Concert Loudspeaker Processors

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Due to the ever-increasing public awareness of sound system fidelity, the pro-user's desire for dependable and "idiot-proof" audio equipment, and the loudspeaker manufacturer's constant battle to be one step ahead of the competition, the age of the concert loudspeaker processor has arrived.

Apogee Sound, Community Light and Sound, Eastern Acoustic Works, Electro-Voice, Meyer Sound Laboratories, Professional Audio Systems, and Renkus-Heinz are but a few of the companies presently manufacturing processor-based concert loudspeaker systems. Each company has their own design philosophies and individual product features, but as a whole, processor-based concert loudspeaker systems share the same general objectives. This article will attempt to explicate the most common design objectives and lightly touch upon the methodology in which the manufacturers are attempting to achieve the desired results.

The concert loudspeaker processor, in many instances, is nothing more than a combined electronic cross-over, signal delay, speaker protector, and response corrector packaged together for a particular loudspeaker and placed inside a single rack-mountable box. The objective of the loudspeaker processor is to optimize the acoustic output of the loudspeaker while protecting the loudspeaker componentry, all the while trying to remain as transparent as possible throughout the dynamic range of the loudspeaker. It seems simple enough, but applying this philosophy is extremely difficult. However, aside from the difficulties in design, the manufacturers are developing loudspeaker systems with definite advantages directly resulting from the loudspeaker processing.

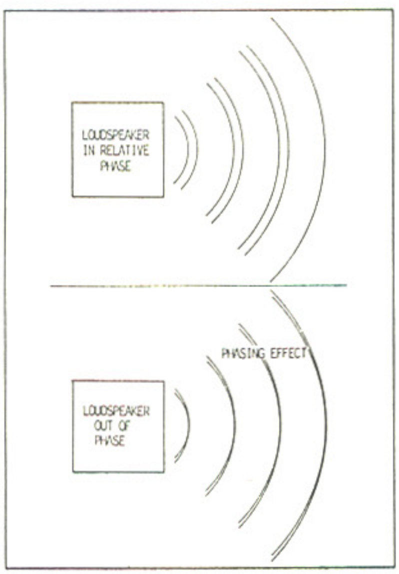
Aside from the obvious size and convenience qualities of the processor, there are a couple of other benefits as well. For example, by placing all of the working components in one box, and applying the same design philosophy throughout the entire unit, the processor is apt to be much quieter than individual components strapped together. As an aside, the technician's time can be spent in other places rather than patching together outboard components while trying to figure out input and output impedances. An additional benefit is the manufacturer's ability to customize the processor to a particular loudspeaker. Herein lies the real power of the concert loudspeaker processor.

By designing a loudspeaker processor for a specific loudspeaker, the manufacturer is able to incorporate circuitry for a known sound source to achieve optimal performance from that sound source as well as protect the sound source with the use of protective circuitry. The net effect is a seemingly more efficient loudspeaker system than traditional loudspeaker systems. As mentioned previously, the majority of the processed loudspeaker systems perform these optimizational functions with the use of electronic cross-overs, signal delays, speaker protection circuits, and equalization or speaker response correction circuits. The next four sections will touch upon these four functions of the loudspeaker processor.

ELECTRONIC CROSS-OVERS

The electronic cross-over in loudspeaker processors is much the same as other electronic cross-overs. The difference lies in the manufacturer's ability to design cross-over frequencies, slopes, and phase to meet the needs of the loudspeaker in order to create the optimum performance. This obviously cannot be accurately achieved with off-the-shelf cross-overs since the manufacturer has no way of knowing with what sound sources the cross-over will be in line.

Figure 1. A loudspeaker in or out of phase.



The loudspeaker processor facilitates precise tailoring of the adjoining cross-over frequencies to the specific sound sources they are serving, thus creating a smoother transition from sound source to sound source assuming the speaker components are chosen properly. The smoother transition gives the loudspeaker the illusion of being only one sound source rather than multiple sound sources working together, again assuming the speaker components are chosen correctly.

Cross-over slopes can be designed to make the transition from sound source to sound source longer or shorter, depending on the response output of the loudspeaker as a whole. Combinations of different cross-over slopes are also used to generate the desired results from the loudspeaker components.

Finally, phase can be adjusted for each cross-over frequency in order to align the acoustic wavefronts of the transitional sound sources. Alignment is achieved by matching the acoustic phase of the first sound source with the acoustic phase of the second sound source at the cross-over point, thereby putting the two sound sources in the same relative phase (*Figure 1*). Acoustic wavefront alignment is important in order to reduce the cancellation and summation of the acoustic energy being emitted from the loudspeaker. It is important to note that two sound sources with different coverage patterns, although in relative phase on-axis, will not remain in relative phase throughout their off-axis coverage pattern due to the difference in flare rate between the two sound sources. The proper choice of loudspeaker components is imperative for a successful loudspeaker, even with a loudspeaker processor.