PHY 305F – ELECTRONICS LABORATORY I
Fall Semester 2003

EXPERIMENT 6
D.C. POWER SUPPLIES
Lab notebook is due at 1 PM in MP238 on November 24

LEARNING OBJECTIVES:

(1) To become familiar with rectifier diodes.

(2) To become familiar with diode rectifier and smoothing circuits.

(3) To become familiar with voltage regulator chips.

REFERENCES:

R.E. Simpson, Introductory Electronics for Scientists and Engineers, 2nd Edition, Ch. 4 & pages 511-526.

A.J. Diefenderfer and B.E. Holton, Principles of Electronic Instrumentation, 3rd Edition, Chapter 5.

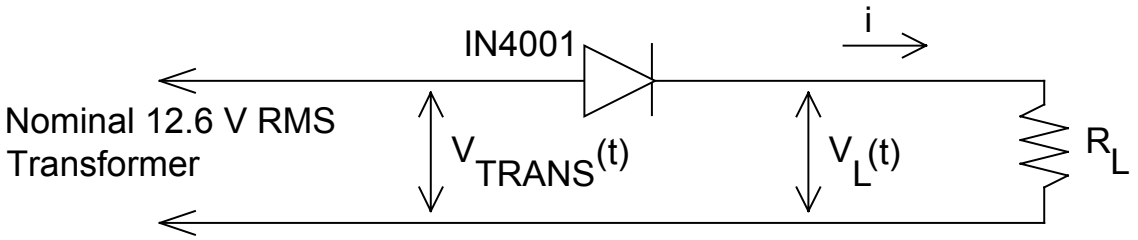
P. Horowitz and W. Hill, The Art of Electronics, 2nd Edition, pages 44-48.

G. Rizzoni, Principles and Applications of Electrical Engineering, 3rd Edition, Chapter 8.

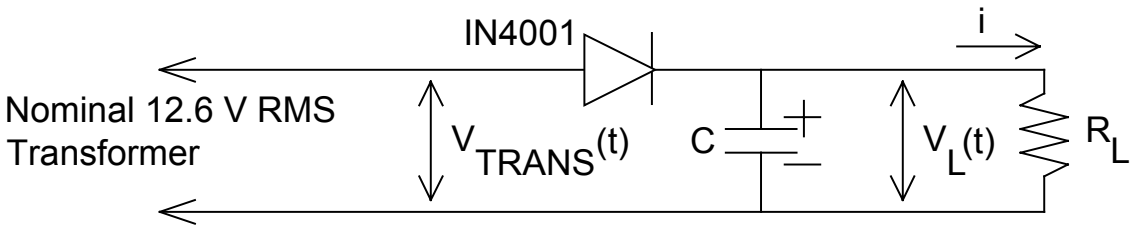
WHAT TO DO:

(1) Find the current-voltage characteristics of the 1N4001 Si diode using the DC supply on your bench and an appropriate load (current limiting) resistor. Use the two multimeters in DC ranges to make the measurement. Do not exceed the diode's maximum ratings of 1 A current and 50 V peak reverse voltage. Plot a linear scale I vs. V curve for about two values of voltage in the reverse diode direction and five values of current in the forward direction. (Be careful that you do not exceed the power rating of the resistor that you use for a load.) Also, using the same data, plot the I vs. V curve using semi-log graph paper or plotting program.

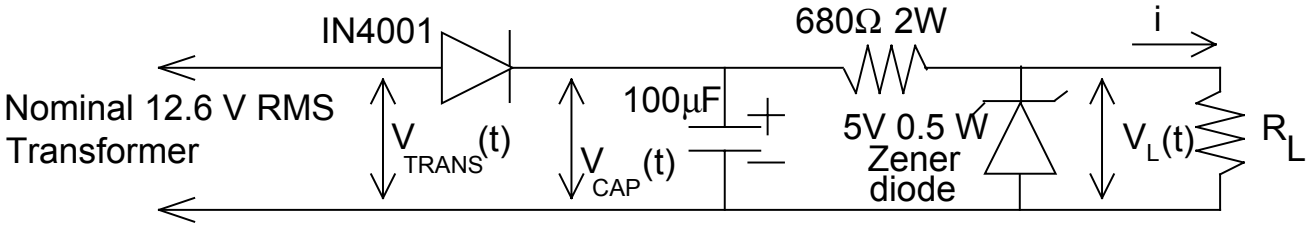
(2) Connect a simple half-wave rectifier circuit feeding a load resistor R_L as shown in the figure below. For four values of load current, i, ranging from 1 mA to 50 mA, observe on the oscilloscope both the output voltage $v_L(t)$ and the transformer voltage $v_{TRANS}(t)$, simultaneously noting the DC value of the output voltage as measured on your multimeter.



