HauntMaven.com - Wolfstone's Haunted Halloween Site

http://wolfstone.halloweenhost.com/HalloweenTech/anemak_MakingLEDEyes.html

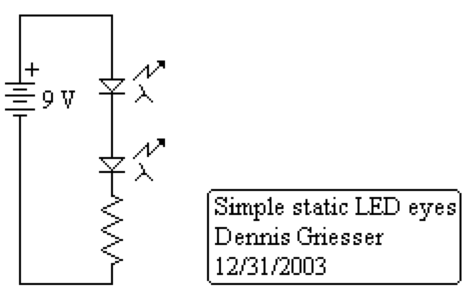
Making LED Creature Eyes

There seems to be a lot of excitement of the various Halloween e-mail lists concerning LED eyes for creatures. I'm a little ambivalent about this, because with LED eyes it is easy to do *something*, but hard to do *something good*.

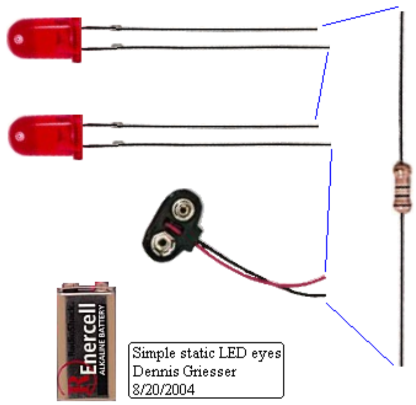
Simple LED Eyes

Basic Static LED Eyes

The basic LED eye is just a light that says on all the time. There is no need for a power switch - just remove the battery when done using the lights.



Schematic diagram of basic LED eyes.



Pictorial diagram of basic LED eyes.

The resistor is not polarized, you can hook either end to the battery and it will still work.

LEDs are polarized. The anode, which hooks to the positive power, usually has a longer lead wire.

The battery clip is polarized: the red wire is positive.

Parts list:

quantity	*component*
1	9V battery
1	9V battery clip, e.g. Radio Shack#270-325
2	LEDs
1	resistor

You can use almost any LED. Pick your favorite size, shape, and color. But make sure that both LEDs are the same type. Go for LEDs that are *just* LEDS, and contain no internal resistors or flashing or driving circuitry.

The value of the resistor is calculated based on the voltage drop across the LEDs and the desired current. If you bought the LEDs new, like in a blister pack at Radio Shack, they should come with technical information which you can punch into my LED calculator.

If all this sounds too complex and you want to scream, "just tell me what to buy", please see Basic Static LED Eyes - For Those Who Hate Math.

If the LEDs lack technical information, or you are very lazy, try these ballpark values (based on 9V battery, 2 LEDs, 20 mA current):

LED color	voltage drop	resistor
ordinary red	1.7 V	330 Ohm, 1/4 Watt
high-brightness, high-efficiency, or low-current red	1.9 V	270 Ohm, 1/4 Watt
orange or yellow	2 V	270 Ohm, 1/4 Watt
green	2.1 V	270 Ohm, 1/4 Watt
bright white, emerald green, and most blue-derived types	3.4 V	120 Ohm, 1/8 Watt
430 nM bright blue types	3.8 V	82 Ohm, 1/8 Watt

Resistors specified as 1/8 Watt can use 1/4 Watt instead - use whichever is cheaper and easier to find. You can always use a resistor with a higher wattage, with no performance penalty.

The resistance value is calculated for maximum brightness from the LED. Somewhat larger resistance values will work, giving less light. Very much larger resistance values may be too dim. Since brighter LEDs often cost more, it might not be a good idea to buy an expensive bright LED and dim it down by using an overly large resistance.

Basic Static LED Eyes - For Those Who Hate Math

This is a rehash of Basic Static LED Eyes, but *I have already done the math* for some specific LEDs from Radio Shack.

