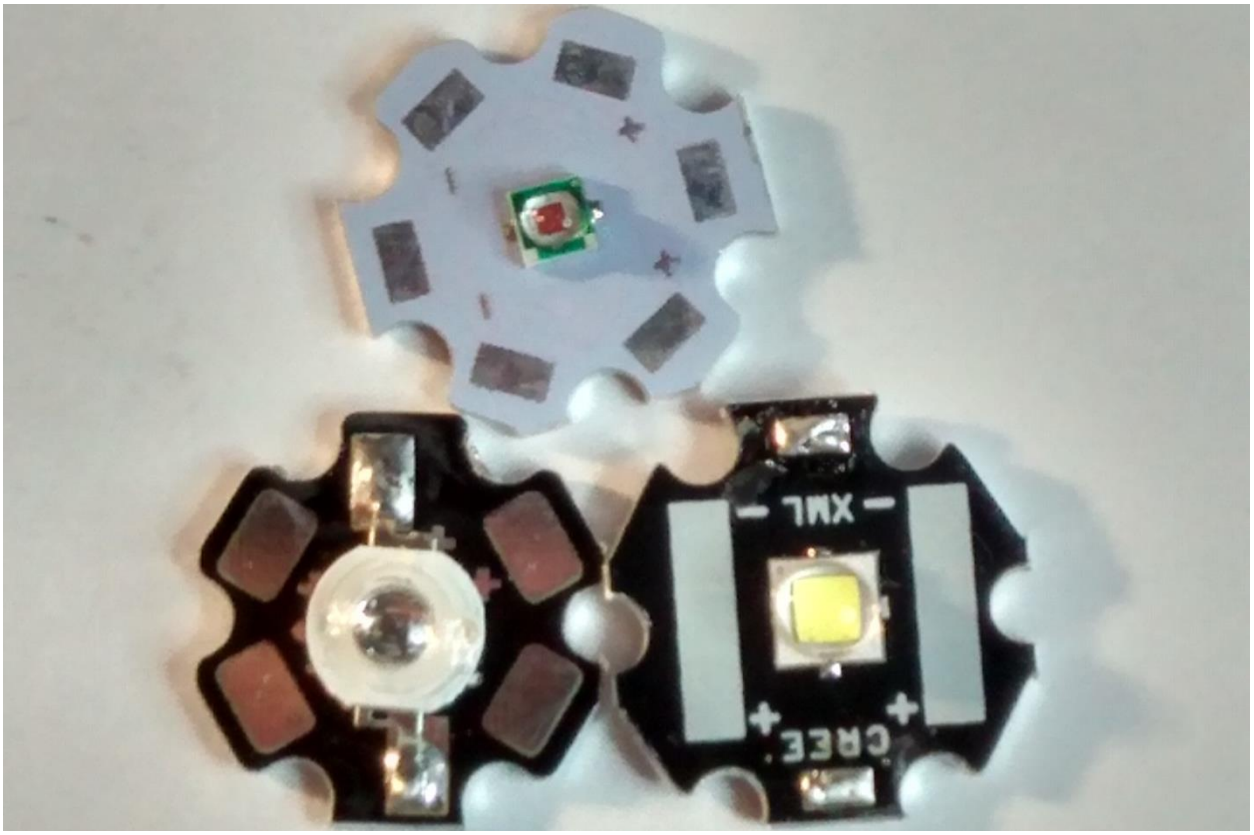


Figure 7 LUXEON III or "STAR" LEDs

Final Reassembly

The PCB can now be reinstalled in the base of the LED assembly shown in figure 4. Once the PCB is re-installed I removed the spring contact that was soldered to the bottom in figure 8. I then attached 2 wires to the bottom that will be used for the 5 Volt power supply feed.

Next a small Teflon coaxial cable was brought in to supply drive and attached to the ground and to the 10 k resistor which goes to the2N2222 transistor as shown in figure 9.

This is a good time to test the LED assembly before Final reassembly. If all is correct the current should be approximately 6oo mA with a 5 Volt supply.

Next remove the yellow button from the bottom battery cover. Now push the white push button out of the cover (friction fit) and remove entirely. Install a ½ inch grommet in the hole, which will now be used to route the 5 Volt supply and driver cables out of the final assembly.

Reinstall the LED module into the main body, tightening with the “snap ring” tool. Reinstall the Lens and retainer. Route the cables through the ½ inch grommet and reinstall the bottom battery cover to the main body.

