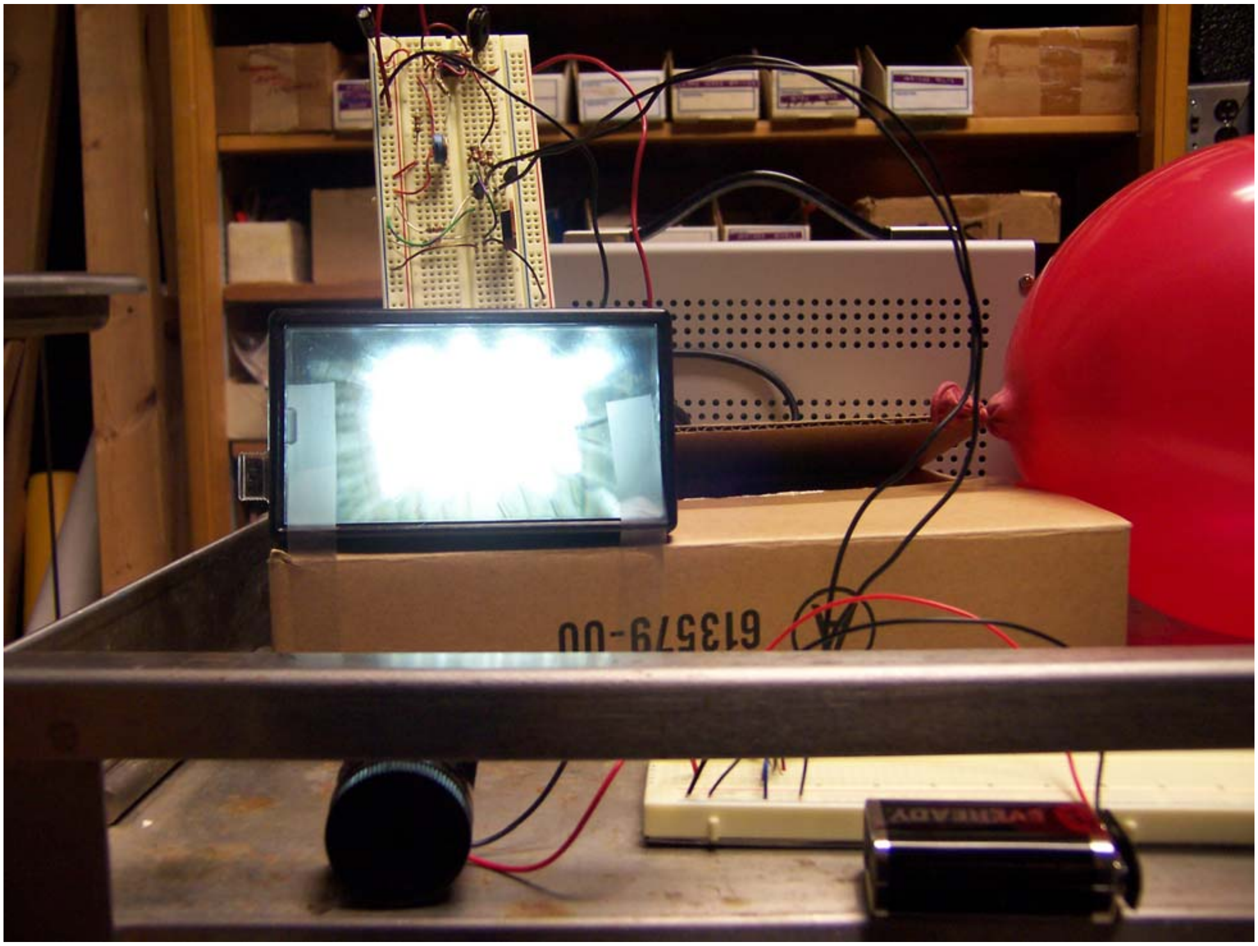
