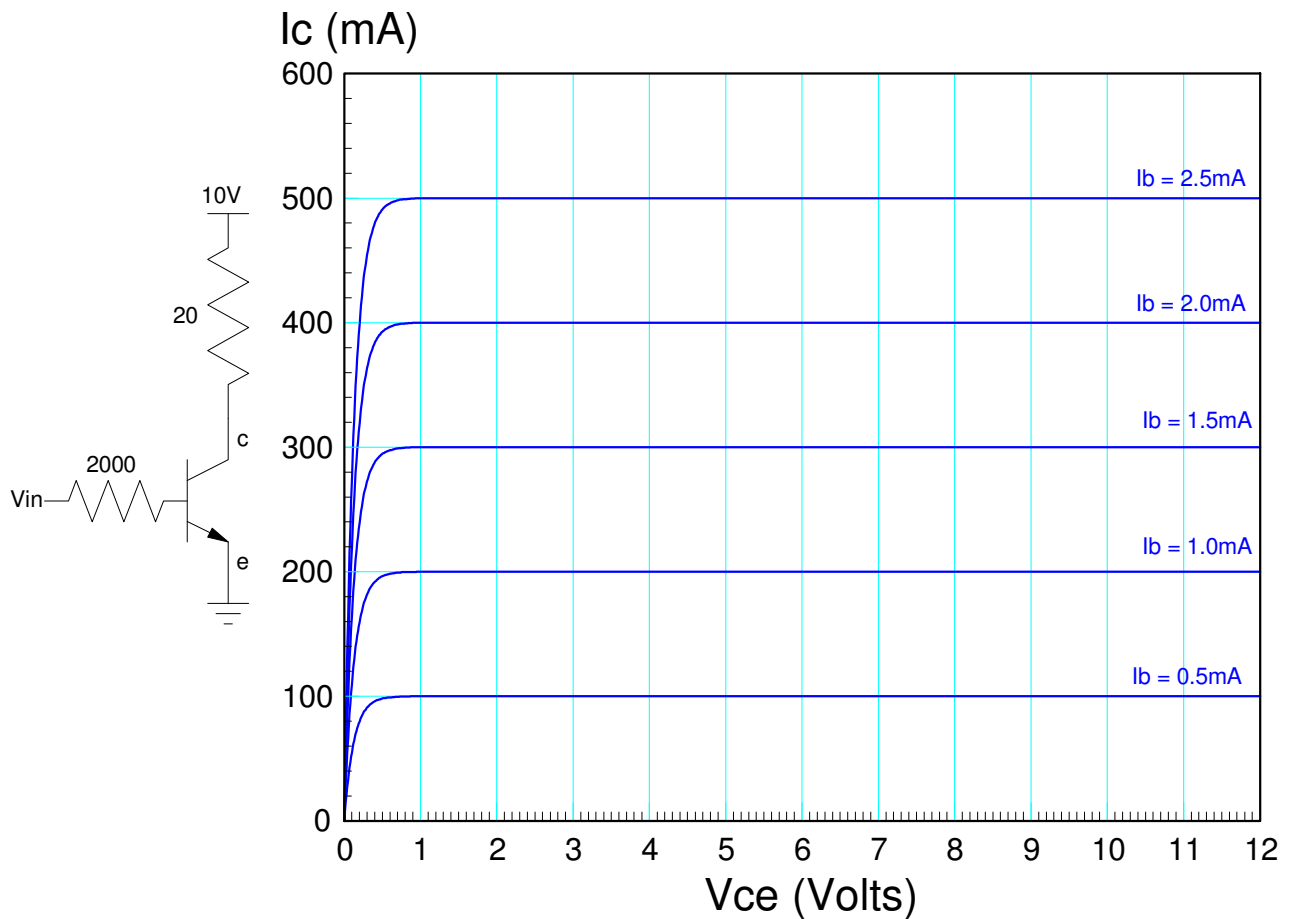


ECE 320 - Homework #4

Transistors, BJT Switch, Schmitt Triggers, H-Bridge

Transistors

- 1) Determine the current gain, β , for the transistor show below. Also label the off, active, and saturated regions.
- 2) Draw the load-line and determine the Q-point for
 - $V_{in} = 0V$
 - $V_{in} = 3V$
 - $V_{in} = 6V$



