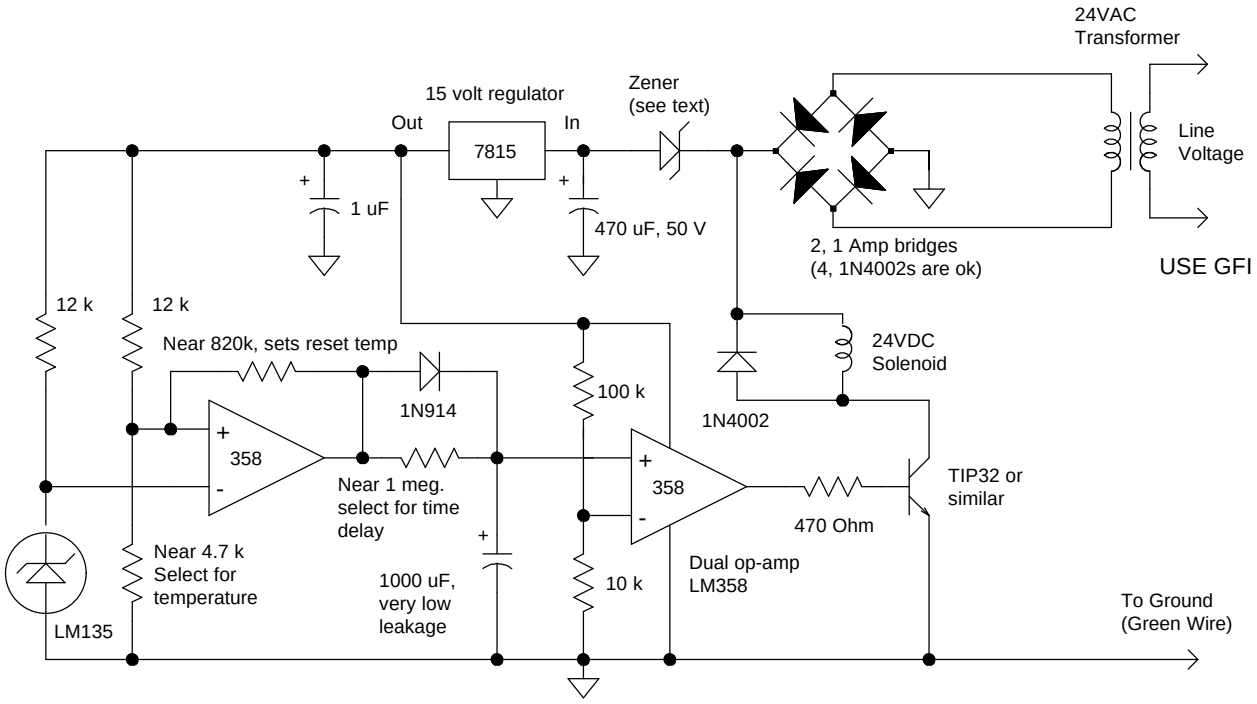
Shower Stopper



The shower stopper is a project suggested by one of the readers of the Technical Library. His request was for a circuit that would activate a solenoid to shut off the hot water to the shower after a reasonable length of time. It seems that certain members of his household enjoy long, warm showers. This circuit is probably sadistic!

The circuit detects when the hot water is turned on in the shower by means of a temperature sensor connected to the hot water pipe. When the temperature rises to the point determined by the 4.7 k resistor, the first op-amp output drops starting a slow discharge of the low-leakage 1000 uF capacitor. When the capacitor voltage drops to about 1.5 volts (after enough time for a shower) the output of the second op-amp goes low, turning off the solenoid and thus shutting off the hot water supply. Exclamations, shouts and other utterances will then be heard issuing forth from the shower since the cold water will remain on.

Several points should be considered when constructing this device. First, the 1000 uF capacitor used for the timing should have very low leakage. Most modern electrolytics will work but it is a good idea to test the candidate electrolytic before installation. Connect the capacitor in series with a 10 k resistor to a 15 volt power supply. After several minutes, measure the voltage across the 10 k resistor and verify that it is below about 10 millivolts. Alternately, a sensitive current meter may be connected in series to verify that the leakage is below or near 1 uA but use caution to avoid excessive meter current.

The temperature sensor may be a different device if appropriate changes are made to the circuit. The first op-amp simply acts as a comparator which goes low when the temperature of the water pipe reaches a preset value. A feedback resistor gives the circuit a little hysterisis so that the water pipe must cool down a few degrees before the next shower is allowed. The amount of hysterisis determines how much time will elapse before the circuit resets. The 820k resistor sets the hysterisis. A lower value will increase the waiting time. The temperature set-point should be fairly high - near the maximum temperature - or else the reset time may be too long, even with low electrical hysterisis.

The 1N914 charges the capacitor quickly when the temperature drops back down below the reset temperature. This diode should be a low-leakage silicon diode.

The circuit is designed to operate a 24 VDC solenoid valve. The 1N4002 across the solenoid protects the power transistor from switching transients.

The power transformer may be wired to the light in the bathroom so that the solenoid is only activated when the light is on instead of continuously. This wiring will allow only cold showers when the lights are off, however!

A zener is shown connected between the power supply bridge and the three-terminal 15 volt regulator. The maximum rated voltage for most three-terminal regulators is 35 VDC but the rectified voltage from many smaller transformers may exceed this value when the loading is light. The zener may be selected to give about 25 volts at the regulator input. A 12 volt, 1 watt zener is a good first guess. Make sure that the input voltage does not drop below about 18 volts, however, or else the circuit will not operate properly. Reduce the zener voltage in this event.

Do not fail to connect the ground to the green wire. If you are not familiar with proper wiring practices then this device can be quite dangerous. Line voltages and water pipes make a deadly combination for the inexperienced. This device should be installed behind the wall with proper installation hardware. An electrician's approval is highly recommended. Do not attempt to build this device if you do not have the proper knowledge. Power the device from a circuit protected by a ground fault interrupter. Use a 24 VAC transformer designed for continuous household duty.

Oh, and do not use this device on any persons bigger than you!