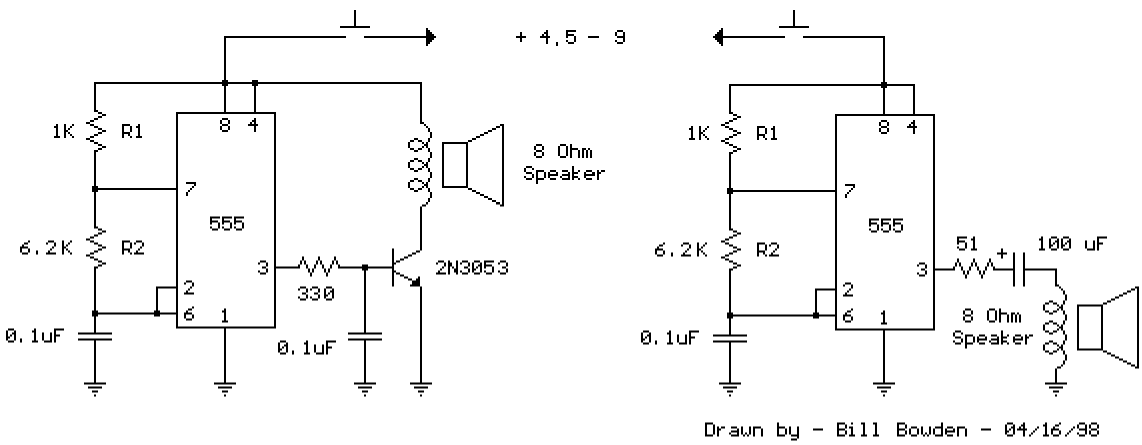
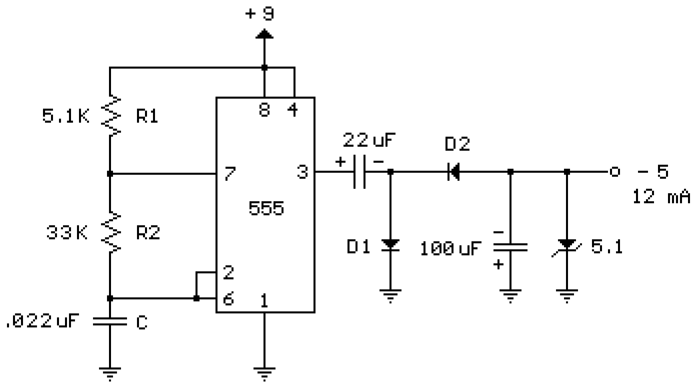
555 Tone Generator (8 ohm speaker)

This is a basic 555 squarewave oscillator used to produce a 1 Khz tone from an 8 ohm speaker. In the circuit on the left, the speaker is isolated from the oscillator by the NPN medium power transistor which also provides more current than can be obtained directly from the 555 (limit = 200 mA). A small capacitor is used at the transistor base to slow the switching times which reduces the inductive voltage produced by the speaker. Frequency is about 1.44/(R1 + 2*R2)C where R1 (1K) is much smaller than R2 (6.2K) to produce a near squarewave. Lower frequencies can be obtained by increasing the 6.2K value, higher frequencies will probably require a smaller capacitor as R1 cannot be reduced much below 1K. Lower volume levels can be obtained by adding a small resistor in series with the speaker (10-100 ohms). In the circuit on the right, the speaker is directly driven from the 555 timer output. The series capacitor (100 uF) increases the output by supplying an AC current to the speaker and driving it in both directions rather than just a pulsating DC current which would be the case without the capacitor. The 51 ohm resistor limits the current to less than 200 mA to prevent overloading the timer output at 9 volts. At 4.5 volts, a smaller resistor can be used.

