What is an amplifier?

An amplifier is a device for making a larger, more powerful signal out of a small, weak signal.

It was on February 18, 1908 that Lee DeForest was granted U.S. Patent No. 879,532 titled "space telegraphy," but in actuality, the patent was for a vacuum tube triode amplifier that DeForest called the “audion amplifier.” For the first time it was possible to amplify signals.

The first amps were developed to support radio. Later, other applications were developed. All electronics depend in some way on amplification. Our industry uses Amps for audio.

An amp consists of two basic elements:
* A power supply that supplies a large energy source and
* An amplifier section that modulates the large energy source in accordance with the small signal

The result is a large, powerful signal.

CLASSES OF AMPS

Class A: A small signal modulates a larger current. This larger current is present when the small signal is not present. Efficiency up to about 26 percent. Excellent quality sound.

Class B*:* Uses a push-pull arrangement where one amplification device operates on the positive side of the waveform and another operates on the negative side. Efficiency up to 75%. Sounds bad because of distortion caused by switching from one device to another.

Class C: A small signal turns a larger signal on or off. There is no in-between state. Efficiency up to 90 percent. Not usable for audio. Audio requires accurate reproduction of all levels—not just no power and full power levels.

Class D: A variation of Class C. Class D is a way of modulating a Class C amplifier to allow it to carry audio information. Sounds very good with latest technology. Efficiency up to 90 percent. Produces Electromagnetic Interference (EMI)

Class AB*:* A variation of Class B. Always has a small current flowing (class A operating region) and this eliminates the switching distortion inherent in Class B. Efficiency up to 65 percent. Sounds excellent—if well-designed

Class H*:* A variation of Class AB. Changes the power supply voltage to the amplifier depending on the signal level. Improved dynamic efficiency. Requires complex power supply. Single tone efficiency up to 65 percent Sounds excellent—if well-designed

POWER SUPPLIES

Type 1: Standard (Analog) Power Supply: Efficiency to 80 percent. Heavy, for large amounts of power. Components are large

Type 2: Switching Power Supplies: Efficiency to 90 percent. Lightweight—even for large amounts of power. Components are small. Can support universal line input voltages. Can support regulated output w/no power loss. Produces EMI

Efficiency is the power output of a device divided by the power input to the device. Power input that is not outputted by a system is dissipated as heat from the system. The greater the efficiency of an amplifier, the less AC power is required to deliver the same output power to the load.

A typical Class AB amplifier with a 65 percent efficiency, used with a standard analog power supply running at about 80 percent efficiency yields an overall amplifier efficiency of approximately 50 percent. Efficiency is typically rated at full power, continuous tone levels.

At lower power levels, efficiency is much worse. It is at low signal levels where Class D and Class H designs offer significant improvements. Class D maintains almost the same efficiency for all power levels while Class H switches to a lower power supply at lower signal levels in order to maintain good efficiency.

SWITCHING SUPPLIES

A switching supply consists of four basic building blocks:

1) A DC supply that operates directly off the AC line

2) A power oscillator which converts the DC supply to a very high frequency, typically 50 kHz—200 kH

3) A transformer that changes the high frequency power signal to the various outputs needed

4) Rectification and filtering stages that produce the DC outputs needed

SMALLER & LIGHTER

Because the transformer in a switching supply is operating off a very high frequency power signal—instead of 50/60 Hz—it can be much smaller and lighter.

This is the major advantage of a switching supply. Since switching supplies are more complex than a standard supply, their circuitry usually costs more. In addition, more parts have to be added to control the EMI produced by switchers.

But these costs are usually more than compensated for by the reduction in size, weight (and cost) of the transformer. In addition, costs of the chassis can be reduced because the weight it has to support is much less. Since the power supply is the heaviest part of an Amp, the entire product is much lighter and easier to handle.

AMP DESIGN TRENDS

For many years, the standard amp was a Class AB design with a standard analog power supply. Manufacturers have been experimenting with other types of both amplifier design and power supply design in order to support customer needs better.

The primary customer needs today for amps are:
- High Power
- Good Sound
- Low Cost
- Lightweight Construction

“Good sound” is very controversial. There is so much confusion about technical terms for rating good sound—and how these terms actually relate to the listening experience—that the focus today for most consumers is power rating and cost.

POWER RATINGS

Twenty years ago the rated output power of an amp was the continuous tone output level of the amp; a 300 W amp could produce a 300 W tone all day long. Then it was recognized that most audio Amps are not used on continuous tones, but are used on audio signals.

Audio signals consist of many tones of different power levels. So customers didn't need an amp that produced continuous tones all day; they needed an amp that could produce audio signals all day. This is easier and cheaper to do. Manufacturers today have adopted various methods for rating the power output of their products. This is causing much customer confusion.

Manufacturers, industry and standards groups have contributed to defining how to rate power output for audio Amps. There have been many methods proposed for rating amplifier power. Many of these proposals—such as tone bursts tests—attempt to rate the instantaneous or short duration power levels.

Because audio signals vary in duration and level, the validity of these rating methods depends on how the Amp is used and the characteristics of the signals it is amplifying. Some methods use non-audio signals, such as square waves, to determine the amplifier power rating; this causes the number to be higher.

Today, the primary standards are dictated by the Federal Trade Commission (FTC). Many manufacturers also use standards developed by Industry associations—such as the Electronics Industry Association (EIA). Some manufacturers use other methods.

Safety agencies (particularly those in the European Union, and Underwriters Laboratories here in the US) have developed standards for measuring average continuous power of an amplifier. These are used in turn to measure maximum AC line power consumption and to confirm maximum temperatures. Safety groups have determined that typical worst-case power for an amplifier amplifying an audio signal occurs at one-eighth of the non-clipped output power (measured with a 1 kHz tone).

The amp is then "cooked" with a bandwidth-limited (20-20 kHz) pink noise signal whose power is equal to 1/8 of the tone full power. Measurements are then made for temperature and AC line power consumption. Thus 1/8 of the maximum tone power before clipping represents realistic worst-case continuous power levels for an audio amplifier.

Standards bodies are always reviewing and updating industry standards. We can expect standards for audio amplifier testing and ratings to change as our customers' needs and usage change—and as our knowledge and technology improves.