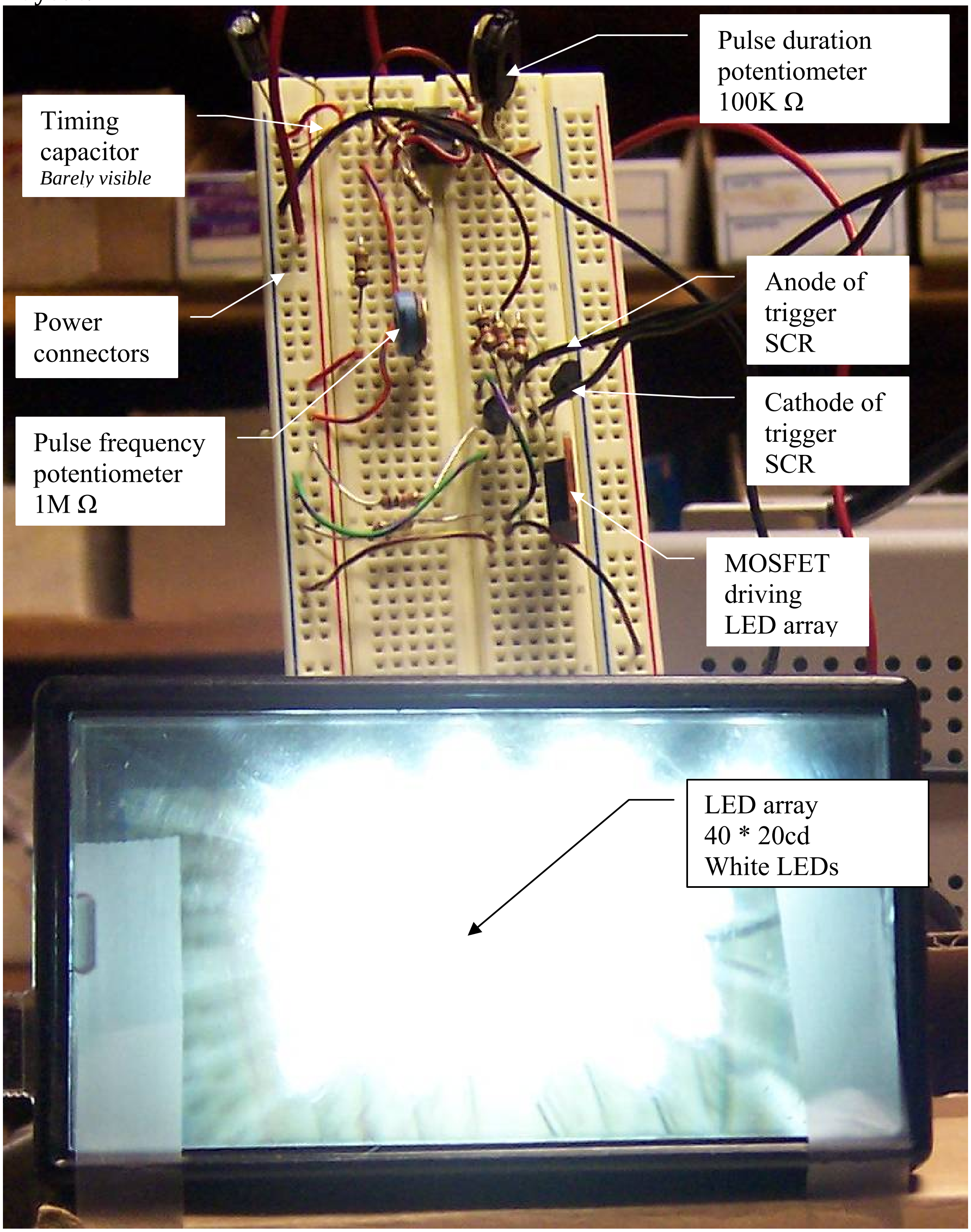


