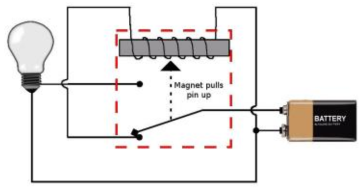
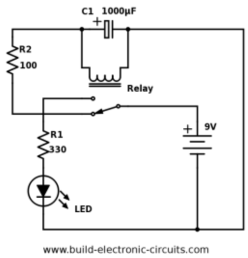
LED indicator circuits

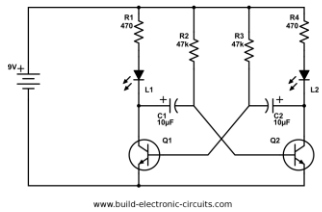
There are several ways of making a blinking LED circuit. You can make one using relays or transistors; or you can make one using components like an inverter, a 555 Timer or a microcontroller. The easiest is to use a relay as an electromechanical switch, as exists in the classical wiring loom of the Ferret.



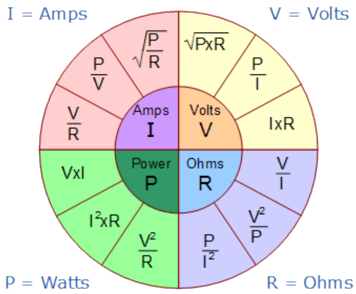
When the relay coil has power, the switch will disconnect the power from the electromagnet and connect the power to the light bulb instead so that it will light up. But when the relay no longer has power, it will switch back and turn off the power from the light bulb and give power back to the electromagnet again. This happens so fast that a resistor and capacitor are required to slow the blink rate down (which must be between 60 – 120 flashes per minute; 1-2 Hz). The classic thermal flasher relay unit is a metal canister. It has three screw terminals, "B" for Battery, "L" for Load, and "P" for Panel (dashboard indicator lamp). The flasher relay requires around 42 watts to work properly - 2 x 21watt 24 volt bulbs (for ach side). **The correct flasher unit for the Ferret = a Lucas 24V/48W flasher.** (A different resistor will be required to drive all four indicator bulbs for the hazard warning function).

When power from the battery is applied to the circuit on the right, the capacitor starts charging through the resistor R2. After a short delay, the relay coil pulls the relay into the other position, turning on the LED. Because the capacitor now is charged, it will hold the relay in this position. But the capacitor only has enough energy to keep the electromagnet in the relay powered for a short while before it discharges. At this moment, the relay goes back into its original state and turns the LED off again. The cycle then repeats.





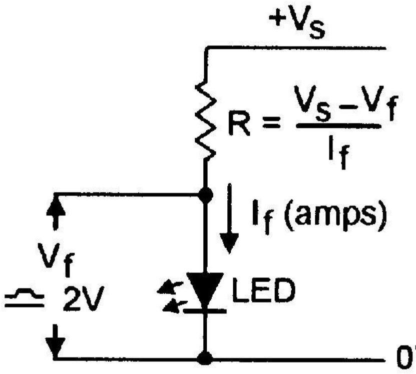
The circuit for blinking an LED using transistors is called an *Astable Multivibrator*. The two capacitors C1 and C2 will alternate between being charged and discharged and thereby turning the transistors Q1 and Q2 on and off. When a transistor is on it allows current to flow through it so that the LED above it will light up.

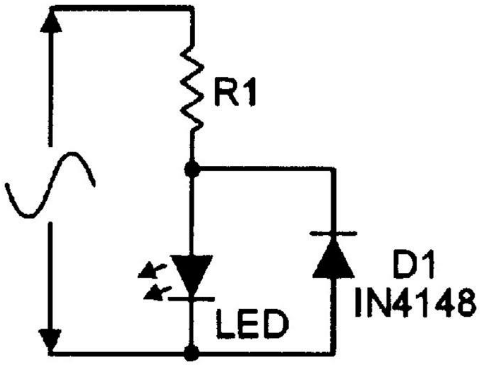


LEDs have typical power-to-light energy conversion efficiencies some 10 to 100 times greater than a simple tungsten filament lamp and have very fast response times (less than 0.1µS, compared to 10s or 100s of milliseconds for a tungsten lamp), and are thus widely used as visual indicators and as simple flashing light units. For a 24v supply, and a 24v incandescent flasher bulb, the resistance is 24 ohms, and the current draw 1 amp (see here).

Since a thermal relay incorporating a bimetal strip relies upon the high current draw (ca. 0.85-1.0 amps at 24volts, or 1.5-1.8 amps @ 12v) from an incandescent bulb and a minimum load, usually 15 watts; it will not work with LED replacements. An LED must be wired in series with a current-limiting device such as a resistor, otherwise (because of the very low current draw of circa 20 mAmps) the LED will not function correctly. Either the lights will not flash at all and just stay on constantly, or they will flash erratically, or flash too fast (hyperflash) about 2.5 cycles/second, which is above the legal rate.

