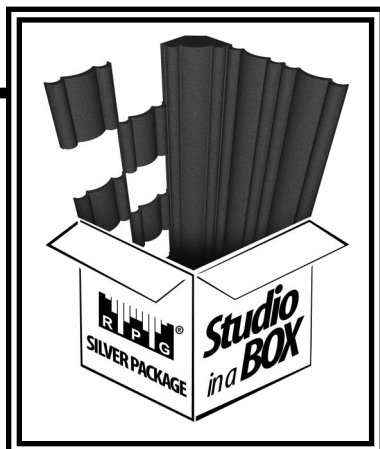


DiffuseReflections

The Newsletter for Progressive Acoustics Research

Volume 5, Issue 1, 1999



The Studio in a Box™
Silver Package is a low cost foam package containing 10 ProFoam™ Panels for reflection control, 32 ProFoam™ Tiles for enhanced envelopment, and 4 ProCorners™ for extended low frequency control

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After 15 years of commitment to basic acoustics research, peer review publication, and education, there are signs that our efforts are making a difference. The sound diffusion market that we pioneered in 1983 has blossomed into an architectural industry.

For up to the minute information, we invite you to visit RPG's web site:
<http://www.rpginc.com>.

DIFFUSE NEWS



Dr. Peter D'Antonio
President and CEO

Making a Difference

After 15 years of commitment to basic acoustics research, peer review publication, and education, there are signs that our efforts are making a difference. The sound diffusion market that we pioneered in 1983 has blossomed into an architectural industry. Sound diffusion is taking its rightful place along with absorption and reflection in the acoustical palette. More and more projects are including an appropriate mix of these acoustical ingredients. Sound diffusing products are being specified in thousands of facilities around the world and it is personally very gratifying to have been a part of this trend.

Research

A commitment to basic research has produced a product line that has expanded from a few number theory reflection phase gratings to a full spectrum of sound diffusing, absorbing, variable acoustics, and performance products. RPG®'s DISC project was initially conceived to discover methods to measure and quantify sound diffusion. It has spawned two international working groups: the AES SC-04-02 and the ISO/TC 43/SC 2 Building Acoustics Working Group (WG 25). Since developing a diffusion coefficient has been my personal quest for nearly 20 years, this is indeed gratifying. Soon these diffusion coefficients will help acousticians evaluate potential scattering surfaces and complement the library of absorption coefficients to improve acoustical performance prediction and auralization of virtual spaces. Collaboration with Dr. Trevor Cox has yielded a new approach to shape optimization by combining boundary element prediction with multi-dimensional optimization. This Shape Optimizer software is proving to be a powerful tool to design surfaces that provide specific or generalized scattering performance. Multi-dimensional optimization is also playing a

key role in new software to determine the optimum locations for loudspeakers, listener, and acoustical surface treatment in critical listening rooms and home theaters.

Publication

A commitment to peer review publication has produced a body of work on sound diffusion. Recently, the AES published our extensive two part review entitled "Two Decades of Diffusor Design and Development." Part I deals with Application and Design while Part II covers Prediction, Measurement, and Characterization. We will also be contributing several papers on diffusion to the forthcoming special edition of Applied Acoustics. I was delighted to chair a comprehensive session on "Characteristics of Scattering" at the Acoustical Society of America in Norfolk, Virginia.

Education

A commitment to education has always been an important activity at RPG®. For the past 10 years I have been an adjunct professor at the Cleveland Institute of Music. Undergraduate students have contributed significant research in performance and practice room acoustics. We are now investigating anechoic recording of musical instruments as part of a program to obtain anechoic music for auralization research. Recently, I began teaching in the Peabody Conservatory of Music Masters Program. Topics include sources of acoustic distortion, the acoustic tool palette, characterizing diffusing surfaces, room acoustic measurements, and auralization. Students will be designing and renovating an existing control room and documenting before and after acoustical performance with a variety of the excellent measurement programs now available. Dr. Christopher Jaffe and the students of his new Sonics in Architecture class at Rensselaer Polytechnic Institute of Troy, New York visited RPG® for an acoustics seminar and a tour of our research and manufacturing facilities. We will continue to participate in this program.



