E1.1 Ideal Rectification

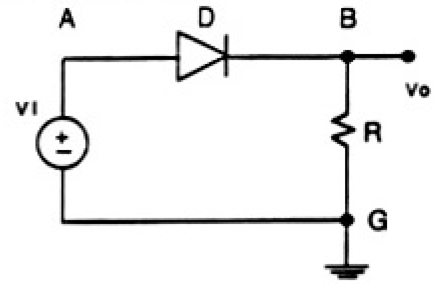

Figure 4.1 A Simple Rectifier Circuit

- Assemble the circuit shown in Fig. 4.1, with a IN4004 diode and 1 kΩ resistor.
- Set the generator to provide a sine wave at 100 Hz with 10 V peak amplitude.
- Use your "normalized" two-channel oscilloscope, appropriately triggered. (See Appendix E3) to display υ_I and υ_O, with the circuit, the generator, and the oscilloscope grounds interconnected.

- Estimate the diode voltage drop at the peak and at an output voltage which is one-tenth the peak.
- Examine the relationship between υ_I and υ_O near where υ_O begins to go positive. Estimate the time (and corresponding phase angle) at which the output voltage is 1/2 the diode drop at the peak, and the corresponding diode drop. Verify your observations by a calculation based on the amplitude and frequency of the input sine wave.
- Switch the generator to provide a square-wave output. Notice the direct effect of diode drop.
- * Switch the generator to a triangle wave and reconsider the situation near zero output, as suggested above for the sine wave.

E1.2 Rectification and a Do-It-Yourself Curve Tracer

- Assemble the rectifier circuit shown in Fig. 4.1 with a 1N4004 diode and 1 kΩ resistor.
- Set your generator to provide a 12 V peak sine wave at 100 Hz.
- Connect your oscilloscope common to the node (*B*) *between* the diode and resistor, while measuring the voltages across each of them individually. (See Appendix E4 concerning the use of power-ground-isolating line-cord adapter).
- Repeat some of the measurements of E1.1.
- * Switch your oscilloscope horizontal display controls so that the voltage across *R* constitutes the horizontal signal input while that across *D* provides the vertical input. The display you see is the diode characteristic, and the setup is called a characteristic-curve tracer. (See Appendixes B2, E10.)

* E1.3 Rectification With a Diode Which Breaks Down

In this exploration we will use a zener (breakdown) diode to illustrate the effect of a particular imperfection of rectifier diodes, namely reverse breakdown.

- Assemble the circuit of Fig. 4.1 using your 1N957B zener diode and 1 kΩ resistor, with a 10 V peak sine wave, and oscilloscope connected as in E1.1.
- Note the unusual output which results from diode reverse conduction.
- Lower the input until the output appears qualitatively as it did in E1.1, although smaller. Note the peak input voltage.

E2.1 Basic Measurements

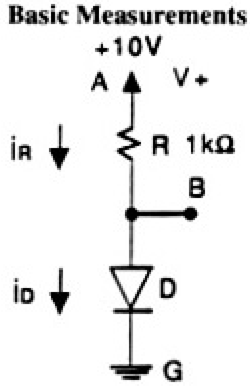

Figure 4.2 A Diode Forward-Drop Test Circuit

- Assemble the circuit shown in Fig. 4.2, using a IN4004 diode, 1 kΩ resistor and 10 V dc supply. Note that the circuit is essentially the same as that in Fig. 4.1, but with a dc signal source, and circuit ground redefined. The latter idea, that of choice of an appropriate ground (or common) connection, is an important issue in electronics design (See pp. 810-811 of the Text).
- Use your DVM (with black lead grounded) to measure nodes *A* and *B*. Adjust the supply to 10.0(0) V for convenience. What is the value of i_D?
- Shunt *R* with a resistor of equal value (1 kΩ); measure v_D; find i_D.
- With two 1 kΩ resistors connected, shunt *D* with a second IN4004 diode (assumed matched). What does v_D become? What do you conjecture the current in each diode to be?
- ** Remove the *first* diode and remeasure, then the *second* resistor and remeasure. Now you have results for two diodes which are nominally the same, the beginning of a *statistical analysis*!
- * Repeat all (or some) of the above with two IN914 diodes.

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