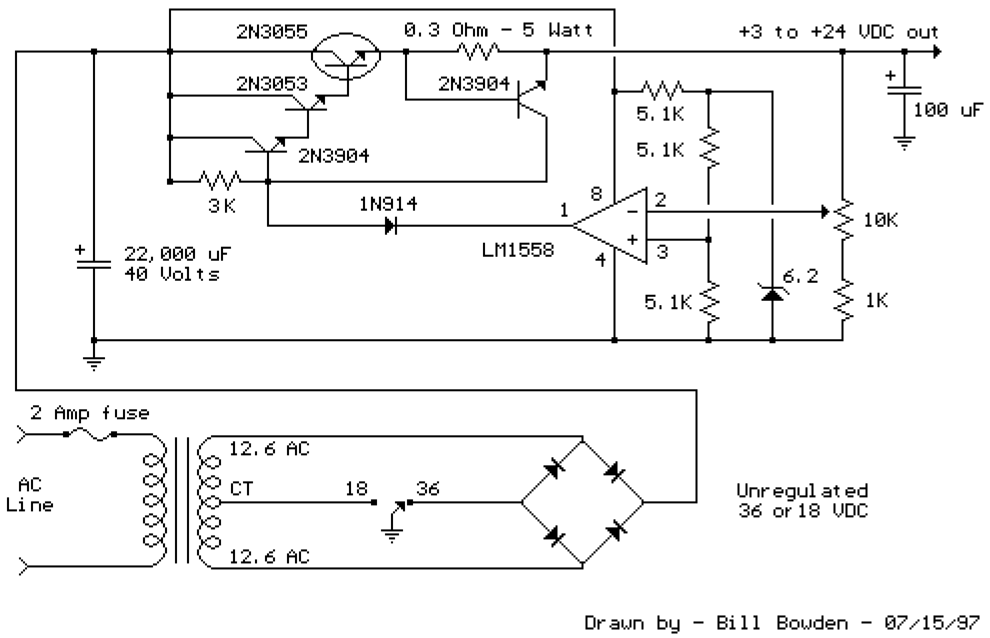
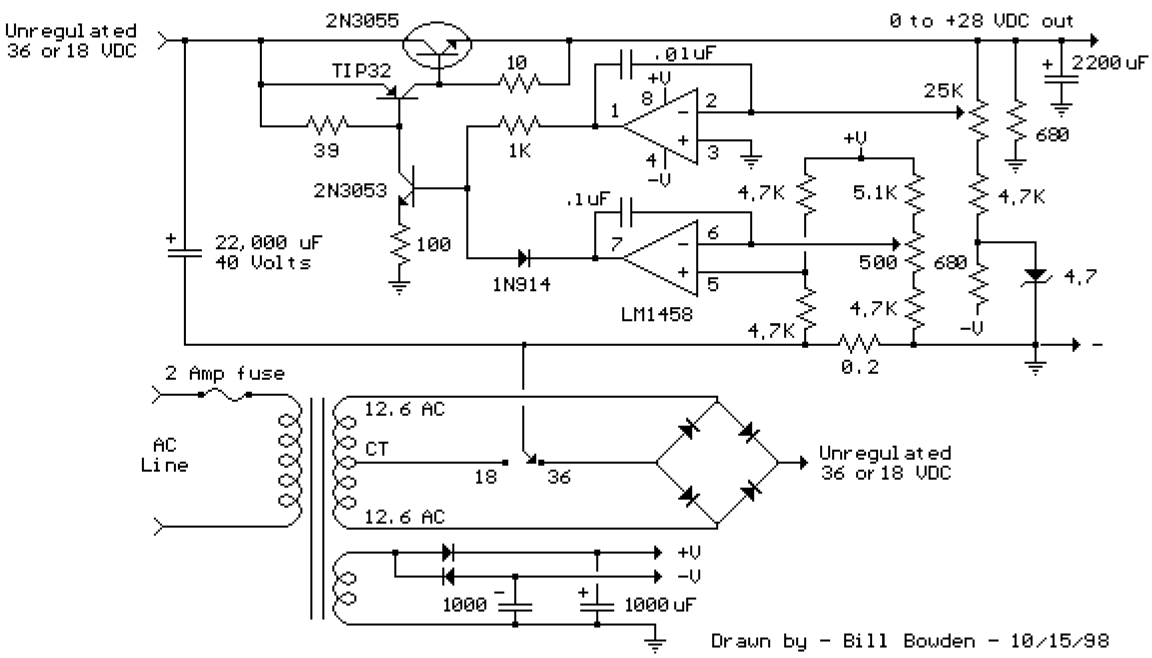
# Variable 3 - 24 Volt / 3 Amp Power Supply

