Olympus BHM Microscope LED Illumination
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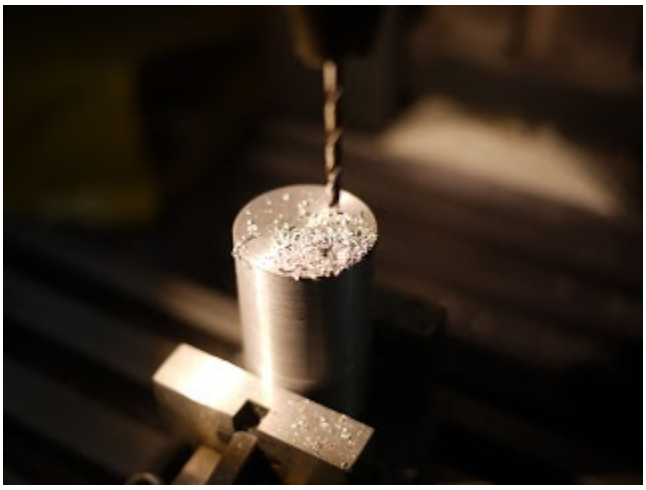
I'm involved with electronics, both at work and at home and now and again I blow up an integrated circuit or have some dismantled equipment with unidentifiable components in it. Both of these situations can be investigated using a microscope capable of magnification high enough to view the very small circuitry on an IC. While watching Dave Jones of the EEVBlog on YouTube unbox and fire up his Olympus BHM microscope, I was impressed with the images he showed of IC dies. A few weeks later and I'd bought my own BHM. Mine was bought without any objectives, though, so some more days passed before I had managed to buy some plan objectives. (One of these objectives turned out to be slightly radioactive, but that's another story).

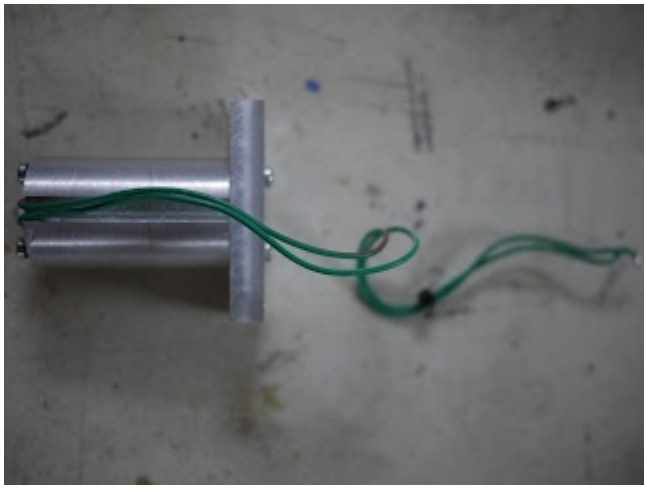
The BHM was fitted with what I believe is standard filament bulb illumination driven by a variable transformer power supply. The PSU is quite nice, the bulb not so much, there's a lot of orange tint to the illumination. I decided to build an LED replacement, so ordered some Cree LEDs and set about making a way to hold one. The LED I ended up using is a 1W version, although I did buy some 3W versions with identical mounting dimensions.

I had a cylinder I had cast from some melted down scrap, and turned it to the diameter of the lamp holder that fits on the back of the microscope. After it was the correct diameter I drilled some holes that hold the LED into place:

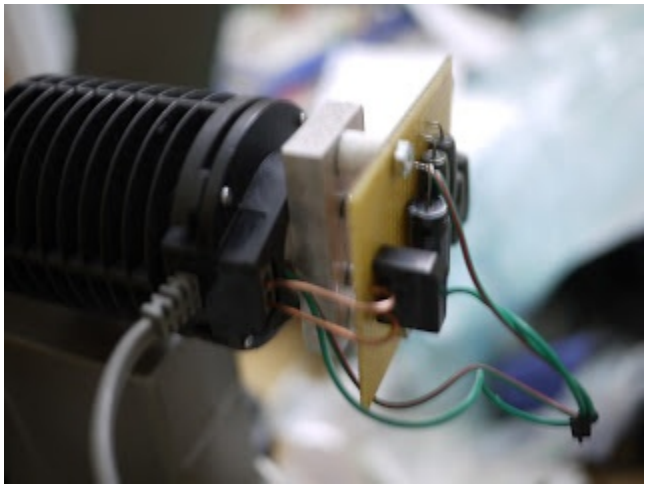


The LED is then fixed in place with three screws:

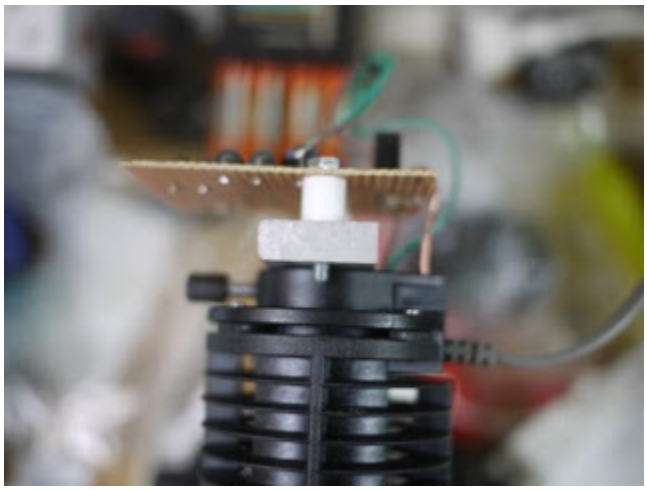
I don't know if this is how the LED was designed to be mounted, but it works well. The back of the LED is made of metal and is used to transfer heat to whatever heatsink is being used. In this case the aluminium cylinder is a heat sink that carries the heat out of the back of the Olympus fitting. I had bread-boarded the circuit and checked how hot the circuit and LED got and it doesn't get very hot at all. This was with the 1W LED, I haven't run the 3W LED in this system as the 1W is sufficient for my needs, but I suspect the heat sinking would be fine for the higher dissipation devices. The connections for the LED run in a channel milled down the length of the cylinder. I put a block of aluminium on the end as a mounting plate for the circuitry and as extra heat-sinking outside of the light holder.



