LED Anti-Collision Lights

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1) Overview

I am building a Lancair 360, which is a low-drag composite aircraft. I wanted to build an LED strobe and position light system that would not increase drag. While there are several bright LED aviation strobe systems commercially available, most protrude from the wingtips. In contrast, the system described here fits inside clear fairings that follow the natural shape of the wings. In addition to reducing drag, by building it myself, I was able to use the latest LEDs, making the strobes brighter than many commercial systems. I was also able to provide large-area heat sinks to spread out the heat produced by the LEDs.

On the Lancair the entire trailing edge of both the elevator and rudder are moving control surfaces. Adding LEDs here would mean adding moving weight, which must then be counter-balanced with lead or tungsten on the other side of the hinge pins. To avoid this weight, instead of putting the LEDs on the rudder, I decided to place rear-facing strobe and white position lights on both wing tips. Seen from behind the aircraft, from any angle, at least one wing tip is always visible. Actually, both wing tips are visible from all but a small range of angles.

I made my own lexan fairings to cover the rear-facing LEDs.

For forward facing angles I used LEDs inside the clear wing tip fairings supplied with the Lancair kit. I mounted the LEDs to a heat sink plate made of 1/8 inch thick aluminum.

2) LED choices.

I have been working on this project on and off for several years, and have bought samples of quite a variety of LEDs. Recently, LEDs have improved considerably in intensity and also prices have come down. Finally a really nice, economical unit is available. The LEDs I used for the forward facing strobes are type BXRA-C1202-00000 by Bridgelux, available from Newark Electronics for $17.30 each. These draw 2.2A each at 14.2V according the data sheet, well below the maximum pulsed current, 2.8A. Assuming about 0.1 ohms wiring resistance and 14.2 volts at the supply bus, the operating current should be about 2.1 amps or almost 30 watts for each LED array.

A look at the I/V curve shows that there is a slight risk of over-current when these LEDs are used directly across a 14 V source. If the voltage regulator fails or is misadjusted to above about 15 V, the LEDs could suffer excessive current. This might burn out the LEDs, but of course 15 V would wreck havoc throughout the electrical system…starting with the battery. I will have a voltage monitor and overvoltage warning in the plane. I assume I would shut down the alternator if I saw 15 V, so I think the risk of over-current damage is minimal. In any event, the LEDs are held in place with screws so they can be replaced if they ever do fail.

For the rear-facing strobes on each wing tip I wanted an LED that did not take up as much space as the Bridgelux devices. I used a series string of three LUW W5AP-MYNY-5P7R from Osram, which I ordered from Mouser for $11.70 each. I mounted three in a row inside the trailing edge of the wing tip. Unfortunately, this part is now obsolete and if I were starting over I would use W724C0 from Seoul Semiconductor instead. Four of these in series would act very much like one Bridgelux device, drawing about 2 amps without need of a current limiting resistor.

I attached the Osram devices to a heat sink with “Arctic Ceramic” thermally conductive epoxy. These devices have a metal mounting surface that must be thermally attached but electrically insulated. The arctic ceramic does this, but do be careful not to push the LED too hard into the epoxy or it might make electrical contact with the heat sink. Check for isolation with an ohmmeter before the epoxy sets.

3) Strobe Intensity.

