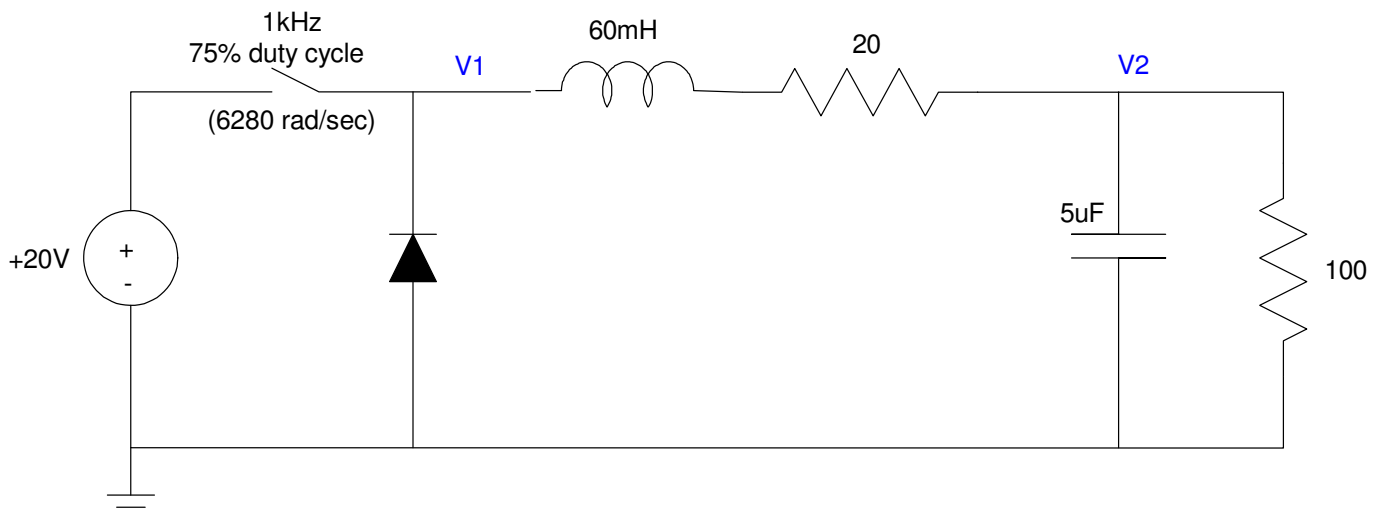


ECE 320 - Homework #5

DC to DC Converter, Fourier Transforms, AC to DC Converter, SCR

DC to DC Converters

- 1) Determine the voltages (both DC and AC) for V1 and V2.
- 2) Simulate the circuit in CircuitLab and determine V2 (DC and AC)
- 3) Change the duty cycle and C so that
 - The DC voltage at V2 = 5.00V
 - The ripple at V2 is 1Vpp
- 4) Check your results for problem #6 in CircuitLab



Fourier Transforms

- 5) Going back to problem #1, determine the Fourier Transform for V1 out to the 3rd harmonic (3kHz)
- 6) Using the Fourier Transform approximation for V1, determine V2 out to the 3rd harmonic (3kHz)