This regulated power supply can be adjusted from 3 to 25 volts and is current limited to 2 amps as shown, but may be increased to 3 amps or more by selecting a smaller current sense resistor (0.3 ohm). The 2N3055 and 2N3053 transistors should be mounted on suitable heat sinks and the current sense resistor should be rated at 3 watts or more. Voltage regulation is controlled by 1/2 of a 1558 or 1458 op-amp. The 1458 may be substituted in the circuit below, but it is recommended the supply voltage to pin 8 be limited to 30 VDC, which can be accomplished by adding a 6.2 volt zener or 5.1 K resistor in series with pin 8. The maximum DC supply voltage for the 1458 and 1558 is 36 and 44 respectively. The power transformer should be capable of the desired current while maintaining an input voltage at least 4 volts higher than the desired output, but not exceeding the maximum supply voltage of the op-amp under minimal load conditions. The power transformer shown is a center tapped 25.2 volt AC / 2 amp unit that will provide regulated outputs of 24 volts at 0.7 amps, 15 volts at 2 amps, or 6 volts at 3 amps. The 3 amp output is obtained using the center tap of the transformer with the switch in the 18 volt position. All components should be available at Radio Shack with the exception of the 1558 op-amp.



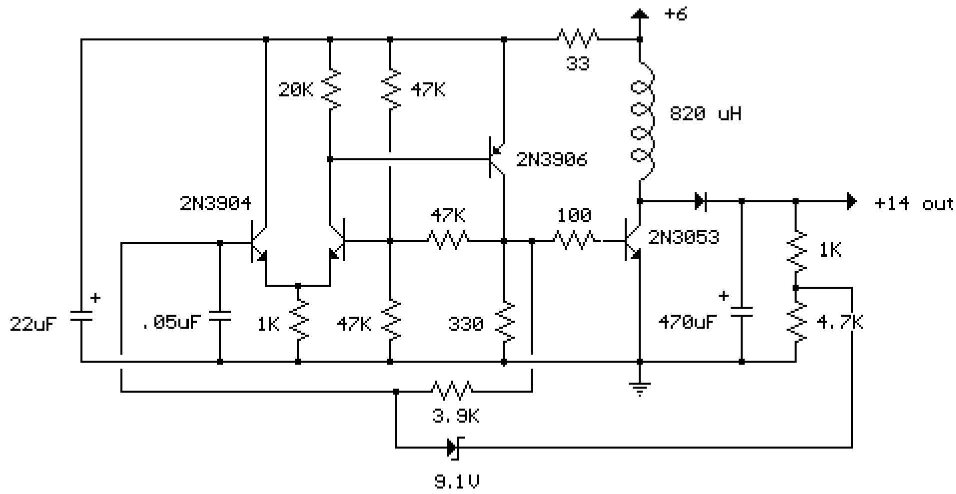
# Variable Voltage and Current Power Supply