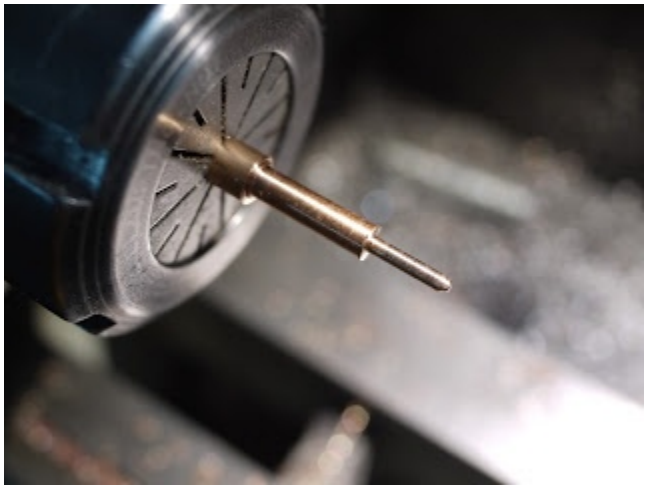
The PSU outputs a.c. which is fine for the bulb but not so good for the LED. I added a bridge rectifier, some dropper resistors and a capacitor to convert the a.c. to a d.c. supply. This mounts on the block on the end of the assembly. Initially I used bits of wire to connect the circuitry to the PSU:



3D printed stand-offs hold the circuit board away from the aluminium block:



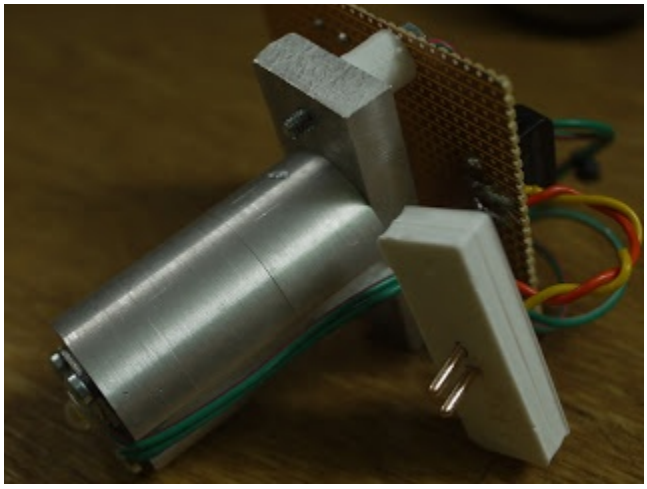
I wasn't very happy with using wire to connect the PSU and didn't fancy hunting around for a suitable connector, so I made one. I turned a couple of pins from phosphor bronze:



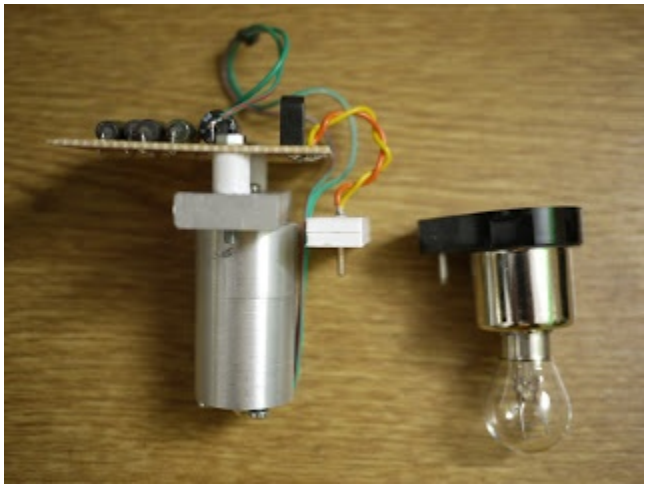
A two part 3D printed shell holds the pins in place. The pins have a shoulder that holds them in to the shell. The pins turned out nicely:

Here's the light in place and generating photons. The LED is positioned very close to the position the bulb filament is in when fitted, and I end up with a pretty even illumination across the field of view.

The light and the connector look like this when assembled:



I may add bolts to hold the connector together, but the pins are a tight fit so I may not. Here's the original bulb in its holder as a comparison:



The LED leads are soldered across a capacitor for now, I'll tidy them up later. Once I've run this for a while I'll make a PCB to mount the components anyway, so this is probably temporary. Having run this for a while I think I may need even more smoothing capacitance as I do get some flicker when I'm using a camera. When viewing directly the flicker is imperceptible.

I have made a video showing the illuminations system:

https://www.youtube.com/watch?v=G20T_qkYCmE

There's a write up on my blog here:

https://trochilidae.blogspot.co.uk/2018/01/olympus-bhm-microscope-led-light-bhm.html

Comments to the author, Andrew Menadue, are welcomed, email:
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