North Carolina School of Science and Mathematics
LED Strobe Light
Built by Patrick Wong '05.

**Description:**
The LED Strobe Light is a frequency generator-based pulsed LED driver. In addition to adjusting the time between pulses, the LED Strobe Light's light pulse length can be adjusted as well. In addition, different "clock" capacitors can be used with the LED Strobe Light to generate different ranges of frequencies. The device is powered from a power supply capable of withstanding large current pulses – typically *not* a battery. In addition, the LED strobe light can be triggered by a sound trigger, so as to activate the stroboscope only when the sound trigger is activated. This allows the stroboscope to be used as a flash.

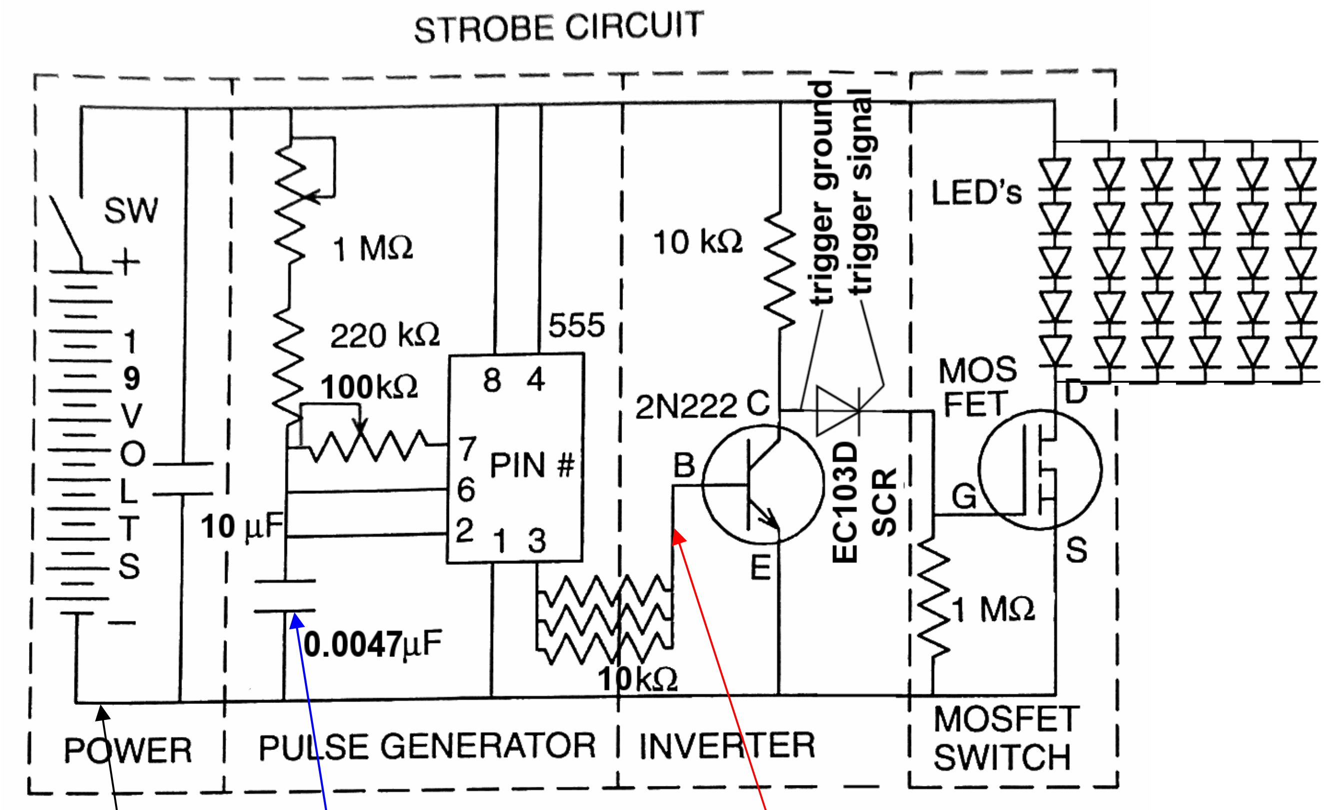
The original idea for the circuit came from the following paper:
Robert F. Dorner, "Add Flash to Your Class with an LED Student Strobe," *The Physics Teacher*, vol. 35, March, 1997, p. 164.

**Layout:**




Yes, it’s flashing!

