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To: Bob Hamilton, NanoLab Equipment Manager
From: Greg Mullins, Senior Equipment Engineer

Re LED Microscope Illumination Project

Scope: Converting the illumination source of a Nikon Optiphot 150 from incandescent lamp to LED source to dramatically reduce the frequency and expense of bulb replacement and improve the overall quality of light in the viewing field.
Parts purchased thru LED Supply (ledsupply.com)
Project cost: ~ $45.00

Parts List:

Cree XML2 Neutral-White High Power LED ~ $10.00
(p/n CREEXML2-NW296)

LUXdrive BuckBlock – 700mA Constant Current LED Driver w/Dimming ~ $18.00
(p/n 0A011-D-V-700)

Wall-Wart Power Supply – 12vdc, 1A ~ $10.00
(p/n 12VDC10A)

Heat-sink – Finned w/ Adhesive Tape ~ $5.00
(p/n HS13137)

Potentiometer – 20 kOhm ~ $2.00
(p/n 20K-POT)

In replacing the brightness of an Osram 12v/100w lamp, I selected the Cree XML2 LED for its 4000K color temperature and capability of handling upwards of 3000mA of current. Not knowing exactly how much brightness would be required; this LED gives enough headroom for many applications. As I want this to fit into the current lamp socket, I acquired two lamp leg pins that could be soldered to the base of this LED package to allow it to fit into the lamp socket, making them long enough to be inserted, with the LED sitting in the center of the optical path.

Because this LED can get pretty warm, I selected a recommend heat-sink. In looking at the microscope lamp housing, I found that I could cut this heat-sink in half, fit it into the housing without issue, and still provide good thermal control. It comes with a piece of thermal adhesive tape to fasten it to the backside of the LED.

I chose the LUXdrive 700mA Driver for its capability of a dimming function, expecting and finding that 700mA was quite capable of providing the brightness for the task. Had I needed more intensity, I could have used the LUXdrive 2100mA Constant Current Driver (p/n 0A009-D-V-2100), as it would still be under the Max drive current spec of the LED. Both drivers provide dimming capability with the addition of a 20 kOhm pot.

A recommended power source for this project was a simple 12vdc/1A wall wart power converter that was within the input voltage spec of 10-32vdc of the LED driver.

Installation:

The nice thing about these components are that they are designed thin & compact, fitting well underneath/inside the microscope housing. I found that using a double-sided 3M Dual Lock reclosable fastening system (better than Velcro) worked great in holding things in place. Here's how I connected it up.

1. In wanting to use the AC connection of the microscope, I removed the bottom cover of the scope and gained access to the electronics of the lamp controller. Clipping the power lines that come into the lamp power supply (keeping the AC In and ON/OFF switch in tact), I rerouted them to the Wall-Wart power supply (which is a single housing that normally plugs directly into a wall receptacle) and soldered the AC directly to the plug leads, encased with shrink tubing.

2. I attached the DC side of the Wall-Wart output to the Vin (+/-) lines of the LED driver, noting the positive/negative connections.

3. Next, verified the microscope wires from the power supply out to the lamp to ascertain proper polarity of the new DC connection, then clipped and wired up the LED +/- lines of the LED driver.

4. Lastly, I mounted the 20 kOhm pot into the base of the microscope, and then wired the pot up to the DIM/DIM-GND lines of the LED driver.

Once I verified all my connections again and tied up any loose wiring, I inserted the LED to the approximate center of the optical path and turned it on! Fiat Lux! I took the opportunity to clean up the lamp housing optical path, and then replaced the base electronics and lamp housing covers. Next I turned the power back on and set the brightness to max to let it warm up. After an hour, there were no noticeable thermal issues, and the quality of illumination was very clear and uniform. The intensity was very useable – not too bright, and, as with an LED, as you turn down the brightness, there is a voltage cut-off point that shuts the LED off. At its lowest intensity before cut-off, if for some reason it is still too bright, there are two options on the microscope to achieve a lower intensity – a built-in ND filter, and an iris in the illumination path – both worked great for this purpose. Also of note, the Dark Field operation of this modification worked very well, with nice, clean imagery.

Make sure to visibly label the microscope regarding your modification so that someone doesn't try to replace the LED with a regular lamp. I did leave all previous components and connections in place in case there was a desire to return it to its original state.

The appended photographs provide an overview of how things came together.