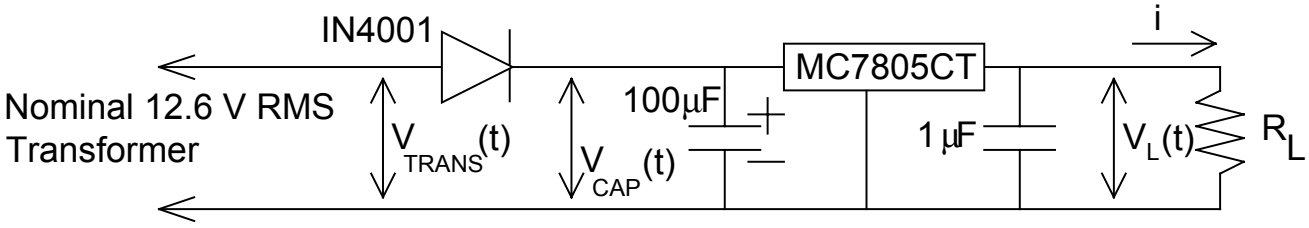
(3) Connect the half-wave rectifier circuit of part (2) to a smoothing capacitor C as shown in the figure below. For the same four values of load current i, repeat the observations of part (2) for two values of C, 100 μF and 10 μF. Be careful to observe the polarity of the capacitor.



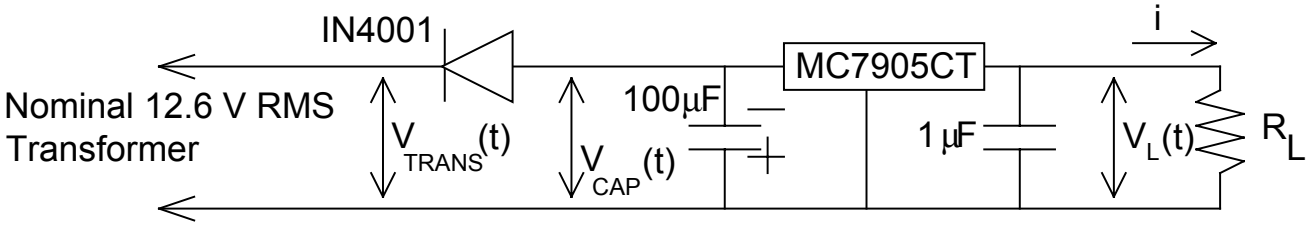
(4) Connect the smoothed half-wave rectifier circuit of part (3) to a simple zener diode regulator circuit as shown in the figure below. For the same four values of load current i, repeat the observations of part (2). Compare v_{TRANS}, v_{CAP}, and v_L using the CRO. Connect the transformer input to the variac and determine how effective this circuit is in dealing with changes in supply voltage.



(5) Connect the smoothed half-wave rectifier circuit of part (3) to a positive DC voltage regulator chip (MC7805CT) as shown in the figure below. For the same four values of load current i, repeat the observations of part (4).



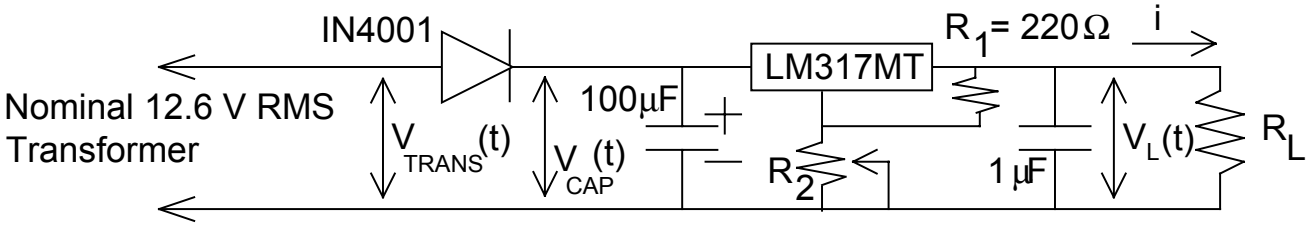
(6) Repeat part (5) using a negative regulator chip (MC7905CT) as shown in the figure below. Note the change in polarity of the diode and the capacitor.



(7) Connect the smoothed half-wave rectifier circuit of part (3) to a positive DC variable voltage regulator chip (LM317MT) as shown in the figure below. Note that R_2 controls the output voltage according to: $V_{out} = 1.25\ [\ (R_2 / R_1) + 1]$ Volts.

(a) For one value of R_2, check the output as the load is varied, as in part (2).

(b) For load resistance $R_L = 1.0$ kΩ, observe the output for five values of R_2, ranging from 0 Ω to 9 kΩ.



COMMENTS:

(1) In each case (parts 2, 3, 4, 5) observe and compare the amount and nature of the ripple.

(2) For parts 4 to 7, what happens when v_{CAP} falls to a value comparable to the regulated voltage?

(3) At each step in the experiment, be sure that you understand the wave shapes, and explain in your lab notebook how the circuits are operating.

Voltage regulator pin connections:

Positive **MC7805CT**	**Negative** **MC7905CT**	**Variable** **LM317MT**
Tab common to pin 2	1. Ground	1. Adjust
1. Input	2. Input	2. Output
2. Ground	3. Output	3. Input
3. Output	Tab common to pin 2