To be active or not to be active – that is the question...

1. Active versus Passive – the Situation

In any hifi-system, the loudspeakers are the pivotal component concerning sound quality. That is not to say that the other components do not matter. Nevertheless, it is indisputable that the loudspeaker is decisive for the sound of a hifi-system. It is – besides the acoustical properties of the listening room and the recording itself – the core of any music reproduction.

The history of loudspeaker development has produced a great variety of very different systems and designs. The circuit technology of the frequency-separating filter that separates the audio signal into different frequency ranges is determining the design of a loudspeaker. In this respect we distinguish between active and passive systems. Usually, this is a topic that is often underestimated in its importance for sound quality. Active-passive is much more than just a technical negligibility: In fact, the impact of the dividing network on the overall sound of a loudspeaker is substantial.

Active or passive – which system is preferable? Considering the aspects mentioned before, it may become a little more comprehensive why the very question comes up over and over again in the hifi-world. For decades it has been spooking as a debate on principles in the journals and magazines and for some time, now, in the web forums. It is a debate that often has a polemic character and that is one corner stone of controversy in *high fidelity*.

For the music lover interested in that matter the arguments of this discussion are not always comprehensible. This is the reason why we would like to present the basics of this topic, i.e. the advantages and disadvantages of both active and passive systems, aiming at explaining the fundamental technical differences of these systems and their impact on the sound of a loudspeaker in an intelligible way.

2. Active und passive loudspeaker – the basic Difference

Generally speaking, active and passive loudspeaker systems are different in respect to the amplifying and the crossover network. Active systems (in the strict sense of the word) have a built-in amplifier and an electronic dividing network whereas passive systems are driven by an external receiver or power amplifier and have a passive frequency-separating filter. That means:

a) A passive system amplifies – necessary for the transformation into sound waves – the music signal externally whereas an active system has integrated amplifier sections.

This difference brings about differences concerning the design of active and passive loudspeakers. The most crucial aspect is the succession of amplification and frequency-separation of the filter(s). That means, the second important difference concerns

b) the design (construction) and the parts employed in the crossover network.

Before we address these aspects in more detail we can pin down that active/passive is not a marginal feature of loudspeakers but an alternative of principle nature in terms of amplification and crossover network.

3. Passive Loudspeaker Systems

Passive Systems still dominate the world of hifi. This predominance has many reasons of which the following two are the most important ones in regard of our topic:

- On the one hand, the occasional susceptible active electronics and,
- on the other hand, the fact that there have been only a very few convincing agents of this kind on the market which could live up to the promise of technical superiority.

But how do passive systems basically work and what are the problems with this technology?

3.1 Construction of a passive loudspeaker

For the transformation of the audio signals into sound waves, passive loudspeakers require an external power amplifier. That means that the loudspeaker gets a signal that already has been amplified and is many times 'bigger' than the original signal.

In the loudspeaker, this signal hits the (passive) crossover network that divides it up into the different frequency bands.

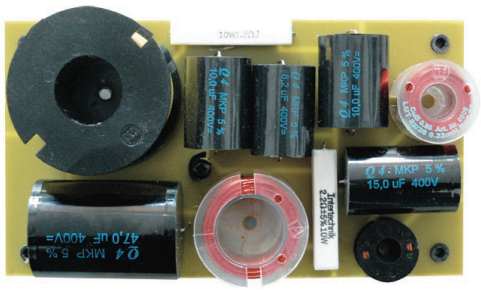

Figure 1: passive crossover network

The massive components (spoolings, condensers, etc.) are obvious at first glance, especially when compared to an electronic crossover network (see fig. 3).

Having been divided into these different bands, the electrical signals are being sent to the corresponding drivers, which transform them into mechanical vibration, i.e.: sound waves.

Now, the crucial point here is the downspout of amplification, split-up, and distribution of the audio signal, to put it simply: Where and when happens what to the signal? Figure 2 visualizes the way of the signal: First comes the amplification, then the split-up into the different bands, and finally the transmission to the driver.

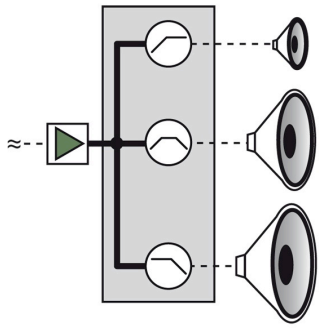

Figure 2: Schematic representation of the signal's run in a passive three way loudspeaker

The original audio signal ≈ is amplified ▶ (bold lines) and separated • into high ◠ (high pass), middle ◡ (band pass), and low ◡ (low pass) frequencies. Then the signal is forwarded (dashed lines) to the corresponding driver that transforms it into sound waves and radiates them.

3.2 Disadvantages of passive systems

It is exactly this progression of the signal described above that causes the main problem of passive loudspeakers (compared to active):

- Generally, the high signal streams require massive components of the frequency-separating filters. These massive components inevitably cause distortions and phase shifts. To put it differently: Exactly because the original signal is being amplified before it reaches the crossover network, its components (resistors, spoolings, condensers, etc.) have to be quite voluminous to be capable to withstand the amperage. So, **a strong signal hits strong resistances. Inescapably, this signal will be impaired and distorted**.
- The most important specific deprivation caused by passive filters is the so-called 'damping factor'. This factor indicates the precision with which an amplifier is able to control the movements of the membranes (of the drivers). A bad damping factor means that the amplifier is not capable of controlling (the vibrations of) the membrane(s) in an exact way. Distortions concerning the sound are inevitable. Up to date high-class amplifier achieve excellent damping factors – but the passive crossover network impairs this factor drastically. To put it simple: **In passive loudspeakers, the frequency-separating filters are located in between the amplification and the driver units and necessarily cause a loss of precision with which the amp can control the drivers**.