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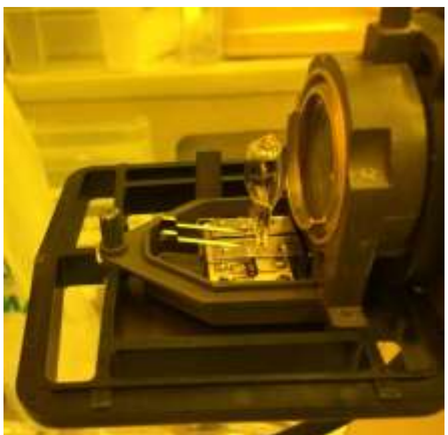

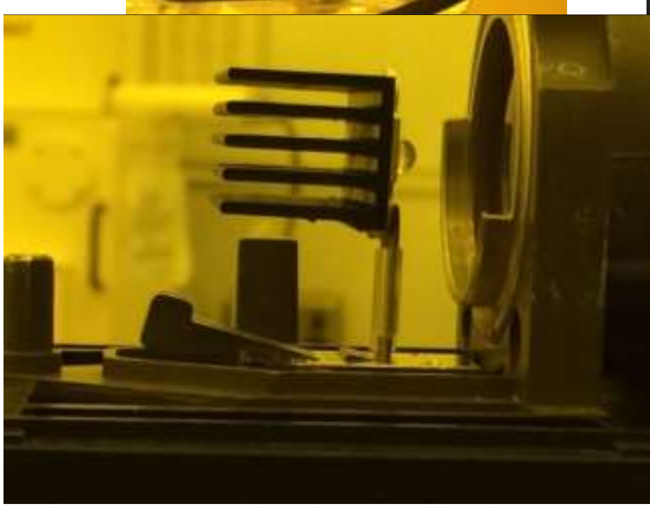

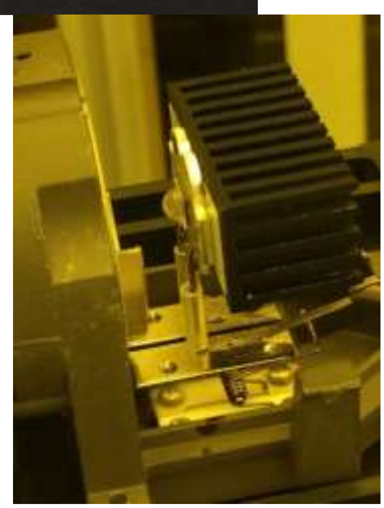

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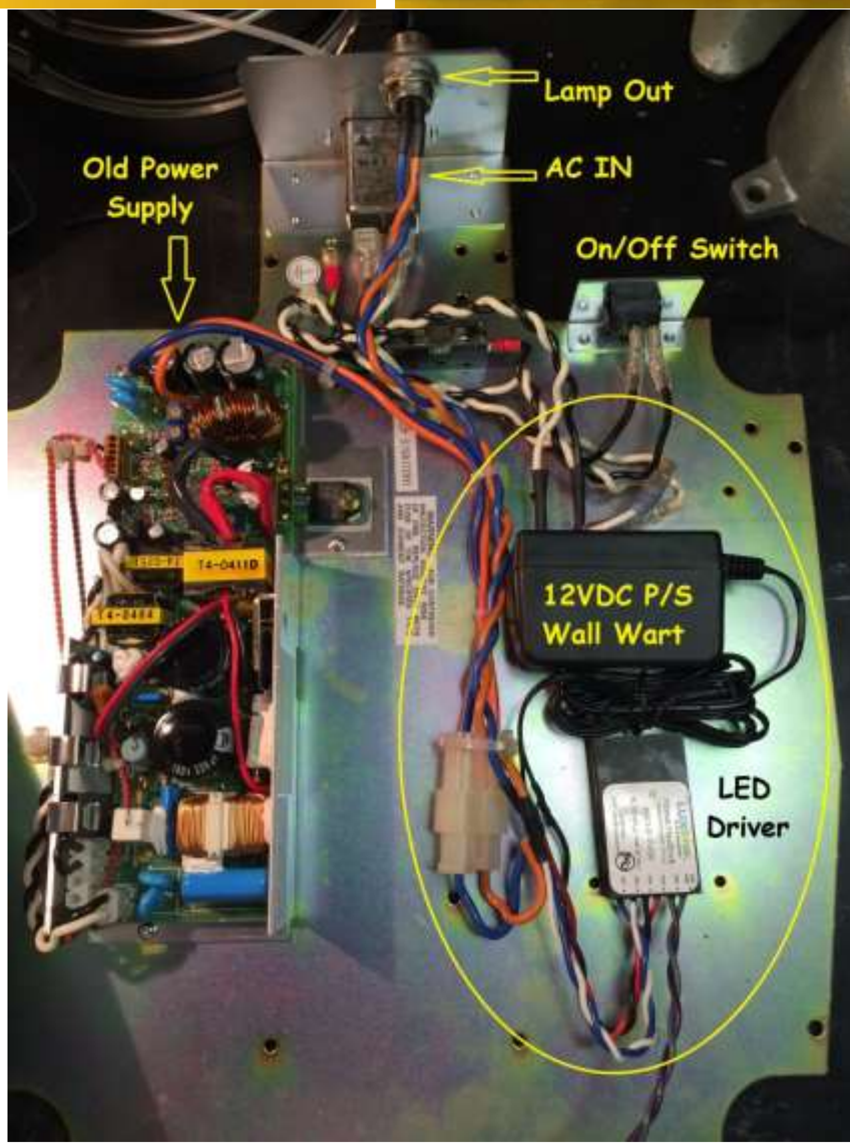

