WSR's Holosonic™ Home Theatre System

Part I — The "Dream": Building A Dedicated Home Theatre From Scratch

GARY REBER
PHOTOS BY DAVID KESSLER STUDIO

Widescreen Review's New State-Of-The-Art Reference Theatre At New Facility

The following introduces a series of articles on the design, development and execution of a new state-of-the-art Reference Home Theatre Laboratory at *WSR's* new office facility.

After nine years of continuous growth, WSR Publishing, Inc. has moved into its new headquarters after outgrowing its old offices. As owners and founders of *Widescreen Review*® magazine (1992) and other WSR Publishing, Inc. ventures, including WidescreenReview.com, SurroundMusic.net and WebDVD Publications, Marlene and I have purchased a new 5,000 square foot building in Temecula (north of San Diego, southeast of Los Angeles) to house our fast-growing enterprises. Build-out of the facility, which utilizes over 7,000 square feet of offices and "home theatre" review rooms on two floors, commenced on January 2, 2001, and was completed for move-in on March 24.

A key element of the new building is a state-of-the-art reference theatre that will serve as *Widescreen Review's* and Surround Music's review laboratory.

Usually, dedicated home theatres—as designed and promoted by Theo Kalomirakis' Theaters, Theatre Design Associates, Inc., Acoustic Innovations, First Impressions, etc. and reported on in such picture-book dominant publications as *Audio Video Interiors* and *Home Theater Interiors*—are interior design driven rather than optimized for video and audio performance. Elaborate staging and seating areas complemented by colorful fabric-covered walls decorated with stylish sconces and acoustically treated so as to usually impart a "dead"-room sound are the rule. Audio is regulated to non-full range "hidden" dissimilar speaker designs all around, often built into the walls. At best, video displays (usually front-projection types), are calibrated, but always must fight with the light pollution caused by ambient light and the room interior colors, which to a lesser or greater degree reflect back on to the screen to contaminate the picture causing a washed-out quality and less-than-ideal contrast ratio.

Then, too, the audio implementation is typically of the Home THX®-type, an approach which attempts to "simulate" the inherent limitations of "dubbing" stages and thus, movie theatres. (See the side bar on "The Home THX Approach.") The end result is overly electronic-processed audio which leaves untapped the full potential of the multichannel 5.1 and 6.1 audio formats for delivering outstanding soundstage and holosonic™ soundfield imaging.

The approach at *WSR* is completely different from that of THX, and the typical approaches practiced by the majority of theatre designers. We have sought to build a home theatre in which picture and sound performance is paramount. Our implementation embraces principles of purist high-end audio applied with dedicated diligence to home theatre to create a believable sense of enveloping holosonic space.

While not colorfully ornate in interior appearance, our built-from-the-ground-up dedicated theatre's interior is striking and optimally functional with no visual distractions. We have eliminated ambient light completely with our virtually all-black treated room accentuated with highlights in a video-complementary gray.

We also decided to erect a component, mirror-less, rear-projection system as our principal viewing system, once again to eliminate light pollution and maximize picture contrast, shadow delineation, clarity and

visual impact.

A core philosophy at *WSR* is identical full-range-capable speaker systems for each of the five or six main channels and their equidistant positioning relative to the primary "sweet-spot" or "the chair."

I remember that for years the Home THX Program completely ignored equidistant loudspeaker time synchronization as practiced in stereo and during the 1970's quadraphonic era. Instead LF, CF and RF were lined up in a straight row, with surround loudspeakers positioned with a complete disregard for the equidistant principal and the symmetrical relationship of the loudspeakers relative to the listener. It was not until the Spring of 1996 that, in an article published in the *Home THX Express* newsletter entitled, "Speaker Position Time Synchronization™," THX recognized the equidistant principal. For the first time Home THX broke ranks with the practice on the dubbing stage, which the Home THX Program regards as sanctimonious. Still the Home THX Program solution is to employ electronic delay, rather than optimization through physical equidistant loudspeaker positioning. (See Issue 20 for an analysis of the THX "Speaker Position Time Synchronization" approach.)

We have successfully implemented various identical systems using point source, bipolar/omnipolar and dipolar loudspeaker designs. In our flagship Holosonic Home Theatre System™, we are using a point source direct radiator loudspeaker design. To emphasize our philosophy of speaker placement, we have carpeted a large 20-foot diameter circle in gray, with black carpet therefrom out to the edges of the room boundaries. We provided for sufficient black carpeting in front of the screen area of the theatre to minimize any slight light reflection off the gray carpeted area to protect the "blackness" we sought to create in order to optimize video contrast and resolve the deepest of blacks and the minute subtleness of shadow detail.

Screens, Rear-Projection And Projector Light Output

A decision was made to employ two 1.78:1 (otherwise referred to as a 16:9 aspect ratio) seven-foot wide screens, one for rear-projection and the other, front-projection. The screen width determination was a critical factor in the size of the room we would build and the distance from the screen area to the choicest seat or "the chair." From the position of "the chair" the room is built-out. We chose Stewart Filmscreen for the project because of the proven, documented superior video

Delivery Of Owings Corning Trus Joint™ TimberStrand™ LSL Wall Studs

Contractor Jeff Hodges Reviewing Home Theatre Construction Plans

performance their screens deliver. A fixed 1.78:1 aspect ratio, 84-inch wide by 47-1/4-inch high (96.50 inches diagonal) AeroView® 100 handles the theatre's rear-screen day-to-day DVD and HDTV picture review demands at the magazine. AeroView 100 is an accurate light transmissive material with extremely wide dispersion and virtually no distortion. Behind the screen is a dedicated flat black-treated and acoustically isolated mirror-less projection room, which measures approximately 8-feet by 14-feet, 6-inches, sufficient to handle the throw distances of the largest nine-inch CRT projectors without the use of a first surface mirror. The AeroScreen 100 is fitted with Stewart Filmscreen's Model LVC Horizontal ScreenWall ElectriMask electric motorized aspect ratio masking panel system using Stewart Filmscreen's Ve-Lux® non-reflective light-absorptive black fabric material for the frame treatment and the front screen wall.

Above the AeroView 100 is a motorized drop front-projection screen of the same aspect ratio dimensions housed in a black batten Luxus Model A ElectriScreen enclosure. The screen material is made of Stewart Filmscreen's newest screen fabric, GrayHawk® 088. This material is optimized for displaying images projected from fixed pixel displays. Thus, we are able to review both CRT projectors in rear-screen mode and fixed pixel projectors, such as those based on DLP and D-ILA technologies in front-projection mode. A third six-foot wide (54 inches x 72 inches; 1.33:1 aspect ratio) Stewart Filmscreen StudioTek® 130 is available as a roll-in for front-projection reviews of LCD and other CRT projectors.

Our primary CRT projectors are the nine-inch Runco DTV-1101 coupled with Runco's VHD- 4404 Ultra multi-function video processor and the Sony G-90 coupled with Faroudja's DVP5000 digital video processor/scaler.