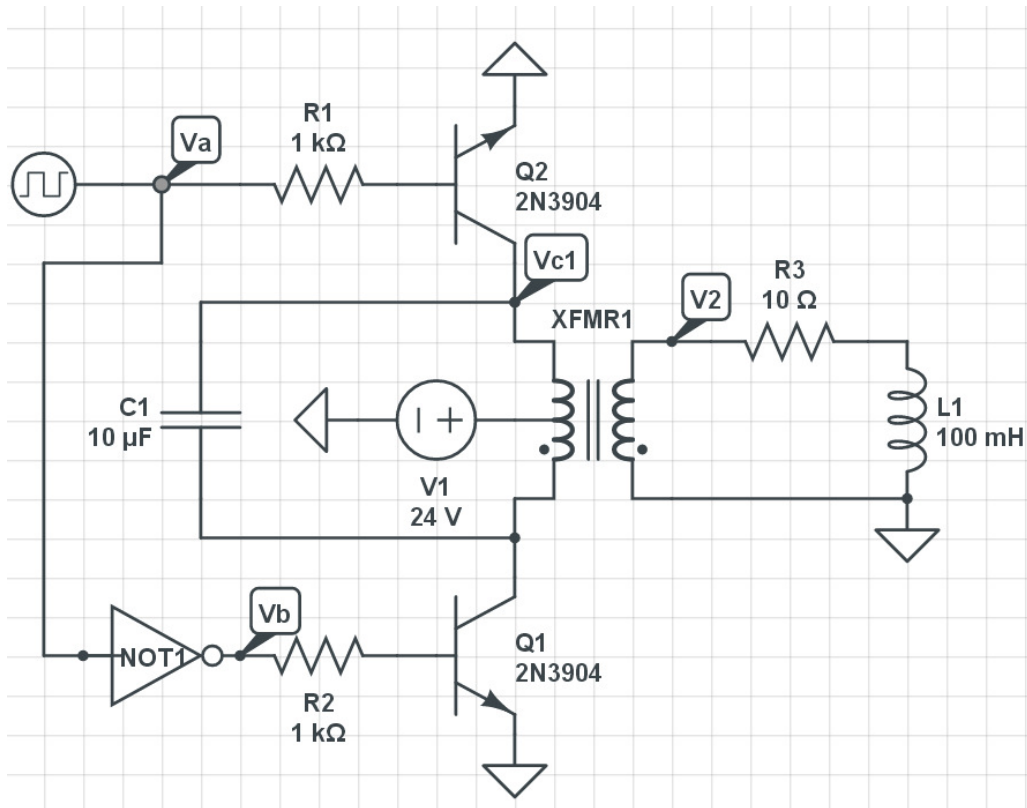
DC to AC

7) Let

- A = 0V / 5V square wave, 60Hz, 0 degree time delay
- B = 0V / 5V square wave, 60Hz, 180 degree time delay
- C1 = 10uF

Determine using CircuitLab the voltage V2 (i.e. the voltage across a DC motor, modeled as a 10 Ohm & 100mH load)

8) Adjust C1 so that the voltage across the motor is as close to a sine wave as possible (trial and error)



SCR

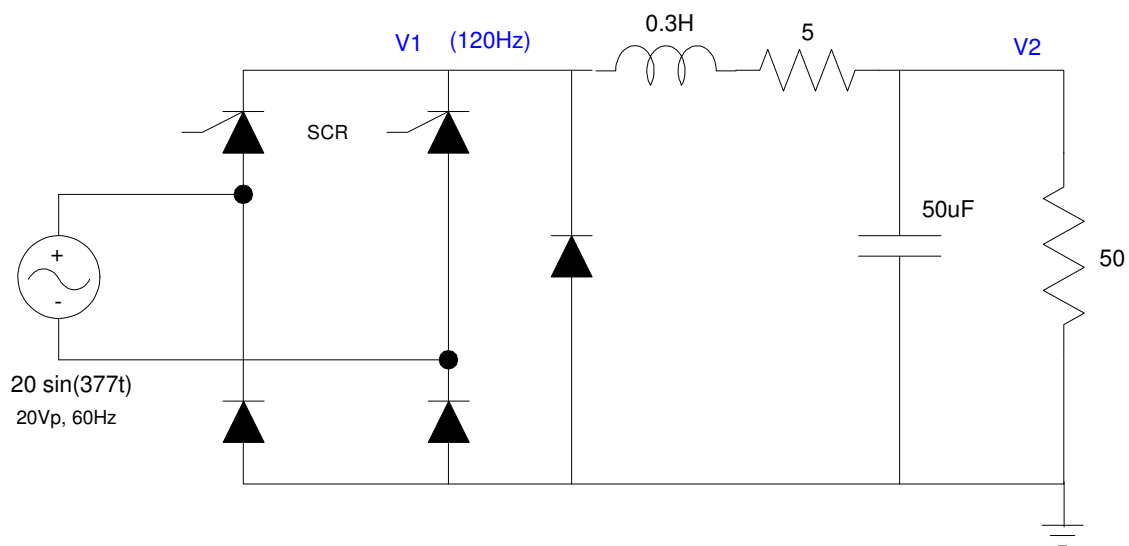
9) Assume a firing angle of 45 degrees. Determine the voltage at V1 and V2 (both DC and AC).