LEDs					*resistor*		
color	brightness *MCD*	*voltage*	current *mA*	*part number*	resistance *ohms*	*wattage*	*part number*
Red	3000	1.7 V	20 mA	276-307	330	1/4	271-1315
Blue	2600	* 3.7 V	20 mA	276-316	100	1/4	271-1311
Yellow	1900	2.1 V	40 mA	276-351	150	1/2	271-1109

White	1100	* 3.6 V	20 mA	276-320	100	1/4	271-1311
Red wide-angle	800	1.7 V	20 mA	276-309	330	1/4	271-1315
Yellow	720	2.1 V	40 mA	276-350	150	1/2	271-1109
Green	620	2.1 V	30 mA	276-304	220	1/4	271-1313
Red	120	1.8 V	20 mA	276-330	330	1/4	271-1315
Green	20	2.2 V	10 mA	276-022	470	1/4	271-1317
Red	10	2.25 V	28 mA	276-041	220	1/4	271-1313
Yellow	6.3	2.15 V	36 mA	276-021	150	1/2	271-1109
Red	1.5	2.0 V	10 mA	276-209	560	1/2	271-1116

For connection details, please see Basic Static LED Eyes.

I have simplified the selection of parts as follows:

- I assume 2 LEDs and a 9-volt battery.
- All LEDs are T-1-3/4 (5mm) size.
- I used only Radio Shack resistors. Sometimes I had to increase the wattage and/or resistance to use their easily-found, but limited, selection of parts.
- You can always use a resistor with a higher wattage, with no performance penalty.
- The resistance value is calculated for maximum brightness from the LED. Somewhat larger resistance values will work, giving less light. Very much larger resistance values may be too dim. Since brighter LEDs often cost more, it might not be a good idea to buy an expensive bright LED and dim it down by using an overly large resistance.

Notes:

- Specifications are current as of August 2004.
- LEDs with "*" to the left of their voltage should work, but don't give much headroom with a 9V power supply.
- Please let me know if you find any typographical errors in this table.

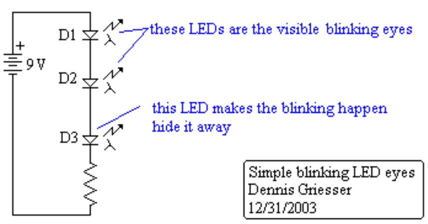
After you get these "canned" combinations working, you might want to try other sources for LEDs and resistors. You will probably find better prices and a larger selection.

Simple Blinker Eyes

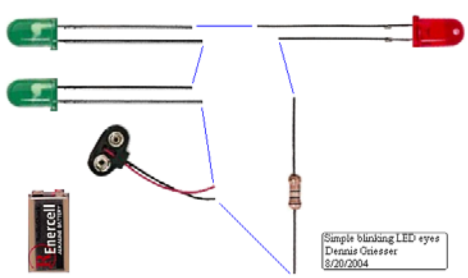
The simplest blinker uses a self-flashing LED. Not only does this LED flash itself, but will make other LEDs flash when wired in series with it.

There's a problem, though. The self-flashing LED is unlikely to match the color and intensity of the LED that flashes with it. The solution is simple - use three LEDs:

- One is the flasher. It is hidden away, and serves only as a simple timing component.
- Two are visible, and selected so they present the desired look.



Schematic diagram of simple flashing LED eyes.



Pictorial diagram of simple flashing LED eyes.

The resistor is not polarized, you can hook either end to the battery and it will still work.

LEDs are polarized. The anode, which hooks to the positive power, usually has a longer lead wire.

The battery clip is polarized: the red wire is positive.

Parts list:

quantity	reference	component
1		9V battery
1		9V battery clip, e.g. Radio Shack#270-325
2	D1, D2	LEDs, any color
1	D3	red self-flashing LED

You can use almost any LED for the two visible eyes D1 and D2. Pick your favorite size, shape, and color. But make sure that both LEDs are the same type. Go for LEDs that are *just* LEDS, and contain no internal resistors or flashing or driving circuitry.

The third LED, D3, that does the flashing work, should probably be red (they are inexpensive and have a low voltage drop).

The value of the resistor is calculated based on the voltage drop across the LEDs and the desired current. If you bought the LEDs new, like in a blister pack at Radio Shack, they should come with technical information which you can punch into my LED calculator. Since you have three LEDs, I would subtract the blinker LED voltage from the real battery and put that into the calculator as the battery voltage for the remaining two LEDs. Note that in many cases, the resistor value is quite low. I have run circuits like this without the resistor, but if you want to be textbook, put it in.

