

value of the displayed waveform. Repeat this procedure several times until you become proficient in using the oscilloscope.

AC Circuit Measurements

Refer to Fig. 15-36. Calculate and record the following circuit

values:

$$R_T = \frac{V_{1(rms)}}{I_{rms}} = \frac{V_{2(rms)}}{I_{rms}} =$$

and record the following rms values: $I_{rms} =$, $V_{1(rms)} =$, $V_{2(rms)} =$

Using the oscilloscope, measure and record the following peak-to-peak values. (You will need to use both channels and the

$$V_{1(pp)} = \frac{V_{1(rms)}}{V_{1(pp)}} = \frac{V_{2(pp)}}{V_{2(rms)}} =$$

Convert the peak-to-peak values to rms values, and record your

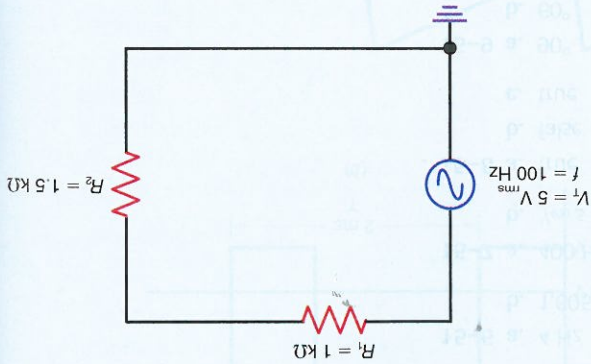
answers.

$$V_{1(rms)} = \frac{V_{1(pp)}}{2}, V_{2(rms)} = \frac{V_{2(pp)}}{2}$$

How do these values compare to the values measured with the

DMM?

Figure 15-36



With your DMM set to measure dc voltage, measure and record the following values in Fig. 15-36:

$$V_{1(dc)} = \frac{V_{1(rms)}}{V_{1(dc)}} = \frac{V_{2(dc)}}{V_{2(rms)}} =$$

Are these measurements what you expected?

Cumulative Review Summary (Chapters 13-15)

- Iron, nickel, and cobalt are magnetic materials. Magnets have a north pole and a south pole at opposite ends. Opposite poles attract; like poles repel.
- A magnet has an invisible, external magnetic field. This magnetic flux is indicated by field lines. The direction of field lines outside the magnet is from a north pole to a south pole.
- An electromagnet has an iron core that becomes magnetized when current flows in the coil winding.
- Magnetic units are defined in Table 13-1.
- Continuous magnetization and demagnetization of an iron core by alternating current causes hysteresis losses that increase with higher frequencies.
- Current in a conductor has an associated magnetic field with circular lines of force in a plane perpendicular to the wire.
- Motor action results from the net force of two fields that can aid or cancel. The direction of the resultant force is from the stronger field to the weaker.
- The motion of flux cutting across a perpendicular conductor generates an induced voltage.
- Faraday's law of induced voltage states that $v = N d\phi/dt$.
- Lenz's law states that an induced voltage must have the polarity that opposes the change causing the induction.
- Alternating voltage varies in magnitude and reverses in polarity. One cycle includes the values between points having the same value and varying in the same direction. The cycle includes 360° , or 2π rad.
- Frequency f equals cycles per second (cps). One cps = 1 Hz.
- Period T is the time for one cycle. It equals $1/f$. When f is in cycles per second, T is in seconds.
- Wavelength λ is the distance a wave travels in one cycle. $\lambda = v/f$.
- The rms, or effective value, of a sine wave equals $0.707 \times$ peak value. Or the peak value equals $1.414 \times$ rms value. The average value equals $0.637 \times$ peak value.
- Phase angle θ is the angular difference between corresponding values in the cycles for two sine waves of the same frequency. The angular difference can be expressed in time based on the frequency of the waves.
- Phasors, similar to vectors, indicate the amplitude and phase angle of alternating voltage or current. The length of the phasor is the amplitude, and the angle is the phase.
- The square wave and sawtooth wave are common examples of nonsinusoidal waveforms.
- Direct current motors generally use commutator segments with graphite brushes. Alternating current motors are usually the induction type without brushes.
- House wiring uses three-wire, single-phase power with a frequency of 60 Hz. The voltages for house wiring are 120 V to the grounded neutral and 240 V across the two high sides. Three-phase ac power has three legs 120° out of phase. A Y connection with 120 V across each phase has 208 V available across each two legs.

Cumulative Self-Test

Answers at back of book.

- Which of the following statements is true? (a) Alnico is commonly used for electromagnets. (b) Paper cannot affect magnetic flux because it is not a magnetic material. (c) Iron is generally used for permanent magnets. (d) Ferrites have lower permeability than air or vacuum.
- Hysteresis losses (a) are caused by high-frequency alternating current in a coil with an iron core; (b) generally increase with direct current in a coil; (c) are especially important for permanent magnets that have a steady magnetic field; (d) cannot be produced in an iron core because it is a conductor.
- A magnetic flux of 25,000 lines through an area of 5 cm^2 results in (a) 5 lines of flux; (b) 5000 Mx of flux; (c) flux density of 5000 G; (d) flux density corresponding to 25,000 A.
- If 10 V is applied across a relay coil with 100 turns having 2Ω of resistance, the total force producing magnetic flux in the circuit is (a) 10 Mx; (b) 50 G; (c) 100 Oe; (d) 500 A-c.
- The ac power-line voltage of 120 V rms has a peak value of (a) 100 V; (b) 170 V; (c) 240 V; (d) 338 V.
- Which of the following can produce the most induced voltage? (a) 1-A direct current; (b) 50-A direct current; (c) 1-A 60-Hz alternating current; (d) 1-A 400-Hz alternating current.
- Which of the following has the highest frequency? (a) $T = 1/1000 \text{ s}$; (b) $T = 1/60 \text{ s}$; (c) $T = 1 \text{ s}$; (d) $T = 2 \text{ s}$.
- Two waves of the same frequency are opposite in phase when the phase angle between them is (a) 0° ; (b) 90° ; (c) 360° ; (d) π rad.
- A 120-V, 60-Hz power-line voltage is applied across a $120\text{-}\Omega$ resistor. The current equals (a) 1 A, peak value; (b) 120 A, peak value; (c) 1 A, rms value; (d) 5 A, rms value.
- When an alternating voltage reverses in polarity, the current it produces (a) reverses in direction; (b) has a steady dc value; (c) has a phase angle of 180° ; (d) alternates at 1.4 times the frequency of the applied voltage.