Problem 1-2

Transistor Switch (NPN & PNP)

For the following circuits, assume TIP31 and TIP32 tansistors

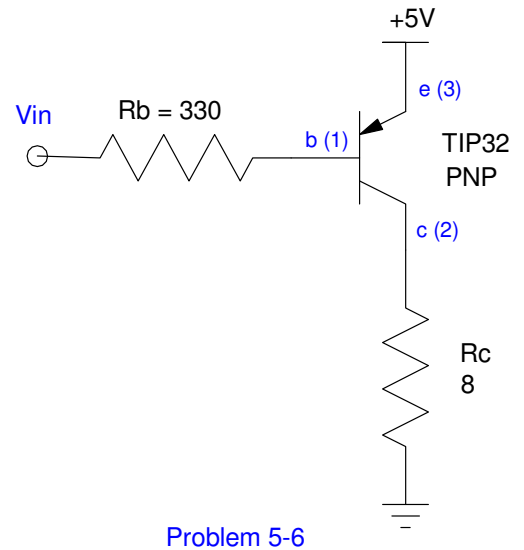
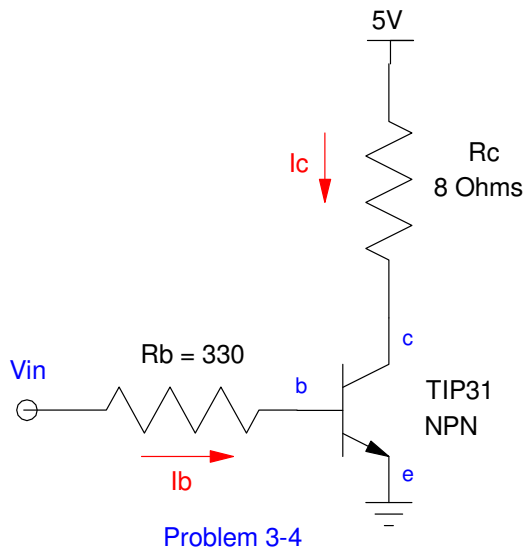
		beta	Vbe	Vce(sat)	Ic(max)
TIP31	NPN	100	0.7V	0.2V	3A
TIP32	PNP	100	0.7V	0.2V	3A

NPN Swirtch (TIP31)

- 3) Determine the voltages and currents {Vb, Vc, Ib, Ic}
- What is the largest Rb can be to keep the transistor in the saturated region?
- 4) Simulate this circuit in CircuitLab. From CircuitLab, determine {Vb, Vc, Ib, Ic}

PNP Switch (TIP32)

- 5) Determine the voltages and currents {Vb, Vc, Ib, Ic}
- What is the largest Rb can be to keep the transistor in the saturated region?
- 6) Simulate this circuit in CircuitLab. From CircuitLab, determine {Vb, Vc, Ib, Ic}



