

ECE 320 - Homework #5

555 Timers, Transistors used as a Switch, Schmitt Triggers. Due Monday, February 13th
Please email to jacob.glower@ndsu.edu or submit as a hard copy or submit on BlackBoard

Pick an NPN and PNP transistor (preferably, ones in your lab kit)

	3904 NPN	6144 NPN	3906 PNP	TIP117 PNP
hfe (beta)	100	200	100	1,000
Vce(sat)	0.2V	0.2V	0.2V	0.9V
Vbe(on)	0.7V	0.7V	0.7V	1.4V

Assume a thermistor with

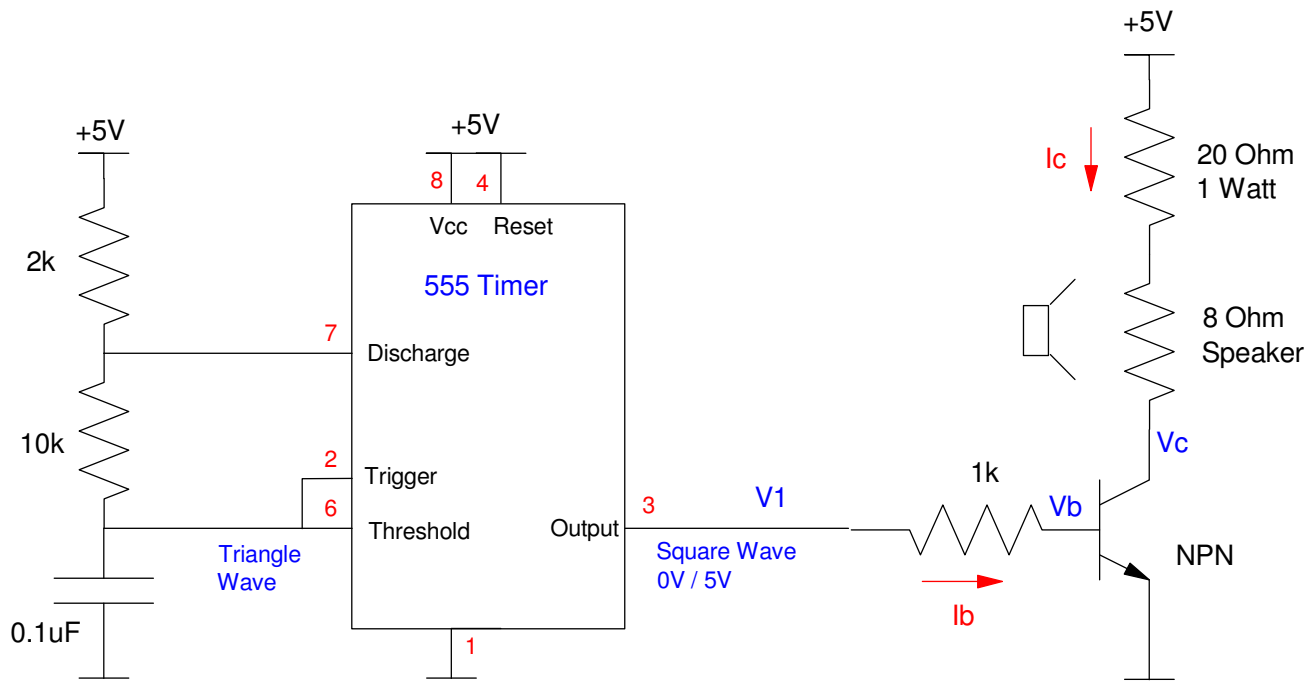
$$R = 1000 \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

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 {Vb, Vc} and currents {Ib, Ic} when
 - V1 = 0V
 - V1 = 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 ($V_3 = 5V$) when $T > 50C$, and
 - Turn off the speaker ($V_3 = 0V$) when $T < 50C$
- 6) Simulate the comparator in CircuitLab to verify the on / off temperature (or resistance or voltage)
 - use a voltage source (V_4) 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 ($V_3 = 5V$) when $T > 55C$, and
 - Turn off the speaker ($V_3 = 0V$) when $T < 45C$
- 9) Simulate the comparator in CircuitLab to verify the on / off temperature (or resistance or voltage)
 - use a voltage source (V_4) 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)

