Introduction

Transistors provide useful functions in electronic circuits. They can be used for switching and also for signal amplification. The name transistor derives from the phrase “transfer resistor”.

Bipolar Junction Transistors

The bipolar junction transistor was one of the first types of transistors developed at Bell Labs in 1948 and 1951 by William Shockley and his coworkers. Bipolar junction transistors have three semiconductor regions referred to either as P-type or N-type. Bipolar junction transistors have three terminals: the emitter, the base, and the collector.

Types of Bipolar Transistors

There are two types of bipolar junction transistors: NPN and PNP. NPN are used much more commonly. In an NPN transistor, a small region of P-type material is placed between two larger regions of N-type material. In a PNP transistor, a small region of N-type material is placed between two large regions of P-type material. The base terminal connects to the smaller region in between the two larger regions.

Amplification

Amplifier circuits take an input signal and change its strength, ideally without distorting the signal. Amplification occurs when an amplifier increases the strength of the input signal. Attenuation occurs when an amplifier reduces the strength of the input signal. The increase or decrease in signal strength is called gain, and is measured for amplifiers in terms of the log of the ratio of the output signal strength over the input signal strength. The units of gain are decibels (dB).

Amplifier Configurations Using Bipolar Junction Transistors

The remainder of this paper discusses the three types of amplifier configurations that use bipolar junction transistors:

1. common emitter
2. common base
3. common collector

The names of these configurations derive from the necessary consequences of these configurations. One of the terminals receives the input signal, and another

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one of the terminals supplies the output signal. Two conductors are required to complete a circuit, and the third terminal is used by both input and output as the second conductor. It is this terminal common to both the input and output of the circuit which is referred to in the names of these amplifier configurations.

Common Emitter

The common emitter configuration is the most common one. In this configuration, the base accepts the input signal, and the collector outputs the output signal. This configuration provides a useful amount of gain, the best of the three configurations.

The output signal is 180 degrees out of phase with the input signal.

Common Base

The common base configuration is primarily used for impedance matching. It provides lots of voltage gain but negative current gain. Disadvantages of this configuration include low input resistance *(why is the low input resistance bad?)*, which limits its usefulness in other purposes. The output signal is in phase with the input signal.

Common Collector

The common collector configuration is also primarily used for impedance matching. It provides lots of current gain but negative voltage gain. Its power gain is the lower than the other two configurations. The output signal is in phase with the input signal.

Common collector configurations can be used in DC power supplies to amplify the effect of a Zener diode in voltage regulation, so that the Zener diode need only regulate the lesser amount of current supplied to the transistor base.

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