Room Size

The optimal viewing distance from the screen for high-resolution material such as anamorphic widescreen DVD and HDTV is three to four times picture height, or approximately 12 to 15-feet in our particular case. Considering "the chair" position and the "circle of sound," or "clock," positioning of our Dunlavy Signature Series SC-V loudspeakers along the arc of a 20-foot diameter circle, the room needed to be at least 22 feet deep, using a Dunlavy HRCC for dedicated below-screen center channel movie sound. We opted to build the viewing room to a 26-foot depth to fully accommodate both a back surround channel full-range SC-V and a music-only center channel full-range SC-V (used when appropriate). (Further, the additional 14 feet-6 inches "length" extension provided by the rear-projection room helps to optimize extremely deep bass response to 16 Hz.) For width, we were limited to a maximum of 22 feet due to the location of the theatre in relation to the *WSR* offices, which share the same building. Based on these given dimensions, our acoustic designer, Dr. Peter D'Antonio, President of RPG Diffusors, Inc., using his proprietary automated Room Optimizer™ computing program for listener and loudspeaker placement, calculated the optimum final dimensions which would cause the least room modal low frequency acoustic distortion. Thus, our room turned out to be 26-feet deep x 21-feet, 8.6-inch wide x 13 feet, 11.9-inch high, or approximately 8,000 cubic feet in volume. These dimensions allowed us to slightly offset the "circle of sound" in the positioning of its depth and width dimension to optimize the placement of the listener, multiple loudspeakers, and subwoofers, and not have "the chair" positioned equidistant but off-center from the walls of

Accoustical Room Builder John Feeney Laying Out Owens Corning Trus Joint™ TimberStrand™ LSL Wall Studs

Putting Up Partial 14-Foot Accoustical Wall

Side View Of Accoustical Wall Construction

the room. An offset is acoustically preferable for optimum audio delivery, again to optimize speaker boundary interference response (SBIR) and modal coupling, and minimize frequency "combing" or cancellation. RPG's program utilizes modern geometrical image model prediction techniques along with powerful multi-dimensional optimization to achieve the smoothest and flattest bass response in a rectangular room by properly positioning the listener and loudspeakers.

In addition to optimizing the bass response, RPG's program also calculates first order reflection positions for mid to high frequency acoustical surface treatment. Absorptive surfaces minimize comb filtering and improve imaging. Diffusive surfaces enhance envelopment and sound distribution throughout the room.

Speaker Selection And Optimum Speaker Placement Relative To Listener

Loudspeaker selection prior to building a dedicated home theatre is the ideal. Every loudspeaker manufacturer designs for an optimized listening distance from the position of the tweeter. In the case of the Dunlavy Signature Series loudspeakers, that distance is 10 feet as measured anechoically. That is the ideal distance where the individual drivers' wavefront merge into a coherent "full-range system" wavefront to reproduce as a point source transducer. Usually acceptable results can be obtained with distances closer than the "intended" distance but in the case of Dunlavy Signature Series loudspeakers not closer than seven feet. Of course, further away than ten feet to distances up to 12 to 14 feet are acceptable as well.

We chose the Dunlavy Signature Series SC-V model for the primary five- and six-channel transducers because the SC-V was a single-unit sealed enclosure system with truly full-frequency range performance. It is also fully time- and phase-accurate. No other speaker on the market, except for the larger SC-VI, provides this level of performance with an audible and measurable frequency response of 20 Hz-20 kHz ± 1 dB at 10 feet, measured anechoically with a rated sensitivity of 91 dB and a nominal impedance of 6 Ohms! As documented through individually serial numbered testing in one of Dunlavy's large anechoic chambers, the SC-V is capable of passing a square wave that is as accurate as what one would expect of CD players.

The SC-V is large with a footprint that measures 28-inches deep x 15-inches wide by 78-inches high, and weighs a stable 330 pounds. Our Dunlavy Signature Series system features six SC-V speakers (four used to reproduce LF, RF, LS and RS, one to reproduce the surround back channel and one used to reproduce the center channel in music-only six-channel playback), one HRCC (for dedicated center channel movie sound), one SM-1 (to reproduce a height channel when appropriate) and two Tower TSW-5 Subwoofers (which are flat to 16 Hz and housed in an identical-looking SC-V sealed enclosure) to reproduce the .1 Low Frequency Enhancement (LFE) channel. Thus, the loudspeaker system is flat ±1 dB 16 Hz-20 kHz (anechoic measured) at a ten-foot distance to the listener. (Please see the On Screen conversation with speaker designer John Dunlavy in Issue 47 for an education on speaker design and accuracy.)

The Dunlavy SC-Vs are positioned on a 90 degree axis at the four primary vector points representing front stereo pair and back stereo pair or surrounds. This forms a stereo spread of approximately 14 feet (tweeter center to tweeter center). At that spread distance, the Dunlavy's project a most uncanny soundstage with unsurpassed phantom imaging suspended in a three-dimensional space between each channel vector. Thus, each side wall represents a stereo pair in relation to "the chair" listener position. The SC-V back surround is directly on the center line with "the chair" and equidistant between the left back surround and the right back surround SC-Vs. When reviewing audio components and SACD and DVD-Audio multichannel discs, the center channel is reproduced by a SC-V as well, which is moved into the center front position when required for such reviews. Otherwise, for movie sound reviews the center channel is reproduced by a HRCC loudspeaker with a frequency response of 29 Hz-20 kHz ± 1 dB. The HRCC is positioned in the cavity below the Stewart Filmscreen AeroView and GrayHawk screen housings, slightly further away from "the chair" than the ten feet prescribed for the SC-Vs.

One of the design challenges in constructing the room was providing for a height speaker, which can be employed either to reproduce a "specified" height recorded channel or as an enhancement channel vector for the back surround channel. A specially-constructed 1-inch thick MDF box houses the Dunlavy Signature

Look Through To Home Theatre Under Construction

Equi=Tech's Model ET 12.5W Balanced Power Hard-Wired AC System

Editor Gary And Accoustical Builder John Feeney Determining "The Chair" Sweetspot Position

Series SM-1 professional monitor speaker with a frequency response of 60 Hz-20 kHz ± 1 dB (-3 dB at 45 Hz). The SM-1 is positioned at the same 10-foot (precisely 10.84-foot) distance as the SC-Vs above the listener's ears (measured at the SC-V tweeter height of 40 inches off the floor). Two 1.5-inch conduits are provided to run 35-feet of Dunlavy Le Grand loudspeaker cable up the left side wall near the equipment racks and up the back wall to the SM-1 to provide flexibility in amplifier location within the room. With this speaker in position, we are able to experiment with some of the SACD and DVD-Audio six-channel recordings with a recorded height channel and back surround-enhanced movie soundtracks.

We have always practiced physical equidistant speaker positioning at *WSR* when possible, with the center channel speaker at an even greater physical distance for improved dialogue integration in the case of movie sound. When physical equidistant positioning is not possible, one must resort to electronic time delay, though this is a compromise, especially in regards to three- and four-way speaker systems which require a minimal physical distance to the listener to resolve a coherent full-frequency wavefront. (Please see Issue 15 for a comprehensive article on "Home Theatre Surround Sound—Doing It Right.") In our case, we have the capability to move the HRCC out into the room up to the same 10-foot distance as the main SC-Vs for experimentation.