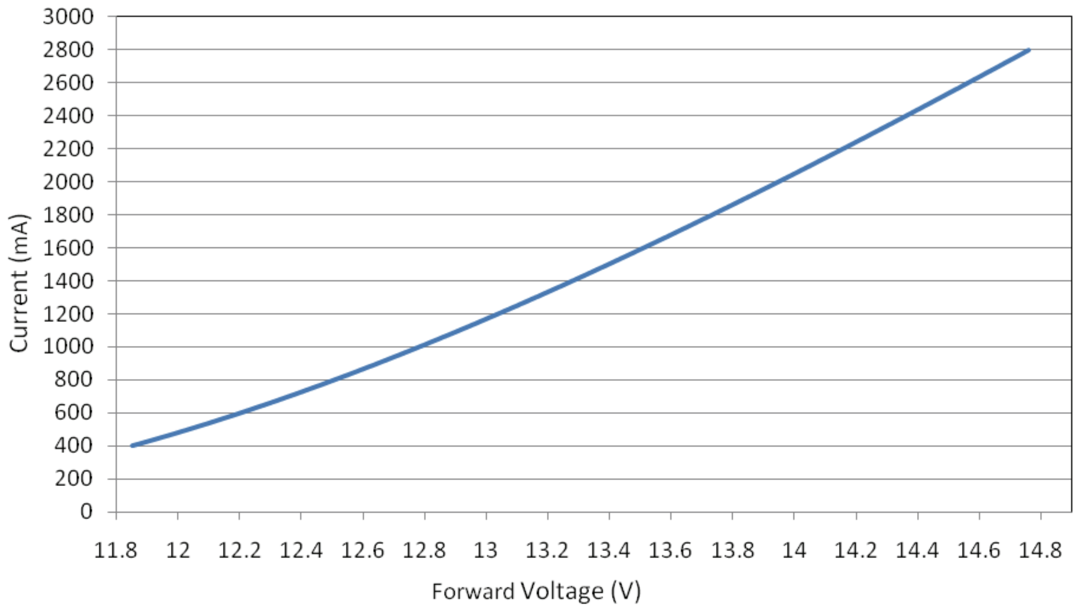
At 2.1 amps the Bridgelux LEDs each put out about 575 candellas (cd) in the face-on direction. This falls gradually to about half the face-on value at a 60 degree angle from the normal. The circuit I built flashes the strobes in a pattern of two 100 ms pulses on the right then two on the left, repeating each second. Applying the FAA formula for effective intensity to this pattern, the peak intensity is reduced to an effective intensity 40% of the peak value, which is 230 cd, face-on. The FAA requires that the effective intensity be at least 400 candella within 5 degrees above or below the horizontal plane, which means that two or more LEDs must be visible at any position in the horizontal plane. This is why I have three on each side.

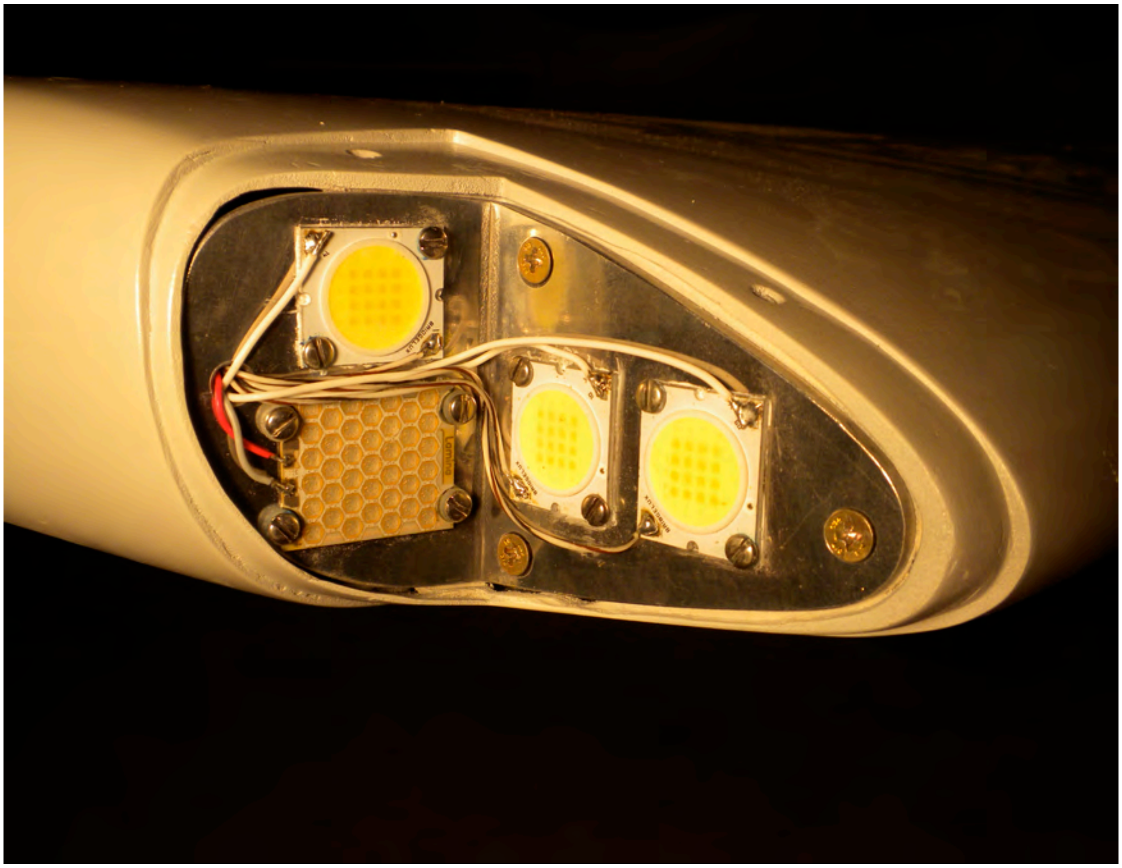
For about 10 degrees each side of the forward direction the viewer sees LEDs on both wing tips and would see 4 flashes each second.