The best (and therefore quite expensive) crossover networks available today can reduce this impairment but never avoid it. Even the best ones diminish the damping factor drastically, on average down to five (yes, 5!) percent of the original value!

4. Active loudspeakers

Due to their different construction, active systems are able to avoid the problems explained above. They can process the electrical signal much more efficiently and almost lossless before it is being sent to the single driver.

But how do active systems basically work and are there any other problems with this technology?

4.1 Design of an active speaker

The crossover network of active systems gets the electrical signal directly from the music source (e.g. CD-Player, preamplifier, etc.) and therefore does not need massive components to withstand high currents.

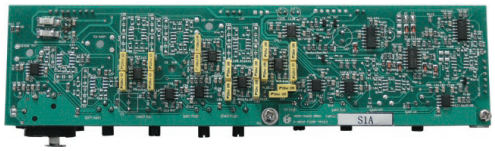

figure 3: active (electronical) crossover network

A comparison with a passive filter (see fig. 1) makes the differences become evident.

Since the electronical signal is very weak and the components of the network do not subtend any considerable resistance to the signal, it can be split-up with almost no loss or any kind of impairment. Within the realm of their frequency bands, the signals now reach their own amplifier. They are amplified and sent to the corresponding driver. That means, that each driver gets an almost loss-free electrical signal that it now has to transform into mechanical vibrations.

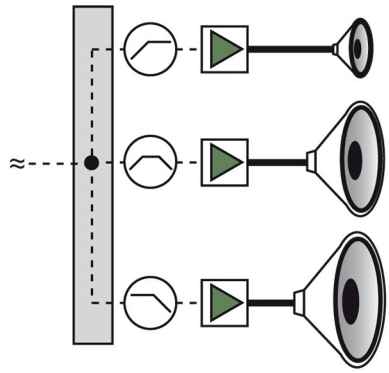

Figure 4: Schematic representation of the signal's run in an active three way loudspeaker

The original audio signal ≈ is sent directly (dashed lines) to the electronic crossover network • and separated into high (high pass), middle (band pass), and low (low pass) frequencies. An own amp then amplifies 'his' frequency range. Finally, this signal is sent (bold lines) to the driver.

So, each driver has its own power amplifier. The loss-free processing of the signals and the direct coupling of driver and amplifier result in an optimal damping factor, so the amp has perfect control over the driver. This means that a fundamental problem of all passive speakers can be avoided and the aim of authentic music reproduction approaches.

4.2 Disadvantages of active systems?

So how about possible problems of active loudspeaker systems? One hears respectively reads of mainly two objections: On the one hand the alleged susceptibility to damage of the active electronics, on the other hand higher costs.

The latter one is simply a prejudice although a very obstinate prejudice that has been passed on over decades. There are differences concerning specific models, of course. But in general, an active speaker system is not more – rather less! – expensive than a set of passive loudspeakers and adequate external amplifiers. The point is not to compare apples and oranges but systems of assimilable quality.

The mentioned susceptibility, however, is a different matter and a point that one has to take serious. It is a fact that in the past some active systems did show technical problems. The main reasons for that were deficient amplifier designs and strong heat development. Especially with bigger systems this heat could cause problems because it made the system susceptible do different kinds of damage and diminished the durability.

This problem has been tackled by the development of new amplifier technologies. ADAMs PWM (Pulse Width Modulation) amplifiers have an extremely high efficiency of more than 90%. That means they produce only one fifth of earlier A/B amplifiers. Due to substantial progress in components and circuit technology excellent power amplifiers became possible which belong to the absolute top class concerning technical data as well as sound quality.

So, the one and only serious problem of active speaker systems could have been solved. What remains is a distinct superiority concerning both technical aspects and the sound quality.

5. ADAM loudspeakers: passive option, active optimum

Which system is to be preferred – an active or a passive loudspeaker? In the professional audio world, this question has been answered a long time ago decidedly in favor of active systems. Accordingly, this question is not posed anymore in the professional area. The superiority of active systems has not only been theoretically but also practically proved.

Nevertheless, in the world of hifi passive system are still predominant. It would go beyond the realm of this text to speculate about the reasons concerning habits, the market and alike. Without any doubt one can achieve good results with passive loudspeakers if the hifi components (and the loudspeakers in particular) are of the appropriate quality. That is the main reason why ADAM offers hifi speakers as passive (or semi active) versions, too. Our active technology is an important feature but only one of many features, which are responsible for the outstanding sound quality they are famous for. This allows any music lover who does not want to relinquish his own amplifier(s) to enjoy the ADAM sound.

We are, however, convinced of the advantages of active loudspeakers. Due to our far-reaching experience in the production of active studio monitors and our proprietary transducer technology we are able to offer loudspeakers that avoid earlier problems of active systems. We have developed many both passive and active models and thus have a wealth of experiences in that matter. Over and over again we found that despite similar overall sound the active versions always showed advantages concerning the precision and the resolution of the sound.

Truly, we are not alone in advocating active systems. To give you only one example amongst many more, the eminently respectable German magazine *image hifi* writes:

> "...refrain from the baublery with power amplifiers and loudspeaker cables. Thus with active configurations alone one can expand into the very best reproduction of music. No driver, as perfect as it may be, can give back what the passive crossover network takes away from the signal." (02/2001)

Active or passive? At the end of the day it is one's own ear, it is one's own taste that decides – and there's (no) accounting for taste. If, however, one takes the technical and acoustical facts serious, this decades-long question would need to be rephrased: why still passive at all?