



Introduction To Amplifiers

Course Number: EE-02-120

PDH: 5

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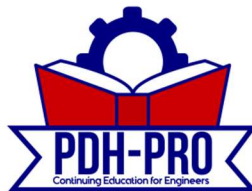
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CHAPTER 1

AMPLIFIERS

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. By successfully completing the OCC/ECC, you indicate that you have met the objectives and have learned the information. The learning objectives are listed below.

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

1. Define amplification and list several common uses; state two ways in which amplifiers are classified.
2. List the four classes of operation of, four methods of coupling for, and the impedance characteristics of the three configurations of a transistor amplifier.
3. Define feedback and list the two types of feedback.
4. Describe and state one use for a phase splitter.
5. State a common use for and one advantage of a push-pull amplifier.

INTRODUCTION

This chapter is a milestone in your study of electronics. Previous modules have been concerned more with individual components of circuits than with the complete circuits as the subject. This chapter and the other chapters of this module are concerned with the circuitry of amplifiers. While components are discussed, the discussion of the components is not an explanation of the working of the component itself (these have been covered in previous modules) but an explanation of the component as it relates to the circuit.

The circuits this chapter is concerned with are AMPLIFIERS. Amplifiers are devices that provide AMPLIFICATION. That doesn't explain much, but it does describe an amplifier if you know what amplification is and what it is used for.

WHAT IS AMPLIFICATION?

Just as an amplifier is a device that provides amplification, amplification is the process of providing an increase in AMPLITUDE. Amplitude is a term that describes the size of a signal. In terms of a.c., amplitude usually refers to the amount of voltage or current. A 5-volt peak-to-peak a.c. signal would be larger in amplitude than a 4-volt peak-to-peak a.c. signal. "SIGNAL" is a general term used to refer to any a.c. or d.c. of interest in a circuit; e.g., input signal and output signal. A signal can be large or small, ac. or d.c., a sine wave or non-sinusoidal, or even nonelectrical such as sound or light. "Signal" is a very general term and, therefore, not very descriptive by itself, but it does sound more technical than the word "thing". It is not very impressive to refer to the "input thing" or the "thing that comes out of this circuit."

Perhaps the concept of the relationship of amplifier-amplification-amplitude will be clearer if you consider a parallel situation (an analogy). A magnifying glass is a magnifier. As such, it provides magnification which is an increase in the magnitude (size) of an object. This relationship of magnifier-magnification-magnitude is the same as the relationship of amplifier-amplification-amplitude. The analogy is true in one other aspect as well. The magnifier does not change the object that is being magnified; it is only the image that is larger, not the object itself. With the amplifier, the output signal differs in amplitude from the input signal, but the input signal still exists unchanged. So, the object (input signal) and the magnifier (amplifier) control the image (output signal).

An amplifier can be defined as a device that enables an input signal to control an output signal. The output signal will have some (or all) of the characteristics of the input signal but will generally be larger than the input signal in terms of voltage, current, or power.

USES OF AMPLIFICATION

Most electronic devices use amplifiers to provide various amounts of signal amplification. Since most signals are originally too small to control or drive the desired device, some amplification is needed.

For example, the audio signal taken from a record is too small to drive a speaker, so amplification is needed. The signal will be amplified several times between the needle of the record player and the speaker. Each time the signal is amplified it is said to go through a STAGE of amplification. The audio amplifier shown connected between the turntable and speaker system in figure 1-1 contains several stages of amplification.

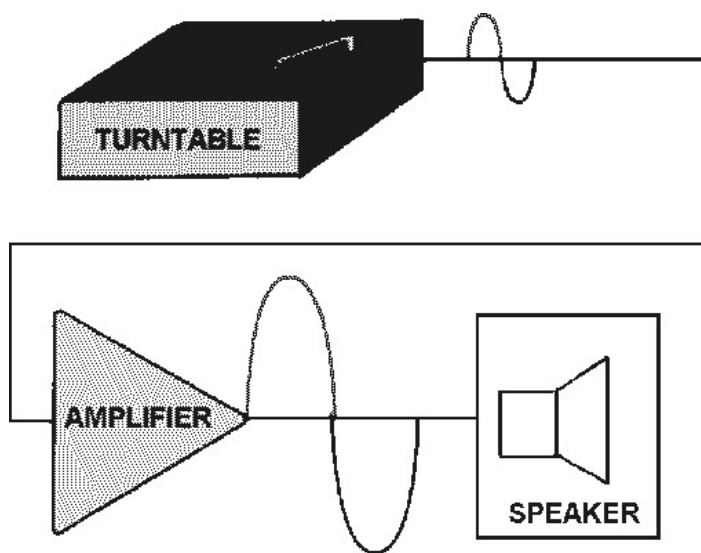


Figure 1-1. —Amplifier as used with turntable and speaker.

Notice the triangle used in figure 1-1 to represent the amplifier. This triangle is the standard block diagram symbol for an amplifier.

Another example of the use of an amplifier is shown in figure 1-2. In a radio receiver, the signal picked up by the antenna is too weak (small) to be used as it is. This signal must be amplified before it is sent to the detector. (The detector separates the audio signal from the frequency that was sent by the transmitter. The way in which this is done will be discussed later in this training series.)