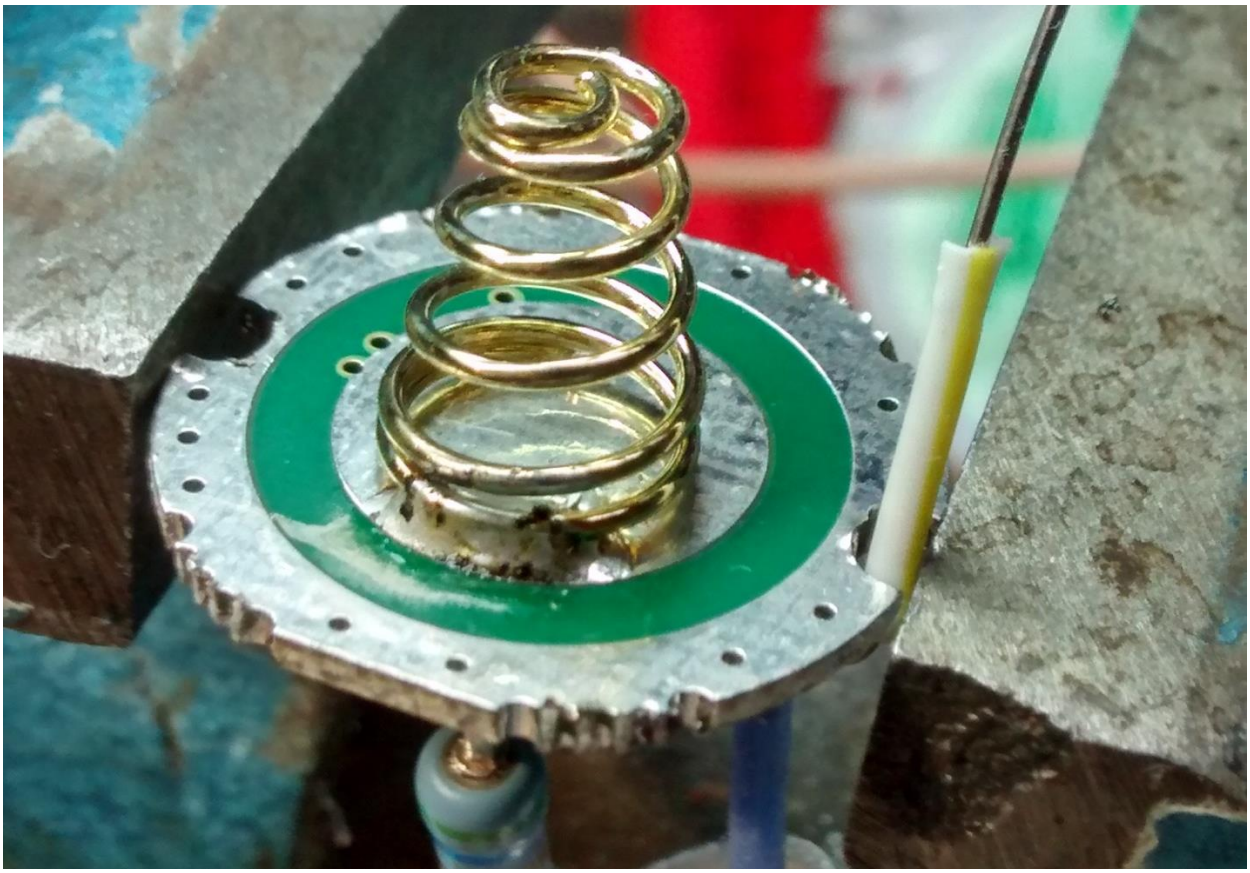


Figure 8 Bottom of PCB showing spring to Be removed

Use of Flashlights

These flashlights are ideal light sources, having high output and with its adjustable lens are able to focus on one of the page magnifier Fresnel Lens in order to improve the transmit gain. I intend on using both LED types, a Red LED version initially for lining up on the path, and then changing over to an IR LED for the actual communications.

There are some higher output flashlights available but at a significant cost and it is not known how easy these will be to modify for Red or IR LEDs. This is something for future work.