**Circuit Diagram**




**Highlighted are best places to place oscilloscope probes.**

**Negative rail (ground)**

**This capacitor controls the range of frequencies generated**

**Behind the triple 10K resistors**

**The MOSFET is a IRF-510 MOSFET.**
**The LEDs are 3.7V 20000mcd Super-bright White LEDs.**

**Specifications:**

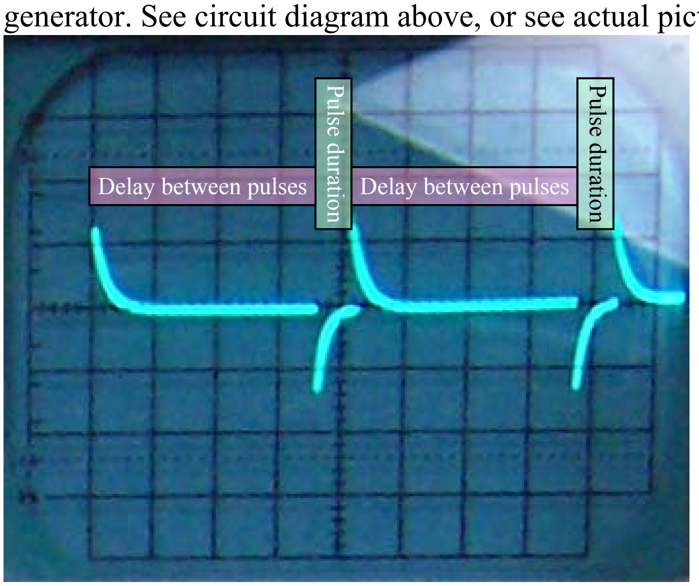
Power: 19V DC Power Supply [or 2 9-volt batteries] (9V battery for the sound trigger)
Trigger: Must provide input of at least 0.2mA and 1.7V.

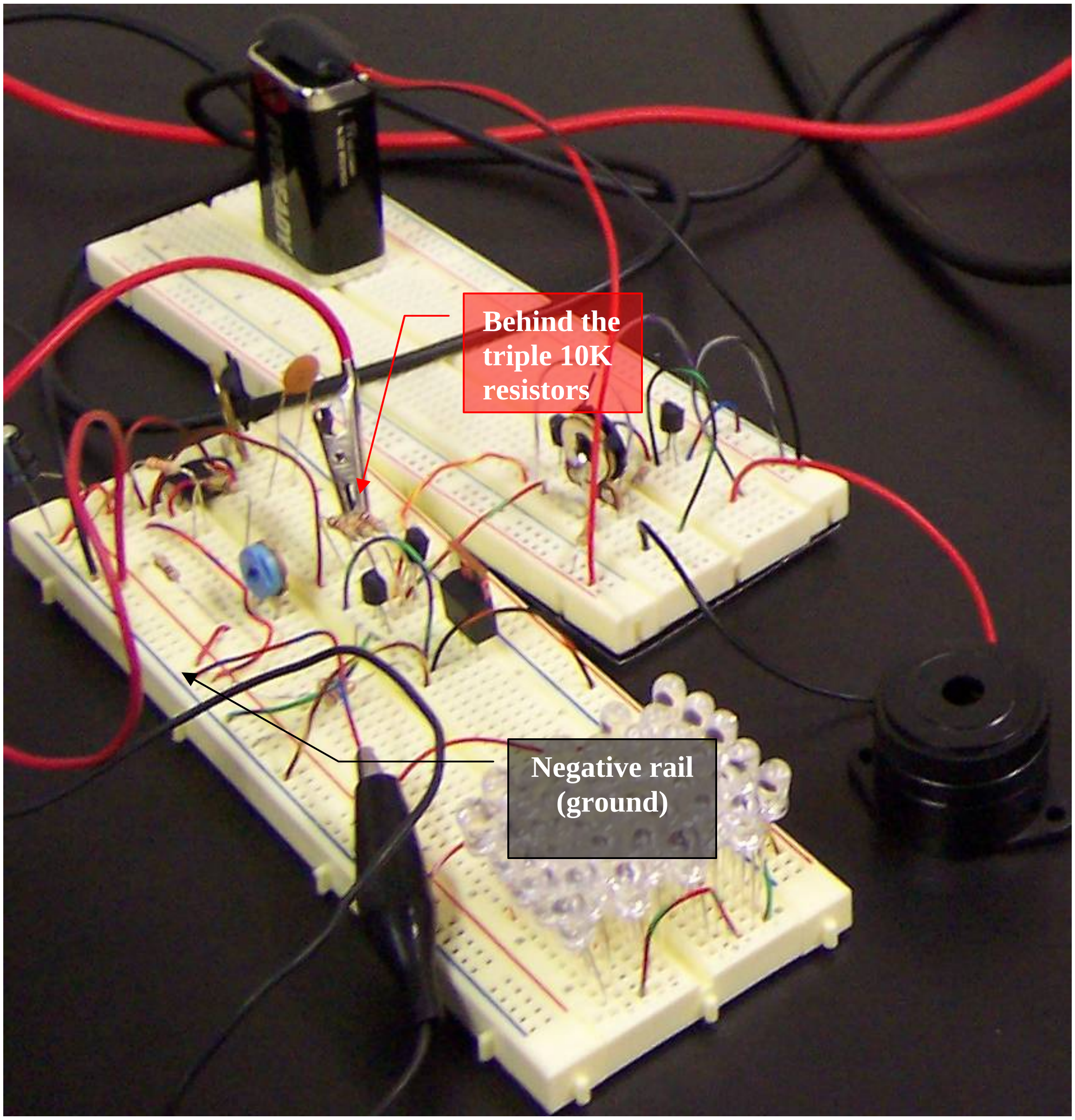
| Timing Capacitor* | Minimum pulse length | Pulse frequency (minimum) | Pulse frequency (maximum) |
|---|---|---|---|
| 0.047 uF | 12 us | ~30Hz | ~204Hz |
| 0.0047 uF | 1 us | ~230Hz | ~1260Hz |

