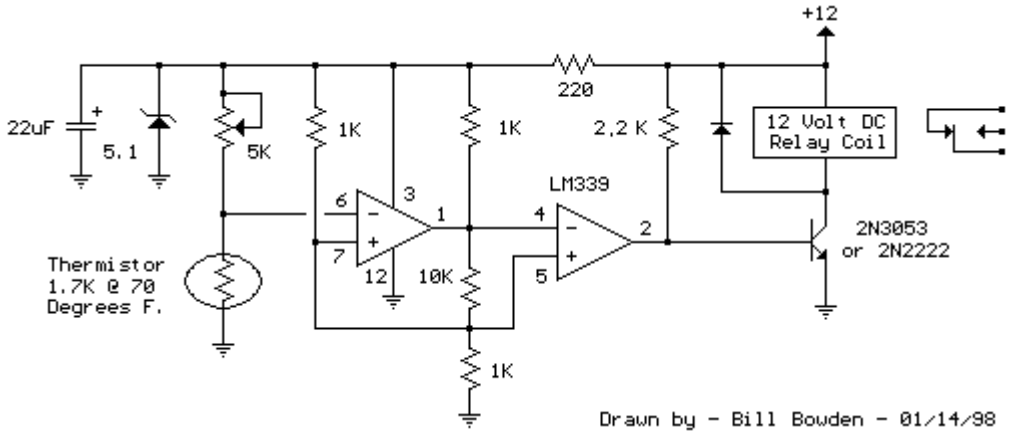
Electronic Thermostat and Relay Circuit

Here is a simple thermostat circuit that can be used to control a relay and supply power to a small space heater through the relay contacts. The relay contacts should be rated above the current requirements for the heater.

Temperature changes are detected by a (1.7K @ 70F) thermistor placed in series with a 5K potentiometer which produces about 50 millivolts per degree F at the input of the LM339 voltage comparator. The two 1K resistors connected to pin 7 set the reference voltage at half the supply voltage and the hysteresis range to about 3 degrees or 150 millivolts. The hysteresis range (temperature range where the relay engages and disengages) can be adjusted with the 10K resistor between pins 1 and 7. A higher value will narrow the range.

In operation, the series resistor is adjusted so that the relay just toggles off at the desired temperature. A three degree drop in temperature should cause the relay to toggle back on and remain on until the temperature again rises to the preset level. The relay action can be reversed so it toggles off at the lower end of the range by reversing the locations of the 5K potentiometer and thermistor. The 5.1 volt zener diode regulates the circuit voltage so that small changes in the 12 volt supply will not effect operation. The voltage across the thermistor should be half the supply or about 2.6 volts when the temperature is within the 3 degree range set by the potentiometer. Most any thermistor can be used, but the resistance should be above 1K ohm at the temperature of interest. The series resistor selected should be about twice the resistance of the thermistor so the adjustment ends up near the center of the control.



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Thermostat for 1KW Space Heater (SCR controlled)