MEASUREMENT GONIOMETERS

In Volume 1 Issue 1 we described a 5th scale two dimensional measurement apparatus developed to characterize the scattering from architectural surfaces. Figure 1 shows a sample at the center of two concentric semicircles. The inner semicircle has a radius of 1m and contains 37 fixed microphones providing 5 degree angular resolution. The outer semicircle has a radius of 2m and contains fixed positions to vary the angle of incidence of the loudspeaker.

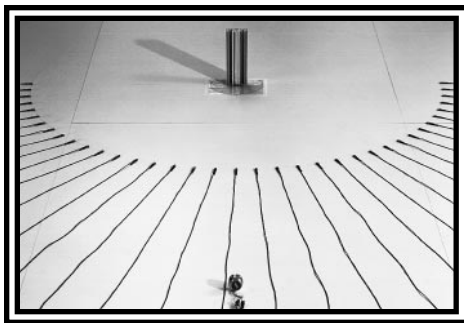


Figure 1. 5th scale 2D diffusion measurement apparatus showing sample in center of 1m radius microphone semicircle with 37 fixed microphones and 2m radius loudspeaker semicircle. The loudspeaker is shown at normal incidence.

Data Reduction

Under computer control 37 MLS stimuli are emitted in turn. A microphone switcher selects the appropriate microphone and 37 impulse responses are recorded. The data analysis is shown in Figure 2. To isolate the scattering from the sample under test (rectangle in B), a background measurement containing the direct sound and the room interference is subtracted. The speaker/microphone response is then deconvolved from the measurement and the scattered data are windowed. These windowed data for all of the angles of observation are concatenated in Figure 2C in the form of a “temporal” angular response. Each impulse response is transformed into its frequency response, Figure 2D, and 1/3 octave