Owens Corning QuietZone Building Materials And Industrial Acoustics Doors

The entire home theatre room and the rear-projection room were constructed with the complete QuietZone® Noise Control System build-materials package from the Owens Corning Science and Technology Center Acoustical Design Division. This scientifically developed "noise control" system eliminates unwanted sound. The system consists of QuietZone Acoustic Batt insulation engineered to absorb sound vibrations and gypsum board, QuietZone Acoustic Wall Framing, and QuietZone silicone-enhanced acrylic mastic Acoustic Caulk sealant to block sound vibrations, along with a QuietZone Acoustic Floor Mat. The Acoustic Floor Mat is a closed cell, polyethylene foam, specially designed to isolate impact noise in floors and reduce flanking noise around walls through the floor. It is applied between the concrete subfloor and a two-inch gypsum concrete overlayment (over which is laid one-inch thick carpet material) that then "floats" on the mat. Owens Corning's QuietZone acoustic framing provides effective noise control through the application of a continuous "barrier" of gypsum wallboard with acoustical caulking, "absorption" with QuietZone acoustic batts, "vibration" through "breaks" and vibration "isolation" using patented 14-foot Trus Joint™ TimberStrand™ LSL wall studs connected by several acoustically resilient metal clips.

Owens Corning Quietzone Products

Our HVAC, or heating, ventilation and air conditioning system, was specially fabricated with ductboard and ductliner as well to hush background noise due to ventilation hum and on/off ventilator switching. The end result is a HVAC system that is virtually noise-free.

The Sound Transmission Class rating of the theatre is STC-63 dB. STC is a single number (laboratory) rating of how well a structure (wall, floor, door, window partition) reduces sound passing through it. A minimum STC-60 (partition) performance level is recommended for home theatre. Unlike standard wall constructions which vibrate, conduct and radiate sound, an STC-60 wall or acoustic door reduces the source energy level to one-millionth of its original level. The end result achieved with our acoustically treated STC-63 rated room is an exceptionally quiet room capable of accurately reproducing the complete frequency spectrum from the slightest sound (0 dB) to the threshold of pain (130 dB). The room is optimized to reproduce deep bass from 16 Hz to 20 Hz at "real life" sound pressure levels (SPL).

The theatre is constructed as a room within a room in the corner of the building's concrete tilt-up construction. The theatre and projection room (which extends the depth dimension of the room for extended bass response and virtually noise-free projector operation) are fitted with special Industrial Acoustics Noise-Lock® acoustical doors with a STC-61 dB rating.

Not only was it critical that the room achieve a high STC rating, but all that would have been degraded if we didn't also specify high STC-rated acoustic doors. So often, dedicated home theatres (or rooms remodeled for home theatre) are built without sufficient

Accoustical Builder John Feeney Laying Out Home Theatre Room

Owens Corning Accoustical Batts Installation Being Applied

STC-rated doors. In our case, we chose Industrial Acoustics' Noise-Lock door construction, which is used by Hollywood sound and dubbing stages and world-class recording studios. (Please see upcoming Issue 49 for articles on the QuietZone approach and the design of the Industrial Acoustics doors.)

Feeney Acoustical Builders, based in Grass Valley, California, and Hodges Construction (who also served as our general contractor on our new building) of Murrieta, California, were retained to construct the room. John Feeney and Jeff Hodges are certified specialists in fabricating acoustical sound home theatres using Owens Corning QuietZone building materials and Industrial Acoustics Noise-Lock doors.

"Circle Of Sound" Aesthetic Environment

Before I discuss the acoustical treatment of the room, one of the design elements in the aesthetic environment of our home theatre, which relates to the "circle of sound," is the two-color carpeted floor treatment and the "sweet-spot" bullseye seating mark for the "primary" listener/viewer seated in "the chair." In order to convey *WSR's* equidistant speaker positioning philosophy, I decided on carpeting the "circle of sound" in gray carpet, outlined by black carpet throughout the rest of the room and in the rear-projection room. At the center of this solid circle of gray is a solid four-foot diameter circle of black carpet, which designates the precise equidistant seating position for "the chair," which is in supple gray leather. This position is located 7.3 inches to the left from left to right room center or 11 feet-5.6 inches from the left wall and 12 feet, 11 inches from the screen wall at an ear height of 40 inches at the SC-V tweeters. The equidistant speaker radius is 10 feet with the speaker angles nearly spot on at 90 degrees. The SM-1 height speaker also is positioned 10 feet above ear and SC-V tweeter height to its tweeter.

Speaking of "the chair," it was specially designed for us by First Impressions of North Miami, Florida. "The chair" is the cornerstone of a home theatre. It/they need to be comfortable so that you can sit for two or three hours without hurting your back or falling asleep. This well-engineered chair features a low back (below ear level), so as not to block the ears receiving soundwaves from the surround hemisphere of the room. The height of the seat is just right, placing the ears and eyes at near center of the screen (bottom of screen below eye height) and within plus or minus two-inches of the 40-inch tweeter height of the Dunlavy Signature Series SC-Vs depending on the size of the reviewer sitting in "the chair." "The chair" is designed as a rocker on a 360 degree caster mechanism-supported base. This allows the movie sound reviewer to turn in any direction to monitor the soundfield presentation. This swivel feature also can be used effectively in conjunction with our Martinsound MultiMAX EX Surround Sound Multiformat Monitor Controller to critically monitor individual channels or any combination of channels. The MultiMAX EX controls individual or combination channel selection (or for that matter to A/B up to five different 6.1 processors and two different 6.1 speaker systems) and provides monitoring control of discrete 8, 7.1, 6.1, 5.1 or LCRS and all Dolby® and DTS® formats including Surround EX™ and DTS-ES™, as well as DVD-Audio and SACD. We also use a M-Audio CT14 SPDIF switcher to evaluate up to four 6.1 Dolby Digital/DTS Digital Surround™ processors at one time.

Secondary seating similar to "the chair," except in black, is provided to the right and left of "the chair," with additional customized seating behind. A specially designed sofa/queen sleeper and chaise lounges configured in a specially designed U-shape is positioned behind "the chair" to accommodate up to ten people. The additional chairs, sofa and chase lounges are upholstered in a black fabric to optimize acoustic properties.

Acoustical Treatment

Acoustical treatment is a critical element in the design of a dedicated home theatre. All too often, rooms are "over-treated" and result in an unpleasant "deadness," that is often irritating to people spending a couple of hours in the room with a movie. I firmly believe in a room that is not dead sounding, but not too bright. It needs to support a pleasant naturalness when having a conversation with someone in the room. Thus, our room is uncharacteristic of the other sonic signatures often associated with other home theatre designers. One of the world's foremost authorities on acoustical room design is Dr. Peter D'Antonio. Dr. D'Antonio shares with me this view of a balanced non-dead room, and has developed and patented a number of RPG Diffusor Systems room treatment products to achieve the desired result. That is why I decided to have Dr. D'Antonio serve as our acoustical consultant in the design and building of our reference home theatre laboratory.