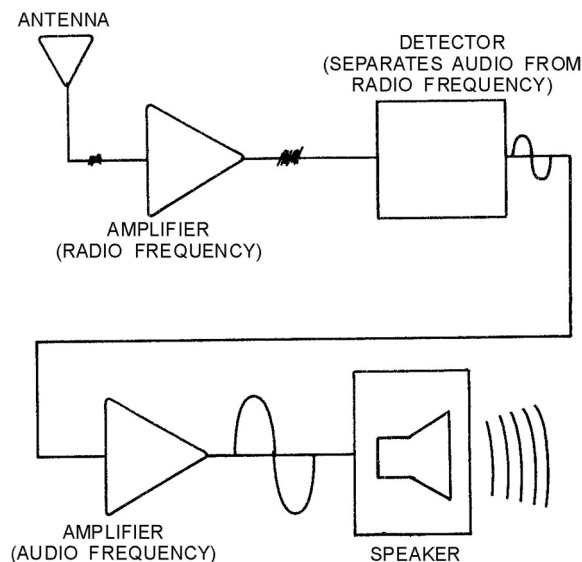


Figure 1-2. —Amplifiers as used in radio receiver.

The audio signal from the detector will then be amplified to make it large enough to drive the speaker of the radio.

Almost every electronic device contains at least one stage of amplification, so you will be seeing amplifiers in many devices that you work on. Amplifiers will also be used in most of the *NEETS* modules that follow this one.

- Q-1. What is amplification?*
- Q-2. Does an amplifier actually change an input signal? Why or why not?*
- Q-3. Why do electronic devices use amplifiers?*

CLASSIFICATION OF AMPLIFIERS

Most electronic devices use at least one amplifier, but there are many types of amplifiers. This module will not try to describe all the different types of amplifiers. You will be shown the general principles of amplifiers and some typical amplifier circuits.

Most amplifiers can be classified in two ways. The first classification is by their function. This means they are basically voltage amplifiers or power amplifiers. The second classification is by their frequency response. In other words what frequencies are they designed to amplify?

If you describe an amplifier by these two classifications (function and frequency response) you will have a good working description of the amplifier. You may not know what the exact circuitry is, but you will know what the amplifier does and the frequencies that it is designed to handle.

VOLTAGE AMPLIFIERS AND POWER AMPLIFIERS

All amplifiers are current-control devices. The input signal to an amplifier controls the current output of the amplifier. The connections of the amplifying device (electron tube, transistor, magnetic amplifier,

etc.) and the circuitry of the amplifier determine the classification. Amplifiers are classified as voltage or power amplifiers.

A **VOLTAGE AMPLIFIER** is an amplifier in which the output signal voltage is larger than the input signal voltage. In other words, a voltage amplifier amplifies the voltage of the input signal.

A **POWER AMPLIFIER** is an amplifier in which the output signal power is greater than the input signal power. In other words, a power amplifier amplifies the power of the input signal. Most power amplifiers are used as the final amplifier (stage of amplification) and control (or drive) the output device. The output device could be a speaker, an indicating device, an antenna, or the heads on a tape recorder. Whatever the device, the power to make it work (or drive it) comes from the final stage of amplification which is a power amplifier.

Figure 1-3 shows a simple block diagram of a voltage amplifier with its input and output signals and a power amplifier with its input and output signals. Notice that in view (A) the output signal voltage is larger than the input signal voltage. Since the current values for the input and output signals are not shown, you cannot tell if there is a power gain in addition to the voltage gain.

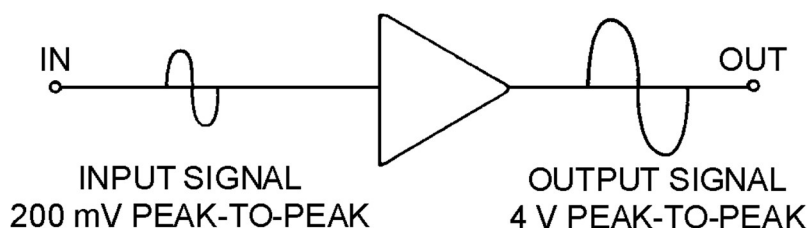


Figure 1-3A.—Block diagram of voltage and power amplifiers.

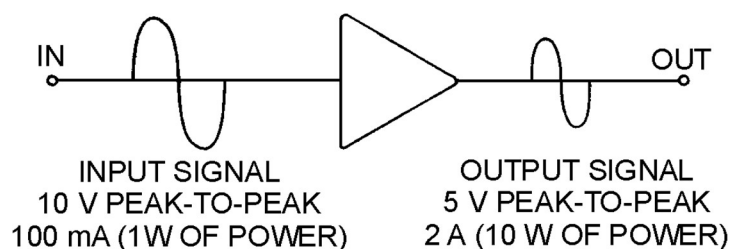


Figure 1-3B.—Block diagram of voltage and power amplifiers.

In view (B) of the figure the output signal voltage is less than the input signal voltage. As a voltage amplifier, this circuit has a gain of less than 1. The output power, however, is greater than the input power. Therefore, this circuit is a power amplifier.

The classification of an amplifier as a voltage or power amplifier is made by comparing the characteristics of the input and output signals. If the output signal is larger in voltage amplitude than the input signal, the amplifier is a voltage amplifier. If there is no voltage gain, but the output power is greater than the input power, the amplifier is a power amplifier.



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