ECE 320 - Homework #5

555 Timers, Transistors used as a Switch, Schmitt Triggers. Due Monday, Sept 27th

Assume a 3904 transistor (NPN) and 3906 (PNP) ($0.04 each)

$$\beta = 100 \qquad \min(|V_{ce}|) = 0.2V \qquad \max(I_c) = 200mA$$

Assume a thermistor with

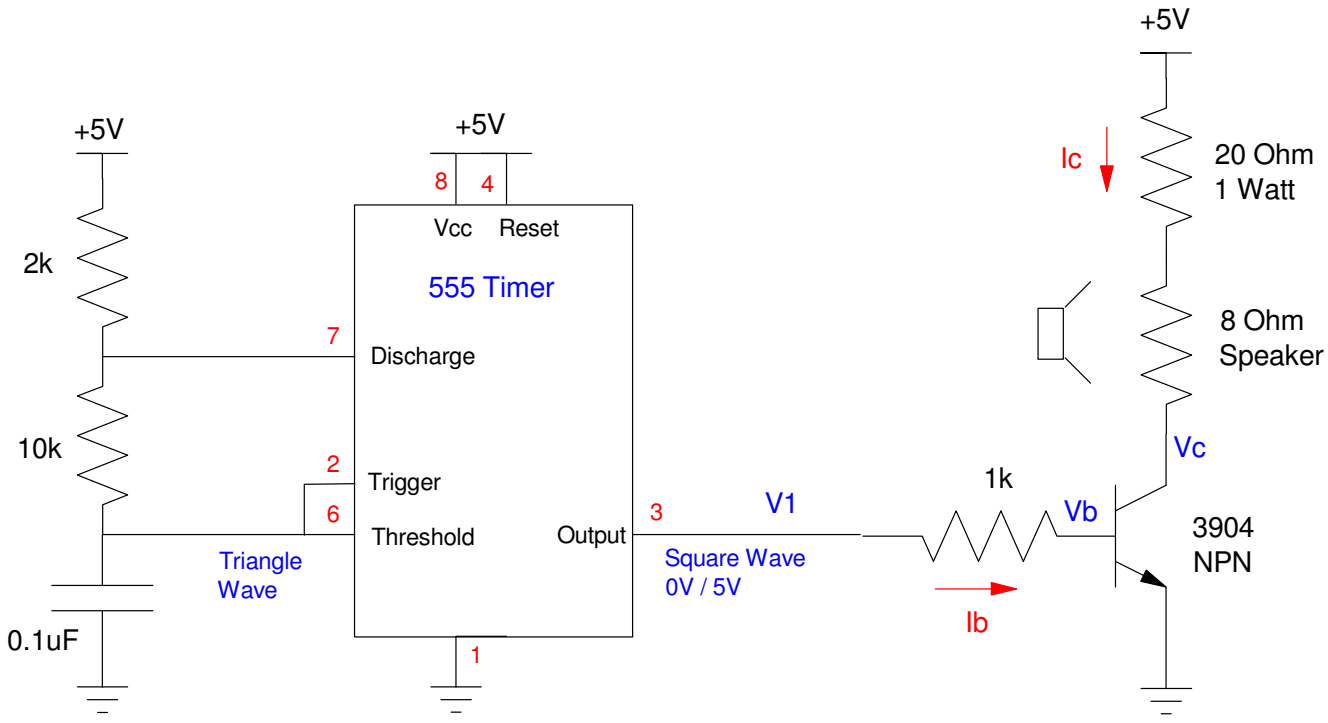
$$R = 1000 \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

Transistor Switch

1) For the circuit shown below
   - Assume V1 = 5V. Determine Ib, Ic, Vb, and Vc.
   - Assume V1 = 0V. Determine Ib, Ic, Vb, and Vc.
2) Using CircuitLab, determine {Ib, Ic, Vb, and Vc} for
   - V1 = 0V
   - V1 = 5V

Is the transistor turning on (Vc = 0.2V) and off (Ic = 0)?

3) Simulate the circuit with the 555 timer in CircuitLab.
   - What frequency should you hear at the speaker?
4) Build this circuit with your lab kits and verify
   - The freqency at V1
   - That the transistors is off when V1 = 0V (connect the 1k resistor to ground rather than the 555 timer)
   - That the transistor is saturated when V1 = 5V (connect the 1k resistor to +5V)
   - That the speaker is loud and annoying (the transistor acts as an amplifier)



Circuit for problem 1 - 4

Comparitor

Add an electronic switch to turn the speaker on and off

5) Design a comparitor (shown in blue - don't add the red resistors (they are for a Schmitt trigger)) to

- Turn on the speaker (V2 = 5V) when T > 30C, and
- Turn off the speaker (V2 = 0V) when T < 30C

6) Simulate the comparitor in CircuitLab to verify the on / off temperature (or ressitance or voltage)

7) Build this circuit and verify it's on and off temperature (or voltage or ressistance. Replace R with a potentiometer for test purposes)

Schmitt Trigger

Add an electronic switch to turn the speaker on and off

8) Design a Schmitt Trigger (modify section in blue) to

- Turn on the speaker (V2 = 5V) when T > 35C, and
- Turn off the speaker (V2 = 0V) when T < 30C

9) Simulate the comaritor in CircuitLab to verify the on / off temperature (or ressitance or voltage)

10) Build this circuit and verify it's on and off temperature (or voltage or ressistance. Replace R with a potentiometer for test purposes)