RPG's VariScreen™ and Skyline® acoustic treatments dominate the theatre's interior design. By using RPG's VariScreens we are able to have variable acoustic control to adjust for various loudspeaker systems under review. This is a real plus for the magazine's purpose, as we have the opportunity to review numerous speaker designs, and I

Closeup Of Wall System Under Construction

Accoustical Builder Jeff Hodges Applying Owens Corning Caulking

wanted to maintain maximum flexibility in the control of the room's acoustics. I did not want to lock myself in with fixed in-wall acoustical treatments that would require major refitting if we didn't like the end result.

RPG Diffusor's VariScreen and Skyline products are optimized for flexibility and extreme fine tuning of a room's acoustics. The VariScreen is an eight-foot high by four-foot wide free-standing variable acoustics two-panel screen with a broad bandwidth absorbor on one side and RPG's flat binary amplitude diffsorbor (BAD™) on the other. This hinged Guilford of Maine acoustic transparent black fabric upholstered panel can be positioned and adjusted with a variable Depth Air Cavity (VDAC™) to control low frequency modal problems.

RPG's Skyline is the most efficient and powerful omnidirectional primitive root number theory two dimensional diffusor available. The Skyline scatters incident sound uniformly so that the acoustic glare in all directions is minimized. The Skyline array is suspended overhead "the chair" location in a 14 x 14-foot T-bar ceiling grid (with 2 x 2 slots to hold in place individual Skyline panels). Just over the "sweet spot" is an opening in the grid that is 4 x 4 feet to allow the coherent wavelength of the SM-1 height loudspeaker to immerse the listener seated in "the chair." (Please see the upcoming Issue 50 for an article by Dr. Peter D'Antonio on the acoustical design and treatment of our room.)

Lighting By Image Crafters

Integrating lighting into a home theatre can be very simple or elaborate, depending on one's needs. First you must determine how the room will be used. Secondly, you must determine what needs to be lit and what cannot be lit (i.e. the screen). In the case of *Widescreen Review*'s Reference Home Theatre Laboratory, Spencer Kalker, President of Image Crafters (IC), and I discussed in detail how the room was to be used. We listed numerous scenarios including: Critical Viewing; Critical Listening; Testing Of Speakers, Electronics and Projectors; Writing Articles on a Computer; Reading; Presenting Seminars; and Holding Meetings. Each of these room usage scenarios has different requirements with regard to how the lighting is placed in the room, what type of lights are used, and how each circuit is controlled and dimmed. A feature of the lighting scheme is a "circle of light," which matches the 20-foot diameter "circle of sound," but positioned about 10 feet above floor level. This is accomplished with IC Lights' LiteRail system in conjunction with the Lutron Graphic Eye and the latest in Halogen bulb-lighting technology.

The project was exciting and challenging, but also typical for those interested in maximizing the usage of a room. Compromising the importance of the lighting is simply compromising the investment in effort and money on the space. Designing the lighting system properly has enhanced every aspect of the room and helped ensure that all the elements involved in the space are maximized and enjoyed to their fullest.

Additionally, to optimize the viewing environment and minimize eye strain when viewing over a long period of time, we use a Cinema Quest fluorescent fixture (Model APP23118 LC-W), with a proper 6500K "color temperature" bulb and Ideal-Lume dimming filter, placed below our display screens to achieve the Society of Motion Picture and Television Engineers (SMPTE) standards pertaining to ambient light in the room.

Equipment Selection As WSR's Reference

As a premiere home theatre magazine with a prestigious reputation, we are constantly being solicited to use particular equipment in the magazine's various reference home theatre systems. As it turns out, we get to determine which equipment will best serve our purpose for each reference system. We often cross-reference our equipment and DVD movie reviews on different reference systems, which represent varying levels of component system cost and performance.

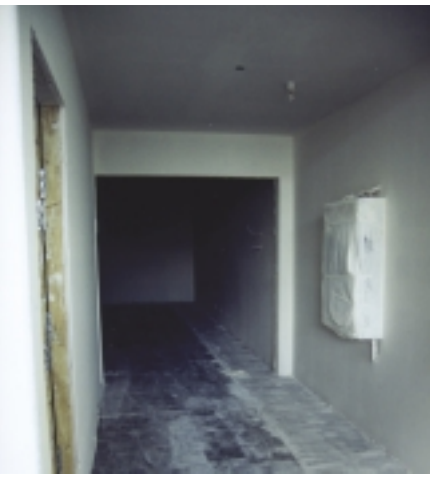
In deciding on the equipment we desired for this "ultimate" reference project, we began with the selection of the Dunlavy Signature Series loudspeakers because of their renown attention to audible and measurable accuracy. That is not to say that we won't provide opportunities for other speaker manufacturers; we certainly will, as now we have an optimized environment to review "all" speaker designs.

Amplification is provided by two companies—California Audio Labs and Krell. We desired extremely high-powered, effortless, distortion-less amplifiers that operated mainly in true Class A bias, and that wouldn't distort or melt down handling sustained 100 dB levels. California Audio Labs custom designed for us a special 1,000-watt per channel (at 8 ohms) version of their CL2500 MCA power amplifier technology (reviewed in Issue 38, May 2000), but built on a two-channel chassis. CAL will be this version making available to consumers on special order. We are using five of these two-channel units to drive the entire nine channels of our Dunlavy Signature Series loudspeaker system.

In another setup using our Martinsound MultiMAX Multiformat Monitor Controller to switch, we are using eight Krell FPB Series 350-watt Class A bias monoblock amplifiers (FPB-350Mc) and one FPB-250Mc 250-watt Krell for the SM-1 height loudspeaker. These are state-of-the-art amplifiers, and as with our reference speakers, we will be able to accommodate other manufacturers' amplifiers for review.

We are using two Sony DVPS9000ES Progressive Scan DVD players with two-channel SACD capability, a Toshiba SD-9200 Progressive Scan DVD player with DVD-

Drywaller Taping Wall And Ceiling Seams Around Dunlavy SM-1 MDF Housing



Drywall Textured Prior To Painting

Audio capability, and a Pioneer DV-09 DVD-Video player. Also installed is a Panasonic TU-DST51 digital television decoder and a Panasonic PV-HD1000 D-VHS recorder.

For audio monitoring purposes we are using nine channels of Audio Control R-130 One-Third Octave Real Time Spectrum Analyzers (RTA). These have been used at the magazine since its inception to determine the frequency spectrum of the various movie soundtracks we review routinely.

A specially fabricated Dorrough Loudness Monitor (340-A meters) is capable of monitoring the signal level of eight discrete channels.

A Martinsound MultiMAX Multiformat Monitor Controller serves as our control center to critically analyze individual channels and any combinations thereof.

Our video system is comprised of a Runco DTV-1101 9-inch CRT projector integrated with a Runco VHD-4404 Ultra multi-function video processor and a Sony G-90 nine-inch CRT projector integrated with a Faroudja DVP5000 digital video processor/scaler. An AccuPel HDG-2000 HDTV Calibration Generator is used for test signal calibrations. Video switching is accomplished with the Extron Matrix 128 HV/Crosspoint/Component Converter. Test equipment includes a Leader Instruments Model 5100 Component/HD Waveform Monitor and a Leader Instruments Model 5870 Vector/Waveform Monitor. For HDTV testing, we use as a reference source a Sencore recorder and are equipped with both DISH Network Model 6000 HDTV and RCA/DirecTV DTC100 HDTV digital satellite reception, as well as an over-the-air antenna.

