Introduction To Circuit Protection

Course Number: EE-02-110

PDH: 5

Approved for: AK, AL, AR, FL, GA, IA, IL, IN, KS, KY, LA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, VT, WI, WV, and WY

State Board Approvals

Florida Provider # 0009553 License #868
Indiana Continuing Education Provider #CE21800088
Maryland Approved Provider of Continuing Professional Competency
New Jersey Professional Competency Approval #24GP00025600
North Carolina Approved Sponsor #S-0695
NYSED Sponsor #274

Course Author: Mathew Holstrom

How Our Written Courses Work

This document is the course text. You may review this material at your leisure before or after you purchase the course.
After the course has been purchased, review the technical material and then complete the quiz at your convenience.
A Certificate of Completion is available once you pass the exam (70% or greater). If a passing grade is not obtained, you may take the quiz as many times as necessary until a passing grade is obtained).
If you have any questions or technical difficulties, please call (508) 298-4787 or email us at admin@PDH Pro.com.

CHAPTER 1

CIRCUIT MEASUREMENT

LEARNING OBJECTIVES

Learning objectives are stated at the beginning of each chapter. These learning objectives serve as a preview of the information you are expected to learn in the chapter. The comprehensive check questions are based on the objectives. The learning objectives are listed below.

Upon completion of this chapter, you will be able to:

1. State two ways circuit measurement is used, why in-circuit meters are used, and one advantage of out-of-circuit meters.
2. State the way in which a compass reacts to a conducting wire including the compass reaction to increasing and decreasing dc and ac high and low frequencies.
3. State how a d'Arsonval meter movement reacts to dc.
4. State the purpose of a rectifier as used in ac meters.
5. State the meaning of the term "damping" as it applies to meter movements and describe two methods by which damping is accomplished.
6. Identify average value as the value of ac measured and effective value (rms) as the ac value indicated on ac meter scales.
7. Identify three-meter movements that measure dc or ac without the use of a rectifier.
8. State the electrical quantity measured by an ammeter, the way in which an ammeter is connected in a circuit, and the effect of an ammeter upon a circuit.
9. Define ammeter sensitivity.
10. State the method used to allow an ammeter to measure different ranges and the reason for using the highest range when connecting an ammeter to a circuit.
11. List the safety precautions for ammeter use.
12. State the electrical quantity measured by a voltmeter, the way in which a voltmeter is connected in a circuit, the way in which a voltmeter affects the circuit being measured, and the way in which a voltmeter is made from a current reacting meter movement.
13. Define voltmeter sensitivity.
14. State the method used to allow a voltmeter to measure different ranges and the reason for using the highest range when connecting a voltmeter to a circuit.

15. Identify the type of meter movement that reacts to voltage and the most common use of this movement.
16. List the safety precautions for voltmeter use.
17. State the electrical quantity measured by an ohmmeter, the second use of an ohmmeter, and the way in which an ohmmeter is connected to a resistance being measured.
18. State the method used to allow an ohmmeter to measure different ranges and the area of an ohmmeter scale that should be used when measuring resistance.
19. State the two types of ohmmeters and the way in which each can be identified.
20. List the safety precautions for ohmmeter use.
21. State the primary reason for using a megger and the method of using it.
22. Identify normal and abnormal indications on a megger.
23. List the safety precautions for megger use.
24. State how a multimeter differs from other meters, the reason a multimeter is preferred over separate meters, and the way in which a multimeter is changed from a voltage measuring device to a current measuring device.
25. State the reason the ac and dc scales of a multimeter differ, the reason for having a mirror on the scale of a multimeter, and the proper way of reading a multimeter using the mirror.
26. List the safety precautions for multimeter use.
27. State the purpose of a hook-on type voltameter.
28. State the electrical quantity measured by a wattmeter and a watt-hour meter.
29. Identify the two types of frequency meters.
30. Identify the type of meter and interpret the meter reading from scale presentations of an ammeter; a voltmeter; an ohmmeter; a megger; a multimeter (current, voltage, and resistance examples); a wattmeter; a watt-hour meter; and a frequency meter (vibrating reed and moving-disk types).

CIRCUIT MEASUREMENT

This chapter will acquaint you with the basics of circuit measurement and some of the devices used to measure voltage, current, resistance, power, and frequency. There are other quantities involved in electrical circuits, such as capacitance, inductance, impedance, true power, and effective power. It is possible to measure any circuit quantity once you are able to select and use the proper circuit measuring device. You will NOT know all there is to know about circuit measuring devices (test equipment) when you finish this chapter. That is beyond the scope of this chapter and even beyond the scope of this training series. However, more information on test equipment is provided in another portion of this training series.

A question which you might ask before starting this chapter is "Why do I need to know about circuit measurement?"

If you intend to accomplish anything in the field of electricity and electronics, you must be aware of the forces acting inside the circuits with which you work. Modules 1 and 2 of this training series introduced you to the physics involved in the study of electricity and to the fundamental concepts of direct and alternating current. The terms voltage (volts), current (amperes), and resistance (ohms) were explained, as well as the various circuit elements, e.g., resistors, capacitors, inductors, transformers, and batteries.

In explaining these terms and elements to you, schematic symbols and schematic diagrams were used. In many of these schematic diagrams, a meter was represented in the circuit, as shown in figure 1-1.

As you recall, the current in a dc circuit with 6 volts across a 6-ohm resistor is 1 ampere. The @(UPPERCASE A) in figure 1-1 is the symbol for an ammeter. An ammeter is a device that measures current. The name "ammeter" comes from the fact that it is a meter used to measure current (in amperes), and thus is called an AMpere METER, or AMMETER. The ammeter in figure 1-1 is measuring a current of 1 ampere with the voltage and resistance values given.

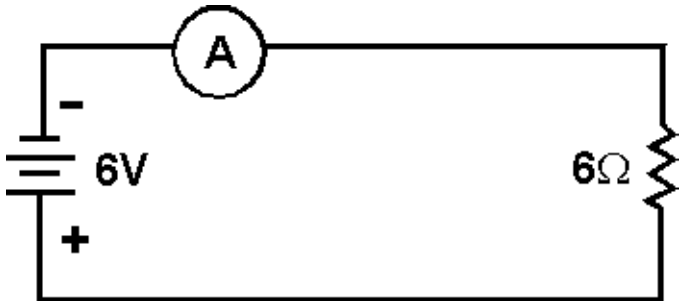

Figure 1-1.—A simple representative circuit.

In the discussion and explanation of electrical and electronic circuits, the quantities in the circuit (voltage, current, and resistance) are important. If you can measure the electrical quantities in a circuit, it is easier to understand what is happening in that circuit. This is especially true when you are troubleshooting defective circuits. By measuring the voltage, current, capacitance, inductance, impedance, and resistance in a circuit, you can determine why the circuit is not doing what it is supposed to do. For instance, you can determine why a radio is not receiving or transmitting, why your automobile will not start, or why an electric oven is not working. Measurement will also assist you in determining why an electrical component (resistor, capacitor, inductor) is not doing its job.

The measurement of the electrical parameters quantities in a circuit is an essential part of working on electrical and electronic equipment.

INTRODUCTION TO CIRCUIT MEASUREMENT

Circuit measurement is used to monitor the operation of an electrical or electronic device, or to determine the reason a device is not operating properly. Since electricity is invisible, you must use some sort of device to determine what is happening in an electrical circuit. Various devices called test equipment are used to measure electrical quantities. The most common types of test equipment use some kind of metering device.

Purchase this course to see the remainder of the technical materials.