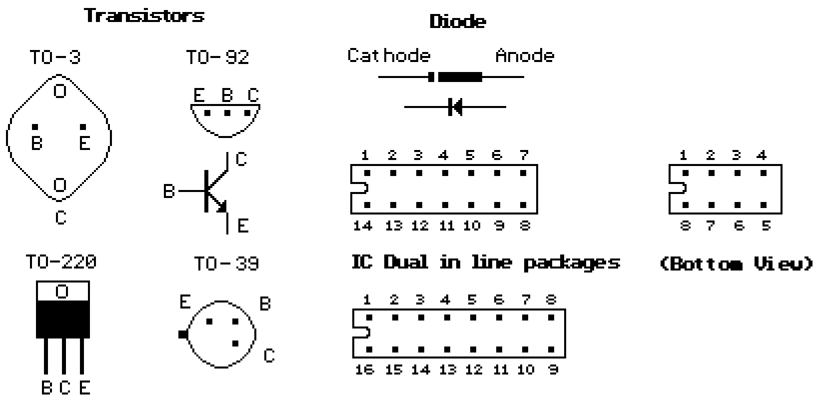


Generating -5 Volts From a 9 Volt Battery

A 555 timer can be used to generate a squarewave to produce a negative voltage relative to the negative battery terminal. When the timer output at pin 3 goes positive, the series 22 uF capacitor charges through the diode (D1) to about 8 volts. When the output switches to ground, the 22 uF cap discharges through the second diode (D2) and charges the 100 uF capacitor to a negative voltage. The negative voltage can rise over several cycles to about -7 volts but is limited by the 5.1 volt zener diode which serves as a regulator. Circuit draws about 6 milliamps from the battery without the zener diode connected and about 18 milliamps connected. Output current available for the load is about 12 milliamps. An additional 5.1 volt zener and 330 ohm resistor could be used to regulate the +9 down to +5 at 12 mA if a symmetrical +/- 5 volt supply is needed. The battery drain would then be around 30 mA.



Transistor / Diode / IC (DIP) Outlines

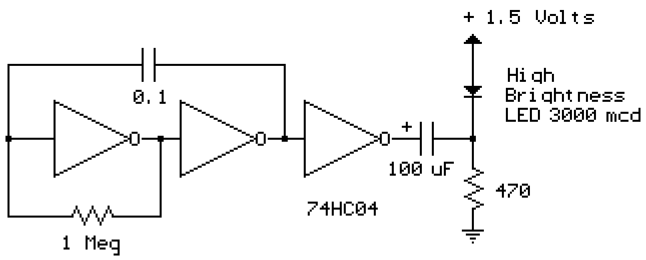


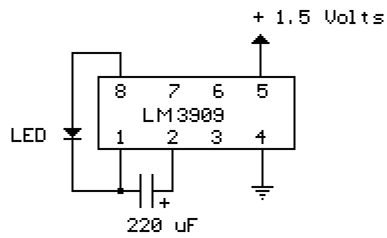
1.5 Volt LED Flashers

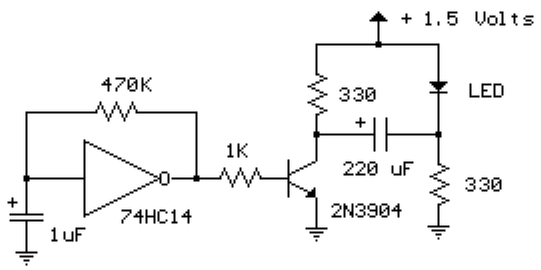
The LED flasher circuits below operate on a single 1.5 volt battery. The circuit on the upper right uses the popular LM3909 LED flasher IC and requires only a timing capacitor and LED.