Another method of using opamps to regulate a power supply is shown below. The power transformer requires an additional winding to supply the op-amps with a bipolar voltage (+/- 8 volts), and the negative voltage is also used to generate a reference voltage below ground so that the output voltage can be adjusted all the way down to 0. Current limiting is accomplished by sensing the voltage drop across a small resistor placed in series with the negative supply line. As the current increases, the voltage at the wiper of the 500 ohm pot rises until it becomes equal or slightly more positive than the voltage at the (+) input of the opamp. The opamp output then moves negative and reduces the voltage at the base of the 2N3053 transistor which in turn reduces the current to the 2N3055 pass transistor so that the current stays at a constant level even if the supply is shorted. Current limiting range is about 0 - 3 amps with components shown. The TIP32 and 2N3055 pass transistors should be mounted on suitable heat sinks and the 0.2 ohm current sensing resistor should be rated at 2 watts or more. The heat produced by the pass transistor will be the product of the difference in voltage between the input and output, and the load current. So, for example if the input voltage (at the collector of the pass transistor) is 25 and the output is adjusted for 6 volts and the load is drawing 1 amp, the heat dissipated by the pass transistor would be (25-6) * 1 = 19 watts. In the circuit below, the switch could be set to the 18 volt position to reduce the heat generated to about 12 watts.



# 2 Watt Switching Power Supply

In this small switching power supply, a Schmitt trigger oscillator is used to drive a switching transistor that supplies current to a small inductor. Energy is stored in the inductor while the transistor is on, and released into the load circuit when the transistor switches off. The output voltage is dependent on the load resistance and is limited by a zener diode that stops the oscillator when the voltage reaches about 14 volts. Higher or lower voltages can be obtained by adjusting the voltage divider that feeds the zener diode. The efficiency is about 80% using a high Q inductor.

