

ECE 320 - Homework #5

555 Timers, Transistors used as a Switch, Schmitt Triggers. Due Monday, February 14th

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

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

Assume a thermistor with

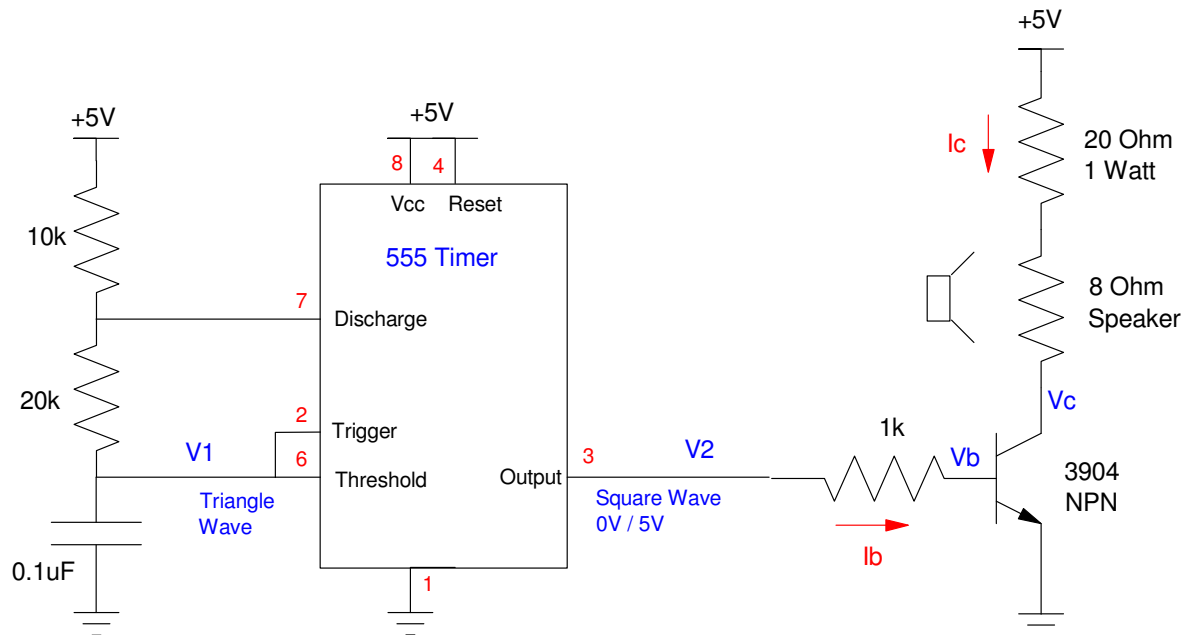
$$R = 1000 \exp \left(\frac{3905}{T+273} - \frac{3905}{298} \right) \Omega$$

555 Timers

- 1) Determine the on and off times for the voltage at V2 for following 555-timer circuit
- 2) Simulate this circuit in CircuitLab and verify the on and off times

Transistor Switch

- 3) Determine the voltages $\{V_b, V_c\}$ and currents $\{I_b, I_c\}$ when
 - $V_2 = 0V$
 - $V_2 = 5V$
- 4) Verify your calculations using CircuitLab



Comparator

Add an electronic switch to turn the speaker on and off

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

- Turn on the speaker ($V3 = 5V$) when $T > 40C$, and
- Turn off the speaker ($V3 = 0V$) when $T < 40C$

6) Simulate the comparator in CircuitLab to verify the on / off temperature (or resistance or voltage)

- use a voltage source ($V4$) to simulate the voltage at the voltage divider)

7) Build this circuit and verify it's on and off temperature (or voltage or resistance. 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 ($V3 = 5V$) when $T > 45C$, and
- Turn off the speaker ($V3 = 0V$) when $T < 40C$

9) Simulate the comparator in CircuitLab to verify the on / off temperature (or resistance or voltage)

- use a voltage source ($V4$) to simulate the voltage at the voltage divider)

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

