Time Offset Correction™ (TOC™) and "Ideal Phase Response".

Time Offset Correction™ and equalization make it possible to remove the effects of the individual drivers' phase responses as well as compensating for the differences in their apparent acoustical locations. In passive networks and analog processors, all-pass delay is used to electronically move one of the drivers so that the acoustic centers of both drivers appear to be in the same plane.

When this is done, the response of the drivers and the dividing filters look very much the same as the dividing filters alone. Figure 1 shows the phase response of Dividing filters similar to the ones used in TOC™ processors.

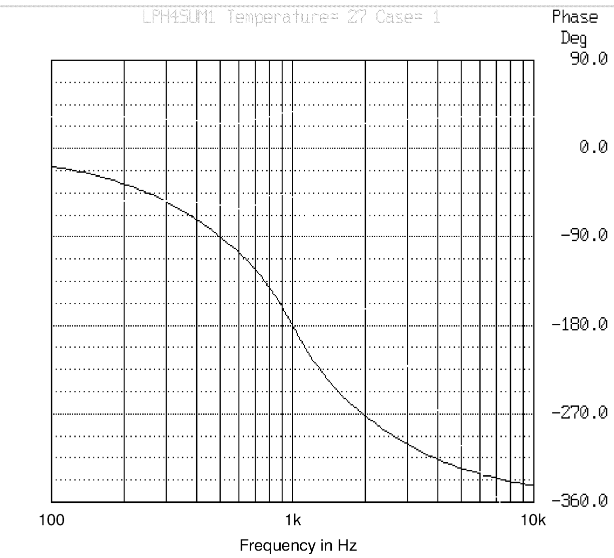

Figure 1. Phase response of Four Pole Linear Phase Dividing

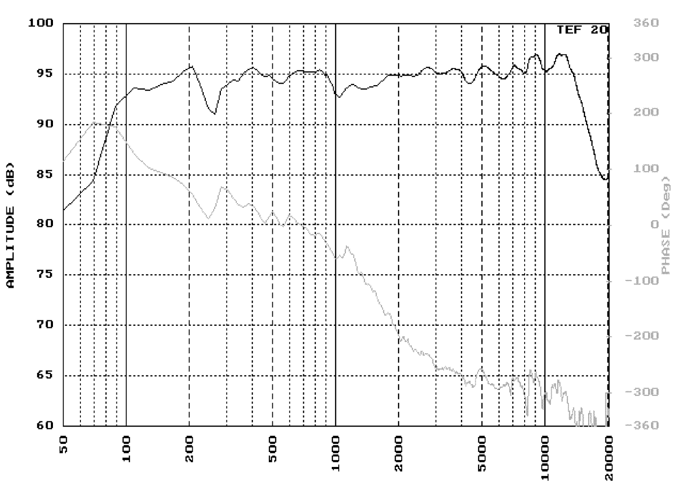

Figure 2. RS-2 with correct delay

The crossover frequency of the filters shown is 1 kHz. Their phase goes from close to 0° at 100 Hz to close to 360° at 10 kHz crossing 180° at 1 kHz.

Figure 2 shows the magnitude and phase response of an RS-2 (a model similar to an RS-2.2). We can see that the phase goes from about +100° at 100 Hz to somewhat over -250° at 10 kHz. It crosses -180° at the crossover frequency (1.2 kHz). This very close to the phase response of the dividing filters themselves as shown in Figure 1.

What would response of this system look like if we did not use TOC™?

Figure 3 shows the magnitude and phase response of the same system without TOC™.

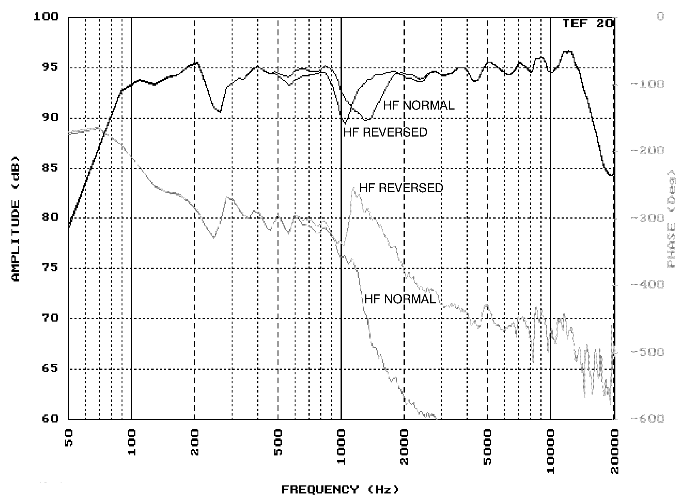

Figure 3. RS-2 without TOC™. Both Normal and Reversed polarities are shown.

