A class of its Own – PA Amplifiers

In the following basic article we would like to discuss the distinctive criteria of PA amplifiers. An important factor of modern power amplifiers is not least the weight. In the past, power amplifiers were often reviewed according to the factor watt per kilogram. In times of line arrays and other actively separated speaker systems even in the semi-professional sector, attributes like handiness and compactness became more and more important for power amplifiers. Now, frequently terms like “class H” or “class D” and “switch-mode power supply” can be read in article descriptions, which often are confusing or have no informative value for outsiders. We have prepared a short introduction for you in order to change that as fast as possible.

Power Supply Unit

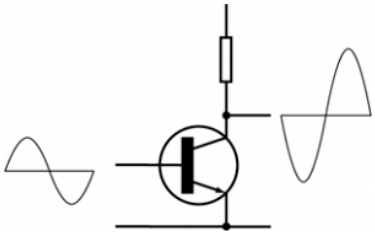
As a main component of the power supply unit, conventional power amplifiers possess a large toroidal transformer which converts the 230 V power tension into several low tensions. These are necessary to supply power to the individual components such as pre-amplifier and power amplifier of a PA amplifier. As the transistors of the power amplifier blocks require direct current, large rectifiers and several electrolytic capacitors are located behind the toroidal transformer for grading. A conventional power supply unit sometimes takes up more than half the volume and mass of an amplifier. The advantage of this technique is that it is fairly simple, inexpensive and stable during operation. Moreover the technique is known for its pulse strength in terms of the amplification of low frequencies. And although there are amplifiers weighing 30 to 35 kilograms they have their right to exist. The press-praised* Omnitronic B-3600, which draws its maximum output power of 3,600 watts from a mass of 32 kilograms, can serve as an example.

Switch-mode power supply units (abbr. SNT or SMPS) work far more efficiently than their conventional counterparts and are much smaller in size. Optically, they almost cannot be distinguished from a power amplifier block but they only account for a third of an amplifier’s mass and volume. Switch-mode power supply units make use of the advantage that a significantly smaller transformer can be used with higher transmission frequencies. With a mains frequency of 50 hertz, for example, you would need a 25-kilogram copper transformer for transforming 4,000 watts whereas with a frequency of 125 kilohertz a 500-gram transformer would do. The disadvantage of SMPS is the occurring signal interference which must be filtered out and only gradually made the technique affordable.

With the sophisticated SMA series, Omnitronic offers inexpensive PA amplifiers with SMPS technology, which are both convincing by their cost/performance ratio and their outstanding performance/weight ratio. The top model SMA-2000 is rated at 2,000 watts power, yet weighs a mere 9 kilograms. In comparison: The popular Omnitronic P-2000 weighed more than twice as much and was rated at the same power.

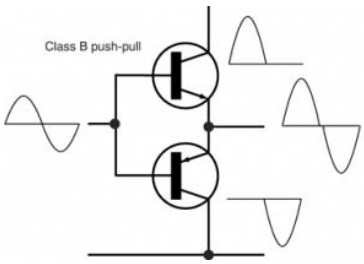
Switch Concepts

Class A



The technically easiest method to amplify a signal electronically is to use a class A amplifier. Here an active component (transistor or electronic tube) takes over both the positive and negative half-wave of the incoming alternating current signal. The advantages of this technique are the extremely simple structure and the superb sound. However, as the active component must be constantly kept in the center of the linear part of its characteristic line, class A amplifiers require a very high standby current and thus have a very bad degree of efficiency, which ideally is at 50 percent but often is even less than 25 percent. For the high output power that the modern PA technique is calling for, class A amplifiers are certainly out of the question. However, they have earned themselves a permanent place for applications which demand lower output power. Hi-fi aficionados, for example, use them in their home stereo systems. In the professional stage sector class A circuits rather than anywhere else can be found as pre-amplifiers in premium mixing consoles and external channel strips. Today, almost every guitar amplifier is still equipped with a class A amplifier as an output power over 200 watts is rarely needed..

Class B



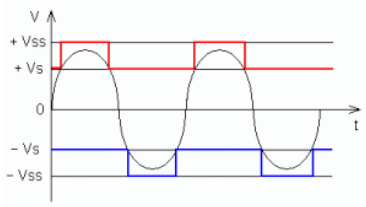
Far more efficient than class A amplifiers are class B amplifiers with a theoretical efficiency of almost 80 percent. Here two separate active components each take up a half-wave of the incoming alternating current signal. During each half-wave the other components are switched off which cuts the high standby current. The disadvantage of the circuit is, however, that during the transition of positive to negative half-wave of the amplified signal a distinct transfer distortion is can be heard, which renders the use of class B amplifiers impossible in the professional audio sector. Class B is used in the radio technique but even there has become almost completely displaced by the even more effective class C (with up to 90 percent degree of efficiency).

Class AB

Class AB combines the major advantages of class A and B, i.e. the professionally usable sound quality with a high degree of efficiency, which is still acceptable even at high output. For this class AB also uses separate components for both half-waves. Yet contrary to class B they are not constantly turned on and off but are steadily supplied with mains power. Thus far less distortion takes place in the transmission area of the alternating current signal. The degree of efficiency still is substantially higher than with class A and usually is at 40 to 60 percent. Most audio amplifiers available on the market work according this basic principle.

With the P series, Omnitronic offered a successful AB power amplifier for years. In mid 2009 this popular series was replaced by the new E series, which features pretty much the same circuitry, is available with power ratings ranging between 200 and 1,300 watts, and is particularly designed for beginners. The smaller models of the lines SMA (including the SMA-1000) and B (through B-1300) also operate with class AB circuits.

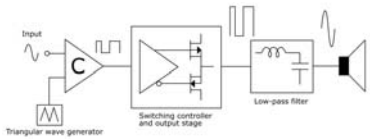
Class G/H



A further development from class AB to even more efficient power amplifiers are circuits with graded supply voltage. While the basic structure corresponds to class AB power amplifiers, here the transistors are not supplied with a fixed tension but with varying tensions depending on the momentarily required output power. For this grading the degree of efficiency can be increased compared to a class AB power amplifier (in the ideal case up to 85 percent) without a loss in sound quality. The classification is not standardized which is the reason why class G can mean both, graded and steady supply voltage.

With Omnitronic class H stands for graded supply voltage. The most important amplifiers of this class are the top models of the lines SMA (SMA-1500 and SMA-2000)[1] and the press-praised B-2000 and B-3600[2].

Class D



Class D amplifiers, which are colloquially called “digital amps”, are different from all concepts mentioned so far as they do not directly process the waveform of the signal which is to be amplified but rather a “digitized” version of the signal. The input signal is scanned with a frequency far above the audio range and thus is converted to a square wave via pulse-width modulation (PMW). As these amplifiers only have the condition on or off they are also known as switching amplifiers. With class D amplifiers an efficiency of more than 90 percent can be achieved which is why they are getting more and more popular in the professional PA sector. First examples of this class had to fight with audible distortions particularly in the high frequency range. But these problems were eliminated by further development in the past few years. Due to the high efficiency very compact modules can also be implemented in active speaker boxes.

Class D amplifiers can be found in Omnitronic’s new, very compact EDP series rated at 300 to 1,000 watts output power while requiring only one rack unit, and in the upgraded versions of the active systems AS-900 and AS-1500.

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[1] Soundcheck, issue 9/2010, tools4music 5/2010
[2] tools4music, issue 5&6.2009, pictures: Wikipedia