Maximum pulse length is equal to about half of the reciprocal of the maximum pulse frequency.
*Capacitors are sensitive to temperature; the circuit was operated at 21 degrees C.

**Instructions for use**:

1. Use the correct timing capacitor. If you want 1000Hz and you're using the 0.047uF capacitor, most likely you won't be getting anything close to 1000Hz.
   A simple replacement will do, since only the frequency generator depends on it.
   Generally, I recommend using capacitors between 0.1 uF and 0.0047uF.
   Connect the new capacitor between the *negative rail* and *pin 2 of the 555*.
2. Plug in the power, because the circuit won't work without it.
3. Adjust the pulse frequency potentiometer. Generally, the amount of delay between each pulse is proportional to the amount the resistance the potentiometer is putting into the circuit. Also, the LEDs appear brighter as the frequency increases.
4. Adjust the pulse length. A clear relationship was not found. Increasing the resistance increases the flash duration, though. A shorter pulse length makes the LEDs appear dimmer. If the pulse duration decreases below a certain point, the LEDs will appear to shut off. With the Super-bright White LEDs, this was around 1us, although at 1us it was too dim to be very useful.
5. If you are NOT using a trigger, short the SCR out by connecting the cathode and anode of the SCR with a wire.
6. If you are using a trigger, connect the two trigger wires to the device that triggers the flash.
7. If you need precise measurements of the pulse lengths, refer to the diagrams below for best test points and an explanation of the output of the frequency generator. See circuit diagram above, or see actual picture below.



