



Active Versus Passive Loudspeakers

The performance benefits of active over passive loudspeakers is substantial. Even a system, which incorporates the best available stand-alone power amplifier, will never achieve the performance of a similar active system. Yet active loudspeakers are slow to be accepted for home use, when they are the only choice of the professionals who master your DVDs and CDs.

This is a strange anomaly that doesn't exist in other significant consumer markets. Take the motor industry for example. When buying a car, would you buy the chassis from Ford and the engine from General Motors. Of course not, the engine would have to be unnecessarily modified and overbuilt to be able to drive the many different transmission loads imposed upon it. Yet this is the accepted thinking in the market for residential hi-fi and home theatre installations, where the use of separately sourced amplifiers and loudspeakers, and the extra cost and inefficiency this entails, is not only tolerated, it is recommended!

Why is it then that the obvious merits of Active loudspeakers long accepted as standard in the professional arena have been slow to be accepted for home use?

Many Hi-Fi dealers pledge to sell customers the 'best system for their money', and yet they sell separates, when one of the many advantages of self powered active loudspeakers, is a considerable economy in cost, for any given performance level.

Why is this? The common complaint is one of inflexibility. Generally, you cannot upgrade an active speaker with new amplifiers, which limits consumer choice. This is a myth that relies more on the commercial sensibilities of dealers and their suppliers (the separates manufacturers) than on anything else. It is simply the fact that an active loudspeaker is an optimized coupling between amplifier and loudspeaker driver, and is the best solution, and an upgrade in the longer term is unlikely to be necessary. Thus an active system will always provide a superior result than its separate counterparts. Dollar for Dollar, in performance and value for money, there is no contest.

The Professional Approach

The demands of the recording industry were for highly accurate, ruggedly built speakers, capable of reproducing the dynamics and subtleties of the original performance, and frequently capable of being used on location as well as in the studio. The only solution to meet this need was to design and build the amplifiers and drive units as a single close matching entity in one enclosure. Hence, Active loudspeakers are today used by virtually every recording company, every major recording studio, and every major film studio.

What then are the main advantages of Active loudspeakers and disadvantages of Separates?

Economics

Firstly, it costs a lot less to design and build high quality amplifiers and drive units in a single enclosure than it does to build similar quality separates. Equal or better performance at lower cost is a good starting point. The advent of DVD and Home Theatre has done much to take the 'black art' out of sound reproduction in the home. Gone are the wooden blocks, and green inks but crazily priced loudspeaker cables are still prevalent. Active loudspeakers only need a low cost, good quality microphone cable, to transmit the high impedance output from today's surround processors. Another major cost saving.

Crossovers: Electronic Vs. Passive

A major source of difficulty in designing a Passive loudspeaker system lies less in selecting the drive units or enclosure, but in designing and building the passive crossover. This device with its large capacitors and resistors receives the low impedance, full frequency output from the amplifier, and divides it between the two, three or more drive units. It is hardly surprising when taking a look at the size and complexity of these non-powered components that the passive crossover can absorb up to 20% of the amplifier's power output. And that's not the only problem!

The magnitude of the frequency response of both active and passive loudspeakers can be controlled, with good design, to be within 1dB of one another. However, the phase component of the frequency response will always be better in an active system. The active filters produce better filter roll-off characteristics at crossover. Combine this with the inclusion of a variable all-pass filter at each crossover point to correct the phase response of the drive units through the crossover regions and the result is a loudspeaker with much better group delay characteristics. The benefit to the listener will be improved polar response and therefore radiated power response. Such an active loudspeaker will have a large stable sound field with stable imaging and source location. Very difficult and costly to achieve with a passive loudspeaker system.

A passive crossover will only operate correctly into the load impedance of a particular loudspeaker drive unit. However, the impedance of a loudspeaker drive unit will change with the amount of power input. This is because loudspeakers are very inefficient and most of the input power is dissipated as heat in the voice coil. As a result the temperature of the voice coil will rise and because copper has a positive temperature coefficient of resistance the impedance of the loudspeaker drive unit will rise. The result will be frequency response errors as the filters move from their designed response with increased input power. This effect does not occur in active loudspeakers where the filter response is maintained independent of input power to the loudspeaker.

Active Vs. Passive Amplifiers

The Separates amplifier manufacturer, has no idea what is going to be hung on the end of his product. Hence the need (as would be the case in the car analogy), to massively over-build to ensure that the amplifier will sound good with almost any speaker impedance and cable. It is not surprising that the massive amplifiers that typify the high end today are both costly and power consuming.

These problems of efficiency, size and cost are much reduced in the case of amplifiers designed for Active loudspeakers. Here the designer has the luxury of designing an amplifier pack containing separate mono amplifiers that only have to power one drive unit, whose every performance characteristic, bandwidth, frequency range, power handling, and shortcomings, are known to the designer.

Because the amplifiers in an active loudspeaker system are only required to operate over reduced frequency bands the intermodulation distortion products present in a passive system will be dramatically reduced, by typically 20dB, in an active system.

For a given amount of amplifier power, an active loudspeaker can be expected to produce approximately 6dB more level (twice as much) than the equivalent passive system. Furthermore, power for each drive unit may be more optimally specified in an active system. A tweeter, for example, requires much less power than a woofer to produce a balanced system performance.

A power amplifier designed specifically for the limited frequency range of an individual drive unit gains further benefits in efficiency, due to the fact that the wider the amplifier bandwidth, the less efficient it is. A well designed two or three way mono active power amp, for a given input and power rating, will always be capable of safely reaching

higher peak SPL levels with less distortion than the equivalent single wide band power amp. This additional safety margin is now essential for coping with the wider dynamic range of DVD-Audio, SACD, DTS and Dolby Digital film soundtracks. In an active system the absence of both passive crossovers and long cable runs, together with a known amplifier damping factor, prevents the modification of the loudspeaker drive unit "Q" ensuring better controlled low frequency performance.

Companies such as ATC who design and build both amplifiers and drive units are able to achieve even closer system matching. An Active amplifier usually comprises two or three dedicated mono amplifiers on a plain chassis which is then bolted onto the rear of the loudspeaker enclosure. Thus, there is no need for the customer to pay for the elaborate aesthetics, heavy metal styling currently fashionable in stand-alone amplifiers, which does nothing to enhance performance.

The Future

With high bit rate multi-channel music now a reality, and DVD players like Pioneer's excellent Elite 57Ai capable of playing both multi-channel SACD and DVD-Audio music, the Home Entertainment user of today has available sound quality sources never previously available in the home. Whilst there is much debate about the lack of digital interconnects affecting the quality of 5.1 SACD and DVD-Audio, the fact remains that the loudspeaker is still the weakest link in the reproduction chain. It surely makes good sense to install the most efficient transducer available, and that is the well designed and built self-powered Active loudspeaker.

Those wishing to upgrade to multi-channel and home cinema or install a completely new system, owe it to themselves to seek out and listen to a good Active system, before making their purchase decision. Beware of dealers and installers who only advocate five or more stacked, costly separate power amps, and the expensive cables that connect them.

Hopefully, the success of Active subs will perhaps lead the way to a greater acceptance of full frequency Active loudspeakers.

There are, of course, a number of well built passive monitors that give their owners a great deal of pleasure, perhaps where high SPLs and wide ranging dynamics are not required or practical. However, where the wide dynamics of DVD-Audio, SACD and film soundtracks can be replayed at realistic levels, the active loudspeaker comes into its own. After all, the SACD and DVD-Audio, DVD and CD you are listening to, were almost certainly monitored on them.