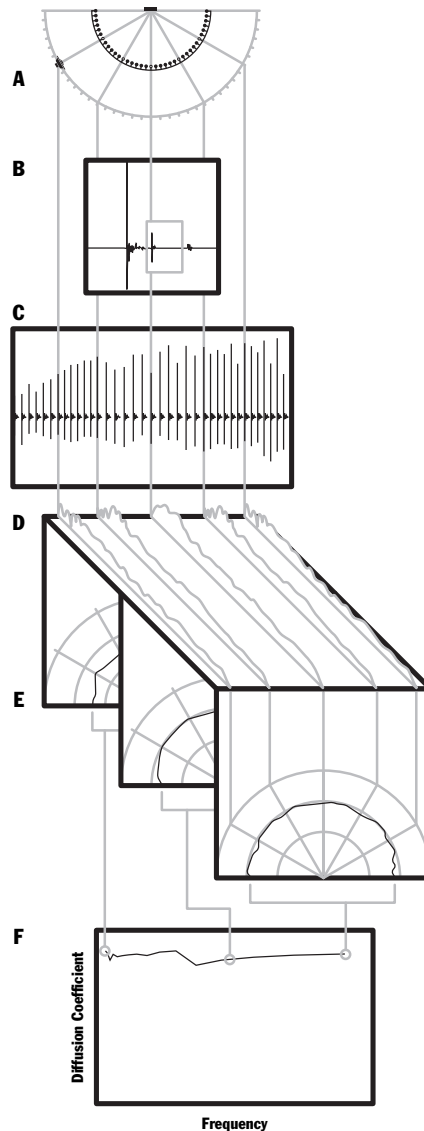


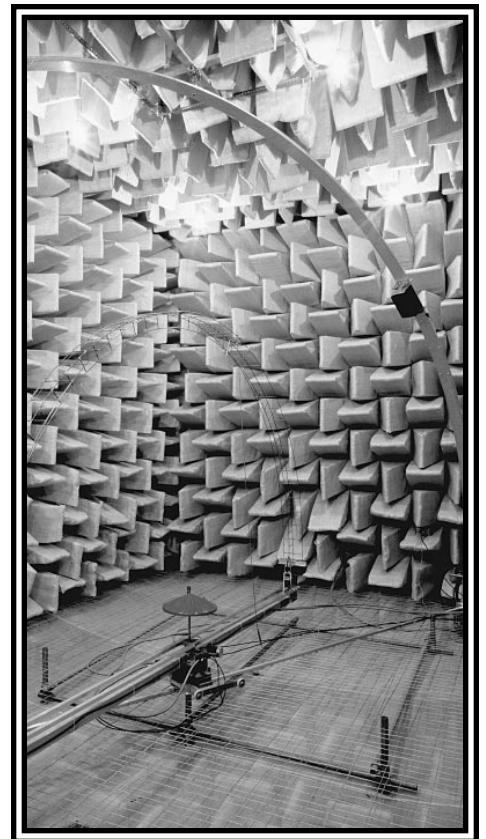
Figure 2. Data reduction procedure illustrating (A) 2D measurement geometry with loudspeaker at 60 degrees, (B) impulse response for a given microphone, (C) deconvolved and concatenated impulse responses for all microphones, (D) 5 sample frequency responses, (E) 3 sample 1/3-octave polar responses, and finally (F) a plot of the diffusion coefficient

polar responses are obtained, Figure 2E. The auto correlation of these polar responses is used as a diffusion coefficient metric and is plotted versus frequency to obtain the diffusion response, Figure 2F.

3D Goniometer

For one dimensional scattering surfaces like cylinders and 1D QRDs, the 2D diffusion apparatus is useful. For two dimensional surfaces, a 3D goniometer is needed to measure the backscattering on the surface of a hemisphere. Such an apparatus has been designed and built as part of a grant funded by the European Physical Sciences Research Council and RPG® Diffusor Systems. This 3D goniometer is shown in Figure 3. The sample is placed at the center of the 1m radius microphone arc and the 2m speaker arc. For a given loudspeaker azimuth and elevation angle, measurements are made for various azimuth and elevation positions of the microphone to uniformly describe the performance on the surface of a hemisphere.

Figure 3. 3D Goniometer.