If all this sounds too complex and you want to scream, "just tell me what to buy", please see Simple Blinker Eyes - For Those Who Hate Math.

If the LEDs lack technical information, or you are very lazy, try these ballpark values (based on 9V battery; 2 LEDs; 20 mA current; blinker LED rated at 2.25V, leaving 6.75V for the 2 eye LEDs):

LED color	voltage drop	resistor
ordinary red	1.7 V	180 Ohm, 1/8 Watt
high-brightness, high-efficiency, or low-current red	1.9 V	150 Ohm, 1/8 Watt
orange or yellow	2 V	150 Ohm, 1/8 Watt
green	2.1 V	150 Ohm, 1/8 Watt
bright white, emerald green, and most blue-derived types	3.4 V	none; might not work
430 nM bright blue types	3.8 V	none; might not work

Resistors specified as 1/8 Watt can use 1/4 Watt instead - use whichever is cheaper and easier to find. You can always use a resistor with a higher wattage, with no performance penalty.

The resistance value is calculated for maximum brightness from the LED. Somewhat larger resistance values will work, giving less light. Very much larger resistance values may be too dim. Since brighter LEDs often cost more, it might not be a good idea to buy an expensive bright LED and dim it down by using an overly large resistance.

Simple Blinker Eyes - For Those Who Hate Math

This is a rehash of Simple Blinker Eyes, but *I have already done the math* for some specific LEDs from Radio Shack.

LEDs					*resistor*		
color	brightness *MCD*	*voltage*	current *mA*	*part number*	resistance *ohms*	*wattage*	*part number*
Red	3000	1.7 V	20 mA	276-307	220	1/4	271-1313
Blue	2600	* 3.7 V	20 mA	276-316	none		
Yellow	1900	2.1 V	40 mA	276-351	68	1/2	271-1106
White	1100	* 3.6 V	20 mA	276-320	none		
Red wide-angle	800	1.7 V	20 mA	276-309	220	1/4	271-1313
Yellow	720	2.1 V	40 mA	276-350	68	1/2	271-1106
Green	620	2.1 V	30 mA	276-304	100	1/4	271-1311
Red	120	1.8 V	20 mA	276-330	220	1/4	271-1313
Green	20	2.2 V	10 mA	276-022	270	1/2	271-1112
Red	10	2.25 V	28 mA	276-041	100	1/4	271-1311
Yellow	6.3	2.15 V	36 mA	276-021	100	1/4	271-1311
Red	1.5	2.0 V	10 mA	276-209	330	1/4	271-1315

For connection details, please see Simple Blinker Eyes.

I have simplified the selection of parts as follows:

- I assume 2 visible LEDs, a blinker LED, and a 9-volt battery.
- The blinker LED is assumed to be Radio Shack#276-036, with a typical voltage of 2.25V.
- All LEDs are T-1-3/4 (5mm) size.

- I used only Radio Shack resistors. Sometimes I had to increase the wattage and/or resistance to use their easily-found, but limited, selection of parts.
- You can always use a resistor with a higher wattage, with no performance penalty.
- The resistance value is calculated for maximum brightness from the LED. Somewhat larger resistance values will work, giving less light. Very much larger resistance values may be too dim. Since brighter LEDs often cost more, it might not be a good idea to buy an expensive bright LED and dim it down by using an overly large resistance.

Notes:

- Specifications are current as of August 2004.
- LEDs with "*" to the left of their voltage may work, but don't give any headroom with a 9V power supply. I suggest that you avoid these.
- Please let me know if you find any typographical errors in this table.

After you get these "canned" combinations working, you might want to try other sources for LEDs and resistors. You will probably find better prices and a larger selection.

Multiple Self-flashers

This technique is actually easier than the IC timer, and produces a nice flickering, rippling effect. For details, please see flickering eyes.