Comparator & Schmitt Trigger

Assume a thermistor with

$$R = 2000 \cdot \exp\left(\frac{3904}{T+273} - \frac{3904}{298}\right) \Omega$$

7) Design a circuit which outputs

- 0V for $T < 30^\circ\text{C}$ and
- 5V for $T > 30^\circ\text{C}$

8) Design a circuit with hysteresis

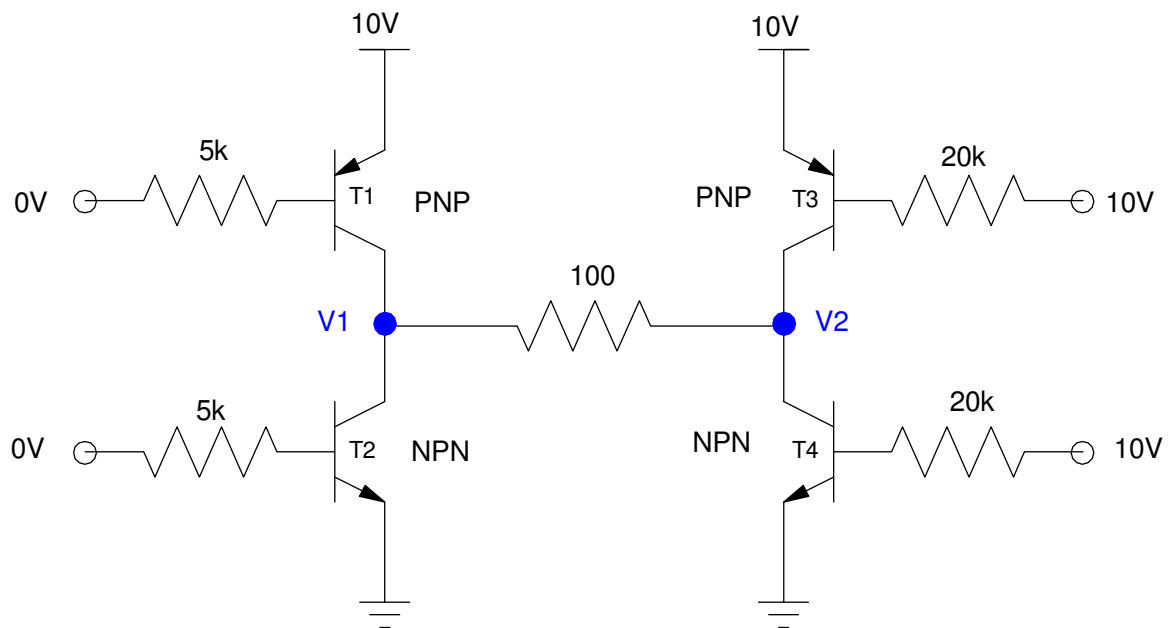
- $V_o = 0\text{V}$ for $T < 30^\circ\text{C}$
- $V_o = 5\text{V}$ for $T > 35^\circ\text{C}$
- No change for $30^\circ\text{C} < T < 35^\circ\text{C}$

H-Bridge

9) Determine the voltages and currents for the following H-bridge.

10) Change the base resistors so that the transistors are either off or saturated

- Determine the voltages and currents for your modified H-bridge.