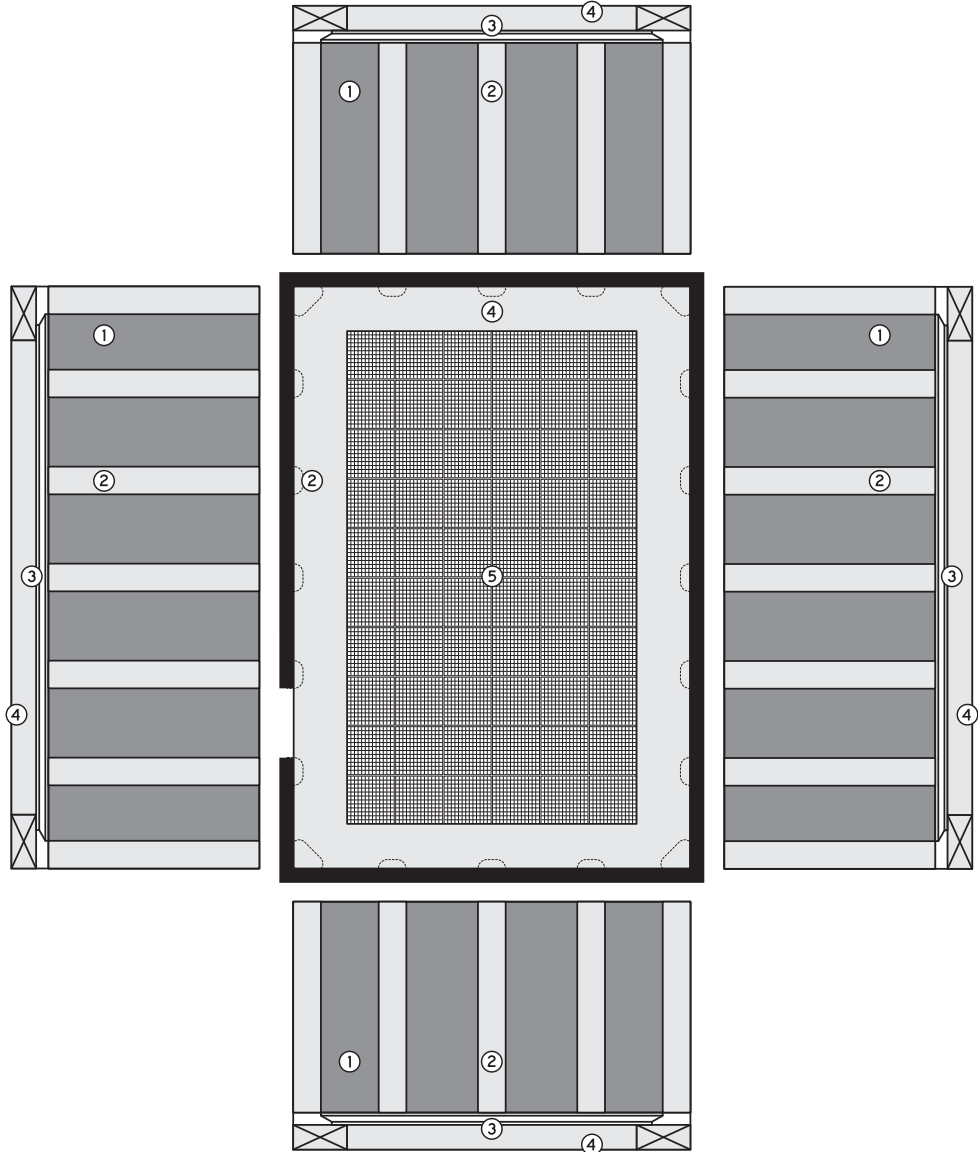


Diffuse Applications

CINEMUSIC IV

Fabric wrapped panels are probably the most widely used acoustical treatment in home theaters. While they offer reflection control and an aesthetic benefit, they cannot provide the envelopment necessary in today's 5.1 surround sound home theaters, because they lead to an acoustically "dead" space. To extend the performance of a flat fabric wrapped panel, RPG® developed the binary amplitude diffractor (BAD™): the first flat variable impedance diffuser. The BAD™ Panel diffuses sound above 1 kHz and absorbs below that frequency. As the panel size is made thicker or spaced from a boundary surface, the absorption extends to lower frequencies, without affecting diffusion.

By combining traditional fabric wrapped panels, BAD™ Panels, and bass absorbers in the soffit, side walls, and corners, RPG® offers the first panelized home theater system that can provide a suitable acoustical environment for surround sound formats. Vertical field cuts edges are concealed by the upholstered square, rounded, or flat joint covers. The rounded and square joint covers can also provide some low frequency absorption. Horizontal field cut edges are concealed by crown and base molding. The Bass Absorbing Soffit System™ installs onto ceiling and wall cleats.



- ① **BAD™ Panels**
- ② **Fabric Wrapped Joint Covers**
- ③ **Crown Moulding**
- ④ **Bass Absorbing Soffit System™ (B.A.S.S.)**
- ⑤ **Skyline® Array**

▲ Figure 1. Plan and elevations for CineMusic IV.

◀ Figure 2. Rendering of CineMusic IV Home Theater System.