Advanced LED Eyes

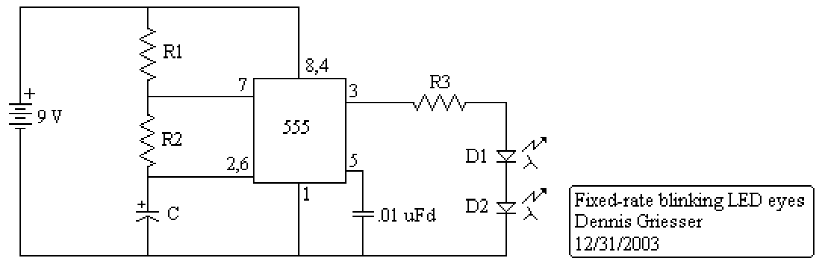
IC Timer Blinker

The simplest blinker relies on a self-flashing LED to provide the flashing. This is cheap, easy, and effective. What it lacks is control - the LED eyes flash at a fixed speed that is determined by the flashing LED you use.

This can be addressed by using an integrated circuit timer. We chose the 555, which is easy to use and commonly available. We will present two circuits.

You can use almost any LED for the two visible eyes D1 and D2. Pick your favorite size, shape, and color. But make sure that both LEDs are the same type. Go for LEDs that are *just* LEDS, and contain no internal resistors or flashing or driving circuitry.

The value of resistor R3 depends on the voltage drop and current of the LEDs that you select. Use the information in basic static LED eyes for the resistor value.



Calculate the resistors for exactly the flash you want. Once built, the rate is fixed.

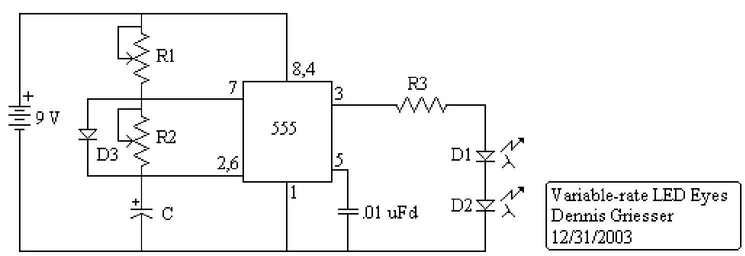
The eyes are on for t1 seconds, then off for t2 seconds.

t1 = .693 x (R1+R2) x C
t2 = .693 x R2 x C
(R1 and R2 are in Ohms; C is in Farads - try our 555 timer calculator)

The duty-cycle can range from 55% to 95% (duty-cycle of 80% means that the eyes are on for 80% of the time).

If you want to experiment with different timings, and duty cycles less than 55%, you can build this version:

This circuit lets you adjust the on and off at any time.

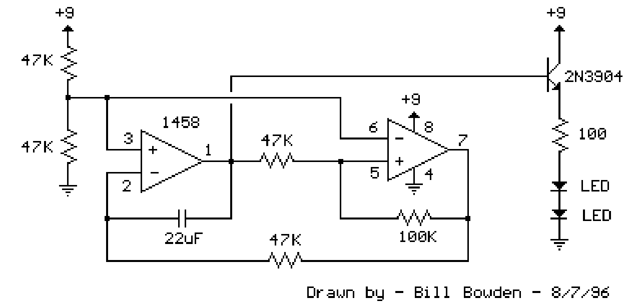


t1 = .693 x R1 x C
t2 = .693 x R2 x C

Diode D3 (across R2) can be any small signal diode like the 1N4148 or 1N914.

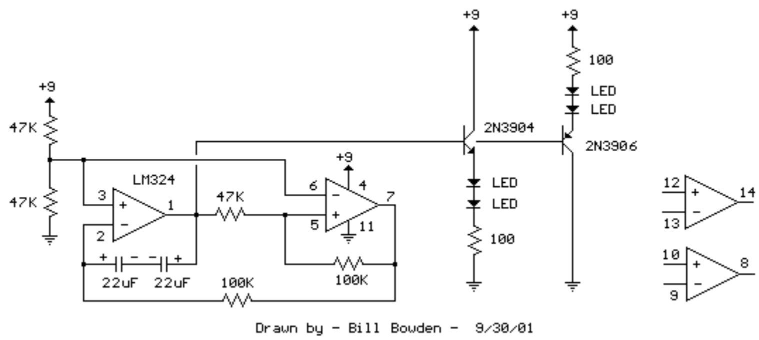
Bill Bowden's Fading Eyes

This is a circuit published on Bill Bowden's web page (http://ourworld.compuserve.com/homepages/Bill_Bowden/homepage.htm). For theory of operation and other notes, please visit Bill's excellent page.