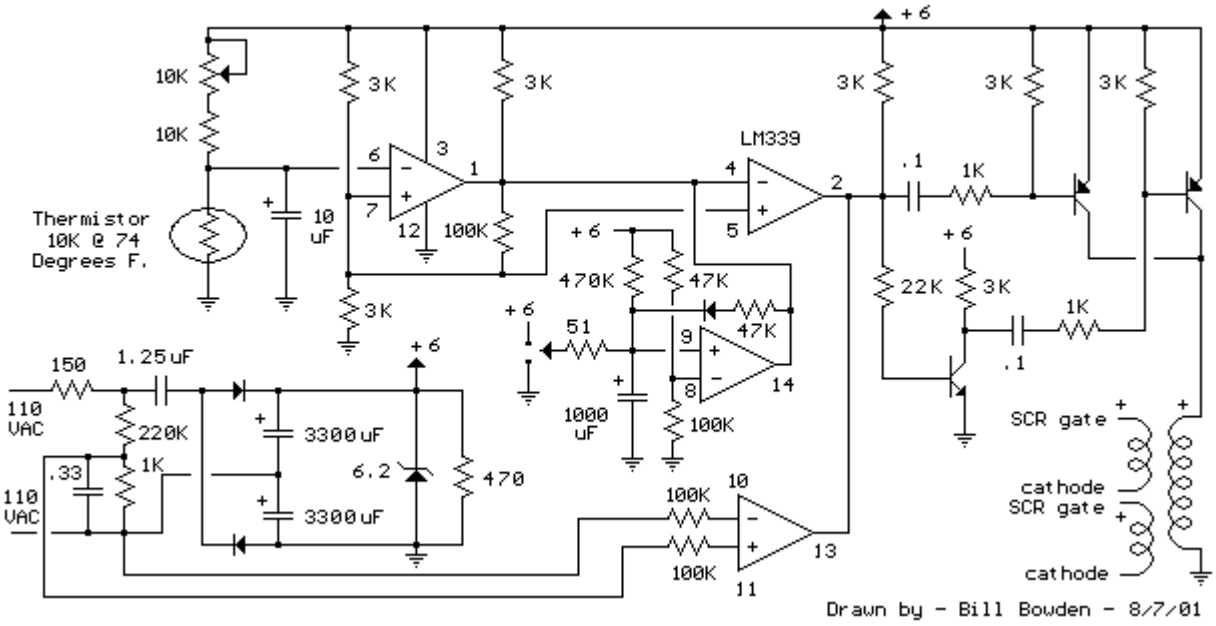
Below is a thermostat circuit I recently built to control a 1300 watt space heater. The heater element (not shown) is connected in series with two back to back 16 amp SCRs (not shown) which are controlled with a small pulse transformer. The pulse transformer has 3 identical windings, two of which are used to supply trigger pulses to the SCRs, and the third winding is connected to a PNP transistor pair that alternately supply pulses to the transformer at the beginning of each AC half cycle. The trigger pulses are applied to both SCRs near the beginning of each AC half cycle but only one conducts depending on the AC polarity.

DC power for the circuit is shown in the lower left section of the drawing and uses a 1.25uF, 400 volt non-polarized capacitor to obtain about 50mA of current from the AC line. The current is rectified by 2 diodes and used to charge a couple larger low voltage capacitors (3300uF) which provide about 6 volts DC for the circuit. The DC voltage is regulated by the 6.2 volt zener and the 150 ohm resistor in series with the line limits the surge current when power is first applied.

The lower comparator (output at pin 13) serves as a zero crossing detector and produces a 60 Hz square wave in phase with the AC line. The phase is shifted slightly by the 0.33 uF, 220K and 1K network so that the SCR trigger pulse arrives when the line voltage is a few volts above or below zero. The SCRs will not trigger at exactly zero since there will be no voltage to maintain conduction.

The upper two comparators operate in same manner as described in the "Electronic thermostat and relay" circuit. A low level at pin 2 is produced when the temperature is above the desired level and inhibits the square wave at pin 13 and prevents triggering of the SCRs. When the temperature drops below the desired level, pin 2 will move to an open circuit condition allowing the square wave at pin 13 to trigger the SCRs.

The comparator near the center of the drawing (pins 8,9,14) is used to allow the heater to be manually run for a few minutes and automatically shut off. A momentary toggle switch (shown connected to a 51 ohm resistor) is used to discharge the 1000uF capacitor so that pin 2 of the upper comparator moves to a open circuit state allowing the 60 Hz square wave to trigger the SCRs and power the heater. When the capacitor reaches about 4 volts the circuit returns to normal operation where the thermistor controls the operation. The momentary switch can also be toggled so that the capacitor charges above 4 volts and shuts off the heater if the temperature is above the setting of the pot.


+6
10K
10K
3K
3K
3K
3K
3K
LM339
Thermistor
10K @ 74
Degrees F.
10
uF
100K
.1
1K
+6
470K
47K
22K
3K
+6
51
47K
1K
.1
1000
uF
100K
150
1.25uF
110
VAC
220K
1K
.33
110
VAC
3300uF
6.2
470
3300uF
+6
100K
100K
SCR gate
cathode
SCR gate
cathode
Drawn by - Bill Bowden - 8/7/01

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