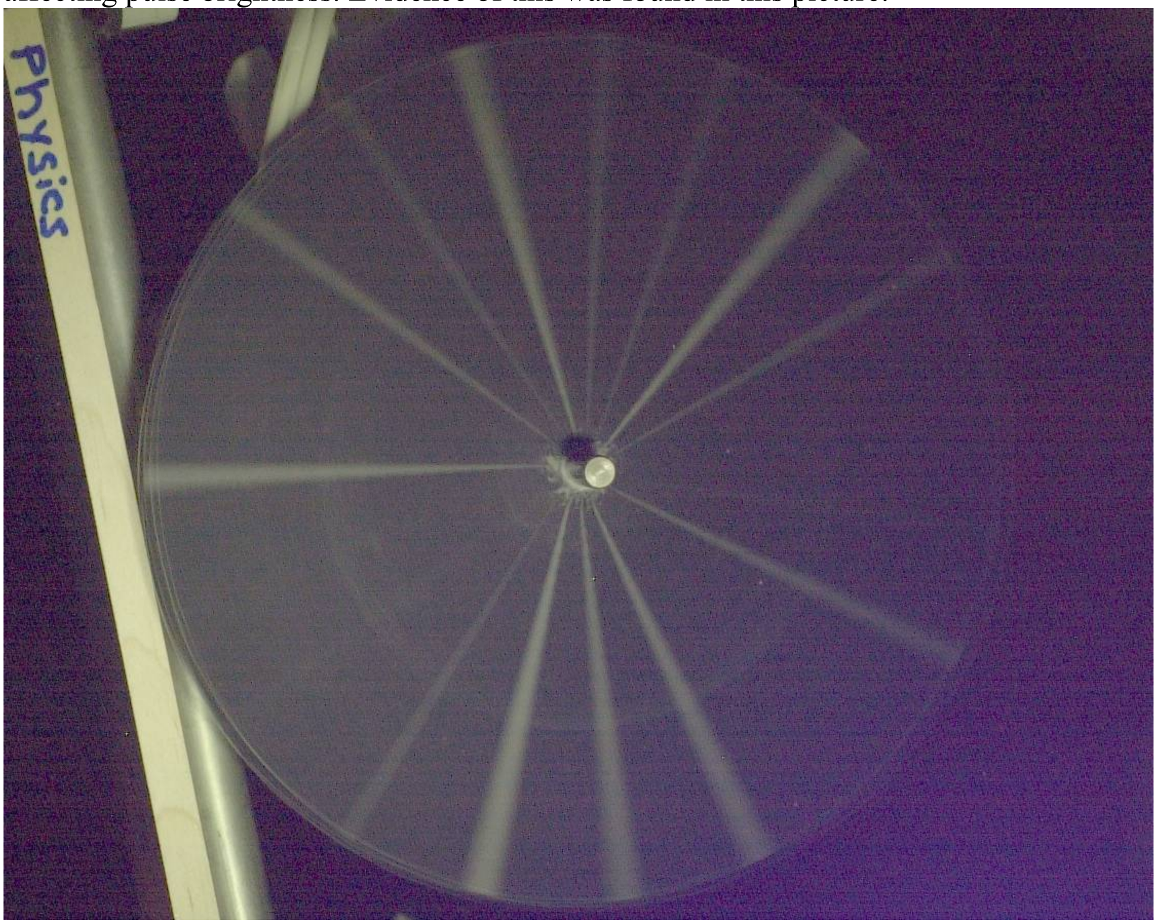


Connect the red terminal to where the red box is pointing to. Connect the black terminal to ground.

**Additional Notes:**

- Increasing voltage to increase brightness of the LEDs is *strongly discouraged*. It works, but significantly reduces LED lifespan. Discoloration of emission from LED was noted, and meaning the LED was burning.
- Increasing the current supplied to the LEDs is *strongly recommended*. This can be done by using a robust, filtered power supply, or a large capacitor coupled with a battery (for ~5 LEDs, 10uF should be enough). If no capacitor is used, either greatly reduced battery life will result, or greatly diminished light output from the LEDs will be observed (the latter was observed, the former was not tested for). Even with filtering capacitors, batteries still do not run this circuit as well as quality power supplies do.

- Increasing number of 5-LED "chains" is highly recommended for increasing brightness. However, since light is perceived as logarithmic, a tenfold increase in the number of LEDs only yields a doubling in brightness.
- The SCR used in this circuit unfortunately does not stay "connected" after the trigger "deactivates". That means that the sound trigger may cause the trigger to go off for long periods (like 20ms). On top of that, the sound trigger circuit can trigger fast enough to turn the output of the frequency generator on and off several times during a pulse, affecting pulse brightness. Evidence of this was found in this picture:




Nikon D1, 2000x1312, f/2.4, 1s, 105mm, ISO 400, gamma adjusted +2.56
Subject was 1.6m from camera, spinning 52.8 revolutions/sec. LED strobe was flashing at 1000 Hz and was 0.5m from the subject. The LED strobe was triggered by a clap.

Note the faint lines between brighter ones. That's the sound trigger closing the SCR during the pulse, resulting in no signal to the MOSFET and thus no flash at that point. Thus, the line either is absent or is dimmer than others.

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