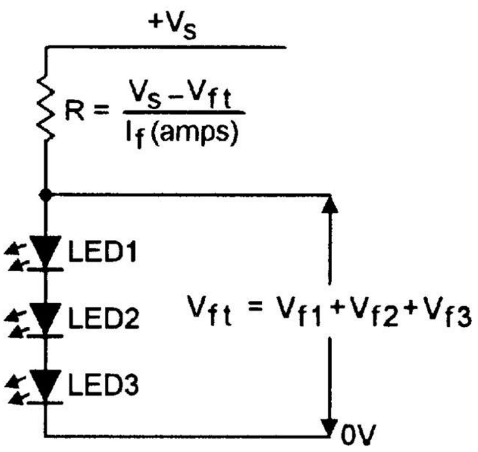
An LED must be wired in series with a current-limiting device such as a resistor. If an LED is required to operate at 20mA from a 24v supply, R needs a value of (24v – 2v)/0.02A = 1,100 Ω. In practice, R can be connected to either the anode or the cathode of the LED (the cathode is the shorter lead). An LED can be used as an indicator in an AC circuit by wiring it in inverse parallel with a IN4148 (or similar) silicon diode to prevent the LED from being reverse-biased; the LED is fed with a half-wave current in this mode, so - for a given brightness - the 'R' value must be halved relative to that shown in the left-hand figure. For low voltages of 5v or 12v, the current-limiting resistor is usually housed in the LED body, or incorporated into one of the LED leads in higher voltage types.

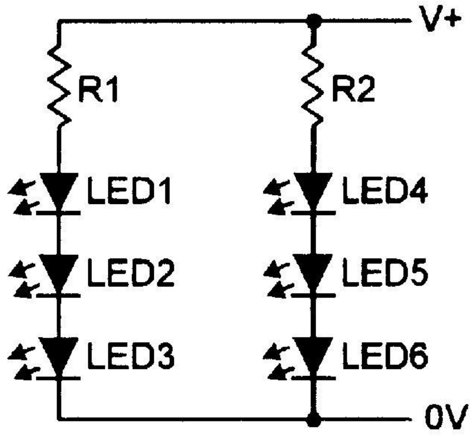




If several LEDs need to be driven from a single power source, this can be done by wiring all LEDs in series, as shown in the left-hand figure, provided that the supply voltage is significantly greater than the sum of the individual LED forward voltages. For a 24v supply, a V_{fn} value of 2v, as in the example above, the value of V_{ft} = 8 volts. For a series of 20mA LEDs, the value of the resistor required is now 800 Ω rather than 1,100 Ω.

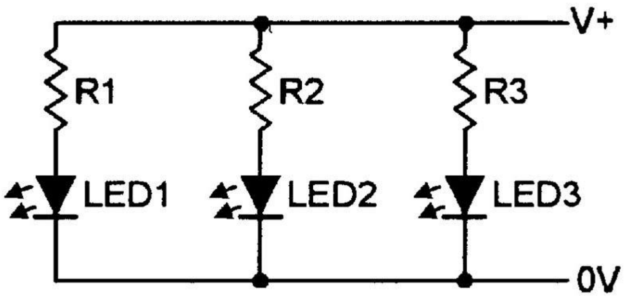
This circuit thus consumes a minimum total current, but is limited in the number of LEDs that it can drive. Any number of these basic circuits can, however, be wired in parallel, so that any number of LEDs can be driven from a single source, as shown in the six-LED circuit, on the right.

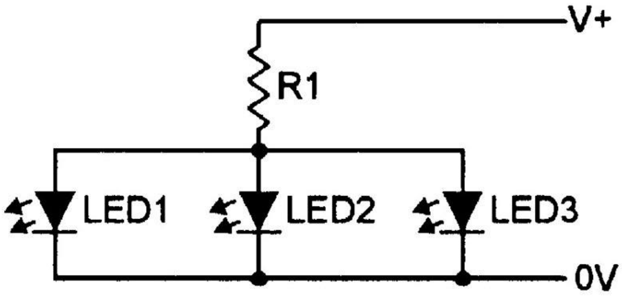




An alternative way of simultaneously powering several LEDs is to simply wire a number of the circuits above in parallel, but this is very wasteful of supply current (which equals the sum of the individual LED currents).

The figure on the right shows what not to do: here all the LEDs are wired directly in parallel. Often, this circuit will not work correctly because inevitable differences in the forward characteristics of the LEDs cause one LED to hog most or all of the available current, leaving little or none for the remaining LEDs.





Information taken from: http://www.nutsvolts.com/magazine/article/practical-led-indicator-and-flasher-circuits