Picture optimization is calibrated with the AV Standards TVS Pro Optical Comparator for video display gray scale setup and the Sencore CP290 Auto "ColorPro" Portable Color Analyzer. We also use an USL, Inc. (Ultra Stereo Labs) PSA-200 system for analyzing and displaying the luminance values (in ANSI lumens) of every part of our screens.

For sound alignment we use the Checkpoint LG-120 Sound Alignment System "Line Generator," a calibrated tool with the industry standard angles of dispersion (120˚, 90˚, 60˚, 45˚, 30˚ and 15˚). By dialing in the desired angle and aiming the LG-120 in the same direction, we are able to clearly see the angle of sound dispersion and the area of coverage.

Various other equipment such as the Pioneer Elite CLD-99 LaserDisc player, several complete system high-end interconnect and loudspeaker cables, and numerous Richard Gray's Power Company Model 400S AC power optimizers complete our reference equipment. The entire room has a dedicated electrical system with power distribution provided by Equi=Tech's Model ET 12.5W SIF balanced power hard-wired AC system. Balance power is essentially a 120-volt circuit that has 60 volts to groiund on each side, instead of 120 volts on one side and zero, or neutral, on the other. The design virtually eliminates electrical noise in an audio and video system.

As previously discussed, our monitoring control system is the Martinsound MultiMAX Multiformat Monitor Controller. A Dorrough Eight-Channel Loudness Monitor/Signal Meter is used to determine signal activity and level in each audio channel. We also use a Pandora International Ltd. PBX3001A Cursor Generator to accurately measure (electronically) DVD aspect ratios.

For back surround enhancement, we use a SMART Devices CS-3X, Jr. Surround Extended Adapter.

Finally, an assortment of customed designed Billy Bags' Pro-Stands serve as our equipment racks.

We do not know of any other magazine or Web site in the world that has this level of playback monitoring performance. Our capability even exceeds that of the majority of professional mastering, dubbing and recording studios.

The Future

We are excited! And we thank our loyal readers and quality advertisers who have supported *Widescreen Review* all these years. With this new state-of-the-art facility we intend to be better than ever as a reliable and trusted essential home theatre resource.

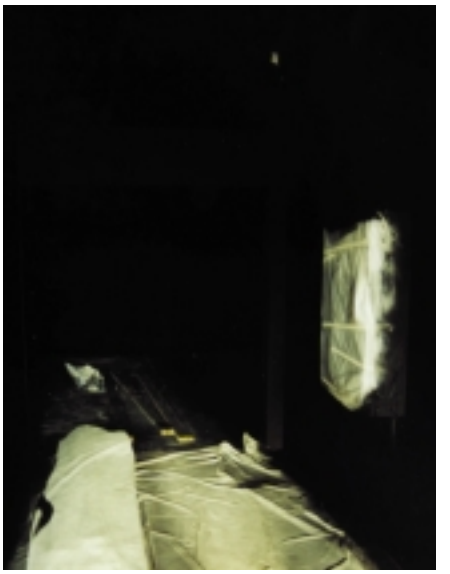
As for the other aspects of our new building and corporate headquarters, there are other reference systems housed in the building along with offices that accommodate upwards of 24 staff people, complete with a "Bistro" cafe and full-service kitchen, and a plaza with an 18-foot high ceiling.

There is nearly 10,000 linear feet of Monster Cable Data Speed 350 C5-8 Category 5 Computer Data Communication Cable installed throughout the facility. CAT5e (enhanced) consists of four twisted pairs of high quality copper enclosed in an outer jacket. Its high capacity makes it ideal for fax, modem and very high-speed digital computer transmissions. Monster Cable RG-6 CL3/FTA rated MV-QUAD-shield coax is installed at all TV, satellite, and network locations as well. All network communications cabling is installer-certified by Temecula Valley Communications to deliver the bandwidth promised without interference or interruption.

Further, Leviton OL 30X1 Surge Suppressor Duplex Receptacles are installed throughout along with Leviton Cat 5400 Surge Suppressor Power Control Centers at each computer station in each office. Our halogen lighting system throughout the facility is controlled with remote Leviton Scene Control Products

Painter Julio Ortiz Overseeing Sprayer

Spraying Quiet Zone Walls Black



A Room Of Blackness

as well.

Our new facility will soon host what we are branding the "WSR University" or "WSR's College Of Knowledge" seminars, which will be open to home theatre enthusiasts on a tuition basis. We will tell you more on this aspect of *WSR* in future issues of the magazine and on our Web sites at www.WidescreenReview.com and www.SurroundMusic.net.

This concludes Part I of this series of articles on *WSR's* Holosonic Reference Home Theatre. Future issues of *Widescreen Review* will explore in depth the building and inner-workings of this project as follows:

Part II, Issue 49, June 2001
The Building Phase

This article will describe in detail the building of the optimized structure using Owens Corning QuietZone building materials and Industrial Acoustics sound doors.

Part III, Issue 50, July 2001
Acoustics

RPG's VariScreen and Skyline acoustic treatments dominate the theatre's design. By using RPG's VariScreen we are able to have variable acoustic control to adjust for various loudspeaker systems under review. There will be an article by Dr. Peter D'Antonio of RPG Diffusor Systems on the acoustical design for the theatre.

Part IV, Issue 51, August 2001
Equipment Choices

This part will cover the choice in equipment, with a review of the Dunlavy Signature Series speaker system and the impact of the selection on the design of the room.

Part V, Issue 52 September 2001
An Optimized Video Display

This article will discuss the video display considerations and equipment choices for the reference home theatre.

Part VI, Issue 53, October 2001
Aesthetics And Lighting

This part will present the approach we took to aesthetics and lighting in the reference home theatre.

