## ECE 320 - Homework #5

Transistors used as a Switch, H-Bridges. Due Wednesday, February 10th

## **Transistor Switch**

Assume a TIP112 transistor (NPN) and TIP117 (PNP) (\$0.34 each)

 $\beta = 1000 \quad \min(|V_{ce}|) = 0.9V \quad \max(I_c) = 4A$ 

1) Design a circuit to meet the following requirements (i.e. a transistor used as a switch)

Input: 0V / 5V binary signal capable of 20mA

• Output: DC Motor which draws 200mA @ 10V Relationship:

• When Vin = 0V, 0V is applied to the motor

• When Vin = 5V, 10V is applied to the motor +/- 1V

2) Check your design in PartSim

• Model th emotor as a 20 Ohm resistor (200mA @ 10V)

• When Vin = 0V, is 0A flowing ni the motor?

• When Vin = 5V, is 200mA flowing through the motor (i.e. the 20 Ohm resistor)?

3) Check your design in lab.

- When Vin = 0V, are the voltages and currents what you calculated and simulated?
- When Vin = 5V, are the voltages and currents what you simultated?

Vin = 0V (off)	Calculated problem 1	Simulated problem 2	Measured problem 3
Vin	0.0V		
Vbe			
Vce			
lc			

Vin = 5V (on)	Calculated problem 1	Simulated problem 2	Measured problem 3
Vin	5.0V		
Vbe			
Vce			
lc			

## **H-Bridges**

- 4) Determine the voltages and currents for the following H-bridge. Assume TIP transistors
  - | Vbe | = 1.4V
  - $\beta = 1000$
  - $V_{ce(sat)} = 0.9V$



5) Design an H-Bridge cable of running a DC servo motor forward (+10V), reverse (-10V) and stop (0V). Assume the DC servo motor draws 200mA @ 10V.

- 6) Check your design for problem #2 in PartSim (or similar program)
- 7) Lab: Build your circuit in lab and verify it works for all three states (forward, reverse, stop).
  - note: Check Vce. If it's 0.9V, the transistor is saturated (on)