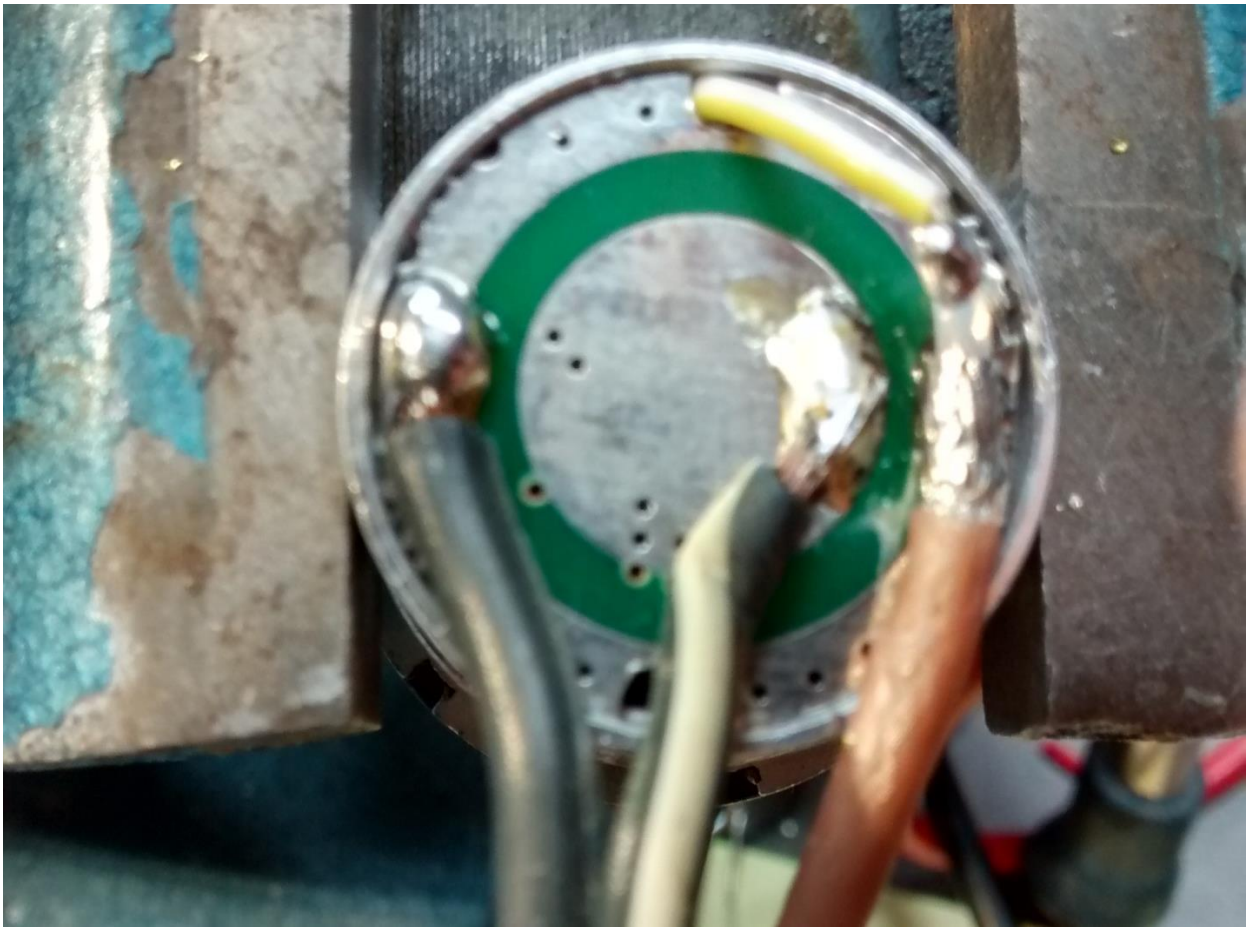
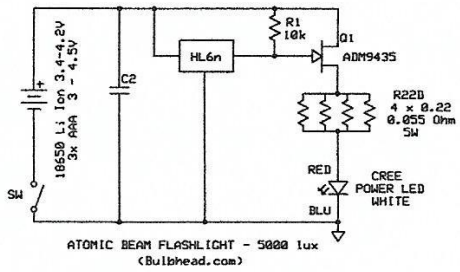
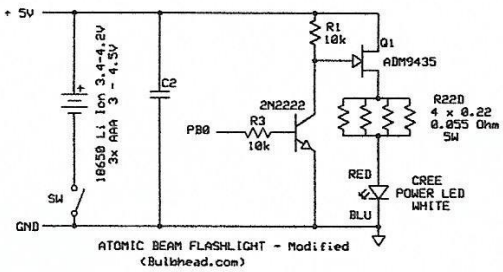


Figure 9 Power and Coaxial Driver Connections to PCB

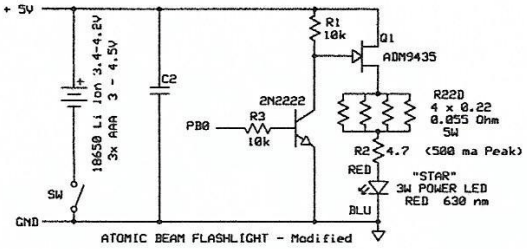
APPENDIX



ATOMIC BEAM FLASHLIGHT - 5000 lux
(Bulbhead.com)

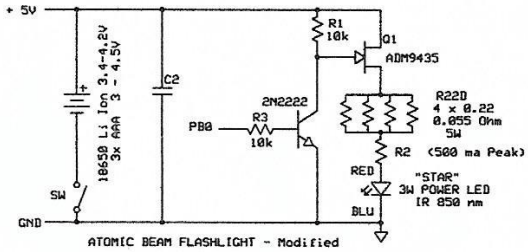


ATOMIC BEAM FLASHLIGHT - Modified
(Bulbhead.com)



ATOMIC BEAM FLASHLIGHT - Modified

Adjust R2 for 1A - 100% Duty Cycle
Adjust R2 for 2A - 50% Duty Cycle



ATOMIC BEAM FLASHLIGHT - Modified

Adjust R2 for 1A - 100% Duty Cycle
Adjust R2 for 2A - 50% Duty Cycle

Can use Internal Battery OR External 5V to power LED
REMOVE INTERNAL BATTERY WHEN USING EXTERNAL POWER

REMOVE BATTERY WHEN NOT IN USE - SW MIGHT BE ON WITH NO INDICATION

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K0XL LED DRIVER Page 2
RC Jahnke V 2.0 07/01/2018