Part VII, Issue 53, October 2001
The End Result

Finally, this is an article devoted to a critique of the end result—an unparalled home theatre experience. ■

Acknowledgements

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Paul Svoboda, Business Manager, Owens Corning Acoustic Systems Business, One Owens Corning Parkway, Toledo, Ohio 43659, 419 248 7531, www.owenscorning.com

Norman Varney, Acoustic Design Center Lead, Owens Corning Science & Technology Center, 2790 Columbus Road, Route 16, Granville, Ohio 43023, 740 321 6314, www.owenscorning.com

Ken DeLasho, Vice President, Industrial Acoustics Corporation, 1160 Commerce Avenue, Bronx, New York 10462, 718 931 8000, www.industrialacoustics.com

Dr. Peter D'Antonio, President, RPG Diffusor Systems Inc., 651-C Commerce Drive, Upper Marlboro, Maryland 20772, 301 249 0044, www.rpgdiffusors.com

Mark Cerasuolo, Leviton Integrated Networks, 18911 Northcreek Parkway South, Bothell, Washington 98011, 425 415 7864, www.leviton.com

Spencer Kalker, President, Image Crafters, Inc., 62 Grace Meadows Drive, Taunton, Massachusetts 02718, 508 828 2668, www.imagecraftersinc.com

Noel Lee, President, & Daniel Graham, Monster Cable Products, Inc., 455 Valley Drive, Brisbane, California 94005, 415 840 2000, www.monstercable.com

Extron Electronics, 1230 South Lewis, Anaheim, California 92805, 714 491 1500, 800 633 9876, www.extron.com

Martinsound, 1151 West Valley Boulevard, Alhambra, California 91803, 626 281 3555, www.martinsound.com

M-Audio, 45 East Saint Joseph Street, Arcadia, California 91006, 626 445 2842, www.m-audio.com

Dorrough Electronics, 5221 Collier Place, Woodland Hills, California 91364, 818 998 2824, www.dorrough.com

Martin Glasband, Equi=Tech Corporation, 18258 Redwood Highway, Selma, Oregon 97538 541 597 4448, 877 384 8324, www.equitech.com

Leader Instruments Corporation, 6484 Commerce Drive, Cypress, California 90630, 714 527 9300, www.leaderusa.com

AccuPel, P.O. Box 1891, Tualatin, Oregon 97062, 503 524 9870, www.accupel.com

CinemaQuest Inc., 3551 South Monaco Parkway, Suite 301, Denver, Colorado 80237, 303 740 7278, www.cinemaquestinc.com

Sencore, 3200 Sencore Drive, Sioux Falls, South Dakota 57107, 605 339 0100, 800 736 2673, www.sencore.com

AV Standards, 6825 Madison Avenue, Indianapolis, Indiana 46227, 317 784 1358, www.avstandard.com

USL, Inc. 181 Bonetti Drive, San Luis Obispo, California 93401, 805 549 0161, www.uslinc.com

Checkpoint, 3112 Kashiwa Street, Torrance, California 90505, 310 891 1550, www.checkpoint3d.com

Shane Lesovsky, Temecula Valley Communications, Inc., 27576 Commerce Center Drive, Suite 133, Temecula, California 92590, 909 694 0374.

John Feeney, Feeney Acoustical Builders, 14660 McCourtney Road, Grass Valley, California 95945, 530 477 7647, 530 613 5992 Cell

Jeff Hodges, Hodges Construction Company, 40485 Murrieta Hot Springs, Suite D-102, Murrieta, California 92563, 909 676 7712, 909 308 8539 Pager, 909 229 0961 Cell

LUCASFILM THX®

The Home THX® Approach

By Gary Reber

While the THX® Sound System, which adheres to a set of performance parameters encompassing controlled room acoustics ("dead" room sound) and strictly (but "confidential") specified sound reproduction equipment, is generally regarded as the top of the motion picture production and exhibition sound pyramid, it was developed to "sell" and thus "profit by" with license royalty payments by equipment manufacturers and certification fees collected from theatrical exhibitors. The THX concept was broadened in October 1989[1] to encompass a set of specifications for licensing consumer electronics manufacturers and thus expand the "profitability" of the growing Lucasfilm Ltd. enterprise. An employee of Lucasfilm named **T**omlison **H**olman was the principal architect of the so-called e**X**periment or cross**X**over (the singular product produced by Lucasfilm), and the concept of dissimilar speaker dispersion patterns and electronic equalization. The THX Approach was patented using direct radiators in the front of the hemisphere and dipole radiators in the back of the hemisphere in a home theatre context.

While Lucasfilm positions the THX Sound System in theatres as the accepted "standard" by which theatre sound is judged, this should not be taken strictly on face value. There are other theatrical sound systems which, while sharing many of THX's non-proprietary attributes, nevertheless are different and with claimed performance exceeding THX. Taken as a whole or examined part by part, the THX Approach denotes nothing technologically revolutionary, nor for that matter, exceptionally innovative, but rather advanced motion picture industry practice based on the body of linear technical developments at the time of its inception in 1983 (in conjunction with the release of *Return Of The Jedi*).

What Tomlinson Holman did was to integrate into a comprehensive design a compilation of improvements in sound system and loudspeaker design that many people contributed to, while adding several innovative components along the way, which represented a set of proven and repeatable performance parameters or standards for dubbing theatres and movie theatres based on then current equipment technologies and professional practice.[2]

Thus, THX represents a set of specifications which define the performance of a theatre sound system to "accurately" reproduce what the filmmakers heard in a dubbing theatre when they created the motion picture soundtrack. This was Lucasfilm's original mission—*to influence by example* the industry upgrade of the entire sound signal chain so that audiences could "hear the difference" and experience the *full* impact of what filmmakers were capable of creating.

But it is important to remember that both the Professional THX Sound System and Home THX approaches were created in an era of Dolby® Stereo matrix surround with monaural surround.[3] This has since been succeeded by discrete digital formats such as Dolby Digital and DTS® Digital Surround™, and even more recently by "6.1" discrete digital formats such as Dolby Digital Surround EX™ and DTS-ES 6.1 Discrete (and Matrix).

What was once a dream for movie sound excellence was taken a step further to become a successfully "marketed" home theatre franchise stimulated by the movie-going public and consumer demand for better sonics, and equipment manufacturers and home theatre retailers who want to meet that demand. Thus, the Home THX licensing program was launched to "sell" equipment that would "recreate" the actual experience designed and heard by filmmakers in a Dolby Surround mix to the fullest extent possible in the home as it was "meant to be heard."[4]

The Home THX Design Goal

The design goal of the Home THX System approach is to come as close as possible to "re-creating," as opposed to "interpreting," the "intent" of the filmmaker working within the technical aesthetic parameters and limitations of the Dolby Stereo and discrete digital formats as construed in a dubbing theatre. Home THX is a serious approach or method to reproducing what was created exactly in the manner and style that it was created and "heard" by the filmmaker in a dubbing theatre. Other opinions, interpretations, methods, and approaches such as those advocated by *WSR*, may have their place in the view of the THX Group, but THX is a strict re-creation.

While the THX Group supports their approach by reason of the claim, "intent of the filmmaker," their reasoning is perhaps a little presumptuous because not every filmmaker is so locked into the "sound" they "heard" in the dubbing theatre that they cannot appreciate or even prefer listening to their own soundtracks on home theatre systems with sound resolution nuances and

1. Issue 2 and Issue 3 of *Widescreen Review* featured a two-part article entitled "The THX Story—Part I: Excellence In Theatre Presentation and Part II: The Vanguard Of Home Theatre." A THX special edition of the magazine was also produced in 1993. Unfortunately, only Issue 3 Part II of "The THX Story" is still available as a back issue.

2. The dubbing stage or theatre is a highly specialized, theatre-sized, soundtrack production mixing environment. The various sound elements contained in a movie soundtrack—dialogue, music, Foley and sound effects—are combined or mixed by skilled sound engineers (credited as re-recording mixers) in this special record and monitoring studio. As they create the mix, they repeatedly listen to the results and adjust the sound elements until they obtain exactly the desired effect. Thus, the dubbing stage is said to serve as the "reference" standard for a film's soundtrack.

