HALLOGRAPH WHITE PAPER

Every sophisticated concert hall in the world uses adjustable panels to contour the balance of the hall’s sound. The large size of typical halls requires specially designed wooden reflectors for careful tuning of the warmth to clarity ratio. Even with the most well thought out planning and architectural design, very often the hall does not achieve a perfect musical balance without fine tuning of these movable panels. The difficulties of finding that elusive musical balance are at least as difficult in the home audio system. The levels of indirect energy reaching the listener in the home are extremely high as compared to live venues and impact new ambient cues that distort those on the recording. The perfect loudspeaker would have a very high ratio of direct energy (as compared to indirect) reaching the listener. Years ago ACOUSTIC RESEARCH had an experimental speaker they called the MAGIC SPEAKER. It had a very sophisticated approach to what they called, "controlled directivity", that all but eliminated the ambient or secondary reflections. On the outside of each cabinet they had additional processed, separately amplified and time delayed speakers. These produced an ambient signal that was delayed more than 5ms so that ambient sound wouldn't merge with the direct signal and a sufficiently loud enough gain level to nullify the audibility of the room reflections. I also considered such an approach years ago when I was working with a brilliant loudspeaker designer, Mike Petroff. He had invented the finest non digital spatializer for two channel stereo. After a protracted bidding war among large companies, his design was licensed to HARMON KARDON. We were going to design secondary speakers to be placed behind the primary front speakers that incorporated his spatializer circuitry along with time delay. None of these attempts ever came to market because of high cost and engineering complexity. Some listeners have chosen to sit very near field to their speakers which does help to increase the direct energy reaching them. There are compromises to this choice, one of which is an increase in crosstalk between the two channels. Enter an acoustic solution, the Hallograph. Its cost is relatively low for a high end component and it requires no additional amplification.

The working principals of how the Hallograph alters the sonic envelope are reflection and diffusion. What makes the Hallograph unique in this genre of products is the intentional conturing of the reflection signal and the high level of diffusion from such a small surface area. The Hallograph is almost like a secondary speaker that to some degree decouples the primary speaker from the room. Rather than softening the room sounds, which requires extensive materials and treatment, we have tried to produce a musically complimentary device that dominates what the listener hears as the earliest reflections. Simply position them behind and to the outside of each speaker. In most rooms this ends up being the corners behind the speakers. If there are no corners, then place them just a few feet behind and to the outside of each speaker, symmetrically. Face the reflector panels toward the listener and then tow in for more warmth and tow out for more clarity. Experimentation leads to the right neutral angle that will then work for all recordings. One or two additional pairs can increase benefits.   These are placed on the sides of the room between the listener and the front speakers and also in some cases a pair behind the listener in the rear corners.   The most dramatic effects are from the first pair behind the speakers. In fact, the other positions will only produce minor benefits if the primary Hallographs are not in place.

In an ideal world, what the listener should hear is the direct signal from the speaker without the room imposing its own chaotic signals on the ambient cues in the recording. This direct energy from the speakers already contains the ambient cues the microphones picked up at the recording site. There is no debate in the audio world that the room's reflections, in the majority of situations, imposes its own colored and distorting character on musical reproduction. The room is in effect **a modification of the image, writing over its own signature and ambient cues.** We can't eliminate the room, but we can reduce the perception of it to some degree. Introducing a new boundary that is designed as a diffuser by virtue of its superior geometry to the rooms flat surfaces also is an established way to provide benefits.

Typical reflector/diffusers use a single type of wood and or absorbent material mounted against each other. Let's call these the "Paddle type". The diffusion in these types is generated from the asymmetrical depth of the pieces in relation to each other. We use a spaced, undulated and rounded over "Fork type" geometry to achieve the asymmetry essential to produce diffusion. In addition, there are four different types of wood used in the Hallograph that adds even more "asymmetry" which increases diffusion. This open fork diffuser has double diffusion because the return wave off the wall is sent through the diffusers a second time, unlike the paddle type. If you think of the secondary sound waves in a room as water moving chaotically in all directions, this fork type diffuser has a much more powerful smoothing effect per square inch than the paddle type diffusers. Our fork diffuser is akin to a powerful propeller that the water, or in this case, the sound waves go through, which smoothes out their peaks.   In addition our diffuser has more than 60 undulations per channel and rounded over edges that multiplies the surface diffusion taking place. Unlike Paddle Type Diffusers which require many more panels, one pair of Hallographs can have a dramatic effect. Our stand, which is 4 feet in length, is also asymmetrical and does produce some audible improvement in bass clarity. The goal is to push the room's enormously distorting effects further into the background with a far more neutral ambient soundfield. One question that comes to mind is why not place the Hallographs at the usual first reflection point? If you have a reflected signal from the Hallograph that is now the dominant ambient sound the listener hears, then it is not necessary to put it at the first reflection point which is usually somewhere in front of the speakers on the side walls. Instead, to take advantage of the crosstalk cancellation properties and depth improvement that the Hallograph provides, you place the first pair for any given system to the outside and behind the speakers. To achieve this goal, the reflector material in the Hallograph consists of several types of wood that all have different resonant signatures. All the wood lengths are staggered on the three reflectors per side. Each reflector has a flat surface that gently curves into a round over section. These interlaced, but geometrically different surfaces have a striking effect. The Hallograph's own **direct return energy (from the flat portion of the reflector) and its ambient signals (from the curved reflector area)** dramatically impacts the sonic envelope one hears. This ratio of direct to ambient surface tuning, just as is the case in a concert hall, restores a more natural hall acoustic. The inherent differences from recording to recording are no longer stamped with the listener's room signature. Instead, the varieties of the original venues are heard far more realistically. **Behind each reflector is a chamber wherein we modify the frequency**