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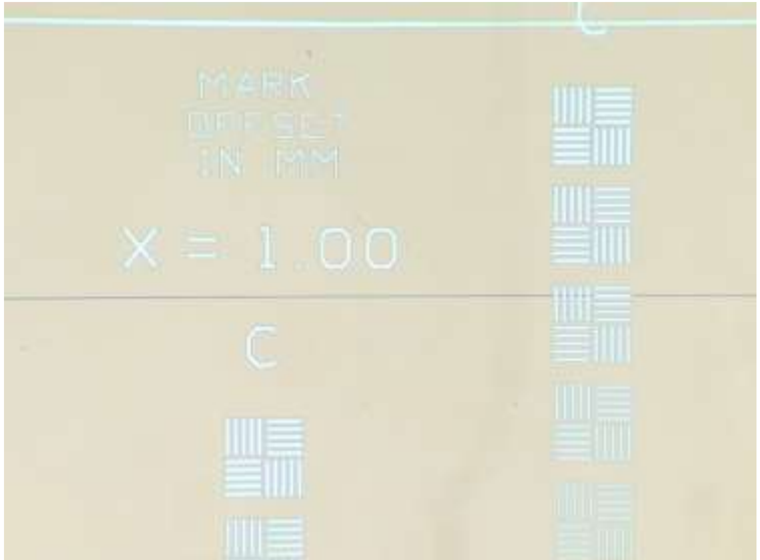

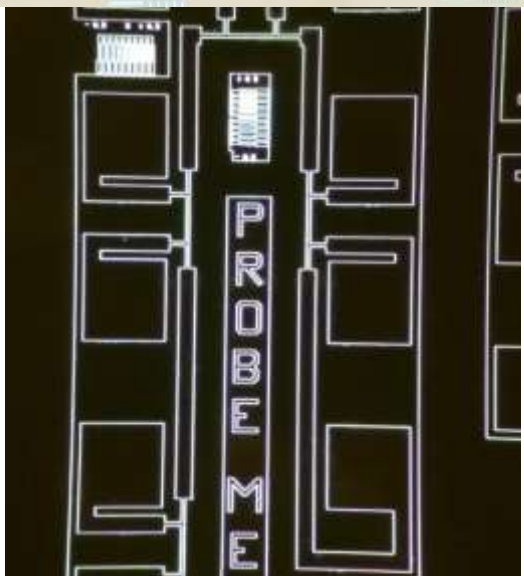

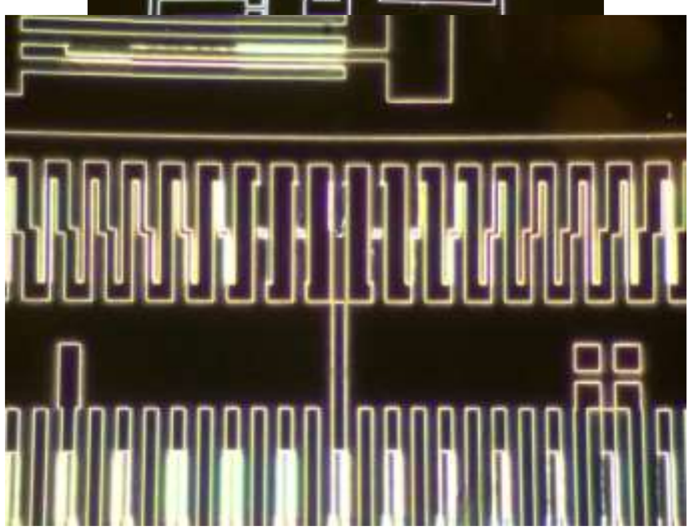

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