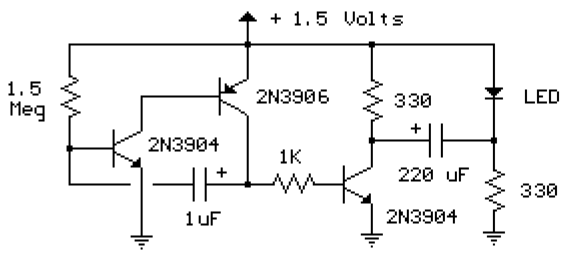
The top left circuit, designed by Andre De-Guerin illustrates using a 100uF capacitor to double the battery voltage to obtain 3 volts for the LED. Two sections of a 74HC04 hex inverter are used as a squarewave oscillator that establishes the flash rate while a third section is used as a buffer that charges the capacitor in series with a 470 ohm resistor while the buffer output is at +1.5 volts. When the buffer output switches to ground (zero volts) the charged capacitor is placed in series with the LED and the battery which supplies enough voltage to illuminate the LED. The LED current is approximately 3 mA, so a high brightness LED is recommended.

In the other two circuits, the same voltage doubling principle is used with the addition of a transistor to allow the capacitor to discharge faster and supply a greater current (about 40 mA peak). A larger capacitor (1000uF) in series with a 33 ohm resistor would increase the flash duration to about 50mS. The discrete 3 transistor circuit at the lower right would need a resistor (about 5K) in series with the 1uF capacitor to widen the pulse width.





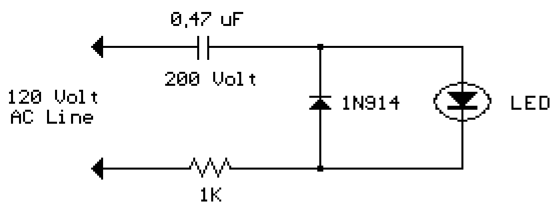


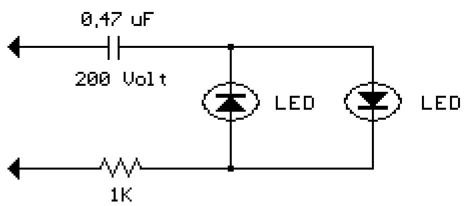


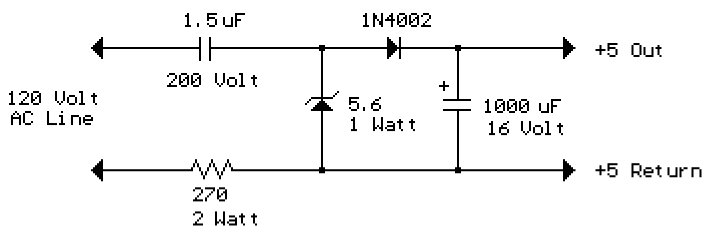
AC Line powered LEDs

The circuit below illustrates powering a LED (or two) from the 120 volt AC line using a capacitor to drop the voltage and a small resistor to limit the inrush current. Since the capacitor must pass current in both directions, a small diode is connected in parallel with the LED to provide a path for the negative half cycle and also to limit the reverse voltage across the LED. A second LED with the polarity reversed may be subsituted for the diode, or a tri-color LED could be used which would appear orange with alternating current. The circuit is fairly efficient and draws only about a half watt from the line. The resistor value (1K / half watt) was chosen to limit the worst case inrush current to about 150 mA which will drop to less than 30 mA in a millisecond as the capacitor charges. This appears to be a safe value, I have switched the circuit on and off many times without damage to the LED. The 0.47 uF capacitor has a reactance of 5600 ohms at 60 cycles so the LED current is about 20 mA half wave, or 10 mA average. A larger capacitor will increase the current and a smaller one will reduce it. The capacitor must be a non-polarized type with a voltage rating of 200 volts or more.

The lower circuit is an example of obtaining a low regulated voltage from the AC line. The zener diode serves as a regulator and also provides a path for the negative half cycle current when it conducts in the forward direction. In this example the output voltage is about 5 volts and will provide over 30 milliamps with about 300 millivolts of ripple. Use caution when operating any circuits connected directly to the AC line.