10) Change this circuit so that

- The voltage at V2 is 10.00V (DC)
- With a ripple of 500mVpp

11) Simulate this circuit in Matlab by

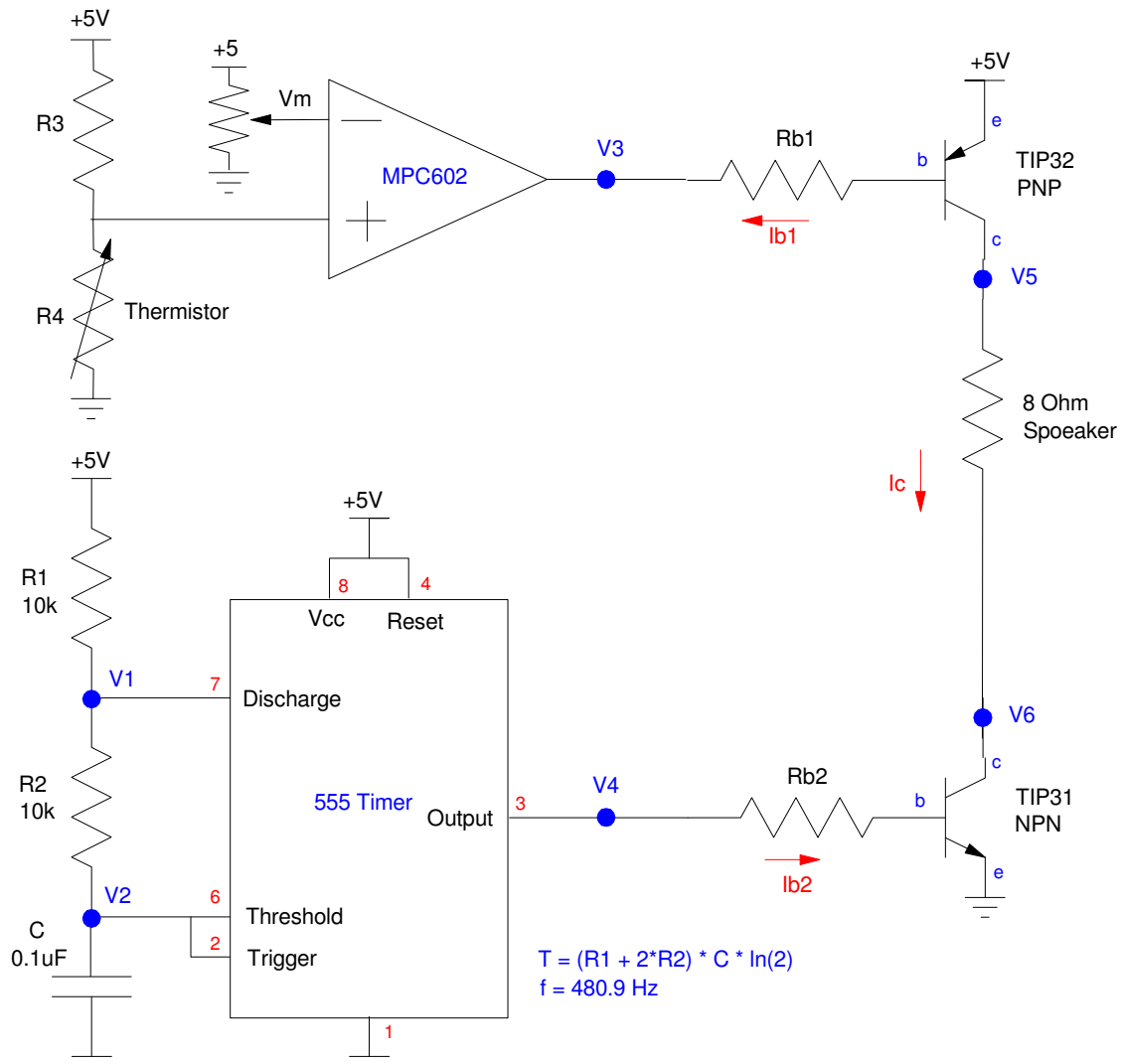
- Writing the differential equations which describe this circuit (state variables: I_L and V_C)
- Specify $V_1(t)$ as a full-wave rectified sine wave, clipped at X degrees (from problem #4)
- Use numerical integration to find $V_2(t)$



Lab: Temperature Alarm

12) Build and demonstrate the following circuit. Adjust V_m so the the comparator switches at about room temperature (blowing hot air on the thermistor causes the comparator's output to change.) Include a photo of your breadboard circuit for full credit.

- 10pt 555 timer outputs a square wave
- 10pt Comparator switches from 0V to 5V as the thermistor warms up
- 10pt NPN transistor turns on and off with the 555 timer
 - ON when $V_4 = 5V$ ($V_6 = 0.9V$ - saturated)
 - OFF when $V_4 = 0V$
- 10pt PNP transistor turns on and off with the comparitor
 - ON when $V_3 = 0V$ ($V_5 = 5.0V - 0.9V$ - saturated)
 - OFF when $V_3 = 5V$
- 10pt Demonstration
 - Alarm on when hot (blow hot air on the thermistor)
 - Alarm off when the thermistor cools off
 - Adjust V_m to turn on / off at about room temperature



Breadboard Example