response, amplitude and most importantly, the time signature of the reflector. In effect we have created a complimentary interface between the speaker and the room. What is meant by the time coefficient (also known as the time signature) is how long a given material goes on ringing once it is activated by sound waves striking it. In the chambers behind each reflector we "treat" the time signature so it has a much shorter ring than the material a rooms walls are made of. This treatment also effects the frequency response which has a direct correlation with time signature character. Amplitude is manipulated by the choice of wood, diffusion geometry of the design and additional treatment that will be explained in the patent.

Human hearing is most sensitive to the loudest and low treble frequency sounds in a room. If you have a full bandwidth signal playing through a 15 inch speaker at 50 db and a 5 inch speaker playing the same signal at 56 db, you wouldn’t even be able to find the larger speaker in a darkened room. The 5 inch would be the only one we could locate. In our case the room is the 15 inch speaker and the Hallograph is the 5 inch. The reflector material of the Hallograph is louder than the plaster or dry wall slap of rooms. Also, the black African wood potion of the Shakti reflector has such a tight pore structure that its more like metal in its speed of return of sound as compared to a rooms walls. If you were standing on railroad tracks 4 miles from a train coming and I was 2 miles away, but not on the tracks, you, though twice as far away, would hear the train before I, because of the faster transfer of sound through the metal rails. Objective measurements may also suggest that the treble character of this wood is such that human aural perception is highly sensitive to its sonic envelope.

As mentioned earlier we shorten the time signature or ringing that our reflector produces as compared to walls or any other wood acoustic device, so again the return to the listener is more in concert with the direct signal from the speakers. In fact, some portion of our reflectors is not rounded, but flat and the signals from there may be filling in some off axis frequency response errors. The Hass effect says that signals arriving 1 to 5 ms after the direct signal blend with and widen the image of the primary signal. Signals arriving later that that are perceived as ambiance. Looking closely at the Hallograph reflectors shows that there is both a flat and curved area that blends together. These angles were carefully worked out to produce the most natural ambient and direct coupling effects with the primary signals. Some of the sound is returned so fast that we get a broader sound field that is more natural. Some energy off the Hallographs curved portions enhances the depth because of its more diffusely scattered and delayed arrival at the listeners seat. Keep in mind that Bell Labs in the 1930's said STEREO SOUND would require three speakers, a **widely spaced left and right and a center channel**. Since phono system limitations couldn't allow for the center channel, you couldn't place the left and right far enough apart without distorting the center information. A device that widens the stage is not falsifying the sound, but rather restoring some of the actual true width and depth. On many natural recordings, after hearing them with the Hallographs in place and then removing them, makes the sound seem like what one might call a very inferior super mono. It is well known that stereo positioning of two loudspeakers produces crosstalk or left and right channel bleed around the face of the listener. The position of the Hallographs to the outside and behind each speaker seems to be reducing this, by reinforcing the amplitude of the hard left or hard right miked instrument or voice. The speed and short ring off the Hallograph is a contributing factor to this benefit.

Reflected sound traveling through large halls has very little information above 10 kHz. The type of wood and damping techniques we use in the chambers behind the reflectors is reducing the reflectors 10 kHz and up signals which contribute to a more natural hall acoustic. Also, since the Hallograph is swamping the sound coming off the walls, the 10kHz to 20kHz signals from the listening room's reflections are less audible. The listener still hears the direct signals full response to 20kHz but not the home listening room generated ambient highs (that often carry info above 10 kHz) that wouldn't be there in natural recordings. Once we settled on the 48 inch height off the ground, we found that the beneficial effects carried over to even mono recordings. Lower heights tended to make mono have a bit of an artificial stereo effect, now they only become deeper and richer with no unnatural signature. This is a test that took the Hallograph from being an interesting tuning device, with its own character and limitations, to a transducer of sorts, which is capable of revealing more accurately the original recording site in all its glory.

Ben Piazza
Shakti Innovations 2004