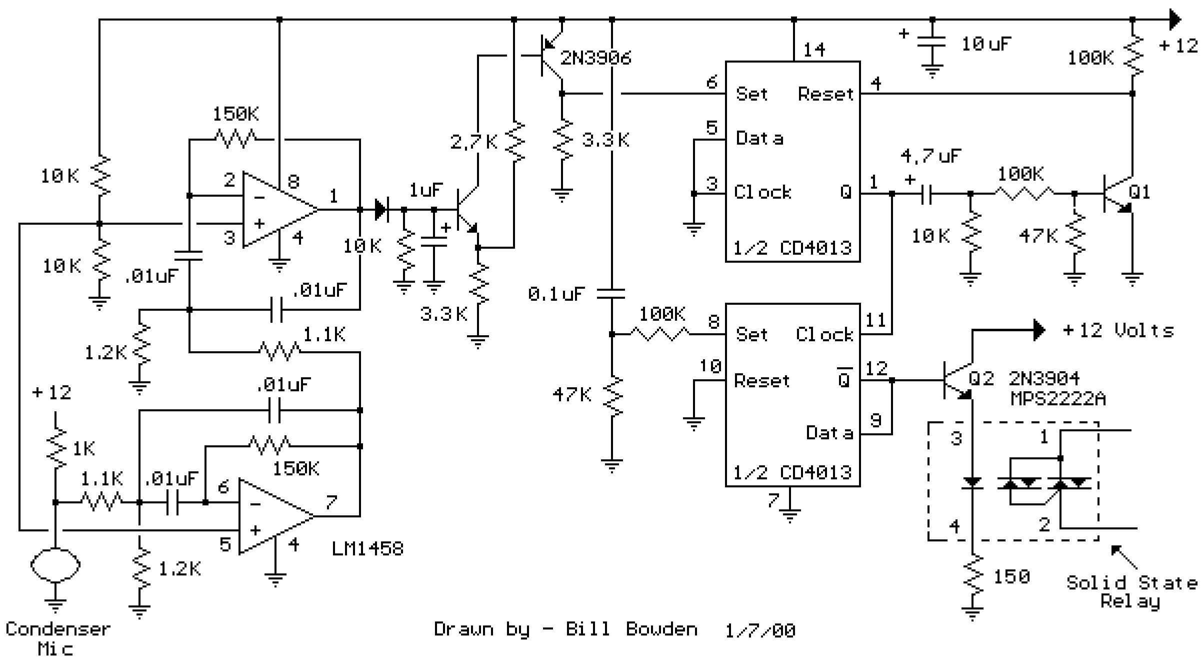


# Whistle On - Whistle Off

This is an extension of the CMOS toggle flip flop circuit shown in the "Circuits controlling relays" section with the addition of two bandpass filters and condenser microphone so the relay can be toggled by whistling at it. The condender mic used is a PC board mount Radio Shack #270-090C. The filters are tuned to about 1700 Hz, or the third Ab above middle C on a piano keyboard which is a fairly easy note for me to whistle. Resistor values for the filter can be computed using the three formulas below but we need to assume a gain and Q factor for the filter and the Q of the circuit must be greater than the square root of (Gain/2). The microphone produces only a couple millivolts so the overall gain needs to be around 4000 or around 65 for each filter. The Q or quality factor is the ratio of the center frequency to the bandwidth (-3dB points) and was chosen to be 8 which is greater than 5.7 which is the minimum value for a gain of 65. Both capacitor values need to be the same for easy computation of the resistor values and were chosen to be 0.01uF which is a common value and usable at audio frequencies. From those assumptions, the resistor values can be worked out from the following formulas.

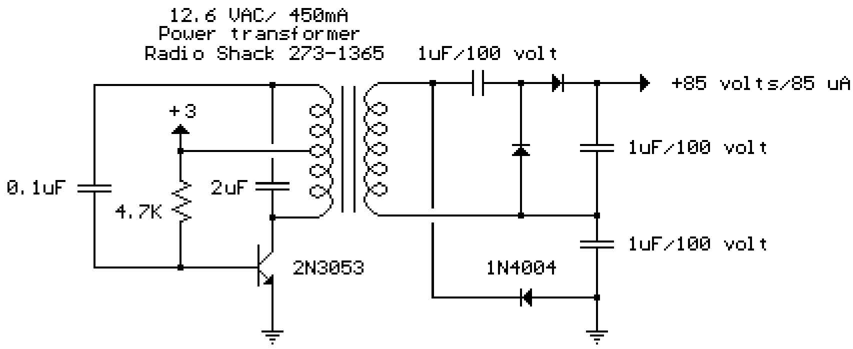
R1 = Q/(G*C*2*Pi*F) = 8/(65*.01^-6*6.28*1700) = 1152 or 1.1K
R2 = Q / ((2*Q^2)-G)*C*2*Pi*F) = 8/((128-65)*.01^-6*6.28*1700)= 1189 or 1.2K
R3 = (2*Q)/(C*2*Pi*F) = 16/(.01^6*6.28*1700) = 150K

The op-amps are biased using a voltage divider of two 10K resistors so the output will be centered around half the supply voltage or 6 volts. The output of the second filter charges a 1uF cap at the base of a NPN transistor (2N3904 or similar). The emitter voltage is biased at 6.6 volts using the 3.3K and 2.7K resistors so that the transistor will conduct and trigger the flip flop when the peak signal from the filter reaches 8 volts. The 8 volt figure is the emitter voltage (6.6) plus the emitter base voltage drop (0.7) plus the diode drop (0.7). The sensitivity can be adjusted by changing the value of either the 2.7K or 3.3K resistors so that more or less signal amplitude is needed to trigger the flop flop.



