LED lamp cycles on and off, why?

Martin Rowe - November 14, 2016

When renovating my home, I had three recessed lighting fixtures installed above the desks in the office. Six more are in the kitchen, four in the living room, and one each in two bedrooms. At first, all the BR30 lamps were 65 W incandescent. Given that the office and kitchen lights can be on for hours at a time, I wanted to cut energy use and replaced the flood lamps with LEDs. All have worked as expected for over two years, except one.

After using one of the office BR30 LEDs (Feit Electric from Costco) for over a year, I noticed it would cycle on and off every few minutes after about 30 minutes of use. Suspecting a heating problem, I removed the lamp from the fixture and installed it in a standing lamp. Sure enough, the LED stays on because the heat was no longer constrained in the recessed fixture. The question is: Why does only one of the LED lamps cycle on and off? Does the temperature-sensing circuit turn the LEDs off too soon?

Figure 1 shows the lamp. It has a hefty heat sink. It's rated at 13 W, 750 lumens, 145 mA.
It was time to make some measurements. First, I wanted to see the times between when the lamp cycles on and off. That was easy, just install the lamp in the fixture above my desk. Using my phone's stopwatch, I recorded the on/off times. **Figure 2** shows the cycle times.
Figure 2. The LED floodlight turns on and off as shorter intervals the longer it's powered.

The leftmost "1" in the horizontal axis indicates when the lamp was turned on after being off all night. The lamp turned itself off about 30 minutes later, shown by the leftmost zero. The lamp cooled to the point where it turned on again, about 14 minutes later. After another 6.7 minutes, the LED turned off, and so on. You can see that the on/off eventually settled down to between about 1.6 min. to 2.3 min. The entire elapsed time is about 2½ hours.

Now it was time to compare the operating temperature of the cycling lamp to a good one. Here’s where things get interesting. Using a DT9828 USB data-acquisition module and a Type-J thermocouple (TC), I attached the TC to the base of the cycling LED. Figure 3 shows the end of the thermocouple wire taped to the base.
Figure 3. After creating a thermocouple by twisting the bare wires together, I taped the TC to the base of the cycling LED lamp.

I set the DT9828 to sample the temperature at 1 sample/sec for 2½ hours, taking 10,800 samples. As expected, the temperature profile tracked the times on/off cycles. When the lamp changed state, the temperature would continue to rise or fall for 30-to-60 sec before changing direction. That's expected, given the heat sink's thermal mass. Figure 4 shows the temperature. Remember this is not the temperature at the LED junctions, which will be considerably hotter. It's for comparison purposes only.
Figure 4. A plot of the lamp's case temperature shows a peak at 44°C. After that, the temperature cycled around 40°C. Click to enlarge.

I repeated the measurement for a properly working lamp. As you might expect, the temperature plot is different because the lamp stayed on for the entire 2½ time period. As Figure 5 shows, this lamp stayed on despite rising to a higher temperature, nearly 60°C, taken at the same location on the base.
Figure 5. A good LED lamp stays on, even at temperature higher than those where the faulty lamp turned itself off.

What caused the cycling LED lamp to cycle? There are two likely causes.

- The temperature-measuring circuit caused the lamp to turn off prematurely.
- Insufficient thermal conduction from the LEDs to the heat sink.

Opening the cycling and good lamps revealed a difference. The lamps diffuser pops off quite easily, even with my short fingernails. Figure 6 shows the 22 LEDs on the cycling lamp.
Figure 6. The cycling LED lamp with the light diffuser removed shows a board with 22 LEDs held in place with screws.

To get a better view of the board, I removed the white bezel. In Figure 7, you get a closer view of the board.
Figure 7. Removing the bezel let’s you see what appears to be a lack of thermal paste.

Now, take a look at Figure 8, which shows a good LED lamp. Note the thermal paste surrounding the board, which is missing from the lamp in Fig. 7.
Figure 8. The good LED lamp had more thermal paste than the cycling lamp. But, other good lamps didn’t have thermal paste bulging out from under the board.

The time had come to remove the PCB from the metal structure. Doing so revealed that some thermal paste was there (Figure 9), but was that enough given how the white paste came out along the edges of the good lamp? A quick run to the electronics store and I had more thermal paste.
Figure 9. The lamp manufacturer did place some thermal conducting paste user the LED board, but adding more made no difference.

Unfortunately, adding thermal paste made no difference, for the lamp in question continued to cycle at about the same rate.

Now what? The next step is to repeat the temperature measurements and see if adding thermal paste made any difference.

I contacted Feit Electric by e-mail, asking that my message be forwarded to engineers. My message included the plots in Figures 3 and 4. A reply came from customer service, who will send a replacement lamp. But, that's not the point. I want to know why this one lamp cycles and how to fix it.

Suggestions? It might be time to crack open the lamp and get access to the control circuit.

Also see

- Incandescent lamps and service life
- LED bulbs can bring heat
- Teardown: What killed this LED bulb?