With the advent of discrete 5.1 and 6.1 movie soundtracks, a movement is afoot to "re-mix" the sound elements in accordance with a new defacto home theatre standard which subscribes to matched full range loudspeakers and .1 LFE subwoofers positioned equidistant in a home-sized theatre room in which the speakers are localized near-field along a time-accurate radius arc.

3. Motion picture theatre and home theatre systems are complete sound and picture reproduction systems. They cover the source to the loudspeakers and everything in between. The motion picture industry classifies the audio chain portion of the system into two distinct areas, the "A" and "B" chain. The A chain broadly covers the playback and source processing and includes the decoding of the left, center, right and surround matrix encoded stereo soundtrack in the case of Dolby Stereo (Surround) or the 5.1 or 6.1 discrete channels in the case of discrete digital soundtracks, which produces signals suitable for amplification. The B chain amplifies these signals for reproduction over the theatre's loudspeaker system. Dolby Laboratories and Digital Theater Systems (DTS) manufacturer A chain products used in theatre sound systems including optical and magnetic sound preamplifiers, noise reduction systems, surround processors, CD-ROM drives and third-octave room equalizers, while other companies supply B chain components including amplifiers, crossovers, interconnect and loudspeaker cables, and screen and loudspeaker systems.

With home theatre, the division can be less discernible since the A and B chains are often part of integrated products. For the purposes of this discussion, it is important to be aware that THX processing is related to the B chain while Dolby Surround, Dolby ProLogic, Dolby Digital and DTS Digital Surround are related to the A chain.

Several aspects of sound quality are attributable to B chain characteristics—maximum undistorted sound pressure levels (SPL), harmonic distortion, frequency response, dialogue intelligibility, and sound imaging and staging are among them. THX says that their approach improves these characteristics, but not everyone agrees with the THX approach, which in attempting to emulate the dubbing stage compromises the full potential holosonic experience achievable in the home using tried and proven audiophile practices applied to surround sound.

soundfield spatial reproduction capabilities exceeding that of the film studio dubbing stage. There can be no argument that such use of any system's capabilities steps beyond the technical aesthetic capabilities of today's dubbing stage. And these capabilities can put home theatre enthusiasts into another realm of technical aesthetics that are closer to the idea of virtual reality. There are home theatre systems that can be put together with capabilities that far outperform the best Home THX systems in these respects, and with performance exceeding that which is possible in the best Professional THX systems. The state-of-the-art Holosonic Home Theatre System™ at *Widescreen Review* is one example of such a feat.

A Matter Of Interpretation

Motion pictures are illusions of reality which provide a vivid and visceral experience. There is a diversity of creative origination that produces the sight and sound illusion we call motion pictures. It is a creative collaboration between the filmmaker artisans who make the movies and the artisan engineers who make the delivery technologies. This is not a static situation but a fluid, progressive affair in which the goal is to push the creative and technical envelope closer to the idea of virtual reality. There is no question that the movie soundtracks of the future are going to be better than they are today. Today, even in the best of theatres (dubbing or public), you cannot close your eyes and believe that you are there. In home theatre as in music reproduction, everything that is done should have the thought behind it of re-creating the "real-life" experience (even when exaggerated for creative ends) in an as vivid and real interpretation as the technology will allow. In this sense, there is no other absolute "reference," (certainly not a dubbing stage) but the sounds of real life soundfields and all the discrete detailed spot sounds and their directional cues within. For example, take a moment and listen carefully to the sounds all around you. Walk down a city street with your eyes forward, listen attentively and you will hear the future of surround sound. Imagine the truck tractor-rig in *Terminator 2* pulling up behind you with its rumbling, droning exhaust system, bolting around you on through to the screen action and onward. That kind of effect is what home theatre enthusiasts can experience now, thanks to the current generation digital discrete formats.

Creative interpretation, methods, performance, and presentation within the constraints of the delivery technology distinguishes the capability of one home theatre system approach from another to re-create the illusion with the most visceral impact. There are conceivably as many "valid" approaches or "interpretations," as there are opinions and tastes as to what sounds the most "real." This is true for both the people who create the illusion and for us who want to hear it as "real" as possible. This is what "high fidelity" sound reproduction is all about. The equipment and loudspeaker technologies that are marketed as home theatre products are the result of the aspirations of their designers to re-create "their interpretation of an illusion" based on "real" sounds. This diversity of product has been supported by a variety of consumer tastes for the re-creation of sonic illusions, whether it be a music performance or a sight and sound real- or fantasy-life entertainment experience. This has resulted in the tremendous growth and diversity of consumer entertainment electronics, particularly in the home theatre segment of the market. This explains why there are approximately 2,200 versions of loudspeakers (not to speak of the hundreds of amplifiers and other components), each one with its own distinctive sound. Decades of man-hours have created all sorts of interpretations as represented by the vast assortment of equipment and loudspeakers and system configurations available to the consumer.

Since the home has become an increasingly important venue for motion pictures, the opportunities for a higher performance experience present themselves, separate and apart from the limiting factors dictated by the playback in the theatre. Cinema sound differs greatly from the more intimate, personalized environment of home theatre. As a mass entertainment medium designed to be experienced by an "audience," the very large spaces within most theatres dictate a completely different approach from that of the supremely intimate environment of a home theatre setup in a living room or other room in the home.

The hard reality is a home IS NOT a movie theatre, just as film IS NOT video. They are fundamentally different spaces and different media. Turning one into the other can never be, in absolute terms. The THX Group sees the sonics of the dubbing stage as the absolute reference because that is where the sound elements are assembled to create a soundtrack. But this "theatrical" purist approach is NOT NECESSARILY the answer for those, including many prestigious filmmakers and sound professionals outside the Lucasfilm organization, who want more than what the technical aesthetics of today's format and dubbing stage sound system can deliver, particularly in the portrayal of spatial imaging.

Think of the question of accuracy in these terms. A recording engineer carefully records a symphony orchestra in the concert hall. In the studio, a mix to two tracks is made which is pressed on CD for the home consumer. What is the producer and recording engineer's intent in making the recording? a) For the home listener to hear the most accurate reproduction of the recording studio monitoring system (exactly as it was heard in the studio)? or b) For the home listener to hear the most accurate re-creation of the live performance (close to what was heard in the concert hall)? In movie sound terms, what is the filmmakers ultimate intent? a) For the home theatre listener to hear the most accurate reproduction of the dubbing theatre sound system (close to what was "heard" when the film soundtrack was mixed)? or b) For the home theatre listener to hear the most accurate re-creation of the "actual" soundscapes and discrete sounds suggested by the story-picture (close to what real life sounds like)? Should not the goal be to put the listener in the movie, not in the theatre?

