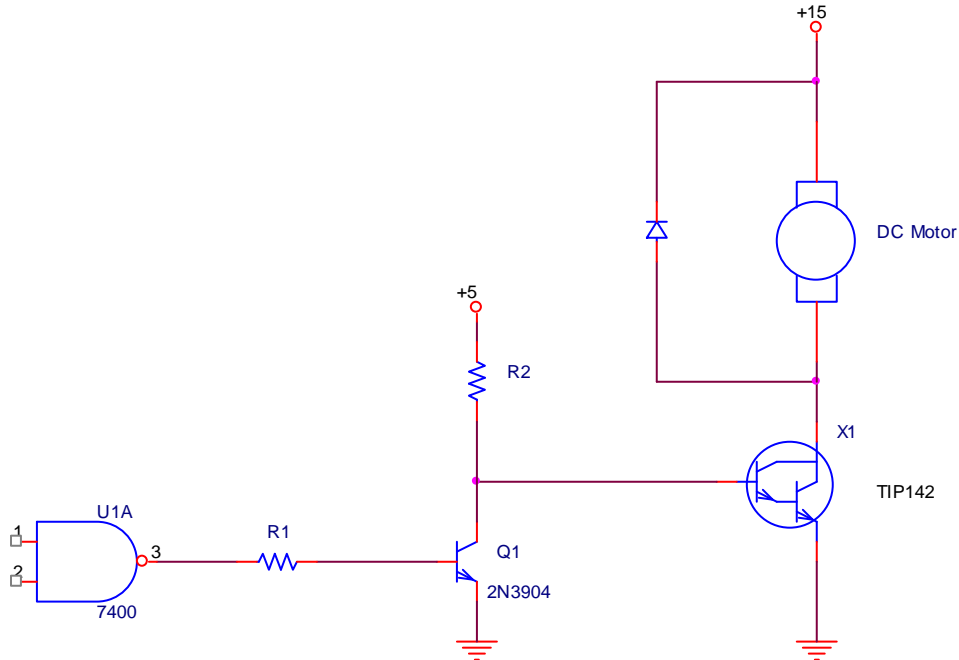


Problem 1:

Design the circuit below to turn on and off the DC motor from the output of a TTL logic gate. The motor should turn on when the output of the NAND gate is a logic HIGH. The motor requires 12 to 15 volts and draws 5 amps. The motor should be on when the output of the 7400 is between 3.5 and 5 volts. The maximum high output current of the logic gate is 1 mA.



Your design must work for the worst case minimum and maximum parameters of the 7400, Q1 and X1. For your design you must:

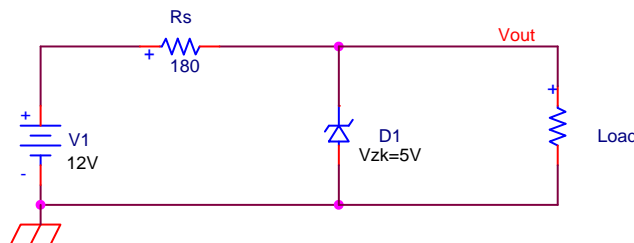
- Choose a freewheeling diode. Include a datasheet and highlight a specification that shows that it can handle the required current.
- Include a datasheet for the TIP 142 and highlight all specifications used in your design.
- Include a datasheet for the 2N3904 and highlight all specifications used in your design.
- Calculate values for R1 and R2 that will work in the worst case scenario. Choose standard 5% resistors.
- Simulate your circuit with PSpice. For the motor, use a resistor that draws at least 5 amps when 12 volts is applied across it. Include two simulations in you results:
 - One that shows that the voltage across the motor is between 12 and 15 volts when the output of the 7400 is a logic high voltage. The motor voltage should be zero when the output of the 7400 is a logic low voltage.
 - One that shows that the current through the motor is constant and greater than 5 amps when the output of the 7400 is a logic high voltage. The motor current should be zero when the output of the 7400 is a logic low voltage.

Use a 0 to 5 volt square wave as the input to the logic gate (part T_TTL) and set the frequency to 1 Hz.

Problem 2:

For the circuit below:

- For what values of the load is the output voltage of the circuit constant?
- For the range of load values found in part (a), what is the maximum power absorbed by the Zener?
- For the range of load values found in part (a), what is the maximum power absorbed by Rs?

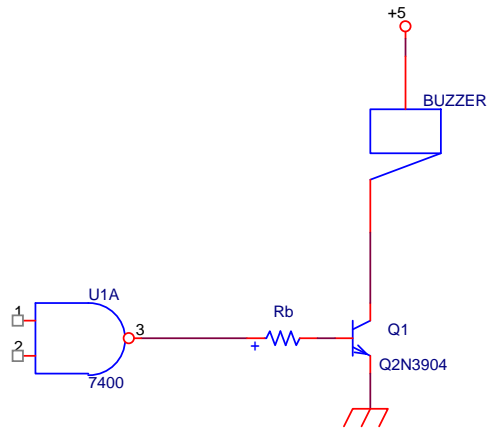


Problem 3:

We wish to drive a buzzer from the output of a TTL gate using the circuit below. The buzzer requires 50 mA to operate.

- Find the value of the base resistor (Rb) needed to make the circuit below work for all possible outputs of the TTL gate. Assume $\beta=100$ and that the output voltage of the TTL gate is between 3.5 V and 5 V.

b) For your choice of R_b from part (a), what is the largest amount of current the TTL gate must supply?



Problem 4: Book problem D5.65

Problem 5:

a) Visit ON Semiconductor's web site (www.onsemi.com) and obtain the following information:

- A datasheet for an MBR6045WT Schottky diode. Turn in this datasheet with your homework.
- A PSpice model for the MUR210. Print out this model and turn it in with your homework.

b) Using the MBR6045WT diode model obtained in part (a), run a PSpice simulation to view the switching speed of this diode. Use a similar simulation to the one shown in class for the MUR420. You may need to change the frequency of the input waveform a bit. Use a part called DBREAK in your simulation for the diode. See section 7.F.1 of the PSpice manual for an example of using the model you obtained.