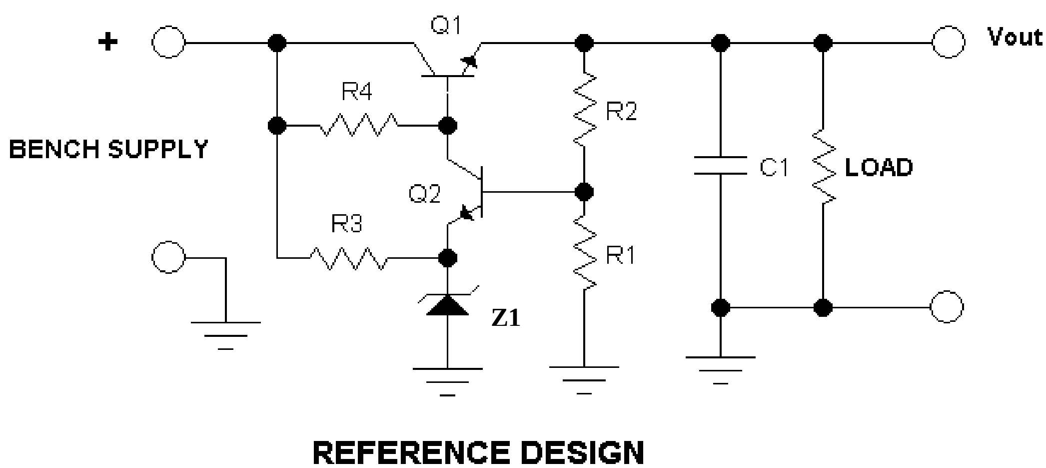
EECS 371 Design Project #7
Linear Power Supplies

Please carefully study H&H, Ch 6.01 thru 6.18 as well as BB material.

Part 1:
The circuit shown below is a classic linear regulator.
Calculate values for operation as specified. Build, test performance, and record values as requested below. Please be prepared to explain how all values were calculated.
Do NOT attempt to build with plug-in proto board; solder components using PCB “kluge” board. Be sure to consider voltage drops and use proper wiring techniques.



Specifications:

Vin = 12 Vdc to 18 Vdc. Vout = 9 Vdc +/- 0.5 V. Iout = 0 to 1.5 Amp
Line + Load Regulation < 1.5% .

a. Measure and record Line Regulation and Load Regulation. What design aspects contribute to regulation? ____

Reg_{line} =____________ % @ FL. Reg_{load} = ____________ % @ Vin = 15V

b. Calculate the heat sink size for operation at 50C ambient. Assume worse-case operation.
Heat sink <______________ deg C/W.

c. Calculate the heat sink size needed in the case of a continuous short-circuited output (worse case).
Heat sink < ______________ deg C/W. What would the output current be? _________Amp

d. Measure input dropout voltage: Vin_{min} =__________. Do you think you should measure this at no load or full load? ___________. Also measure *differential* dropout voltage: Vi/o_{min} = _________.
What circuit considerations contribute to a high (poor) I/O-differential value?
____.

e. Measure quiescent (no load) current. Iq = ______. Discuss why, broadly speaking, a higher performance supply would have a higher quiescent current. Modify your circuit with a resistor(s) value change that results in an increased Iq, and then **test** to demonstrate this effect. Provide test results showing how load regulation (at @ Vin = 15V) can be improved at the expense of a higher Iq:

$Reg_{load} =$ __________ % at Iq1 $Reg_{load} =$ ___________ % at Iq2

f. Add circuitry to your supply to add active current limiting to limit maximum output current to 2 amp. Measure and record short-circuit current. With current limiting in place, what is the worse-case heat sink requirement with a continuous short-circuit?

I_{SC} = ______________. Required heat sink: _______________ deg C/W.

Part 2.

Operate your supply on the "12V, 3A" unregulated supply in place of the bench supply. Using the Variac AC supply, determine the AC line dropout voltage (at FL, of course). $VACin_{min}$=__________.

Keep this built for your recitation.

Part 3; THESE ARE DESIGN ONLY; INCLUDE AN ACCURATE SCHEMATIC WITH ALL COMPONENT VALUES:

a. Design a power supply similar to the one in Part 1 above, but change it to a variable supply with an adjustment range of 4 V to 9V DC.

b. Add a "shutdown" control. This is a 5V input, referred to ground, that shuts off the supply with a logic "1". During shutdown, quiescent current must be < 10uA.

c. Design and prepare an accurate, complete schematic of a variable "split tracking" power supply, using a supply similar to that above as the positive section. Specifications below.

Specifications for Tracking Supply:

Vin: +/- 12 Vdc to 18 Vdc; Vout: +/-4 to 9 Vdc; Iout: 0 to +/- 1 Amp

You are **not** required to build this circuit, but be prepared to discuss your design principles. Of course, if you wish you may build it to confirm your design.

Discussion: this power supply would be driven from a split bench supply (or from a center- tapped transformer with a bridge rectifier and two filter capacitors). Each side of the input supply would vary from 12 to 18 volts. A single control would vary the regulated outputs from 4 to 9 Vdc (one supply would be positive and one would be negative, with a common ground).

It would be best to design this circuit using discrete transistors, but if you must you may use op-amps.

FOR Saturday: Provide a schematic, with values, for the circuits in Part 1 and Part 3 (a) and (b).