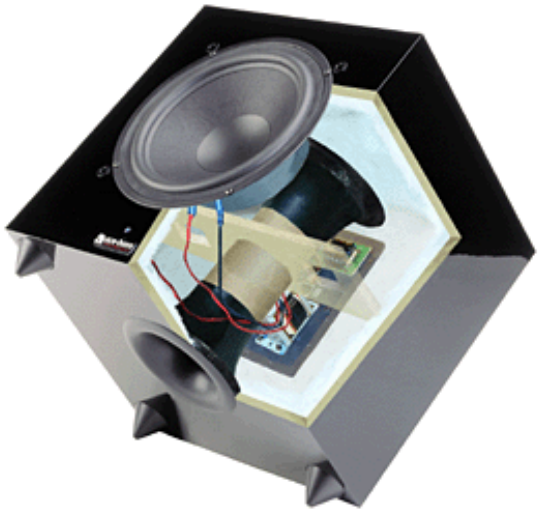
ACE-BASS–
More bass in a smaller box

MORE INFO

More bass in a small box. Audio Pro's ace-bass technology is as simple as that. To produce bass means moving a large volume of air. There are many ways to produce good bass in a speaker. The most common method is to take a very large box and a very big woofer. A better solution is to choose an Audio Pro subwoofer with ace-bass.

With our patented ace-bass technology, we can manufacture subwoofers in very small boxes that still have an extremely deep, pure, fast and powerful bass. With ace-bass technology, we can electronically affect the woofer's mechanical characteristics, making it successfully behave as if it was a much larger box. That's how we achieve the 'impossible' woofer effect that enables such deep, powerful bass to come from a small box. The amplifier and the woofer are tied together in a tight symbiosis. Every Ace-bass system is unique, and its components are perfectly trimmed together.



Powered by ace-bass

An Audio Pro ace-bass subwoofer can be compared to a turbo-charged engine. Turbo-charged engines are small engines with extremely good qualities and performance. The ace-bass circuit is the speaker's turbo charge.

The ace-bass advantages are obvious. With a smaller box, the subwoofer will be easy to place (or hide, if necessary). The smaller box also means a stronger construction, with better damping and few unwanted resonances. You get a much deeper, purer, faster and more powerful bass compared to other subwoofers.

You will notice the difference in music as well as Home Theater. One proof of how well ace-bass works is that the subwoofer B1.35 was appointed "Subwoofer of the Year 1999" by the HiFi & Musik magazine.

In Elektronikvärlden (a Swedish hi-fi magazine) No. 8, 1988, Bertil Hellsten wrote a very good and instructive description of the ace-bass technology. Below is an abstract of the article:

General

There are many ways to accomplish good bass in a loudspeaker. One is to have a large cabinet and a large woofer.

In practice, the lower limit for a woofer is set by the lower resonance frequency, which can be lowered by increasing the membrane's mass. By adding weights, you can go lower and lower in frequency. But, at the same time, the speaker will respond increasingly slowly.

In addition, the membrane's compliance and damping will no longer match, so the result isn't useful. To achieve a very low limiting frequency in a small woofer, a combination of mass, compliance and damping is needed, and this is impossible to achieve mechanically.

Audio Pro's solution - electronic mechanics

Seen from the amplifier's point of view, the loudspeaker is an electrical component with its mechanical attributes transformed into electrical magnitudes. The mass corresponds to a capacitance, and the compliance to an inductance that is in parallel with the capacitance. The attenuation corresponds to a resistance that is in parallel with both of the above.

By adding more inductances, resistances and capacitances, one should easily be able to change the loudspeaker's mechanical attributes. This is the main idea behind Audio Pro's ace-bass loudspeaker constructions.

But there is a catch. The drive unit's voice coil has a resistance that lies serially with the parallel 'mechanical' components. This means that we can't parallel-connect directly to the woofer's mechanical parameters. It is not connected to the amplifier firmly enough.

If we were to increase the damping by parallel-connecting the amplifier output with a resistance, we would still never get a lower value than what the voice coil's resistance gives, and that is not good enough. The same thing happens to the other attributes. They are 'hidden' by the voice coil's (and the speaker cable's) resistance.

Negative resistance

The solution is to serially connect the amplifier output with a

negative resistance. But you can't buy that at your nearest electronics parts shop. It can only be achieved by positive feedback in the amplifier's output stage.

There are several sensitive factors that can easily cause the system to self-oscillate. However, correctly trimmed, you can achieve a system that exactly equalizes all the resistances that are in series with the drive units' properties. In this way, you can also reach and affect the loudspeaker's mechanical attributes electrically.

You can also choose to let this influence decrease with increasing frequency, where it's no longer needed.

By using this feature fully, Audio Pro maintains that you can decrease the speaker's physical volume by 90%, compared to a conventional bass reflex box!

ACE-BASS is an abbreviation for Amplifier Controlled Euphonic Bass.

ACE-BASS – Audio Pro's exclusive technique to accomplish superior bass

To get good low bass from a small box means confronting several problems, and many attempts have been made to solve these.

The active methods (where the amplifier is designed as a part of the loudspeaker) include equalized or boosted systems and different types of servo or feedback systems. However, most of these methods are restricted to closed box systems, and some actually increase distortion rather than reducing it.

