AMPLIFIER CLASSES

AS YOU READ THROUGH THE BROCHURES supplied by various amplifier manufacturers you will probably come across terms such as "Class A," "Class AB," "Class B," etc. These terms all refer to the type of circuits used in the final power-output stages of audio amplifiers. There are many ways in which to arrange an amplifier's output stages, and these are identified by the "Class" notations. While it is possible to design good-sounding amplifiers in all classes, let's examine the difference between them.

In a Class-A amplifier, the transistor or transistors that supply power to the speaker load continuously conduct current, and that current value is essentially constant. In the absence of an audio signal, all the current (and power) is dissipated within the transistors themselves. When a signal appears, part of the power developed by the output stage is transferred to the speaker load. This arrangement is, therefore, highly inefficient, in that the same amount of power is drawn from the amplifier's power supply regardless of whether the amplifier is producing its maximum rated power, no power at all, or anything in between. Class-A amplifiers (what few exist these days) are therefore generally noted for their lower power-output ratings, and require unusually large heat-sink devices to dissipate the heat generated by the always fully on transistors. Class-A amplifiers are, however, capable of producing extremely low-distortion sound and are favored by those listeners to whom the unusually large energy consumption is of secondary importance.

A Class-B amplifier requires at least two output transistors. Each transistor is designed to amplify one-half of the alternating waveforms that constitute an audio signal. One transistor amplifies the positive-going wave, while the other transistor amplifies the negative-going half-cycle of each alternation. In the absense of all audio input signals, each transistor draws almost no current, and a Class-B amplifier, in the absence of input signals, runs extremely cool. As signal levels increase, current drawn from the power supply also increases until maximum power-output levels are reached. Thus, a Class-B amplifier is much more efficient than a Class-A unit. Class-B efficiency (at full power output) can reach as high as 65% or so (it is less than that at lower power levels), as opposed to the typically low 20% to 25% for a Class-A design.

While Class-B amplifiers can be designed to produce equally low distortion, special care must be taken in their design to make sure that no discontinuities in output take place as the signal is switched from one transistor to the other. Failure to observe proper design techniques can result in "notch distortion," or "crossover distortion," which is particularly annoying at low listening levels.

Class-C amplifiers are not normally used in audio amplifier circuits, but are reserved for radio receivers and transmitters. A Class C-amplifier conducts for less than one-half of each cycle, and depends upon the flywheel action of an associated resonant circuit to fill in the missing portion of the waveform. A Class-C amplifier is therefore practical to use where the same single frequency is to be amplified continuously, but is impractical for amplifying constantly varying complex audio signals.

The so-called Class-D amplifier is also known as a "switching amplifier," or "pulse-width modulation" amplifier. One or two manufacturers offer limited quantities of Class-D amplifiers, and a great deal of experimentation with this type of amplifier continues. In a Class-D amplifier, a very high-frequency series of pulses are modulated in their width by the audio signal. The output stages need to conduct for a short interval only to amplify the tips of these pulses, and when they do conduct, they are highly efficient—conducting as much as 90% to 95%. The high-frequency pulses associated with Class-D amplifiers (500 kHz or more) present special problems in the transistor switching speed and suitable transistor availability.

The recently developed Class-G amplifier uses a minimum of two pairs of output transistors. One pair is powered by a lower voltage supply than the other. When signal levels are relatively low, only the low-powered pair of transistors does the amplifying. When signals exceed the low-voltage supply amplitude, the other transistor pair, which operates from the higher voltage supply, takes over, while the first pair is simultaneously turned off. In this way, each pair of transistors is always operating over its most efficient range, and overall amplifier efficiency is greater with a Class-B design. Thus, less massive heat sinks are needed for the output transistors, and the complete amplifier or receiver is lighter in weight.

Somewhat similar to Class-G operation is the new and tentatively labeled Class-H amplifier. Only one set of output transistors is used, but these transistors are connected to two different power-supply voltages. The lower voltage powers the output devices for low-level signals, while the higher voltage takes over when the input signal amplitudes exceed the limits of the low-voltage supply. As in Class-G, this approach results in a more efficient use of the output transistors, and the audio signals themselves do not have to be switched from one device to another during the process.