This version ramps up and down one pair of eyes.

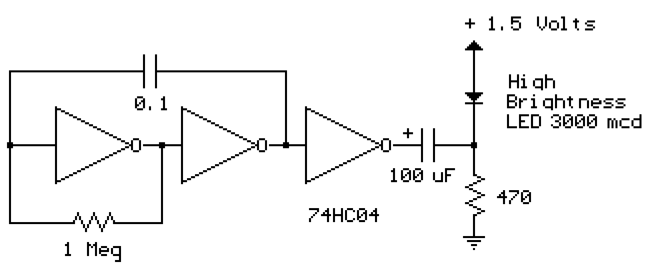
Essentially the same circuit is used in the Cowlacious Designs fading LED eyes.

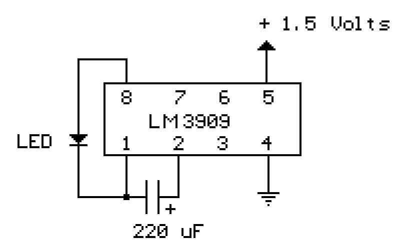


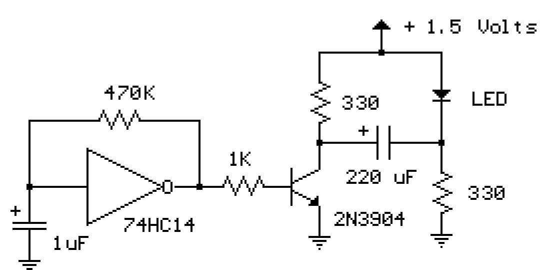
This version ramps one pair of eyes up as another pair ramps down.

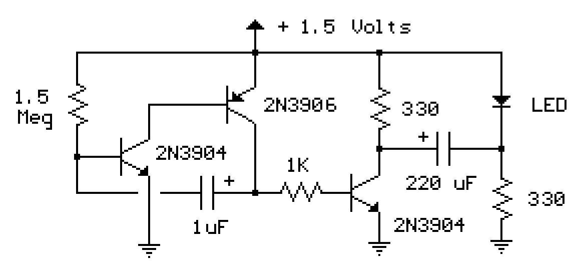
Assorted LED Flashers

These circuits flash LEDs when powered by a 1.5V cell. They come from Bill Bowden's web page (http://ourworld.compuserve.com/homepages/Bill_Bowden/homepage.htm). For theory of operation and other notes, please visit Bill's excellent page.



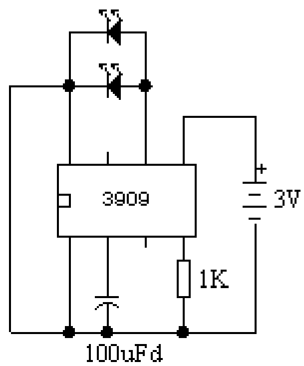






WARNING: The LM3909 flasher chip was discontinued a long time ago. You might be able to find some, somewhere. But you should consider LM3909 circuits to be historical curiosities.

These LED eyes from Malcom Little also use the 3909 flasher chip:



- 2 ea. - Jumbo Red Led Radio Shack # 276-214
- 1 ea. LM3909 LED Flasher IC Radio Shack # 276-1705
- 1 ea. 1K ohm 1/4 watt resistor
- 1 ea. 100 microfarad capacitor
- 2 ea. AA Alkaline Battery

Malcom's original schematic was dated Nov 18, 1999.

WARNING: The LM3909 flasher chip was discontinued a long time ago. You might be able to find some, somewhere. But you should consider LM3909 circuits to be historical curiosities.

Buying LED Eyes

As I mentioned previously, it is easy to make LED eyes do *something*, but hard to do *something good*. If you want fancy lighting effects, such as LED eyes that gradually dim and fade, you probably shouldn't bother with making them yourself. You will spend a lot of time, and only save a few bucks.

You might consider commercial LED creature eyes.