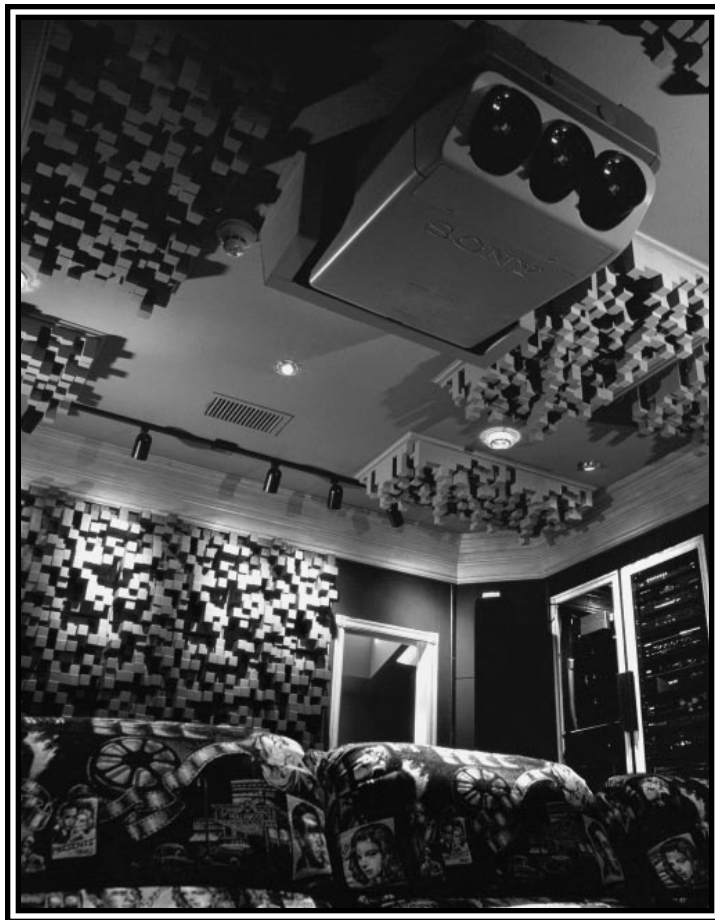
Project Profile: TMC Home Theater Systems

CLIENT

"After spending 12 years owning and operating a major recording studio, I know the importance of room treatment. The fact is, and has always been, your speakers will only sound as good as the room in which they are located. In the past, treating a room consisted of using porous absorption to deaden the room. The results were fair at best. In the home theater of today, Dolby Digital, DTS, and 5.1 music mixes require a livelier, more dynamic room to properly recreate their sound stages. In fact, overdeadening the room will result in a much less enveloping sound field. Envelopment is what home theater is all about. Dr. Peter D'Antonio, founder of RPG® Diffusor Systems, Inc., has developed a great range of home theater room treatment products that provide diffusion, absorption, and low frequency control. Having used these treatments first hand, I can say the result is outstanding!

The imaging from the speakers has been greatly improved. First reflection problems have been totally eliminated, and there is a great sense of "air" surrounding the speakers that was never there before. Acoustic analysis of the room proved it to be nearly flat across the frequency range after RPG® products were installed! It's not surprising that these people definitely know their stuff, considering their impressive list of clients in the pro field! Thanks to RPG® for bringing your knowledge and professional expertise to the new and exciting world of home theater! I continue to be very impressed with Pamela Marchesano, RPG's Home Theater Specialist. She has worked hard to answer any questions and provided detailed assistance whenever necessary."

Ted Michael Curtis, President, TMC Home Theater Systems, Edmund, Oklahoma

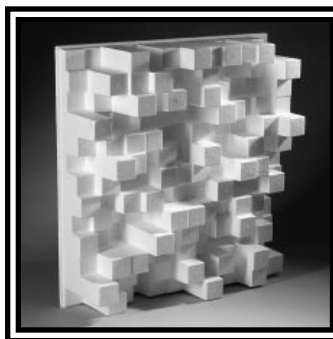


TMC Home Theater Systems Showroom, rear view.

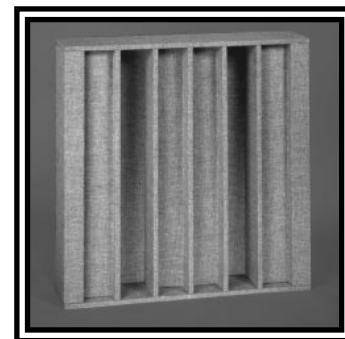


TMC Home Theater Systems Showroom, front view.

PRODUCTS



Skyline®



Abffusor®