In the horizontal plane the FAA regs are satisfied, but if I had more space in the forward facing fairings I would add one more Bridgelux device. Another way to get more intensity would be to use W724C0 LEDs instead of the Bridgelux devices. These would be epoxied to the forward-facing heat sink plate.

For angles outside +- 5 degrees the intensity provided by this arrangement far exceeds FAA requirements.

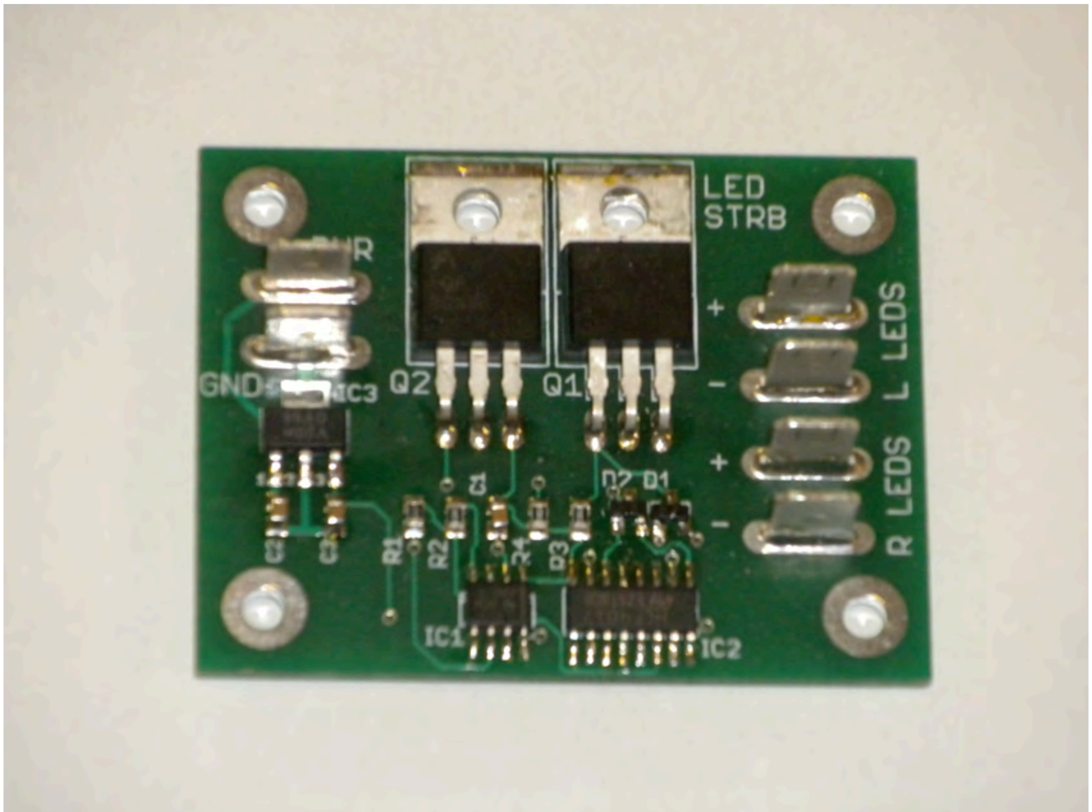
Figure 18: Typical Current vs. Voltage, BXRA-N0800, BXRA-W0800 and BXRA-C1200