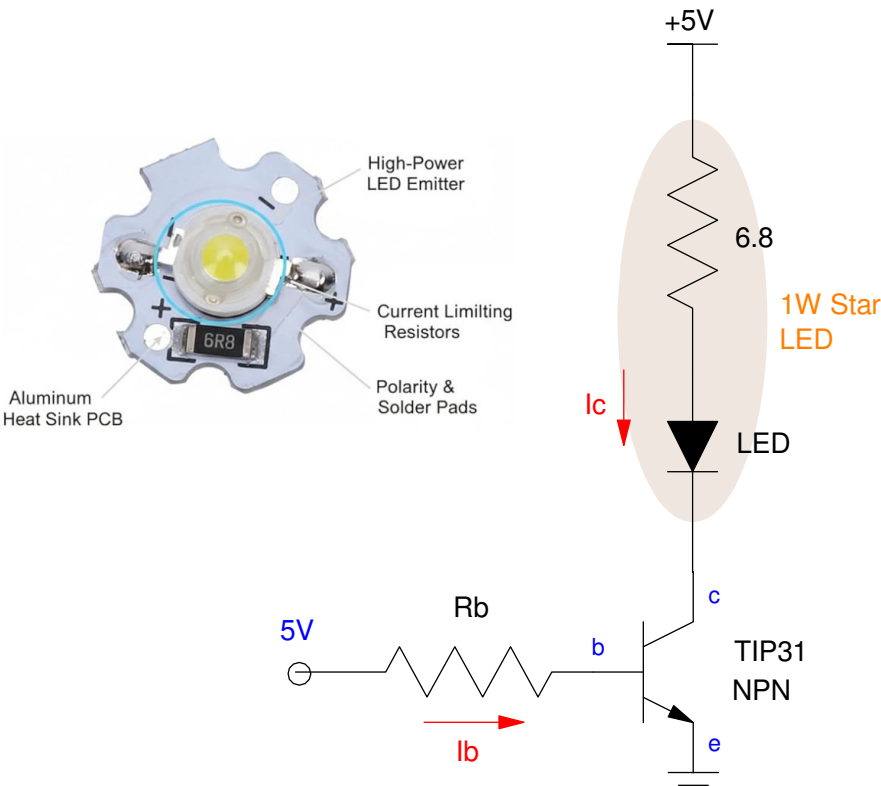
Lab: NPN Switch

		beta	Vbe	Vce(sat)	Ic(max)
TIP31	NPN	100	0.7V	0.2V	3A

11) Calculate the currents and voltages for the following NPN switch as R_b varies

- Assume the star LED has $V_f = 3.0V$
- Also note the state of the transistor (off - active - saturated)

R_b	V_{be}	V_{ce}	I_b	I_c	State
100					
330					
1k					
10k					
100k					
infinite					

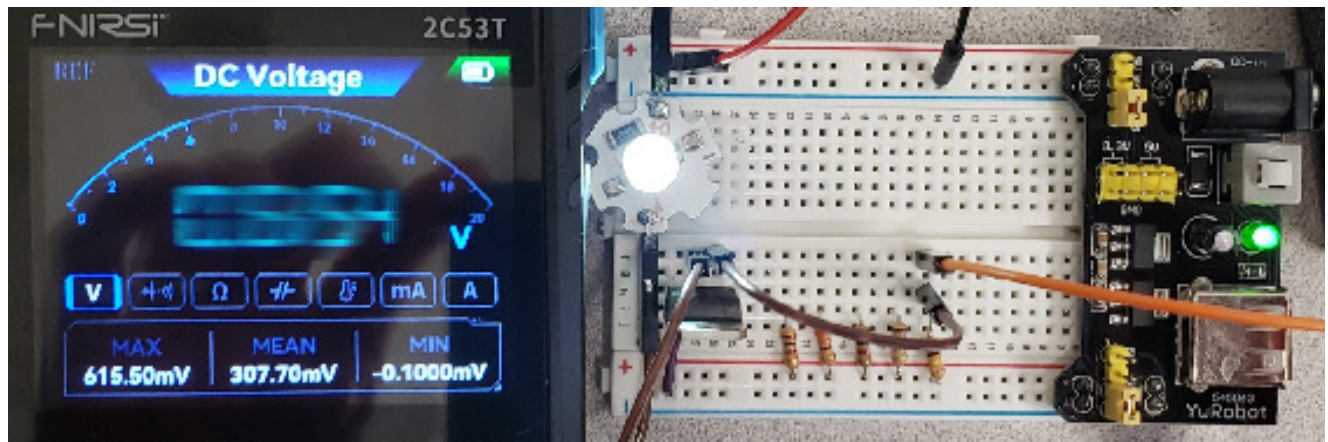


12) Build this circuit and measure the voltages and then calculate the currents as R_b varies

- note: Currents are computed using voltage measurements and resistances
- Include a photo for full credit

R_b	V_{be}	V_{ce}	I_b	I_c	State
100					
330					
1k					
10k					
100k					
infinite					

13) Plot the measured I_c vs. V_{ce} along with the load line for this circuit



Sample of what your circuit might look like

Notes:

- Use a powered breadboard
 - Red rails (top and bottom) = +5V
 - Blue rails = 0V
- Keep your circuit neat and orderly
- Color code your wires
 - Red = +5V
 - Black = Ground
- Take a photo showing one of your measurements