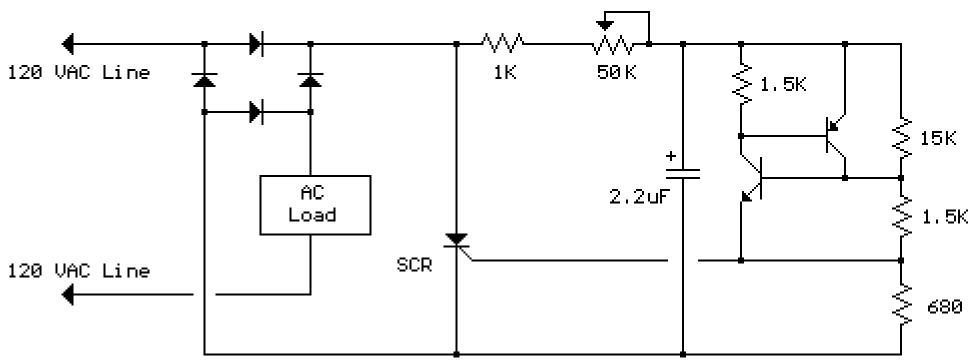
# DC to DC Converter

Here is a DC to DC converter using a standard 12 VAC center tapped power transformer and a single bi-polar NPN transistor. The circuit is not very efficient but will produce a high voltage usable for low power applications. The input battery voltage is raised by a factor of 10 across the transformer and further raised by a voltage tripler consisting of three capacitors and diodes connected to the high voltage side of the transformer. The circuit draws about 40 milliamps and should operate for about 200 hours on a couple of 'D' alkaline batteries. Higher voltages can be obtained by reducing the 4.7K bias resistor.



# 120 VAC Lamp Dimmer

The full wave phase control circuit below was found in a RCA power circuits book from 1969. The load is placed in series with the AC line and the four diodes provide a full wave rectified voltage to the anode of a SCR. Two small signal transistors are connected in a switch configuration so that when the voltage on the 2.2uF capacitor reaches about 8 volts, the transistors will switch on and discharge the capacitor through the SCR gate causing it to begin conducting. The time delay from the beginning of each half cycle to the point where the SCR switches on is controlled by the 50K resistor which adjusts the time required for the 2uF capacitor to charge to 8 volts. As the resistance is reduced, the time is reduced and the SCR will conduct earlier during each half cycle which applies a greater average voltage across the load. With the resistance set to minimum the SCR will trigger when the voltage rises to about 40 volts or 15 degrees into the cycle. To compensate for component tollerances, the 15K resistor can be adjusted slightly so that the output voltage is near zero when the 50K pot is set to maximum. Increasing the 15K resistor will reduce the setting of the 50K pot for minimum output and visa versa. Be careful not to touch the circuit while it is connected to the AC line.



# Varying brightness AC lamp

In this circuit, an SCR is used to slowly vary the intensity of a 120 volt light bulb by controlling the time that the AC line voltage is applied to the lamp during each half cycle.

Caution:

The circuit is directly connected to the AC power line and should be placed inside an enclosure that will prevent direct contact with any of the components. To avoid electrical shock, do not touch any part of the circuit while it is connected to the AC power line. A 2K, 10 watt power resistor is used to drop the line voltage down to 9 volts DC. This resistor will dissipate about 7 watts and needs some ventilation.

Operation:

A couple NPN transistors are used to detect the beginning of each half cycle and trigger a delay timer which in turn triggers the SCR at the end of the delay time. The delay time is established by a current source which is controlled by a 4017 decade counter. The first count (pin 3) sets the current to a minimum which corresponds to about 7 milliseconds of delay, or most of the half cycle time so that the lamp is almost off. Full brightness is obtained on the sixth count (pin 1) which is not connected so that the current will be maximum and provide a minimum delay and trigger the SCR near the beginning of the cycle. The remaining 8 counts increment the brightness 4 steps up and 4 steps down between maximum and minimum. Each step up or down provides about twice or half the power, so that the intensity appears to change linearly. The brightness of each step can be adjusted with the 4 resistors (4.3K, 4.7K, 5.6K, 7.5K) connected to the counter outputs.

The circuit has been built by Don Warkentien (WODEW) who suggsted adding a small 47uF capacitor from ground to the junction of the current source transistor (PNP) to reduce the digital stepping effect so the lamp will brighten and fade in a smoother fashion. The value of this capacitor will depend on the 4017 counting rate, a faster rate would require a smaller capacitor.