Another difference that distinguishes the cinema from the home is that the theatre concept does not embrace the idea of a "stereo sweet spot" since it implies an inequality among seats which is undesirable, whereas the home theatre experience allows one to optimize performance within the listening area traditionally arranged for stereophonic reproduction.[5] (A reference to "the chair" position in the home theatre.) This is not practical in situations where more than one or two (at most) persons want to watch a movie. Unless you sit in the "sweet spot," directly in front of the screen display equi-

4. The THX banner terms "intended" and "meant to be heard" can be over-inflated pronouncements that exaggerate the creative intentions of filmmakers. This is because the execution of a creative intent is limited by the capabilities of the delivery system to reproduce what the filmmakers "would like to hear," and thus, not necessarily, what was "meant to be heard." The "digital dream" is a delivery system which allows for the re-creation of a complete soundfield, not just some diffuse surround field, with limited if any, capability for sound localization and full-frequency response. This is perhaps, the singular most revolutionary aspect of the digital future of sound. Filmmakers now have with the new discrete digital delivery systems, a palette and canvas to create technical aesthetics without the limitations inherent in the Dolby Stereo MP Matrix format. How the palette is applied to the canvas will define a whole new concept and meaning to "intended" and "meant to be heard." In other words, the digital future of sound will allow a boundless integration of the soundtrack that accompanies the picture. That future is in the making as filmmakers are embracing the discrete digital sound formats with approaches that go beyond the limitations of the THX dubbing stage approach and define new system designs that are capable of re-creating "life-like" holosonic™ soundfields with identical full-frequency response-capable loudspeaker systems that really image between the discrete vector channels.

distant between the two loudspeakers, the dialogue, at least, will appear to come unnaturally from outside of the image when monitoring with two loudspeakers. Thus a center channel loudspeaker maintains the normal balance between picture and sound (particularly actors and dialogue) in the same manner as in a movie theatre in which the loudspeakers are placed behind the screen, so that the dialogue sound appears localized at the center of the wide screen. Still (with or without a center channel loudspeaker), persons sitting either to the left or right of the "sweet spot" will perceive off-balanced soundstaging due to the precedent effect of being closer to the left or right loudspeaker.

Since the advent of home theatre, a certain amount of bewilderment and confusion has occurred because manufacturers and dealers, and ultimately consumers, are trying to comprehend the right path to the "correct" presentation of a motion picture experience in the home. But the reality is that there is no absolute "correct" interpretation because the spaces and the media are fundamentally different. We can get awfully close to the framework of the dubbing theatre as Home THX does, but in the final analysis it comes down to one's perspective and personal taste. To compound this situation, various approaches, some more dogmatic than others, are being promoted which are seen by well respected design engineers to be ill suited to the next revolution in sonic illusionism—full bandwidth discrete digital arrangements for re-creating in the home a virtual near holosonic™ sonic image.

One of the criticisms of Home THX by its detractors has been that the diffuse approach, both mechanical and electronic, to the design and application of the surround loudspeakers restricts the system's potential to fully resolve the discrete digital delivery format with "intended" localization of sounds in the stereo surrounds and between each of the other channel vectors (side wall and back wall imaging). They reason that the THX surround approach does not fully support the potential for the current discrete digital motion picture sound design because every sound is heard through and shaped by that surround filter which restricts image specificity for an enhanced soundscape with vivid realism. The Home THX Program has stalled and failed to adapt to the potential delivery in the home of the new discrete digital formats. At present the THX Group's focus is the strict "re-creation" of surround sound in the home patterned off the presentation "heard" in a standardized dubbing theatre.

The Digital Dream

In several other significant respects, the question is raised: Is the Home THX Program compromised in terms of its stated objective? Initially positioned at its announcement as a standard for an all-out performance, cost-no-object system, over the course of the last 10 years, the "good, better, and best" product differentiation has called attention to the question of just what is the Home THX "standard's" concept—a "minimum" (Select?) "adequate," (Integrated?) the "ultimate" (Ultra?), or a performance criteria somewhere in between? Measured objectively or evaluated subjectively, the challenge remains for consumers to sort out the product-specific differences which ultimately will be dictated by perceived performance, features, build quality and appearance. In these regards, each THX-certified manufacturer, as well as non-THX-certified manufacturer is unique.

To be a veritable Home THX System, the "system" must be assembled from THX-approved components. This allows for a degree of choice of sound quality within the specific equipment offerings. The tightly cast THX performance specifications for such parameters as loudspeaker response (80 Hz-20 kHz) and amplifier damping factor, however, lessen the significant differences that normally are heard between competing components. Thus, the "systems" tend to sound kindred, similar but not identical, defined by a particular style based on approximating the sonic characteristics of the standardized dubbing theatre in the home. That was the design/implementation intent—that any Home THX "system" cobbled together from any combination of THX-certified components would "accurately" duplicate the "sound" of the film studio dubbing theatre. (The latter should perhaps be stated as—duplicate the "sound" of a standardized dubbing theatre equipped with the Professional THX Sound System.) The reality is better stated as—to "approximate" or "come as close as possible" because no two Home THX Systems exactly sound the same (nor, for that matter, no two dubbing theatres, even THX dubbing theatres and THX cinemas).

In the hopefully unlikely event that our analysis herein will be incorrectly misinterpreted, we believe that the Home THX System will surely please many home theatre enthusiasts, with performance that comes very close to emulating today's dubbing theatre film mixing presentation in the manner and style of a Professional THX Sound System. Non-THX systems with Dolby ProLogic and Dolby Digital and DTS Digital Surround decoding can be put together to provide substantially the same benefit without THX certification, but with THX there is no risk that the system won't perform the way it is designed to. The THX Group has successfully brought about a better understanding of what it takes to experience movies produced under optimal dubbing theatre conditions. While there are other interpretations which have their own validity such as that what we advocate at *WSR*, you owe it to yourself to spend some quality time with a Home THX System retailer, and listen to and evaluate its performance against other systems in the same class. Do not be persuaded by anyone that there is one and only one "correct" home theatre system approach, Lucasfilm's or anyone else's, because these can only be opinions. Carefully consider what the possibilities are and what you want from the system, and what the system will be able to deliver with discrete quintaphonic and sextophonic digital motion picture soundtracks and discrete multichannel music-only fare. The search for the one approach that serves you best can be frustrating and time consuming, but it will be worth the time and effort in endless enjoyment. ■

5. While a "stereo sweet spot" is (in marketing terms) anathema to theatre sound, the reality is that the soundtrack is mixed at a particular seating area within the space of the dubbing theatre. The console-mixer-position defines the optimal listening position or "sweet spot"—approximately two-thirds back from the screen, positioned equidistant from the surround loudspeaker arrays in the theatre. This same "surround stereo sweet spot" area at the console mix position translates to the commercial theatre and to the home theatre. The obviousness of an optimized listening area should not be surprising—the identical psychoacoustic principle has provided the motivation for both professional recording engineers in both motion picture sound and music recording, as well as audiophiles to carefully arrange their particular seating area within the listening room where the phantom or hard-center image is optimal. The dictates of a quintaphonic or sextaphonic discrete full spectrum playback home theatre format plus a limited bandwidth low frequency channel (.1 LFE) requires the same setup attention to assure proper imaging along each of four paths optimally arranged symmetrically as defined by the discrete channel vectors. For optimal soundfield reproduction and localization, the listener audience needs to hear the direction of each of the channels for maximum surround holosonic effect.