Here we see that regardless of the H.F. driver polarity, there are discontinuities in the phase response near the crossover frequency. The phase scale is similar to Figure 2. The part of the phase plot labeled "H.F Normal" greatly increases it's slope at 1.2 kHz and goes through a total of more than 500°. The part of the phase plot labeled "H.F. Reversed" jumps positive by 90° just below 1.2 kHz before continuing negative. Above the frequency of the jump it looks the same as Figure 2.

These phase discontinuities cause cancellations in the magnitude response which are seen as the 5 dB dips on either side of the crossover frequency. Neither of these are close to the "Ideal" in Figure 1.

The sonic effects of these dips in magnitude response are noticeable. They detract from the clarity of the human voice both because of the missing energy at those frequencies and because the upper frequencies do not have the same temporal relationship that was present in the original voice. Neither of the plots with “no delay” are good with transient material like percussion, piano or guitar and they have poor off-axis response.

TOC™ and “Off-Axis Response”

Since most Pas systems are Coaxial, one might think that Time Offset Correction would not affect the response of a system when the listener is not directly in front of it, or that the effect would be lost. In actuality quite the opposite is true.

Figures 4 and 5 illustrate this. They show the Off-Axis response of a PI-12-1 with and without TOC™.

Since this system a passive network which contains a passive implementation of TOC™, removing this part of the network significantly affects the on-axis response. It may look like we are comparing apples to oranges. This is not the case, however. These measurements were done in the same place, on the same day with the same components. The only difference is the passive network used to make figure 5 did not contain the parts used in the delay circuit.

Obviously, the response is radically different when measured off-axis. At no angle are any of the responses of one the same as the other.

As it has been pointed out earlier, this difference in response is noticeable. Both smoothness and clarity suffer when the listener is off-axis.

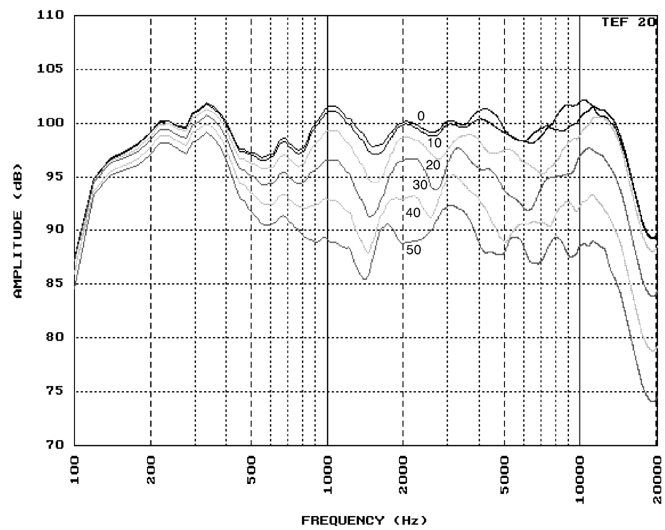

Figure 4. Off-Axis response (to 50°) of a PI-12-1 with TOC™

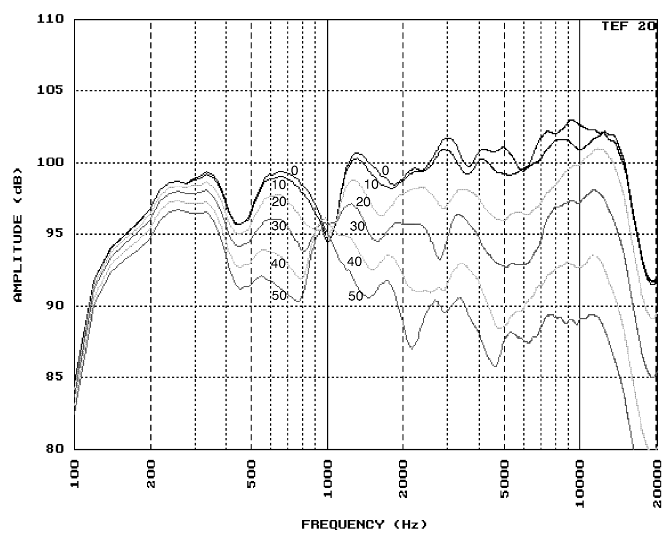

Figure 5. Off-Axis response (to 50°) of a PI-12-1 without TOC™