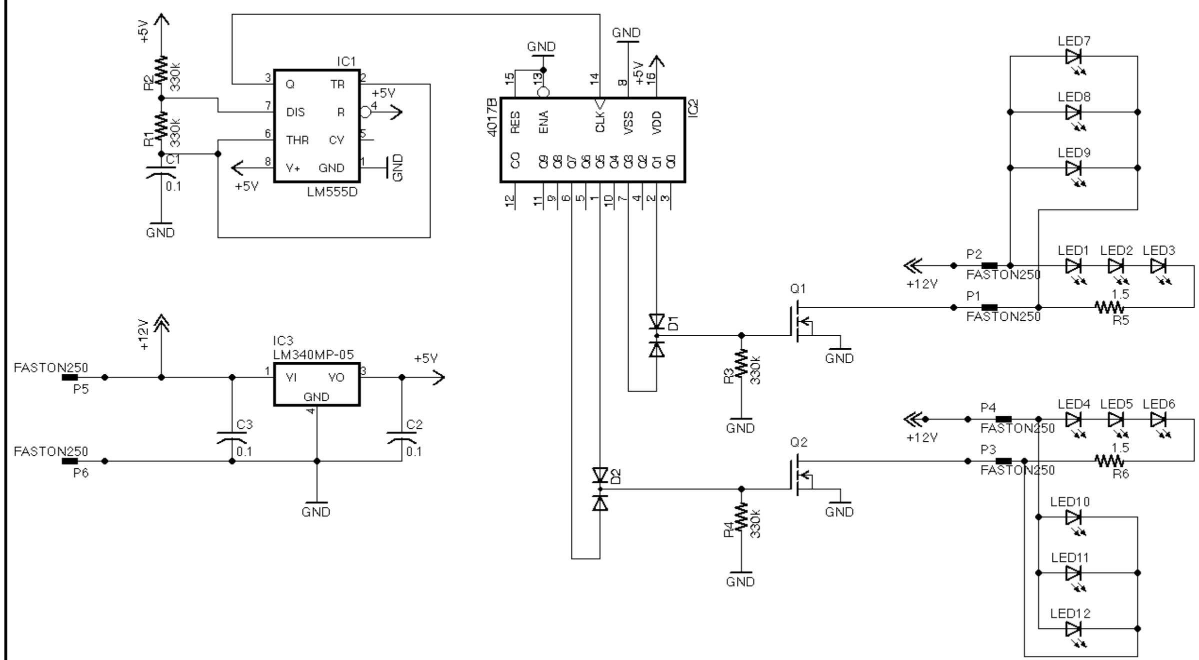


Forward and side facing strobe LEDs. The yellow devices are the Bridgelux LEDs which have a pulsed input power of about 30 Watts each. The fourth device shown is the Green LED position light. This device was made by Lamina Ceramics (now Lighting Science) a few years ago, but seems not to currently be available. I have not yet found an equivalent.

Rear facing LEDs. The three on the right are the strobe LEDs. The one on the left is the position light. All four are glued to an aluminum block. The bottom frame shows the block and a larger area heat sink attached to it on the underside of the wing.



I laid out a circuit to drive the strobe LEDs using the Eagle Printed Circuit program.



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