PHY 305F – ELECTRONICS LABORATORY I
Fall Semester 2003

EXPERIMENT 1
REALITIES OF PASSIVE CIRCUITS AND METERS
Lab notebook is due at 1 PM in MP238 on September 29

LEARNING OBJECTIVES:

(1) To discover that meters are really one-dimensional instruments and don't necessarily tell you what you think they are saying – and to start to find out what they are saying.

(2) To understand what i-v curves for various components look like and what these curves mean.

(3) To determine the equivalent circuit characteristics of a couple of simple configurations.

(4) To observe transfer characteristics of a simple R-C circuit.

(5) To regain facility in using the resistor colour code.

(6) To practise using the standard instruments at your work station.

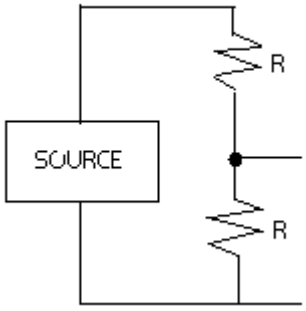
WHAT TO DO:

(1) For two values of resistors, one of approximately 1 kΩ and the other approximately 10 kΩ, measure and plot i vs. v curves for a limited number (maximum of five) of widely spread-out values of i. Do this using sine wave AC. Also make this measurement for one resistance value only, using DC and square wave AC. Compare your graphs to the values that you observe for these components using an ohmmeter. For this section, you may need to use two multimeters.

(2) Measure and plot an i vs. v curve for a signal diode, as in part (1), but for a DC source only. Be careful that you do not exceed the 0.25 W power dissipation rating of the diode. (Also, if you wish, you may try this using a thermistor.)

(3) Using the ohmmeter function of the meters, check the input resistance of the two meters used as voltmeters and of the cathode ray oscilloscope (CRO) set on DC input. Consider how the values you obtain might affect readings that you take with these instruments.

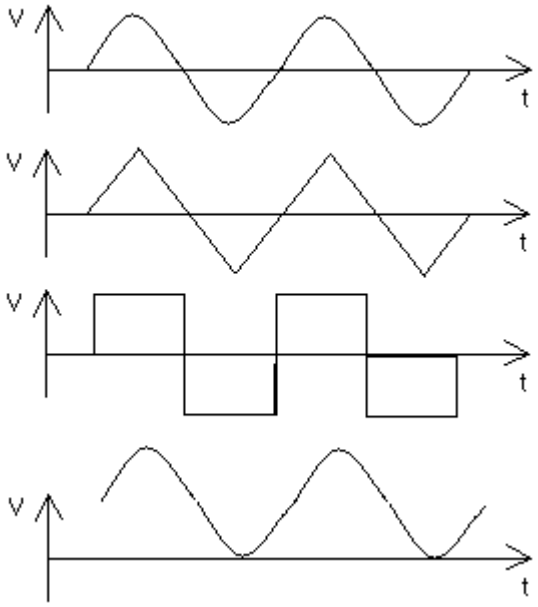
(4) Construct a 1:2 voltage divider as in the figure at right, using two nominally identical values of resistors, R. Find the Thévenin equivalent resistance of this circuit, and explain how this was done experimentally. Your source of power for this divider may be either your DC supply or your Wavetek function generator.



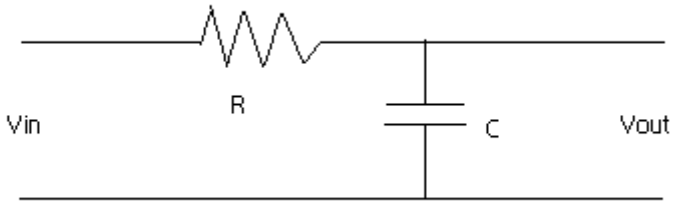
(5) Measure the Thévenin equivalent resistance of the Wavetek function generator. How might this resistance affect the attenuation of the voltage divider in part (4) if the Wavetek were used as the source?

(6) Observe the frequency responses of the two meters and the CRO by connecting them in parallel to the Wavetek function generator, set to deliver sine wave output. In particular, look at frequencies where the meter responses deviate from their normal mid-frequency-range values, i.e., at high or low frequencies. Plot your results in the form of meter readings vs. log frequency for constant generator signal level, over a wide range of frequencies.

(7) Observe the responses of the two meters to different wave shapes, by connecting them both in parallel with the CRO and with the Wavetek function generator. Look at responses to sine wave AC shifted by adding a DC component equal to the AC amplitude (see waveshapes illustrated at right). Choose one reliable intermediate value of frequency in making these observations. Speculate on whether the meters are really measuring the RMS (root-mean-square) value of the voltage as the meter dial claims.



(8) Measure the transfer characteristics of the RC circuit shown below, i.e., plot curves of log attenuation vs. log frequency and of phase shift vs. log frequency over a wide variety of frequency of sine wave AC. Attenuation is output voltage divided by input voltage. Choose the values of R and C so that RC = 0.12 ms.



COMMENTS:

(1) If you don't know how to wire up the circuit that you require in any of the above, then (i) try sketching what you think is needed and see if the wiring makes sense, (ii) if that fails, ask for help.
(2) In your lab notebook write-up, pay particular attention to commenting on how your observations deviate from what you would have expected if your measuring instruments had been ideal.
(3) When you are finished, please return components (that haven't been burnt out) to the component drawers from which you obtained them. This means that you must learn to use the resistor colour code.
(4) You can plot curves using on the computers using faraday. However, log-linear and log-log graph paper should also be available in the filing cabinet in MP238 if you wish to use it.