

HauntMaven.com - Wolfstone's Haunted Halloween Site



http://wolfstone.halloweenhost.com/Flash/flsint_Flash.html

Flashing Lights

We define "flashing lights" as a regular on-and-off cycle, which repeats. The light need not stay on as long as it stays off, but each on period is as long as any other on period, and each off period matches all other off periods. This is in contrast to "flickering lights", which we define as having a random or irregular element.

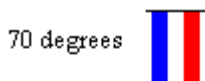
The undisputed king of the flashing lights is the strobe light.

This page discusses theory of operation. For some commercial products, please see commercial flashers.

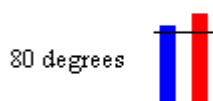


Thermal Blinker

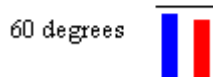
A thermal blinker uses a bi-metallic element, which responds to heat. It takes advantage of the fact that heating an object makes it expand, and that different materials expand at different rates.




Consider these strips of metal that are the same length at 70 degrees.



When you raise the temperature, you find that both strips expand, but due to the different types of metal used, the red strip expands to a greater length.




At lower temperatures, the red strip also shrinks faster.

70 degrees 

But if you fasten the strips together when the temperature is 70 degrees, heating will make the red side of the strip want to expand to a greater length than the other.

80 degrees 

As the two-metal strip gets hotter, the red side grows longer than the blue side, pushing the strip to the left.

60 degrees 

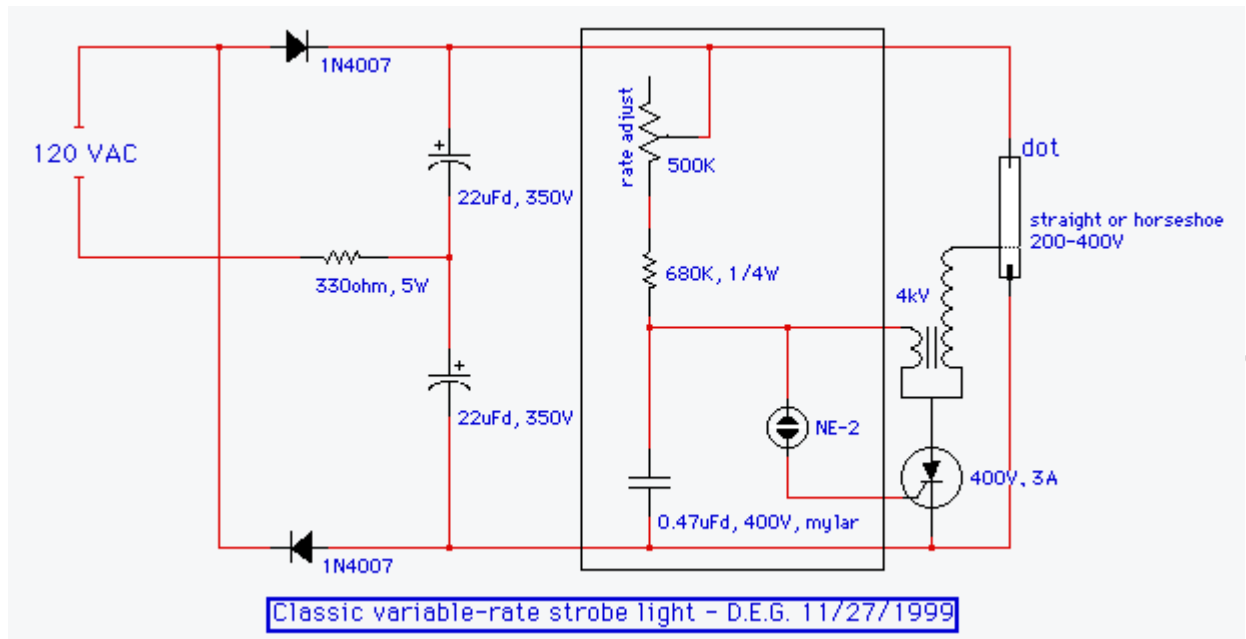
As the two-metal strip gets cooler, the red side grows shorter than the blue side, pushing the strip to the right.

A bi-metallic strip that pushes to one side or the other in response to temperature is a classic way to make a thermostat. It is also the basis of the blinking Christmas tree lamp, and other flashers:

- At rest, the bi-metallic element makes electrical contact and current flows through it to light the lamp filament.
- The lamp lights up and grows warm.
- After a brief time, the rising heat causes the bi-metallic element to move, breaking the electrical contact.
- The lamp goes out and begins to cool.
- When the lamp cools enough, the bi-metallic element moves back and lights the lamp again.

Relaxation Oscillator

The "relaxation oscillator" is commonly used to provide regular trigger pulses for strobe lights. It is simple and inexpensive.



Here's a simple strobe, with the relaxation oscillator near the center, enclosed in a rectangle.

The relaxation oscillator consists of few components:

- a resistor (in this case two, to allow you to adjust the rate)
- a capacitor
- a neon lamp

The circuit relies on a special characteristic of the common NE-2 neon lamp. This is a small tube that has two leads that go through the bottom of the glass envelope and attach to metal electrodes inside the lamp. The neon gas that separates the electrodes within the tube makes a poor conductor of electricity. You could try all day to pass 75 volts through the NE-2 and it would act like an insulator. But if you crank the voltage up high enough, the gas ionizes and suddenly turns into a good conductor of electricity. This is called the "turn-on threshold" voltage, and is roughly 90 volts for a NE-2. We would see that as an orange glow in the tube, and a meter would indicate that there is plenty of electricity flowing through what was formerly an insulator. Once the tube fires up, it continues being conductive, even if the voltage is reduced below the turn-on voltage. When you drop to about 60 volts, the NE-2 goes out. This is the turn-off threshold. In order to start it up again, you must get back up to the turn-on threshold. This is an example of the phenomenon called hysteresis, and is the key to the relaxation oscillator.

- When we start out, the capacitor has no charge in it.
- Voltage is applied, and the capacitor slowly builds up a charge, which is seen as a voltage across the NE-2 lamp.
- The NE-2 lamp does nothing as the voltage slowly rises.
- When the voltage across the NE-2 hits 90 volts, the lamp suddenly turns on.
- The charge across the capacitor is shorted out by the NE-2, and the capacitor discharges.

- The NE-2 stays turned on as the voltage drops, facilitating further discharge.
- When the voltage hits 60, the NE-2 goes out.
- Deprived of a discharge path, the capacitor starts charging up again.

The circuit replays this cycle again and again, with the voltage across the capacitor slowly rising from 60 to 90, and then suddenly dropping when the NE-2 fires.

Self-Flashing LEDs

Nowadays, it is easy to make a blinker by simply attaching a self-flashing light emitting diode (LED) to a battery.

It looks like a LED, it lights up like a LED, it comes in assorted colors like a LED, it consumes low power like a LED - but it has a built-in timer chip that turns the LED on and off. The only drawback to the self-flashing LED is that you don't get any real control over the rate at which it flashes. It does what the guys at the factory like it to do.

Note that you can put an ordinary LED and a flasher in series, and then *both* will flash.

Timer Chips

Solid-state timer chips provide inexpensive, simple, and accurate sources of regular pulses.

555 Timer Chip

The 555 timer chip was introduced in 1971 and is still a popular device. It requires few components, is easy to obtain, and simple to use.

There is an excellent 555 timer tutorial at <http://www.uoguelph.ca/~antoon/gadgets/555/555.html>