LED Traffic Lights

The LED traffic Light circuit controls 6 LEDs (red, yellow and green) for both north/south directions and east/west directions. The timing sequence is generated using a CMOS 4017 decade counter and a 555 timer. Counter outputs 1 through 4 are wire ORed using 4 diodes so that the (Red - North/South) and (Green - East/West) LEDs will be on during the first four counts. The fifth count (pin 10) illuminates (Yellow - East/West) and (Red - North/South). Counts 6 through 9 are also wire ORed using diodes to control (Red - East/West) and (Green - North/South). Count 10 (pin 11) controls (Red - East/West) and (Yellow - North/South). The time period for the red and green lamps will be 4 times longer than for the yellow and the complete cycle time can be adjusted with the 47K resistor. The eight 1N914 diodes could be subsituted with a dual 4 input OR gate (CD4072).

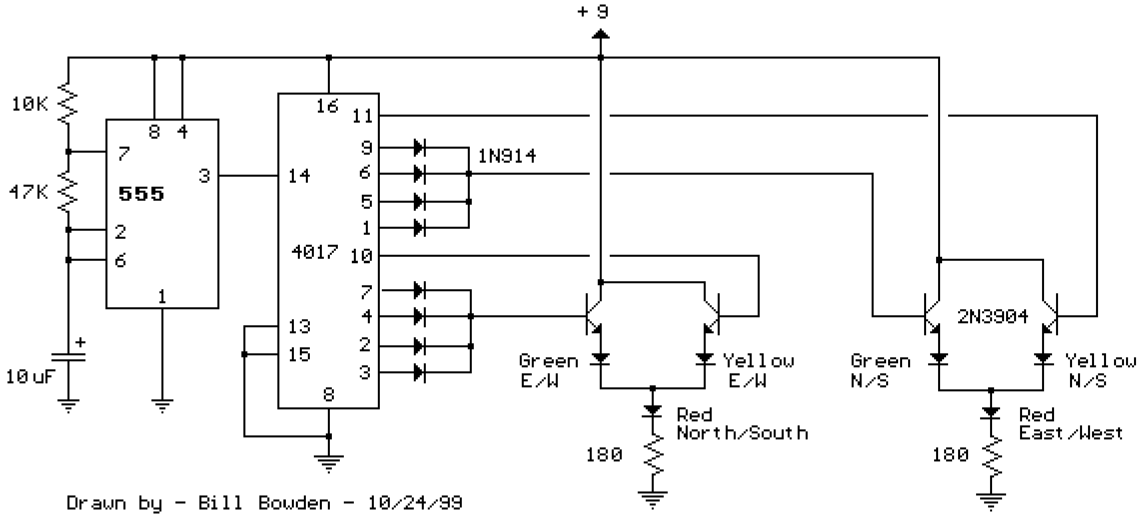


Photo Electric Street Light

This is basically a Schmitt Trigger circuit which receives input from a cadmium sulfide photo cell and controls a relay that can be used to switch off and on a street lamp at dawn and dusk. I have built the circuit with a 120 ohm/12 volt relay and monitored performance using a lamp dimmer, but did not connect the relay to an outside light.

The photo cell should be shielded from the lamp to prevent feedback and is usually mounted above the light on top of a reflector and pointed upward at the sky so the lamp light does not strike the photo cell and switch off the lamp.

The photo cell is wired in series with a potentiometer so the voltage at the junction (and base of transistor) can be adjusted to about half the supply, at the desired ambient light level. The two PNP transistors are connected with a common emitter resistor for positive feedback so as one transistor turns on, the other will turn off, and visa versa. Under dark conditions, the photo cell resistance will be higher than the potentiometer producing a voltage at Q1 that is higher than the base voltage at Q2 which causes Q2 to conduct and activate the relay.

The switching points are about 8 volts and 4 volts using the resistor values shown but could be brought closer together by using a lower value for the 7.5K resistor. 3.3K would move the levels to about 3.5 and 5.5 for a range of 2 volts instead of 4 so the relay turns on and off closer to the same ambient light level. The potentiometer would need to be readjusted so that the voltage is around 4.5 at the desired ambient condition.