A superior alternative is the bass reflex system. This offers a great step forward in low-frequency reproduction, because it has higher efficiency than closed box systems and can also give much more output at the lowest frequencies. This method, called ACE-Bass, gives the loudspeaker unit new mechanical parameters to obtain the desired frequency response and, since the new synthesized parameters are more linear than the real ones, distortion is also reduced. ACE-Bass was invented by Karl Erik Stahl and first presented at the 61st Audio Engineering Society Convention, New York, in November 1978.

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A few words on speaker theory

In order to understand the following simplified explanation of ACE-Bass, some speaker theory is necessary.

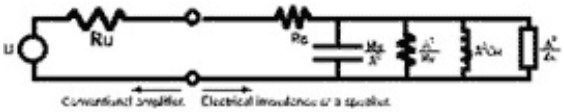

Fig 1. Electrical diagram of a speaker system

The electrical characteristics of a speaker system are shown in Fig. 1. An amplifier drives the system with its output voltage U and output impedance RU. RE is the voice coil resistance, and ZB is a mechanical parameter that depends on the box and the surrounding air. The cone and the voice coil have a certain weight, known as the moving mass MM. The suspension of the cone has a compliance CM and damping RM. These mechanical parameters provide the electrical parallel resonance circuit, where A is the force factor of the driver (also called the BL factor). As Fig. 1 shows, the mechanical parameters of the speaker affect its electrical impedance. As shown later, ACE-Bass takes advantage of the opposite interaction - the electrical output impedance of the amplifier affects the mechanical parameters. It is also possible to look at the same system from the mechanical viewpoint, as shown in Fig. 2.

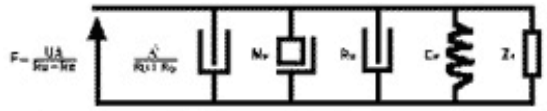

Fig 2. Mechanical diagram of the speaker system

F is the force generated by the output voltage U of the amplifier and the 'motor' of the driver. Besides the real damping RM, an extra 'electrical' damping A2/ (RU+ RE) occurs. Normally the output resistance of the amplifier, RU, is close to zero, but by making it positive or negative, it is possible to give the total damping an arbitrary value. This well known technique has sometimes been used before. What is new with ACE-Bass is that, by using a similar method, the moving mass and compliance are also affected.

ACE-Bass - to tame the mechanical parameters of a speaker

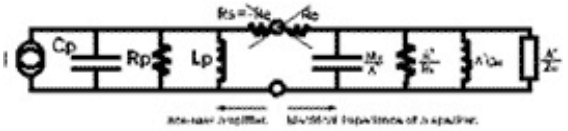

Fig 3. Electrical diagram for ace-BASS

In order to obtain this control over all three mechanical parameters, the conventional amplifier in Fig. 1 is exchanged for the special ACE-Bass amplifier, as seen in Fig. 3. The ACE-Bass amplifier consists of a negative resistance RS, a new parallel circuit and a driving current generator, instead of the voltage generator. The negative output impedance then cancels the voice coil resistance and the new parallel circuit - consisting of Cp, Rp and Lp - will be in parallel with the old one, which is produced by the real mechanical parameters of the speaker.

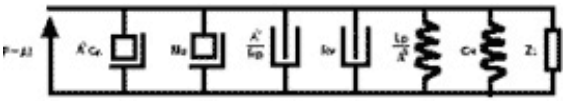

Fig 4. Mechanical diagram for ace-BASS

If instead the same ACE-Bass system is viewed from the mechanical side, Fig. 4 results. Compared to the conventional system in Fig. 2, it can be seen that the total moving mass has increased by A2Cp, and the damping by A2/Rp, and that the compliance has become stiffer by Lp/A2. By selecting suitable values for Cp, Rp and Lp in the output impedance of the amplifier, it is thus possible to achieve the desired mechanical parameters. These apparent mechanical parameters, which are created by means of the output impedance of the ACE-Bass amplifier, are in fact so real that if a mechanical engineer should measure the mechanical parameters of the speaker, he would find the apparent parameters and not the real ones, but only as long as the amplifier is connected.

The ACE-BASS amplifier

The ACE-Bass amplifier as defined by Fig. 3 can be realized in various ways. Since negative resistances do not exist as components, they have to be generated by the amplifier. In order to eliminate bulky and costly components, the parallel circuit (Cp, Rp and Lp) can also be generated by the amplifier. The design used in all Audio Pro ACE-Bass amplifiers is shown in Fig. 5.

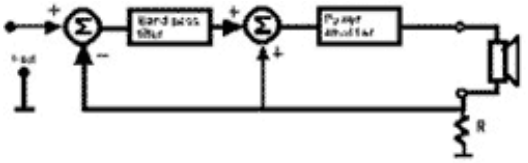

Fig 5. Block diagram for an ace-BASS amplifier

The current through the speaker is sensed by R. The positive feedback around the power amplifier provides the negative resistance, while the negative feedback around the bandpass filter provides the parallel circuit. (This technique of creating the ACE-Bass amplifier by feedback loops should not be confused with motional feedback, which is not related to ACE-Bass.)

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